**General Introduction**

**Morphology and Biology**

Nemertean worms, also called ribbon worms, are slender worms without external body appendages (Figs. 1 & 2). They range in length from a few millimetres to several meters, while their body diameter rarely exceeds a few mm, but can be up to 20 mm. One nemertean species, *Lineus longissimus* (Fig. 3), has been recorded in the book of Guinness 1995 as the longest living animal on earth. In this species, individuals of more than 30 m body length with a body diameter of a few mm have been recorded. However, the common nemerteans that one typically finds are several cm up to 50 cm in length. Most nemerteans are marine but there are also a few freshwater and fully terrestrial species. With the exception of a few hermaphroditic species, nemerteans are gonochoric.

Development can be direct (in the Hoplonemertea) or indirect. Direct development can be via a non-feeding planktonic larva or an encapsulated larva with a benthic crawl-away juvenile. Indirect development is typical for the Pilidiophora (which includes the old order Heteronemertea) and usually involves a feeding planktonic larval stage (Pilidium) of variable duration (days to weeks), but this may be modified as a non-feeding benthic or planktonic development (e.g., Iwata or Desor's larva).

All nemerteans have an eversible proboscis, which they employ in prey capture and sometimes for escape. Some species actively forage for their more sedentary prey, while others hide in strategic positions, e.g. in mussel or algal patches, waiting for their mobile prey.
species. Due to the lack of any external appendages, nemerteans move either by cilia (in the smaller species) or peristaltic contractions of the body musculature (in the larger species). Consequently, nemerteans are relatively slow-moving organisms, comparable in speeds to snails, sea stars and sea urchins. Upon encountering a prey organism, however, a nemertean can rapidly evert its proboscis and immobilize prey with highly potent toxins. Nemerteans of one major group (Hoplonemertea) possess a stylet in the proboscis, which they use to puncture the hard exoskeleton of prey, mainly small crustaceans. Nemerteans without such a stylet prey on other worms, mainly polychaetes, but also on bivalves. A few nemerteans are obligate symbionts, living either in association with marine decapod crustaceans (mainly crabs) and preying on their developing embryos or living in the mantle cavity of bivalves and feeding on particles brought in by the host.

**Phylogeny**

Based on morphological characteristics, two classes of nemerteans had been previously distinguished: the Enopla with one or more stylets on the proboscis and the styletless Anopla. Recent molecular analyses confirmed that the Enopla are monophyletic but challenged the monophyly of the Anopla. Thollesson & Norenburg (2003) distinguished the Enopla (=Hoplonemertea), which comprise the Monostilifera (with one functional stylet) and the Polystilifera (with several functional stylets). Based on their results, these authors abandoned the Anopla but created the Pilidiophora, which includes all of the Heteronemertea and some former Paleonemertea. The Pilidiophora and the Hoplonemertea form the new clade Neonemertea, which is separated from the remaining taxa previously belonging to the class Anopla, namely the Paleonemertea, which apparently is not monophyletic.

**Collection and Identification**

Nemerteans should be collected alive, because when they are preserved without appropriate treatment their posterior identification may be severely compromised. When fixed in formalin or ethanol, most species contract or fragment, evert the proboscis and moreover lose their colour. Thus, in preserved samples one often finds nemerteans, but these are usually impossible to identify. Large species from intertidal or shallow subtidal hard bottoms can be found by turning over rocks and small boulders. Upon encountering a nemertean, it should be carefully transferred into a sampling jar with the aid of a spatula, soft forceps or a paint brush. Smaller species (less than 5 cm in body length) can best be obtained alive by transferring benthic substrata (gravel, coral rubble, mussel patches, kelp holdfasts) to the laboratory (in large buckets...
or trays) and maintaining them in standing seawater for a few hours. The agitation during sample transfer usually induces the nemerteans to abandon their hiding places, which is when they can be easily found, often crawling along the wall of the buckets or trays. They can then be placed in a petri-dish to observe them under a dissecting microscope. Careful observation of the living specimen allows identifying important body characteristics that often cannot be seen after preservation, such as body colour, cerebral furrows, number and pattern of eyes, movement patterns and general body shape.

