

ANNEX III

**SEAMOUNT ASSOCIATED SPECIES  
(FISHES, CRUSTACEANS AND CEPHALOPODS)**



**SEAMOUNT ASSOCIATED SPECIES  
(Fishes, crustaceans and cephalopods)  
NAMIBIA-0802**

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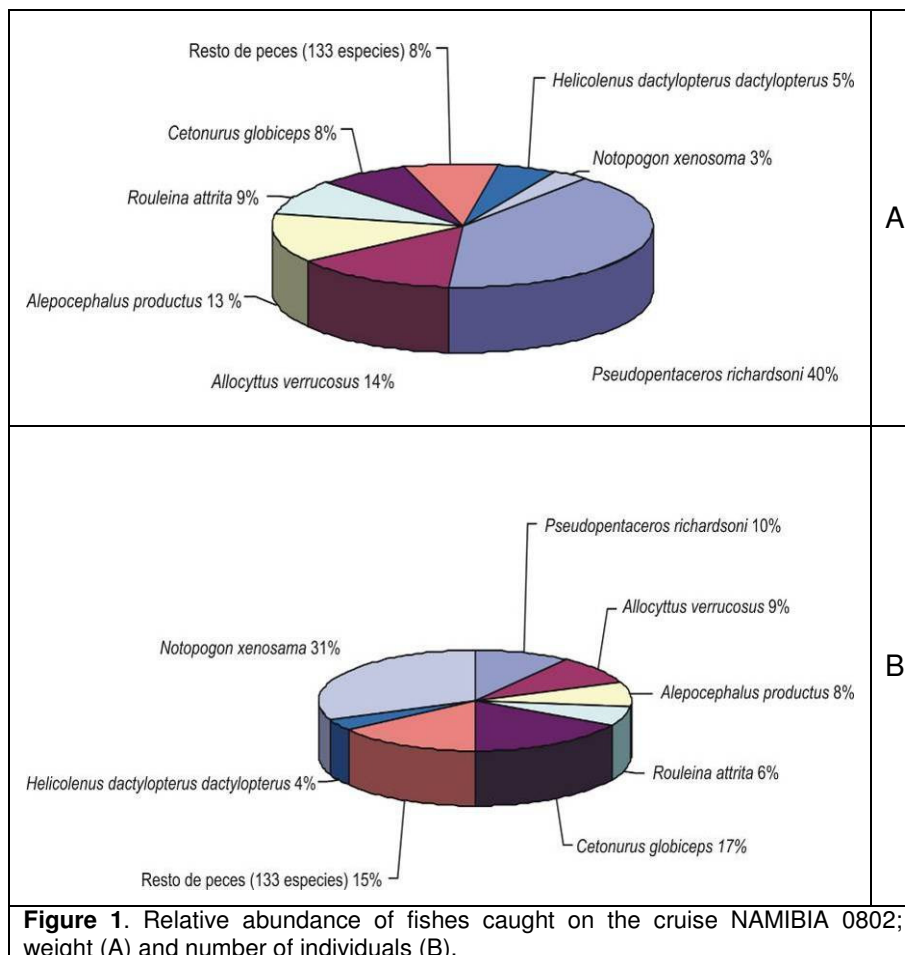
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## 1.- Seamount Species

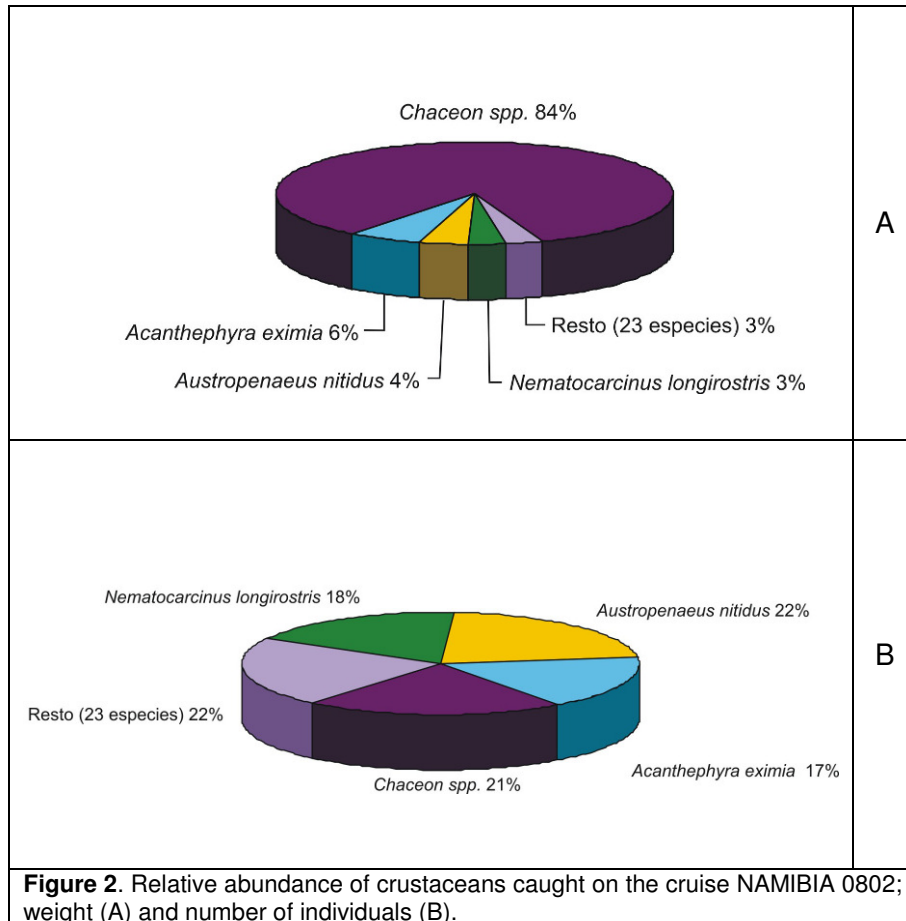
A total of 138 species of fish, 24 crustacean and 15 cephalopods were collected (Annex A). Some decapod species such as hermit crabs have been included in the benthos report. The total weight and length of each fish species was recorded. In addition, biological sampling of all crustaceans, cartilaginous fishes and all other specimens of commercial importance were recorded.

The most representative fish species in the catches (by weight) of the survey (Annex B) were: *Pseudopentaceros richardsoni* (40%), *Alloctytus verrucosus* (14%), *Alepocephalus productus* (13%), *Rouleina attrita* (9%), *Cetonus globiceps* (8%), *Helicolenus mouchezi* (5%), *Notopogon xenosoma* (3%), other species (n=133; 8%) (Figure 1-A). Considering the abundance (number of individuals) in the catches, the most representative species were: *Notopogon xenosoma* (31%), *Cetonus globiceps* (17%), other fishes (15%), *Pseudopentaceros richardsoni* (10%), *Alloctytus verrucosus* (9%), *Alepocephalus productus* (8%), *Rouleina attrita* (6%) and *Helicolenus mouchezi* (4%) (Figure 1-B).



The most representative crustacean species in the catches (by weight) of the survey were: *Chaceon* spp. (84%), *Acanthephyra eximia* (6%), *Austropenaeus nitidus* (4%), *Nematocarcinus longirostris* (3%) and other species (n=23; 3%) (Figure 2-A). Considering the abundance (number of individuals) in the catches, the most

representative species were: *Austropenaeus nitidus* (22%), *Chaceon* spp. (21%), *Nematocarcinus longirostris* (18%), *Acantheephyra eximia* (17%) and other species (22%) (Figure 2-B).



## 2.- Biology of the most representative species in the catches

### 2.1.- Bony fish

For the more abundant bony fish species or those of commercial interest the size composition was calculated, as were the descriptive statistics, length-weight relationship<sup>1</sup>, sex-ratio, gonadosomatic index<sup>2</sup>, condition factor<sup>3</sup> and maturity ogives<sup>4</sup>: *Pseudopentaceros richardsoni*, *Helicolenus mouchezi*, *Hoplostethus atlanticus*, *Allocyttus verrucosus*, *Alepocephalus productus*, *Rouleina attrita*, *Cetonurus globiceps* and *Notopogon xenosoma*.

<sup>1</sup>  $TW = a * TL^b$

<sup>2</sup>  $GSI = (GW * 100) / TW$

<sup>3</sup>  $K = TW / (TL^3 * 10^5)$

<sup>4</sup>  $P_f = 1 / (1 + e^{a+b*TL})$

### 2.1.1.- *Pseudopentaceros richardsoni* – Pelagic Armorhead / Southern Boarfish

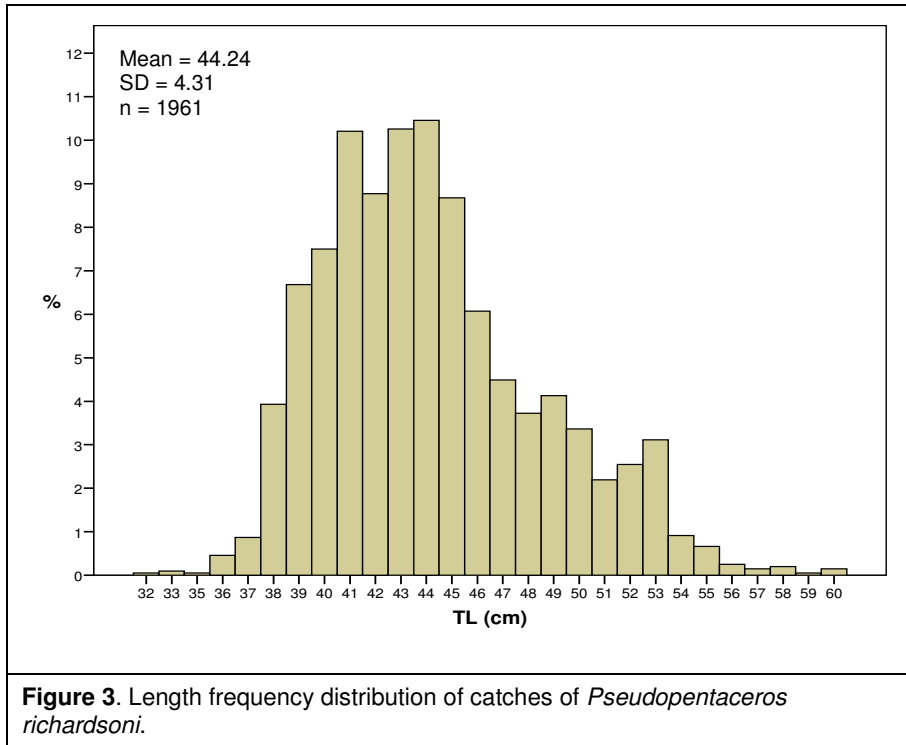


#### **Length composition of catches**

The total length of this species ranged between 32 and 60 cm and it was caught at between 232 and 478 m depth (Table 1). The mean values of length and depth were 44.2 cm and 260.3 m respectively.

<b>Table 1.</b> Descriptive statistics of specimen sizes (cm) and depth (m) of catches of <i>Pseudopentaceros richardsoni</i> .					
Variable	n	Min.	Max.	Mean	SD
TL	1961	32	60	44.2	4.3
Depth	1961	232	479	260.3	77.0

In Figure 3, the length frequency distribution of all individuals caught is presented.



**Descriptive statistics of measurement and biological data by sex**

The observed length range (TL) in males ranged between 32.8 - 43.5 cm and for females 37.6 - 59.3 cm (Table 2). The total weight (TW) for males ranged between 680 and 2190 g, less than those of the females (1004 - 4525 g). Values of eviscerated weight (EW) for males ranged between 632 and 1912 g and between 902 and 3818 g for females. The maximum gonadal weight (GW) of males (96 g) was much lower than that of the females (272 g), but the minimum was the same for both sexes (3 g). The gonadosomatic index (GSI) for males and females were similar with a minimum value of 0.3 and a maximum of 5.5 for males and 6.6 for females. The average condition factor (K) for males and females was 1.9 and 2 respectively.

**Table 2.** Descriptive statistics of length (cm), weight (g), gonadosomatic index (GSI) and condition factor (K) by sex of *Pseudopentaceros richardsoni*.

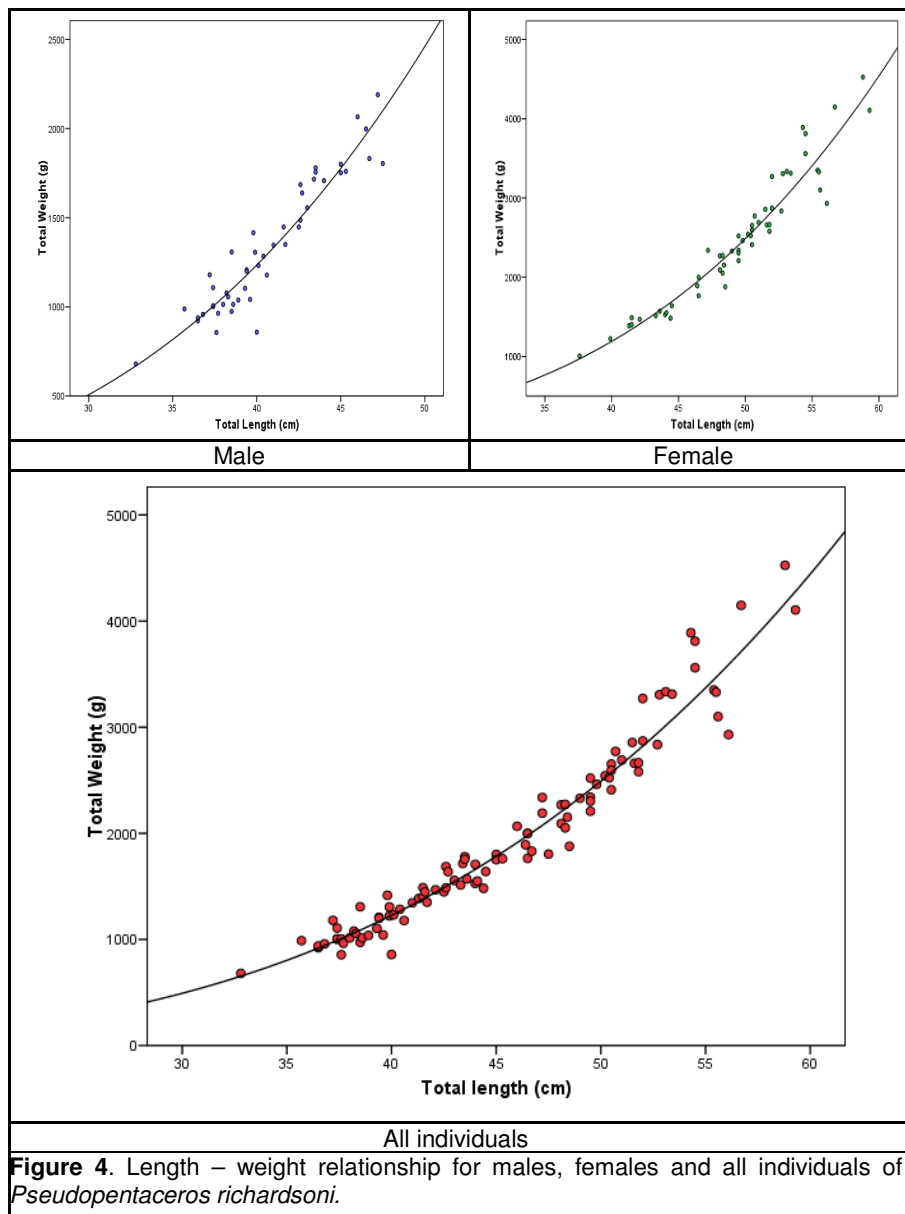
Sex	Variable	n	Min.	Max.	Mean	SD
Male	TL	48	32.8	43.5	40.7	3.4
	TW	48	680	2190	1334	369.4
	EW	48	632	1912	1193.8	323
	GW	48	3	96	30.6	19.4
	GSI	48	0.3	5.5	2.2	1.0
	K	48	1.3	2.3	1.9	0.2
Female	TL	55	37.6	59.3	49.4	4.8
	TW	55	1004	4525	2486.3	811
	EW	55	902	3818	2129.8	644.5
	GW	55	3	272	95.6	66.1
	GSI	55	0.3	6.6	3.5	1.5
	K	55	1.7	2.4	2.0	0.2



### Length – weight relationship

The results of the length – weight relationship analysis for males, females and all individuals are presented in Table 3. In all cases, the allometry coefficients ( $b$ ) show close or lightly greater values than 3, which indicate an isometry or a small positive allometry between both variables. The determination coefficient ( $R^2$ ) shows high values in all cases, which indicate the high correlation between the total length and the green weight of specimens. Figure 4 shows their graphic representation with real values.

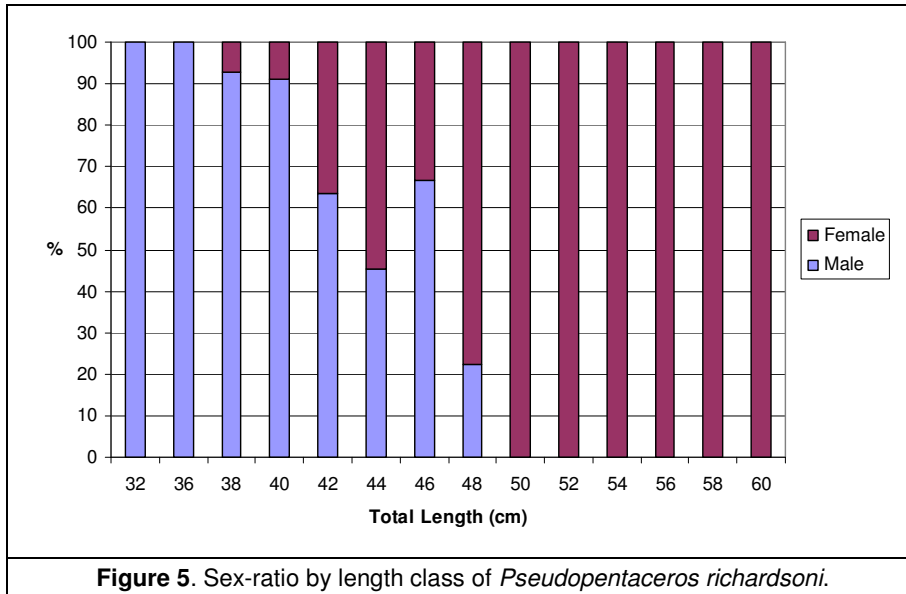
	a	b	$R^2$	n	TL range	TW range
Male	0.014	3.091	0.946	48	32.8-47.5	680-2190
Female	0.006	3.305	0.877	55	37.6-59.3	1004-4525
All individuals	0.010	3.172	0.959	103	32.8-59.3	680-4525



**Figure 4.** Length – weight relationship for males, females and all individuals of *Pseudopentaceros richardsoni*.

**Sex-ratio**

The sex-ratio by length class shows all fish smaller than than 37 cm TL are males. After 37 cm, the female proportion increases gradually with all fish greater than 50 cm being female (Figure 5).



**Figure 5.** Sex-ratio by length class of *Pseudopentaceros richardsoni*.

**Maturity**

Male mean length goes from 37.4 cm TL for stage I of maturity to 39.2 cm for stage II and reaches the size of 41.1 cm at stage III of maturity. For females at maturity stage II the mean length value is 37.6 cm TL, 49.5 cm at stage III and one specimen of 58.8 cm was at IV maturity stage (Table 4).

Sex	Maturity stage	n	Min.	Max.	Mean	SD
Male	I	1	37.4	37.4	37.4	
	II	10	32.8	43.5	39.2	3.4
	III	37	35.7	47.5	41.1	3.3
Female	II	1	37.6	37.6	37.6	
	III	53	39.9	59.3	49.5	4.5
	IV	1	58.8	58.8	58.8	

### 2.1.2.- *Helicolenus mouchezi* - None

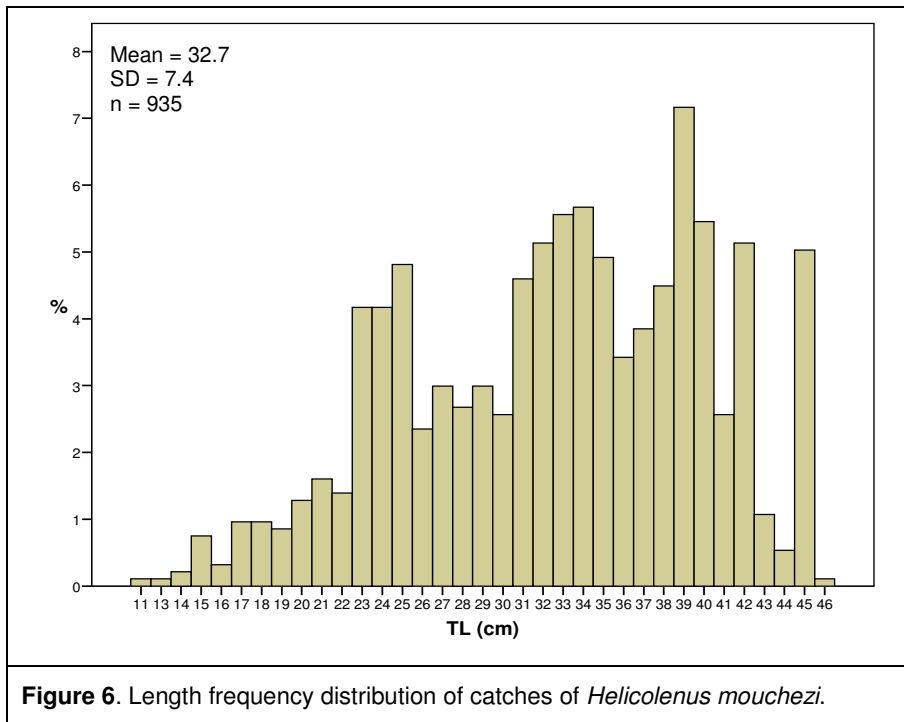


#### **Length composition of catches**

The total length of this species ranged between 11 and 46 cm and it was caught at between 232 and 479 m depth (Table 5). The mean values of length and depth were 32.7 cm and 281.6 m, respectively.

<b>Table 5.</b> Descriptive statistics of specimen sizes (cm) and depth (m) of catches of <i>Helicolenus mouchezi</i> .					
Variable	n	Min.	Max.	Mean	SD
TL	935	11	46	32.7	7.4
Depth	935	232	479	281.6	96.5

In Figure 6, the length frequency distribution in 2 cm intervals for all individuals caught is presented. The wide range of sizes and the small number of individuals sampled in some length classes complicates interpretation of its natural length frequency distribution.



**Figure 6.** Length frequency distribution of catches of *Helicolenus mouchezi*.

**Descriptive statistics of measurement and biological data by sex**

The observed length range (TL) in males ranged between 13.1 - 45 cm and for females between 11.6 and 43.7 cm (Table 6). The total weight (TW) for males ranged between 30 and 1696 g, greater than that for the females (18 - 1590 g). Values of eviscerated weight (EW) of males ranged between 26 and 1547 g and between 14 and 1428 g for females. The maximum gonadal weight (GW) of males (14 g) was similar to that of the females (20 g), but the minimum was the same for both sexes (1 g). The gonadosomatic index (GSI) for males and females were similar with a minimum value of 0.17 and a maximum of 3.3 for males and between 2.2 and 6.6 for females. The average condition factor (K) for males and females was the same (1.6).

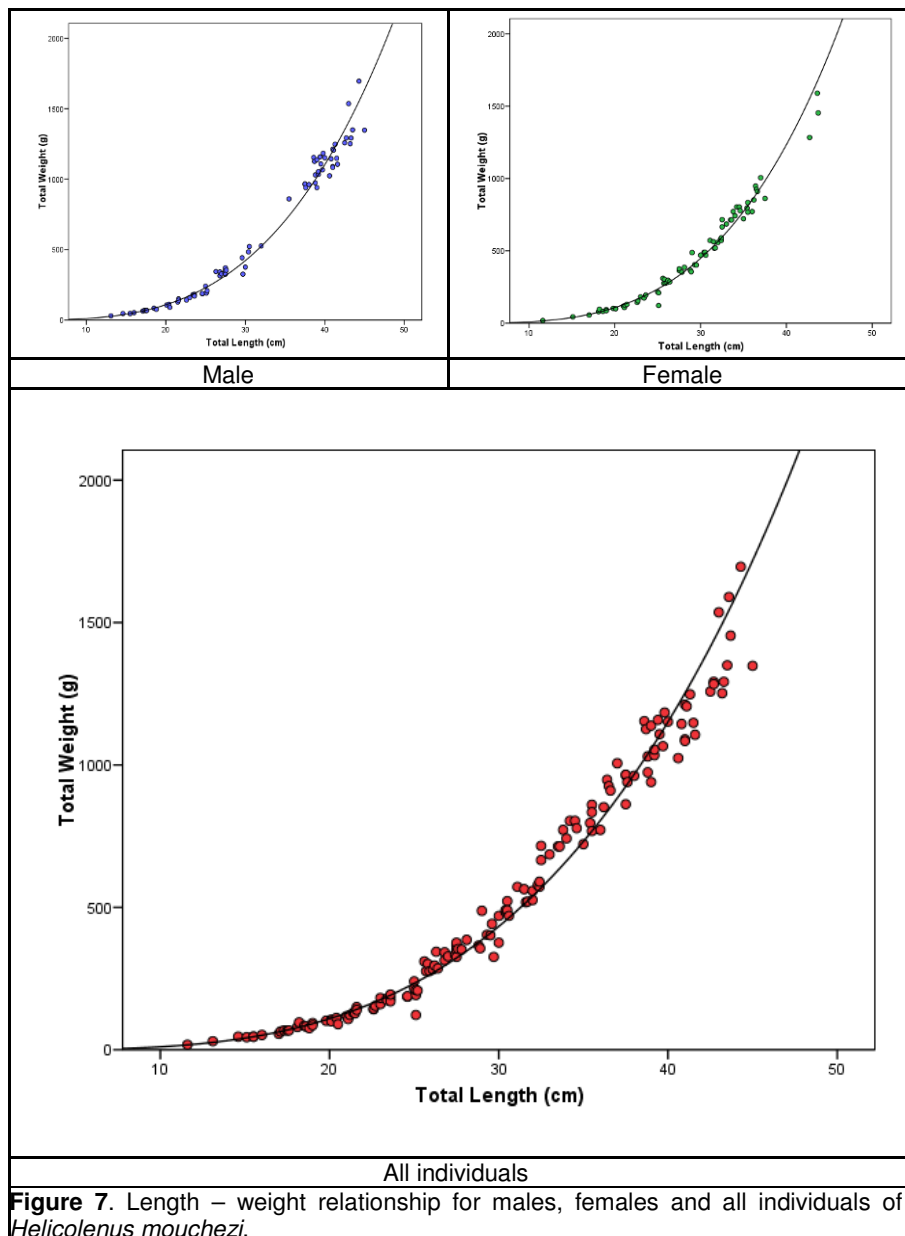
<b>Table 6.</b> Descriptive statistics of length (cm), weight (g), gonadosomatic index (GSI) and condition factor (K) by sex of <i>Helicolenus mouchezi</i> .						
Sex	Variable	n	Min.	Max.	Mean	SD
Male	TL	78	13.1	45.0	31.0	9.4
	TW	78	30	1696	633.4	490.1
	EW	78	26	1547	566.8	449.7
	GW	78	1	14	4.5	3.8
	GSI	78	0.17	3.3	1.0	0.8
	K	78	1.0	2.0	1.6	0.2
Female	TL	74	11.6	43.7	28.8	6.8
	TW	74	18	1590	482.0	340.3
	EW	74	14	1428	429.4	297.0
	GW	74	1	20	4.7	3.8
	GSI	74	0.2	5.6	1.3	1.1
	K	74	0.8	2.1	1.6	0.3

### Length – weight relationship

The results of the length – weight relationship analysis for males, females and all individuals are presented in Table 7 and their graphic representation with the real values in Figure 7. In all cases, the allometry coefficients (b) show greater values than 3, which indicate an isometry or a small positive allometry between both variables. The determination coefficient ( $R^2$ ) shows high values in all cases, which indicate the high correlation between the total length and the green weight of specimens.

**Table 7.** Parameters of the Total Length (cm) - Total Weight (g) relationship ( $TW=aTL^b$ ) for males, females and all individuals of *Helicolenus mouchezi*.

