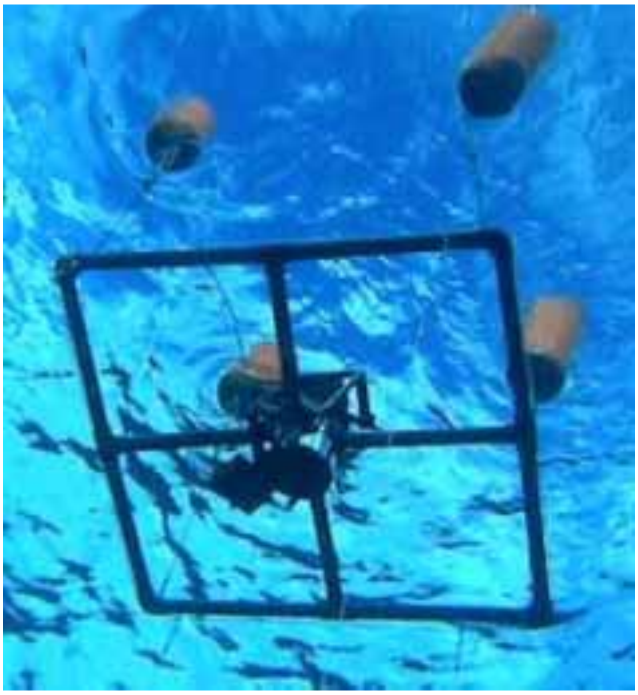
Institut de recherche pour le développement

Marine mammal depredation and pelagic longline fishery: assessment of the efficiency of a scaring mitigating device in Saint-Paul Bay (Reunion Island)



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1. Introduction

Depredation is defined as the removal of fish or bait from fishing gear by marine predators such as in priority sharks and toothed whales and is opposed to predation, which is the catch of free ranging fish (Donoghue et al., 2003). It is documented worldwide and is known in many fisheries but opposite to bottom longline fishery targeting toothfish (*Dissostichus eleginoides*), pelagic longline fisheries targeting tuna (*Thunnus* spp) and swordfish (*Xiphias gladius*) received less interest from the scientific community regarding this issue. In the Indian Ocean, this phenomenon is characterized by a lack of data. Only a few papers deal with this problem (Nishida and Shiba, 2004 ; Sivasubramanian, 1964 ; Poisson et al., 2001 ; Romanov et al., 2007)

In tropical areas, depredation on pelagic longline capture involves false-killer whales (*Pseudorca crassidens*), pilot whales (*Globicephala macrorynchus*) and pelagic sharks, and depredation on bait involves small delphinids, such as spinner dolphins (*Stenella longirostris*) or Risso's dolphins (*Grampeus griseus*).

The monitoring of the extent and magnitude of depredation is of a great importance since it leads to many negative consequences affecting commercial aspects (expenditure of extra money when fixing damaged gear and/or moving away to avoid areas of high depredation rate, loss of fish), biological aspects (change in hunting behavior of cetaceans, risks of injury or mortality when interacting with fishing gear, threats by fishermen) and assessment aspects (increase of fishing effort, fish loss not taken into account in stock analysis) (Donoghue et al, 2002).

Many mitigation measures have been tested so far but none of them proved to be efficient speaking of long term (Jefferson and Curry, 1995). Most research are currently focusing on the use of active and passive acoustic means to deter depredation from cetaceans. They can be efficient at short term but are found to create opposite effect at medium term as they are used as an acoustic attractor by cetaceans (Mooney et al., 2009 ; Brotons et al., 2008 ; Franse, 2005).

There are good evidences that cetaceans use their sight to locate the gear and/or the boat, follow them and depredate the fish caught. In order to mitigate depredation events and then reduce interactions between toothed whales and longline close to the gear, we propose to develop the physical protection of capture. The goal of this study is to test the efficiency of scaring devices protecting physically catches and frightening predators. As a first step of those experiments, we chose to work at a small scale by conducting surveys in Saint-Paul Bay, located in the south-western of La Reunion Island. We tested those devices on a coastal species of small delphinids, the bottlenose dolphin (*Tursiops aduncus*), which is known to be resident within the study area (Dulau-Druot et al, 2008).

2. Materials and methods

Study area and biological material

Our surveys started on July 19th, 2010, four days a week (and are still going on). These surveys aimed at searching for dolphins and assessing the efficiency of our scaring devices on them. The study area extended from the Saint-Gilles harbor to Saint-Paul Bay, and was restricted to the coastal waters (up to 60 m deep). Surveys started at 07.00 am and ended at 11.30 am.

