



# Evaluation of electropositive metal for reducing shark bycatch in a commercial pelagic longline fishery <sup>+</sup>



Aurelie Godin <sup>1,2</sup> \*, **Tonya Wimmer** <sup>2</sup>, John. H. Wang <sup>3</sup> and Boris Worm <sup>1</sup>

<sup>1</sup> Dalhousie University, <sup>2</sup> WWF- Canada, <sup>3</sup> Joint Institute for Marine and Atmospheric Research

\* Corresponding Author

+ Accepted for Fisheries Research









# Canada's Sharks

- ~ 30 sharks in Canada
- 13 species assessed by national body
  - 4 federally protected
- Primary threat in Canada is bycatch



© Simon Buxton / WWF-Canon



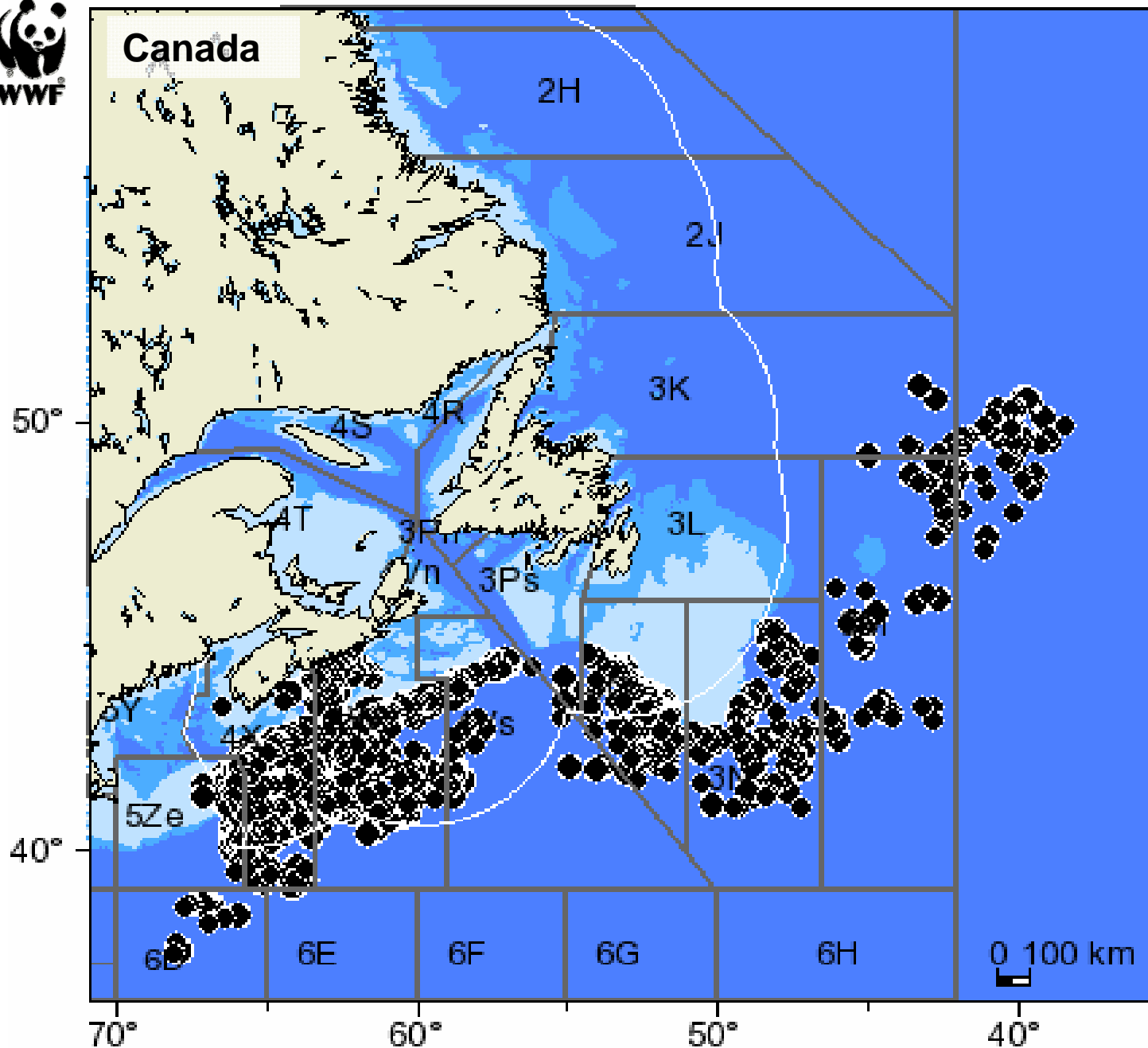




**Target species:**

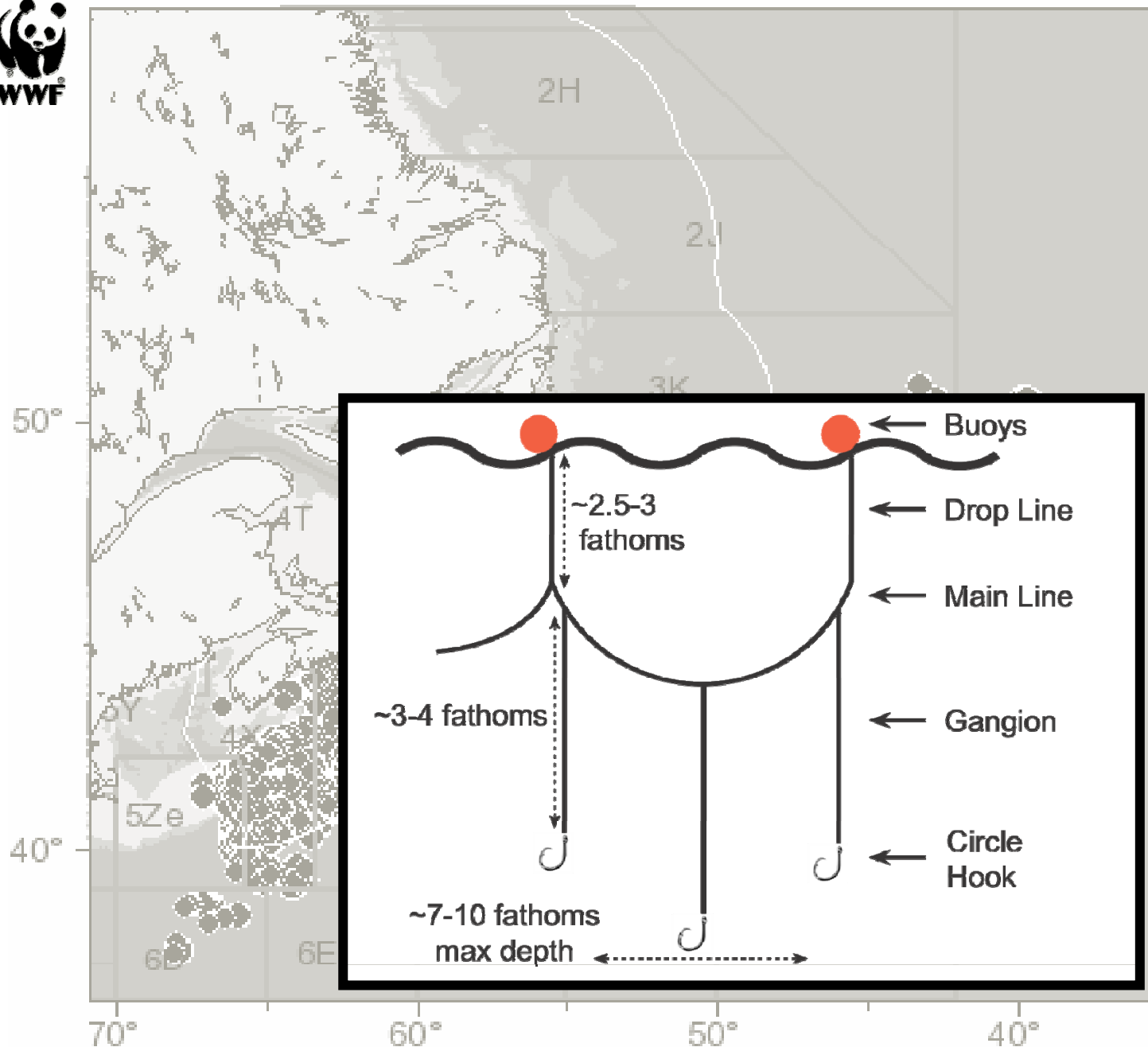
- Swordfish
- other tunas: bigeye, albacore, yellowfin





