

# Does FAD Deployment Have a Real Effect on Fishing Redeployment Towards Offshore Resources?

## Est-ce que le Développement des DCP a un Réel Effet sur le Redéploiement de la Pêche sur les Ressources au Large?

## ¿Tiene la Colocación de DCP un Real Efecto sobre la Redistribución de la Pesca Hacia los Recursos en Mar Adentro?

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### ABSTRACT

Since 1960, Caribbean region has sort to develop the fishing of potential of large pelagic species in offshore waters especially to reduce the excessive use of insular shelves. At that time, Fish Aggregating Device (FAD) was perceived as a suitable mode to exploit those resources. This paper attempts to answer this question: “Was FAD development able to redeploy the fishing activity towards offshore resources and at the same time reduce the effort on coastal resources?” In order to answer that question, the fishing development around FAD is compared among three islands namely Guadeloupe, Dominica and Martinique. It shows that in Guadeloupe and in Martinique 300 vessels operate around FAD, representing 39 and 33% of the active vessels, respectively, while 59 and 61% of professional fishermen are using fish pots respectively. In Dominica, 45% of the vessels operate around FAD and only 15% are using fish pots. The results indicate a greater utilization of the insular shelf resources in Martinique and Guadeloupe as compared to Dominica. However, the extent of the difference cannot be explained on the basis of the width of the insular shelf. Observations indicate that as soon as the carrying capacity of the FAD fishery is approached, a parallel increase in insular shelf fishery activity is realized in Martinique. Three reasons are given by fishermen and discussed here, to explain this progression:

- i) Market saturation in pelagic products (because of the high supply of pelagic species, it is difficult to sell this product at a good price),
- ii) Irregularity of the FAD fishing (seasonality of catches because of pelagic migration and FAD submersion due to strong seasonal currents), and
- iii) Increase of fuel price.

All these factors suggest that the development of FAD fishery without simultaneous implementation of regulations to reduce the effort on inshore fishing is an important consideration to effect a reduction on inshore fishery pressure. In other words, the promotion of FAD fishing by itself is not sufficient enough to reduce the effort on coastal resources.

KEY WORDS: FAD, resources, exploitation, effort, shelf, production

### INTRODUCTION

Currently, the date of the very first FAD fishing experiment remains unknown because it was probably not recorded in the literature. However the first FAD program in the Caribbean region occurred between 1965 and 1971 under a PNUD/FAO project for developing fishing in the Caribbean (Wolf and Rathjen 1974). It is only in 1982 that Martinique tried to develop large pelagic fishing by FAD utilization (Goodwin 1986) and between 1988 - 1990 for Guadeloupe and Dominica (Guiste, pers. comm.). Between 1998 and 1999, the FAD fishing yield in Martinique was 26.7kg per fishing trip whereas the offshore fishing yield without the use of FAD was 59 kg per fishing trip but this last activity strongly depends on the season. In Guadeloupe, the FAD yield was 30 kg per fishing trip in 1992 and 43 kg in 1995 (Reynal et al. 2000). Very little data was collected in Dominica during this period; however since the emergence of FADs we could notice that catch landings of large migratory species have increased significantly (Defoe and Philbert 2013). FAD fishing has now more than 20 years of practice in Martinique, Guadeloupe and Dominica, it is interesting to see if its utilization had a positive impact on coastal resources by limiting its exploitation which was one of the reasons for the introduction of this technique. Increase supply of offshore large pelagic fish is another reason to develop FAD activity, since Caribbean islands strongly depends on imports for many products and creates an economic dependence on other countries. The composition of fish products from those imports should be lessened if the country can supply enough of this product.

### FAD Fishery Development in Small-scale Fleet

The fishing fleets in Guadeloupe, Dominica and Martinique are what we can call a “small scale fleet”. The majority of the vessels are smaller than 10 meters length which operates multipurpose gears that affords them the capacity to switch easily their type of fishery.

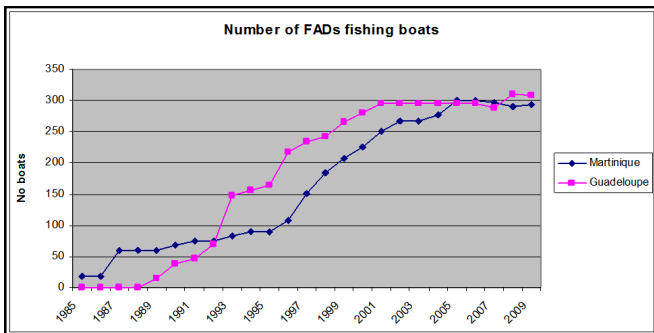
The FAD activity can be measured by several ways; here we counted the number of FAD vessels existing on the island.

