IDENTIFICATION OF CEPHALOPODS

IN SWEDISH WATERS

VIDAR ØRESLAND
KENNET LUNDIN & GERT OXBY

This is the first photo-illustrated identification guide for the 13 most common cephalopods in the Skagerrak, Kattegat, the Sound and southwestern Baltic Sea. We provide short concise species descriptions in combination with 75 full images and detailed images of species-specific characteristics as well as photos of an eye tumour that causes blindness. The guide is aimed at people with an interest in marine life, fishing, scuba diving, as well as researchers and those who participate in government and Citizen Science monitoring programs of living marine resources.

Publikations from Divers and Scientists West Coast Sweden

Øresland, V., Ulmestrand, M., Agnalt, A.-L., Oxby, G. (2017). Recorded captures of American lobster *(Homarus americanus)* in Swedish waters and an observation of predation on the European lobster (Homarus gammarus). Can. J. Fish. Aquat. Sci. 74: 1503-1506

Øresland, V., Oxby, G., Oxby, F. (2018). A comparison of catches of European lobster *(Homarus gammarus)* in a lobster reserve using traditional pots and scuba diving technique. Crustaceana 91: 1425-1432

Øresland, V. (2019). The polychaete Histriobdella homari and major groups of epibionts on the European lobster *(Homarus gammarus)* and other decapods. Crustaceana 92: 189-203

Øresland, V., Oxby G., Oxby F. (2020). Abundance and size of European lobsters *(Homarus gammarus)* and brown crabs *(Cancer pagurus)* inside and outside the Kåvra lobster reserve (west coast of Sweden). Crustaceana 93 (2) 157-169

Øresland, V. & Oxby, G. (2021). A photo-illustrated dissection guide for bobtail squids. Divers and Scientists West Coast Sweden, Guide No. 1., 122 pp

Øresland, V. & Oxby, G. (2022). A 3D modelling guide for small animals using photographs. Divers and Scientists West Coast Sweden. Guide No. 2., 70 pp

Øresland, V & Oxby, G, (2023). Divers and Scientists´ Nikon D500 camera and photography guide. Divers and Scientists West Coast Sweden. Guide No. 3., 33 pp.

Øresland, V., Lundin, K. & Oxby, G, (2024). Identification of cephalopods in Swedish waters. Divers and Scientists West Coast Sweden, Guide No. 4., 76 pp.

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CONTENT

INTRODUCTION

We hope that with this guide we will increase interest in cephalopods, which are more common in our waters than many people might think, e.g. in shallow water, where they can be most easily observed during night dives. The guide is aimed at people with an interest in marine life, fishing, scuba diving, research, as well as those who participate in government and non-profit monitoring programmes of living marine resources. The importance of non-profit organizations in research and monitoring programmes has increased in recent years through Citizen Science Projects. It is therefore important that easy to use identification guides are available. The most common method for species identification of plants and animals is to use an identification key. It consists of a series of paired statements to choose among which identify various higher taxonomic levels down to different genera and, finally, to species level. The advantage of an identification key is that one can determine a specimen even though the key can include hundreds of different species. The disadvantages are that one needs detailed morphological knowledge about the specimens to be identified and that an identification key can become somewhat outdated when new morphological and taxonomic knowledge has been published.

An **alternative** to a traditional identification key is used in this guide. The reasons are that we wish to encourage readers to **first** learn how to **observe, note** and **photograph** different **species-specific characters** and then decide for themselves which species descriptions and photos in the guide may be useful to compare with their own observations and photos. This is beneficial since we only have 13 common species in the Skagerrak, the Kattegat, the Sound and the southern Baltic Sea. We show these species here and go through the necessary biological knowledge of cephalopods, as well as the importance of proper documentation.

Here, the identification of cephalopod specimens is based on having close at hand a cephalopod and/or good photographs showing the whole body and detailed arms and suckers, etc. Some species of cephalopods can be very similar in appearance and undergo changes as they get older. If there are several cephalopods of similar appearance and of different sizes to be identified, it is clearly advantageous to examine them **next to each other**. Our photos are taken of adult, or almost adult, specimens. Young specimens will not always have had time to develop the characteristics we demonstrate.

The photos in this guide show colours, shapes and structures for comparison with the specimens to be identified. Most species have particular characteristics. Here we provide full and detailed images of the cephalopods' species-specific external characteristics together with some internal ones that require simple dissection. During the identification process, one needs a small pair of scissors and a scalpel (to be able to access the internal organs), some needles, a magnifying glass or a simple stereo microscope as well as a camera/mobile camera and a ruler placed along the cephalopod to provide on the photo a length scale in mm. Plastic bags for freezing or jars for preservation (see below), plus water-resistant notepaper for ID information are also important to have at hand.

Cephalopods in Swedish waters are very **poorly researched** and there has never been a large targeted fishery for cephalopods as is found in other countries. This may explain why there are few publications on species identification, morphology and ecology/biology in our own waters. For each species, we mention the most important publications we have used for identification. Recently published ID guides and a major overview of the overall knowledge about squids in the world are included at the end of the reference list. All publications can be downloaded free of charge from the internet. The most common ways to get cephalopods are through trawlers, when fishing with pots for lobster, crab and langoustine, through anglers, scuba divers and fish shops (note that their cephalopods are often imported). Good photos taken during scuba diving can sometimes be species identified.

BRIEFLY ABOUT CEPHALOPODS

Distribution. Cephalopod species can have a wide geographical distribution and some of those found in Swedish waters are also precent in e.g. the Mediterranean and of course also in the nearby North Sea and the Norwegian Sea. We have no endemic species, i.e. species that only occur in Swedish waters. Cephalopods live in salt water, but they can also be found in brackish water in the southernmost part of the Baltic Sea (perhaps especially in connection with heavy saltwater inflows). Please note that the distribution, depth and species names given in publications may be incorrect, e.g. the entire Baltic Sea is sometimes purported to be the distribution area of some species and information on depths is sometimes based on relatively deep trawl catches. The distribution and existence of different species in our waters can also change over time, i.e. within weeks, months, seasons and years, and even over long periods. Species that currently exist in neighbouring waters may in the future become part of our fauna (even if they do not reproduce here). Occasional, scattered finds of new species may occur without them being considered part of our fauna.

Appearance may vary. The appearance of cephalopods can show significant variation, which can also be influenced by whether they are alive or dead, have been frozen and then thawed, or whether they have been in preservative liquid (usually 96% ethanol or 10% formalin). The arms of preserved specimens can be twisted, the structure of the skin affected and suckers that for some species should lie in a single or double row (along the arm) can lie in zigzags. Note, however, that a zigzag placement of suckers can be natural. Ethanol and formalin have a shrinking effect and thus affect length and shape. One should therefore, if possible, measure the body length of fresh or thawed specimens, photograph them and then photograph them again no earlier than 14 days after fixation. All photos in this guide are taken of thawed or formalin (our own specimens) or ethanol fixed/preserved specimens (on loan from the Natural History Museum of Gothenburg). Cephalopods in ethanol have a consistently poorer fixation that results in poorer photos. There is a lack of knowledge about the different morphological effects of freezing/thawing, formalin and ethanol over time.

Taxonomy. Our cephalopods are either **eight-armed** (octopus) or **ten-armed** (bobtail squids and squids with 8 arms, two long catching arms/tentacles, and two fins). These two main groups consist of different families, which in turn include different genera under which the different species are categorized. A species name consists of two parts, a genus name and a descriptive part known as a species epithet which, unlike the genus name, is not an actual name that can stand alone. Genus and species names are written in italics. If a family name is followed by sp. or spp., it signifies that one or more specimens belong to the genus but that the species affiliation is unknown. This is common during expeditions if, for practical reasons, the species cannot be identified in the field. The entire taxonomic classification of our cephalopods is not dealt with here, as it is easy to obtain such up-to-date information via the internet (**Molluscabase** or **WoRMS - World Register of Marine Species**). The position of the different species in the taxonomic hierarchy (e.g. family, subfamily, genus, species) can change over time (see historical examples of this in the taxonomic websites above). This is worth remembering when reading older literature. For some related cephalopod species around the world, there is still **a great deal of uncertainty** as to whether they should in fact be considered as separate species or merged into one. To solve this problem, taxonomic sub-species or ecomorphs are sometimes created when specimens may look slightly different but are still considered so closely related that they should be included in the same species. There are several names for this, but in principle they all mean the same thing, i.e. the presence of related groups, which indicates an evolutionary development that may lead to the emergence of new species in the future. Note that different species concepts are debated from both theoretical and practical points of view (Aldhebiani, 2018 and De Queiroz, 2007).

Identification. We describe here only common and relatively common species in the Skagerrak, Kattegat, Sound and the southern Baltic Sea. The Gothenburg Museum of Natural History and the Swedish Museum of Natural History in Stockholm also have specimens of species that have only been found a few times in our waters. If it is not possible to identify a specimen to species, expert teuthologists or museums should be contacted. **Take photos** (mobile camera will usually suffice) of the fresh or thawed cephalopod, from different angles, with a uniform light or dark background, with **a ruler** and **an ID tag** (see below) included. Next, take close-up shots of the suckers of the arms, the hectocotylus of the males and the clubs of the tentacles (see below).

Catch documentation. Make this documentation on **the front** of the **water-resistant ID tag as soon as possible.** If a specimen is incorrectly documented, it would only be suitable for dissection exercises! Each specimen must **always** have an **ID tag** in the **jar** or **plastic bag** (frozen specimen). All the information should be written with a pencil or with water-resistant ink. Ensure that the ID tag is large enough and write clearly. On the **front of the ID tag**, is written the **species name** (if known), e.g. *Sepietta oweniana*, an **ID code** of the specimen (e.g. *S. oweniana* 1 for the first individual then 2, etc.), **the catch date/time, position, depth, method** of catch, responsible **collector**/fisherman. Also included should be the name of the person who i**dentified** the cephalopod and the method of **preservation** (note, too whether the specimen was first fixed in formalin and then transferred to ethanol). Make sure that the front-page text can be read through the jar or the plastic bag (if possible). All observed **biological data** is written on **the back of the ID tag** (see "**Species ID documentation**" below). The **ID code** should be written on the lid of the jar for easy sorting. All ID data should be copied to an **Excel file** and backed up to external hard drives.

The size of cephalopods and **terms for the arms. Weight** is measured in **grams** and **mantle length** (ML) is measured in **mm.** The outer part of the body behind the head is referred to as the mantle. **Fig. 1** shows how ML is measured. Measuring total length is **problematic** as the arms often shrink and bend in preservative fluid. **Fig. 2** shows how the various arms are named. **Always note** if weight and ML refer to a fresh, thawed, 10 % formalin or 96% ethanol-fixed specimen.

Dissection. Cephalopods are **exciting** to **dissect** as they have interesting adaptations such as three hearts and often a bladder with ink. The males have one or two arms that have been modified to function as a penis (hectocotylus, see below), **the appearance** of which varies with the **species** and is therefore a very i**mportant characteristic.** With the help of hectocotylus, the male transfers his own sperm sacs to the female (see below). Sometimes it may be necessary to **dissect** females as well as injured and young specimens in order to be able to make valid species and sex determination. All our cephalopods have a siphon (funnel) on the underside of the body where it meets the head. Through the siphon, faeces, water and ink (if any) leave the body. Inside the siphon and in the body in general, there are certain **organs** that should sometimes be used for **species and sex identification** and which must then be dissected. Øresland & Oxby (2021) (122 pages/107 photos, which can be downloaded for free from **ResearchGate** /Vidar Oresland or the Divers & Scientists website) describes how to dissect small cephalopods and their internal organs. Muus (1959) and Muus (2002) provide fine figures of Scandinavian cephalopods and some of their internal organs as well as information about occurrence and biology/ecology etc.

DNA. If notes and photos of all external and internal species characteristics are not sufficient to identify the species and sex, remans DNA analysis, in which case one should contact the Swedish Museum of Natural History in Stockholm for advice. DNA analysis, which is performed on fresh, frozen/thawed or 96% ethanol preserved material, is today an important tool for taxonomic studies. **Note that DNA** analyses are based on **comparisons** with DNA databases. If these are based on material with incorrect original catch data and identifications, serious scientific errors can occur. Specimens sent for DNA analysis must therefore be well documented, which includes complete catch data, ID notes and photos, so that any uncertainties about a preliminary ID determination can be assessed later even if the specimen is no longer available. If a new species is discovered, all data, including photos and the specimen itself must be made available to the museum. Species found in the North Sea and the Norwegian Sea may well be discovered in Swedish waters (which are very poorly studied).

SPECIES ID DOKUMENTATION

Make notes and **photo-document** the following **nine points** for **species** and **sex ID identification** and write on **the back of the ID tag** the observations **in English** and information about the photos. **Name** each **photo file** with the specimen code and brief note of what the photo represents followed by a running number. Photo code S.oweniana3hectocot2 denotes the second photo of the hectocotylus of our third *Sepietta oweniana.* All photo files can then be sorted automatically by species, specimen and subject.

1.Total weight. Stated in **grams.** Weighing can be problematic if the specimen is wet so one should always first empty any internal water by lightly shaking the specimen then wipe it dry with paper towels.

2. Body and fins. The specimen should be photographed from above and below, with outstretched fins and a ruler parallel to the body. Always put a note with a preliminary individual code above the ruler so that you can see what has been photographed. What do **the shape, position and size of the fins** look like in relation to the length and shape of the body? Measure **ML** (mm) (**fig. 1**).

3. The mantle. Is the mantle connected to the top of the head (**fig. 1**)? Are there small protrusions on the body, head and around the eyes (**fig. 2**)? This can vary between individuals of the same species and also be affected by the preservation method. Take note of the colours of the body.

4. Arms. Are there **8 arms** or **10 arms** (**fig. 3**)?

5. Arm suckers. Do the **suckers** on the arms appear in **one or more parallel rows** (in the longitudinal direction of the arm)**?** Two rows can sometimes be zigzagged. The number of rows in some species can vary on different **parts of an arm** and **between different arms.**

This also applies to the size of the suckers**.** Do the suckers have **teeth** (**fig. 4**) and what do they look like? **Examine all the arms**.

6. The tentacles club. How does the size of the suckers vary on the different parts of the club (**fig. 5**)? How many rows of suckers are there on the different parts of the club? What do the teeth of the suckers look like on the different parts of the club?

7. Hectocotylus and sex. What does the **male hectocotylus** look like? Shape and structure can vary greatly between the different species, and we provide three completely different **examples**: a narrow longitudinal **depression** in the arm in *Eledone cirrhosa* (**fig. 6**); a few **modified suckers** in *Sepietta oweniana* (**fig. 7**); and a **ligula** with **lamellae** in *Bathypolypus arcticus* (**fig. 8**). Hectocotylus often appears on either the left or right **first**, **third or fourth arm** (counted from the top between the eyes). However, both corresponding left and right arms can be modified in some species, i.e. they have two hectocotyli which nevertheless differ from each other. With the help of the hectocotylus, the male's sperm sacs (spermatophores) (**fig. 9**) can be transferred to the female.

8. Other observations. Damages and parasites (which can be species-specific).

9. Dissection. Whether or not this is necessary is first determined if the above points are insufficient for species or sex identification. Are ova (i.e. unfertilized eggs) or spermatophores present (**figs. 9-10**)? If the specimen's arms are injured, it may not be possible to determine whether they have had a hectocotylus.

