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# year of the ocean





**T**he ocean covers more than 70 percent of the Earth's surface. The ocean's presence on the planet is so vast that we feel at home in, on or near the ocean. The emotional link between humans and the ocean is strong. Throughout history, it has influenced the culture, thinking and development of all civilizations.

Today, more than one-half of the U.S. population live and work within 50 miles of a coastline, even though coastal areas account for only 11 percent of the nation's land area.

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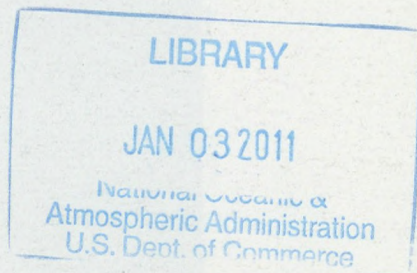
## The Ocean: Earth's Lifeblood

**T**he ocean is the lifeblood of our planet. From the life-giving rain that nourishes crops to lifesaving medicines; from the fish that come from the ocean floor to the global goods that are transported on the sea's surface—the ocean plays an important role in your life.



The products and services that come from the ocean also provide many jobs. In fact, one out of every six U.S. jobs is marine-related. One-third of the nation's gross domestic product comes from coastal areas through fishing, transportation, recreation and other industries dependent on healthy waters and marine habitats.

Our daily activities also affect the ocean. The household cleaners, lawn fertilizers and motor oils we use can end up in the ocean if we are not careful. Our fragile coastlines, among the most complex natural environments on Earth, already sustain millions of homes. These coastlines are major recreation places and locations for industry, commerce and national defense. As human demand for use of marine environments and ocean resources increases, so must our care of these finite resources.



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## International Year of the Ocean

**I**n recognition of the importance of the marine environment, the United Nations has declared 1998 as the International Year of the Ocean.

During this year, governments, organizations and individuals have the opportunity to raise public awareness of the role the ocean plays in our lives. This year, each of us can make a commitment to care for the marine environment.

In the United States, the Commerce Department's National Oceanic and Atmospheric Administration (NOAA) has primary responsibility for the stewardship of marine resources. Its activities include understanding, monitoring and managing the health of the ocean, its shorelines and others who depend on the marine environment to survive.

During the Year of the Ocean, the Ocean Principals Group, which is comprised of ocean-oriented federal agencies, such as the departments of Commerce, Defense, Interior, State, and Transportation; independent agencies, including the National Aeronautical and Space Administration, the Environmental Protection Agency, the National Science Foundation, and the Federal Emergency

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Management Agency; along with other organizations and businesses, will work together to better educate the public about ocean issues and motivate them to make wise choices and take prudent actions with respect to our ocean and coastal environment.

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## How the Ocean Affects Us

**O**cean temperatures and currents strongly influence our weather and climate, from normal rainfall to severe hurricanes, floods and droughts. It is the ocean that generates the rain necessary to sustain life on Earth. The rain nourishes our crops, and all Earth creatures, big and small, need water to survive.

When most people first think of the ocean, they often envision a beautiful beach vacation. The travel and tourism industry is one of the largest employers and foreign-revenue earning industries in the United States, and beaches are the leading tourist destination. Miami Beach alone has more tourists each year than Yellowstone, Grand Canyon and Yosemite National Parks combined.

The ocean is also an important source of food and other resources. In 1996, U.S. consumers ate an average of 15 pounds of seafood per person. Scientists use marine organisms in their search for lifesaving medicines—in fact, they are already using resources from the sea to develop treatments for cancer, AIDS and other diseases.

The ocean is our global highway. More than 98 percent of U.S. foreign trade passes through our nation's ports. Natural gas and oil, which made up as much as 25 percent of U.S. energy resources in 1996, comes from beneath the ocean floor.

So, in addition to providing food, fun, energy and transportation, the ocean is key to our nation's economy, both now and in the future.



**O**ur relationship to the ocean is clearest when we are near it. But our impact on its health usually begins far from shore.

At least 80 percent of water pollution starts on land. From the soapy water that enters the storm drain while washing a car, to the oil leaking from a car engine – these pollutants enter our waterways and ocean and hurt marine habitat and wildlife.

With more than half the population living in coastal areas, it is little wonder that 40 percent of the country's commercial development and 46 percent of its residential construction takes place near our coastlines. Construction debris is another form of land-based pollution. However, it can be controlled through thoughtful planning and use of environmentally sound construction procedures.

Our coastlines consist of wetlands, reefs and estuaries—areas where most fish and other sea creatures spend some part of their life cycle. Land-based pollution that

## How We Affect the Ocean

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## Help Protect Our Ocean

runs into these areas can injure these critical habitats and may harm the ecosystem.

