



Australian Government

Australian Centre for
International Agricultural Research

PROJECT SUMMARY

ACIAR Project FIS/2002/074

*Capacity development to monitor, analyse
and report on Indonesian tuna fisheries*



Craig Proctor, Purwanto, Agus Budhiman, Subhat Nurhakim, Budi Iskandar Prisantoso, Retno Andamari, Lilis Sadiyah, Tim Davis, Natalie Dowling, Campbell Davies, Wudianto, Victor Nikijuluw, Achmad Poernomo, Parlin Tambunan, Nilanto Perbowo, Dyah Retnowati, Gede Merta, Budi Nugraha, Setiya Triharyuni, I. Gede Bayu S., Duto Nugroho, Kusno Susanto, Team observers and Team enumerators



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The Australian Centre for International Agricultural Research (ACIAR) was established in June 1982 by an Act of the Australian Parliament. Its mandate is to help identify agricultural problems in developing countries and to commission collaborative research between Australian and developing country researchers in fields where Australia has special research competence.

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Context

The tuna fisheries shared by Indonesia and Australia have begun to show signs of decline. Catch and fish sizes have been on a downward trend that, if left unaddressed, is likely to result in the collapse of the fishery. With an estimated value in exports of US\$200 million a year to Indonesia, the impact of collapse would be widespread in commercial fishing sectors in both countries and in the artisanal fisheries in Indonesia. Through the Australian Centre for International Agricultural Research (ACIAR), Australia and Indonesia have been working cooperatively to improve this situation. The overall goal of this project was to improve Indonesia's capacity to monitor and assess its tuna and billfish fisheries, and its ability to report this information internationally. These are considered two critical steps in achieving effectively managed and sustainable fisheries.

Key achievements

Trial observer program – established and successfully operated for the Indian Ocean tuna longline fishery based at Benoa Fishing Port in Bali. During the project, our team of 6 observers was fully trained, then between them completed 2,935 observer days over 83 sea trips, covering 1,681 longline sets on the vessels of 12 fishing companies. This program addressed critical gaps on 'catch per unit effort' and has greatly improved understanding of all aspects of at-sea operations of the fishery.

Review of eastern Indonesian tuna fisheries – covered seven key landing ports, and provided baseline information vital to a collaborative project to establish improved data collection at two key tuna landing ports in Sulawesi (Bitung and Kendari). The project also made significant contributions to development of sampling protocols and delivery of training to enumerators (data collectors).

Capacity development in stock assessment – two trainees with a mathematics background were recruited by the project to Indonesia's Research Centre for Capture Fisheries (RCCF)¹ and became skilled in: database handling and programming; data exploration and analysis; the basics of stock assessment; and fisheries concepts. One of the trainees completed her PhD in late 2010, undertaken through the project.

Increased participation in Regional Fisheries Management Organisations (RFMOs) – project activities contributed to Indonesia becoming a full member of the Indian Ocean Tuna Commission (IOTC) and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), and further progressed toward becoming a full member of the Western and Central Pacific Fishery Commission (WCPFC). The observer program and expansion of port-based monitoring in eastern Indonesia have improved Indonesia's capacity to meet data-reporting requirements to the RFMOs.

¹ Change from "Research Centre for Capture Fisheries" to "Research Centre for Fisheries Management and Conservation" in 2010.

Establishment of a new research station – the project assisted in establishing a new base for monitoring and research activities at Benoa Fishing Port. The opening of this station in February 2009 was seen as a landmark event in the long history (since the early 1990s) of Indonesia – Australia collaborations on tuna fisheries.

Capacity development in other research areas – staff from RCCF were trained in Australia on techniques for determining the age of tuna; others were trained at the Gondol Research Institute for Mariculture (in Bali) on techniques for studies of reproductive biology of tunas and other species.



Project particulars

Project country: Indonesia

Commissioned organisation: Commonwealth Scientific and Industrial Research Organisation (CSIRO) Marine Research, Australia

Project leaders: Mr Craig Proctor (CSIRO, Australia), Dr Purwanto (RCFMC, Indonesia), Ir. Agus Apun Budhiman M.Aq. (DGCF, Indonesia) and previously, Dr Subhat Nurhakim (RCCF), Dr Wudianto (RCCF), Dr Victor Nikijuluw (RCCF), Dr Achmad Poernomo (RCCF), Mr Parlin Tambunan (DGCF), Ir.Nilanto Perbowo M.Sc. (DGCF).

