



# Non Target Species Report 2017

**The Gulf of Mannar Blue Swimming Crab Fishery**

*A sub project of the Sri Lankan blue swimming crab fishery improvement proje*



## Field Report

Updated on 27<sup>th</sup> March 2017

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## Executive Summary

To understand the impact of Blue Swimming Crab fishery on Non target species series of studies have been done in related to Gulf of Mannar and Palk Bay fishery in Sri Lanka. Five studies were done in Gulf of Mannar fishery from January 2016 to March 2017 by covering three major BSC landing centres known as Anawasala, Bathalangunduwa (Puttalam district) and Thalvupadu (Mannar District).

Total number of 557 (13.65mt) catches were recorded and 55.1% (7.5mt) from total catch were other captured species. A total of 135 NTS were provisionally identified in the Gulf of Mannar fishery using the FAO UN Species Identification for Fisheries Purposes Fish Key, posters for Sri Lankan marine molluscs, reference books and the internet. 79 of the NTS identified were finfish. The next most common class of NTS were molluscs (24), crustaceans (20), echinoderms and others (11) and reptiles (1). (Annex A) No birds or mammals were observed in the catch of 557 BSC fishermen assessed at five landing centres between January 2016 and March 2017.

Two ETP species (according to Appendix 1 of the Convention on International Trade in Endangered Species (CITES)) were recorded from Palk Bay fishery and they are observed below a negligible and or sporadic level ( $\geq 0.5\%$  of the TC). One Out of Scope species were recorded and no turtles, seabirds or dugongs were recorded in the study period. One primary species was recorded and the percentage weight from total catch does not exceed more than 2% (for less resilient species) or 5% (for resilient species) based on MSC guidelines for resilience. Three Secondary Main species were recorded which was weight percentage more than 5% from total catch. All the main species were analysed by using the PSA method described in Marine Stewardship Council (MSC) 2014.



## A. Non Target Species Studies in the Gulf of Mannar Fishery

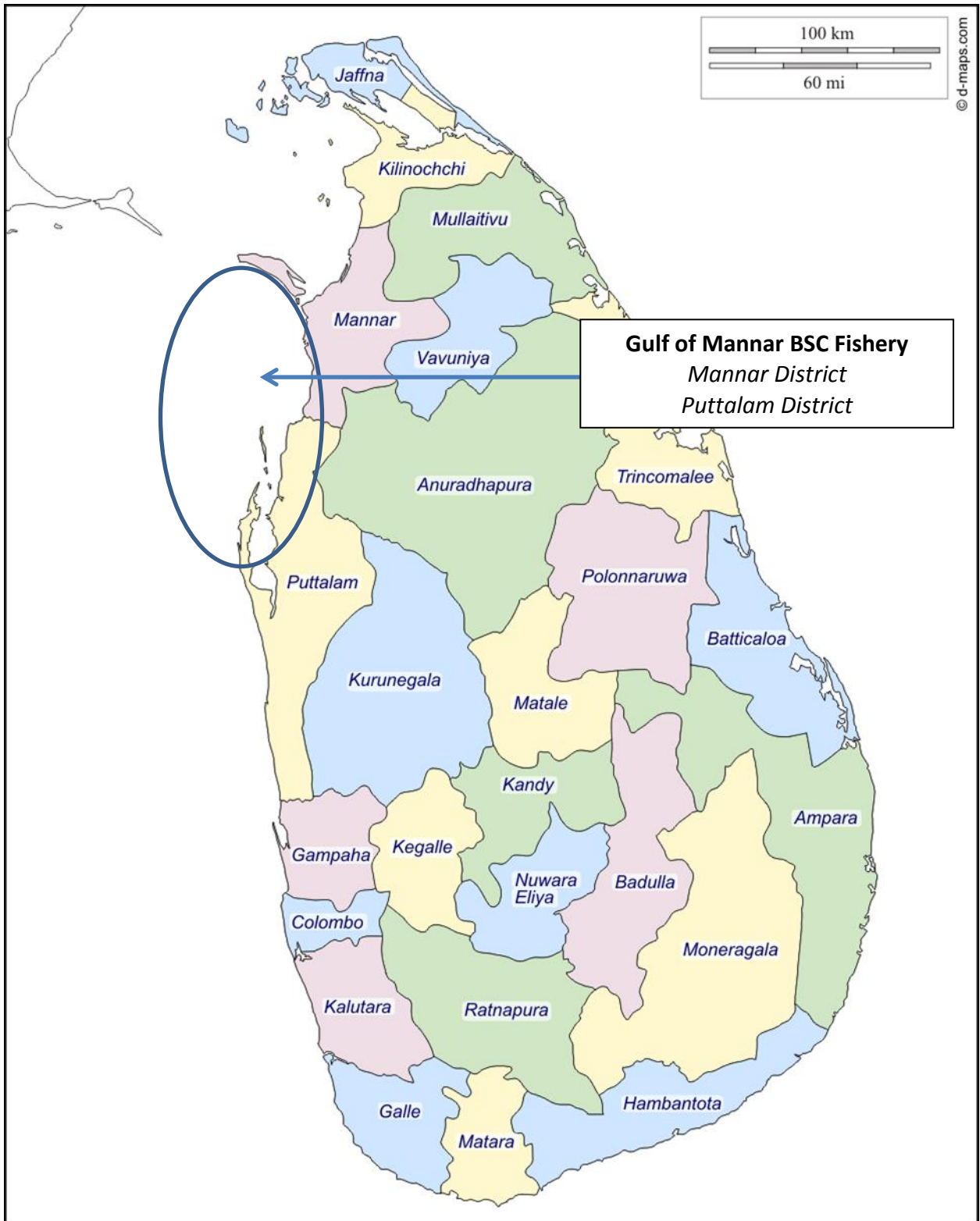
The BSC fishery in the Gulf of Mannar is very similar to the coastal, near shore day fishery found in the Palk Bay. The fishery in the Gulf of Mannar differs from the fishery in the Palk Bay in that a portion of fishermen in the Gulf of Mannar fishery harvest BSC within the confines of the Puttalam Lagoon: a shallow (<5 m) bar built estuary over 50 km in length. Small scale fishermen also use bottom-set crab nets with mesh sizes ranging from 3½” to 6” (88.9 mm - 152. 4 mm) in the Gulf of Mannar fishery. The height, shape and length of the nets is much the same as in the Palk Bay fishery. The nets are lightly floated, designed to catch crabs swimming with one to two feet of the sea bed. The same operating system applies in the Gulf of Mannar fishery. Bottom-set crab nets are laid in the evening (≈ 5pm) and hauled the next morning (≈6 am) at a distance of ≈1 km ≈ 10 km from the shore (REF). Fishermen deploy nets from non-motorised and motorised, traditional and FRP boats. Two districts in the North Western and Northern Province, namely Puttalam and the southern coast of Mannar District, are located adjacent to the Gulf of Mannar fishery (see map below).

According to a field survey conducted by the Department of Fisheries and Aquatic Resources (DFAR) in 2015 (DFAR 2015), a total of over 6,123 fishermen from the 36 fish landing sites were reportedly targeting BSC either on a full time or part time basis (see Table 1). However it should be noted that this survey did not assess the number of Fishery Inspector Divisions, landing centres from which fishermen harvest BSC in the Gulf of Mannar. The FIP is currently in the process of cross checking and updating this information. Between January 2013 and September 2016, the TSF sourced 17% of its raw materials from the Gulf of Mannar fishery in Puttalam District.

**Table 1 Overview of the BSC fishery in the Gulf of Mannar <sup>1</sup>**

District	No. FI divisions	No. landing sites	Resident		Migrant	
			Fulltime	Part-time	Fulltime	Part-time
Puttalam	07	36	6,123	694	178	40
Mannar	NA	NA	NA	NA	NA	NA
<b>Total</b>	<b>07</b>	<b>36</b>	<b>6,123</b>	<b>694</b>	<b>178</b>	<b>40</b>

<sup>1</sup> Technical report on Survey of Fishing Effort for Sri Lankan Blue Swimming Crab in the Northwest and Northern Coast of Sri Lanka and Development of a Management Plan. 2015. DFAR, New Secretariat, Maligawatte, Colombo 10, Sri Lanka



**Figure 1: Blue Swimming Crab Fishing area of Gulf of Mannar**



### Field Surveys

To better understand the impact of BSC fishing on OCS in the Gulf of Mannar fishery a series of Other Capture Species (OCS) studies were designed and implemented with assistance from the FIP over period 20 months between January 2016 and March 2017. The initial research programme in the fishery was conducted independently by an undergraduate student from Ocean University (see below). Thereafter replication of the OCS studies in other landing centres in each fishery was completed by the same student after graduating from Ocean University; working as a Research Assistant for the SLBSC FIP. A brief description of the OCS conducted in each fishery is given below

In January 2016 Eranga Gunasekera an undergraduate student from Ocean University, commenced the first scientific study of OCS associated with the BSC fishery in the Gulf of Mannar. Eranga assessed the catch of BSC fishermen at a landing centre in Anawasala, Puttalam District in the Northern Western Province. Eranga used the same simple alphanumeric field key and photographs developed earlier by Wathsala in the Palk Bay fishery, to identify OCS in BSC fishermen's catch. New codes were added for OCS not observed in the Palk Bay study. Eranga submitted her final year dissertation in August 2016. She was supervised by Dr. M. F. M. Fairoz<sup>2</sup>, Senior Lecturer, Department of Oceanography and Marine Science.

As noted above, Eranga joined the FIP as a research assistant thereafter (in July 2016). A young man from the fishing community in Anawasala (Charles) was subsequently trained to conduct independent assessments of OCS, using the OCS codes and quantitative field data sheets developed by the Wathsala and Eranga with support from the FIP. Eranga and Charles conducted a further four field studies to assess the impact of the BSC fishing on OCS in the Gulf of Mannar, at landing centres in Puttalam District (thrice) and Mannar District (once) between January 2016 and March 2017, as shown in see Table 2.

