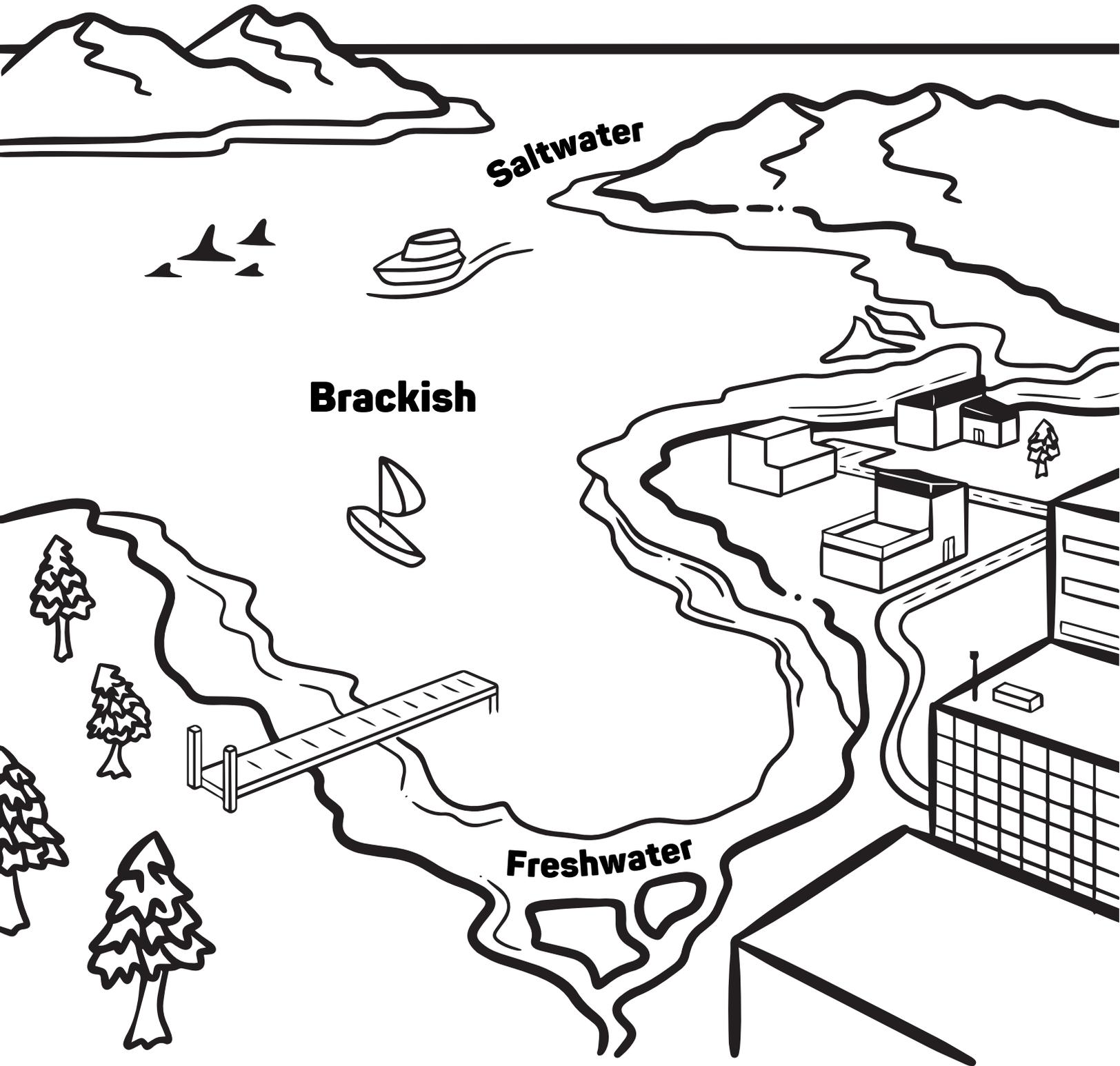
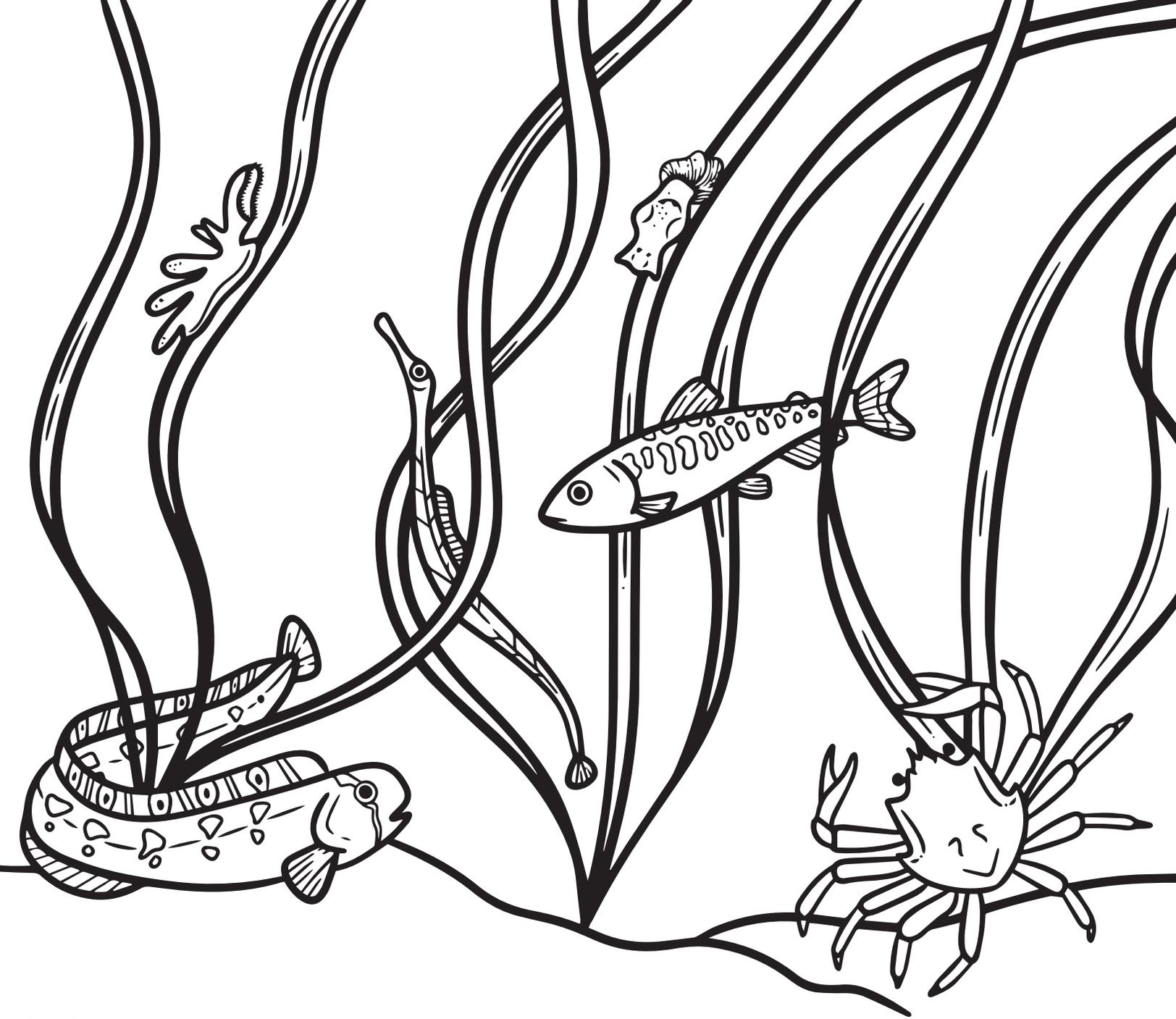


# **EDUCATIONAL COLOURING BOOK**

# Estuaries

**Estuaries** are formed where the **freshwater from rivers meets the saltwater ocean and mix to form "brackish" water** (in between salt and freshwater). They are important ecosystems for the land, the air, and the sea. Estuaries are common in protected bays with calm waters, and the habitats they create provide nurseries and feeding grounds for species of special concern, including salmon and sea birds.





# Eelgrass

**Eelgrass (*Zostera marina*)** is a flowering marine plant. They are found along shorelines, growing in the soft seabed in the intertidal zone. They can grow as tall as 2.5 metres in water and up to 6 metres deep. Many animals depend on dense eelgrass meadows for food and habitat. These meadows are especially important for juvenile species, making a nursery habitat that protects them from predators.

