Liberia Sustainable Management of Fisheries Project (LSMFP)
National Fisheries & Aquaculture Authority
P. O. Box 10-1384
United Nations Drive, Bushrod Island
1000 MONROVIA 10, LIBERIA

REQUEST FOR EXPRESSION INTEREST (REOI)

Preparation Advance No. IDA V3100

PROJECT ID: P172012

Subject: Request for Expression of Interest (REOI) consulting services to conduct an independent fish stocks assessment in the Liberian coastal waters for NaFAA

Reference No.: LR-NAFAA-201399-CS-QCBS

Assignment Title: Recruitment of a Firm to Conduct an Independent Fish Stock Assessment in Liberian Coastal Waters on behalf of NaFAA

The government of Liberia through the National Fisheries and Aquaculture Authority (NaFAA) has received support from the World Bank Group toward the preparation and implementation of the, "Liberia Sustainable Management of Fisheries Project (LSMFP)", and intends to apply part of these funds to contract a research vessel to assess its coastal pelagic and demersal fish resources. The results of the assessment will inform management decision for their sustainable exploitation and to attract investment into the sector.

The study will survey demersal fish resources with an emphasis on shrimps and pelagic resources of the continental shelf of Liberia to determine the distribution and abundance of fish resources within the EEZ. In addition to determining distribution and abundance of demersal, pelagic and shrimp resources and related communities, and collecting biological samples as specified below, sampling will be carried out to determine physical, chemical and biological conditions, sampling of micro plastics and recording the occurrence of marine debris. Data will also be collected, and recorded, of sedentary and mobile benthos.

Specific objectives and scope of the assessment will include but not be limited to the following:

- Hydrography of the continental shelf
  - Mapping of sea temperature, salinity, dissolved oxygen, chlorophyll-a, nutrients, pH and measurements of ocean currents).
  - Measurement of dissolved oxygen concentrations, ocean acidification and the calcium carbonate saturation horizon relevant for calcifying organisms.

- Primary productivity, zooplankton, ichthyoplankton and jellyfish
  - Determination of primary productivity, phytoplankton abundance and distribution.
  - Determination of the abundance and biomass patterns of meso-zooplankton communities and their species composition.

- Provision of the patterns of abundance of fish eggs and larvae to the lowest possible taxonomic level.

- Pelagic resources
- Map the distribution and estimate the abundance of pelagic resources using acoustic methods and trawling for target identification.
- Obtain information on maturity of *Sardinella aurita, Sardinella maderensis, Scomber colias and Trachuru trecae* at the time of the survey.

- Map the occurrence of microplastics and describe associated neustonic communities.
- Record the occurrence of debris collected by surface and bottom trawls.
- Demersal resources
- Determine the distribution and estimate abundance of demersal resources, especially of shrimps using the swept-area method
- Measurement of biological parameters for priority species (length, weight, gonad stage and weight; collection of otoliths for selected species).
- Identification of spawning/nursery areas

Table 1: Species to consider for full assessment

	Demersal species		**Demersal species**
1	Shrimps	8	*Pseudotolithus spp*
2	*Epinephelus aenus*	9	*Sepia hierredda*
3	*Dentex canariensis*	10	*Cynoglossus spp*
4	*Dentex angolensis*	11	*Pentanemus quinquarius*
5	*Galeoides decadactylus*	12	*Pomadasys spp*
6	*Lutjanus spp*	13	*Penaeus notalis*
7	*Pagellus bellottii*	14	*Brachydeuterus auritus*
	Lobster (more than one species?)		

The National Fisheries and Aquaculture Authority (NaFAA) now invites eligible research firms to indicate their interest in performing the Services. Interested firms must provide information indicating that they are qualified to perform the services (brief corporate profile, description of similar assignments, experience in similar conditions, availability of appropriate skills, etc.), and capacity to mobilize a research vessel for the trawl survey.