**Table 2 NTS Studies completed in the Gulf of Mannar 2016 – 2017**

Survey	Lead Researcher	Institution	District	Landing Centre	Mesh Size
JAN – MAR '16	E. Gunasekera	OU	Puttalam	1. Anawsala	4½"
AUG '16	E. Gunasekera	FIP	Puttalam	2. Anawsala	4½"
OCT '16	Charles	FIP	Puttalam	3. Baththalanguduwa I	5" & 6"
JAN '17	Charles	FIP	Puttalam	4. Baththalanguduwa II	5" & 6"
MAR '17	E. Gunasekera	FIP	Mannar	5. Thalvupadu	4½" & 5"

<sup>2</sup> fairoz.mfm@gmail.com



## B. Non-Target Species Survey Results

### Catch Data

A summary of the catch landed by fishermen targeting BSC at five landing centres in the Gulf of Mannar is presented in Table 3. OCS caught along with BSC at five landing centres in the Gulf of Mannar was studied over a period of 58 days. A total of 557 catches landed by BSC fishermen were assessed. On average 9.6 catches were assessed every day.

The total catch (TC) landed by 557 fishermen was 13.65 mt. The lowest total catch was landed at the second survey on Baththalangunduwa (2) (Puttalam District), where fishermen were not very cooperative with the field collection team. BSC comprised 44.9% of the TC (6.13 mt), ranging from 36.7% at Baththalangunduwa (2) (Puttalam District), where fishermen were targeting both BSC and small rays using larger mesh bottom-set crab nets (6") to 61.8% at Thalupaddu (Mannar District).

OCS comprised 55.1% of the TC (7.51 mt), ranging from 38.2% at Baththalangunduwa (2) (Puttalam District) to 63.4 at Baththalangunduwa (1) (Puttalam District). 7.6% of the TC (1.04 mt) was discarded. The remaining OCS (47.4% / 6.48 mt) was retained. For the fishery overall 12,609.92 mt of the catch landed by fishermen was retained (i.e., BSC + Retained OCS), equivalent to 92% TC.

The average TC for small scale BSC fishermen in the Gulf of Mannar was 24.5 kg, ranging from 14.25 in Anawasala (Puttalam District) to 47.68 at Baththalangunduwa (2) (Puttalam District). The average BSC catch was 11.01 kg per day, with OCS comprising the balance 13.49 kg. The average bycatch from the BSC fishery in the Gulf of Mannar was 1.86 kg per boat, per day.



**Table 3 A summary of the catch landed by fishermen targeting BSC at five landing centres in the Gulf of Mannar**

District	02		Puttalam		Puttalam		Puttalam		Puttalam		Mannar	
Field Study	05		ANA-1		ANA-2		BATH-3		BATH-4		THALU-5	
Landing Centres	4											
No. Days	58		20	34%	11	19%	17	29%	5	9%	5	9%
No. Samples / Net Sets	557		182	33%	155	28%	126	23%	13	2%	81	15%
Av. Samples / day	9.6		9.1		14.1		7.4		2.6		16.2	
<b>Total Catch</b>	<b>13,648.52</b>		<b>2,594.37</b>		<b>2,557.27</b>		<b>6,007.85</b>		<b>352.18</b>		<b>2,136.85</b>	
<b>Total BSC Catch</b>	<b>6,134.68</b>	44.9%	<b>1,309.03</b>	50.5%	<b>1,359.60</b>	53.2%	<b>2,207.50</b>	36.7%	<b>217.80</b>	61.8%	<b>1,040.75</b>	48.7%
<b>Total OCS Catch</b>	<b>7,513.83</b>	55.1%	<b>1,285.33</b>	49.5%	<b>1,197.67</b>	46.8%	<b>3,800.35</b>	63.3%	<b>134.38</b>	38.2%	<b>1,096.10</b>	51.3%
<b>Bycatch</b>	<b>1,038.60</b>	7.6%	<b>88.62</b>	11.1%	<b>212.97</b>	8.3%	<b>330.72</b>	5.5%	<b>90.65</b>	25.7%	<b>115.65</b>	5.4%
<b>Retained</b>	<b>6,475.23</b>	47.4%	<b>996.71</b>	38.4%	<b>984.70</b>	38.5%	<b>3,469.64</b>	57.8%	<b>43.73</b>	12.4%	<b>980.45</b>	45.9%
<b>Average TC</b>	<b>24.50</b>		<b>14.25</b>		<b>16.50</b>		<b>47.68</b>		<b>27.09</b>		<b>26.38</b>	
Av. BSC	11.01		7.19		8.77		17.52		16.75		12.85	
Av. OCS	13.49		7.06		7.73		30.16		10.34		13.53	
Av. Bycatch	1.86		1.59		1.37		2.62		6.97		1.43	
Av. Retained	11.63		5.48		6.35		27.54		3.36		12.10	



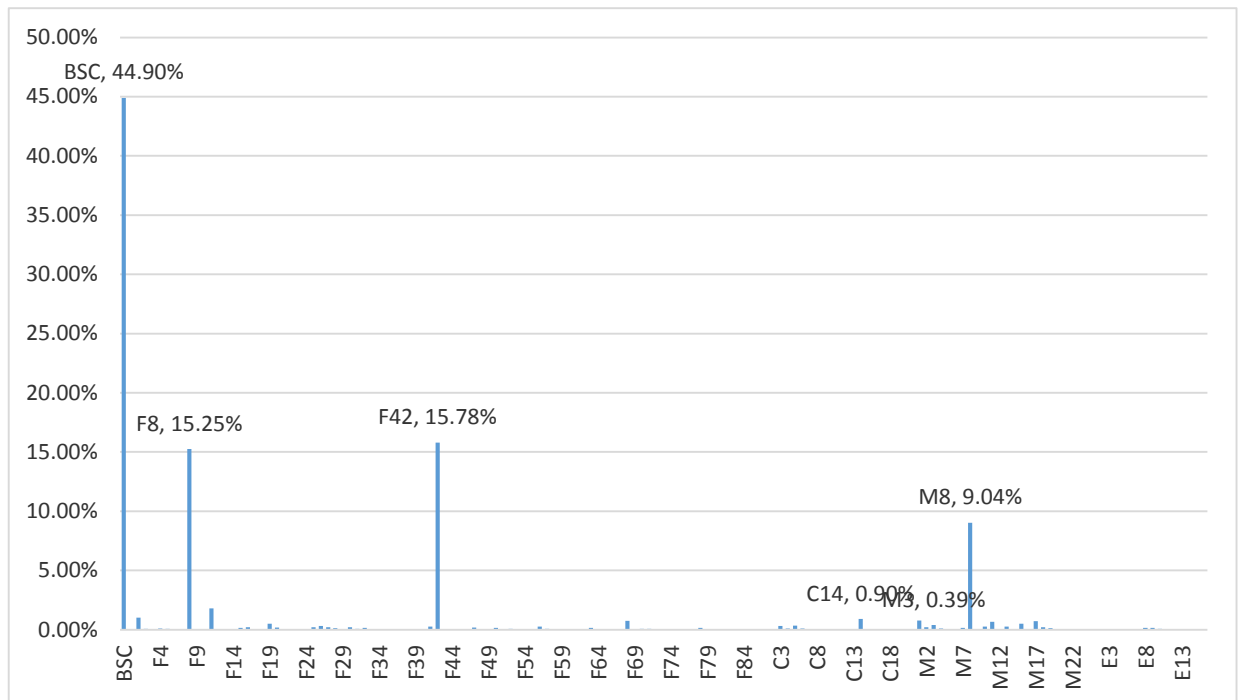


### NTS Data

A total of 135 NTS were provisionally identified in the Gulf of Mannar fishery using the FAO UN Species Identification for Fisheries Purposes Fish Key, posters for Sri Lankan marine molluscs, reference books and the internet (see Table 4). 79 of the NTS identified were finfish. The next most common class of NTS were molluscs (24), crustaceans (20), echinoderms and others (11) and reptiles (1). No birds or mammals were observed in the catch of 557 BSC fishermen assessed at five landing centres between January 2016 and March 2017.

**Table 4 Summary of the NTS recorded from 535 BSC catches sampled in the Gulf of Mannar**

Class	No.	Category of Non-Target Species			
		ETP	Out of Scope	Primary	Secondary
Finfish <sup>3</sup>	79	02	00	00	77
Crustaceans	20	00	00	01	19
Molluscs	24	00	00	00	24
Echinoderms <sup>4</sup> +	11	00	00	00	11
Reptiles	01	00	01	00	00
Birds	00	00	00	00	00
Mammals	00	00	00	00	00
Totals	135	02	01	01	131