Collaborating institutions: Research Centre for Fisheries Management and Conservation (formerly Research Centre for Capture Fisheries), Indonesia; Directorate General of Capture Fisheries, Indonesia

Background

Indonesia's fisheries for tuna and tuna-like species are highly significant on the world scale. They are collectively the largest among nations fishing in the Eastern Indian Ocean, with the commercial longline fishery alone having around 1,100 vessels currently active (IOTC 2010). Indonesia accounted for 15% of the total catch by nations fishing for these species in the Indian Ocean, with estimated landings of 180,000 tonnes from all gears² (Herrera 2008). In 2006, Indonesian production of tunas was in excess of 800,000 tonnes, with an export value of US\$250 million (MMAF 2008). This includes production from both the commercial and artisanal/small-scale sectors.

Over the past 20 years or more, however, for some of the key target species there has been a declining trend in numbers and size of fish in individual vessel catches from these fisheries. Fleets now need to operate further from 'traditional' fishing grounds to achieve profitable catches.

A previous ACIAR project (FIS/2001/079, 'A review of Indonesia's Indian Ocean tuna fisheries and extension of catch monitoring at the key off-loading ports') produced a status report on Indonesian tuna fisheries in the Indian Ocean during 2002-03. This preparatory project was the first step in what is seen as a long-term cooperative effort between Australia and Indonesia to assist Indonesia in acquiring improved research and management capacity in tuna fisheries, thereby facilitating active participation in international Regional Fisheries Management Organisations (RFMOs).

²'Gear' in this case refers to all the fishing methods used to catch pelagic fish, including purse-seine, pole and line, longline, hook and line, troll-line, gill-net, etc. (FAO 2010).

Both countries agreed that the best approach to increased cooperation was through institution building, technical cooperation, training and skill sharing, and developing capacity by improving practices and procedures for data management and reporting in support of fisheries management. The goal of the current project (FIS/2002/074, 'Capacity development to monitor, analyse and report on Indonesian tuna fisheries') was for Indonesia to develop statistically robust data collection, synthesis and reporting systems, and the fishery stock assessment capacity to enable Indonesian scientists to provide robust data summaries and stock assessments of its fisheries to international management organisations. Achieving this goal would go a long way to ensuring sustainability of the shared stock tuna fisheries of both Indonesia and Australia, and provide a greatly improved outlook for the fish populations and associated ecosystems.

Primary goal

To improve Indonesia's capacity to independently monitor and assess its tuna and billfish fisheries, and the capacity for reporting to international management organisations – critical steps towards the higher goal of achieving capacity for effective management procedures and sustainable fisheries.

Objectives

1. To improve and extend existing national systems and capabilities for the collection, compilation and analysis of reliable, high-quality fisheries data for Indian Ocean tuna longline fisheries in Indonesia.
2. To conduct a thorough review of Indonesia's tuna fisheries operating in the eastern region, including Banda Sea and Western Pacific Ocean waters, as a preliminary step to the establishment of improved port-based monitoring at selected eastern Indonesian tuna landing ports.
3. To develop a broader based capacity within the Ministry of Marine Affairs and Fisheries to analyse and interpret fisheries data and to ultimately be able to independently produce and report fisheries assessments in line with international requirements for shared fish stocks.

Summary of results

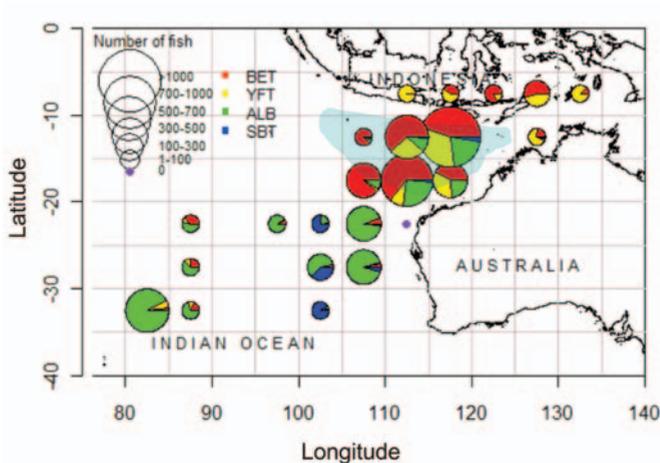
Objective 1 – *To improve and extend existing national systems and capabilities for the collection, compilation and analysis of reliable, high-quality fisheries data for Indian Ocean tuna longline fisheries in Indonesia.*

