Sustainability Assessment Report for

Tonggol/longtail tuna (*Thunnus tonggol*) taken in the Gulf of Thailand and Andaman Sea

Richard Banks

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Carried out by: Poseidon Aquatic Resource Management Ltd

Client: Abba Seafood AB and Sustainable Fisheries Partnership

Contact for assessment: Maria Åberg and Duncan Leadbitter

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ACRONYMS

BMSY	Equilibrium total biomass at Maximum Sustainable Yield
CB	Certification Body
CCRF	Code of Conduct for Responsible Fisheries (FAO))
CPUE	Catch Per Unit Effort
CHARM	Coastal Habitats and Resources Management Projects
DOF	Department of Fisheries
DOFM	Department of Fisheries Malaysia
DMCR	Department of Marine and Coastal Resources
EAFM	Ecosystem Approach to Fisheries Management
EEZ	Exclusive Economic Zone
ESD	Ecologically Sustainable Development
FSARG	Fisheries Statistics Analysis and Research Group
FL	Fork Length
FAO	Food and Agricultural Organization
HS	Harvest Strategy
IOTC	Indian Ocean Tuna Committee
IUU	Illegal , Unreported, Unregulated
JDA	Joint Development Area
LPS	Light Purse Seine
MCS	Monitoring, Control and Surveillance
MRFDB	Marine Fisheries Research and Development Bureau
MPA	Marine Protected Area
MEY	Maximum Economic Yield
MSY	Maximum Sustainable Yield
MoU	Memorandum of Understanding
M&E	Monitoring and Evaluation
NPOA	National Plan of Action
PAFM	Precautionary Approach to Fisheries Management
PI	Performance Indicator
PSA	Productivity Susceptibility Analysis
RBF	Risk Based Framework
SICA	Scale Intensity Consequence Analysis
TAC	Total Allowable Catch
TEP	Threatened, Endangered or Protected
TPS	Thai purse seiners
TUN	Tuna Purse Seine
WCPFC	Western Central Pacific Fisheries Commission
VMS	Vessel Monitoring System

1. INTRODUCTION

This report sets out the results of a sustainability audit of the Thai Tonggal/longtail tuna (*Thunnus tonggol*) purse seine fishery, caught by tuna purse seiners (TUN) operating from the East coast (Nakhon si Thammarat, Songkla, Pattani, Narrathiwat and Trat) and West (Rangong, Phuket, Phnagna, Krabi and Satun) coasts of Thailand in the Gulf of Thailand and Andaman Sea respectively (Map 1). The Gulf of Thailand forms part of the South China Sea, whilst the Andaman Sea is part of the Indian Ocean.

Map 1: Fishing grounds and principal fishing ports
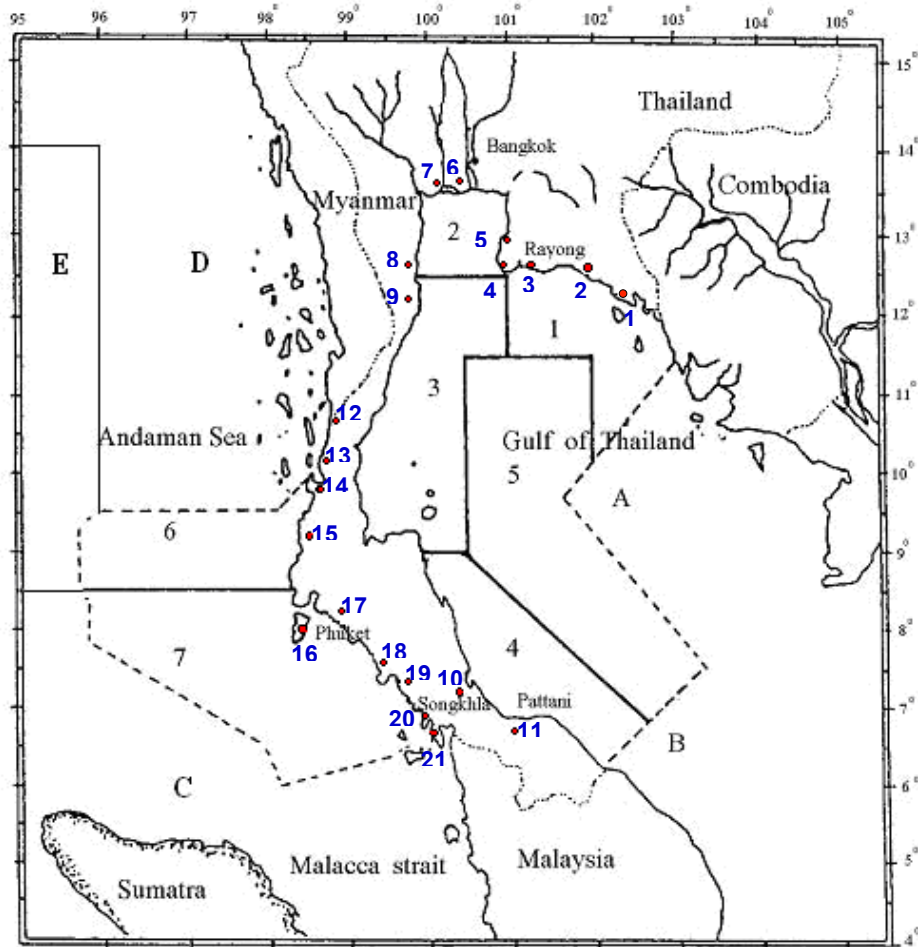
1. Laem Ngop, Trat Province	**12. Muang, Ranong Province**
2. Thamai, Chanthaburi Province	**13. Kuraburi, Phang-nga Province**
3. Muang, Rayong Province	**14. Takuapa, Phang-nga Province**
4. Sattahip, Chonburi Province	**15. Taimuang, Phang-nga Province**
5. Sriracha, Chonburi Province	**16. Muang, Phuket Province**
6. Pak Nam, Samutprakan Province	**17. Muang, Krabi Province**
7. Muang, Samutsakhon Province	**18. Kantang, Trang Province**
8. Cha-Um, Phetchaburi Province	**19. Palian, Trang Province**
9. Pranburi, Prachuap Khiri Khan Province	**20. La-nga, Satun Province**
10. Muang, Songkhla Province	**21.Munag , Satun Province**
11. Muang, Pattani Province	

1.1   Methodology

This assessment of catch sustainability and management is based on the Fisheries Assessment Methodology (FAM) developed by the Marine Stewardship Council as a mechanism for conducting audits of the sustainability of fisheries with reference to selected components of the FAO's Code of Conduct for Responsible Fisheries. However, it is not a formal pre-assessment for certification purposes. Whilst the FAM does not cover socio-economic aspects, unlike some other fishery evaluation systems, it does have clear performance thresholds which provide workable goals for fishery management planners.

1.2   Scope and aims

The scope of this audit is defined a follows

Species:	Tonggol/longtail tuna (*Thunnus tonggol*)
Geographical Area:	Gulf of Thailand and Andaman Sea
Method Management	Open access
System of Capture	Neritic tuna purse seine
Management Authority	Department of Fisheries, Thailand under the auspices of the Fisheries Act, 1947
Client Group:	Abba Seafood AB

1.3 Assessment aims

The principal aims of the assessment are to determine, on the basis of information made available by the client, the position of the fishery in relation to the Marine Stewardship Council (MSC) Fisheries Assessment Methodology. In particular, the audit will:

- Outline the key attributes of the fishery that are relevant to management based on an Ecosystem Approach to Fisheries Management (EAFM)
- Identify those attributes that require management intervention to facilitate a level of performance that could ensure long term sustainability.

In preparing this audit the assessor has undertaken the following:

- Documentation of available written information
- Sought out anecdotal information via stakeholder interviews
- Conducted an evaluation of risks to the species of interest using the Risk Based Framework set out in the Fisheries Assessment Methodology.

This involved meetings with fishers and their representative bodies, the national fisheries management agency the Department of Fisheries (DoF), the national research body, the Marine Fisheries Research and Development Bureau (MRFDB), part of DoF, provincial fishery managers and

elected local government representatives, an officer from the provincial fishery management unit, a university and FAO staff and consultants.

This report sets out:

- The information on which the audit report is based
- The background of the fishery/fisheries
- The location and scale of the fishery/fisheries
- Fishery management arrangements
- Other relevant fisheries
- Key stakeholders in the fishery
- Preliminary evaluation of the fishery against the FAM
- Limit of identification of landings from the fishery
- Issues requiring management intervention.

2. INFORMATION SOURCES USED

This audit is based upon the following information sources:

2.1 Meetings

Table 1: List of persons met

Date	Name	Organisation	e-mail
2/05/11	Simon Funge Smith	Regional Office for Asia and the Pacific, Food & Agriculture Organisation	Simon.FungeSmith@fao.org
	Praulai Nootmorn	DoF	nootmorn@yahoo.com 085-0706589
	Smith Thummachua	DoF	smiththummachua@gmail.com 0867001725
	Sumboon Siriraksophon	SEAFDEC	somboon@seafdec.org
	Saisunee Chaksuin	Project Manager WWF Thailand Country Office WWF Greater Mekong Programme	saisuneec@yahoo.com 89 996 5082
3/05/11	Adit Kapilakarn Orawan Sirivarasant Kanlayanee Janggit	Songkla Canning Public Company Limited (R&D Customer Service Dept) Deputy General Manager	adit@thaiunion.co.th orawan_si@thaiunion.co.th kanlayanee_ja@thaiunion.co.th +66 7 433 4005-8
3/05/11	Middleman 1	Songkla fishing port	
	Middleman 2	Songkla fishing port	
	Permsak Perngmark	Director, Marine Fisheries Research & Development Centre, DoF	Permsak2504@yahoo.com 0818979043
4/05/11	Songlar Thaweesri Pat Varaporn Vajarasatien	Siam International Food Co Ltd (SIF) Canning	songlha@gmail.com +660816471749 Pattana999@gmail.com

4/05/11	Kittiwara Banlang	Middleman, Songkla port Purse seine skipper	0836920088
05/05/11	Kessara Manachamni Wannipa Rujiprapakorn Thana	Sales, Chotiwat Manufacturing Co Ltd (CMC) Procurement	Kessara.ma@chotiwat.com wannipa@ru@chotiwat.com
06/05/2011	Wudtichai Wangkhahart, Ms Thumawadee (Fishery Biologist) Chalit Sa nga ngam (Tuna Programme technician)	Andaman Sea Fisheries Research and Development Center	wungkahart@yahoo.com Chalitster@gmail.com Chalit 084-3047792
11/05/2011	Dr Anthony Lewis	Independent consultant	Alewis9@bigpond.com

2.2 Other Information

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Pakjuta Khemakorn and Kingkan Vibunpant (2008), Purse Seine Fisheries in the Southern Gulf of Thailand, Southern Marine Fisheries Research and Development Center (Songkhla), Marine Fisheries Research and Technological Development Institute, Marine Fisheries Research and Development Bureau, Department of Fisheries

D. Lymer, S. Funge-Smith, P. Khemakorn,S. Naruepon & S. Ubolratana (2008), A review and synthesis of capture fisheries data in Thailand: Large versus small-scale fisheries. Food and Agriculture Organization of the United Nations, Regional Office for Asia and the Pacific, Bangkok

Praulai Nootmorn, National Report of Thailand in 2009, Andaman Sea Fisheries Research and Development Center, Marine Fisheries Research and Technological Development Institute, Marine Fisheries Research and Development Bureau, Department of Fisheries

Praulai Nootmorn Thumawadee Jaiyen and Supachai Rodpradit (2009), Tuna Data Collection in Thailand

Imsamran N and Sirriraksohhon S (2010), Preliminary report on the development of a tuna data base as a tool for tuna management in SE Asia, SEAFDEC/Japanese Trust Fund

Weerasak Yingyuad and Isara Chanrachkij (2010), Purse Seine Fisheries of Thailand, Training Department Southeast Asian Fisheries Development Center

Yesaki, M. (1987), A review of the biology and fisheries for longtail tuna (*thunnus tonggol*) in the indo-pacific region, Indo-Pacific Tuna Development and Management Programme, Colombo, Sri Lanka.