**Figure 2 Weight (kg) of each NTS observed in the bycatch from the BSC fishery in the Gulf of Mannar**

<sup>3</sup> Includes bony fish, sharks and rays

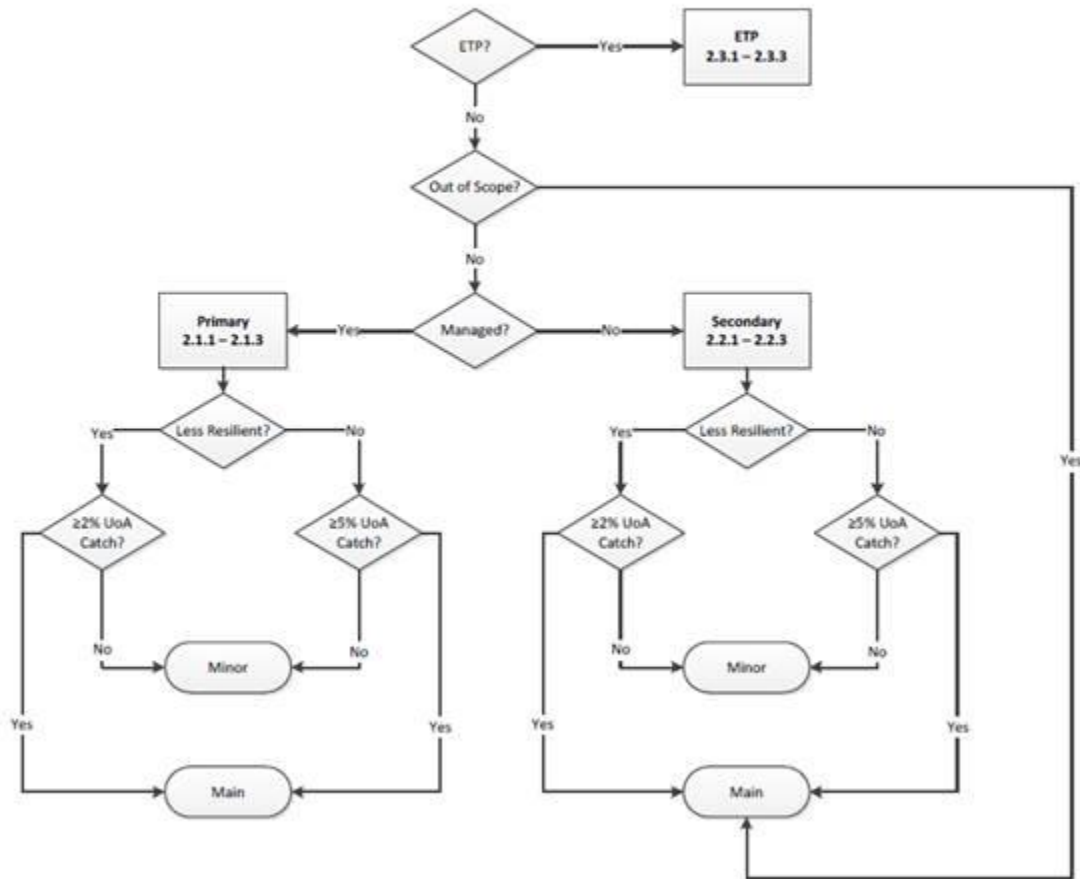
<sup>4</sup> Includes sea urchins, starfish, brittlestars, sea anemones, sea cucumbers, featherstars and jelly fish

### C. Non Target Species Analysis

Data were analysed by using the Marine Stewardship Council’s (MSC) Fishery Assessment Methodology - Principle 2 (Ecological Impacts of a Fishery). Endangered, Threatened and Protected (ETP) species, Out of Scope species, Primary and Secondary non-target species were identified in accordance with MSC guidelines (MSC, 2014). Thereafter NTS under each category (i.e., ETP, Out of Scope, Primary Major / Minor and Secondary Major / Minor) were analysed according to MSC Principle 2 decision tree for ‘Main’ and ‘Minor’ species (Figure 1)

The decision tree outlined in [Figure GSA4](#) provides an overview of the intent of the separation between primary, secondary and ETP species. Teams may use the decision tree as a guide on the designation of P2 species, but should primarily be guided by the definitions of ‘primary’, ‘secondary’, ‘ETP’ and ‘less resilient’ in the FCR and GFCR.


Figure GSA4: Decision tree to assist teams in the designation of P2 species components





## ETP Non Target Species

**Definition:** Species that are recognised by national ETP legislation (MSCP2, SA3.1.5.1) and species listed in following binding international agreements (MSCP2, SA3.1.5.2)

- Species that are recognised by national ETP legislation;
- Species listed in the binding international agreements given below: 
  - a. Appendix 1 of the Convention on International Trade in Endangered Species (CITES), unless it can be shown that the particular stock of the CITES listed species impacted by the UoA under assessment is not endangered.
  - b. Binding agreements concluded under the Convention on Migratory Species (CMS), including:
    - i. Annex 1 of the Agreement on Conservation of Albatross and Petrels (ACAP);
    - ii. Table 1 Column A of the African-Eurasian Migratory Waterbird Agreement (AEWA);
    - iii. Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS);
    - iv. Annex 1, Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS);
    - v. Wadden Sea Seals Agreement;
    - vi. Any other binding agreements that list relevant ETP species concluded under this Convention

ETP in the Bycatch of the Gulf of Mannar Fishery							
SLN	Other Capture Species	Conservation Status	No.	Per Catch	Total (kg)	% Total Catch	Status
F59	Great hammerhead	CITES	2	0.00	0.55	0.00%	Main
F69	Hedgehog seahorse	CITES	1	0.00	0.00	0.00%	Main

02 endangered species were identified in the bycatch from the Gulf of Mannar fishery (see below) according to Appendix 1 of the Convention on International Trade in Endangered Species (CITES). All of those species were observed below a negligible and or sporadic level ( $\geq 0.5\%$  of the TC) and therefore deemed likely to significantly contribute to a conservation concern.



## Out of Scope Species

**Definition:** Amphibians, reptiles, birds and mammals that are not listed in the IUCN Red List as Near Threatened (NT) , Vulnerable (VU), Endangered (EN) or Critically Endangered (CE) (MSC P2,SA3.1.5.3)

**Marine Reptiles:** One reptile the hook-nosed sea snake (*Enhydrina schistose*) was observed in the bycatch of the BSC fishery in the Gulf of Mannar (see Annex A). Three individuals were caught during the 58 day survey period, irregularly (0.01 per catch) and a negligible and or sporadic level (0.04% of the total catch. The conservation status of the hooked-nosed sea snake is Least Concern s).

SLN	Non Target Species	No.	Per Catch	Total (kg)	% Total Catch	Status
OS1	Hook-nosed Seasnake	03	0.01	5.16	0.04%	Main

Six turtle species are commonly found in Sri Lankan waters (see Annex C). No turtles were observed in the catch landed by 557 BSC fishermen at five landing centres in the Gulf of Mannar conducted between January 2015 and March 2017 (58 days).

No incidents of turtles interacting with bottom-set crab nets were reported by fishermen BSC landing centres surveyed in Mannar or Puttalam in May 2017

**Seabirds:** No seabirds were observed in the bycatch of the BSC fishery in the Gulf of Mannar Fishery

**Marine Mammals:** No dugongs (dugong dugon) were observed in the catch landed by 557 BSC fishermen at five landing centres in the Gulf of Mannar conducted between January 2015 and March 2017 (58 days).

## Primary Non Target Species

Species where management tools and measures are in place, intended to achieve stock management objectives reflected in either limit or target reference points (MSC P2, SA3.1.3.3)

The only one species which has management tools and measures in the bycatch of the Palk Bay is Spiny legged lobster(Liyanage and Long,2009; [www.intrafish.com](http://www.intrafish.com)) and the percentage weight of the Spiny legged lobster from total catch does not exceed more than 2% (for less resilient species) or 5% (for resilient species) based on MSC guidelines for resilience.

Low reproductive rate (Dayton *et al.*, 1995), life history traits such as late or moderate age of maturity, low fecundity and slow growth rate are the characters of species with low resilience for fishing mortality (e.g. Most Shark species, Rock fish, some rays). Low resilience to fishing implies that these species are more susceptible to overfishing (Barker and Schluessel, 2004).

The Productivity analysis for Longlegged spiny Lobster was done according to the MSC guidelines.

### Long-legged spiny lobster (C19)

<b>SLBSC FIP Species Code</b>	C19					
<b>Species Name</b>	Longlegged spiny lobster					
<b>Scientific Name</b>	<i>Panulirus longipes</i>					
<b>Local Names</b>	Pokirissa (S), Singi (T)					
<b>Conservation Concern</b>	Least Concern					
<b>NTS Status</b>	<b>Primary Minor</b>					
<b>Justification</b>	<i>Panulirus longipes</i> is a Least Concerned species and there are management measure in place for the species in Sri Lanka. <i>Panulirus longipes</i> was not present above 5% of the total catch in the Palk Bay fishery					
<b>Non Target Species Survey Results</b>						
<b>Total Catch</b>	<b>C19</b>	<b>C19 (% TC)</b>		<b>No. Catches</b>	<b>C19 (n=)</b>	<b>Per Catch</b>
13,648.52 kg	5.24kg	<b>0.04%</b>		557	<b>10</b>	<b>&lt;0.001(0.02)</b>

**Key Relevant Information:** The age at maturity of the *Panulirus longipes* is less than 5years (wikipedia.org) and their life span is 10years ([www.spc.int](http://www.spc.int)). Spiny lobsters feed on sea snails, clams, crabs, sea urchins,plants (coralline algae) and dead animals([www.spc.int](http://www.spc.int)) and the trophic level of lobster is 2.52 (Cortes,1999). Male deposits a sperm packet (spermatophore) on the underside of a female and the female releases many thousands of eggs which are fertilised as they pass over the sperm packet. The fertilized eggs are carried for about a month before they hatch into very small floating forms (the larval stages) ([www.spc.int](http://www.spc.int)). Usually they carried 8000-10000 eggs ([www.spc.int](http://www.spc.int)). According to *Chittleborough* *Panulirus longipes* are highly density dependence and have Dependatory dynamics at low population sizes.They are live in clear or slightly turbid water at depths of 1 to 18 m (also reported from 122 m), in rocky areas





and coral reefs. (Froese and Pauly, 2016) Fishermen rarely caught spiny lobsters less than their size of maturity and mostly they are retained.

**Productivity -Susceptibility Analysis (PSA)**

Score (Low Risk = 1; Medium Risk = 2; High Risk = 3)

Productivity Attributes	Relevant Information	Score
Average age at maturity	(<5yrs)	1
Average maximum age	(10yrs)<10yrs(www.spc.int)	1
Fecundity	(8000-10000eggs)100-20000(www.spc.int)	2
Average maximum size	-	
Average size at maturity	-	
Reproductive strategy	Live bearers(www.spc.int)	3
Trophic level	2.52 (Cortes,1999)	1
Density dependence	<i>Invertebrates only</i>	3
<b>Total Productivity</b>		<b>1.83</b>

**Scoring Guidelines** Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

According to the Productivity analysis Long-legged Spiny Lobster is highly resilient species and also the weight percentage form total catch is less than 2%. Therefore Long-legged Spiny Lobster is known as primary minor species.

Primary Non Target Species in the Bycatch of the Gulf of Mannar BSC Fishery							
SLN	Non Target Species	No.	Per Catch	Total (kg)	% Total Catch	Resilience	Status
C19	Longlegged spiny lobster	10	0.02	5.24	0.04%	High	Minor



## Secondary Non Target Species

Species that comprise a percentage of the weight of the total catch more than 2% (for less resilient species) or 5% (for resilient species) based on MSC guidelines for resilience.