Deep ocean dumping and overfishing are two human activities that have depleted important fish stocks. Both of these problems are being addressed through domestic and international regulation and enforcement.

**G**et educated and share your knowledge! The more we learn about the ocean and our relationship with it, the better equipped we are to protect it.

To add to your knowledge and appreciation of the ocean, a chart follows that identifies the “ocean critters” illustrated on the Year of the Ocean poster.

The ocean is the last frontier on Earth and holds both challenges and great potential. Many problems of national and international importance might be solved through the scientific exploration of marine systems and application of our newfound knowledge.

Ongoing exploration and research are key to sustaining as well as discovering new ocean resources. Because the ocean touches nearly every facet of human life, there are numerous ocean-related careers. Biological, chemical, physical and geological oceanography and underwater archaeology are fascinating careers that put scientists in direct contact with the ocean. Engineering, medicine, marine policy and law, film making, zoology and tourism are only a few examples of careers that can have links to the marine environment.

Even if the ocean isn't your life's work, you can support ocean research, marine education, as well as conservation and restoration programs conducted by private organizations and federal, state and local governments.

The more you learn about the vast frontier of the ocean – the other “wild blue yonder,” – the more you will be touched by the ocean's beauty, its mystery and its majesty.

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## The Largest Environment for Life On Earth

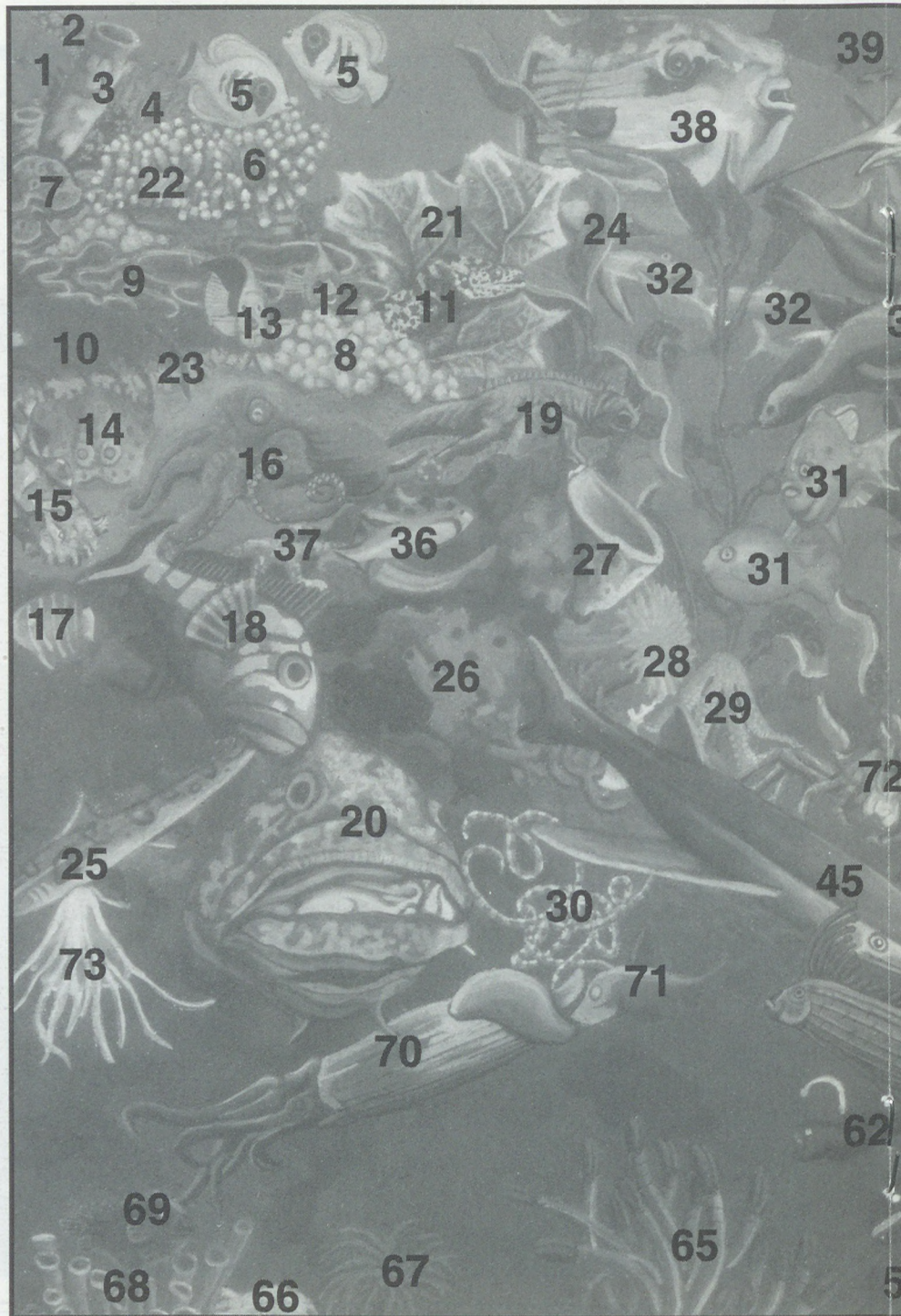
Covering more than 70 percent of the planet's surface, the ocean is the largest environment for living things on Earth. The organisms that live in the ocean are more diverse than the ones on land or in fresh water.