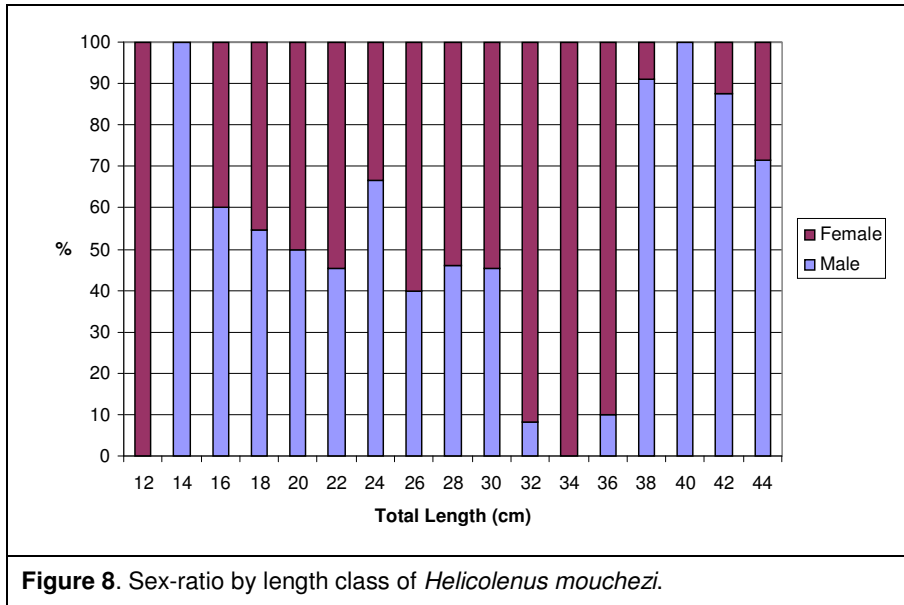
	a	b	$R^2$	n	TL range	TW range
Male	0,005	3.343	0,991	78	13.1-45.0	30-1696
Female	0,003	3.516	0,983	74	11.6-43.7	18-1590
All individuals	0,004	3,398	0,987	152	11.6-45.0	18-1696



**Figure 7.** Length – weight relationship for males, females and all individuals of *Helicolenus mouchezi*.

**Sex-ratio**

The sex-ratio by length class does not show any well defined pattern. The proportion of females increase up to 36 cm TL while males are predominant in sizes greater than 36 cm (Figure 8).

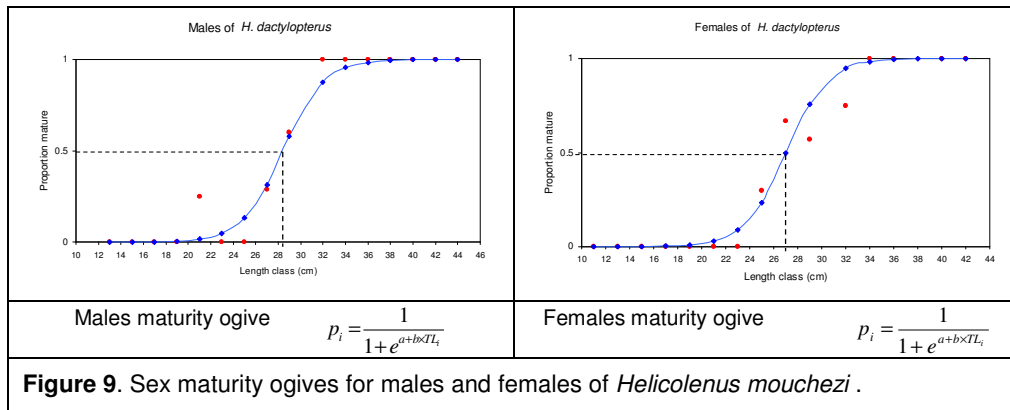


**Maturity**

Male mean length goes from 22.3 cm TL for stage I of maturity to 37.5 cm for stage II and reaches 40.6 cm at stage III of maturity. For females at maturity stage II the mean length value is 22.9 cm and 33.3 cm at stage III (Table 8).

Sex	Maturity stage	n	Min.	Max.	Mean	SD
Male	I	36	13.1	30.0	22.3	4.7
	II	30	21.6	45.0	37.5	5.7
	III	12	38.0	43.3	40.6	1.9
Female	II	32	11.6	31.7	22.9	4.6
	III	42	26.1	43.7	33.3	4.2

From the current data, size at first maturity seems to be different for males and females. Thus, size at first maturity for males is reached at 28.41 cm and for females at 27.02 cm (Table 9 and Figure 9).



**Table 9.** Maturity ogive parameters of *Helicolenus mouchezi*.

Sex	a	b	n	TL <sub>50</sub> (cm)
Males	15.599	0.549	78	28.41
Females	15.727	0.582	41	27.02
All individuals	15.978	0.579	119	27.59

**2.1.3.- *Hoplostethus atlanticus* - Orange roughy**



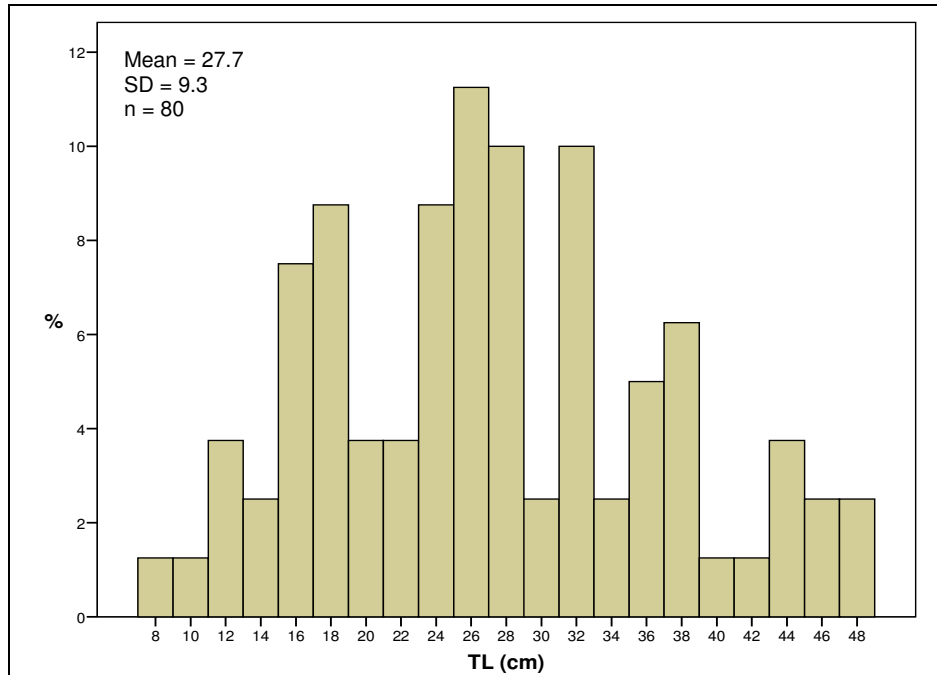
***Length composition of catches***

The total length of this species ranged between 8.8 and 48 cm caught between 867 and 988 m depth (Table 10). The mean values of length and depth were 27.7 cm and 920.8 m respectively.

<b>Table 10.</b> Descriptive statistics of specimen sizes (cm) and depth (m) of catches of <i>Hoplostethus atlanticus</i> .					
Variable	n	Min.	Max.	Mean	SD
TL	80	8.8	48.0	27.7	9.3
Depth	80	867	988	920.8	42.5

In Figure 10, the length frequency distribution in 2 cm length classes of all individuals caught is presented. The wide range of sizes and the small number of individuals sampled in some length classes complicates interpretation of its natural length frequency distribution.





**Figure 10.** Length frequency distribution of catches of *Hoplostethus atlanticus*.

**Table 11.** Descriptive statistics of length (cm), weight (g), gonadosomatic index (GSI) and condition factor (K) by sex of *Hoplostethus atlanticus*.

Sex	Variable	n	Min.	Max.	Mean	SD
Male	TL	13	18.5	41.2	30.1	6.3
	TW	13	128	1184	489.4	301.8
	EW	13	108	1044	434.6	264.7
	GW	11	2	68	14.9	21.6
	GSI	11	0.6	7.7	2.1	2.1
	K	13	0.3	2.0	1.4	0.5
Female	TL	48	10.6	48.0	30.1	9.2
	TW	48	23	1910	595.1	518.0
	EW	48	18	1724	511.7	431.6
	GW	45	1	152	25.0	36.2
	GSI	45	0.5	8.0	2.9	1.9
	K	48	1.5	2.8	1.7	0.2
Immature	TL	15	8.8	29.5	18.0	4.6
	TW	15	11	428	120.5	95.6
	EW	15	9	382	109.9	87.4
	K	15	1.5	2.4	1.8	0.2

### **Descriptive statistics of measurement and biological data by sex**

The observed length range (TL) for males ranged between 18.5 – 41.2 cm, between 10.6 - 48 cm for females and 8.8 - 29.5 cm for immatures (Table 11). The total weight (TW) for males ranged between 128 and 1184 g and for females between 23 and 1910 g and between 11 and 428 g for immatures. Values of eviscerated weight (EW) for males ranged between 108 and 1044 g and between 23 and 1910 g for females and

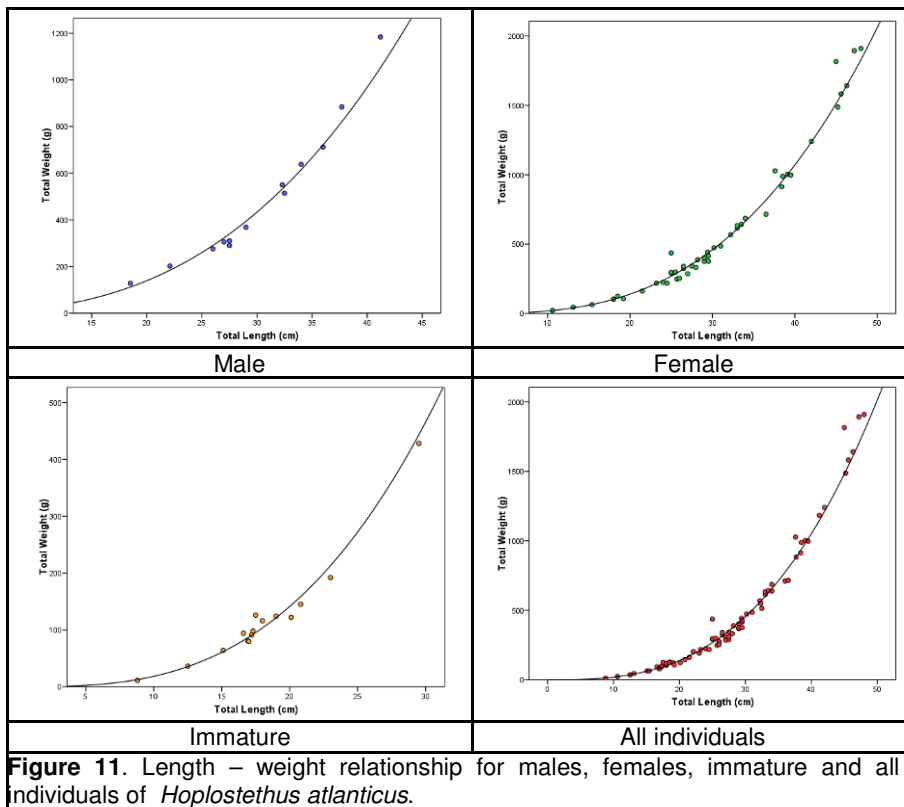
between 9 and 382 for immatures. The minimum gonadal weight (GW) of males (2 g) was similar to that of the females (1 g), and the maximum was greater for females (152 g) than for males (68 g). The gonadosomatic index (GSI) for males and females was similar with minimum values of 0.6 (males) and 0.5 (females); and a maximum of 7.7 for males and 8 for females. The average condition factor (K) for males (1.4) is smaller than for females (1.7).

**Length – weight relationship**

The results of the length – weight relationship analysis for males, females and all individuals are presented in Table 12 and their graphic representation with the real values in Figure 11. In all the cases, the allometry coefficients (b) show lower values than 3, which indicate an isometry or a small negative allometry between both variables. The determination coefficient ( $R^2$ ) shows high values in all cases, which indicates the high correlation between the total length and the green weight of specimens.

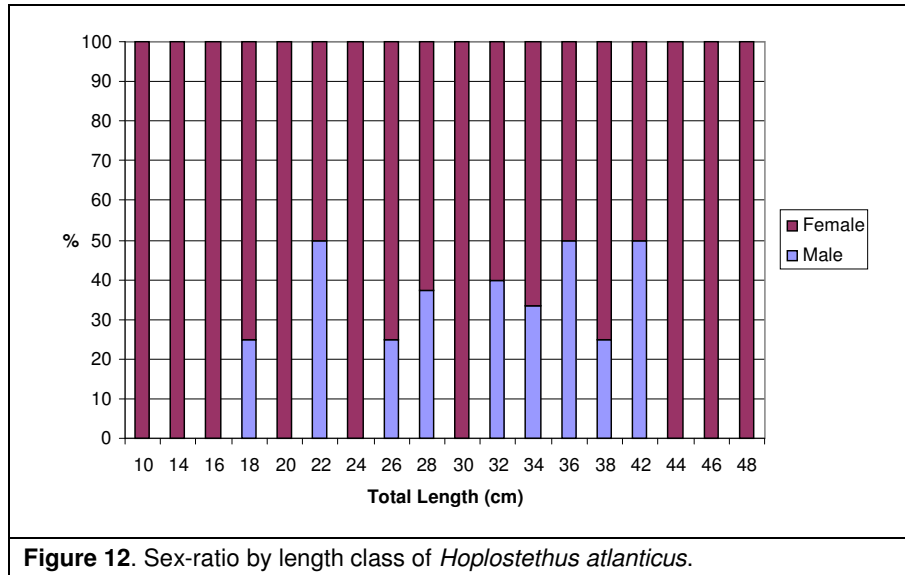
**Table 12.** Parameters of the Total Length (cm) - Total Weight (g) relationship ( $TW=aTL^b$ ) for males, females and all individuals of *Hoplostethus atlanticus*.

	a	b	R <sup>2</sup>	n	Range TL	Range TW
Male	0.032	2.796	0.980	13	18.5-41.2	128-1184
Female	0.021	2.936	0.988	48	10.6-48.0	23-1910
Immature	0.021	2.943	0.979	15	8.8-29.5	11-428
All individuals	0.023	2.914	0,989	74	8.8-48.0	11-1910



### Sex-ratio

The sex-ratio by length class shows a predominance of females in almost all size class while males do not exceed 50% in the intermediate sizes. In the smallest and largest sizes females dominate completely (Figure 12).

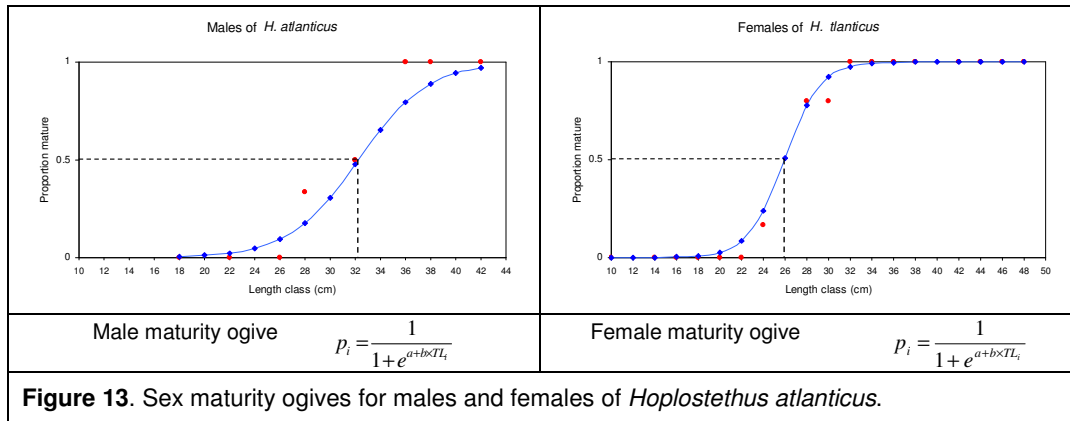


### Maturity

Males reach stage I of maturity at a mean length of 26.9 cm TL, stage II at 30.7 cm and stage III at 38.6 cm (Table 13). For females at maturity stage I the mean length value is 21.7 cm of TL, 28.2 cm at stage II and 38.8 cm at stage III. Only three individuals at stage IV were found, one male and two females.

Sex	Maturity stage	n	Min.	Max.	Mean	SD
Male	I	8	18.5	34.0	26.9	5.0
	II	2	29.0	32.3	30.7	2.3
	III	2	36.0	41.2	38.6	3.7
	IV	1	37.7	37.7	37.7	
Female	I	17	10.6	29.4	21.7	5.5
	II	12	24.5	34.0	28.2	2.7
	III	17	27.5	48.0	38.8	6.7
	IV	2	38.4	39.1	38.8	0.5

From the current data, size at first maturity seems to be different for males and females. Thus, size at first maturity for males is reached at a mean length of 32.26 cm and for females at 25.93 cm (Table 14 and Figure 13).



<b>Table 14. Maturity ogives parameters of <i>Hoplostethus atlanticus</i></b>				
Sex	a	b	n	TL <sub>50</sub> (cm)
Males	11.713	0.363	13	32.26
Females	15.688	0.605	46	25.93
All individuals	10.607	0.383	74	27.69

#### 2.1.4.- *Allocyttus verrucosus* - Warty oreo

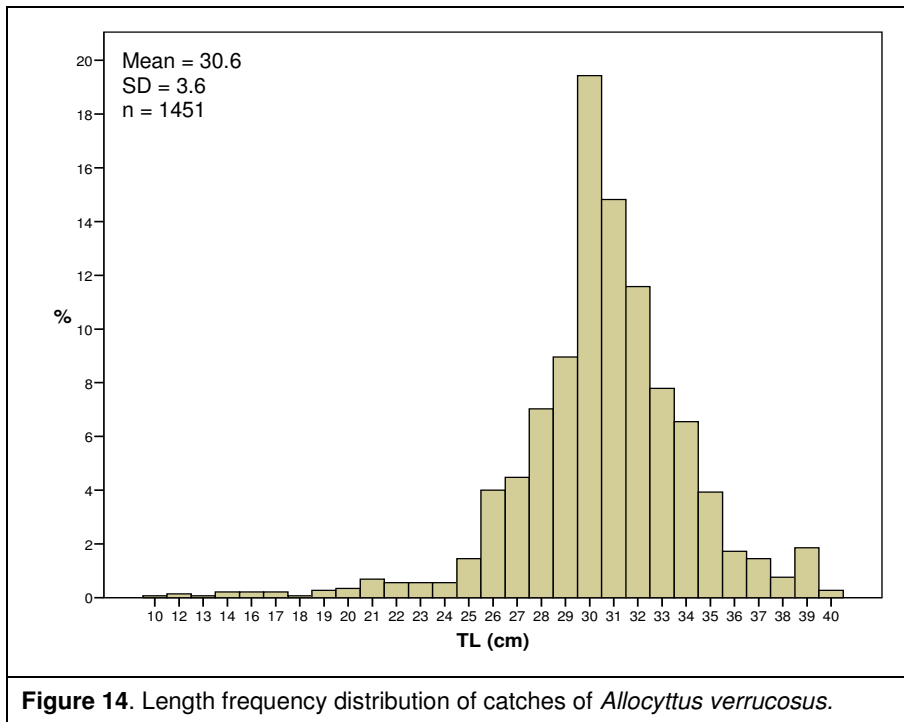


#### **Length composition of catches**

The total length of this species ranged between 10 and 40 cm and it was caught at between 479 and 1660 m depth (Table 15). The mean values of length and depth were 30.6 cm and 1042.4 m respectively.

<b>Table 15.</b> Descriptive statistics of specimen sizes (cm) and depth (m) of catches of <i>Allocyttus verrucosus</i> .					
Variable	n	Min.	Max.	Mean	SD
TL	1451	10	40	30.6	3.6
Depth	1451	479	1660	1042.4	83.8

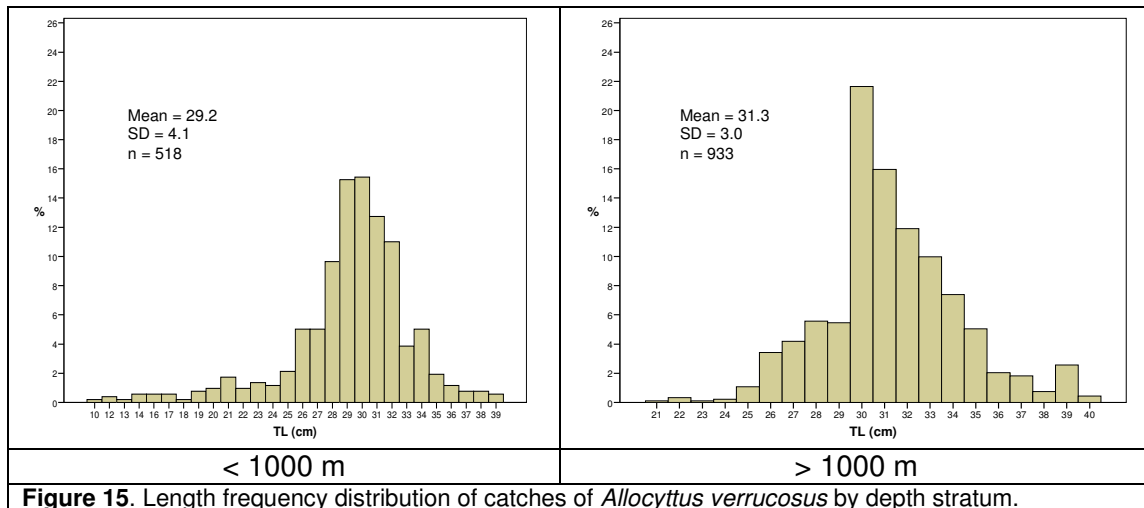
In Figure 14, the length frequency distribution by length class of all individuals caught is presented. One predominant mode is present at 30 cm TL and of interest is the relatively low presence of small fish between 10 and 25 cm of total length.



**Figure 14.** Length frequency distribution of catches of *Allocyttus verrucosus*.

Length frequency distributions below and above 1000 m depth have been tested for normality and mean differentiation (Kolmogorov-Smirnov and Mann-Whitney tests) and significant differences have been found. In Table 16 and Figure 15 the descriptive statistics for length and new length frequency distribution for these two strata are presented. The mode occurs at 30 cm in both cases but in shallower stratum fish smaller than 21 cm are present.

<b>Table 16.</b> Descriptive statistics of specimen sizes (cm) of <i>Allocyttus verrucosus</i> , at depth <>1000 m.					
Depth stratum	n	Min.	Max.	Mean	SD
< 1000 m	518	10	39	29.2	4.1
> 1000 m	933	21	40	31.3	3.0



**Figure 15.** Length frequency distribution of catches of *Allocyttus verrucosus* by depth stratum.

### 2.1.5.- *Alepocephalus productus* - Smalleye smooth-head

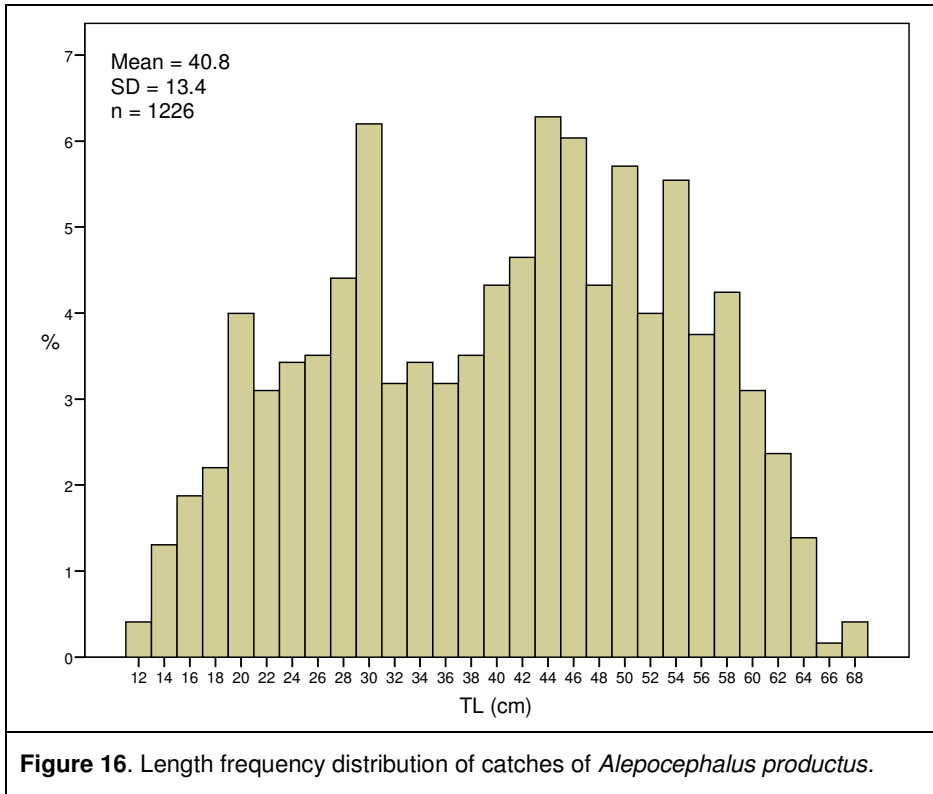


#### **Length composition of catches**

The total length of this species ranged between 12 and 68 cm and it was caught at between 867 and 1660 m depth (Table 17). The mean values of length and depth were 40.8 cm and 1011.1 m respectively.

Variable	n	Min.	Max.	Mean	SD
TL	1226	12	68	40.8	13.4
Depth	1226	867	1660	1011.1	138.4

In Figure 16, the length frequency distribution in 2 cm length classes of all individuals caught is presented.

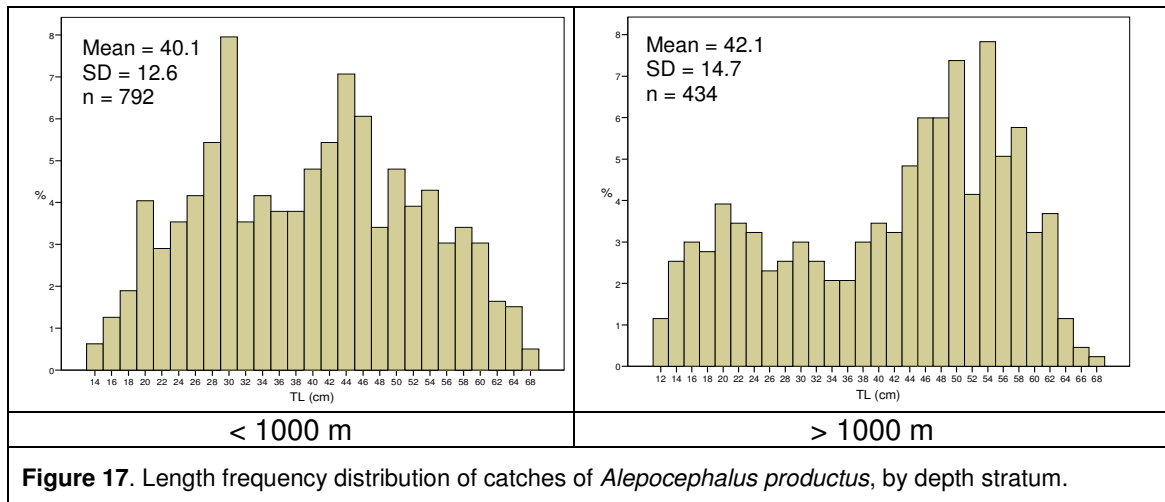


**Figure 16.** Length frequency distribution of catches of *Alepocephalus productus*.

Length frequency distributions below and above 1000 m depth have been tested for normality and mean differentiation (Kolmogorov-Smirnov and Mann-Whitney tests) and significant differences have been found. In Table 18 and Figure 17 the descriptive statistics for length and new length frequency distribution for these two strata are presented.