<b>Secondary Non Target Species in the Bycatch of the Gulf of Mannar BSC Fishery</b>						
<b>SLN</b>	<b>Non Target Species</b>	<b>No.</b>	<b>Per Catch</b>	<b>Total (kg)</b>	<b>% Total Catch</b>	<b>Status</b>
<b>F08</b>	<b>Pale-edged stingray</b>	<b>3561</b>	<b>6.39</b>	<b>2081.82</b>	<b>15.25%</b>	<b>Main</b>
<b>F42</b>	<b>Bluespotted stingray</b>	<b>1036</b>	<b>1.86</b>	<b>2153.73</b>	<b>15.78%</b>	<b>Main</b>
<b>M8</b>	<b>Spiral melongena</b>	<b>20489</b>	<b>36.78</b>	<b>1233.37</b>	<b>9.04%</b>	<b>Main</b>



## D. Main Species Productivity Selectivity Analysis

Following 06 Main Species were analyzed by using Productivity Selectivity Analysis described in Marine Stewardship Council (MSC) 2014.

Table 9: Main species in the Bycatch of Palk Bay

SLN	Other Capture Species	Conservation Status	MSC Status	No.	Per Catch	Total (kg)	% Total Catch	Status
OS1	Hook nosed Sea snake	-	OSC	03	0.01	5.16	0.04%	Main
F08	Pale-edged stingray	-	S-Main	3561	1.38	2081.82	15.25%	Main
F42	Bluespotted stingray	-	S-Main	1036	1.86	2153.73	15.78%	Main
F59	Great hammerhead	CITES	ETP	2	0.00	0.55	0.00%	Main
F69	Hedgehog seahorse	CITES	ETP	1	0.00	0.00	0.00%	Main
M08	Spiral melongena	-	S-Main	20498	36.78	1233.37	9.04%	Main



### Hook-nosed Sea snake OS1

<b>SLBSC FIP Species Code</b>	OS1					
<b>Species Name</b>	Hook-nosed sea snake					
<b>Scientific Name</b>	<i>Enhydrina schistose</i>					
<b>Local Names</b>	Walakkadiya (T/S)					
<b>Conservation Concern</b>	<i>Least Concern</i>					
<b>Non Target Species Status</b>	<b>Out of Scope Species</b>					
<b>Justification</b>	<i>Enhydrina schistose</i> is an Out of Scope and there is no management in place for the species in Sri Lanka.					
<b>Non Target Species Survey Results</b>						
<b>Total Catch</b>	<b>OS1</b>	<b>OS1 %</b>		<b>No. Catches</b>	<b>OS1</b>	<b>OS1 / Catch</b>
13,648.52 Kg	5.16 kg	<b>0.04</b>		557	<b>3</b>	<b>0.01%</b>

**Key Relevant Information:** Sea snakes in the Family Elapidae mature at about 18 month and that time their growth rate begins to decline (Heatwole and Cogger, 1993). The average maximum age of Elapidae is around eight to ten years (8-10 yrs) (Heatwole and Cogger, 1993). Species of the Family Elapidae produce a small number of young with an average size range from three to twenty (Heatwole and Cogger, 1993). The maximum size of Elapidae (Hook-nosed sea snake) species is around 140cm (Rasmussen, 2011). The average size at the maturity of Family Elapidae is around 60cm (Heatwole and Cogger, 1993). All the hook-nosed sea snakes are live bearers. The snakes do not come onto the land for breeding (Heatwole and Cogger, 1993; Palomares and Pauly, 2016). The trophic level of the Family Elapidae and also marine reptiles is 2.4 (Cortes, 1999). The MSC productivity parameter density dependence not applicable to vertebrates.



Areal overlap (availability) is the overlap of the fishing effort with a species concentration of the stock (MSC, 2014). In Sri Lanka records of the Hook-nosed sea snake have been recorded mostly from the north and North West coast (*ibid*) The Puttalam Lagoon makes up only a small part of the concentration of the stock of the Hook-nosed sea snake distribution in Sri Lanka. Sea snakes are mostly marine, but some travel up river and estuaries (*ibid*). Encounterability or overlap of the Elapidae (Hook-nosed sea snake / Wallakadiya) within the water column relative to the fishing gear has a low risk because sea snakes are mainly found in the marine waters (Rasmussen, 2011; Heatwole and Cogger, 1993) and bottom set gill nets for *P. Pelagicus* set in the lagoon area. Sea snakes are distribute in the upper middle and bottom of the water column and *P. Pelagicus* fishery mainly target on bottom of the water column. Size at maturity of the Elapidae (Hook-nosed sea snake / Wallakadiya) is 60cm (Heatwole and Cogger, 1993) and the length of the species which were caught for the gears are more than that length. According to the information of the study period all NTS of Elapidae (Hook-nosed sea snake / Wallakadiya) are released back to the lagoon, but most of them are dead when released



**Productivity -Susceptibility Analysis (PSA)**  
Score (Low Risk = 1; Medium Risk = 2; High Risk = 3)

Productivity Attributes	Relevant Information	Score
Average age at maturity	< 5 years (Heatwole and Cogger, 1993)	1
Average maximum age	< 10 years (Heatwole and Cogger, 1993)	1
Fecundity	<100 per year (Heatwole and Cogger, 1993)	3
Average maximum size	100-300cm (Heatwole and Cogger, 1993)	2
Average size at maturity	40-200cm(Heatwole and Cogger, 1993)	2
Reproductive strategy	Live Bears (Heatwole and Cogger, 1993)	3
Trophic level	2.75-3.25(Cortes, 1999)	2
Density dependence	<i>Invertebrates only</i>	-
<b>Total Productivity</b>		<b>2.00</b>

**Scoring Guidelines** Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

Susceptibility Attributes	Relevant Information	Score
<b>Areal overlap</b> (Considers all fisheries)	10 – 30% (Gunasekera, 2016)	2
<b>Vertical overlap</b> (Considers all fisheries)	Low overlap with the fishing gear because sea snakes are mostly in marine water (Gunasekera, 2016)	1
<b>Selectivity of fishery</b> (Specific to fishery under assessment)	The size of maturity of the sea snakes are 60cm and most of the snakes were caught are more than that size(Gunasekera, 2016)	1
<b>Post-capture mortality</b> (Specific to fishery under assessment)	Majority of them are released and survive. But some were killed because it can be harmful when clean the net.	1
<b>Total Susceptibility</b>		<b>1.03</b>

**Scoring Guidelines** Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows:  $S = [(s1 * s2 * s3 * s4) - 1/40] + 1$ .

**Productivity – Susceptibility Analysis (PSA) Score** = 2.25

**MSC PSA Derived Score** = 90

**Risk Category** = Low Conservation Concern

**MSC Scoring Guidepost** =  $\geq 80$

### Pale-edged Stingray (F8)

<b>Scientific Name</b>		<i>Telatrygon (Dasyatis) zugei</i>				
<b>Local Names</b>		Appa maduwa (S), Senthirikka(T)				
<b>Conservation Concern</b>		-				
<b>Non Target Species Status</b>		<b>Secondary Main</b>				
<b>Justification</b>		<i>Telatrygon (Dasyatis) zugei</i> an ETP species and there is no management in place for the species in Sri Lanka. <i>Telatrygon (Dasyatis) zugei</i> was not present above 5% of the total catch in the Palk Bay fishery				
<b>Non Target Species Survey Results</b>						
<b>Total Catch</b>	<b>F8</b>	<b>F8 %</b>		<b>No. Catches</b>	<b>No. F8</b>	<b>F8 / Catch</b>
13,648.52 kg	2081.82kg	15.25%		557	3561	6.39%

**Key relevant information:** Benthic and inshore coastal waters are the major habitats of pale-edged stingrays and their maximum size is 20cm (De Bruin et al, 1995). In accordance with the Productivity Analysis, the average age at maturity of the pale-edged stingray of the family Dasyatididae is 3½ years. The average maximum age is around 14 years (Froese and Pauly, 2016). Pale-edged stingray of the family Dasyatididae produce small batches of eggs within which a single young is contained. A maximum number of three eggs are produced per batch (*ibid*). The average maximum size of the pale-edged stingray is 20cm (Froese and Pauly, 2016; De Bruin et al, 1995) and the average size at maturity is around 12cm (*ibid*). Pale-edged stingrays are internal live bearers and their trophic level is 3.3 +/- s.e. 0.26 (*ibid*).



The distribution of Family Dasyatididae mostly can be found in the North and North western coast of Sri Lanka (Froese and Pauly, 2016). They are common down to a depth of 100 m (FAO UN Reference). BSC fishing takes place mainly in depths not more than 3 m. Therefore the availability of Pale-edged stingray is in medium risk. There are high overlap of the *P. pelagicus* fishing gear with Dasyatididae (pale-edged stingray) because pale-edged stingray are benthic and common on inshore substrates, mostly in brackish water (Froese and Pauly, 2016; De Bruin et al, 1995; NARA, 2002). Size at maturity of the Dasyatididae (Pale-edged stingray) is 12cm (Froese and Pauly, 2016) and NTS which were caught for the gear is around 18-20cm. Medium and large sized pale-edged stingray are salted and dried. Small rays are discarded dead on the beach



### **Productivity -Susceptibility Analysis (PSA)**

Score (Low Risk = 1; Medium Risk = 2; High Risk = 3)

<b>Productivity Attributes</b>	<b>Relevant Information</b>	<b>Score</b>
Average age at maturity	< 5 years (Froese & Pauly, 2016).	1
Average maximum age	< 14 years (Froese & Pauly, 2016)	1
Fecundity	<100 per year (Froese and Pauly, 2016)	3
Average maximum size	<100 cm (20 cm) (Froese & Pauly, 2016; De Bruin et al, 1995)	1
Average size at maturity	<40 cm (18 cm)	1
Reproductive strategy	Live Bears (Froese and Pauly, 2016)	3
Trophic level	> 3.5 (Froese and Pauly, 2016)	3
Density dependence	<i>Invertebrates only</i>	-
<b>Total Productivity</b>		<b>1.86</b>

**Scoring Guidelines** Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

<b>Susceptibility Attributes</b>	<b>Relevant Information</b>	<b>Score</b>
<b>Areal Overlap</b> (Considers all fisheries)	10 – 30% (Gunasekera, 2016)	2
<b>Vertical Overlap</b> (Considers all fisheries)	High overlap due to bottom-set nets (Gunasekera, 2016)	3
<b>Selectivity of Fishery</b> (Specific to fishery under assessment)	The mesh sizes used to catch pale-edged stingrays and BSC ranges from 5" (127 mm) to 6" (152.4 mm). A study of the size of female pale-edged stringays found that the majority of rays caught using large mesh nets were above the size on maturity (pelagikos pvt ltd 2017)	1
<b>Post-capture Mortality</b> (Specific to fishery under assessment)	Large and medium rays are retained for salted, dry fish. Small rays are discarded, dead.	3
<b>Total Susceptibility</b>		<b>1.43</b>

**Scoring Guidelines** Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows:  $S = [(s1 * s2 * s3 * s4) - 1/40] + 1$ .