The Year of the Ocean poster is an artistic depiction of just a few of the millions of species that live in the ocean. From right to left, the poster shows how species change with the latitude, from warm tropical coral reefs to cold polar ice floes. Five major ocean habitats are shown: tropical or reef habitat, temperate waters, open ocean, the deep sea, and polar regions. From top to bottom, the poster shows how species change with depth, from surface waters to the ocean floor. Most sea life lives in the top 500 feet (150 meters) of the ocean. Below about 3300 feet (1000 meters), the ocean receives no light from the surface.

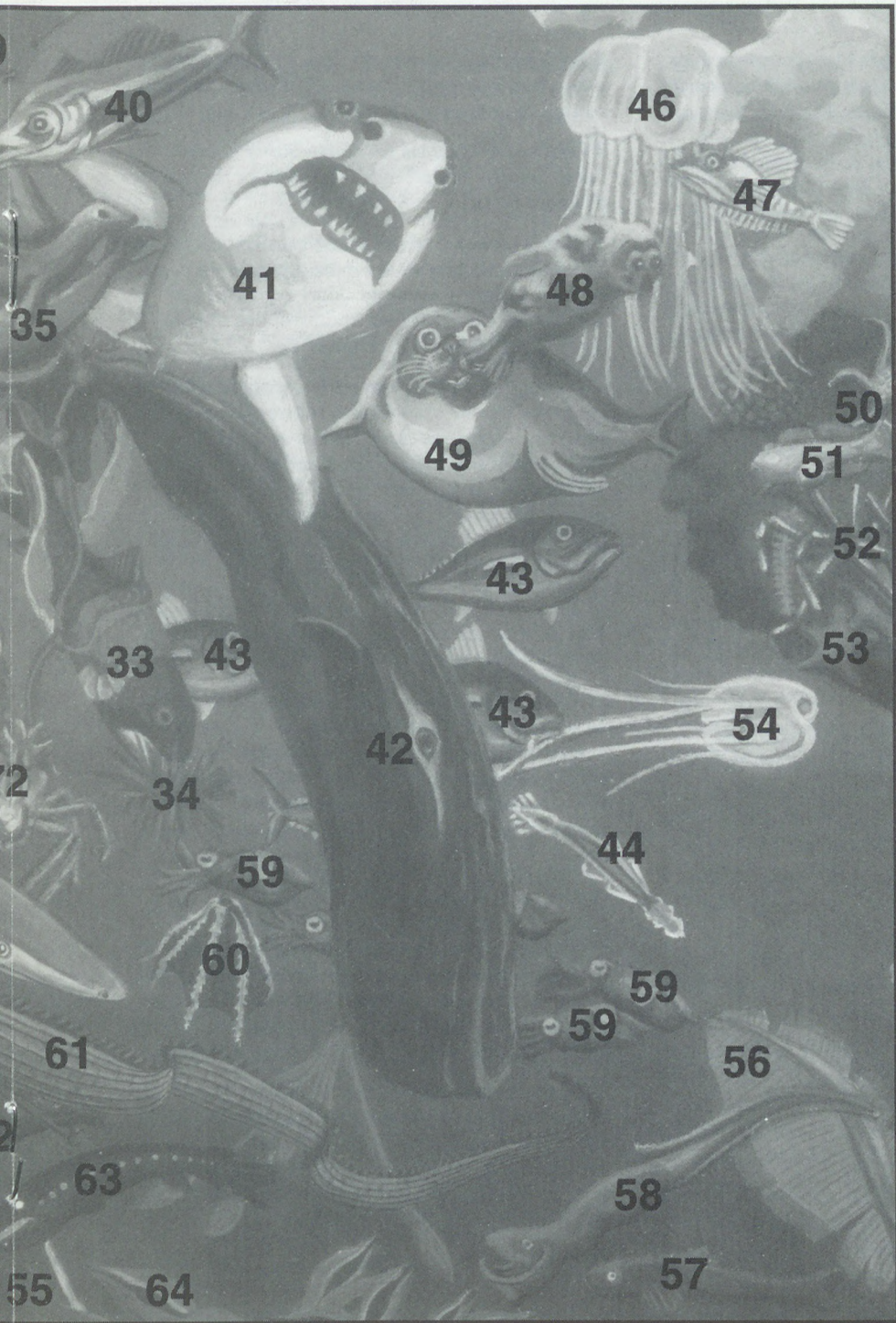
From the warm, sunlit waters of coral reefs to the dark, cold waters of the deep sea, the ocean teems with life. The ocean—get into it!