**Table 18.** Descriptive statistics of specimen sizes (cm) of *Alepocephalus productus*, at depth <>1000 m.

Batimetric range	n	Min.	Max.	Mean	SD
< 1000 m	792	14	68	40.1	12.6
> 1000 m	434	12	68	42.1	14.7



**Figure 17.** Length frequency distribution of catches of *Alepocephalus productus*, by depth stratum.



### 2.1.6.- *Roulenia attrita* - Softskin smooth-head



#### ***Length composition of catches***

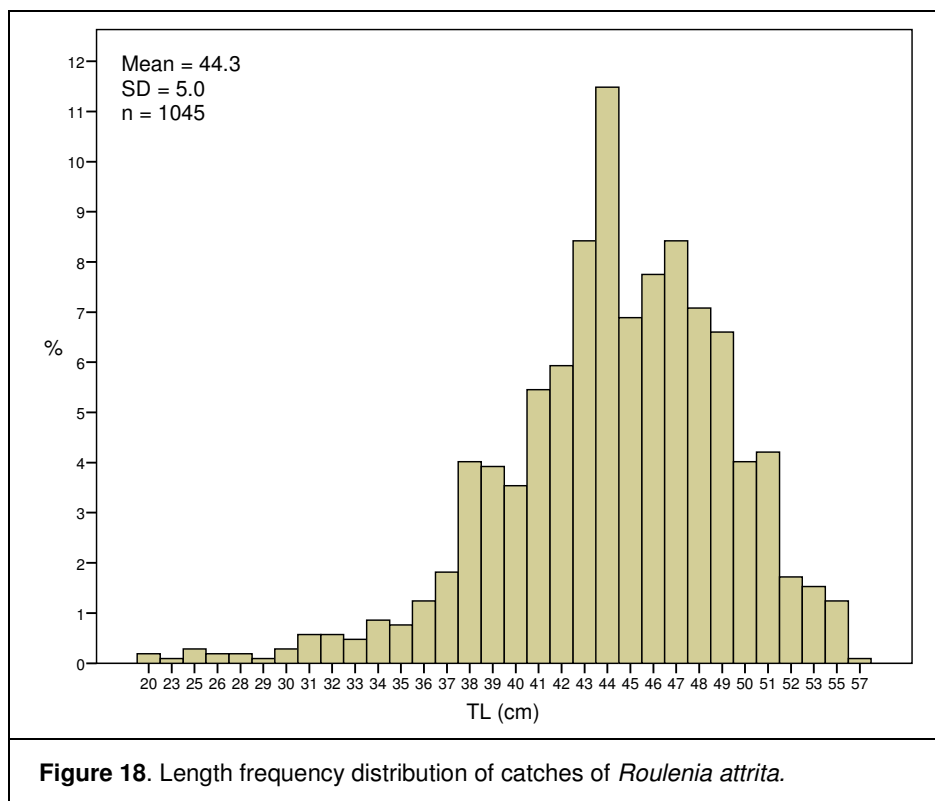
The total length of this species ranged between 20 and 57 cm and it was caught at between 973 and 1660 m depth (Table 19). The mean values of length and depth were 44.3 cm and 1093.1 m respectively. It was observed that 92% of individuals were caught at between 973 and 1155 m depth (Table 20).

<b>Table 19.</b> Descriptive statistics of specimen sizes (cm) and depth (m) of catches of <i>Roulenia attrita</i> .					
Variable	n	Min.	Max.	Mean	SD
TL	1045	20	57	44.3	5.0
Depth	1045	973	1660	1093.2	144.5

**Table 20.** Frequency distribution of *Roulenia attrita* in relation to depth

Depth	Frequency	Percentage	Percentage accumulation
973	2	0.2	0.2
981	135	12.9	13.1
1024	548	52.4	65.6
1095	4	0.4	65.9
1155	273	26.1	92.1
1270	3	0.3	92.3
1487	19	1.8	94.2
1542	52	5.0	99.1
1660	9	0.9	100.0

In Figure 18, the length frequency distribution by length class of all individuals caught is presented. One predominant mode is observed at 44 cm TL.



### 2.1.8.- *Notopogon xenosoma* - Longspine bellowfish

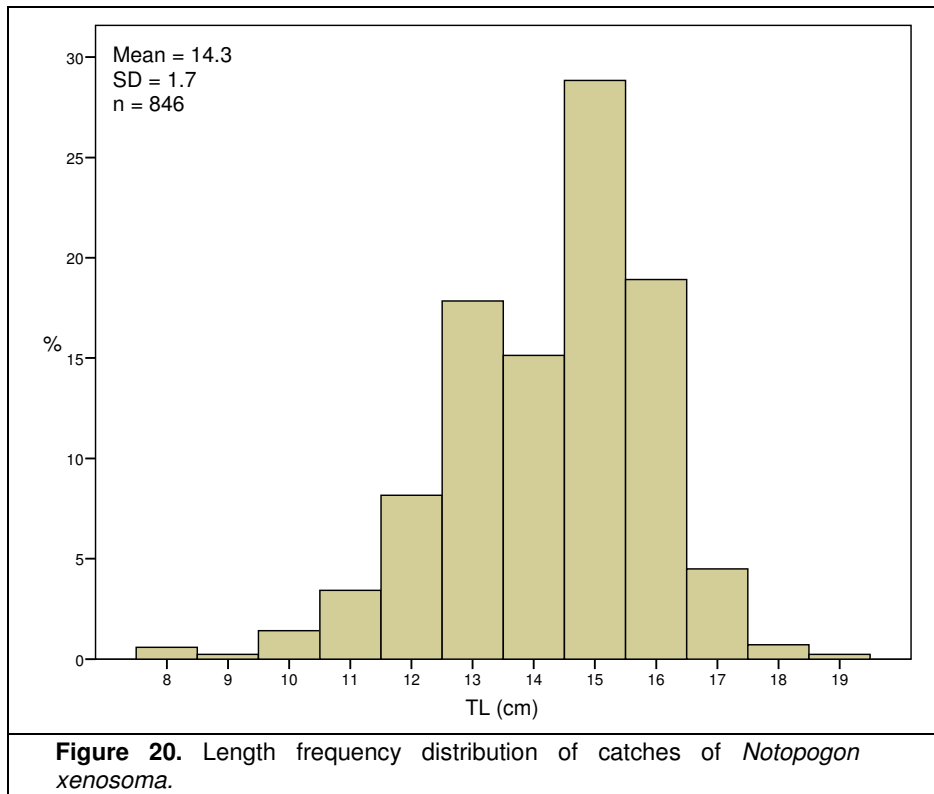


#### **Length composition of catches**

The total length of this species ranged between 8 and 19 cm and it was caught at between 232 and 237 m depth (Table 21). The mean values of length and depth were 14.3 cm and 233.3 m respectively.

Variable	n	Min.	Max.	Mean	SD
TL	846	8.0	19.0	14.3	1.7
Depth	846	232	237	233.3	1.6

In Figure 20, the length frequency distribution by length class of all individuals caught is presented. One predominant mode is observed at 15 cm TL.



## 2.2.- Cartilaginous fishes

The diversity of chondrichthians in the catches was very low with only eight species at low abundance caught. One of the most remarkable findings in the survey was the total absence of skates. Taking into consideration that not all the depths were sampled because of the seamount cliffs (300 – 800 m) that are inaccessible to bottom trawling, the reasons for the poor results are unknown, but food availability, water conditions and other necessities determine the carrying capacity of the environment for those species, conditioning their abundance at specific trophic levels.

Species have been grouped by taxonomic families but analyzed individually. Length composition of catches, descriptive statistics, length-weight relationship and reproduction are presented.

**Scyliorhinidae Family:** small sharks of less than 1.5 m TL, demersal and sedentary. Distributed worldwide in tropical, warm and cold waters, and inhabiting the seafloor from shallow waters to 2000 m depth. They are, for the most part, ovoviviparous.

### 2.2.1.- *Apristurus* sp. – Catshark



This is a small demersal shark species that forms small assemblages. It is of no commercial interest. The genus *Apristurus* is in continuous review and individuals collected must be revised to determine their exact taxonomic position.

A total of 28 individuals were caught in eight hauls carried out at between 968 and 1270 m depth. Descriptive statistics of total length and weight by sex are shown in Table 22.

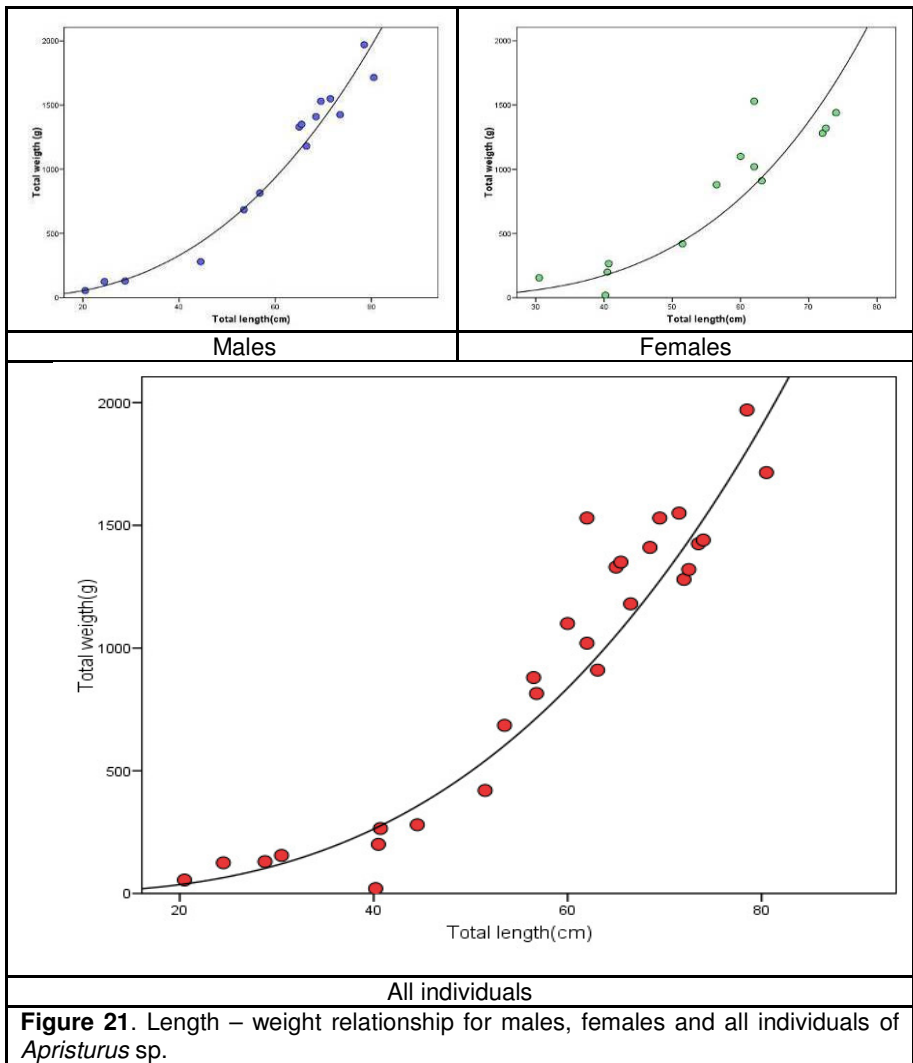
**Table 22.** Descriptive statistics of length (cm) and weight (g) by sex of *Apristurus* sp.

Sex	Variable	n	Min.	Max.	Mean	SD
Males	TL	15	20.5	80.5	57.8	19.6
	TW	15	55	1970	1036.7	637.8
Females	TL	13	30.5	74.0	55.8	14.1
	TW	13	155	1530	824.6	513.1

In Table 23, results of the length – weight relationship analysis for males, females and all individuals are shown. Their graphic representation with the real values is presented in Figure 21. The allometry coefficients (b) show a small negative allometry between both variables. The determination coefficient ( $R^2$ ) shows high values in all cases, which indicates the high correlation between the total length and the green weight of specimens.

**Table 23.** Parameters of the Total Length (cm) - Total Weight (g) relationship ( $TW=aTL^b$ ) for males, females and all individuals.

	a	b	$R^2$	n	Range TL	Range TW
Male	0.024	2.578	0.979	15	20.5-80.5	55-1970
Female	0.005	2.965	0.920	13	30.5-74	155-1530
All individuals	0.016	2.675	0.952	28	20.5-80.5	55-1970



***Reproduction***

32.1% of individuals analyzed were immature and 67.8% were mature adults. None showed any spawning activity.

**2.2.2.- *Apristurus manis* - Ghost catshark**



A species of North Atlantic distribution, and whose presence in the South Atlantic is not clear. Therefore, taxonomic determination must still be confirmed. A species of no commercial value.

Only two individuals were caught at about 981 m depth and their measurements are shown in Table 24. Both specimens were preserved for collection.

<b>Table 24.</b> Descriptive statistics of length (cm) and weight (g) by sex of <i>Apristurus manis</i> .					
Variable	n	Min.	Max.	Mean	SD
TL	2	69	78	73.5	6.4
TW	2	1230	1920	1575.0	487.9

***Reproduction***

The male specimen was in the activity stage and the female inactive.



**Etmopteridae Family:** It includes five genus and 41 species. They are demersal sharks smaller than 90 cm TL that are present in all the oceans, inhabiting depths between 500 and 6000 m. Some species are solitary and others form great assemblages at depth. The most remarkable feature of this family is the presence of a spine in both dorsal fins.

### 2.2.3.- *Etmopterus princeps* - Great lanternshark.



This is a deep-sea shark that inhabits the slope at depths of between 500 and 2500 m. It is of little commercial value but its meat is used for human consumption.

A total of 132 individuals were caught at between 981 and 1155 m depth, 103 males and 29 females. Descriptive statistics of total length and weight by sex are shown in Table 25.

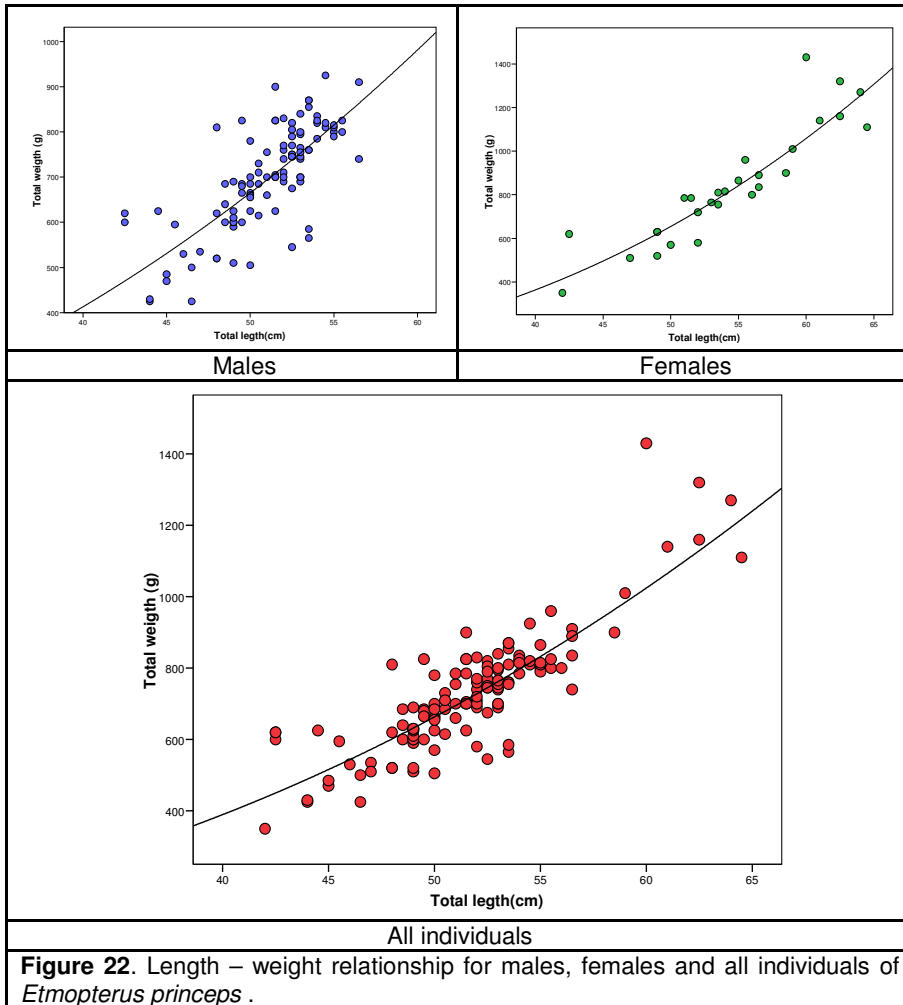
Sex	Variable	n	Min.	Max.	Mean	SD
Males	TL	15	103	42.5	56.5	51.0
	TW	15	102	425.0	925.0	700.3
Females	TL	29	42.0	64.5	54.3	5.8
	TW	28	350.0	1430.0	840.5	261.3

In Table 26, results of the length – weight relationship analysis for males, females and all individuals are shown. Their graphic representation with the real values is shown in Figure 22. The allometry coefficients (b) show a marked negative allometry between

both variables. The correlation between the total length and the green weight of specimens is not very high.

**Table 26.** Parameters of the Total Length (cm) - Total Weight (g) relationship ( $TW=aTL^b$ ) for males, females and all individuals.

	a	b	R <sup>2</sup>	n	Range TL	Range TW
Male	0.152	2.136	0.555	102	42.5-56.5	425-925
Female	0.022	2.635	0.831	28	42-64.5	350-1430
All individuals	0.059	2.385	0.703	132	42-64.5	350-1430



### Reproduction

Although differences in bathymetric distribution by sex and maturity stage are known for this species, it has not been found in the current analysis, probably due to too few samples. 30% of males were immature and 70% adults but only one was active. For females, 76% were immature and 30% of the adults were inactive.

#### 2.2.4.- *Etmopterus brachyurus* - Shorttail lanternshark



This is a small deep-sea shark that inhabits the slope at depths of between 450 and 2500 m, is quite rare and not well known.

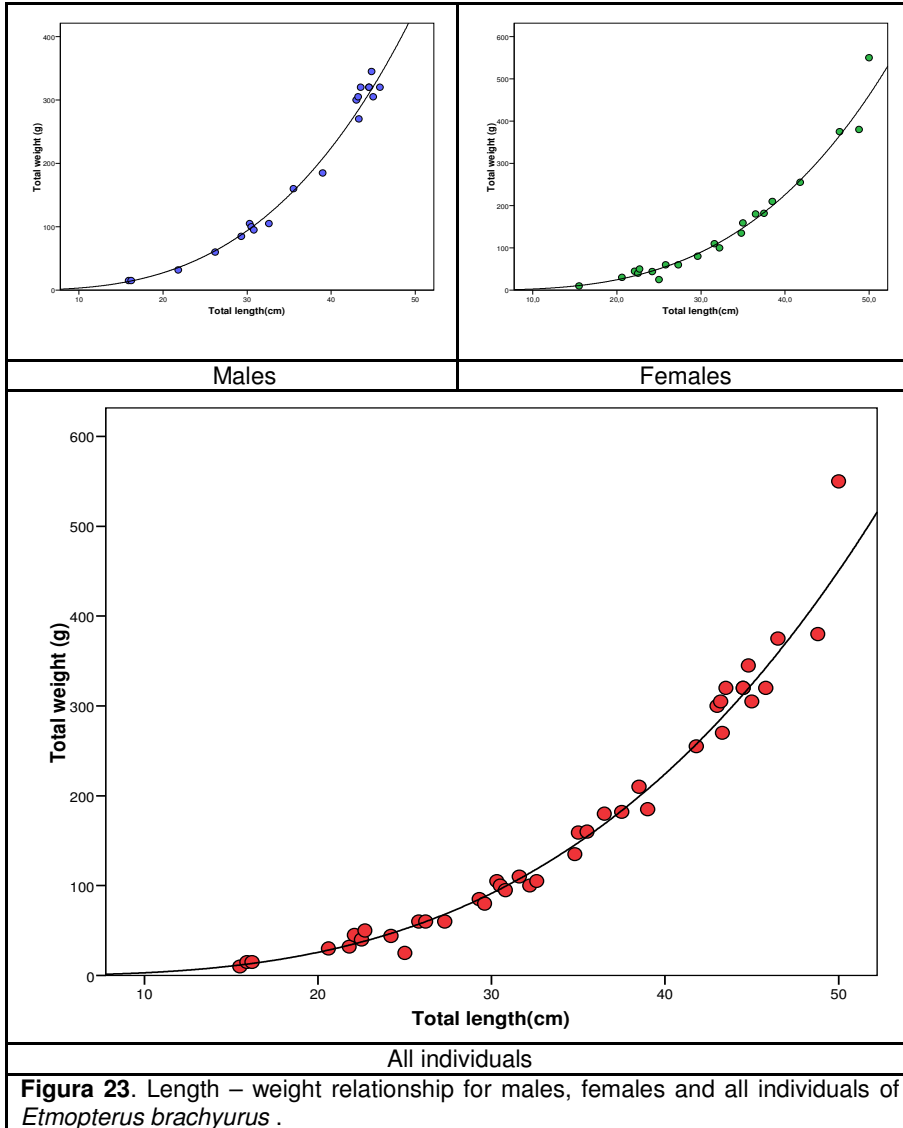
A total of 41 individuals were caught at between 867 and 1270 m depth, 20 males and 21 females. Descriptive statistics of total length and weight by sex are shown in Table 27.

Sex	Variable	n	Min.	Max.	Mean	SD
Males	TL	20	15	345	188.1	122.1
	TW	20	15.9	45.8	35.3	9.9
Females	TL	21	10	550	146.7	141.3
	TW	21	15.5	50.0	31.8	9.7

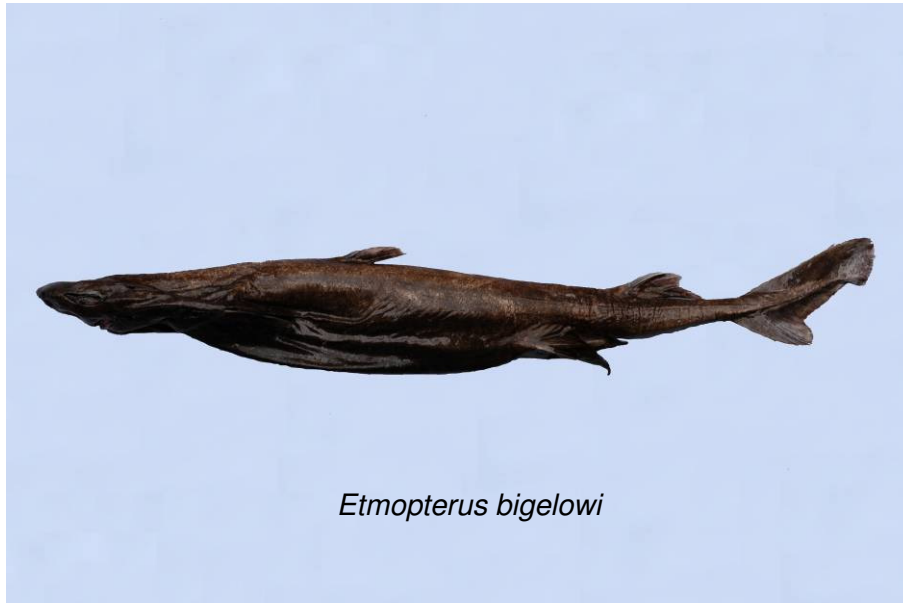
In Table 28, results of the length – weight relationship analysis for males, females and all individuals are shown. Their graphic representation with the real values is shown in Figure 23. The allometry coefficients (b) show a small positive allometry between both variables. The correlation between the total length and the green weight of specimens is quite high.

**Table 28.** Parameters of the Total Length (cm) - Total Weight (g) relationship ( $TW=aTL^b$ ) for males, females and all individuals.

	a	b	R <sup>2</sup>	n	Range TL	Range TW
Male	0.003	3.036	0.994	20	15-345	15.9-45.8
Female	0.002	3.200	0.962	21	10-550	15.5-50.0
All individuals	0.002	3.123	0.977	41	10-550	15.5-50.0



### 2.2.5.- *Etmopterus bigelowi* - Blurred smooth lantern shark

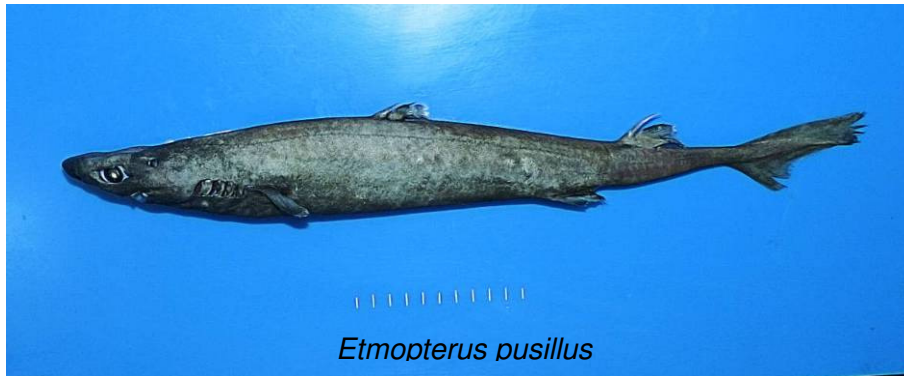


This is a small demersal shark which is distributed worldwide at between 150 and 1000m depth.

Only two males were caught at about 900 m depth. Descriptive statistics of total length and weight by sex is shown in Table 29.

Variable	n	Min.	Max.	Mean	SD
TL	2	400	880.0	640	339.4
TW	2	47.1	59.5	53.3	8.8

**2.2.6.- *Etmopterus pusillus* - Smooth lanternshark**



This is a small demersal shark, common in the Atlantic and Pacific oceans. Its distribution ranges between 300 and 100<sup>0</sup> m depth.

Only one individual (male) was caught at about 980 m depth.

### 2.2.7.- *Zameus squamulosus* - Velvet dogfish



This is a demersal and/or mesopelagic shark of medium size that forms large assemblages in specific areas at depths of between 300 and 2200 m.

Three individuals were caught at between 972 and 1270 m depth, 1 male adult and 2 immature females. Descriptive statistics of total length and weight by sex is shown in Table 30.

Sex	Variable	n	Min.	Max.	Mean	SD
Males	TL	1	52	52	52	
	TW	1	785	785	785	
Females	TL	2	48,1	52.2	50.2	2.9
	TW	2	620.0	685.0	652.5	46.0

**Chimaeridae Family:** Included in the order of chimaeras that is present in all the oceans at between 200 and 3000 m depth. Its morphology is quite extraordinary and unmistakable. The family includes 2 genera and 20 species.

**2.2.8.- *Hydrolagus affinis* - Smalleyed rabbitfish**



Three individuals were caught in one haul at about 1660 m depth, 1 male adult of 125 cm TL and 2 immature females of 38 and 99 cm TL. Descriptive statistics of total length and weight by sex are shown in Table 31.

**Table 31.** Descriptive statistics of length (cm) and weight (g) by sex of *Hydrolagus affinis*.

Sex	Variable	N	Min.	Max.	Mean	SD
Males	TL	1	125	125	125	
	TW	1	11520	11520	11520	
Females	TL	2	39.0	99.0	69.0	42.4
	TW	2	100.0	4940.0	2520.0	3422.4



## 2.3.- Crustacean

From samples obtained by trawls the size composition of catches was calculated, as were descriptive statistics, length-weight relationship and sex-ratio, for the more abundant crustacean species or those of commercial interest: *Austropenaeus nitidus*, *Chaceon* spp. and *Acanthephyra eximia*.

### 2.3.1.- *Austropenaeus nitidus*.

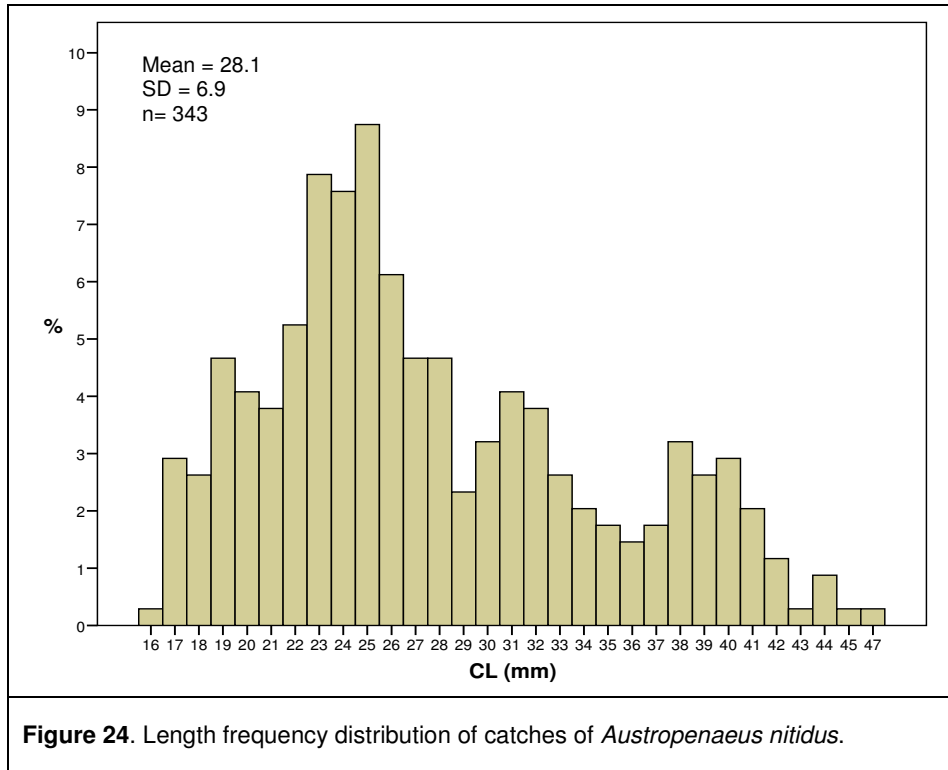


#### **Length composition of catches**

The cephalothorax length (CL) was used as a measure of size in this species. The size of specimens ranged between 16.6 and 47.7 mm and it was caught at depths ranging between 933 to 1155 m (Table 32).