- year-round season but primarily June – Nov.

- 77 licenses  
~40-50 active



- year-round season but primarily June – Nov.

- 77 licenses  
~40-50 active

- ~ 800- 1000 hooks/set

- 30-50 miles

- daytime haulback





**Sharks contribute >30% of the targeted catch  
90% are blue sharks**



# Rare-Earth Metal Pilot Study

---



**Goal:** Determine whether the use of rare-earth metals reduce shark bycatch in a commercial pelagic longline fishery





# Study Design

- Standard swordfish fishing practices, mackerel bait
- Treatments:
  - Nd/Pr alloys
  - control lead weight
- + normal hooks





# Study Design

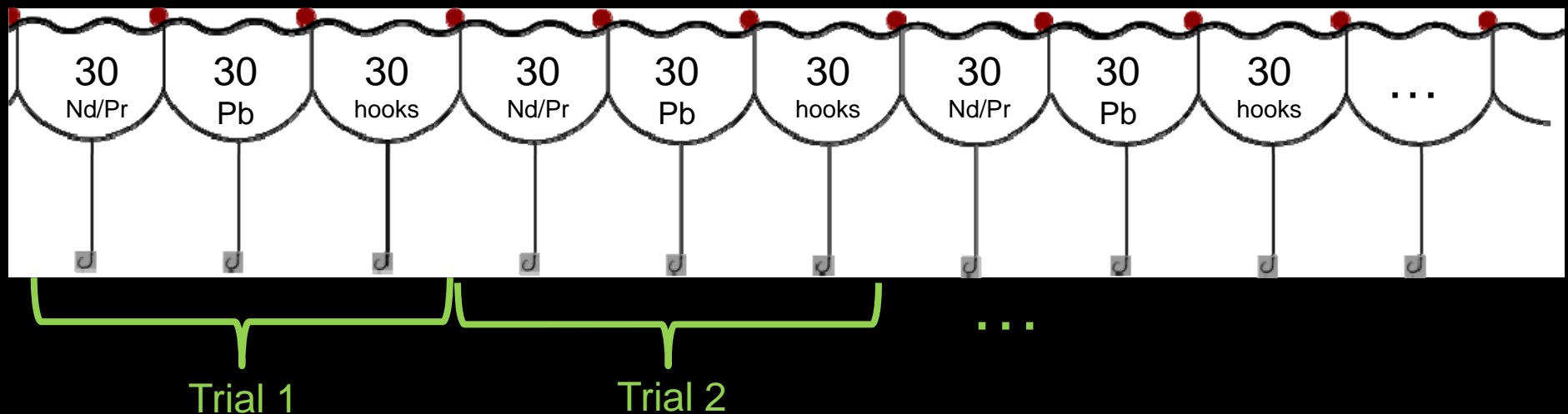






# Study Design

- Alternate 30 hooks per treatment and 30 normal hook x 10 = 900 hooks/set
- One trial = 30 Nd / Pr, 30 lead, 30 normal; 10 trials in total

