

Outburst of FAD fishing following quota implementation

The case of Indian Ocean yellowfin

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One fifth of global tropical tuna from the Indian Ocean

In a nutshell

- ~ 1 million t y^{-1} tropical tunas and $\sim 380,000$ t y^{-1} neritic tunas
- Importance of artisanal fisheries: $\sim 70\%$ total catch
- Ongoing, intense debate about allocation criteria
- Development of Coastal States fisheries vs. overcapacity
- Poor data for many coastal and high-seas fisheries (Moreno 2013)

Stock status

- Stock of yellowfin subject to overfishing and overfished since 2014
- Rebuilding plan implemented since 2017, including a catch limit

One fifth of global tropical tuna from the Indian Ocean

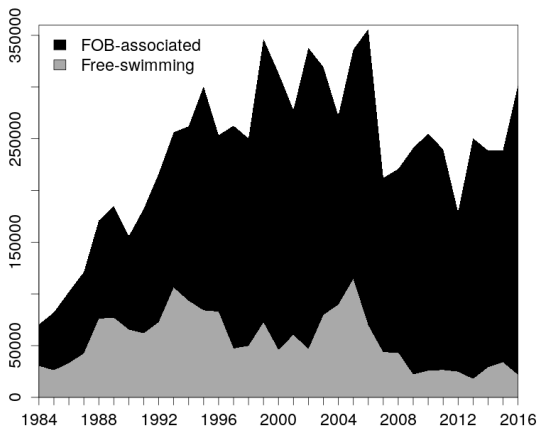
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A fishery predominated by catch on floating objects



Annual catch on schools associated with floating objects and free-swimming schools for the Indian Ocean purse seine fishery during 1984-2016 (source: IOTC)

High investments and constant innovation in FAD fishing

- Very large purse seiners with high operational costs
- A fleet of support vessels for managing the array of FADs
- Steady increase in the numbers of buoys used (Maufroy et al., 2017)
- Research and developments in FAD design (Franco et al., 2009)
- Major improvements in buoys and softwares
- Advent of echo-sounder buoys from the 2000s (Lopez et al., 2014)

Increasing number and improvements in support vessels



From old, small, slow vessels to brand-new, large, fast support vessels with state-of-the-art equipments and experienced skippers. (Left) Seychelles-flagged IRIA FLAVIA built in 1965 and used in the late 1990s and (Right) Spanish-flagged HAIZEA BAT built in 2014

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Design to increase catchability and reduce detectability

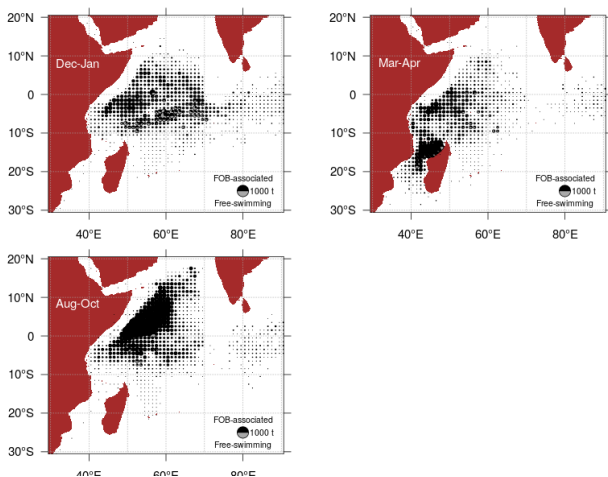


Innovative FAD with powerful lights developed by the Spanish fleet. Artificial lights to attract fish were then prohibited (IOTC Res. 16/07)

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Strong, consistent spatio-temporal patterns in fishing



Spatial distribution of the fishery during 2007-2016 showing some typical fishing grounds and a clockwise rotation over the year (Kaplan et al., 2014; Davies et al., 2014)

