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Being a bouillabaisse of fascinating facts about

FISH: The most-asked questions

The National Marine Fisheries Service annually answers thousands of questions about the oceans and the life that thrives within them. Questions come from seasoned scientists, from teachers, from elementary school pupils—from a whole host of citizens seeking knowledge that may be highly specialized, or may be rudimentary.

On the basis of a canvass of experienced marine scientists in the Fisheries Service, more than a hundred questions have been chosen as most representative. They are the questions asked most frequently, the topics that people find most interesting.

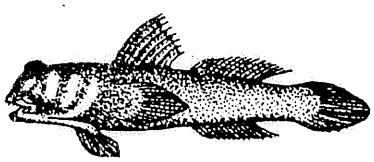
Marine Finfish and How They Live

Is life found at all depths in the ocean?
The question was settled in 1960, when Piccard and Walsh reported a swimming animal, resembling a sole or other flatfish about a foot long, at 35,800 feet deep, observed from a porthole of the bathyscaphe *Trieste.*

Some scientists believed, as recently as 1860, that marine life could not exist below 1,800 feet. That view was altered when a telegraph cable laid in the ocean bottom at 6,000 feet deep was retrieved and found covered with many forms of marine life.

How many fish species are there?
The most oft-quoted estimate is 20,000. There may be as many as 20,000 more.

Which is the oldest fish, as a class?
The most primitive fish-like animals are those with sucking mouths, such as lampreys and hagfishes, whose evolution stopped short of the development of biting jaws. Mainly bottom-dwellers, these animals are of great interest to zoologists, for many parts of their bodies show forms and functions that help to explain some of the evolutionary steps leading from low to advanced life forms.



What is the world's largest fish? The smallest?
The largest is the whale shark, which grows to more than 50 feet in length and may weigh several tons; second largest is the basking shark, which may measure 35 to 40 feet long. The smallest fish is the tiny goby, an inhabitant of fresh-to-brackish-water lakes in Luzon, Philippines. It seldom is longer than a half-inch at adulthood, yet is so abundant it supports a fishery.

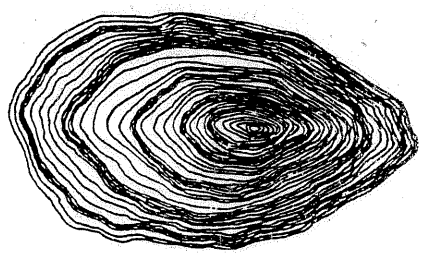
What is the most common fish in the sea?
Any of the several species of *Cyclothone,* a deepwater fish sometimes called a "bristlemouth." Rarely visible at depths that man can readily reach, the fish is about the size of a small minnow. It is netted at 500 meters or deeper all over the world.

What is an anadromous fish? A catadromous fish?
An anadromous fish, born in fresh water, spends most of its life in the sea and returns to fresh water to spawn. Salmon, smelt, shad, striped bass, and sturgeon are common examples. A catadromous fish does the opposite —lives in fresh water and enters salt water to spawn. Most of the eels are catadromous.

Why do scientists classify fish?
Since common or colloquial names of fish vary from place to place (menhaden, for example, are known by at least three different names, and striped bass are called "stripers" in New England and "rockfish" in Chesapeake Bay), investigators would have no way of differentiating among species without a uniform naming system.

The system used to name the 20,000-odd fishes known to science is called "the binomial system of nomenclature." It usually consists of a scientific name in two parts, the generic and specific names, or three parts if subspecies have been described. The words of the names are latinized regardless of the language or alphabet of the study and are frequently descriptive of a significant feature of the organism. The generic name generally applies to several species showing basic characteristics while a specific (species) name is based on a few characteristics applying to one species, separate and distinct from all others. (Example: The generic name *Morone* applies to white perch, white bass, and striped bass; the species names for those three fishes are *Morone americanus, M. chrysops,* and *M. sexatilis.*)

How is the age of a fish determined?
Mainly by two methods: Growth "rings" on scales, and/or ringlike structures found in otoliths (small bones of the inner ear), are examined and counted. The rings correspond to seasonal changes in the environment and can be compared to the annual rings of tree trunks. A series of fine rings are laid down in scales for each year of life—in summer, the rings grow faster and have relatively wide separations; in winter, slower growth is indicated by narrow separations between rings. Each pair of rings indicates one year. Because scale rings are sometimes influenced by other factors, scientists often use otoliths, whose ringlike structures also indicate years of life.



How long do fish live?
A few weeks or months (some of the small reef fishes) to 50 years or more (sturgeons). Longevity information is still sparse, but scientists have learned that species live 10 to 20 years in temperate waters.

Do some fish give birth to living young?
Yes, many do. These are called viviparous fishes. The sea perches of the Pacific coast, for example, give birth to living young of considerable size, sometimes one-fifth the size of the mother. Several kind of sharks produce living young.

Do fish breathe air?
Yes, but not directly into the lungs as mammals do (except for some tropical fish). As

water passes over a system of extremely fine gill membranes, fish absorb the water's oxygen content. Gills contain a network of fine blood vessels (capillaries) that take up the oxygen and diffuse it through the membranes.

How do fish swim? How fast?
Primarily by contracting bands of muscles in sequence on alternate sides of the body so that the tail is whipped very rapidly from side to side in a sculling motion. Vertical fins are used mainly for stabilization. Paired pectoral and pelvic fins are used primarily for stability when a fish hovers, but sometimes may be used to aid rapid forward motion.

Tunas and tuna-like fish, billfish, and certain sharks are the speed champions, reaching 50 miles per hour in short bursts. Sustained swimming speeds generally range from about 5 to 10 miles per hour among strong swimmers.

Can fish swim backwards?
A number can, but usually don't. Those that can are mostly members of one of the eel families.

