A photograph of a fishing boat on the water under a cloudy sky. The boat is in the center of the frame, and the water is a deep blue-green color. The sky is overcast with grey clouds. The background shows dark, silhouetted mountains.

# Improving Species-Selectivity of Longlining with Fabricated Baits

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- Although demersal longlining is relatively benign to habitat, it is often criticized by environmentalists for its lack of selectivity
- One reason is that the most commonly used baits -- squid and herring -- are so attractive to so many species, that we call them “the french fries of the ocean”.



# Selectivity of Fabricated Baits – Three Experiments

- Alaskan demersal longline fisheries
  - Pacific cod (target) vs halibut, sharks & rays (bycatch)
- Northeast Haddock Fishery
  - Haddock (target) vs Atlantic cod (bycatch)
- Blue shark bycatch in pelagic longline fisheries

# Alaska Demersal Longline Experiments



# Alaskan Longline Team

- **Matrix:** Mimi Fielding & Hal Cook (Marco Marine)
- **Waste-based Attractants & Bait manufacture:** Susan Goldhor & Radu Giurca
- **Tank testing:** Radu Giurca & Alaska SeaLife Center
- **At-sea testing; data analysis:** Dan Erickson
- **Vessels:** F/V Sebrika; F/V Rocinante (Seward, AK)
- **Funding & organization:** Alaska Fisheries Development Foundation; Alaska Science & Technology Foundation; Marco Marine; Wildlife Conservation Society.

- Alaska longliners pay high prices for squid bait shipped from places as distant as the Falklands,



- while Alaskan processors dump a billion pounds of frames, heads and guts into the ocean each year.



We chose wastes from Alaska Pollock (*Theragra chalcogramma*) because:



- Largest quantity processed of any species
- Relatively long production period
- Adult Pacific cod stomach content studies show Alaska pollock is a favorite food

# Method – Bait Fabrication

Wastes are drippy, variable, spoil easily and won't stay on a hook. But, current methods in food technology can overcome these barriers.

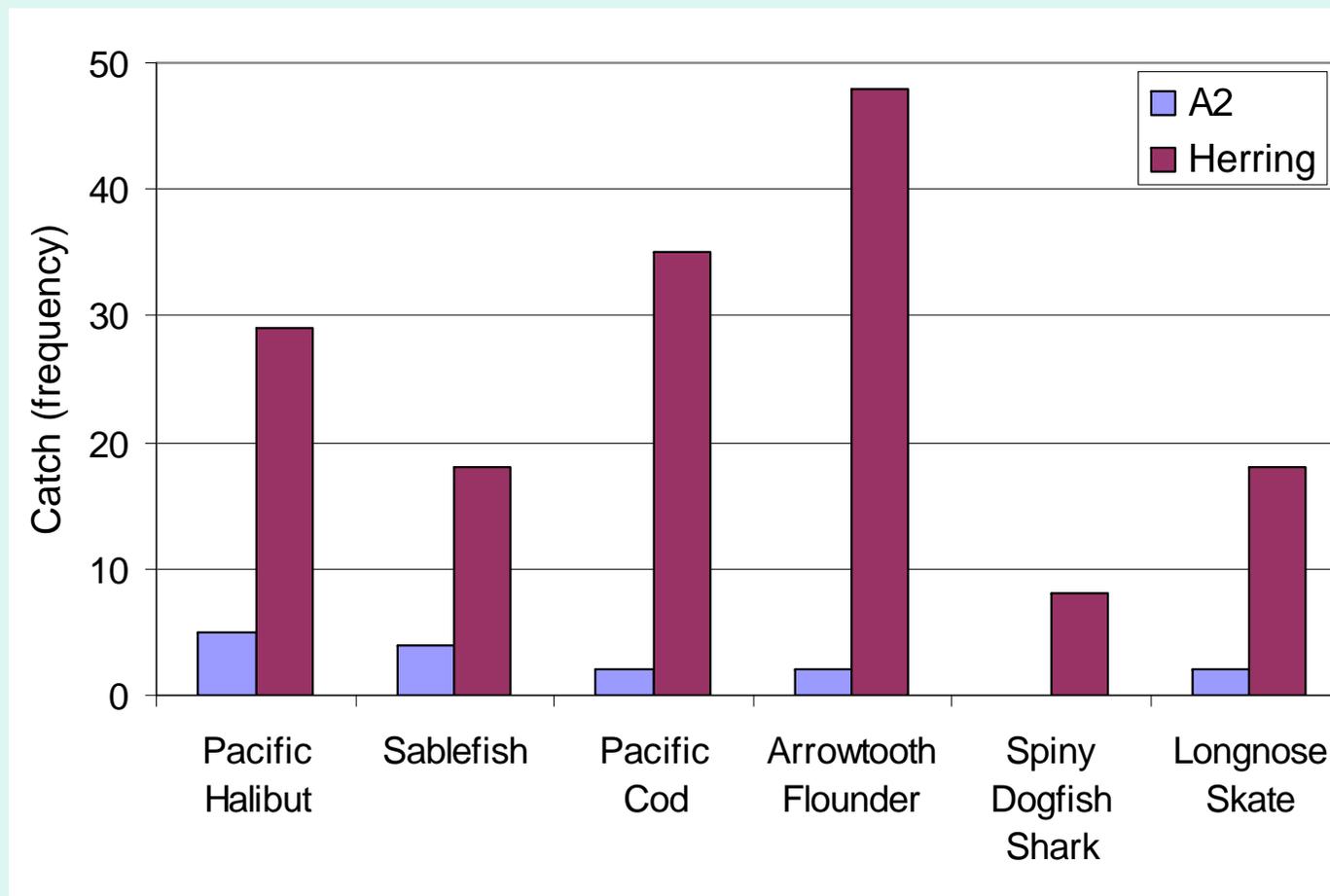
We turned the wastes into liquid, and then embedded that liquid into a gum-based matrix which was tough enough to stay on a hook, and which released attractants over time.

