Workshop on Southern Albacore Research
(Auckland, New Zealand, 9-12 June 1986)

Outlines of research on albacore conducted by ORSTOM in the Western and Central South Pacific Ocean from 1965 to 1985

R. GRANDPERRIN* and J.C. LE GUEN*

A research programme on albacore has been carried out by ORSTOM in the Western and Central South Pacific Ocean from 1965 to 1985. The main results are summarized in this paper at the end of which references of produced documents are given.

SURFACE ALBACORE

The fact that albacore are available to a surface fishery in the Northern Pacific Ocean strongly suggested that a similar resource is present in the Southern hemisphere, not only around New Zealand where a summer fishery has been developed but also further east (ref. 39 and 40). An exploratory fishing survey was therefore conducted in the Central South Pacific Ocean on board the R.V. CORIOLIS (12 February - 4 March 1982) using trolling fishing technique (ref. 28, 32 and 33). "The area surveyed extended from 38°S to 42°S and 157°W to 180° (Fig. 1). During this exploratory cruise measurements of the hydrobiological conditions were obtained in areas immature albacore occurred. This included temperature, salinity and oxygen measurements from 0 to 500 m and chlorophyll "a" contents from 0 to 200 m. Juvenile albacore caught (n = 39) were distributed in four different groups from two to five years and they were present in waters with surface isotherms, well defined structure (16 to 19°C) and frontal zone. These conditions were found in the so called "subtropical convergence" (ref. 51 and 52) which represents a very favourable hydrology structure for concentration of albacore and location of potential albacore surface fishing grounds. Environment of this juvenile and sub-adult albacore population is similar to conditions described in other albacore surface fisheries and they present a comparable age structure to the North Pacific and North-East Atlantic populations".

* ORSTOM, B.P. A5, Nouméa, New Caledonia.

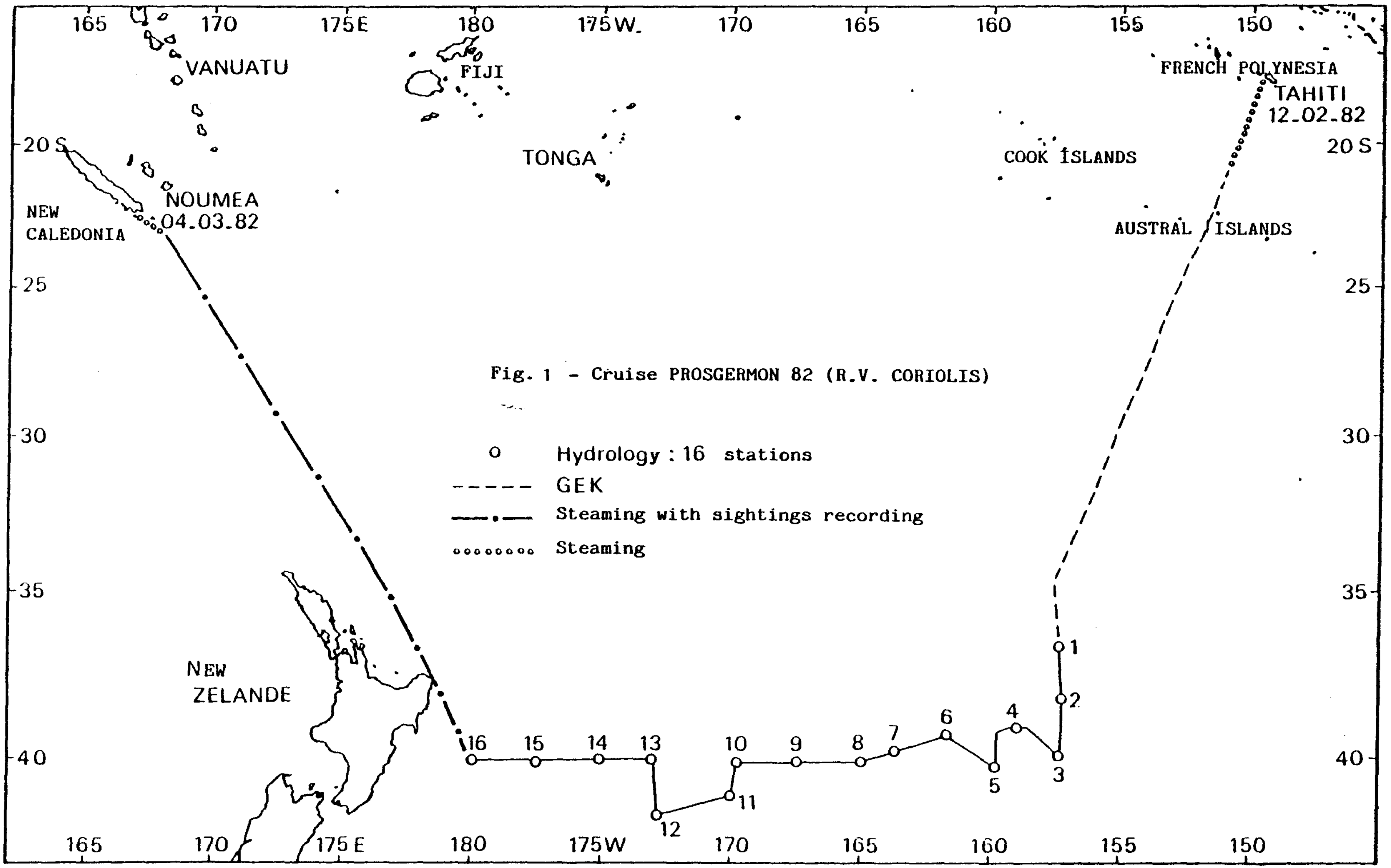


Fig. 1 - Cruise PROSGERMON 82 (R.V. CORIOLIS)

In order to extend the area surveyed further east a similar cruise is scheduled early 1987 from 155°E to 110°E (longitude of Easter Island).

DEEP-SWIMMING ALBACORE

Statistical data from commercial fisheries and biological and hydrological data from research surveys were collected.