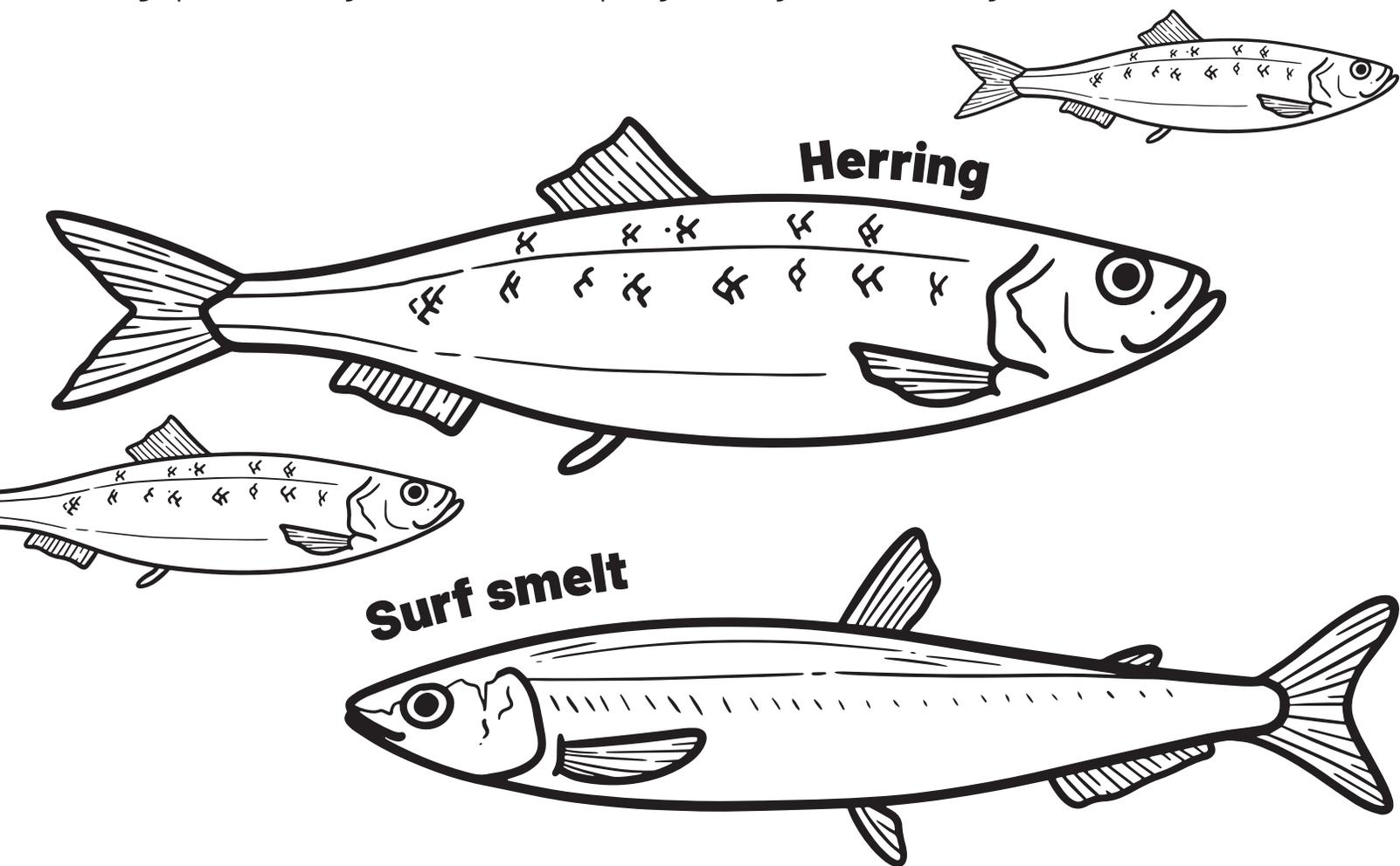
Like trees and flowering plants on land, eelgrass produces oxygen through photosynthesis, helping keep the oceans healthy and full of life. Eelgrass beds also help keep the ocean floor stable by trapping sediment with their roots. This then creates more soft-sediment habitat for more eelgrass to grow.

Learn more about the Resilient Estuaries of the Salish Sea project at [seachangesociety.com](http://seachangesociety.com)

# Forage Fish

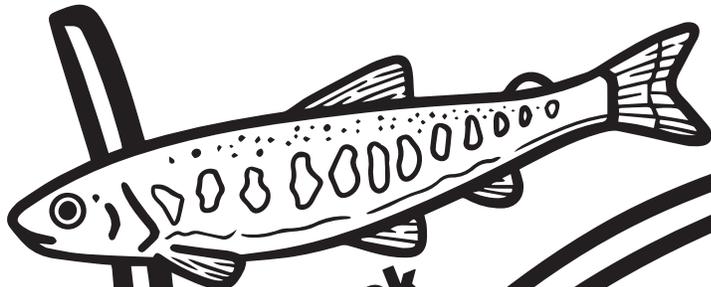
Forage fish species like **herring** (*Clupea pallasii*) and the **Pacific sand lance** (*Ammodytes hexapterus*) play crucial roles in estuarine ecosystems. They are also important to the food web, serving as prey for predators such as salmon, seabirds, and orcas. These fish need healthy eelgrass beds and intertidal habitats to spawn (fertilize and lay eggs).

**Herring** spawn on eelgrass beds in the spring, turning coastlines bright blue.

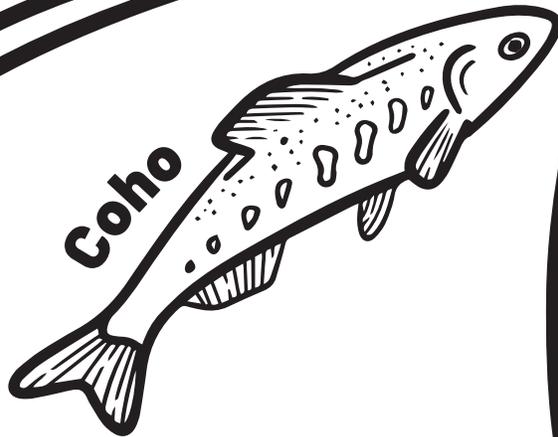


**Sand lance** will bury themselves face-first into the sand to hide from predators.

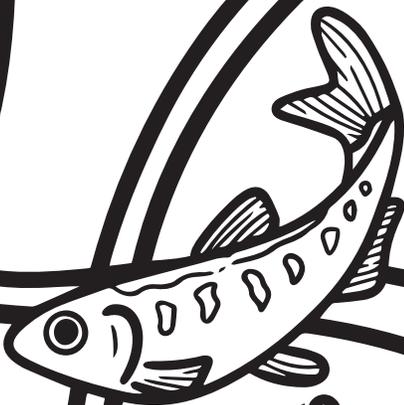
# Juvenile Salmon



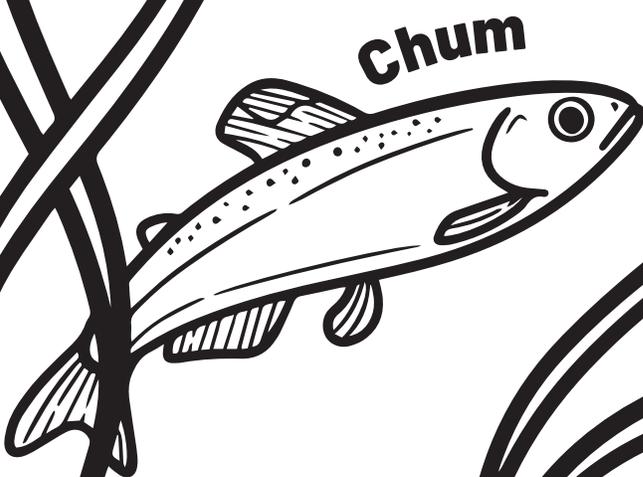
**Chinook**



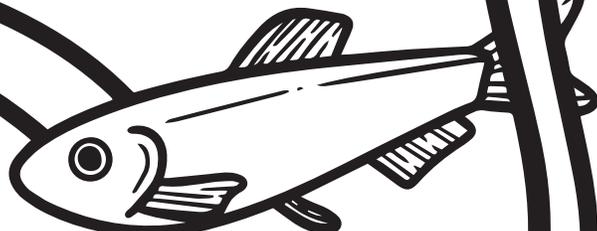
**Coho**



**Sockeye**



**Chum**



**Pink**

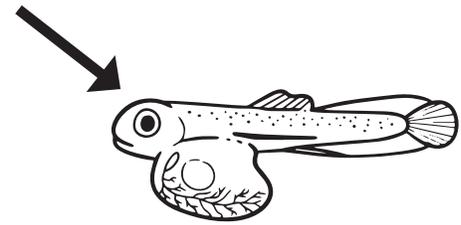
**Estuaries are important nurseries for salmon smolts**, with food and shelter for the growing salmon. The mix of freshwater and saltwater in estuaries also creates a brackish ecosystem and helps salmon prepare to live in the open ocean. Salmon smolts will travel between smaller estuaries, creating a travelling path or “salmon highway”, avoiding predators and continuing to grow.

Learn more about the Resilient Estuaries of the Salish Sea project at [seachangesociety.com](http://seachangesociety.com)

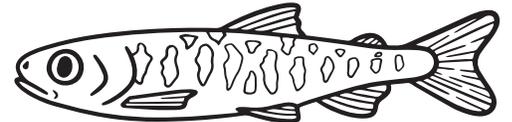
# Salmon Lifecycle



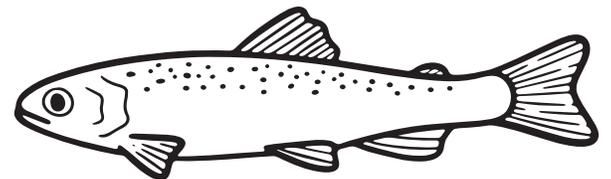
**Egg Stage:** Salmon lay their eggs in gravel nests called redds. Eggs will remain in these redds for 6-20 weeks.



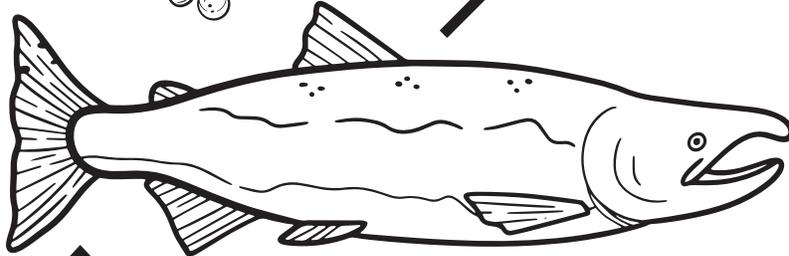
**Alevin Stage:** In later winter and spring, tiny fish hatch. These are alevins. Alevins still have a yolk sac attached to their bodies that provides them with the nutrients they need to grow.



