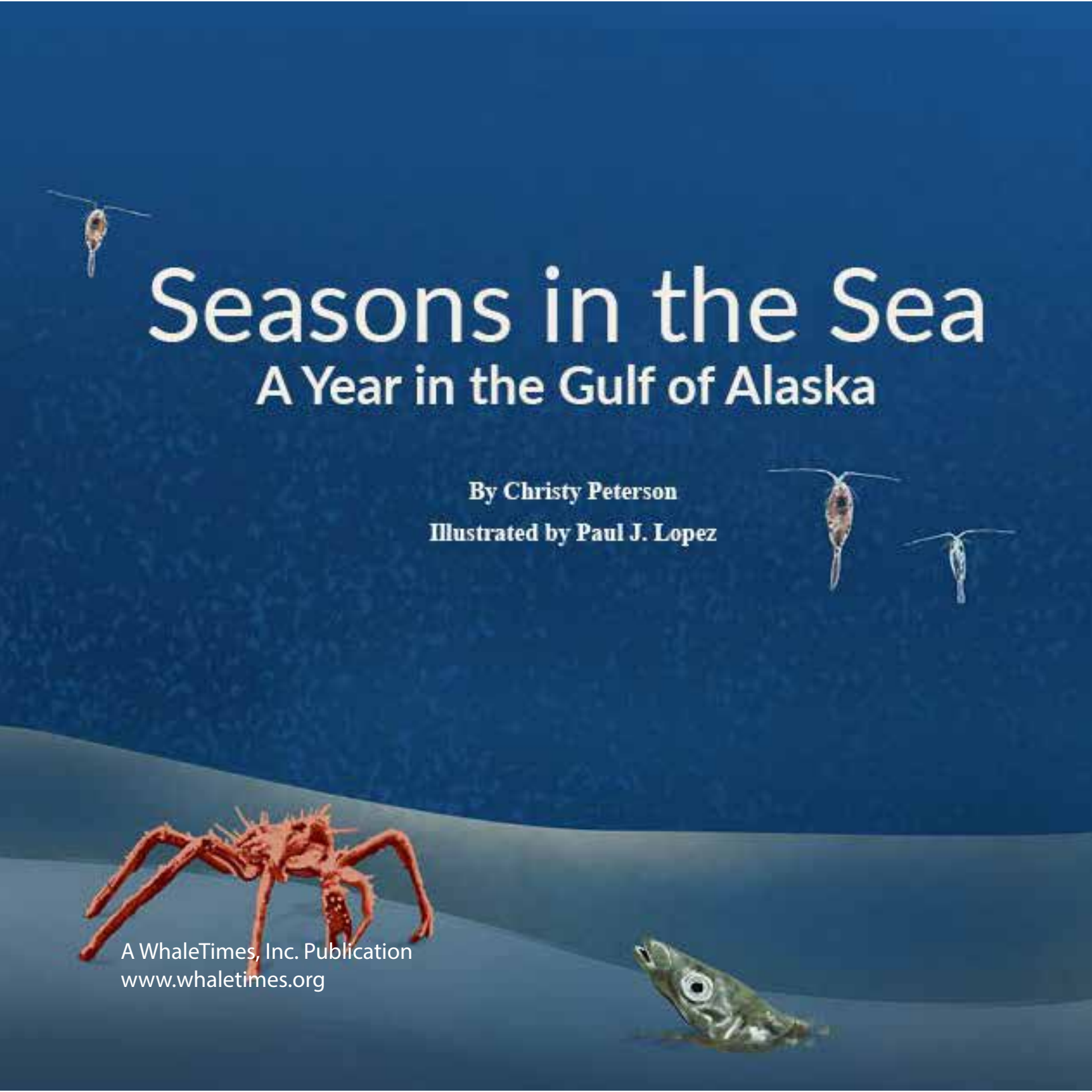


Seasons in the Sea

A Year in the Gulf of Alaska

By Christy Peterson

Illustrated by Paul J. Lopez

A WhaleTimes, Inc. Publication
www.whaletimes.org

Seasons in the Sea:

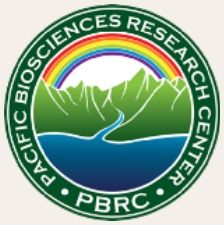
A Year in the Gulf of Alaska

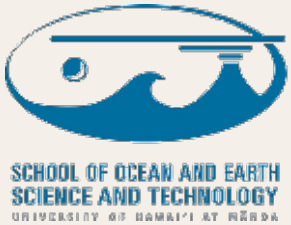
By Christy Peterson
Illustrated by Paul J. Lopez

We would like to acknowledge the ocean and land is the original homeland of the Alutiiq and Sugpiaq People and recognize the generations of Indigenous knowledge systems and lifeways that have and continue to shape their communities, land, and sea.

