

Assessing the Status of Tuna Resources in Sulu and Sulawesi Seas through Collaborative Research Survey

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Covering a total area of about 900,000 km², the Sulu and Sulawesi Seas (SSS) embrace an important large marine ecosystem in the tropical seas of Southeast Asia in terms of biological diversity. Bounded by three Southeast Asian countries, namely: Indonesia, Malaysia and the Philippines, the SSS has very rich fishing grounds for large and small pelagic as well as coastal and coral reef fishes, making it an important source of food and livelihoods for small-scale and commercial fishers. The SSS has tropical climate with a wide range of biophysical characteristics contributing to abundance of biodiversity including coastal and marine commercially important aquatic species. As part of the Coral Triangle, existing evidence have shown that the SSS is an important spawning and nursery grounds, and serves as migratory routes for the oceanic (bigeye, yellowfin, and skipjack) and neritic tunas. These tuna species are economically important for many Southeast Asian countries, not only for domestic consumption but also for export, making it imperative to assess the status and trend of tuna resources in the SSS for sustainable management and development of the resources.



Tunas are economically important to the peoples in Southeast Asia, especially for fishers in countries surrounding the SSS (Fig. 1) whose livelihoods depend on tuna fisheries. However, the unstable production of tunas in the region necessitates the development of a mechanism to collect information in order that the status of the tuna stocks could be established. Records have indicated that the highest producers of tunas in Southeast Asia are Indonesia, Philippines, and Malaysia (Table 1), and followed to some extent by Thailand.

In response to the request of the SEAFDEC Council of Directors for SEAFDEC to develop a collaborative mechanism under the SEAFDEC framework for the conduct of joint activities to determine the maximum sustainable yield of tunas in the Sulu and Sulawesi Seas (SSS), a series of sub-regional technical meetings were convened by SEAFDEC with financial support from the Japanese Trust Fund (JTF) to discuss the said concern. As a result, the **Joint Program on Tuna Research Survey in Sulu and Sulawesi Seas** was developed with the collaboration of concerned SEAFDEC Member Countries, namely: Indonesia, Malaysia, Philippines, and Viet Nam.

The tunas produced by the Southeast Asian countries are the major oceanic tunas, such as skipjack (*Katsuwonus pelamis*), yellowfin (*Thunnus albacares*) and bigeye (*T. obesus*), as well as other oceanic tunas such as albacore (*T. alalunga*) and southern blue fin (*T. maccoyii*), and neritic tunas, namely: frigate (*Auxis thazard*), bullet (*A. rochei*), kawakawa (*Eythynnus affinis*), and longtail (*T. tonggol*) tunas. During the five-year period from 2008 to 2012, the abovementioned major tuna producing countries contributed an annual average of about 98% to the total volume of tuna production of Southeast Asia, more than

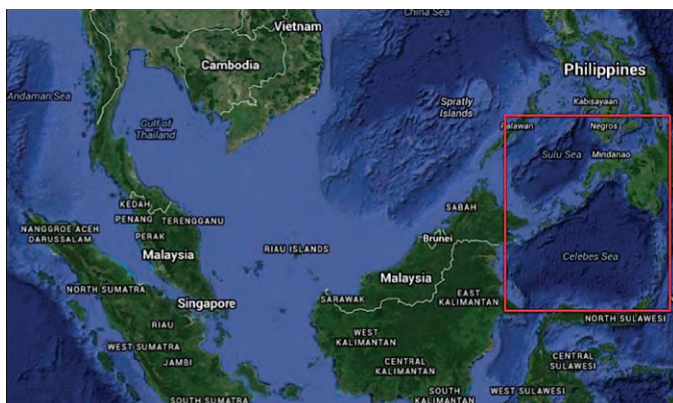


Fig. 1. Sulu and Sulawesi Seas bounded by Indonesia, Malaysia and the Philippines

