413. Romero, A. 2003c. Anguilliformes (eels and morays), pp. 255-270, In: Grzimek's
414 Animal Life Encyclopedia, 2nd. Edition, Vol 4, Fishes I., (M. Hutchins, D.A.
Thoney, P.V. Loiselle, and N. Schlager, eds.). Farmington Hills, MI: Gale Group.

Anguilliformes
(Eels and morays)

Class Actinopterygii
Order Anguilliformes
Number of families 15

Photo: The pale blue, mottled head of an American conger (*Conger oceanicus*) on a rock off the Island of Mahe, in the Seychelles. (Photo by Lawson Wood/Corbis. Reproduced by permission.)

Evolution and systematics

Fossil Anguilliformes are known from the Upper Cretaceous (about 93 million years ago) until the Pliocene (about two million years ago) and have been found in Africa, Europe, North America, the East Indies, Australia, and New Zealand. The Anguilliformes also are called Apodes ("limbless"), because of their lack of protruding fins, and true eels, because there are many other fishes (about 45 families) that do not belong to this group but have similar burrowing habits, and an eel-like shape as a result of convergent evolution. Anguilliformes are related to the Elopiformes (tarpons), the Albuliformes (spiny eels and halosaurs), and the Saccopharyngiformes (snipe and gulper eels) because they all have a leptocephalus, or ribbonlike, larval stage during development. The larval stage groups them into the subdivision or superorder called Elopomorpha. Some researchers, such as Filleul and Lavoué, have questioned this phylogenetic relationship based on molecular studies. Nelson divided this order into three suborders and 15 families (Anguillidae: 15 spp.; Heterenchelyidae: 8 spp.; Moringuidae: 6 spp.; Chlopsidae: 16 spp.; Myrocongridae: 2 spp.; Muraenidae: 200 spp.; Synaphobranchidae: 26 spp.; Ophichthidae: 250 spp.; Colocongridae: 5 spp.; Derichthydae: 3 spp.; Muraenesocidae: 8 spp.; Nemichthydae: 15 spp.; Congridae: 150 spp.; Nettastomatidae: 30 spp.; Serrivomeridae: 10 spp.). Much more work is needed in this area to determine the exact phylogenetic relationships within this group.

Physical characteristics

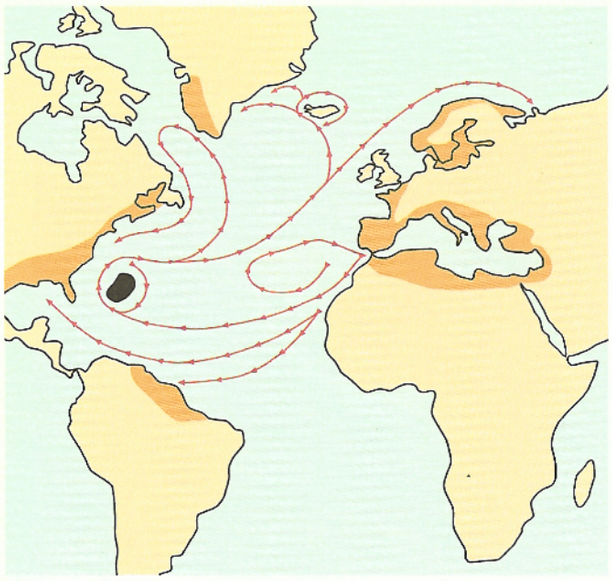
In addition to their eel-like bodies, anguilliform species have widely varying coloration that ranges from black or dark gray in deep-sea species to rich colors and complex patterns in tropical reef species. Adult sizes range from about 4 in (10 cm) to 11.5 ft (3.5 m), as in the moray species *Thyrsoidea macrura*. Systematists have emphasized numerous other morphological characteristics that have been found useful for phylogenetic purposes, including the lack of pelvic fins and the continuous dorsal, anal, and caudal fins that can have up to 650 soft rays, giving some individuals the appearance of having a pointed tail. Most species do not have pectoral fins, but when they are present, they lack bony connections to the skull. Most species also lack scales; in those species that have them, they are cycloid in type and embedded under the skin. The gill openings usually are narrow, with the gill region elongated and the gills displaced posteriorly. These species also have lost gill rakers. The skeleton is reduced, but the vertebrae may number as many as 700. They lack both pyloric caeca and oviducts but have retained the swim bladder. In summary, this order has many morphological simplifications or losses as a result of their evolutionary trend toward a worm-like configuration; the increased number of vertebrae is the result of the same phenomenon.

Distribution

Both the current distribution and the fossil record indicate that the members of this order always have occupied the same geographical areas, that is, tropical and temperate ocean. Anguilliformes are found in rivers draining into the North Atlantic, Baltic, and Mediterranean. They also have been introduced into Asia, South America, and Central America, but for the most part they have not reproduced in those areas. However, Anguillidae have a more restricted distribution, and do not inhabit the eastern Pacific and South Atlantic.

Habitat

The order Anguilliformes can be found in a wide variety of marine, brackish, and freshwater habitats, including streams,



Migration pattern of the American eel and the European eel. (Illustration by Barbara Duperron)

lakes, deep-sea waters, and coral reefs. Some representatives of this order are catadromous, meaning that adults spend most of their lives in estuaries and freshwater and then move to the sea to spawn. The same species can be found in marine, estuarine, and freshwater environments. While some are pelagic, most are found living in small openings in coral reefs and rocks or burrowing in soft substrates. In general, morays and congers inhabit coral reefs and rock crevices, whereas certain congrids of the subfamily Heterocongrinae form vast colonies of up to several hundred individuals in tropical reef areas. Despite the fact that they favor these specific habitats as adults, all of the leptocephalus larvae form part of the marine plankton at one time or another in their life cycle.

Behavior

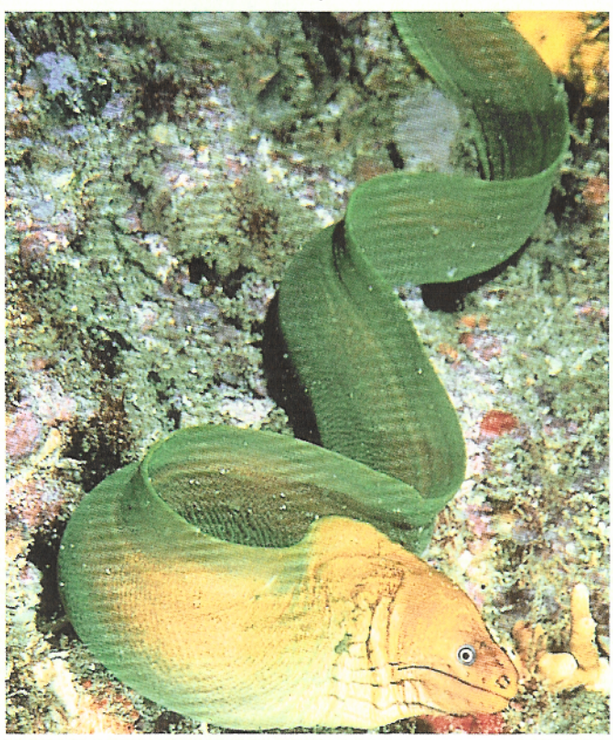
One of the most extraordinary aspects of their biology is their ability to migrate, yet they are slow swimmers. They swim by means of sinuous lateral movements of the body and median fins. Another interesting aspect of their swimming behavior is the ability of burrowing species to swim backward, which allows them to retreat rapidly into their burrows while still being able to look at any potential enemy. Although they can congregate in large numbers under specific circumstances, both larvae and adults do not form schools and thus can be considered to be solitary.

