IMPACTS OF VIETNAMESE OCEANIC TUNA FISHERIES ON SHARKS AND TURTLES

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1. INTRODUCTION

The Vietnam's tuna fisheries occur most notably in the south central provinces Binh Dinh, Phu Yen and Khanh Hoa with two main gears of longline and handline in combination with lights used to attract fish (Dao Manh Son, 2005a; 2005b). There is still a small proportion of under-sized tuna in catches of purse seine and gillnet which is considered secondary species. Fishing grounds of oceanic tuna are offshore areas in Central and South East (Vu Viet Ha & nnk., 2010), in which Hoang Sa and Truong Sa archipelagos are main fishing grounds in North East monsoon, while in South West monsoon is South Truong Sa water.

In catches of oceanic tuna fisheries, beside targeting tuna - yellow fin tuna (YFT) and big eye tuna (BYT) - there are many by-catch species including turtles (Vu Viet Ha & Nguyen Van Hai, 2011). To reduce catching non-target species, WWF and RIMF have conducted experiments to compare effectiveness of c-hooks with j-hooks in tuna fisheries to obtain scientific basic for recommendation on replacing j-hooks with c-hooks in longline fishery to reduce by-catch of turtles and other non-target species. The experiment results showed that using c-hooks in fishing reduced the rates of hooked turtles, but not of sharks (Vu Viet Ha & Nguyen Van Hai, 2011).

In the period of 2015-2018, WWF-Vietnam had implemented observer program on tuna fishing vessels to study effects of tuna fishing on by-catch species, focusing on turtles and sharks, and on the effectiveness of using c-hooks in the fishery. Using onboard observer program data which was conducted in the period of 2015-2018 and other data sources collected by RIMF, this report will provide overview on the interaction of longline and handline tuna fisheries with turtles and sharks.

2. OVERVIEW OF VIETNAM'S OCEANIC TUNA FISHERIES

2.1. Gears composition and fishing vessels

Two main gears of oceanic tuna fishery are longline and handline. The longline gear was introduced into Vietnam fisheries in 1996 and has since become the main fishing gear in tuna fishing. The handline in combination with lights appeared in late 2011 and has been replacing longline gear thanks to higher catch and lower fishing cost. According to statistics of sub-department of fisheries of Binh Dinh, Phu Yen and Khanh Hoa, in 2015 the total of tuna fishing vessels was 2,466 vessels in which 85.24% was handline and 14.7% was longline. The changing proportion from longline to handline in tuna fishery is different among provinces: 100% in Khanh Hoa and 98% in Binh Dinh. In Phu Yen, according to field survey, most vessels had changed to handline fishing. However, the data on changing proportion have not been updated annually. Up to 2015, the proportion of handline was 50.25% and longline was 49.72% in total of tuna fishing vessels.

Table 1. Number of oceanic tuna fishing vessels in Binh Dinh, Phu Yen, Khanh Hoa in the period of 2013 - 2015

Year/Province	Total vessels	Handline (%)	Longline (%)
2013	**2.074**	**74,11**	**25,89**
Binh Dinh	1477	98,83	1,17
Khanh Hoa	188	100,00	0,00
Phu Yen	409	0,00	100,00
2014	**2.416**	**67,90**	**32,10**
Binh Đinh	1615	98,50	1,50
Khanh Hoa	218	100,00	0,00
Phu Yen	583	0,00	100,00
2015	**2.466**	**85,24**	**14,76**
Binh Đinh	1696	98,59	1,41
Khanh Hoa	237	100,00	0,00
Phu Yen	533	50,28	49,72

(Source: Sub-Depratment of Fisheries of Binh Dinh, Phu Yen, Khanh Hoa, 2015)

2.2. Fishing grounds

The fishing grounds of longline tuna fishery are quite scattered and change largely between two monsoons. Data analysis in the period of 2008-2015 conducted by RIMF in Vietnam's waters (Vu Viet Ha & Nguyen Viet Nghaa, 2013) shows that in the months of North East monsoon (October and November) the fishing grounds of the fishery are mainly in sub zone I, II and central water of Hoang Sa and Truong Sa archipelagos. These areas have higher catch than other areas. For the ending months of monsoon (February to March) tuna vessels congregate in southern waters of Truong Sa archipelago. In South West monsoon, fishing grounds of the fishery are widely distributed offshore of Central and South West Vietnam (Figure 1), in which sub zone II and IV have high density of fishing vessels and higher catch than other sub zone (Figure 1).

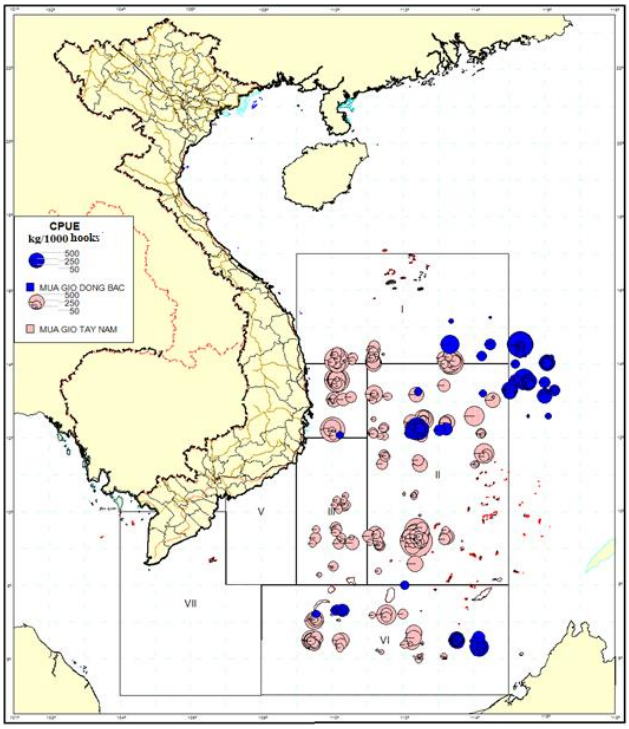

Figure 1. Fluctuation of fishing ground in longline fishing in North East monsoon and South West monsoon based on data observer in period of 2008-2012 (Vu Viet Ha & Nguyen Viet Nghia, 2013)

2.3. Catch

In 2012, using data of commercial fisheries survey conducted by WCPFC, RIMF analyzed, assessed and defined the total catch of tuna in the year (Jan – Dec) to be 23.8 thousand tons, including 17.7 thousand tons of YFT (74.4%) and 6.1 thousand ton of BYT (25.6%). 2012 was the time of introducing handline gear. Although entering the fishery late but the total catch of handline was significant, around 10.7 thousand tons (Table 2), accounting for 44.96% in total catch of oceanic tuna fishery.