Variable	n	Min.	Max.	Mean	SD
CL	343	16.6	47.7	28.1	6.9
Depth	345	867	1660	1066.0	174.5

In Figure 24, the length frequency distribution of all individuals caught is presented. Males and females show morphometric differences (Table 32) and males represent the main component in the smaller sizes ranges of between 18 and 30 mm CL.



**Descriptive statistics of measurement data by sex**

The cephalothorax length range of females is greater than that of males, as is common in species of the Aristeidae family, at between 16.6 – 47.7 mm. However, the length of males ranged between 18.6 and 29.6 mm. The weight of males ranged between 2 and 9 g with a mean value of 5 g. Female weight ranges are greater, between 1 and 32 g with a mean value of 11.3 g (Table 33).

**Table 33.** Descriptive statistics of cephalothorax length (mm) and weight (g) by sex of *Austropenaeus nitidus*.

Sex	Variable	n	Min.	Max.	Mean	SD
Male	CL	85	18.6	29.6	23.5	2.4
	TW	86	2	9	5.0	2.0
Female	CL	258	16.6	47.7	29.7	7.2
	TW	259	1	32	11.3	7.2
All individuals	CL	343	16.6	47.7	28.1	6.9
	TW	345	1	32	9.8	6.9

**Length-weight relationship**

The parameters defining the length-weight relationship of females were:  $a=0.001$ ,  $b=2.773$  y  $R^2=0.927$ . The relationship for males seems to be unrealistic possibly due to incorrect data recording. The graphic representation of the fitted curve and the values are shown in Figure 25.

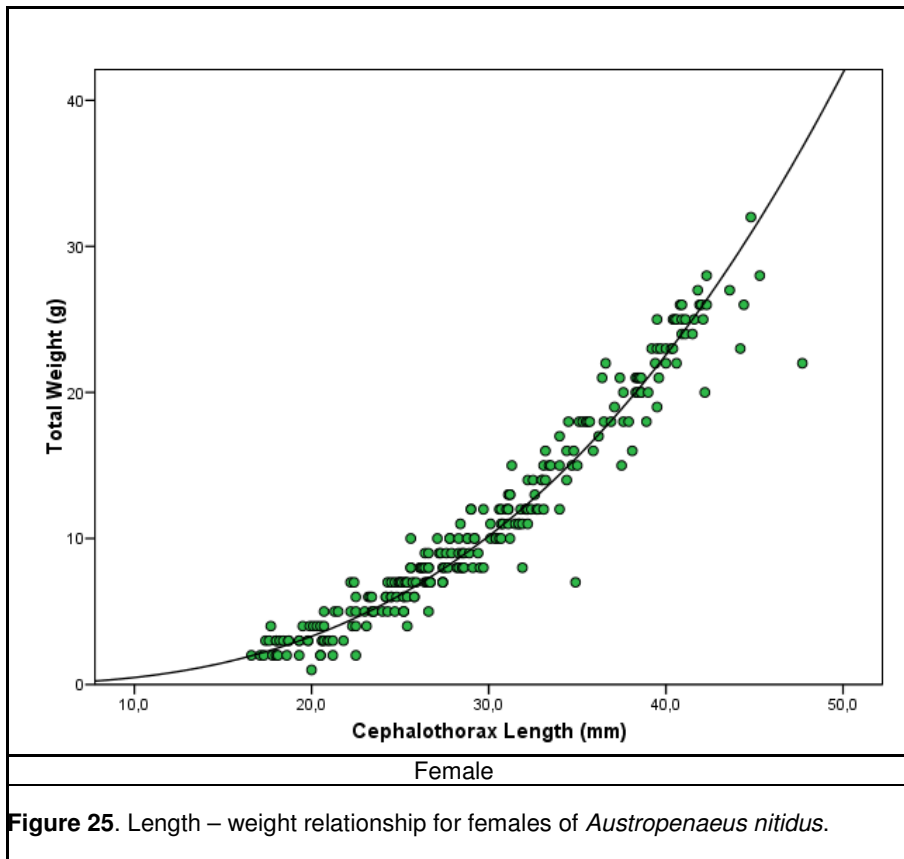


Figure 25. Length – weight relationship for females of *Austropenaeus nitidus*.

**Sex-ratio**

All the individuals greater than 30 mm CL were females and males are only present in length classes between 18 and 29 mm (Figure 26).

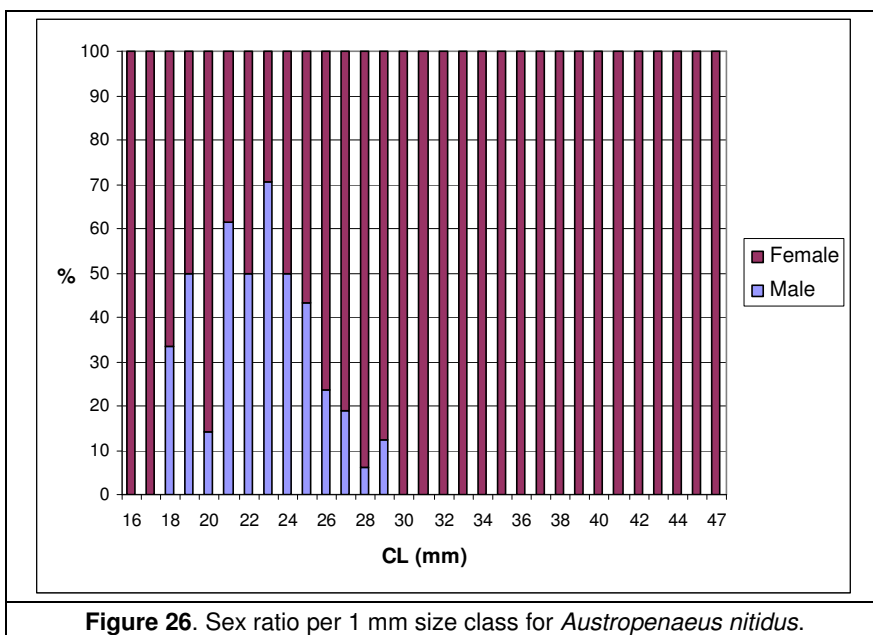


Figure 26. Sex ratio per 1 mm size class for *Austropenaeus nitidus*.

**2.3.2.- *Chaceon* spp.**

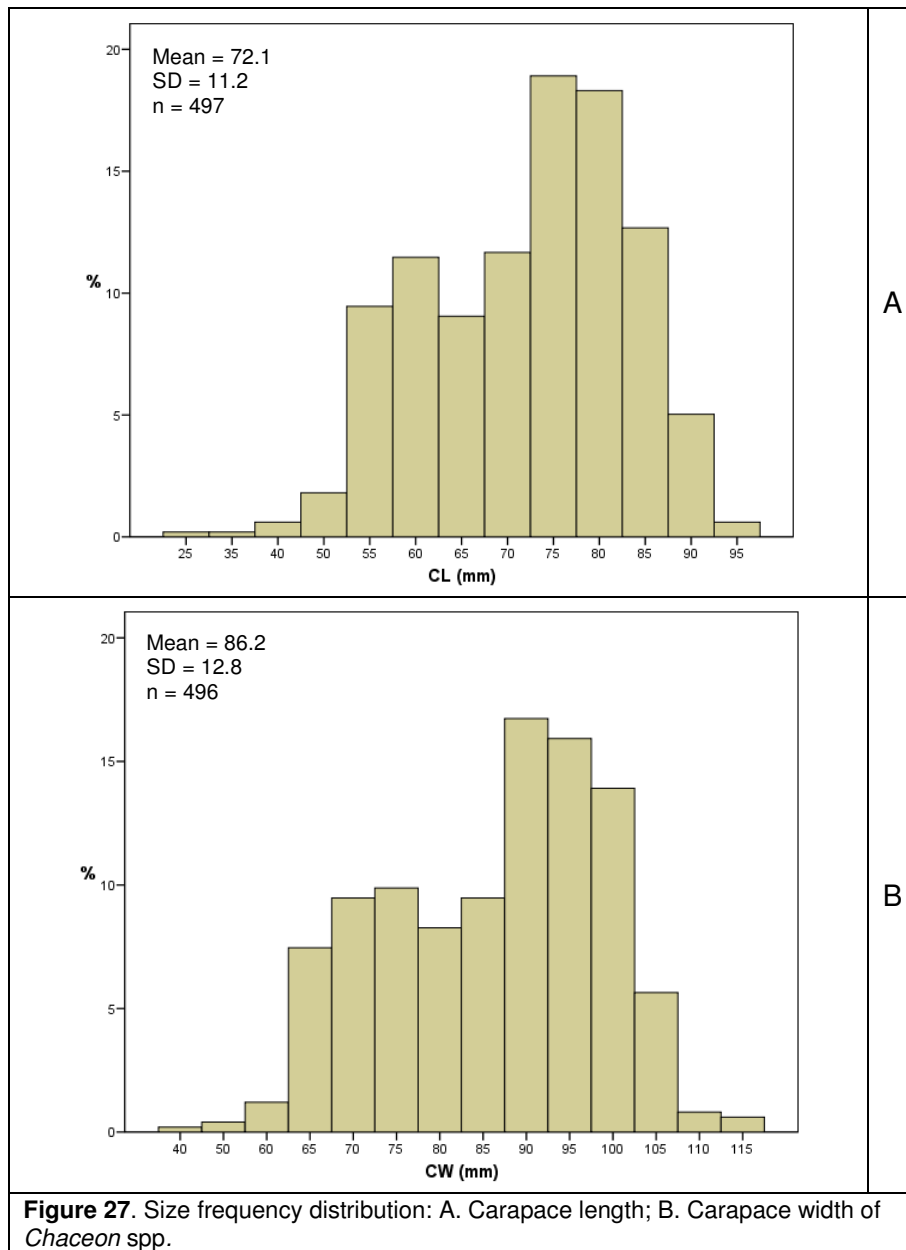
Two species of geryonids were present in the catches, *Chaceon erytheiae* and *Chaceon chuni*. With the exception of one haul both species were caught in the same trawls. In spite of the initial identification some doubt persists and the initial results are under review. Because of that and considering that the lengths of both species were similar we decided to process all the data together as a group of species (*Chaceon* spp.).



### Size composition of catches

The carapace width (CW) and carapace length (CL) were both considered as a measure of size of *Chaceon* spp. The size of individuals ranged between 41.6 and 116.5 mm CW and between 27.8 - 96.9 mm CL. The samples were caught at depths ranging between 867 and 1660 m (Table 34).

Variable	n	Min.	Max.	Mean	SD
CL	497	27.8	96.9	74.5	11.2
CW	496	41.6	116.5	82.7	12.7
Depth	497	867	1660	890.0	114.2



In Figures 27 a and b, size frequency distribution (CL and CW) in 5 mm intervals are presented. Two clear modes are present in the size distribution, which is a common pattern in geryonids.

**Descriptive statistics of measurement data by sex**

Males reach larger sizes than females and ranged between 35.1 and 96.9 mm CL with a mean value of 80.8 mm, which correspond to 41.6 and 116.5 mm CW and the mean value of 95.9 mm. The female CL range was between 27.8 - 86.5 mm (mean=64.2 mm), corresponding to 51.7 y 99.1 mm CW (mean= 76.7 mm). The total weight of males fluctuated between 19 and 488 g with a mean value of 269.8 g, greater than that for females 26 - 266 g (mean=120.8 g) (Table 35).

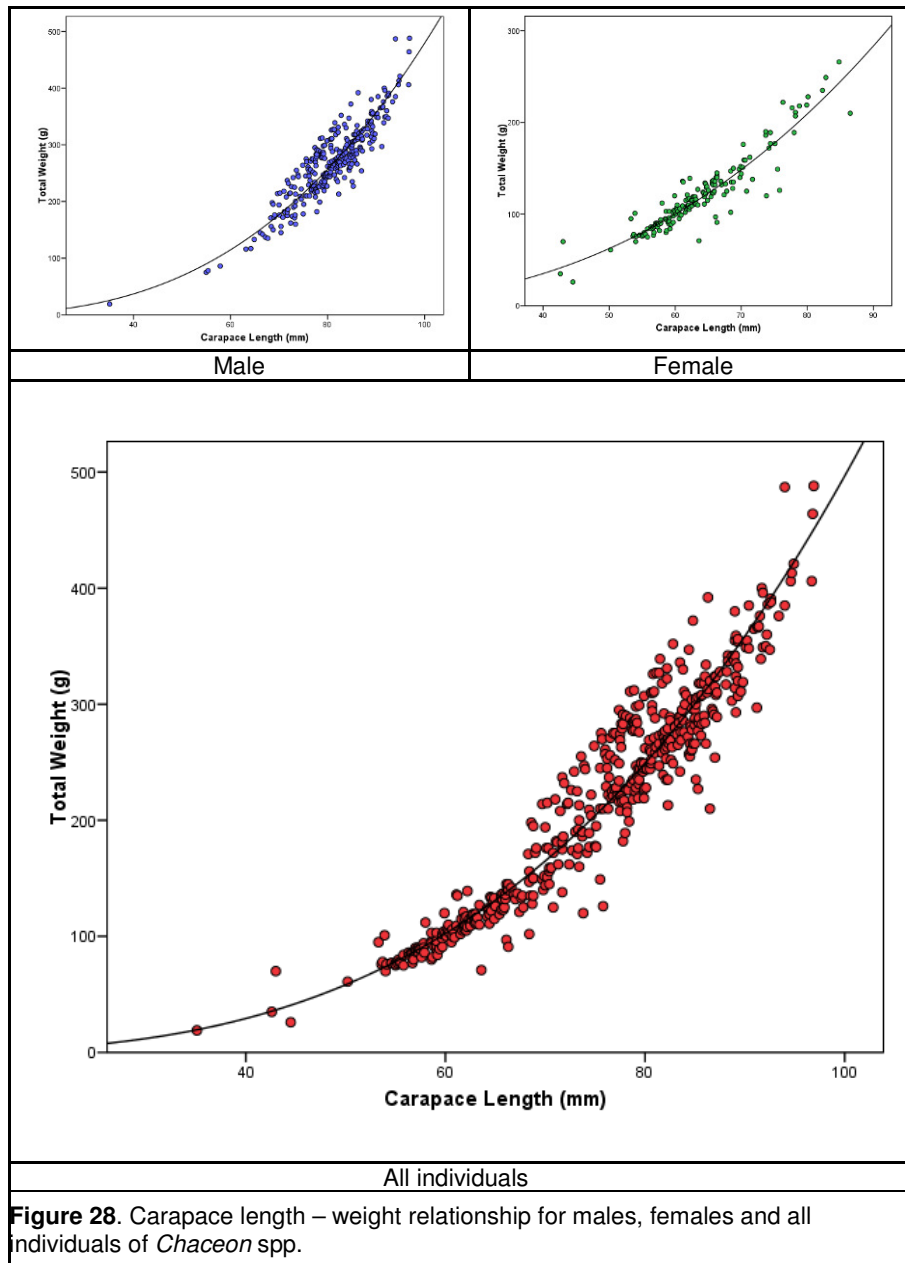
Sex	Variable	n	Min.	Max.	Mean	SD
Male	CL	310	35.1	96.9	80.8	7.4
	CW	310	41.6	116.5	95.9	8.7
	TW	310	19.0	488.0	269.8	65.9
Female	CL	187	27.8	86.5	64.2	8.3
	CW	186	51.7	99.1	76.7	8.6
	TW	187	26.0	266.0	120.8	38.7
All individuals	CL	497	27.8	96.9	74.5	11.2
	CW	496	41.6	116.5	88.7	12.7
	TW	497	19.0	488.0	213.7	92.1

Size frequency distributions below and above 1000 m depth have been tested for normality and mean differentiation (Kolmogorov-Smirnov and Mann-Whitney tests) and no significant differences have been found. However, it was observed that smaller crabs seem to be distributed at deeper depths.

**Length-weight relationship**

The results of the carapace length – weight relationship analysis for males, females and all individuals are presented in Table 36 and their graphic representation with the real values is shown Figure 28. In all cases, the allometry coefficients (b) show lower values than 3 for males and females, which indicate a small negative allometry between both variables. The determination coefficient ( $R^2$ ) shows high values in all cases, which indicate then the high correlation between the carapace length and the green weight of specimens.

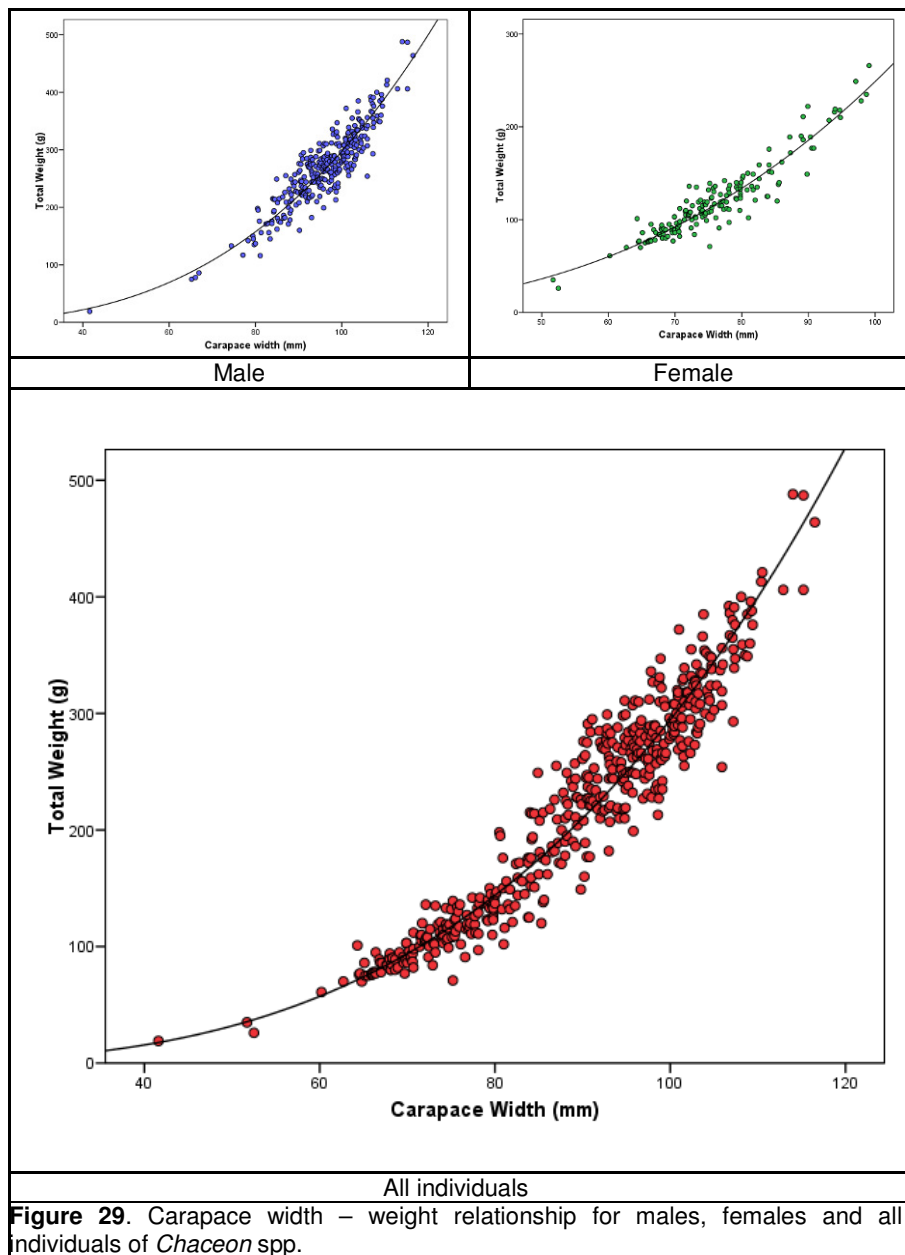
	a	b	$R^2$	N	CL range	TW range
Male	0.001	2.800	0.859	310	35.1-96.9	19-488
Female	0.003	2.572	0.858	169	42.6-86.5	26-266
All individuals	0.001	3.090	0.933	479	35.1-96.9	19-488



**Figure 28.** Carapace length – weight relationship for males, females and all individuals of *Chaceon* spp.

The results of the carapace width – weight relationship analysis for males, females and all individuals are presented in Table 37 and their graphic representation with the real values is shown in Figure 29. In all cases, the allometry coefficients (b) show lower values than 3 for males and females, which indicate a small negative allometry between both variables. For all individuals the allometry is positive. The determination coefficient ( $R^2$ ) shows high values in all cases, which indicate the high correlation between the carapace length and the green weight of specimens.

	a	b	$R^2$	n	CW range	TW range
Male	0.001	2.849	0.867	308	41.6-116.5	19-488
Female	0.001	2.781	0.876	166	51.7-99.1	26-266
All individuals	0.001	3.205	0.939	479	41.6-116.5	19-488



**Figure 29.** Carapace width – weight relationship for males, females and all individuals of *Chaceon* spp.

### Sex-ratio

The sex-ratio (Figure 30) in 5 mm size classes (CL) shows a confusing pattern for the smaller size class due to the scarcity of individuals in this range. Females are more abundant until 65 mm CL, the size from which males gradually begin to be dominant.



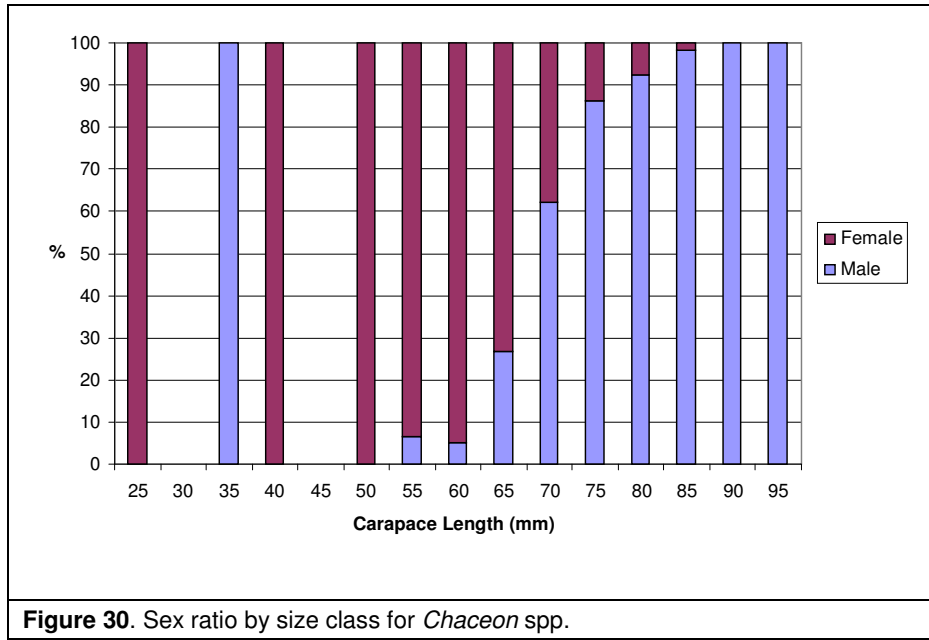


Figure 30. Sex ratio by size class for *Chaceon* spp.

**2.3.3.- *AcanthePHYra eximia***



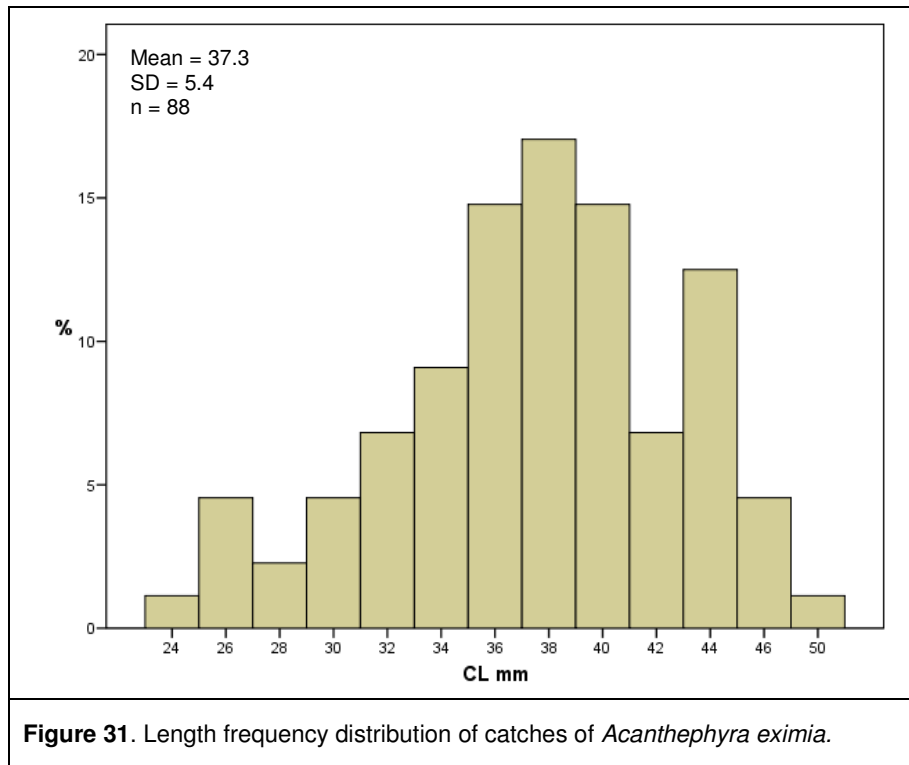
***Length composition of catches***

The cephalothorax length (CL) was used as a measure of size in this species. Size of specimens ranged between 24.2 y 49.1 mm and it was caught at depths ranging from 986 to 1095 m (Table 38).

**Table 38.** Descriptive statistics of specimen sizes (mm) and depth (m) of catches of *AcanthePHYra eximia*.

Variable	n	Min.	Max.	Mean	SD
CL	88	24.2	49.1	37.3	5.4
Depth	88	986	1095	1060.1	47.7

In Figure 31, the length frequency distribution by 2 mm length class of all individuals caught is presented. A main mode is present at 38 mm CL.



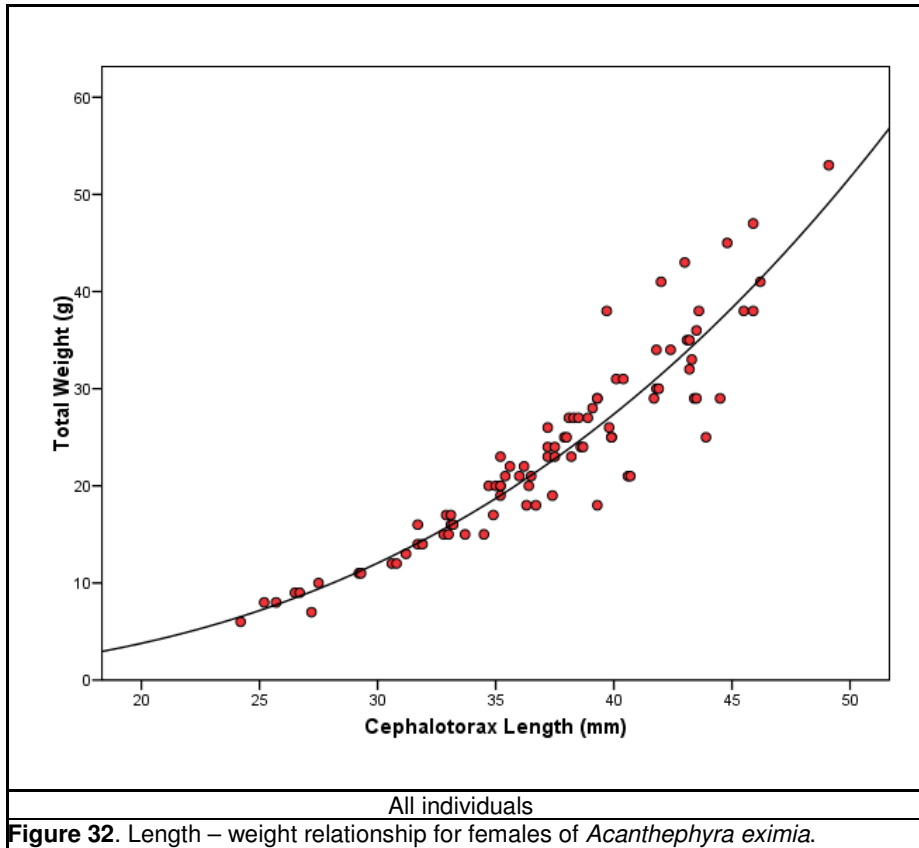
### ***Descriptive statistics of measurement data***

The cephalothorax length range for ovigerous females was between 35.2 - 49.1 mm CL. Unsexed individuals ranged between 24.2 and 46.2 mm. The weight of ovigerous females was between 6 and 43 g with a mean value of 20.1 g. The weight of non-sexed individuals ranged between 21 and 53 g, with a mean value of 31.2 g (Table 39).

