**Living Marine Habitats of Alaska**

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**Cover:** A diversity of seafloor life creates structurally complex habitat in this deep, cold-water garden near Adak Island in the Aleutians. In the center are bright orange colonies of hydroids, and directly below is a white ribbonish bryozoan. Just to the left are salmon-colored basket stars, and in the bottom center of the photo are pink colonies of *Stylaster* hydrocoral. In the lower left corner are brownish hydroids, above them are yellowish demosponges, and in the upper left quadrant are feathery hydroids. In the upper right corner is a colony of the pink gorgonian coral, *Calcigorgia* sp. In the lower right quadrant are pale yellow encrusting sponges, and in the lower right corner are darker yellow sponges. **PHOTO: R. STONE, NOAA FISHERIES.**

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Introduction

What does “fish habitat” really mean? Isn’t the entire blue ocean habitat for fishes? Habitat can be simply defined as the place where organisms live. But from coastal estuaries to the abyss of ocean trenches, different physical and biological features support the ocean’s diversity of marine life. Simply saying that these animals live in the ocean is not enough. Through close examination of a species’ life history, we begin to understand the many essential ingredients that create what we call habitat.

Like animals on land, marine species need food to eat, shelter from predators and a refuge in which to reproduce. Marine animals are sensitive to numerous environmental factors: the right concentrations of salt in the water, the amount of light, temperature, current, the availability of prey and the community of organisms around them. It is a combination of these factors that determines a species’ habitat.

A young rockfish, for instance, relies on habitat-forming structures such as cold-water corals, sponge and rocky outcroppings to hide from predators. Juvenile red king crab are known to take refuge in the arms of sea stars and feed among the shelter of dense aggregations of hydroids, bryozoans and sponges. Salmon’s needs for habitat vary at different life stages, ranging from free flowing freshwater streams and lakes for spawning and rearing, to wetlands, eelgrass meadows and the open ocean as juveniles and adults.

In general, marine habitat is a place in the water column or along the seafloor containing all the essential features necessary for a diversity of creatures to survive. Like terrestrial forests and grassy plains, marine habitats consist of living habitat-forming features such as kelp, eelgrass, sea whips and corals. Both biological and physical features influence the types and density of plankton, fish and other creatures occupying these areas. Alteration of any of these features may result in reduced biological diversity and abundance, or the complete elimination of organisms that are not resilient to natural disturbances or human induced change.

Through photographs and text, this guide will explore some of the many living seafloor habitats found off the coast of Alaska. While many questions about these ocean habitats remain unanswered, each year scientists bring back new answers from the deep. From coastal waters to mysterious offshore environments, Living Marine Habitats of Alaska provides a glimpse into the wide diversity of the North Pacific and Bering Sea ecosystems.
Imagine flying slow-motion through the waving canopy of a forest.

That’s what divers say swimming through a kelp forest is like. Large kelp forests are dispersed throughout the Alaska coast. They can be found growing along rocky coastlines, on top of open-ocean pinnacles or inside protected inlets.

Kelps are actually large brown algae. There are three common types of canopy-forming kelps found in Alaska: *Macrocystis* (*M. pyrifera* and *M. integrifolia*), *Nereocystis luetkeana*, and *Alaria fistulosa*. *N. luetkeana*, generally known as bull kelp, is the most common kelp in Alaska ranging from the eastern Aleutians to southern California. This species can reach up to 10 meters long and grow over five inches (13 centimeters) in a single day. *M. pyrifera*, which in North America is found from Southeast Alaska to Baja California, can reach a length of 36 meters. *Nereocystis* and *Alaria* are annuals and therefore grow to their massive size in just part of one year. All three of these kelp types are anchored to the rocky bottom by large, root-like holdfasts. Giant columns of stipes rise from the holdfasts like tree trunks and reach to the surface of the water. Attached to the flexible stipe are vegetative blades which look and function like leaves, and gas-filled floats that keep the blades on or near the surface. A kelp frond is made up of a stipe and its associated blades.