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From July 2014 to June 2015, a comprehensive survey on the status and fluctuation fisheries resources in Vietnam water was conducted using "logbook" method. The result showed that most of the longline fleets had changed to handline. Total catch of tuna in this was estimated at 30.5 thousand tons including 91.4% YFT and 8.6% BYT. Total catch of handline was estimated at 24.1 thousand tons, accounted for 20.09% in total tuna catch (Table 2).

Table 2. Catch of YFT and BYT (tons) exploited in Vietnam water year 2012 and 2014-2015

Year	Gear	YFT	BYT	Total	Proportion (%)
2012	Longline	10.048	3.090	13.138	55,04
	Handline	7.695	3.014	10.710	44,96
Total		**17.743**	**6.105**	**23.849**	**100,0**
Proportion (%)		**74,4**	**25,6**	**100,0**	
7/2014-6/2015	Handline	22.587	1.544	24.132	79,01
	Other (Longline, purse seine, gillnet)	5.399	9.714	6.370	20,09
Total		**27.987**	**2.516**	**30.503**	

Year	Gear	YFT	BYT	Total	Proportion (%)
Proportion (%)		**91,4**	**8,6**	**100,0**	

3. OBSERVER PROGRAM

+ Onboard observer trips conducted by RIMF normally combine surveys and stock assessments to collect additional data on species composition in catches of every gear. In the period of 2000-2018, observer program for tuna fishery was implemented by different projects including:

- Vietnam fishery resources assessment project stage 2 (2000-2005). Onboard observer on longline tuna fishery.
- Biomass assessment and exploiting feasibility of surface fish ("cá nổi") in offshore water of Central and South East (2003-2005). Onboard observer for longline tuna fishery.
- Comprehensive survey on status and fluctuation of fisheries resources in Vietnam water (2011-2015), monitoring program on longline and handline tuna fishery.
- Set up model on forecast catch and related ocean structure to server for offshore fishery in Vietnam water (2006-2008). Monitoring longline tuna fishery.
- Comprehensive survey on marine resources in Truong Sa archipelago water/longline tuna fishery (2001-2003). Monitor longline tuna fishery.
- Study on fishing ground and technology on exploiting tuna for genus *Thunnus albacares*, *Thunnus obesus* to serve for commercial aquaculture (2008-2010). Monitor longline tuna fishery.

- Research on improving quality of forecasting fishing ground in oceanic tuna fishery in Vietnam water (2015-2017). Monitor longline tuna fishery.
- Communication program on reduce by-catch turtles in fishery conducted by WWF-Vietnam and RIMF. Monitor longline fishery and pilot using c-hook in tuna fishery to reduce by-catch species (2009-210).
- Onboard observer program on tuna fishing vessels (2015-2018). Implement supervision on longline and hanline tuna fisheries.

While conducting these observer trips, RIMF staff onboard tuna fishing boats recorded relevant information of fishing operation including: fishing time, gear, location, species composition of catches, number and amount of each species. Caught species were classified according to FAO guideline (W. Fischer & P. J. P. Whitehead 1974; B. B. Collette & C. E. Nauen 1983; L. J. V. Compagno 1984) and other guideline (J. R. Paxton et al. 1989; I. Nakamura & N. V. Parin 1993; Nguyen Huu Phung & Tran Hoai Lan, 1994; Nguyen Huu Phung & Nguyen Nhat Thi, 1994; Nguyen Huu Phung, 1997).

Monitoring trips under the observer program on fishing boats were coordinated by WWF-Vietnam in the period 2009-2018, with observers being staff of sub-Decafires (sub-fishery department now) of Binh Dinh, Phu Yen, Khanh Hoa and Nha Trang University. Before embarking, observers were trained on sampling method, taxonomy, classification of popular species in catches of longline and handline tuna fisheries. During the monitoring program, observers had record fishing operation information including: gear, fishing technique, location, haul amount, species composition, amount and number of each species in a single catch. The guideline on species identification of popular species in tuna fishery is developed by WWF according to FAO guideline.

In the period of 2000-2018, a total of 106 observer trips was conducted on tuna fishing vessels in Vietnam's waters, in which 61 trips were conducted by WWF-Vietnam and 45 trips by RIMF. Among observer trips in the period 2015-

2018, the rate of c-hook was very low as fishermen mainly used j-hooks to catch tuna (

Table 4). The statistics of using j-hook and c-hook in longline and handline tuna fisheries are showed in Table 5. On average in the period of 2015-2018, each hanlined vessels used 8.19 ± 4.82 j-hooks and 1.7 ± 3.25 c-hooks, meanwhile longline vessels used 713.27 ± 203.70 j-hooks and 82.54 ± 96.12 c-hooks. It shows that the replacement rate of j-hooks by c-hooks in tuna fishery is still low.

