A new protocol to collect independently verifiable scientific data from small scale (<24 m) Sri Lankan longline vessels in compliance with IOTC Resolutions

N. D. P. Gunawardane*, C., Suraj Chandrakumara*, Geethamali Chandrasiri*, Kalyani Hewapathirana*, Steve Creech**

* Department of Fisheries and Aquatic Resources, Sri Lanka
** Director, Pelagikos private limited

Abstract

Independent scientific data is a vital component for effective fisheries management. Scientific data provides an independent source of detailed, high quality information on fishing activity and catch at a sufficient level of resolution to be used for analyses, such as the standardisation of catch rates, the analysis of non-target species and the need for mitigation measures (IOTC, 2016). Under the IOTC's Regional Observer Scheme (Resolution 11/04) each CPC is required to submit a range of scientific data by independent observers, who are deployed on selected vessels for the duration of a fishing trip. The small size of Sri Lankan multi-day fishing vessels registered to fish in the LO (9.7 m to 28.6 m / average 12.4 m) compared to the average of length of the IOTC registered fleet; the lack of on-board facilities on Sri Lankan vessels (*i.e.* accommodation, bathroom) and the obvious health and safety concerns (*e.g.* absence of life rafts) precludes the deployment of independent on-board observers on Sri Lanka's small scale fishing fleet (≈ 1,600 vessels). In response to this challenge the Department of Fisheries in Sri Lanka (DFAR) has recently evolved a new protocol through which to collect high quality digital, independently verifiable, scientific data in compliance with the IOTC's Resolutions. The new protocol combines existing primary data collected from each fishing trip through DFAR's successful Logbook System; new primary data collected by DFAR officers using a semi-structured interview and visual verification and digital images incorporating spatial and temporal information.

The new protocol builds on the strengths of DFAR's existing catch data systems, the availability of qualified human resources and incorporates the skills, knowledge and

resourcefulness of Sri Lankan fishermen. The new protocol uses simple digital technology and requires only a small amount of training to deploy and generate high quality, independently verifiable digital data about the total catch (*i.e.* target and non-target species, retained or discarded, dead or alive IOTC, 2011). Under the new protocol, a skipper (Local Observer) is trained to take a digital image of each fish / reptile / bird / mammal caught using an electronic tablet. The tablet is configured to incorporate the location, date and time when the image was taken. A scale (length in cm) is incorporated into each image using a story board. The story board enables the Local Observer to record the set number, catch number, sex, type of catch (*i.e.* retained, discarded – dead or alive) and observed weight of each 'fish' caught. The stored images are downloaded by DFAR officers at the conclusion of each trip. A simple software programme is used to extract the spatial and temporal data attached to each image into an Excel format. Scientific data is then extracted manually from each image by DFAR officers and added to the Excel datasheet. Trip data from the Logbook System and gear data from the semi-structured interviews and visual verification complete the collection of independently verifiable, digital scientific data using the new protocol. The capital cost of the new protocol is low. There are no new operation or maintenance costs. The technology and human resources need to run the system are in place. The new protocol has been tested initially with longline fishing vessels, but is expected to work as effectively on vessels operating gillnets and or gillnet and longline combination.

KEY WORDS; Sri Lanka, Small Scale, Longline Fisheries Management, Scientific Data, Regional Observer Scheme, Digital Images, Image Processing

Acknowledgement

Authors would like to thank Secretary of Ministry of Fisheries and Aquatic Resources Development, Mr.Ginige Janaka Prasanna Kumara, Director General of, Department of Fisheries in Sri Lanka for the guidance provided from the beginning of this programme. Appreciation and gratitude also extended to Information Technology Division, High seas Unit of Operation Division and supporting staff of Pelagikos private limited for their assistance on developing the system and software. It is also acknowledge the contribution given by the field officers of Department of Fisheries, exporters, boat owners and skippers for their valuable contribution and continuous support to adopt this new technology driven system.

1.0 Introduction

Sri Lanka, being a party to International Conventions and regional agreements related to responsible fisheries in the region, is committed to implement Conservation and Management Measures of IOTC (CMMs) ensuring the sustainability of tuna and tuna like species under management of IOTC. As such, to overcome shortcomings in the legal and management regime those hinder effective compliance with national, regional and international obligations of high seas fisheries, was well established during the last two years and a road map to address the issues and shortcomings in high seas fisheries management was prepared and successfully implemented, enabling the creation of a conducive environment to combat against IUU fishing in Sri Lanka.