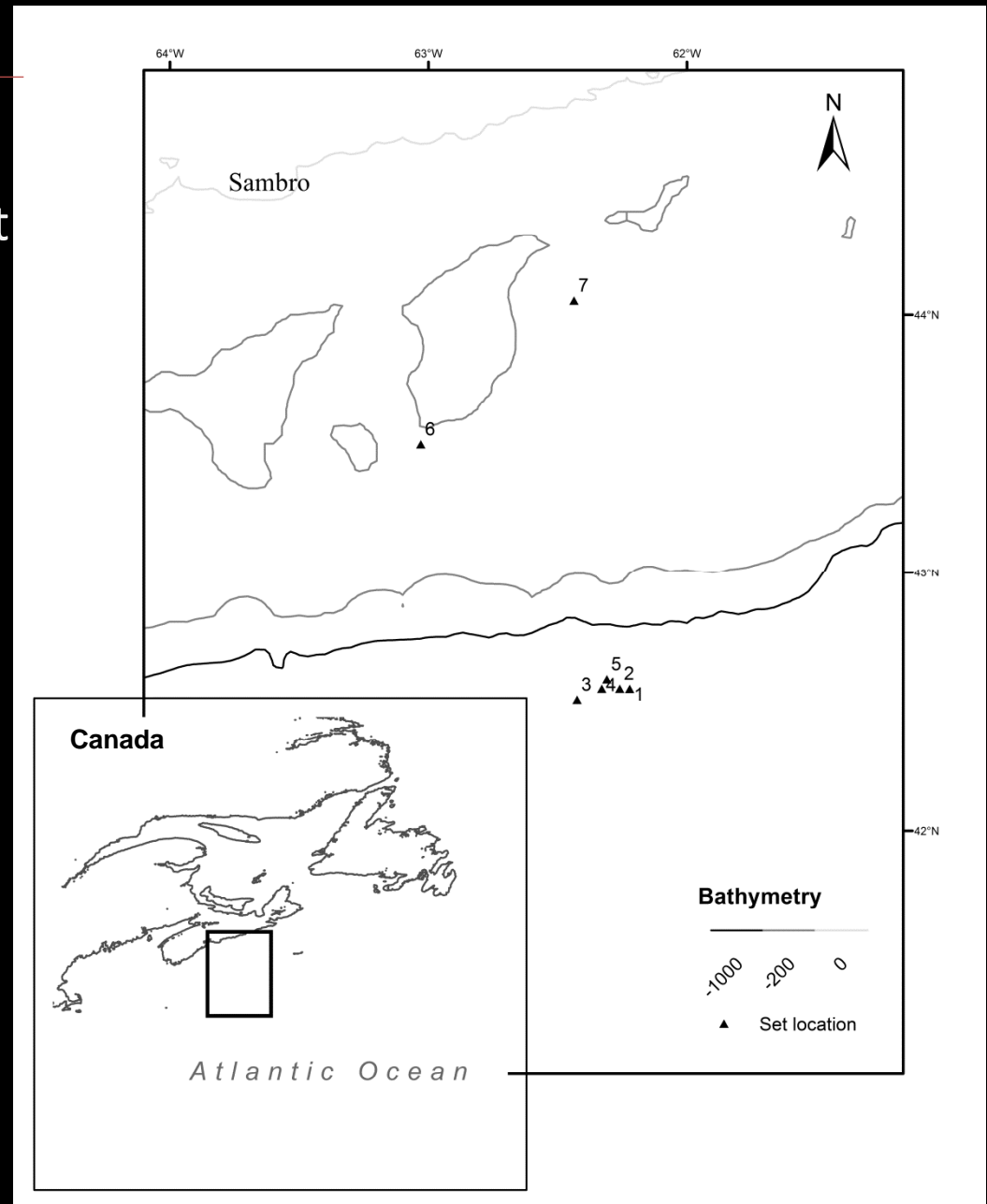


- Lanthanide metals replaced after every two sets
- Calculation of CPUE per treatment; GLMM to assess effect of treatments