The identification of nemerteans is further complicated due to their lack of external body characteristics. Consequently, their identification is almost entirely based on histology, where the number and thickness of muscle layers, position of the cerebral ganglia and the nerve cords relative to body-wall musculature, structure of the rhynchocoel and the proboscis, and other characters are of importance (Figs. 1&2). In order to prepare these delicate worms for histology, they must be very carefully preserved (after anesthetizing them) in particular liquids and then embedded in paraffin wax. The embedded worms are then sectioned and stained for better visualization of the relevant internal organs.

These complicated procedures represent an important obstacle to species identification and it is mainly for this reason that for many regions of the world we have no thorough inventory of nemertean diversity. In contrast, it is relatively easy to match unknown nemerteans to those described from other regions of the world, which has led to many questionable species distributions. The lack of reliable species identifications often also impedes studies of their biology and ecological role. Nevertheless, when found alive, some of the more common nemertean species can be easily identified based on their body size and primarily on their colouration. While poorly known to the general public and even to many marine biologists, nemerteans are ubiquitous predators in most marine habitats.

Nemerteans of the Chilean Fjord Region

In this chapter four of the best known nemertean species from southern Chile are shown and described. Common names are given by the editors to enhance local non-scientific species knowledge. For Chile about 45 nemertean species have been recorded (R. Gibson, personal comment) and several of these are found in the fjord region of southern Chile. Their identification is complicated and next to nothing is known about their biology. The first records of the Nemertean fauna from Chile come from Bürger, Isler and Coe (for references see Friedrich, 1970). These records were synthesized by Friedrich (1970), who also examined the nemerteans collected in 1948–1949 during the Lund University Chile Expedition (unfortunately most of these samples were preserved without particular procedures, making a correct identification improbable). During the 1980s, Dr. Malva Sanchez added several new records to this list. She and her co-workers also described several new species, including Prosorhochmus nelsoni (originally described as Amphiporus nelsoni) and Procephalothrix hermaphroditicus, both also known from southern Chile. The complete species list presented in Appendix 2 is mainly based on the records by Friedrich (1970). Most of these records need to be interpreted with great caution and require reconfirmation or re-descriptions.

Classification

Class Neonemertea Thollesson & Norenburg, 2003
Order Enopla (=Hoplonemertea) Schultze, 1852
Suborder Monostilifera Brinkmann, 1917
Family Prosorhochmidae Bürger, 1895
Prosorhochmus nelsoni (Sanchez, 1973)
Order Pilidiophora (previously Anopla)
Thollesson & Norenburg, 2003
Suborder Heteronemertea Bürger, 1892
Family Baseodiscidae Bürger, 1904
Baseodiscus aureus (Bürger, 1896)
Family Lineidae McIntosh, 1873–74
Lineus atrocaerulus (Schmarda, 1859)
Parborlasia corrugatus (McIntosh, 1876)

Order Enopla (=Hoplonemertea)
As in all other hoplonemerteans, esophagus opens internally from the rhynchodaeum (Fig. 1) — consequently there is no external mouth opening in P. nelsoni (and in most other enoplans). 2-layered body-wall musculature with outer circular muscle layer and interior longitudinal muscle layer (Fig. 2). Lateral nerve cords medial to body-wall muscle layers.

Genus Prosorhochmus
Externally visible characters are an anterior frontal furrow (transverse across the snout), giving the appearance of a
smile; 2 pairs of eyes, and lateral, dorso-ventrally oriented, cephalic furrows. Rhynchocoel extends throughout body length, proboscis armed with 1 central stylet and 2 pouches of accessory stylets. Dermis and body-wall musculature moderately thick. Frontal organ well-developed with 1 ciliated tubular canal opening at tip of head.

Order Pilidiophora (previously Anopla, Heteronemertea)
Mouth postero-ventral to cerebral ganglia, separated from anterior, terminal proboscis pore (Fig. 1). 3 primary body-wall muscle layers, typical for heteronemerteans, with lateral nerve cord between outer longitudinal and circular muscle layer; internal organs, including rhynchocoel, intestine, blood vessels and nephridia, medial to inner longitudinal muscle (Fig. 2).

