

Walleye Pollock Life-Cycle Game

GOAL
Help Walleye Pollock survive to Adulthood.

GAME PLAY

TO BEGIN: Place game piece on start. Roll to see who goes first. Highest number goes first. Lowest number becomes the pollock BANKER. Each player receives 5 POLLOCK EGG CARDS from the bank.

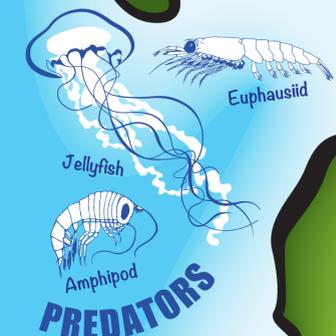
PREDATOR: There are two options: 1. Discard one card to escape, or 2. Go back to start to indicate you've been eaten; if you choose this option you must trade in all your cards for egg cards, but you will receive one extra.

LEVEL UP: Exchange cards for next life-stage when you are old enough. Repeat the process for each new level.

SHORT CUT: If you land here, you have the option of taking the shorter route, but you need to make your decision before your next turn.

OCEAN EDDY: If you land here, hang out in the Eddy until you roll the correct number. Then start from the Ocean Eddy space on the game board.

END OF GAME: Add up all the discards by life stage, discuss different game strategies to incorporate things like cannibalism, impacts to fishery, or decrease mortality. Modify the game and play again.



PREDATORS

Alaska Peninsula

Alaska

Cook Inlet

Prince William Sound

Kenai Peninsula

Start

End

The player who reaches the end with the most adults wins.

Kodiak Island

Gulf of Alaska

OCEAN CONDITIONS

- 1 Jellyfish Bloom**
Yolk-sac larva and larvae lose a turn
- 2 Currents Shift**
Eggs, yolk-sac larvae and larvae are lost at sea and lose a turn trying to get back
- 3 Cooler Sea Surface Temperature**
Pollock are happy
Go to next Level Up
- 4 Warmer Sea Surface Temperature**
Pollock eggs lose a turn
- 5 Late Spring Algae Bloom**
Juvenile pollock starve
Go back to Juvenile Level Up
- 6 Optimal Conditions for Survival**
Go to next Free space



Ocean Eddy
Roll 1, 3, or 6 to return to board

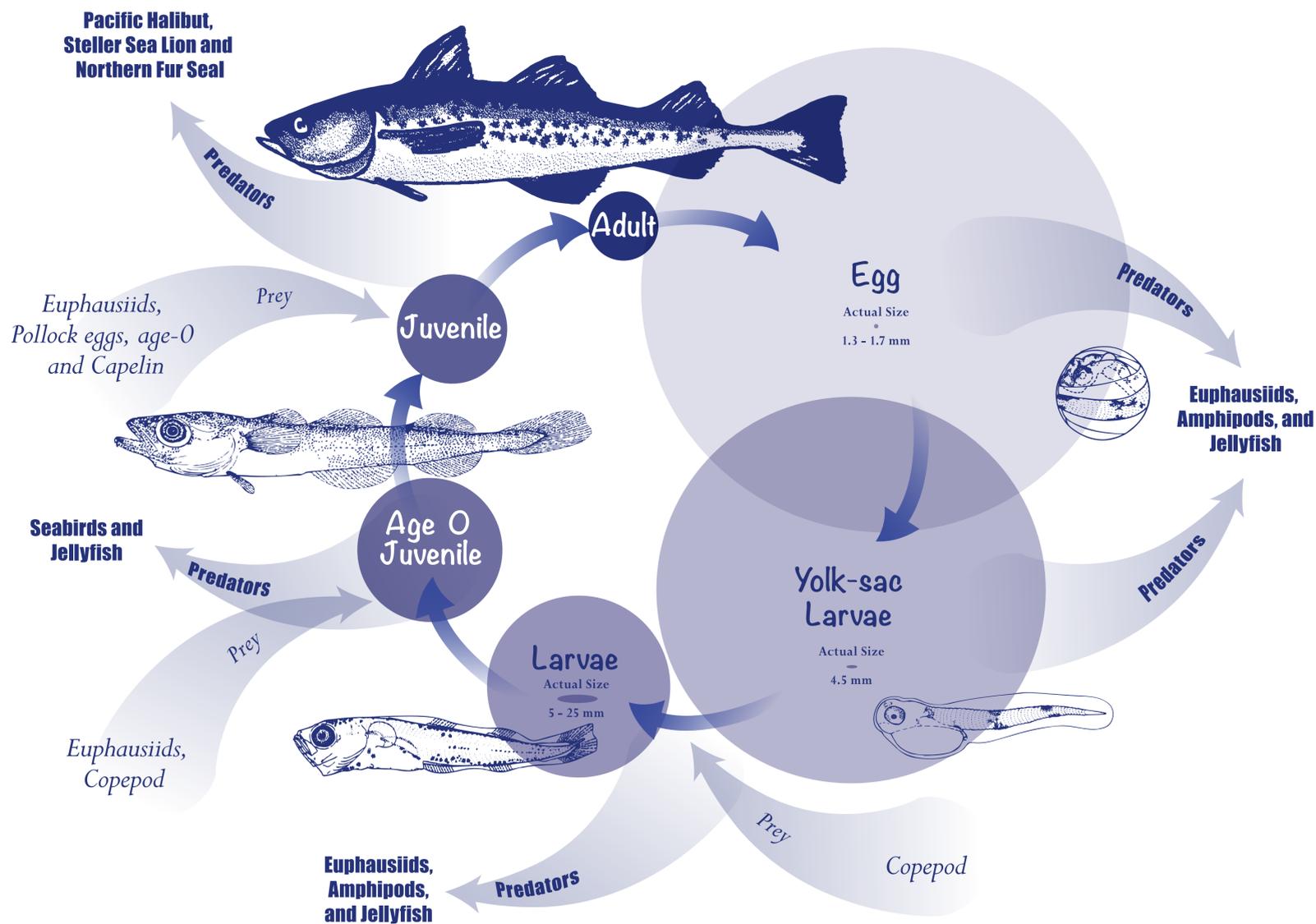
* Beware! This is a dangerous path!



