VIETNAM YELLOWFIN TUNA
FISHERIES IMPROVEMENT PROJECT

REPORT ON 2017
OBSERVER TRIPS WITH CIRCLE HOOKS TRIALS

By
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1. Introduction

The Vietnam Yellowfin tuna Fishery Improvement Project (FIP) has been under implementation since 2014, with the goal of improving the tuna fishery so that it may enter a Full Assessment for MSC certification within 5 years. Based on the FIP Action Plan, a key objective for improved management is the expansion of onboard observers, in order to meet or exceed key thresholds (e.g. WCPFC general goal of 10% permanent coverage). In fact, since 2011 WWF and tuna industry partners have steadily rolled out Observer Program training in close cooperation with the Government of Vietnam. The ultimate goal is to develop a permanent Observer Program in Vietnam's tuna fishery that is managed by industry and Government, and not dependent on external funding, in order to help ensure long-term sustainability of the fishery through improved data collection (target and retained species, bycatch of sharks and turtles etc.).

In addition, bycatch mitigation (e.g. of sea turtles) is an important goal for improved management of the fishery. Experimental evidence, including past experiments in Vietnam, have concluded that the use of circle hooks (in lieu of traditional "J" hooks) can help reduce incidental bycatch of sea turtles by up to 80%, without serious negative impacts on target catch. Thus under the FIP Action Plan, there is an emphasis on further testing and adoption of circle hooks (C-hooks). These can be piloted/tested in conjunction with the continued expansion of the Observer Program. Since 2011, and especially since the start of the FIP, tuna industry partners have been actively supporting the testing and adoption of C hooks.

Under technical support from the FIP Coordination Units and financial support from WWF Vietnam, WWF-US and industries partners (Sea Delight & Anova), four (4) observed longline trips with circle hook trials in early 2017.

2. Methodologies

2.1. Implementation period & venue

Training and at-sea deployment was originally planned for the period August - October 2016. However, due to a variety of reasons (availability of vessels, bad weathers, less catch during period end-months of 2016), these trips were delayed to the beginning of 2017. Finally, these observed and C-hooks trials were implemented from end of February to beginning of April 2017 on the longline fishing boats from Dong Tac ward, Tuy Hoa city, Phu Yen province.

2.2. Selecting and training of observers

Due to the specific technical requirements to observe and effectively record the information, candidate observers were careful assessed and selected based on their scientific credentials (i.e. species ID), experience and willingness. Four (04) technical staff from the Research Institute for Marine Fisheries (RIMF) – Vung Tau branch were selected.

Local staff and fishers were also selected to be observers. These observers had additional training by VINATUNA staff on fish taxonomy and on correct method of recording data on observer data forms.

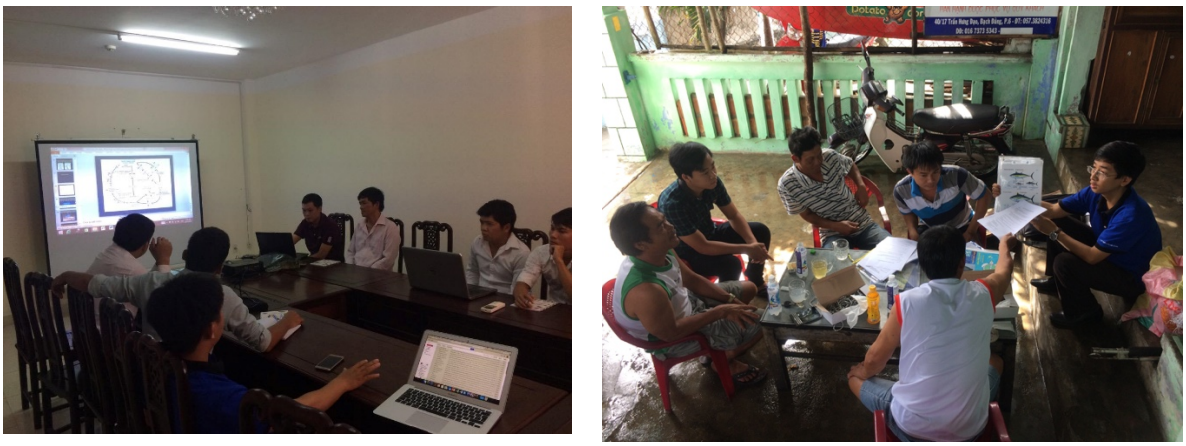

Figure 1. Training of observers

2.3. Choosing circle hook types

In recent years, circle hooks have been introduced and trialed in three provinces - Binh Dinh, Phu Yen & Khanh Hoa - under support from WWF and industries and in conjunction with Government activities. In some cases, the local fishers have modified these circle hooks in various ways. However, these modified circle hooks (called "***circular hooks***") do not in fact display the same benefits (in terms of reduced sea turtle bycatch) and so were not applied under the FIP activities.