Genus Baseodiscus
Externally visible characters are presence of ventral mouth, and pair of lateral, dorso-ventrally oriented, cephalic furrows mark back of so-called head region, with pore to a cerebral sense organ at midpoint of each furrow. Each furrow bears orthogonally directed faint secondary furrows and ridges (hence, each primary furrow appears comb-like) that can be seen in live or well-preserved specimens. Longitudinal cephalic slits absent. Eyes usually present and scattered along entire cephalic margin. Caudal cirrus absent. Rhynchocoel usually less than ⅓ body length; proboscis with 1 or 2 muscle layers (in everted state: longitudinal or outer longitudinal + inner circular); rhynchocoel-wall musculature not interwoven with body-wall muscle layer. Dermis thick, usually divided into outer glandular zone and well-developed inner connective tissue zone.

Genus Lineus
Externally visible characters are lateral, longitudinal cephalic slits and ventral mouth in head region. Caudal cirrus absent. Proboscis with 2 or 3 muscle layers (in everted state: outer circular + inner longitudinal, or dermal outer longitudinal + outer circular + inner longitudinal); rhynchocoel-wall musculature not interwoven with body-wall muscle layer. Dermis may or may not be separated from muscle layers by connective layers.

Genus Parborlasia
Externally visible characters are lateral, longitudinal cephalic slits along head and ventral mouth. Proboscis with 3 muscle layers (as above); rhynchocoel-wall musculature not interwoven with body-wall muscle layer. Thick dermal glandular zone may or may not be separated from muscle layers by connective layers.

Fig. 3. The nemertean Lineus longissimus is common in coastal waters of NW Europe.
**Proserhohmus nelsoni** (Sanchez, 1973)

**Common name:** Smiling nemertean; Nemertino sonriente

**Description:** Small; adult individuals with body lengths to 4–5 cm. Bright orange colour (see A–C). Anterior part of head bluntly rounded; antero-dorsal horizontal epidermal fold anterior to eyes separates 2 ventral apical lobes from median dorsal lobe, creating the appearance of a “smile” (see D). Proboscis pore can be seen at tip of head. 2 pairs of reddish-brown eyes (often of black appearance) easily visible in living individuals. Reddish cerebral ganglia shine through just behind eyes. Shallow, vertical cephalic furrows also visible laterally in this region (C). Rhynchocoel extending almost to posterior end of worm, with proboscis inside, visible in living individuals (A). Proboscis armed with a stylet; 2 sacs with accessory stylets, usually 1–2 per sac; stylet basis with unusual blunt posterior end (B). Accessory stylets replace main stylet when broken or blunt after repeated use. In histological sections, epidermis followed by circular muscle layer, a thin layer with diagonal musculature and thick longitudinal muscle layer. Numerous bundles of dorso-ventral muscles. Esophagus opens internally to rhynchodaeum; thus no external mouth opening. Prominent cephalic glands in head region; cerebral organs in region of eyes (1 on each side). **Possibility for confusion:** Amphiporus sp. 2, (Friedrich, 1970), which has 6 eyes (4 in *P. nelsoni*) and living animals lack characteristic “smile”.

**Habitat:** Rocky exposed shores. **Depth:** Low intertidal–1 m. **Abundance:** Common. **Distribution:** SE Pacific (PP–NPZ). **Chile:** 18°S–42°S. **Biology:** Food and proboscis pass through proboscis pore and thus proboscis has to be retracted into rhynchocoel before feeding can commence. Can often be seen foraging during low tides at night or under overcast skies, crawling over rocky surfaces or in turf algae. It feeds primarily on small crustaceans, usually amphipods of the genus *Hyale* and isopods of the genus *Ligia*. Upon encountering a potential prey organism, the proboscis is rapidly everted and the stylet punctures the exoskeleton of the amphipod or isopod, injecting a highly potent toxin into the body of the prey, which becomes immediately paralyzed. Initial digestion is extracorporal. The worm’s foregut is partially everted and applied to the puncture hole, enzymes are pumped into the chitinous body of the prey, after which the nemertean seeks entrance through the cuticle with the head. The food slurry is then absorbed via the mouth opening at the tip of the head, often accompanied by peristaltic movements of the body-wall musculature. The entire feeding process is rarely lasting >15 min. Sexes are separate and the female deposits the fertilized eggs in a mucus mass, where embryonic development takes place. No information about duration of the larval phase is available.