3. TUNA FISHERIES PRODUCTION IN THE THAILAND

3.1 Target species

Fishing activity by tuna purse seiners takes place in both the Gulf of Thailand in the South China Sea, and the Andaman Sea in the Indian Ocean. Purse seine Target species comprise longtail tuna (*Thunnus tonggol*), and kawakawa[1] (*Euthynnus affinis*). Frigate tuna (*Auxis thazard*) and a much smaller number of skipjack (*Katsuwonus pelamis*) are also caught in the Andaman Sea fishery. In the case of this assessment, kawakawa and frigate tuna are treated as a retained species.

In recent years (2009), catches of Andaman Sea longtail tuna by this fleet have declined to no more than 7% of the total. However, previously these quantities had been as high as 30% of the total.

Table 1 Catch (tons) and percentage of tuna catch by Purse seine vessels in Thailand, January 2009 to April 2010.

Gear	Longtail tuna	Kawakawa	Frigate tuna	Skipjack tuna	Total	%
			Gulf of Thailand			
LPS	2,445	2,169	15		4,629	**13%**
TPS	9,389	5,167	34		14,590	**41%**
TUNA	10,296	6,021	-		16,317	**46%**
	22,130	13,357	49	-	35,536	**100%**
	62%	38%	0%	0%	100%	
			Andaman Sea			
LPS	1,993	4,946	6,574	401	13,914	**88%**
TPS	328	231	158	4	721	**5%**
TUNA	786	177	80	206	1,249	**8%**
	3,107	5,354	6,812	611	15,884	**100%**
	20%	34%	43%	4%	100%	
Total	25,237	18,711	6,861	611	51,420	

Source: Nootmorn et al (2010)

It is noteworthy that catches from the three different fleets operating in Thailand, longtail tuna species account for of around half of Thai catches[2]. According to the middlemen interviewed, these

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[11] Referred to locally as Bonito

products were not sourced for processing[3]. These other fisheries are referenced in Section 9. Fish not sold for canning is sold direct to the Thai fish markets for domestic consumption.

For the purposes of this assessment the target species are defined as: longtail tuna (*Thunnus tonggol*) from the South China Sea, and longtail tuna from the Andaman Sea. Indian Ocean and Gulf of Thailand Kawakawa, and Indian Ocean skipjack and frigate tuna are defined as retained species.

There is some confusion about vessel definitions as shown in the Thai statistics. Procurement officers from the three canning factories interviewed, stated that their sourcing was only from the Tuna purse seine fleet, as opposed to Light Purse seine, or Thai purse seine. The total volumes as shown in the above table appear to be correct when compared with Thai export data. From an assessment point of view, it is important to have confirmation on this issue since LPS and Thai purse have very different fishing techniques and target fisheries (Yingyuad, 2010). For the purpose of this assessment, we have assumed that the fishing unit is the tuna purse seine fleet, but have taken the total longtail tuna catch to be 25,000t (Nootmorn et al (2010)). This is also consistent with the data shown in Yinyuad (Appendix 2).

3.2 Number of fishing vessels and gear characteristics

There are a reported 193 dedicated tuna Purse seine fishing vessels in Thailand specifically targeting longtail tuna (and kawakawa (and frigate tuna in the Andaman Sea))[4]. The purse seiners are large vessels of generally 20 to 32 metres in length, and over 100 gross tons, 300-520 HP and a holding capacity of 80,000 to 120,000 kilos. All vessels have modern equipment on board such as radar, sonar, echo sounder, fish finder, wireless radio and power block. Fish schools are detected by sonar.

The purse seine is usually operated from a medium-scale boat by 30-45 fishermen. A net hauler (a machine to assist hauling the purse seine net) is always installed on the port side. The operation is mostly conducted by surrounding the free schooling fish during both day and night by visual and sonar searching methods. The purse seine net is from 800 to 1800 m in length and 100-120 m in depth. The main net has 47-100 mm mesh-size, the material is black and green nylon 210 d/12-36 and 210/18 mixed with Saran and polyethylene 380 d/18-36 with 25 mm mesh size at the cod-end. The float line is shorter than the sinker line (E=0.7/E=0.75). The ratio between the depth and the length of net is 1/5-1/7. The ground rope is attached with iron purse rings and sinker, the total weight is 2-3 kg/point. Polyethylene cross-rope, diameter 38-40 mm is used for the purse line. The number of sets per 24 hours varies according to sighting the

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[3] A review of EIU import figures (CEDES) indicates that 21,805 tonnes (product weight) was imported into the EU in 2008. Assuming a conversion factor of 0.4, the catchweight equivalent of this would indicate around 54,000 tonnes. This is high and could suggest – 1 DoF catch data is not accurate; 2 – EU export data contains other species 3 – Sourcing includes from other tuna boats.

[4] Extracted from DoF statistics *for surrounding net* vessel > 100 GT

schools, but may be up to nine. Set catches may be as much as 500 kgs/set. Trip lengths range from around 3 to 20 days, depending on the success of spotting the fish whilst at sea.

Source: Yinguad *et al* (2010)

These vessels are highly mobile, but are registered in the specific ports of Nakhon si Thammarat, Songkla, Samut Sakhon, Pattani, Narrathiwat, Rayong and Trat on the East coast and Rangong, Satun, Phnagna and Phuket on the West coasts. East coast vessels fish in both the Gulf of Thailand and in the Andaman Sea according to the season, operating into 3 distinct groups of 40 vessels per group. Each group works collectively, sharing intelligence. West coast vessels tend to operate exclusively in the Andaman Sea (Chalit, pers com, 2011).

3.2 Fishing history

The neritic tuna resources in the Gulf of Thailand prior to the 1980s were lightly exploited with annual production of 3,298-19,929 metric tons, but the fishery rapidly developed post 1982 due to strong demand from the country's tuna canning industries. Since 1982, neritic tuna fisheries have dramatically expanded following an improvement to purse seine fishing gear. Newer fishing boats of larger sizes entered the fishery, built with freezers to preserve the catch for longer fishing periods (up to 10 days). The total longtail catch increased to around 130,000 tonnes by the late 1990s. High catches were supported by fisheries outside Thai waters through joint ventures or fishing agreements with neighbouring countries (Malaysia, Indonesia and Myanmar). Lymer *et al* (2008) reported that 69,000t of longtail tuna and 40,000t of Bonito (kawakawa) were caught outside the Thai EEZ in 2004. Notable reductions in catch occurred in the Andaman Sea from around 1999 onwards, and then from 2007 onwards in the Gulf of Thailand (Nootmorn, 2009**).** Data provided by DoF[5] also indicates that at least up to 2005, substantial quantities of the Gulf of Thailand longtail tuna catch (86%) were caught outside the Thai EEZ. Lymer *et al* also stated that purse seiners from Rayong and Pattani provinces sometimes fish in Indonesia coastal area and are at risk of being arrested by Indonesian patrols. DoF now suggest that IUU fishing is quite unlikely (Permsak, pers

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[5] DoF, Tuna Capture Thailand by fishing area_Progress1 (1998-2005)

com, May, 2011), given the high levels of enforcement by the Indonesian and Malaysian authorities. Whilst the boundary in the Andaman Sea is clearly delineated, The Gulf of Thailand has a remaining overlapping claim with Malaysia (Thummachua, pers com, May 2011), which has been turned into Joint Development Area (JDA). Fishermen of both countries have rights to fish in the JDA, and this is an area of high longtail tuna interaction. When interviewed, fishers stated that catches were recorded Latitude 120 40' and all logbooks generally contain the same reference. This location is well within the Thai EEZ and at variance with historic catches (DoF, 2005), when historically, much of the Gulf of Thailand fish was caught outside the EEZ, and it is presently unclear whether activity continues outside the JDA or not. The reduction in catch within the Gulf of Thailand would suggest that IUU activity if it exists, is probably quite low, but location of fishing activity would have to be verified to confirm whether IUU was a significant issue or not.

Figure 1: Distribution of Thailands Longtail tuna catch (tonnes), 2005
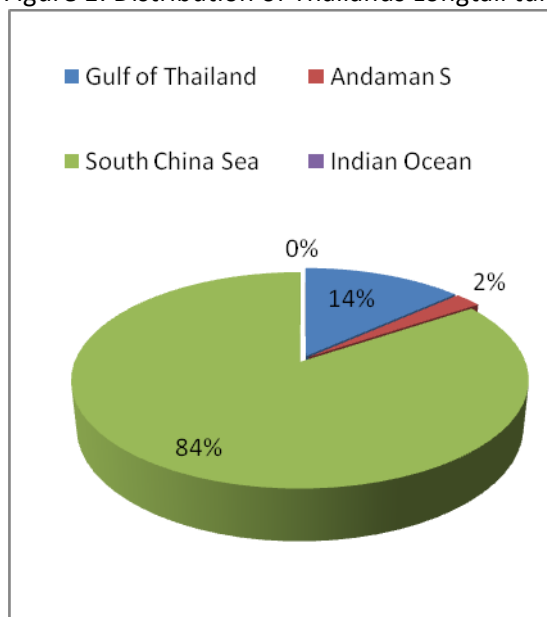
In respect to the Andaman Sea, Thailand has an access arrangement with Myanmar, the Fishing Rights Programme, agreed in 2004. A small number of purse seiners (estimated to be 15 in number) have access to Myanmar waters (Thummachua, pers com, 2011).

Current fishing grounds are spread out from around 16 nautical miles offshore to the more distant fishing grounds in the deep waters off Chumphon Province to Nakhon Sri Thammarat Province (March to August), moving to the Andaman Sea between (August to November) from the southern Province of Trang to Myanmar waters and then off Trat Province in the Gulf of Thailand (November to January). The Fishing seasons in the Gulf of Thailand are affected by El Nino and La Nina oscillations.

Thai catches are reported to have been fairly stable in the Gulf of Thailand. The catch trends show increases up until 2005 (Figure 2), but then when comparing with the 2009 catch (Table 1), it is evident that there has been a marked reduction from 2005 as a result of the loss in distant water access. A significant issue is that most catches are reported from area B (> 80%). Some of the area forms part of the JDA. It is unclear however, pre removal of reciprocal rights access with Malaysia, how much of the catch may have been taken outside the JDA area, including into Indonesian waters. The likelihood is that Thailand may have lost access to as much as 70% of the Gulf of Thailand/South China Sea resource, after 2005.

Contrasting data for the Andaman Sea illustrates a more worrying trend (Figure 3). Whilst as per the Gulf of Thailand, there have been notable reductions in catch, MRFDB papers also cite significant reductions in CPUE for the Andaman Sea, with catches in the smaller scale fleets falling to approximately one quarter of historic levels over a 5 year period (**Aosamboon *et al* and Loychuen *et al*).