1 - Commercial fisheries

They concern the Japanese, Korean and Taiwanese longliners operating in the South West Pacific and within the E.E.Z. of French Polynesia and New Caledonia. Reports on fishing positions, efforts, catches and C.P.U.E. by species, etc... have been produced (ref. 5,6,7,8,9,10,11,12, 13,14,15,24,25,26,27,29,30 and 41).

In Vanuatu, a detailed study of the activities of the Taiwanese fleet based in Pallicolo (Santo Island) including fish measurements led to the following conclusions (ref. 3) :

- best catch rates are obtained between 25°S and 40°S (subtropical to temperate waters) were surface temperature gradients (range of fluctuations within a month) are maximum,

- although strong salinity gradients do not seem to influence the fishing, the best catch rates are obtained were surface salinities are above average,

- length - frequencies analysis shows that large-sized albacore are caught in "equatorial" waters (zone extending from the equator to 15°S) from April to June whilst smaller fish are captured in temperate zone from July to December.

2 - Research surveys

From 1965 to 1974 research conducted by ORSTOM was devoted to the study of the pelagic food webs in the tropical Pacific Ocean with emphasis put towards the study of the trophic relationships leading to longline tuna (albacore and yellowfin tuna). About 40 cruises were carried out in order to describe the physical and biological characteristics of the environment. The methods used for sampling and measuring are detailed hereafter.

Tuna : about 200 horizontal and vertical longline sets (ref. 1,4,20,21,23 and 37); for some of them, the depth of a total of 20 000 hooks and corresponding catches were recorded within the depth range 50 to 650 m.

Nekton : about 100 midwater trawl hauls from the surface down to depths ranging from 50 to 800 m (net size : 22 m from wing to wing, 50 m from wings to cod-end, about 50 m^2 surface of month opening).

Micronekton : about 1500 10-foot Isaacs-Kidd midwater trawl hauls (300 of which with an opening-closing type BE cod-end) from the surface down to 1400 m.

Zooplankton : about 1500 zooplankton net (50 cm and 1 m diameter O-ring nets, OMORI opening-closing larval net) vertical and oblique hauls from the surface down to 1400 m.

Neuston : about 100 neuston net hauls (15 mn)

Phytoplankton and primary production : phytoplankton net hauls, sampling of water for filtration using opening closing bottles, in situ incubation using the C^{14} method, etc,...

Hydrology : thousands of stations (temperature, salinity, nutrients, currents, etc...); data from voluntary observing ships.

The results concerning mainly albacore and the trophic relationships leading to them are summarized hereafter.

Vertical distribution of albacore (ref. 18,19,22,35 and 36).

The distributions of catch-rates and fishing efforts according to depth are shown on fig.2. The maximum concentration of albacore extends from 250 to 500 m. No correlation could be established (statistical tests) between depth and forklength, between depth and sex-ratio nor between depth and gonad maturation. This therefore seems to indicate that there is only one single population of albacore tuna throughout the water column. (ref. 18).

Temperature (ref. 18)

Vertical profiles of temperature were recorded from bathythermograph or CTD casts made at longline setting locations. By relating the

