

DIFFERENT MEANS CONTRIBUTING TO ANCHORED FAD'S FISHING SELECTIVITY IN THE LESSER ANTILLES¹

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SUMMARY

In order to improve the sustainable development of FADs fishing, it is important to reduce the capture of juveniles or species that need a decrease in fishing effort, temporarily or definitively. Through previous statistics data coming from commercial fishing trips and new experimental fishing trips, we compared different gears and techniques selectivity for the species and the size of the capture around FADs. We also compared different type of bait used, the best hours to fish for better productivity and to target adults. Finally we look at the influence of the FAD distance from shore. We observed that fishers' strategies have a critical influence on FADs setting and targeted species. The further the FAD is deployed and the better yield the fisherman obtain. The fishers who target Dolphin fish deploy several FADs while the others exploit generally one FAD per trip. The main results from experimental fishing trips show that the jigging technique around FADs catches blackfin tuna adults. Most of the blackfin and yellowfin tuna captures happened late in the morning and we observed a drop off after 12:00 pm. Flying fish bait (live or dead) seems to be more efficient, except for the blue marlin. An analysis of FADs governance is necessary before advising some technics.

RÉSUMÉ

Afin d'améliorer le développement durable de la pêche avec DCP, il est important de réduire la capture de juvéniles ou d'espèces qui doivent faire l'objet d'une réduction de l'effort de pêche de manière temporaire ou définitive. Sur la base de données statistiques d'années antérieures provenant de sorties de pêche commerciale et de nouvelles données de sorties de pêche expérimentale, nous avons comparé la sélectivité de différents engins et techniques pour les espèces et la taille de la capture réalisée avec DCP. Nous avons également comparé les différents types d'appâts utilisés, les heures de pêche donnant lieu au meilleur rendement et permettant de cibler les adultes. Finalement, nous avons examiné l'effet de la distance entre les DCP et la côte. Nous avons observé que les stratégies des pêcheurs avaient un impact fondamental sur la pose des DCP et les espèces ciblées. Plus le DCP est déployé au large et meilleur est le rendement du pêcheur. Les pêcheurs qui ciblent la coryphène commune déploient plusieurs DCP alors que les autres exploitent généralement un seul DCP par sortie. Les principaux résultats des sorties de pêche expérimentale ont fait apparaître que la technique de la turlutte autour des DCP permet de capturer des spécimens adultes de thon à nageoires noires. La plupart des thons à nageoires noires et des albacores sont capturés en fin de matinée et une baisse a été constatée à partir de midi. Le poisson volant utilisé comme appât (mort ou vivant) semble être l'appât le plus efficace, sauf dans le cas du makaira bleu. Il est nécessaire d'analyser la gestion des DCP avant de pouvoir formuler un avis sur les techniques utilisées.

RESUMEN

Para mejorar el desarrollo sostenible de la pesca sobre DCP, es importante que se reduzca la captura de juveniles o especies que requieren un descenso en el esfuerzo pesquero, temporal o definitivo. Mediante datos estadísticos previos procedentes de mareas de pesca comercial y mareas nuevas de pesca experimental, se compara la selectividad de los diferentes artes y técnicas para la especie y la talla de captura sobre DCP. También se comparan los diferentes tipos de cebo utilizados, las mejores horas para pescar y obtener una mejor productividad y

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dirigirse a los adultos. Por último, se observa la influencia de la distancia de los DCP a la costa. Se observa que las estrategias de los pescadores tienen una influencia clave en el plantado de los DCP y en las especies objetivo. Cuanto más lejos está plantado el DCP mejor rendimiento obtiene el pescador. Los pescadores que se dirigen al dorado despliegan varios DCP mientras que otros explotan generalmente un DCP por marea. Los principales resultados de las mareas de pesca experimental muestran que la técnica de jigging en torno a los DCP captura atún aleta negra adulto. La mayor parte de las capturas de atún aleta negra y rabil se producen a finales de la mañana y se ha observado un descenso tras las 12:00 pm. El cebo con peces voladores (vivos o muertos) parece ser más eficaz, excepto en el caso de la aguja azul. Es necesario realizar un análisis de la gobernanza de los DCP antes de aconsejar algunas técnicas.