# Results

- 7 sets (70 trials), 6300 hooks set between Sept 27 – October 3
- Soak time: 6 – 8 hours
- 337 individuals of 7 species:
  - blue shark (64.7%)
  - swordfish (27.9%)
  - shortfin mako (4.7%)



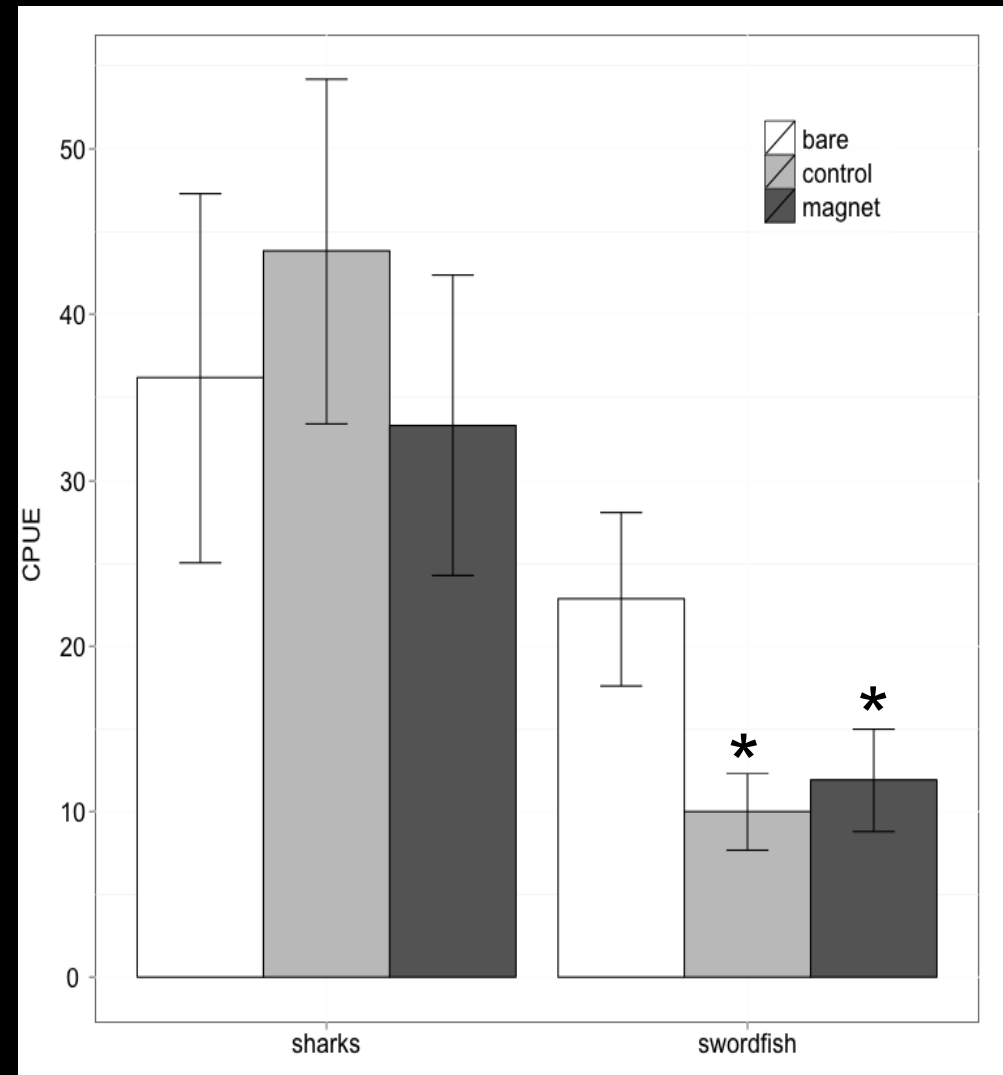


# Results

- Sharks – 33.3 – 43.8 / 1000 hooks
- Swordfish – 10 – 22.9 / 1000 hooks

\* Swordfish catch significantly different on treatments than bare hook:

