WCPFC–SC1 **FT IP–3**

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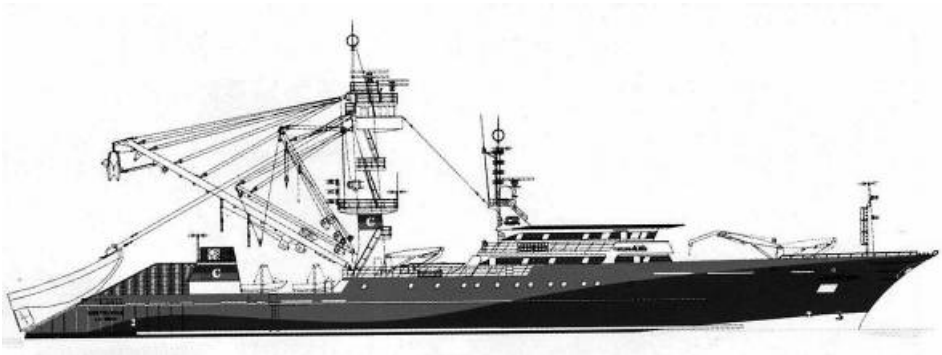
Depth, temperature, and capture time of longline targeted fish in New Caledonia: results of a one year study



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Depth, temperature, and capture time of longline targeted fish in New Caledonia: Results of a one year study

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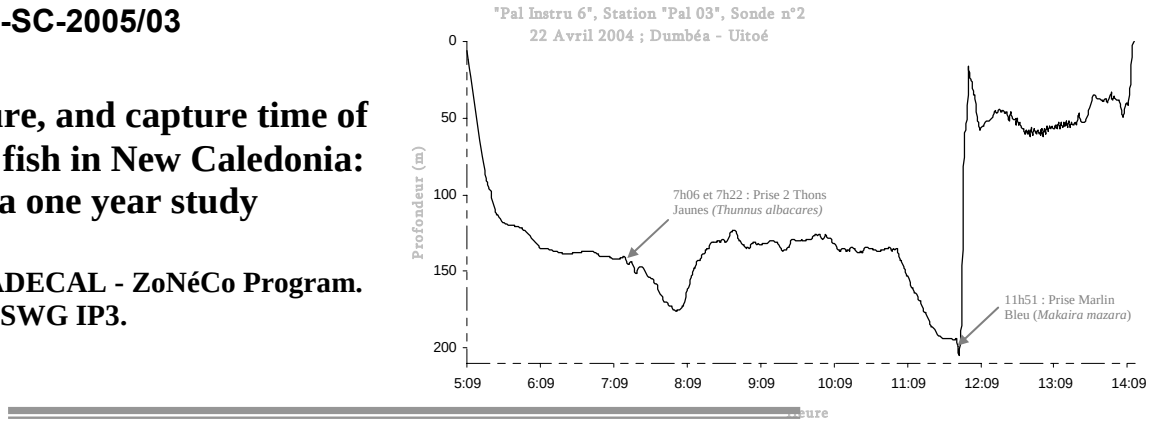
FTSWG IP3.



In order to improve available knowledge on the vertical distribution of the tunas targeted by longliners and advise fishing operators on the depths at which to set hooks according to the species targeted, New Caledonia's ZoNéCo EEZ marine resource assessment programme has performed experimental cruises to set instrument-fitted longlines.

The horizontal longline, reduced in size to 200 hooks, is fitted with two kinds of measuring instrument:
- Temperature Depth Recorders (MICREL P2T600) that record depth and temperature in real time. Placed in the middle of a segment of longline, they record the maximum depth reached.
- Hook Timers (MICREL HookTimer) above each hook, recording the time of capture for each fish.

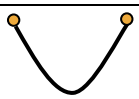
After data processing these instruments provided the following information for each fish caught:
- Time fish caught.
- Depth at which caught.
- Water temperature at time and place of capture.