Sex	Variable	N	Min.	Max.	Mean	SD
Without eggs	CL	58	24.2	46.2	35.7	5.5
	TW	58	6	43	20.1	8.5
Ovigerous Female	CL	30	35.2	49.1	40.4	3.2
	TW	30	21	53	31.2	7.9
All individuals	CL	88	24.2	49.1	37.3	5.4
	TW	88	6	53	23.9	9.8

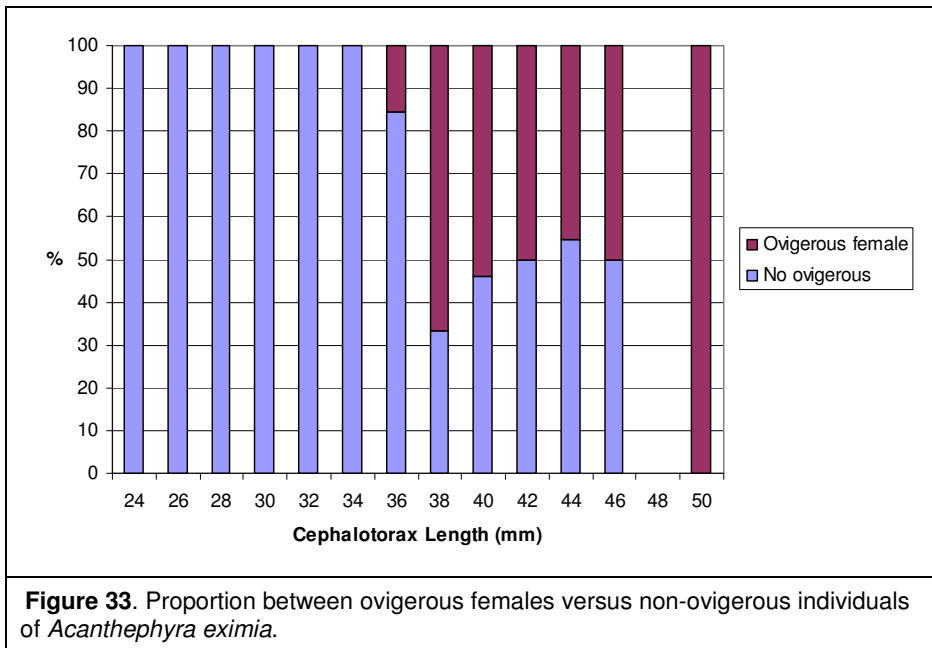
### ***Length-weight relationship***

The parameters defining the length-weight relationship of females were:  $a=0.001$ ,  $b=2.852$  y  $R^2=0.920$ . The graphic representation of the fitted curve and the values are shown in Figure 32.



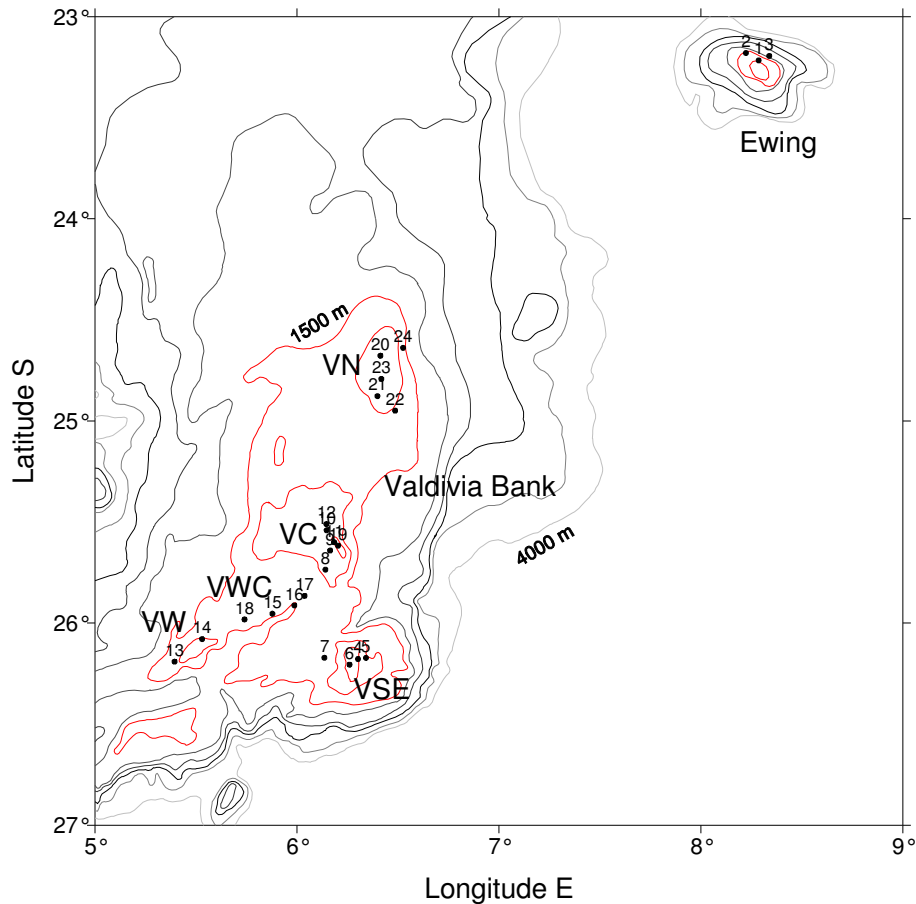
**Proportion between ovigerous females versus non-ovigerous individuals**

Ovigerous females appear at 36 mm CL and between 40 and 46 mm CL the proportion is around 50% (Figure 33).





In Figure 2 the area of study with the places and hauls considered in the current analysis is represented. Areas are described above.



**Figure 2.-** Area studied and places considered in the analysis and sampling haul locations

Haul classification shows a clear relationship with depth and four assemblages have been identified that correspond to the following criteria:

- 1 - Shallower assemblage (200-500 m) from Valdivia Bank (Figure 1 and Table 1).
- 2 - 800 - 1100 m assemblage from Valdivia Bank (Figure 1 and Table 2).
- 3 - 900 - 1300 m assemblage from Ewing and Valdivia Bank (Figure 1 and Table 3).
- 4 - Deeper assemblage (1300 – 1700 m) from Valdivia Bank (Figure 1 and Table 4).

The first dichotomy differentiates the shallower group (1) from deeper groups (2, 3 and 4) from hauls (Figure 1). In the deeper assemblages, groups 2 and 3 are closer to each other with respect to the deepest group 4.

The most representative fish species of the shallower stratum (200-500 m) were the boarfish (*Pseudopentaceos richardsoni*) and the blackbelly rosefish (*Helicolenus mouchezi*) (Table 1). *Macroramphosus scolopax* and *Notopogon xenosoma* also show an important presence in this assemblage but only from hauls shallower than 300 m depth.

**Table 1. Species presence in Valdivia shallower assemblage (200-500 m)**

Family	Species	Hauls			
		4	5	6	19
BERYCIDAE	<i>Beryx splendens</i>				*
CAPROIDAE	<i>Artigonia rubescens</i>			*	
CENTRISCIDAE	<i>Macroramphosus scolopax</i>	*	*	*	
	<i>Notopogon xenosoma</i>	*	*	*	
CONGRIDAE	<i>Conger cinereus</i>				*
	<i>Gnathophis capensis</i>	*			
EMMELICHTHYIDAE	<i>Emmelichthys nitidus nitidus</i>		*		
EPIGONIDAE	<i>Epigonus denticulatus</i>				*
GEMPYLIDAE	<i>Promethichthys prometheus</i>				*
MACROURIDAE	<i>Lucigadus ori</i>				*
	<i>Nezumia brevibarbata</i>				*
MACROURIDAE	<i>Coelorinchus polli</i>				*
MERLUCCIIDAE	<i>Macruronus magellanicus</i>				*
MORIDAE	<i>Gadella imberbis</i>				*
OREOSOMATIDAE	<i>Alloctytus verrucosus</i>				*
PENTACEROTIDAE	<i>Pseudopentaceros richardsoni</i>	*	*	*	*
SEBASTIDAE	<i>Helicolenus mouchezi</i>	*	*	*	*
TETRAODONTIDAE	<i>Sphoeroides pachygaster</i>	*			
HOMOLIDAE	<i>Paromola</i> sp.				*
SERGESTIDAE	<i>Sergestes atlanticus</i>	*			

Fish species that are present in the 800-1100 m assemblage are shown in Table 2. In this depth stratum, species of the Macrouridae family, such as *Bathygadus favosus*, *Cetonurus globiceps*, *Coelorinchus labiatus*, *Gadomus capensis* and *Nezumia brevibarbata* are the most representative. Other species that characterize this assemblage are; fishes such as *Etmopterus brachyurus*, *Alepocephalus productus*, *Guttigadus globiceps* and the orange roughy (*Hoplostethus atlanticus*); and crustaceans such as *Chaceon erythraeae*, *Nematocarcinus longirostris* and *Acanthephyra acanthitelsonis*.

**Table 2. Species presence in Valdivia 800-1100 m assemblage**

Family	Species	Hauls								
		7	8	9	10	12	20	21	23	
ALEPOCEPHALIDAE	<i>Alepocephalus australis</i>	*	*	*						
	<i>Alepocephalus productus</i>	*	*	*	*	*	*	*	*	
	<i>Rouleina atrita</i>	*	*							
	<i>Talismania longifilis</i>						*			
BATHYLAGIDAE	<i>Bathylagus antarcticus</i>	*	*		*					
BATHYSAURIDAE	<i>Bathysaurus ferox</i>				*					
CERATIIDAE	<i>Ceratias holboellii</i>	*								
	<i>Ceratias</i> sp.					*				
	<i>Cryptopsaras couesii</i>							*		
DIRETMIDAE	<i>Diretmichthys parini</i>	*				*	*	*		
	<i>Diretmus argenteus</i>							*		
ETMOPTERIDAE	<i>Etmopterus bigelowi</i>		*							
	<i>Etmopterus brachyurus</i>	*	*	*	*		*	*		
EVERMANELLIDAE	<i>Coccorella atlantica</i>							*		
GEMPYLIDAE	<i>Nealotus tripes</i>					*				
GONOSTOMATIDAE	<i>Cyclothone</i> sp.						*	*		
LIPARIDIDAE	<i>Paraliparis</i> sp.					*	*			
MACROURIDAE	<i>Bathygadus favosus</i>	*	*	*	*	*	*	*		
	<i>Cetonurus globiceps</i>	*	*	*	*	*	*	*		
	<i>Coelorhynchus braueri</i>							*		

Family	Species	Hauls							
		7	8	9	10	12	20	21	23
	<i>Coelorhynchus karrerae</i>			*	*	*	*	*	*
	<i>Coelorhynchus acanthiger</i>		*	*	*	*	*	*	*
	<i>Coelorhynchus labiatus</i>	*	*	*	*	*	*	*	*
	<i>Coryphaenoides striaturus</i>	*	*	*				*	
	<i>Gadomus capensis</i>	*	*	*	*	*	*	*	*
	<i>Malacocephalus laevis</i>						*		
	<i>Nezumia brevibarbata</i>	*	*	*	*	*	*	*	*
	<i>Sphagemacurus hirundo</i>		*	*	*	*		*	
	<i>Squalogadus modificatus</i>	*	*						
MELAMPHAIDAE	<i>Poromitra megalops</i>				*	*			
	<i>Scopelogadus beanii</i>								*
	<i>Scopelogadus mizolepis bispinosus</i>	*							
MELANOCETIDAE	<i>Melanocetus johnsonii</i>				*				
MORIDAE	<i>Antimora rostrata</i>		*	*	*	*	*	*	*
	<i>Guttigadus globiceps</i>	*	*	*	*	*	*	*	*
	<i>Halargyreus johnsonii</i>	*	*	*	*	*	*	*	*
MYCTOPHIDAE	<i>Electrona risso</i>				*	*			
	<i>Hygophum</i> sp.			*					
	<i>Lampaneda dea</i>				*		*		
	<i>Lampanyctus</i> sp.	*	*		*	*		*	*
	<i>Myctophum phengodes</i>								*
NEMICHTHYIDAE	<i>Avocettina acuticeps</i>						*	*	
	<i>Nemichthys curvirostris</i>						*		
NOTACANTHIDAE	<i>Notacanthus sexspinis</i>			*					
OREOSOMATIDAE	<i>Alloctytus guineensis</i>							*	
	<i>Alloctytus verrucosus</i>	*	*	*			*	*	*
	<i>Neocyttus rhomboidalis</i>								*
PHOSICHTHYIDAE	<i>Photichthys argenteus</i>		*	*	*			*	*
SCOMBROLABRACIDAE	<i>Scombrobrax heterolepis</i>						*		
SCORPAENIDAE	<i>Trachyscorpia eschmeyerii</i>				*	*			
SOMNIOSIDAE	<i>Scymnodon squamulosus</i>		*						
STERNOPTYCHIDAE	<i>Argyropelecus gigas</i>	*		*	*	*		*	*
	<i>Sternoptyx pseudodiaphana</i>	*						*	*
	<i>Sternoptyx</i> sp.			*					
STOMIIDAE	<i>Chauliodus sloani</i>	*	*	*	*		*	*	*
	<i>Echiostoma barbatum</i>	*							
	<i>Eustomias trewavasae</i>								*
	<i>Idiacanthus atlanticus</i>								*
	<i>Malacosteus niger</i>		*		*	*			
	<i>Stomias boa boa</i>	*							*
SYNAPHOBRANCHIDAE	<i>Diastobranchus capensis</i>	*				*			*
	<i>Synaphobranchus kaupii</i>							*	
TRACHICHTHYIDAE	<i>Hoplostethus atlanticus</i>		*	*	*	*	*	*	*
TRICHIURIDAE	<i>Aphanopus microphthalmus</i>			*					
ARISTEIDAE	<i>Aristaeopsis edwardsiana</i>	*		*			*		*
	<i>Austropenaeus nitidus</i>	*	*	*	*	*	*	*	*
GERYONIDAE	<i>Chaceon erythrae</i>	*	*	*	*	*	*	*	*
LOPHOGASTRIDAE	<i>Gnathophausia zoea</i>	*			*				
NEMATOCARCINIDAE	<i>Nematocarcinus exilis</i>						*	*	
	<i>Nematocarcinus longirostris</i>	*	*	*	*	*	*	*	*
OPLOPHORIDAE	<i>Acanthephyra acanthitelsonis</i>	*	*	*	*	*	*	*	*
	<i>Acanthephyra eximia</i>	*	*	*		*	*	*	
	<i>Notostomus auriculatus</i>							*	
	<i>Notostomus gibbosus</i>				*		*		
PANDALIDAE	<i>Heterocarpus grimaldii</i>					*			*
PASIPHAEIDAE	<i>Pasiphaea semispinosa</i>								*
	<i>Pasiphaea</i> sp.				*		*		
PENAEIDAE	<i>Funchalia woodwardi</i>	*							*
POLYCHELIDAE	<i>Polycheles</i> sp.		*				*	*	
SERGESTIDAE	<i>Sergestes atlanticus</i>	*		*	*				*
	<i>Sergestes nudus</i>						*		

Species from assemblage 3 are presented in Table 3 below and among those which stand out as more representative of this group are fishes such as *Alepocephalus productus*, *Coryphaenoides striaturus*, *Gadomus capensis*, *Antimora rostrata*, *Apristurus* sp., *Argyropelecus gigas*, *Diastobranchus capensis* and the warty oreo



(*Alloctytus verrucosus*); and crustaceans such as *Austropenaeus nitidus*, *Chaceon erytheiae* (and possibly *C. chuni*) and *Nematocarcinus longirostris*. This assemblage contains hauls from Valdivia Bank and also the three hauls taken at Ewing seamount.

**Table 3. Species presence in Ewing-Valdivia 900-1300 m assemblage**

Family	Species	Hauls								
		1	2	3	13	14	17	18	24	
ALEPOCEPHALIDAE	<i>Alepocephalus australis</i>			*			*			
	<i>Alepocephalus productus</i>		*	*	*	*	*	*	*	
	<i>Conocara fiolenti</i>		*	*			*			
	<i>Rouleina atrita</i>	*	*	*			*			
ANOLOGASTERIDAE	<i>Anoplogaster cornuta</i>		*						*	
BATHYLAGIDAE	<i>Bathylagus antarcticus</i>		*						*	
BATHYSAURIDAE	<i>Bathysaurus ferox</i>	*				*	*	*	*	
BYTHITIDAE	<i>Cataetyx laticeps</i>								*	
CARISTIIDAE	<i>Caristus groenlandicus</i>								*	
CERATIIDAE	<i>Ceratias</i> sp.			*						
CHIASMODONTIDAE	<i>Chiasmodon niger</i>		*							
DIRETMIDAE	<i>Diretmichthys parini</i>				*			*		
ETMOPTERIDAE	<i>Etmopterus brachyurus</i>				*	*	*	*	*	
	<i>Etmopterus princeps</i>	*	*	*						
	<i>Etmopterus pusillus</i>	*								
GEMPYLIDAE	<i>Ruvettus pretiosus</i>					*				
GIGANTACTINIDAE	<i>Gigantactis meadi</i>								*	
GONOSTOMATIDAE	<i>Cyclothone</i> sp.				*	*	*			
	<i>Diplophos taenia</i>		*							
GONOSTOMIDAE	<i>Gonostoma bathyphilum</i>						*			
HALOSAURIDAE	<i>Aldrovandia affinis</i>	*		*				*		
	<i>Aldrovandia phalacra</i>					*				
HOWELLIDAE	<i>Howella sherborni</i>		*							
LINOPHRYNIDAE	<i>Linophryne</i> sp.				*					
MACROURIDAE	<i>Bathygadus favosus</i>	*			*		*	*	*	
	<i>Cetonus globiceps</i>	*			*	*	*	*	*	
	<i>Coelorinchus acanthiger</i>	*								
	<i>Coelorinchus labiatus</i>	*	*	*		*		*		
	<i>Coryphaenoides striaturus</i>	*	*	*	*	*	*	*	*	
	<i>Gadomus capensis</i>	*	*	*	*	*		*	*	
	<i>Malacocephalus laevis</i>					*				
	<i>Mesobius antipodum</i>	*				*		*		
	<i>Nezumia brevibarbata</i>	*	*	*			*	*	*	
	<i>Sphagemacurus hirundo</i>		*		*		*	*	*	
	<i>Squalogadus modificatus</i>		*	*						
	MELAMPHAIDAE	<i>Poromitra megalops</i>		*			*			
		<i>Scopeloberyx robustus</i>		*		*			*	
<i>Scopelogadus beanii</i>						*	*	*	*	
<i>Scopelogadus mizolepis bispinosus</i>			*							
MELANOCETIDAE	<i>Melanocetus johnsonii</i>		*			*	*	*		
MELANONIDAE	<i>Melanonus zugmayeri</i>		*			*		*		
MORIDAE	<i>Antimora rostrata</i>	*	*	*	*	*	*	*	*	
	<i>Gadella imberbis</i>					*				
	<i>Guttigadus globiceps</i>		*	*				*	*	
	<i>Halargyreus johnsonii</i>				*	*	*	*	*	
	<i>Lepidion</i> sp.		*							
MYCTOPHIDAE	<i>Ceratoscopelus warmingii</i>								*	
	<i>Electrona risso</i>		*		*		*	*		
	<i>Lampaneda dea</i>								*	
	<i>Lampanyctus</i> sp.		*		*	*	*	*	*	
	<i>Symbolophorus boops</i>				*					
NEMICHTHYIDAE	<i>Avocettina acuticeps</i>					*				
	<i>Avocettina infans</i>								*	
NOTACANTHIDAE	<i>Notacanthus sexspinis</i>	*		*						
OPHIDIIDAE	<i>Lamprogrammus shcherbachevi</i>	*								
OREOSOMATIDAE	<i>Alloctytus verrucosus</i>	*	*	*	*	*	*	*	*	
	<i>Neocyttus rhomboidalis</i>	*	*	*						
PARALEPIDIDAE	<i>Lestidium atlanticum</i>				*		*			
	<i>Macroparalepis affinis</i>		*							
PHOSICHTHYIDAE	<i>Photichthys argenteus</i>	*	*		*		*	*		
PLATYTROCTIDAE	<i>Platytrectes apus</i>		*							
SCOMBROLABRACIDAE	<i>Scombrolabrax heterolepis</i>	*	*							
SCYLIORHINIDAE	<i>Apristurus manis</i>	*								
	<i>Apristurus</i> sp.	*	*	*	*	*	*	*	*	
SERRIVOMERIDAE	<i>Serrivomer beanii</i>		*					*		
SOMNIOSIDAE	<i>Scymnodon squamulosus</i>		*				*			
STEPHANOBERYCIDAE	<i>Acanthochoaenus luetkenii</i>						*			
STERNOPTYCHIDAE	<i>Argyropelecus aculeatus</i>				*					
	<i>Argyropelecus gigas</i>	*	*		*	*	*	*		

**Table 3. Species presence in Ewing-Valdivia 900-1300 m assemblage**

Family	Species	Hauls							
		1	2	3	13	14	17	18	24
	<i>Argyrolepelecus sladeni</i>	*	*						
	<i>Sternoptyx pseudodiaphana</i>							*	
STOMIIDAE	<i>Chauliodus sloani</i>	*	*		*		*	*	*
	<i>Eustomias trewavasae</i>				*				
	<i>Idiacanthus atlanticus</i>				*	*			
	<i>Leptostomias</i> sp.					*			
	<i>Melanostomias</i> sp.		*						*
	<i>Stomias boa boa</i>							*	
SYNAPHOBRANCHIDAE	<i>Diastobranchus capensis</i>	*	*	*	*	*	*	*	*
	<i>Ilyophys blachei</i>	*		*			*		
	<i>Simenchelys parasitica</i>	*		*					
	<i>Synaphobranchus kaupii</i>		*	*		*			*
TRACHICHTHYIDAE	<i>Hoplostethus atlanticus</i>	*		*		*			
ARISTEIDAE	<i>Aristaeopsis edwardsiana</i>	*	*	*					
	<i>Austropenaeus nitidus</i>	*	*	*	*	*	*	*	
CRANGONIDAE	<i>Pontophilus gracilis</i>	*							
GERYONIDAE	<i>Chaceon erythraeae</i>		*	*	*	*	*	*	
LOPHOGASTRIDAE	<i>Neognathophausia ingens</i>					*		*	
NEMATOCARCINIDAE	<i>Nematocarcinus longirostris</i>	*	*	*	*	*	*	*	
OPLOPHORIDAE	<i>Acanthephyra acanthitelsonis</i>	*	*	*	*	*		*	
	<i>Acanthephyra eximia</i>	*	*	*	*	*		*	
	<i>Acanthephyra</i> sp.						*		
	<i>Notostomus auriculatus</i>							*	
	<i>Notostomus gibbosus</i>				*				
	<i>Oplophorus</i> sp.	*	*	*					
PANDALIDAE	<i>Heterocarpus grimaldii</i>	*							
PENAEIDAE	<i>Funchalia woodwardi</i>	*	*	*				*	
POLYCHELIDAE	<i>Polycheles</i> sp.	*	*	*					

Finally, the assemblage 4 (Table 4), which contains the deepest hauls carried out in the survey and it is characterize by the following fish species of fish; *Alepocephalus productus*, *Conocara murrayi*, *Rouleina attrita*, *Bathysaurus ferox*, *Bathygadus favosus*, *Coryphaenoides striaturus*, *Nezumia brevibarbata*, *Scopelogadus beanie* and *Chauliodus sloani*; and crustaceans such as *Austropenaeus nitidus*, *Chaceon chuni*, *Glyphocrangon longirostris*, *Nematocarcinus longirostris* and *Gordonella kensleyi*.

**Table 4.- Species presence in Valdivia deeper assemblage (1300-1700 m)**

Family	Species	Hauls		
		15	16	22
ALEPOCEPHALIDAE	<i>Alepocephalus productus</i>	*	*	*
	<i>Bathytroctes microlepis</i>	*		*
	<i>Conocara murrayi</i>	*	*	*
	<i>Leptoderma</i> sp.	*	*	
	<i>Narcetes stomias</i>		*	
	<i>Rouleina attrita</i>	*	*	*
ASTRONESTHIDAE	<i>Borostomias antarcticus</i>	*		
BATHYSAURIDAE	<i>Bathysaurus ferox</i>	*	*	*
	<i>Bathysaurus mollis</i>			*
BYTHITIDAE	<i>Cataetyx laticeps</i>	*	*	
CHIASMODONTIDAE	<i>Kali macrura</i>		*	
CHIMAERIDAE	<i>Hydrolagus affinis</i>			*
EURYPHARYNGIDAE	<i>Eurypharynx pelecyanoides</i>	*	*	
GONOSTOMATIDAE	<i>Bonapartia pedaliota</i>	*		
	<i>Cyclothone</i> sp.		*	*
GONOSTOMIDAE	<i>Gonostoma bathyphilum</i>			*
HALOSAURIDAE	<i>Aldrovandia affinis</i>		*	
	<i>Aldrovandia oleosa</i>			*
HOWELLIDAE	<i>Howella sherborni</i>		*	
IPNOPIDAE	<i>Bathypterois filiferus</i>	*		*
	<i>Bathypterois phenax</i>		*	
MACROURIDAE	<i>Bathygadus favosus</i>	*	*	*
	<i>Cetonus globiceps</i>		*	*
	<i>Coelorinchus labiatus</i>	*		
	<i>Coryphaenoides striaturus</i>	*	*	*
	<i>Nezumia brevibarbata</i>	*	*	*

Table 4.- Species presence in Valdivia deeper assemblage (1300-1700 m)		Hauls		
Family	Species	15	16	22
	<i>Sphagemacrurus hirundo</i>		*	
MELAMPHAIDAE	<i>Melamphaes simus</i>			*
	<i>Melamphaes suborbitalis</i>		*	
	<i>Poromitra crassiceps</i>	*		*
	<i>Poromitra megalops</i>	*		
	<i>Scopelogadus beanii</i>	*	*	*
MORIDAE	<i>Antimora rostrata</i>		*	*
	<i>Halargyreus johnsonii</i>	*	*	
MYCTOPHIDAE	<i>Ceratospelus warmingii</i>			*
	<i>Electrona risso</i>	*		
	<i>Hygophum</i> sp.		*	
	<i>Lampanyctus</i> sp.			*
NOTACANTHIDAE	<i>Notacanthus sexspinis</i>	*		
	<i>Polyacanthonotus africanus</i>	*		
OMOSUDIDAE	<i>Omosudis lowii</i>			*
ONEIRODIDAE	<i>Chaenophryne draco</i>		*	
OPHIDIIDAE	<i>Porogadus milles</i>	*		
	<i>Porogadus</i> sp.			*
	<i>Spectrunculus grandis</i>		*	*
OREOSOMATIDAE	<i>Allocyttus verrucosus</i>	*		*
	<i>Oreosoma atlanticum</i>			*
PHOSICHTHYIDAE	<i>Photichthys argenteus</i>		*	*
SERRIVOMERIDAE	<i>Serrivomer beanii</i>			*
STEPHANOBERYCIDAE	<i>Acanthochaenus luetkenii</i>	*	*	
STERNOPTYCHIDAE	<i>Argyropelecus aculeatus</i>	*		
	<i>Argyropelecus gigas</i>	*	*	
	<i>Sternoptyx pseudobscura</i>	*		
	<i>Sternoptyx pseudodiaphana</i>		*	
STOMIIDAE	<i>Chauliodus sloani</i>	*	*	*
	<i>Eustomias trewavasae</i>	*		
	<i>Idiacanthus atlanticus</i>		*	
	<i>Stomias boa boa</i>	*		
SYNAPHOBRANCHIDAE	<i>Ilyophys blachei</i>	*		*
ARISTEIDAE	<i>Austropenaeus nitidus</i>	*	*	*
GERYONIDAE	<i>Chaceon chuni</i>	*	*	
	<i>Chaceon erythraeae</i>			*
GLYPHOCRANGONIDAE	<i>Glyphocrangon longirostris</i>	*	*	
LOPHOGASTRIDAE	<i>Gnathophausia zoea</i>	*		
	<i>Neognathophausia ingens</i>	*	*	
NEMATOCARCINIDAE	<i>Nematocarcinus ensifer</i>	*	*	
	<i>Nematocarcinus longirostris</i>	*	*	*
OPLOPHORIDAE	<i>Acanthephyra eximia</i>	*	*	
	<i>Acanthephyra</i> sp.	*	*	
	<i>Notostomus</i> sp.			*
	<i>Oplophorus</i> sp.	*		
	<i>Systellaspis cristata</i>	*		
SERGESTIDAE	<i>Sergestes atlanticus</i>		*	
	<i>Sergestes nudus</i>	*		
SOLENOCERIDAE	<i>Gordonella kensleyi</i>	*	*	*

The analysis excludes one important depth stratum which is located between 300 (only 1 sample at between 400-500m) and 800 m depth and which was inaccessible to trawl sampling as mentioned before. This depth stratum includes the seamount cliffs in the study area which is the habitat, for instance, of species of the Berycidae and Centrolophidae fish families.