Feeding ecology and diet

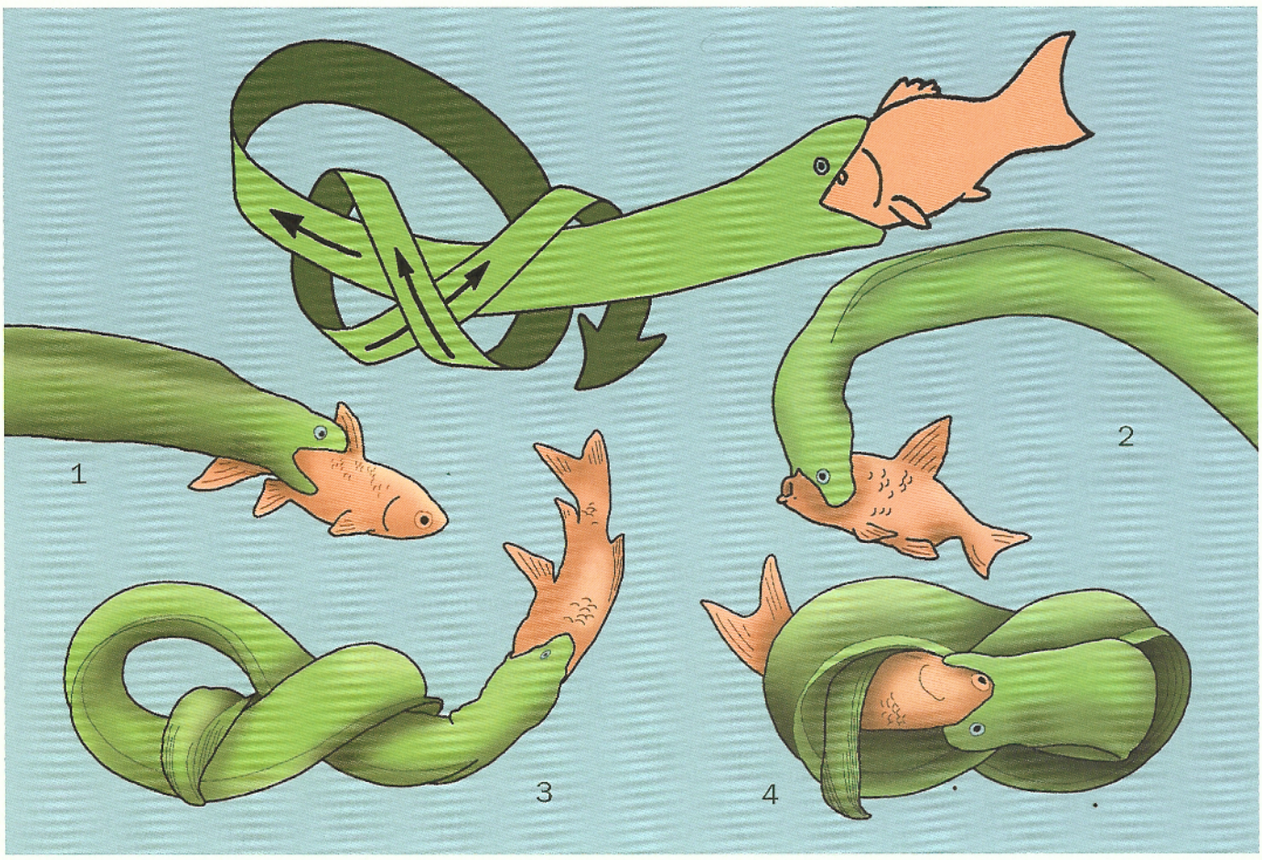
The species of this order can be labeled generalists and opportunistic feeders, to the point that virtually any animal species they encounter can become a source of food for them, from aquatic insects in freshwater to crustaceans and many other species of fishes. This flexibility toward food items and even feeding habits is evident during development: depending upon the stage of development, they will shift toward the most appropriate food source and capturing tactics. Extreme cases include the parastic snubnosed eel, *Simenchelys parasitica*, which burrows into the tissues of other species of fish. They can attach themselves to the heart of their host, from which they consume the blood. Other species feed on dead animals that lie on the bottom, including whales. This has led to a renewed interest in the ecological role played by some anguilliforms in benthic habitats, including the recycling of nutrients. Anguilliformes are preyed upon mostly by other types of fish. When they are in larval form, small fish and even some invertebrates will prey on them. As they grow larger, the size of their predators also increases.

Reproductive biology

The migratory and reproductive biological characteristics of anguilliforms are intertwined closely; thus, one cannot be explained without explaining the other. Although the life cycle of every anguilliform species has yet to be studied, it is believed that all of them undergo the same complex path of development, regardless of the final habitat they occupy. Fertilization among these fishes is external, and the eggs are relatively large (about 0.98 in, or 2.5 mm), which allows them to undergo extended development even before being able to



A yellow moray (*Gymnothorax prasinus*) in Wreck Bay, New South Wales, Australia. (Photo by Animals Animals ©A. Kuiter-OSF. Reproduced by permission.)



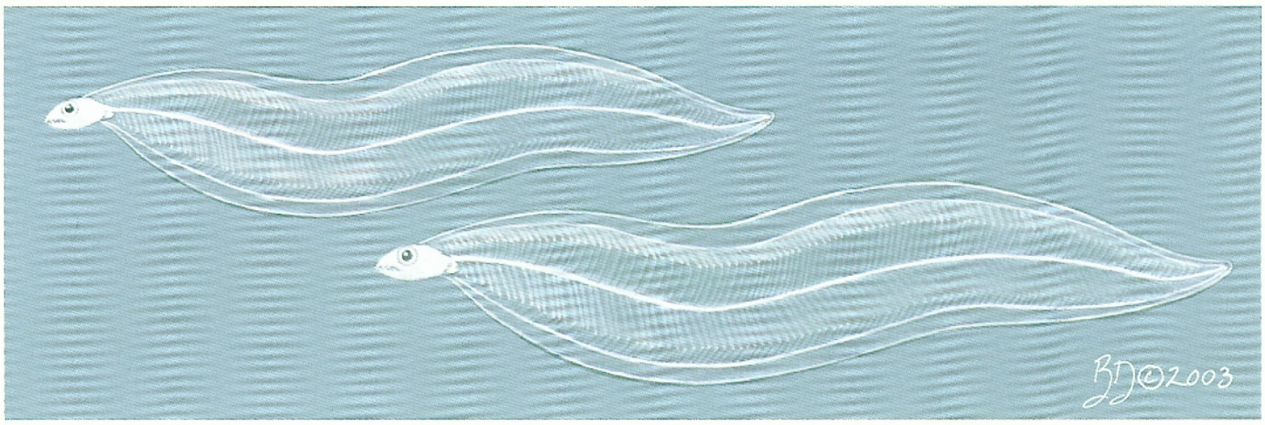
Certain eels possess the ability to tear apart prey items by tying themselves into a knot in order to obtain leverage against the prey item. The general procedure is this: (1) the eel grabs a fish that is too large to swallow whole, often by the head (2). The tail of the eel then turns back toward the eel's body and forms a series of interlacing loops which forms a knot similar to a square knot or a figure-eight knot (3). This knotting process continues until the heads of the eel and prey contact the knotted eel's body. The eel then pulls its own head through the knot and with it a mouthful of food (4). The prey fish is generally decapitated by this action. The eel then bites onto another section of the prey animal and the process continues. (Illustration by Dan Erickson)

feed. The eggs hatch, producing a prolarva, which in turn transforms into the leptocephalus larva.

The leptocephalus larva is so singular that biologists have studied it closely since the nineteenth century, when many researchers thought these larvae were actually adult fishes, given their complex morphologic features and behavior. They are elongated and laterally compressed while being transparent and gelatinous, which could make them difficult to detect. Although there is a great deal of morphological diversity among leptocephalus larvae, they all have a small and round caudal fin that is continuous with the dorsal and anal fins. This gives them varied shapes that are leaflike in appearance. In fact, the diversity of larval morphological features even within the same species is such that it is difficult to tell which larva belongs to which adult form. A couple of important characteristics of these larvae is their W-shaped myomeres (muscle packages) and prominent sharp teeth. These two features, together with their size, usually 2–4 in (5–10 cm) in length, make them sustained swimmers and powerful predators of other planktonic organisms. Some, like the slender snipe eel, *Nemichthys scolopaceus*, can reach 18 in (45 cm) in length, undoubtedly very large for fish larva.

Leptocephalus larvae can be found at varying depths, from the surface of the ocean to 1,600 ft (500 m). As opportunistic feeders, they eat anything that is available, from diatoms to small crustaceans and other fish larvae. By the same token, they are preyed upon by different species of fish. It has been calculated that, on average, of six million eggs released by the European eel, *Anguilla anguilla*, only one survives to reach adulthood.

Leptocephalus larvae undergo metamorphosis in the open ocean after a period that ranges from six months to three years. In general, it can be said that the colder the waters, the longer the larval stage. The juveniles usually look like smaller versions of the adults. These juveniles are the product of many changes that can be summarized as follows: (a) reduction in the total body mass (up to 90% of weight) and body length, making the initial juvenile smaller than the larva itself; (b) transformation of the leaflike shape into a cylindrical shape;



Eels go through a larval (leptocephalus) stage during which they are paper-thin, as shown by these American eel larvae (*Anguilla rostrata*). (Illustration by Barbara Duperron)

(c) loss of larval teeth; (d) loss of larval melanophores (pigment cells); (e) loss of pectoral fins; and (f) change in the position of the dorsal fin to much farther back.