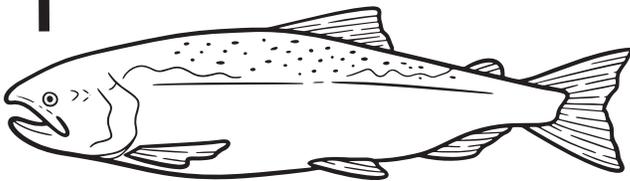
**Fry Stage:** When they leave the redd, salmon are known as fry. At this stage, they are very small and vulnerable. Some fry will immediately head to the ocean, but others will stay in freshwater habitats for a few years.



**Smolt Stage:** Salmon fry undergo a transformation known as smoltification. Their bodies change so they can survive in the saltwater of the ocean. They lose the spots and brown colouration that helped them hide in freshwater habitats, and turn silver. During this life stage, estuaries provide food and a safe sanctuary for the young salmon.



**Spawning Stage:** After spending 2-5 years in the ocean, salmon will make the journey back to the same freshwater streams and rivers where they were born. They transform again, but this time to survive in freshwater: their silver scales turn to shades of brown, red, and green. Some will develop hooked jaws, teeth, and humped backs. Once they spawn, the salmon will die, feeding the upland forests and wildlife.

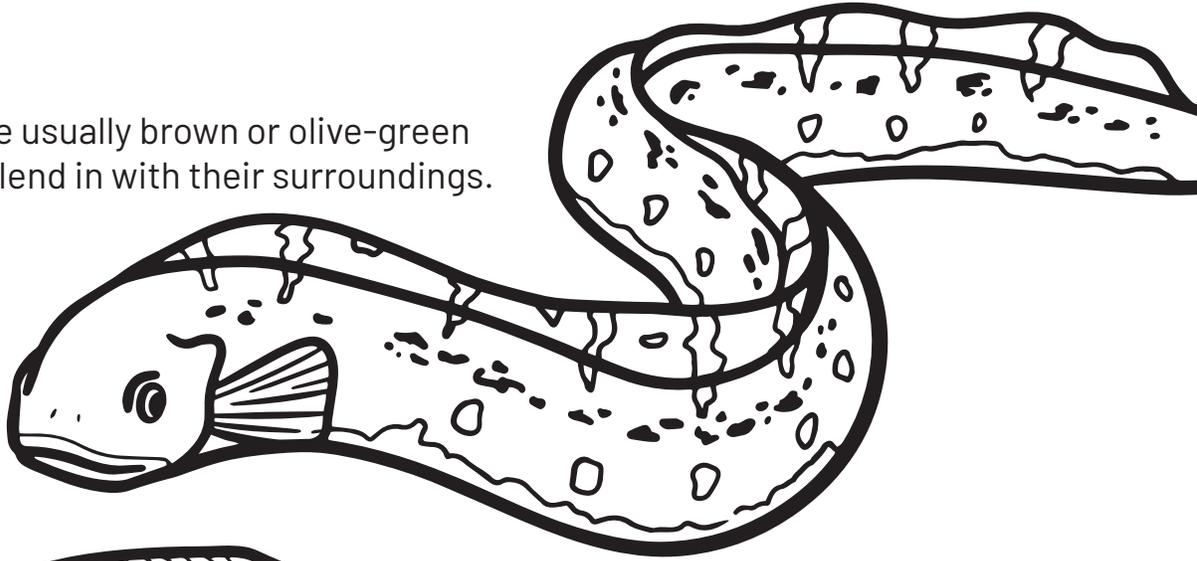


**Ocean Stage:** Salmon spend several years in the ocean, feeding on plankton, small fish, and invertebrates. They will swim great distances as they hunt and avoid predators like orcas and sharks, and the challenges of changing ocean conditions.

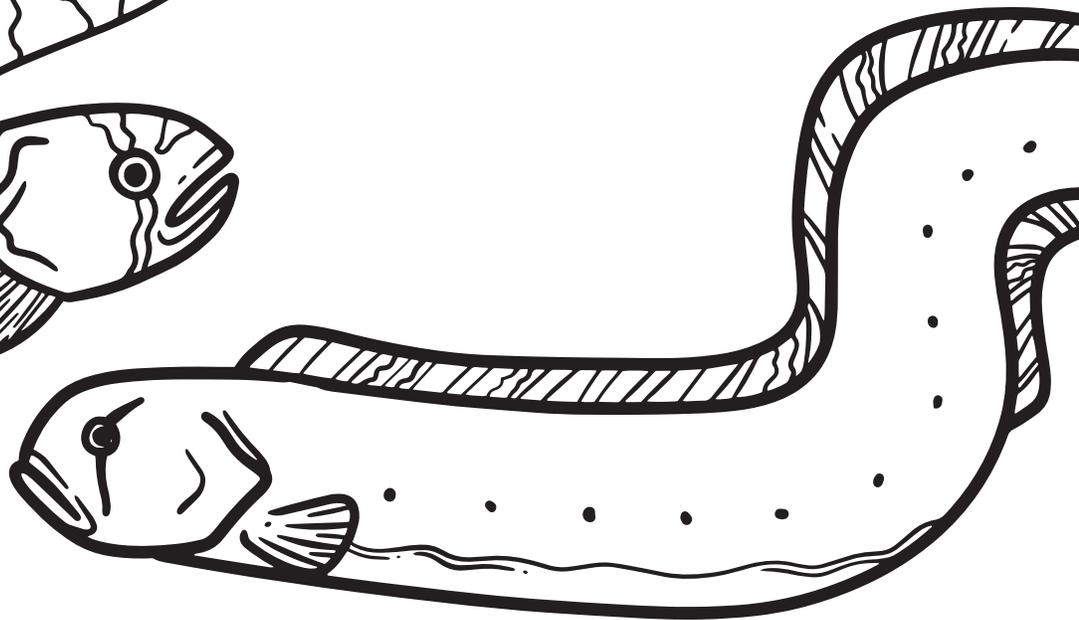
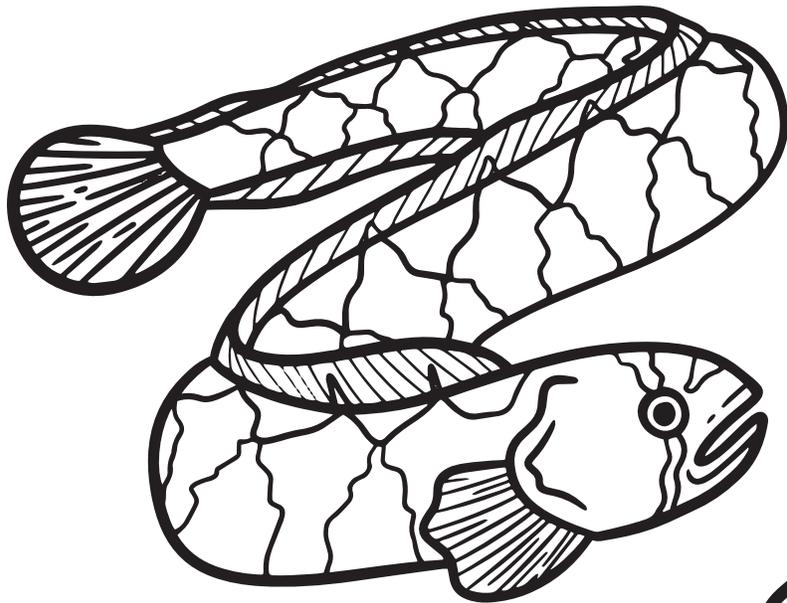
# Gunnels

Gunnels are long, eel-like fish. They have a long dorsal fin along their body which has between 70-100 spines. They live in rocky shallow waters, hiding under rocks and in kelp and eelgrass. Gunnels can also survive out of water and breathe air! This helps them survive in low-tide habitats. You may find them under rocks on the beach during low tide! They feed on small crustaceans, mollusks, and marine worms, using their slender bodies to move through tight spaces to find food.