KEYWORDS

Anchored FAD, Artisanal and small scale fishing, Selectivity

Introduction

In order to improve the sustainable development of FADs fishing, it is important to reduce the catches of juveniles or species that need a decreased in fishing effort, temporarily or definitively. The aim of this paper is to put together different means contributing to the catches selectivity in terms of size and species composition.

Species Found and Targeted Under Fads in French West Indies

Resources aggregated around FADs have been described from experimental fishing around FADs (Taquet *et al.* 1998 and Taquet 2000; Diaz and Gervain 2007) or statistical monitoring of commercial fishing (Reynal *et al.* 2007a and b). Twenty two species were captured around FADs in Guadeloupe (Diaz and Gervain 2007) and around 26 in Martinique (Taquet 2000), a total of 36 different species around French Caribbean FADs.

The dominant species in the catches of commercial fishermen are blue marlin (*Makaira nigricans*), dolphin fish (*Coryphaena hippurus*) and yellowfin tuna (*Thunnus albacares*). These three species represent about 80% of the total catches. But the largest part of the fish biomass aggregated close to the FADs is in the subsurface between 30 and 100 m depth, upstream of the FADs, up to 400 m from the device. The cone-shaped aggregation is composed mainly of blackfin tuna (*Thunnus atlanticus*) and also of yellowfin tuna and skipjack about 50 cm fork length. Its estimated biomass by echo sounder represents about 95% of fish biomass aggregated around moored FADs. It was assessed (Doray *et al.* 2009) to be 7 tons on average daytime (SD: 5.4, from 1 to 24 tons).

Among the main species captured or potential for fishing around FAD, two are managed by ICCAT (yellowfin tuna and blue marlin) and two are not (blackfin tuna and dolphin fish). Actually blue marlin is managed by TAC and quota. Due to the use of the small fish as living bait to capture the big one (blue marlin and yellowfin tuna) the proportion of juveniles is high in the capture around anchored FADs. Doray *et al.* (2002) estimated the proportion of juveniles caught around FAD in Martinique as 79 % for whole landings, 93 % for yellowfin tuna, 75 % for blackfin tuna, 74 % for dolphin fish but only 8 % for blue marlin.

FAD Fishing Impact on Emblematic Species

The question of the FAD fishing impact on the emblematic species like marine mammals, turtles, sharks or birds was studied during 54 fishing trips with professional fishermen, surveys realized between 2003 and 2005 in Martinique and statistics on fishing processed in 2009 and 2010.

Fishermen often look after birds in order to locate schools of fish. The birds accidental catch with trolling lines is exceptional especially around FADs, most likely because there is in general a little weight at the end of the lines (their minimum estimated depth is approximately 2m, except when “poppers” are used) to avoid the lines to get tangled with the engine of the other vessels.

No turtle has been detected near FADs unlike marine mammals. In order to estimate the number of time they have been seeing by fishermen, a study carried out from February 2003 to December 2005 took in consideration the observation or not of marine mammals near FADs. During this study, 2526 forms were completed of which 2502 indicated the coast side where the active FAD is located and 2408 indicated the coast side and the distance of the FAD from shore. In total, professional fishermen indicated the presence of cetacean during 183 fish trips, so in 7% of the cases. No identification of the marine mammals has been tried during this study. Values of the presence rate up to the average were recorded in 2003 (16% vs 6 and 7% the other years), between 0 and 12 NM on the Caribbean side (presence rate of 11%). During the whole year, the higher rates were observed in August (20% of the fish trips; 44% in 2003, 24% in 2004 and only 3% in 2005), September (11%) and in December (18%). Most of the time, it looks like marine mammals are not disturbing the fishing activity. Some fishermen wonder about the effect of their presence on the fish which might be scared and so bit less the hook. At the same time, groups of dolphins can stay around coastal FAD areas, several days in arrow, and eliminate the catches by trolling lines or the bait on the drifting lines (buoys), preventing the FADs use during all their stay. This phenomenon observed in 2003 in the North Caribbean of Martinique was really a trouble during several weeks for the small vessels without the capacity to go offshore. The fishermen had to fish with pots on the insular shelf waiting for the departure of the cetacean.

