FAO, Rapport sur les pêches N° 394
FAO Fisheries Report No. 394

FIPL/R394

Conseil général des pêches pour la Méditerranée (CGPM)

General Fisheries Council for the Mediterranean (CFCM)

Rapport de la cinquième consultation technique

SUR L'ÉVALUATION DES STOCKS DANS L'ADRIATIQUE ET LA MER IONIENNE

Report of the fifth technical consultation

ON STOCK ASSESSMENT IN THE ADRIATIC AND THE IONIAN SEAS

Bari, Italie/Italy, 1-5 juin/June 1987

ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FAO Rapport sur les pêches N° 394
FAO Fisheries Report No. 394 FIPL/R394(Fr/En)

RAPPORT DE LA CINQUIEME CONSULTATION TECHNIQUE DU CONSEIL GENERAL DES PECHES POUR LA MEDITERRANEE SUR L'EVALUATION DES STOCKS DANS L'ADRIATIQUE ET LA MER IONIENNE

Bari, Italie, 1-5 juin 1987

REPORT OF THE FIFTH TECHNICAL CONSULTATION OF THE GENERAL FISHERIES COUNCIL FOR THE MEDITERRANEAN ON STOCK ASSESSMENT IN THE ADRIATIC AND THE IONIAN SEAS

Bari, Italy, 1-5 June 1987

Edité par/Edited by

J.F. Caddy et/and M. Savini
Département des pêches/Fisheries Department
FAO, Rome

ORGANISATION DES NATIONS UNIES POUR L'ALIMENTATION ET L'AGRICULTURE
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome 1988

M-43
ISBN 92-5-002677-3

PREPARATION DU PRESENT RAPPORT

Le présent texte constitue la version définitive du rapport que la Consultation technique sur l'évaluation des stocks dans l'Adriatique et la mer Ionienne a approuvé à sa cinquième session.

Les documents présentés au cours de la réunion constituent la deuxième partie du rapport. Les bibliographies de ces textes sont telles que présentées par les auteurs.

PREPARATION OF THE PRESENT REPORT

The present text is the final version of the report approved by the Technical Consultation on Stock Assessment in the Adriatic and Ionian Seas at its Fifth Session.

The documents presented at the meeting are included in the second part of the report. The bibliographies of these documents are as presented by the authors.

Distribution:

Participants
Liste de distribution du CGPM/
GFCM Mailing List
Communauté économique européenne/
European Economic Community
Département des pêches de la FAO/
FAO Fisheries Department
Fonctionnaires régionaux des pêches de la FAO/FAO Regional Fishery Officers

La référence bibliographique de ce document doit être donnée ainsi/For bibliographic purposes this document should be cited as follows:

Caddy, J.F. and/et M. Savini (eds), Rapport de la 1988 cinquième Consultation technique du Conseil général des pêches pour la Méditerranée sur l'évaluation des stocks dans l'Adriatique et la mer Ionienne. Bari, Italie, 1-5 juin 1987. Report of the fifth Technical Consultation of the General Fisheries Council for the Mediterranean on stock assessment in the Adriatic and Ionian seas. Bari, Italy, 1-5 June 1987. FAO Rapp.Pêches/FAO Fish.Rep., (394): 306 p.

RESUME

La réunion a passé en revue les progrès réalisés en matière d'évaluation des stocks dans l'Adriatique depuis 1985. Les principaux sujets abordés ont été la constitution d'une base de données biologiques, l'amélioration de la collecte des statistiques, l'état des stocks démersaux et pélagiques, les problèmes des pêcheries côtières, les aspects socio-économiques de la pêche et l'harmonisation des législations. La Consultation a adopté une série de directives et de recommandations en matière de recherche, de statistiques, de collaboration sous-régionale et d'aménagement. Elle a fait des propositions concrètes sur l'organisation de la prochaine réunion prévue en Yougoslavie en 1989.

SUMMARY

The meeting reviewed the progress made in stock assessment in the Adriatic since 1985. The main topics considered were the establishment of a biological data base, the improvement of statistics collection, the state of demersal and pelagic stocks, the problem of coastal fisheries, the socio-economic aspects of the fishery and the harmonization of legislations. The Consultation adopted a series of directives and recommendations in the fields of research, statistics, sub-regional collaboration and management. It made concrete proposals for the organization of its next meeting planned to be held in Yugoslavia, in 1989.

TABLE DES MATIERES/CONTENTS

Page

PREMIERE PARTIE/PART ONE

RAPPORT DE LA CONSULTATION/REPORT OF THE CONSULTATION

I. INTRODUCTION 1

II. ADOPTION DE L'ORDRE DU JOUR 1

III. ELECTION DU PRESIDENT ET DES VICE-PRESIDENTS 1

IV. SITUATION ACTUELLE DES STATISTIQUES DES PECHES DANS L'ADRIATIQUE 1

A. Données sur les captures et l'effort de pêche 1
B. Informations sur les fréquences de tailles 4
C. Taille des flottilles, par catégories 4
D. Informations sur les coûts/avantages et la rentabilité économique 4

V. ETAT D'AVANCEMENT DE LA CARTOGRAPHIE DES DONNEES RELATIVES AUX PECHERIES 5

A. Cartes des principaux fonds de pêche et zones interdites à la pêche 5
B. Cartes des nurseries, des biocénoses et des habitats critiques pour la pêche et l'aquaculture 5
C. Préparation d'un atlas hydrographique des pêcheries de l'Adriatique 6

VI. CONSTITUTION ET ANALYSE DE SERIES CHRONOLOGIQUES DE DONNEES SUR LES PECHES ET L'ENVIRONNEMENT 6

VII. RESSOURCES PELAGIQUES 8

A. Grands pélagiques 8
B. Petits pélagiques 8
C. Aménagement des stocks de petits pélagiques 10

VIII. RESSOURCES DEMERSALES 10

A. Pêcheries de mollusques 10
B. Pêcheries de crustacés 10
C. Poissons démersaux 11

IX. ETUDES SOCIO-ECONOMIQUES SUR LES PECHERIES DE L'ADRIATIQUE 12

X. PROGRES ACCOMPLIS DANS L'HARMONISATION DES LEGISLATIONS ET L'APPLICATION DE REGLEMENTATIONS EN MATIERE DE PECHE 12

XI. CONCLUSIONS ET RECOMMANDATIONS DES GROUPES DE TRAVAIL _AD HOC_ ET DE LA CONSULTATION 12

XII. PROGRAMME DE TRAVAIL POUR LA PROCHAINE INTERSESSION 13

A. En matière de recherche 13
B. En matière de statistiques 14
C. En matière de collaboration sous-régionale 14
D. En matière d'aménagement 15

XIII. AUTRES QUESTIONS 15

XIV. DATE ET LIEU DE LA SIXIEME CONSULTATION 15

XV. ADOPTION DU RAPPORT 15

		Page
I.	INTRODUCTION	16
II.	ADOPTION OF THE AGENDA	16
III.	ELECTION OF CHAIRPERSON AND VICE-CHAIRPERSONS	16
IV.	THE STATE OF FISHERIES STATISTICS IN THE ADRIATIC	16
	A. Catch and Effort Data	16
	B. Information on Size Frequency Data	19
	C. Size of Fleets by Categories	19
	D. Information on Cost, Benefits and Economic Returns	19
V.	PROGRESS ACHIEVED IN MAPPING FISHERIES-RELATED DATA	19
	A. Mapping Main Fishing Grounds and Closure Areas	19
	B. Mapping Nursery Areas, Biocoenoses and Critical Habitats for Fisheries and Aquaculture	20
	C. Adriatic Fisheries and Hydrographic Atlases	20
VI.	ESTABLISHMENT OF HISTORICAL FISHERIES AND ENVIRONMENT DATA AND THEIR ANALYSIS	20
VII.	PELAGIC RESOURCES	22
	A. Large Pelagic Fish	22
	B. Small Pelagic Fish	22
	C. Management of Small Pelagic Stocks	24
VIII.	DEMERSAL RESOURCES	24
	A. Molluscan fisheries	24
	B. Crustacean Fisheries	24
	C. Demersal Fish	24
IX.	MAJOR STATE OF SOCIO-ECONOMIC STUDIES IN ADRIATIC FISHERIES	25
X.	UPDATE OF PROGRESS IN HARMONIZATION OF LEGISLATION AND APPLICATION OF FISHERIES REGULATIONS	25
XI.	CONCLUSIONS AND RECOMMENDATIONS OF THE AD HOC WORKING GROUPS AND THE CONSULTATION	26
XII.	PROGRAMME FOR THE NEXT INTERSESSIONAL PERIOD	26
	A. Research	26
	B. Statistics	27
	C. Sub-regional collaboration	27
	D. Management	27
XIII.	OTHER MATTERS	28
XIV.	DATE AND PLACE OF THE SIXTH CONSULTATION	28
XV.	ADOPTION OF THE REPORT	28

ANNEXE/APPENDIX

1.	Ordre du jour	29
1.	Agenda	31
2.	Liste des participants/List of participants	33
3.	Documents présentés à la Consultation/Documents presented to the Consultation	39

Page

DEUXIEME PARTIE/SECOND PART

CONTRIBUTIONS

A. ETUDES SUR L'ENVIRONNEMENT DES PECHES/FISHERIES ENVIRONMENTAL STUDIES

Time series of productivity parameters indicating eutrophication in the Middle Adriatic waters (by T. Pucher-Petković, I. Marasović, I. Vukadin and L. Stojanoski) 41

Composition and spatial distribution of zooplankton at the spawning areas of sardine in the eastern Adriatic (by D. Regner) 51

Bibliography of long-term time series in the Adriatic (by S. Regner) 57

Studies of the Adriatic biological resources (by T. Vucetić) 63

Time series of oceanographic parameters: eutrophication of the open Adriatic waters (by M. Zore-Armanda, L. Stojanoski and I. Vukadin) 71

B. RESSOURCES PELAGIQUES/PELAGIC RESOURCES

Some preliminary results from mapping commercial catches of small pelagic fish in the North Adriatic (by B. Ales) 78

Preliminary evaluation of anchovy and sardine stocks in the lower Adriatic (by N. Casavola, G. Marano, L. De Martino and C. Saracino) 84

Catch, size distribution, growth and sex ratio of swordfish (Xiphias gladius L.) in the Gulf of Taranto (by G. De Metrio and P. Megalofonou) 91

Acoustic survey in the eastern Adriatic in 1986 (by I. Kacić) 103

Juvenile sardine along the eastern Adriatic coast - studies and protection (Part 2) (by I. Kacić, G. Sinovcić and V. Alegría-Hernandez) 105

Cours des prises avec palangre de surface dans l'Adriatique du Sud (côtes italiennes), triennat 1984-86 (par G. Marano, L. Rositani, N. Ungaro et V. De Zio) 112

Relation between phytoplankton productivity and Sardina pilchardus in the middle Adriatic (I. Marasović, T. Pucher-Petković and V. Alegría) 121

The spawning of the sardine (Sardina pilchardus Walb.) in the Adriatic as related to the distribution of temperature (by S. Regner, G. Piccinetti-Manfrin and C. Piccinetti) 127

Trends of annual catches or stock densities of some pelagic fishes in recent "Pelagia years" in the Adriatic (by T. Vucetić and V. Alegría-Hernandez) 133

C. RESSOURCES DEMERSALES/DEMERSAL RESOURCES

Stock-recruitment relationship for the hake (Merluccius merluccius L.) from the open middle Adriatic-Jabuka Pit (by V. Alegría-Hernández and S. Jukić) 137

On the growth of the four-spotted scaldfish, Lepidorhombus boscii, from the southern Adriatic (by G. Bello and E. Rizzi) 142

Distribution of the Adriatic fishes of Triglidae family as affected by ecological factors (by I. Jardas) 147

Growth and temporal distribution of juvenile sparids in the Sibenik area in the middle Adriatic (by J. Dujakovic Jurica) 152

Page

Biology and ecology of Mugilidae species on the eastern Adriatic coast (Sibenik Bay) (by Z. Modrusan, E. Teskeredzic and S. Jukić) 159

On the density-dependent regulation of the 0 group hake (Merluccius merluccius L. 1758) in the Patraikos Gulf, Greece (by C. Papaconstantinou and K. Stergiou) 168

Elaboration des données sur les ressources démersales de la haute et moyenne Adriatique (par C. Piccinetti et S. Jukić) 172

Distribution with depth and catches per unit effort of the hake and the red mullet off the western coast of Greece (by V. Vassilopoulou and C. Papaconstantinou) 174

The ascent of Mugilidae fry into a coastal lagoon of the southern Adriatic Sea (by P. Villani) 181

D. RESSOURCES EN INVERTEBRES/INVERTEBRATES RESOURCES

An estimate of growth and mortality parameters for Norway lobster (Nephrops norvegicus) in the central Adriatic Sea (by C. Froglia and M.E. Gramitto) 189

Studies for the evaluation and of the consistency of beds of Chamelea gallina in the Adriatic - Evaluation of clam stocks in the lower Adriatic (by G. Marano, A.M. Pastorelli and R. Vaccarella) 204

Notes on the distribution of commercial crustaceans in the southern Adriatic, trawl-survey 1985-86 (by T. Petruzzi, A.M. Pastorelli and G. Marano) 213

The importance of the mollusca cephalopoda in the context of trawl surveys carried out in the Ionian Sea (1985-86) (by A. Tursi, G. D'Onghia, A. Matarrese, P. Panetta, E. Cecere, R. Cavallo and P. Pacifico) 222

E. GENERAL

Evolution de l'effort de pêche au chalut en haute et moyenne Adriatique (par E. Arneri et C. Piccinetti) 230

Distribution de l'effort de pêche dans les pêcheries des mers italiennes, densité (CV/n mi²) et cpue (kg/CV) pour les différents métiers de pêche (par G. Bombace et N. Cingolani) 234

Summary report on the quality check sample survey of fisheries catch and effort statistics - Adriatic area (by G. Bombace, N. Cingolani, S.R. Coppola and J. Mortera) 245

Caractéristiques de la flottille yougoslave de pêche en Adriatique (par P. Cetinić) 260

Definition and preliminary evaluation of the Italian fishing zones exploited by the national fleet (by S.R. Coppola and N. Cingolani) 266

Evolution technologique de l'effort italien de pêche au chalut dans l'Adriatique au cours des quarante dernières années (par M. Ferretti et P. Arata) 275

A preliminary note on management of coastal resources along the eastern Adriatic coast by regulation of fishing gears: mesh size selectivity (by I. Jardas, A. Pallaoro, S. Jukić and P. Cetinić) 279

Contribution to the knowledge on the short and long-term effects of the application of 40 mm codend mesh size in Adriatic trawl fishery-eastern Adriatic coast (by S. Jukić and C. Piccinetti) 282

Preliminary ecological and biological studies of juvenile fish species of commercial interest in the national park "Kornati" (by M. Kraljević and J. Jug-Dujaković) 291

Abundance of commercial fish in the Patraikos, Korinthiakos Gulfs and the Ionian Sea, Greece (by K. Stergiou and C. Papaconstantinou) 300

PREMIERE PARTIE/PART ONE

RAPPORT DE LA CONSULTATION/REPORT OF THE CONSULTATION

I. INTRODUCTION

1. La cinquième Consultation technique sur l'évaluation des stocks dans l'Adriatique s'est tenue à Bari, du 1er au 5 juin 1987, à l'aimable invitation du Gouvernement italien.

2. En ouvrant la réunion M. D. Charbonnier, Secrétaire du Conseil général des pêches pour la Méditerranée, a exprimé aux autorités italiennes, tant nationales que régionales et locales, les remerciements de la FAO pour leur invitation, ainsi que pour avoir mis à la disposition de la réunion les moyens techniques dont elles disposaient, y compris des services d'interprétation simultanée propres à faciliter considérablement les échanges de vues. Il a particulièrement exprimé sa gratitude à Monsieur le Professeur G. Marano, Directeur du Laboratoire de biologie marine de Bari, qui s'était chargé d'organiser la réunion, ainsi qu'à MM. G. Casone, Président de la province de Bari et A. Alto, Recteur de l'Université de Bari, qui honoraient de leur présence la séance d'ouverture de la Consultation. Il a enfin exprimé les remerciements du Secrétariat aux participants[1/] dont les travaux antérieurs avaient été accueillis avec satisfaction par la dix-huitième session du CGPM, qui avait souhaité le maintien et l'intensification de la coopération internationale dans l'Adriatique.

3. Monsieur G. Casone, Président de la province de Bari, a salué les participants au nom des autorités administratives. Il a précisé que l'aide apportée par le Laboratoire de biologie marine de Bari aux pêcheries de la région revêt une importance considérable à l'échelle nationale. Il a cependant souligné que cette zone, bien que très poissonneuse, souffre d'une mauvaise gestion qui se traduit par une surexploitation de certaines espèces et par des déséquilibres biologiques et économiques. Cela explique l'importance des travaux de la Consultation qui, en permettant notamment de recueillir des données fiables auprès de tous les pays riverains, permettront d'asseoir les bases scientifiques d'un aménagement rationnel des ressources.

4. Monsieur A. Alto, Recteur de l'Université de Bari, a souligné combien son Université s'intéresse aux sciences de la mer. Cet intérêt est d'ailleurs partagé par bon nombre des 120 universités de la côte méditerranéenne qui se tiennent régulièrement en contact et coopèrent sous les auspices de l'Université de Bari.

5. Monsieur G. Marano a ensuite souhaité la bienvenue aux participants. Il a déclaré que les consultations sur les stocks de l'Adriatique revêtent une importance de plus en plus grande et il a exprimé sa conviction que la présente réunion apporterait une importante contribution à la protection des stocks de la région.

II. ADOPTION DE L'ORDRE DU JOUR

6. L'ordre du jour figurant à l'annexe 1 a été adopté.

III. ELECTION DU PRESIDENT ET DES VICE-PRESIDENTS

7. Monsieur G. Marano a été élu président de la Consultation et M. S. Regner et Mme C. Karlou, vice-présidents.

IV. *SITUATION ACTUELLE DES STATISTIQUES DES PECHES DANS L'ADRIATIQUE*

A. Données sur les captures et l'effort de pêche

8. La Consultation a entendu une série d'exposés sur les progrès accomplis dans la collecte de données sur les captures et l'effort de pêche dans l'Adriatique.

9. Bombace, Cingolani, Coppola et Mortera[2/] (ce rapport) ont révélé la très large part revenant aux pêcheries de l'Adriatique (en particulier de la haute Adriatique) dans les débarquements et l'effort de pêche italien, ainsi qu'il ressort des enquêtes menées dans le cadre du Programme PESTAT.

1/ La liste des participants figure à l'annexe 2

2/ La liste des documents présentés à la Consultation figure à l'annexe 3

10. On fait ressortir la nécessité de procéder systématiquement par échantillonnage dans les enquêtes statistiques sur ce secteur très diversifié, ainsi que celle d'éviter les interruptions. Par ailleurs, comme il est dit par Ferretti et Arata (ce rapport), il faut bien se rendre compte que les divers engins contribuent dans des mesures différentes à l'effort total. Ainsi, dans le cas du chalut "rapido", l'effort augmente sans doute proportionnellement à la puissance motrice en chevaux-vapeur tandis que, dans le cas des chalutiers traditionnels, le facteur d'accroissement est probablement additif l'effort augmentant avec le nombre de bateaux et ne dépendant pas autant de la puissance motrice de chacun en chevaux-vapeur.

11. On a brièvement évoqué les méthodes utilisables pour mesurer directement l'effort de pêche dans une zone relativement restreinte; la surveillance du temps passé sur les fonds de pêche par des bateaux de différentes catégories de taille à l'aide de systèmes radar installés sur des plate-formes dans l'Adriatique nord a été mentionnée comme une possibilité à explorer.

12. Bombace et Cingolani (ce rapport) étudiaient la corrélation entre l'intensité de pêche (effort total, exprimé en chevaux-vapeurs, exercé sur la superficie du plateau continental: CV/milles marins carrés) et les taux de capture obtenus par la flottille italienne. Il en ressortait que l'effort total en chevaux-vapeur et les taux de capture correspondants sont plus élevés dans la haute Adriatique et tendent è être moindres dans la basse Adriatique ainsi que, par exemple, autour de la Sicile et de la Sardaigne. Cela permet certainement de penser que la productivité par surface est plus élevée dans la haute Adriatique, mais met aussi en évidence la forte intensité de pêche dans ce secteur. Il est clair également qu'il n'existe pas de corrélation entre les indices de capture-intensité de pêche pour les différents secteurs.

13. La stratégie d'aménagement suggérée par ce tableau, à savoir un déplacement de l'effort de pêche des zones intensément exploitées vers celles qui le sont moins, a été jugée d'une validité douteuse par la Consultation, car la comparaison ne tenait pas compte de la valeur des ressources récoltées; en outre, pour ce qui concerne la flottille de chalutiers, il est probable que le pourcentage chalutable d'un secteur donné est moindre sur les fonds accidentés, si bien que l'intensité de pêche effective, exprimée en CV/milles marins carrés, a peut-être été sous-estimée dans les cas de ce genre (voir tableaux 1 et 2).

14. La Consultation a reconnu que l'effort exprimé en termes de puissance motrice (CV) n'est pas strictement additif et que la puissance motrice totale de la flottille ne rend pas véritablement compte de l'effort exercé par différentes catégories de bateaux; mais, tout en jugeant nécessaire d'être mieux informée sur les autres facteurs pertinents, elle a estimé que la puissance totale en chevaux-vapeurs reste une source d'informations utiles et fondamentales, d'autant plus qu'elle s'est accrue de façon spectaculaire au cours de la dernière décennie (voir Arneri et Piccinetti, ce rapport).

Tableau 1

Effort de pêche exercé par unité de surface et taux de capture dans la zone géographique de l'Adriatique (tous engins)

Italie	Total chevaux vapeur/ milles marins carrés	cpue
	6,2	398,5
Haute Adriatique	59,1	597,7
Zone ligurienne	52,3	456,4
Sud de la mer Tyrrhénienne	52,2	106,1
Adriatique centrale	18,4	579,1
Mer Ionienne	16,2	288,6
Nord de la mer Tyrrhénienne	13,2	227,8
Basse Adriatique	13,2	296,7
Zone sarde	9,8	240,6
Zone sicilienne	2,0	461,7

Tableau 2

Effort de pêche exercé par unité de surface et
taux de capture (chalutiers)

Italie	Total chevaux vapeur/ milles marins carrés	cpue
	3,3	230,2
Haute Adriatique	26	238,1
Zone ligurienne	16,4	334,4
Sud de la mer Tyrrhénienne	12,7	54
Adriatique centrale	12,7	178,4
Partie moyenne de la mer Tyrrhénienne	12	103
Basse Adriatique	10	171,3
Zone sarde	0,6	?
Zone sicilienne	1,3	337,6

15. Il est néanmoins manifeste qu'il faudrait préciser les paramètres dont dépend l'effort effectivement exercé, étant donné que, comme le font observer Arneri et Piccinetti (ce rapport), on ne peut admettre automatiquement que le temps de pêche effectif d'un grand bateau est supérieur à celui d'un petit bateau. Les éléments déterminants de l'effort de pêche - à savoir la puissance motrice en chevaux-vapeurs, le temps effectivement passé à pêcher, et la vitesse de la pêche et la taille et l'efficacité des engins - doivent être pris tous les trois en considération. On observe par exemple qu'au cours de la période 1967-87, une réduction de 12 à 36 pour cent du nombre de jours de mer des chalutiers italiens.

16. Tous ces facteurs, auxquels il faut ajouter l'abondance du poisson, ont une influence sur le taux de capture obtenu et si celui-ci n'est pas corrigé en conséquence, sa fiabilité en tant qu'indice de l'abondance en est considérablement réduite. La Consultation a envisagé diverses lignes de conduite pour la poursuite des travaux, notamment prospections par chalutage pour déterminer les modifications de l'abondance, examen de la composition par âge des captures et analyse des taux de capture obtenus par une catégorie donnée de bateaux ayant subi un minimum de transformations techniques.

17. Quoique l'on ait reconnu que l'équipement s'est modifié, même celui des plus anciens bateaux, il vaudrait la peine, semble-t-il, dans le cas des flottilles yougoslaves et italiennes, de surveiller les modifications des taux de capture des catégories de bateaux qui n'ont pas subi de transformations radicales ces dernières années.

18. Il existe une longue série de données sur les taux de capture des chalutiers et des senneurs dans les eaux territoriales yougoslaves (Cetinić, ce rapport); on ne peut en dégager aucune tendance significative pendant la période correspondante, mais il n'est pas certain que l'on puisse généraliser cette conclusion à l'ensemble de l'Adriatique.

19. Le problème de la détermination de modifications intervenues pendant les années antérieures aux premières prospections italiennes a été mentionné une nouvelle fois. La Consultation a recommandé que des prospections au titre du programme PESTAT soient régulièrement prévues dans le secteur italien de la pêche en vue de recueillir des données précises pour faciliter la planification de ce secteur. L'IRPEM (Istituto di Ricerche sulla Pesca Marittima) d'Ancône prévoit de poursuivre cette activité, si possible sur une base triennale, conformément au cycle de financement italien.

20. Il semble qu'une collaboration spéciale dans le domaine des statistiques se soit instaurée à titre officieux entre des chercheurs yougoslaves et italiens; et cette collaboration devrait être renforcée et recevoir un appui officiel.

21. Malgré les difficultés précitées d'étalonnage de l'effort de pêche, on peut reconnaître des signes d'une lente diminution du taux de capture moyen dans l'Adriatique nord, malgré l'accroissement de la puissance de pêche. Il pourrait être intéressant d'examiner de plus près le secteur artisanal dont l'effort intéresse dans une large mesure les zones côtières où les effets de la pêche

sont particulièrement sensibles, car quelques-unes des flottilles traditionnelles de ce genre ont peut-être été moins affectées par le progrès technique que les flottilles industrielles. L'évolution de leur taux de capture pourrait donc être moins biaisée par des facteurs autres que l'abondance.

22. Une grande partie des bateaux yougoslaves sont très vieux, ainsi qu'il est dit par Cetinić (ce rapport) et des plans de renouvellement de la flottille sont en cours. Il faudra surveiller l'effet de ce renouvellement sur l'effort de pêche et un interétalonnage de la puissance de pêche avec celle des bateaux existants est recommandé.

23. La Consultation a examiné les conclusions générales selon lesquelles l'effort et l'intensité de la pêche se sont accrus à un degré spectaculaire en termes réels, plus spécialement dans la haute Adriatique, pendant la dernière dizaine d'années.

24. Il est évident qu'il y a des lacunes considérables dans les données statistiques officielles et que les résultats de prospections plus systématiques au titre du programme PESTAT ne valent que pour la période limitée pendant laquelle elles ont été conduites; il est donc impossible de déterminer précisément dans quelle mesure l'effort de pêche a augmenté, d'autant plus que l'effort exprimé en termes de puissance de pêche des bateaux n'est pas strictement additif.

25. D'autres incertitudes sont dues à l'utilisation d'engins de pêche et équipements électroniques améliorés (ce qui a pour effet d'accroître l'effort de pêche effectif) et au fait que le nombre de jours de pêche est moindre dans le cas des grands bateaux (ce qui a pour effet de réduire l'effort total effectif). Pour tenter de déterminer plus précisément dans quelle mesure l'effort de pêche dans l'Adriatique a augmenté ces dernières années, un petit groupe de travail ad hoc a été constitué pour examiner la question. Ses conclusions ont été les suivantes:

26. Le groupe a noté pour commencer que les données statistiques sur la flottille ne sont pas précises et qu'il conviendrait en premier lieu de les améliorer en continuant à soutenir le programme PESTAT. Par ailleurs, l'effort de pêche peut ne pas dépendre uniquement de la puissance motrice, surtout pour les bateaux qui ont plus de 300 CV et faudrait donc entreprendre différents types d'essais dans des zones de pêche variées afin de constituer une série exploitable de données sur la base desquelles il sera possible d'établir un coefficient de corrélation permettant de calculer l'effort de pêche à partir des informations sur la flottille. Le groupe de travail a donc recommandé que le programme PESTAT soit poursuivi et il a demandé aux laboratoires d'Ancône et de Fano d'entreprendre des études parallèles sur l'efficacité de bateaux de pêche de puissance différente, dans des zones différentes, et de présenter les résultats de ces études à la prochaine Consultation.

27. Les données statistiques sur une importante pêcherie pélagique de l'Adriatique sud, principalement axée sur l'espadon, ont été brièvement examinées (Marano, Rositani, Ungaro et De Zio, ce rapport). On a souligné la nécessité de comparer les séries de données sur les taux de capture avec des séries correspondantes pour d'autres zones (par exemple dans la mer Ionienne). Les saisons auxquelles sont capturés les grands poissons pélagiques diffèrent quelque peu selon les espèces et il conviendrait d'être mieux informé sur l'itinéraire de leurs migrations.

B. Informations sur les fréquences de tailles

28. Les problèmes d'étalonnage de l'effort de pêche font qu'il est difficile de définir une mesure précise de l'effort (f) telle que f soit proportionnel à la mortalité par pêche (F); il est donc nécessaire d'estimer directement la mortalité et plusieurs méthodes actuellement disponibles à cet effet se fondent sur les fréquences de tailles des captures effectuées par les flottilles commerciales et les navires de recherche. Pour le moment toutefois, indépendamment des activités de recherche, il semble qu'aucun échantillonnage systématique de la taille et de l'âge des captures commerciales ne soit entrepris dans l'Adriatique, et cela en raison du prix élevé du poisson.

C. Taille des flottilles, par catégories

29. Des données de ce genre sont régulièrement collectées par l'Albanie, la Grèce, l'Italie et la Yougoslavie.

D. Informations sur les coûts/avantages et la rentabilité économique

30. Pour comprendre l'évolution des taux de captures et celle de l'effort de pêche exercé sur un stock partagé par des pays dont les systèmes économiques sont différents et sur le marché desquels les prix sont différents, il y a lieu de prendre en considération les aspects économiques. Quelle est la valeur d'une même cpue dans le cas de chaque flottille? Quel est le coût réel de la récolte dans chaque cas? La présente Consultation a réaffirmé, comme la consultation précédente, la

nécessité d'entreprendre de nouvelles études bioéconomiques sur ce problème. Il est également important de tenir compte des aspects économiques et sociaux lors de l'examen des effets possibles de mesures d'aménagement.

31. A l'échelle nationale, on a fait ressortir les problèmes que soulèvent les conflits entre les embarcations artisanales et les navires de plus grande taille qui, dans les eaux italiennes, sont surtout les gros chalutiers. Dans une perspective économique, il y a lieu de comparer les coûts des diverses catégories d'engins et de bateaux, compte tenu aussi bien des emplois offerts que des effets possibles sur les zones de pêche côtières, qui peuvent servir de nurseries aux poissons juvéniles.

V. ETAT D'AVANCEMENT DE LA CARTOGRAPHIE DES DONNEES RELATIVES AUX PECHERIES

A. Cartes des principaux fonds de pêche et zones interdites à la pêche

32. Une description de l'aire de répartition des trigles dans l'Adriatique (Jardas, ce rapport) a conduit à se demander s'il convient de prendre en compte les zones bathymétriques plutôt que les délimitations des biocénoses ou les types de sédiments pour la détermination de la distribution. Dans l'Adriatique, on a la chance d'être bien informé sur les deux derniers de ces facteurs spatiaux et leur utilisation pour la description des habitats est encouragée. A noter toutefois que plusieurs espèces se déplacent vers le large après avoir passé leur stade juvénile dans les eaux côtières.

33. Une carte de la répartition saisonnière des pêcheries de petits pélagiques dans l'Adriatique nord est en cours d'établissement (Bolje, ce rapport). Elle fait apparaître les préférences différentes de la sardine et du sprat en ce qui concerne leur habitat. On a souligné que dans ce type d'étude, il est nécessaire de faire la synthèse des données sur l'effort de pêche déployé dans chaque secteur par les deux flottilles nationales.

34. Une carte préliminaire de la répartition de l'effort de pêche dans les eaux de la côte Adriatique italienne établie sur la base des résultats de prospections au titre du programme PESTAT, a été présentée par Coppola et Cingolani (ce rapport) pour des zones de 30 x 30 milles marins carrés, l'effort étant exprimé en TJG/milles marins carrés. La prédominance du chalutage de fond dans tous les secteurs (80-90 pour cent du total des TJG) a été notée, l'effort atteignant son niveau le plus élevé dans le golfe de Trieste (2 500 TJG/milles marins carrés/an) et entre Venise et Chioggia (2 116 TJG/milles marins carrés/an). La catégorie des plus grands chalutiers (catégorie 3.2) est représentée dans la plupart des zones côtières.

35. Les conclusions de cette étude sont que les cartes des zones de pêche doivent avoir pour objectif principal de montrer la répartition de l'effort et qu'un haut degré de concentration de l'effort est évident. Les surfaces unitaires prises en considération devraient idéalement être plus petites près de la côte, et devraient être comprises entre des isobathes déterminées.

36. Il a été rendu compte par Piccinetti et Jukić (ce rapport) de nouvelles techniques de cartographie automatisée utilisant les données géographiques provenant de stations d'échantillonnage régulier ou aléatoire (prospections par chalutage); elles éviteront peut-être la nécessité de choisir entre sondage stratifié et prospections régulières, aussi longtemps que la stratification est convenable.

B. Cartes des nurseries, des biocénoses et des habitats critiques pour la pêche et l'aquaculture

37. Ainsi qu'il est indiqué par Jardas, Pallaoro, Jukić et Cetinić (ce rapport), la taille de première capture dans les pêcheries yougoslaves de la côte adriatique est généralement peu importante, ce qui suscite des préoccupations pour une grande variété d'espèces qui passent le début de leur vie dans les eaux côtières. Les conclusions préliminaires formulées dans ce document servent déjà de base à un examen de mesures de réglementation du maillage des filets maillants en Yougoslavie.

38. Pour une forte proportion de ces espèces, la taille de première capture est inférieure à la taille à la maturité, situation dangereuse dans une pêcherie intensément exploitée, et dont les conséquences demandent à être minutieusement examinées, en particulier dans le cas des hermaphrodites protandres et des sparidés.

39. Des études préliminaires décrites par Jug-Dujaković et par Kraljević et Jug-Dujaković (ce rapport) ont déjà été faites sur les diverses nurseries. La première d'entre elles rend compte de l'entrée saisonnière échelonnée dans les nurseries côtières de huit espèces de sparidés et du ralentissement des taux de croissance des juvéniles présents dans ces eaux durant les mois d'hiver.

40. Outre les stades juvéniles de quelques espèces marines, des espèces anadromes telles que les mulets passent un certain temps dans les zones d'estuaires ainsi que décrit par Modrusan,

Teskeredzič et Jukič (ce rapport). Les températures estivales élevées y sont associées à une meilleure croissance des organismes-fourrages du littoral et les effectifs par classe d'âge sont plus nombreux.

C. Préparation d'un atlas hydrographique des pêcheries de l'Adriatique

41. Aucune communication à ce sujet n'a été présentée, quoique des informations géographiques continuent d'être recueillies à titre individuel.

VI. CONSTITUTION ET ANALYSE DE SERIES CHRONOLOGIQUES DE DONNEES SUR LES PECHES ET L'ENVIRONNEMENT

42. Les longues séries de données disponibles, en particulier pour l'Adriatique orientale, sont bien décrites dans la documentation publiée et des experts scientifiques yougoslaves leur ont consacré une série de communications particulièrement utiles pour comprendre l'évolution de la situation dans l'Adriatique[1/]. Leur contenu est résumé ci-après.

43. Les participants ont noté que la quatrième Consultation avait recommandé l'examen de séries rétrospectives de données océanographiques en vue de se rendre compte de l'évolution correspondante de stocks de poisons.

44. De 1952 à ce jour, une série exceptionnelle de données océanographiques a été recueillie selon un processus normalisé dans les stations de la coupe Split-Gargano; comme celles qui ont été recueillies de la même manière ailleurs dans le monde, ces données offrent le seul indice disponible des modifications intervenues au cours d'une longue période.

45. Zore-Armanda, Stojanoski et Vukadin (ce rapport) décrivent les modifications de la température, de la salinité et des concentrations d'oxygène indiquées par les enquêtes annuelles; pour chaque année, les chiffres ont été obtenus en faisant la moyenne de tous les échantillonnages mensuels effectués suivant cette coupe, de la surface à 170 m de fond. Toutes les séries chronologiques font apparaître des fluctuations marquées, avec une autocorrélation apparente et, souvent, des tendances clairement discernables sur de longues périodes. Cela vient renforcer l'impression déjà retirée des publications antérieures, à savoir que les afflux de masses d'eau plus salée dans l'Adriatique atteignent un maximum à intervalles d'une dizaine d'années.

46. C'est ainsi que la température moyenne de l'eau était élevée avant 1956, au milieu des années soixante et au début des années quatre-vingt.

47. Des afflux de masses d'eau très salée ont été évidents au milieu des années cinquante, à la fin des années soixante et au début des années quatre-vingt. Il serait extrêmement intéressant de savoir ce qui s'est passé simultanément dans les pêcheries. On notera néanmoins par ailleurs qu'une tendance à long terme à l'accroissement de la salinité se manifeste depuis 1965 dans toute la colonne d'eau et qu'elle pourrait, peut-être, être liée à l'achèvement de la construction du barrage d'Assouan sur le Nil en 1964.

48. Etant donné le caractère assez progressif de l'évolution des paramètres, l'hypothèse relative à l'influence du barrage d'Assouan n'a pas recueilli l'assentiment de tous les participants à la Consultation. A ce propos, on a signalé que les effets des apports d'eau douce déversés par les cours d'eau locaux (par exemple le Pô) n'ont pas été clairement distingués. Il y a toutefois semble-t-il une bonne correspondance entre la série de données relatives aux concentrations d'oxygène et la "crise de l'oxygène" de 1977 dans l'Adriatique nord. Il faudrait examiner de plus près le mécanisme de diminution de la teneur en sels nutritifs parallèlement à l'eutrophisation.

49. De plus, la transparence de l'eau ne cesse de diminuer depuis 1960. La suggestion selon laquelle cette dernière tendance serait due à l'accroissement de la production primaire semble confirmée par l'écart progressivement croissant entre les fortes concentrations superficielles d'oxygène et les faibles concentrations près du fond, ces dernières se réduisant au point qu'elles risquent de devenir préjudiciables aux ressources démersales, si cette tendance se maintient.

50. Les concentrations de phosphates et la salinité ont augmenté de façon spectaculaire en 1969, ce qui suggèrerait peut-être un afflux abondant d'eau provenant de la Méditerranée orientale, mais une lente diminution de la teneur en phosphates et autres éléments nutritifs semble maintenant évidente dans toutes les couches. La Consultation s'est demandée comment il faut interpréter cette tendance en regard de l'accroissement apparent de l'eutrophisation signalé par Pucher-Petkovič, Marasovič, Vukadim et Stojanoski (ce rapport), quoique ces derniers semblent confirmer le document par

---

1/ Voir ce rapport: Zore-Armanda, Stojanoski et Vukadin; Pucher-Petkovič, Marasovič, Vukadin et Stojanoski; Vucetič; Regner D.; Vucetič et Alegria-Hernandez

Zore-Armanda, Stojanoski et Vukadin (ce rapport) faisant état d'un accroissement soutenu de la production primaire dans les eaux côtières de l'Adriatique centrale, qui est passée de 149 à 245 g C m^{-2} $année^{-1}$ entre 1962 et le début des années quatre-vingt. En revanche, en mer ouverte, la production primaire (et la biomasse) n'ont fortement augmenté que pendant les quatre dernières années étudiées, passant de 60 à 96 g C m^{-2}. En outre, la distribution de fréquence des taux de production primaire de 1962 à 1983 fait apparaître un déplacement des valeurs les plus fréquentes vers le niveau supérieur de production. Les auteurs estiment que l'effet d'eutrophisation ayant son origine sur le littoral a commencé de se manifester en eaux libres à peu près dix ans plus tard que dans la région côtière.

51. Il semble que les moyennes annuelles pour l'ammoniac, les nitrates et les phosphates aient fortement diminué depuis 1978. Diverses hypothèses ont été formulées à ce sujet, mais aucune explication définitive n'a encore été trouvée.

52. Marasovič, Pucher-Petkovič et Alegría (ce rapport) faisaient état de l'existence de trois principales zones géographiques distinctes de production primaire dans l'Adriatique. L'Adriatique centre-sud (zone A) est celle qui a la plus faible productivité correspondant à une influence maximale de l'eau méditerranéenne; l'Adriatique nord (zone B) a une productivité élevée et les chenaux entre les îles de l'Adriatique orientale ont une valeur intermédiaire (zone C); les grandes baies de la côte Adriatique sont celles qui ont la plus forte productivité (zone D). Il semble que les zones B et C se soient élargies ces dernières années. Les captures de sardines semblent avoir augmenté parallèlement à la production primaire dans l'Adriatique est, et la zone de captures maximum semble également s'être déplacée vers le sud, quoique cet effet soit surtout évident à l'échelle sous-régionale.

53. Depuis 1967, un accroissement ininterrompu des captures yougoslaves de sardines a été enregistré parallèlement à une diminution du nombre de jours de pêche. Bien que les raisons de cet état de choses n'aient pas encore été entièrement éclaircies (elles pourraient l'être par exemple en entreprenant une prospection acoustique), il semble que la biomasse de sardines ait augmenté.

54. L'hypothèse importante avancée par Marasovič, Pucher-Petkovič et Alegría (ce rapport) est que l'accroissement actuel de la biomasse est dû à une progression générale de l'eutrophisation et ne résulte pas seulement de l'afflux de masses d'eau. Il est possible que cette eutrophisation ait commencé dans l'Adriatique nord et soit d'origine terrestre, car certains indices permettent maintenant de penser que les arrivées d'eau ne sont pas associées comme précédemment à un accroissement de l'eutrophisation, sans doute en raison du rôle important joué par des éléments nutritifs d'origine endogène.

55. La Consultation a souligné qu'il importe d'examiner de plus près cette hypothèse qui, si elle se révèle correcte, revêtira une grande importance pour un aménagement intégré de la mer Adriatique. Une ligne de conduite semble s'imposer, à savoir déterminer plus précisément ce qui s'est passé lors d'incursions antérieures de masses d'eau et faire la comparaison avec des épisodes plus récents.

56. Vucetič et Alegría-Hernandez examinaient les conséquences de ces événements plus haut dans la chaîne alimentaire, en particulier celles associées aux périodes d'abondance de la méduse *Pelagia* sp. Les périodes de grande abondance de cette espèce semblent être associées à un accroissement de captures de *Boops boops* et de *Trachurus* sp., qui sont apparemment tous deux des prédateurs de *Pelagia*. Il semble qu'il y ait un accroissement général de la biomasse de *Pelagia*, ce qui soulève la question de l'influence relative de la pêche et de l'eutrophisation dans les modifications des taux de capture. La Consultation a toutefois noté la possibilité que l'augmentation des captures soit due à une meilleure accessibilité ou à une plus grande vulnérabilité des stocks. Là aussi, des prospections acoustiques aideront à se rendre compte précisément de la situation. Néanmoins, il ressort clairement de l'ensemble des communications que l'hypothèse du régime stationnaire est d'une validité très douteuse pour expliquer ce qui se passe dans les pêcheries de la mer Adriatique.

57. Au cours du débat général sur les communications précitées, on s'est demandé si l'utilisation de moyennes annuelles est la meilleure procédure à suivre pour interpréter des séries chronologiques. Par exemple, la salinité des eaux de fond peut être un meilleur indice de l'incursion de masses d'eau et la température des eaux superficielles en hiver peut donner une meilleure indication de la survie des espèces de poissons se trouvant dans les nurseries à cette époque de l'année. Il est clair que des travaux complémentaires s'imposent pour permettre d'utiliser cette base de données.

58. Quelques contradictions apparentes entre des séries chronologiques italiennes plus récentes et les comptes rendus qui ont été présentés ont conduit à examiner les différences entre les épisodes de brève durée (par exemple floraisons de plancton) et les tendances à long terme. Il faudrait chaque fois que possible confronter des données intéressant des intervalles de temps comparables.

59. Des analyses antérieures[1/] de séries chronologiques relatives aux captures yougoslaves de sardines pendant une période de 100 ans avaient fait apparaître la prédominance de cycles de 25, 11 et 3 ans; ces cycles avaient précédemment été associés à des afflux de masses d'eau et ils ressortaient également des relevés de salinité, de température, de production primaire et de production d'oeufs. Il serait absolument nécessaire de mettre à jour ces études antérieures jusqu'au moment précédant immédiatement la période actuelle de production élevée et de tenter de prévoir les niveaux de production en admettant la seule intervention des mécanismes antérieurs. Les résultats obtenus pourraient alors être comparés avec les observations récentes, en vue de déterminer la nature et la direction des écarts.

60. En général toutefois, la Consultation a reconnu que l'ensemble de communications existant était propre à stimuler de nouvelles études et il a été recommandé que quelques-unes des communications qui seront faites à des consultations futures aient pour objectif de préciser et développer les conclusions et hypothèses préliminaires présentées ici.

61. D'un point de vue pratique immédiat, les modifications de la production qui ont été enregistrées semblent favorables au développement des pêcheries pélagiques, quoique l'on ne puisse exclure les risques de dystrophie et épisodes associés imputables à la baisse des concentrations d'oxygène.

VII. RESSOURCES PELAGIQUES

A. Grands pélagiques

62. L'évolution d'une nouvelle pêcherie d'espadons du golfe de Tarante entre 1978 et 1986 a été examinée (De Metrio et Megalofonou, ce rapport). Au cours de cette période, les taux de capture et la taille moyenne des captures ont fortement diminué. Les données disponibles indiquent un recrutement irrégulier dans un stock relativement local et une concentration actuelle de l'effort de pêche sur les juvéniles. Il est évident que des mesures de contrôle des opérations s'imposent pour éviter une capture excessive de juvéniles; un mode d'intervention possible serait de réglementer la taille minimale des hameçons. Il serait utile d'étudier en coopération les populations d'espadon vivant dans l'ensemble de la Méditerranée.

B. Petits pélagiques

(a) Etudes acoustiques

63. Azzali et Luna examinaient l'évolution des ressources de petits pélagiques de l'Adriatique occidentale telle qu'elle ressortait des prospections acoustiques régulièrement entreprises entre 1976 et 1985.

64. Au cours de cette période, la biomasse de sardine et d'anchois dans le nord et le centre de l'Adriatique, tout d'abord peu importante, s'est accrue pour atteindre deux maximums principaux: le premier (vers 1978) dans l'Adriatique nord, avec une large prédominance de l'anchois, et le second en 1983/84, avec une prédominance de la sardine et, dans une moindre mesure, du chinchard. La répartition spatiale au cours des deux périodes a été inégale mais assez différente, et on suggère que, dans le cas des populations de juvéniles vivant plus particulièrement dans la strate correspondant aux fonds de 40 à 60 m, la concurrence pour l'espace et les ressources alimentaire est très vive. La comparaison avec les captures commerciales montre que les captures d'anchois sont restées importantes jusqu'en 1985 même après la réduction de la biomasse, en raison de la meilleure accessibilité de bancs qui s'étaient déplacés vers la côte.

65. Par ailleurs, le sprat a profité de la moindre abondance des deux autres espèces dominantes et accru ses effectifs. Il semble que la taille moyenne de toutes les espèces ait augmenté au cours de la période des prospections. On ne peut que supposer à l'heure actuelle que cela correspondait à un accroissement de l'âge moyen.

66. Des informations sur la biomasse de pélagiques dans l'Adriatique centrale et méridionale qui ont également été présentées indiquaient une biomasse totale et une proportion d'anchois très inférieures (Azzali et Luna).

1/ Regner et Gacić, 1974 et 1977 (voir bibliographie par Regner, ce rapport)

67. L'hypothèse d'une concurrence a été examinée compte tenu des préférences différentes de la sardine, de l'anchois et du sprat en matière de température, et compte tenu plus particulièrement des informations présentées antérieurement sur le caractère dynamique des conditions hydrographiques. Il semblerait que la concurrence soit particulièrement vive entre les poissons de taille semblable vivant aux mêmes profondeurs. On ne sait pas très bien quelle est la corrélation entre les maximums de biomasse et les intrusions de masses d'eau ou autres événements hydrographiques, mais il est certains qu'en général ces derniers ont conditionné d'une certaine manière l'apparition de tels maximums. La Consultation a estimé que cette question est l'une de celles qu'il faudra résoudre en priorité.

68. Des études effectuées dans l'Adriatique orientale entre 1975 et 1984 (Kacić, ce rapport) ont fait apparaître des accroissements importants de la biomasse de sardine. En 1986, le stock a plus que doublé, mais la pêche a cessé en raison de la petite taille des poissons; elle devrait néanmoins être bonne l'année prochaine.

69. Etant donné la nécessité urgente de regrouper les données océanographiques et les données sur le pêcheries pélagiques, l'IRPEM d'Ancône a proposé d'inviter des spécialistes en océanographie physique et biologique à la réunion de biologistes spécialistes des poissons pélagiques, en vue de comparer les résultats obtenus par des méthodes directes et indirectes d'évaluation des pélagiques (voir paragraphe 81 du rapport de la quatrième Consultation et paragraphe 103 du présent rapport). Les participants tenteront de mettre en correspondance les données physiques et les phénomènes biologiques à tous les niveaux trophiques. Cette suggestion a été favorablement accueillie par la délégation yougoslave.

70. La continuité géographique des populations de sardines et d'anchois dans toute l'Adriatique sud-ouest a été clairement mise en évidence par les études sur les oeufs et les larves (Casavola, Marano, Martino et Saracino, ce rapport). Dans cette zone, il n'y a guère de signes que l'exploitation par pêche soit préjudiciable au stock de sardines; il a néanmoins été proposé de contrôler saisonnièrement la pêche des "bianchetto" pour protéger les anchois aux époques où ils viennent se mêler à eux.

71. Une étude des juvéniles de sardines dans les baies de l'Adriatique est a été entreprise en vue de protéger ce stade du cycle biologique des sardines (Kacić, Sinovcić et Alegría-Hernandez, ce rapport). Les pêcheries de "bianchetto" et de sardines juvéniles devraient être étudiées globalement, car des analyses distinctes ne fourniraient pas les informations nécessaires pour protéger et aménager le stock de sardines dans l'ensemble de l'Adriatique.

72. La répartition des zones de reproduction des sardines avait été décrite dans un certain nombre de communications antérieures, mais Regner, Piccinetti-Manfrin et Piccinetti (ce rapport) s'efforçaient d'examiner les mécanismes hydrographiques en cause, en particulier l'apparente coïncidence géographique des zones de reproduction et des zones frontales de remontée des eaux notée au cours de prospections conjointes italo-yougoslaves entreprises entre 1979 et 1986. Dans les limites de leurs tolérances de température, les stocks de sardines se déplacent vers l'Adriatique orientale pour se trouver fortement associés à ces discontinuités hydrographiques en décembre-mars. Cette observation aura peut-être des conséquences pratiques pour l'estimation de la biomasse de poissons parvenus à maturité, car les strates à échantillonner pourront être délimitées autour des zones frontales ressortant de l'imagerie par satellite.

73. Les avantages biologiques de cette stratégie fondée sur le cycle vital étaient décrits par Regner (ce rapport). L'auteur a constaté que le printemps est la saison où le zooplancton est le plus dense dans les zones précitées, avec une prédominance des copépodes.

74. Les utiles résultats du cours de formation organisé à Ancône du 6 au 11 avril 1987, avec des participants d'Albanie et de Grèce[1/] ont été brièvement décrits. Il a permis d'unifier les méthodes de travail, et montré la nécessité d'adopter des procédures analogues pour les prospections entreprises de part et d'autre de la ligne de séparation de l'Adriatique en son milieu et de coordonner ces prospections.

75. Il est évident qu'il faut adopter des deux côtés de l'Adriatique une approche commune des problèmes de recherche et d'aménagement des stocks pélagiques et, dans cette optique, un groupe de travail de biologistes spécialistes des espèces pélagiques s'est réuni séparément pour examiner une stratégie de prospetion. Il a présenté le rapport ci-après.

1/ Le rapport de ce cours, préparé par l'IRPEM d'Ancône et intitulé "Rapport du cours de formation pratique sur les techniques de prospection acoustique et l'utilisation de l'équipement" a été distribué aux participants à la Consultation

76. Le groupe ad hoc est convenu de la nécessité d'entreprendre une prospection conjointe en vue d'évaluer la biomasse de pélagiques. Il a été proposé que les instituts d'Ancône et de Split prennent les contacts nécessaires avec toutes les personnes concernées des autres instituts de la mer Adriatique et de la mer Ionienne, ainsi qu'avec les administrations des pêches d'Albanie, de Grèce, d'Italie et de Yougoslavie, pour que cette prospection puisse être entreprise. La première initiative à prendre est d'évaluer l'équipement, les appareils électroniques et les compétences disponibles dans les différents instituts et, sur la base des informations recueillies, établir un plan de travail pour l'interétalonnage de l'équipement et la conduite de la prospection. Une aide de la FAO - par l'intermédiaire du CGPM - sera nécessaire pour faciliter les contacts entre les pays intéressés et la conduite des enquêtes, et permettre de déroger, le cas écheant à des réglementations restrictives, étant entendu que cela n'entraînera aucune obligation financière pour l'Organisation.

77. La Consultation a examiné les sources d'erreurs dans les études sur la densité et la distribution des oeufs entreprises par les instituts de recherche. Elle a recommandé d'entreprendre des études sur les oeufs en utilisant la méthode consistant à estimer la fécondité de lots et à calculer la production totale d'oeufs à partir des courbes d'intensité de la reproduction, en utilisant du matériel provenant de stations fixes.

78. Il a également été recommandé que les données sur les captures et l'effort de pêche, ainsi que les paramètres biologiques éventuellement nécessaires, soient recueillies conformément à la méthodologie commune sur laquelle se sont mis d'accord les instituts qui étudient ce problème.

79. La délégation de la Grèce a fait appel à la coopération italienne pour la conduite d'une prospection acoustique conjointe dans la mer Ionienne, en collaboration avec l'Albanie. L'IRPEM d'Ancône a donné son accord de principe, de même que les deux autres délégations concernées.

C. Aménagement des stocks de petits pélagiques

80. La suggestion selon laquelle les stocks pélagiques devraient être aménagés séparément dans le nord, le centre et le sud du secteur italien de l'Adriatique a été examinée, plus particulièrement en ce qui concerne les petits pélagiques. Cette approche pourrait avoir une utilité pratique, quoiqu'aucune information probante n'ait été présentée quant à l'identité ou au caractère distinct des stocks en cause, ou quant à leur continuité possible de part et d'autre de la ligne médiane. Pour qu'une veritable coopération internationale en matière d'aménagement des stocks de petits pélagiques puisse s'instaurer, il importera tout d'abord de mieux coordonner les études en vue de définir d'authentiques unités de stocks et de déterminer les rapports entre les populations de diverses zones. Le CGPM est un cadre tout indiqué pour une tentative de ce genre.

VIII. RESSOURCES DEMERSALES

A. Pêcheries de mollusques

81. Tursi, D'Onghia, Panetta, Cecere, Cavallo, Matarrese et Pacifico (ce rapport) rendaient brièvement compte de la grande diversité des céphalopodes de la mer Ionienne. On ne sait pas grand-chose de la biologie de leurs pêcheries ni de leurs paramètres de croissance, mais en l'absence de variations saisonnières marquées des captures, il devrait être possible de procéder à des estimations de la croissance et de la mortalité.

82. Une possibilité analogue existe en ce qui concerne les stocks de *Chamelea gallina* de la basse Adriatique, pour lesquels les données sur la biomasse et la composition par âge suggèrent que le recrutement n'est peut-être pas constant d'une année à l'autre et qu'il faudrait tenir compte de ce fait pour leur aménagement.

B. Pêcheries de crustacés

83. Les pêcheries de crustacés de l'Adriatique sud sont limitées là où il existe des fonds chalutables, mais elles assurent une part importante de la production aux profondeurs inférieures à 200 m (Petruzzi, Pastorelli et Marano, ce rapport).

84. La détermination des paramètres de croissance et de mortalité des crustacés soulève des difficultés considérables. Celles-ci ont pû être surmontées dans l'étude présentée par Froglia et Gramitto (ce rapport) en raison d'une mortalité massive de *Nephrops norvegicus* en 1977 au large d'Ancône: la progression modale des classes d'âge a par la suite été facile à suivre après le recrutement important observé en 1982 et il a été possible d'en déduire des taux de croissance effectifs où ont pu être comparés avec ceux de la population de *Nephrops* vivant en eaux plus profondes dans la fosse de Pomo.

85. Les taux de croissance dans la zone située au large d'Ancône qui possède de riches ressources benthiques sont plus élevés que dans la fosse de Pomo et plus élevés en fait que ceux de populations étudiées ailleurs (Froglia et Gramitto, ce rapport).

86. Les taux de mortalité de ce stock sont élevés. Il est difficile d'en rendre la prédation responsable, car il est rare que l'on trouve des Nephrops d'une taille quelconque dans le contenu stomacal des poissons locaux. Indépendamment des mortalités catastrophiques (comme on n'en avait jamais enregistré avant 1977), le taux de mortalité est imputable en grande partie à la pêche. Il est évident qu'il y a lieu de mettre au point des modèles de rendement adaptés à cette situation.

87. Les participants yougoslaves ont demandé son aide à M. C. Froglia pour une étude en coopération des stocks yougoslaves et des stocks partagés de Nephrops.

C. Poissons démersaux

88. La question de la taille optimale de première capture et du maillage approprié pour les culs de chalut dans une pêcherie multispécifique est particulièrement complexe. Jukić et Piccinetti (ce rapport) présentaient un examen préliminaire des effets à court et à long terme des modifications du maillage, fondé d'une part sur des considérations relatives au rendement par recrue et, de l'autre, sur les pertes économiques immédiates (en poids et en valeur) résultant de l'évasion du poisson lorsque de nouveaux maillages plus grands sont adoptés. Les expériences effectuées avec des culs de chalut de maillages différents ont fourni les informations de base nécessaires. Les résultats ont été calculés pour: (a) le merlu; (b) le mulet cabot; (c) le pageot et (d) la langoustine (50-80 pour cent de la biomasse chalutée). L'essentiel des pertes résultant de l'adoption d'un maillage de 40 mm pendant la saison correspondant à celle où les expériences ont été effectuées concernerait les céphalopodes; leur montant serait de l'ordre de $EU 8-16 par unité de temps. Avec une maille de 70 mm, les pertes économiques seraient excessives et ne sont pas jugées acceptables mais, en général, l'adoption uniforme d'une maille d'au moins 40 mm permettrait d'assurer un accroissement important du rendement par recrue de toutes les espèces, sauf peut-être Trachurus, qui aurait toutes chances de compenser les pertes immediates précitées. Les effets d'une modification (diminution) de la mortalité par pêche semblaient moins prononcés.

89. Les mesures d'aménagement que suggère cette étude doivent être envisagées compte tenu de leurs incidences sociales et économiques. En pratique, il pourrait être plus facile d'envisager des périodes de fermeture de la pêche et une réduction de l'effort de pêche à des périodes critiques de l'année, plutôt qu'une modification du maillage, quoique cette dernière mesure semble offrir la possibilité d'améliorer le rendement.

90. La relation entre la taille des stocks de merlu et le recrutement ultérieur de juvéniles a été présentée pour la nursery de la moyenne Adriatique (la fosse de Jabuka) (voir Alegría-Hernandez et Jukić, ce rapport); elle a été établie sur la base des résultats des prospections par chalutage effectuées au cours de la période 1960-85 avant la dispersion des juvéniles de cette nursery. Cette relation a pu être mise en correspondance avec une relation stock-recrutement du type Ricker, qui suggère que la taille optimale du stock de reproducteurs serait d'environ 80 000 t. On a toutefois noté la très grande variabilité des effectifs de la classe d'âge 0 pour une population donnée de géniteurs et il apparaît que la survie des juvéniles présente des oscillations ayant une périodicité de plusieurs années; les années 1975 et 1977 ont été des années de très bon recrutement. La Consultation a noté avec satisfaction la première tentative d'application d'un modèle de ce genre aux stocks de l'Adriatique, mais elle a suggéré qu'idéalement, il faudrait également faire une comparaison entre les effectifs recrutés et les paramètres du milieu. La probabilité qu'un certain degré de protection de merlus juvéniles permette d'améliorer considérablement les captures faites ailleurs dans l'Adriatique a été discutée.

91. Des vues ont été échangées sur la possibilité de réglementer la pêche en contrôlant le maillage ou en instituant des saisons de fermeture à l'époque de l'année où les merlus du groupe 0 sont le plus vulnérables; semblables mesures devraient être coordonnées entre les pays concernés.

92. La situation des pêcheries des eaux grecques de la mer Ionienne était décrite par Papaconstantinou et Stergiou et par Stergiou et Papacostantinou (ce rapport). Les fluctuations observées dans les zones où la pêche est interdite ne sont pas les mêmes que dans les zones exploitées et des comparaisons plus détaillées se justifieraient en raison des conséquences pratiques de cette situation pour l'aménagement.

93. L'état des pêcheries dans une zone abritant une nursery de merlus juvéniles dans le golfe de Patraikos (Grèce) était examiné par Papaconstantinou et Stergiou (ce rapport). Un échantillonnage saisonnier entrepris dans cette zone sur une base mensuelle a suggéré un taux élevé de réduction instantanée des effectifs de cette population du groupe 0, qui ne peut pas être dû aux activités de pêche puisque celle-ci a été interdite pendant la plus grande partie de la période. Il est possible qu'il y ait une certaine émigration du golfe vers la mer Ionienne, mais le point de vue de l'auteur

est que le stock de la mer Ionienne est distinct de celui du golfe, et se reproduit également à une époque différente. La conclusion du document est que pendant l'année étudiée (1983), la mortalité a été due essentiellement à la famine et probablement au fait que les ressources trophiques du golfe étaient insuffisantes pour alimenter l'importante population de juvéniles.

94. La conclusion selon laquelle le taux de mortalité naturelle des juvéniles est élevé (de même que pour le stock de l'Adriatique) semble indiscutable, mais il reste quelques questions à résoudre en ce qui concerne la quantification de l'émigration pour la détermination des taux de mortalité apparente à partir des courbes de capture. Un examen plus approfondi de cet aspect s'impose avant que l'on puisse recommander en toute sécurité la récolte de l'excédent de merlus juvéniles se trouvant dans le golfe.

95. Les paramètres nécessaires pour l'établissement de la courbe croissance de von Bertalanffy ont été présentés pour Arnoglossus (Bello et Rizzi, ce rapport).

IX. ETUDES SOCIO-ECONOMIQUES SUR LES PECHERIES DE L'ADRIATIQUE

96. Aucune communication nouvelle à ce sujet n'a été autre que l'étude sur le maillage à utiliser pour la capture du merlu (Jukić et Piccinetti, ce rapport), mais la Consultation a souligné que la rentabilité économique, l'état de la ressource et les marchés sont des éléments interdépendants. Il est important de déterminer quelle est la strate la plus rentable dans ces flottilles. Un échantillonnage pour l'établissement d'indices économiques et d'indices de production est indispensable pour les poissons de haute et de faible valeur marchande.

97. Les aspects économiques doivent également être pris en considération pour la mise en valeur des zones côtières, en particulier pour ce qui concerne la pêche artisanale, les récifs artificiels et l'aquaculture.

X. PROGRES ACCOMPLIS DANS L'HARMONISATION DES LEGISLATIONS ET L'APPLICATION DE REGLEMENTATIONS EN MATIERE DE PECHE

98. Les points ci-après sont ressortis des échanges de vues:

(i) il existe des réglementations du maillage (maille étirée de 40 mm), mais elles demandent encore à être effectivement appliquées dans de nombreuses pêcheries, en particulier par la flottille chalutière côtière;

(ii) il y a lieu de réduire les niveaux d'effort de pêche. Malheureusement, les limitations prévues dans les licences ne sont pas toujours respectées et, lorsqu'elles le sont, elles confèrent aux détenteurs de licence une importante valeur de capital, ce qui risque de causer des problèmes sociaux.

99. En Italie, l'application des réglementations dépend du contrôle exercé sur le maillage par les capitaineries de port, etc. Les mesures disciplinaires ne sont pas toujours efficaces; d'autres moyens d'encourager à observer les réglementations sont les mesures économiques et la présentation de résultats de recherches convaincants.

100. La protection des nurseries préoccupe également les instituts de recherche italiens qui commencent maintenant à recevoir un soutien du Gouvernement.

101. La loi N° 41 de 1982 prévoit la création d'un comité de coordination composé d'experts scientifiques des pêches pour diriger les travaux d'évaluation des stocks, et la préparation tous les trois ans d'un plan d'aménagement.

102. Les juristes devraient se pencher sur le problème de l'harmonisation des législations de pêche des pays de l'Adriatique, et le Conseil général des pêches pour la Méditerranée est prié de formuler une recommandation dans ce sens.

XI. CONCLUSIONS ET RECOMMANDATIONS DES GROUPES DE TRAVAIL AD HOC ET DE LA CONSULTATION

103. La réunion d'Ancône initialement prévue par l'IRPEM en vue de comparer les différentes méthodes d'évaluation des stocks pélagiques (voir paragraphe 85 du rapport de la quatrième Consultation), et qui doit maintenant se tenir en 1988, permettra pour la première fois à des groupes de travail ad hoc de se réunir au cours de l'intersession; il est recommandé que les résultats préliminaires de recherches soient présentés à ces groupes et à d'autres groupes ad hoc pour permettre à la prochaine Consultation de se concentrer sur un nombre plus limité d'études complètes. Chaque fois que possible, ces études devraient avoir été entreprises en application de recommandations formulées par des consultations antérieures.

104. La période de deux ans qui sépare les consultations est trop brève pour que d'importants travaux nouveaux puissent être entrepris et menés à bonne fin, et la Consultation a recommandé que cet intervalle soit porté à trois ans et que les groupes de travail ad hoc se réunissent au moins une fois au cours de l'intersession pour planifier les activités et faire le point des résultats.

105. La création de trois groupes de ce genre est envisagée, pour s'occuper respectivement des questions suivantes: (a) espèces pélagiques/prospections acoustiques et océanographie des pêcheries; (b) espèces démersales/ressources benthiques; (c) statistiques.

106. Le directeur de l'IRPEM a offert d'accueillir au moins le premier de ces groupes de travail en 1988 et le directeur de l'institut de Split a proposé d'accueillir le groupe de travail ad hoc sur les ressources démersales/ benthiques. Tout institut qui serait désireux d'accueillir le groupe de travail ad hoc sur les statistiques devrait se mettre en contact avec le Secrétariat au cours de l'intersession.

107. Les problèmes pratiques que pose à la FAO le soutien des activités supplémentaires au titre de ces groupes de travail ad hoc ont été soulignés par le Secrétariat qui a indiqué qu'il ne faut escompter aucune assistance financière. La Consultation a pris acte de cette situation et du fait que le coût de l'organisation de la réunion et de la publication des résultats devra être supporté par l'institut hôte qui se chargera également de prendre contact avec tous les instituts et pays membres concernés.

108. Les résultats des activités des groupes de travail ad hoc seront publiés sous le nom d'auteur "CGPM", après qu'un projet préliminaire ait été envoyé pour approbation au Secrétariat. Une fois qu'un rapport aura été approuvé, l'institut hôte se chargera d'en diffuser une copie à toutes les personnes figurant sur la liste d'adresses dans les pays membres du CGPM qui sera fournie par le Secrétariat. La procédure sera expérimentée avec le rapport de la réunion d'Ancône sur les études acoustiques (voir paragraphe 74).

109. En ce qui concerne les prospections acoustiques conjointes proposées, des contacts seront pris au niveau des directeurs des instituts, l'institut d'Ancône jouant le rôle de chef de file. Les délégués albanais et grecs ont indiqué qu'ils souhaiteraient participer à cette activité conjointe initialement prévue par les Italiens et les Yougoslaves. En cas de difficultés l'obtention de bateaux et d'équipement, les experts scientifiques albanais et grecs seront invités à bord des bateaux italiens et yougoslaves.

XII. PROGRAMME DE TRAVAIL POUR LA PROCHAINE INTERSESSION

110. Outre les recommandations ou suggestions d'action contenues dans les parties précédentes du présent rapport (voir en particulier les paragraphes 19, 22, 26, 60, 62, 77, 78 et 104) la Consultation, pour établir son programme de travail pour la prochaine intersession, s'est référée aux directives et recommandations qu'elle avait adoptées lors de sa quatrième réunion. Ces directives et recommandations, reproduites à l'annexe 4, ont été commentées comme suit:

A. En matière de recherche

(i) Stocks démersaux

111. Utiliser les données de campagnes de chalutage pour compléter les cartes de distribution des espèces: Cette directive, qui a été partiellement suivie, doit être maintenue.

112. Calculer les taux de mortalité à partir des fréquences des tailles: Cette directive doit être maintenue.

113. Améliorer les informations sur les taux de croissance des espèces commerciales: Cette directive a été partiellement suivie et doit être maintenue.

114. Etudier la distribution géographique des âges et des tailles pour analyser les migrations: Cette directive a été partiellement suivie et doit être maintenue.

115. Analyser les données de longueur dans les captures de la campagne "Hvar": Cette directive a commencé à être appliquée, ainsi qu'il ressort de certains documents présentés. Les travaux vont se poursuivre.

116. Campagnes de chalutage expérimental: Des campagnes ont été conduites ("Pipeta") et vont se poursuivre sur une base régulière.

117. Echantillonnage biologique des captures et/ou des débarquements: La Consultation a confirmé qu'il était difficile de suivre cette directive, malgré son importance. Elle sera appliquée dans toute la mesure des moyens disponibles.

118. La Consultation a par ailleurs estimé qu'il serait utile de procéder à des études sur l'alimentation des poissons en vue d'établir les relations prédateurs/proies.

(ii) Stocks pélagiques

119. Définition des unités de stock: La Consultation a estimé que cette directive devait être maintenue. Elle a proposé de considérer les sous-unités de stocks (étant donné l'élargissement des recherches à la mer Ionienne, (voir paragraphe 135 ci-après) et de ne pas limiter les migrations à l'axe nord-sud mais au contraire de les étudier dans toutes leurs directions.

120. Analyse coût-bénéfice de la pêcherie pélagique de Yougoslavie: Cette analyse est encore en cours d'élaboration et des résultats pourront être présentés à la prochaine Consultation:

121. Travaux sur la fécondité des petits pélagiques: Les données sur la fécondité des petits poissons pélagiques sont relativement rares, mais les études se poursuivront désormais sans interruption, en particulier pour ce qui concerne l'anchois et la sardine.

122. Comparaison des méthodes d'évaluation: L'IRPEM a confirmé son invitation de tenir à Ancône un atelier sur la comparaison des résultats obtenus par les diverses méthodes d'évaluation des pélagiques (voir paragraphe 103).

123. Hydrologie/climatologie: Une bibliographie annotée relative aux variations à long terme est en cours de mise au point finale, une fois achevée, elle sera distribuée par le Secrétariat.

124. A ce propos, le représentant de la Commission des Communautés européennes a informé la Consultation de la préparation d'une étude sur les séries chronologiques de statistiques de pêche, en partie inspirée par les conclusions de consultations techniques du CGPM; elle est financée par la Commission et exécutée par des institutions de Grèce et l'Imperial College de l'Université de Londres. Cette étude utilisera des nouvelles techniques d'analyse des séries chronologiques en vue d'analyser des données sur l'anchois et la sardine des eaux grecques ainsi que sur d'autres espèces de la Méditerranée. La collaboration des chercheurs de l'Adriatique et de l'Ionienne serait bienvenue.

125. Le représentant de la CCE a d'autre part indiqué que la Commission finançait aussi des activités de recherche halieutique devant conduire à un meilleur aménagement des ressources; ce financement s'adresse soit directement aux pays membres de la CEE soit parfois à la FAO (CGPM). Il suit un programme de recherche élaboré annuellement qui tient compte des recommandations émanant du CGPM lui-même ou de ses organes subsidiaires.

B. <u>En matière de statistiques</u>

126. La collecte des statistiques de la petite pêche côtière et de la pêche privée se révèle très difficile en Yougoslavie, surtout dans le second cas. En revanche, l'Italie a publié en trois volumes les données statistiques recueillies par le programme PESTAT (statistiques de la flottille de pêche, et statistiques des captures et de l'effort de pêche)1/.

C. <u>En matière de collaboration sous-régionale</u>

127. La Consultation a noté que les campagnes d'évaluation des biomasses par la méthode des oeufs et des larves et les campagnes de chalutage scientifique se déroulaient de façon satisfaisante.

128. Les campagnes de prospection acoustique se sont révélées plus difficiles à réaliser sur une base multi-nationale. Cependant des propositions ont été faites qui pourraient prochainement améliorer cette situation (voir paragraphe 109).

129. Stage de démonstration: Un stage de démonstration sur l'utilisation du matériel acoustique a été organisé à Ancône par l'IRPEM et son rapport présenté à la Consultation (voir paragraphe 74).

130. Elaboration d'une base de données hydrologiques: ni l'Atlas, ni la Base de données hydrologiques recommandés par la quatrième Consultation n'ont été réalisés. Ce travail devrait cependant être disponible lors de la prochaine consultation.

1/ Quaderni dell'Istituto di Ricerche sulla Pesca Marittima, Vol. IV N° 1 Supplemento, 1984; Vol. V N° 1 Supplemento (1a parte), 1986; Vol. V N° 1 Supplemento (2a parte), 1986

131. Programme concerté d'études sur les petits pélagiques: Ce programme a reçu un commencement d'exécution et il semble que la collaboration qui s'est instaurée entre l'IRPEM et l'Institut d'océanographie de Split doive se traduire par une élaboration commune des données recueillies par ces deux institutions.

D. En matière d'aménagement

132. La Consultation a noté que des études économiques destinées à évaluer le coût de la surpêche étaient en cours et a décidé que cette directive devait être maintenue.

133. Régulation de l'âge de première capture: Des études sont en cours et la Consultation a maintenu cette directive.

134. Harmonisation des législations: La Consultation a estimé qu'il s'agissait là d'une proposition digne d'intérêt, surtout si l'on considérait le problème des ressources exploitées par plus d'un pays; elle a cependant pensé que la réunion de juristes qu'impliquait l'harmonisation des législations était pour l'heure en dehors des préoccupations immédiates de cette consultation (voir paragraphe 102).

XIII. AUTRES QUESTIONS

135. Lors de la discussion de différents points de l'ordre du jour, il s'est avéré que la zone géographique couverte par la Consultation technique devrait également comprendre la mer Ionienne. La Consultation a donc décidé que son titre serait dorénavant le suivant: "Consultation technique sur l'évaluation des stocks dans les mers Adriatique et Ionienne".

XIV. DATE ET LIEU DE LA SIXIEME CONSULTATION

136. La Consultation a estimé que pour laisser un temps suffisant à la préparation sérieuse et à la tenue des différents groupes de travail qui devront avoir lieu pendant l'intersession (voir paragraphe 104) un intervalle de trois ans devrait être prévu d'ici à la sixième consultation; elle aura donc lieu, sous réserve de l'approbation de la dix-neuvième session du CGPM, en 1990.

137. Les participants yougoslaves ont proposé que cette consultation se tienne à l'Institut de biologie marine de Kotor, et cette invitation a été approuvée par acclamations.

XV. ADOPTION DU RAPPORT

138. Le rapport de la cinquième Consultation technique sur l'évaluation des stocks dans l'Adriatique a été approuvé le 5 juin 1987. A cette occasion les participants ont renouvelé au directeur du Laboratoire de biologie marine de Bari et à ses collaborateurs leurs remerciements chaleureux pour l'excellente organisation de la réunion.

I. INTRODUCTION

1. The Fifth Technical Consultation on Stock Assessment in the Adriatic took place from 1 to 5 June 1987 at the kind invitation of the Italian Government.

2. In opening the meeting, Mr D. Charbonnier, Secretary of the General Fisheries Council for the Mediterranean, thanked the Italian authorities, national, regional and local, for their invitation and for having made facilities available to the meeting, including equipment for simultaneous interpretation, which had greatly assisted the group's discussions. He expressed special gratitude to Professor G. Marano, Director of the Marine Biology Laboratory in Bari, for the work he had undertaken in organizing the meeting, and to Mr G. Casone, President of the Province of Bari, and Mr A. Alto, Rector of the University of Bari, who had honoured the opening session of the Consultation with their presence. On behalf of the Secretariat, he thanked participants[1/], whose work in the previous period had been appreciated by the Eighteenth Session of the GFCM, which had expressed the hope that international cooperation in the Adriatic would continue and expand.

3. Mr G. Casone, President of the Province of Bari, greeted participants on behalf of the administrative authorities. He emphasized the contribution made by the Marine Biology Laboratory in Bari to fishing activities in the region, which were of considerable importance to the nation. He did, however, point out that this zone, although well stocked with fish, suffered from bad management, which was reflected in overexploitation of some species and biological and economic imbalances. Hence, he concluded, the importance of the work of the Consultation which, by gathering reliable data from Mediterranean countries, would lay the scientific bases for rational resource management.

4. Mr A. Alto, Rector of the University of Bari, mentioned the interest of this University in marine studies. This interest was shared by many of the 120 universities bordering the Mediterranean, who were regularly in contact with each other in the framework of cooperation promoted by the University of Bari.

5. Lastly, Mr G. Marano welcomed participants. He stated that the Adriatic Consultations were becoming increasingly important and expressed his conviction that the present meeting would have a major role to play in further protection of stocks in the region.

II. ADOPTION OF THE AGENDA

6. The agenda shown in Appendix 1 was adopted.

III. ELECTION OF CHAIRPERSON AND VICE-CHAIRPERSONS

7. Mr G. Marano was elected Chairman of the Consultation, Mr S. Regner Vice-Chairman and Mrs C. Karlou Vice-Chairwoman.

IV. THE STATE OF FISHERIES STATISTICS IN THE ADRIATIC

A. Catch and Effort Data

8. The Consultation heard a series of papers addressing progress in collection of catch and effort data in Adriatic fisheries.

9. The dominant role of Adriatic fisheries (especially in the upper Adriatic) in Italian landings and fishing effort, based on the PESTAT surveys is revealed by Bombace, Cingolani, Coppola and Mortera (this report)[2/].

10. The importance of a systematic sampling approach to statistical survey of this highly diverse sector was emphasized, as well as the need for continuity. At the same time, as shown by Ferretti and Arata (this report), it is important to realize that differences exist between gears in their impact on total effort. Thus for the "rapido" trawl fishery the effort probably increases in proportion to horsepower while for traditional trawlers, effort is probably additive by number of boats, and less affected by individual horsepower.

11. The possibilities open for direct measurement of fishing effort in a relatively restricted area were touched on briefly: monitoring time on ground by vessels of different size categories by radar from platforms in the Northern Adriatic was mentioned as one possibility that might be explored.

1/ The list of participants is attached as Appendix 2

2/ Documents presented at the Consultation are listed in Appendix 3

12. Bombace and Cingolani (this report) examined the relationship between fishing intensity (total horsepower exerted over the shelf area: hp/n mi^2 and the corresponding catch rates obtained by the Italian fleet. Based on this comparison, both total horsepower and catch rates are higher for the upper Adriatic, and tend to be lower in the lower Adriatic and for example around Sicily and Sardinia. This is strongly suggestive of a higher productivity per surface in the upper Adriatic, but also emphasizes the high intensity of fishing effort exerted on this latter area. It is also clear that there is no relationship between catch rate and horsepower exerted per area, when comparisons are made between areas.

13. The management strategy that this picture suggests of a transfer of effort from heavily fished to less fished areas was considered suspect by the Consultation, since the comparison does not take into account the value of resources harvested, and for the trawl fleet, it is probable that the percentage area trawlable is lower in rocky bottom areas which would tend to understimate the effective hp/n mi^2 apparent in these areas (see Tables 1 and 2).

14. Although total fleet horsepower is not strictly additive in terms of true effort exerted by different classes of boats, the Consultation felt that a better knowledge of other relevant factors is needed, but total horsepower is still a useful basic data source, and has certainly increased dramatically over the last decade (see Arneri and Piccinetti, this report).

Table 1

Horsepower exerted per unit area and catch rates in the Adriatic area (all gears)

Italy	Total horsepower/n mi^2	cpue
	6.2	398.5
High Adriatic	59.1	597.7
Ligurian area	52.3	456.4
Lower Tyrrhenian	52.2	106.1
Middle Adriatic	18.4	579.1
Ionian area	16.2	288.6
High Tyrrhenian	13.2	227.8
Lower Adriatic	13.2	296.7
Sardinian area	9.8	240.6
Sicilian area	2.0	461.7

Table 2

Horsepower exerted per unit area and catch rate (trawlers)

Italy	Total horsepower/n mi^2	cpue
	3.3	230.2
High Adriatic	26	238.1
Ligurian area	16.4	334.4
Lower Tyrrhenian	12.7	54
Middle Adriatic	12.7	178.4
Middle Tyrrhenian	12	103
Lower Adriatic	10	171.3
Sardinian area	0.6	?
Sicilian area	1.3	337.6

15. It is clear however that what is needed is a better clarification of the data components determining effort exerted, given that as noted by Arneri and Piccinetti (this report), it cannot be assumed automatically that a large vessel spends more time actually fishing than a small one. The three components of fishing effort, horsepower, time spent actually fishing, and speed of fishing and size and effectiveness of gear, all need to be taken into account. Thus, over the period 1967-87, number of days spent at sea by Italian trawl fleet has decreased by between 12 and 36%.

16. All of these factors, in addition to fish abundance, affect the catch rate obtained, and have serious impacts in reducing the reliability of this index as a measure of abundance, if not corrected for. Several lines for future work were considered by the Consultation, namely to rely on trawl surveys for abundance changes, to look at age structure of the catch, and to look at catch rates for a fixed class of boat, which has shown minimal technological changes.

17. Although it was recognized that changes in equipment have taken place, even for the older boats, one line of investigation that seems worth pursuing for both Italian and Yugoslav fleets, would be to monitor changes in catch rate by classes of vessels which have not changed radically in recent years.

18. A long series of catch rates exists for trawlers and seiners within Yugoslav territorial waters (Cetinić, this report), which has shown no significant trend over the period, though whether this is characteristic of changes in the whole Adriatic was not clear.

19. The problem mentioned earlier of determining historic changes in the earlier years before Italian surveys were initiated was mentioned. The Consultation recommended that the PESTAT survey be somehow incorporated as a regular function in the Italian fisheries sector, in order that precise data be available to assist planning in this sector. Ancona IRPEM (Istituto di Ricerche sulla Pesca Marittima) plans to continue this activity, possibly triennially, in accord with the Italian funding cycle.

20. Specific collaborative activity on statistics between Italy and Yugoslavia appears to be proceeding on an informal basis between individual workers, and should be strengthened and supported officially.

21. There seems evidence, despite the above difficulties in effort calibration, that in the Northern Adriatic the mean catch rate is slowly decreasing, despite increases in fishing power. Looking more closely at the small-scale sector which largely exerts its effort on the sensitive inshore areas may be productive, since some of these traditional types of activity may have been less affected by technological changes than industrial boats. Their catch rate evolution may therefore be less biased by factors other than abundance.

22. The advanced age of a significant percentage of the Yugoslav fleet was referred to by Cetinić (this report), and plans for fleet renewal are underway. The effect this will have on the effort exerted by this fleet will need monitoring, and cross calibration of fishing power with existing boats is recommended.

23. The Consultation discussed the general conclusions that in real terms, fishing effort and intensity have increased dramatically, especially in the upper Adriatic, over the last decade or so.

24. Obviously, there have been considerable inadequacies in official sources of statistics, and the more systematic surveys made by PESTAT only apply for the limited period when they were carried out; all of which poses uncertainties as to the precise extent of increase in effort, especially since the increase in effort exerted with fishing power of vessel is not strictly additive.

25. Other uncertainties relate to improved fishing gear and better electronic equipment (increasing the effective fishing effort), and the fact that the number of days fished decreases for larger vessels (thus decreasing the effective total effort). In an attempt to gain a better idea of the extent to which effort has increased in the Adriatic over recent years, a small *ad hoc* working group was convened to discuss this matter. Their conclusions are as follows:

26. The Group first noted that the statistical data on the fleet was not really accurate and that it would be necessary as a first step to improve it, while continuing to support the PESTAT Programme. It was also indicated that fishing effort cannot be estimated only on the basis of horsepower especially for those vessels of more than 300 hp. It is therefore necessary to test different types of fisheries in various fishing zones in order to establish a workable series of data which could be used to establish a correlation coefficient allowing to measure fishing effort from the data concerning the fleet. The group therefore recommended the continuation of the PESTAT Programme and requested the laboratories of Ancona and Fano to launch parallel studies on the efficiency of the fishing vessels of different horsepower in various areas. The results of these studies should be submitted to the next Consultation.

27. The statistics for a large pelagic fishery in the Southern Adriatic aimed principally at swordfish were briefly reviewed (Marano, Rositani, Ungaro and De Zio, this report). The need to compare catch rate series with other areas (e.g., in the Ionian Sea) was stressed. The seasonality of large pelagic fish catches differs somewhat by species and calls for a better understanding of migration routes.

B. Information on Size Frequency Data

28. The problems raised in effort calibration that make it difficult to establish a precise measure of effort (f) such that f is proportional to fishing mortality (F) exerted, lead to the need to estimate mortality directly, for which several procedures now exist using size frequencies from the commercial and research catch. At present, however, apart from research data, it seems that no systematic sampling of commercial catches for size and age are being carried out in the Adriatic, due to the high price of fish.

C. Size of Fleets by Categories

29. This type of data is being regularly collected by Albania, Greece, Italy and Yugoslavia.

D. Information on Cost, Benefits and Economic Returns

30. In understanding the evolution of catch rates, and the fishing effort exerted on a common stock by nations not sharing a similar economic system or a similar market price, economic considerations need to be taken into account. What is the value of the same cpue unit when taken by catch fleet? what was the real cost of harvesting it in each case? the need stressed by the fourth consultation for further bioeconomic studies of this problem was repeated by the present consultation. Social as well as economic considerations are also important in considering possible effects of management action.

31. On a national basis, the problems posed by conflict between small-scale fisheries and larger boats was highlighted, with larger trawlers forming the main component of these latter in Italian waters. From an economic perspective, the costs by gear/vessel class need to be compared, both from an economic perspective, in terms of the employment provided, as well as in terms of possible impacts on inshore fishing areas which may be nursery grounds for young fish.

V. PROGRESS ACHIEVED IN MAPPING FISHERIES-RELATED DATA

A. Mapping Main Fishing Grounds and Closure Areas

32. A description of the area distribution of Triglidae in the Adriatic (Jardas, this report) prompted a discussion of the appropriateness of the use of depth as opposed to biocoenosis or sediment type in determining distribution. In the Adriatic we are in the fortunate position of having good information on the last two categories, and their use in habitat description is encouraged. For several species, however, movement offshore occurs after a juvenile stage spent in coastal waters.

33. The distribution of fisheries for small pelagics in the Northern Adriatic is being mapped on a seasonal basis (Bolje, this report). This is revealing the difference in habitat preference between sardine and sprat. The need to integrate effort data by area for both national fleets in this type of study was stressed.

34. A preliminary mapping of fishing effort distribution in Italian coastal areas in the Adriatic from the PESTAT survey was presented (Coppola and Cingolani, this report) by 30 x 30 n mi^2 areas, using GRT/n mi^2 units. The dominance of the bottom trawl fishery in all sectors (80-90% of the total GRT) was noted, with highest effort in the Gulf of Trieste (2 500 GRT/n mi^2/year) and between Venice and Chioggia (2 116 GRT/n mi^2/year). The largest trawler category (class 3.2) is present in most coastal zones.

35. The conclusions of this study is that a mapping of fishing areas requires to be done with this as a main objective and that a high degree of concentration of effort is evident. The unit areas used should ideally be smaller near the coast, and related to bathymetry.

36. New automated procedures for mapping geographical data using either regular or random (trawl survey) stations were reported by Piccinetti and Jukić (this report), which promise to avoid the need for a firm decision between stratified random and regular surveys, as long as station coverage is adequate.

B. Mapping Nursery Areas, Biocoenoses and Critical Habitats for Fisheries and Aquaculture

37. The generally low size at first capture in coastal Adriatic fisheries was documented for the Yugoslav coast by Jordas, Pallaoro, Jukić and Cetinić (this report) and causes concern with respect to a large variety of species occurring in coastal areas in their early life history. The preliminary conclusions reported in this paper are already being considered as a basis for mesh regulations of gillnets in Yugoslavia.

38. For a large proportion of these species, the size at first capture is lower than the size at maturity, a dangerous situation for an intensive fishery, and one whose implications need careful consideration, especially for protendrous hermaphrodites as for sparids.

39. The diversity of nursery areas has received preliminary investigation, as described by Jug-Dujakuvić and by Kraljević and Dujaković (this report). The first of these reports on the staggered seasonal timing of entry to the coastal nursery areas of 8 species of sparids, and the depression of growth rates evident over the winter months, for juveniles present at that time.

40. In addition to juvenile stages of some marine species, anadromous species such as the mullets, spend time in estuarine areas as described by Modrusan, Teskeredzić and Jukić (this report). Here, high summer temperatures are associated with better growth of littoral food organisms, and larger year classes.

C. Adriatic Fisheries and Hydrographic Atlases

41. No specific communications were presented on these items, although the accumulation of geographic information continues on an individual basis.

VI. ESTABLISHMENT OF HISTORICAL FISHERIES AND ENVIRONMENT DATA AND THEIR ANALYSIS

42. The existence of long series of data particularly for the Eastern Adriatic, is well described in the literature and was the focus for an integrated series of papers by Yugoslav scientists of particular interest and relevance to our understanding of the evolution of events in the Adriatic Sea 1/, which are reported on here in an integrated fashion.

43. It was noted that the fourth Consultation had recommended looking at oceanographic time series, to see their effects on fish stocks.

44. The Split-Gargano series of transects provides a unique series of oceanographic data, collected in a standard fashion over a long period extending from 1952 to the present, which as for similar series of standard oceanographic station elsewhere in the world, offers the only available index of changes over a significant time period.

45. Zore-Armanda, Stojanoski and Vukadin (this report) describe changes in temperature, salinity and oxygen levels, as shown by annual surveys, averaged for all monthly samplings from surface to 170 m over this profile, for each year. All time series shows marked fluctuations, apparently of an outocorrelated nature, often with significant trends visible over long time periods. This in itself reinforces the impression established in earlier literature, that intrusions of more saline water masses into the Adriatic are most marked at intervals of the order of a decade or so.

46. Thus, mean water temperature was high before 1956, in the mid 1960s, and in the early 1980s.

47. High salinity intrusions were evident in the mid-1950s, the late 1960s and the early 1980s. It would be of considerable interest to learn what events in the fisheries were associated with these events. In addition, however, long term trends of increasing salinity are evident from 1965 throughout the water column, that it is speculated by the authors may be related to completion of the Aswan Nile Dam in 1964.

48. Considering the fairly gradual nature of trends in parameters, the hypothesis of the Aswan Dam impact did not meet with full agreement from members of the Consultation. In this connection, the impact of inflow of local rivers (e.g., the Po) is not clearly distinguished. There appears, however, to be good correspondence in the oxygen series with the 1977 "oxygen crises" in the Northern Adriatic. The precise mechanism whereby nutrient salts decreased as eutrophication proceeded needs further attention.

1/ See this report: Zore-Armanda, Stojanoski and Vukadin; Pucher-Petković, Marasović, Vukadin and Stojanoski; Vucetić; Regner, D.; Vucetić and Alegría-Hernandez

49. Also, water transparency has decreased steadily since 1960. The suggestion that this last trend is due to increased primary production seems supported by the progressive divergence between high surface, and low bottom oxygen levels, the latter lagging behind the former, and possibly being a cause of concern to demersal resources, if continued.

50. Phosphate and salinity levels peaked dramatically in 1969, perhaps suggesting a large influx of Eastern Mediterranean water, but a slow decrease in phosphate and other nutrients now seems evident in all layers. The implication of this trend in the face of the apparent increases in eutrophication reported by Pucher-Petcković, Marasović, Vukadin and Stojanoski (this report) raised questions in the Consultation, although this latter paper appears to confirm Zore-Armanda, Stojanoski and Vukadin (this report), showing a steady increase in primary production in the middle Adriatic coastal waters from 149 in 1962 to 245 g C m^{-2} $year^{-1}$ in the early 1980s. As distinct from the coast primary production (and biomass) in the open waters has increased rather considerably only in the last 4 years of investigations, from 60 to 96 g C m^{-2}. Besides, frequency distribution of primary production levels from 1962 to 1983 show a shift of the most frequent values toward the higher production level. The authors consider that the eutrophication effect originating from the land began to exert themselves in the open water approximatly a decade later than in the coastal region.

51. Sharp declines in annual means for ammonia, nitrate and phosphate appear to have occurred since 1978. Various hypotheses were suggested for this, with no final resolution at this point.

52. The existence of a geographical differentiation between three main areas of primary production in the Adriatic, was illustrated by Marasović, Pucher-Petković and Alegría (this report). Area A (the central Southern Adriatic) has the lowest productivity corresponding to highest effect of Mediterranean water, the Northern Adriatic (area B) has a high productivity, and coastal strip of channel waters along the Eastern Adriatic is intermediate in value (area C). The big bays on the Adriatic coast have the highest productivity (area D). It seems that areas B and C have enlarged in recent years. Sardine catches appear to have gone up with primary production in the Eastern Adriatic, and the area of peak catches appears also to have moved southward, although this effect is most clearly evident on a sub-regional basis.

53. From 1967 a continuous increase in Yugoslav sardine catch has been recorded with a decrease in fishing days exerted. Although there remains some question on this point (that could be resolved by acoustic survey for example), it appears that sardine biomass has increased.

54. The important hypothesis suggested in Marasović, Pucher-Petković and Alegría (this report) is that the increased biomass is now due to a general increase in eutrophication, and not just events of water mass incursions. The possibility that this eutrophication is of Northern Adriatic and terrestrial origin is suggested as likely, since indications now suggest that water incursions are not associated with increased eutrophication as formerly, presumably because nutrients of endogenous origin play an important role.

55. The Consultation underlined the importance of following up this hypothesis, which has major implications if correct for integrated management of the Adriatic Sea. One obvious approach is to define more exactly the course of events in earlier incursions, and compare them with more recent ones.

56. Vucetić and Alegría-Hernandez (this report) consider the implications of these events higher in the food web, particularly those associated with periods of abundance of the jelly fish Pelagia sp. Periods of high abundance of this species seem associated with increased catches of Boops boops and Trachurus sp., both of which apparently include Pelagia in their diet. General increases in Pelagia biomass seem to be suggested, and pose the question as to the relative impacts of fishing and of eutrophication in changing catch levels. The Consultation noted, however, that the possibility also exists that increases in catch are due to improved availability or vulnerability of stocks. Again, acoustic surveys will be needed to help establish the precise state of affairs. What seems clear however from all these papers, is that the steady state assumption is very suspect as an explanation of fishery events in the Adriatic Sea.

57. In general discussion on the above papers, it was questioned if using annual averages is the best strategy for interpreting time series. For example, bottom water salinity may be a better index of incursion events, and surface temperature in winter of survival of those fish species in nursery areas at that time of year. Clearly, more work carried out under specific hypothesis is called for using this data base.

58. Some apparent anomalies between rare recent Italian time series and the work reported led to a discussion on the difference between short term events (e.g., plankton blooms) and long term trends. Data, where possible, should be compared over comparable time intervals.

59. Earlier work[1/] on time series analysis of 100 years of Yugoslav sardine catch has revealed periodicities of 25, 11 and 3 years as predominating, and these were formerly associated with intrusions of water masses, and also showed up in records of salinity, temperature, primary production and egg production. There is a clear need to update these earlier studies until just before the current period of high production, and attempt to predict the levels of production, assuming that only earlier mechanisms apply. These results can then be compared with those observed recently, in order to detect the nature and direction of anomalies.

60. In general, however, the Consultation recognized that this group of papers provides an important impulse to future work, and it was recommended that some submissions to future consultations should aim to clarify and develop the preliminary conclusions and hypotheses presented here.

61. From an immediate practical perspective, the changes in production recorded seem to be favourable to development of pelagic fisheries, though the dangers of dystrophy and associated low oxygen events cannot be excluded.

VII. PELAGIC RESOURCES

A. Large Pelagic Fish

62. A new swordfish fishery in the Gulf of Taranto was discussed for the period 1978-86 (De Metrio and Megalofonou, this report). Over this period both catch rates and mean sizes declined significantly. Evidence suggests irregular recruitment of a relatively local stock with current effort concentration on juvenile individuals. The need for some means of control of these fisheries to avoid excessive capture of young individuals is evident: possibly regulation of minimum hook size. Cooperative study of swordfish populations throughout the Mediterranean would be worthwhile.

B. Small Pelagic Fish

(a) Acoustic studies

63. The evolution in time of small-pelagic resources in the Wester Adriatic as determined by regular acoustic surveys over the period 1976-85, was addressed by Azzali and Luna (this report).

64. The trend of sardine and anchovy biomass from the Northern and Middle Adriatic over this period rises from a low level to two major peaks: the first (around 1978) in the Northern Adriatic being largely dominated by anchovy, the second in 1983-84, by sardine and to a lesser extent, horse mackerel. Spatial distribution in both periods is patchy but somewhat different, and the hypothesis is suggested for juvenile populations particularly present in 40-60 m depth strata, that competition for space and food resources is very strong. Comparison with commercial catches shows that for anchovy, catches remained high until 1985, even after biomass dropped, due to increased availability of schools that moved toward the coast.

65. In addition, sprat take advantage of declines in abundance of either dominant species to increase in numbers. All species seem to have shown increasing mean size over the period. That this also reflected an increase in mean age can only be assumed at present.

66. Information on pelagic biomass of Middle and Southern Adriatic was also presented, where total biomass and proportion of anchovy is much lower (Azzali and Luna).

67. The hypothesis of competition was discussed in light of differing temperature preferences of sardine, anchovy and sprat, especially considering information presented earlier on the dynamic nature of hydrographic conditions. Competition would appear most strongly between similar sized fish in the same depth strata. It is unclear what is the timing of biomass peaks in relation to water intrusions or other hydrographic events, although in general, these must have played some part in the timing. Resolution of this question is considered by the Consultation a priority for future work.

68. Studies in the Eastern Adriatic in 1975-84 (Kacić, this report) have shown large increases in biomass of sardine. In 1986 the stock more than doubled, but fishing stopped due to the small size of fish, but should be good next year.

1/ Regner and Gacić, 1974 and 1977 (see bibliography by Regner, this report)

69. In relation to the pressing need to integrate oceanographic and pelagic fisheries data, Ancona IRPEM proposed to invite physical and biological oceanographers to the meeting of pelagic fish biologists to compare results obtained by direct and indirect methods of pelagic assessment (see paragraph 81 of the report of the fourth Consultation and paragraph 105 of the present report). An attempt will be made to put together timing of physical data and biological events at all trophic levels. This suggestion was welcomed by the Yugoslav delegation.

70. The apparent geographical continuity of sardine and anchovy populations through the South Western Adriatic was evidenced from egg and larval studies by Casavola, Marano, Martino and Saracino (*this report*). *Here, there appears little evidence for fishing pressure affecting the sardine* stock, though seasonal regulation of the "bianchetto" fishery to protect a seasonal admixture of anchovies was proposed.

71. Juvenile sardine was studied in the bays of the Eastern Adriatic to protect their juvenile phase (Kačić, Sinovčić and Alegría-Hernandez, this report). "Bianchetto" fishery and juvenile sardine fishery should be possibly approached. Different approaches will not give satisfactory results to protect and to manage sardine stock in the Adriatic as a whole.

72. The distribution pattern of spawning for sardines has been described in a number of earlier papers, but Regner, Piccinetti-Manfrin and Piccinetti (this report) attempt to address the hydrographic mechanisms involved, in particular the apparent geographical coincidence between spawning areas and frontal upwelling areas noted in the course of Italo-Yugoslav joint surveys from 1979-86. Within limits of its temperature tolerance, sardine stocks move to the Eastern Adriatic to become strongly associated in December-March with such hydrographic discontinuities. This observation may have practical implications for estimating the biomass of mature fish, in that survey stations can be stratified by front distribution as shown from satellite imagery.

73. The biological advantage of this life history strategy was illustrated by Regner (this report). The author found in spring largest densities of zooplankton in the above areas, with copepods dominant.

74. The successful training course held at Ancona from 6 to 11 April 1987 was briefly described, where participants from Albania and Greece participated[1/]. This provided a common working approach, and underlined the need for similar procedures and coordination of surveys on both sides of the mid-line of the Adriatic.

75. The need for a common approach on both sides of the Adriatic to problems of research and management of pelagic stocks is evident, and in this connection, a working group of pelagic biologists met separately to discuss survey strategy. Their report is the following:

76. The ad hoc group agreed on the necessity to carry out a joint echosurvey for the evaluation of the pelagic biomass. It was suggested that the Institutes of Ancona and of Split make the necessary contacts with all concerned in the other institutes of the Adriatic and Ionian Sea and in the Fisheries Administrations in Albania, Greece, Italy and Yugoslavia in order to make such a survey possible. It is noticed that the first step to be taken is to assess the available equipment, electronic devices and skills in the different institutes, and in the light of the information obtained, set up a work plan for the intercalibration of the equipment and the implementation of the survey. The assistance of FAO through GFCM would be required to facilitate contacts between the countries concerned and the execution of the surveys, and to overcome restrictive regulations if any; it being understood that such an assistance would not involve any financial commitment from the Organization.

77. The Consultation reviewed the sources of errors experienced by the research *institutions in* surveying egg density and distribution. It therefore recommends to start egg surveys using the method of batch fecundity estimation, together with the integration of the egg production over spawning curves using fixed stations.

78. It is also recommended that data on catch and effort and the biological parameters eventually needed should be collected using common methodology agreed on between the institutes working on the problem.

79. The Greek delegation called for Italian cooperation in a joint echosurvey of the Ionian Sea, together with the Albanians. This was agreed to in principle by the Ancona IRPEM, and by the two other delegations concerned.

1/ The report has been prepared by IRPEM Ancona under the title "Report of the practical training course on acoustic survey techniques and equipment utilization", and distributed to the Consultation

C. Management of Small Pelagic Stocks

80. The suggestion that pelagic stocks be managed separately in the Northern, Middle and Southern Italian Adriatic was discussed; in particular, the proposal that the Italian sector of the Adriatic be divided into Northern, Middle and Southern sectors from the perspective of small pelagic stock management. This could be a useful practical approach, though no evidence was presented as to the identity or separateness of the stocks involved, or their possible continuity across the mid-line. The whole question of international cooperation in management of small pelagic stocks appears to await more coordination in defining true stock units and relationships between populations in different zones. GFCM provides the obvious context for such an attempt.

VIII. DEMERSAL RESOURCES

A. Molluscan Fisheries

81. Tursi, D'Anghio, Panetta, Cecere, Cavallo, Matarrese and Pacifico (this report) summarize the high diversity of cephalopods in the Ionian Sea: not much is known of their fishery biology and growth parameters, but no marked seasonality of catch is evident, suggesting the possibility of deriving growth and mortality estimates.

82. A similar possibility for the Chamelea gallina stocks in the lower Adriatic, where biomass and age composition data suggest that recruitment may not be constant from year to year, and needs to be taken into account in management.

B. Crustacean Fisheries

83. Crustacean fisheries in the Southern Adriatic are restricted by the presence of trawlable grounds, but here they form a significant part of the catch at depths below 200 m (see Petruzzi, Pastorelli and Marano, this report).

84. The determination of growth and mortality parameters for crustaceans presents considerable difficulties, which are overcome in the study of Froglia and Gramitto (this report) due to the occurrence of massive mortality of Nephrops norvegicus, in 1977 off Ancona. Modal progression of year classes were then easily followed after the strong recruitment observed in 1982, and real growth rates derived which could be compared with the deeper Nephrops population in the Pomo pit.

85. Growth rates off Ancona in an area with rich benthic resources, are higher than from Pomo pit, and in fact for populations studied elsewhere (Froglia and Gramitto, this report).

86. Mortality rates are high for this stock, which it is difficult to consider due to predation, since Nephrops of any size are rarely found in stomach contents of local fish. Apart from catastrophic mortalities (which prior to 1977 were never recorded), fishing mortality must account for much of the death rate. The need to develop appropriate yield models for this situation is evident.

87. The Yugoslav participants requested assistance by C. Froglia in a cooperative study of Yugoslav and joint stocks of Nephrops.

C. Demersal Fish

88. The question of the optimal size at first capture, and the appropriate cod end mesh size to achieve this for a multispecies fishery, is a complex matter. Jukić and Piccinetti (this report) took a preliminary look at the short and long term effects of changes in mesh size, incorporating both yield per recruit considerations, and short term economic losses through escapement of fish (by weight and value) through mesh sizes at the new larger mesh size. Cod-end cover experiments provided the basic information. The results were calculated for (a) hake, (b) striped mullet, (c) pandora and (d) Norway lobster (50-80% of the trawled biomass). The main losses in moving to 40 mm mesh during the season when the experiments were carried out would be cephalopods, of the order of US$ 8-16 per unit time. For the 70 mm mesh, economic losses are excessive and not considered feasible, but in general, a uniform movement to at least a 40 mm mesh size would provide significant increases in Y/R for all species except possible Trachurus: increases that are likely to outweigh the short-term losses described above. The effects of a change (decrease) in fishing mortality were less pronounced.

89. The management implication of this study need to be considered in the light of their social and economic implications. It may be more feasible to consider fishery closure periods and a reduction in fishing effort at critical times of year, than a mesh size change, although this latter measure seems to offer the opportunity for improved yield.

90. The relationship between stock size and subsequent recruitment of juvenile hake was presented for the middle Adriatic nursery area (the Jabuka pit) (see Alegría-Hernandez and Jukić, this report), based on 1960-85 trawl surveys before dispersal of juveniles from this nursery area. A stock-recruit relationship of the Ricker type was fitted, which suggests an optimal spawning stock size of around 8 000 t. The very wide variation in 0-group year class strength for a given parent population is noted however, and it appears that survival of juveniles shows oscillations with period of several years: 1975 and 1977 being very good recruitment years. The Consultation noted with satisfaction the first attempt at fitting such a model to Adriatic stocks, but suggest that ideally, a comparison should also be made between recruitment strength and environmental prameters. The likelihood that a degree of protection of juvenile hake could show great benefit in improved catches elsewhere in the Adriatic was discussed.

91. Approaches to regulations by either mesh size or seasonal closures at the most vulnerable time of year for 0-group hake were discussed, and would need to be coordinated between the countries concerned.

92. The fisheries situation in Greek waters of the Ionian Sea is described by Papaconstantinou and Stergiou and by Stergiou and Papaconstantinou (this report). Areas closed to fishing show a different pattern of fluctuations than those fished, which merits further detailed comparison because of its practical implication for management.

93. The fisheries situation in a juvenile hake nursery area in the Patraikos Gulf, Greece, was discussed by Papaconstantinou and Stergiou (this report). Seasonal sampling on a monthly basis in this area suggested a strong instantaneous rate of decline in numbers of this 0-group population, that cannot be due to the fishery which was closed for most of the period. Some migration from the Gulf into the Ionian Sea may take place, but it is the author's view that the Ionian Sea stock is separate, also in timing of spawning. The conclusion of the paper is that in the year in question (1983), mortality was predominantly due to starvation and to the likelihood that trophic resources in the Gulf were insufficient to support the large juvenile population.

94. The conclusion that natural mortality rate of juveniles (as for the Adriatic stock) is high seems established but some questions remain as to the quantitative role of emigration in determining apparent mortality rates from catch curves. This aspect of the study seems to need further development before harvest of excess number of juvenile hake in the Gulf can be safely recommended.

95. Parameter values for von Bertalanffy growth were presented for four-spotted scald fish (Bello and Rizzi, this report).

IX. MAJOR STATE OF SOCIO-ECONOMIC STUDIES IN ADRIATIC FISHERIES

96. No new communications were received on this topic other than the study on hake mesh size (Jukić and Piccinetti, this report), but the Consultation emphasized that economic efficiency, the state of the resource and the markets are all tied together. Determining which stratum of the fleets is most profitable is important. Sampling for economic and production indices is critical, both for high and low priced fish.

97. Economic considerations also enter into coastal development, especially for the small scale fishery, artificial reefs and aquaculture.

X. UPDATE OF PROGRESS IN HARMONIZATION OF LEGISLATION AND APPLICATION OF FISHERIES REGULATIONS

98. The following points emerged:

(i) mesh size regulations (40 mm stretched) exist, but still need to be enforced in many fisheries, especially for the inshore trawl fleet;

(ii) fishing effort levels need to be reduced. Unfortunately, licence limitations are not always enforced, and when carried out, strictly, result in large capital values accruing to the licence holders, which could cause social problems.

99. Italian approaches to regulation depend on port captains controlling mesh size, etc. Disciplinary measures are not always effective: economic measures and convincing supporting research are other incentives.

100. Protection of nursery areas is another preoccupation of research institutes in Italy, which is now beginning to receive governmental support.

101. Law 41 of 1982 provides for a coordinating committee of fishery scientists to direct work in stock assessment, and every three years a management plan is called for.

102. The attention of jurists to the problem of harmonization of fisheries legislation between Adriatic countries seems called for, and the Council is requested to make a recommendation to this effect.

XI. CONCLUSIONS AND RECOMMENDATIONS OF THE AD HOC WORKING GROUPS AND THE CONSULTATION

103. The Ancona meeting scheduled by IRPEM and originally intended for comparison of different methods of pelagic evaluations (see paragraph 95 of the report of the Fourth Consultation) which will now take place in 1988, will allow a first opportunity for ad hoc groups to meet in the intersessional period, and it is recommended that preliminary results of research be presented at this or other ad hoc groups, allowing the next Consultation to concentrate on a more limited number of complete studies. Where possible, these studies should be referred to recommendations of previous consultations.

104. The two-year period between consultations is too brief for significant new work to be started and completed, and the Consultation recommends that the interval should be raised to three years, and that ad hoc working groups should meet at least once in the intersessional period, to plan work and consolidate results.

105. Three such groups are being considered here, dealing with: (a) pelagics/ acoustics and fisheries oceanography; (b) demersals/benthic resources; (c) statistics.

106. The Director of IRPEM offered to host at least the first of these groups in 1988 and the Director of the Split Institute offered to host the ad hoc working group on demersal/benthic resources. Any institute wishing to host the statistics ad hoc working group should contact the Secretariat early in the intersessional period.

107. The practical problems faced by FAO in supporting the extra work involved with these ad hoc working groups was emphasized by the Secretariat, and no financial assistance will be forthcoming in this respect. The Consultation recognized this, and realized that the cost of holding the meeting and publishing results will have to be covered by the host institute, which will take the responsibility of contacting all member institutes and countries concerned.

XII. PROGRAMME FOR THE NEXT INTERSESSIONAL PERIOD

110. In preparing its programme of work for the next intersessional period, the Consultation referred not only to the recommendations and suggestions for action contained in the previous sections of this report (see in particular paragraphs 19, 22, 26, 60, 62, 77, 78 and 104) but also to the guidelines and recommendations adopted at its Fourth Session. Comments on these guidelines and recommendations (shown in Appendix 4) were as follows:

A. Research

(i) Demersal stocks

111. Use the trawl cruise data to complete the species distribution maps: This guideline, which has been partially followed, should be maintained.

112. Calculate the mortality rates from size frequencies: This guideline should be maintained.

113. Improve information on growth rates of commercial species: This guideline has been partially followed and should be maintained.

114. Study age and size geographical distribution to investigate migrations: This guideline has been partially followed and should be maintained.

115. Analyse the length data for the "Hvar" cruise catches: This guideline is beginning to be put into practice, as is shown by some of the documents submitted. Work will continue.

116. Experimental trawl surveys: Surveys have been made ("Pipeta") and will continue on a regular basis.

117. Biological sampling of catches and/or landings: The Consultation confirmed that it was difficult to follow this guideline, despite its importance. It will be implemented as far as resources permit.

118. The Consultation also considered it would be useful to undertake studies on the eating habits of fish in order to establish predator/prey relations.

(ii) Pelagic stocks

119. Definition of stock units: The Consultation considered that this guideline should be maintained. It proposed to consider stock sub-units (given the expansion of research to the Ionian Sea - see paragraph 135 below) and not to limit studies on migrations to the north-south axis but rather to include all directions.

120. A cost/benefit study of Yugoslav pelagic fisheries: This analysis is still being prepared and results will be submitted to the next Consultation.

121. Work on fecundity of small pelagics: Data on small pelagic fish fecundiy are relatively scarce, but from now on continuing studies will be carried out, especially on anchovy and sardine.

122. Comparison of assessment methods: IRPEM confirmed its invitation to hold a workshop in Ancona to compare results obtained by the different methods of pelagic fish assessment (see paragraph 103).

123. Hydrology/climatology: An annotated bibliography on long-term variations is in the final stages of preparation and will be distributed by the Secretariat as soon as available.

124. In this connection, the Representative of the Commission of the European Communities (CEC) informed the Consultation of the preparation of a study on fishery statistics time series, partly inspired by the conclusions of GFCM Technical Consultations. The study was financed by the Commission and executed by institutions in Greece and Imperial College, University of London. New techniques of analysing time series would be used to study data on anchovy and sardine in Greek waters, and also other Mediterranean species. The collaboration of Adriatic and Ionian researchers would be welcome.

125. The CEC Representative also indicated that the Commission was financing fishery research activities that were expected to lead to better resource management; this financing was channelled either directly to EEC member countries or sometimes to FAO (GFCM). It followed a research programme prepared annually, which took into account recommendations made by GFCM or its subsidiary bodies.

B. Statistics

126. The collection of statistics on small-scale coastal fishing and private fishing in particular has proved very difficult in Yugoslavia. Italy, however, has published statistical data collected by the PESTAT programme in three volumes (statistics on the fishing fleet and statistics on catches and the fishing effort)[1/].

C. Sub-regional collaboration

127. The Consultation noted that biomass evaluation surveys, using the method of eggs and larvae, and scientific trawl surveys were continuing satisfactorily.

128. Exploratory acoustic surveys have proved more difficult to conduct on a multinational basis. Proposals have, however, been made that could improve this situation in the near future (see paragraph 109).

129. Demonstration course: A demonstration course on the use of acoustic equipment was held in Ancona by the IRPEM and its report was submitted to the Consultation (see paragraph 74).

130. Development of a Hydrological Data Base: Neither the Atlas nor the Hydrological Data Base recommended by the Fourth Session of the Consultation have been produced. This work should however be available by the next Consultation.

131. Joint study programme on small pelagic fish: This programme has been started and it seems that collaboration between IRPEM and the Institute of Oceanography in Split will lead to joint processing of the data collected by these two institutions.

D. Management

132. The Consultation noted that economic studies to assess the cost of overfishing were under way, and decided that this guideline should be maintained.

1/ Quaderni dell'Istituto Ricerche Pesca Marittima, Vol. IV N° 1 Supplemento, 1984; Vol. V N° 1 Supplement (1a parte), 1986; Vol. V N° 1 Supplemento (2a parte), 1986

133. Control of age at first capture: Studies are under way and the Consultation maintained this guideline.

134. Harmonization of legislation: The Consultation considered this was a worthwhile proposal, particularly in view of the problem of resources fished by more than one country; it thought, however, that the meeting of jurists involved in harmonizing legislation was for the time being outside the immediate concerns of this Consultation (see paragraph 102).

XIII. OTHER MATTERS

135. During discussion of the various agenda items, it was agreed that the geographical zone covered by this Technical Consultation should also include the Ionian Sea. The Consultation therefore decided that its title henceforth should be as follows: "Technical Consultation on Stock Assessment in the Adriatic and Ionian Seas".

XIV. DATE AND PLACE OF THE SIXTH CONSULTATION

136. The Consultation decided that, to allow enough time for thorough preparation and meetings of the various working groups during the intersessional period (see paragraph 104) there should be an interval of three years between this and the Sixth Consultation; it would therefore take place, subject to approval by the Nineteenth Session of GFCM, in 1990.

137. The Yugoslav participants proposed that this Consultation be held in the Marine Biology Institute in Kotor, and this proposal was approved by acclamation.

XV. ADOPTION OF THE REPORT

138. The report of the Fifth Technical Consultation on Stock Assessment in the Adriatic was adopted on 5 June 1987. Participants took this opportunity to extend to the Director of the Marine Biology Laboratory of Bari and his collaborators their warmest thanks for the excellent organization of the meeting.

ANNEXE 1

Ordre du jour

1. Ouverture de la Consultation

2. Adoption de l'ordre du jour et organisation de la Consultation

3. Election du Président et des Vice-Présidents

4. Brève présentation des rapports

   4.1 Pélagiques
   4.2 Démersaux
   4.3 Autres

5. Etat d'avancement de la compilation et de l'analyse des statistiques halieutiques et biologiques concernant la petite pêche et la pêche industrielle

   5.1 Données de prises et d'effort
   5.2 Données de fréquences de taille et d'âge
   5.3 Taille et âge à la première capture des espèces clés
   5.4 Taille des flottilles par port, catégorie, type d'engin de pêche et âge
   5.5 Données sur les coûts et les bénéfices et rendements économiques
   5.6 Discussion sur les bases de données communes pour les pêcheries de l'Adriatique

6. Etat d'avancement de la cartographie des données relatives aux pêcheries

   6.1 Cartographie des lieux de pêche principaux et des zones de fermeture
   6.2 Cartographie des zones de nurseries, des biocénoses et des habitats critiques
   6.3 Cartographie des principaux types d'utilisation des eaux côtières pour la pêche et l'aquaculture
   6.4 Préparation d'un atlas hydrographique de l'Adriatique
   6.5 Télédétection et cartographie des données halieutiques
   6.6 Préparation éventuelle d'un atlas des pêches de l'Adriatique

7. Constitution et analyse de séries historiques de données sur les pêches et l'environnement

8. Groupe de travail *ad hoc* sur les ressources pélagiques (voir ordre du jour ci-après)

9. Groupe de travail *ad hoc* sur les ressources démersales (voir ordre du jour ci-après)

10. Etat d'avancement des études socio-économiques sur les pêches de l'Adriatique

11. Etat d'avancement de l'harmonisation de législations et de l'application des régulations des pêches

12. Conclusions et recommandations des groupes de travail *ad hoc* et de la Consultation

13. Programme de travail pour la prochaine intersession

14. Autres questions

15. Date et lieu de la prochaine Consultation

16. Adoption du rapport

GROUPE DE TRAVAIL AD HOC SUR LES RESSOURCES PELAGIQUES

(Mercredi 3 juin)

Ordre du jour

1. Election du Président et du Rapporteur

2. Adoption de l'ordre du jour

3. Etat d'avancement de l'estimation des paramètres de populations des petits et grands pélagiques

    3.1 Identification d'unités de stocks et migrations
    3.2 Etudes sur l'âge et la croissance
    3.3 Maturité, fécondité et ponte
    3.4 Recrutement
    3.5 Taux de mortalité
    3.6 Résumé des paramètres des stocks

4. Analyse des changements de populations et état des stocks pélagiques

    4.1 Etudes des biomasses
    4.2 Modèles de production
    4.3 Approches analytiques
    4.4 Autres

5. Résumé des tendances des pêches pélagiques

6. Comparaison des évaluations réalisées par des études analytiques, acoustiques et sur les oeufs et larves

7. Travail proposé pour l'intersession

8. Conclusions et recommandations en vue de l'aménagement

GROUPE DE TRAVAIL AD HOC SUR LES RESSOURCES DEMERSALES

(Mercredi 3 juin)

<u>Ordre du jour</u>

1. Election du Président et du Rapporteur

2. Adoption de l'ordre du jour

3. Etat d'avancement de l'estimation des paramètres de populations

    3.1 Identification d'unités de stocks et migrations
    3.2 Etudes sur l'âge et la croissance
    3.3 Maturité, fécondité et ponte
    3.4 Recrutement
    3.5 Taux de mortalité
    3.6 Résumé des paramètres des stocks

4. Analyse des changements de populations et état des stocks démersaux

    4.1 Etudes des biomasses
    4.2 Modèles de production
    4.3 Approches analytiques
    4.4 Autres

5. Résumé des tendances des pêches démersales

6. Analyse des effets à court et à long terme de régulations du maillage sur les rendements de la pêche démersale à différents niveaux de l'effort de pêche.

7. Problèmes particuliers relatifs à la "vongola" (<u>Venus gallina</u>)

8. Travail proposé pour l'intersession

9. Conclusions et recommandations en vue de l'aménagement.

APPENDIX 1

Agenda

1. Opening of the Consultation

2. Adoption of the Agenda and arrangements for the Consultation

3. Election of the Chairman and Vice-Chairmen

4. Brief presentation of papers

   4.1 Pelagics
   4.2 Demersals
   4.3 Others

5. Progress in compilation and analysis of fisheries and biological statistics for small-scale and industrial fisheries

   5.1 Catch and effort data
   5.2 Size and age frequency data
   5.3 Size and age at first capture for key species
   5.4 Fleet size by port, category, gear type and age
   5.5 Cost and earning data and economic performance
   5.6 Discussion on common data bases for Adriatic fisheries

6. Progress achieved in mapping fisheries-related data

   6.1 Mapping main fisheries grounds and closure areas
   6.2 Mapping nursery areas, biocoenoses and critical habitats
   6.3 Mapping main types of usage of coastal waters relevant to fisheries and aquaculture
   6.4 Production of a hydrographic atlas of the Adriatic
   6.5 Remote sensing approaches to mapping fisheries-related data
   6.6 Desirability of an Adriatic fisheries atlas

7. Establishment of historical time series of fisheries and environmental data and their analysis

8. *Ad hoc* Working Group on pelagic resources (see agenda below)

9. *Ad hoc* Working Group on demersal resources (see agenda below)

10. Update of progress in socio-economic studies of Adriatic fisheries

11. Update of progress in harmonization of legislation and application of fisheries regulations

12. Conclusions and recommendations of the *ad hoc* Working Groups and the Consultation

13. Programme of work for the next intersessional period

14. Any other matters

15. Date and place of the next Consultation

16. Adoption of the report

AD HOC WORKING GROUP ON PELAGIC RESOURCES

(Wednesday 3 June)

Agenda

1. Election of the Chairman and Rapporteur

2. Adoption of the Agenda

3. Progress achieved in estimating population parameters for small and large pelagic resources

3.1 Identification of stock units and migrations
3.2 Age and growth studies
3.3 Maturity, fecundity and spawning
3.4 Recruitment
3.5 Mortality rates
3.6 Summary of stock parameters

4. Analysis of population changes and status of pelagic stocks

4.1 Biomass surveys
4.2 Production modelling
4.3 Analytical approaches
4.4 Others

5. Summary of trends in the pelagic fisheries

6. Comparison of assessments made by analytical, acoustic and eggs and larval surveys

7. Proposed intersessional work

8. Conclusions and recommendations for management

AD HOC WORKING GROUP ON DEMERSAL RESOURCES

(Wednesday 3 June)

Agenda

1. Election of the Chairman and Rapporteur

2. Adoption of the Agenda

3. Progress achieved in estimating population parameters

3.1 Identification of stock units and migrations
3.2 Age and growth studies
3.3 Maturity, fecundity and spawning
3.4 Recruitment
3.5 Mortality rates
3.6 Summary of stock parameters

4. Analysis of population changes and status of demersal stocks

4.1 Biomass surveys
4.2 Production modelling
4.3 Analytical approaches
4.4 Others

5. Summary of trends in the demersal fisheries

6. Analysis of short and long terms effects of mesh size regulations on demersal fishery yield at different levels of fishing effort

7. Special problems of the "vongola" (*Venus gallina*)

8. Proposed intersessional work

9. Conclusions and recommendations for management

ANNEXE/APPENDIX 2

Liste des participants/List of participants

AMATO E.
Istituto Centrale per la Ricerca Scientifica e Tecnologica Applicata alla Pesca Marittima
Via L. Respighi, 5
00197 Roma
Italie/Italy

Tel. (06) 872276/877551

ARCULEO M.
Istituto di Zoologia
Via Archirafi 18
90123 Palermo
Italie/Italy

Tel. (091) 6166080

ARDIZZONE G.D.
Dipartimento di Biologia Animale e dell'Uomo
Università di Roma "La Sapienza"
Viale dell'Università 32
00185 Roma
Italie/Italy

Tel. (06) 4958254

ARNERI E.
Laboratorio di Biologia Marina e Pesca
Viale Adriatico 52
61032 Fano
Italie/Italy

Tel. (0721) 83689

ARTEGIANI A.
Istituto Ricerche Pesca Marittima (IRPEM) - CNR
Molo Mandracchio
60100 Ancona
Italie/Italy

Tel. (071) 204197/55313

AZZALI M.
Istituto Ricerche Pesca Marittima (IRPEM) - CNR
Molo Mandracchio
60100 Ancona
Italie/Italy

Tel. (071) 204197/55313

BELLO G.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

BELLUSCIO A.
Dipartimento di Biologia Animale e dell'Uomo
Università di Roma "La Sapienza"
Viale dell'Università 32
00185 Roma
Italie/Italy

BIAGI F.
Centro Interuniversitario di Biologia Marina
P.le Mascagni 1
57100 Livorno
Italie/Italy

Tel. (0586) 805504

BOLJE A.
Droga
Obala 27
66320 Portoroz
Yougoslavie/Yugoslavia

Tel. (066) 73155

BOMBACE G.
Directeur
Istituto Ricerche Pesca Marittima (IRPEM) - CNR
Molo Mandracchio
60100 Ancona
Italie/Italy

Tel. (071) 204197/55313

CASAVOLA N.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

CAU A.
Istituto di Zoologia di Cagliari
Via Poetto 1
Cagliari
Italie/Italy

Tel. (070) 370263

CETINIC P.
Directeur
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

CINGOLANI N.
Istituto Ricerche Pesca Marittima (IRPEM) - CNR
Molo Mandracchio
60100 Ancona
Italie/Italy

Tel. (071) 204197/55313

DE GIOSA E.
De Giosa Service srl.
Fishery Development
Via Calefati, 122
70121 Bari
Italie/Italy

Tel. 214996/491500/216614
Tlx 800065

DE MARTINO Laura
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

DE METRIO G.
Istituto Comunale di Biologia Marina di Nardo
Nardo (Lecce)
Italie/Italy

Tel. (0833) 823261

DE ZIO V.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

D'ONGHIA G.
Istituto di Zoologia ed Anatomia Comparata
Università di Studi di Bari
Via Amendola 165/A
Bari
Italie/Italy

Tel. (080) 243350

FERRETTI M.
Istituto Centrale per la Ricerca Scientifica e Tecnologica Applicata alla Pesca Marittima
Via L. Respighi, 5
00197 Roma
Italie/Italy

Tel. (06) 872276/877551

FROGLIA C.
Istituto Ricerche Pesca Marittima (IRPEM) - CNR
Molo Mandracchio
60100 Ancona
Italie/Italy

Tel. (071) 204197/55313

GALLO Maria
Istituto di Zoologia ed Anatomia Comparata
Via Amendola 165/A
70126 Bari
Italie/Italy

Tel. (080) 243346

GIANNETTI G.
Istituto Ricerche Pesca Marittima (IRPEM) - CNR
Molo Mandracchio
60100 Ancona
Italie/Italy

Tel. (071) 204197/55313

GIOVANARDI O.
Istituto Centrale per la Ricerca Scientifica e Tecnologica Applicata alla Pesca Marittima
Via L. Respighi, 5
00197 Roma
Italie/Italy

Tel. (06) 872276/877551

GRASSO M.
Dipartimento di Biologia Animale
Università di Lecce
73100 Lecce
Italie/Italy

Tel. (0832) 621529

GRECO S.
CNR
Istituto Talassografico
Spianata S. Raineri
98100 Messina
Italie/Italy

Tel. (090) 773724

GRIMALDI P.
Istituto di Zoologia ed Anatomia Comparata
Via Amendola 165/A
70126 Bari
Italie/Italy

Tel. (080) 243347

GRIMALDI-DE ZIO Susanna
Istituto di Zoologia ed Anatomia Comparata
Via Amendola 165/A
70126 Bari
Italie/Italy

Tel. (080) 243346

JARDAS I.
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

JUG-DUJAKOVIC J.
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

JUKIC
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

KACIC I.
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

KARLOU Constantina
Fisheries Technology Laboratory
15 Karaoli and Dimitriou St.
18531 Piraeus
Grèce/Greece

Tel. 4120178

KRALJEVIC M.
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

LEFKATHITOU Eugenia
Ministry of Agriculture
Fisheries Department
20 Ethnikis Antistasu St.
GR-65110 Kavala
Grèce/Greece

Tel. (030) 51-834504 Ext. 331

LEMBO G.
COISPA
L.go Ciaia 3
70125 Bari
Italie/Italy

Tel. (080) 227635

LUNA M.
Istituto Ricerche Pesca Marittima (IRPEM) - CNR
Molo Mandracchio
60100 Ancona
Italie/Italy

Tel. (071) 204197/55313

MARANO G.
Directeur
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 2112007213486

MAROSOVIC Ivona
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

MARIANI M.
ENEL-CRTN P/O G.I.T.V Sud
Via Aurelia Nord 32
00053 Civitavecchia
Italie/Italy

Tel. (0766) 32744

MATARRESE A.
Istituto di Zoologia ed Anatomia Comparata
Via Amendola 165/A
70126 Bari
Italie/Italy

Tel. (080) 243346

MEGALOFONOU Persefoni
Istituto Comunale di Biologia Marina di Nardo
Nardo (Lecce)
Italie/Italy

Tel. (0833) 823261

MORONE Rosaria
Istituto di Zoologia ed Anatomia Comparata
Via Amendola 165/A
70126 Bari
Italie/Italy

Tel. (080) 243346

NOTI T.
Directeur de la pêche
Ministère de l'alimentation
Tirana
Albanie/Albania

Tel. 78-21
Tlx. 4206 Miulet AB

OSMANI K.
Station de recherche scientifique sur la pêche
Durrës
Albanie/Albania

Tel. 25-52

PAPACONSTANTINOU C.
National Centre for Marine Research
Agios Kosmas
Hellinikon/R
16604 Athens
Grèce/Greece

Tel. 9821354

PASTORELLI Annamaria
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

PETRUZZI T.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

PICCINETTI C.
Directeur
Laboratorio di Biologia Marina e Pesca
Viale Adriatico 52
61032 Fano
Italie/Italy

Tel. (0721) 83689

PUCHER-PETKOVIC Teresa
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

RAMBALDI E.
COIPA
Viale Mazzini 55
Roma
Italie/Italy

Tel. (06) 317903

REGNER Dubravka
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

REGNER S.
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

RELINI G.
Istituto di Anatomia Comparata
Viale Balbi 5
16126 Genova
Italie/Italy

Tel. (010) 207623/202600

RELINI ORSI Lidia
Istituto di Anatomia Comparata
Viale Balbi 5
16126 Genova
Italie/Italy

Tel. (010) 207623/202600

REPETTO Nadia
COOP. C.B.M.
Via Monte Sleme 200
Genova Borzoly
Italie/Italy

Tel. (010) 673292

RIZZI Ermenegilda
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

ROSITANI L.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

SARACINO C.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

SCALERA LIACI Lidia
Istituto di Zoologia ed Anatomia Comparata
Via Amendola 165/A
70126 Bari
Italie/Italy

Tel. (080) 243346

SPEDICATO Maria Teresa
COISPA
L.go Ciaia 3
70125 Bari
Italie/Italy

Tel. (080) 227635

TARULLI E.
Istituto Centrale per la Ricerca Scientifica e Tecnologica Applicata alla Pesca Marittima
Via L. Respighi, 5
00197 Roma
Italie/Italy

Tel. (06) 872276/877551

TUNESI L.
CRE Studio Professionale Associate
Via Roma 16/1
16033 Lavagna (GE)
Italie/Italy

Tel. (0185) 392674

TURSI A.
Istituto di Zoologia ed Anatomia Comparata
Via Amendola 165/A
70126 Bari
Italie/Italy

Tel. (080) 243346

UNGARO N.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

VACCARELLA R.
Laboratorio di Biologia Marina
Molo Pizzoli (Porto)
70123 Bari
Italie/Italy

Tel. (080) 211200/213486

VACCHI M.
Istituto Centrale per la Ricerca Scientifica e Tecnologica Applicata alla Pesca Marittima
Via L. Respighi, 5
00197 Roma
Italie/Italy

Tel. (06) 872276/877551

VILLANI P.
Istituto per lo Sfruttamento Biologico delle Lagune
CNR
Via Fraccacreta, 1
71010 Lesina
Italie/Italy

Tel. (0882) 91166/91483

VUCETIC Tamara
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

WURTZ M.
Istituto di Anatomia Comparata
Viale Balbi 5
16126 Genova
Italie/Italy

Tel. (010) 207623/202600

ZORE-ARMANDA Mira
Institut za oceanografiju i ribarstvo
P.P. 114
58000 Split
Yougoslavie/Yugoslavia

Tel. (058) 46682/46688

Communauté économique européenne (CEE)/ European Economic Community (EEC)

VAMVAKAS K.
Administrateur principal
Direction générale de la pêche
Commission des Communautés européennes
200 rue de la Loi
1049 Bruxelles
Belgique/Belgium

Tel. (2) 2355784
Tlx FISEU 24189
Cable COMEUR Bruxelles

Secrétariat du CGPM (FAO)/GFCM (FAO) Secretariat

Département des pêches/Fisheries Department
FAO
Via delle Terme di Caracalla
00100 Roma
Italie/Italy

Tlx 611127 FAO I

BEN ALAYA H.
Chargé de liaison (pêches)/Fishery Liaison Officer
Unité des institutions internationales et de liaison//International Institutions and Liaison Unit
Division des politiques et de la planification de la pêche/Fishery Policy and Planning Division

Tel. 5797-6411

CADDY J.F.
Secrétaire technique/Technical Secretary

Tel. 5797-6482

CHARBONNIER D.
Secrétaire du CGPM/Secretary of GFCM

Tel. 5797-6616

COPPOLA R.
Statisticien/Statistician
Unité de rassemblement de données sur les pêches/Fishery Data Centre
Service de l'information, des données et des statistiques sur la pêche/Fishery Information, Data and Statistics Service

Tel. 5797-6668

DEFENDI Anne Marie
Secrétaire/Secretary

Secrétariat local/Local Secretariat

MASELLI Eleonora

Interprètes/Interpreters

BURI Maria Rosaria
SANASI Carmelita
MASSARIELLO Liliana

ANNEXE/APPENDIX 3

Documents présentés à la Consultation/Documents presented to the Consultation

1. Ordre du jour/Agenda

2. Liste des participants/List of Participants

3. Documents présentés à la Consultation/Documents presented to the Consultation

4. Alegría-Hernandez, V. and S. Jukič, Stock recruitment relationship for the hake (Merluccius merluccius L.) from the open middle Adriatic - Jabuka pit

5. Arneri, E. et C. Piccinetti, Evolution de l'effort de pêche au chalut en haute et moyenne Adriatique

6. Bello, G. and E. Rizzi, On the growth of the four-spotted scaldfish, Lepidorhombus boscii, from the southern Adriatic

7. Bolje, A., Some preliminary results from mapping commercial cables of small pelagic fish in north Adriatic

8. Bombace, G. et N. Cingolani, Distribution de l'effort de pêche dans les pêcheries des mers italiennes, densité (CV/n mi²) et cpue (kg/CV) pour les différents métiers de pêche

9. Bombace, G., N. Cingolani, S.R. Coppola and J. Mortera, Summary report on the quality check sample survey of fisheries catch and effort statistics - Adriatic Area

10. Casavola, N., G. Marano, L. De Martino and C. Saracino, Preliminary evaluation of anchovy and sardine stocks in the lower Adriatic

11. Cetinič, P., Caractéristiques de la flottille yougoslave de pêche en Adriatique

12. Coppola, S.R. and N. Cingolani, Definition and preliminary evaluation of the Italian fishing zones exploited by the national fleet

13. De Metrio, G. and P. Megalofonou, Catch, size distribution, growth and sex ratio of swordfish (Xiphias gladius L.) in the Gulf of Taranto

14. Ferretti, M. et P. Arata, Evolution technologique de l'effort italien de pêche au chalut dans l'Adriatique au cours des quarante dernières années

15. Froglia, C. and M.E. Gramitto, An estimate of growth and mortality parameters for Norway lobster (Nephrops norvegicus) in the Central Adriatic Sea

16. Jardas, I., Distribution of the Adriatic fishes of Triglidae family as affected by ecological factors

17. Jardas, I., A. Pallaoro, S. Jukič and P. Cetinič, A preliminary note on management of coastal resources along the eastern Adriatic coast by regulation of fishing gears: mesh size selectivity

18. Jug-Dujakovič, J., Growth and temporal distribution of young sparids in the Sibenik area in the middle Adriatic

19. Jukič, S. and C. Piccinetti, Contribution to the knowledge on the short and long-term effects of the application of 40 mm codend mesh size in Adriatic trawl fishery - Eastern Adriatic coast

20. Kacič, I., Acoustic survey in the Eastern Adriatic in 1986

21. Kacič, I., G. Sinovcič and V. Alegría-Hernandez, Juvenile sardine along the Eastern Adriatic coast - Studies and protection (part 2)

22. Kraljevič, M. and J. Jug-Dujakovič, Preliminary ecological and biological studies of juvenile fish species of commercial interest in the national park "Kornati"

23. Marano, G., A.M. Pastorelli and R. Vaccarella, Studies for the evaluation and of the consistency of beds of Chamelea gallina in the Adriatic - Evaluation of dam stock in the lower Adriatic

24. Marano, G., L. Rositani, N. Ungaro et V. De Zio, Cours des prises avec palangre de surface dans l'Adriatique du sud (côtes italiennes), triennat 1984-86

25. Marasović, I., T. Pucher-Petković and V. Alegria, Relation between phytoplankton productivity and Sardina pilchardus catch in the middle Adriatic

26. Modrusan, Z., E. Teskeredzić and S. Jukić, Biology and ecology of Mugilidae species on the Eastern Adriatic coast (Sibenik Bay)

27. Papaconstantinou, C. and K. Stergiou, On the density-dependent regulation of the 0 group hake (Merluccius merluccius L. 1758) in the Patraikos Gulf, Greece

28. Petruzzi, T., A.M. Pastorelli and G. Marano, Notes on the distribution of commercial crustaceans in the Southern Adriatic, trawl - survey 1985-86

29. Piccinetti, C. et S. Jukić, Elaboration des données sur les ressources démersales de la haute et moyenne Adriatique

30. Pucher-Petković, T., I. Marasović, I. Vukadin and L. Stojanoski, Time series of productivity parameters indicating eutrophication in the middle Adriatic waters

31. Regner, D., The composition and spatial distribution of zooplankton at the spawning areas of sardine in the Eastern Adriatic

32. Regner, S., Bibliography of long-term time series in the Adriatic

33. Regner, S., G. Piccinetti-Manfrin and C. Piccinetti, The spawning of the sardine (Sardina pilchardus Walb.) in the Adriatic as related to the distribution of temperature

34. Stergiou, K. and C. Papaconstantinou, Abundance of commercial fish in the Patraikos, Korinthiakos Gulfs and the Ionian Sea, Greece

35. Tursi, A., G. D'Onghia, P. Panetta, E. Cecere, R. Cavallo, A. Matarrese and P. Pacifico, The importance of the Mollusca Cephalopoda in the context of trawl surveys carried out in the Ionian Sea (1985-86)

36. Vassilopoulou, V. and C. Papaconstantinou, Distribution with depth and catches per unit effort of the hake and the red mullet off the Western coast of Greece

37. Villani, P., The ascent of Mugilidae fry into a coastal lagoon of the Southern Adriatic Sea

38. Vucetić, T., Studies of the Adriatic biological resources - Long term (1960-83) fluctuations of zooplankton biomass in the Palagruza - Gargano area

39. Vucetić, T. and V. Alegría-Hernandez, Trends of annual catches or stock densities of some pelagic fishes in recent "Pelagia years" in the Adriatic

40. Zore-Armanda, M., L. Stojanoski and I. Vukadin, Time series of oceanographic parameters: eutrophication of the open Adriatic waters

DEUXIEME PARTIE/PART TWO - CONTRIBUTIONS

A. ETUDES SUR L'ENVIRONNEMENT DES PECHES/FISHERIES ENVIRONMENTAL STUDIES

TIME SERIES OF PRODUCTIVITY PARAMETERS INDICATING EUTROPHICATION IN THE MIDDLE ADRIATIC WATERS

by

Tereza Pucher-Petković, Ivona Marasović, Ilija Vukadin and Lambe Stojanoski
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

The results of long-term research on primary in situ production, chlorophyll biomass, productivity parameters are presented as well as some factors which reflect to a considerable extent biological processes in the Adriatic.