Like forests on land, kelp forests provide shelter and food for many species of animals. While they are usually found in nearshore waters, they can live in depths to 46 meters if the water is clear enough to allow light to filter down to young plants. The inflated floats and frond mats provide a platform for birds and sea otters, and the submerged portions of the plant provide a habitat for many fishes and marine invertebrates.

Alaska kelp forests are some of the richest kelp communities in the world. A kelp community can be made up of multiple algal species, invertebrates, fish, birds and marine mammals, all of which are linked to each other through complex relationships. The kelp fronds form a surface where a community of microscopic forms, such as diatoms, as well as larger forms, such as bryozoans and hydroids are found. (Bryozoans and hydroids are colonial invertebrates that can look like whitish fuzz, moss or feathers. Both groups have feeding polyps.) Snails, sea urchins and small crustaceans graze and hunt on the kelp fronds. In Alaska, kelp forests provide habitat for more than 20 species of fish for at least part of their life cycle. Many fish species are attracted to kelp forests by the abundant food, but only a few are exclusively kelp dwellers. Atka mackerel, kelp greenling and herring spawn in kelp beds. Fish such as lingcod, sculpins and rockfish feed on the small invertebrates and other fish that live there.
Despite its name, eelgrass (Zostera sp.) is not a true grass. Eelgrass belongs to a group of plants called seagrasses, which are the only flowering plants adapted to an underwater marine environment. Unlike seaweeds, which use a holdfast to fasten to the bottom, eelgrasses have true roots that anchor the plant in sandy or muddy substrates. This trait makes them highly successful at establishing themselves in soft-sediment areas.

Eelgrass meadows are part of an important ecosystem in the protected nearshore waters of Alaska. They are often partially or entirely submerged at the heads of bays and inlets. These meadows provide habitat for many animals that live in or on the bottom (benthic), on the plant and blades themselves, and in the water surrounding the plants (pelagic). Many animals graze on the algal and diatomaceous films that grow on the eelgrass blades. Hydroids, ascidians (sea squirts), bryozoans and polychaetes live on the surface of eelgrass blades. In turn these organisms provide food for foraging fish, birds and invertebrates. Bivalves, snails and worms live in the muddy or sandy bottom around the roots. Crabs graze or scavenge on and around the eelgrass.

Eelgrass meadows provide nursery grounds for young salmon, herring, Dungeness crabs, helmet crabs, and mollusks. Herring spawn on eelgrass blades and the eggs provide nutrient-rich food for many birds and fish. Helmet crabs scurry through the meadows and eat the softer portions of the blades. Juvenile rockfish use eelgrass meadows mainly in the summer before moving to rocky reefs in the fall and winter.

One of the world’s largest eelgrass meadows is in Izembek Lagoon, which lies near the tip of the Alaska Peninsula, facing the Bering Sea. The underwater meadow in Izembek stretches for miles. Izembek Lagoon was designated as a wetland of international importance under the international Ramsar Convention because of its unique habitat features. Studies have shown that the animal community of Izembek Lagoon is sustained largely by eelgrass production.

Top left: A sunflower star (Pycnopodia helianthoides) found among eelgrass blades encrusted with herring eggs. PHOTO: ALLAN FUKUYAMA, ALASKA DEPARTMENT OF FISH AND GAME (ADF&G).

Top middle and right: Eelgrass meadows like these in Southeast Alaska are important nursery grounds for juvenile fish and crab species. PHOTO: S. JOHNSON, NOAA FISHERIES.
Sea Whips and Sea Pens

Some of the most distinctive groups of long lived, habitat-forming organisms are the feathery animals called sea whips and sea pens (order Pennatulacea). They tend to be members of deep-sea biotic communities but can be encountered at all depths. Sea whips and sea pens are found on soft substrates such as mud and sand at depths greater than eight meters but are more common at deeper sites, as great as 91 meters.

All forms of sea pens and sea whips are colonies of individual polyps. They have two distinct polyp types. One polyp, called the primary polyp, grows large, loses its tentacles and forms the stalk of the colony. Secondary polyps are grouped together, protruding off the stalk and form short “branches.” The secondary polyps catch plankton for the entire colony with their stinging tentacles. The feather-like appearance gives the sea pens their common name because they look like old-fashioned quill pens. Some species are long lived and can reach a length of one and a half meters or more. Sea pens and whips are benthic animals adapted exclusively for living partly embedded in mud or sand.