Do all fish swim in the horizontal position?
Most do. The sea horse is among the exceptions. Another is the shrimp fish of the Indian Ocean, which congregates in schools of several individuals and swims vertically, its long tube-like snout pointing directly upward. A catfish indigenous to the Nile and other African rivers also swims in the vertical posture. Many kinds of midwater deepsea fishes swim or rest vertically.

Do fish chew their food?
Not in the human manner. Carnivorous fish use their sharp teeth to seize and hold prey while swallowing it whole or in large pieces. Bottom dwellers such as rays are equipped with large flat teeth that crush the shellfish they consume. Herbivorous fish (grazers) often lack jaw teeth, but have tooth-like grinding mills in their throats, called pharyngeal teeth. Fish would suffocate if they tried to chew, for chewing would interfere with the passage of water over the gills, necessary for obtaining oxygen.

Can fish distinguish color?
Most fish are colorblind, despite the opinion of many sportfishermen. Fish can see color shadings, reflected light, shape, and movement, which probably accounts for the acceptance or rejection of artificial lures used by fishermen.

Are all fish edible?
Most kinds encountered by anglers are. The organs of some species are always poisonous to man; other fish can become toxic because of elements in their diets. The latter are most often from tropical regions of both the Atlantic and Pacific Oceans. Scientific literature has pinpointed danger areas in which the disease called "ciguatera" (a disease dangerous to man) may occur in tropical and subtropical fish.

How can poisonous fish be distinguished from edible ones?
They cannot, without personal knowledge of the types of fish which are at times poisonous. Frequently local customs can be relied upon. A comprehensive three-volume publication on the subject is entitled "Dangerous Marine Animals" by Dr. Bruce Halstead.

Why do food fish sometimes have a strong odor?
For most species, truly fresh fish is almost odorless. Fish begin to smell "fishy" when deterioration sets in, often caused by incorrect storage practices that bring about the release of oxidized fats and acids through bacterial and enzymatic action.

Is there much salt in fish?
Very little in most. More than 240 species contain so little salt that doctors recommend them in salt-free diets. Shark meat is salty—as salty as the sea the shark lives in.

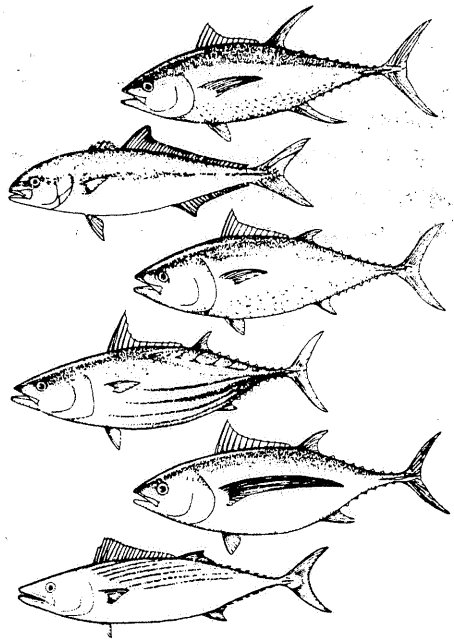
What is the blood-like material found along the backbone in the body cavity of most fishes?
The kidney. It is usually removed when the fish is cleaned.

Can shark meat be used as food for humans? Is it true that the meat of the hammerhead shark is poisonous?
Yes to the first question. Shark meat is palatable and nutritious if properly prepared. In some countries shark meat is marketed under its common name, in others it is marketed under various names. The fish in England's "fish and chips" is very often dogfish (a shark) or school shark. The prejudice against shark meat arises from a distaste for the scavenging habits people attribute to sharks, and to the fact that the meat spoils quickly. The meat of certain species is apt to be strongly flavored, a characteristic that may be reduced by icing for 24 hours, then soaking for two hours in brine. Dry salted shark has become a staple food in some countries where salt cod was formerly popular. But shark liver should never be eaten—its high concentrations of vitamins can cause illness in humans.

It is only a rumor that the hammerhead is poisonous.

What is the true description of a sardine?
Commercially, the name has come to signify any small herring-like ocean fish. In the United States, it is mandatory that when the name "sardine" is used on a can, the country or state of origin be listed, and a statement must appear that identifies preserving and flavor supplements.

How many kinds of tuna are there, and which kind makes up the biggest catch?
There are seven commercial and sport-caught tunas, as well as several related species, all of which are members of what is called the scombrid family. Commercially caught tunas consist of albacore, bigeye, blackfin, bluefin, bonito, skipjack, and yellowfin. Yellowfin, taken in the eastern Pacific and tropical Atlantic, makes up the biggest U.S. commercial catch. Albacore, caught in the eastern Pacific, is the true "white-meat" tuna; skipjack, caught throughout the world in tropical and subtropical waters, makes up the second largest U.S. commercial catch; bigeye is caught mostly in tropical waters; blackfin is caught commercially only in the Caribbean and off South America; the very large bluefin (rod-and-reel record, 1,040 pounds) is a highly prized sport catch in the Atlantic and Pacific; and the widely distributed bonito is used largely as pet food.



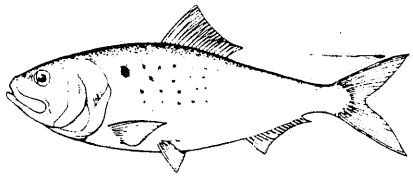
Do tunas have scales?
Yes, all species do, but scales are so small over most of the body as to be nearly invisible. Prominent scaling appears only around the head, on the cheeks, and in a triangular area on each side of the body near the head.

Are saltwater catfish good to eat?
The two species of sea catfish caught in U.S. waters are edible. The gafftopsail catfish is considered more tasty than the smaller common sea catfish.

