

## Darwin Initiative Main Project Annual Report

**Important note:** To be completed with reference to the Reporting Guidance Notes for Project Leaders:

*it is expected that this report will be about 10 pages in length, excluding annexes*

**Submission Deadline: 30 April**

### Darwin Project Information

Project Reference	21-013
Project Title	Alternative livelihood opportunities for marine protected areas fisherwomen
Host Country/ies	Sierra-Leone, UK
Contract Holder Institution	University of Stirling (UoS)
Partner institutions	Fourth Bay College, University of Sierra Leone Institute of Marine Biology and Oceanography (IMBO), Njala University (NJU), Macalister Elliot and Partners Ltd. (MEP).
Darwin Grant Value	£247,264
Funder (DFID/Defra)	DFID
Start/end dates of project	1 Apr 2014 to 31 Mar 18
Reporting period (e.g., Apr 2015 – Mar 2016) and number (e.g., Annual Report 1, 2, 3)	Annual Report 1: Apr 2014 to Mar 2015
Project Leader name	Francis Murray
Project website/blog/Twitter	<a href="http://www.stir.ac.uk/aquaculture-mangrove-oyster/">http://www.stir.ac.uk/aquaculture-mangrove-oyster/</a>
Report author(s) and date	Francis Murray, William Leschen, Salieu Sankoh, Richard Wadsworth.

