

MARINE MAMMAL-LONGLINE BYCATCH WORKSHOP, 22-25 OCTOBER 2013



Assessment of the efficiency of « spiders » and net sleeves as depredation mitigation measures in pelagic longline fishery

Njaratiana RABEARISOA ⁽¹⁾, Pascal BACH ⁽¹⁾, Christophe GUINET ⁽²⁾

⁽¹⁾ Institut de Recherche pour le Développement, La Réunion, France

⁽²⁾ CEBC-CNRS, Villiers-en-Bois, France





Outline

- ❖ Context
- ❖ Depredation mitigation measures tested in the SWIO
- ❖ Spiders and net sleeves
- ❖ DEPREL
- ❖ Conclusion and perspectives



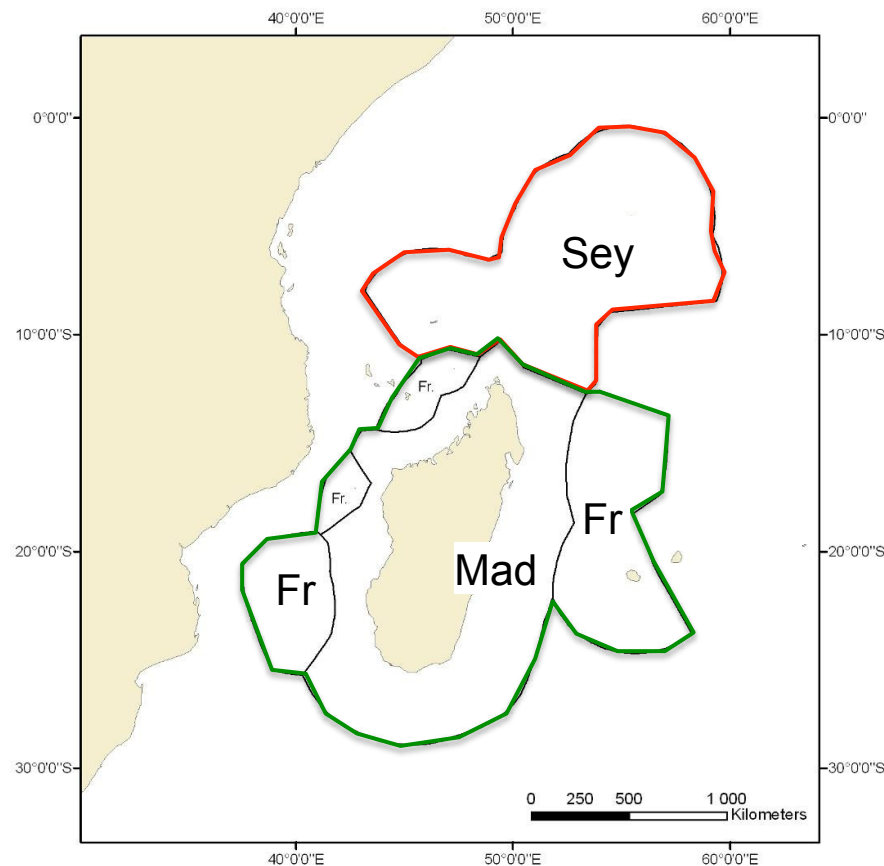
Context

IOTC, Seychelles, July 2007: 1st symposium dedicated to depredation in pelagic longline fisheries

- ❖ The Indian Ocean is impacted by depredation as well
- ❖ Depredation affecting longline fisheries in the south-west Indian Ocean is poorly documented



Pelagic longlining in Reunion Island and in Seychelles



Seychelles longlining fleet

- Started in 1995
- 9 vessels (2009)
- Landings: 296t (2009)

Reunion longlining fleet

- Started in 1991
- 37 vessels (2009)
- Landings: 2181 t (2009)



Target species



Swordfish (*X. gladius*)



Yellowfin tuna (*T. albacares*)



Bigeye tuna (*T. obesus*)



Albacore tuna (*T. alalunga*)

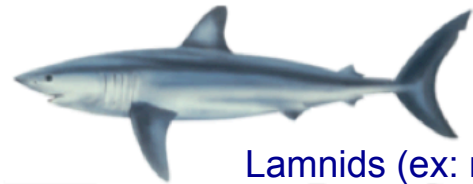


Depredation and pelagic longline fishery

❖ Pelagic sharks



Carcharinids (ex: blue shark)



Lamnids (ex: mako shark)



Sphyrnids (ex: great hammerhead shark)



Alopiids (ex: thresher shark)

❖ Toothed whales



Short-finned pilot whale (*G. macrorhynchus*)

