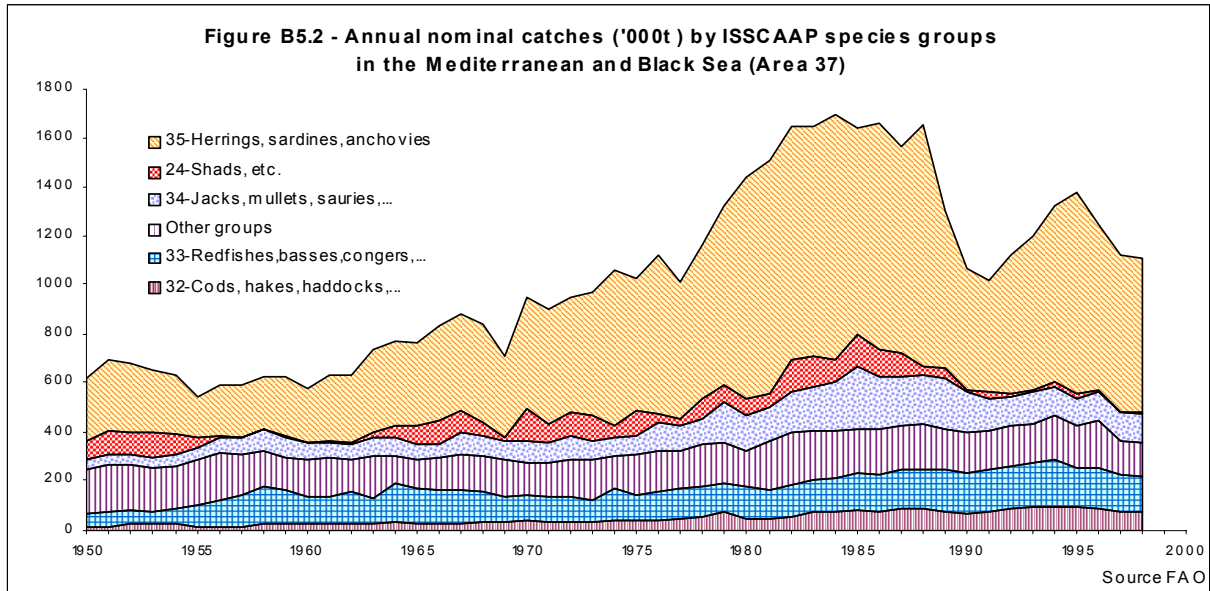


**Unit 3. Fish Ecology**  
**Outcome 2: Principle Commercial species in the Mediterranean.**  
**Part 1: Mediterranean Commercial Important Species**

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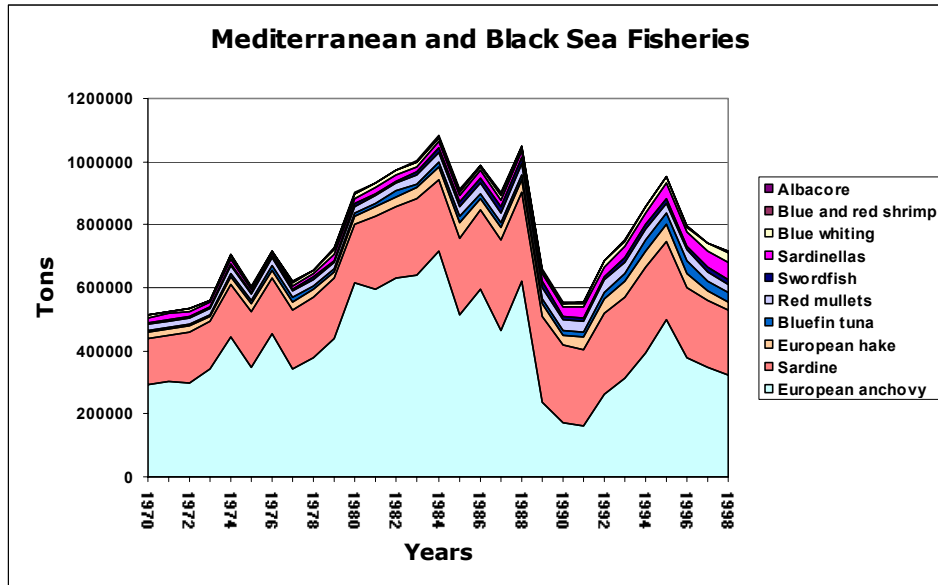
*The views expressed are those of the authors and not of the FAO*

Nominal catches in the Mediterranean and the Black Sea (FAO Fisheries Area 37) increased from slightly over 0.6 million tons in 1960, to more than 1.6 million tons in 1989 after which they declined precipitously to 1 million tons in 1991 as a result of the collapse of the sprat and anchovy fishery in the Black Sea. Total catches have subsequently increased to 1.7 million tons in 1995, before declining steadily to 1.4 million tons in 1998.