Projects funded by the National Science Foundation (NSF) (grants: OCE-1756767, OPP-2222376)

WhaleTimes contributors: Editor: Ruth A. Musgrave; Book design: Emma Peterson; Copy Editor: Katherine Martin





Seasons in the Sea: A Year in The Gulf of Alaska is a publication of WhaleTimes Press

ISBN: 979-8-9896218-0-4

PO Box 604
Hulett, WY 82720
whaletimes.org

Table of Contents

Winter in the Gulf of Alaska

It's winter in the Gulf of Alaska. The sun doesn't peek its head over the horizon until late morning and disappears again by late afternoon. It's cold and dark. Snow covers the mountains. Ice makes the shoreline sparkle.

Many of Alaska's animals are curled up in their winter burrows and dens. Ducks, harbor seals, and a few other animals are still active. Fur, feathers, or thick layers of fat protect them from the cold. The winter sun is low on the horizon and barely penetrates the water of the Gulf. But deep in the frigid, dark water, something is waking up.

HARBOR SEAL

COPEPOD
Copepods are tiny, shrimp-like animals. There are many types of copepods on Earth. These adult females are Neocalanus flemingeri, copepods that live in the subarctic Pacific Ocean. They are about the size of a grain of rice.

New Life Awakes

Deep under the ocean surface, thousands of copepods have been sleeping for months. Now they are waking up. The females are laying their eggs. Most females lay around 500 eggs—some as many as 1,000!

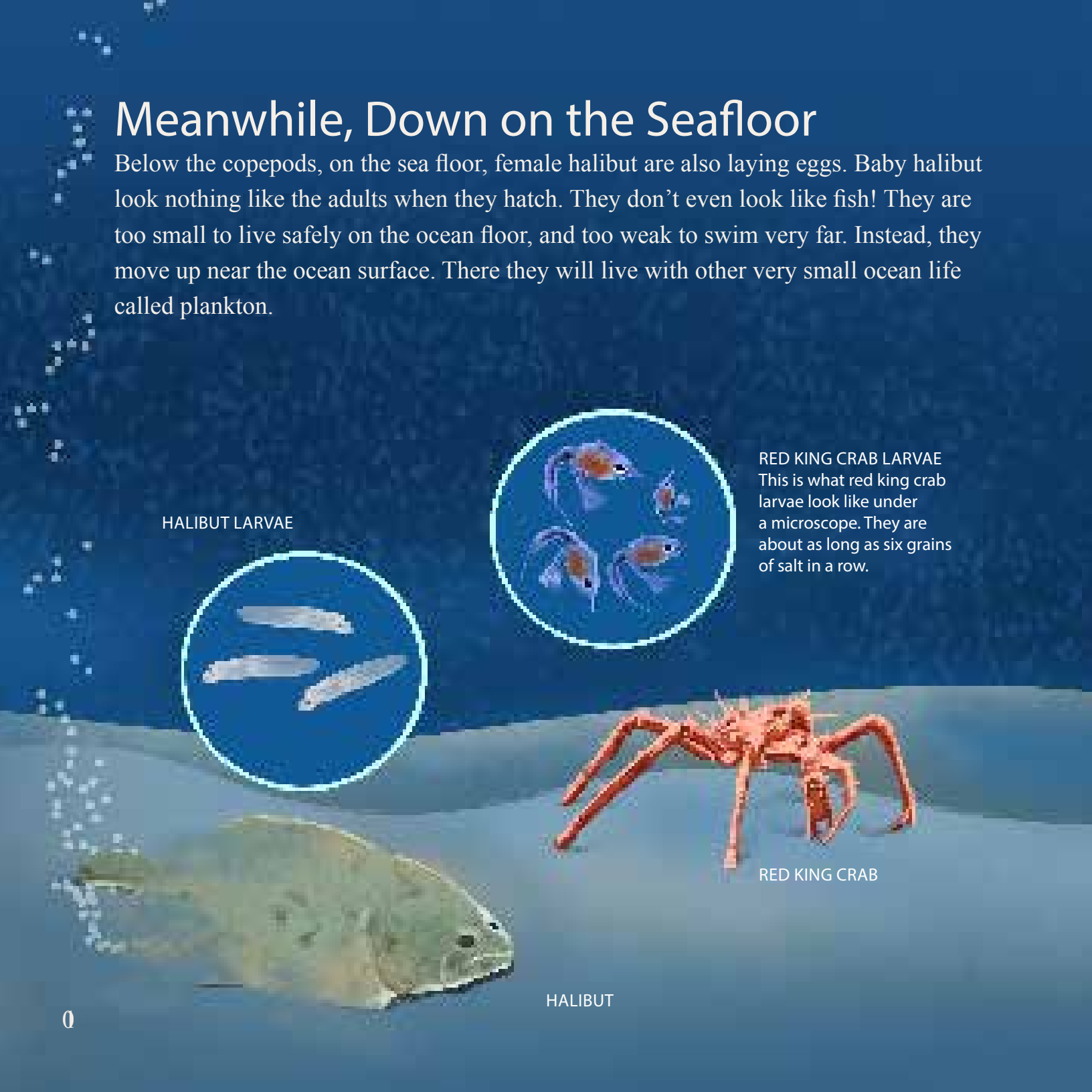
The copepod eggs hatch in about two days. The babies don't look like adult copepods. They will grow, change shape, and shed their skin several times before they grow up. First though, they have to find food. But it's the middle of an Alaskan winter. There's not much for them to eat. How will they survive?

