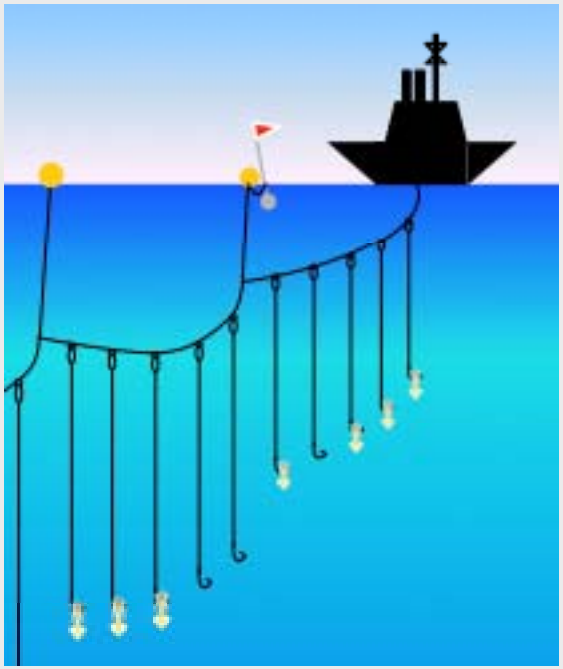
Bait innovation as a new challenge in pelagic longlining

Bach P., T. Hodent, C. Donadio, E. Romanov, L. Dufossé, J.-J. Robin

Last fishing trials partially supported by European Fishing Funds

1 - RATIONALE



Due to this lack of selectivity (species and size), pelagic longline fisheries are likely the primary source of :

- mortality of long-lived protected species (seabirds, sea turtles, marine mammals)
- Bycatch of **sharks,** not targeted billfishes and **juveniles swordfish**

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… and fishing grounds where pelagic longlines are operating are called « **Ocean Roulette » or « underwaters minefields » in the conservationist sphere** (Hinman, 1998).

1 - RATIONALE

Bycatch mitigation measures in pelagic longlining

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Many studies were focused on fishing practices and gear technology to mitigate bycatch of **seabirds** (tori line, night setting, weighted leader, …), **sea turtles** (hook shape, bait type, hooks out shallow waters, reducing soak time and daytime hauling) and **sharks** (prohibiting wire leader, hook shape)

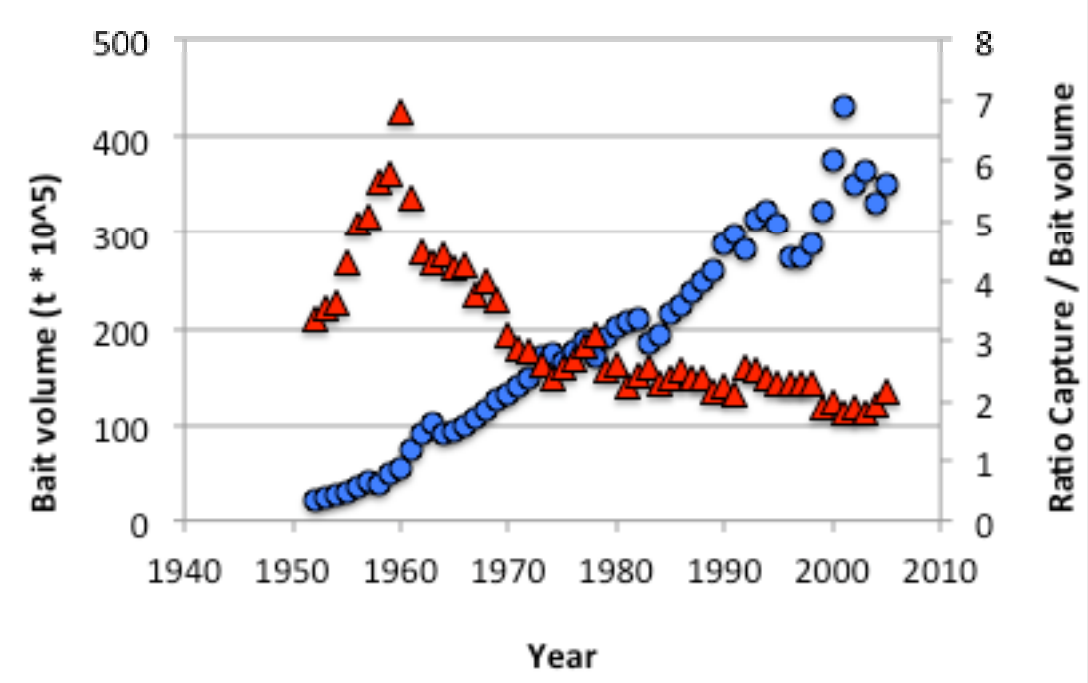
(from Serafy et al.,, 2009)