# Result – A Fabricated Bait

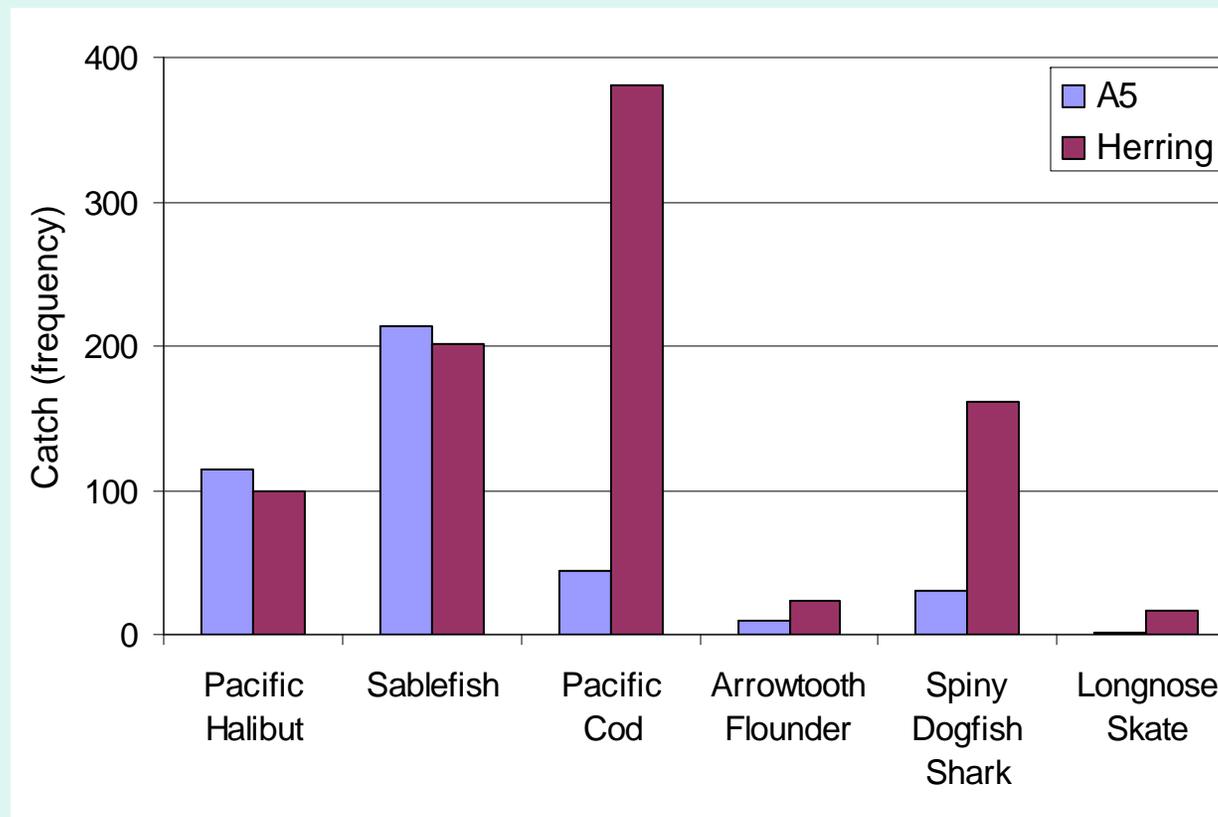
- Squid-like texture
- Stays on hook
- Consistent
- Freeze-thaw stable
- Releases attractants over several hours
- Can be cut to size