Table 3. Number of observer trips conducted by RIMF and WWF-Vietnam in the period 2000-2018

Data source/Gear	Year	Number of trips	Conducted by
Project on assessment Vietnam's marine resources stage 2/longline tuna fishery	2000-2002	5	RIMF
Research on biomass and exploiting feasibility of surface water fish in offshore water of Central and South East water/longline tuna fishery	2003-2005	3	RIMF
Comprehensive survey on status and fluctuation of fisheries resources in Vietnam water/ longline (1 trip) and handline (4 trips) tuna fisheries.	2011-2015	5	RIMF
Develop model on forecast catch and marine structure to serve for offshore fishery in Vietnam water/longline tuna fishery.	2006-2008	3	RIMF
Survey on marine resources in Truong Sa archipelago/longline tuna fishery.	2001-2003	4	RIMF
Study on fishing ground and technology on exploiting tuna for genus Thunnus albacares, Thunnus obesus to serve for commercial aquaculture. Monitor longline tuna fishery.	2008-2010	5	RIMF
Communication program on reduce by-catch turtle in fisheries/longline fishing	2009-2010	16	WWF
Onboard observer on tuna fishery vessels/ longline (2 trips) and handline (23 trips)	2015-2016	25	WWF

Data source/Gear	Year	Number of trips	Conducted by
Research on improving quality of forecasting fishing ground in oceanic tuna fishery in Vietnam water.	2015-2017	20	RIMF
Onboard observer program on tuna fishing vessels/longline and hanline fisheries	2017-2018	20	WWF
Total: - **WWF:** - **RIMF:**		**106** **61** **45**	

Table 4. Fishing gears in observer trips on tuna fishing vessels in the period 2015-2018 (x: using; 0: not using; "-": no info)

Gear	Trip code	J-hook	C-hook
Handline	22	0	x
Handline	23	0	0
Handline	24	-	-
Handline	26	-	-
Handline	27	0	x
Handline	31	x	0
Handline	32	x	x
Handline	33	-	-
Handline	34	x	0
Handline	35	-	-
Handline	36	x	0
Handline	37	x	0
Handline	38	x	0
Handline	39	0	x
Handline	40	x	0
Handline	41	x	0
Handline	42	0	x
Handline	43	x	0
Handline	44	x	0
Handline	47	x	0
Handline	48	0	x
Handline	49	x	0
Handline	50	x	0
Handline	51	x	0
Handline	54	x	0

Gear	Trip code	J-hook	C-hook
Handline	55	x	0
Handline	59	x	0
Handline	60	x	0
Handline	62	x	0
Handline	64	x	0
Handline	65	x	0
Handline	66	x	0
Handline	68	x	0
Handline	69	x	0
Handline	70	x	0
Handline	72	x	0
Handline	73	x	0
Handline	75	x	0
Handline	78	x	0
Longline	45	x	0
Longline	46	x	0
Longline	57	x	x
Longline	71	x	x
Longline	76	x	x
Longline	79	x	0

Table 5. Statistics on average number of hooks by type in longline and handline tuna fisheries according to observer data in the period 2015-2018

Hook type	Average (Handline)	Average (Longline)	df	p	N (Handline)	N (Longline)	SD (Handline)	SD (Longline)
J hook	8.19	713.27	707	0,00	590	119	4.82	203.70
C-hook	1.7	82.54	549	0,00	471	80	3.25	96.12

4. BY-CATCH

4.1. Sea turtles

Sea turtles are by-catch species of oceanic tuna fishery. In Vietnam, there are five sea turtle species including: *Chelonia mydas*, *Caretta caretta*, *Lepidochelys olivacea*, *Eretmochelys imbricate* and *Dermochelys coriacea*. Areas in Vietnam's waters where sea turtles are encountered are shown in Figure 2. Four out of five species distributed in Vietnam's waters have been recorded to often lay egg in sandy beaches of mainland and islands including *Chelonia mydas*,

Lepidochelys olivacea, *Eretmochelys imbricate* and *Dermochelys coriacea*. Although technically present in Vietnam water, *Caretta caretta* has never been recorded laying egg in Vietnam's waters.

Today, increases in fishing vessels and fishing efforts are happening in all of Vietnam's waters. Fishing activities are not only affecting target species but also by-catch species. All sea turtle populations in Vietnam have been decreasing over time, in which two species are in the threatened group including *Eretmochelys imbricate and Dermochelys coriacea*, two are in the endangered group including *Chelonia mydas* and *Caretta caretta*. Meanwhile *Lepidochelys olivacea* is in the vulnerable group according to criteria of IUCN on defining ETP species (Table 6).