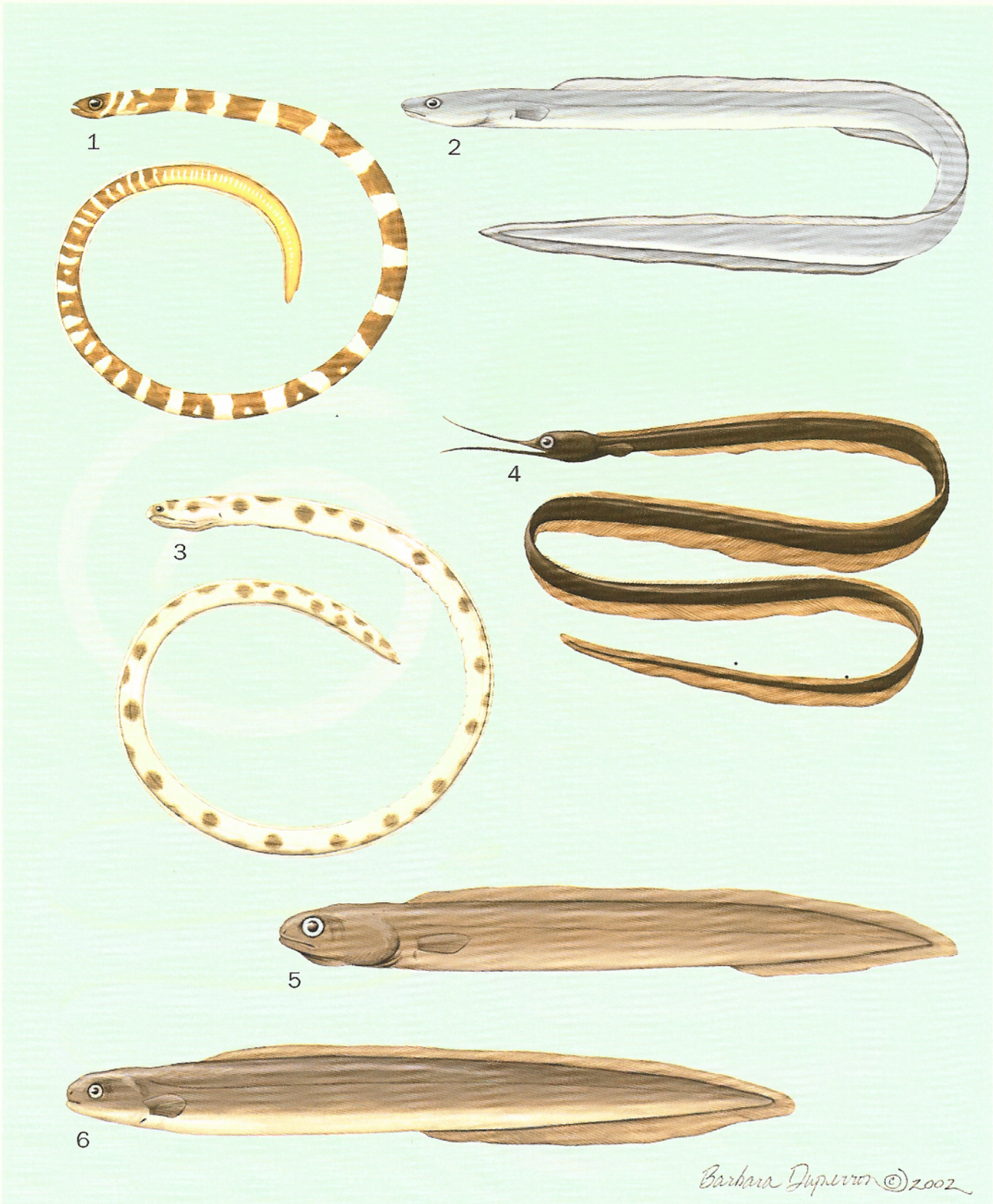
The juveniles use oceanic currents to disperse; once they have occupied what is going to be their habitat as adults, they continue to grow and mature. This process can be quite lengthy, up to 10 years for some species. The complexity of this process also involves their sexual maturation, which includes phases of neutrality, precocious feminization, and juvenile hermaphroditism before they become adult males or females. As in some reptiles and other species of vertebrates, the sex ratio (proportion of males to females) can be the result of environmental factors (the more stressful the environmental conditions, the higher the proportion of females). Once true eels become fully adult, they undergo either a short-distance or a long-distance migration to a spawning area.

Conservation status

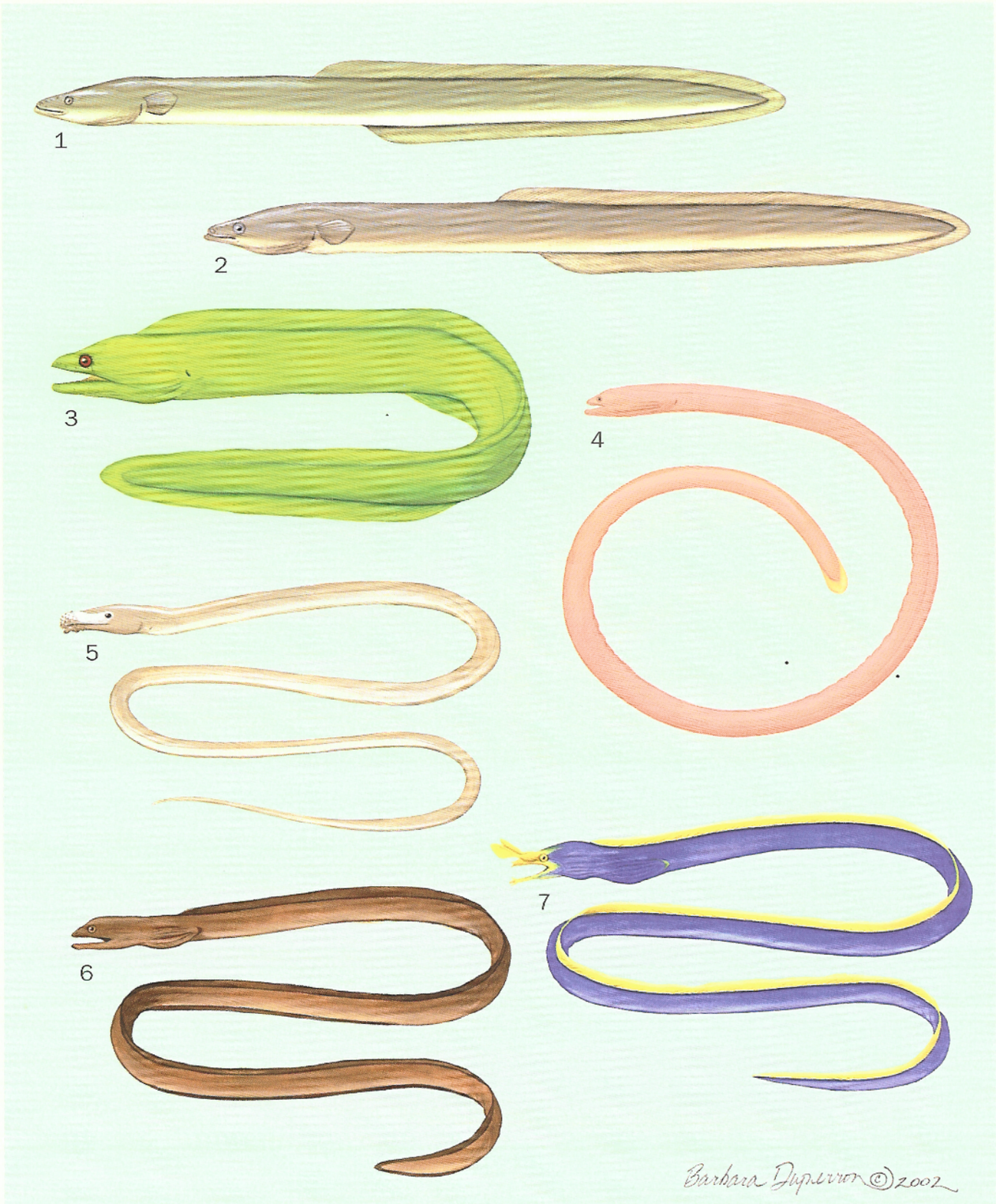
No anguilliform species have been listed by the IUCN under any category. With freshwater habitat modification and the threat posed to coral reefs all over the world, however, several species could be considered threatened in one way or another.