Few studies on **gear technology regarding the bait** while bait is concerned at the different steps of the capture process from the detection of the gear by chemical stimuli, the detection of the bait and its attack by visual stimuli (Bjordal & Lokeborg, 1996; Ward, 2008)

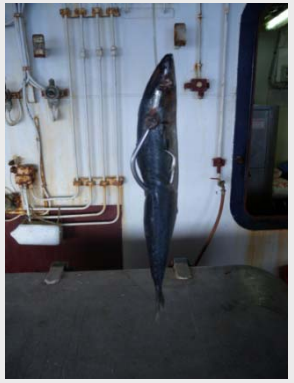
2 - DEVELOPMENT OF AN ARTIFICAL BAIT IN PELAGIC LONGLINING

WHY ?

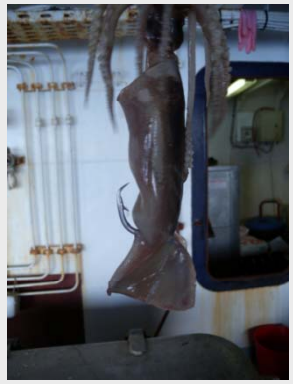
1 – Improve the valorization of both **fishery catches** and by-products



(from Fontenau, 1997; 2009; 2010; com.. pers.)



Mackerel



Squid

350 000 mt of baits (180 gr) used by pelagic longline fisheries/year worldwide = ~ ½ target species landings

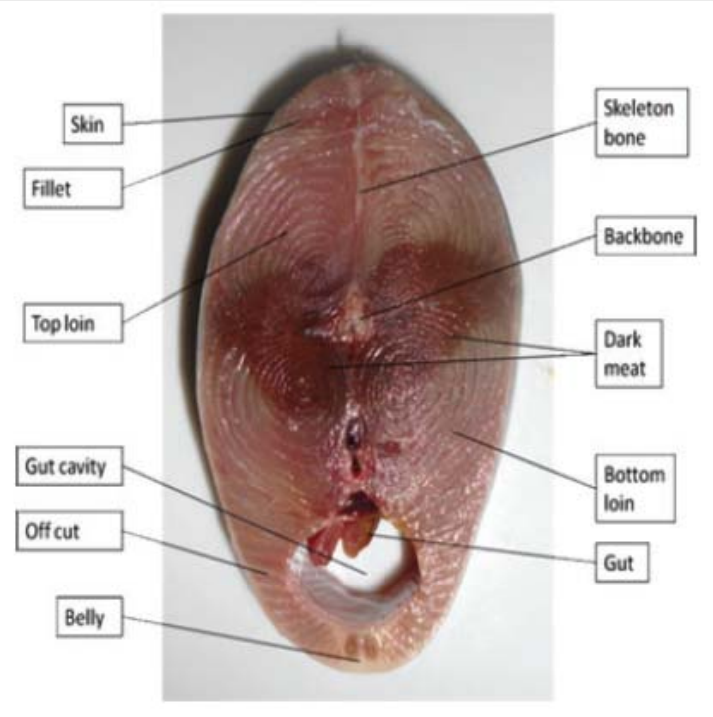
2 - DEVELOPMENT OF AN ARTIFICAL BAIT IN PELAGIC LONGLINING

WHY ?

1 – Improve the valorization of both fishery catches and **by-products**

- ✓ Tuna industry produces a huge amount of solid wastes (450 000 mt/year of viscera, gills, dark flesh/muscle, head, bone, and skin), (Sutanbawa Y, Aknes A. 2006)

- ✓ As major byproducts (fish oil, fishmeal, fertilizer, pet food and fish silage) have still **low economic values** (Herpanti et al., 2011), **solid wastes can be used for bait**



(*from Herpandi et al., 2011)*

2 - DEVELOPMENT OF AN ARTIFICAL BAIT IN PELAGIC LONGLINING

WHY ?