Figure 2: Purse seine catches in the Gulf of Thailand (includes all fishing sectors)
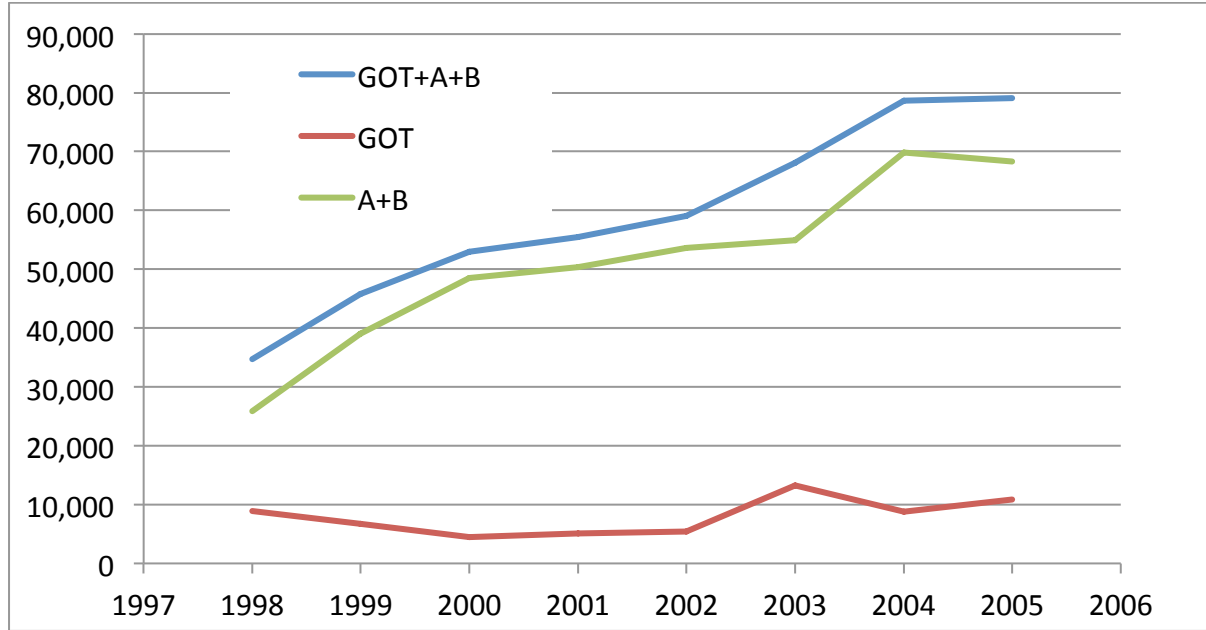
Source: DoF Note GoT -= Gulf of Thailand; A & B are outside territorial waters – See Map 1)

Figure 3: Purse seine catches in the Andaman Sea (includes all fishing methods)
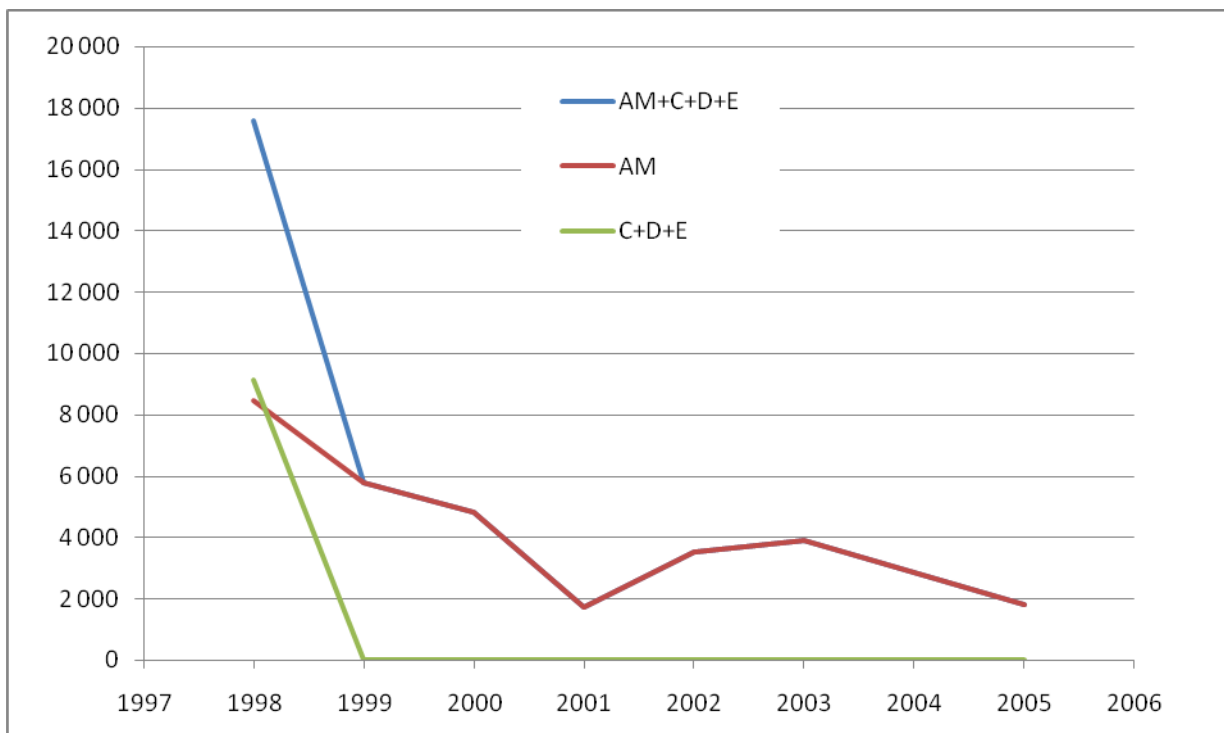
Source: DoF Note AM = Andaman Sea (C,D & E are outside territorial waters – See Map 1)

4. BIOLOGY

4.1 Stock assessment

Longtail tuna *(Thunnus tonggol)* is an oceanic species that forms schools of varying sizes. It is most abundant over areas of broad continental shelf. Longtail tuna grows to around 145 cm FL or 35.9 kg, but the most common size in the Indian Ocean ranges from 40 to 70 cm. Longtail tuna grows rapidly

to reach 40 to 46 cm in FL in one year. The size caught within the range of the stock was 27-52 cm (Yesaki, 1987). The modal length of the catch (FL) is at 36-40 cm (Chantawong, 1997).

The spawning season varies according to location. Off the East coast, the season commences in January to February and April to June, corresponding with the peak fishing seasons. Off the west coast of Thailand, there are two distinct spawning seasons: January-April and August-September. The latter period corresponds to the peak fishing season for the Andaman Sea.

No quantitative stock assessment is currently available for longtail tuna in either the Indian Ocean or for the South China Sea. Therefore the stock status of these stocks is uncertain. The Scientific Committee of IOTC notes the catches of longtail tuna have however been increasing, and that the position of longtail tuna should be reviewed at the first meeting of the IOTC Working Party on Neritic Tunas (IOTC report, 2009)[6]. No attempt has been made by WCPFC to assess the status of longtail or any other neritic tunas as this is not covered within the Agreement that established the Commission. MRFDB estimate from some of the existing stock size parameters that the Gulf of Thailand tuna is over exploited by between 5-15% (Permasak, pers com, May 2011) and possibly more heavily over exploited in the Andaman Sea as a consequence of heavy juvenile overfishing in the case of the latter.

The stock size of tuna cannot be estimated from an area limited only to Thai waters because tunas are highly migratory species. They migrate beyond the Thai waters on the East coast. Longtail tuna have been reported occurring on the edge of shelf areas of eastern Indonesia and in the Philippines, Papua New Guinea and Australia. In The Andaman Sea the stocks migrate through the entire Malacca Strait, throughout the Andaman Sea and across North and West Sumatra. More studies are required to explain their distribution.

4.2 Distribution

Yesaki (1987) suggests that there is a high probability that there are numerous longtail tuna stocks (self-sustaining units) throughout the distributional range of the species. Several authors have noted differences in characters of longtail tuna from various areas throughout its range. Serventy (1956) found body depth and distance from tip of snout to origin of first dorsal fin of fish from western Australia to differ significantly from those measurements for fish of northern and eastern Australia. Wilson (1981b) concluded from a study of 13 morphometric measurements that fish from western Australia had larger head, deeper body, and longer pectoral fin than fish from Papua New Guinea. Gibbs and Collette (1967) found total gillraker counts for fish from Southeast Asia and Australia to be similar to one another and less than counts of fish from India and Red Sea. Silas (1967) found significant differences in the number of gillrakers, especially on the lower limb, for fish from western and northern Australia versus fish from India. Significant differences were also found in the number of gillrakers for fish from Oman, as compared to those from the Gulf of Mannar in the southeastern part of India (Abdulhaleem, 1989). Lewis (1981) found fixed and large differences in enzyme frequencies for longtail tuna from Malaysia and Australia. These differences in morphometric, meristic, and electrophoretic characters may reflect distinct stocks. Longtail tuna is essentially a neritic species with most phases of its life cycle confined to the continental shelf. Longshore migrations, without any breaks in the continental shelves may lead to speciation[7]. This suggests that the Andaman Sea and Gulf of Thailand stock may be one and the same species, and the range of the

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[6] Subsequent minutes of IOTC meetings did not indicate that further discussion on Neritic tunas had taken place.
[7] Specification means that tonggol could evolve into distinct genetically identifiable species from sub regions. However, there has been no attempt to correlate the interaction and linkages between species from the Gulf of Thailand or the Andaman Sea.

stock could extend from India in the West to Vietnam in the East (A Lewis, pers com, May 2011).

Map 2: Distribution of longtail species occurring in the Thailand

Source: FishBase (http://www.aquamaps.org/receive.php)
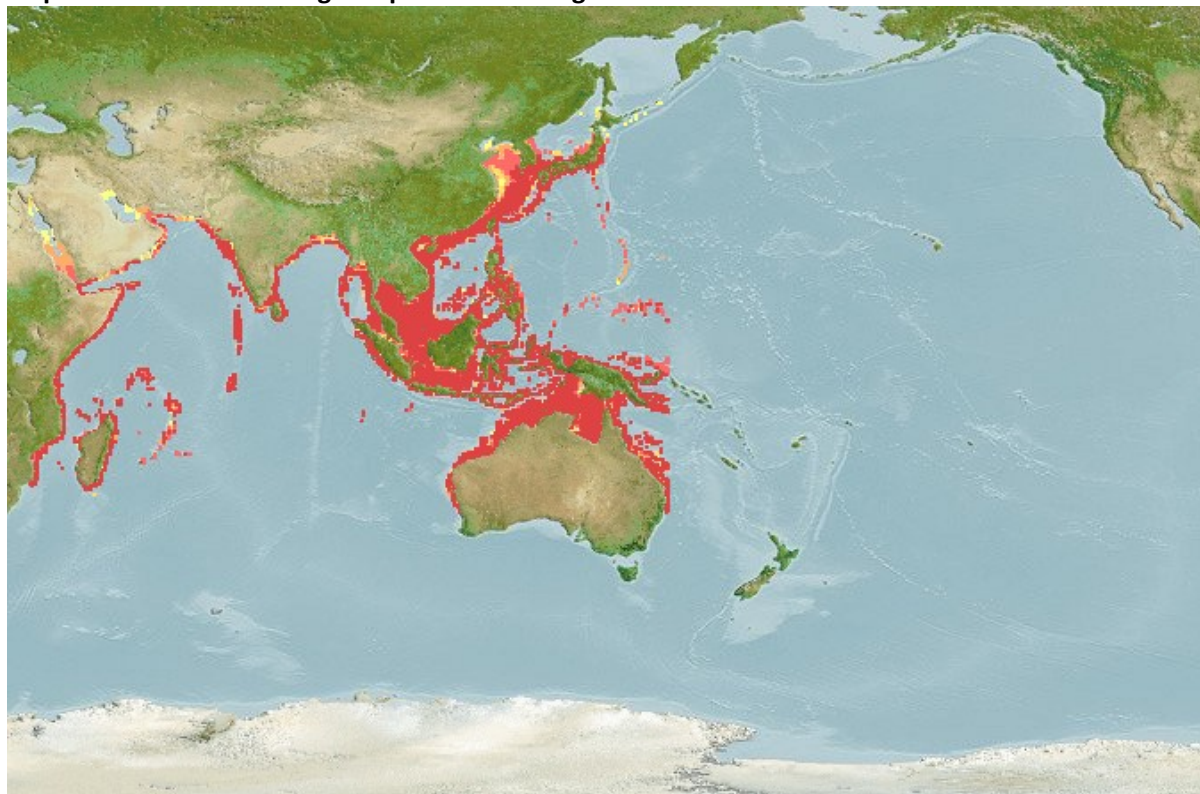
4.3 Biological factors

Some key biological factors associated with the species are cited from Yesaki 1987. Some specific conclusions are:

- Longtail tuna have fairly high rates of natural mortality, - 0.429 for longtail tuna (sizes ranging from 22 to 116 cm, fork length
- Sex ratios of longtail tuna found to be 1: 1 in both the South China Sea, off the west coast of Thailand.
- Twenty-two cm pre adults are recruited to the purse-seine fishery in the Gulf of Thailand.
- Fifty percent of the females were sexually mature at 396 mm in some areas (Australia and Papua New Guinea) but longtail tuna from Southeast Asia mature at a smaller size. However, the literature gives no size – this needs some clarification.
- Longtail is associated with a fast growth curve based on the results of tagging experiments in Australia (but no such experiments have occurred in SE Asian waters)
- The Fecundity of longtail tuna ranging in size from 43.8 to 49.1 cm varied from 1.2 to 1.9 million eggs and averaged 1.4 million eggs.

Table 2 below provides a summary of data extracted from FishBase.

