Artificial bait in pelagic longline fisheries : Insights from trials and research needed

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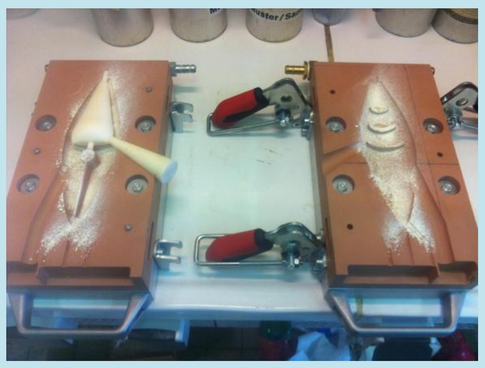
Introduction

Pelagic longline fisheries (PLF) have brought the attention of environmental NGOs, fisheries managers and policymakers because of the interaction of longlines with endangered, protected and threatened megafauna, and the impact of PLF on non-managed and data-poor bycatch species. Another important but cryptic impact of PLF concerns global food security due to the use of exploited marine resources as a bait (small pelagic fish, squids). The development of artificial bait is an alternative that brings potential ecological and economic benefits. In this context, our study presents the development of the Ecological-Based Artificial Bait (EBAB) and first fishing trials undertaken to assess (i) the fishing efficiency of EBAB on target species (swordfish and tunas), (ii) its ability to mitigate bycatch and (iii) its durability.

Material & Methods

Development of the EBAB prototype

◆ EBAB (Ecological Based Artificial Bait) is a flexible small pelagic fish-shape mold made from elastomeric polyurethane (obtained by Reaction Injection Molding) which combines both flexibility and resistance. The prototype is designed to resist to predator bites.



Mold structure preparation

*EBAB (Bach et al., 2012 *)*

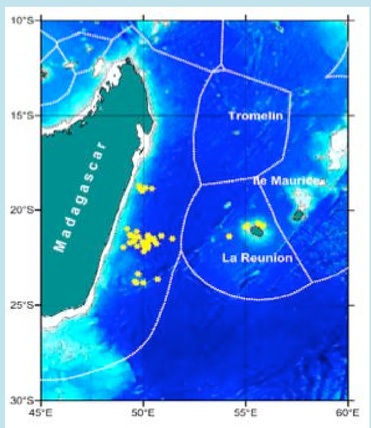
◆ The anterior part of the artificial bait envelope has a hollow compartment designed to receive an attractant (fish pulp sausage). The posterior part of the prototype has a slot of the length of a hook with a large shank inside which sits the hook. This slot is narrow enough to maintain the hook by friction. The hook may nevertheless drop out of the slot after hooking of a fish, and the mold may slide up the line to avoid damages if it was ingested by the fish.

***** *Bach P., Hodent T., & Robin J.-J., 2012.Patent EP12183563, September.*

Pulp preparation

← By-products used for the preparation of the pulp to attract fish come from the local tuna industry based in La Reunion (Indian Ocean).
Solid wastes are processed by a mechanical separation → to produce raw pulp with a yield of 70%.

← Texturizing agents (carrageenan) active at low temperature (no cooking) and appealing factors (such as fish protein hydrolysates) are mixed with the pulp to produce sausages (pulp roll ~ 7 cm, 25 gr) → which will be inserted frozen into the mold.



Location of the fishing sets

Fishing trials

◆ EBAB were tested during 46 commercial fishing operations from May to August 2012 in South West Indian Ocean. For each fishing set 100 or 200 EBABs were deployed either at the beginning at the end or in the middle of the longline. A total of 8583 EBABs were deployed simultaneously to 56423 natural baits (13% of baits). For each fish caught the species, the size of the individual as well as the hooking position were recorded..

Results

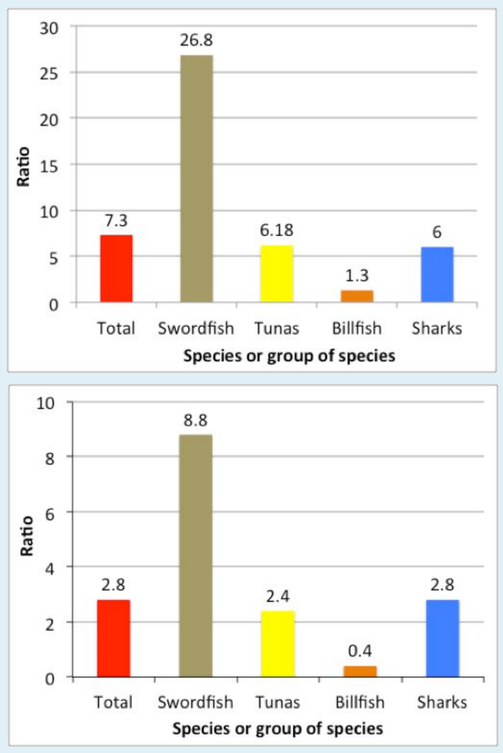
Jaw hooked bigeye caught with EBAB showing the liberation of the mould on the branchline to avoid its damage.

◆ 17 fishing sets out of 46 (37% of total fishing operations) were positive for EBAB (at least one fish caught). Target species such as tunas and swordfish were caught in 11 fishing sets (65% of positive sets with EBAB). A total of 25 species or group of species was caught with natural bait against 11 with EBAB. Tunas and swordfish caught with EBAB represented 45% of total catch while they represented 35% of the catch on natural bait. No pelagic stingray and dolphinfish were caught with EBAB while these two species were abundant on hooks with natural bait. No sea turtles were caught on EBAB while one Risso dolphin was accidentally hooked by the pectoral fin.