2 – To reduce by-catch

- ✓ Juveniles of target species
- ✓ Sea turtles
- ✓ Sharks

3 – To improve gear efficiency (reduce bait lost during soak time)

4 – Economy of the fishery

- ✓ Avoid baits out of stocks (small scale fishery)
- ✓ Reduce the bait part in the exploitation cost

3 - ECOLOGICAL BASED ARTIFICIAL BAIT (EBAB) DEVELOPMENT

A - Exam of patented products with the National Institute of the Intellectual Property

UK Patent Application (19) **GB** (11) **2 276 302** (13)

(43) Date of A Publication **28.09.1994**

FISHING BAIT

FISH ATTRACTING FEED MANUFACTURED FROM FISHERY WASTES

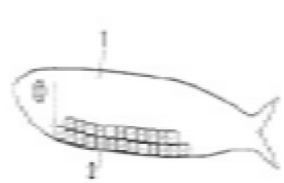
Patent Number: JP10165110 A **1998**0623

FISHING BAIT

SMOOTH SOLID-SHAPED FISH BAIT AND METHOD FOR PRODUCING THE SAME

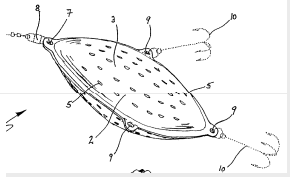
Patent Number: JP2010035434 A **2010**0218

FISH PLASTIC MOLD + FLESH



(10) International Publication Number

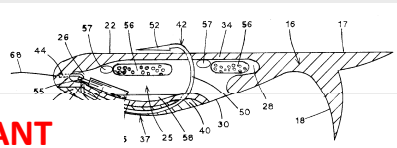
WO 2005/077163 A1



PLASTIC MOLD + FLESH

Patent No.: **US 6,266,916 B1**

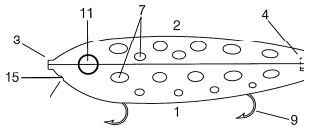
Date of Patent: **Jul. 31, 2001**



FISH PLASTIC MOLD + ATTRACTANT

Número de Publicación Internacional

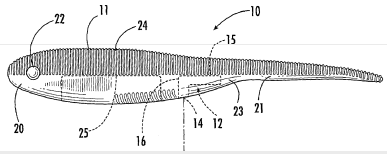
WO 2009/144337 A2



FISH PLASTIC MOLD + FLESH

Pub. No.: US 2003/0192227 A1

Pub. Date: Oct. 16, 2003



FISH PLASTIC MOLD + ATTRACTANT

3 - ECOLOGICAL BASED ARTIFICIAL BAIT (EBAB) DEVELOPMENT

B -Exam of reports and scientific literature

Only 1 artificial bait application dedicated for pelagic longline fisheries.

Tested in 1997 in the NE Atlantic to target Swordfish:

- Plastic bait only (0.13 /1000 h)
- Plastic with fish oil (6.5 /1000 h)
- **Plastic with piece of mackerel (14 /1000 h)**

* reference mackerel (14.7 /1000 h)

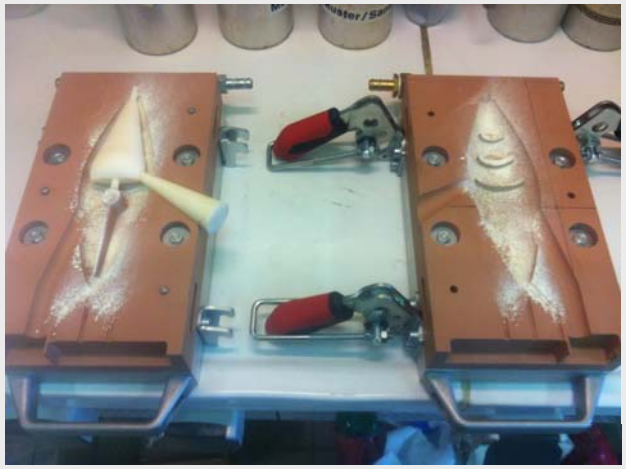
(from Mejuto et al., 2005)

3 - ECOLOGICAL BASED ARTIFICIAL BAIT (EBAB) DEVELOPMENT

C – THE MOLD

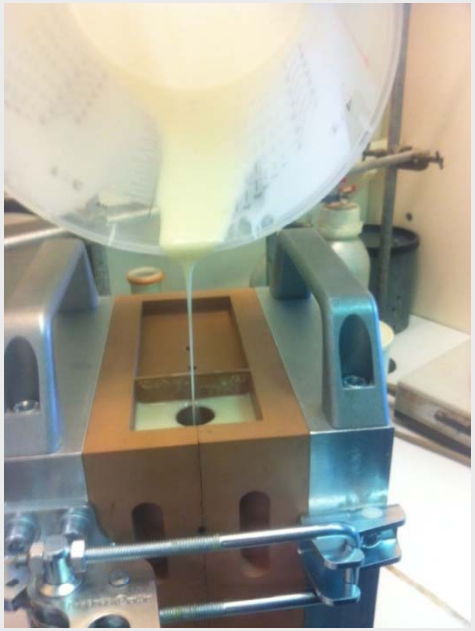
- Fish shape in monoblock
- Polyurethane elastomer (resistance, flexibility)