During experimental fishing trips realized by horizontal and diagonal bottom lines (gears no used by professionals), by day and night, in Martinique (Taquet 2000) and in Guadeloupe (Diaz and Gervain 2007), sharks were detected near FADs. Those sharks were identified as: *Carcharhinus longimanus* (3 individuals fished among 709 fish), *Carcharhinus signatus* (one individual), *Prionace glauca* (4) and *Isurus oxyrinchus* (1). Fishing statistics made in Martinique indicated that “various sharks” represented 1.3% of total weight landed coming from FAD fishing in 2009 and 1.5% in 2010. This species group is fished in Martinique, around FADs (21% of their annual landing, in weight) and by bottom lines (79%).

Means Contributing to FADs Fishing Selectivity

FADs mode of utilization and target species

The effect and impact of FADs utilization mode on the catches can be seeing through a comparison between FAD fishing in Martinique and that same activity in Guadeloupe. Indeed, fishermen from Guadeloupe mainly target dolphin fish (Guyader *et al.* 2011 and 2013). For that reason, a lot of private FADs are owned by one fisherman whereas in Martinique the fishing activity is more organized by groups, so fewer FADs are deployed. The species composition of the landings is different from one island to the other.

In Martinique, in 2009 and 2010, blue marlin, main species fished, represented 44% to 36% of the total FAD catches (weight). At the same time, dolphin fish catches were between 9% and 4% and yellowfin tuna between 15% and 25% (Reynal *et al.* 2013). In 2008, in Guadeloupe, the three main species, yellowfin tuna, dolphin fish and blue marlin were respectively 36%, 33% and 18% of total FADs landings (Guyader *et al.* 2010). From these studies, we can say that fishers strategies have a critical influence on FADs setting and targeted species.

Distance of FAD deployment from shore

From 1595 data forms completed by FAD fishermen from Martinique during 2004 and 2005, it is been possible to compare yields per fishing trip obtained according to the distance of FAD deployment from shore. Between 0 and 12 miles, fishermen captured in average 10.5 fish with a total of 44.9 kg, with an average of 5.5 hours fished, the hourly yield is 8.2 kg. Between 12 and 24 miles, the catches per fishing trip, the catches per fishing trip became 14.7 individuals and 89.7 kg with in average 6 hours and 04 minutes fished, the hourly yield is 14.8 kg. Further than 24 miles, the captures reached 19.9 fish and 135.7 kg. The hourly yield is 19.4 kg with a time of fish of 6 hours and 59 minutes. This increase of catch offshore is mainly thanks to skipjack catches which yields varied between 1.5 kg (within 12 miles) to 4.3 kg (outside 20 miles). For yellowfin tunas, the yields per fishing trip varied between 17 kg (within 12 miles), 42 kg (12-24 miles) and 86 kg in average (for FAD outside 24 miles). The blue marlin gave in average better results outside 12 miles (36-34 kg outside 12 miles and 17 kg inside). This difference can be stronger by the fact that captains from small vessels avoid this last species which can be dangerous to take on board. The average number of vessel present around the FAD varied from 5.4 (within 12 miles), to 3.8 (between 12 and 24 miles) and 4 (outside 24 miles). From these data we can estimate a daily catches by FAD according its distance from shore. This estimation would be 240 kg with 90 kg of yellowfin tuna, for coastal FAD, 340 kg (160 kg of yellowfin tuna) for FAD deployed between 12 and 24 miles, and 540 kg (344 kg of yellowfin tuna) for FAD outside 24 miles.