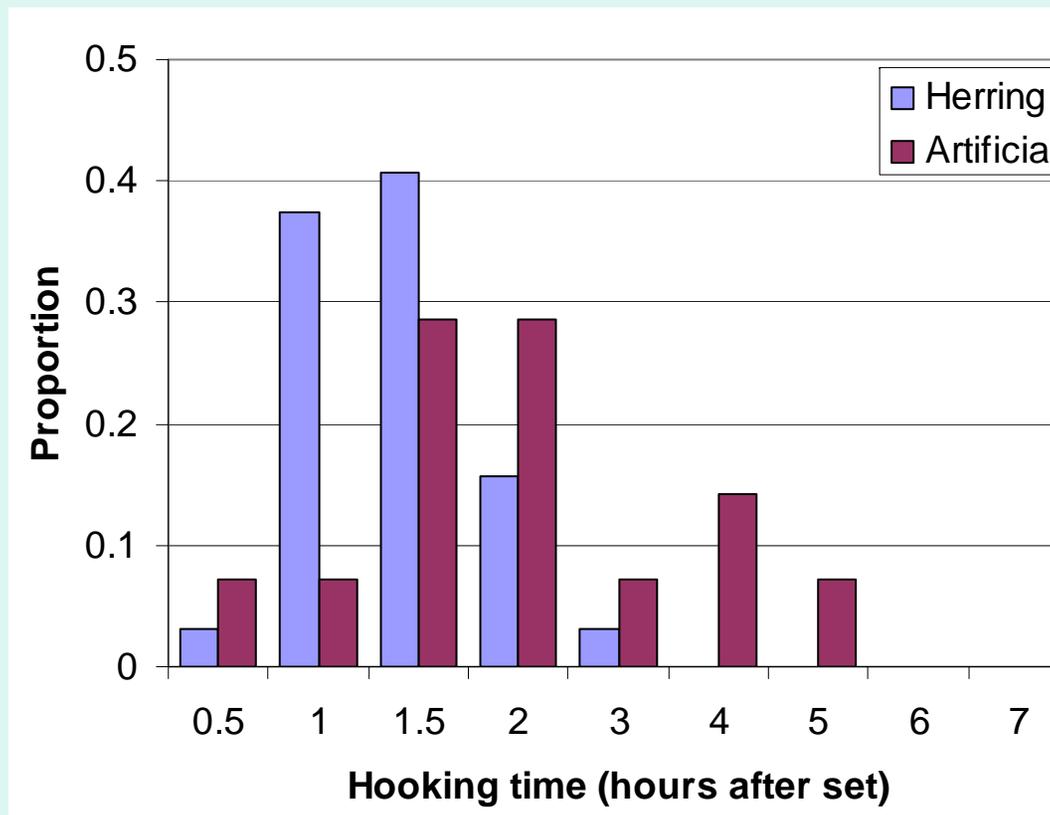
# Initial formulations caught almost NOTHING relative to herring bait



Subsequent formulations produced high catches of Pacific halibut & sablefish and reduced shark & skate bycatch. However, it did not catch cod.



Artificial bait offers the chance to manipulate the hooking time. Our Alaska bait started fishing more slowly, but continued to fish longer than did herring.



