
EXERCISE 24 CYCLOSTOMATA : OBSERVATION AND CLASSIFICATION OF SPECIMENS AND STUDY OF AMMOCOETE LARVA

Structure

- 24.1 Introduction
- Objectives
- 24.2 Material Required
- 24.3 General Scheme of Classification of Superclass Agnatha (Cyclostomata)
- 24.4 Class Cephalaspidomorpha: Type Specimen – *Petromyzon*
- 24.5 Ammocoete Larva of *Petromyzon*
- 24.6 Class Myxini: Type Specimen – *Myxine*
- 24.7 Terminal Questions

24.1 INTRODUCTION

This exercise is based on section 2.2 (Unit 2) of Block 1, of LSE-10 theory course. As you will recall, members of Superclass Cyclostomata (lampreys and hagfishes) are distinguished from all other living Craniata by three main characters: (i) possession of a suctorial mouth devoid of functional jaws, (ii) a single nostril and (iii) absence of lateral appendages or paired fins. Gill chambers in Cyclostomata are round pouches, hence the name *marsupiobranchii*, with gill slits in 1-16 pairs. The tail of Cyclostomes is diphyccercal. The skeleton is cartilaginous. Superficially, the Cyclostomes look like eels. The geographical distribution is interesting in that each branch of it contains genera that are mainly northern and others that are exclusively southern.

Objectives

After performing this exercise you will be able to:

- identify and give the scientific and common names of the specimens of *Petromyzon* and *Myxine* belonging to Superclass Cyclostomata,
- classify the identified cyclostomes up to the level of class,
- list characters justifying the classification of the identified genera and mention special feature, if any, and draw labelled diagram of each of the identified genera,
- mention the habit and habitat and geographical distribution, and economic importance, if any, of each of the identified genera.

24.2 MATERIALS REQUIRED

1. Museum specimens of the following cyclostomes:
 - i) *Petromyzon*
 - ii) *Myxine*
 - iii) *Ammocoete* Larva
2. Laboratory manual
3. Practical Record Book
4. Pen, Pencils, Eraser, Ruler

7. How is lancelet easily identified?

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8. Give one main difference between fishes and *Branchiostoma* pertaining to fins.

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9. List two major chordate characters found in *Branchiostoma*.

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24.1 INTRODUCTION

This exercise is based on section 2.2 (Unit 2) of Block I, of LSE-10 theory course. As you will recall, members of Superclass Cyclostomata (lampreys and hagfishes) are distinguished from all other living Craniata by three main characters: (i) possession of a suctorial mouth devoid of functional jaws, (ii) a single nostril and (iii) absence of lateral appendages or paired fins. Gill chambers in Cyclostomata are round pouches, hence the name *marsupiobranchii*, with gill slits in 1-16 pairs. The tail of Cyclostomes is diphyccercal. The skeleton is cartilaginous. Superficially, the Cyclostomes look like eels. The geographical distribution is interesting in that each branch of it contains genera that are mainly northern and others that are exclusively southern.

Objectives

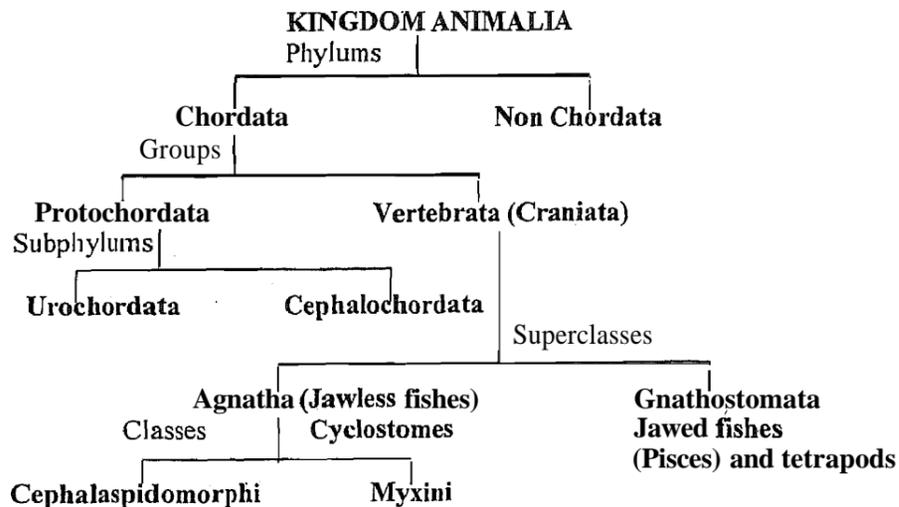
After performing this exercise you will be able to:

- identify and give the scientific and common names of the specimens of *Petromyzon* and *Myxine* belonging to Super-class Cyclostomata,
- classify the identified cyclostomes up to the level of class,
- list characters justifying the classification of the identified genera and mention special feature, if any, and draw labelled diagram of each of the identified genera,
- mention the habit and habitat and geographical distribution, and economic importance, if any, of each of the identified genera.