Reaction Injection Molding (RIM)



Mold structure preparation

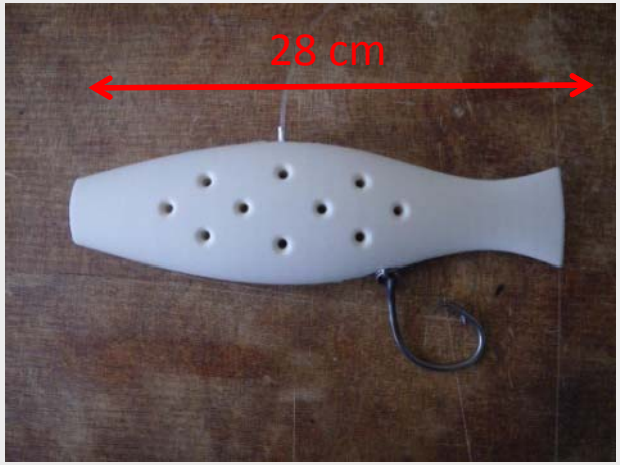
Mold structure closed



Manual casting

3 - ECOLOGICAL BASED ARTIFICIAL BAIT (EBAB) DEVELOPMENT

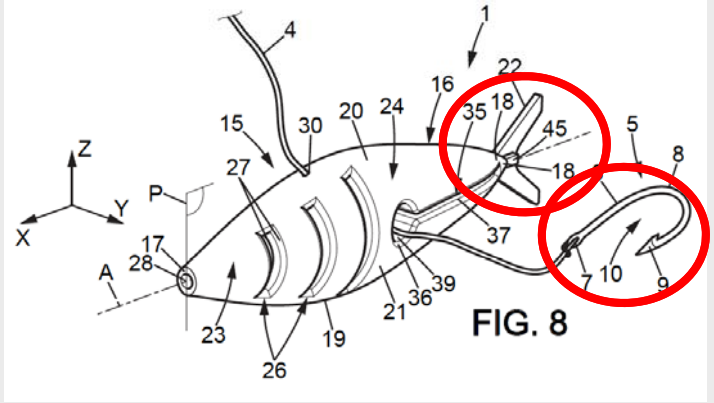
C – THE MOLD



EBAB V1 (May 2010)

EBAB V2 (May 2011)

EBAB V2 (December 2011)



Bach P., Hodent T., & Robin J.-J., 2011.
Patent FR 11 58054, December 2011.

3 - EBAB DEVELOPMENT

D – THE PULP

1/ By-products (tuna and swordfish)

2/ Mechanical separation (LIMA RM 70S)

3/ Raw pulp (yield 70 %)

4/ Pulp mixed (attractive and texturing products

<u>Texturing</u> :
carrageenan, konjac
<u>Attractant</u>:
Shrimp odor

5/ Laboratory tests

<u>Dispersive effect</u> :
- Soap (5%, 15%, 25%)
- Salt (25%, 50%)
- Sand (5%, 15%, 25%, 50%)
- Fish flour (5%, 50%)

6/ Pulp sausage production
(Pulp roll ~ 7 cm, 25 gr)