**ANNEX A**  
**SPECIES LIST**



## Species list

### Fishes

Family	Species
<b>ALEPOCEPHALIDAE</b>	<i>Alepocephalus australis</i> Barnard, 1923 <i>Alepocephalus productus</i> Gill, 1883 <i>Bathytroctes microlepis</i> Gunther, 1878 <i>Conocara fiolenti</i> Sazonov & Ivanov, 1979 <i>Conocara murrayi</i> (Koefoed, 1927) <i>Leptoderma</i> sp. <i>Narcetes stomias</i> (Gilbert, 1890) <i>Rouleina attrita</i> (Vaillant, 1888) <i>Talismania longifilis</i> (Brauer, 1902)
<b>ANOPLOGASTERIDAE</b>	<i>Anoplogaster cornuta</i> (Valenciennes, 1833)
<b>ASTRONESTHIDAE</b>	<i>Borostomias antarcticus</i> (Lonnberg, 1905)
<b>BATHYLAGIDAE</b>	<i>Bathylagus antarcticus</i> Gunther, 1878
<b>BATHYSAURIDAE</b>	<i>Bathysaurus ferox</i> Günther, 1878 <i>Bathysaurus mollis</i> Gunther, 1878
<b>BERYCIDAE</b>	<i>Beryx splendens</i> Lowe, 1834
<b>BYTHITIDAE</b>	<i>Cataetyx laticeps</i> Koefoed, 1927
<b>CAPROIDAE</b>	<i>Antigonia rubescens</i> (Günther, 1860)
<b>CARISTIIDAE</b>	<i>Caristius groenlandicus</i> Jensen, 1941
<b>CENTRISCIDAE</b>	<i>Macroramphosus scolopax</i> (Linnaeus, 1758) <i>Notopogon xenosoma</i> Regan, 1914
<b>CERATIIDAE</b>	<i>Ceratias holboelli</i> Krøyer, 1845 <i>Ceratias</i> sp. <i>Cryptopsaras couesii</i> Gill, 1883
<b>CHIASMODONTIDAE</b>	<i>Chiasmodon niger</i> Johnson, 1864 <i>Kali macrura</i> (Parr, 1933)
<b>CHIMAERIDAE</b>	<i>Hydrolagus affinis</i> (de Brito Capello, 1868)

Family	Species
<b>CONGRIDAE</b>	<i>Conger cinereus</i> Rüppell, 1830 <i>Gnathophis capensis</i> (Kaup, 1856)
<b>DIRETMIDAE</b>	<i>Diretmichthys parini</i> (Post & Quéro, 1981) <i>Diretmus argenteus</i> Johnson, 1864
<b>EMMELICHTHYIDAE</b>	<i>Emmelichthys nitidus nitidus</i> Richardson, 1845
<b>EPIGONIDAE</b>	<i>Epigonus denticulatus</i> Dieuzeide, 1950
<b>ETMOPTERIDAE</b>	<i>Etmopterus bigelowi</i> Shirai & Tachikawa, 1993 <i>Etmopterus brachyurus</i> Smith & Radcliffe, 1912 <i>Etmopterus princeps</i> Collett, 1904 <i>Etmopterus pusillus</i> (Lowe, 1839)
<b>EURYPHARYNGIDAE</b>	<i>Eurypharynx pelecanooides</i> Vaillant, 1882
<b>EVERMANELLIDAE</b>	<i>Coccorella atlantica</i> (Parr, 1928)
<b>GEMPYLIDAE</b>	<i>Nealotus tripes</i> Johnson, 1865 <i>Promethichthys prometheus</i> (Cuvier, 1832) <i>Ruvettus pretiosus</i> Cocco, 1833
<b>GIGANTACTINIDAE</b>	<i>Gigantactis meadi</i> Bertelsen, Pietsch & Lavenberg, 1981
<b>GONOSTOMATIDAE</b>	<i>Bonapartia pedaliota</i> Goode & Bean, 1896 <i>Cyclothone</i> sp. <i>Diplophos taenia</i> Günther, 1873
<b>GONOSTOMIDAE</b>	<i>Gonostoma bathyphilum</i> (Vaillant, 1884)
<b>HALOSAURIDAE</b>	<i>Aldrovandia affinis</i> (Günther, 1877) <i>Aldrovandia oleosa</i> Sulak, 1977 <i>Aldrovandia phalacra</i> (Vaillant, 1888)
<b>HOWELLIDAE</b>	<i>Howella sherborni</i> (Norman, 1930)
<b>IPNOPIDAE</b>	<i>Bathypterois filiferus</i> Gilchrist, 1906 <i>Bathypterois phenax</i> Parr, 1928
<b>LINOPHRYNIDAE</b>	<i>Linophryne</i> sp.



Family	Species
<b>LIPARIDIDAE</b>	Paraliparis sp.
<b>MACROURIDAE</b>	<i>Bathygadus favosus</i> Goode & Bean, 1886 <i>Cetonurus globiceps</i> (Vaillant, 1888) <i>Coelorhynchus braueri</i> Barnard, 1925 <i>Coelorhynchus karrerae</i> Trunov, 1984 <i>Coelorinchus acanthiger</i> Barnard, 1925 <i>Coelorinchus labiatus</i> (Koehler, 1896) <i>Coelorinchus polli</i> Marshall & Iwamoto, 1973 <i>Coryphaenoides striaturus</i> Barnard, 1925 <i>Gadomus capensis</i> (Gilchrist & von Bonde, 1924) <i>Lucigadus ori</i> (Smith, 1968) <i>Malacocephalus laevis</i> (Lowe, 1843) <i>Mesobius antipodum</i> Hubbs & Iwamoto, 1977 <i>Nezumia brevibarbata</i> (Barnard, 1925) <i>Sphagemacurus hirundo</i> (Collett, 1896) <i>Squalogadus modificatus</i> Gilbert & Hubbs, 1916
<b>MELAMPHAIDAE</b>	<i>Melamphaes simus</i> Ebeling, 1962 <i>Melamphaes suborbitalis</i> (Gill, 1883) <i>Poromitra crassiceps</i> (Günther, 1878) <i>Poromitra megalops</i> (Lütken, 1878) <i>Scopeloberyx robustus</i> (Günther, 1887) <i>Scopelogadus beanii</i> (Günther, 1887) <i>Scopelogadus mizolepis bispinosus</i> (Gilbert, 1915)
<b>MELANOCETIDAE</b>	<i>Melanocetus johnsonii</i> Günther, 1864
<b>MELANONIDAE</b>	<i>Melanonus zugmayeri</i> Norman, 1930
<b>MERLUCCIIDAE</b>	<i>Macruronus magellanicus</i> Lönnberg, 1907
<b>MORIDAE</b>	<i>Antimora rostrata</i> (Günther, 1878) <i>Gadella imberbis</i> (Vaillant, 1888) <i>Guttigadus globiceps</i> (Gilchrist, 1906) <i>Halargyreus johnsonii</i> Günther, 1862 <i>Lepidion</i> sp.
<b>MYCTOPHIDAE</b>	<i>Ceratoscopelus warmingii</i> (Lütken, 1892) <i>Electrona risso</i> (Cocco, 1829) <i>Hygophum</i> sp. <i>Lampaneda dea</i> Fraser-Brunner, 1949 <i>Lampanyctus</i> sp. <i>Myctophum phengodes</i> (Lütken, 1892) <i>Symbolophorus boops</i> (Richardson, 1845)

Family	Species
<b>NEMICHTHYIDAE</b>	<i>Avocettina acuticeps</i> (Regan, 1916) <i>Avocettina infans</i> (Günther, 1878) <i>Nemichthys curvirostris</i> (Strömman, 1896)
<b>NOTACANTHIDAE</b>	<i>Notacanthus sexspinis</i> Richardson, 1846 <i>Polyacanthonotus africanus</i> (Gilchrist & von Bonde, 1924)
<b>OMOSUDIDAE</b>	<i>Omosudis lowii</i> Günther, 1887
<b>ONEIRODIDAE</b>	<i>Chaenophryne draco</i> Beebe, 1932
<b>OPHIDIIDAE</b>	<i>Lamprogrammus shcherbachevi</i> Cohen & Rohr, 1993 <i>Porogadus milles</i> Goode & Bean, 1885 <i>Porogadus</i> sp. <i>Spectrunculus grandis</i> (Günther, 1877)
<b>OREOSOMATIDAE</b>	<i>Alloctytus guineensis</i> Trunov & Kukuev, 1982 <i>Alloctytus verrucosus</i> (Gilchrist, 1906) <i>Neocyttus rhomboidalis</i> Gilchrist, 1906 <i>Oreosoma atlanticum</i> Cuvier, 1829
<b>PARALEPIDIDAE</b>	<i>Lestidium atlanticum</i> Borodin, 1928 <i>Macroparalepis affinis</i> Ege, 1933
<b>PENTACEROTIDAE</b>	<i>Pseudopentaceros richardsoni</i> (Smith, 1844)
<b>PHOSICHTHYIDAE</b>	<i>Photichthys argenteus</i> Hutton, 1873
<b>PLATYTROCTIDAE</b>	<i>Platytrectes apus</i> Günther, 1878
<b>SCOMBROLABRACIDAE</b>	<i>Scombrolabrax heterolepis</i> Roule, 1921
<b>SCORPAENIDAE</b>	<i>Trachyscorpia eschmeyeri</i> Whitley, 1970
<b>SCYLIORHINIDAE</b>	<i>Apristurus manis</i> (Springer, 1979) <i>Apristurus</i> sp.
<b>SEBASTIDAE</b>	<i>Helicolenus mouchezi</i> (Delaroche, 1809)
<b>SERRIVOMERIDAE</b>	<i>Serrivomer beanii</i> Gill & Ryder, 1883
<b>SOMNIOSIDAE</b>	<i>Scymnodon squamulosus</i> (Günther, 1877)

Family	Species
<b>STEPHANOBERYCIDAE</b>	<i>Acanthochaenus luetkenii</i> Gill, 1884
<b>STERNOPTYCHIDAE</b>	<i>Argyropelecus aculeatus</i> Valenciennes, 1850 <i>Argyropelecus gigas</i> Norman, 1930 <i>Argyropelecus sladeni</i> Regan, 1908 <i>Sternoptyx pseudobscura</i> Baird, 1971 <i>Sternoptyx pseudodiaphana</i> Borodulina, 1977 <i>Sternoptyx</i> sp.
<b>STOMIIDAE</b>	<i>Chauliodus sloani</i> Bloch & Schneider, 1801 <i>Echiostoma barbatum</i> Lowe, 1843 <i>Eustomias trewavasae</i> Norman, 1930 <i>Idiacanthus atlanticus</i> Brauer, 1906 <i>Leptostomias</i> sp. <i>Malacosteus niger</i> Ayres, 1848 <i>Melanostomias</i> sp. <i>Stomias boa boa</i> (Risso, 1810)
<b>SYNAPHOBRANCHIDAE</b>	<i>Diastobranchus capensis</i> Barnard, 1923 <i>Ilyophys blachei</i> Saldanha & Merret, 1982 <i>Simenchelys parasitica</i> Gill, 1879 <i>Synaphobranchus kaupii</i> Johnson, 1862
<b>TETRAODONTIDAE</b>	<i>Sphoeroides pachygaster</i> (Müller & Troschel, 1848)
<b>TRACHICHTHYIDAE</b>	<i>Hoplostethus atlanticus</i> Collett, 1889
<b>TRICHIURIDAE</b>	<i>Aphanopus microphthalmus</i> Norman, 1939

Crustaceans

Family	Species
<b>ARISTEIDAE</b>	<i>Aristaeopsis edwardsiana</i> (Johnson, 1867) <i>Austropenaeus nitidus</i> (Barnard, 1947)
<b>CRANGONIDAE</b>	<i>Pontophilus gracilis</i> Smith, 1882
<b>GERYONIDAE</b>	<i>Chaceon chuni</i> (Macpherson, 1983) <i>Chaceon erytheiae</i> (Macpherson, 1984)
<b>GLYPHOCRANGONIDAE</b>	<i>Glyphocrangon longirostris</i> (S.I. Smith, 1882)
<b>HOMOLIDAE</b>	<i>Paromola</i> sp.
<b>LOPHOGASTRIDAE</b>	<i>Gnathophausia zoea</i> Willemoes-Suhm, 1873 <i>Neognathophausia ingens</i> (Dohrn, 1870)
<b>NEMATOCARCINIDAE</b>	<i>Nematocarcinus ensifer</i> (S. I. Smith, 1882) <i>Nematocarcinus exilis</i> (Bate, 1881) <i>Nematocarcinus longirostris</i> (Bate, 1888)
<b>OPLOPHORIDAE</b>	<i>Acanthephyra acanthitelsonis</i> Bate, 1888 <i>Acanthephyra eximia</i> Smith, 1884 <i>Acanthephyra</i> sp. <i>Notostomus auriculatus</i> Barnard, 1950 <i>Notostomus gibbosus</i> Milne-Edwards, 1882 <i>Notostomus</i> sp. <i>Oplophorus</i> sp. <i>Systemaspis cristata</i> (Faxon, 1893)
<b>PANDALIDAE</b>	<i>Heterocarpus grimaldii</i> Milne Edwards y Bouvier, 1900
<b>PASIPHAEIDAE</b>	<i>Pasiphaea semispinosa</i> Holthuis, 1951 <i>Pasiphaea</i> sp.
<b>PENAEIDAE</b>	<i>Funchalia woodwardi</i> Johnson, 1868
<b>POLYCHELIDAE</b>	<i>Polycheles</i> sp.
<b>SERGESTIDAE</b>	<i>Sergestes atlanticus</i> Milne Edwards, 1830 <i>Sergestes nudus</i> Illig, 1914
<b>SOLENOCERIDAE</b>	<i>Gordonella kensleyi</i> Crosnier, 1988

## Cephalopods

Family	Species
<b>Cephalopods</b>	
<b>AMPHITRETIDAE</b>	Amphitretidae
<b>CHIROTEUTHIDAE</b>	<i>Chiroteuthis</i> sp.
<b>CIRROTEUTHIDAE</b>	Cirroteuthidae
<b>CRANCHIIDAE</b>	Cranchiidae <i>Galiteuthis</i> sp. <i>Teuthowenia</i> sp. <i>Megalocranchia</i> sp.
<b>HISTIOTEUTHIDAE</b>	<i>Histioteuthis</i> sp.
<b>LYCOTEUTHIDAE</b>	<i>Lycoteuthis</i> sp.
<b>MASTIGOTEUTHIDAE</b>	<i>Mastigoteuthis</i> sp.
<b>OCTOPOTEUTHIDAE</b>	<i>Octopoteuthis</i> sp.
<b>OMMASTREPHIDAE</b>	<i>Ommastrephes bartramii</i> (Lesueur, 1821) <i>Todarodes sagittatus</i> (Lamarck, 1798)
<b>ONYCHOTEUTHIDAE</b>	<i>Moroteuthis robsoni</i> Adam, 1962
<b>TREMOCTOPODIDAE</b>	<i>Tremoctopus</i> sp.



**ANNEX B**  
**CATCHES BY SPECIES**





Fishes	Number	Weight (kg)
<i>Notopogon xenosoma</i>	5398	194.716
<i>Cetonurus globiceps</i>	3009	646.496
<i>Pseudopentaceros richardsoni</i>	1805	3163.200
<i>Allocyttus verrucosus</i>	1567	1071.212
<i>Alepocephalus productus</i>	1344	1016.236
<i>Rouleina attrita</i>	1047	725.855
<i>Helicolenus mouchezi</i>	624	420.700
<i>Gadomus capensis</i>	346	25.520
<i>Bathygadus favosus</i>	221	3.202
<i>Macroramphosus scolopax</i>	181	4.236
<i>Epigonus denticulatus</i>	174	5.045
<i>Nezumia brevibarbata</i>	168	4.535
<i>Sphagemacrurus hirundo</i>	151	2.498
<i>Etmopterus princeps</i>	130	95.480
<i>Coelorinchus labiatus</i>	114	25.788
<i>Guttigadus globiceps</i>	99	1.735
<i>Hoplostethus atlanticus</i>	92	44.783
<i>Coryphaenoides striaturus</i>	85	16.976
<i>Antimora rostrata</i>	71	21.308
<i>Diastobranchus capensis</i>	63	32.000
<i>Halargyreus johnsonii</i>	55	31.216
<i>Coelorhynchus karrerae</i>	49	1.682
<i>Cyclothone</i> sp.	46	0.029
<i>Argyropelecus gigas</i>	38	0.527
<i>Conocara murrayi</i>	35	14.240
<i>Etmopterus brachyurus</i>	33	21.158
<i>Photichthys argenteus</i>	32	0.637
<i>Conocara fiolenti</i>	30	10.603
<i>Apristurus</i> sp.	28	26.685
<i>Lampanyctus</i> sp.	28	0.897
<i>Chauliodus sloani</i>	28	0.688
<i>Alepocephalus australis</i>	27	23.124
<i>Coelorinchus acanthiger</i>	26	2.626
<i>Bathysaurus ferox</i>	24	12.600
<i>Neocyttus rhomboidalis</i>	24	5.808
<i>Scopelogadus beanii</i>	18	0.300
<i>Promethichthys prometheus</i>	17	12.500
<i>Coelorinchus polli</i>	16	1.020
<i>Scopelogadus mizolepis bispinosus</i>	16	0.183
<i>Bathytroctes microlepis</i>	12	1.590
<i>Bathypterois filiferus</i>	12	1.127
<i>Diretmichthys parini</i>	11	6.392
<i>Aldrovandia affinis</i>	11	0.500
<i>Conger cinereus</i>	10	9.145
<i>Bathysaurus mollis</i>	10	0.804
<i>Ilyophys blachei</i>	9	4.292
<i>Synaphobranchus kaupii</i>	9	2.764
<i>Squalogadus modificatus</i>	9	2.708
<i>Acanthochaenus luetkenii</i>	8	0.182
<i>Lucigadus ori</i>	8	0.080
<i>Electrona risso</i>	8	0.068
<i>Sternoptyx pseudodiaphana</i>	7	0.063
<i>Poromitra megalops</i>	7	0.040
<i>Mesobius antipodum</i>	6	3.750
<i>Idiacanthus atlanticus</i>	6	0.052
<i>Cataetyx laticeps</i>	5	16.826
<i>Melanocetus johnsonii</i>	5	0.341

<i>Melanonus zugmayeri</i>	5	0.311
<i>Antigonia rubescens</i>	5	0.168
<i>Bathylagus antarcticus</i>	5	0.166
<i>Serrivomer beanii</i>	5	0.152
<i>Scopeloberyx robustus</i>	5	0.075
<i>Stomias boa boa</i>	5	0.070
<i>Sphoeroides pachygaster</i>	4	1.600
<i>Notacanthus sexspinis</i>	4	0.290
<i>Aldrovandia phalacra</i>	4	0.228
<i>Malacosteus niger</i>	4	0.061
<i>Lampaneda dea</i>	4	0.041
<i>Argyropelecus sladeni</i>	4	0.023
<i>Spectrunculus grandis</i>	3	28.450
<i>Hydrolagus affinis</i>	3	16.560
<i>Scymnodon squamulosus</i>	3	7.670
<i>Allocyttus guineensis</i>	3	1.836
<i>Trachyscorpia eschmayeri</i>	3	1.400
<i>Scombrobrax heterolepis</i>	3	0.410
<i>Ceratias</i> sp.	3	0.161
<i>Echiostoma barbatum</i>	3	0.138
<i>Leptoderma</i> sp.	3	0.070
<i>Emmelichthys nitidus nitidus</i>	3	0.052
<i>Eustomias trewavasae</i>	3	0.042
<i>Avocettina acuticeps</i>	3	0.034
<i>Ceratoscopelus warmingii</i>	3	0.014
<i>Apristurus manis</i>	2	3.150
<i>Coelorhynchus braueri</i>	2	0.434
<i>Gadella imberbis</i>	2	0.311
<i>Simenchelys parasitica</i>	2	0.280
<i>Anoplogaster cornuta</i>	2	0.116
<i>Malacocephalus laevis</i>	2	0.102
<i>Poromitra crassiceps</i>	2	0.090
<i>Melanostomias</i> sp.	2	0.080
<i>Howella sherborni</i>	2	0.033
<i>Eurypharynx pelecanoides</i>	2	0.020
<i>Paraliparis</i> sp.	2	0.017
<i>Hygophum</i> sp.	2	0.016
<i>Gonostoma bathyphilum</i>	2	0.014
<i>Argyropelecus aculeatus</i>	2	0.012
<i>Lestidium atlanticum</i>	2	0.007
<i>Kali macrura</i>	2	0.006
<i>Lamprogrammus shcherbachevi</i>	1	4.500
<i>Ruvettus pretiosus</i>	1	3.600
<i>Macruronus magellanicus</i>	1	2.184
<i>Aphanopus microphthalmus</i>	1	2.174
<i>Lepidion</i> sp.	1	1.657
<i>Etmopterus bigelowi</i>	1	0.880
<i>Narcetes stomias</i>	1	0.858
<i>Etmopterus pusillus</i>	1	0.660
<i>Beryx splendens</i>	1	0.598
<i>Ceratias holboelli</i>	1	0.277
<i>Omosudis lowii</i>	1	0.220
<i>Gnathophip capensis</i>	1	0.218
<i>Caristius groenlandicus</i>	1	0.152
<i>Gigantactis meadi</i>	1	0.146
<i>Macroparalepis affinis</i>	1	0.123
<i>Chaenophryne draco</i>	1	0.106
<i>Polyacanthonotus africanus</i>	1	0.092
<i>Porogadus milles</i>	1	0.077
<i>Talismania longifilis</i>	1	0.068

<i>Borostomias antarcticus</i>	1	0.060
<i>Platyroctes apus</i>	1	0.060
<i>Leptostomias</i> sp.	1	0.054
<i>Coccorella atlantica</i>	1	0.046
<i>Nemichthys curvirostris</i>	1	0.036
<i>Bathypterois phenax</i>	1	0.032
<i>Nealotus tripes</i>	1	0.032
<i>Diretmus argenteus</i>	1	0.029
<i>Melamphaes suborbitalis</i>	1	0.029
<i>Melamphaes simus</i>	1	0.021
<i>Porogadus</i> sp.	1	0.019
<i>Myctophum phengodes</i>	1	0.018
<i>Diplophos taenia</i>	1	0.016
<i>Linophryne</i> sp.	1	0.011
<i>Aldrovandia oleosa</i>	1	0.010
<i>Oreosoma atlanticum</i>	1	0.008
<i>Sternoptyx pseudobscura</i>	1	0.008
<i>Avocettina infans</i>	1	0.006
<i>Cryptopsaras couesii</i>	1	0.006
<i>Chiasmodon niger</i>	1	0.005
<i>Bonapartia pedaliota</i>	1	0.003
<i>Sternoptyx</i> sp.	1	0.003
<i>Symbolophorus boops</i>	1	0.002

Crustaceans	Number	Weight (kg)
<i>Austropenaeus nitidus</i>	534	5.051
<i>Chaceon</i> spp.	515	116.764
<i>Nematocarcinus longirostris</i>	435	4.536
<i>Acanthephyra eximia</i>	414	7.973
<i>Acanthephyra acanthitelsonis</i>	145	0.844
<i>Nematocarcinus ensifer</i>	126	0.663
<i>Acanthephyra</i> sp.	67	0.410
<i>Gordonella kensleyi</i>	39	0.502
<i>Notostomus gibbosus</i>	33	0.368
<i>Aristaeopsis edwardsiana</i>	19	0.190
<i>Polycheles</i> sp.	18	0.293
<i>Sergestes atlanticus</i>	8	0.017
<i>Neognathophausia ingens</i>	7	0.065
<i>Notostomus</i> sp.	7	0.036
<i>Funchalia woodwardi</i>	6	0.049
<i>Glyphocrangon longirostris</i>	6	0.045
<i>Nematocarcinus exilis</i>	5	0.010
<i>Gnathophausia zoea</i>	5	0.006
<i>Oplophorus</i> sp.	5	0.004
<i>Pasiphaea</i> sp.	4	0.062
<i>Heterocarpus grimaldii</i>	4	0.045
<i>Notostomus auriculatus</i>	3	0.033
<i>Paromola</i> sp.	2	1.530
<i>Sergestes nudus</i>	2	0.001
<i>Pasiphaea semispinosa</i>	1	0.003
<i>Systellaspis cristata</i>	1	0.003
<i>Pontophilus gracilis</i>	1	0.001

Cephalopods	Number	Weight (kg)
<i>Histioteuthis</i> sp.	9	0.408
Cranchiidae	6	0.103
<i>Chroteuthis</i> sp.	3	0.023
<i>Todarodes sagittatus</i>	2	7.240
<i>Mastigoteuthis</i> sp.	2	0.181
<i>Octopoteuthis</i> sp.	2	0.122
Amphitretidae	1	9.300
<i>Moroteuthis robsoni</i>	1	2.410
<i>Ommastrephes bartramii</i>	1	2.100
<i>Tremoctopus</i> sp.	1	0.110
<i>Teuthowenia</i> sp.	1	0.050
<i>Lycoteuthis</i> sp.	1	0.049
Cirroteuthidae	1	0.010
<i>Megalocranchia</i> sp.	1	0.010
<i>Galiteuthis</i> sp.	1	0.005

ANNEX IV  
**HYDROGRAPHY**



## HIDROGRAFÍA DEL ÁREA DE ESTUDIO DE LA CAMPAÑA NAMIBIA-0802

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### Introducción

Teniendo en cuenta el objetivo principal de la campaña (detección de bio-construcciones) y la amplia zona de estudio, los trabajos de toma de muestras de datos hidrográficos se planificaron sobre zonas muy concretas de las principales montañas submarinas, siguiendo un sistema de radiales en aspa de estaciones hidrográficas sobre las mismas.

En el presente documento se presentan los resultados preliminares de los estudios relacionados con la hidrografía de la zona y aquellos aspectos más relevantes observados en los mismos.

### Material y métodos

Para la obtención de datos se utilizó una batisonda *CTD* modelo *Sea-Bird 25*, que permitió realizar medidas de las propiedades físico-químicas de la columna de agua como temperatura, salinidad, fluorescencia, oxígeno, densidad y presión. La profundidad máxima a la que se puede utilizar este equipo es de 6800 metros, sin embargo, la profundidad máxima a la que se largó el *CTD* fue 1700 metros y la mínima 200 metros.

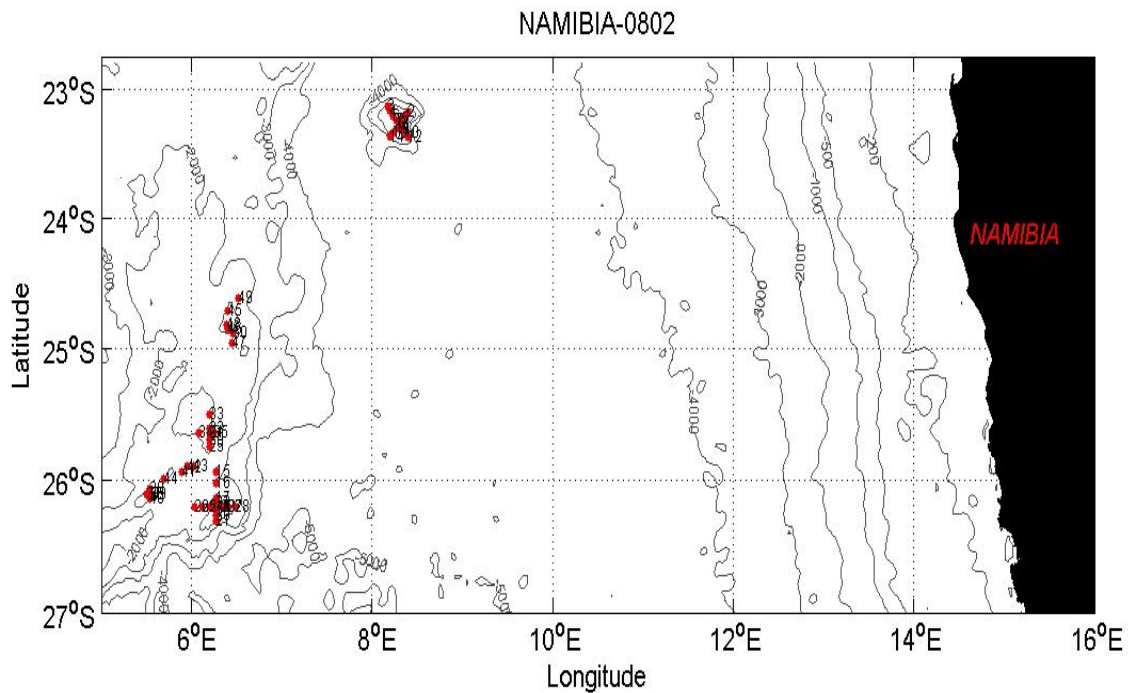
Se realizaron un total de 50 estaciones de *CTD* cuya distribución geográfica por zonas y transectos se muestra en la figuras 1, 2 y 3. Se dividió el área de estudio en dos zonas: montaña submarina de Edwin y montañas submarinas del Banco de Valdivia, sobre las que situaron los transectos o radiales.