The Scientific Advisory Committee (SAC) of the General Fisheries Commission for the Mediterranean (GFCM) in May 2000 decided to analyse available scientific information on the eleventh most important shared demersal, small pelagic and large pelagic species. These species were:

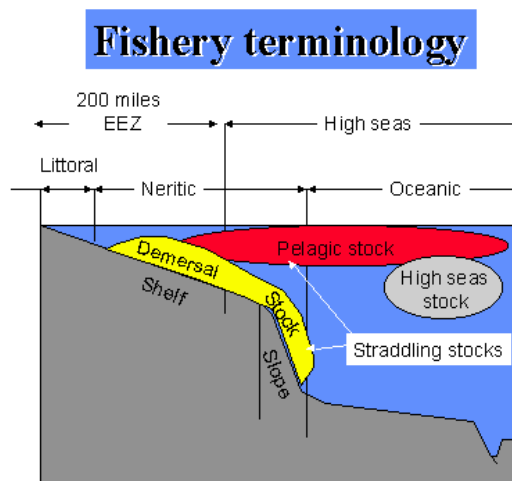
- Demersal species: (species living in close relation with the bottom and depending on it)
  - european hake (*Merluccius merluccius*)
  - red mullet (*Mullus barbatus*) and striped red mullet (*Mullus surmuletus*)
  - blue whiting (*Micromesistius poutassou*)
  - blue and red shrimp (*Aristeus antennatus*)
  
- Pelagic species: (species that spend most of their life swimming in the water column with little contact with or dependency on the bottom.)
  - anchovy (*Engraulis encrasicolus*)
  - sardine (*Sardina pilchardus*)
  - sardinella (*Sardinella aurita*).
  
- Large pelagics:
  - bluefin tuna (*Thunnus thynnus*)
  - swordfish (*Xiphias gladius*)
  - albacore (*Thunnus alalunga*)



Although FAO fisheries statistics consider almost 200 species or group of species in their Mediterranean database, the eleven species mentioned above account for 50% of total Mediterranean landings.

The GFCM, as a Regional Fisheries Commission deals mainly with shared stocks and with highly migratory stocks. These species were chosen not only because of their shared or highly migratory nature, but also due to its importance both in terms of landings and economics as it has been said before. For instance, even if *Aristeus antennatus* landings are not very important, it is an important commercial fishery species due to the high values that they reach at the market.

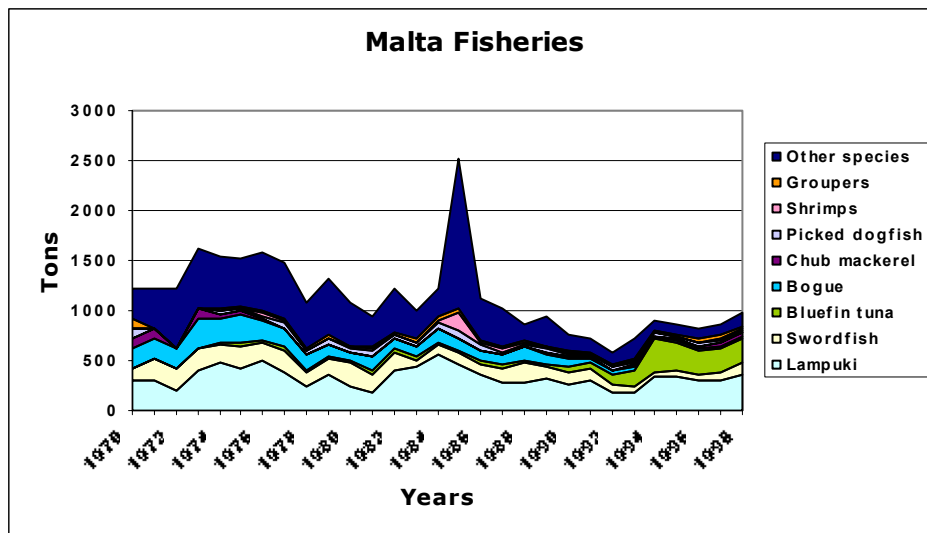
We have already introduced some concepts that are very important from a fisheries management point of view. As shared stocks we define the stocks of fish that migrate across the EEZs boundary of adjacent or opposite coastal states. Straddling stocks are stocks which occurs both within the EEZ and in an area beyond and adjacent to EEZ. For highly migratory species we understand marine species whose life cycle includes lengthy migrations, usually through the EEZ of two or more countries as well as into international waters (this term usually is used to denote tuna and tuna-like species, marlins and swordfish). In the figure below there is an explanatory figure of some of these concepts.



The figure below shows the evolution of fisheries landings in Malta according to FAO statistics. Landings in Malta decreased slightly from 1200 tons in 1970, to 1000 tons in 1998. The most important eight fishery resources remained around 800 tons during the whole period. These resources account in 1998 for more than 80% of the total catches.

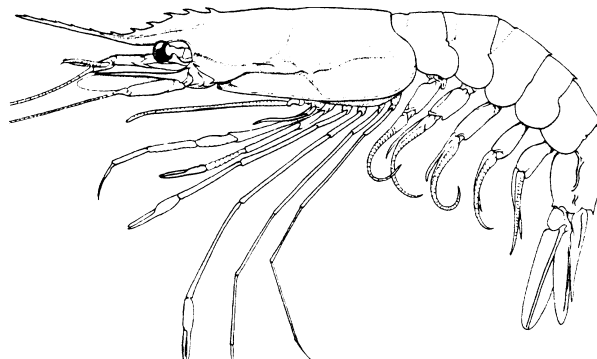
Among Malta commercial fishery species, the most important are large pelagics as dolphin fish (*Coryphaena hippurus*), swordfish (*Xiphias gladius*) and bluefin tuna (*Thunnus thynnus*). There are also some important demersal fisheries resources as groupers (*Epinephelus alexandrinus* and *Polyprion americanus*), picked dogfish (*Squalus acanthias*) and shrimps (*Aristeus antennatus*).

An important characteristic of Malta fisheries is the low significance of the small pelagic species in their landings. Only bogue (*Boops boops*) and chub mackerel (*Scomber japonicus*) are of relative importance.



During this course we will focus on the species mentioned before and the families to which they belong.

**Family Aristidae**



Distribution: Atlantic, Indian, and Pacific Oceans.