**Longfin gunnels** are usually brown or olive-green which helps them blend in with their surroundings.



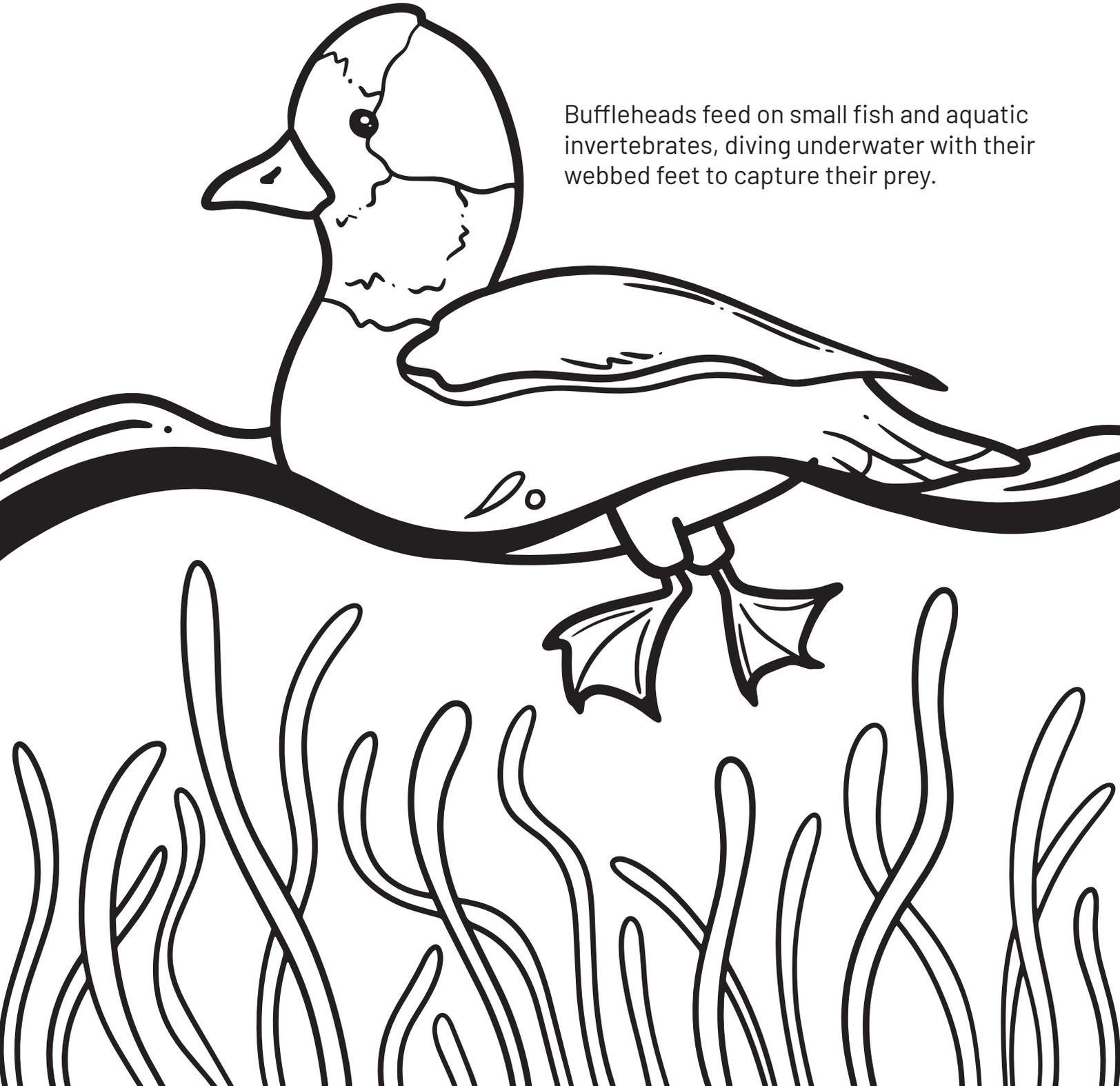
**Saddleback gunnels** are named for their saddle-like markings on their backs and are commonly shades of brown or even red.



**Penpoint gunnels** are a remarkable shade of green, helping them blend in with kelp and eelgrass beds where they hide to avoid predators and to ambush prey.

# Buffleheads

**Buffleheads (*Bucephala albeola*)** are charming and punctual migratory birds found in the winter in the Salish Sea. Male buffleheads have black and white plumage, with iridescent shades of green, purple, and blue reflecting on their head in the sunlight. Females are shades of brown, white, and grey, with no iridescence like the males. This helps the female bufflehead camouflage while the male's colouration helps them attract females.



Buffleheads feed on small fish and aquatic invertebrates, diving underwater with their webbed feet to capture their prey.

# Sculpins

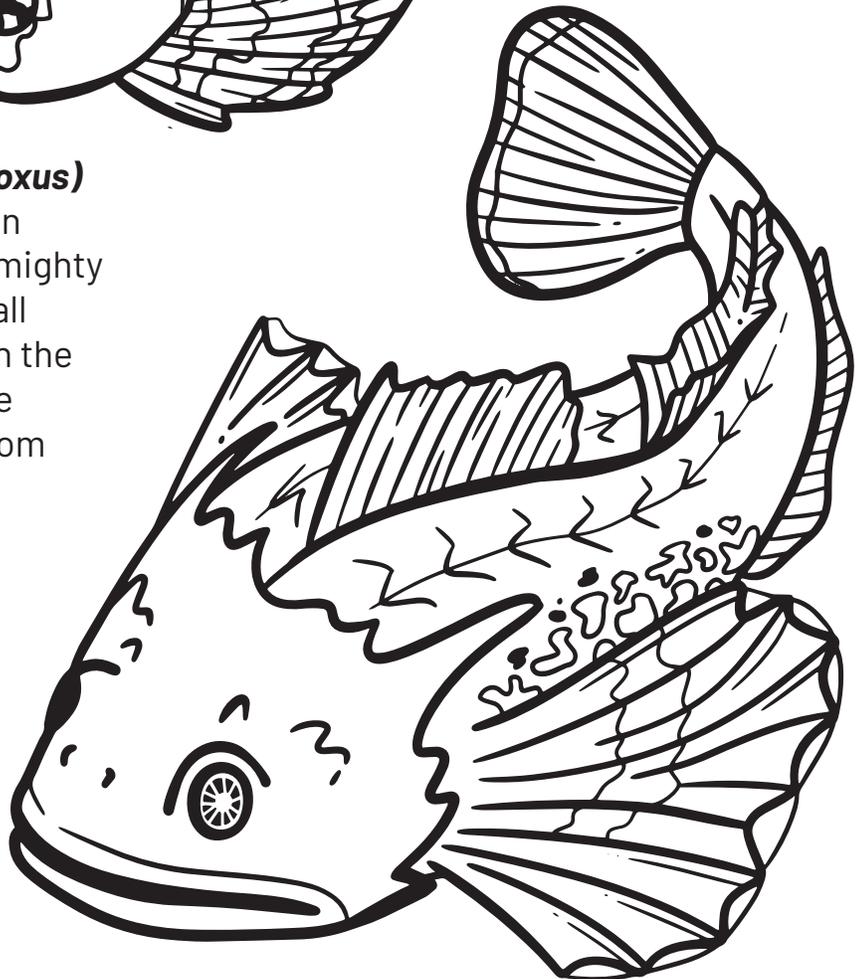
Sculpins are a large group of bony fish, with over 50 species in the Salish Sea alone! These fish are sneaky and love to hide, living on the seafloor with rocks and algae with modified pectoral fins that help them sit on blades of eelgrass, kelp, and rocks. They are often hard to spot due to their colouration that allows them to be camouflaged.

**Tidepool sculpins (*Oligocottus maculosus*)** are another species found in estuary and low-tide habitats. They can grow to be 8 cm long and change their colouration to blend in. Just like the tadpole sculpin, they are hunters that feed on isopods, molluscs, marine worms, and even algae!



**Tadpole sculpins (*Psychrolutes paradoxus*)** are small, bottom-dwelling fish that can grow to be 9 cm long. These small but mighty fish are skilled hunters, preying on small invertebrates and crustaceans found in the rocky tidal and estuary waters. Tadpole sculpins stalk their prey, darting out from hiding spots to capture prey with their lightning-fast strikes.

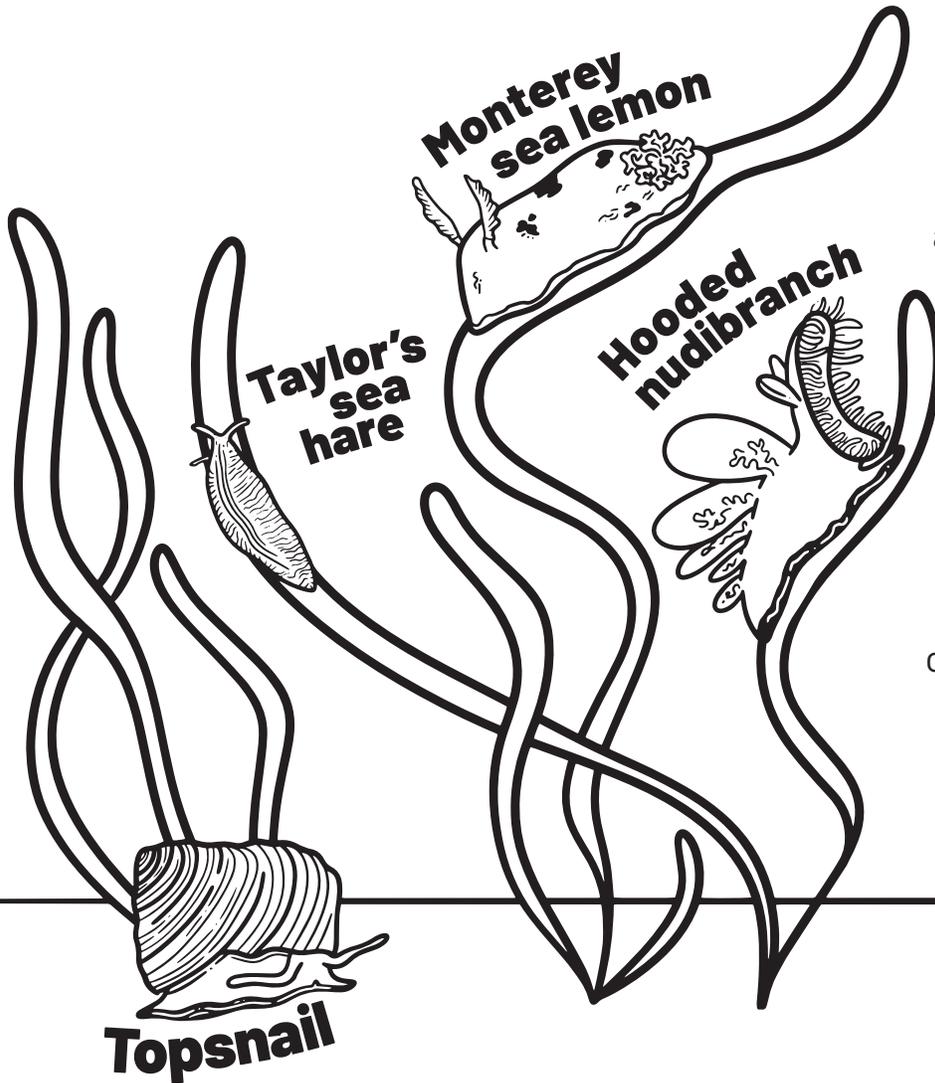
**Buffalo Sculpin (*Enophrys bison*)** are a larger species, growing up to 37 cm long! They are named for the horn-like spines on their head. These spines are also poisonous, protecting them from predators.