Collation and analysis of historical and newly established data

A detailed comparison of catch per unit effort (CPUE) and bycatch datasets from the Indian Ocean longline fishery was undertaken. The three datasets examined were from: 1. A Bali-based fishing company, PT Perikanan Samodera Besar; 2. Fisheries High School ‘observer’ program; and 3. this project’s trial observer program. Exploratory analyses determined the deficiencies in the three datasets and assessed the consistencies between them and the relative merits of each in addressing different questions for the fishery. A simulation model was developed to evaluate the minimum monitoring requirements, under different conditions, for delivering data that best reflect the total catch and effort of the fishery and the underlying stock abundance. This assessment was made by Ms Lilis Sadiyah, recruited to the project as explained under Objective 3.



Ms Sadiyah submitted her PhD thesis for assessment in Nov 2009 and was awarded her PhD in Dec 2010.



Example of spatial effort coverage and tuna catch composition from observer program data, as analysed by Ms Sadiyah (Colour key: Bigeye tuna – red, yellowfin tuna – yellow, albacore tuna – green, southern bluefin tuna – blue. Pale blue area is southern bluefin spawning ground).

Trial observer program – Indian Ocean longline fishery

The port-based monitoring established at key tuna landing ports in the earlier ACIAR project (FIS/2001/079) provided good data on the quantity of landings, catch composition, fish weight and length, and opportunities for some biological sampling. However, it did not provide the level of CPUE information required for science-based stock assessment of the fishery. In recognition of this information gap and the need for good-quality data on at-sea operations, the project established a trial observer program for the longline fishery.

In July 2005, six Indonesian trainee observers were recruited and, together with six trainees from Timor Leste, received 6 days of training from CSIRO and RCCF/Research Institute for Marine Fisheries (RIMF) project staff, with some inputs from Ms Jennifer Giles (expert on sharks and rays, at the time from Australian Volunteers International), the Office of Surveillance of Fishing Vessels (WASKI) and Asosiasi Tuna Longline Indonesia. The training course was conducted both in the classroom and in the field. In February 2008, the observer team also received a week of basic safety training at the Maritime Higher Education Institute in Jakarta.



Indonesian and Timor Leste trainees in classroom training.



Safety training.



In-field training on fish identification.



Observers receiving course certificates from Observer Program Manager, Ms Retno Andamari.

From August 2005 to December 2009, the project's team of 6 observers completed 2,935 observer days over 83 sea trips, covering 1,681 longline sets across vessels of 12 fishing companies. The observers recorded information on all aspects of the fishing trips, including: vessel and gear characteristics; trip schedule and tracking of vessel position; bait and line configuration; setting and hauling; catch size and composition (target tuna and bycatch species); and sea and weather conditions. Research trials with mini-loggers (temperature-depth recorders) and hook-timers were also done by the observers on 10 trips to obtain information about fish feeding behaviours. On return to port, the observers entered the data into a custom-built database and produced trip reports as output of the program, with copies also provided to the relevant vessel owner companies.

Summary of the Trial Observer Program for tuna longline fleet based at Benoa, Bali

Observer name	Started	Finished	Total no. trips	Total days at sea	Trip duration (range in days)
Muhamad Sururi	Jul 2005	Jul 2006	5	116	20 – 32
Irwan Jatmiko	Jul 2005	Mar 2008	8	261	7 – 99
Gamadi	Jul 2005	Oct 2008	11	272	21 – 41
I Gede Arya Susanjaya	Aug 2006	Mar 2008	3	149	26 – 96
I Nyoman Suprihanta	Mar 2008	Dec 2009*	6	201	17 – 51
Akhmad Yusuf Afandi	Mar 2008	Dec 2009*	11	407	15 – 75
Abram Barata	Jul 2005	Dec 2009*	12	471	21 – 71
Andi Bahtiar	Jul 2005	Dec 2009*	12	404	21 – 56
Dian Novianto	Jul 2005	Dec 2009*	15	654	19 – 150
		Total	83	2935	7 – 150

*Still active as observers at completion of the project.

The size and number of vessels that carried observers during the program

Size of vessel (GT)	No. of vessels
10 – 30	3
30 – 60	4
60 – 90	6
90 – 120	9
120 – 150	5
Total	27



Post-trip data entry into database and report preparation.

