Semi-Annual Report

Submitted to the Northeast Consortium

Project Title	**Do rare earth metals deter spiny dogfish? A feasibility study on the use of Mischmetals to reduce dogfish catches in hook and lobster gear in Gulf of Maine.**	
Contract #	PZ07087	
Contracted	Gulf of Maine Research Institute	
		Amount
Contract period	March 30, 2007 – December 30, 2008	$24,356
Period being reported	April 1 2007 through September 30 2007 (6 months).	

Project Leader:

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Submitted by:

Shelly Tallack (GMRI Principal Investigator) — Date: 10/25/07

1. Summary of Scope of Work

This report refers to the Scope of Work contracted by the Northeast Consortium to undertake an industry-science study to assess the potential to reduce the catch of spiny dogfish in hook and lobster gears, using a rare earth metal alloy. Core goals and deliverables include:

- Work collaboratively with industry individuals.
- Assess the potential for cerium-lanthanide alloy to deter dogfish from hook and lobster gear.
- Undertake dedicated research trips during the summer of 2007 to complete the field work.
- Analyze data and prepare for presentation at appropriate fishing/research meetings.
- Prepare a final report for funders and industry upon completion of this contract.
- Prepare a manuscript for publication in a peer-reviewed journal.

2. Project participants

The Primary Investigator is Dr. Shelly Tallack (GMRI). Graham McKay (GMRI) has played a substantial role, as research technician with primary duties involving gear preparation and data collection/entry. Christopher Andrews, Eric Tomazin and Eric O'Connor are the three industry partners who collaborated with GMRI from FV Survivor (Permit # 240736, Hull # 619131, Portland, ME).

3. Major accomplishments and milestones

3.1 Project Design

GMRI worked collaboratively with a number of scientists looking at a similar question for both other shark species (e.g. Eric Stroud, SharkDefense) but also spiny dogfish on the East coast (John Mandelman, New England Aquarium) and on the West coast (Al Stoner, Steve Kaimmer) in order to finalize the experimental design. Most notably, this involved a quick and dramatic decision in the planning stages to move away from assessing magnets to instead assessing the cerium/lanthanide alloy. A number of conference calls and emails eventuated to ensure that all studies would have comparable experimental designs, to enable a comparison of findings from both lab and field studies on the East and West coasts upon study completions.

3.2 Permitting and contracts

During the early months of this project, before the NEC contract was secured, the necessary permits and documentation were obtained to undertake this study. Specifically, GMRI applied for an LOA for FV Survivor (Feb 07). GMRI submitted the proposal for IACUC approval (and re-approval after the change in experimental design to testing alloys and not magnets); IACUC approval was secured in June 2006. GMRI responded to NEPA review comments (Jul 07).

3.3 Equipment design and equipment purchase

GMRI consulted with John Mandelman (NEAQ), Al Stoner and Steve Kaimmer on the design of the alloys, how to handle them (the alloy filings are highly flammable) and rigging in the longline gear. Alloys were purchased from a supplier in Canada in June/July 2007; the alloy ingots were cut using a local company in Massachussets during July and August 2007. Graham and Shelly completed gear preparations in early August 2007.

3.4 Research trips

Dogfish research trips were undertaken as planned, during August and September of 2007. Despite dogfish typically be predominant in inshore waters during this time of year, this year was a little different with more dogfish being reported from more offshore locations (e.g. Cashes Ledge) and for two trips, very few dogfish were caught.

3.5 Data entry, management and analysis

GMRI designed the necessary datasheets and associated database. Data entry is planned for October 2007; data analysis will be undertaken once all data has been entered and error-checked.

4. Unexpected difficulties and project alterations

4.1 Low sample numbers

The poor catch of dogfish in the early trips led to disappointing sample numbers, despite setting the planned number of gear sets. Later trips were more successful in finding dogfish.

4.2 Dissolution rates of alloys

The cerium/lanthanide alloy works by reacting with the salt water, resulting in the production of a gas. It is believed that the output of this gas is what acts as a deterrent to dogfish. However, this reaction also means that the alloys gradually disintegrate. The fast rate of dissolution was not anticipated, and over the course of the study, the triangular slices of alloy disintegrated at an alarming rate (Figure 1).