After many consultations with fishers (mostly vessel owners and captains) and comparisons between traditional J-hooks, "circular hooks" and real circle hook samples, it was determined that a sample of circle hooks need to meet four (04) criteria to archive requirements from fishers as well as from sea turtle protection including:

- Minimum size 14: Circle hooks can range from size 10, 12, 14, 16 and 18 and all of these are available on the markets. According to scientific studies to date, in general the "bigger the better" in terms of reducing sea turtle encounters. However, from the perspective of fishers, they would like to use as small size as possible (size 10 or size 12). Thus, to balance expectations from fishers and ETPs protection, a compromise was reach in which Size 14 were applied.
- Real circle hooks: the hook point needs to be perpendicular with the shank (body) of the hook.
- Hook with ring: The hooks with ring are more flexible to make easier actions during fishing activities. These are more acceptable for fishers.
- Offset: In order to be easy on hooking the baits, an offset of $10^0 – 15^0$ is most ideal for fishers using C-hooks.

By the above technical requirements, stainless steel C-hooks, sourced from Korea, were choosen to be used on these trials on the longliners in Phu Yen. The decision to use the Korean hooks was also based on the general perception that these were high-quality hooks and relatively strong.

Figure 2. Circle hook size 14 (right) and traditional J-hook (left)

2.4. Choosing longline vessels for trials

There are not many longliners in the Vietnam tuna fishery (estimated at less than 20 longliners in Vietnam). The main target species for longliners is yellowfin tuna; however, it should be noted that especially for longliners (as compared to handline) there are more than one target species – other species such as shark (particularly Tresher shark but other sharks as well), lancetfish, and billfishes are all targeted and all have important commercial value.

Figure 3. Meeting with fishing vessel owners to explain the objectives

Identifying the longliners to join in these trials was carefully considered. The project team with VINATUNA staff and support from industry consulted with each boat owners home to explain to owners and skippers the intention of the trails, the general benefits of C-hooks, and the overall scientific consensus demonstrating their "win-win" nature.

Figure 4. Delivery of circle hooks to captains

2.5. CPUE calculation method

A key aspect of the C-hook trials is to obtain a reliable estimation of Catch Per Unit Effort (CPUE) using the C-hooks. The CPUE indicator will be demonstrated as kg per 100 hooks and calculated by following equation:

$$CPUE = \frac{C}{N} * 100 \ (1)$$

Of which:

- C is the catch
- N is the number of used hook for each hook types or by species.

CPUE indicators will be calculated for total catch (overall CPUE) and for target species for each type of hooks (J-hooks & C-hooks)

3. Results

In the plan of FIP activities in 2016, there were four (04) observer trips designed to combine using different hook types. In these four trial trips with observer, there was one trip did not use C-hooks in the whole fishing trip (despite an agreement was made between VINATUNA, owner and industry representatives before going out for fishing). Thus, in this study, we only use information from three (3) trips which used circle hooks.

In these 3 trips, there was a total of 53 fishing sets on longliners. From these, 44 fishing sets deployed a mix of J and circle hooks and 9 sets used J hooks only. In total, fishers used 49,350 hooks, of which, 41,800 traditional J-hooks were used (accounting for 84.7%) and 7,550 circle hooks were used (15.3%). On average, each fishing set used 625 hooks including 529 J-hooks and 96 C-hooks.

3.1. The catch & CPUE indicator

For the three fishing trips with 53 fishing sets (including 44 sets with circle hooks and 9 sets without circle hooks), fishers caught 732 individual fishes with the total catch of 9,512 kg. Of which, J-hooks caught 8,215 kg and circle hooks caught 1,297 kg, accounting for 86% and 14%, respectively. For the total catch, the general CPUE indicator was 19.27 kg per 100 hooks; CPUE of J-hooks was 19.65 kg per 100 hooks and CPUE of circle hooks was 17.18 kg per 100 hooks.

Yellowfin tuna is the target species and the main catch, with 3,133 kg accounted for 33% total catch. Of these yellowfin tuna, J-hook caught 2,480 kg, accounted for 79% and C hook caught 653 kg accounted for 21%. The total CPUE for yellowfin tuna was

6.35 kg per 100 hooks while CPUE of J-hooks was 5.93 kg per 100 hooks and CPUE of circle hooks was 8.65 kg per 100 hooks.

The CPUE indicators have shown that, although overall CPUE (for all species) of J-hooks (19.65 kg per 100 hooks) was higher than CPUE of C-hooks (17.18 kg per 100 hooks), the CPUE for target species (yellowfin tuna) was higher for C-hooks (i.e. 8.65 kg per 100 hooks for C-hooks VS. 5.93kg per 100 hooks).