**Productivity – Susceptibility Analysis (PSA) Score = 2.34**

**MSC PSA Derived Score = 88**

**Risk Category = Low Conservation Concern**

**MSC Scoring Guidepost =  $\geq 80$**

## Blue-spotted sting ray F42

<b>SLBSC FIP Species Code</b>	F42					
<b>Species Name</b>	Blue-spotted Stingray					
<b>Scientific Name</b>	<i>Dasyatis kuhlii</i>					
<b>Local Names</b>	Pulli Thirukai (T); Maduwa (S)					
<b>Conservation Concern</b>	<a href="#">No Data</a>					
<b>Non Target Species Status</b>	<b>Secondary Main</b>					
<b>Justification</b>	<i>Dasyatis kuhlii</i> is not ETP or Out of Scope and there is no management in place for the species in Sri Lanka. <i>Dasyatis kuhlii</i> was present above 5% of the total catch in the Gulf of Mannar fishery					
<b>Non Target Species Survey Results</b>						
<b>Total Catch</b>	<b>F42</b>	<b>F42 %</b>		<b>No. Catches</b>	<b>No. F42</b>	<b>F42 / Catch</b>
13,648.52 Kg	2153.73kg	<b>15.78</b>		557	<b>1036</b>	<b>1.86%</b>

**Key relevant information:** *Dasyatis kuhlii* is one of the ray species categorized under family Dasyatidae. The maximum life span of *D.kuhlii* is 14.2 years and they mature in age of 3.5years. The average size at maturity of Blue spotted stingray is 27.6cm and the maximum length is 70cm (Froese and Pauly, 2016). They are ovoviviparous and gives birth to litters of 1-2 pup (*ibid*). They are feed on crabs and shrimps with the trophic level of 3.3 +/- s.e. 0.26 (Froese and Pauly, 2016). The distribution of Family Dasyatidae mostly can be found in the North and North western coast of Sri Lanka (Froese and Pauly, 2016). Therefore the availability of Bluespotted sting ray is in low risk. Major habitats of Bluespotted stingray is sandy bottoms near rocky or coral reefs and they can be found in the deep waters but move into reef flat and into shallow lagoons at high tide (Froese and Pauly, 2016). The size at maturity of *Dasyatis kuhlii* is 27.6cm. Most of the rays caught by Blue swimming crab fishermen were larger than above size. *D.kuhlii* is one of the retained species in the area.



### Productivity -Susceptibility Analysis (PSA)

Score (Low Risk = 1; Medium Risk = 2; High Risk = 3)

Productivity Attributes	Relevant Information	Score
Average age at maturity	3-6 years (Jacobsen and Bennett 2010)	1
Average maximum age	10-13 years (Pierce and Bennett 2009)	2
Fecundity	1-3 pups (Froese and Pauly 2016)	3
Average maximum size	<70cm (Froese and Pauly 2016)	1
Average size at maturity	12-46.5cm (Froese and Pauly 2016)	1
Reproductive strategy	Live bearer (Froese and Pauly 2016)	3
Trophic level	3.3 (Froese and Pauly 2016)	3
Density dependence	<i>Invertebrates only</i>	-
<b>Total Productivity (average)</b>		<b>2.00</b>



**Scoring Guidelines:** Productivity score ( $P$ ) = average of the productivity attribute scores ( $p1, p2, p3, p4$  (finfish only),  $p5$  (finfish only),  $p6, p7$ , and  $p8$  (invertebrates only))

Susceptibility Attributes	Relevant Information	Score
<b>Areal overlap</b> (Considers all fisheries)	<10% (Froese and Pauly, 2016).	1
<b>Vertical overlap</b> (Considers all fisheries)	High overlap due to bottom-set nets (Gunasekera, 2016)	3
<b>Selectivity of fishery</b> (Specific to fishery under assessment)	The mesh sizes used to catch blue-spotted stingrays and BSC range from 5" (127 mm) to 6" (152.4 mm). No data has been collected to assess the selectivity of bottom-set crab nets for blue-spotted stingrays	3
<b>Post-capture mortality</b> (Specific to fishery under assessment)	Almost all blue-spotted stingrays are retained for salted, dry fish.	3
<b>Total Susceptibility (multiplicative)</b>		<b>1.65</b>

**Scoring Guidelines:** Susceptibility score ( $S$ ) = product of the susceptibility attribute scores ( $s1, s2, s3, s4$ ), rescaled as follows:  $S = [(s1 * s2 * s3 * s4) - 1/40] + 1$ .

**Productivity – Susceptibility Analysis (PSA) Score = 2.59**

**MSC PSA Derived Score = 82**

**Risk Category =Low Conservation Concern**

**MSC Scoring Guidepost =  $\geq 80$**

Great hammerhead Shark (F59)

<b>SLBSC FIP Species Code</b>	F59					
<b>Species Name</b>	Great hammerhead					
<b>Scientific Name</b>	<i>Sphyrna mokarran</i>					
<b>Local Names</b>	Udalu mora (S)					
<b>Conservation Concern</b>	<i>Endangered</i>					
<b>Non Target Species Status</b>	<b>ETP Species</b>					
<b>Justification</b>	<i>Sphyrna mokarran an ETP species and there is no management in place for the species in Sri Lanka. Sphyrna mokarran was not present above 5% of the total catch in the Gulf of Mannar fishery</i>					
<b>Non Target Species Survey Results</b>						
<b>Total Catch</b>	<b>F59</b>	<b>F59%</b>		<b>No. Catches</b>	<b>No. F59</b>	<b>F59/ Catch</b>
13,648.52 Kg	0.55kg	<b>0.00</b>		557	<b>2</b>	<b>0.00%</b>

**Key Relevant Information:** Life span of Great hammerhead is 48years and they mature at age of 8.2years (Froese and Pauly, 2016). They are live bearers and they give birth to 13-42 young per litter. (Froese and Pauly, 2016). Maximum size of Great hammerhead shark is 610cm and they mature at 250-300cm. (Froese and Pauly, 2016). They feed on stingrays and other batoids, groupers and sea catfishes, but also preys on other small bony fishes, crabs, squid, other sharks, rays, and lobsters and the trophic level is 4.3 +/- s.e. 0.46 (Froese and Pauly, 2016).



The fishery for pelagic sharks in Sri Lanka extended well beyond the EEZ, particularly off the western and southern coasts (FAO) therefore the areal overlap with the fishery is in low risk. Major habitats of Great Hammerhead shark are coastal-pelagic and semi-oceanic habitats with close inshore and well offshore, over the continental shelves, island terraces, and in passes and lagoons. They are often bottom and reef associated with depth range of 1-300m. (Froese and Pauly, 2016). So there are moderate risk to overlap with bottom set crab net. The size of maturity is 250-300cm. The only one Great hammerhead that we got during our study was less than that size and therefore discarded.

**Productivity -Susceptibility Analysis (PSA)**

Score (Low Risk = 1; Medium Risk = 2; High Risk = 3)

<b>Productivity Attributes</b>	<b>Relevant Information</b>	<b>Score</b>
Average age at maturity	5-15yrs(8.2yrs) (Froese and Pauly, 2016)	2
Average maximum age	>25yrs(48yrs) (Froese and Pauly, 2016)	3
Fecundity	<100eggs per yr(13-42 young per litter) (Froese and Pauly, 2016)	3
Average maximum size	>300cm(610cm) (Froese and Pauly, 2016)	3
Average size at maturity	100-300cm(250-300cm) (Froese and Pauly, 2016)	2
Reproductive strategy	Live bearers(Froese and Pauly, 2016)	3
Trophic level	>3.25(4.3 +/- s.e. 0.46) (Froese and Pauly, 2016)	3
Density dependence	<i>Invertebrates only</i>	-
<b>Total Productivity</b>		<b>2.71</b>



**Scoring Guidelines** Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))

Susceptibility Attributes	Relevant Information	Score
<b>Areal overlap</b> (Considers all fisheries)	Pelagic sharks in Sri Lanka extended well beyond the EEZ, particularly off the western and southern coasts (FAO).	1
<b>Vertical overlap</b> (Considers all fisheries)	They are semi oceanic and depth range is 1-300m. (Froese and Pauly, 2016)so there are moderate risk of vertical overlap.	2
<b>Selectivity of fishery</b> (Specific to fishery under assessment)	They caught individuals less than size of maturity rarely	1
<b>Post-capture mortality</b> (Specific to fishery under assessment)	Large and medium size sharks are retained and small ones are discarded	3
<b>Total Susceptibility</b>		<b>1.13</b>

**Scoring Guidelines** Susceptibility score (S) = product of the susceptibility attribute scores (s1, s2, s3, s4), rescaled as follows:  $S = [(s1 * s2 * s3 * s4) - 1/40] + 1$ .

