Gear modifications to a shrimp trawl to reduce seabed impacts in the Atlantic Canada inshore shrimp fishery

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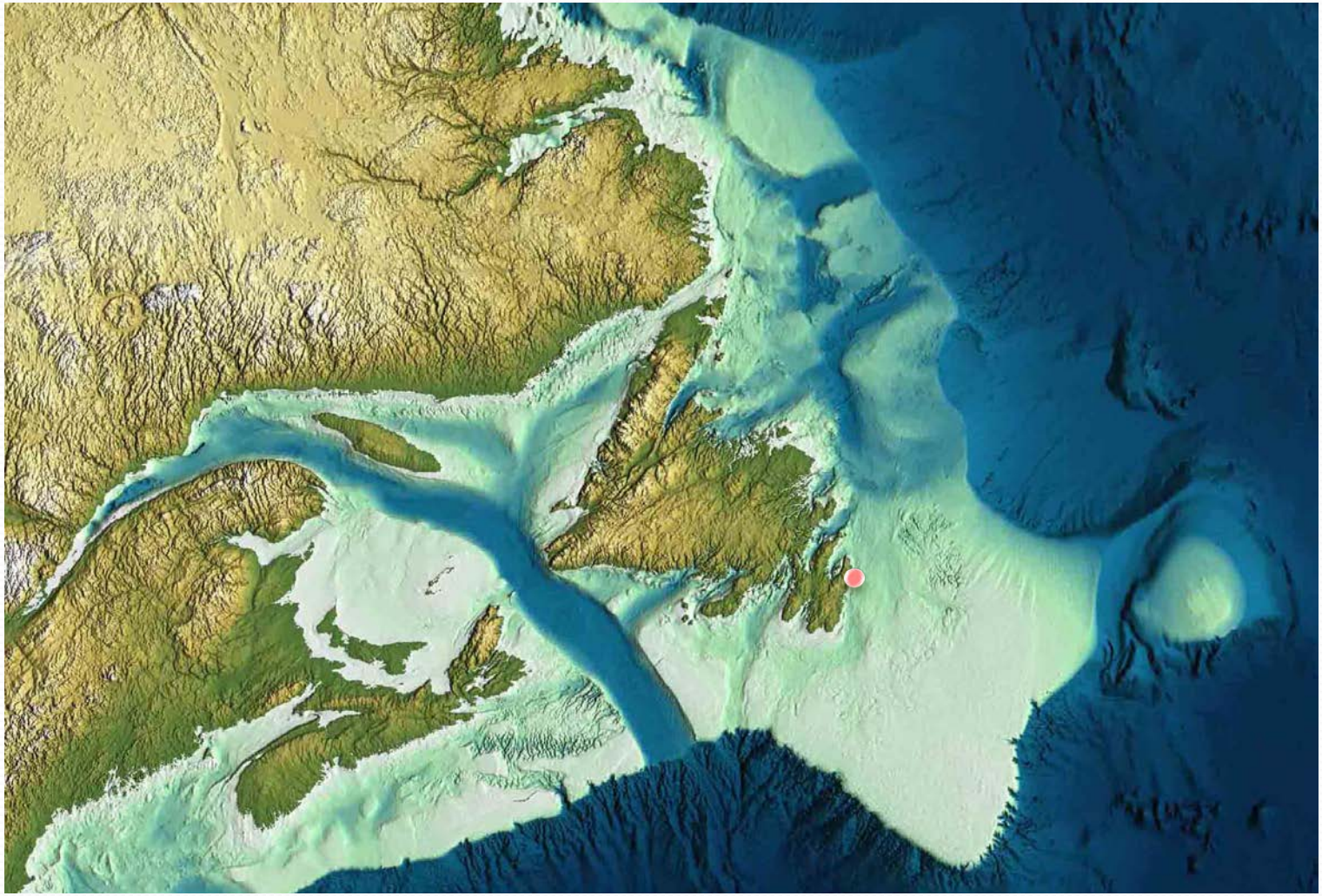