From November 2003 to October 2004, monthly cruises were carried out on F/V *Dar Mad* (boat belonging to Service Territorial de la Marine Marchande et des Pêches Maritimes) off the west coast of New Caledonia. A total of more than 8100 hooks was set over 43 fishing days, yielding 4.2 mt of fish, 60% of which were marketable.

Setting the longline:

During these cruises, the longline was set using either of two contrasting strategies: a 'shallow set', to a depth of 250-300 m or a 'deep set', aiming at depths of 400-500 m.

Table 1: Characteristics of set parameters depending on strategy and depths reached.

	'SHALLOW SET'	**'DEEP SET'**
No of hooks	25 hooks per basket (with 60g weighted swivels)	
Max. depth	250- 300 m	400- 500 m
Boat speed	3.5 - 4.5 kts	2.5 - 3.5 kts
Shooter speed	0 (taut)	6 - 8 kts
Branchline interval	18 seconds	16 seconds
Sagging Ratio SR = boat speed/line setter speed	 SR = 0.85	 SR = 0.5

Max. depth reached (80% of segment)	200 - 320 m	300 - 510 m

Bathymetric stratification in the water column

The value of breaking down fishing effort by bathymetric stratification of the water column is to obtain a representative image of catch distribution by depth in terms of effort (number of hooks) set at each depth.

By using information on maximum depth and sagging ratio for each longline segment, it was possible to develop a key to the distribution of hooks by depth strata for various 'set profiles', characterised by the sagging ratio and the maximum depth .

This distribution key was then applied to all the stations on the cruises carried out and yielded a realistic hook distribution by depth strata and an understanding of the true impact of fishing on the resource.

Low CPUEs did not necessarily imply low abundance of target species in any specific area but may have been due to the fishing gear having been deployed outside the normal habitat (depth and temperature range) of the target species.

Table 2: Distribution key for hooks in the water column, in terms of maximum deployment depth and sagging ratio (two stratification levels).

	Max D. < 300 m		Max D. < 400 m		Max D. < 500 m		Max D. > 500 m	
	SR > 0,8	SR < 0,8	SR > 0,6	SR < 0,6	SR > 0,5	SR < 0,5	SR > 0,4	SR < 0,4
0-100	24%	8%	8%	8%				
100-200	76%	40%	24%	16%	16%	16%	8%	
200-300		52%	56%	40%	16%	16%	8%	8%
300-400			12%	36%	48%	32%	8%	8%
400-500					20%	36%	24%	16%
500-600							52%	32%
600+								36%

Table 3 : Distribution key for hooks in the water column, in terms of maximum deployment depth and sagging ratio (single stratification levels).

	Max Depth < 300 m SR ≈ 0.8	Max Depth < 400 m SR ≈ 0.6	Max Depth < 500 m SR ≈ 0.5	Max Depth > 500 m SR ≈ 0.4
0-100	16 %	8 %		
100-200	58 %	20 %	16 %	8 %
200-300	26 %	48 %	16 %	8 %
300-400		24 %	40 %	8 %
400-500			28 %	24 %
500 +				52 %

What is the benefit of knowing the depths at which longline hooks are set and the preferred habitat of target species?

- First because each species lives at depths where the conditions are the most suited to its physiological needs (temperature, oxygen etc). Gaining a better knowledge of these habitats then allows fishers to set their longline at those specific depths.
- Also, in terms of stock monitoring and assessment, knowing the depth preferences of the various species makes it possible to analyse with accuracy the real impact of fishing on a particular species and thus the abundance fluctuations of that species and its 'health'.