DISCARD
Add up all the discards at the end of the game. Compare the number of casualties to survivors.



Walleye Pollock Life Cycle



Survival in a Dangerous Environment

Take a spin around the walleye pollock life cycle:

Imagine that you are a walleye pollock egg adrift in the cold waters of Alaska. You are only slightly larger than a pinhead or the period at the end of this sentence. In order to survive you must overcome big challenges. You are not only fragile, but vulnerable to changing ocean currents and temperature. Ocean temperatures may limit or increase growth. Strong ocean currents can sweep you far out to sea where food is scarce and you may starve. You don't have to worry about food until you hatch because your yolk sac has been supplying you with nutrients. A few days after hatching your yolk sac is empty and you now must search for food. Even as you search, you are vulnerable to many predators such as jellyfish, euphausiids (krill), and not to mention small fish. As you get older new predators like arrowtooth flounder find you appetizing. If you should find good ocean conditions, find lots to eat, and manage to escape being eaten, then there's a good chance you will grow up to be an adult to contribute by spawning the next generation of fish. If too many young pollock don't survive to adulthood, then there is a possibility the population of pollock will decrease in the future. This would mean lower quotas for fishermen to ensure pollock populations are kept at a sustainable level.

Essential Question: How can the ecosystem influence pollock population?

Objectives: Players will be able to explain pollock life cycle and how ecosystem factors relate to their survival and recruitment to the fishery.

Get to Know Walleye Pollock

Walleye pollock make up the largest by volume fishery in the U.S. The fishery as well as the center of their abundance is located in the Bering Sea, a smaller fishery happens in the Gulf of Alaska. They are in the gadid family with other cod and cod-like species and live in large schools about 300 to 1000 feet below the surface of the ocean. They are an important part of the Bering Sea ecosystem as predators and for providing a source of food as prey for many species of animals.

Throughout their life history pollock populations are also influenced by many environmental factors. These include oceanographic factors such as currents, temperature and nutrients. Environmental factors strongly influence pollock survival at their larva stage. The success of pollock at the larval stage is dependent on the spring plankton bloom where microscopic plants called phytoplankton begin growing in the ocean. When the bloom begins depends on factors such as the amount of sunlight, nutrients and temperature of the water. The spring phytoplankton bloom is important because it supports reproduction of copepods that are a source of food for walleye pollock. Copepods are small animals, the size of a grain of rice, belonging to a group of animals called zooplankton. Many zooplankton feed on phytoplankton. The youngest stage of copepods are called copepod nauplii, and they are the food source of the larval pollock. If the spring plankton bloom does not occur near or during the time when the larvae are ready to eat, then their survival will decrease.

Recruitment for commercially fished species occurs when they grow to the size captured or retained by the nets or gear used in the fishery. For each species or ecosystem component NOAA Scientists study, they attempt to learn what biotic and abiotic factors cause or contribute to the observed population fluctuations. These population fluctuations occur on many different time scales (for example, between years, between decades).

Egg

Beginning in late winter, trillions of tiny walleye pollock eggs are spawned near the bottom in specific areas in Alaska waters. In the Gulf of Alaska, pollock spawn in Shelikof Strait and in the Bering Sea they spawn around the Pribilof Islands and along the Alaska Peninsula. These eggs will drift for two weeks impacted by currents and predators.

Yolk-sac Larva

When larvae (plural of larva) first hatch they rely on food stored in a membranous pouch under their bodies called a yolk sac. While their eyes, stomachs and mouths develop the yolk sac is their only food source for about a week after hatching.

Larva

Once the yolk sac is consumed the larvae, still tiny at about 5 mm in length, catch their own food as they drift with the ocean currents. For about three months the larvae will continue to grow.

Age-0 to Juvenile

After their larval stage and before their first birthday, walleye pollock are called "Age-0 (zero)" and measure about 5 inches in length (about 13 cm). These juveniles are an important food source for sea birds, jellyfish and even adult pollock.

Juvenile

Walleye pollock are considered juveniles until they have developed enough to spawn (3-4 years). Juvenile fish in the Gulf of Alaska spend their time near shore in coastal bays and estuaries known as nursery areas and in the Bering Sea they have no place to hide.

Adult

Walleye pollock mature into adults at 3 to 4 years of age and are about 14 inches (35 cm) long. Adults can live up to 17 years, and can grow as large as 3 ft in length (1 m)



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