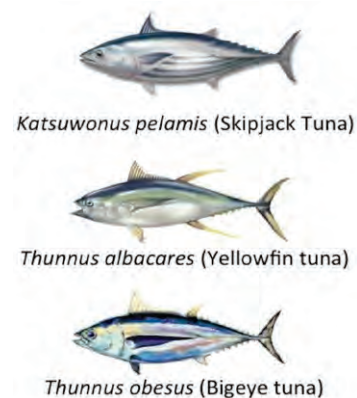


Table 1. Production of tunas by major tuna-producing countries of Southeast Asia (2008-2012)

	2008	2009	2010	2011	2012
Indonesia					
Quantity (in thousand metric tons (MT))	912.5	925.7	910.7	1,045.4	1,362.9
Value (in million US\$)	949.5	312.1	1,077.0	1,272.3	972.4
Philippines					
Quantity (in thousand metric tons (MT))	636.8	612.0	574.9	499.1	535.6
Value (in million US\$)	895.6	767.3	800.3	800.0	971.2
Malaysia					
Quantity (in thousand metric tons (MT))	67.2	56.0	50.5	60.1	72.9
Value (in million US\$)	250.8	55.1	145.9	113.5	129.7
Total tuna production of Southeast Asia					
Quantity (in thousand metric tons (MT))	1,662.6	1,633.6	1,588.3	1,641.4	1,987.1
Value (in million US\$)	2,144.0	1,189.4	2,065.4	2,224.0	2,096.3

Sources: SEAFDEC (2010), SEAFDEC (2011), SEAFDEC (2012), SEAFDEC (2013), SEAFDEC (2014)

Table 2. Total fisheries production of Southeast Asia (2008-2012)

	2008	2009	2010	2011	2012
Total fisheries production of Southeast Asia					
Quantity (in thousand metric tons (MT))	27,207.8	28,917.1	31,438.5	33,487.7	39,571.2
Value (in million US\$)	28,585.8	29,215.3	38,744.2	43,782.9	44,958.9
Southeast Asian production from marine capture fisheries					
Quantity (in thousand metric tons (MT))	13,814.4	14,140.4	14,874.5	15,095.5	15,590.5
Value (in million US\$)	12,338.2	10,416.7	15,898.8	21,178.8	20,049.0
Tuna production of Southeast Asian Countries					
Quantity (in thousand metric tons (MT))	1,662.6	1,633.6	1,588.3	1,641.4	1,987.1
Value (in million US\$)	2,144.0	1,189.4	2,065.4	2,224.0	2,096.3

Sources: SEAFDEC (2010), SEAFDEC (2011), SEAFDEC (2012), SEAFDEC (2013), SEAFDEC (2014)

11% to the marine fisheries production, and about 6% to the total fisheries production of the region (**Table 1** and **Table 2**).

According to FAO (2014), the share of tuna in the total export value in 2012 was about 8% although during the last three years, the global tuna markets had been unstable in view of the fluctuating tuna production by the major tuna-producing countries. This was also true at the regional scene where production of tunas had been at an unsteady pace over the past five years, not only in terms of volume but also in monetary value (**Table 2**).

In an effort to address the abovementioned concerns, the countries participating in the **Joint Program on Tuna Research Survey in Sulu and Sulawesi Seas** agreed to carry out a three-year plan of activities in the SSS using the M.V. SEAFDEC 2. Specifically, the focus of the Joint Program would be on the use of FADs in the SSS, status and trend of tuna stocks and estimated maximum sustainable yield of target tuna species, and spawning and nursery grounds of tuna resources. Considering that three major species of oceanic tunas are produced by the

countries surrounding the SSS (**Table 3**), the participating countries therefore agreed that the Joint Program would put more emphasis on the yellowfin tuna (*Thunnus albacares*), bigeye tuna (*Thunnus obesus*), and skipjack tuna (*Katsuwonus pelamis*).