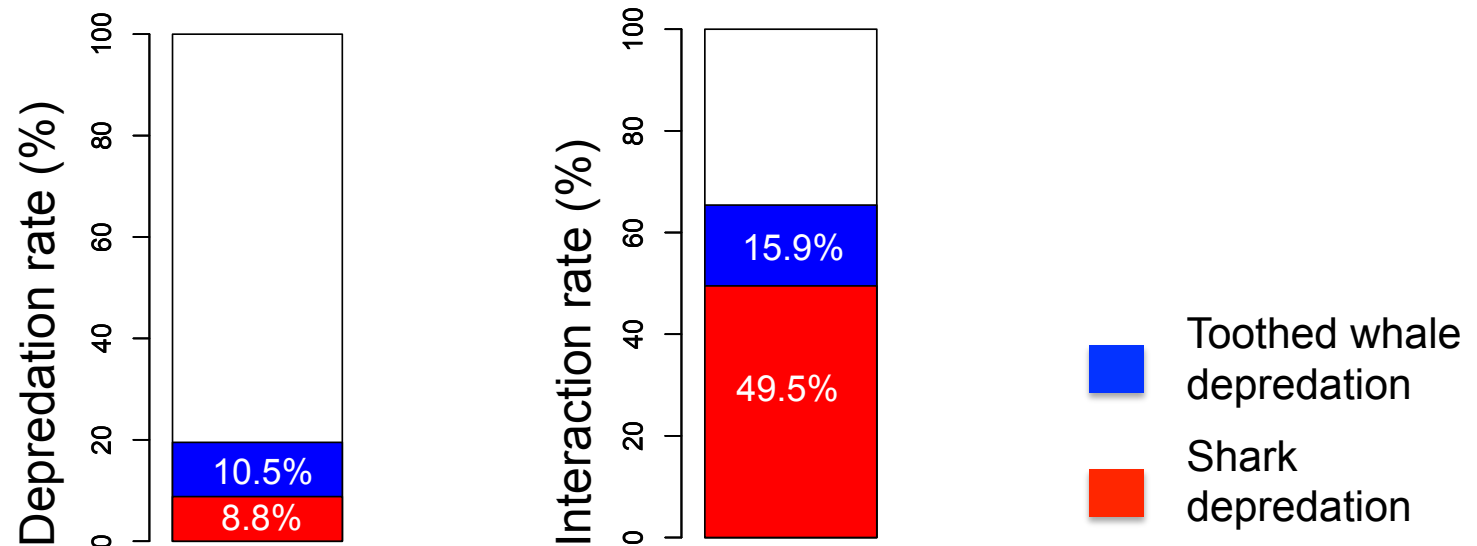


False killer whale (*P. crassidens*)



Impacts of depredation by sharks and toothed whales on the domestic pelagic longline fishery in Seychelles (in prep)

Depredation extent in Seychelles

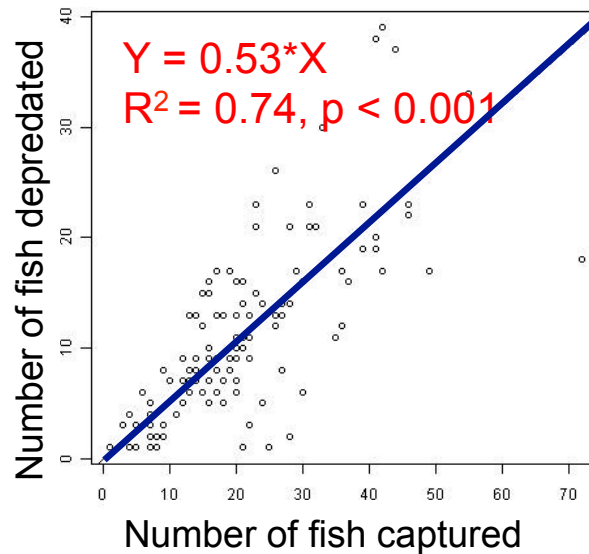


- ❖ Global depredation rate: 19.5%
- ❖ Shark depredation is more frequent
- ❖ Financial loss: ≈19,000€ (USD 23,000) per year and per boat

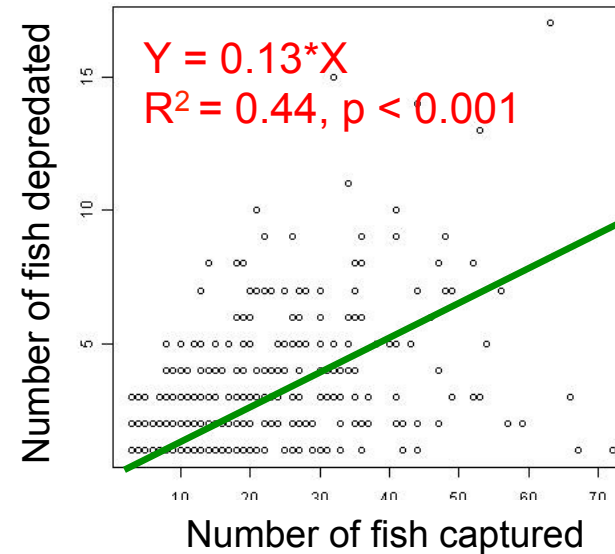


Depredation rate per depredation event

Odontocetes



Sharks



$$\text{Slope ratio} = \frac{0.53}{0.13} = 4$$



Toothed whale depredation
leads to more catch loss



Outline

- ❖ Context
- ❖ Depredation mitigation measures tested in the SWIO
- ❖ Spiders and net sleeves
- ❖ DEPREL
- ❖ Conclusion and perspectives

DEPREDATION MITIGATION MEASURES TESTED IN THE SWIO



Acoustic method

- ❖ AQUAmark 100 acoustic porpoise deterrent
- ❖ 23 instrumented longlines set between Oct 2000 and Jan 2001
- ❖ 50 deterrents, one every 200m (protect between 10 and 30% of the entire longline)