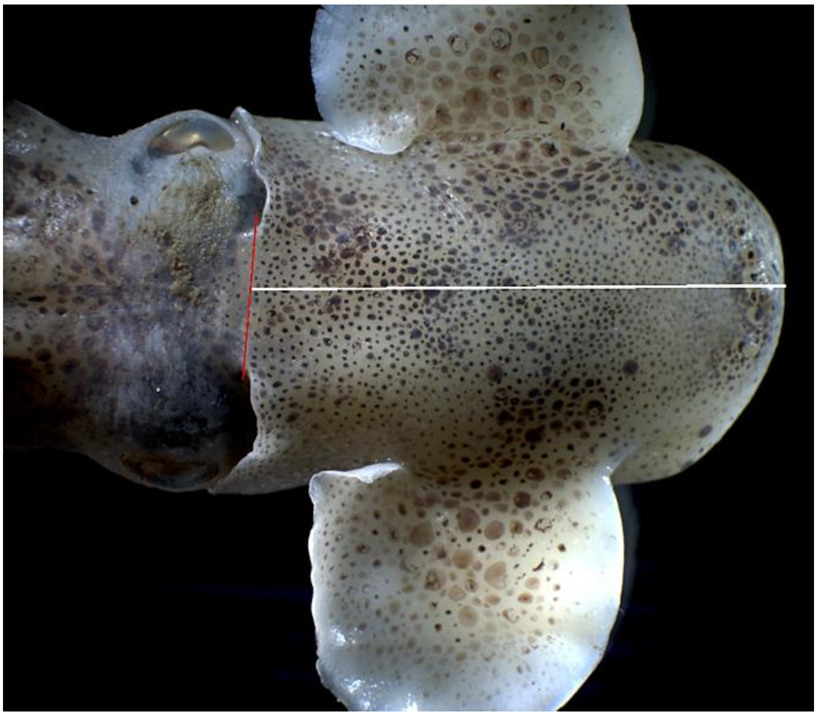

Fig. 1. Measurement of the length of the mantle (ML) of the ten-armed ***Sepietta oweniana*** (in formalin). Note how the top of the mantle in this species is **fused** together with the head (red line). In octopuses, we measure ML from a line between the front edge of the eyes and the end of the mantle because there is no clear transition between the mantle and the head. ML is always measured along the middle of the dorsal side.

Fig. 2. ***Bathypolypus arcticus*** (in formalin) from Kosterrännan. Small protrusions around the eye and a larger one above the eye.

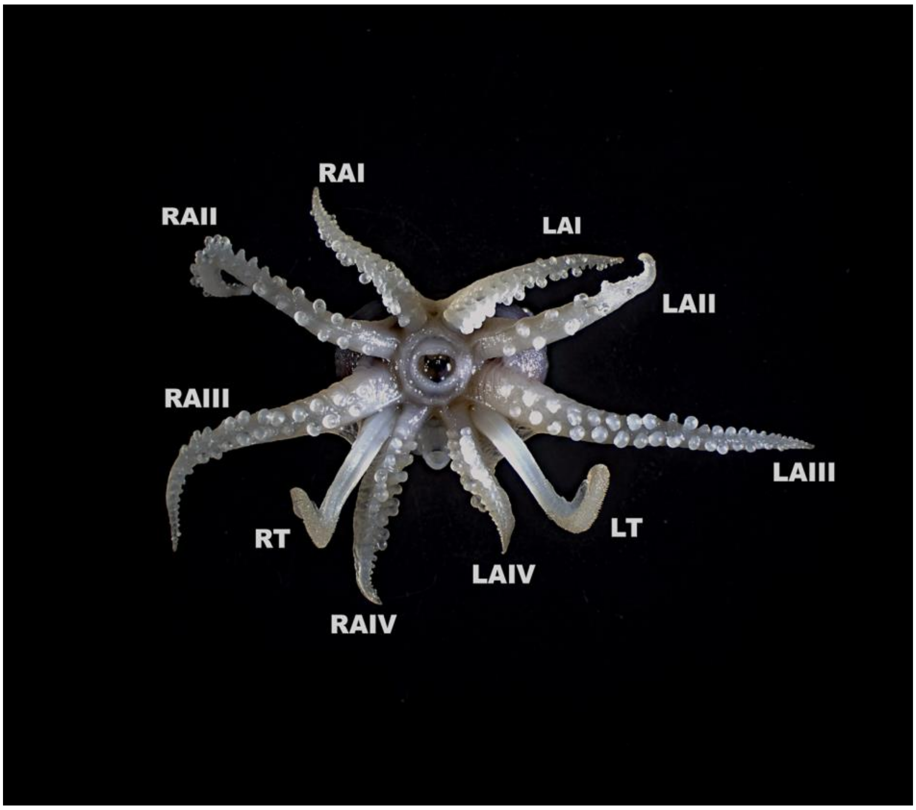

Fig. 3. ***Sepietta* *oweniana*** (female in formalin). The four pairs of arms and the tentacle pair (catching arms with club). A is arm, T is tentacle, R is right and L is left.

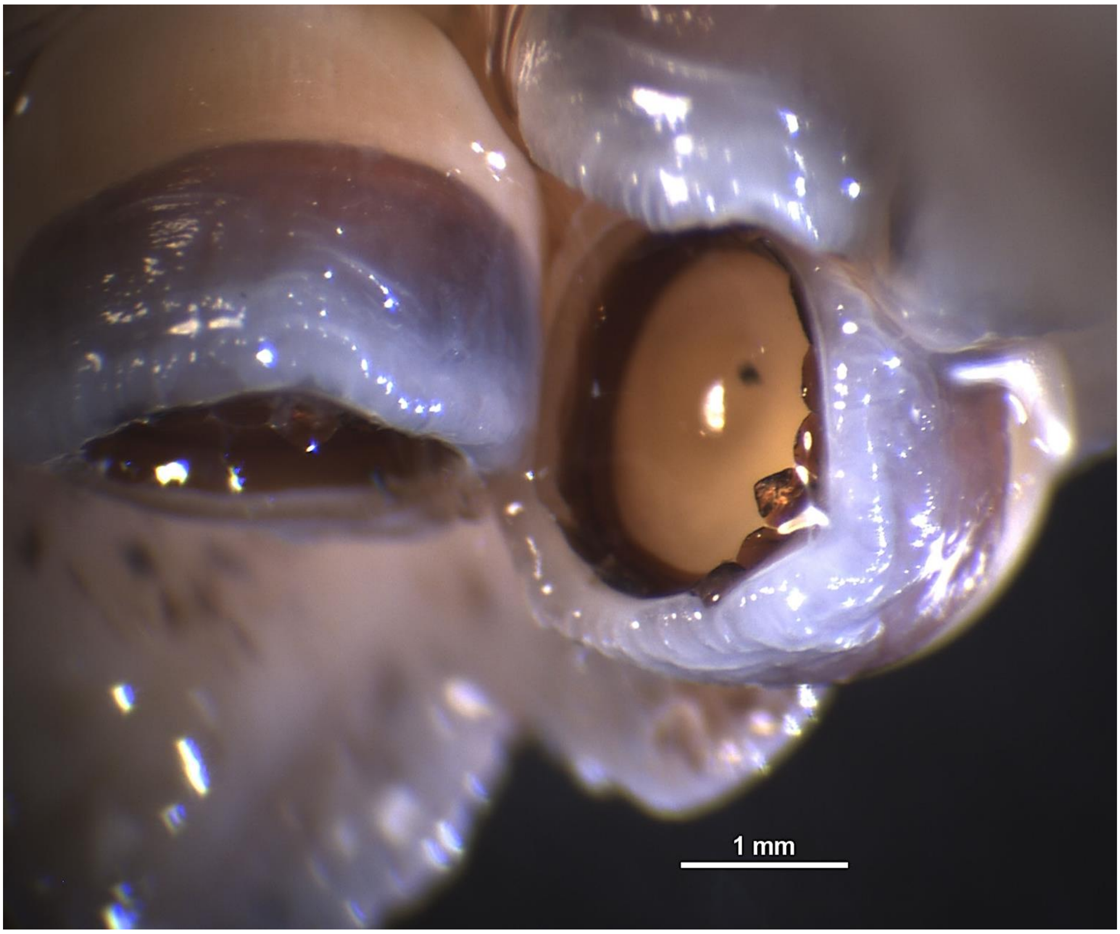

Fig. 4. ***Illex coindetii*** (in formalin). A larger pointed tooth on an arm sucker. Note that in this specimen the teeth are covered by a light sheath which has to be folded down with needles.

Fig. 5. ***Rossia macrosoma*** (in formalin). Female with **decreasing size** of the suckers on the tentacle club (according to Muus, 1959).

Note that the length of the club and the number of rows of suckers can be difficult to estimate as with **some species** the club is often bent and the suckers can be very small and numerous. If problems arise, the club can be cut off and mounted on cork board with needles. We prefer to measure the length of the club as the distance between the first sucker and the end of the club using the NIS Elements photo programme or similar software.

Fig. 6. ***Eledone cirrhosa*** (thawed) where the male's right third arm, RAIII, has formed a hectocotylus which has a fairly clear short notch in the outer part of the arm (arrow). At the centre of the hectocotylus, the notch takes on a different shape (see "**Species descriptions and photos"**).

Fig. 7. ***Sepietta oweniana*** (in formalin) where the male's first left arm, LAI, has been modified into a hectocotylus. The downward pointing arrow shows a hook-like, modified sucker and the three upward-pointing arrows also show modified suckers that are all used to hold sperm sacs, which are to be transferred to the female. The left arrows indicate where two suckers have detached from the arm, which does sometimes happen. The lines separate three different parts of the hectocotylus (distal, copulation, and proximal part) with suckers of species-specific shape, size, and location. The left side of the arm is the dorsal part (closest to the top of the specimen) and the right is the ventral side (closest to the underside).

Fig. 8. ***Bathypolypus arcticus*** (in formalin) from Kosterrännan where the male's right third arm, RAIII, has formed a hectocotylus with a **ligula** at the end of the arm with about **14 lamellae** (see arrow, the number of lamellae varies with the size of the specimen).

Fig. 9. ***Sepietta oweniana*** (in formalin). Dissected sperm sacs (spermatophores). The male transfers the spermatophores to females with the help of the hectocotylus.

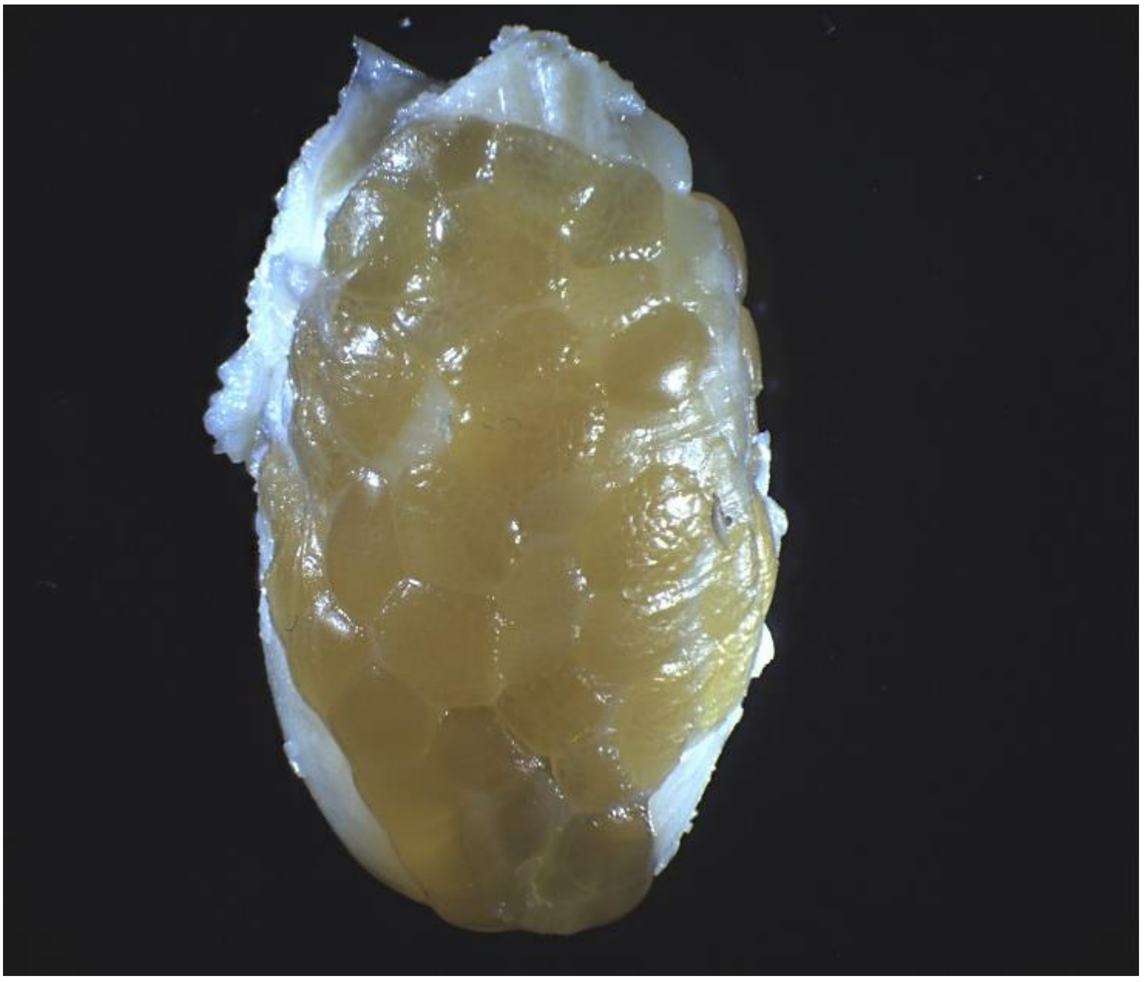

Fig. 10. Dissected *Sepietta oweniana* (in formalin). Ova from female for sex identification (see Øresland & Oxby, 2021).

Once notes and photos have been taken, check the relevant part of **the SPECIES LIST** below, i.e. **Eight-armed octopuses, Ten-armed bobtail squids** or **Ten-armed squids**, in order to become familiar with **the number of species** available.

The eight-armed octopuses can be relatively small (*Bathypolypus,* ML rarely reach more than 50 mm), but are **usually much larger** and *Eledone cirrhosa* can have an ML of up to 150 mm and a maximum weight of <2 kg.

Ten-armed bobtail squids are **small** cephalopods. Their body length (**ML)** is <85 mm and they have **short arms** and **thin round fins** that are markedly different from ten-armed squids.

Ten-armed squids are **large** and have an **elongated body** with **powerful fins** compared to bobtail squids.

SPECIES LIST

Eight-armed octopuses

Eledone cirrhosa (Horned or Curled octopus)

Bathypolypus arcticus (North Atlantic octopus or Spoon arm octopus)
Bathypolypus bairdii (Baird´s octopus)

Rare, or not yet found species, that are found in nearby waters.
Octopus vulgaris (Common octopus). This species is present in the North Sea and south therefrom (Drerup & Cooke, 2019a). It has two rows of arm suckers, which distinguishes it from *Eledone cirrhosa*. Both species can grow **to <2 kg**.

Macrotritopus defilippi (Lilliput longarm). This is a small octopus with long arms that is found in the North Sea and south therefrom. See Drerup & Cooke (2019a).

Ten-armed bobtail squids

Small squids of ML <85 mm with an egg/ball-shaped body.

Rossia macrosoma (Stoat bobtail squid)
Rossia palpebrosa (Warty bobtail squid)

Sepietta oweniana (Common bobtail squid)

Sepiola atlantica (Atlantic bobtail squid)
Sepiola tridens (Red bobtail squid)

Rare, or not yet found species, that are found in nearby waters.

Sepietta neglecta. There is little knowledge about this species in Swedish waters as very few specimens have been found. It is present in the North Sea and could therefore be found on the west coast. We **describe** it here **without photos** but with references to relevant literature.

Adinaefiola pfefferi. This species can be found in the North Sea (Heij, Goud, & Martin, 2017 and Goud, Heij & Hiemstra, 2019). See Bello (2020) for latest species description.

Adinaefiola ligulata. This species can be found in the North Sea and Norwegian waters (Heij, Goud, & Martin, 2017 and Goud, Heij & Hiemstra, 2019). See Bello (2020) for latest species description.

Rondeletiola minor. This species can be found in the North Sea and Norwegian waters (Heij, Goud, & Martin, 2017 and Goud, Heij & Hiemstra, 2019).
.

Ten-armed squids

Large cephalopods that have an elongated body with powerful fins compared to bobtail squids.

Alloteuthis media (Midsize squid)

Loligo forbesii (The veined squid)
Loligo vulgaris (European squid)

Todaropsis eblanae **(**Lesser flying squid)

Illex coindetii (Broadtail shortfin squid)

Rare, or not yet found species, that are found in nearby waters.

Alloteuthis subulata (European common squid). The present presence of the species in the North Sea has been dismissed by DNA analyses (Sheerin et al., 2023). See **"Species descriptions and photos"** for more information about *Alloteuthis. Alloteuthis* species are difficult to identify by appearance alone. Both species are **described together** to **genus**.