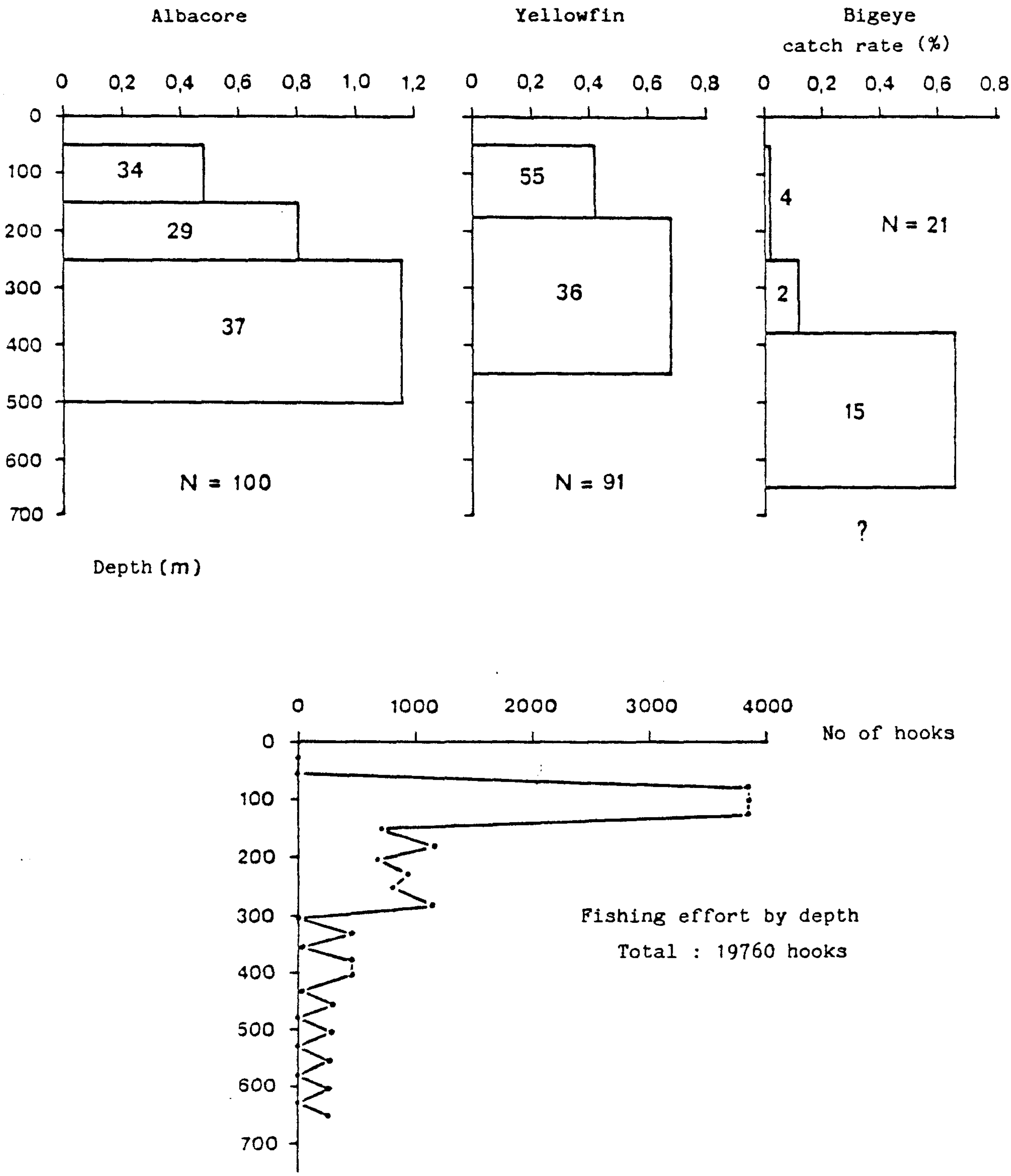


Fig. 2 — Vertical distributions of tuna
(from GRANDPERRIN, 1975)

depth of every hook and fish caught to the temperature, it then was possible to define several temperature ranges corresponding to different catch rates.

27°C - 28°C : not catch of albacore

25°C - 22°C : catch rates fairly constant; average 0.3 per 100 hooks

21°C - 11°C : catch rates showing strong variability; average 1.1%

10°C - 7°C : no catch.

The above figures show that longline albacore tuna are able to live within a total temperature range of 14°C (25°C to 11°C).

Time of feeding activity (ref. 18,19,35 and 36)

Several pairs of longline sets were made, each pair consisting in one set during the day and one set during the following night at the same position. Dawn and dusk periods were avoided. The results are summarized in table 1; they show that longline albacore tuna do not feed at night. An attempt to determine the time of death of catches during longline fishing was made (ref. 42).

Table 1 - Results of pairs of day-time and night-time longline sets (same location)

	day-time	night-time
Number of sets	9	9
Number of hooks	3170	2091
Catch (number)		
Albacore	26	0
Yellowfin	11	0
Bigeye	2	1
Catch rate (%)		
Albacore	0.8	0
Yellowfin	0.3	0
Bigeye		

Diet (ref. 17,18,19,34,35,36,38,43,44,45,46,47,48,49 and 50)

235 stomach contents of albacore were examined. Their average weight was 17g with values ranging from 0 to 220g (ref.18). Table 2 gives the stomach contents composition by large taxinomic groups.

Table 2 - Composition of 235 albacore stomach contents : percentages of each taxinomic groups (+ means present in very small percentage)

Fish and fish larvae		43
Cephalopods		35
Crustaceans		
Euphausiids	+	
Sergestids	+	
Carids	+	
Phronimids (Amphipods)	+	
Other Amphipods	2.6	
Stomatopods larvae	1.0	
Phyllosoma	0.9	
Various larvae	3.5	
Various Crustaceans	+	
Total Crustaceans		9
Various plankton		
Heteropods	+	
Phronimids barrels	1.0	
Miscellaneous	+	
Total various plankton		1
Unidentified (digested)		12
		100 %

Appendix 2 and 3 respectively detail the family and species composition of fish ingested (ref. 18).

The otoliths found in the stomach contents were identified including the ones of Cololabis saira used as bait. This allowed to estimate that full digestion lasts a maximum of about 12 hours (ref. 18).

Availability of food

Comparison between stomach contents and net catches from the 0-1500 m water column shows that there is a strong discripancy between the food of tuna and the standing crop (table 3). This might induce to

Table 3 - Percentages of fishes (by number) in tuna stomach contents and in net catches

	Tuna	Nets
. Fishes found only in net catches	-	84 %
. Fishes found in both tuna stomach contents and net catches	63 %	16 %
. Fishes found only in tuna stomach contents	37 %	-
	100 %	100 %
	(N= 2922)	(N=15248)

think that tuna are selective feeders. In fact, this discripancy is explained by the fluctuations occuring in the vertical distributions of the nektonic and micronektonic organisms within the 24 hours cycle. Vertical distributions of the main components of the fauna (total biomass, fishes, fish larvae, Cephalopods, Euphausiids, Carids, Sergestids, Peneids, Mysids, Amphipods, Pteropods, Heteropods, jelly fish) have been described (ref. 18 and 36). Space-time distributions have been detailed by species for Euphausiids (ref. 36 and 48), Amphipods (ref. 36 and 45) and fishes (ref. 18 and 36). As far as fishes are concerned, figure 3 shows that they can be classified into six different clusters according to their vertical migratory pattern. As the feeding activity of albacore tuna occurs from the one hand above a depth of 500 m and from the other hand at day-time, albacore can prey only upon organisms present at the same time in the same water layer. As a consequence, figure 3 shows that:

- . type (a) organisms never occur in stomach contents,
- . types (b) and (c) occur occasionnally,
- . types (d) and (e) often occur,
- . type (f) always occur.

This leads to the conclusion that albacore tuna are opportunist feeders on the whole fauna available in their habitat at day-time.

Reproduction and larvae

Albacore seem to spawn during the warmer months in low latitudes (ref. 26). Larvae were caught by the mean of plankton nets in the 0-100 m water layer around New Caledonia between 20°S to 26°S in February-March (ref. 16) and in French Polynesia between 16°S and 27°S from February to April (ref. 31). During the extensive programme carried out