The shortlisting criteria includes the following qualifications:

Qualification Requirements and Composition of Stock Assessment Team:

The prospective contractor must have satisfactory knowledge and experience in the conduct of independent fisheries resource stock assessment and follow the guidelines in the TOR; the proposed scientists and technicians must have experience in assessment of multi-species tropical fisheries and species. The consultant must possess or be capable of accessing a research vessel equipped with the relevant, standardized research equipment or demonstrate that a suitable charter vessel can be arranged. The firm must have a proven record of having conducted similar exercises in a similar environment and fisheries in the relevant region; and must provide all required

specialists and equipment for performing the duties outlined in this TOR. The detailed Terms of Reference (TOR) for the assignment can be found at the following websites:

a) www.nafaa.gov.lr
b) www.emansion.gov.lr
c) www.moa.gov.lr

The attention of interested Consulting Firm is drawn to Section III, paragraphs, 3.14, 3.16, and 3.17 of the World Bank's "Procurement Regulations for IPF Borrowers" dated July 2016, revised November 2017, and August 2018, setting forth the World Bank's policy on conflict of interest. Please refer to paragraph 3.17 of the Procurement Regulations on conflict of interest related to this assignment which is available on the Bank's website at http://projectsbeta.worldbank.org/en/projects-operations/products-and-services/brief/procurement-newframework .

A Consultancy Firm will be selected in accordance with the **Quality and Cost-Based Selection Method (QCBS)** method set out in the Procurement Regulations.

Further information can be obtained at the address below during office hours, i.e. 0900 to 1600 hours GMT.

Expressions of interest must be delivered in a written form to the address below (in person, or by mail, or by fax, or by e-mail) by **Tuesday August 10, 2021 @ 4:00PM GMT**

Liberia Sustainable Management of Fisheries Project (LSMFP)
Attn: The Project Coordinator
Mesurado Pier, Freeport of Monrovia
Monrovia, Liberia
Tel: +231777963901/0770532901
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TERMS OF REFERENCE (ToR): FOR ASSESSMENT OF LIBERIA'S COASTAL PELAGIC AND DEMERSAL FISHERIES RESOURCES

1. INTRODUCTION

1.1 Background

The Government of Liberia recently passed legislation to strengthen management of the fisheries resources, and a new regulation is in the making to implement the new fisheries management act. Efforts by Liberia with support from the Word Bank through the West Africa Regional Fisheries Project (WARFP) phase 1 worked to eradicate illegal industrial fishing within Liberia. With the establishment of fishing zones, including an Inshore Exclusion Zone (IEZ), a satellite based vessel monitoring system (VMS) for strict monitoring of vessel activity, and a restrictive licensing scheme on foreign industrial trawlers, Liberia fish stocks have/are recovering well. The catch size and volume for the artisanal sector doubled from 2009 to 2017. Coastal fishing communities are achieving better social-economic and ecological performance - triple-bottom line result.

The Government of Liberia has received a project preparatory advance (PPA) from the World Bank Group in support of the preparation of the national fisheries project, "Liberia Sustainable Management of Fisheries Project", and intends to apply part of these funds to contract a research vessel to assess of its coastal pelagic and demersal fish resources. The results of the assessment will inform management decision for their sustainable exploitation and to attract investment into the sector.

1.2 The Liberian Coastal Environment

Liberia has a coastline of 580 km and an exclusive economic zone (EEZ) that extends 200 nautical miles off-shore. This area consists of relatively warm waters with moderate to low nutrient content. The continental shelf extends from Côte d'Ivoire to Robertsport in the north of Liberia, with an average width of 34 km. The widest part is in the central of Liberia's coastline. An inshore exclusion zone (IEZ) reserves a zone to six nautical miles offshore for the sole use of subsistence, artisanal and semi-industrial fishing activities - trawling is not allowed inside the IEZ.

Data on Liberian fishery stocks are sparse and incomplete. Fishery dependent data may underestimate actual fish production. Fishery independent data from regional surveys may better show the actual bio-ecological state of the resources. This data paucity undermines effective sustainable management of the fisheries as well as our ability to maximize the full economic potential of the resources.

In keeping with the ecosystem approach to fishery management, strong scientific research, based on "credible data", should form the basis for all fishery management decisions.

