Main Results from the Work Completed by the "Lesser Antilles" Working Group on the Sustainable Development of Moored FADs Fishing and Perspectives

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ABSTRACT

Moored FADs are highly popular in the Lesser Antilles and beyond because they give small fishing boats access to resources normally accessible by large-scale boats only. Because of this, FAO/COPACO with Ifremer support, set up a Lesser Antilles working group with the aim of achieving the sustainable development of this emergent fishery, and a research project was launched in Martinique. The initial results of the Ifremer project and the working group effort has highlighted the potential impacts of the FADs and their use, but also provides solutions to remedy some of them. Those multidisciplinary studies focused on the FADs design, and a description of the fishing techniques and the catches around the devices. The different aggregations around the FADs were surveyed by acoustic methods together with a description of their behaviour and usage. This article gives those results and introduces the research project to be implemented in all the Lesser Antilles for facilitating the harmonization of the moored FADs fishing management processes.

KEY WORDS: Moored FADs, fishery, fish aggregation, Lesser Antilles

Mayores Resultados del Grupo de Trabajo sobre el Desarollo Sostenible de la Pesquería Asociada a los DAP Anclados en las Pequeňas Antillas y Perspectivas

Dispositivos para la agregación de peces (DAP) anclados tienen éxito en las Pequeňas Antillas, principalmente porque autorizan explotación de grandes pelagicos con barcos menores (flotas artesanales), recursos que usualmente se explotan con flotas de altura. Por eso, la FAO/COPACO, con apoyo de Ifremer, anima un grupo de trabajo dedicado al desarollo sustentable de esta nueva pesquería en las Pequeňas Antillas. Un programa de investigaciones esta llevado en Martinica. Los primeros resultados del programa y el trabajo del grupo ponen de relieve los impactos potenciales de los DAP y su explotación y permiten identificar soluciones para remediar. Estos estudios pluridisciplinarios enfocaron inicialmente en la concepción tecnologica de los DAP, descripción de las tecnicas de pesca y de las capturas. Las distintas agregaciones alrededor de los DAPs fueron monitoreadas, con metodos acusticos que permitieron caracterizar los comportamientos de los cardumenes. Este informe presenta estos resultados e introduce el proyecto de programa de investigaciones llevado para el manejo concertado de las pescas asociadas a los DAPs anclados en las Pequeňas Antillas.

PALABRAS CLAVES : DAP anclados, pesquería, agregación de peces, Pequeňas Antillas

INTRODUCTION

Since the 1990s, Fish Aggregation Devices (FADs) have become increasingly popular in the Lesser Antilles and beyond, because they make it possible for the small, non-decked units to reach, at low costs, offshore resources which they could do only partially for six months of the year. Given this evolution, the FAO/COPACO with the assistance of Ifremer set up a "Lesser Antilles" working group to ensure the sustainable development of this increasing fishing. The participants of this working group come from: Antigua and Barbuda, St Kitts and Nevis, Guadeloupe, Dominica, Martinique, St Lucia, Barbados, St Vincent and the Grenadines, Grenada, Trinidad and Tobago, Curaçao, and Cuba. The creation of this working group on the sustainable development of fishing associated with moored FADs was decided in October 2001, during the plenary session of the COPACO which was held in Barbados. Since then, the working group has met twice, the first time in Martinique in 2001 and the second in Guadeloupe in July 2004. Between these two meetings a research project « DAUPHIN » (Dcp ancrés Antilles: étude acoUstique des concentrations de Poissons et influence des facteurs Halieutiques bIologiques et eNvironnementaux) *(French Antilles moored FADs: acoustic survey of fish aggregation and biological, environmental and fishing factors incidence)* was launched in 2003 by Ifremer Martinique, in order to secure a first assessment of the resources found around the FADs and their relation with fishing. Currently, a scientific and technical research project "MAGDELESA" (Moored fish AGgregating DEvice in the LESser Antilles) is being drafted and must be finalized at the next meeting of the working group, early 2006. The latter project will be carried out jointly by the members of the working group, the FAO/COPACO, Ifremer and the IRPM of Guadeloupe, with the support of scientists from other organizations who agreed to assist and contribute to this work.

The objective of the group is to provide information allowing developers to define the development scenario best adapted to their island. To do so, several aspects of FADs fishing were (or will be) dealt with, including:

i) FADs technology resources and their exploitation,
ii) FADs management systems and their socio-economic consequences
iii) Safety and working conditions aboard fishing boats, and
iv) Quality of the fishery products.