24.2 MATERIALS REQUIRED

1. Museum specimens of the following cyclostomes:
 - i) *Petromyzon*
 - ii) *Myxine*
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24.3 GENERAL SCHEME OF CLASSIFICATION OF SUPERCLASS AGNATHA (CYCLOSTOMATA)



Features of classes of Superclass – Agnatha

Superclass Agnatha (Jawless fishes) or Cyclostomata (Gr. *cyklos*, circular and *stoma*, mouth) comprises only two classes: (i) Cephalaspidomorphi and (ii) Myxini.

Class I – Cephalaspidomorphi (Gr., <i>kephale</i>, head, <i>aspidos</i>, shield, <i>morphe</i>, form)	Class II – Myxini (Gr. <i>myxa</i>, slime)
<ol style="list-style-type: none"> 1. These are commonly called lampreys and are found both in marine and fresh water. 2. Body is slender, eel-like, rounded with naked skin. 3. One or two median fins, no paired appendages. 4. Sucker-like oral disc and tongue with well developed teeth. 5. Seven pairs of gills each with external gill opening. 6. Eyes well developed in adult. 7. Sexes are separate, long larval stage, consisting of <i>ammocoete</i> larva. 8. Examples are lampreys which are about 30 species, with common example of <i>Petromyzon</i> and its <i>ammocoete</i> larva. 17 species are found in North America. 	<ol style="list-style-type: none"> 1. These are commonly called hagfishes, which are all marine. 2. Body slender, eel-like, rounded with naked skin containing slime glands. 3. No paired appendages present, no dorsal fin (the caudal fin extends anteriorly along the dorsal surface). 4. Biting mouth with two rows of eversible teeth. 5. Five to sixteen pairs of gills with a variable number of gill openings. 6. Eyes are degenerate. 7. Sexes separate (ovaries and testes in same individual but only one is functional, so partially hermaphroditic), no larval stage and development is direct. 8. Example – <i>Myxine</i> (hagfish)

24.4 CLASS CEPHALASPIDOMORPHI: TYPE SPECIMEN - PETROMYZON

Petromyzon is commonly known as 'sea lamprey' or 'lamper eel'.

Examine the specimen of *Petromyzon marinus* (Fig. 24.1 a to 24.1 c). Rotate the jar from all sides to note the details as follows:

- i) Body is cylindrical, elongated, eel-like, stout with unpaired fins (Fig. 24.1 a).
- ii) Unpaired or median fins in the form of two membranous median dorsal fins present near the posterior end.

- iii) A caudal fin supported by fin-rays is also present. An anal fin is present in females behind anus.
- iv) Body is divided into head, trunk and a laterally compressed tail.
- v) Exoskeleton is absent and the skin is naked and slimy and heavily pigmented.
- vi) Mouth is in the form of suctorial funnel. It bears overlapping oral fimbriae along its marginal membrane, hooks and radiating rows of horny teeth. It is used for sucking (Fig. 24.1 b).

