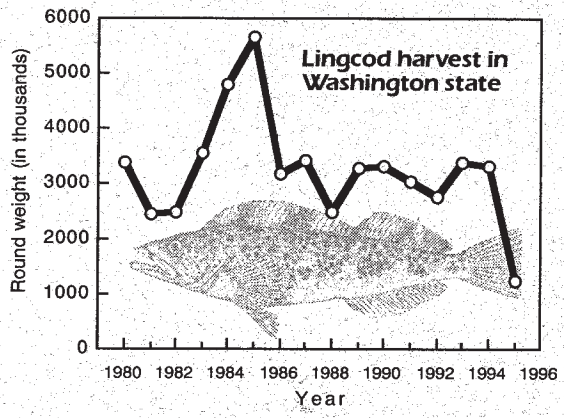
Northwest Fisheries Science Center

Fish Matters

Opening Day Edition

Lingcod populations on the decline in Puget Sound

"Lingcod is one of the best eating fish you can catch, even though they are ugly" says Commander Jim Herkelrath, a Project Officer at the Northwest Fisheries Science Center and former captain of the NOAA Research Vessel *David Star Jordan*. "Have you ever tried one?"



Jim recommends the blue plate special at a local restaurant for novice lingcod diners as he pulls a faded snapshot stuck in the corner of a framed NOAA poster hung on his office wall. The photo shows Jim, with a ruddy-cheeked grin, holding two lingcod as he stands in the stern of a fishing boat off the Oregon Coast.

Years ago Jim remembers fishing for lingcod near Anacortes, which at that time was a good fishing spot. But many recreational fishers gave up fishing for lingcod in Puget Sound years ago because they are just too hard to find. Lingcod harvests in Washington have decreased approximately 63% between 1980 and 1995 (see graph above).

The reasons for the declines in lingcod are not well understood but are likely to include a number of factors including over-harvesting and increased marine mammal predation. In addition, the lingcod lifecycle may lead to infrequent reproductive success due to poor survival of early life history stages.

Known for their gaping mouths, projecting lower jaw, and numerous sharp teeth, lingcod are territorial and cannibalistic. Their coloring is bold with mottled shades of grey, brown, and green. They are found along the West Coast from Alaska to

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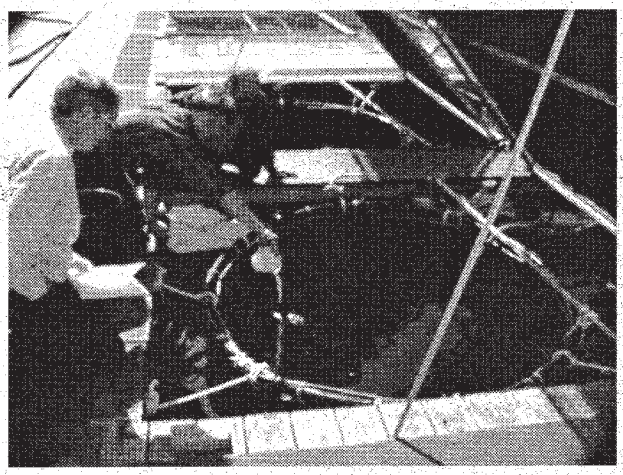
Marine Enhancement Research Team helps put the fish back into sportfishing in Puget Sound

A whole new generation of lingcod fishers may feel the thrill of hooking their first lingcod if collaborative research between the Northwest Fisheries Science Center and the Washington Department of Fish and Wildlife (WDFW) is successful in finding a way to increase populations of this popular but declining species.



Ken Massee (NWFSC) feeding artemia to lingcod larvae at Manchester Research Station. Observing are Larry LeClare (WDFW) in background and Ray Buckley (WDFW) in foreground.

The Center, which recently started a new and innovative Marine Enhancement Research Project, is one of few research institutions in the country where research on highly valued but declining recreational species such as lingcod, Pacific halibut, and rockfish will be conducted.

The goal of the project is to help ensure species abundance by developing techniques for spawning and raising these depleted or declining species in captivity. Once raised successfully in captivity, the juveniles would be released to enhance specific populations like lingcod in southern Puget Sound.