Significance to humans

Eels, whether "true eels" or otherwise, have been mentioned in mythology from ancient Greece to Polynesia. Today, only the freshwater eels (family Anguillidae) are of major economic importance in areas in which they are abundant, because of their value as food at both juvenile and adult stages. Some morays and congers are popular in public aquaria and among marine aquarists.



1. Splendid garden eel (*Gorgasia preclara*); 2. American conger (*Conger oceanicus*); 3. Tiger snake eel (*Myrichthys maculosus*); 4. Slender snipe eel (*Nemichthys scolopaceus*); 5. Froghead eel (*Coloconger raniceps*); 6. Snubnosed eel (*Simenchelys parasitica*). (Illustration by Barbara Duperron)



1. European eel (*Anguilla anguilla*); 2. American eel (*Anguilla rostrata*); 3. Green moray (*Gymnothorax funebris*); 4. Rusty spaghetti eel (*Moringua ferruginea*); 5. Pignosed arrowtooth eel (*Dysomma brevirostre*); 6. Slender giant moray (*Strophidon sathete*); 7. Ribbon moray (*Rhinomuraena quaesita*). (Illustration by Barbara Duperron)

Species accounts

European eel
Anguilla anguilla

FAMILY
Anguillidae

TAXONOMY
Muraena anguilla Linnaeus, 1758, "Europe." Tucker (1959) suggested that the European eel and the American eel, *A. rostrata*, are the same species.

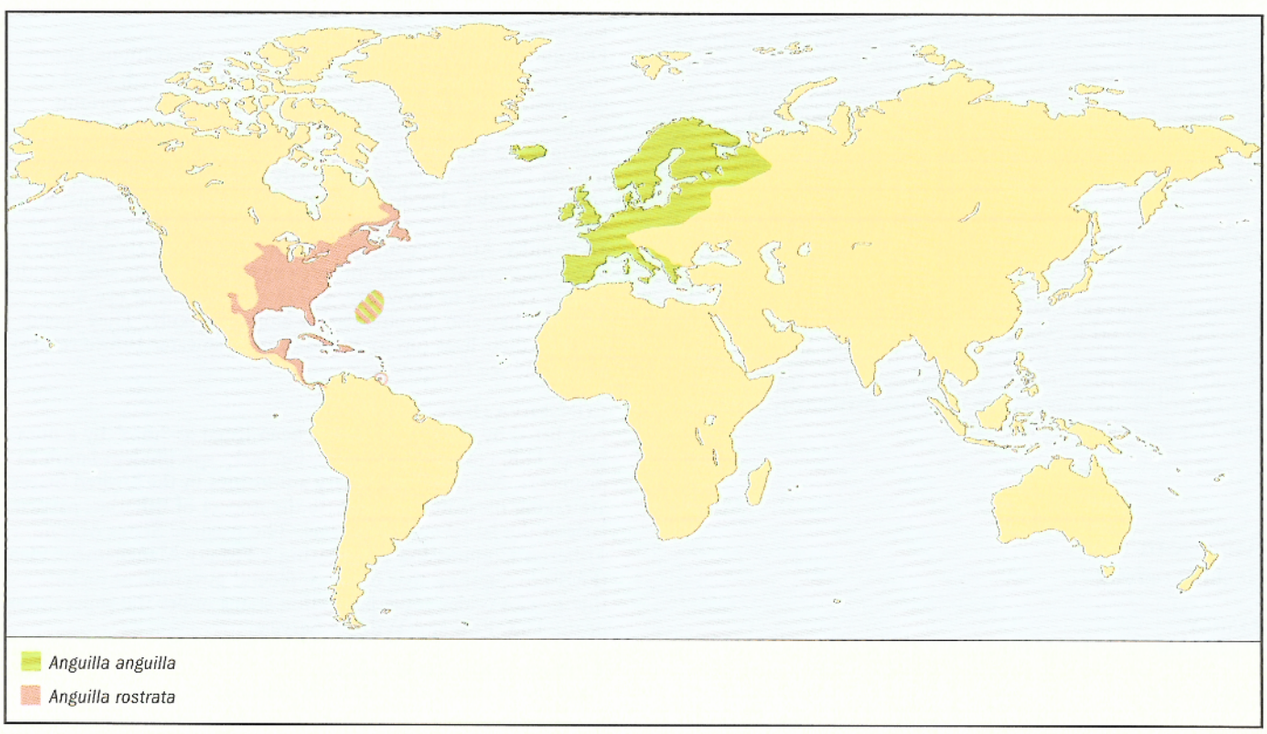
OTHER COMMON NAMES
English: Common eel; French: Anguille; German: Aal; Spanish: Anguila.

PHYSICAL CHARACTERISTICS
Specimens have been reported to reach 52.36 in (133 cm) in length, with a weight of 14.548 lb (6.599 kg). Distinguished from other types of freshwater eels mostly by the number of vertebrae, which range from 110 to 119. Color greenish-brown to yellowish-brown. It has small vertical gill openings that are restricted to the sides. The lower jaw is slightly longer and projects. The dorsal fin originates far behind the pectoral fins, whereas the anal fin originates slightly behind the anus and well back from the origin of the dorsal fin.

DISTRIBUTION
Rivers of the North Atlantic, Baltic, and Mediterranean, along the coasts of Europe from the Black Sea to the White Sea. Its spawning area is the western Atlantic, specifically the Sargasso Sea. It has been introduced successfully into Finland and Romania. Introductions in Norway, Israel, Japan, Taiwan, Brazil, Indonesia, California, Eritrea, and Jordan have not been successful.

HABITAT
Waters where the temperatures range from 32–86°F (0–30°C). Young eels grow in freshwater where they stay for 6–12 years (males) or 9–20 years (females). After becoming sexually mature, they migrate to the sea, where they can be found in deep waters living on the bottom, under stones, in the mud, or in crevices. Spawning takes place in the Sargasso Sea. The larvae are brought by the Gulf Stream to the coasts of Europe. They evolve into small eels before moving into freshwater basins.

BEHAVIOR
The European eel spawns in the Sargasso Sea in the subtropical northwestern Atlantic Ocean. Their larvae, leptocephali, are transported by the Gulf Stream and North Atlantic current system to Europe. Despite being an individualistic species, large groups of elvers and young eels can be observed from time to time in estuaries and rivers. An elver is a small cylindrical young eel, more advanced in development than a leptocephalus larva but less developed than an adult eel. Those congregations of elvers and juveniles are not fish schools in the real sense of the word (active assembling for selective advantages such as protection against predators or reproduction) but rather a mass response to environmental conditions. When elvers and young eels are observed in mass from time to



time in estuaries and rivers, it is because they are responding individually to particular ecological conditions and not because they are actually forming schools.

FEEDING ECOLOGY AND DIET
Opportunistic feeders. They include among their food items almost any species of aquatic fauna, freshwater as well as marine, that they encounter. Adults do not feed during migration to sea. Other eels, herons, cormorants, pikes, and gulls prey upon them.

REPRODUCTIVE BIOLOGY
The American eel (*A. rostrata*) and the European eel (*A. anguilla*) spawn in Sargasso Sea, located in the subtropical northwestern Atlantic Ocean, between January and May. Their larvae, leptocephali, are transported by the Gulf Stream and North Atlantic current system to North America and Europe, respectively.

Before entering the continental coastal zones and estuaries, the leptocephali transform into elvers. Once there, and before entering the freshwaters, they develop into small (juvenile) eels. The young eels spend their growing period in freshwater, where males stay for 6 to 12 years; females spend from 9 to 20 years there. While in freshwater, they live on the bottom under stones or in the mud or rock crevices. At the end of their growth period, the eels become sexually mature and migrate to the sea, where they inhabit deep waters.

There is a significant differential in time in the life cycle span between both species. The overall mean age of European elvers is 350 days at metamorphosis (from leptocephalus to glass eel) and 448 days at estuarine arrival, with 98 days between metamorphosis and estuarine arrival. These ages were all significantly greater than those of American elvers 200, 55, and 255 days, respectively. Also, growth rate of the American eel (0.008 in [0.21 mm] per day) is greater than that of European eel (0.006 in [0.15 mm] per day). This is a result of delayed metamorphosis in the European species, which allows the European eel larvae to be transported from North America to Europe by the oceanic current. Thus, the European eel evolves the strategy to delay metamorphosis by reducing growth rate, enabling it to segregatively migrate with the American eel. The differences in leptocephalus stage duration and growth rate are the principal factors determining the segregation of migrating American and European eels.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
The European eel is consumed fresh, dried or salted, or smoked, and it can be fried, boiled, and baked. It is particularly popular among Mediterranean Europeans. This species has been raised by the aquaculture industry, particularly in Japan and Taiwan, with some success. ◆

American eel
Anguilla rostrata

FAMILY
Anguillidae

TAXONOMY
Muraena rostrata Lesueur, 1817, Cayuga Lake, New York.