# Gastropods

Gastropods are a diverse group of mollusks coming in remarkable sizes and colours in the Salish Sea. Snails, nudibranchs, and sea hares are all gastropods. Shell-less gastropods like nudibranchs and sea hares are called sea slugs!

Sea hares are large, soft-bodied gastropods with internal or reduced shells. They are herbivores that eat algae and marine plants. Sea hares can also release ink when scared, like an octopus! The **Taylor's sea hare** is often found in eelgrass beds, safely camouflaged by their green or yellow colouration.



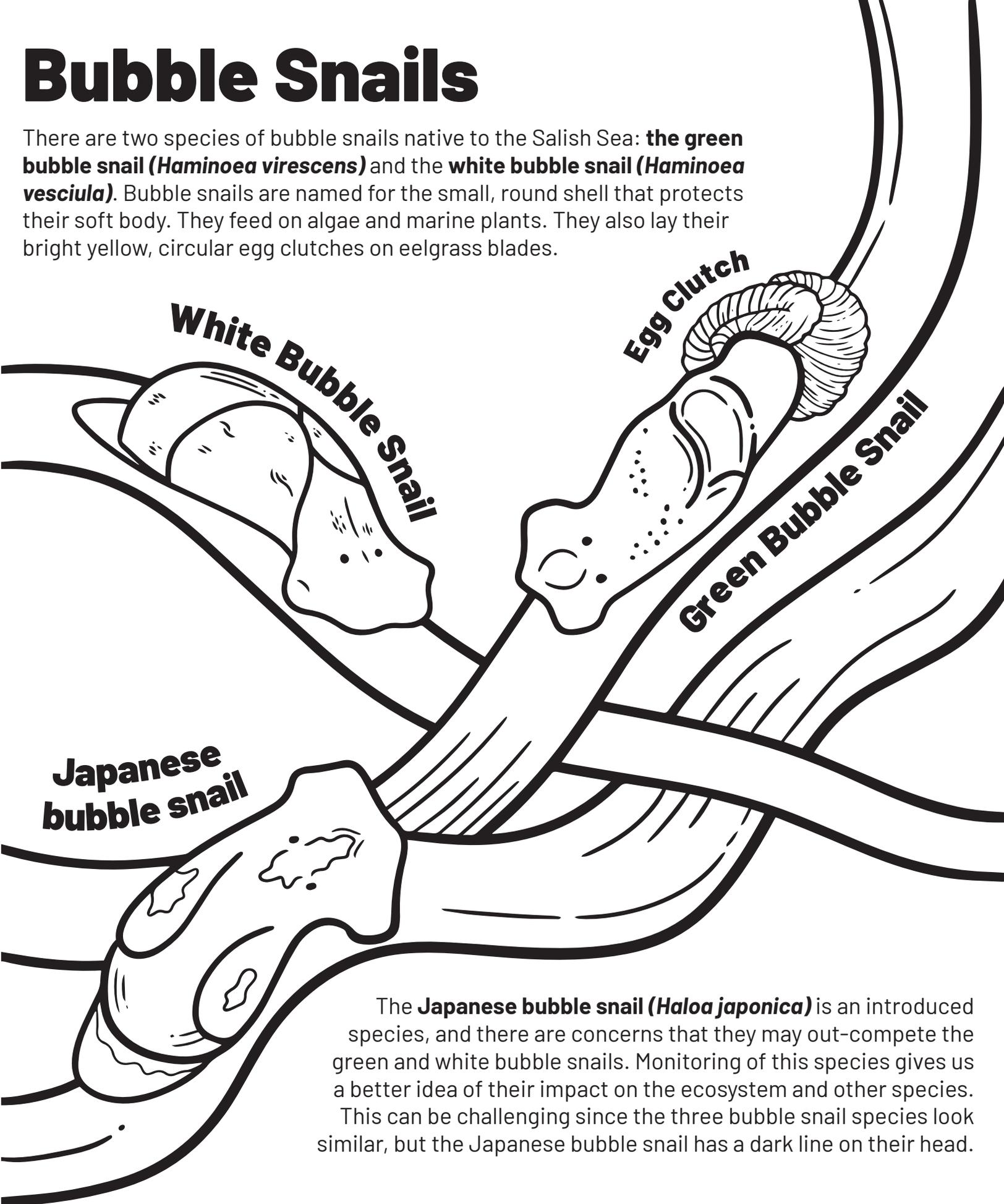
**Nudibranchs** have reduced shells or no shells at all. They have their gills on the outside and a pair of rhinophores on their heads that look and act like antennae. Nudibranchs are predators, feeding on sponges, anemones, and other small invertebrates.

They are known for their vibrant colouration, like the **Monterey sea lemon (*Doris montereyensis*)**. This colouration can help them camouflage but is also a warning to predators as many nudibranchs are toxic.

Snails are one of the most recognizable gastropods, known for their spiral-shaped shells that protect their soft bodies. The **Western ridged topsnail (*Calliostoma ligatum*)** is a common intertidal snail with brown and tan stripes and a pointed top. They live in eelgrass and kelp forests in the intertidal and are related to the flashy **purple-ringed topsnail (*Calliostoma annulatum*)**.

# Bubble Snails

There are two species of bubble snails native to the Salish Sea: the **green bubble snail** (*Haminoea virescens*) and the **white bubble snail** (*Haminoea vesciula*). Bubble snails are named for the small, round shell that protects their soft body. They feed on algae and marine plants. They also lay their bright yellow, circular egg clutches on eelgrass blades.

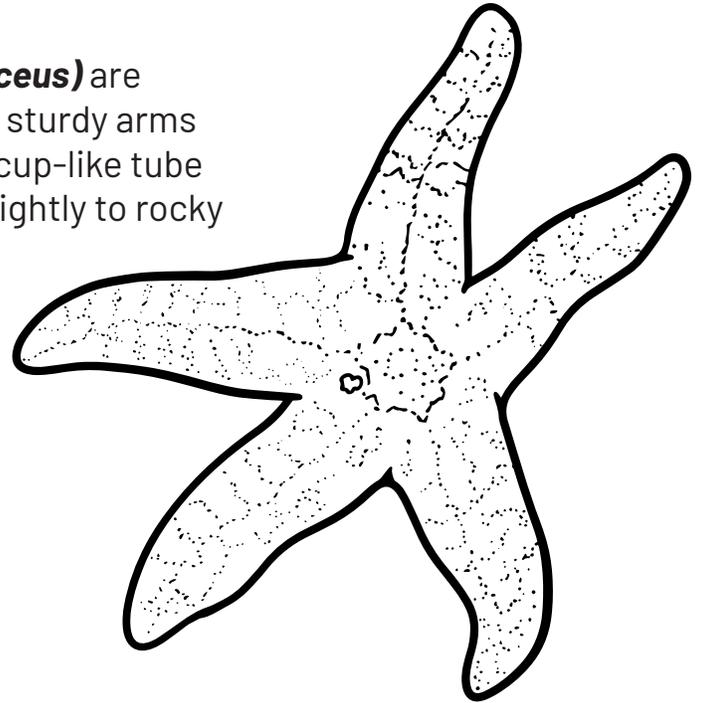
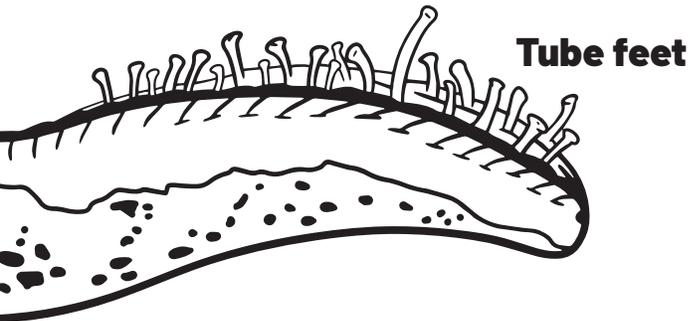


The **Japanese bubble snail** (*Haloa japonica*) is an introduced species, and there are concerns that they may out-compete the green and white bubble snails. Monitoring of this species gives us a better idea of their impact on the ecosystem and other species. This can be challenging since the three bubble snail species look similar, but the Japanese bubble snail has a dark line on their head.