The main conclusions from the participants of the working group on the sustainable development of fishing associated with moored FADs, as well as the issues at stake for them in the years to come are presented below for each topic.

THE FADS TECHNOLOGY

Several types of FADs currently exist in the Caribbean. Their lifespan is considered to be too short, and an effort is being made to preserve them longer while reducing their maintenance and manufacturing costs. To that end, a survey of the causes of loss of the FADs was undertaken and solutions to avoid the subsequent negative impact were identified. Apart from assembly errors, the main causes of loss of FADs seem to be:

i) Defective beaconing and buoys undersize and therefore the cargo liners cut the rope while passing,
ii) Fishing lines that cut the buoy rope,
iii) Fish bites when they eat the organisms fixed on the rope,
iv) Rust and frictions of the metal parts connecting the elements of the rope and its wear and tear, and
v) High intensity currents.

In the area of the Lesser Antilles, there can be very strong currents which prohibit the use of "light" FADs as in Curaçao where only "heavy" devices financed by public funds are viable (Van Buurt In press). In other cases, there were occurrences of a drift of the devices under the effect of the currents which deteriorated underwater equipment such as telephone cables, as reported by a country outside of the Lesser Antilles. When the FAD is well moored, it can be pulled beneath the surface by the currents. In this case, depending on the depth to which the head of the FAD is immersed, the fish may or may not remain near the device, often making them more difficult to catch. There can also be an implosion of the buoys which ensure the buoyancy of the head of the FADs, and they never come back to the surface. The monitoring of FADs, in Martinique, showed that they could be made non-operational for several months in a year due to their immersion during the times of strong currents, resulting in a portion of the fishing fleet returning to exploit coastal waters resources. (Reynal *et al.* In press, b).

These observations indicate that attention must be paid to the top part of the FADs (the first 200 meters starting from surface). The lower part of the FADs being in perfect state several years after the original sinking (Tacquet *et al.* 1998, a). A scrape resistant rope is necessary to resist frictions, fish bites and cuts due to fishing lines. The protection of the rope by a sheath (sprinkler pipe, PVC electric sheath) was tried. It does not guarantee a total protection in particular against fishing lines. In the absence of adequate material at an affordable cost, a solution was proposed and tested which consists in making two head devices (Gervain and Diaz 2002). In that case, when one of the heads is damaged, the other one keeps the FADs floating, time for them to repair the defective part.

The regrouping of the multiple floats generally used in the Lesser Antilles, in only one bulkier buoy should be tested within the framework of next program

"MAGDELESA", in order to make the FADs head better visible by the cargo liners. The search for more reliable nocturnal beaconing material (solar light) and diurnal (radar reflector or transponder, flag) will be also undertaken. By the end of this project, recommendations should be made for the assembly but also the maintenance of the FADs, so that they better comply with the duration and lawful beaconing requirements.

Ifremer developed a computer assisted FADs design software that enables to select the type of FADs best appropriate, according to the funds, equipment, and conditions at sea available. It provides a predictive model of the behaviour of the FAD according to its specifications and the conditions of swell and current. It is thus possible to adjust the buoyancy of the head of the FADs to prevent it from sinking, to calculate the weight of the ballast necessary to prevent skidding of the device, and to anticipate the resistance needed for the rope so that it is not ripped apart in the event of strong traction due to the current or any other causes (Anon. 2004).

THE RESOURCES AND THEIR EXPLOITATION

A description of the catches has revealed that fishing around the FAD gave significant numbers of blue marlin (*Makaira nigricans*) and of yellowfin tuna (*Thunnus albacares*). Their numbers grew in the early years of FAD fishing development and the greater understanding of the vertical drifting line with one hook. Blackfin tuna (*Thunnus atlanticus*) were also caught but in lesser quantity and as a matter of fact they decreased, whereas the other species increased (Doray 2002). The species exploited around the FAD are not in the same proportions as those fished by the traditional surface trolling line around flotsam where mostly the dolphinfish (*Coryphaena hippurus*) and the wahoo (*Acanthocybium solandri*) are caught. The development of FADs fishing in the Lesser Antilles will, therefore, modify the specific composition of the fishermen landings. For whatever species, FADs fishing probably generates catches of more juveniles than in the traditional surface trolling. This information, however, is to be validated because the data we have are not representative of fishing and probably give a ratio of a coastal activity of commercial fishing of juveniles probably higher than it is actually. The proportion of juvenile marlins observed in the sample of landings observed is 8%. It is higher for the yellowfin tuna, 93% of the number of fish caught, and for the blackfin tuna with 75% of the fished individuals that had not reached sexual maturity (Doray *et al.* 2002).