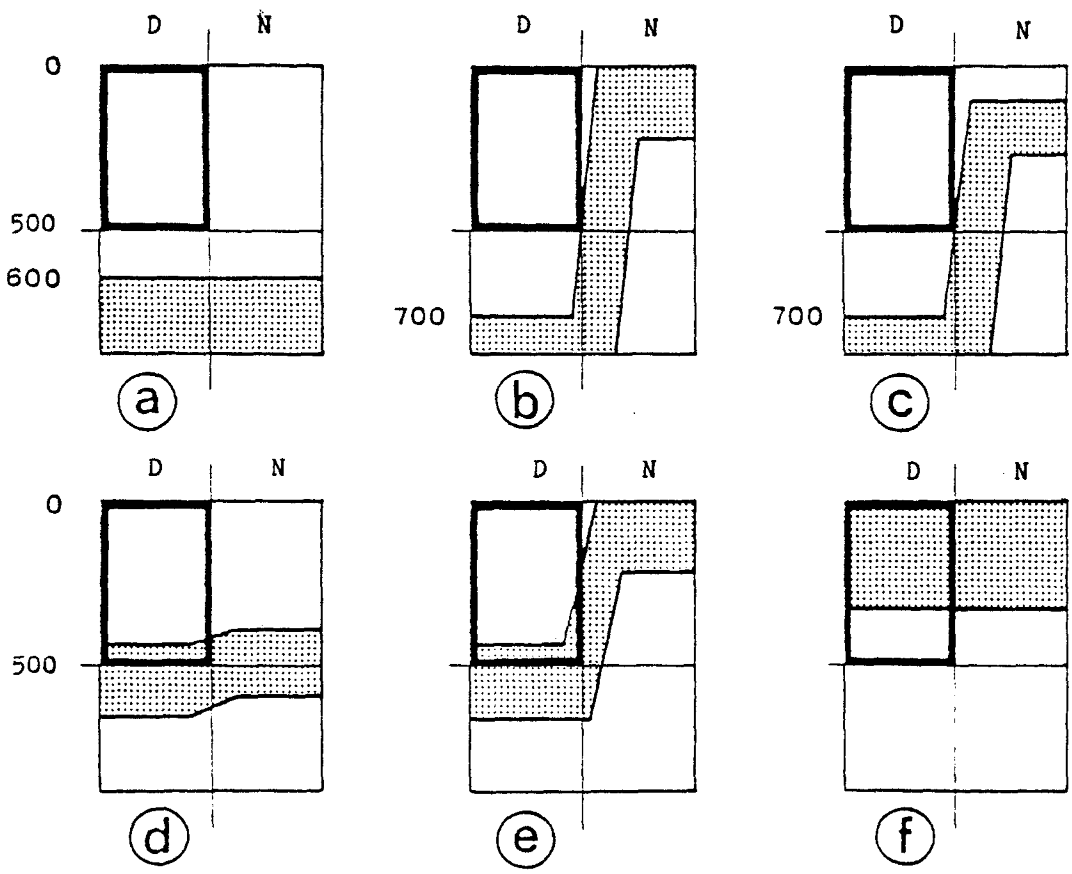
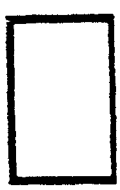


Fig. 3 - Time-space albacore feeding activity and various types of vertical migratory patterns of nektonic and micronektonic fish. (from GRANDPERRIN, 1975).



Time-space albacore feeding activity.

a. deep non migrating fish

b. large amplitude migrating fish

c. deep migrating fish

d. intermediate small amplitude migrating fish

e. superficial migrating fish

f. superficial non migrating fish

D : day-time, N : night-time

by the South Pacific Commission Skipjack Tagging and Assessment Programme, 3896 skipjack stomach contents were analysed out of which 38 had a total of 52 albacore tuna juveniles ranging from 10 mm to 120 mm in standard length (ref. 2).

CONCLUSION

Since 1965, ORSTOM has devoted a substantial effort into the description of the physical and biological characteristics of the tropical Central and Western Pacific Ocean environment. These studies have been based on traditionnal hydrological and biological surveys and more recently on additionnal sampling by voluntary observing ships (XBT, sea-surface temperature and salinity, chlorophyll and zooplankton). Although the knowledge of the trophic relationships leading to tunas has been substantially improved, we know virtually nothing on the links between the physical characteristics of the environment and the presence of tunas. Emphasis should therefore be put on this matter in discussing research priorities.

BIBLIOGRAPHY

1. ANGOT, H. et R. CRIOU - 1959 - La pêche du thon à la longue ligne. Ses possibilités dans les eaux voisines de la Nouvelle-Calédonie. ORSTOM. IFO, Océanogr., Nouméa, 29 p.
[Longlining for tuna around New-Caledonia].

2. ARGUE, A.W., F. CONAND and D. WHYMAN - 1983 - Spatial and temporal distributions of juvenile tunas from stomachs of tunas caught by pole-and-line gear in the central and western Pacific Ocean. South Pacific Commission , Noumea, New-Caledonia, Tuna and Billfish Assessment Programme, Technical Report 9 : 1-47.

3. BOUR, W., M. KULBICKI et F. MARSAC - 1982 - Analyse des débarquements de la pêche palangrière basée à Pallicolo (Vanuatu). ORSTOM, Centre de Nouméa. Océanogr., 56 p.
[Landings by longliners in Pallicolo (Vanuatu)].

4. BOURRET, P., P. FOURMANOIR, R. FRIESS, R. GRANDPERRIN, C. HOFFSCHIR, P. LABOUTE, M. LEGAND, A. MICHEL, J. PAGES, P. RANCUREL, R. REPELIN, J. RIVATON et C. ROGER - 1972 - Résultats des stations de longue ligne horizontale et de lignes verticales effectuées dans le Pacifique sud-ouest par le Centre ORSTOM de Nouméa en 1970 et 1971. Croisières DIAPHUS 1 à 9. ORSTOM, Nouméa, Océanogr., 36 p.
[Results of experiments of horizontal and vertical longlining carried out in the South-West Pacific in 1970 and 1 71 by the ORSTOM Noumea Laboratory. Cruises DIAPHUS 1 to 9].

5. CHABANNE, J. - 1980 - La pêche thonière dans la zone économique exclusive de Polynésie Française en 1979. ORSTOM Tahiti, Notes et Doc. Océanogr., 7, 21 p.
[The tuna fishery within the E.E.Z. of French Polynesia in 1979].

6. CHABANNE, J. - 1981 - La pêche thonière en Polynésie Française. Etat actuel et perspectives. La Pêche Maritime, 1245 : 745-751.
[The tuna fishery in French Polynesia : present status and prospects].