Hold onto that question! There are other creatures stirring in the cold and dark. Let's meet them first.

NAUPLIUS
A newly-hatched copepod is called a nauplius. They are much smaller than the adults.

Meanwhile, Down on the Seafloor

Below the copepods, on the sea floor, female halibut are also laying eggs. Baby halibut look nothing like the adults when they hatch. They don't even look like fish! They are too small to live safely on the ocean floor, and too weak to swim very far. Instead, they move up near the ocean surface. There they will live with other very small ocean life called plankton.



Red king crabs scuttle along the seafloor. The females have kept their eggs inside their bodies since mating months ago. After the babies hatch, the female releases them into the water. Just like the baby halibut, baby crabs look nothing like adults. They are called larvae. They also join the growing plankton community.

The fish poking its head out of the sand is a sand lance. It laid its eggs near the shore last fall. When those eggs hatch, the babies will join the copepod nauplii and the crab and halibut larvae near the ocean surface. And just like all the other babies, they'll be hungry.

What are they going to eat? Just wait!

Something big is about to happen.

SEA OTTER

Spring Comes to the Gulf

That big thing happens right around the time spring begins. The changing season brings warmer temperatures, Snow and ice start to melt. Plant shoots peek out of the ground and leaves begin to unfurl on the trees. Soon, birds will begin nesting.

Winter storms, which churned the water and brought nutrients to the surface, have mostly passed. Each day, the sun stays up a little longer. The days and nights are about the same length now. Longer days mean more light. More light and all those extra nutrients causes the big thing to begin!

Diatoms, plankton that look like fancy pieces of glass, soak up the extra sun. They use the sun's energy and those nutrients from the water to make food for themselves, just like plants on land.

This food allows the diatoms to grow and divide, grow and divide, grow and divide, grow and divide until there are so many of them, they are called a bloom.

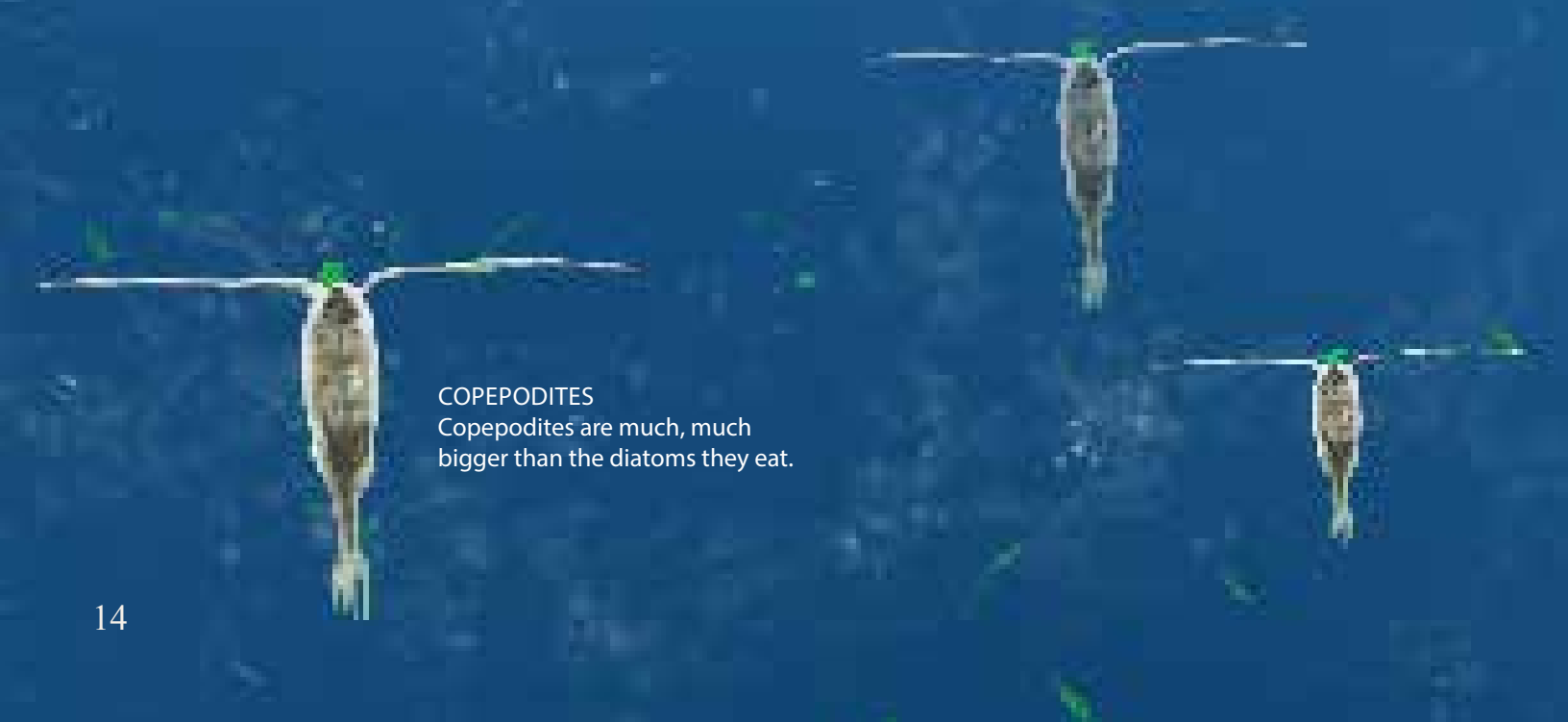
Diatoms are so tiny, they can only be seen under a microscope.