Todarodes sagittatus (European flying squid). See Jereb et al. (2015). This species was rare on the Swedish west coast during the 1900s, but has become more common in recent years. However, it is only seen irregularly and we have no good specimens. We provide only a brief description of the species here. Compare with *Todaropsis eblanae*.

Ommastrephes bartrami (Neon flying squid or Red flying squid). See Jereb et al. (2015) and Drerup & Cooke (2019a). Occurs in the North Sea.

Onychoteuthis banksii (Clubhook squid). See Drerup & Cooke (2019a). Found in the North Sea.

Cuttlefish

Rare, or not yet found species, that are found in nearby waters.

Sepia officinalis (Common cuttlefish). This species belongs to the family Sepiidae. It is a southern species which closest occurrence is mainly in the southern North Sea. Isolated finds come from the Koster area and from the Danish side of the Kattegat. The species has a very characteristic shape as the mantle is dorsoventrally flattened and has fins that run along almost the entire sides of the mantle. Inside the mantle is an elongated so-called sepia shell. It floats to the surface after the cephalopod has died and is carried long distances by the ocean currents and are commonly washed up on beaches along the entire west coast.

Next, go to the relevant part of "**Species descriptions and photos"** and compare your notes and photos with the descriptions of the few species that may be relevant.

SPECIES DESCRIPTIONS AND PHOTOS

The descriptions of the species are based on summaries of the publications we consider to be the most relevant for Swedish waters and our own notes and photos of specimens caught in the Skagerrak, Kattegat and the Sound. For some species, there is still a lack of good and, above all, simple and practical descriptions. We have tried to limit the number of species characteristics to a minimum. However, this should not hinder the search for better ones. If no access to reliable DNA methodology is available, one has then to settle for identification to genus to avoid mistakes.

Eight-armed octopuses

The head and mantle are **fused** on the upper side of these cephalopods (see ML measurement in **fig. 1**). They lack fins and tentacles and have **one or two** rows of suckers on their arms.

Eledone cirrhosa (Horned or Curled octopus)

Goud, Heij & Hiemstra (2019), Muus (1959), Muus (2002)

1. The mantle dorsal side is dark with **diffuse blotchy streaks** (**fig. 11**) and **the ventral side is light** (**fig. 12**).
2. Marked transition between the dorsal and ventral sides of the mantle (**fig.11**).
3. The skin may have small, pronounced protrusions, especially on the head and around the eyes, which may show a distinct protrusion on the upper side of the eye (**figs. 13 & 14**).
4. **Arms**. **One row of suckers** that can sometimes be perceived on the outer parts as if they are sitting in a zigzag.
5. A hectocotylus (**LAIII**) with a rather undeveloped groove in the outer part of the arm (arrow) which is more pronounced further in (**fig. 16**) and the hectocotylus is shorter than the other arms.
6. Maximum weight about <**2 kg** and ML up to at least **160 mm.**

Fig. 11. ***Eledone cirrhosa*** (ML 108 mm, **thawed**). Smooth skin and, here, without protrusions on the body and around the eyes. The upper side of the body is dark with **dark diffuse blotchy areas** on the head and the top of the mantle (seem to be most evident on fresh/thawed specimens). **Arms with only one row of suckers.** The "loose" mantle skin (above the scale line) between the dorsal and ventral side is most clearly visible in fresh and thawed specimens. RAII here is injured (the tip is of) and the **hectocotylus** (**RAIII, arrow**) is shorter than the uninjured arms.

Fig. 12. ***Eledone cirrhosa*** (thawed) with a **typical light underside**.

Fig. 13. ***Eledone cirrhosa*** (ML 136 mm (in **formalin**). Notice how the preservative has affected the appearance of the skin with a more **knobbly** surface, **protrusions** by the eye and the **absence** of dark diffuse streaks on the top of the mantle compared to **fig. 11** above.

Fig. 14. ***Eledone cirrhosa*** (ML 136 mm, in **formalin**). Enlargement of the eye which has a clear protrusion on the top.

Fig. 15. ***Eledone cirrhosa*** (ML 160 mm, thawed). A **hectocotylus (RAIII**) where the male has formed a rather undeveloped groove in the outer part of the arm (**arrow**) which is more pronounced further in (**fig. 16**).

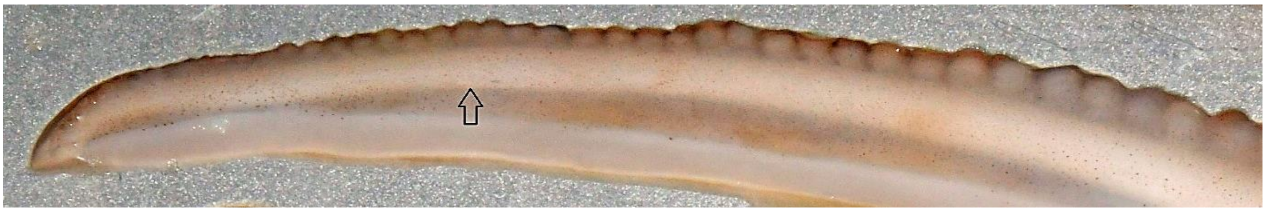

Fig. 16. ***Eledone cirrhosa*** (ML 126 mm, thawed). A **hectocotylus** (**RAIII**) with a **pronounced groove** (arrow).

Bathypolypus

There exist two species of this genus in our waters, but they can be difficult to distinguish by external characteristics. The males can be identified to species by **appearance** and by the number of **lamellae in the ligula** (on the **hectocotylus**). To be more certain of a correct identification, it is necessary to dissect the specimens for the **crop diverticulum** (a bulge on the esophagus that acts as a crop, see fig. 2 in **Muus, 2002**) and the presence of two W-shaped or paddle-shaped **glands inside the siphon** (but these show **great variation**, see fig. 18 in **Muus, 2002**). These dissections are especially difficult to perform on ethanol-preserved specimens, where internal organs are often poorly fixed compared those in formalin. We recommend **a light staining** of the inside of the siphon with the dye **Azure B** (Øresland & Oxby, 2021) to facilitate dissection. We also recommend that the identification of **females** is made to **genus** if the crop diverticulum is unclear and until better species characteristics are published and DNA barcoding is not an option. *Bathypolypus* does not have an ink sac. All our specimens were caught during bottom trawling in the deep Koster fjord.

Bathypolypus arcticus (North Atlantic octopus or Spoon arm octopus)

Goud, Heij & Hiemstra (2019), Muus (2002), Taite et al. (2023)

1. **Double row** of suckers that can be zigzagged (**fig. 17**).
2. **Pronounced protrusions** on the skin and around the eyes (**fig. 17** and **18**), occur (possibly as a preservative effect) but the species may also have smooth skin.
3. **A hectocotylus** (**RAIII**) with well-developed ligula that has **10–16 lamellae** (**fig. 19**).
4. Dissection. Carefully cut open the siphon and unfold it to reveal the two species-specific **W-shaped** siphon glands (no photo). Characteristics with great variation (see Muus 2002).
5. Dissection. The oesophagus has a **sac-shaped bulge** (crop diverticulum) that is typical of the species (**fig. 20**).
6. ML rarely reaches over 50mm.

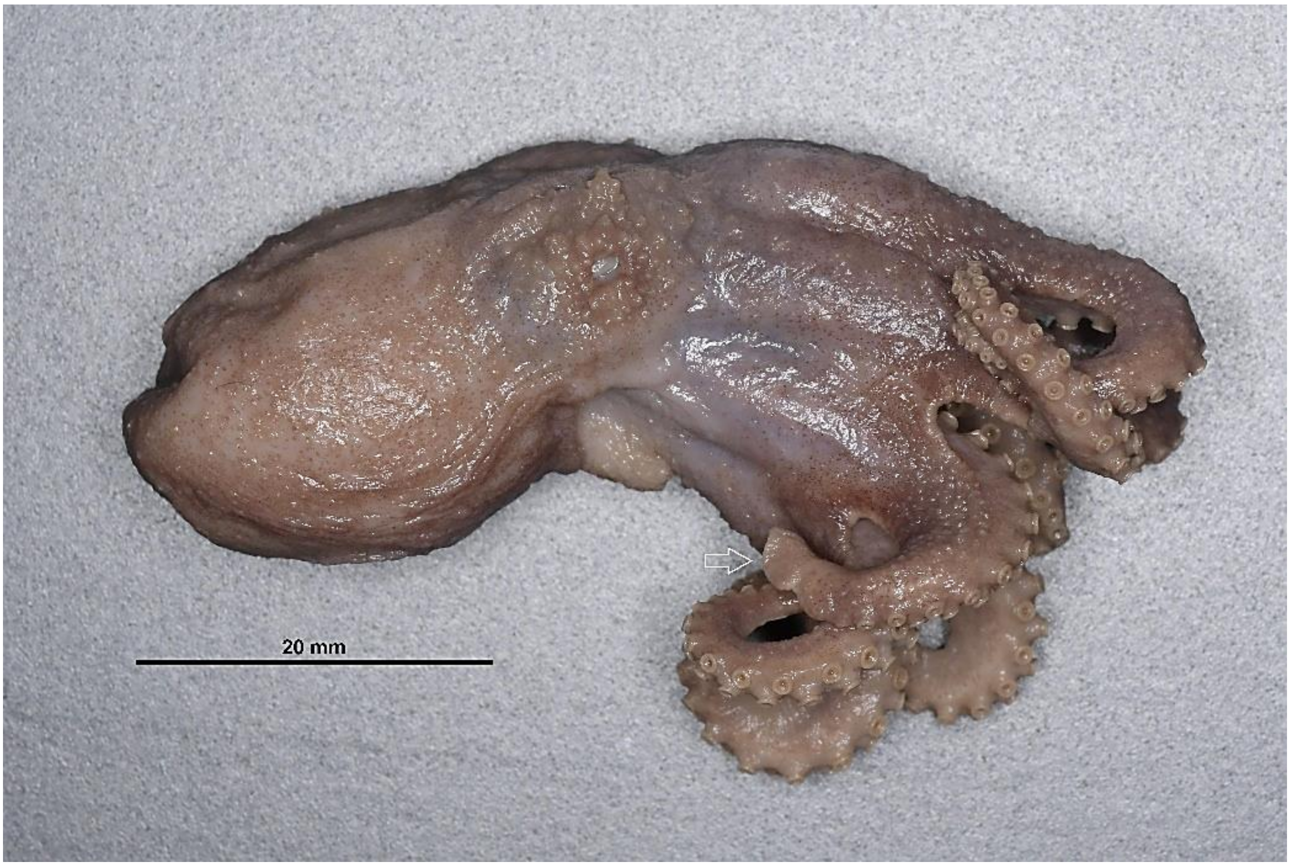

Fig. 17. ***Bathypolypus arcticus*** (in formalin). Knobbly skin and two rows of suckers. The **arrow** shows the smooth top of the hectocotylus on the RAIII.

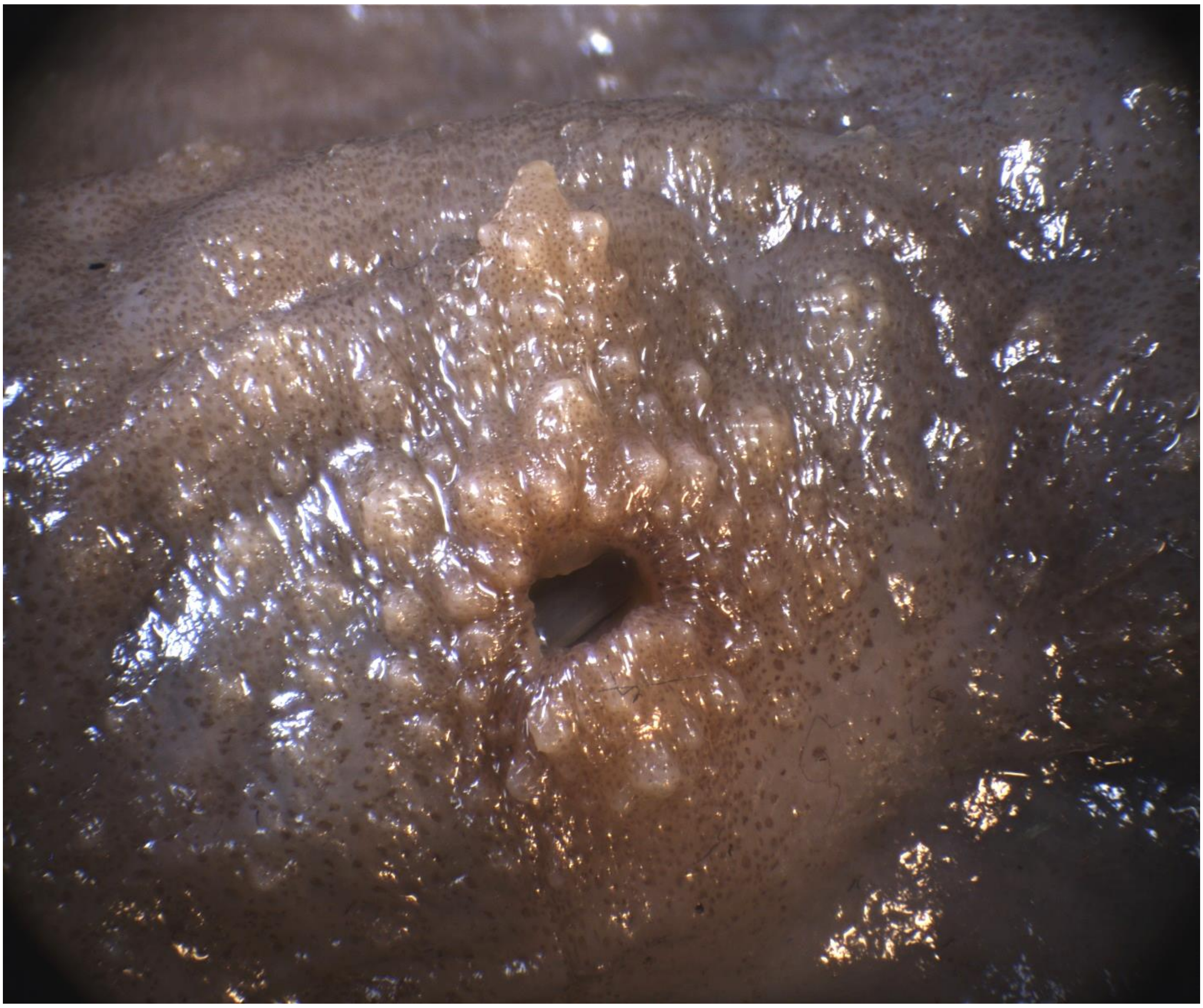

Fig. 18. ***Bathypolypus arcticus*** (in formalin) with knobbly small protrusions around the eye and a larger protrusion above the eye (compare with *Eledone cirrhosa,* **figs. 13 & 14**).

Fig. 19. ***Bathypolypus arcticus*** (in formalin). A hectocotylus on **RAIII** with well-developed ligula with about 14 lamellae. The arms have two rows of suckers. Compare the appearance of the lamellae with *Bathypolypus bairdii* (**fig. 21**).