# First Lesson Learned

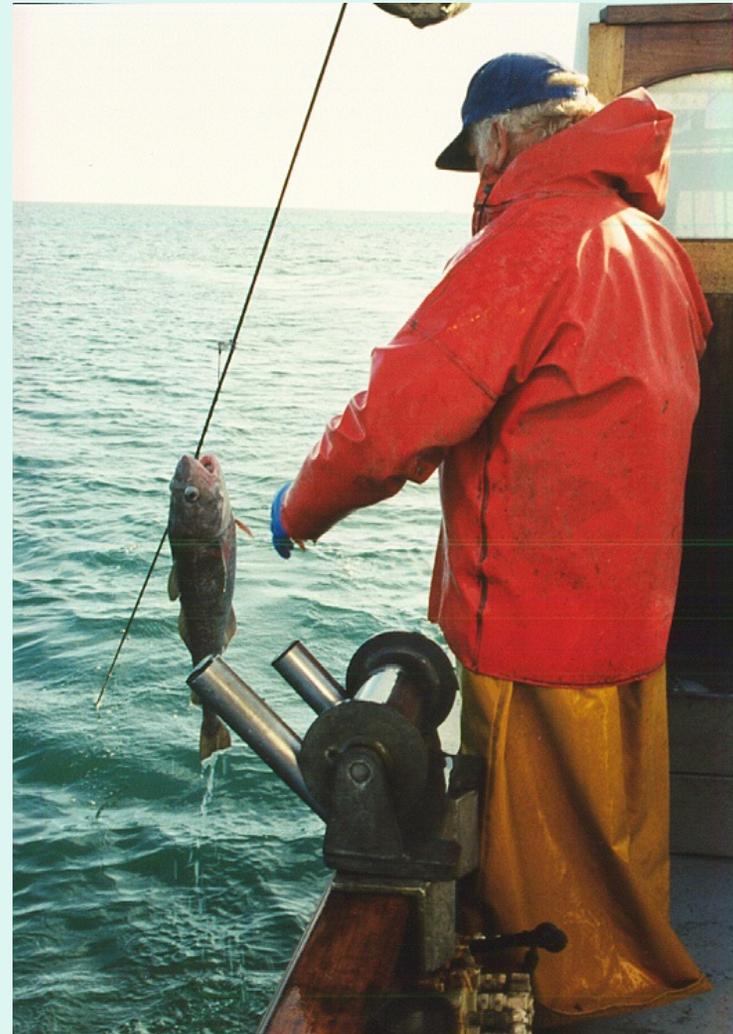
- Good news: Our fabricated bait was more effective than squid or herring for catching Pacific halibut and sablefish, and greatly reduced bycatch of sharks and skates. Fishermen loved its ease of use, its consistency, and its ability to withstand multiple freeze/thaw cycles.
- Bad news: It greatly reduced the catch of cod.
- Lesson learned: cod are unexpectedly fussy eaters.

# Second Lesson Learned

- There is a difference between the attractant, which brings fish to a bait, and the bait itself. Although we'd tested captive cod and made sure that they were attracted to our liquid digest, they didn't take the solid bait. Folk wisdom says that cod will eat anything. Our data suggest that they draw the line at artificial bait.

# Use of fabricated baits to reduce cod bycatch in the North Atlantic

- Cod are scarce in the North Atlantic, so quotas are low.
- Could cod's unwillingness to take fabricated baits be useful in the North Atlantic haddock fishery?