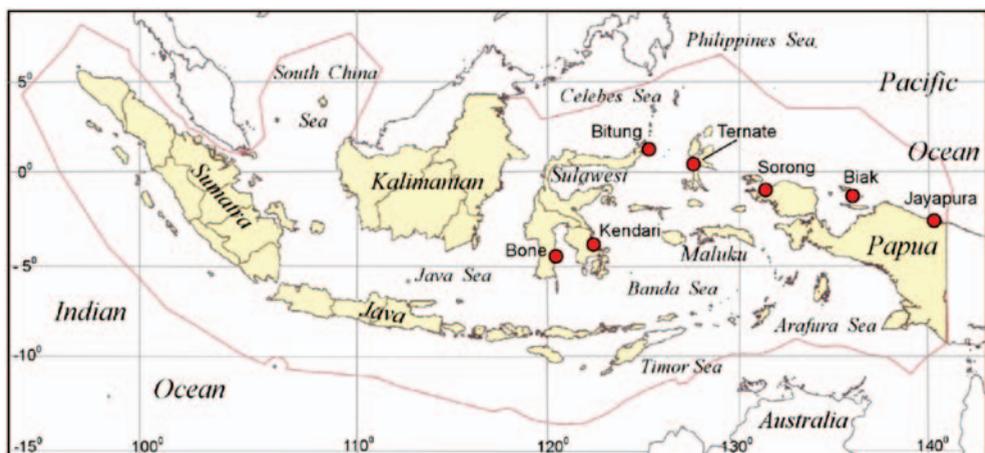


Line hauling operations at sea.

Objective 2 – To conduct a thorough review of Indonesia's tuna fisheries operating in the eastern region, including Banda Sea and Western Pacific Ocean waters, as a preliminary step to the establishment of improved port-based monitoring at selected eastern Indonesian tuna landing ports.

Review of tuna fisheries at seven eastern Indonesian ports

The primary focus of the project's review of eastern Indonesian tuna fisheries was to provide the Indonesia and Philippines Data Collection Project (IPDCP) with sufficient data to make informed recommendations for planning the development and implementation of port-based monitoring at key landing sites. The survey team – Budi Nugraha (RIMF) and Craig Proctor (CSIRO) – made three survey trips between September 2005 and July 2006. The ports surveyed comprised Jayapura, Sorong and Biak (all in Papua), Bitung (North Sulawesi), Ternate (North Maluku), Kendari (South-East Sulawesi) and Bone (South Sulawesi).



Map showing the locations (red circles) of the seven ports surveyed.

The review provided information to an IPDCP workshop in January 2007 on:

- the nature and extent of longline and surface tuna fisheries (commercial and small-scale) operating at each port, fleet sizes and structures, fishing areas, fleet operating 'behaviours', product processing and distribution routes (overseas and within Indonesia), the history of development of tuna fisheries in each area, and the key target tuna, tuna-like and bycatch species being caught
- the current methods used to collect, aggregate and report on tuna and tuna-like species catch data, by national, provincial and district fisheries offices, port authorities, processing companies, vessel-owner companies and vessel-owner organisations

- available catch-related data for tuna and tuna-like species held by the abovementioned offices, agencies, institutions and companies
- identifying for each of the ports surveyed, the requirements for establishing and operating an effective shore-based monitoring program.

The recommendations from the workshop led to the development of a proposal by RCCF (with major inputs from this project) for a trial of monitoring at two of the seven ports that were judged as highest priority – Bitung and Kendari.



Mr Budi Nugraha (left) with District fisheries staff in Biak, Papua.



Fish market at Sodoha, Kendari, SE Sulawesi.



Tuna canning factory in Sorong, Papua.

Establishment of monitoring at select eastern ports

The main aim for the monitoring program was that it would provide adequate information to enable Indonesia to meet its data-reporting requirements for science-based stock assessments, i.e. to address the gaps in data obtained through existing data-collection procedures. Monitoring trials, conducted in October 2008, were a success, and led to the development of a full-scale proposal (for submission to the Global Environment Facility, GEF) for establishment of monitoring at the ports at Bitung and Kendari. This project provided inputs during the development process and assisted RCCF, the Secretariat of the Pacific Community (SPC), the Western and Central Pacific Fisheries Commission (WCPFC) and fisheries consultant Dr Tony Lewis with the development and refinement of data collection sheets and sampling protocols to suit the eastern Indonesian fisheries, and with the delivery of training to enumerators recruited to the program.



