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Self-reporting data collection project for the pelagic longline fishery based in La Reunion

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Abstract

Overexploitation of target and bycatch species in marine capture fisheries is the most widespread and direct driver of degradation of marine communities and loss of global marine biodiversity. Logbook data in general covered only the part of the catch landed to be commercialized. Observer programs can be difficult to implement depending on the size of fishing boats and present several constraints leading to inferences biases. In this context, IRD with the cooperation of the CAP RUN launched in 2011, a self-reporting of exhaustive catch and effort data for the pelagic longline fishery based in Reunion Island. The aim of this project is to increase the coverage level of the fishing activity of all longliners of the fleet in terms of fishing effort and spatial distribution. The project is undertaken with the financial support of the "Data Collection Framework" program of the European Union. It is based on financial motivations of collaborative fishermen. The selection of data to be collected corresponds to a compromise between data reported by observers, fisher's knowledge and availability for data reporting. Information collected concerns the fishing activity, commercialized catch, discards and interactions between the gear and pelagic resources. In 2011 and 2012, 127 and 398 fishing operations were self-reported. The interest of this kind of project is discussed.

Keywords : logbook, observer, incentive, pelagic longline, target species, bycatch.

Introduction

In recent decades, fishery activities demonstrate steady growth in both inland and marine waters due to an increased demand for animal protein. This trend displayed by landings of target species (FAO, 2012) suggesting that impacts on bycatch species and ecosystem evolved in the same direction (Kelleher 2005 ; Pauly et al. 2005). Historically the level of fishery productions is usually represented by the quantity of landing (Maunder and Punt, 2004) because it is easy to collect both catch and length distribution data is much at ports or landings sites than directly from the industry. However landings without fishing effort information cannot help to scientists and managers to interpret variations of the level of catch, changes in stock abundance and to propose a fishing capacity regulation to eventually anticipate and prevent overfishing. Overall yield and catch species composition impacted by a given fishery are related to intensity of the fishing effort and the location where the fishing effort is deployed. The harvesting capacity of the fleet and landings cannot depict the impacts of the fishing activity on so-called bycatch species. According to Gilman (2011), the term ‘bycatch’ can be defined as consisting of: (i) retained catch of non-targeted, but commercially valuable species, referred to as ‘incidental catch’ or ‘byproduct’; (ii) discarded catch, whether the reason for non-retention is economic or regulatory; and (iii) unobserved mortalities. Moreover, for some fisheries such as pelagic and demersal longline fisheries, landing data cannot quantify the level of the losses due to depredation by sharks, toothed whales or other predators leading to an underestimation of both landings and catch rates of commercial species (Gilman et al. 2006; Romanov et al., 2007; Bach et al., 2011; Forney et al., 2011; Hamer et al., 2012).

Bycatch in purse seine and pelagic longline tuna fisheries, the two primary gear types for catching tunas, is a primary mortality source of some populations of seabirds, sea turtles, marine mammals and sharks. Bycatch of juvenile tunas and unmarketable species and sizes of other fish in purse seine fisheries, and juvenile swordfish in longline fisheries, contributes to the overexploitation of some stocks, and is an allocation issue. While we are still not able to collect accurate data for targeted species, the current challenge of the ecosystem approach to fisheries (necessary for maintaining marine biodiversity, ecosystem structure and fishery resources (Pikitch et al. 2004)) is to expand data collection efforts for all the species impacted by fisheries.

At-sea observers program is likely the most valuable source of data to obtain a detailed description of fishing gear, the characteristics of fishing activities, an exhaustive specific composition of catches, the status of fish (marketable versus discard) and biological information on individual catch (length, sex, sexual maturity and biological samples for stock identification (genetics), trophic ecology, ageing). While logbook information are limited to commercial catch, observer programs are crucial for assessing the amount and nature of discarded species: such data cannot be collected without direct observations. There are numerous evidences that observer programs already provided valuable information on the impact of fisheries on resources and the dynamics of fleets (Gillis and Showel, 2002; Rochet and Trenkel, 2005).

The Indian Ocean Tuna Commission (IOTC) taking into account « *the need to increase the scientific information, in particular to provide the IOTC Scientific Committee working material in order to improve the management of the tuna and tuna-like species fished in the Indian Ocean* » adopted the resolution 11/04 defining a Regional Observer Scheme in accordance with the provisions of Article IX, paragraph 1 of the IOTC Agreement. Under this resolution, the observer program must covered at least 5 % of the number of operations/sets for each gear type by the fleet of each CPC while fishing in the IOTC area of competence. Fishing boats concerned are vessels of 24 meters overall length and over, and under 24 meters if they fish outside their EEZs shall be covered by this observer scheme. For vessels under 24 meters if they fish outside their EEZ, the above mentioned coverage should be achieved progressively by January 2013.