General Features: Animals either a) with rostrum very long in females and young males, but becoming rather short in adult males, and always bearing more than 2 upper teeth (subfamily

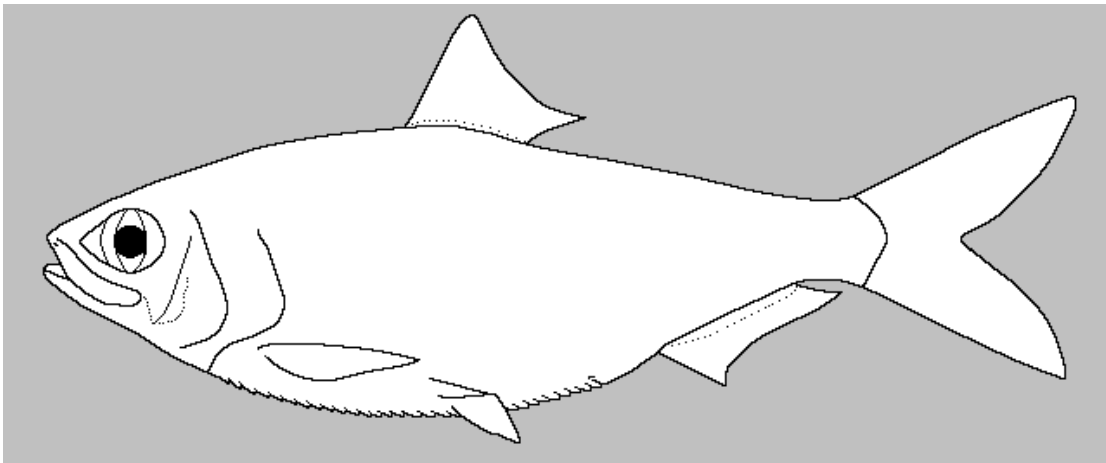
*Aristeinae*); or b) rostrum short, not extending beyond eyes and armed with 1 or 2 upper teeth (subfamily *Benthesicyminae*). No styliform projection at base of eyestalk, but a tubercle present on its inner border (very small in *Aristaeomorpha*). In the subfamily *Aristeinae*, upper antennular flagellum very short and attached to the base of distal antennular segment. All 5 pairs of legs well developed, fourth leg bearing 2 well-developed arthrobranches (hidden beneath carapace). In males, endopod of second pair of pleopods (abdominal appendages) with appendix masculina and appendix interna, but without lateral projection. Third and fourth pleopods divided into 2 branches. Telson with 1 to 4 pairs of movable lateral spines. Typical coloration of deep-sea crustaceans: body reddish or scarlet, sometimes pale white and with red cross bands on abdomen.

**Habitat and biology:** All representatives of this family are marine and occur in very deep waters (generally deeper than 300 m). Usually they are benthic and prefer soft bottom. *Aristeid* shrimps are generally of large size and can reach a body length of 33 cm. The sexes are easily distinguished by the presence of a large copulatory organ (petasma) on the first pair of pleopods (abdominal appendages) of males, while the females have the posterior thoracic sternites modified into a large sperm receptacle process (thelycum) which holds the spermatophores or sperm sacs (usually whitish or yellowish in colour) after mating. The eggs are small and numerous, and are released directly into the water and not retained on the female abdomen. The larvae are planktonic and have the nauplius stage.

**Interest to fisheries:** Important fisheries species. High market price.

**Species of commercial interest in the Mediterranean:** Blue and red shrimp (*Aristeus antennatus*), giant red shrimp (*Aristaeomorpha foliacea*).

### **Family Clupeidae**



**Distribution:** Found in all seas from 70 N to about 60 S.

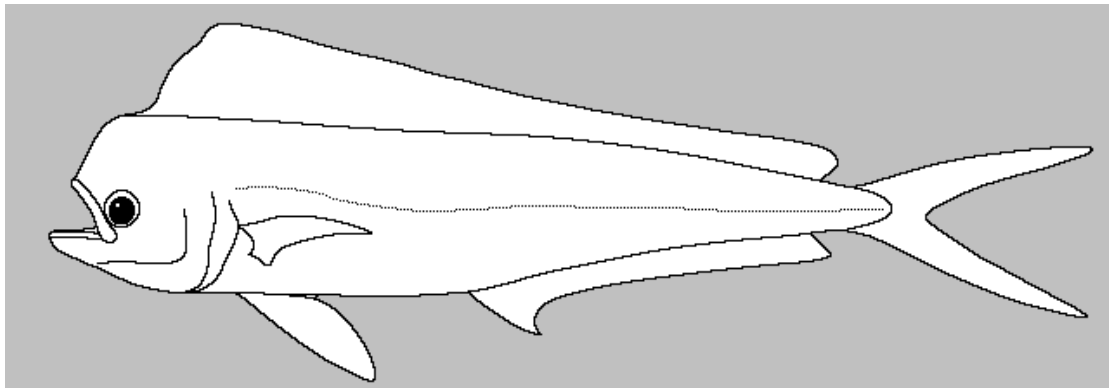
**General Features:** Typically, clupeids are fusiform fishes, oval in cross-section, with a complete series of scutes along the belly (pelvic scute always present). The mouth is terminal and the jaw teeth are small or minute. The dorsal fin is short and near the midpoint of the body. The pelvic fins are just in front of, below or just behind the dorsal fin base, and the anal fin is short and its origin is well behind the last dorsal finray. However, there is great variation in body shape and depth (round bodied to strongly compressed and deep), scutes (some or all absent along belly, but a few or a complete series of pre-dorsal scutes occasionally present), mouth shape (lower jaw prominent to mouth fully inferior in the gizzard shapes), teeth (absent in some, canines in others), and scales (deciduous in some, minute in others). Adults are usually 10 to 20 cm standard length but there is a great variation in size.