Although the three islands have similar type of fleet, the FAD development is peculiar to each island and fishing behavior differs. The FAD development on the French islands went through three stages (Figure 1):

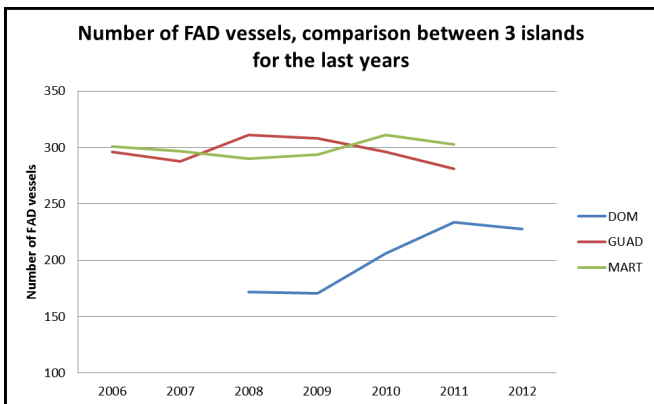
- i) A light rise where Martinican FAD activity is above Guadelupian for the first seven years of FAD fishery (1985 - 1992),
- ii) A strong increase where Guadelupian FAD activity goes over Martinican between 1992 to 2002, and
- iii) A ceiling around 300 vessels for both islands as if a maximum capacity of the FAD fleet has been reached in 2002 in Guadeloupe and 2006 in Martinique.

If we compare the number of French FAD vessels to Dominican FAD vessels for the past 5 years, we can see that the situation is completely different. Dominican FAD fleet is still in full growth. From 2009 to 2012 we had an additional 100 FAD vessels (Figure 2).

Nowadays a clear difference between the three islands is the FAD density present in the sea. Martinique and Dominica have about the same number of FAD in their waters, 29 in Dominica (Defoe and Philbert, 2013), around



**Figure 1.** Number of FAD vessels from 1985 to 2009 in Martinique and Guadeloupe. Source: SIH Ifremer (“Système d’Information Halieutique”).

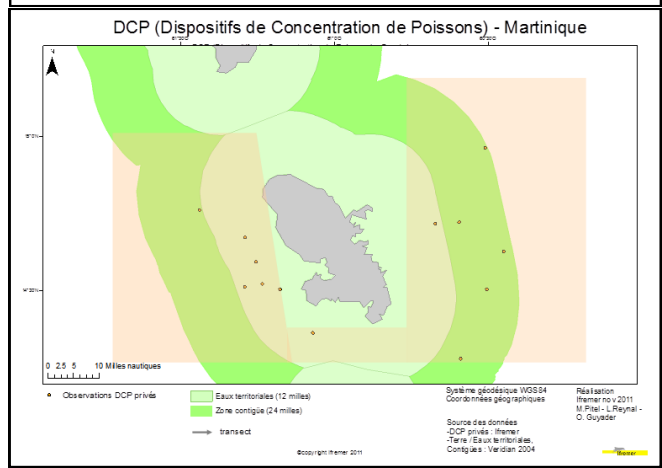
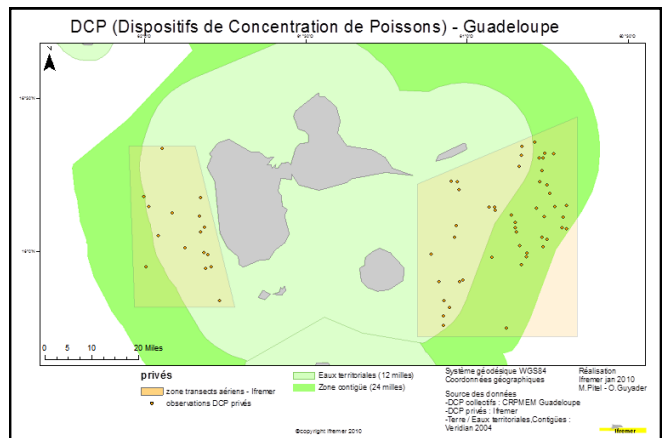


**Figure 2.** Number of FAD vessels from 2006 to 2011 in Martinique and Guadeloupe; and from 2008 to 2012 in Dominica. Sources: SIH and Fisheries Division of Dominica.

16 in Martinique whereas more than 400 FADs are present in Guadeloupe (data from SIH, 2013). An airplane survey conducted in 2008 above Martinique and Guadeloupe could already show this singularity (Figure 3). Fishermen in Dominica and Martinique visit only one or two FADs per fishing trip whereas in Guadeloupe they will visit on average 4 to 5 FADs in the same trip thanks to their close proximity.

The effect and impact of FADs utilization mode on the catches can explain a part of this difference between FAD fishing in Martinique and that same activity in Guadeloupe. Indeed, fishermen from Guadeloupe mainly target dolphin fish. For that reason, there are a lot of private FADs owned by one fisherman whereas in Martinique the fishing activity is more organized by groups. The consequence is that fewer FADs are deployed in Martinique compared to Guadeloupe. Martinican fishermen target mainly blue marlin and yellowfin tuna. The composition of landings is different from one island to the other (Figure 4).

In Martinique, in 2009 and 2010, blue marlin, main species fished, represented 44% to 36% of the total FAD catches, respectively. At the same time, dolphin fish catches were between 9% and 4% and yellowfin tuna



**Figure 3.** Airplane survey of FADs above Guadeloupe and Martinique, the red spots representing the FADs. Source: Ifremer, 2008.

between 15% and 25% (data from Reynal et al. 2013). In 2008 and 2010 in Guadeloupe, the three main species, yellowfin tuna, dolphin fish and blue marlin were 36% to 35%, 33% to 29% and 18% to 9% respectively of total FADs landings (data from Guyader et al. 2010). Finally in Dominica we obtained in 2010 32% for the yellowfin tuna, 16% for the dolphin fish and 7% for the blue marlin (data from Fisheries Division database, 2013). See Figure 5.