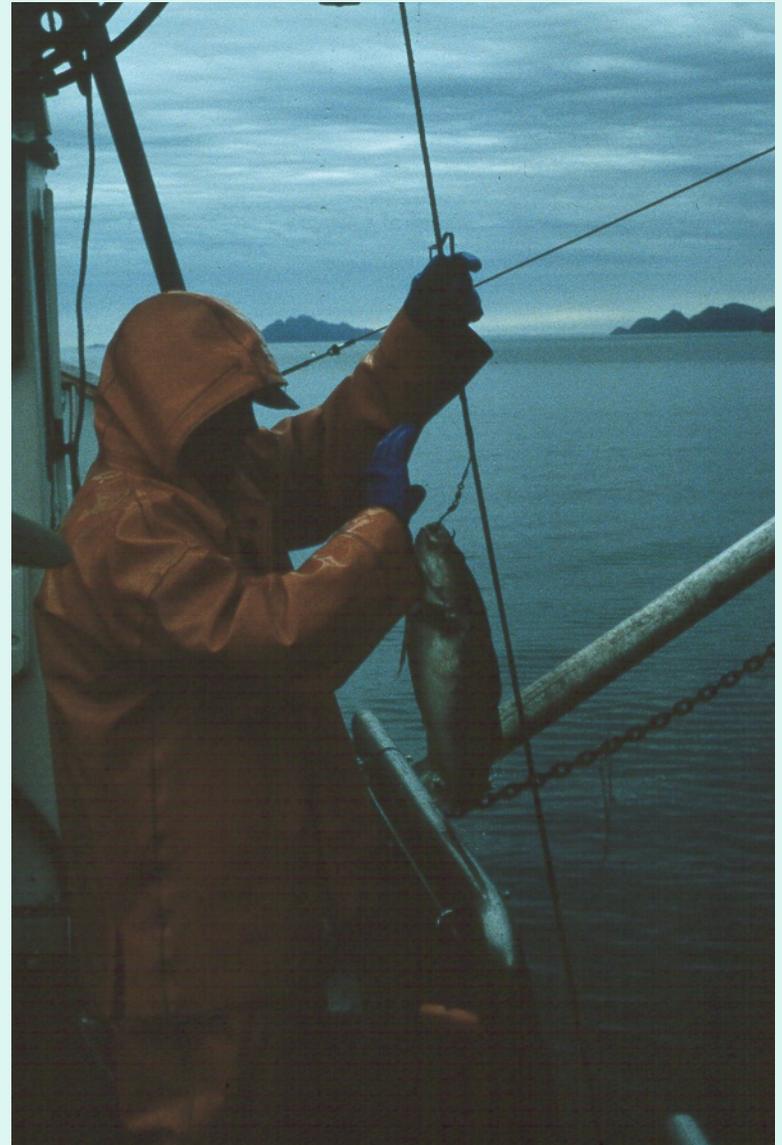
# NORBAIT

- Developed by Svein Lokkeborg, Mustad and others in Norway as a haddock bait.
- Composed of ground herring and gum in a net tube.
- Commercially available.



- A test of Norbait in New England's haddock fishery showed that Norbait reduced cod bycatch dramatically, relative to natural baits

This study was funded by the **North East Consortium**



# Catch (Cod wgt / Haddock wgt) by bait type

Square	Depth	Squid	Herring	Fabricated
41691	78 m	0.0467	0.0121	0.0036
	90 m	0.0746	0.0251	0.0012
41682	78 m	0.0214	0.0054	0.0016
	90 m	0.0347	0.0113	0.0005

Table. Mean Cod/Haddock Caught by Weight in Closed Area 1

- All Baits Used on Same Day

Data from Jennifer Ford, Ecology Action Center, Nova Scotia

# Catch by gear type (longline vs trawl) expressed as: [Cod (kg) / Haddock (kg)]

Square	Longlines	Trawl	
		< 50m	≥ 50m
41674	0.071 (0.030-0.154)	0.826 (0.689-0.910)	0.541 (0.312-0.754)
42671	0.013 (0.009-0.018)	0.450 (0.320-0.587)	0.169 (0.112-0.246)
41673	0.035 (0.020-0.060)	0.693 (0.640-0.741)	0.359 (0.221-0.525)
42672	0.037 (0.016-0.083)	0.709 (0.504-0.853)	0.377 (0.220-0.564)

Table. Cod per haddock, by volume, in hauls targeting all groundfish with different fishing gears in summer 2005. The bracketed numbers are the 95% confidence intervals.

Data from Jennifer Ford, Ecology Action Center, Nova Scotia

# Lessons Learned

- Longlining is significantly more selective than trawling when fishing for haddock. It eliminates the possibility of operator manipulation of separator panels, and reduces cod bycatch considerably.
- The selectivity of demersal longlines can be improved using fabricated baits.
- We predict that fabricated baits will be increasingly developed, and used in future bottom fisheries, where selectivity is an issue.