7. CHABANNE, J. et P. COUPUT - 1984 - La pêche palangrière japonaise dans la Z.E.E. de Polynésie Française en 1981. ORSTOM Tahiti, Archives Océanogr., 84/04, 50 p.
[The Japanese longline fishery within the E.E.Z. of French Polynesia in 1981].

8. CHABANNE, J. et P. COUPUT - 1984 - La pêche palangrière japonaise dans la Z.E.E. de Polynésie Française : juin à décembre 1980. ORSTOM Tahiti, Archives Océanogr., 84/12, 55 p.
[The Japanese longline fishery within the E.E.Z. of French Polynesia : June-December 1980].

9. CHABANNE, J. et P. COUPUT - 1984 - La pêche palangrière coréenne dans la Z.E.E. de Polynésie Française en 1983. ORSTOM Tahiti, Archives Océanogr., 84/06, 79 p.
[The Korean longline fishery within the E.E.Z. of Frence Polynesia in 1983].

10. CHABANNE, J., P. COUPUT et L. MAREC - 1983 - La pêche palangrière japonaise dans la Z.E.E. de Polynésie Française en 1982. ORSTOM Tahiti, Archives Océanogr., 83/12, 47 p.
[The Japanese longline fishery within the E.E.Z. of French Polynesia in 1982].

11. CHABANNE, J., P.COUPUT et L. MAREC - 1983 - La pêche palangrière coréenne dans la Z.E.E. de Polynésie Française en 1982. ORSTOM Tahiti, Archives Océanogr., 83/11, 93 p.
[The Korean longline fishery within the E.E.Z. of French Polynesia in 1982].

12. CHABANNE, J., P. COUPUT et L. MAREC - 1984 - La pêche palangrière coréenne dans la Z.E.E. de Polynésie Française en 1981. ORSTOM Tahiti, Archives Océanogr., 84/01, 96 p.
[The Korean longline fishery within the E.E.Z. of French Polynesia in 1981].

13. CHABANNE, J. et P. JAMES - 1980 - La pêche des navires palangriers japonais dans la zone économique exclusive de Polynésie Française: octobre 1979 - avril 1980. ORSTOM Tahiti, Notes et Doc. Océanogr., 6, 23 p.
[The Japanese longline fishery within the E.E.Z. of French Polynesia : October 1979 - April 1980].

14. CHABANNE, J. et L. MAREC - 1985 - La pêche palangrière japonaise dans la Z.E.E. de Polynésie Française en 1984. ORSTOM Tahiti, Archives Océanogr., 85/18, 62 p.
[The Japanese longline fishery within the E.E.Z. of French Polynesia in 1984].

15. CHABANNE, J. et L. MAREC - 1985 - La pêche palangrière coréenne dans la Z.E.E. de Polynésie Française en 1984. ORSTOM Tahiti, Archives Océanogr., 85/13, 84 p.
[The Korean longline fishery within the E.E.Z. of French Polynesia in 1984].

16. CONAND, F., P. BOUCHET, H. FERRER, J.M. GUILLERM, J. MUYARD, H. WALICO, C. HENIN, M. BARRO, D. BINET, C. HOFFSCHIR, J.L. KOCHER et P. WAIGNA - 1980 - Rapport de la campagne HYDROTHON 02 à bord du N.O. CORIOLIS (22 février - 29 mars 1979), ORSTOM Nouméa, Océanographie, Rapports Scientifiques et Techniques 8, 23 p.
[HYDROTHON 02 cruise report en board R.V. Coriolis (22 February 29 March 1979)].

17. FOURMANOIR, P. - 1971 - Liste des espèces de poissons contenus dans les estomacs de thons jaunes, Thunnus albacares (Bonnaterre) 1788 et de thons blancs, Thunnus alalunga, (Bonnaterre) 1788. Cah. ORSTOM, sér. Océanogr., 9(2) : 109-118.
[List of fishes found in the stomach contents of yellow-fin tuna and albacore].

18. GRANDPERRIN, R. - 1975 - Structures trophiques aboutissant aux thons de longue ligne dans le Pacifique sud-ouest tropical. Thèse de Doctorat d'Etat, 296 p.
[Trophic relationships leading to longline tunas].

19. GRANDPERRIN, R. - 1976 - Structures trophiques aboutissant aux thons de longue ligne dans le Pacifique sud-ouest tropical. J. Rech. Océanogr., 1(2) : 43-49.
[Trophic relationship leading to longline tunas].

20. GRANDPERRIN, R., J. BOJKO, P. BOURRET, P. FOURMANOIR, R. FRIESS, B. de GEOFFROY, F. GOWE, C. HOFFSCHIR, P. LABOUTE, G. LOUBENS, P. RANCUREL, J. RIVATON, C. ROGER et H. WALICO - 1974 - Résultats des stations de longue ligne horizontal et de lignes verticales effectuées de jour dans le Pacifique sud-ouest par le Centre ORSTOM de Nouméa en 1973 et 1974. ORSTOM, Nouméa, Océanogr., 21 p.
[Results of experiments of horizontal and vertical longlining carried out in the South-West Pacific in 1973 and 1974 by the ORSTOM Noumea Laboratory].

21. GRANDPERRIN, R., P. BOURRET, A. MICHEL et J. MARTEAU - 1969 - Résultats des stations de longue ligne expérimentale effectuées dans le Pacifique Sud Central par le Centre ORSTOM de Nouméa en 1969. ORSTOM, Nouméa, Océanogr., 39, 34 p.
[Results of experimental longlining carried out in the South Central Pacific in 1969 by the ORSTOM Noumea Laboratory].

22. GRANDPERRIN, R. et M. LEGAND - 1971 - Aperçu sur la distribution verticale des germons dans les eaux tropicales du Pacifique sud : nouvelle orientation de la pêche japonaise et de la pêche expérimentale. Cah. ORSTOM, sér. Océanogr., 9(2) : 197-202.
[Outline of the vertical distribution of albacore in the tropical waters of the South Pacific : new trends of the japanese fishery and experimental fishing].