4 - EBAB FISHING TRIALS

EBAB V1 – December 2010

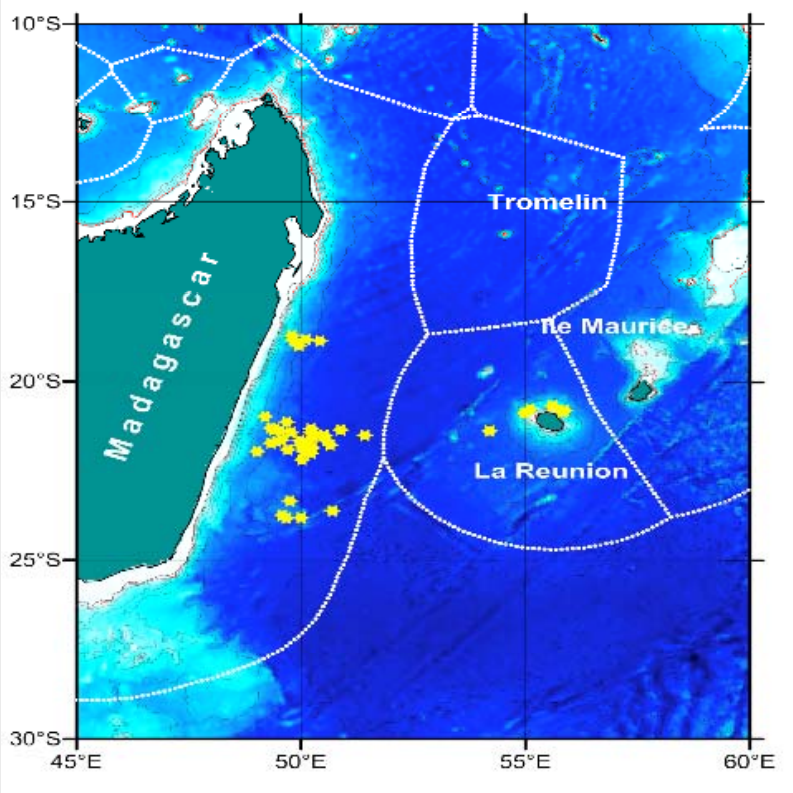
- 7 fishing sets
- 3500 natural baits / 420 EBABs (11%)
- 60 EBABs per set

EBAB V2 – July/August 2011

- 14 fishing sets
- 7000 natural baits / 1120 EBABs (14%)
- 80 EBABs per set

EBAB V3 – May/July 2012

- 46 fishing sets
- 56423 natural baits / 8563 EBABs (13%)
- from 96 to 198 EBABs per set

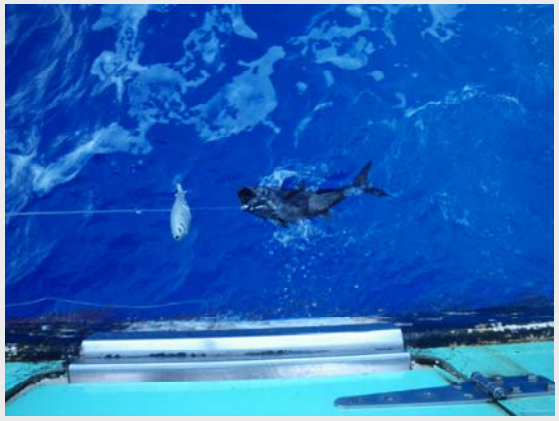


4 - EBAB FISHING TRIALS

Hooking contact and success on EBAB

Many hooking contacts observed on EBAB V1 and EBAB V2 but no success

Hooking success recorded with EBAB V3



4 - EBAB FISHING TRIALS – RESULTS FOR EBAB V3

Positive fishing sets

- Capture occurred in 17 fishing sets (37% of total fishing operations)
- Tunas & swordfish occurred in 11 fishing sets (65% of positive sets)

4 - EBAB FISHING TRIALS

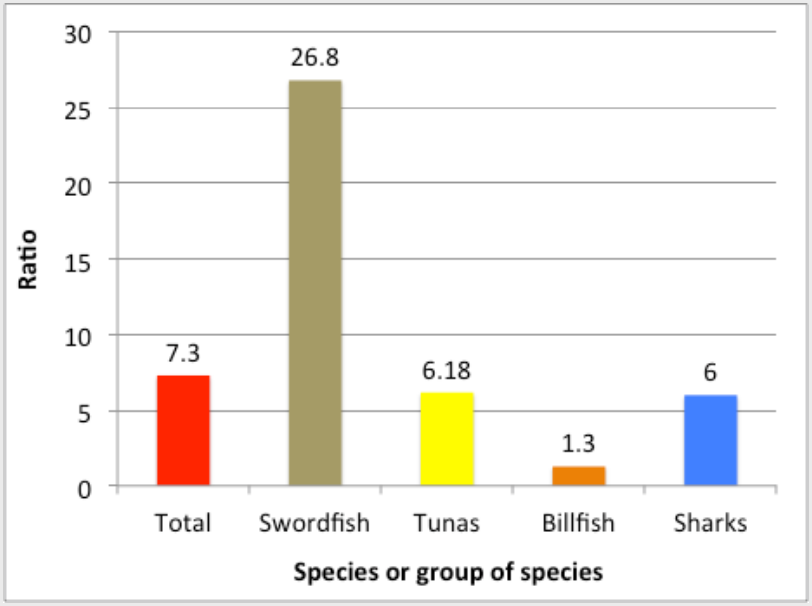
Species selectivity

- 25 species or group of species caught by natural baits against 11 with EBAB V3
- Tuna & swordfish caught with EBAB V3 (45% of total catches)
- No pelagic stingray and dolphinfish caught with EBAB while they were abondant on hooks baited with natural baits
- Risso's dolphins caught with EBAB but no sea turtles