Catch distribution results:

The results obtained after processing the data are summarised below in text and in the figures:

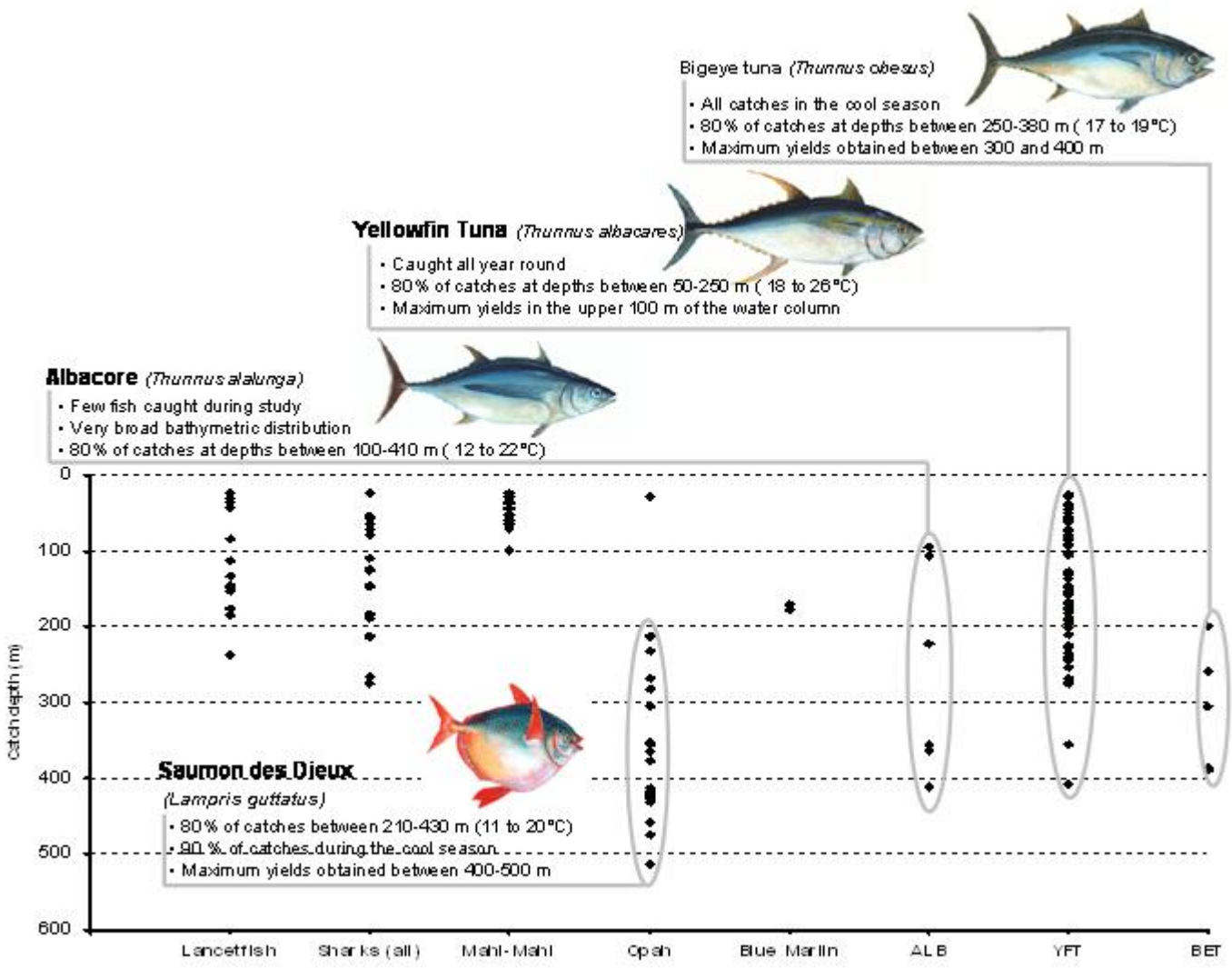


Figure 1 : Depth distribution summary

Albacore (*Thunnus alalunga*)

- Very broad bathymetric distribution.
- Few fish were caught during this study (5% as against 45-60% by the professionals)
- 80% of catches at depths between 100 and 410 m, corresponding to a temperature range of 12 to 22°C.