Conclusions

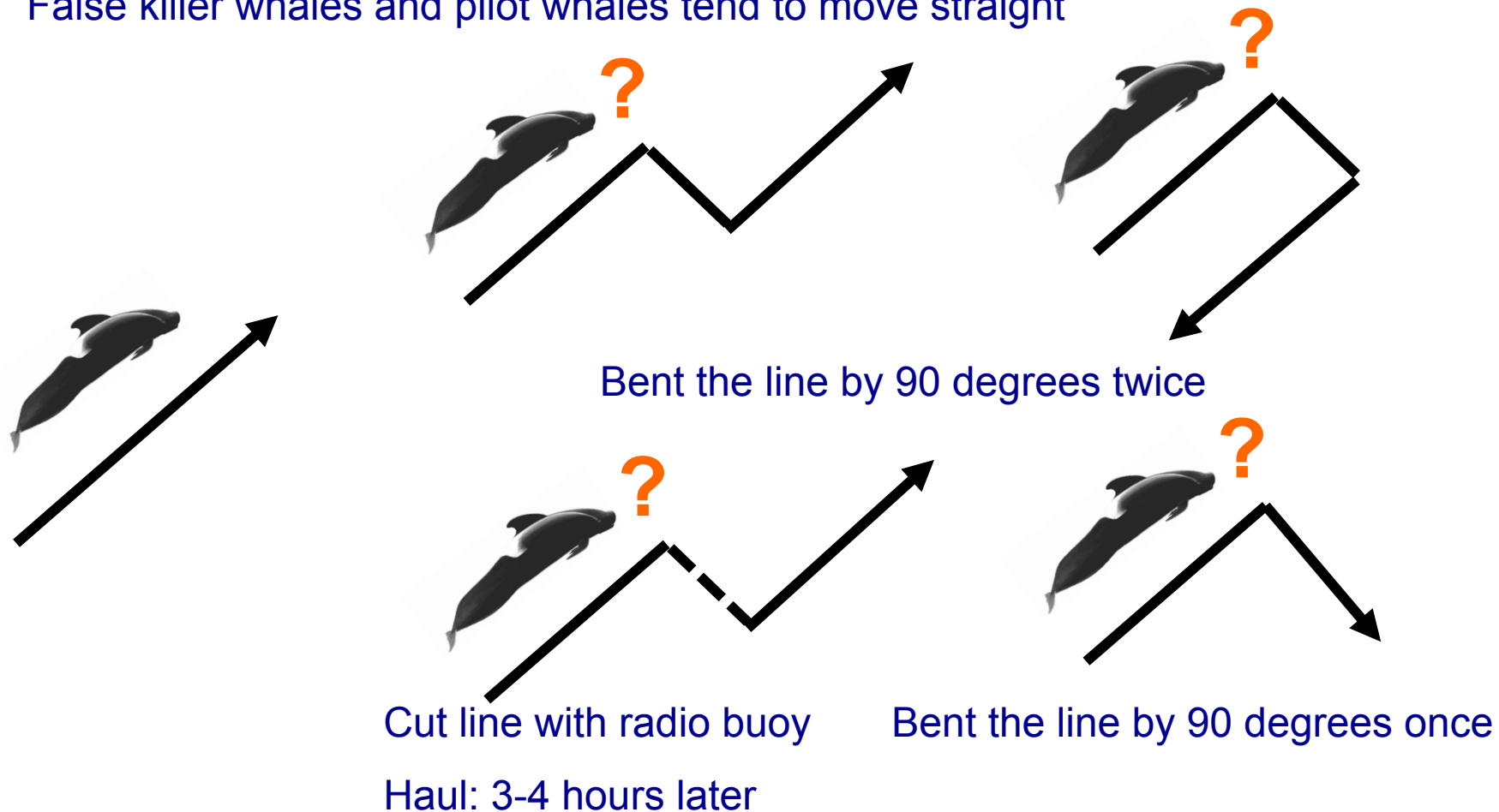
- ❖ Low quantity of data, no possible assessment of the efficiency of the deterrents regarding depredation and their neutrality regarding the catchability of targeted species
- ❖ Expensive, low lifespan, hard to set up

DEPREDATION MITIGATION MEASURES TESTED IN THE SWIO



Operational method: line alteration

False killer whales and pilot whales tend to move straight





Outline

- ❖ Context
- ❖ Depredation mitigation measures tested in the SWIO
- ❖ **Spiders and net sleeves**
- ❖ DEPREL
- ❖ Conclusion and perspectives

Modelling indices of shark and toothed whale depredation impacting the Seychelles pelagic longline fishery (in prep)

SPIDERS AND NET SLEEVES



Rabearisoa N., Guinet C., Tixier P., Bach C. Pelagic longline fishing trials to shape a mitigation device of the depredation by toothed whales. Journal of Experimental Marine Biology and Ecology, 432-433: 55–63.