Provision of training to enumerators at Bitung Fishing Port, North Sulawesi.



Objective 3 – *To develop a broader based capacity within the Ministry of Marine Affairs and Fisheries to analyse and interpret fisheries data and to ultimately be able to independently produce and report fisheries assessments in line with international requirements for shared fish stocks.*

Training of RCCF scientists in stock assessment principles and skills

Two graduates from the Faculty of Mathematics at Bogor Agricultural University (Institut Pertanian Bogor) were recruited by this project to RCFMC. This was seen by all as a highly significant development as there had been no previous recruitment of staff with strong mathematics background as the foremost prerequisite. Both graduates received training in Australia, to different levels, in database handling and programming, database analysis, data exploration, stock assessment basics and fisheries concepts.

The first graduate trainee appointed was Ms Lilis Sadiyah, who was subsequently awarded an ACIAR John Allwright Fellowship and completed the analysis of data outlined earlier (under Objective 1) as a PhD project at the School of Zoology, University of Tasmania in Hobart, Australia. She obtained her PhD in 2010 after completing her thesis entitled 'An evaluation of Indonesia's Indian Ocean tuna longline fisheries, based on historical and newly established sources of CPUE information'. The outcomes of Ms Sadiyah's project will have important application in the development of a formal national fisheries observer program for Indonesia and her study has significantly improved our overall understanding of the Indonesian longline fishery operating in the Indian Ocean. But most important has been the development of Ms Sadiyah into a skilled fisheries scientist within RCCF. She has become a key person in the interpretation of fisheries data and in reporting assessments of Indonesia's tuna catches to the relevant RFMOs (in particular, to the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) Scientific Committee meetings).

Both trainees received several capacity development opportunities, including presentations by Ms Sadiyah at local and international conferences, workshops and meetings. The second trainee, Ms Setiya Triharyuni, played an important role in organising and acting as 'MC' for several key meetings. In the majority of cases, the trainees were required to address the meetings.



Ms Sadiyah (right) discussing her results with her CSIRO supervisor, Dr Natalie Dowling.



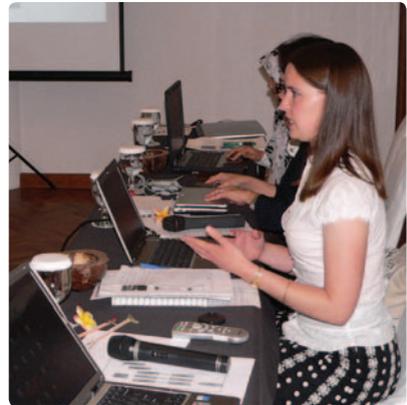
Project staff Ms Dyah Retnowati, Ms Lilis Sadiyah and Ms Retno Andamari discuss tuna fisheries with Dr Gavin Begg (BRS, Australia) at the International Fisheries Observers Conference, Victoria, Canada, May 2007.



Ms Sadiyah presenting at World Oceans Conference, Manado, North Sulawesi, May 2009. To her right is Session Chair and project member, Dr Campbell Davies.



Ms Setiya Triharyuni (right) in one of her key roles as MC at the International Steering Committee Meeting for Monitoring of Indonesia's Tuna Fisheries, Jakarta, May 2008. Also shown (seated) is project member Ms Dyah Retnowati (DGCF).



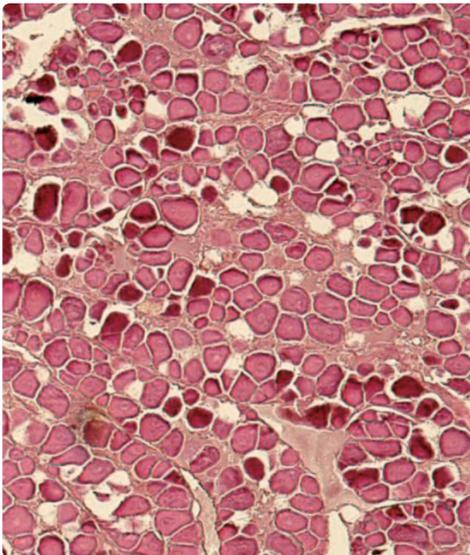
Dr Natalie Dowling (CSIRO) presented to the Project's Coordination Meeting in November 2007 in Bali on "The minimum requirements and biggest challenges in doing effective stock assessment in pelagic fisheries".