Sea pens and sea whips can be found across the Gulf of Alaska and in the Bering Sea. They have been most frequently documented in trawl catches in Shelikof Strait and along the shelf break in the Bering Sea. They have a patchy distribution in the southeastern Bering Sea but are commonly caught on the outer shelf. Near Kodiak Island in the Gulf of Alaska, the sea whips Protoptilum sp. and Halipteris willemoesi have been observed in densities as high as ten individuals per square meter. Sea pens such as Ptilosarcus gurneyi have been found in dense aggregations in Southeast Alaska at depths less than 30 meters.

Researchers are beginning to see a clear relationship between an abundance of diverse marine life and sea whip abundance, indicating that sea whip habitat may increase productivity. They provide vertical relief to otherwise flat habitats. Worms, bivalves, sea cucumbers, basket stars, commercial shrimps, several species of flatfishes, small octopuses and squids can be found among groves of sea pens and sea whips. Sea stars and nudibranchs have been documented preying on sea pens. Stands of sea pens and sea whips provide shelter for many organisms including gadids, rockfish and crab.

Sea whips (Halipteris willemoesi) off Kodiak Island. A basket star (upper left) uses a sea whip as a feeding platform. Inset: A diver swims through a grove of sea whips (Halipteris willemoesi) off Southeast Alaska. PHOTOS: R. STONE, NOAA FISHERIES.
Cold-Water Corals
Thoughts of corals often spark images of snorkeling in warm blue water over rich coral reefs and through schools of brightly colored fish.

What many people do not realize is that corals are also found in the deep and dark waters of Alaska's North Pacific and Bering Sea. These are not reef-building corals like those found off the coast of Australia, but rather gardens of sea fans, bamboo coral and red tree coral, growing deep in the ocean waters of the Aleutian Islands and Gulf of Alaska.

One of the most abundant corals throughout the Gulf of Alaska and the Aleutians is the gorgonian coral, Primnoa, also known as red tree coral. Primnoa has a calcium carbonate skeleton that supports branching colonies of individual polyps. The polyps use stinging cells to capture plankton. Distribution information in the Gulf of Alaska indicates that Primnoa corals grow between depths of 30 and 800 meters. Red tree corals can reach up to three meters in height and seven meters in width. Large red tree corals may be hundreds, perhaps even thousands of years old. It is thought that Primnoa has a limited reproductive period and a growth rate of about one centimeter per year.

Red tree corals are not the only corals out there. There are five major taxonomic groups and at least 34 species of coral found off the coast of Alaska. The Aleutian Islands have the highest diversity of coral species, and gorgonian corals are the most common group. Cold-water coral gardens are believed to be valuable components of the offshore ecosystem.

Other animals known to inhabit coral gardens include sea stars, nudibranchs, polychaetes, snails, sponges and anemones. Basket stars are suspension feeders that attach to corals such as Primnoa and use the coral as a feeding platform. Rockfish and shrimp seek shelter in the coral canopy or below the coral stands. Researchers have documented golden king crabs mating under the branches of Primnoa. The coral gardens in the Aleutians can be compared to tropical coral reefs, sharing characteristics such as complex seafloor architecture and high biological diversity.

There is still much to learn about cold-water coral biology, such as the role that corals play in enhancing species diversity and their role as habitat for deep-water fishes. Considering the close association between gorgonian corals and a diversity of megafauna, we can assume gorgonians create critical habitat by providing shelter and prey for a variety of animals.
SUMMITS OF THE OCEAN
Pinnacles and Seamounts

Beneath the ocean are hidden many spectacular landscapes. Some of the most stunning are pinnacles and seamounts. Like their counterparts in a rugged desert, pinnacles and seamounts are formed in a variety of ways. Some are islands or rock masses that have had their outer edges gradually worn away by the ocean's persistent currents. Others are the final remnants of underwater volcanoes. Whatever their origin, pinnacles and seamounts attract marine life and support an oasis of teeming communities across different depths.