Welcome to the Feast

The bloom is the food the young copepods have been waiting for. They've grown since the winter. They are called copopodites now. The copopodites gobble up dozens of diatoms every day. But they are not alone. Millions of tiny creatures come together to feed on the bloom.

Those tiny creatures are food for millions more very small animals. The halibut larvae are here. So are the young red king crabs and sand lances. Young copepods are a favorite snack of all three. In fact, copepods of all ages are important food for many ocean creatures.

But not all the copepodites will be eaten. They are speedy and can escape from predators. Many survive and and move on to their next stage of life.



COPEPODITES
Copepodites are much, much bigger than the diatoms they eat.

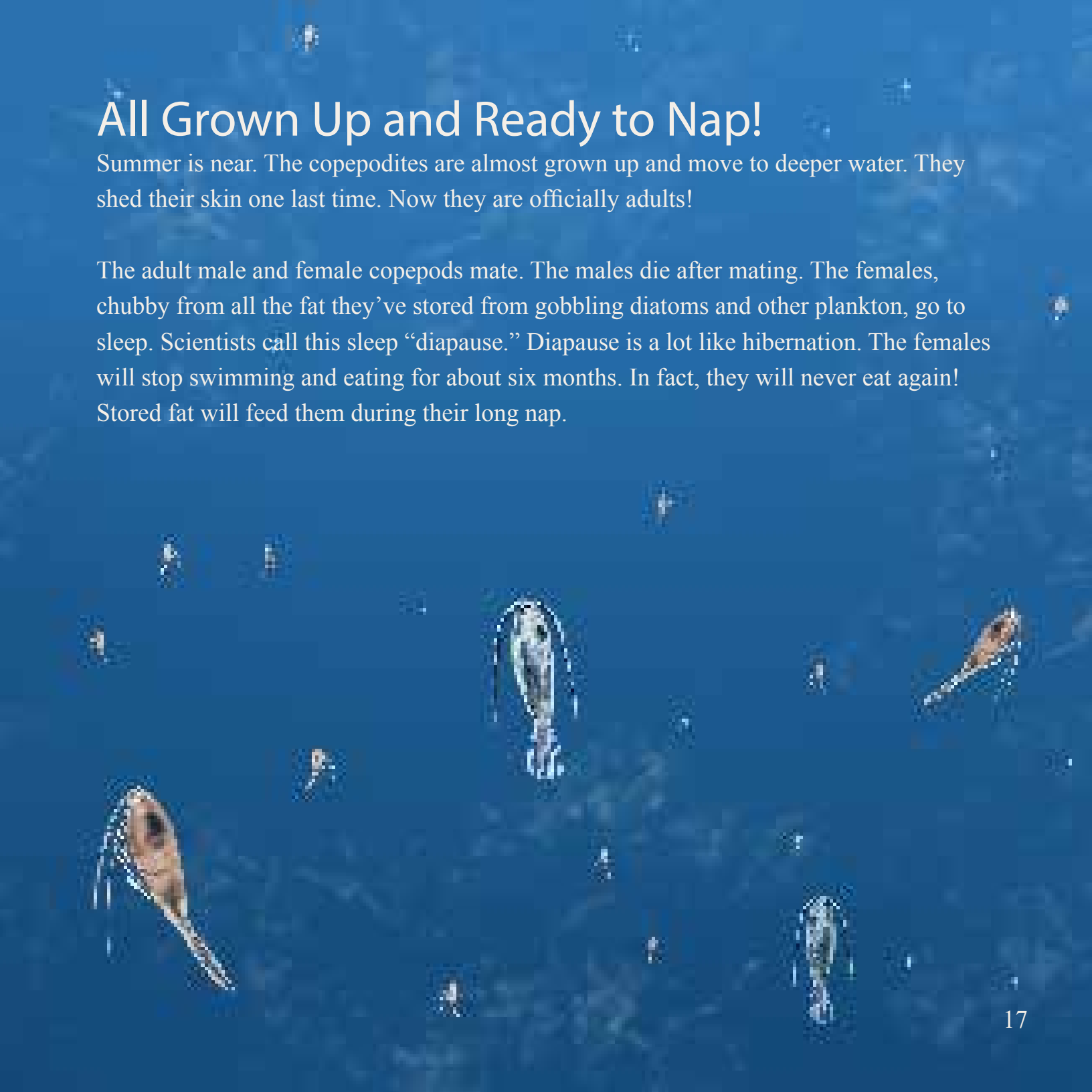
Young halibut, red king crabs, and sand lances are about 10-30 times bigger than the copepodites.