All countries within the purview of IOTC are required to implement effective national observer deputation programmes in the IOTC area of competence. Accordingly, Sri Lanka too has to deploy scientific observers in compliance with IOTC resolution 11/04, in respect of vessels above 24m as well as vessels below 24 lengths fishing outside the Exclusive Economic Zone (EEZ).

Out of about 1615 active vessels operating in High Seas Sri Lanka had only one long line vessel over 24m in 2015 and less than 1% are in the range of 24-15m length category while the balance is in the 10.3-15 range and far beyond the scope of international convention and guidelines. While Sri Lanka is fully supportive in combating IUU fishing and was able to subscribe to most of the requirements such as log books, standard gear markings, radio call signs, VMS transponders, de-hookers and line cutters on board in these smaller vessels, deployment of observers on board is constrained due to:

- **Safety:** Safety issues are more critical in smaller vessels with rather limited deck area where the observer will be in very close proximity to the fishing operations and associated activities, endangering his physical wellbeing.

- **Lack of space:** These boats are normally designed to accommodate a maximum of 4-5 crew members with meager personal comforts, in addition to taking substantial amounts of fuel, foods, water, ice, salt and fishing gear for a voyage of 21-28 days.

Lack of minimum requirements such as accommodation, sanitary facilities and safe working space will greatly compromise the work of an observer.

The length, width, deck area and facilities and the wheel-house arrangement in a typical artisanal type Sri Lankan vessel are not designed with an objective of facilitating an officer on board during fishing trips. Although the stability is tested and verified by the marine engineers it might be marginally enough for conducting fishing operations which requires greater tolerances and adaptation to dynamic conditions at sea. Although the fishers are capable of tolerating such harsh condition with minimum requirements, deploying an officer on board such a vessel and expecting him to do the same is unethical and practically not possible. However, it is unique in the region that the Sri Lankan bona fide fishermen are engaged in high seas fishing in these small vessels as a subsistence fishery from the past. Details and the structure of a typical Sri Lankan fishing boat (13.7 m in length) is given in Annex-1.

- **Increased cost of fishing**: Maintenance costs may increase in carrying an observer and there will also be a financial burden for their payments. Leaving a crew member ashore to enable the vessel to take an observer may adversely impact on fishing operations leading to reduction in catch and income.

- **Working in inclement weather**: An observer might not be able to carry out his duties during harsh weather conditions and in rough sea conditions due to the lack of facilities on board.

In response to this challenge the DFAR has recently evolved a new protocol through which to collect high quality digital, independently verifiable, scientific data in compliance with the IOTC's Resolutions. The new protocol combines existing primary data collected from each fishing trip through DFAR's successful Logbook System; new primary data collected by DFAR officers using a semi-structured interview and visual verification and digital images incorporating spatial and temporal information.

2.0 Methodology

Here the electronic tablets distributed among the fishers under elog system scheme was used as the data collecting devices. Skippers who showed positive intends with electronic reporting was selected from two fisheries districts; Negombo and Chilaw for the data collection process. Long line fishermen were included for the first phase of the data collection programme.

Additional training was provided for the skippers at harbour offices on collection information for local observer scheme (Figure-1). Most of the fishermen of ; Negombo and Chilaw use Negombo and Dickowita harbours as their destiny of departure. Thus Officers of those harbours were also trained on collecting information from skippers.

Skippers were asked to provide following information related to each operation/ haul taken place during the fishing voyages.