Table 2: target species summary of biological characteristics for longtail tuna

Characteristics	Longtail tuna (Thunnus tonggol)
Average age at maturity	2-3 years
Average maximum age	10 years

Fecundity	1.2 to 1.9 million eggs and averaged 1.4 million eggs.
Average maximum size	70.0 cm FL
Average size at maturity (common)	26 cm FL
Reproductive strategy	Open water
Trophic level (from diet composition unless otherwise stated)	4.5 s.e. 0.77 Based on diet studies.
Resilience	High: Medium, minimum population doubling time 1.4 - 4.4 years (K=0.32; assuming tm=2-4)
Vulnerability	Moderate to high vulnerability (47 of 100)

Source: www.FishBase.org

Because of a lack of stock assessment data, this species will be subjected to a Risk Assessment, as set out in the MSC Fisheries Assessment Methodology[8].

Table 3: PSA Productivity and Susceptibility attributes of longtail fishery interactions

Characteristic	*Definition*	*Risk (Score)*
Average age of maturity	<5 years	Low (1)
Average maximum age	< 10 years	Low (1)
Fecundity	➢ 20,000 eggs	Low (1)
Average maximum size	100-300 cm	Medium (2)
Average size at maturity	< 40 cm	Low (1)
Reproductive strategy	Broadcast spawner	Low (1)
Trophic level	< 2.75	Low (1)
Availability (Overlap of species range)	>30%	High (3)
Encounterability (Habitat)	High overlap with fishing gear	High (3)
Selectivity	1-2 times mesh size / > 2 times mesh size	Medium (2) to High (3)
Post capture mortality	Retained species	High (3)

 Source: MSC Fisheries Assessment Methodology (pp 105)

6. ENVIRONMENTAL INTERACTIONS

6.1   Retained species

Longtail tuna are generally found in the neritic regime with kawakawa (*Euthynnus affinis)* and frigate tuna (*Auxis thazard*) and skipjack tuna (*Katsuwonus pelamis).* Skipjack tuna (*Katsuwonus pelamis*) and frigate tuna (*Auxis thazard*) are caught as a bycatch in the Andaman Sea fishery, accounting for 16% and 6% of the total respectively, but rarely in the Gulf of Thailand fishery. There were anecdotal reports of skipjack caught in the Gulf of Thailand fishery but representing no greater than 5% of the total catch. Because the overall volumes are minor, it has been decided to exclude these species from the assessment.

Table 4: target species summary of biological characteristics for kawakawa

Characteristics	*Kawakawa (35%)*
Average age at maturity	2-3 years
Average maximum age	5 years
Fecundity	1.2 to 1.9 million eggs and averaged 1.4 million eggs.
Average maximum size	100.0 cm

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[8] http://www.msc.org/documents/scheme-documents/methodologies/Fisheries_Assessment_Methodology.pdf/view

Average size at maturity (common)	60.0 cm
Reproductive strategy	Open water
Trophic level (from diet composition unless otherwise stated)	4.5 s.e. 0.79 Based on diet studies.
Resilience	High, minimum population doubling time less than 15 months (K=0.4-0.5; tm=3; Fec=210,000)
Vulnerability	Moderate vulnerability (37 of 100)

Sources: FishBase.org, peer review papers

Table 5: PSA Productivity and Susceptibility attributes of kawakawa fishery interactions

Characteristic	Definition	Risk (Score)
Average age of maturity	<5 years	Low (1)
Average maximum age	< 10 years	Low (1)
Fecundity	➢ 20,000 eggs	Low (1)
Average maximum size	100-300 cm	Medium (2)
Average size at maturity	40-200 cm	Medium (2)
Reproductive strategy	Broadcast spawner	Low (1)
Trophic level	< 2.75	Low (1)
Availability (Overlap of species range)	>30%	High (3)
Encounterability (Habitat)	High overlap with fishing gear	High (3)
Selectivity	1-2 times mesh size / > 2 times mesh size	Medium (2) to High (3)
Post capture mortality	Retained species	High (3)

6.2 Bycatch species

Data are non existent but, anecdotally, bycatch does not occur as no fish are discarded, or juvenile tunas and other species escape from the larger meshes (45-100mm diameter).

6.3 Endangered, threatened and protected

Longtail tuna were found with only 5 out of a total of 510 porpoise pods observed and with none of the 6 whales sighted off the west coast of Thailand. However, this species was found under a school of whale sharks (*Rhincodon typus*) and successfully fished with pole-and-line (Yesaki, 1987). Fishers, when interviewed made no reference to interactions with whales, turtles or sharks. This indicates that there may be some potential for interaction with whale sharks, but there is no fishery specific information available to gauge the level of risk. Dr. Kanjana Adulyanukosol, DoF (pers com) confirms that there is no evidence of interactions with whale sharks or indeed any other cetacean or shark species.

Seventy-three percent of all fish schools sighted during pole-and-line activities were accompanied by birds. Percentages of longtail, kawakawa, skipjack, and frigate tuna schools accompanied by bird flocks were similar and ranged from 68% to 75% (Yesaki, 1987). Sooty terns were dominant and especially common in the oceanic and outer-neritic regimes. White terns and gulls were more common in the inner-neritic, whereas frigate birds and shearwaters were common throughout the neritic regime (Lee, 1982).

Thailand has Notifications in place (CHARM, 2005) that:

- Prohibit fishing on all kinds of sea turtles and tortoises,
- Prohibit fishing of dolphins

- Prohibit fishing and retention of Whale shark

6.4 Benthic impact

The fish are targeted in the water column and therefore gear does not interact with the sea bed.

6.5   Trophic effects

Neritic tunas are relatively high in the food chain and as such, there are unlikely to be significant ecosystem related issues. Nevertheless, MFRDB are reported to make assessments of stomach contents, and this information could be fed into an ecosystem type model.

6.6 Other impacts.

There are no known negative ecosystem impacts. FADs are not deployed by tuna purse seiners.

7.   DATA COLLECTION AND RESEARCH

7.1 Data collection

Two DoF organizations collect, process, analyse, and report fish landing data, namely, the Fisheries Statistics Analysis and Research Group (FSARG) and Marine Fisheries Research and Development Bureau (MRFDB). FSARG collects data throughout the country, for national fisheries statistics, while MRFDB collects data from large to middle-scale fisheries in Thai Waters for research purposes.

FSARG collects data in collaboration with Provincial Fisheries Offices, namely, (a) marine fisheries statistics based on the sample survey (logbook survey) and (b) marine fisheries statistics by landing places. Data collection covers the 3 species of neritic tuna and tuna like species, namely, king mackerel, longtail tuna and eastern little tuna, as well as effort data (days fished).

Marine fisheries statistics are based on a sample survey multiplied upwards based on the number of licensed vessels of each fishing category in each port. The data is extracted from landing declarations and counted against the province where the fishing gear is registered no matter where the vessel actually lands its catch. FSARG has been conducting surveys of this type at 37 selected landing places along Thai coasts since 1974. This data is re interpreted following extrapolation of information gleaned from vessel logbooks, from a sample size of 10% for the purse seine sector. No bycatch or ETP species interactions are recorded in the logbooks. FSARG has been collecting logbook data since 1964. FSARG produces five publications each year, namely, Fisheries Statistics of Thailand, Marine Fisheries Statistics Base on the Sample Survey, The Landing Place Survey and Thai Fishing Vessels Statistics and Fishing Community Production Survey. Those publications are distributed to all DOF organizations.

MRFDB also collect data. This includes species caught (including all neritic tunas), weight, number and size frequency, and effort (days fished, fishing trip length and hours fished). All data collected by MRFDB are inputted, processed and analyzed and reported and published as MRFDB technical papers. MRFDB also undertake long term monitoring on fish larvae, phytoplankton, zooplankton, environmental parameters using a research survey vessels. No observer program exists. Each centre has one dedicated research vessel. Both land-based and vessel survey information are as yet not incorporated into stock assessment modelling.. The organisation has limited in-house ability to undertake stock assessments, although attempts are now being made to estimate MSYs for the demersal and pelagic fisheries in the Gulf of Thailand and the Andaman Sea. Previously, estimates of excess effort have been undertaken in some of the main fisheries. In-house stock assessment

training currently uses a translated FAO publication, and no tertiary level academic courses are available within Thailand. While some external analytical training (e.g. EcoSYM/EcoFAD) has been available through the Bay of Bengal Programme (BOBP), CPUE trends are the main measure of stocks status presently used. No research plan linked to national objectives currently exists.

8. FISHERY MANAGEMENT

8.1 Overall Governance

Thailand is a constitutional monarchy with a bicameral legislature consisting of a 200 member elected Senate and a House of Representatives that consists of 100 proportional representatives and 400 members of parliament elected from 400 constituencies.

There are three levels of government, National Government, Provincial Government, and Local Government. The National Government comprises the office of the Prime Minister, 13 Ministries, and 36 Ministers constituting a Cabinet. 75 provinces exist including 23 coastal provinces with responsibility for fisheries inside 6nm. Provincial Governors and District Officers are appointed by the National Government and act as their representatives. Provinces are divided into a number of districts, headed by district officers falling under the responsibility of the Provincial Governor.

The main laws governing fisheries are:
- The Fisheries Act B.E. 1947 (revised in 1953 and 1985) ("the Act")
- The Act Governing the Right to Fish in Thai Waters B.E. 1939 ("the Thai Waters Act")
- The Thai Vessel Act B.E. 1938

The Act provides the overarching framework for fisheries management and sets out arrangements on types of fishing ground (sanctuary, leasable area, reserved area and open area), licencing and penalties and offences. The Act was revised in 1985 to strengthen the severity of penalties and to make domestic vessels responsible for any damage or expense created where they have violated the laws of a foreign state. Under the Act, the Minister is empowered to make notifications on fishery specific conservation and management arrangements. These are implemented through *Notifications of the Ministry of Agriculture*. The Act also allows for the Provincial Governor to make management arrangements for fisheries within their province, with the agreement of the Minister. The Act has also been used in the past to apply local co-management arrangements.

The Act has recently been the subject of an extensive 8yr review, with a revised Act recently submitted to parliament for scrutiny. The revisions are aimed at modernising the fisheries legislation, most explicitly in the context of updating legislation to incorporate references to international conventions, Port State Measures, and reference to the ecosystem and precautionary approaches to fisheries management. However, the revised Act has encountered delays in passing through the legislature and is now unlikely to reach Parliamentary approval in 2011.

The Thai Waters Act establishes Thailand's territorial waters and EEZ. Fishing by foreign flagged vessels is prohibited, as is fishing by Thai-flagged vessels whose crews include foreigners unless otherwise authorised by Thai authorities. The Thai Vessel Act requires the owners of a fishing vessel with an engine or a vessel 6t or larger to register fishing rights with the Harbour Department. Only Thai nationals or companies are eligible to register fishing rights.

A number of other environment-related pieces of legislation also influence fisheries management including the Wildlife Reservation and Protection Act B.E. 1992, which lists a number of protected species, and the Enhancement and Conservation of the National Environmental Quality Act B.E. 1992, which provides for the protection wetlands amongst other things.

The principal institution responsible for fisheries management is the Department of Fisheries (DoF). DoF's main tasks include:

- Implementation of relevant Acts;
- Research and development on fisheries and aquaculture;
- Survey of waters inside and outside the Thai EEZ to support increased productivity and management;
- Application of legal measures to manage capture and other fisheries;
- Research and development in relation to post-harvest food safety and quality issues;
- Management of international fisheries affairs;
- Development of fishery information systems;
- Other operational matters as required.

A number of other national agencies also play a role in fisheries-related issues including the Department of Marine and Coastal Resources (DMCR), Ministry of Natural Resources and Environment, the Navy's Civil Affairs Department and the National Social and Economic Development Board.

In recent years, increasing responsibility for monitoring, control and enforcement have been delegated to the local authority (Sub-district authority or Ao Bo To) consistent with the policy of decentralization in the National Constitution B.E. 2540. Under these arrangements, marine fishers are required to seek permission from Ao Bo To on the use of various fishing gears, as well as submit gears for examination[9].

Amongst the fishing industry, the National Fisheries Association of Thailand, the Thai Overseas Fisheries Association, the Thai Frozen Foods Association and the Food Processors Association of Thailand are the main representative bodies.