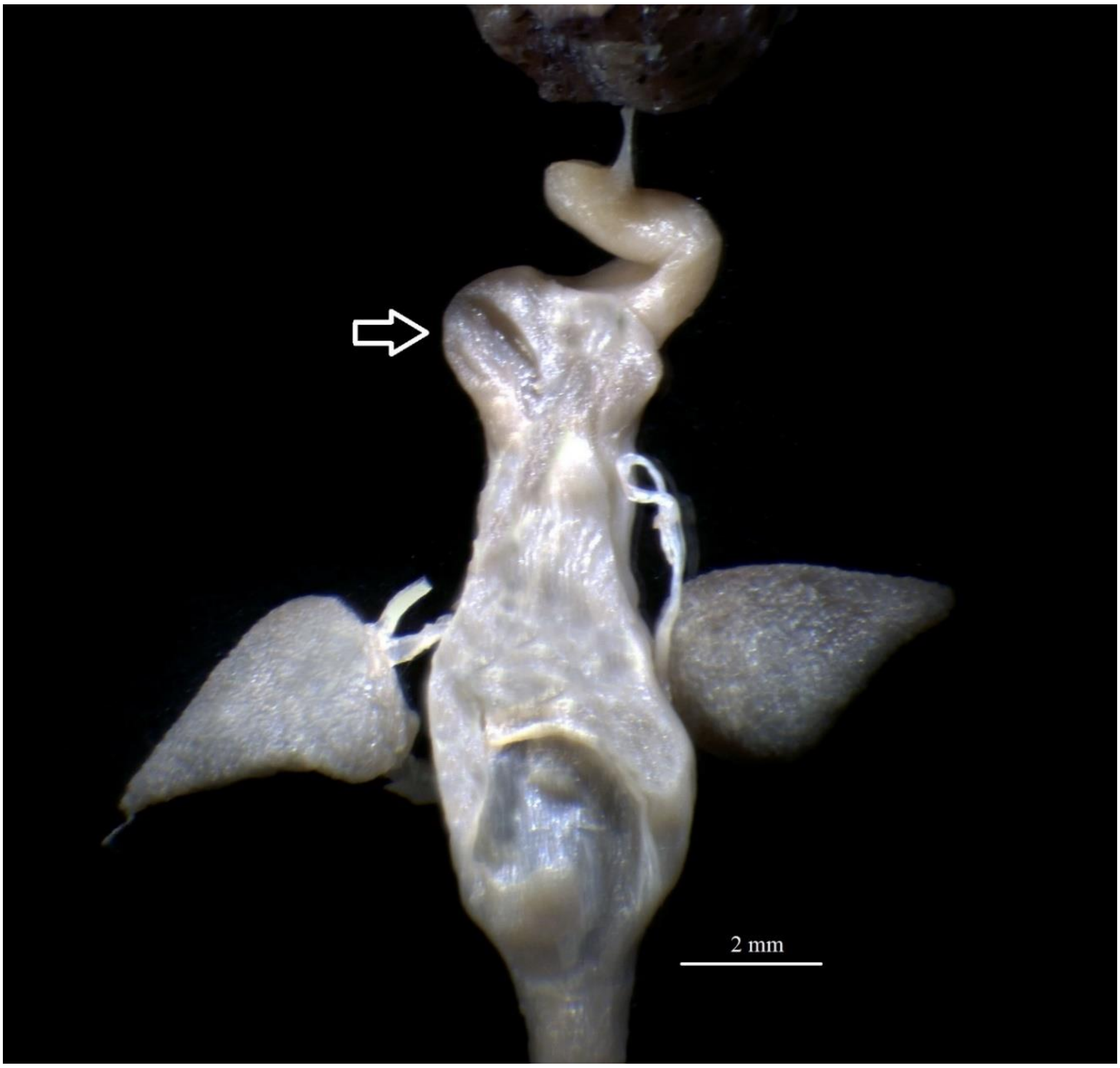

Fig. 20. Bathypolypus arcticus (in formalin). Dissected esophagus. The arrow indicates the crop diverticulum as shown in fig. 2 in **Muus** (**2002**).

Bathypolypus bairdii (Baird´s octopus)

Muus (2002), Taite et al. (2023)

1. **Double row of suckers** that can be zigzagged.
2. A hectocotylus (**RAIII**) with a well-developed ligula which has **8–12 lamellae** (**fig. 21**). Its appearance differs from of *B. arcticus* (**fig. 19**).
3. May have pronounced protrusions on the skin and around the eyes similar to *B. arcticus* (possibly due to the preservative), but can also have smooth skin.
4. Dissection. The siphon glands are paddle-shaped (no photo, great variation in the characteristics, see Muus (2002).
5. Dissection. The oesophagus **lacks** a well-developed crop diverticulum (**Fig. 22**) compared to *B. arcticus.* This dissection showed interesting morphological structures that should be investigated in detail (applies to both *Bathypolypus* species), which we leave to others due to lack of specimens
6. ML up to 40-50 mm (rarely over 70 mm).

Fig. 21. ***Bathypolypus bairdii*** (in ethanol) according to Muus (2002). A hectocotylus (**RAIII**) with 11 lamellae. Compare with *Bathypolypus arcticus* (**fig. 19**) how the lamellae here are **connected towards the middle.**

Fig. 22. ***Bathypolypus bairdii*** male (in ethanol). Esophagus with a possible crop diverticulum which, however, is not as marked as in *B. arcticus* (**fig. 20**) and fig. 7 in Muus (2002).

Ten-armed bobtail squids

Small cephalopods, ML <85 mm with short arms and thin round fins that differ markedly from ten-armed squids (see below). Bobtail squids have often been misidentified in the scientific literature and especially females and young individuals can cause problems. Detailed dissection photos/figures of internal organs are still lacking for most species (but see Øresland & Oxby, 2021, for *Sepietta oweniana*). Our three **genera** are easy to distinguish as *Rossia* has a mantle that is **not** connected to the top of the head, and *Sepietta* has **no** light-producing organs in the body **which *Sepiola* has** (requires a simple dissection).

Rossia

In order to identify our two *Rossia* species, we have followed the Muus (1959) description of the size of the suckers on the tentacle club and the number of rows of suckers on the arms. The suckers on the **club** clearly **decrease in size** towards the tip of the club in *Rossia macrosoma* and **the arms** have **4 rows of suckers** in the middle. The size of the suckers on the club of *Rossia palpebrosa* **decreases less** in size compared to *Rossia macrosoma* and **the arms** have **only two rows** of suckers. All our collected *Rossia* specimens, as well as those on loan from the Gothenburg Museum of Natural History (a total of > 38), could without exception, be identified according to Muus' (1959) characteristics mentioned above. This is in contrast to what is described by Goud, Heij & Hiemstra (2019) and Jereb & Roper (2005) who state that the suckers of both species on the clubs are small and of equal size. However, the number of rows of suckers on the arms that they indicate for each species is consistent with Muus (1959) and **this characteristic alone is enough** to identify the *Rossia* species in our waters. Both species occur in deeper waters, such as in Kosterrännan where they are caught in trawls.

Rossia macrosoma (Stoat bobtail squid)

Goud, Heij & Hiemstra (2019), Heij, Goud, & Martin (2017), Muus (1959)

1. Head and mantle are **not fused** together on the upper side (**fig. 23**).
2. ML <85 mm.
3. The mantle and head are **smooth.**
4. **A hectocotylus** usually on **both AI** arms. The male's RAI and LAI have a well-developed, longitudinal **skin fold** on one side of the arm (**fig. 24**). Compare with female AI (**fig. 25**).
5. All **arms** have 2 rows of suckers closest to the base and **then 4 rows** and finally 2–3 rows, which is typical of the species (**fig. 26**).
6. **The male's** arms AII, AIII and AIV have **larger suckers** (**fig. 23 & 26**) compared to those of the females (**fig. 27**).
7. **The suckers** on the **tentacle club gradually decrease in size** (**fig. 28**).

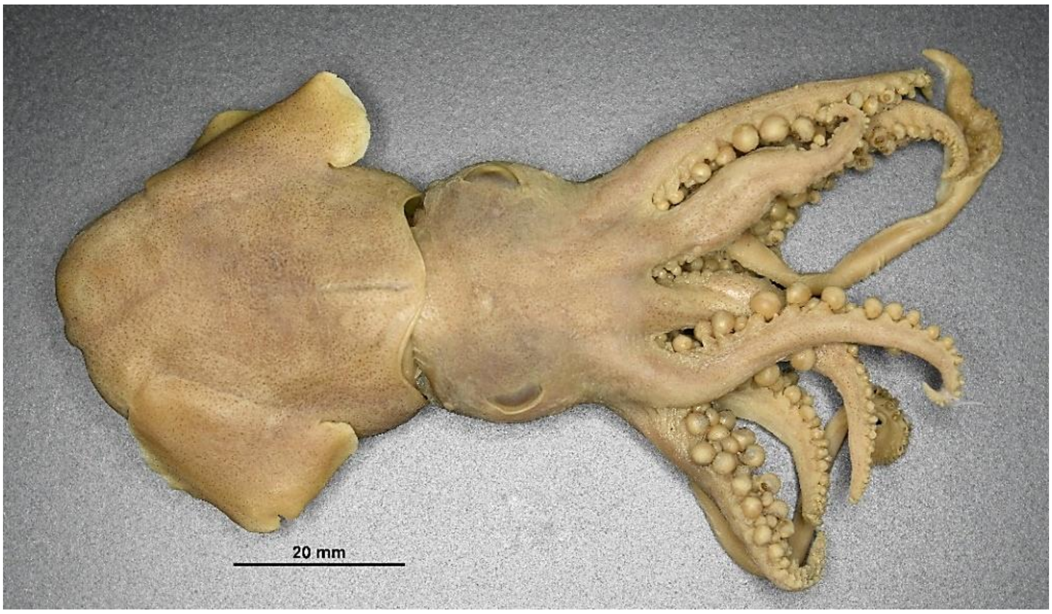

Fig. 23. ***Rossia macrosoma,*** male (in ethanol). The mantle is **not** connected to the head. Note the male's large suckers.

Fig. 24. ***Rossia macrosoma,*** male (in ethanol). A **hectocotylus** on **LAI**. A longitudinal skin fold can be seen outside the row of suckers (same for RAI).

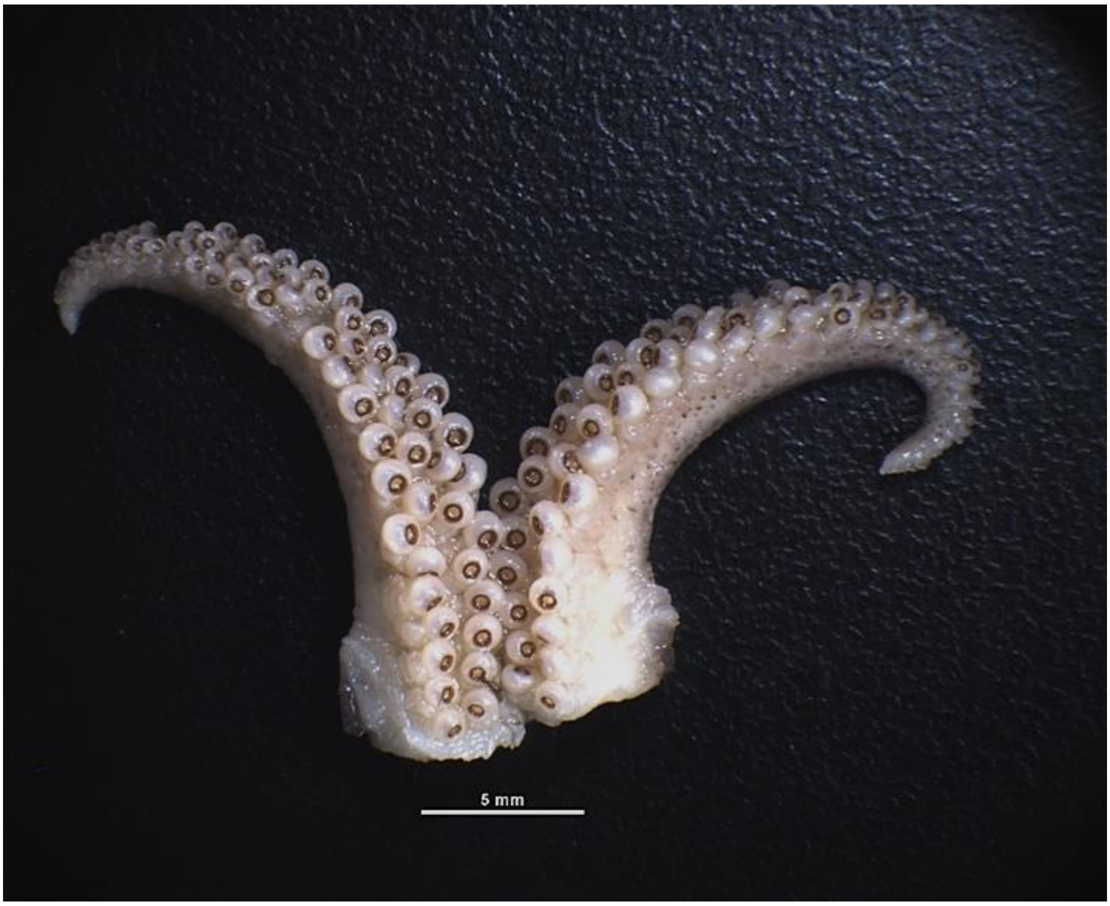

Fig. 25. ***Rossia macrosoma*** (in formalin). **Female** with 2-4 suckers in a row on **RAI** and **LAI**.

Fig. 26. ***Rossia macrosoma*** (in ethanol). **Male** with small and **large suckers** in 2–4 rows on **RAII - RAIV**.

Fig. 27. ***Rossia macrosoma*** (in formalin). **Female** with smaller suckers of **equal size** in **2–4 rows** on the **RAII -RAIV** compared to the male (**Fig. 26**).

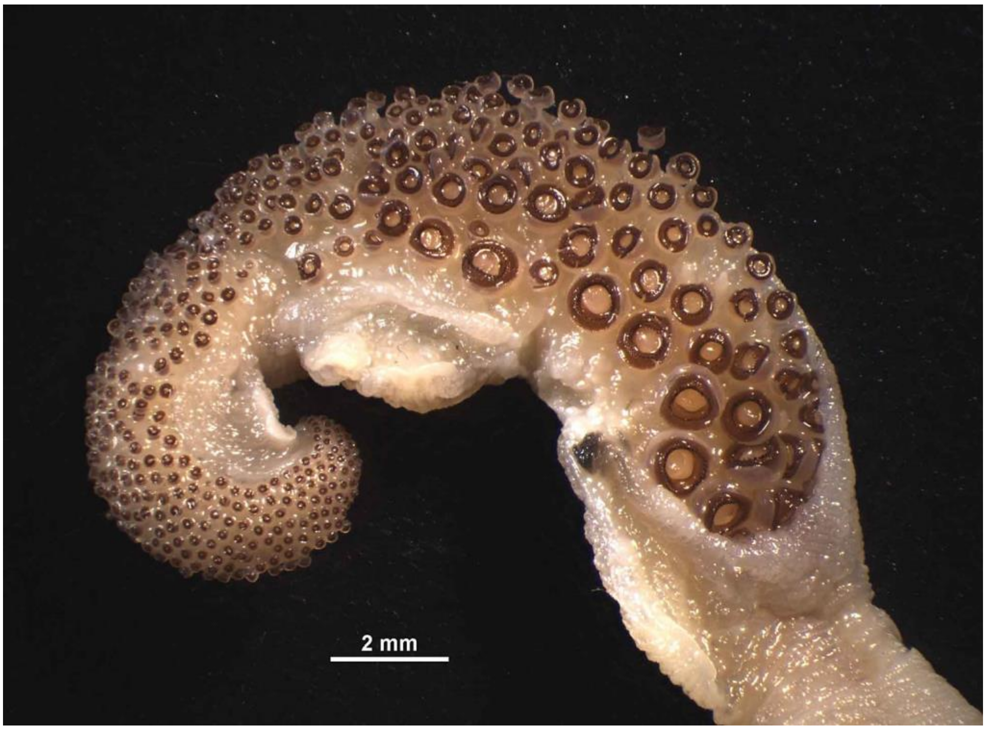

Fig. 28. Rossia macrosoma (in formalin). Tentacle club with **decreasing size** of the suckers (according to Muus, 1959).

Rossia palpebrosa (Warty bobtail squid)

Goud, Heij & Hiemstra (2019), Heij, Goud & Martin (2017), Mercer (1973), Muus (1959)

1. The head and mantle are **not fused together** (**fig. 29**).
2. ML <46 mm.
3. The skin often has small knobbly protrusions, especially around the eyes (**fig. 30**).
4. **Two rows of suckers** on **all arms** (**fig. 31**), but the arm tips have four or more small suckers.
5. **The male's** AII and A III have larger suckers compared to the female's.
6. **A hectocotylus** on **both AI** (we found no males and the old ethanol-fixated museum specimens were in poor condition).
7. The **suckers** on the tentacle club **decrease less in size** (**fig. 32**) compared to *Rossia macrosoma.*

Note that this species has previously been referred to as *R. glaucopis* in Muus (1959), but Morov et al. (2011) showed with morphological and genetic data that *R. glaucopis* in the northeast Atlantic should be considered as *R. palpebrosa* and that the species is polytypic and exists here as two ecological morphs (an Arctic "palpebrosa" and a subarctic "glaucopis"). We do not make such a division into morphs here.