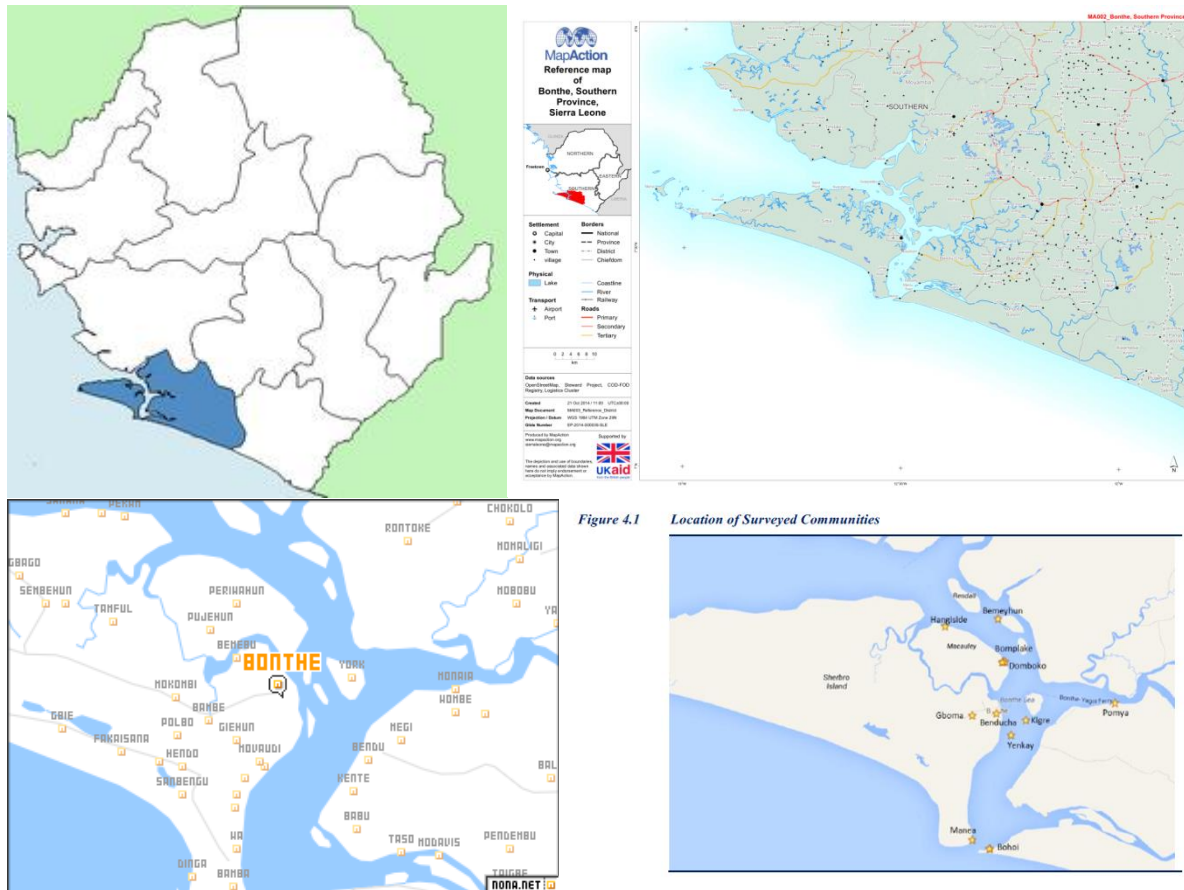
### 1. Project Rationale

Many Sierra Leonean fisherwomen living in coastal mangrove areas are trapped in a vicious downward spiral of environmental destruction and resource depletion. Because they are poor, lacking capital and alternative sources of income, they are compelled to harvest local oysters throughout the year in what is now a widespread and unregulated activity. Consequently the harvested oysters become smaller and less valuable, so they have to harvest more exacerbating the problem. It is a hard and dangerous life, injuries such as infected cuts from roots and shells are common. Mangrove trees are damaged by the harvesting and habitat for other species is disturbed. If the oysters are exterminated from an area one of the few options left for the women will be to cut the trees for firewood. The government are making efforts to regulate the fishing effort of artisanal fishermen with from the start of 2014, only 11,000 boats being registered /licensed to fish throughout the country. Alternative livelihoods will need to be found by those excluded from fishing. Most of the commercial fish species in Sierra Leone also depend on the mangroves as spawning and nursery areas. This project aims to support the work of the Marine Protected Area by providing alternative livelihoods based on carefully managed extensive culture and value-added marketing of native mangrove oysters in order to make it a financially viable income earning activity for local women whilst also protecting its sustainability for the future. This native oyster depletion and degradation problem was first identified during 2006/7 by a previous Darwin Initiative project under which two reconnaissance surveys (Wadsworth

2009a & 2009b) were undertaken to consider the possibility of including the mangrove forests as a “biodiversity offset” to a commercial Rutile-mineral mining concession (NACE 2009).

The research area is located in Bonthe District, Southern Province around the Sherbro River estuary, an area which includes the settlement of Bonthe Town on Sherbro Island (Figs 1a-c).

Sherbro Island borders the Atlantic Ocean to the west, and is separated from the African mainland by the Sherbro River in the north and by the Sherbro Strait to the east. The Sherbro Estuary is 32 miles (51 km) long and up to 15 miles (24 km) wide, covering a total area of approximately 230 square miles (600 km<sup>2</sup>). At the western extremity is Cape St Ann, and on the eastern end, is the chief port and commercial centre of Bonthe.



**Figure 1a-c: Location of project area in the Sherbro estuary and Bonthe town. The map bottom right (Fig 1c) indicates the locations of communities visited during preliminary scoping work.**

## 2. Project Partnerships

Planned year 1 activities have been severely disrupted by the on-going Ebola outbreak in Sierra Leone, delaying the development effective working relationships between the project partners and its affiliates and intended beneficiaries. As this report is being written, erratic numbers of new Ebola cases are still being reported still recommends UK citizens against non-essential travel to Sierra Leone.

During this time Stirling University has maintained regular contact with local partners, IMBO and NJU to review weekly UK-FCO and WHO Ebola situation reports (<http://apps.who.int/ebola/ebola-situation-reports>) and to discuss planning options. Within this context, IMBO the local coordinator has taken lead responsibility for primary scoping field work (Section 3.1) consistent with their local knowledge of Ebola conditions. As part of this effort IMBO have had limited liaison with the following project affiliates: the West African Regional Fisheries Project, the Ministry of Fisheries and Marine Resources (MFMR) and with the MPA

management and devolved Local Management Committees (LMCs). Once travel restrictions and delays throughout the country are rescinded Dr Sankoh will also liaise with oyster fisherwomen groups – the principle intended beneficiaries of the project. Since the project is yet to start supporting and developing the sales and marketing channels for the female oyster growers the MaCallister Elliot partner is yet to engage in activities as laid out in the proposal.