Deep-water currents moving across the ocean floor rise to the surface as they collide with the base of a pinnacle or seamount. Currents bring nutrients from the seafloor to the ocean surface where, with sunlight, they spark blooms of plankton and a cascading bounty of life. Hydrocorals and red tree corals have been found growing on pinnacles and seamounts. Adult and juvenile rockfish, greenlings and lingcod find shelter in the coral and rocky relief. Lingcod are known to spawn in very deep water at the base of pinnacles. Some pinnacles, such as the Albatross Pinnacle south of Kodiak, come close to the surface and provide a base for waving forests of kelp that in turn provide essential rearing habitat for juvenile fish. The pinnacles are covered with sponges, anemones, hydroids, tunicates, barnacles, crabs, worms, snails, chitons, and other invertebrates and algae.

Seamounts, underwater volcanic mountains, are unique deep-sea habitats. There are two parallel seamount chains in the Gulf of Alaska, spanning several hundred miles. The seamounts rise from depths as great as 4,200 meters to as shallow as 170 meters. Deep-sea explorers of seamounts in the Gulf of Alaska have discovered giant spider crabs seven feet across and creatures that use methane, released from thermal vents, as their basis for life. It is thought that these seamounts harbor a great diversity of sea life, including species that may exist nowhere else on earth.

Many seamounts and pinnacles off the coast of Alaska have been identified and named. The Sitka Pinnacles have been designated a marine protected area, a 3.1 square nautical mile area closed to all bottom-contact fishing to protect the nest-guarding lingcod and rockfish that swarm these two extremely productive pinnacles. Further explorations will undoubtedly identify more seamounts and pinnacles and help unveil their ecological value to surrounding ocean habitats.

Left: The Sitka Pinnacles Marine Reserve, a 3.1 square nautical mile protected area in Southeast Alaska, is an important breeding and feeding habitat for lingcod (Ophiodon elongatus). In this photo, bright pink hydrocoral (Stylantheca petrograpta) covers the rocky relief. PHOTO: ADF&G.

Top: Juvenile rockfish (Sebastes sp.) swarm a rocky outcropping on the Sitka Pinnacles. The pinnacles, covered with anemones (Metridium) and hydrocoral, are an important refuge for lingcod and a diversity of rockfish species. PHOTO: ADF&G.
Juvenile red king crab (*Paralithodes camtschaticus*) use the branches of sea stars such as *Asterias amurensis* pictured here, as a cryptic refuge from predators.

PHOTO: B. DEW, NOAA FISHERIES.

Opposite page: A juvenile red king crab feeding on kelp. PHOTO: B. DEW, NOAA FISHERIES.
During the spring months, red king crab (*Paralithodes camtschaticus*) begin their migration from the deep, cold waters far from shore to nearshore shallow waters. They move from rocky or muddy soft bottoms to more lush nearshore areas with dense aggregations of invertebrates and kelp that provide structurally complex habitat for spawning crabs. The crabs mate and prepare to leave the next generation in these rich protected waters.

Hatching is most successful when the timing concurs with the spring phytoplankton and subsequent zooplankton blooms. Red king crabs spend two to five months in pelagic larval stages before settling to the benthic life stage, far from where they were hatched. Settlement on unprotected bottom leaves young crab exposed to predation, waves and currents. Settlement in habitat with adequate protection, food and temperature range is critical to survival at this stage.

Young-of-the-year red king crab and blue king crab (*P. platypus*) spend their early years at depths of 50 meters or less. They go about their solitary life in rocky areas, filled with boulders, cobble and shell hash and covered with kelp, sponges, hydroids, bryozoans and stalked ascidians. These living habitats provide protection from predators as well as food for the juvenile crab. There have been many observations of small red king crab hiding in between the rays of sea stars. King crab are known to feed on hydroids where hydroids are the dominant epifauna but no one food item is critical to their survival. Fishes such as Pacific cod, Pacific halibut and sculpins prey on juvenile crabs and sea otters prey on sub-adult and adult red king crab.