The Joint Program on Tuna Research Survey in Sulu and Sulawesi Seas

Furthermore, as also agreed by the participating countries, the Joint Program should be spearheaded by the SEAFDEC Training Department (TD) and Marine Fishery Resources Development and Management Department (MFRDMD), with the JTF providing financial and technical support. Nevertheless, in terms of the operating expenditures under the Joint Program, the participating countries agreed to share the expenses incurred, especially when the cruise survey is conducted in their respective waters. In order to propel the objectives of the Joint Program forward, benchmark information and other relevant data with respect to tuna fisheries in the three participating countries were compiled as shown in **Box 1**.

Table 3. Production of oceanic tunas by major tuna-producing countries of Southeast Asia (2008-2012):
Qty in thousand MT; Value in million US\$

	2008		2009		2010		2011		2012	
	Qty	Value	Qty	Value	Qty	Value	Qty	Value	Qty	Value
Indonesia	453.6	466.3	458.9	108.1	513.0	689.4	614.7	804.4	702.8	670.0
Skipjack tuna	296.8	262.4	300.8	49.4	330.0	355.8	372.5	421.3	429.0	343.8
Yellowfin tuna	102.8	141.9	103.4	38.6	130.4	211.9	175.8	267.6	190.2	239.5
Bigeye Tuna	54.0	62.0	54.7	20.1	52.6	121.7	66.4	115.5	83.6	86.7
Philippines	425.6	646.1	409.8	316.9	387.2	565.3	330.0	561.8	344.3	714.3
Skipjack tuna	222.0	296.5	251.5	55.1	228.2	267.7	197.4	278.4	206.5	345.7
Yellowfin tuna	168.4	292.1	152.5	249.6	147.3	274.7	123.0	260.8	125.3	334.3
Bigeye Tuna	35.2	57.5	5.8	12.2	11.7	22.9	9.6	22.6	12.5	34.3
Malaysia	3.4	8.7	7.3	11.7	8.6	13.0	8.2	14.3	13.3	11.3
Skipjack tuna	0.3	0.4	4.5	6.1	5.2	6.4	6.3	9.4	5.5	8.0
Yellowfin tuna	1.5	3.8	1.4	2.7	2.2	4.6	1.2	3.7	1.1	2.2
Bigeye tuna	1.6	4.5	1.4	2.9	1.2	2.0	0.7	1.2	6.7	1.1
Total	882.6	1,121.1	876.0	436.7	909.8	1,267.7	952.9	1,380.5	1,060.4	1,395.6

Sources: SEAFDEC (2010), SEAFDEC (2011), SEAFDEC (2012), SEAFDEC (2013), SEAFDEC (2014)

Box 1. Information on tuna fisheries in three participating countries of the Joint Program on Tuna Research in SSS

Indonesia

The landing data of tuna and tuna like species in Indonesia has been compiled and reported by group level since 1977, but the country started to compile data on yellowfin and bigeye tunas, and kawakawa by species level starting in 2014. Moreover, Indonesia also collects fishing effort data based on five (5) fishing gears, *i.e.* longline, Danish seine, purse seine, handline, and pole and line. From the Sulawesi Sea, the major landings comprise mostly large pelagic species followed by small pelagic and demersal species. Length-frequency data for tuna had also been compiled although such data still need validation since local enumerators have not been adequately prepared in terms of capacity building, in the aspect of species identification. From 1980 to date, the country had conducted at least seven (7) resource survey cruises in the SSS, the result of which would be useful to understand the status of fishery resources and the environmental conditions in the SSS. The main fishing ports in the north Sulawesi Sea used for landing tunas are located in Tumumpa and Bitung in Indonesia.