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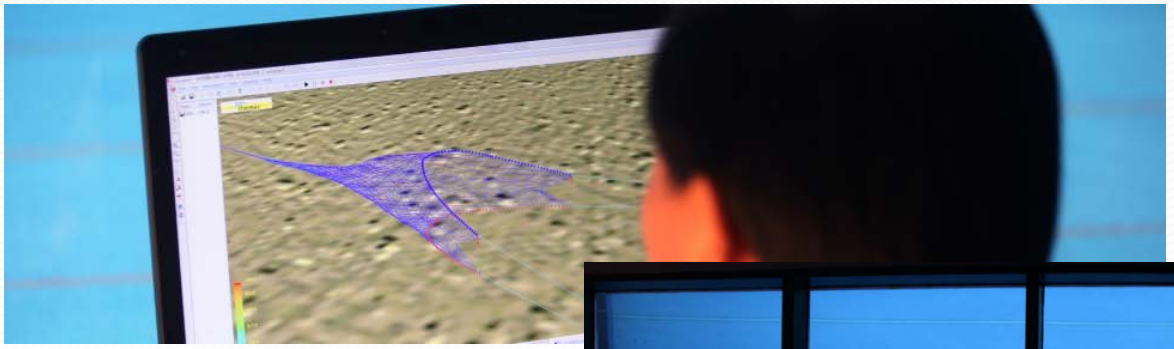
Background

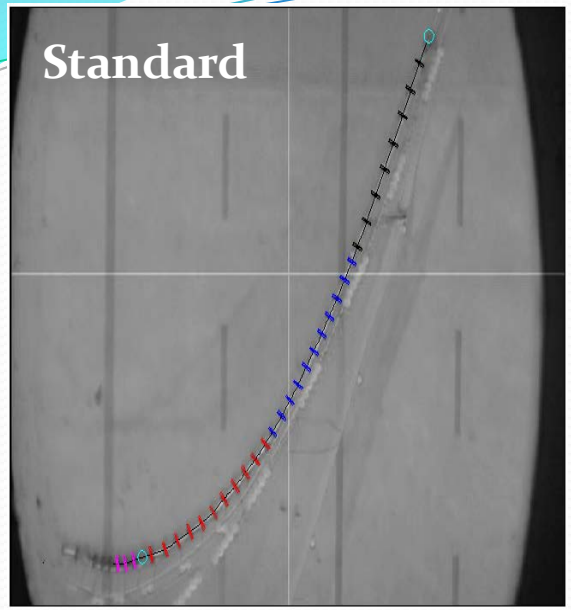
- Canada is one of the world's leading producers of coldwater shrimp.
- 85 thousand tonnes with a landed value of just over $191 million for both inshore and offshore shrimp fisheries.
- Bottom trawling is the only economical means to harvest shrimp.
- Gear modifications help to reduce ecological impacts.

