

Development of BSAI and GOA halibut ecosystem indicators

Allan Hicks and Lauri Sadorus
International Pacific Halibut Commission

11/11/2016

The NPFMC motion from the December 2015 meeting under section C-2 BSAI Harvest Specifications – Ecosystem Indicators requested that ecosystem indicators for BSAI and GOA halibut be developed for the Ecosystems Considerations chapter in the SAFE report.

The Council requests that the Plan Team members and AFSC develop ecosystem indicators for BSAI and GOA halibut in conjunction with IPHC for inclusion in the Ecosystem Considerations chapter in the SAFE report.

The Plan Team will discuss the initial development at the November 2016 meeting. Because nothing has been done, a subgroup of the Plan Team suggested that Lauri and Allan quickly put together a list of some potential indicators to discuss at the November Plan Team meeting. Further work will be done in 2017 for inclusion in the 2017 Ecosystem Considerations chapter.

The IPHC has been considering some changes to documents and reporting of results, specifically summaries of assessment results. One of the products being considered is similar to the Report Card of ecosystem indicators requested by the NPFMC. Additionally, research is ongoing to investigate various factors that could be measured to indicate health and condition of the population (e.g., fat content of individual fish).

It is possible that this IPHC summary could be used to populate a NPFMC report card for the Ecosystem Considerations chapter. Indicators may be related to

- population status and trends,
- average condition across individuals in the population (e.g., size-at-age),
- climate trends that are influential on the population (e.g., PDO),
- trends of young fish in the Bering Sea and Gulf of Alaska (incoming recruitment), and
- various sources of mortality on the population (e.g., fishing, natural, and depredation).

Some potential complications related to the desired NPFMC product are

1. The IPHC assessment is coastwide, and assessment-based indicators may be difficult to split into regions. The coastwide status, however, may be a useful indicator for each area.
2. The IPHC assessment is complete and presented at the IPCH Annual Meeting in January, which occurs after the NPFMC specifications process (December). It may be possible to create a report card for Pacific halibut in early December after the Interim Meeting, but there is a high possibility that the Pacific halibut indicators available for inclusion in the SAFE document will be lagged by one year.

During 2017 and ongoing, the IPHC is willing to work with Council staff and AFSC personnel to develop a set of useful indicators for inclusion in the SAFE document that will meet the request of the NPFMC.

Appendix A: A description of Pacific halibut life-history

From November to March, mature halibut complete a cross-shelf migration and concentrate on spawning grounds along the edge of the continental shelf at depths from 200-500 m or more. Major spawning sites have been identified in the Gulf of Alaska from British Columbia to south of Kodiak Island, and in the Bering Sea south and east of the Pribilof Islands along the shelf edge. Reproductive output varies with sex, age, and size of the fish.

The number of eggs produced by a female is related to its size. A 50-pound (30 kg round weight) female will produce about 500,000 eggs, whereas a female over 250 pounds (151 kg round weight) may produce four million eggs. Halibut are believed to be “batch spawners”, meaning that only a portion of a female’s eggs are hydrated at a time and released, and this process is repeated several times over the spawning season until all the eggs have been expelled. The free-floating eggs are about 0.12 inches (3 mm) in diameter when released and fertilization takes place externally. The eggs hatch after 15 to 20 days at 5-6°C, and more quickly in warmer water (12 to 14 days at 7-8°C). The eggs and larvae are heavier than the surface seawater and drift passively in deep ocean currents. As the larvae grow, their specific gravity decreases and they gradually move towards the surface and drift to shallower waters on the continental shelf. Laboratory studies have shown that halibut eggs require a careful balance of salinity and temperature in order to achieve positive buoyancy and thus successful drift to the surface. Postlarvae may be transported westward many hundreds, even thousands of miles by the Alaskan Stream and Alaska Coastal Current.

Larval nutrition is derived from a yolk sac until it is absorbed during the early postlarval stage; first feeding occurs approximately 55 days after hatch. At about six months of age (~2.5 cm) the fish has metamorphosed into the adult form and settles to the bottom in shallow nursery areas along the coast. The survival of young halibut beyond the larval stages and the varying strength of each year class to maturity, may be driven by food availability, proximity to predators, temperature or other environmental factors, or a combination of these. Recruitment of juvenile halibut to the adult stock has been highly variable over the historical record.

Distribution and migration

In summer, Pacific halibut are a demersal flatfish found on the continental shelf of the northern Pacific Ocean and the Bering Sea. They have been recorded on the North American coast from Santa Barbara, California to Nome, Alaska and also occur along the Asiatic coast from the Gulf of Anadyr, Russia to Hokkaido, Japan. Halibut can occupy variable depths and temperatures with water temperatures ranging from 1.4°C to about 12°C, but are found most readily mid-range in 3-8°C water and at depths < 275 m in the summer.

To counter the egg drift that occurs with counter-clockwise ocean currents, the young halibut migrate long distances in a clockwise direction. One- and two-year-old Pacific halibut are commonly found in inshore areas of the central and western Gulf of Alaska and Bristol Bay in the Bering Sea, but are virtually missing from southeast Alaska, British Columbia and westward of Bristol Bay. Juvenile halibut begin dispersing further offshore and to other areas at around 1-3 years of age and by age six, are widely dispersed throughout the halibut range.

By the time Pacific halibut become large enough to be caught by the commercial fishery, much of the extensive counter-migration to balance egg and larval drift has taken place. However, many adult halibut continue to migrate along the continental shelf in addition to the annual cross-shelf spawning migration.