Sampling for these studies have been performed on a monthly basis at permanent stations of the profile Kastela Bay - Stoncica. Results of the analyses are presented mainly as five year running averages illustrating adequately the trend of variations of studied parameters. Studies of phytosynthetic activity, oxygen, nutrients and sea water transparency were carried out from 1962 through 1983, while nitrogen salts were included into the research in 1971 and chlorophyll biomass in 1977. Study area is given in Figure 1.

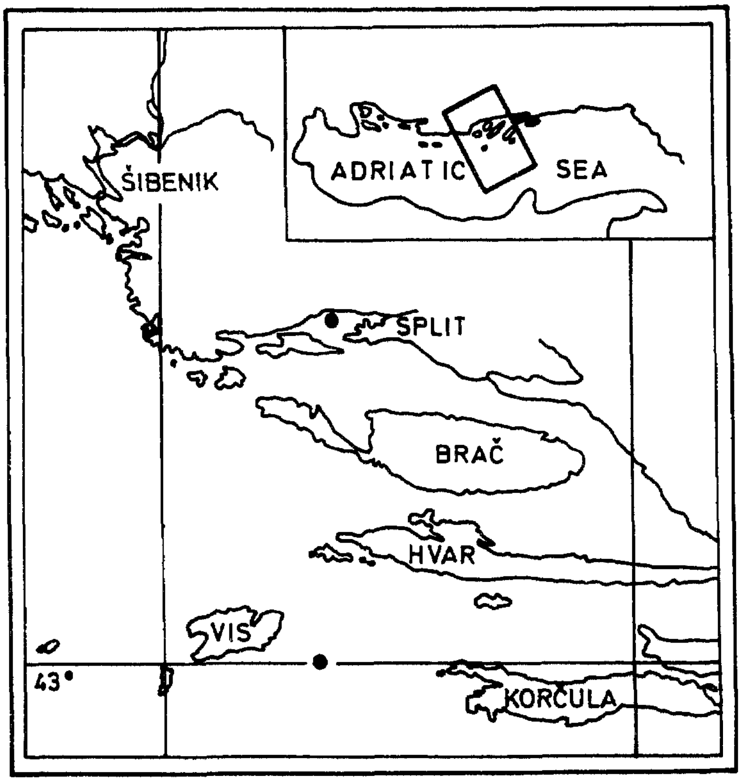


Figure 1 Positions of stations investigated

2. EARLIER INVESTIGATIONS

Seasonal and long-term variations of primary and secondary production, including fish, were the major subject of a series of earlier works (Pucher-Petković, Zore-Armanda and Kacić, 1971; Zore-Armanda, Pucher-Petković and Kacić, 1971; Pucher-Petković and Zore-Armanda, 1973; Karlovac et al., 1974; Pucher-Petković, 1974; Vucetić, 1971, 1976; Vucetić and Kacić, 1973).

Particular attention was given to mechanisms affecting fluctuations of organic production, such as climatic factors over wider areas of the Mediterranean and Atlantic and differences in air pressure gradients over the Adriatic and Ionian Sea, i.e., between Trieste and Athens (Zore-Armanda, 1969, 1971; Zore-Armanda and Pucher-Petković, 1976). The quantity of levantine intermediate water entering the Adriatic directly depends on these factors and has been a significant regulator of Adriatic organic productivity in a way that more intensive ingressions were always associated with increased production (Buljan, 1953, 1968; Pucher-Petković and Zore-Armanda, 1973). It seems, however, that natural fluctuations of primary production have been more and more disguised recently (Marasović and Pucher-Petković, in press) and that primary production has been increasing. It is quite logical that these changes were recorded first from the coastal area. Therefore Kastela Bay will be discussed first, so that the phenomenon observed in the open sea with a certain phase lag will be better understood.

3. RESULTS AND DISCUSSION

Kastela Bay

Figure 2 depicts the fluctuations of primary production in the Kastela Bay (1962/63 - 1983) and shows that the quantity of carbon assimilated by phytoplankton has gradually increased. Primary gross production in this bay was earlier estimated at about 150 g C m^{-2} per year (Pucher-Petković, 1974) and to have been on the average 189 g C m^{-2} $year^{-1}$ between 1971 and 1979; exceeding 244 g C m^{-2} $year^{-1}$ between 1979 and 1983. Mean production increased to 187 g C m^{-2} per year for the entire area which exceeds earlier estimates by about 20%. This value has risen as high as 39% for the last five years. In addition, an atypical phytoplankton density maximum appears now in the bay in summer. This has been understood to be as a result of nutrients entering the sea from outside the Adriatic (Pucher-Petković, 1975; Pucher-Petković and Marasović, 1980). Some changes in the structure of phytoplankton community have also been observed from 1968 onwards. This refers to summer quantitative dominance of some species characteristic of the first eutrophication stage which were poorly represented previously (*Nitzschia seriata*, *Leptocylindrus danicus*, *Skeletonema costatum*). However, during periods of stronger ingress of Mediterranean waters into the Adriatic, as in 1976 (Morović, 1983), the typical seasonal phytoplankton density cycle was established again with pronounced summer stagnation in 1976-78. Howeer, a summer maximum occurred once more in 1979 and 1980 (Marasović and Pucher-Petković, 1983).

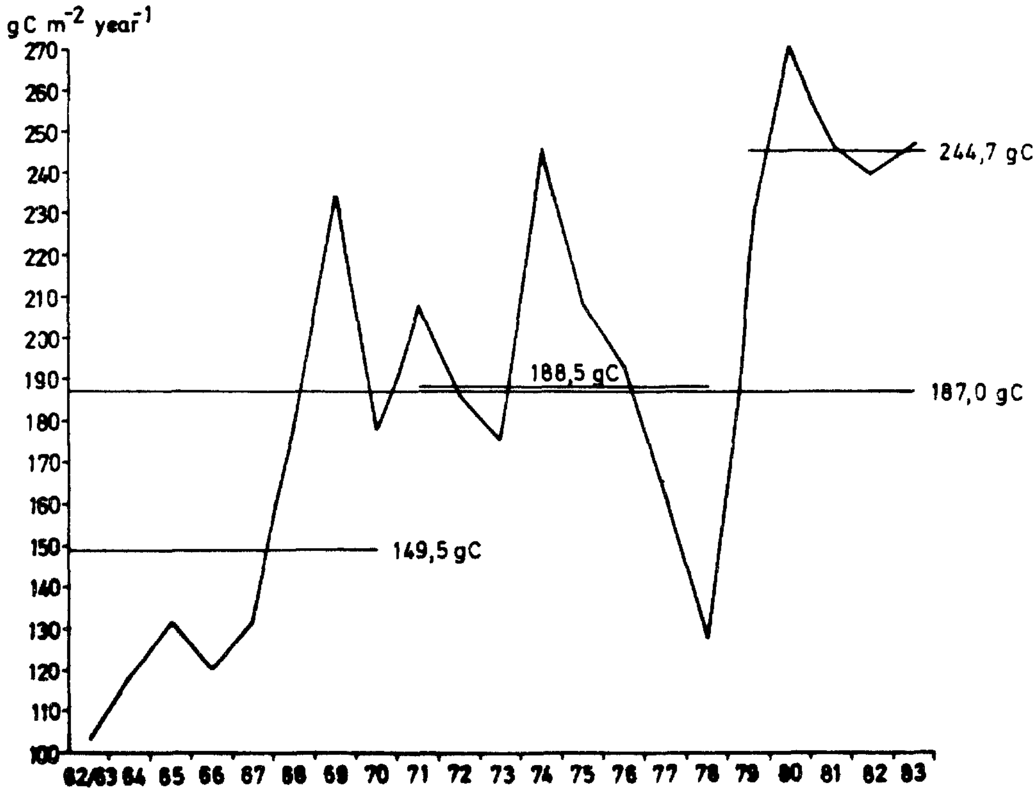


Figure 2 Fluctuations of primary production in the Kastela Bay

As seen from Figure 2, the years 1976-78 were at the same time the less productive years. This explanation appears at first sight quite controversial compared with the earlier model. However, this may be understood if it is taken into account that at this productivity level the effects of natural eutrophication of the bay are covered by nutrient salts coming from the land. As a result, the ingress of water from outside the Adriatic now leads to a production decrease and restoration of the average level of production, and not the production increase as formerly.

The frequency distribution of daily gross primary production (Figure 3) varied during the period of investigation. Values between 100 and 300 mg C m^{-2} day^{-1} were most frequent during the first years. Later on however, 500-700 mg C production levels and even more than 900 mg C m^{-2} day^{-1} became more and more frequent.

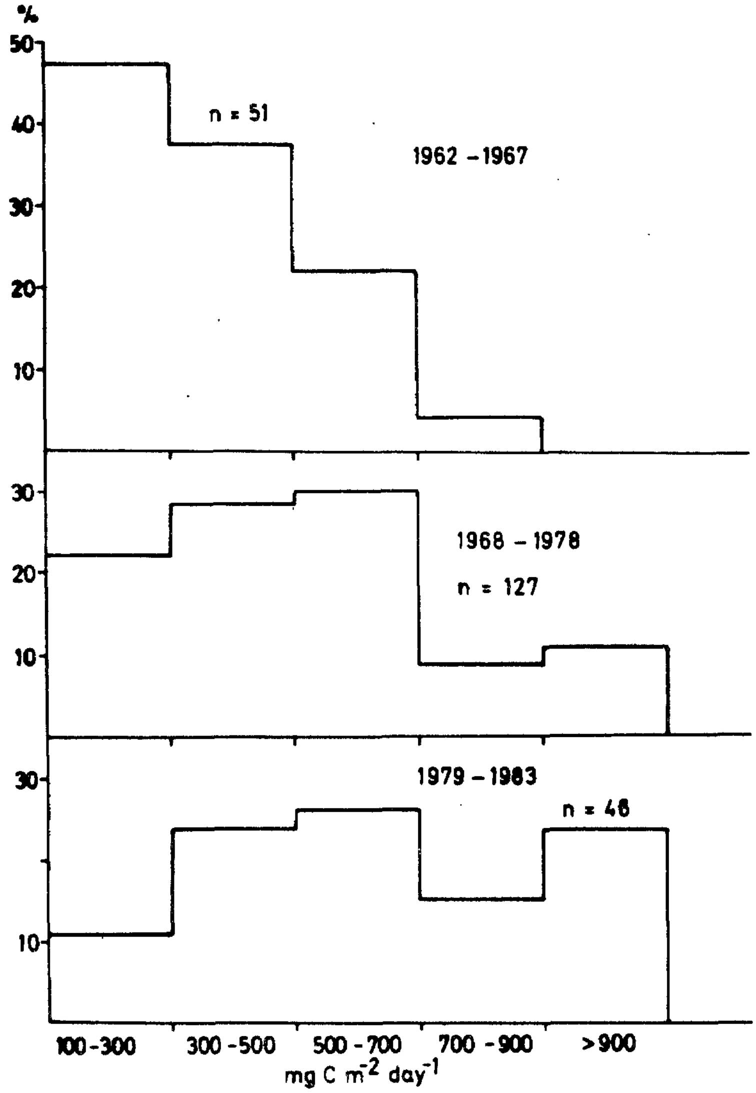


Figure 3 Frequency distribution of mg C m^{-2} day^{-1} in Kastela Bay

It is apparent from Table 1 that chlorophyll biomass also, even though measured over a shorter period and not so systematically as the photosynthetic activity, has shown a certain increase.

Even though the sea water transparency in the coastal area is affected by larger quantities of detritus in addition to phytoplankton, a tendency for a water transparency decrease is observed associated with the increase of phytoplankton (Pucher-Petković and Marasović, 1980; Morović, 1983). Mean Secchi depths given as running averages for five year periods are presented in Table 2. A decreasing trend (from 13 to 10 m) is obvious.

Table 1

Chlorophyll biomass (Chl a) in the Kastela Bay

Period	mg Chl a m^{-2}(0-35 m)	mg Chl a m^{-3}
1977-78	30.85	0.880
1979-80	35.47	1.010
1981-82	24.69	0.710
1983-84	34.46	1.040
1985-86	37.52	1.070

Table 2

Sea water transparency in the Kastela Bay

Period	Secchi m	Period	Secchi m
1962-66	13	1971-75	10
1963-67	12	1972-76	10
1964-68	11	1973-77	10
1965-69	11	1974-78	10
1966-70	10	1975-79	10
1967-71	10	1976-80	11
1968-72	10	1977-81	11
1969-73	10	1978-82	10
1970-74	10	1979-83	10

Water column oxygen saturation is a parameter where the level of photosynthetic activity is particularly strongly reflected. Figure 4 depicts the variations of primary production over five year periods, O_2% variations in the water column, and separately in the upper, most productive euphotic layer (0-10 m). Oxygen saturation shows continuous increase associated with the increase of primary production through the period of investigations. This increase amounts to 5.8% in the water column even reaching 7.3% in the upper euphotic layer.

Of the productivity parameters, the orthophosphate (P-PO_4) and nitrogen components (N-NH_4 and N-NO_3) were considered and presented in Figure 5. Five year means are indicative of a permanent phosphate increase up to the 1971-75 period, accompanied by the primary production as observed by Pucher-Petković and Marasović (1980). From 1972-76 these values began to decrease with a further production increase. A contemporaneous decrease of ammonia was also recorded as well as that of nitrates somewhat later. Even though the data on two last parameters were not available for the period prior to 1971, they are undoubtedly indicative of the decrease in nitrogen compounds in Kastela Bay.

Open waters (Stoncica)

The open Middle Adriatic (represented by Station Stoncica near the Vis Island) is far less productive than the coastal area (Figure 6). An earlier estimate for Stoncica for the period up to 1971 gave annual mean gross primary production of about 60 g C m^{-2} (Pucher-Petković, 1974). This is clearly shown by the figure that is distinct from the coastal values. Primary production in the open waters has increased rather considerably only from 1980 onwards. As a result the mean values of gross primary production for this last period have been 96 g C m^{-2} $year^{-1}$. If all the previous data are taken into account, annual mean gross production of 65 g C m^{-2} appears to exceed the former estimate for the period up to 1971 by 7.5%, and by as much as 38% for the last four years. Mean value of primary production varied within the range of the earlier estimate up to 1979, and its year-to-year variations can be attributed to natural fluctuations. However, we consider that eutrophication effects originating from on-land have risen in importance more recently, i.e., approximately a decade later than in the coastal region.

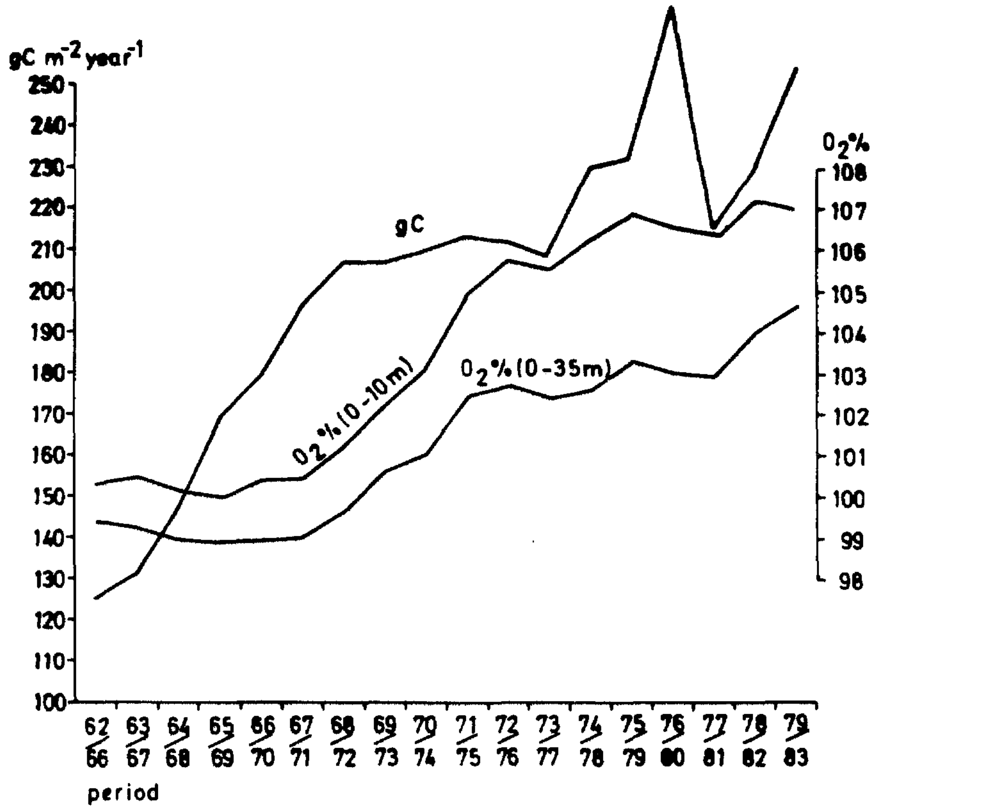


Figure 4 Fluctuations of primary production and oxygen saturation in Kastela Bay (five year running averages)

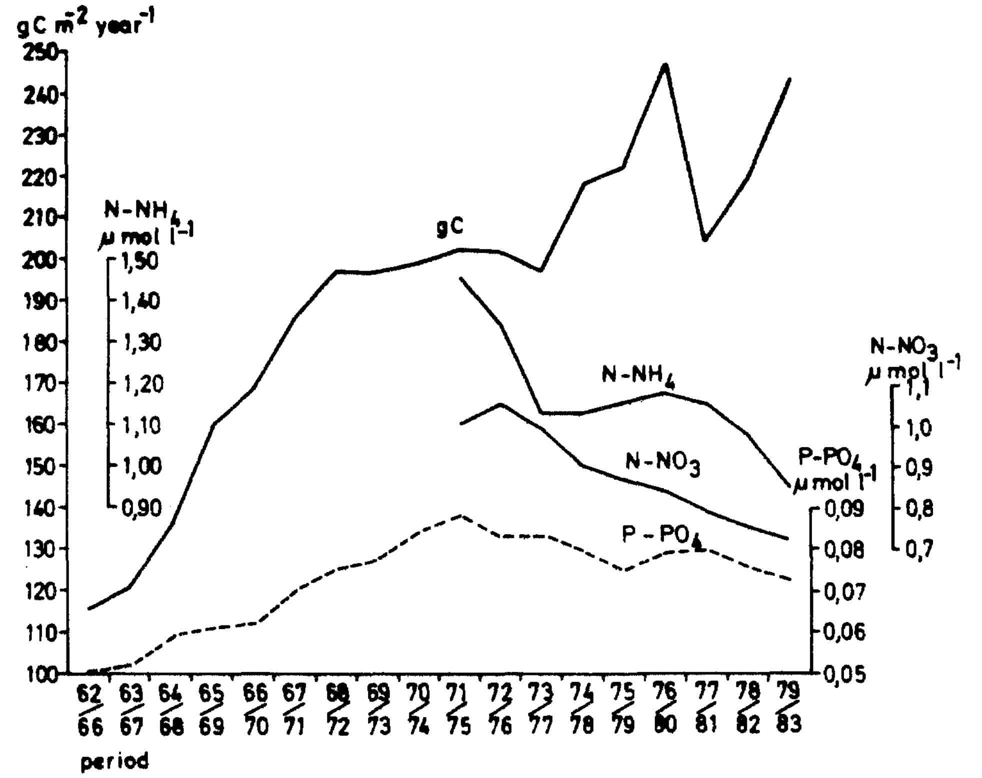


Figure 5 Fluctuations of primary production and nutrients ($P-PO_4$, $N-NH_4$, $N-NO_3$) in Kastela Bay (five year running averages)

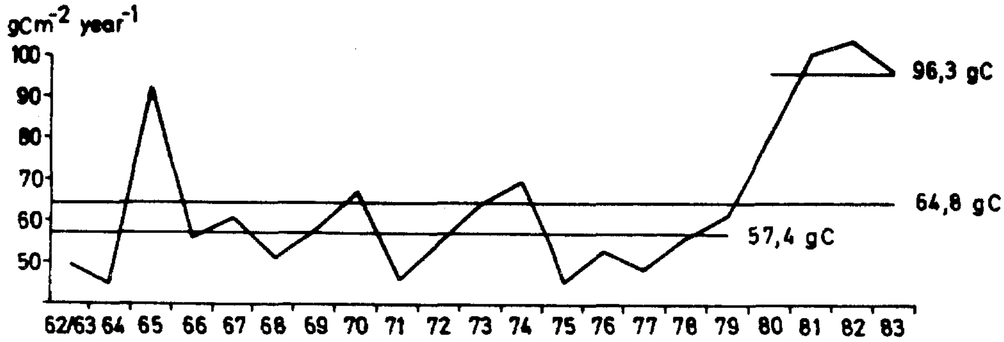


Figure 6 Fluctuations of primary production at Stoncica

Some signs of changes in the qualitative-quantitative relations in the phytoplankton community of this area became apparent at Stoncica as early as in 1974; namely, in December 1974, a neritic diatom Nitzschia seriata occurred in abundance never before recorded. This, after Pucher-Petković and Marasović (1981) could be a sign of eutrophication originating from the land. Vucetić (1981) recorded mass occurrence of surface neritic zooplankton species Penilia avirostris at the same station in the same year attributing its presence to "neritization" of the open Adriatic waters.

Frequency distributions of daily gross primary production levels (9 categories) occurring at Stoncica are still better illustrative of the earlier mentioned phenomena than the mean values (Figure 7). The frequency distribution of different primary production levels is summarized for both the less productive (1962-79) and the more productive period (1980-84). It is obvious for the former period that the values of daily primary production ranging from 100-150 mg C m^{-2} and those from 50-100 mg C m^{-2} are most frequent. Later on, maximum frequencies were shifted to the right. So the categories of 150-200 mg C m^{-2} day^{-1} and those from 200 to 250 mg C m^{-2} day^{-1} are now equally frequent. It is of interest that the higher category of production of 300-400 mg C m^{-2} day^{-1} is also relatively frequent.

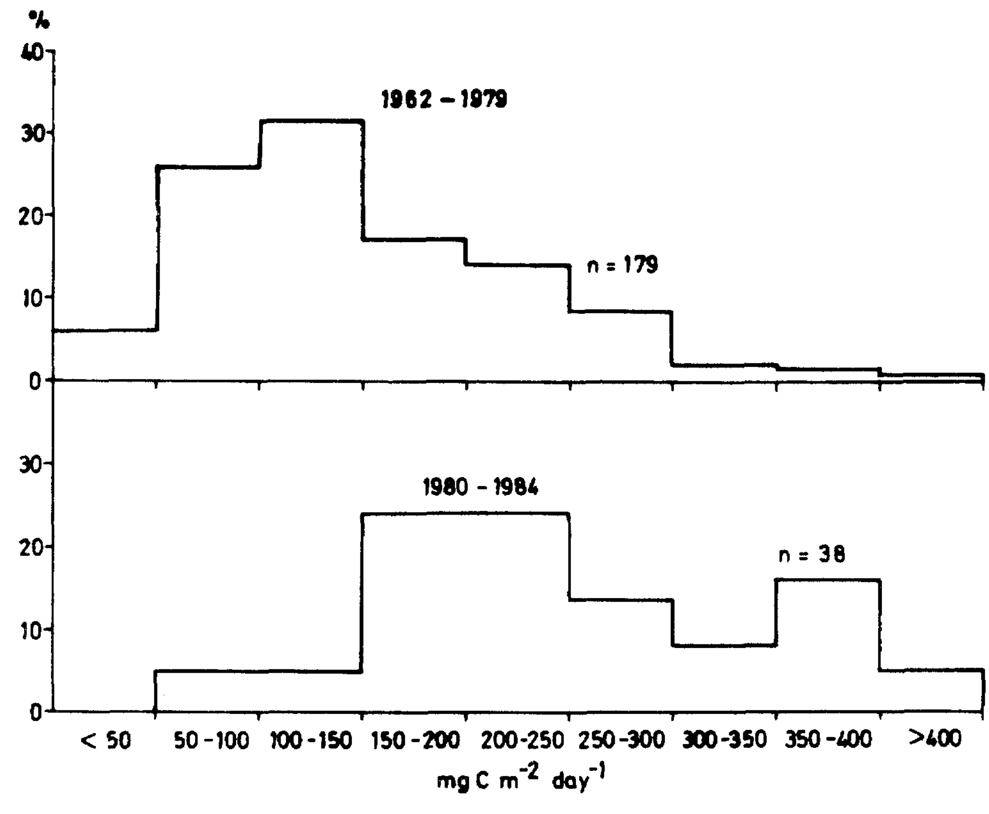


Figure 7 Frequency distribution of mg C m^{-2} day^{-1} at Stoncica

Chlorophyll a shows a continuous increase at Stoncica from 1977 to 1986 (Table 3).

Table 3

Chlorophyll biomass (Chl a) at Stoncica

Period	mg Chl a (0-100 m)	mg Chl a m^{-3}
1977-78	17.67	0.177
1979-80	18.30	0.183
1981-82-83-84	20.64	0.206
1985-86	21.07	0.210

The analysis of Secchi depths is indicative of a decrease in transparency at this station as mentioned already by Morović (1983). However, minimum values of sea water transparency for five year periods were recorded from the Kastela Bay as early as the 1966-70 period (Table 2) and from the open sea much later (1974-78). This is presented in Table 4.

Table 4

Sea water transparency at Stoncica

Period	Secchi m	Period	Secchi m
1962-66	27	1971-75	26
1963-67	27	1972-76	25
1964-68	26	1973-77	25
1965-69	26	1974-78	24
1966-70	26	1975-79	25
1967-71	26	1976-80	25
1968-72	26	1977-81	25
1969-73	27	1978-82	24
1970-74	26	1979-83	24

Oxygen saturation has increased at this station even though at a slower rate. The O_2% curve of the most productive layer (20-50 m) and that of saturation for the entire water column coincide, and show progressively greater separation from the saturation curve for the bottom layer. On the one hand this is due to increased production in the illuminated upper part of the water column, and increased stagnation or lower oxygen saturation at 100 m depth (Figure 8) on the other.

As to the nutrient salts, the phosphate curve and primary production curve are parallel by the 1975-79 period. With greater increase in primary production, this factor showed stagnation over a longer period before finally decreasing. As in Kastela Bay, of the nitrogen components, ammonia began to decrease much earlier than the nitrates (Figure 9).

4. CONCLUSIONS

Observations of levels in primary production in Kastela Bay over two decades are indicative of its continuous increase. Year-to-year fluctuations in production have been less marked recently.

Annual gross primary production was estimated at 187 g C m^{-2} for the entire period of investigations (1962/63-83) in relation to 150 g C m^{-2} for the period up to 1971. This means that the global increase has amounted to about 20%, and to as high as 39% over the last five years. The phytoplankton biomass has also increased.

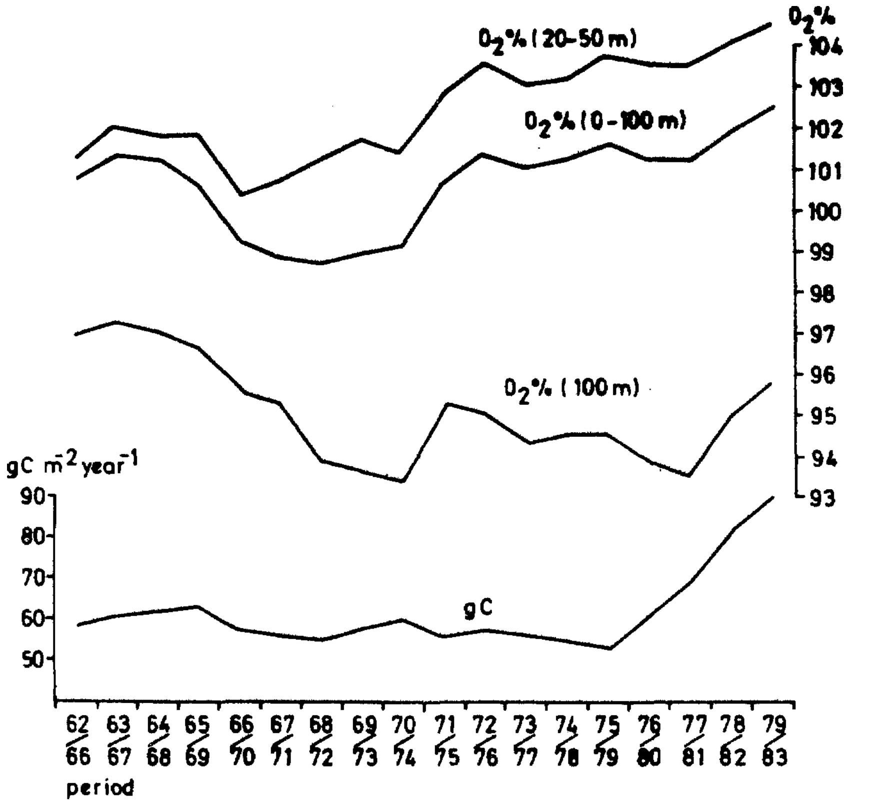


Figure 8 Fluctuations of primary production and oxygen saturation at Stoncica (five year running averages)

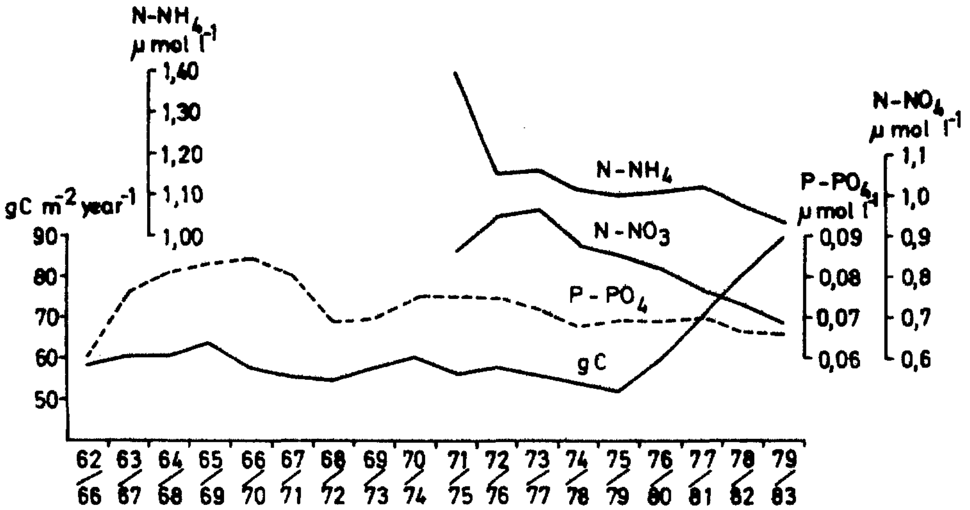


Figure 9 Fluctuations of primary production and nutrients (P-PO_4, N-NH_4, N-NO_3) at Stoncica (five year running averages)

Diminution of sea-water transparency, oxygen saturation increase, and the decrease of nutrient concentrations may be associated with this increase in primary production.

Mean value of gross primary production in the open Adriatic waters ranged within the limits of the earlier estimate (60 g C m^{-2} $year^{-1}$) up until 1979. Mean values have exceeded this earlier estimate by about 38% over the last four years, and the frequency distribution of primary production levels has shown a shift of the most frequent values toward higher production levels. The increase in primary production was also accompanied with an increase of phytoplankton biomass. The production increase in the open sea is also accompanied by a decrease of sea-water transparency and nutrient concentrations.

Oxygen saturation of the entire water column as well as that of the most productive layer (20-50 m) have increased with the production increase. However, oxygen saturation curves in the upper layers show a departure from the oxygen saturation curve for the bottom layer (100 m). This is partly due to the increased production and partly to the stronger or poorer stagnation of oxygen saturation at 100 m.

To conclude, the changes recorded from the open sea are in fact a sequence of events begun earlier close to the coast. It is assummed that increases in primary production in the open sea recently has been due to eutrophication originating from the land in addition to the effects of natural environmental factors.

5. REFERENCES

Buljan, M., 1953. Fluctuations of salinity in the Adriatic. Izv.Inst.Oceanogr.Ribar., Split, 2(2):63 p.

__________, 1968. Fluktuacija oceanografskih svojstava srednjeg Jadrana u razdoblju od 1962-67. Pomor.Zb., 6:845-65

Karlovac, J., et al., 1974. Procjena bioloskih resursa Jadrana na osnovi planktona. Acta Adriat., 16(9):157-83

Marasović, I. and T. Pucher-Petković, 1983. Irregular phytoplankton blooms in the Kastela Bay (Central Adriatic). Rapp.P.-V.Réun.CIESM, 28(9):97-8

__________. Phytoplankton productivity of the Adriatic Sea in the relation to fishing grounds. In The International Symposium, Modern classification of Preceedings of algae, 8-13 January, 1987 (in press)

Morović, M., 1983. Long-term changes of transparency in the Central Adriatic. Rapp.P.-V.Réun. CIESM, 28(2):181-2

Pucher-Petković, T., 1974. Essai d'évaluation de la production primaire annuelle dans l'Adriatique. Rapp.P.-V.Réun.CIESM, 22(9):71-2

__________, 1975. Fitoplankton Kastelanskog zaljeva u odnosu na organsku poluciju. Pomor.Zb., 13:491-500

Pucher-Petković, T. and I. Marasović, 1980. Développement des populations phytoplanctoniques caractéristiques pour un milieu eutrophisé (Baie de Kastela, Adriatique centrale). Acta Adriat., 21(2):79-93

__________, 1981. Importance relative du phytoplancton de tailles différentes dans les eaux du large de l'Adriatique centrale (Stoncica). Rapp.P.-V.Réun.CIESM, 27(7):87-9

Pucher-Petković, T. and M. Zore-Armanda, 1973. Essai d'évaluation et pronostic de la production en fonction des facteurs du milieu dans l'Adriatique. Acta Adriat., 15(1):1-32

Pucher-Petković, T., M. Zore-Armanda and I. Kacić, 1971. Primary and secondary production of the Middle Adriatic in relation to climatic factors. Thalassia Jugosl., 7(1):301-11

Vucetić, T., 1971. Long term zooplankton standing crop fluctuations in the Central Adriatic coastal region. Thalassia Jugosl., 7(1):419-28

__________, 1976. Evaluation of biological resources as first steps for fisheries management and protection. Pomor.Zb., 14:535-54

__________, 1981. Some species of plankton as indicators of neritisation (eutrophication) of the eastern Central Adriatic. Journ.Etud.Pollut.Mar.CIESM, 5(1980):769-70

Vucetić, T. and I. Kacić, 1973. Seasonal and annual fluctuations of zooplankton and echo traces abundance in the fishing ground of the Central Adriatic. GFCM Stud.Rev., (53):19-38

Zore-Armanda, M., 1969. Water exchange between the Adriatic and the eastern Mediterranean. Deep-Sea Res., 16:171-8

__________, 1971. Influence of long-term changes in the oceanographic/meteorological conditions in the North Atlantic on the Mediterranean. In The ocean world. Proceedings Joint of the Oceanographic Assembly, Tokyo, 1970, pp. 151-4

Zore-Armanda, M. and T. Pucher-Petkovič, 1976. Some dynamic and biological characteristics of the Adriatic and other basins of the Eastern Mediterranean Sea. Acta Adriat., 18(1):15-27

Zore-Armanda, M., T. Pucher-Petkovič and I. Kacić, 1971. Klimatski faktori i mogućnost predskazivanja velicine organske produkcije u Jadranu. Pomor.Zb., 9:545-59

COMPOSITION AND SPATIAL DISTRIBUTION OF ZOOPLANKTON AT THE SPAWNING AREAS OF SARDINE IN THE EASTERN ADRIATIC

by

Dubravka Regner
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

This preliminary paper gives some results on the composition and spatial distribution of mesozooplankton and macrozooplankton of the eastern part of the Adriatic Sea. The data were obtained from material collected during the Yugoslav fisheries expeditions in March and April 1982 and December 1986. Material from 1984 is also in preparation.

These surveys were undertaken as a part of a Yugoslav-Italian project on the stock assessment of the small pelagic fish, using estimates of the egg-production in plankton. The investigations were carried out along the eastern Adriatic coast, from the coastal waters to the middle line, and from the Bay of Trieste to Boka Kotorska Bay (Figure 1).

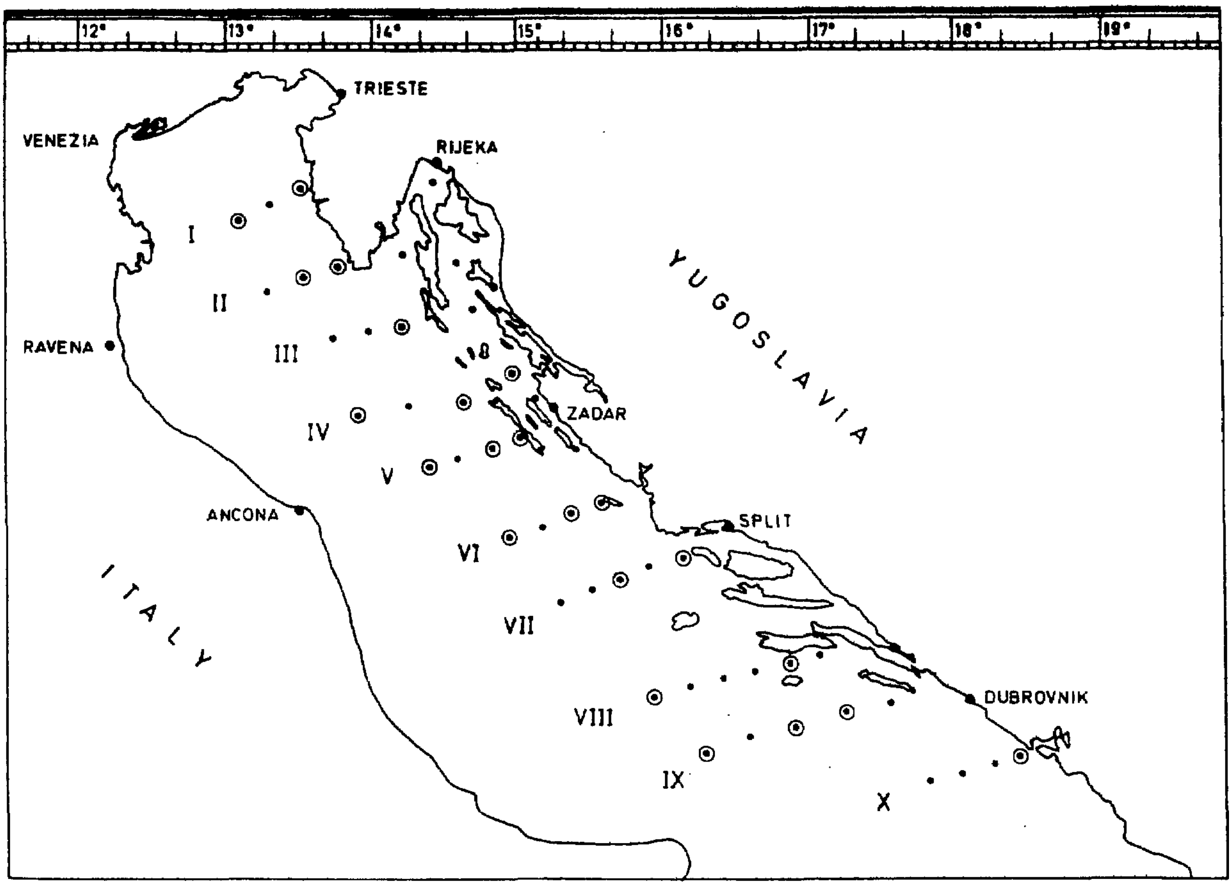


Figure 1 The study area

2. MATERIAL AND METHODS

In 1982, zooplankton samples were taken by vertical hauls of a "Hensen" plankton net (0.42 m^2 mouth surface, mesh size 333 µm), towed at a speed of 0.5 m/sec from bottom to surface. In 1986, zooplankton material was collected by a Bongo-20 net consisting of two cylinders of 20 cm diameters, each with its own plankton net (mesh size 250 µm). The maximal depth was 60 m at the deeper areas, and at shallow stations about 5 m above the bottom.

3. RESULTS AND DISCUSSION

As already mentioned, this paper includes data on the qualitative and quantitative composition of zooplankton over the spawning areas of sardine in the eastern Adriatic, and the composition and the ratio between separate zooplankton groups will be considered first.

Analysis of the results obtained in 1982 showed that Copepoda were quantitatively the best represented group of zooplankton organisms (Table 1).

Table 1

Mean percentages of some important zooplankton groups in the eastern Adriatic (Spring, 1982)

Copepoda	Siphonophora	Appendicularia	Phyllopoda	Chaetognatha
64%	15%	14%	2%	2%

The average percent of Copepoda for all investigated stations was about 64% (Figure 2), and slightly higher in the middle Adriatic than in the southern and northern parts. In absolute terms, their percentage varied between 13 and 96% of the zooplankton. In addition, the percent Copepoda slightly increased between the channel area and open waters (62% to 70%). It is obvious then that the distribution of zooplankton as a whole is dependent on Copepoda distribution. This is in agreement with all earlier studies and fits into the existing picture of horizontal distribution of Copepoda in the Adriatic Sea (Hure, Janora and Scotto di Carlo, 1980; Regner, 1983).

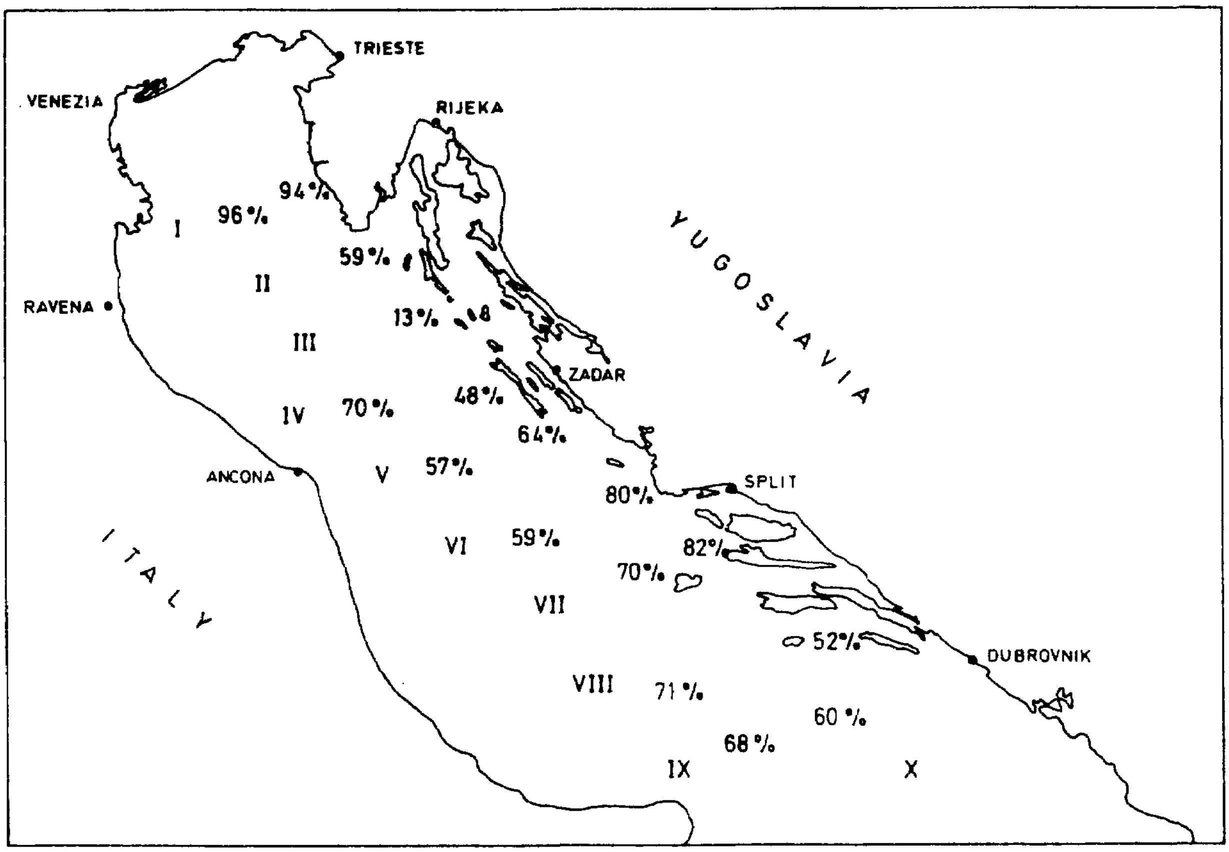


Figure 2 The percentage proportion of Copepoda (Spring, 1982)

The Copepoda merit, in view of their abundance and important role in food chains (being the first step of organic matter consumers, as well as being the main food of commercially important fish species (including sardine)), presentation of some data on their composition. It should be kept in mind that data refer to the spring season with its own peculiarities. The composition of Copepoda in spring 1982 included neritic and oceanic species, as well as (in the northern Adriatic) some brackishwater species. Ctenocalanus vanus, was the best represented species, making up 14% of copepods in the eastern Adriatic.

In the northern Adriatic, Ctenocalanus vanus, Paracalanus parvus and Centropages typicus were the copepod species best represented. These species are widely distributed, or ordinary neritic species, and the presence of Clausocalanus pergens, a typical oceanic species, points to the strong water mass circulation in this part of the Adriatic during spring.

In the middle Adriatic Ctenocalanus vanus, Centropages typicus, Paracalanus parvus and Calanus tenicornis, Calusocalanus pergens and Acartia clausi were the most numerous species.

In the southern Adriatic, Ctenocalanus vanus and Paracalanus parvus, Calanus tenuicornis and Clausocalanus pergens were best represented. However, markedly oceanic species like Pleuromamma gracilis, Pleuromamma abdominalis, Haloptilus longicornis and others were also recorded from this area (Table 2).

Table 2

Percentage of dominant copepod species in the eastern Adriatic in 1982

Northern Adriatic	Middle Adriatic	Southern Adriatic
Ctenocalanus vanus (17%) Paracalanus parvus (14%) Acartia clausi (13%) Centropages typicus (9%) Clausocalanus pergens (6%)	Ctenocalanus vanus (15%) Centropages typicus (10%) Paracalanus parvus (9%) Calanus tenuicornis (4%) Clausocalanus pergens (4%) Acartia clausi (4%)	Ctenocalanus vanus (8%) Paracalanus parvus (8%) Calanus tenuicornis (6%) Clausocalanus pergens (4%)

This wide distribution and high proportion of neritic species throughout the eastern Adriatic was also established by the research carried out by Hure, Ianora and Scotto di Carlo (1980). In terms of percentages, the Siphonophora group come next (15%); increasing steadily southwards. The Appendicularia group follows Syphonophora, with 14% throughout the study area, and a maximum of 80% on station 12. Phyllopoda groups came next with 3%, decreasing southwards and then Chaetognatha with 2%, best represented in the middle Adriatic.

Some other observations follow on the distribution of zooplankton along north-south and inshore-offshore directions. As shown by Figure 3, the highest values for total zooplankton per cubic metres were recorded from the shallow northern Adriatic on profile I. The next two profiles, II and III, showed much reduced (1/4 to 1/6) quantities, which increased in profile IV in the upwelling zone, which is the spawning area of sardine (Regner et al., in press). With the exception of station 26, where the open sea mixes with cold and less saline channel waters, the number of zooplankton organisms decreases toward the southern Adriatic. This has been known for Copepoda, since the beginning of this century (Steuer, 1910; Hure, Ianora and Scotto di Carlo, 1980; Regner, 1983 and 1985).

The number of zooplankton slightly increased in the southern upwelling zone at station 36 of the VIII profile where is also a spawning area of sardine (Regner et al., in press). In spring 1982, the number of zooplankton increased from the channel region to the open sea in an offshore direction.

Now, let us consider the results from December 1986. Copepoda were again the best represented zooplankton group with an average of about 70% (Table 3).

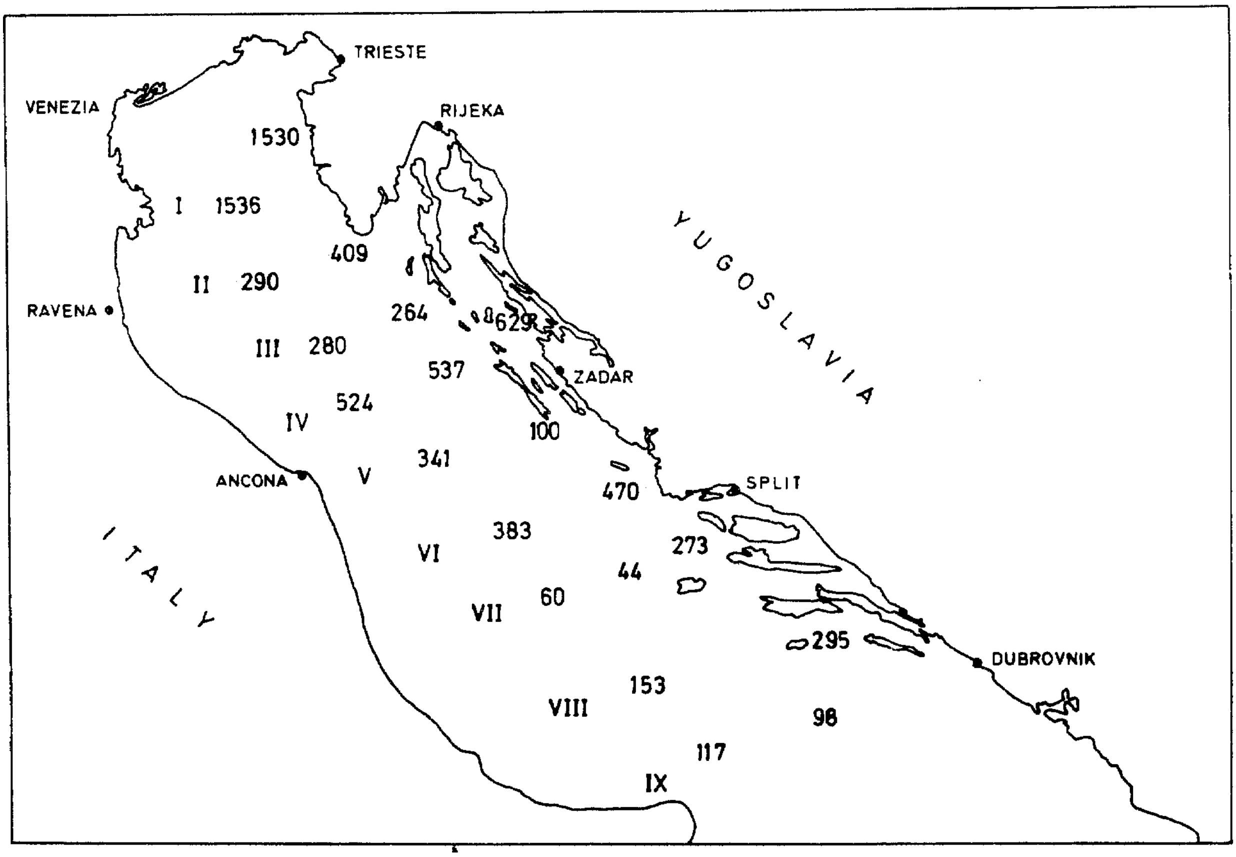


Figure 3 The number of zooplankton organisms per cubic metres

Table 3

Mean percentages of some important zooplankton groups
in the eastern Adriatic (winter 1986)

Copepoda	Chaetognatha	Appendicularia	Siphonophora	Phyllopoda
70%	9%	6%	4%	3%

Figure 4 shows that Copepoda were better represented in the northern Adriatic (78%) and the southern (74%), than in the middle Adriatic (58%). In addition, their percentage decreased from the channel area to the open waters (78% to 68%). The composition of Copepoda in winter 1986 included some dominant species other than those present in spring 1982. The best represented species in the northern Adriatic were: Acartia clausi, Paracalanus parvus and Temora longicornis.

In the middle Adriatic Acartia clausi, Ctenocalanus vanus, and Clausocalanus furcatus prevailed, while in the southern Adriatic, Clausocalanus furcatus, Ctenocalanus vanus, Mecynocera clausi and Paracalanus parvus were dominant species of copepods (Table 4).

In terms of percentage presence, Chaetognatha come next (9%), increasing from the northern to the southern Adriatic. They are followed by the Appendicularia group (6%), also increasing southwardly, and Siphonophora with 4%, and Phyllopoda with 3%.

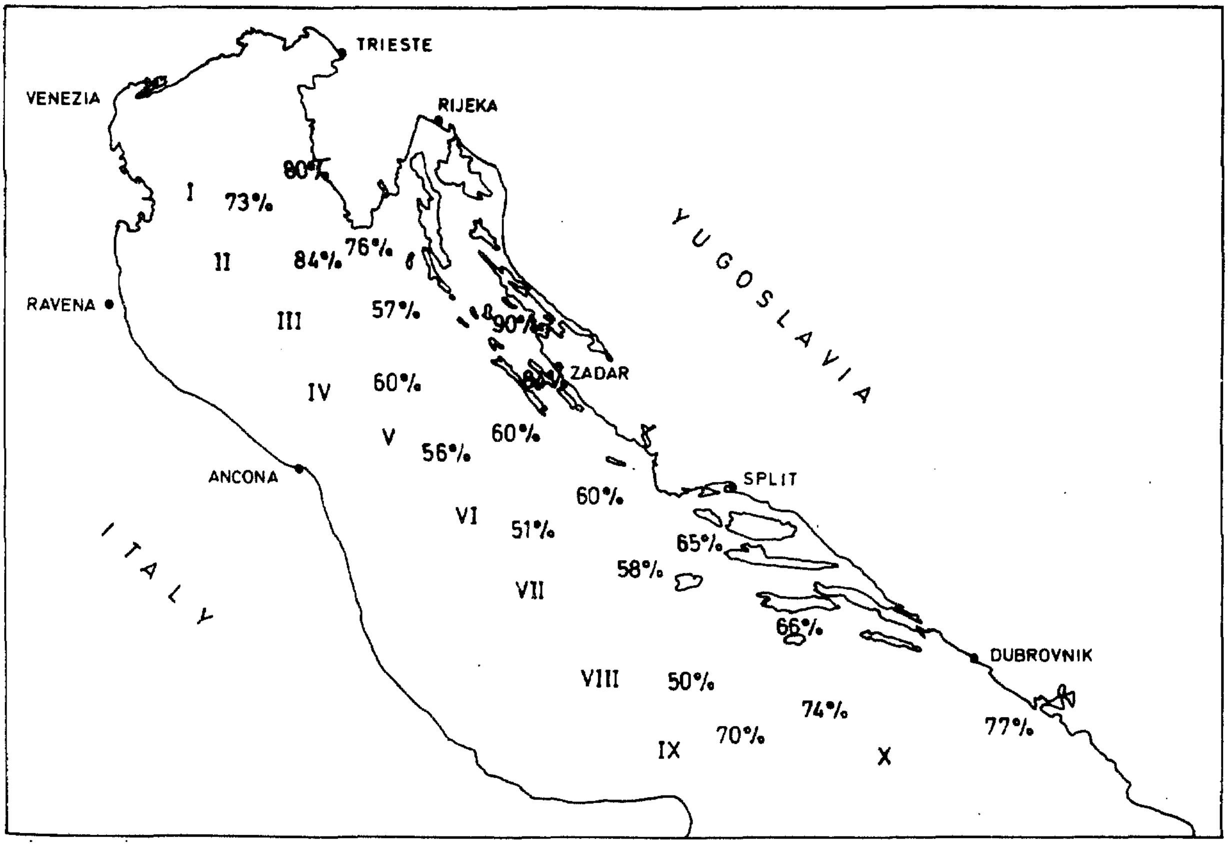


Figure 4 The percentage proportion of Copepoda (winter 1986)

Table 4

Percentage of dominant copepod species in the eastern Adriatic in winter 1986

Northern Adriatic	Middle Adriatic	Southern Adriatic
Acartia clausi (35%)	Acartia clausi (12%)	Ctenocalanus vanus (6%)
Paracalanus parvus (8%)	Ctenocalanus vanus (10%)	Mecynocera clausi (5%)
Temora longicornis (6%)	Clausocalanus furcatus (9%)	Paracalanus parvus (5%)

In winter 1986 the number of zooplankton per cubic metre and their distribution along the eastern Adriatic have also been studied (Figure 5). The highest values of zooplankton were found on profiles I and II in the northern Adriatic. The next profile, profile III, showed half this peak abundance, while on profiles IV, V and VI, numbers per cubic metre were similar. On profiles VII, VIII and IX, some lower values appeared, with slight increases on profile X. Summing all of these results on zooplankton number per cubic metre, we can conclude that smaller differences were found between profiles in north-south direction, than in the spring season. Thus, from the highest densities in the northern Adriatic, number of zooplankton decreased progressively in a southward direction.

Consequently, we can say that the density of zooplankton did not reveal any evidence for upwelling over the sardine spawning areas, which is in agreement with recent information on the dynamics of the Adriatic Sea (Zore-Armanda, 1968; Zore-Armanda and Bone, 1983).

In an offshore direction, the number of zooplankton organisms per cubic metre decreased from the channel region to the open sea; just the opposite of the spring situation.

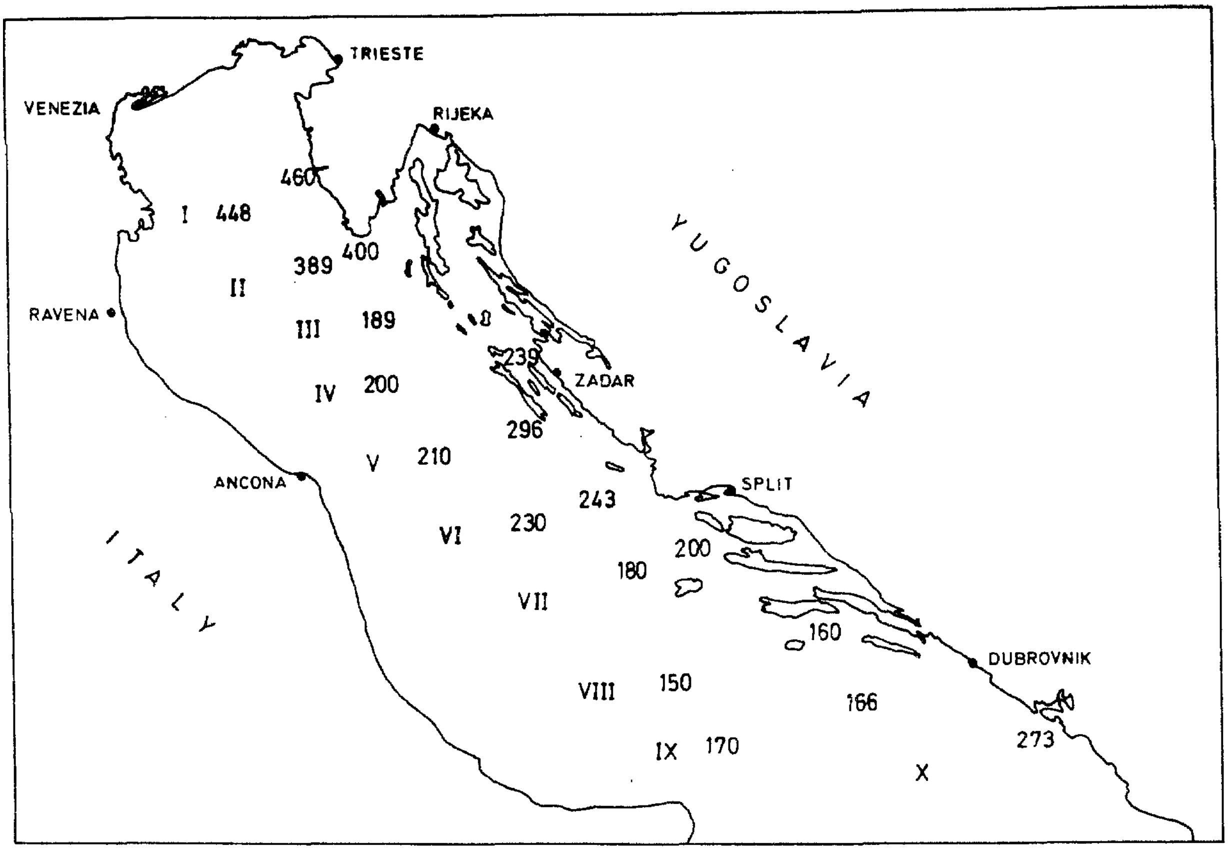


Figure 5 The number of zooplankton organisms/m^3

4. CONCLUSION

Summing up the results presented above, the dynamics of water masses in eastern Adriatic caused upwelling zones to form in spring 1982, and this was reflected in the quantitative distribution of copepods and zooplankton as a whole.

On the contrary, in December 1986, it seems that the water masses along the eastern Adriatic were more homogeneous, causing a quite different distribution of zooplankton.

5. REFERENCES

Hure, J., A. Ianora and B. Scotto di Carlo, 1980. Spatial and temporal distribution of copepod communities in the Adriatic Sea. J.Plankt.Res., 2(4):295-316

Regner, D., 1983. The relative importance of copepods in the net zooplankton of the Adriatic Sea. Rapp.P.-V.Réun.CIESM, 28(9):195-6

__________, 1985. Seasonal and multiannual dynamics of copepods in the middle Adriatic. Acta Adriat., 26(2):11-99

Regner, S., et al., Spawning of sardine, Sardina pilchardus (Walbaum, 1792) in the Adriatic under upwelling conditions. Acta Adriat. (in press)

Steuer, A., 1910. Adriatische Planktoncopepoden. Sitzungsber.Akad.Wiss.Wein, 119(1):1005-39

Zore-Armanda, M., 1968. The system of currents in the Adriatic sea. GFCM Stud.Rev., (34):1-48

Zore-Armanda, M. and M. Bone, 1983. Topographic characteristics and current system in the Adriatic. Rapp.P.-V.Réun.CIESM, 28(2):65-6

BIBLIOGRAPHY OF LONG-TERM TIME SERIES IN THE ADRIATIC

by

Slobodan Regner
Institute of Oceanography and Fisheries, Split

Alegría Hernandez, V., 1983. Assessment of pelagic fish abundance along the eastern Adriatic Sea coast with special regard to sardine (Sardina pilchardus Walb.) population. Acta Adriat., 24(1/2):55-95

___________, 1984. Application of production model to the eastern Adriatic sardine (Sardina pilchardus Walb.) population. FAO Rapp.Pêches/FAO Fish.Rep., (290):171-93

___________, 1984a. Preliminary analysis of tuna catches along the eastern Adriatic coast. Bilj.-Notes Inst.Oceanogr.Ribar., Split, (57):6 p.

___________, 1986. Catch per unit effort as an index of sardine (Sardina pilchardus Walb.) distribution changes along the eastern Adriatic. FAO Rapp.Pêches/FAO Fish.Rep., (345):127-36

Alegría, V., B. Granić and S. Jukić, 1982. The protection of the hake (Merluccius merluccius L.) in the Adriatic sea by regulation of the level of exploitation. Acta Adriat., 23 (1/2): 431-40

Alegría, V. and S. Jukić, 1981. Seasonal fluctuations of sardine (Sardina pilchardus Walb.) population abundance along the eastern Adriatic coast. Rapp.P.-V.Réun.CIESM, 25(6):61-8

Artegiani, A. and R. Azzolini, 1986. Italian advances in hydrological data base for the Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (345):41-52

Artegiani, A., A. Tomasin and A. Goldmann, 1972. Sur la dinamique de la mer Adriatique due aux excitations Météorologiques. Rapp.P.-V.Réun.CIESM, 21(4):181-3

Basioli, J., 1974. The Adriatic and Mediterranean fisheries illustrated by statistical data. Acta Adriat., 16(1):15-29

___________, 1984. Ribarstvo na Jadranu. Zagreb, Znanje, 392 p.

Buljan, M., 1953. The nutrient salts in the Adriatic waters. Acta Adriat., 5(9):15 p.

___________, 1953a. Fluctuation of salinity in the Adriatic. Izv.Rep.Ribr.Exped."Hvar", 2(2): 64 p.

___________, 1957. Fluctuation of temperature in the open Adriatic. Acta Adriat., 8(7):26 p.

___________, 1964. Some results of a few years hydrographic investigations of the sea near Maslinica. Pomor.Zb., 2:907-22 (in Serbo-Croatian)

___________, 1965. Some results of long-term hydrographic investigations at the Stoncica station (Middle Adriatic). Rapp.P.-V.Réun.CIESM, 18(3):767-71

___________, 1968. Fluktuacija oceanografskih svojstava Jadrana u razdoblju od 1962-1967. Pomor.Zb., 6:845-65

___________, 1968a. Relation between factors affecting productivity and fish catch in the central Adriatic sea. GFCM Stud.Rev., 41:25-39

___________, 1969. Oceanographic conditions in the middle Adriatic area. 3. Long-term observations of temperature and salinity fluctuations. Thalassia Jugosl., 5:35-53

___________, 1974. Basic characteristics of the Adriatic Sea as a production basin. Acta Adriat., 16(2):31-62

Buljan, M. and M. Zore-Armanda, 1966. Hydrographic data on the Adriatic sea collected in the period from 1952 through 1964. Acta Adriat., 12:438 p.

___________, 1976. Oceanographical properties of the Adriatic sea. Oceanogr.Mar.Biol., 14:11-98

Polli, S., 1953a. L'attuale deformazione della crosta terrestre. Ann.Geofis., Roma, 6(4):555-60

___________, 1954. L'attuale aumento del livello del mare lungo le coste del Mediterraneo. Geofis.Meteorol., Genova, 2(1/2):13-6

___________, 1954a. Dati climatici di Grado. Atti Sci.Ist.Sper.Talassogr., Trieste, (311):4 p.

___________, 1954b. Criteri di realtà fisica per un ciclo climatico. Geofis.Meteorol., Genova, 2(3/4):3-6

___________, 1955. Variazioni delle costanti armoniche delle maree col livello del mare. Ann.Geofis., Roma, 7(2):201-7

___________, 1955a. I cicli di 5.6 e 8.0 anni e la loro realtà fisica. Riv.Meteorol.Aeronaut., (2):12 p.

___________, 1957. Il livello del mare quale riferimento altimetrico. Ann.Geofis., Roma, 10(1):1-5

___________, 1963. Il problema della sommersione di Venezia. Pubbl.Ist.Sper.Talassogr., Trieste, (402):10 p.

___________, 1963a. Sullo sprofondamento e sul fenomeno dell'acqua alta. Ateneo Veneto, 1(2):9 p.

___________, 1968. L'eccezionale acqua alta nella laguna di Venezia in relazione agli ultimi eventi idrometeorici. Pubbl.Accad.Naz.Lincei, Roma, (112):63-78

___________, 1970. Livelli medi del mare di Trieste. Pubbl.Ist.Sper.Talassogr., Trieste, (459): 8 p.

Princi, M., F. Stravisi and M. Specchi, 1980. Osservazioni morfologiche, fisiche e chimiche sulla baia di Muggia (Golfo di Trieste-Alto Adriatico). Mem.Biol.Mar.Oceanogr., Messina, Suppl.10:275-84

Pucher-Petković, T., 1968. Fluctuations pluriannuelles du phytoplancton en relation avec certains facteurs météorologiques et hydrologiques. Rapp.P.-V.Réun.CIESM, 19(3):399-401

___________, 1970. Seasonal and long-term fluctuations of the primary production in the central Adriatic. Pomor.Zb., 8:847-56 (in Serbo-Croatian)

___________, 1971. Recherches sur la production primaire et la densité des populations du phytoplancton en Adriatique (1962-1967). Rapp.P.V.Réun.CIESM, 20(3):339-43

___________, 1974. Essai d'évaluation de la production primaire annuelle dans l'Adriatique. Rapp.P.-V.Réun.CIESM, 22(9):71-2

___________, 1975. Fitoplankton Kastelanskog zaljeva u odnosu na organsku produkciju. Pomor.Zb., 13:491-500

___________, 1976. Effet des eaux résiduaires urbaines sur la densité et l'évolution saisonaire du phytoplancton. Rapp.P.-V.Réun.CIESM, 23(9):93-4

___________, 1979. Long-term observations of the phytoplankton and primary production in the Central Adriatic. Nova Thalassia, 3:267-82

Pucher-Petković, T. and I. Marasović, 1979. Evolution de quelques populations diatomiques dans une aire soumise à l'eutrophisation (Adriatique Centrale). Rapp.P.-V.Réun.CIESM, 25/26 (8):89-90

___________, 1980. Développement des populations phytoplanctoniques caractéristiques pour milieu eutrophisé (Baie de Kastela, Adriatique Centrale). Acta Adriat., 21(2):79-93

___________, 1982. Quelques caractéristiques du phytoplancton dans les eaux du large de l'Adriatique centrale. Acta Adriat., 23(1/2):61-74

Pucher-Petković, T. and T. Vucetić, 1969. Long-term observations of plankton fluctuations in the central Adriatic. GFCM Stud.Rev./Etud.Rev.CGPM, (41):13-23

___________, 1969a. Fluktuacije klimatskih i hidrografskih svojstava i njihov utjecaj na biolosku produktivnost Jadrana. Hidrogr.God., 1969:85-91

Pucher-Petković, T. and M. Zore-Armanda, 1973. Essai d'évaluation et pronostic de la production en fonction des facteurs du milieu dans l'Adriatique. Acta Adriat., 15(1):39 p.

Pucher-Petković, T., M. Zore-Armanda and I. Kacić, 1971. Primary and secondary production of the Middle Adriatic in relation to climatic factors. Thalassia Jugosl., 7 (1):301-11

Ratković, D., 1983. Climatic characteristics in May 1980 regarding data at the Marjan cape station. Hidrogr.God., 1978-1979:59-64 (in Serbo-Croatian)

Regner, D., 1977. The oscillations of copepods number in the Kastela Bay (central Adriatic) in relations to some ecological factors. Rapp.P.-V.Réun.CIESM, 24:165-6

___________, 1981. The changes in seasonal oscillations of copepods in the central Adriatic. Rapp.P.-V.Réun.CIESM, 27(7):177-9

___________, 1982. The oscillations of copepod density in the Kastela Bay as influenced by some environmental factors. Acta Adriat., 23(1/2):137-52

___________, 1984. Seasonal and multiannual oscillations of copepod density in the central Adriatic. In Studies on copepoda, 2. Crustaceana, suppl.7:352-9

___________, 1984a. Visegodisnja istrazivanja kopepoda istocnog priobalnog podrucja Jadranskog mora. Stud.Mar., 13:1-15

___________, 1985. Seasonal and multiannual dynamics of copepods in the Middle Adriatic. Acta Adriat., 26(2):11-99

___________, 1986. Eutrophication effects on the Copepod community of the eastern Adriatic coast. Rapp.P.-V.Reun.CIESM, 30(2):202

___________, 1987. The impact of pollution on the copepod community from the eastern Adriatic coast. Chemosphere, 16:369-79

___________, 1987a. The impact of pollution on the copepod community of the Kastela Bay. FAO Fish.Rep./FAO Rapp.Pêches, (352) Suppl:201-15

Regner, D. and T. Vucetić, 1970. Les fluctuations des Copépodes pélagiques dans la région de Split (Adriatique Centrale). Rapp.P.-V.Réun.CIESM, 21(8):485-7

___________, 1980. Seasonal and multiannual fluctuations of copepods in the Kastela Bay (1960-1969). Acta Adriat., 21(2):101-22

Regner, S., 1974. The oscillations of the quantity of the anchovy's planktonic phase in the central Adriatic from 1968 to 1971. Acta Adriat., 15(5):14 p.

___________, 1980. The larval stages of fish in the Kastela Bay. Acta Adriat., 21(2):123-36

___________, 1982. Investigations of qualitative and quantitative composition of the larval fish stages in the plankton of the open sea of the central Adriatic Stud.Mar., 11-12:45-60 (in Serbo-Croatian)

___________, 1985. Ecology of planktonic stages of the anchovy, Engraulis encrasicolus (Linnaeus, 1758), in the central Adriatic. Acta Adriat.(Ser.Monogr.(1), 26(1):5-113

Regner, S. and M. Gacić, 1974. The fluctuations of sardine catch along the eastern Adriatic coast and solar activity. Acta Adriat., 15(11):15 p.

___________, 1977. An attempt of long-term forecast of sardine catch along the eastern Adriatic coast. Rapp.P.-V.Reun.CIESM, 24(5):77-9

Rizzoli, P., 1970. Le masse d'acqua ed il sistema di correnti del Mediterraneo con particolare riguardo al mare Adriatico (sintesi bibliografica). Rapp.Tech.Cons.Natl.Ric., Roma, (2):38 p.

Robinson, A.R., A. Tomasin and A. Artegiani, 1973. Flooding of Venice: phenomenology and prediction of the Adriatic storm surge. Q.J.R.Meteorol.Soc., 99(422):688-92

Trotti, L., 1970. Crociere mare Adriatico. Raccolta Dati Oceanogr.Cons.Natl.Ric., Roma, (Ser.A), (29) Scaccini, A., 1951. La temperatura e la salinità nelle acque superficiali dell'Adriatico a Fano dal 1945 al 1951. Note Lab.Biol.Mar.Pesca, Fano, 1(7):49-56

__________, 1953. La temperatura e la salinità nelle acque superficiali dell'Adriatico a Fano dal 1945 al 1951. Bull.Inst.Océanogr., Monaco, (1024):10 p.

Scaccini, A. and M. Scaccini Cicatelli, 1969. Premiers résultats sur la diffusion des sels nutritifs dans les eaux de l'Adriatique occidentale. Rapp.P.-V.Réun.CIESM, 19(4):753-4

Scaccini Cicatelli, M., 1956. Le variazioni della salinità delle acque costiere dell'Adriatico a Fano in rapporto col deflusso del Po e di altri fiumi minori. Boll.Pesca Piscic. Idrobiol., 10(2):3-23

__________, 1963. Relations entre les débits du Po et les salinités des eaux côtières adriatiques près de Fano. Rapp.P.-V.Réun.CIESM, 16(3):631-8

__________, 1965. La temperatura e la salinità nelle acque superficiali dell'Adriatico a Fano dal 1957 al 1962. Note Lab.Biol.Mar.Pesca, Fano, 1(16):145-68

__________, 1965a. La température et la salinité des eaux superficielles de l'Adriatique à Fano de 1957 à 1962. Rapp.P.-V.Réun.CIESM, 18(3):761-6

__________, 1971. L'apporto di sali nutritivi nell'Adriatico da parte di due corsi d'acqua appenninici. Boll.Pesca Piscic.Idrobiol., 26(1-2):43-60

__________, 1972. Condizioni idrologiche delle acque marine ad un miglio al largo di Fano dal 1967 al 1971. Note Lab.Biol.Mar.Pesca, Fano, 4(6):113-52

__________, 1973. Température et salinité des eaux superficielles de l'Adriatique à Fano de 1963 à 1968. Rapp.P.-V.Réun.CIESM, 21(7):331-2

__________, 1973a. L'apport en sels nutritifs à l'Adriatique occidentale par quelques cours d'eau. Rapp.P.-V.Réun.CIESM, 21(7):333-5

__________, 1974. Influenza delle acque del Po sull'idrologia dell'Adriatico alla latitudine di Fano (1967-1971). Note Lab.Biol.Mar.Pesca, Fano, 4(10):237-68

__________, 1975. La temperatura e la salinità nelle acque superficiali dell'Adriatico a Fano dal 1969 al 1974. Note Lab.Biol.Mar.Pesca, Fano, 5(1):1-32

__________, 1983. L'influence du Pô sur les eaux marines côtières devant Fano (1972-1981). Rapp.P.-V.Réun.CIESM, 28(7):45-6

Scaccini Cicatelli, M. and M. Falcioni, 1972. Condizioni idrologiche delle acque marine costiere di Fano dal 1967 al 1971. Note Lab.Biol.Mar.Pesca, Fano, 4(5):85-112

Scaccini Cicatelli, M., M. Poli Molinas and M.V. Olmo, 1972. L'apport en sels nutritifs à la mer par deux cours d'eau qui descendent des Apennins. Rapp.P.-V.Réun.CIESM, 20(4):677-8

Smodlaka, N., 1985. Primary production of the organic matter as an indicator of the eutrophication in the northern Adriatic Sea. Ph.D. Thesis. University of Zagreb, Zagreb, 262 p.

Stravisi, F., 1976. Considerazioni statistiche sui valori medi mensili di cinque elementi meteorologici. Pubbl.Ist.Talassogr., Trieste, (529):53 p.

__________, 1977. Il regime dei venti a Trieste (1951-1975). Boll.Soc.Adriat.Sci., (61):87-104

__________, 1980. Caratteristiche climatiche di Peschiera del Timavo, Malchina, Opicina, Domio e San Bartolomeo (Provincia di Trieste). Boll.Soc.Adriat.Sci., (64)

__________, 1983. The vertical structure annual cycle of the mass field parameters in the Gulf of Trieste. Boll.Oceanol.Teor.Appl., 1(3):239-50

__________, 1984. Normal climatic data for the Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (290):59-67

Tegaccia, N., 1982. Hydrological features of the coastal area off the province of Pesaro (Adriatic sea): chemical surveys. Thalassia Jugosl., 18

Tegaccia, N. and T. Tegaccia, 1984. Chronological series of hydrological data on the northern and central Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (290):69-79

Vucetić, T., 1967. Long-term observations of zooplankton fluctuation in the Bay of Kastela. CGPM Debats Doc.Tech./GFCM Proc.Tech.Pap., 8(26):261-5

____________, 1970. Les principales masses d'eau en Adriatique et leur influence sur les communautés pélagiques. Journ.Etud.Planktonol.CIESM, (1970):105-14

____________, 1970a. Fluktuacije zooplanktona u srednjem Jadranu. Pomor.Zb., 8:867-81

____________, 1971. Fluctuations à long terme du macrozooplancton dans l'Adriatique Centrale (oeufs de Sardina pilchardus W., Engraulis encrasicholus L. et larves de différents poissons). Arch.Oceanogr.Limnol., 17:141-56

____________, 1973. Long-term zooplankton standing crop fluctuation in the central Adriatic coastal region. Thalassia Jugosl., 7:419-28

____________, 1973a. Zooplankton and the circulation pattern of the water masses in the Adriatic sea. Neth.J.Sea Res., 7:112-21

____________, 1973b. Fluctuation of zooplankton and echo-trace abundance in fishing grounds of the central Adriatic. GFCM Stud.Rev., (53):19-38

____________, 1975. Synchronism of the spawning season of some pelagic fishes and the timing of maximal food (zooplankton) production in the central Adriatic. Publ.Stn.Zool., Napoli, 39(1):347-65

____________, 1979. Significance of long term ecological monitoring of the Adriatic sea ecosystem with a special emphasis on the plankton. Nova Thalassia, 3:233-47

Vucetić, T. and V. Alegria Hernandez, 1986. Long-term fluctuations of predator fish and the prey plankton jelly-fish Pelagia noctiluca in the Mediterranean (Adriatic). Rapp.P.-V.Réun. CIESM, 30(2):230

Zadro, M.B. and G. Poretti, 1971. Analisi degli spettri complessi delle maree marine registrate a Trieste. Geofis.Meteorol., 20(3-4):83-9

Zavodnik, D., 1983. 400 years of the Adriatic marine science. Thalassia Jugosl., 19(1-4):405-29

Zore-Armanda, M., 1961. Tipovi vode u Jadranu, njihovo formiranje i transformiranje pod uplivom vanmorskih faktora mijesanja i advekcije. Ph.D. Thesis. Split, 78 p.

____________, 1961a. Deep water movements in the Adriatic. Rapp.P.-V.Réun.CIESM, 16(3):625-30

____________, 1963. Les masses d'eau de la mer Adriatique. Acta Adriat., 10(3):93 p.

____________, 1963a. Mixing of three water types in south Adriatic. Rapp.P.-V.Réun.CIESM, 17(3):879-85

____________, 1963b. Les masses d'eau de la Mer Adriatique. Thèse présentée à la Faculté des sciences de l'Université de Paris, Série A, 1039 (1062):93 p.

____________, 1964. Results of direct current measurements in the Adriatic. Acta Adriat., 11 (41):293-308

____________, 1965. Les variations saisonières du niveau de la mer le long de la côte orientale Adriatique. Rapp.P.-V.Réun.CIESM, 18(3):807-10

____________, 1966. Gradijent tlaka zraka u istocnom Mediteranu i salinitet jadranske vode. Hidrogr.God., 1965:61-7

____________, 1968. The system of currents in the Adriatic Sea. GFCM Stud.Rev., (34):48 p.

____________, 1968a. Raspored tlaka zraka i cirkulacija vode u istocnom Mediteranu. Hidrogr.God., 1967:67-78

____________, 1969. Water exchange between the Adriatic and the eastern Mediterranean. Deep-Sea Res., 16:171-8

Zore-Armanda, M., 1969a. Origine possible des fluctuations de la salinité de l'eau Adriatique. Rapp.P.-V.Réun.CIESM, 19(4):719-22

__________, 1969b. Température relations in the Adriatic Sea. Acta Adriat., 13(5):51 p.

__________, 1969c. Occeanographic conditions in the middle Adriatic area. 2. System of currents in the surface layer and their effect on the distribution of temperature. Thalassia Jugosl., 5:465-75

__________, 1970. Meteoroloski uvjeti i mogućnosti prognoze ulova male plave ribe u Jadranu. Morsko Ribar., 22(4):157-60

__________, 1971. Influence of the long-term changes in the North Atlantic on the Mediterranean. In The ocean world. Proceedings of the Joint Oceanographic Assembly, Tokyo, 1970, pp. 151-4

__________, 1972. Response of the Mediterranean to the oceanographic-meteorological conditions of the North Atlantic. Rapp.P.-V.Réun.CIESM, 21(4):203-5

__________, 1972a. Répartition saisonière de la salinité et régime des courants dans les eaux de l'Adriatique. Rapp.P.-V.Réun.CIESM, 21(4):207-10

__________, 1973. Kolicina leda u sjevernom Atlantiku i neka oceanografsko-meteoroloska svojstva istocnog Mediterana. Hidrogr.God., 1971:75-87

__________, 1974. Formation of eastern Mediterranean deep water in the Adriatic. Colloq.Int. Cent.Natl.Rech.Sci., Paris, (215):127-33

__________, 1974a. Some aspects of air-sea interaction in the eastern Mediterranean. Quad.Accad. Naz.Lincei, Roma, 371(206):59-68

__________, 1983. Oceanographic time series in the Adriatic Sea. IOC Tech.Ser., (1):43-6

__________, 1983a. Some physical characteristics of the Adriatic sea. Thalassia Jugosl., 19(1-4):433-50

__________, 1984. Hydrographic and productivity conditions of the Palagruza region in the Middle Adriatic. Acta Adriat., 25(1/2):119-38

__________, 1985. Klimatske karakteristike mora u srednjem Jadranu. Geofizika, 2:180-93

Zore-Armanda, M., I. Kacić and T. Pucher-Petković, 1973. Meteorological conditions and ichthyologic production in the Adriatic. Rapp.P.-V.Réun.CIESM, 21(10):809-11

Zore-Armanda, M. and T. Pucher-Petković, 1972. Pretskazivanje o (vjerovatno) raspolozivoj kolicini riba u Jadranu u 1972 godini. Morsko Ribar., 24(2):54-6

__________, 1976. Some dynamic and biological characteristics of the Adriatic and other basins of the eastern Mediterranean Sea. Acta Adriat., 18(1):15-27

Zore-Armanda, M., T. Pucher-Petković and I. Kacić, 1971. Klimatski faktori i mogućnost pretskazivanja velicine organske produkcije u Jadranu. Pomor.Zb., 9:545-59

Zupanović, S., 1955. Valeur des données statistiques dans l'étude des déplacements de la sardine (Clupea pilchardus Walb.) dans l'Adriatique orientale. CGPM Débats Doc.Tech./GFCM Proc. Tech.Pap., 3:341-7

__________, 1955a. A statistical contribution to the study in ecology of sardine (Sardina pilchardus Walb.) in the eastern Adriatic. Acta Adriat., 7(10):1-31

__________, 1968. O uzrocima fluktuacija u lovinama srdele na istocnoj obali Jadrana. An.Jadranskog Inst.JAZU, 4:401-91

__________, 1985. Biological effects of hydroclimatic changes in the middle Adriatic. Acta Adriat., 26(2):165-89

Zapanović, S. and M. Zore-Armanda, 1964. Fluctuations hydrographiques et pêche de la sardine (Sardina pilchardus Walb.) sur la côte orientale de l'Adriatique moyenne. CGPM Débats Doc.Tech./GFCM Proc.Tech.Pap., 7:47-56

STUDIES OF THE ADRIATIC BIOLOGICAL RESOURCES

Long Term (1960-83) Fluctuations of Zooplankton Biomass in the Palagruza-Gargano Area

Stations 11, 13 (42°N - 11' and 16 E)

by

Tamara Vucetič
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

Data on zooplankton biomass of an area could be useful in evaluating its productivity and consequently also indicative of the general biological productivity of the Adriatic ecosystem. At the same time, it is also directly indicative of the state and possibility of survival of "zooplankton feeders", among which all juvenile stages and some adults of commercially important fishes, particularly sardinae and anchovy, are included.

The area from Palagruza to Monte Gargano has been intensively surveyed ever since 1960; that is from the initiation of long-term observations of oceanographic properties fluctuations on the Split-Gargano profile. Closer to the Yugoslav coast, monthly samplings were performed while this more offshore area was sampled seasonally (4 times a year).

The analysis of data available so far, from 1960 to 1983, including seasonal and annual biomass variations were established, as well as their ranges; that is the differences between minimum and maximum values, also departures from long-term (22 year) means, differences in seasonal aspects between individual years, and differences between means for all years studied. The same measurements also showed oscillations in annual mean values.

Zooplankton data (number as density; dry weight as biomass) represent an equilibrium value between potential activity of primary producers such as phytoplankton, and predation intensity by the food consumers or predators, including mostly pelagic fish.

Comparing the data on long term variations of zooplankton with those for primary producers from the Central Adriatic area, it is possible to get the impression that a decrease in zooplankton biomass coincides in time with a trend for phytoplankton density increase. On the other hand, a negative correlation can also be seen between fish catch data and zooplankton biomass.

This negative relationship or correlation between phytoplankton-zooplankton on the one hand, and zooplankton-predators on the other could be explained by different mechanisms. For example, zooplankton experience good feeding conditions after increases of phytoplankton production, and react by an increase in population density. However, at the same time increased density of zooplankton feeders (fish) as consumers cause zooplankton population to decrease.

It will be worthwhile to consider the possibility of other mechanisms, such as for example, changes in pelagic fish behaviour (juveniles and adults) as a reflection of environmental changes. Intensive water mass movements can cause changes in migration intensity and direction, and/or difference of schooling intensity, which by increasing availability and vulnerability of stocks, makes fisheries more efficient, and potentially results in catch increases.

2. REFERENCES

Buljan, M., 1953. Fluctuation of salinity in the Adriatic. Izv.Inst.Oceanogr.Ribar., Split, 2(2):1-63

Karlovac, J., et al., 1974. Evaluation of biological resources in the Adriatic sea based on plankton investigations Acta Adriat., 16(9):157-84

Marasovič, I., T. Pucher-Petkovič and V. Alegria. Relation between phytoplankton productivity and Sardina pilchardus catch in the middle Adriatic. FAO Rapp.Pêches/FAO Fish.Rep. (this document)

Morovič, M., 1983. Long-term changes of transparency in the Central Adriatic. Rapp.P.-V.Réun. CIESM, 28(2):181-2

Pucher-Petković, T., 1968. Fluctuations pluriannuelles du phytoplancton en relation avec certains facteurs météorologiques et hydrologiques. Rapp.P.-V.Réun.CIESM, 19(3):399-401

Pucher-Petković, T., M. Zore-Armanda and I. Kačić, 1971. Primary and secondary production of the Middle Adriatic in relation to climatic factors. Thalassia Jugosl., 7(1):301-11

Pucher-Petković, T., et al. Time series of productivity parameters indicating eutrophication in the middle Adriatic waters. FAO Rapp.Pêches/FAO Fish.Rep. (this document)

Regner, S. and M. Gacić, 1974. The fluctuations of sardine catch along the eastern Adriatic coast and solar activity. Acta Adriat., 15(11):15

Regner, S., C. Piccinetti and M. Specchi, 1984. Estimate of spawning biomass of sardine in the northern and central Adriatic 1979-82 by means of eggs survey. FAO Rapp.Pêches/FAO Fish.Rep., (290):223-32

Vucetić, T., 1967. Long-term observation of the zooplankton fluctuation in the bay of Kastela. CGPM Débats Doc.Tech./GFCM Proc.Tech.Pap., 8(37):261-5

___________, 1971. Fluctuations à long term du macrozooplankton dans l'Adriatique centrale: oeufs de Sardina pilchardus Walb., d'Engraulis encrasicholus L. et larves de différents poissons. Arch.Océanogr.Limnol., 17(2):142-56

___________, 1971a. Long term zooplankton standing crop fluctuations in the central Adriatic coastal region. Thalassia Jugosl., 7(1):419-28

___________, 1973. Zooplankton and the circulation pattern of the water masses in the Adriatic Sea. Neth.J.Sea Res., 7:112-21

___________, 1975. Synchronism of the spawning season of some pelagic fishes and the timing of the maximal food (Zooplankton) production in the Central Adriatic. Publ.Stn.Zool.Napoli, 39(1):347-65

___________, 1976. Evaluation of biological resources as first steps for fisheries management and protection. Pomor.Zb., 14:535-54

___________, 1979. Significance of long term ecological monitoring of the Adriatic sea ecosystem with a special emphasis on the plankton. Nova Thalassia, 3:233-47

___________, 1981. Some species of plankton as indicators of neritisation (eutrophication) of the eastern Central Adriatic. Journ.Etud.Pollut.Mar.CIESM, 5(1980):769-70

___________, 1982. Unusual occurrence of Pelagia noctiluca in the Adriatic, influence of the water masses dynamics on the distribution of Pelagia noctiluca in the Adriatic. Acta Adriat., 23(1/2):105-15

___________, 1983. Fluctuation in the distribution of the scyphomedusae Pelagia noctiluca (Forskal) in the Adriatic. Oceanol.Acta, Vol.Spéc.Dec.1983:207-11

___________, 1985. Relationship between the jellyfish Pelagia noctiluca occurrence and catch of tunny fish in the Mediterranean Sea (Adriatic). Rapp.P.-V.Réun.CIESM, 29(9):331-2

Vucetić, T. and V. Alegria Hernandez, 1986. Long term fluctuations of predator fish and the prey plankton jelly-fish Pelagia noctiluca in the Mediterranean (Adriatic) Rapp.P.-V.Réun. CIESM, 30(2):230

___________, Trend of annual catches or stock densities of some pelagic fishes in recent "Pelagia years" in the Adriatic. FAO Rapp.Pêches/FAO Fish.Rep., (this document)

Vucetić, T. and T. Pucher-Petković, 1969. Long term observation of plankton fluctuation in the central Adriatic. Etud.Rev.CGPM/GFCM Stud.Rev., (41):13-23

Zore-Armanda, M., 1968. The system of currents in the Adriatic Sea. GFCM Stud.Rev., (34):48 p.

___________, 1969. Water exchange between the Adriatic and Eastern Mediterranean. Deep-Sea Res., 16:171-8

___________, 1971. Influence of long-term changes in the oceanographic meteorological conditions in the North Atlantic on the Mediterranean. In The ocean world: Proceeding Joint of the Oceanographic Assembly, Tokyo, 1970, pp. 151-4

Zore-Armanda, M., I. Kacić and T. Pucher-Petković, 1973. Meteorological conditions and production in the Adriatic. Rapp.P.-V.Réun.CIESM, 21(10):809-11

Zore-Armanda, M., L. Stojanoski and I. Vukadin, Time series of oceanographic parameters eutrophication of the open Adriatic waters. FAO Rapp.Pêches/FAO Fish.Rep., (this document)

Zupanović, S., 1968. Causes of fluctuations in sardine catches along the eastern coast of the Adriatic Sea. An.Jadranskog Inst., 4:401-89

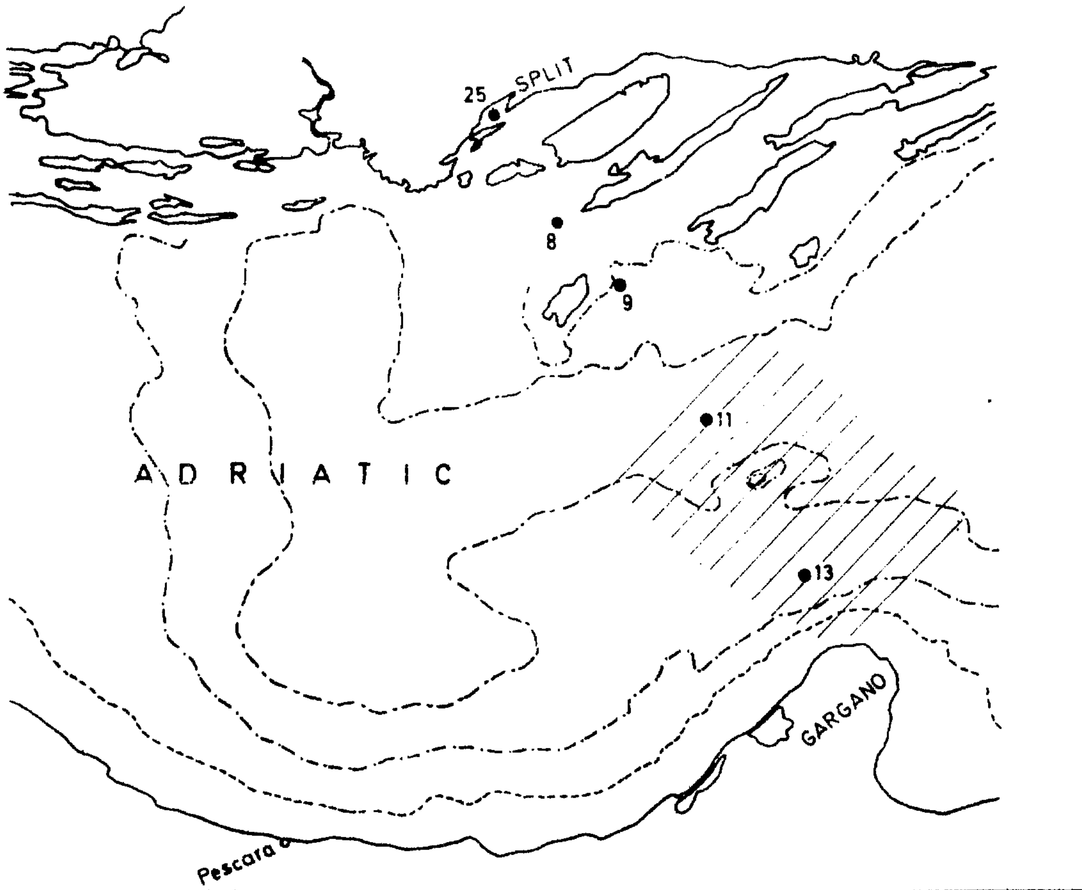


Figure 1 Positions of collecting stations in the middle Adriatic Sea St. 11. Palagruza; St. 13 M. Gargano

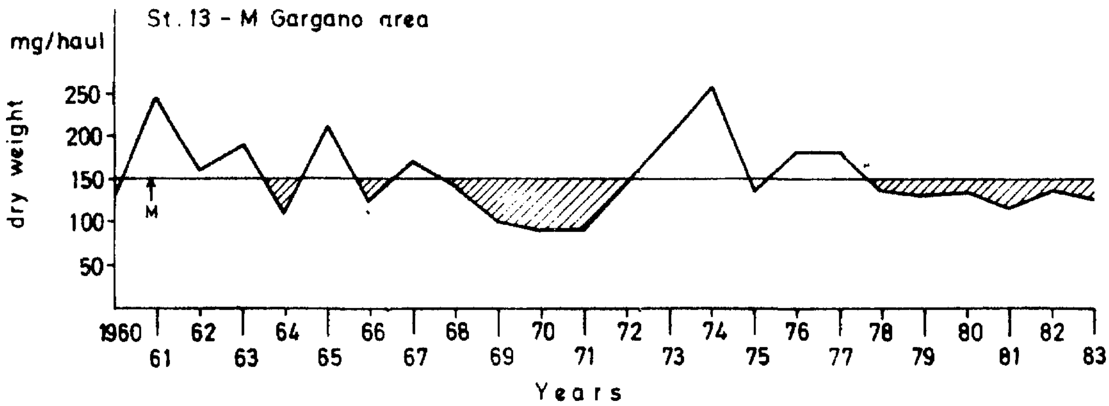


Figure 2 Long-term (1960-82) zooplankton fluctuation in M. Gargano area

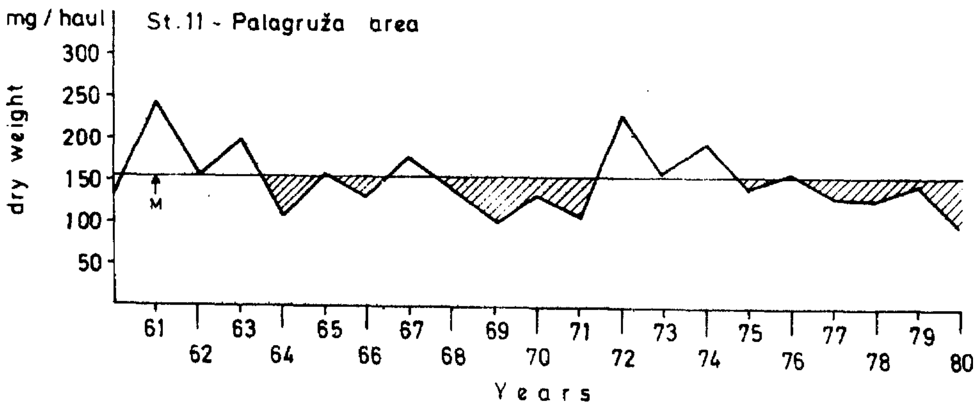


Figure 3 Long-term (1960-82) zooplankton fluctuation in Palagruza area

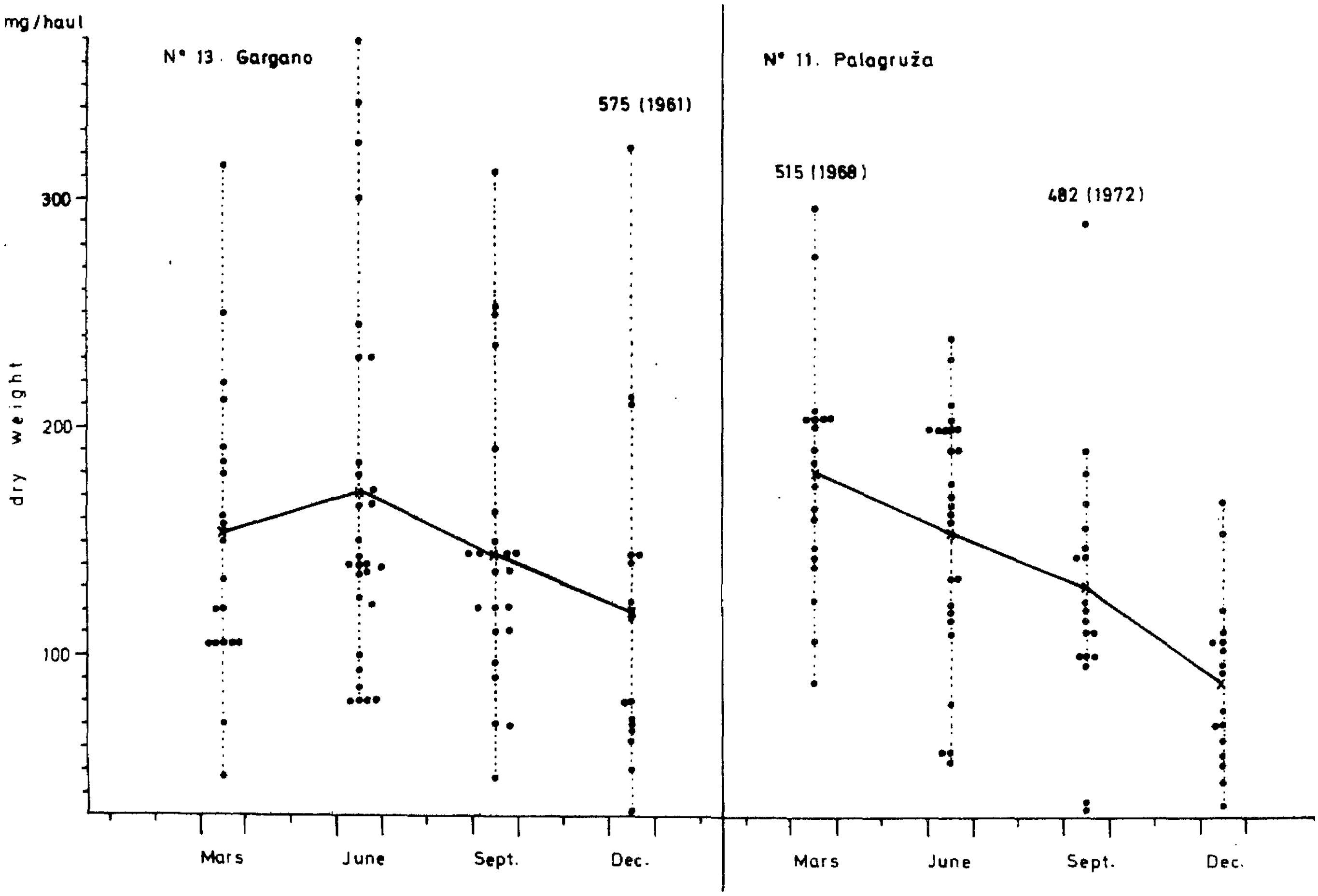


Figure 4 Seasonal zooplankton fluctuation in Palagruza and M. Gargano area (x_____x seasonal mean)

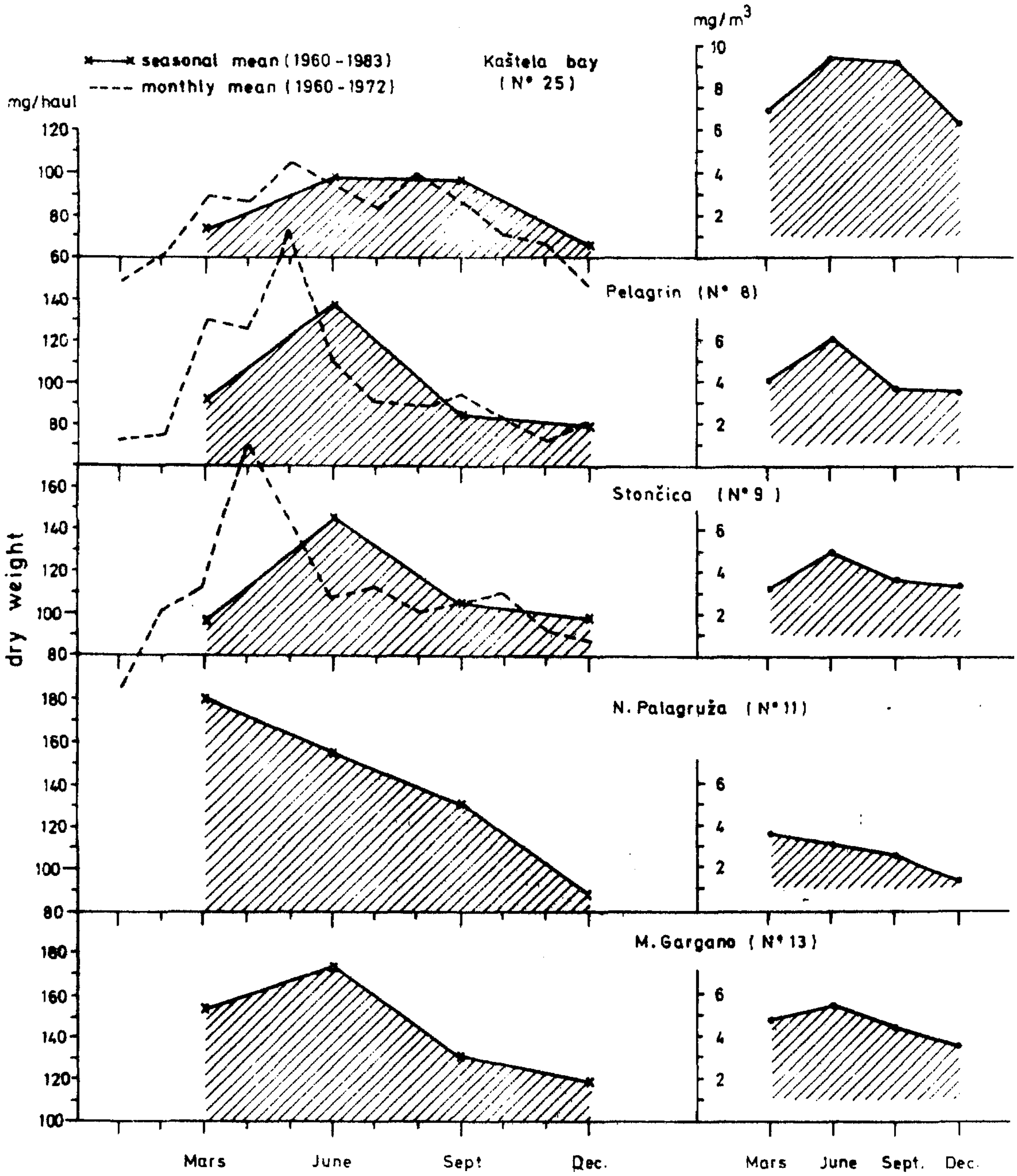


Figure 5 Seasonal distribution of zooplankton biomass on the Split-Gargano transeet
x_____x seasonal mean (1960-82) ----- monthly mean (1960-82)

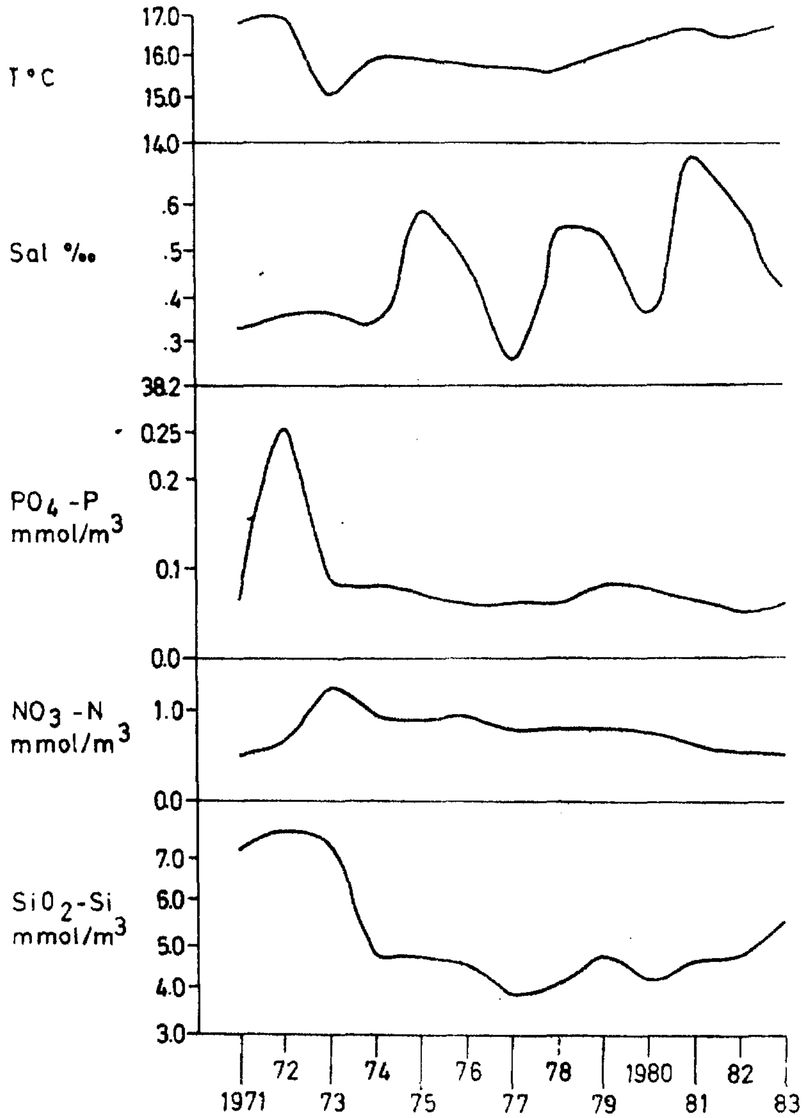


Figure 6 Trends in temperature, salinity, phosphate, nitrate and silicate variations at the Stoncica Station (1971-83)

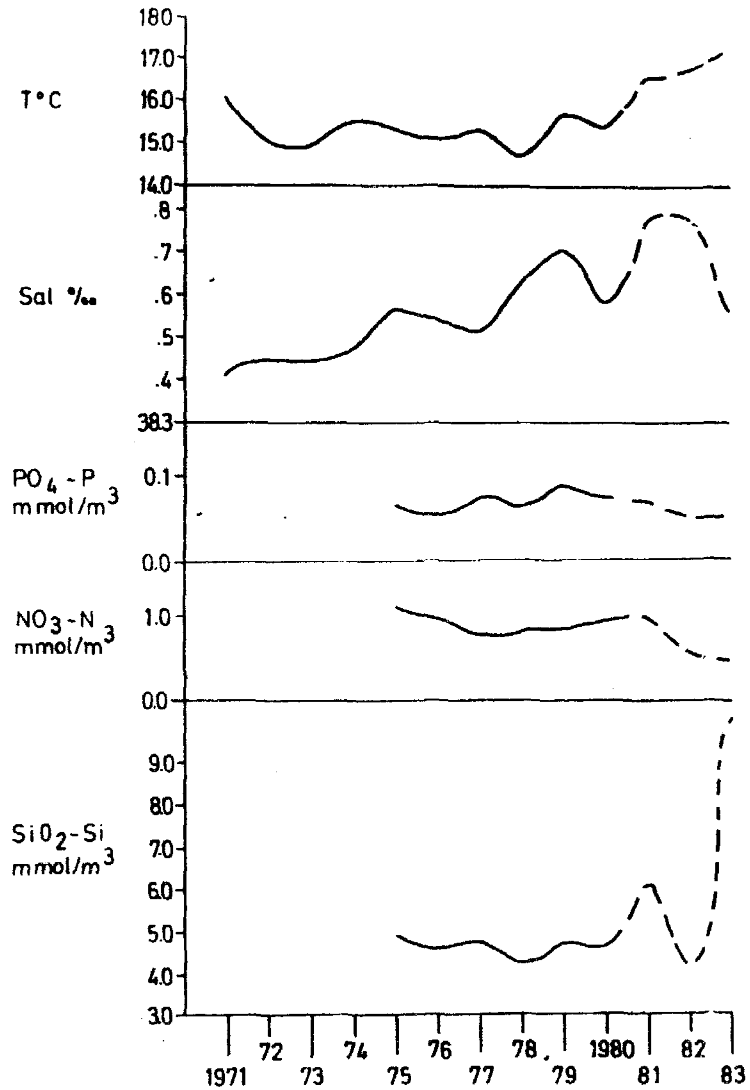


Figure 7 Trends in temperature, salinity, phosphate, nitrate and silicate variations at the N. Palagruza Station (1971–83)

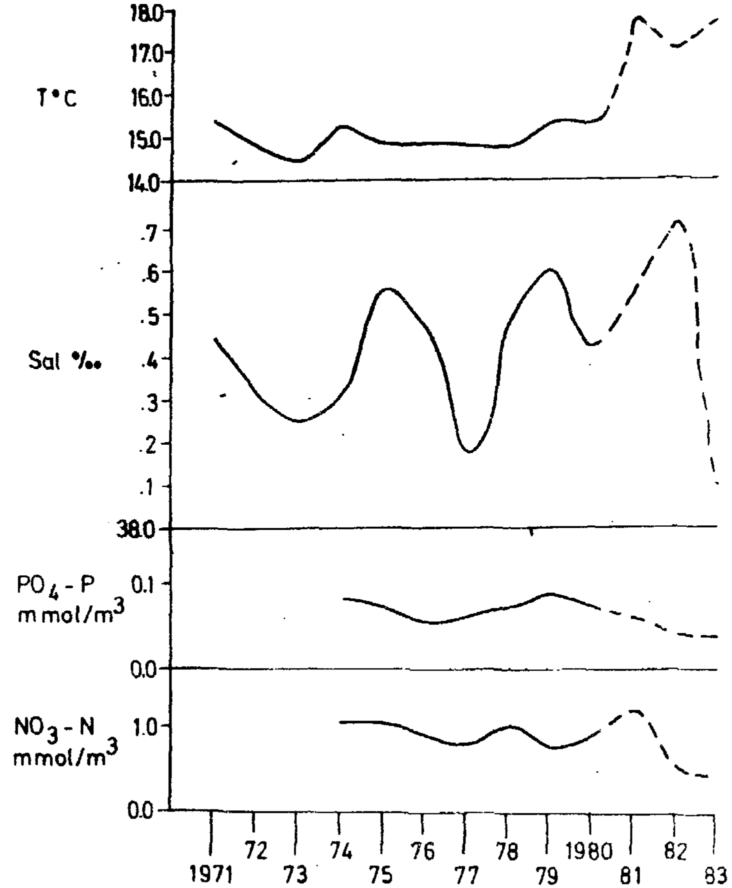


Figure 8 Trends in temperature, salinity, phosphate and nitrate variations at the M. Gargano Station (1971–83)

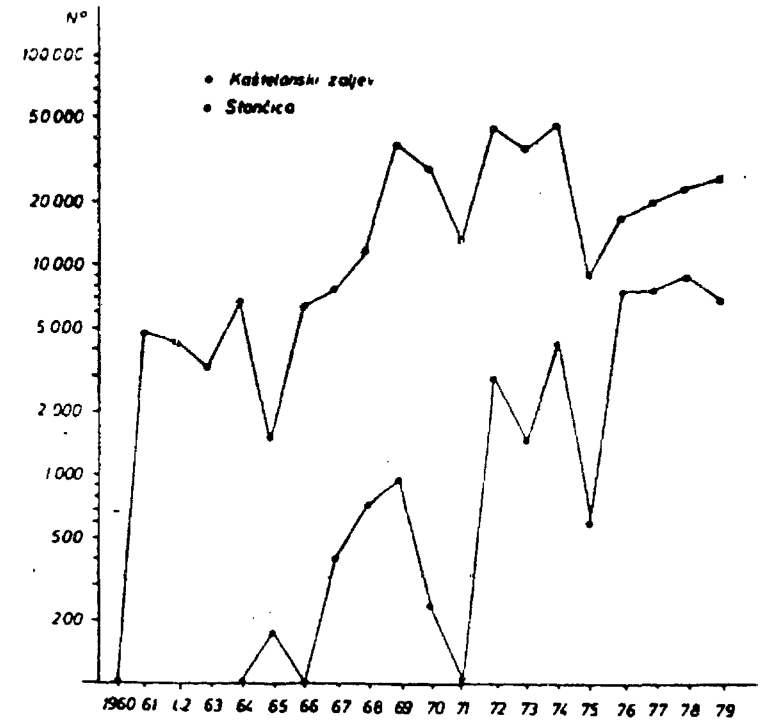


Figure 9 Long-term fluctuation of Penilia avirostris in the East Central Adriatic (seasonal mean VII, VIII, IX). (Vucetić, 1981)

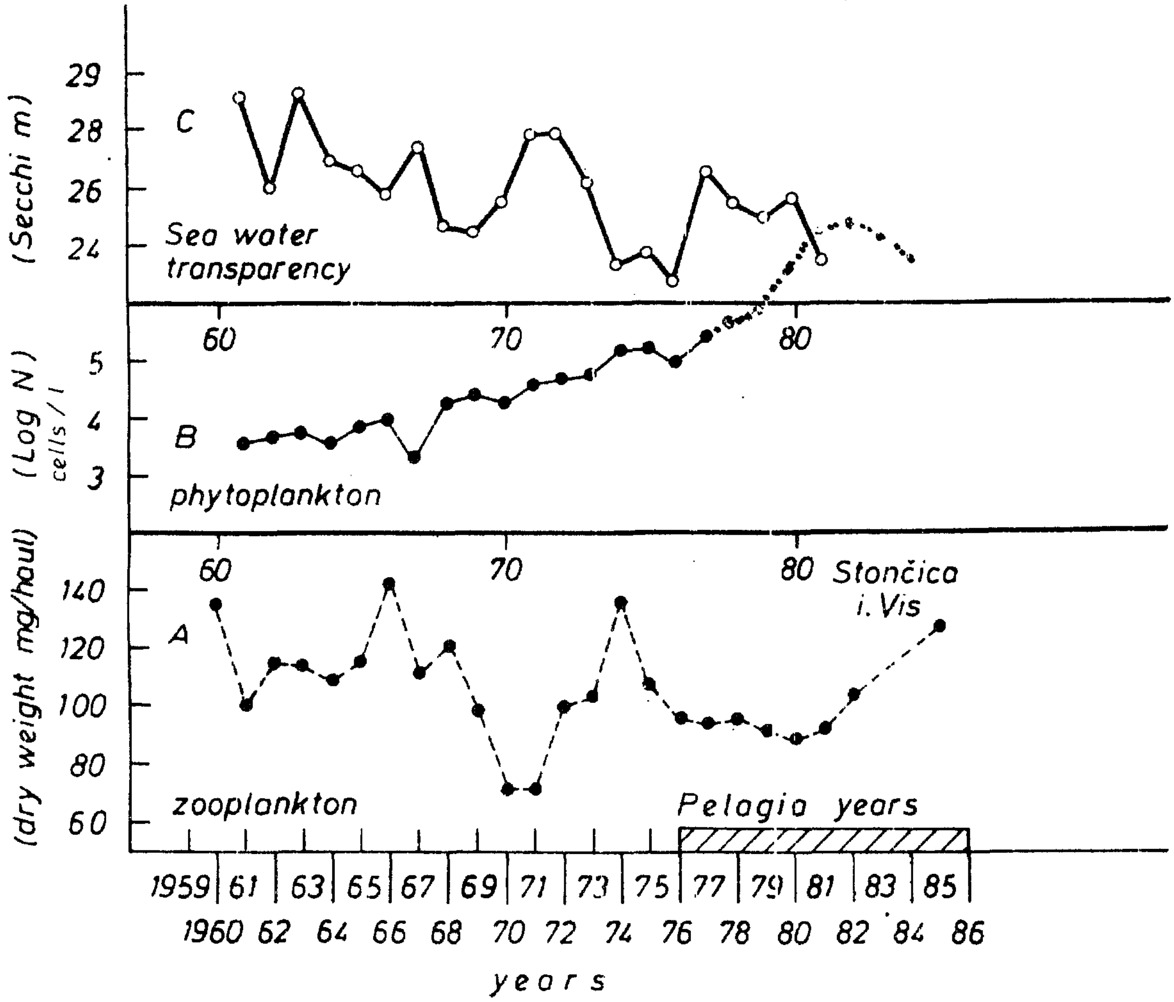


Figure 10 Trends of transparency, phytoplankton, zooplankton and "Pelagia years" (1960-85) in the Central Adriatic (Data from Morović, Pucher-Petković and Vucetić unpublished data)

TIME SERIES OF OCEANOGRAPHIC PARAMETERS: EUTROPHICATION OF THE OPEN ADRIATIC WATERS

by

Mira Zore-Armanda, Lambe Stojanoski and Ilija Vukadin
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

The Institute of Oceanography and Fisheries, Split, has been engaged in collecting oceanographic data at a number of representative stations since 1948. Early sampling covered only hydrographic parameters, but later sampling was widened to include currents, chemical and biological parameters.

The purpose of such surveys was to provide information on long-term variations of primary and secondary production of the open Adriatic waters as well as to maintain a continuous survey of the possible pollution of the sea.

2. METHODS AND STUDY AREA

Three stations in the vicinity of the eastern coast are sampled monthly: Station 25 in Kastelanski zaljev (Kastela Bay), Station 8 (Pelegrin) near Island of Hvar and station 9 (Stoncica) near Island of Vis. The last one has the best time series of all parameters (about 330 measurements).

Stations on the transverse profile Split-Gargano (maximum depth 170 m) as well as stations in Jabuka (270 m depth) and the South Adriatic Pit (1 250 m depth) are visited on a seasonal basis (Figure 1). Standard oceanographic methods for basic hydrographic parameters and nutrients are applied.

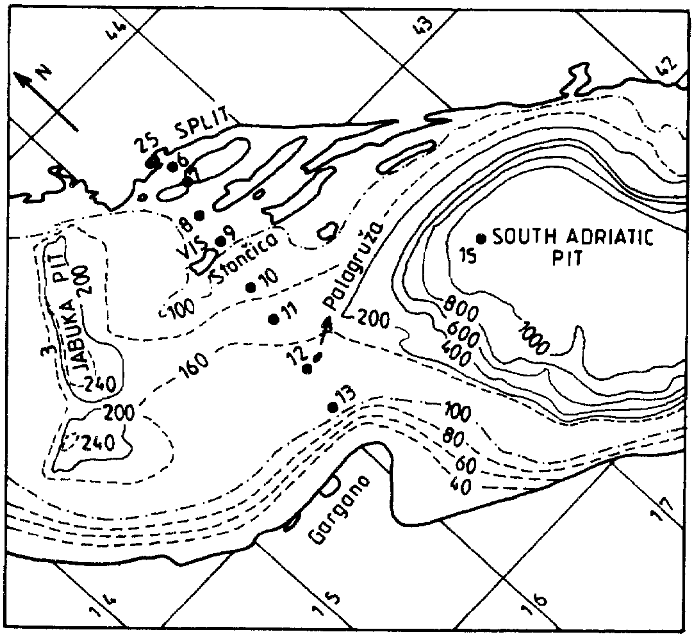


Figure 1 Study area

The long period data series have been continuously analysed. The importance of salinity variations in the whole basin, due to influence of occasional or periodic ingressions of Ionian Sea water were showed by Buljan, 1953. Later on, it was understood that the salinity variations are due to uneven influence of the Eastern Intermediate Mediterranean water (60 - 600 m depth) and that they could be connected to changes of the air pressure gradients over the Mediterranean (Zore-Armanda, 1969, 1974). Higher presence on the intermediate water as well as discharge from Po and other North Italian rivers affect the productivity level in the area (Pucher-Petkovic and Zore-Armanda, 1973). Some of the variability in the parameters studied are evidently caused by large-scale meteorological forcing due to climatic changes, but details of such interaction have not yet been established.

About a decade ago it became apparent that the eutrophication of the eastern Adriatic coastal waters had started (Pucher-Petković, 1975; Buljan, Stojanoski and Vudakin, 1977; Vucetić, 1981). The present analysis of the entire data base of both physical and chemical parameters indicate a similar trend of eutrophication in the open waters. Parallel increase of salinity in the same area could not be connected to eutrophication.

3. RESULTS AND DISCUSSION

Temperature: Data for the Split-Gargano profile (Stations 8 - 13) have been averaged for each year at different depths. Year to year differences are rather strong, particularly in the surface and bottom layer. No long-term trend has been observed (Figure 2).

