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DISPOSITIFS DE CONCENTRATION DU POISSON: SERVENT-ILS REELLEMENT A LA PECHE? LE CAS DU SUD-OUEST DE EFATE (VANUATU)

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Resume

La pêche d'espèces pélagiques autour de six dispositifs de concentration de poisson (D.C.P.) mouillés dans le sud-ouest Efate entre juin 1982 et juillet 1985 a été étudiée. Certaines conditions favorables à ce type de pêche ont été dégagées. Ainsi, le choix du site d'implantation des radeaux est primordial dans la durée de vie du D.C.P, et dans sa productivité. Il est le résultat d'un compromis entre la protection contre les contraintes physiques en surface, la sélection de la topographie du lieu d'ancrage et la recherche d'une bonne productivité. La pose de D.C.P. est responsable d'une diminution d'efficacité de l'effort de pêche et d'une chute des prises par unité d'effort dans les zones ne subissant pas l'effet agrégateur. Cette chute des P.U.E. contre balance les bons rendements réalisés autour des radeaux. C'est pourquoi, sur l'ensemble d'une région (zones des D.C.P. incluses), les prises par unité d'effort ne varient pas de manière significative après la mise en place de radeaux agrégateurs. Savoir si la concentration de poissons autour des D.C.P. (95% des captures) se répercute sur l'abondance dans les zones situées hors de l'influence agrégatrice recquiert des informations complémentaires de celles fournies par les pêcheurs, ceux-ci modifiant leur stratégies de pêche avec l'apparition du phénomène d'agrégation.

FISH AGGREGATING DEVICES : ARE THEY REALLY OF ANY HELP TO FISHING ? EXAMPLE : SOUTH-WEST EFATE (VANUATU)

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SUMMARY

A study was carried out on the fishing operations for pelagic species around six fish aggregating devices (F.A.D.) moored off South-West Efate between June 1982 and July 1985. Certain conditions were established which are likely to facilitate this type of fishing activity. For instance, the choice of site for mooring the rafts is of paramount importance for the life expectancy of the FAD and its productivity. It is the result of a compromise between protecting the device against the physical constraints on the surface, the choice of topography at the site of anchorage and the potential for productivity. The installation of FAD's has led to a decrease in the efficiency of the fishing effort and a drop in catch per unit of effort (C.P.U.E.) in those zones which are not subject to the aggregating effect. This drop in CPUE offsets the good yields achieved around the rafts. Thus, throughout an area as a whole (FAD zones included), the catch per unit of effort shows no significant variation following the installation of the aggregating rafts. To establish whether the concentration of fish around the FAD's (95% of catches) has repercussions on the abundance of fish in zones outside the aggregating influence would require additional information to that provided by the fishermen, as they alter their fishing strategy according to the aggregating phenomenon.

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FISH AGGREGATING DEVICES : ARE THEY REALLY OF ANY HELP TO FISHING ? EXAMPLE : SOUTH-WEST EFATE (VANUATU)

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INTRODUCTION

In Vanuatu, the setting-up of Fish Aggregating Devices (FAD's) is part of the development policy for commercial fishing at village level. The policy is aimed mainly at the fishing of benthic fish along the deeper reef slope and pelagic species offshore.

Fishing for benthic fish requires the use of pelagic species as bait, which is why fishing around FAD's was thought to be a good means of obtaining a regular supply of such bait. It then dawned that the quality of the catches (mostly Thunidae) and their frequency and abundance could provide a regular supply of the local consumer market.

The migratory tendency of offshore pelagic fish means that the coastal fisheries have difficulty in keeping up with them. Dropping rafts which aggregate these species for a while was seen first and foremost as an "aid" to fishing. In theory, by saving time looking for pelagic shoals, vessels should be able to cut down their fuel consumption. Thus, at little cost, those boats which have hardly any autonomy could seek out the highly commercial species otherwise reserved for industrial fishing. The object of this paper is to establish whether these rafts are of any real help in fishing for pelagic species.