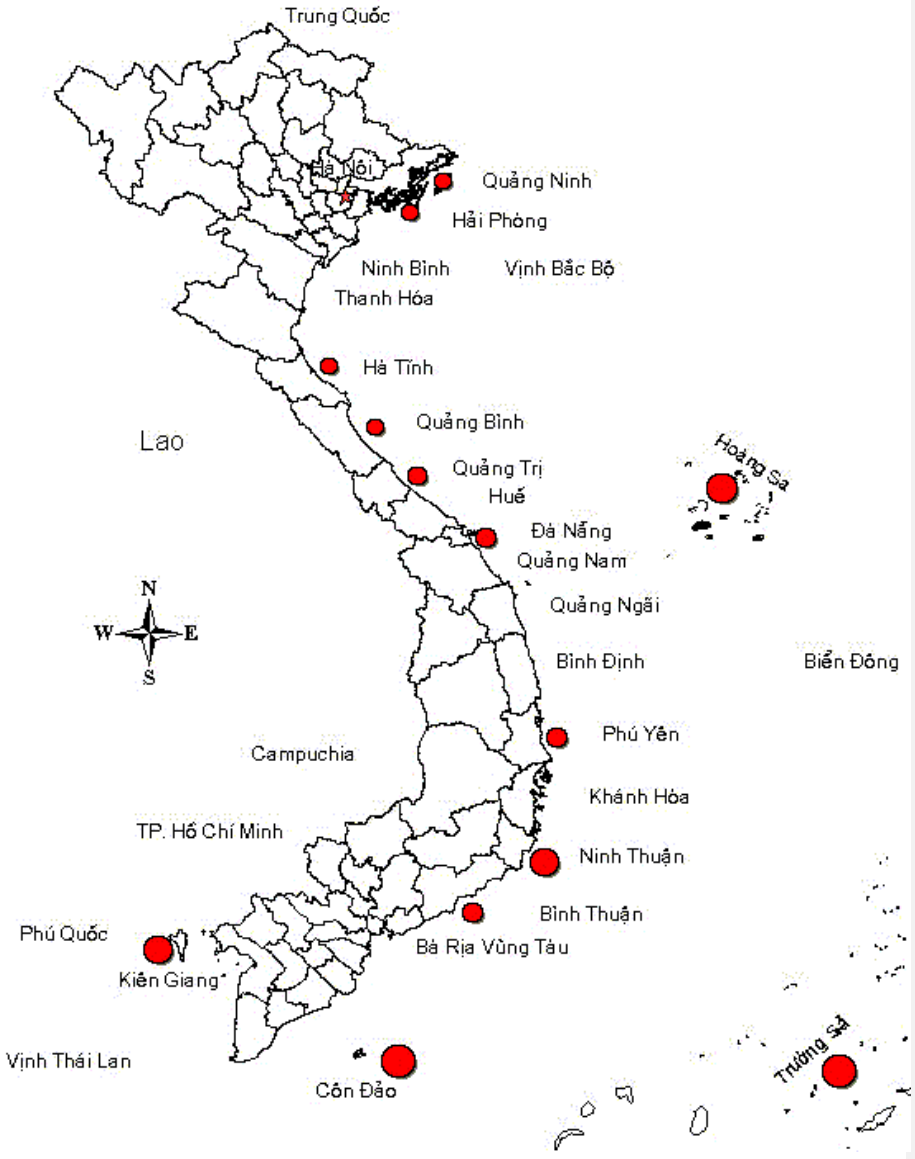

Figure 2. Distribution map of sea turtles in Vietnam's waters

(Source: Fisheries Ministry, 2002)

Table 6. List of sea turtles distribution in Vietnam's waters

Scientific name	Vietnamese name	Status - IUCN
1. *Chelonia mydas*	Vích (Rùa xanh)	Endangered
2. *Eretmochelys imbricata*	Đồi mồi	Threatened
3. *Dermochelys coriacea*	Rùa da	Threatened
4. *Caretta caretta*	Quản đồng	Endangered
5. *Lepidochelys olivacea*	Đồi mồi dứa	Vulranable

In years 2009-2010, WWF-Vietnam and RIMF co-operated to conduct 14 observer trips on tuna fishing vessels in three provinces Binh Dinh, Phu Yen and Khanh Hoa. C-hooks were introduced to tuna fishery to reduce by-catch of sea turtles and marine mammals. The implementation was tested on longline tuna vessels with a rate of 50% j-hooks and 50% c-hooks to assess the effectiveness of catches as well as the reduction of by-catch impact to turtles. The result showed no difference on catch amount between j-hooks and c-hooks ($p > 0.05$), but catch composition was different. C-hooks were more effective with YFT, sharks and marlin. Meanwhile j-hooks were more effective with BYT. Preliminary results showed that c-hooks were more likely to reduce by-catch of sea turtles compared to j-hooks. Eight sea turtle individuals from four species were recorded: 04 *Lepidochelys olivacea*, 01 *Dermochelys coriacea*, 02 *Eretmochelis imbricata* and 01 *Chelonia mydas*. Of these individuals, two turtles died before capture, the remaining six turtles were rescued and released back to the sea by observers and cruise members. During the observer trips that used c-hooks, data analysis showed that the rate of turtles hooked by c-hooks was lower than j-hooks. Seven of eight captured turtles were hooked by j-hooks (accounted for 88%) and one hooked by c-hooks (accounted for 12%) (Vu Viet Ha & Nguyen Van Hai, 2011).

Observer program for tuna fishery coordinated by WWF-Vietnam in the period 2015-2018 had conducted 45 trips (Table 3) and recorded 14 sea turtles from February to July 2017. The rest of the trips in 2017 recorded no sea turtles. Sea turtles hooked or entangled into fishing line were *Lepidochelys olivacea* and

Chelonia mydas. Among by-catch turtles (Table 7), six individuals were entangled into line (42.86%), four turtles were hooked deep in throat (28.57%), three turtles were hooked at mouth (21.43%) and one was hooked outside the mouth (7.14%). After being rescued and released back to the sea, 12 turtles were still confirmed to be alive while two turtles were unknown.

20 observer trips from the study on improving quality of forecasting fishing grounds of tuna fishery in Vietnam's water (conducted by RIMF) recorded two sea turtles. All hooked turtles were rescued, healed and released back to the sea in good condition.

Table 7. Statistics on hooked sea turtles in observer trips from Feb to Jul 2017

Hooked position	**Number of turtle**	**Rate (%)**
Entangled line, flying fish fishing panel	6	42,86
Hooked in deep throat	4	28,57
Hooked at mouth	3	21,43
Hooked outside of mouth	1	7,14
Total	**14**	**100,00**

Areas where sea turtles were encountered in observer trips in the period of 2008-2018 are shown in Figure 3. Among 86 observer trips conducted in this period, 24 turtles were recorded in tuna fishing grounds. The frequency of encountering sea turtles depended on fishing grounds and migration route of sea turtles. The analysis of observer data showed that, Truong Sa archipelago's waters had highest concentration of encountering turtles, especially areas with co-ordinates from 112º00E – 116º00E; 10º00N – 12º00N and 109º00E-110º00E; 7º00N – 8º00N (Figure 3). Hoang Sa archipelago's area and the waters between Hoang Sa and Truong Sa archipelagos overlap with the migration route of sea turtles into Vietnam's waters yet there were few turtles encounters during the observer trips.

Nesting sites of sea turtles are mainly in coastal areas of mainland or islands, while fishing grounds of tuna fishery are offshore water. Therefore, there were no recorded effects of tuna fishery in the nesting sites.