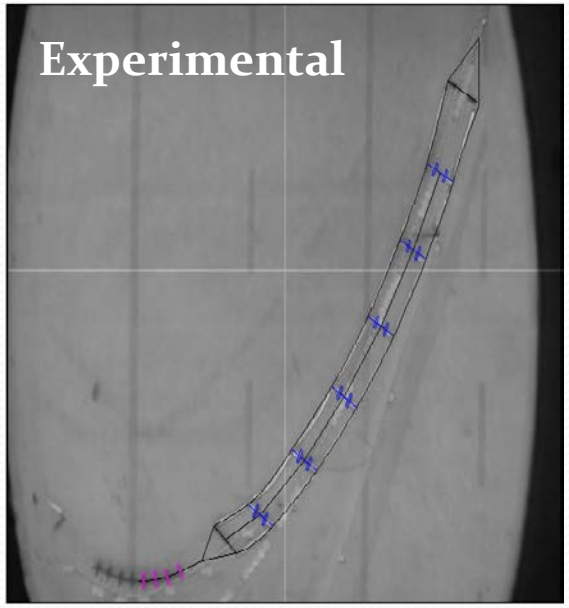
Objectives and Goals

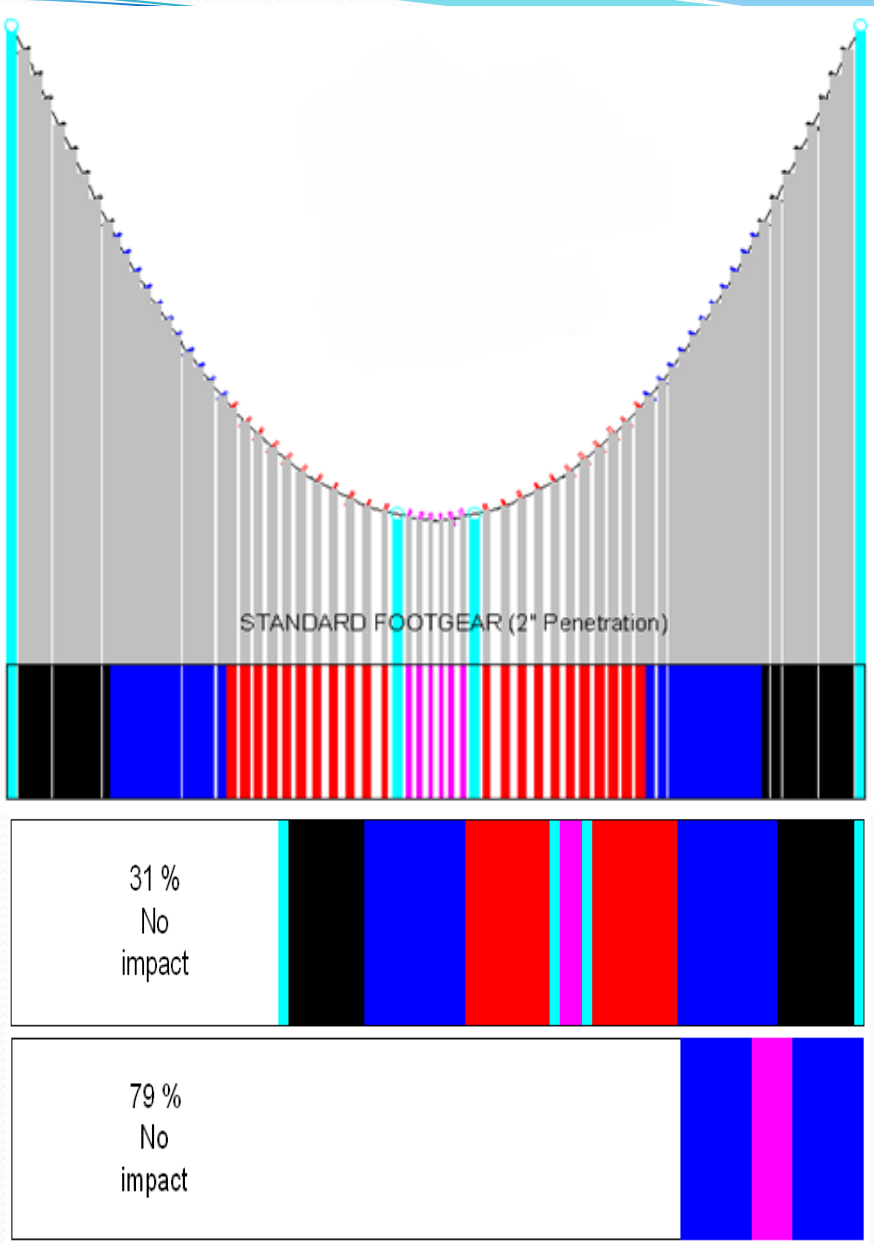
- Design and build an innovative footgear that reduces seabed impact through a reduction in contact area with the seabed.
- Conduct a Comparative Fishing Experiment
  - Catch rates, size of shrimp (shrimp carapace length), number of shrimp per kg, and bycatch (percentage of total catch).
  - Compare experimental trawl with a standard trawl
- Acceptance by industry.
- Note: Bottom impacts were <u>not</u> measured.