Basically, we found the same species were captured in the three islands but in different proportions. Main species captured are the yellowfin tuna (represented in yellow in Figure 5) with the highest number of catch in Guadeloupe, with decreasing numbers toward the south, same for the dolphin fish (represented in light green in Figure 5), another important species captured on FAD and finally the blue Marlin (represented in blue in Figure 5) is more captured in the South (Martinique) for 2010.

FAD fishing started with young fishermen in the French islands, their first results in terms of quantities of fish landed most likely convinced older fishermen to practice that type of fishery (Figure 6). Indeed, FAD fishing looked as a productive fishery compared to coastal fisheries such as fishing pots practiced at that time by a majority of fishermen. This change of fishing behavior from older people could possibly have an impact on coastal resources by exploiting them less.

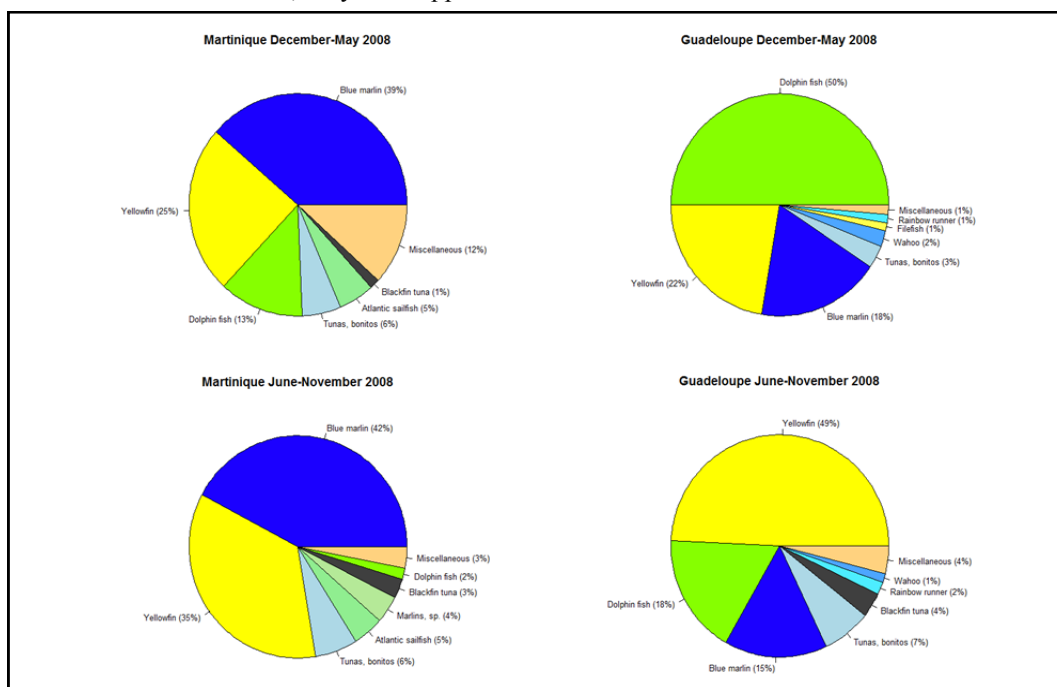
**Fishing Activities in Addition to FAD Fishery, Where the Effort is Allocated**

The increase in FAD fishing does not necessarily mean a desertion of the other fishing activities. For example in the French islands in 2010, only 20% approxi-

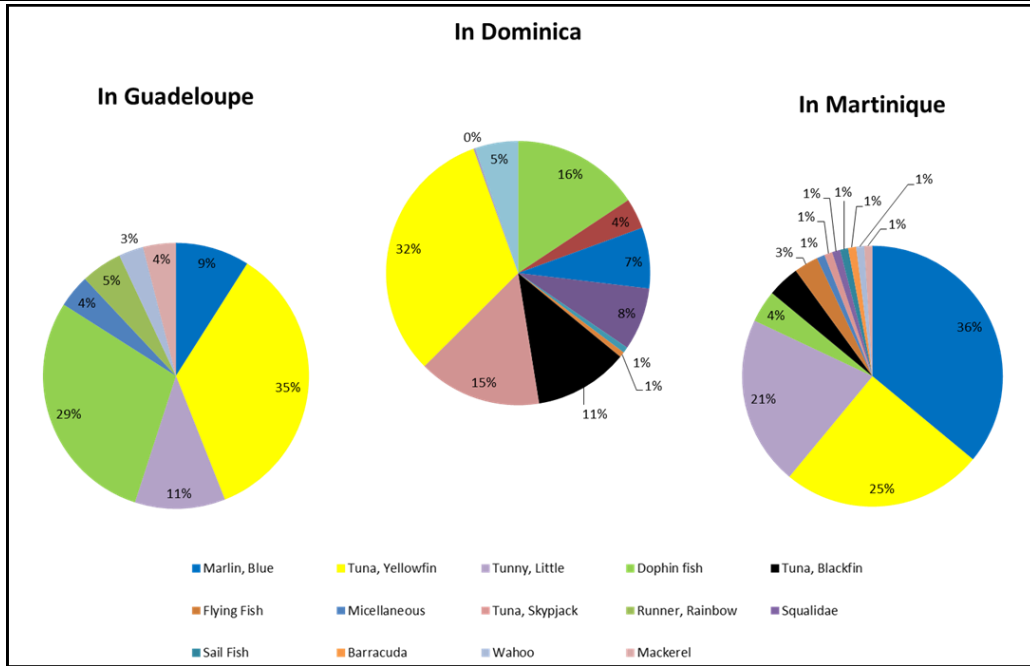
mately of FAD vessels are exclusive in the FAD fishing. The fish pots represent about the same proportion in Guadeloupe and even more, 34%, in Martinique. In Guadeloupe the most common strategy applied by FAD fishermen is to use multipurpose fixed gears in addition to the FAD activity (represent 31% of the FAD vessels), see Figure 7.