El estudio hidrográfico se realizó siguiendo transectos perpendiculares sobre cada monte submarino, con una rejilla (*grid*) regular de 2' x 2' en las zonas menos profundas, aumentando la distancia entre estas al aumentar la profundidad.

Las diferentes estaciones hidrográficas se agruparon en los siguientes transectos:

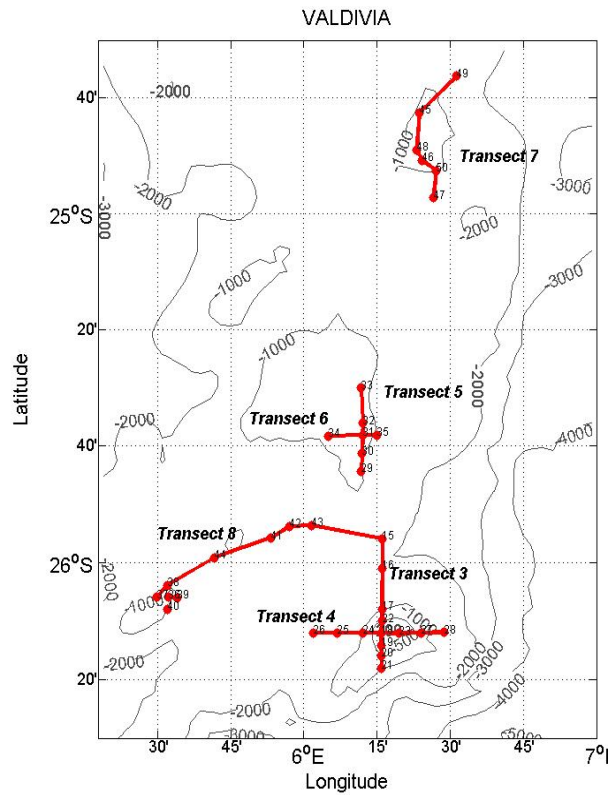
- 1: estaciones nº 14, 13, 11, 8, 5, 1, y 2; zona de Ewing.
- 2: estaciones nº 3, 4, 6, 7, 8, 9, 10, y 12; zona de Ewing.
- 3: estaciones nº 15, 16, 17, 22, 18, 19, 20, y 21; zona del Banco de Valdivia Sureste.
- 4: estaciones nº 26, 25, 24, 18, 23, 27, y 28; zona del Banco de Valdivia Sureste.
- 5: estaciones nº 33, 32, 31, 30, y 29; zona del Banco de Valdivia Centro.
- 6: estaciones nº 34, 31, y 35; zona del Banco de Valdivia Centro.
- 7: estaciones nº 49, 45, 48, 46, 50, y 47; zona del Banco de Valdivia Norte.
- 8: estaciones nº 37, 38, 44, 41, 42, 43 y 15; zona del Banco de Valdivia Oeste.

Algunas de las estaciones hidrográficas que se realizaron no estaban previstas inicialmente y se realizaron al final de cada lance de pesca, ante la imposibilidad de cubrir esas nuevas zonas con el protocolo establecido en el plan de campaña.

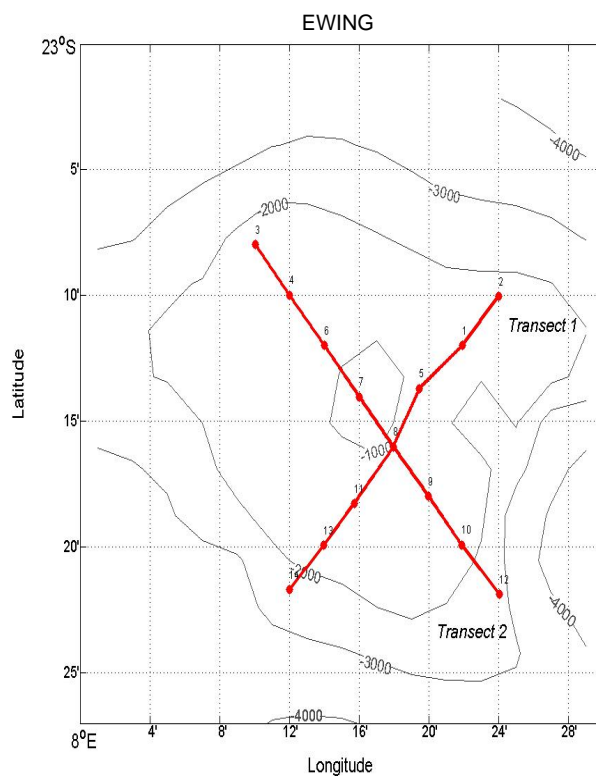


**Figura 1.** Localización de las estaciones hidrográficas en la zona de estudio / **Location of the hydrographic stations in the zone of study**





**Figura 2.** Transectos realizados en el Banco de Valdivia / **Transects considered in the Valdivia Bank.**



**Figura 3.** Transectos realizados en la montaña submarina de Ewing / **Transects considered in the Ewing seamount.**

Para el procesamiento de los datos hidrográficos se ha utilizado el software de la propia casa *Seabird*, con él que se ha realizado el filtrado e interpolado de los datos. A continuación se utilizó el programa informático *MATLAB* para realizar los cálculos numéricos necesarios para obtener y representar las variables oceanográficas en dos y tres dimensiones.

Obtenidos los ficheros correspondientes para cada estación, con los perfiles de bajada y subida del *CTD*, ficheros originales en código binario con extensión *.hex*; se transformaron en variables físicas en formato *.cnv* para aplicar a continuación una serie de filtros que permitieron calcular la desviación estándar, suavizado de variables (presión), alineación de datos de conductividad y oxígeno disuelto con los de temperatura, así como, corregir errores de  $T^a$  propios del equipo asociados a su inercia térmica, calcular las variables derivadas (densidad, salinidad,  $T^a$  potencial...), etc.

Posteriormente se examinaron cada uno de los ficheros, se eliminaron los registros correspondientes a los tiempos de atemperamiento del *CTD* y se convirtió cada perfil a formato *MatLab*, obteniéndose ficheros con extensión *.mat*. Los pasos sucesivos del procesamiento de datos se realizaron directamente sobre estos ficheros, excepto errores puntuales de formato en las cabeceras que se corrigieron directamente sobre ficheros *.hex* y *.cnv*.

Cada una de las variables oceanográficas (temperatura potencial, salinidad, fluorescencia, oxígeno, etc) de los perfiles hidrográficos realizados durante la campaña fueron graficados frente a la presión para así conocer la estructura vertical de cada estación; esto ha permitido comparar las propiedades hidrográficas de las distintas estaciones y zonas de estudio.

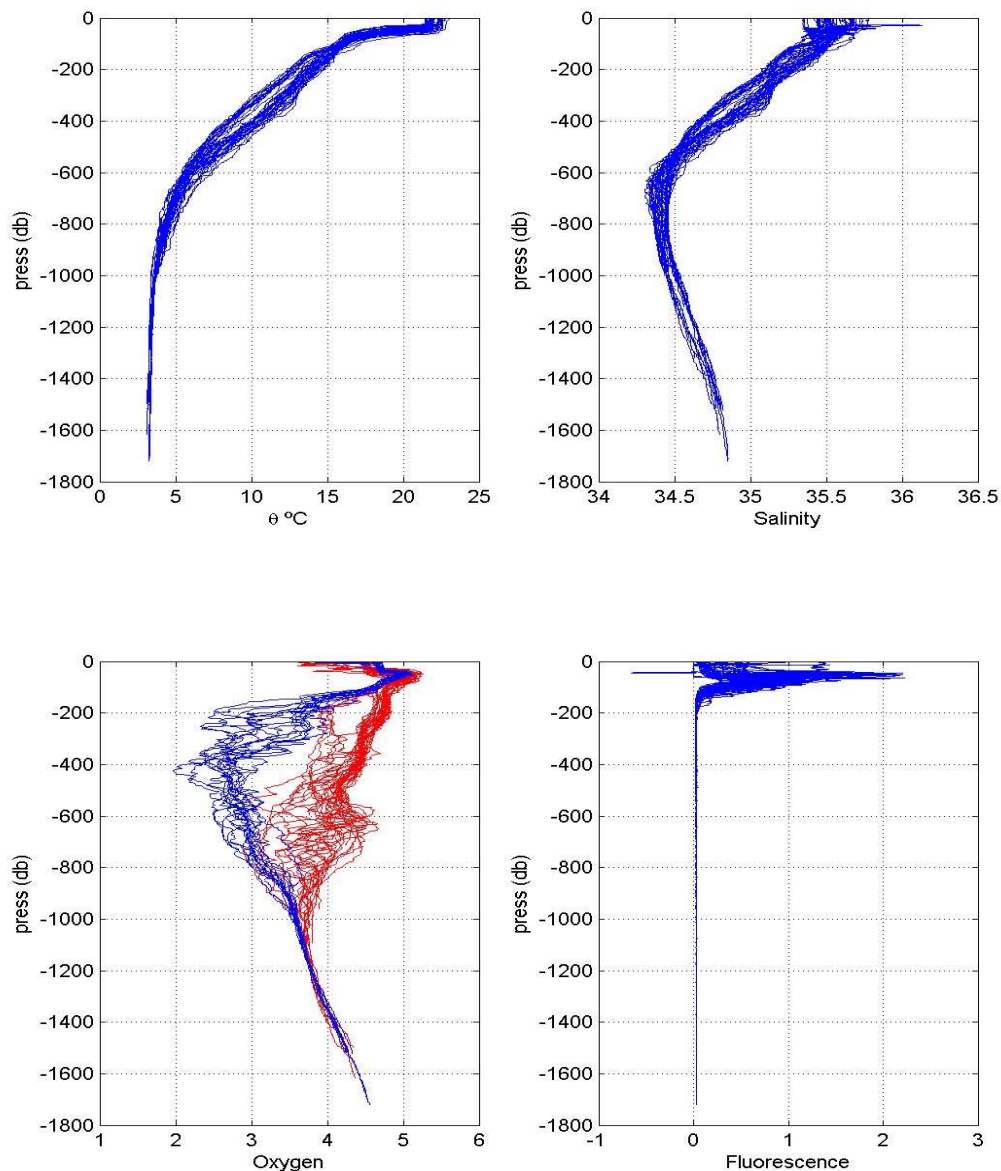
## Resultados

Cada uno de estos perfiles que se representan a continuación, corresponde al total de las 50 estaciones permite observar los resultados de manera conjunta y poder establecer similitudes y diferencias entre éstas o grupos de las mismas. Esto ha permitido apreciar que el comportamiento de los perfiles es similar para las variables de temperatura, salinidad y fluorescencia, no siendo así en el caso del oxígeno disuelto como se puede observar en la figura 4.

Asimismo, se puede observar en las gráficas de la temperatura y salinidad (figura 4), que en los primeros 60db de la columna de agua aparece una capa de mezcla claramente diferenciada. Es frecuente existencia una capa superficial de temperatura más elevada y relativamente uniforme, al igual que ocurre en los valores de salinidad.

La temperatura alcanza valores entre 23 °C y 21.5 °C en las aguas de mezcla superficiales. Por debajo inicia un acusado descenso hasta los 90 db de presión y alcanza los 16 °C . Continúa con un descenso más lento hasta llegar a los 1000 db y se sitúa entre los 4 °C y 5 °C . Por último, y hasta alcanzar la presión máxima de 1700 db, toma valores mas uniformes y relativamente mas bajos hasta alcanzar lo valores mínimos de 3.2 °C y 3.5°C en aguas profundas.

La salinidad alcanza sus valores máximos en la capa de mezcla superficial con valores comprendidos entre 35.3 y 35.7. Luego inicia un descenso hasta los 690db de presión, donde alcanza los valores mínimos de 34.3. A partir de aquí comienza un ligero ascenso hasta llegar a los 1700 db y alcanzar el valor de 34.85.



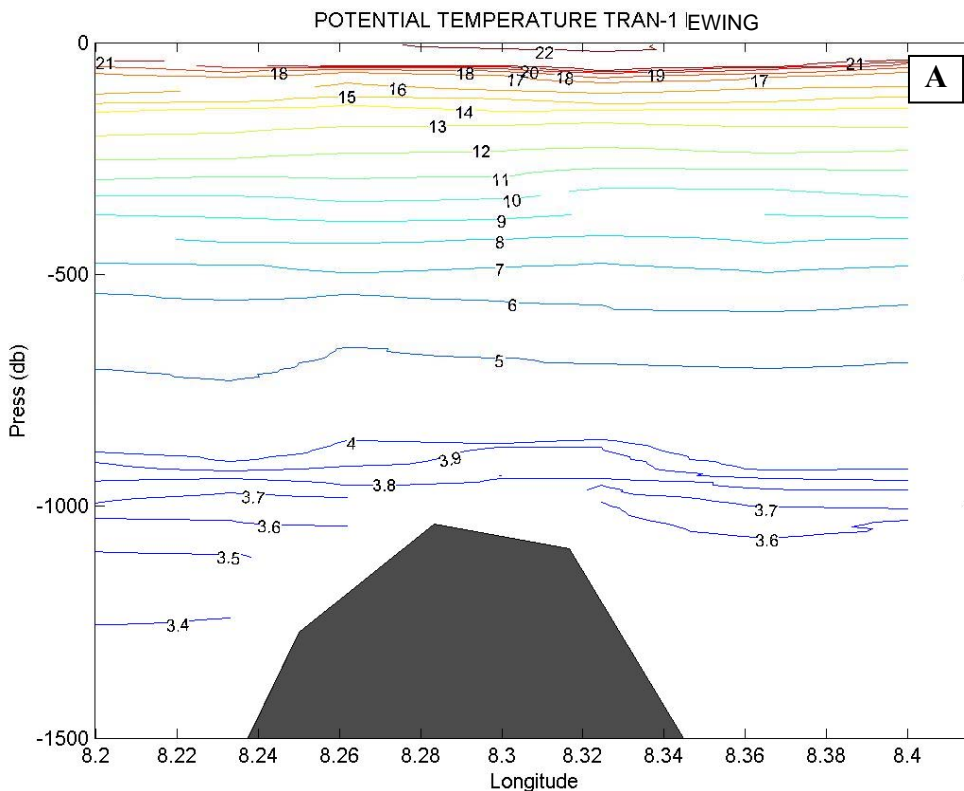
**Figura 4.** Perfiles hidrográficos de las distintas variables frente a la presión para el total de las estaciones / **Hydrographic profiles of the different variables by pressure for all the stations**

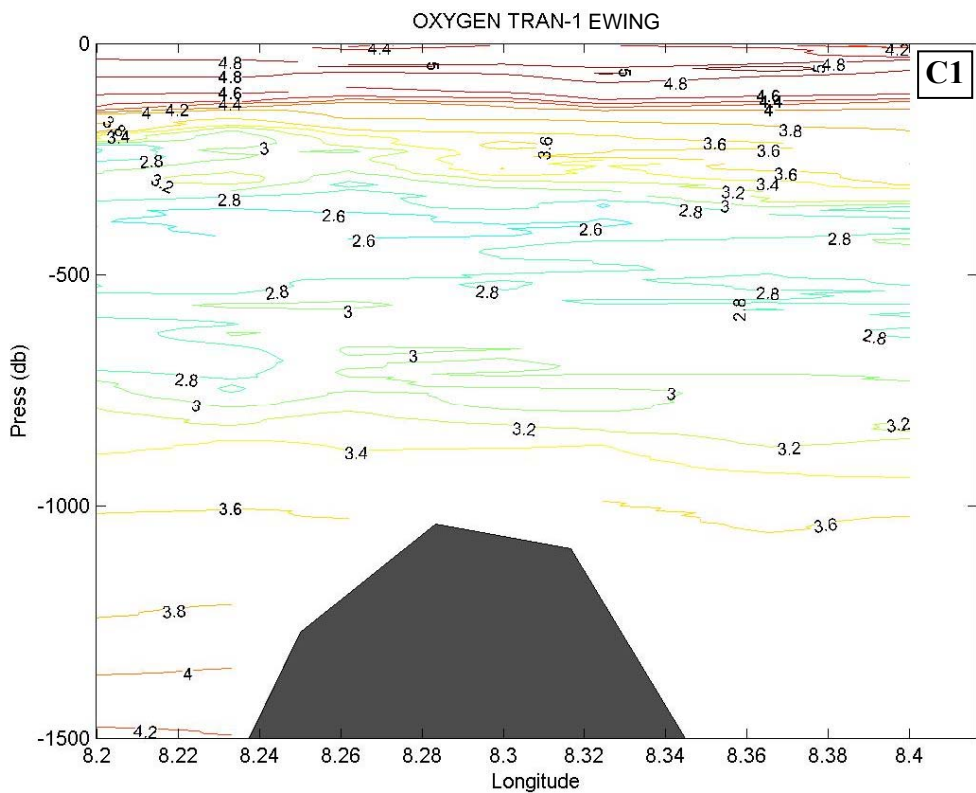
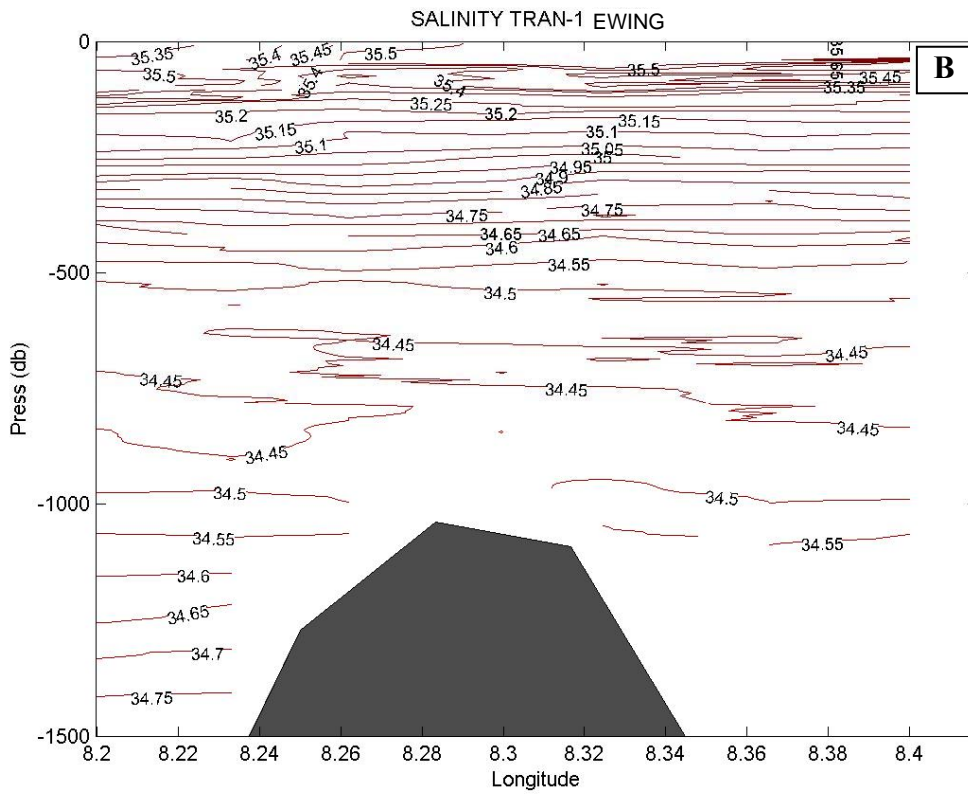
La fluorescencia tiene una distribución apreciable hasta los 100-150 db de presión. En superficie los valores de fluorescencia son bastante oscilantes entre 0.05 y 0.8, alcanzando incluso valores próximos a 1. Sus valores máximos (2.2) se localizan entre los 45 y 65 db. A partir de este punto, inicia un descenso alcanzando su valor mínimo (0.03) entre las presiones de 100-150 db, que se mantiene casi constante en el resto de la columna de agua.

En la representación de la concentración de oxígeno disuelto se puede observar que en los primeros 50 db aparecen valores relativamente bajos, debido posiblemente a una alta producción primaria. Por debajo, en los 100 db de presión aproximadamente, alcanza su máximo valor (5.2 ml/l). A continuación inicia un nuevo y ligero descenso hasta los 200db en que alcanza valores entre 4 y 4.5 ml/l. A partir de ahí, se observan dos curvas diferentes en función de la presión. Si se representan los valores que alcanzan los datos de concentración de oxígeno obtenidos en las estaciones de Ewing (en color azul), y por otro, los valores de concentración de oxígeno obtenidos en la estaciones del Banco de Valdivia (representados en color rojo), se observa entre ambos conjuntos que existe una clara diferencia en su recorrido. Los valores de la montaña submarina de Ewing son claramente inferiores a los obtenidos en el Banco de Valdivia; en Ewing se alcanzan valores mínimos de 2 ml/l en 400db, mientras en el Banco de Valdivia se alcanza el valor mínimo (3 ml/l) a mayor profundidad (750 db). Llegados los 1000 db, ambos grupos se unen nuevamente con valores en el rango 3.7-3.8 ml/l, para iniciar un ligero ascenso conjunto de la concentración de oxígeno hasta alcanzar los 4.55 ml/l en los 1700 db.

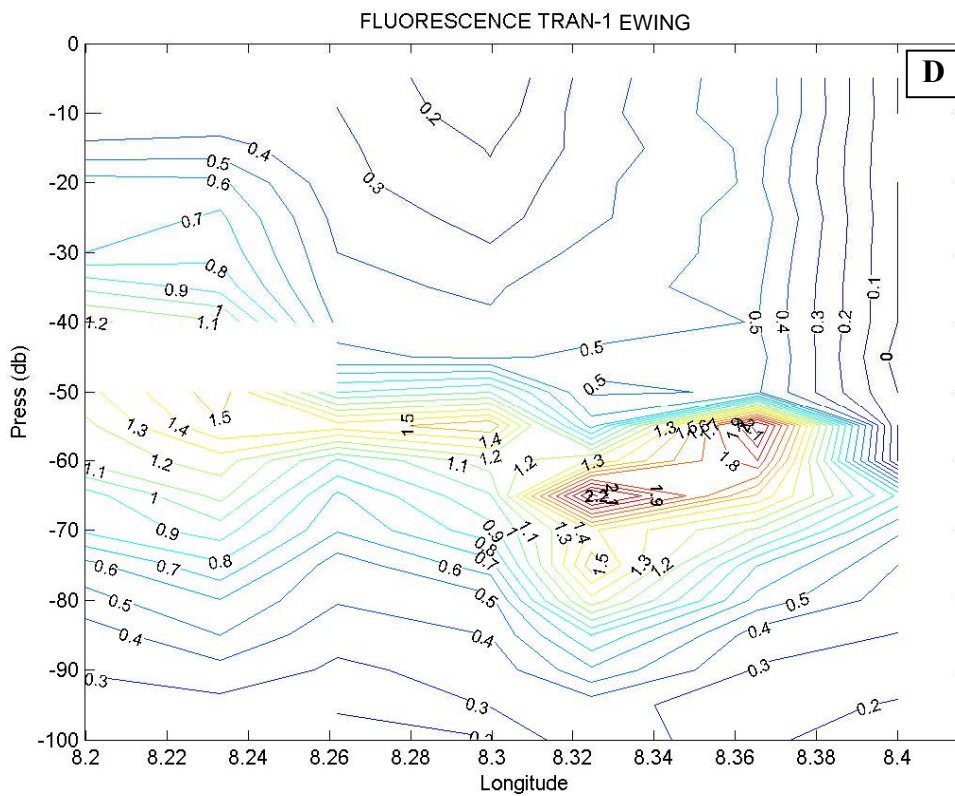
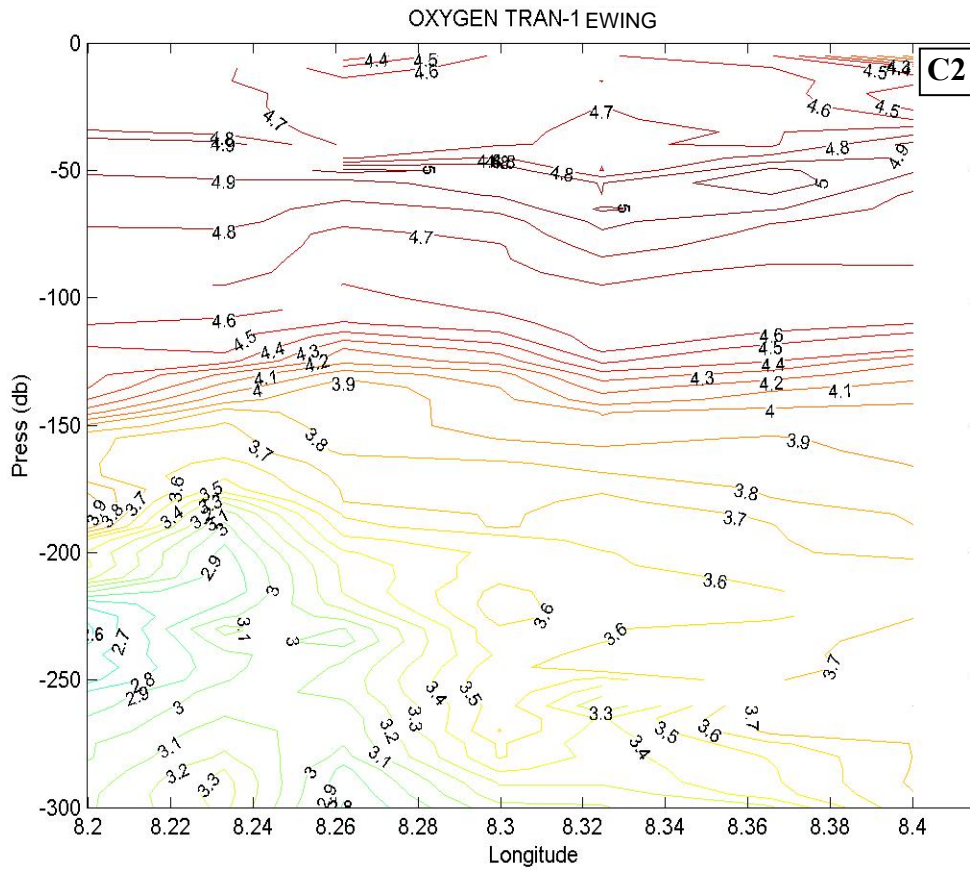
Para cada transecto se realizaron contornos verticales de cada una de las variables físico-químicas hasta la máxima profundidad registrada, excepto para la fluorescencia, que sólo fue representada hasta los 100-200 metros. En las figuras 5 y 6, se presentan los contornos de las interpolaciones verticales del transecto 1 (Ewing) y el transecto 4 (Banco de Valdivia Sureste), con los datos de temperatura potencial (A), salinidad (B), oxígeno (C), fluorescencia (D) y densidad (E)).