8.2 General Management Arrangements

At the national level, Thailand's fisheries management is led by DoF. The organisation's overall capacity to implement effective fisheries management has generally been weak. No fishery specific management plans have been developed for the main fisheries, and few of the measures outlined in the CCRF in relation to management planning – for example, the development of target and limit reference points appropriate to the stock and appropriate harvest control rules – have not been applied. The purse seine fisheries remain open access, and previous attempts to introduce limited licensing systems have failed[10]. Despite longstanding evidence of overfishing and overcapacity, fisheries management policies continue to be influenced by production driven objectives, and few measures have been taken to effectively reduce fishing capacity. That said, the number of vessels in the purse seine fishery have remained relatively stable, if not declining in response to the fuel crisis in 2008. Changes in standardised effort (i.e. that incorporates any changes in technology) are not assessed by DoF.

The purse seine fisheries are open access, whereas others, most particularly the trawl fisheries, are subject to licence moratoriums. The main management measures available include closed areas, closed seasons and minimum legal landing sizes. Minimum mesh sizes are also applied though there

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[9] Ibid, DoF (2006)

[10] FAO (2005). *Report of the National Seminar on the Reduction and Management of Commercial Fishing Capacity in Thailand*. Cha-Am, Thailand, 11-14 May 2004. Food and Agriculture Organization of the United Nations Rome, 2005

is general agreement they are too small. However, the only Notification relating to surrounding nets identified refers to minimum mesh size of 2.5 cm. This is not to say that larger mesh size restrictions do not exist. No quotas are applied.

Effective fisheries management is complicated by a range of factors including the multi-species and multi-gear nature of the fisheries, which makes stock specific management difficult.

DoF staff acknowledge the need to strengthen institutional capacity in modern fisheries management practices, such as EAFM, as well as approaches such as the Risk Based Approach, which are encouraged under the Master Plan but for which there is little internal capability to implement.

8.3 Overall strategies

Thailand's domestic and international fisheries policy objectives for marine capture fisheries are set out in a Master Plan for Marine Fisheries ("the Master Plan"), approved by cabinet and commencing from 2010. The Master Plan takes into account a number of overarching economic and development plans of the Thai Government including National Economic and Social Development Plans (1-9) of 1963-2006 and the 10th National Economic and Social Development Plan (2007-2011). The Vision, Mission, Objectives and strategies to achieve the objectives are set out in Box 1.

Box 1: Main features of the Master Plan: Marine Fisheries Management of Thailand.

Vision: "Sustainable fisheries development based on the sufficiency economy that places the people at the centre"

Mission

1) To manage all activities pertaining to resource use, rehabilitation, maintenance and protection of the marine environment to ensure its high productivity under the current socio-economic reality and the state of the marine resources and ecosystem;

2) To carry out the human resource development, institutional strengthening, and activities leading to the generation of bodies of knowledge pertaining to marine fisheries and environment management;

3) To promote the application of the FAO Code of Conduct for Responsible Fisheries, and to promote the networking of such an observance at all levels.

Objectives

1) To manage the responsible and sustainable marine fisheries;

2) To facilitate the rapid recovery of the depleted fish stocks and to safeguard marine ecosystem from any destructive practices;

3) To support the fishery institutional strengthening and co- management, including the networking at all levels to enable their active participation in marine fisheries management;

4) To promote the capacity building of fishing enterprises at all levels to enable their effective operations under the changing fisheries situation around the globe, and the increasingly stringent governance;

5) To enhance fishermen's quality of life;

6) To ensure the seafood safety and the confidence of consumers of fish and fish products.

To accomplish the tasks and results as outlined in the objective and the targets within the scope provided by the vision and the mission, this Master Plan formulates five strategies to address matters in marine fisheries management.

These are:

Strategy 1: Efficiency enhancement of marine fisheries management system and co-management

- Review and upgrade fisheries law to ensure effective enforcement
- Demarcate the boundaries of fishing grounds
- Promote fisheries co-management, leading to rights based fishers

- Management fishing capacity in recognition of stock depletions issues

Strategy 2: Structural strengthening and efficiency improvement of fisheries bodies

- Establish fisheries management structure with a focus on stakeholder national and regional fishery management committees.
- Strengthen the capacities of fishery organizations
- Support to local government agencies to support strengthening of community organization activities in fisheries management
- Establish a marine fisheries database
- Develop and enhance local body knowledge in fisheries management

Strategy 3: Development and promotion of responsible and sustainable fisheries

- Develop and promote fishing gears to improve selectivity
- Regulate practices that are destructive to fish stocks and their habitats
- Promote the utility of fish catch to its fullest potential
- Develop methods that make use of potential resources not currently utilize

Strategy 4: Ecosystem and Fishing Ground Rehabilitation to Safeguard Biodiversity and Marine Environmental Quality

- Introduce temporal and permanent closed areas supported by participatory support by community organizations
- Promote the ecosystem approach to fisheries management
- Promote sea ranching

Strategy 5: Promotion and development of distant water fisheries

- Establish a distant water fishing data base
- Restructure the distant water operations
- Improve the institutional stricture of distant water fisheries

Source: DoF (2008). *The Master Plan Marine Fisheries Management of Thailand*. Department of Fisheries, Ministry of Agriculture and Cooperatives. November 2008.

In addition to the actions outlined in the Master Plan, the 2006 Fishery Policy Directions of Thailand Statement notes that rights-based fisheries management is being actively promoted by government and will replace open access arrangements over time. Likewise, the statement notes that a specific fishing capacity reduction program for the Gulf of Thailand is being developed and is hoped to be implemented 'in the coming years'[11].

8.4 Monitoring, control and surveillance

Thailand has a range of agencies involved in fisheries MCS. These include:
- DoF (Marine Fishery and Management and Compliance Sections) – at sea patrols, boarding and inspection, licensing, logbooks, etc;
- Marine Police – all illegal activities including breaches of fisheries law;
- Marine Department – vessel registration and safety checks, port inspections;
- Navy – at sea surveillance, boarding and inspection;
- Immigration – policing of crew nationality requirements;
- DMCR – marine protected areas, protected species.

DoF currently has approximately 400 fisheries inspectors throughout six coastal centres. MCS

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[11] Ibid, DoF (2006)

priorities are determined largely at the local level. Each of the six regional centres has its own compliance plan, based on the time and resources available, seasonal circumstances, relevant local closures and the like. Thailand has NPOA-IUU and this was been implemented from 1st January 2010.

Responsibility for maritime surveillance is split between DoF, Marine Police and the Navy. DoF has a fleet of 56 vessels - 21 X >60ft boats; 8 X 30ft boats; 30 X 18-28ft boats – to patrol both the Gulf of Thailand and the Andaman Sea, however deployment is often limited by fuel costs. Moreover, most of the vessels are over 10 years old and a significant proportion of the budget is absorbed in maintenance costs. Many vessels are not operational and requests to repair or replace vessels have often been rejected. Most DoF vessels are also limited in range to 20-30 miles. The Marine Police is also operationally divided into regional centres, each covering about 3 coastal provinces. Each centre operates a fleet of 4-5 60ft patrol vessels which support the enforcement of all maritime laws. Maritime Police also operates a fleet of larger patrol vessels (3 X 180ft boats; 3 X 110ft boats), which are coordinated from Marine Police HQ. Marine Police patrols tend to operate on intelligence and ad hoc information and it is not known how much patrol time is dedicated to fisheries compliance.

Some coordination between the agencies involved in fisheries MCS occurs (i.e. Navy, DoF, Marine Police, Customs, DMCR), led by the Navy. This has included discussions on specific issues – e.g. a recent workshop on IUU fishing – as well as annual meetings to review effectiveness, however it is not known how effective this process has been.

Electronic systems to support MCS are not well developed. No VMS system currently exists on domestic vessels, however a pilot system is currently being trialled. No electronic system exists to collect, store, process and exchange information. Consequently, MCS information is not yet routinely cross-referenced, other by occasional checks at landing sites.

The internal perception of the effectiveness of current port inspection measures is weak. No power is currently given to DoF under the fisheries legislation to inspect landings at port, and likewise no power is available to prohibit the sale of fish from known IUU vessels (e.g. vessels on RFMO blacklists) to domestic processors. Some inspections are carried out by the Department of Marine, however these are largely focused on vessel registration and safety. To address these shortcomings in the short term, DoF have approached the major processors to agree compliance MOUs to prohibit the sale of IUU fish. In the longer term, changes are proposed in the current revision of the Act to provide powers for port state compliance.

The internal perception of the effectiveness of the current sanction regime is also weak to moderate. Fines average 5,000-10,000 baht (US$160-320) with the maximum penalty one year in prison for repeat offences. There is a general view that historically fines were too low, though this is being addressed in the current review of the Act. The most common breaches are the use of prohibited gear, violations of closed areas and unlicensed fishing activity. A major impediment to effectiveness in the sanction regime has been political lobbying at the local level to avoid prosecution.

No domestic aerial surveillance capability exists.

Domestic training capacity on MCS issues is weak. No relevant courses are available through domestic technical institutions and most officers receive training only from within the agency. Some external providers have undertaken workshops on MCS related issues (e.g. FAO/APFIC/SEAFDEC on port state measures.

8.5   Subsidies

There are no subsidies paid to the fishing industry in Thailand.

9. OTHER FISHERIES AFFECTING THE TARGET STOCKS

9.1 Thai fisheries

There are 1,183 purse seine vessels operating in the Gulf of Thailand and Andaman Sea (DoF, 2007). Aside from the dedicated neritic tuna vessels, there are two other groups, light purse seine (LPS) and Thai purse seine (TPS). These number just under 1,000. The critical issue with these vessels is that they collectively catch more than half of the longtail tuna.

Size data was not available. A distinguishing feature between East and West coast, is that in the West coast (Andaman Sea) a larger number of longtail tuna are caught in inshore waters (Chantawong, 1999), **whereas** for the East coast, the main fishery is predominantly offshore (Yingyuad *et al*). Based on a broad spectrum of existing knowledge, this would suggest higher levels of vulnerability to the West coast stock.

The Risk Based assessment for longtail tuna, will have to incorporate the impact on this species by the other purse seine fisheries[12].

9.2 Other regional frigate tuna fisheries

Comprehensive catch data on longtail tuna was available from IOTC showing the distribution within the Indian Ocean. The table below identifies the tonnages for Thailand, Indonesia, Malaysia and India.

Table 6: Catches by fishing segment in the Indian Ocean, 2008

Fleet segment	'000 mt	
Malaysia purse seine	16.18	29%
Indonesia purse seine	2.2	4%
Thai PS	0.8	4%
Thai LPS	2.0	1%
Thai TPS	0.3	1%
Indonesia gillnet	28.4	51%
Indian gillnet	4	7%
Indonesia other	2	4%
Total	54.58	

Source: IOTC, adjusted to include Thai data (Table 6)

Information on Pacific catches is held by SEAFDEC. Information is still being sought. Other catch data is available from Malaysia and Indonesia. Estimates are made for Indonesian catches until such time as additional data is available.

Table 7: Catches by fishing segment in the Pacific, 2008

Fleet segment	'000 mt

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[12] MSC Policy Advisory note 18.

Malaysia purse seine	49.3	35%
Thai tuna Tonggal P.seine	10.2	7%
Thai purse seine	9.4	7%
Thai LPS	2.4	2%
Vietnam purse seine	10	7%
Indonesia purse seine	60	42%
Total	195.88	

Source: DoF, DoFM

10.KEY STAKEHOLDERS

The following is not an exhaustive list, but indicates the breadth of consultation that would need to be carried out for future work, including through participatory workshops. This list would be completed in consultation with the stakeholders identified below and additional stakeholders may be identified during the assessment. However, 'stakeholders' for consultation must have a valid and established interest in the fisheries under assessment.