Faced with these results, the question is: what is the attractiveness of FADs compared to the other activities?

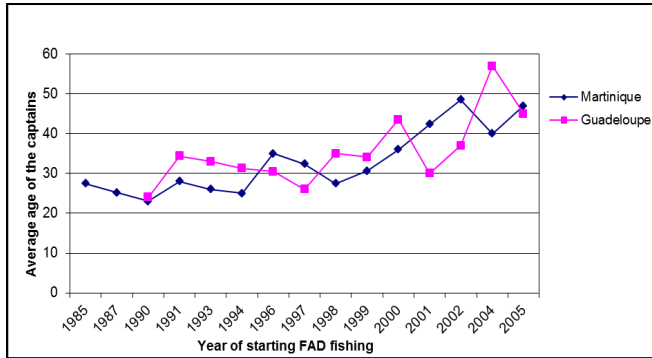
Thanks to studies carried out in Guadeloupe, we were able to note several observations. In terms of quantity landed, FAD fishing and trolling line seem to be very attractive compared to other fishing activities such as pots or gillnets (coastal activities) even if there is an important variability factor in FAD fishing (Figure 8). In average, FAD fishing induces bigger gross revenue than coastal activities (figure 9). However when you deduce the costs of operation (fuel, ice, food, gear, maintenance...) the income for the FAD fisherman is closer but still above the income coming from fish pots and gillnets (Figure 10). Also, it is important to point out that the variability for FAD fishing can put the fisherman in a dangerous economic situation in a short period due to the cost of the associated with a fishing trip. Finally, if you take in consideration the size of the crew and the hours fished, fish pots and gillnets may appear in some situations as more interesting business than FAD and trolling line on a monetary approach (Figure 11). From this, one can easily understand why the choice of FAD activity and the intensity of this activity are not homogeneously distributed within the fleet. Non-monetary incentives can also be seen to influence fishermen's behavior (Guyader et al. 2013).



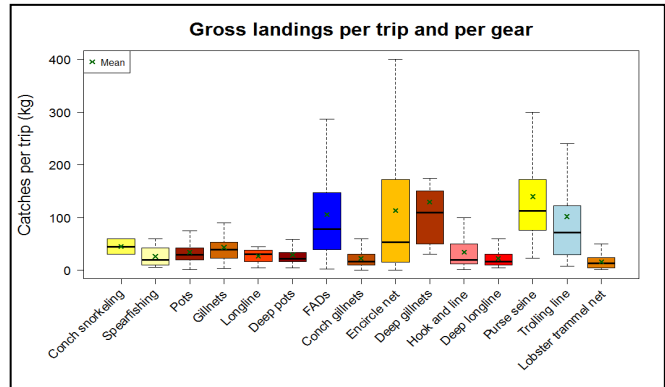
**Figure 4.** Landing structure of the catches around FADs in Martinique and Guadeloupe during dolphin fish season and out of the season, 2008. Source: SIH Obsdeb.



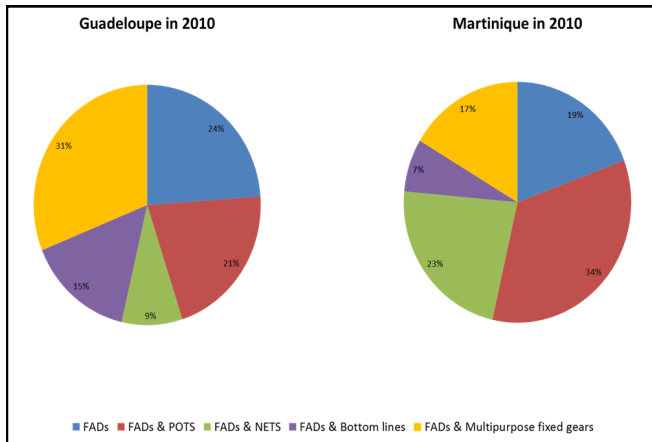
**Figure 5.** Species captured around FAD in the three islands, Guadeloupe, Dominica and Martinique in 2010. Source: SIH and Fisheries Division of Dominica.