Spider



8 legs-device covering the fish

Net sleeve

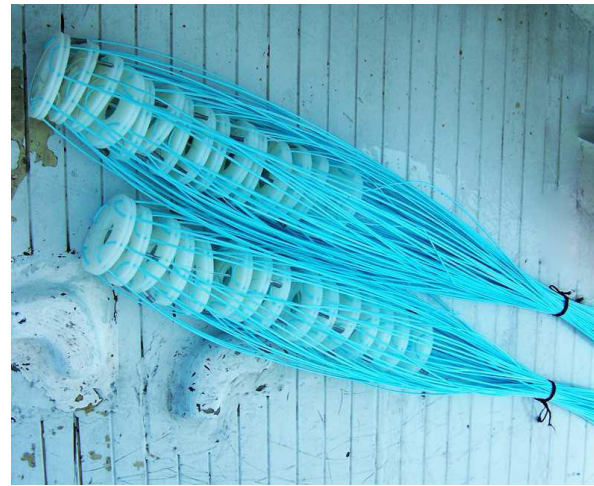
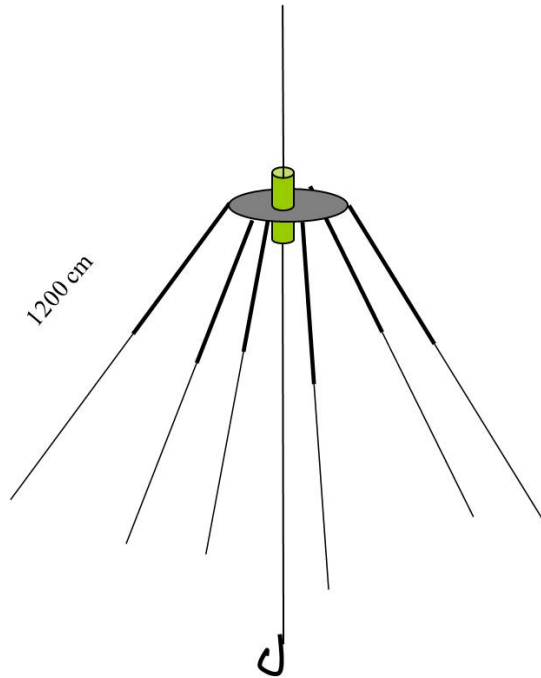


Fiberglass mosquito netting device
hiding the fish

SPIDERS AND NET SLEEVES

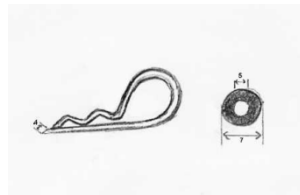
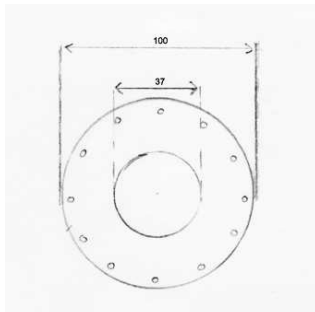


Survey #1: Spiders (Nov. 2007)



Deterrent device made up of:

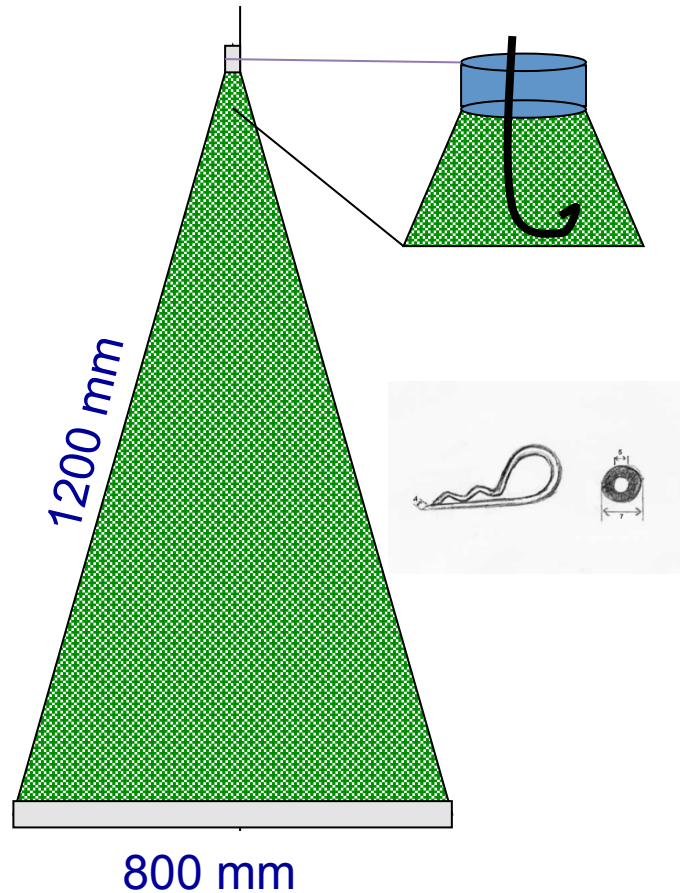
- a 10 mm thick plastic disc (radius 100 mm) with 16 evenly spaced holes on its outer range
- a triggering system
- four 2400 mm polyester strands inserted and hung to make eight 1200 mm hanging legs