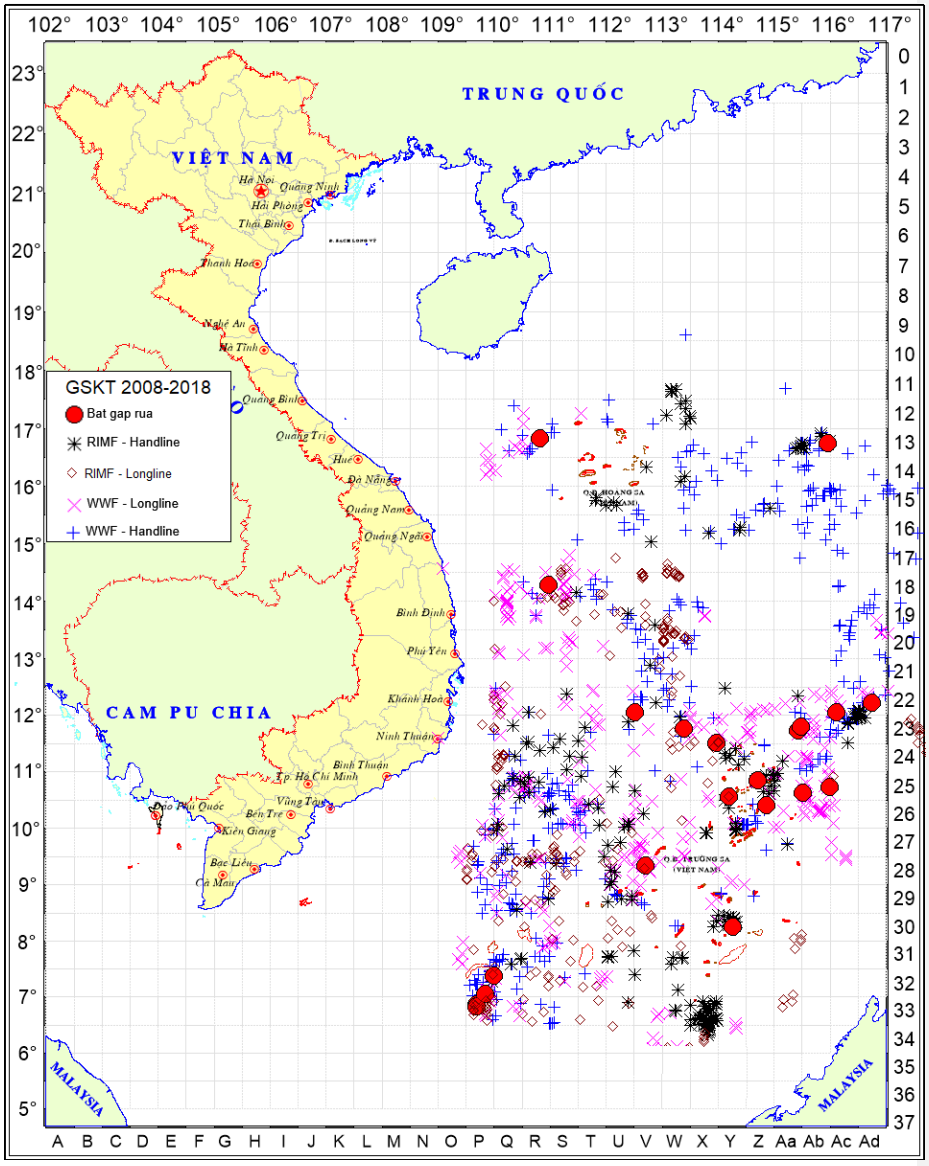

Figure 3. Positions of tuna fishing vessels and positions of turtles encounters based on observer data in the period 2008 – 2018.

4.2. Sharks

Beside BYT and YFT, there are many other species in catches of tuna fishery. A research on marine stock status in the period of 2000-2005 in Vietnam's water using longline, gillnet and trawl (Vu Viet Ha & Tran Van Cuong, 2009) had recorded 38 species of sharks from 23 genera and 16 families. From these numbers, offshore water of Central and South East water recorded 20 shark species from 11 genera and 10 families in catches of gillnet and longline fishing, accounting for 69.5% in total of shark species in Vietnam's waters. Species that were encountered with high frequency in offshore waters of Central and South East were: *Alopias pelagicus*, *Carcharhinus albimarginatus*, *C. amblyrhynchoides*, *C. plumbeus*, *C. sealei*, *Prionace glauca*, *Carcharodon carcharias*, *Pseudocarcharias kamoharai*, *Rhicodon typus*, *Centrophorus granulosus*, *Hemigaleus microstoma*, *Hemiscyllium ocellatum*, *Cephaloscyllium isabellum* and *Squatina japonica*.

Areas of high interaction with sharks in Vietnam's waters based on data of fishery resources survey are shown in Figure 4. For longline fishing, sharks encounters were in offshore waters of Binh Dinh, Phu Yen, Khanh Hoa and Truong Sa archipelago in North East monsoon. In South West monsoon, sharks were sighted more in South West water of Hoang Sa and Truong Sa archipelago but less so in Binh Dinh and Phu Yen waters. Research by Vu Viet Ha and Tran Van Cuong (2009) on distribution of sharks in Vietnam water showed that in sharks were in nearshore waters more in South West monsoon than in North East monsoon (Figure 4).

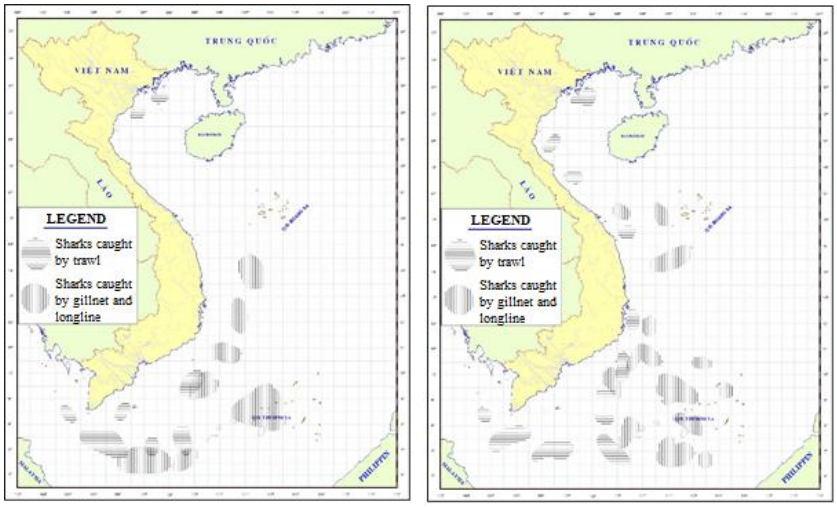

Figure 4. High distribution area of sharks in Vietnam's water based on database from trawl, gillnet and longline from the years 2000-2005. North East monsoon (left); South West monsoon (right) (Vu Viet Ha & Tran Van Cuonng, 2009)

When fishing, fishing vessels normally gather in particular fishing grounds therefore species composition of catches are different among observer trips. Main groups of catches are tuna, sharks, billfish-marlin, pompano dolphinfish, mackerel and other groups. Rate of sharks in catches of tuna fishery varies largely among observer trips. Rate of sharks in longline catches is higher than in handline catches (t-test p = 0.028). Significant fluctuation of shark rate in catches is dues to fleets changing of fishing grounds. Vessels operating in Truong Sa archipelago water had higher catch of sharks than other waters. The observer data indicated that averagely sharks took 2.41% in total catch of handline fishery (Figure 5). The highest recorded rate of sharks in the catch was 16.38% (Table 9). The onboard observer program showed that many fishing trips did not catch shark in handline fishery.