Table 7: Key stakeholders

Praulai Nootmorn	DoF	nootmorn@yahoo.com 085-0706589
Smith Thummachua	DoF	smiththummachua@gmail.com 0867001725
Permsak Perngmark	Director, Marine Fisheries Research & Development Centre, DoF	Permsak2504@yahoo.com 0818979043
Ms Thumawadee (Fishery Biologist) Chalit Sa nga ngam (Tuna Programme technician)	Andaman Sea Fisheries Research and Development Center	Chalitster@gmail.com Chalit 084-3047792
Mana	Thai Fishermen's Association	
Sumboon Siriraksophon	SEAFDEC	somboon@seafdec.org
Saisunee Chaksuin	Project Manager WWF Thailand Country Office WWF Greater Mekong Programme	saisuneec@yahoo.com 89 996 5082
Adit Kapilakarn Orawan Sirivarasant Kanlayanee Janggit	Songkla Canning Public Company Limited (R&D Customer Service Dept) Deputy General Manager	adit@thaiunion.co.th orawan_si@thaiunion.co.th kanlayanee_ja@thaiunion.co.th +66 7 433 4005-8
Songlar Thaweesri Pat Varaporn Vajarasatien	Siam International Food Co Ltd (SIF) Canning	songlha@gmail.com +660816471749 Pattana999@gmail.com
Kessara Manachamni Wannipa	Sales, Chotiwat Manufacturing Co Ltd (CMC)	Kessara.ma@chotiwat.com wannipa@ru@chotiwat.com

Rujiprapakorn Thana	Procurement	

11. PRELIMINARY EVALUATION AGAINST MSC PRINCIPLES & CRITERIA

This sustainability evaluation measures compliance with the MSC Principles and Criteria as expressed in the Fisheries Assessment methodology. A series of questions have therefore been developed to determine:

- the availability of sufficient information to measure the fishery against the requirements of the Principles and Criteria; and,
- the implementation of management measures to ensure that the fishery is both well managed and sustainably managed.

During the evaluation, compliance with the Principles and Criteria will be determined by applying a scoring system to these questions (or 'performance indicators').

For this evaluation, the information available has been used to determine the general position of the fishery in relation to a series of generic performance indicators. This will also aid the evaluation team in modifying the performance indicators to best suit the fishery in question during the assessment.

The position of the fishery in relation to the generic performance indictors is presented in the following table, and provides an indication of the availability of information in relation to the various requirements of the MSC Principles and Criteria for Sustainable Fishing. It also indicates, on the basis of available evidence, the extent to which the fishery meets these requirements.

Principle 1	A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

Criterion 1.1.1: It is highly likely that the stock is above the point where recruitment would be impaired. The stock (or fishing mortality) is at or fluctuating around its target reference point.	There are a number of references to the overfished state of the stocks both in the Gulf of Thailand and Andaman Sea, and these papers were written prior to the reduction in access beyond territorial waters, especially into the Indonesian and Malaysian EEZ. The Thai authorities state that the stock is overfished by between 5-30%, but these estimates require elaboration and detail. There are no current estimates available of BMSY. Stock boundaries have not been determined and its unclear just how many stocks occur in SE Asia and elsewhere, Existing data deficiency requires the Risk Based Framework (Appendix 1) is applied. The analysis shows that the longtail fishery is Medium Risk, with likely prospect that the stock is heavily overfished. This assessment is taken collectively for both the Andaman Sea and Gulf of Thailand. On the basis of current information (declining CPUE and length frequencies), there is a high likelihood that the Andaman Sea stock has reached a position where recruitment is being impaired. The status of

	the Gulf of Thailand stock is more uncertain. Fishers indicated no specific declines in CPUE for the Gulf of Thailand stock, but no CPUE data was available to MRFDB to test the finding. However, it is believed to exist.

Criterion 1.1.2: Reference Points Reference points are appropriate for the stock and can be estimated. The limit reference point is set above the level at which there is an appreciable risk of impairing reproductive capacity The target reference point is such that the stock is maintained at a level consistent with BMSY (or some measure or surrogate with similar intent or outcome)	There are no formal reference points adopted. However, a formal longtail stock assessment is being proposed for 2012 to cover both the Gulf of Thailand and Andaman Sea.

Criterion 1.2.1: Harvest Strategy The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy work together towards achieving management objectives reflected in the target and limit reference points. The harvest strategy may not have been fully tested but monitoring is in place and evidence exists that it is achieving its objectives.	There is no harvest control strategy. It is also reported that MRFDB lack the capacity to assess stock status.

Criterion 1.2.2: Harvest Control - Rules and Tools Well defined harvest control rules are in place that are consistent with the harvest strategy and at a minimum ensure that the exploitation rate is reduced as limit reference points are approached. The selection of the harvest control rules take into account a limited range of uncertainties. Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the harvest control rules.	There are no harvest control rules in place. There is a self imposed limit on tuna purse seine mesh size, 45 mm mesh, but the critical issue is that other smaller mesh purse seine fisheries may be intercepting the stock in coastal waters. The 45 mm restriction may be a Law supported by a Notification, but is not shown in CHARM (2005). There is Notification which prohibits night fishing with nets less than 2.5 cm. There is s a need to clarify all regulations applying to Thai 'surrounding nets'. Seasonal closures are applied in the Gulf of Thailand from 15th February to 15th May and in the Andaman Sea from 1st April to 30th June yearly. Purse seine is one of gears that prohibited during the seasonal and area closed.
Criterion 1.2.3: **Information / Monitoring** Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data is available to support the harvest strategy. Stock abundance and fishery removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule, and one or more indicators are available	It is believed, in response to a good data collection system, that there is a monitoring system in place, but there is a dearth of reports which quantified the year on year changes. Reports may of course exist, but current copies (post reduction in resource access) were not made available to the assessor. ***Clear attention needs to be paid to monitoring fishing effort*** and evaluating stock densities and abundance. Relevant information should be reported on catch, effort, fish sizes and other biological indicators for the target (and main retained species) species of interest. However, there also appears to be a lack of published information available showing the results of the data collection. This is believed to exist but perhaps not made readily available outside the MRFDB.

and monitored with sufficient frequency to support the harvest control rule.	

Criterion 1.2.4: Assessment of Stock Status The assessment is appropriate for the stock and for the harvest control rule, and is evaluating stock status relative to reference points. The stock assessment is subject to peer review.	Stock assessments are believed to be underway and should be available in 1-2 years. These should be updated on a regular basis.

Principle 2	Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends

2.1 Retained Species – i.e. commercial by-catch / by-product

2.1.1 Stock Status a) Main retained species are highly likely to be within biologically based limits, or if outside the limits there is a partial strategy of demonstrably effective management measures in place such that the fishery does not hinder recovery and rebuilding.	For this assessment the most abundant retained species is kawakawa. These stocks are likely to have similar traits to that of longtail tuna, though FishBase argues that this species may be more resilient to fishing pressure. However, the status of retained species is unknown. A risk based assessment was undertaken revealing potential medium risk.

2.1.2 Management Strategy a) There is a partial	The current mesh size adopted in the target fishery is believed to be sufficiently selective, thereby allowing juveniles and small species to

strategy in place that is expected to achieve the outcome 80 level of performance or above for the main retained species. b) There is some objective basis for confidence that the partial strategy will work, based on some information directly about the fishery and/or species involved. c) There is some evidence that the partial strategy is being implemented successfully.	escape. There are some strategies in place to limit access by vessels to coastal waters. These have tended to evolve through pressure from local provincial consultations with fishers, without recourse to scientific justification. These need to be clearly documented.

2.1.3 Information/ monitoring a) Information is sufficient to qualitatively (if risk is shown to be low as defined in the SG80 outcome indicator) or quantitatively estimate outcome status with respect to biologically based limits. b) Information is adequate to support a partial strategy to manage main retained species. c) Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the strategy).	Relevant information is collected on catch, effort, fish sizes and other biological indicators. This information fails to be brought forward through reports and incorporated into any formal stocks assessment. The data reporting regime is very much production oriented and provides inadequate information for fisheries management purposes. ***Clear attention needs to be paid to monitoring and reporting on fishing effort*** and evaluating stock densities and abundance.

2.2 By-catch Species – i.e. non-commercial species/discards

a) Main by-catch species are highly likely to be within biologically based limits or if outside such limits there is a partial strategy of demonstrably effective mitigation measures in place such that the fishery does not hinder recovery and rebuilding.	As far as could be ascertained there are no discards. There is no literature on the subject and juveniles are not caught in the target fishery but in TPS and LPS.

a) There is a partial strategy in place for managing by-catch that is expected to achieve the by-catch outcome 80 level of performance or above. b) There is some objective basis for confidence that the partial strategy will work, based on some information directly about the fishery and/or the species involved. c) There is some evidence that the partial strategy is being implemented successfully.	There are some strategies in place to limit access by vessels to coastal waters. These have tended to evolve through pressure from local provincial consultations with fishers, without recourse to scientific justification.

a) Information is sufficient to qualitatively (if risk is shown to be medium as defined in the SG80 outcome indicator) or quantitatively estimate outcome status with respect to biologically based limits. b) Information is	There are no discarded by-catch species.

adequate to support a partial strategy to manage main affected species. c) Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the strategy).	

2.3 Endangered, Threatened and Protected Species

a) The effects of the fishery are known and are highly likely to be within limits of national and international requirements for protection of ETP species. b) Direct effects are highly unlikely to create unacceptable impacts to ETP species. c) Indirect effects have been considered and are thought to be unlikely to create unacceptable impacts.	Insufficient data made available, but there may be some possibility of interactions with whale sharks. Independent evidence would be required to ensure compliance with the prohibitions stated in Notifications and the Fisheries Act. This is an issue for other purse seine encounters in the Pacific. Dr. Kanjana Adulyanukosol confirms that there are no interactions.

a) There is a strategy in place for managing the fishery's impact on ETP species, including measures to minimise mortality and injury that is designed to achieve the ETP outcome 80 level of performance or above. b) There is an objective basis for confidence that	There is no strategy in place. It is noteworthy however that Thailand has Notifications in place that: - Prohibit fishing on all kinds of sea turtles and tortoises, - Prohibit fishing of dolphins - Prohibit the take of whale sharks

the strategy will work, based on some information directly about the fishery and/or the species involved. c) There is evidence that the strategy is being implemented successfully.	

| a) Information is sufficient to determine whether the fishery may be a threat to recovery of the ETP species, and if so, to measure trends and support a full strategy to manage impacts.

b) Sufficient data are available to allow mortality and the impact of fishing to be quantitatively estimated for ETP species. | There is insufficient information available, but indications are, for the tuna purse seine fleet, that bycatches are nonexistent. Logbooks will need to record ETP bycatch interactions, as it is unlikely that purse seine fisheries have no encounters, noting earlier references to schools swimming with whale sharks (Yesaki, 1987) and sooty terns. The latter are highly unlikely to be enmeshed in nets, but it is conceivably possible, as is the case for the larger Pacific tuna fisheries, for smaller whale sharks to be caught but see comment above from Dr. Kanjana Adulyanukosol. |

2.4 Habitat

a) The fishery is highly unlikely to reduce habitat structure and function to a point where there would be serious or irreversible harm.	This is unlikely to be an issue as the gear does not make contact with the sea bed.

| a) There is a partial strategy in place that is expected to achieve the habitat outcome 80 level of performance or above.

b) There is some objective basis for confidence that the | No strategy is in place or required. |

partial strategy will work, based on some information directly about the fishery and/or habitats involved. c) There is some evidence that the partial strategy is being implemented successfully.	

a) The nature, distribution and vulnerability of all main habitat types in the fishery area are known at a level of detail relevant to the scale and intensity of the fishery. b) Sufficient data are available to allow the nature of the impacts of the fishery on habitat types to be identified and there is reliable information on the spatial extent, timing and location of use of the fishing gear. c) Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).	No information available.

2.5 Ecosystem (Communities, trophic impacts etc)

a) The fishery is highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a	The wider fishery needs to be evaluated from an ecosystem perspective as the tunas (Longtail tuna and kawakawa) are undoubtedly part of a wider food web. Nevertheless, these species are high in the trophic chain. There is presently no understanding of ecosystem assessment and modelling within MRFDB, which will need to be addressed. This issues could be collectively developed within the context of a regional

serious or irreversible harm.	management forum embracing other countries (Malaysia and Indonesia specifically)..

a) There is a partial strategy in place that takes into account available information and is expected to restrain impacts of the fishery on the ecosystem so as to achieve the outcome 80 level of performance. b) The partial strategy is considered likely to work, based on plausible argument (e.g. general experience, theory or comparison with similar fisheries/ecosystems). c) There is some evidence that the measures comprising the partial strategy are being implemented successfully.	There is no strategy that allows for the incorporation of an Ecosystem Approach to Fisheries but plans are in place to both incorporate Ecosim into the decision making process and to increase capacity for analyses to be undertaken.

a) Information is adequate to broadly understand the functions of the key elements of the ecosystem. b) Main impacts of the fishery on these key ecosystem elements can be inferred from existing information, but may not have been investigated in detail. c) The main functions of the components (i.e. target, by-catch, retained and ETP species	No localised information available.

and habitats) in the ecosystem are known. d) Sufficient information is available on the impacts of the fishery on these components to allow some of the main consequences for the ecosystem to be inferred. e) Sufficient data continue to be collected to detect any increase in risk level (e.g. due to changes in the outcome indicator scores or the operation of the fishery or the effectiveness of the measures).	