*The following organizations have assisted in the development of Year of the Ocean materials: The National Aquarium, NOAA's Office of Oceanic and Atmospheric Research, NOAA's National Marine Fisheries Service.*









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**Tropical or Reef Habitat:** In warm tropical or subtropical waters, coral reefs provide habitat for thousands of different species. Many of these are brightly colored and adapted to very specific ways of life. Like terrestrial rain forests, reefs are disappearing rapidly as a result of human activities, including pollution and overfishing.

1 Reef lobster—*Enoplometopus occidentalis*—Living in crevices and caves, these nocturnal marine crustaceans that live on the sea bottom scavenge for dead animals but also eat live fish, seaweed, small mollusks and other bottom-dwelling invertebrates.

2 Star coral—*Montastrea cavernosa*—One of many marine invertebrates in the class Anthozoa, it has stinging cells and internal or external skeletons of a stonelike, horny, or leathery consistency. The term “coral” is also applied to the skeletons alone, particularly the stonelike ones. See 6, 7, 8, 9, 28, and 67.

3 Tube sponge—Phylum Porifera—A tube sponge may be 3 to 6.5 feet tall. Size within a species may vary with age, environmental conditions, and food supply. See 26, 27, and 38.

4 Gorgonian—*Gorgonia* species—A “soft coral” composed of polyps that grow together to form a flat structure instead of a rocky reef, it has a central internal skeleton, composed of a flexible, horny substance supporting the colony. See 21.

5 Butterflyfish—Family Chaetodontidae—Most often found on reefs and in warm waters, the precise number of species in this family is unknown, but exceeds 150. Their bright colors are usually patterned to provide protection from predators. See 12 and 17.

6 Long-tentacled anemone—*Heteractis magnifica*—Sedentary marine animals resembling flowers but closely related to jellyfish, anemones occur in all oceans from the intertidal zone to depths of more than 33,000 feet. See 2, 7, 8, 9, 28 and 67.

7 Brain coral—*Diploria strigosa*—This species forms boulders that are ridged and shaped like the surface of the brain. See 2, 6, 8, 9, 28, and 67.

8 Boulder coral—*Porites* species—Another of the many forms taken by corals, which are closely related to anemones. See 2, 6, 7, 9, 28, and 67.

9 Plate coral—*Agaricia tenuifolia*—Stony corals form reefs that can extend only a few feet or thousands of miles. See 2, 6, 7, 8, 28, and 67.

10 Sea grass—One of the non-algal plants living in salt water, sea grasses are most common in very shallow waters near shore. They provide food and shelter for the larvae and juveniles of many species of fishes and invertebrates.

11 Spotted moray—*Gymnothorax moringua*—Morays generally live in tropical and subtropical waters. Most have large flattened bodies and often anchor their rear half in coral and rocks, extending the head in the current, ready to grab prey that comes close. They are dangerous when provoked, with ferocious teeth producing deep wounds that usually become infected.

12 Butterflyfish—Family Chaetodontidae—Butterflyfish are most often found in reefs and in warm waters. See 5 and 17.

13 Rock beauty—*Holocanthus tricolor*—An angelfish of warm Atlantic and Caribbean waters, reaching a length of 12 inches. Juveniles have a different color pattern from adults. In most angelfish, the lips are a different color from the body, appearing to be painted on.

14 Blue spotted ray—*Taeniura lymma*—Sharks, skates, and rays are closely related; skates and rays can be thought of as flattened sharks with very large pectoral fins. Stingrays are noted for the long, sharp spines at the base of the tail. Each spine has a venom sac at its base, and stings are extremely painful. Wounds are frequently the result of a swimmer stepping on a ray.