23. GRANDPERRIN, R. et C. ROGER - 1973 - Pêche au thon à la longue ligne et chalut pélagique à alevins entre la Nouvelle-Calédonie et les Nouvelles-Hébrides. Compte rendu des croisières COR 73-2 et COR 73-3 (DIAPHUS 11) ORSTOM, Nouméa, Océanogr., 14 p.
[Longlining for tuna and midwater trawling between New Caledonia and the New Hebrides. Cruise reports COR 73-2 et COR 73-3 (DIAPHUS 11)].

24. HALLIER, J.P. - 1983 - La pêche palangrière en Nouvelle-Calédonie est-elle viable ? ORSTOM, Centre de Nouméa, Océanogr., 25 p.
[Is a longline fishery feasible in New-Caledonia ?].

25. HALLIER, J.P. - 1984 - La pêche à la palangre dans la Z.E.E. de Nouvelle Calédonie (août 1981 - décembre 1983). ORSTOM Nouméa, Environnement et ressources hauturières, Rapports Scientifiques et Techniques 31, 53 p.
[Longline fishing within the E.E.Z. of New-Caledonia (August 1981 - December 1983)].

26. HALLIER, J.P. - 1984 - Albacore : a tuna resource of the Pacific Ocean. ICLARM Newsletter 7(4) : 15-17.

27. HALLIER, J.P. - 1984 - Une nouvelle expérience de pêche thonière à la palangre en Nouvelle-Calédonie. Commission du Pacifique Sud, Seizième Conférence Régionale Technique des Pêches (Nouméa, Nouvelle-Calédonie, 13-17 août 1984), SPC Fisheries 16/WP15, 14 p. [A new longline fishery in New Caledonia].

28. HALLIER, J.P. et J.Y. LE GALL - 1983 - Campagne exploratoire de pêche au germon de surface dans l'océan Pacifique sud central et occidental. Commission du Pacifique Sud, Lettre d'information sur les pêches 24 : 10-16.
[A surface albacore survey in the central and western South Pacific Ocean].

29. HALLIER, J.P. et G. MOU-THAM - 1985 - La pêche à la palangre par les navires locaux : première année d'activité (novembre 1983 - octobre 1984). ORSTOM Nouméa, Environnement et ressources hauturières, Rapport Scientifiques et Techniques 34, 44 p.
[Longline fishing by local boats : first year (November 1983 - October 1984)].

30. HALLIER, J.P., G. MOU-THAM et J. RIVATON - 1985 - La pêche à la palangre dans le Pacifique sud-ouest : japonaise de 1969 à 1980, taïwanaise de 1972 à 1982, coréenne en 1979. ORSTOM Nouméa, Environnement et ressources hauturières, Rapports Scientifiques et Techniques 35, 79 p.
[Longline fishing in the South-West Pacific : japanese from 1969 to 1980, taïwanese from 1972 to 1982, Korean in 1979].

31. HENIN, C., B. CALVEZ, F. CONAND, C. HOFFSCHIR, E. JOSSE et P. WAIGNA - 1980 - Rapport de la campagne THON-AUSTRALES 01 à bord du N.O. Coriolis, 1er février - 1er avril 1978. ORSTOM Nouméa, Océanogr., Rapports Scientifiques et Techniques 9, 38 p.
[THON-AUSTRALES 01 cruise report on board R.V. Coriolis (1st February - 1st April 1978)].

32. LE GALL, J.Y. et J.P. HALLIER - 1982 - Pêche exploratoire de germon de de surface à la traîne dans le Pacifique sud central et ouest. La Pêche Maritime déc. 1982 : 1-7.
[A surface albacore survey in the central and western south Pacific Ocean].

33. LE GALL, J.Y., J.P. HALLIER, F. GALLET et H. WALICO - 1982 - Résultats de la campagne PROSGERMON à bord du N.O. Coriolis (12 février - 4 mars 1982). ORSTOM Nouméa, Océanogr., Rapports Scientifiques et Techniques 26, 61 p.
[PROSGERMON cruise report on board R.V. Coriolis (12 February - 4 March 1982)].

34. LEGAND, M. - 1961 - Contenus stomacaux des albacores et yellosfins capturés à la longue ligne par l'ORSOM III. ORSTOM, IFO, Océanogr., Nouméa, 9 p.
[Stomach contents of albacore and yellowfin tuna caught with a longline by the R.V. ORSOM III].

35. LEGAND, M., P. BOURRET, P. FOURMANOIR, R. GRANDPERRIN, J.A. GUEREDRAT, A. MICHEL, P. RANCUREL, R. REPELIN and C. ROGER - 1971 - On trophic relationships at higher levels of the food chain in the tropical Pacific Ocean, 12th Pacific Sciences Congress, Canberra, Australia (18 August - 3 September 1971)].

36. LEGAND, M., P. BOURRET, P. FOURMANOIR, R. GRANDPERRIN, J.A. GUEREDRAT, A. MICHEL, P. RANCUREL, R. REPELIN et C. ROGER - 1972 - Relations trophiques et distributions verticales en milieu pélagique dans l'Océan Pacifique intertropical. Cah. ORSTOM, sér. Océanogr., 10 (4) : 303-393.
[Pelagic food web and vertical distributions in the intertropical Pacific Ocean].

37. LEGAND, M. et R. GRANDPERRIN - 1969 - Résultats des stations de longue ligne expérimentales effectuées dans le Pacifique sud-ouest et central par le Centre ORSTOM de Nouméa de 1956 à 1968, ORSTOM, Nouméa, Océanographie 30, 33 p.
[Results of experimental longlining carried out by the ORSTOM Noumea Laboratory in the South-West and Central Pacific Ocean].

38. LEGAND, M. et R. GRANDPERRIN - 1973 - Feedings habits of deep swimming tunas. Oceanography of the South Pacific 1972, comp. R. FRASER, New Zealand National Commission for UNESCO, Wellington, 1973: 519.

39. MARCILLE, J. - 1979 - La pêche du germon (Thunnus alalunga) en surface au sud de la Polynésie Française est-elle possible ? ORSTOM Tahiti, Océanographie, 13 p.
[Is it possible to fish for surface albacore south of French Polynesia ?].