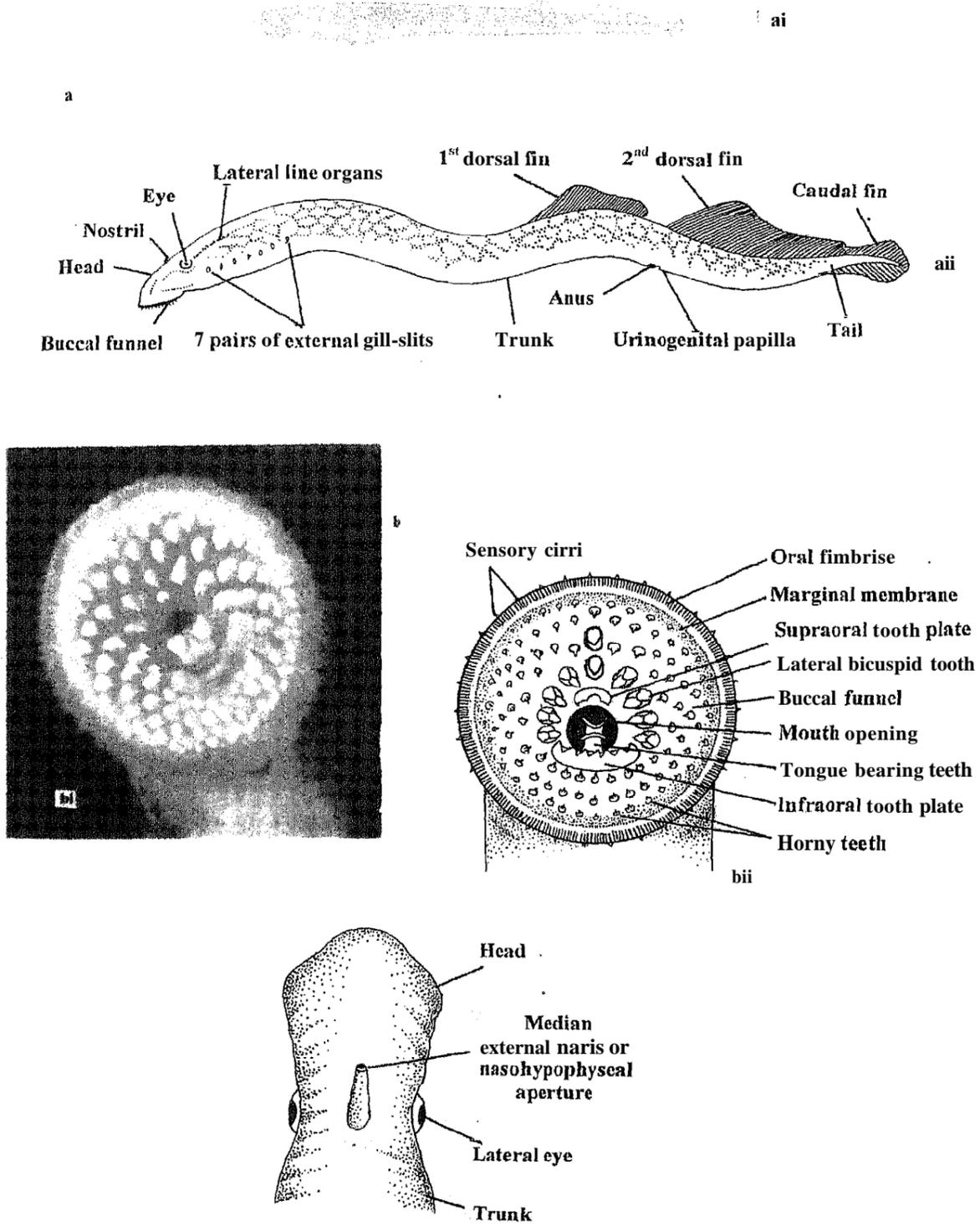


Fig. 24.1: *Petromyzon*. a) Entire (ai & aii), b) Buccal funnel (bi & bii) in ventral view, c) Head in dorsal view.

- vii) A long rasping, protrusible and piston-like tongue is present, but jaws are absent.
- viii) Head bears one pair of large lateral eyes, covered by a transparent area of skin (Fig. 24.1 c).
- ix) Pineal eyes are present behind the nasohypophysial sac (Fig. 24.1 c).
- x) Single nostril present mid-dorsally on the head. The nasal sac does not communicate with mouth (Fig. 24.1 c).
- xi) Pharynx is perforated with 7 pairs of round gill slits and branchial basket is well formed.
- xii) Cloaca is present on ventral side, at the junction of trunk and tail. (Fertilization is external. Development is indirect with a larval form known as ammocoete.)

Feature of Special Interest

Secondary sexual characters develop in females as a prominent anal fin, and in males as a penial tube and a thickening at the base of dorsal fin.

Habit and Habitat

Petromyzon or lamprey lives as ectoparasite on aquatic (marine) vertebrates (Fig. 24.2) and is anadromous in habit, i.e., it ascends fresh water rivers and streams for spawning. Lampreys stop feeding during migratory phase.

Lampreys build their nests in shallow water. The gamete cells are carried by the current of water into the interstices of the stony rim of the nest. The eggs are embedded in the nest by both the parents through their vigorous tail movements, which stir up the sand from the floor of the nest. When spawning is complete, the adults drop away from the nest and die within several days.