Over time, this meant that the alloys were disappearing from the gear – as a result, GMRI undertook just 6 of the 7 planned research trips. However, GMRI was able to carry out an additional sea day on the UNH vessel which tends the cod farming cages; during this trip, it was possible to obtain video footage on how dogfish are interacting with the alloys underwater.

Figure 1: Dissolution effects in the alloys: a fresh piece of alloy (A) and a piece of alloy showing dramatic disintegration (B).

A)  B) 

5. Next steps

GMRI will continue to work on analyzing the data with the aim of:

- Preparing findings for presentation at appropriate fishing/research meetings.
- Developing a website summarizing the progress of this project.
- Preparing a final report for funders and industry upon completion of this contract.
- Preparing a manuscript with John Mandelman (comparing field findings with laboratory findings) for publication in a peer-reviewed journal.

6. Impacts on fishing and scientific community

To date impacts have been limited to the single commercial vessel which participated in this project; the crew and owners appreciated being involved in this collaborative research opportunity and were genuinely interested in the question being addressed. News had also spread and other fishermen were also asking about the findings. An article summarizing the aims of the study appeared in the September 2007 publication of Commercial Fishing News (Annex 1).

Future impacts will depend on the results, which will be disseminated to both the fishing and science community via a website, presentations (NEC has indicated in interest for this study to be presented at the end of year NEC Project Participant's meeting) and a final report.

7. Photo gallery

Graham McKay preparing longlines rigged with and without alloys

Disintegrating alloys

Baited longline

Large female dogfish caught

Annex I – Article published in CFN in September 2007.

Can mischmetal stave off dogfish hordes?

PORTLAND, ME – Spiny dogfish continue to be a contentious topic of discussion between fishermen who find them to be a nuisance species and the managers who limit their harvest.

Few will dispute that there are plenty of dogfish out there. The problem from the management perspective is that females don't reach maturity until they are anywhere from 12 to 25 years of age. This makes the dogfish particularly vulnerable to overfishing.

So if fishermen are not allowed to harvest the species, there are really only a couple of options – either avoid dogfish altogether through area or seasonal closures or make fishing gear more selective.

Over the past several years, several different cooperative research projects funded by the Northeast Consortium have looked at the dogfish problem. Project goals have generally focused on providing managers with improved discard mortality estimates and more comprehensive descriptions of their habitat use and migration patterns.

In particular, Shelly Tallack of the Gulf of Maine Research Institute has focused her efforts on the dogfish dilemma, collaborating last summer with the Cape Cod Commercial Hook Fishermen's Association and various industry partners.

Currently, Tallack is working with Christopher Andrews and Eric Tomevin of the fishing vessel Survivor out of Portland on a project development award from the Northeast Consortium.

The research partners are taking an unusual approach to avoiding dogfish bycatch in the hook-and-line and lobster pot fisheries by using mischmetal as a deterrent.

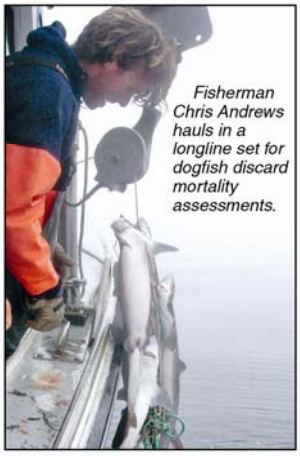
Mischmetal is a "mixed metal" alloy that is also called cerium mischmetal. A typical composition includes approximately 50% cerium and 45% lanthanum. Its most common use is in the "flint" ignition device found in most lighters.

Eric Tomevin photo

Shelly Tallack photo

Shelly Tallack and Joe Tomevin remove a hook from a spiny dogfish.

The ampullae of Lorenzini, visible as dark spots on the skin, are small pores around the head of the spiny dogfish that are filled with electrically conductive jelly and used for electroreception.



Fisherman Chris Andrews hauls in a longline set for dogfish discard mortality assessments.