Can fabricated baits play a role in pelagic longlining as well?

Since our bait had reduced shark bycatch in Alaska, we decided to run preliminary tests on blue sharks, a major bycatch on swordfish longlines.

Number of blue sharks (Prionace glauca) discarded dead per year, by U.S. pelagic longliners, from 1987 to 1997:

7,043 to 29,329\*

Blue shark populations, like other sharks are diminishing dramatically

Data from National Marine Fisheries Service, 1999

# Reduction of Blue Shark Bycatch in Pelagic Longline Fisheries

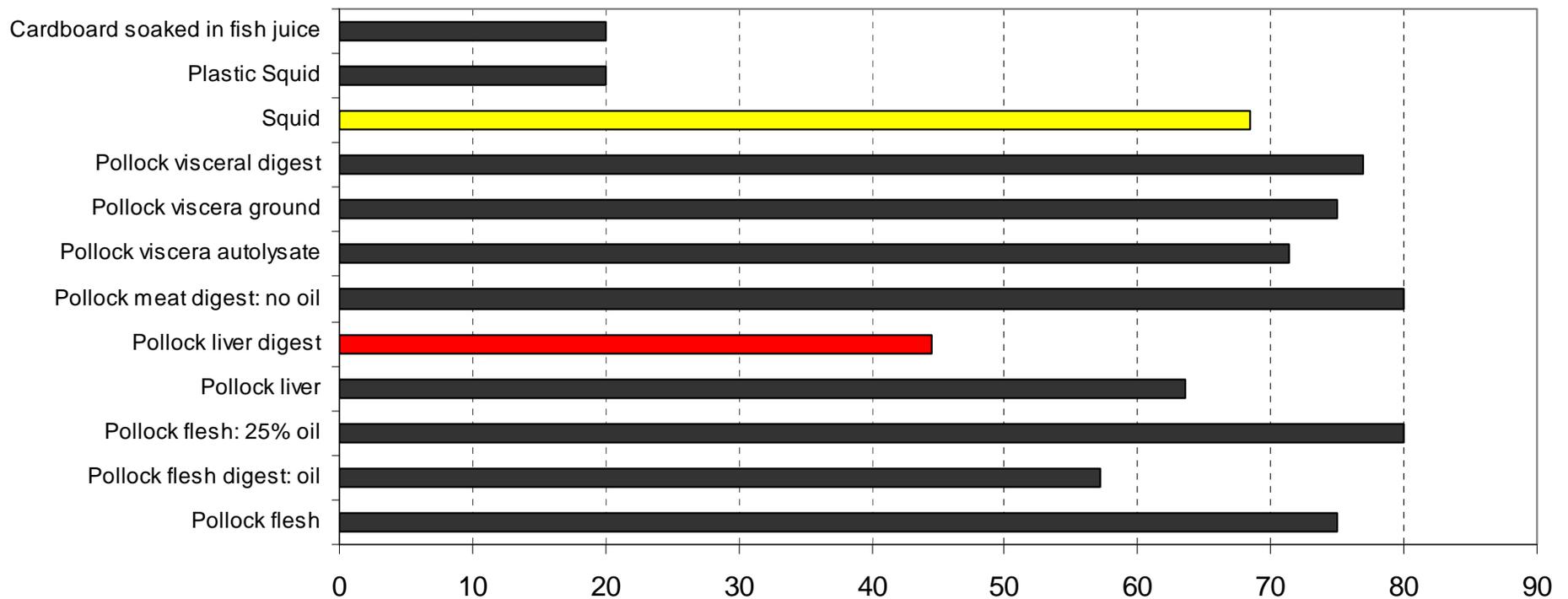
- Researchers: Susan Goldhor  
Gregory Skomal
- Goal: Can we create a bait that is not appealing to blue sharks?
- This research supported by a **Saltonstall-Kennedy** grant from **N.M.F.S.**