SPIDERS AND NET SLEEVES

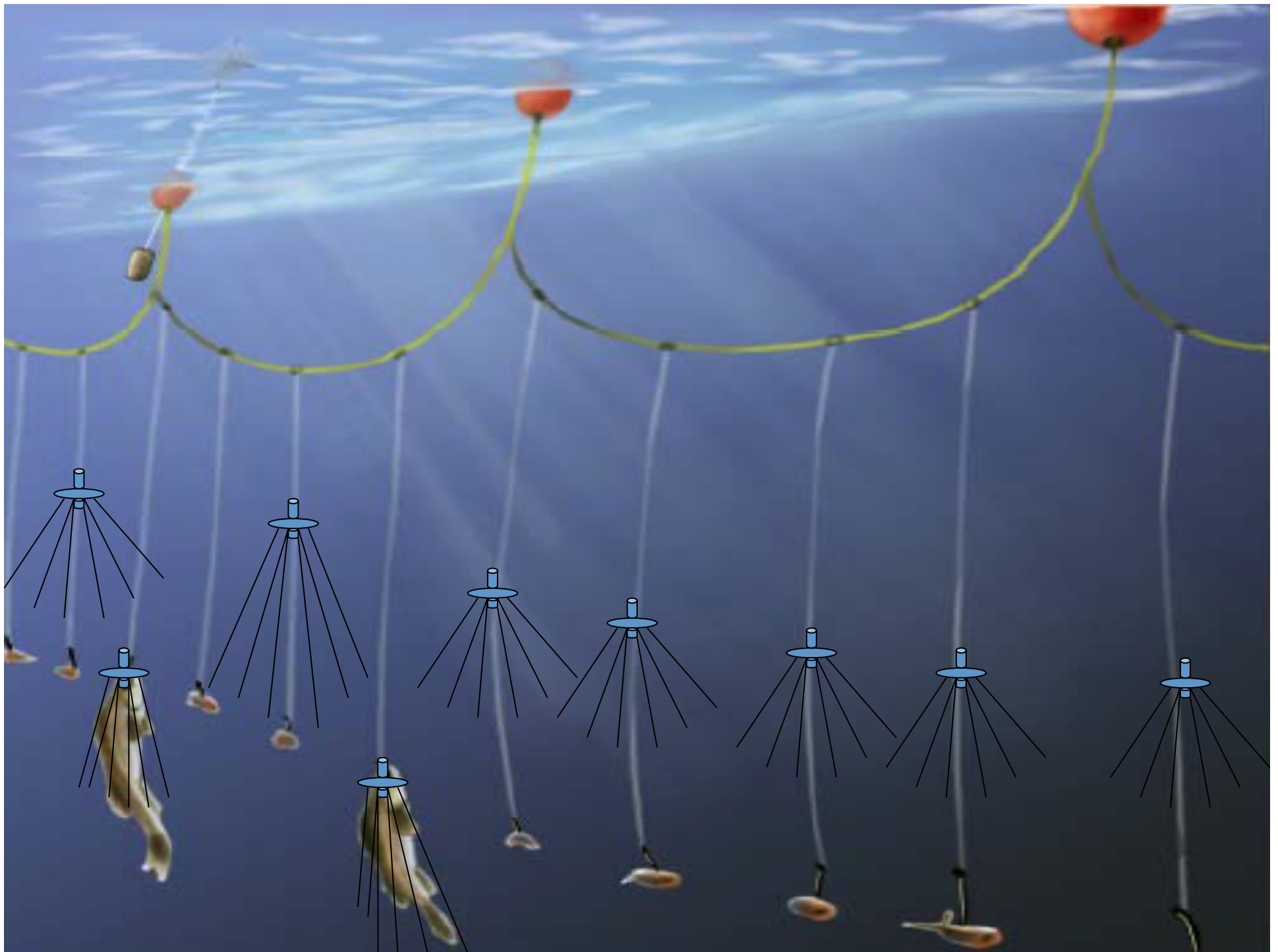


Survey #2: Net sleeves (Nov. 2008)



Net sleeve made up of:

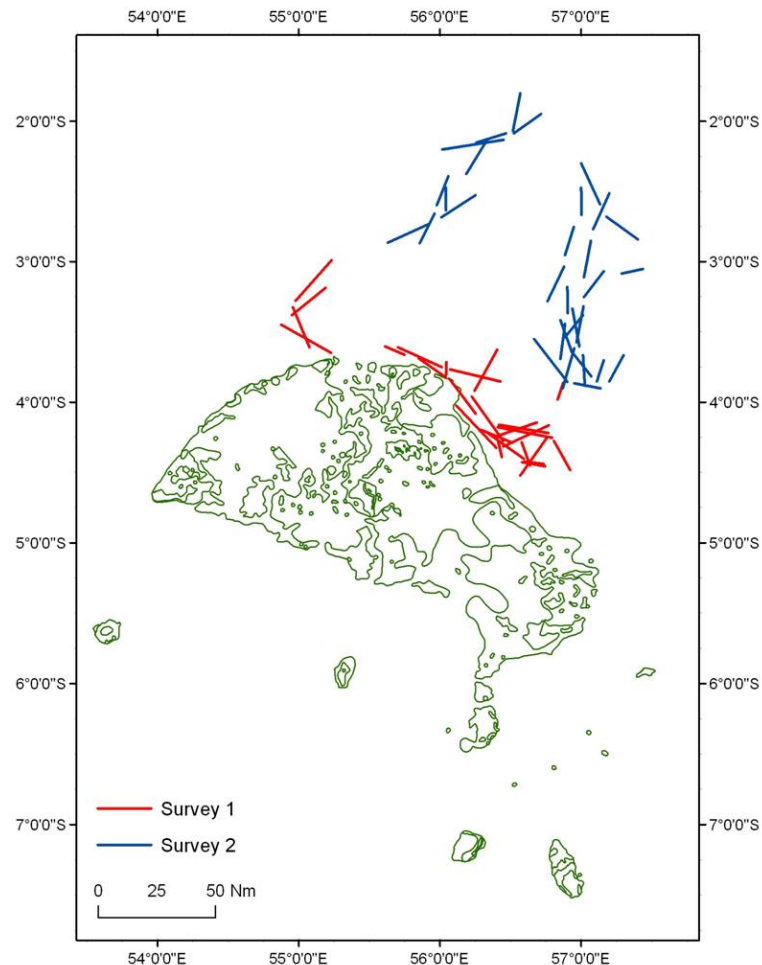
- fibreglass mosquito netting or propylene fiber net
- metallic or plastic hoop
- small lead weights