**Productivity – Susceptibility Analysis (PSA) Score** = 2.94

**MSC PSA Derived Score** = 70

**Risk Category** = Medium Conservation Concern

**MSC Scoring Guidepost** = 60-79



Hedgehog seahorse (F69)

<b>SLBSC FIP Species Code</b>	F69					
<b>Species Name</b>	Hedgehog seahorse					
<b>Scientific Name</b>	<i>H. spinosissimus</i>					
<b>Local Names</b>	Muhudu ashwaya (S)					
<b>Conservation Concern</b>	<i>Endangered</i>					
<b>Non Target Species Status</b>	<b>ETP Species</b>					
<b>Justification</b>	<i>H. spinosissimus</i> an ETP species and there is no management in place for the species in Sri Lanka. <i>H. spinosissimus</i> was not present above 5% of the total catch in the Gulf of Mannar fishery					
<b>Non Target Species Survey Results</b>						
<b>Total Catch</b>	<b>F69</b>	<b>F69%</b>		<b>No. Catches</b>	<b>No. F69</b>	<b>F69/ Catch</b>
13,648.52 Kg	0.00	<b>0.00%</b>		557	<b>01</b>	<b>0.00%</b>

**Key Relevant Information:** Life span of Hedgehog seahorse is 2.6-3.5yrs and they mature at age of 0.7-1.0 years (Froese and Pauly, 2016). They are live bearers and they give birth to 600-700 young and Male carries the eggs in a brood pouch. (Froese and Pauly, 2016). Maximum size of Hedgehog seahorse is 17.2cm and they mature at 10.4cm. (Froese and Pauly, 2016). They feed on Feeds on small prey and organic debris and the trophic level is 0.0 (Froese and Pauly, 2016).



The areal distribution of Hedgehog seahorse is Indo-Pacific: Sri Lanka to Taiwan and Australia therefore the areal overlap with the fishery is in low risk. Major habitats of Hedgehog sea horse are continental shelf, on muddy or sandy bottoms and in coral reefs. (Froese and Pauly, 2016). So there are moderate risk to overlap with bottom set crab net. The size of maturity is 10.4cm and fishermen regularly caught sea horses with less than size of maturity and there are very less number of seahorse as a bycatch

**Productivity -Susceptibility Analysis (PSA)**

Score (Low Risk = 1; Medium Risk = 2; High Risk = 3)

<b>Productivity Attributes</b>	<b>Relevant Information</b>	<b>Score</b>
Average age at maturity	0.7-1.0yrs (Froese and Pauly, 2016)	1
Average maximum age	2.6-3.5yrs (Froese and Pauly, 2016)	1
Fecundity	600-700(Froese and Pauly, 2016)	2
Average maximum size	17.2 cm(Froese and Pauly, 2016)	1
Average size at maturity	10.4cm (Froese and Pauly, 2016)	1
Reproductive strategy	Live bearers (Froese and Pauly, 2016)	3
Trophic level	0.0 (Froese and Pauly, 2016)	1
Density dependence	<i>Invertebrates only</i>	-
<b>Total Productivity</b>		<b>1.43</b>

**Scoring Guidelines** Productivity score (P) = average of the productivity attribute scores (p1, p2, p3, p4 (finfish only), p5 (finfish only), p6, p7, and p8 (invertebrates only))



Susceptibility Attributes	Relevant Information	Score
<b>Areal overlap</b> (Considers all fisheries)	They are distributed in Indo-Pacific Ocean	2
<b>Vertical overlap</b> (Considers all fisheries)	Major habitats of Hedgehog sea horse are continental shelf, on muddy or sandy bottoms and in coral reefs	2
<b>Selectivity of fishery</b> (Specific to fishery under assessment)	Individual less than size at maturity are regularly caught	2
<b>Post-capture mortality</b> (Specific to fishery under assessment)	Mostly retained for export market	3
<b>Total Susceptibility</b>		<b>1.58</b>

**Scoring Guidelines** Susceptibility score ( $S$ ) = product of the susceptibility attribute scores ( $s_1, s_2, s_3, s_4$ ), rescaled as follows:  $S = [(s_1 * s_2 * s_3 * s_4) - 1/40] + 1$ .

**Productivity – Susceptibility Analysis (PSA) Score = 2.13**

**MSC PSA Derived Score = 93**

**Risk Category = Low Conservation Concern**

**MSC Scoring Guidepost = ≥80**

Spiral Melongena (M08)

<b>SLBSC FIP Species Code</b>	M8					
<b>Species Name</b>	Spiral Melongena					
<b>Scientific Name</b>	<i>Pugilina cochlidium</i>					
<b>Local Names</b>	Sangu					
<b>Conservation Concern</b>	Not yet been assessed					
<b>Non Target Species Status</b>	<b>Secondary Main</b>					
<b>Justification</b>	<i>Pugilina cochlidium</i> is not ETP or Out of Scope and there is no management in place for the species in Sri Lanka. <i>Pugilina cochlidium</i> was present above 5% of the total catch in the Gulf of Mannar fishery					
<b>Non Target Species Survey Results</b>						
<b>Total Catch</b>	<b>M8</b>	<b>M8 %</b>		<b>No. Catches</b>	<b>No. M8</b>	<b>FM8/ Catch</b>
13,648.52 Kg	1233.37kg	9.04		557	20,489	36.78%



**Key relevant information:** Species in the Family Melongenidae are resilience species with early maturity, short life histories, medium fecundity, high reproductive rate and moderate growth rate (Fisher, 2015). In accordance with the reproductive analysis, Spiral melongena of family Melongenidae are benthic egg layers and they lay 50-500 eggs per time (Palomares and Pauly, 2016). These sea snails are carnivorous and feed on other shells such as oysters, mussels and clams. Their trophic level is 2.1 (Cortes, 1999).

The NTS spiral melongena is found throughout the northwest and northern coast lines in estuaries, lagoons and coastal waters (NARA, 2002). The effort of the *P. pelagicus* fishery covers about 10 – 30% of the of the spiral melongena stock in the northern and north-western province. There is high overlapp of the bottom set fishing gear for *P. pelagicus* and the NTS spiral melongena because spiral melongena are highly abundant in benthic and inshore substrates mostly in brackish water (Froese and Pauly, 2016; De Bruin et al, 1995; NARA, 2002). The NTS Melongenidae (Mihirilssa / Spiral melongena) that were caught for the gear are around 100 mm total length and size at maturity nearly 40 – 50 mm (Froese and Pauly, 2016). The meat / muscle part of the Melongenidae is retained: boiled, dried and sold by most fishermen in the local market. The shell of the Melongenidae is potentially a good source for lime production, but currently the shells are simply discarded by fishermen.

**Productivity - Susceptibility Analysis**

Score (Low Risk = 1; Medium Risk = 2; High Risk = 3)

Productivity Attributes	Relevant Information	Score
Average age at maturity	< 5 years - early maturity (Fisher, 2015)	1
Average maximum age	< 10 years - short life histories (Fisher, 2015)	1
Fecundity	50-500 eggs per time (Palomares & Pauly, 2016) Medium fecundity (Fisher, 2015)	2
Average maximum size	Vertebrates only	-
Average size at maturity	Vertebrates only	-
Reproductive strategy	Benthic egg layers (Palomares and Pauly, 2016)	2
Trophic level	2.1 (Cortes, 1999).	1



Density dependence	Unknown	3
<b>Total Productivity (average)</b>		<b>1.67</b>

**Scoring Guidelines:** Productivity score ( $P$ ) = average of the productivity attribute scores ( $p1$ ,  $p2$ ,  $p3$ ,  $p4$  (finfish only),  $p5$  (finfish only),  $p6$ ,  $p7$ , and  $p8$  (invertebrates only))

Susceptibility Attributes	Relevant Information	Score
<b>Areal overlap</b> (Considers all fisheries)	10 – 30% (Gunasekera, 2016)	2
<b>Vertical overlap</b> (Considers all fisheries)	High overlap due to bottom-set nets (Gunasekera, 2016)	3
<b>Selectivity of fishery</b> (Specific to fishery under assessment)	Mesh size is large (114.3 mm) compared to the size on maturity at 40 – 50 mm (Froese and Pauly, 2016) and (Gunasekera, 2016). The majority if not all spiral melongena are above the size on maturity, but no empirical evidence is available as proof (Gunasekera, pers., com. 2017).	3
<b>Post-capture mortality</b> (Specific to fishery under assessment)	The muscle part of the mollusc is retained, but the shells are discarded. (Gunasekera, 2016)	3
<b>Total Susceptibility (multiplicative)</b>		<b>2.33</b>

**Scoring Guidelines:** Susceptibility score ( $S$ ) = product of the susceptibility attribute scores ( $s1$ ,  $s2$ ,  $s3$ ,  $s4$ ), rescaled as follows:  $S = [(s1 * s2 * s3 * s4) - 1/40] + 1$ .

**Productivity – Susceptibility Analysis (PSA) Score = 2.86**

**MSC PSA Derived Score = 73**

**Risk Category = Medium Conservation Concern**

**MSC Scoring Guidepost = 60-79**



## E. Principle 2 Score for the Gulf of Mannar Fishery

Ten MAIN SPECIES in the bycatch from the BSC fishery in the Gulf of Mannar were evaluated using the PSA method described in Marine Stewardship Council (MSC) 2014. As information and data on each of the six MAIN SPECIES is limited, the fishery's potential impacts on each species was scored according using the Productivity - Susceptibility Analysis to generate the Vulnerability (PSA) Score for each species.

The Vulnerability (PSA) was scored according to the PSA method described in Marine Stewardship Council (MSC) 2014. A summary of the evaluation of each MAIN SPECIES is given below

	Main Species	Justification	Productivity – Susceptibility Analysis			PSA Score	Conservation Concern
			Productivity	Susceptibility	Vulnerability		
F69	Hedgehog seahorse	ETP	1.43	1.58	2.13	93	Low
OS1	Hook-nosed sea snake	Out of Scope	2.00	1.03	2.25	90	Low
F08	Pale-edged Stingray	Secondary Main	1.86	1.43	2.34	88	Low
F42	Blue-spotted sting ray	Secondary Main	2.00	1.65	2.59	82	Low
M08	Spiral melongena	Secondary Main	1.67	2.33	2.86	73	Medium
F59	Great hammerhead	ETP	2.71	1.14	2.94	70	Medium



## F. Unwanted Catch of the Blue Swimming Crab Fishery of Gulf of Mannar

Among 135 total Non-Target Species (weight percentage of 55.1% from the total catch) in Gulf of Mannar Blue Swimming Crab fishery, 111 species were having discarded proportions with the discarded weight percentage of 7.6% from the total catch).