### **3. Project Progress**

#### **3.1 Progress in carrying out project activities**

Due to restricted access to our research-areas arising from the on-going Ebola outbreak, the project partners were granted a 12 months no-cost project extension (to 31 mar 2018). Since April 2014, the ability of the Sierra Leonean partners to travel and conduct field-work within country has also been severely restricted. Within this context, a local partner report summarising Year 1 field work outcomes is presented in Annex 6 and activity progress described under logframe outputs below:

#### **Inception Meeting**

Whilst not listed as an activity/ output it was our intention to initiate the project with an Inception meeting for project partners and local stakeholders in Freetown. Instead, consortium members, Dr Francis Murray and Mr William Leschen (UoS), Dr Richard Wadsworth NJU, held an inception meeting at the University of Stirling on the 26<sup>th</sup> August 2014 to discuss project planning. Dr Sankoh (IMBO) also joined by Skype. With the Ebola outbreak at its height it was decided to request the no-cost extension (Annex 4). Contingency planning was discussed and a new time plan was formulated based on at least a six month delay before the country would be clear of the virus. Ultimately this was extended to 12 months as despite significant improvement the outbreak still shows no definitive sign of abating.

#### **Output 1**

**Activity1.1 Multi-stage sample design for selection of 6-8 intervention communities according to social and environmental criteria** (e.g. harvesting mangrove oysters along salinity and primary productivity gradients)

This was to be a key collaborative post-inception meeting office and field scoping activity. Central to the design was collection or development of appropriate sample-frames auditing all existing mangrove gathering activity and community and household involvement in the project area. This comprehensive frame would then provide the basis for selection of communities for more in-depth research, stratified on key ecosystem and livelihood characteristics in order to enhance the generalizability of our findings. Suitable primary data sources are very limited in the Sherbro Estuary context such that greater reliance has to be placed on interview of knowledgeable key informants in the project area. Dr Sankoh initiated this process, consulting with local Chiefs and others during Activity 1.2 (below) identifying 15 communities in the research area. Further delineation/ GPS and GoogleEarth mapping of the oyster zones, their dependent communities and households will be undertaken during subsequent visits once greater rapport and trust has been established. Further details of selection considerations, constraints following field visits are presented in Annex 5.

**Activity 1.2. Baseline livelihood surveys & selection of target-households:**

#### **Preliminary Scoping visit**

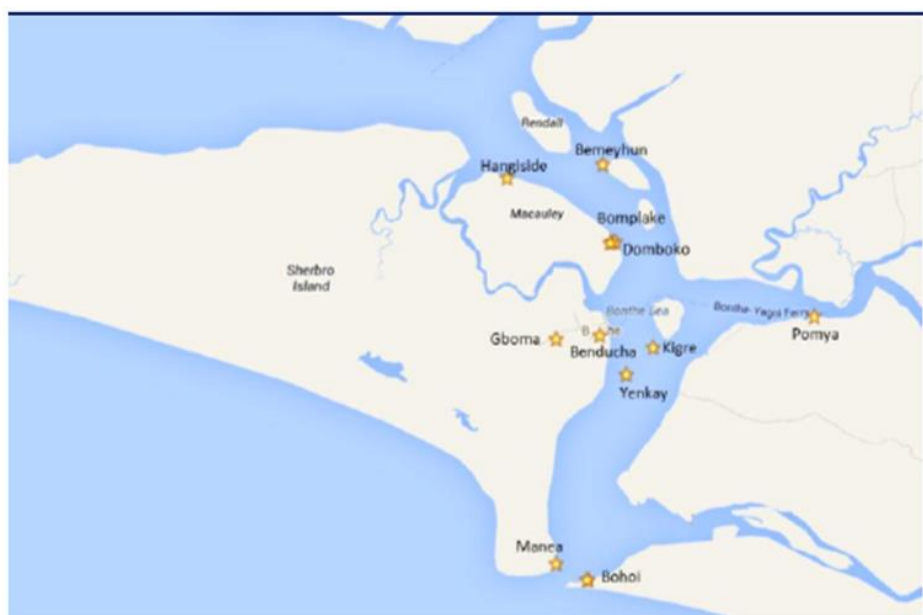
Whilst it hasn't yet been possible to carry out the full surveys due to the countrywide situation, just before local travel restrictions were enforced, Drs Sankoh and Wadsworth (IMBO and NJU) carried out an initial **Scoping Visit** to the Bonthe area between 17<sup>th</sup> – 21<sup>st</sup> April 2014 as an extended follow-up to the initial field work undertaken by the Sierra Leonean partners between the first and second stages of writing the proposal. The team consisted off:

- Dr Saliue Sankoh (National Coordinator of the West African Fisheries Development Project)
- Dr Richard Wadsworth (Department of Biological Sciences, Njala University)
- Mz Caroline Kennedy (an MSc student from Bath University, UK, completing her thesis on solar powered desalination for rural communities)

The main purpose of the field work was to:

- make contact with the local elected officials (the Mayor) and traditional authorities (the Paramount Chief),
- make contact with organisations with compatible objectives (such as the Environmental Justice Foundation EJF),
- make contact with community management committees (of the newly established co-management zones in the Marine Protected Area),
- make contact with fourteen communities along a north-south (freshwater-sea water) transect
- to start to understand the economic and technological constraints faced by oyster fisherwomen and their families
- to raise awareness of the project.

A total of 15 communities (villages) were identified; the figure below shows the locations of ten communities visited over 3 days (several of the target villages could not be reached because of tidal conditions).



**Figure 2. Location of sample-frame communities**

, Main findings from Scoping Visit:

- All the indications are that the fishing communities are among the poorest segment of a poor country, they are eager for change but for the most part function on a very hand-to-mouth existence. They are often in debt for loans used to purchase boats and nets and as such are unable to switch to other occupations as easily as they might otherwise do.
- While education is valued by the communities only one of the 10 outlying villages (those with no land connection with Bonthe Town) had a functioning school (a second village had a school but the single teacher was on-strike until the community patched the thatch roof of his one room school). Levels of literacy are therefore likely to be lower here than in the general mainland population.

- The distribution of oysters is predictable at the broadest spatial scale, where sites that are too riverine or too marine have few oysters (but other shellfish take their place). The main oyster production zone is in the north-west; the Pomya community has too much freshwater, while Monca and Bohoi are too saline (Fig 2).
- Only one community at Bemeyhun reported “rock oysters” (that is oysters growing permanently submerged on rocks or gravel), but they were reluctant to show the sites, claiming the beds were “too far off”. Discarded shells were considerably larger (~50% longer) than shells at other communities.
- At a finer spatial scale the distribution of oysters seems very difficult to predict. It is unclear whether the patchy nature of the distribution represents past exploitation or existing environmental variables.
- More detailed mapping of bio-physical characteristics is required.
- It appears that the idea of co-management committees to oversee the exploitation of natural resources in the estuary is accepted, and perhaps, welcomed. However, there are indications that strict no-take zones may cause friction between adjacent communities where one is affected and the other is not.

### *Outputs*

Results gathered during the field work:

- were presented in Ghana at the Mangrove and climate change workshop.
- helped confirm & validate the conclusions reached by the reconnaissance survey.

### Further work required

So far we have only a qualitative understanding of the distribution of oysters in the mangrove swamps; we need to understand whether the observed patterns are predominantly driven by harvesting or abiotic and biotic factors. This will require much more time physically visiting and surveying the different locations where oysters are being harvested.