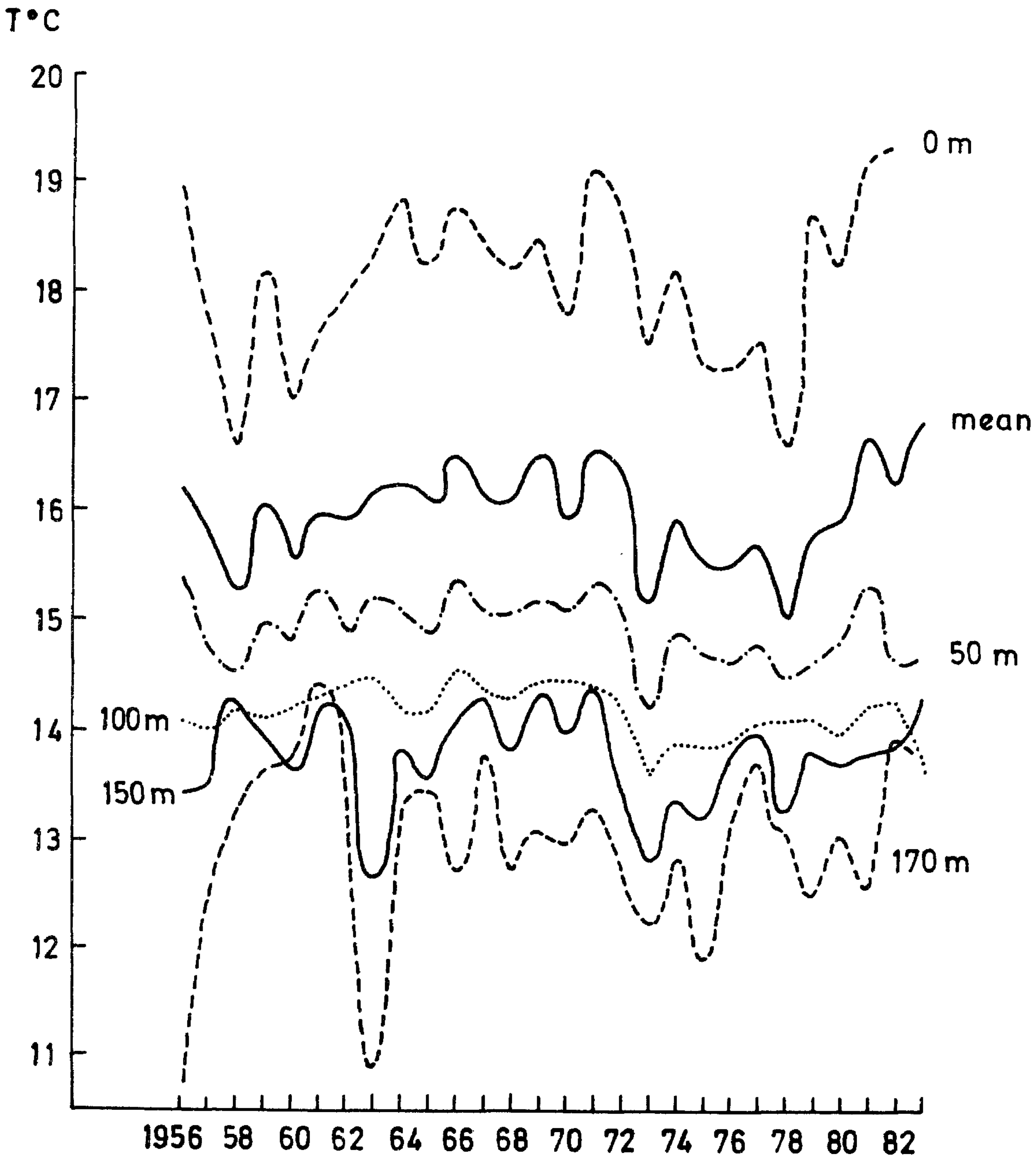


Figure 2 Mean temperatures (1956-82) for 0,50 m, 100 m and 170 m at the profile Split-Gargano for the Stations 8 - 13, and the mean temperature of the entire water column

Salinity: Data for the Split-Gargano profile have been averaged in the same way. Year to year variations are as well strong, but the trend of salinity increase is clear after 1965 (Figure 3). The same trend has been noticed close to the eastern coast (in Kastela Bay) and in the Southern Adriatic. In the unpublished paper (Zore-Armanda and Gacić, n.d.) this trend was connected to the function of the Aswan High Dam. After construction of the Dam (in function from 1964), the Nile discharge was radically reduced to a tenth of the previous discharge and the Eastern Mediterranean loses about 15% of the previous total freshwater discharge.

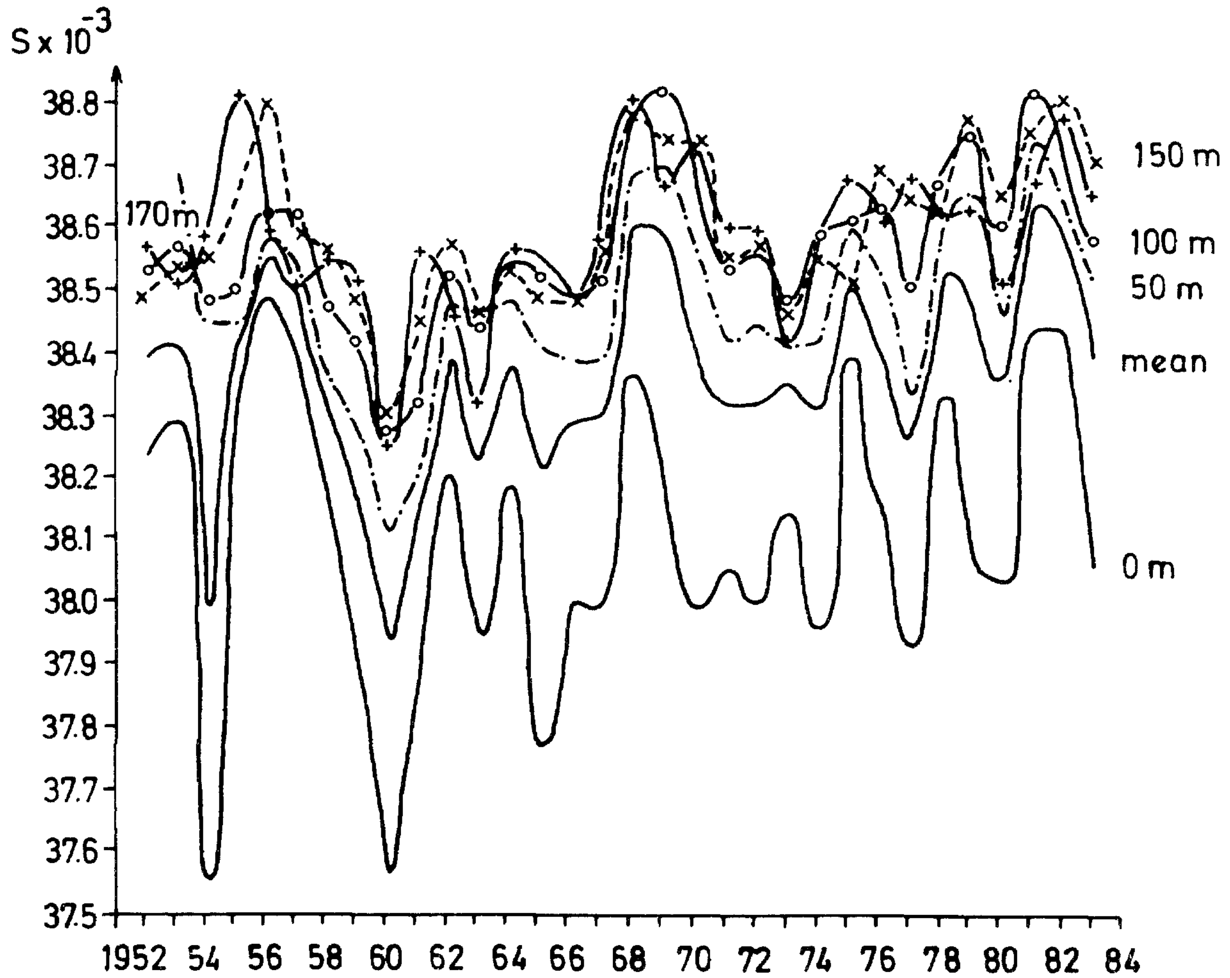


Figure 3 Variations of salinity (S x 10^{-3}) on the profile Split-Gargano (Stations 8 - 13)

Secchi transparency: Averaged data for the Split-Gargano profile show clear trend of a decrease, especially after 1970 (Figure 4). These data indicate production increase. However, a very low value was observed in 1960, but observations did not extend throughout the year.

Oxygen content: Data for the same profile and averaged in the same way show even higher year to year variability (Figure 5). As to the saturation, different layers behave differently. Year-to-year fluctuations in the surface layer have been less important for the last decade with slight increase from 1970 onwards. Saturation in the 50 m layer at the same time reaches the saturation of the surface layer. Saturation in the 100 m layer shows a clear downward trend. All this may be understood as an indication of higher productivity in the open waters, especially present from 1970 onwards.

Nutrients: Phosphate content shows drastic decrease at this profile for the last decade (Figure 6). This may partly be attributed to a change in methodology in 1971, from spectrophotometry to more sensitive extraction with iso-butanol method.

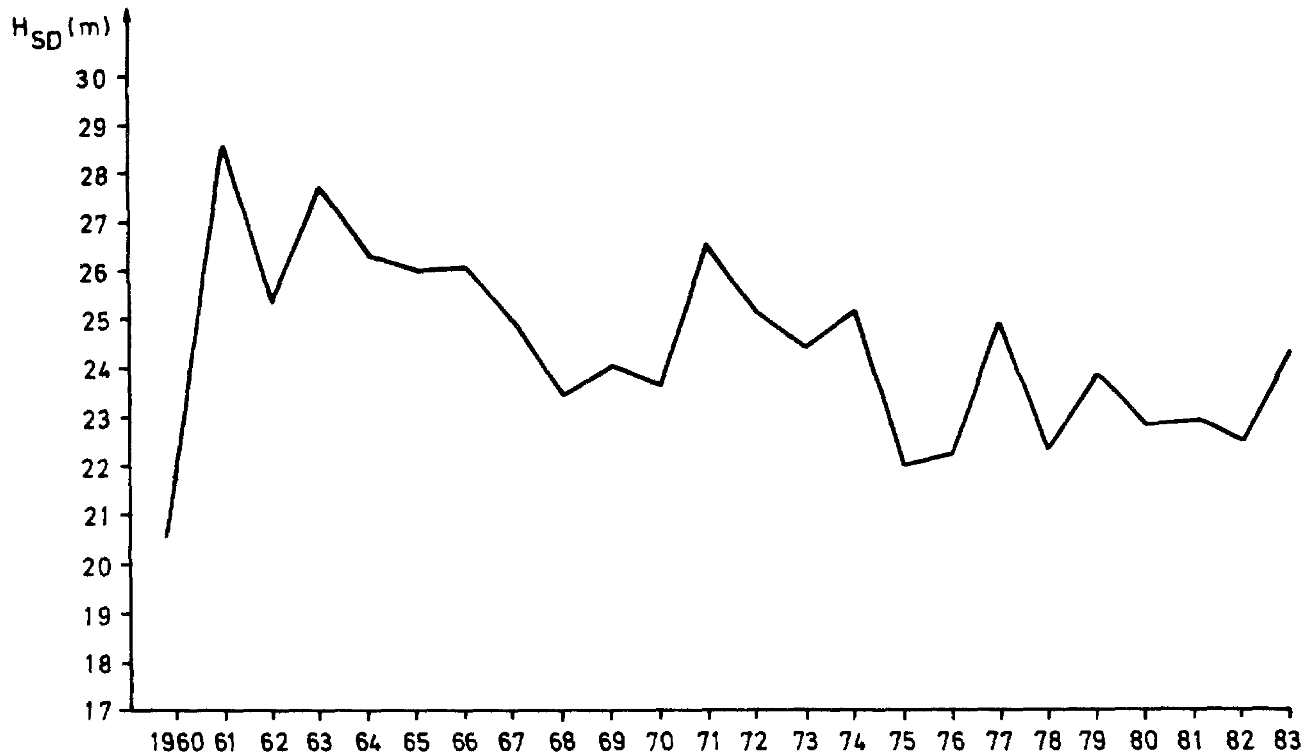


Figure 4 Mean values of transparency for a profile in the middle Adriatic

In 1969 the strong increase was observed. It could be associated with very strong ingression of Eastern Mediterranean intermediate waters at that time. Namely, it was shown (Buljan, 1974; Buljan and Zore-Armanda, 1979) that advection of this water from the Ionian Sea caused increase of nutrients in the open Adriatic. From this year the slight decrease of nutrients has been constant. We have no long data series from the Split-Gargano profile for the other nutrients. However, the data from the last decade for nitrates and nitrites show a decreasing trend. Silicates show an opposite trend. Decrease in nutrient content may be an indication of higher productivity, or the lower content in advective waters from the Eastern Mediterranean due to Aswan Dam function.

Biology: A number of biological factors indicate higher productivity and eutrophication. Plankton data for Stoncica Station (9) are also very indicative for eutrophication. These data are presented in a separate contribution.

4. SUMMARY AND CONCLUSIONS

Standard hydrographic parameters (temperature, salinity, transparency, dissolved oxygen content and nutrients) have been investigated on the profile Split-Gargano (Central Adriatic) and in two Adriatic pits (Jabuka and the South Adriatic pit). Significant changes of some parameters in the last decade indicate that the eutrophication has taken place in these areas of open Adriatic waters.

These indications of eutrophication include a decrease of Secchi transparency, increase of oxygen saturation in the surface layer and 50 m depth and decrease in the 100 m depth, decrease of nutrient content and increase of primary and secondary productivity. At the same time the increase of salinity has been noticed as well. This parameter as well as nutrients decrease may be influenced by function of Nile damming. Trends of the other parameters most probably are due to increased disposal of waste into the sea. Oxygen deficiencies in the bottom layer in the northern Adriatic have already been reported together with the disappearance of some hydromedusa species in that area (Benović, Justić and Bender, 1987).

Figure 5 Oxygen saturation (O_2%) in the entire study area of the middle Adriatic waters

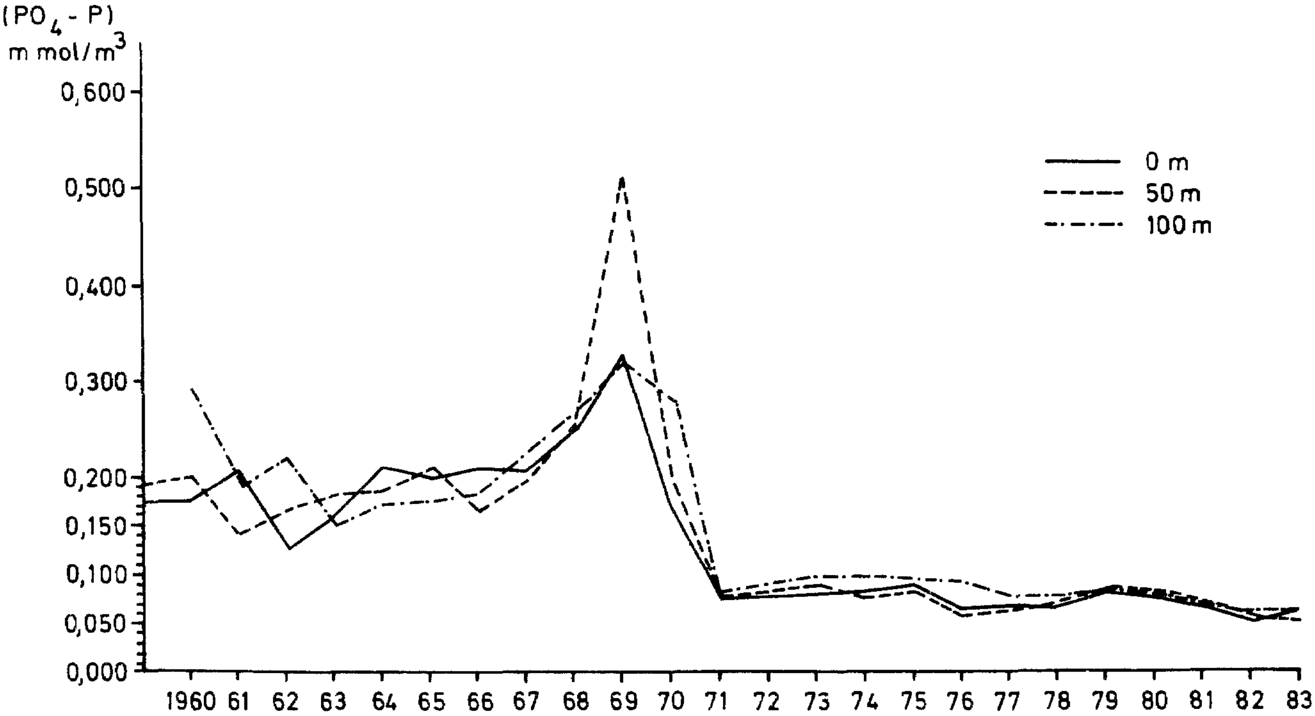


Figure 6 Content of phosphate (PO_4-P; mmol/m^3) on the profile Split-Gargano (Stations 8 - 13)

5. REFERENCES

Benović, A., D. Justić and A. Bender, 1987. Enigmatic changes in the hydromedusan fauna in the northern Adriatic Sea. Nature, Lond., 326:597-9

Buljan, M., 1953. Fluctuations of salinity in the Adriatic. Izv.Inst.Oceanogr.Ribar., Split, 2(2):1-64

Buljan, M., 1974. Osnovne karakteristike Jadrana kao produkcionog bazena. Acta Adriat., 16(2):31-62

Buljan, M., L. Stojanoski and I. Vukadin, 1975. Distribution of nutrient salts in water of middle and south Adriatic Sea. Thalassia Jugosl., 11(1-2):137-49

__________, 1977. Nutrient salts as a possible indicator of urban pollution in the Adriatic coastal waters. Journ.Etud.Pollut.Mar.CIESM, 3(1976):189-90

Buljan, M. and M. Zore-Armanda, 1979. Hydrographic properties of the Adriatic Sea in the period from 1965 through 1970. Acta Adriat., 20(1-2):1-368

Pucher-Petković, T., 1975. Fitoplankton Kastelanskog zaljeva u odnosu na organsku poluciju. Pomor.Zb., 13:491-500

Pucher-Petković, T. and I. Marasović, 1980. Développement des populations phytoplanctoniques caractéristiques pour un milieu eutrophisé (Baie de Kastela, Adriatique Centrale). Acta Adriat., 21(2):79-93

Pucher-Petković, T. and M. Zore-Armanda, 1973. Essai d'évaluation et pronostic de la production en fonction des facteurs du milieu dans l'Adriatique. Acta Adriat., 15(1):1-38

Vucetić, T., 1981. Some species of plankton as indicators of neritisation (eutrophication) of the eastern Central Adriatic. Jown.Etud.Pollut.Mar.CIESM, 5(1980):769-70

Vucetić, T. and V. Alegria, 1986. Long-term fluctuations of predator fish and the prey plankton jelly-fish, Pelagia noctiluca in the Mediterranean (Adriatic). Rapp.P.-V.Reun.CIESM, 30(2):230

Zore-Armanda, M., 1969. Water exchange between the Adriatic and the Eastern Mediterranean. Deep-Sea Res., 16:171-8

____________, 1974. Formation of eastern Mediterranean deep water in the Adriatic. Colloq.Int.CNRS Paris, (215):127-33

Zore-Armanda, M. and M. Gacić, n.d. Is there any relation between the Aswan High Dam and long-term salinity increase in the Adriatic? Unpubl.

B. RESSOURCES PELAGIQUES/PELAGIC RESOURCES

SOME PRELIMINARY RESULTS FROM MAPPING COMMERCIAL CATCHES OF SMALL PELAGIC FISH IN THE NORTH ADRIATIC

by

Bolje Ales
DROGA Portoroz, TOZD "RIBA" Izola
Research and Development Department
Yugoslavia

1. INTRODUCTION

In order to determine the monthly (and perhaps daily) migration of small pelagic fish (Clupea pilchardus Walb., Clupea sprattus L.) in the North Adriatic, and to define optimal fishing grounds for commercial purposes, daily catches of three (3) pairs of pelagic trawlers were recorded geographically.

For this purpose, the area investigated was divided into a network of squares, each of 5 square nautical miles (Figure 1). Commercial catches of pilchard (Clupea pilchardus Walb.) and sprat (Clupea sprattus L.) in these squares were recorded and summed up for each month starting in March 1987. The total fishing effort (number of pairs of pelagic trawlers) was calculated monthly for

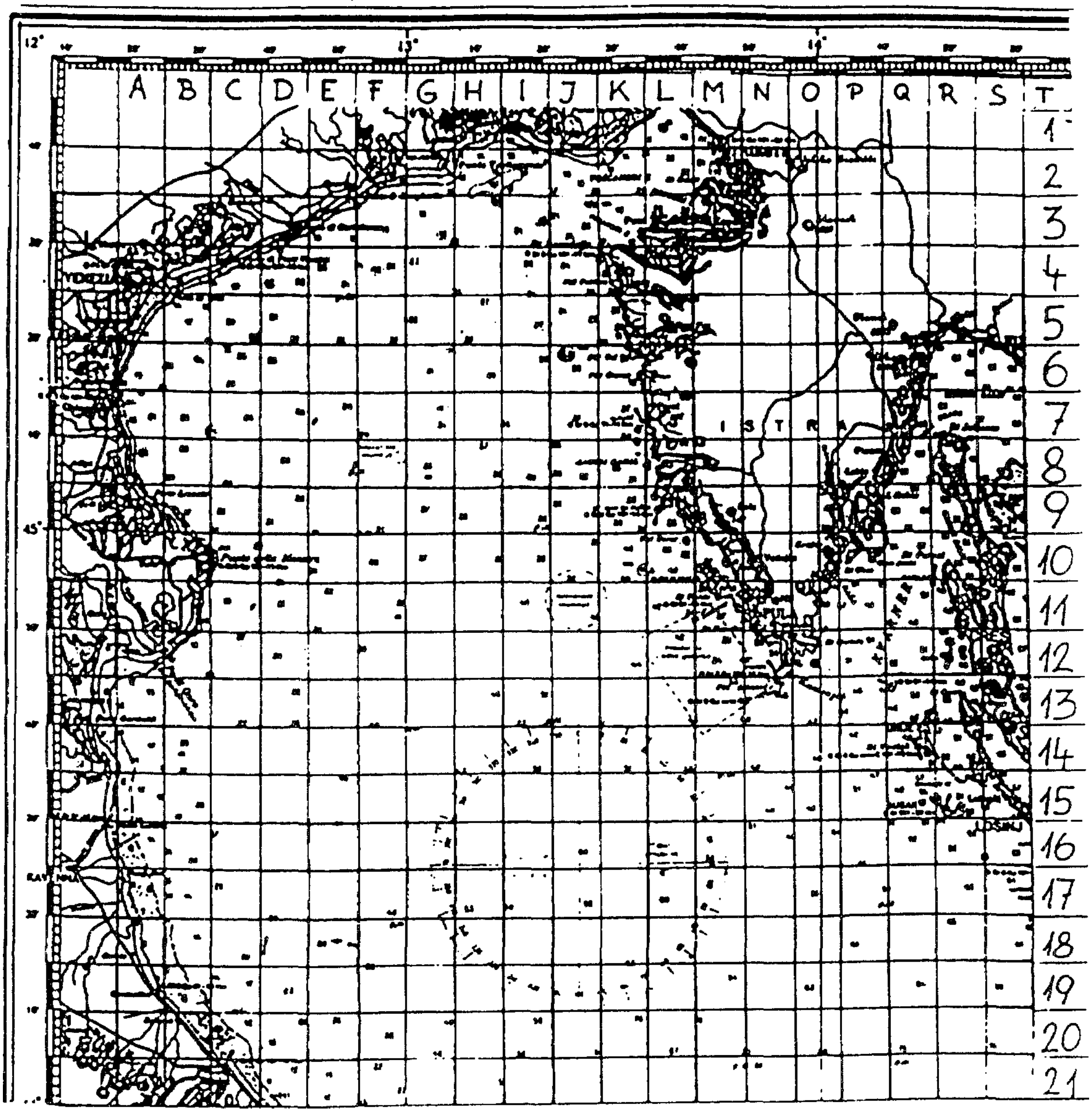
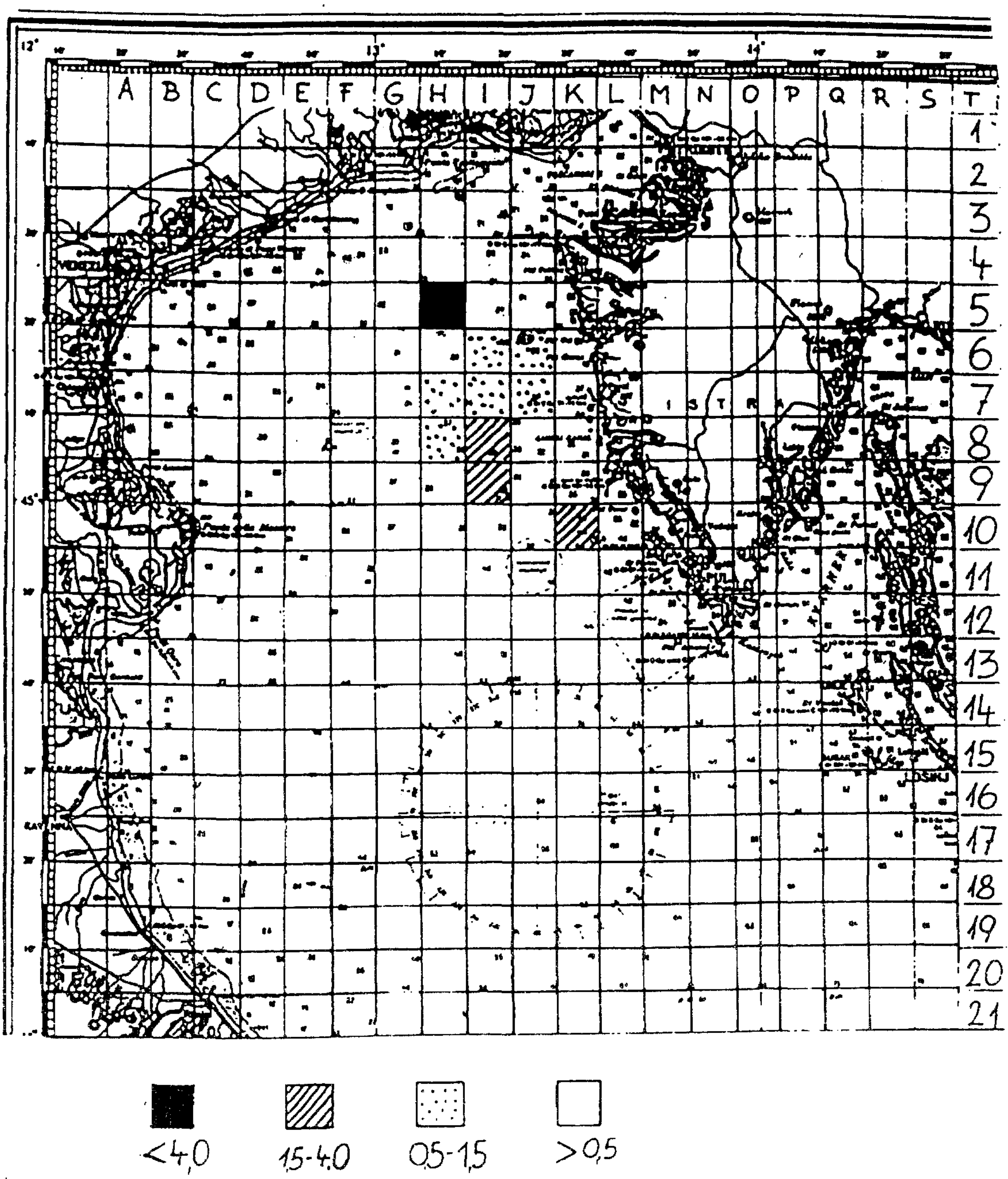


Figure 1 North Adriatic area divided into squares of 5 square nautical miles

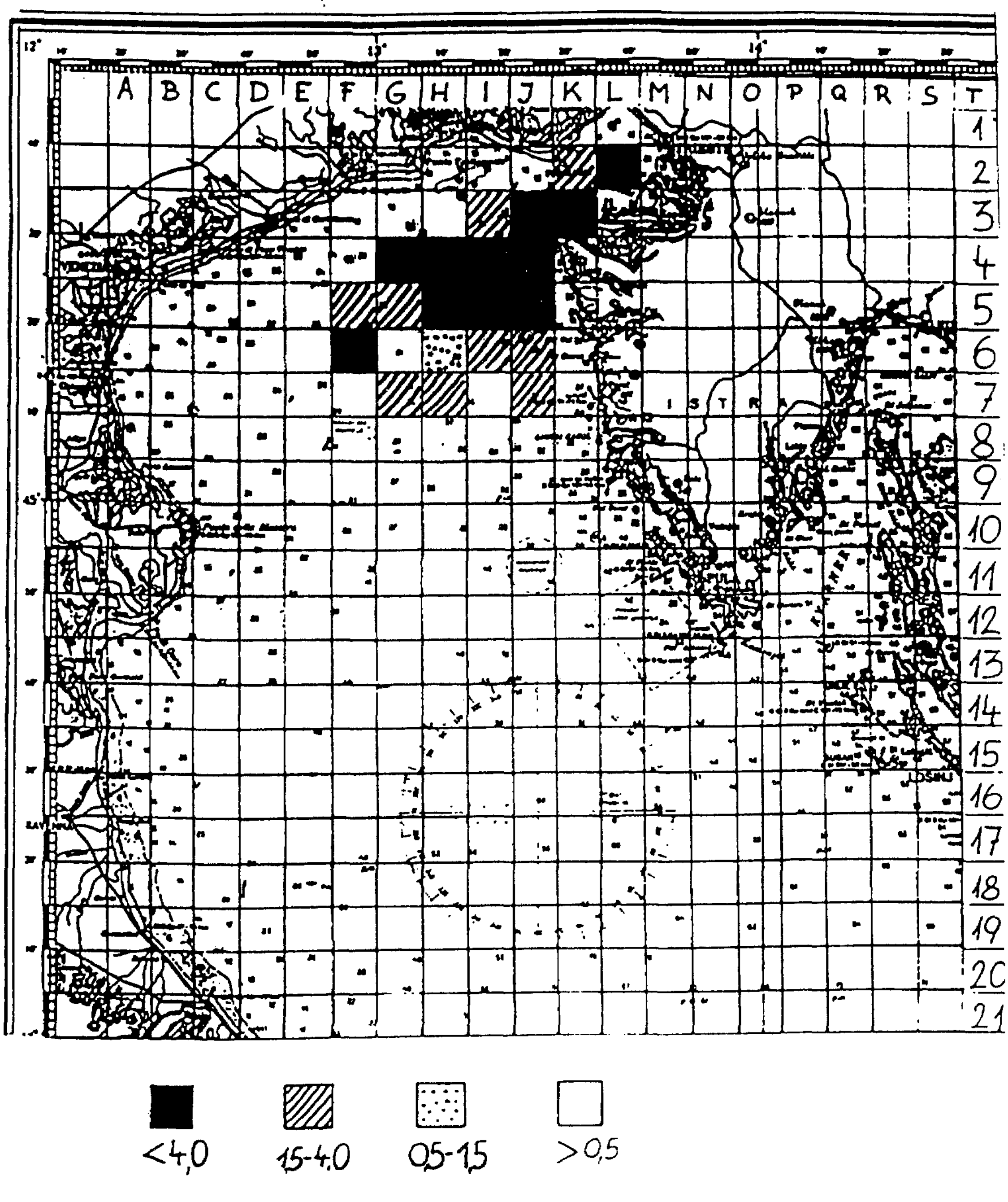
each square. The index of catch/effort for each square was calculated as an index of relative fish abundance. Results were also rearranged and maps of mean catch/effort drawn for the months of March and April 1987.

2. RESULTS AND DISCUSSION

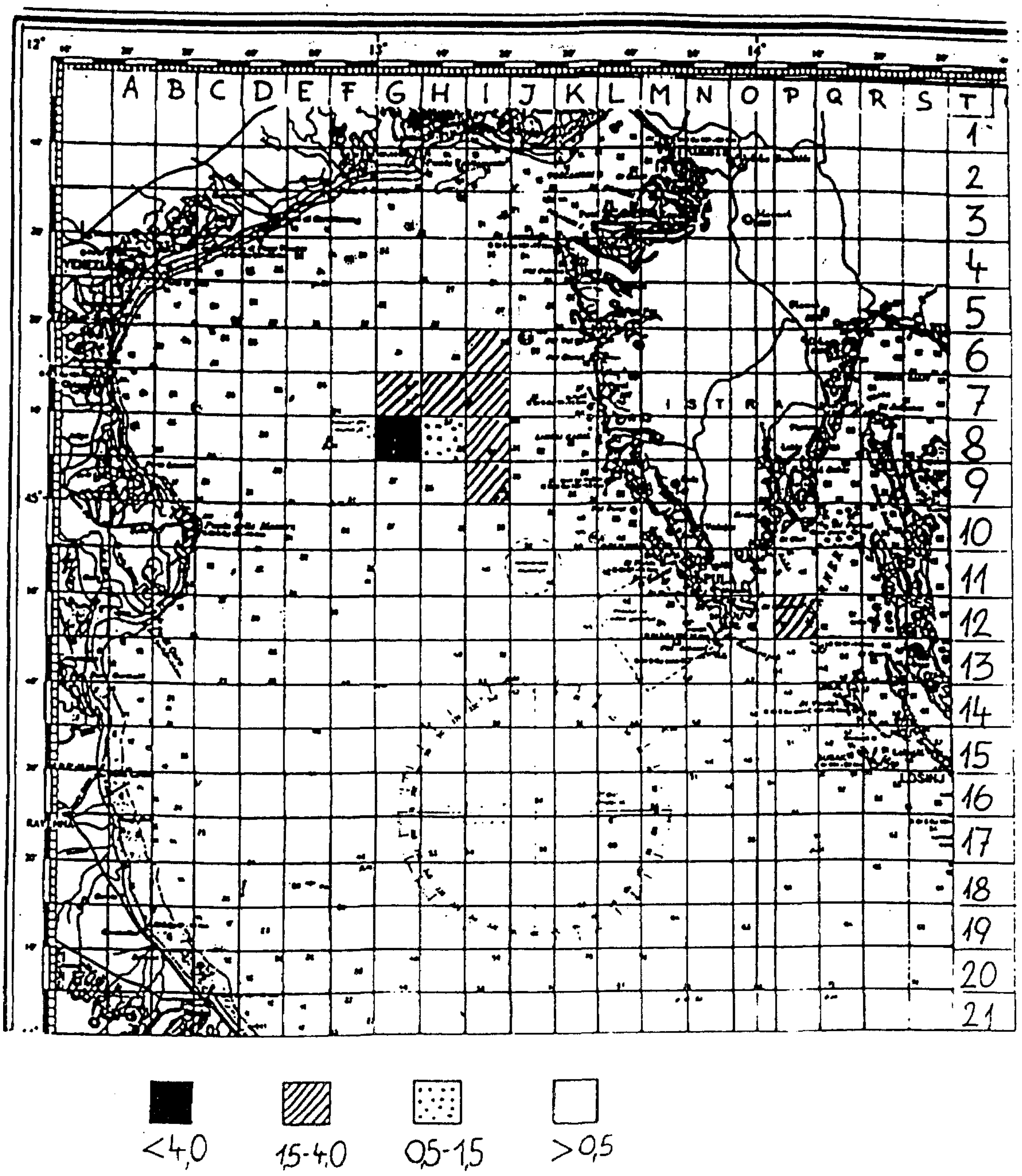
The catches of sprat in March 1987 were concentrated in the area between 10 and 25 nautical miles west of Lim canal (see Map 3). Although the highest effort was in square H 7, the highest catch/effort was in G 8 square, with a mean catch of 6,4 tons/pair of pelagic trawlers.



Map 1 Map of mean catch of pilchard (Clupea pilchardus Walb.) in North Adriatic (tons/pair of pelagic trawlers). March 1987

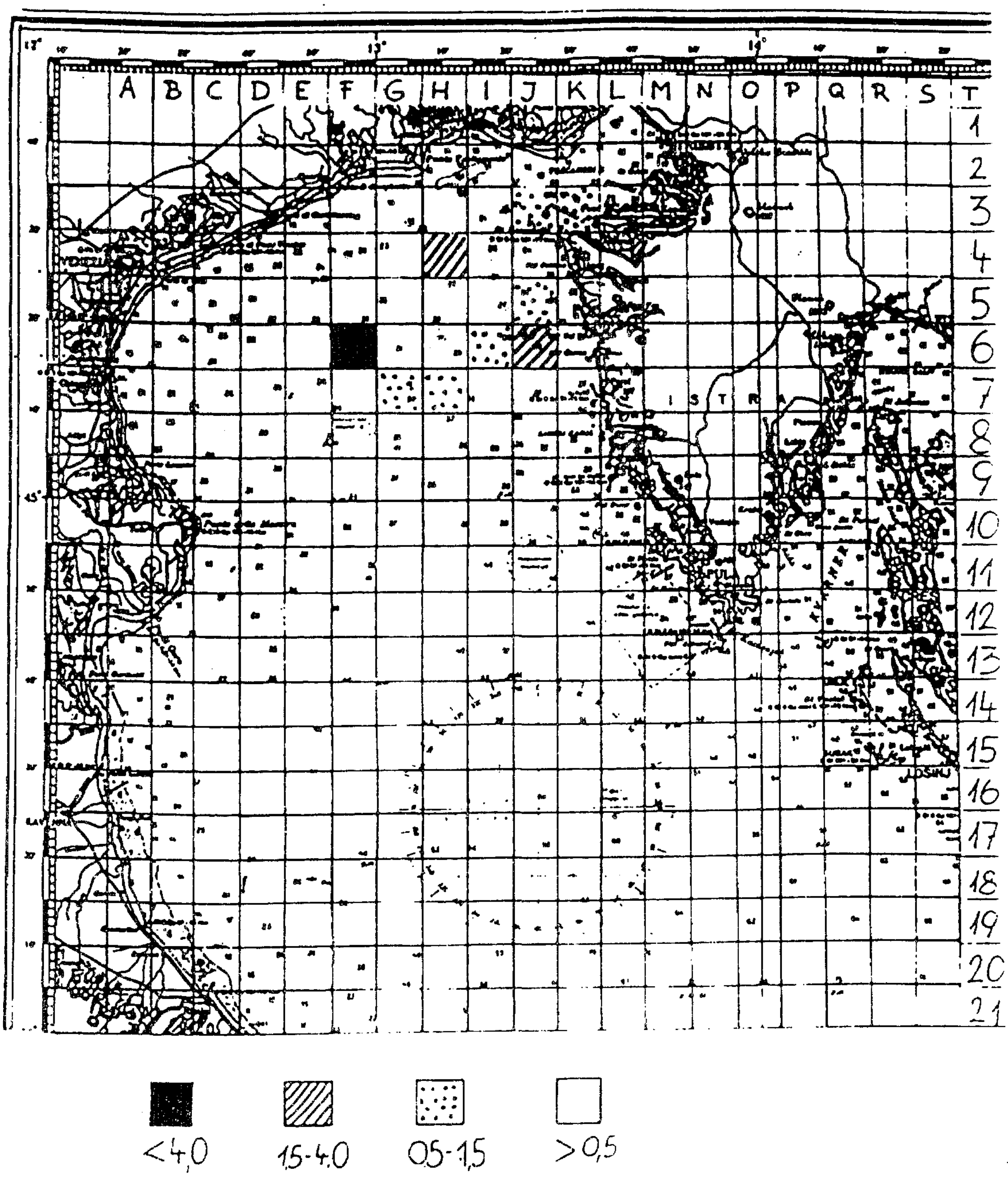


Map 2 Map of mean catch of pilchard (Clupea pilchardus Walb.) in North Adriatic (tons/pair of pelagic trawlers). April 1987



Map 3 Map of mean catch of sprat (Clupea sprattus L.) in North Adriatic (tons/pair of pelagic trawlers). March 1987

The situation in April 1987 was rather different (Map 4): the catches of sprat were not concentrated in the area west of Lim canal as in March, but dispersed in the North Adriatic with square F 6 being the position showing the highest catch/effort index (5.8 tons/pair of pelagic trawlers). Generally the proportion of sprat in the April catches decreases; being 69.9% in March and only 11.5% in April (mean values).



Map 4 Map of mean catch of sprat (Clupea sprattus L.) in North Adriatic (tons/pair of pelagic trawlers). April 1987

On the other hand, the proportion of pilchard in the catches rose from 29.8% in March to 85.6% in April.

The catches of pilchard in March 1987 (Map 1) showed two maximum values of catch/effort index: the K 10 square with 2.5 tons/pair of pelagic trawlers and H 5 with 4.0 tons/pair of pelagic trawlers. Otherwise, values did not exceed 1.7 tons/pair of pelagic trawlers; showing sprat prevalent in the area 10 to 25 nautical miles west of Lim canal. The high values of K 10 and H 5 squares could be a sign that the North Adriatic pilchard sub-population was migrating toward the northern part of North Adriatic, from well defined (Stirn, 1976) spawning grounds in deep water west of Dugi Otok island. The geographical distribution and catch/effort values of pilchard commercial catches in April 1987 (Map 2) indicate an increase of pilchard abundance in North Adriatic. Fishing grounds with higher catch/effort values are those west from Savudrija cape and in Trieste gulf (see Map 2).

The highest catch/effort values are in L 2 and H 4, with 12,0 and 15,0 tons/pair of pelagic trawlers respectively, although the highest effort was in K 3 square.

Two months work mapping the main fishing grounds of sprat and pilchard in the North Adriatic indicated:

1. Optimal fishing grounds (fishing grounds with highest catch/effort values) differ for sprat and pilchard. Sprat is prevalent in fishing grounds near the Italian coast (square F 6, G 8) that coincide with a salinity gradient declining toward coast (Stirn, 1969). Kubik and Stirn (1976) pointed out the ecological determinants of sprat as boreal elements preferring cooler waters with lower salinity (4-38%). On the other hand, pilchard is more stenovalent; not populating areas with salinities lower than 35% and prevailing in areas near the Istrian coast (squares H 4, H 5, L 2).

2. The choice of squares of 5 square nautical miles was determined by the trawling speed of pelagic trawlers, so that to the extent possible, entire catch of a pair pelagic trawlers should be in a single square. Although many catches occurred in two squares, in this case the catches were equally divided between two squares. A larger square might have been more suitable.

3. Work on mapping commercial catches will be continued for at least a year so to record the entire cycle of migration of small pelagic fish. With some oceanographic data such as temperature, salinity and current distribution, as well as the phyto- and zoo-planktonic situation, we could improve our knowledge on the optimal fishing grounds and migration of small pelagic fish.

4. More accurate work on mapping the main fishing grounds from both sides of Adriatic sea should be done. Data from commercial catches and research vessels for all species of demersal and pelagic commercial fishes shoud be treated in an integrated fashion with the use of computer graphics. Our knowledge of fish migration and fishing grounds for different species of commercial fish should be improved so as to realize practical advantages to the commercial fishery.

3. REFERENCES

FAO, 1976. Monitoring of fish stock abundance: the use of catch and effort data. A report of the ACMRR Working Party on fishing effort and monitoring of fish stock abundance. Rome, Italy, 16-20 December 1975. (155):101 p.

Kubik, L. and J. Stirn, 1976. Biological baselines for improved exploitation of pelagic fish resources of the North Adriatic. Sci.Rep.Split, (8)

Stirn, J., 1969. Pelagial severnaga Jadrana. Razpr.Slov.Acad.Znam.Umet.(VI), 12(2):1-92

PRELIMINARY EVALUATION OF ANCHOVY AND SARDINE STOCKS IN THE LOWER ADRIATIC

by

N. Casavola, G. Marano, L. De Martino and C. Saracino
Laboratory of Marine Biology of Bari, Italy

1. INTRODUCTION

In order to rationalize fishing and at the same time to draw up a development plan for the sector, it is necessary to know the potential biological resources of Italian seas. Pelagic fishing which is chiefly for anchovies and sardines, has shown a certain increase in the last few years also because of the liberalization of fishing for young fish for consumption in the months of January and February.

To this end, the Italian Ministry of the Marina Mercantile has requested that the Laboratory of Bari together with other units (Trieste, Fano, Naples and Genoa) estimate the levels of stock of these pelagic fish.

There have been no previous studies on these fish for this purpose in the Lower Adriatic, although the Gulf of Manfredonia has the highest concentration of these young for the whole Italian coast.

2. MATERIALS AND METHODS

From the various methods used to determine the biomass of the fish capable of reproduction, the "egg-larva" method was chosen. This method was chosen in the light of the existing biological information about anchovies and sardines in the Adriatic (Casavola, Saracino and Merano, 1980; Casavola et al., 1981, 1982; Marano, Casavola and Vaccarella, 1981; Marano et al., 1981; and because it permits a quantitative sampling technique for ichthyoplankton which is now standardized (Smith et al., 1967).

In addition, with this technique it is possible to make an evaluation of the biomass capable of reproduction for all the species whose eggs and larvae can be identified. This method consists of the evaluation of the total quantity of eggs deposited at every stage of egg-laying in the area of reproduction. From the simultaneous knowledge of the relative levels of fecundity and of the sex-ratio, the stock of fish capable of reproduction can be calculated.

The area considered was from Vieste to Otranto which ahs an area of 16 300 km^2, and 22 sites were identified with a distance between each of 10 miles. Those were situated in 6 sections, with a distance of 30 miles between each section, in a transverse direction to the coast (Figure 1). In order to better define the reproductive period and the variation of density of the species being studied, a zone with 3 fishing sites was chosen facing the city of Bari.

The catch of ichthyoplankton was made with double-oblique hauls, using model 20 BONGO plankton nets consisting of two linked cylindrical-conical nets with meshes of 236 u and 336 u respectively equipped with a flow-meter and a depth-gauge.

The nets were drawn for 10-15 minutes at a speed of 1.5-2 knots to a maximum depth of 50 m for anchovies, and 70 m for sardines, since eggs are not found beneath those levels (Regner, 1972).

To date 8 seasonal surveys have been carried out:

Summer 1984 survey from 24.6.84 to 27.7.84
Spring 1985 survey from 2.4.85 to 22.4.85
Summer 1985 survey from 16.7.85 to 19.7.85
Autumn 1985 survey from 26.10.85 to 9.11.85
Spring 1986 survey from 21.3.86 to 19.5.86
Summer 1986 survey from 11.7.86 to 2.8.86
Autumn 1986 survey from 4.10.86 to 12.11.86
Spring 1987 survey from 27.3.87 to 8.4.87

The plankton samples caught were at once fixed in 4% formalin on board, and in the laboratory the eggs were counted and separated by growth stage (Vucetic, 1957). The larvae were grouped by length at 1 millimetre intervals. From the number of eggs in the sample, and from the depth and duration of the haul and from the volume of water filtered, the number of eggs per square metre was calculated. In addition, because the hatching of the eggs is related to water temperature (Varagnolo, 1964; Gamulin and Hure, 1955) it is possible to calculate the number of eggs per square metre per day.

SAMPLING SITES

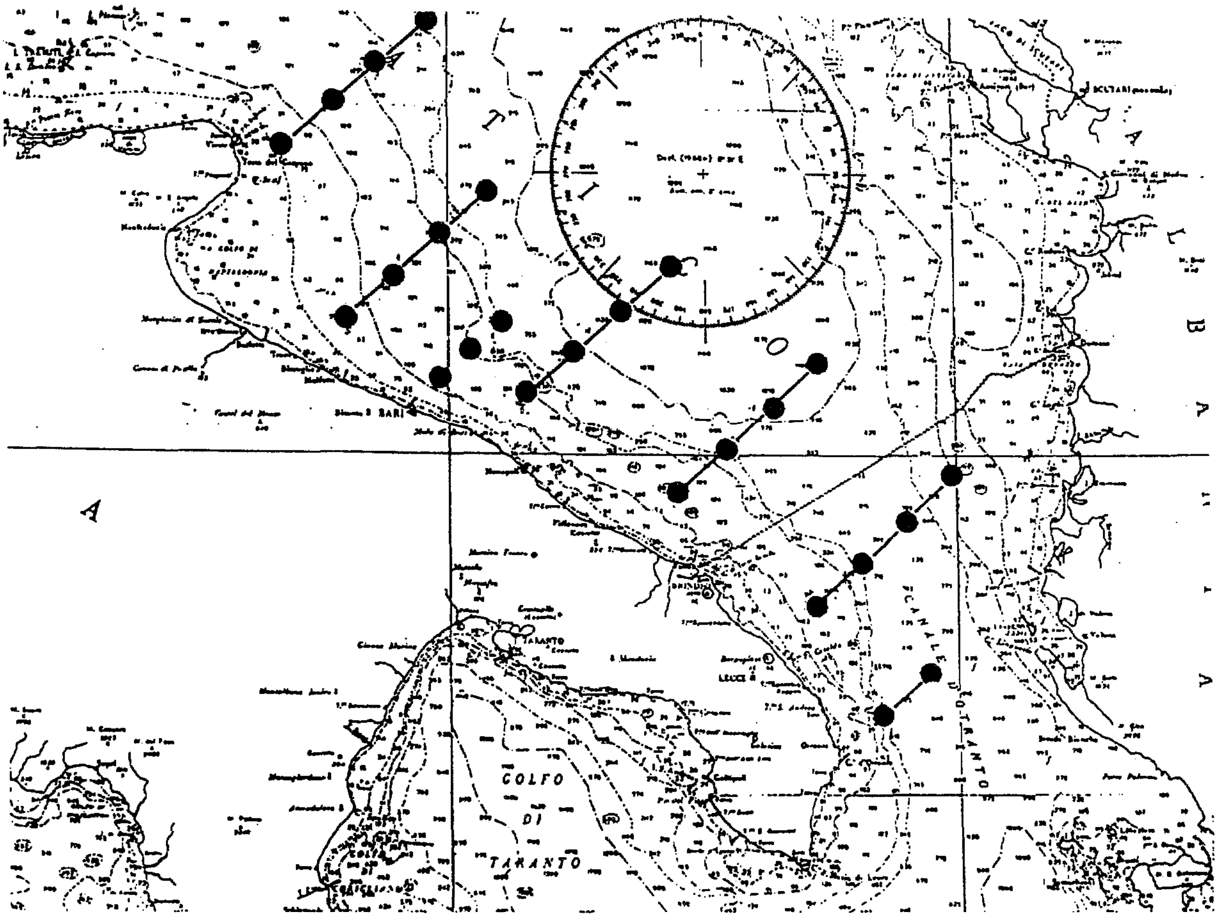


Figure 1 Sampling sites

Besides the samples of ichthyoplankton, samples of phytoplankton were taken, together with samples of water in order to determine possible correlations between the presence of eggs and hydrological characteristics. The water samples were taken with a model NIO bottle with a capacity of 5 litres and a remote control opening. On the spot measurements of temperature and salinity by depth were made with a Beckman probe, of water transparency with Secchi discs and of oxygen fixation in bottles using the Alstenberg method.

For each water sample the following parameters were measured in the laboratory: orthophosphate phosphorus, total phosphorus, ammoniacal, nitrite and nitric nitrogen and silicates. From the surface samples the concentration of chlorophyll-a was also determined.

All these analyses were carried out using Strickland and Parson's methods (Strickland and Parson, 1972).

3. RESULTS

The chemical and physics data confirm the marked poverty of the waters of the Lower Adriatic, with very limited amounts of azote and phosphorus (Casavola, De Martino and Martino, in press) which is clearly inferior to those for the upper and central Adriatic (Marchetti and Passino, 1979; Chiaudani et al., 1982).

The distribution of anchovy eggs is given by date for July 1984 and July 1985 (Figures 2 and 3). The reproduction of anchovies seems to take place most frequently in the zone between the isobaths 100 and 200 m, while in the open seas at depths below 500 m, and to the south of Brindisi there are no eggs (Casavola et al., 1986, in press). The egg density for the whole area examined was found to be 2.4 eggs/m^2/day for 1984 and 3.5 eggs/m^2/day for 1985. The egg-laying period, as determined by samples from fixed sites, lasts for some 180 days in the period April-October.

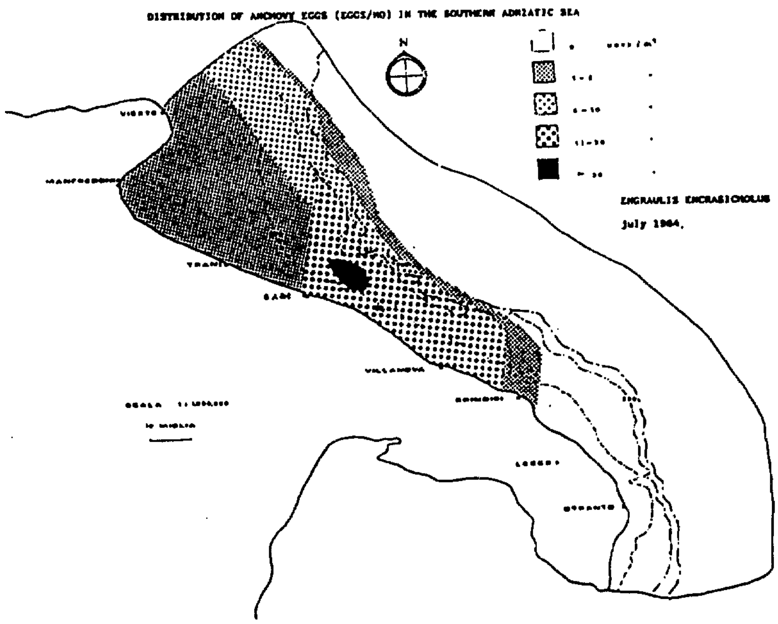


Figure 2 Distribution of anchovy eggs (eggs/hq) in the southern Adriatic Sea

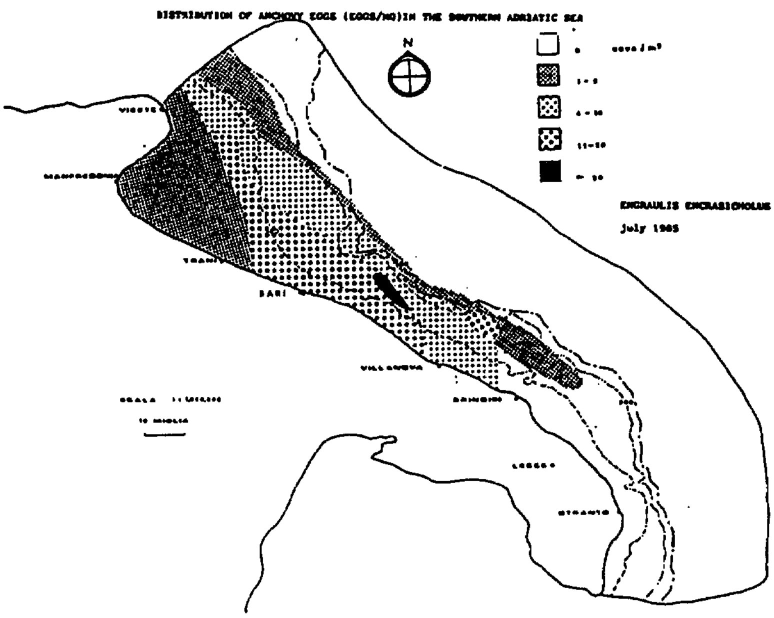


Figure 3 Distribution of anchovy eggs (eggs/hq) in the southern Adriatic Sea

The data available for sardines are those for April and November 1985. The reproductive period lasts longer than that of Engraulis from October until May. For sardines as well (Figures 4 and 5) reproduction seems to take place between the 100 to 200 isobaths and at depths below 500 m there are no eggs. It is however interesting to note that eggs are present in all the Lower Adriatic as far as Otranto. The density of sardine eggs for the whole area examined was 12.5 eggs/m^2/day in the spring survey and 51.58 eggs/m^2/day in the autumn survey. These values are much greater than those for anchovies.

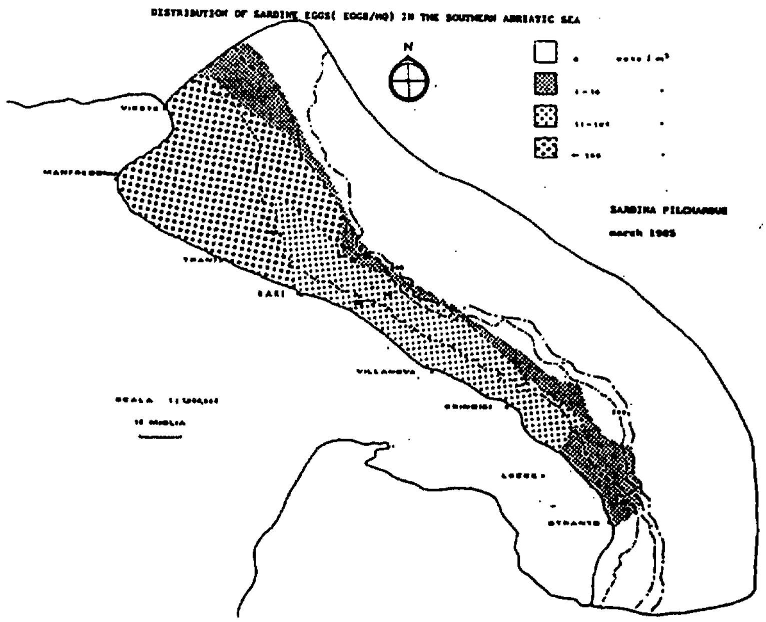


Figure 4 Distribution of sardine eggs (eggs/hq) in the southern Adriatic Sea

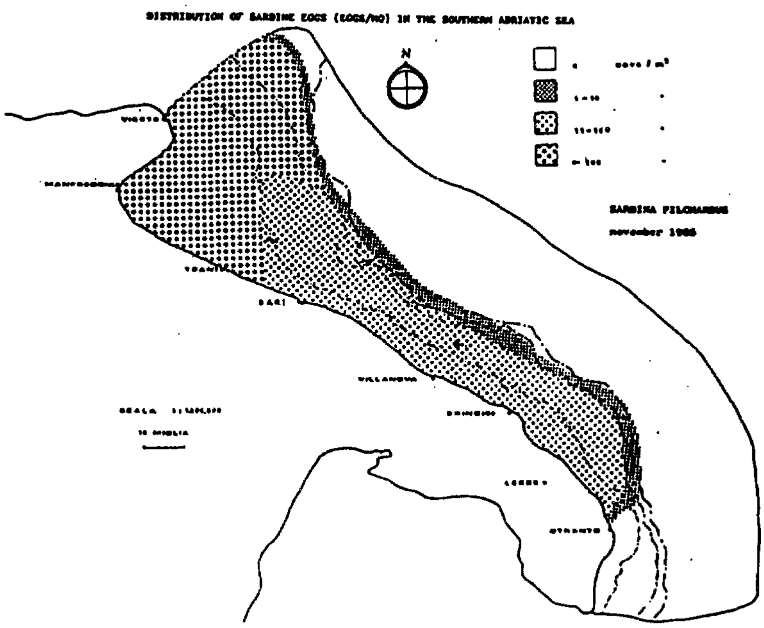


Figure 5 Distribution of sardine eggs (eggs/hq) in the southern Adriatic Sea

When those preliminary data are correlated with the relative fecundity, 1 299 for anchovies (Regner, Piccinetti and Specchi, 1985) and 927 for sardines (Sinovcić, 1984), the size of the biomass relative to the stocks for the anchovies was 4 400 t for 1984, and 4 900 t for 1985. For sardines, for the egg-laying season of 1984-85 it was 188 000 t and for the 1985-86 season it was 150 000 t.

These initial estimates of biomass should be regarded as preliminary data that currently give a maximum estimate, since they are not correlated with the mortality and, moreover, refer only to two egg-laying seasons. As the investigations continue, more reliable data may become available and it may also be possible to evaluate the various parameters which are relevant for a correct estimate of the biomass.

4. CONCLUSIONS

In the Lower Adriatic the egg-laying periods are not notably different from those in other Adriatic areas (Piccinetti, Regner and Specchi, 1979) (Figure 6).

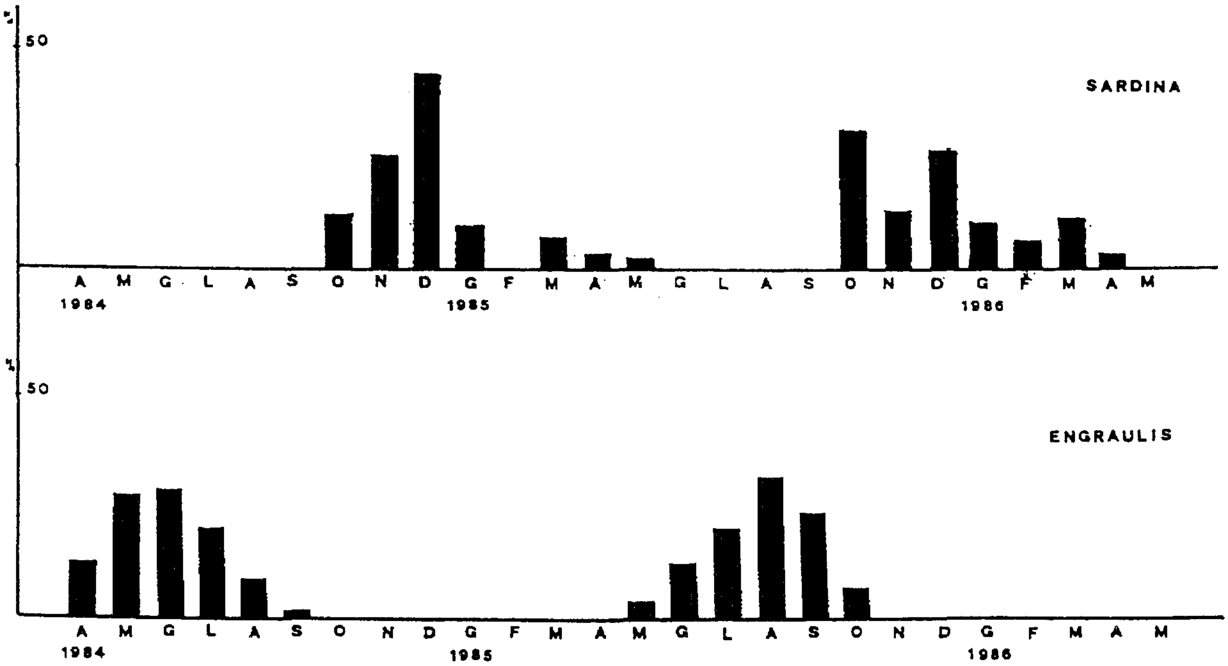


Figure 6 Monthly density (%) of eggs in the control area

Sardina pilchardus reproduces itself in all the southern area from Vieste to Otranto, but only in the coastal area at depths down to 500 m. The estimates (though approximate) of the sardine biomass (13 t/km^2 for the 1984-85 season and 11 t/km^2 for that of 1985-86) are similar to those made for more years in the central and higher Adriatic (Piccinetti, Regner and Specchi, 1981; Regner, Piccinetti and Specchi, 1983). From this it may be deduced that there is a certain continuity of sardine distribution over the whole Adriatic.

As for Engraulis, the data clearly show that this species is much less frequent in the Lower Adriatic (0.3 t/km^2 in both years surveyed) and it does not appear to reproduce there probably because of the particular oceanographic conditions (currents and depths).

In general its biomass is greatly inferior to that of sardines with an average ratio of 1:36.

Comparing these data for biomass even though they are preliminary and need to be confirmed, it can clearly be seen that Engraulis has different distributions across the Adriatic. In fact, while in the north and centre it is abundant and more common than the other clupeoid (Sardina), it is much less common in the south; roughly 1/80 compared to the northern areas.

On the basis of preliminary data on the size of stocks of clupeiforms, it may be noted that fishing activity does not seem to influence the population of Sardina pilchardus: in fact it might even encourage it. The quantity of Engraulis which is caught seems to reach about 50% of the estimated population and this explains the difficulty in taking this clupeoid.

For several years in the Gulf of Manfredonia in the winter months, considerable quantities (some 700 t) fo "bianchetto" (that is, chiefly young sardines) have been caught (Rizzoli, 1984). As has already been said, the conservation of Engraulis stock requires that young Engraulis are not caught in this "bianchetto" and thus it is desirable that permission for fishing for fry in the Gulf of Manfredonia is limited to the period from 15 January to 15 March.

5. REFERENCES

Casavola, N., L. De Martino and G. Martino, Caratteristiche talassografiche del Basso Adriatico. In Atti del diciassettesimo Congresso della Società Italiana di Biologia Marina. Nova Thalassia, (in press)

Casavola, N., C. Saracino and G. Marano, 1980. Pesca e biologia di Engraulis encrasicholus (L.) nel Basso Adriatico. Mem.Biol.Mar.Oceanogr., Messina, Suppl. 10:377-8

Casavola, N., et al., 1981. Osservazioni sulla pesca e ciclo riproduttivo dei clupeiformi nel Basso Adriatico: Engraulis encrasicholus (L.). Oebalia, 7:27-42

__________, 1982. Biologia di Sardina pilchardus Walb. (Osteichthyes) nel Basso Adriatico. Nat.Sicil., 4(1):140-2

__________, Ittioplancton di clupeiformi nel Basso Adriatico. In Atti del diciassettesimo Congresso della Società Italiana di Biologia Marina. Nova Thalassia, (in press)

__________, 1986. Considérations sur la distribution des clupeiformes Engraulis encrasicholus et Sardina pilchardus en Adriatique. FAO Rapp.Pêches/FAO Fish.Rep., (345):153-5

Chiaudani, G., et al., 1982. Caratteristiche trofiche delle acque costiere adriatiche: campagna di rilevamento 1978-79. In Progetto finalizzato: Promozione qualità dell'ambiente. Rome, CNR, AQ/2/14:35 p.

Gamulin, T. and J. Hure, 1955. Contribution à la connaissance de la ponte de la sardine (Sardina pilchardus (Walb.)) dans l'Adriatique. Acta Adriat., 7(8):1-23

Marano, G., N. Casavola and R. Vaccarella, 1981. Pesca del "bianchetto" in terra di Bari. Quad. Lab.Tecnol.Pesca, Ancona, 3(1):101-10

Marano, G., et al., 1981. Osservazioni sulla pesca e ciclo riproduttivo dei clupeidi nel Basso Adriatico: Sardina pilchardus (Walb.). Quad.Lab.Tecnol.Pesca, Ancona, 3(1):5-15

Marchetti, R.and R. Passino, 1979. Strategia per interventi integrati nel settore dell'eutrofizzazione in Italia. In Progetto finalizzato: Promozione e qualità dell'ambiente. Rome, CNR, AC/2/45-70:472 p.

Piccinetti, C., S. Regner and M. Specchi, 1979. Estimation du stock d'anchois (Engraulis encrasicholus L.) de la haute et moyenne Adriatique. Invest.Pesq., Barc., 43(1):69-81

__________, 1981. Estimation préliminaire de la production maximale d'anchois et de sardine en Adriatique. FAO Rapp.Pêches/FAO Fish.Rep., (253):155-8

Regner, S., 1972. Contribution to the study of the ecology of the planktonic phase in the life history of the anchovy Engraulis encrasicholus (Linnaeus, 1758) in the Central Adriatic. Acta Adriat., 16(2):1-40

Regner, S., C. Piccinetti and M. Specchi, 1983. Estimate of spawning biomass of sardine in the northern and central Adriatic from 1979 to 1982 by means of egg survey. FAO Rapp. Pêches/FAO Fish.Rep., (290):223-32

__________, 1985. Statistical analysis of the anchovy stock estimates from data obtained by egg surveys. FAO Rapp.Pêches/FAO Fish.Rep., (345):169-84

Rizzoli, M., 1984. Considérations sur la pêche du "Bianchetto" en Adriatique. FAO Rapp.Pêches/FAO Fish.Rep., (290):233-4

Sinovcić, G., 1984. Fecundity of Sardine. Sardina pilchardus (Walb.) from the central Adriatic. Nova Thalassia, 6 Suppl.:351-63

Smith, P.E. and S.L. Richardson, 1977. Standard techniques for pelagic fish egg and larva surveys. FAO Fish.Tech.Pap., (175):100 p.

Strickland, J.D.M. and T.R. Parson, 1972. A practical handbook of seawater analysis, Bull.Fish.Res. Board Can., (168):310 p.

Varagnolo, S., 1964. Variazioni diurne della presenza degli stadi di sviluppo di alcuni telostei marini nel plancton di Chioggia. Boll.Zool., Napoli, 31(2):1037-47

Vucetić, T., 1957. Quelques observations sur l'écologie de la ponte de l'anchois (*Engraulis encrasicholus* L.) dans les lacs de l'île de Mljet, CGPM. CGPM Debats Doc.Tech./GFCM Proc.Tech.Pap., 4:227-33

CATCH, SIZE DISTRIBUTION, GROWTH AND SEX RATIO OF SWORDFISH (*Xiphias gladius* L.) IN THE GULF OF TARANTO

by

G. De Metrio and P. Megalofonou
Istituto Comunale di Biologia Marina di Nardò (Lecce) - Italy

1. INTRODUCTION

Since 1984 we have been investigating in the south Ionian Sea all the area along both the Apulian and the Calabrian coasts from Otranto to Capo Spartivento, as part of a vast research project on stock assessment of big Scombroidei exploited by Italian Fishery set up and financed by the Ministry of the Merchant Navy.

Preliminary results concerning the whole area and referring to investigations carried out on the size of the fleet, equipment and fishing areas, on the total catch, fishing effort and cpue have been reported elsewhere (De Metrio *et al.*, 1986).

Here, we think it of interest to report data for *Xiphias gladius* L. concerning only Porto Cesareo, situated on the Ionian coast of the Salento in the Gulf of Taranto which, independently of the above-mentioned project, has been the object of our studies since 1978 (De Metrio *et al.*, 1981, 1982, 1984). Therefore this study, on the basis of data collected over nine years, enables us today to draw certain conclusions as to the tendency of the catches and also to arrive at conclusions concerning the biology of the species.

2. MATERIALS AND METHODS

The number and weight of swordfish caught by the vessels of Porto Cesareo regularly effectuating fishery were taken daily during the fishing season from 1978 to 1986. The number of hooks and fishing days was also recorded. In 1985 and 1986 data concerning lower jaw fork length in centimetres and eviscerated weight in kilogrammes of 779 specimens were recorded. In the same years the gonads of 233 specimens were examined in order to estimate the sex and sexual maturity.

3. RESULTS AND DISCUSSION

3.1 Fishing Season

From the investigations carried out in the course of nine years it results that the fishing season can cover the period from the second ten days of April to the end of August or, at most, to the second ten days of September (Figure 1). Beginning of activity is conditioned by:

(a) meteomarine conditions,
(b) results of trial catches by vessels.

The end of the fishing season is determined by:

(a) poor catch,
(b) the beginning of albacore fishing.

However, as observed in Figure 1, since 1982 the fishing season has shortened considerably and activity is mainly concentrated in the months of July and August.

3.2 Fishing Areas

The fishing area is situated in the Gulf of Taranto at a distance of between 20 to 40 miles from the coast (Figure 2). Fishery takes place at a depth range from approximately 550 to 750 m.

3.3 Fishing Equipment

Only the longline is used. Both its length and number of hooks have increased considerably. In 1978 it was 25 km long and supplied with 700 hooks; now it is 35 km long with about 1 000 hooks.

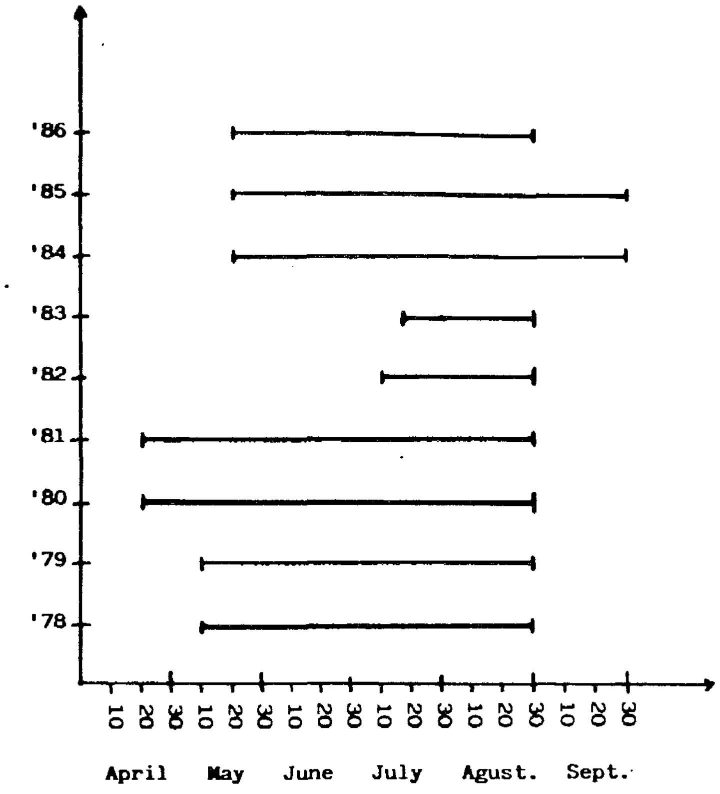


Figure 1 Period of longline fishery operates by the fleet of P. Cesareo during 1978-86 in the Gulf of Taranto

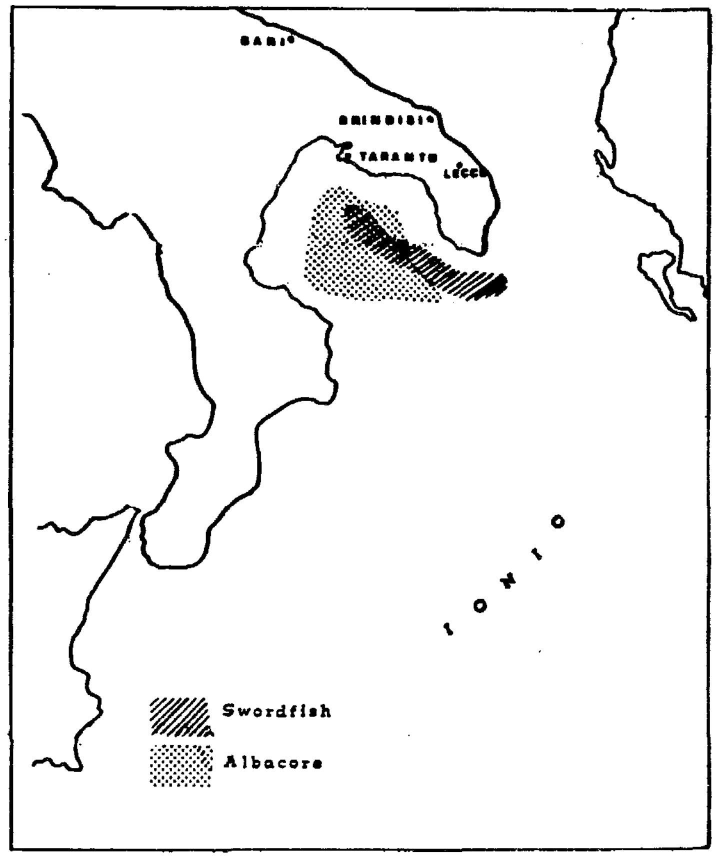


Figure 2 Swordfish and albacore fishing areas in the Gulf of Taranto

3.4 Fishing Effort and cpue

The fishing effort has been obtained with the formula

$$E = \frac{\bar{a}}{1\,000} \times g$$

where $\bar{a}/1\,000$ represents the average number of hooks placed daily in the sea divided by the unit of measure of the effort considered in 1 000 hooks and g the number of fishing days. The cpue were calculated in biomass and in the number of specimens with the formulae

$$\frac{kg}{E} \quad e \quad \frac{N^{o}.\ specimens}{E}$$

In Figure 1 data referring to the nine years under consideration are summarized. Total number of hooks, total catch in kilogrammes, total number of specimens, cpue in biomass and in number of specimens, average weight are reported for each year. It can be seen that the greatest fishing effort was in 1980 with 560 000 hooks at sea corresponding in cpue to 98.3 kg also the highest figure in the nine years under study. The minimum effort is found in 1983 with 116 250 hooks corresponding to 54.2 kg in cpue which, although low, does not however represent the minimum found.

The entity of fishing effort in total number of hooks and total quantity of fish caught in kilogrammes, over the years, is illustrated in Figure 3. In the first three years the effort is more or less constant while in 1981 it decreases suddenly. This is more accentuated in 1982 and 1983 where it touches minimum to then show an upward trend in 1984 with greater increase in 1985. A certain drop is evident in 1986.

Figure 3 Total quantity catches and fishing effort for swordfish caught by the vessels of P. Cesareo during 1978-86

Comparing this graph with the one for the fishing period it can be noticed that the variations in effort are related to the time span during which fishing has been carried out. This would reasonably lead to the conclusion that the variations in effort are to be attributed to bad atmospheric conditions. Poor catches will also certainly have forced fishermen to look to other species.

The total quantity of fish caught is clearly in proportion to the effort and the highest figure reported is in 1980 with 53 888 kg of production while the minimum is in 1983 with 6 340 kg. Observing the overall period of nine years it is evident that maximum production was obtained in the three year period 1978-80, the minimum in the three year phase 1981-83 followed by a certain pick-up in the last three years, even though production still falls way behind that of the first period.

Analysing the graph (Figure 4) for the cpue in biomass it is clear that they undergo considerable shifts in the course of the years with highest peaks in 1979, 1980, 1982, and 1984 and lowest points in 1981, 1983, 1985 and 1986 and from 1980, high and low points alternate yearly interrupted in 1980. However, it is important to notice that increases reported in 1982 and 1984 respectively with 77.5 and 78.18 kg/Unit Effort have never reached the levels in 1979 and 1980 again with, respectively 88.9 and 98.3 kg/Unit Effort.

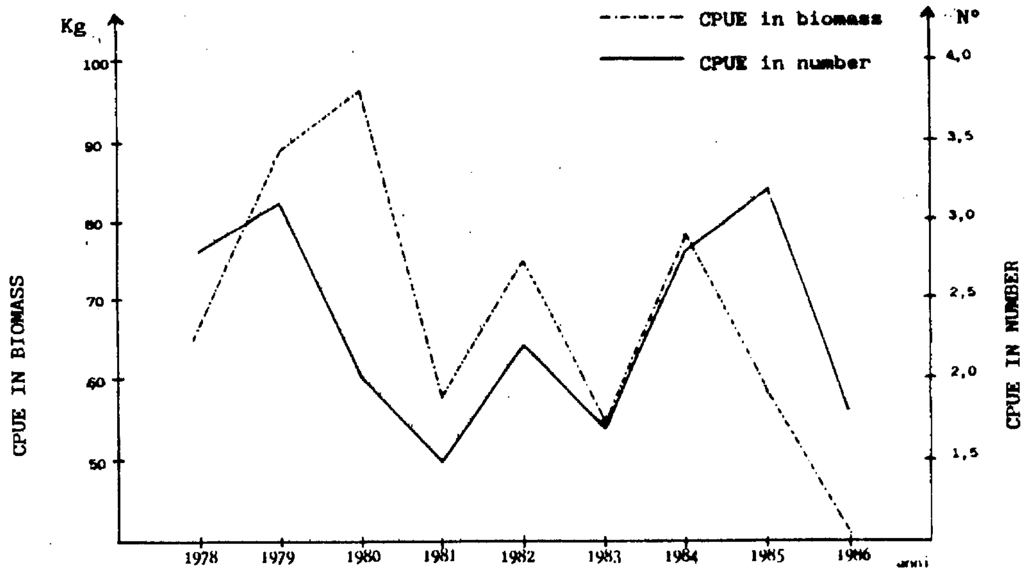


Figure 4 Catches-per-unit-effort in biomass and in number of specimens in 1978-86 for swordfish. Unit effort = 1 000 hooks

Comparing this graph with the one for cpue in number of specimens it appers clear that maximum and minimum figures do not always correspond. Sometimes they are even in contrast. This is very evident in 1980 and 1985.

In the first case a low cpue in numbers contrasts with a high cpue in biomass together with a high average weight of specimens. It is clear that this depends on the fact that the catch was made up of big fish which, when compared to data for other years, must be considered an exception difficult to account for.

In the second case the opposite is found: the highest cpue in number of specimens with an average weight of 18.5 kg, the lowest recorded, corresponds to a fairly low cpue in biomass. From this it is clear that catches were mainly of young fish.

The explanation for this lies in the fact that in the summer of 1984, as we were able to observe from the frequency of the catches of very young specimens in the months of September and October during the fishing period, there was a vast production and high survival rate for young fish in the area that contributed to the stock on which the fishing effort was directed in 1985. This can also be deduced from the distribution of the frequency of sizes. A similar situation must have come about between 1977 and 1978 and probably between 1978 and 1979 as well.

Table 2 and Figure 5 present the data and the tendency of cpue in biomass in different months. The lowest values are generally observed in June.

3.5 Average Weight

The maximum average weight, 48.2 kg, was recorded in 1980 while the minimum weight of 18.4 kg was in 1985. Observing the graph relative to weight variation over the years a sudden rise is evident from 1978 to 1980 followed by a constant decrease up to 1985. In 1986 a slight gain is reported.

Table 1

Summarized results of swordfish fishery data from the port of Porto Cesareo from 1978 to 1986

Year	Effort Number hooks /1 000	Catch in kg	Catch in number	Average weight in kg	Average weight geometr. in kg	cpue in kg per 1 000 hooks	cpue in number per 1 000 hooks
1978	491.17	32 646	1 375	23.74	18.2	66.5	2.80
1979	451.50	40 047	1 387	28.87	21.7	88.9	3.10
1980	559.50	53 888	1 118	48.20	40.4	98.3	2.00
1981	256.94	14 805	397	37.29	28.8	57.8	1.50
1982	150.10	11 632	325	35.79	28.8	77.5	2.20
1983	116.25	6 340	192	33.00	28.1	54.2	1.70
1984	232.80	18 200	660	30.53	25.5	78.18	2.83
1985	334.40	19 674	1 084	19.45	14.6	58.83	8.24
1986	264.75	10 871	476	24.05	19.1	41.07	1.80

Table 2

Capture per unit effort in biomass of swordfish caught by the vessels of Porto Cesareo in different months during the nine-year period 1978-86

Year	cpue kg April	May	June	July	August	September
1978	-	70.59	26.84	71.67	83.91	-
1979	-	58.88	77.63	102.70	136.75	-
1980	119.41	102.36	48.23	100.51	102.53	-
1981	62.07	54.58	51.19	53.15	69.51	-
1982	-	-	-	80.14	75.63	-
1983	-	-	-	65.59	42.44	-
1984	-	67.34	88.56	68.3	82.92	86.0
1985	-	28.70	39.96	50.14	64.45	70.38
1986	-	55.49	23.61	48.1	36.45	-

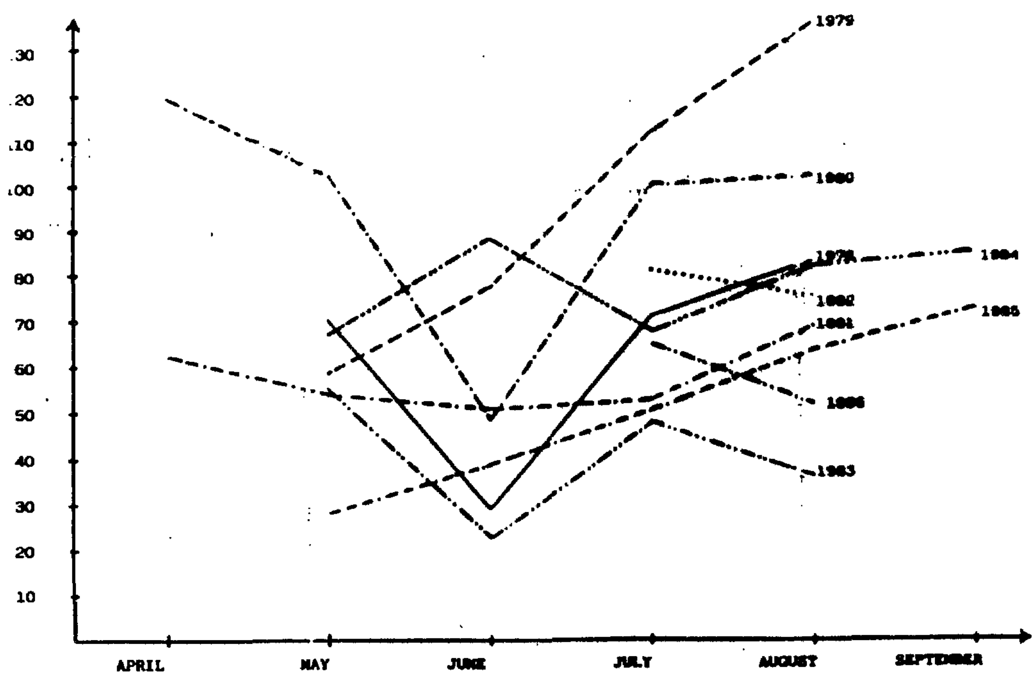


Figure 5 Monthly variations of cpue in biomass of swordfish during the nine-year period 1978-86

For closer study of yearly variations it would seem advisable to consider the drop in 1980 as casual and examine the curve from 1981. From that moment there is a decrease in average weight which was gradual until the heavy recruitment on specimens born in 1984. A recovery follows, to be expected, which would confirm with its low figure, the general tendency to gradual decrease of average weight during the years. The low average weight values recorded in 1978 and 1979 also appear to be the results of a former drop caused by the same reasons as those in 1985.

Taking into consideration that the weight generally follows a loglinear distribution, the geometrical average values were computed to

$$x = \ln(\text{kg})$$

These values were transformed in kilogrammes (Figure 6)

$$\text{kg} = e^{x}$$

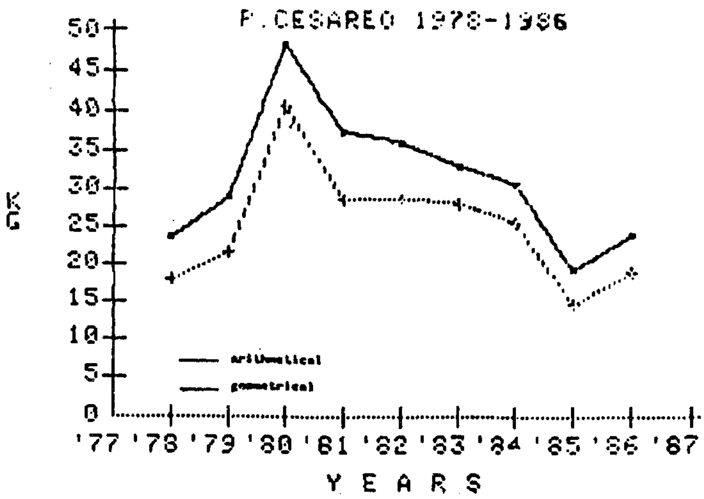


Figure 6 Annual variations of average weight (arithmetic and geometric) of swordfish from 1978 to 1986

3.6 Size Distribution

The study of the distribution of sizes was carried out on 1985 and 1986 catches.

In 1985 the fork length of 462 specimens was measured. The smallest fish in the sample was 64 cm and the biggest 205 cm. The main bulk of the catches came from specimens with FL up to 110 cm (69.2%). The most frequent class was the one with FL between 95 and 105 cm. Swordfish with FL between 110 and 135 cm made up 17% while those with FL 135 were only 13.8%.

In 1986, 317 specimens with minimum FL 75 cm and maximum 225 cm were measured. The specimens with FL up to 110 cm were 40.4% while the most frequent class was the one with a FL between 115 and 125 cm with a percentage of 21.5%. The class from 95 to 105 cm were present with 18.3%. Fish with FL between 110 and 135 cm represented 38.5% while those with FL 135 cm, 21.1%.

Considering that the fish with FL up to 110 cm belong to the first age class and those with FL between 110 and 135 cm to the second class it may be concluded that, in both years, most of the catch, 86.2% in 1985 and 78.9% in 1986 was made up of the first two age classes.

3.7 Length-Weight Relationship

A total of 462 swordfish was measured during the fishing period in 1985 and the relationship between fork length and eviscerated weight was computed. The smallest fish in the sample was 64 cm and the biggest 205 cm.

We found the following relationship:

$$W = 5.701 \times 10^{-6} \times FL^{3.16} \qquad r = 0.953$$

where W is the eviscerated weight in kilogrammes
FL is the lower jaw fork length in centimetres
r is the regression coefficient

In Figure 8 the graph demonstration of the weight-length relationship is reported.

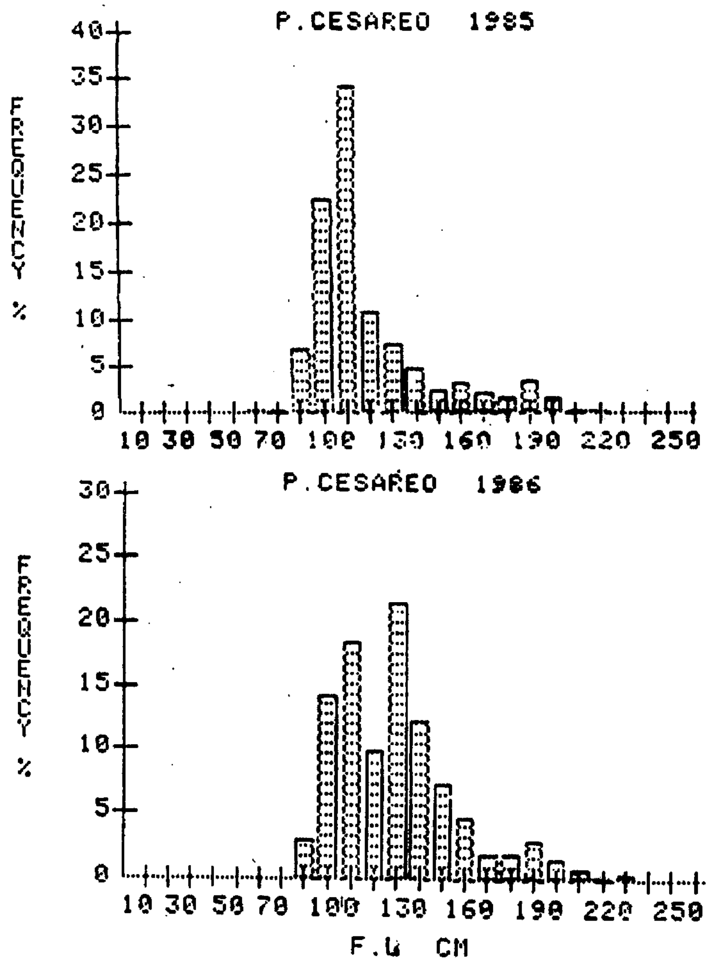


Figure 7 Length frequency distributions of 462 and 317 swordfish caught by the longline vessels of Porto Cesareo in 1985 and 1986 respectively

3.8 Growth Rate

Information on swordfish growth is limited and somewhat contradictory. Attempts at ageing have been made by using several techniques. Until recently, most preliminary size-at-age or growth estimates have been based on modal analysis of size frequency distributions (Yabe et al., 1959; Kume and Joseph 1969; Beckett 1974; Ovchinnikov et al., 1980).

In this study following the Petersen method, an approximate monthly and annual growth rate of swordfish has been estimated as well as the length at first and second years of life.

Figure 9 presents the length frequency distributions of swordfish caught by the longline vessels of Porto Cesareo in different months during the period of 1985-86. Each mode usually corresponds to individual age groups. Due to a successful spawning in the summer of 1984 the first two modes (a) and (b) are clearly evident.

In June 1985 the first mode (b) at 87.5 cm corresponds to the young individuals which were spawned during the summer of 1984. This mode moves on to 97.5 cm in July and arrives at 102.5 cm in September. At the same time, in September, the mode (a) appears at 62.5 cm corresponding to the small fish spawned during the summer of the same year (1985).

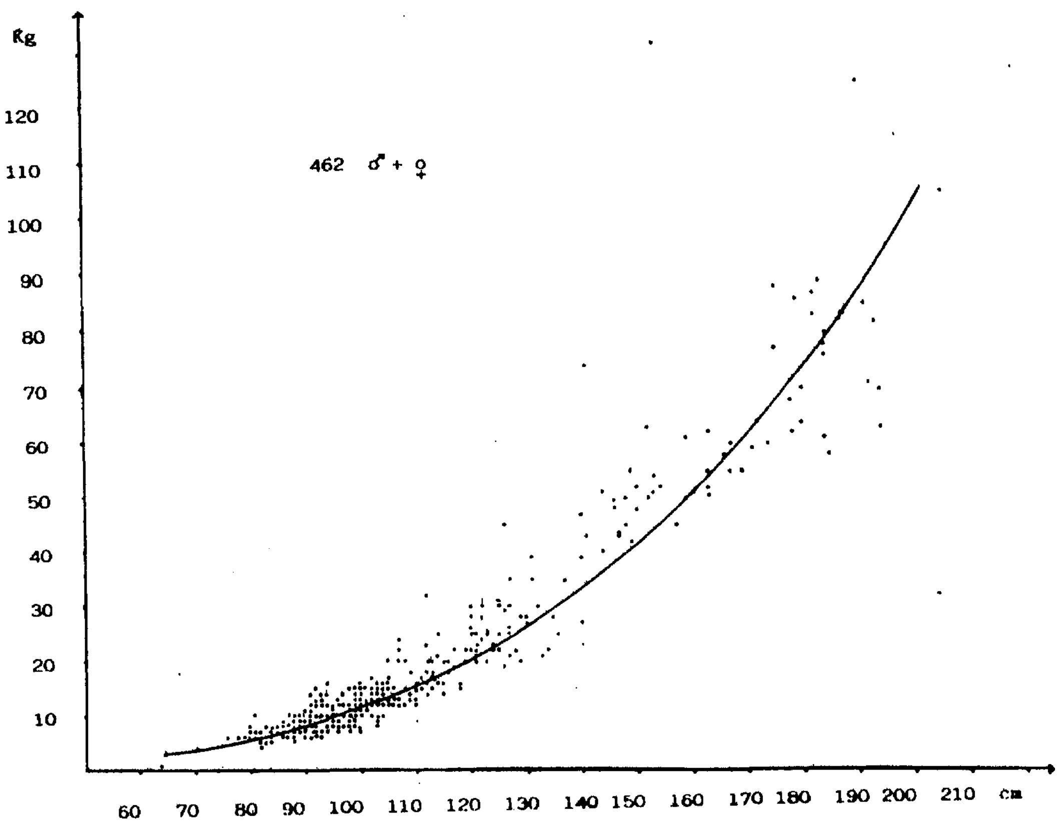


Figure 8 Length-weight correlation of swordfish from Gulf of Taranto

In June 1986 the mode (b) is at 122.5 cm, it stays at 122.5 cm in July and moves on to 132.5 in August. Mode (a) in 1986 follows the same progression of mode (b) in 1985. In June it is found at 87.5 cm, in July at 97.5 cm and arrives at 102.5 cm in August.

Taking into consideration; first the fact that swordfish spawn from June through August with the peak of the spawning season in July (Sella, 1911; Sanzo, 1922; Cavaliere, 1963) and second the above length frequencies, it is possible to estimate approximately the size at the first two years of life. Thus the average size of swordfish in the first year is about 97.5 cm and it reaches 122.5 cm in the second year of age. Besides fairly reasonable estimates are obtained for growth rates:

Table 3

The growth pattern of swordfish derived from the interpretation of the length frequency distributions

Months	Growth (cm)	Monthly growth rate (cm)	Monthly growth rate on annual basis (cm)
From July 84-September 84 (2-3)	62.5	20.8 - 31.2	
September 84-June 85 (9)	25	2.7	
June 85-September 85 (3)	15	5	3.3 (40)
September 85-June 86 (9)	20	2.2	
June 86-August 86 (2)	10	5	2.7 (32.7)

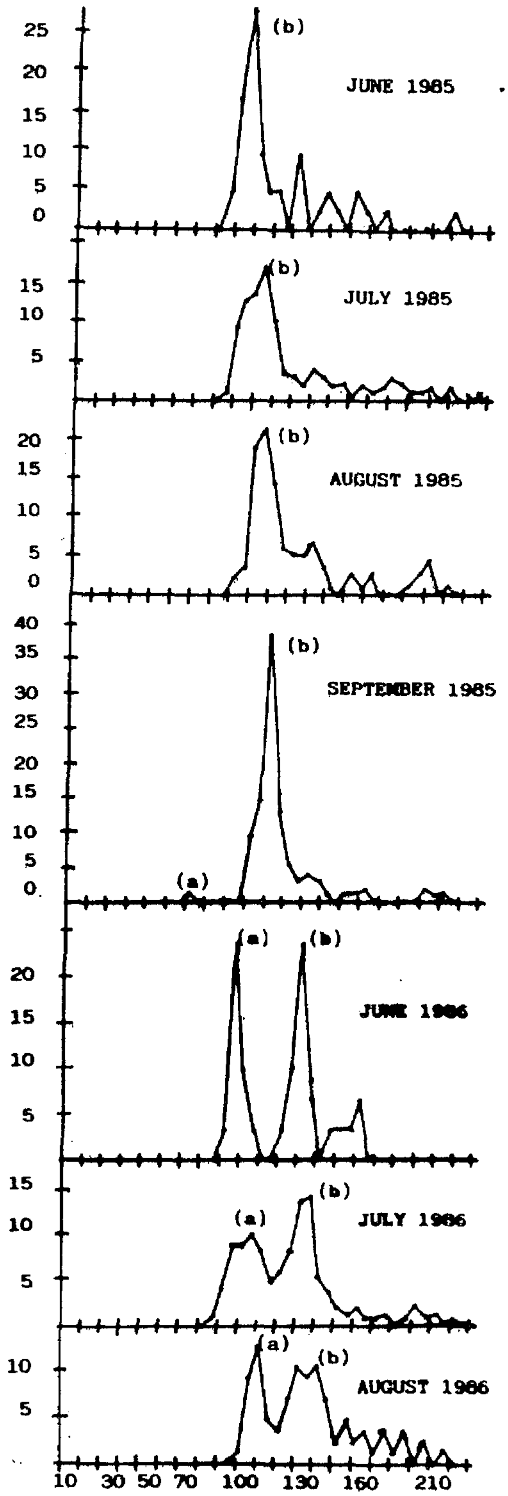


Figure 9 Length frequency curves of swordfish in varied months during the two year period 1985-1986

It is evident that the individuals of 62.5 cm grow about 40 cm after one year with an average monthly growth rate of 3.3 cm. After one more year the same individuals increase in size about 32.7 cm with an average monthly growth of 2.7 cm. Besides the growth rate in summer is higher than that in other months.

3.9 Recruitment

The size at first capture by longline in the Gulf of Taranto is between 55 and 65 cm. These young specimens, born from the end of June to the end of July, begin their recruitment during September and October, so that at time of capture they are two or three months old. The reasons for such a precocious recruitment are mainly due to:

(a) accidental capture coinciding with adult swordfish catch and above all with long line fishing of albacore;

(b) specific fishing for sport;

(c) specific professional fishing, this latter in minor degree.

For the fisherman of Porto Cesareo recruitment of young fish is due exclusively to factor (a) while factors (b) and (c) concern the ports of the Ionian coast of Calabria.

The phenomenon interests all of the Gulf of Taranto and it is quite widely spread (De Metrio et al., 1983, 1984, 1986) even if it does not lend itself to assessment given the difficulty in collecting data. It is, in fact, illegal fishing, inasmuch as Italian law fixes minimum size of capture at TL not inferior to 140 cm (including sword). Howver, we have calculated that along the Ionian coast of Calabria about 650 000 small swordfish were captured in 1984, of which about 2/3 were to be attributed to sport fishery. In the same year 3 309 fish were captured accidentally by the Porto Cesareo vessels during albacore longline fishery.

3.10 Sex-Ratio

During the two year period 1985-86 the gonads of 233 specimens were examined. It was observed that females outnumbered males. The sex-ratio, as males/females was found to be 0.70 in 1985 and 0.47 in 1986.

Taking into accont the size, it is noted that the proportion of females to males was roughly equal over the size range 60-135 cm (51.4-48.6%) but above this range the proportion of females becomes higher (16.7%-83.3%) (Figure 10). The gonad examination also indicated that males begin to reach sexual maturity at the end of their first year. The smaller swordfish with mature testes was 90 cm long. No mature female under two years old was found.

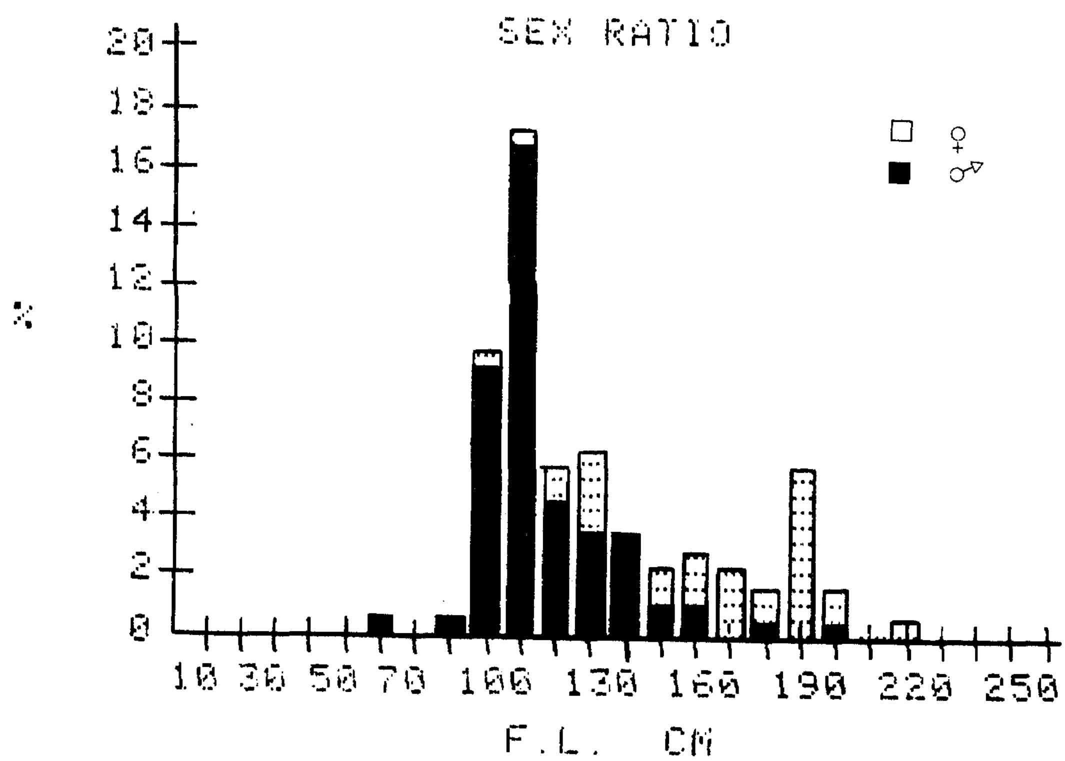


Figure 10 Size frequency distributions of male and female swordfish caught by the vessels of Porto Cesareo in 1985

4. CONCLUSIONS

Although nine years of observation have given a considerable quantity of information it must be remembered that P.C. is only one of the ports in the Mediterranean and therefore cannot be considered representative enough to be able to reach general conclusion, on the basis of collected data, on a species which, for its biology, is subject to frequent and vast migration. Perhaps this will be possible when the other investigation we are carrying out at the moment in the rest of the Ionian Sea and in the Aegean will allow us to collect a vaster quantity of data. It seems necessary to examine some considerations further.

The quantities of total catch are in proportion to the fishing effort which varies according to marine conditions. In fact, the vessels are relatively small (12 to 14 m long) and therefore their activity is considerably limited by bad weather conditions.

Capture per unit effort oscillations shown over the years may, very probably, be partly attributed to differing conditions in temperature and in the density of the waters in the various years which may have affected the presence and the permanence of spawning swordfish in the area and partly to the lesser or greater survival of juveniles. The catch of the latter in the following year contributed on one hand to raise the values of cpue in number but on the other hand to diminish the values of cpue in biomass and so cause sudden drops in average weights.

From an examination of the size frequency distribution it can be deduced that in 1984 production and survival rate of juveniles were high and this increased the stock on which fishing effort was carried out in 1985 and 1986. In fact the main bulk of the catch in these years was made up of fish, one or two years old.

A study of the catches in the fishing port of Croton, in the Gulf of Taranto and in Creta in the Aegean gave the same results so it can be concluded that the 1984 phenomenon concerned vast areas of the Mediterranean.

Growth rate in the first two years of life is very rapid. At the end of the first year we found a FL of 97.5 cm and at the end of the second, a FL of 122.5 cm.

Our results agree perfectly with those of Berkeley and Houde (1983) who calculated the age of swordfish in the straits of Florida using the spines of the anal pin.

The size at first capture is between 55 and 65 cm when the age of the fish is about two or three months.

Recruitment begins in September and continues throughout October and November. The capture of young fish is abundant particularly when longlines are used with small hooks (Longline for albacore fishing) and this fact is beginning to worry professional fishermen who are urging for measures to be taken. The problem concerns vast areas of the Mediterranean and would require solutions, the results of the elaboration of a common strategy agreed on by the different countries interested in the exploitation of this resource.

The determination of the sex carried out with gonad examinations both in 1985 and 1986 revealed a higher number of females.

In a sample of 233 specimens the proportion between males and females was almost equal up to a FL size of 135 cm while, over that size, females predominated.

The gonad examination also enabled us to establish that males reach sexual maturity at the end of their first year. Instead, no females in their first or second years have been observed to have mature gonads.

5. SUMMARY

The results of investigations carried out from 1978 to 1986 on the swordfish longline fishery in the Gulf of Taranto by the fishing fleet of the pilot port of Porto Cesareo, situated on the Ionian coast of the Salento, are reported.

For the nine years studied, the yearly variations of the fishing effort and the cpue both in biomass and in number of specimens are reported. A constant tendency to average weight decrease in the specimens caught is reported from 1980.

The size distribution and weight/length relationship were also studied in the last two years (1985-86) on representative samples of the catch (462 in 1985 and 317 in 1986). It is noted that

the main bulk of the catch comes from specimens aged up to two years and that age at recruitment coincides with the second-third month of life. A rough estimation of the size at first capture is between 55-65 cm.

A growth pattern of swordfish is given, according to the Petersen method, from the interpretation of the frequency of the sizes. Swordfish 97.5 cm long is considered one year old while 122.5 cm two years old. Specimens between 62 cm and 132 cm grow about 36 cm/year.

The gonad examination of 233 specimens indicated that males mature at a smaller size than females. Males begin to reach sexual maturity at the end of the first year at a length of around 90 cm.

Lastly, the sex ratio was computed. It is found that females outnumber males with 58.9% in 1985 and 67.9% in 1986. The proportion of females to males was roughly equal over the size range 60-135 cm.

6. REFERENCES

Beckett, K.S., 1974. Biology of swordfish, Xiphias gladius L. in the Northwest Atlantic Ocean. NOAA Tech.Pap.NMFS (Spec.Sci.Rep.-Fish.Ser.), (675):105-6

Berkeley, S. and E. Houde, 1983. Age determination of Broadbill Swordfish, Xiphias gladius L., from the straits of Florida using anal fin spine. NOAA Tech.Rep.NMFS, (8)

Cavaliere, A., 1963. Studi sulla biologia e pesca di Xiphias gladius L. Nota 1. Boll.Pesca Piscic. Idrobiol., 17(2)

De Metrio, G., et al., 1981. Andamento della pesca del pesce spada (Xiphias gladius L.) nel triennio 1978-80 al largo delle coste del Salento. Atti Relaz.Accad.Pugliese Sci., 39(2)

___________, 1983. Catture di giovani esemplari di pesce spada (Xiphias gladius L.) nelle acque dello Ionio. In Nuova Thalassia, 6 Suppl:511-6

___________, 1984. Survey on summer-autumn population of Prionace glauca L. (Pisces Chondrichthyes) in the Gulf of Taranto (Italy) during the four year period 1978-81 and its incident on swordfish (Xiphias gladius L.) and albacore (Thunnus alalunga) (Bonn.) fishing. Oebalia, 10:105-16

___________, 1986. Valutazione sull'entità, la composizione strutturale e la dinamica biologica degli stock dei grandi Scombroidei (Thunnus thynnus L.), Thunnus alalunga (Bonn.) (Xiphias gladius L.) nel Golfo di Taranto. (Relazione preliminare). In Atti del Primo Seminario, Ministero della Marina Mercantile, Roma 10-11 novembre 1986 (in press)

Kume, S. and J. Joseph, 1969. Size composition and sexual maturity of billfish caught by the Japanese longline fishery in the Pacific Ocean east of 130°W. Bull.Far.Seas.Fish. Res.Lab., 2:115-62

Megalofonou, P., et al., 1985. Osservazioni sulla prima maturità sessuale del maschio di Xiphias gladius L. (Nota preliminare). In Atti del trentanovesimo Convegno della Società Italiana di Scienza Veterinaria, Bari, 25-28 settembre 1985

Ovchinnikov, V., 1970. Swordfish and billfishes in the Atlantic Ocean: ecology and functional morphology. Springfield, Virginia, U.S. Department of Commerce, National Technical Information Service, TT 71-50011

Palko, B.J., G.L. Beardsley and W.J. Richard, 1981. Synopsis of the biology of the swordfish, Xiphias gladius L. NOAA Tech.Rep.Natl.MAr.Fish.Serv.Circ., (441):21 p. Issued also as FAO Fish.Synop., (127):21 p.

Sanzo, L., 1922. Uova e larva di Xiphias gladius L. Mem.R.Comm.Talassogr.Ital., (79):19 p.

Sella, M., 1911. Contributo alla conoscenza della riproduzione e dello sviluppo del pesce spada (Xiphias gladius L.). Mem.R.Comm.Talassogr.Ital., (2):1-16

Yabe, H., et al., 1959. Study on the life history of the swordfish, Xiphias gladius L. Rep.Nankai Reg.Fish.Res.Lab., 10:107-50

ACOUSTIC SURVEY IN THE EASTERN ADRIATIC IN 1986

by

Ivo Kacić
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

This paper describes preliminary findings on relative abundance and distribution of small pelagic fish (mostly srdine) stocks and makes comparison with earlier results.

2. DATA PRESENTATION

Acoustic survey was carried out in August 1986 by the R/V Bios, using Scientific sounder EK 38A over a constant zig-zag grid of stations.

The surveyed area covered part of the middle and northern Adriatic and part of the open sea waters out to 20 Nm offshore, and in the Gulf of Trieste to 0.5 Nm from the borderline. A total of 3 456 mi^2 were covered by the survey.

The data are presented as:

1. Maximum number of echo traces (fish concentration) crossed per nautical mile - Max/N

2. Mean number of echo traces (fish concentration) crossed per nautical mile - X/N

3. DISTRIBUTION AND ABUNDANCE

The main results of the 1986 acoustic survey were the following:

The number of echo traces of small pelagic fish concentrations gradually increased from the area of Susak Island toward the western Istrian waters. This applies to the south-western so called "Melure" area. The highest number of fish traces was recorded from the area west of Rovinj-Porec-Novigrad-Umag; 10-14 mi offshore.

The number of concentrations in the Gulf of Trieste was lower than that in the west-Istrian area, but still higher than recorded earlier. The maximum number of concentrations was recorded from the area between Porec and Novigrad. This small area is often a "focus" of small pelagic fish distributions (most frequently sardine) for the entire Yugoslav fishing area. Here, the average number of fish concentration traces ($\bar{X}$/N) was 3.67 (Table 1), and the maximum number of fish concentration traces (Max/N) of 12.0 traces crossed per mile was also recorded from this area.

Table 1

Abundance of pelagic fish (number of echo traces) in the eastern Adriatic
(Max/N; X/N = maximal and average number of echo traces crossed per nautical mile)
from 1975 to 1986

Year	N/m crossed	Area covered (square n mile)	Number of echo traces	Abundance		Differences
				Max/N	$\bar{X}$/N	
1975	852	7 668	2 370	4.2	1.4	
						+ 1.2
1977	482	4 338	663	4.1	2.6	
						- 1.4
1982	504	4 536	652	4.1	1.2	
						+ 2.5
1986	384	3 456	1 411	12.0	3.7	

These findings are indicative of the fact that rather large and significant concentrations of small pelagic fish, predominantly sardine, were present in the northern Adriatic in 1986. The comparison of these results with those from previous years (Kacić, 1980; 1981 and 1984) indicate that relative fish abundance,that is for the small pelagic fish stock, increased by more than 100 percent.

Such a large number of traces of small pelagic fish concentrations may be accounted for by the occurrence of large number of juvenile sardine in the northern Adriatic a year ago. According to fishermen, juvenile sardine appeared in the west-Istrian waters as early as January 1986. Fish length ranged from 30 to 40 mm at that time. In August, when acoustic survey was performed, there were 120 sardines kilogramme.

This occurrence of large sardine quantities posed problems for fishermen and fishing as well as for fishing industry. Fishing was stopped first on the western (Italian) side and thereafter on the eastern (Yugoslav) side of the northern Adriatic.

This occurrence of juvenile sardine, recorded also during acoustic surveys, may have significant implications to the sardine stock increase in the Adriatic, and, in our opinion, to the catch increase already seen in the 1987 fishing season. Perhaps the sardine catch data for the area of west-Istrian waters for the first months of this year (January-February) are already indicative of this trend (Table 2).

Table 2

The commercial catch of sardine for the first two months of 1986 and 1987 from the Istrian surveyed area, and the entire eastern Adriatic fishery

Year	Catch (in tons)	
	Istria January-February	Eastern Adriatic January-February
1986	1 017	173
1987	1 602	444

4. CONCLUSIONS

The results of an acoustic survey and data on mass occurrence of juvenile sardine in the northern part of the eastern Adriatic point to the fact that the sardine stock has increased in relation to preceding years. An increase in sardine catch is to be expected in the eastern Adriatic in 1987. These indicators may be of direct use for planning and fishery management in the eastern Adriatic.

5. REFERENCES

Kacić, I., 1980. Pelagic fish in the Adriatic: distribution and stock assessment. FAO Fish.Rep., (239):21-31

____________, 1981. Pelagic fish in the northern Adriatic: distribution and movements. FAO Rapp. Pêches/FAO Fish.Rep., (253):131-6

____________, 1984. Distribution and quantity of small pelagic fish in the eastern Adriatic: comparison of results. FAO Rapp.Pêches/FAO Fish.Rep., (290):217-22

JUVENILE SARDINE ALONG THE EASTERN ADRIATIC COAST - STUDIES AND PROTECTION (PART 2)

by

Ivo Kacić, Gorenka Sinovcić and Veronica Alegría-Hernandez
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

A report (Kacić, Sinovcić and Alegria-Hernandez, 1986) on juvenile sardine in the bays of the eastern Adriatic coast was presented at the preceding Technical Consultation. This paper reports on further observations of the occurrence of juvenile sardine. It has been concluded that better knowledge of juvenile growth needs more attention for the entire Adriatic and calls for several years of investigations, since few published papers by either Italian or Yugoslav workers (Marano, Casavala and Vaccarella, 1978; Kacić, Sinovcić and Alegria-Hernandez, 1986) have addressed this subject.

2. MATERIAL AND METHODS

Juvenile sardine were studied mainly in Novigrad and Karin Bays (Figure 1) and partly in Kastela Bay. Novigrad Bay is a closed marine bay with the Zrmanja River emptying into it, and is liable to rather great temperature and salinity variations. Samples for studies of biological characteristics of juvenile sardine were collected at least once a month. The data presented here were collected from May 1986 to April 1987. Several sample catches originate from Karin Bay (May, 1987) and one from Kastela Bay (May, 1986). No winter catches were obtained.

Total fish length (mm) and weight (g) were measured. The length-weight relationship was expressed by the function:

$$W = aL^{b}$$

where W is the weight, L total length, b the index of ponderal growth and a a constant.

For studies of the state of juvenile sardine under exploitation, fishermen were requested to fill up the forms recording daily catch by species, time spent searching for fish, time spent luring fish by light, to fish circling capture. Catch per Unit Effort (cpue) values were calculated on the basis of these data. One hour of searching for fish and luring by light was used as the unit of effort.

Echo-monitoring with SKIPPER SOUNDER MOD. 406, 38.5 KHz (frequency) was carried out parallel with searching, as well as a parallel echo-survey by the R/V BIOS (SIMRAD-Scientific Sounder EK 38 A, 38 KHz frequency).

3. RESULTS AND DISCUSSION

3.1. Growth of Juvenile Sardine

Monthly variations of length frequencies of juvenile sardine are given in Figure 2. Juvenile sardine appeared first in catches in April with the smallest length of 63 mm, and mean length 81.34 mm. Fish grew rather rapidly, attaining a mean length of 95.73 mm by the 43rd day. Thereupon, a period of slower growth followed, and in May, mean fish length was 126.20 mm. Mean lengths by dates of sampling are given in Figure 3.

A sample was collected from Karin Bay in June. Mean sardine length was 70.93 mm, reaching 76.14 mm 20 days later. The months later juvenile sardine from this area had attained a mean length of 102.46 mm.

A bimodal frequency distribution of lengths in some of the samples of juvenile sardine is indicative of the occurrence of new younger individuals in the study area. This is in agreement with the long spawning season of this species. Taking into account the fact that sardine spawn from the end of autumn to the beginning of spring and release eggs on several occasions during the spawning season (Muzinić, 1954; Karlovac, 1967; Gamulin and Hure, 1983) it may be assumed that juvenile sardine entering the Novigrad Bay earlier belonged to the early reproduction period and were about five months old. Their length ranged from 63 to 95 mm.

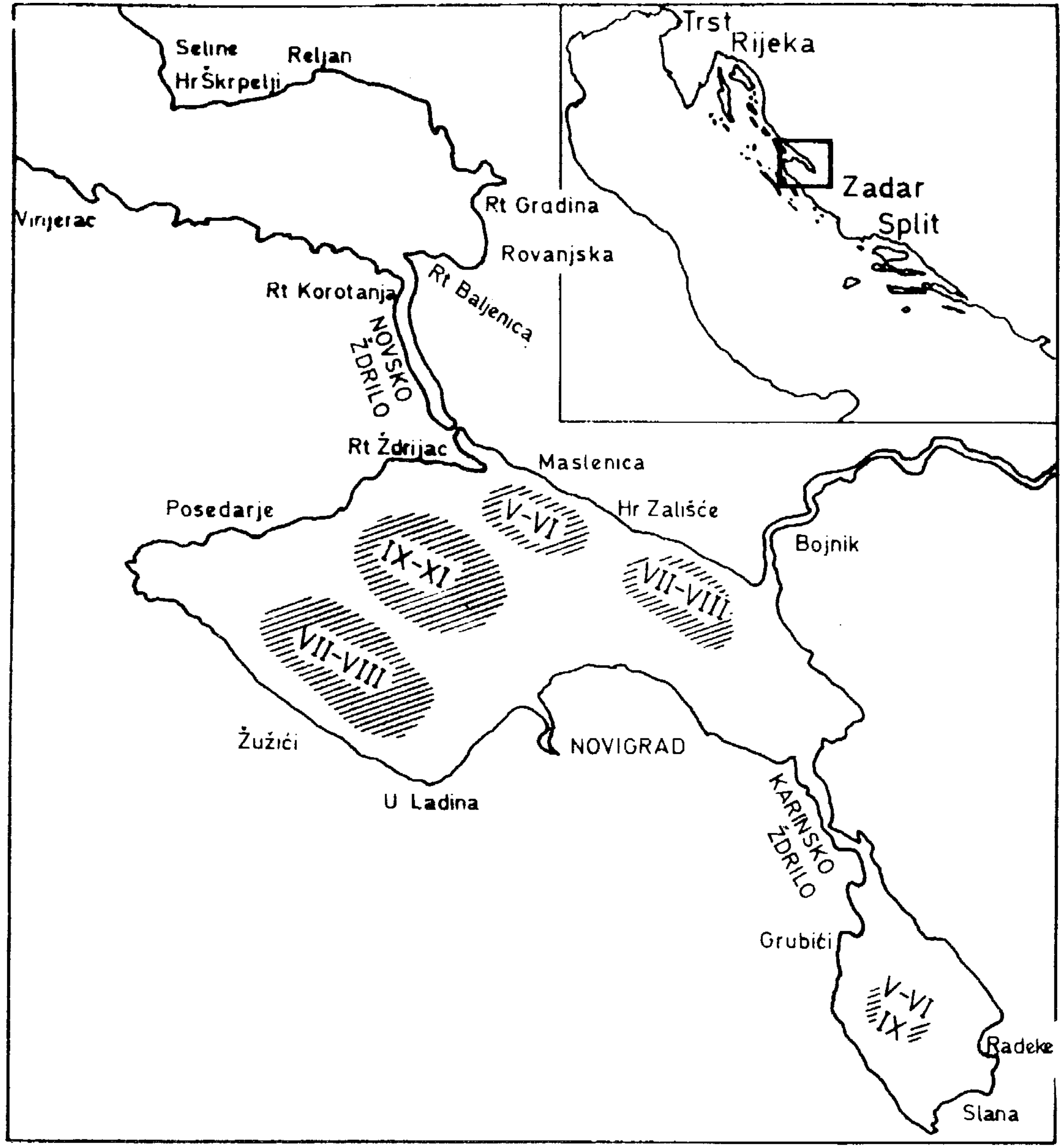


Figure 1 Study area with most frequent distribution of concentrations of juvenile sardine in the Novigrad and Karin bays

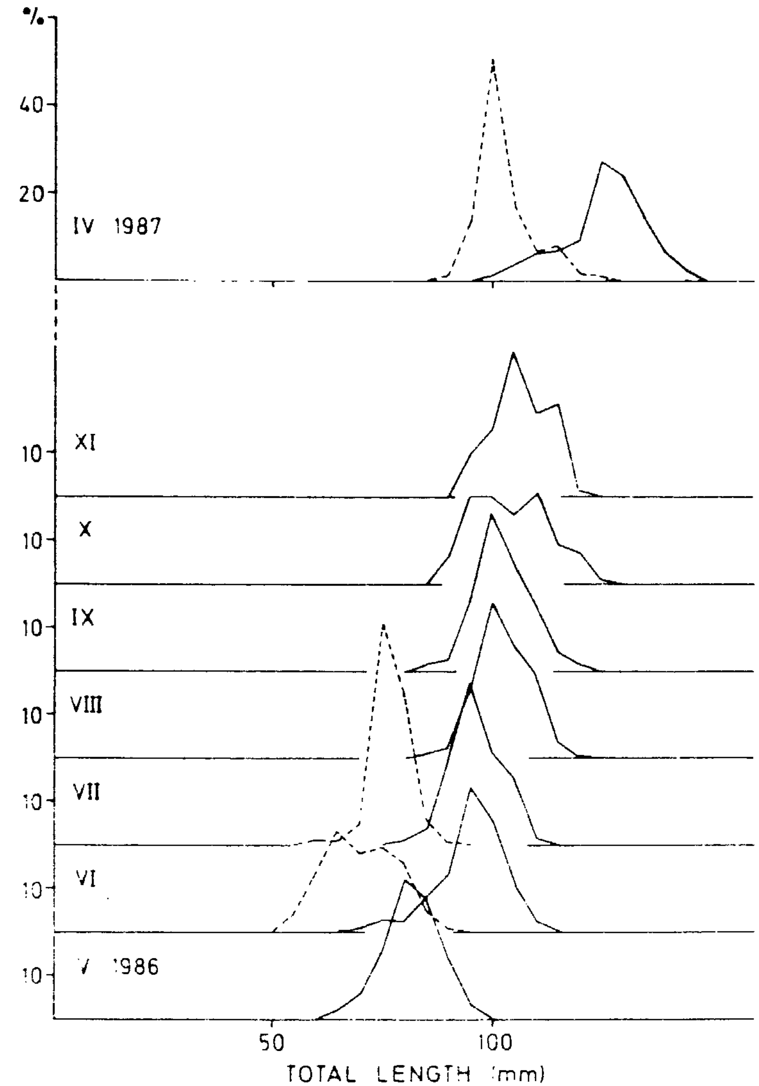


Figure 2 Total length frequency distribution of juvenile sardine from Novigrad Bay (——) and Karin Bay (---)

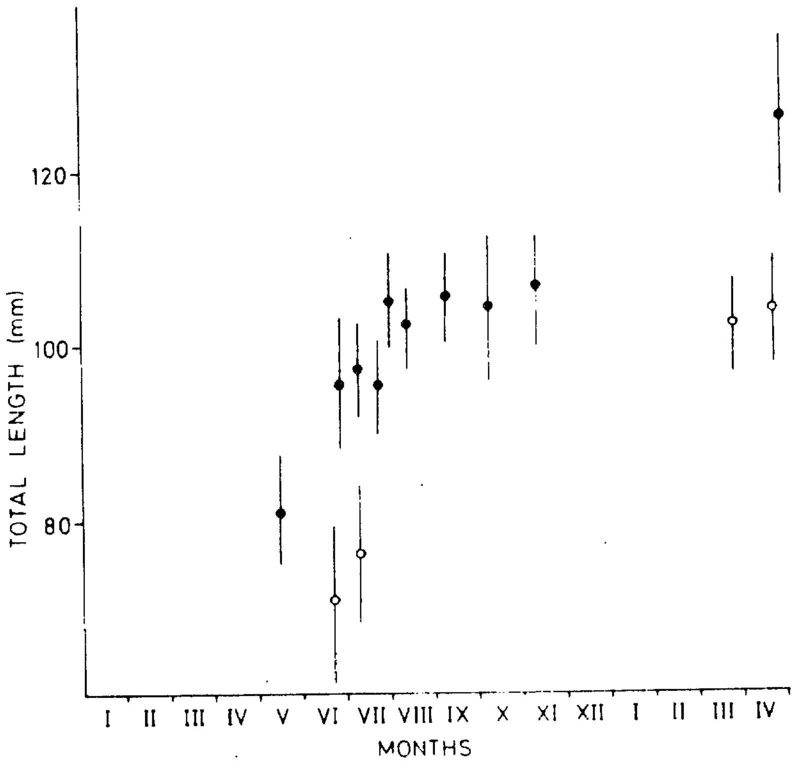


Figure 3 Juvenile sardine growth expressed as mean length of samples (with one standard deviation on each side) from Novigrad Bay (•) and Karin Bay (o)

Juvenile sardine in the Karin Bay very likely belonged to the late spawning. They appeared in the catch at an age of about three to five months. Muzinić (1957) noticed that in the first growth stage sardine ranged in length from 6 to 15 cm, which she explained by the long spawning period.

Parameters for length-weight were calculated for juvenile sardine on their appearance in the study area, and a year later when they were supposed ready to leave it. Results presented in Table 1 were used for the calculations of the values of the curve given in Figure 4.

Table 1

Length-weight relationships in juvenile sardine in the beginning of fishing season and a year later for the 1986-87 period

Date	Novigrad Bay			Karin Bay		
	r^2	$a(x10^6)$	b	r^2	$a(x10^6)$	b
May 1986	0.858	3.406	3.122	-	-	-
June 1986	0.971	5.330	3.036	0.946	0.837	3.468
April 1987	0.931	7.765	2.972	0.915	3.697	3.112

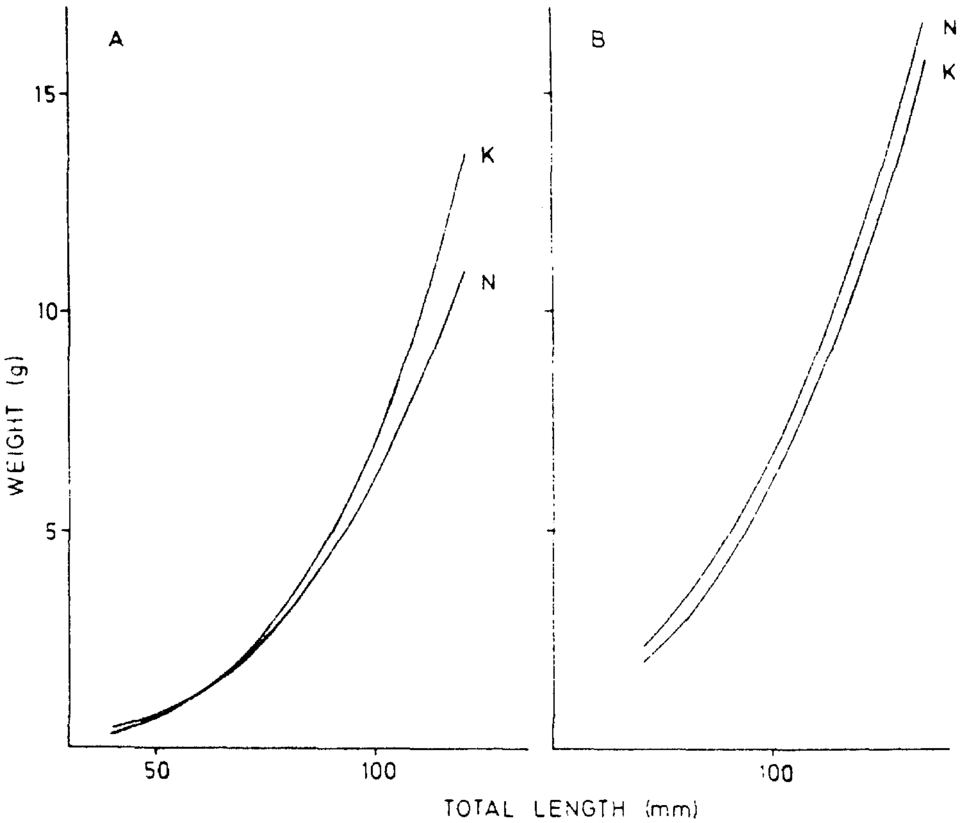


Figure 4 Length-weight relationship of juvenile sardine from Novigrad Bay (N) and Karin Bay (K) in June 1986 (A) and April 1987 (B)

Sardine from the Karin Bay showed markedly positive allometry in ponderal growth, as distinct from older sardine from the Novigrad Bay. A year later both groups grew in accordance with the isometric model.

It may be concluded that sardine immigrated into this almost completely closed bay at a very young age, leaving it probably at the beginning of maturation.

Juvenile sardine appeared in the closed bays of the middle Adriatic in the second half of May 1987, though there are some reports that they may also appear there earlier (Muzinić, 1957). Only one catch from the Kastela Bay was analysed. Total length range was 46-66 mm with mean length 55.20 mm.

Length frequency distribution for the whole catch is indicative of a unimodal distribution:

LT (mm)	45	50	55	60	65
%	2	13	47	33	5

3.2 Catch and Catch per Unit Effort (cpue)

Monthly catch distribution, fishing effort and catch per unit effort are given in Table 2. In 1986, with almost constant fishing effort, catch per unit effort showed a positive increasing trend of 16.73 kg per month. However, this does not signify that the population was steadily increasing or that new individuals had entered the study area, since fish already there could have grown in weight.

Table 2

Monthly catches, fishing effort and catch per unit effort of juvenile sardine in Novigrad Bay in the 1985-86 period

Year	Month	Catch (kg)	Fishing effort (h)	Catch per unit effort (kg/h)
1985	VI	500	18	27.78
	VII	-	85	-
	VIII	550	95	5.79
	IX	400	40	10.00
	X	3 400	149	22.82
1986	IV	180	16	73.75
	V	16 000	90	177.78
	VI	16 300	94	173.40
	VII	13 550	101	134.16
	VIII	17 180	88	195.23
	IX	-	-	-
	X	19 030	106	179.52
	XI	27 400	101	271.29
	XII	12 370	63	196.35

3.3 Distribution and Abundance (Echo-survey)

Hydroacoustic data show that juvenile sardine entered the bay at the end of March, though they were first captured in April. This is probably due to sardine schooling in the early, juvenile stage, which is dependent on size.

Juvenile sardine concentrations were very frequent in May, June, August and the beginning of November (Figure 5). These higher concentrations recorded from different areas of the Novigrad Bay in individual months are given in Figure 1. These coincide with the most frequent sardine fishing grounds.

The number of recorded concentrations was higher in 1986 than in some other years. This is indicative of the particular year class strength. No trend of decrease of the number of trace concentrations was observed from the beginning of the fishing season to its termination in autumn.

3.4 Conclusions

Studies of juvenile sardine carried out up to now in the Novigrad and Karin Bays, as well as in bays along the eastern Adriatic coast are indicative both of some differences in their occurrence and distribution, and of different fishing regulations between the different Adriatic areas. We refer here to the results of Marano, Casavala and Vaccarella (1978) reporting on the fishery of "Bianchetta" in the area of Bari. That paper reported on the catch of juvenile sardine from January to May of fish from 30-70 mm in length. The regulation prohibiting the catch of juvenile fish was cancelled in 1977 owing to the occurrence of large quantities of juvenile sardine and anchovy. However, sardine of that size are not fished for in the eastern Adriatic. At the same time the catch of individuals smaller than 100 mm is prohibited (except for experimental purposes).

Joint research on this important Adriatic fish, should be given more attention in reaching an agreement beneficial to all parties for protection of stocks.

Studies of sardine spawning (Gamulin and Hure, 1983; Regner, Piccinetti and Specchi, 1984), point to a unique sardine spawning ground in the Adriatic and not to isolated focuses. Owing to this the stock of juvenile sardine should be jointly approached since individual approaches will not give satisfactory results in solving the problems of rational exploitation and management of common and shared sardine resources.