Lingcod, along with rockfish (copper, quillback, and black), Pacific cod, halibut, pollock, greenling, and cabezon were identified as the marine species with the greatest potential for enhancement at a recent scientific conference (Marine Fish Culture & Enhancement Conference, October 4-6, 1993). These species were identified for stock enhancement by ranking them according to commercial and recreational demand, availability of viable spawn, and ease of biological culture among other criteria.

In February of this year the National Marine Fisheries Service received a petition from a member of the public to list as threatened or endangered, under the Endangered Species Act, 18 species of marine fish in Puget Sound. The petition listed thirteen rockfish species, lingcod, Pacific herring, Pacific cod, walleye pollock, and Pacific hake. The Fisheries Service is in the process of reviewing the petition to determine if further action under the Endangered Species Act is required. These same 18 species have been nominated as candidates by the Washington Department of Fish and Wildlife for the Washington state list of endangered, threatened or sensitive species.

The Center's research is intended to improve and scale-up laboratory culture techniques for mass culture of lingcod and test releases of juveniles in southern Puget Sound. This research is conducted in cooperation with the WDFW. The WDFW supplies the divers to collect lingcod egg masses and conduct underwater surveys, tagging and genetic research, while the Center develops the culture technology. Both agencies will work together on studies aimed at developing stocking criteria. The research program includes the following steps:

1) Conduct research on captively spawned fish to improve spawning, egg incubation, larval rearing, and marking techniques
2) Survey nesting adults in areas to be stocked
3) Collect small portions of eggs from numerous nests located in the survey
4) Mass rear collected eggs to a size suitable for stocking
5) Develop *in situ* methods to acclimate juveniles prior to release
6) Evaluate contribution to fisheries of released juveniles through mark and recapture studies
7) Determine habitat requirements for early life stages of wild fish

Opening Day Supplement

National Marine Fisheries Service promotes ethical fishing by anglers

On March 29, 1999, the Commerce Department's National Marine Fisheries Service announced the adoption of a new code that promotes ethical fishing behavior by anglers. The code is part of the Fisheries Service's ongoing efforts to implement the public education requirements of President Clinton's 1995 Executive Order regarding the management of recreational fisheries.

Known as the Code of Angling Ethics, it was developed with the help of angling groups, including the American Sportfishing Association, the Coastal Conservation Association, the Recreational Fishing Alliance and Trout Unlimited.

"The code gives us an official avenue to foster sound resource management attitudes and actions with our angling constituents," said Rolland Schmitten, the former Director of the National Marine Fisheries Service (Penny Dalton is the new Director). "It is a strong step by the agency to meet its commitment to work with our recreational fisheries constituents as partners in ensuring a healthy marine environment."

"While the code may seem self evident to some, it was developed with a broad base of angler support, and the final result outlines simple actions that, if practiced by all, will benefit the quality of the angling experience today and for future generations," said Dick Schaefer, Chief of the Intergovernmental and Recreational Fisheries Office for the Fisheries Service.

The Fisheries Service will provide the code to anglers, fishing clubs, bait and tackle shops, and fishing boat operators through a variety of cards, stickers, and posters that promote its use. The code is posted on agency's recreational fisheries web site at http://www.nmfs.gov/irf.html.

Code of Angling Ethics

- **Promotes, through education and practice, ethical behavior in the use of aquatic resources**
- **Values and respects the aquatic environment and all living things in it**
- **Avoids spilling, and never dumps, any pollutants, such as gasoline and oil, into the aquatic environment**
- **Disposes of all trash, including wornout lines, leaders, and hooks, in appropriate containers, and helps to keep fishing sites litter-free**
- **Takes all precautionary measures necessary to prevent the spread of exotic plants and animals, including live baitfish, into non-native habitats**
- **Learns and obeys angling and boating regulations, and treats other anglers, boaters, and property owners with courtesy and respect**
- **Respects property rights, and never trespasses on private lands or waters**
- **Keeps no more fish than needed for consumption and never wastefully discards fish that are retained**
- **Practices conservation by carefully handling and releasing alive all fish that are unwanted or prohibited by regulation, as well as other animals that may become hooked or entangled accidentally**
- **Uses tackle and techniques which minimize harm to fish when engaging in "catch and release" angling**

Federal fisheries agency adds nine West Coast salmon to endangered list

Action marks first time protection has extended to heavily populated areas

In mid-March the Commerce Department's National Marine Fisheries Service added nine populations of salmon and steelhead in Washington and Oregon, including metropolitan Portland and Seattle, to the endangered species list–marking the first time federal protection has been extended to salmon found in streams in heavily populated areas of the Pacific Northwest.