Species or group of species	NATURAL BAIT	EBAB
TARGET AND MAJOR COMMERCIAL SPECIES		
Swordish (*Xiphia gladius*)	X	X
Albacore tuna (*Thunnus alalunga*)	X	X
Yellowfin tuna (*Thunnus albacares*)	X	X
Bigeye tuna (*Thunnus obesus*)	X	X
BYCATCH (conserved on board)		
Marlin (*Makaira spp, Tetrapterus audax*)	X	X
Sailfish (*Istiophorus platypterus*)		X
Spearfish (*Tertrapturus angustirostris*)	X	
Dolphinfish (*Coryphaena hippurus*)	X	
Opah (*Lampris guttatus*)	X	
Barracuda (*Sphyraena barracuda*)	X	
Bramids	X	
Skipjack (*Katsuwonus pelamis*)	X	
BYCATCH (Discards)		
FINFISH		
Escolar (*Lepidocybium flavobrunneum*)	X	
Snake mackerel (*Promethichtys promoteus*)	X	
Lancetfish (*Alepisorus ferox, A. brevirostris*)	X	X
Moonfish	X	X
ELASMOBRANCHS		
Pelagic stingray (*Pteroplatytrygon violacea*)	X	
Manta rays	X	
Blue shark (*Prionace glauca*)	X	X
Oceanic white tip (Carcharhinus longimanus)	X	X
Requin gris (Requiem shark)	X	
Mako shark (*Isurus spp.*)	X	
Hammerhead shark (*Sphyrna spp.*)	X	
PROTECTED SPECIES (Discards)		
Green turtle (*Chelonia mydas*)	X	
Loggerhead sea turtle (*Caretta caretta*)	X	
Risso's dolphin (*Grampus griseus*)	X	X

◆ In total EBAB was 7.3 times less efficient than the natural bait. Ratio between catch on natural bait and catch on EBAB was 27 and 6 for the swordfish and tunas respectively. EBAB caught 6 times less sharks than natural baited hooks.

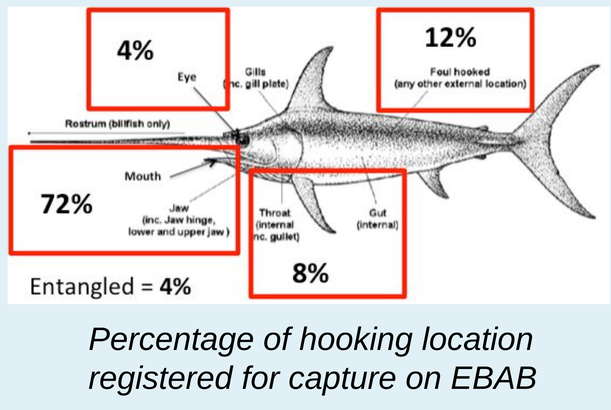
◆ For positive sets, these ratios were 8.8 and 2.4 for swordfish and tunas, respectively. For sharks, the ratio was 2.8 while in this case EBAB was more efficient on billfish (ratio = 0.4).



◆ Although "J-hooks" were used with EBAB, most hooks set in the jaw (72%) suggesting further potential to decrease the post-release morality of discarded bycatch.

◆ Finally, results of experiments proved the resistance of the prototype as the rate of replacement was 12 EBAB for 1000 hooks (65 molds were damaged by squids and 35 were lost on cut-off branchlines).

Variations of the ratio between the numbers of fish caught on natural bait and on EBAB for total sets (top) and positive sets with EBAB (down).



Percentage of hooking location registered for capture on EBAB

Discussion & Conclusion

◆ Although a low fishing efficiency for target species and a species-selectivity proved sub-optimal, overall EBAB trials were promising. Jaw hooking of J hooks with EBAB is similar to that obtained with circle hooks, thus possibly reducing post-release mortality of bycatch, particularly sharks. With a rate of replacement of 12 EBAB for 1000 hooks EBAB was proved as highly reusable. Development of artificial baits is likely one of the major challenges for pelagic longline fisheries (PLF) in the nearest future. Such an innovation might alternate negative perception of the longline gear by the general public. Gear technology research has already played a central role in searching win-win solutions in the Ecosystem Approach to Fisheries (EAF) framework. Based on these preliminary results further research must be developed to improve (i) the design of the mold (hook anchorage in the slot, rigidity) and (ii) the texture of the pulp. Moreover knowledge on sensory biology of the most susceptible species should be considered in specifications.

The development of EBAB and fishing trials were supported by the EU FP7 #210496 project MADE: Mitigating Adverse Ecological Impacts of Open Ocean Fisheries and the Fishing European Funds on the La Reunion Council). We wish to address special thanks to T. Hodent, J.J. Robin & H. Grenier (Univ. Montpellier 2), C. Donadio & L. Dufossé (Univ. Réunion); J.D. Filmater, J.P. Lamoureux, P. Cotel, E. Richard, A. Vastel, P. Le Bourdonnec (IRD, UMR « EME »), Réunion Pélagique, ENEZ DU and all captains and crews involved in fishing trials.