Fig. 29. ***Rossia palpebrosa*** female (in formalin). One eye is damaged. The AI pair was dissected and dyed blue, and then put together prior to photography.

Fig. 30. ***Rossia palpebrosa*** female (in formalin). Eye surrounded by knobbly skin.

Fig. 31. Rossia palpebrosa (in formalin). Female with **two rows** of suckers (on AII-AIV, the arm tips have four or more small suckers). To be compared with *R. macrosoma* female with **2-4** rows (**fig. 27** above). The tentacle has been cut off.

Fig. 32. ***Rossia palpebrosa*** female (in formalin). Tentacle club with slightly less diminishing size of suckers compared to *Rossia macrosoma* (**fig. 28** above).

Sepietta* and *Sepiola: Mantle and head **are connected**.

Sepietta oweniana (Common bobtail squid)

Bello (1995), Bello (2019), Goud, Heij & Hiemstra (2019), Heij, Goud & Martin (2017), Jereb, et al. (2015), Øresland & Oxby (2021)

Sepietta oweniana is a very **common** species that is often seen during night dives in sand/gravel where it burrows during the day. We found the species from 3 m and deeper during diving on the Swedish west coast.

1. Head and mantle are connected (**fig. 32**).
2. **No light-producing organs** around the ink sac (may require dissection).
3. **ML <50 mm**.
4. **All arms** have **two rows** of suckers.
5. The tentacle **club** is >10 **mm long** (at ML 19 mm) and has **>16 rows** of suckers. The length and number of suckers are variable and affected by body size (**fig. 33**). Note that the length of the club and the number of rows of suckers can be difficult to estimate as the club is often bent and the suckers can be very small and numerous. If problems arise, the club can be cut off and mounted on a cork board with needles. We prefer to measure the length of the club as the distance between the first and last sucker using NIS Elements photo programme or similar software.
6. The **hectocotylus** (**LAI)** is **species-specific** (**fig. 34**) but some morphological variation has been described by Bello (2019).
7. **Dissection. Females** of S. *oweniana* and *Sepietta neglecta* (below) are **difficult to identify** as the external characteristics are quite similar. Dissect and compare with photos of *S. oweniana* in Øresland & Oxby (2021) and figures in Bello (1995) of the shape, structure and location of the bursa copulatrix and other organs. Determining the sex of **small** specimens is done by dissection of the genitals.

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Fig. 32. ***Sepietta oweniana*** male (in formalin).

Fig. 33. ***Sepietta oweniana*** (in formalin). The club has small suckers in >16 rows (which can be difficult to count, especially with poor ethanol fixation). The length of the club depends on the size of the specimen and measures here 11 mm between the first and last sucker (ML = 32 mm).

Fig. 34. ***Sepietta oweniana*** (in formalin). A hectocotylus on **LAI** (see **fig. 7** for more information).

Sepietta neglecta (Elegant or Dwarf bobtail)

Bello (1995), Goud, Heij & Hiemstra (2019), Heij, Goud, & Martin (2017)

Few specimens of the species have so far been reported from Swedish waters (Heij, Goud, & Martin, 2017) but they exist in the North Sea. The females can be difficult to distinguish from *Sepietta oweniana* females and incorrect identification can therefore appear in the literature. We have **no specimens or photos** but do provide a description of the species. **Females** should be identified to **genus** until further information is published (e.g. more comprehensive information regarding internal organs and the maximum ML of species in different distribution areas). Specimens should be compared, side by side, with S. *oweniana* specimens.

1. The head and mantle are **connected**.
2. **ML** < **25 mm**.
3. **No light-producing organs** around the ink sac (may require dissection).
4. All arms **have two rows** of **small suckers**.
5. The **club** has **~16 rows** of suckers (often slightly fewer). There is differing information available about the length of the club.
6. The male hectocotylus (**LAI)** is **species-specific** (see fig. 12 **in Heij, Goud, & Martin** (**2017**).
7. Females are difficult to distinguish from *S. oweniana* females (see number of rows of suckers on the club, which is an uncertain characteristic).
8. Dissection as for *S. oweniana* (see above). Look for differences among internal bodies when new data is needed and compare specimens of the same size (see Bello, 1995).

Sepiola has light-producing organs

Sepiola atlantica (Atlantic bobtail squid)

Bello (1995), Gold, Heij & Hiemstra (2019), Heij & Gold (2010), Heij, Gold, & Martin (2017), Jereb et al. (2015)

1. Head and mantle are **connected** (**fig. 35**).
2. **ML is <25mm**.
3. Two white kidney-shaped **light-producing organs** almost covering the black ink sac (**fig. 36**). Easily seen by cutting open the mantle on each side of the funnel.
4. **All arms** have **two rows** of **suckers. The AIV** arms **have smaller suckers in 5–8 rows** distally (**fig. 37**).
5. A **hectocotylus** is on the **LAI** (**fig. 38**). Compare with the female's AI (**fig. 39**).
6. The tentacle **club is >7 mm** long with **eight rows** of suckers located at the end of a **stem** (**fig. 40**) which is most visible when observed under magnification in water.
7. **The funnel** has **no internal flap**/funnel valve in any of our dissected specimens (as found in *Sepietta oweniana,* see Øresland & Oxby (2021).

Fig. 35. ***Sepiola atlantica*** (female in ethanol). Head and mantle are **connected**.

Fig. 36. ***Sepiola atlantica*** (male in ethanol) with two white, **light-producing organs** (**LO**) that almost cover the black ink sac.

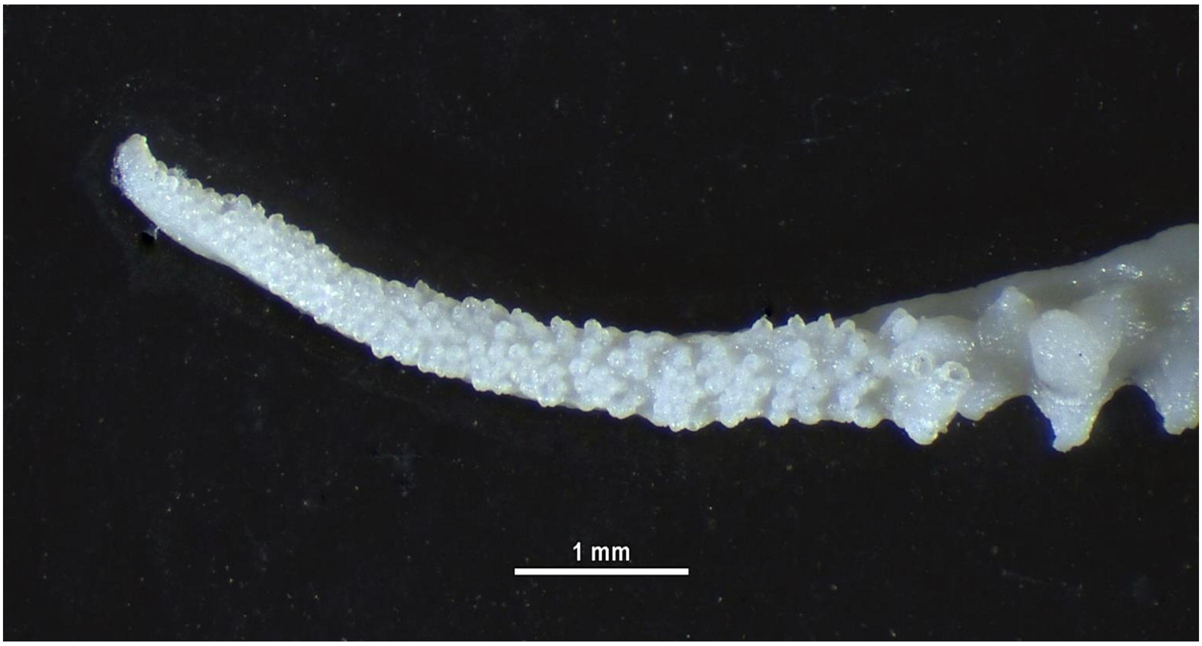

Fig. 37. ***Sepiola atlantica*** (in ethanol). **AIV** with five or more rows of small suckers at the end of the arm. Larger suckers in two rows further along the arm.

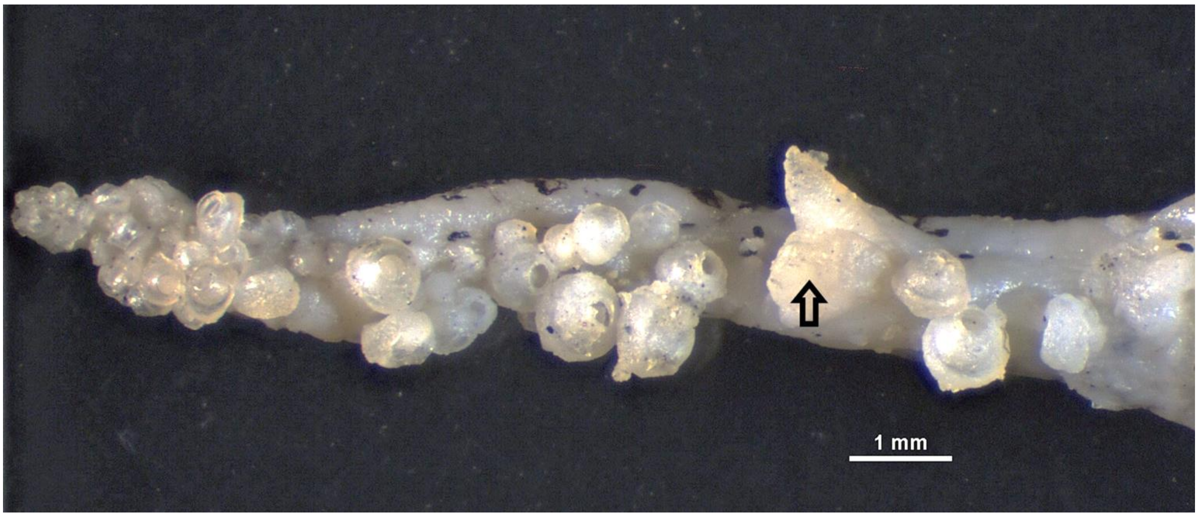

Fig. 38. ***Sepiola atlantica.*** **Hectocotylus** on **LAI** (in ethanol). Note that the arrow shows a two-part, modified sucker that has sometimes been depicted in the literature as a large flat sucker (which was also how it looked initially in our studied hectocotylus). When lifted up with a needle, one can see its true appearance.

Fig. 39. Sepiola atlantica female (in ethanol). **AI** to be compared with the male hectocotylus on LAI (**fig. 38**).

Fig. 40. ***Sepiola atlantica***. The **club** with small suckers found at the end of a stem (best seen and photographed in water as done here).

Sepiola tridens (Red bobtail squid)

Goud, Heij & Hiemstra (2019), Heij & Goud (2010), Heij, Goud, & Martin (2017)

The morphological differences between **females** of *S. tridens* and *S. atlantica* are small. New photos of internal organs may help to identify them. We have not found the species in our waters and therefore **only** provide a **written description**.

1. Head and mantle are **connected**.
2. ML is a maximum of **20 mm**.
3. Inside the body there are **two white kidney-shaped light-producing organs**, on the black ink sac (dissect as in **fig. 36**).
4. Only **two rows** of suckers on the **arms**. The **AIV arms** have **smaller** suckers in 6-8 rows distally (in *Sepiola atlantica* there are about 5–8 rows).
5. A **hectocotylus** is on the **LAI arm** (see Heij, Goud, & Martin (2017, fig. 12).
6. **Club** length is **<7mm** with **eight rows** of suckers.
7. We have not found any information about the presence of an internal flap in the funnel (as with *Sepietta oweniana*, see Øresland & Oxby (2021).

Ten-armed squids

These are large cephalopods that have an **elongated body** and more **powerful fins** compared to bobtail squids. The mantle is **not** connected to the head and the arms have two rows of suckers. Skin lesions often occur on large cephalopods during trawling. Despite large commercial catches of squids, some species are poorly described, which in combination with great morphological variation can make identification of the species problematic.

Alloteuthis media (Midsize squid)
Alloteuthis subulata (European common squid)

Gebhardt & Knebelsberger (2015), Jereb, et al. (2015), Muus (1959), Sheerin et al. (2023)

These two species are **significantly smaller** than other squids in our waters. They are **difficult** to distinguish by external characteristics alone. Both species have "**heart-shaped"** fins, unlike the *Loligo* species (below) which have distinctly rhombic fins. Juveniles of *Alloteuthis* can be confused with those of the genus *Loligo.* Note that the fins are elongated into a **pointed "tail**", but **great variations in shape and ML** occur (Muus, 1959, fig. 85). Past misidentifications may have resulted in mixing of information in the literature on both species. Identification should therefore be limited **to genus** until better external and internal morphological data are available.

Historically, both species have been considered to co-exist in the North Sea and southwards (Muus, 1959), but Sheerin, et al., 2023) were able to show with **DNA** and **morphological** studies that ***Alloteuthis media*** is the more northerly species of the two and the **only one DNA-identified** in the **North Sea.** Individuals from the **Kattegat** and **Danish waters** could also be DNA-identified (so existence in **the Skagerrak** can be assumed). However, it cannot be ruled out that *Alloteuthis subulata* has previously been found in the North Sea and in our waters (and thus perhaps the species can return). DNA and external and **internal** morphological data based on large data sets from different areas, seasons, size/age classes and sex are needed to provide a basis for better species identification. We thus get an opportunity to gain knowledge about the distribution of species, possible migrations, population dynamics and biology/ecology etc.

Both species

Note that these and other characteristics that appear in the literature may be unreliable.
We do not provide max ML since their tail length is extremely variable according to Muus (1959).

1. The fins start near the centre of the mantle (**fig. 41**).
2. The body is covered with a pronounced **coloured dot pattern** (**fig. 41**).
3. **Club** suckers in four rows with two **large suckers in the middle** and two smaller ones next to them. **Fig. 43** shows the outermost part of the club with small suckers,
4. The club length is **maximum 11 mm** in ***A. subulata*** and **at least 12 mm** in ***A. media***.
5. The **hectocotylus (fig. 44)** of both species on the **LAIV** and the first **9–16 pairs of suckers are normal** and the **outer** suckers are **papillae-like** (as in *Loligo forbesii*, which, however, can be easily distinguished from *Alloteuthis,* spp., see below). Better studies of the club and hectocotylus of both *Alloteuthis* species are desirable.

6. In our specimens we have found an eye tumour (**fig. 45-47 a-b**) that, so far, appears to be limited to *Alloteuthis,* as we have not found it in any other genus in our waters. The tumour grows into the eye from the side and causes **blindness** and may have a **high prevalence** (**59%**). We found 7 specimens with no tumour, 3 with one tumour and 7 with 2 tumours (one on each eye). There is a similar high prevalence in large specimens at the Gothenburg Museum of Natural History. We have found this tumour also in **small individuals** (ML 18–40 mm, prevalence **59%,** n=51). There is a need for more research on the distribution, ecological consequences and development of this tumor as well as possible environmental and epigenetic causes. This should also include investigating possible tumours of *Alloteuthis subulata.* The tumour was confirmed by Camino Gestal Mateo using histological and molecular data from our samples in Swedish waters. See Gestal, Pascual, & Culloty (2019) for more information on tumours in cephalopods.

Fig. 41. ***Alloteuthis sp***. (male in formalin). Note the short arms in relation to the length of the mantle and the shape and position of the fins (ML = 145 mm). The fins start near the middle of the mantle.

Fig. 42. ***Alloteuthis sp***. (in formalin). Clubs with suckers in different sizes.

Fig. 43. ***Alloteuthis sp*.** The outermost part of the **club** with small suckers.

Fig. 44. ***Alloteuthis sp*.** **Bottom: Male hectocotylus** on **LAIV** with suckers at the end of the arm modified into a papilla shape. Note that small thin structures are often more visible in water. **Top: female LAIV** with small suckers at the end.