Habitat and biology: Clupeids are typically marine coastal and schooling fishes, some freshwater and anadromous. They feed on small planktonic animals (mainly crustaceans), forming large schools and scattering large numbers of pelagic eggs from which planktonic larvae hatch.

Interest to fisheries: One of the most important families of commercial fishes, processed for food, oil, or fish meal.

Species of commercial interest in the Mediterranean: Sardine (*Sardina pilchardus*) and sardinella (*Sardinella aurita*)

### ***Family Coryphaenidae***



Distribution: Atlantic, Indian and Pacific Ocean.

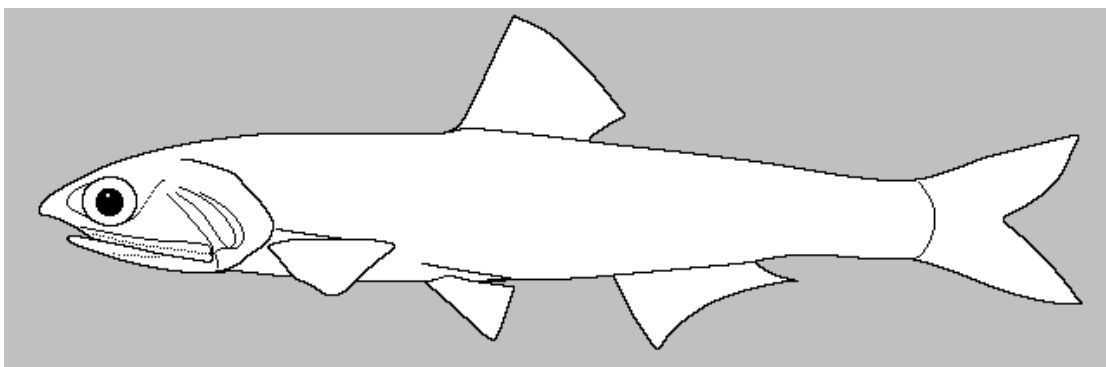
General Features: Slender fishes with compressed head and body. The single dorsal fin originates on the head and extends over nearly the full length of the body. No spines; soft rays. No spines on anal fin. Deeply forked caudal fin. Forehead steep and high in adult males. Live specimens with exceedingly beautiful colors. Attains 1.5 m maximum length.

Habitat and biology: Dolphin fishes inhabit the surface waters where they feed upon small fishes and other animals.

Interest to fisheries: Important in some local fisheries.

Species of commercial interest in the Mediterranean: Dolphin fish (*Coryphaena hippurus*)

### ***Family Engraulidae***



Distribution: Occurring in all seas from about 60°N to 50°S.

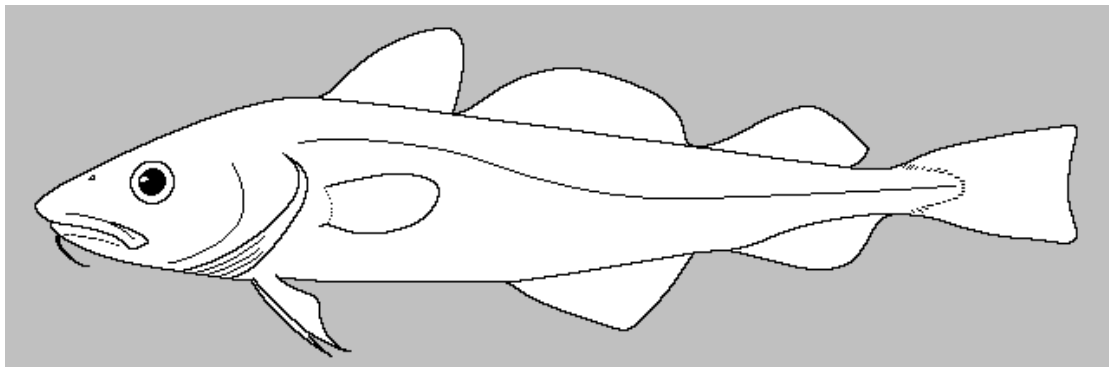
General Features: Small or moderate-sized clupeoid fishes (usually 10 to 20 cm standard length). Anchovies are characterized by a usually prominent pig-like snout projecting beyond the tip of the lower jaw, the latter almost always long, slender and “underslung”, its articulation behind the eye, usually well behind. Jaw teeth are usually small or minute. Gillrakers are usually short and not numerous. The dorsal fin is short and usually near the midpoint of the body; the pectoral fins are low on the body; the pelvic fins are before, under or behind the dorsal fin base; the anal fin is usually moderate. Typically, the back is blue/green and the flanks silver (sometimes with a distinct silver stripe).

Habitat and biology: Anchovies are typically marine coastal and schooling fishes. Some species enter brackish or freshwater to feed or spawn and some live permanently there and are found high up the Amazon. Most species feed on small planktonic animals (especially crustaceans), either by locating individual prey or by more indiscriminate filter-feeding, a few are piscivorous. Most, perhaps all scatter quite large numbers of eggs from which hatch planktonic larvae.

Interest to fisheries: Commercially important for food and fishmeal; also used as bait.

Species of commercial interest in the Mediterranean: Anchovy (*Engraulis encrasicolus*)

### ***Family Gadidae***



Distribution: They are found in circumpolar to temperate waters, mainly of the Northern Hemisphere.

General Features: Gill openings extend upward above the level of pectoral fins. Three dorsal fins and two anal fins. Anterior dorsal fin originating at rear of or behind head; caudal fin externally symmetrical. Pelvics before pectorals. No spines. Teeth present on vomer. Usually with barbel. No otophysic connection between swim bladder and auditory capsules. Egg without oil globule. Small to very large fishes, ranging in size from 15 cm (*Gadiculus argenteus*) to at least 200 cm in total length (*Gadus morhua*, *Molva molva*).