40. MARCILLE, J. - 1979 - Nouvelles techniques pour développer la pêche thonière à partir des territoires français du Pacifique Sud : résultats des essais effectués par la Pacifique Tuna Development Foundation. La Pêche Maritime oct. 1979 : 1 - 7.
[New techniques to develop tuna fishery from the French Territories of the South Pacific].

41. MOU-THAM, G. et R. GRANDPERRIN - 1985 - La pêche thonière à la palangre en Nouvelle-Calédonie (palangriers locaux) Centre ORSTOM de Nouméa, Rapports 11 à 16 (mars à octobre 1985), 16 p., 13 p., 13 p., 13 p., 17 p.
[Longline fishing in New Caledonia (local longliners)].

42. PAGES, J. - 1973 - An attempt to determine the time of death of catches during longline fishing. In Oceanography of the South Pacific 1972, comp. R. FRASER, New Zealand National Commission UNESCO, Wellington : 445-447.

43. REPELIN, R. - 1972 - Amphipoods consumed by longline pelagic fishes from the Western South Pacific. International Symposium on the Oceanography of the South Pacific. Wellington 9-15 Feb. 1972.

44. REPELIN, R. - 1972 - Etude préliminaire des Amphipodes du bol alimentaire des poissons pélagiques provenant de pêches à la longue ligne. Cahiers ORSTOM, sér. Océanogr., 10(1) : 47-55.
[Preliminary study of Amphipods as food of longline fish].

45. REPELIN, R. - 1978 - Les Amphipodes pélagiques du Pacifique occidental et central. Biologie, écologie et relations trophiques avec la faune ichtyologique. Travaux et documents de l'ORSTOM n° 86, 381 p.
[The pelagic Amphipods of the Western and Central Pacific Ocean. Biology, ecology and trophic relationships with the ichthyofauna]

46. ROGER, C. - 1973 - Recherches sur la situation trophique d'un groupe d'organismes pélagiques (Euphausiacea) V Relations avec les thons. Mar. Biol., 19(1) : 61-65.
[Research on the trophic level of Euphausiacea V. Relationships with tuna].

47. ROGER, C. - 1973 - Recherche sur la situation trophique d'un groupe d'organismes pélagiques (Euphausiacea) VI Conclusions sur le rôle des euphausiacés dans les circuits trophiques de l'Océan Pacifique intertropical. Mar. Biol., 19(1) : 66-68.
[Research on the trophic level of Euphausiacea. VI Conclusions on the role of Euphausids in the food web in the intertropical Pacific Ocean.

48. ROGER, C. - 1974 - Les Euphausiacés du Pacifique équatorial et sud-tropical. Zoogéographie, écologie, biologie et situation trophique. Mem. ORSTOM, 265 p.
[The Euphausids of the equatorial and south-tropical Pacific Ocean. Zoogeography, ecology, biology and trophic level].

49. ROGER, C. et R. GRANDPERRIN - 1975 - Importance of bathymetric distributions of macroplanctonic organisms upon the structure of pelagic food webs. 13th Pacif. Sci. Congr. 18-30 Aug., 1975, Vancouver, Canada.

50. ROGER, C. et R. GRANDPERRIN - 1976 - Pelagic food webs in the tropical Pacific. Limnology and Oceanography, 21(5) : 731-735.

51. ROUGERIE, F. - 1982 - Rapport de la mission POLYDROTHON 82 du N.O. Coriolis. ORSTOM Tahiti, Archives d'Océanographie n° 82-02, [POLYDROTHON 82 Cruise Report, R.V. Coriolis)].

52. ROUGERIE, F., A. LEBEAU, Y. GOURIOU et A. RAYMOND - 1982 - Relevés océanographiques du B.C.B. MARARA dans le sud Polynésien en 1979, 1980 et 1981. Rapport CEA-R-5155, 43 p.
[Hydrological stations carried out on board B.C.B. MARARA in the southern zone of French Polynesia in 1979, 1980 and 1981].

Appendix 1 - Decreasing importance of various albacore fish-preys : families ranked according to number (R1), to occurence (R2) and to R = R1 + R2 (from GRANDPERRIN, 1975).

Families	Number		Occurrence		R=R1 + R2
	% (1)	R1	%	R2	
Sternoptychidae	8.6	36	16.8	35.5	71.5
Gempylidae	6.0	33	17.5	37	70
Bramidae	6.4	34	16.8	35.5	69.5
Chaetodontidae	8.1	35	8.4	32	67
Myctophidae	2.9	28	9.8	34	62
Latilidae	4.6	31	7.0	30	61
Etalidae	3.5	29	8.4	32	61
Paralepididae	2.7	27	8.4	32	59
Acanthuridae	4.3	30	6.3	28.5	58.5
Alepisauridae	2.1	25	4.9	26.5	51.5
Anoplogastridae	1.7	23	6.3	28.5	51.5
Ostracionidae	2.3	26	4.2	25	51
Chiasmodontidae	2.0	24	4.9	26.5	50.5
Lutjanidae	23.3	37	1.4	12	49
Nomeidae	5.8	32	1.4	12	44
Molidae	1.4	20	2.8	23	43
Anthiidae	1.4	20	2.8	23	43
Zeidae	1.4	20	2.1	18.5	38.5
Caproidae	1.2	17	2.1	18.5	35.5
Scorpaenidae	1.2	17	2.1	18.5	35.5
Diretmidae	0.8	11.5	2.8	23	34.5
Scombrolabracidae	1.0	14.5	2.1	18.5	33
Percichthyidae	1.2	17	1.4	12	29
Serranidae	0.6	10	2.1	18.5	28.5
Polymixiidae	0.6	10	2.1	18.5	28.5
Bregmacerotidae	1.5	22	0.7	4.5	26.5
Balistidae	1.0	14.5	1.4	12	26.5
Scopelarchidae	0.8	11.5	1.4	12	23.5
Trichiuridae	0.6	10	1.4	12	22
Tetraodontidae	0.4	8	1.4	12	20
Uranoscopidae	0.2	4	0.7	4.5	8.5
Triacanthidae	0.2	4	0.7	4.5	8.5
Trachichthyidae	0.2	4	0.7	4.5	8.5
Priacanthidae	0.2	4	0.7	4.5	8.5
Omosudidae	0.2	4	0.7	4.5	8.5
Blenniidae	0.2	4	0.7	4.5	8.5
Apogonidae	0.2	4	0.7	4.5	8.5
	100	-	100	-	-

(1) in % of identified fish (N = 518)

Appendix 2 - Decreasing importance of various albacore fish-preys : families, genera and species ranked according to number (R1), to occurence (R2) and to R = R1 + R2 (from GRANDPERRIN, 1975).