- control – 56% reduction
- Nd/Pr – 48% reduction





# Conclusions

- No significant deterrent effect of electropositive metals on sharks
- Presence of treatments appeared to reduce the catch of swordfish
- Lanthanide metals not a feasible option due to deterioration over time







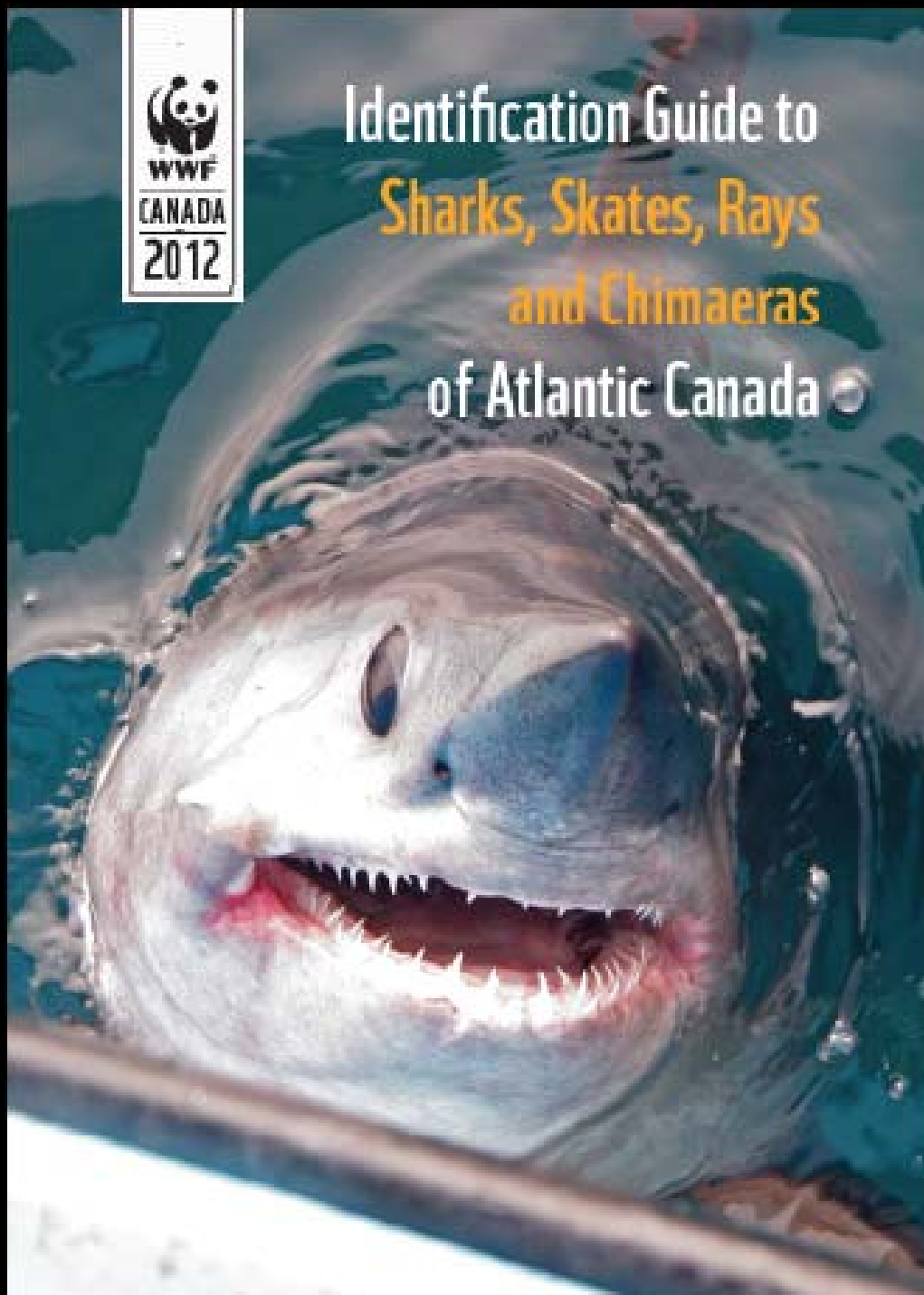
# Next Steps

- Collaborative pilot projects
- Shark bycatch hotspot analysis
- Improve handling of released sharks
- Data collection and quality