Capacity development in other research areas

In Australia, trainees from RCCF learned techniques for age determination of tunas using sections of the fish's otoliths – structures in the inner ear that can be 'read' similar to the growth rings of trees to determine factors such as the fish's age. Training was also provided at the Gondol Research Institute for Mariculture, in Bali, on histological examination of gonads for studies of reproductive biology of tunas and other species.



Training in Australia for trainees from Research Centre for Capture Fisheries on techniques for age determination of tunas using reading of otolith sections.



Right: training at Gondol Mariculture Research Institute (Bali) on histological techniques for studies of reproductive biology of tunas and other species.



Establishment of a new research station

The earlier ACIAR tuna fisheries project (FIS/2001/079) was instrumental in establishing a base at Bena Fishing Port for the daily monitoring and sampling activities. From 2002–08, this base was located in an office rented from one of the fishing companies, PT Sari Segara. During 2007-08, RCCF and RIMF, with assistance from this project, initiated a strategy for development of a new base at Bena that would be formally recognised as a regional research facility within AMFR and receive an annual operational budget. The new station, which required extensive renovation of an existing building at the fishing port, commenced research activities in February 2009. This was seen as a landmark event in the long history (since the early 1990s) of Indonesia-Australia collaborations on tuna fisheries. The project's extension year included assistance in establishing at the new facility the daily monitoring of tuna landings as well as the new research techniques outlined above.



Tuna Fisheries Research Station at Bena, Bali.

Increased participation in the RFMOs

The project assisted Indonesia to achieve increased participation in the Regional Fisheries Management Organisations. During the project period Indonesia became Full Member of the Indian Ocean Tuna Commission (IOTC) and the Commission for the Conservation of Southern Bluefin Tuna (CCSBT), and further progressed towards becoming a Full Member of the Western and Central Pacific Fishery Commission (WCPFC).



Steering Committee Meeting for Monitoring of Indonesia's Tuna Fisheries, in Jakarta, May 2008, which was co-organised with the RFMOs, IOTC and WCPFC.

Primary impacts of the project

- The observer and port-based monitoring programs have assisted Indonesia to move closer to achieving the capacity for meeting all the data-reporting requirements of the relevant RFMOs for pelagic fisheries – IOTC, WCPFC and CCSBT. There is now improved capacity for the provision of data on annual catch estimates by gear and species, number of vessels active by gear and size class, operational catch and effort, and size composition (of target and bycatch species).
- With the project's capacity development of the stock-assessment trainees within RCCF, and with provision of training in new research areas, Indonesia is now better placed to do the assessments and undertake research activities that had previously been done only by external agencies. Improved independence in these areas has Indonesia better placed to provide better quality stock assessments and increased capacity for better quality fisheries management, leading to an improved chance of attaining sustainable fisheries.
- The increased capacity for achieving sustainable fisheries has potential for significant flow-on economic and social benefits to Indonesia, as well as to other countries, such as Australia, that share the stocks of tuna and tuna-like species.

Recommendations from the project

- Australia, through ACIAR and/or other funding agencies, should continue to collaborate with Indonesia on shared stock pelagic fisheries, and include focus areas as determined by Indonesia's needs and priorities.
- Next-phase project(s) should build on the capacity-development achievements of this project, further developing Indonesia's capacity for doing science-based stock assessments and for improved data collection, with attention to all fishing gears.
- Further Indonesia-Australia collaborations on pelagic fisheries should include a continuation of working with the RFMOs to achieve a national observer program and effective national logbook program.

Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AMFR	Agency for Marine and Fisheries Research
CCSBT	Commission for the Conservation of Southern Bluefin Tuna
CPUE	Catch Per Unit Effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DGCF	Directorate General for Capture Fisheries
IOTC	Indian Ocean Tuna Commission
RCCF	Research Centre for Capture Fisheries (recent name change to Research Centre for Fisheries Management and Conservation)
RFMO	Regional Fisheries Management Organisation
RIMF	Research Institute for Marine Fisheries
WCPFC	Western and Central Pacific Fisheries Commission

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Publications resulting from the project

Papers and posters presented

Basson M., Andamari R., Sadiyah L. and Proctor C.H. 2007. An update on the use of the Indonesian Fishery High School dataset to obtain a standardised CPUE series for SBT on the spawning grounds. Paper presented at the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) 8th Meeting of the Stock Assessment Group and 12th Meeting of the Extended Scientific Committee, Hobart, Australia, 4 - 8 September 2007.