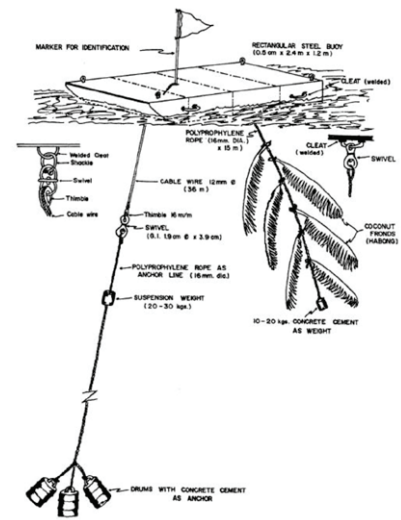
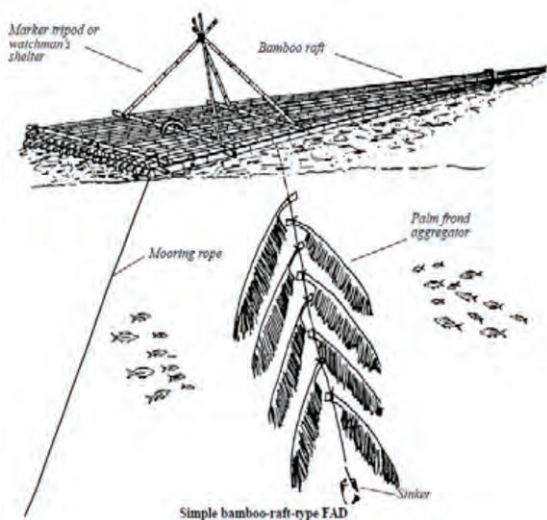
Malaysia

Tuna catch data has been compiled by Malaysia since 1991 based on tuna landed, however, Malaysia started to collect the monthly catch by species and effort data of handline only in 2008. For tuna purse seine, the total catch was recorded only for skipjack, kawakawa and other neritic tunas. Nevertheless, information on the number of Fish Aggregating Devices (FADs) in its waters had also been compiled. Recently, tuna stock assessment in Malaysia was carried out based on landing data at Semporna District compiled for Sabah State of Malaysia where most of tunas are landed. Currently, the Department of Fisheries (DOF) Malaysia is implementing two (2) tuna fishery programs: strategic action plan for tuna fisheries development industry (2013 to 2020) that focuses on catch and marketing data; and research program supported by the Coral Triangle Initiative (CTI) on resources and biology of tropical tunas in SSS (2012 to 2013) which aimed to establish effective measures for sustainable exploitation of shared tuna stocks within the tuna spawning areas and of juvenile stages that are adequately protected. In 2009, DOF Malaysia in collaboration with a university in Malaysia conducted a survey of large pelagic species in the SSS of Malaysian waters where several fishing gears were used. Data from such survey would be reviewed to obtain information about the condition of tuna resources in such waters. The data collected under this Joint Program, especially the relevant data from Indonesia and the Philippines would complement those from the current study conducted by Malaysia.

Philippines

The national initiatives of the Philippines on tuna data collection include the conduct of port sampling, use of log-sheets and observers program, vessel monitoring system, and from cannery receipts. The major fishing gears used for tuna fisheries in the Philippines include purse seine, ring net, and hand-line catching tunas near FADs. Tuna is a major export commodity for the Philippines, where several national institutes have been involved in the management of its tuna fishery resources. The country also promotes a number of management plans related to tuna fisheries, *i.e.* national tuna management plan; national plan of action to deter illegal, unreported and unregulated fishing; and national tuna FADs management policy. In addition, the country also conducted several research programs in the SSS, especially on resource assessment, biology of tunas, physiology of tunas, tuna tagging, boats and gear design, socio-economic as well as post-harvest technology. Moreover, a number of research activities had been planned for future work on tuna in the Philippines, *i.e.* genetic identification and characterization of tunas, oceanographic survey on major tuna fishing grounds, studies on mitigation the effect of FADs to fishery resources, and gear selectivity of tunas. Nevertheless, the Philippines still need capacity building on tuna assessment, especially for the researchers who are supporting its National Stock Assessment Program.