Before testing those depredation mitigating devices at a larger scale on pelagic longliners operating in open waters, we chose to work at a small scale with resident dolphins. In the case we obtain positive results, we will develop those experiments at a larger scale onboard fishing vessels and in real fishing conditions on the species involved in catch depredation.

Description of the scaring device

The general principle of our mitigating system is the scaring effect it could have on marine mammals. We designed them based on the tori lines towed behind longliners, attached from a high point at the stern and consisting of a backbone from which streamers hang down at regular intervals. Those tori lines aim at scaring marine birds, preventing them from accessing the baited hooks and getting caught on the longline (Keith, 1999).

Two similar square PVC frameworks of one meter side, which we will call "devices", were maintained at the sea surface by four buoys at each corner and equipped with four baited branchlines of five meters long (Fig 1.a and 1.b). The "scaring" consists of six or eight streamers of one meter long made up of tarpaulin material and fixed on a PVC tube. The branchline was inserted into the PVC tube of the scaring device, and the bait was fixed at its end by a knot (**no hook was used to avoid risks of injury on dolphins**). The lower strands of the frightener were leaded so that they covered the bait. The upper ones were equipped with water balls so that they can move more freely, causing a scary effect on the dolphins and preventing them from taking the bait (Fig. 1.f). Both devices were equipped with a video camcorder, enclosed in a waterproof housing and fixed at the center of the framework, recording the behavior of the dolphins interacting with the bait (Fig 1.c and 1.d). The branchline can be baited with unprotected fish (Fig. 1.e) or protected one (Fig. 1.f).

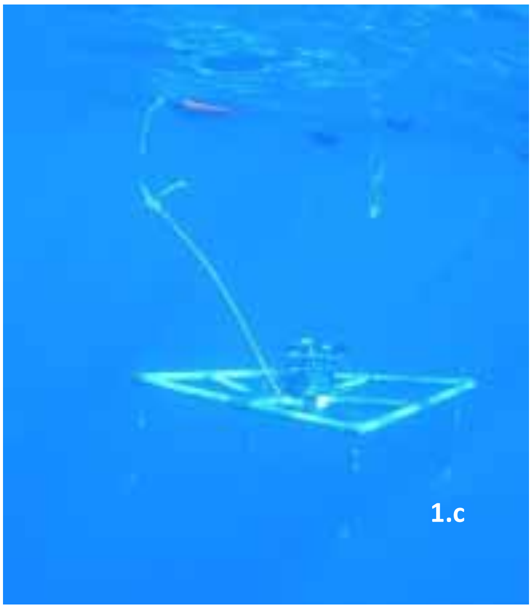
Experimental protocol

Surveys started by an area prospection to search for dolphins. When we found a group, we put the devices in the water (Fig. 2.a). During the first surveys, both devices were unequipped with scarings in order to observe the interaction between dolphins and unprotected baits, and assessing whether the general configuration of our devices don't scary them. Then, we put one baited device equipped with scarings and another one without scarings (both in the vicinity of the group). That allowed us to compare the dolphins' behavior towards both of them. With a kayak, a diver went near the devices and swam around them with a camera to take some underwater photos of the dolphins and the devices (Fig. 2.b and 2.c).

Data collection consisted in recording the geographical position of the study area, the characteristics of the dolphins group (size, species and physical particularities of some individuals…), the current strength, and the state of the bait before and after their interaction with the dolphins (whether they were damaged or not). A minimum of 3 and a maximum of 6 people embarked onboard the boat.