Shelly Tallack photo

Sensory overload

The spiny dogfish and many other shark species possess an organ called the "ampullae of Lorenzini" that detects weak electrical fields at short ranges.

The ampullae of Lorenzini are small pores around the head that form a sensory network. When asked, "Why magnets and metal alloys?", Tallack noted that magnetic devices have been investigated as shark deterrents for several years and specifically cited the work done by SharkDefense LLC researchers.

"It's believed the fields produced by magnets may overload the shark's sensory system and cause the animal to move away from the source," she said.

She added that even the surfing industry has attempted to incorporate magnetic material into surfboards to minimize the chance of a shark attack while people are surfing.

Recently, electropositive metals such as mischmetal have been shown to cause similar shark avoidance behaviors.

Tallack said her interest in shark deterrents was sparked while attending the ICES International Symposium on Fishing Technology in the 21st Century, which was organized by the Northeast Consortium and held in Boston last fall.

The use of magnets was highlighted during the symposium as a novel and effective approach to reduce bycatch of shark species – specifically lemon shark – on hook gear.

This kind of innovation actually received the World Wildlife Foundation's Smart Gear Competition's top prize in 2006.

Nonstick material

Given the controversy surrounding dogfish management, it was not difficult for Tallack to enlist the support and collaboration of commercial fishermen Andrews and Tomevin.

Their original plan was to test the effectiveness of magnets to deter spiny dogfish from hook and lobster gear in Gulf of Maine waters.

However, recent laboratory studies on the Pacific coast revealed that the spiny dogfish had a much stronger aversion to mischmetal than to magnets. In fact, when exposed to the alloy, dogfish either avoided hook gear altogether or consumed less bait when an interaction did occur.

"Since finding an industry feasible deterrent is the aim, it made more sense to use the nonmagnetic materials, which will not stick together and tangle the gear," Tallack said. "This is particularly preferable for gear with hooks."

Bycatch reduction

This study will compliment Tallack's recent dogfish study, also supported by the Northeast Consortium, on discard mortality from hook gears, which was conducted in collaboration with the Cape Cod Commercial Hook Fishermen's Association.

"If you can modify fishing gears to reduce the dogfish bycatch in the first place, then not only are you minimizing negative impacts on the resource, you also are helping fishermen by reducing their interactions with a species that has earned itself a negative reputation as a pest," said Tallack.

Fieldwork

As of late July, the project was in the gear preparation stage.

"We are due to hit the water in late August or early September for field trials and to test the gear," explained Tallack.

A total of seven research trips have been planned and the experimental design will be relatively simple. Three gear types will be compared – manual rod-and-reel, longline, and lobster pots. For each gear type, an alloy-rigged gear will be compared against a control setup with no mischmetal. For hook gear this means rigging the alloy close to the baited hook. On lobster gear, pots will be rigged with the alloy around the trap entries.

A parallel lab study, which is observing the behaviors of spiny and smooth dogfish in response to both magnets and mischmetal, is currently underway under the direction of John Mandelman of the New England Aquarium. Mandelman will be replicating the West Coast lab work to verify their findings on the East Coast populations since biological differences may exist between Pacific and Atlantic dogfish populations.

Tallack, Andrews, and Tomevin plan to share their findings. The two studies will compliment each other because, while behaviors are more readily observed in the lab, practical application to the fishery is best assessed in the field.

Because the study is operating as a Northeast Consortium Research Development Fund project, its budget is very limited, Tallack explained.

"We look on this study as a potential stepping stone to a more in-depth evaluation," she said. "If the findings are favorable and the alloys show good signs of being a deterrent for spiny dogfish, we would like to look into refining the gear design to be as practical and affordable as possible for application to commercial and recreational fisheries."

Tallack said she hopes results will become available towards the end of the year.

Ken La Valley

Ken La Valley is an extension specialist with University of New Hampshire (UNH) Cooperative Extension/New Hampshire Sea Grant who is working to connect commercial fishermen interested in cooperative research with scientists who want to work with fishermen. He encourages anyone with ideas to get in touch.

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