Gears and fishing techniques

The study of the catches from FADs show a quite important quantity of small tunas (FL < 40 cm) fished (422 individuals in 54 fish trips made by professionals). They are caught during the day by surface trolling line (163 individuals, between 2 to 10m), but moreover by sub-surface trolling line (250 individuals, between 4 and 25 m) (Reynal *et al.* 2007).

Middle size tunas around FADs (between 40 cm and 1 m) are fished by night and day. By the day, they are captured in deeper waters than the small tunas (84% by sub-surface and 16% by surface trolling lines). Also recent experimental fishing trips by jigging show a better capture of middle size blackfin tunas (between 45 and 60 cm FL) during the day. By night, blackfin tuna seems to have a different behavior towards trolling lines. Just before sunrise (from 4:00 am and from 1 to 2 am during full moon nights), fishermen can catch them with line going down 30 m deep. This fishing activity stops by day (from 6:00 am approximately), the other tunas (yellowfin, skipjack, etc.) are less captured by this technique.

Large fish (billfish, yellowfin tuna bigger than 1 meter) are targeted by day. They are almost always fished by drifting buoys. However some fishermen informed us on possible catch of large yellowfin tuna by night by trolling line, even if this technique is not really adequate for this type of fish. Unlikely tunas, no billfish are captured by night (except for the swordfish caught during experimental fish trips).

Yellowfin tunas bigger than 1 meter were principally fished in deeper waters (below 80 m) than middle size tunas. These observations suggest a distribution according to their size, from the surface where we find more small tunas until 180m deep (maximal depth where we captured the largest individuals).

In general the experimental fishing trips with jigging carried out during 2013 enabled to catch yellowfin and blackfin tunas mostly late in the morning. The afternoon starting, the captures of this species decreased.

Bait choice for the drifting vertical lines

Detailed analysis of 40 fishing trips enables us to count the catches at sea (Reynal *et al.* 2007). During these fish trips, 545 catches happened by surface and deep trolling lines, also 508 drifting buoys were deployed (12.7 per fishing trip in average). Those enable us to catch 62 fish. 402 of those buoys had live bait and 106 dead bait (frozen fish or sliced dead fish after using it alive). Alive baits are essentially juveniles (92%). The number of immature fished per fishing trip is 11.5 in average (79% of the catches). Those juveniles are not all landed, because a part of them is lost during the fishing with drifting buoys. If the little tunas used as bait are still in good shape when landed, they can be sold on the market.

According to the nature of the bait, the catches from the drifting buoys seem to be different. With live fish or recently fished, the best result of capture per buoy settled (20%) is obtained with flying fish (number of observations, n=62). The worst result (8%) was with yellowfin tuna as a bait (n=36). Blackfin tuna and skipjack as a bait gave us the following results: 15% (n=195) and 10% (n=153) respectively. Dead bait (called "Dolle") enable to have a capture in 18% of the cases (n=98).

Frozen squid as a bait have been tested also during experimental fishing trips, we obtained a result of 8% (n=110) and frozen squid with dead fish gave us 13% of capture (n=26).

Among all the observations made no blue marlin had been captured with dead bait or flying fish alive. Otherwise, only small yellowfin tunas (< 85 cm) were caught with those baits.

Future development

This ongoing work must be completed by bio-economic issues including seasonality of the catch and bait availability. A thought on the governance mode of FADs is necessary before advising some techniques (blackfin tuna fishing by night, dolphin fish with numerous FADs). Also work conditions and safety at sea are worth considering (jigging or distance of FAD from shore). The risk for some stocks insufficiently or not assessed has to be taken into account (blackfin tuna, dolphin fish).

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