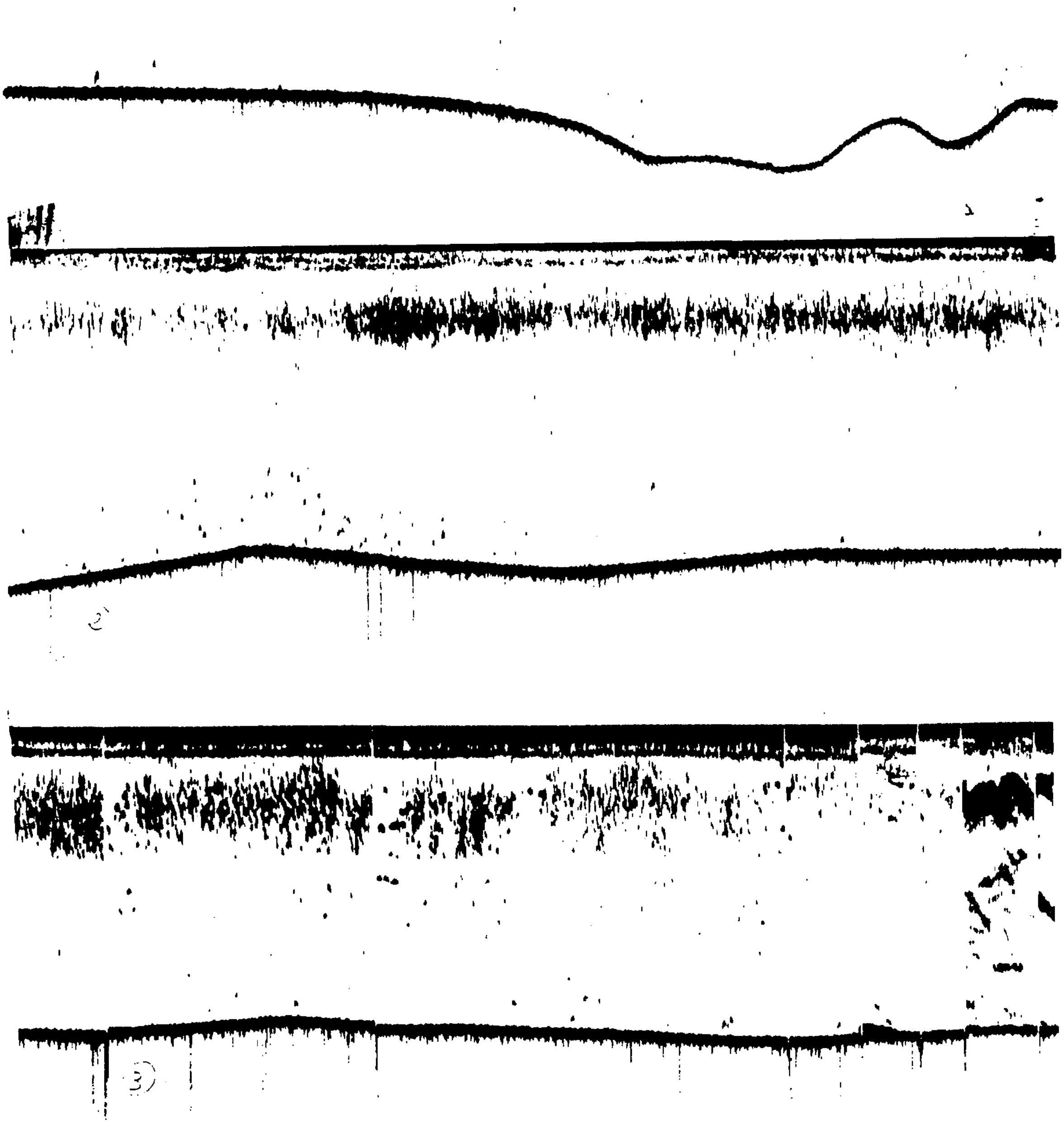


Figure 5 Echograms with numerous concentrations (shoals and layers) of juvenile sardine from Novigrad Bay (July, 1986) and their light-luring

4. REFERENCES

Gamulin, T. and J. Hure, 1983. The spawning and spawning areas of pelagics fishes (Sardina pilchardus, Engraulis encrasicolus, Scomber scomber, Sardinella aurita and Sprattus sprattus) in the Adriatic Sea. Acta Adriat., 24(1-2):97-131

Kacić, I., G. Sinovcić and V. Alegria-Hernandez, 1986. Juvenile sardine along the eastern Adriatic coast: studies and protection. FAO Rapp.Pêches/FAO Fish.Rep., (345):165-8

Karlovac, J., 1969. Etude de l'écologie de la sardine Sardina pilchardus Walb. dans la phase planctonique de sa vie en Adriatique moyenne. Acta Adriat., 13(2):112 p.

Marano, G., N. Casavala and R. Vaccarella, 1978. Pesca del "Bianchetto" in Terra di Bari. Quad.Lab. Tecnol.Pesca, Fano, 3(1 Suppl.):101-10

Muzinič, R., 1954. Contribution ` l'étude de l'écologie de la sardine (Sardina pilchardus Walb.) dans l'Adriatique orientale. Acta Adriat., 5(10):219 p.

____________, 1957. Sur la croissance de la jeune sardine (Sardina pilchardus Walb.) dans les eaux de Split. Bilj.Inst.Oceanogr.Ribar., Split, (12):4 p.

Regner, S., C. Piccinetti and M. Specchi, 1984. Estimate of spawning biomass of sardine in the northern and central Adriatic from 1979 to 1982 by means of egg surveys. FAO Rapp. Pêches/FAO Fish.Rep., (290):223-32

COURS DES PRISES AVEC PALANGRE DE SURFACE DANS L'ADRIATIQUE DU SUD (COTES ITALIENNES), TRIENNAT 1984-86

par

G. Marano, Rositani L., Ungaro N., De Zio V.
Laboratoire de biologie marine de Bari
Italie

1. INTRODUCTION

Dans l'Adriatique du Sud, la pêche par palangre de surface est née et s'est développée depuis 10 ans environ (Marano et al., 1983).

L'engin employé à une longueur de 30-40 km et 2 500-3 500 hameçons (figure 1).

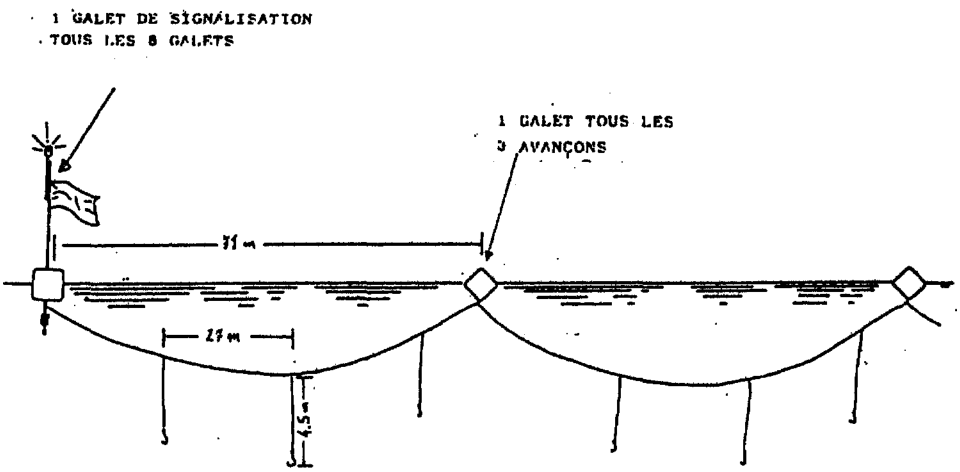


Figure 1 Palangre de surface

La pêche par palangre est adressée principalement à l'espadon Xiphias gladius L. et au germon Thunnus alalunga Bonn. (Marano et al., 1986).

Il est important de souligner que cette activité de pêche a un caractère périodique, en effet elle est pratiquée dans la période qui va de la fin du printemps au début de l'automne; dans les autres mois les mêmes bateaux pêchent par palangre de fond, chalut, etc., en adressant, donc, leurs efforts pour la plupart sur les ressources démersales.

Les bateaux qui pratiquent cette activité de pêche sont concentrés dans les ports de Mola, Monopoli, Savelletri et Otranto, dont le plus important, pour nombre de bateaux et de prises, est Monopoli.

Les données ci-dessous sont référées précisément au port de Monopoli.

2. PORT-ECHANTILLON DE MONOPOLI

Dans ce port les bateaux qui pêchent par palangre de surface rejoignent le nombre de 40-45 unités et ont puissance et tonnage différents.

La zone de pêche est comprise entre les 25 et les 70 milles de la côte, par rapport à l'espèce et à la période de l'année. En effet la pêche au germon est effectuée dans les mois d'été et d'automne en des aires plus voisines à la côte.

Les battues de pêche ont une durée de 2 à 5 jours.

3. MATERIAUX EMPLOYES ET METHODES

Le recensement de captures a été exécuté par des releveurs qui ont transcrit sur des fiches convenables, lors du débarquement, pour chaque bateau, les suivantes données: nombre et poids de prises pour espèce, jours de pêche, nombre d'hameçons effectivement utilisés et, lorsqu'il était possible, des mensurations biométriques. Ces données ont permis une valutation préliminaire des efforts de pêche dans les trois ans 1984-85-86 et, donc, du cours des efforts même pour les trois espèces les plus importantes (à peu près le 90 % des prises totales): l'espadon X. gladius, le germon T. alalunga et le requin bleu Prionace glauca L.

L'autre thonidé d'importance commerciale, le thon rouge Thunnus thynnus L., notamment très nombreux dans cette pêche dans d'autres districts, au contraire, dans l'Adriatique du Sud, représente un pourcentage négligeable du total.

Pour mieux connaître cette activité, nous avons même suivi, sur des bateaux professionnels, les différentes phases des battues de pêche.

4. RESULTATS

Les quantités totales des espadons débarquées dans le port de Monopoli, dans les trois ans examinés, sont les suivantes:

An	Nombre	Poids total en kg
1984	2 696	83 858
1985	5 387	121 028
1986	2 441	81 181

Les valeurs de l'Effort ($E = \frac{\text{jours x N moyen d'hameçon}}{100}$) et les Captures pour Unité d'Effort en biomasse ($cpue = \frac{kg}{E}$) et en nombre ($cpue = \frac{N}{E}$) dans les mêmes années sont:

An	E	cpue-kg	cpue-N
1984	20 850	4,02	0,13
1985	20 700	5,80	0,26
1986	15 705	5,02	0,15

Nous avons représenté ces données dans les figures suivantes:

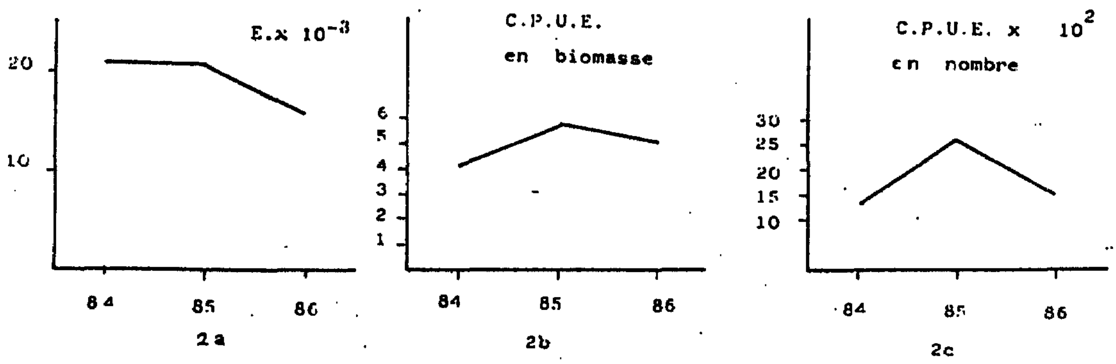


Figure 2 Effort et cpue dans les trois ans pour l'espadon

En outre dans la figure 3 nous avons représenté l'E dans les différents mois des trois années.

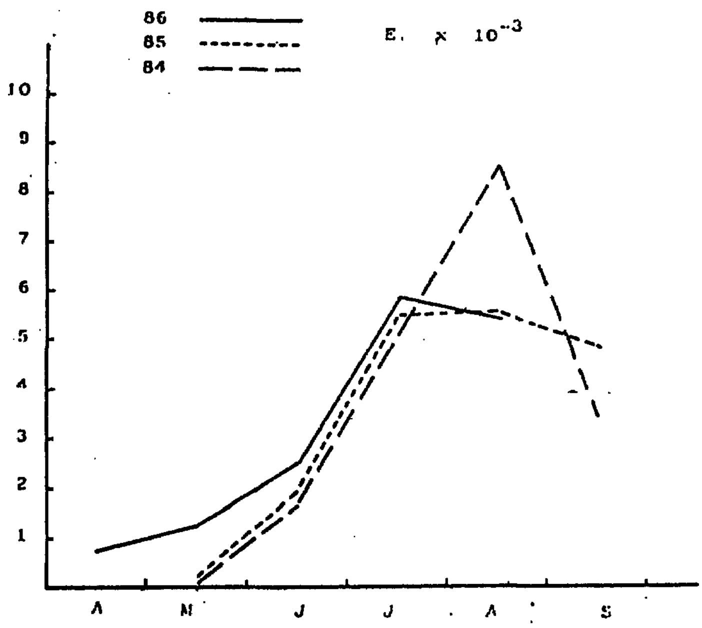


Figure 3 Effort dans les différents mois des trois ans pour l'espadon

Pour le germon les quantités totales débarquées sont les suivantes:

An	Nombre	Poids total en kg
1984	25 637	128 925
1985	55 331	295 111
1986	52 815	256 116

Les valeurs de E et des cpue en biomasse et en nombre sont les suivantes:

An	E	cpue-kg	cpue-N
1984	16 335	7,89	1,57
1985	28 950	10,19	1,91
1986	23 362	10,96	2,26

Représentées dans les figures suivantes:

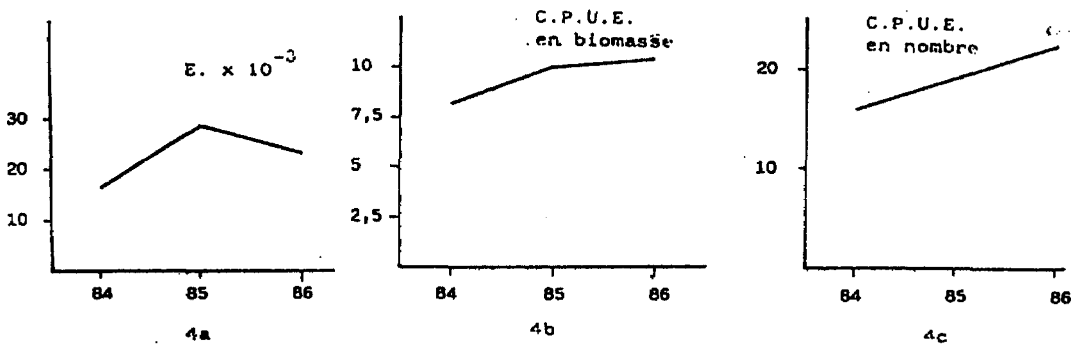


Figure 4 Effort et cpue dans les trois ans pour le germon

De l'observation des figures 5b et 5c on peut relever que la période la plus avantageuse pour la pêche au germon est celle comprise entre septembre et octobre.

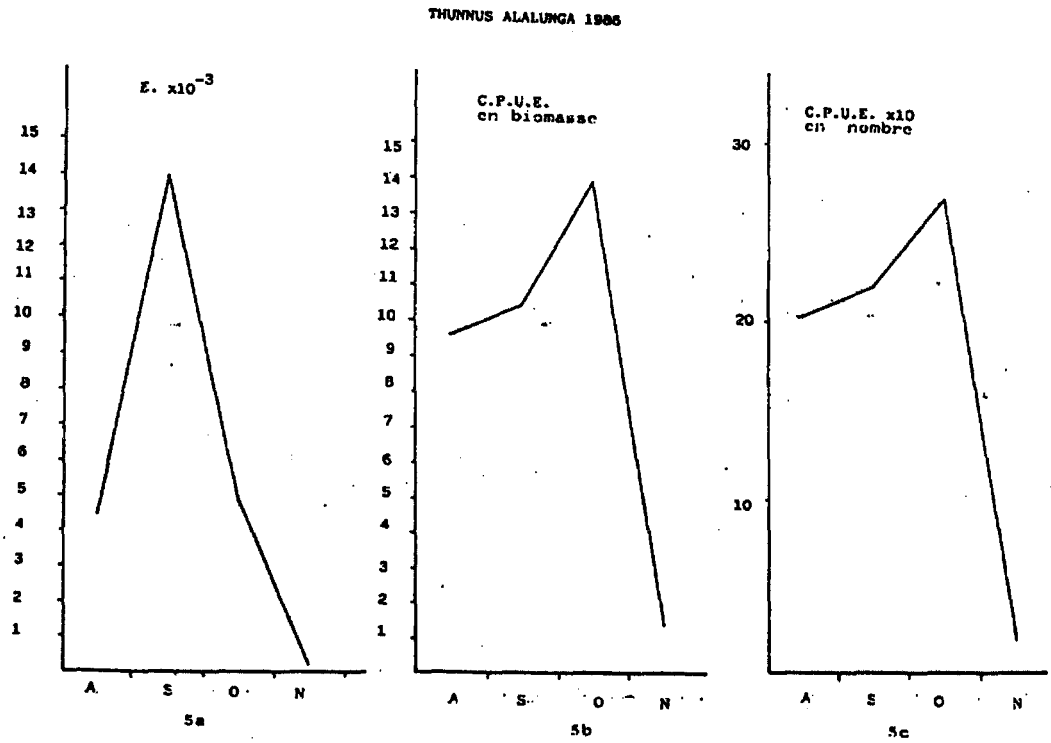


Figure 5 Effort et cpue dans les différents mois en 1986 pour le germon

Les quantités totales des requins bleus débarquées, toujours relatives au port de Monopoli, sont les suivantes (à remarquer que ces quantités sont référées seulement aux individus capturés pendant les battues de pêche adressées aux espadons):

An	Nombre	Poids total en kg
1984	1 478	24 078
1985	1 568	26 701
1986	2 695	43 059

Les valeurs de E et des cpue en biomasse et en nombre sont les suivantes:

An	E	cpue-kg	cpue-N
1984	20 850	1,3	0,07
1985	20 700	1,5	0,08
1986	15 705	2,7	0,17

Représentées dans les figures suivantes:

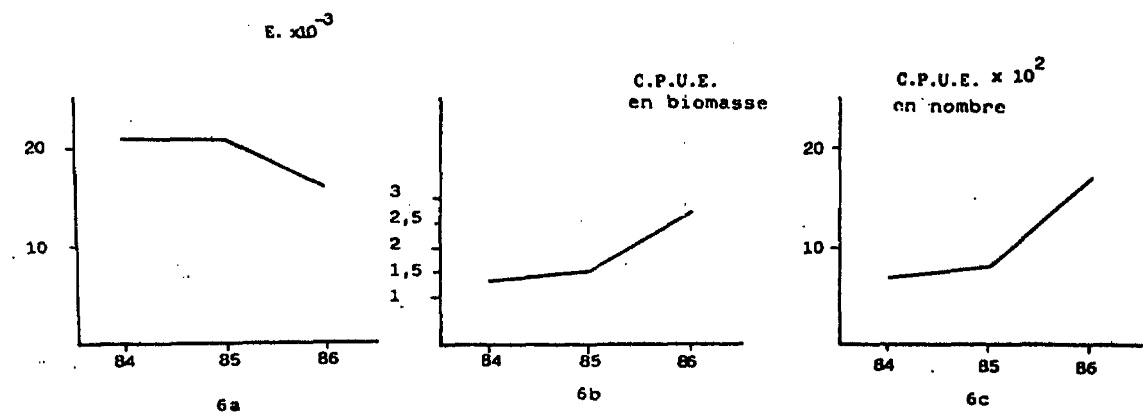


Figure 6 Effort et cpue dans les trois ans pour le requin bleu

Dans le tableau 1 nous reportons les valeurs du nombre, du poids et des pourcentages relatifs des différentes espèces pêchées.

5. CONCLUSION

Les considérations que nous avons reportées, étant donné la courte période de la recherche, sont nécessairement préliminaires et susceptibles de variations, soit pour le fait que les méthodologies, les zones et les périodes de pêche sont en phase de perfectionnement, soit parce que notre travail va continuer en considérant même des autres aspects (périodes de maturation, sex ratio, mensurations biométriques, etc.) et, donc, l'élaboration d'un plus grand nombre de données pourra nous fournir un tableau plus complet sur la situation des stocks.

Cela posé, nous pouvons remarquer dans les figures 2a et 6a, référées à l'espadon et au requin bleu, qu'en 1986 la valeur de l'E va diminuer par rapport aux années précédentes. Pour le germon (figure 4a) cette valeur est comprise entre celles des années précédentes.

Cela est à rapporter, probablement, aux conditions météorologiques et marines plus mauvaises en 1986 qu'en 1984-85 et que, donc, ont permis moins de battues de pêche; en outre il semble que les pêcheurs, dans la dernière année considérée, ont différencié plus rationnellement les périodes de pêche pour l'espadon et pour le germon (figures 3 et 5a).

Pour l'espadon les valeurs les plus hautes des cpue, soit en biomasse qu'en nombre, sont celles référées au 1985 (figures 2b et 2c), mais la variation de ces valeurs est plus évidente pour les cpue en nombre.

Cela montre qu'en 1985 les espadons capturés étaient plus petits, probablement ceux nés en 1984, année dans laquelle on a eu une grande natalitée (De Metrio <u>et al.</u>, 1986). On arrive au même résultat par une valutation du poids moyen effectuée sommairement en divisant le poids total par le nombre total des captures: pour le 1984 le P est = 31,10 kg; pour le 1985 = 22,47 kg; pour le 1986 = 33,26 kg.

Les cpue en biomasse et en nombre référées au germon présentent des valeurs qui vont toujours croître du 1984 au 1986 (figures 4b et 4c).

L'expérience des pêcheurs qui va de plus en plus s'améliorer d'un côté, et la petite exploitation des stocks due à la récente introduction de la pêche au germon de l'autre côté, pourraient être à la base de ce gain.

En outre il est intéressant de remarquer que la période de reproduction du germon est indiquée entre juillet et septembre (Tortonese, 1975; Whitehead <u>et al.</u>, 1986) et elle correspond à la période de pêche de cette espèce.

Dans les figures 6b et 6c on peut observer pour le requin bleu un gain des cpue, soit en nombre, qu'en biomasse, qui est évident surtout en 1986.

Cela est dû au fait que dans cette dernière année la pêche a été commencée en avril, tandis qu'en mai. De la figure 7, en outre, on voit que les valeurs plus hautes des cpue, pour le requin bleu, se trouvent dans les premiers mois de la saison de pêche, au contraire pour l'espadon les valeurs les plus hautes sont relevées dans les derniers mois. Il faut souligner que les périodes de pêche les plus avantageuses, pour les deux espèces, corrispondent aux périodes de reproduction indiquées soit pour l'espadon soit pour le requin bleu (Tortonese, 1970; Whitehead <u>et al.</u>, 1986).

D'autres considérations sortent en comparant le port-échantillon de Monopoli avec Porto Cesareo (sur la côte ionienne), qui a été objet d'études parallèles conduites par l'Unité de recherche de Nardo.

Les valeurs des cpue en biomasse (figure 8b) pour l'espadon ont une diminution remarquable et constante dans les trois ans pour Porto Cesareo, en outre même dans la mer Ionienne, en 1985, il y a un plus grand nombre de jeunes individus dans les prises (figure 8a) (De Metrio <u>et al.</u>, 1986).

Dans les trois ans, le cours des valeurs des cpue en biomasse pour le germon à Porto Cesareo est opposé à celui de Monopoli (figure 8c). Probablement la diminution des cpue pour cette espèce est due à une action, plus prolongée dans le temps, des efforts de pêche sur le stock de la mer Ionienne.

En effet cette activité de pêche est plus ancienne dans la Ionienne (elle est pratiquée à peu près depuis 20 ans) que dans l'Adriatique.

Tableau 1

Biomasse et nombre des différentes espèces par année

	Biomasse						Nombre					
	1984		1985		1986		1984		1985		1986	
	kg	(%)	kg	(%)	kg	(%)	kg	(%)	kg	(%)	kg	(%)
Xiphias gladius	83 858	32,53	121 028	25,90	81 181	19,96	2 696	8,42	5 387	8,37	2 441	4,02
Thunnus alalunga	128 925	50,02	295 111	63,17	256 116	62,97	25 637	80,07	55 331	85,97	52 815	87,03
Thunnus thynnus	2 722	1,05	8 491	1,81	5 435	1,33	95	0,29	576	0,89	444	0,73
Prionace glauca	31 473	12,21	28 943	6,19	47 422	11,66	2 202	6,87	1 819	2,82	2 892	4,76
Ruvettus pretiosus	5 946	2,30	8 208	1,75	6 183	1,52	1 199	3,74	849	1,31	1 088	1,79
Alopias vulpinus	4 129	1,60	4 539	0,97	7 178	1,76	33	0,10	40	0,06	69	0,11
Brama brama	292	0,11	566	0,12	1 050	0,25	148	0,46	348	0,54	442	0,72
Mobula mobular	272	0,10	-------	-----	-------	-----	2	0,00	------	-----	------	-----
Lamna nasus	103	0,03	-------	-----	-------	-----	3	0,00	------	-----	------	-----
Autres espèces	-------	-----	225	0,04	2 139	0,52	------	-----	4	0,00	494	0,81
Total par ann'e	257 720		467 111		106 704		32 015		64 354		60 685	

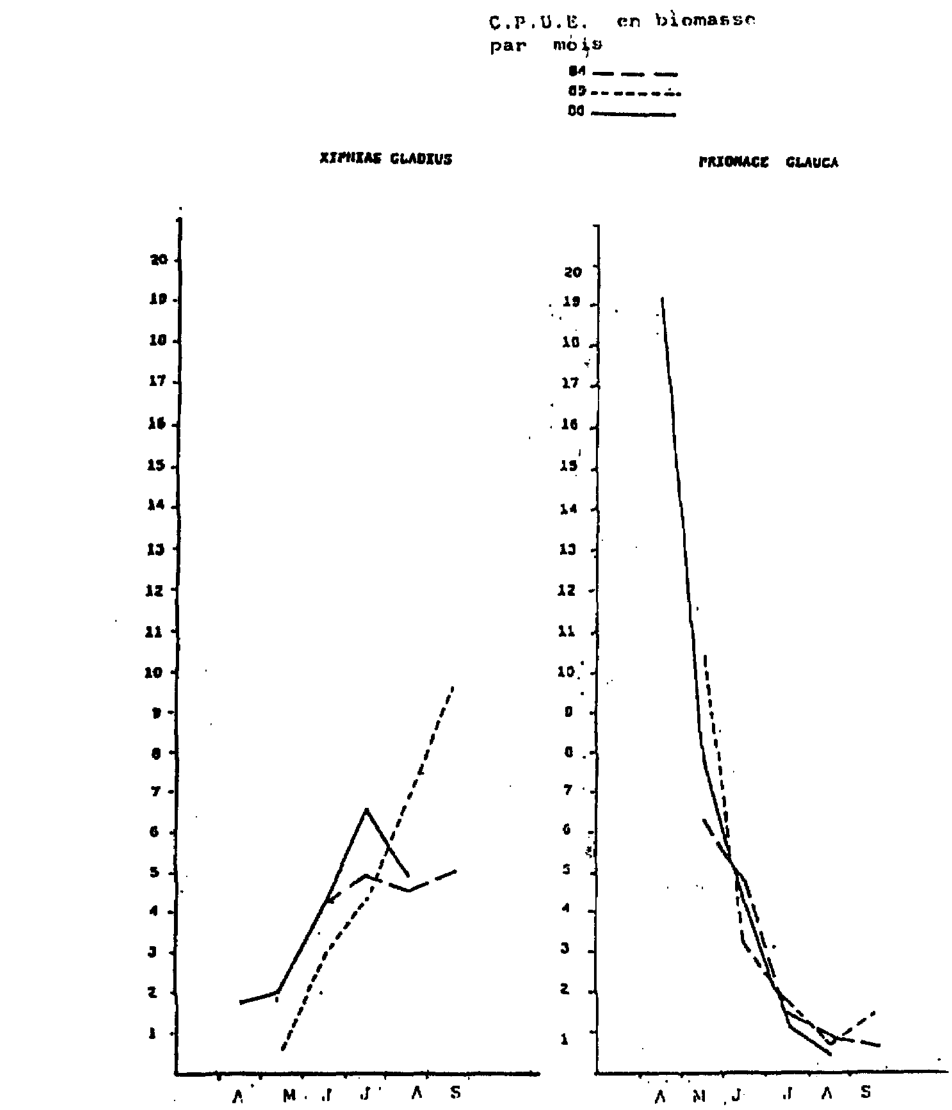


Figure 7 cpue dans les différents mois des trois ans pour l'espadon et le requin bleu

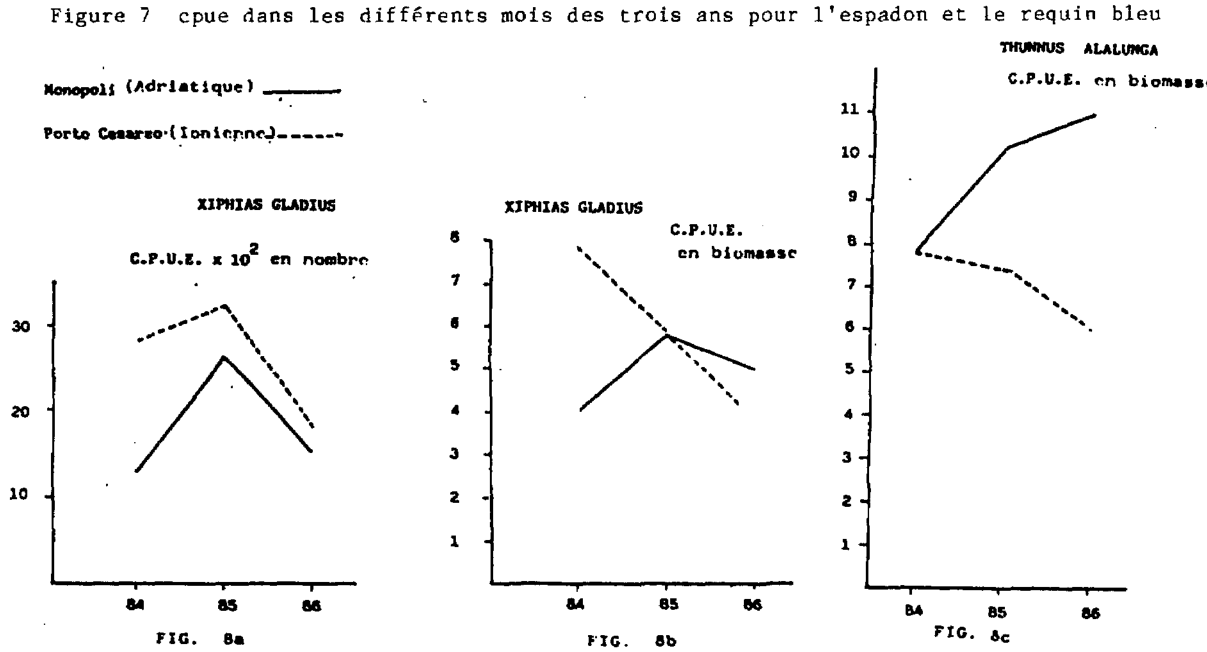


Figure 8 Comparaison entre les cpue pour X. Gladius et T. alalunga référée à Monopoli et à Porto Cesareo

Les valeurs des E dans les deux ports-échantillon dans les trois ans, ont un cours pareil (figure 9); d'ailleurs les valeurs des E référées à Porto Cesareo sont plus bas et cela est à rapporter au nombre plus bas des bateaux intéressés dans le port ionien (16 contre 45 du port de Monopoli).

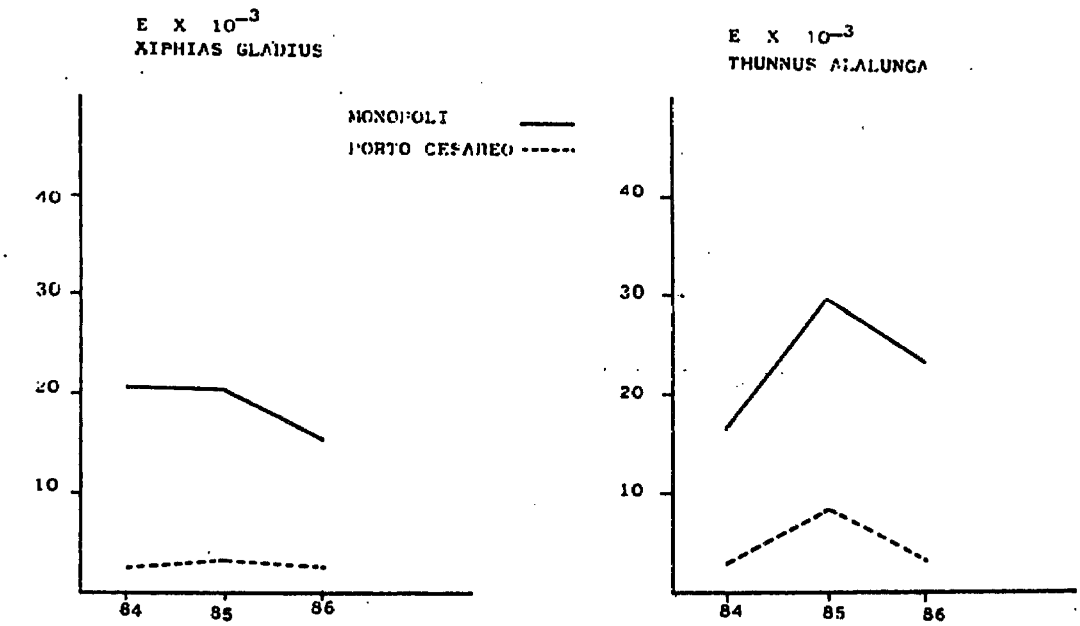


Figure 9 Comparaison entre les efforts pour X. gladius et T. alalunga référée à Monopoli et à Porto Cesareo

Cette activité de pêche, peu connue au niveau national, représente un pourcentage remarquable dans les quantités totales des prises.

Dans l'Adriatique du Sud, en effet, le produit de la pêche par palangre de surface rejoint 400-500 t par an, composées, dans la plupart, d'espèces de bonne valeur commerciale.

Nous pensons, donc, que cette activité de pêche doit être justement considérée et favorisée par le moyen de convenables structures de stockage dans les ports de plus grand rendement.

En outre, d'après les données à notre disposition, y comprises celles des mers les plus méridionales (Calabria, Sicilia), il est souhaitable que l'activité toute entière soit rationalisée et, surtout, que la fréquente capture des jeunes espadons et thonidés soit évitée.

Cependant la flottille italienne est la plus intéressée à cette activité et donc la réglementation de cette pêche favorisera surtout les pêcheurs italiens.

6. REFERENCES

De Metrio, G., et al., 1986. Valutazione sull'entità, la composizione strutturale e la dinamica biologica dei grandi Scombroidei (Thunnus thynnus L., Thunnus alalunga Bonn., Xiphias gladius L.) nel Golfo di Taranto. In Atti del Primo Seminario, Ministero della Marina Mercantile, Roma 10-11 novembre 1986 (en préparation)

Marano G., et al., 1983. Prime osservazioni sulla pesca di Xiphias gladius L. (Osteichthyes) nel Basso Adriatico. Thalassia Salentina, 12:50-9

__________, 1986. Attività di pesca con "long-line" nel Basso Adriatico: grandi Scombroidei. In Atti del Primo Seminario, Ministero della Marina Mercantile, Roma 10-11 novembre 1986 (en préparation)

Nakamura, I., 1985. FAO species catalogue. Vol. 5. Billfishes of the world. An annotated and illustrated catalogue of marlins, sailfishes, spearfishes and swordfishes known to date. FAO Fish.Synop., (125)Vol.5:65 p.

Tortonese S., 1956. Leptocardia, Ciclostomata, Selachii. Fauna Ital., 2:334 p.

___________, 1975. Osteichthyes. Fauna Ital., 11:636 p.

Whitehead, P.J.P. et al., (Eds) 1984. Fishes of the north-eastern Atlantic and the Mediterranean. Poissons de l'Atlantique du nord-est et de la Méditerranée. Paris, Unesco, Vol.1:112-3

___________, 1986. Fishes of the north-eastern Atlantic and the Mediterranean. Poissons de l'Atlantique du nord-est et de la Méditerranée. Paris, Unesco, Vol.2:1006-7

RELATION BETWEEN PHYTOPLANKTON PRODUCTIVITY AND *SARDINA PILCHARDUS* IN THE MIDDLE ADRIATIC

by

Ivona Marasović, Tereza Pucher-Petković and Veronica Alegria
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

The more recent data of oceanographic and fishery studies led us to try and estimate Adriatic productivity on the basis of chlorophyll *a* biomass. Results were compared with the results of a previous estimate of Adriatic productivity (Buljan, 1964), based on nutrient quantity assessment. The results indicate that the middle Adriatic has become more eutrophic than earlier. Since we have also recorded a recent permanent increase in primary production in the Adriatic the increase in fish catch (particularly of sardine) is related to the increase in primary production and eutrophication.

2. RESULTS AND DISCUSSION

The assessment of phytoplankton biomass by means of chlorophyll *a* concentration was introduced at the beginning of the nineteen seventies. It was, therefore, of interest to try to prove the distinction already made between different productive zones in the Adriatic, by applying this method and comparing results to the earlier estimation made by Buljan (1964). He made as assessment of the Adriatic productivity on the basis of phosphate quantities and depth of individual areas, and concluded that four productive zones may be distinguished in the Adriatic (Figure 1). The major part of the Adriatic (about 57%) constitutes the zone of lowest production (about 0.03 u mol $P\text{-}PO_4\ l^{-1}$). This zone (zone A) is not affected by land factors, while ingression effects are strongly felt. Adriatic ingressions are periodic stronger incursions of eastern Mediterranean water into the Adriatic, and the consequence of these events has been an increase in Adriatic productivity (Buljan, 1953; Zupanović, 1955; Zore-Armanda, 1966, 1969 and 1971; Pucher-Petković *et al.*, 1971; Pucher-Petković and Zore-Armanda, 1973; Karlovac *et al.*, 1974; Pucher-Petković, 1974; Vucetić and Kacić, 1973). Zone B, covering about 23% of the Adriatic surface area, is the zone of high production (about 0.12 u mol $P\text{-}PO_4\ l^{-1}$). Here belongs the area of shallow northern Adriatic directly affected by the Po River, which is one of the biggest European rivers. This river passes through areas of intensive agriculture carrying and discharging into the Adriatic large quantities of nutrient salts. The current regime of the northern Adriatic causes the transport of these nutrients along the Italian coast. Zone C is the area of channel waters of moderate production (about 0.07 u mol $P\text{-}PO_4\ l^{-1}$), partly affected by the land and partly by ingressions. Zone D includes the areas of high production (0.20 u mol $P\text{-}PO_4\ l^{-1}$) with more or less closed bays along the Adriatic coast.

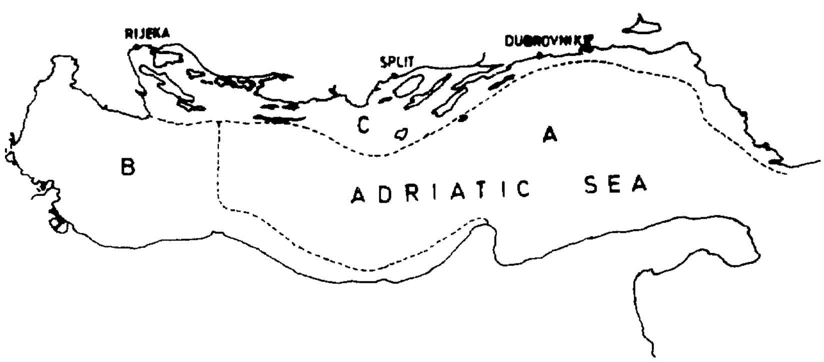


Figure 1 Scheme of division of Adriatic on four productive zones. Zone D includes semi-enclosed bays on the coast. (From Buljan, 1964).

However, our results were somewhat different from expected, since the chlorophyll *a* distribution showed some departure from previously defined productive zones. These departures were recorded in all seasons; both during productive (winter, spring) and non-productive parts of the year. This led us to conclude that some relationships between the zones as defined by Buljan have changed. Even though these data were obtained under quite different situations, that is during different seasons, all the results given in Figures 2, 3, 4 point to the fact that the so called

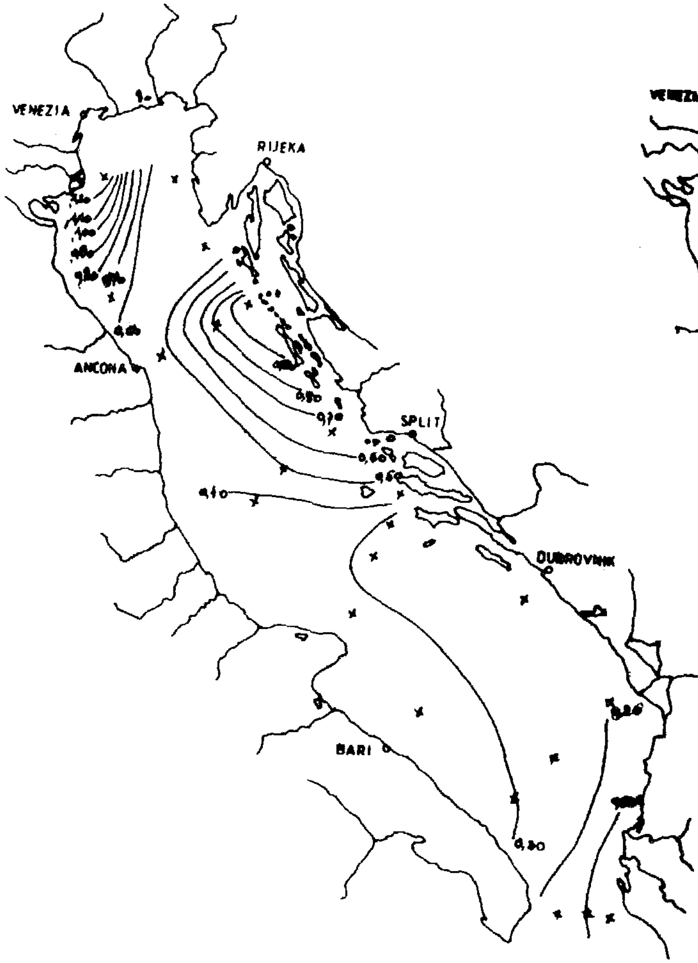


Figure 2 Mean values of chlorophyll a 0-50 m, April, 1976

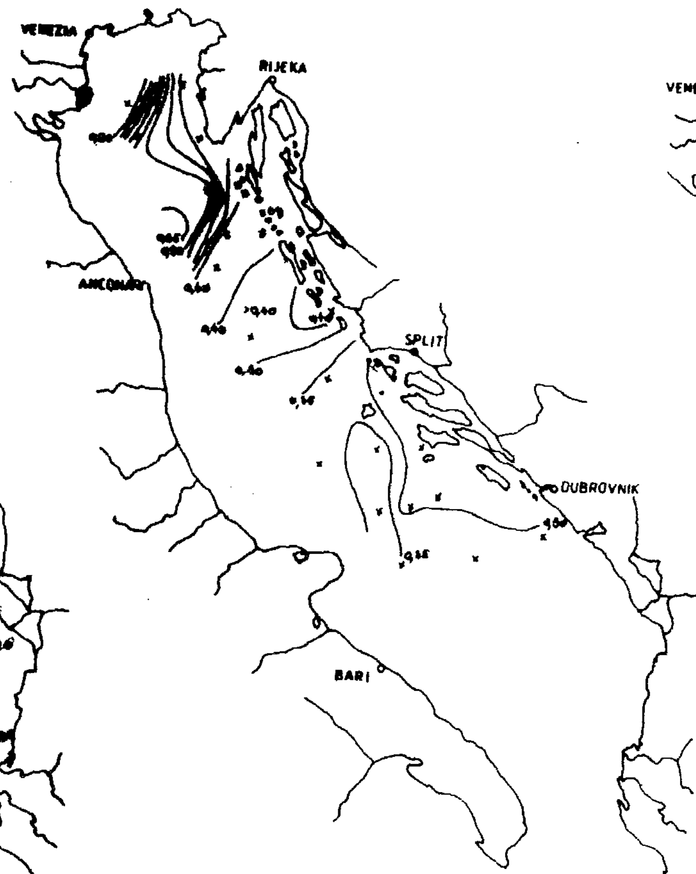


Figure 3 Mean values of chlorophyll a 0-50 m, cruises 1974, 1976, 1985 and 1986

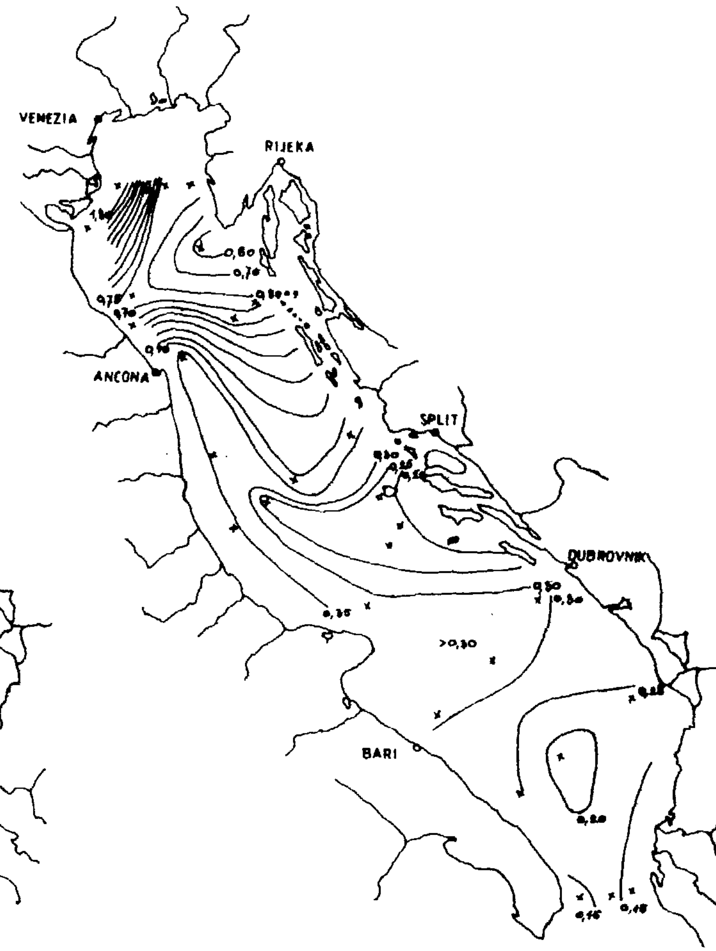


Figure 4 Mean values of chlorophyll a 0-50 m, cruises March 1982

zone A (zone of low production) has been reduced while zone C (zone of moderate production) has been enlarged. At the same time zone B (zone of high production), now sometimes extends to cover half of the Adriatic; that is boundary of this zone has been shifted almost to a line connecting Split and Ancona. As is well known, this is the area of sardine spawning and intensive fishing for small pelagic fish. From 1967 onwards a continuous increase of small pelagic fish catch (particularly sardine catch) has been recorded, with a contemporaneous reduction of the number of fishing days. This is one of the best indicators that fish population size has increased continuously. This increase is very likely the result of the increased trophic support to the population, due to the gradual eutrophication of the Adriatic and not due to the cyclic variations, which for the Adriatic occur with periodicities of 2.3, 3.5, 8 and 11 years (Zupanović, 1968; Regner and Gacić, 1974; Regner, 1985).

The results of research carried out by the Institute of Oceanography and Fisheries, Split, for over three decades, include regular and complete oceanographic observations and measurements at the Station Stoncica in the middle Adriatic (a station influenced by the open sea), and show that the increase in fish catch has been accompanied with an increasing trend in both primary production and chlorophyll _a_ quantities. Fluctuations of sardine catch in the middle Adriatic coincide well with these fluctuations of primary production on station Stoncica, but a better coincidence is shown by curves of primary production and autumn sardine catch in the middle Adriatic (Figure 5). During the period 1976-80, the data for these two curves do not show any correlation. We can assume that over this period, Adriatic ingressions existed because we recorded simultaneous changes in many abiotic and biotic factors in the Adriatic. The proportion of coccolithophorids in relation to diatoms increased, while phosphate quantity and total biomass of phytoplankton declined (Marasović and Pucher-Petković, 1983). Phosphate and nitrate showed a slight decrease, while saturation of oxygen showed a considerable decrease (the value for the entire water column was 98.8% O_2, and for bottom layer from 75-100 m was 91.6% O_2. This value had never been reached seriously in this part of the Adriatic) (Pucher-Petković _et al._, this document). It was unexpected that changes in sardine catch during this period were not found. But when we compared the primary production of Stoncica and the sardine catch only for fishing ground D (this zone is around Vis Island where the Stoncica Station is also situated) (Figure 6) these two curves displayed a very good correlation (Figure 7). Sardine catch was markedly reduced during the 1977 to 1980 period (Table 1), and this decrease may be related to the enhanced inflow of Mediterranean waters.

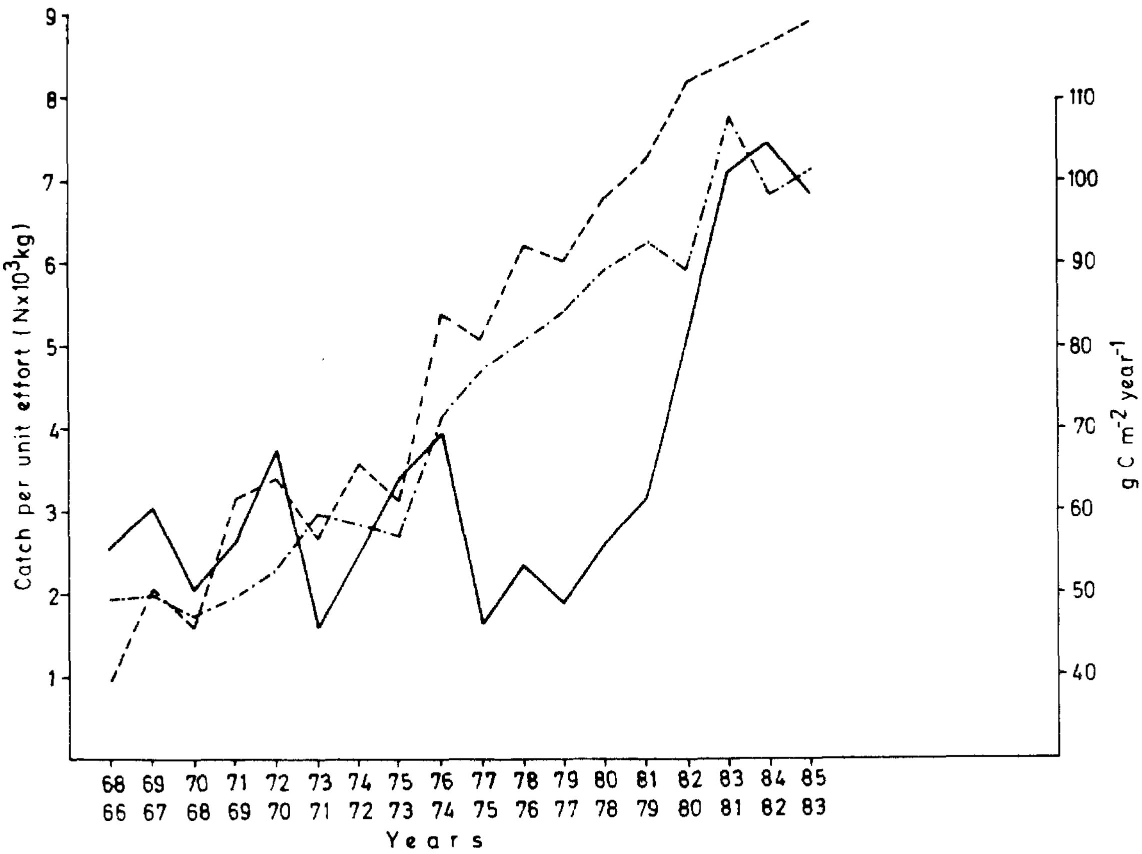


Figure 5 Primary production of Station Stoncica (———), annual sardine catch in the middle Adriatic (-•-•-•), autumn sardine catch (-----) in the middle Adriatic

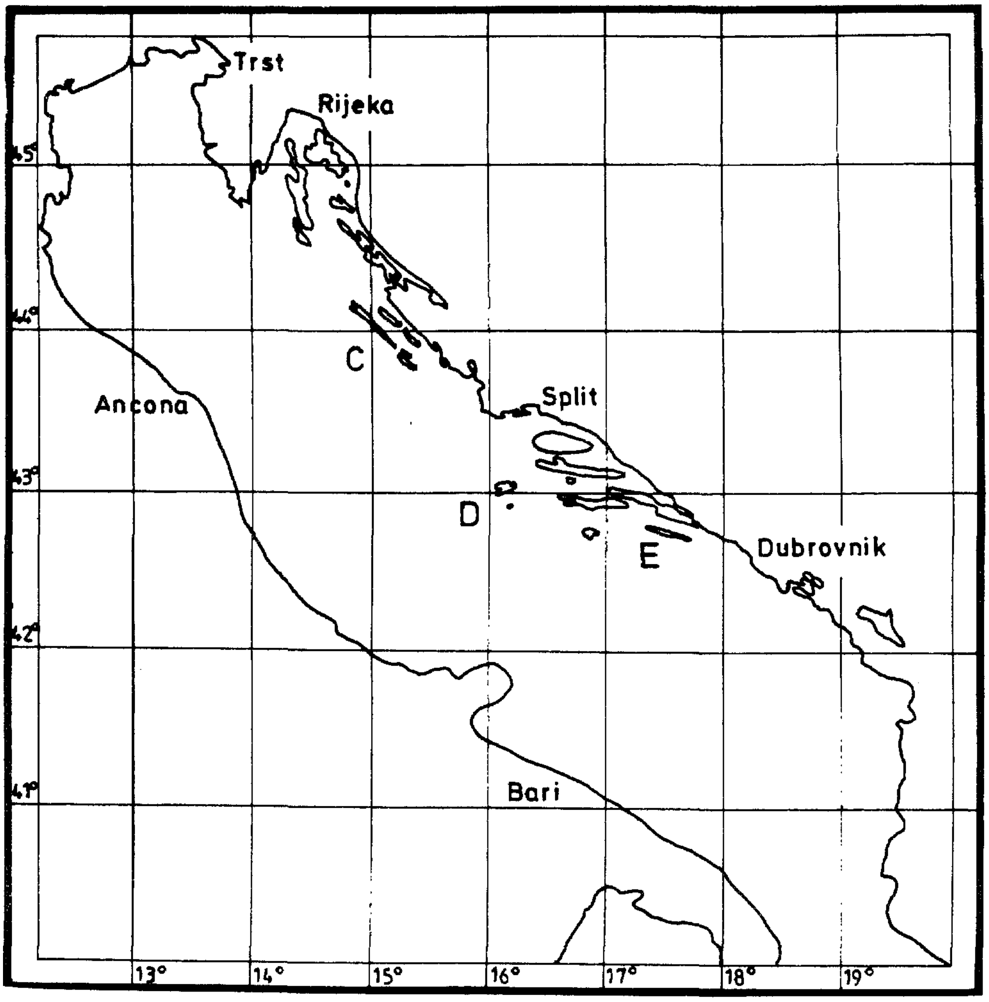


Figure 6 Fishing grounds (A, B, C) in the middle Adriatic

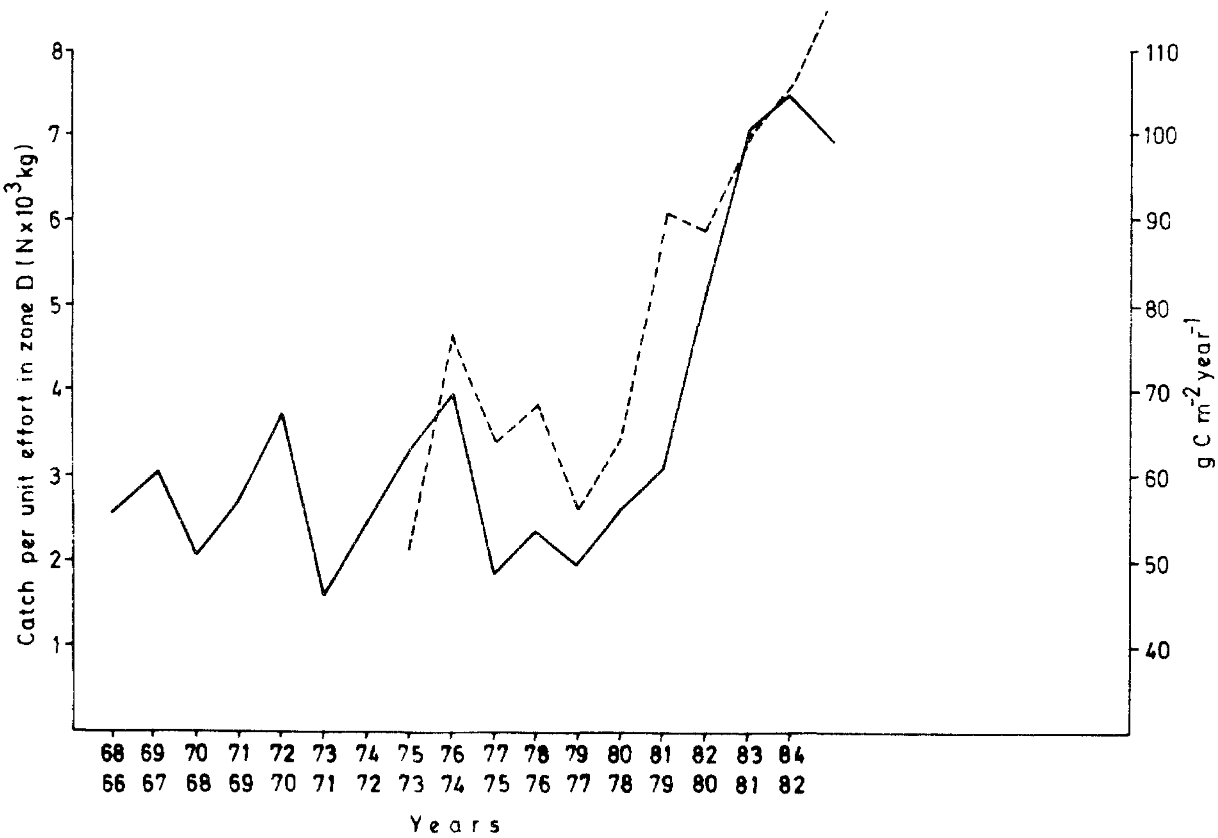


Figure 7 Primary production (——) on the Station Stoncica (middle Adriatic) and sardine catch in fishing grounds D

Table 1

Sardine catch per unit effort in three fishing grounds C, D, E in the middle Adriatic (kg)

Year	C	D	E
1975	2.609	2.129	1.721
1976	4.359	4.615	1.438
1977	4.682	3.425	1.785
1978	3.024	3.816	1.801
1979	3.109	2.610	1.856
1980	2.892	3.422	1.977
1981	4.356	6.025	2.220
1982	4.809	5.761	3.511
1983	6.862	6.976	2.081
1984	6.288	7.516	2.910
1985	5.823	8.860	3.455

On the basis of all data we supposed that in recent times ingressions of eastern Mediterranean water into the Adriatic have provoked a decrease rather than an increase of eutrophication of Adriatic waters. We assume that the productivity increase of the Middle Adriatic waters is generated by nutrient rich waters of coastal origin.

All the results obtained thus indicate that eutrophication has reached the open Adriatic waters, and continues to have a positive effect on fishery resources of the Adriatic Sea.

3. REFERENCES

Buljan, M., 1953. Fluctuation of salinity in the Adriatic. Izv.Inst.Oceanogr.Ribar., Split, 2(2):63 p.

__________, 1964. Ocjena produktivnosti Jadrana dobivena na temelju njegovih hidrografskih svojstava. Acta Adriat., 11(4):35-45

Karlovac, J., et al., 1974. Procjema bioloskih resursa Jadrana na osnovi planktona. Acta Adriat., 16(9):157-83

Marasović, I. and T. Pucher-Petković, 1983. Irregular phytoplankton blooms in the Kastela Bay (Central Adriatic). Rapp.P.-V.Reun.CIESM, 28(9):97-8

Pucher-Petković, T., 1974. Essai d'évaluation de la production primaire annuelle dans l'Adriatique. Rapp.P.-V.Réun.CIESM, 22(9):71-2

Pucher-Petković, T. and M. Zore-Armanda, 1973. Essai d'évaluation et pronostic de la production en fonction des facteurs du milieu dans l'Adriatique. Acta Adriat., 15(1):1-32

Pucher-Petković, T., M. Zore-Armanda and I. Kacić, 1971. Primary and secondary production of the middle Adriatic in relation to climatic factors. Thalassia Jugosl., 7(1):301-11

Pucher-Petković, T., et al., Time series of productivity parameters indicating eutrophication in the middle Adriatic waters. FAO Rapp.Pêches/FAO Fish.Rep., (this document)

Regner, S., 1985. Ecology of planktonic stages of the anchovy, Engraulis encrasicolus (Linnaeus, 1758) in the central Adriatic. Acta Adriat., 26(1):1-113

Regner, S. and M. Gacić, 1974. The fluctuations of sardine catch along the eastern Adriatic coast and solar activity. Acta Adriat., 15(11):11 p.

Vucetić, T. and Kacić, 1973. Seasonal and annual fluctuations of zooplankton and echo traces abundance in the fishing ground of the Central Adriatic. GFCM Stud.Rev., (53):19-38

Zore-Armanda, M., 1969. Water exchange between the Adriatic and the Eastern Mediterranean. Deep-Sea Res., 16:171-8

Zore-Armanda, M., 1971. Influence of long term changes in the oceanographic/meteorological conditions in the North Atlantic on the Mediterranean. In The ocean world. Proceedings of the Joint Oceanographic Assembly, Tokyo. 1970. pp. 151-4

Zupanović, S., 1955. A statistical contribution to the study in ecology of sardine (Sardina pilchardus Walb.) in the eastern Adriatic. Acta Adriat., 7(10):

__________, 1968. O uzrocima fluktuacija u lovinama srdele na istocnoj obali Jadrana. An.Jadranskog Inst., (4):491 p.

THE SPAWNING OF THE SARDINE (Sardina pilchardus WALB.) IN THE ADRIATIC AS RELATED TO THE DISTRIBUTION OF TEMPERATURE

by

S. Regner
Institut za oceanografiju i ribarstvo,
Split, Yugoslavia

and

G. Piccinetti-Manfrin and C. Piccinetti
Laboratorio di Biologia Marina e di Pesca,
Fano, Italy

1. INTRODUCTION

Many papers deal with the problem of defining the sardine spawning areas in the Adriatic (Gamulin, 1948, 1954; Gamulin and Hure, 1955; Gamulin and Karlovac, 1956; Karlovac, 1958, 1964, 1967, 1969; Hure, 1961; Gamulin and Zavodnik, 1961; Stirn, 1969; Stirn and Kubik, 1974; Piccinetti, Regner and Specchi, 1980, 1981; Gamulin and Hure, 1983). All these authors were mainly concerned with describing the geographical distribution of sardine spawning areas, without an explanation of why sardine spawn in certain areas, or, if they provided explanations, they did so only for restricted areas. The first authors who analysed the causes of the distribution of sardine spawning centres over the whole Adriatic were Skrivanić and Zavodnik (1973). They found that sardine spawned in the areas of mixing of water masses from the shallow northern Adriatic with the water masses originating from the Mediterranean. They called these zones of mixing "equilibrium areas", where the conditions for the spawning of sardine are most favourable. Most recently, Regner et al. (in press) analysed the spawning of sardine along the eastern Adriatic coast up to the middle line during the spring of the year 1982, and compared intensity of spawning with the distribution of temperature, salinity, water density, and quantity of phytoplankton, micro and mesozooplankton. They found that sardine were spawning along the boundaries of upwelling zones, where the quantities of phytoplankton and zooplankton were also rich. These two papers gave us the idea of comparing the intensity of spawning of sardine with the distribution of temperature in the different months of the spawning season, over as wide as possible an area.

2. MATERIAL AND METHODS

The material for this study was collected during the egg surveys carried out within the framework of the Italian-Yugoslav Joint Project for the Stock Assessment of Small Pelagic Fish (sardine and anchovy). In general, material was collected along 11 profiles, distributed from the Gulf of Trieste to the line connecting Monte Gargano and Cape Ostra at the entrance of Boka Kotorska Bay (Figure 1). The mean distance between profiles was about 25 nautical miles, while the distance between stations along the profiles was 10 nautical miles. There were 13 surveys in total performed in the period from 1979 to 1986, during the spawning season of sardine, but not all the profiles were occupied during all the cruises, and a number of stations occupied were not on the profiles. The surveys during which the maximum number of profiles was occupied were those performed in December 1979, February 1980, March 1981, and March 1982. these four surveys were chosen for this study.

Sardine eggs were collected with a BONGO-20 plankton net, consisted of two cylinders of 20 cm diameter; each with its own plankton net. The mesh size was 250 µm. At each station, the net was towed obliquely at a speed of 1.5 to 2.0 knots. At the stations where the depth did not exceed 60 m, the net was towed to about 5 m above the bottom, while at the deeper stations, the net was lowered to the depth of 60 m. The quantity of sardine eggs was expressed as the number of eggs under 1 m^2 per day. This was calculated using the method described in detail by Regner et al. (1981).

At every station the data on temperature for every 5 m of depth were recorded by the CSTD probes, with a precision of $\pm$ 0.01^{o}C. The maximum depth at which temperature was measured was 70 m.

3. RESULTS AND DISCUSSION

The production of 100 or more sardine eggs under 1 m^2/day was accepted in this study as a criterion for establishing the centres of spawning areas.

During December 1979, when the cooling of the waters along the Italian coast had just begun, the centre of spawning was situated over the profiles VII, VIII, IX, X, and XI (Figure 2). This centre extended 10 to 20 miles off the Italian coast, forming the belt parallel to the coast from the level of Civitanova to Monte Gargano. The maxima of egg production were found between isotherms of 13 and 15°C, immediately along the frontal zone (Figure 2).

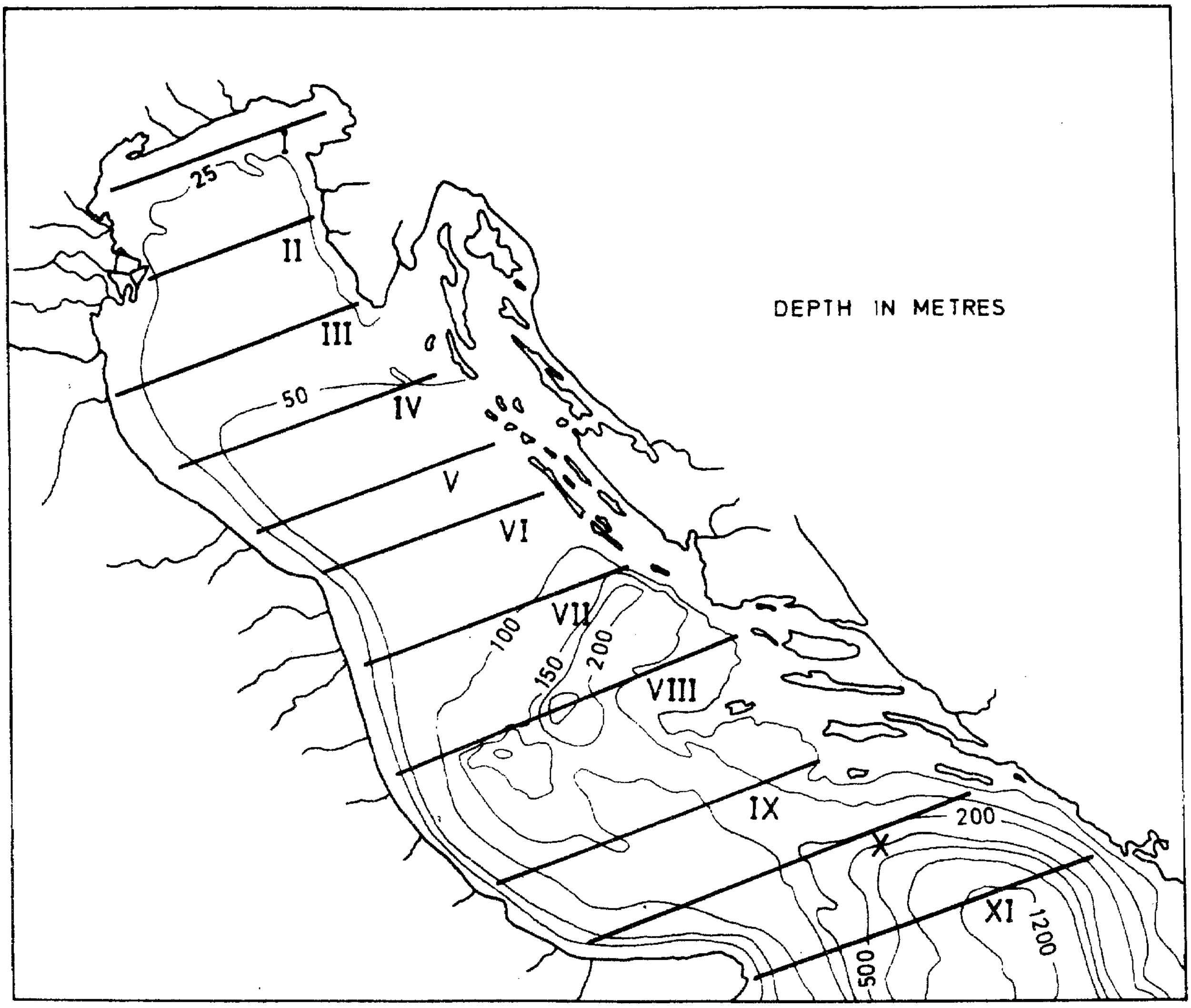


Figure 1 The distribution of profiles at the area of survey

Two months later, in February 1980, the water along Italian coast was cooled so much, that the isotherm of 13°C in the central part of the surveyed area reached the middle of the Adriatic, while in the southern parts it came within 30 to 50 miles of the Italian coast, with the exception of the profile XI near Monte Gargano (Figure 3). In that situation two centres of spawning were formed, the first one on profile VII, one just midway between the east and the west coasts at the north-west boundary of the Jabuka pit; the second along profile X, also midway between the west and the east coasts, at the boundary of the southern Adriatic pit. The first centre fell between isotherm 12 and 13°C, and the second between 13 and 14°C (Figure 3). The centre at profile VII was again near the frontal zone. A somewhat higher production of eggs (about 80-90 eggs/m²/day) was also found on profiles IV and V, in the northern part of the central and southern parts of the northern Adriatic, at temperatures between 11-12°C; again near the frontal zones.

In March 1981, all the northern Adriatic was cold, and only on profile I one isolated area of intensive spawning was found at a temperature of 11°C (Figure 4). The main centres of spawning occurred on profiles VI and VII, 10 to 20 miles off the outer coasts of the islands along the Yugoslav coast at temperatures between 14 and 15°C. One area of intensive egg production was found near the Italian coast, over profile IX, near the frontal zone. The temperature in this area was near 11°C.

During March 1982, the situation was quite different. All the northern Adriatic and the waters along the Italian coast were very cold, and there was no spawning of sardine in these areas. Sardine spawned intensively 10 to 20 miles off the coasts of the Yugoslav islands, over profiles VI, VII, and IX (Figure 5). In this month, upwellings developed along the eastern Adriatic coast, i.e., they were well formed over profiles V, VI, and IX. As can be seen from Figure 5, sardine was spawning at the boundaries of these upwelling zones.

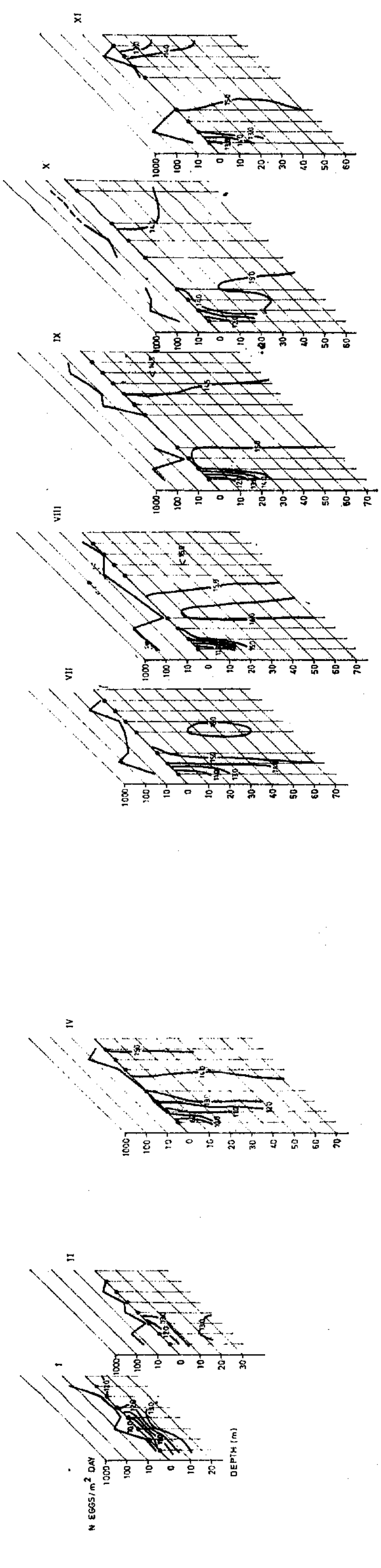


Figure 2 December, 1979

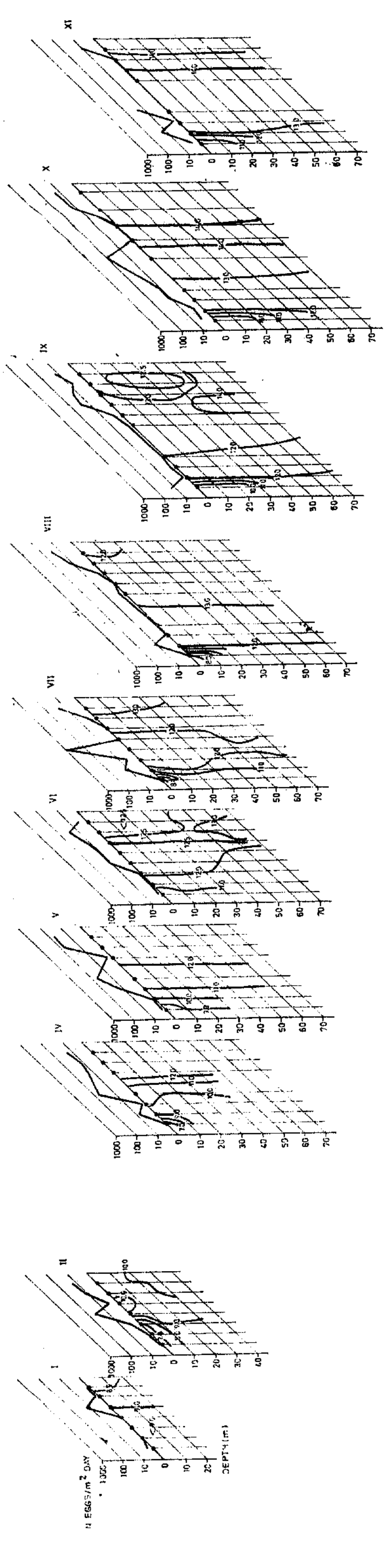


Figure 3 February, 1980

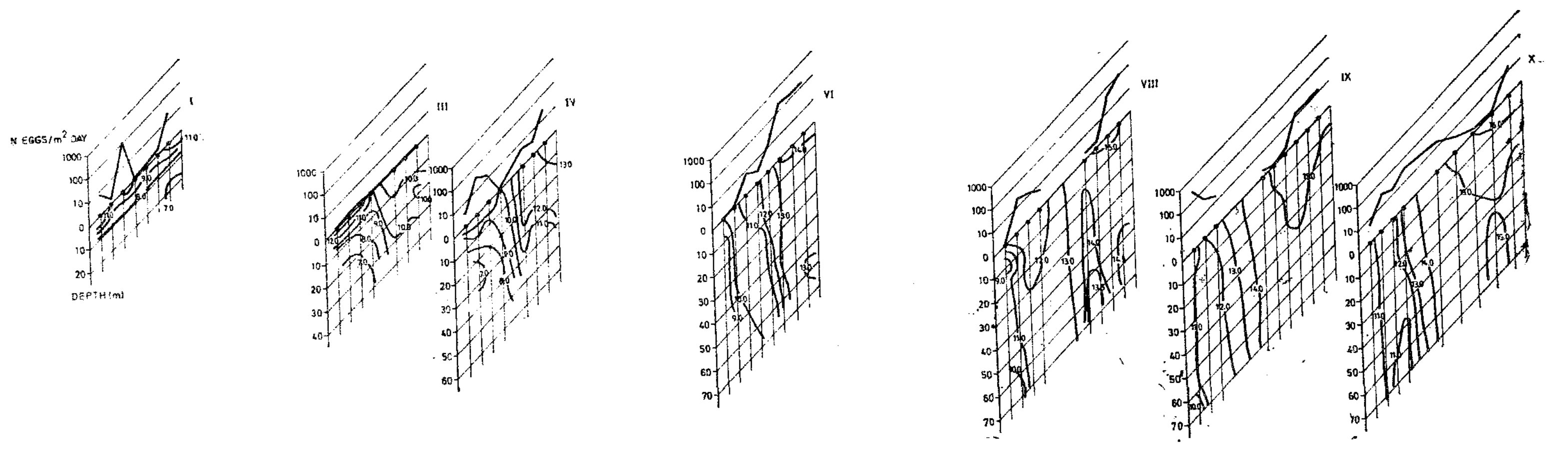


Figure 4 March, 1981

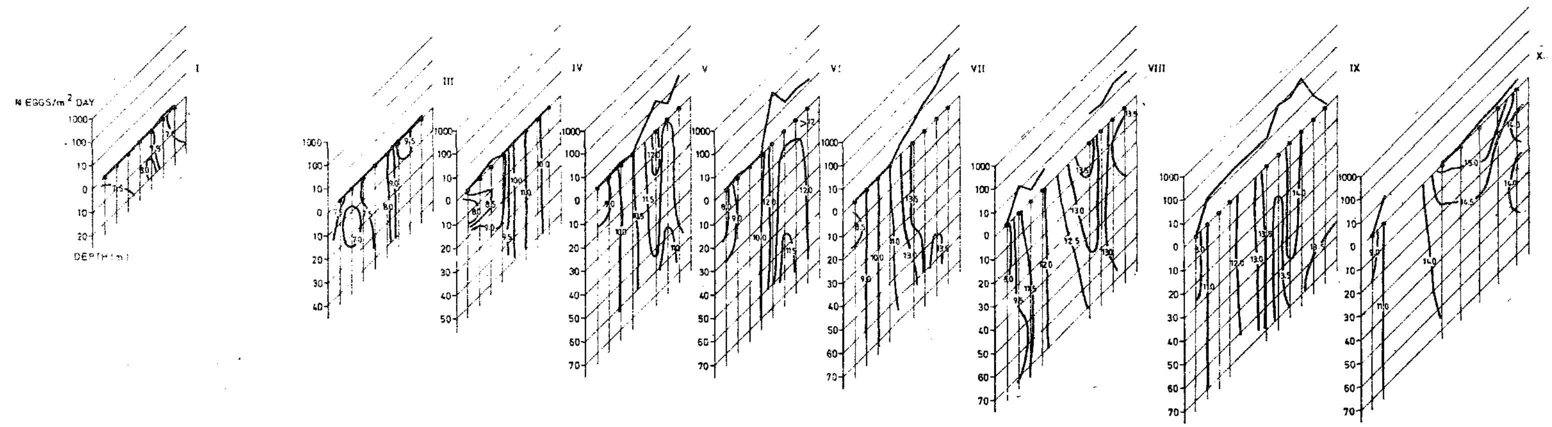


Figure 5 March, 1982

Figures 2-5 show that sardine spawned within water temperatures ranging from 9 to 15°C, with the maxima of egg production between 11 and 15°C. This is in good accordance with earlier data (Karlovac, 1967; Skrivanić and Zavodnik, 1973). It is also evident, however, that sardine tend to spawn along the boundaries of frontal zones, even though there were zones of a convenient temperatures also in the homogeneous water masses.

During earlier investigations, large quantities of chlorophyll, phytoplankton cells, and zooplankton were found along the frontal zones caused by upwellings. It was concluded that these increased quantities of food were the reason that sardine spawned near zones of upwelling (Regner, et al., in press). From this it can be supposed that along all the frontal zones found during these four surveys there were good trophic conditions, which probably led to the formation of centres of spawning. This means that during the spawning season, within the limits of their temperature tolerance, sardine appear to find areas of high production for spawning.

The Adriatic Sea, according to Buljan (1964), can be divided into four zones of productivity. The zone with the lowest productivity, zone A, covers the open waters of the Adriatic up to the line connecting Ancona and Dugi Otok island. The second zone, B, covers the shallow part of the northern Adriatic, and that part of Italian coastal waters up to Monte Gargano, and from the coast to the isobath of 50-70 m. This is a productive part of the open Adriatic. The last two zones, C and D, include the channel areas between the islands and the bays along the Yugoslav coast, and the lagoons along the Italian coast, respectively. Organic productivity in these last two zones is high, but they are not of significant importance for the spawning of sardine.

Due to their shallowness, as can be seen from Figures 2-5, the waters of zone B are too cold during the maximum for the sardine spawning season, which in the Adriatic lasts from December to March. As a result, sardine in this period have to spawn mainly in the less productive zone A. The data obtained during our surveys, however, show that sardine tend to spawn at the boundaries of the zones A and B along the Italian coast, in the area between Ancona and Monte Gargano, until the temperature of these waters falls below 10°C. After that, fish have to move toward the less productive waters of the open central and southern Adriatic, and finally toward the eastern coast. In these less productive waters, sardine also try to find areas of relatively increased productivity along the frontal zones caused either by upwelling or by mixing of the waters from the channel areas with the waters of the open Adriatic. Because of this situation, it will be necessary to pay more attention to the biological conditions along frontal zones in future investigations.

The results of the investigation presented in this paper show that the centres of spawning for sardine can be found along the boundaries of the frontal zones in the central and the southern Adriatic with the greatest probability. This fact can be very useful for planning future egg surveys. Analysing satellite pictures in the infrared and UV spectra immediately before the cruises, should allow the positions of frontal zones to be detected. Knowing the positions of frontal zones, it will be possible to make a more optimal pre-stratification of egg surveys.

4. CONCLUSIONS

The results of these investigations of the relationship between the distribution of water temperatures and sardine egg production during the cruises performed in December 1979, February 1980, March 1981, and March 1982, show that sardine tend to spawn mainly along the frontal zones of the central and a part of southern Adriatic. It seems that sardine starts to spawn along the boundaries of productive waters off the western Adriatic coast, until the temperature falls below 10°C. After that, the sardine is forced to move across the open Adriatic waters, toward less productive areas along the coasts of the eastern Adriatic islands. In these waters, sardine also tends to spawn near frontal zones where organic production seems to be relatively higher.

5. REFERENCES

Buljan, M., 1964. Ocjena produktivnosti Jadrana dobivena na temelju njegovih hidrografskih svojstava. Acta Adriat., 11(4):35-45

Gamulin, T., 1948. Quelques observations sur la ponte de la Sardine (*Sardina pilchardus* Walb.) dans la zone insulaire de la Dalmatie moyenne. Acta Adriat., 3(4):1-35

__________, 1954. La ponte et les aires de ponte de la Sardine (*Sardina pilchardus* Walb.) dans l'Adriatique de 1947 à 1950. Izv.Inst.Oceanogr.Ribar., Split, 4(4c):1-23

Gamulin, T. and J. Hure, 1955. Contribution à la connaissance de l'écologie de la sardine (*Sardina pilchardus* Walb.) dans l'Adriatique. Acta Adriat., 7(8):1-23

__________, 1983. Miejevsćenje i mrijestilista pelagicnih riba u Jadranskom moru. Acta Adriat., 24(1/2):97-131

Gamulin, T. and J. Karlovac, 1956. Etude intensive d'une aire de ponte de la sardine (Sardina pilchardus Walb.) en Adriatique moyenne en 1950-51. Acta Adriat., 8(3):1-47

Gamulin, T. and D. Zavodnik, 1961. Spawning of the sardine (Sardina pilchardus Walb.) off the west coast of Istria (northern Adriatic). CGPM Debats Doc.Tech./GFCM Proc.Tech.Pap., 6:121-3

Hure, J., 1961. Contribution ` la connaissance de la ponte de la sardine et du maquereau au large de l'Adriatique moyenne. CGPM Debats Doc.Tech./GFCM Proc.Tech.Pap., 6:107-10

Karlovac, J., 1958. Investigations on the larvae and postlarvae of the sardine (Sardina pilchardus Walb.) in the open waters of the Adriatic Sea. Izv.Inst.Oceanogr.Ribar., Split, 4(4D):1-28

___________, 1964. Mrijescenje srdele (Sardina pilchardus Walb.) u srednjem Jadranu u sezoni 1956-57. Acta Adriat., 10(8):1-40

___________, 1969. Etude de l'écologie de la sardine (Sardina pilchardus Walb.) dans la phase planctonique de sa vie en Adriatique moyenne. Acta Adriat., 13(2):1-109

___________, 1969a. La ponte de la sardine (Sardina pilchardus Walb.) en Adriatique moyenne, à l'époque de son maximum, au cours de quatre saisons de recherches. Thalassia Jugosl., 5:149-57

Piccinetti, C., S. Regner and M. Specchi, 1980. Etat des stocks d'anchois et de sardine en Adriatique. FAO Rapp.Pêches, (239):43-52

___________, 1981. Distribution des oeufs de sardine en Adriatique. Rapp.P.-V.Réun.CIESM, 27(5):167-70

Regner, S., et al., 1981. Preliminary statistical analysis of sardine stock estimation from data obtained by egg surveys. FAO Rapp.Pêches, FAO Fish.Rep., (253):143-54

___________, Spawning of sardine, Sardina pilchardus (Walbaum, 1792), in the Adriatic under upwelling conditions. Acta Adriat. (in press)

Skrivanič, A. and D. Zavodnik, 1973. Migrations of the sardine (Sardina pilchardus) in relation to hydrographical conditions of the Adriatic Sea. Neth.J.Sea Res., 7:7-18

Stirn, J., 1969. Pelagial severnega Jadrana. Razpr.Slov.Akad.Znan.Umet(IV, 12(2):1-92

Stirn, J. and L. Kubik, 1974. Contributions to the knowledge of migrations and the volume of the pilchard and anchovy in the northern Adriatic. Acta Adriat., 16(24):401-22

TRENDS OF ANNUAL CATCHES OR STOCK DENSITIES OF SOME PELAGIC FISHES IN RECENT "PELAGIA YEARS" IN THE ADRIATIC

by

T. Vucetić and V. Alegría-Hernandez
Institute of Oceanography and Fisheries
Split, Yugoslavia

The phenomenon of an intensive explosion recently of the populations of jellyfish "Pelagia" in the Adriatic has been accounted for by some authors by overfishing or by the absence of zooplankton feeders. This would mean, if correct, that on the one hand, the principal jellyfish predators, pelagic fish, have been removed from the sea by overfishing; on the other hand, it might mean that since fish and jellyfish (Pelagia) are predators on the same food, much more food has become available to jellyfish if fish biomass has been reduced due to fishing or the other types of mortality.

In an attempt to confirm or refute these hypotheses, we examined the population dynamics of the most important predators or pelagic fish in the "Pelagia years" on the one hand, and the state of the planktonic community on the other.

Vucetić (1984) pointed to the positive relationship between the maximum catch of tunny fish and the unusual occurrence of jellyfish Pelagia in the Mediterranean (Adriatic). Searching for a better explanation of this phenomenon in terms of predator-prey relationships, we attempt here to compare "Pelagia years" with the long-term catch of some jellyfish predators such as Boops boops, Scomber scombrus, Scomber japonicus, Auxis rochei, Sarda sarda, Thunnus thynnus, and food competitors Sardina pilchardus, Sprattus sprattus, Engraulis encrasicolus.

The analysed catch statistics was separately treated as: YU-Yugoslav catch in the eastern Adriatic, YU-IT - Yugoslav with Italian catch for the Adriatic as a whole and MED catch for the Mediterranean as a whole.

From the catch statistics we have followed changes in population density of individual fish species, taking into consideration the changes in fishing intensity and fishing efficiency. All the jellyfish Pelagia findings were taken as "Pelagia years".

It is to be expected that the increase in predator fish density coincides with the decrease in the number of prey-zooplankton and jellyfish Pelagia, or that vice versa, jellyfish would show a population explosion during periods of decrease or absence of fish predators.

From previous research on the Pelagia phenomenon (Vucetić, 1982, 1983, 1984; Kyrtatos 1984), bogue has been frequently recorded as a jellyfish predator, and Trachurus sp. (larval stages) as commensal with adult Pelagia and other medusae. For this reason special attention was paid to these two species. The Yugoslav catch statistics (YU) showed that during the "Pelagia years" (P.Y.) the annual catch of bogue decreased in comparison with 1963-71 period (Figures 1a, b). Separating the data of bogue catch by seasons, the same trend was found, particularly for the summer (July, August, September) season. The data for the Adriatic as a whole (YU - IT) gave the same picture, so that it seems that the smaller the quantity of bogue, the higher the jellyfish abundance in the Adriatic. However, in the Mediterranean, good catches of bogue were realized during the "Pelagia years".

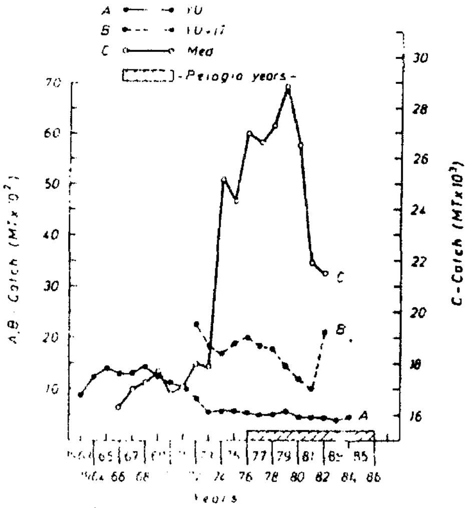


Figure 1a Annual catch Boops boops

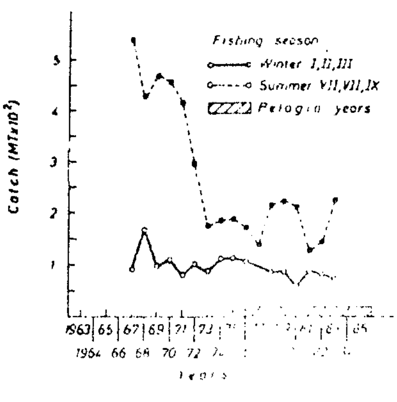


Figure 1b Seasonal catch Boops boops

The horse mackerel catches showed quite the opposite trend (Figures 2a, b): the catch increased in the Adriatic and Mediterranean during the "Pelagia years". The same trend was recorded by taking the winter and summer YU catch separately. An extremely high catch was realized in the summer of 1971, and again from 1977-83, exactly in the "Pelagia years".

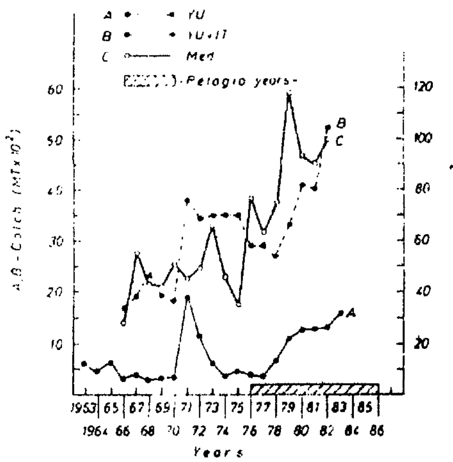


Figure 2a Annual catch Trachurus sp.

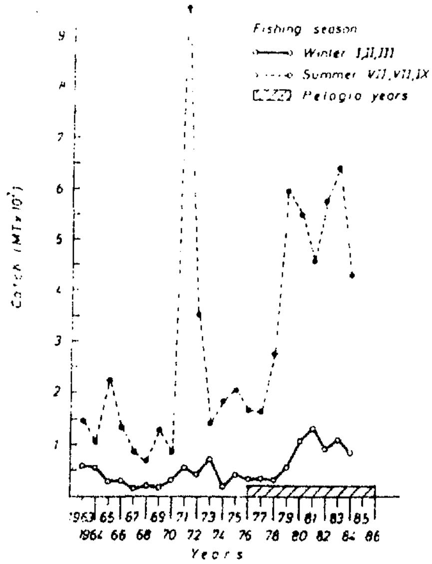


Figure 2b Seasonal catch Trachurus sp.

The YU catch of Atlantic mackerel (a predator of Pelagia, and competitor for the same food as Pelagia) decreased in "Pelagia years". At the same time a pronounced increase was found for IT catch in the Adriatic as well, as for the Mediterranean as a whole. Quite the contrary, the catch of Spanish mackerel increased in both cases; both in the Adriatic (YU catch) and in the whole Mediterranean, in "Pelagia years".

The catch statistics for small pelagic fish (sardine, sprat and anchovy taken together) showed a pronounced increase in "Pelagia years" in the Adriatic (YU catch and YU-IT catch), as well as in the Mediterranean as a whole.

It was observed for sardine that the trend in annual Yugoslav fishing effort declined slowly and continuously and the catch increased, which means that the population density has increased (Alegria, 1983; Regner, Piccinetti and Specchi, 1984). This was to be expected also from other research which provided an increase in primary production and secondary producer biomass (including small pelagic fish), for the recent period (Zupanović, 1968; Vucetić and Morović, in press).

As shown by Vucetić (1984) an increase in abundance of tuna fish, Atlantic bonito and plain bonito, was also recorded during "Pelagia years" both from the Adriatic and from the Mediterranean as a whole (Figure 6).

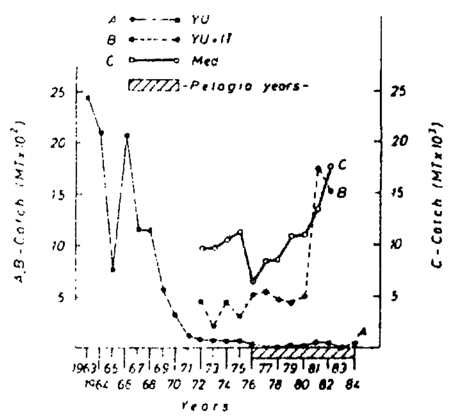


Figure 3 Annual catch Scomber scombrus

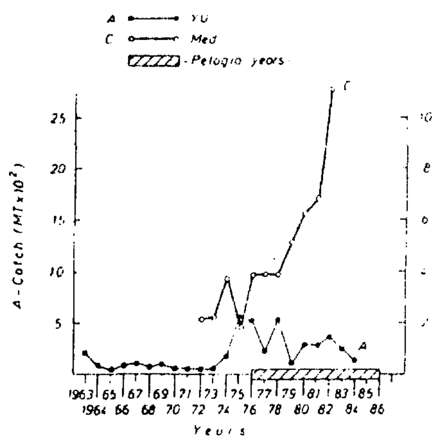


Figure 4 Annual catch Scomber japonicus

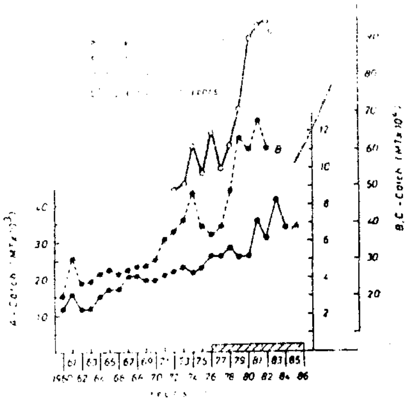


Figure 5 Annual catch Sardina, Spratus, Engraulis

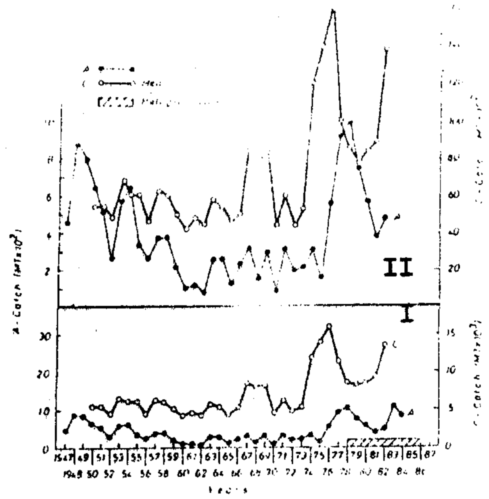


Figure 6 Annual catch Auxis r., Sarda s., I Thunnus thynnus II

Taking into consideration all the above data, it is difficult to conclude that the Pelagia population explosion in the recent years is associated with a decrease in predator fish populations. Based on the analysis of fish which are predators of Pelagia and at the same time competitors on the same plankton food, a predator-prey correlation with negative trend is to be expected and not the positive trend found (Table 1).

Table 1

Catch trend or population density increase of some predator fish in the "Pelagia years" (1977-86)

	ADRIATIC		MEDITERRANEAN
	YU	YU+IT	
Boops boops	-	+	+
Trachurus sp.	+	+	+
Scomber scombrus	-	+	+
Scomber japonicus	+		+
Small pelagic fish			
Sardina pilchardus, Sprattus sprattus, Engraulis encrasicolus	+	+	+
Thunnus thynnus	+	+	+
Auxis rochei, Sarda sarda	+	+	+

\+ catch increase
\- catch decrease

It is possible to conclude that the trend in catch or population density of the above pelagic fish increased at the same time as jellyfish Pelagia population density increased. This could be associated, however, with some other factors common to both phenomena, such as a general production increase (primary and secondary producers) reflecting changes in water mass dynamics or nutrient supply (see Zore-Armanda, Stojanski and Vudakin; Pucher-Petković, et al.; this document).

2. REFERENCES

Alegria, V.H., 1983. Assessment of pelagic fish abundance along the eastern Adriatic coast with special regard to sardine (Sardina pilchardus Walb.) population. Acta Adriat., 24(1/2): 55-95

Alegria, V.H., 1984. Preliminary analysis of tuna catches along the eastern Adriatic coast. Bilj.Inst.Oceanogr.Ribar., Split, (57):6 p.

Kyrtatos, N., 1985. Recherches et observations critiques sur l'apparition en masse de Pelagia noctiluca et d'autres organismes zooplanctoniques en Méditerranée. Rapp.P.-V.Réun.CIESM, 29(9):189

Pucher-Petković, T., et al., Time series of productivity parameters indicating eutrophication in the middle Adriatic waters. FAO Rapp.Pêches/FAO Fish.Rep., (this document)

Regner, S., C. Piccinetti and M. Specchi, 1984. Estimate of spawning biomass of sardine in the northern and central Adriatic 1979-82 by means of eggs survey. FAO Rapp.Pêches/FAO Fish.Rep., (290):223-32

Vucetić, T., 1982. Unusual occurrence of Pelagia noctiluca in the Adriatic. Influence of the water masses dynamics on the distribution of Pelagia noctiluca in the Adriatic. Acta Adriat., 23(1/2):105-15

__________, 1983. Fluctuation in the distribution of the scyphomedusae Pelagia noctiluca (Forskal) in the Adriatic. Oceanol.Acta, Dec. 1983 Vol.Spec. pp. 207-11

__________, 1985. Relationship between the jellyfish Pelagia noctiluca occurrence and catch of tunny fish in the Mediterranean Sea (Adriatic). Rapp.P.-V.Réun.CIESM, 29(9):331-2

Vucetić, T. and V. Alegria-Hernandez, 1986. Long term fluctuations of predator fish and the prey plankton jelly-fish Pelagia noctiluca in the Mediterranean (Adriatic). Rapp.P.-V.Réun.CIESM, 30(2):230

Zore-Armanda, M., L. Stojanski and I. Vukadin, Time series of oceanographic parameters eutrophication of the open Adriatic waters. FAO Rapp.Pêches/FAO Fish.Rep., (this document)

Zupanović, S., 1968. Causes of fluctuations in sardine catches along the eastern coast of the Adriatic Sea. An.Jadranskog Inst., (4):401-89

C. RESSOURCES DEMERSALES/DEMERSAL RESOURCES

STOCK-RECRUITMENT RELATIONSHIP FOR THE HAKE (Merluccius merluccius L.) FROM THE OPEN MIDDLE ADRIATIC-JABUKA PIT

by

Verónica Alegría-Hernández and Stjepan Jukić
Institut za oceanografiju i ribarstvo
Split, Yugoslavia

1. INTRODUCTION

Significant changes in the abundance of demersal stocks of the Adriatic Sea have been observed for the last decades as a consequence of postwar increases in fishing intensity expended by commercial trawl fisheries. Among the heavily exploited semi-demersal and demersal stocks in the middle and northern part of the Adriatic Sea, population of European hake Merluccius merluccius (L.) together with the Norway lobster (Nephrops norvegicus L.) population from the open middle Adriatic (Jabuka Pit) have been important targets of the commercial trawl fishery. According to the GFCM Statistical Bulletin 1970-80, the production of hake from the whole Adriatic was approximately 3 000 t per year. One should bear in mind, however, that official national fishery statistics in practice may not exactly represent the actual annual yield.

Due to the commercial importance of the hake in the Adriatic trawl fishery, studies on biology, ecology, population dynamics and management were carried out by a large number of authors (Karlovac, 1959; Karlovac, 1965; Muzinic and Karlovac, 1975; Jukić, 1975). Special knowledge of hake population dynamics and management derives from studies of Zupanović (1968), Alegría Hernández, Granić and Jukić (1982), Flamigni (1984) and Giovanardi, Rizzoli and Jukić (1986) among others.

Though some studies on the influence of the fishing effort on hake stock size and on management aspects have been carried out such as studies of selectivity bottom trawl codends (Jukić, 1975), maximum utilization (Alegría Hernández, Granić and Jukić, 1982; Giovanardi et al., 1985), there still remain significant gaps in our knowledge of the factors governing the magnitude of recruitment to the hake stock in this and other parts of the Adriatic Sea; particularly gaps in our knowledge of the relationship between recruitment and parental stock size. This problem, as far as the exploitable Adriatic stock is concerned, limits the reliability of some essential management advice that can be given for any specific commercial stock or fishing ground.

Presented in this paper are preliminary observations of the relationship between parental and recruited stock size within demersal populations, while being aware that this biological relationship is essential for management of the resources.

2. MATERIAL AND METHODS

The stock-recruitment relationship of the hake population was analysed on the basis of a long series of catch and fishing effort data from a commercial trawl fleet, for the period 1960-85. This fleet fishes exclusively on the trawl fishing ground of the Jabuka Pit called Blitvenica, which makes about 10% of the entire area. Catch per unit effort values were calculated from catch of juveniles, and effort data, and used for making estimates of the numbers of 0-age individuals. The average weight of juvenile hake was estimated to be 6.3 g. The number of recruits fully vulnerable to the fishing gear was estimated on the basis of the "swept area" technique (Alverson and Pereyra, 1969; Pauly, 1984).

In the estimation of stock size, the following equation was used:

$$B = (C/f.A)/(a.X_1)$$

where B is the standing stock size, A the total exploitable surface by the commercial fleet, that is stratum of 983.3 km^2, a "swept area" per unit time (one hour) by a commercial trawl of 300 hp, of 0.1111 km^2, and X_1 is the catchability coefficient for hake, taken as 0.5. For the fitting of a stock-recruitment relationship the Ricker (1954, 1975) model was used.

3. RESULTS AND DISCUSSION

Estimates of the size of both stock components, juvenile and parental, are presented in Table 1 for the period 1960-85.

Table 1

Data for the derivation of Ricker type stock-recruitment relationship for hake (Merluccius merluccius L.) from Jabuka Pit in the open middle Adriatic for 1960-85

Year	Parental stock (tons)	Number of recruits ($x10^6$)	Recruitment (tons)
1960	2 524	880	
1961	2 420	955	14 982.7
1962	2 720	1 174	18 418.6
1963	2 496	63	988.4
1964	2 367	813	12 754.9
1965	3 333	1 215	19 061.8
1966	2 954	1 349	21 164.1
1967	3 191	1 500	23 533.1
1968	1 397	353	5 538.1
1969	1 793	199	3 122.1
1970	1 730	578	9 068.1
1971	3 452	523	8 205.2
1972	3 567	545	8 550.4
1973	4 829	713	11 186.1
1974	8 127	659	10 338.9
1975	9 417	1 577	24 741.1
1976	9 235	878	13 774.7
1977	11 915	1 732	27 172.9
1978	6 515	916	14 370.9
1979	6 180	452	7 091.3
1980	4 204	425	6 687.7
1981	5 742	812	12 739.3
1982	6 574	406	6 369.6
1983	4 680	686	10 762.5
1984	6 411	1 002	15 720.1
1985	5 895	461	7 232.5

Monthly fluctuations of indices of relative abundance of hake (kg/day), on the basis of the 25 year data series for juvenile and adult stock components are presented in Figure 1. They point to the fact that the juvenile component reaches one significant maximum in spring (May) and another smaller one in autumn, while the adult maximum population is recorded in summer; predominantly in July.

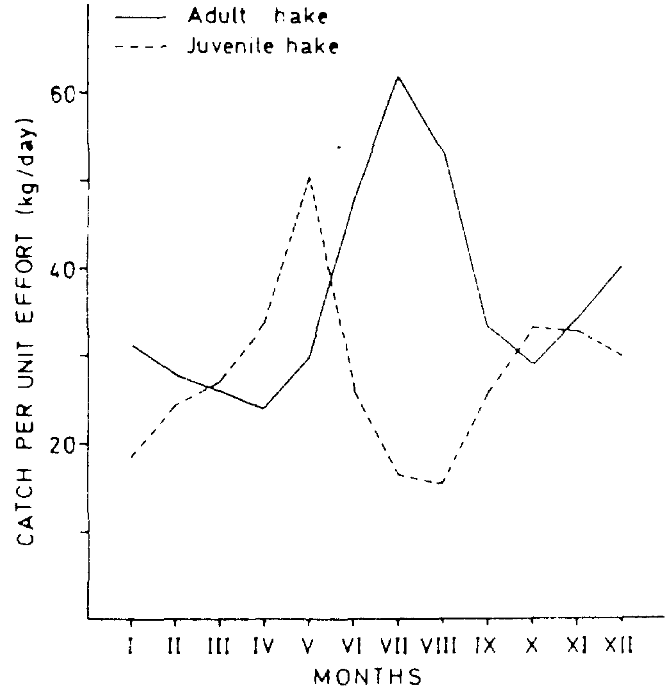


Figure 1 Monthly fluctuations of mean catch per unit effort of the hake from the open middle Adriatic (Jabuka Pit, Blitvenica)

Annual fluctuations of the adult spawning stock and juvenile stock for the period 1960-85 expressed as indices of abundance and given as catch per unit effort, are shown in Figure 2. A comparison between the catch per unit effort of the spawning hake population and that of juveniles, but one year later, points to similar although opposite trends in abundance indices. This suggests that a density dependent relationship exists between the strength of recruit stock and that of adults. During the period 1963-67 a rather small hake stock size produced a significant number of strong classes recruited a year later. That was also reflected in a higher than average adult hake yield in this fishing area about four years later. On the other hand, a large population of spawners for the period 1973-85 led to a poorer biological strength of juveniles, compared to the situation during the 1963-67 period.

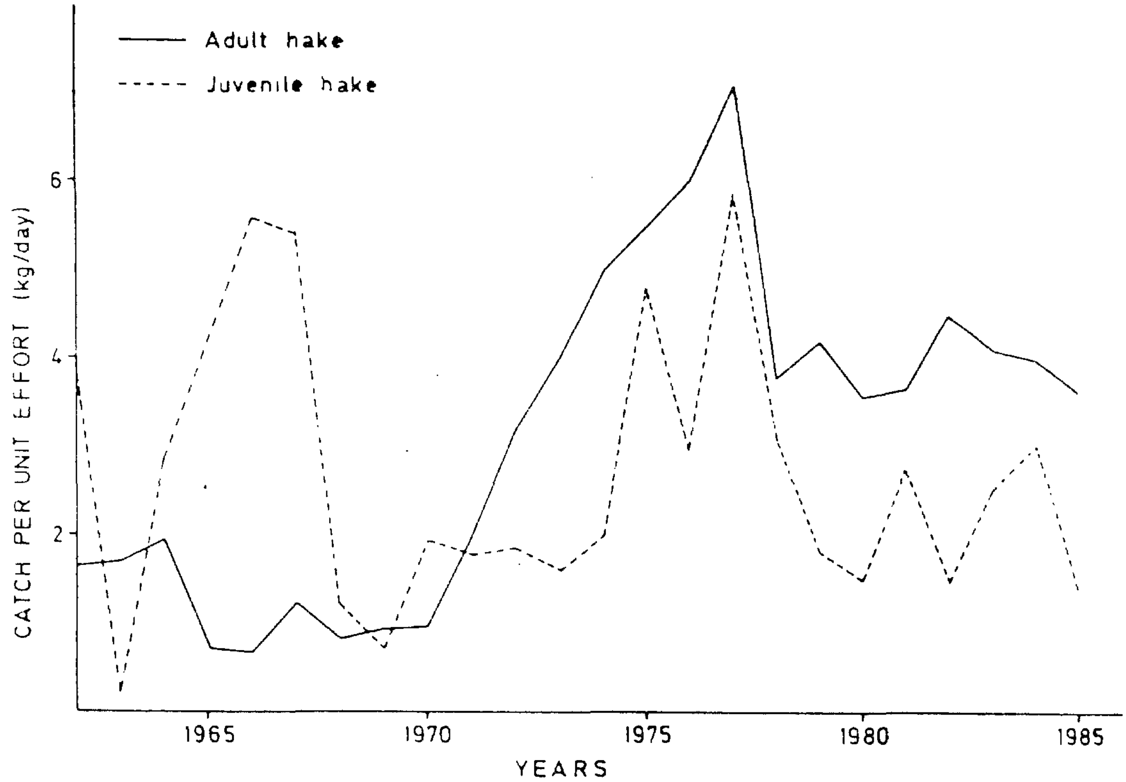


Figure 2 Annual fluctuations of abundance indices of the dualt and juvenile hake stocks from the open middle Adriatic (Jabuka Pit, Blitvenica) during the period 1963-85

Studies of the biology and ecology of the hake population in the Adriatic, as well as analyses of commercial catches during the postwar period, undoubtedly point to the fact that the Jabuka Pit is the main hake spawning ground in the Adriatic Sea. It was also found that adult individuals, attaining first sexual maturity in the third year leave the channel regions off the eastern coast of the Adriatic and migrate for spawning toward the open and deeper waters (Jabuka Pit), below 150 m (Zupanović, 1968); environmentally probably the most stable habitat of the entire area; characterized by small annual variations of hydrographic properties in the bottom layer (Buljan and Zore-Armanda, 1979). A minimum temperature 10.74 ^{o}C and salinity 38.21 ^{o}/oo and maximum 12.02 ^{o}C and 38.84 Sal ^{o}/oo were recorded by these authors.

In this region hake spawn throughout the great part of the year; the larger number of eggs and larvae being found during autumn-spring, with maximum in January and February (Karlovac, 1965). During the spawning period a large proportion of stomachs of adult hake from the Jabuka Pit were found empty (Karlovac, 1965). However, juvenile individuals from 0-age group remain in this region till the end of the first year to feed intensively (Jukić, 1972). After the first year, young and immature individuals leave Jabuka Pit and migrate towards channel and island regions changing their feeding behaviour.

Data on fecundity of the Adriatic hake are rather scarce but according to several sources, namely Karlovac (1965), data on the trawl surveys during 1956-66 by Zupanović (1968) and later on by Jukić (1975), it is clear that this part of the Adriatic, with the greatest indices of relative abundance of 0-age hake group throughout the year, represents the main hake spawning ground.

Measures of recruitment and estimates of relative year class strength of the 0-age group of the hake population from the Jabuka Pit ground below the isobath of 150 m, are based on the "knife-edge recruitment" concept. Until last year (1984) all specimens of juvenile hake, mostly 6 months of age, had been vulnerable to "unselective" bottom fishing gear, i.e., bottom trawls with knotless and very small code-nds, ranging in some cases between 16 and 24 mm stretched mesh size (Jukić, 1975). Quite recently, acceptance of the 40 mm codend mesh size proposed as a regulatory measure in the Mediterranean trawl fishery by GFCM, has slightly changed the situation in the Adriatic trawl fishery since 1984. According to national fisheries regulations along the eastern coast of the Adriatic, actually some fishermen use 40 mm codend mesh size in their bottom trawls.

Traditionally the Yugoslav trawl fleet operated only during daytime when the availability of bottom and semi-pelagic species, such as hake, horse mackerel and Norway lobster to the fishing gear is greater. Juvenile hake are vulnerable year round and are always mixed with adults in the trawl catches.

Using the data from Table 1 on the weight of parental stock, and the corresponding number of recruits, an estimate of the parameters of Ricker's type recruitment curves (first and second form) was obtained by means of program FB-25 (Pauly, 1984) (Figure 3). The following estimated values for the stock recruitment parameters were obtained:

Correlation coefficient	0.456
Stock-dependent mortality coefficient	0.00013
Stock-independent mortality coefficient	0.304
Maximum parental stock	7676.2 tons
Maximum recruitment	859.4 tons

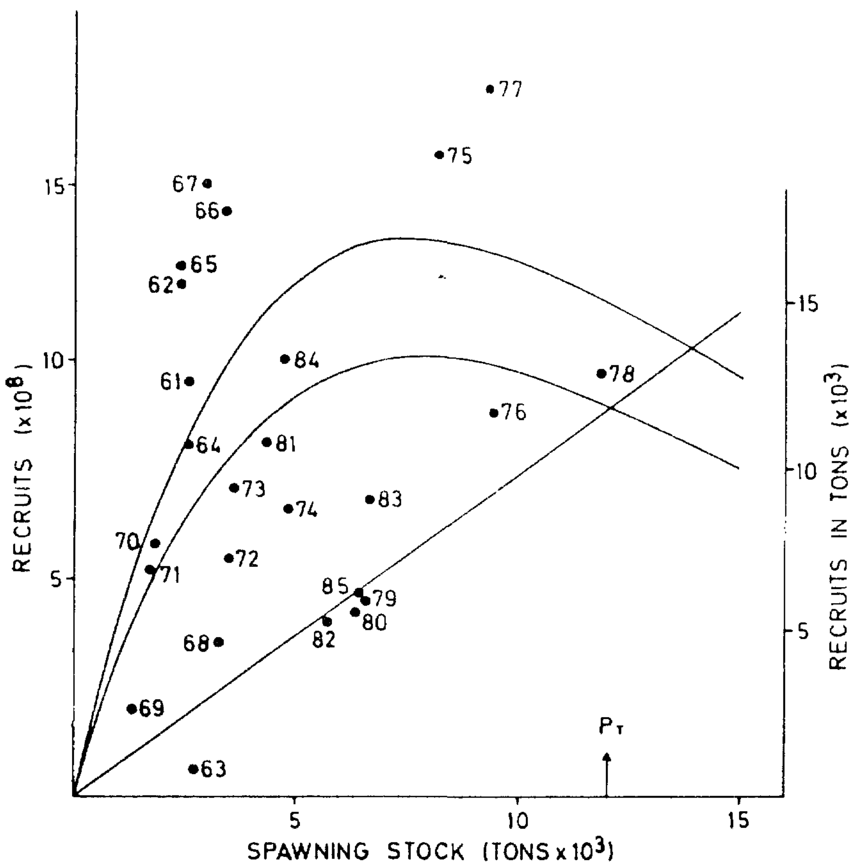


Figure 3 Stock-recruitment data of the hake from the open middle Adriatic (Jabuka Pit, Blitvenica) fitted with Ricker curves (MG and AM) based on data from Table 1

Taking into consideration catch statistics for the hake population from the open middle Adriatic for the period 1960-85, Ricker's model predicts that maximum recruitment occurs at some intermediate level of parental stock size.

To conclude, the assessment of the stock size of recruited 0-age hake in the spawning area of the Jabuka Pit is a measure for this and other Adriatic fishing grounds, for deciding on a more successful management measure for restocking of demersal populations.

4. REFERENCES

Alegria Hernandez, V., B. Granić and S. Judić, 1982. The protection of the hake (Merluccius merluccius L.) in the Adriatic Sea by regulation of the level of exploitation. Acta.Adriat., 23(1/2):431-40

Alverson, D.L. and W.T. Pereyra, 1969. Demersal fish exploration in the northeastern Pacific Ocean: an evaluation of exploratory fishing methods and analytical approaches to stock size and yield forecast. J.Fish.Res.Board Can., 26(8):1985-2001

Buljan, M. and M. Zore-Armanda, 1979. Hydrographic properties of the Adriatic Sea in the period from 1965 through 1970. Acta Adriat., 20(1-2):368 p.

Flamigni, C., 1984. Preliminary utilization of trawl survey data for hake (Merluccius merluccius L.) population dynamics in the Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (290):109-15

Giovanardi, O., M. Rizzoli and S. Jukić, 1986. Preliminary considerations on the fisheries management of the hake (Merluccius merluccius L.) stock in the Adriatic Sea. FAO Rapp. Pêches/FAO Fish.Rep., (345):71-7

Jukić, S., 1972. Nutrition of the hake (Merluccius merluccius), bukve (Boops boops), arbuna (Pagellus erythrinus) in the bay of Kastela. Acta Adriat., 14(4):3-40

__________, 1975. Trawl fishing grounds in the central Adriatic. Acta Adriat., 17(1):3-86

Jukić, S. and R. Arneri, 1984. Distribution of hake (Merluccius merluccius L.), striped mullet (Mullus barbatus L.) and pandora (Pagellus erythrinus L.) in the Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (290):85-91

Karlovac, J., 1965. Contribution ` la connaissance de l'écologie du merlu (Merluccius merluccius L.) dans le stade planctonique de sa vie en Adriatique. Rapp.P.-V.Réun.CIESM, 18(2):461-4

Karlovac, O., 1959. La nourriture du merlu (Merluccius merluccius L.) de la mer Adriatique. CGPM Débats Doc.Tech./GFCM Proc.Tech.Pap., 5:333-9

Muzinić, R. and J. Karlovac, 1975. On food preferences of the Adriatic hake, Merluccius merluccius L. Acta Adriat., 17(7):3-47

Papaconstantinou, C., E. Caragitsou and T. Panos, 1986. Preliminary utilization of trawl survey data for hake (M. merluccius) population dynamics from the western Greek waters. FAO Rapp.Pêches/FAO Fish.Rep., (345):87-92

Pauly, D., 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud.Rev., (8):325 p.

Ricker, W.E., 1954. Stock and recruitment. J.Fish.Res.Board Can., 11(5):559-623

__________, 1975. Computation and interpretation of biological statistics of fish populations. Bull.Fish.Res.Board.Can., (191):382 p.

Zupanović, S., 1968. Study of hake (Merluccius merluccius L.) biology and population dynamics in the central Adriatic. GFCM Stud.Rev., (32):24 p.

ON THE GROWTH OF THE FOUR-SPOTTED SCALDFISH, *Lepidorhombus boscii*, FROM THE SOUTHERN ADRIATIC

by

G. Bello and E. Rizzi
Laboratorio Provinciale di Biologia Marina
Bari, Italy

1. INTRODUCTION

The four-spotted scaldfish, *Lepidorhombus boscii* (Risso, 1810) (Osteichthyes, Scophthalmidae), is one of the target species of the programme "Valutazione Risorse Demersali" (Demersal Resources Assessment) of the Southern Adriatic, funded by the Italian 'Ministero della Marina Mercantila'. It is among the most abundant teleosts in the depth stratum 200-400 m (Table 1), and also occurs in significant numbers between -60 and -650 m.

Table 1

Lepidorhombus boscii catch in the depth stratum 200-400 m; 1985 surveys
(After Bello, Marano and Rizzi, in press)

	Spring	Autumn
Mean % of commercial catch	13.1	13.8
Mean % of commercial teleosts	16.0	23.0
Mean cpue (kg/h)	2.9	2.7

2. MATERIALS AND METHODS

The sample observed in the present study was collected in May 1986 in the South-West Adriatic Sea, between 60 and 620 m of depth. Otoliths were removed from 150 sexed specimens ranging from 8.8 to 28.1 cm total length; placed in water, and observed with incident light against a dark background. We succeeded in determining the age of 137 sagittae; the others could not be clearly determined either because of false rings or because of their opacity.

The growth pattern of the sagittae was found to be regular; i.e., there is a band of hyaline material laid down during the cold part of the year and an opaque one during the warm months. In fact the marginal ring of the sagittae of scaldfish collected in May is hyaline, and in a few specimens incipient deposition of opaque material could be detected. On the contrary the marginal ring of otoliths from the autumn specimens observed, ended with an opaque ring (results not reported here). The nucleus of all sagittae is opaque. Therefore the otoliths of *L. boscii* from the Southern Adriatic show a growth pattern reversed with respect to the one described by Froglia and Giannetti (1986) in some flatfish from the North Central Adriatic.

One year of age was conventionally attributed to otoliths exhibiting the opaque nucleus and one hyaline band, although they belonged to scaldfish a little older than one year; and so on for the following year classes. Reproduction actually occurs in late winter (Tortonese, 1975; Bello, Marano and Rizzi, in press).

Total length has such a wide range within each year class (Table 2), that the length-frequency distribution (Figure 1) cannot be used to indicate age by the Petersen's method. Therefore to avoid some undesired negative effects in fitting the von Bertalanffy growth equation, the weighted means of the l_t values were used (Ricker, 1975). Length measurements were approximated to the nearest millimetre below. The computed parameters of the equations are reported in Table 3. According to Bini (1968) the scaldfish in the Mediterranean can reach a length of 30 cm.

Table 2

Age-length key for Lepidorhombus boscii

Year classes										
	Males						Females			
L	1	2	3	4	5	6	2	3	4	5
8	1									
9	6									
10	3	1								
11	1									
12		5					1			
13		4	1					1		
14		7	2	1			4	3		
15		2	8	1			4	3		
16		2	12	1				5		
17		2	5	2				5		
18			4	2			1	6	1	
19				5	1			5	2	
20			1					6		
21				1				4		
22						1		1		
23										
24										
25									1	1
26									1	
n	11	23	33	13	1	1	10	38	6	1
$\bar{l}$	9.81	14.13	16.45	18.22	19.60	22.30	14.93	18.12	20.45	25.10

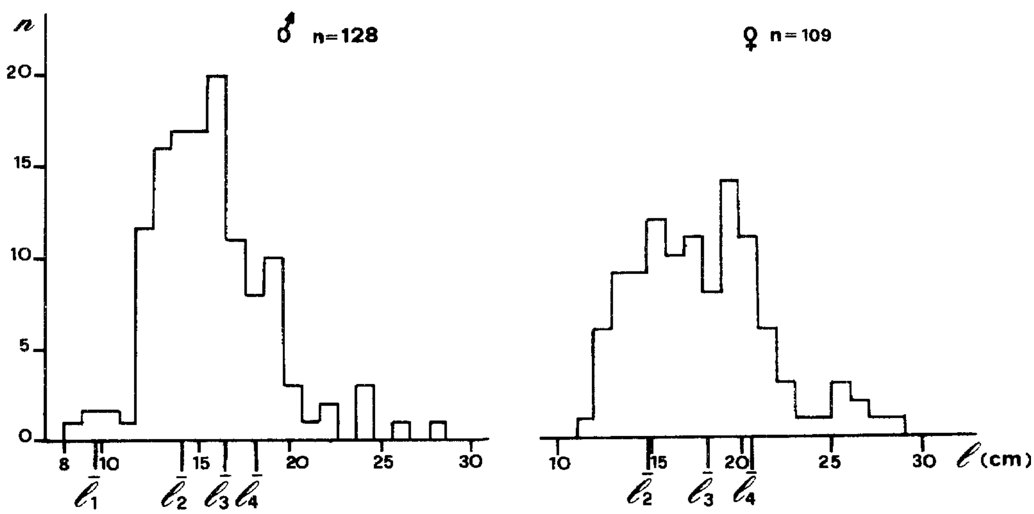


Figure 1 Length frequency distribution of Lepidorhombus boscii; $\bar{l}_t$ = mean length at age t

Table 3

Von Bertalanffy growth equation parameters for Lepidorhombus boscii

	L_∞ (cm)	K	t_o
♂♂	27.6	0.211	-1.27
♀♀	28.5	0.262	-0.85

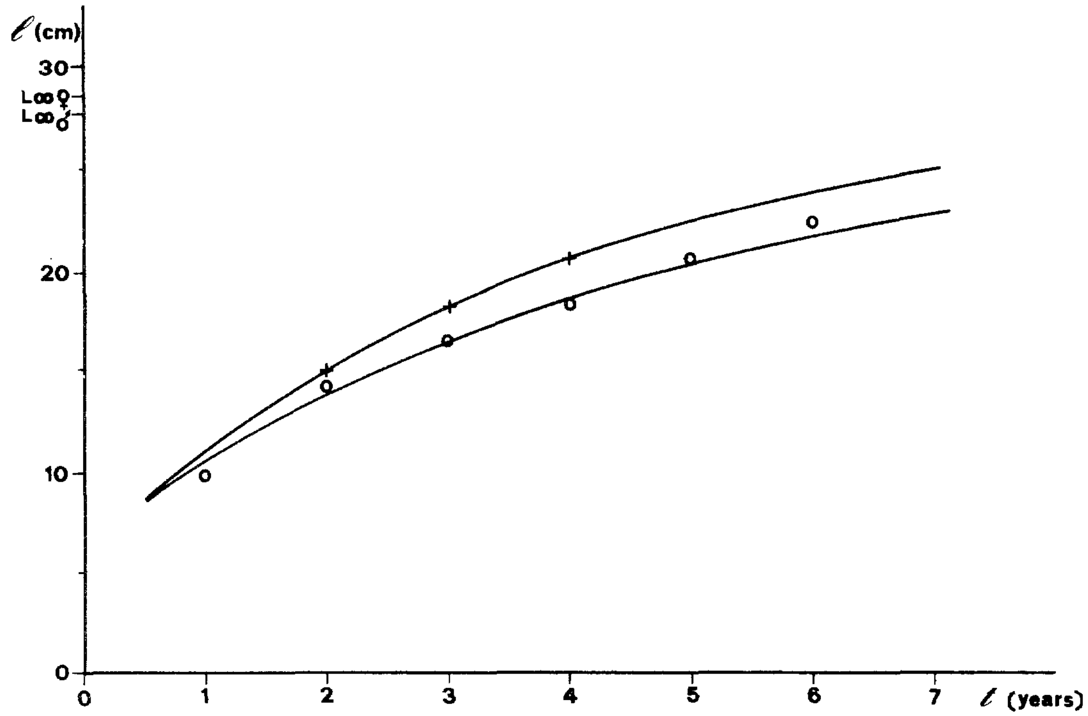


Figure 2 Von Bertalanffy growth curves for Lepidorhombus boscii; ♂ = males; ♀ = females

As regards the length/weight relationship of the two sexes, we did not find any difference between them, hence we computed the parameters of the power curve $w = a\,l^b$ using all available specimens, including the unsexed one (Table 4).

Table 4

Length/weight relationship parameters for L. boscii

	n	a	b	r	P
♂♂	128	0.00344	3.240	0.993	<0.001
♀♀	109	0.00323	3.263	0.992	<0.001
both sexes	237	0.00333	3.253	0.993	<0.001

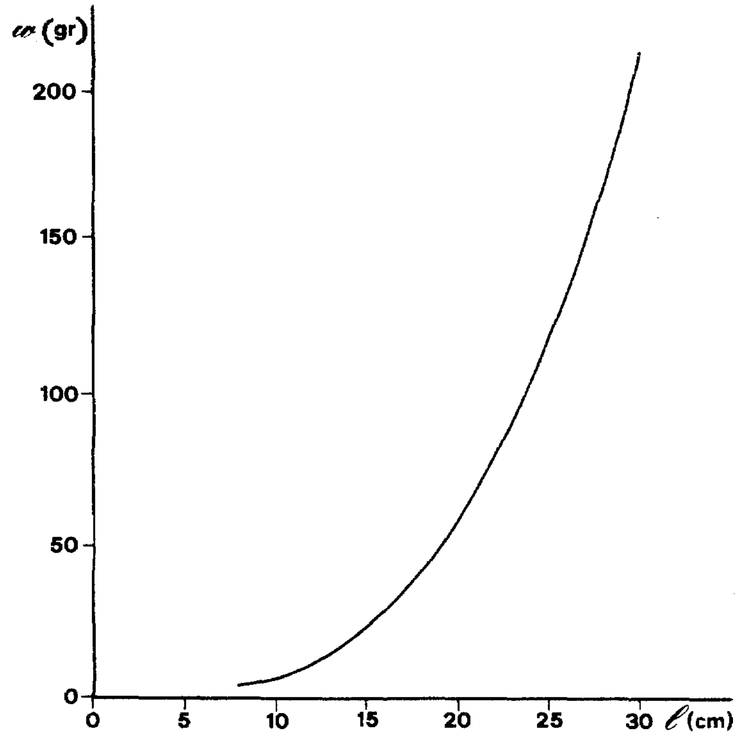


Figure 3 Length/weight relationship for Lepidorhombus boscii; both sexes

The sex ratio, computed on 267 specimens, is m/f = 1.14

In spite of the identical length/weight relationship, females grow faster than males, and reach larger sizes. Sexual dimorphism in size, viz. female larger than male, was detected in other Mediterranean flatfishes by Cau and Deiana (1982) and by Froglia and Giannetti (1986).

The optimal market size (l > 20 cm) is reached at the age of about 4 and 5 years respectively for female and male (Table 5).

Table 5

Expected length (l_t) and weight (w_t) values at age t computed using the von Bertalanffy parameters and the length/weight power curve parameters

	♂♂		♀♀	
Age	l_t(cm)	w_t(gr)	l_t(cm)	w_t(gr)
1	10.50	6.98	10.94	7.97
2	13.75	16.77	14.98	22.17
3	16.39	29.70	18.09	40.94
4	18.52	44.19	20.49	61.40
5	20.24	58.99	22.34	81.33
6	21.64	73.33	23.76	99.38

Plotting $\ln(L_{\infty} - l_t)$ against t (Figure 4) for males, a possible inflection point in the growth curve can be visualized, which probably occurs during the second year of life[1]. It can therefore be assumed that at least the male of L. boscii has a differential growth in length, i.e., it grows faster during the first period of life; the following decrease of growth rate could be linked with the onset of sexual maturity, which seems to occur after the first year of life.

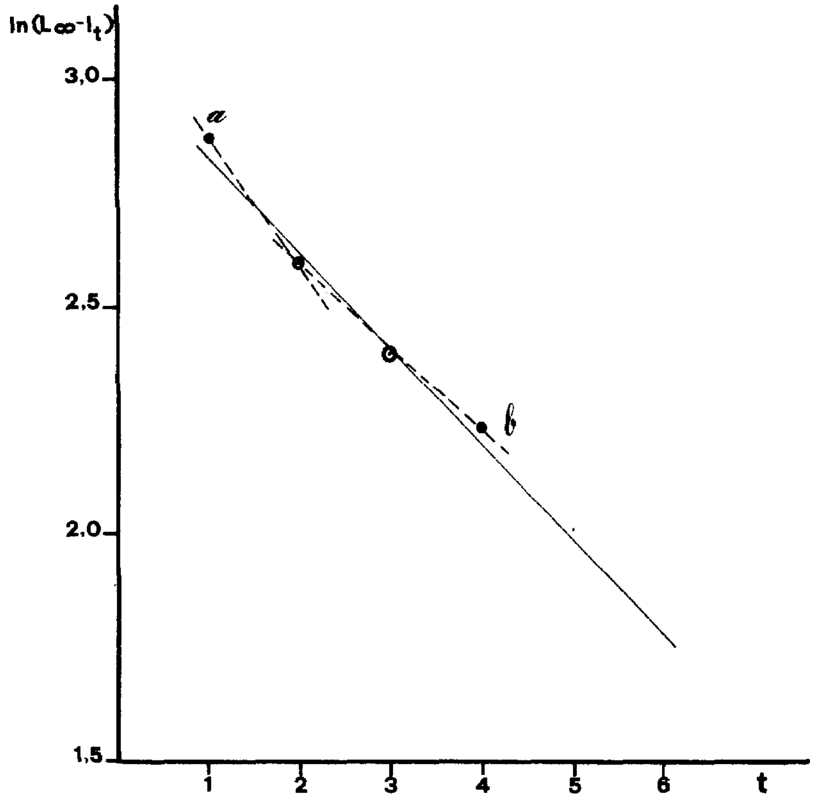


Figure 4 L. boscii, males; $\ln(L_{\infty} - l_t)$ plotted against age for L_{∞} = 27.6 cm -----: regression line computed using all six points (weighted means); - - - : regression lines for the age points 1 and 2 (a) and the age points 2, 3, and 4 (b). Circles are proportional to number of specimens

As regards the exploitation of the South Adriatic stock of Lepidorhombus boscii, specimens longer than 20 cm (optimal market size) represent only 13.1% in number, but 34.9% in weight of the sample. In spite of this, and of the comparatively long time needed to reach 20 cm, the stock seems to withstand the current fishing pressure, thanks to the early age of first reproduction and its distribution in grounds not heavily exploited because of their depth.

3. REFERENCES

Bello, G., G. Marano and E. Rizzi, Risorse demersali del BAsso Adriatico: risultati del primo anno d'indagine. In Atti del Primo Seminario, Ministero della Marina Mercantile, Roma 10-11 novembre 1986 (in press)

Bini, G., 1968. Atlante dei pesci delle coste italiane. Mondo Sommerso, 8:164 p.