The Clinton Administration expects the move to encourage successful state and local salmon conservation efforts in the Pacific Northwest.

People–not nature–have created the conditions that have affected the health of these fish. The endangered species listings are the result of such factors as land-use and water-development projects that degrade watershed and stream conditions critical to salmon survival, habitat loss, over-harvesting, dam construction and operation, and certain hatchery practices.

"Our goal here is to restore salmon," said Department of Commerce Secretary William M. Daley. "But we know that we cannot accomplish that alone. As we have all said repeatedly, extinction is not an option! We want to work together with state and local officials to preserve, for future generations, healthy salmon stocks along with clean and productive rivers and streams."

"One of our greatest challenges is to restore the great salmon runs of the Pacific Northwest to sustainable levels," said Terry Garcia, Assistant Secretary of Commerce for Oceans and Atmosphere. "Healthy salmon resources are essential to the economic health and prosperity of the region."

The salmon populations listed, known as ESUs or evolutionary significant units, range from the sockeye salmon in Washington's rugged Olympic Peninsula to chinook salmon, the largest of any salmon, found in the heavily urbanized area of Puget Sound. Those listed mid-March are:

Four chinook ESUs
- Puget Sound chinook (threatened)
- Lower Columbia River chinook (threatened)
- Upper Columbia River spring-run chinook (endangered)
- Upper Willamette River chinook (threatened)

Two chum ESUs
- Hood Canal summer run chum (threatened)
- Columbia River chum (threatened)

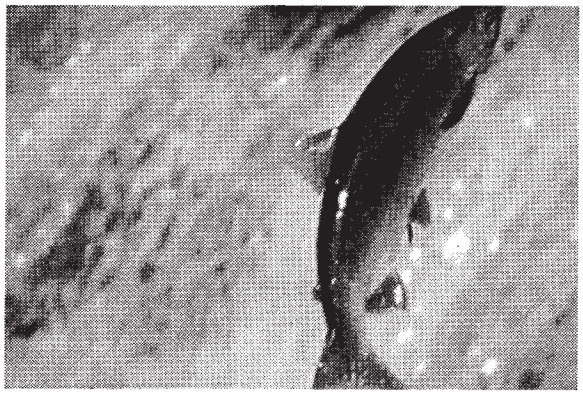
Two steelhead ESUs
- Upper Willamette River steelhead (threatened)
- Middle Columbia River steelhead (threatened)

One sockeye ESU
- Ozette Lake sockeye (threatened)

At this time, no immediate regulations will apply to state and private activities in the areas where species are listed as threatened. However, because it is listed as an endangered species, any accidental or incidental "take" of Upper Columbia River spring chinook would require a permit. In the future, Fisheries Service staff will work closely with its partners to develop "tailor-made" regulations that would include state and local conservation initiatives. The Fisheries Service said that the listing decisions would go into effect in two months.

Garcia added that "Governors John Kitzhaber and Gary Locke and many political leaders in the region have committed to me their support and willingness to do what it takes to save these fish. We are serious about achieving that goal and are committed to working cooperatively with the states,

counties, Indian tribal governments, and the public to produce comprehensive conservation plans that build on those partnerships to restore salmon habitat and recover these fish. We must work together to meet the challenge and find the right path to recovery into the 21st century."



The agency is deferring, for six months, its decision on four remaining chinook salmon (ESUs): Snake River fall-run, southern Oregon and California coastal, California Central Valley fall-run, and California Central Valley spring-run chinook. The Fisheries Service will use the six-month extension to resolve areas of scientific disagreement about the ESUs. A final determination will be made in September. Garcia said President Clinton's FY2000 budget proposal asks Congress for $100 million for West Coast and Alaska salmon protection to help local and tribal efforts–some of which are already underway–in the three western states.

Under the Endangered Species Act, a species likely to become extinct is categorized as endangered. A species likely to become endangered within the foreseeable future is categorized as threatened.

Additional specific information related to this decision, including maps and fact sheets, is available on the Fisheries Service's Northwest region web site at www.nwr.noaa.gov.