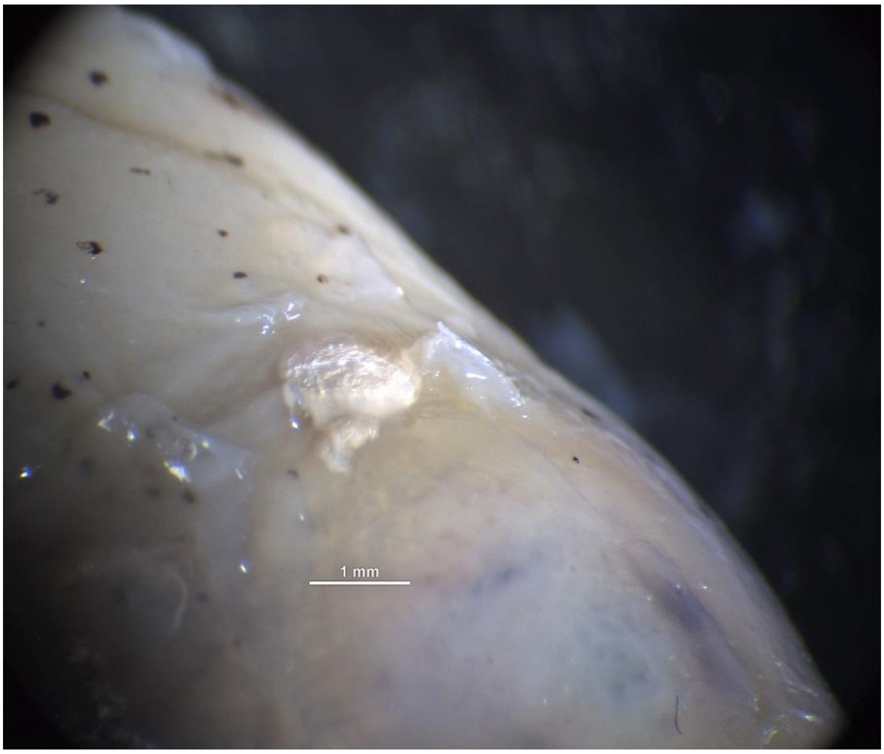

Fig. 45. ***Alloteuthis sp*.** A small whitish tumour close to the eye.

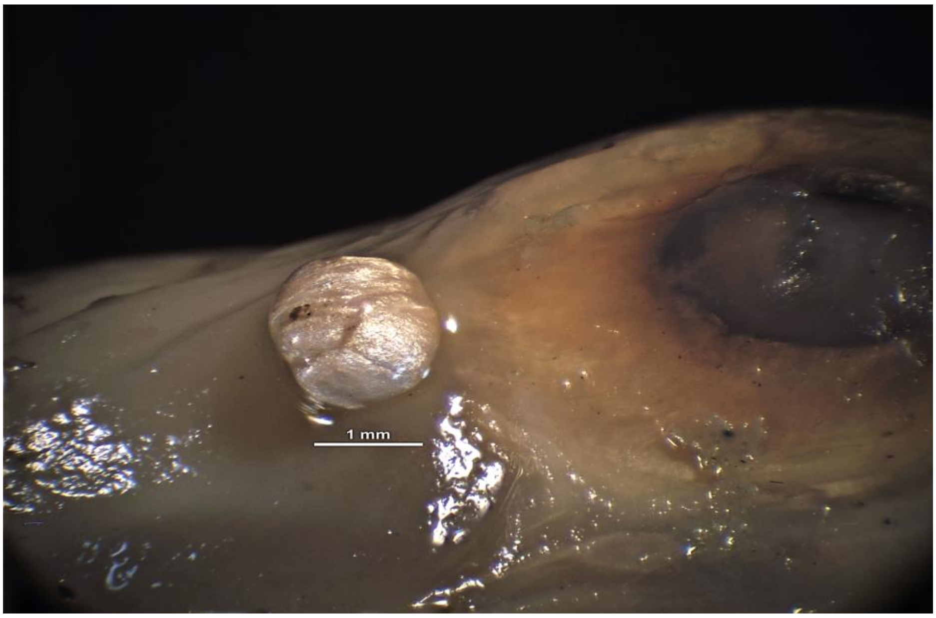

Fig. 46. ***Alloteuthis sp.*** A medium sized tumour close to the eye.

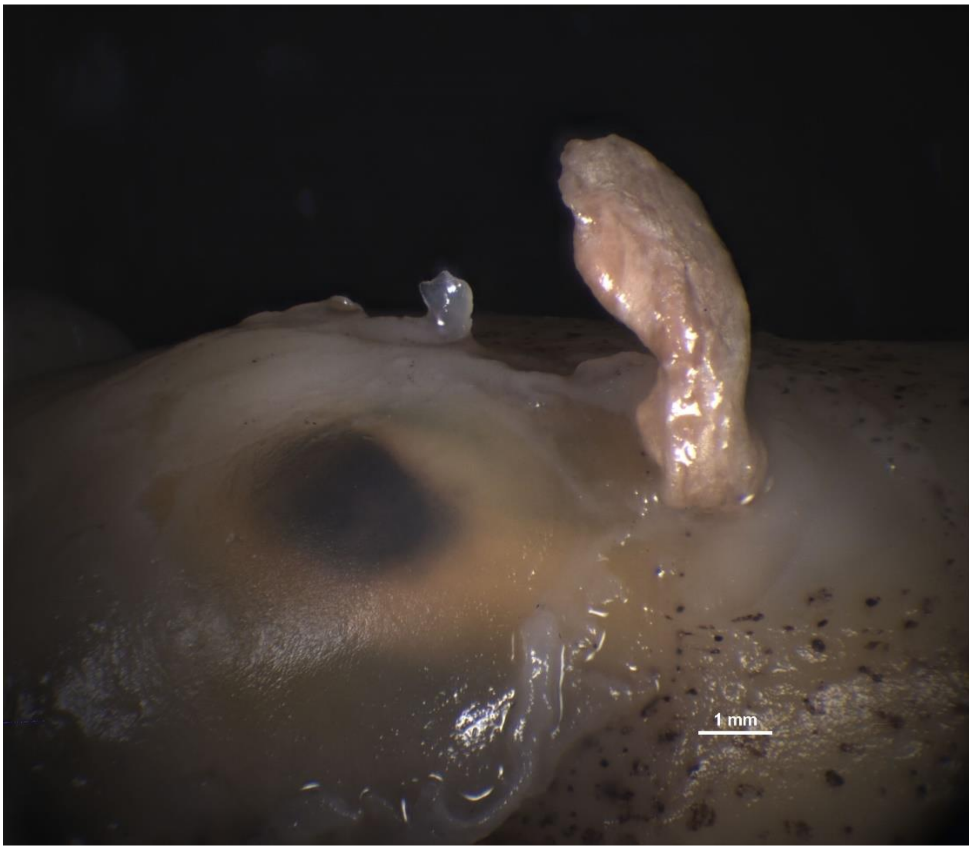

Fig. 47a. ***Alloteuthis sp.*** A large tumour close to the eye.

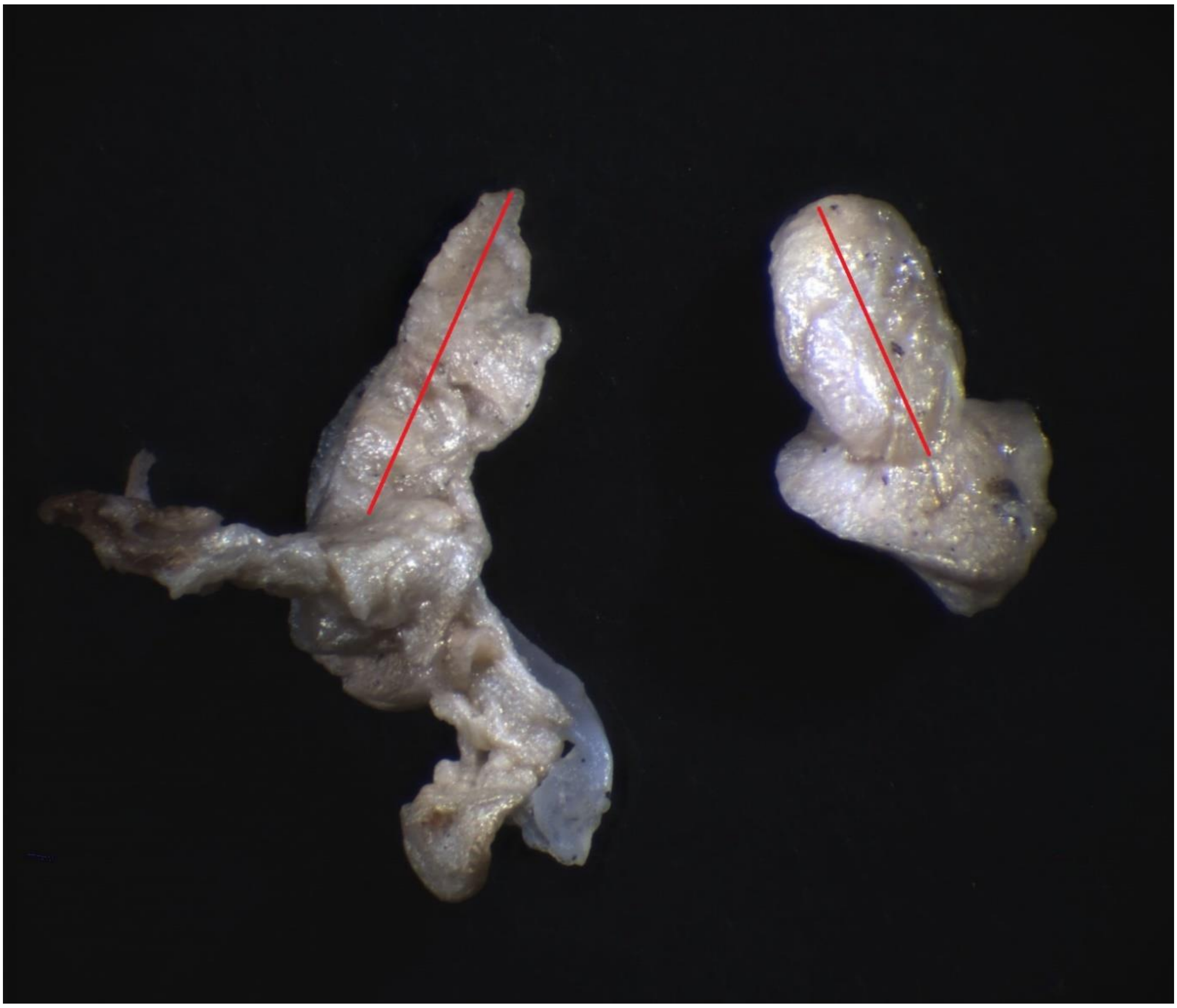

Fig. 47 b. ***Alloteuthis sp.*** A large and medium-sized eye tumour. The area below the red line is a part of the tumour inside the eye.

Loligo

Both of our two *Loligo* species have **two rows** of suckers on their **arms** and **four rows** on the tentacle clubs. The male **hectocotylus** is found on **LAIV** where the suckers on the outermost third of the tentacle have taken on a papilla-like shape. The fins are "**rhombic**" (**fig. 41**) and **never extended as with *Alloteuthis***. The length of the fins >50% of ML. Both species occur in the Skagerrak, the Sound, the Kattegat and down to the southwestern Baltic Sea.

Loligo forbesii (The veined squid)

Goud, Heij & Hiemstra (2019), Jereb et al. (2015), Muus (1959)

1. The fins start at about **1/3–1/4 of the length of the mantle** (**fig. 48**).
2. The mantle has **distinct 1–4 cm long dark, reddish-brown streaks**, which are most easily seen on the sides and underside of the mantle (**fig. 49**).
3. The **club** has four rows of large suckers (**fig. 50**). The large suckers sometimes seem to have both large and small teeth, but, if they are to be used for species identification, a larger amount of material needs to be examined.
4. ML: males 10-45 cm; females 17-35 cm.
5. Weight: males 155–3700 g; females 200–1150 g.
6. A **hectocotylus** (no photo, but see fig. 80 in Muus, 1959) is on **LAIV** and has, on **the first third, two rows of ordinary suckers.** These have subsequently been modified into **large papillae** that gradually decrease in size on the outermost third of the arm.
7. **Arms**. The large suckers generally seem to have even-sized teeth.

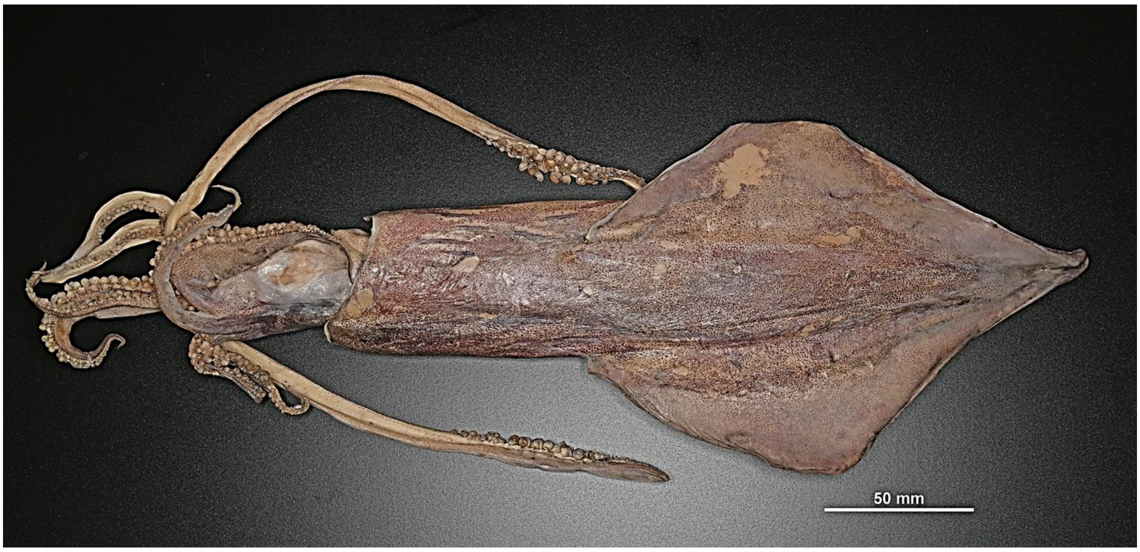

Fig. 48. *Loligo forbesii* (female in formalin). The head is here slightly twisted in relation to the mantle due to preservation.

Fig. 49. Loligo forbesii (female in formalin) with **typical dark streaks**.

Fig. 50. ***Loligo forbesii*** (female in formalin). **Club** with large suckers in four rows.

Loligo vulgaris (European squid)

Goud, Heij, & Hiemstra (2019), Jereb et al. (2015), Muus (1959)

1. Larger males **sometimes** have dark reddish streaks (as in *L. forbesii*), but they are smaller and fewer in number.
2. The fins start at **about 1/3** of the length of the mantle (**fig. 51**).
3. ML <46 cm.
4. The **club** has large suckers in four rows (**fig. 52**). Specimens with ML < 80 mm have not yet developed similar suckers and can thus be confused with young *Loligo forbesii*. Large **teeth** with **smaller pointed teeth in between** may appear on the large suckers of the club (**fig. 53**) but if they are to be used for species identification, a larger material needs to be examined. The outer small suckers of the club are shown in **fig. 54**.
5. The **hectocotylus** on the **LAIV** has papilla shaped suckers at the end (we have no photo). The **female's** LAIV is shown in **fig. 55**.

Fig. 51. ***Loligo vulgaris*** female (in formalin) with slightly bent tail and left fin and the mantle was damaged during trawling.