Families, genera, species	Number		Occurrence		R=R1 + R2
	% (1)	R1	%	R2	
. Sternoptyx sp.	5.2	69	10.5	71	140
Centropyge sp.	6.9	70	5.6	66.5	136.5
Hoplolatilus sp.	4.6	67.5	7.0	69	136.5
. Brama orcini	4.2	66	9.8	70	136
Naso sp.	3.5	65	5.6	66.5	131.5
. Anoplogaster cornutus	1.7	60.5	6.3	68	128.5
Pristipomoides sp.	1.9	62	4.9	64.5	126.5
. Myctophidae ind.	2.9	64	3.3	62	126
. Paralepididae ind.	1.7	60.5	4.9	64.5	124.5
. Argyropelecus sp.	2.0	63	3.5	60.5	123.5
. Nealotus tripes	1.4	55	4.2	63.	118
. Alepisaurus brevirostris	1.5	58	2.8	55	113
. Mola mola	1.4	55	2.8	55	110
. Argyropelecus olfersi	1.4	55	2.8	55	110
Lepidocybium flavobrunneum	1.0	46.5	3.5	60.5	107
Lutjanus sp.	23.1	71	1.4	36	107
Chaetodon sp.	1.2	51	2.8	55	106
. Pterycombus petersii	1.0	46.5	2.8	55	101.5
Setarches guntheri	1.2	51	2.1	47.5	98.5
. Lactoria diaphana	1.5	58	1.4	36	94.
Scombrolabrax heterolepis	1.0	46.5	2.1	47.5	94
. Taractes asper	0.8	39	2.8	55	94
. Pseudoscopelus sagamianus	0.8	39	2.8	55	94
. Diretmus argenteus	0.8	39	2.8	55	94
Rexea solandri	0.8	39	2.8	55	94
Scombrosphyraena oceanica	1.2	51	1.4	36	87
Zenion sp.	1.2	51	1.4	36	87
Gempylidae ind.	0.8	39	2.1	47.5	86.5
Anthias squamipinnis	1.0	46.5	1.4	36	82.5
. Cubiceps sp.	4.6	67.5	0.7	14	81.5
. Alepisaurus ferox	0.6	30.5	2.1	47.5	78
Etelis oculatus	0.6	30.5	2.1	47.5	78
. Gempylus serpens	0.6	30.5	2.1	47.5	78
Antigonia rubescens	0.8	39	1.4	36	75
. Diplospinus multistriatus	0.8	39	1.4	36	75
. Scopelarchus guntheri	0.8	39	1.4	36	75

(1) in % of identified fish (N = 518)

. true pelagic fish

Appendix 2 (continued) - Decreasing importance of various albacore fish-preys : families, genera and species ranked according to number (R1) to occurence (R2) and to R = R1 + R2 (from GRANDPERRIN, 1975).

Families, genera, species	Number		Occurrence		R=R1 + R2
	% (1)	R1	%	R2	
. Bregmaceros rarisquamosus	1.5	58	0.7	14	72
. Chiasmodon sp.	0.6	30.5	1.4	36	66.5
. Nesiarchus nasutus	0.6	30.5	1.4	36	66.5
. Cubiceps panciradiatus	1.2	51	0.7	14	65
Anthias sp.	0.4	23	1.4	36	59
Ostracion tuberculatus	0.4	23	1.4	36	59
. Paralepis atlantica	0.4	23	1.4	36	59
. Lestidiops jayakari	0.4	23	1.4	36	59
Polymixia berndti	0.4	23	1.4	36	59
Ostracoberyx sp.	0.4	23	1.4	36	59
Lagocephalus sp.	0.4	23	1.4	36	59
Acanthurus sp.	0.8	39	0.7	14	53
Balistidae ind.	0.8	39	0.7	14	53
Symphysanodon sp.	0.8	39	0.7	14	53
. Chiasmodontidae ind.	0.6	30.5	0.7	14	44.5
Antigonia capros	0.4	23	0.7	14	37
. Benthodesmus sp.	0.4	23	0.7	14	37
Synagrops sp.	0.2	9.5	0.7	14	23.5
Balistes vidua	0.2	9.5	0.7	14	23.5
Cirripectes sebae	0.2	9.5	0.7	14	23.5
. Pteraclis velifera	0.2	9.5	0.7	14	23.5
. Pteraclis sp.	0.2	9.5	0.7	14	23.5
Etelis carbunculus	0.2	9.5	0.7	14	23.5
. Omosudis lowei	0.2	9.5	0.7	14	23.5
Lactoria fornasini	0.2	9.5	0.7	14	23.5
Rhinesomus reipublicae	0.2	9.5	0.7	14	23.5
. Lestidiops pacificum	0.2	9.5	0.7	14	23.5
Polymixia sp.	0.2	9.5	0.7	14	23.5
Pristigenys niphonia	0.2	9.5	0.7	14	23.5
Sacura margaritacea	0.2	9.5	0.7	14	23.5
Gephyroberyx darwini	0.2	9.5	0.7	14	23.5
Halimochirus sp.	0.2	9.5	0.7	14	23.5
Aphanopus sp.	0.2	9.5	0.7	14	23.5
Uranoscopus sp.	0.2	9.5	0.7	14	23.5
Zanion longipinnis	0.2	9.5	0.7	14	23.5
	100	-	100	-	-

(1) in % of identified fish (N = 518)
. true pelagic fish.