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Table 8. Proportion (%) of groups in catches of observer trips on longline and handline fishing in Vietnam's waters in the period of 2015-2018

Gear	Year	Month	Strip code	billfish + Marlin	Tuna	Sharks	Pompano dolphinfish	Mackerel	Squid	Other	Total
Handline	**2016**	8	22	0,00	0,93	0,00	18,56	4,20	74,01	2,31	100,00
Handline	**2016**	8	23	0,00	100,00	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2016**	8	24	0,00	93,28	0,00	0,00	4,29	0,00	2,44	100,00
Handline	**2016**	8	26	4,39	86,72	4,39	0,00	4,07	0,00	0,44	100,00
Handline	**2016**	8	27	0,00	71,84	16,38	4,96	5,58	0,00	1,24	100,00
Handline	**2015**	10	31	5,56	94,44	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2015**	10	32	4,96	90,95	0,00	4,09	0,00	0,00	0,00	100,00
Handline	**2015**	10	33	10,43	80,44	9,13	0,00	0,00	0,00	0,00	100,00
Handline	**2015**	10	34	0,00	95,09	0,00	4,01	0,90	0,00	0,00	100,00
Handline	**2015**	10	35	0,00	86,71	0,00	0,00	0,00	0,00	13,29	100,00
Handline	**2015**	11	36	18,47	60,62	5,15	0,00	1,22	0,00	14,54	100,00
Handline	**2015**	9	37	0,00	91,54	0,00	5,31	0,00	0,00	3,15	100,00
Handline	**2015**	10	38	0,00	93,50	5,24	0,00	1,26	0,00	0,00	100,00
Handline	**2015**	10	39	15,44	54,05	15,44	9,40	5,66	0,00	0,00	100,00
Handline	**2015**	10	40	0,00	100,00	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2015**	10	41	0,00	100,00	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2015**	1	42	5,69	63,70	0,00	26,87	1,25	0,00	2,49	100,00
Handline	**2015**	1	43	0,00	92,43	0,00	0,00	0,00	7,57	0,00	100,00
Handline	**2015**	1	44	2,22	93,88	0,00	3,80	0,11	0,00	0,00	100,00
Handline	**2015**	1	47	1,08	91,49	0,00	7,16	0,27	0,00	0,00	100,00
Handline	**2015**	1	48	0,00	92,28	0,00	7,72	0,00	0,00	0,00	100,00
Handline	**2015**	1	49	5,52	94,48	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2015**	1	50	0,59	99,41	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2017**	10	51	0,00	97,60	0,00	0,60	0,00	0,00	1,80	100,00
Handline	**2017**	10	54	5,94	83,11	0,00	1,83	4,57	4,57	0,00	100,00

Gear	Year	Month	Strip code	billfish + Marlin	Tuna	Sharks	Pompano dolphinfish	Mackerel	Squid	Other	Total
Handline	**2017**	10	55	0,00	75,76	0,00	11,11	0,00	13,13	0,00	100,00
Handline	**2017**	10	59	0,00	68,29	0,00	24,67	0,00	3,83	3,22	100,00
Handline	**2018**	8	60	20,94	65,83	0,00	1,34	0,00	0,00	11,89	100,00
Handline	**2018**	8	62	0,00	56,52	32,92	5,59	3,11	0,00	1,86	100,00
Handline	**2017**	10	64	0,00	100,00	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2017**	10	65	1,93	92,07	0,00	5,07	0,00	0,00	0,93	100,00
Handline	**2018**	8	66	2,47	78,77	0,00	16,54	1,23	0,99	0,00	100,00
Handline	**2018**	8	68	0,00	62,56	0,00	3,08	4,50	28,26	1,61	100,00
Handline	**2017**	10	69	0,00	70,11	0,00	24,14	0,00	5,75	0,00	100,00
Handline	**2018**	7	70	0,00	99,25	0,00	0,00	0,75	0,00	0,00	100,00
Handline	**2018**	7	72	3,98	79,84	0,00	0,00	1,82	14,03	0,33	100,00
Handline	**2017**	10	73	0,00	100,00	0,00	0,00	0,00	0,00	0,00	100,00
Handline	**2017**	10	75	2,41	96,21	0,00	0,00	1,38	0,00	0,00	100,00
Handline	**2017**	10	78	0,00	88,20	5,46	0,00	1,31	0,00	5,03	100,00
Longline	**2015**	1	45	20,65	69,79	0,00	0,00	9,56	0,00	0,00	100,00
Longline	**2015**	1	46	19,01	68,93	0,00	2,52	4,60	0,00	4,93	100,00
Longline	**2017**	3	57	3,19	1,50	93,96	0,00	0,00	0,00	1,34	100,00
Longline	**2017**	2	71	18,98	67,18	5,33	0,14	5,33	0,00	3,04	100,00
Longline	**2017**	3	76	30,86	60,77	0,00	0,00	2,20	0,00	6,17	100,00
Longline	**2017**	2	79	18,26	68,37	0,22	0,00	0,00	0,00	13,15	100,00

Tuna longline fishery's recorded average rate of sharks in catches was 16.59% (Table 9, Figure 5). The observer trip in October 2017 recorded the highest rate of sharks in catches with 94% in total catch. Data from observer program also recorded many fishing trips had no shark in catches.