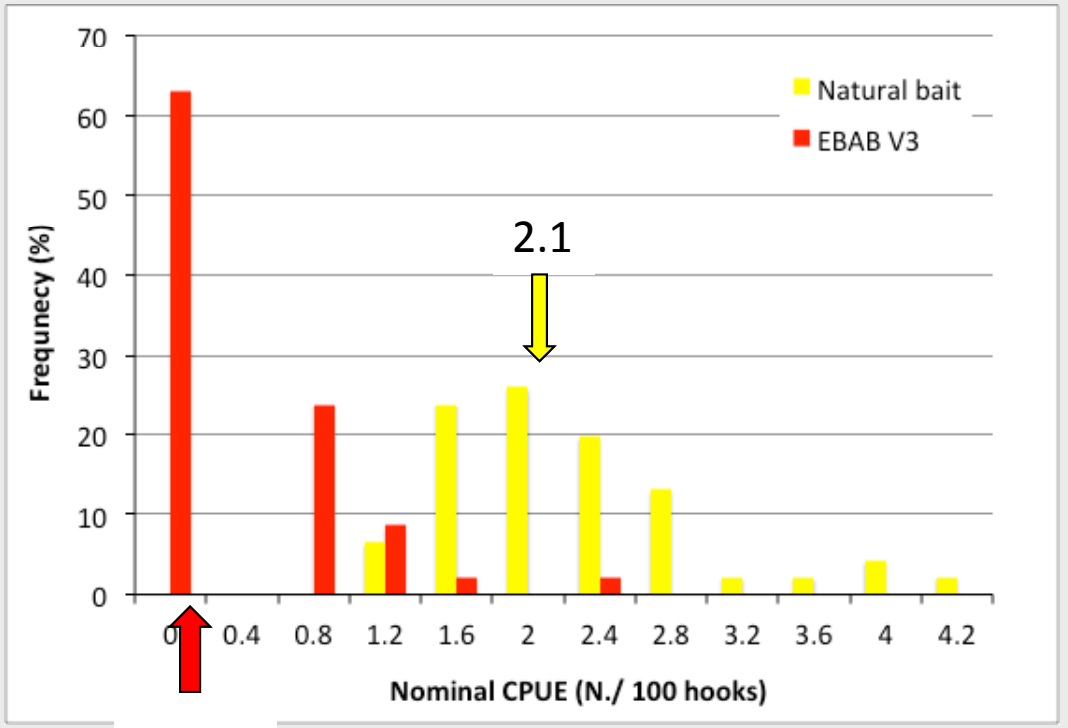
Species or group of species	NATURAL BAIT	EBAB
TARGET AND MAJOR COMMERCIAL SPECIES		
Swordish (*Xiphia gladuis*)	X	X
Albacore tuna (*Thunnus alalunga*)	X	X
Yellowfin tuna (*Thunnus albacares*)	X	X
Bigeye tuna (*Thunnus obesus*)	X	X
BYCATCH (conserved on board)		
Marlin (*Makaira spp*, *Tetrapterus audax*)	X	X
Sailfish *(Istiophorus platypterus*)		X
Spearfish (*Tertrapturus angustirostris*)	X	
Dolphinfish (Corryphaena 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

4 - EBAB FISHING TRIALS – RESULTS FOR EBAB V3

Capture rate (nominal CPUE) on EBAB V3 vs natural bait (total sets)