# Methods

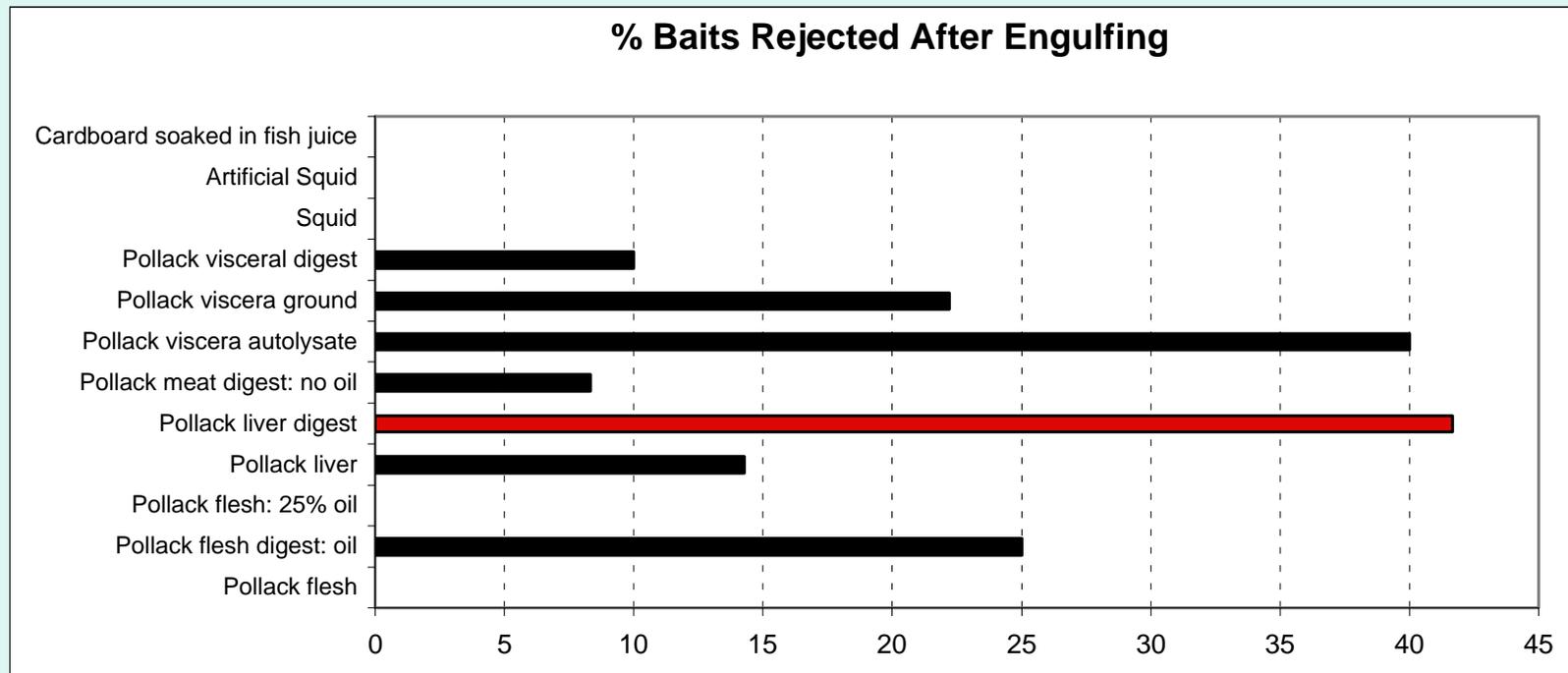
- Sharks were chummed to a vessel
- Baits were presented on a longline, with monofilament gangions, without hooks.
- Our response variable was the blue sharks' behavior towards different baits
- Our bait variables were: natural versus fabricated; and, in the latter, the type of binder, color, and type of attractant, including different organs of the fish (Alaska pollock) used as bait.

# Percent of Baits Bitten by Blue Shark

## % Baits Bitten



Even though certain baits (especially liver and other viscera) were rejected after being taken, the tendency of blue sharks to bite at almost everything means that in a fishing situation, they would be hooked.



**Our first attempt to develop a bait that would not attract sharks failed. Although our baits reduced the bycatch of sharks and skates by demersal longlines in the North Pacific, they would do little to reduce the bycatch of blue sharks by pelagic longlines.**

**(Although liver digest may be worth further exploration.)**

# Conclusion

- Modified and fabricated baits are promising for improving the selectivity of longlines
- We believe the numbers and types of species selective longline baits will increase, as interest, incentives, and funding increase
- The result will be ecologically and biologically more responsible fisheries.