What is the fish listed as "scrod" in New England restaurants?
The name comes from a Middle Dutch word "schrode" meaning a strip or shred. In New England scrod may be immature cod or haddock weighing 1½ to 2½ pounds. Sometimes the term is applied to cusk of about the same weight, or to pollock weighing 1½ to 4 pounds. When fishermen use the word, they are usually reefrring to gutted small haddock.

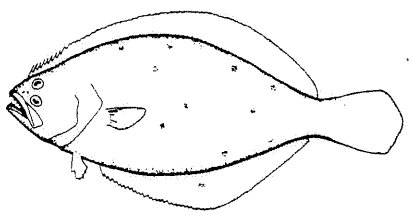
What are menhaden?
Menhaden are silvery, herring-like fish that travel in large schools along the Atlantic and Gulf of Mexico coasts of the United States. Plankton-eaters, menhaden attain a weight of about three-quarters of a pound. Flesh is oily and considered inedible for humans. The

fish are caught by purse-seine nets in shallow water and processed into oil for cosmetics and fish meal for animals, particularly for poultry. Menhaden support the largest fishery by volume and the eighth most profitable fishery in the United States.

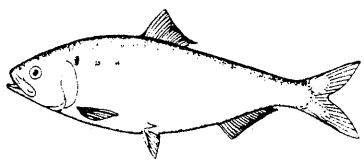


Where are Atlantic menhaden spawned, and where do they go after hatching?
Spawning is in the ocean. One important spawning site is at Onslow Bay, North Carolina. Some spawning takes place along the Atlantic coast from Massachusetts to Florida. The young menhaden first drifts with currents until it reaches an inlet, then works upstream to live for the summer near freshwater. In fall, schools move downstream to permanent ocean residence.

What do herring eat?
They subsist on zooplankton. Herring, which populate the oceans in enormous numbers, play an important role in the oceanic food chain in that they are primary converters of plankton. Herring form the food base for many larger species, and enormous quantities are taken commercially for fish meal, human food, and bait.



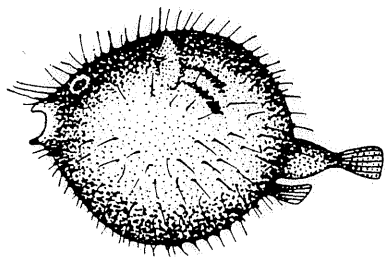
Are the eyes of flatfishes on the right or left side?
Except for the rare abnormal specimen, two of the four flatfish families (tongue soles and turbots) are always sinistral (eyes on the left side); the other two (both flounders) are dextral (eyes on the right side).



Has any kind of marine or ocean dwelling fish been successfully transplanted from coast to coast in the United States?
Yes, larvae and juveniles of the shad and the striped bass were taken from the Atlantic and released in the Pacific in the 1870's. So successful were the transplants that shad became permanent inhabitants of waters from southeast Alaska to Los Angeles, and striped bass support a good sport fishery off the California and Oregon coast.

How large do ocean sunfish get?
All four species reach from seven to ten feet in length. Because of their tremendous weight, the fish are difficult to land and weigh. One accurately weighed specimen tipped the scales at 3,102 pounds.

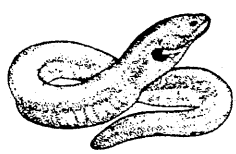
How do porcupine fish inflate themselves?
All puffer-like fish inflate by pumping water into special sacs when in their natural environment. Out of water, a puffer fills the sacs with air instead, and takes on a ballon-like appearance.



What is an "exotic" fish?
One not native to an area, but introduced either by accident or design. Some such species can cause problems. Often their natural predators are absent from the new area, permitting more rapid reproduction rates than those of natural inhabitants, sometimes at the expense of more desirable native fish. The "walking catfish" in Florida is an example. Thought to have escaped from a private aquarium, the catfish have shown a remarkable ability to avoid eradication efforts by man. An aggressive and voracious fish, it poses a threat to other forms of aquatic life. Population is now estimated in the millions.

What fishes are named after other animals?
Many are named after animals—alligator, bird, boar, buffalo, cat, cow, dog, elephant, frog, goat, goose, hawk, horse, leopard, lizard, parrot, porcupine, rabbit, sheep, squirrel, tiger, toad, unicorn, viper, wolf, and zebra.

What kind of fish is a "Bombay Duck"?
Also called bummalo, Bombay Duck is a marine lizardfish from southern Asia, particularly abundant in the Ganges Delta and the Arabian Sea of western India. The ordinarily small fish is split, boned, and sun-dried, and used as a condiment.



How much electricity does an electric eel generate?
The average discharge is more than 350 volts, but discharges as high as 650 volts have been measured. Voltage increase until the eel is about three feet long, after which only amperage increases. Some South American eels measure 10 feet in length.

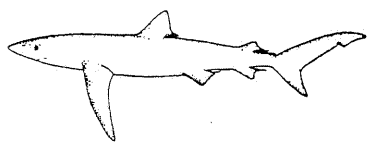
What are moray eels and where are they found?
Moray eels belong to a family of fish which differs from the common eels by their lack of side fins, their well-developed teeth, and their lack of scales. Common eels have embedded scales, but these are not readily noticeable.

Morays occur in tropical and subtropical seas of the world. In the United States, they are usually found in quantity only in Florida waters, although they have been seen as far north as North Carolina and even New Jersey. Little is known of their breeding habits except that the young pass through a stage which is very thin, ribbonlike, and transparent. Morays feed largely on other fish caught as they work their way through coral reefs. Some morays are equipped with teeth in the back of the mouth for crushing hard-shelled animals such as clams and oysters.

Morays are occasionally caught on hook and line by fishermen, sometimes are captured by trawlers that drag nets over the bottom. People in some parts of the world value the moray as food.