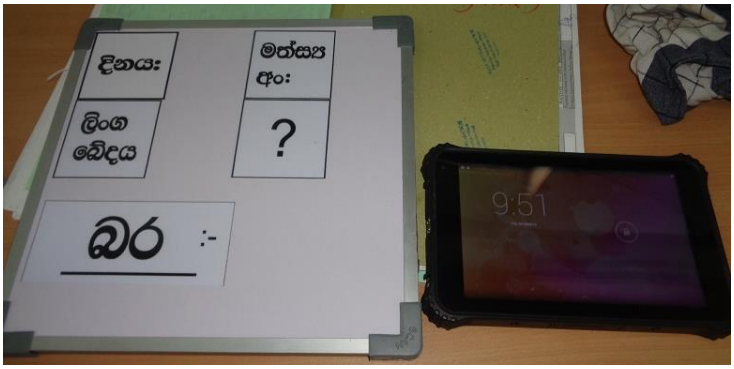
1. Trip details including departures and arrivals
2. Fishing gear data (hauling data)
3. Cruise details fishing locations
4. Total fish catch details (acquired through log book)
5. Details of individuals fish or aquatic animals (i.e. Turtles, Dolphins.. etc) released during the operations
6. Details of individuals fish retained on board as bycatch
7. Details of individuals fish retained as the main harvest
8. Weight and the length of each fish caught during the operation
9. Sex and maturity levels of each fish

Figure 1; Skipper and Officer Training programmes on local observer programme

Fishing locations and total landing data is acquired though the log books. Additionally, the above details were conformed during the interview had with the skipper at the point of arrivals.

2.1 **Data collection through the photographs**

Collecting data on weight and length requires additional knowledge. This task of skippers was simplifying by asking them to take only the photograph of each fish retained on board. Here an indicting/ story board (Figure; 2) is given to each skipper. Information on weight, sex and the status of the fish has to be write in the board. The indicating board has to be kept near to each fish when taking the photograph. Length of each fish can be calculated during the analysis using the scaling of the photograph.



Date	Fish no ?
Gender	
Weight	……

Figure 2; Indicting/ Story board to be coupled with the tablet for data collection

Accordingly, the weight data, sex data will be captured using the detailed mentioned in information board when talking the photograph. All the other data can be acquired by analysing the images of the fish. Here an application called GPS locator is installed in each tablet so that the location of taking the photograph is automatically chopped in the photo. Additionally, date time is also recorded and can be extracted later during the analysing process (Figure; 3). The length of the story board is used as a scale factor for measuring the fish.

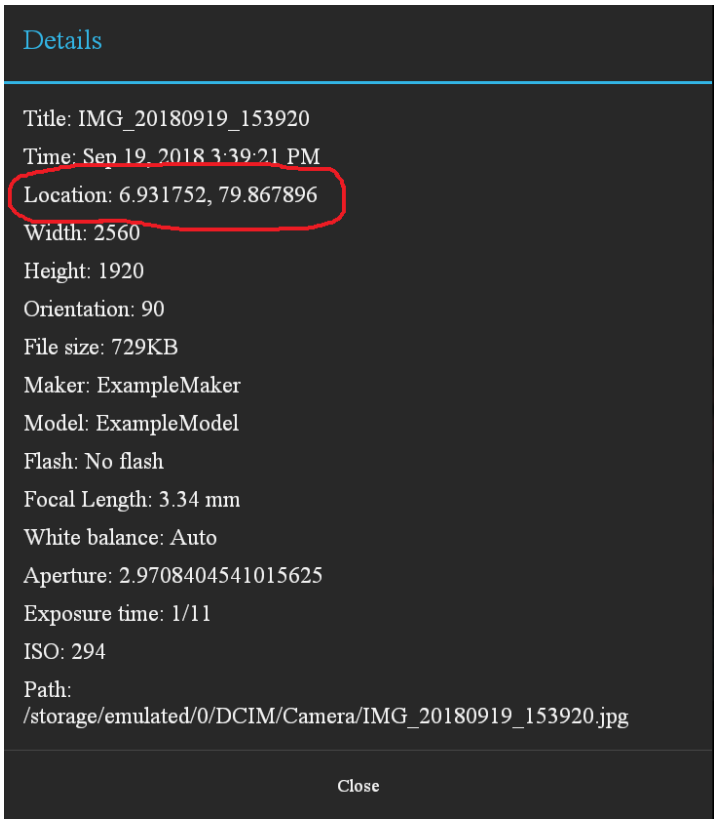


Figure 3; Information chopped in the images (extracted from a photograph)

Then the details of each image is extracted to an excel table using a software (Table;1).