SPIDERS AND NET SLEEVES



Methodology



Spiders (November 2007)

- ❖ 26 fishing operations (2 longlines equipped with 480 hooks per day)
- ❖ 60 to 222 devices deployed per day

Net sleeves (November 2008)

- ❖ 32 fishing operations (2 longlines equipped with 425 hooks per day)
- ❖ 20 to 30 devices deployed per day





Technical results: efficiency of the devices

		Spider			Net sleeve		
Satisfaction rate		😊	😊😊	😊😊😊	😊	😊😊	😊😊😊
Depredation mitigation properties	Fish coverage (proportion of correctly covered fish)			80%	15%		
	Efficiency	0.74			No data		

$$\text{Efficiency} = \frac{\text{Proportion of protected and undepredated fish}}{\text{Proportion of unprotected and undepredated fish}}$$

> 1 : efficient device

< 1 : inefficient device



SPIDERS AND NET SLEEVES



Operational results: user-friendliness

		Spider			Net sleeve		
Satisfaction rate		😊	😊😊	😊😊😊	😊	😊😊	😊😊😊
Setting	Attachment on the branchline						
	Sinking of the branchline						
Fishing	Trigger rate (with capture)			87%		62%	
	Trigger rate (without capture)			9%		26%	
Hauling	Traction on the branchline						
	Entanglement rate		4%		18%		
	Storage on board						





Results summary

☑ Positive points

- ❖ Assessment of the expectations of fishermen and the constraints related to open sea fishing operations
- ❖ First trials of a physical depredation mitigation device on board a pelagic longliner and under professional fishing conditions
- ❖ Ecologically neutral device, without any impact on the ecosystem

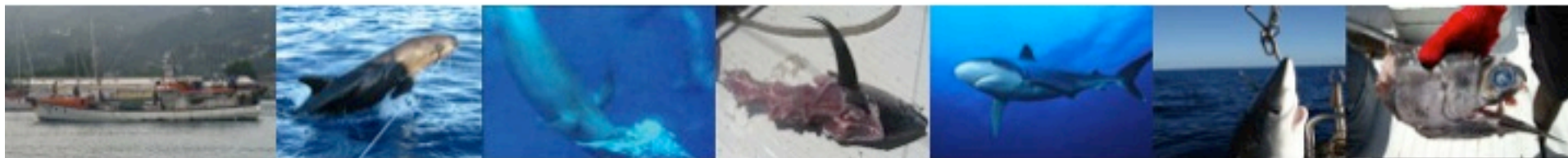
☒ Negative points

- ❖ Bulky device, hard to manipulate
- ❖ Protective aspect still to be improved



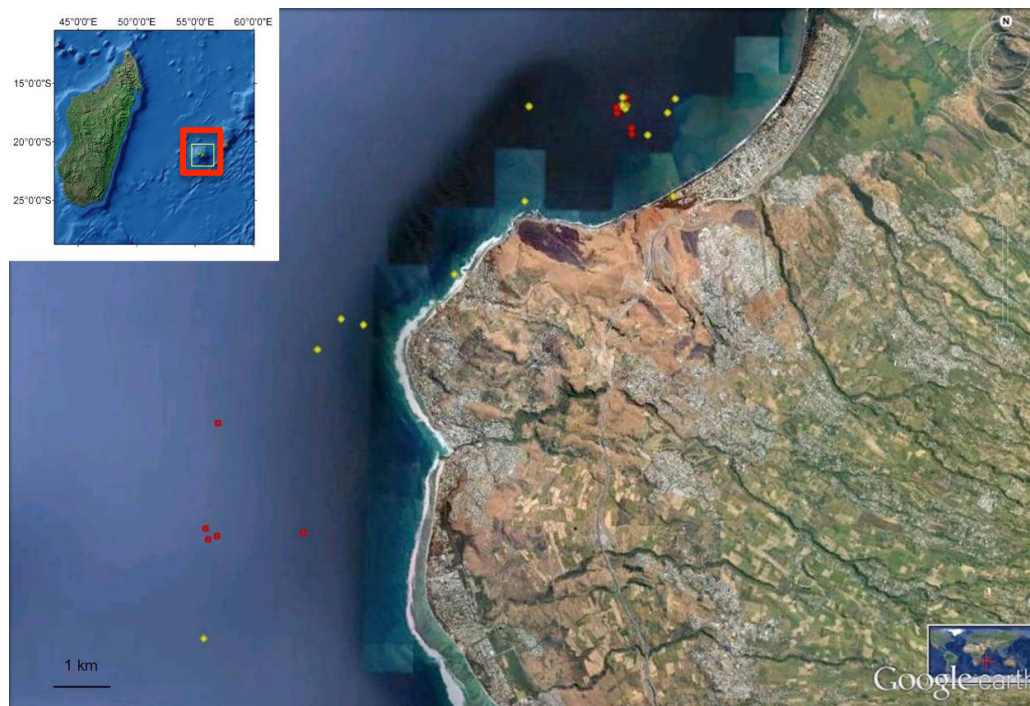
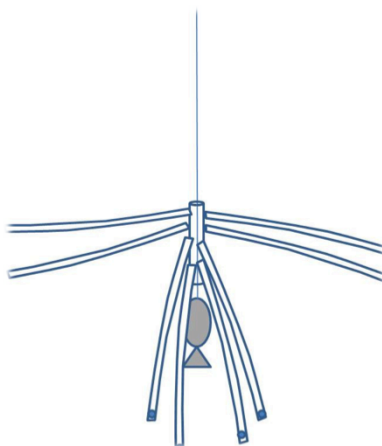
Outline