Principle 3	**The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.**

3.1 Governance and policy

3.1.1 Legal and/or customary framework a) The management system is generally consistent with local, national or international laws or standards that are aimed at achieving sustainable fisheries in accordance with MSC Principles 1 and 2. b) The management system incorporates or is subject by law to a mechanism for the resolution of legal disputes arising within the system. c) Although the	There is no management system in place across the whole of the study area which focuses on longtail tuna, or its associated retained species. A Fisheries Act is in place, and its replacement is in process. The new Act does contain reference to PAFM, EAFM and Port State Measures. This Performance Indicator will only be deemed to be acceptable once the new Act is in place. Historic delays in the Act reaching Parliamentary approval suggest that it could be a long time before the Act is approved. Existing Notifications are not a substitute for the Act. There is management hierarchy in place with DoF responsible for overall policy and implementation of management actions. Management measures may be introduced as Notifications. Many of the measures appear to be ad hoc, and not linked to a Harvest control strategy.

management authority or fishery may be subject to continuing court challenges, it is not indicating a disrespect or defiance of the law by repeatedly violating the same law or regulation necessary for the sustainability for the fishery. d) The management system generally recognises and respects the legal rights created explicitly or by custom of people dependent on fishing for food and livelihood in a manner consistent with the objectives of MSC Principles 1 and 2.	
3.1.2 Consultation, roles and responsibilities **a) Organisations and individuals involved in the management process have been identified. Functions, roles and responsibilities are generally understood.** b) The management system includes consultation processes that obtain relevant information from the main affected parties, including local knowledge, to inform the management system.	Thailand has a very consultative and democratic approach to fisheries with consultative bodies and their membership inscribed in law both at the national level and, where ordinances exist, at the provincial level. However, there are no fishery specific Management Advisory Committee for tuna species, nor a process for feeding through current assessment information.
3.1.3 Long term objectives a) Long-term objectives	Long Term Objectives are contained as part of the National Fisheries Masterplan (DoF, 2008). This is good quality, and makes reference to EAFM.

to guide decision-making, consistent with MSC Principles and Criteria and the approach, are implicit within management policy.	

3.1.4 Incentives for sustainable fishing a) The management system provides for incentives that are consistent with achieving the outcomes expressed by MSC Principles 1 and 2.	There are no fisheries incentives (subsidies) that would encourage overfishing.

3.2 Fishery- specific management system

3.2.1 **Fishery- specific objectives** a) Objectives, which are broadly consistent with achieving the outcomes expressed by MSC's Principles 1 and 2, are explicit within the fishery's management system.	There is no neritic tuna management plan in place. This means that no fisheries specific measures have been adopted. The access regime is open access. This system does not support a sustainable management regime with more effort allowed to enter into the fleet. It is especially worrying given the decline in fishing opportunities in the Andaman Sea and South China Sea. One critical problem is the effect that other surrounding net fisheries may have on the longtail tuna stock.

3.2.2 Decision-making processes a) There are informal decision-making processes that result in measures and strategies to achieve the fishery-specific objectives. b) Decision-making processes respond to serious issues identified in relevant research, monitoring, evaluation and consultation, in a transparent, timely and adaptive manner and take some account of	There are formal decision making processes applied by DoF. However, in the case of the tuna fisheries, they are clearly not responding to relevant research. The precautionary approach to fisheries management is not being applied. There are no explanations of decisions taken, or for that matter why management decisions are not made for the tuna fleet.

the wider implications of decisions. c) Decision-making processes use the precautionary approach and are based on best available information. d) Explanations are provided for any actions or lack of action associated with findings and relevant recommendations emerging from research, monitoring, evaluation and review activity	
3.2.3 Compliance & enforcement a) Monitoring, control and surveillance mechanisms exist and are implemented in the fishery under assessment. b) Sanctions to deal with non-compliance exist and there is some evidence that they are applied. c) Fishers are generally thought to comply with the management system for the fishery under assessment, including, when required, providing information of importance to the effective management of the fishery.	There are no apparent management measures in place. Compliance issues include the possibility of incursions of fishermen outside territorial limits. Allegedly, a large proportion of the Thai catch was taken outside the EEZ in Malaysian or Indonesian waters. Stricter controls applied by Malaysian and Indonesian compliance organisations, have been a significant reason for the decline in domestic catches. A VMS system is under development, but until such time as it is applied to the tonggol fleet, it will be extremely difficult to confirm the legitimacy or otherwise of tonggol from Thai waters can only be verified once a VMS monitoring and verification system has been applied. The level of non compliance is unknown but reports from DoF indicate significantly lower than on previous occasions. This issue will require independent verification from VMS type checking procedures. An additional problem may also include use of small mesh nets by Thai (non tonggol) and Light purse seiners.
3.2.4 Research plan a) Research is undertaken, as required, to achieve the objectives	A Research Plan is in the process of development (*Praluai Nootmorn pers com, May 2010*). No details were made available.

consistent with MSC's Principles 1 and 2. b) Research results are available to interested parties.	
3.2.5 Management performance evaluation a) The fishery has in place mechanisms to evaluate some components of the management system and is subject to occasional internal review.	There is no mechanism for peer review of management decision making system within Thailand, However, the Master Plan does contain provision for M&E.

12. ISSUES REQUIRING MANAGEMENT ACTION

The MSC Standard is based upon three principles, Principle 1 relating to the status of the target stock, Principle 2 relating to the condition of the ecosystem upon which that stock depends, and Principle 3 relating to the management system. This provides a structured framework that can help identify issues which require attention.

Based on the information discussed above, there are a number of areas where performance may fall below that required by the MSC standard. These will provide the basis for a series of management improvement recommendations that will be prepared in a subsequent document. An overview of the issues identified is provided below.

Principle 1: A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery. The following observations are made:

- P1 1.1: The risk based framework suggests that the stock may be over-exploited at all levels of the fishery – tuna purse seine and other coastal purse seiners. Other (and historic) information suggests that there may be some evidence of recruitment overfishing. Most other Thai purse seine fleets are experiencing declines in CPUE. There was however, no reliable information made available on CPUEs for the neritic tuna purse seine sector;
- P 1.1.2: Limit Reference and Target reference points have not been set for longtail tuna for the range of the species. There may be some uncertainty in this range which could include both the Andaman Sea and the South China Sea. This would require either MRFDB/DoF to set national restrictions that take account of stock status across the range of the species, or that a collective LRP/TRP is set by all the countries involved. It is likely that different LRP/TRPs would have to be set for the Andaman Sea and South China Sea respectively ;
- P 1.2.1 Harvest control rules are not specifically applied to the longtail tuna/Tonggal. A system of Open access exists despite increasingly shrinking fishing opportunities.;

- P 1.2.2: Tools, Closed seasons and minimum mesh sizes) are not specific to the fishery.
- P 1.2.3 information is collected but seemingly not disseminated into regular publications, or used to provide input to management decisions. It would appear that report outputs rely more on the dedication of individual researchers, as opposed to any directed activity;
- P 1.2.4 Data collection systems are in place, but whilst some indicators on stock status may be available, there is presently no stock assessment.

Principle 2: Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

- P2 1.1: Retained species (kawakawa) and frigate tuna stock status is uncertain, but likely to be at the level of medium risk, as per the target species, and more information is required to better characterise the risks posed by the fisheries;
- There is no harvest strategy which is specific to retained species. The tools in place – closed seasons and areas apply across a range of all fisheries;
- P2.3.1: There is insufficient information available to allow for any interpretation on interactions with ETPs. However, encounters with whale sharks are reported as unlikely;
- P 2.5.1: There is no supporting ecosystem research that assesses the impact of the fishery on other species.

Based on the above, it will not be possible to assess aspects of Principle 2 without provision of data on retained species.

Principle 3: The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

- P 3.1.1: An amended Fisheries Act has yet to be implemented, and there is no current evidence that the Precautionary Approach to Fisheries Management is being applied throughout the range of the stock (including the other countries that target longtail tuna). There are also presently no measures in place that seek to support the application of the Ecosystem Approach to Fisheries Management;
- P 3.1.2: Formal consultative processes exist, but are untested since there are no specific management measures applied to this fishery;
- P 3.2.1: There are no fishery specific management measures. The existing measures are unlikely to control fishing effort in any meaningful way, especially against the background of shrinking fishing opportunities in this fishery. The neritic tuna fishery could provide a good opportunity for developing a Rights Based management scheme.
- P 3.2.2: There is presently no informal or formal management decision making process which takes account of stock status;
- P 3.2.3 Compliance systems need to clearly illustrate that fishing is legitimately taking place inside the Thai EEZ or the JDA or if outside (e.g. Myanmar waters), is linked to an approved access partnership agreement;
- P 3.2.4: A clear research plan, harvest control rules and a management structure needs to be developed to allow for monitoring of CPUE, catch by species and size distribution of species for each gear type; and,

- P 3.2.5 A formal Management Plan peer review structure needs to be implemented, assuming that Management plans will become a feature in the future.

APPENDIX 1: SICA table. P1 worst case is the direct capture impacting on population size.

Performance Indicator	Risk-causing activities	Spatial scale of activity	Temporal scale of activity	Intensity of activity	Relevant subcomponents	Consequence score	MSC Score
Target species outcome	Fishing activities from all fisheries including: • **Reproductive capacity**	6	5	4		3	<60
					Population size		

APPENDIX 2: PSA scores

FISHERY_NAME	Productivity Scores [1 3]								Susceptibility Scores [1 3]					PSA scores (automatic)		
	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level (fishbase)	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Risk Category Name	MSC scoring guidepost
A Malaysia purse seine	1	1	1	2	2	1	1	1.29	3	3	2	3	2.33	2.66	Med	60-80
A Indonesia purse seine	1	1	1	2	2	1	1	1.29	3	3	2	3	2.33	2.66	Med	60-80
A Thai LPS	1	1	1	2	2	1	1	1.29	3	3	3	3	3.00	3.26	High	<60
A Thai TPS	1	1	1	2	2	1	1	1.29	3	3	3	3	3.00	3.26	High	<60
A Thai purse seine	1	1	1	2	2	1	1	1.29	3	3	2	3	2.33	2.66	Med	60-80
A Indonesia gillnet	1	1	1	2	2	1	1	1.29	3	2	2	3	1.88	2.27	Low	>80
A Indian gillnet	1	1	1	2	2	1	1	1.29	3	2	2	3	1.88	2.27	Low	>80
A Indonesia other	1	1	1	2	2	1	1	1.29	3	2	3	3	2.33	2.66	Med	60-80
GoT Malaysia purse seine	1	1	1	2	2	1	1	1.29	3	3	3	3	3.00	3.26	High	<60
GoT Thail tuna tonngol P.seine	1	1	1	2	2	1	1	1.29	3	3	2	3	2.33	2.66	Med	60-80
GoT Thai purse seine	1	1	1	2	2	1	1	1.29	3	3	3	3	3.00	3.26	High	<60
GoT Thai LPS	1	1	1	2	2	1	1	1.29	3	3	3	3	3.00	3.26	High	<60
GoT Vietnam purse seine	1	1	1	2	2	1	1	1.29	3	3	3	3	3.00	3.26	High	<60
GoT Indonesia purse seine	1	1	1	2	2	1	1	1.29	3	3	3	3	3.00	3.26	High	<60
Weighted average														3.00	Med	60-80
P 2 Retained species																
Kawakawa and frigate tuna	1	1	1	2	2	1	1	1.29	3	3	2	3	2.33	2.66	Med	60-80

Source: MSC Policy Advisory note PA 18)

APPENDIX 3: Scale Intensity Consequence Analysis (SICA) and Productivity and Susceptibility Analysis (PSA)