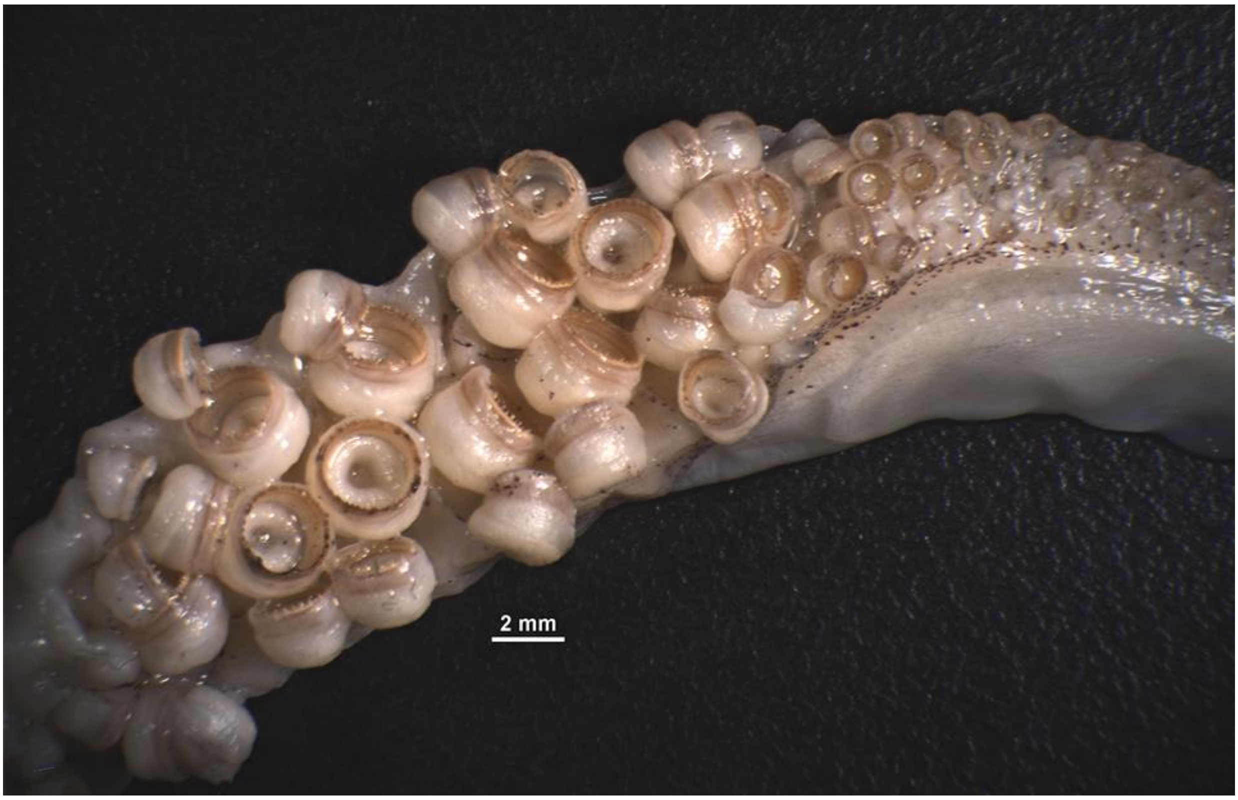

Fig. 52*. *Loligo vulgaris. Club with suckers in four rows.

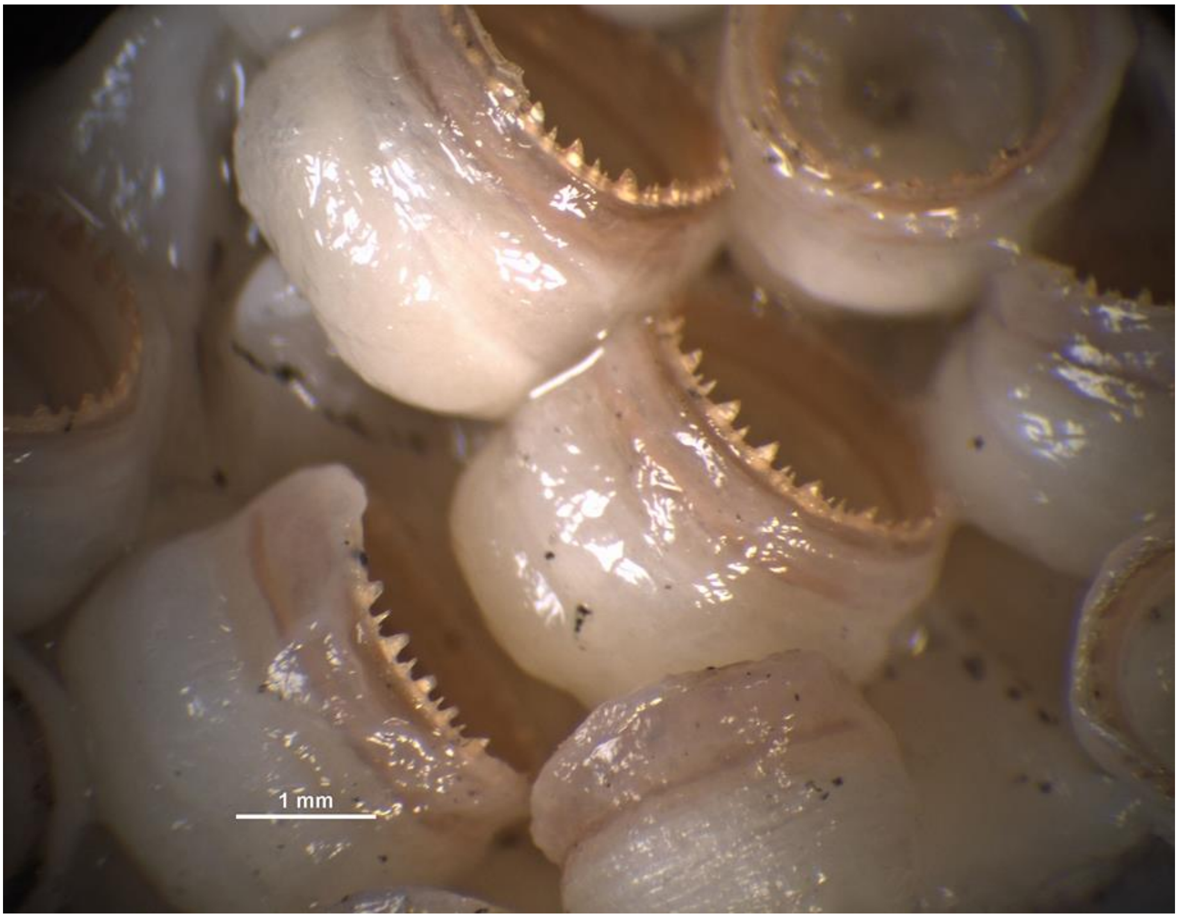

Fig. 53. ***Loligo vulgaris.*** The **club's** large suckers **can** have short, pointed, narrow teeth between the large teeth, but this differs between the various suckers. **Note** that even the large suckers on **the arms** can have small teeth in-between the large ones. These small teeth can be **difficult to discern** and easily get lost in chlorine which should therefore not be used for *Loligo*.

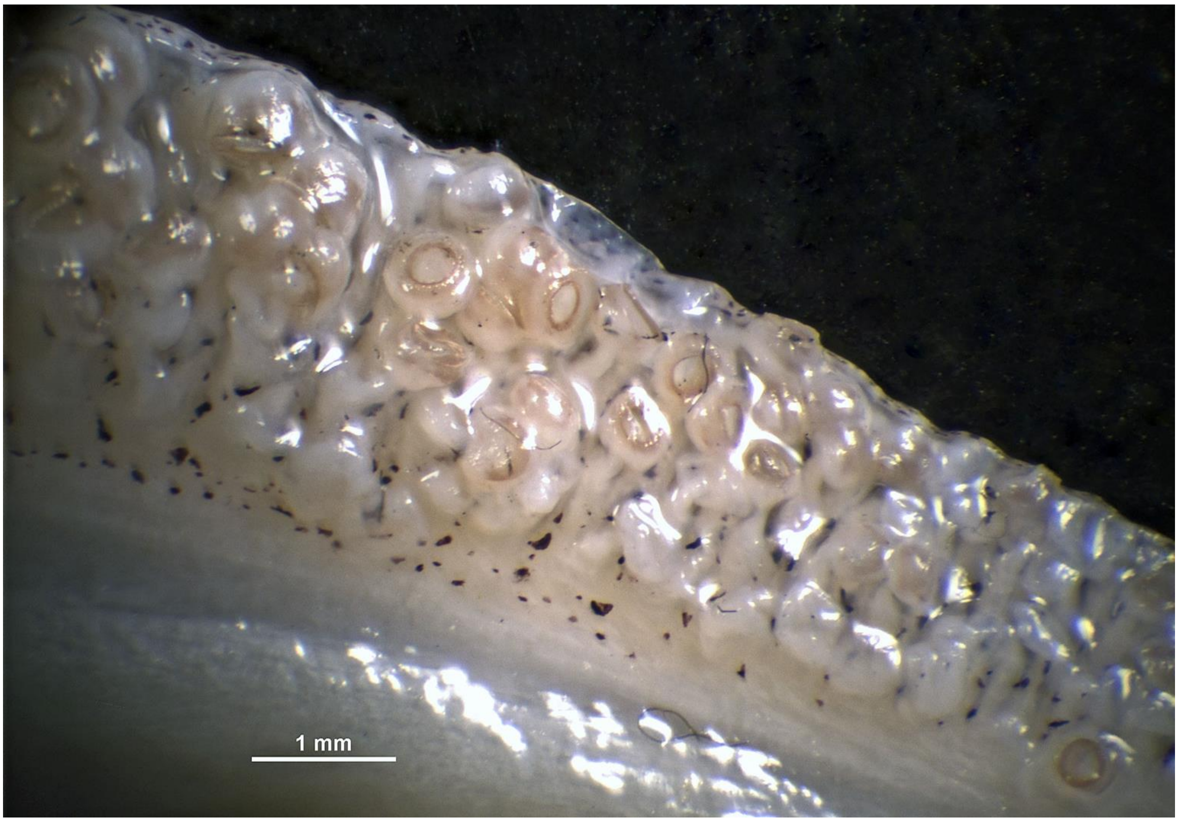

Fig. 54. ***Loligo vulgaris.*** Club with outer small suckers.

Fig. 55. ***Loligo vulgaris***. Female LAIV.

Todaropsis eblanae (Lesser flying squid)

Goud, Heij, & Hiemstra (2019), Jereb et al. (2015), Muus (1959)

1. The body has a **dark** oblong **dorsal marking** and dark **spots over the eyes** (**fig. 56**). Compare with *Illex coindetii* (**below**) which has similar colours.
2. The fin length measures close to **50% of the mantle length** (**fig. 56**). It has a rhomboid shape with an upper part that **turns in** towards the centre of the mantle. Compare with *Illex coindetii* (**fig. 63** below) which has similar fins but in a different location.
3. The **arms** have two alternating rows of suckers (**fig. 57**) and the largest have pronounced, pointed teeth (**fig. 58**).
4. Both **AIII** have a **strong outer "swim strip**" that is almost of the same width as the arm. The other arms have a smaller "swim strip" (**fig. 59**).
5. A **hectocotylus** on both **LAIV** and **RAIV** but differing in appearance (**fig. 60**).
6. The tentacle **club** has **large suckers**, which are up to 4 times larger in diameter compared to the smaller, **outer** suckers (**fig. 61**). The largest suckers have about **30 short pointed teeth** with some variation (**fig. 62** shows 37 teeth).
7. Max ML: males 220 mm; females around 270 mm.

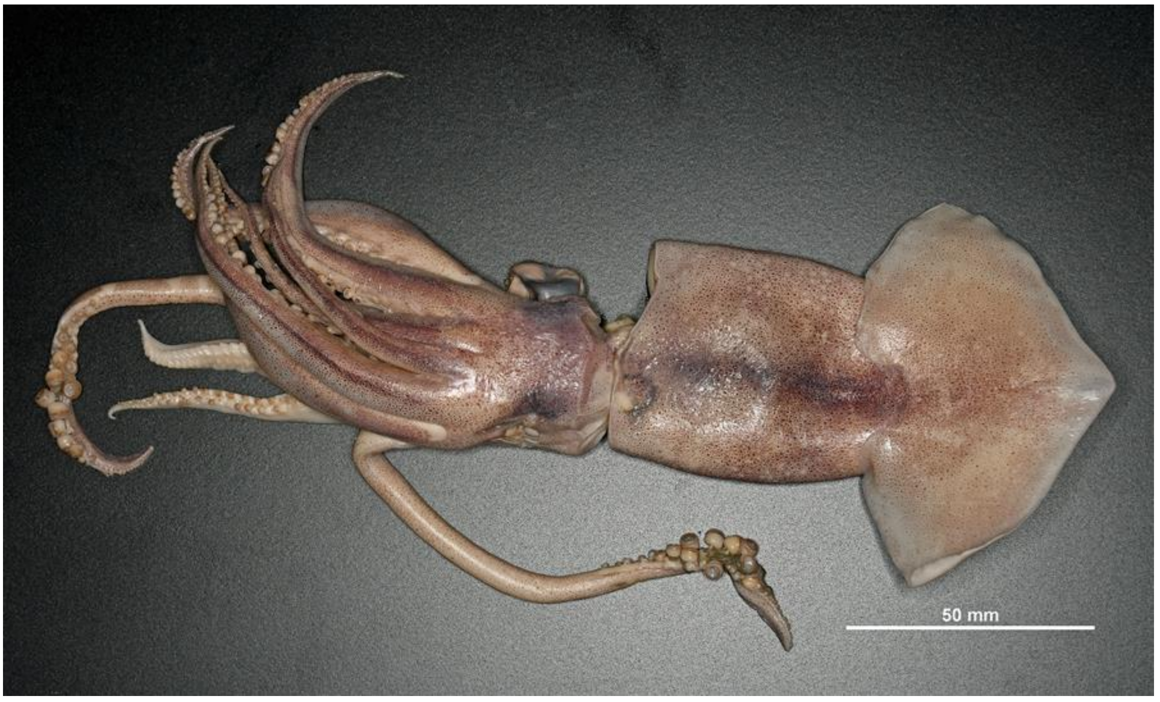

Fig. 56. *Todaropsis eblanae.* Rhomboid-shaped fin (close to 50% of ML).

Fig. 57. ***Todaropsis eblanae.*** Suckers on the **arms** are in alternating rows.

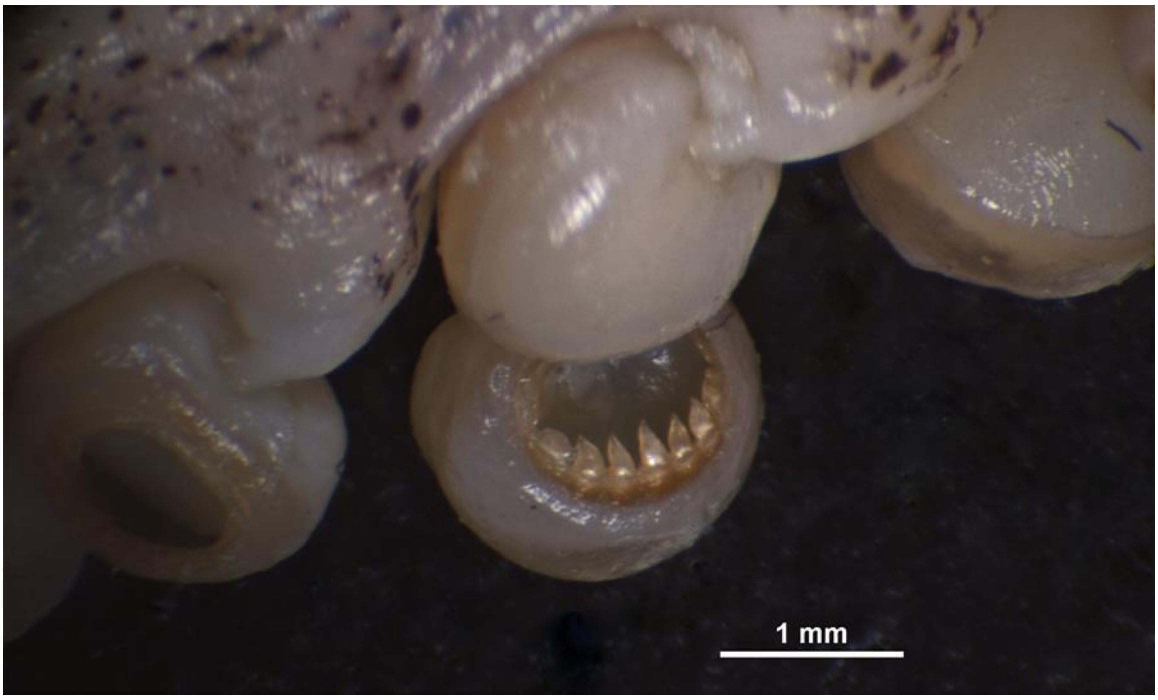

Fig. 58. ***Todaropsis eblanae.*** Powerful teeth on the large suckers of the **arms**.