- ❖ Context
- ❖ Depredation mitigation measures tested in the SWIO
- ❖ Spiders and net sleeves
- ❖ **DEPRED**
- ❖ Conclusion and perspectives



Testing harmless devices in the interaction between baits and dolphins to mitigate toothed whales depredation in pelagic longlining (in prep)

DEPRED (DEPREDAtion mitigation device by preventing predator attacks and protecting capture)





First step of DEPRED experiments (August 2010)



Objective

Assessing the efficiency of DEPRED by comparing the dolphins' behavior towards platforms with branchlines equipped or not with DEPRED devices

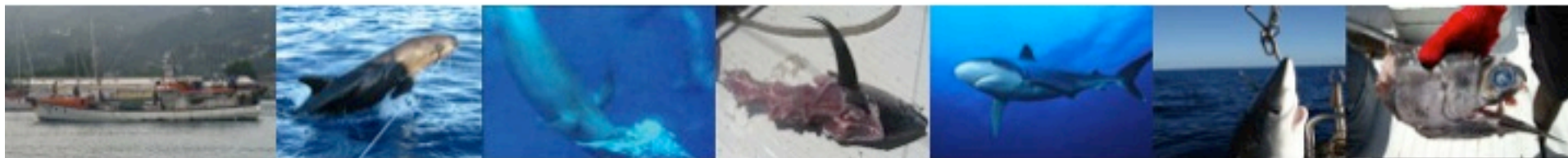


First step of DEPRED experiments (August 2010)

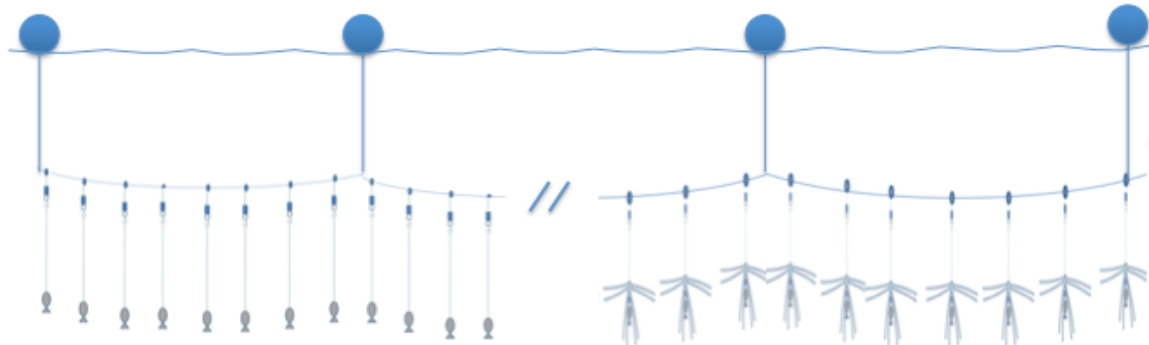
Experiment #	Number of platforms set	Species	Without DEPRED		With DEPRED	
			Number of bait set	Number of bait depredated	Number of bait set	Number of bait depredated
2	4	<i>Tursiops aduncus</i>	15	7	0	0
4	4	<i>Tursiops aduncus</i>	3	2	12	0
7	2	<i>Tursiops aduncus</i>	4	0	4	0



Dolphins encountering the device for the first time stayed and turned around the support at a given distance while they attacked the bait on unprotected branchline

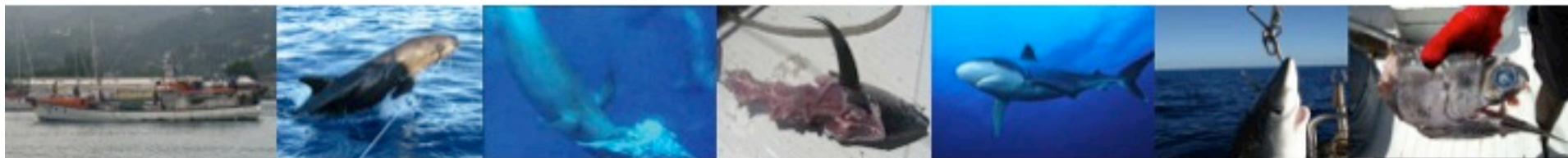


Second step of DEPRED experiments (March-June 2011)