Some Pacific morays measure as long as 10 feet and are considered dangerous to man when aggressions are aroused, generally by divers' actions. Several records exist of attacks on humans by wounded morays.

What is pearl essence?
It is the silvery substance in the skin of herring and other fishes. Pearl essence is a lucrative byproduct of herring fisheries inasmuch as it is essential to the manufacture of lipstick, nail polish, paints, ceramics, and costume jewelry.

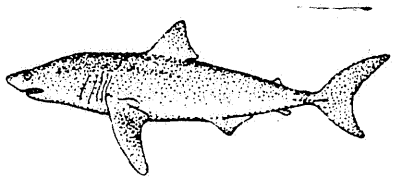


Is the blue shark really blue?
In life the blue shark displays a brilliant blue color on the upper portion of its body and is normally snowy white beneath. The blue quickly fades to dull grey after the shark is killed. The mako and porbeagle sharks also exhibit a blue coloration, but it is not nearly as brilliant as that of a blue shark. In life most sharks are brown, olive, or grayish.

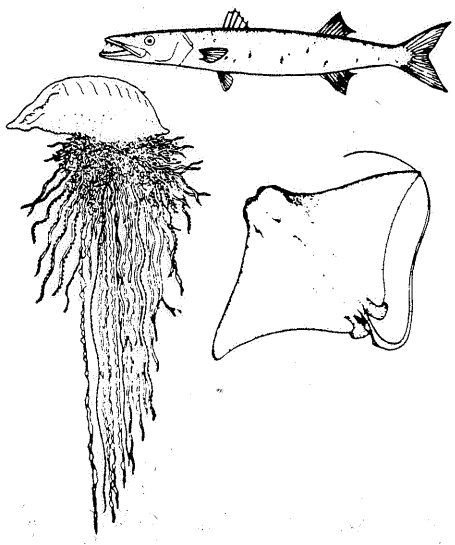
What attracts sharks? Which are most dangerous?
Considerable research has been devoted to finding out what stimuli attract sharks and incite them to attack. Results are mostly inconclusive, but some general principles have been advanced: Certain types of irregular sounds—like those made by a swimmer in trouble or a damaged fish—seem to attract sharks from great distances. Sound, rather than sight or smell, seems to be a shark's primary cue for moving into an area. Some scientific experiments indicate that sharks can distinguish light colors from dark, and that they may even be able to distinguish colors. Yellow, white, and silver seem to

attract sharks. Many divers maintain that clothing, fins, and tanks should be painted in dull colors to avoid shark attacks.

Though blood itself may not attract sharks, its presence in combination with other unusual factors will excite the animals and make them more prone to attack.



The most dangerous species in order of documented attack records are: the great white shark, bull shark, tiger shark, grey nurse shark, lemon shark, blue shark, whaler shark, sand tiger, several species of hammerheads, and the mako. Some species such as the nurse shark are extremely sluggish and have poorly developed teeth, but even these have been known to attack man when excited or disturbed.



What sea creatures other than sharks may be dangerous to swimmers?
The barracuda (though divers claim its ferocious reputation is undeserved), moray eels, octopuses, and sharp-spined sea urchins can be dangerous to swimmers. The Portuguese man-of-war has tentacles up to 50 feet long with specialized cells that produce painful stings and welts on contact by swimmers. Sting rays, toadfish, catfish, and jellyfish can inflict damage on swimmers and waders. Certain coral-reef organisms are to be avoided by divers.

How many species of Pacific salmon are there?
There are six: Chinook, coho, pink, sockeye, chum, and masu. The first five are found in North America. The masu occurs only on the Asiatic coast of the North Pacific.

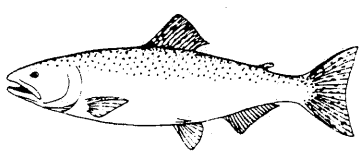
Is it true that salmon return to spawn in freshwater areas where they were born?
Almost always. Some straying has been documented, but it is minor. Most spawning salmon return to the precise stream of their birth, sometimes overcoming great distances and hazardous river conditions to reach home.

What is the difference between the Atlantic salmon and the Pacific salmon?
The Atlantic salmon is actually a member of the genus *Salmo*, or trout family, not a salmon, which is placed in the genus *Oncorhynchus*. The misnomer is so widely accepted that it would only cause confusion to rename the species. The main biological difference between the Atlantic and Pacific "salmons" is that *Salmo* may spawn more than once, and *Oncorhynchus* die soon after one spawn.

Where do salmon go in the ocean?
Contrary to earlier beliefs, many salmon from North American rivers roam far at sea in the North Pacific Ocean and the Bering Sea. The oceanic distribution of the salmon is dependent upon the species and point of origin. Sockeye and chinook salmon from northwest Alaska, for example, may migrate across the Bering Sea to areas close to Kamchatka, U.S.S.R., and south of the Aleutian Islands into the North Pacific Ocean; the sockeye also migrate eastward to the Gulf of Alaska. Salmon such as the pink, chum, and coho from central and southeast Alaska, British Columbia, and Washington State, migrate out into the northeastern Pacific and Gulf of Alaska. Many steelhead trout from Washington and Oregon are known to migrate far at sea to areas off the Alaskan Peninsula. Some salmon migrate several thousand miles from the time they leave the rivers as juveniles until they return as adults. A chinook salmon tagged in the central Aleutian Islands and recovered a year later in the Salmon River, Idaho, had traveled about 3,500 miles; a steelhead trout tagged south of Kiska Island (western Aleutians) was recovered about six months and 2,200 miles later in the Wynoochee River, Washington.