Numerical / Physical Modeling / Full-Scale





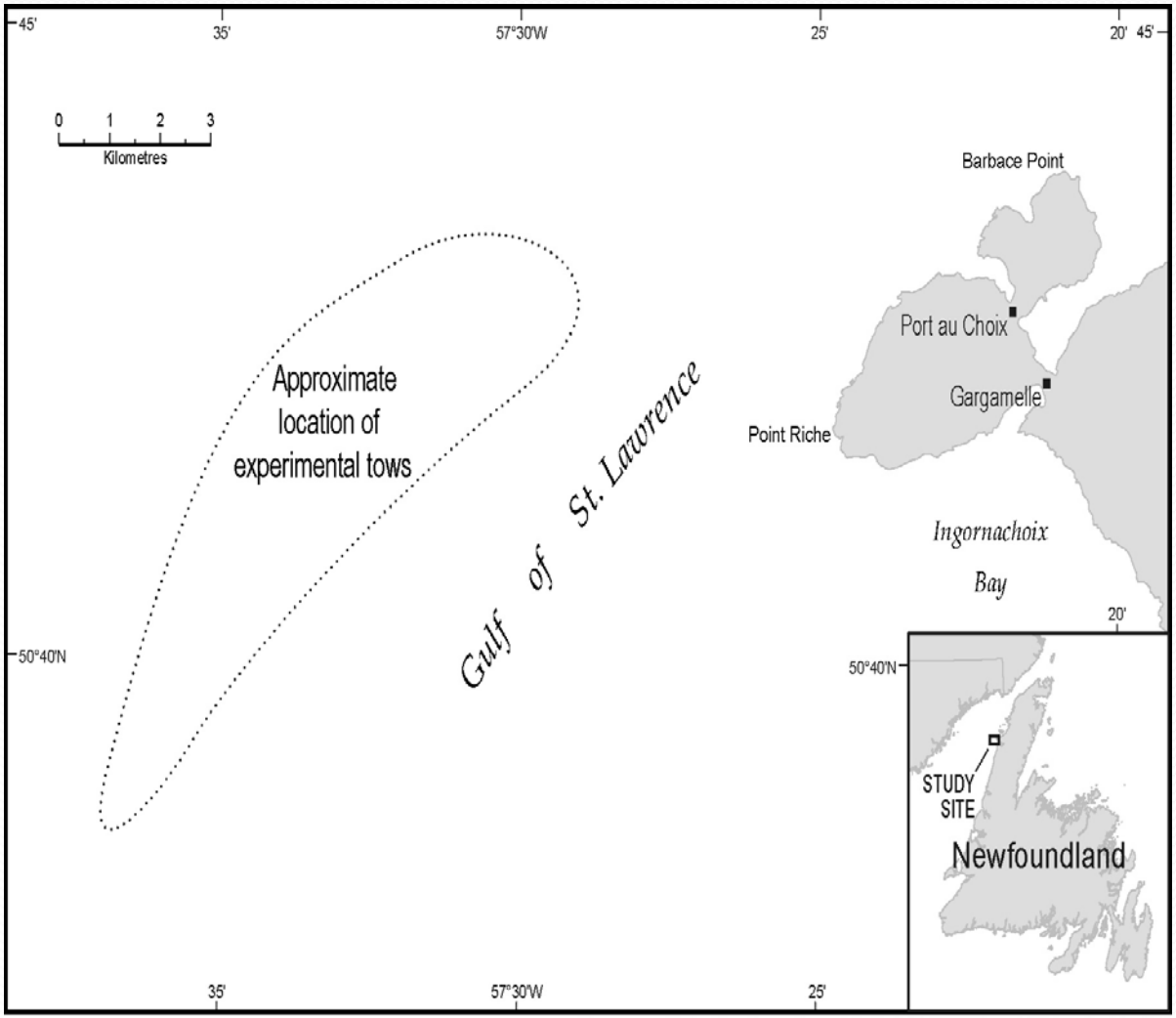




Standard
(69% contact area)

Experimental
(21% contact area)

Study area



Map prepared in the Map Room, Queen Elizabeth II Library Memorial University, July 2013