To date, the Fisheries Department has anchored some thirty FAD's in Vanuatu waters (Table 1, Fig. 1). Most of them (18) were set up between June 1982 and July 1985, which is the period chosen for this study. With the assistance of the vessels from the Fisheries Department in Port Vila, we decided that the south-western area of Efate was an appropriate study site. Every single trip made between June 1982 and July 1985 has been analysed systematically.

Comparisons were drawn between the fishing efforts and yields from offshore trolling prior to and after the installation of FAD's. With the results we have endeavoured to identify the conditions required to improve the use of these aggregating rafts as a means of facilitating fishing for pelagic species.

Fish Aggregating Device Programme implemented by the Fisheries Department

On Efate, as in the rest of the island group, catamarans such as the Alia type and/or Hartley mono-hulls are used for small-scale commercial fishing. Equipped with 25 HP engines, these vessels, between 5 and 7 meters long, may go out to sea up to some fifteen miles away from the coasts. Two or four hand reels are fitted onto the boat. The line is held by a boom and is used for bottom fishing from a vertical position with the vessel kept stationary, or for trolling when fishing pelagic species. In this manner, the same boat can, in one trip, take advantage of the benthic species and also the pelagic species by alternating these two methods of fishing.

The FAD model used in Vanuatu from June 1982 to July 1985 is the second generation FAD advocated by BOY & SMITH (1984). These rafts were anchored at depths between 250 and 1150 meters, with twelve of them being dropped below the 300 m isobath (Fig. 2).

One after the other, six FAD's were set up around Efate (Table 2, Fig. 3), at depths between 240 and 800 meters. Four of them, FAD's No. 2, 3, 10 and 11, were anchored in open areas out at sea, therefore probably exposed to the south-westerly winds. Two rafts (FAD No. 1 and 12), one of which was in a coastal area, were set up in zones which are fairly well sheltered from the winds and high sea currents.

Whilst FAD's No. 3 and No. 10 had only a short life-span (three to five months), FAD No. 12, presumed to be protected from the winds, lasted barely six months. Yet FAD's No. 2 and 11, although exposed to the physical elements of the high sea, remained in place for over twelve months, which is considered a good life-span for a raft (BOY & SMITH, 1984).

An examination of the topography of the anchorage sites provided clues as to the life expectancy of FAD's. Indeed, those rafts which we noted for their short life-span were all anchored in the vicinity of steep inclines (24%) which are likely to be subject to swirling currents. If the anchor is not heavy enough, therefore, turbulences at the bottom may drag the raft down to great depths. This is probably one of the reasons why the payaos which were dropped in 1989 and 1990 at the former sites of the No. 2 and No. 11 FAD's failed to remain in place for more than one or two months, not having been weighted enough (700 kg as opposed to 1000 kg which should be used).

Basically, a site should be chosen primarily for its aggregating potential (BERGSTROM, 1983). To this end, it is essential to note the crossing zones of the Thunidae. If we take this factor alone into account, we come to the example of the No.3 and No.10 FAD's, whose extremely short life impeded the scope for production. To choose a site solely for the purpose of safeguarding the FAD leads to the example of FAD No. 12, which yielded nothing at all. In the end, only FAD's No. 2 and 11, which, whilst exposed to the high seas, were well anchored on a gentle slope, close to the lanes of pelagic shoals, turned out to be the most effective of the lot. The exceptional lifespan of FAD No. 1 offset the lower productivity compared to those more exposed to the high seas. Thus, the choice of site is a compromise between raft life expectance and productivity.

Impact of FAD's on fishing strategies and use of sea space

There is no doubt that setting up a fish aggregating zone out at sea, supposedly deserted, causes changes, both in the fishing strategies and in the fishermen's concept of sea space.

Before the installation of the FAD's, there were two types of trips :

- trips out to the coastal areas, fishing for benthic species
- trips out to sea, fishing for pelagic species.

These latter trips always involved active searching for shoals and trolling was not started until a pelagic shoal had been sighted. Because of the time it took, trips out to sea were often separate from coastal trips.