The participating countries also agreed that the specific activities to be implemented under the Joint program would include: (i) review of catch and effort, biological data/information on tuna harvested in SSS; (ii) primary data collection: tissue samples for genetic study, spawning ground information using the M.V. SEAFDEC 2; (iii) tuna



Left-right: traditional FADs, bamboo payaos (Philippines) and steel payaos (Philippines)

Box 2. Activities and work plan of the Joint Program on Tuna Research in SSS

Review of catch and effort, biological data on tuna harvested from SSS

- Identification of tuna landing sites in SSS
- Review of periodical tuna production from respective national fisheries statistics
- Determining the total catch from SSS including species composition, and identifying the needs for data collection
- Sharing of information on at-sea-observation/onboard observer program for identifying tuna spawning grounds and species composition
- Compilation of data for common use on regional stock assessment

Primary data collection

- Compilation of fisheries data from identified landing sites, including catch and effort and biological data (using simplified Standard Operational Procedures (SOPs) for data collection; and tissue samples for genetic analysis of major tuna as necessary)
- Tuna spawning ground profiling using the M.V. SEAFDEC 2 in participating countries' jurisdictions

Tuna stock assessment

- Identification of peer reviewers/experts on tuna stock assessment in respective countries, in or outside the region
- Establishment of the experts working group for regional tuna stock assessment
- Standardizing the methodology for assessment of sub-regional tuna stocks
- Estimating the Maximum Sustainable Yield of the target tunas

Determining of tuna spawning grounds in SSS

- Identification of peer reviewers/experts on tuna larvae identification in respective countries, in or outside the region
- Establishment of experts working group for tuna larvae identification
- Utilizing the SEAFDEC standardized methodology for tuna larvae identification
- Identification of spawning grounds of the target tunas

Assessment of FADs used for tuna fisheries in SSS

- Evaluation of the concentration of FADs in SSS through collaborative survey onboard the M.V. SEAFDEC 2
- Determining species composition and size of tuna caught near FADs using appropriate sampling gears, such as trolling, long-line, or from national observers program

stock assessment; (iv) identification of the tuna spawning grounds; and (v) assessment of FADs used for tuna fisheries (**Box 2**). In addition, sub-regional meetings and technical consultations would be convened to discuss the results of the Joint Program cruise surveys. The working mechanism agreed upon by the participating countries is shown in **Box 3**.

Results and Discussion

In order to facilitate the conduct of the activities in the Joint Program, the participating countries adopted the Standard Operating Procedures (SOPs) for data collection under the research areas to be carried out in SSS (**Box 4**) as well as the final cruise plan of the M.V. SEAFDEC 2 during the survey from 17 October to 8 December 2014 (**Box 5**). The participating countries are responsible in analyzing their respective data. The preliminary findings from the surveys on data collection at the selected landing

Box 3. Working mechanism for the participating countries in the Joint Program on Tuna Research in SSS

- Identify and nominate the country experts responsible for stock assessment, larval fish identification, FADs, and genetics
- Collect catch and effort data from the landing sites (and information from observer program) and undertake the first level analysis
- Share information based on results from the findings of the survey for regional analysis through working group meetings
- Co-finance the use of the M.V. SEAFDEC 2 for cruise surveys in SSS
- Cost-share the expenses including travel costs of country experts joining the meetings
- Designate technical staff to participate in relevant cruise surveys of the M.V. SEAFDEC 2, and undertake the first level analysis of all data compiled and specimens collected
- Participate in sub-regional working group meetings for analyzing specific issues, e.g. stock assessment, identification of tuna spawning grounds

Box 4. SOPs for data collection under the Joint Program on Tuna Research in SSS

Tuna Stock Assessment

- **Tuna fishery profile in SSS:** total no. of tuna catchers, total no. of fishing gear, major landing sites, etc.
- **Catch landing:** monthly total weight by species and gear
- **Length frequency:** monthly length distribution by species and gear
- **Weight frequency:** monthly average weight distribution by species and gear
- **Growth pattern:** monthly length frequency by species
- **Gonad:** monthly stage of maturity by species

The following information may be also collected, if the country can support such scientific data collection:

- **Stomach contents:** stomach content by species
- **Genetic:** tissue sampling

Tuna Spawning Ground

Horizontal towing by Neuston net and oblique by Bongo net (500 micro m) will be carried out onboard the M.V. SEAFDEC 2 during the survey in SSS. Details of the data collection are as indicated in the SOPs.