The Northwest Fisheries Science Center's involvement in recreational fisheries

The Northwest Fisheries Science Center, in Seattle, operates under the following broad mandates:

National Recreational Fisheries Coordination Council (NRFCC)
The goal of the NRFCC, created under President Clinton's 1995 Executive Order 12962, is for federal agencies including the Department of Commerce to "improve the quantity, function, sustainable productivity, and distribution of U.S. aquatic resources for increased recreational fishing opportunities."

Department of Commerce (DOC)
DOC's responsibilities include expanding U.S. exports, developing innovative technologies, gathering and disseminating statistical data, measuring economic growth, granting patents, promoting minority entrepreneurship, predicting the weather, and monitoring stewardship.

National Oceanic and Atmospheric Administration (NOAA)
NOAA's mission is to describe and predict changes in the Earth's environment and to conserve and manage wisely the nation's coastal marine resources.

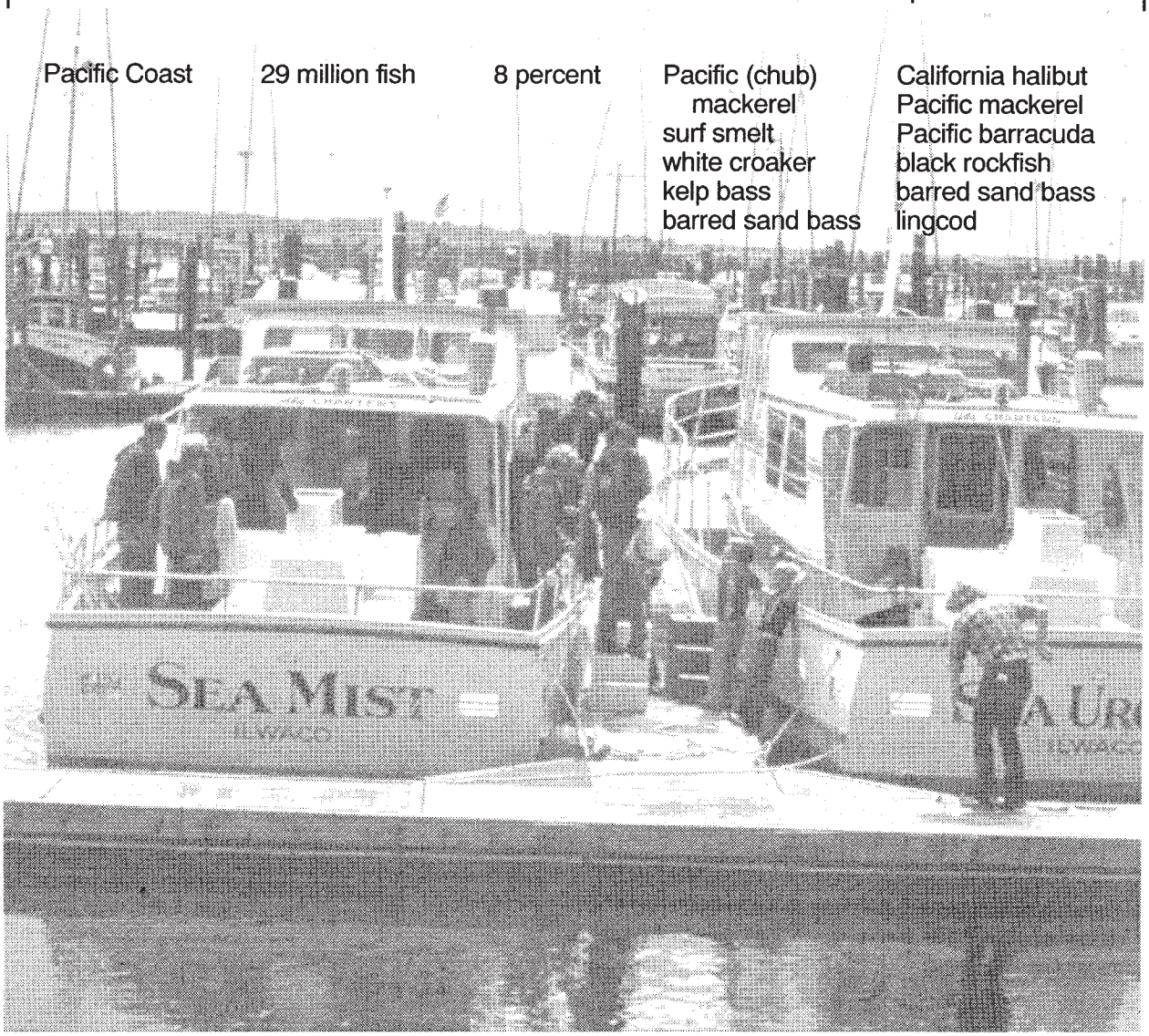
National Marine Fisheries Service (NMFS)
NMFS's mission is to provide stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of the environment. One of NMFS's national objectives is to "eliminate overfishing and rebuild overfished stocks important to commercial, recreational, and subsistence fisheries."