1.   Introduction

The risk-based approach to MSC fishery assessment introduces two new elements (and acronyms) to the conventional MSC fishery certification process: **Scale Intensity Consequence Analysis** (**SICA)** and **Productivity and Susceptibility Attributes (PSA).** An overview of the proposed incorporation of the risk based-approach is shown in figure 1. As illustrated, if sufficient information to allow a performance indicator to be scored in the conventional way does not exist then the risk-based assessment is triggered using the SICA and PSA approach.
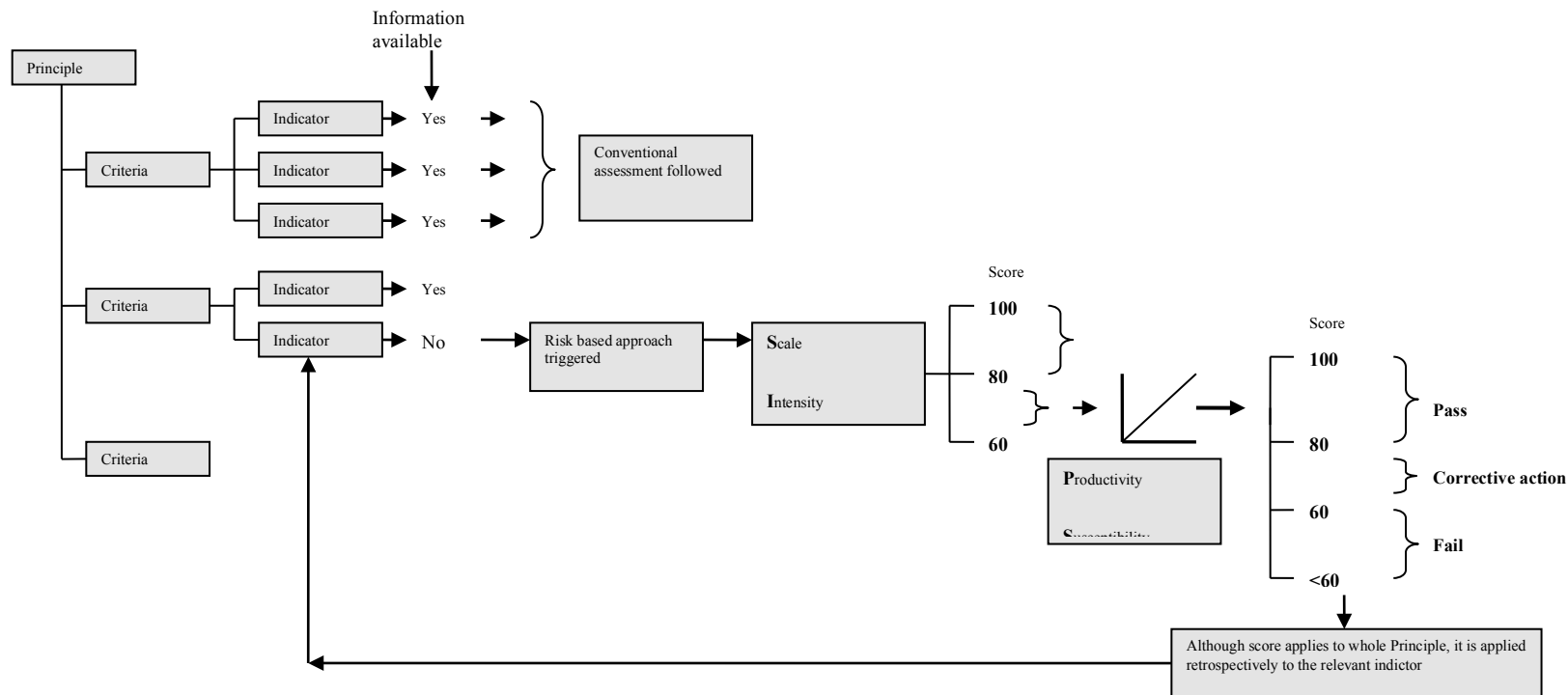
2.   Scale Intensity Consequence Analysis (SICA)

If a conventional Performance Indicator (PI) cannot be assessed in the conventional way, a risk based PI is used instead. In a similar way to the normal stakeholder interview the assessment team will ask questions that allow them to qualitatively evaluate the risk posed by the fishery, i.e. decide on whether the risk is "moderate", "minor" or "negligible". In order to make such a judgment questions need to be asked that help to describe the scale, intensity and the likely consequence of the activity (i.e. **S**cale **I**ntensity **C**onsequence **A**nalysis). The SICA is used to screen out low risk activities by identifying the significance of their impact on any species, habitat or community.

There are 6 steps to be carried out at part of the SICA process for each relevant Performance Indicator (PI). These steps are:

SICA Step	Action
1	Score **spatial scale** of the activity relevant to the PI.
2	Score **temporal scale** of the activity relevant to the PI
3	Choose the most **vulnerable attribute** relevant to the PI
4	Score the **intensity** of the activity for that attribute
5	Score the **consequence** resulting from the intensity of the activity for that attribute (i.e. Negligible / Minor / Moderate risk consequences equivalent to conventional MSC scores of 100 / 80 / 60),
6	**Document** the rationale for each of these steps and the confidence (Low or High) in the consequence against the PI.

The following sections describe how these steps are completed.

2.1   Score the spatial scale of the activity

<1 nm	1-10 nm	10-100 nm	100-500 nm	500-1000 nm	>1000 nm
1	2	3	4	5	6

The largest spatial area (relative to the distribution of the stock) is used to determine a score for the spatial scale of the activity. For example, if the relevant activity was longlining and it takes place within an area of 200 nm by 300 nm, then the spatial scale is scored as 4.

2.2 Score temporal scale of the activity

Decadel (1 day every 10 years or so)	Every several years (1 day every several years)	Annual (1-100 days per year)	Quarterly (100-200 days per year)	Weekly (200-300 days per year)	Daily (300-365 days a year)
1	2	3	4	5	6

The highest frequency is used to determine the temporal scale score for the relevant Performance Indicator activity. The number of days that an activity occurs can be combined, e.g. if the activity "fishing" was undertaken by 10 boats during the same 150 days of the year, the score is 3. If the same 10 boats each spend 30 non-overlapping days fishing, the temporal scale of the activity is a sum of 300 days, indicating that a score of 6 is appropriate. In the case where the activity occurs over many days, but only every 10 years, the number of days divided by the number of years in the cycle is used to determine the score. For example, 100 days of an activity every 10 years averages to 10 days every year, so that a score of 3 is appropriate.

2.3 Choose the most vulnerable species, habitat or community likely to be affected by the activity associated with the PI.

The most vulnerable species, habitats, or communities are selected. With Principle 1 PIs there is likely to be only the one target species to consider. With Principle 2 PI's, a number of by-catch species may be assessed, for example.

2.4 Score the intensity of the relevant activity

The intensity of the activity is based on the scale, nature and extent of the activity.

Negligible	Minor	Moderate	Major	Severe	Catastrophic
1	2	3	4	5	6

Negligible   = remote likelihood of detection at any spatial or temporal scale

Minor   = activity occurs rarely or in few locations and evidence of activity even at these scales is rare

Moderate   = detection of activity at broader spatial scale or obvious but local detecting

Major   = detectable evidence of activity occurs reasonably often at broad spatial scale

Severe   = easily detectable localized evidence of activity or widespread and frequent evidence of activity

Catastrophic   = local to regional evidence of activity or continual and widespread evidence

2.5   Score the consequence of intensity for that activity

The consequence for the activity is scored using the above factors. Where information is not available or agreement is not possible the most plausible score is applied to the activity.

2.6   Provide a reason for the scoring of each of the above steps and a confidence rating

The scores and reasons for the PI's overall consequence score is recorded. A confidence rating is provided, i.e.:

Confidence	Score	Rationale for the Confidence Score
Low	1	• Data exists but is considered to be poor or conflicting • No data exists • There is no agreement between experts
High	2	• Data exists and is considered sound • There is consensus between experts • The consequence is constrained by logical consideration

2.7   If the score from the SICA produces a score of less than 80, the assessment team proceeds to a further step, the Productivity and Susceptibility Analysis (PSA).

3.   Productivity and Susceptibility Analysis (PSA)

The PSA approach is based on the assumption that the potential risk to a species, habitat or community will depend on:

1. The **productivity** of the species, habitat or community, which will determine the rate at which recovery can occur after the fishing related activity; and,

2. The extent of the impact due to the fishing related activity, which will be determined by the **susceptibility** to the fishing activities.

3.1   Scoring a species for productivity

The productivity of a species can be scored using *productivity attributes*. Seven productivity attributes for over 400 habitats and species have been developed to support the Australian risk based assessment approach, they are:

Productivity Attribute
Average age at maturity
Average maximum age
Fecundity
Average maximum size
Average size at maturity
Reproductive strategy
Trophic level
Total
Average

These are presented on excel spreadsheets and have been made available to use in the MSC risk based approach. (For ease, hereafter these will be referred to as the "PSA worksheets"). Each productivity attribute is scored as either, 3 = "low", 2 = "medium", or 1 = "high". By taking the average score of all seven attributes it is possible to provide an overall productivity score for a species.

3.2 Scoring a species for susceptibility

Susceptibility is scored using susceptibility attributes they are:

Susceptibility Attribute	Description
Availability	Considers overlap of the fishing effort with a species distribution. Where a fishery overlaps a large proportion of a species range the risk is high because the species has no refuge, and the potential for impact is high.
Encounterability	Considers the likelihood that a species will encounter fishing gear that is deployed within its geographic range.
Selectivity	Considers the potential of gear to capture or retain the species.
Post-capture mortality	Post-capture mortality (PCM) evaluates the survival of a species if released after capture. The PCM of a species is affected by its biology and fishing practices.

All of the susceptibility attributes are supported and calculated using the PSA worksheets.

They are scored as: 1 = "low", 2 = "medium" or 3 = "high" and rescaled such that they can be plotted along with the productivity scores on a 2D diagnostic chart. This can be undertaken using the PSA excel worksheets. The relative position of the species on the plot will determine relative risk.

The following figure shows how the diagnostic chart displays PSA values for each species. Low risk species have high productivity and low susceptibility, while high risk species have low productivity and high susceptibility. The curved lines divide the potential risk scores into thirds on the basis of the distance from the origin (0,0).
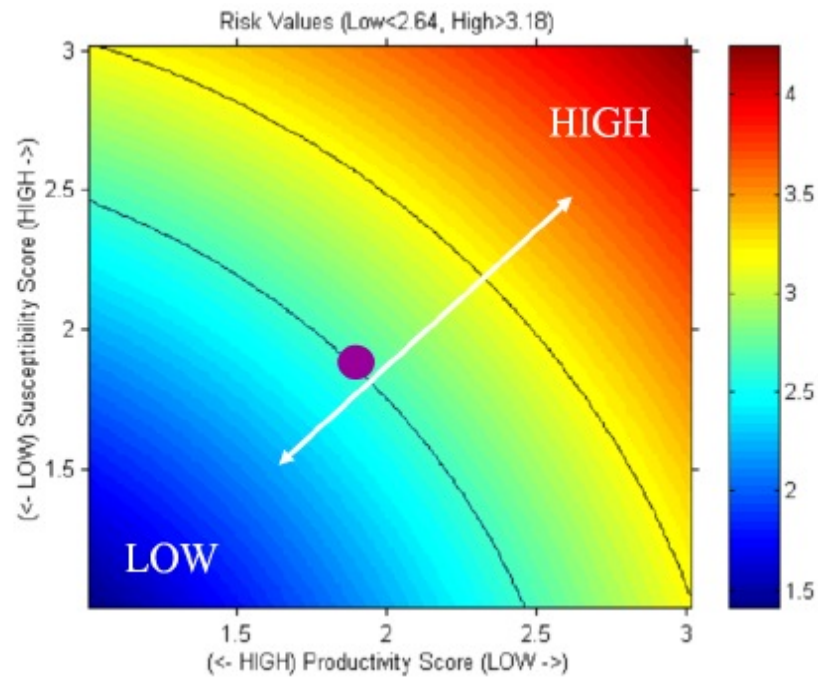
The possible PSA scores lie between 1.41 and 4.24 and can be interpreted as follows:

PSA Risk Category	PSA Score	Scoring Guidepost
High	>3.18	<60
Medium	3.18 – 2.64	60-80
Low	<2.64	>80

Where any score is >80, the indicator is passed for that species, habitat type or community assemblage. Where any of the species, habitat types or community assemblages scores 60-80 a condition is set on that PI. This is similar to the setting of conditions in the conventional assessment process. Any score <60 will result in failure for the PI.