COPEPODS
Because it is so dark in deep water, it is hard for predators to see the sleeping females. This helps keep them safe while they rest.

All Grown Up and Ready to Nap!

Summer is near. The copepodites are almost grown up and move to deeper water. They shed their skin one last time. Now they are officially adults!

The adult male and female copepods mate. The males die after mating. The females, chubby from all the fat they've stored from gobbling diatoms and other plankton, go to sleep. Scientists call this sleep "diapause." Diapause is a lot like hibernation. The females will stop swimming and eating for about six months. In fact, they will never eat again! Stored fat will feed them during their long nap.



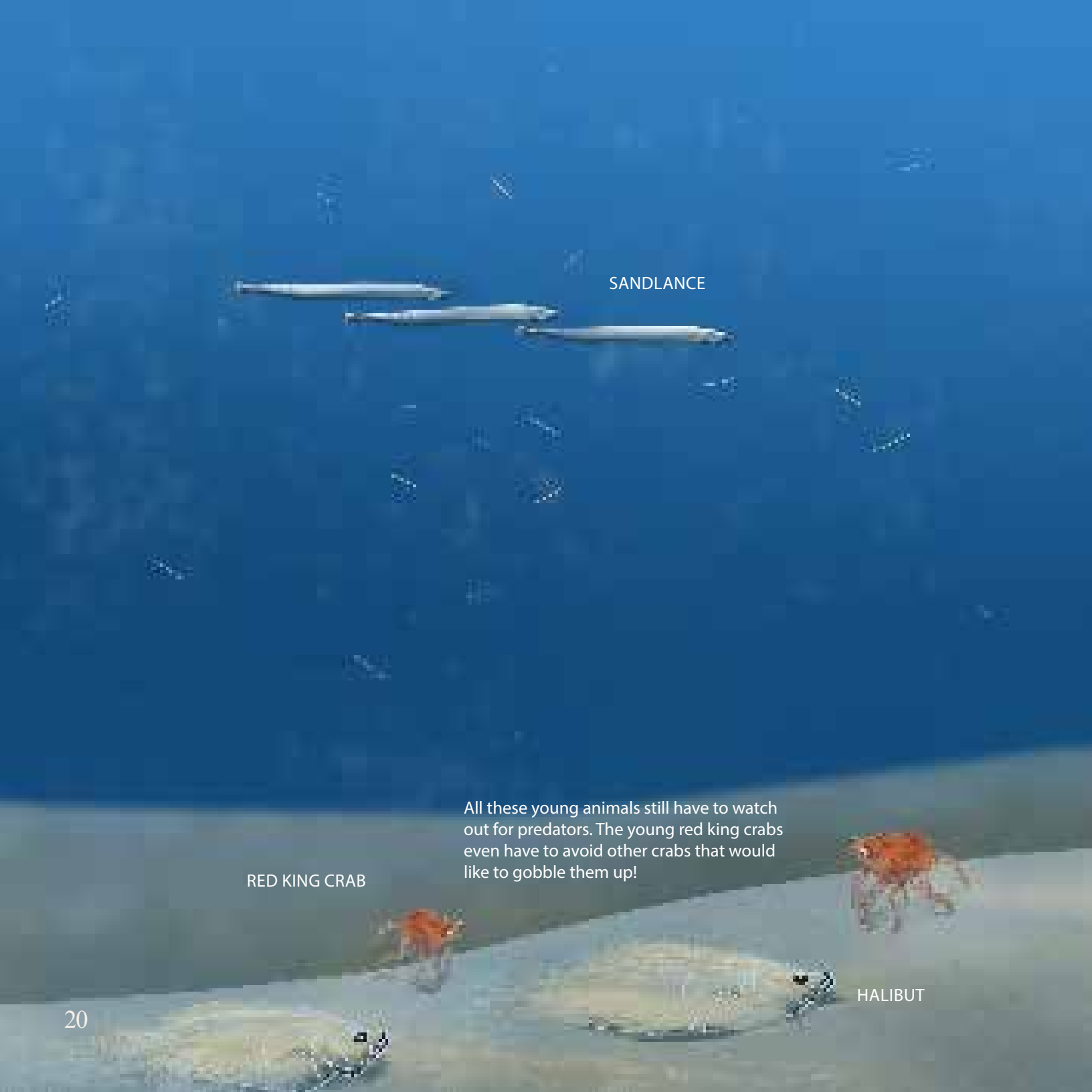
Long Summer Days in the Gulf

Summer in the Gulf of Alaska is the opposite of winter. The sun goes down late at night and then pops up again very early in the morning. Life is everywhere. Humpback whales have returned. Sea birds dive into the water, on the hunt for sand lances and other ocean life. Fishing boats bob on the waves, as anglers reel in their nets and lines

By now, the feeding frenzy in the ocean has gone on for weeks. The diatom blooms have faded. Different kinds of plankton use the sun's energy and the remaining nutrients to make food. This creates smaller blooms that feed the plankton community over the summer. Krill, the humpback whale's favorite food, are abundant. Smaller species of copepods eat and grow. Jellyfish ride the summer currents.

Where are the young animals in our story? They are grown up and ready to move out of the plankton community!

SANDLANCE
Sand lance are important food for many sea birds, including puffins.



All these young animals still have to watch out for predators. The young red king crabs even have to avoid other crabs that would like to gobble them up!