Table 1; Example Data extracted table (*tested at dickowita harbour*)

image_index	image_name	image_date	image_time	image_longitude	image_latitude
1	DSCN0018.JPG	9/21/2018	8:00:21		
2	DSCN0019.JPG	9/22/2018	9:24:13	79.86719	7.00618
3	DSCN0020.JPG	9/22/2018	9:36:11	79.86734	7.005958
4	DSCN0021.JPG	9/22/2018	9:37:13	79.86722	7.006183
5	DSCN0022.JPG	9/22/2018	9:37:43	79.8672	7.006185
6	DSCN0023.JPG	9/22/2018	9:37:59	79.86719	7.006187
7	DSCN0024.JPG	9/22/2018	9:38:37	79.86719	7.006192
8	DSCN0025.JPG	9/22/2018	11:11:20	79.8658	7.006727

Skipper was tasked to meet the harbour officer after landing and provide the log sheet data, and the data recorded during the fishing to the harbour office. The photos taken during the fishing trip will also downloaded to the external hard drives. Some of those photos given in Figure 4. All information collected by the harbour officer will then emailed to the head office where the trained officer at head office will do the analysis to generate the information required to observation purposes.

(A) (B)

Figure 4; Photographs taken during the fishing trip by the skippers. (A. Kept on board, B. Live Release)

2.2 The pilot programme

20 skippers were trained and 17 of them were send to sea with all equipment. List of the skippers and registration numbers of boats included in the pilot programme is given in Annex-II. Information were collected at the point of arrival. Percentage coverage of the observer data were determined using the details of certified log sheets related to the same trip.

3.0 Results

Percentage of coverage of observer data for each trip is mentioned below

Table 2; Summery of the data collected through the pilot programme for local observer programme

Type of data	**Sub details**	**Method of collection**			**% of submission from the trips completed so far**
		Photographs	Log books	Details from skippers	
Status of the fish	Kept on board, discard, release ..etc	√		√	80%
Fishing gear information	Details Gear on board		√	√	100%
	Set details (gear/ effort information of each fishing operation)		√	√	100%
Cruise details	Fishing location	√	√	√	100%
	Arrival departure details		√	√	100%
Fish catch details	Species wize total catches during the fishing trip		√	√	100%
Biological data of each fish	Which fish caught by which operation during the trip			√	75%
	Length of individual fish	√			75%
	Weight of individual fish	√		√	72%
	Sex and maturity details of individual fish	√		√	23%

Mention below is the results of the overall analysis of the data from the trips completed. Mean weights and lengths of some important species were calculated using the estimated data using the photographs.

Table 3; Summery of the length weight data acquired though the trips completed up to now

Fish Type	Number of Fish	Mean Weight(kg)	Std Dev of Weight	Mean of Length(CM)	Std Dev of Length
Big Eye Tuna	85	37.00	6.71	116.56	13.87
Sail fish	17	35.00	3.33	134.40	12.55
Striped Marlin	68	32.50	6.45	159.80	20.59
Sword fish	68	30.00	9.13	162.65	21.61
Yellow fin tuna	816	40.31	7.10	117.13	11.41

Fishing locations stored in the photographs and conformed using the log sheet data were also mapped in order to identify the fishing grounds.