Table 1. Catch and CPUE indicators

Hook types	No. of hooks	Hook percentage	Total catch (kg)	Average CPUE (kg/100hooks)	Total YFT (kg)	CPUE YFT (kg/100hooks)
Circle hooks	7,550	15%	1,297	17.18	653	8.65
J – Hooks	41,800	85%	8,215	19.65	2,480	5.93
Total	49,350	100%	9,512	19.27	3,133	6.35

In terms of the size of yellowfin tuna as targeted species, 732 individual tunas were caught during the fishing trips. From these, 56 individual tunas were caught by circle hooks and 676 tunas were caught by J-hooks. The overall size, minimum weight of caught tuna was 27.5kg while the maximum was 70.0 kg and the average weight was 45.1kg. While the average size of tuna caught by J-hooks was 44.6kg; the average size of tuna caught by C-hooks was slightly bigger at 47.3kg. The size of caught tuna is demonstrated in table 2 below:

Table 2. Size of YFT caught by hook types

Hook types	Min (kg)	Max (kg)	Average (Kg)
C-hooks	35.0	70.0	47.3
J-hooks	27.5	70.0	44.6
Total	27.5	70.0	45.1

3.2. Species composition

In three fishing trips with 53 fishing sets, fishers caught 732 individual fishes belong to 20 species. Of which, target species (yellowfin tuna) reached 33% total catch with 3,133kg with 71 individual fishes. Other non-target retained species included Thresher Shark species (*Alopias spp*) of 47 individual fishes with 2,945 kg, accounting for 31% total catch. The third species is Largehead hairtail (*Trichiurus lepturus*) caught 1,239 kg with 451 individual fishes, accounting for 13% total catch. The details of species composition are illustrated in table 3 below:

Table 3. Species composition sorted by volume (kg)

No.	Vietnamese Name	Scientific Name	Commercial Name	Individual Fish	Quantity (kg)	Percentage
1	Cá ngừ Vây vàng	*Thunnus albacares*	Yellowfin tuna	71	3.133	32,9
2	Cá nhám chuột	*Alopias spp*	Thresher Shark	47	2.945	31,0

3	Cá hố ma	*Alepisaurus ferox*	Long snouted lancetfish	451	1.240	13,0
4	Cá cờ kiếm	*Xiphias gladius*	Swordfish	13	708	7,4
5	Cá mập mượt	*Carcharhinus falciformis*	Silky shark	5	275	2,9
6	Cá Thu Ngàng	*Acanthocybium solandri*	Wahoo	52	263	2,8
7	Cá cờ đen	*Istiompax indica*	Black marlin	3	220	2,3
8	Cá Dầu / Mắt Ngọc	*Ruvettus pretious*	Oil-fish	36	196	2,1
9	Cá Cờ Gòn	*Makaira nigricans*	Blue marlin	2	150	1,6
10	Cá Cờ Buồm	*Istiophorus platypterus*	Indo-Pacific sailfish	3	108	1,1
11	Cá Thầy bói	*Lepidocybium flavobrunneum*	Escolar	27	83	0,9
12	Cá Đuối nạng	*Manta spp.*	Manta rays	1	50	0,5
13	Cá Nhồng	*Sphyraena barracuda*	Great barracuda	9	46	0,5
14	Đồi mồi dứa	*Lepidochelys olivacea*	Olive ridley turtle	1	30	0,3
15	Cá Mập xanh	*Prionace glauca*	Blue shark	1	30	0,3
16	Cá Bánh Lái	*Mene maculata*	Moon fish	5	14	0,1
17	Rùa xanh	*Chelonia mydas*	Green turtle	1	10	0,1
18	Cá Đuối đen / Đuối dơi	*Mobula spp.*	Devil rays	1	6	0,1
19	Cá Nục heo	*Coryphaena hippurus*	Mahi mahi	2	4	0,0
20	Cá ngừ vằn	*Katsuwonus pelamis*	Skipjack tuna	1	2	0,0
	Total			**732**	**9.512**	**100,0**

Noted: Value 0.0 means less than 0.05

3.3. Information of ETP species

In three (3) observed trips with C-hook trials, both sea turtle & shark species were encountered. Two (2) sea turtle species, *Lepidochelys olivacea* and *Chelonia mydas*, were observed on the set 23 and set 25 on 22nd and 24th, March 2017, both were caught by J-hooks, and fishers just cut the line to release the sea turtles.