The observer program for the pelagic longline fisheries based in Reunion Island the observer program started in 2007 to be fully operational since 2008 (Bach et al., 2008). This program is a part of the Data Collection Framework (DCF) of the European Union (E.U.). The organization of an observer program and the application of statistical inferences to estimate characteristics of both fishery activities and total catch (target, non-target, discards) present several constraints leading to inferences biases and drifts in the precision of estimations (overestimation or underestimation), (Benoît and Allard, 2009). One of the major reasons is a non-random deployment of observers among sampling strata (vessel, trip, fishing sets). This type of constraint called “deployment effect” (Benoît and Allard, 2009) is particularly observed for no homogeneous fishing fleets, i.e. when some fishing boats of the fleet are too small to embark an observer.

Social scientists have collected data on human behavior for a long time by using self-reporting methods (on field, direct telephone survey, voice interactive response survey). For fisheries the self-reporting is not an innovation as today many fisheries authority require fishing vessels for license delivery to maintain logbooks or electronic logbooks (to report data on their activities and retained catches (FAO, 1999). However, these data does not allow a comprehensive analyzes of the fisheries impact at an ecosystem level. Incentives can be used to obtain a collaboration of fishermen to enlarge the field of observations in order to cover widely the fishing activity and the amount of capture retained on board and discarded.

In this context, we present in this paper a new self-reporting data project developed for the pelagic longline fishery based in Reunion Island. The potential application of similar projects in the Indian Ocean region is discussed.

The self-reporting exhaustive catch and effort data project

Context

Since 2007, the observer program of the pelagic longline based in La Reunion provided valuable data on the fleet activity and the catch either retained or discarded (Bach et al., 2008 ; 2009 ; 2010 ; 2011 ; 2012). Initially, this program was based on the deployment of observer on board fishing vessels of 24 meters LOA, which corresponds to the maximum size of longliners involved in Reunion Island pelagic fisheries (Bourjea et al., 2009). The activity of this segment of the fleet was recently reduced and the major part of active vessels is now composed of vessels with an overall length (LOA) less than 19 m (Bach et al., 2010). The coverage level of the observer program reached about 4% of the total fishing effort in number of hooks as large boats deployed more hooks during fishing operations than smaller vessels. However, due to different fishing strategies among boats the spatial coverage of the fishing activity reported by observers is biased. Since 2011, the fishing activity of largest boats decreased drastically. In order to monitor the fishing activity for boats below 20 m LOA which in general cannot accept observer on board IRD launched in May 2011 a self-reporting exhaustive catch and effort data project with the collaboration of the CAP RUN (Centre technique d'Appui à la Pêche RéUNionnaise ≈ Center for the Development of Sustainable Fishing in La Réunion) under the “Data Collection Framework” rules. This program is based on financial motivations and a back knowledge of their activities provided by the DCF “Observer program” to collaborative fishermen. Fishermen transmit information following dedicated templates and in return they obtain financial compensation and a summary report on their activities for at the scale of a cruise or 10 fishing operations.

Data collected

The data collection of the self-reporting project is closely related to data reported by observers omitting information that need special training or time allocated. Observers data that usually contains information on: (i) fishing activity and deployment of temperature depth recorders on the mainline, (ii) commercial species (kept on board, discarded alive or dead, depredated) and (iii) discarded species (finfish, sharks, marine mammals, seabirds, seaturtles). For each individual biological information (length, sex, sexual maturity) and details on interaction between the gear and the fish (i.e. hooking position) are reported.

The selection of data to be collected in the frame of the self-reporting program corresponds to a compromise between data collected by observers, fisher’s knowledge and availability for data reporting.

In this context, data obtained from the self-reporting project are similar to those collected by observer with exception of a less precise taxonomic resolution, absence of biological information and details on interaction between the gear and the fish.

Information on the fishing activity

- Exact (GPS) geographic positions of the setting and the hauling (both start and finish),
- Date and time of the setting and the hauling (both start and finish),
- Boat speed while setting,
- Horizontal shape of the longline (U, linear, Z, L),
- Number of hooks between floats, number of floats by section, number of sections, total number of hooks,
- Length of floatline (4 different lengths can be reported),
- Length of the branchline and leader,
- % of bait type used (squid, mackerel, sardine, local mackerel, others),
- % of hook type used (tuna, circle, straight=J-hook),
- Number of lightsticks between floats,
- Weighted swivel (Yes or No),
- Line shooter used (Yes or No),
- Deployment of temperature depth recorder (section number, length of the floatline 1, length of the floatline 2, species caught on monitored basket).