### Non-Target Finfish in the Blue Swimming Crab fishery of Gulf of Mannar

Total number of Non-Target Fish species of Gulf of Mannar Fishery was 79 and 58 of them have discarded proportions. Discarded weight percentage of 57 species from total catch were less than 0.5 % (reference point) and discarded weight percentage of one species was higher than 0.5%. Most finfish species of the Blue swimming crab catch were retained by selling, drying or consuming. These small number of finfish of some species were discarded because, they are very small in size or cannot consume or sell because of the bad quality of fish. Pale-edged Stingray is the only one finfish species that having high discarded weight percentage from total catch which was more than 0.5%. These stingrays are mostly discarded in Anawasala landing site because the fishing grounds are in lagoon area and very small sized rays were caught for the Blue swimming crab nets. As a solution fishermen need to be put rays back to the water as soon as possible or they must target Blue Swimming Crab when they setting their nets.

SLN	Non-Target Species	No.	Per ton	Total (kg)	% Total Catch
F08	Pale-edged Stingray	1259	92.2	226.63	1.66%

### Non-Target crustaceans in the Blue Swimming Crab fishery of Gulf of Mannar

Total number of crustacean species in the Gulf of Mannar fishery were 20 and 18 were having discarded proportions and each discarded weight percentages less than 0.5% from total catch. Among them Ridged swimming crab, Bloodspotted crab and Longlegged spiny lobster are mostly retained and some of them were discarded due to their small size. In Gulf of Mannar mostly the fishery was operating in the lagoon and fishermen mostly doing net cleaning in the land. So we can suggest them to clean the nets in the water and throw them back in live.

### Non Target Molluscs in the Blue Swimming Crab fishery of Gulf of Mannar

Total number of Mollusc species in the Gulf of Mannar fishery were 24 and 23 of them were having discarded proportions. Among those 23, 21 species having each discarded weight percentage less than 0.5% of and only two species have higher than 0.5% of discarded weight percentage. Rock snail, cuttle fish, Spiral melongena, Indian chank, Octopus spp, are mostly retained and other molluscs are mostly discarded. Lace murex and spider conch are the only species which having high weight percentage of discards with higher than 0.5%. Those species were mostly recorded from Bathalangunduwa and Thalvupadu which having fishing grounds in sea area. So we can suggest to clean them in the water before landing. Currently all the shells of mollusc species (Ex: In Anawasala the mussel part of Spiral melongena is major retained species) were discarded and we can suggest to use those shells to made creative items for tourism



industry. Other mollusc which discarding as a whole should be throw back in live to the water before come to the land.

SLN	Non Target Species	No.	Per ton	Total (kg)	% Total Catch
M1	Lace murex	240	17.6	81.60	0.60%
M17	Spider conch	462	33.8	96.10	0.70%

#### **Non Target Echinoderms in the Blue Swimming Crab fishery of Gulf of Mannar**

There were 11 species of Non-Target echinoderm species in the Gulf of Mannar Fishery and all of them are mostly discarded. Common star fish mostly recorded from Anawasala fish landing site where the fishing grounds are in lagoon area. *Protoreaster lincki*, *P. alveolatus* and *Pentaceraster spp* were mostly recorded form Bathalangunduwa and Thalvupadu landing sites where the fishing grounds are sea area. To prevent these unwanted species the most suitable option is to clean their nets in the sea before arrive to the landing site.

#### **Non Target Reptiles in the Blue Swimming Crab fishery of Gulf of Mannar**

There were one non-target reptile species recorded from Anawasala landing site which was Hook-nosed Seasnake. Only three of them were recorded in the study period and mostly fishermen release them before they come to land. But if it highly entangled fishermen release them after arriving to land because sea snakes are poisonous. Most of the time those snakes were surviving after releasing.



Annex A

Non Target Species in the Bycatch of the Gulf of Mannar Fishery

SLN Non Target Species List		Non Target Species								
		No	/catch	Total (Kg)	% of TC	ETP?	OoS?	1° Main?	2° Main?	Note
<b>Finfish</b>										
F1	Spiny Flathead	179	0.32	136.86	1.00%	No	No	No	No	<2.0%
F2	Goatee croaker	102	0.18	7.84	0.06%	No	No	No	No	<2.0%
F3	Large-tooth flounder	19	0.03	3.28	0.02%	No	No	No	No	<2.0%
F4	Bengal tonguesole	72	0.13	14.52	0.11%	No	No	No	No	<2.0%
F5	Coastal trevally	42	0.08	10.26	0.08%	No	No	No	No	<2.0%
F6	Silver silago	23	0.04	1.32	0.01%	No	No	No	No	<2.0%
F7	Talang Queenfish	5	0.01	1.00	0.01%	No	No	No	No	<2.0%
F8	Pale-edged stingray	3561	6.39	2081.82	15.25%	No	No	No	Yes	>2.0%
F9	Largescale tonguesole	17	0.03	5.61	0.04%	No	No	No	No	<2.0%
F10	Scorpion fish	9	0.02	2.18	0.02%	No	No	No	No	<2.0%
F11	Spotted catfish	558	1.00	246.51	1.81%	No	No	No	No	<2.0%
F12	Splendid Pony fish	1	0.00	0.03	0.00%	No	No	No	No	<2.0%
F13	Striped Goat fish	18	0.03	2.74	0.02%	No	No	No	No	<2.0%
F14	Painted sweetlips	9	0.02	5.80	0.04%	No	No	No	No	<2.0%
F15	Black blotch emperor	80	0.14	20.88	0.15%	No	No	No	No	<2.0%
F16	Boxfish	135	0.24	26.25	0.19%	No	No	No	No	<2.0%
F17	Deepbody silverbiddy	16	0.03	2.97	0.02%	No	No	No	No	<2.0%
F18	Jarboa terapon	29	0.05	1.26	0.01%	No	No	No	No	<2.0%
F19	Puffer fish	55	0.10	68.47	0.50%	No	No	No	No	<2.0%
F20	Kelee shad	265	0.48	25.99	0.19%	No	No	No	No	<2.0%





SLN Non Target Species List

		Non Target Species								
		No	/catch	Total (Kg)	% of TC	ETP?	OoS?	1° Main?	2° Main?	Note
F21	Bluetail mullet	35	0.06	5.85	0.04%	No	No	No	No	<2.0%
F22	Hardyhead silverside	0	0.00	0.00	0.00%	No	No	No	No	<2.0%
F23	Striped ponyfish	0	0.00	0.00	0.00%	No	No	No	No	<2.0%
F24	Goidstripe sardinella	0	0.00	0.00	0.00%	No	No	No	No	<2%
F25	Unicorn leatherjacket	34	0.06	26.14	0.19%	No	No	No	No	<2%
F26	Longtail butterfly ray	<b>215</b>	<b>0.39</b>	<b>42.69</b>	<b>0.31%</b>	<b>No</b>	No	No	No	<2%
F27	Lesser Tigertooth croaker	125	0.22	28.89	0.21%	No	No	No	No	<2%
F28	Tigertooth croaker	95	0.17	17.96	0.13%	No	No	No	No	<2%
F29	Indian Halibut	13	0.02	5.84	0.04%	No	No	No	No	<2%
F30	Picnic seabream	50	0.09	27.06	0.20%	No	No	No	No	<2%
F31	Oriental sole	73	0.13	10.39	0.08%	No	No	No	No	<2%
F32	Indian longfin eel	80	0.14	19.64	0.14%	No	No	No	No	<2%
F33	Eel catfish	1	0.00	1.70	0.01%	No	No	No	No	<2%
F34	Tenpounder	22	0.04	5.45	0.04%	No	No	No	No	<2%
F35	Silver pomfret	50	0.09	6.10	0.04%	No	No	No	No	<2%
F36	Goldlined spinefoot	59	0.11	4.16	0.03%	No	No	No	No	<2%
F37	Grey largeeye bream	2	0.00	0.25	0.00%	No	No	No	No	<2%
F38	Darkbanded fusilier	1	0.00	0.27	0.00%	No	No	No	No	<2%
F39	Manyscaled flounder	0	0.00	0.00	0.00%	No	No	No	No	<2%
F40	Barramundi	8	0.01	2.81	0.02%	No	No	No	No	<2%
F41	Spotted sicklefish	173	0.31	35.14	0.26%	No	No	No	No	<2%
F42	Bluespotted stingray	<b>1036</b>	<b>1.86</b>	<b>2153.73</b>	<b>15.78%</b>	<b>No</b>	<b>No</b>	<b>No</b>	<b>Yes</b>	<b>&gt;2%</b>
F43	Bigeye ilsha	5	0.01	1.39	0.01%	No	No	No	No	<2%



SLN Non Target Species List

		Non Target Species								
		No	/catch	Total (Kg)	% of TC	ETP?	OoS?	1° Main?	2° Main?	Note
F44	Striped threadfin	5	0.01	0.82	0.01%	No	No	No	No	<2%
F45	Malabar thryssa	14	0.03	0.50	0.00%	No	No	No	No	<2%
F46	Harry hotlips	3	0.01	1.37	0.01%	No	No	No	No	<2%
F47	Malayan flounder	176	0.32	25.11	0.18%	No	No	No	No	<2%
F48	Indian threadfish	34	0.06	5.86	0.04%	No	No	No	No	<2%
F49	Blackspot snapper	12	0.02	2.32	0.02%	No	No	No	No	<2%
F50	Shortnosed tripodifish	101	0.18	19.40	0.14%	No	No	No	No	<2%
F51	Striped eel catfis	3	0.01	0.42	0.00%	No	No	No	No	<2%
F52	Orangespotted grouper	<b>32</b>	<b>0.06</b>	<b>11.14</b>	<b>0.08%</b>	<b>No</b>	No	No	No	<2%
F53	Largespot flounder	6	0.01	1.19	0.01%	No	No	No	No	<2%
F54	Numbfish	2	0.00	0.31	0.00%	No	No	No	No	<2%
F55	Bignose shark	1	0.00	4.40	0.03%	No	No	No	No	<2%
F56	Sharpnose stingray	<b>128</b>	<b>0.23</b>	<b>34.32</b>	<b>0.25%</b>	No	No	No	No	<2%
F57	Honeycomb stingray	<b>9</b>	<b>0.02</b>	<b>10.51</b>	<b>0.08%</b>	No	No	No	No	<2%
F58	Grey bamboo shark	<b>3</b>	<b>0.01</b>	<b>3.79</b>	<b>0.03%</b>	No	No	No	No	<2%
F59	Great hammerhead	<b>2</b>	<b>0.00</b>	<b>0.55</b>	<b>0.00%</b>	<b>END</b>	No	No	No	<b>Endangered</b>
F60	Spotted scat	2	0.00	0.38	0.00%	No	No	No	No	<2%
F61	Great barracuda	7	0.01	1.36	0.01%	No	No	No	No	<2%
F62	Cobia	12	0.02	5.90	0.04%	No	No	No	No	<2%
F63	Whiptail stingray	8	0.01	22.45	0.16%	No	No	No	No	<2%
F64	Bloch's gizzard shad	1	0.00	0.16	0.00%	No	No	No	No	<2%
F65	Lutke's halfbeak	1	0.00	0.10	0.00%	No	No	No	No	<2%
F66	Yellowfin seabream	1	0.00	0.58	0.00%	No	No	No	No	<2%