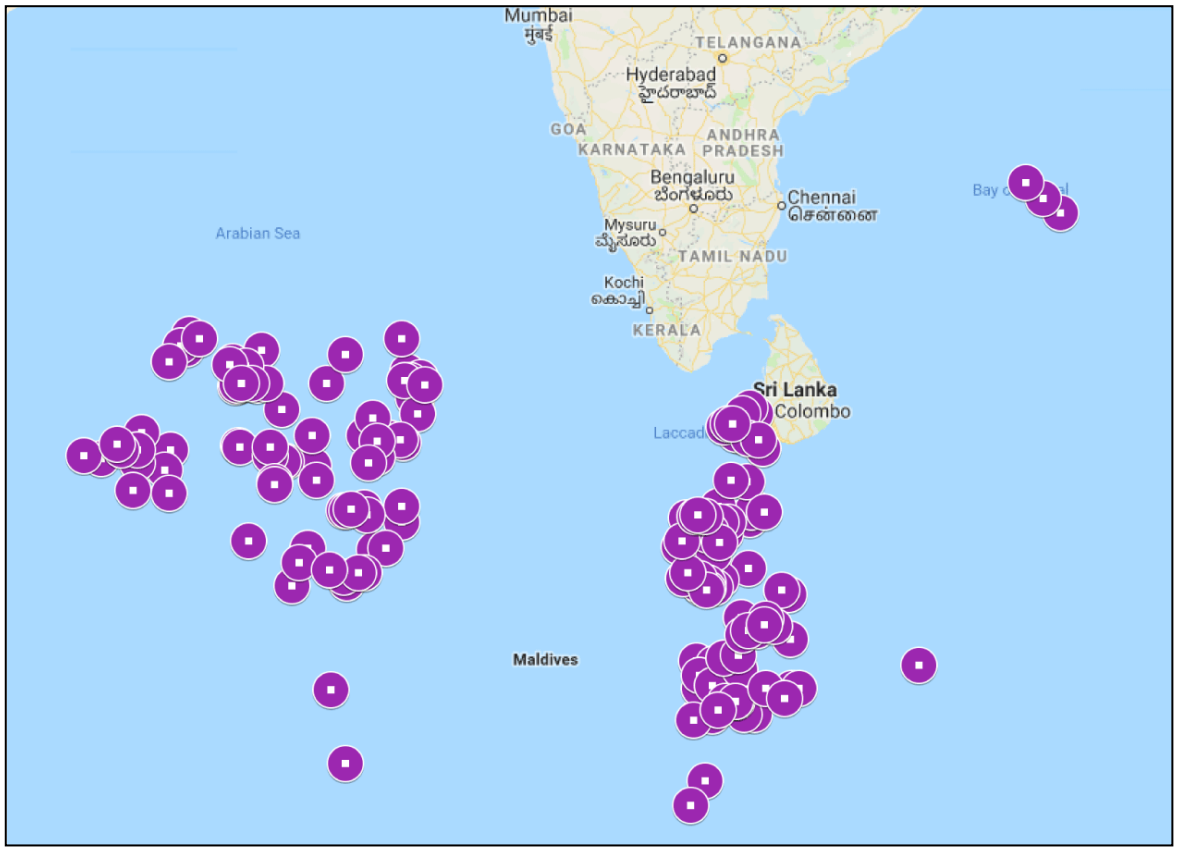


Figure 6; Fishing locations identified using the local observer data

Additional discussions were held with skippers on the above results and following issues were identified

- Lack of knowledge on gender identification of fish
- Most of the fish caught by these boats were not processed but kept on board as whole fish. Therefore it is hard to identify the gender just by looking at the external appearance.
- Lack of time to write down all required details in the story board
- Inability to write the details during the rains using ink

Accordingly following action taken in order to minimize the issues and achieve 100% coverage of catch data.

- Provide more training on gender identification
- Introduce flip board as an alternative to the story board so that fishermen spend less time on recording data and it enables the data collection during the rains as well.

Figure 6; Proposed flip board as an alternative to the story board

4.0 Discussion

Data collected through skippers is always proposed as a solution for fulfil the scientific data collection. However lack of scientific knowledge and skills of skippers were always mentioned as a bottle neck of make such proposal successful. The paper is focusing of adopting a protocol to get assistance of skippers with less scientific knowledge and skills. Information technology used as a solution to fill the above gap. However gender identification is identified as one of the areas where in the percentage of coverage is relatively low due to the fact that most of the fish caught by artisanal boats of Sri Lanka were not processed but kept on board as whole fish. Therefore it is hard to identify the gender just by looking at the external appearance. However Skippers were able to identify genders in 23% of the occasions. Therefore authors would like to seek IOTCs suggestion of the percentage coverage of gender reporting of fish for artisanal vessels. However it can be determined that the proposed protocol is a solution to be consider to resolve the issue of lack of observer coverage in artisanal vessels.

The technology and human resources need to run the system are in place. Therefore it is also proposed to continue the pilot programme for several more trips in order to streamline the data collection and analysing process of local observer programme. The new protocol has been tested initially with longline fishing vessels, but is expected to work as effectively on vessels operating gillnets and or gillnet and longline combination as well.

References

Berkes F., R. Mahon, P. McConney, R.C. Pollnac and R.S Pomeroy, 2001. Managing small-scale fisheries: Alternative directions and methods. International Development Research Centre, Ottawa, Canada.

Berkes, F., 2003. Alternatives to Conventional Management: Lessons from Small-Scale Fisheries. Environment, 31(1).