15 Spotted wobbegong—*Orectolobus ornatus*—Carpet sharks are bottom dwellers with the lower lobe of the tail absent. This Australian species blends into the sea bottom, where it ambushes bottom-dwelling prey at night. It has a fringe of fleshy barbels around its broad snout.

16 Common octopus—*Octopus vulgaris*—Distributed from the North Atlantic as far south as Guiana, this species reaches a length of three feet and a weight of ten pounds. The Giant Pacific Octopus span can extend 30 feet across and it can reach a maximum weight of nearly 600 pounds. Stories of octopus attacks on divers are false; octopus are generally shy and avoid confrontations with humans if possible.

17 Butterflyfish—Family Chaetodontidae—These are “picker” feeders: they use their long snout with the mouth at the end to pick small organisms and food particles from crevices and holes. See 5 and 12.

18 Nassau grouper—*Epinephelus striatus*—A member of the sea bass family, this species lives in warm waters along rocky shores and coral reefs in the western North Atlantic. A valuable commercial species, it is in such demand that populations have been seriously damaged by overfishing.

19 Marine iguana—*Amblyrhynchus cristatus*—The only sea-going lizard in the world, the marine iguana is found throughout the Galapagos Islands in densities of 4,500 per mile of coastline. Marine iguanas eat marine algae, crustaceans, and grasshoppers. Most feed on exposed reefs close to shore. Larger males are famous for their offshore swimming and diving abilities. They can reach 40 feet underwater and usually dive five to ten minutes, although the longest observed was about 60 minutes.

20 Potato grouper—*Epinephelus tukula*—An Indo-Pacific member of a warm-water family that includes some of the largest of all reef fishes, groupers are disruptively colored so they can blend with the coral reef or rocky bottom.

21 Purple sea fan—*Gorgonia ventalina*—The living tissues form a layer over the entire surface, often in bright colors. See 4.

22 Common clownfish—*Amphiprion ocellaris*—Living among anemone tentacles, and producing a skin secretion inhibiting anemone tentacles from stinging, clownfishes can shelter amid the

tentacles safe from harm, taking advantage of the anemone’s own formidable defenses. They can also steal food from the anemone.

23 Cortez garden eel—*Taenioconger digueti*—These eels from the Gulf of California live in colonies at a depth of 12 to 132 feet; each individual has a burrow well-separated from the others. Because they feed by extending the upper half of the body up into the water to catch small animals that drift or swim by, they look like a garden that was planted.

**Temperate Waters:** Warm and cool temperate waters extend between the subtropical and subpolar regions in each hemisphere. They are highly productive, but support relatively fewer species than tropical regions. However, populations of individual species may be extremely high owing to the rapid growth of plankton that provides food for them.

24 Giant Kelp—*Macrocystis* spp.—Giant kelp are very large seaweeds found in colder seas and belonging to the order Laminariales (about 30 genera) of brown algae. Giant kelp is rich in minerals and produces algin, a complex carbohydrate useful in various industrial processes, including ice cream and tire manufacture.

25 Leopard shark—*Triakis semifasciata*—Living in the northeastern Pacific Ocean near the bottom, females may reach a length of about 7 feet, but males only grow to 5 feet. The markings are distinctive: black crossbars and blotches on a pale brown or gray background. This species is frequently on display in public aquaria.

26 Velvety red sponge—*Ophlitaspongia pennata*—There are more than 5,000 species of sponges in the Phylum Porifera, occurring in many forms including tubes, balls, vases, incrustations, and shapeless masses. See 3, 27, and 68.

27 Vase sponge—*Phylum Porifera*—Sponges live in colonies or as solitary animals attached to the sea bottom or to other solid objects. See 3, 26, and 68.

28 Northern red anemone—*Tealia crassicornis*—Occurring in the northeastern Pacific Ocean; they can be thought of as an upside-down attached

jellyfish. They are largest, most numerous, and most colorful in warmer seas. See 2, 6, 7, 8, 9, and 67.

29 Ochre sea star—*Pisaster ochraceus*—Sea stars are in the Phylum Echinodermata, which is generally characterized by five-rayed symmetry, a hard, spiny covering, and tube feet. Others include sea lilies, sea urchins, sea cucumbers, basket stars and brittle stars, and the recently discovered sea daisies. Ochre sea stars are very common in the intertidal and shallow waters of the northeastern Pacific Ocean. See 37 and 53.

30 Serpent star—Ophiuroidea—An echinoderm, serpent stars can climb and some are capable of coiling their arms vertically. They are predominantly carnivores and feed by capturing food and bringing it to the mouth by arm looping or by moving the mouth to the food. See 50.