On FADs

Only man-made FADs will be considered, and the major activities include: (i) determining the species composition and size of tuna caught in the FADs area using binocular observation and radar recording; and (ii) catch data using log-sheets.

Genetic Study for Tuna Resources

Each country is responsible for genetic data collection and analysis of a species of tuna, *i.e.* Indonesia (bigeye tuna); Malaysia (skipjack tuna); and Philippines (yellowfin tuna). Tissue samples of each leg of the cruise survey of the M.V. SEAFDEC 2 should be taken from about 20–30 specimens for one (1) species, samples from landing sites could also be used in case specimens from onboard data collection using the M.V. SEAFDEC 2 are not sufficient.

sites and the cruise survey of the M.V. SEAFDEC 2 carried out in the SSS in 2014 were reported and discussed during the Working Group Meeting in February 2015. In order to assist the participating countries in the process of selecting appropriate methodology for analysis as well as in analyzing all data collected from the cruise surveys, the JTF provided technical support for the secondment of an international expert on tuna stock assessment. The subsequent survey cruise in 2015 (**Box 6**) was also agreed upon and as finally decided, results for the Joint Program would be reported through an end-of-program Meeting before the end of 2015.

References

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Box 5. 2014 Cruise Plan for the M.V. SEAFDEC 2 under the Joint Program on Tuna Research in SSS

Duration: 17 October - 8 December 2014 (52 days)

Ports of Call: Puerto Princesa (Philippines), Zamboanga City (Philippines), Sandakan (Malaysia), Bitung (Indonesia)

Area of Operations: Sulu Sea and Sulawesi Sea (63 survey stations in 3 legs)

Leg 1: Puerto Princesa-Zamboanga City (25 Oct-2 Nov 2014: 25 stations)

Leg 2: Zamboanga City-Sandakan-Bitung (5-13 Nov 2014: 21 stations)

Leg 3: Bitung (22-28 Nov 2014: 17 stations)

Objectives: To undertake activities on: (1) oceanographic survey (ICTD, bongo net, Neuston net, current indicator) in 63 stations; (2) hydro-acoustic survey using scientific echo sounder, echo sounder and full circle scanning sonar (scientific echo-sounder to be operated along the sailing track); and (3) conduct fishing trials by trolling, handline and short "longline" at any survey stations or where convenient or appropriate.

Box 6. 2015 Cruise Plan for the M.V. SEAFDEC 2 under the Joint Program on Tuna Research in SSS

Duration: 20 March - 11 May 2015 (52 days)

Ports of Call: Puerto Princesa (Philippines), Zamboanga City (Philippines), Sandakan (Malaysia), Bitung (Indonesia)

Area of Operations: Sulu Sea and Sulawesi Sea (63 survey stations in 3 legs)

Leg 1: Puerto Princesa-Zamboanga City (28 Mar-5 April 2015: 25 stations)

Leg 2: Zamboanga City-Sandakan-Bitung (8-16 April 2015: 21 stations)

Leg 3: Bitung (25-30 April 2015: 17 stations)

Objectives: To carry out activities on: (1) oceanographic survey (ICTD, larvae and plankton net, bongo net, Neuston net, temperature-depth sensor (TD), current indicator) in 63 stations; (2) hydro-acoustic survey using scientific echo sounder, echo sounder and full circle scanning sonar (scientific echo-sounder to be operated along the sailing track); and (3) fishing trials by trolling, handline and short "longline" at any survey station or where convenient or appropriate (in some stations, small boat equipped with portable echo sounder may be used to determine fish schools near payaos).

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