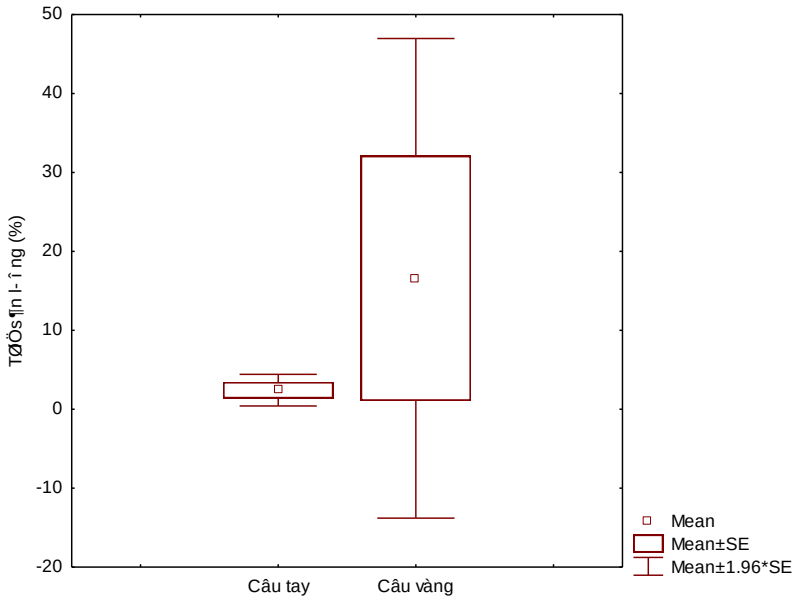

Figure 5. Proportion of sharks in catches of tuna handline and longline fisheries

In many observer trips, observers noted that most fishing vessels did not use c-hooks but instead used j-hooks. Normally catches in Vietnam are not classified as species, but rather divided into groups with Vietnamese names, so there was little information on species composition in catches.

Table 9. Proportion of sharks in total catches of longline and handline tuna fisheries according to data of observer program in the period of 2015-2018 by WWF-Vietnam

Gear	Year	Month	Lowest (%)	Medium (%)	Highest (%)	N	SD
Handline	2015	1	0,00	0,00	0,00	7,00	0,00
		9	0,00	0,00	0,00	1,00	-
		10	0,00	3,31	15,44	9,00	5,60
		11	5,15	5,15	5,15	1,00	-
	2016	8	0,00	4,15	16,38	5,00	7,09
	2017	10	0,00	0,55	5,46	10,00	1,73
	2018	7	0,00	0,00	0,00	2,00	0,00
		8	0,00	8,23	32,92	4,00	16,46
	Average		0,00	2,41	32,92	39,00	6,39
Longline	2015	1	0,00	0,00	0,00	2,00	0,00
	2017	2	0,22	2,77	5,33	2,00	3,61
		3	0,00	46,98	93,96	2,00	66,44
	Average		0,00	16,59	93,96	6,00	37,97

Onboard observers recorded sizes of caught sharks in catches from largest to smallest for some identifiable species. The rest were recorded in Vietnamese name or noted generally as shark so it was not clear what species they were. The result of weighing and measuring of some sharks in observer trips is shown in Table 10. In the years 2015-2018, the number of caught sharks was 65 by j-hook fishing, 8 by c-hook fishing and 4 from unclear hook type. All were weighed and measured.

Of these numbers, hammer sharks and long-tail sharks were the most frequently weighed. The average size of hammer sharks caught by j-hooks was 116 ± 72 cm, with biggest of 280 cm (n=20). The average size of long tail sharks caught by J-hook was 198.9 ± 55.5 cm with biggest of 320 cm (n=19). For c-hooks, only three long-tail sharks were classified and weighed. The biggest size was 320 cm with average size of 296.5 ± 33.2 cm (n=3). Three long-tail big-eye sharks were classified and weighed, including two sharks caught by j-hook and one caught by c-hook with biggest size of 164 cm (Table 10).

Table 10. Average size (cm, kg) of some shark species in catches of tuna fishery

Hook type/fish species	**Length (cm)**			**N**
	Average	**Biggest**	**Standard deviation**	
C hook				**8.0**

Alopias pelagicus	296.5	320.0	33.2	3.0
Alopias superciliosus	150.0			1.0
Prionace glauca	191.8	206.0	16.0	4.0
J-hook				**65.0**
Alopias pelagicus	198.8	320.0	55.5	19.0
Alopias superciliosus	158.0	164.0	8.5	2.0
Prionace glauca	191.7	267.0	50.9	7.0
Sphyrna lewini	116.0	280.0	72.6	20.0
Unclear hook type				**4.0**
Alopias pelagicus	317.0	320.0	4.2	2.0
Prionace glauca	231.5	275.0	61.5	2.0

Baits used in tuna fishery are squid and flying fish. Statistics on frequency of used bait in observer trips in the years 2009 and 2015-2018 showed that 99.5% of fishing hauls used squid as bait. In bait composition, proportion between main bait (squid) and sub bait (flying fish or undefined fish) was 90% squid and 10% fish.

In longline fishery, proportion of fishing haul using squid was 46.71% and using flying fish was 41.88%. Proportion between main bait as quid and/or flying fish and sub bait as undefined fish was 72.3% and 97.8%, respectively (Table 11). Beside squid and flying fish used as main bait, there were other small fish such as mackerel scads and moonfish which were rotationally used at small proportions.

Table 11. Bait in tuna fishery in the period 2009, 2015-2018 according to observer program

Gear/bait type	No of samples	Proportion (%)	Rate of main and sub bait (%)
Handline	1107,0	100,00%	89,9
Fish	5,0	0,45%	70,0
Squid	1102,0	99,55%	90,0
Longline	1034,0	100,00%	85,5
Fish	40,0	3,87%	98,0
Flying fish	433,0	41,88%	97,8
Squid	483,0	46,71%	72,3
Flying fish + Largehead hairtail	78,0	7,54%	-

In monitoring trips on tuna fishing vessels, supervisors recorded little information on pre-treatment and preservation of sharks. There was almost no information on fins separation of sharks on boats in tuna fishery. Accessing information from 65 observer trips on tuna fishing vessels in the period of 2015-2018 conducted by RIMF and WWF indicated that only one observer trip recorded information on fin separation, discard or retention of shark body as bait on boat numbered PY 96262 TS in Phu Yen province. This fishing trip took place in March 2017 at South fishing ground of Truong Sa archipelago. Catch of sharks was not recorded in details, with only information on fins cutting and body discard during fishing trip.