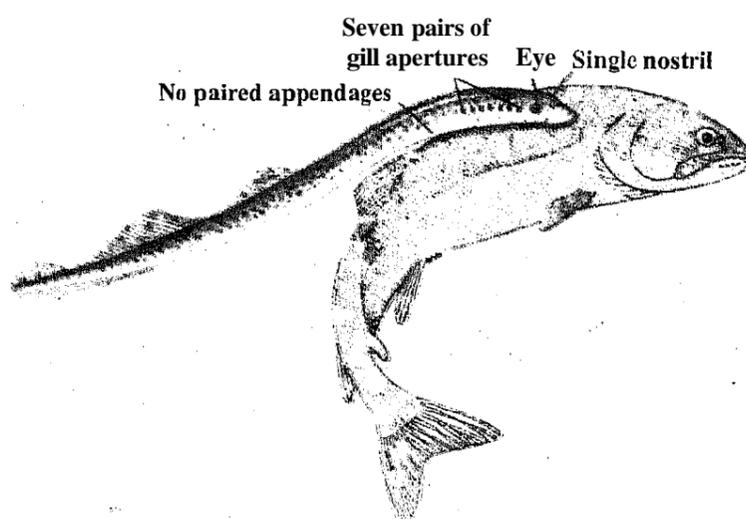


Fig. 24.2: *Petromyzon* attached to host fish.

Geographical Distribution

Petromyzon has a world-wide distribution and is found both in sea water of coastal regions and fresh water of streams and lakes in North America, Europe, West Africa, Japan, Chile, Australia, New Zealand and Tasmania.

Economic Importance

It causes serious deterioration of the great lake fisheries in the United States by sucking the blood of fish. Its salivary juice prevents coagulation of blood of the victim, i.e., it has anticoagulant property.

Larval lampreys are used as bait for sport fishing and commercial fishing.

Classification and its Justification

Kingdom	Animalia	Animals, multicellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Chordata	Dorsal tubular nerve cord, notochord and paired gill-slits are present.
Group	Vertebrata (Craniata)	Notochord is replaced by vertebral column; two pairs of appendages; circulatory system closed; hepatic portal system present; blood red containing R.B.C.
Superclass	Agnatha (Cyclostomes)	Jaws and paired appendages absent.
Class	Cephalaspidomorphi	Eel-like with suctorial mouth having horny teeth; median fins and a single nasal aperture; mouth without tentacles; nasal aperture is mid-dorsal and terminal; gills open to independent gill-slits, nasohypophysial sac does not communicate with the pharynx; well-developed and a complete branchial basket present.
Genus	<i>Petromyzon</i>	
Species	<i>marinus</i>	
Common name	Sea Lamprey	

24.5 AMMOCOETE LARVA OF PETROMYZON

It is a free-swimming larva of *Petromyzon*.

Examine the specimen of Ammocoetes larva (Fig. 24.3) and note the following features:

- i) Ammocoete larva hatches out of egg of *Petromyzon*.
- ii) Ammocoete larva has a long, slender body with an oral hood surrounding the mouth, much like the amphioxus.
- iii) Ammocoete larva is without exoskeleton but is covered by thick mucous.
- iv) Paired fins are absent but confluent median fin without fin rays is present.
- v) There are two dorsal fins and a caudal fin around the tail.
- vi) Mouth is not funnel-like, and the buccal cavity is without teeth, hooks and papillae.
- vii) Jaws are absent but mouth (buccal cavity) is guarded by dorsal and ventral lips. Dorsal lip is circular and hood-like. Buccal cavity is provided with a number of buccal tentacles or oral cirri but is devoid of teeth and tongue.
- viii) At the posterior end of the buccal cavity is present the velum, which is followed by pharynx.