Fig. 1.a: PVC frame equipped with a camrecorder

Fig. 1.b: Underwater device equipped with buoys



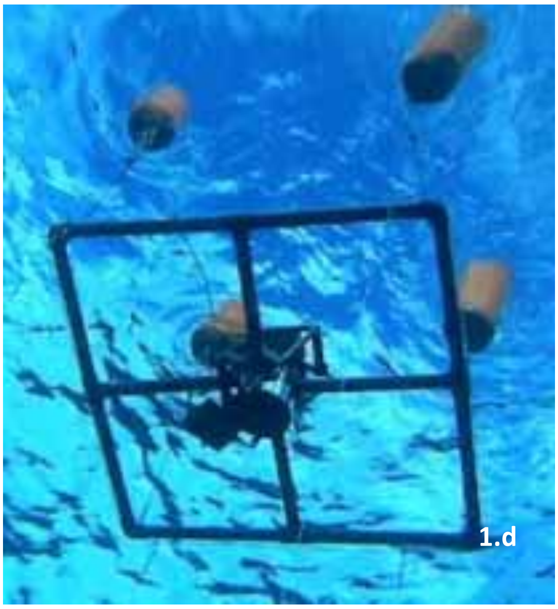


Fig. 1.c & 1.d: PVC frame equipped with a camcorder, 4 branchlines and 4 buoys

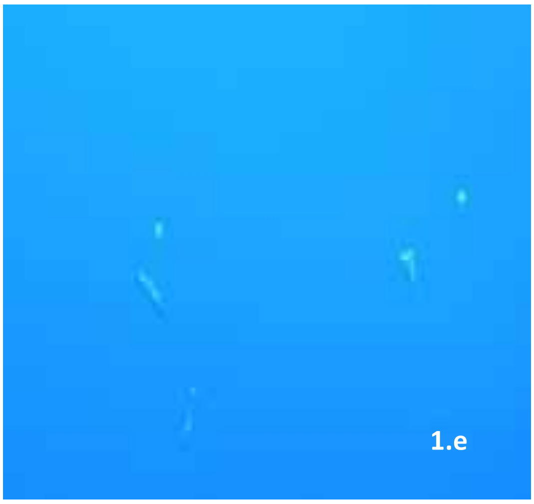


Fig. 1.e & 1.f: Devices equipped with 4 unprotected baits (left) and 4 "frighteners"-protected baits (right)

Fig. 2.a: IRD team putting the device into the water
Fig. 2.b: Diver (on the middle) filming a dolphin (on the right) evolving near the device (on the left)
Fig. 2.c: Intern checking the device

Expenses report

8000 Euros were allocated to those surveys within the framework of the component 4 of the SWIOFP project. To date, we spent about 5700 Euros (devices construction, camera hire and purchase, boat and kayak rental…) (Tab.1)

Tab. 1 Expenses report

Designation	Quantity	Unit price (euros)	Total price (euros)
Boat rental	14	100,00	1400
Fuel	14	30	360,00
2 Kayaks (90 euros / week)	4	90	360,00
Camcorder rental + insurance			1660,25
Camcorder purchase + battery			1346,22
PVC bend = 40 m/m	12	0,95	11,4
PVC Tube =40 m/m	3	10,00	30
PVC Tube = 16 m/m	2	1,50	3
PVC Tube 6m	1	18,12	18,12
Bait, tools and diverse materials			528,22
TOTAL			**5717,21**

3. Preliminary results

To date, we conducted 14 surveys (representing four surveys a week, and one week without any survey due to climatic conditions). We made 16 observations of *T. aduncus* and 3 observations of *S. longirostris*. Based on those observations, we were able to put our devices into the water 13 times during the whole study period (Fig. 3).

Fig. 3: Survey area and spatial distribution of device settings

Fig. 4.a & 4.b: Dolphin diving near the device
Fig. 4.c: Dolphin attacking an unprotected bait
Fig. 4.d: Dolphin attacking a "frightener"-protected bait

During the first survey, the behavior of the encountered dolphins did not allow us to work properly. Instrumented devices were put into the water all the same to observe the underwater behavior of the whole device. That allowed us to reconsider some points: the buoys size, the floatline and branchline lengths, the tie system of the bait…

During the second survey, we worked in the vicinity of a group of 4 *T. aduncus*. We put the instrumented devices into the water, both with unprotected baits. During the first half an hour, dolphins interacted with only one of them, and attacked 2 baits out of 4 (Fig 4.c). There was no interaction between the second device and the dolphins, letting 4 baits out of 4 intact. We then replaced the damaged baits by intact ones, and we put both devices into the water once again (representing a total of 7 intact baits). 45 minutes later, 5 baits out of 7 were totally eaten, one was partially damaged, and only one was intact. Dolphins were clearly observed swimming and diving around the devices (Fig 4.a and 4.b). We then concluded that without scarings, dolphins were not afraid to eat the baits. The general configuration of our devices (framework, camcorder, branchline…) does not seem to scary them and prevent them from coming nearby.

During the fourth survey, we worked in the vicinity of 12 *T. aduncus*. We first put the two instrumented devices into the water, with all their branchlines protected by "scarings" but none of them was attacked (whereas we clearly saw from the sea surface that the dolphins turned around the devices). We then removed the "scarings" on the second device, and let the first one untouched. 40 minutes later, none of the protected bait was attacked, but among the three unprotected baits of the second device, one was intact, one was damaged, and one was completely eaten. Those first results allowed us to conclude that the scaring devices by evolving around the bait, seem to scary the dolphins, and prevent them from attacking the baits.