The main species composing the catches around the FADs have, according to the ICCAT (International Commission for the Conservation of Atlantic Tunas) assessment, a production close to (yellowfin tuna) or even above (blue marlin) the maximal sustainable yield (MSY). The blackfin tuna is a species listed by CICTA for sub-regional management. This still is to be made and no assessment of this regional resource has been carried out yet (Reynal and Doray 2002).

In the wake of this report, Ifremer with the assistance of the IRD, decided to launch from the very start of the year 2003, the "DAUPHIN" project co-financed by the Regional Council of Martinique, Europe (IFOP) and the French government (FIDOM). The objective of this project is to describe fish aggregations around the FADs and to assess the biomass by acoustic method. In the same time, a description of fishing and its catches undertaken to see whether there was a uniform exploitation of all the resources around the FADs.

The influence of the biological and environmental factors on the fish concentrations was also studied within the framework of this project. The ongoing "DAUPHIN" project has made it possible to identify several types of fishing around the FADs. On the devices placed at less than 10 nautical miles from the coast, small skiffs powered by an 80 hp engine on average have trips of just above 4 hours and target primarily adult blackfin tuna before sunrise and sometimes at sunset. Between 10 and 20 miles from the coast, the boats which exploit the FADs are 150 hp on average, have trips of more than nine hours, and have a fuel consumption more than three times higher than that of the previous ones (124 L per trip against 39 L). Decked boats also start using FADs fishing for which they do several day trips.

Small coastal units land significantly less quantities of fish than larger, offshore units; on average, 30 and 50 kg/ trip, respectively. The smallest fishing units catch more blackfin tunas than those working on the FADs placed further away from the coast that mostly take blue marlin and yellowfin tuna. The latter catch very few adult blackfin tunas, contrary to the small boats using the FADs located less than 10 miles off the coast. The greatest number of adult blackfin tunas are caught before sunrise using a trolling line. It should be noted that small tunas catches by the most coastal boats are relatively significant, because they undertake a commercial fishing of juveniles after dawn (Reynal *et al.* In press).

The acoustic study carried out around the FADs has revealed four types of aggregations in day time:

i) A layer of small tunas, 30 cm, made up of blackfin tuna, yellowfin tuna and skipjack tuna (*Katsuwonus pelamis*). This layer represents approximately 2 % of the biomass aggregated,

ii) A school of wreck fish made up of carangs (Carangidae), tiggerfishes (Balistidae) and dolphinfish. This aggregation is also not very significant since it represents approximately 2% of the biomass aggregated, most of the biomass incorporated under the FAD (95%) is made up of subsurface tunas of approximately 50 cm (3 kg). It is also made up of blackfin tuna, yellowfin tuna and skipjack tuna. It is shaped as a conical school of approximately 400 m wide and 70 m high upstream the FADs. The biomass thus concen-

trated was evaluated to be 45 tons on average (between 4 and 140 tons).

iii) Around these fish aggregations the large predators like the blue marlin or big yellowfin tunas (of more than 30 kg) but also the sharks and other billfish. These large fish constitute approximately 1% of the aggregate biomass (Doray In press). The daytime trolling lines around the FADs give primarily catches of surface small tunas. These fishes are in general used as bait for the vertical drifting line fishing the large predators. There are few catches of subsurface fish; they appear passive vis-a-vis the trolling and drifting lines. After sunset, the deep micronecton comes up to the surface. The subsurface tuna school breaks up. Some fish move away from the FAD, the others come up to the surface (Doray, under press). It is at that time when the fishes come towards surface that fishing using deep trolling line (weighted to fish between 7 and 32 m) or small vertical drifting lines of adult blackfin tunas at the end of the day is made possible. When the fish approach the FADs before sunrise, they are also caught by trolling line (Reynal *et al.* In press a).

iv) The study of the stomach contents of the fish caught near the FADs is ongoing within the framework of the "DAUPHIN" project; it should provide a clearer understanding of the fish patterns of behaviour around the devices and also partly explain the catchability with fishing lines.

Relatively significant echoes were recorded with the sounder, although they could not be identified. It could be deep squids, however, experiments are necessary to confirm this hypothesis. In addition, other fishes living too deeply during the day to be detected by the scientific sounder used for the study, come to the surface at night. This is the case for example of the swordfish (Doray In press). The fishing of this species is not however to encourage (at least in Martinique), because they are mainly juveniles (Taquet *et al.* 1998b).