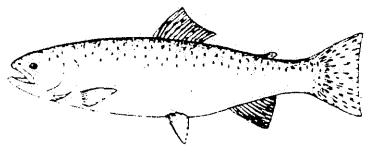
What is a kokanee, or silver trout?
It is the landlocked subspecies of a sockeye salmon. The kokanee spends its entire life in fresh water and usually does not attain the size of its sea-migrating cousin.

Do landlocked Pacific salmon die after spawning?
Yes. This phase of their life history is the same as their seagoing relatives.



How large do salmon get?
Weights of 100 pounds and slightly over have been reported from European countries for the Atlantic salmon; the record for the largest of the Pacific species, chinook, is 261 pounds for a fish caught on commercial gear in Alaskan waters.

What is the oldest known age of salmon and steelhead (in completed years)?
Pacific salmon: chinook—7; sockeye—7; silver—4; chum—6; pink—2
Atlantic salmon: 8
Steelhead trout: 8



Is a steelhead a salmon or a trout?
The steelhead is a rainbow trout that migrates to sea as a juvenile and returns to fresh water as an adult to spawn. Unlike the Pacific salmon, the steelhead trout does not always die following spawning and may spawn more than once and return to the sea after each spawning.

Hold old are salmon when they migrate from fresh water to the ocean?
That depends on species:
Chinook—fall chinook, 3–4 months after hatch; spring chinook, 12–16 months;
Coho—12–24 months;
Chum—a week to a month;
Sockeye—12 months to 36 months;
Pink—a week to a month.

How many eggs do salmon have?
Generally from 2,500 to 7,000 depending on species and size of fish. The chinook salmon generally produces the most and largest eggs.

What are salmon fed in a hatchery?
Vitamin-rich, high-protein diets made up of dried meals from coarse fish, animal meat excess, plant meal and bone meal, or meal from calcium-rich shells.

How many of the young salmon released from hatcheries come back as adults?
Releases of large fingerlings usually result in returns of one to five percent.

Why are fishladders constructed?
A fishladder, or fishway, often used in salmon country, is constructed to provide for upstream passage of fish over a dam or a natural barrier that might prevent or impede progress to spawning grounds.

How can I maintain a small saltwater aquarium?
Three principal rules must be followed:

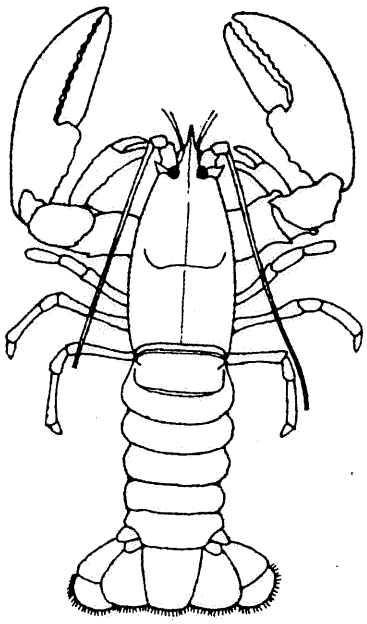
(1) Keep it clean. Remove excess food, coral, algae, and miscellaneous debris. Omit over-decoration with coral, sponges, and other marine plants. Marine aquariums are vulnerable to pollution by spoiled food.

(2) Stock sparingly, using no more than a single one-inch-long fish per gallon of water capacity.

(3) Use quartz sand on a sub-sand filter in the bottom of the aquarium. Good filtration is vital. In addition, some monitoring of fish behavior is advisable—fin-nipping, for instance, may be a sign of problems. Consult literature for precise information.

Shellfish and Other Invertebrates

How many kinds of lobsters are there in this country, and why are different varieties called lobster?
Two kinds of lobster-like crustaceans exist in United States waters. The "true" lobster (the American lobster) is designated as such to differentiate it from the other form found here, the spiny lobster. The two, from different families, display two differences: The true lobster has claws on the first four legs, lacking in the spiny lobster; the spiny lobster has



a pair of horns above the eyes, lacking in the true lobster. To avoid confusion over common names, it is best to call the true lobster the "American lobster," and the spiny lobster just that. The item marketed as "lobster tail" usually is a spiny lobster. The spiny lobster is found in warm waters off Florida, in the West Indies, and off southern California. Record weight for the American lobster is 45 pounds.

Does the deepwater northern lobster population differ from that found just off the coast?
The species in each population are identical in all respects.

How far do lobsters travel?
Inshore lobsters tend to stay in one place, seldom moving more than a mile or so, but deepwater lobsters farther out on the Continental Shelf follow a seasonal migratory pattern shoreward in summer, returning to the Shelf again in the autumn. The record travel so far is 225 miles covered by a lobster tagged off the Continental Shelf and recovered at Port Jefferson, Long Island, New York.

What does a lobster eat?
Mussels, crabs, clams, and seaworms, as well as dead fish.

What color is a lobster's blood?
Colorless. When exposed to oxygen, it develops a bluish color.

What is "tomalley"?
Tomalley is the lobster's liver. It turns green when cooked and is considered a delicacy.

What is the coral colored material often seen in a cooked lobster?
Coral is the egg mass of a female lobster. Cooking colors the tiny eggs a deep coral or red.

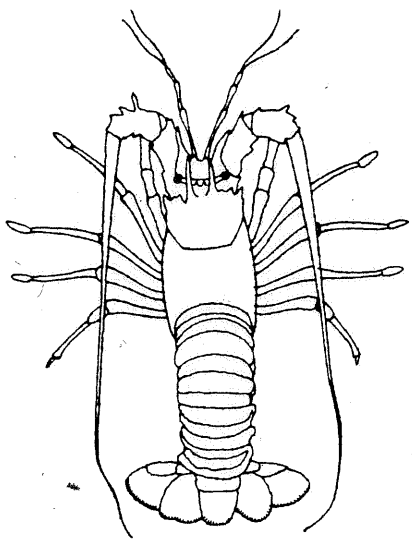
How does a lobster grow?
It sheds its hard shell and grows a new, larger one. Since the skeleton is on the outside, this molting is essential to growth.