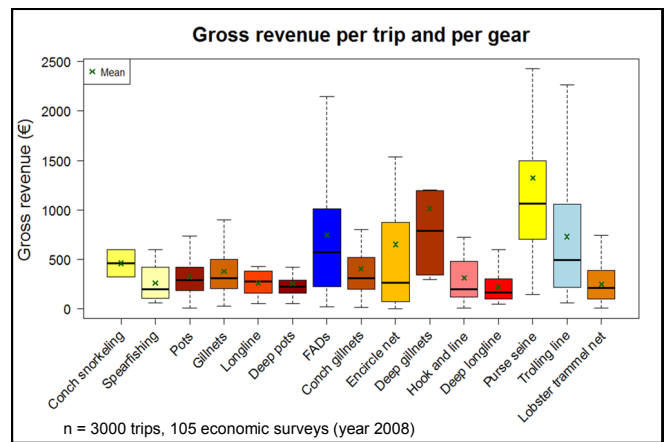
**Figure 6.** Fishermen average age when they start FAD activity between 1985 and 2005 in French Islands. Source: SIH.



**Figure 8.** Landings per trip and per gear in Guadeloupe. Source: O. Guyader et al. 2011.



**Figure 7.** Proportion of vessels per fishing activity among FAD fleet in Guadeloupe and Martinique 2010. Source: SIH.



**Figure 9.** Gross revenue per trip and per gear in Guadeloupe. Source: O. Guyader et al. 2011.

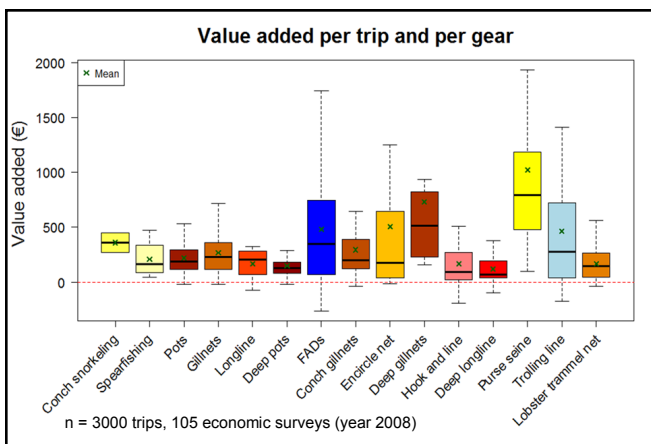


Figure 10. Value added per trip and per gear in Guadeloupe. Source: O. Guyader et al. 2011.

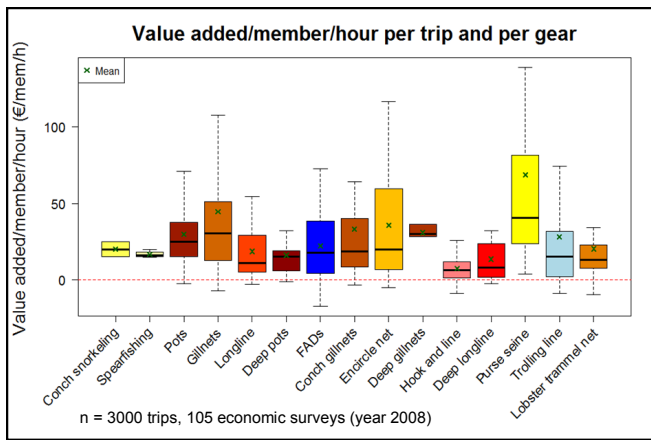


Figure 11. Value added/member/hour per trip and per gear in Guadeloupe. Source: O. Guyader et al. 2011.

In some cases, this behavior not only changes from year to year but also in the same year according to the fish seasonality. French Islands follow a similar pattern. Fisherman activity depends on the fish seasonality. First part of the year, during dolphinfish season, this species is captured by trolling line offshore. When the season is over activity on FAD is more important. At the same period, second half of the year, FAD fishing time is shared with fish pot which is a coastal activity. In Dominica, the FAD activity is dominant all year long (Figure 12). The narrowness of the insular shelf of Dominica and the low power of the vessels may be two of the reasons of the pelagic activity on FAD instead of practicing more effort in offshore waters, distant from FAD or in coastal waters.

In Guadeloupe, Désirade island, we can see an evolution between 2007 and 2011 for FAD fishing (Figure 13). This activity increased and became popular among young fishermen who invested more in bigger vessel (8 - 9 meters length) in 2011 than in 2006 (Figure 14). However, the age of the captain can be an impediment to FAD fishing as he gets older.