Once the rafts were set up, the fishermen decided there was no longer any purpose in seeking out pelagic shoals out at sea. Boats head straight for the rafts, with their lines dropped into the water as soon as they leave the harbour. With this strategy, they can carry on their trolling activities in the coastal zones, offshore and around the FAD's all in one trip. This has led to a re-distribution of fishing space.

Prior to the installation of FAD's, offshore was the zone beyond the isobathic 300 meters, which is marked in South-West Efate by a sharp increase of the reef slope. The area up to that limit was seen as coastal zone (Fig. 3).

Following the set-up of the FAD's, three zones can now be outlined :

- a coastal zone up to the 300 m isobath,
- a zone under the influence of the aggregating power of the FAD, estimated to be equal to a surface circle with a one mile radius around the raft (CILLAURREN, 1988),
- the offshore zone beyond the impact of the raft.

Effect of the FAD's on the fishing efforts and yields

Two fishing periods have been identified :

- the period prior to the installation of the rafts, from August 1981 to August 1982
- the period following the installation of the rafts, from June 1982 to July 1985.

Table 3 shows the overall results of fishing operations. Generally speaking, throughout SW Efate, the trolling time per trip has hardly changed with the installation of the rafts and corresponds to 3.7 hours approximately. In the coastal zone, trolling time per trip has not changed much since the rafts were set up; it averages 2.65 hours per trip. Offshore, the average length of time spent trolling during a trip has dropped from 5.2 hours to 3.4 hours, 1.7 hours being devoted to trolling around the rafts.

Whilst the overall CPUE (catch per unit of effort) in terms of number of fish has increased from 0.68 to 0.81 since the setting-up of the rafts, the CPUE in terms of weight would appear to have decreased in that same period. When we look at the changes in CPUE per zone, we note that the CPUE in terms of weight has decreased significantly along the coast and offshore since the FAD's have been set up. Moreover, they account for 95% of the trolling catch.

The most significant is the drastic decrease in CPUE along the coast and offshore since the event of the FAD's. In actual fact, 95% of the catch is taken whilst trolling around the aggregating rafts.

To find out whether these changes are of any import, a Wilcoxon test (test without parameters) was carried out to compare the relative fishing efforts and the yields achieved before and after installation of the rafts in SW Efate. Given the extreme seasonal fluctuations noted in the abundance of tuna (MARCILLE & BOUR, 1981; CILLAURREN, 1988), it is obviously impossible to check and compare the "effectiveness" of the various FAD's if the data does not correspond to exactly the same periods of time. We therefore selected two periods, once from December 1981 to March 1982 and the other from December 1982 to March 1983. There were no rafts during the first period and two rafts were in place throughout the whole of the second period. The test compared the fishing trips made beyond the 300 m isobath and including the zone of FAD influence (Table 4).

The findings of the test show that trolling time decreased considerably after installation of the FAD's, but that the fishing yields (weight and number of fish per trip) for the whole of the area beyond the isobathic 300 m remained fairly constant both prior and subsequent to the rafts. Given the productivity around FAD's (23.3 kg per trolling hour), this result may seem paradoxical. In reality, the high fishing yields achieved around the FAD's are offset by very low CPUE's recorded outside their zone of influence. There could be two explanations for this decrease in offshore production :

- either the shoal aggregation around the rafts caused the number of fish to drop off outside the FAD area;

- or the fishing effort offshore has become less intensive following the installation of the rafts.

From our observation of the fishing strategies before and after setting up the rafts, it would appear to be the latter. The fishing effort having altered, we are unable to establish whether the wealth of fish around the rafts is to the detriment of areas outside the rafts' zone of influence.

CONCLUSION

The experience with trolling around FAD's anchored off SW Efate has shown that the choice of an appropriate site is a compromise between fishing potential and physical constraints on the FAD, both on the surface and deep down. As many zones known to be rich offshore are exposed, it is better to anchor the rafts on a gently sloping bottom and to give priority to the quality of the mooring line and the anchorage even if this means a higher cost of FAD. The life expectancy and productivity of the raft will benefit therefrom.