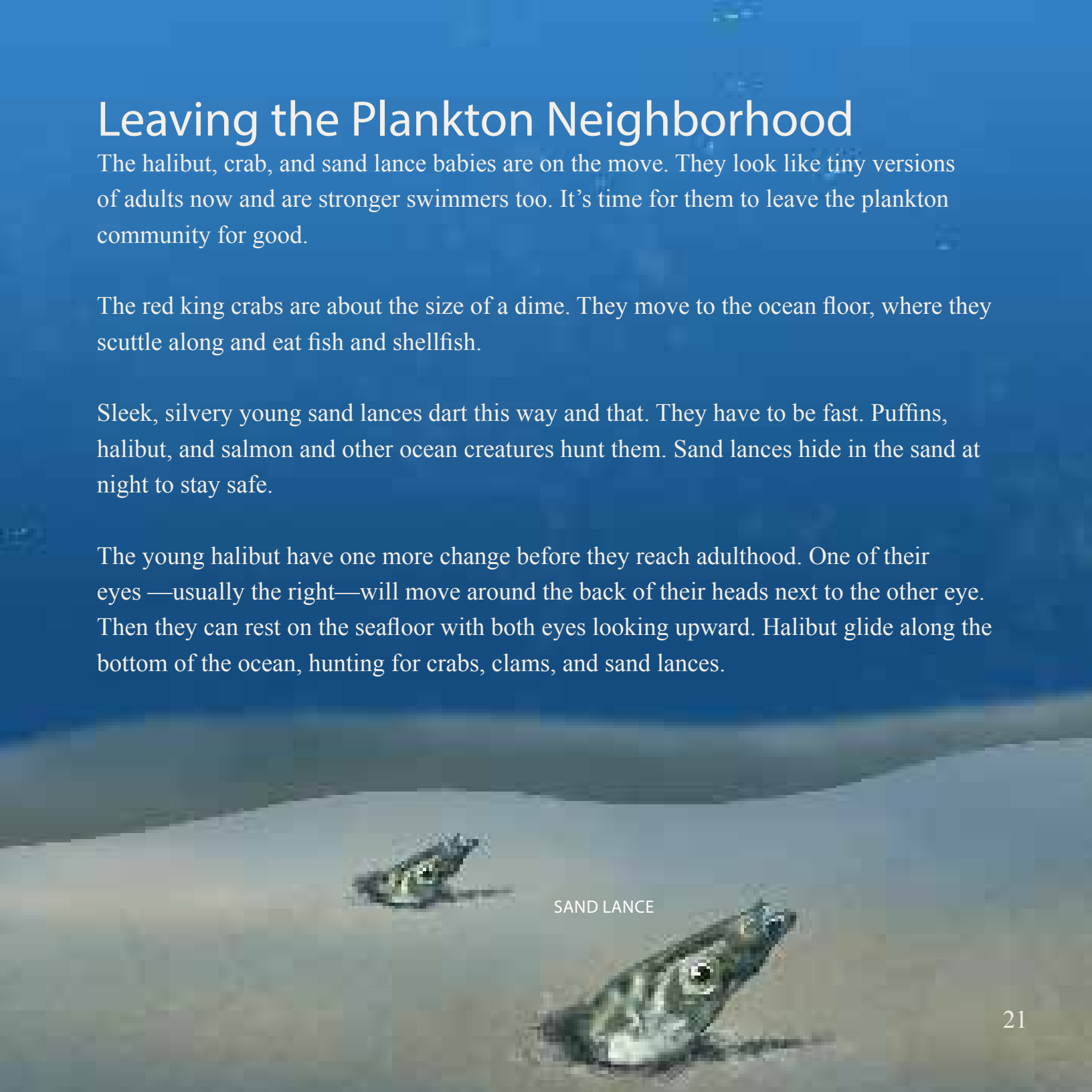
Leaving the Plankton Neighborhood

The halibut, crab, and sand lance babies are on the move. They look like tiny versions of adults now and are stronger swimmers too. It's time for them to leave the plankton community for good.

The red king crabs are about the size of a dime. They move to the ocean floor, where they scuttle along and eat fish and shellfish.

Sleek, silvery young sand lances dart this way and that. They have to be fast. Puffins, halibut, and salmon and other ocean creatures hunt them. Sand lances hide in the sand at night to stay safe.

The young halibut have one more change before they reach adulthood. One of their eyes —usually the right—will move around the back of their heads next to the other eye. Then they can rest on the seafloor with both eyes looking upward. Halibut glide along the bottom of the ocean, hunting for crabs, clams, and sand lances.