**Main references:** Sánchez (1973); Thiel et al. (2001); Maslakova et al. (2005).
Prosorrhochmus nelsoni
Baseodiscus aureus

Phylum Nemertea
**Baseodiscus aureus** (Bürger, 1896)

**Common name:** Golden brown nemertean; Nemertino cobre  
**Synonymy:** *Baseodiscus pallidus* Isler, 1900; probably *B. platei* (Bürger, 1896).  
**Description:** Large; individuals of up to 45 cm body length and 7 mm body width have been recorded. Body dorsum rounded anteriorly, but flattened through most of body length; ventrum flat. Colour yellowish red to reddish brown dorsally, with rapid but not sharp transition laterally to dirty yellowish ventrum (A). Head bullet-shaped or with broadly rounded anterior margin (B–E), with dorso-lateral margins, including cephalic furrows, pale to unpigmented; head can be retracted almost completely into remaining body (B). Mouth either a ventral slit or a large round opening (arrow in C), situated short distance posterior to level of lateral furrows (arrow in E). Eyes were not mentioned in the original description, but were recorded for its junior synonym, *B. pallidus*; 10 or more irregularly scattered blackish eyes along cephalic margin, from close to proboscis pore up to lateral furrows (observed in collected specimens). Friedrich (1970) reports that the rhynchocoel extends through \(\frac{1}{3}\) the body length, that the proboscis has outer longitudinal and inner circular musculature, and that the outer dermal zone of glandular cells is separated from the body-wall musculature by a well-developed connective tissue zone. **Possibility for confusion:** None.  
**Habitat:** Under boulders in the low intertidal.  
**Depth:** Intertidal–2 m.  
**Abundance:** Common.  
**Distribution:** SE Pacific (PP).  
**Chile:** 30°S–41°S.  
**Biology:** Unknown.  
**Main reference:** Friedrich (1970).

**Lineus atrocaerulus** (Schmarda, 1859)

**Common name:** Common ringlet nemertean; Nemertino anillado común  
**Description:** Intermediate size; may reach body length of 40–50 cm and a few mm Ø. Colour dark with up to >50 characteristic white rings along whole length of body; may feature rosy colour around mouth and along edges of cephalic slits (C). Mouth ventral as in other lineids and immediately posterior to cephalic slits and brain (see arrow in D). Obvious, deep, longitudinal cephalic slit on each side of head (C), leads at posterior end to opening of cerebral organ canal. In histological sections, the 3 primary body-wall muscle layers recognizable below thick epidermis with abundant glands. Rhynchocoel extends throughout whole body length. **Possibility for confusion:** None. Can be easily recognized and distinguished from all other nemertean species by its cephalic slits and dark colouration with characteristic white rings (A).  
**Habitat:** Under boulders, among mussels and in kelp holdfasts.  
**Depth:** Intertidal–20 m.  
**Abundance:** Common.  
**Distribution:** SE Pacific (Peru; PP–NPZ).  
**Chile:** 18°S–44°S.  
**Biology:** The unarmed proboscis (i.e. without a stylet) is used to capture the prey, mostly polychaete worms. However, besides occasional chance encounters of nemerteans consuming scaleworms (polychaetes), very little is known about the feeding ecology of *L. atrocaerulus*. Its reproductive biology is virtually unknown but Sánchez & Moretto (1984) found mature females in austral spring. Most likely, *L. atrocaerulous* has a planktonic larval stage, the pilidium larva that is known from other lineids.  
**Main references:** Friedrich (1970); Gibson (1983); Sánchez & Moretto (1984).
Lineus atrocaerulus
**Parborlasia corrugatus** (McIntosh, 1876)