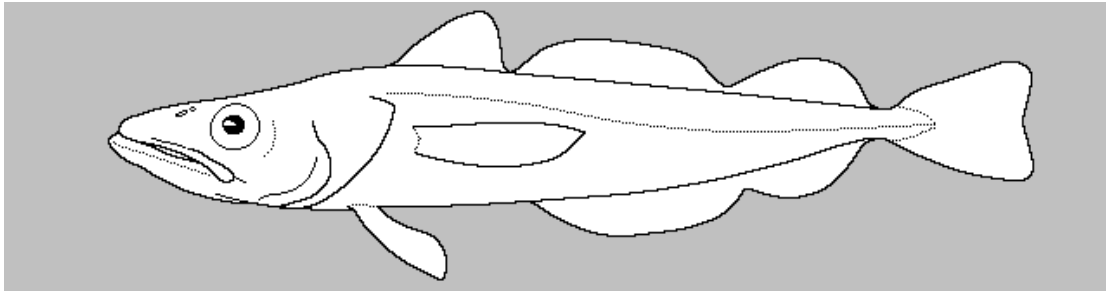
Habitat and biology: Most species are demersal or benthopelagic, only a few are predominantly pelagic. Gadids are typically marine fish, but a number of species tolerate low salinities and hence also inhabit estuaries, and occasionally even freshwaters. Very few species are confined to littoral or inshore, inhabit only shelf waters, but most extend to deeper waters on the slope beyond 500 m. Long-distance migrations are known for several gadid species. Some undertake diel vertical migrations, moving from the bottom to the surface at

night. Schooling behaviour is well developed in certain species. Gadids feed on fish and invertebrates.

Interest to fisheries: The family *Gadidae* is second only to the *Clupeidae* in terms of the global volume of fish landings from marine waters.

Species of commercial interest in the Mediterranean: Blue whiting (*Micromesistius poutassou*).

### ***Family Merlucciidae***



Distribution: The species of this Family are distributed on both sides of the Atlantic Ocean, in the eastern Pacific Ocean and off southern New Zealand.

General Features: Body long, slender and laterally compressed. Head large or medium-sized, and little depressed in most species; mouth large, lower jaw slightly projecting beyond the upper in most species, end of upper jaw reaching below middle of eye. Eye large, its diameter 1/2 to 1/5 of head length. Strong, pointed teeth in jaws in most species; teeth in upper jaw biserial or in a single row; teeth also present on vomer but not on palatines. No barbel on chin. Two dorsal and one anal fins; first principal rays spinous in most species; dorsal fin, better developed than the anal; pectoral fins rather long and high in position; pelvic fins with 7 to 10 rays and normally developed in most species; caudal fin truncated or tapering. Anus situated close to origin of anal fin in most species. Colour: usually steel grey on back, silvery white on sides and belly.

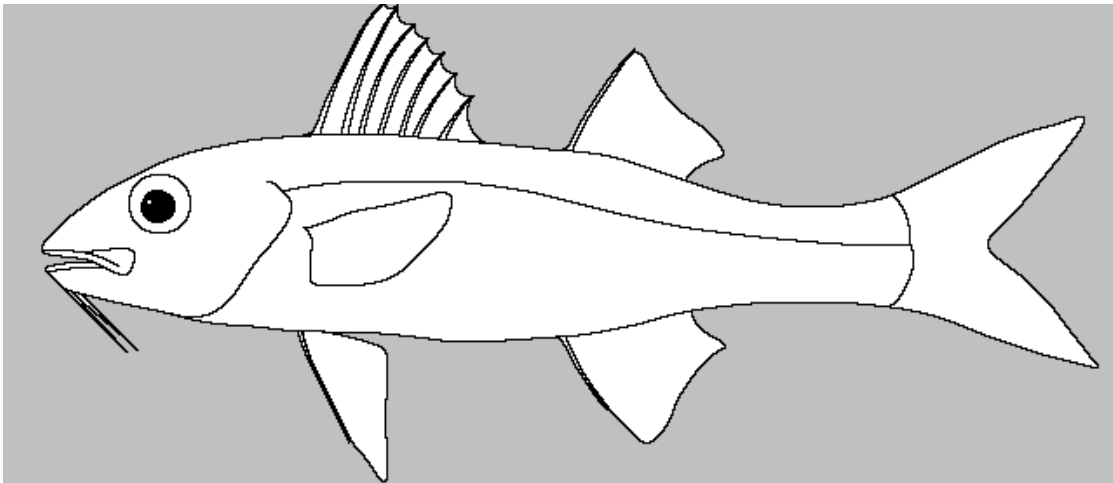
Habitat and biology: These fishes inhabit the continental shelf and upper slope, but some enter estuaries and/or very deep waters over 1000 m depth. They are voracious predators, but their food preferences change during growth. Most undertake diurnal vertical movements and spawn in spring or in summer.

Interest to fisheries: Their interest to fisheries is considerable. Worldwide catches of merlucciids make the *Merlucciidae* the second most important family of the Gadiformes.

Species of commercial interest in the Mediterranean: European hake (*Merluccius merluccius*).



***Family Mullidae***



Distribution: Atlantic, Indian, and Pacific Oceans, rarely in brackish waters.