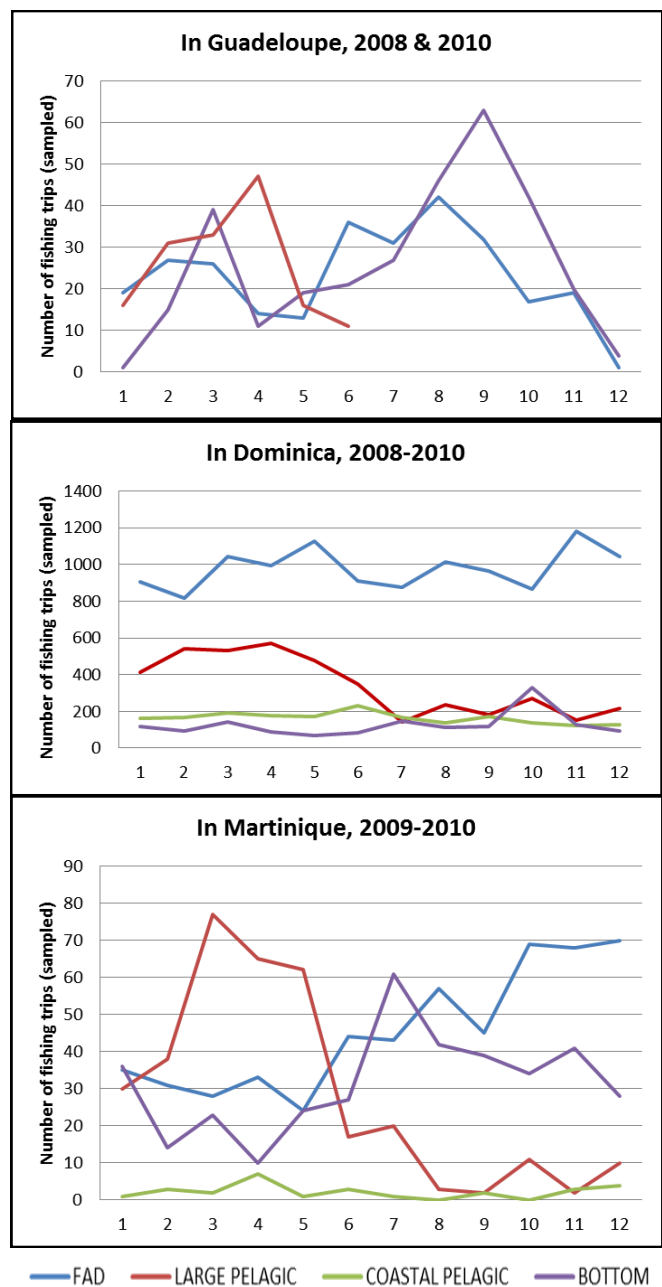


Figure 12. Seasonality of number of fishing trips per fishery type in Guadeloupe, Dominica, and Martinique. Source: SIH and Fisheries Division of Dominica

**Factors Limiting FAD Development**

As we saw previously, non-monetary variables affect the FAD attractiveness: harbors with narrow insular shelf, owner age, vessel size, crew size, and seasonality of the FAD activity. Those are all interim factors, but we have to look at the development of this activity in a global scale also. Indeed, the local market has to compete with the imports.

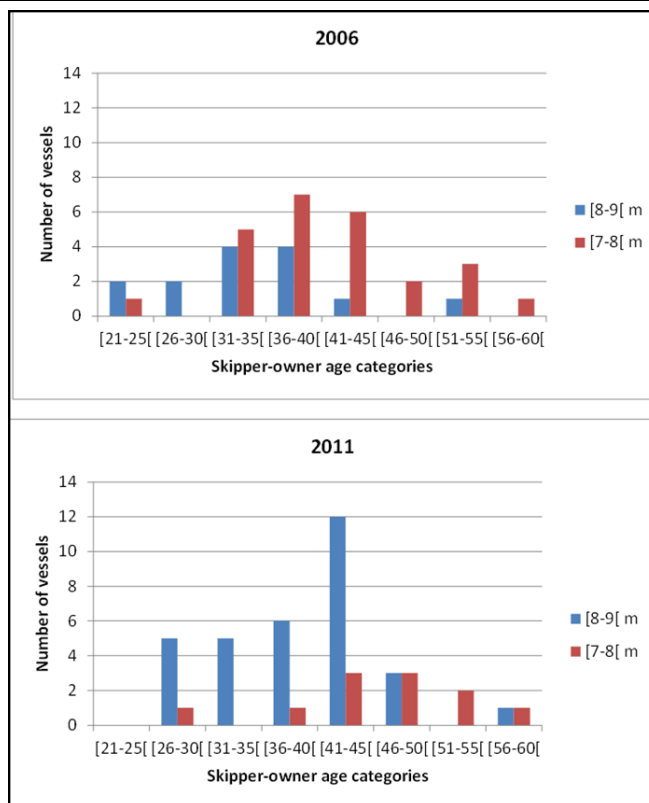
In Martinique, from 1987 (beginning of FAD fishery) to 2008 fish imports increased with a rate of 85% (Figure

15). Paradoxically, one of the goals of the FAD industry was to reduce the dependency on other countries fish products and become more self-sufficient by producing more. It is difficult to compete with imported products which are very numerous in developed countries, indeed most of the time imported products have more attractive prices than local products. The situation in Dominica is different; globally fish imports have been decreasing for the past 15 years (Figure 16). Also, we are reminded that local prices of pelagic fish for consumers in Dominica (around 5€/kg) are more attractive than in Guadeloupe (around 8€/kg) and in Martinique (8.9€/kg).