SLN Non Target Species List		Non Target Species								
		No	/catch	Total (Kg)	% of TC	ETP?	OoS?	1° Main?	2° Main?	Note
F67	Brushtooth lizardfish	4	0.01	0.62	0.00%	No	No	No	No	<2%
F68	Stargazers	104	0.19	101.40	0.74%	No	No	No	No	<2%
F69	Hedgehog seahorse	1	0.00	0.00	0.00%	END	No	No	No	Endangered
F70	Spotted eagle ray	1	0.00	8.00	0.06%	No	No	No	No	<2%
F71	Live sharksucker	30	0.05	8.42	0.06%	No	No	No	No	<2%
F72	Oriental silago	2	0.00	0.50	0.00%	No	No	No	No	<2%
F73	Crown squirrelfish	4	0.01	0.39	0.00%	No	No	No	No	<2%
F74	Indian mackerel	1	0.00	0.18	0.00%	No	No	No	No	<2%
F75	Annandale's guitarfish	1	0.00	1.50	0.01%	No	No	No	No	<2%
F76	Robust tuskfish	2	0.00	0.08	0.00%	No	No	No	No	<2%
F77	Pale snapper	14	0.03	1.82	0.01%	No	No	No	No	<2%
F78	Ballonfish	7	0.01	19.01	0.14%	No	No	No	No	<2%
F79	Toadfish	1	0.00	0.23	0.00%	No	No	No	No	<2%
F80	Emperor red snapper	1	0.00	0.11	0.00%	No	No	No	No	<2%
F81	Cock grunter	0	0.00	0.00	0.00%	No	No	No	No	<2%
F82	Orbicular batfish	1	0.00	0.31	0.00%	No	No	No	No	<2%
F83	Onespot snapper	0	0.00	0.00	0.00%	No	No	No	No	<2%
F84	Mozambique largeeye	0	0.00	0.00	0.00%	No	No	No	No	<2%
F85	Blacktip reef shark	0	0.00	0.00	0.00%	No	No	No	No	<2%
F86	Starry triggerfish	3	0.01	1.20	0.01%	No	No	No	No	<2%
F87	Eclipse Parrotfish	1	0.00	0.60	0.00%	No	No	No	No	<2%
Crustaceans										
C1	Flathead lobster	7	0.01	2.52	0.02%	No	No	No	No	<2%



SLN Non Target Species List

		Non Target Species								
		No	/catch	Total (Kg)	% of TC	ETP?	OoS?	1° Main?	2° Main?	Note
C2	Mantis shrimp	29	0.05	0.84	0.01%	No	No	No	No	<2%
C3	Ridged swimming crab	251	0.45	42.62	0.31%	No	No	No	No	<2%
C4	Bloodspotted crab	141	0.25	12.53	0.09%	No	No	No	No	<2%
C5	Box crab	502	0.90	44.75	0.33%	No	No	No	No	<2%
C6	Curcifix crab	228	0.41	13.49	0.10%	No	No	No	No	<2%
C7	Spider crab	7	0.01	0.25	0.00%	No	No	No	No	<2%
C8	Spider crab	2	0.00	0.11	0.00%	No	No	No	No	<2%
C9	Spider crab	34	0.06	0.83	0.01%	No	No	No	No	<2%
C10	Indian white shrimp	2	0.00	0.04	0.00%	No	No	No	No	<2%
C11	Giant tiger prawn	12	0.02	0.74	0.01%	No	No	No	No	<2%
C12	Blunt toothed crab	100	0.18	4.86	0.04%	No	No	No	No	<2%
C13	Common moon crab	14	0.03	0.22	0.00%	No	No	No	No	<2%
C14	Indo-pacific swamp crab	233	0.42	122.42	0.90%	No	No	No	No	<2%
C15	Angular crab	75	0.13	0.30	0.00%	No	No	No	No	<2%
C16	Orange mud crab	5	0.01	1.26	0.01%	No	No	No	No	<2%
C17	Sentinel crabs	34	0.06	1.68	0.01%	No	No	No	No	<2%
C18	Rock crab	8	0.01	1.15	0.01%	No	No	No	No	<2%
C19	Longlegged spiny lobster	10	0.02	5.24	0.04%	No	No	No	No	<2%
C20	Salt marsh mud crab	0	0.00	0.00	0.00%	No	No	No	No	<2%
C21	Helmet crab	17	0.03	1.24	0.01%	No	No	No	No	<2%
	Molluscs									
M1	Lace murex	281	0.50	103.53	0.76%	No	No	No	No	<2%
M2		967	1.74	27.25	0.20%	No	No	No	No	<2%



SLN Non Target Species List

		Non Target Species								
		No	/catch	Total (Kg)	% of TC	ETP?	OoS?	1° Main?	2° Main?	Note
M3	Woodcock murex	3426	6.15	53.72	0.39%	No	No	No	No	<2%
M4	Indian volute	19	0.03	11.44	0.08%	No	No	No	No	<2%
M5	Veined rapa whelk	7	0.01	0.75	0.01%	No	No	No	No	<2%
M6	Murex	8	0.01	0.88	0.01%	No	No	No	No	<2%
M7	Cuttle fish	45	0.08	19.86	0.15%	No	No	No	No	<2%
M8	Spiral melongena	20489	36.78	1233.37	9.04%	No	No	No	Yes	>2%
M9	Cone snail	0	0.00	0.00	0.00%	No	No	No	No	<2%
M10	Screw shell	1263	2.27	34.57	0.25%	No	No	No	No	<2%
M11	Indian chank	370	0.66	91.30	0.67%	No	No	No	No	<2%
M12	Common mussle	440	0.79	6.05	0.04%	No	No	No	No	<2%
M13		1909	3.43	36.63	0.27%	No	No	No	No	<2%
M14	Java turrid	153	0.27	2.59	0.02%	No	No	No	No	<2%
M15	Spindle shell	124	0.22	67.08	0.49%	No	No	No	No	<2%
M16	Moon snail	3	0.01	0.07	0.00%	No	No	No	No	<2%
M17	Spider conch	462	0.83	96.10	0.70%	No	No	No	No	<2%
M18	Windowpane oyester	417	0.75	26.75	0.20%	No	No	No	No	<2%
M19	Clam shell	2290	4.11	15.59	0.11%	No	No	No	No	<2%
M20		4	0.01	0.16	0.00%	No	No	No	No	<2%
M21		13	0.02	1.10	0.01%	No	No	No	No	<2%
M22	Octopus	4	0.01	0.14	0.00%	No	No	No	No	<2%
M23	Harp shell	2	0.00	0.28	0.00%	No	No	No	No	<2%
M24	Whelk	50	0.09	1.84	0.01%	No	No	No	No	<2%
M25		21	0.04	0.37	0.00%	No	No	No	No	<2%



SLN Non Target Species List		Non Target Species								
		No	/catch	Total (Kg)	% of TC	ETP?	OoS?	1° Main?	2° Main?	Note
M26	King's crown conch	0	0.00	0.00	0.00%	No	No	No	No	<2%
M27	Spotted stun	0	0.00	0.00	0.00%	No	No	No	No	<2%
<b>Echinoderms +</b>										
E1	S.virgulata	216	0.39	2.27	0.02%	No	No	No	No	<2%
E2	Long spined black sea urchin	0	0.00	0.00	0.00%	No	No	No	No	<2%
E3	Chocolate chip sea star	20	0.04	3.68	0.03%	No	No	No	No	<2%
E4	Star fish	5	0.01	1.03	0.01%	No	No	No	No	<2%
E5	Common Star fish	334	0.60	2.33	0.02%	No	No	No	No	<2%
E6	<b>Sea cucumber</b>	<b>27</b>	<b>0.05</b>	<b>0.28</b>	<b>0.00%</b>	No	<b>No</b>	No	No	<2%
E7	Short spined black sea urchin	5	0.01	0.19	0.00%	No	No	No	No	<2%
E8	Red-knobbed starfish	77	0.14	21.97	0.16%	No	No	No	No	<2%
E9	P. alveolatus	91	0.16	20.80	0.15%	No	No	No	No	<2%
E10	Pentaceraster spp	48	0.09	9.27	0.07%	No	No	No	No	<2%
E11	Lytechinus spp	1	0.00	0.01	0.00%	No	No	No	No	<2%
E12	P. tuberculatus	0	0.00	0.00	0.00%	No	No	No	No	<2%
E13	A. gibbosa	0	0.00	0.00	0.00%	No	No	No	No	<2%
E14	L.maculata	1	0.00	0.02	0.00%	No	No	No	No	<2%
E15	Sea anemones	0	0.00	0.00	0.00%	No	No	No	No	<2%
E16	Feather star	0	0.00	0.00	0.00%	No	No	No	No	<2%
O1	<b>Jelly Fish</b>	0	0.00	0.00	0.00%	No	No	No	No	<2%
<b>Reptiles</b>										
R1	Hookednosed Seasnake	3	0.01	5.16	0.04%	No	Yes	No	No	Out of Scope