Trawl section	Standard trawl	Experimental trawl	% Difference
Upper Wing Starboard	92.3	91.5	+ 0.87
Upper Wing Port	92.1	91.6	+ 0.54
Upper Bunt Wing Starboard	46.1	45.5	+ 1.32
Upper Bunt Wing Port	45.5	45.8	- 0.30
Lower Wing Starboard	91.9	91.5	+ 0.44
Lower Wing Port	91.7	92.1	- 0.44
Lower Bunt Wing Starboard	45.7	45.6	- 0.22
Lower Bunt Wing Port	46.0	46.4	- 0.86
Codend Top	42.5	43.7	- 2.78
Codend Bottom	43.4	43.7	- 0.69
Side Panel 1 Starboard	44.9	45.2	- 0.69
Side Panel 1 Port	46.2	45.7	+ 1.09
Side Panel 2 Starboard	45.2	45.7	- 1.09
Side Panel 2 Port	45.8	46.4	- 1.29
Side Panel 3 Starboard	45.5	46.0	- 1.09
Side Panel 3 Port	45.5	45.6	- 0.22
Side Panel 4 Starboard	44.6	45.5	- 1.98
Side Panel 4 Port	44.9	45.0	- 0.22
Side Panel 5 Starboard	45.6	46.1	- 1.09
Side Panel 5 Port	45.6	45.3	+ 0.66
Side Panel 6 Starboard	43.9	44.2	- 0.68
Side Panel 6 Port	44.7	44.6	+ 0.22
First Upper Belly	45.8	45.5	+ 0.66
First Lower Belly	43.5	43.2	+ 0.46
Second Upper Belly	45.9	45.8	+ 0.22
Second Lower Belly	45.1	46.0	- 1.96
Third Upper Belly	45.4	45.2	+ 0.44
Third Lower Belly	45.2	46.0	- 1.74
Fourth Upper Belly	44.7	45.1	- 0.89
Fourth Lower Belly	44.8	44.7	+ 0.22
Extension Piece Top	43.5	42.6	+ 2.11
Extension Piece Bottom	43.1	45.2	- 4.65
Grid Section Top	44.1	44.5	- 0.90
Grid Section Bottom	43.1	42.9	+ 0.47
Extension Top	42.0	42.7	- 1.64
Extension Bottom	42.6	42.5	+ 0.24

Quality control:

Record mesh counts, average mesh size for all 36 panels

Methods

- Using alternate haul method
- 20 paired tows total (15 minute tows)
- Variables measured
  - Overall catch rate (kg of shrimp/min)
  - Shrimp carapace lengths
  - Number of shrimp per kg
  - Trawl geometry
- Bycatch of non-target species.

Preliminary Analysis

- Good trawl geometry
- Steering chains sometimes “kinked up”
- Noticed the footgear occasionally “mudding up”