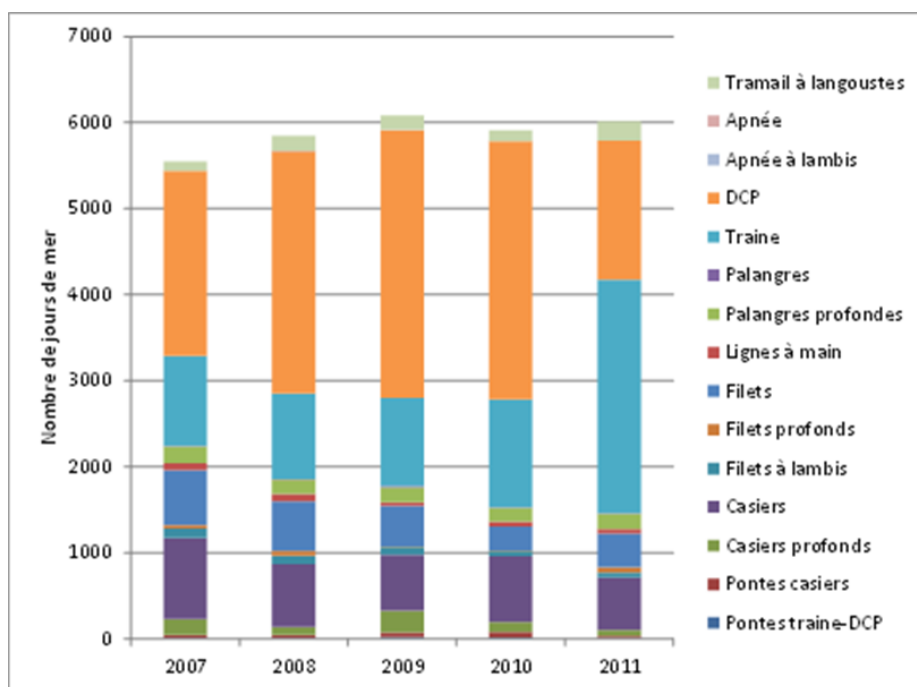
From Figure 2, we saw that FAD fleet started to reach their maximum capacity around 2001, we can believe fishermen had to find an alternative income around that time. On average, wire sales increased between 2002 and 2004 among the fishermen cooperatives in Martinique (Figure 17). This indicates that fish pots are still being built and set on the insular shelf despite FAD deployments and development.

### DISCUSSION AND CONCLUSIONS

The FAD fishery has for sure an effect on the redeployment of the activity towards offshore during its development stage. Indeed, on both French islands we can observe a diversification of the fishing activities in favor of the FAD fishery. However, when the “ceiling” of FAD development is reached, it looks like the fishermen diversify their fishing techniques, operating complementary fish-



**Figure 14.** Number of vessel per size categories and according to the age group of the skipper-owner in Désirade Island, Guadeloupe, in 2006 and 2011. Source: O. Guyader et al. 2013.



- Trammel net for lobsters
- Spearfishing
- Free diving for Queen Conch
- FAD
- Trolling line (offshore)
- Vertical lines
- Deep vertical lines
- Hand lines
- Nets
- Deep nets
- Nets for Queen Conch
- Fish pots
- Deep fish pots
- Pots decked vessels
- FAD-trolling decked vessels

**Figure 13.** Evolution of the different fishing activities on Désirade Island, Guadeloupe, between 2007 and 2011. FAD activity and trolling line in offshore waters represented in orange + light blue. Source: O. Guyader et al. 2013



ing activities which captures and revenues can be lower than those coming from FADs, but they are more regular. This way, the fishermen can compensate the periods with loss-making fishing trips.

In Martinique and Guadeloupe, the development limit seems to be related to the rivalry with the imports coming from developing and developed countries (imported fish price is generally lower). In Dominica, it looks like this upper limit of FAD development is not being reached yet.

It is clear that the way FADs are managed or not managed can influence how fishing vessel owners behave, and this in turn affects the economic performance of their fishing units. Also, FADs economic returns seems sensitive at local level as shown in this table:

	Unmanageable	Manageable
Fuel cost	Fuel price, see yield for Quantity caught/ Fuel consumption	FAD distance from shore and number of FADs visited per trip
Gear (FADs) cost	Gear price	FADs ownership/ overcapacity
Catches	Large pelagic species variability/seasonality	With FADs interactions according to the species (Tunas vs Dolphinfish)
Prices	Imports	with better supply management
Age	Return to insular shelf	Pension or other activities/ investments

This leads to the question: How to regulate moored FADs fisheries (incentives, compliance, role of co-management...) to improve the net benefits for the fishing communities?

The resolutions we can suggest from this work are:

- i) To improve FAD monitoring in all countries,
- ii) To improve monitoring of fishing activity of all fleet considering the multipurpose nature of small scale fishing vessels, and
- iii) Development of FAD fishery with simultaneous implementation of regulations to reduce/control the effort on inshore fishing is an important consideration to effect a reduction in inshore fishing pressure (license establishment?)