1.3 Institutional arrangements

The National Fisheries and Aquaculture Authority (NaFAA) is responsible for the fisheries resource assessment and will select the institution that is to undertake this study. NaFFA will nominate the Liberian nationals who are to participate in the survey.

The contractor will communicate and report to NaFAA on issues related to the study, and will work with the NaFAA Research & Statistics Department to ensure the objectives of the study are achieved.

2. Objectives and Scope of the Assessment

2.1 Study Objective

The study will survey demersal fish resources with an emphasis on shrimps and also pelagic resources of the continental shelf of Liberia to determine the distribution and abundance of fish resources within the EEZ. In addition to determining distribution and abundance of demersal, pelagic and shrimp

resources and related communities, and collecting biological samples as specified below, sampling will be carried out to determine physical, chemical and biological conditions, sampling of microplastics and recording the occurrence of marine debris.
Data will also be collected, and recorded, of sedentary and mobile benthos.

2.2 Specific objectives and scope

- Hydrography of the continental shelf
  - Mapping of sea temperature, salinity, dissolved oxygen, chlorophyll-a, nutrients, pH and measurements of ocean currents).
  - Measurement of dissolved oxygen concentrations, ocean acidification and the calcium carbonate saturation horizon relevant for calcifying organisms.

- Primary productivity, zooplankton, ichthyoplankton and jellyfish
  - Determination of primary productivity, phytoplankton abundance and distribution.
  - Determination of the abundance and biomass patterns of meso-zooplankton communities and their species composition.
  - Provision of the patterns of abundance of fish eggs and larvae to the lowest possible taxonomic level.

- Pelagic resources
  - Map the distribution and estimate the abundance of pelagic resources using acoustic methods and trawling for target identification.
  - Obtain information on maturity of *Sardinella aurita, Sardinella maderensis*, *Scomber colias and Trachuru trecae* at the time of the survey.

  - Map the occurrence of microplastics and describe associated neustonic communities.
  - Record the occurrence of debris collected by surface and bottom trawls.
- Demersal resources
  - Determine the distribution and estimate abundance of demersal resources, especially of shrimps using the swept-area method
  - Measurement of biological parameters for priority species (length, weight, gonad stage and weight; collection of otoliths for selected species).
  - Identification of spawning/nursery areas

Table 1: Species to consider for full assessment

	Demersal species		**Demersal species**
1	Shrimp (four species ?)s Octopus	8	*Pseudotolithus spp*
2	*Epinephelus aenus*	9	*Sepia hierredda*
3	*Dentex canariensis*	10	*Cynoglossus spp*
4	*Dentex angolensis*	11	*Pentanemus quinquarius*
5	*Galeoides decadactylus*	12	*Pomadasys spp*
6	*Lutjanus spp*	13	*Penaeus notalis*
7	*Pagellus bellottii*	14	*Brachydeuterus auritus*
	Lobster (more than one species?)		

2.3 Sampling Methods

The survey area will be covered, first by a demersal trawl survey and then by an acoustic survey of pelagic fishes. Environmental measurements will be carried out concurrently with the first coverage.

The design for the pelagic fish survey will consist of parallel transects 10 nm apart and perpendicular to the coast, extending from about 20 m to 500 m depth. Acoustic targets will be identified by pelagic trawling (for which the vessel should be capable). The design for the survey of the demersal resources will follow a systematic sampling design with transects spaced 10 NM, and semi-random stations as used in previous bottom trawl surveys in the area from about 20 to 800 meters.

CTD stations will be taken at each demersal trawl station. In addition, CTD casts on the superstations of the environmental transects will be placed every one degree of longitude (every fourth pelagic transect). Additional environmental transects will be sampled east and west of Cape Mount. Three Points at a distance of 0.5-degree longitude, i.e. every second acoustic transect) will be sampled due to the increased hydrographic interest for this area during the upwelling period. More extended hydrographic transects (120 NM) will be undertaken West of Cape Mount and East of Maryland.