Yellowfin tuna (*Thunnus albacares*)

- 80% of catches between depths of 50 and 250 m, corresponding to a temperature range of 18 to 26°C.
- This species is caught all year round.
- The maximum yields are obtained in the upper 100 meters of the water column.

Bigeye tuna (*Thunnus obesus*)

- Although catches were low (n : 7) , the parameters recorded tend to confirm the results of previous research.
- 80% of catches at depths between 250 and 380 m, corresponding to a temperature range of 17 and 19°C.
- Strong seasonal variability is recorded, with all catches occurring in the cool season.
- During this season, the theoretical maximum yields are obtained at depths between 300 and 400 meters.

Opah (*Lampris gutattus)*

- 80% of catches were recorded at depths between 210 and 430 m, corresponding to a temperature range of 11 and 20°C.
- 90% of catches were made during the cool season.
- During this season, the theoretical maximum yields are obtained at depths between 400 and 500 meters.

Daily cycle:

The results obtained during this study confirm that maximum yields are recorded at dawn and in the late afternoon each day. The yields increase regularly from late morning until dusk.

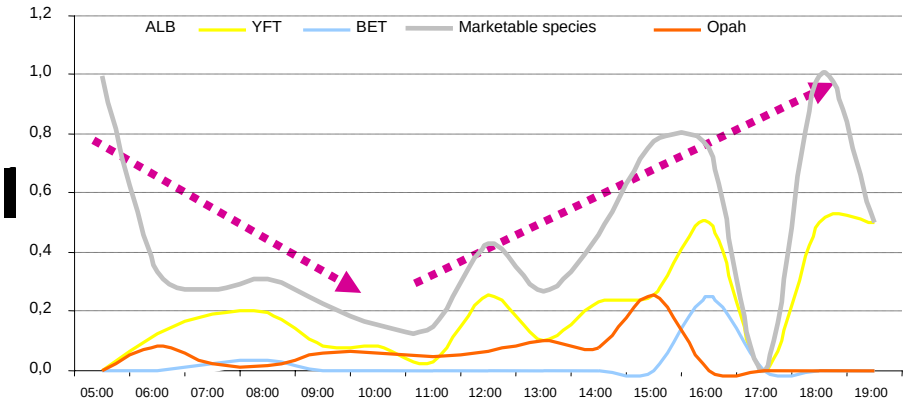


Figure 2 : Yields per hour for main species.

Yields per species group:

- Maximum yields for all commercial species combined occur in the upper 100 meters of the water column.
- The greater the fishing depth, the smaller the proportion of non-marketable species, until their complete disappearance at depths greater than 300 m.
- Down to a depth of 200 meters, shark catches (all species combined) are considerable.

Distribution of species under the influence of temperature:

The value of the following diagram is to show the distribution of the main species in terms of an easily measurable variable (either by deploying a bathythermograph or from the satellite map showing water temperatures at intermediate depths). The longline captain can then choose the longline set depth by reference to species (or the various targeted species).