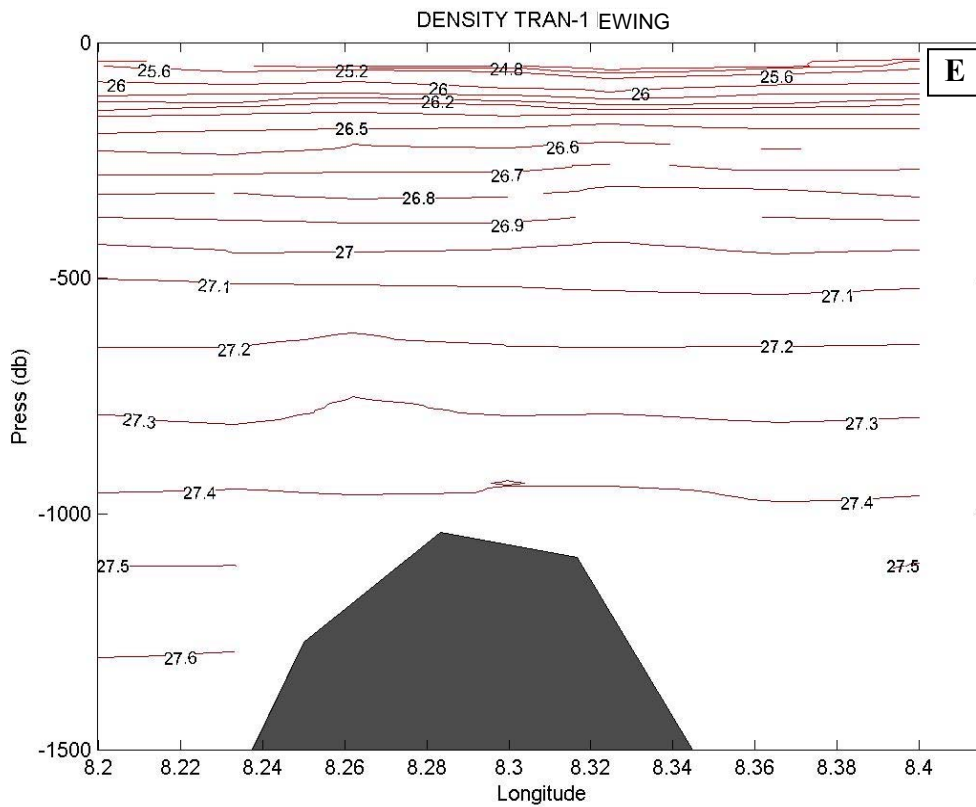
**SERIE DE CONTORNOS DEL TRANSECTO 1 / CONTOURS SERIES OF TRANSECT 1**





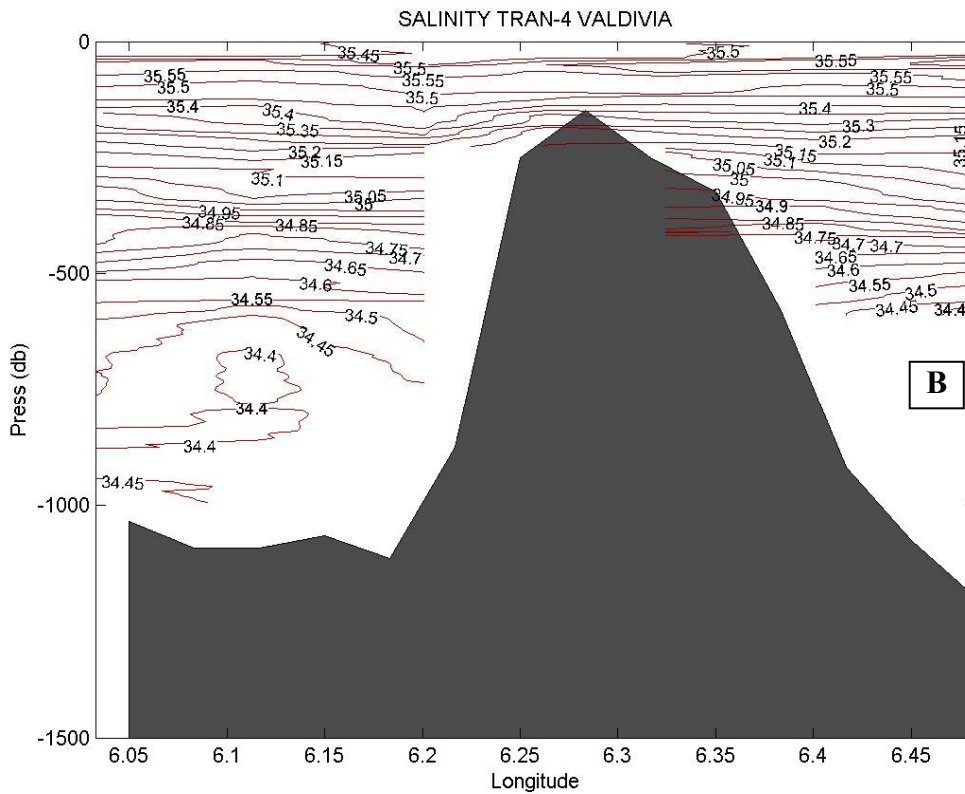
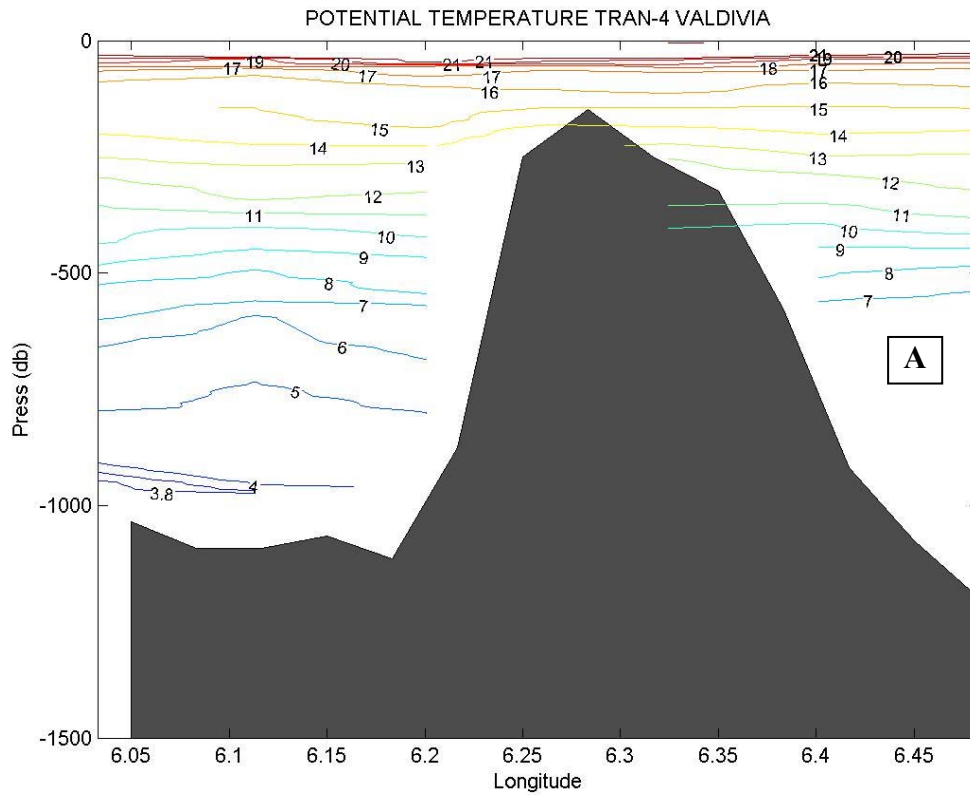




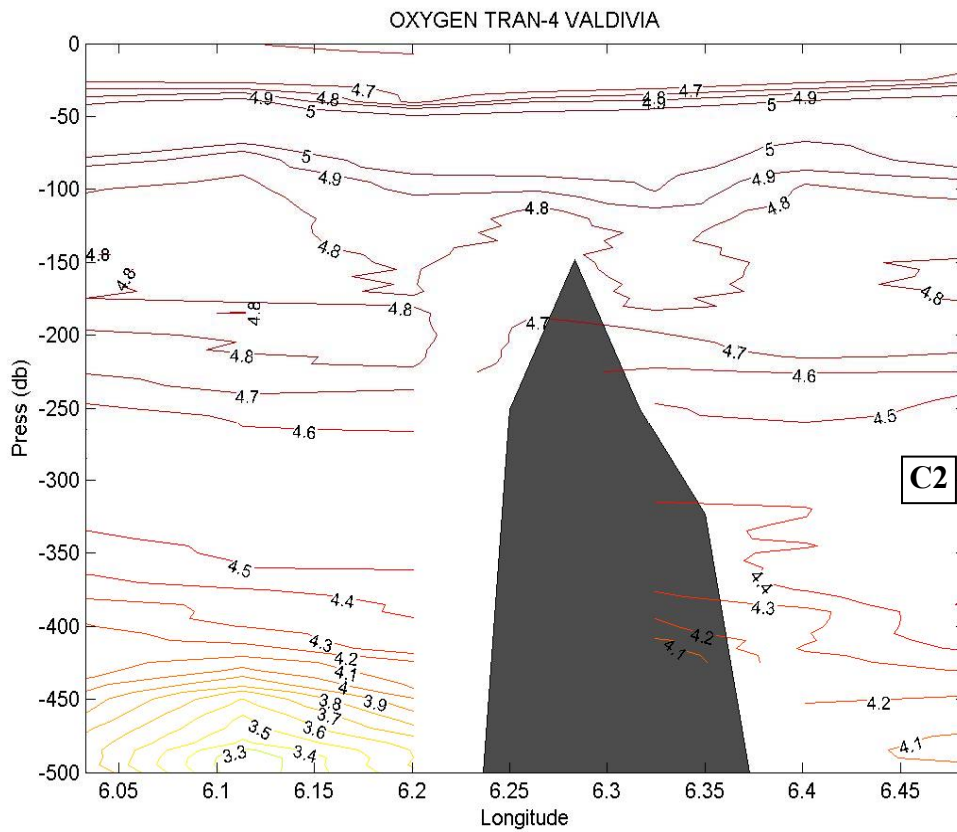
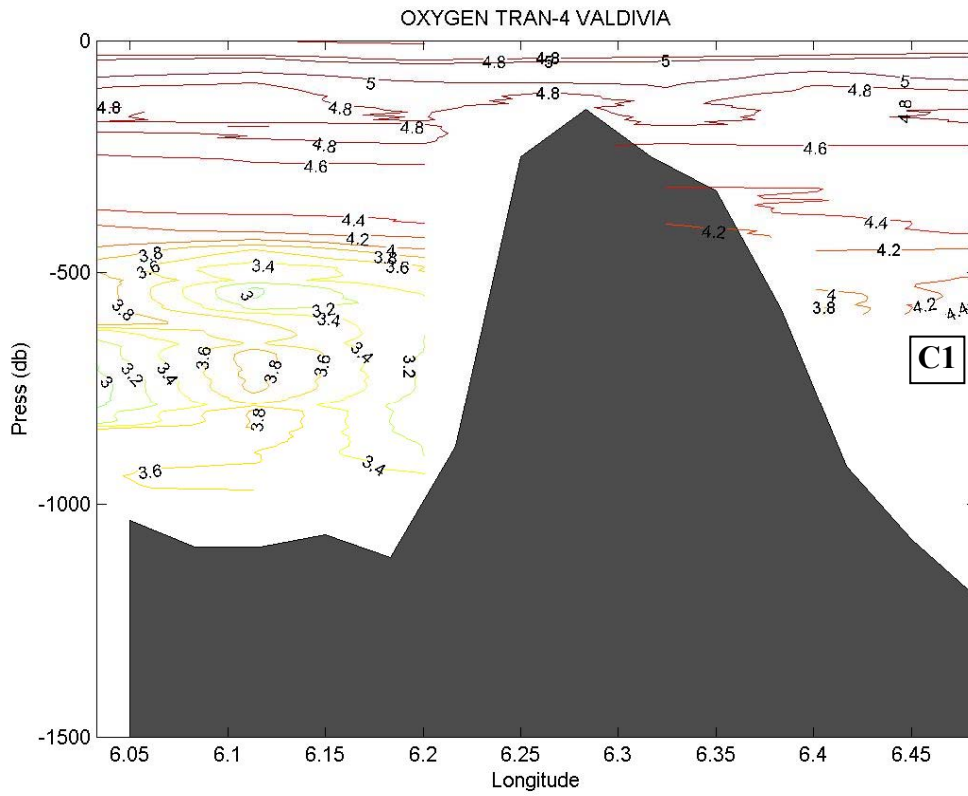


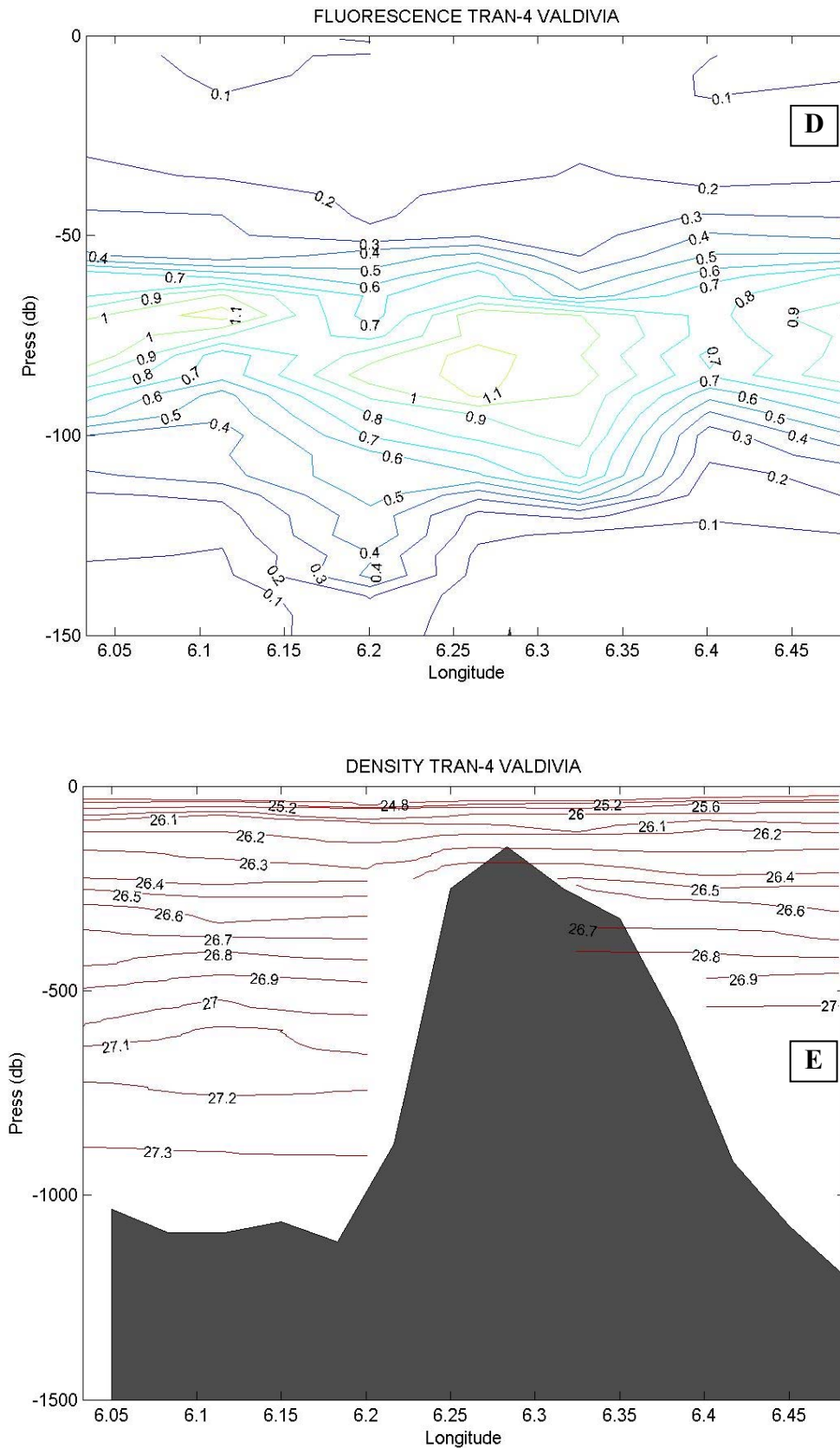
**Figura 5.** Contornos verticales del transecto 1 (Ewing) de la temperatura potencial (A), salinidad (B), oxígeno (C), fluorescencia (D) y densidad (E). En C2 se representa la distribución del oxígeno en las capas superiores a 300 db / **Vertical contours of transect 1 (Ewing) of potential temperature (A), salinity (B), oxygen (C), fluorescence (D) and density (E).** Oxygen distribution up to layer of 300 db is presented in C2.

**SERIE DE CONTORNOS DEL TRANSECTO 4 / CONTOURS SERIES OF  
TRANSECT 4**









**Figura 6.** Contornos verticales del transecto 4 (Banco de Valdivia) de la temperatura potencial (A), salinidad (B), oxígeno (C), fluorescencia (D) y densidad (E). En C2 se representa la distribución del oxígeno en las capas superiores a 500 db / **Vertical contours of transect 4 (Valdivia Bank) of potential temperature (A), salinity (B), oxygen (C), fluorescence (D) and density (E). Oxygen distribution up to layer of 500 db is presented in C2.**

A partir de los contornos de densidad de las montañas submarinas del Banco de Valdivia y Edwin, se aprecia, como estos montes submarinos suponen obstáculos al paso de las corrientes marinas y producen alteraciones en la corriente principal, pudiendo generar corrientes locales.

La corriente incidente en el monte es dispersada a ambos lados del monte submarino en toda la columna de agua, incluso en superficie, aunque el monte no alcance las capas superficiales. Este fenómeno es conocido como Columna de Taylor o Cono de Taylor. En el centro del monte submarino se produce por tanto, una zona de “calma”, es decir, de ausencia de corrientes, que propicia la concentración de producción primaria y el enriquecimiento de las aguas superficiales, que en ausencia de monte submarino tendría propiedades de aguas oceánicas inicialmente “oligotróficas”. Estas zonas, se convierten por tanto, en pequeños “oasis” de vida respecto a zonas circundantes, que suelen mantener una biomasa y diversidad mucho más bajas.

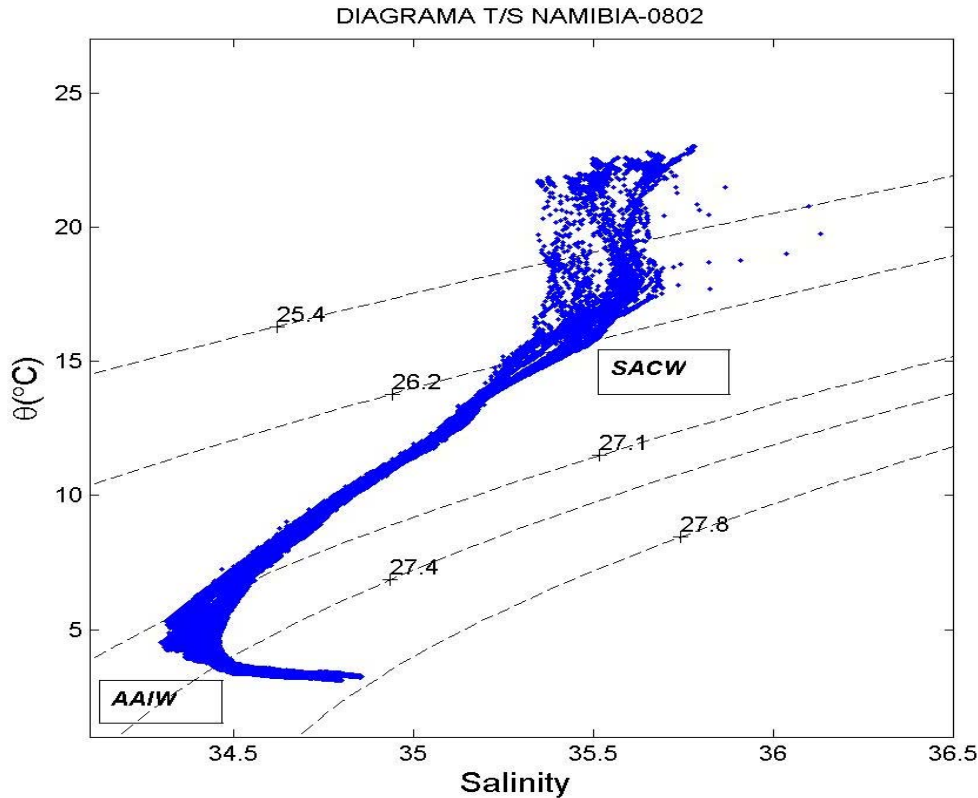
Además, ocasionalmente, alrededor de estas estructuras se pueden localizar flujos verticales que originan afloramientos de aguas profundas más densas y ricas en nutrientes (afloramiento/upwelling), enriqueciendo aún más la zona fótica próxima a los montes. Estos desplazamientos verticales son ocasionados por remolinos mesoescalares asociadas a estos montes de tipo ciclónico, que en el hemisferio sur giran en el sentido horario. Observando las inclinaciones de las isopícnas en los contornos de densidad iniciales, podemos deducir la existencia de remolinos ciclónicos alrededor de las montañas.

En los contornos de oxígeno disuelto, sobre todo en la representación de concentración de oxígeno hasta los 300 db de profundidad en la zona de Edwin y 500db en la de Valdivia, se observan ciertas anomalías porque aparecen unos valores muy bajos en los primeros 50db de la capa fótica, debido posiblemente a una alta producción primaria.

Entre 60 y 80 db la fluorescencia llega a 1.1 y la concentración de oxígeno es de 5 ml/l entre 50 y 100 db en el Banco de Valdivia. En Edwin, el comportamiento es similar salvo que los valores de fluorescencia llegan a 2.2 y en un rango de presión más amplio (40 - 80 db). La concentración de oxígeno es igual a la del Banco de Valdivia, con valores de 5 ml/l entre 50 y 100 db.

Para cada transecto se realizaron diagramas T/S, temperatura potencial frente a salinidad, lo que permitió identificar las diferentes masas de agua predominantes de la zona de estudio (figura 7).

Este diagrama corresponde a todos los perfiles del total de las estaciones, y permite apreciar que el comportamiento es similar en todas y cada una de las estaciones hidrográficas que han sido representadas.



**Figura 7.** Diagramas  $\theta$ /S, temperatura potencial frente a salinidad /  $\theta$ /S diagram, potential temperature by salinity.

En aguas sub-superficiales hasta 120 db de presión y valor de densidad  $26.2 \text{ kg m}^{-3}$ , se encuentra una capa de agua con una gran dispersión de valores de salinidad y temperatura, influenciada por los procesos o fenómenos de evaporación-precipitación.

Por debajo y entre los valores de densidad de  $26.2$  y  $27.1 \text{ kg m}^{-3}$ , que equivalen a 120 y 590 db de presión respectivamente, se observa una masa de agua que se corresponde a la SACW (South Atlantic Central Water), en la que los datos de temperatura y salinidad se comportan de manera lineal con la presión.

A continuación, por debajo de esta densidad y hasta aproximadamente  $27.8 \text{ kg m}^{-3}$ , los 1700 db, se localiza la AAIW (Antarctic Atlantic Intermediate Water), caracterizada por presentar los valores mínimos de salinidad y temperatura. Esta masa de agua, generada en el Océano Austral, viaja hacia el norte y en su camino se va hundiendo por variaciones en su densidad. En la latitud de estudio ( $23^{\circ}$ - $26^{\circ}$  Sur) se localiza a una presión media de entre 590 y 1700 db.

ANNEX V

**SEABIRD AND CETACEAN OBSERVATIONS**



## **Seabird Inventory and Cetacean Observations Namibia – 0802**

*Pete Bartlett\** (Observations)  
*Jessica Kemper\** (Report)

\*Lüderitz Marine Research Centre – Namibia

### **Aims:**

To make an inventory of seabirds and marine mammals present in the survey area.

To analyze the patterns of distributions and abundance in relation to oceanographic features and known fish distribution.

### **Methods:**

Counts of seabirds were made during daylight hours, usually from 08h00 to 20h00 local time. When possible, standard “10-minute-counts” of the birds seen around the vessel were done while the vessel was cruising. During each count period, all individuals of each noted species were counted. Birds seen actively following the vessel (within an arc of 60° aft) were recorded separately from birds flying elsewhere around the vessel, sitting on the water or feeding. During the standard counts, scans (using binoculars) were made at least once every 2 min to detect inconspicuous species. Care was taken to count individual birds only once.

Additional, incidental, observations were made between counts, when unusual species were observed and while the vessel was on station or trawling. Observations of marine mammals (Cape fur seals, whales and dolphins) and turtles were recorded following the same format.

The time and duration of each observation and count was recorded with a watch which was adjusted to the vessel’s electronic log watch, in order to match the bird data with the data recorded by the electronic log (position, speed, depth, heading, sea temperature etc.).

## Results:

A total of 319 standard “10-minute counts” were done between 3 February and 1 March 2008. Of these, 233 counts were effected while the vessel was cruising, 16 during CTD stations and 70 during trawl operations. And additional 134 incidental observations were recorded. The summary of the bird species and numbers identified during all 453 observation periods is given in Table 1.

In general, bird abundance and densities (in terms of species as well as individuals) were poor. Abundance and densities were highest close to Walvis Bay. No major feeding frenzies were observed, except for one large group of terns (*Sterna sp.*) feeding together with two large groups of seals near Pelican Point. No more than seven individuals of up to three species were seen at the Valdivia Bank at any time and no more than ten individuals of up to three species were noted at the Ewing Seamount. The most commonly seen seabirds were White-chinned Petrels (mostly following the vessel), Cory’s Shearwaters and Leach’s Storm Petrels.

Of notable interest are several sightings of the endangered Spectacled Petrel. This species only breeds at Inaccessible Island, Tristan da Cunha group, with an estimated breeding population of 3000 – 4000 pairs. This species is relatively scarce in southern African waters. A surprise visitor, a Warbler (*cf. Acrocephalus sp.*) rested on deck, intermittently feeding on insects on the trawl nets on 9 February at 26°09’S, 06°15’E.

Few marine mammals were seen during the entire survey. By far the most common species, the Cape Fur Seal *Arctocephalus pusillus pusillus* was observed in small to large groups of up to 300 individuals on 14 and 15 February, feeding close to shore (in the vicinity of 22°56’S, 14°09’E). No seals were observed further offshore.

Other sightings included two large unidentified whales at 23°47’S, 12°07’E, one large whale, possibly a Humpbacked Whale (*Megaptera novaeangliae*) at 23°49’S, 12°03’E, one large unidentified whale at 23°55’S, 11°52’E and one (Grey?) dolphin at 24°11’S, 11°16’E; all three sightings were noted on 13 February. Two unidentified whales were seen at 23°03’S, 11°56’E on 1 March. One unidentified, medium-sized turtle (carapace length c. 50cm) was seen on 25 February at 24°49’S 06°25’E.

The relative abundance and distribution of seabirds along surveyed areas need to be further analyzed, as well as the link between seabird distribution with oceanographic features and prey distribution.

## Conservation concern:

Some pollution was recorded during the survey. This included floating buoys, mesh netting, ropes, plastic bottles and boxes, a 200 litre plastic drum and surgical gloves. All items were recorded offshore (between longitudes 06°01’E and 08°26’E).

Of particular conservation concern are ropes and netting, which can cause the entanglement and subsequent drowning or starvation of marine mammals and turtles. Ingestion of foreign matter, particularly plastics and rubber is known to result in mortalities. Surgical gloves and plastic bottles resemble prey (e.g. jellyfish) and could be ingested by a range of seabirds (and potentially subsequently fed to chicks) as well as turtles. The extent of plastic pollution and its effect on seabird populations is



monitored at a number of seabird breeding colonies worldwide. However, data on the extent (and distribution) of pollution at sea are lacking; this should be routinely monitored during seabird-, marine mammal- or turtle surveys at sea.

**Table 1:** Seabird species and numbers of individuals identified during the 10 minute observation periods and in total (including incidental sightings).

<b>Species</b>	<b>Common name</b>	<b>10-min count</b>	<b>total count</b>
<i>Diomedea chlororhynchos</i>	Yellow-nosed Albatross (adult)	13	19
<i>Diomedea chlororhynchos</i>	Yellow-nosed Albatross (immature)	20	21
<i>Diomedea cauta</i>	Shy Albatross	9	12
<i>Diomedea melanophris</i>	Black-browed Albatross	1	3
<i>Diomedea sp.</i>	Yellow-nosed or Black-browed Albatross	3	7
<i>Morus capensis</i>	Cape Gannet (adult)	2	2
<i>Morus capensis</i>	Cape Gannet (immature)	0	2
<i>Puffinus puffinus</i>	Manx Shearwater	0	1
<i>Calonectris diomedea</i>	Cory's Shearwater	74	125
<i>Puffinus griseus</i>	Sooty Shearwater	10	19
<i>Puffinus sp. 1</i>	Shearwater (med. dark)	24	24
<i>Puffinus sp. 2</i>	Shearwater (all dark)	0	3
<i>Procellaria aequinoctialis</i>	White-chinned Petrel	150	176
<i>Procellaria conspicillata</i>	Spectacled Petrel	21	30
<i>Catharacta antarctica</i>	Sub-antarctic Skua	5	5
<i>Stercorarius pomarinus</i>	Pomarine Skua	19	21
<i>Stercorarius parasiticus</i>	Arctic Skua	14	16
<i>Stercorarius longicaudus</i>	Long-tailed Skua	0	1
<i>Oceanites oceanicus</i>	Wilson's Storm-Petrel	1	3
<i>Oceanites leucorhoa</i>	Leach's Storm-Petrel	56	84
<i>Oceanites sp.</i>	Storm Petrel (dark with white rump)	30	42
<i>Phalaropus sp.</i>	Phalarope	2	2
<i>Sterna sp.</i>	Terns (mixed; Arctic? Common?)	135	135
<i>Larus dominicanus vetula</i>	Kelp Gull	6	6