3. REQUIRED SERVICES OF THE CONSULTANTS

The successful consultants will carry out a full study to determine the abundance and distribution of the pelagic and demersal fisheries resources on the continental shelf of Liberia and provide support to the Research and Statistics Department of NaFAA as agreed or offered in the tender application.. The assessment will address the specific objectives listed in Section **2. O*bjective and Scope of Study"***. *To do this, the consultants will:*

a. Conduct a comprehensive stock assessment of the key species with particular reference to:
    i. Species of the inshore (within the IEZ)
    ii. offshore pelagic fisheries, excluding Tuna (beyond the IEZ)
    iii. inshore demersal fishery species (within the IEZ)
    iv. shrimp fishery species
    v. offshore demersal fishery (beyond the IEZ)
b. Map the hydrographic and environmental conditions in the survey area (temperature, salinity, dissolved oxygen, chlorophyll-a, nutrients, pH and ocean currents).
c. Provide support to the Research and Statistics Department of NaFAA in the areas of data analysis and reporting.

More detailed descriptions of the tasks expected of the contractor are described in the following attached Schedules:

1. Vessel Operating Requirements
2. Reporting Requirements
3. Vessel Acoustic Survey Capacity
4. Biological Sampling Requirements

5. Otolith Collection Protocol

4. CONSULTANTCY OUTPUTS

The consultancy firm will produce a comprehensive report indicating the biomass distribution and abundance the pelagic species and demersal species (see Annex 6) including all sources of potential error in the estimates and confidence intervals where possible. A separate report will describe the results of the hydrographic and environment conditions.

5. DURATION OF THE WORK

Total duration of the study shall be 2 months. Marine survey work will last for 20 days. And a further 42 days will be allowed for analyses, validation and presentation of the final survey report.

6. DUTY STATION

The analysis of the results will be done at NaFAA technical office in Monrovia.

7. QUALIFICATIONS OF THE INTERNATIONAL CONSULTANTS/ASSESSMENT GROUP

The prospective contractor must have satisfactory knowledge and experience in the conduct of independent fisheries resource stock assessment and follow the guidelines in the TOR; The proposed scientists and technicians must have at least Master degrees in the following fields; Fish Biology, Benthic ecology, Marine Biology, Oceanography and other related disciplines, and with at least 10-year experience in fish stock assessment of multi-species tropical fisheries and species. The consultant must possess or own a research vessel equipped with the relevant, standardized research equipment or demonstrate that a suitable charter vessel can be arranged. The firm must have a proven record of having conducted similar exercises in a similar environment and fisheries in the relevant region; and must provide all required specialists for performing the duties outlined in this TOR.

8. LANGUAGE REQUIREMENTS

The official language for communication and presentation of all documents and reports will be English.

9. STUDY TIMELINE

Activity	**Time**	**Responsible**
Conduct of the stock assessment survey for actual data collection	20 days	international consultancy firm/ fishery resource assessment group
Preparation of draft report	Two Weeks	
Compilation of the study report	1 Month	international consultancy firm/ fishery resource assessment group
Validation meeting of the compiled study report	1 Day	international consultancy firm/ fishery resource assessment group and NaFAA

Presentation of final Stock assessment report	1 Day	international consultancy firm/ fishery resource assessment group and NaFAA

10. MODE OF APPLICATION

The interested firm will submit a technical and financial proposal in separate sealed envelopes that will be assessed for compliance with the qualification/eligibility criteria to perform the services for which the solicitation is made.

11. REPORTING

The firm will be required to prepare a report following the details outlined in annex 6. The firm will report to the Project Coordinator on all matters related to the conduct of this service. An inception report will be required within 2 weeks of the award of a contract, and draft report within 2 weeks of completion of the survey, and a final report within 42 days of signing the contract.

ANNEXES

Schedule of Professional Services and Delivery Requirements

1. Vessel Operating Requirements and Capabilities
2. Collection of Biological Information
3. Otolith Collection Protocol
4. Collection of Oceanographic Information
5. Capability of Survey Vessel to Undertake Acoustic Surveys of Small Pelagic Species and Analysis and Report of Data
6. Reporting Requirements and Provision of Archived Data Sets

Annex 1: Vessel Operating Requirements and Capabilities

The contractor will provide the following information in regards to the intended survey vessel:

Vessel name
Vessel owner/operator
Is the vessel owned by the respective institution or will the vessel be chartered? Provide details of the owner of the vessel.