Davies, S L and Reynolds, J. E., 2002. Guidelines for developing an at-sea fishery observer programme, FAO Technical Paper No T414, FAO, Rome. 116p.

FAO, 1995. Code of Conduct for Responsible Fisheries, Rome, FAO, 41p.

FAO, 2004. Guidelines on the collection of demographic and socio-economic information on fishing communities for use in coastal and aquatic resources management, FAO Fisheries Technical Paper No. 439, FAO, Rome, 120p.

IOTC, 2011. Regional observer programme manual, The Indian Ocean Tuna Commission, Seychelles.

IOTC, 2011. Resolution 11/04 on a regional observer scheme, The Indian Ocean Tuna Commission, Seychelles.

Muhammad Moazam and Rab Nawaz, 2018. Using a Crew-Based Observer Programme as a Platform of Opportunity for Understanding the Distribution of Whales in the Northern Arabian Sea. IOTC-2018-WPEB14-INF03.

Pauly, D., 2006. Major trends in small-scale marine fisheries, with emphasis on developing countries, and some implications for the social sciences. MAST 4: 22-77

Pomeroy, R. and F. Berkes, 1997. Two to Tango: the role of government in fisheries co-management. Marine Policy, 21(5): 465-480.

Read D. Porter, 2000. Fisheries Observers as Enforcement Assets: Lessons from the North Pacific. Marine Policy, Elsevier Press, Published online January 2010. doi: 10.1016/j.marpol.2009.11.005.

Van Helvoort, G., 1986. Observer program operations manual. FAO Technical Paper No. 275. Rome, FAO, 207p.

Annex-1

Specifications of a typical Sri Lankan high seas fishing multiday boat

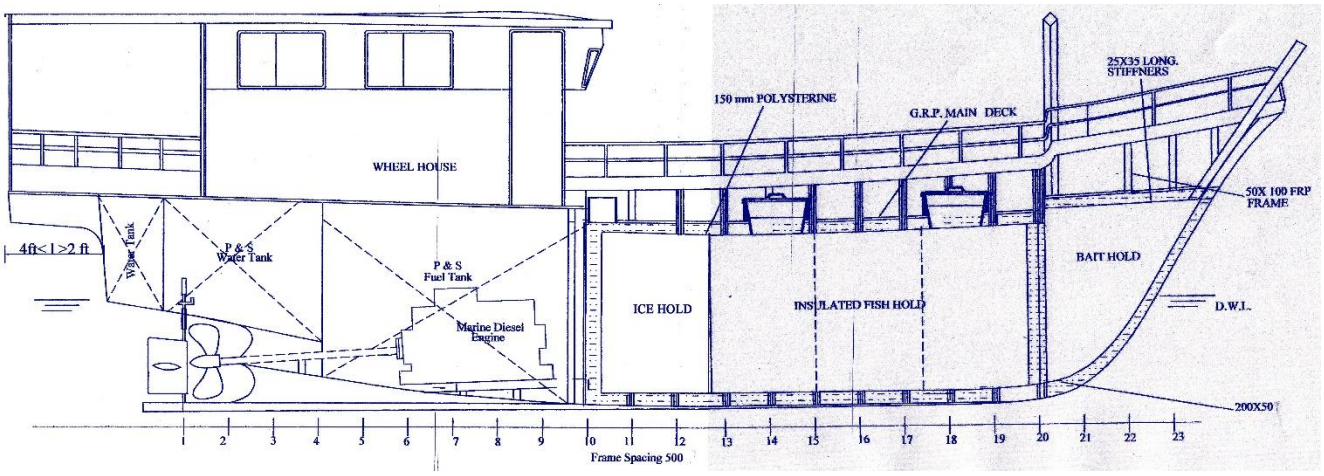
1.0 Basic Specifications

No	Description	Dimensions/ value
1	Length Overall	13.7 m (45Ft)
2	Length of WL	11.88 m
3	Breadth	4.0 m
4	Depth	2.1 m
5	Draft	1.3 m
6	Gross tonnage	15-21.0 MT
7	Hull material	Fibreglass
8	Fuel type	Diesel
9	Fuel capacity	5500 L
10	Fresh water capacity	1500 L
11	Fish hold capacity	20.0 m^3
12	Number of bunks (beds)	3
13	Toilet	-
14	Engine (inboard)	200-250 Hp (Average)
15	Maximum speed	6 -7 Knot (Maximim)