Autumn in the Gulf

Mid-September—the first day of autumn. Humpback whales head south to warmer waters. Birds gather, ready to fly away from the coming cold, snow, and dark. Flowers fade and tree leaves begin to turn. The water cools and the days get shorter.

Sand lances are preparing for winter too. The adults gather in huge groups along the shore. There the females lay their eggs in the sand. The males fertilize the eggs. Then the adults burrow in the sand to sleep away the winter.

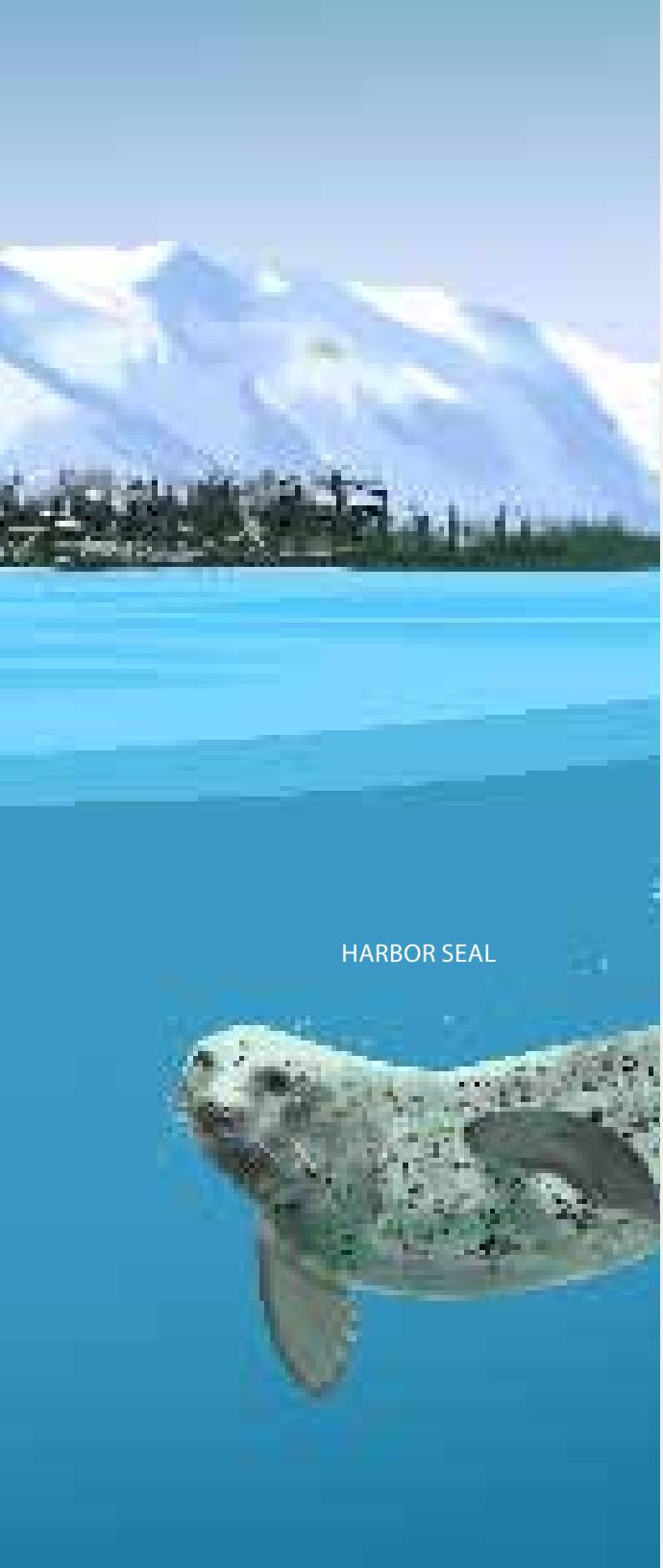
Halibut and red king crabs continue to roam the ocean floor, looking for food. Copepod females have been sleeping since the beginning of summer. The plankton community has shrunk. Everyone is ready to wait out the coming cold and storms.