Does the vessel have an agent in Monrovia? If yes, who?
A copy of the most recent vessel survey certificate (that will show the classifying society, class, and other vessel details etc.).
Provide a general description of the intended insurance cover for the vessel while it will be undertaking the survey covered in the intended contract:

- Injury/loss of life of NaFFA arising from events while on the chartered vessel
- Loss of survey time caused by vessel operational reliability/failure or crew-related problems.

Expected port where the vessel will be moored at time of tender offer
Range/endurance of vessel without refueling
Expected range of vessel on arrival in Monrovia

Indicate the course plotting capability the vessel has? Can course and station information be saved off-line for future reference?

Will the vessel be able to be inspected by NaFFA (or their nominees) prior to finalization of any bid?
Name expected vessel officers and details of their experience with scientific cruises
List crew by task

Name, scientific roles, and CVs of scientific staff to be supplied by the contractor. These staff will be required to undertake operation of the acoustics system and analysis of the acoustics data; collection of water samples and their preservation or undertake at-sea analysis; operation of the plankton sampling net and preservation of samples.
Number and nature of possible berths for Liberian supernumeraries? Is linen, towels, soap, etc. provided?

Types of fishing the vessel can undertake? E.g., ability to do pelagic trawling, i.e., would the vessel carry pelagic doors and a pelagic trawl; Can the vessel be rigged with a shrimp try net(s)?; Maximum depth demersal and pelagic trawls can be fished; Can the cod end be fitted with net liner – if yes, details?; Minimum safe fishing depth?; and Net design diagrams for the respective nets that will be operated.

List all scientific cruises undertaken during the last 3 years indicating cruise objective, port(s) and dates of departure and return. If the cruise had to be abandoned indicate for what reason. Provide the name and CVs of the Chief Scientist and any research technicians if they are proposed for the cruise, their research institution and contact details.
Attach copies of reports produced from the surveys.

Is the vessel equipped with a functioning hydrographic winch/wire?
Does the vessel have a set of water sampling bottles? If yes – how many? What type?

Does the vessel have a wet lab? A dry lab? Sizes?
Is there freezer storage for samples? Volume?

Indicate the power supply capacity for electronic equipment, etc. – 220/240 AC etc.

Vessel Operations

Will the crewing schedule enable the vessel to operate 24 hours a day, or periods that extend beyond 12 hours as required? Does the vessel have a pre-determined manner of crew shift operation?

Annex 2 – Collection of Biological Information

Biological Measurements – Demersal Species Schedule

For the following species, measure all specimens that are caught up to a maximum of 100 individuals per species per tow. Start sampling with the least frequent species. All of the species in the following table should be identified to the level of species.

Osteichthyes – Demersal Species

1	*Epinephelus aenus*	8	*Sepia hierredda*
2	*Dentex canariensis*	9	*Cynoglossus* spp
3	*Dentex angolensis*	10	*Pentanemus quinquarius*
4	*Galeoides decadactylus*	11	*Pomadasys* spp
5	*Lutjanus* spp	12	*Penaeus notalis* and other species
6	*Pagellus bellottii*	13	*Brachydeuterus auritus*
7	*Pseudotolithus* spp		

Pelagic Species

1	*Sardinella aurita*	3	*Scomber colias*
2	*ardinella maderensis*	4	*Trachuru trecae Cynoglossus* spp
3	*Ilisha africana*	5	*Engraulis encrasicolus*

Length – fork or total length as appropriate to the species; for crustaceans, measure the carapace length. Use a measuring board, tape or vernier calipers.
Weight – accuracy of the scales?
Sex – M/F/?
Gonad condition. Use a numeric indicator, 1 – 6 or 1 – 8 as appropriate. Append a description of the scale that is used.
Gonad weight should be collected if possible for a select number of species.