31 Garibaldi—*Hypsypops rubicundus*—The official California state fish, Garibaldi occur in shallow warm waters. Adults are easily recognized by their uniformly reddish gold color, and reach a maximum length of about 12 inches. Young are reddish with iridescent blue spots.

32 Striped jack—*Caranx dentex*—Fast swimmers, striped jack eat smaller fishes, squids, and shrimps. Most species have rows of large heavy scales along the side near the tail fin, with small scales elsewhere, reducing drag and increasing swimming efficiency.

33 California sheephead—*Semicossyphus pulcher*—This fish can reach a length of 3 feet and weight of 36 pounds, though most are much smaller. They range from Monterey Bay to the Gulf of California and are found most abundantly in kelp beds or along rocky shores.

34 Red sea urchin—*Strongylocentrotus franciscanus*—Urchins are echinoderms having a globular body, movable spines, radially arranged internal organs, and tube feet extending from pores arranged in bands extending from top to bottom over the skeleton. The mouth is on the underside of the body and teeth are extruded to scrape algae and other food from rocks. Sea urchins live

on the ocean floor, usually on hard surfaces, and use the tube feet or spines to move about.

35 Sea lion—*Zalophus californianus*—Sea lions differ from seals in having external ears, a coat of short, coarse hair that lacks a distinct undercoat, and the ability to rotate their hind flippers forward to use all four limbs in moving about on land. Sea lions eat mostly fish, squid, and octopus. Breeding in large herds, the males establish harems of three to 20 females. See 48 and 49.

36 Port Jackson shark—*Heterodontus portusjacksoni*—This is a relatively small Australian shark with teeth in both the upper and lower jaws; small and pointed in the front, but large and flat-surfaced in the back, allowing it to eat both soft and hard-shelled prey such as snails, oysters, sea urchins, and crustaceans.

37 Troschel's seastar—*Evasterias troscheli*—Seastars are in the class Asteroidea, having rays or arms surrounding an indistinct disk. The 1,800 living species of starfishes occur in all oceans, although the North Pacific has the greatest variety. See 29 and 53.

**Open Ocean:** Animals of the open waters have boundaries defined only by water temperature and salinity. Some species are fast-moving and wide ranging, making feeding or reproductive migrations over thousands of miles. Because nutrients are more abundant nearer shore, productivity is higher closer to continents than in the central regions. Thus, there are relatively fewer organisms of all kinds (especially phytoplankton, microscopic plants) in the center. This results in much clearer water.

38 Ocean sunfish—*Mola mola*—Molas grow very large, reaching to 10 feet in depth and weighing as much as 600 pounds. They eat jellyfish. The young swim with the body in a vertical position like other fishes, but adults spend most of their time on their sides, floating as though dead.

39 Atlantic manta—*Manta birostris*—The few species of mantas range in size from ocean giants of over 20 feet to species of only a few feet across the pectoral fins. The two flexible head protru-

sions, called cephalic fins, help direct small pelagic food organisms into the wide mouth. The Atlantic manta can have a wing span at least 22 feet and weigh well over 3,000 pounds.

40 Billfish—Family Xiphiidae—Billfishes live in the open ocean and can swim almost 70 miles per hour. Their most important identifying feature is the long upper jaw forming a bill, or spear, which may be used to stun prey as they speed through schools of fish.

41 Great white shark—*Carcharodon carcharias*—The white shark, or man-eater, roams all warm and temperate seas, but appears most abundantly in waters off Australia. They average 12 feet long, but can reach over 30 feet. They are so large and powerful that it is very difficult to study them. Great whites are credited with many attacks on humans, probably mistaking them for seals or sea lions. However, as a top predator, they are an essential part of marine ecosystems and should be protected.

42 Sperm whale—*Physeter macrocephalus*—Sperm whales occur in all seas, are the largest of the toothed whales, and can dive to depths below 6,600 feet. They have the largest brains that have ever existed on earth, but it is ratio of brain to body weight that is important in intelligence, not just brain weight. They eat squid and fish; battles with giant squid often result in clear sucker marks on the skin of the whale. See 70.

43 Yellowfin tuna—*Thunnus albacares*—Tunas are fast swimmers; this species can reach speeds over 40 miles per hour. They average 15 to 25 pounds weight, but can reach 300. The long pectoral fins, pelvic fins, and finlets are bright yellow, but the brightness fades soon after death.

44 Arrow worm—*Sagitta macrocephala*—These planktonic (drifting) animals are well-adapted pelagic predators, even though they are an inch long or shorter. They are streamlined, have transparent bodies, and possess heavy grasping spines or hooks near the mouth.