**Common name:** Common scavenger nemertean; Nemertino carroñero común  
**Description:** Large; individuals of >200 cm body length have been reported; body width of contracted large individuals to 30 mm. Colour uniform; white, greenish, bright and very dark pink. Edges of cephalic slits with yellowish-white colour, which extends along anterior part of head. Some specimens with characteristic white band in head region, which may completely cross body but often only 2 white patches slightly before posterior end of cephalic slits (A). “Collar” in posterior head region (A). Remarkably large mouth ventrally behind anterior tip of body. Histological studies revealed spherical bodies along both edges of head, interpreted by Gibson (1983) as eyes — these structures usually are not visible in living individuals. Central lacuna, which may be interrupted by tissue and muscle strings, in head region below rhynchodaeum. Dermis separated by thick connective layer from body-wall musculature; rich in gland cells. Rhynchocoel extending throughout entire body length; but proboscis, which is coiled several times in anterior half of rhynchocoel, does not reach all the way through rhynchocoel.  
**Possibility for confusion:** *P. fueguina* Serna de Esteban & Moretto 1968, which has a transverse yellow band about the head in living animals.  
**Habitat:** Diverse benthic habitats, including intertidal boulder shores and subtidal soft sediments.  
**Depth:** Intertidal→800 m.  
**Abundance:** Common in the circumantarctic region.  
**Distribution:** Circumantarctic; SE Pacific (NPZ–SPZ); Strait of Magellan.  
**Chile:** 42°S–56°S.  
**Biology:** Well known as a fast and efficient scavenger that quickly aggregates on carrion deposited on the seafloor. Dense aggregations of tens of individuals are often found on recently dead animals. They can be easily collected by putting out fresh bait, which is perceived over large distances and quickly localized and exploited by this nemertean.  
**Comments:** Mostly known from preserved benthos samples. In this context, Gibson (1983) notes that “living *P. corrugatus* typically possess bodies that are smooth and moderately flattened, with a somewhat wedge-shaped and distinct head. During fixation, however, they characteristically contract strongly into a variety of shapes; often the epidermal surface is then so conspicuously wrinkled that the origin of the specific name is obvious.”  
**Main reference:** Gibson (1983).
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caudal cirrus</td>
<td>Small tail-like appendix at the posterior end of the body, extending beyond the anal pore.</td>
</tr>
<tr>
<td>Cephalic furrows or slits</td>
<td>Groove-like invaginations on the side of the head of some nemertean species; furrows shallow, often inconspicuous; slits conspicuous when present in the Heteronemertea.</td>
</tr>
<tr>
<td>Cephalic glands</td>
<td>Mucus-producing glands in the head region, often strongly developed; open through the frontal organ to the exterior.</td>
</tr>
<tr>
<td>Cerebral canal</td>
<td>Canal that connects the cerebral sensory organ with the exterior of the body.</td>
</tr>
<tr>
<td>Cerebral ganglia</td>
<td>The brain of the nemerteans, with dorsal and ventral paired lobes, often visible in living animals.</td>
</tr>
<tr>
<td>Cerebral organ</td>
<td>An organ in the interior of the head, close to the cerebral ganglia, and connected to the exterior via the cerebral canal.</td>
</tr>
<tr>
<td>Frontal organ</td>
<td>An organ at the tip of the nemertean head, probably of sensory function.</td>
</tr>
<tr>
<td>Lacunae</td>
<td>Expanded, poorly delimited regions of the circulatory system.</td>
</tr>
<tr>
<td>Proboscis</td>
<td>Eversible tube-like organ that is usually housed in the rynchocoel; used for prey capture.</td>
</tr>
<tr>
<td>Proboscis pore</td>
<td>Opening of the proboscis to the exterior.</td>
</tr>
<tr>
<td>Rynchocoel</td>
<td>Body cavity that houses the proboscis.</td>
</tr>
<tr>
<td>Rynchodaeum</td>
<td>Connection between the proboscis pore and the rynchocoel.</td>
</tr>
<tr>
<td>Stylet</td>
<td>A hard needle-like structure on the proboscis that is used to puncture the hard exoskeleton of the prey organisms; found in Enopla (except Malacobdella).</td>
</tr>
<tr>
<td>Stylet, accessory</td>
<td>Replacement stylets that are formed in small pouches in the proboscis.</td>
</tr>
</tbody>
</table>

## Bibliography