OTHER COMMON NAMES
English: Common eel; French: Anguille américaine; German: Amerikanischer Aal; Spanish: Anguila Americana.

PHYSICAL CHARACTERISTICS
Males grow to 59.84 in (152 cm) and females to 47.24 in (120.0 cm); these eels weigh as much as 16.16 lb (7.330 kg). The major difference between the European eel and the American eel is the number of vertebrae, which is 110 to 119 and 103 to 111, respectively. Otherwise, the species are almost identical.

DISTRIBUTION
Western Atlantic from Greenland and the Atlantic coast of Canada and the United States to Panama and throughout much of the West Indies south to Trinidad. The range includes the Great Lakes, the Mississippi River, and the Gulf basin. It has been introduced to Guam and Japan.

HABITAT
At sea they are found over rather deep waters; in freshwater they are inhabit permanent streams with continuous flow.

BEHAVIOR
Individuals of this species are solitary and nocturnal. While in freshwater, they hide during the day in undercut banks and in deep pools near logs and boulders and sometimes bury themselves in the substrate, whether mud, sand, or gravel. At night they typically swim near the bottom in search of food. They can breathe through the skin along with their gills and are able to live for several hours outside water.

FEEDING ECOLOGY AND DIET
Like the European eel, food items vary with the stage of development and location. The leptocephalus larvae, for example, is planktivorous; the elver feeds on aquatic insects, small crustaceans, and dead fish; and the adult eats insects, crustaceans, clams, worms, fish, frogs, toads, and dead animal matter. Sharks are their main predator.

REPRODUCTIVE BIOLOGY
Despite many attempts to conduct direct observations, knowledge of reproductive behavior can only be inferred, based on circumstantial evidence. We know that during the autumn adults migrate to the Sargasso Sea to spawn, with spawning taking place in January. At that time, females lay up to four million buoyant eggs, dying shortly after. After fertilizing the eggs, the males also die. With the help of ocean currents, the leptocephalus larvae drift toward coastal waters for as long as 18 months. After becoming an elver, American eels undergo a slow transformation that includes increases in their size, eye diameter relative to body size, and in the amount of eye pigments. They also become darker along the body. They spend most of their lives (up to 20 years) in freshwater before returning to the sea for spawning.

CONSERVATION STATUS
Not listed by the IUCN. It has been listed as "rare" by a number of U.S. counties and states, but lacks specific legislation to protect it. Nonetheless, fishery authorities in the United States are taking measures to decrease the impact of fisheries, particularly at the larval and elver level. The Atlantic States Marine Fisheries Commission is preparing a Fishery Management Plan (FMP), requesting that the U.S. federal government include this species under some protection status under the supervision of the U.S. Fish and Wildlife Service.

SIGNIFICANCE TO HUMANS
They are consumed as food and prepared in many ways. Larvae and elvers (considered a delicacy) are captured using fine

mesh fyke nets and dip nets; adults are caught with eel pots and trot lines. Although they can be caught in considerable numbers, their handling can be difficult, because the adults exude a noticeable layer of slime over the entire body. Moreover, large eels actively bite when caught on a hook and line. ◆

Froghead eel
Coloconger raniceps

FAMILY
Colocongridae

TAXONOMY
Coloconger raniceps Alcock, 1889, Bay of Bengal.

OTHER COMMON NAMES
Japanese: Fusa-anago.

PHYSICAL CHARACTERISTICS
May grow to 19.7 in (50 cm). The body is stubbier (particularly in the anterior region) than the bodies of most true eels. They have numerous pores in short tubes.

DISTRIBUTION
Indo-West Pacific area, from East Africa and Madagascar in the west to the western Pacific in the east to southern Japan in the north.

HABITAT
Deep-sea species usually found at depths between 980 and 3,720 ft (300–1,113 m).

BEHAVIOR
Because of its deep-water habits, it is rarely observed except very occasionally by deep sea submersibles.

FEEDING ECOLOGY AND DIET
Apparently feeds on other fishes.

REPRODUCTIVE BIOLOGY
Nothing is known.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
None known. ◆