45 Blue shark—*Prionace glauca*—Named for their deep metallic blue color and living in the open

ocean in subtropical and cool-temperate seas, blue sharks have very large pectoral fins that help keep them from sinking. Often seen at the surface swimming slowly with the first dorsal fin and the tip of the tail out of water, their food is mostly fish.

**Polar Waters:** Some of the coldest marine waters, the Arctic and Antarctic regions are highly productive, especially in the spring and fall. Their biological diversity is lower than other regions, probably because many species cannot survive the extreme conditions. Those that are successful tend to be very abundant. Whales make feeding migrations into polar regions in the spring, and leave for warmer waters before winter.

46 Lion's mane jellyfish—*Cyanea capillata*—The largest jelly known, this species grows up to 8 feet wide and 1000 feet long, and has up to 12,000 stinging tentacles. When an animal comes in contact with these tentacles, it is stung and injected with a neurotoxin (nerve poison).

47 Icefish—Family Channichthyidae—Members of this Antarctic family have a kind of antifreeze that allows them to survive in the coldest water, even that below freezing. They have no hemoglobin (the oxygen-carrying blood pigment) but in the low temperatures at which they live, their blood carries enough dissolved oxygen for life.

48 Weddell seal—*Leptonychotes weddelli*—Seals survive extremely cold temperatures by having a thick layer of blubber which insulates them. True seals lack external ears and must drag their hind flippers. This Antarctic seal weighs 900 to 1,000 pounds; it searches around sea ice for prey, usually fish and squid. Its main predator is the killer whale. See 35 and 49.

49 Ringed seal—*Phoca hispida*—Ringed seals usually live in ice-covered waters. They live on both seasonal and permanent ice. They can be found in all seas of the Arctic ocean and in some northern Finnish and Russian lakes. The world population is estimated at 5 million, with 1 to 1.5 million in Alaskan waters. See 35 and 48.

50 Serpent star—Class Ophiuroidea—Serpent stars occur in warm, cold, deep, and shallow waters. Like most echinoderms, they cannot tolerate marked changes in salinity, temperature, or light intensity. They use their spines and tube feet in locomotion, may move forward with any part of the body and reverse direction without turning around. See 30.

51 Antarctic cod—Family Nototheniidae—The Antarctic cods are a large, diverse family, dominating the Antarctic fish fauna. Most are bottom dwellers feeding on invertebrates and occasionally algae; some live associated with sea ice, but others live in midwater. They are a very important food for most penguins, seals and cetaceans.

52 Arctic sea spider—Class Pycnogonida—Related to spiders but not one, the Arctic sea spider lives in very cold waters. They walk on the ocean bottom on slender legs, or crawl among plants and animals; some may tread water. They have a very small body; the internal organs extend out into the legs.

53 Bat Star—*Patiria miniata*—Starfish can digest food outside of the body by extruding their stomach around prey. They move by walking with their tube feet. See 29 and 37.

54 Long tentacle comb jelly—Phylum Ctenophora—Transparent, gelatinous planktonic animals, ctenophores have cells which, instead of stinging, have a sticky tentacle to which food particles adhere to be drawn into the mouth.

55 Antarctic octopus—Class Cephalopoda—The cephalopods are a small group of highly advanced, exclusively salt water molluscs, to which octopus, squid, cuttlefish, and chambered nautilus belong. Extinct forms outnumber the living. The best-known cephalopod features are the possession of arms and tentacles, eight (octopus) or ten (squid) in most forms, and the use of ink for protection.

56 Gurney's sea pen—*Ptilosarcus gurneyi*—Sea pens are colonial coelenterates that stick up from the mud like a feather, feeding by filtering water

through the branches. When threatened, they pull themselves down into the mud. When disturbed they may also display startling flashes of brilliant orange bioluminescence.

**Deep Sea:** The deep sea is cold, dark, and relatively deserted. Because there is no sunlight, food comes from the surface waters where plants can live; below the photic (lighted) zone, there are no plants. The animals are all predators; they have evolved many bizarre and unique structures and behaviors to survive. The discovery 20 years ago of communities of specialized animals and bacteria living around hydrothermal (hot water) vents in volcanically active areas provides the best-known example of organisms that do not depend upon energy derived from sunlight.

57 Sablefish—*Anoplopoma fimbria*—Living in cold North Pacific waters at moderate to great depths near the bottom, sablefish are a valuable commercially-fished species, caught by trawling, trapping, or bottom-fishing with baited longlines. They reach a length of three feet and average 20 pounds in weight.