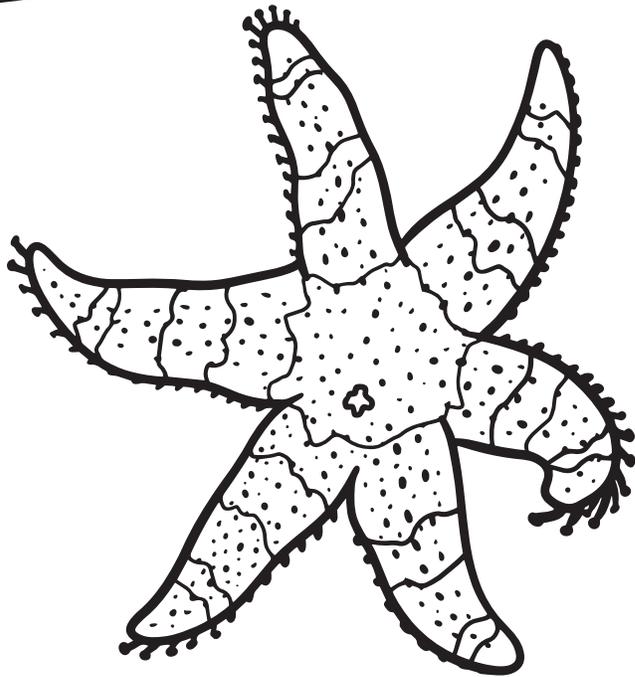
# Sea Stars

From tiny species measuring in at just a few centimetres to species measuring over a half a metre, sea stars are an incredible group of marine animals! Sea stars are echinoderms, which means “spiny skin”.

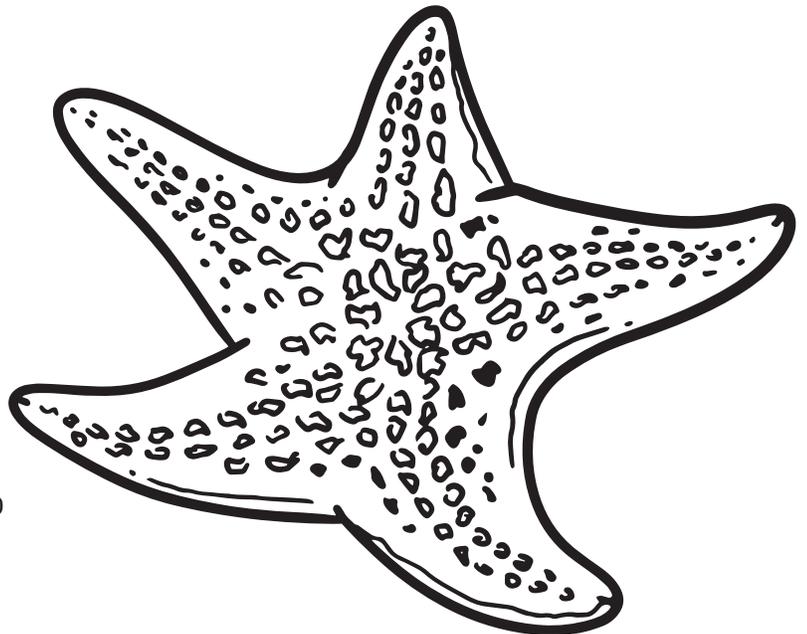
Often orange or purple, **Ochre stars (*Pisaster ochraceus*)** are common in estuaries and intertidal zones. Their five sturdy arms radiate from a central disc each with small, suction cup-like tube feet. These tube feet enable the ochre star to cling tightly to rocky surfaces and pry open mussels and clams.



**The six-ray star (*Leptasterias hexactis*)** is a small species of sea star found in the Salish Sea. These sea stars usually have six arms, but can sometimes have eight! Their spiny skin can be shades of green, black, brown, and red. Despite being small, six-rayed stars are incredible predators, preying on small invertebrates like mollusks, barnacles, and crustaceans.



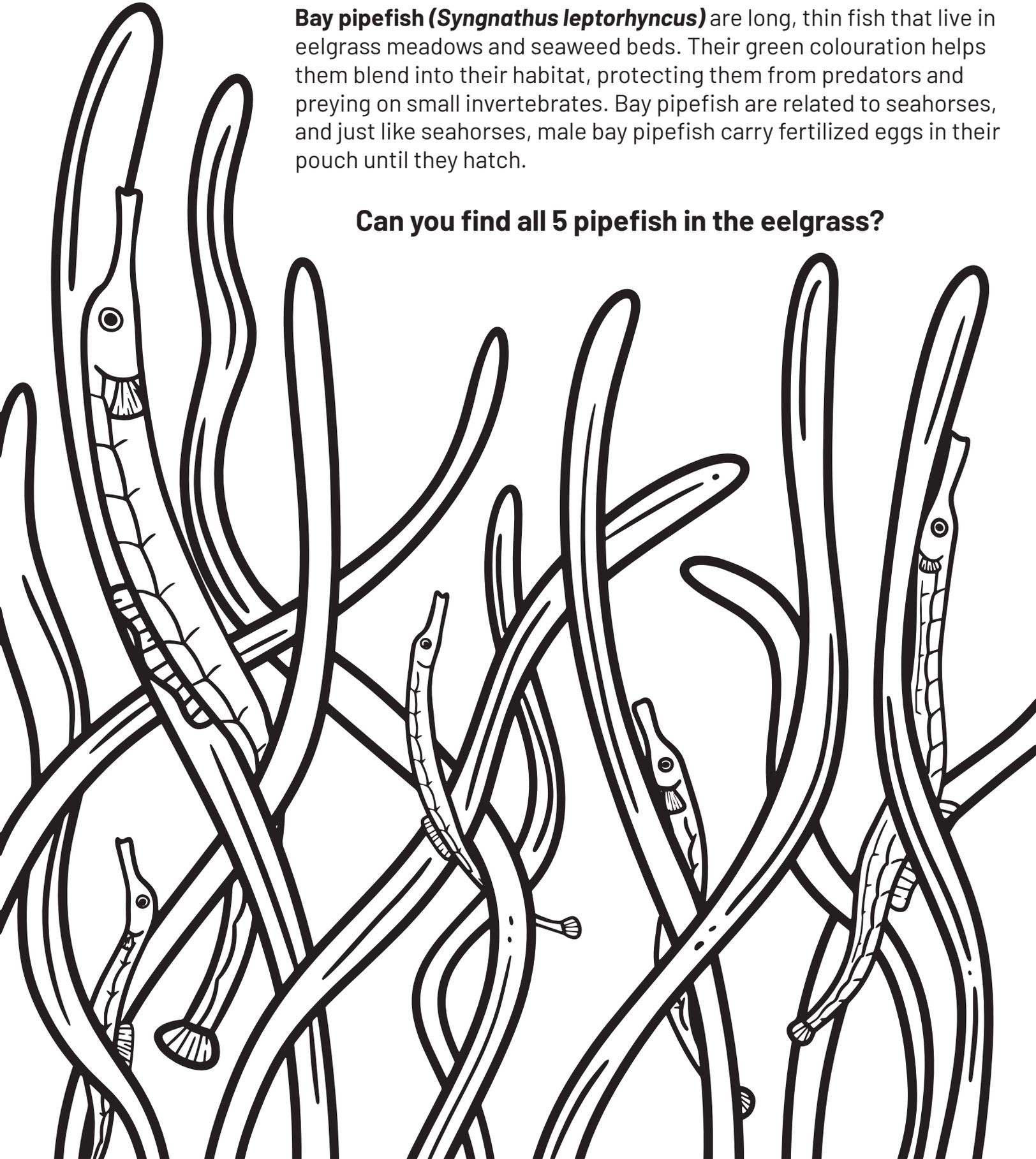
**Leather stars (*Dermasterias imbricata*)** are named for their unique appearance, with tough, leathery skin and distinctive pentagonal shape. The speckled pattern on their skin ranges from red and brown to vibrant shades of purple and blue.



# Bay Pipefish

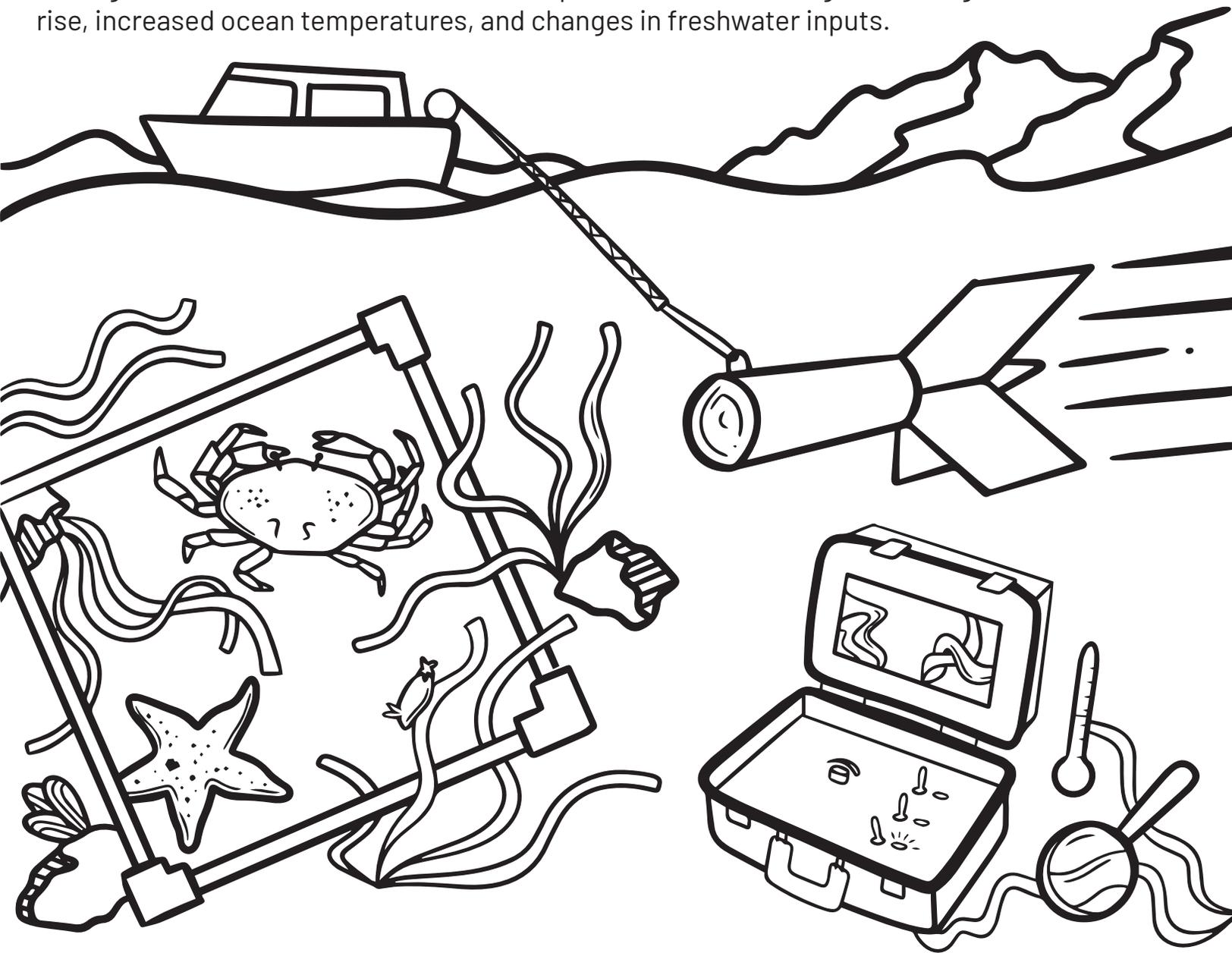
**Bay pipefish (*Syngnathus leptorhyncus*)** are long, thin fish that live in eelgrass meadows and seaweed beds. Their green colouration helps them blend into their habitat, protecting them from predators and preying on small invertebrates. Bay pipefish are related to seahorses, and just like seahorses, male bay pipefish carry fertilized eggs in their pouch until they hatch.