Basson M., Bromhead D., Davis T.L.O., Andamari R., Merta I.G.S. and Proctor C. 2005. Indonesian fishery school data on southern bluefin tuna: summary and preliminary analyses. Paper presented at the CCSBT 6th Meeting of the Stock Assessment Group and 10th Meeting of the Extended Scientific Committee, Taipei, Taiwan, 29 August – 3 September and 5-8 September 2005.

Dowling N. 2007. The minimum requirements and biggest challenges in doing effective stock assessment in pelagic fisheries. Paper presented to the Project Coordination Meeting, Bali, 3-4 November 2007.

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Sadiyah L., Andamari R., Iskandar Prisantoso B., Retnowati D. and Proctor C. 2007. Trial observer program for Indonesia's tuna longline fishery in the Indian Ocean. Poster presented at the International Fisheries Observers Conference, Victoria, Canada, 15-18 May 2007.

Sadiyah L., Dowling N., Iskandar Prisantoso B., Andamari R., Proctor C. and Barmuta L. 2009. Characterizing Indonesia's Indian Ocean tuna longline fishery based on newly established sources of information Paper presented at the International Symposium on Ocean Science, Technology and Policy, World Oceans Conference, Manado, Indonesia, 12- 14 May 2009.

Sadiyah L., Dowling N., Proctor C., Andamari R. and Iskandar Prisantoso B. 2008. A preliminary report on Indonesia's Indian Ocean tuna and bycatch longline fisheries, based on historical and newly established sources of CPUE information: a project overview. Presented at the CCSBT 13th Meeting of the Extended Scientific Committee, Rotorua, New Zealand, 8-12 September 2008.

Other publications, manuals, reports

Andamari R., Proctor C. and the observer team 2010. Manual for observers aboard longline vessels.

Merta G. and Proctor C. 2005. Translation into Bahasa Indonesia of 'A field guide to the Indo-Pacific billfishes' by J. Pepperell and P. Grewe.

Merta G. and Proctor C. 2007. Translations into Bahasa Indonesia of the 'Handbooks for the identification of yellowfin and bigeye tunas': 1. 'A handbook for the identification of yellowfin and bigeye tunas in fresh condition' by D.G. Itano; 2. 'Training guide for the identification of yellowfin and bigeye tunas to assist Indonesian port sampling and observer programs' by D.G. Itano; and 3. 'A handbook for the identification of yellowfin and bigeye tunas in fresh but less than ideal condition' by S. Fukofuka and D.G. Itano.

Proctor C. and Nugraha B. 2007. A review of tuna fisheries in eastern Indonesia. A preliminary report prepared for the Eastern Indonesia Tuna Fishery Data Collection Workshop, Jakarta, January 2007.

Sadiyah L. 2010. An evaluation of Indonesia's Indian Ocean tuna longline fisheries, based on historical and newly established sources of CPUE information. PhD thesis School of Zoology, University of Tasmania, December 2010.

Turner R. 2005. Turning the tide on tuna. Partners in Research for Development (Magazine), July edition, p. 12.



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 - Gondol Research Institute for Mariculture, Bali
 - > Directorate General of Capture Fisheries, Jakarta
 - > Directorate General of Marine Resources and Fisheries Surveillance
 - Office of WASKI [Office of the Surveillance of Fishing Vessels] at Benoa Fishing Port
 - > Office of Marine Affairs and Fisheries, Province of Bali
- CSIRO Marine and Atmospheric Research
- University of Tasmania
- Indonesian Tuna Commission
- Asosiasi Tuna Longline Indonesia
- Asosiasi Tuna Indonesia
- Indonesia's tuna fishing industry
- Indian Ocean Tuna Commission
- Overseas Fishery Cooperation Foundation of Japan
- Commission for the Conservation of Southern Bluefin Tuna
- Western and Central Pacific Fisheries Commission
- Secretariat of the Pacific Community – Oceanic Fisheries Programme
- Australian Government Department of Agriculture, Fisheries and Forestry
- Dr Anthony Lewis, Fisheries Consultant, Australia.



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