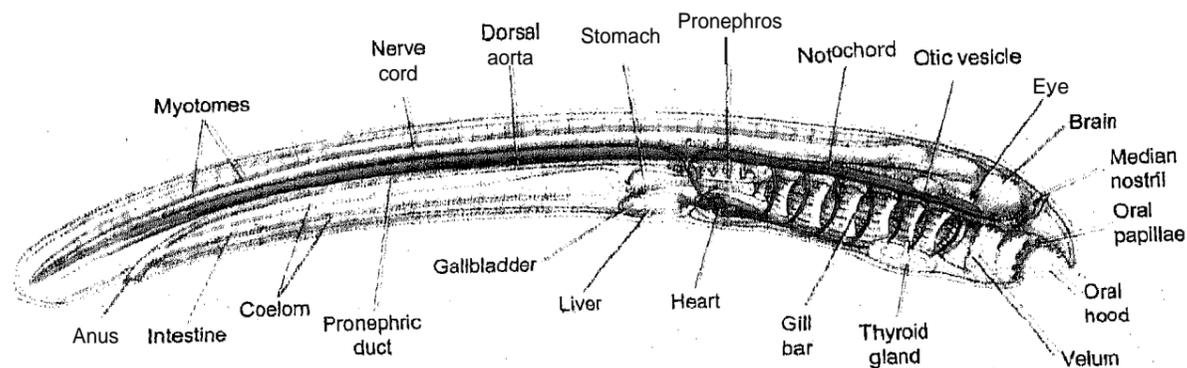


Fig. 24.3: Ammocoete larva.

- ix) Two eyes one on each side of the mid-brain are present. Eyes are **subcutaneous** (liidden under the skin) and a single nostril is present as a **median** aperture.
- x) External and internal nasal apertures and **penial** organs are absent.
- xi) Seven pairs of gill slits are present in the pharynx.
- xii) Pharynx possesses **peripharyngeal** groove and an **endostyle**, which is akin to thyroid gland of higher vertebrates and lies on ventral surface of the pharynx.
- xiii) Anal aperture is present on ventral side at the junction of trunk and tail.

Habit and Habitat

Ammocoete larva is a fresh water larvae. It exhibits a prolonged larval period of 5 to 8 days. It shows anadromous type of nature in young stages and catadromous type of nature in adulthood. It is a filter feeder but instead of drawing water by ciliary action into the pharynx as amphioxus does the ammocoete produces feeding current by muscular pumping action much like modern fishes. The larva lies in mud and feeds on small organisms brought by the currents of water produced by muscular action of the branchial apparatus.

Geographical Distribution

It is found in the fresh waters, where it hatches and continues to grow. The young lamprey returns to sea water after metamorphosis is complete and becomes an adult.

Special Features

Ammocoete larva is of great phylogenetic significance because it exhibits characters of a generalized chordate and resembles adult *Amphioxus* in many respects. It is a connecting link between Cyclostomata and Cephalochordata.

24.6 CLASS MYXINI: TYPE SPECIMEN – *MYXINE*

Myxine is commonly known as 'hag fish' or 'slime eel'.

Examine the specimen of *Myxine glutinosa* (Fig. 24.4) carefully and note the following **features**:

- i) Body is cylindrical, elongated, eel-like with feebly developed dorsal fin being continuous with the caudal fin (Fig. 24.4 ai & aii).
- ii) Paired fins are absent. A caudal and a ventral fin are present. The caudal fin extends anteriorly along the dorsal surface.
- iii) Fins are not supported by fin-rays.
- iv) Body is differentiated into head, trunk and tail.
- v) Exoskeleton (any kind of scales) is absent but mucus glands are numerous and arranged in two rows all along the body length.
- vi) Eyes are subcutaneous, greatly reduced and covered with a pigmented fold of the skin.
- vii) Branchial basket reduced. Pharynx is perforated with paired round gill-slits, 12 in number (six pairs), which open externally through one pair of common gill-slit.
- viii) Mouth is subterminal, suctorial without jaws but with a single, hooked palatine tooth. It is guarded by wrinkled and soft lips with 4 pairs of tentacles (barbells) around it (Fig. 24.b).
- ix) The single, median and terminal nasal aperture lies close to the mouth and communicates with it.
- x) Hagfish is hermaphrodite, protandrous (testes maturing first) with single ovotestis.