**Can you find all 5 pipefish in the eelgrass?**



# Resilient Estuaries of the Salish Sea

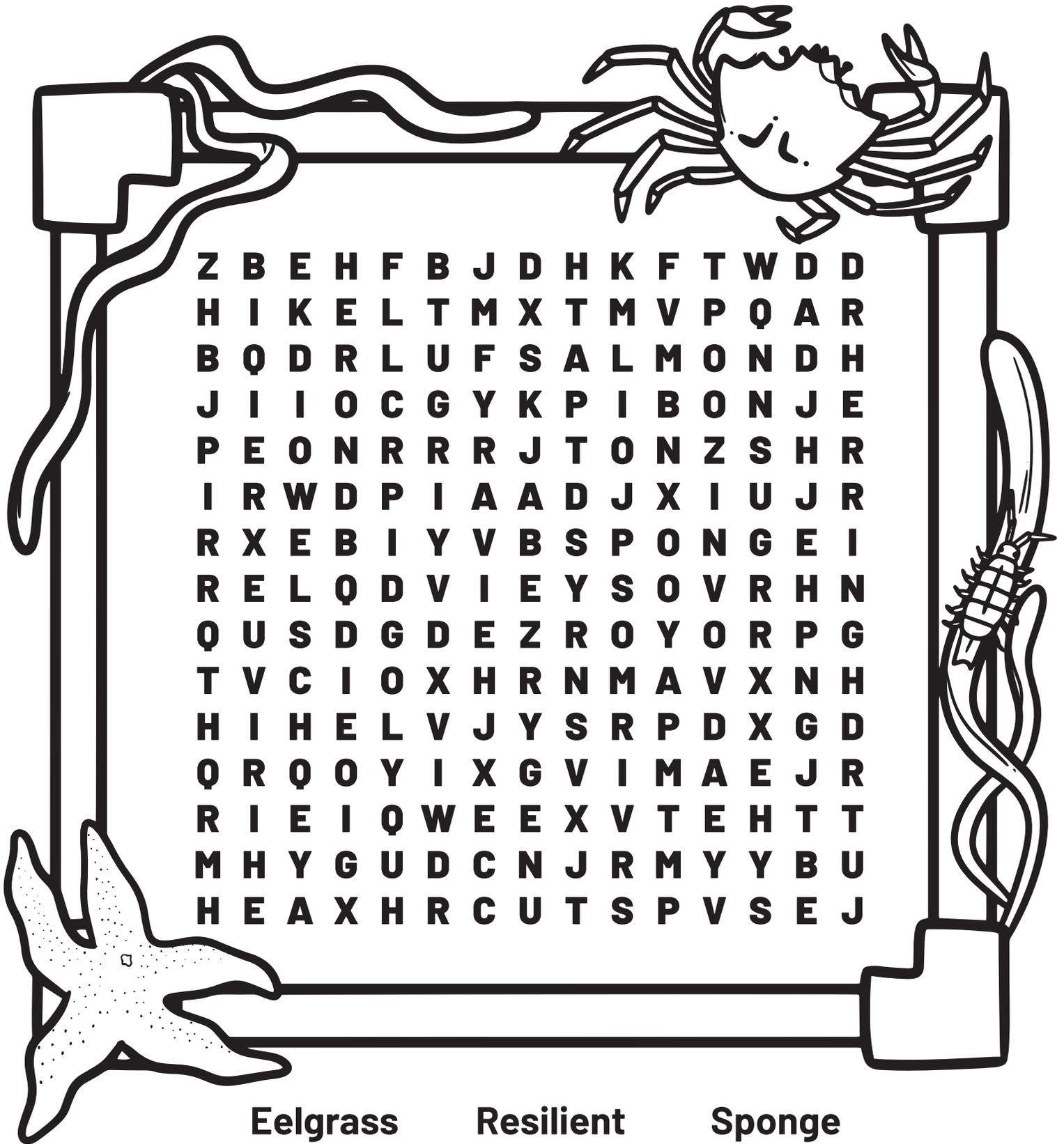
**Estuaries face many threats** since humans spend lots of time around them, stepping on sensitive habitat and littering. Shoreline change, invasive species, upstream pollution, and water vessel use result in estuary areas being damaged from many directions. Adding to this are the current and future impacts of climate change, including sea level rise, increased ocean temperatures, and changes in freshwater inputs.



**The Resilient Estuaries of the Salish Sea (RESS)** is working with partners and collaborators to identify a network of smaller estuaries within the Northern Salish Sea that will likely have increased resiliency with the growing impacts of climate change.

Learn more about the Resilient Estuaries of the Salish Sea project at [seachangesociety.com](http://seachangesociety.com)

