

fishing practices could be involved in. Data analyzed came from fishermen logbooks and scientific cruises and covered the 2004-2006 period, representing a total of 705 fishing operations. The proportion of sets impacted by toothed whale depredation was 16% while the proportion of damaged fish reached 58% when toothed whales interacted with longlines. Toothed whale global depredation rate reached 10.7%. Logistic regression analysis and generalized additive models showed that both depredation occurrence and rate were positively related to the abundance of target fish, suggesting the co-occurrence of toothed whales in areas of high concentration of pelagic fish. Obviously, alternative fishing practices cannot be considered as an efficient way to mitigate depredation. Consequently we investigated fishing gear improvement by deploying a technology designed to physically protect the hooked fish by hiding them to predators. The efficiency of "spiders" was tested during a fishing trial of 26 longline fishing operations when 12,480 hooks and 1,970 devices were set. 117 fish were caught on branchlines equipped with spiders and among those devices, 87.3% were correctly triggered and 80% of capture were correctly protected. While more trials should be carried out to deeply verify the efficiency of "spider" devices, we remain convinced that the consideration of the fishing gear technology might be more actively investigated to propose innovative measures to mitigate toothed whale depredation in pelagic longlining.

Context

- **Depredation** = damage or removal of fish from fishing gear by predators (toothed whales in our context)
- Depredation leads to negative impacts on (i) ecology, behaviour and conservation of the species involved, (ii) quality of fishery statistical data and (iii) economy of the fishery sectors (for the Seychelles longline fishery considered in the study, the commercial loss reached 12K\$/boat/year, and depredation rate reached 10.7% of number of catches/year)

Objectives

- Identify risky fishing practices for longline fishery targeting swordfish
- Assess physical protection of capture as depredation mitigation measure

Species involved



- Short-finned pilot whale (*Globiocephala macrorhynchus*)
- False killer whale (*Pseudorca crassidens*)

Damage characteristics

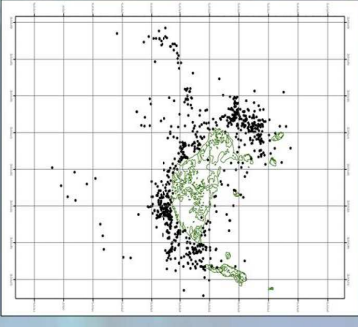
- high damages on fish caught (only heads left over)
- traces of conical teeth
- large bites with ragged border



Risky fishing practices identification

Study area and data

Fishing sets location around Mahe plateau

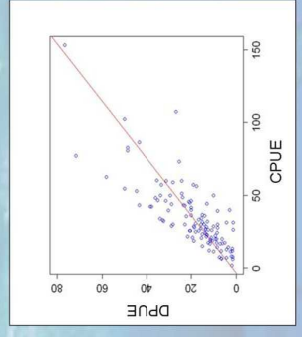


- 705 longline sets (2004 to 2006) in Seychelles EEZ from both commercial operations & scientific surveys
- 112 sets depredated only by toothed whales (depredation occurrence rate = 16%)

Results

Total DPUE vs total CPUE

$$DPUE = 0.51 * CPUE + 1.57 \quad (R^2 = 0.8, p < 0.01)$$



- Toothed whales damage in average 50% of the total catch per fishing set

Logistic regression analysis (depredation occurrence)

- * Depredation is more frequent
 - in areas with high CPUE
 - in the south-west of Mahe plateau

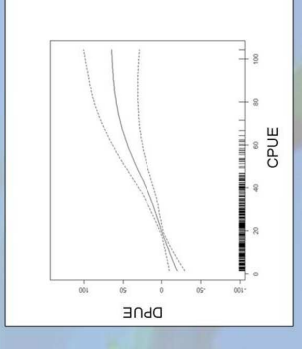
Statistical approach

Response and explicative variables used for GAM and logistic regression analysis

Response variables
DPUE (nb of depredated fish per 1000 hooks)
Depredation occurrence (presence/absence)
Covariates
Hooks number (fishing effort)
Time of fishing
Soaking time
Fishing area
Season
Bathymetry
Proximity to the shelf break
CPUEs (nb of target species and bycatch per 1000 hooks)

GAM analysis (depredation volume)

Estimated nonparametric smooth of CPUE

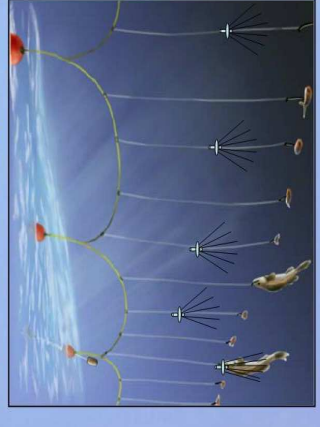


- * Positive correlation between depredation and CPUE
- * Spatial trends for toothed whale depredation:
 - higher in the south-west of Mahe plateau
 - higher near the shelf break

Assessment of the "spider" as depredation mitigation device

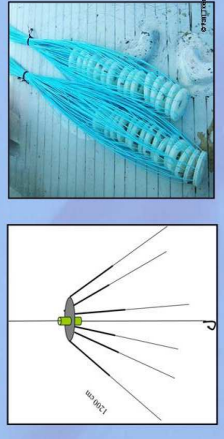
Survey design

Configuration of the longline equipped with spiders



Design of the spider device

Configuration and storage of the spider



- Physical mitigation device made up of:
- a 10 mm thick plastic disk (radius = 100 mm)
 - eight 1200 mm long hanging legs
 - a triggering system (beta pin and elastic ring), activated

Results

Spiders & depredation



1. & 2. Depredated swordfish and tuna covered with a spider
3. Captured tuna covered with spider

- Depredation on branchlines equipped with spiders only occurred on 2 sets out of 26
- 4 fish out of 22 were covered with spiders and

Functional & operational results

Triggering rate (device release in presence of catch)	87%
Intempestive triggering rate (device release without catch)	9%
Coverage rate (correctly covered fish)	80%
Entanglement rate (% of untriggered spiders entangled with the line)	9%
Loss rate (% of spiders lost at sea)	5%

Positive results:

- Efficiency of the triggering system
 - Great implication of the fishermen
 - Satisfying coverage of the catch
- Issues:**
- Strong manual tension required while