How many times must a lobster molt before it reaches market size?
Between 20 and 30 molts take place before a lobster reaches the one-pound market size.

How old is a one-pound lobster?
No one knows exactly, but aquarium studies suggest 5 to 7 years.

How many one-pound lobsters are needed for a pound of lobster meat?
Five, on the average.

How long can a lobster live out of water?
Several days if kept in a cool, moist environment. The lobster is a gill-breather, and moisture is essential to survival.



Can a lobster be kept alive in fresh water with ice?
No. Fresh water is lethal to a lobster. The animal has salty blood and tissue, which require a seawater environment if life is to be maintained.

Why does a lobster turn red when cooked?
The red pigment is the most stable component of the coloring in a lobster shell. The greens and browns which darken the shell in a live lobster are destroyed by cooking.

How can one tell if a boiled lobster was alive when cooked?
Upon the death of a lobster the tail loses its elasticity and ability to curl under the body. When plunged into boiling water, a live lobster curls its tail under. It remains in that position during and after cooking.

Have people been poisoned by eating lobsters that were allowed to die before being cooked? Is it true that a dead lobster deteriorates very rapidly? What happens when a live lobster is frozen?
Lobsters are not poisonous if they die before cooking, but cooking should not be delayed. Many lobsters sold commercially are killed and frozen before cooking. Lobsters and other crustaceans do spoil rapidly after death, which is why many buyers insist on receiving them alive. If the lobster is "headed" before or soon after death, the body meat will keep fresh longer. This is because the so-called head includes the thorax, the site of most of the viscera and gills, which spoil much more rapidly than claw or tail meat. Freezing slows deteriorative changes and harmful chemical actions that follow death.

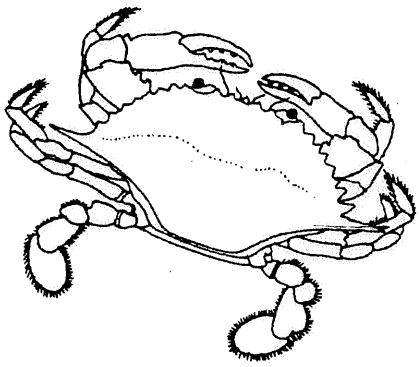
Is it possible to raise lobsters on a commercial basis?
Not yet, but research is underway to develop rearing techniques and to assess the economic feasibility of rearing the American lobster commercially. In the opinion of many scientists working with the American lobster, commercial aquaculture can be achieved in the near future with a sufficient level of effort. Future projections for the culture of the spiny lobster are not, however, optimistic. Unlike the American lobster which has a relatively short larval life (several weeks), the spiny lobster has a larval life of about six or seven months. The technical difficulties presented by the fragile, demanding requirements of the early life stages discount the use of traditional hatchery methods with any degree of success or practicality.

Have Maine lobsters been successfully transplanted to the west coast?
Attempts have been made to do so, but success has been limited. The Canadian government discontinued in mid-1973 a six-year-old experiment in which the lobsters were reared successfully in the waters off British Columbia. The decision to drop the project was evidently dictated by economics.

I've heard that lobsters molt, but I've never seen a cast-off shell. Why?
Lobsters often eat the cast-off shell to regain needed minerals.

Can crabs swim?
Most crabs "walk" or run across the ocean bottom. Some, such as the commercially caught blue crab of the Atlantic coast (a member of the one family of "swimming crabs") can swim. Their rearmost pair of legs is modified for swimming and legs are paddle-shaped.

How do crabs grow?
By shedding their outgrown shell. The rigid shell imprisons the crab and limits growth. Once the shell is shed, the crab can absorb water and expand into its newgrown shell.

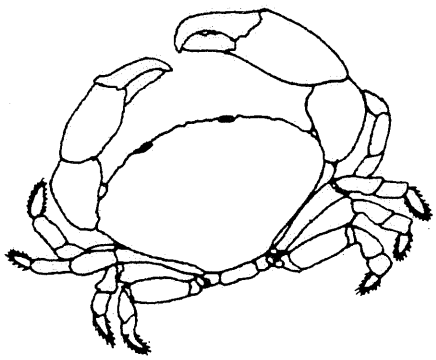


How much does a blue crab increase in size on molting?
Under normal conditions, about a one-third increase occurs with each molt.

What is the difference between soft- and hard-shell crabs?
They are the same species. A soft-shell crab is one that has just discarded its shell. Crabs which have just shed their shell hide in rocks or bury themselves in sand and mud to escape predators. They emerge after the new shell hardens, a quick process.

How old does a blue crab get?
A female may live 2 years, a male 3.

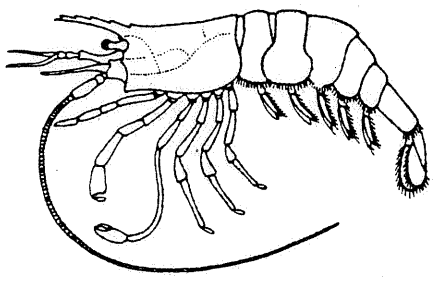
What is a "coconut crab"? Where do they live?
A large, land hermit crab, which lives on tropical Pacific islands. The crab is so named because it eats coconuts, is even caught on coconut used as bait. The meat is considered a delicacy in the islands.



Is a stone crab harmed when its large claw is broken off?
Fisherman often break off the large claw and throw the crab back into the water. If the break is made at the first joint, the crab is not harmed. The stone crab can and does sever its own claw at the first joint (by muscular contraction) to escape from danger.