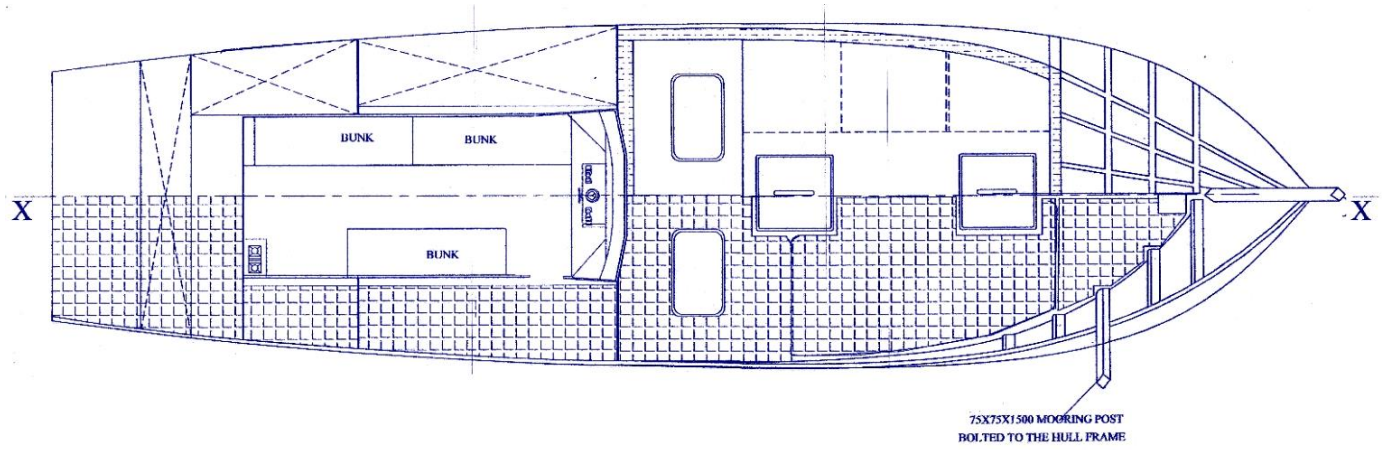
2.0 Picture of a typical Sri Lankan high seas fishing multiday boat

3.0 Line Drawing of typical Sri Lankan high seas fishing multiday boat

Part-1 (Half sectional plan)



Part-2 (Exterior plan)



Annex-2

List of vessels and Skippers included in the local observer scheme

Name of the Skipper	Status of the Skipper	Registration Number of the Boat	Boat Status
P.J.S. FERNANDO	Trained	IMULA0719CHW	Data Collected
R.P.S. PUSHPAKUMARA	Trained	IMULA0699CHW	Data Collected
W.N.S. FERNANDO	Trained	IMULA0238CHW	Data Collected
M.M. FERNANDO	Trained	IMULA0526CHW	Data Collected
R.N. SANDEEPA	Trained	IMULA0847CHW	Data Collected
W.M.D. NILMAN	Trained	IMULA0718CHW	Data Collected
W.Y.T. FERANANDO	Trained	IMULA0769CHW	Data Collected
W.A.S.J. PUSHPAKUMARA	Trained	IMULA0762CHW	Data Collected
W. THUSITHA MANOJ	Trained	IMULA793CHW	Data Collected
W.A.P. PERERA	Trained	IMULA0502CHW	Data Collected
T.R.N. FERNANDO	Trained	IMULA0638NBO	Data Collected
W.L.P.E.K. FERNANDO	Trained	IMULA0776CHW	Data Collected
W.M.S.P. FERNANDO	Trained	IMULA0563CHW	Data Collected
P.M. CHAMARA	Trained	IMULA0594CHW	Data Collected
W.A.S.T. FERNANDO	Trained	IMULA0822CHW	Data Collected
W.P.S.K. SUSANTHA FERNANDO	Trained	IMULA0732CHW	Data Collected
W.P.D.L. FERANANDO	Trained	IMULA0736CHW	Data Collected
W.L.D. THISERA	Trained	IMULA0434KLT	Departed
N.I.M. FERNANDO	Trained	IMULA0046NBO	Departed
W.R.T. FERNANDO	Trained	IMULA0792CHW	Departed