Northwest Fisheries Science Center (NWFSC)
The Center is responsible for providing scientific and technical support for the management, conservation, and development of the Pacific Northwest region's anadromous and marine fishery resources.

Who is catching the nation's sportfish and where?

Below is a summary of the nation's recreational finfish catch by major region in 1997. (Source: National Marine Fisheries Service, September 1998)

	Total number fish caught	Percent of total fish caught	Largest number of fish caught (non-bait fish)	Largest harvest (by weight)
United States	366 million fish	100 percent		
Atlantic and Gulf of Mexico	337 million	92 percent	spotted seatrout Atlantic croaker summer flounder stripped bass black sea bass bluefish	dolphin striped bass bluefish red drum king mackerel summer flounder spotted seatrout
Pacific Coast	29 million fish	8 percent	Pacific (chub) mackerel surf smelt white croaker kelp bass barred sand bass	California halibut Pacific mackerel Pacific barracuda black rockfish barred sand bass lingcod



8) Evaluate ecological and genetic impacts of released juveniles on their wild cohorts and other species.

In 1998 lingcod were cultivated in captivity at the Center to the juvenile stage (about 6 inches long) for the first time in the United States. Lingcod have been raised to the juvenile stage in Canada on a laboratory scale of production, but the Center's research is focusing on technology that could be scaled up to hatchery-scale production. The survival rate during the first year averaged 0.5% which is orders of magnitude greater than the survival rate in the wild. Last year's juveniles are still thriving, at the Center's Manchester Research Station, as are some of their siblings, which are now living at the Seattle and Point Defiance Aquaria and Marine Science Center in Poulsbo.

During the 1999 season, scientists hope to raise the survival rate to 10% which would produce 3,000 juveniles for restocking from 30,000 hatched larvae. Scientists are trying to determine proper nutritional regimes, optimal levels of light for feeding and optimal water temperature and salinity to improve survival rates. Scientists are also trying to determine what factors they need to consider when releasing juveniles. What size should they be? Where and when should they be released? What are the genetic ramifications of releasing juveniles at different locations? What will their impact be on wild lingcod?

The research at the Center is currently divided among three locations. At the small aquaculture facility at the Center's headquarters in Seattle, scientists are raising lingcod broodstock (parents) in recirculated seawater. Here scientists are trying to define spawning and egg incubation techniques. Since lingcod spawn only once a year, which limits the amount of eggs and the time available to conduct research, scientists are using phase-shifted temperature and photoperiod regimes to develop spring, summer, fall, and winter broodstocks to quadruple the time available to work on egg and larvae stages.

At the larger aquaculture facility, located at the Manchester Research Station, scientists are coordinating the collection by WDFW divers of portions of wild lingcod egg masses from reefs and rocky areas of Puget Sound. The collected masses are then incubated, hatched, and held until they develop into the juvenile stage. Then they will be tagged and released back to the locations near where the egg masses were collected. The goal is to increase survival rates while preserving potential genetic integrity (we do not know if lingcod form one or more populations in Puget Sound of lingcod throughout Puget Sound.) Progress of tagged juveniles will be monitored by the Center.

Scientists at the Mukilteo Research Station may have the toughest assignment. They are working with three rockfish species. Rearing rockfish in an aquaculture setting presents a different set of challenges than lingcod because the broodstock fish copulate rather than spawn and the developing eggs are carried within the female and released as larvae. If experimental releases of juvenile lingcod in southern Puget Sound are able to boost lingcod populations, marine enhancement programs for other rockfish may not be far behind. Dr. Michael Rust, a fisheries biologist and team leader of the Marine Enhancement Research Team at the Center envisions multispecies marine fish hatcheries which would be used to produce fish by location and need. For example, one hatchery might produce 10,000 lingcod to enhance South Puget Sound lingcod populations one year, then the following year it might produce 7,000 black rockfish for Willapa Bay. Unlike salmon, lingcod and other targeted marine fish are longer lived so efforts to boost their populations may only be necessary periodically rather than annually.