Dependence on high relief habitat is ended late in the red king crabs' second year with the advent of a unique podding behavior. As the crabs grow in size, what was once a cryptic hiding place for solitary individuals becomes unsuitable. Podding behavior may be a solution to the problem of growing out of their hiding places. Both juvenile (greater than one and a half years old) and adult red king crab have been observed forming pods. It is uncertain what the function of this unique behavior is, possibly a defense mechanism from predators.

King crab nursery grounds, shallow areas with high relief and invertebrate communities, are found throughout Alaska. Shallow areas north and adjacent to the Alaska Peninsula, the eastern portion of Bristol Bay, nearshore areas of the Pribilof Islands and the Gulf of Alaska are important king crab spawning and juvenile rearing habitats. Blue king crabs have a discontinuous distribution with populations found around the Pribilof Islands, St. Matthew, St. Lawrence, Nunivak and King islands. There are some isolated populations in the Gulf of Alaska.
Fields of the Benthos

Along the continental shelf in the eastern Bering Sea and much of the Gulf of Alaska, the seafloor is soft and covered with sand, mud, silt, bits of broken shell and other fine materials. These marine waters overlying the continental shelf are rich in life, and the soft sediments are often inhabited by many organisms living within the upper layers of the seafloor (infauna) or on the surface of these seafloor substrates (epifauna).

Wherever there is suitable substrate on the seafloor, most of the dominant animals live as plants do on land, attached to the ground (epifauna). Some of these animals look so plantlike that early biologists classified them as plants. Unlike plants, these organisms filter the water for food or catch small prey with stinging tentacles. Sponges, anemones, soft corals, ascidians, sea whips, sea pens and bryozoans are distributed throughout the North Pacific and Bering Sea, many of which provide important living structure to soft sediment seafloor habitats.

In addition to the animals that provide vertical relief to the flat, soft sediment communities, there are many species of polychaetes and mollusks that burrow into the sediments. These burrowers (infauna) act to stabilize the sediments and they are a food source for crab and fish. Sea stars, nudibranchs and numerous other slow-moving animals prey upon sedentary creatures such as barnacles, mussels and sponges.

The pink bulb-like body of the sea onion (Boltenia ovifera), a solitary ascidian, floats in the water but is tethered to the bottom by the holdfast at the end of its stalk. In turn, other ascidians, bryozoans and hydroids attach themselves to the sea onion’s stalk. The sea onion and its relative the sea potato (Styela rustica) are common in the southeast Bering Sea and they are particularly abundant north of the Alaska Peninsula. Together with anemones and sponges, sea onions and sea potatoes cover the sandy floor at depths of 25-100 meters.

Other invertebrates found on sandy bottoms include sand dollars, urchins, worms, clams and scallops. Finer sediments support a greater variety of burrow dwellers and other associated animals such as polychaetes, bivalves, sea cucumbers, sea pens, basket stars, commercial shrimps, several species of flatfishes and small octopuses.

These sea peaches (Halocynthia aurantium), ascidians in the same family as the sea onion (Boltenia ovifera), occur throughout the Bering Sea and south to Puget Sound. As seen here, sea peaches often grow in clumps or fields, providing a unique element to this low relief habitat. PHOTO: R. STONE, NOAA FISHERIES.
Winter at the Bering Sea ice-edge: as far as the eye can see, ice stretches like an endless white expanse, blending into the horizon from sea to sky. Barren is the first thought that comes to mind, but nothing could be further from reality. The sea ice is part of a dynamic system, under continuous motion caused by wind, currents and waves which form cracks, pressure ridges and leads into the pack ice. **Polynyas**, important to marine mammals and seabirds, are large openings in the ice pack formed by upwelling, winds and currents. Algae grow in the underside of the sea ice. Zooplankton and larval fishes graze at the ice edge where there is a concentration of nutrients. But the greatest activity occurs in the spring when ice-melt triggers an explosive bloom of phytoplankton, making the Bering Sea one of the most productive ocean systems in the world.