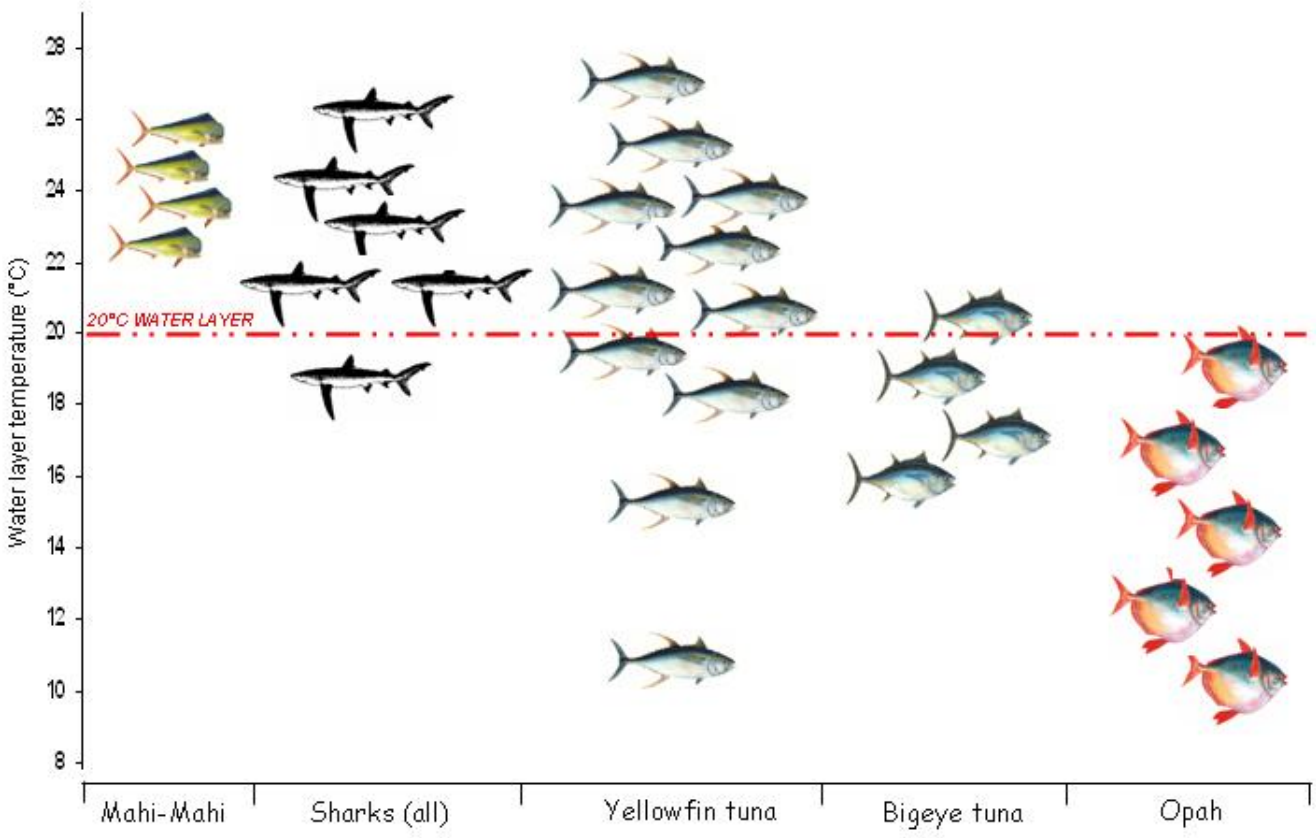


Figure 3 : Distribution of some species around the 20°C isotherm.

Qualifications to be applied to these results:

- As the longlines are set during the day, the depth (and temperature) catch distribution per species presented here is valid only for the daytime. The research on pelagic species shows different nocturnal behaviour, characterised by frequent visits to the surface in search of prey. Tagging-based studies have also revealed the existence of these surface-depth food-seeking migrations in the daytime.
- The fishing grounds used in the survey probably have an influence on specific composition and mean size of the species caught Also, care should be taken in extrapolating these results to large specimens because the preferred habitat may vary with the physiological needs of the fish (and therefore with its age).

Recommendations:

Supply this type of measuring device to fishing boat operators so that:

- They know their setting depths and variations more accurately;
- To obtain information on typical New Caledonian longline hook distribution so as to refine stock appraisal through improved bathymetric distribution of fishing effort and its impact on an unevenly distributed resource.

Develop access to remote sensing data so that fishermen can, on the basis of available knowledge, circumscribe an area favourable to the presence of a given species on the basis of the relevant satellite imagery.

The full report and other mission reports are available on the ZoNéCo website: www.data.zonéco.nc

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