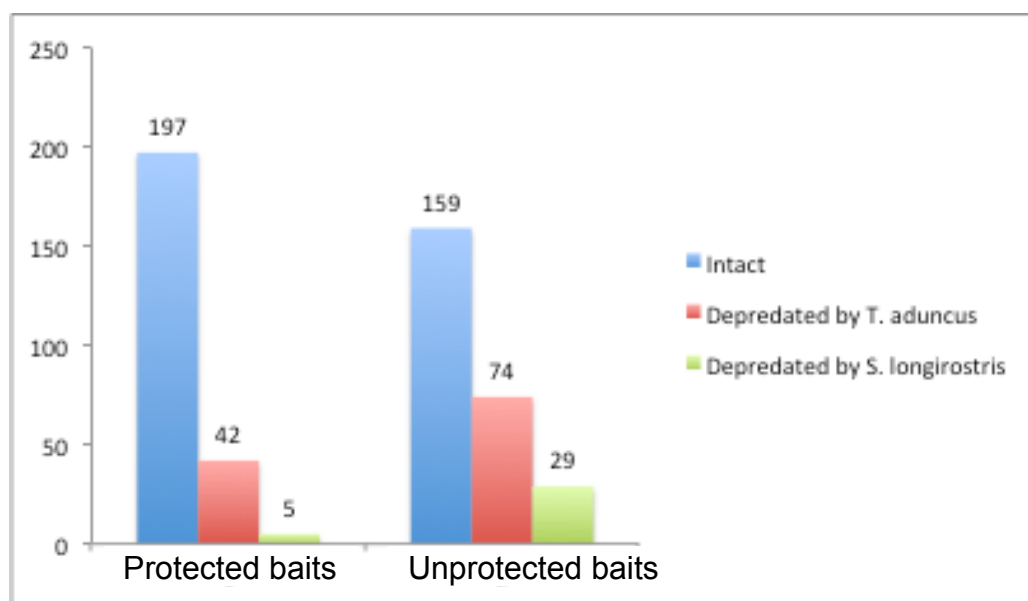


- ❖ 500 meters long experimental longline
- ❖ 40 baited branchlines equipped with DEPRED
- ❖ 40 baited unprotected branchlines





Second step of DEPRED experiments (March-June 2011)



9 sets out of 20 impacted by dolphin depredation

For 8 sets out of 9:
Number of damaged unprotected baits > Number of damaged protected bait

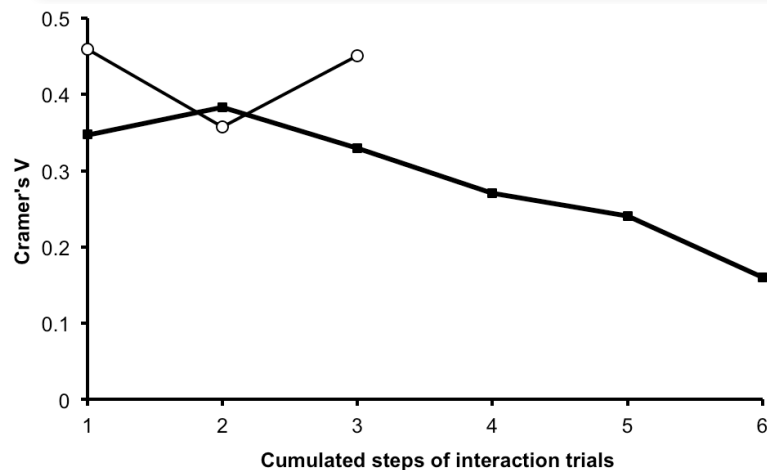
		With DEPRED	Without DEPRED
Total number of baits		339	330
<i>T. aduncus</i> depredation rate (%)	Mean	17.6	31.6
	Range	7.5 - 40	10.3 - 67.5
<i>S. longirostris</i> depredation rate (%)	Mean	6.7	35.5
	Range	2.5 - 15	17.9 - 65



Second step of DEPRED experiments (March-June 2011)

Cramer's V coefficient

- ❖ Measure of the association between nominal variables, ranging from 0 to 1 (0: no association; 1: perfect correlation)
- ❖ Null hypothesis: similarity of interactions between dolphins and bait, whatever the bait configuration (protected or not)



Trend of the Cramer's V calculated for cumulated steps of interaction trials between baits and dolphin species (black square: *T. aduncus* ; white circle: *S. longirostris*)

Decline of the depredation mitigation effect of the DEPRED after the second longline set for *Tursiops aduncus* while this mitigation effect remained stable after the third longline set for *Stenella longirostris*



Outline

- ❖ Context
- ❖ Depredation mitigation measures tested in the SWIO
- ❖ Spiders and net sleeves
- ❖ DEPREL
- ❖ Conclusion and perspectives



Lines of inquiry

- ✓ Definition of an optimal depredation mitigation device

CONCLUSION AND PERSPECTIVES



Definition of an optimal depredation mitigation device

- ❖ Significantly reduces depredation
- ❖ Should not affect target species catchability
- ❖ Should not alter fish quality
- ❖ Cheaper than the loss induced by depredation
- ❖ Harmless for fishermen and predators
- ❖ Easy and quick to use
- ❖ Easy to store
- ❖ Biodegradable if lost
- ❖ Reusable



Lines of inquiry

- ✓ Definition of an optimal depredation mitigation device
- ✓ DEPREDD
 - ⇒ Ongoing work to
 - improve the average depredation mitigation rate and the coverage skills of DEPREDD
 - add an automatic triggering system
 - ⇒ Offshore tests onboard professional longliners (to be done)



Lines of inquiry

- ✓ Definition of an optimal depredation mitigation device
- ✓ DEPREDD
 - ⇒ Ongoing work to
 - improve the average depredation mitigation rate and the coverage skills of DEPREDD
 - add an automatic triggering system
 - ⇒ Offshore tests onboard professional longliners (to be done)
- ✓ Lack of information about depredation process
 - ⇒ Experimental longlines to study behavioural ecology of individuals involved in depredation and better understand depredation mechanism



Thank you for your attention.