One of the problems is the length of time it takes to get to the rafts, as it is unproductive despite the fact that trolling lines are dropped in the water. Because of the vessels' lack of autonomy (one day out at sea), travelling time impinges on trolling time around the rafts. Hence, even though fishing around FAD's offers the possibility of increasing the fishing yields and thereby the income generated, this distinct advantage loses its appeal because of the low catches whilst travelling to and from. It becomes an expenditure which cannot be properly offset.

On the whole, it can be said that fishing around rafts presents a definite advantage as opposed to pelagic fishing without FAD's, but this is conditional upon :

- the least possible "loss" of time in travelling to and from,
- the FAD being situated in such way that its aggregating power ensures fishing yields equal to those of ordinary commercial fishing operations (i.e. 20 to 25 kg/trolling hour),
- the life expectancy of the FAD being long enough to enable the fishermen to get the full benefit of its productivity.

It is difficult to assess the impact of fishing around aggregating rafts on the abundance of fish in any one area. This requires additional information to that provided by the fishermen. Indeed, the would-be increase in abundance due to aggregation has repercussions on the fishing effort which is also concentrated around the rafts. It does not take much for the fishermen, feeling frustrated, to discontinue using FAD's, if the raft is too far away or its productivity proves disappointing.

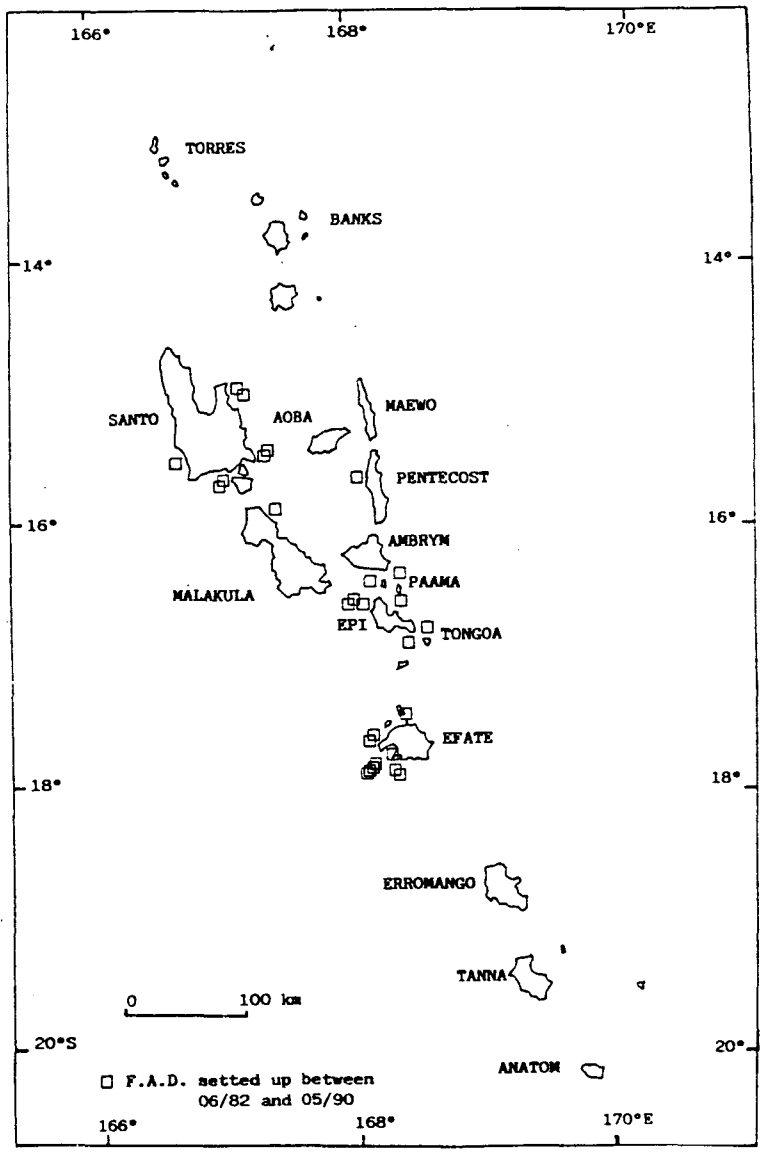
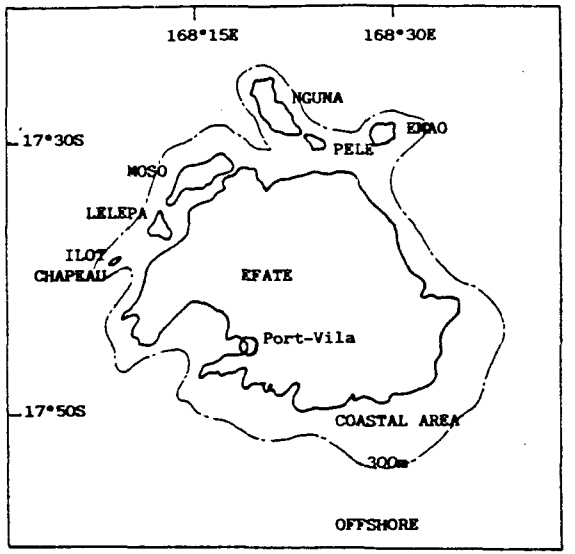
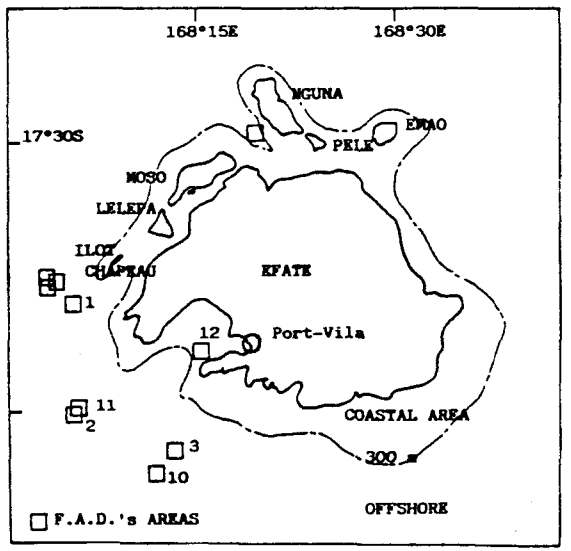