# Quadrat Word Search



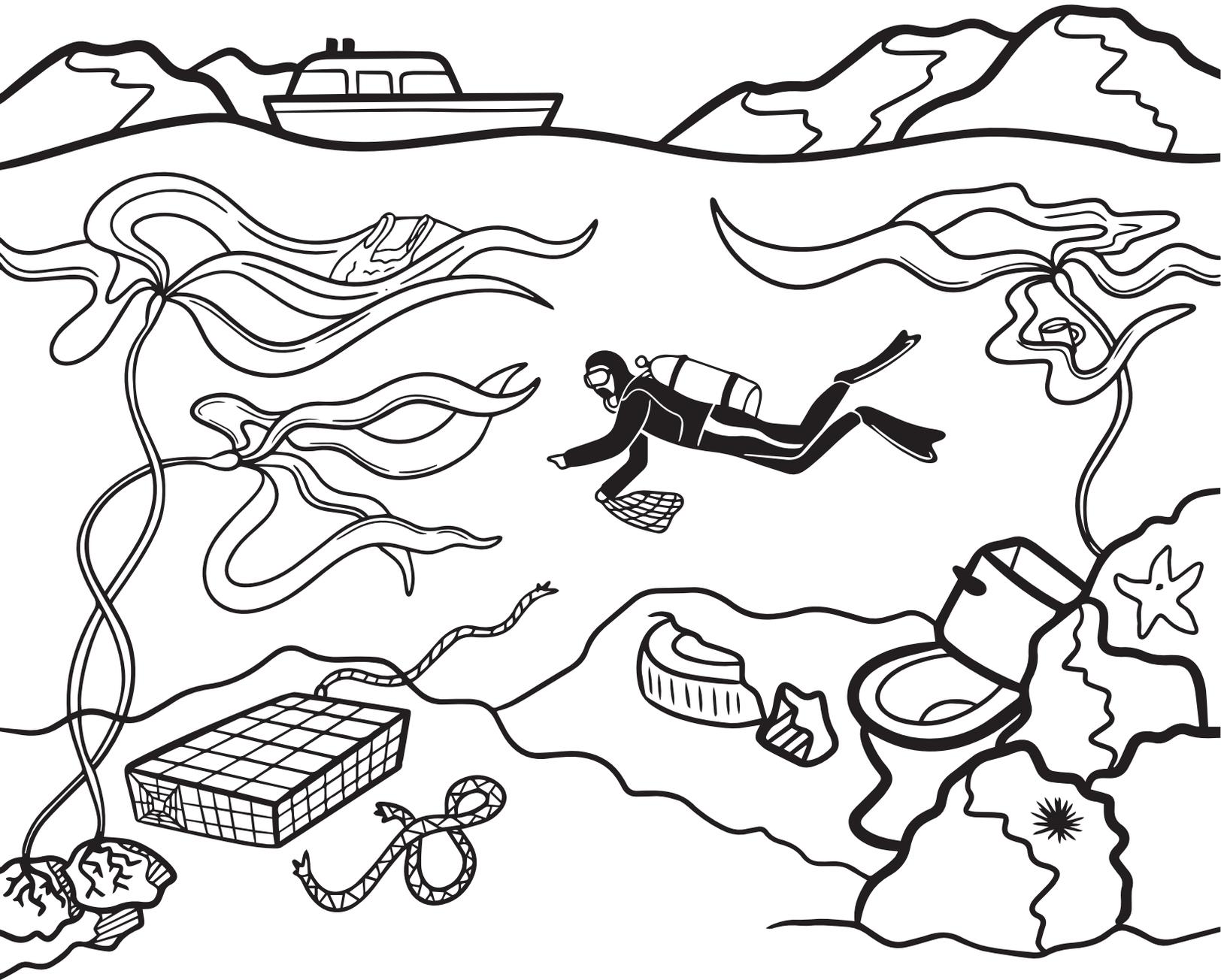
Eelgrass  
Salmon  
Biodiversity

Resilient  
Crab  
Herring

Sponge  
Heron  
River

# RESS Debris Cleanup

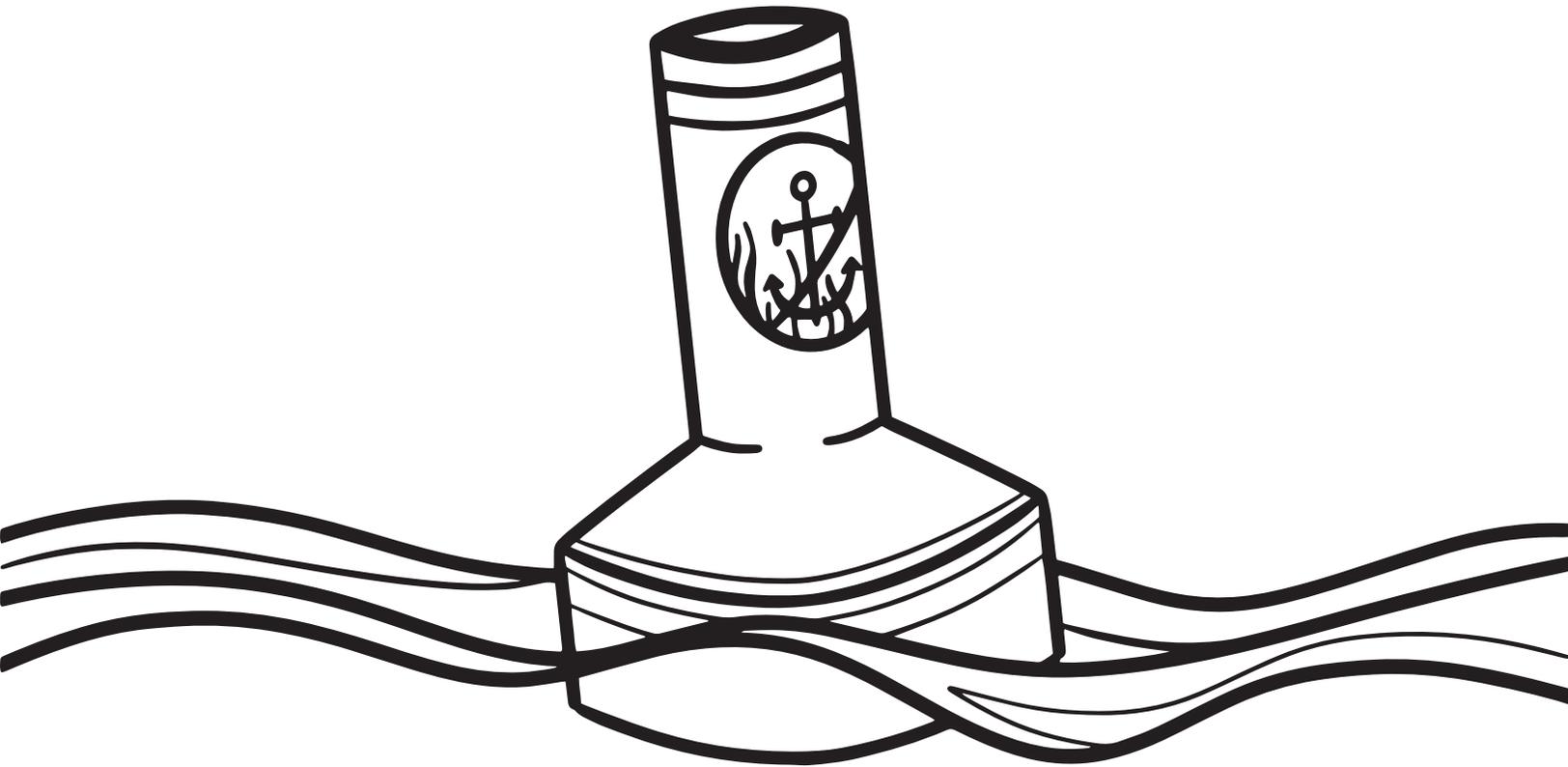
To help estuaries and the seafloor, the Resilient Estuaries of the Salish Sea project clean up garbage that sits on the seafloor. Divers work with boats and lift any human-made objects out of the ocean and into the landfill. We have found tires, mugs, boats, crab traps, fishing line, and even a toilet.



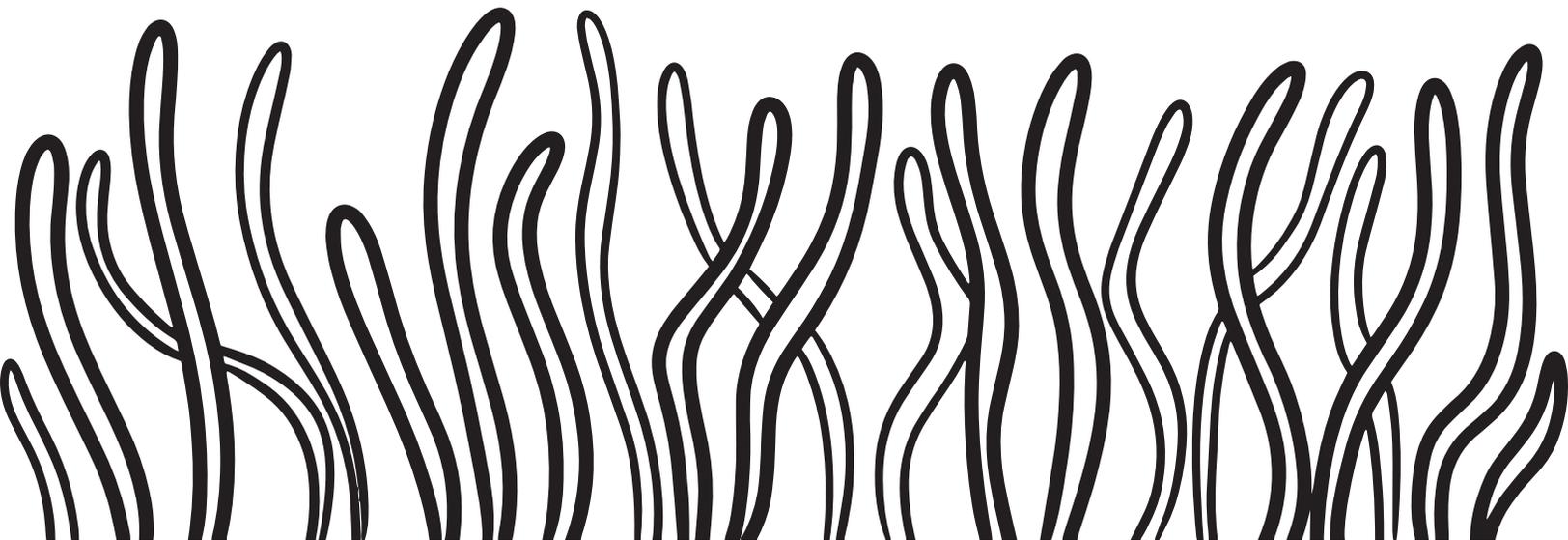
When **garbage, or "debris" as we often call it, is left in the ocean, it can make the area uninhabitable.** The debris can cover up the sandy seafloor where plants and animals grow, plastics break down into small bits that can make animals sick, ropes can entangle marine life (and people as well), and some debris is made of materials that can leech chemicals and other pollutants into the water, like tires and the chemical 6PPD.

# RESS Mooring Buoys

**Eelgrass beds, and other seafloor habitats, are sensitive.** Anchoring can cause damage by uprooting the eelgrass. Anchoring can also disturb the seafloor and stir up the sand, which makes the water muddy and can smother eelgrass and other species.



**Buoys with signs that tell people that there is an eelgrass bed below allow boaters to anchor away from the beds.** This protects eelgrass beds from damage caused by anchors and boat propellers. By encouraging safe boating habits and working together, we can help keep estuaries healthy and strong.



# RESS Eelgrass Planting

**Eelgrass planting brings back eelgrass to areas where they may have been removed or thinned out.** Before planting, the RESS team choose a suitable place based on water depth, seafloor type, water quality, amount of pollution, and existing eelgrass beds. Estuaries are ideal eelgrass bed habitats as they are sheltered nearshore habitats with sandy or muddy substrates.

Planting typically involves taking **rhizomes** (underground stems covered in roots and shoots) from other eelgrass beds to restoration sites.

After planting, it is important that we come back to check on and maintain the eelgrass bed to ensure success.

The rhizomes are carefully harvested from healthy donor eelgrass beds and planted by hand, mechanical seeding, or biodegradable planting grids.