KILLER WHALE
PACIFIC SALMON
SAND LANCE

The Cycle Begins Again

Darkness has returned to the Gulf. The sun barely rises before it sets again. Storms lash the coastline. Huge waves churn the water, stirring up nutrients. Snow falls and ice forms. The world seems to get quieter.

But deep under water, something is about to happen…



Science in the Gulf of Alaska

At the center of this story is one species of copepod, *Neocalanus flemingeri.* There are huge numbers of these animals in the Gulf of Alaska. They are a major food source for sand lances. Sand lances are food for many other Alaskan fish, birds, and mammals.

Neocalanus flemingeri are also food for halibut and red king crab. Since these species are vital to the fishing communities in Alaska, this means that *Neocalanus flemingeri* are vital to these communities too.

But there is still a lot we don't know about these animals. Scientists are investigating how the seasonal cycles and climate change affect *Neocalanus flemingeri*, their food, and their predators. This helps them learn more about these copepods and the conditions they need to survive and thrive all year.

Glossary

Copepodite

A young copepod that looks much like an adult, but still needs to grow and shed its skin several times before becoming an adult.

Juveniles

Young animals. In this book, it refers to young that are no longer larvae, but are not yet adults.

Larva (plural: larvae)

The immature form of an animal that is often very unlike the adult.

Nauplius (plural: nauplii)

A young copepod in its first stages of life.

Nutrients

Substances that living things need for their bodies to live, grow, and have energy.

Phytoplankton

Aquatic life that swims weakly and moves with currents and that makes its own food like plants on land.

Plankton

Aquatic life that swims weakly and moves with currents.

Zooplankton

Aquatic life that swims weakly and moves with currents and that eats other plankton.

Acknowledgements

The University of Hawai‘i team includes Lauren Block, Angelene Dedloff, Vittoria Roncalli, Daniel Hartline, and Petra Lenz. They collaborated with researchers from the University of Alaska, Fairbanks, and were assisted by the Seward Marine Center team, especially Brian Mullaly, Captain of the R/V Nanuq. Special thanks to Lauren Block and Angelene Dedloff, who provided scientific background on the organisms, seasonal cycle, and food web of the Gulf of Alaska; Tehya Chance for assistance with the copepod and larvae illustration accuracy; and Jennifer Elhard and Capt. Brian Mullaly, who hosted Christy Peterson during her visit to the Seward Marine Center.

Halibut and red king crab are vital to fishing communities in the Gulf of Alaska. But what nurtures and sustains these sea animals upon which so many depend? Author Christy Peterson and artist Paul J. Lopez worked closely with a team of scientists studying the lives of tiny sea animals that provide food for much of the Gulf of Alaska's food web. Beginning in winter, The Seasons in the Sea follows a species of copepod, *Neocalanus flemingeri,* through its life cycle. Lively text and beautiful illustration illuminate these relationships for young readers.

Christy Peterson has written more than 50 books and articles for students. Her book, *Into the Deep: Science, Technology, and the Quest to Protect the Ocean* (Twenty First Century Books) was a Washington State Book Awards finalist. Christy and her family live in Vancouver, WA.

Paul J. Lopez followed his childhood love of nature and marine life into a career as an artist and illustrator. He has worked on projects ranging from posters and picture books to resources for teachers and wildlife paintings. He lives in San Diego, CA, with his wife and two daughters.

A WhaleTimes, Inc. Publication
www.whaletimes.org

ISBN 979-8-9896218-0-4
90000>
9 798989 621804