The main goal of the working group on the sustainable development of fishing associated with the moored FADs, is now to seek year-round profitability, but more selective techniques, making it possible to catch targetted species or sizes of fish while preserving the others. In particular, it seems sound to be able to catch adult blackfin tunas at the subsurface layer and large yellowfin tunas by limiting the catches of juveniles or blue marlin. To do so, a first stage should be carried out within the framework of the "MAGDELESA" project. It will consist of a description of the various existing techniques in the Lesser Antilles and their catches, in order to identify those which are already operational and which could be better developed. At the same time, the study of the seasonality of the catches by species and size, in relation to the feed or reproduction patterns, will make it possible to better appreciate the factors influencing their abundance and their catchability around the FADs.

A better knowledge of the space-time dynamics of the micronecton which composes the tunas feed would also make it possible to better explain the variability of the abundance of certain species around FADs.

Of course, the data collected within the framework of this part of the project will be useful to improve the statistics of landings and fishing effort needed for assessment of the stocks exploited around FADs. The experimentation of new fishing techniques could be organized at a later stage when they are identified. An inventory of the techniques used throughout the world around the FADs was carried out and presented during the first meeting of the working group (Prado 2002).

THE FADs MANAGEMENT SYSTEMS AND THEIR SOCIO-ECONOMIC IMPACT

As there is no economist in the working group on FADs, not much has been achieved in this field. However, many of the issues at stake have found their answer in the in-depth study of FADs fishing and its relationships to other fishing techniques. The indirect impact of the development of FADs fishing on the coastal resources of highly exploited insular shelves and more generally on the regulation of the fleet capacity would deserve a close attention. The development of fisheries associated with FADs could lead to an increase in the number of fishermen, explained by the improvement in the yield during the development stage of this emerging activity. In such cases, it is also common to see an increase in the power of fishermen's boats, without this being technically or economically justified. It is also possible that FAD fishing incomes could be used as a means to fund gear intended for fishing insular shelf species and thus contribute to intensifying their exploitation. In a context characterized by a high unemployment rate, the managers of the Lesser Antilles will probably have difficulties in implementing and enforcing regulations on the fleet capacity. However, this is essential to secure a good stock management and to avoid an over-capitalization of the fleets. Without regulation, a good knowledge of the economic results of FADs fishing, its various components, and their interferences with the exploitation of other resources is essential. This should enable the managers to decide whether the profits generated by FADs fishing should be used for upgrading the production equipment. The improvement of fishers' working conditions and security, as well as norms concerning the quality of the products, which could more easily be enforced, would constitute an indirect regulation of the catch capacity.

In all the Lesser Antilles, there is a homogeneous approach on the legal framework for FADs installation. Before their installation, they must be receive regulatory authorization declaring the device and its proposed location

are in accordance with shipping rules. However, it seems that because of the trend towards promoting individual management of the FADs or because the administrative rules are too constraining, many fishermen actually install their devices themselves. This individual management of the FADs brings advantages in term of flexibility of operation which results apparently in better fishing outputs (Diaz *et al.* 2002). The disadvantage, however, is that fishermen increasingly deploy their FADs far away and do not mark them to avoid any exploitation by those who did not contribute to the production and installation costs (Ramedine In press). This situation, which seems to be the general pattern, carries several consequences:

i) The discarding of the small fishing boats and the recourse to boats requiring a more significant investment,
ii) The increased costs of the FADs exploitation because of the high number of devices, fuel consumption…,
iii) The reinvestment of the incomes generated by FADs fishing in activities on the insular shelf,
iv) The abandonment of the fishing of the adult blackfin tunas which is practised over a short period of the day and would be thus profitable only with FADs close to the coast,
v) The development of user conflicts and a difficult control of the entire set of existing FADs by the regulating authorities, and
vi) Inadequate conditions of navigation safety.

To try and provide the developers with answers to all the issues at stake, a relatively detailed study of all situations likely to occur is necessary. To do so, the socio-economic surveys will identify the population using FADs and will characterize the exploitation structures through the reconstitution of the fishery unit's activity schedule (kind of gear used and species targets per month over the year). On this basis, exploitation typologies will be defined, and we will seek to homogenize them between the islands by using a common job-reference list.