Fig. 59. ***Todaropsis eblanae.*** Large swim strip on **AIII** (top) that decreases significantly before reaching the end of the arm.

Fig. 60*.* *Todaropsis eblanae*. A hectocotylus on **both LAIV** and **RAIV** but differing in appearance.

Fig. 61. ***Todaropsis eblanae*****.** The tentacle **club.** Note the size of the middle and outer suction cups.

Fig. 62. ***Todaropsis eblanae***. The tentacle **club.** Teeth (n = 37, in this case) on large suckers. Compare with the suckers on the arms (**fig. 58**).

Todarodes sagittatus (European flying squid)
Goud, Heij, & Hiemstra (2019), Jereb et al. (2015)

We have no specimens and therefore **only** provide a **written description**.

Distinguished from *Todaropsis eblanae*) mainly by:
1. Larger body length: ML >650 mm.
2. The fin is rather **more arrow-shaped** than rhombic, hence the name sagittatus, from the Latin sagitta meaning arrow.
3. The tentacle **club** is relatively l**ong, with suckers** found **far down on the tentacle**, where they gradually decrease in size.

Illex coindetii (Broadtail shortfin squid)

Goud, Heij, & Hiemstra (2019), Jereb et al. (2015), Muus (1959) (who used the name *Illex illecebrosus coindettii*)

The appearance of this species **varies greatly** with different morphological variants and **colours** (here seen as dark, brown and red). For the purpose of identification, it is important for future research to indicate the colour of the specimens. One should not rule out the possibility that the red variant here is due to external factors. Descriptions of the species are highly variable. Since the species is of commercial interest, differences in morphology between various distribution areas should be better described. We **currently identify** all our specimens within the genus as ***Illex coindetii being*** aware that future taxonomic knowledge and changes in distribution within the genus may change this. Genetic studies of different colour variants are desirable.

1. The body is elongated with fins that are slightly rhombic and **fold in** towards the middle of the mantle (compare with *Todaropsis eblanae*, **fig. 56**). Fin length measure **about** 40% of the ML and start at about 60% of the ML (**figs. 63–65**). Compare this with *Todaropsis eblanae* (**fig. 56**) which also has rhombic fins but they start further forward on the mantle.
2. The **colours varies a great deal**. The body has a **dark** oblong **dorsal marking** and dark **spots over the eyes** (**figs. 63–65**). Compare this with *Todaropsis eblanae* (**fig. 56**) which has similar dark markings.
3. **The arms** have two rows of suckers with **wide and flat teeth** on the **large** suckers. **One tooth can be larger** and **pointed,** but **some** are **without a point** or need dissecting **in order to** be seen. We found one **pointed tooth in all** our colour variants (**figs. 66–69**). The wide teeth vary in width. **Small suckers** on the arms have **strong** and **pointed** teeth (**fig. 70**). Suckers should be placed in household chlorine, diluted with water, for no more than 5 -10 minutes, since smaller teeth especially can be corroded. The suckers should then be transferred into water before the process has gone too far.
4. **The large suckers of the club** are centrally located, with smaller suckers along the sides (**figs. 71-72**). The large suckers of the club do **not** appear to have a large tooth and the teeth are wide (**fig. 73**) as with the large suckers on the **arms**. Small suckers have pointed teeth. The **club end** has **8 rows** lengthwise with small suckers (**fig. 74**).
5. A hectocotylus is on the **LAIV or RAIV** and rarely on both (**fig. 75**).
6. Max ML: males 279 mm; females around 379 mm.

Fig. 63. *Illex coindetii.* Dark variant in formalin.

Fig.64.* *Illex coindetii. Brown variant in formalin.

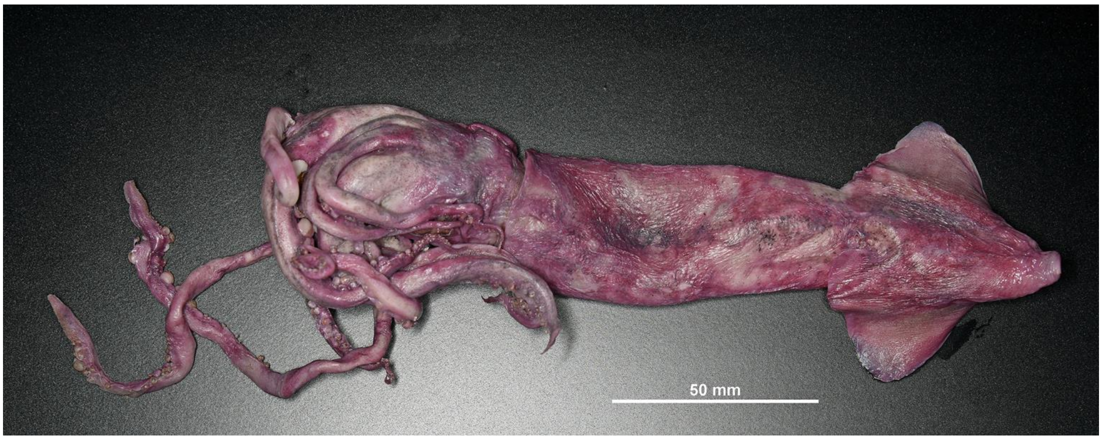

Fig. 65. Illex *coindetii.* Red variant in formalin. This is perhaps a less common colour variant in Swedish waters. One should not rule out the possibility that the red variant here is due to external factors.

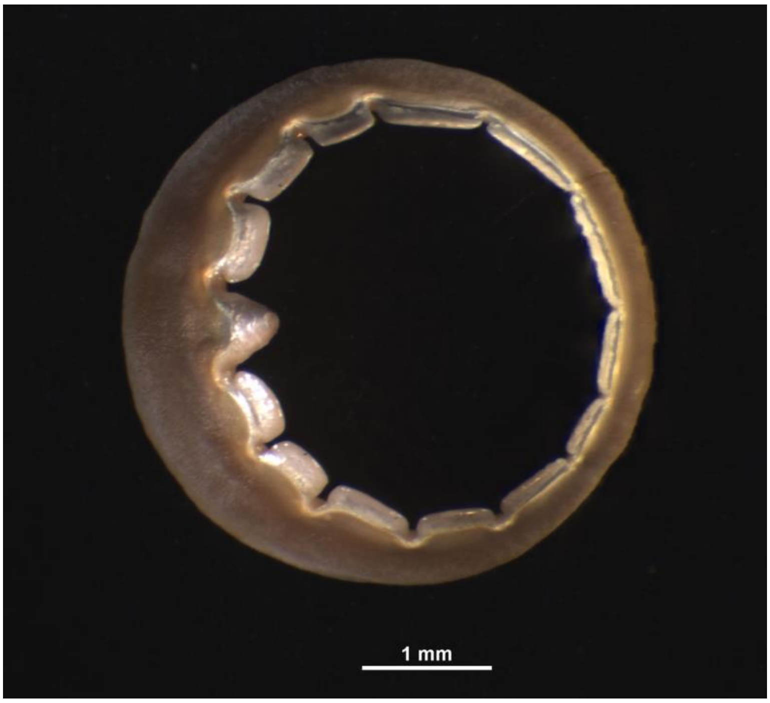

Fig. 66. ***Illex coindetii*** (dark variant, arm). A large pointed tooth (from a large sucker which has been in chlorine).

Fig. 67. ***Illex coindetii*** (brown variant, arm). A large sucker with a large pointed tooth. Note that the teeth are covered by a light sucker sheath in this specimen, which necessitated folding down the sheath with dissection needles.

Fig. 68. ***Illex coindetii*** (red variant, arm). A large pointed tooth (from a large sucker which has been in chlorine).

Fig. 69. ***Illex coindetii*** (red variant, arm). A large pointed tooth and wide teeth on the opposite side (from a large sucker which has been in chlorine).

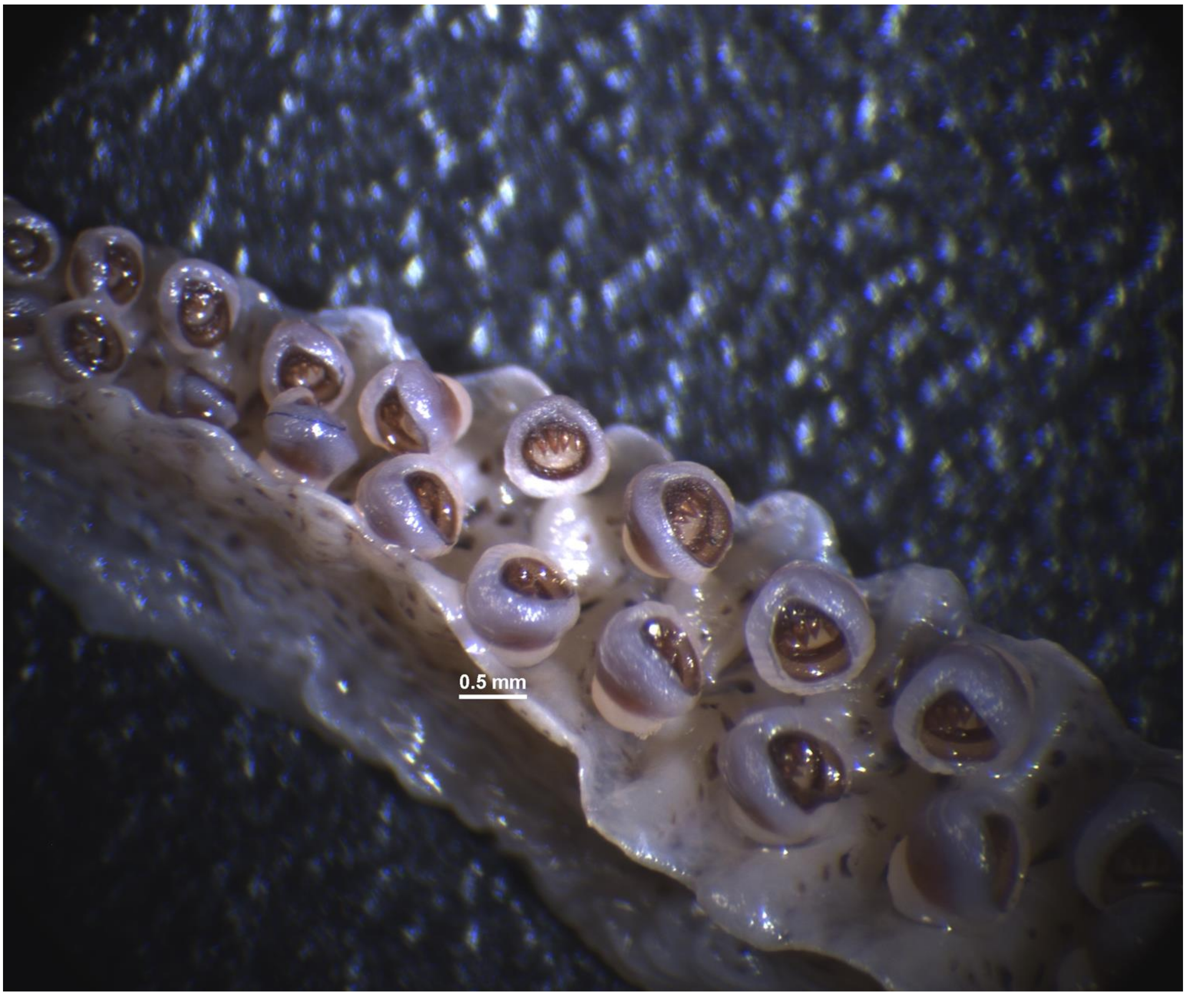

Fig. 70. ***Illex coindetii*** (brown variant). **Arm** with strong and pointed teeth **on small** suckers.

Fig. 71. *Illex coindetii* (red variant). **Club** (somewhat deformed).

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Fig. 72. ***Illex coindetii*** (brown variant). **Club** with large suckers centrally and smaller ones along the sides.

Fig. 73. ***Illex coindetii*** (red variant). **Club** with large suckers that do **not** seem to have a large pointed tooth as seen on the arms. **Small** suckers have **pointed** teeth.

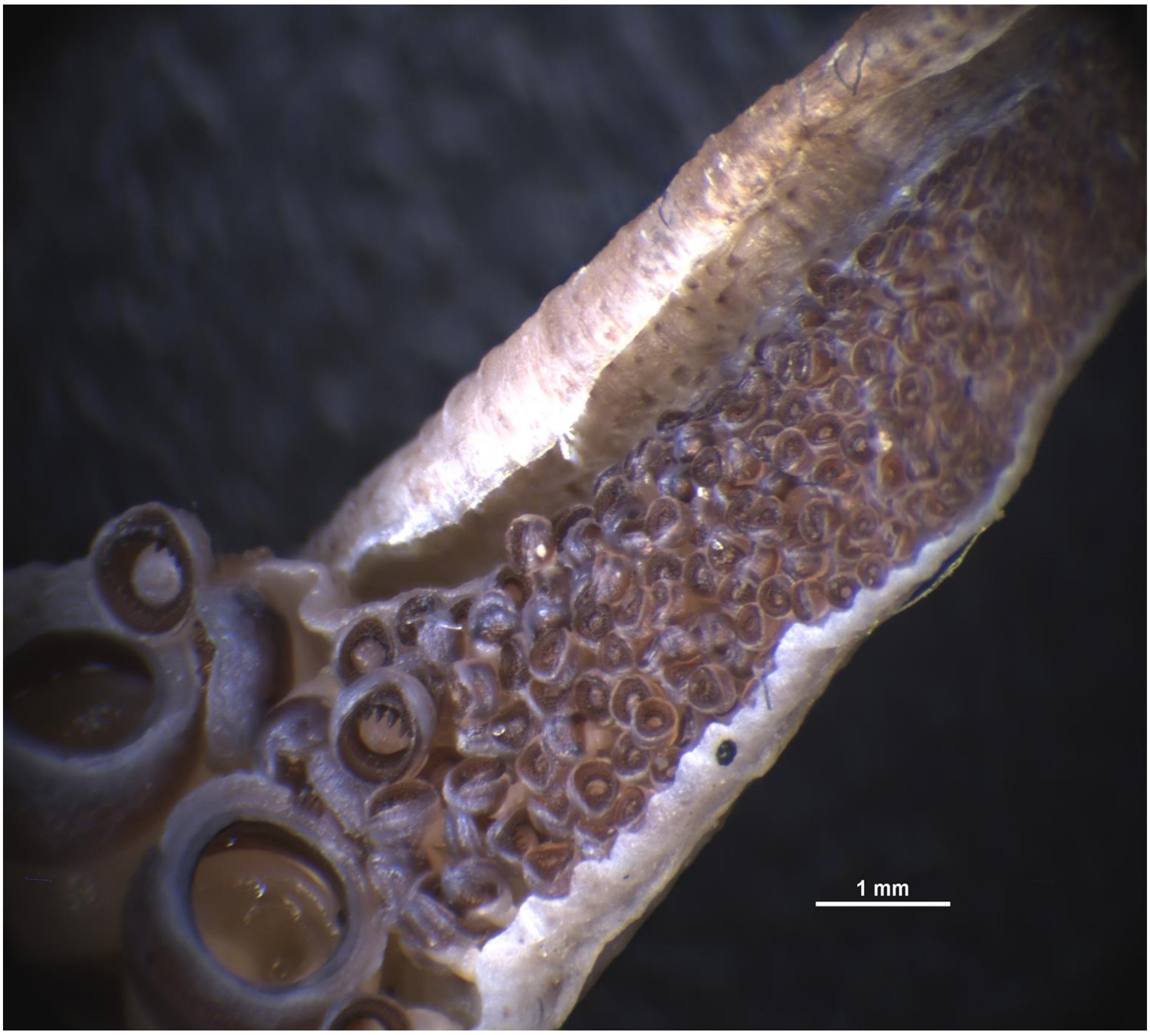

Fig. 74. ***Illex coindetii*** (brown variant). **The outer part of the club** with s**mall** suckers in about eight rows.

Fig. 75. ***Illex coindetii*** (red variant). The outer part of the male **hectocotylus** on the LAIV (cut off) with modified suckers.

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