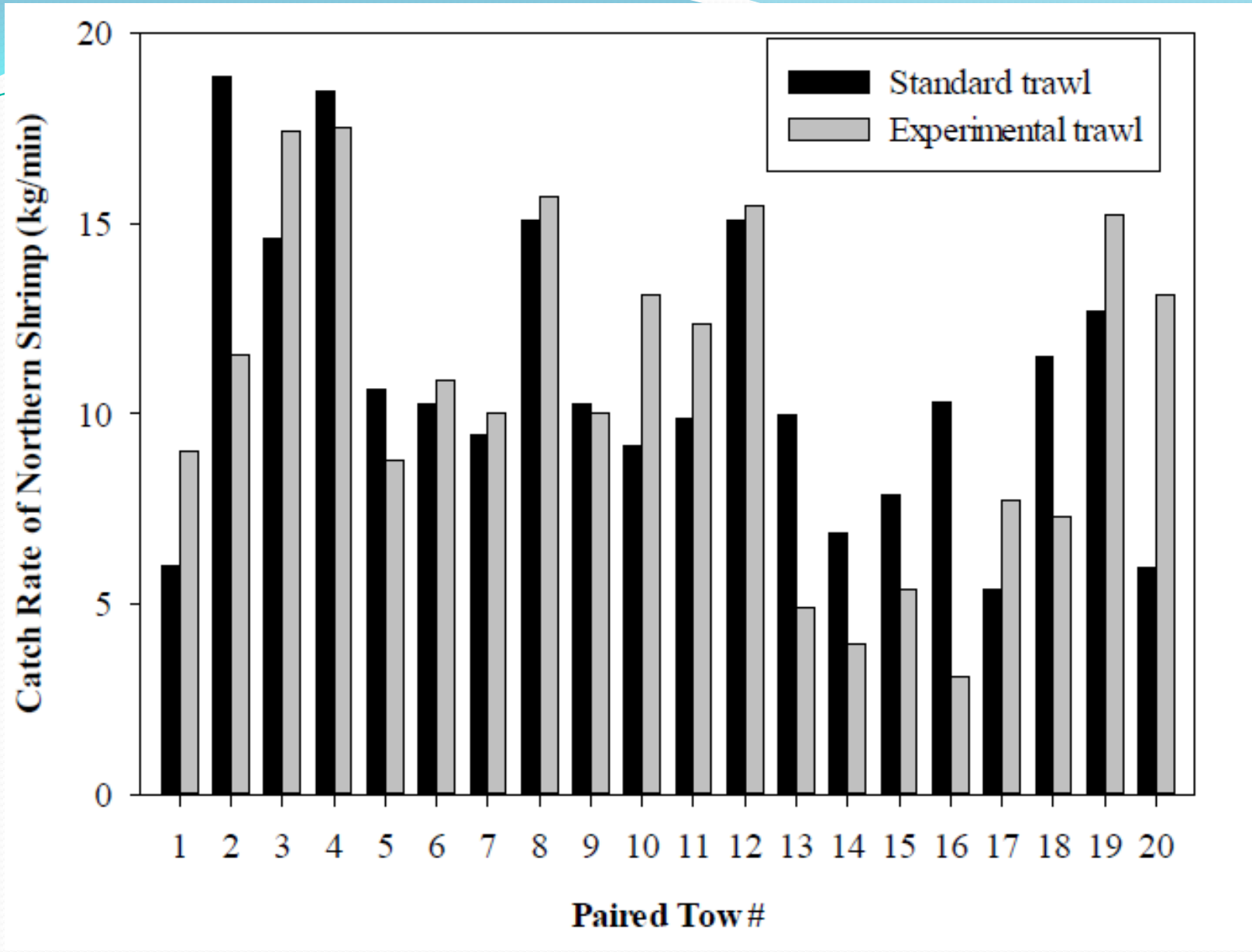


Fig 1: Catch rates of Northern shrimp (40 tows)