MSC-certified purse seine fisheries

Some good progress

- PNA free school fishery in the Western Pacific in 2012
- Jealsa yellowfin free school fishery in the Atlantic in March 2019
- Echebstar whole skipjack fishery in Nov. 2018
- 42 EU-owned purse seiners involved in the SIOTI FIP
- Companies develop non-entangling and eco-friendly designs
- Release of buoy data by the industry for both monitoring and research
- **But**, some remaining concerns about FADs: effects on habitats (e.g. corals), ghost mortality, fishing efficiency, marine pollution

Assessing the changes in fishing following the quota

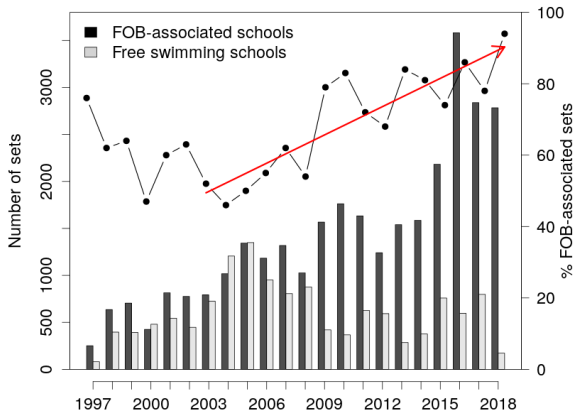
Focus on the Seychelles fleet

- Total allowable catch of 33,211 t of yellowfin split evenly between the 13 Seychelles purse seiners in 2017-2018
- Weekly monitoring of the total catch of each purse seiner and preliminary species composition derived from past port samples
- Monitoring of the limit of 350 buoys conducted by AZTI and SFA

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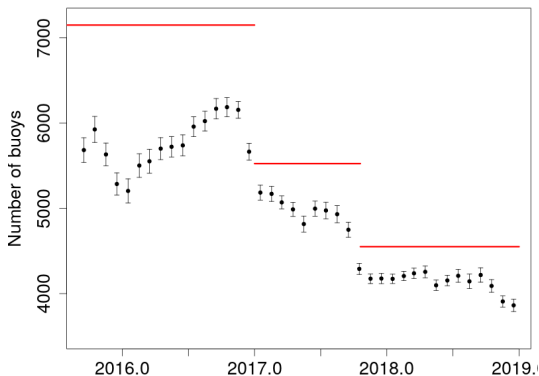
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94% of fishing sets on floating objects in 2018



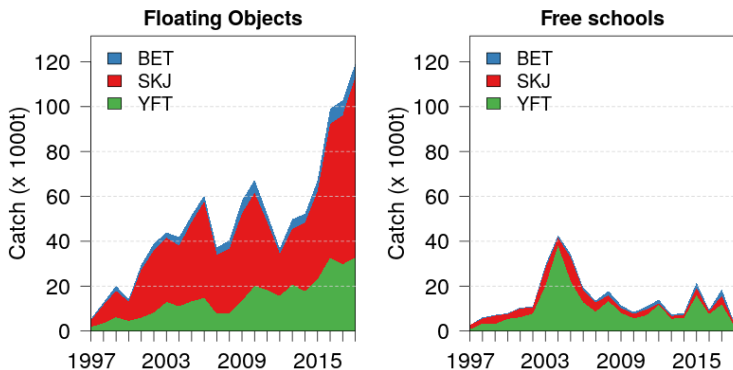
Annual number of fishing sets made by the Seychelles fleet during 1997-2018. Red arrow indicates linear model fitted to data for 2003-2018

Strong reduction in buoys in compliance with IOTC limits



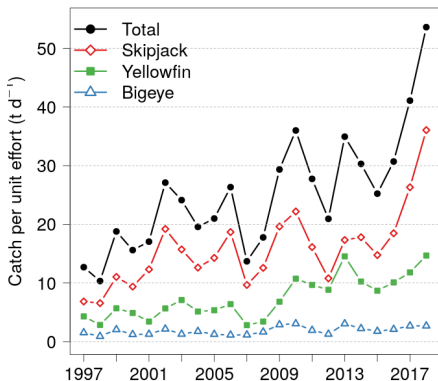
Monthly average number of buoys in use in the Seychelles purse seine fleet during 2015-2018. Vertical lines indicate standard deviation between average numbers of buoys per vessel