# Identification Guide to **Sharks, Skates, Rays** **and Chimaeras** of Atlantic Canada





Canada

COSEWIC - Not Assessed 54

### Common Names

Common Thresher Shark, Renard Marin (fr)

### Description

- A large stout shark with an extremely large caudal fin with a narrow tip
- Colour: Brown, grey, blue-grey or black on top with metallic hues; white underneath extending over pectoral fin bases

### Size (cm)

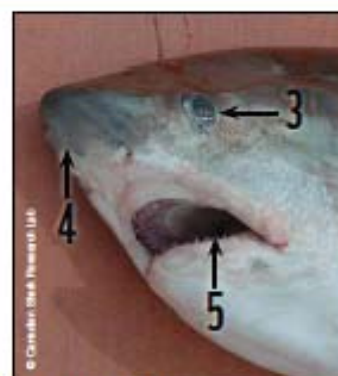
At Birth: 150 cm  
Average Size: 303-505 cm  
Maximum: 6 m

### Habitat

- Preferring temperate to tropical waters, they often swim at or near the surface of coastal waters; juveniles may be found inshore in shallow water
- Depth: 0-350 m

### Distribution

- Ranges from eastern Newfoundland (northernmost part of its range in the Northwest Atlantic) southward to northern South America
- A summer visitor to Atlantic Canadian waters, it may occur from July to November, but most frequently during August and September



### Identification Keys

- 1 - Extremely large upper lobe of the caudal fin (may be as long or longer than its body length); lower lobe short but well developed
- 2 - Second dorsal fin is much smaller than the first; origins well behind the rear tip of the pelvic fin
- 3 - Relatively large eyes placed forward on the head
- 4 - Short, stubby snout
- 5 - Relatively small jaw and teeth
- 6 - Sharp, curved teeth without serration





Common ID COSEWIC - Not Assessed 88

### Common Names

Round Ray, Rale Ronde (fr)

### Description

- Distinct spade-shaped disc with rounded corners and a snout with small terminal point
- Colour: Top of disc ash gray to chocolate brown; usually with 1 pale spot between eyes, and 1-2 pale spots on rear of each wing (not on young juveniles). Underside disc white to gray with sooty patches on pelvics and the rear of pectorals

### Size (cm)

Maximum: 55 cm (TL)

### Habitat

- Found in deeper waters along the continental shelf and slope
- Depth: 70-1240 m; commonly 300-800 m

### Distribution

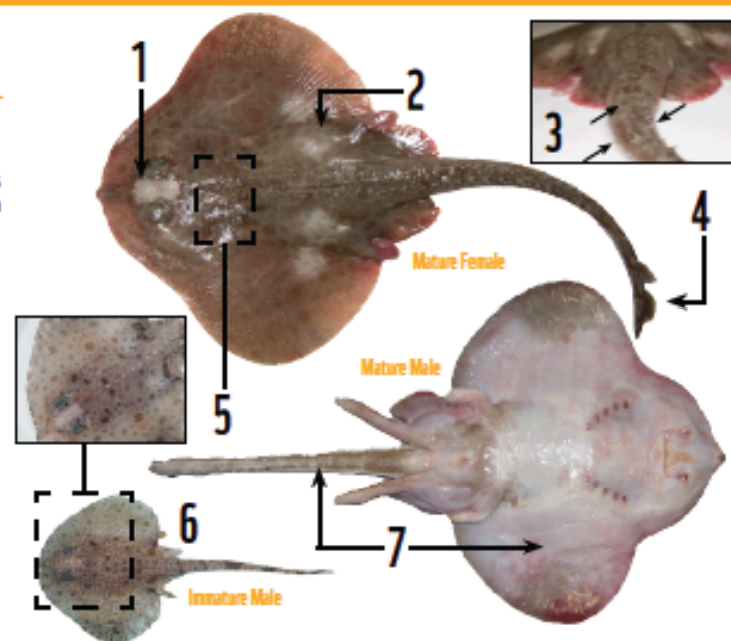
- Ranges from Davis Strait off west Greenland, Gulf of St. Lawrence to the slopes off Nova Scotia and Georges Bank
- Exploratory trawling have captured Round Skate offshore from LaHave to Browns Bank in depths of 530 – 1097 m