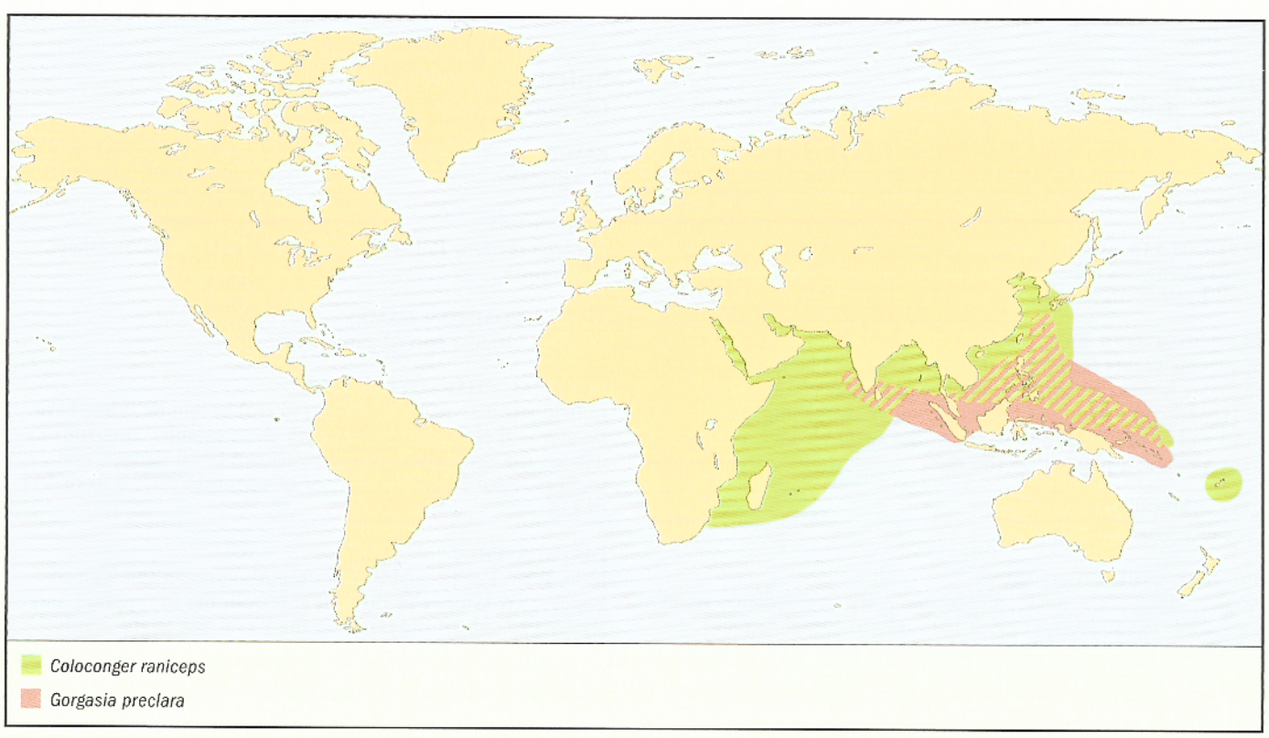
American conger
Conger oceanicus

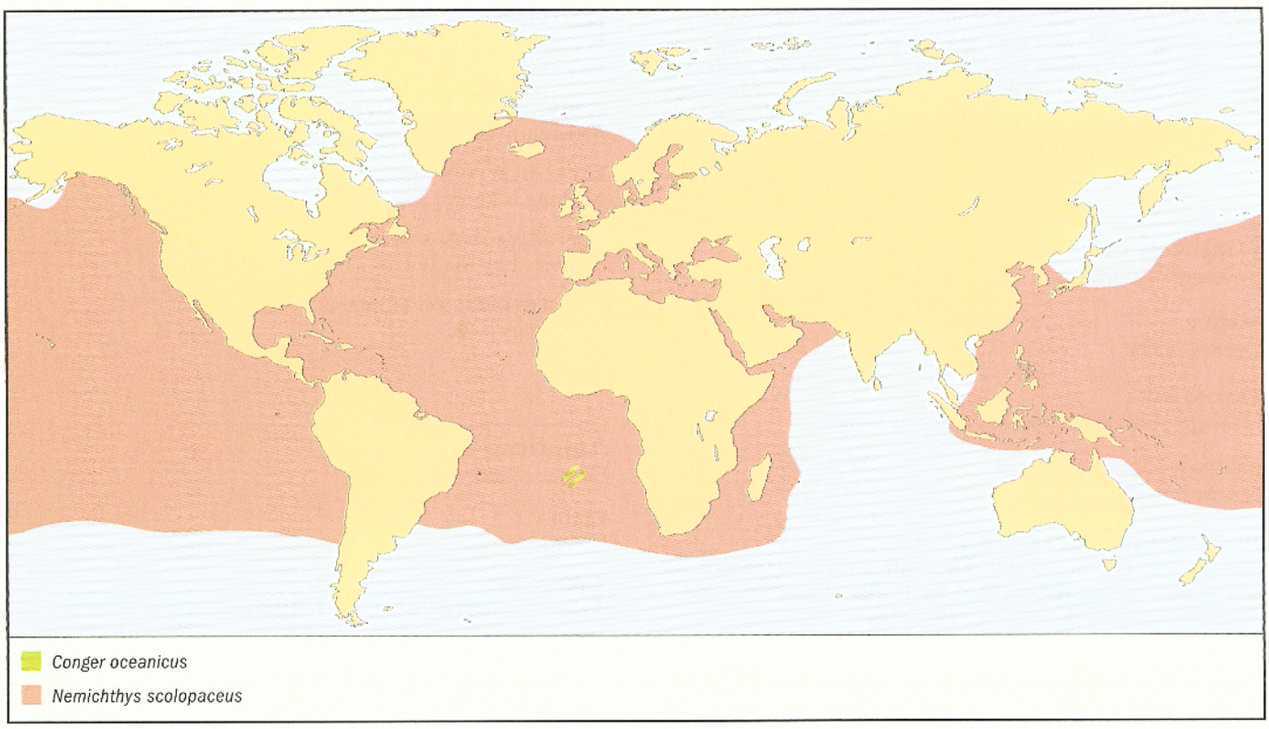
FAMILY
Congridae

TAXONOMY
Anguilla oceanica Mitchill, 1818, Atlantic.

OTHER COMMON NAMES
English: Conger eel, sea eel; French: Congre d'Amérique; Spanish: Congrio americano.

PHYSICAL CHARACTERISTICS
Specimens may reach 90.6 in (230 cm) and 88.2 lb (40 kg). The species has a long snout and a very large dorsal fin that originates much closer to the pectoral fins. It is gray on the dorsum and white on the venter.





DISTRIBUTION
Western Atlantic from Cape Cod, Massachusetts, to northeastern Florida in the United States as well as in the northern Gulf of Mexico westward to the Mississippi delta. In the eastern Atlantic it has been reported around Saint Helena Island, South Carolina.

HABITAT
Usually inhabits shallow inshore waters to depths of 1,565 ft (477 m).

BEHAVIOR
Chiefly nocturnal feeder in shallow waters (60 ft [18 m] or less).

FEEDING ECOLOGY AND DIET
Feeds mainly on fishes but also on shrimps, worms, and other small benthic organisms.

REPRODUCTIVE BIOLOGY
Spawning occurs from June through August. The leptocephalus larva reaches a maximum length between 5.9 and 6.3 in (15–16 cm). Metamorphosis consists of thickening of the head and body and development of the swim bladder, permanent teeth, and pigment in the skin.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
Anglers along piers, docks, and jetties in the mid-Atlantic states commonly catch this species. It is caught in baited fish and crab traps as well as on hook and line but seldom in nets, because the fish can squirm through them. It is difficult to remove them from hooks. They are marketed fresh and salted in the Chesapeake Bay region, but today the species is not subject to commercial fishing in the United States and is rarely eaten. American congers are much more appreciated in parts of Europe, Africa, and Asia, where they are smoked. ◆

Splendid garden eel
Gorgasia preclara

FAMILY
Congridae

TAXONOMY
Gorgasia preclara Böhlke and Randall, 1981, Sumilon Island, Philippines.

OTHER COMMON NAMES
English: Orange-barred garden eel.

PHYSICAL CHARACTERISTICS
Individuals may reach 15.75 in (40 cm) in length. They have slender and elongated bodies with short mouths, anterior nostrils on the snout tip between restricted labial flanges, and small pectoral fins. The number of vertebrae ranges from 144 to 156.

DISTRIBUTION
Indo-West Pacific region from the Maldives in the west to Papua New Guinea in the east and from the Philippines and Ryukyu Islands in the north to the Coral Sea in the south.

HABITAT
Found in colonies on sand slopes exposed to current at depths usually below 90 ft (30 m).

BEHAVIOR
Live individually in burrows, forming large colonies. They hover above their sand burrows and retreat tail first when disturbed.

FEEDING ECOLOGY AND DIET
They feed on plankton that they capture while standing in their burrows.

REPRODUCTIVE BIOLOGY
Nothing is known.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
None known. ◆

Rusty spaghetti eel
Moringua ferruginea

FAMILY
Moringuidae

TAXONOMY
Moringua ferruginea Bliss, 1833, Island of Mauritius.

OTHER COMMON NAMES
English: Slender worm-eel; Gela (Solomon Islands): Poli ni tahi.

PHYSICAL CHARACTERISTICS
May reach 55.1 in (140 cm) in length. It has a wormlike, very elongated body with yellow to reddish coloration. The dorsal and anal fins are reduced to low folds. It lacks scales and has greatly reduced eyes. The gill openings are low on the body. The rusty spaghetti eel has about 73 lateral-line pores before the anus.

DISTRIBUTION
Indo-Pacific, from East Africa in the west to Easter Island in the east and from the Ryukyu Islands in the north to Australia in the south. It is distributed throughout Micronesia as well.

HABITAT
Found in sandy bottoms.

BEHAVIOR
Fossorial in that it can burrow headfirst. The physical attributes, such as an elongated body and reduced eyes, allow for this behavior.

FEEDING ECOLOGY AND DIET
Feeds on small prey found either on the bottom or burrowed in the sand.

REPRODUCTIVE BIOLOGY
Little is known, except that rusty spaghetti eels seem to show sexual dimorphism in size and coloration.

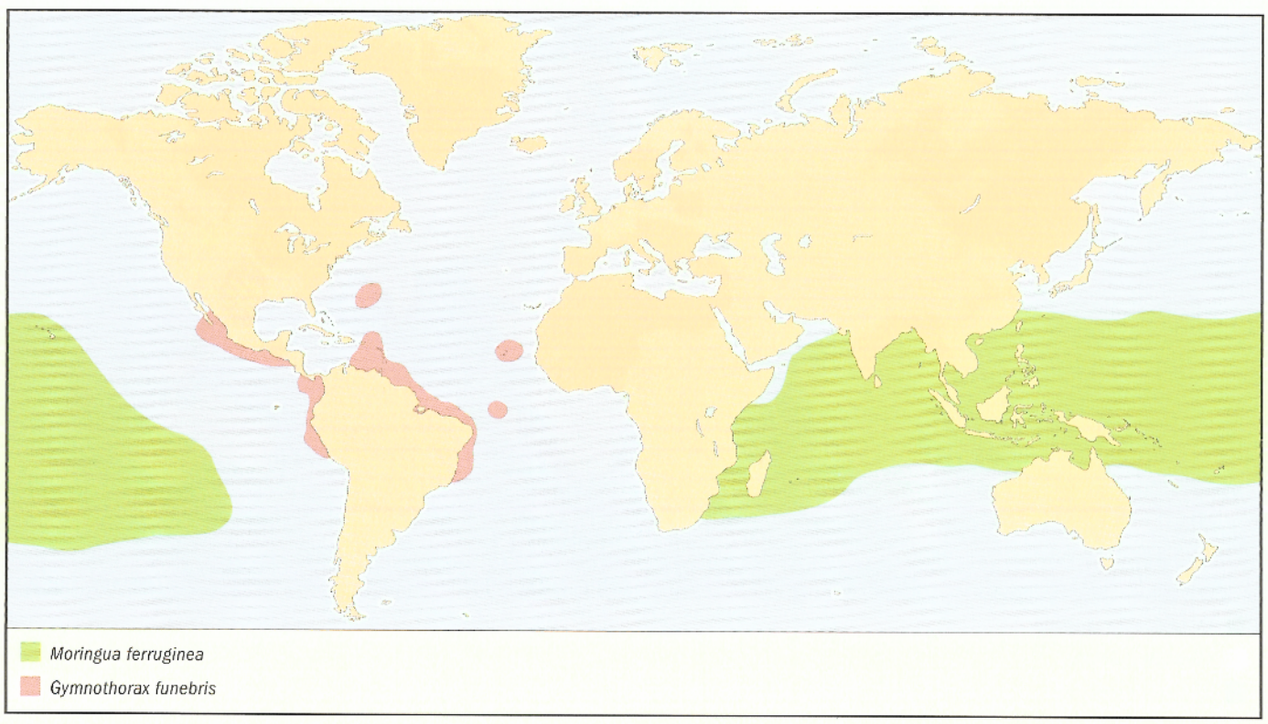
CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
None known. ◆

Green moray
Gymnothorax funebris

FAMILY
Muraenidae

TAXONOMY
Gymnothorax funebris and *Lycodontis funebris* Ranzani, 1840, Atlantic Ocean.