On the basis of this register, a representative sample of fishermen (fishing units) will be defined. They will be subject to a standardized socio-economic inquiry making it possible, in particular, to characterize the promotion and marketing methods of the landings, the structure of the takings and of the variable and fixed costs of fishery units (including FADs, jobs and capital invested).

We shall also use the catches and effort survey described above, which will be completed to collect economic information (value of landings and cost of fishing effort, etc.). As far as possible, a comparative approach to the economic performance of the units exploiting FADs compared with other fishing techniques will be undertaken, to measure the economic incitement of choosing this kind of fishing. This implies collecting economic information from strata of vessels not exploiting FADs.

According to the islands' context (and available means), we will develop a methodology to assess the economic weight of recreational fisheries using direct surveys by questioning service providers or fishermen.

A common retrospective enquiry on a sample of fishing units will also be developed, allowing to better judge the evolution of the professional activity (and eventually recreational fisheries) in terms of investment, catch techniques and valorisation, jobs on board and on land, and the consequences in terms of fishery effort transfers (insular shelf, offshore). Regarding tthe first point, we will seek to accurately quantify the economic and social implications linked with this development. We will also seek to identify the development or pegging factors of FAD activity (technical changes, public policies, market evolution), and we will develop an approach for comparing FAD experiments and exploitation mode in the different islands. This work could be accomplished through interviews with the main local or regional players (see below). From this work, we will identify the links between the management of FADs and their modes of access and the conditions of development and socio-economic performance of fishing fleets.

The issue of FADs management practices was dealt with during the previous meeting of the working group in 2004. The first elements on the existing systems and their impact on the sustainable development of FADs fishing were brought forth by the participants in the working group (Ramedine In press). It is now necessary to have more detailed knowledge of the processes, rules of installation (formal or not) and causes of conflict. The comparative analysis of the multiple situations met should be under-taken within the framework of "MAGDELESA" and make it possible to test hypotheses on the decisive role of financing for the devices (private or public), or on the social, cultural, or economic dimensions in the success or the failure of the FADs.

SAFETY AND WORKING CONDITIONS

FADs generate new work conditions accompanied by new risks. Safety and working conditions at sea, in relation to the boats and gear used in this new context of FADs fishing, have not yet been addressed, although they were identified as significant.

The implementation of FADs done from small fishing boats, or the hand lifting of fish sometimes weighing several hundred kilograms have had their death toll. The long-term consequences of the violent physical efforts by the crews with bad postures due to narrow dimensions and the lack of proper equipment onboard should be closely examined in order to seek relevant solutions.

An objective of project "MAGDELESA" envisages shall be devoted to the issue of working conditions and safety around the FADs. The objective is to identify the primary risks for the fishermen. The incidents, near-

accidents, and accidents are often more numerous in the initial phases. The pioneers, direct witnesses to these degraded situations, can, if they take time to think it over, learn the lessons from the incidents, near-accidents, and accidents and modify the gear and processes and also increase the seamen awareness of the "risky" phases of the operation (training). But this practical know-how is not archived, and the experience feedback is not shared.

The objective of the project will be to improve and share the feedbacks after accidents or near-accidents. This will require:

i) Securing possible statistical data on accidents and chronic physical disorders reported to the local governments (administrations in charge of maritime safety, medical services, etc.),
ii) Identifying victims and/or witnesses of accidents, in order to have them interviewed on the causes of the most harmful and recurring accidents,
iii) Selecting reference situations for on-board observation at sea. Such choices will be done with the assistance of the operators and FAD fishing technology experts and will include the main types of ships and FADs used, the various kinds of equipment and the differences (if any) in manpower aboard, and
iv) Investigating at sea, on-board reference situations, for risk assessment by means of observations and discussions with the crew members. These embarked campaigns will also be used to take pictures and video recordings facilitating the sensitisation of other fishermen and for longer-term design of teaching aids.

The field trip missions will require full support from fishing authorities for the carrying out of the survey but also once the conclusions come out. These conclusions will have to be circulated, promoted, and translated into actual actions within the fishing sector with all stake-holders. These actions may include:

i) Managers to supplement their regulations or within the framework incentive policies for upgrading landing sites or fishing boats,
ii) Shipyards for the improvement of fishing boats,
iii) Co-operatives for securing new boat equipments, and
iv) Trainers within the framework of initial or continuing vocational trainings, etc.