The amount of a given year’s ice production affects the Bering Sea environment by influencing the temperature of shelf waters, local changes in flow and the transport of nutrients. Seasonal ice cover in the Bering Sea begins in November and grows to greater than 80 percent coverage of the continental shelf during its maximum extent in March. The spring phytoplankton blooms support the higher **trophic level** production of zooplankton. This in turn supports vast populations of benthic invertebrates, fishes, birds and marine mammals.

Ice cover affects the distribution of benthic and pelagic species inhabiting the Bering Sea shelf. Capelin, a small fish in the smelt family, migrate along the advancing and retreating polar ice front. Capelin are an important component of the Bering Sea food web, providing essential nutrients for marine mammals and birds feeding along the winter ice edge. Many species of seabirds and mammals use the ice edge as migration routes and depend on the reliable food supply.

Map: Percent probability that the eastern Bering Sea ice edge will extend to the indicated boundary by March 1 of each year.

Right: Walrus (*Odobenus rosmarus*) at home in the midst of the Bering Sea ice.

**PHOTO:** CAPTAIN B. CHRISTMAN, NOAA CORPS.
Glossary

Ascidians: Included in the subphylum Urochordata and commonly known as sea squirts, ascidians look like a jug with two openings, an incurrent and excurrent siphon. Most grow attached to seafloor substrates.

Benthic: Pertaining to the bottom of the ocean, the seafloor.

Bivalves: The clams, mussels and other mollusks. They have a two-valved shell, filtering gills and shovel-like foot.

Bryozoans: Belonging to the phylum Bryoza, these colonies of microscopic animals can look like moss, coral, sponge or algae with feeding tentacles. The individuals among the colonies are called zoöids.

Crustacea: The group of arthropods including crabs, shrimps, lobster and barnacles.

Diatomaceous film: A film of diatoms, one-celled microscopic algae.

Epifauna: Animals that live on the surface of the substrate.

Gadids: Fishes of the family Gadidae, including pollock and cod. There are more than 50 species of gadids that inhabit the coastal zones, continental shelves and slopes of northern seas.

Hydrocorals: The common term for the taxonomic group of corals, Stylasterina.

Hydroids: Animals of the taxonomic group Hydrozoa, a class of cnidarians that are made up of colonies of polyps. Hydroids often look like small ferns.

Invertebrate: An animal that does not have a backbone.

Megafauna: Animals large enough to see with the unaided eye. Antonym: microfauna.

Mollusk: Pertaining to the phylum Mollusca, including chitons, tusk shells, oysters, snails, slugs, nudibranchs, squid and octopuses.

Nudibranch: Animals of the phylum Mollusca and class Gastropoda. Nudibranchs, sometimes referred to as sea slugs, take many different shapes and can be an array of colors.

Pelagic: The water column, away from the seafloor.

Polychaete: Belonging to the phylum Annelida which incorporates all the segmented worms. Polychaetes are the marine equivalent of land-based worms.

Polynya: Large enclosed openings in the ice cover, due to currents or upwelling. They are biologically important in that they provide open water in winter used by birds and mammals and present an ice edge with increased productivity.

Polyp: The cylindrical, typically attached stage of cnidarians (animals such as jellyfish, sea anemones, sea pens and hydroids). An individual polyp has tentacles to catch prey, a mouth, digestive tract and primitive nervous system.

Sponge: Animals of the phylum Porifera, the most simple form of multicellular animal life. Some sponge species function as shelter for fishes and crab.

Substrate: The seafloor type or material on or in which an organism lives.

Trophic level: Each of the steps in a food chain.

Tunicates: Members of the subphylum Urochordata (= Tunicata). Sea squirts (ascidians) are tunicates.

PHOTO: R. REUTER, NOAA FISHERIES.
References

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References
The geographic features off the coast of Alaska, such as the Gulf of Alaska seamounts, the deep Aleutian Trench (south of the Aleutian Islands), and the large continental shelf of the Bering Sea, are one factor that influences the distribution and diversity of living marine habitats.
People throughout Alaska working to protect the health and diversity of our marine ecosystem.

ALASKA MARINE CONSERVATION COUNCIL