What are the small crabs found inside oysters? Are they harmful to oysters? May humans eat them?
These are "pea" crabs. They live, often in pairs, inside the oyster shell, eating food collected on mucous strands in the oyster. Because they do cause damage to oyster mantle and gills, the crabs are considered parasites. Pea crabs are not harmful to man.

How do prawns, crayfish, and shrimp differ?
As so often happens, common names are used loosely and inconsistently in the shrimp family. The "prawn" of Great Britain and other countries is essentially the same animal as the shrimp of the United States. In this country, the term "shrimp" applies to all crustaceans of the *Natantia* group, regardless of size. "Crayfish" or "crawfish" are names given to both a common freshwater crustacean and to the saltwater spiny lobster.



Is there more than one kind of shrimp?
Numerous varieties exist, among them brown, white, pink, royal red, brine, and rock shrimp.

How big do shrimp grow?
Depending on the species, size ranges from about ½ inch long on the west coast of the United States, to almost 12 inches elsewhere.

How long do shrimp live?
The life cycle varies geographically and by species. Some live as long as 6½ years, others live only a year.

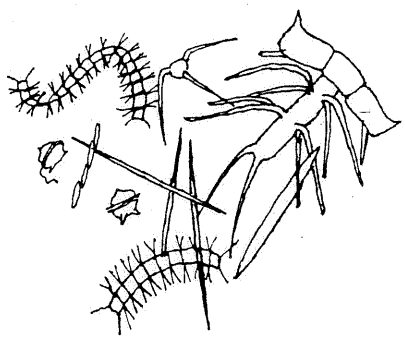
How many eggs does a shrimp produce in one spawning?
About 500,000.

How much shrimp is produced in the United States, and where is the largest catch taken?
The annual catch has been running close to 400 million pounds for several years. The Gulf States usually lead in shrimp catches, with Texas and Louisiana the leading States. Alaska has been an important shrimp producer for the past several years. The shrimp fishery has the highest market value of all U.S. fisheries.

What are the commercially important shrimp on the east coast of the United States, and what are their ranges?
Three shrimp species are of primary commercial importance: Pink shrimp from Cheseapeake Bay through the Gulf of Mexico and the West Indies to Brazil; white shrimp from Fire Island, New York, to Cape Kennedy, Florida, in the Gulf of Mexico from Pensacola, Florida, to Campeche, Mexico, in Cuba and Jamaica; brown shrimp from Massachusetts down the east coast through the Gulf of Mexico, and the West Indies to Uruguay.

What is the biggest bivalve mollusk, cephalopod mollusk, and crustacean known to man?
The biggest bivalve mollusk is the clam *Tridacna,* native to the Indo-Pacific, which reaches a weight of 500 pounds. The giant squid, nearly sixty feet long, is the biggest cephalopod. The Alaskan king crab is the largest of the crustaceans, weighing up to 15 pounds, and measuring four to five feet across shell and claws.

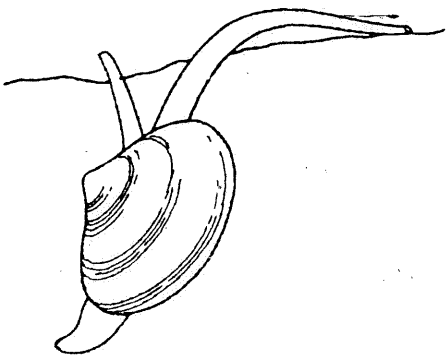
What do oysters and clams eat?
Called filter feeders, oysters and clams eat plankton. By pumping water through their bodies, the mollusks strain the microscopic organisms through their gills, which act as sieves.



Clams seem to squirt water through their siphons. What purpose does the siphon serve?
Three main purposes: breathing, obtaining food, and eliminating waste products. Since clams are relatively immobile and movement is usually limited to burrowing in the sand, their double-tubed siphon—which operates much like a snorkel—is their lifeline. Inflowing water is pumped through the siphon, passed over the gills, and strained to remove food particles. After receiving carbon dioxide from the gills and other waste products from the digestive tract, the water is expelled through the outgoing siphon. Constant circulation of the water is maintained by the beating of a multitude of microscopic hairs (called cilia) located inside the tube and in the gill chamber.

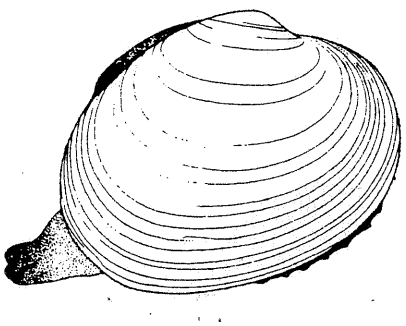
What causes a reddish color in the liquor of shucked oysters and clams?
The red algae they sometimes consume, often composed of the microscopic one-celled dinoflagellates which appear in planktonic mass.

How does a clam shell grow?
A thin tissue that adheres to the inner surfaces of the shell, called the mantle, and a thickened rim of muscular tissue at the mantle edge deposit new shell material at the shell edge. Rings on the shell indicate how many years old a clam may be.



How do clams establish themselves on the sea bottom?
Certain kinds of clams, in early stages of life possess a gland that produces a thread-like material (byssus) that serves to anchor them to grains of sand or rocks. Other types of clams lack a byssal gland and use the foot to burrow into the seabed. As the clam grows, its wedge-shaped foot, which expands and contracts as it moves, becomes more important as a burrowing tool.

How do clams reproduce?
Eggs and sperm are released into the water seasonally, generally in mid-summer when water is warm and planktonic food is abundant. After fertilization of an egg, cellular division produces larvae and eventually tiny clams that settle to the bottom. In a few species, the larval stage is completed within the mantle cavity of the parent.