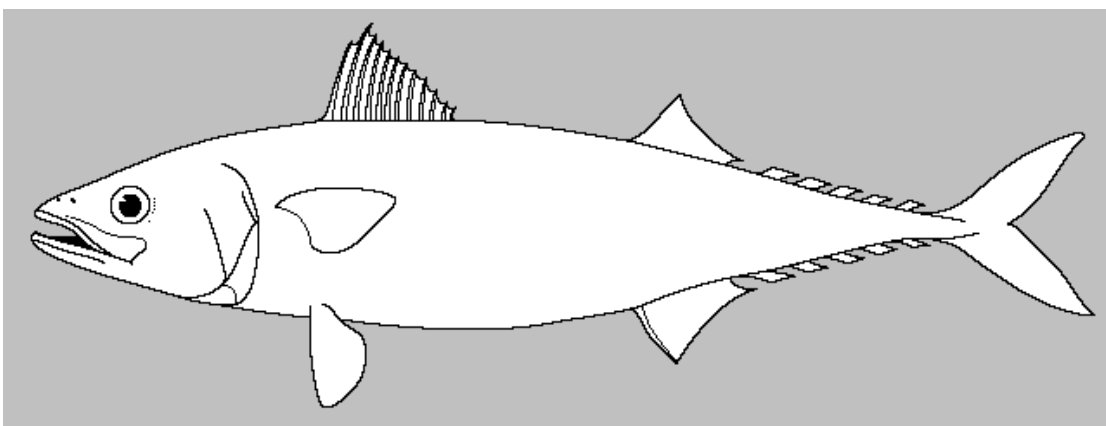
General Features: Elongated body. Dorsal fins far apart. First dorsal fin with 6-8 spines; second dorsal with one spine and 8-9 soft rays, shorter than anal fin. Spines in anal fin 1 or 2, with 5-8 soft rays. Forked caudal fin. Chin with 2 long barbels, which contain chemosensory organs and are used to probe the sand or holes in the reef for benthic invertebrates or small fish. Up to 60 cm maximum length. Many brightly colored.

Habitat and biology: Pelagic spawners.

Interest to fisheries: Valued as food fish. Very important commercial fishes, highly appreciated due to the excellent quality of their flesh

Species of commercial interest in the Mediterranean: Red mullet (*Mullus barbatus*), Striped red mullet (*Mullus surmulletus*)

***Family Scombridae***



Distribution: Tropical and subtropical seas.

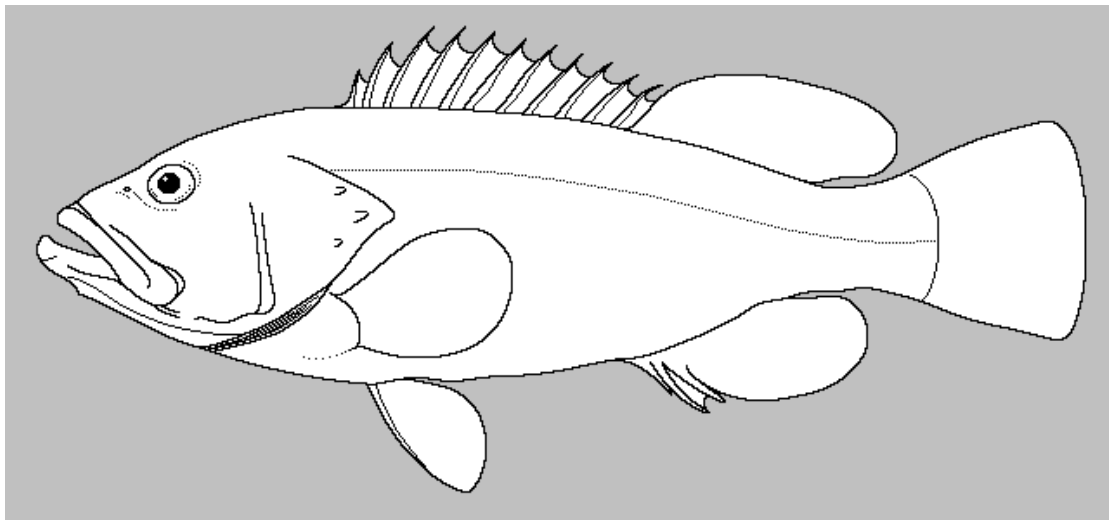
General Features: The 2 dorsal fins separate and depressible into grooves. Finlets following anal and posterior dorsal fins. Origin of anterior dorsal fin well behind the head. Pectoral fins high on body. Pelvic fins below pectorals, 6 fin rays. Two keels on slender caudal peduncle.

**Habitat and biology:** Scombrids are dioecious (separate sexes) and most display little or no sexual dimorphism in structure or colour pattern. Females of many species attain larger sizes than males. Batch spawning of most species takes place in tropical and subtropical waters, frequently inshore. The eggs are pelagic and hatch into planktonic larvae. Scombrids are active predators. The mackerels (*Scomber* and *Rastrelliger*) filter plankton out of the water with their long gillrakers. The Spanish mackerels, bonitos, and tunas feed on larger prey, small fishes, crustaceans, and squids. The main predators of smaller scombrids are other predacious fishes, particularly larger scombrids and billfishes. *Tunnus* and close relatives with a specialized vascular system for heat exchange.

**Interest to fisheries:** Among the most important of commercial and sport fishes. Virtually all scombrids are highly appreciated fish for their high quality flesh. Scombrids are marketed fresh, frozen, canned, smoked and salted.

**Species of commercial interest in the Mediterranean:** Bluefin tuna (*Thunnus thynnus*), albacore (*Thunnus alalunga*), chub mackerel (*Scomber japonicus*), bullet tuna (*Auxis rochei*), little tuny (*Euthynnus alletteratus*) and atlantic bonito (*Sarda sarda*).