OTHER COMMON NAMES
English: Black moray; French: Murène verte; Spanish: Culebra morena.

PHYSICAL CHARACTERISTICS
Grows to 98.5 in (250 cm) in length and weighs up to 64 lb (29 kg). It is considered the largest Atlantic moray. Individuals of this species are uniformly greenish to dark gray-greenish. The green moray's color is a result of a yellowish mucous over the animal's dark blue skin.

DISTRIBUTION
Distributed throughout the western and eastern Atlantic (from Nova Scotia, Canada, to Brazil, including the Gulf of Mexico and Bermuda) and the eastern Pacific.

HABITAT
Benthic and solitary species commonly seen along rocky shorelines, reefs, and mangroves, including dirty harbors, in waters shallower than about 90 ft (about 30 m).

BEHAVIOR
Cleaned by some species of gobies and other fish species, as observed on the coral reefs in Bonaire and the Netherlands Antilles and at the Fernando de Noronha archipelago in the western South Atlantic.

FEEDING ECOLOGY AND DIET
Feeds on fishes and benthic crustaceans.

REPRODUCTIVE BIOLOGY
Little is known about reproduction, except that green morays have external fertilization and, like any other anguilliform, they have a leptocephalus larval stage.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
Green morays are consumed as food and are marketed both fresh and salted. Large individuals are ciguatoxic, however. Ciguatera is a type of food poisoning caused by the consumption of tropical marine species that harbor a heat-resistant, acid-stable toxin known as ciguatoxin. The green moray consumes certain species of microorganisms that form this toxin. This natural toxin can concentrate as it moves up the food chain, but its adverse effects appear to be limited to humans. Because of its large size and aggressiveness, the bites of this moray are particularly dangerous. ◆

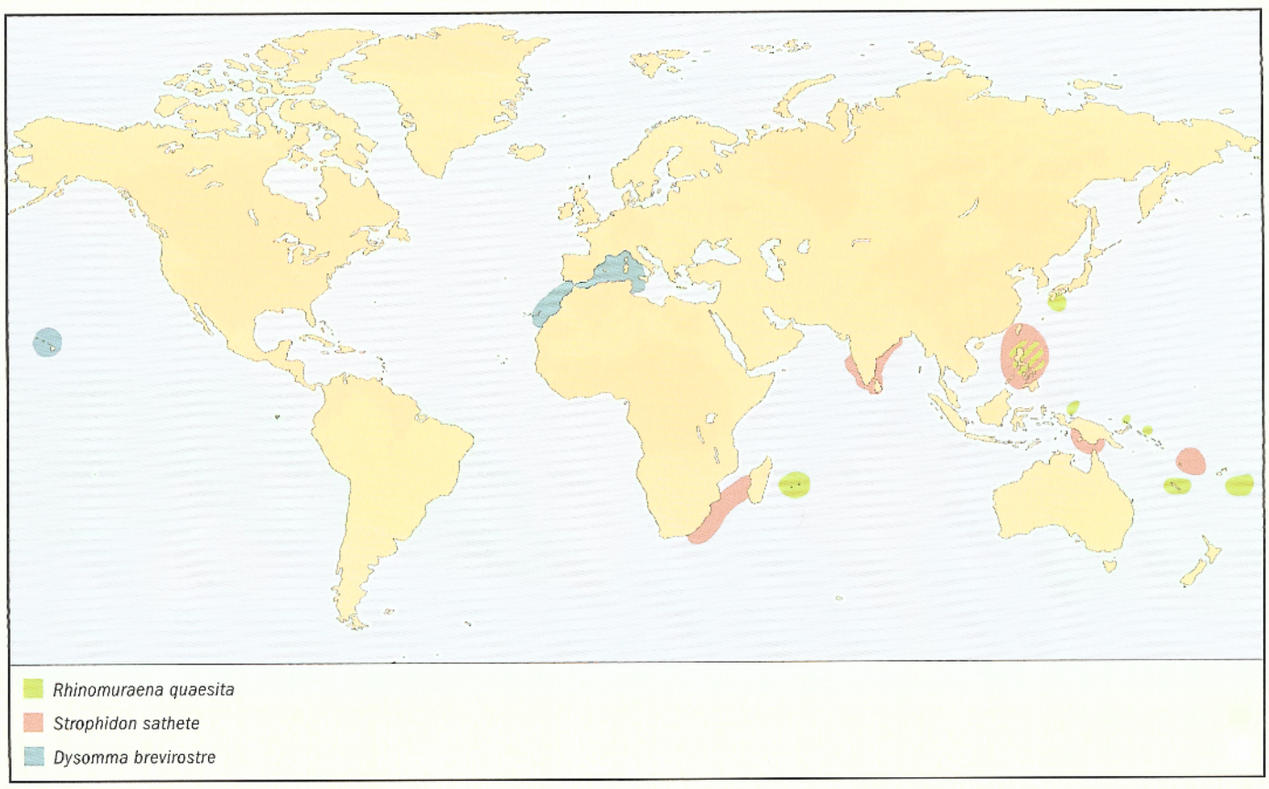
Ribbon moray
Rhinomuraena quaesita

FAMILY
Muraenidae

TAXONOMY
Rhinomuraena quaesita Garman, 1888, Marshall Islands.

OTHER COMMON NAMES
English: Ribbon eel, black ribbon eel; French: Rhinomurène noire; Samoan: Pusi.

PHYSICAL CHARACTERISTICS
May reach 51.2 in (130 cm) in length. It has a very elongated body. Mature males are mostly blue, whereas mature females



are almost completely yellow. They have three fleshy tentacles on the tip of the lower jaw; a single fleshy, pointed projection at the tip of the snout; and tubular anterior nostrils ending in gaudy, fanlike expansions.

DISTRIBUTION
Indo-Pacific from East Africa in the west to the Tuamotu Archipelago in the east and from southern Japan in the north to New Caledonia and French Polynesia in the south, including the Marianas and Marshall Islands in Micronesia.

HABITAT
Lagoons and associated seaward reefs as deep as 180 ft (60 m).

BEHAVIOR
Secretive, nonmigratory species that normally hides in sand or rubble, sometimes with only its head protruding.

FEEDING ECOLOGY AND DIET
Feeds on small fishes.

REPRODUCTIVE BIOLOGY
Fertilization in this species is external. This may be the only moray that undergoes abrupt changes in coloration and sex. It is classified as a protandrous hermaphrodite, that is, functioning males reverse sex to become females.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
It is acquired for display in aquaria because of its striking coloration and unusual morphological features. ◆

Slender giant moray
Strophidon sathete

FAMILY
Muraenidae

TAXONOMY
Muraenophis sathete Hamilton, 1822, Ganges River.

OTHER COMMON NAMES
English: Gangetic moray, giant estuarine moray; French: Murène fil géante; German: Süsswassermuräne; Spanish: Morenilla gigante; Tagalog (Philippines): Payangitan.

PHYSICAL CHARACTERISTICS
Specimens as large as 157.5 in (400 cm) have been recorded. Individuals of this species have a very elongated body. This species is brownish-gray dorsally and paler on the venter.

DISTRIBUTION
Indo-West Pacific Ocean, from the Red Sea and East Africa to the western Pacific.

HABITAT
Benthic muddy environments of marine and estuarine areas, including inner bays and rivers.

BEHAVIOR
The most interesting behavioral feature of this species is their ability to stand vertically from a burrow with the head kept horizontally beneath the surface, rising and falling with the tide.

FEEDING ECOLOGY AND DIET
Feeds on a wide variety of crustaceans and fishes.

REPRODUCTIVE BIOLOGY
Almost nothing is known about reproduction.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
This species is consumed in India, the Philippines, Sri Lanka, South Africa, and other southeastern African countries as well as in Oceania. ◆

Slender snipe eel
Nemichthys scolopaceus

FAMILY
Nemichthyidae

TAXONOMY
Nemichthys scolopacea Richardson, 1848, type locality not available.

OTHER COMMON NAMES
English: Atlantic snipe eel, glass snake, threadfish; French: Avocette ruban; Spanish: Pez agazadicha.