Cau, A. and A.M. Deiana, 1982. On the reproduction biology and linear and ponderal growth of some Soleidae. FAO Rapp.Pêches/FAO Fish.Rep., (266):93-6

Froglia, C. and G.F. Giannetti, 1986. Remarks on rings formation in otoliths of Solea vulgaris and other flatfishes from the Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (345):121-2

Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish populations. Bull.Fish.Res.Board Can., (191):382 p.

Tortonese, E., 1975. Osteichthyes (Pesci Ossei). Parte 2. Fauna ital., 11:636 p.

1/ Actually the graph of Figure 4 is biased by gear selection which affects mostly the one year class scaldfish: larger specimens suffer a higher fishing mortality; hence the actual mean l_1 is somewhat smaller than our computed l_1 = 9.81 cm, and so the actual $\ln(L_{\infty} - \bar{l}_1)$ value should be higher than the plotted one, which in turn should give a stronger inflection

DISTRIBUTION OF THE ADRIATIC FISHES OF TRIGLIDAE FAMILY AS AFFECTED BY ECOLOGICAL FACTORS

by

Ivan Jardas
Institute of Oceanography and Fisheries
Split, Yugoslavia

1. INTRODUCTION

The family Triglidae in the Mediterranean and Eastern Atlantic contains eight species. Of these, seven are present in the Adriatic Sea: Trigla lyra, L., T. lucerna L., Aspitrigla cuculus (L.), A. obscura L., Trigloporus lastoviza (Brünn.), Eutrigla gurnardus (L.) and Lepidotrigla cavillone (Lac.). L. cavillone, A. cuculus and E. gurnardus are most frequent in trawl catches in the Adriatic Sea, while A. obscura occurs most rarely in trawl catches, being recorded only from the shallower waters of the southern Adriatic (Merker and Ninció, 1973; Jovanović and Stjepcević, 1982). Fishes of this family are benthic, but some of them come to the surface from time to time (Hureau, 1986).

The distribution of the Triglidae with respect to some basic ecological factors (depth, bottom substratum) is presented here above all, on the basis of data from the Fishery-Biology HVAR Expedition (Karlovac, 1959) and unpublished data of the author. These data cover the open sea while the data for the channel area of the northern and middle Adriatic are from Zupanović (1961) and Crnković (1970) and a number of other reports for different Adriatic areas (Kirincić and Lepetić, 1955; Lepetić, 1965; Froglia and Galli, 1970; Piccinetti, 1971; Merker and Nincić, 1973; Jukić and Piccinetti, 1981; Piccinetti and Piccinetti Manfrin, 1981; Froglia and Magistrelli, 1981; Piccinetti and Giovanardi, 1984, etc.).

Trigla lyra L.

This species is found in the middle and southern Adriatic (Figure 1), with largest specimens up to 51 cm and about 1 kg found in the southern Adriatic (Jardas and Zupanović, 1983), and is more frequent in open waters than in channels. It avoids areas overgrown by sponges or algae (Grubisić, 1982). On the basis of its presence in trawl catches, it occurs in rather large numbers in the Adriatic.

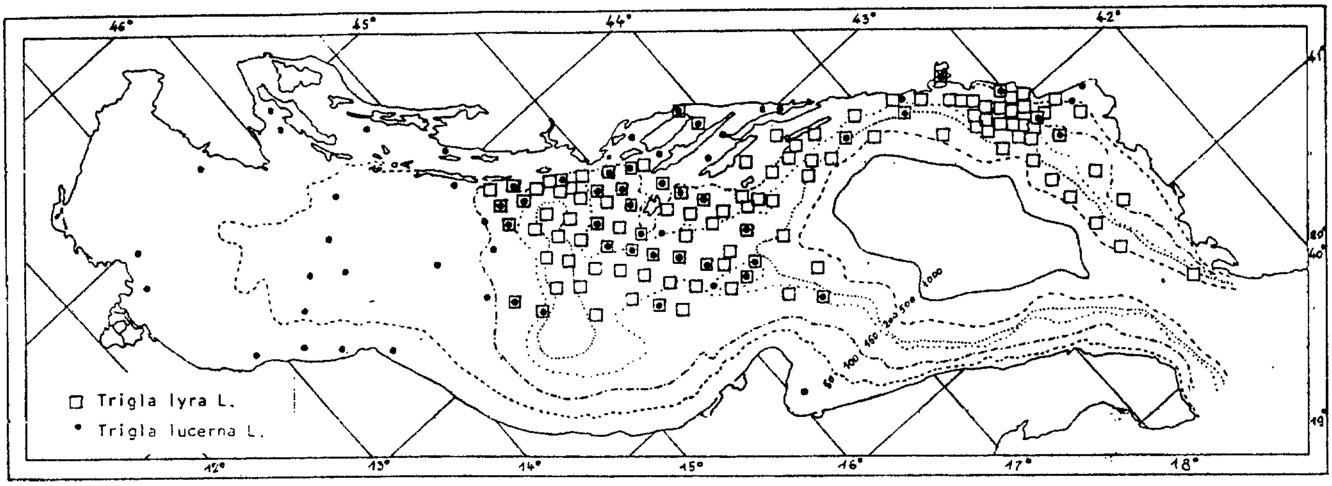


Figure 1 Horizontal distribution of Trigla lyra L. and Trigla lucerna L. species

These fish are generally recorded from catches trawled between 10 and 500 m, but from the data in this paper on experimental trawl catches (from 44 to 341 m depths) they occur in approximately equal numbers at all the depths (Figure 4). Grubisić (1982) reported these fish to be most frequent at 80-150 m depths, and Hureau (1986) reported their vertical distribution as between about 10 and 700 m, with preferential depths above 400 m.

Aspitrigla cuculus (L.)

This counts as a rather common Adriatic Triglid, being distributed in the middle and southern Adriatic (Figure 2), and more numerous in open waters.

A. cuculus has been generally recorded in the Adriatic between 10 and 250 m depths, but on the basis of analysed data it occurs in higher numbers between 80 and 180 m (Figure 4), on muddy, muddy-sandy and sandy bottoms with preference for muddy-sandy and sandy bottoms. Mean numbers of individuals per experimental trawl haul were 4.5 for muddy bottoms, 17.1 for muddy-sandy bottoms and 10.7 for sandy bottoms.

Trigloporus lastoviza (Brünn.)

This species is distributed throughout the Adriatic (Figure 2) but is rather rare in trawl catches. It occurs in higher numbers in channel areas. Its vertical range of distribution extends from several metres (trammel nets) to about 250 m depth. On the basis of the data available here it has been recorded from trawl catches at 34 to 161 m depths, but was better represented in trawl catches at depths down to 110 m (Figure 4).

T. lastoviza prefers bottoms of coarser texture (muddy-sandy and sandy ones), but it was often recorded from muddy bottoms also. The mean number of individuals per experimental trawl haul was 1.3 for muddy bottoms, 2.5 for muddy-sandy bottoms and 1.8 for sandy bottoms. Grubisić (1982) found that it inhabits smooth bottoms irrespective of whether they are muddy or sandy.

Eutrigla gurnardus (L.)

Distributed throughout the Adriatic (Figure 3), this species is among the rarer Adriatic triglids judging from trawl catches, and is generally recorded from 30 to 300 (400) m depths. On the basis of the data available here it is present in experimental trawl catches at 40 to 215 m depths, but more numerous in catches realized at 55-180 m depths (Figure 4). After Hureau (1986) they can be caught at surface by night.

This species was captured from muddy, muddy-sandy and sandy bottoms. Mean numbers of individuals per experimental trawl haul, as shown by the data used here, was 7.2 for muddy bottoms, 10.8 for muddy-sandy bottoms and 8.9 for sandy bottoms. It obviously prefers coarser bottoms.

Lepidotrigla cavillone (Lac.)

This species is distributed throughout the Adriatic (Figure 3), and is the most numerous of the Adriatic Triglidae; making up a significant proportion of trawl catches at a number of localities.

L. cavillone was recorded in the Adriatic mainly at depths between 30 and 450 m, but from the data we had available it occurred in trawl catches from 29 to 282 m depths. It was almost equally numerous in catches at all depths (Figure 4). After Grubisić (1982) it mainly inhabits depths of between 50 and 140 m.

As to the substratum, it was found at muddy, muddy-sandy and sandy bottoms. Mean numbers of individuals per experimental trawl haul from the data analysed, were 53.4 for muddy bottoms, 113.5 for muddy-sandy bottoms and 52.2 for sandy bottoms.

2. CONCLUSIONS

The species T. lucerna, T. lastoviza, E. gurnardus and L. cavillone show the widest horizontal distribution. The species T. lyra and A. cuculus inhabit mainly the middle and southern Adriatic.

With respect to vertical distribution, all species inhabit mainly the littoral zone with T. lyra, E. gurnardus and L. cavillone more common in the lower zone of the continental slope.

These fish inhabit mainly muddy, muddy-sandy and sandy bottoms. T. lyra shows a marked preference for muddy bottoms, and A. gurnardus, T. lastoviza, E. gurnardus and to a certain extent L. cavillone, prefer coarser muddy-sandy and sandy bottoms. Only T. lucerna shows a tolerance for different bottom types.

L. cavillone, E. gurnardus, A. cuculus and to a certain extent T. lyra are the most frequent and most numerous species in trawl catches.

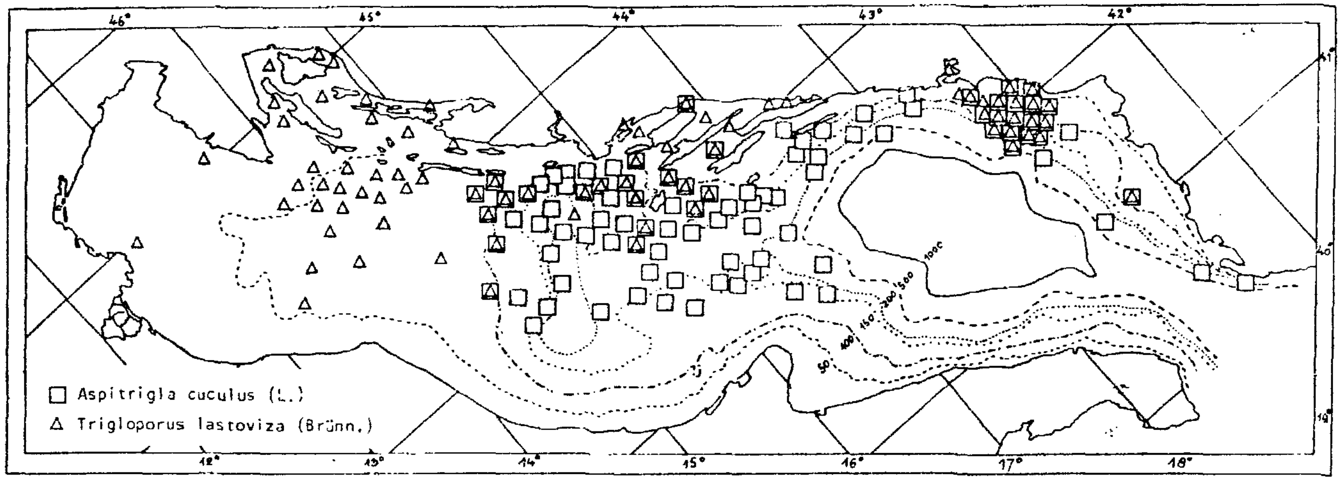


Figure 2 Horizontal distribution of Aspitrigla cuculus (L.) and Trigloporus lastoviza (Brünn.) species

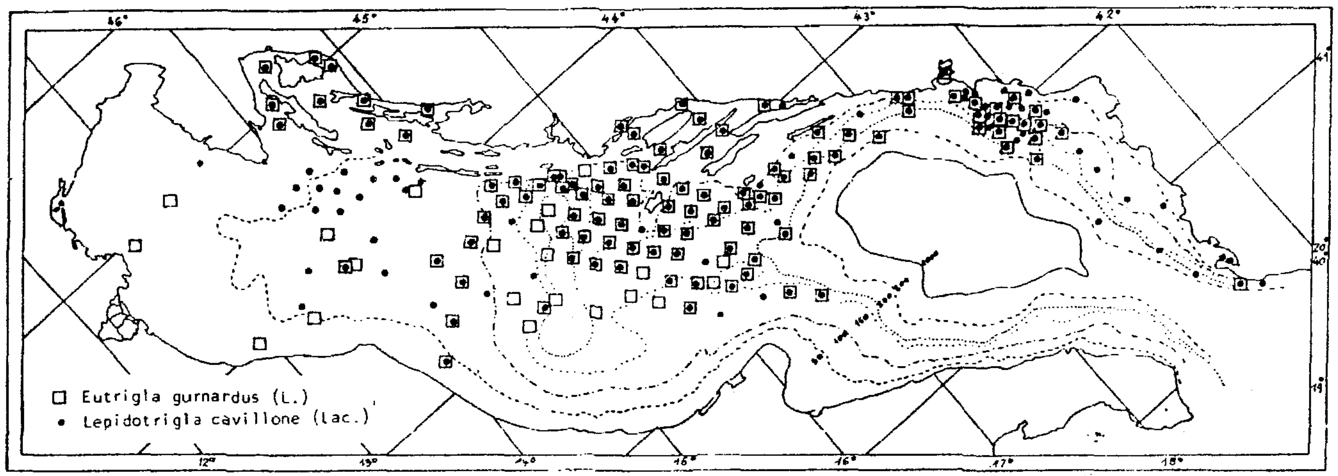


Figure 3 Horizontal distribution of Eutrigla gurnardus (L.) and Lepidotrigla cavillone (Lac.) species

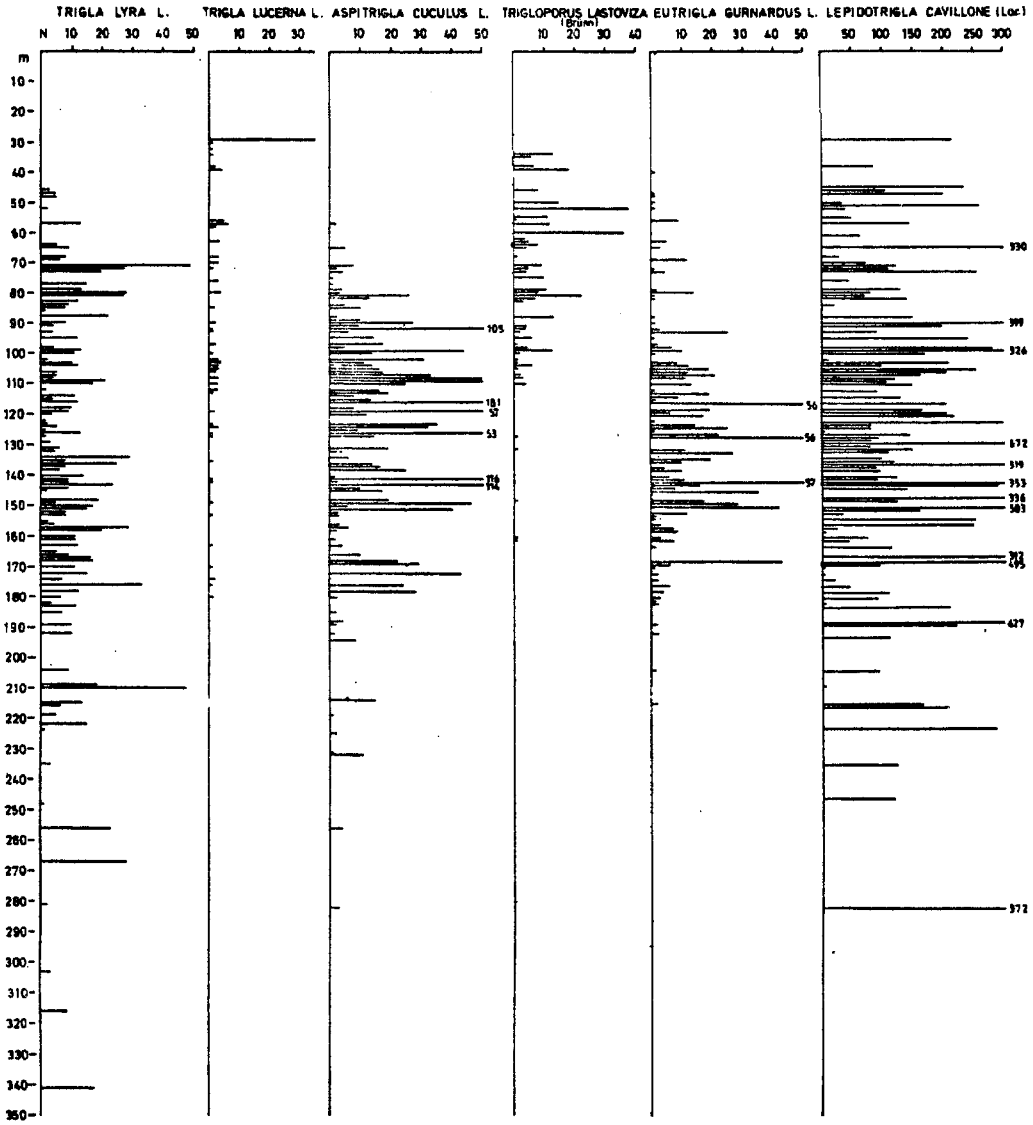


Figure 4 Mean number of individuals of Adriatic Triglidae species per experimental trawl hauls on different depths

According to the same data this species is caught at muddy, muddy-sandy and sandy bottoms, and the highest mean number of individuals per experimental trawl haul was obtained for muddy bottoms (10.3), compared with muddy-sandy bottoms (4.6) and sandy bottoms (2.9). Its preference to muddy bottoms is obvious.

Trigla lucerna L.

This species is distributed throughout the Adriatic; equally numerous in the channel and open sea areas (Figure 1). It counts among the rarer Adriatic Triglidae judged from its presence in trawl catches. Its vertical distribution ranges from 10 to 300 m. On the basis of the data available here it has been recorded from experimental trawl catches realized at 29 to 180 m depths, occurring in higher numbers down to about 120 m (Figure 4). After Hureau (1986) this species occasionally comes to the surface also.

The data analysed show that these fish inhabit muddy, muddy-sandy and sandy bottoms. No marked preference to any bottom type was recorded. Mean number of individuals per experimental trawl haul was 0.7 for muddy and sandy bottoms and 0.5 for muddy-sandy bottoms.

3. REFERENCES

Crnković, D., 1970. Prilog bioloskoj i ekonomskoj problematici koćarenja u kanalskom podrucju sjeveroistocnog Jadrana. Thalassia Jugosl., 6:5-90

Froglia, C. and B. Galli, 1970. Selettività e capacità di cattura di una rete a strascico di tipo italiano su popolazioni di Mullus barbatus L., Quad.Lab.Tecnol.Pesca, Ancona, 1(1):1-21

Froglia, C. and F. Magistrelli, 1981. Osservazioni sulla pesca a strascico nella fascia delle tre miglia della costa in un'area antistante il Delta del Po. Quad.Lab.Tecnol.Pesca, Ancona, 3(1 Suppl.):49-65

Grubisić, F., 1982. Ribe, rakovi i skoljke Jadrana. Liburnija - Naprijed, Rijeka - Zagreb, 239 p.

Hureau, J.-C., 1986. Triglidae. In Fishes of the north-eastern Atlantic and the Mediterranean, edited by P.J.P. Whitehead et al. Paris, Unesco, pp. 1230-8

Jardas, I. and S. Zupanović, 1983. Ishrana i neke druge karakteristike populacije lastavice, Trigla lyra L., 1758 (Pisces, Triglidae) u podrucju juznojadranske kotline (Crnogorsko primorje). Stud.Mar., Kotor, 13-14:167-87

Javanović, R. and B. Stjepcevic, 1982. Ucesće nekih ekonomski vaznih vrsta riba u kocarskim lovinama na podrucju juznog Jadrana. Stud.Mar., Kotor, 11-12:61-83

Jukić, S. and C. Piccinetti, 1981. Quantitative and qualitative characteristics of demersal resources in the Adriatic Sea with some population dynamics estimates. FAO Rapp.Pêches/ FAO Fish.Rep., (253):73-91

Karlovac, O., 1959. Istrazivanja naselja riba i jestivih beskraljesnjaka vucom u otvorenom Jadranu. Izv.Inst.Oceanogr.Ribar., Split, 5(1):1-203

Kirincić, J. and V. Lepetić, 1955. Recherches sur l'ichtyobenthos dans les profondeurs de l'Adriatique méridionale et possibilité d'exploitation au moyen de palangres. Acta Adriat., 7(1):113 p.

Lepetić, V., 1965. Sastav i dinamika ihtiobentosa i jestivih avertebrata u Bokokotorskom zalivu i mogućnosti njihove eksploatacije. Stud.Mar., Kotor, 1:1-127

Merker, K. and T. Nincić, 1973. Sastav i gustina bentoskih ihtio-naselja u juznom Jadranu. Stud.Mar., Kotor, 6:75-117

Piccinetti, C., 1971. Osservazioni periodiche sulla pesca a strascico con la tartana nelle acque costiere del medio Adriatico. Note Lab.Biol.Mar.Pesca, Fano, 4(1):1-24

Piccinetti, C. and O. Giovanardi, 1984. One year trawling survay in the coastal area of the Gulf of Manfredonia. FAO Rapp.Pêches/FAO Fish.Rep., (290):247-52

Piccinetti, C. and G. Piccinetti Manfrin, 1981. Utilisation du chalutage pour estimer les ressources démersales dans une aire limitée. FAO Rapp.Pêches/FAO Fish.Rep., (253):121-3

Zupanović, S., 1961. Kvalitativno-kvantitativna analiza ribljih naselja kanala srednjeg Jadrana. Acta Adriat., 9(3):147 p.

GROWTH AND TEMPORAL DISTRIBUTION OF JUVENILE SPARIDS IN THE SIBENIK AREA IN THE MIDDLE ADRIATIC

by

Jug Dujakovic Jurica
Institute of Oceanography and Fisheries, Split

1. INTRODUCTION

The Sibenik area includes the estuary of the Krka River and several coves and lagoons where newly metamorphosed juveniles of some commercially important fish migrate, such as Sparidae, Serranidae, Mugilidae. Juveniles reside there for some time and leave these areas at the end of summer.

The present study of the distribution and growth of juvenile sparids in the Sibenik area is part of research into the temporal distribution and qualitative-quantitative composition of juvenile fish populations in this area. The data will improve our knowledge of the population dynamics of the commercial fish stocks in the middle Adriatic and lend eventually to mapping of nursery areas in the area of study.

2. STUDY AREA

Five coves with different ecological and geomorphological features were selected for sampling fingerlings in the area of Sibenik in the middle Adriatic (Figure 1). The ecological characteristics of each sampling station are given in Table 1.

Table 1

Environmental characteristics of the middle Adriatic stations sampled by beach-seine

Station	Type of bottom	Salinity (%)	Temperature (C)	Depth (m)
1	sandy-muddy	17.7 - 36.5	2.8 - 26.3	0.1 - 0.5
2	mud	17.0 - 30.2	12.1 - 25.1	0.3 - 1.2
3	mud	34.3 - 37.5	8.8 - 27.2	0.2 - 0.7
4	sandy-rocky	37.7 - 38.8	9.8 - 26.3	0.3 - 1.1
5	black mud	2.9 - 14.3	13.1 - 20.2	0.3 - 1.0

3. MATERIAL AND METHODS

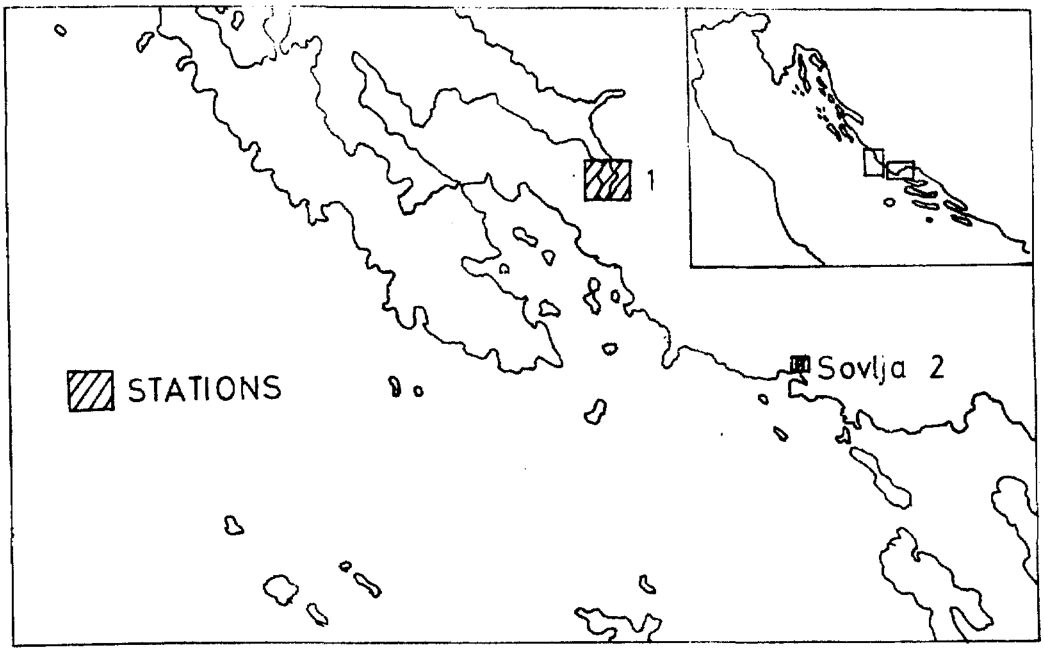
The beach seine for collecting juvenile fish was 25 m long and constructed in two sections: outer wings of 8 mm mesh size, inner wings of 5 mm mesh size. A single net haul was standardized over 40-50 m.

Monthly samples were collected from December 1984 to August 1985. Two hauls were performed at each station at different positions and each sample was preserved in 4% formalin. Sparids were separated from the rest of the catch and identified by species. Total length (mm) and weight were taken. The number of specimens per sample was also recorded. Identification keys, Soljan (1965) and Ranzi (1930), were used for identification and nomenclature after Bauchot and Hureau (1986).

The allometric weight-length relationship was described by the equation

$$W = aL^b$$

where W = weight, L = total length, b = allometric factor or weight-length and a = constant.



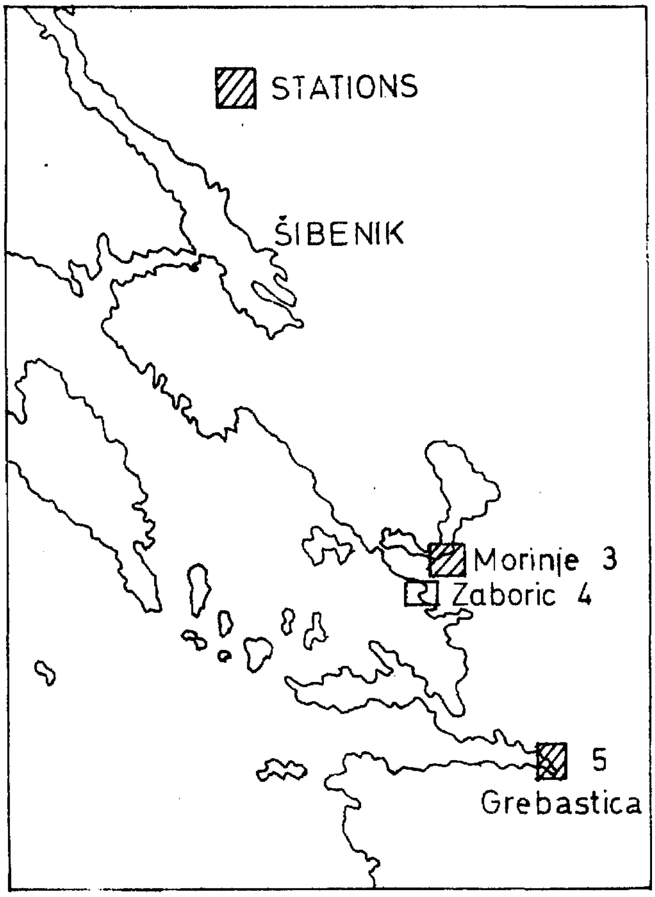


Figure 1 Study area in the middle Adriatic

A refractometer was used for field salinity measurements, while samples were also taken for electrochemical determination in the laboratory. Sea water temperature was measured by a thermometer with a 0.1°C precision.

4. RESULTS AND DISCUSSION

A total of 1 062 juvenile sparids were captured from 28 December 1984 to 20 September 1985 at four middle Adriatic stations. The number of specimens of individual species and their percentage in the total eight month catch at each individual station in the entire study area are given in Table 2. No specimen of the sparid family was recorded from station 5. The catch consisted mainly of mugilid fingerlings. Out of 18 sparid species inhabiting the Adriatic (Soljan, 1965) we identified 10 species and studied 8 species occurring in our samples: Sparus aurata (Linnaeus, 1758), Diplodus puntazzo (Cetti, 1777), Diplodus annularis (Linnaeus, 1758), Diplodus sargus (Linnaeus, 1758), Diplodus vulgaris (E. Goeffrei-Saint-Hilaire, 1817), Sarpa salpa (Linnaeus, 1758), Lithognathus mormyrus (Linnaeus, 1758), Oblada melanura (Linnaeus, 1758). Only two individuals of the species Dentex dentex (Linnaeus, 1758) were captured from station Morinje (3) in June and July, and one individual of Spondylosoma cantharus (Linnaeus, 1758) from station Zaboric (4).

Table 2

The number of juvenile sparid species captured at four middle Adriatic stations and the relative proportions of individual species in the total catch and in the catch per individual station

Species	Total catch		Relative catch per station (%)			
	Number	%	1	2	3	4
S. aurata	221	20.8	19.1	19.8	25.4	10.5
D. annularis	122	11.4	11.5	5.2	20.0	20.3
D. puntazzo	275	25.9	29.4	23.5	25.7	15.4
D. sargus	77	7.3	8.5	5.2	3.3	3.3
D. vulgaris	60	5.6	3.6	-	6.7	20.3
L. mormyrus	61	5.7	5.5	1.7	2.3	24.4
O. melanura	26	2.5	1.5	1.1	2.0	8.9
S. salpa	220	20.7	20.9	27.8	14.4	8.9
Total (number)	1 062		330	349	299	123

The specie Sparus aurata, Diplodus puntazzo and Sarpa salpa were predominant at stations 1, 2 and 3; making up more than 60% of the total sparids in the samples. Their fry prefers coves and estuaries with partly reduced salinity (Lo Bianco, 1909). Freddy, Berg and Bilio (1981) established a 15-25 ppt range to be optimum for the growth and survival of the gilthead sea bream in aquaria. Values at station 5 (2.9-14.3 ppt) are presumably too low for sparids. This is in agreement with the results of Audouin (1962) who found that gilthead sea bream could live and feed actively at 5-44 ppt. Salinity at station four ranging from 37.7-38.8 ppt seems to be the likely cause of the occurrence of sparid species two months later than at other localities; that is when they had attained a length of 35 mm, and the condition factor exceeds 1.

4.1 Temporal Distribution and Spawning Period

The presence of different juvenile sparid species in the catches is dependent on the locality at which the respective catches were realized and on the spawning season of each individual species. Table 3 presents spawning seasons of individual sparid species from available literature, and shows the time of their first appearance in the study area.

The highest numbers of juvenile sparids were recorded from our localities in April, May and June. The presence of fingerlings of eight species (by numbers) in monthly catches at each individual station, and in the entire study area are given in Figure 2.

Table 3

The spawning season of individual fish species (after the available literature) and the time of their first appearance in the study area (author's data)

Species	Months											
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
S. aurata		o								x	x	x[1/]
D. puntazzo									x	x[1/]		o
D. annularis				x	x	x[2/]		o				
D. sargus				x	x	x[1/]	o					
D. vulgaris			o							x	x[2/]	
S. salpa		o							x	x[1/]		
L. mormyrus				o								
O. melanura				x	x	x[3/] o						

1/ Lo Bianco (1909)
2/ Ranzi (1930)
3/ Bauchot and Hureau (1986)

4.2 Growth in Length

The growth of juvenile sparids in the study area is given by the variations of monthly mean length in samples. Temperature values by individual months are also given (Figure 3).

Growth of the species entering coastal waters early in winter (D. puntazzo, D. vulgaris, S. aurata) showed stagnation during low winter temperatures. During the first three months in coastal waters, D. puntazzo grew in mean length from 28.1 to 29.3 mm with standard deviations not exceeding 0.63. The growth increase began in spring, coinciding with the sea water temperature increase. Length ranges grew wider with intensified feeding and greater activity at higher temperature. After three to four months of intensive spring growth, fish left the area of our stations at the beginning of summer.

4.3 Weightlength Relationships

Weightlength relationships of juvenile sparid species were derived for all specimens of individual species captured from the study area (Table 4). The coefficient of ponderal growth shows no significant departure from 3. Positive allometric growth was found in juveniles of all studied species, with the exception of O. melanura sp. (b = 2.94), presumably due to its very small range of sizes.

5. CONCLUSIONS

The time of first appearance of newly metamorphosed juveniles in the shallow coves of the Sibenik area were established for the following species: S. aurata (February), D. puntazzo, D. annularis (July), L. mormyrus (April), O. melanura (June), S. salpa (March), D. vulgaris (March), D. sargus (June).

Juvenile sparid species were found at localities where salinity varied from 8.8-37.5%.

Growth of species the juveniles of which enter shallow coastal waters early in winter, shows stagnation during low winter temperatures and therefore these species reside there longer than species entering these waters at the end of spring.

Positive allometric growth was established for all species studied except O. melanura.

I would like to thank Dr Veronika Alegria-Hernandes for her advice and for reading and commenting on the manuscript.

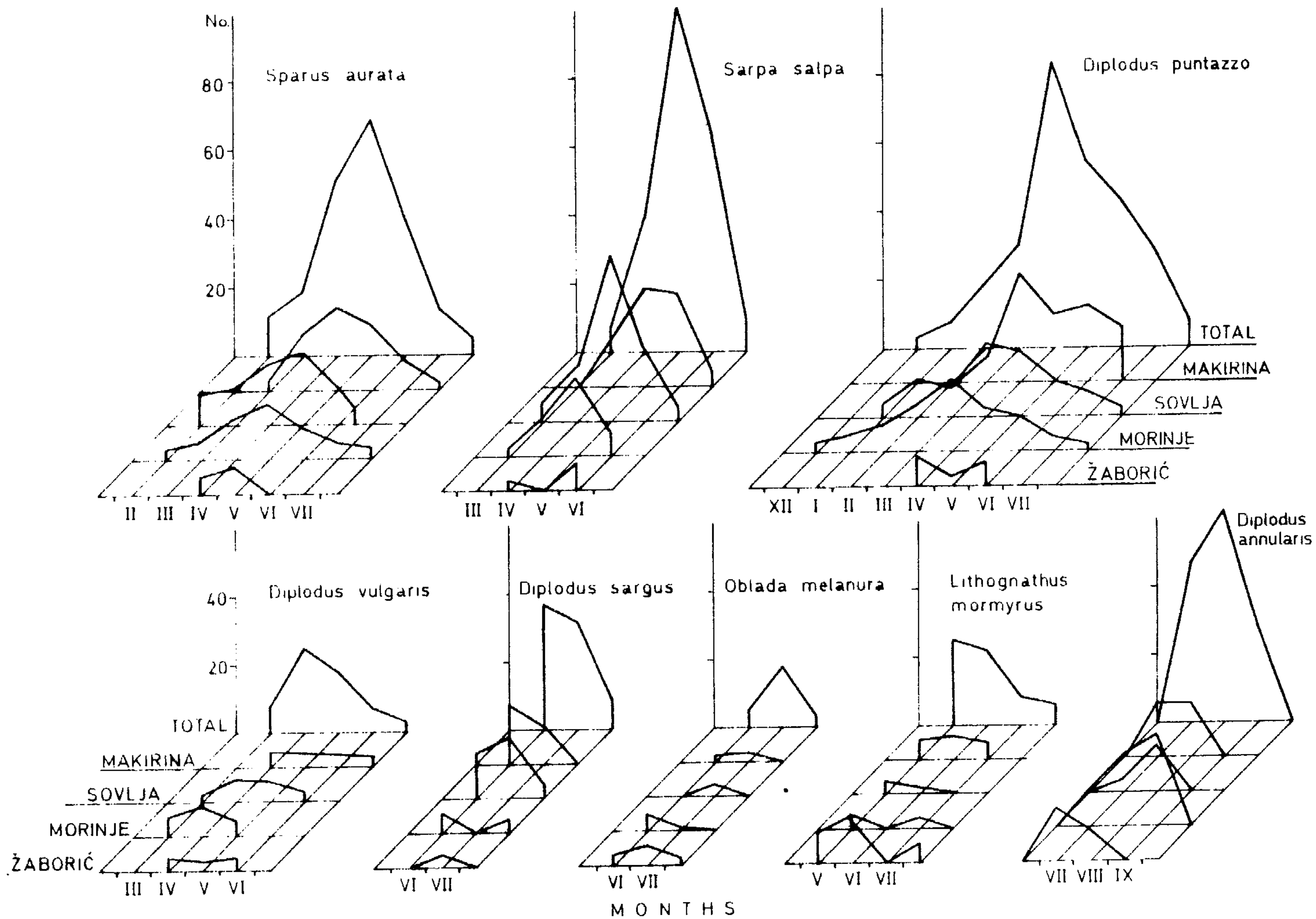


Figure 2 The number of individuals of sparid species separately for each individual station and for the entire study area present in monthly catches (No = the number of fishes)

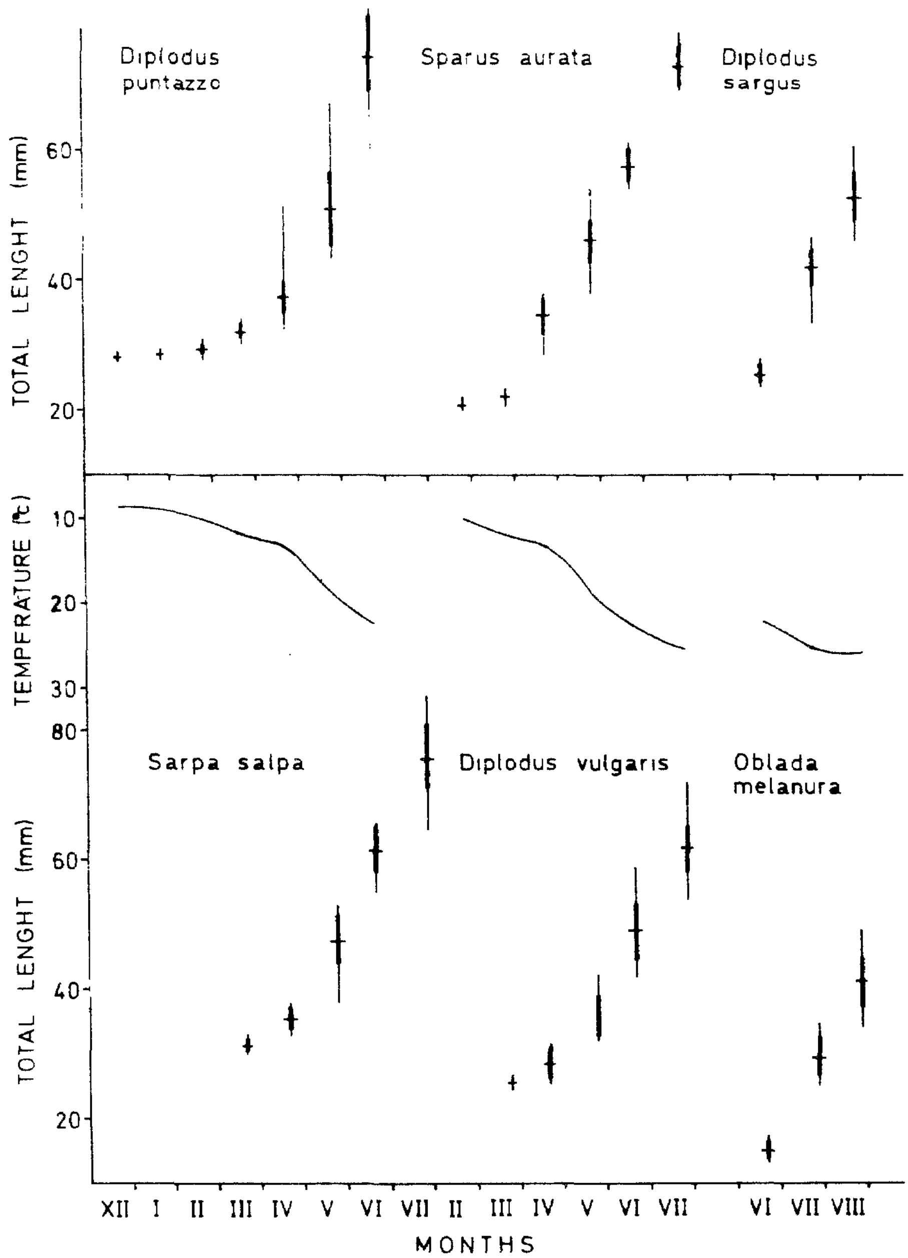


Figure 3 Monthly mean lengths, standard deviations and length ranges for individual sparid species in the Sibenik area, and monthly mean sea water temperatures

Table 4

Parameters of the weightlength relationship for juvenile sparid species in the Sibenik area in middle Adriatic (December 1984 - September 1985)

Species	r	a x 10^5	b
S. aurata	0.989	2.573	3.36
D. puntazzo	1.0	1.277	3.02
D. annularis	1.0	1.265	3.01
D. sargus	1.0	1.091	3.05
D. vulgaris	1.0	0.488	3.26
S. salpa	0.98	0.728	3.11
L. mormyrus	0.99	0.453	3.21
O. melanura	0.99	1.205	2.94

6. REFERENCES

Audouin, J., 1962. La daurade de l'étang de Thau (Chrysophrys aurata L.). Rev.Trav.Inst.Pêches Marit., Nantes, 26:105-26

Bauchot, M.L. and J.C. Hureau, 1986. Sparidae. In Fishes of the north-eastern Atlantic and Mediterranean, edited by P.J.P. Whitehead. Paris, Unesco, pp. 883-907

Freddy, A., L. Berg and M. Bilio, 1981. Most convenient salinity-temperature combination for egg incubation and first larval development of Sparus aurata L. Realism in aquaculture. Poster 57, presented at Venezia 81 (Piazza del Santo 9, Padova, Italy)

Katavic, I., 1984. Inducirano mrijescenje i uzgoj ranih stadija lubina Dicentrarchus labrax (Linnaeus, 1758) i komarce Sparus aurata (Linnaeus, 1758). Thesis.Zagreb, 232 p.

Ranzi, S., 1930. Stadi giovanili di Sparidi del Golfo di Napoli. Pubbl.Stn.Zool.Napoli, 18:282-312

Soljan, T., 1965. Ribe Jadrana (Pisces Maris Adriatici). Izd.Zavod Izd.Udzbenika SRS, Beograd, 3:451 p.

BIOLOGY AND ECOLOGY OF MUGILIDAE SPECIES ON THE EASTERN ADRIATIC COAST (SIBENIK BAY)

by

Z. Modrusan, E. Teskeredzic
"Ruder Bosković" Institute
Center for Marine Research Zagreb
41000 Zagreb, Bijenicka c. 54
Yugoslavia

and

S. Jukić
Institute for Oceanography
and Fisheries
Split, Yugoslavia

1. INTRODUCTION

Six of the characteristically Mediterranean species of the Mugilidae family appear in the Adriatic Sea. They are: Mugil cephalus cephalus L. 1758; Chelon labrosus (Risso, 1826); Liza (Liza) ramada (Risso, 1826); Liza (Liza) aurata (Risso, 1810); Liza (Protomugil) saliens (Risso, 1810) and Oedalechilus labeo (Cuvier, 1829). All of the six species occur in the Adriatic Sea also. As distinctly euryhaline organisms, mullets are found in the coastal waters, river estuaries and harbours, where inflows of freshwater occur.

Claridge and Potter (1985), report on the abundance, distribution and size composition of mullet populations in the Severn estuary and Bristol Channel. There, temperature and salinity values have a dominant influence on the timing of spawning in the natural environment (Heldt, 1948; Morović, 1961; Oren, 1981), and also in inducing spawning under laboratory conditions (Liao, 1975; Nash and Shehadeh, 1980). Farrugio (1975) reports on mullet migrations at the time of spawning from Tunisian lakes in search of constant temperature and salinity conditions, so that their gonads can reach total sexual maturity.

Spawning takes place in bathypelagic waters, at a sea-water temperature of 12-24°C, and a salinity of more than 38°/oo.

In the estuary of the Krka River, mullet populations occur and are dominant species of fish in terms of their biomass (Modrusan and Teskeredzić, 1986). This paper reports up to data information on the composition of these populations, their density, distribution and growth.

2. MATERIAL AND METHODS

Seasonal variations of dynamic parameters of the mullets population are speculated to relate to the considerable annual fluctuations in temperature and salinity, characteristic of this water body. The research was performed in the period 26 January to 1 December 1984 from two fishing vessels with floating nets 400 m in length, 40 m in depth, and a mesh size of 28 mm (knot to knot), were used for sampling, which was performed twice a week. In the period 1985/86, we analysed the catch by gillnets of 100 m/4 m/24 mm, and by hook and trap. The floating nets, used in fishing, were set only in the lower, deeper sections of the estuary, while the small-scale artisanal fishing gears were used in the whole estuary, between the Krka River falls and its outlet to the open sea at the end of the Sv. Ante's Channel (Figure 1).

Total lengths (Lt) of each specimen were measured from the top of the head to the tip of the tail in centimetres. Total weight (Wt) fish is given in grams.

Age was estimated by scale analysis: scales being taken always from the back of the belly fin, at the height of the lateral line. After rinsing, in distillated water, they were observed with 5x enlargement.

Temperature and salinity were observed at six positions in the estuary, once a month during 1984 and 1985. Samples were taken at depths of 0.5 m and 10 m.

Sampling stations were selected in an attempt to cover the entire area of the estuary; about 10 nautical miles of total length. Position M_1 near Skradin, and M_2 in Prokljan Lake are much shallower and strongly influenced by freshwater. The average depth at positions M_3 near Sibenik Bridge, M_4 in Crnica, M_5 on Martinska, and M_6 at the exit from the estuary, were about 30 m deep, and all of these latter are strongly influenced by the sea (Figure 1).

3. RESULTS

3.1 Analysis of the Catch by Floating Nets

All of the mullet specimens caught by the large floating net belonged to Liza (Liza) ramada species. From almost the entire annual catch, 330 specimens of this species were analysed. The

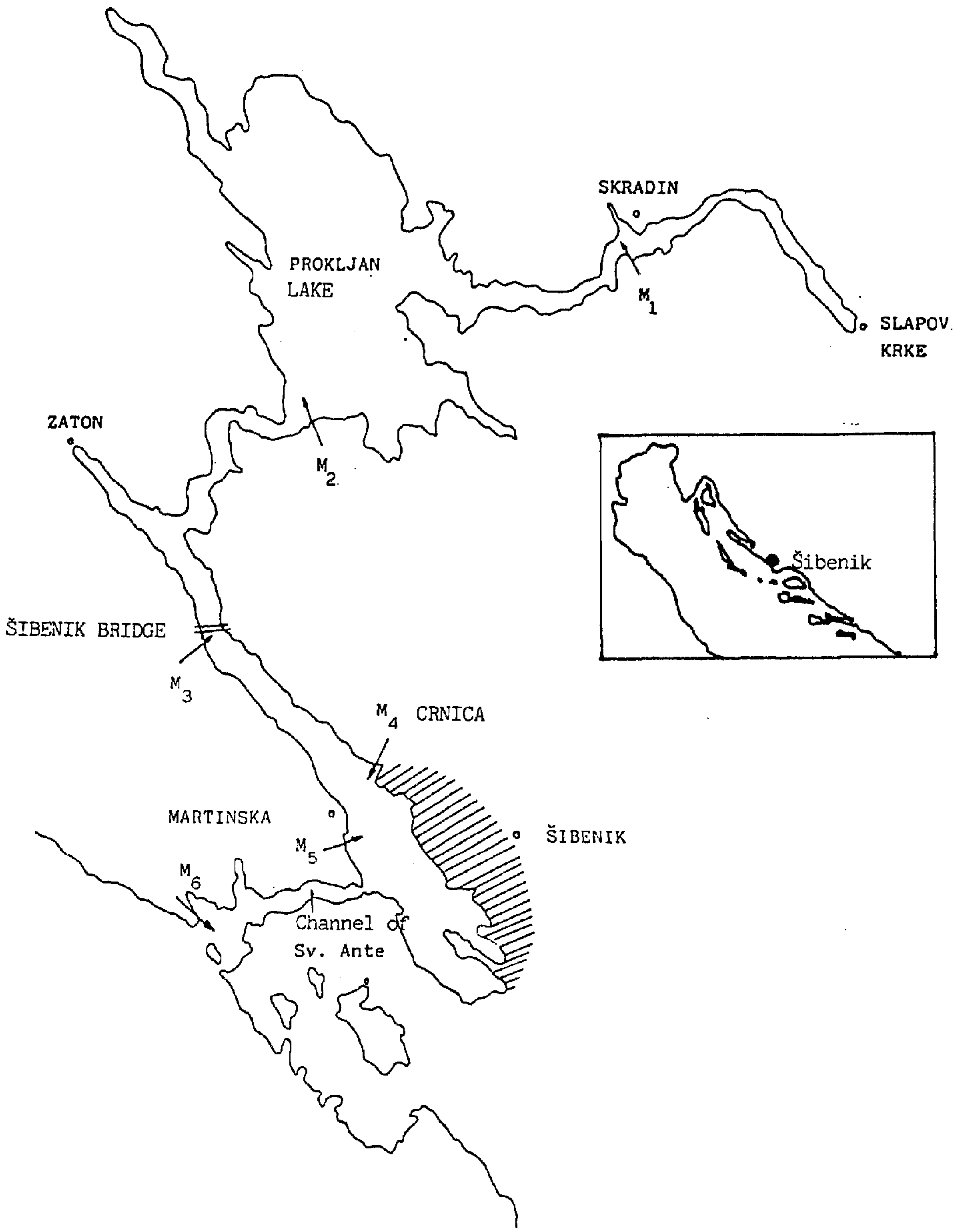


Figure 1 The Krka River estuary with research locations denoted; showing position of the estuary in the Adriatic sea

catch came from the lower section of the estuary, near the urban zone of Sibenik. Most fish were caught in relatively shallow locations (15-20 m), although in this section of the estuary, the depth reaches 40 m. Professional fishermen caught a total of 113.5 t during the entire research period.

Figure 2 shows seasonal variations of the catch. Beginning on 26 January 1984, samples were taken with more or less success. The minimum catch was registered in October, while in November the catch was unsuccessful, and finally in December fishing was terminated.

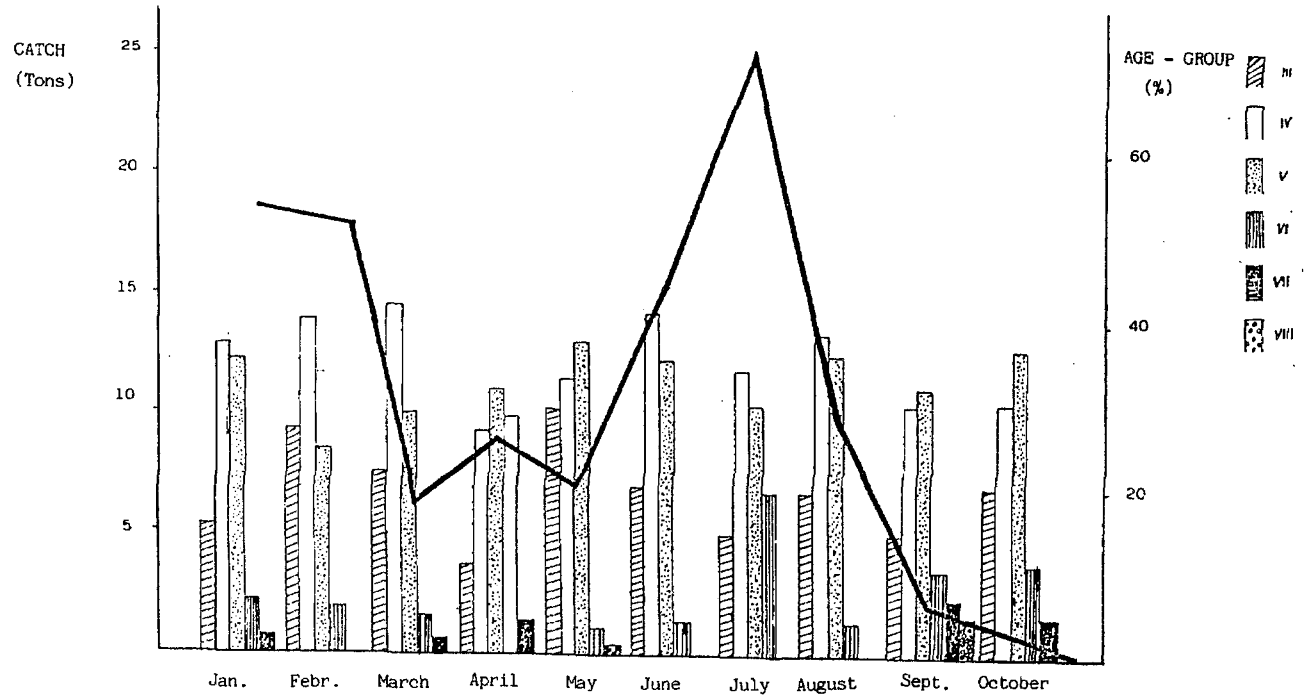


Figure 2 Seasonal variations in the catch of Liza (Liza) ramada (Risso, 1826) by floating net, and the occurrence of the different age groups by percentage

Figure 2 shows percentage representation of age groups in the monthly catch.

All specimens analysed ranged from 3^+ to 8^+ years of age, and total length of the specimens ranged from 29.0-54.0 cm. The greatest share, 67%, were specimens of 4^+ and 5^+ years of age.

The lowest individual weight of the fish registered was 180 g; the hishest 1 260 g. The relationship among age, length and weight groups, and their percent occurrence are shown in Table 1.

Table 1

Relationship between length, weight and age of Liza (Liza) ramada and percent occurrence

Age group (years)	Total length (Lt) (cm)	Total weight (g)	Number of fish analysed (samples)	Occurrence in percents
3+	33.5	283	55	16.6
4+	35.9	410	114	34.6
5+	40.9	602	107	32.4
6+	46.0	875	30	9.1
7+	49.0	930	18	5.5
8+	51.5	1 260	6	1.8

3.2 Analysis of the Catch by Small-Scale Artisanal Fisheries Gears

In the course of 1985/86 in the catch small-scale artisanal gear took the following species of mullet:

Species	Number	Percentage
Chelon labrosus	485	66.6
Liza (Liza) ramada	121	16.6
Liza (Liza) aurata	103	14.2
Mugil cephalus cephalus	13	1.8
Oedalechilus labeo a/	6	0.8

a/ Oedalechilus labeo is not an estuary dependent species

A total of 728 samples were analysed. Among the Adriatic mugilids, the species Liza (Protomugil) saliens (Risso, 1810) was not recorded. Figure 3 shows the recorded position of mullet catches in the Krka river.

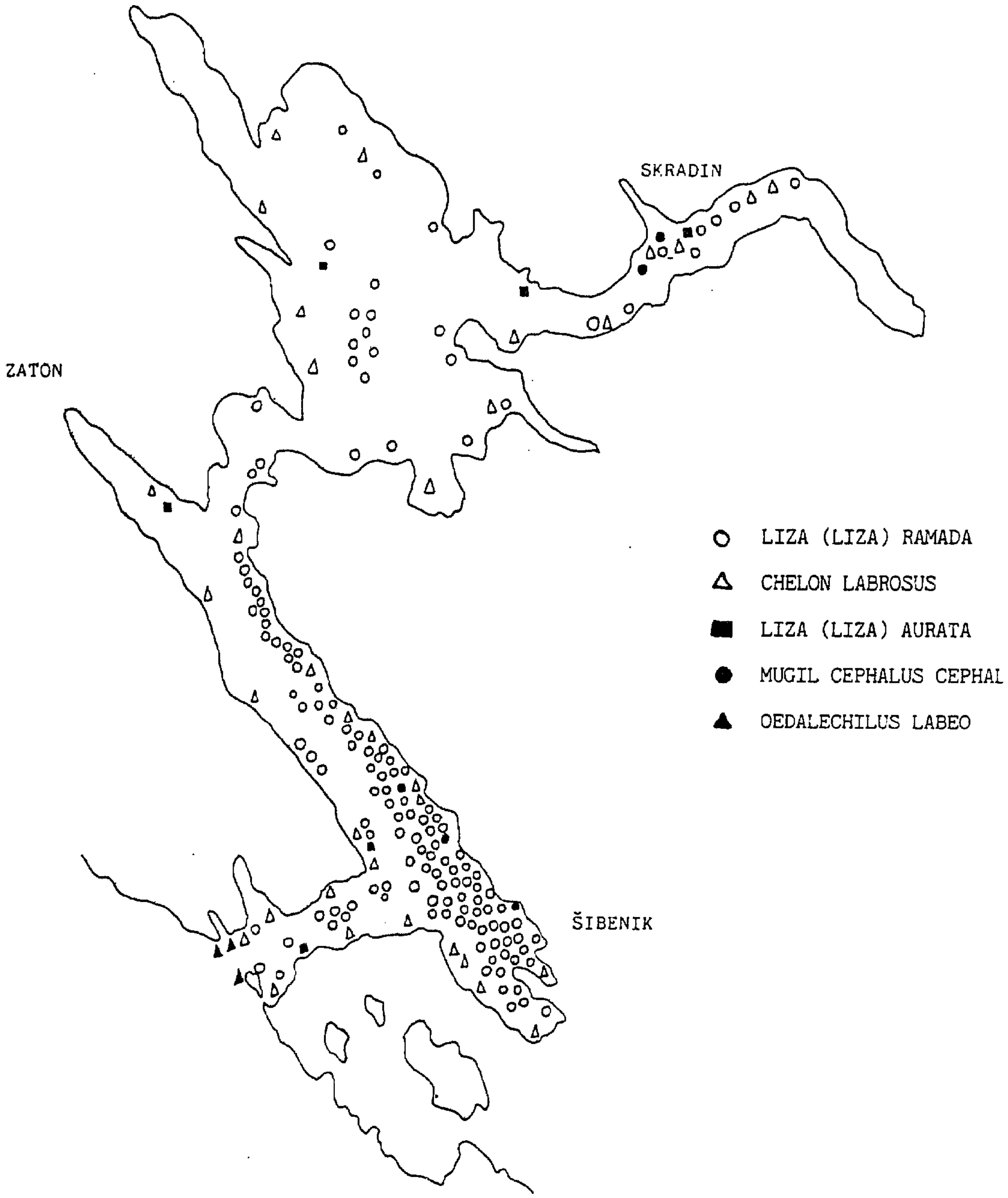


Figure 3 Spatial distribution of mullet populations in the Krka river estuary

Chelon labrosus was the most commonly represented species in the catch by small-scale artisanal fisheries gears, forming 66.6% of the total. Populations of this species occur close to shore throughout the entire estuary. The specimens samples were from 2^+ to 6^+ years with 50% in the third year of life (Table 1).

Although Liza (Liza) ramada represented 100% of the catch of the floating net, it made up only 16.6% of the catch by small-scale artisanal gears. Samples were analysed from the whole area of the estuary, but the highest density of this species was registered in the vicinity of the urban zone of Sibenik. This species was not represented in the catches by hook and by fish trap, but exclusively by gillnet. This is due to its specific nutrition. Adult specimens also dominated the catch by the small-scale artisanal gears (Table 2).

Table 2

Relationship between length, weight and age of individual mullet age groups represented in the catch by small-scale artisanal gears

Species	Age group	Lt (cm)	Wt (g)	Percentage
Chelon labrosus (Risso, 1826)	2^+	24.0	180	31.9
	3^+	30.5	270	50.0
	4^+	34.5	350	12.1
	5^+	38.0	510	4.2
	6^+	40.0	800	1.8
Liza (Liza) ramada (Risso, 1826)	2^+	22.5	145	15.2
	3^+	31.0	310	43.7
	4^+	36.0	425	32.1
	5^+	38.0	505	9.0
Liza (Liza) aurata (Risso, 1810)	2^+	23.0	145	87.7
	3^+	27.5	215	9.4
	5^+	34.5	360	2.9
Mugil cephalus cephalus, Linnaeus, 1758	4^+	36.0	465	36.0
	5^+	40.5	820	64.0
Oedalechilus labeo (Cuvier, 1829)	3^+	22.0	100	100.0

The share of Liza (Liza) aurata in the catch amounted to 14.2%. This species is also estuary dependent. Out of 103 samples of this species, 87.7% were juveniles in the second year of life, at an average length of 23.0 cm (Tables 2 and 3).

This species was represented in the catch only during March, June and November.

Only 13 specimens of Mugil cephalus cephalus were caught: nine by gillnet in the area of Sibenik harbour; the other four in the vicinity of Skradin harbour. All specimens were taken in June. Oedalechilus labeo was also observed in the lower section of the estuary near Jadrija in June, 1986. Six specimens of the 3^+ age group were taken (Table 2).

Considerable seasonal variations occur in the catch by small-scale artisanal fisheries gears. Maximum catch occurs in summer, and the minimum in winter. Only Liza (Liza) ramada and Chelon labrosus were taken during the winter months, and then all specimens were in the juvenile phase, or sexually mature. Table 3 and Figure 4 show the growth characteristics of the four Mugilidae species in Sibenik Bay.

Table 3

Constants for growth equations of four species of the genus Mugilidae:
Chelon labrosus (Risso, 1826); Liza (Liza) ramada (Risso, 1826);
Liza (Liza) aurata (Risso, 1810) and Mugil cephalus cephalus Linnaeus, 1758;
along the eastern Adriatic coast (Sibenik Bay)

Species	(L_{oo})	(K)	(t_o)	t_{max} = 3/K
1. Chelon labrosus (Risso, 1826)	44.0	0.36	-0.1	approximately 8 years
2. Liza (Liza) ramada (Risso, 1826)	40.0	0.75	0.9	" " 5 years
3. Liza (Liza) aurata (Risso, 1810)	51.0	0.30	-0.4	" " 10 years
4. Mugil cephalus cephalus (Linnaeus, 1758)	70.0	0.13	-0.9	" " 23 years

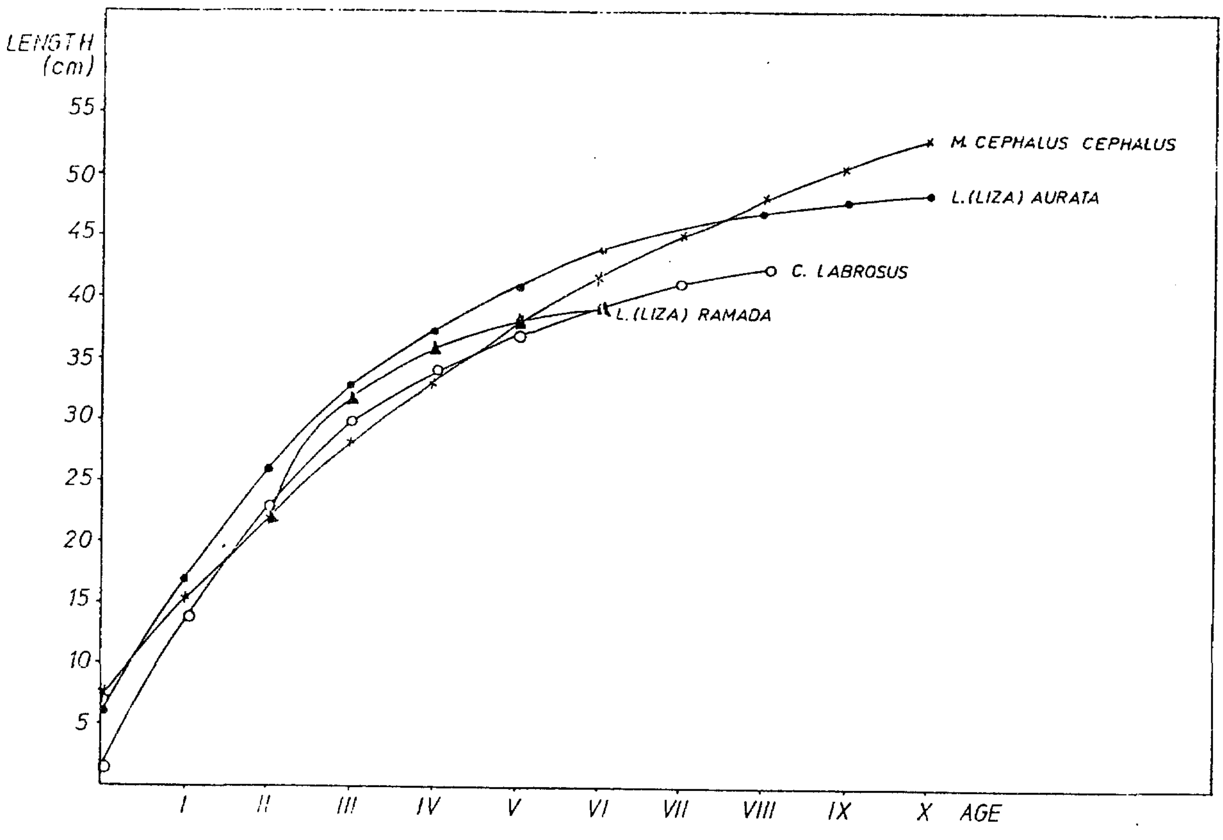


Figure 4 Growth characteristics of the four Mugilidae species along the eastern Adriatic coast (Sibenik Bay)

Tables 4 and 5 show the results of water analyses in the estuary during the research, and Figure 5 the graphic representation of seasonal variations in temperature and salinity at depths of 0.5 m in relation to the catch by small-scale artisanal gears.

Table 4

Average monthly temperature values (°C) for locations investigated at depths of 0.5 and 10 m, during 1984 and 1985

Locality	Depth (m)	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
M_1	0.5	5.8	7.3	11.2	13.1	19.0	20.4	24.8	25.5	23.0	20.8	14.3	11.0
	7.0[a]	11.0	12.6	12.2	14.2	18.3	21.4	24.6	28.0	23.5	22.6	17.4	15.5
M_2	0.5	6.3	6.3	11.1	12.5	15.2	18.1	25.2	25.0	20.0	14.4	11.8	7.6
	10.0	10.1	11.1	11.9	13.2	15.0	17.0	22.2	22.6	23.6	19.0	14.9	12.2
M_3	0.5	6.8	6.6	11.0	12.9	15.3	20.7	25.5	24.4	21.0	14.8	13.5	9.3
	10.0	11.1	10.6	11.3	13.0	15.0	19.5	22.3	22.9	25.0	19.4	16.8	12.7
M_4	0.5	7.0	6.8	11.0	12.8	15.5	21.0	25.6	24.0	21.5	14.8	13.5	7.5
	10.0	11.0	11.4	11.6	13.0	15.2	20.1	22.9	21.5	23.0	19.8	16.8	13.2
M_5	0.5	6.3	6.9	10.7	12.7	15.5	20.5	25.7	22.1	22.3	15.0	8.6	7.5
	10.0	10.5	11.3	11.2	13.0	15.3	20.3	22.5	22.7	23.0	19.8	16.5	12.8
M_6	0.5	8.6	8.0	11.4	12.3	15.5	21.0	24.6	23.0	20.1	18.8	15.5	12.0
	10.0	11.8	11.5	11.6	12.5	16.0	22.0	23.4	23.2	20.4	20.2	15.8	13.2

a/ At location M_1, the depth is only 7 m

Table 5

Average monthly salinity values (°/oo) for locations investigated at depths of 0.5 and 10 m, during 1984 and 1985

Locality	Depth (m)	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
M_1	0.5	2.0	4.0	1.0	2.0	1.0	3.0	6.0	4.0	5.0	6.0	4.7	1.5
	7.0[a]	35.0	28.0	16.0	36.0	37.0	36.0	38.0	38.0	37.0	37.0	36.5	38.0
M_2	0.5	12.0	8.5	3.0	6.5	4.0	7.0	10.5	12.0	6.0	3.0	18.0	23.0
	10.0	36.0	34.0	34.0	38.5	34.0	35.5	37.0	36.5	37.0	37.0	37.5	36.0
M_3	0.5	16.5	11.5	4.0	10.0	6.0	10.0	11.0	17.0	16.0	5.0	18.0	27.5
	10.0	35.5	36.7	32.5	38.5	35.0	36.0	28.5	37.0	38.0	37.0	37.0	36.0
M_4	0.5	17.5	13.0	11.5	10.5	10.0	13.0	19.0	20.5	23.0	5.0	20.0	26.5
	10.0	36.0	36.5	27.0	38.5	36.0	38.0	28.0	37.0	38.0	37.0	38.5	36.0
M_5	0.5	17.0	11.5	6.5	10.5	7.0	12.5	16.0	17.0	21.0	5.0	21.0	27.5
	10.0	34.0	34.0	35.5	38.5	34.0	36.5	30.0	37.0	38.0	37.0	38.5	38.5
M_6	0.5	17.0	14.0	6.0	8.0	12.5	24.0	27.0	29.0	30.0	32.0	36.0	30.0
	10.0	35.0	38.0	31.0	36.0	37.0	38.5	38.5	34.5	38.5	38.5	38.5	38.5

a/ A location M_1 the depth is only 7 m

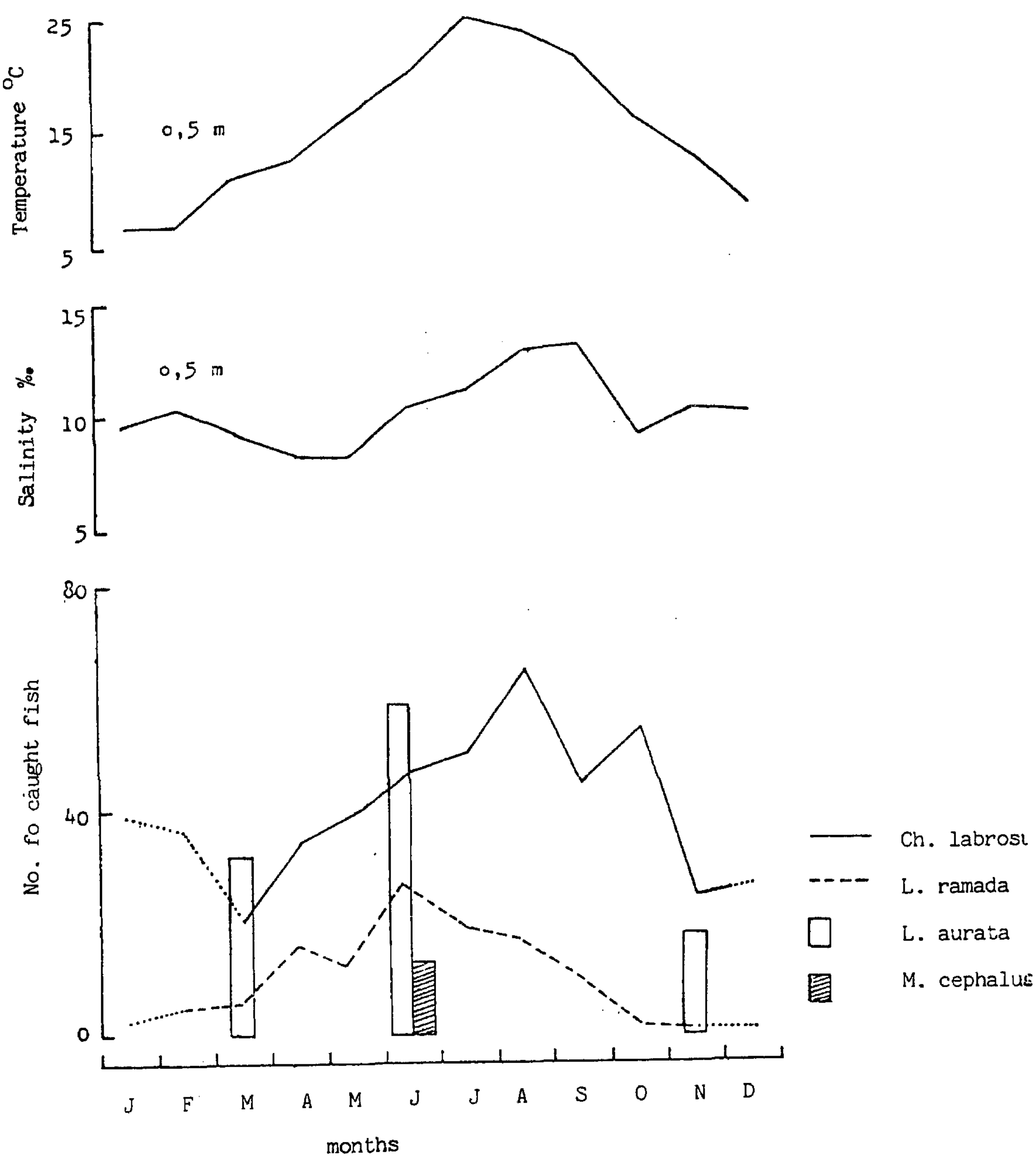


Figure 5 Seasonal variations in temperature, salinity and catch by small-scale artisanal gears. Liza (Liza) aurata and Mugil cephalus cephalus were represented in the catch only in March, June and November. Histograms show the catch variations. The dotted line indicates the period of absence of adult Chelon labrosus and Liza (Liza) ramada

4. CONCLUSION

The mullet population in the Krka estuary is dominated by four estuary-dependent species: Liza (Liza) ramada, Chelon labrosus, Liza (Liza) aurata and Mugil cephalus cephalus. Liza (Liza) ramada was the sole species caught by floating net, but in the catch by small-scale artisanal fisheries gears, the species Chelon labrosus and Liza (Liza) aurata were dominant. Mugil cephalus cephalus is the smallest species and is of no great importance for the fishery.

The maximum catch by both floating net and small-scale artisanal fisheries gears was registered in summer, and the minimum in winter. Adults were absent from the catch in winter.

Smaller schools of three other species occurred near shore, especially in the upper section of the estuary which is shallower. The disposition and density of populations are here well-balanced, with the exception of Mugil cephalus cephalus which is weakly represented. Notable seasonal variations were found in the presence and composition of mullet populations in the estuary.

The minimal catch of mullets in winter months are doubtlessly conditioned by low values of temperature and salinity, and by spawning migrations.

In summer, the main population of the dominant species Liza (Liza) ramada inhabits the lower section of the estuary, near the urban zone of Sibenik. Higher temperatures, good growth of vegetation and the presence of numerous organisms in littoral zone, are main sources of food in the summer period for populations of the other estuary dependent species of mullets, and consequently their density increases.

5. REFERENCES

Claridge, P.N. and I.C. Potter, 1985. Distribution, abundance and size composition of mullet populations in the Severn estuary and Bristol Channel. J.Mar.Biol.Assoc.U.K., 65:325-35

Farrugio, H., 1975. Les muges (Poissons, Teleosteens, Mugilides) de Tunisie. Répartition et pêche, contribution à leur étude sistématique et biologique. Thèse. Université des Sciences et Techniques du Languedoc, 201 p.

Heldt, H. 1948. Contribution de l'étude de la biologie des muges des lacs Tunisiens. Bull.Stn. Océanogr.Salambo, (41):1-50

Liao, I.-C., 1975. The experiments on induced breeding of the grey mullet in Taiwan from 1963 to 1973. Paper presented at the IBP/PM International Symposium on the grey mullets and their culture. Haifa, 2-8 June, 1974. Aquaculture, 6:31-58

Modrusan, Z. and E. Teskeredzić, 1986. Mullets from the Krka River estuary. Ichthyologia, 17(1):37-45

Morović, D., 1961. Jadranski mugilidi (cipli, skocci) s posebnim obzirom na vrste Mugil cephalus L. i Mugil chelo Cuv.. Disertacija. Zagreb, Polj. fak. Sveuc., 131 p. (mimeo)

Nash, C.E. and Z.H. Shehadeh, 1980. Review of breeding and propagation techniques for grey mullet, Mugil cephalus L.. ICLARM Stud.Rev., (3):87 p.

Oren, O.H. (ed.), 1981. Aquaculture of grey mullets. Cambridge, Cambridge University Press, International Biological Programme, 26:507 p.

ON THE DENSITY-DEPENDENT REGULATION OF THE 0 GROUP HAKE (Merluccius merluccius, L. 1758) IN THE PATRAIKOS GULF, GREECE

by

C. Papaconstantinou and K. Stergiou
National Centre for Marine Research, Athens 16604, Greece

1. INTRODUCTION

The hake (Merluccius merluccius) ranks among the most important commercially species in Greek Seas, amounting to some 1 200 t annually. Although considerable research has been devoted to the study of the biology (Tsimenidis, Papaconstantinou and Daulas, 1978; Tsimenidis and Papaconstantinou, 1985; Papaconstantinou, Caragitsou and Panou, 1986) and feeding (Caragitsou and Tsimenidis, 1977; Papaconstantinou and Caragitsou, 1987) of hake in Greek waters, certain questions have arisen concerning the seasonal migration and oscillation in abundance of 0 group hake. In general, it has been noted that the abundance of the 0 group hake declines abruptly between September and November-December in areas considered as nursery grounds (e.g. Saronikos and Patraikos Gulfs), as opposed to areas where mature hake predominate (e.g. Thermaikos, Korinthiakos and Euboikos Gulfs).

It is to the seasonal migration and fluctuation in abundance of 0 group hake in the Patraikos Gulf (Figure 1), and their implications to fishery management of that area, that the present paper is primarily addressed.

2. MATERIAL AND METHODS

Trawl samples were collected by means of a 425 HP motorboat equipped with a 14 mm mesh (from knot-to-knot) codend, on a seasonal basis from June 1984 to April 1985 over a grid of 28 stations in the Patraikos and Korinthiakos Gulfs and the Ionian Sea (Figure 1). Two subareas were distinguished in the Ionian Sea; namely, subarea A (depth < 130 m) and subarea B (depth > 350 m) (Figure 1). Each haul lasted 45 min.

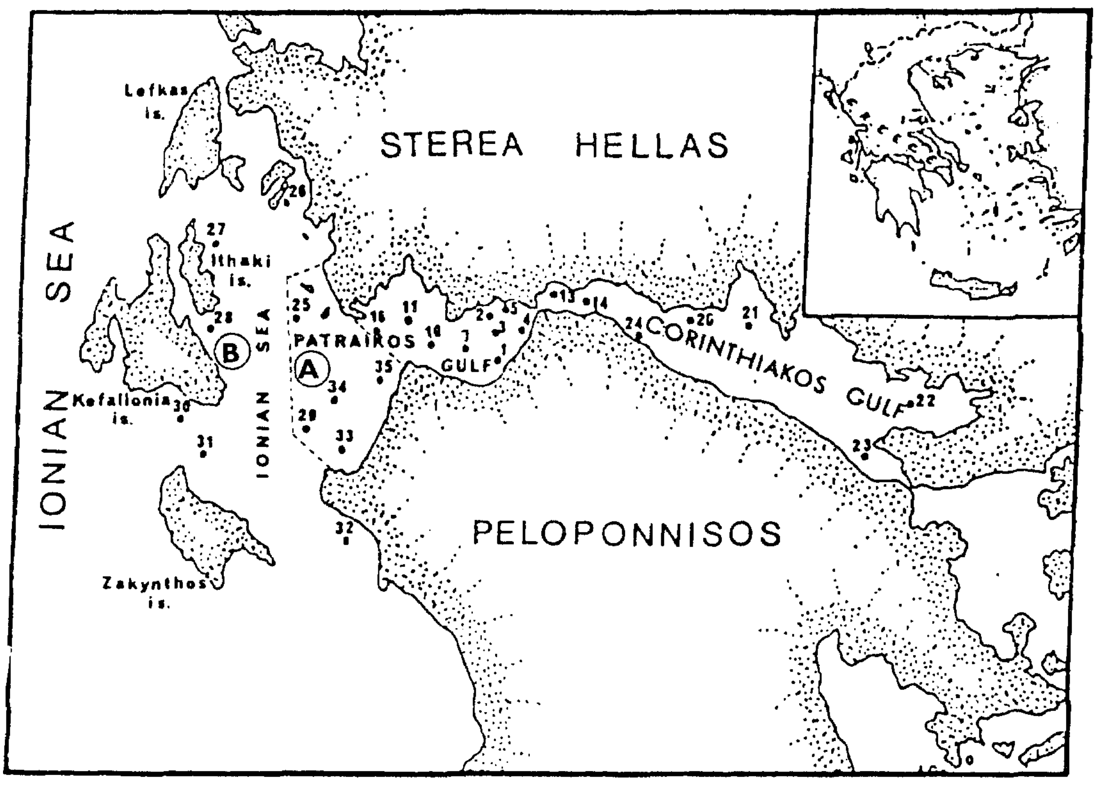


Figure 1 Location of sampling stations

catch-curve method (Ricker, 1975; Pauly, 1980), natural mortality estimates from Pauly's (1980) method.

3. RESULTS AND DISCUSSION

The sharp decrease in the abundance of the 0 and, to some extent, 1 group hake in the Patraikos Gulf between September and November-December (Figure 2), during the study period, must be attributed to the following reasons:

(a) fishing mortality of the 0 and 1 group

The abrupt decline in the abundance of both groups of hake cannot be associated with the trawl fishery inasmuch as sampling took place just before or right after the opening of the fishing season, which, in the Patraikos Gulf, ranges between the 1st of December and the 28th of February.

(b) migration from Patraikos Gulf to adjacent regions

Based on the length-frequency distribution (Figure 2), a massed migration of the 0 group hake from the Patraikos Gulf to the Ionian Sea and/or the Korinthiakos Gulf between September and December does not seem probable. Nevertheless, restricted migration to the subarea B of the Ionian Sea (d $<$ 130 m, Figure 1) seems to take place early in the following spring. It is hard, however, to decide whether this migration is of a massed nature or not, for, in that area of the Ionian Sea, two populations of hake intermingle, which differ in the timing of recruitment. One population inhabits the Patraikos Gulf and recruits appear in late summer-early autumn, and another the subarea A of the Ionian Sea, recruited in late spring-early summer.

From Figure 2 it becomes apparent that the timing of the 0 group hake recruitment in the Korinthiakos Gulf is delayed as compared with that in the Patraikos Gulf. Immature hake of lengths between 160 mm and 190 mm appear in that area in November - December, yet, their length is on the average smaller than that in the Patraikos Gulf. This, coupled with the absence of immature hake of lengths smaller than 160 mm in September in the Korinthiakos Gulf, may indicate that hake migrates from Patraikos Gulf to Korinthiakos Gulf between September and November-December. However, the geomorphology and the extended area of the Korinthiakos Gulf, together with the fact that hake of lengths 160-190 mm were found throughout that region, render this hypothesis questionable.

The absence of hake in the areas adjacent to Patraikos Gulf, whose length represents the evolution of the 0 group hake of the Patraikos Gulf, makes it improbable that the sharp decline of the 0 group hake abundance in the Patraikos Gulf is attributed to migration, which, if it occurs seems to be restricted to movements towards the Korinthiakos Gulf.

3.1 Natural Mortality of the 0 and 1 Group Hake

The trawling season in the Patraikos Gulf opens in December and closes the end of February. Hence, the 0 group hake which appear as recruits in June, exhibiting a maximum in September and a minimum in November-December, can be assumed to be a population that is not subjected to fishing at this age. On that premise, total mortality of the 0 group hake may be assumed to equal natural mortality, assuming the stock is closed (i.e. no migration). This assumption is of great significance for the estimation of seasonal fluctuations in the 0 group hake in that area.

Seasonal fluctuations in the total (=natural) mortality are shown in Table 1, from which some general remarks can be drawn:

(a) total (=natural) mortality exhibited a minimum in June during both 1983 and 1984.

(b) total (=natural) mortality exhibited a maximum in December 1983 and November 1984, not differing considerably from that of September, and

(c) the seasonal change of total (=natural) mortality exhibited similar patterns during both years of investigation. This is to be expected inasmuch as Pauly's method is based on the number of individuals in a sample.

The natural mortality rate, often theoretically considered as constant, is a function of the following components: (a) the number of hake recruits, and (b) the environmental factors.

Low natural mortality is observed in summer and the high mortality in autumn is mainly attributed to the high densities of young hake. In November-December however, a sharp decline in the abundance of young hake occurs as shown by the slope of the catch-curve. This, in turn, is associated with the decreasing abundance of young hake with size, since the number of mature hake is small and does not undergo seasonal oscillations (Figure 2).

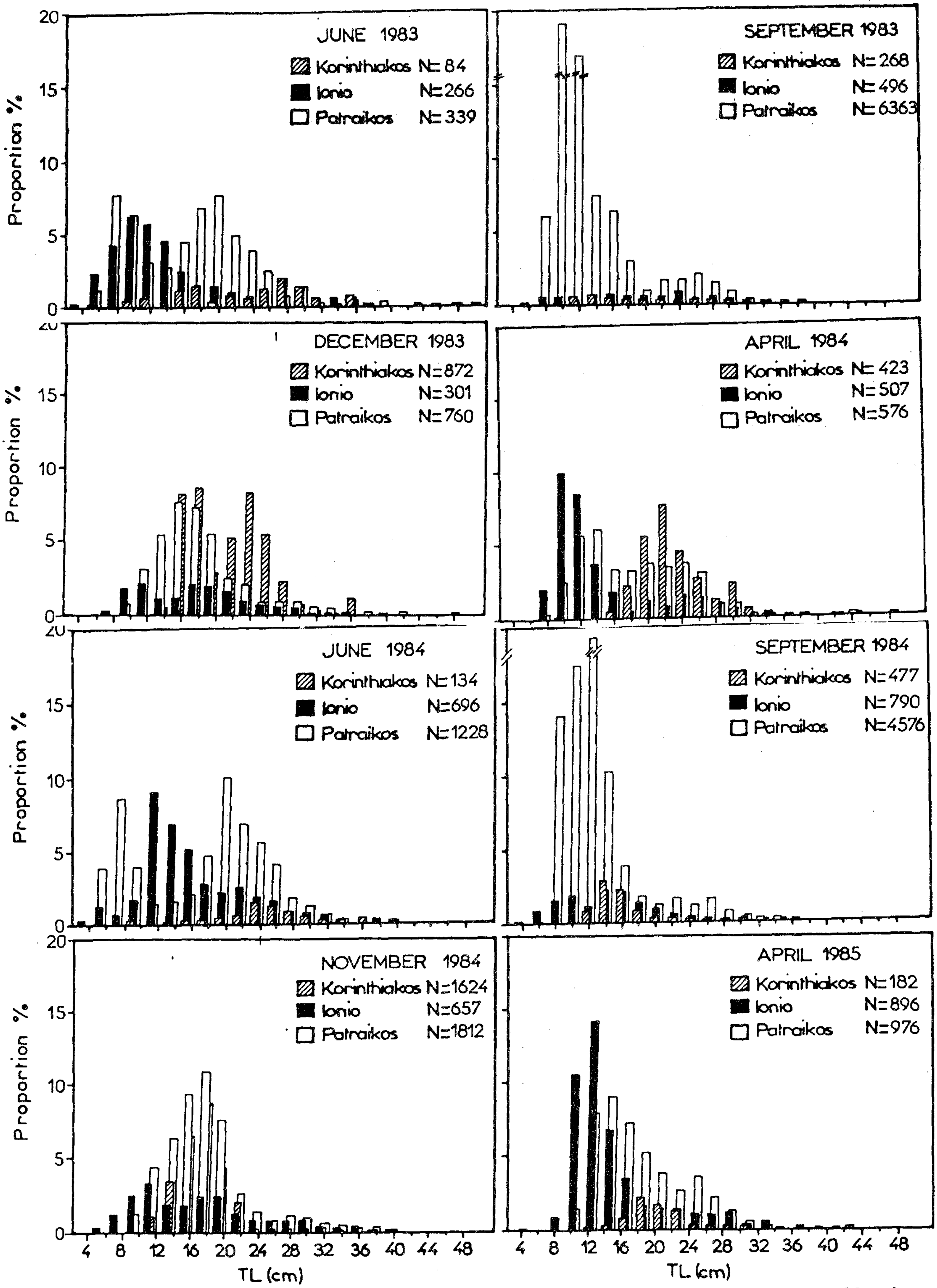


Figure 2 Length-frequency distribution of hake in the Patraikos and Korinthiakos Gulf and the Ionian Sea, June 1983 - April 1985

Table 1

Total mortality of 0 and 1 group hake (M. merluccius) in the Patraikos Gulf, June 1983 - June 1985

Round	Number of specimens	Total mortality (annual)
June 1983	399	0.845
September	6 363	1.302
December	760	1.089
March	576	1.020
June	1 228	0.887
September	4 276	1.502
November	1 812	1.011
March	976	1.133
June 1985	1 448	0.788

In general, abundance changes greatly with time. Although natural mortality is often presumed to be constant, this may not be the case here.

There are indications that for 0 group hake, natural mortality is related to the trophic potential of the nursery grounds. The young immature hake feed mainly upon euphausiids and mysiids (Papaconstantinou and Caragitsou, 1987); both groups of organisms abounding on the Patraikos Gulf nursery grounds. The biomass of these planktonic groups cannot adequately fulfil the requirements of the young hake during the period of high hake abundance in late summer and autumn. This is presumed to lead to an increased mortality, if young hake gain less energy than they expend preying upon euphasiids and mysiids. If we accept food availability as the main density-dependent factor controlling natural mortality in that area, which according to the hitherto presented data seems quite probable, then natural mortality cannot be assumed to be constant. It should rather undergo strong seasonal oscillations, rendering the whole model very complex since the parameters which control mortality change greatly with time.

Although the mathematical description of this phenomenon is complex, this study suggests that natural mortality due to inadequate food resources in the nursery grounds as opposed to fishing mortality and migration, affect 0 group hake abundance in the Patraikos Gulf. If true, this is of great significance in considering the management of the nursery grounds, since in this case, the Patraikos Gulf should be fished in order to remove that fraction of the young hake that perishes due to inadequate food resources in the area. This could be largely achieved by changing the timing of the trawling fishing season in the area of concern.

4. REFERENCES

Caragitsou, E. and N. Tsimenidis, 1977. The feeding of hake (Merluccius merluccius) in the Saronikos Gulf. Thalassographica, 1(3):232-44

Papaconstantinou, C. and E. Caragitsou, 1987. The food of hake (Merluccius merluccius) in Greek seas. Vie Milieu, (in press)

Papaconstantinou, C., E. Caragitsou and T. Panou, 1986. Preliminary utilization of trawl survey data for hake (Merluccius merluccius) population dynamics from the western Greek waters. FAO Rapp.Pêches/FAO Fish.Rep., (345):87-92

Pauly, D., 1980. A selection of simple methods for the assessment of tropical fish stocks. FAO Fish.Circ., (729):54 p. Issued also in French

Ricker, W.E., 1975. Computation and interpretation of biological statistics of fish populations. Bull.Fish.Res.Board Can., (191):382 p.

Tsimenidis, N. and C. Papaconstantinou, 1985. A preliminary study of the fecundity of hake (Merluccius merluccius, L., 1758) in the Greek seas. Invest.Pesq., Barc., 49(1):55-9

Tsimenidis, N., C. Papaconstantinou and C. Daoulas, 1978. Age and growth studies of the hake (M. merluccius) in the Saronicos and Thermaikos gulfs. Thalassographica, 2(1):27-56

ELABORATION DES DONNEES SUR LES RESSOURCES DEMERSALES DE LA HAUTE ET MOYENNE ADRIATIQUE

par

C. Piccinetti et S. Jukić
Laboratoire de biologie marine et pêche, Fano
Institut d'océanographie et pêche, Split

Le traitement des données recueillies pendant les campagnes de chalutage "Pipeta" réalisées à partir de 1982 conjointement par le Laboratoire de biologie marine et pêche de Fano et l'Institut d'océanographie et pêche de Split demande un effort énorme avec les méthodes traditionnelles.

On dispose maintenant de 8 campagnes sur toute l'Adriatique au nord de la ligne Gargano - Kotor, avec des données sur les populations halieutiques démersales, les biocoenoses et les principaux paramètres physico-chimiques du milieu. Chaque campagne couvre environ 50 stations avec 150 heures de chalutage.

Les premiers résultats, présentés aux précédentes consultations techniques sur les ressources de l'Adriatique, montrent l'intérêt scientifique de la recherche et la complexité du traitement de toutes les informations recueillies.

Dans le but de raccourcir le temps de traitement et de permettre une appréhension plus détaillée, on a mis au point avec la collaboration de la société d'informatique Ecobit, spécialisée dans la gestion des données écologiques sur le territoire, un programme de traitement.

Ce programme, sur la base des données recueillies telles que: coordonnées des traits de chalut, captures en kilogramme/heure, composition par taille des espèces commerciales, composition de l'épifaune, du benthos, température et salinité sur le fond, etc., nous permet d'avoir la carte de distribution quantitative de chaque espèce dans la zone, un index de biomasse espèce par espèce, les relations existantes entre les espèces et les facteurs du milieu, la distribution des aires de concentration par taille (aire de concentration de jeunes, etc.).

Les cartes, qui représentent aussi des paramètres abiotiques tels que sédiments et caractéristiques hydrologiques, montrent, dans la succession temporelle, les caractéristiques dynamiques des stocks, caractéristiques importantes pour la stratégie d'aménagement des ressources partagées.

Les premiers résultats du travail entrepris sont montrés aux participants à la Consultation dans deux séries de cartes relatives aux principales espèces pour les deux premières campagnes. Dans la figure 1 est reportée la carte de distribution et abondance pour Eledone moschata (Lamarck, 1799).

Dans cette carte on a reporté, en noir, les différentes lignes qui dans l'original sont mises en évidence par différentes couleurs.

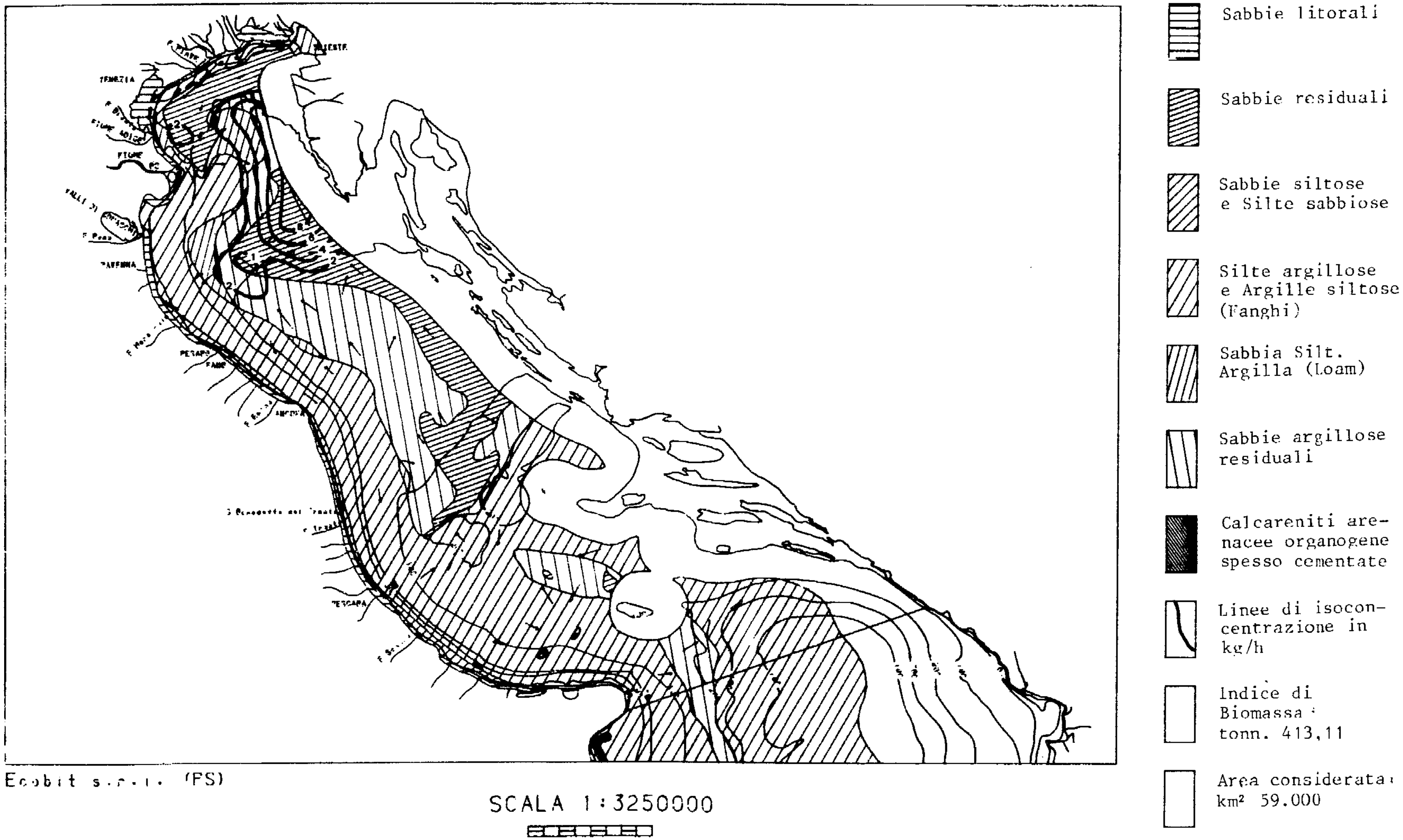
Pour calculer l'index de biomasse de chaque espèce on considère la valeur moyenne de capture par heure de pêche dans chaque station et avec la génération d'une série de triangles on considère aussi l'autocorrélation existante entre les stations voisines.

Nous considérons cette analyse comme un premier pas pour améliorer l'exploitation des données.

LABORATORIO DI BIOLOGIA MARINA E PESCA - FANO
INSTITUT ZA OCEANOGRAFIJU I RIBARSTVO SPLIT

CAMPAGNA: PIPETA 1 Maggio 1982

Etedone moschata (Lam.) Moscardino



Ecobit s.r.l. (PS)

SCALA 1:3250000

DISTRIBUTION WITH DEPTH AND CATCHES PER UNIT EFFORT OF THE HAKE AND THE RED MULLET OFF THE WESTERN COAST OF GREECE

by

V. Vassilopoulou and C. Papaconstantinou
National Centre for Marine Research
166 04 Elliniko, Greece

1. INTRODUCTION

The hake (Merluccius merluccius L., 1758) and the red mullet (Mullus barbatus L., 1758) are two very common species in the Greek waters, with a high commercial interest.

The present work provides information concerning the distribution with depth and the catches per unit effort (cpue), in the Patraikos and Korinthiakos Gulfs and in the Ionian Sea, as a contribution to the effort for management of fisheries resources.

2. MATERIAL AND METHODS

The material used in this work came from nine seasonal trawl samplings, from June 1983 to June 1985, which were carried out in the framework of fisheries investigations conducted by the National Centre for Marine Research (NCMR). The fishing trawler used had a 425 hp engine and a net with a codend mesh size of 14 mm, knot to knot.

For a better knowledge of bathymetric distribution and the cpue of the two species, the three study areas were distinguished by depth zone. The Patraikos Gulf was divided into three zones with depths of 0-50 m, 50-100 m and >100 m; and the Korinthiakos Gulf and the Ionian Sea into four depth zones of 0-75 m, 75-150 m and >250 m.

3. RESULTS - DISCUSSION

3.1 Distribution with Depth

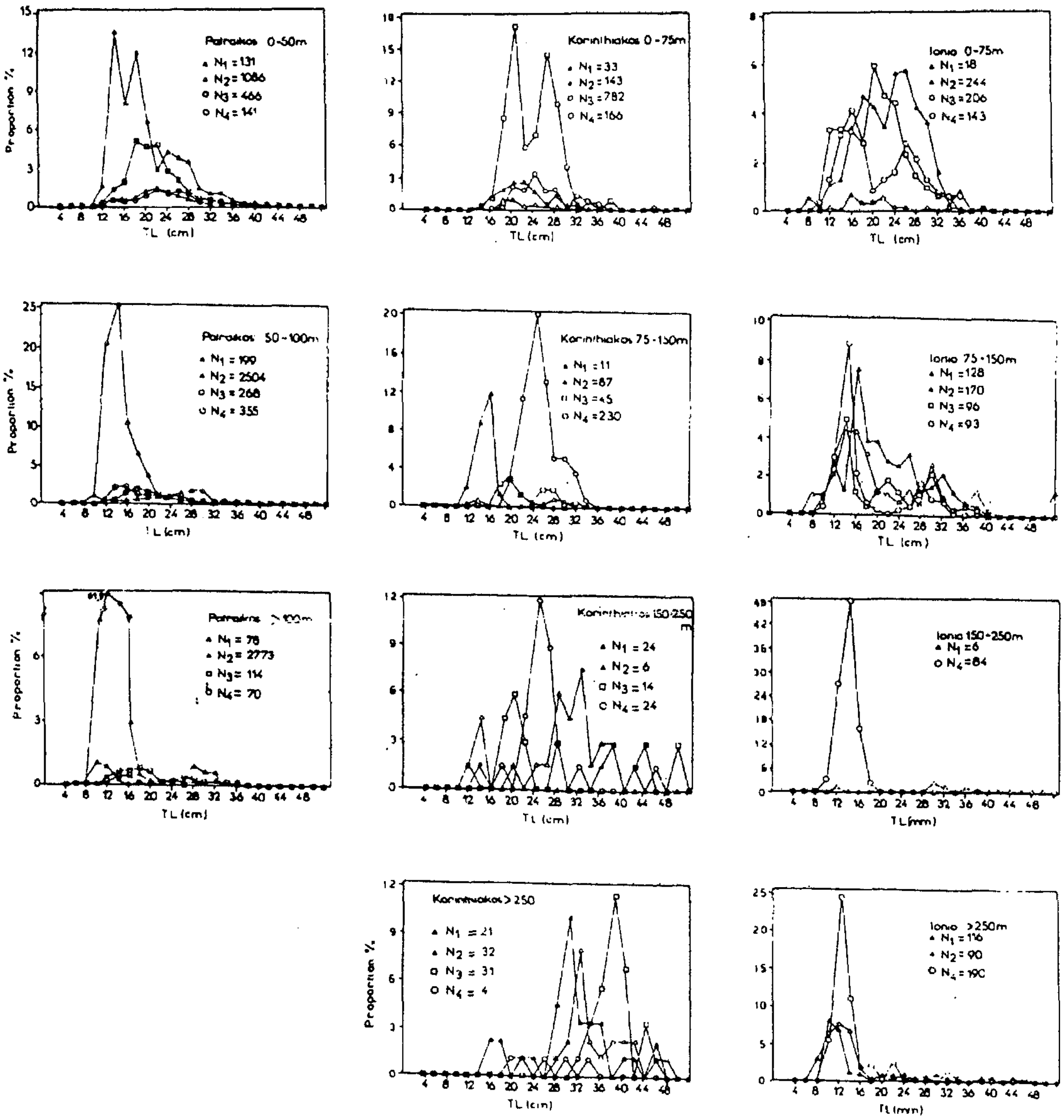
(a) Hake

The bathymetric distribution of the hake extends down to 310 m, which is the greatest depth fished in the study area.

In the Patraikos Gulf hake recruitment takes place at depths greater than 50 m in June and September (Figures 1a and 2a). A shift in abundance of young hakes (180 mm TL), from greater to lesser depths is observed during the winter, and then larger specimens are fished in relatively shallow waters. Tsimenidis, Papaconstantinou and Daoulas (1978), report a similar movement for the hakes of the Thermaikos Gulf. High abundance in the 50-100 m and >100 m depth zones occurs in September; mainly due to the concentration of 0 age group individuals (<180 mm TL), that makes up the main body of hake in this Gulf. From the above, it is assumed that Patraikos Gulf is a nursery ground and hence needs special management.

In the Korinthiakos Gulf few young hakes with lengths below 120 mm TL are found year-round; a fact that does not allow assumptions on the exact timing of recruitment (Figures 1b and 2b). The limited abundance of young hakes here seems to be in direct relation to the fact that Korinthiakos, being a deep closed gulf with a restricted continental shelf, is not a favourable area for their aggregation. An abrupt increase in the 140-240 mm length group, which is the dominant group in this marine area, is evident in the 0-75 m depth zone, during the winter. This phenomenon could be connected with a possible movement of individuals from the Patraikos Gulf, which at the same time of the year shows a decrease in abundance of the corresponding length group. On the other hand, the simultaneous presence of these individuals throughout a rather extended gulf like Korinthiakos renders this hypothesis quite improbable.

In the Ionian Sea, there are no strict bathymetric limits for hake recruitment. Young hakes (60 mm TL) appear for the first time from June till September at stations 75-150 m deep near the Patraikos Gulf, while at the same time specimens of 80 mm length also appear at deep stations of the Ionian Sea. This fact possibly implies an earlier hake recruitment in deeper waters, (Figures 1c and 2c). The highest abundance value coincides with the 75-150 m depth zone, while a lot of young of the year were fished in waters deeper than 250 m. The above leads to the conclusion that two different hake stocks intermingle here; one that spawns in the Patraikos Gulf and the other in the deep Ionian Sea waters.



1a 1b 1c

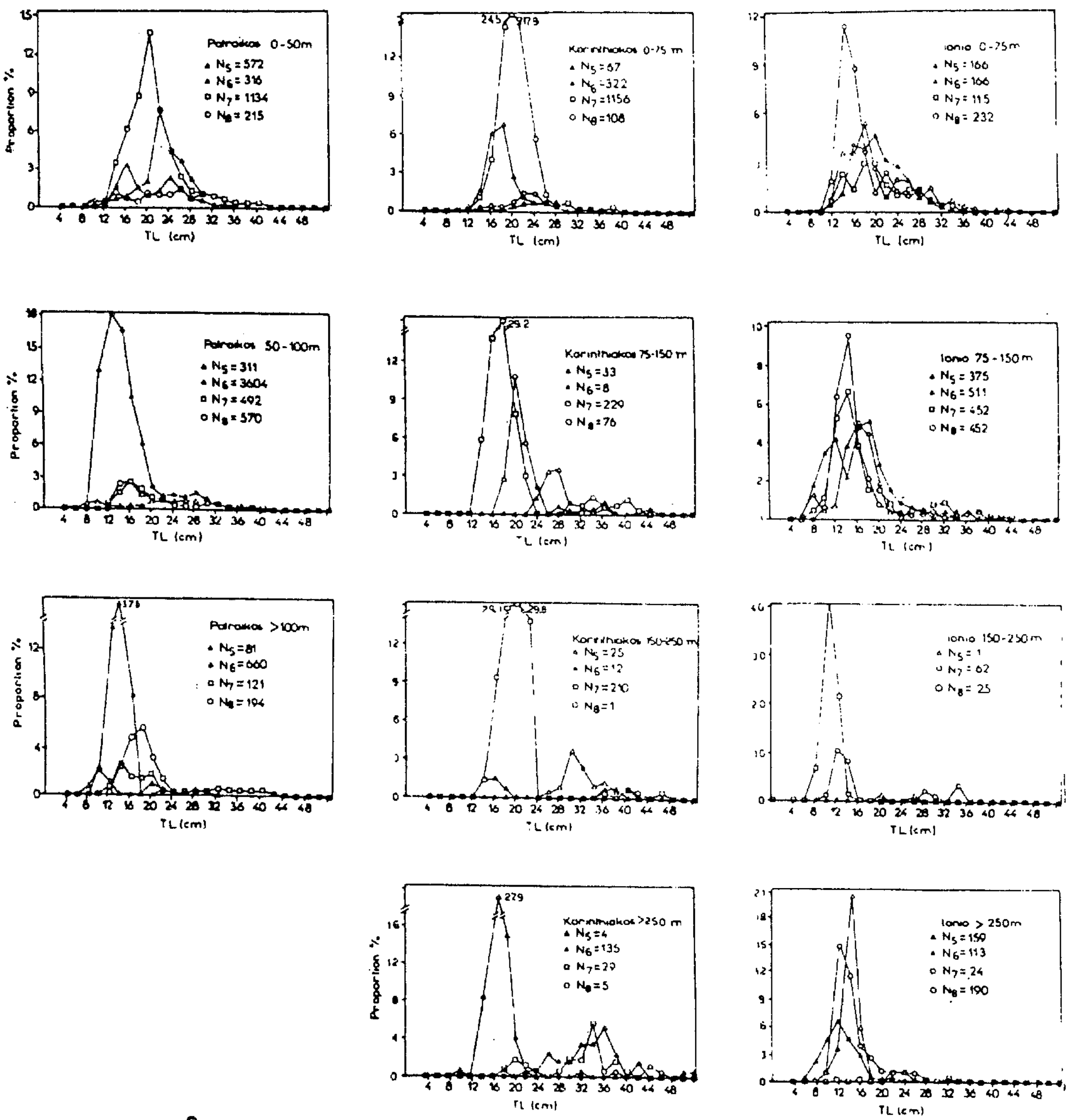
Figures 1a, 1b and 1c Length distribution of the hake at various depth ranges of the Gulfs of Patraikos and Korinthiakos and of the Ionian Sea respectively, during June 1983 - April 1984. (Na = June 1983, Nb = September 1983, Nc = December 1983, Nd = April 1984)

Thus, it is presumed that in the study area exist three independent hake populations; one in the Patraikos Gulf, another in the Korinthiakos Gulf and a third one in the Ionian Sea.

(b) Red mullet

The distribution with depth of red mullet extends to 190 m, while young individuals are fished coastally in shallower waters.

In the Patraikos Gulf the recruits (≃90 mm FL) appear at depths less than 50 m in September (Figures 3a and 4a). A shift of larger specimens to greater depths is observed. Many workers mention similar distribution with depth; Scaccini (1947) along the western shores of the Adriatic, Bougis (1952) in South France, Ananiadis (1949) in the Aegean, and Papaconstantinou, Tsimenidis and Daoulas (1981) in the Gulfs of Saronikos and Thermaikos. Abundance values show a sharp decline with depth, since 85% of the individuals were found in the 0-50 m depth zone. On the other hand, a remarkable abundance increase was noted in the second of the two years of the survey.



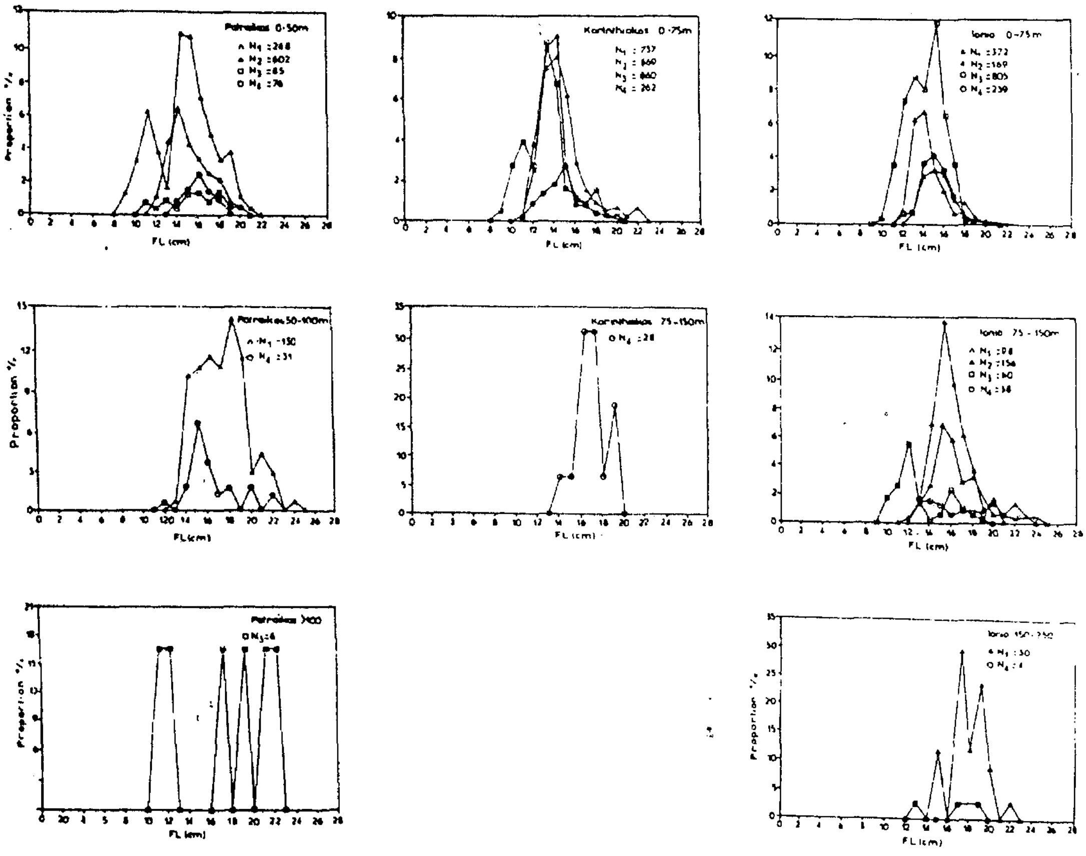
2a 2b 2c

Figures 2a, 2b and 2c Length distribution of the hake at various depth ranges of the Gulfs of Patraikos and Korinthiakos and of the Ionian Sea respectively, during June 1984 - April 1985. (Ne = June 1984, Nf = September 1984, Ng = November 1984, Nh = April 1985)

In the Korinthiakos Gulf, young red mullets (90 mm FL) showed up for the first time in depths of 0-75 m in December 1983-84 and April 1984-85 (Figures 3b and 4b). Specimens of 110-150 mm FL were caught in deeper water than those larger than 150 mm FL. Ninety-five percent of the abundance over the two years appears in the 0-75 m depth zone, while red mullets were significantly more numerous during the first year of the study. The delay in recruitment time and the low abundance values during the second year leads to the assumption that in the Korinthiakos, the 1983-84 year class is stronger than that for the following year; a situation the reverse of that in the Patriakos Gulf.

This observation, in combination with the reduced migratory ability, the great depths, and the restricted continental shelf of the Korinthiakos Gulf, together with the different bathymetric distribution by length group in the two marine areas, corroborate the view that there are two different red mullet stocks; one in the Patraikos and the other in the Korinthiakos Gulf.

In the Ionian Sea, young of the year (90 mm FL), appear as recruits in early winter at depths of 40-75 m (Figures 3c and 4c). A shift similar to the one in the Patraikos Gulf is observed, namely, of larger fish heading toward greater depths. Thus, specimens greater than 150 mm FL are mainly found in waters deeper than 75 m. Abundance decreases with depth, reaching its highest value (79%) in the 0-75 m depth zone.



3a 3b 3c

Figures 3a, 3b and 3c Length distribution of the red mullet at various depth ranges of the Gulfs of Patraikos and Korinthiakos and of the Ionian Sea respectively, during June 1983 - April 1984. (Na = June 1983, Nb = September 1983, Nc = December 1983, Nd = April 1984)

3.2 Seasonal Variations in cpue

(a) Hake

The seasonal variation in cpue was calculated for each depth zone of the three areas from the relationship:

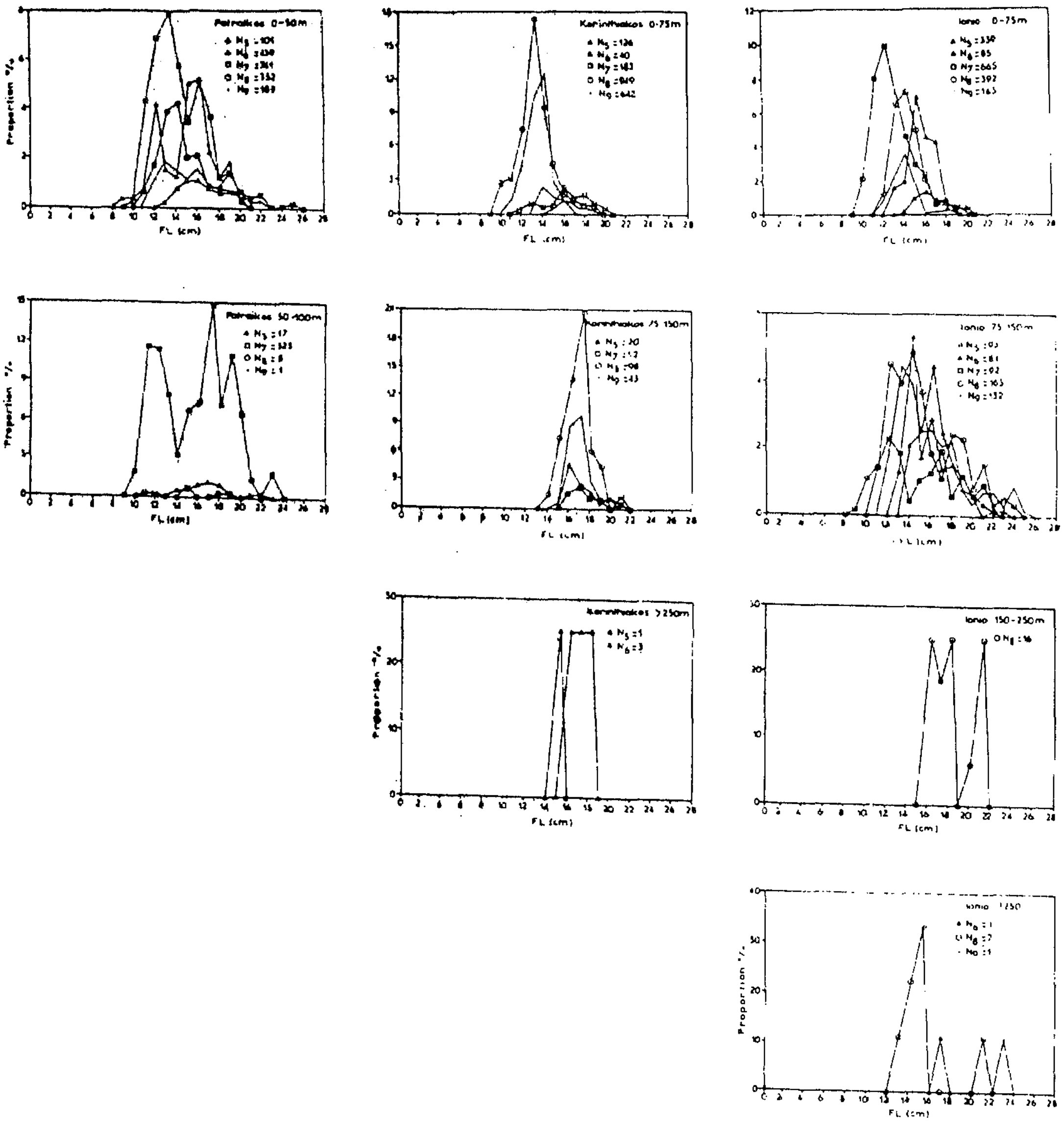
$$\text{cpue} = \frac{\text{Weight of fished stock (kg)}}{\text{Duration of fishing effort (h)}}$$

The mean cpue of hake in the Patraikos Gulf (16.1 kg/h) is twice that for the Korinthiakos (7.8 kg/hr) and 3.5 times that for the Ionian Sea (4.6 kg/h).

Catch per unit effort is high in depths greater than 50 m in the Patraikos Gulf, in the 0-75 m depth zone in the Korinthiakos Gulf, and in the 75-150 m and >250 m depth zones in the Ionian Sea (Figure 5). Catch per unit effort attains a maximum in fall in the Patraikos and in winter in the other two areas. The above is correlated with the depth distribution of hake. Such charges may be attributed for the Patraikos Gulf and the >250 m depth zone of the Ionian Sea, to the recruitment of young hakes, while for the Korinthiakos Gulf and the 75-150 m zone of the Ionian, the presence of individuals greater than 140 mm TL is the main factor.

(c) Red mullet

The mean cpue of red mullet does not differ significantly in the three areas of the survey, being 2.4 kg/h for the Patraikos, 2.8 kg/h for the Korinthiakos and 2.3 kg/h for the Ionian Sea.



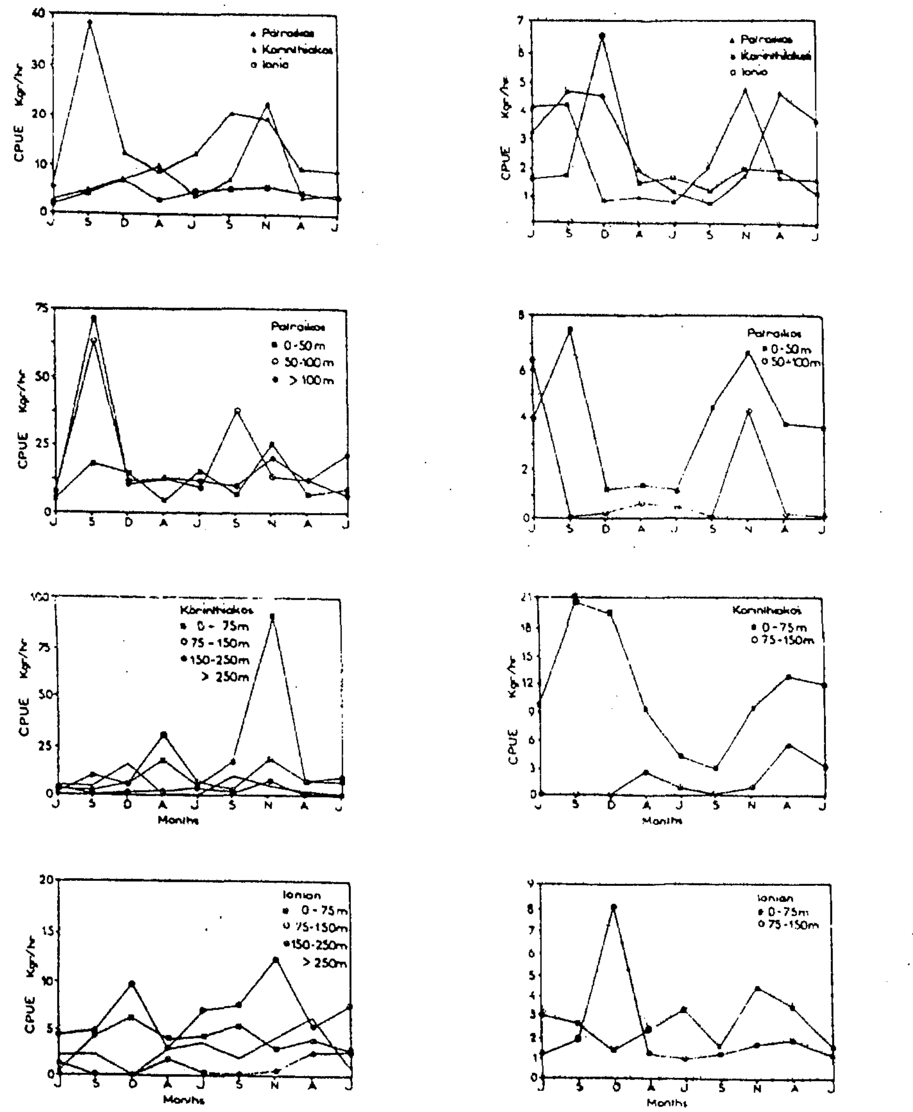
4a 4b 4c

Figures 4a, 4b and 4c Length distribution of the red mullet at various depth ranges of the Gulfs of Patraikos and Korinthiakos and of the Ionian Sea respectively, during June 1984 - June 1985. (Ne = June 1984, Nf = September 1984, Ng = November 1984, Nh = April 1985, Ni = June 1985)

In the Patraikos Gulf the highest cpue appears in the 0-50 m depth zone in September 1983-84 and in December 1984-85. The above are correlated with the red mullet's distribution with depth and seem to be in direct relation with the period of recruitment of the fish and the presence of large specimens in the catches (Figure 6).

In the Korinthiakos Gulf, cpue exhibits a maximum in the 0-75 m depth zone, in the September-December period and in spring, for the two years of the survey respectively, which are mainly related to the presence of young individuals in the fished stock.

In the Ionian Sea red mullets appear mainly in the 0-75 m and also in the 75-150 m depth zones. From the depth distribution it was ascertained that catches in the 0-75 m zone is mainly composed of fish smaller than 150 mm FL, whereas, fish larger than 150 mm make up the major part of the cpue in the 75-150 m zone.



5 6

Figures 5 and 6 Seasonal variation of the cpue at various depth ranges of the Gulfs of Patraikos and Korinthiakos and of the Ionian Sea during June 1983 - June 1985, for the hake and the red mullet respectively. (1 = June 1983, 2 = September 1983, 3 = December 1983, 4 = April 1984, 5 = June 1984, 6 = September 1984, 7 = November 1984, 8 = April 1985, 9 = June 1985)

4. REFERENCES

Ananiadis, C., 1949. Study on the biology of the red mullet Mullus barbatus (Rond) forma typica (Fage) in the Aegean Sea. Praktika Hellenic Hydrobiol.Inst., 3(2):85-150

Bougis, P., 1952. Recherches biométriques sur les rougets (Mullus barbatus L. et Mullus surmuletus, L.). Thèse, Paris

Papaconstantinou, C., N. Tsimenidis and Ch. Daoulas, 1981. Age, growth and reproduction of red mullet (Mullus barbatus, L., 1758) in the Gulfs of Saronikos and Thermaikos. Thalassographica, 4(1):39-66

Scaccini, A., 1947. Contributo alla conoscenza della biologia dei Mullidi nell'Adriatico medio Occidentale. Note Lab.Biol.Mar., Fano, (1):1-8

Tsimenidis, N., C. Papaconstantinou and Ch. Daoulas, 1978. Age and growth studies of the hake (*Merluccius merluccius* L.) in the Saronikos and Thermaikos gulfs. Thalassographica, 2(1):27-56

THE ASCENT OF MUGILIDAE FRY INTO A COASTAL LAGOON OF THE SOUTHERN ADRIATIC SEA

by

Paolo Villani
Istituto per lo Sfruttamento Biologico delle Lagune
CNR - 71010 Lesina, Italy

1. INTRODUCTION

Knowledge of the migration period of catadromous Mugilidae gives useful information about the most favourable times to collect these species, which harvest plays a leading role in induced breeding and other aspects related to their aquaculture. Mugilids are an important food fish in many developing countries and studies on their wild populations or evaluations of the fisheries for fry in the southern Adriatic (Rossi and Villani, 1980; Villani, Pesaro and Gandolfi, 1982). Along southern Adriatic coasts there is no local subsistence fishery for juveniles and the availability of naturally occurring fry in coastal lagoons is little known.

The aim of this report is to describe the periods of inshore migration of Mugilidae, to observe the juvenile stages of a commercial species, and to evaluate their abundance and natural growth, because the importance of this study is that Italian fish farmers still harvest juveniles in wild for commercial purposes.

2. MATERIAL AND METHODS

The Lesina Lagoon is shallow and coastal with an approximate area of 5 000 ha and is connected with the Adriatic Sea by two short canals. A detailed map of the lagoon and of the sampling sites is shown in Figure 1. The maximum depth is 2 m and average depth is about 0.8 m. The average water temperature fluctuates around 27-32°C in summer time and winter temperatures do not fall below 6°C. The year-round average salinity is 18%, but this shows considerable variations in different areas of the lagoon (Marolla, 1980), i.e., it reaches lowest values of 2% in the eastern area directly supplied with fresh waters from several springs, and highest values of 34-36% in western part supplied with sea water. Two areas, as shown in Figure 1 were randomly chosen as sampling stations. Our fry samples were collected by eelpots (2 mm mesh) spirally settled with a fixed net (paranza). Each catch was brought to the laboratory for detailed analysis, and the samples weighted and measured. The stomach contents of selected sub-samples for each mullet species were also checked with an under-light microscope. A continuous identification was made of species by their meristic characters or by their pyloric caeca according to Farrugio (1977).

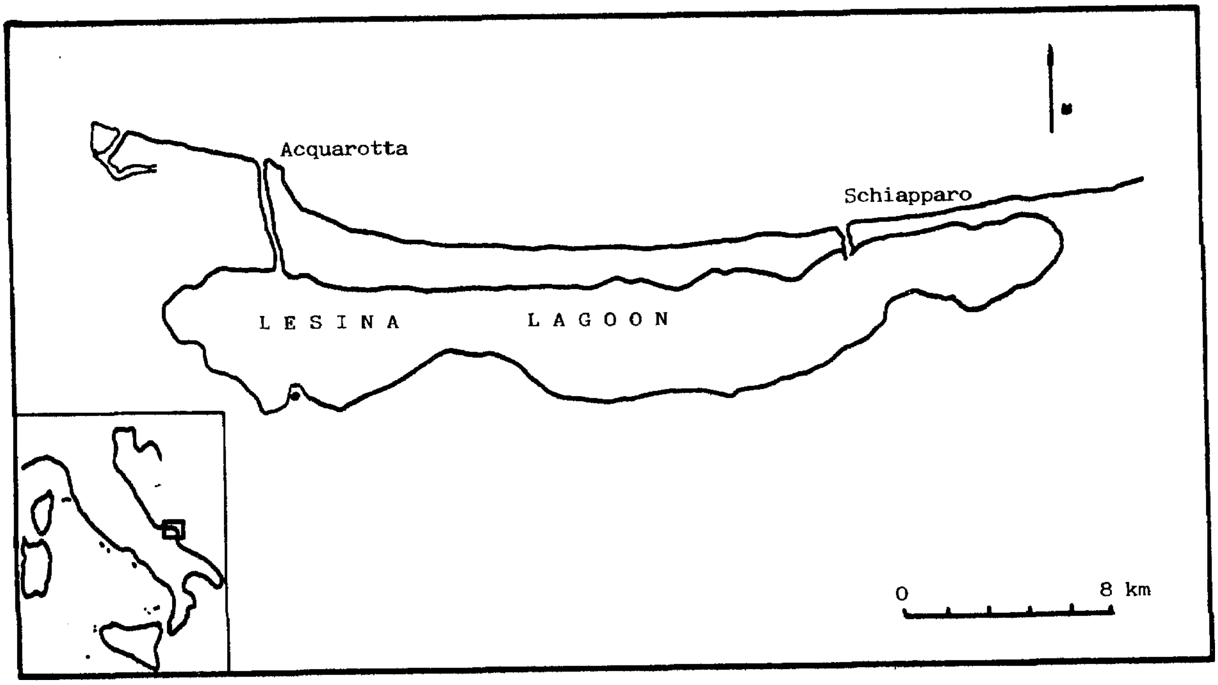


Figure 1 Map of the catch sites

3. RESULTS

The most abundant species collected was the grey mullet. The data reported in Table 1 show the total mean monthly catch operated in this area and the maximum catch occurs in April-May period though there are two peaks in a year; a major one in spring, and a minor one in summer (Figure 2). In Lesina lagoon six mugilid species are present: common grey mullet (*Mugil cephalus* L.), lipped grey mullet (*Liza ramada* Riss.), golden grey mullet (*Liza aurata* Riss.), leaping grey mullet (*Liza saliens* Riss), tick lipped grey mullet (*Chelon labrosus* Riss) and harbour grey mullet (*Oedalechilus labeo* Riss). The major period of migration practically coincides with catches of the smallest specimens. Figure 3 shows evidence of two waves of mullet populations in the study area throughout the year. From Figure 3 it seems that three grey mullet species (*Liza saliens*, *L. ramada*, *L. aurata*) tend to migrate into the lagoon from winter to late spring. The *L. ramada* population has a low mean length for a long period of migration.