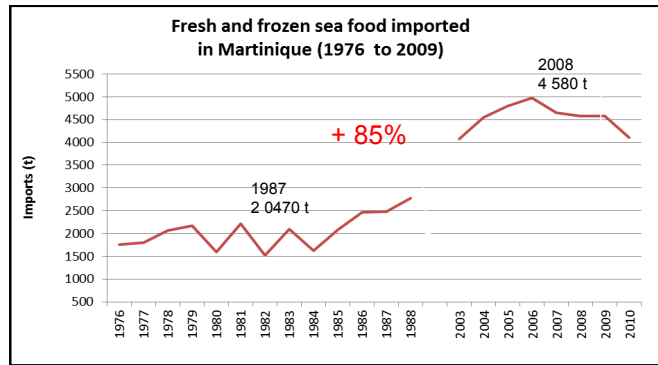
**LITERATURE CITED**

Defoe, J. and A. Philbert. 2013. Case Study on Dominica FAD Fishery. Non published document, Fisheries Division of Dominica, Roseau, Commonwealth of Dominica.

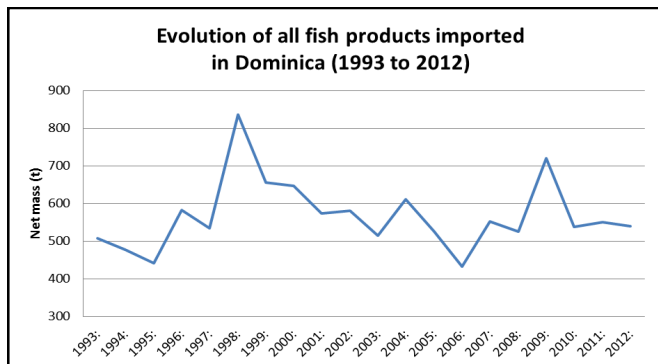
Goodwin M.H., 1986. Evaluation of fisheries enhancement technology for the Eastern Caribbean. Final report prepared for United States Agency for International Development Office-Caribb. Gulf and Caribbean Fisheries Institute. 22 pp.

Guyader O., M. Bellanger, L. Reynal, S. Demanèche, and P. Berthou. 2013. Fishing strategies, economic performance and management of moored fishing aggregating devices in Guadeloupe. *Aquatic and Living Resources* 26:97-105.

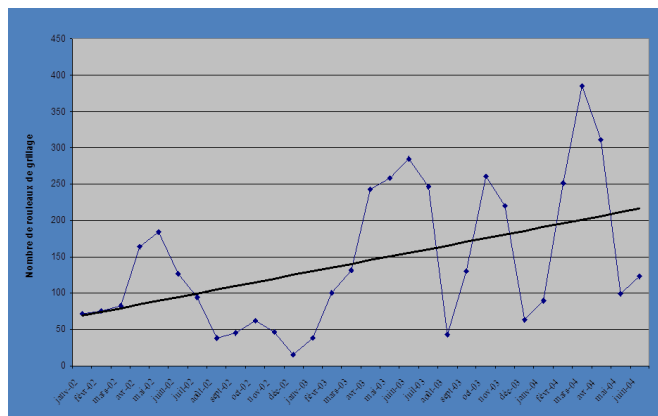
Guyader O., P. Berthou, L. Reynal, S. Demanèche, M. Bruneau, M. Bellanger, B. Angin, C. Merrien, F. Guegan, P. Lespagnol, M. Pitel, M. Jézéquel, E. Leblond, and F. Daurès. 2011. *Situation de la pêche en Guadeloupe en 2008: Rapport du projet pilote Système d'Informations Halieutiques Guadeloupe 2007-2009*. Ifremer-SIH-2011/02/28, 83 pp.



**Figure 15.** Imports of fish products in Martinique from 1976 to 2010. Source: Douanes.



**Figure 16.** Fish imports evolution in Dominica from 1993 to 2012. Source: Central Statistics Office of Dominica.



**Figure 17.** Evolution of wire sales in Martinican fishermen cooperatives from 2002 to 2004. Source: Coopemar.

REYNAL L., G. Van Buurt, and M. Taquet. [sous presse]. Perspectives de développement des DCP ancrés dans les petites Antilles. L'exemple de trois îles: Guadeloupe, Martinique et Curaçao. In: Le Gall J.Y., Cayré P., Taquet M.(eds), *Pêche thonière et dispositifs de concentration de poissons, Caraïbe Martinique*, 15-19 oct. 1999. Ed.Ifremer, Actes Colloq., ()

Reynal, L., S. Demanèche, O. Guyader, J. Bertrand, P. Berthou, C. Dromer, M. Bruneau, M.Bellanger, C.Merrien, F. Guegan, P. Lespagnol, M. Pitel, M. Jézéquel, E. Leblond, and F. Daurès 2011. *Projet pilote du Système d'Informations Halieutiques (SIH) Martinique (2007-2010). Premières données sur la pêche en Martinique (2009-2010)*. Ifremer-SIH-2013/06/30. <http://archimer.ifremer.fr/doc/00156/26762/>, 176 p.

Wolf, R.S. and W.F. Rathjen. 1974. Exploratory fishing in the Caribbean. *Marine Fisheries Review* 36(9):1-7.