Figure 1 - F.A.D.'s set up in Vanuatu between 1982 and 1990



a) prior F.A.D.'s set up



b) after F.A.D.'s set up

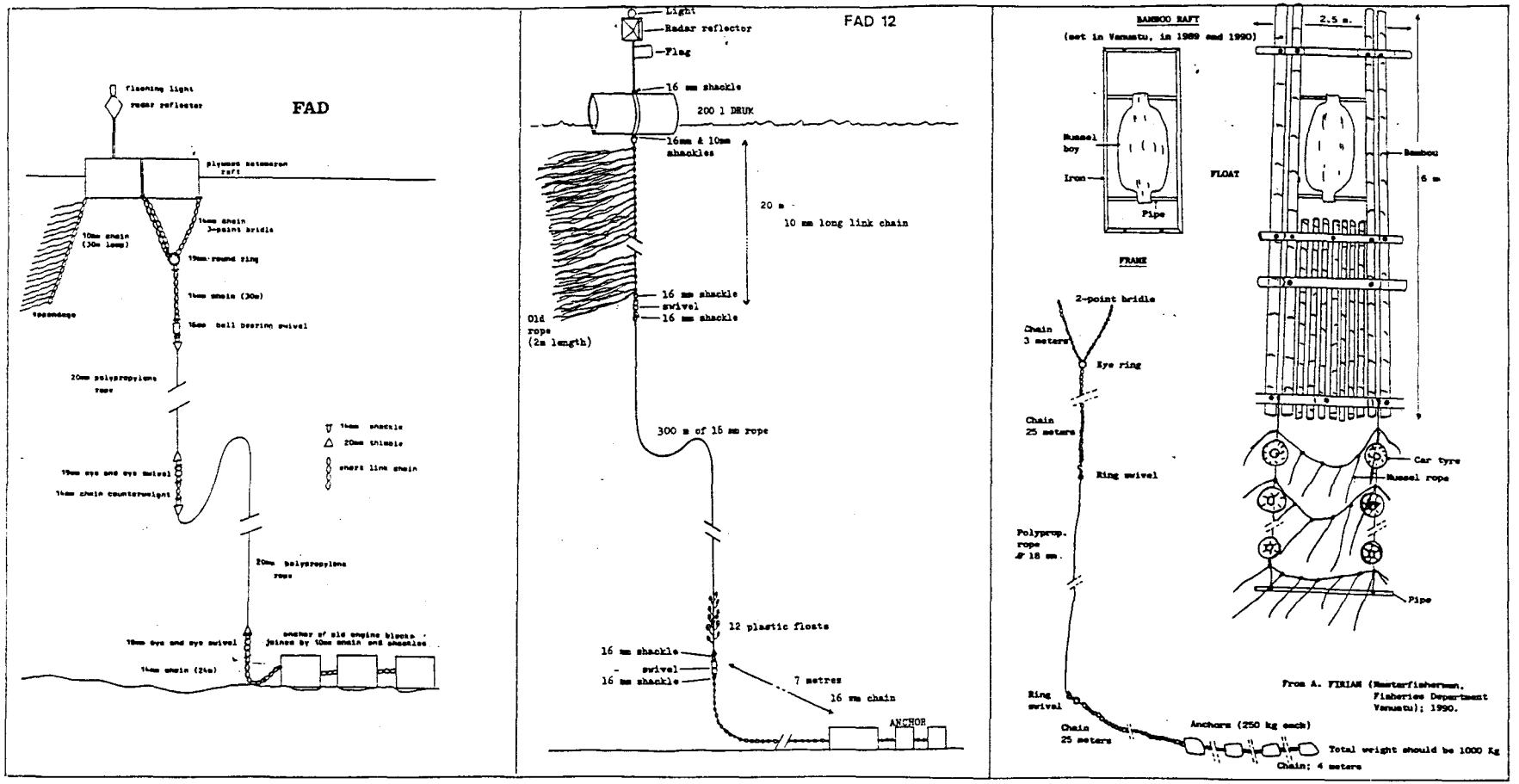
Figure 3 - Fishing areas around Efate

Table 1 - Sequence of F.A.D. installation and lose since june 1982 in Vanuatu

ISLAND	LOCATION	DEPTH in m.	DATE SET	DATE LOST	LONGEVITY
EFATE	17°42'S/168°5'8E	500	17/06/82	06/03/85	33 months
	17°50'.2S/168°5'.9E	700	13/09/82	13/01/84	16 "
	17°52'.8S/168°13'.1E	780	16/03/83	30/08/84	5 "
	17°54'.3S/168°12'.4E	800	12/09/84	11/12/84	3 "
	17°49'.7S/168°5'.8E	800	27/09/84	?	
	17°46'.2S/168°15'.2E	240	30/08/84	10/03/85	7 "
	17°41'S/168°04.1'E	510	01/89	en place	>17 "
	17°41'40S/168°03'37E	500-700	05/09/89	12/89	1 "
	17°41'S/168°03'E	500-800	04/90	05/90	1 "
	Nguna	500-600	1986	1987	12
SANTO	15°40'S/167°E	200-300	03/83	?	
	15°30'S/168°40'E	720	16/03/83	10/09/84	18
	15°S/167°7'E	300	15/11/84	1/12/84	0.5
	15°41'S/167°01'E	700-1000	14/12/84	?	
	15°2'.5S/167°12'.2E	200-400	16/07/85	?	
	15°28'S/167°20E	800	13/08/85	?	
	15°28'S/167°19'.5E	600-900	18/05/87	?	
MALEKULA	15°56'35S/167°21'40E	200-500	03/83	?	
PENTECOST	15°45'2S/168°05'5E	700	3/12/84	85?	
PAAMA	16°28'S/168°07'30E	400	14/09/83	25/01/85	16
LOPEVI	16°25'S/168°18'E	1150	22/09/83	9/03/84	6
EPI	Lamen Bay	200-500	12/84	12/84	<=1
	16°34'S/168°4'5E	500-1000	26/10/87	?	
	16°33'S/168°7'E	500-1000	26/10/87	?	
TONGOA	16°55'5S/168°25'1E	650	23/11/84	29/01/85	2
	15°49'S/168°35E	700	21/07/88	?	