If photographs are taken for subsequent species identification they should show the left side of the fish and include a legible label indicating the vessel initials, date and tow number. A tape or 30 cm rule should be included in the photograph.

Otoliths
Otoliths should be collected from all Osteichthyes species. For this either coin envelopes or vials for smaller ear bones should be used. The protocol to be used for this aspect of biological sampling is given in the Annex to this Schedule.

Biological Schedule for Cephalopods

Cephalopods

1	*Loligidae – Allloteuthis africana*	8	*Sepia officinalis*
2	*Lolliguncula mercatoris*	9	*Sepia hierredda*
3	*Octopus vulgaris*	10	*Sepia berthelotti*
4	*Illex coindetii*	11	*Sepia elegans*
5	*Ommastrephes bartrami*	12	*Sepia orbignyana*
6	*Ommastrephes pteropus*	13	*Sepia ornata*
7	*Etc.*	14	

Record:
Species
Weight
Sex
Mantle length if possible
Total length if possible.

Photograph all animals of uncertain identification.

Biological chedule for Crustaceans

Record for the following species:

Crustaceans

Aristeidae	*Parapenaeus longirostris*
Heterocarpus	*Solenocera africana*
Panulirus regious	*Penaeus notialis*
Calappa rubroguttata	*Portunus valides*
Scyllarides herkiotsii	Etc.

Carapace length (shrimp and lobsters – posterior eye orbit to center of end or carapace) or carapace width (crabs). Use Vernier calipers as necessary.
Weight
Sex
External embryos?

If possible record a sample of 100 individuals, which may only be possible for shrimp.

Biological Schedule for Chondricthyans (sharks and rays)

Record for all specimens of sharks:

Species
Total length
Weight is possible
Sex
If female, if pups are present, number.

If the identity of the shark is uncertain take a photograph (a guide will be provided). Include a metre stick or 30 cm ruler in the photo and a label that clearly indicates vessel name/initials, date and tow number.

Photographs should be taken of all animals for which species identification is uncertain. Photos should include appropriate identification – trip number, tow number, date, etc. and a rule to indicate size.

Rajidae

Sessile/sedentary Invertebrates

Care should be taken to record any bycatch of sedentary or sessile benthos, i.e. corals and sponges in particular. Normal record keeping practices should be undertaken.

Other Benthos
Record occurrence when other benthic species are encountered.

Annex 3: Otolith Collection Protocol

1. INTRODUCTION

This Protocol is based on the following assumptions.

i. Length frequency measurements are collected from fish sampled from the catch and are used to infer an age distribution of the catch.
ii. The objective is selecting the fish for removing their otoliths is to obtain a relationship with minimum whose lengths are measured error.
iii. To best achieve this the number of samples for each class interval should reflect the variability of ages for the respective class intervals (often called bins).
iv. As yet there is no information to inform on this variability and thus a sample size of three males and three females for each one-centimeter class should be used as a start.
v. It is expected that otoliths from larger fish will show more variability and that in the future the sample size will be increased for larger fish.

This protocol is designed to collect otoliths in a manner that enables the preparation of an age-length key. A well-founded age-length key will allow the ages of fish measured by the standard 100-fish measuring programme to be inferred from the length measurements. In this way a minimum error age-length key should be obtained.

2. WHEN TO COLLECT THE OTOLITHS SAMPLE

Ideally a complete sample of otoliths from an area would be collected during the same trip but this is not essential and sampling could continue from, e.g. commercial vessels. Each main area should be sampled once each year. This could mean one complete sample from the northern, central and southern sections of the Liberian coast.

3. PROTOCOL FOR SELECTING THE FISH FOR OTOLITH EXTRACTION

The fish from the 100-fish sample *can be (and should be) used* for the otolith sample. But, once the required 3 fish for each sex in each centimeter class have had their otoliths removed, there is no need to continue taking further otolith samples for that particular length class. However, after the 100-measurement lengths sample has been taken there will be some, possibly many, length classes (or bins) for which 3 fish were not encountered. Thus, otoliths from fish in these length classes should continue to be taken from the catch. The length measurements and sex observations from these fish *should not be included in, or added to, the measurements from the standard 100-fish sample.* The additional fish sampled for otoliths can come from a subsequent tow but the tow should be from the same area.