Table 1

Monthly abundance of young fry catches in Lesina lagoon

Month	*Liza saliens*	*Liza ramada*	*Liza aurata*	*Mugil cephalus*	*Chelon labrosus*	*Oedalechilus labeo*	Total
Januray	200	40		40	10		290
February		60	70	10			140
March	180	290	110				580
April	450	560	10				1 120
May	220	320	10		80	500	1 130
June		260					260
July	120	350			10		480
August	70	10	110				190
September	10						10
October	50			20		40	110
November	10	10		40			60
December	30	10		30			70

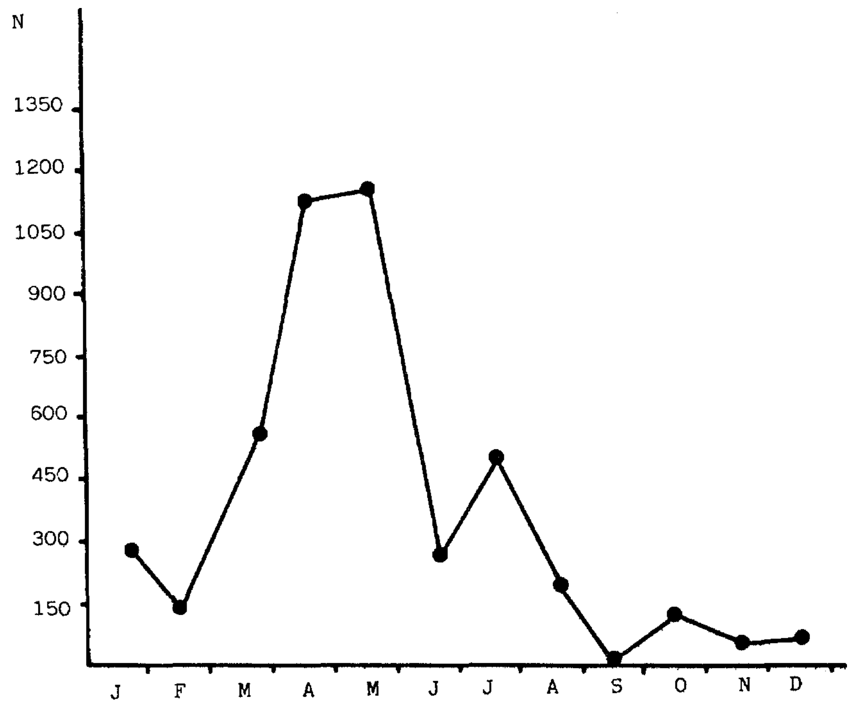


Figure 2 Variation in monthly abundance of young fry

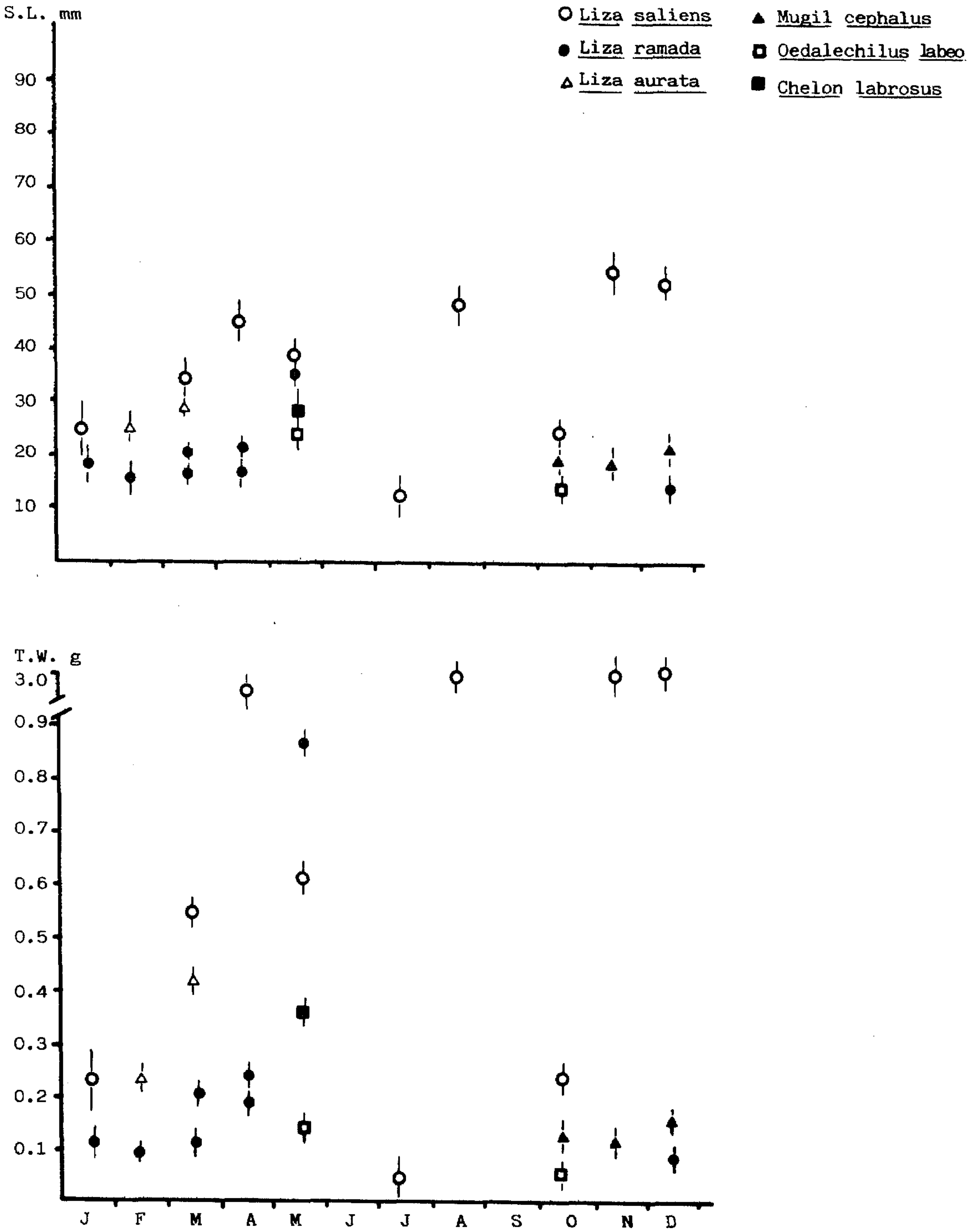


Figure 3 Average sizes and weights of young fry species on different sampling dates

The first appearance of M. cephalus occurs during the late autumn, at an average size of 18 mm in length. Smaller sizes of 13 mm in length are present of O. labeo specimens which can be caught late in October.

Large specimens of 25-50 mm in length occur of L. saliens, which is also the only fish fry occurring in this southern area all year round. The inshore migration of leaping grey mullet shown in Figure 3 has two marked peaks, one in spring and another in autumn. Smaller individuals which can be found in July average 12 mm in length. This species has a very long spawning period ranging from May to at least October, as reported by Gandolfi and Torricelli (1978). For this reason there are different length frequencies in large samples which probably contain fry from several later

Table. 2

Migration period of six mullet species in different areas of Tyrrhenian and Adriatic Seas

	January	February	March	April	May	June	July	August	September	October	November	December
PO DELTA			▲□■	□■	□■	■	■	■	■	■	△■	
SCHIAPPARO	▲	▲□	▲	▲	●					○		▲
FORTORE	△▲■●	▲□	▲□		▲●		■			△■○		
MOUTH ARNO	△▲	▲■	△▲□■	▲■	▲□■●	▲□■●	■●	▲□■●	△■	△■	△▲■	△▲■
TIRSO	▲■	▲	▲		●	▲○●	●	△	△▲			▲
TEULADA	△□	▲				□●	●	△■	△■	△	△□■	□■

△ Mugil cephalus L.

▲ Liza ramada Ris.

□ Liza aurata Ris.

■ Liza saliens Riss.

○ Oedalechilus labeo Ris.

● Chelon labrosus C.

spawnings. The sizes of fry making up these first schools in July are the smallest of the grey mullets. This early appearance of small specimens of the 0 age class and 0.05 g in weight during the summer time could be tentatively explained by the plentiful faunal biomass available in the Lesina lagoon.

Liza ramada samples occur in December (Figure 3) with smallest sizes of about 14 mm. Entry into the lagoon continues into the winter (January-April), with few individuals showing a common growth pattern; perhaps because fish are collected in waters with different temperatures, ranging from 7 to 15°C (Figure 4). Their growth is very slow from January to March.

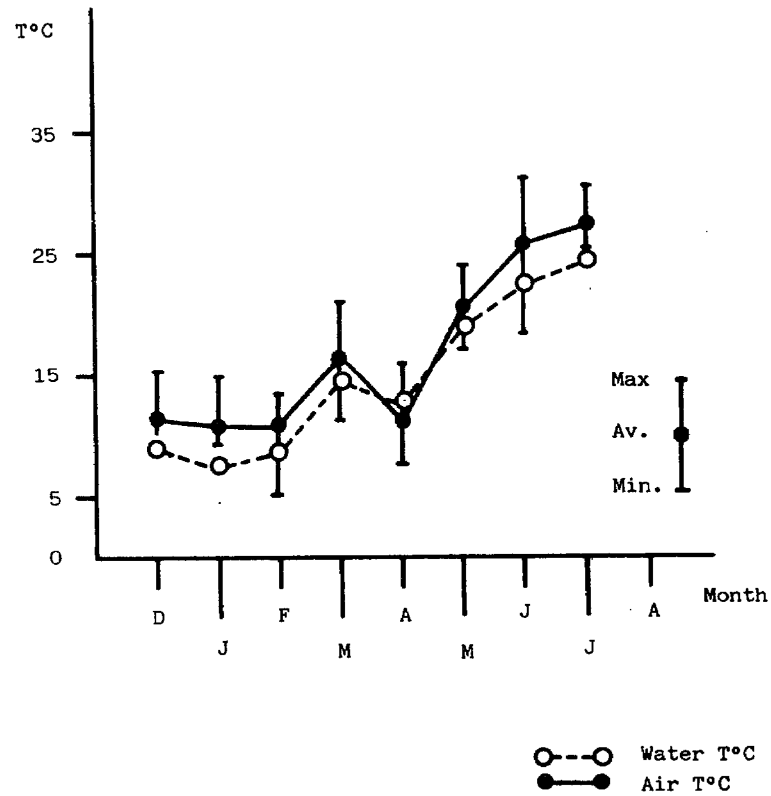


Figure 4 Monthly variations of average temperatures in coastal lagoon

Liza aurata fry are often found in southern Adriatic waters together with L. ramada samples, and can be easily singled out by their bigger size and identified by their pyloric caeca. The smallest specimens appear in February in Lesina lagoon (Table 2) and show a standard length of 25 mm.

Mugil cephalus, is a catadromous species moving into shallow coastal lagoons and other estuarine waters. A small number of specimens run inshore into the Lesina lagoon at a very small size (18 mm) from October to February (Table 1).

Chelon labrosus fingerlings were collected on May at around 18 mm in length. This is the least abundant species among grey mullets.

In Table 2 the migration periods of six mullet species from different areas of Italian coasts are reported. As far as the migration periods and average sizes of mullet fry are concerned, there are no clean-cut differences in timing of their appearance in estuarine waters. A slightly earlier ascent is observed in Sardinian coastal areas (Tirso and Teulada stations); probably due to different thermal conditions, to the contrary, different frequencies of appearance are shown by many species: L. saliens stands out from other species in the northern Adriatic, and L. aurata, L. ramada fingerlings migrate with less frequency. In the southern Adriatic all estuarine species are present, plus L. saliens and M. cephalus migrate out of lagoon waters. In the northern Thyrrenian Sea, L. ramada, L. saliens and M. cephalus are widely represented as opposed to L. aurata and C. labrosus fry (mouth of the Arno). Along the Sardinia coast, all mullet species are caught during inshore migration, with a predominance of L. ramada at the mouth of the Tirso, and M. cephalus at the mouth of the Leonaxiu. In Table 3 the number of young mullets of each species making up different observed sub-samples is tabulated.

Table 3

Fingerling sub-samples of different mullet species utilized for stomach contents analysis. Stomach fullness indices are reported (- : empty; + : almost empty; ++ : full by half; +++ : full) according to Laevastu, 1967

Month	Species	Individual/ Specimen	Fullness Index -	+	++	+++
November	Liza ramada	1		1		
	Liza aurata	11	1	5	2	3
	Liza saliens	1				1
	Mugil cephalus	5	2	3		
February	Liza ramada	19	8	4	3	4
	Liza saliens	1	1			
March	Liza ramada	10	1	4	3	2
June	Oedalechilus labeo	10		3	3	4
	Liza ramada	1			1	
	Liza saliens	10	2	5		3
July	Liza saliens	20	1	2	3	14
October	Mugil cephalus	10	10			

The stomach fullness indices of each fry population are on the average rather high, except for M. cephalus in October and L. saliens in February that had empty stomachs. The stomach contents analyses so far present meagre information to assist in evaluating the different diets of the several species captured, or of the evolutin in time of the diet for individual species (Table 4). However, the diet mainly consisted of zooplanktonic organisms in all these samples. The worms (Nematoda, Digenea), which are present in the stomach contents of L. ramada and L. aurata are in all probability as parasites.

4. SUMMARY AND CONCLUSIONS

Periods of inshore migration of Mugilidae fry in a coastal lagoon were studied and the relative abundances of juvenile fish were evaluated, and vary from month to month.

Six mugilid species are present in Lesina lagoon: Mugil cephalus L., Liza ramada Riss., Liza aurata Riss., Liza saliens Riss., Oedalechilus labeo Riss, Chelon labrosus Cuv. It has been found that the young fry tend to migrate into the lagoon at a size of about 10-50 mm; most frequently between 15 and 25 mm in length. Seasonal occurrence is as follows: the first appearance of M. cephalus occurs during late autumn with an average size of 18 mm. The smallest specimens of L. ramada migrate into the lagoon in December (SL = 14 mm). L. aurata appears during late winter-spring at 25 mm in length. The inshore migration of L. saliens occurs in the middle of summer (SL = 12 mm). Chelon labrosus fry migrate into coastal waters in May at 18 mm in length, and specimens of O. labeo are caught latest, in October (SL = 13 mm).

The Lesina lagoon is an important nursery area for commercial species of mullet reproducing in the sea. Mugilid fry migrations into the lagoon show two peaks for the whole year: the autumn peak is characterized by M. cephalus and O. labeo fingerlings: the spring peak is characterized by migrations of L. ramada, L. aurata and C. labrosus fry. The fish fry of L. saliens probably contribute to form a third summer peak.

The reproductive cycle of grey mullets, the production of juveniles, and their dense migration into coastal lagoons, are all timed to meet optimum ecological needs; i.e., into productive areas at a time when they easily can find the required food, due to an abundance of nutrients produced in the lagoons. The length frequency distributions of mugilids fingerlings indicate that fry tend to migrate into the lagoon at a size of about 10-50 mm; most frequently between 15 and 25 mm in length.

These results are in agreement with those reported by Perlmutter, Bograd and Pruginin, 1957, on mullet migrations along the Israeli coast, but they are at variance with results of De Angelis (1967), who did not record the appearance of L. ramada and L. aurata in the Lesina lagoon.

Table 4

Diet composition of different mullets fish fry in migration

Months	Nov.	Feb.	Mar.	June	November	Nov.	Feb.	June	July		Oct.	Nov.	June
Species	*Liza ramada*				*Liza aurata*	*Liza saliens*					*Mugil cephalus*		*Oedalechilus labeo*
N	1	19	10	1	11	1	1	10	10	10	5	10	10
SL x (mm)	17.0	18.3	19.1	21.0	20.7	16.0	18.0	11.5	12.7	10.9	20.6	18.6	22.1
Trematoda Digenea		*	*		*								
Nectochaetes			*			*							
Cirripeds nauplii			*		*	*			*				
Copepods nauplii			*			*			*	*			
Unidentif. copepods		*						*					*
Calanoids										*			
Cyclopoida										*			
Harpacticoida			*			*		*	*				
Invert. eggs			*		*			*	*	*			*
Polychaete bristles			*										*
Adult insects	*			*	*				*				*
Bivalves veliger			*						*				*
Gastropods veliger													*
Dinoflagellates	*		*	*	*						*		*
Filamentous algae			*										*
Unidentif. organisms	*	*	*		*	*							
Sand						*							*

5. REFERENCES

De Angelis, C.M., 1967. Osservazioni sulle specie del genere Mugil segnelate lungo le coste del Mediterraneo. Boll.Pesca Piscic.Idrobiol., 22:5-36

Farrugio, H., 1977. Clès commentées pour la détermination des adultes et des alevins de Mugilidae de Tunisie. Cybium (3e Sér.), 2:57-73

Gandolfi, G. and P. Torricelli, 1978. La rimonta del novellame di Mugilidi (Pisces, Mugilidae) alla foce del fiume Magra (Golfo di La Spezia). Ateneo Parmense (Acta Nat.), 14:157-66

Laevastu, T., 1967. Manual of methods in fisheries biology. Research on fish stocks. FAO Man. Fish.Sci., (1)Fasc. 9

Marolla, V., 1980. Nota preliminare sulle principali caratteristiche chimico-fisiche della laguna di Lesina. Rapp.Cons.Natl.Ric., Lesina, (3)

Perlmutter, A., L. Bograd and J. Pruginin, 1957. Use of the estuarine and sea fish of the family Mugilidae (grey mullets) for pond culture in Israel. CGPM Debats Doc.Tech./GFCM Proc. Tech.Pap., 4:289-304

Rossi, R. and P. Villani, 1980. A biological analysis of eel catches (Anguilla anguilla L.) from the lagoons of Lesina and Varano, Italy. J.Fish Biol., 16:413-23

Villani, P., M. Pesaro and G. Gandolfi, 1982. The ascent of elvers, Anguilla anguilla (L.), in two Italian localities of the Adriatic coast. Nova Thalassia, 5:125-39

6. ACKNOWLEDGEMENTS

The author thanks Mr V. Marolla and Mr P. D'Apote for their technical assistance. His thanks are also due to Mrs L. Longari for typing the manuscript.

D. RESSOURCES EN INVERTEBRES/INVERTEBRATES RESOURCES

AN ESTIMATE OF GROWTH AND MORTALITY PARAMETERS FOR NORWAY LOBSTER (Nephrops norvegicus) IN THE CENTRAL ADRIATIC SEA

by

C. Froglia and M.E. Gramitto
Istituto Ricerche Pesca Marittima (CNR)
Ancona, Italy

1. INTRODUCTION

After World War II several authors (Karlovac, 1953; Crnkovic, 1965; Jukic, 1974; Froglia and Gramitto, 1981) investigated different aspects of the biology and fishery of the Norway lobster (Nephrops norvegicus), the most valuable crustacean in the Adriatic fishery, but none attempted to estimate its growth parameters.

Also outside the Adriatic Sea, data on Norway lobster growth are rather scanty and this is largely because crustaceans, unlike fish and bivalves, have no permanent hard structures making possible absolute ageing. Available estimates of growth of Nephrops norvegicus are based on aquaria experiments (increment at moult and duration of intermoult period; Thomas, 1965), combined with data on size-frequency distributions from research catches and with data from tagging studies (Hillis, 1972, 1979; Farmer, 1973; Conan, 1975, 1978; Sarda, 1985).

From these studies Nephrops norvegicus appears to be a slow-growing and long-lived species that within its geographical range, the northernmost latitudes excepted, spawns annually. Each method used to estimate crustacean growth has the pros and cons: growth in aquaria may be influenced by the amount of food supplied and by the captive environment, especially, when individuals are kept in small volumes for long periods; tagging experiments are partly hampered by the fact that tags could be lost at moulting; moreover, to get enough returns it is necessary to tag a large number of individuals. On the other side, size frequency distributions obtained from bottom trawl catches could give an incomplete picture of the population present in the investigated ground because Norway lobster is a burrowing species, therefore, it is vulnerable to bottom trawls only when outside the burrow.

A circadian rhythm of emergence from the burrow probably related to the light intensity reaching the bottom was evidenced by many authors, moreover, berried females spend most of their time inside the burrows as do juveniles during the first year of life (for a review, see Chapman, 1980).

Nicholson (1979) questioned the use of size frequency distributions to investigate growth of slow growing species, like Nephrops seems to be in the northern Atlantic. Nevertheless, computational facilities (personal computers and software) presently available in most research institutes, make modal progression analysis in a series of length frequency distributions obtained from trawl samples, the fastest technique to get a notion of the growth of the first age classes of Norway lobster and to try to obtain preliminary estimates of total mortality (Z).

2. MATERIAL AND METHODS

2.1 Sampling

In all the biological research cruises we have been making since 1970 on board the R/V S. LO BIANCO, Norway lobster has been considered a target species due to its economic value.

Our biological investigations on the Adriatic offshore trawling grounds, since 1976, are concentrated on two areas: the first located about 15 mi NNW of Ancona (depth 50-55 m) and the second in the western Pomo pit (depth 200-250 m) (Figure 1). A Mediterranean bottom trawl (foot-rope 43 m) with 100 mm (stretch) meshes in the wings and 27 mm (stretch) meshes in the codend is used in all our samplings.

All specimens of Nephrops norvegicus in bottom trawl catches are measured, sorted by sex, and the "soft" condition is recorded, females are also sorted by ovaries, development, and presence of external eggs. To record Nephrops size, in 1970 we chose the total length (TL) (from tip of rostrum to edge of telson, setae omitted) to the half centimeter below, for an easier comparison with length frequency distributions available from previous Adriatic investigations (Karlovac, 1953; Crnkovic, 1965). In 1984 we decided to follow the recommendation made in 1962 by the "ICES Special Meeting to Consider Problems in the Exploitation and Regulation of Fisheries for Crustacea" (Cole, 1965), and

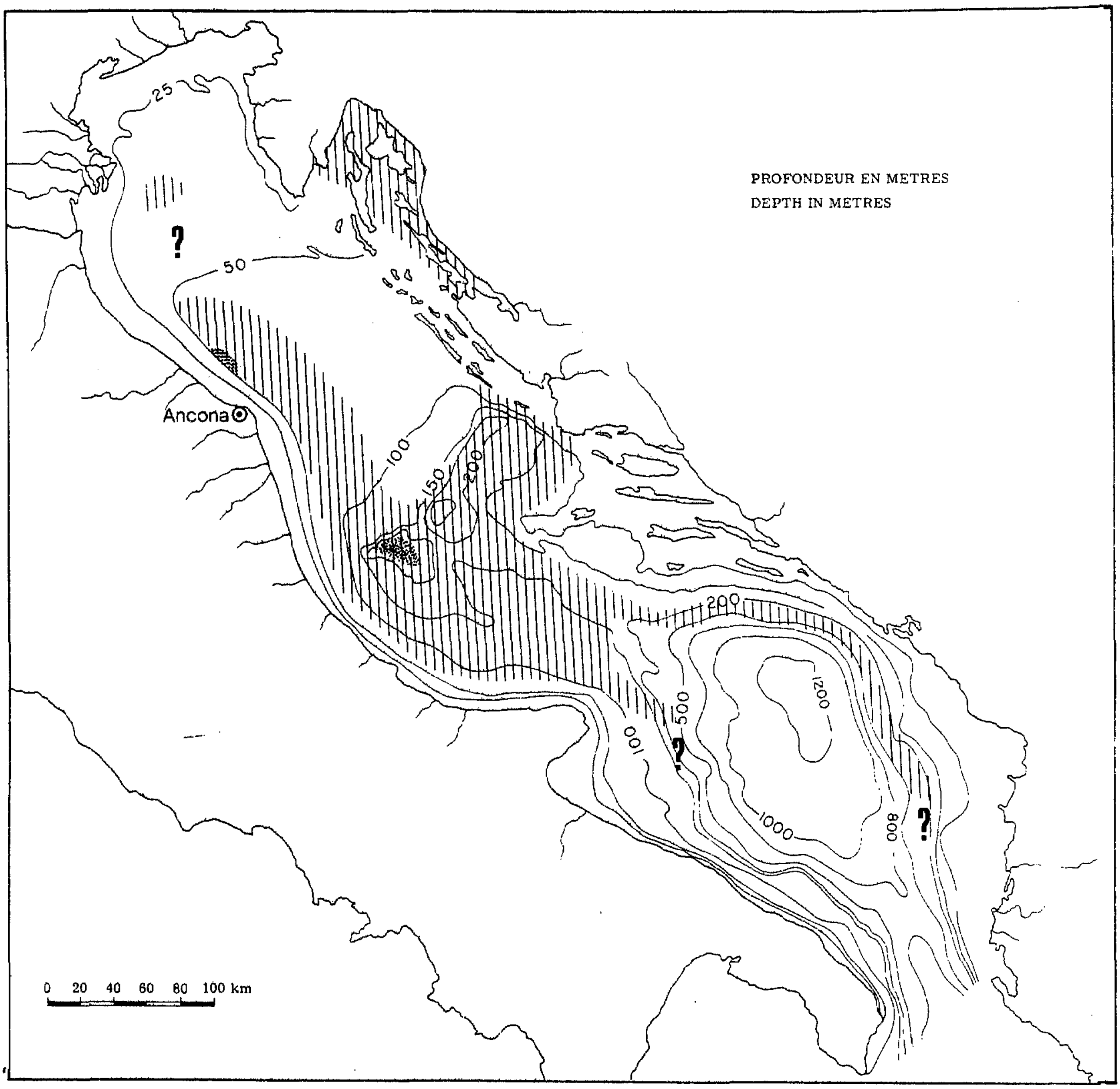


Figure 1 Distribution of Nephrops norvegicus in the Adriatic Sea. Stippled areas: sampling localities mentioned in the text

to adopt the Standard Carapace Length (from rear margin of eye socket to dorsal median edge of carapace), and for the sake of comparison with previous data, in the next two years both measures were taken in all samples caught in the two areas.

To facilitate comparison of our results with those from other authors outside the Adriatic Sea, predictive regressions of carapace length (CL) on total length (TL) (mm) are herein reported separately for the two sexes and the two areas:

Off Ancona, Males	CL = 0.3146 TL - 0.8587	(r = 0.997 N = 287)
Off Ancona, Females	CL = 0.3055 TL - 0.3756	(r = 0.997 N = 249)
Pomo pit, Males	CL = 0.2980 TL + 0.5602	(r = 0.997 N = 331)
Pomo pit, Females	CL = 0.2925 TL + 0.7432	(r = 0.997 N = 169)

Most of our samples were collected in June and July (mating and early spawning season for N. norvegicus) when the vulnerability of both sexes is at the maximum (Froglia and Gramitto, 1981) and the size frequency distribution in the trawl catch can be considered a reliable estimate of the population at sea: other seasons were irregularly sampled, mostly in 1977 and in 1985.

2.2 Growth Estimate

The length frequency distributions obtained in different years were processed on a personal computer with a Basic version of the programme NORMSEP and the results used as input data for the programme BGC3 (Tomlinson, in: Abramson, 1971) to compute the parameters of the Von Bertalanffy growth equation[1/].

For each sex, 25 size frequency distributions obtained for the coastal area off Ancona in the years from 1976 to 1986 and 27 size frequency distributions obtained for the western Pomo pit in the period 1970-85 were examined. Each set of data is the sum of several hauls made within a month. Pooling together several hauls proved necessary, especially in the coastal area characterized by low densities of N. norvegicus.

2.3 Mortality Estimate

The mesh size of the trawl net used in our sampling is similar to that in use on board commercial trawlers, and we think it reasonable to assume that the length frequency distributions obtained from all our samples (over 6 300 males, 6 400 females on the Pomo ground) are representative of commercial catches in the two areas.

Under this assumption we estimated the instantaneous total mortality rate (Z) from the length-converted catch curve (Pauly, Ingles and Neal, 1984) and with the formulas:

$$Z_1 = K\ (Loo - Lm)/(Lm - Lo) \quad \text{(Beverton and Holt, 1956)}$$

$$a = (n/n+1)K/\ln[(Loo - Lo)/(Loo - Lm)] \quad \text{(Ssentongo and Larkin, 1973)}$$

3. RESULTS AND DISCUSSION

3.1 Growth Estimate

Previous Adriatic investigations (Karlovac, 1953; Jukic, 1974; Froglia and Gramitto, 1981) evidenced that in the Pomo (Jabuka) pit (depth 200-250 m) the population mean size as well as females size at first maturity are considerably smaller than in any other Adriatic area. Froglia and Gramitto (1981) estimated in 9 and 12.5 cm the size (TL_{50}) of ovigerous females respectively for the Pomo pit and the grounds off Ancona and suggested that these differences might be the result of different growth rates. Hence length frequency distributions obtained for the two areas are separately analysed here.

The coastal area off Ancona in summer 1977 was influenced by an oxygen crisis that involved a wide area of the North Adriatic with severe mortalities of benthic organisms. As a result of oxygen undersaturation, catches of Norway lobster were very large in summer 1977 but in the following years dropped to low levels with progressive increase of the mean size in the surviving population (Figure 2), probably as a consequence of a heavy mortality suffered by the juveniles of the year class 1977 (Froglia and Gramitto, 1982). First evidence of a substantial recruitment was observed only in 1982, with increase of catches and simultaneous decrease of the mean size in the population. These events made it possible in 1982, and in subsequent years, to obtain clearer size frequency distributions, uninfluenced by the presence of few old slow-growing individuals.

In the Adriatic, Norway lobster females with mature dark green ovaries are found from June to September, whereas berried females are caught from late June to March and females carrying eggs ready to hatch are observed from January to late March (Froglia and Gramitto, 1981). Santucci (1926) described 3 larval stages for N. norvegicus in the Mediterranean Sea; in the Adriatic Sea, Karlovac (1953) collected larvae only in winter months with a peak in January-February. From larvae rearing in aquaria, larval lifespan was estimated to be slightly less than one month, at 11-14°C (Figueiredo, 1979), first postlarva measured 1.2-1.4 cm TL, i.e., 3.7-4.7 mm CL; two months later, after 3 moults, postlarvae measured over 2 cm TL (Figueiredo, 1979a).

1/ We are deeply grateful to Dr L. Fiorentini (Data Processing Service - IRPEM) for making available the Basic programmes and for his assistance in the analysis of data

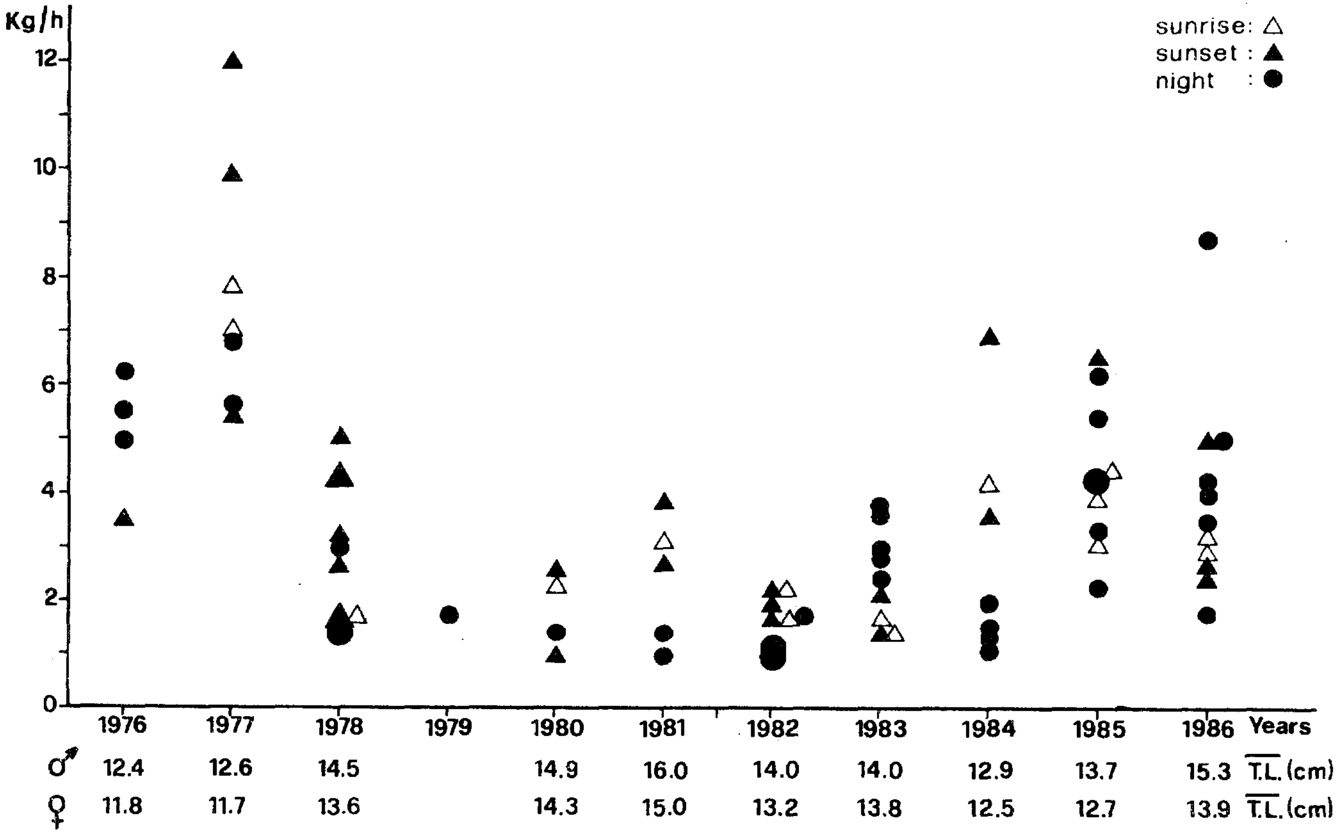


Figure 2 Catch/hour and mean size (T.L.) of Nephrops norvegicus obtained in experimental trawlings done off Ancona in the mating season (June-July) in the years 1976-86 (larger symbol represents more than one two with identical yield)

To age the modes detected in our size frequency distributions we assumed the conventional birthday of Nephrops norvegicus in the whole Adriatic Sea at February the first and the recruitment to benthic life one month later at a TL of 1.5 cm. The consistency of size frequency distributions obtained through the years in the months of June and July (Figure 3), and the modes progression evident in the time series, let us suppose that these modals identify year classes. Figure 5 is a sample of the size frequency distributions and their normal components for the first 3 age classes, as obtained from processing data with NORMSEP. In all June samples obtained off Ancona, the first mode for both sexes, is found at a TL of around 9 cm; we assume this as the cohort hatched the year before in February; hence the second mode represents age class 2+. It is noteworthy that for females, the second mode, at a TL of around 13 cm, is coincident with the size at first maturity as reported by Froglia and Gramitto (1981) for the same area.

We have not tried to extract more than 3 normal components, even if in some size frequency distributions, especially for males, up to five modes are detectable, since these may include more than one yearclass and are composed of a small number of individuals. The length frequency distributions for the western Pomo pit show a smaller range of sizes (Figure 4) when compared with those of the shallow grounds off Ancona, and it is difficult, especially for the females, to bring out more than two normal components (Figure 6).

We assume that in June samples, the first mode evident, for both sexes at a total length around 7 cm, is made by individuals in age class 1+. The second mode, which we assign to the age class 2+, for the females is again coincident with the size at first maturity (T.L. 9 cm) reported for the western Pomo pit population by Froglia and Gramitto (1981).

Chapman (1980) suggests juvenile N. norvegicus do not emerge from burrows and can find enough food from digging in the sediment. For the Pomo area a mode at 4 cm TL is clearly detectable in some autumn samples and we assume it is made of individuals in the 0+ age class born in February the same year. This early appearance of small specimens of the 0+ age class is here tentatively explained with the low infaunal biomass available in the Pomo pit (Artegiani et al., 1979). In an area of relatively high density of Norway lobsters and low infaunal biomass, juveniles could have to emerge from their burrows and to crawl around searching for food in an early period of their life. In each area the length at age values are practically coincident in the two sexes until the length at first maturity of females, suggesting a common growth pattern with several moults per year in the juvenile phase.

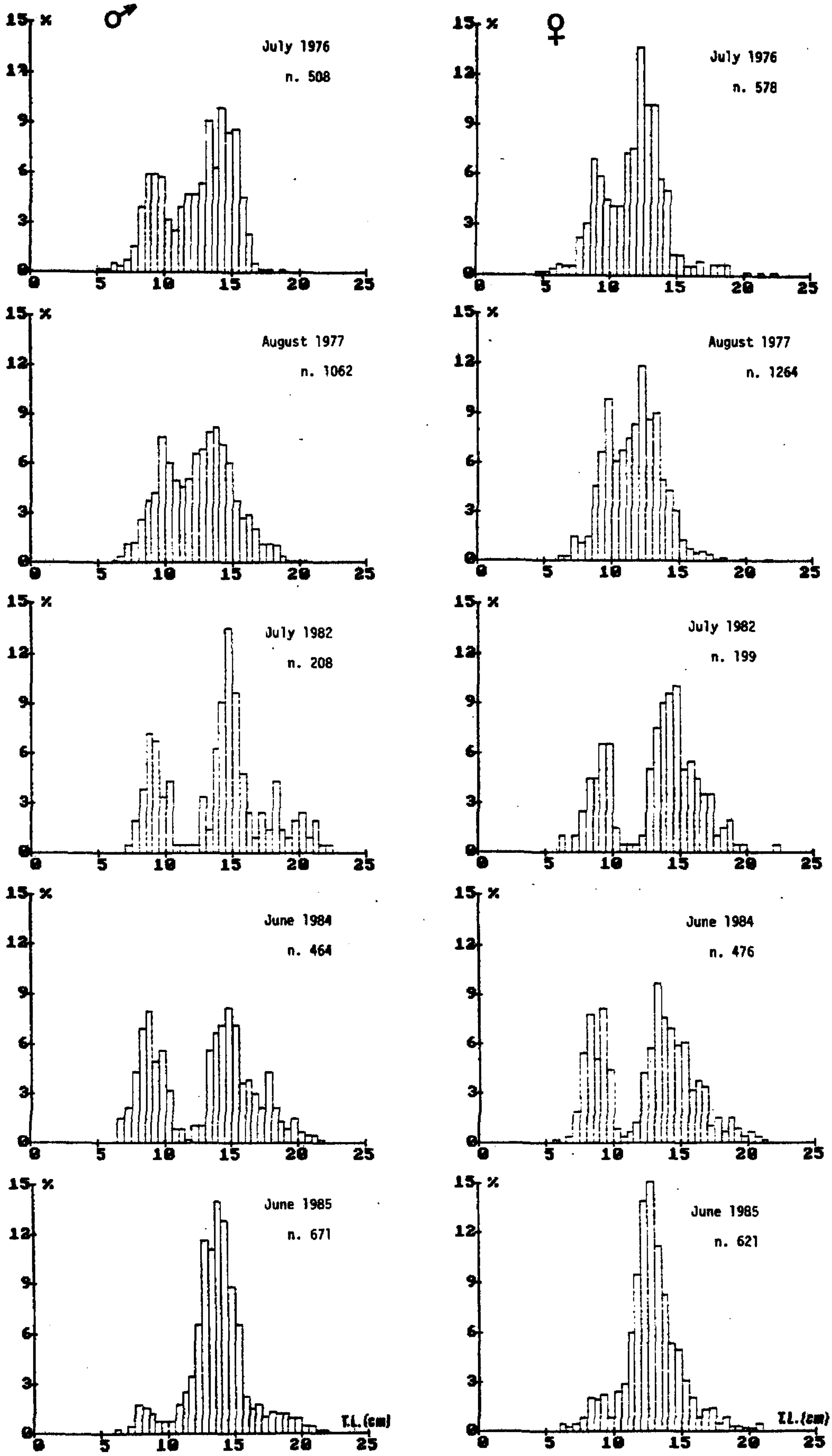


Figure 3 Size frequency distributions recorded in experimental catches off Ancona in selected years from 1976 to 1985 in the period June-August

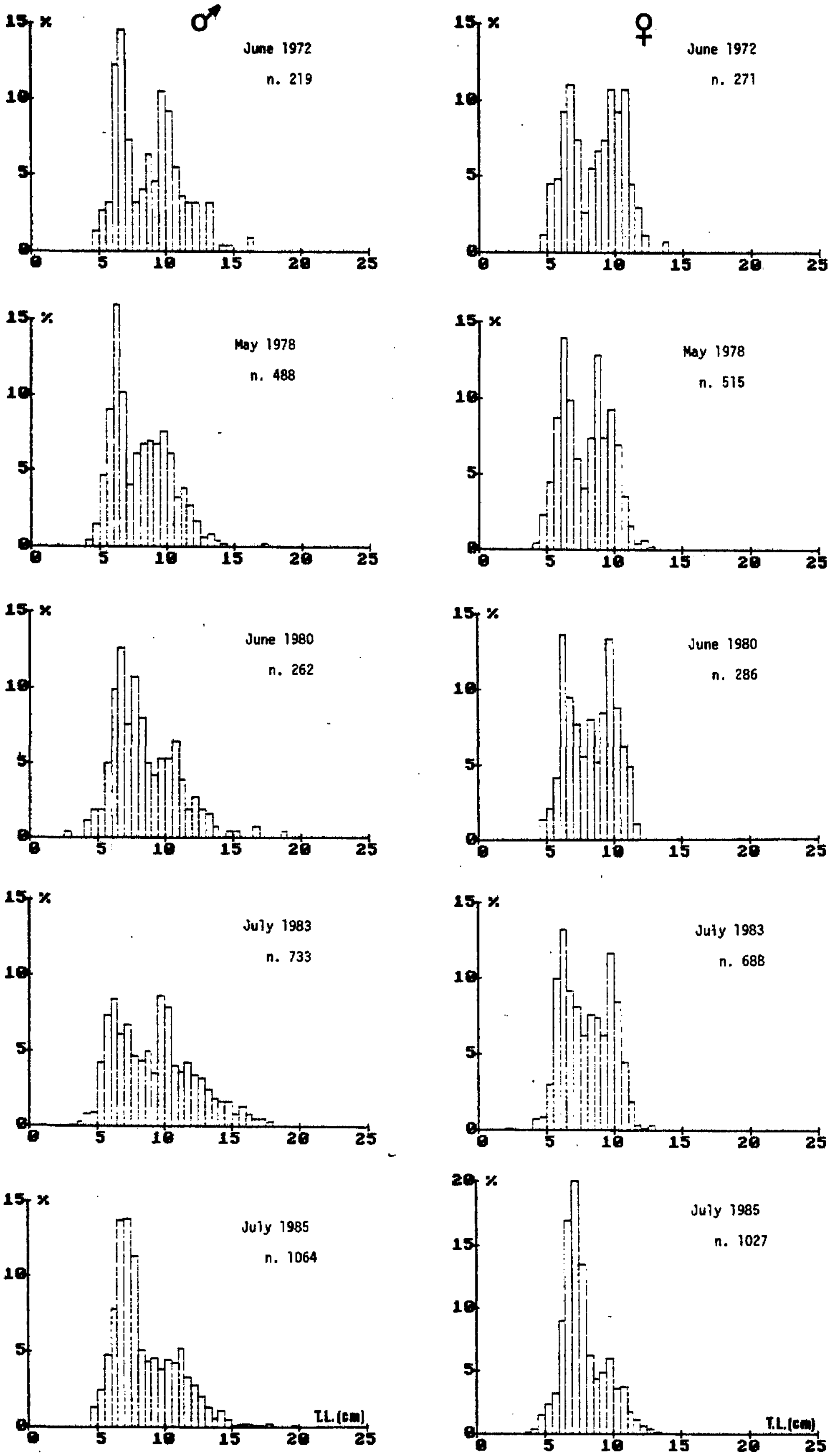


Figure 4 Size frequency distributions recorded in experimental catches in the western Pomo pit in selected years from 1976 to 1985 in the period May-July

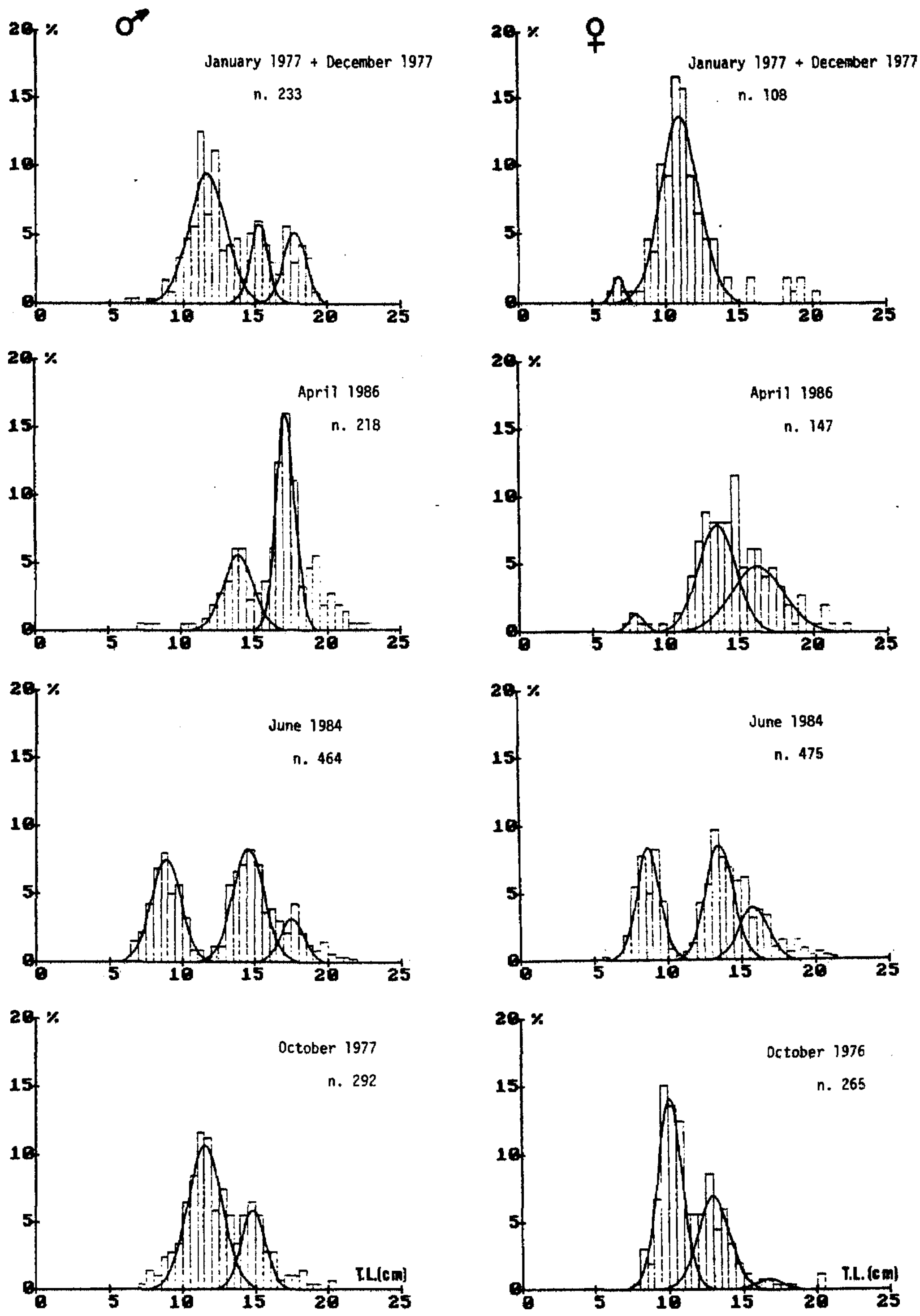


Figure 5 Size frequency distributions and normal components, as obtained from NORMSEP, in selected experimental trawl catches obtained off Ancona

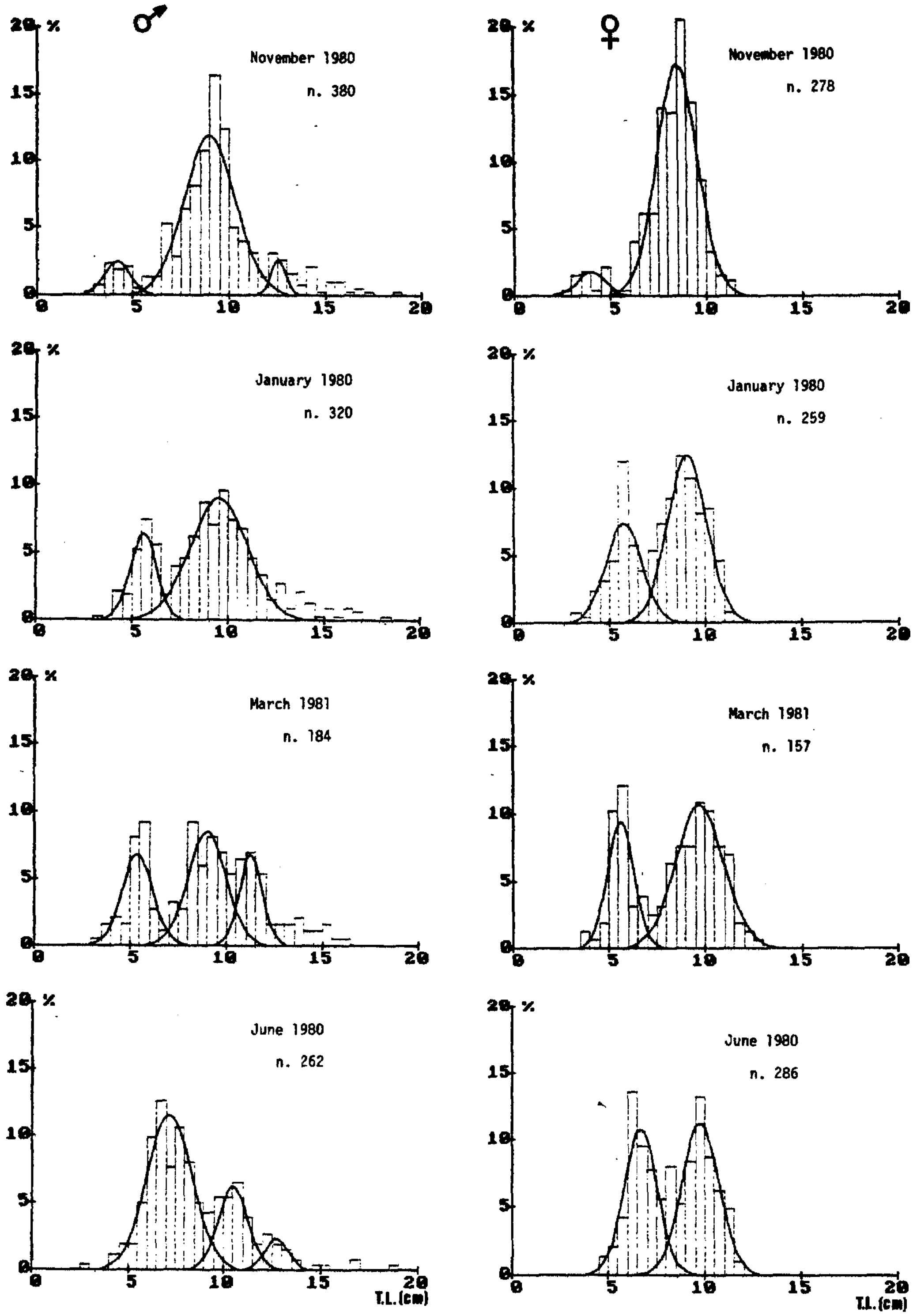
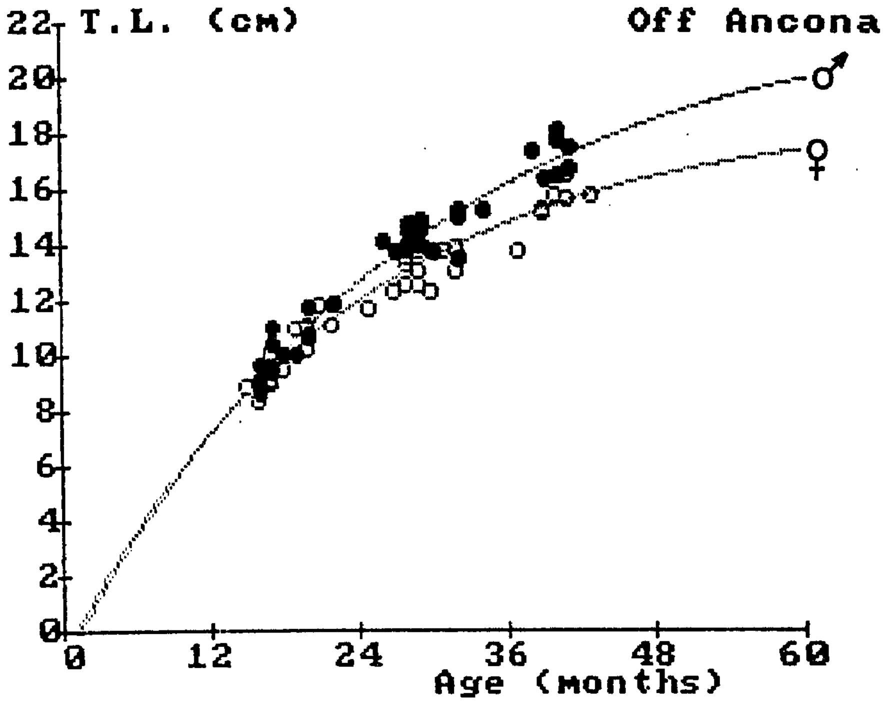


Figure 6 Size frequency distributions and normal components, as obtained from NORMSEP, in selected experimental trawl catches obtained in the western Pomo pit

Aquaria experiments (Thomas, 1965; Sardà, 1985) suggest that adult females moult only once per year in the period following egg hatching, and preceding mating (obviously females cannot moult while carrying eggs on pleopods), whereas adult males probably moult at least twice per year, with a main peak in spring. Thus the growth pattern of the two sexes would diverge after females reach sexual maturity.

Differences in growth between adults of the two sexes are clearly evident from the Von Bertalanffy growth curves computed separately for males and females (Figure 7). Parameters of the Von Bertalanffy equation are summarized in Table 1, together with the maximum total length recorded during our investigations. Values of Loo are in rather good agreement with the maximum sizes recorded for each sex in the two areas. Slower growth of females is evidenced by higher values of K.



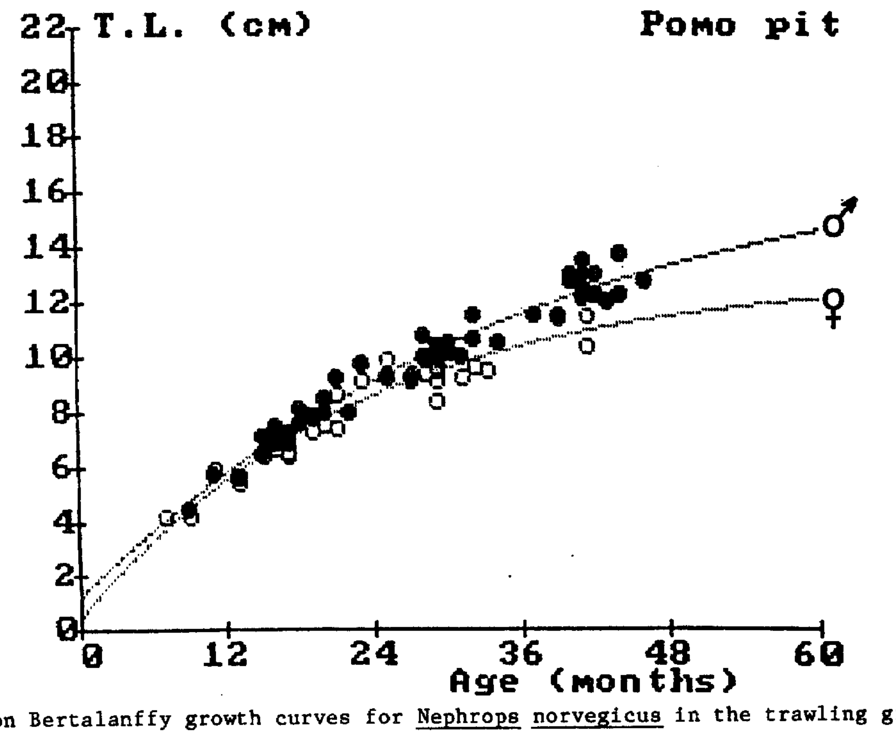


Figure 7 Von Bertalanffy growth curves for Nephrops norvegicus in the trawling grounds off Ancona and in the Western Pomo pit

Table 1

Parameters of the Von Bertalanffy growth equation and maximum total length recorded for males and females off Ancona and in the western Pomo pit (total length in centimetres, age in months)

Area	Sex	to	K	TLoo	TLmax
ANCONA	Males	1.70	0.036	22.6	22.5
	Females	1.48	0.044	18.8	23.0
POMO	Males	-1.91	0.027	17.7	20.0
	Females	-0.27	0.044	12.9	14.0

3.2 Mortality Estimate

All methods proposed to estimate Z presuppose that fishery is in equilibrium which may be not the case for the present population off Ancona (see Figure 2 showing the trend of the mean length in samples taken in June-July from 1976 to 1986). Thus, for the area off Ancona, two sets of Z were computed: the first for the years 1976-77 is assumed to represent a population under equilibrium, and the second for the years 1982-86 (period of population recovery after the extramortality induced by the oxygen crisis of summer 1977). According to Morizur (1982), who tried similar estimations of mortality on the Atlantic stocks of Norway lobster, in presence of intensively exploited populations, the Ssentongo and Larkin formula gives a more reliable estimate of Z than the Beverton and Holt formula; as appears from Table 2, the latter always produced the lower estimate of Z.

Table 2

Estimates of total mortality (Z) for the Adriatic *Nephrops norvegicus* fishery (K for age expressed in years; sizes expressed as TL in centimetres)

Area	Sex	K	TLoo	TLm	TLc	Z1	Zz	Z
ANCONA	Males	0.43	22.6	12.8 a/	10	1.5	1.7	1.6
				14.0 b/		0.9	1.1	1.2
	Females	0.53	18.8	11.7 a/	10	2.2	2.5	2.2
				13.2 b/		0.9	1.2	1.3
POMO	Males	0.32	17.7	8.9	6	1.0	1.1	1.1
	Females	0.53	12.9	8.2	6	1.1	1.4	1.4

a/ Equilibrium condition, years 1976-77

b/ Non-equilibrium condition, years 1982-86

Both formulas utilize length at first capture (L_c). Jukic (1974) gives selection factors ranging from 0.9 to 1.5 for Nephrops size expressed as TL (equivalent to selection factor of 0.4 - 0.5 for size expressed as CL). With mesh size smaller than 40 mm, L_c would be below 4 cm TL, but such small individuals are nearly absent from our samples off Ancona and rare in the Pomo pit.

To estimate L_c we used the length-converted catch curve and reconstructed the "selection pattern" as suggested by Pauly, Ingles and Neal (1984). Obtained values of L_c are considerably higher than expected from selectivity studies and are different for the two areas. Probably in the present Adriatic fishery, the L_c for Norway lobster results more from the concealement behaviour of juveniles than from codend selectivity.

Values introduced in the formulas to compute Z_1 (Beverton and Holt) and Z_2 (Ssentongo and Larkin) are given in Table 2 together with the values of Z obtained from the length-converted catch curve.

4. CONCLUSIONS

The Norway lobster population sampled off Ancona shows a remarkably higher growth than the population sampled in the western Pomo pit (Figure 8). A genetical explanation for this difference is unlikely if we remember that N. norvegicus has a pelagic larval life lasting some weeks and that the two sampling sites are distant less than 100 mi and are within the general distribution area of N. norvegicus in the Adriatic trawling grounds (Figure 1). Environmental factors could play a fundamental role in explaining this differences.

In the Pomo pit the benthic biomass, as obtained from grab samples, is only 1 g wet weight/square metre, whereas on the trawling grounds off Ancona it is over 30 g wet weight/square metre (Artegiani et al., 1979; Froglia, unpublished data). This lower infaunal biomass is associated with higher densities of Norway lobsters, and it is well known that competition for available food could limit growth. Moreover, the temperature regime near the bottom is different in the two areas (off Ancona: min. 10.5°C, max. 16°C; Pomo pit: min. 9.5°C, max. 11.5°C) and most species within their temperature range, show a faster growth at higher temperatures.

Our estimates of annual growth of N. norvegicus in both Adriatic areas are higher than those available for the Atlantic coasts of Europe (Hillis, 1979; Farmer, 1973, 1975; Conan, 1975; Morizur, 1983) (Figure 9); at the same time. Annual sea temperatures in both Adriatic areas are higher.

It is worthy of note that off the Atlantic coast of France (Morizur, 1983), as well as off the Isle of Man (Farmer, 1974,1975), and Scotland (Thomas, 1964), female size at first maturity is still lower than that recorded for the Pomo pit, and this would be in agreement with the lower growth recorded in those regions. We think that within a region, sexual maturity is strictly related to age and, from our data for the Adriatic grounds, we estimate the first maturity at age 2+; Morizur (1983) for the northern Bay of Biscay, estimates first maturity at age 2+; occasionally delayed to age 3+ in severe years characterized by lower growth rate.

Total mortality Z estimates obtained with the three methods, range between 1.0 and 1.4 for the Western Pomo pit, and between 1.5 and 2.5 for the area off Ancona (assuming equilibrium conditions). Females show the higher values; this result could seem unlikely keeping in mind the lower vulnerability of females to bottom trawls for most of the year. We have to remember however, that fishing effort concentrates on Nephrops grounds in late spring and early summer, when catches of Norway lobster are higher and females dominate in catches.

From available data on stomach contents of demersal and benthic bony fish, presently associated with Adriatic "Nephrops grounds", it appears that none of them preys significantly on Norway lobsters.

Small Nephrops were found only in 0.3% of the stomachs of 1 213 Trisopterus minutus capelanus collected in the area off Ancona (Gramitto, unpublished data) and never found in stomachs of Merluccius merluccius (Froglia, 1974), Zeus faber (Jardas, 1973) and Antonogadus megalokynodon (Gramitto, 1985), nor in stomachs of gurnard, brill and turbot (Froglia, unpublished data). Jardas (1971) states that cartilagineous fishes do not prey on Nephrops norvegicus in the Adriatic Sea, moreover rays and spurdogs are very rare in the two areas considered. Predation on Norway lobster, after its recruitment to benthic life, being insignificant, fishing mortality has to be by far the main component of total mortality.

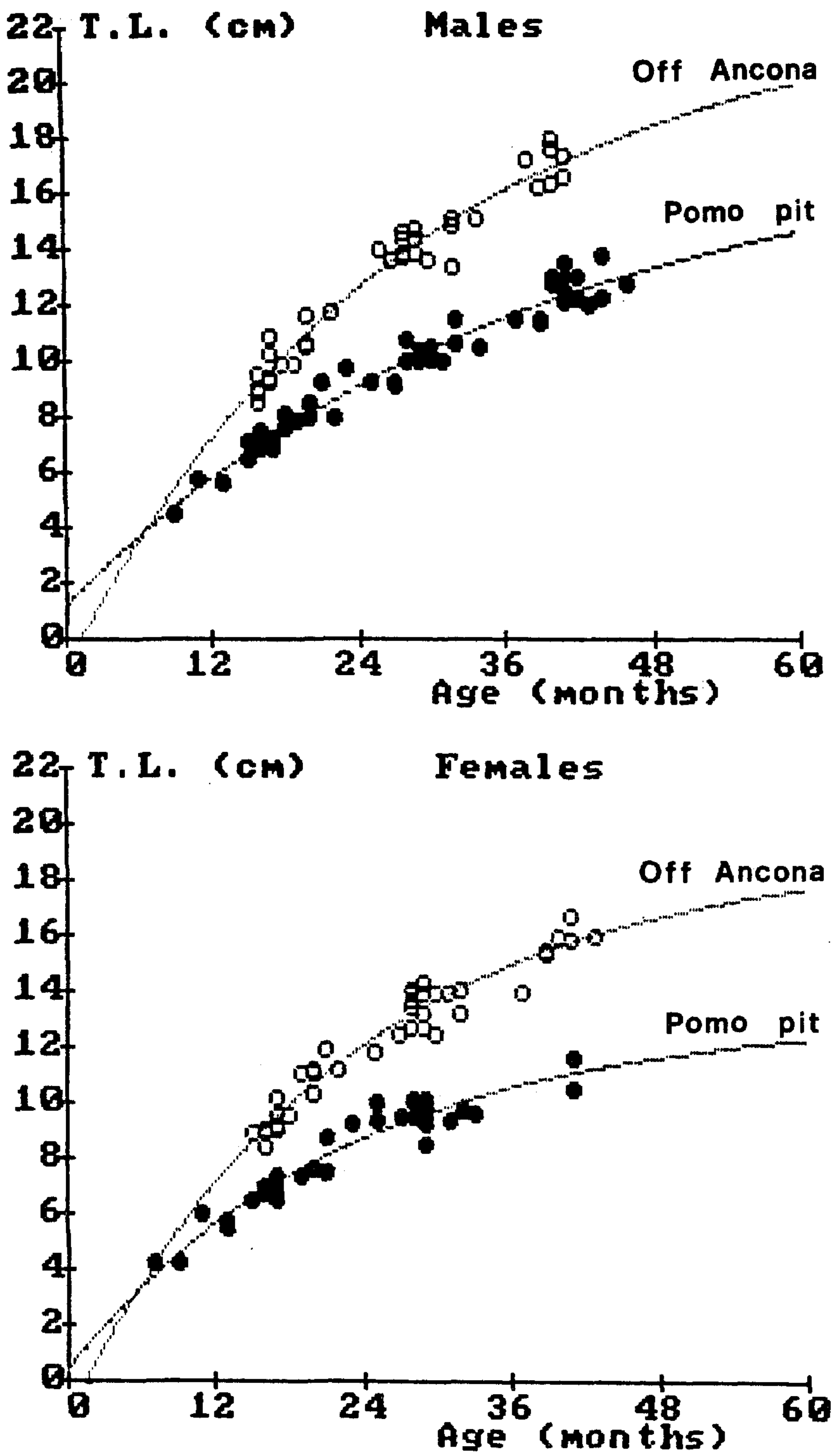


Figure 8 Von Bertalanffy growth curves for males and females: differences between the two sampling areas

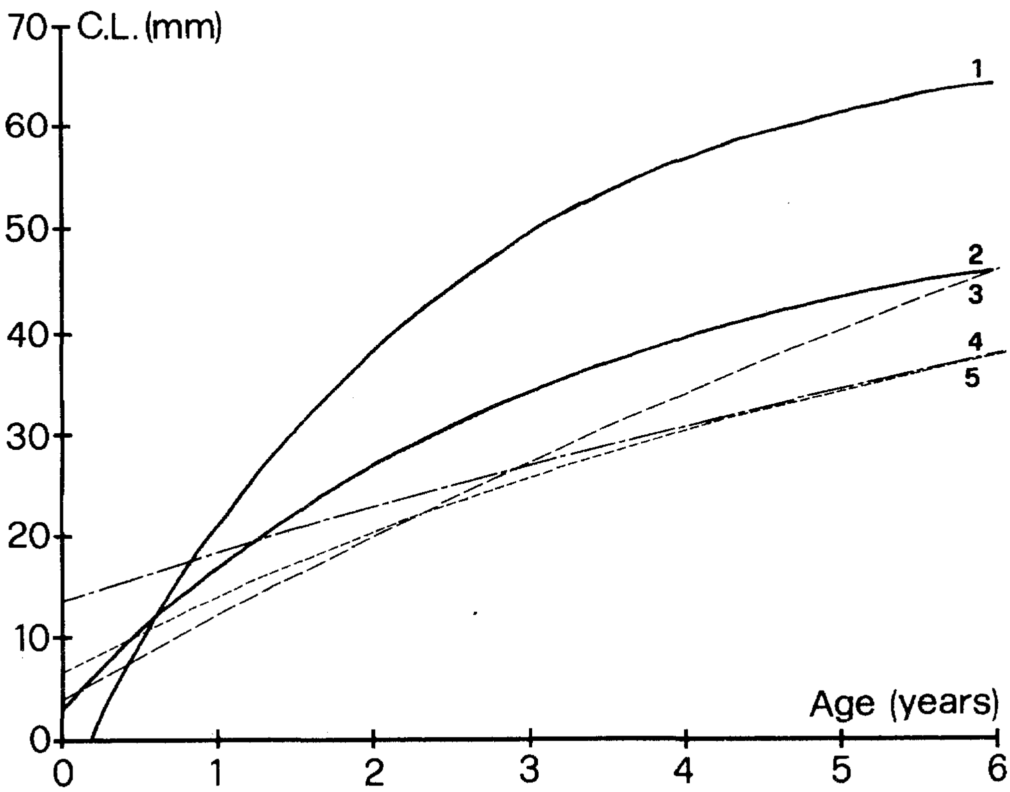


Figure 9 Von Bertalanffy growth curves for males of Nephrops norvegicus from selected areas: (1) Off Ancona, (2) Western Pomo pit, (3) South Britain (Conan, 1975), (4) Mediterranean Spain (Sardà, 1985), (5) Isle of Man (Farmer, 1973). For the Adriatic original data expressed as TL were converted to CL with the equations given in the text. Curves 3 - 4 - 5 are drawn from literature data

5. REFERENCES

Abramson, N.J., (comp.), 1971. Computer programs for fish stock assessment. FAO Fish.Tech.Pap., (101):pag.var.

Artegiani, A., et al., 1979. Primi risultati delle indagini sui fattori biologici, oceanografici e sedimentologici che condizionano la distribuzione degli scampi (Nephrops norvegicus) in Adriatico. In Atti del Convegno scientifico nazionale. Progetto finalizzato oceanografia e fondi marini, Roma, 5-7 marzo 1979, edited by P.D. Petrelli. Roma, Consiglio Nazionale delle Ricerche, Vol.1:229-41

Beverton, R.J.H. and S.J. Holt, 1956. A review of methods of estimating mortality rates in exploited fish population, with special reference to source of bias in catch sampling. Rapp.P.-V.Réun.CIEM, 140:67-83

Chapman, C.J., 1980. Ecology of juvenile and adult Nephrops. In The biology and management of lobsters, edited by J.S. Cobb and B.F. Phillips. New York, Vol. 2:143-78

Cole, H.A., (ed.), 1965. Special meeting, 1962. To consider problems in the exploitation and regulation of fisheries for crustacea. Rapp.P.-V.Réun.CIEM, 156:217 p.

Conan, G., 1975. Périodicité des mues, croissance et cycle biologique de Nephrops norvegicus dans le Golfe de Gascogne. C.R.Hebd.Séances Acad.Sci., Paris, 281:1349-52

__________, 1978. Life history, growth, production and biomass modelling of Emerita analoga, Nephrops norvegicus and Homarus vulgaris (Crustacea, Decapoda). Ph.D.Dissertation. University of California, San Diego, 349 p.

Crnkovic, D., 1965. Ispitivanje ekologije i mogucnosti racionalnog unapredjenja eksploatacije raka Nephrops norvegicus (L.) u kanalskom podrucju sjevernoistocnog Jadrana. Disertacija Zagreb, Prirodoslovno Matematicki Fakultet Sveuciliste, 211 p.

Farmer, A.S., 1973. Age and growth in Nephrops norvegicus (Decapoda: Nephropidae). Mar.Biol., 23:315-25

__________, 1974. The development of the external sexual characters of Nephrops norvegicus (L.) (Decapoda: Nephropidae). J.Nat.Hist., 8:241-55

__________, 1975. Synopsis of biological data on the Norway lobster Nephrops norvegicus (Linnaeus, 1758). FAO Fish.Synop., (112):97 p.

Figueiredo, M.J., 1979. Artificial culture of Nephrops norvegicus (L.). 1. Further studies on larval culture of Nephrops norvegicus (L.) reared from the egg. Bol.Inst.Nac.Invest. Pescas, Lisboa, 1:5-12

__________, 1979a. Artificial culture of Nephrops norvegicus (L.). 2. Some studies on the growth of early post-larvae of Nephrops norvegicus (L.) reared from the egg. Bol.Inst. Nac.Invest.Pescas. Lisboa, 1:13-23

Froglia, C., 1973. Osservazioni sull'alimentazione del merluzzo (Merluccius merluccius L.) del medio Adriatico. In Atti del quinto Congresso Nazionale della Società Italiana di Biologia Marina, pp. 327-34

Froglia, C. and M.E. Gramitto, 1981. Summary of biological parameters on the Norway lobster. Nephrops norvegicus (L.) in the Adriatic. FAO Rapp.Pêches/FAO Fish.Rep., (253):165-78

__________, 1982. Effetti della crisi di ossigeno del 1977 sulla pesca degli Scampi in Adriatico. Boll.Mus.Ist.Biol.Univ.Genova, 50 Suppl.:195-201

Gramitto, M.E., 1985. Osservazioni sull'alimentazione di Antonogadus megalokynodon (Kolombatovic) (Pisces; Gadidae) nel Medio Adriatico. Quad.Ist.Ric.Pesca Maritt., Ancona, 4(2):205-8

Hillis, J.P., 1972. Juvenile Nephrops caught in the Irish Sea. Nature, Lond., 237:280-1

__________, 1979. Growth studies on the prawn, Nephrops norvegicus. Rapp.P.-V.Réun.CIEM, 175:170-5

Jardas, I., 1972. Prilog poznavahju ekologije nekih jadranskih hrskavicnjaca (Chondroichthyes) s posebnim osvrtom na ishranu. Acta Adriat., 14(7):60 p.

__________, 1973. O ishrani Kovaca, Zeus faber-pungio C.V., u Jadranskom moru. Ekologija, 8(1):147-61

Jukic, S., 1974. The Yugoslav Nephrops fishery. Acta Adriat., 15(8):18 p.

Karlovac, O., 1953. An ecological study of Nephrops norvegicus (L.) of the High Adriatic. Izv.Inst.Oceanol.Ribar., Split, 5(2C):51 p.

Morizur, Y., 1982. Estimation de la mortalité pour quelques stocks de langoustine Nephrops norvegicus. ICES C.M. 1982/K:10:19 p. (mimeo)

__________, 1983. Utilisation de critères fonctionnels (présence de spermatophore, maturation des ovaires) pour la détermination de la taille et de l'âge à maturité sexuelle des Nephrops norvegicus femelles de la région sud-Bretagne. J.Cons.CIEM, 41:28-36

Nicholson, M.D., 1979. The use of length-frequency distributions for age determination of Nephrops norvegicus. Rapp.P.-V.Réun.CIEM, 175:176-81

Pauly, D., J. Ingles and R. Neal, 1984. Application to shrimp stocks of objective methods for the estimation of growth mortality and recruitment-related parameters from length-frequency data ELEFAN I and II) In Penaeid shrimps, their biology and management, edited by J.A. Gulland and B.J. Rothschild. Farnham, Survey. Fishing News Books Ltd., pp. 220-34

Santucci, R., 1926. Lo sviluppo e l'ecologia post-embrionali dello "Scampo" (Nephrops norvegicus (L.)) nel Tirreno e nei mari nordici. Mem.R.Com.Talassogr.Ital., (125):38 p.

Sardà, F., 1985. Estudio de la edad, crecimiento y frequencia de muda, en cautuvidad, de Nephrops norvegicus L. del mar Catalan. Invest.Pesq.Barc., 49(2):139-54

Ssentongo, G.W. and P.A. Larkin, 1973. Some simple methods of estimating mortality rates of exploited fish populations. J.Fish.Res.Board Can., 30(5):695-8

Thomas, H.J., 1964. The spawning and fecundity of the Norway lobsters(Nephrops norvegicus) around the Scottish coast. J.Cons.CIEM, 29:221-9

____________, 1965. The growth of Norway lobsters in aquaria. Rapp.P.-V.Réun.CIEM, 156:209-16

STUDIES FOR THE EVALUATION AND OF THE CONSISTENCY OF BEDS OF Chamelea gallina IN THE ADRIATIC

EVALUATION OF CLAM STOCKS IN THE LOWER ADRIATIC

by

G. Marano, A.M. Pastorelli and R. Vaccarella
Laboratorio Provinciale di Biologia Marina di Bari
Key words: fishing, bivalvia, Adriatic sea

1. INTRODUCTION

For many years clam fishing in the Adriatic has been carried out by boats with drags preceeded by air-tubes. These methods, although they have facilitated fishing, have caused the exhaustion of the beds of bivalves, both because of the excessive number of boats used and because of the limited size of the beds.

In the lower Adriatic, the area in which this type of fishing is carried out extends from "Torrente Saccione" to the port of Barletta. In this area the number of clam-fishing boats is as follows: there are 27 which belong to the sub-district of Cagnano Varano, 26 to Lesina, 3 to Manfredonia and 9 to Margherita di Savoia. To these 65 which operate in the district of Manfredonia, can be added the 13 of the district of Molfetta.

The area from Vieste to Manfredonia is not included because of the morphology of its sea-bed. Thus two areas can be defined one to the north of Gargano from Torrente Saccione to Vieste and one to south from Siponto (Manfredonia) to Barletta.

The two areas are different because of the quality of the water and because of the nature of the sediments. In fact in the northern zone down to a depth of 10 m the sea-beds are made up of fine even sands which host communities of "Chamelea gallina and Owenia fusiformis".

With increasing depth, and then with the reduction of hydrodynamics, an increase in fine sediments such as lime and clay can be observed particularly near the estuaries of the Saccione and Fortore rivers (Ambrosano, Ferretti and Falcinelli, 1986).

In the second area, chiefly composed of the Gulf of Manfredonia, the mud-clay element prevails over that of sand and the communities of "Chamelea gallina and Diopatra neapolitana" are found again. In particular the absence of sand deposits at the mouths of Carapelle and Ofanto rivers should be noted, given the importance of their respective catchment basins (Viel, Damiani and Setti, 1986). Everywhere in this area at a depth of around 10 m a decrease in the communities of C. gallina and D. neapolitana is found together with an increased density of O. fusiformis.

In addition, the great abundance of edible bivalves (Mytilus galloprovincialis, Ostrea edulis, Crassostrea angulata, Acanthocardia tuberculata, Venerupis aurea, Callista chione, Scapharca inaequivalvis, etc.) as well as clams must be related to the high eutrophy of the water caused by nutrients from the rivers Candelaro, Cervaro, Carapelle and Ofanto (Marano et al., 1985).

The evaluation of the beds of C. gallina in the Adriatic was carried out jointly by the operating units of Trieste, Fano, Ancona and Teramo in June and July 1984 and in the same months in 1985 and 1986. It was financed by the Ministry of the "Marina Mercantile" with the aim of rationalizing fishing activities and of enriching stocks.

2. MATERIALS AND METHODS

In each area drags of 50 m parallel to coast were carried out at depths from 2 to 12 m along 34 sections perpendicular to the coast and each some 2 miles apart (Figure 1).

In the first season (1984) two different professional drag-boats were used for fishing the molluscs; a "cannellara" with an opening 2.40 m and a distance between the rungs of 6 mm and a "vongolara" with an opening of 2.60 m and a distance between the rungs of 11-12 mm.

In sections 1 to 20 (northern area) it was necessary to use the "cannellara" to gather the largest number of molluscs (in particular from the uncommercial sections) to give a more realistic image of the biomass and the number of young of C. gallina in relation to the sea-bed. On the other hand in sections 21-34 the mud content of the sands increased considerably with the consequent fouling of the drag so that these were worked with the "vongolara" described above.

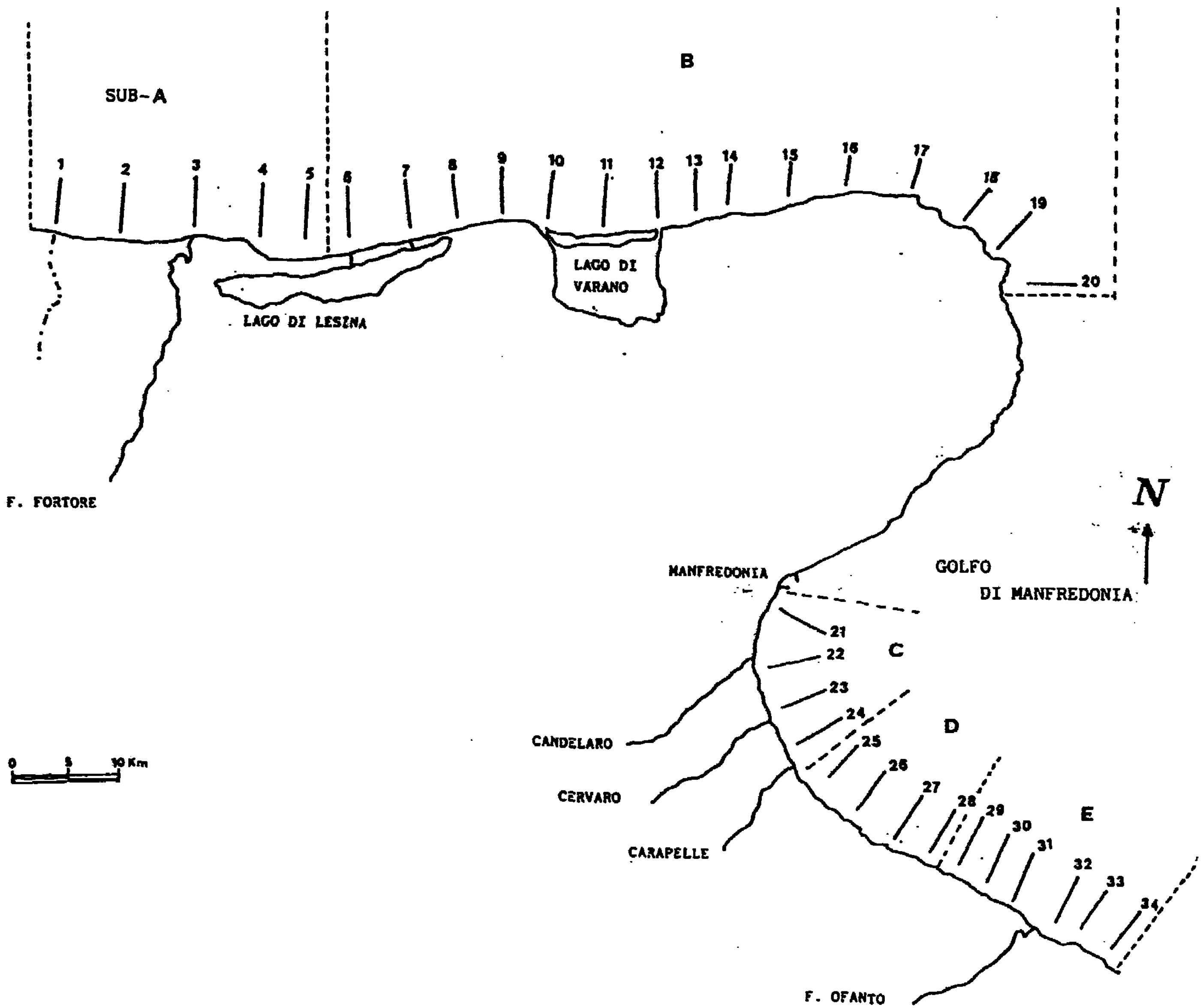


Figure 1 Cartography of sampling stations

LIST OF SPECIES CAUGHT

ANTOZOI

Calliactis parasitica (Couch)

POLICHETI

Diopatra neapolitana Delle Chiaje
Eunice vittata (Delle Chiaje)
Sigalion mathildae (Audoiun, M. Edward)
Arabella iricolor (Montagu)
Glycera sp.
Lumbriconereis sp.
Owenia fusiformis (Delle Chiaje)
Eunice pennata (O.F. Muller)
Onuphis eremita Audouin, M. Edward
Psammolice arenosa (Delle Chiaje)
Nephthis sp.
Polyodontes maxillosus (Ranzani)
Phyllodoce sp.
Stylaroides monilifer (Delle Chiaje)

SIPUNCULIDI

Sipunculus nudus L.

CROSTACEI DECAPODI

Penaeus kerathurus (Forskal)
Sicyonia carinata (Brunnich)
Paguristes oculatus (Fabricius)
Diogenes pugilator (Roux)
Upogebia pusilla (Leach)
Carcinus mediterraneus (Czerniavsky)
Liocarcinus vernalis (Risso)
Brachynotus sexdentatus (Risso)
Brachynotus gemmellari (Rizza)
Pinnotheres pisum (L.)
Ilia nucleus (L.)
Macropodia rostrata (L.)
Parthenope angulifrons (Latreille)
Nannosquilloides occulta (Giesbrecht)

BIVALVI

Ostrea edulis (L.)
Venerupis aurea (Gmelin)
Chamelea gallina (L.)
Dosinia lupinus (L.)
Donax trunculus L.
Donax semistriatus Poli
Tellina pulchella Lamarck
Fabulina fabuloides (Monterosato)
Angulus tenuis Da Costa
Tellina nitida Poli
Ensis siliqua (L.)
Ensis ensis (L.)
Ensis minor (Chenu)
Pharus legumen (L.)
Nucula nucleus (L.)
Lentidium mediterraneum (O.G. Costa)
Callista chione L.
Spisula subtruncata (Da Costa)
Mactra stultorum (L.)
Corbula gibba (Olivi)
Gregariella barbatella (Cantr.)
Mytilus galloprovincialis Lamarck
Modiolus barbatus (L.)
Acanthocardia tuberculata (L.)
Glycymeris violacescens (Lamarck)
Scapharca inaequivalvis (Brug.)

GASTEROPODI

Acteon tornatilis (L.)
Hinia reticulata (L.)
Aphorrhais pespelecani (L.)
Philine aperta (L.)
Neverita josephinia Risso
Naticarius millepunctata (Lamarck)
Murex brandaris (L.)
Trunculariopsis trunculus (L.)
Nassarius mutabilis (L.)

ECHINODERMI

Echinocardium cordatum (Penn.)
Acrocnida brachiata (Mont.)
Astropecten pentacanthus (Delle Chiaje)
Astropecten johnstoni (Delle Chiaje)
Thyone fusus (O.F. Muller)
Lapidoplax digitata (Mont.)

SELACI

Raja asterias (Valm.)
Raja sp.

TELEOSTEI

Echiichthys vipera (Cuv.)
Lithognathus mormyrus (L.)
Gobius niger (Padoa)
Solea impar (Benn.)

In the subsequent years 1985-86 following, the first results and the experience of other units of researchers, it was decided to use an experimental drag, in order to unify the methods of sampling in the various areas examined and to have, in addition, a more realistic estimate of the biomass of the mussels. In fact the drag was divided into three equal sections each 80 cm wide. In the two side ones the distance between the rungs was about 12 mm while in the central one it was 6 mm.

Even the use of these procedures during the sampling did not prevent the "experimental" drag from operating in an anomalous way in some cases because of the wide variations in the nature of the sediment.

In detail, on bottoms of mixed sand and mud the drag's behaviour was excellent in that it took specimens selected according to the "mesh" of each section, but on muddy or clay bottoms the more rapid filling of the central section caused the regurgitation of the material changing by default the values of the total biomass with respect to the commercial values. Therefore in this note the results shown relate only to the commercial fraction (bigger than 25 mm) of the mussels sampled in 1984 and 1985.

From the material gathered a sub-sample of 10 kg was taken, frozen and subsequently thawed in the laboratory on sieves wih a mesh of 3 mm.

The biomass was calculated from the bivalves after thawing so that it is necessary to take into account underestimates caused by the loss of intervalve water. As well as the weight the density and somatometric indices were taken. The same measurements were also made for the accompanying species (Table all.).

3. RESULTS AND DISCUSSION

Because of the environmental and geomorphic characteristics of the areas examined and, as a result of the information obtained, 5 sub-areas were defined of which 2 (A, B) were in the northern zone and 3 (C, D, E) in the southern zone (Tables 2 and 3).

In 1984 in the whole northern area the yield of the beds was scarce. In fact in the major part of the sections the values were rather small since on some sites only small sized specimens were gathered so that in total the biomass of the commercial product was 20.35% of the total biomass.

In particular 20.65 of the 92 sites had no clams of commercial dimensions and 64.12% had values less than 10 kg/1 000 m² (Table 1).

The average production of the commercial product was low in both sub-areas A and B (Table 2), although in the first sub-area the biomass gathered was somewhat large and (including specimens of uncommercial size) averaged around 36 kg/1 000 m². The largest quantity of clams was caught in the section "Pietre Nere" where, at a depth of 5 m, it has been estimated that the biomass is over 700 kg/1 000 m² and at 6 m depth is over 200 kg/1 000 m².

Table 1

Percentage frequency of sites by biomass intervals

Commercial biomass kg/1 000 m²	Number of sites	%
0	19	20.65
$\leqslant$ 1	34	36.96
1.1-5	25	27.17
5.1-10	5	5.43
10.1-30	7	7.61
30.1-50	1	1.09
50.1-100	1	1.09
> 100.1	0	0
	92	100

Table 2

Distribution of commercial biomass

	Sections	Depth m (min/max)	Samples taken	Commercial biomass (kg)	Depth m (min/max)	Samples taken	Commercial biomass (kg)
			1984			1985	
Sub-area A	1. Torrente Saccione	2 9	7	43.323	2 9	8	1 538.458
	2. Torrente Fantine	2 7	6	21.151	2 11	10	1 177.063
	3. Foce Fortore	2 8	7	4.725	2 8	7	47.185
	4. Canale Acquarotta	3 9	6	11.514	2 8	7	166.379
	5. Pietre nere	2 9	8	5.456	2 7	6	94.523
				86.169			3 023.608
		N= 34	$\bar{X}$=2.5343	$\frac{S^2}{\bar{X}}$ = 5.29171	N= 38	$\bar{X}$=79.5689	$\frac{S^2}{\bar{X}}$= 342.50503
Sub-area B	6. Bosco Lesina	2 4	3	12.495	2 6	5	10.731
	7. Foce S. Andrea	2 6	5	0.093	2 7	6	2.115
	8. Isola di Lesina	2 5	4	15.116	2 5	4	12.464
	9. Torre Mileto	2 5	4	4.275	2 4	3	1.593
	10. Foce Capoiale	2 7	6	6.091	2 7	6	3.178
	11. Isola Varano	2 7	6	21.063	2 6	5	4.963
	12. Foce Varano	2 6	4	20.953	2 6	4	4.258
	13. Casa Sansone	3	1	0.295	2 5	4	1.340
	14. Rodi Garganico	2 4	3	4.450	2 6	5	7.192
	15. S. Menaio	2 4	3	6.625	2 4	3	1.227
	16. Peschici	2 4	3	1.315	2 4	3	0.279
	17. Punta Manacore	2 4	3	1.991	2 5	4	1.867
	18. Vieste	2 5	4	66.225	2 5	4	4.886
	19. Vieste S. Lorenzo	2 5	4	51.905	2 5	4	1.281
	20. Vieste Pizzomunno	2 6	5	1.646	2 6	5	5.234
				214.538			62.608
		N= 58	$\bar{X}$= 3.6989	$\frac{S^2}{\bar{X}}$=25.0995	N= 65	$\bar{X}$=0.9632	$\frac{S^2}{\bar{X}}$= 3.58783

The total quantity of clams in this section down to a depth of 9 m was 1 095 kg but only 0.5% of this was composed of specimens of a commercial size.

In the second area the average total biomass remained at levels around 4-5 kg/1 000 m².

The results of the 1985 season confirmed the characteristics of the two areas, but in this case there was a considerable difference in the values for the commercial biomass. In fact for the first area there was a commercial yield much greater than that of the previous year with an average of 79.568 kg/1 000 m² for 38 sites, while the 65 sites of the second area averaged 0.963 kg.

The huge number of young observed the previous year led to a consequent increase in production in the northernmost area in which the beds were more widespread and were found down to depths of 12 m. By contrast in the remaining area in which the beds were close to the coast at depths of 5-6 m, intensive fishing had further worsened the situation. As an indication of this, the total biomass values found for sub-area A were 122.792 kg/1 000 m² while for sub-area B they were 2.514 kg/1 000 m².

For B however in some cases (as has already been noted) the central section of the drag-net gathered quantities less than those taken by the side sections, though in every case this only happened when the clam specimens were particularly scattered, as was most common in the southern section. The average and variance values for density showed, in fact, that in moving from the first sub-area to the second the distribution of the specimens changed from dense to scattered (Elliot, 1977).

In the zone south of Gargano in 1984 the drag of the "vongolara" type was used which had a distance between the rungs of 12 mm. Even in this case in one section (number 21 Siponto) only small quantity of commercial size clams was taken while the values for the total biomass were among the highest. The specimens gathered were of small size (17.96 mm ± 5.78 for 1 614 individuals) and these were caught due to the presence of thick beds of <u>Cymodocea nodosa</u> (Vaccarella, Marano and Pastorelli, in press).

For the southern zone 3 sections have been identified: the 2 flanking sub-areas where clam yield is greater and a central one where it is lower.

The highest yield in the two flanking sub-areas came from the parts near to the Candelaro, Cervaro and Carapelle Rivers for the north and near to the River Ofanto for the south, since these put into the sea large quantities of food so causing eutrophic conditions in the water, while the lower yield found in the central area is due to the presence of mixed sea-beds with <u>Cymodocea nodosa</u>, rocks and mud where the most common species is <u>Acanthocardia tuberculata</u>.

The average values for the commercial biomass are shown in Table 3. It can be seen that sub-areas C and E although they have very similar average values show different distributions of catches and thus of biomass. In fact the variance for sub-area C indicates a less uniform distribution (in 1984 only 2 boats operated in this zone) while the distribution for sub-area E is much more uniform which suggests a greater exploitation of the beds.

<u>Table 3</u>

Distribution of commercial biomass

	Sections	Depth m (min/max)	Samples taken	Commercial biomass (kg)	Depth m (min/max)	Samples taken	Commercial biomass (kg)
			1984			1985	
Sub-area C	21. Siponto	2 5	4	10.589	2 5	4	95.812
	22. La Bufalara	2 5	4	84.379	2 5	4	145.744
	23. Saraceno	2 6	5	401.735	2 5	4	172.251
	24. Torre Rivoli	3 6	4	121.551	2 6	5	250.169
				618.254			663.976
		N= 17	$\bar{X}$=36.3678	$\frac{S^2}{\bar{X}}$=198.24669	N= 17	$\bar{X}$=39.0574	$\frac{S^2}{\bar{X}}$=57.06094
Sub-area D	25. Zapponeta	3 6	4	1.197	3 6	4	6.478
	26. Idrovora Salina	2 5	4	10.934	3 5	3	0.415
	27. Torre di Pietre	2 6	5	35.369	2 6	5	14.773
	28. Foce Quarta	2 5	3	5.805	2 6	5	45.763
				53.305			67.429
		N= 16	$\bar{X}$= 3.3315	$\frac{S^2}{\bar{X}}$= 13.94777	N= 17	$\bar{X}$= 3.9664	$\frac{S^2}{\bar{X}}$= 9.48482
Sub-area E	29. Margherita Porto	2 6	5	119.669	2 6	5	249.617
	30. Margherita Città	2 5	4	17.312	2 7	6	1 236.380
	31. Ofanto	2 5	4	81.069	2 6	5	68.057
	32. Foce Ofanto	3 6	4	94.980	2 6	5	84.119
	33. Barletta	2 6	5	308.032	2 7	6	513.372
	34. Barletta Porto	2 8	7	156.702	2 8	7	410.336
				777.764			2 561.881
		N= 29	$\bar{X}$= 26.8194	$\frac{S^2}{\bar{X}}$= 26.23233	N= 34	$\bar{X}$= 75.3494	$\frac{S^2}{\bar{X}}$= 187.2891

The main characteristic of the beds of clams examined is the evident reduction of the bivalves at a depth of around 8 m caused by the limited extension of the upper layer of the infralitoral. In fact only in certain well defined areas around the River Saccione and the port of Barletta were clam beds found at depths of 9-12 m. For the rest of the area examined the beds were already drastically reduced at depths of 5-6 m.

In the cases of beds which did not go very deep, the highest values of commercial biomass were found between 2 and 3 m, while, when the beds go deeper, the depth of main interest lies between 4 and 6 m (Table 4).

Table 4

Average values of commercial biomass by depth and by sub-area (kg/1 000 m²)

	Depth (m) 'm Sub-area		2	3	4	5	6	7	8	9	10
1984	A	n	4	4	5	4	5	5	3	2	
		$\bar{X}$	0.7042	1.562	4.1584	3.687	4.6292	1.3342	2.325	2.3865	
		S^2	1.0945	4.4025	29.1030	23.2738	31.6748	1.5287	9.1059	10.9184	
	B	n	14	15	14	8	5	2			
		$\bar{X}$	4.6747	7.4260	2.3886	0.2352	0.2992	0.4435			
		S^2	142.0892	205.8290	17.8328	0.13845	0.1586	0.0257			
	C	n	3	4	4	4	2				
		$\bar{X}$	18.6520	7.3352	97.3975	34.2395	3.2045				
		S^2	442.6474	13.3188	28660.9254	2338.4597	4.0072				
	D	n	3	3	4	4	2				
		$\bar{X}$	2.0633	9.602	2.2297	2.3475	0				
		S^2	8.1589	211.5966	14.9761	19.6227	0				
	E	n	5	6	6	6	4				
		$\bar{X}$	20.9386	41.743	35.6036	21.0023	20.4147	N.V.	N.V.		
		S^2	283.0461	1456.6391	896.2229	301.5675	528.6206				
1985	A	n	5	5	5	5	5	5	4	2	
		$\bar{X}$	0.144	13.1766	22.1162	72.1976	203.493	167.033	80.828	50.0295	N.V.
		S^2	0.0251	215.7351	581.9614	6058.6865	87163.1895	104705.985	11397.0710	936.0166	
	B	n	15	15	15	11	7	2			
		$\bar{X}$	2.24	1.2478	0.5204	0.1373	0.1391	0			
		S^2	9.0023	1.7057	2.2016	0.0651	0.0870	0			
	C	n	4	4	4	4					
		$\bar{X}$	46.6332	79.0105	25.409	14.858	N.V.				
		S^2	4540.1022	3164.8335	591.1507	599.0385					
	D	n	2	4	4	4	3				
		$\bar{X}$	5.8155	2.436	8.5147	2.9772	0.0286				
		S^2	40.2214	4.9533	117.8929	27.1331	0.0014				
	E	n	6	6	6	6	6	3			
		$\bar{X}$	25.595	25.9536	140.9566	84.2036	103.4838	89.9703	N.V.		
		S^2	1317.3419	447.2304	17174.0447	14076.7096	45331.1535	10894.3713			

The highest values of total biomass gathered were found between 3 and 5 m, but in this case a high percentage is made up of small specimens.

From the initial data on the commercial biomass for the year 1984 and 1985, it is possible to report some general and preliminary findings on the changes in stock and about its consistency in the two districts extrapolating averages taken from the individual samples and generalizing about the surfaces where the bivalves are present.

The district of Manfredonia goes from the River Saccione to the Ofanto estuary and the beds there have an area of about 178 km². The district of Molfetta goes from the Ofanto to Barletta with a surface area of some 11.45 km².

The data shown in Table 5 give for 1984 the values for the total biomass and for the commercial biomass of C. gallina and other commercial bivalves for each district while in the next table (Table 6) is shown the increase in commercial biomass for 1985 as against 1984 for each district.

Table 5

1984

	Manfredonia (177.76 km²)		Molfetta (11.45 km²)	
	Total biomass (t)	Commercial biomass (t)	Total biomass (t)	Commercial biomass (t)
Chamelea gallina	4 651.32	2 201.75	449.27	399.6
Scapharca inaequivalvis	2 929.54		1.59	
Mactra stultorum	996.18		85.59	
Achantocardia tuberculata	447.76		25.79	
Venerupis aurea	315.30		1.75	
Ensis spp.	156.30		–	
Donax spp.	27.76		–	
	9 488.16		563.98	

Table 6

Chamelea gallina commercial biomass

		Maritime district of Manfredonia	Marine district of Molfetta
1984	Surface extent (km²)	177.76	11.45
	Commercial biomass (q)	22 017.5	3 996.02
	No. clam fishing boats	65	13
1985	Surface extent (km²)	177.76	11.45
	Commercial biomass (q)	67 297.09	6 410.90
	No. clam fishing boats	70	13

It can be seen that for 1984 in the district of Manfredonia the commercial biomass was 22.017 q, about one third of the 1985 level. For the district of Molfetta for 1985 the commercial biomass was estimated to be double that for the previous year.

This type of increase is also suggested by the official data from the Statistics Office for the Fishing Industry (Table 7).

Table 7

Chamelea gallina commercial biomass (q)

		Values	
		estimated by the survey	of the statistical office for fishing
1984	District of Manfredonia	22 017.50	5 788.48
	District of Molfetta	3 996.02	1 866.00
1985	District of Manfredonia	67 297.09	31 815.05
	District of Molfetta	6 410.90	6 232.00

Although the date for the biomass is very preliminary and thus indicative only of order of magnitude, it is desirable to compare it with the data on catches by individual fisherman compiled by the port authorities. There is no doubt that the estimate of the biomass made (in this paper) is subject to revision particularly as regards the estimates of the real extent of the surfaces where the molluscs area present. Since, moreover the populations of C. gallina are subject to fluctuations in reproduction and numbers of young specimens which can be very large it is desirable to have biomass values which related to additional year in order to have a significant picture.

A comparison of the preliminary data with those for fishing returns shows that the former are considerably greater than the fishing estimates as regards 1984, but in 1985 the two are quite similar. Moreover the fishing returns for the district of Molfetta seem to be well-correlated to the real situation since they relate to a smaller number of boats from a single port.

In the district of Manfredonia, because of the intense fishing activity and because of the fluctuations in the number of young, the fishermen frequently reduce their activity ceasing to fish for some months when the yields are scarce. It is to be hoped that in this district also fishing is suspended during June and July as it is in the district of Molfetta.

4. SUMMARY

The result of sampling taken from beds of C. gallina in the Lower Adriatic are presented. These data obtained in 1984 and 1985 generally indicate that the beds are relatively uncommercial, though in 1985 a considerable increase in production was observed.

The values for the biomass for each district have been calculated, although in a preliminary and indicative way.

5. REFERENCES

Ambrosano, E., O. Ferretti and F. Falcinelli, 1986. Tipologia geomorfica costiera e caratterizzazione mineralogica dei sedimenti di spiaggia del litorale pugliese. In Indagine ambientale del sistema marino costiero della regione Puglia. Bari, ENEA, pp. 55-67

Elliot, J.M., 1977. Statistical analysis of samples of benthic of freshwater invertebrates. Sci.Publ.Freshwat.Biol.Assoc.U.K., (25):156 p.

Marano, G., et al., 1985. Banchi naturali a bivalvi del litorale pugliese, classificazione delle acque 1984. Oebalia, 11(3):887-9

Vaccarella, R., G. Marano and A.M. Pastorelli, Valutazione e distribuzione dei banchi a bivalvi nel Golfo di Manfredonia. In Atti del diciassettesimo Congresso della Società Italiana di Biologia Marina (in press)

Viel, M., V. Damiani and M. Setti, 1986. Caratteristiche granulometriche e composizione mineralogica dei sedimenti della piattaforma pugliese. In Indagine ambientale del sistema marino costiero della regione Puglia. Bari, ENEA, pp. 127-47

NOTES ON THE DISTRIBUTION OF COMMERCIAL CRUSTACEANS IN THE SOUTHERN ADRIATIC, TRAWL-SURVEY 1985-86

by

T. Petruzzi, A.M. Pastorelli and G. Marano
Laboratory of Marine Biology of Bari
Italy

1. INTRODUCTION

The southern Adriatic has oceanographic and bathymetric characteristics which are markedly different from those of the surrounding Adriatic areas. In fact, the area which can be trawled extends to a depth of 600-700 m, and thus the crustaceans trawled belong to epibathal species typical of the deep sea bed.

The investigation refers to research carried out in 1985 and 1986 in four surveys with trawls in the spring and autumn months.

2. MATERIALS AND METHODS

In total 167 trawls were made daily, each lasting one hour, along the coast from Vieste to Otranto from depths of 15 to 650 m. The area included in the research was 12 100 km^2.

After reference to the charts of the sea-bed for the continental platform and shelf, 42 sites were selected for fishing (Figure 1). No investigation was made of some places because of the existence of war residues or because the sea-bed could not be trawled (in total 3 100 km^2).

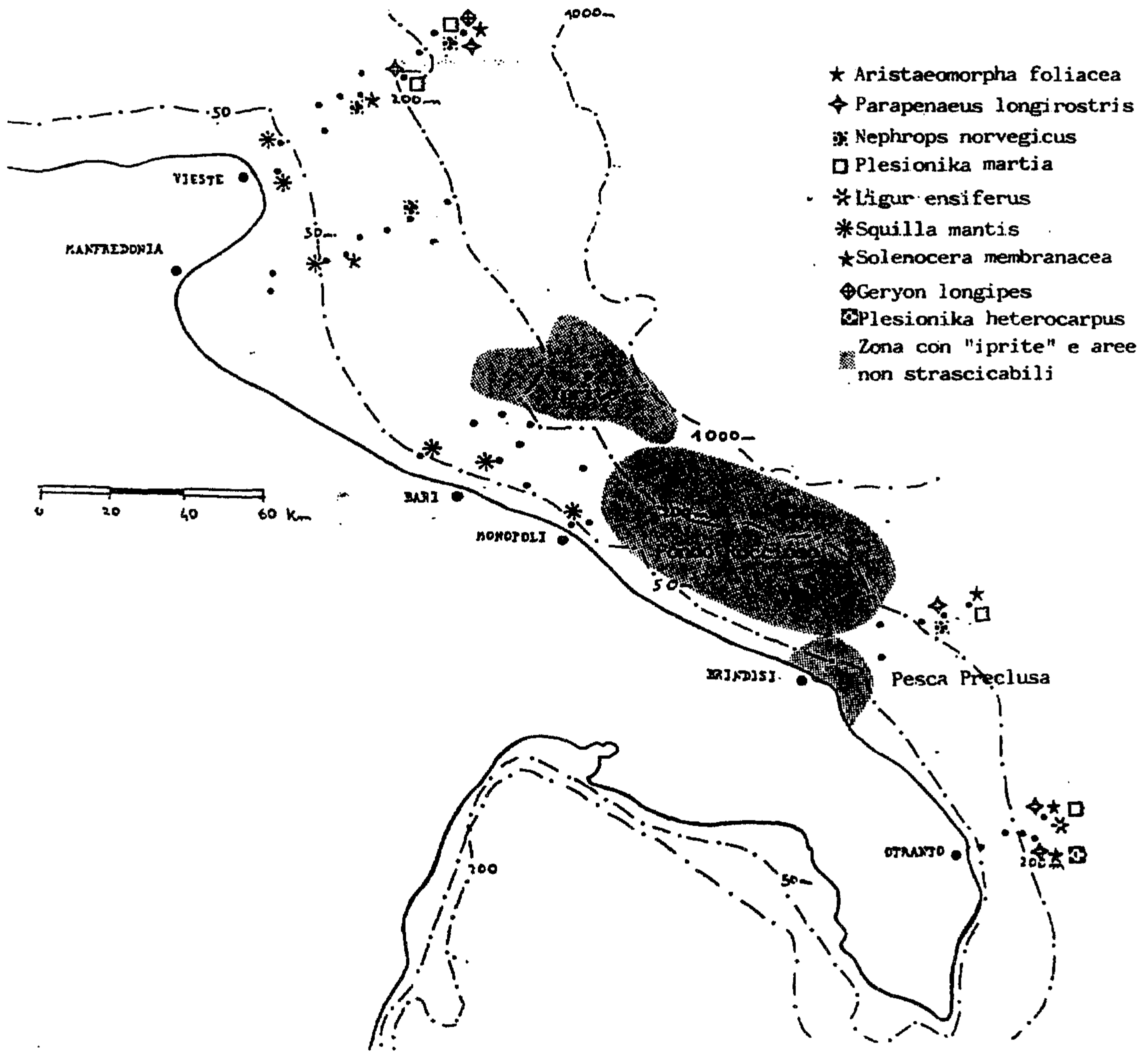


Figure 1 Location of commercial crustaceans in the southern Adriatic

A fishing boat of 48 t gross weight with a 190 hp motor was used for the survey. It was equipped with radar, echo-scanner, Loran a freezer and winch, and used a net of the following specifications: rope with floats 3 600 cm (30 floats), rope with lead weights 3 600 cm (30 lead weights), estimated size of the mouth opening when fishing 400 cm, 240 sections in the mouth, 320 sections in the sack, each of 16 mm; rope dimensions 274 m long, diameter 25-30 mm; a wooden frame to keep the net open 150 x 90 cm, weight 60 kg (in the codend, nets are used with from 16 mm to 18-22 mm sections, depending on the sea-bed).

The part of the catch consisting of discards was merely weighed on board ship, but the rest was later examined in the laboratory. For the crustaceans the following somatometric measures were made as well as classifying them: for the Macrura, total length from the tip of the rostrum to the end of the telson, carapace length (CL) from the eye socket to the median posterior edge of the carapace; for the Prachiura the width was measured from the base to the third lateral spike, and the length from the front spike to the rear edge of the carapace. In addition, each species was weighed in total and the individual weight was taken for each complete animal.

2. RESULTS AND DISCUSSION

In terms of weight, the crustaceans were a rather small percentage of the total catch, only 2.6% of the 1 142 kg taken in 1985 (Figure 2) (Bello, Marano and Rizzi, in preparation). Although the data for 1986 are still in the final stage of examination, the proportion of crustaceans was still small.

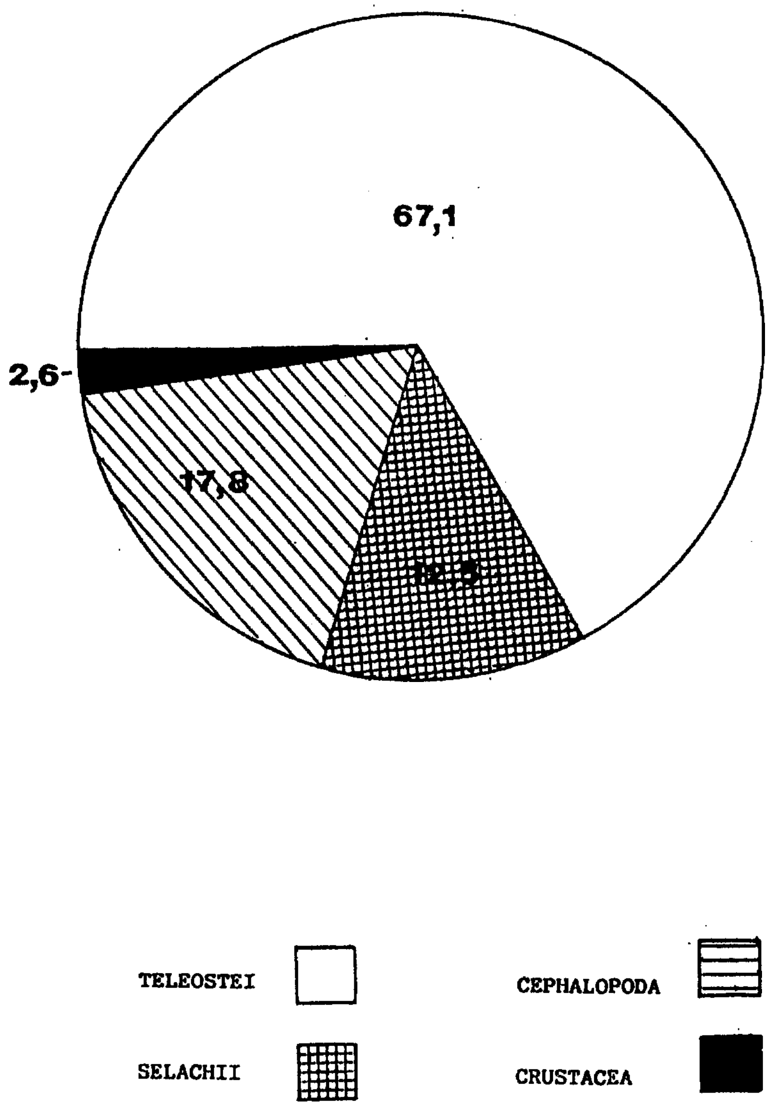


Figure 2 Percentages of total catch - 1985

However, fishing only in daylight hours has reduced the catch for the species which are generally caught at night. The commercial species found were (in order of abundance): Plesionika martia (A. Milne Edwards), Nephrops norvegicus (Linnaeus), Parapenaeus longirostris (Lucas), Squilla mantis (Linnaeus), Geryon longipes A. Milne Edwards, Aristaeomorpha foliacea (Risso), Aristeus antennatus (Risso), Maya squinado (Herbst), Solenocera membranacea (Risso), Geryon maritae Manning and Holthius, Penaeus kerathurus (Forskal), Ligur ensiferus (Risso).

In Table 1 together with number and weight, the average hourly catch by depth for species of prime interest is shown. It can be seen that the most productive depth was between 200 and 650 m, where the largest hourly catches were made for several species. The shrimps of the genus Plesionika which were represented by the species P. martia (the most common) and by P. heterocarpus (Costa), had, in fact, average hourly catches which varied from a minimum of 0.8 kg/h in Spring 1985 to a maximum of 2.8 kg/h in the Autumn of the same year: in particular an increase in the catches during the autumn samplings was noted.

Table 1

Catches and average hourly yields for each fishing survey

Bathymetric levels		0-50			51-100			101-200			200-400			400-650		
Species		No	W	kg/h	No	W	kg/h	No	W	kg/h	No	W	kg/h	No	W	kg/h
N. norvegicus	S.85							4	633	0,05	9	170	0,03	7	207	0,05
	A.85				1	151	0,01	6	449	0,03	27	697	0,2	15	563	0,2
	S.86				1	37	0,003	9	301	0,02	108	2 083	0,35	64	2 665	0,7
	A.86							12	570	0,04	48	799	0,2	54	1 395	0,35
P. longirostris	S.85				1	19	0,002				67	1 256	0,25	26	363	0,1
	A.85	2	9	0,001	2	10	0,0009	43	192	0,02	30	297	0,1	18	208	0,05
	S.86							8	59	0,004	38	578	0,1	51	730	0,2
	A.86				1	18	0,002	8	86	0,006	117	1 699	0,34	8	135	0,03
A. foliacea	S.85													13	269	0,07
	A.85										60	823	0,3	22	465	0,1
	S.86													26	621	0,15
	A.86										25	422	0,08	9	255	0,06
Plesionika spp.	S.85							11	21	0,002	135	169	0,03	524	3 088	0,8
	A.85										115	265	0,09	1 966	11 205	2,8
	S.86										25	79	0,01	958	5 028	1,3
	A.86										157	468	0,09	1 243	6 518	1,6
S. mantis	S.85	22	778	0,1	2	76	0,006									
	A.85	21	590	0,08	24	325	0,03									
	S.86	24	749	0,09	2	72	0,007									
	A.86	45	1 599	0,2	6	307	0,03									
G. longipes	S.85													51	4 205	1,0
	A.85															
	S.86													1	56	0,01
	A.86															

In autumn, the berried females were on average 23.8% of the total population, while in the spring sampling some 40%. Parapenaeus longirostris the most common species, were caught on 21.2% of the sites from 35 m to 650 m, with the maximum concentration from 200-400 m. The catches made at depths 35-100 m were made up of a few small-sized individuals.

As regards size, the males were most common in the 28 mm CL class, while the females, which were always larger, were in the range 32 to 37 mm CL, except in autumn 1985 (Figure 3). It was also noted that the distribution of this species is greatly influenced by depth: in particular the females were predominant in less than 300 m (1.7:1), while at depths below 300 m the sex-ratio changed to reveal a male preponderance which in the total number of catches had a 1.5:1 ratio.

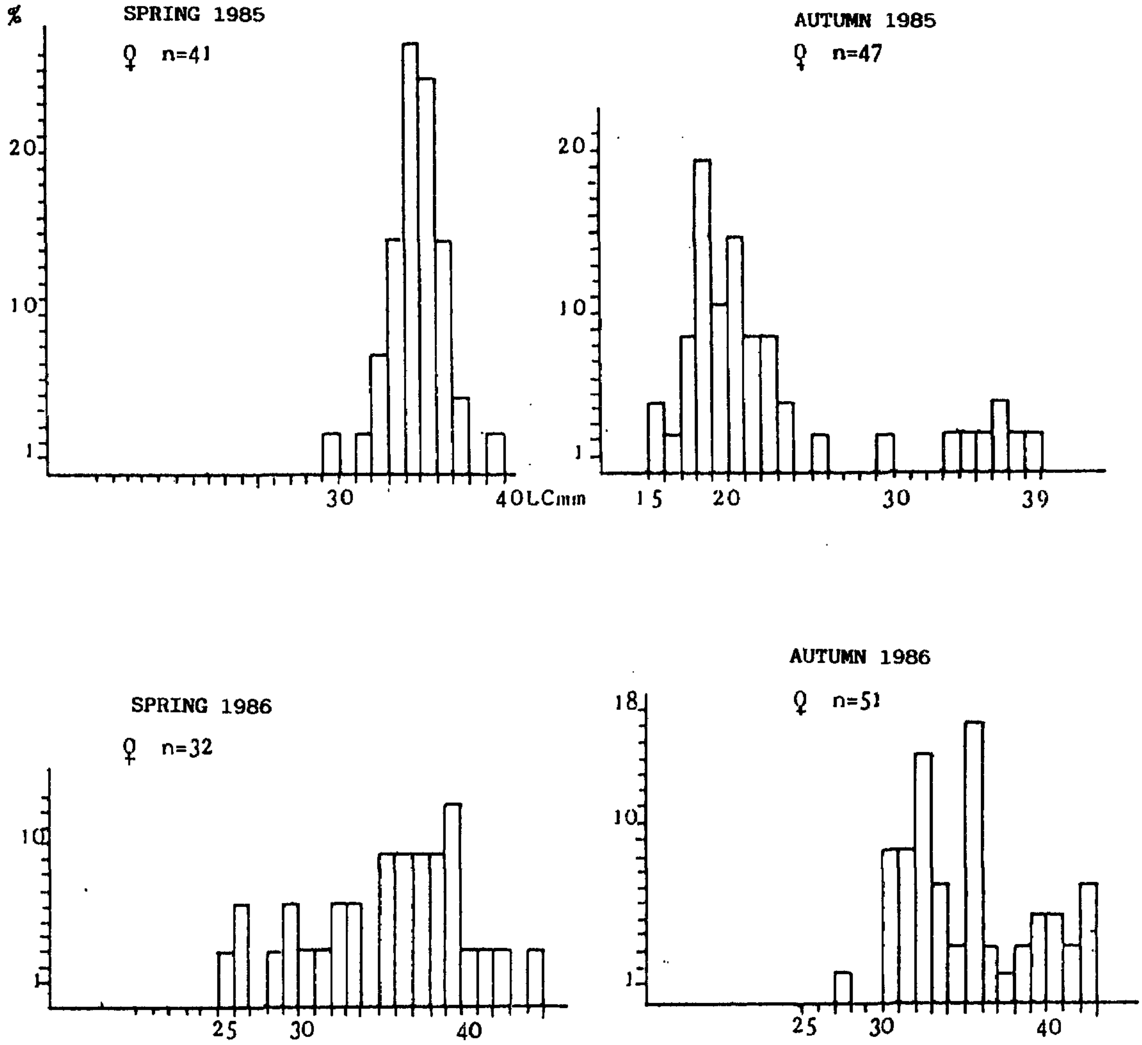


Figure 3 Size frequency distribution for Parapenaeus Longirostris (females)

Nephrops norvegicus which is economically a very important species was found at depths from 92 to 650 m, but the most significant average hourly yields were at depths below 200 m with a maximum of 0.7 kg/h in spring 1986. In Figures 5 and 6 the size and frequency distributions are shown.

For both males and females the most common sizes were those between 32 and 36 mm CL. The sex-ratio calculated from the total number of specimens caught was virtually 50:50. Berried females from a size of 27 mm CL were found only in the autumn samplings with a frequency of 45%. The eggs had the dark-green colour typical of stages I and II of ripening (Gramitto and Froglia, 1980). The size to weight ratio were separately calculated for each sex (Figure 7).

Another commercially interesting species found was Aristaeomorpha foliacea which, unfortunately, was very scarse in the catches with a maximum hourly yield of 0.3 kg/h in Autumn 1985 in 200-400 m. It was caught from a minimum depth of 355 m down to a maximum of 650 m. The size of males varied between 26 and 41 mm CL, and the females from 17 to 57 mm CL. The estimates here refer to a limited number of specimens. The sex-ratio was 1.5:1 of female predominance; 35% of them with spermatophora. The other crustacean species which are economically interesting were caught as isolated examples. Among these were Ligur ensiferus and the crab Geryon maritae; species rarely or never noted in the Lower Adriatic. Ligur ensiferus was caught in the 1985 spring samplings at only one site; Otranto 5 (coordinates 40°18'30"N-18°40'36"E) at a depth of 561 m; 23 specimens were caught with a total weight of 106.4 g.

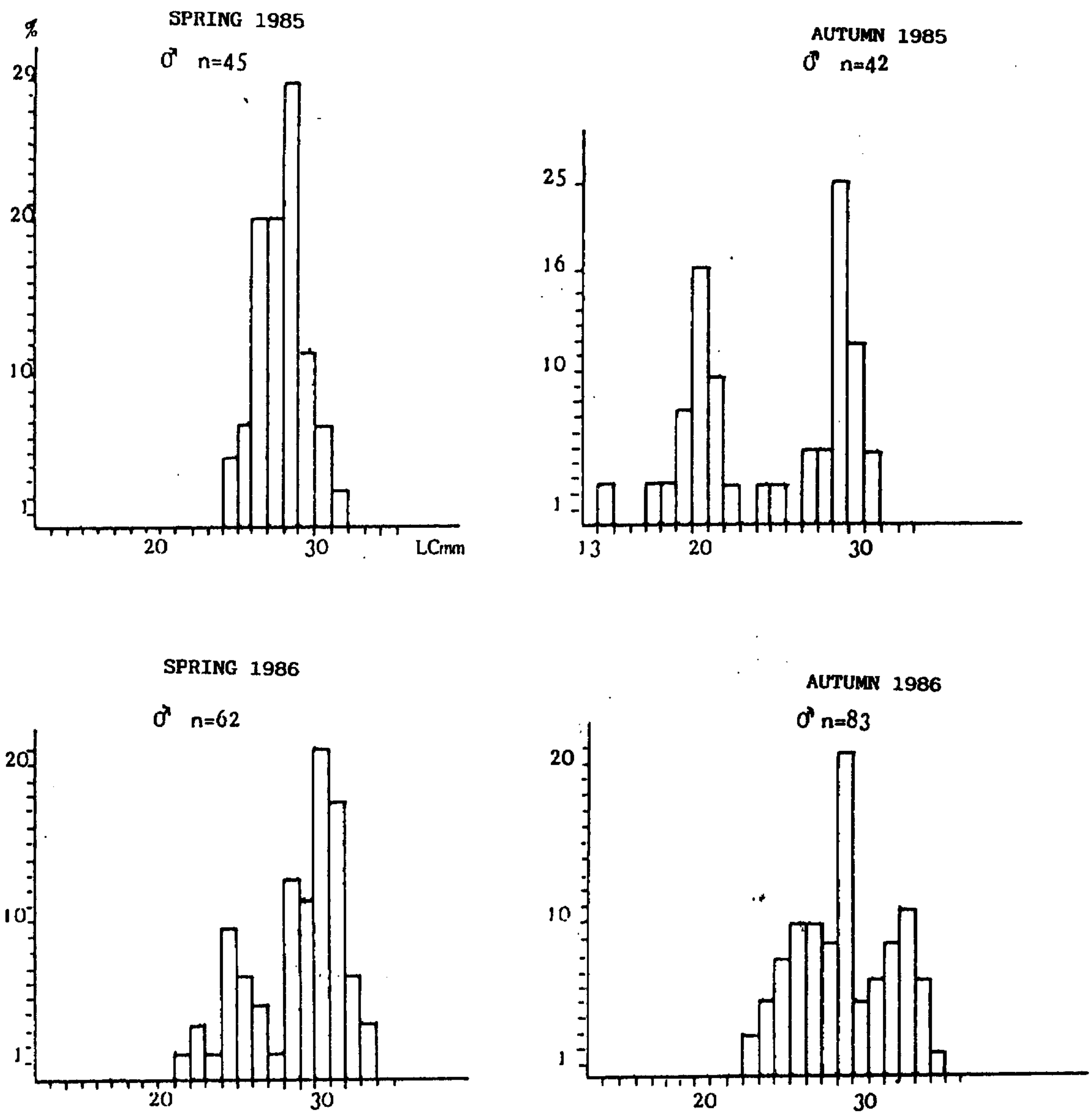


Figure 4 Size frequency distribution for Parapenaeus longirostris (males)

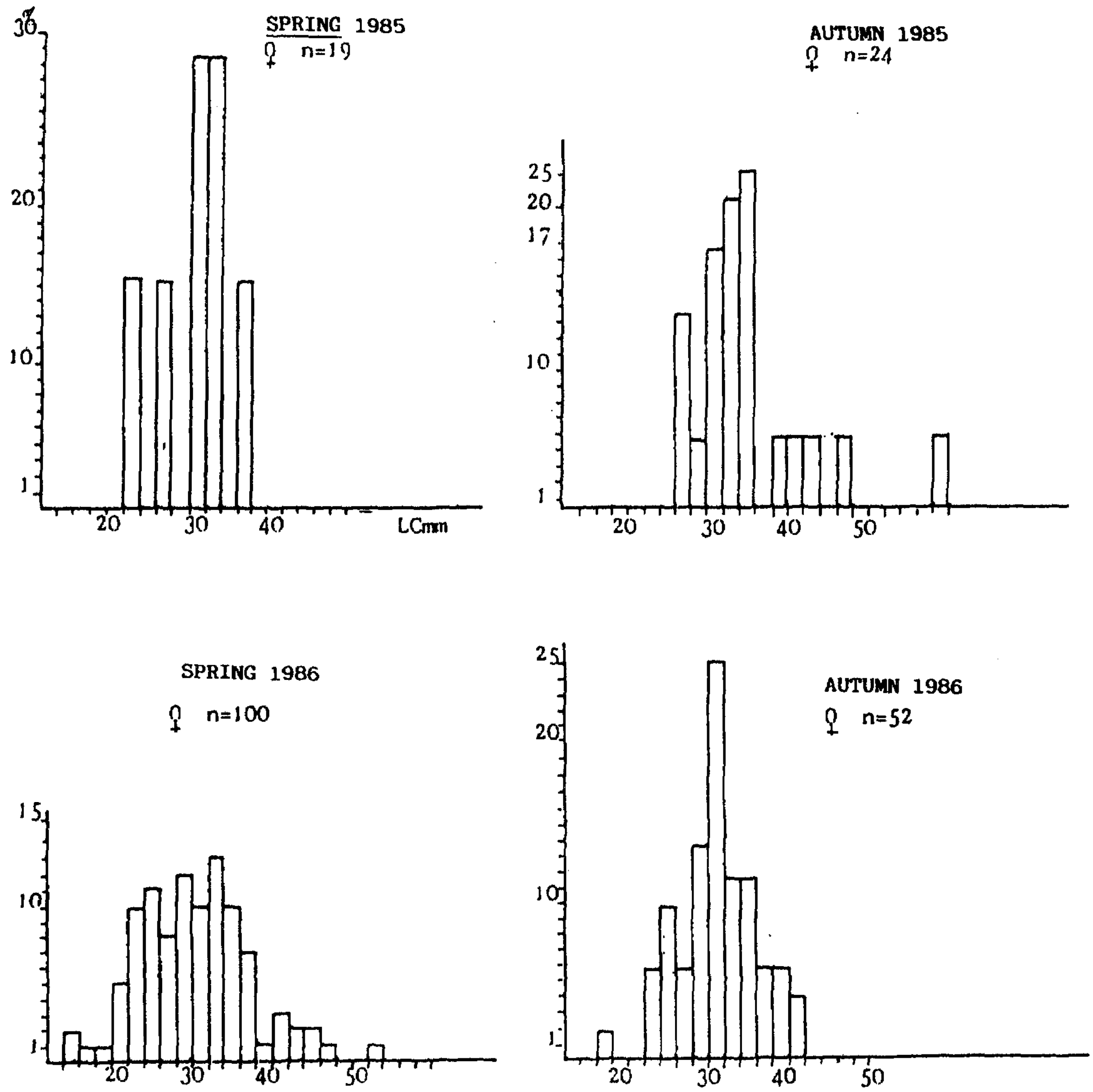


Figure 5 Size frequency distribution for Nephrops norvegicus (females)

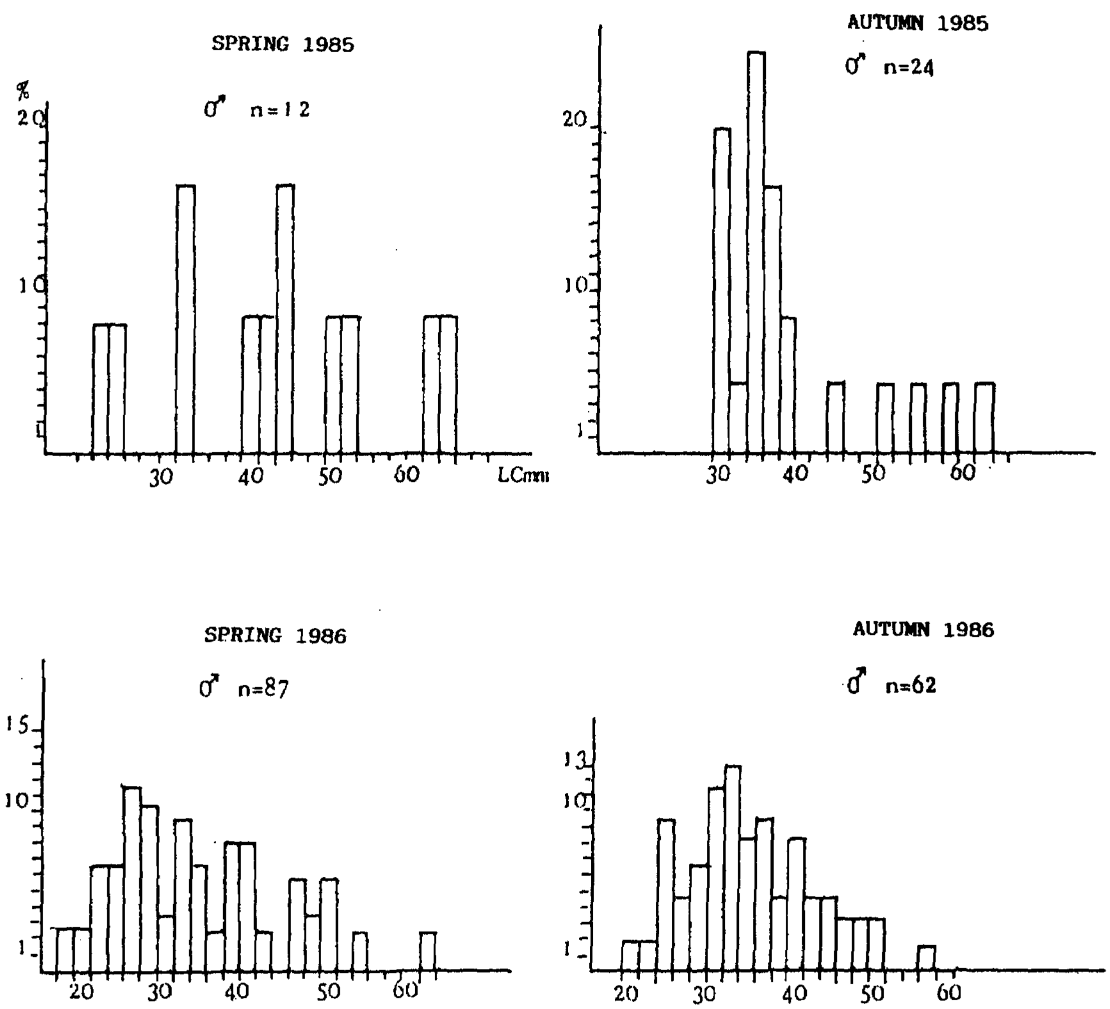


Figure 6 Size frequency distribution for Nephrops norvegicus (males)

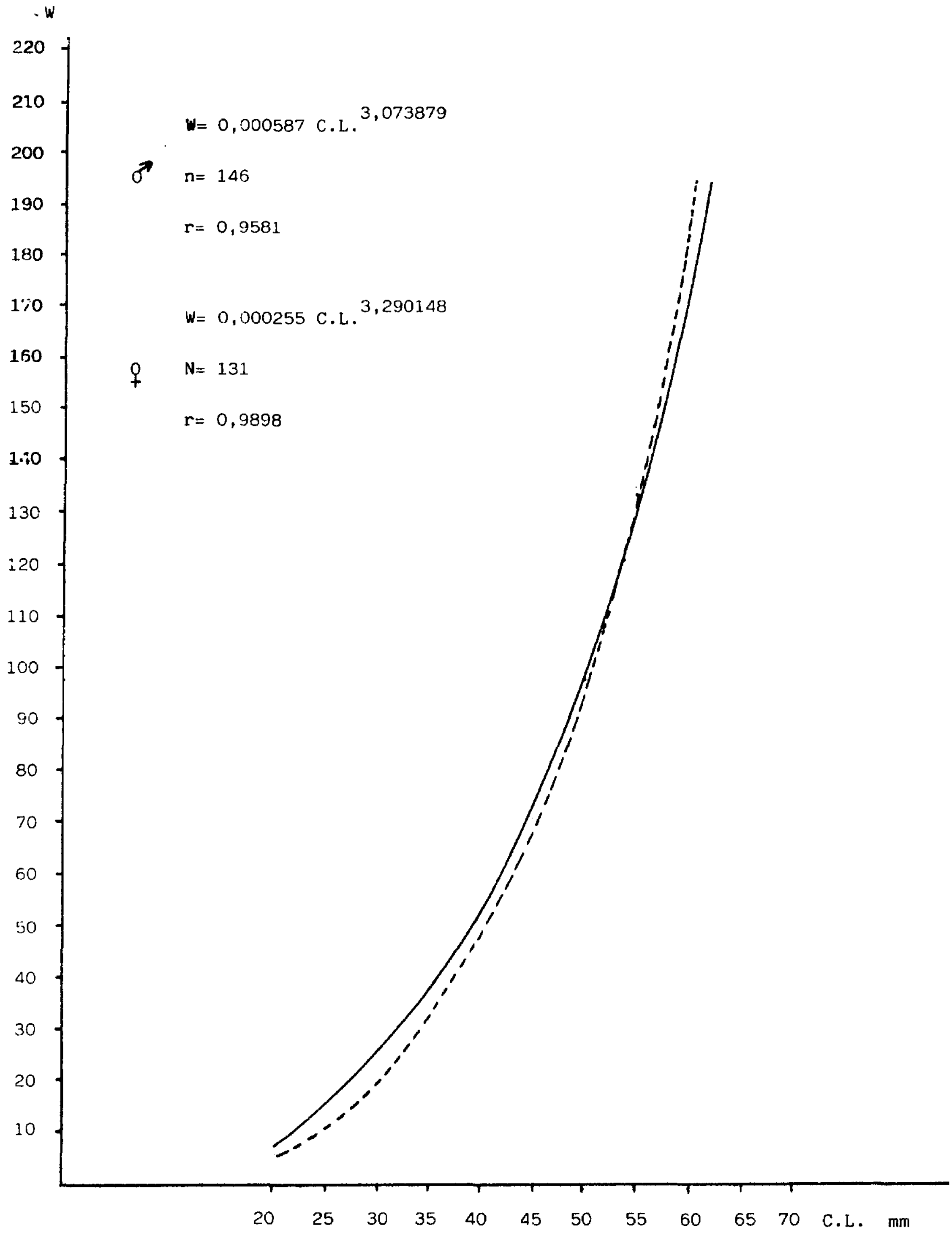


Figure 7 Size to weight ratio for Nephrops norvegicus (males ________) (females --------)

Geryon maritae was caught only in the 1985 Autumn samplings at only one site, Brindisi 6, (coordinates 40°40'48"N-18°35'30"E) at a depth of 580 m. The two specimens caught were both female and lacked the ambulatory appendixes and chelipods. The maximum dimensions of the cephalothorax of the samples were 104 mm and 110 mm respectively, and they had a total weight of 339 g.