Table 2 - Fish aggregating devices set up in SW Efate between June 1982 and July 1985

RAFTS	LOCATION	Miles from PORT-VILA	Miles from the COAST	DEPTH in meters	DECLIVITY of ANCHORAGE	EXPOSITION TO SE WINDS	PRODUCTIVITY IN Kg/Troll.hour	LONGEVITY in months	REASONS FOR LOSS
F.A.D. N°1	17°42'S 168°5'.9E	16.7	4.3	500	At the top of slope 11%	Partially sheltered	15.2	33	Shipping
F.A.D. N°2	17°50'.2S 168°54.9E	17.6	9.2	700	6%	Exposed	23	16	Cable Corrosion
F.A.D. N°3	17°52'.8S 168°13'.1E	11.8	6.3	780	At bottom of slope 23%	Exposed	19.2	4.5	?
F.A.D. N°10	17°54'.3S 168°12'.4E	12.7	7.3	800	At bottom of slope 23%	Exposed	10.5	3	?
F.A.D. N°11	17°49'.7S 168°5'.8E	17.6	9.2	800	6%	Exposed	25.8	> 12	?
F.A.D. N°12	17°46'.2S 168°15'.2E	4.1	0.8	240	24%	Sheltered	null	6	Carried away by currents



a) offshore F.A.D. between 1982 and 1985

b) coastal F.A.D. between 1982 and 1985

c) offshore F.A.D. in 1989 and 1990

Figure 2 - Successive models of F.A.D. set up in Vanuatu between 1982 and 1990

Table 3 - Trolling carried out by Fisheries Department in SW Efatz prior to F.A.D.'s (from 08/81 to 08/82) and following installation of F.A.D.'s (from 09/82 to 07/85).

LOCATION	AREA	NUMBER OF TRIPS	TROLLING HOURS	TROLLING PERIOD/Tr.	Nb. OF HOURS@REEL	NUMBER OF FISH	CATCHES IN KG	C.P.U.E. IN NUMBER	C.P.U.E. IN WEIGHT
BEFORE THE SETTING OF F.A.D.'s	COASTAL	52	138	2.7	609	220	629	0.36	1.03
	OFFSHORE	39	201	5.2	899	800	2254	0.89	2.51
	TOTAL	91	339	3.7	1508	1020	2883	0.68	1.91
AFTER THE SETTING OF F.A.D.'s	COASTAL	594	1535	2.6	5345	640	1763	0.12	0.33
	F.A.D.	439	743	1.7	2741	7987	17319	2.91	6.32
	OFFSHORE	431	736	1.7	2700	101	348	0.04	0.13
	TOTAL	799 (1)	3014	3.8	10786	8728	19430	0.81	1.80

(1) Several sites may be visited during each trip

Table 4 - Effect of the installation of F.A.D.'s offshore on the fishing effort and production

STATEMENT	BEFORE SETTING UP F.A.D.	AFTER SETTING UP F.A.D.
PERIOD	FROM 12/81 TO 03/82	FROM 12/82 TO 03/83
NUMBER OF TRIPS	29	52
NB.of TROLLING H.	157.50	184.20
TR.HOURS/TRIP	5.43	3.54
NUMBER OF CATCHES	773	1074
CATCHES in KG.	2133	2401.1
NB.OF CATCHES/TRIP	26.70	20.65
KG./TRIP	73.55	46.18
NB./TROLLING HOUR	4.90	5.83
KG./TROLLING HOUR	13.54	13.04
WILCOXON TEST TROLLING H./TRIP NB.PRISES/SORTIE Kg/SORTIE	BEFORE F.A.D. HIGHER THAN AFTER F.A.D. Test significance = 4.2 to 1% BEFORE F.A.D. EQUAL TO AFTER F.A.D. Test significance = 0.56 BEFORE F.A.D. EQUAL TO AFTER F.A.D. Test significance = 0.78	

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