Avoidance of free schools to reduce yellowfin catch



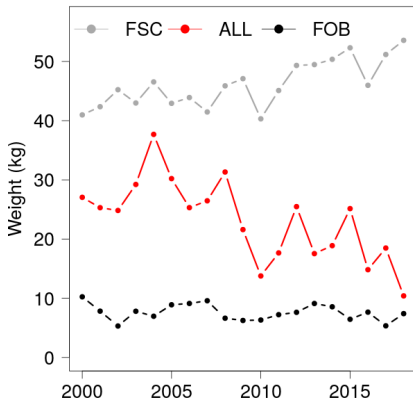
Annual catch by species taken by the Seychelles fleet during 1997-2018. Increase of total catch by 20% between 2015-2016 and 2017-2018

Highest catch rates on floating objects observed in 20 years



Annual FOB catch per searching day. High catch rates in 2017-2018 are explained by both increase in number of sets per day and increase in mean catch per set

Lowest mean weight in the catch observed in 20 years



Annual mean weight of yellowfin in the purse seine catch. Major increase in catch of juveniles of yellowfin resulted in a mean weight of ~10 kg in 2018

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Implementing and enforcing the catch limit on yellowfin

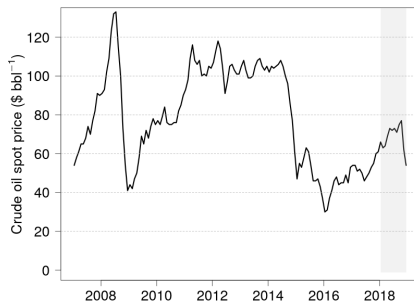
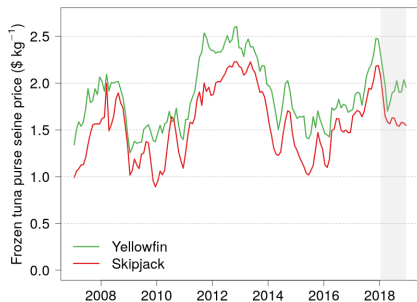
The Seychelles experience

- Incentives for misreporting yellowfin to continue fishing
- Several vessels stopped before the end of the year
- Quota exceeded by 8,500 t in 2017 and 1,800 t in 2018
- **Major burden on the Seychelles authorities** to develop and implement some monitoring and control systems (staff, costs, etc.)
- Lack of legal tools to enforce catch limit
- General distrust between the industry and the SFA
- Some feeling of unfairness between companies

Adaptive strategy to address the quota “constraint”

- Final mutation of the Seychelles fishery towards 100% FOBs
- Disruption of the typical spatio-temporal patterns of the fishery
- High catch rates supported by echosounder buoys: Increased detection, expanded fishing grounds, and better selection of FOBs
- Environmental conditions may have favored the aggregation of tuna in large schools in 2017-2018
- Profitable economic model with high price for skipjack in recent years and rather low fuel costs

BUT lower skipjack prices in 2018 and increasing fuel costs



(left) Monthly Cost-Insurance-Freight price (USD/kg) of frozen yellowfin and skipjack tuna caught with purse seine imported in Thailand during 2007-2018, (right) Monthly average Crude Oil Spot Price during 2007-2018 (Sources compiled by FFA)

Unexpected adverse effects of the quota implementation

- Major increase in catch of juveniles of yellowfin and bigeye while model projections **assume constant fishing patterns** and **constant proportion of catch taken from each fishery**
- Increased number of sets on floating objects at the scale of the whole purse seine fishery and expected increase in bycatch levels: To analyse with observer and EMS data
- Potential increase in buoys deactivations at sea to comply with limits and maintain a stock of accessible FADs: To analyse with buoy data
- Overall trends in the fishery opposite to that advocated by consumers (e.g. FAD-free, MSC), NGOs and administrations

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