58 Gulper eel—*Saccopharynx harrisoni*—This deep-sea fish has a huge mouth and sharp teeth. It can swallow animals at least as large as itself. Despite its capacity for food, it is very fragile, with small, weak bones. It reaches a length of at least four feet and has a whip-like tail with a light at the tip. It is collected very rarely.

59 Deep sea squid—*Heteroteuthis dispar*—This three-inch long deep sea squid is one of just a few animals (in addition to some shrimp and fish) that can expel a bioluminescent ink to confuse predators.

60 Vampire squid—*Vampyroteuthis infernalis*—Neither a squid nor an octopus, this deep-water species has ten arms like a squid. Instead of having two long prey-catching arms, two of its arms are sensory filaments that withdraw into pockets. Vampire squid have large globular eyes an inch across and, unlike octopods, many luminescent organs on the body.

61 Oarfish—*Regalecus glesne*—The only representative of this family, the oarfish has pelvic fins reduced to one ray but extremely long and often expanded to a paddle tip, thus its common name. It is a huge fish, reaching a length of at least 35 feet.

62 Viperfish—*Chauliodus sloani*—A remarkable fish, *Chauliodus* has teeth so long that it must open its mouth to make the jaws vertical before it can swallow prey; when the mouth is closed, the teeth overlap the jaws. It can eat large prey by lowering the internal skeleton of the gills, allowing prey to pass into the throat without interference. Apparently it impales prey on the teeth by swimming at them, and the first vertebra (right behind the head) acts as a shock absorber!

63 Deepsea dragonfish—*Grammatostomias flagellibarba*—A ferocious deep-sea predator, this fish is only six inches long; it has a large head and mouth armed with many sharp teeth. Attached to the chin, dragonfishes have a long barbel, at the end of which is a luminous lure that attracts prey.

64 Rift clam—*Calyptogena magnifica*—This deep-water clam lives around hydrothermal vents, feeding on sulphur bacteria. Its shell is white and the animal inside is a deep red. This fast-growing, large clam measures almost a foot in length. It lives in a methane-rich environment that would normally be poisonous.

65 Deep sea tube worms—*Riftia pachyptila*—These four to six foot “worms” have no mouth and no gut, and live around deep-sea vents. Blood-red feathery plumes (tentacle groups), where digestion occurs, emerge from white tubes. *Riftia* is so different that it has been placed in a new and distinct phylum: the Vestimentifera.

66 Vent crab—*Cyanograea praedator*—Vent crabs are one of the characteristic animals associated with hydrothermal vents. They are completely white, and occur in high abundance in small areas.

67 Tube anemone—Class Anthozoa (Phylum Cnidaria)—Tube anemones are similar in basic features to other anemones but unlike them, each lives in a slime tube. They are widely distributed in tropical and

subtropical waters. See 2, 6, 7, 8, 9, and 28.

68 Tube sponges—Sponges have a porous skeleton of interlocking spicules (bony, needle-like structures), glasslike rods, or horny fibers. Food is obtained by filtering water as it moves through the body of the sponge. Sponges can regenerate by restoration of damaged or lost parts or by complete regeneration of an adult from fragments or even single cells. See 3, 26, and 27.

69 Giant deep sea angler—*Ceratias holboelli*—The angler is named for the luminescent lure at its tip, modified from the front dorsal fin. Males attach themselves to a female fish and grow to be a permanent part of her, losing their mouths, digestive systems, and gills.

70 Giant squid—*Architeuthis princeps*—Cephalopods are the largest invertebrates. One giant squid was reported to have been almost 60 feet long, including the 20-foot tentacles. *Architeuthis* swims in the same way as other squids, whether by jet propulsion or by using the fins. This squid is a favored prey of sperm whales. See 42.

71 Ratfish—*Chimaera phantasma*—Most chimaeras have bodies that taper toward the rear to a slender tail. The snout is rounded and conical with big eyes located on the sides of the head, and there is only a single gill opening. Ratfishes have teeth fused into large, sharp incisors at the front, giving them the appearance of rodents.

72 Japanese spider crab—*Macrocheira kaempferi*—Probably the biggest living arthropod; this crab lives in the North Pacific near Japan between 150-1000 feet. Reaching over 12 feet from leg tip to leg tip, and weighing as much as 40 pounds, its body is only about 15 inches in diameter.

73 Deep sea jelly—*Periphylla* sp.—The deep bell-shaped body lined by dark pigment probably masks light from the bioluminescent animals it eats. Jellyfish move by rhythmic muscular contractions of the bell, providing a slow jet propulsion. Hanging downward from the center is a stalk-like structure with the mouth at its tip, opening into the main body cavity. Unlike some other jellyfish, *Periphylla* has very short tentacles.



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