Depredation by sharks and toothed whales on pelagic longlining in Seychelles waters: identification of risky fishing practices

Njaratiana Rabearisoa [1*], Vincent Lucas[2], Christophe Guinet [3], Pascal Bach [1]

[1] IRD, UR 212 EME, 16 rue Claude Chappe, 97420 Le Port, La Réunion
[2] Seychelles Fishing Authority, BP 449, Victoria, Seychelles
[3] CEBC-CNRS, 79360 Villiers en Bois, France
* Corresponding author: njaratiana.rabearisoa@ird.fr

Context

Depredation = damage or removal of fish from fishing gear by predators (# predation = hunt of free ranging fish)

• Depredation leads to negative impacts on (i) ecology, behaviour and conservation of the species involved, (ii) fishery statistical data and (iii) economy of the fishery sectors (for the Seychelles longline fishery considered in the study, the commercial loss reached 25K$ /boat/year)

• The fishing area of concern is a region with one of the highest depredation rates in the world (~20% of number of catches/year)

Objectives

• Qualitative and quantitative depredation indicators: shark vs toothed whale depredation

• Identify risky fishing practices for longline fishery targeting tuna and swordfish

Species involved and identification

• Pelagic sharks :
  * blue shark (*Prionace glauca*)
  * whitetip shark (*Carcharhinus albimarginatus*)
  * silky shark (*Carcharhinus falciformis*)…

• Biting identification
  - clean-cut edges
  - several small bites
  - sporadic damage of the catch

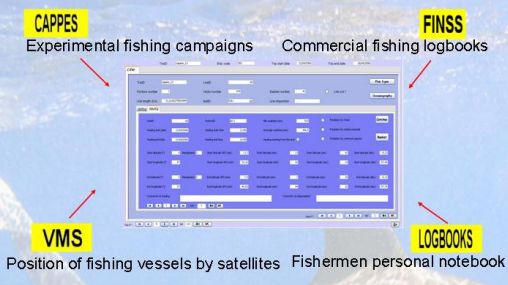
• Toothed whales :
  * false killer whale (*Pseudorca crassidens*)
  * short-finned pilot whale (*Globicephala macrorhynchus*)

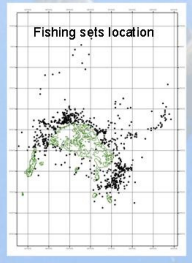
• Biting identification
  - high damage of individual fish (only heads left over)
  - traces of conical teeth
  - large bites with ragged border
  - high damage of the catch

Material and methods

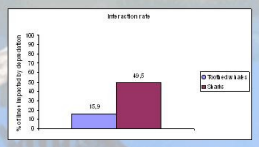
Data

• Database produced from different sources of information:





• 705 longline sets (2004 to 2006) in Seychelles EEZ from both commercial operations & scientific surveys



• Interaction rate with the line (% of lines affected by depredation): shark depredation is three times more frequent than toothed whale depredation

• No depredation co-occurrence by sharks and toothed whales (349 were depredated by sharks and 112 were depredated by toothed whales)

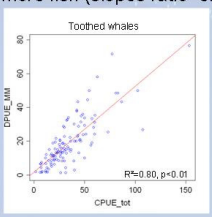
Statistical approach

• Statistical methods: GAM and logistic regression

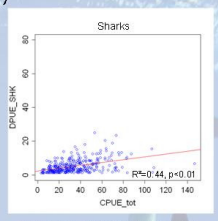
Response variables	Covariates
DPUE (nb of depredated fish per unit effort)	Hooks number
Dep. rate (nb of depredated fish/ total catch)	Time of fishing
Nb of depredated fish	Soaking time
Depredation occurrence (presence/absence)	Fishing area
	Season
	Bathymetry
	Proximity to the shelf break
	CPUEs (tuna, swordfish, sharks, other fish)

Results

* When depredation occurs on a fishing set, toothed whales damage six times more fish (slopes ratio=6.37)



DPUE_MM=0.51*CPUE+1.57



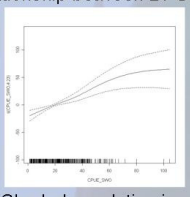
DPUE_SHK=0.08*CPUE+2.24

$$\frac{\text{slope}\left(\text{DPUE}_{\text{MM}} = f(\text{CPUE})\right)}{\text{slope}\left(\text{DPUE}_{\text{SHK}} = f(\text{CPUE})\right)} = 6.37$$

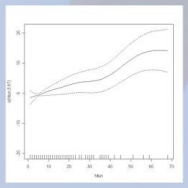
* Yield (CPUE-DPUE) is lower when toothed whale depredation occurs

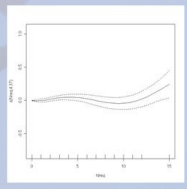
• **Logistic regression analysis (depredation occurrence)**
  * Toothed whale depredation is more frequent
    - in areas with high CPUE
    - in the south-west of Mahe plateau
  * Shark depredation is more frequent
    - in the north-west of Mahe plateau

• **GAM analysis (depredation volume)**
  * Toothed whale depredation increases with the CPUE, confirming the previous relationship between DPUE and CPUE



* Shark depredation increases with:
  the number of fish caught the number of sharks caught





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

* No spatial trends for shark depredation

Discussion - Conclusion

• Depredation mainly occurs in the richest fishing areas, suggesting the co-occurrence of sharks, toothed whales and target fish in the same foraging areas (even if depredation co-occurrence by sharks and toothed whales was not observed).
• Depredation events by sharks are more frequent, but depredation by toothed whales leads to greater damage.
• No seasonal trends appeared, neither regarding shark nor toothed whale depredation.
• Regarding the fishing strategy, no recommendation on the fishing practice can be made to reduce depredation. However, if depredation occurs mainly during daytime, night time hauling should be an alternative depredation mitigation measure. Further commercial surveys must be carried out to test this hypothesis.
• Future research: development of depredation mitigation devices and gear technology, knowledge improvement of the behaviour of the main predatory species.