Information on marketable catch

For each species or group of species: Albacore tuna, Bigeye tuna, Yellowfin tuna, Swordfish, Marlins (1 group for blue marlin, striped marin, and black marlin), Sailfish, Shortbill spearfish,

Dolphinfish, Wahoo, Great barracuda, Black escolar, Oilfish, Opah, Pomfrets (1 group for Sickle pomfret, Brillant pomfret, Ray's bream, Taractes spp., others pomfrets),
- the number and estimated weight (actually fishermen estimate dressed weight) of individuals kept on board and the number of discarded fish without depredation or either depredated by shark or toothed whale

Information on discards of non-marketable species

For each species or group of undesirable species: Pelagic stingray, Moonfish, Manta rays, a generic group of non-identified fishes: 'very long fish'. Very long fishes – often considered as "snoeks" or "snooks" by fishermen – include non-identified lancetfishes, non-dentified gempylids (snake mackerel *Gempylus serpens*, oilfish *Ruvettus pretiosus*, escolars *Lepidocybium flavobrunneum, Promethichthys prometheus, Rexea* spp., and snoeks *Thyrsitoides marleyi, Nesiarchus nasutus*),

- the number of individuals caught.

For each species or group of species for sharks: Blue shark, Oceanic white tip, other requiem sharks (1 group), Mako sharks (1 group), Thresher sharks (1 group), Hammerhead sharks (1 group), Crocodile shark,
- the number of individuals kept on board,
- the number of individuals discarded with the status alive or dead.

For endangered species such as marine turtles (by species if possible), marine mammals (dolphins, false killer whale, finned pilot whale, seabirds) :
- the number of individuals discarded alive (with or without hook), discarded dead or landed.

Information on interactions (depredation)

- To note observed interactions with dolphins and/or large toothed whales (false killer whale, finned pilot whale)
- To note bait depredation by squid and/or dolphins,
- To note depredation on fish caught by squid and/or cookiecutter shark.

The Database

The database of self-reporting exhaustive data was built under PostgreSQL/PostGIS. PostgreSQL is a free and open source object-relational database management system that has a great compatibility with a range of operation systems and tools. PostGIS is the geographic information system extension of PostgreSQL that is useful to map data with GIS software (e.g. QuantumGIS).
The database is physically hosted on a Linux server located at IRD premises in Reunion Island. The database is administrated by IRD and inputs from self-reporting forms are made by the CAP RUN under a Data Collection Framework (DCF) convention. The database can be remotely administrated, queried and updated. Various software (e.g. LibreOffice, R) and administration tools (e.g. pgAdmin) can remotely access the database (through the local network or the internet), allowing for example data inputters to work on the database from their own office. SQL queries can be performed on the database through any software that

can connect to a PostgreSQL database, for example using the statistical computing software R (widely used among ecologists) with RPostGreSQL package.
The database consists in a set of tables that contain the data (e.g. fishing operations, gear, catch, bycatch, interactions, species). Tables are cross-referenced using primary and secondary keys (Figure 1).

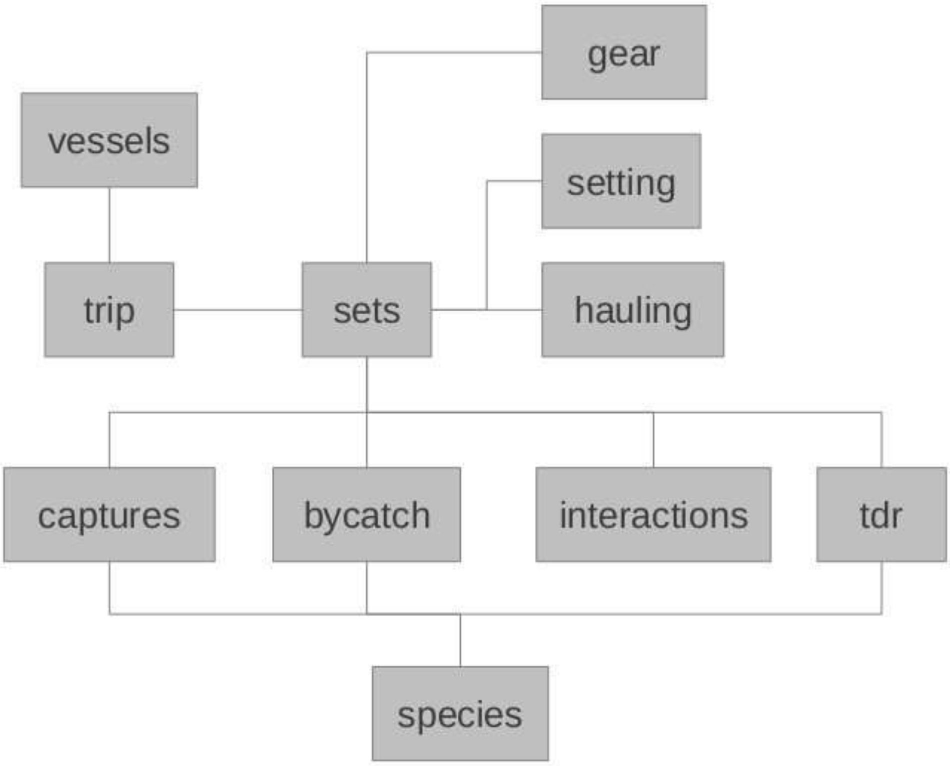

Figure 1 – Simplified scheme of the architecture of the database of self-reporting information.