According to Dr. Rust, "multispecies marine hatcheries could provide a way to enhance recreational as well as commercial fisheries".

Adult black rockfish broodstock at Mukilteo Research Station.

Excerpted from *The Oregonian*, 4/18/99

Urban runoff a ruination for streams, fish

by Brain T. Meehan

Research in Puget Sound and Alaska by the National Marine Fisheries Service shed new light on chemicals and salmon. Since 1987, scientists at the service's Northwest Fisheries Science Center in Seattle have studied the impact of contaminants on chinook salmon smolts in the Duwamish River estuary.

Scientists sample some of the smolts before they are released from an upstream hatchery. Another set is collected three to five weeks later in the estuary, which flows through an industrial part of Seattle.

"When we started doing this 10 years ago, we didn't expect to see very much," said Tracy Collier, a fisheries service scientist. "We thought we'd be able to show some exposure."

But the studies revealed much more. Even though smolts only briefly passed through the contaminated estuary, their growth rate slowed, and they became more vulnerable to disease when compared with fish moving through cleaner systems. Collier said the suspect contaminants are polychlorinated biphenyls or PCBs, long-lasting industrial insulators that now are banned, and polyaromatic hydrocarbons, which are related to petroleum products. The fisheries service has expanded that work into seven Oregon estuaries, from Coos Bay to the lower Columbia.

The sensitivity of salmon to polyaromatic hydrocarbons raises a grim specter in urban watersheds, where oil residues stream off parking lots and streets each time it rains.

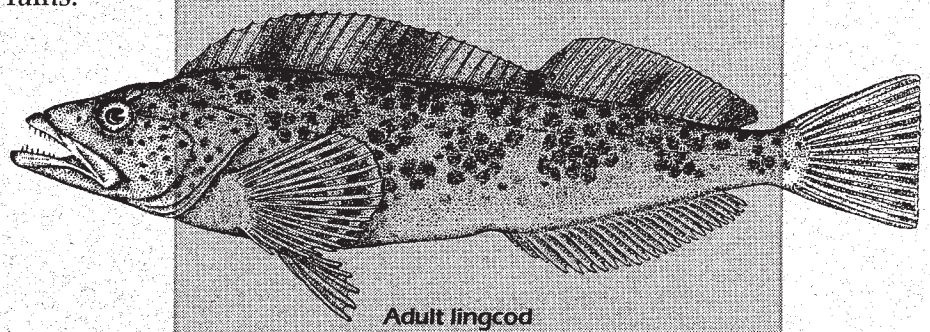
Lingcod populations continued from front page

Baja and prefer to live in rocky areas or on the edges of underwater reefs. The lingcod lifecycle is noted for its infrequent reproductive success in terms of adult recruitment. It is estimated that over the course of a female lingcod's life she will produced 1-4 million eggs, of which 2 will live long enough to reproduce in the wild. The survival of early lingcod life history stages is also highly influenced by the ocean environment. The largest lingcod ever recorded was 59 inches long and weighed 80 pounds.

Lingcod are "a wiley fish" according to Jim, who grumbles that they often retreat into the rocks after being hooked. "Be careful" he says, if you are lucky enough to pull one on board, "those are a real set of teeth and could really do some damage." Jim recommends pliers and a good pair of gloves to remove the hook and warns that the gills are sharp as well.

Mr. Ling and Mr. Cod, as he fondly calls the fish in his photo, were caught in 60 fathoms of water using his favorite lure combo of three shrimp flies tied to the leader followed by a shiny striped diamond jig with a triple hook. Fishing for lingcod isn't easy because you can easily lose your gear by snagging or cutting it on the rocks they call home. The best technique is to stay "hove-to" in the current while you wait for a bite since the same rocks that grab your gear can also grab your anchor and line.

When asked if he has any plans to go fishing, Jim smiled and said "I hope to see Mr. Ling and Mr. Cod again soon."



Adult lingcod
(Illustration courtesy of Environment Canada)