Attention: Be extremely careful not to damage the margins of the otoliths.

Note that data collected from the 100-fish 'random' sample can be used when their otolith are removed to determine the age-length key. However, the reverse *is not true* – fish purposively

selected to get an evenly balanced otolith sample across the size range *must not be used to make inferences about the age distribution of the particular catch from which they were collected.* If this were done the results would be meaningless.

An additional column should be used on the Excel spread sheet recording the data for the ≤100-observation biological cate if the otoliths were saved, e.g.

Sample no.	Length	Weight	Sex	Gonad condition	Gonad weight	Otoliths collected	Comment
						N/Y/	

"N" = no otoliths taken. Note, the sample number is automatic on the Excel spread sheet.

4. WHAT EQUIPMENT IS NEEDED?

- Knives – there should be no shortage of these on board, but think about safety gloves.
- Forceps/tweezers to pick the otoliths out of the skull pockets
- Coin envelopes to store the otoliths, one envelop per fish. Coin envelopes (they are about 4 * 7 cm in size) *may not be available in Monrovia*. And vials. Add some material so that the otoliths are not damaged by movement withing the vial.
- Paper towels to dry the otoliths before putting in the envelopes
- Pen ideally with non-smudge or water proof ink or appropriate pencil.

5. LABELING AND STORING THE OTOLITH SAMPLES

Otoliths can be stored in various ways but the easiest way appears to be the best way. When preparing for sea ensure that you have adequate "coin envelopes". These are small, about 4 * 7 cm and most stationary shops sell them in boxes of 1000: they should be inexpensive ($15/box?). Buy those made from good quality paper, acid free if possible.– it may be that the otoliths will sit on a shelf for > 10 years before being examined. It is surprising the number of envelopes that are encountered years later for which incomplete information has been recorded and which then can't be used!

Envelopes can be labeled (See figure below) in your cabin before going to the factory deck to speed the process. Otolith removal and data entry is best done using two people. The vessel officers have been asked to help by making a factory-deck crew member available to assist as required. Try to use the same person if possible. One person should remove the otoliths – he will have continually messy hands, the other person should record the related information, put the otoliths in the envelopes and seal them. Figure 1 shows an example of good recording practice.

Figure

Example of data to be recorded on the otolith envelope,

Date / /202 Trip No.: xxxxx_ Initials

Species: BYS **Tow No.xxx**

Sample Number – from 100-sample spread sheet (as available)

Length **Sex: M/F**

6. NOTING MAXIMUM FISH SIZE

An important parameter in fish stock assessment is the maximum size that is obtained by the fish, referred to as the asymptotic length (L_∞) or weight (W_∞). Take some measurements and otoliths from these individuals when they are encountered, but take care not to aggregate their data with those from the 100-fish 'random' sample! It will bias their results.

Use the following sheet to manage your otolith collection efforts – *keep the sheet when it is completed though.*

Adjust the lengths depending on the species involved. E.g, the maximum size of small pelagic species may be <20 – 25 cm. Here a 0.5 cm class interval may be chosen.

Otolith Sample Schedule. Trip No. Tow(s) No. Feature: Name:

	Males			**Females**		
Length	1	2	3	1	2	3
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Annex 4: Collection of Oceanographic Information

The contractor will provide the following information in regard to the intended survey activities.

The contract will call for observations to be made of the following oceanographic variables.

- Mapping of sea temperature
- Salinity
- dissolved oxygen
- chlorophyll-a,
- Other nutrients (phosphorous, nitrates, silicates)
- pH
- ocean currents.
- ocean acidification and
- calcium carbonate saturation horizon relevant for calcifying organisms.

The contract will call for the following planktonic observations:

- Primary productivity
- Characterization of the zooplankton fauna and their abundance and distribution
- Characterization of the ichthyoplankton and their abundance and distribution
- Characterization of jellyfish fauna and their abundance and distribution
- Determination of the abundance and biomass patterns of meso-zooplankton and their species composition.
- Determination of the distribution and abundance of fish eggs and larvae to the lowest possible taxonomic level.