PHYSICAL CHARACTERISTICS
Grows to 51.2 in (130 cm). They are extremely long eels whose posterior end is exceptionally narrow, to the point that it ends as a long filament. They have exceptionally long jaws that curve outward and do not close together, except among fully mature males. They are also unusual because of their proportionally very large eye. In color they vary between dark brown and gray, often darker ventrally, with the anal fin and tips of the pectoral fins almost black. Males are quite different from females in that once they fully develop, their jaws shorten, and they lose their teeth. This feature led some researchers to believe that each sex was a separate species.

DISTRIBUTION
Worldwide in tropical and temperate seas. In the western Atlantic they range from Nova Scotia in Canada to the northern Gulf of Mexico and all the way south to Brazil. In the eastern Atlantic they are found from Spain to South Africa, including the western Mediterranean, although there are some reports from Iceland. In the northwestern Pacific they inhabit Japanese waters and the Arafura Sea. In the eastern Pacific they occur from Alaska to Chile, including the Gulf of California.

HABITAT
Pelagic, found mostly in middle to deep waters between 295 and 6,560 ft (91–2,000 m). The depth varies with the latitude—they occur in shallower waters at higher latitudes.

BEHAVIOR
As with many planktonic organisms, it is possible that their extremely elongated bodies are used to increase drag and therefore buoyancy in midwaters.

FEEDING ECOLOGY AND DIET
Feed on crustaceans while swimming with their mouths open.

REPRODUCTIVE BIOLOGY
They are oviparous, with external fertilization, buoyant eggs, and planktonic leptocephalus larva. The leptocephalus larva is

very elongated, with a filiform tail. The strong sexual dimorphism in the direction of degenerative changes in males and females suggests that they may display semelparity, that is, that they breed only once and then die immediately.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
None known. ◆

Tiger snake eel
Myrichthys maculosus

FAMILY
Ophichthidae

TAXONOMY
Muraena maculosa Cuvier, 1816, Mediterranean Sea.

OTHER COMMON NAMES
English: Ocellated snake eel, spotted snake eel; Afrikaans: Swartogies-slangpaling; Tahitian: Puhi popooru.

PHYSICAL CHARACTERISTICS
Specimens may reach 39.4 in (100 cm). The young have black saddles. Adults are pale cream in color, with large and small black spots. All have a stiffened, pointed tail.

DISTRIBUTION
Indo-Pacific region from the Red Sea and East Africa in the east to the central Pacific in the west. The species does not occur in the Hawaiian islands, where it has been replaced by *M. magnificus*.

HABITAT
Sandy areas of reef flats, lagoons, and seaward reefs. Lives buried in the sand.

BEHAVIOR
The most interesting behavioral characteristic of tiger snake eels is their ability to burrow tail first and then move equally forcefully forward and backward through the sediment. They may aggregate in large numbers under a light at night.

FEEDING ECOLOGY AND DIET
Feeds on small fishes and invertebrates.

REPRODUCTIVE BIOLOGY
Nothing is known.

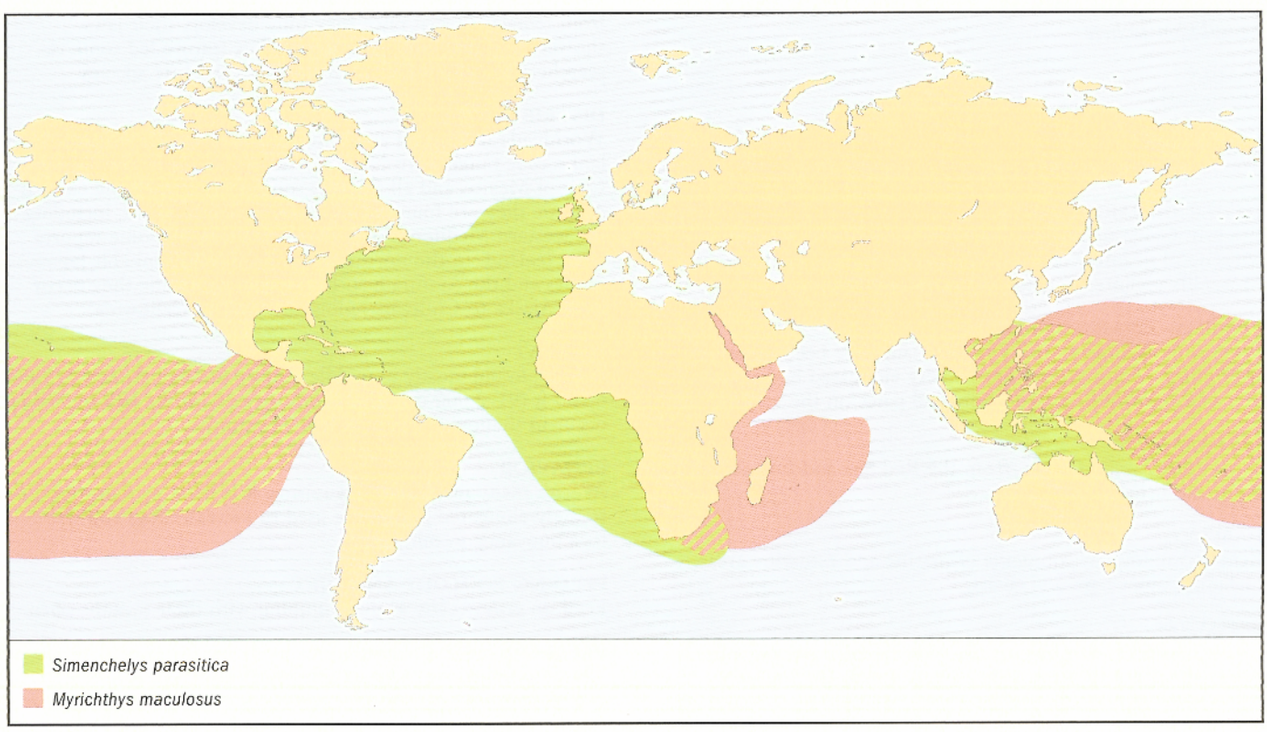
CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
None known. ◆

Pignosed arrowtooth eel
Dysomma brevirostre

FAMILY
Synaphobranchidae

TAXONOMY
Nettastoma brevirostre Facciolà, 1887, Sicily, Italy.



OTHER COMMON NAMES
None known.

PHYSICAL CHARACTERISTICS
Individuals reach 11.8 in (30 cm) in length. Like most deep-sea fishes, they are pale in coloration. This species lacks pectoral fins as well as scales. The lower jaw is shorter than the upper jaw. It has between 193 and 204 vertebrae.

DISTRIBUTION
North Atlantic, from Madeira to the Gulf of Guinea, including the western Mediterranean. It is found all the way to Messina in Sicily. It also occurs off the coasts of Florida in the United States and has been recorded in Hawaii.

HABITAT
Muddy substrates of waters at a depth range between 1,150 and 2,130 ft (350–650 m).

BEHAVIOR
Burrowing, solitary species.

FEEDING ECOLOGY AND DIET
Probably feeds on small benthic fish and invertebrates.

REPRODUCTIVE BIOLOGY
Nothing is known.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
None known. ◆

Snubnosed eel
Simenchelys parasitica

FAMILY
Synaphobranchidae

TAXONOMY
Simenchelys parasitica and *S. parasiticus* Gill, 1879, Massachusetts.

OTHER COMMON NAMES
English: Slime eel; French: Anguille à nez court.

PHYSICAL CHARACTERISTICS
Specimens may reach 24 in (61 cm). This species has a slimy body with a blunt, thick, round snout and a small mouth. The gill slits are broadly separated, and the scales are embedded in the skin. Coloration is gray to grayish-brown; it is darker on the fin edges and along the lateral line.

DISTRIBUTION
Worldwide species, particularly in tropical and subtropical waters.

HABITAT
Individuals of this species are found at depths of 1,200–8,700 ft (365–2,650 m), over muddy, deep-sea bottoms. They also parasite on other fishes.

BEHAVIOR
Little is known besides their feeding behavior. They are capable of homing in on dead animals.

FEEDING ECOLOGY AND DIET
Feeds on benthic invertebrates and fish, including dead tissue. It is parasitic on some fishes. Large, dead fishes may look as if they are alive as these eels feed inside their carcasses.

REPRODUCTIVE BIOLOGY
Nothing is known.

CONSERVATION STATUS
Not listed by the IUCN.

SIGNIFICANCE TO HUMANS
No significant economic importance but are of scientific value because their unusual ecological characteristics and feeding habits.

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