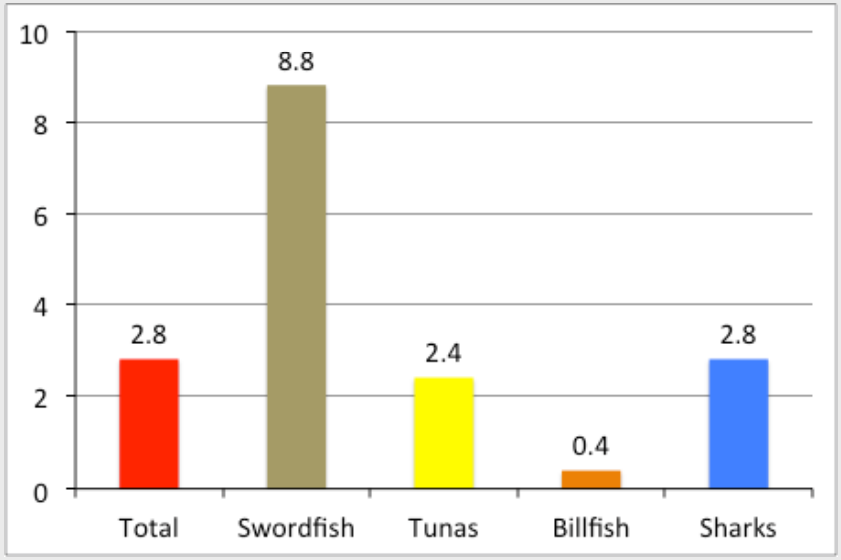
Ratio nCPUE bait / nCPUE EBAB



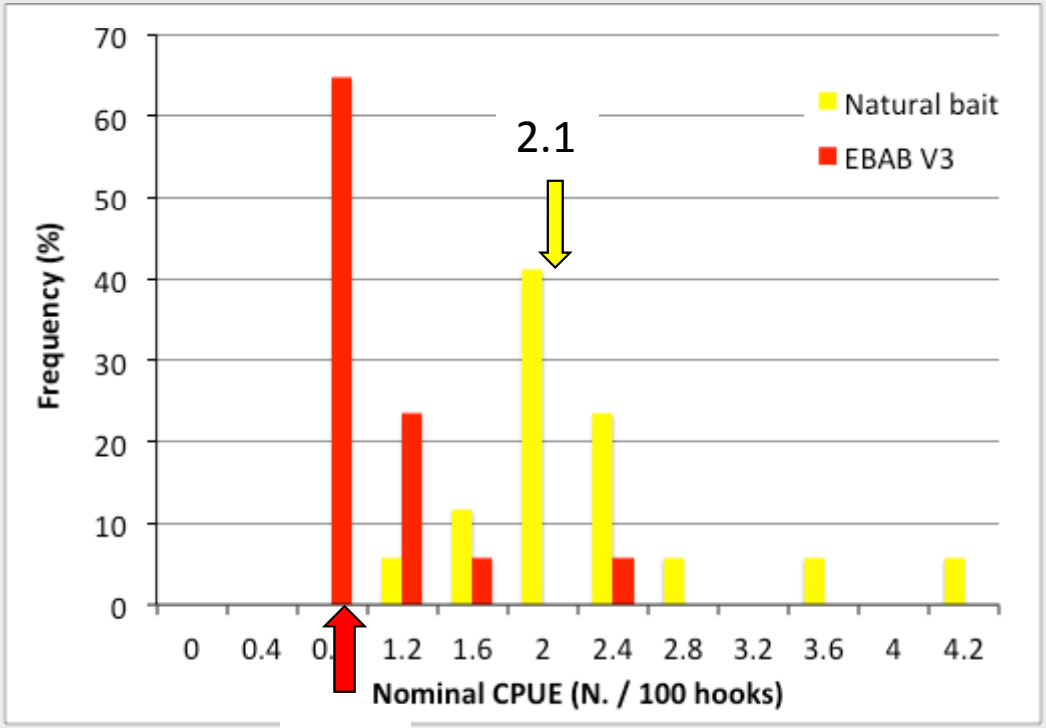
Frequency distribution of nCPUEs per set

4 - EBAB FISHING TRIALS – RESULTS FOR EBAB V3

Capture rate (nominal CPUE) on EBAB V3 vs natural bait (positive sets on EBAB)