The contractor will indicate what method of analysis would be used to determine each of these required variables, who would be responsible for the analysis and where it would be done.

Annex 5: Capability of Survey Vessel to Undertake Acoustic Surveys of Small Pelagic Species and Analysis and Report of Data

List all functional bridge acoustic equipment carried and the capabilities of each unit.
Indicate the manufacturer, date of installation
List the agency responsible for the servicing/maintenance of the respective acoustics units.

Note when the acoustic system was:

- Last calibrated
- How it was calibrated and
- Provide a calibration certificate.

If a calibrated sphere was used provide the accompanying sphere specifications.
If a standard hydrophone was used provide the accompanying hydrophone specifications.
If the acoustic system has not had a comprehensive calibration (from calibration sphere to system output) within the last two years, this should be undertaken and the calibration report provided to NaFFA.
Provide other relevant information as is available.

Which bridge officers and/or ship's scientific staff are qualified to operate the acoustic system for echo integration surveys?

A log of all system-related variables used during acoustic surveying should be kept with appropriate documentation. This will include system power and gain settings and values for variables such as the absorption coefficient.

Indicate the backscattering cross section area – biomass relation that will be used (Target Strength – biomass function) for producing estimates of biomass of fish This should include citations to work that was done to produce the values for these parameters.

Will the contractor provide the expertise to process and analyse the acoustic data? Have the capacity to archive the acoustic data for subsequent onshore processing?

Indicate how the acoustic data will be analyzed, where, and the nature of the reports that will be provided.

Will the analyst be able to provide advice on the possible error in the acoustic estimates that are provided? If so, what are the sources of error that should be expected?

ANNEX 6: – REPORTING REQUIREMENTS AND PROVISION OF ARCHIVED DATA SETS

The contractor, in collaboration with NaFFA staff as necessary, will maintain the following records and deliver in electronic form the following records at the end of the research cruise.

1. CRUISE DIARY/SUMMARY REPORT THAT WILL CONTAIN THE FOLLOWING INFORMATION

Trip Details: dates**,** port visits, general area of operations.

Crew List
Scientific crew list and role

Sightings of fishing vessels with identification ifs possible and/or description of vessel.

Sampling Activity

Summary of demersal, pelagic and plankton sampling

- Numbers of tows
- General Locations
- Catch results
- Summary of Biological Information that was collected

Environmental Information
Weather encountered
Oceanographic information collected
Marine mammals and other mega-fauna sighted
Sea Birds
Sharks/rays encountered

2. SUMMARY OF BIOLOGICAL SAMPLING OPERATIONS

Biological data by tow and species
Otoliths collected
Photographs for species identification

3. FISHING TOW LOG

Header to contain information to identify vessel, name of person completing the log, dates, tow number and gear code, e.g. MW – mid-water trawl.
Start time of tow (when brakes applied on winch) – 24-hour clock
Stop time of tow (when haul back begins).
Gear depth at start and finish of tow

4. PLANKTON TOW LOG (Spread Sheet)

Spread sheet header to contain information to identify vessel, name of person completing the log, dates, tow numbers and gear code, e.g. BN – bongo net.

Start time of tow (when brakes applied on winch) – 24-hour clock
Stop time of tow (when haul back begins).
Gear depth at start and finish of tow

5. SUMMARY OF OCEANOGRAPHIC SAMPLES COLLECTED

Spread sheet header to contain information to identify vessel, name of person completing the log, dates, wire sample numbers and gear code, e.g., NB – Neskin bottle.
Time wire deployed – 24-hour clock
Depth to which sampling undertaken

6. DELIVERY OF ALL OPERATIONS DATA, RECORDS, ETC.

The contractor will deliver to NaFFA the original data collection sets if written and copies of all electronic data files.

7. VESSEL OPERATIONS DATA

Disposition of rubbish

Disposition of Oil

Disposition of Sewage

Health & safety briefing, issues; training exercises undertaken.
Rescue Craft – short description