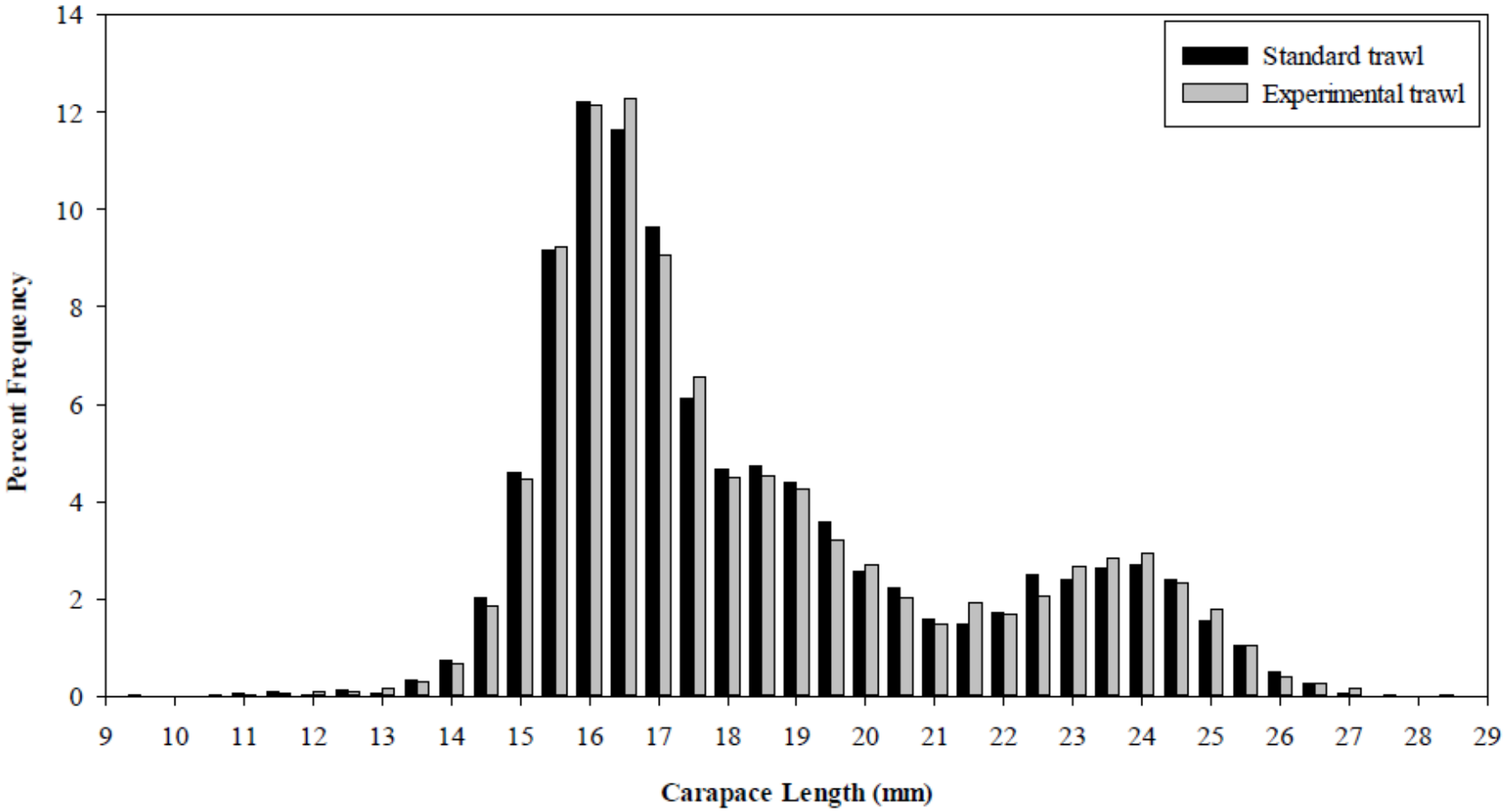


Fig 2: Percent frequency distributions for shrimp carapace length cross 20 paired tows of the standard and experimental trawls.

Table 1: Summary of independent-samples t-tests comparing the effect of trawl type on the mean catch rate of Northern shrimp, carapace length of shrimp, and count per kg of shrimp.

Source	Trawl type	No. of tows	Mean	SE	Analysis		
					df	t-statistic	p-value
Catch rate (kg/min)	Standard	20	10.92	0.87	38	0.502	0.619
	Experimental	20	10.63	0.98			
Carapace length (mm)	Standard	20	18.06	0.11	38	0.840	0.406
	Experimental	20	18.21	0.13			
Count per kg (#/kg)	Standard	20	241.51	6.03	38	0.406	0.687
	Experimental	20	237.80	6.86			

Table 2: Summary of independent-samples t-test comparing the effect of trawl type on the mean percent contribution of total catch of all bycatch species combined.

Trawl type	No. of tows	Percent of total catch (%)		Analysis		
		Mean	SE	df	t-statistic	p-value
Standard	20	1.55	0.25	38	2.138	0.039*
Experimental	20	2.31	0.34			