Data collected in 2011 and 2012

Initially launched to assess the feasibility and the potential in terms of knowledge inputs of the impact of the pelagic longline fishery based in La Reunion, the self-reporting project was based on the monitoring of 400 sets per year.
In 2011, the first year of the project 127 fishing sets were monitored totalizing 143562 hooks. In 2012, 398 fishing sets were monitored totalizing 501478 hooks.
So far, 46 species and group of species were inventoried in the database (Table 1). Romanov et al. (2013) and Sabarros et al. (2013) propose a preliminary analysis of data registered in the database for depredation and commercial and discards, respectively.

Discussion

Overexploitation of target and bycatch species in marine capture fisheries is the most widespread and direct driver of degradation of marine communities and loss of global marine biodiversity. Then one of the major objectives of Regional Fisheries Management Organizations is to improve data collection and consequently reduce stock assessments uncertainty. In the same time, there is an ongoing effort deployed worldwide to develop program to improve quality of self-reporting (both catch data and fishing activities) by fishermen. Such programs have generally two major objectives: i) reduce costs and increase efficiency on the collection of commercial fishery data; and, ii) to involve fishing industry in the assessment process by having them work closely with the scientists. The self-reporting exhaustive catch and effort data project launched in Reunion Island to some extend is an answer to this effort.

Preliminary analysis of these self-reported data (Romanov et al., 2013; Sabarros et al., 2013) clearly shown the interest of this type of project (i) to improve the observation coverage of both the fishing effort deployed by the fleet and spatial distribution of the fishing activity, (ii) to improve the accuracy of estimations of the impact of a phenomena like the depredation. Of course, an analysis in depth must be still undertaken to assess the accuracy of these self-reported data.

Therefore, as a complement or an alternative for some observer program difficult to implement, we confirm that self-reporting projects can be implemented, relying on strait collaboration between scientists and fishers being and be based on clear aims, aiming to generate high quality data. However, as principal condition for the success of such kind of project it is essential that the fishers have some incentives, in order to keep them motivated. Assuming that such conditions are set, further important pre-requisits as training in data recording and species identification are usually provide a highly positive feedback for data quality.

Table 1 – List of species and group of species recorded in the self-reporting project database

Major commercialized species or group of fish	
SWO	Swordfish
YFT	Yellowfin tuna
BET	Bigeye tuna
ALB	Albacore tuna
BIL	Marlins nei
SFA	Sailfish
SSP	Shortbill spearfish
Finfishes generally discarded	
DOX	Dolphinfishes nei
LEC	Escolar
MOP	Sunfish nei
RZV	Slender sunfish
LAP	Moonfish, opah, mambo
MAK	Mako sharks
ALI	Lancetfishes nei
BAR	Barracudas nei
OIL	Oilfish
BRZ	Pomfrets, ocean breams nei
SKJ	Skipjack tuna
CUP	Cubicapes spp.
MZZ	Marine fishes nei
DIO	Globefish, porcupine fish
LOB	Pacific tripletail
RRU	Rainbow runner
TRE	Jacks, crevaties nei
VLF	Very long fish
VVL	Very very long fish
Sharks	
BSH	Blue shark
CWZ	Carcharhinus sharks nei
OCS	Oceanic white tip
SP?	Hammerhead sharks nei
TIG	Tiger shark
THR	Thresher shark nei
PSK	Crocodile shark
Rays, Mantas	
SRX	Rays, stingrays, mantas nei
PLS	Pelagic stingray
MAN	Mantas, devil rays nei
Endangered species	
TTL	Loggerhead turtle
DKK	Leatherback turtle
TUG	Green turtle
TTH	Hawksbill turtle
TTX	Marine turtles nei
LKV	Olive ridley turtle
DLP	Dolphins nei
SHW	Short-finned pilot whale
HUW	Humpback whale
Others	
OMZ	Ommastraphidae squids nei

VLF = often considered as “snooks” by fishermen – include non-identified lancetfishes, non-dentified gempylids (snake mackerel *Gempylus serpens*, oilfish *Ruvettus pretiosus*, escolars *Lepidocybium flavobrunneum, Promethichthys prometheus, Rexea* spp., and snoeks *Thyrsitoides marleyi*, *Nesiarchus nasutus*).

VVF = includes families Trachipteridae, Lophotidae, Regalecidae, and Radiicephalidae.

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