### **Family Serranidae**



**Distribution:** Tropical and temperate oceans.

**General Features:** Operculum bearing 3 spines - a main spine with one below and one above it. Lateral line complete and continuous, not reaching onto caudal fin (lacking in one species). Dorsal fin may be notched, with 7-12 spines. Three spines on anal fin. Caudal fin usually rounded, truncate, or lunate; rarely forked. Tip of maxilla exposed even with mouth closed. One spine on pelvic fin; soft rays 5. Groupers attain up to 3 m maximum length and weights of up to 400 kg.

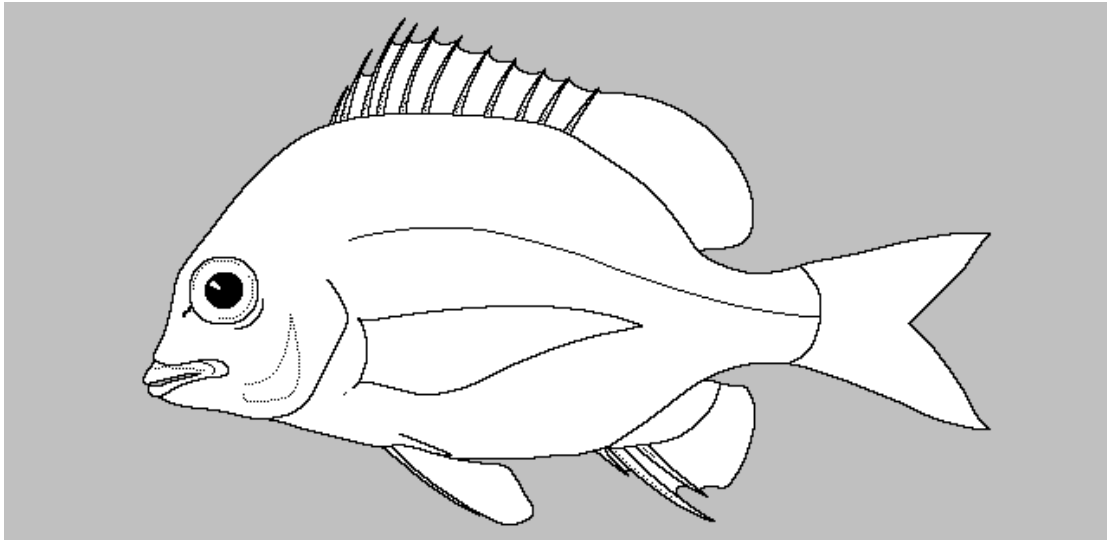
**Habitat and biology:** Marine species, although some species enter freshwater. Monoecious with some functional hermaphrodites; groupers are protogynous hermaphrodites. They change sex from females to a few dominant males. They are bottom-dwelling predators. They feed on crustaceans and fishes.

**Interest to fisheries:** Although groupers are usually the most expensive fishes in local markets, separate catch statistics are not reported for most species, and landings are often summarized

as "serranids" or "groupers". This lack of species specific catch data is due, in part, to the difficulty of identifying many of the species.

Species of commercial interest in the Mediterranean: Groupers (*Epinephelus spp*), wreckfish (*Polyprion americanum*) and combers (*Serranus spp*)

***Family Sparidae***



Distribution: Tropical and temperate Atlantic, Indian and Pacific Oceans.

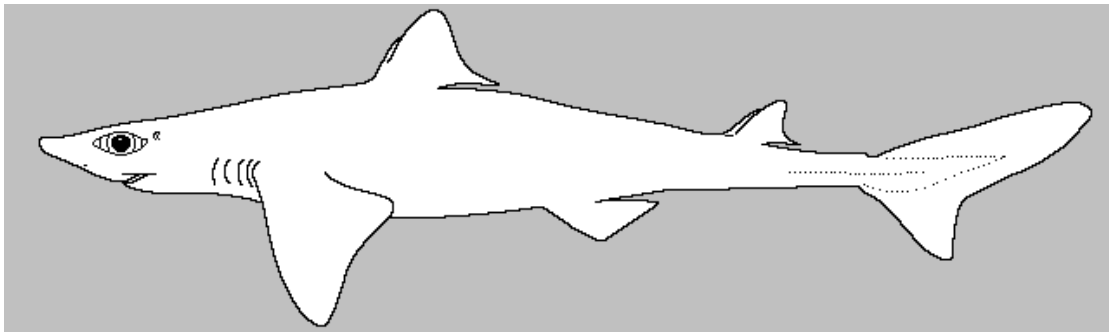
General Features: Typically, sparids are fusiform or oval fishes. Small mouth, slightly protractile. Teeth well developed. No teeth present on vomer. One dorsal fin usually having 10-13 spines; soft rays 10-15. Three spines in anal fin; soft rays 8-14. The pectoral fins are long and pointed; the pelvic fins are inserted under or behind the pectoral fin base. One lateral line well developed, reaching the base of the caudal fin. Caudal fin more or less forked. Maxilla hidden by a sheath when mouth is closed. To about 1.2 m maximum length. Wide range of colours.

Habitat and biology: Chiefly marine; very rare in fresh and brackish water. Carnivores of hard-shelled benthic invertebrates. Many species have been found to be hermaphroditic; some have male and female gonads simultaneously; others change sex as they get larger.

Interest to fisheries: Premier food and game fishes.

Species of commercial interest in the Mediterranean: Bogue (*Boops boops*), dentex (*Dentex dentex*) and seabreams (*Diplodus spp*, *Pagellus spp*, *Pagrus spp*, and *Sparus aurata*).

*Family Squalidae*



Distribution: Atlantic, Indian and Pacific Oceans, boreal to tropical.

General Features: Both dorsal fins with spines, not grooved; teeth on lower jaw not much larger than those on upper jaw; upper precaudal pit usually present; caudal peduncle with a pair of lateral keels.