PRODUCTS QUALITY

The catches made around the FADs cannot be preserved under the best conditions aboard the fishing boats. The fish holds are not large enough to store the largest species (marlins and large tunas) or hold sufficient quantities of ice. Moreover, in certain coastal sites the fishermen have no ice. In addition, the boats used around the FADs in the Lesser Antilles are often “go-fasts” with hulls and bang on the waves. The fish is then bumped, leading the fishermen to sometimes use foam mattresses to limit the bruises on the flesh. The mattresses, difficult to clean, can become sources of bacterial contamination of the fish. The vibrations can also generate gaping in relation to the occurrence of fish rigor mortis, inducing a depreciation of the quality of the flesh at the time of the filleting, accompanied by a loss in the water holding capacity (Bremmer 1992, Bremmer 1999, Nakayama *et al.* 1999, Loye 2001). Tunas are known to produce histamines (Arnold and Brown 1978, Gilbert 1980) that may cause severe allergic reactions. To limit the risk, the fish must be bled as soon they are caught. However, in the Lesser Antilles, the food practices are such that the fisherman does his best to prevent the fish from losing its blood. The use of evisceration is to reduce the risks of early oxidation of the lipidic parts, blood being a powerful catalyst of oxidation (Hiremath 1973, Richards 2002). The faulty refrigeration also increases the risks of amine biogene production after the death of the fish (Huss 1995). It is, therefore, relevant to make the assessment of the quality of the products and the risks to public health relating to the conditions of conservation on board. Lastly, the methyl-mercury which is found in the natural environment is more concentrated in the flesh of older and larger piscivorous fishes. (Abarnou *et al.* 1997, Baker 2001). Considering the significant quantities of these fish consumed by populations in the coastal areas, it is necessary to closely maintain a progress report relative to the risks to which they may be exposed.

A section of project "MAGDELESA" will also be devoted to the quality of the products in relation to the techniques and fishing zones, over several periods of the year (Poulter *et al.* 1982). Fish temperature surveys will be implemented from the catch to the end consumer.

Macroscopic observations of flesh samples will be carried out at various stages of the products distribution chain. The samples will then be analyzed (TVB-N, TMA, TMAO, peroxide value and microbiology) in order to monitor the evolution of the quality of the fishery products until the sale to the consumer, according to their nature and their processing.

Close attention will be paid to the tropical flora microbial deterioration, which is different from that of temperate waters (Shewan 1977). The analysis of the methyl-mercury concentrations in the flesh should be undertaken on various parts of the fish in order to identify possible risks for the consumers (Cravedi *et al.* 2001).

CONCLUSIONS

The first scientific and technical works completed in support of the sustainable development of fishing associated with moored FADs highlighted the interest of the multidisciplinary approach adopted by the "Lesser Antilles" working group. The investigation into the causes of losses of the FADs and the monitoring of their manage-

ment processes emphasized the failures of certain types of devices currently used and their impact on the intra-annual stability of fishing. The catches around the FADs primarily consist of three species, one of which, the blue marlin, is overfished according to the ICCAT's latest evaluations. Catches of juveniles in high numbers must also be reduced. An acoustic study of the fish concentrations around the FADs, carried out by Ifremer, shows that the species targeted by the professionals constitute a relatively small share of the aggregate biomass. Such catches are mostly adult blackfin tunas (50 cm fork length) that hardly bite the hook in daytime. These fish can be caught on a very short lapse of time at dawn or dusk, and therefore, they are the preferred target of small boats around the coastal FADs. The blue marlins and large yellowfin tunas are sought by the largest units which can more easily move away from the coast in safety. The progressive abandonment of the public FADs for devices financed by the fishermen themselves seems to further encourage the small units on the insular shelf and the desertion of blackfin tunas fishing. This evolution could be due to the more significant conflicts around the most coastal FADs, which are more accessible than the offshore devices.

Searching for more selective fishing techniques is essential to optimize the use of the resources concentrated around the moored FADs. This requires a better knowledge of techniques used by the fishermen in the Lesser Antilles and the analysis of the factors supporting the catchability of fish around the devices.

In order to answer the new issues arising as to the sustainable development of FADs fishing, a new project "MAGDELESA" is being finalized and should be carried out in collaboration with the Lesser Antilles islands, the FAO/COPACO, Ifremer, and IRPM, with the support of researchers from other organizations. In this project, new topics will be approached in the area social and economic factors, safety, and working conditions aboard the fishing boats and the products quality. The end purpose of this work is to develop, on the basis of the technical, biological, and socio-economic information collected, a tool for appraising the various management scenarios and for regulating access to the FADs, and to the pelagic resources as a whole, in the rationale of sustainable management of the Lesser Antilles fisheries.

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