Table 4. ETP species information

No.	Species	Quantity	Total weight (kg)	Status	Caught by C-hooks	Caught by J-hooks	Observed date
1	*Lepidochelys olivacea*	1	30	Cut line & release		One sea turtle was hooked on the mouth	22nd Mar, 2017
2	*Chelonia mydas*	1	10	Cut line & release		One sea turtle was hooked deeply in the digestive system	24th Mar, 2017
3	Silky Shark (*Carcharhinus falciformis)*	5	275	Dead & landed	2	3	28th Mar & 1st Apr, 2017
4	Manta rays (*Manta spp)*	1	50	Dead & landed		1	2nd April, 2017

Figure 5. Observed sea turtle (left) and sharks (right)

4. Conclusions, Recommendations & Next Steps

4.1. Conclusions

In summary, four (04) fishing trips with onboard observers & C-hook trials were conducted with three (3) trips applying C-hooks (mixed with J hooks). In total 53 fishing sets with 49,350 hooks were used and data from these three trips are used to analyze information in this report based on the data of these three trips.

It should be stressed that with limited number of trips/sets, this is likely not a sufficient sample size to derive clear scientific conclusions. However, based on direct

comparison of C-hook vs. J-hook on fishing trips/sets (i.e. with all other control parameters similar), some general observations can be made:

1. The process confirmed that it is feasible to achieve support from tuna captains/owners to conduct C-hook trials, as well as enlist interested and enthusiastic individuals to participate in observer training. This is an important insight given the need to expand not only C-hook adoption, but also overall observer program coverage (i.e. towards a national program with ongoing observer data etc.);
2. For overall total fishing, the CPUE of J-hooks was slightly higher (19.65 kg per 100 hooks) than C-hooks (17.18 kg per 100 hooks);
3. For fishing on the main target species (yellowfin tuna), the CPUE of C-hooks was significantly higher (8.65 kg/100 hooks Vs. 5.93 kg/100 hooks). And the average size of tuna caught by C-hooks was slightly bigger than J hooks (47.3kg Vs. 44.6kg);
4. Two sea turtles (*Lepidochelys olivacea* and *Chelonia mydas*) were observed and rescued during the observed trips. These were caught by J-hooks. No sea turtles were encountered from the C-hooks;
5. The trials also confirmed the general perception that "tuna longline" in Vietnam is essentially a multi-species longline fishery. Yellowfin tuna, although the main target catch (and largest by weight), comprised only 33% of overall total catch by weight.

4.2. Discussion

While the sample size of these trials was insufficient to draw clear scientific conclusions, overall the trials did appear to align with some general consensus in the international scientific community. For example, the general consensus from past studies is that C-hooks (by virtue of their shape and "self-setting" attributes) can actually *increase* catch rates on yellowfin tuna. The fact that catch rates on the target species did not decrease, and actually improved, will certainly help in terms of future buy-in and support from the fishing community, and may help alleviate some concerns that there would be negative economic impacts from C-hooks. However, further controlled experiments are needed.

Likewise, for impacts on sea turtles (as the main conservation objective), the trials seemed to confirm or be in line with the international evidence that C-hooks reduce hooking encounters with sea turtles. The trials themselves also helped raise awareness on sea turtle protection, providing an opportunity to highlight examples of industry-fisher-government cooperation in this key aspect of longer-term bycatch mitigation strategy.

Since the individual CPUE hook rates were only monitored and calculated for yellowfin tuna, it is not possible to make any inference on the impact of C-hooks on catch rates of other species such as sharks. The summary total catch rates were different, with J hooks achieving an overall higher average rate. This could be because J hooks catch more of the other species such as billfishes and sharks; however, no real interpretation can be made without further trials (and with specific monitoring of catch rates of other target species)

4.3. Recommendations and Next Steps

Some recommendations and next steps include:

1. Further testing of C-hooks effectiveness, in order to scale up the recent interest and to ensure commitment from boat owners and skippers.
2. Continue to expand awareness programs with boat owners and skippers, showcasing some of the results to date, raising further support and interest, and continuing to focus on good experimental design (i.e. to avoid any changes or adjustments made by fishers while at sea)
3. Develop a national sea turtle bycatch mitigation program, supported by MARD, VINATUNA, individual companies and WWF, which includes scaling up of C-hook testing as well as distribution of training, materials and equipment (e.g. de-hooker kits). Such a mitigation strategy is also essential for meeting key FIP milestones (i.e. towards meeting MSC performance indicators)
4. Expand C-hook trials with handline vessels. While sea turtle encounters are expected to be lower in handline operations, this needs to be tested. Furthermore, any national bycatch mitigation program would need to ensure that handline vessels are trained and supportive of mitigation measures (i.e. including standardized use of de-hooking tools).
5. Expand training of fishers and skippers on ETP species, including training on at-sea rescue of sea turtles, species ID, and awareness on national regulations and programs related to protection of ETP species
6. Develop a standardized data form for C-hook testing to be used in all future trials (including if possible data fields for monitoring CPUE of all important commercial species, including sharks and billfishes). These forms should include information on hook position and other details.