5. RECOMENDATONS

The rate of encountering sea turtles recorded from longline and handline oceanic tuna fisheries in Vietnam in the period of 2015-2018 was low: only two out of 45 observer trips in this period recorded turtles in the catch.

The frequency of interaction with sea turtles in tuna fishery depended on fishing grounds: Truong Sa archipelago had the most interaction with turtles than other waters.

Rate of sea turtles entangled in fishing lines or in flying fish net was the highest, next was hooked deep in throat, hooked inside then outside of the mouth.

The main bait of handline was squid, of longline was squid and fish. Besides that, smaller fish species were used as bait at very low proportion.

The proportion of sharks in total catch of oceanic tuna fisheries largely varied among surveys and depended on gears and fishing grounds. Sharks in catches of longline fishery were normally higher than in handline fishery. Observer program also recorded a lot of fishing trips that had no sharks in catches.

The observer data in the period of 2015-2018 only recorded fish in different groups but not classified as species. Therefore information on secondary and by-catch species was very limited.

Basic biological information like sizes and weights of caught sharks were noted in some trips conducted by RIMF, for species including long-tail shark, long-tail big-eyes shark, hammer shark and green shark. Other biological and ecological information of other sharks species was not recorded in onboard observer trips.

REFERENCES

Commented [VTB3]: Dịch tiếng Anh

Vũ Việt Hà & Trần Văn Cường (2009). "Thành phần loài, phân bố và trữ lượng nguồn lợi cá nhám ở biển Việt Nam." Tạp chí Nông nghiệp và Phát triển Nông thôn Số 9/2009: 58-66.

Vũ Việt Hà, Trần Văn Cường, Nguyễn Văn Hải, Nguyễn Hoài Nam, Mai Văn Điện, Trần Văn Thanh & Nguyễn Văn Minh (2010). Đánh giá biến động nguồn lợi

và Gear cá thông qua các nguồn số liệu điều tra, giám sát và thống kê Gear cá thương phẩm giai đoạn 1996-2009. Báo cáo Total kết hoạt động 2.6.28. Dự án Hợp phần Tăng cường quản lý khai thác thủy sản (SCAFI): 163 trang.

Vũ Việt Hà & Nguyễn Văn Hải (2011). "Bước đầu so sánh hiệu quả của việc sử dụng lưỡi câu vòng và lưỡi câu thường trong khai thác nguồn lợi cá nổi ở biển Việt Nam. ." Tạp chí khoa học và công nghệ biển 1(11): 73-84.

Nguyễn Hữu Phụng (1997). Danh mục cá biển Việt Nam, Tập 4: Bộ cá Vược (Perciformes), tiếp từ bộ phụ cá bàng chài (Labridae) đến bộ phụ cá chim trắng (Stromateoidei), Nhà xuất bản Khoa học và Kỹ thuật Hà Nội.

Nguyễn Hữu Phụng & Trần Hoài Lan (1994). Danh mục cá biển Việt Nam, Tập 1: Lớp cá lưỡng tiêm (Amphioxi) và lớp cá sụn (Chondrichthyes), Nhà xuất bản Khoa học và Kỹ thuật Hà Nội.

Nguyễn Hữu Phụng & Nguyễn Nhật Thi (1994). Danh mục cá biển Việt Nam, Tập 2: Lớp cá xương (Osteichthyes) từ bộ cá cháo biển (Elopiformes) đến bộ cá đối (Mugiliformes), Nhà xuất bản Khoa học và Kỹ thuật Hà Nội.

Đào Mạnh Sơn (2005a). "Nghiên cứu trữ lượng và khả năng khai thác cá nổi lớn ở vùng biển xa bờ miền Trung và Đông Nam Bộ." Báo cáo Total kết đề tài cấp bộ. Viện Nghiên cứu Hải sản, Hải Phòng.

Đào Mạnh Sơn (2005b). "Nghiên cứu, thăm dò nguồn lợi hải sản và lựa chọn công nghệ khai thác phù hợp phục vụ phát triển Gear cá xa bờ Việt Nam." Tuyển tập các công trình nghiên cứu Gear cá biển. Tập 3, trang 133-188. Nhà xuất bản Nông nghiệp Hà nội.

B.B. Collette & C.E. Nauen (1983). Scombrids of the world. An annotated and illustrated catalogue of tunas, mackerels, bonitos and related species known to date, Vol. 2. . FAO Fisheries Synopsis. Rome

L.J.V. Compagno (1984). FAO species catalogue. Vol. 4. Sharks of the world. An annotated and illustrated catalogue of sharks species known to date, Vol. 4. FAO. ROME

W Fischer & P. J. P. Whitehead, Eds. (1974). FAO species identification sheets for fisheries purpose. Eastern Indian Ocean (fishing area 57) and Western Cetral Pacific (fishing area 71). Volume 1. ROME, FAO.

I. Nakamura & N.V. Parin (1993). Snake mackerels and cutlassfishes of the world (families Gempylidae and Trichiuridae). An annotated and illustrated catalogue of the snake mackerels, snoeks, escolars, gemfishes, sackfishes, domine, oilfish, cutlassfishes, scabbardfishes, hairtails, and frostfishes known to date, Vol. 15. . FAO Fish. Synop. 125(15):136 p. Rome

J.R. Paxton, D.F. Hoese, G.R. Allen & J.E. Hanley (1989). Pisces. Petromyzontidae to Carangidae. Zoological Catalogue of Australia, 7. Australian Government Publishing Service, Canberra.

Vũ Việt Hà & Nguyễn Viết Nghĩa (2013). Báo cáo tổng hợp hiện trạng nguồn lợi hải sản ở vùng biển xa bờ giai đoạn 2011-2012, Viện Nghiên cứu Hải sản: 43 trang.