Trunk stout to slender but not markedly compressed, with or without low abdominal ridges. Head conical to moderately depressed. Last (5th) gill slits may be enlarged but not abruptly expanded from first 4 gill slits. Spiracles moderately large to very large, close behind eyes. Nostrils usually well apart from each other, separated by a space their width or more. Mouth arched or transverse, with short, moderately long, or very long labial furrows that may virtually encircle the mouth; lips usually not expanded and papillose. Teeth highly variable, with a cusp always present and cusplets variably present or absent. Two small to moderately large dorsal fins, the first variably smaller or larger than the pelvic fins, with its base at least partly anterior to the pelvic origins and usually well anterior to them; caudal fin with or without a subterminal notch.

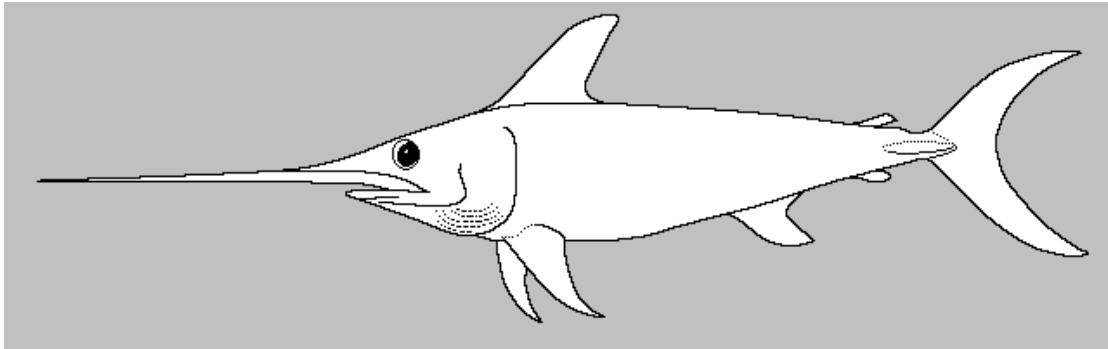
Habitat and biology: Dogfish are primarily social sharks, with some species forming immense schools that are highly nomadic, moving locally and on regular yearly migrations. All members of this family in which reproduction is known are ovoviviparous (aplacental viviparous), having one or two to over 20 young in a litter. Dogfish feed on a wide variety of prey, chiefly bony fishes but also other sharks, cephalopods, crustacea, and other invertebrates. Several species apparently feed communally, and may locally exhaust or drive away prey species.

Members of this family are found on the continental and insular shelves and slopes near the bottom. No dogfish are oceanic although some species have pelagic young that live well off the bottom offshore, and none range into polar waters. Depths range from the intertidal to about 900 m on the deep slope, with most on the shelves and uppermost slopes above 600 m.

Interest to fisheries: Their interest to fisheries is considerable. Species of *Squalus* are taken in large quantities for human consumption and other purposes. None of the dogfish sharks are very dangerous to people; some species use their mildly toxic finspines or sharp teeth as weapons when captured and can inflict punctures or lacerations on unwary fishermen.

Species of commercial interest in the Mediterranean: Piked dogfish (*Squalus acanthias*).

*Family Xiphiidae*



This family includes a single species, *Xiphias gladius*.

Distribution: Cosmopolitan in tropical, temperate and sometimes cold waters of all oceans, including the Mediterranean Sea, the Sea of Marmara, the Black Sea, and the Sea of Azov.

General Features: Body elongate and cylindrical. Upper jaw prolonged into a long bill. Eyes large. Mouth not protrusible. Fine, file-like teeth present in specimens of about 1 m (body length), disappearing with growth. Gill openings wide; no gillrakers. Two widely separate dorsal fins in adults (continuous in immature specimens), the first much larger than the second; first dorsal with 34 to 49, second dorsal with 4 to 6 rays; two separate anal fins in adults (continuous in immature specimens) the first much larger than the second; first anal with 13 or 14, second anal with 3 or 4 rays; position of second anal fin slightly more forward than that of second dorsal fin; pectoral fins falcate, a little rigid and situated low on body sides, with 16 to 18 rays; pelvic fins absent; caudal fin large and lunate. Caudal peduncle with a large keel present on each side and a deep notch on both the dorsal and ventral surfaces; anus situated near first anal fin origin. Colour: back and sides of body blackish-brown, gradually fading to light-brown on ventral side. The average weight in the Mediterranean Sea ranges from 115 to 160 kg. Usually females are larger than males.

Habitat and biology: Adult swordfish are opportunistic feeders, known to forage for their food from the surface to the bottom over a wide depth range. Over deep water, they feed primarily on pelagic fishes, including tunas (*Thunnus*), dolphinfishes (*Coryphaena*), barracudas (*Sphyraenidae*) and pelagic squids, while in relatively shallow waters they take chiefly neritic pelagic fishes (mackerels, herrings, anchovies, sardines, sauries, needlefishes, etc.). Large adults often make feeding trips to the bottom where they feed on demersal fishes. It is most likely true that the swordfish uses its sword to kill some of its prey, particularly squids and cuttlefishes, as is shown by the slashes on the bodies of prey found in swordfish stomachs.

This is an epi and mesopelagic, oceanic species, usually found in surface waters warmer than 13°C. The swordfish is primarily a warm-water species and, generally speaking, its migrations consist of movements toward temperate or cold waters for feeding in summer and back to warm waters in autumn for spawning and overwintering.

Interest to fisheries: There are important fisheries in the Atlantic, Indian and Pacific oceans. Very important commercial species due to the excellent quality of their flesh.

Species of commercial interest in the Mediterranean: Swordfish (*Xiphias gladius*).

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