3. CONCLUSIONS

The crustaceans in the southern part of the Adriatic are mainly present at depths below 200 m, and in addition, the trawlable areas at these depths are found only in the zones of Vieste and Brindisi-Otranto. However, in these zones the crustaceans represent a relevant proportion of the commercial catch with trawls.

The first investigations have shown that the most common and abundant species is Plesionika martia. It was also noted that Aristeus antennatus, a species which in other parts of the Mediterranean, accompanies Aristaeomorpha foliacea (commonly met with in the survey), and was only caught in two areas and at different times. The species most commonly found nearer the surface was Squilla mantis which makes up a sizeable part of the professional catch (Marano et al., 1977). Since our studies were only carried out during daylight hours, the catches were modest and certainly less than representative of the real population level.

4. REFERENCES

Bello, G., G. Marano and E. Rizzi, Risorse demersali del Basso Adriatico: risultati del primo anno d'indagine. Mem.Minist.Mar.Mercant., Roma, (in preparation)

Bombace, G. and C. Froglia, 1973. Premières remarques sur les peuplements de l'étage batyal de la Basse Adriatique. Rev.Trav.Inst.Pêches Marit., Nantes, 37:159-61

Cau, A., A.M. Deiana and M. Mura, 1982. Nuovi dati sull'accrescimento e sulla maturità sessuale di Aristaeomorpha foliacea (Risso, 1827) (Decapoda Peneide). Nat.Sicil., 4(6)Suppl.2:429-34

Gramitto, M.E. and C. Froglia, 1980. Osservazioni sul potenziale riproduttivo dello scampo (Neogrios norvegicus) in Adriatico. Mem.Biol.Mar.Oceanogr., Messina, Suppl. 10:213-8

Marano, G., et al., 1977. Osservazioni sulla pesca a strascico lungo il litorale di Bari. Oebalia, 3:17-31

Orsi Relini, L. and G. Relini, 1985. The red shrimp fishery in the Ligurian Sea: mismanagement or not? FAO Rapp.Pêches/FAO Fish.Rep., (336):99-105

Vaccarella, R., G. Marano and T. Petruzzi, 1986. Pesca a strascico nel Basso Adriatico: Crostacei. In Atti del diciottesimo Congresso della Società Italiana di Biologia Marina (in press)

THE IMPORTANCE OF THE MOLLUSCA CEPHALOPODA IN THE CONTEXT OF TRAWL SURVEYS CARRIED OUT IN THE IONIAN SEA (1985-86)

by

A. Tursi, G. D'Onghia and A. Matarrese
Istituto di Zoologia ed Anatomia Comparata
Universita' degli Studi
Via Amendola 165/A, 70126 Bari, Italy

and

P. Panetta, E. Cecere,
R. Cavallo and P. Pacifico
Istituto Sperimentale Talassografico
CNR, Via Roma 3, 74100 Taranto, Italy

1. INTRODUCTION

This study reports the data on commercial catches of cephalopod molluscs found in four samplings carried out in 1985-86 in the Ionian Sea (from the Cape of Otranto to Cape Spartivento) by the Istituto Sperimentale Talassografico of CNR in Taranto in collaboration with the Istituto di Zoologia ed Anatomia Comparata of the University of Bari. The context of the study was a project "Evaluation of Undersea Demersal Resources", financed by the Ministry of the Merchant Navy.

The biological resources of the Ionian Sea are not very well described in the scientific literature, since the only data reported come from the first part of the twentieth century. Unfortunately these are not readily usable (Police, 1930). Information on commercial returns of the sea-based industries of the Ionian Sea are reported in the ISTAT statistics, although these have certain well-known limitations, as well as in the recently published PESTAT volumes.

However, in the context of the national project "Stock Assessment of Demersal Fish", financed by the Ministry of the Merchant Navy, the investigations carried out in basins such as the Ionian became of major interest since they have scarcely been subject to scientific scrutiny.

Mollusca Cephalopoda are assuming an ever greater importance in the context of the demersal fishery resources of the Mediterranean, as may be seen from the FAO statistics based on 10 years observations (Worms, 1979), as well as from recent work carried out in other parts of Italy (Relini and Orsi Relini, 1984; Wurtz and Repetto, 1983). Recent data on the catch of the cephalopod molluscs in the Ionian in the context of fishing catches are, however, scarce (Bello, 1985; Panetta et al., in press).

The results attached to this paper are relative to four experimental fishing samples taken in 1985 and 1986. Clearly, in order to be able to give meaningful opinions on the dynamics of cephalopod stocks in the Ionian Sea, it is necessary to have available a historical series of data over many years surveyed according to standard procedures, so the results reported in this paper have a preliminary character. Moreover, since cephalopods have a short life history, it is necessary to repeat the sampling frequently in order to be able to understand fully their dynamics.

2. MATERIALS AND METHODS

The samples were taken respectively in April/May and September/October of 1985 and 1986 between Cape of Otranto (Lecce) and Cape Spartivento (Reggio Calabria), so covering all the Gulf of Taranto. In Figures 1 and 2 the catches taken in 1985 and 1986 respectively are shown. A fishing boat (GRT 57 t) and 220 hp was used. This had a nylon net whose opening at the mouth at the cord level was of some 10 m with 480 sections (24 mm), while in the sack were 240 sections of 16 mm each. Because of the limited size of the sections, the cover for the sack was not used. In certain zones frequented by dolphins the so-called "dolphin-guard" was used. This is a net of floating material fixed at certain points to the sack of the trawlnet. The experimental system used was random-stratified. The area under investigation was divided into 5 strata according to depth: 0-50 m, 50-100 m, 100-200 m, 200-400 m and 400-700 m. In Table 1 are shown the total areas, whether trawlable or not, and the relative percentages of the depths considered. The catches, taken from dawn to dusk, each lasted for 1 hour. They were: 34 during the 1985 spring sampling, 39 in autumn 1985, 37 in spring 1986 and 37 in the autumn of that year. The catch was divided into four categories thus:

(a) commercial species, i.e., irrespective of size;

(b) fish discards: all the non-commercial species;

(c) debris: natural detritus, organic and inorganic, as well as algae and phanerogams;

(d) refuse: material clearly of human origin.

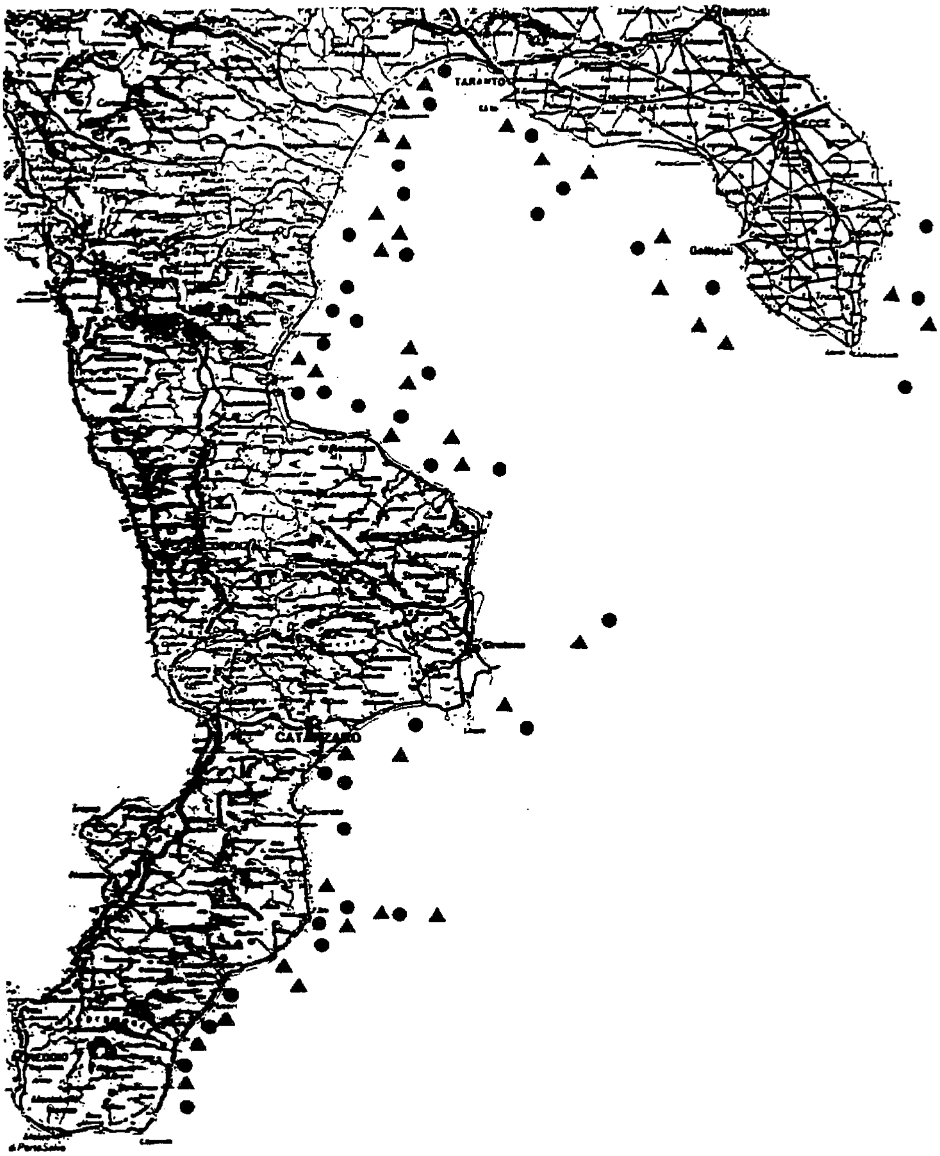


Figure 1 Distribution of the catches of the trawl surveys carried out in 1985 in the Ionian Sea

▲ Catches carried out in the trawl survey of April/May 1985

● Catches carried out in the trawl survey of September/October 1985

Each category was weighed on board and examined. For the commercial species there was a preliminary sub-division by species, then a weighing and a count of individuals. The following steps in the investigations were carried out in the laboratory to which were brought either sub-samples (when numerous examples of the species had been taken), or the entire sample.

For each sample the following measurements were made: total length, weight, sex and maturity.

All relevant information was coded and filed in a data base constructed for them in an IBM computer.

The other categories (discards, debris of natural origin and refuse) were weighed and briefly analysed for constituent.

Figure 2 Distribution of the catches of the trawl surveys carried out in 1986 in the Ionian Sea

▲ Catches carried out in the trawl survey of April/May 1986

● Catches carried out in the trawl survey of September/October 1986

Table 1

Values of the total surface areas (expressed in square miles), whether trawlable or not, and relative percentages for each depth in the Ionian Sea

Depth (m)	Total surface (mi^2)	Trawlable surface (mi^2)	Percentage	Non-trawlable surface (mi^2)	Percentage
0- 50	355.07	229.81	65.0	125.26	35.0
50-100	342.92	306.31	89.0	36.61	11.0
100-200	647.04	613.88	95.0	33.16	5.0
200-400	720.34	713.57	99.0	6.77	1.0
400-700	1 172.07	1 171.40	99.9	0.67	0.1
TOTALS	3 237.44	3 034.97	94.0	202.47	6.0

3. RESULTS

(a) Catches

The list of species of cephalopod molluscs discovered in this study is shown in Table 2. The estimate of the catches of cephalopod fishing was carried out individually for each of the four samples. For each catch the quantity (expressed in kilos/hour) of the species taken was estimated and, later, the values of the various catches at each depth summed. Thus, an average catch was obtained per hour for each individual depth stratum, and furthermore, the percentage of cephalopods relative to the total commercial catch was calculated. The results are shown in Table 3. From this Table it can be seen that:

Table 2

Cephalopods found in the four trawl surveys carried out in 1985 and 1986 in the Ionian Sea

Alloteuthis media (L.)	*Rondeletiola minor* (Naef)
Eledone cirrhosa (Lam.)	*Rossia macrosoma* (Delle Chiaje)
Eledone moschata (Lam.)	*Sepia elegans* Blainville
Histioteuthis reversa (Verrill)	*Sepia officinalis* L.
Illex coindetii (Verany)	*Sepia orbignyana* Ferussac
Neorossia caroli (Joubin)	*Sepietta oweniana* (Orbigny)
Octopus vulgaris (Lam.)	*Scaergus unicirrhus* (Delle Chiaje)
Octopus salutii Verany	*Todarodes sagittatus* (Lam.)
Pteroctopus tetracirrhus (Delle Chiaje)	*Todaropsis eblanae* (Ball)

Table 3

Values of the average catch rates (with relative standard deviation) expressed in kilograms/hour and percentages for the total commercial catch of cephalopods, in each of the four trawl surveys in 1985 and 1986 in the Ionian Sea

	Depth	Samples taken	kg/h s.d.	Percentage
A	0- 50	7	3.7±5.6	21.5
P	50-100	4	3.4±1.8	23.7
R	100-200	2	2.3±1.0	20.2
'8	200-400	14	2.3±2.4	9.5
5	400-700	7	0.5±1.0	1.8
S	0- 50	11	5.0±3.8	33.5
E	50-100	3	4.1±2.9	24.5
P	100-200	6	2.7±1.4	16.3
'8	200-400	10	1.1±1.0	5.2
5	400-700	9	0.5±0.6	2.8
A	0- 50	9	1.7±1.4	11.4
P	50-100	8	1.6±1.0	9.0
R	100-200	2	6.7±0.4	31.6
'8	200-400	9	1.9±1.2	10.6
6	400-700	9	0.2±0.4	2.2
S	0- 50	9	6.0±4.6	49.2
E	50-100	6	3.4±3.5	28.3
P	100-200	5	2.9±2.3	23.6
'8	200-400	9	1.3±0.8	10.8
6	400-700	8	0.5±0.6	3.3

- the four samplings showed an average hourly cath rate that was virtually identical;
- the hourly catch rate on average did not show marked seasonality, though the autumn samplings gave an average hourly catch rate slightly greater than those in spring;
- on average the depth strata which gave the greatest hourly catch rate were those less than 200 m for both years investigated;
- on average, cephalopods contributed 25% of the total commercial catch for the first three depth strata, while for the last two depth strata they contributed on average 6%;
- the standard deviations of the catches were nearly always very great (coefficient of variation, on average = 0.9) and therefore, the results are not very reliable for drawing inferences.

(b) Composition of the Species

Among the cephalopod molluscs in the context of the four samplings, the species most frequently found were: Illex coindetii, Sepia officinalis and Sepia elegans; these were followed by Eledone moschata, Eledone cirrhosa and Octopus species (Octopus vulgaris and Octopus salutii).

For the listed species the contribution of each to the total of cephalopods caught at each depth stratum is shown in Table 4.

For the rest, given the limited size of samples, it was decided to incorporate the relative data of catch rate in the total for the cephalopods.

Relative to the average hourly catch rate in kilogram/hour and to the percentage of each species in the total of cephalopods caught, it is clear that in each of the four samplings, the species Illex coindetii made the major contribution in terms of weight in the depths between 100 and 400 m.

As regards size distribution in terms of depth, the 1985 samplings within 200 m produced too few specimens to permit any meaningful analysis. In 1986 on the other hand, the 50-100 m depths showed a greater number of individuals whose sizes were distributed normally in both samplings. In spring there was a modal frequency of 8-9 cm and an average size of 9.1±2.0 cm; in autumn the modal frequency was 5-6 cm and the average length was 6.3±1.6 cm.

At depth strata of 100-200 m, in both years, there occurred a difference between the spring and autumn samplings relating to the size of the individuals taken; in detail, the spring samplings had average dimensions of 9.5±1.4 cm in 1985 and 10.4±1.9 cm in 1986; in autumn the average size was 8.5±1.9 cm for 1985 and 8.5±2.4 cm for 1986.

The depth stratum from 200 to 400 m showed a consistency both across the seasons and the years. In April of both years, the length distributions in the normal state showed an average size of 10.7±4.2 cm in 1985 and of 13.0±3.7 cm in 1986. In the autumn samplings, the average dimensions observed for the individuals caught were of 12.6±4.0 cm in 1985 and 8.2±2.2 cm in 1986, with typically gaussian distributions. Clearly, individuals of larger size come from greater depths and this is not related to seasonal factors.

Sepia officinalis was present only in the first two depth strata (0-100 m) and the average hourly catch rates and percentages in respect of the total cephalopods were higher at the first depth (0-50 m) especially in the autumn samplings.

This species was found almost exclusively in the autumn and in the first depth level. The distribution of the mantle length was normal with a modal frequency of 7-8 cm and average sizes of 7.8±2.4 cm in September 1985, and of 7.9±2.8 cm in September 1986. In the spring of 1986 the examples caught showed an average length of 9.5±3.3 cm. Moreover, in the 50-100 m stratum a small number of individuals were found in the autumn of the second year of research with an average dimension of 4.5±2.2 cm.

Sepia elegans showed very low hourly catch rates and a wider spatial distribution by depth than the previous species though its maximum catch rate was found at above 100 m.

This species in the first two samplings in 1985 showed a situation similar to that for Sepia officinalis: being found in significant quantities (15.1% of the total) in the autumn sampling and having a preference for the 50-100 m level with a modal frequency of 3-4 cm and an average size of 6.0±2.4 cm. In 1986, the species was also caught at depth strata below 50 m, particularly from 50-100 m, with examples of 3.7±0.7 cm in spring and 3.6±0.9 cm in autumn.

Table 4

Mean hourly catch rate (kg/h), standard deviation (s.d.) and percentage (%) relative to the average commercial catch rates of cephalopods of every target species in the depth strata shown for each of the four trawl surveys carried out in 1985 and 1986 in the Ionian Sea

Species		April 1985					September 1985					April 1986					September 1986				
		a/ I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V	I	II	III	IV	V
Illex coindetii	kg/h	0.1	0.2	1.4	2.0	0.3	0	0	0.5	0.4	0.1	0	0.1	4.7	0.7	0.1	0	0.5	0.8	0.5	0
	s.d.	0.3	0.4	0.1	1.1	0.6	0	0	0.3	0.4	0.1	0	0.2	1.0	0.6	0.4	0	0.6	0.7	0.3	0
	%	3.5	6.0	61.0	86.0	60	0	0	19.0	31.0	10	0	7.0	70	37.0	65.0	0	15.0	28.0	38.0	0
Sepia elegans	kg/h	0	0.1	0	0	0	1.5	0.8	0.1	0	0	0	0.3	0	0	0	0	0.1	0.2	0	0
	s.d.	0	0.1	0	0	0	1.6	1.3	0.1	0	0	0	0.4	0	0	0	0	0.1	0.2	0	0
	%	0	1.5	0	0	0	30	19.0	3.0	0	0	0.6	18.0	0	0	0	0	3.0	7.0	0	0
Sepia officinalis	kg/h	1.0	0.9	0	0	0	2.5	0.8	0	0	0	0.5	0.3	0	0	0	3.1	0.1	0	0	0
	s.d.	1.3	0.5	0	0	0	2.5	0.8	0	0	0	0.4	0.5	0	0	0	2.9	0.1	0	0	0
	%	27.0	26.0	0	0	0	50	19.0	0	0	0	28.0	18.0	0	0	0	51.0	2.0	0	0	0
Octopus	kg/h	0.7	1.6	0	0.2	0.1	0.5	1.9	0	0.4	0.1	0.8	0	0.5	0.2	0	3.0	1.1	0	0.2	0
	s.d.	0.1	1.2	0	0.3	0.1	0.7	1.6	0	0.5	0.5	1.3	0.1	0.7	0.3	0	4.2	2.4	0	0.2	0
	%	19.0	47.0	0	8.0	10	10	46.0	0	31.0	20	47.0	3.0	8.0	1.0	0	49.0	32.0	0.7	15.0	2.0
Eledone cirrhosa	kg/h	0	0.2	0.2	0.1	0	0	0.4	0.2	0	0	0.1	0.5	0.4	0.2	0	0	0.5	0.2	0	0
	s.d.	0	0.3	0.3	0.1	0	0	0.3	0.2	0	0	0.2	0.5	0.1	0.3	0	0	0.6	0.2	0	0
	%	0	6.0	8.0	0	0	0	10	7.0	0	0	4.0	30	6.0	11.0	0	0	15.0	7.0	1.5	0
Eledone moschata	kg/h	0.1	0.6	0.1	0.1	0	0	0.2	0.3	0	0	0.3	0.1	0	0	0	0	0.2	0.3	0.1	0
	s.d.	0.1	0.5	0.1	0.1	0	0	0.3	0.4	0	0	0.3	0.1	0	0	0	0	0.2	0.5	0.1	0
	%	3.0	17.0	4.0	1.5	0	0	4.0	11.0	0	0	18.0	8.0	0	0	0	0	6.0	10	4.0	0
Others	kg/h	1.8	0	0.7	0.1	0.2	0.4	0	1.5	0.4	0.3	0	0.3	0.8	0.8	0.1	0	0.9	1.4	0.6	0.5
	s.d.	0.1	0	1.1	0.7	0.4	0.1	0	1.4	0.6	0.3	0	0.3	1.0	0.7	0.1	0	0.1	1.2	0.7	0.7
	%	47.0	0	30	4.0	30	8.0	0	56.0	36.0	58.0	0	18.0	13.0	42.0	35.0	0	26.0	48.0	42.0	90

a/ I = 0-50 m; II = 50-100 m; III = 100-200 m; IV = 200-400 m; V = 400-700 m

In this last period a certain number of samples were also taken at 100-200 m depth with an average mantle length of 4.2±0.6 cm.

As regards the genus Octopus, two species have been grouped together; Octopus vulgaris and O. salutii; the highest catch rates for these were observed in the 0 to 50 m depth stratum for 1986, and in the 50 to 100 m depth stratum in 1985. In particular, the average catch rate was 1.9 kg/h for the first depth stratum quoted and 1.8 kg/h for the second.

The species Eledone cirrhosa and Eledone moschata are quite widespread in relation to the depth, and less abundant. On average the hourly average catch rate for Eledone cirrhosa was 0.5 kg/h (5.7% of the total for the cephalopods), while for Eledone moschata the catch rate was 0.12 kg/h; 5.2% of the total.

The other cephalopods which have been grouped in a single category are largely found below a depth of 100 m. The main species present in this category were Todaropsis eblanae, Alloteuthis media and Rossia macrosoma.

4. CONCLUSIONS

Examination of the results obtained by the processing of the data for the four trawl surveys carried out in 1985 and 1986 shows that:

- the cephalopods are on average 17% of the total commercial catches;
- the average hourly yields are generally superior (3.6 kg/h) in the levels between 0-200 m to those in the other levels;
- catch rates have not shown significant seasonal variation in the two years of the study;
- the species found with greatest frequency and with the highest average hourly catch rates were Illex coindetii and Sepia officinalis; while Illex coindetii was chiefly caught in the 0-400 m levels, Sepia officinalis was found exclusively in the 0-50 m level;
- in the first 100 m depth a modest contribution to the total weight of cephalopods was made by the species Octopus vulgaris and Octopus salutii, with an average hourly catch rate of 1.2 kg/h

5. ACKNOWLEDGEMENT

The authors wish to thank Mr C. Macripo, B. Pavia, O. Caciorgna, M. De Filippis and C. Caroppo, for the advice given in drafting the present paper.

6. REFERENCES

Bello, G., 1985. Su una raccolta di Cefalopodi pescati nel mesobatiale del Golfo di Taranto. Boll.Malacol., 21(10-12):275-80

Gulland, J.A., 1969. Manual of methods for fish stock assessment. Part 1. Fish population analysis. FAO Man.Fish.Sci., (4):154 p. Issued also in French and Spanish

Holden, M.J. and D.F.S. Raitt, 1974. Manual of fisheries science. Part 2. Methods of resource investigation and their application. FAO Fish.Tech.Pap., (115) Rev.1. 214 p. Issued also in French and Spanish

Mangold-Wirz, K., 1963. Biologie des Céphalopodes benthiques et nectoniques de la mer catalane. Vie Milieu, 13 Suppl:1-285

Naef, A., 1921-23. Cephalopoda. Fauna Flora Golfes Neapel, 1(1):1-821

Police, G., 1930. Itinerari pescherecci. Boll.Pesca Piscic.Idrobiol., Roma, 4:1003-7

Panetta, P., et al., Il ruolo dei molluschi Cefalopodi nella valutazione delle risorse marine dello Jonio (Campagne di pesca 1985). In Atti del diciassettesimo Congresso della Società Italiana di Biologia Marina (in press)

Relini, G. and L. Orsi Relini, 1984. The role of Cephalopods in the inshore trawl fishing of the Ligurian Sea. Oebalia, 10:37-58

Worms, J., 1979. L'exploitation des Céphalopodes en Méditérranée: évolution et perspectives. Rapp.P.-V.Réun.CIESM, 25/26(10):169-84

Wurtz, M. and N. Repetto, 1983. Aspects of Cephalopods fishery in the Ligurian Sea. Rapp.P.-V.Réun CIESM, 28(5):269-75

E. GENERAL

EVOLUTION DE L'EFFORT DE PECHE AU CHALUT EN HAUTE ET MOYENNE ADRIATIQUE

par

E. Arneri et C. Piccinetti
Laboratoire de biologie marine et pêche - Fano

L'aménagement rationnel des ressources biologiques peut être obtenu par une régulation de l'effort de pêche. Les connaissances sur le milieu, la biologie et dynamique des espèces, les technologies de pêche représentent le support pour définir les modalités de la régulation de l'effort de pêche qui représente le moyen principal disponible pour influencer les effets de la pêche sur les ressources.

Toute régulation de l'effort de pêche demande la connaissance de l'état actuel et de l'évolution temporelle de l'effort et si possible des réponses des ressources aux variations de l'effort de pêche, de façon à en prévoir le niveau optimal.

Depuis plusieurs années, en particulier pendant les réunions du Groupe de travail sur l'évaluation des ressources et les statistiques du CGPM, on a souligné que la qualité des statistiques d'effort et de capture en Méditerranée n'est pas en général satisfaisante.

Pour la pêche italienne en Adriatique en particulier, comme ont noté Levi et Giannetti (1973) on manque de données fiables sur le temps effectif de pêche, sur les captures en fonction des caractéristiques des bateaux, sur la distribution spatiale de l'effort de pêche dans les différentes saisons, etc.

Récemment avec la réalisation sistématique de campagnes de chalutage, dans le cadre de la collaboration entre l'Institut d'océanographie et pêche de Split et le Laboratoire de biologie marine et pêche de Fano, on a obtenu une connaissance de la distribution des principales espèces, des déplacements saisonniers, de la composition par taille et plus généralement de la biologie des espèces capturées. Ces données constituent une base pour une réglementation de l'effort de pêche.

Dans le but d'améliorer les connaissances sur l'effort de pêche au chalut exercé par les chalutiers italiens en Adriatique, et d'avoir des éléments sur l'évolution de l'effort dans le temps, on a réalisé cette recherche.

L'effort de pêche au chalut est proportionnel à la surface chalutée, c'est-à-dire, pour chaque chalutier, aux dimensions du chalut, à la vitesse de traîne et au temps de pêche. Pour déterminer la surface totale chalutée il faut additionner les surfaces couvertes par tous les chalutiers.

Il est difficile déterminer chalutier par chalutier la surface couverte par unité de temps. En tenant compte du fait que la dimension du chalut et la vitesse de traîne dépendent de la puissance du moteur du bateau et qu'il existe une relation entre puissance et tonnage, on a utilisé des index de la surface chalutée tels que le nombre, le tonnage total et la puissance totale de la flottille ou des chalutiers.

Pour l'Adriatique on n'a pas établi de relation entre la puissance du moteur et la surface chalutée dans l'unité de temps, c'est-à-dire si un chalutier de 500 CV couvre une surface deux fois plus grande qu'un chalutier de 250 CV, ou cinq fois plus grande qu'un chalutier de 100 CV. Il est probable que la relation surface chalutée/puissance du bateau ne soit pas constante si la puissance varie.

Il faut considérer que la puissance nominale d'un chalutier peut indiquer seulement d'une façon grossière la puissance utilisée pour traîner le chalut car il y a des situations où le chalutage est effectué en utilisant une partie seulement de la puissance disponible.

Les informations statistiques disponibles en longue série ne sont pour l'Italie que les données ISTAT relatives au nombre des chalutiers, au tonnage des chalutiers et à la puissance totale de la flottille.

Le tableau 1 fournit ces données pour la haute et moyenne Adriatique.

Pendant la période 1967/83, dernière année de statistique comparable, on a eu une augmentation de 24,5 %, du nombre des chalutiers, une augmentation de 72,6 % du tonnage des chalutiers, tandis que la puissance totale de toute la flottille a augmenté de 150,5 %. Ces augmentations différentes sont liées aux changements dans la structure de la flottille. Le tonnage moyen des chalutiers en particulier a augmenté du 38,7 % (tableau 2). La puissance moyenne a augmenté du 77,1 % pour toute

Taleau 1

Données sur l'évolution des chalutiers opérant en Adriatique (N° et TJB) et de la puissance totale de la flottille à moteur

	N°	Var. %	TJB	Var. %	Hp	Var. %
1967	2 364		35 447		203 982	
1977	2 643		49 420		351 732	
1983	2 943	+ 24,5	61 171	+ 72,6	510 305	+ 150,2

Tableau 2

Données sur l'évolution du tonnage moyen des chalutiers, de la puissance moyenne et de la puissance par TJB de la flottille à moteur

	TJBm	Var. %	Hpm	Var. %	Hp/TJB	Var. %
1967	15,0		52,5		3,8	
1977	18,7		74,5		4,6	
1983	20,8	+ 38,7	93,0	+ 77,1	5,9	+ 55,3

la flottille, et la puissance installée par TJB a augmenté du 55,3 %. Ces variations montrent les limites du choix d'un index d'effort, sans connaître la relation tonnage/aire chalutée et/ou puissance/aire chalutée par unité de temps.

Le deuxième facteur important pour déterminer l'effort de pêche dans le chalutage c'est le temps de pêche.

Dans tous les travaux réalisés en Adriatique on a utilisé des index d'effort qui considèrent le temps de pêche comme une constante dans les années. Par contre il a été souligné plusieurs fois que les pêcheurs ont tendance à diminuer les temps de pêche (CGPM, 1976).

Nous avons réalisé en janvier et février 1987 une recherche dans tous les ports de pêche entre Trieste et Termoli pour déterminer le temps de pêche et les variations dans le temps. Dans tous les ports de pêche on a recherché les contrats de travail avec les jours et les horaires de pêche, on a posé des questions aux pêcheurs, aux armateurs, aux bureaux des ports et aux organisations professionnelles sur l'activité de pêche au chalut.

Chaque port de l'Adriatique a une histoire particulière, différente des autres ports; les informations obtenues n'ont pas toutes la même précision, en particulier sur le moment de modification des horaires de pêche - changements graduels réalisés sur la base des contrats de travail - au gré et à la convenance des pêcheurs. Dans cette situation nous avons fixé trois années 1967, 1977 et 1987 qui peuvent refléter la situation moyenne des années voisines.

Il ne faut pas oublier que l'horaire de pêche par semaine dans une pêcherie souvent est fondé sur un accord verbal entre pêcheurs et armateurs. Même les accords écrits n'entrent pas toujours en vigueur aux dates prévues. Les changements principales dans les horaires de pêche ont eu lieu entre 1971 et 1975 quand s'est répandue l'habitude de ne pas pêcher le samedi et le dimanche, quelles qu'aient été les conditions météorologiques de la semaine précédente.

Pour mettre en relation les données obtenues sur les horaires de pêche par port avec le nombre total de chalutiers, on a regroupé les ports par zones maritimes administratives (Compartimento) et on a pondéré l'horaire de pêche trouvé pour chaque port avec l'importance du port en fonction du nombre de chalutiers en activité au moment de l'enquête.

Un autre problème est lié à la présence dans le même port et/ou dans des ports voisins, de chalutiers de taille très différente, les plus petits pêchant quelques heures par jour seulement dans des conditions météorologiques favorables et dans des zones voisines du port, les chalutiers moyens pêchant quelquefois seulement de jour et d'autres fois jour et nuit en fonction de la saison et les chalutiers de taille supérieure à 50 TJB travaillant en général jour et nuit, et opérant en zones distantes des ports avec des temps de déplacement importants. Dans ces situations on a fait une pondération sur la base du nombre de chalutiers par catégorie. Il faut préciser que les temps de pêche indiqués sont à considérer comme maximaux car les conditions météorologiques, les vacances, les périodes de réparation des bateaux réduisent ces horaires.

Dans le taleau 3 on a indiqué les résultats sur les horaires hebdomadaires de pêche avec les variations en pourcentage.

Tableau 3

Données sur l'évolution des heures de pêche par semaine et sur le tonnage moyen des chalutiers dans les zones maritimes

Comp. maritimes	1967	1977	1987	Variations	TJBm ISTAT
Trieste	60?	60?	60	0	15,9
Monfalcone	72	72	60	-17 %	18,6
Venezia	84?	72	60	-29 %	5,8
Chioggia	72 - 144	60 - 144	60 - 120	-17 %	10,4
Ravenna	72 - 130	72 - 130	60 - 108	-12,5 %	8,6
Rimini	72 - 144	60 - 108	60 - 96	-21 %	16,2
Ancona	130 -132	96 - 120	75 - 108	-36 %	55,1
S. Benedetto	132 - 144	108 - 120	84 - 96	-34 %	40,8
Pescara	132 - 144	108 - 124	84 - 120	-32 %	37,1

Dans toutes les zones il y a eu une diminution notable des temps maximaux de chalutage, cette diminution est différente d'une zone à l'autre et la diminution est plus forte pour les chalutiers de plus grande taille, qui au départ opéraient plus longtemps.

L'horaire de pêche varie maintenant entre 60 et 120 heures par semaine, selon la taille du chalutier et le port d'attache.

Il faut considérer que les chalutiers plus grands consacrent entre 12 et 24 heures par semaine aux déplacements entre les ports et les zones de pêche, temps que l'on peut considérer constant dans le temps pour la même flottille. On doit souligner que à la suite de l'introduction des vacances dans le contrat national de travail des marins pêcheurs, il y a eu récemment une réduction des jours de pêche qui a entraîné une diminution ultérieure du temps de pêche.

Nous avons repris les statistiques officielles pour les années 1967, 1977 et 1983 sur les captures en haute et moyenne Adriatique. Les données se réfèrent à toutes les espèces à l'exclusion des pélagiques et des bivalves, et peuvent représenter l'évolution des captures des espèces démersales dans le temps.

	Captures tonnes	
1967	56 369	
1977	75 781	
1983	88 906	+ 57,7 %

A propos des statistiques officielles de l'ISTAT, une révision récente a montré que le nombre de bateaux, le tonnage et le puissance totale sont surestimés d'environ 25 %, mais on ne connaît pas l'évolution dans le temps de cet erreur liée en partie à la non radiation des bateaux des listes de la flottille. Les statistiques de captures, par contre sont fortement sous-estimés (PESTAT, 1986). C'est-à-dire qu'en réalité la flottille est inférieure et les captures sont supérieures aux chiffres officiels.

Les données exposées, avec les limites indiquées montrent que:

(i) l'effort de pêche a une évolution différente si l'on considère le temps de pêche. On a un effort presque constant dans la période 1967/83 si à côté de la diminution des temps de pêche, on utilise le nombre des chalutiers comme index de surface chalutée. Si l'on prend le tonnage comme index de surface chalutée on a une augmentation de l'effort de pêche et cette augmentation est encore plus grande si on considère la puissance des chalutiers;

(ii) le manque de clés de corrélation puissance/aire chalutée et tonnage/aire chalutée demande une précaution dans l'utilisation de ces index, les paramètres de la flottille variant fortément dans le temps;

(iii) il est possible soutenir différentes hypothèses sur l'évolution de l'effort de la pêche au chalut dans le temps, en utilisant un index ou un autre pour la surface chalutée;

(iv) le pourcentage d'augmentation des captures semble être compris entre les pourcentages de variation de l'effort de pêche, ce qui amènerait à un rendement en hausse, stable ou en baisse par unité d'effort selon que l'on utilise les différents index d'aire chalutée et les temps de pêche;

(v) la contribution à l'effort de pêche total est différente par le même chalutier s'il opère dans un port où la règle est de pêcher 60 heures par semaine ou dans un port où la règle est de pêcher 120 heures;

(vi) les recherches antérieures en Adriatique utilisant des modèles capture/effort dans le but d'obtenir des indications pour l'aménagement des ressources, sont à revoir, car ces travaux ont été réalisés avec des index d'effort non corrects dans l'évolution temporelle;

(vii) les données obtenues montrent la nécessité d'améliorer ultérieurement les connaissances sur l'évolution de l'effort de pêche dans le chalutage en Adriatique.

1. REFERENCES

CGPM, 1976. Rapport de la sixième session du Groupe de travail sur l'évaluation des ressources et les statistiques des pêches du Conseil général des pêches pour la Méditerranée (CGPM). Rome, Italie, 10-14 novembre 1975. FAO Rapp.Pêches, (182):69 p. Publié aussi en anglais

Cingolani M., S.R. Coppola et J. Mortera, 1986. A qualitative assessment of the Italian Fisheries Statistical System. 2. Catch and fishing effort statistics. Quad.Ist.Ric.Pesca Marit., Ancona, 5 (1 Suppl.):754 p.

Levi D. et G. Giannetti, 1973. Fuel consumption as an index of fishing effort. Stud.Rev.GFCM. (53):1-17

DISTRIBUTION DE L'EFFORT DE PECHE DANS LES PECHERIES DES MERS ITALIENNES, DENSITE (CV/n mi²) ET CPUE (KG/CV) POUR LES DIFFERENTS METIERS DE PECHE

par

G. Bombace et Cingolani N.
(IRPEM - CNR - Ancona, Italie)

1. INTRODUCTION

Il est certainement utile, aux fins de l'aménagement des pêches, de connaître la distribution de l'effort de pêche pour les diverses pêcheries, la densité de l'effort par rapport à la surface théoriquement exploitable (CV/n mi²)1/, la cpue2/ exprimée en kilogramme (kg) de production par unité de puissance motrice (CV), dans les diverses zones pour les différents métiers.

On constate alors que la situation de la pêche italienne est aussi complexe que diversifiée d'une zone à l'autre.

Les données font aussi apparaître les situations de conflictualité qui existent dans certaines zones qui, peuvent par conséquent, être considérées comme des pêcheries à risque socio-économique.

Ces données permettent de formuler d'autres considérations et remarques.

2. METHODOLOGIE ET OBSERVATIONS

Les tableaux qui se trouvent en annexe proviennent pour la plupart de l'élaboration des données du programme PESTAT complété, pour les catégories (engins-métiers bateaux) "volante"3/ et "vongolara"4/, par les données d'autres recherches de l'IRPEM.

La situation décrite est celle de 1982. Cela pose certainement des problèmes pour les bateaux construits au cours des dernières années et qui sont repartis dans différentes circonscriptions administratives. Toutefois l'Administration a les moyens d'effectuer cette intégration à partir de la base de données ici présentée.

En ce qui concerne les zones, on a dû effectuer des simplifications, comme il est d'usage pour travaux de synthèse de ce type.

On a considéré comme une zone théoriquement exploitable celle qui va de la côte jusqu'à l'isobathe de 500 m.

Cette zone, à son tour, a été partagée en deux sous-zones: de la côte jusqu'à 200 m, c'est-à-dire l'aire du plateau continental et de 200 m jusqu'à 500 m, c'est-à-dire la première partie du talus continental.

La flottille a été partagée en deux classes de puissance motrice, à savoir jusqu'à CV 199,9 (qui correspond en général à la pêche sur le plateau) et de CV 200 et au-delà (pêche profonde sur le talus).

On a considéré la puissance motrice (CV) en tant qu'index plus significatif de l'effort de pêche.

En ce qui concerne la répartition des mers italiennes en sous-zones on a adopté la subdivision de l'ISTAT5/ pour la flottille (voir figure 1).

1/ CV - Puissance motrice
n mi² - Mille nautique carré

2/ cpue - Capture par unité d'effort

3/ Le "volante" est un chalut semipélagique utilisé pour la capture des petits pélagiques. Le filet "volante" est traîné par deux bateaux (les bateaux employés s'appellent aussi "volanti")

4/ Le "vongolara" est un bateau spécialisé pour la pêche de la petite praire (*Venus* ou *Chamelaea gallina*)

5/ ISTAT - Institut national des statistiques

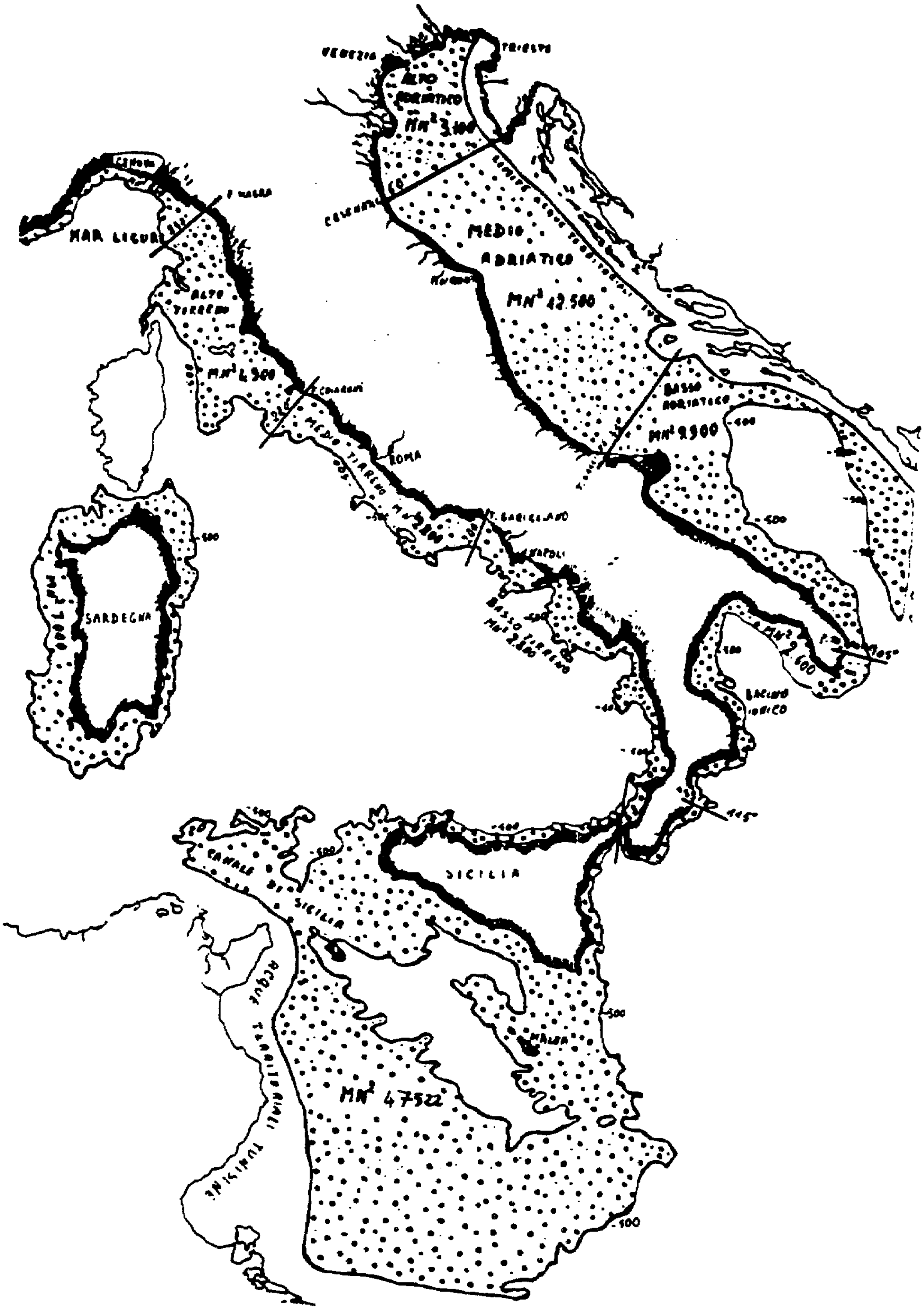


Figure 1 Zones de pêche de la côte jusqu'à 500 m ou à la limite des eaux territoriales des pays riverains

3. LA FLOTTILLE

Le total des bateaux motorisés recensés par l'enquête PESTAT s'élève à 19 205 avec une puissance motrice globale de CV 1 307 970.

Parmi ces bateaux, 17 250 ont une puissance motrice inférieure à 199,9 CV, tandis que 1 955 ont une puissance motrice de 200 CV et au-delà; 4 135 sont des chalutiers (21,5 %) avec une puissance motrice globale de CV 688 972 (52,6 %); 616 sont des bateaux "vongolare" (3,2 %) avec une puissance motrice de CV 45 411 (3,5 %); 254 sont des "volanti" (1,3 %) avec une puissance motrice de CV 81 964 (6,3 %); 12 705 (66,2 %) sont des bateaux qui utilisent des engins fixes, avec une puissance motrice de CV 368 714 (28,2 %); 1 495 (7,8 %) sont des senneurs avec une puissance motrice de CV 122 909 (9,4 %) (voir tableau 1).

Tableau 1

Bateaux motorisés recensés par l'enquête PESTAT

Métiers	Nombre	Pourcentage	Puissance motrice	Pourcentage
Chalutiers	4 135	21,5	688 972	52,6
Vongolare	616	3,2	45 411	3,5
Volanti	254	1,3	81 964	6,3
Engins fixes	12 705	66,2	368 714	28,2
Senneurs	1 495	7,8	122 909	9,4
Total	19 205	100,0	1 307 970	100,0

4. SURFACE TOTALE EXPLOITABLE ET CAPTURES GLOBALES

La surface totale de l'aire théoriquement exploitable, de la côte jusqu'à 500 m de profondeur ou jusqu'à la limite des eaux territoriales des pays riverains, et de 209 460 n mi² 1/.

L'aire qui appartient au plateau continental est de 184 295 n mi² (88 % du total).

A cause des facteurs éco-biologiques le plateau continental est certainement l'aire plus productive. De l'exploitation de cette aire on obtient 439 000 t de produits ce qui représente 84,2 % des captures totales qui sont à peu près de 522 000 t.

L'aire du talus, qui dans le cas considéré est la partie comprise entre l'isobathe de -200 m (limite supérieure) et de -500 m (limite inférieure) est de 40 765 n mi² 2/, c'est-à-dire 19,5 % du total.

De cette partie du talus on obtient presque 83 000 t de produits qui consistent en des ressources typiques comme le merlu, les crevettes rouges, les rascasses de grand fond, etc.

Il faut souligner que dans un but de simplification, on a considéré la surface du fond mais, en réalité, les captures se rapportent soit aux ressources démersales, soit aux ressources pélagiques.

Par comparaison des index moyens nationaux de cpue (kg/CV) des divers métiers de pêche, on obtient le tableau 2.

En comparant les cpue des métiers qui opèrent sur les mêmes ressources (ex. ressources démersales) et à peu près dans les mêmes milieux (ex., plateau continental) on constate que les cpue pour les engins fixes (kg 218/CV) ne s'éloignent pas beaucoup des cpue des chalutiers (kg 293,4/CV).

1/ La subdivision de l'aire globale (-200 m; -500 m) n'est pas valable pour la haute et la moyenne Adriatique étant donné qu'il s'agit d'un unique plateau exploitable par tous les navires

2/ L'aire du plateau pour la haute et la moyenne Adriatique a été considérée aussi dans cette surface

Tableau 2

Comparaison des cpue des divers métiers de pêche

	Métiers de pêche	Jusqu'à 199,9 (plateau) cpue	= 200 (Talus) cpue (kg/CV)	CV Globale aire totale cpue (kg/CV)
1.	Tous les métiers	637,9	133	398,5
2.	Chalut	293,4	191,7	230,2
3.	"Vongolare"	2 107,2		
4.	"Volanti"	178,9	946,2	879
5.	Engins fixes	218		
6.	Senne	931,5		

Si l'on considère que, en général, la valeur unitaire des produits de la petite pêche par engins fixes est certainement plus grande que celle du chalût, que les coûts de la petite pêche sont très modestes par rapport à ceux du chalût, on peut avoir une idée de la validité économique de ce type de petite entreprise.

Les captures totales s'élèvent à 521 221 700 kg, dont 438 729 100 kg (84,2 %) sont produits par un effort de pêche de 687 743 CV (fourni par 17 250 bateaux jusqu'à 199,9 CV), tandis que 82 492 600 kg (15,8 %) sont produits par un effort global presque égal, c'est-à-dire 620 227 CV (exprimé par 1 955 bateaux, chacun au-delà de 200 CV).

De tout cela découle la physionomie caractéristique de la pêche italienne où le gros des captures est réalisé par des bateaux ne dépassant pas 200 CV et qui exercent leur activité, pour la plupart, sur les fonds du plateau continental.

Il faut souligner que cette production globale est, selon toute probabilité, sous-estimée en ce qui concerne les petits pélagiques et les mollusques bivalves en général.

Pour une capture totale de 521 221 700 kg, et un effort global de pêche de 1 307 970 CV, la pêche au chalût apporte 158 628 600 kg (30,4 %) grâce à un effort de 688 972 CV (52,6 % de l'effort global).

Les "vongolare" apportent 95 689 700 kg de produit (18,4 %) grâce à un effort de 45 411 CV (3,5 % de l'effort global).

Les "volanti" apportent 72 047 400 kg (13,8 %) grâce à un effort de 81 964 CV (6,3 % de l'effort global). La petite pêche par engins fixes apporte une production de 80 368 800 kg (15,4 %) un effort de 368 714 CV (28,2 % de l'effort global).

Les senneurs enfin donnent une production de 114 487 200 kg (22 %) grâce à un effort de 122 909 CV (9,4 % de l'effort global) (voir tableau 3).

Tableau 3

Production des divers métiers de pêche

	Captures kg	%	Puissance motrice CV	%
Total	521 221 700	100	1 307 970	100
Chalut	158 628 600	30,4	688 972	52,6
Vongolare	95 689 700	18,4	45 411	3,5
Volanti	72 047 400	13,8	81 964	6,3
Engins fixes	80 368 800	15,4	368 714	28,2
Senne	114 487 200	22	122 909	9,4

5. COMMENTAIRES ET OBSERVATIONS SUR LES DIFFERENTS TABLEAUX

Tableau 4: Ensemble des engins

On peut observer que l'index de plus grande densité (CV/n mi²) concerne la haute Adriatique. Il est presque 10 fois (59,1) supérieur à l'index moyen italien (6,2).

A peu près au même niveau, se trouvent la zone ligurienne (52,3) et la partie inférieure de la mer Tyrrhénienne (52,2).

Il s'agit d'un premier groupe de zones où l'effort de pêche est remarquable par rapport à la surface exploitable.

Toutefois, quoiqu'il s'agisse de zones ayant un index de densité presque égal, elles présentent une différente productivité (cpue).

En effet des trois zones déjà indiquées, la haute Adriatique présente une cpue de 597,7 kg, la zone ligurienne de 456,4, la partie inférieure de la mer Tyrrhénienne de 296,7.

Un autre groupe ayant un index de densité plus bas (à peu près deux ou trois fois l'index moyen national) est constitué par l'Adriatique centrale (18,4), la zone ionienne (16,2), la partie supérieure de la mer Tyrrhénienne, la partie inférieure de l'Adriatique (13,2). Mais, au niveau des cpue on a des différences remarquables.

Pour l'Adriatique centrale on a kg 579,1/CV, pour la zone ionienne kg 288,6/CV pour la partie supérieure de la mer Tyrrhénienne kg 227,8/CV, pour la partie inférieure de l'Adriatique kg 296,7/CV.

Cela montre que pour des densités presque égales on trouve des zones à plus grande productivité naturelle où les ressources soient plus faciles à capturer et ceci, sans tenir compte des espèces capturées et de leur valeur commerciale.

Enfin on trouve un troisième groupe ayant index de densité plus au moins bas comme par exemple la zone sarde (9,8) et la zone sicilienne (2,0) où l'index de densité est inférieur à la moyenne nationale (6,2).

Mais dans ces cas la cpue est de 461,7 c'est-à-dire presque deux fois celle de la zone sarde (240,6).

Tableau 5: Chalutiers

Dans ce tableau on peut aussi observer trois groupes de zones ayant un index de densité identique. A savoir:

(i) Haute Adriatique - Densité 26 - cpue 238,1. Presque 9 fois la densité moyenne nationale (3,3). Il s'agit donc d'une zone à grand risque.

(ii) Zone Ligurienne - Densité 16,4 - cpue 334,4.

Partie inférieure de la mer Tyrrhénienne - Densité 12,7 - cpue 54.

Il s'agit d'une zone peu chalutable.

Adriatique centrale - Densité 12,7 - cpue 178,4

Partie centrale de la mer Tyrrhénienne - Densité 12 - cpue 103

Partie inférieure de l'Adriatique - Densité 10 - cpue 171,3.

(iii) Zone sarde - A cause d'une carence dans le relevé des données on a obtenu des résultats peu fiables. Il faut approfondir l'enquête dans la zone.

Zone sicilienne - Densité 1,3 - cpue 337,6.

Il s'agit de la zone ayant la plus basse densité et la plus haute productivité de toutes les zones considerées.

On connaît les problèmes de la petite pêche au chalut. D'une part elle opère sur les fonds proches de la côte et parfois à l'intérieur de la bande interdite au chalutage où elle entre en conflit avec la petite pêche par engins fixes. D'autre part elle s'oppose à l'application de la maille minimale de 40 mm.

Cette petite pêche au chalut et constituée par 2 262 bateaux d'une puissance inférieure à 149,9 CV et par 524 bateaux de 150 CV à 199,9 CV. Au total cela représente 2 786 petits chalutiers.

Cette petite pêche au chalut est certainement la plus nuisible et, selon toute probabilité, la plus coûteuse. Elle est fort active en Haute Adriatique et dans l'Adriatique centrale.

Il faut reconvertir cette pêche, d'un côté vers le chalutage au large, de l'autre côté vers la petite pêche par engins fixes.

Ça signifie qu'il faut intensifier les efforts pour créer, dans la bande côtière, des zones marines protégées pour la conchyliculture et les récifs artificiels. Les expériences réalisées en Adriatique par l'IRPEM montrent l'existence de remarquables possibilités économiques pour les pêcheurs qui aménagent les zones récifales.

Tableau 4

Densité et cpue de la flottille motorisé

	FLOTTILLE		SURFACE	CAPTURES	DENSITE	C.P.U.E.
CLASSES HPA	N	HPA	Mn²	Kg	HP/Mn²	Kg/HPA
JUSQU'A 199,9	1.196	34.890	483	-	72,2	-
>=200	38	10.070	377	-	26,7	-
S. ZONE LIG.	1.234	44.960	860	20.519.400	52,3	456,4
JUSQU'A 199,9	551	25.715	3.239	-	7,9	-
>=200	135	39.748	1.661	-	23,9	-
HAUTE TYRR.	686	65.463	4.900	14.914.600	13,4	227,8
JUSQU'A 199,9	786	29.623	2.000	-	14,8	-
>=200	131	36.246	800	-	45,3	-
MOYENNE TYRR.	917	65.869	2.800	7.319.800	23,5	111,1
JUSQU'A 199,9	2.822	89.610	1.736	14.512.600	51,6	162,0
>=200	161	56.599	1.064	1.000.900	53,2	17,7
BASSE TYRR.	2.983	146.209	2.800	15.513.500	52,2	106,1
JUSQU'A 199,9	1.078	48.828	5.656	15.023.500	8,6	307,7
>=200	66	19.586	1.344	1.438.700	14,6	73,5
S. ZONE SARDE	1.144	68.414	7.000	16.462.200	9,8	240,6
JUSQU'A 199,9	4.797	156.379	30.722	109.508.900	5,1	700,3
>=200	516	175.428	16.800	43.698.000	10,4	249,1
S. ZONE SICIL.	5.313	331.807	47.522	153.206.900	7,0	461,7
JUSQU'A 199,9	993	34.166	1.509	9.994.000	22,6	292,5
>=200	31	7.975	1.091	2.169.500	7,3	272,0
S. ZONE JON.	1.024	42.141	2.600	12.163.500	16,2	288,6
JUSQU'A 199,9	1.411	78.836	7.872	30.056.200	10,0	381,2
>=200	170	51.484	2.028	8.614.200	25,4	167,3
BASSE ADRIAT.	1.581	130.320	9.900	38.670.400	13,2	296,7
JUSQU'A 199,9	1.709	92.609	12.500	119.880.700	-	1.294,5
>=200	443	137.018	12.500	13.100.000	-	95,6
MOYENNE ADRIAT.	2.152	229.627	12.500	132.980.700	18,4	579,1
JUSQU'A 199,9	1.907	97.087	3.100	96.999.400	-	999,1
>=200	264	86.073	3.100	12.471.300	-	144,9
HAUTE ADRIAT.	2.171	183.160	3.100	109.470.700	59,1	597,7
JUSQU'A 199,9	17.250	687.743	68.817	438.729.100	10,0	637,9
>=200	1.955	620.227	40.765	82.492.600	15,2	133,0
ITALIE	19.205	1.307.970	93.982	521.221.700	13,9	398,5

Tableau 5

Densité et cpue des chalutiers

	CHALUT		SURFACE	CAPTURES	DENSITE	C.P.U.E.
CLASSES HPA	N	HPA	Mn²	Kg	HP/Mn²	Kg/HPA
JUSQU'A 199,9	70	7.476	483	-	15,5	-
>=200	26	6.609	377	-	17,5	-
S. ZONE LIG.	96	14.085	860	4.710.200	16,4	334,4
JUSQU'A 199,9	111	12.889	3.239	-	4,0	-
>=200	96	25.045	1.661	-	15,1	-
HAUTE TYRR.	207	37.934	4.900	4.091.900	7,7	107,9
JUSQU'A 199,9	39	5.415	2.000	-	2,7	-
>=200	102	28.284	800	-	35,4	-
MOYENNE TYRR.	141	33.699	2.800	3.471.100	12,0	103,0
JUSQU'A 199,9	78	7.963	1.736	924.000	4,6	116,0
>=200	56	27.696	1.064	1.000.900	26,0	36,1
BASSE TYRR.	134	35.659	2.800	1.924.900	12,7	54,0
JUSQU'A 199,9	10	1.544	5.656	4.083.000	0,3	2.644,4
>=200	12	2.951	1.344	1.438.700	2,2	487,5
S. ZONE SARDE	22	4.495	7.000	5.521.700	0,6	1.228,4
JUSQU'A 199,9	540	60.556	30.722	26.028.800	2,0	429,8
>=200	410	144.961	16.800	43.348.500	8,6	299,0
S. ZONE SICIL.	950	205.517	47.522	69.377.300	4,3	337,6
JUSQU'A 199,9	106	11.328	1.509	2.916.500	7,5	257,5
>=200	29	7.479	1.091	2.065.300	6,9	276,1
S. ZONE JON.	135	18.807	2.600	4.981.800	7,2	264,9
JUSQU'A 199,9	538	50.767	7.872	8.414.100	6,4	165,7
>=200	161	48.630	2.028	8.614.200	24,0	177,1
BASSE ADRIAT.	699	99.397	9.900	17.028.300	10,0	171,3
JUSQU'A 199,9	772	64.493	12.500	15.201.500	-	235,7
>=200	316	94.150	12.500	13.100.000	-	139,1
MOYENNE ADRIAT.	1.088	158.643	12.500	28.301.500	12,7	178,4
JUSQU'A 199,9	522	38.652	3.100	6.748.600	-	174,6
>=200	141	42.084	3.100	12.471.300	-	296,3
HAUTE ADRIAT.	663	80.736	3.100	19.219.900	26,0	238,1
JUSQU'A 199,9	2.786	261.083	68.817	76.589.700	3,8	293,4
>=200	1.349	427.889	40.765	82.038.900	10,5	191,7
ITALIE	4.135	688.972	93.982	158.628.600	7,3	230,2

Tableau 6: "Vongolare"

Il s'agit de bateaux spécialisés pour la pêche de la petite praire (*Venus* ou *Chamelaea gallina*).

Les données de ce tableau sont complétées par les données provenant d'autres enquêtes de l'IRPEM.

On peut tout d'abord remarquer que la pêche des "vongole" est surtout localisée en Haute Adriatique et notablement en Adriatique centrale moins dans la partie inférieure de l'Adriatique et encore moins dans les parties centrale et inférieure de la mer Tyrrhénienne.

On trouve l'index de densité le plus haut dans la haute Adriatique qui, pour cette pêche spécialisée, apparaît comme une zone à risque.

L'index de densité est ici presque 10 fois plus grand (58,2) que l'index moyen national de densité (6,1).

Les cpue plus grandes se vérifient dans l'Adriatique centrale (3 308,8 kg/CV) par rapport à la moyenne nationale qui est de 2 107,2 kg/CV.

Pour maintenir les niveaux de productivité réalisés jusqu'alors, il faudrait bloquer l'effort de pêche au niveau actuel. Les peuplements de "vongole" sont plus au moins fort exploités selon les zones et, il s'agit très probablement de stocks où, pendant la phase de prérecrutement (oeufs et larves) les facteurs biotiques et abiotiques du milieu ont une incidence remarquable.

En dépit des récommandations des chercheurs et des indications du plan national de pêche, l'effort de pêche a augmenté lors de ces dernières années.

Tableau 6

Densité et cpue des "vongolare"

	"VONGOLARE"		Km COTE	CAPTURES	DENSITE	C.P.U.E.
SOUS-ZONES	N	HPA	Km	Kg	HP/Km	Kg/HPA
S. ZONE LIG.	-	-	343	-	-	-
HAUTE TYRR.	-	-	578	-	-	-
MOYENNE TYRR.	40	773	327	1.200.400	2,4	1.552,9
BASSE TYRR.	41	1.934	935	574.900	2,1	297,3
S. ZONE SARDE	-	-	1.849	-	-	-
S. ZONE SICIL.	-	-	1.500	-	-	-
S. ZONE JON.	-	-	587	-	-	-
BASSE ADRIAT.	69	3.547	569	7.863.100	6,2	2.216,8
MOYENNE ADRIAT.	264	17.150	390	56.745.500	44,0	3.308,8
HAUTE ADRIAT.	202	22.007	378	29.305.800	58,2	1.331,7
ITALIE	616	45.411	7.456	95.689.700	6,1	2.107,2

Tableau 7: Pêche au filet "volante"

L'Adriatique est la mer d'élection pour cette pêche qui est effectuée par un grand filet sémipélagique qui touche à peine le fond, traîné par deux bateaux.

L'index de densité plus haut concerne encore la haute Adriatique; suivent l'Adriatique centrale et la partie inférieure de l'Adriatique.

Un approfondissement, au point de vue biologique, il faut acheminer sur les ressources pélagiques, soit pour ce qui concerne l'évaluation des stocks, les variations de biomasse, les fluctuations de capture et les phénomènes de compensation biologique à l'intérieur du groupe des petits pélagiques (sardines, anchois, sprats, saurels, etc.).

Il est bien certain que ces questions concernent toute la zone de distribution du stock. Elles impliquent donc la collaboration des différents instituts scientifiques de la Région.

Tableau 8: Pêche aux engins fixes

Comme on l'a déjà dit, cette pêche apporte à la production nationale 15,4 % de la biomasse capturée. Elle utilise 28,2 % de l'effort de pêche exprimé en puissance motrice.

Le rapport en pourcentage entre la biomasse capturée et l'effort de pêche employé est le même (1:2 à peu près) pour les engins fixes, que pour le chalut (30,4/52,6).

Pour avoir une idée de cette petite pêche, il faut dire que sur 19 205 bateaux motorisés récencés, 12 705 (66,2 %) appartiennent à cette catégorie. Cela représente au moins, 25 000 petits pêcheurs.

Pour ce qui concerne la distribution de l'effort de pêche par zones (CV/n mi^2) et en particulier sur le plateau, l'index de densité le plus haut correspond à la zone ligurienne (41,4) suivi par la partie inférieure de la mer Tyrrhénienne (34,5).

Plus loin on trouve la zone ionienne (13,5) et la haute Adriatique (12,4), la partie centrale de la mer Tyrrhénienne (11,1), la zone sarde (8,2) (où l'index de densité sur les fonds du talus est supérieur (12,4) à celui que l'on constate sur les fonds du plateau).

Enfin on trouve la partie supérieure de la mer Tyrrhénienne (3,8), la partie inférieure de l'Adriatique (1,9) et l'Adriatique centrale (0,9) qui est la zone ayant index de densité plus bas (au-dessous de l'index moyen national de densité qui est 1,8).

En ce qui concerne les cpue l'index de productivité plus haut se rencontre en Adriatique centrale (564,5 kg/CV); suit la zone sicilienne (380,8), la haute Adriatique (357,6), la zone ionienne (270,3), la zone ligurienne (201,2) et la partie inférieure de l'Adriatique (174,6).

Les autres zones présentent des index de productivité qui sont au-dessous de 100.

Tableau 7

Densité et cpue des "volanti"

	"VOLANTI"		SURFACE	CAPTURES	DENSITE	C.P.U.E.
CLASSES HPA	N	HPA	Mn²	Kg	HP/Mn²	Kg/HPA
JUSQU'A 199,9	0	0	483	0	0,0	-
>=200	0	0	377	0	0,0	-
S. ZONE LIG.	0	0	860	0	0,0	-
JUSQU'A 199,9	0	0	3.239	0	0,0	-
>=200	0	0	1.661	0	0,0	-
HAUTE TYRR.	0	0	4.900	0	0,0	-
JUSQU'A 199,9	0	0	2.000	0	0,0	-
>=200	0	0	800	0	0,0	-
MOYENNE TYRR.	0	0	2.800	0	0,0	-
JUSQU'A 199,9	0	0	1.736	0	0,0	-
>=200	0	0	1.064	0	0,0	-
BASSE TYRR.	0	0	2.800	0	0,0	-
JUSQU'A 199,9	0	0	5.656	0	0,0	-
>=200	0	0	1.344	0	0,0	-
S. ZONE SARDE	0	0	7.000	0	0,0	-
JUSQU'A 199,9	0	0	30.722	0	0,0	-
>=200	0	0	16.800	0	0,0	-
S. ZONE SICIL.	0	0	47.522	0	0,0	-
JUSQU'A 199,9	0	0	1.509	0	0,0	-
>=200	0	0	1.091	0	0,0	-
S. ZONE JON.	0	0	2.600	0	0,0	-
JUSQU'A 199,9	43	7.176	7.872	1.283.500	0,9	178,9
>=200	0	0	2.028	0	0,0	-
BASSE ADRIAT.	43	7.176	9.900	1.283.500	0,7	178,9
JUSQU'A 199,9	0	0	12.500	0	-	-
>=200	111	37.459	12.500	31.754.900	-	847,7
MOYENNE ADRIAT.	111	37.459	12.500	31.754.900	3,0	847,7
JUSQU'A 199,9	0	0	3.100	0	-	-
>=200	100	37.329	3.100	39.009.000	-	1.045,0
HAUTE ADRIAT.	100	37.329	3.100	39.009.000	12,0	1.045,0
JUSQU'A 199,9	43	7.176	68.817	1.283.500	0,1	178,9
>=200	211	74.788	40.765	70.763.900	1,8	946,2
ITALIE	254	81.964	93.982	72.047.400	0,9	879,0

Tableau 8

Densité et cpue des engins fixes

CLASSES HPA	ENGINS FIXES N	HPA	SURFACE Mn²	CAPTURES Kg	DENSITE HP/Mn²	C.P.U.E. Kg/HPA
JUSQU'A 199,9	923	19.980	483	-	41,4	-
>=200	3	553	377	-	1,5	-
S. ZONE LIG.	926	20.533	860	4.132.000	23,9	201,2
JUSQU'A 199,9	434	12.260	3.239	-	3,8	-
>=200	5	1.117	1.661	-	0,7	-
HAUTE TYRR.	439	13.377	4.900	721.900	2,7	54,0
JUSQU'A 199,9	682	22.112	2.000	-	11,1	-
>=200	16	3.733	800	-	4,7	-
MOYENNE TYRR.	698	25.845	2.800	716.000	9,2	27,7
JUSQU'A 199,9	2.353	59.839	1.736	-	34,5	-
>=200	4	830	1.064	-	0,8	-
BASSE TYRR.	2.357	60.669	2.800	4.919.000	21,7	81,1
JUSQU'A 199,9	1.057	46.180	5.656	-	8,2	-
>=200	54	16.635	1.344	-	12,4	-
S. ZONE SARDE	1.111	62.815	7.000	3.846.900	9,0	61,2
JUSQU'A 199,9	3.725	78.994	30.722	-	2,6	-
>=200	75	20.915	16.800	-	1,2	-
S. ZONE SICIL.	3.800	99.909	47.522	38.041.000	2,1	380,8
JUSQU'A 199,9	834	20.321	1.509	-	13,5	-
>=200	2	496	1.091	-	0,5	-
S. ZONE JON.	836	20.817	2.600	5.626.800	8,0	270,3
JUSQU'A 199,9	716	15.235	7.872	-	1,9	-
>=200	5	1.319	2.028	-	0,7	-
BASSE ADRIAT.	721	16.554	9.900	2.891.000	1,7	174,6
JUSQU'A 199,9	655	10.471	12.500	-	-	-
>=200	2	343	12.500	-	-	-
MOYENNE ADRIAT.	657	10.814	12.500	6.105.000	0,9	564,5
JUSQU'A 199,9	1.156	36.313	3.100	-	-	-
>=200	4	1.068	3.100	-	-	-
HAUTE ADRIAT.	1.160	37.381	3.100	13.369.200	12,1	357,6
JUSQU'A 199,9	12.535	321.705	68.817	-	4,7	-
>=200	170	47.009	40.765	-	1,2	-
ITALIE	12.705	368.714	93.982	80.368.800	3,9	218,0

Tableau 9

Densité et cpue de senneurs

	SENNE		SURFACE	CAPTURES	DENSITE	C.P.U.E.
CLASSES HPA	N	HPA	Mn²	Kg	HP/Mn²	Kg/HPA
JUSQU'A 199,9	203	7.434	483	-	15,4	-
>=200	9	2.908	377	-	7,7	-
S. ZONE LIG.	212	10.342	860	11.677.200	12,0	1.129,1
JUSQU'A 199,9	6	566	3.239	-	0,2	-
>=200	34	13.586	1.661	-	8,2	-
HAUTE TYRR.	40	14.152	4.900	10.100.800	2,9	713,7
JUSQU'A 199,9	25	1.323	2.000	-	0,7	-
>=200	13	4.229	800	-	5,3	-
MOYENNE TYRR.	38	5.552	2.800	1.932.300	2,0	348,0
JUSQU'A 199,9	350	19.874	1.736	-	11,4	-
>=200	101	28.073	1.064	-	26,4	-
BASSE TYRR.	451	47.947	2.800	8.094.700	17,1	168,8
JUSQU'A 199,9	11	1.104	5.656	7.093.600	0,2	6.425,4
>=200	0	0	1.344	0	0,0	-
S. ZONE SARDE	11	1.104	7.000	7.093.600	0,2	6.425,4
JUSQU'A 199,9	532	16.829	30.722	-	0,5	-
>=200	31	9.552	16.800	-	0,6	-
S. ZONE SICIL.	563	26.381	47.522	45.788.600	0,6	1.735,7
JUSQU'A 199,9	53	2.517	1.509	1.554.900	1,7	617,8
>=200	0	0	1.091	0	0,0	-
S. ZONE JON.	53	2.517	2.600	1.554.900	1,0	617,8
JUSQU'A 199,9	45	2.111	7.872	-	0,3	-
>=200	4	1.535	2.028	-	0,8	-
BASSE ADRIAT.	49	3.646	9.900	9.604.500	0,4	2.634,3
JUSQU'A 199,9	21	1.370	12.500	-	-	-
>=200	11	4.191	12.500	-	-	-
MOYENNE ADRIAT.	32	5.561	12.500	10.073.800	0,4	1.811,5
JUSQU'A 199,9	38	3.247	3.100	-	-	-
>=200	8	2.460	3.100	-	-	-
HAUTE ADRIAT.	46	5.707	3.100	8.566.800	1,8	1.501,1
JUSQU'A 199,9	1.284	56.375	68.817	-	0,8	-
>=200	211	66.534	40.765	-	1,6	-
ITALIE	1.495	122.909	93.982	114.487.200	1,3	931,5

6. CONCLUSION

Ces données, complétées par d'autres données et renseignements peuvent servir à plusieurs calculs. Par exemple en connaissant les prix moyens des produits au débarquement, il est possible d'estimer la valeur brute de la production.

En outre grâce au nombre des bateaux, et en connaissant les équipages moyens par typologie de pêche, on peut estimer le nombre des pêcheurs qui est loin d'être connu avec précision.

L'IRPEM reviendra sur ces aspects particuliers par des notes ad hoc.

SUMMARY REPORT ON THE QUALITY CHECK SAMPLE SURVEY OF FISHERIES CATCH AND EFFORT STATISTICS - ADRIATIC AREA

by

G. Bombace[1/], N. Cingolani[1/], S.R. Coppola[2/] and J. Mortera[3/]

1. INTRODUCTION

In the management of any economic activity it is of prime importance to have reliable statistical data which must reflect the reality of the phenomenon being studied. Fishing is an important economic activity in Italy and its correct management must be based on reliable statistical data.

The Ministry of the Merchant Navy which governs this sector, cannot correctly manage their fishery programme, reconciling both the necessary biological balance and the expectations of fishing operators, without sound statistical data.

Apart from being reliable, statistical data must be gathered on certain parameters which are of fundamental importance in the biological evaluation of fisheries. These parameters are fishing effort, distribution of catch within fishing areas, and the size of catch of a wide variety of species of commercial interest. The new law No. 41/82 has considered these fundamental aspects and its fulfilment will bring positive benefits to the economy of the Italian fishery sector.

The Istituto di Ricerche sulla Pesca Marittima (IRPEM) - Ancona, on a grant from the Ministry of the Merchant Navy carried out a national quality check statistical survey on the existing fisheries statistics (PESTAT program) with the technical assistance of the Fisheries Department of FAO.

The main objective of this survey was to develop a methodology for collecting better and more useful statistical data. Italian fishing statistics in this field are lacking in many aspects; for example:

- the few statistical recorders do not have the specialization necessary for gathering this type of data;
- the statistics produced give no indication of some of the fundamental parameters necessary for a coherent management of this sector. (For example, at present, no data is given on the distribution of catch by the different type of vessels or by the different gear used);
- no data is collected on catch which is not distributed through fish markets. It is well known that a large portion of catch does not pass through fish markets, which are even absent in several ports;
- the National Statistics Institute (ISTAT) gathers its data through a census of fish catch, which is clearly unrealistic, especially in our country where the landing places are so widely distributed along the coastline. There are more than 800 landing sites.

The most relevant accomplishment of the PESTAT project, apart from having produced reliable estimates on fishing vessels, catch and effort was:

(i) the trial use of a new methodology for collection and processing of fishery statistics;

(ii) the successful training of statistical recorders;

(iii) the IRPEM-Ancona has acquired valuable knowledge of handling fishery statistical data which will be useful for the establishment of the proposed National Statistical Service under Fishery (law No. 41/82).

2. THE IMPLEMENTATION OF THE PESTAT PROGRAMME

The objective of the programme was twofold (see Figure 1):

1/ Istituto di Ricerche sulla Pesca Marittima (IRPEM) - Ancona

2/ FAO, Fisheries Department - Rome

3/ Department of Statistics, University of Rome

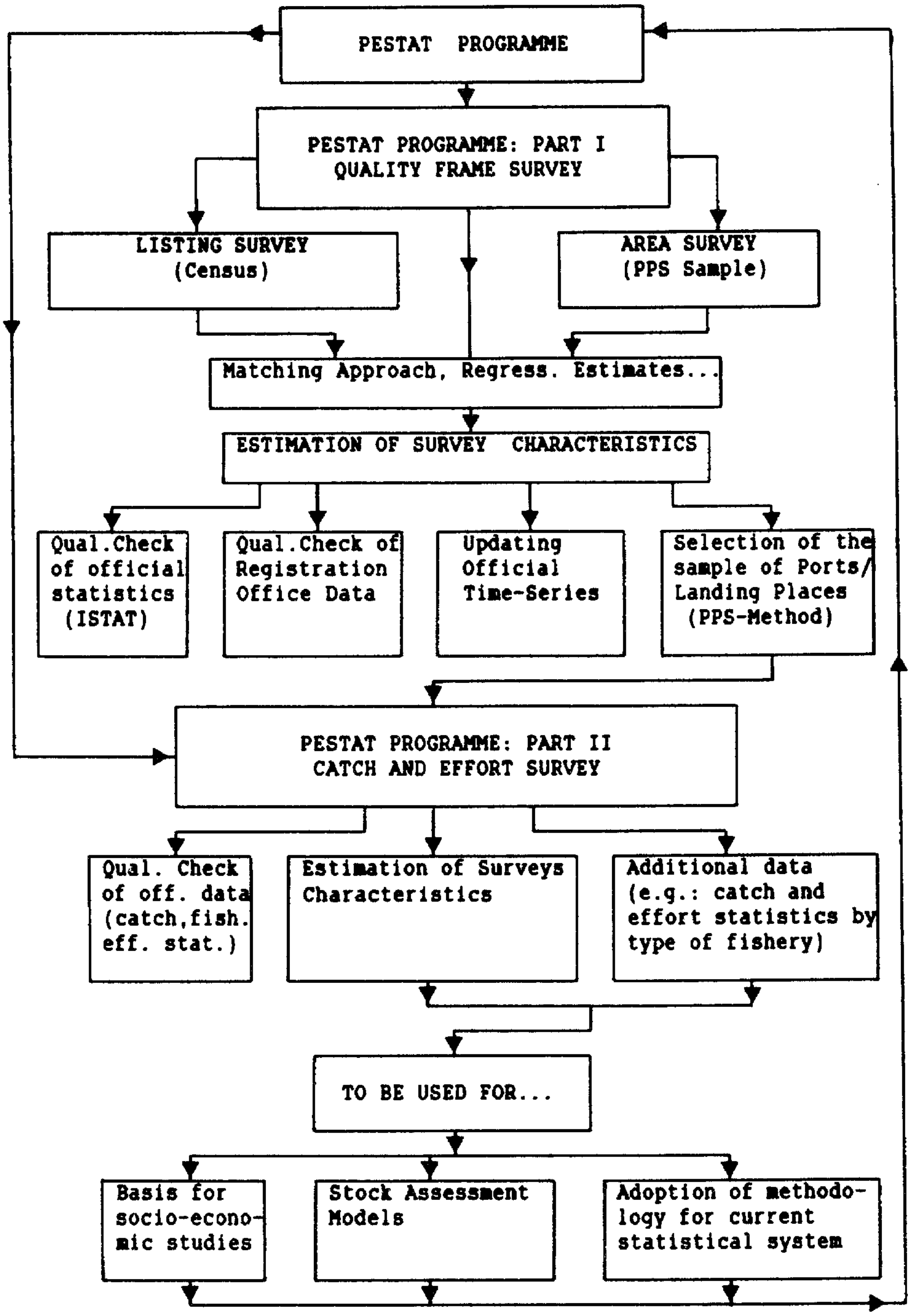


Figure 1 PESTAT Programme: a sample survey system for the quality check of fisheries statistics

(i) a quality check frame survey of the primary fishing industry;

(ii) a quality check sample survey of fish catch and effort.

The methodology used and detailed results with proposals for future applications of the two phases of the PESTAT survey are given in Bazigos et al., 1984 and Cingolani, Coppola and Mortera, 1986. This short note is a summary of the results obtained from the catch and effort sample survey which was carried out in 1982. For the terminology used in this note see the Appendix.

3. STRATIFICATION

The data collected on catch and effort fishery statistics was based on a stratified sample survey using sample units from a PPS Probability Proportional to Size sample.

The levels of stratification were:

- geographical: the Italian coastline was subdivided into 10 geographical Strata (see Figure 2). Within each Stratum a sample of fishing sites (Primary Sampling Unit) was selected using the PPS method.

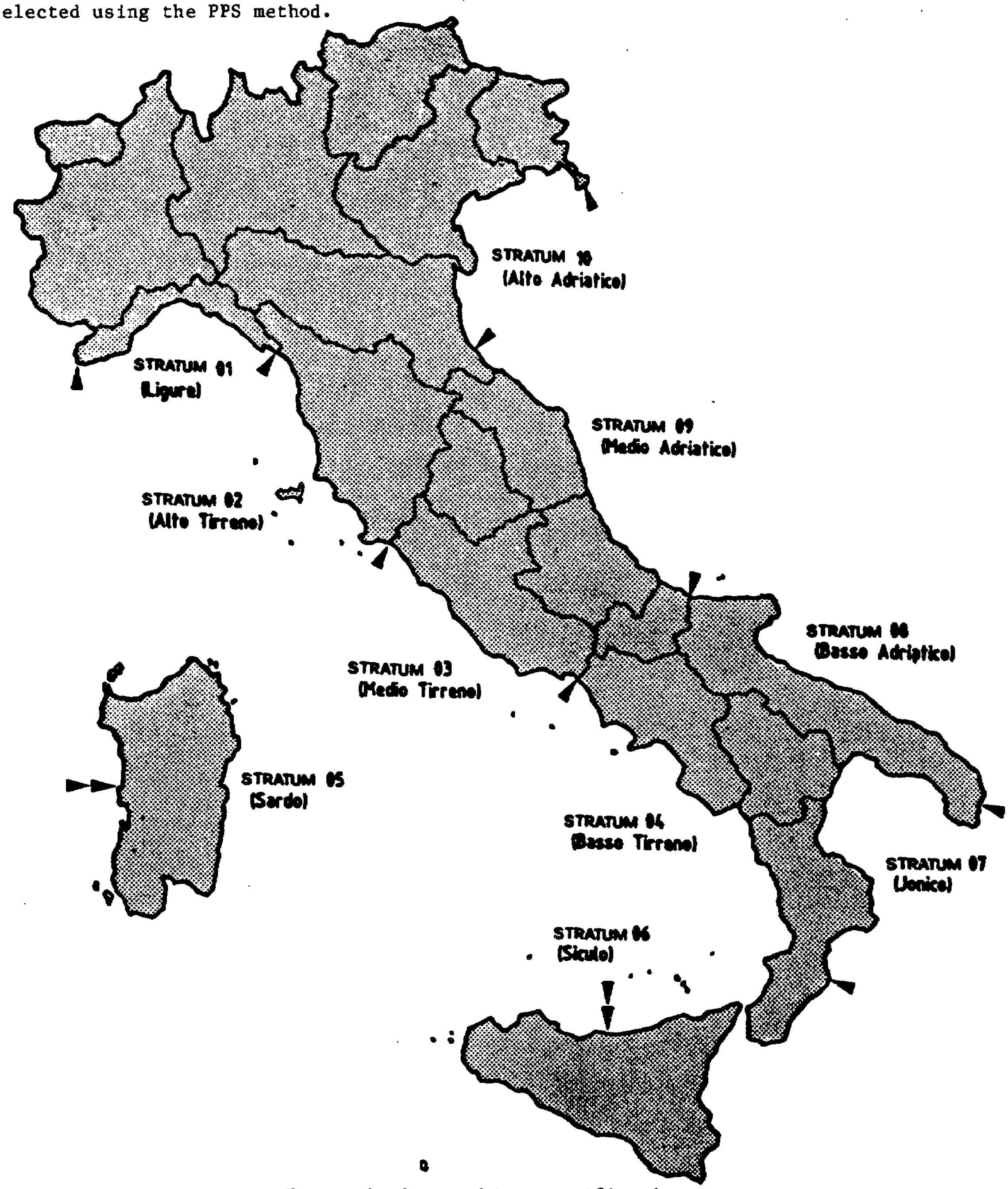


Figure 2 Geographic stratification

- fishing vessels were stratified according to dimension, i.e. motorized and non-motorized fishing vessels, mechanized fishing vessels working on daily trip basis and mechanized fishing vessels working on a more than one-day trip basis. Oceanic fishing vessels were not included in this survey;
- Mechanized fishing vessels were further stratified according to the gear used (see Table 1).

Table 1

Classes of fishing vessels by type and by gear used

Class	Type of fishing vessel/gear used
1.0	Non-motorized + motorized: all gear
2.0	Mechanized fishing vessels/Trips less than one day: ALL GEAR
2.1	Mechanized fishing vessels/Trips less than one day: PURSE SEINERS
2.2	Mechanized fishing vessels/Trips less than one day: TRAWLERS
2.3	Mechanized fishing vessels/Trips less than one day: MECHANIZED DREDGES
2.4	Mechanized fishing vessels/Trips less than one day: FIXED NETS
2.5	Mechanized fishing vessels/Trips less than one day: TRAPS
2.6	Mechanized fishing vessels/Trips less than one day: HOOKS
2.7	Mechanized fishing vessels/Trips less than one day: MID-WATER PAIR TRAWLERS
3.0	Mechanized fishing vessels/Trips more than one day: ALL GEAR
3.1	Mechanized fishing vessels/Trips more than one day: PURSE SEINERS
3.2	Mechanized fishing vessels/Trips more than one day: TRAWLERS
3.4	Mechanized fishing vessels/Trips more than one day: FIXED NET
3.5	Mechanized fishing vessels/Trips more than one day: HOOKS

4. ITALIAN FISH CATCH

The total fish catch estimated by PESTAT for 1982 was 521 222 t. This does not include oceanic nor lacustrine fisheries which were not covered by the survey.

Table 2

Fish catch by stratum and length of coastline (1982)

Stratum	Tons	%	Tons/km coastline	Length of stratum (%)
1	20 519	3.9	59.9	4.6
2	14 915	2.9	25.8	7.8
3	7 320	1.4	22.4	4.4
4	15 513	3.0	16.6	12.5
5	16 462	3.2	8.9	24.8
6	153 207	29.4	102.1	20.1
7	12 164	2.3	20.7	7.9
8	38 670	7.4	68.0	7.6
9	132 981	25.5	341.0	5.2
10	109 471	21.0	290.0	5.1
Italy	521 222	100.0	69.9	100.0

From this table one can see how the Adriatic Sea (Strata 8, 9 and 10) produces 53.9% of the Italian catch.

The Adriatic Sea has also the highest catch density by km coastline; in fact it produces over half the Italian catch, even though its coastline is only 17.9% of the total. The Northern and Central Adriatic (Strata 8 and 10) give 341 and 290 t by km coastline.

A graphical display of Table 2 is given in Figure 3.

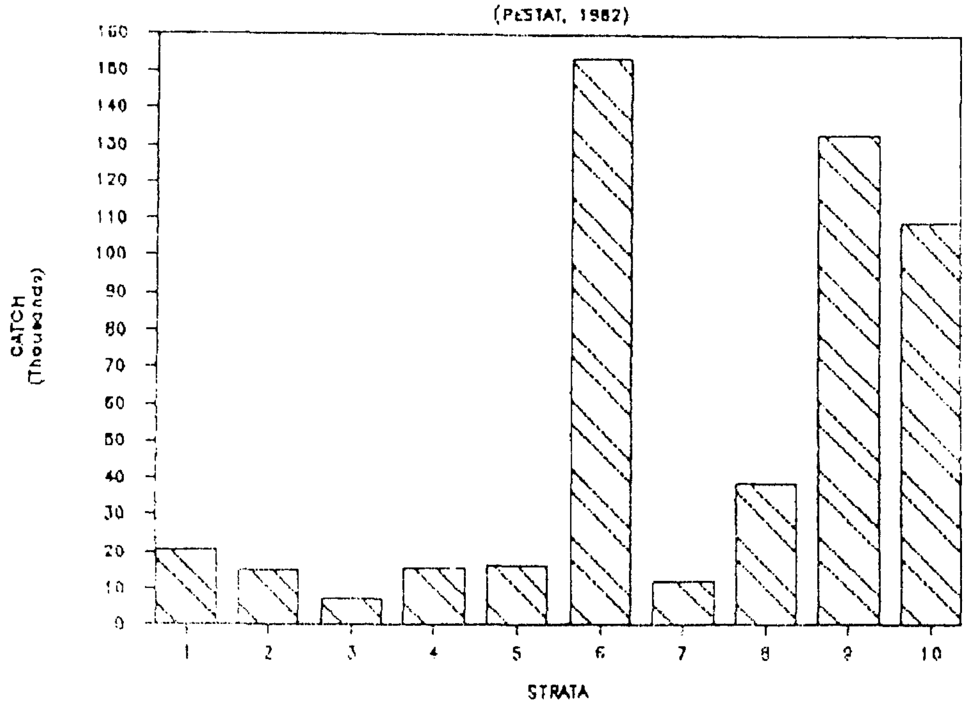


Figure 3 Catch by stratum (PESTAT, 1982)

4.1 <u>The Catch in the Adriatic Sea</u>

Table 3 shows the catch in the three Adriatic sub-areas (Strata 8, 9, and 10). Stratum 8 corresponds to the Southern Adriatic Sea which comprises the Capitaneries of Brindisi, Bari, Molfetta and Manfredonia; Central Adriatic Sea (Stratum 9) is formed by the Capitaneries of Pescara, S. Benedetto del Tronto, Ancona and Rimini, and the Northern Adriatic Sea (Stratum 10) comprises the Capitaneries of Ravenna, Chioggia, Venezia, Monfalcone and Trieste.

<u>Table 3</u>

Adriatic Sea: catch by stratum by km of coastline (1982)

Stratum	Tons	%	Tons/km coastline	Length of coastline (%)
Southern Adriatic	38 670	13.8	68.0	42.6
Central Adriatic	132 981	47.3	341.0	29.2
Northern Adriatic	109 471	38.9	290.0	28.2
Adriatic Sea	281 122	100.0	210.3	100.0

The central Adriatic sub-area produces more than half of the Adriatic catch, even though the coastline is only 29.2% of the total. Figure 4 shows the distribution of catch in the northern, central and southern Adriatic Sea.

4.2 <u>Catch by Species Group</u>

Table 4 shows the distribution of catch for four species groups.

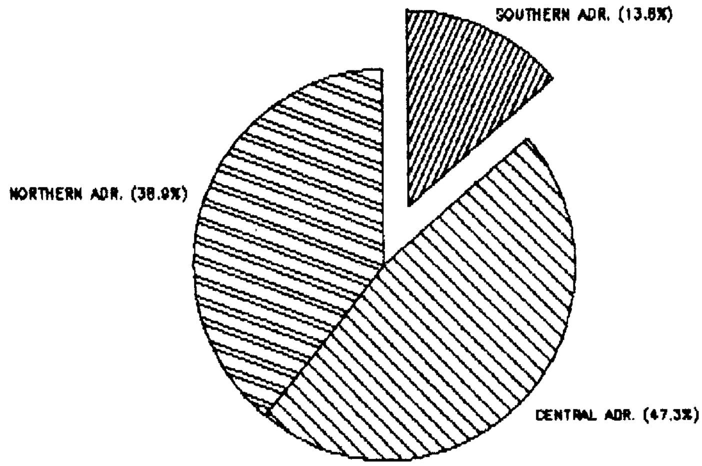


Figure 4 Distribution of catch in the Adriatic (PESTAT, 1982)

Table 4

Catch by species group (1982)

SPECIES GROUP	SOUTH. ADR.		CENTR. ADR.		NORTH. ADR.		ADRIATIC SEA		ITALY	
	TONS	%	TONS	%	TONS	%	TONS	%	TONS	% ADR./ ITALY
AN.,SA.,MA.	8920	9.5	37357	39.8	47505	50.7	93782	100.0	168324	55.7
OTHER FISH	15394	28.9	21835	41.0	16051	30.1	53280	100.0	179044	29.8
MOLLUSCS	12586	9.9	69785	55.1	44412	35.0	126783	100.0	154081	82.3
CRUSTACEANS	1770	24.3	4004	55.0	1503	20.7	7277	100.0	19773	36.8
TOTAL	38670	13.8	132981	47.3	109471	38.9	281122	100.0	521222	53.9

Figure 5 shows the distribution of catch for the same species groups in the Adriatic sub-areas.

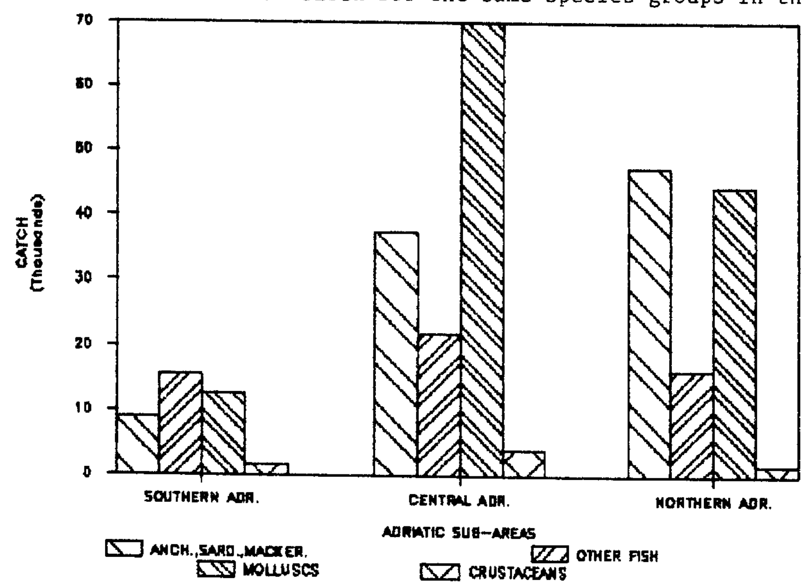


Figure 5 Catch by species group (PESTAT, 1982)

The largest quantities of anchovies, sardines and mackerels group were found in the Northern Adriatic (50.7%). In fact in this stratum the two ports Chioggia and Porto Garibaldi have a high concentration of mid-water pair trawlers. The Central and Northern Adriatic include 90.5% of the catch in this species group.

The larger percentage (41%) of the group "Other Fish," which includes mostly demersals was found in the Central Adriatic. The Central Adriatic supplies 55% of the total catch of Molluscs and, together with the Northern Adriatic, accounts for 90% of this catch. In this group clams are the most abundant.

4.3 Distribution of Catch by Vessel/Gear Category

Table 5 shows the estimated catch by fishing vessel/gear category.

Table 5

Catch by fishing vessel/gear category (1982)[a/]

Fishing vessel/ gear categ.	Southern Adriatic		Central Adriatic		Northern Adriatic		Adriatic Sea		Italy	
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	% Adr./ Italy
1.0	1 594	7.6	6 095	28.9	13 369	63.5	21 058	100.0	51 842	40.6
2.1	9 604	34.0	10 074	35.7	8 567	30.3	28 245	100.0	114 247	24,7
2.2	8 414	27.7	15 201	50.1	6 749	22.2	30 364	100.0	76 590	39,6
2.3	7 863	8.4	56 746	60.4	29 306	31.2	93 915	100.0	95 690	98,1
2.4	1 080	99.1	10	0.9	0	0.0	1 090	100.0	24 859	4.4
2.5	0	0.0	0	0.0	0	0.0	0	-	28	0.0
2.6	218	100.0	0	0.0	0	0.0	218	100.0	3 426	6.4
2.7	1 283	1.8	31 755	44.1	39 009	54.1	72 047	100.0	72 047	100.0
3.1	0	0.0	0	0.0	0	0.0	0	-	240	-
3.2	8 614	25.2	13 100	38.3	12 471	36.5	34 185	100.0	82 039	41,7
3.4	0	0.0	0	0.0	0	0.0	0	-	116	-
3.6	0	0.0	0	0.0	0	0.0	0	-	98	-
Total	38 670	13.8	132 981	47.3	109 471	38.9	281 122	100.0	521 222	53.9

a/ From this Table it can be seen that within the Adriatic Sea, the Central Adriatic has the most abundant catch: 50.1%, for trawlers (class 2.2), 60.4% for mechanized dredges (class 2.3).

For the mid-water pair trawlers (class 2.7) the Northern Adriatic accounts for most of the catch (54,1%). It has also 63.5% of the catch for motorized and non-motorized vessels (class 1.0).

Trawlers with more than one day trips (class 3.2) have catches almost equally distributed in the three Adriatic sub-areas.

Comparing the catch in the Adriatic Sea to the national total, one can see that it accounts for almost the totality of fish catch by mid-water pair trawlers and mechanized dredges. For the other mechanized vessels it accounts for about 40% of national total catch. Figure 6 shows the distribution of catch in the Adriatic sub-areas by vessel/gear category.

4.4 Seasonal Catch Distribution

Fish catch follows a seasonal pattern due to the reproductive cycle of the species and to the limitations or closures imposed by the government. Another factor which produces seasonal patterns is that certain types of gears cannot fish in rough seas. Table 6, shows monthly catch in the different species groups which are drawn in Figure 7.

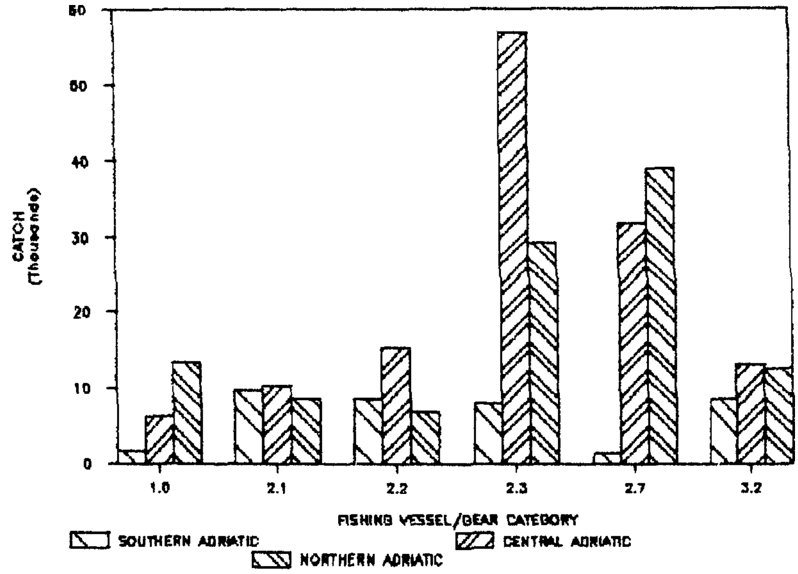


Figure 6 Catch distribution by fishing vessel/gear category (PESTAT, 1982)

Table 6

Monthly catch by species group (1982)

Month	Fishes				Molluscs		Crustaceans		Adriatic Sea	
	An., Sa., Mack		Other fish							
	Tons	%	Tons	%	Tons	%	Tons	%	Tons	%
Jan.	4 703	5.0	3 122	5.8	8 756	6.9	666	9.1	17 247	6.1
Feb.	3 445	3.7	4 143	7.8	6 438	5.1	372	5.1	14 398	5.1
Mar.	4 601	4.9	3 499	6.6	7 806	6.2	601	8.3	16 507	5.9
Apr.	5 885	6.3	3 923	7.4	11 559	9.1	792	10.9	22 159	7.9
May	10 090	10.7	3 503	6.6	9 666	7.6	509	7.0	23 768	8.4
Jun.	13 262	14.1	5 190	9.7	2 865	2.3	516	7.1	21 833	7.8
Jul.	10 449	11.1	4 461	8.4	10 171	8.0	492	6.8	25 573	9.1
Aug.	8 549	9.1	4 829	9.0	12 026	9.5	601	8.3	26 005	9.2
Sep.	10 093	10.8	4 580	8.6	14 117	11.1	470	6.4	29 260	10.4
Oct.	7 849	8.4	5 106	9.6	14 756	11.6	395	5.4	28 106	10.0
Nov.	7 285	7.8	4 315	8.1	15 379	12.1	716	9.8	27 695	9.9
Dec.	7 571	8.1	6 609	12.4	13 244	10.5	1 147	15.8	28 571	10.2
Total	93 782	100.0	53 280	100.0	126 783	100.0	7 277	100.0	281 122	100.0

The group Anchovies, Sardines and Mackerels has a seasonal maximum catch in the summer months, while the group "Other Fish" does not show strong seasonal variation. The decrease in molluscs caught during June is due to the closure of clam fishing during this month. In autumn there is a peak in the catch of this group. In December crustaceans reach their maximum. This is due mainly to the abundant catch of *Squilla mantis*.

4.5 Comparisons with Official Statistics

Table 7, shows the variations between the estimates from the PESTAT survey and those given by ISTAT (Official Bureau of Statistics).

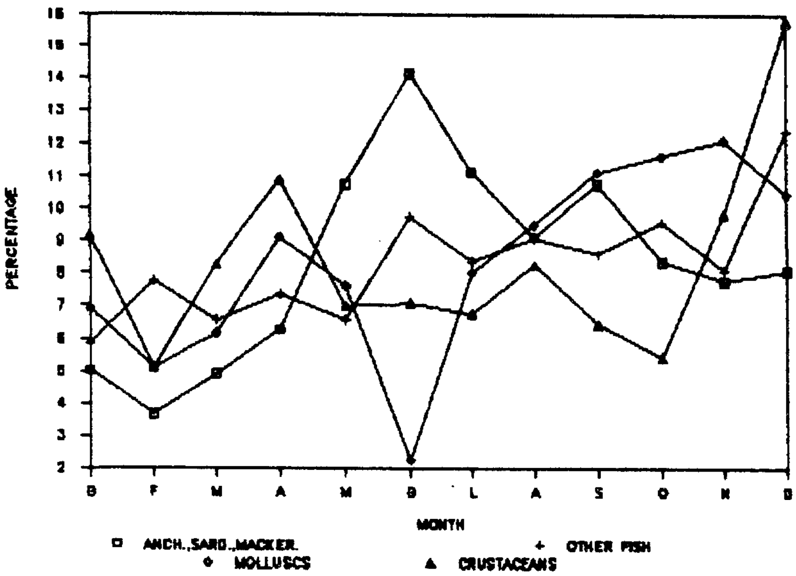


Figure 7 Monthly percentage catch by species group (PESTAT, 1982)

Table 7

Total catch (in tons) by stratum

Strata	Catch (PESTAT)	% of total	Catch (ISTAT)a/	% of total	Absolute variation (PESTAT-ISTAT)	Variation (%)
1	20 519	3.9	10 065	2.7	+10 454	+103.9
2	14 915	2.9	16 189	4.3	-1 274	-7.9
3	7 320	1.4	10 969	2.9	-3 649	-33.3
4	15 513	3.0	24 136	6.5	-8 623	-35.7
5	16 462	3.2	11 717	3.1	+4 745	+40.5
6	153 207	29.4	68 491	18.3	+84 716	+123.7
7	12 164	2.3	8 698	2.3	+3 466	+39.8
8	38 670	7.4	18 456	5.0	+20 214	+109.5
9	132 981	25.5	97 875	26.2	+35 106	+35.9
10	109 471	21.0	107 079	28.7	+2 392	+2.2
Total	521 222	100.0	373 675	100.0	+147 547	+39.5

a/ Does not include oceanic fishery

The greatest discrepancy between the two sets of estimates for the Adriatic sub-areas is found in the Central Adriatic (Stratum 9). This is probably due to the insufficient number of estimates of clam fishing made in this area by ISTAT. Figure 8 shows the percentage variation between PESTAT and ISTAT data.

5. FISHING EFFORT

Fishing effort is a parameter which measures the pressure exerted by the fishing vessel in a certain fishing area on one or more species. It includes various aspects of fishing activity. There are a number of different measures of fishing effort, and many of these were collected in this survey; such as the number of active fishing vessels, the vessel power (HP), the size of vessel (GRT), the number of hauls, the fishing time, the type of gear used, etc.

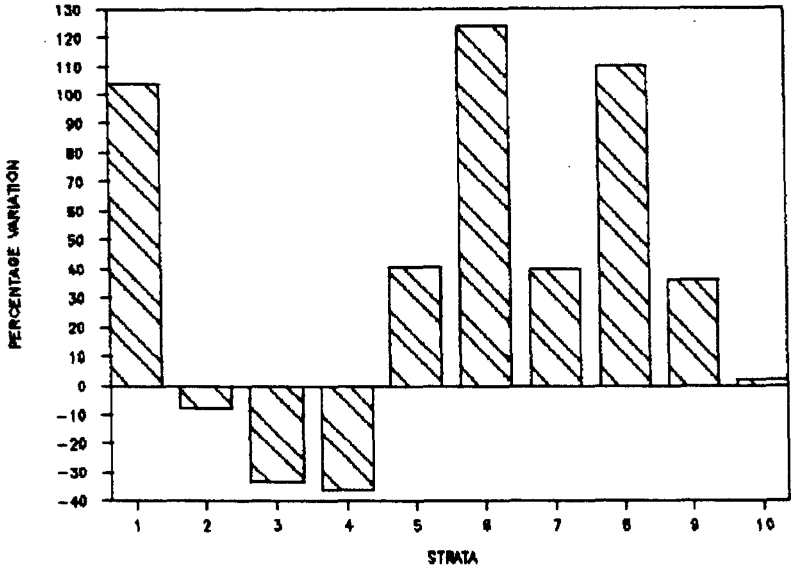


Figure 8 PESTAT and ISTAT Data: % variation by stratum

However, to keep this research as general as possible, only a few of these measurements were used to calculate fishing effort. For the mechanized vessels, effort was measured by the engine power times the fishing time (HP x hrs.). For the motorized and non-motorized vessels effort was measured by number of fishing units times the fishing time (fishing unit x hours).

The same methodology used for calculating the estimated catch was applied to estimate the fishing effort.

5.1 Comparison between Catch and Effort

Catch per unit effort is related to fishing mortality and stock density; two important qualities necessary for stock assessment.

Table 8 shows the percentage distribution in Adriatic sub-areas of fishing catch and effort for each vessel/gear category. The last section of the Table gives a comparison between the Adriatic Sea and the national total. One can see that the Adriatic Sea accounts for 55.4% of the national catch for mechanized vessels with a fishing effort of 43% of total. The motorized and non-motorized vessels account for 40.6% of total catch with 37% of total effort. These results show that the Adriatic Sea is one of the highest fishery production areas in the country.

A comparison between the three Adriatic sub-areas shows that the Central Adriatic has the highest fishing effort (45.5%), followed by the Northern Adriatic (33.6%). The Southern Adriatic has the lowest productivity giving only 14.3% of the total catch, but with 20.9% of fishing effort. The Central Adriatic has the biggest catch/effort ratio and the Northern Adriatic has the largest effort for the motorized and non-motorized vessels. The Central Adriatic has the highest productivity, that is catch/effort for all the different vessel/gear categories. Figure 9 shows the total catch and effort data for the mechanized vessels.

Table 9 similar to the above is relative only to mechanized vessels. In terms of the units used, trawlers (classes 2.2 and 3.2) exert a larger fishing effort than vessels fishing abundant pelagic species such as purse seiners (class 2.1), mechanized dredges (class 2.3) or mid-water pair trawlers (class 2.7).

The national total catch by trawlers (classes 2.2 and 3.2) is 33.8% of the total catch, although they exert 81.1% of the total effort. In the Adriatic Sea, trawlers catch 24.8% of the total catch with 84.4% of the total effort.

Only the Southern Adriatic trawlers have a higher percentage of catch and effort data than the national mean, while in the Northern and Central Adriatic a larger effort produces a lower catch. This is probably due to the excessive trawling intensity which exceeds saturation level in these sub-areas.

Table 8

Catch and fishing effort by area (1982)

Fishing vessel/ gear category	Southern Adriatic		Central Adriatic		Northern Adriatic		Adriatic/Italy	
	% catch	% eff.	% catch	% eff.	% catch	% eff.	% catch	% eff.
1.0	7.6	9.8	28.9	10.9	63.5	79.3	40.6	37.0
2.1	34.0	36.5	35.7	15.6	30.3	47.9	24.7	19.6
2.2	27.7	27.9	50.1	51.4	22.2	20.7	39.6	47.2
2.3	8.4	8.7	60.4	44.2	31.2	47.1	98.1	86.8
2.4	99.1	98.4	0.9	1.6	0.0	0.0	4.4	16.3
2.5	-	-	-	-	-	-	-	-
2.6	100.0	100.0	0.0	0.0	0.0	0.0	6.4	12.6
2.7	1.8	8.8	44.1	42.0	54.1	49.2	100.0	100.0
3.1	-	-	-	-	-	-	-	-
3.2	25.2	10.1	38.3	44.8	36.5	45.1	41.7	42.4
3.4	-	-	-	-	-	-	-	-
3.6	-	-	-	-	-	-	-	-
Total mech.	14.3	20.9	48.8	45.5	36.9	33.6	55.4	43.0

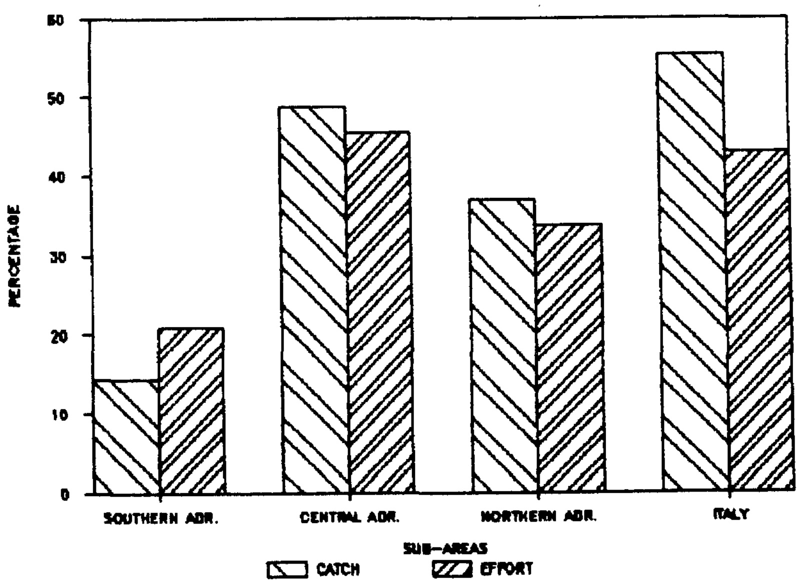


Figure 9 Fishing catch and effort distribution in the Adriatic

Table 9

Catch and fishing effort by fishing vessel/gear category

Fishing vessel/ gear categ.	Southern Adriatic		Central Adriatic		Northern Adriatic		Adriatic Sea		Italy	
	% Catch	% Eff.	% Catch	% Eff.	% Catch	% Eff.	% Catch	% Eff.	% Catch	% Eff.
2.1	25.9	4.9	8.0	1.0	8.9	4.0	10.9	2.8	24.3	6.1
2.2	22.7	57.6	12.0	48.9	7.0	26.6	11.7	43.2	16.3	39.4
2.3	21.2	2.2	44.7	5.2	30.5	7.5	36.1	5.3	20.4	2.7
2.4	2.9	12.0	0.0	0.1	0.0	0.0	0.4	2.6	5.3	6.7
2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
2.6	0.6	1.5	0.0	0.0	0.0	0.0	0.1	0.3	0.7	1.1
2.7	3.5	1.9	25.0	4.2	40.6	6.7	27.7	4.6	15.4	2.0
3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
3.2	23.2	19.9	10.3	40.6	13.0	55.2	13.1	41.2	17.5	41.7
3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

The Central Adriatic has a higher percentage catch with a lower percentage effort than the Northern for the mechanized dredges (class 2.3), while a higher percentage catch for mid-water pair trawlers (class 2.7) than Central Adriatic, although fishing productivity is similar.

Figure 10 shows the percentage distribution of catch and effort in the various vessel/gear categories.

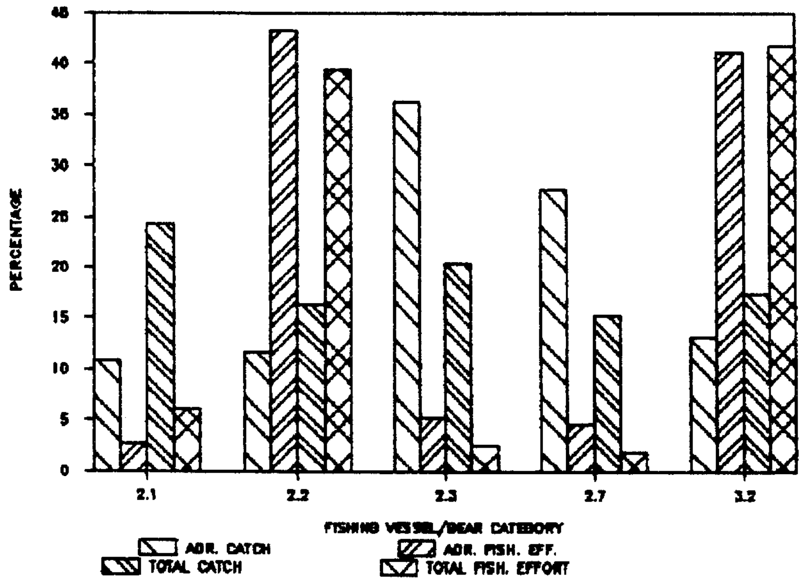


Figure 10 Fish catch and effort distribution by vessel/gear categories

6. CATCH PER UNIT EFFORT (cpue)

For motorized and non-motorized fishing vessels, cpue (catch per unit of effort) was measured by kg/vessel x fishing hour and for mechanized vessels as kg/hp x fishing hour. Table 10 shows cpue for vessel/gear categories in the different Strata. Strata 1 and 9 have the highest performance for motorized and non-motorized vessels (class 1.0). Maximum cpue values were found in Stratum 9 for purse seiners (class 2.1) and mechanized dredges (class 2.3) and in Stratum 1 for trawlers (class 2.2). The highest cpue values for trawlers working on more than one-day trips (class 3.2) were found in Strata 4 and 8, whereas in those Strata (6, 9 and 10) where these vessels were more numerous the average cpue was 0.06.

Table 10

cpue by strata (mechanized)

F.V./ gear category	Strata										Italy 1982
	1	2	3	4	5	6	7	8	9	10	
1.0	5.99	2.56	0.68	0.83	3.59	2.69	0.78	1.68	5.76	1.75	1.98
2.1	0.42	0.50	0.30	0.37	0.48	0.91	0.41	0.74	1.82	0.50	0.63
2.2	0.14	0.07	0.04	0.04	0.08	0.09	0.05	0.05	0.05	0.60	0.07
2.3	-	-	0.20	0.14	-	-	-	1.32	1.89	0.92	1.22
2.4	0.09	0.20	0.03	0.04	0.40	0.37	0.05	0.03	0.02	-	0.12
2.5	-	-	-	-	-	0.01	-	-	-	-	0.01
2.6	0.06	-	0.03	0.21	-	0.19	0.04	0.05	-	-	0.11
2.7	-	-	-	-	-	-	-	0.25	1.30	1.36	1.24
3.1	-	-	-	-	-	1.77	-	-	-	-	1.77
3.2	-	-	-	0.17	0.10	0.07	0.05	0.16	0.06	0.05	0.07
3.4	-	-	-	-	-	0.07	0.03	-	-	-	0.06
3.6	-	-	-	-	-	-	0.03	-	-	-	0.03
Y.'82	0.24	0.18	0.06	0.16	0.13	0.13	0.06	0.14	0.22	0.22	0.16

Figure 11 shows the catch per unit effort in the various vessel/gear categories.

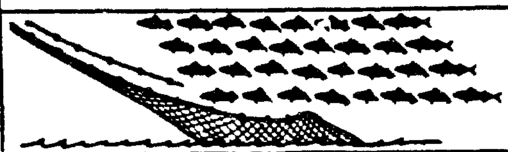
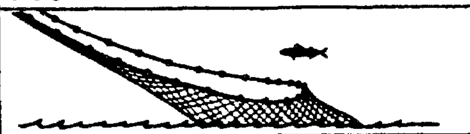
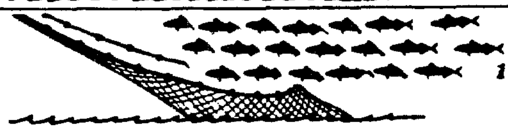
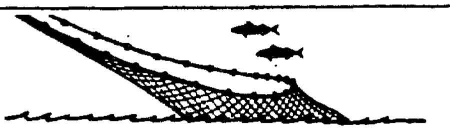
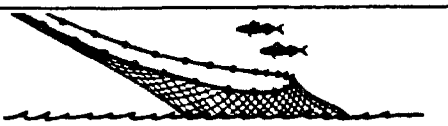
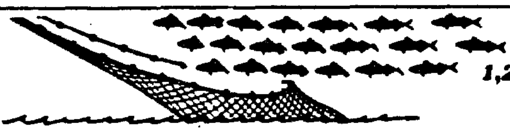
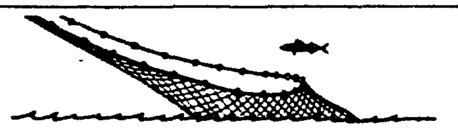
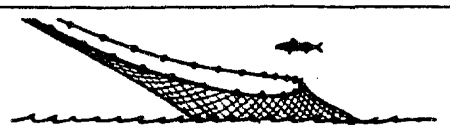
FISHING VESS. CLASS./ UNIT		
1.0	*Kg/vessel x fishing hour*	 1,98
2.1	*Kg/HP x fishing hour*	 0,63
2.2	*Kg/HP x fishing hour*	 0,07
2.3	*Kg/HP x fishing hour*	 1,22
2.4	*Kg/HP x fishing hour*	 0,12
2.5	*Kg/HP x fishing hour*	*not representative data*
2.6	*Kg/HP x fishing hour*	 0,11
2.7	*Kg/HP x fishing hour*	 1,24
3.1	*Kg/HP x fishing hour*	*not representative data*
3.2	*Kg/HP x fishing hour*	 0,07
3.4	*Kg/HP x fishing hour*	 0,06
3.6	*Kg/HP x fishing hour*	*not representative data*

Figure 11 cpue by vessel/gear category

7. REFERENCES

Bazigos, G.P., *et al.*, 1984. Studio di fattibilità per un sistema di rilevazione campionaria delle statistiche della pesca (PESTAT), Parte I. Statistiche sulla Flottiglia da Pesca. *Quad.Ist.Ric.Pesca Marit., Ancona*, 4 (1 Suppl.):358 p.

Cingolani, N., S.R. Coppola and J. Mortera, 1986. Studio di fattibilità per un sistema di rilevazione campionaria delle statistiche della pesca (PESTAT), Parte 2. Statistiche sulle Catture e sullo sforzo di pesca. *Quad.Ist.Ric.Pesca Marit., Ancona*, 5 (1 Suppl.) I e II parte: 754 p.

ISTAT, Annuario statistico della pesca e della caccia. Roma, Istituto Centrale di Statistica (various years)

CARACTERISTIQUES DE LA FLOTTILLE YOUGOSLAVE DE PECHE EN ADRIATIQUE

par

P. Cetinić
Institut d'océanographie et de pêche
Split

Les bateaux de pêche, faisant actuellement partie de notre flottille adriatique de pêche, sont en majorité construits dans les chantiers navals nationaux, alors qu'une moindre partie est d'origine étrangère. Même si la plupart de ces bateaux a, dès le début, été destinée à la pêche, une moindre partie a été construite pour d'autres buts, pour être ensuite réconvertie en bateaux de pêche. Ceci concerne en particulier les bateaux plus vieux, qui sont actuellement dans le domaine de la propriété privée, même si certains d'entre eux, ceux aux dimensions plus grandes, se trouvent aussi en propriété sociale.

Cette analyse ne couvre que les bateaux de pêche, dont la longueur est égale ou supérieure à 12 m, et dont la jauge brute est d'au moins 15 TJB. Les embarcations qui ne remplissent pas ces conditions sont considérées comme des barques et ne sont pas concernées par les considérations qui suivent.

1. NOMBRE ET REPARTITION DES BATEAUX PAR REGIONS

La flottille adriatique yougoslave de pêche compte aujourd'hui environ 242 bateaux dont 143 en propriété sociale et 99 en propriété privée. La répartition des bateaux par zones littorales est présentée au tableau 1.

Le tableau 1 démontre que la plupart des bateaux de notre flottille adriatique de pêche est concentrée dans l'Adriatique du Nord, alors qu'une moindre partie se trouve dans la partie sud. Si l'on admet que la partie nord de l'Adriatique comprend la région au nord de Split, elle représente, à ce moment, environ 75 % du nombre total des bateaux de notre flottille adriatique de pêche. En outre, une partie des bateaux qui se trouvent dans la partie sud de l'Adriatique, en particulier les bateaux en propriété sociale, réalise une partie considérable de leur pêche dans l'Adriatique du Nord. Ceci concerne en premier lieu la pêche de la sardine et d'autres espèces de poisson bleu, qui représentent l'essentiel de notre pêche maritime. En effet, l'Adriatique du Nord, et en particulier la région de l'Istrie occidentale sont beaucoup plus riches et plus propices à la pêche de ces espèces que autres régions de l'Adriatique.

2. DESTINATION ET CARACTERISTIQUES DES BATEAUX DE NOTRE FLOTTILLE DE PECHE

D'une façon générale, on peut dire, que notre flottille adriatique de pêche, est en grande partie vieillie et qu'elle ne correspond plus aux nécessités actuelles de notre industrie de pêche. Ceci concerne surtout les bateaux construits avant 1978, qui ne sont pas uniformisés et qui diffèrent entre eux par leurs caractéristiques techniques de construction. Ce sont principalement les bateaux de pêche combinés, destinés à la pêche à la senne coulissante et au chalutage, ayant plutôt les caractéristiques des senneurs que celles des chalutiers. Actuellement ils pratiquent plutôt la pêche à la senne coulissante, alors qu'une moindre partie pratique la pêche au chalut de fond à panneaux. Ils ont des moteurs peu puissants qui, le plus souvent, sont de 110-147 kW (150-250 CV), et dépassent rarement 220 kW (300 CV). La force motrice des bateaux plus petits est environ 59-88 kW (80-120 CV). Ces puissances de moteurs ne leur permettent pas une pêche efficace aux chaluts-boeufs pélagiques qui sont de plus en plus employés chez nous dans la pêche du poisson pélagique de petites dimensions.

Les caractéristiques générales de ces bateaux sont:

- le pont pour le travail des engins de pêche se trouve dans la partie arrière;
- la cale à poisson, dont la capacité est, selon le bateau, de 1 000 à 10 000 kg de poisson en caisses, se situe dans la partie centrale. Par rapport à la longueur du bateau, qui est de 16-25 m, la grandeur de la cale est désavantageuse et ne permet pas une utilisation convenable de l'espace disponible à bord. Dans la pêche à la senne coulissante, le poisson capturé, qui est principalement la sardine, est tenu à bord, dans des caisses ou en vrac;
- les locaux de l'équipage se trouvent dans la partie avant, sous le pont et derrière l'espace du moteur principal;

Tableau 1

Disposition des bateaux par zones littorales

Numéro	Région de	Nombre de bateaux	
		En propriété sociale	En propriété privée
1.	Kopar	-	1
2.	Izola	20	-
3.	Poreč	14	-
4.	Umag	-	1
5.	Rovinj	28	3
6.	Pula	-	4
7.	Labin	-	1
8.	Opatija	-	1
9.	Rijeka	16	4
10.	Cres-Losinj	-	6
11.	Crikvenica	-	4
12.	Senj	-	1
13.	Krk	-	10
14.	Rab	-	4
15.	Pag	-	5
16.	Zadar	33	13
17.	Biograd	1	1
18.	Sibenik	1	7
19.	Trogir	-	3
20.	Split	13	4
21.	Omis	-	3
22.	Brac	5	1
23.	Hvar	-	4
24.	Korcula	6	2
25.	Vis	3	1
26.	Makarska	-	12
27.	Dubrovnik	-	1
28.	Kotor	3	1
29.	Ulcinj	-	1
30.	Total	143	99
31.	Total global	242	

- la superstructure des bateaux est de grande dimension, située dans la partie centrale et en avant ce qui, dans la majorité des cas, empêche de voir le pont de travail à partir du pont de commandement;

- les treuils sont le plus souvent à mi-longueur du bateau et par leur construction conviennent plutôt à la pêche à la senne coulissante qu'au chalutage;

- la majorité des bateaux possède le bloc "Puretič" (power block) pour le travail à la senne coulissante et presque toute la flottille a des échosondeurs dont une partie devrait être renouvelée, puisque maints d'entre eux sont déjà utilisés depuis des années;

- la plupart des bateaux sont construits en bois et quelques-uns seulement sont en acier;

- lors du chalutage qui s'effectue exclusivement par l'arrière, on fixe aux deux bords du bateau une potence avec des blocs, l'enrouleur de relevage et éventuellement le treuil au filet pour le relevage du chalut.

En ce qui concerne la longueur, ces bateaux peuvent être classés en trois catégories. La première, dont la longueur hors tout est de 15-18 m, la deuxième de 19-21 m et la troisième dépassant 21 m.

Les caractéristiques générales de notre flottille adriatique de pêche nous font constater qu'elle convient surtout à la pêche à la senne coulissante et non pas à celle au chalut, et surtout pas à la pêche aux chaluts pélagiques qui sont de plus en plus utilisés dans notre pêche maritime.

Vu l'état de notre flottille de pêche, qui satisfaisait toujours plus difficilement à nos besoins, on a vers la fin des années soixante-dix et au début des années quatre-vingts procédé à son renouvellement. De nouveaux bateaux de pêche sont construits dans des chantiers navals du pays et on les achète aussi à l'étranger, bateaux qui sont principalement destinés à la pêche aux chaluts-boeufs pélagiques. Ce sont des bateaux de pêche en acier, en bois et en polyester renforcé, dont le nombre est en croissance, de sorte qu'actuellement on dispose de 24 nouvelles unités. Leurs caractéristiques principales sont présentées au tableau 2.

Les bateaux présentés au tableau 2 sont des chalutiers à l'exception de ceux de la série "Greben" où on trouve des chalutiers-senneurs. Ils pratiquent tous la pêche au chalut-boeuf pélagique, sauf la série des bateaux de la série "Jadran" qui pratiquent la pêche au chalut de fond à panneaux. A bord de tous ces bateaux, le chalutage s'effectue par l'arrière du bateau en utilisant un enrouleur, sauf sur les bateaux de la série "Jadran" où le relevage du chalut s'effectue simplement par une rampe arrière. Ils possèdent tous l'équipement nécessaire à la pêche au chalut, y compris sur la plupart des bateaux, des treuils à filet. Sur les chalutiers-senneurs on trouve aussi des blocs "Puretič". Tous les bateaux possèdent l'équipement nécessaire pour le repérage du poisson et le contrôle des chaluts-boef pélagiques (échosondeurs verticaux et sondeurs de filet). Les chalutiers-senneurs possèdent aussi des sonars. Ils ont tous un radar, un pilote automatique et les autres équipements de navigation indispensables.

Tableau 2

Caractéristiques principales des bateaux de pêches nouvellement construits

Caractéristiques du bateau	Série				
	Jadran	Greben	Droga	Mirna	Dinko
Longueur hors tout/m	25,40	23,19	29,13	27,00	25,36
Largeur/m	6,80	6,86	6,60	6,20	0,00
Hauteur/m	3,30	3,70	3,20	-	3,50
TJB	98	119	156	78	123
Force motrice/kW	220	257-588	588	316	588
Cale à poisson/m³	70	80-100	100	60	70
Matériel de construction	acier	plastique	acier	bois	bois
Equipage	8	8	8	8	8
Type de bateau	chalutier par l'arrière	combiné	chalutier par l'arrière	chalutier par l'arrière	chalutier par l'arrière
	chalutier	chalutier-senneur	chalutier	chalutier	chalutier
Destination	chalutage	chalutage-pêche à la senne coulissante	chalutage	chalutage	chalutage

Le tableau 2 démontre clairement que les forces motrices des moteurs principaux sont de 220-588 kW (300-800 CV). Pour la pêche du poisson bleu de petites dimensions, les sardines en particulier, il faut disposer de bateaux d'une force motrice plus grande que celle nécessaire, dans nos conditions, à la pêche au chalut de fond ou à la senne coulissante. Il semble cependant que les forces motrices de 588 kW (800 CV) qui sont en majorité installées sur nos chalutiers, pratiquant la pêche aux chaluts-boeufs pélagiques soient trop fortes et que des forces motrices moindres, et des chaluts-boeufs pélagiques, plus petits, rendraient plus rentable la production de notre flottille adriatique de pêche (Regner, 1982; Cetinic, 1983).

3. TYPES ET CARACTERISTIQUES GENERALES DES ENGINS UTILISES

Selon la destination et le type des bateaux de notre flottille adriatique de pêche, on utilise chez nous les types d'engins de pêche suivants:

- senne coulissante à sardine;
- senne coulissante à thons;
- chalut de fond à panneaux;
- chaluts-boeufs pélagiques.

La senne coulissante à sardine est l'engin de pêche le plus important, utilisé dans notre pêche maritime, car la sardine et les autres espèces du poisson bleu de petites dimensions sont la matière première principale de notre industrie de pêche. La sardine est le poisson, le plus important de notre pêche industrielle et représente plus de 50 % des captures de toute notre flottille.

Les sennes coulissantes utilisées pour la pêche à sardine ont en général une forme rectangulaire où le rapport de la hauteur et de la longueur est de 1:3 à 1:4, ce qui signifie que la hauteur du filet fait 1/3 ou 1/4 de sa longueur. Ce rapport peut différer selon les coutumes des pêcheurs et les régions. Chez nous on utilise le plus souvent les sennes coulissantes ayant une longueur en état armé, de 320 m et une hauteur de 80-90 m, mais ces grandeurs peuvent varier selon la région. Les sennes coulissantes peuvent être à une aile et dans ce cas la poche se trouve d'un côté du filet ou bien à deux ailes et dans ce cas la poche est située au centre du filet. L'utilisation du bloc "Puretić" diminue l'emploi des sennes coulissantes à deux ailes. La longueur du côté de maille sur les sennes coulissantes à sardine ne peut pas être moindre de 8 mm.

Les sennes coulissantes à thons utilisées dans notre pêche maritime ne sont pas différentes des sennes coulissantes à sardine, sauf dans leurs dimensions, l'épaisseur du fil, la grandeur de la maille, la façon d'armement et d'autres caractéristiques moins importantes. Ce sont des sennes coulissantes rectangulaires à une aile, longues de 450 à 700 m. Leur hauteur ne dépasse pas 120 m. La longueur du côté de maille ne doit dans aucune partie du filet être inférieure à 40 mm.

Le chalut de fond à panneaux qui est encore utilisé dans la plupart des chalutiers de notre flottille de pêche est le chalut du type méditerranéen. Ces derniers temps, cependant, on rencontre aussi les chaluts de fond à ouverture verticale plus grande qui, comme on le sait, diffèrent par la construction des chaluts du type méditerranéen. Dans la pêche au chalut de fond on utilise principalement chez nous les panneaux plats rectangulaires même si depuis peu on trouve aussi des panneaux au profil en V. La longueur du côté de maille ne peut dans aucune partie du chalut de fond être inférieure à 20 mm.

Les chaluts-boeufs pélagiques sont l'engin de pêche industrielle le plus récent qui est utilisé par les bateaux de notre flottille adriatique de pêche. L'utilisation plus intense du chalut-boeuf pélagique dans notre pêche maritime a commencé au début des années quatre-vingts, même si les recherches sur son utilisation ont commencé beaucoup plus tôt. On utilise principalement les chaluts-boeufs pélagiques peu résistants dont la grandeur des mailles dans les ailes et dans les premiers segments de l'ouverture du chalut peut aller jusqu'à quelques mètres. On utilise des chaluts pélagiques quadrilatères asymétriques, dont la longueur du côté de maille, ne peut dans aucune partie du chalut pas être inférieure à 8 mm. Cette grandeur de la maille est appliquée seulement dans la poche du chalut, car les chaluts-boeufs pélagiques sont utilisés pour la pêche à sardine et à d'autres espèces de poisson bleu de petites dimensions.

4. AGE DES BATEAUX

La composition de notre flottille de pêche par années de construction des bateaux en propriété sociale et en propriété privée est présentée au tableau 3.