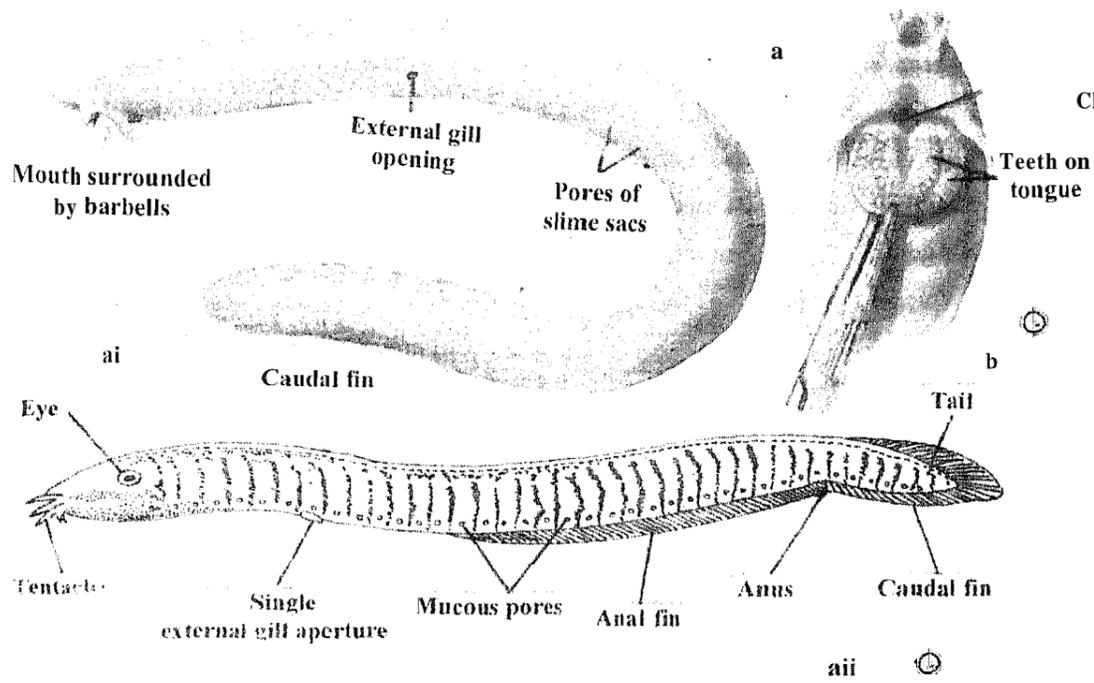


Fig. 21.4: *Myxine* (hagfish). a) Entire animal (ai & aia). b) Ventral view of head showing horny plates used to grasp food during feeding.

Habit and habitat

Myxine is found buried in the sand, mud or sea bottom up to the depth of 300 fathoms. It is marine and quasiparasite, feeding as a scavenger on dead and dying fish, annelids, molluscs and crustaceans. It burrows into the body of its host for consuming flesh, and hence it is also called a **borer** (Fig. 24.5).

Hagfishes are nocturnal feeders. During the daytime they lie buried in the sea bottom at depths of over 2000 feet. These fishes do not migrate to spawn but spawn on ocean floor. The eggs hatch into miniature adults without passing through a larval stage. For feeding and defense it crawls the body into a knot and squeezes out.

Hagfishes are renowned for their ability to generate enormous quantities of slime. On contact with sea-water, the fluid forms a slime so slippery that the animal is almost impossible to grasp.

A medium sized *Myxine* can gelatinise as much as 500 cc of sea-water in less than a minute.



Fig. 24.5: A hagfish attacks a fish which it hooks by twisting itself around the fish's body and then bores into the victim's flesh in order to eat the flesh.

Geographical Distribution

It is distributed in the deep waters of Atlantic, Pacific Oceans and in the sea water of South America. There are about 11 described species of *Myxine* out of which the best known *Myxine glutinosa* is found in North America.

Features of Special Interest

Hagfishes preserve many characteristics of early chordates and thus depict the organization of chordates before jaws were evolved.

Classification and its Justification

Kingdom	Animalia	Animals; multicellular organisms with cells that lack a cell wall, many capable of movement or movement of some of their body parts or capable of movement at some time of their life cycle; heterotrophic nutrition.
Phylum	Chordata	Dorsal tubular nerve cord, notochord and paired gill-slits are present.
Group	Vertebrata (Craniata)	Notochord is replaced by vertebral column; two pairs of appendages; circulatory system closed; hepatic portal system present; blood containing R.B.C.
Superclass	Agnatha (Cyclostomata)	Jaws and paired appendages absent.
Class	Myxini	Eel-like with suctorial mouth, median fins and a single nasal aperture.
Genus	<i>Myxine</i>	Mouth is terminal with 8-tentacles, nostril is median and terminal, nasopharyngeal sac communicates with the mouth, gill slits are 1-15 pairs.
Species	<i>glutinosa</i>	
Common name	Hagfish or Slime eel	

24.6 TERMINAL QUESTIONS

1. What does the term Cyclostomata mean?
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2. How many pairs of gill-slits are found in *Petromyzon*?
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3. Name the larval stage of lamprey.

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4. Elaborate on the statement "Lampreys are carnivores".

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5. Why do lampreys migrate? Are lampreys anadromous or catadromous?

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6. Why is *Myxine* called a borer?

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7. How do hagfishes become slimy?

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