Which of the clam species is of greatest commerical importance to the United States, where is it fished, and what quantities are landed?
The oceanic surf clam is the most important commercial species. The largest clam of the U.S. east coast, it sometimes reaches a shell length of more than eight inches. Landings of surf clams in New Jersey and Virginia account for about half the total U.S. annual landings of all clam species. The surf-clam catch in recent years—in shucked meats—ranged from about 41 to 63 million pounds.

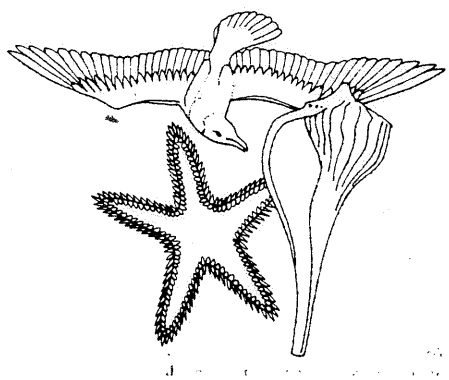
How are soft-shell clams harvested?
They are dug from the intertidal flats of bays and estuaries at low tide in New England, using a short-handled fork to obtain clams living in burrows six to ten inches below the surface. In Chesapeake Bay, because the beds are mostly subtidal, a hydraulic dredge washes clams from the bottom and onto an endless belt that conveys the clams to the dredge boat.

How are hard-shell clams harvested?
Long-handled tongs, rakes, and small dredges operated from small skiffs in shallow subtidal zones of bays and estauries. The larger hydraulic escalator dredge is used for hard-shell clams as well as soft-shells.

How are surf clams caught?
A large (about 1½-ton) hydraulic dredge washes clams off the bottom and carries them aboard 60- to 100-foot vessels.

What is the biggest clam caught and eaten in the United States?
The geoduck (pronounced gooey-duck) clam caught in Northwest Pacific waters, weighs an average three pounds and yields over a pound of flavorful meat. Now sold commercially, geoduck clam meat can be used in minced form or in steaks.

What kinds of predators attack clams and oysters?
Man, water birds, rays, starfish, whelks, drills, and sponges, among others.



What are oyster borers?
An oyster borer, or drill, is an aquatic snail that preys on oysters, especially thin-shelled young oysters. Using a band of scraping teeth (a radula) and a shell-dissolving secretion, the gastropod drills a hole in the oyster shell and eats the creature within.

How do oysters produce pearls?
Pearls begin with the presence of a foreign substance, such as a grain of sand, that lodges in the shell. The oyster's body reacts by depositing layers of nacreous (pearllike) material around the foreign body to wall it off and reduce irritation.

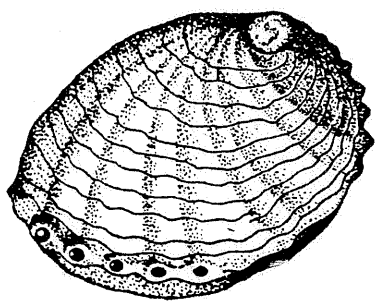
Do all oysters produce pearls?
Many oysters—as well as some clams and mussels—manufacture material like the pearl-producing substance. True pearl-producing oysters, however, inhabit waters of the Indo-Pacific.

Is it safe to eat oysters during the months without R's?
Yes. Fresh oysters properly refrigerated are wholesome and nutritious throughout the year. They spoil rapidly at high temperatures, however. The belief that oysters were unsafe to eat in May through August arose in earlier days when refrigeration was less prevalent than it is today.

How does a scallop move?
It compresses the valves of its shell and forces water backward in jets near the shell-hinge. The force drives the scallop in the direction of the shell opening. The bivalve appears to be clapping the two sides of its shell together.

Are any snails commercially caught for food off the coasts of the United States?
The most commonly eaten snails in this country are the abalone, caught in the waters off California, and various conchs from Atlantic waters.

What purpose do the holes along the edge of an abalone shell serve?
Internal gills discharge water through the holes, as part of an abalone's respiratory process.



Are there any poisonous marine snails?
Yes. Cone shells (family *Conidae*) include members with toxic venom. These mostly tropical forms can be highly toxic, even fatal,

to man. Their poison is injected by a spear-shaped rod called a radula.

What is the sand collar that one often sees on beaches at low tide?
A sand collar is the egg case made by moon snails, of the family Naticidae. The eggs are laid in a gelatin-like matrix with which sand grains are mixed. The individual egg capsules can be seen under a magnifying glass or microscope. When the little snails hatch, they swim around for a while before settling on the bottom.

What is chitin?
The structural material that forms the shells of crustacea, such as crab, shrimp, and lobster.

How does the consumer know that shellfish are safe to eat?
Clams and oysters in the shell should be alive and the shells should be closed tightly or should close when the mollusks are tapped. The U.S. Public Health Service, in cooperation with the States, has a sanitation control program that covers the labeling and shipment of clams, mussels, and oysters. These shellfish may be harvested only from non-polluted waters and processed for shipment in sanitary plants inspected by State shellfish inspectors. Authorities periodically test water for sewage pollution and ban catches from polluted areas.

How unsafe are shellfish from polluted waters?
They are dangerous to man, causing mild to severe illness, sometimes death. Both sewage and industrial wastes can affect shellfish.

Will cooking make sewage-polluted shellfish safe to eat?
Not entirely. Cooking will kill bacteria that cause some diseases, but it is not known whether certain virus diseases, such as infectious hepatitis, can be prevented by cooking.

Is it possible to purify shellfish from sewage-polluted water for safe eating?
Yes. Sewage-polluted shellfish transplanted to clean water purify themselves rapidly and become safe to eat.

Do shellfish contain mercury levels dangerous to man's health?
No. Tests of shellfish to date have shown mercury levels to be below those considered dangerous to humans.