Ce tableau démontre que notre flottille de pêche comprend encore des bateaux construits entre les deux guerres, et certains même auparavant. Les bateaux construits pendant cette période et certains de ceux construits dans la période postérieure ont été reconstruits. Si on exclue une vingtaine de bateaux construits ou achetés pendant des dizaines d'années, on peut dire, en général, que notre flottille adriatique de pêche est vieillie. Cette constatation est illustrée par le tableau 4 qui donne la composition par âge des bateaux de notre flottille adriatique de pêche.

Tableau 3

Composition de la flottille de pêche par années de construction des bateaux

Année de construction	Nombre de bateaux	Année de construction	Nombre de bateaux
1908	2	1943	2
1915	1	1944	3
1930	1	1946	8
1932	2	1947	18
1939	2	1948	15
1940	3	1949	10
1950	12	1970	-
1951	16	1971	-
1952	8	1972	-
1953	8	1973	-
1954	5	1974	1
1955	8	1975	1
1956	9	1976	1
1957	7	1977	1
1958	12	1978	6
1959	11	1979	1
1960	20	1980	3
1961	5	1981	2
1962	1	1982	4
1963	1	1984	3
1964	1	1985	1
1965	-	1986	2
1966	1	inconnue	15[a]
1967	1		
1968	1		
1969	1	Total	242

a/ Le nombre de bateaux de l'année de construction inconnue est approximativement exact

Tableau 4

Composition par âge des bateaux de notre flottille adriatique de pêche

Age	Nombre de bateaux	% par rapport au nombre total
De 1-5 ans	13	5,37
De 6-10 ans	13	5,37
De 11-15 ans	3	1,24
De 16-20 ans	3	1,24
De 21-25 ans	4	1,65
De 26-30 ans	55	22,73
De 31-35 ans	38	15,70
De 36-40 ans	71	29,34
De 41-45 ans	19	7,85
Plus de 45 ans	8	3,31
Bateaux de l'âge inconnu	15	6,20
Total	242	100

Le tableau 4 montre qu'environ 87 % des bateaux de notre flottille adriatique de pêche est âgé plus de 20 ans et que même 46 % des bateaux a plus de 35 ans. Ces données prouvent qu'il faut continuer le processus de modernisation de la flottille adriatique yougoslave de pêche.

5. REFERENCES

Basioli, J., 1986. Stanje ribarske flote i postizana morska lovina. Morsko Ribar., 38(2):71-6

Cetinić, P., 1973. Jadranska ribolovna flota i prijedlozi za njezin napredak. Morsko Ribar., 25(1):4-8

____________, 1983. Mogućnosti i osnovni pravci razvoja ribarstva na Jadranu. Mogućnost i uloga mediteranskog podrucja u jugoslavenskom agrokompleksu. Beograd, Sveske casopisa "Glasnik"

Regner S., 1982. Usporedba ulova male plave ribe lebdećim povlacnim mrezama i plivaricama u 1980 godini. Morsko Ribar., 34(1):16-8

DEFINITION AND PRELIMINARY EVALUATION OF THE ITALIAN FISHING ZONES EXPLOITED BY THE NATIONAL FLEET

by

S.R. Coppola
FAO Fisheries Department
Rome

and

N. Cingolani
National Research Council
Istituto di Ricerche sulla Pesca Marittima
Ancona

1. INTRODUCTION

The purpose of this preliminary study is to verify the possibility of evaluating the level of exploitation of the Mediterranean Sea broken down by elementary fishing zones using sample data collected through the Catch and Effort Assessment Survey conducted in 1982/83 (mentioned below).

This is the first of a series of studies on subjects of specific interest which will be undertaken using the vast amount of data collected during the above-mentioned survey. It is believed that detailed information on selected fishing zones is necessary for the rational management of the fishery resources.

This work contains a first analysis of fishery zones habitually frequented by part of the Italian fishing fleet in terms of number of boats and Gross Registered Tonnage (GRT) fishing in each fishing zone. In this paper the Adriatic Sea only has been considered.

The PESTAT Programme "Feasibility Study of a Fishery Statistical Survey System" was carried out by the Istituto di Richerche sulla Pesca Marittima, Ancona, with the technical assistance of the FAO Fisheries Department, Rome, with Merchant Navy Ministry funding.

It was undertaken in two phases: the first concerning fishing fleet statistics, the second catch and fishing effort statistics.

The results of this study have already been published (Bazigos <u>et al.</u>, 1984) (Cingolani, Coppola and Mortera, 1986), and the reader should refer to these reports for the survey implementation methodology used, etc.

During the above-mentioned research a great deal of data was collected on several items, e.g., data on structural characteristics of the fishing vessels, on deck machinery, on number and composition of crews, on fishing gear (number, type, composition, etc.), on fishing techniques by fishing gear (fishing hours, number of hauls, etc.) and on fishing zones, etc.

However, only part of the data collected have been processed and are contained in the two publications mentioned above; the rest will gradually be analysed and brought to the attention of scientists and others involved in fishery research.

2. METHODOLOGY

The methodology used for collecting the data on fishing zones as well as on all the other items is described in the document mentioned in the above section. Estimates contained in this report, referring to the Adriatic Sea only, were calculated from about 16 000 interviews conducted in 23 ports and landing centres (Primary Sampling Units) scattered well along the coast from the Strait of Otranto to the northeastern border with Yugoslavia (statistical strata 8, 9, 10 on map in Figure 1).

For processing purposes, the following concepts of fishing zones have been adopted.

(i) <u>Elementary Fishing Zones</u>

These are the same geographic fishing areas used in the Catch and Effort Assessment Survey which were obtained by dividing the Mediterranean Sea into squares measuring 30 mi each side, and codified using alpha-numeric codes corresponding to their geographical position (vertical/horizontal).

Figure 2 gives the base map used for this study showing the grid of all the Elementary Fishing Zones and their codification.

Figure 1 Geographic stratification

Only squares with some reported fishing activity were taken into consideration, and in order to estimate coefficients of level of exploitation by unit area (1 square mile), the surface area was estimated by using manual instruments on medium size maps for those adjacent to the coast.

(ii) Aggregated Fishing Zone

These fishing areas are made up of the aggregation of elementary fishing zones exploited by fishing vessels coming from the same statistical stratum (see map in Figure 1). Due to the high mobility of fishing units, especially mechanized and large mechanized, it is not infrequent that the same elementary fishing zone falls in more than one Aggregated Fishing Zone.

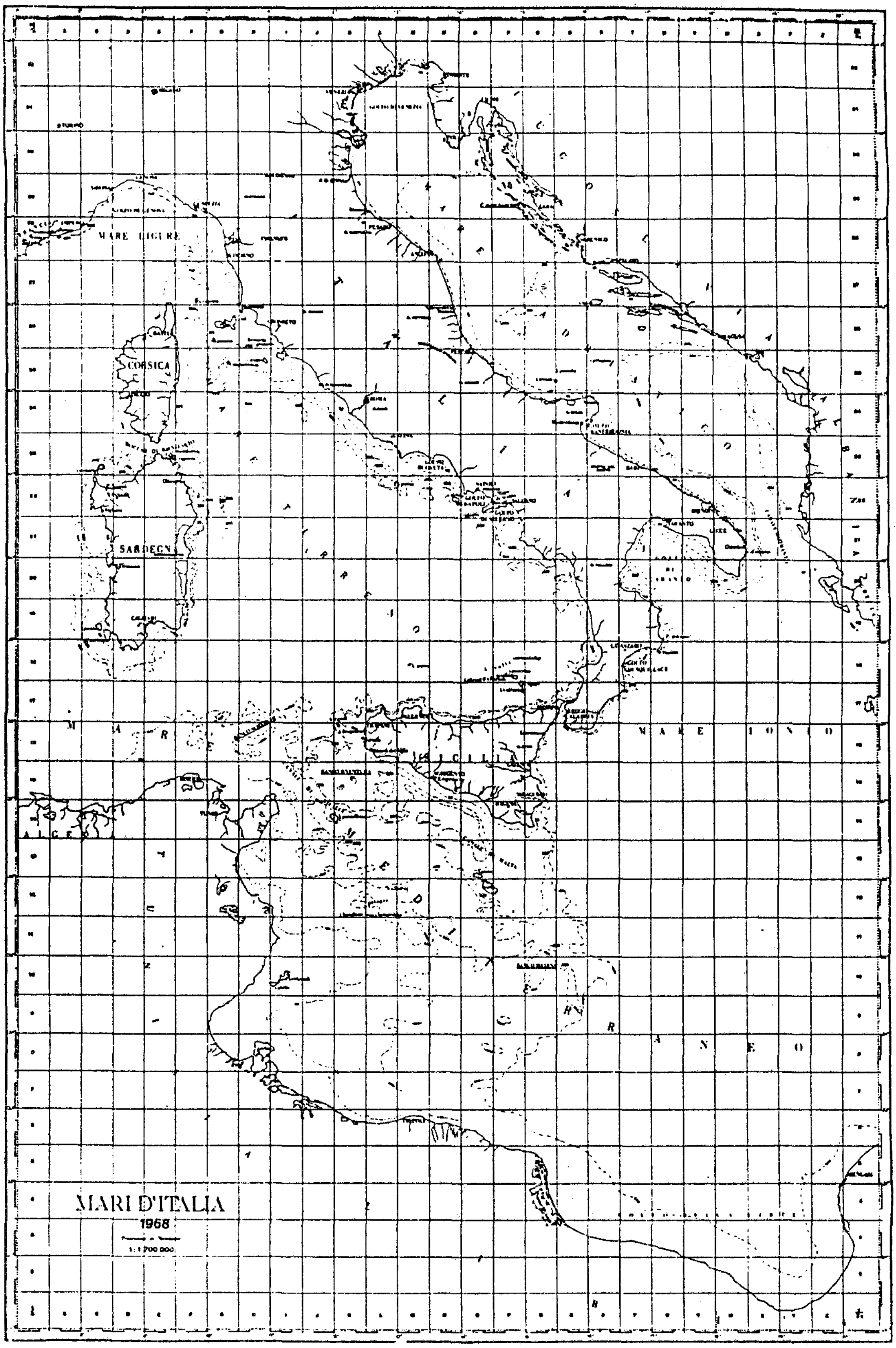


Figure 2 Elementary Fishing Zones and their codification

This aggregation enabled estimates of non-respondent units which were first classified as "unknown" and then proportionally distributed among the other elementary fishing zones within the same Aggregated Zone. This aggregation scheme will also be used for further analysis to raise data from Primary Sample Unit (PSU) level to the total.

3. ESTIMATION PROCESS

To evaluate the level of exploitation of the fishing zones "visited", three processing steps have been followed.

(i) In the first step of this analysis, only sample data were used; the number of fishing vessels by type and by gear category fishing in each elementary fishing zone during the sample days (5-6 days per month) were counted. The same process was used to calculate the corresponding GRT. Elementary fishing zones visited by vessels from the same statistical strata were then grouped together into aggregated zones, and the non-respondents proportionally distributed among them.

(ii) The second step of the data processing was to raise the sample data to the primary sample unit level for the whole year. The raising factors applied, landing raising factor and time raising factor, were the same as those used for processing the catch and effort survey data.

From these calculations the expected number of vessels and corresponding GRT by type and by gear category belonging to the 23 primary sample units that fished in the elementary zones during the year were estimated.

(iii) Finally the "partial" coefficients of exploitation of the fishing zones were calculated. They are expressed in number of vessels or GRT by square mile being fished in each of the elementary fishing zones visited during the year. They were calculated by type of vessels and gear category and classified by importance. The codification used for the type of boat and gear category is given in the Appendix.

The term "partial" is used to underline that no further extrapolation (to population totals) has been done since because it was considered inappropriate in the absence of some other supplementary information. Therefore, these coefficients only refer to the activity of the vessels belonging to the 23 selected fishing sites mentioned above (see also Conclusions at the end of the paper).

4. RESULTS

In order to shorten this report, and since the coefficients expressed in GRT are more significant than those of number of vessels, the results obtained will be given in GRT by type of vessels and by gear category only.

The estimated partial coefficients of exploitation by elementary fishing zones ranged from insignificant values up to a maximum of 5 068 GRT per mi^2/year.

For the evaluation of results the whole set of data was divided into three arbitary classes of fishing density:

Low Density Fishing Zones:	whose partial coefficients range from 1 to 500 GRT/mi^2/year
Medium Density Fishing Zones:	whose partial coefficients range from 501 to 1 500 GRT/mi^2/year
High Density Fishing Zones:	whose partial coefficients are higher than 1 500 mi^2/year

In Tables 1 and 2 the two most important classes with their partial coefficients are listed, showing also the breakdown by type of boat and by gear category. The remaining fishing zones not tabulated can be considered as low density fishing zones.

Table 1

Adriatic Sea: List of Elementary Fishing Zones with high partial coefficient of exploitation by type of vessel and gear category (1982)

Zone	NM+MOT	M1G-2.1	M1G-2.2	M1G-2.3	M1G-2.4	M1G-2.5	M1G-2.6	M1G-2.7	M2G-3.2	Coefficient
M32	2 524	0	839	840	0	0	0	864	0	5 068
K29	0	0	1 753	0	0	0	0	1 211	0	2 964
M28	283	0	1 463	331	0	0	0	226	148	2 452
R24	57	0	1 899	0	C	0	0	68	268	2 292
K31	0	0	92	2 116	0	0	0	6	0	2 214
S24	106	0	1 872	0	17	0	.2	71	134	2 201
N28	69	0	118	.7	0	0	0	198	1 290	1 676
N32	493	486	161	0	0	0	0	508	0	1 650

Table 2

Adriatic Sea: List of Medium Density Elementary Fishing Zones with their coefficients of exploitation by type of vessel and by gear category

Zone	NM+MOT	M1G-2.1	M1G-2.2	M1G-2.3	M1G-2.4	M1G-2.5	M1G-2.6	M1G-2.7	M2G-3.2	Coefficient
S23	192	0	622	0	235	0	130	83	13	1 277
L29	0	0	1 140	29	0	0	0	65	0	1 234
P25	15	0	1 023	0	0	0	0	0	10	1 048
N26	215	0	21	579	0	0	0	0	31	847
T23	40	35	385	0	0	0	10	6	182	661
L28	0	0	564	13	0	0	0	58	0	636
L31	0	0	83	0	0	0	0	343	183	609
T24	.01	58	53	0	0	0	0	0	431	542

In five cases (W21, X21, V23, M29, K30) no data were available.

The map in Figure 3 gives a visual assessment of the preliminary evaluation of the level of exploitation of most dense fishing zones.

The relative importance of the type of vessel and the gear category is shown in Table 3.

5. DISCUSSION AND CONCLUSIONS

Final conclusions will be drawn on completion of the analysis when other sets of data will also be taken into account, such as time spent fishing, species composition of the catch derived from these fishing vessels, etc.

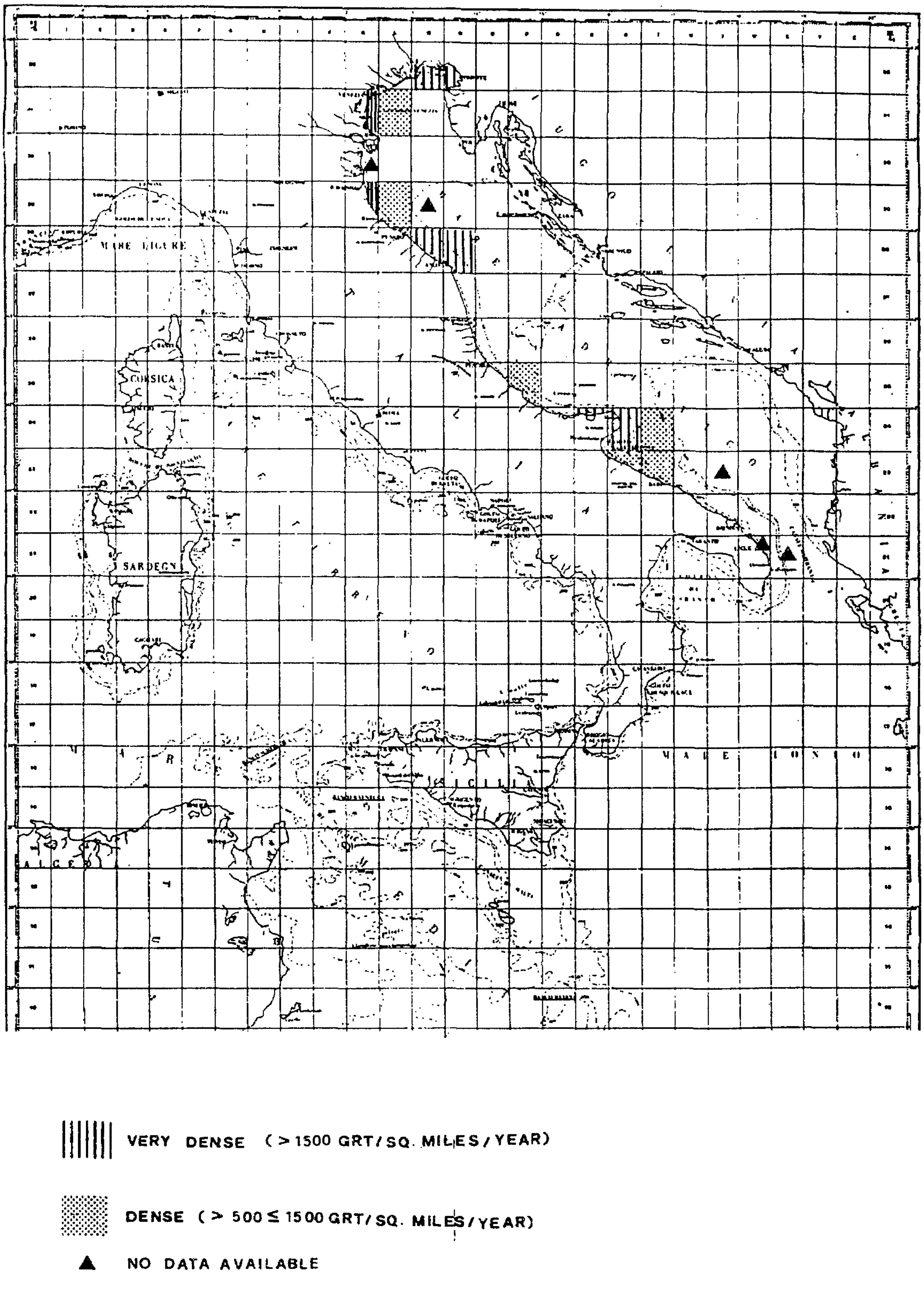


Figure 3 Preliminary and partial evaluation of the level of exploitation of the Adriatic Sea by Elementary Fishing Zones

Table 3

The relative importance of the type of vessel and the gear category

Zone	NM+MOT	M1G-2.1	M1G-2.2	M1G-2.3	M1G-2.4	M1G-2.5	M1G-2.6	M1G-2.7	M2G-3.2	Coefficient
M32	49.8	0	16.6	16.6	0	0	0	17.0	0	5 068
K29	0	0	59.1	0	0	0	0	40.9	0	2 864
M28	11.5	0	59.7	13.5	0	0	0	9.2	6.0	2 452
R24	2.5	0	82.8	0	0	0	0	3.0	11.7	2 292
K31	0	0	4.2	95.4	0	0	0	0.4	0	2 214
S24	4.8	0	85.1	0	0.8	0	0	3.2	6.1	2 201
N28	4.1	0	7.1	0	0	0	0	11.8	77.0	1 676
N32	29.9	29.5	9.8	0	0	0	0	30.8	0	1 650
S23	15.0	0	48.8	0	18.4	0	10.2	6.5	1.1	1 278
L29	0	0	92.5	2.4	0	0	0	5.3	0	1 234
P25	1.5	0	97.6	0	0	0	0	0	0.9	1 048
N26	25.4	0	2.5	68.4	0	0	0	0	3.7	847
T23	6.1	5.3	58.4	0	0	0	1.6	1.0	27.6	661
L28	0	0	88.7	2.1	0	0	0	9.2	0	636
L31	0	0	13.6	0	0	0	0	56.3	30.1	609
T24	0	10.8	9.7	0	0	0	0	0	79.5	543

From an evaluation of the tabulated results (absolute and relative) it appears evident that the most important fishing zones with the highest coefficients of exploitation in the Adriatic Sea are coastal zones.

An important characteristic that can be assumed by interpreting these results is that in all the fishing zones considered, the bottom trawl fishery is always heavily present. Moreover, its predominance is not only shown in absolute values, but mainly as a percentage contribution of this method of fishing to the total. In fact, it is always considerable, and in certain cases, represents the quasi-totality of the exploiting vessels (92 percent, 88 percent, etc.).

Another type of daily trawler, the midwater pair trawler, also plays an important role in the exploitation of the Adriatic Sea and is well distributed geographically.

The artisanal fishery also shows an important presence with an extraordinarily high coefficient of exploitation in the fishing zone M32 (around the Gulf of Trieste), which is the highest in the whole Adriatic Sea (2 524 GRT/mi^2/year).

The second most exploited fishing area seems to be fishing zone K31 (around Venice and Chioggia) where the coefficient of exploitation reached the level of 2 116 GRT/mi^2/year due to extensive use of mechanized dredges.

Large mechanized trawlers (bottom trawlers with more than a one-day trip; Class 3.2) need to be mentioned in this context. They are present in many fishing zones where, in some cases, they appear to be important as in zones L31 (Gulf of Venice) and N28 (off Ancona), and in one zone is the predominant fishing method (zone T24, off the Manfredonia Gulf).

The above considerations definitely need to be validated once the whole analysis is completed, and some more information used to integrate this study.

However, two basic comments should be made at the end of this partial study, because on the one hand, we believe that these estimates should be considered interesting mainly for future comparisons, and on the other, we have some reservations on the use of these data alone to define and evaluate fishing zones. First, the sample data used definitely have a good degree of representativeness in terms of fishing sites (by size and by location), of fishing units (by type and by gear) and also of time coverage (5-6 days a month for the whole year). The sampling scheme was designed for other purposes, however, where fishing areas were only supplementary information. Second, the size of the fishing zones was a constraint derived from a compromise between the survey designer and the fishermen: it would be very difficult to collect data on fishing zones (i.e., fishing grounds) if smaller unit areas were proposed.

From experience gained during this work we would like to suggest introducing some species purpose surveys (having as the objective evaluation of fishing zones), where grids not larger than 25 mi^2 should be used. The possibility should also be considered of applying a variable grid system, with smaller zones for those closer to the coast, and finally a variable division using also the sea bottom depth would definitely increase the accuracy of the results.

6. REFERENCES

Bazigos, G.P., et al., 1984. Studio di fattibilità per un sistema di rilevazione campionaria delle statistiche della pesca (PESTAT). Parte I. Statistiche sulla Flottiglia di Pesca. Quad.Ist.Ric.Pesca Marit., Ancona, 4(1 Suppl.):358 p.

Cingolani, N., S.R. Coppola and J. Mortera, 1986. Studio di fattibilità per un sistema di rilevazione campionaria delle statistiche della pesca (PESTAT). Parte 2. Statistiche sulle catture e sullo sforzo di pesca. Quad.Ist.Ric.Pesca Marit., Ancona, 5 (1 Suppl.) I e II parte:754 p.

APPENDIX

Classes of Fishing Vessels by Type and by Gear Used

CLASS	TYPE OF FISHING VESSEL/GEAR USED
1.0	Non-Motorized + Motorized: **ALL GEAR**
2.0	Mechanized fishing vessels/trips less than one day: **ALL GEAR**
2.1	Mechanized fishing vessels/trips less than one day: **PURSE-SEINERS**
2.2	Mechanized fishing vessels/trips less than one day: **TRAWLERS**
2.3	Mechanized fishing vessels/trips less than one day: **MECHANIZED DREDGES**
2.4	Mechanized fishing vessels/trips less than one day: **FIXED NETS**
2.5	Mechanized fishing vessels/trips less than one day: **TRAPS**
2.6	Mechanized fishing vessels/trips less than one day: **HOOKS**
2.7	Mechanized fishing vessels/trips less than one day: **MIDWATER PAIR TRAWLERS**
3.0	Mechanized fishing vessels/trips more than one day: **ALL GEAR**
3.1	Mechanized fishing vessels/trips more than one day: **PURSE SEINERS**
3.2	Mechanized fishing vessels/trips more than one day: **TRAWLERS**
3.4	Mechanized fishing vessels/trips more than one day: **FIXED NET**
3.6	Mechanized fishing vessels/trips more than one day: **HOOKS**

EVOLUTION TECHNOLOGIQUE DE L'EFFORT ITALIEN DE PECHE AU CHALUT DANS L'ADRIATIQUE AU COURS DES QUARANTE DERNIERES ANNEES

par

M. Ferretti et P. Arata
ICRAP Roma

1. INTRODUCTION

Que l'effort de pêche, au cours des quarante dernières années, se soit fortement accru, c'est là une donnée tellement évidente qu'il est inutile de s'y attarder.

Par contre, comment il s'est accru, de combien, et quels sont les paramètres à prendre comme indice de cet accroissement voilà encore matière à discussion.

Il ne faut certes pas voir le problème seulement en fonction du nombre de chalutiers, vu que la puissance et la jauge ont augmenté et augmentent encore.

Il ne faut pas non plus oublier la grande évolution observée dans les engins de pêche, par exemple avec l'introduction des fibres synthétiques et l'emploi, dans la pêche professionnelle, de nouveaux engins.

Dans cet exposé succinct, nous essaierons de voir ces sujets un par un, pour préciser, dans les limites du possible, l'évolution de l'effort de chalutage dans l'Adriatique, au cours des quarante dernières années.

2. AUGMENTATION DE LA PUISSANCE ET VARIATION DU NOMBRE ET DES CARACTERISTIQUES DES BATEAUX DE PECHE

Tout de suite après la guerre, les bateaux de pêche étaient peu nombreux; en outre, les moteurs installés à bord étaient très petits, et certainement inadaptés, c'est du moins ce que l'on dirait aujoud'hui, au chalutage.

Mais dès les années cinquante, les moteurs de 90 et 120 CV commençaient à entrer en service, moteurs lents, à haut rendement, qui sont en partie encore en service, et dont l'emploi pour la pêche était déjà acceptable.

Nous avons aujourd'hui des bateaux qui pêchent au chalut avec des moteurs atteignant 800 CV, moteurs indéniablement gros pour l'Adriatique, et technologiquement peu utiles, lorsqu'on emploie des chalut de fond à panneaux.

Les mesures effectuées à bord de plusieurs chalutiers de l'Adriatique, de différentes puissances, ont montré que le chalut de fond proprement dit a un remorquage maximum de 2 000 kg par câble de remorquage, donc une capacité de traînée totale de 4 000 kg, la traînée pouvant être effectuée tranquillement au moyen d'hélices à pales fixes et sans tuyère, avec 400 CV.

Les chevaux en plus sont donc en excès et ne sont pas utilisés pour la pêche. On pourrait alors penser qu'ils n'interviennent en aucune façon dans l'effort de pêche. Ce serait une erreur.

Ils ont un effet peu important, mais ils en ont un. En pratique, le gros chalutier, équipé d'un moteur puissant, peut se permettre de pêcher quelques jours de plus que les autres, lorsque les conditions de la mer découragent les plus petits. La puissance élevée n'entraîne donc pas une augmentation directe du nombre des captures par trait de chalut, mais une augmentation possible des journées et des heures de pêche pendant l'année.

Cette affirmation ne vaut pas pour la pêche au rapido, dont nous reparlerons plus avant.

Les tableaux donnent les variations les plus importantes sur les chalutiers de l'Adriatique au cours des dernières années.

Les données sont extraites des annuaires de l'ISTAT, et sont donc les données officielles italiennes, bien que leur crédibilité soit parfois douteuse. Aux fins du présent travail, toutefois, elles devraient être assez fiables, car ce ne sont pas les valeurs absolues qui nous intéressent, mais plutôt les tendances, les pourcentages d'augmentation, qui peuvent rester valables, même si au départ les données sont entachées d'erreurs systématiques.

Le tableau 1 présente des données relatives aux années 1960, 1970, 1980, sur le nombre et la jauge brute des chalutiers, avec les augmentations afférentes, en pourcentage.

Tableau 1

Evolution de nombre et jauge brute des chalutiers italiens en Adriatique

	1960			1970			1980			Accroissement % 1960-80	
	Nombre	Jauge	Jauge moyen	Nombre	Jauge	Jauge moyen	Nombre	Jauge	Jauge moyen	Nombre	Jauge
Nord Adriatique	1 221	8 097	6,63	1 321	10 865	8,22	1 801	19 125	10,62	47,50	136,20
Centre Adriatique	688	18 593	27,02	1 179	47 136	39,98	1 379	52 023	37,73	100,43	179,80
Sud Adriatique	342	7 826	22,88	547	23 610	43,16	754	33 229	44,07	120,47	324,60

Le tableau 2 présente les données relatives aux mêmes années, sur le nombre, la jauge et la puissance de tous les bateaux de pêche, et non pas seulement des chalutiers. Ceci parce que, malheureusement, dans les annuaires ISTAT, les données sur la puissance ne sont pas présentées désagrégées par systèmes de pêche.

Tableau 2

Evolution de nombre, jauge brute, puissance des bateaux de pêche italiens en Adriatique

	1960			1970			1980			Accroissement % 1960-80		
	Nombre	Jauge	Puiss.	Nombre	Jauge	Puiss.	Nombre	Jauge	Puiss.	Nombre	Jauge	Puiss.
Nord Adriatique	2 005	12 215	53 479	2 341	15 121	89 807	2 785	24 123	189 855	38,90	92,92	255,01
Centre Adriatique	1 369	20 382	74 013	1 836	50 667	165 673	2 502	58 240	271 249	82,76	185,74	266,49
Sud Adriatique	1 018	11 433	39 464	1 641	28 947	106 683	1 898	38 882	168 974	86,44	240,09	328,17

Enfin, on trouve dans le tableau 3 les données sur la répartition par classes de jauge des chalutiers en haute et moyenne Adriatique, en 1980.

Ce dernier tableau peut donner une idée de la conformation actuelle de la flotte de chalutiers qui opère dans l'Adriatique.

3. INTRODUCTION DES FIBRES SYNTHETIQUES DANS LA CONSTRUCTION DES CHALUTS

Au cours des années cinquante, les fibres synthétiques, en particulier la fibre polyamidique, et dans une moindre mesure la fibre polyéthylénique, ont complètement remplacé les fibres naturelles (Scaccini Bargnesi, 1966); d'où le changement des chaluts qui a été également provoqué en partie par la nouvelle puissance des moteurs installés.

Tableau 3

Distribution des chalutiers italiens en centre et nord Adriatique par jauge brute.
Données 1980

	Nombre	$	Nombre	%
Jusqu'à 3 tons	849	28,49	1 751	2,46
4 - 10 tons	1 024	34,36	6 724	9,45
11 - 20 tons	223	7,48	3 463	4,87
21 - 35 tons	337	11,31	9 100	12,79
36 - 50 tons	193	6,48	8 255	11,60
51 - 100 tons	244	8,19	18 222	25,61
101 - 199 tons	96	3,22	11 924	16,76
Plus de 200 tons	14	0,47	11 709	16,46

En pratique, les chaluts de chanvre étaient plus courts que les chaluts actuels, et donc à angle plus ouvert. Leur longueur totale, de la corde de dos à la poche, était d'environ 30 m, contre les 40 m actuels, alors que le nombre de mailles n'a pratiquement pas varié, bien que la puissance ait augmenté.

On a observé, en effet, que pour accroître le rendement, il était utile d'augmenter la vitesse de pêche, plutôt que les dimensions du chalut.

Inévitablement, pour que ne se produise pas une réaction et une fuite du poisson, il a fallu adoucir l'angle du chalut et donc allonger celui-ci.

On sait, en effet, que cet angle dépend de la vitesse. Plus la vitesse est grande et plus cet angle doit être petit.

En allongeant les chaluts, on a pu augmenter la vitesse de pêche de 3,1 noeuds à 4 noeds (Scaccini Bargnesi, 1966) et donc la possibilité s'est offerte d'explorer une zone plus vaste dans l'unité de temps, d'où un effort de pêche différent et supérieur.

A propos du passage de la fibre naturelle à la fibre synthétique, on pourrait dire bien des choses. Par contre, sur les changements d'ouvertures verticales des chaluts. Nous n'avons pas de données précises.

Dans le chalut de fond méditerranéen, l'ouverture verticale était petite avec les filets de fibre naturelle, et est restée petite avec les filets en fibre synthétique.

Enfin, une dernière considération relative aux anciens chaluts de chanvre. Au bout de quelques jours de pêche, on disait que le chalut "était fatigué"; en pratique, le chalut s'imprégnait d'eau et de matériau des fonds, et devenait si lourd que la pêche devenait malaisée.

Il fallait donc le faire sécher, entre autres pour éviter la putréfaction, le nettoyer et souvent corriger les déformations qu'il avait subies à l'usage et qui altéraient son efficacité.

Il fallait, en d'autres termes, intervenir et réviser le montage et l'armement du chalut.

Ces opérations, nécessaires mais longues, étaient la cause de temps morts, et avaient donc inévitablement des effets sur l'effort de pêche, qui était par conséquent inférieur à celui des chaluts actuels.

L'utilisation des fibres synthétiques, qui sont fortement résistantes à l'abrasion, surtout dans le cas de filets sans noeuds, a permis de lancer le rapido. Avec les fibres naturelles, le rapido aurait difficilement connu la diffusion qu'il a actuellement. Pour cet engin, l'abrasion sur le fond est si forte qu'il n'aurait pas pu se développer avec les fibres naturelles d'autrefois: l'usure aurait été telle que l'engin n'aurait pas été assez économique.

4. VARIATIONS DANS LE GREEMENT ET L'EMPLOI DES CHALUTS

Il y a également des variations dans le gréement pour la traînée des chaluts, comme aussi des variations dans son mode d'emploi. Examinons les trois principaux chaluts utilisés dans l'Adriatique: le chalut de fond traditionnel, le chalut à perche, le rapido. Nous négligerons par contre d'autres chaluts peu employés ou employés épisodiquement, tels que le chalut à grande ouverture verticale, appelé "volantine".

Dans le chalut de fond traditionnel, la longueur des bras est restée à peu près constante, 200 m, de telle sorte que la distance entre les deux panneaux est demeurée constante, et avec elle la zone explorée.

Mais il faut observer que les bras avaient un diamètre inférieur, environ 18 mm, alors qu'aujourd'hui le diamètre dépasse généralement 22 mm.

Mais un diamètre inférieur, pour une vitesse de pêche inférieure, pourrait ne pas avoir d'affets sur la récolte et sur la canalisation du poisson vers la bouche du chalut.

Les panneaux n'ont pas subi de grands changements, encore que, ces derniers temps, on observe l'apparition, dans la pêche professionnelle, de panneaux ovales en fer, pour remplacer les panneaux traditionnels en bois bordé de fer. En pratique, par conséquent, l'effort de pêche, en ce qui concerne les chaluts de fond à panneaux, n'a pas beaucoup changé du fait des modifications apportées aux chaluts ou au gréement.

La variation la plus notable a été provoquée par la vitesse de pêche accrue, qui, si l'on estime valable l'augmentation de 3,1 à 4 noeuds indiquée par Scaccini et Bargnesi (1966), et confirmée par la mesure de la vitesse de pêche actuelle, ainsi que par ce que rapportent les vieux pêcheurs, entraîne une croissance de l'effort de pêche d'environ 30%.

Le propos est totalement différent en ce qui concerne le remplacement du chalut à perche par le rapido. D'une part, en effet, le rapido permet d'exploiter complètement la puissance du bateau en augmentant le nombre des engins et la vitesse, d'autre part l'action des deux engins sur les ressources est certainement différente, encore que l'un et l'autre soient utilisés en particulier pour la pêche des soles.

Le vieux chalut à perche armé principalement d'un filet en coton, était traîné à très faible vitesse pour éviter qu'il ne se détache du fond, et pour qu'il prenne les espèces pour lesquelles il avait été conçu, tandis que le rapido, grâce à l'action du dépresseur, qui garantit son adhérence au fond, peut être traîné à des vitesses très fortes, atteignant 6 noeuds.

Si l'on ne tient pas compte de l'effet différent des deux engins sur les espèces pour lesquelles ils sont employés, on peut conclure que pour le rapido et le chalut à perche, l'effort de pêche est directement proportionnel à la puissance de tir du chalutier, et l'on peut donc prendre comme indice de l'effort de pêche la puissance qui, comme le montre le tableau 2, a augmenté de plus de 300%.

5. CONCLUSIONS

Les tableaux inclus dans le présent texte montrent la variation du nombre, de la jauge et de la puissance des chalutiers.

Mais ces tableaux ne suffisent pas, à eux seuls, à permettre d'évaluer d'augmentation réelle de l'effort de pêche observé au cours des dernières décennies.

Il ne faut pas négliger l'évolution dans la construction et dans l'usage des filets, ni oublier que les chaluts méditerranéens, au-delà d'une certaine limite, n'exploitent pas la puissance des bateaux de pêche.

En résumé, on peut dire qu'en ce qui concerne le rapido, l'effort de pêche s'est accru en proportion de la croissance de la puissance installée, tandis qu'en ce qui concerne le chalut de fond traditionnel, il s'est accru proportionnellement au nombre de chalutiers, plus 30% environ pour la vitesse accrue de la pêche, rendue possible par les nouveaux chaluts et par les moteurs plus puissants.

A PRELIMINARY NOTE ON MANAGEMENT OF COASTAL RESOURCES ALONG THE EASTERN ADRIATIC COAST BY REGULATION OF FISHING GEARS: MESH SIZE SELECTIVITY

by

I. Jardas, A. Pallaoro, S. Jukić and P. Cetinić
Institute of Oceanography and Fisheries
Split, Yugoslavia

The productivity of coastal fisheries along the eastern coast of the Adriatic is of greatest significance. The data of the official statistics show that the capture of small pelagic fishes is about 81-83 percent, of coastal fishery about 12-13 percent, and of trawler fishing about 4-6 percent of the total catch (Regner et al., 1985). Fishing of small pelagic fishes is carried out mostly by pelagic trawls and purse-seines, of demersal species by trawler fishing, and of coastal species by a number of various fishing gears. In the Adriatic, however, selectivity experiments were carried out mostly on the example of the trawl (mesh size selectivity of the codend) (e.g., Froglia and Galli, 1970; Levi, Froglia and Scorcelletti, 1971; Ferretti et al., 1973; Jukić, 1974, 1975; Jukić and Granić, 1980; Ferretti and Froglia, 1975 and others). Selectivity experiments of the coastal fishing gears along the eastern coast of the Adriatic have not yet been carried out. This is an attempt to consider more seriously the problems in the management of sea resources and fishery regulation in the coastal region, the more so as signs of serious pauperization in the number of grounds have been noticed lately.

This presentation gives the preliminary results of the experiment of gillnets mesh size selectivity of 28 mm (longitudinally ca 56 mm) in relation to some more significant or more numerous fish species (see Table). Most of the results refer to the trammelnet, which was used mainly in catching fish, less so to the gillnet ("prostica") used in catching with the "ludar" (by shying). These two nets differ in construction properties and methods of fishing.

To determine the 50 percent retention length a simple method of relation between the total length and maximum fish girth was applied. On the basis of the girth factor (maximum girth/total length) and of the nomogram for the estimation of the selectivity factor of fishes from the measured body proportions, the selectivity factor (SF) and the 50 percent retention length (Lc) were determined:

$$SF \cdot \text{mesh size} = Lc \text{ (total length)}$$

The summary of the fish species, the number of analysed samples, and the values of the measured body dimensions, the girth factor, SF and Lc for gillnets 28 mm mesh size (longitudinally ca 56 mm) is presented in the Table. The Figure below gives the total length-maximum girth relationship, which is linear in all the studied species as well as in some other samples (Lucas et al., 1954; Margetts, 1954, 1957). It is obvious that the girth factor value, as all the other values accordingly, can depend on the fish growth, season, condition, maturity, and the like.

The SF values were between 2.10 and 3.25, and the Lc values between 11.8 and 18.2 cm LT. In general, roundfish gives higher Lc values and vice versa.

The obtained values of the 50 percent retention length (Lc) were compared with the lengths of the first sexual maturity of fishes. The lengths, at which the first inflexion point (the beginning of the adolescent growth phase) appears at the allometric length-weight shown in the semilog. scale, were taken as the lengths of the first sexual maturity, or this value was taken from the literature, but in some examples both of these were taken for comparison. This was meant for establishing how much the 28 mm mesh size (longitudinally ca 56 mm) protects the juvenile portion of the population. According to the given data (see Table) we can see that the 50 percent retention lengths of the greatest part of the analysed species are situated to the left of the first sexual maturity lengths, which is an unfavourable relationship and it does not provide for enough protection of the juvenile portion of the population. A more favourable relation of the mentioned values was obtained only in *Lithognathus mormyrus*, *Boops boops* and *Scorpaena porcus* species, where the value of the 50 percent retention length is placed on the right of the first sexual maturity, or both values coincide mutually, as is the case with *Diplodus annularis*, *Pagellus acarne* and some other species. This points to the necessity of regulating the fisheries along the eastern Adriatic coast, and to the methods of doing it.

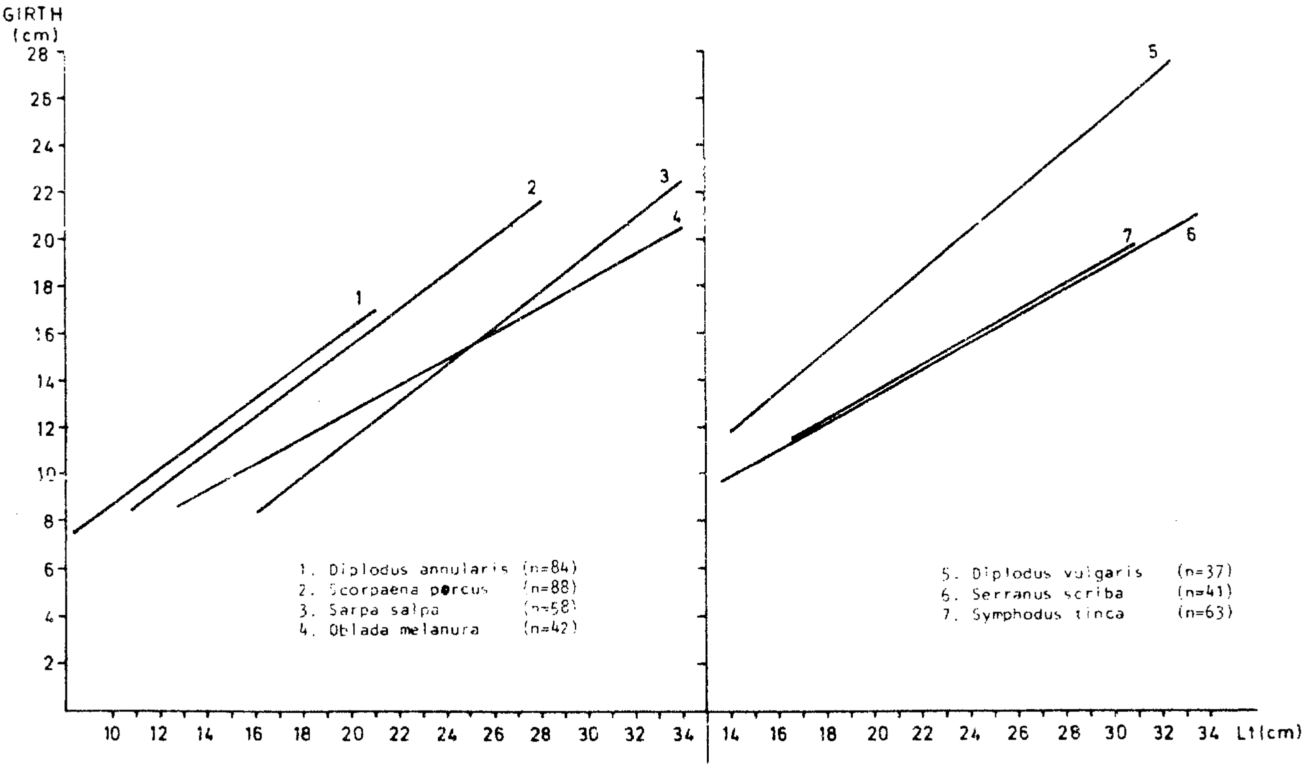


Figure Maximum girth-total length relationship in different fish species

REFERENCES

Bauchot, M.-L. and J.-C. Hureau, 1986. In Fishes of the north-eastern Atlantic and the Mediterranean edited by P.J. Whitehead et al. Paris, Unesco, Vol.2:883-913

Ferretti, M. and C. Froglia, 1975. Results of selectivity experiments, made with different trawls, on more important Adriatic demersal fish. Quad.Lab.Tecnol.Pesca, Ancona, 2(1):3-16

Ferretti, M., et al., 1973. Osservazioni su alcuni fattori che influenzano la selettività di una rete a strascico. Quad.Lab.Tecnol.Pesca, Ancona, 1(5):129-41

Froglia, C. and B. Galli, 1970. Selettività e capacità di cattura di una rete a strascico di tipo italiano su popolazioni di Mullus barbatus L. Quad.Lab.Tecnol.Pesca, Ancona 1(1):1-18

Jukić, S., 1974. The Yugoslav Nephrops fishery. Acta Adriat., 15(8):1-19

____________, 1975. Kocarska podrucja u srednjem Jadranu. Acta Adriat., 17(1):1-86

Jukić, S. and B. Granić, 1980. Selektivnost i zastita demerxalnih resursa Jadrana. Morsko Ribar, 4:

Levi, D., C. Froglia and R. Scorcelletti, 1971. Selettività di una rete di tipo relignato (chalut à grande ouverture verticale). Quad.Lab.Tecnol.Pesca, Ancona, 1(2):23-35

Lucas, C.E., et al., 1954. Mesh selection in the roundfish seine. J.Cons.CIEM, 20(1):35-50

Margetts, A.R., 1954. The length-girth relationships in haddock and whiting and their application to mesh selection. J.Cons.CIEM, 20(1):56-61

____________, 1957. The length-girth relationships in whiting and cod and their selection. J.Cons.CIEM, 23(1):64-71

Quignard, J.-P. and A. Pras, 1986. Labridae In Fishes of the north-eastern Atlantic and Mediterranean, edited by P.J.P. Whitehead et al. Paris, Unesco, Vol.2:919-42

Zei, M., 1951. Jadranske girice (Menidae). Razp.Slov.Okad.Znan.Umet, (3):127 p.

Table
Résumé of obtained results

Species	N	Total length (cm)		Maximum girth (cm)		Girth factor	SF	50% retained length (28 mm mesh size, 56 mm longitudinal)	Data of the first sexual maturity
		Range	X ± s	Range	X ± s				
Serranidae:									
Serranus scriba	41	15.5-23.0	19.57±1.56	10.5-15.5	12.89±1.07	0.66	2.50	14.0 cm	No data
Carangidae									
Trachurus mediterraneus mediterraneus	27	13.0-26.5	21.01±2.36	6.5-13.0	9.96±1.19	0.48	3.25	18.2 cm	No data
Sciaenidae:									
Sciaena umbra	14	19.0-45.0	24.32±6.72	12.0-30.0	16.39±4.57	0.67	2.45	13.7 cm	Authors' data: cca 23-24 cm
Sparidae:									
Diplodus annularis	84	10.5-19.5	14.98±1.69	8.9-17.0	12.20±1.40	0.82	2.10	11.8 cm	Bauchot and Hureau (1986): cca 10 cm, authors' data: cca 11-12 cm
Diplodus vulgaris	37	14.0-33.5	22.05±5.17	11.5-27.0	18.15±4.35	0.82	2.10	11.8 cm	Bauchot and Hureau (1986): cca 17 cm, authors': cca 18-19 cm
Lithognathus mormyrus	21	20.0-34.0	27.26±4.42	12.5-23.5	16.57±2.88	0.61	2.75	15.4 cm	Bauchot and Hureau (1986): cca 14 cm
Pagellus acarne	20	15.0-19.5	17.08±1.40	9.5-12-5	10.95±1.07	0.64	2.60	14.6 cm	Bauchot and Hureau (1986): 13-18 cm
Sarpa salpa	58	17.0-35.0	28.02±4.21	10.5-23.0	17.61±2.95	0.63	2.65	14.8 cm	Authors' data: cca 24-25 cm
Oblada melanura	42	17.5-24.5	20.62±1.58	11.5-15.0	13.00±0.91	0.63	2.65	14.8 cm	Authors' data: cca 17-18 cm
Boops boops	15	16.0-25.0	21.63±3.03	8.5-14.0	11.80±1.81	0.55	3.00	16.8 cm	Bauchot and Hureau (1986): cca 13 cm (W. Mediterranean)
Centracanthidae:									
Spicara maena flexuosa	10	12.0-17.0	14.75±1.89	7.5-10.5	9.05±1.12	0,62	2.70	15.1 cm	Zei (1951): 8-10 cm
Labridae:									
Labrus merula	10	20.5-32.0	25.60±3.91	13.5-22.0	16.75±2.70	0.65	2.55	14.3 cm	Quignard and Pras (1986): 15-20 cm, authors' data: cca 20-21 cm
Symphodus tinca	63	17.5-30.0	21.31±2.85	11.5-18.5	14.00±1.79	0.66	2.50	13.7 cm	Quignard and Pras (1986): o 10.5, o 10.0 cm; authors' data: o cca 16-17, o 13-14 cm
Mugilidae:									
Liza aurata	30	29.0-40.0	33.57±2.50	14.0-20.5	17.62±1.50	0.52	3.10	17.4 cm	No data
Liza saliens	17	27.5-42.0	37.15±3.39	16.0-24.5	21.03±2.11	0.57	2.90	16.2 cm	No data
Scorpaenidae:									
Scorpaena porcus	88	12.5-26.0	17.13±2.61	9.5-22.0	13.08±2.22	0.76	2.25	12.6 cm	Authors' data: cca 10-11 cm
Triglidae:									
Trigloporus lastoviza	11	17.0-31.5	22.91±5.61	9.0-17.0	12.91±2.84	0.57	2.90	16.2 cm	Authors' data: cca 17-18 cm

CONTRIBUTION TO THE KNOWLEDGE ON THE SHORT AND LONG-TERM EFFECTS OF THE APPLICATION OF 40 mm CODEND MESH SIZE IN ADRIATIC TRAWL FISHERY-EASTERN ADRIATIC COAST

by

Stjepan Jukić
Institute of Oceanography and Fisheries
Split

and

Corrado Piccinetti
Laboratorio di Biologia Marina e Pesca
Fano

1. INTRODUCTION

As a consequence of the intensive fishing effort in a Mediterranean trawl fishery (Pearse, 1980), especially in its north regions with wider continental shelf, a 40 mm streched codend mesh size was recommended by GFCM (6th Session 1978) and accepted by member countries.

As far as unit and shared Adriatic multispecies demersal resources is concerned this paper discusses results of 40 mm codend mesh sizes selectivity experiment undertaken along the eastern Adriatic coast in order to assess short and long-term effects 40 mm codend mesh size in yugoslav commercial trawl fishery respecting resources quantitative and qualitative characteristics.

For transition period it has been tried forecast efficiency of the 40 mm codend mesh size in yield per recruit (Y/R) for four commercial populations by changing either size (age) at first capture (C) or fishing mortality rate (F), using Beverton and Holt (1957, 1966) approach.

Under the scope of the experiments, it has been tryed to appraise short-term effects of the 40 mm codend mesh size on economic aspects i.e., edible biomass (thus money) losses in unit fishing time.

2. EXPERIMENTAL METHODS

Experiments of codend selectivity along the eastern Adriatic were carried out in the region of Dalmacija with research vessel "Bios" (300 Hp) and a commercial trawler "Jadran II" (300 Hp) using only the covered codend technique (Figure 1). Selectivity characteristics: 50% retention point (l_c), *selection factor* (b) and *percentage of individuals retained in the following codends* were studied: polyamid codend of 40 mm knotless and with knots and 41 mm respectively.

In all cases attachments of the polyamid top-side cover to codend of 18 mm and 4 mm were used (Table 1; Figure 1).

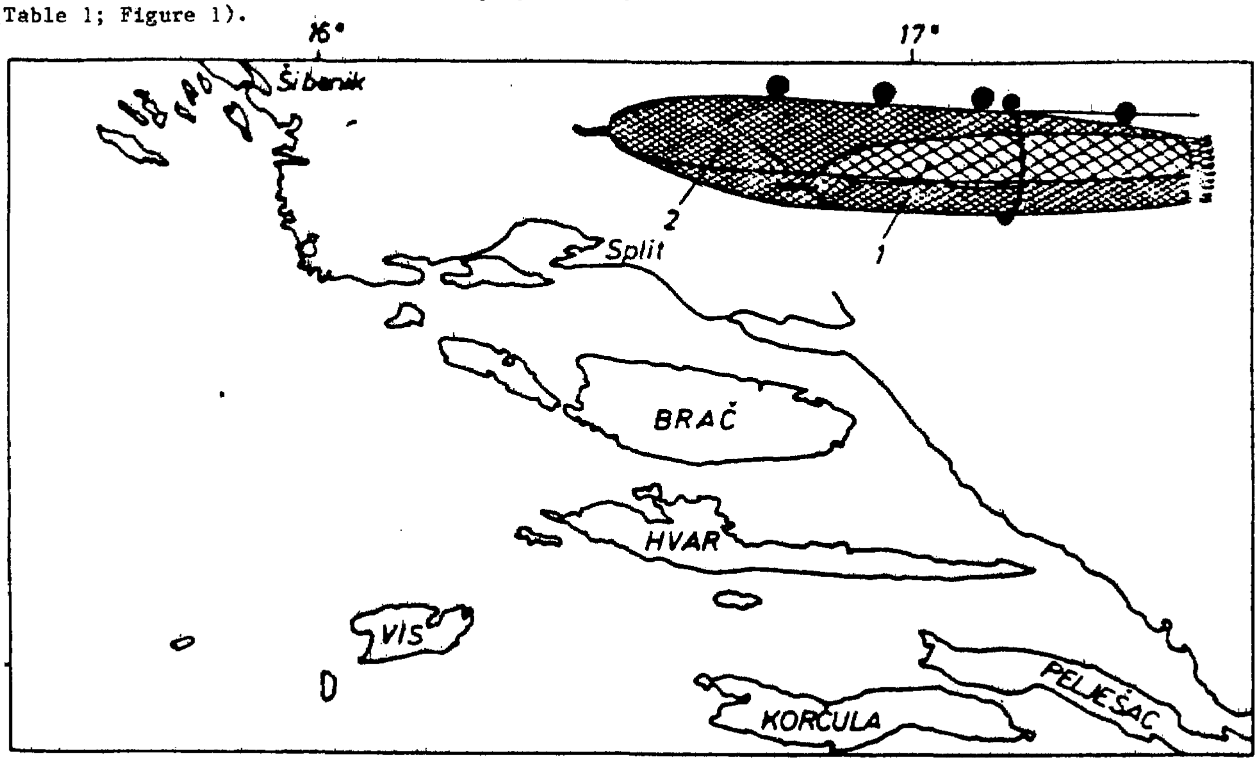


Figure 1 Trawl fishing grounds along eastern Adriatic coast where codend selectivity experiments were carried out, and diagram of attachment of codend top-side cover (2) to codend (1) with floating balls

Table 1

Results of covered cod-end experiments for cod-ends of 40 and 41 mm with and without knots undertaken along the eastern Adriatic coast for five species: Merluccius merluccius L., Mullus barbatus L., Pagellus erythrinus L., Trachurus trachurus L. and Nephrops norvegicus L. by research vessel "Bios" (300 hp); 1-knotless cod-ends (all cod-ends 235/48 dtex)

Length (cm)	Cod-end 40 mm	Cover 4 mm	Total	%	Cod-end 40 mm[1]	Cover 4 mm	Total	%	Cod-end 40 mm	Cover 4 mm	Total	%	Cod-end 40 mm[1]	Cover 4 mm	Total	%
	Merluccius merluccius								Mullus barbatus							
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	3	3	-	-	14	14	-
7	-	-	-	-	-	-	-	-	-	24	24	-		32	32	-
8	-	-	-	-	-	-	-	-	1	22	23	4.3	-	17	17	-
9	-	1	1	-	-	1	1	-	2	5	7	28.5	-	4	4	-
10	-	10	10	-	8	10	18	0.44	3	1	4	75.0	-	3	3	-
11	6	13	19	31.0	20	18	38	0.55	3	1	4	75.0	1	-	1	-
12	7	7	14	50.0	32	21	53	0.60	4	6	10	40.0	5	2	7	0.71
13	10	1	11	90.0	32	11	43	0.74	13	5	18	72.0	16	4	20	0.80
14	16	1	17	94.0	23	8	31	0.74	28	4	32	87.0	36	3	39	0.92
15	19	1	20	95.0	21	1	22	0.95	28	2	31	93.5	47	2	49	0.96
16	30	-	30	100.0	31	1	32	0.97	29	1	30	96.0	46	-	46	100.0
17	43	-	43		35	-	35	100.0	22	1	23	95.0	36	-	36	
18	34	1	35		39	1	31	0.97	17	-	17		18	-	18	
19	47	1	48		19	-	19	100.0	12	1	13		12	-	12	
20	26	-	26		16	-	16		7	-	7		12	-	12	
21	13	-	13		14	-	14		4	-	4		2	-	2	
22	16	-	16		16	-	16		3	-	3		-	-	-	
23	10	-	10		12	-	12		1	-	1		-	-	-	
24	9	-	9		6	-	6		-	-	-		1	-	1	
25	12	-	12		11	-	11		-	-	-		-	-	-	
26	5	-	5		8	-	8		-	-	-		-	-	-	
27	4	-	4		7	-	7		-	-			-	-		
28	1	-	1		3	-	3		-	-			-	-		
29	1	-	1		12	-	12		-	-			-	-		
30	1	-	1		5	-	5		-	-			-	-		
31	2	-	2		6	-	6		-	-			-	-		
32	2	-	2		2	-	2		-	-			-	-		
33	2	-	2		6	-	6		-	-			-	-		
34	-	-	-		1	-	1		-	-			-	-		
35	4	-	4		3	-	3		-	-			-	-		
36	1	-	1		1	-	1		-	-			-	-		
37	1	-	1		4	-	4		-	-			-	-		
38	1	-	1		2	-	2		-	-			-	-		
Total	323	36	359		386	72	458		178	76	254		232	81	313	
(l_c)			12.4 cm				12.0 cm				11.4 cm				11.6 cm	
Coeff. corr. (r)			0.89				0.98				0.84				0.97	
Sel. factor (b)			3.1				3.0				2.8				2.9	
% retained in cover ("lost")		10.0%				12.9%				29.9%				25.9%		

Table 1 (cont'd)

Length (cm)	P. erythrinus Cod-end 40 mm	P. erythrinus Cover 4 mm	P. erythrinus Total	P. erythrinus %	T. trachurus Cod-end 40 mm[1]	T. trachurus Cover 4 mm	T. trachurus Total	T. trachurus %	N. norvegicus Cod-end 40 mm	N. norvegicus Cover 4 mm	N. norvegicus Total	N. norvegicus %
5	-	-	-	-	-	-	-	-	4	-	4	-
6	-	-	-	-	-	-	-	-	9	-	9	-
7	-	-	-	-	-	-	-	-	26	10	36	72.2
8	-	-	-	-	-	-	-	-	65	13	78	83.3
9	-	2	2		-	-	-	-	75	8	83	90.4
10	9	34	43	20.9	-	-	-	-	77	5	82	93.3
11	17	23	40	42.5	-	-	-	-	70	3	73	95.9
12	34	16	50	68.0	-	-	-	-	36	1	37	97.3
13	106	13	119	89.1	-	-	-	-	29	-	29	100.0
14	188	4	192	97.9	-	-	-	-	13	-	13	
15	203	2	205	99.0	1	-	1	-	14	-	14	
16	146	1	147	99.3	-	4	4	-	5	-	5	
17	143	-	143	100.0	8	6	14	57.4	2	-	2	
18	104	-	104		4	3	7	57.1	2	-	2	
19	77	-	77		25	2	27	92.6	2	-	2	
20	43	-	43		38	2	40	95.0	-	-	-	
21	31	-	31		53	1	54	98.1	-	-	-	
22	20	-	20		71	1	72	98.6	-	-	-	
23	15	-	15		37	1	38	97.4	-	-	-	
24	19	-	19		26	-	26	100.0	-	-	-	
25	7	-	7		14	-	14		-	-	-	
26	1	-	1		4	-	4		-	-	-	
27	-	-	-		1	-	1		-	-	-	
28	-	-	-		-	-	-		-	-	-	
29	-	-	-		2	-	2		-	-	-	
30	-	-	-		5	-	5		-	-	-	
31	-	-	-		-	-	-		-	-	-	
32	-	-	-		2	-	2		-	-	-	
33	-	-	-		-	-	-		-	-	-	
34	-	-	-		-	-	-		-	-	-	
35	-	-	-		1	-	1		-	-	-	
36	-	-	-		-	-	-		-	-	-	
37	-	-	-		-	-	-		-	-	-	
38	-	-	-		-	-	-		-	-	-	
Total	1 163	95	1 258		292	20	312		429	40	469	
(1_c)				11.8 cm				17.0 cm				5.7 cm
Coeff. corr. (r)				0.89				0.81				0.93
Sel. factor (b)				2.9				4.2				1.2
% retained in cover ("lost")		7.6%				6.4%				8.5%		

Experiments were carried out mostly along the eastern Adriatic coast and channels of Dalmacija region over clay-loamy and muddy bottom sediments (Gamulin-Brida, 1974) i.e., between isobates 50 and 200 m on the characteristic ichthyocenosis described earlier (Zupanović, 1961; Jukić, 1975).

Mesh size of the codends were measured with the ICES mesh gauge, in wet condition, after that bottom trawls were used several times. Speed of the vessels during the experiments were: 3.5 knots, research vessel, and 4.0 knots, commercial boat.

Attention was devoted mostly to commercially important populations such as: hake (Merluccius merluccius L.), striped mullet (Mullus barbatus L.), pandora (Pagellus erythrinus L.), horse mackerel (Trachurus trachurus L.) and Norway lobster (Nephrops norvegicus L.). These species in yugoslav trawl fishery represent an important part of the marketable biomass.

In the studied areas these stocks represent between 49.6 and 80.6 percentage of the trawl catch biomass (10 years average from commercial landings).

3. RESULTS AND DISCUSSION

The computation of selectivity characteristics of 40 mm codend, especially the 50% retention points (lc) and selection factors (b) have been done by a small programmable calculator (Hp - 40 CX). The programme (FB 2) has been used (Pauly, 1984).

Detailed results of 40 and 41 mm codend mesh size selectivity experiments are presented in Table 1.

3.1 Merluccius merluccius L.

In the case of hake population calculated 50% retention points are: 12.4 cm for 40 mm codend with knots and 12.0 cm for 40 mm knotless codend, with selection factor (b) 3.0 and 3.1. Percentages of hake individuals lost (retained in cover) were fairly small; from 10.0 to 12.9%. Results of experiments with 40 and 41 mm codends are presented in Table 1.

3.2 Mullus barbatus L.

Selectivity experiments with 40 mm codend mesh size on the striped mullet population have given the following 50% retention points: 11.4 cm for 40 mm codend with knots and 11.6 cm for 40 mm knotless, with its selection factors (b) 2.8 and 2.9.

Percentages of the individuals lost (retained in cover) in the 40 mm codend varied from 25.9 to 29.9%.

3.3 Pagellus erythrinus L.

The 50% retention point is 11.8 cm for 41 mm codend. Selection factor 2.9, while the percentage of the individuals retained in the cover was 7.6%.

3.4 Trachurus trachurus L.

Selectivity experiments with regard to horse mackerel population were carried out only by research vessel "Bios" in the central open Adriatic (Jabuka pit). Only polyamid codend of 41 mm was studied. Obtained 50% retention point was 17.0 cm with selection factor 4.2 and percentage individuals lost 6.4%.

3.5 Nephrops norvegicus L.

This associated species with other demersal stocks in the open central Adriatic, prevails mostly on clay-loamy bottom sediments and lower sea temperatures (Karlovac, 1953; Jukic, 1971). It has been one of the main subject of the trawl fishery in the Adriatic. Selectivity codend experiments were done on the trawl fishing ground "Blitvenica" using codend of 41 mm. The 50% retention point obtained was 5.7 cm with selection factor (b) 1.2 and percentage "lost" 8.5%.

Studies of the instantaneous economic effects of the application of the 40 mm (with and without knots) codends in the trawl fishery along the eastern Adriatic coast were carried out by means of commercial trawler "Jadran II" (300 Hp).

Assuming facts that at the present time trawl fishery in the Adriatic suffers of the economic difficulties such as: oil price, yearly maintenance of fishing vessel and the fishing gear costs (bottom trawls) it was felt logically to assess cost-benefit relationships for this specific fishing ground expecting that any significant losses in the biomass (money) that might come from regulative measures might easily constrain further fishing activities. Any losses that might change present economic cost-benefit balance in Adriatic (yugoslav) trawl fishery such as the case of application of the larger mesh size of 40 mm codend should be carefully considered and analysed.

Results of these preliminar trials are given in Table 2. Biomasses lost i.e., passed throughout of codend mesh size and retained in cover of edible part of the trawl catch for mesh sizes of 40 mm (with and without knots) and big codend mesh size of 70 mm were precisely measured and its values converted in US dollars per unit fishing time (one hour). In the case of 40 mm codend, regardless non-edible fish species, part of edible biomass "lost" were composed mostly of species of group Cephalopoda that on domestic markets have fairly high prices per kg i.e., from ND 2 500 to 3 000 (May, 1987). Lost edible biomass in the experiments with codend of 40 mm is equivalent from US$ 8 to 16 and US$ 68 for 70 mm codend per unit time. These potential money losses should be carefully considered in the Adriatic trawl fishery, especially in yugoslav trawl fishery where cooperative fishing sector has been very slightly subsidized by financial funds.

Possible application of 70 mm codend in the yugoslav trawl fishery, because of mentioned economic and biological reasons wouldn't have been logical.

Problems of economic aspects derived by application of proposed 40 mm codend, in yugoslav commercial fishery should have been foreseen and treated together with stocks behaviour patterns i.e., migration of the stocks, its availabilities to the fishing gears and stock-recruitment relationships.

Long-term effects of the application of 40 mm and 41 mm codends were calculated by means of Beverton and Holt (1966) of Yield Functions. Accepting selectivity experiments data i.e., 50% retention points (l_c) for 40 mm and 41 mm codends, growth constants for fish populations, present coefficients of fishing mortality rate (F) derived by various authors during last decade and assuming that natural mortality coefficient (M) equals 0.2 and 0.4 an assessment of eventual profitness to trawl fishery is done (Table 3).

With regard to obtained results in the Table 3 it is clear that in all cases, for a chosen value of (M) predicted changes (increments) in yield per recruit (Y/R) will be higher by acting on changes in size at first capture i.e., increasing (C) or (l_c) values than fishing mortality rates (F) for the present rates of exploitation (E).

Except for horse mackerel (Trachurus trachurus L.) population i.e., species for which present values of the (C) and (F) are fairly close to eumetric catch, other three populations throughout long-term management concept in Adriatic trawl fishery need to have significantly bigger codends than that proposed of 40 mm.

Obtained results in Table 3 of the application of 40 mm codend mesh size in Adriatic trawl fishery applying Beverton and Holt (1966) yield per recruit model technique have pointed out an essential necessity toward more sophisticated input data, especially maximum length (L_{∞}) of the exploited stock (not maximum recorded length) and fishing mortality coefficient (F): Table 4.

Calculated values of the predicted changes in Table 3 of the yield per recruit, acting mostly on the age at first capture, based on the various sources on the informations, in this case, brought long-term concept statement to significant doubtfulness of the effectiveness of technique used for multispecies stocks. Generally, achieved results suggest a significant increment of the codend mesh size i.e., more than 40 mm in the case of Merluccius merluccius, Mullus barbatus and Pagellus erythrinus.

Because of these findings it will be important for management to examine the effects of the changes of mesh size on these and other species and trawl fishing grounds as well as considering on the same time biological and socio-economic aspects.

Taking into consideration obtained preliminary results of the codend selectivity experiments along the eastern Adriatic coast and present level of the exploitation of Adriatic demersal and semi-demersal stocks, it seems that the following management measures might have been recommended for consideration: control of the total fishing effort, possible application of even bigger codend mesh size of 40 mm in the case of specific trawl fishing grounds for which scientific knowledge satisfies sufficient completness and finally, development of either "closing-area" or "closing-season" concept.

Table 2

Results of immediate economic effects in commercial trawl fishery along the eastern Adriatic coast applying different codend mesh sizes on commercial vessel "Jadran" II (300 Hp) - October 1984

Species and groups (after Soljan)	Codend 40 mm 210/48 Den	Cover 4 mm	Knotless codend 40 mm 210/48 Den	Cover 4 mm	Codend 70 mm 210/48 Den	Cover 4 mm
CHONDRICHTHYES	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)
Scyliorhinus canicula (L.)	46.00	0.30	16.50	-	10.60	0.50
Scyliorhinus stellaris (L.)	10.50	-	8.50	0.32	9.30	-
Triakidae,						
Mustelus mustelus (L.) and						
Mustelus asterias Cloq.	13.10	-	19.80	-	-	-
Raja clavata L.	25.40	-	4.50	-	5.50	-
OSTEICHTHYES						
Conger conger (L.)	-	0.40	1.05	0.12	-	-
Gadus (Triappterus) minutus L.	-	0.17	1.05	-	-	-
Merluccius merluccius (L.)	180.37	0.63	42.50	0.30	26.50	13.80
Zeus faber L.	3.34	-	5.15	-	3.50	-
Pagellus erythrinus (L.)	5.85	0.29	-	-	-	-
Boops boops (L.)	1.35	0.57	-	-	1.05	-
Centracanthidae						
Maena maena (L.) and						
Maena smaris (L.)	16.00	1.05	2.00	0.10	2.45	-
Mullus barbatus L.	12.95	1.16	11.80	0.03	5.40	5.70
Carangidae						
Trachurus trachurus (L.)	3.50	0.42	-	-	-	-
Trachurus mediterraneus						
Stdr.	4.00	0.45	3.50	0.13	8.25	5.80
Pleuronectiformes (E. linguatula, A. laterna)	7.45	1.48	3.70	0.63	1.00	7.60
Lophiidae						
Lophius piscatorius L. and						
Lophius budegassa Spin.	21.52	-	11.40		8.50	-
Mixed fish mostly non-edible (S. hepatus, B. ocellaris, G. niger jozo, C. rubescens, L. cavillone, A. cuculus, E. gurnardus)	12.20	44.05	10.40	4.50	5.70	27.40
CEPHALOPODA						
Eledone moschata (Lam.)	20.17	13.20	10.90	2.95	5.80	-
Sepia officinalis (L.)	1.80	0.95	-	-	-	-
Total (kg) only edible	373.30	21.07	142.35	4.58	87.85	33.40
Towing time (minutes)	300		120		120	
Towing speed (through water)	4 knots		4 knots		4 knots	
Non-edible trawl catch (kg)	530		230		170	
Catch per unit effort (kg/hour)	75 kg	4 kg	71 kg	2 kg	44 kg	17 kg
Ratio (codend/cover) only edible	18		36		3	
Loss per hour (in US$)	16		8		69	

US$ 1 = ND 580

Table 3

Calculations of % changes in yield per recruit (Y/R) for four commercially important species in Adriatic trawl fishery on the base of codend mesh size selection experiments for 40 and 41 mm codends (Beverton and Holt, 1966)

1. Merluccius merluccius (L.) (40 mm codend with knots: l_c=12.4 cm; b=3.1)

	L_{oo} = 85.0 cm; K = 0.12; Z = 1.12	
M =	0.2	0.4
	(a) change in size at first capture	
Present C = 0.14 Predicted change in (Y/R)	from C=0.14 to C=0.58 from Y'=.010418 to Y'=.042913 + 312%	from C=0.14 to C=0.54 from Y'=.018632 to Y'=.040515 + 117%
	(b) change in fishing mortality rate	
Present C = 0.14 Predicted change in (Y/R)	from F/m=4.00 to F/M=.667 from Y'=.016033 to Y'=.025010 + 140%	from F/M=1.86 to F/M=.667 from Y'=.018632 to Y'=.025010; present (C) is close to (F) + 34%
2. Mullus barbatus L. L_{oo} = 27.0 cm;	K = 1.8; Z = 1.64; l_c = 11.4 cm; b = 2.8 (a) change in size at first capture	
Present C = 0.42 Predicted change in (Y/R)	from C=0.42 to C=0.90 from Y'=.179956 to Y'=.405861 + 126%	from C=0.42 to C=0.84 from Y'=.273339 to Y'=.372157 + 36%
	(b) change in fishing mortality rate	
Present C = 0.42 Predicted change in (X/R)	from F/M=9.00 to F/M=1.86 from Y'=.179956 to Y'=285357 + 59%	from F/M=3.00 to F/M=1.86 from Y'=.273339 to Y'=.285357; (F) is close to (C) + 4%
3. Pagellus erythrinus L. 41 mm	codend with knots: l_c = 11.8 cm; b = 2.9 L_{oo} = 60.0 cm; K = 0.20; Z = 1.10 (a) change in size at first capture	
Present C = 0.20 Predicted change in (Y/R)	from C = 0.20 to C = 0.70 from Y'=.032914 to Y'=.102236 + 210%	from C = 0.20 to C = 0.52 from Y'=.018275 to Y'=.032041 + 75%
	(b) change in fishing mortality rate	
Present C = 0.20 Predicted change in (Y/R)	from F/M=4.00 to F/M=.818 from Y'=.032914 to Y'=.062169 + 89%	from F/M=1.86 to F/M.818 from Y'=.018275 to Y'=.021833 + 19%

Table 3 (cont'd)

M =	L_{oo} = 85.0 cm; K = 0.12; Z = 1.12 0.2	0.4
4. *Trachurus trachurus* L.	L_{oo}=37.6 cm; K=0.22; Z=0.54; l_c=17.0 cm; b=4.2 (a) change in size at first capture	
Present C = 0.46 Predicted change in (Y/R)	from C=0.46 to C=0.64 from Y'=.083460 to Y'=.094922 + 14%	from C=0.46 to C=0.38 from Y'=.022804 to Y'=.023250 + 2%
	(b) change in fishing mortality rate	
Present C = 0.46 Predicted change in (Y/R)	from F/M=1.86 to F/M01.86 from present (F) (C) is optimal	from F/M=.333 to F/M=2.33 from Y'=.022804 to Y'=.039178; present (F) should be increased 71%

Table 4

Calculations of optimal mesh size of the codends with different values of (L_{oo}) and (M)

	M = 0.2 optimal codend (mm)	M = 0.4 optimal codend (mm)
Merluccius merluccius		
K=0.12; Z=1.12; l_c=12.4; b=3.1		
L_{oo} = 85 cm	158	148
L_{oo} = 50 cm	94	87
L_{oo} = 40 cm	75	69
Mullus barbatus		
K=1.8; Z=1.64; l_c=11.4; b=2.8		
L_{oo} = 27 cm	87	81
L_{oo} = 23 cm	74	69
L_{oo} = 18 cm	58	54
Pagellus erythrinus		
K=0.20; Z=1.10; l_c=11.8; b=2.9		
L_{oo} = 60 cm	144	107
L_{oo} = 30 cm	72	54
L_{oo} = 25 cm	60	45
Trachurus trachurus		
K=0.22; Z=0.54; l_c=17.0; b=4.2		
L_{oo} = 37.6 cm	57	34
L_{oo} = 30 cm	46	27

4. REFERENCES

Alegria-Hernandez, V., 1984. Some aspects of horse mackerel (Trachurus trachurus L.) biology in the Adriatic. FAO Rapp.Pêches/FAO Fish.Rep., (290):123-7

Arneri, E. and S. Jukić, 1985. Some preliminary observations on the biology and dynamics of Mullus barbatus L. in Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (345):79-87

Beverton, R.J.H. and S.J. Holt, 1957. On the dynamics of exploited fish populations. Fish.Invest. Minist.Agric.Fish Food G.B.(2 Sea Fish), 19:533 p.

____________, 1966. Manual of methods for fish stock assessment. Part 2. Tables of yield functions. Manuel sur les méthodes d'évaluation des stocks ichtyologiques. Partie 2. Tables des fonctions de rendement. Manual de métodos para la evaluación de los stocks de peces. Parte 2. Tablas de funciones de rendimiento. FAO Fish.Tech.Pap./FAO Doc. Tech.Pêches/FAO Doc.Tec.Pesca, (38)Rev.1:67 p.

Famigni, P., 1984. Preliminary utilization of trawl survey data for hake (Merluccius merluccius L.) population dynamics in the Adriatic. FAO Rapp.Pêches/FAO Fish.Rep., (290):109-15

Gamulin-Brida, H., 1974. Biocoenoses benthique de la mer Adriatique. Acta Adriat., 15(9):102 p.

Giovanardi, O., M. Rizzoli and S. Jukić, 1985. Preliminary considerations on the fishery management of the hake (Merluccius merluccius L.) stock in the Adriatic Sea. FAO Rapp.Pêches/FAO Fish.Rep., (345):71-9

Gulland, J.A., 1963. Manual of methods for fish assessment. Parti 1. Fish population analysis. FAO Fish.Tech.Pap., (40)Rev.2:95 p.

Haidar, Z., 1970. L'écologie du rouget (Mullus barbatus L.) en Adriatique orientale. Acta Adriat., 14(1):94 p.

Jones, R., 1981. The use of length composition data in fish stock assessment (with notes on VPA and cohort analysis). FAO Fish.Cir., (734):60 p.

Jukić, S., 1971. Studies on the population and the catchability of Norway lobster in the central Adriatic. GFCM Stud.Rev., (48):27-53

____________, 1975. Trawl fishing grounds in the central Adriatic. Acta Adriat., 17(1):86 p.

Karlovac, O., 1953. An ecology study of Nephrops norvegicus (L.) of the high Adriatic. Izv.Inst. Océanogr.Ribar., Split, 5(2C)1:50 p.

Koura, R., 1969. Codend mesh size effect on Italian otter trawl efficiency. GFCM Stud.Rev., (39): 13-21

Panayotou, T., 1982. Management concepts for small-scale fisheries: economic and social aspects. FAO Fish.Tech.Pap., (228):53 p. Issued also in French and Spanish

Pauly, D., 1983. Some simple methods for assessment of tropical fish stocks FAO Fish.Tech.Pap., (234):52 p. Issued also in French and Spanish

____________, 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud.Rev., (8):325 p.

Pearse, P.H., 1980. Regulation of fishing effort with special reference to Mediterranean trawl fisheries. FAO Fish.Tech.Pap., (197):82 p. Issued also in French

Pope, J.A., 1975. Manual of methods for fish stock assessment. Part 3. Selectivity of fishing gear. FAO Fish.Tech.Pap., (41)Rev.1:65 p. Issued also in Spanish

Rijavec, L. and S. Zupanović, A contribution to the knowledge of biology of Pagellus erytrinus L. in the middle Adriatic. Rapp.P.-V.Réun.CIESM, 18(2):195-200

Zupanović, S., 1961. Analyse quantitative-qualitative des populations des poissons dans les canaux de l'Adriatique moyenne. Acta Adriat., 9(3):151 p.

____________, 1968. Study of hake (Merluccius merluccius L.) biology and population dynamics in the central Adriatic. GFCM Stud.Rev., (32):24 p.

PRELIMINARY ECOLOGICAL AND BIOLOGICAL STUDIES OF JUVENILE FISH SPECIES OF COMMERCIAL INTEREST IN THE NATIONAL PARK "KORNATI"

by

M. Kraljević and J. Jug-Dujaković
Institute of Oceanography and Fisheries, Split, Yugoslavia

1. INTRODUCTION

The Institute of Oceanography and Fisheries in Split has been engaged in intensive studies of ecology and biology of juveniles of fish species of commercial interest in the mid-Dalmatian coastal area for the last decade. Some researches dealt with the temporal distribution of grey mullet in the coastal area of the middle Adriatic (Katavić, 1980) some with the feeding of striped seabream (Froglia, 1977; Jardas, 1985) and annular bream (Jardas et al., 1986). Studies of juvenile fish of the outer Adriatic islands started in 1985 and were continued in 1986. About twenty coves in the Kornati archipelago were subject to preliminary survey. Four coves were used as reference stations; Lojena cove on the Levrnaka Island, southwestern cove on the Piskera Island, Sipnata cove on the Kornat Island and Lavsa cove on the Lavsa Island. Ropotnica cove on the Kornat Island was used as alternative station (Figure 1).

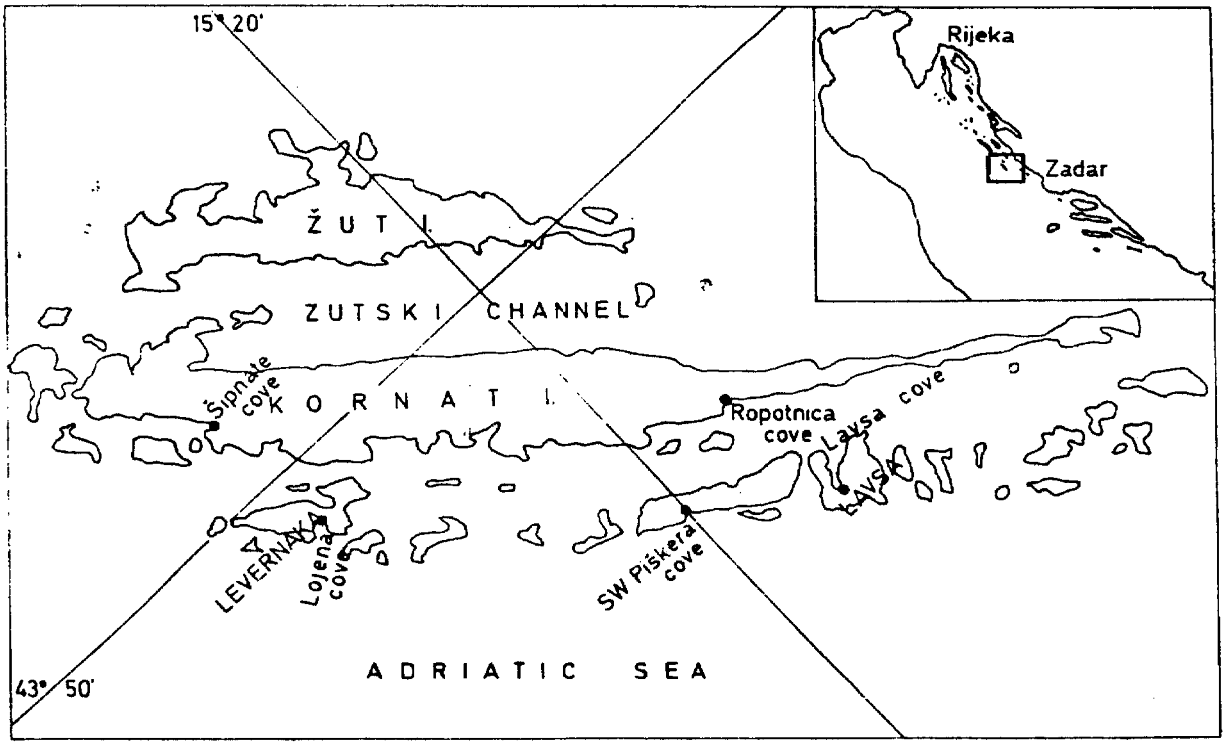


Figure 1 Study area National park "Kornati"

The aim of this study was to select reference coves for further investigations by preliminary survey, to establish the occurrence, quantity, distribution, growth rate, condition factor and weight-length relationship of different juvenile fish species from selected localities. It was also aimed at establishing the time of first occurrence and the time of departure from the Kornati coves by juvenile fish. This phenomenon should be studied in detail in near futurewith respect to different hydrographic and morphological characteristics of the coves.

2. DESCRIPTION OF COVES

Lojena cove: open communication with the open sea. Steep, exclusively rocky shore with gravel at the bottom. Sea bed hard, sandy, laterally overgrown by meadows of *Posidonia* reaching almost into the shores. This has the characteristics of a clean and open cove with no freshwater supply so that abiotic and biotic factors are those typical of the open adriatic.

Southwestern cove of Piskera Island: like the preceding cove, communicates directly with the open sea. Short, deep, with steep shores, gravel bottom, and very difficult for fish in winter. There is no freshwater supply so the physical and chemical characteristics are those typical of the open sea.

Sipnata cove: not extending very far into the island; depth not exceeding 1 m, it has open communication with the sea of channel origin, so that temperature and salinity resemble those of the open sea. The configuration of the land at the inner end of the cove is such that during rainy months larger quantities of fresh water are discharged into the cove decreasing salinity. The shore is rocky, low, with fine sediments at the inner end of the cove, the shore of which is extremely low lying. The bottom is hard, sandy, and overgrown by the meadows of the species of Cymodocea genus.

Lavsa cove: deeply extending into the island. The shore rocky and low, with fine particulate bottom sediments. The inner end of the cove is very shallow, not exceeding 1 m, sea bed sandy-clayey, hard and overgrown with meadows of Cymodocea sp. in places. The inner end of the cove is an intertidal zone which is inhabited by organisms tolerant to great oscillations of temperature and salinity. These observations, configuration and structure of the substratum of the cove indicate that in winter and spring a large quantity of fresh water is discharged into it after rainy days. The cove is suitable for catching larger quantities of juvenile fish for rearing purposes.

Ropotnica cove: short, deep, bordered by steep vertical cliffs steeply sloping into the sea and reaching the bottom. Bottom covered by massive stones, with stones along the shore so that the cove is not easily approached particularly in winter. Therefore this cove will be taken only as an alternative for future work. It is open to freshwater supply only under extraordinary conditions (cloud-bursts, floods) with gravel at the inner end. Plants and animals typical of the open sea.

3. MATERIAL AND METHODS

The beach seine used for collecting juvenile fish was 50 m long. Net depth at the beginning of wings was 30 cm and 250 cm at the central part together with the sac. Outer wings were of 8 mm mesh size and central sac of 4 mm. The net was always hauled from the entrance to the cove to its inner end. Material was sorted on the shore and species of commercial interest preserved in 4% formalin for further analyses in the laboratory. Total fish quantity, total length in mm and weight in g were taken.

We used the following keys for identification of juvenile fish species: Ranzi (1930 and 1933), Vialli (1933), Ben-Tuvia (1975), Trewavas and Ingham (1972) and Farrugio (1975) and the following literature for nomenclature: Tortonese (1973), Trewavas (1973), Bauchot and Hureau (1986), Ben-Tuvia (1986), Hureau (1986). Bini (1968) was also used in determination of Sparidae and Mugilidae.

For calculation of length-weight relationship the formula $W=aL^b$ was used and for condition factor $c.f.=W.100/L^3$ by means of the Pauly's programme FB-1 (Pauly, 1984).

Physical-chemical parameters were measured by classical methods in every cove before net hauling.

4. RESULTS AND DISCUSSION

4.1 Analysis of Physical-Chemical Parameters

Phisical and chemical parameters of surveyed coves are presented in Table 1.

Temperature was high in Sipnata cove (28.2°C) and Lavsa cove (28.4°C) in 1985. In other coves temperature was about 25.0°C what is typical for shallow and wide coves. The following year (1986) considerably lower temperature was recorded from Sipnata (20.4°C) than from Lavsa (24.7°C), being about 22.0°C in other coves. As shown by the data, temperatures recorded in 1986 were considerably lower than in 1985, even though coves were surveyed during the same month (second half of July). The difference ranged from a maximum of 7.8°C in Sipnata cove to a minimum of 2.3°C in the southwestern cove on the Piskera Island.

Salinity values were high in Sipnata and Lavsa (40.60°/oo) and Lojena (39.44°/oo) and approximately similar to the open sea values (about 38°/oo) in other coves of the study area. Salinity was also lower in all the coves in 1986 than in 1985, being about 38‰ except in Sipnata where salinity was somewhat lower (36.85°/oo).

Table 1

Physical-chemical parameters in the study area

Stations	T°C	Sal. ‰	O_2 ml/l	Nutrients (µg - at/l)				
				NO_3-N	NO_2-N	NH_3-N	PO_4-P	SiO_3-Si
1985								
Lojena	25.4	39.44	4.90	0.72	0.149	0.72	0.077	11.62
SW "Piskera"	24.5	38.86	5.21	0.52	0.071	1.10	0.060	12.86
Sipnata	28.2	40.60	7.71	0.55	0.038	0.78	0.051	10.04
Lavsa	28.4	40.60	7.03	0.75	0.053	0.44	0.064	6.61
Ropotnica	25.4	38.24	4.18					
1986								
Lojena	22.0	38.06	5.74	1.00	0.092	1.00	0.068	10.04
SW "Piskera"	22.2	38.04	5.67	0.87	0.095	0.82	0.060	10.04
Sipnata	20.4	36.85	5.37	0.90	0.113	0.82	0.060	10.42
Lavsa	24.7	38.17	8.75	0.84	0.095	0.78	0.064	9.64

Such considerable differences in both parameters may be associated with different meteorological conditions in these two years. In 1985, the weather was typically summery but in 1986 after three rainy days a rather cold wind started to blow, which was enough to cool and mix the sea water in such shallow coves. Due to a rather high quantity of precipitation immediately before our field sampling in 1986, salinity was also lowest in Sipnata (36.85°/oo) as distinct from 1985 (40.60°/oo). Dissolved oxygen quantity was also considerably lower (5.37 ml/l) in 1986 than in 1985 (7.71 ml/l). It was quite normal in other coves typical for the open sea localities. Nutrient contents showed no departures from standard values for the middle Adriatic (Table 1).

4.2 Analysis of Juvenile Fish Catch

Spatial distribution and quantity of juvenile fish of commercial interest in studied coves are given in Table 2. As shown by Table 2 ten juvenile fish species were captured in 1985 of which four belonged to Mugilidae family, five to Sparidae and one to Mullidae. The best represented were thicklip grey mullet (Chelon labrosus (Risso, 1826)) in Lavsa and annular sea bream (Diplodus annularis (L., 1758)) in Sipnata. In 1986 two new species were recorded, flathead grey mullet (Mugil cephalus cephalus L., 1758) in SW cove "Piskera" and common two-banded sea bream (Diplodus vulgaris (E. Geoffrey Saint-Hilaire, 1817)) in Lojena. Presence and quantity of the rest of juvenile fish were similar to those in 1985 (see Table 2). The best represented was again Ch. labrosus in Lavsa cove, D. annularis in Sipnata and Sarpa salpa (L., 1758) in Lojena and Lavsa. Among expected species, gilthead sea bream (Sparus aurata L., 1758) and european seabass (Dicentrarchus labrax L., 1758) were not recorded from the coves studied. This may be due to a too late field sampling (second half of July) since it is well known that these two species begin to leave similar localities along the coast at the end of June migrating towards the open sea. The records of juvenile white sea bream (Diplodus sargus (L., 1758)) and saddled bream (Oblada melanura (L., 1758)) in "outer" coves of the Kornati archipelago (Piskera and Lojena) are in accordance with the earlier records of these species in coves Sovlja, Makirina and Zaborići in the Sibenik area (Jug-Dujaković, 1987, the same publication).

Calculated mean lengths and weights for samples containing more than 4 specimens are presented in Table 3. They refer to the same age groups in all species except in D. annularis and Leaping grey mullet (Liza saliens (Risso, 1810)) of which probably two age groups were present. The difference in mean lengths and weights between D. annularis from Sipnata and those from Lavsa in 1986 (from 2.5 cm, 0.18 g and 5.6 cm, 2.36 g) and in 1985 (from 2.6 cm, 0.19 g and 5.8 cm, 4.23 g). Significant difference between mean lengths and weights was also recorded in L. saliens from SW cove "Piskera" (1.1 cm) and Lavsa (7.6 cm, 4.40 g) from 1985. Weighing of L. saliens from SW "Piskera" was impossible on the balance with ± 0.01 g precision. Such an evident difference in length and weight was not recorded in other species.

Table 2

Number of individuals of different species from the study area

Species	Stations				
	Lojena	SW "Piskera"	Sipnata	Lavsa	Ropotnica
1985					
Liza aurata				+	
Liza saliens		++		+	
Chelon labrosus	+		+	+++	+
Oedachilus labeo		+			++
Diplodus annularis			+++	+	
Diplodus puntazzo				+	
Diplodus sargus	+				
Oblada melanura	++	+			
Sarpa salpa	+		+	+	
Mullus barbatus		+	+		
1986					
Mugil cephalus cephalus		+			
Liza aurata	++			+	
Liza saliens			+	+	
Chelon labrosus			+	++++	
Oedalechilus labeo	+	+			
Diplodus annularis			++++	+	
Diplodus puntazzo			+	+	
Diplodus sargus	+	++			
Diplodus vulgaris	+				
Oblada melanura		+			
Sarpa salpa	++++		+	+++	
Mullus barbatus		+			

+ to 10; ++ to 20; +++ to 30 and ++++ over 30 individuals

It may be assumed that L. saliens, D. annularis and O. melanura appeared for the first time in the coves studied in relation to their spawning (L. saliens - summer months, D. annularis - May to August, and O. melanura - April to June), in the eastern Mediterranean environment (Bauchot and Hureau, 1986; Ben-Tuvia, 1986; Table 3).

Weight-length relationships plotted are rather uniform with very slight departure in Ch. labrosus from Mugilidae family (Figure 2) and Sharpsnout sea bream (Diplodus puntazzo (Cetti, 1777)) from Sparidae family (Figure 3).

Values of the index of ponderal growth calculated from the weight-length relationship exceed 3 in genus Diplodus as distinct from species O. melanura, S. salpa and species of striped mullet of Mugilidae family. This value exceeded even 3.5 in D. puntazzo and Mullus barbatus L., 1758), even though a t-test did not show them to be significantly different from 3. This may be due either to a too small number of individuals (5 and 10) or very small range of sizes (Table 4 and Figures 2 and 3).

Values of condition factor (c.f.) are considerably higher in the Sparidae family than in the Mugilidae (Table 4).

Table 3

Mean total fish length and weight by species at sampling stations of archipelago Kornati for 1985 and 1986

Species		STATIONS									
		Lojena		SW "Piskera"		Sipnata		Lavsa		Ropotnica	
		mean ±SD 1985	mean ±SD 1986	mean ±SD 1985	mean ±SD 1986	mean ±SD 1985	mean ±SD 1985	mean ±SD 1985	mean ±SD 1986	mean ±SD 1985	mean ±SD 1986
<u>Mugil cephalus cephalus</u> L., 1758 - Flathead	L_t(cm)										
grey mullet	W (g)				./.						
<u>Liza aurata</u>(Risso,1810) -Golden grey mullet	L_t(cm)		8.0 ±1.03					6.8 ±0.34			
	W (g)		4.34 ±1.227					2.84 ±0.330	./.		
<u>Liza saliens</u>(Risso,1810) -Leaping grey mullet	L_t(cm)			1.1 ±0.12				7.6 ±0.12			
	W (g)			weighing impossible			./.	4.40 ±2.345	./.		
<u>Chelon labrosus</u> (Risso, 1826) - Thicklip grey	L_t(cm)						3.9 ±0.25	6.0 ±2.00	4.2 ±0.22	5.2 ±0.25	
mullet	W (g)	./.				./.	0.58 ±0.128	3.32 ±3.870	0.78 ±0.107	1.39 ±0.144	
<u>Oedalechilus labeo</u> (Cuvier, 1829)-Boxlip	L_t(cm)		7.8 ±0.99	6.6 ±1.90						7.8 ±0.88	
mullet	W (g)		4.41 ±1.656	2.94 ±1.291	./.					4.11 ± 1.432	
<u>Diplodus annularis</u> (L.,1758)-Annular sea	L_t(cm)					2.6 ±0.28	2.5 ±0.17 5.6 ±0.57	5.8 ±2.00	2.6 ±0.12		
bream	W (g)					0.22 ±0.075	0.18 ±0.042 2.36 ±0.801	4.23 +-3.034	0.19 ±0.042 ./.		
<u>Diplodus puntazzo</u> (Cetti, 1777)-Sharpsnout	L_t(cm)										
sea bream	W (g)						./.	./.	./.		
<u>Diplodus sargus</u> (L., 1758)-White sea	L_t(cm)	5.3 ±0.27			3.2 ±1.09						
bream	W (g)	2.16 ±0.527	./.		0.62 ±0.748						
<u>Diplodus vulgaris</u> (E. Geoffrey Saint-Hilaire,	L_t(cm)		6.4 ±0.79								
1817)-Common two-banded sea bream	W (g)		3.79 ±1.422								
<u>Oblada melanura</u> (L.,1758)-Saddled bream	L_t(cm)	2.1 ±0.66		1.9 ±0.65							
	W (g)	0.13 ±0.105		0.09 ±0.086	./.						
<u>Sarpa salpa</u> (L.,1758)- -Salema	L_t(cm)		6.5 ±0.54			5.7 ±0.82			6.1 ±0.48		
	W (g)	./.	3.47 ±0.857			2.52 ±0.948	./.	./.	2.89 ±0.648		
<u>Mullus barbatus</u> L.,1758 -Striped mullet	L_t(cm)			5.7 ±0.22		6.1 ±0.64					
	W (g)			1.59 ±0.207	./.	2.09 ±0.815					

./. Mean length and weight and standard deviations (SD) were not calculated for samples containing less than 4 specimens

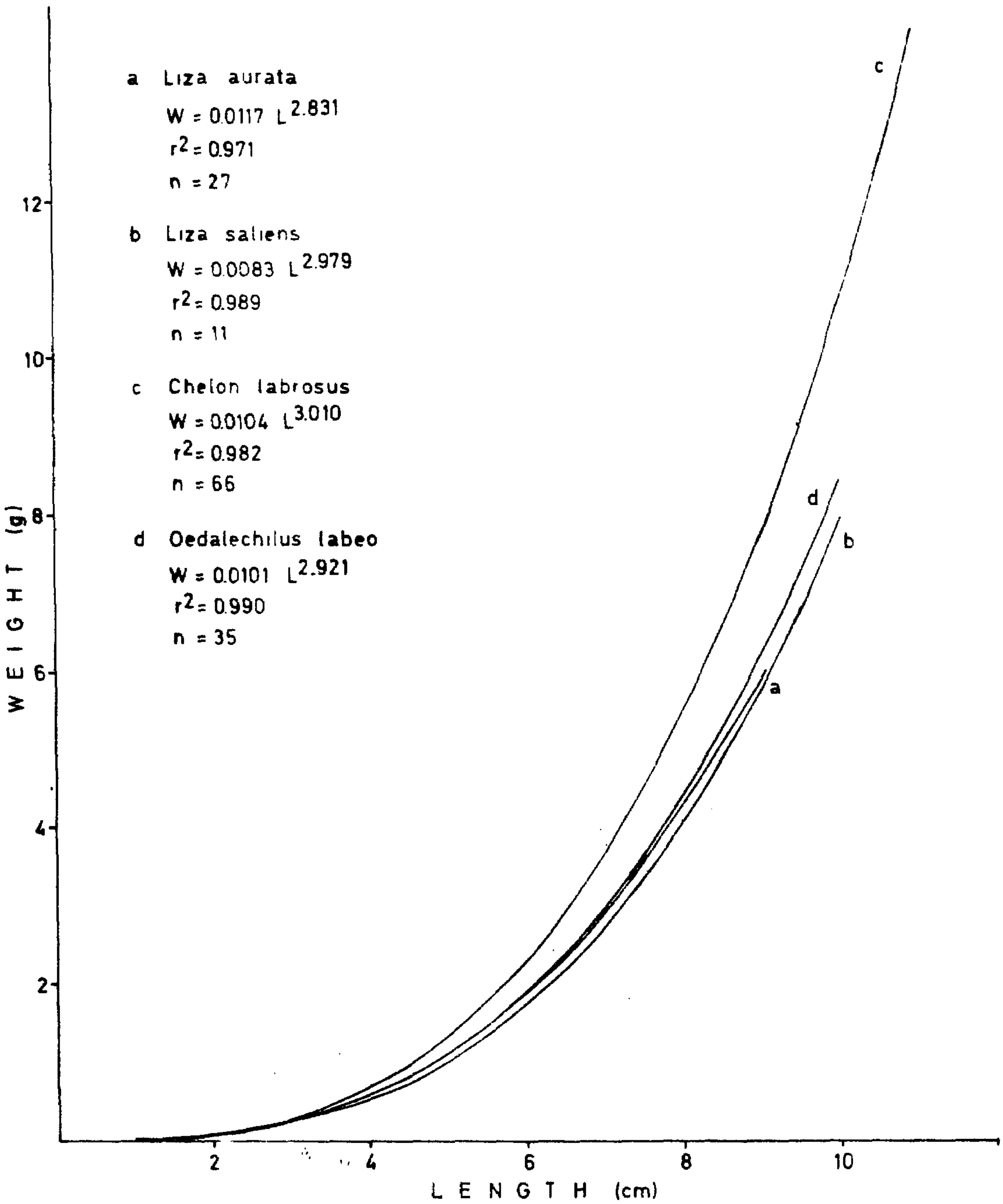


Figure 2 Length-weight relationship for the family Mugilidae from National Park "Kornati"

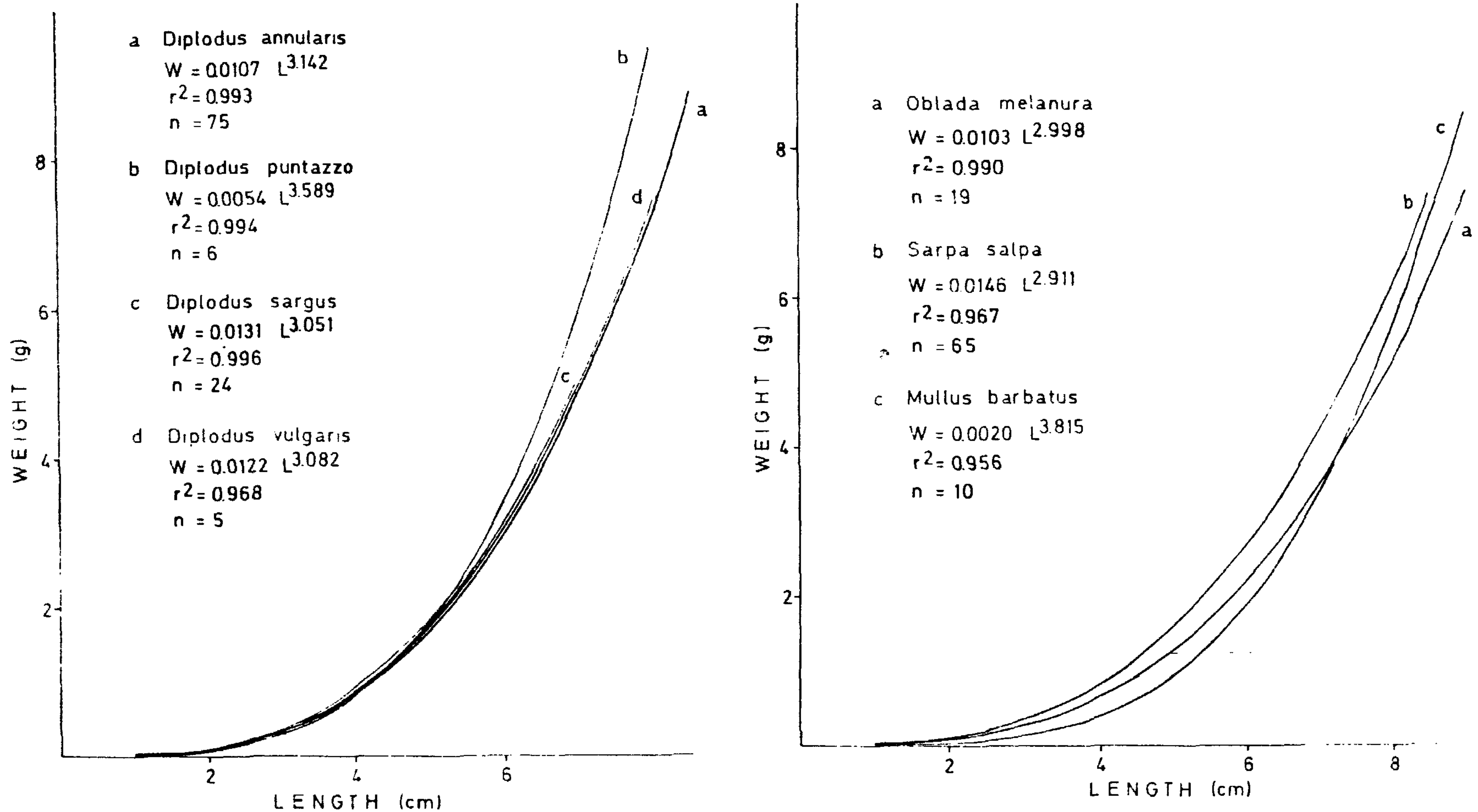


Figure 3 Length-weight relationship for the families Sparidae and Mullidae from National park "Kornati"

Table 4

Comparing of ponderal growth coefficient (b) and condition factor (c.f.) by species of Kornati archipelago

Species	Parameters	
	b	c.f.
Liza aurata	2.831	0.83
Liza saliens	2.979	0.80
Chelon labrosus	3.010	1.06
Oedalechilus labeo	2.921	0.86
Diplodus annularis	3.142	1.26
Diplodus puntazzo	3.589a/	1.42
Diplodus sargus	3.051	1.39
Diplodus vulgaris	3.082	1.42
Oblada melanura	2.998	1.03
Sarpa salpa	2.911	1.24
Mullus barbatus	3.815a/	0.86

a/ T-test showed no significant difference from 3

5. CONCLUSIONS

Temperature, salinity and dissolved oxygen quantity fluctuated considerably at studied localities probably due to different weather conditions.

Juveniles of twelve species of commercial interest were caught from the Kornati archipelago. Of them C. labrosus, D. annularis, and S. salpa were best represented. Species S. aurata and D. labrax were not recorded from studied coves.

Records of D. sargus and O. melanura from the outer coves confirmed some earlier records of juveniles of these species at similar localities.

Even though physical and chemical parameters varied considerably in studied coves, fish juveniles showed uniform growth rate with no significant departures, particularly for boxlip mullet (Oedalechilus labeo (Cuvier, 1829)) and S. salpa. Studies of ecology and biology of juvenile fish appearing in the area of National park "Kornati" should be continued since better knowledge help us in their better protection.

6. ACKNOWLEDGEMENTS

My special thanks are due to Mrs Veronica Alegria-Hernandez for her useful advice and help in preparing the manuscript.

I also wish to express my sincerely gratitude to Mr S. Jukić, Mr S. Regner and Mr I. Jardas and also to Mrs M. Marušić, Mr L. Stojanoski, Mr I. Saskor, Mr V. Kragić and Miss Z. Crvelin.

7. REFERENCES

Bauchot, M.-L. and J.-C. Hureau, 1986. Sparidae. In Fishes of the north-eastern Atlantic and the Mediterranean. Edited by P.J.P. Whitehead, et al. Paris, Unesco, Vol.2:883-907

Ben-Tuvia, A., 1975. Mugilid fishes of the Red Sea with a key to the Mediterranean and Red Sea species. Bamidgeh, 27:22-4

___________, 1986. Mugilidae. In Fishes of the north-eastern Atlantic and the Mediterranean, edited by P.J.P. Whitehead, et al. Paris, Unesco, Vol.3:1197-204

Bini, G., 1968. Atlante dei pesci delle coste italiane. Mugilidae. Milano, Mondo Sommerso, Vol.4:27-42

___________, 1968. Atlante dei pesci delle coste italiane. Sparidae. Milano, Mondo Sommerso, Vol.4:93-152

Farrugio, H., 1975. Les muges (Poissons, Teleosteens) de Tunisie. Répartition et pêche, contribution à leur étude sistématique et biologique. Thèse, Université des sciences et techniques du Languedoc, 201 p.

Froglia, C., 1977. Feeding of Lithognathus mormyrus (L.) in central Adriatic Sea (Pisces, Sparidae). Rapp.P.-V.Réun.CIEM, 24:95-7

Hureau, J.-C., 1986. Mullidae. In Fishes of the north-eastern Atlantic and the Mediterranean, edited by P.J.P. Whitehead, et al. Paris, Unesco, Vol.1:887-82

Jardas, I., 1985. The feeding of juvenile striped seabream, Lithognathus mormyrus (L., 1758) (Pisces, Sparidae). Rapp.P.-V.Réun.CIESM, 29:107-8

Jardas, I., et al., 1986. Preliminary report on feeding of juvenile annular bream, Diplodus annularis (L., 1758), (Pisces, Sparidae) living in the Adriatic Sea. Rapp.P.-V.Réun. CIESM, 30:229

Katavić, I., 1980. Temporal distribution of young mugilids (Mugilidae) in the coastal waters of the central eastern Adriatic. Acta Adriat., 21:137-50

Pauly, D., 1984. Fish population dynamics in tropical waters: a manual for use with programmable calculators. ICLARM Stud.Rev., (8):325 p.

Ranzi, S., 1930. Stadi giovanili di Sparidi del Golfo di Napoli. Pubbl.Str.Zool.Napoli, 10:407-16

__________, 1933. Sparidae. In Uova, larvae e stadi giovanili di Teleostei. Fauna Flora Golfo Napoli, 38:332-82

Tortonese, E., 1973. Sparidae. In Clofnam 1. Checklist of the fishes of the northeastern Atlantic and of the Mediterranean, edited by J.C. Hureau and Th. Monod. Paris, Unesco, pp.405-15

Trewavas, E., 1973. Mugilidae. In Clofnam 1. Checklist of the fishes of the northeastern Atlantic and of the Mediterranean, edited by J.C. Hureau and Th. Monod. Paris, Unesco, pp. 567-74

Trewavas, E. and S.E. Ingham, 1972. A key to the species of Mugilidae (Pisces) in the northeastern Atlantic and Mediterranean with explanatory notes. J.Zool., Lond., 167:15-29

Vialli, M., 1933. Mugilidae. In Uova, larvae e stadi giovanili di Teleostei. Fauna Flora Golfo Napoli, 38:433-57

ABUNDANCE OF COMMERCIAL FISH IN THE PATRAIKOS, KORINTHIAKOS GULFS AND THE IONIAN SEA, GREECE

by

K. Stergiou and C. Papaconstantinou
National Centre for Marine Research, Athens 16604, Greece

1. INTRODUCTION

In order to compare the fish stock potential in various areas, actual catches must be expressed per unit of fishing effort, otherwise comparisons, estimations and conclusions may be biased and/or erratic. However, in the absence of such data. Information on stock structure collected by a research vessel (in this case a commercial vessel used for research), is also very useful.

In the present work, carried out in the framework of the fisheries investigations in Greek waters, information pertaining to the temporal (within year) and spatial variability of the cpue (catch per unit of fishing effort) of 15 tuna of commercial fish listed in Table 1, in the Patraikos, Korinthiakos Gulfs and the Ionian sea (Figure 1) is presented.

Table 1

Catch per unit effort (cpue), in kg/h, of commercial and non-commercial species in the Patraikos, Korinthiakos Gulfs and the Ionian Sea, June 1984 - April 1985

Species	June			September			December			April			Mean		
	P	K	I	P	K	I	P	K	I	P	K	I	P	K	I
M. merluccius	15.9	5.6	6.6	23.7	9.9	7.4	29.3	30.4	7.6	9.3	4.8	6.2	19.6	12.7	7
M. barbatus	0.6	1.1	1.6	2.1	0.5	1.1	4.0	1.7	2.1	1.5	4.5	2.0	2.3	1.9	1.7
P. erythrinus	0.3	0.6	1.2	0.5	0.0	0.5	0.4	0.0	1.0	0.4	2.2	0.8	0.4	0.7	0.9
M. poutassou	31.0	1.9	0.1	31.4	5.1	0.1	7.4	3.6	0.1	22.7	14.2	0.3	23.1	6.2	0.1
T. trachurus	1.1	0.3	0.3	0.7	0.4	0.5	4.1	21.5	0.9	6.0	2.6	1.1	3.0	6.2	0.7
P. acarne	0.3	0.7	1.5	0.1	0.3	3.8	0.2	0.1	0.1	0.7	3.7	0.9	0.3	1.2	1.6
T.m. capelianus	1.0	0.1	0.1	1.0	0.1	0.2	1.0	0.4	0.9	1.2	0.2	0.4	1.1	0.2	0.4
S. smaris	0.2	0.2	3.5	0.1	0.0	0.5	0.0	0.0	1.1	0.1	0.1	1.8	0.1	0.1	1.7
S. flexuosa	8.7	1.6	5.5	6.3	1.0	3.0	2.0	0.4	0.6	4.2	0.7	5.7	5.3	0.9	3.7
D. annularis	1.7	0.2	0.2	2.6	0.0	0.1	0.0	0.0	0.1	1.9	0.2	0.7	1.6	0.1	0.3
L. budegassa	0.5	2.8	0.5	4.2	0.6	0.2	1.7	1.2	0.3	1.8	1.9	0.2	2.0	1.6	0.3
Fam. Triglidae	0.9	0.4	0.2	0.2	0.0	0.3	0.1	0.1	0.5	0.0	0.1	0.1	0.3	0.2	0.3
Z. Fater	0.1	0.0	0.1	0.0	0.0	0.4	1.2	0.0	0.2	0.0	0.0	0.0	0.3	0.0	0.2
P. bogaraveo	0.0	0.1	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0.2
S. aurata	0.5	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.4	0.0	0.0	0.0	0.2	0.0	0.0
Total commercial	62.8	15.5	22.3	72.8	17.9	18.0	52.5	59.4	15.9	49.8	35.2	20.2	59.5	128.0	76.0
Total cpue	77.8	56.7	43.6	77.6	45.0	50.8	118.2	30.4	47.8	52.0	57.9	44.4	81.4	60	46.7
% Commercial	80.7	27.4	51.2	93.8	39.7	35.4	44.4	73.9	33.2	95.7	60.8	45.4	73.1	53.3	40.8

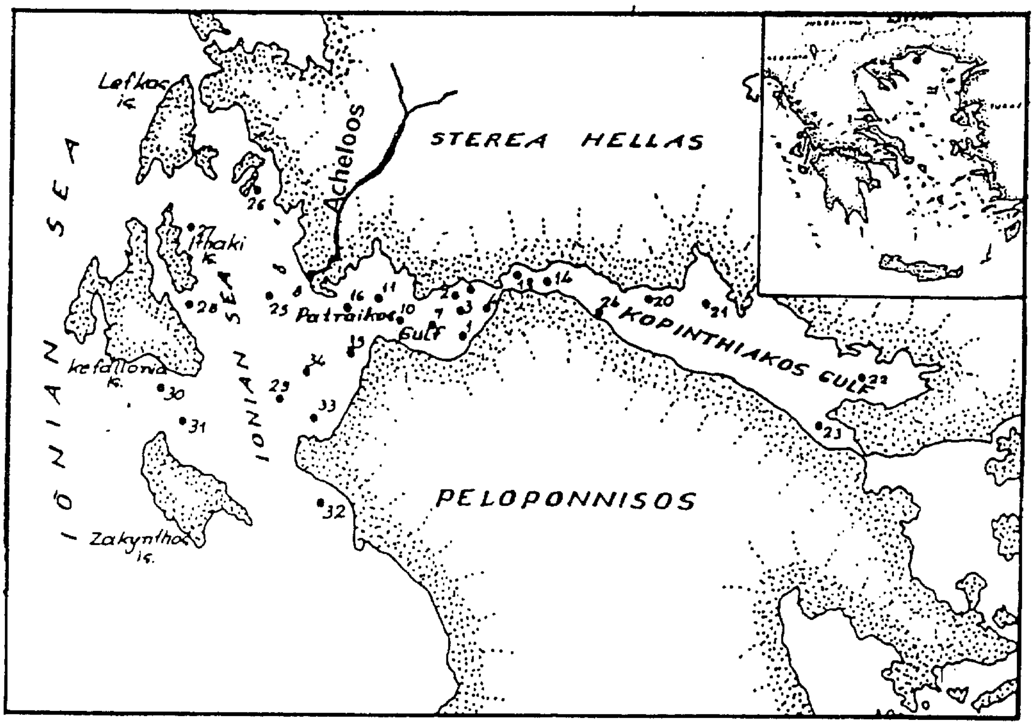


Figure 1 Location of sampling stations

2. MATERIAL AND METHODS

Trawl samples were collected by means of a 425 HP motorboat equipped with a 14 mm codend mesh-size net (from knot-to-knot) during seasonal cruises from June 1984 to April 1985 over a grid of 28 stations (Figure 1). Each haul lasted 45 minutes. The weight of the total catch and catch per species were determined on board, and, consequently, the catch per unit effort, cpue, in kg/h, was estimated.

3. RESULTS AND DISCUSSION

The cpue and proportions of the main commercial species in the area studied during June 1984 - April 1985 are listed in Tables 1 and 2.

The mean (June 1984 - April 1985) cpue was higher in the Patraikos Gulf, 81.4 kg/h, than in the Korinthiakos Gulf, 60 kg/h, and the Ionian Sea, 46.7 kg/h (Table 1). Investigations, however, in June 1983 - April 1984 (Papaconstantinou et al., 1984) showed that the mean cpue was 146.2 kg/h, 49.7 kg/h and 31.4 kg/h in the Korinthiakos, Patraikos Gulfs and the Ionian Sea respectively. The high cpue of the Korinthiakos Gulf in 1983-84 is attributed to the massed, occasional occurrence of G.a. argenteus and M. poutassou at St. 21 in December 1984, where the total catch amounted 1.1 t.

Commercial species made up 73.1% of the mean cpue in the Patraikos Gulf, whereas their proportion was considerably lower in the Korinthiakos Gulf, 53.3%, and the Ionian Sea, 40.8% (Table 1). This must be mainly attributed to the restricted bathymetry of the Patraikos Gulf (depth <120 m) which does not favor the non-commercial Gadidae species. The major bulk of the non-commercial cpue is attributed to G. a. argenteus, in the Korinthiakos Gulf, A. sphyraena and C. aper and L. dieuzeidei in the Ionian Sea (Papaconstantinou et al., 1986).

With regard to the mean annual species composition of the catches per area, M. merluccius, M. poutassou and S. flexuosa dominated the catches in the Patraikos Gulf, amounting 19.6 kg/h (24%), 23.1 kg/h (28%) and 5.3 kg/h (6.5%) respectively (Tables 1 and 2). All other commercial species accounted together for 11 kg/h (14.1%); percentages per species being lower than 4% (Tables 1 and 2). The species composition of the catches did not change significantly with seasons in the Patraikos Gulf (Tables 1 and 2).

M. merluccius, M. poutassou, and T. trachurus represented the major part of the annual catch in the Korinthiakos Gulf, with a mean cpue of 12.7 kg/h (21.1%), 6.2 kg/h (10.1%) and 6.2 kg/h (10.1%) respectively (Tables 1 and 2). The remaining commercial species made up 11.5% (6.9 kg/h) of the

Table 2

Proportion of the commercial species cpue in the Patraikos, Korinthiakos Gulfs and the Ionian Sea in June 1984 - April 1985

Species	June			September			December			April			Mean		
	P	K	I	P	K	I	P	K	I	P	K	I	P	K	I
M. merluccius	20.5	9.8	15.2	30.5	21.9	14.5	24.8	37.8	16.0	17.9	8.8	14.0	24.0	21.1	14.9
M. barbatus	0.8	1.9	3.7	2.7	1.1	2.1	4.1	2.1	4.4	2.9	7.8	4.5	2.8	3.2	3.6
P. erythrinus	0.4	1.1	2.7	0.6	0.0	1.0	0.4	0.0	2.0	0.8	3.8	1.9	0.5	1.2	1.9
M. poutassou	39.9	3.3	0.3	40.5	11.3	0.1	6.3	4.4	0.2	43.6	24.5	0.6	23.4	10.3	0.3
T. trachurus	1.4	0.6	0.6	0.9	1.0	0.9	3.4	26.8	1.9	11.5	4.4	2.5	3.6	10.4	1.5
P. acarne	0.3	1.2	3.5	0.2	0.7	7.5	0.1	0.2	0.2	1.4	6.4	2.0	0.4	2.0	3.4
T.m. capellanus	1.3	0.1	0.3	1.3	0.2	0.4	0.9	0.4	1.8	2.3	0.4	1.0	1.3	0.3	0.9
S. smaris	0.3	0.3	8.0	0.1	0.0	1.1	0.0	0.0	2.3	0.2	0.1	3.9	0.1	0.1	3.7
S. flexuosa	11.2	2.8	12.6	8.1	2.3	5.9	1.7	0.5	1.3	8.0	1.3	12.9	6.5	1.5	7.9
D. annularis	2.2	0.4	0.5	3.4	0.1	0.2	0.0	0.0	0.1	3.6	0.4	1.5	1.9	0.2	0.5
L. budegassa	0.6	5.0	1.2	5.4	1.2	0.3	1.4	1.5	0.7	3.4	3.4	0.5	2.5	2.7	0.7
Fam. Triglidae	1.1	0.8	0.5	0.2	0.0	0.6	0.1	0.1	1.1	0.0	0.1	0.1	0.4	0.2	0.6
Z. faber	0.1	0.0	0.2	0.1	0.0	0.8	1.0	0.0	0.3	0.0	0.0	0.1	0.4	0.0	0.4
P. bogaraveo	0.0	0.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
S. aurata	0.6	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.8	0.0	0.0	0.0	0.2	0.0	0.1

mean cpue, percentages per species being consistently lower than 4%. The high mean cpue of T. trachurus in that area is the result of its exceptionally high abundance in December 1984, cpue = 21.5 kg/h, 26,8%, whereas its abundance during the remaining periods was very low (<3 kg/h) (Table 1). On a seasonal basis, L. budegassa made up a considerable part of the catch in June 1984, P. acarne and M. barbatus in April 1985 (Tables 1 and 2).

M. merluccius and S. flexuosa were the dominant species in the catch of the Ionian Sea, representing 7 kg/h (15%) and 3.7 kg/h (7.9%) respectively. All other commercial species amounted together to 8.4 kg/h (18%), and proportion of species were consistently lower than 4%. On a seasonal basis, S. smaris made up a significant portion of the catch in June 1984, P. acarne in September (Tables 1 and 2).

The cpue in the area studied changes greatly with respect to depth (Table 3). The major part of the Korinthiakos Gulf and the Ionian Sea cpue, 74% and 63% accordingly, is attributed to depths greater than 150 m, while 50% of the Patraikos cpue comes from depths ranging between 100-120 m. This must be related to the high abundance of the Gadidae species (M. merluccius, M. poutassou, G. a. argenteus, etc.) in deeper waters.

The seasonal variation of the cpue for the whole area and for selected stations during June 1985 - April 1985 is shown in Figures 2 and 3. Some general remarks can be drawn. One realizes that cpue in the area studied is closely related to the opening of the trawl fishing season, i.e., cpue decreases along with the opening of the fishing season in autumn and increases slowly again with the end of the season in late spring. The high cpue during December 1984 in Korinthiakos Gulf was the result of the occasionally high abundance of G. a. argenteus and M. poutassou at St 21. On the other hand, in areas where fishing is not allowed (St 13, St 23) cpue shows maxima and minima in winter-spring and summer-autumn respectively.

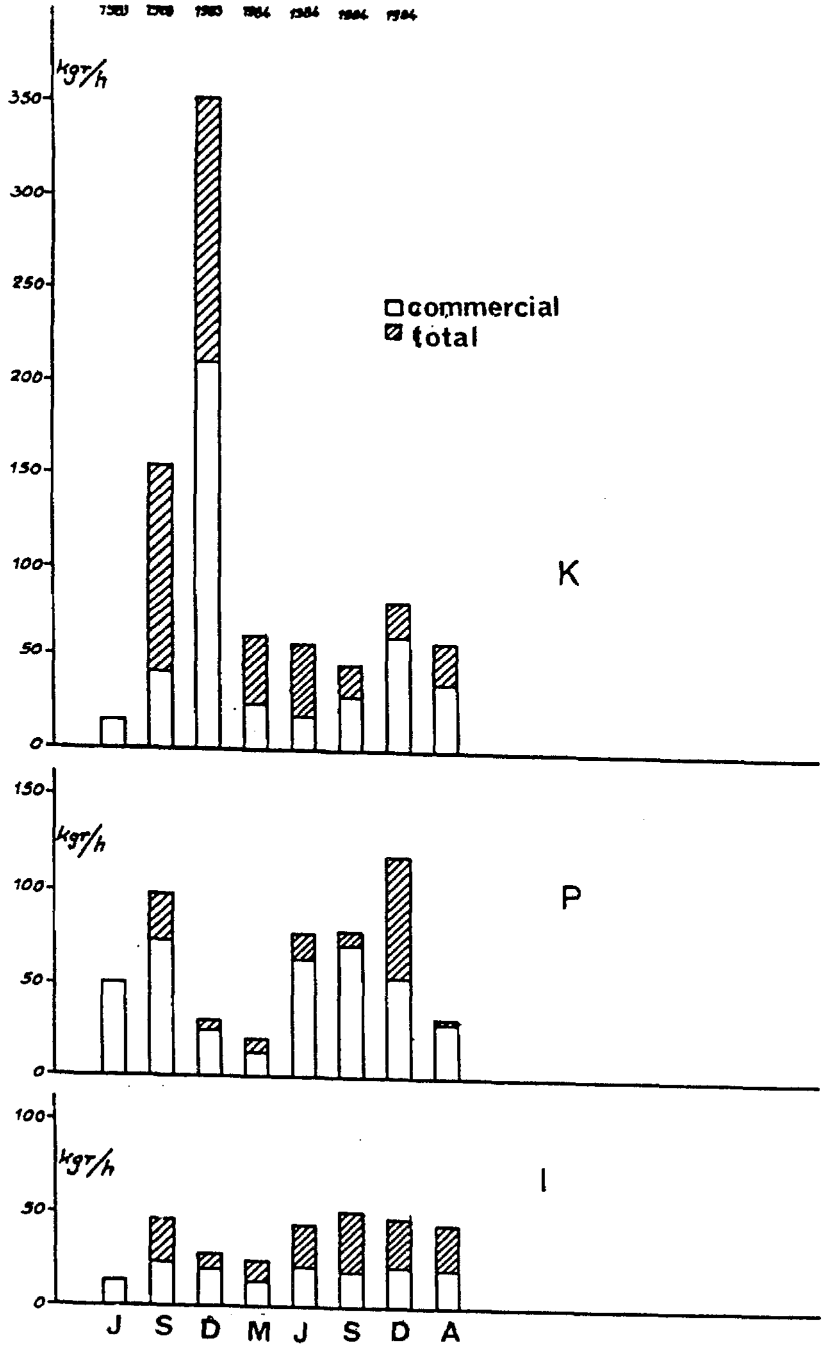


Figure 2 Seasonal changes of the cpue (kg/h) in the Patraikos (P), Korinthiakos (K) Gulfs and the Ionian Sea (I), June 1983 - April 1985

Table 3

Mean cpue, in kg/h, and proportion of cpue per depth in the area studied

Depth	KORINTHIAKOS		IONIAN	
	cpue	%	cpue	%
0 - 75	85	21	31	14
75 - 150	65	16	26	12
150 - 250	177	43	880	41
> 250	80	20	70	33
	PATRAIKOS			
	cpue	%		
0 - 50	40	19		
50 - 100	68	31		
> 100	110	50		

In the Patraikos Gulf, cpue was higher at the stations close to the proximity of the Acheloos River estuary (Stations 11, 16) and lower in the northeastern part of the Gulf (St. 4, 36, 12). The lowest value of cpue was recorded at St. 14, 12.4 kg/h in spring 1984). This can be explained in terms of trawling activity, which, in that area, is very intense due to the massed presence of shrimps. Finally, the cpue does not seem to differ significantly at the various stations of the Ionian Sea.

4. CONCLUSIONS

(a) The proportion of the commercial catch is higher in the Patraikos Gulf, 73.1%, than the Korinthiakos Gulf, 53.3% and the Ionian Sea, 40.8%.

(b) M. merluccius, M. poutassou and S. flexuosa made up the bulk of the commercial cpue in the Patraikos Gulf.

(c) M. merluccius, M. poutassou, T. trachurus and, to a lesser degree, L. budegassa, M. barbatus and P. acarne accounted for the major part of the Korinthiakos Gulf commercial catch.

(d) M. merluccius, S. flexuosa and to a lesser degree, S. smaris and P. acarne dominated the commercial catch in the Ionian Sea.

(e) The opening of the trawl fishing season in autumn leads to decreased cpue in the area studied during winter and spring. Areas where fishing is not allowed show a different pattern of fluctuations.

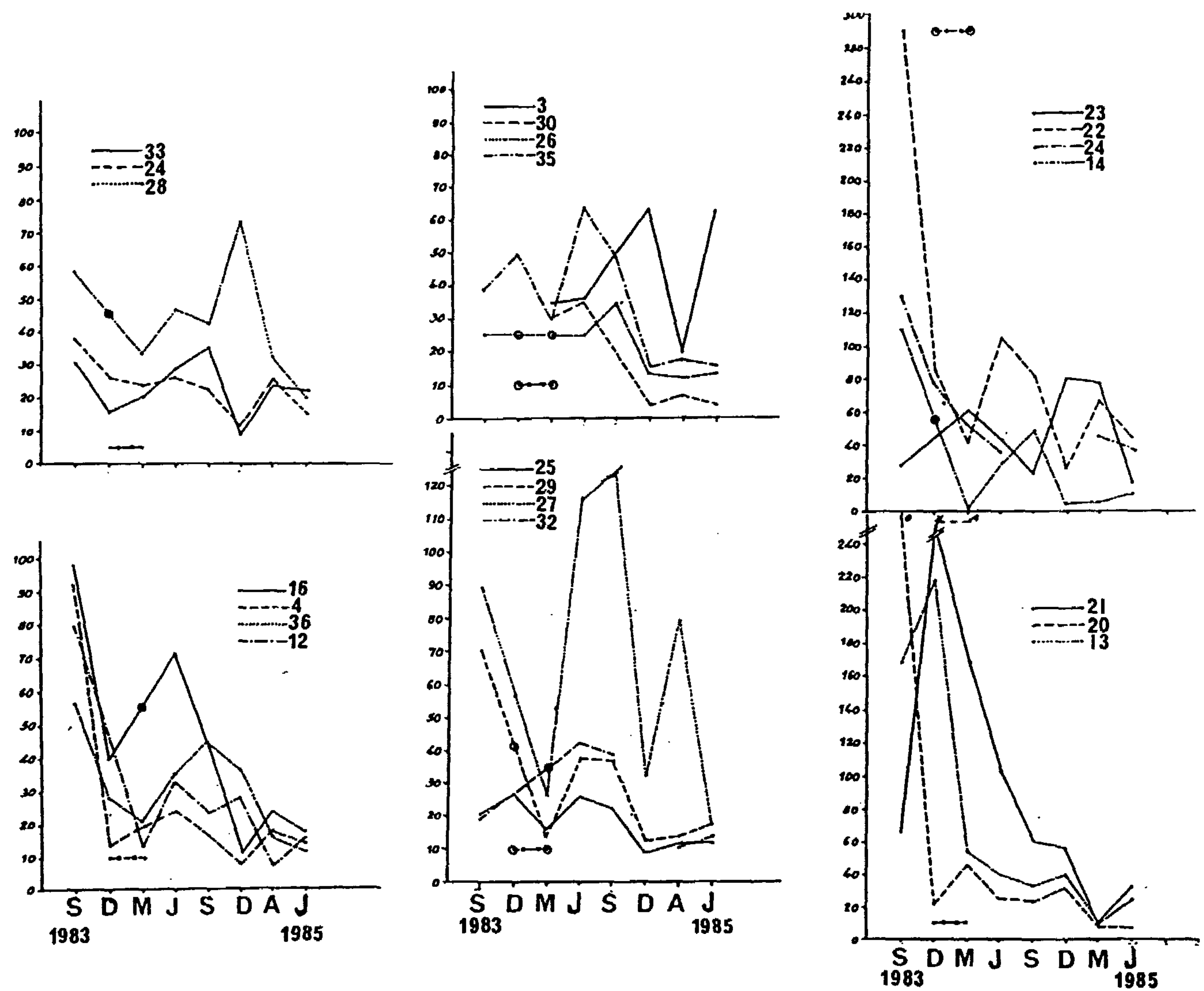


Figure 3 Seasonal changes of the cpue (kg/h) at selected stations in the Patraikos, Korinthiakos Gulfs and the Ionian Sea, June 1983 - April 1985

5. REFERENCES

Papaconstantinou, C., K.I. Stergiou and G. Petrakis, 1986. Abundance of non-commercial fish in the Patraikos and Korinthiakos Gulfs and the Ionian Sea, Greece. FAO Rapp.Pêches/FAO Fish. Rep., (345):107-10

Papaconstantinou, C., *et al.*, 1984. On the commercial demersal fishery resources in the Patraikos, Korinthiakos Gulfs and the Ionian Sea. Preliminary technical report. Athens, National Centre for Marine Research, 320 p.

M-43
ISBN 92-5-002677-3