### Identification Keys

- 2 - 1-2 pale spots on rear of each pectoral fin
- 3 - 3-5 parallel mid-dorsal rows of roughly equal, claw-like thorns
- 4 - Dorsal fins usually joined with no intervening gap or thorn
- 1 - Distinct pale spot between eyes
- 5 - Triangular patch of 20-30 large thorns on shoulders / neck region
- 6 - Juveniles have proportionately longer tail; often confused with Pluto skate (does not occur in Canadian waters)
- 7 - Underside of body / tail bare and translucent white in colour with sooty patches

May be confused with  
Bigelow Skate (see pg. 76)  
and/or Winter Skate (see pg. 100)





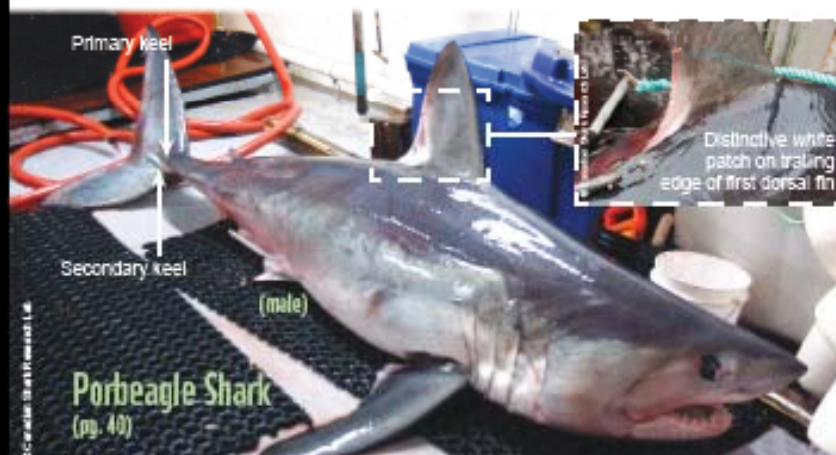
## Shortfin Mako vs. Porbeagle Shark

- Shortfin Mako Shark and Porbeagle Shark are often confused with one another
- There are two distinguishing features that can separate the two:
  - 1) Presence or absence of a white patch on back of the dorsal fin
  - 2) Presence or absence of secondary keel on tail



### Key Differences

- Porbeagles have a white patch (below) which is absent in Shortfin Makos (above), as well as the Longfin Mako
- Primary and secondary keels on porbeagle tail (below) distinguish it from a Shortfin Mako (above), which lacks the secondary keel



- Porbeagle teeth are shorter and tricuspid (a point on either side)



Porbeagle Shark

- Shortfin Mako teeth are long and slender



Shortfin Mako



[wwwf.ca/sharks](http://wwwf.ca/sharks)

# Acknowledgements

Funding: Government of Canada Habitat Stewardship Program for Species at Risk , CSL Group Inc., The Natural Sciences and Engineering Research Council of Canada (NSERC), WWF-Canada, Worm Lab

Support: Captain's Frankie & Gus Reyno, crew of *Addie n' Ainslie*, Troy Atkinson, Nova Scotia Swordfishermen's Association, David Spallin and Javitech and Fisheries and Oceans Canada