During the seventh survey, we worked with a group of 10 *T. aduncus*. One device was equipped with "scarings" and the other one was not. No bait was attacked, even the unprotected ones. Based on the recorded images, we observed some dolphins swimming near the unprotected baits, without attacking them. But only one individual (always the same) turned around the protected instrumented device, and tried to attack one of the bait. After analysis of the movie, we observed that he attempted to attack the only bait which was not correctly protected by the streamers (in other words, the only one to which he had access) (Fig 4.d). Those observations confirmed the first results we obtained before: the streamers seem to be efficient in protecting the fish from the dolphins.

During the other surveys, we encountered some issues, giving us no way to get readable images:

- the dolphins were already feeding on artisanal nets and were not interested in our devices

- we lost sight of them as we put the devices into the water
- the dolphins were simply not interested in them, and kept on coming and going in the study area without stopping nearby the devices
- we encountered no dolphins at all

We also attempted to test the devices on a group of *S. longirostris*, but their fast moving behavior did not allow us to record any images. We summed-up all those observations in Tab. 2

Tab. 2 : Summary of devices sets undertook

Date	N° survey	N° device set	Species	Size group	Comments
19/07/2010	1	1			Devices set without dolphins
19/07/2010	1	2			Devices set without dolphins
20/07/2010	2	3	T. aduncus	4	Dolphins interacted with the unprotected baits
21/07/2010	3	4	T. aduncus		Dolphins left the study area as we set the devices
22/07/2010	4	5	T. aduncus	12	Dolphins interacted with the unprotected baits, and let the protected ones untouched
26/07/2010	5	6	T. aduncus	5	Dolphins left the study area as we set the devices
26/07/2010	5	7	T. aduncus	3	Devices set but dolphins feeding on artisanal nets
27/07/2010	6	8	S.longirostris	50?	Devices set but dolphins disinterest
29/07/2010	7	9	T. aduncus	10	Dolphins interacted with the unprotected and protected baits
30/07/2010	8				No device set
03/08/2010	9				No device set
04/08/2010	10	10	T. aduncus	5	Devices set but dolphins disinterest
05/08/2010	11				No device set
06/08/2010	1	11	T. aduncus	4	Devices set but dolphins disinterest
17/08/2010	13	12	T. aduncus	5	Devices set but dolphins disinterest
18/08/2010	14	13	T. aduncus		Devices set but dolphins disinterest

4. Discussion and perspectives

Most of the time, we encountered the same group of *T. aduncus*, at the same period (between 8.30 am and 10 am), and in the same area in St-Paul Bay. During the first surveys, they showed an obvious curiosity towards our devices, and were not afraid to come and take the unprotected bait (surveys 2, 4). On the contrary, the scaring devices seem to afraid them as the protected bait remained untouched (surveys 4 and 7). But after that (surveys 6, 10, 12, 13, 14), they showed a complete disinterest in our experiments. We concluded then that once they "knew" and "understood" what those devices were, they were not interested at all in them, and we were not able to test them anymore. Moreover, the fact that the surveys lasted less than 5 hours a day limited the opportunities for finding a group of dolphins which will interact with them.

That means that we can move on to the next step: now that we know how the scaring devices behave underwater, we will test them on an experimental longline (about 500m long), with one half of branchlines (about 50) equipped with hook timer and without "scaring" and a second half on brachlines equipped with both "scarings" and hook timers. Hook timers will be deployed to record the time of the attack of the bait by predators. We will set it in the St-Paul Bay at sunset, and haul it at dawn. That will give us more probability of interactions between dolphins and our mitigating system. We will then compare the damage rate of the protected and unprotected baits to assess their efficiency and confirm (we hope) the first results we obtained. On this fishing ground the abundance of large pelagic predators able to attack the bait is low enough to do not introduce biases in the comparative quantitative analysis of bait attacks.

Another stage is the miniaturization of our scaring device in the perspective of its use in a longliner. Indeed, it will be essential to produce a small device in order to make it easy to operate by fishermen. We will also work out the issue of the automatic triggering system of the scaring device: indeed, in the case of the longline fishery, we will have to protect the catch (and not the bait, as we did during our surveys in Saint-Paul Bay). That means that our system will have to be triggered only when a fish will be caught after attacking the bait.

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