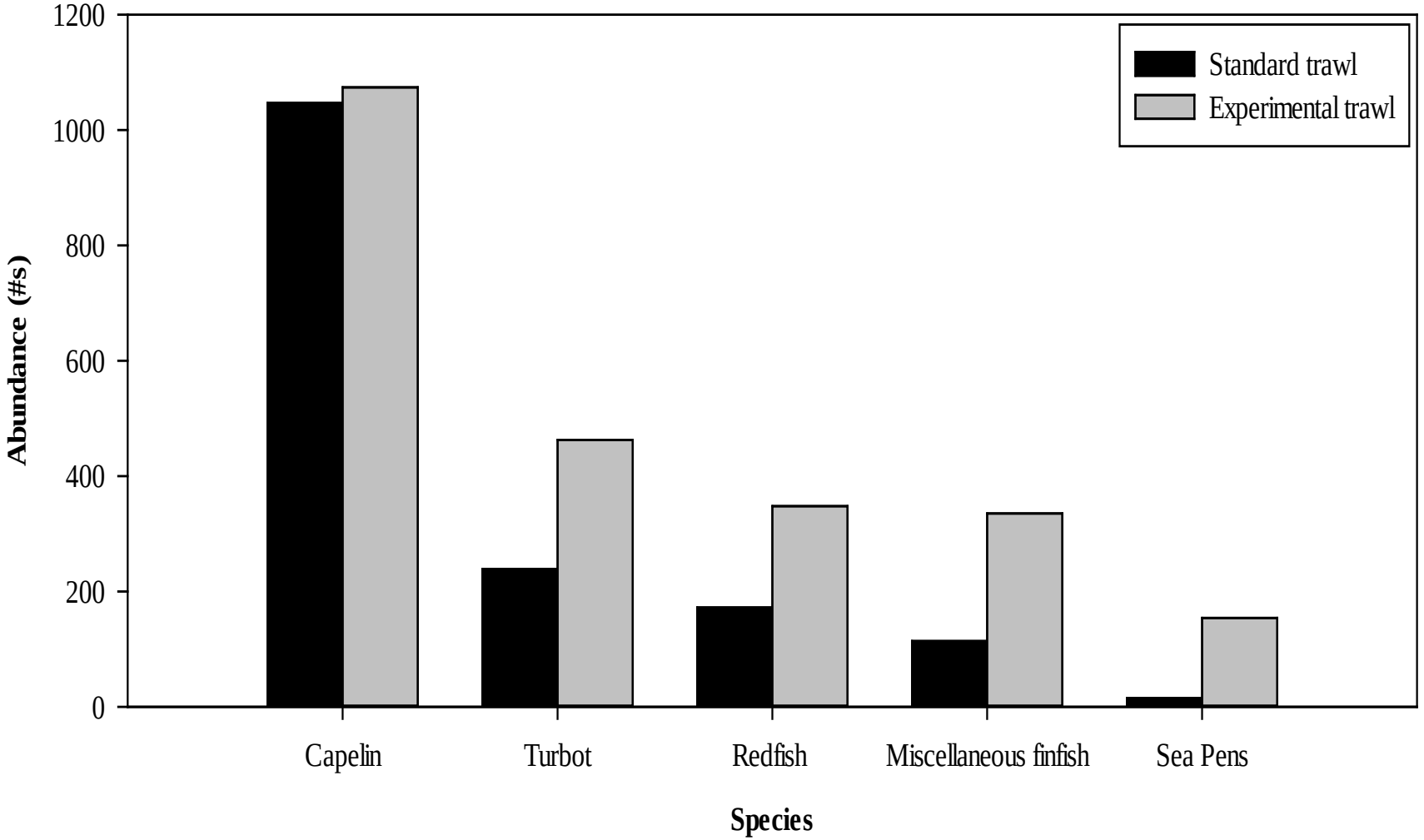


Figure 1: Abundance of non-targeted bycatch species captured in the standard and experimental trawls. The abundance of the three major bycatch species (capelin, turbot, and redfish) and the miscellaneous finfish species (Atlantic cod, eelpout, skate, grey sole, silver hake, Atlantic mackerel, sandlance, eel, alligator fish, and lantern fish) as well as the major soft coral captured, the sea pen, are illustrated.

Summary

- Mixed results….
- Flume tank trials revealed a potential decrease in contact area from 69% to 21%.
- No statistically significant differences in shrimp catch rates, count/kg, and shrimp carapace length between the two trawls.
- However there was a greater abundance of bycatch for all species captured in the experimental trawl.
- Soundbite: sometimes things that look great in a flume tank….don't necessarily pan-out at sea.

Our Next Steps

- Complete our statistical treatment of the dataset
  - Length based analysis of bycatch
- Continue tinkering – steering chains require additional improvement!

Thank you

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