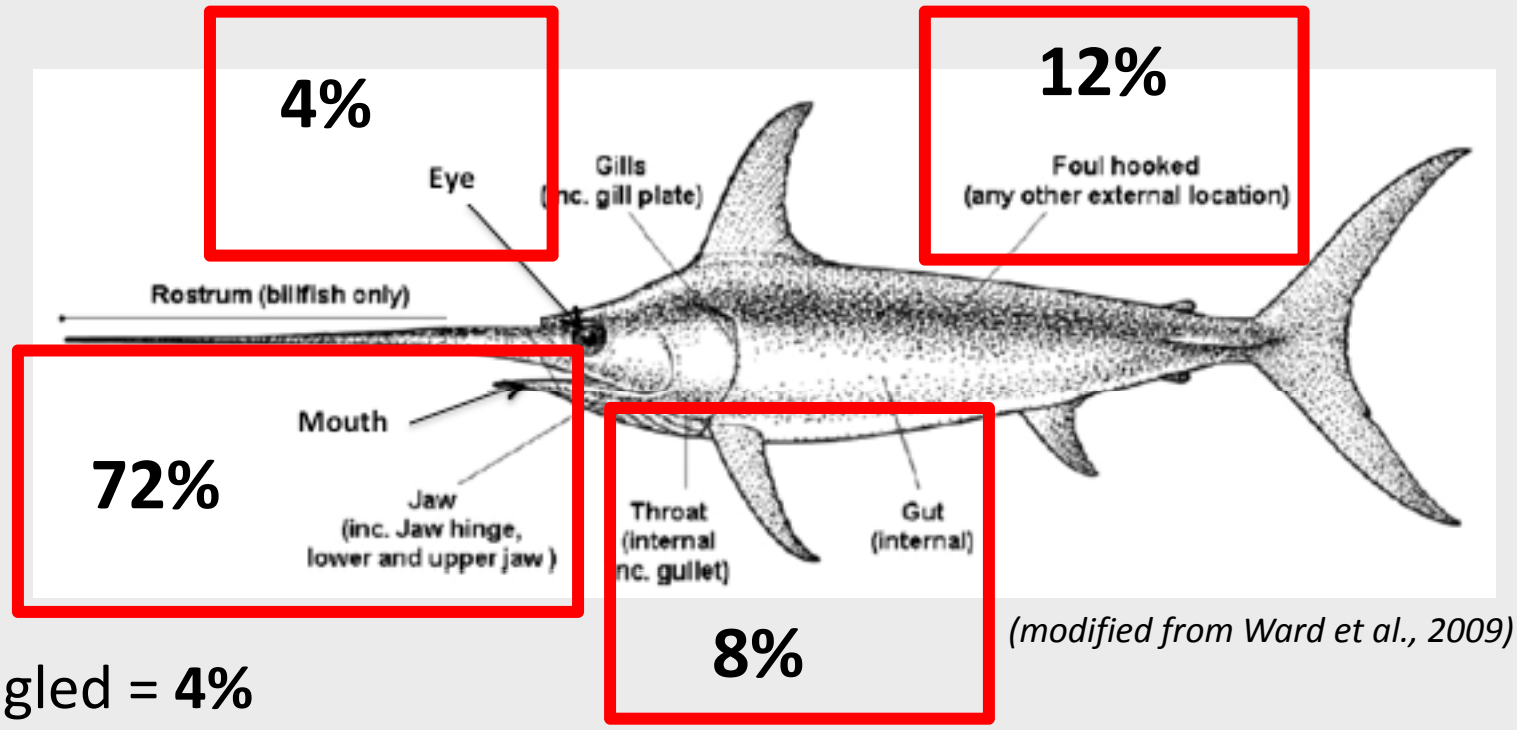
Ratio nCPUE bait / nCPUE EBAB



Frequency distribution of nCPUEs per set

4 - EBAB FISHING TRIALS – RESULTS FOR EBAB V3

Hooking locations



(modified from Ward et al., 2009)

Entangled = **4%**

2 hooking locations unknown due to escape of capture

4 - EBAB FISHING TRIALS – RESULTS FOR EBAB V3

Loss & Damage rate of EBAB V3

Lost while setting	Lost on cutted branchline	Damaged	Total	Deployment	Replacement rate (%)
4	35	65	104	8563	1.2

5 - CONCLUSIONS

POSITIVE FEEDBACKS FROM EBAB V3

- ❑ Capture of species of interest (principally tunas)
- ❑ Good efficiency of the principle of the hook release from the mold
- ❑ High rate of jaw and mouth hookings while J hook shape used
- ❑ Low replacement rate
- ❑ Great interest of fishermen in the research

NEGATIVE FEEDBACKS FROM EBAB V3

- ✓ Low catch rate (ratio bait/EBAB, squid/EBAB, color, attractant, intempestive hook release)
- ✓ Poor selective effect (species)
- ✓ Rather good efficiency for billfish (J hook effect)

5 - CONCLUSIONS

✓ Reducing fishing effort or time-area closure are bycatch mitigation measures more cost-effective than the delay and expense of technological solutions (Jennings and Revill, 2007)

But

- Gear technology has already played a central role in searching win-win solutions in the EAF framework,
- Enhance both food security and valorization of sea by-products is an objective of the EAF

EBAB development combines these aspects of the EAF and put in place innovation for bait as a new challenge in pelagic longlining.

Session 6: MITIGATION TECHNIQUES IN LONGLINE FISHERIES

Bait innovation as a new challenge in pelagic longlining

Bach P., T. Hodent, C. Donadio, E. Romanov, L. Dufossé, J.-J. Robin

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