### **Activity 1.3 Development of initial oyster artificial-substrate based culture-technology and depuration options.**

Dr Francis Murray met with Prof. Mike Rice<sup>1</sup>, University of Rhode Island one of the coordinators of USAID funded project supporting community based organisation of female oyster fisherwomen in the Gambia<sup>2</sup>. The project included a cost-benefit analysis of a simple home-made floating ‘oyster gardening system’<sup>3</sup>. Results indicated the system was unlikely to be profitable under local Gambian production and marketing conditions – however the development approach did incorporate any value-addition strategy. Potentials will be explored for adapting the system to conditions in Sierra Leone using low-cost locally available materials.

### **Output 2**

#### **Activity 2.1 Procurement and adaptation of solar powered freezers**

Drs Sankoh (IMBO) and Wadsworth (NJU) have reviewed solar powered freezer technological options appropriate to field conditions in Sierra Leone (Annex 8) and obtained quotes for a series of different product options in country. Field research by Bath University MSc student Caroline Kennedy researching solar power and desalination contributed to the analysis. Further progress is contingent on lifting of travel restrictions.

<sup>1</sup> [https://en.wikipedia.org/wiki/Michael\\_A.\\_Rice](https://en.wikipedia.org/wiki/Michael_A._Rice)

<sup>2</sup> [http://www.gm.undp.org/content/dam/gambia/docs/GMB\\_UNDP%20Global\\_Case%20Study%20on%20TRY%20Oyster.pdf](http://www.gm.undp.org/content/dam/gambia/docs/GMB_UNDP%20Global_Case%20Study%20on%20TRY%20Oyster.pdf)

<sup>3</sup> <https://www.youtube.com/watch?v=WEbT7SepU5I> <https://www.youtube.com/watch?v=RohXNGZCKPI>  
 ``<https://www.youtube.com/watch?v=Wxs9kJWMclI>

## Output 3

### Activity 3.1 Analysis of markets for oyster-based products and their substitutes

In January 2015, two value-chain market surveys were undertaken as a preliminary assessment of the trade in traditional oyster products, building on an understanding of producer (oyster fisherwomen) perspectives gained from the earlier scoping visit.

#### 1. Sherbro Estuary Processors:

Fourteen respondents in 9 communities close to Bonthe town were interviewed. The average price of a cup of oysters was very similar for all merchants except for two (Le 1,000 / cup fresh and Le 1,500 or Le 2,000 cup dried / smoked)

#### 2. Freetown Area

A transect of nine markets from the very centre of Freetown through to a satellite town were visited. All markets in this survey operate at least 6 days per week and most operate 7 days per week. (Weekly markets such as Yagoi and Gbangatok are much more a feature of rural areas).

### Main findings

- Processing and harvesting chains are more complex than originally thought but selling in the market is predominantly a female occupation (24 of the 26 respondent).
- Oysters for sale in Freetown were mainly sourced from the Sierra Leone River Estuary; however, three respondents (out of 18) sourced their oysters from either Gbangatok or Bonthe.
- Prices were remarkably static along this gradient, everyone charging Le 2,000 or Le 2,500 except for one respondent in Dove Cut, selling for Le 3,500 (these were sourced from Bonthe); therefore the ability of the respondent in Bonthe to sell processed oysters for Le 5,000 / cup might be optimistic – without further ‘value-added’ (e.g. through product differentiation, promotion through recipe competitions etc.).
- The supply chain between mangrove and market was more complex in the Freetown markets with some traders being approached by processors and others going to processing centres.
- Markets in Freetown are open 6 or 7 days per week so traders need constant supply and are more likely to think of the market as their main occupation.
- The consistency in price across all markets is surprising and possibly indicates commoditisation an efficient transmission of price data contributing to perfect competition – or alternatively price fixing collusion (further research required).
- Although smoked oysters command a higher price per cup in all markets the increase in value does not adequately cover the increased number of oysters needed to fill a cup, nor would it cover the extra time and effort needed to smoke the oysters. However, the advantage of the smoked oysters is that they are much easier to transport i.e. it represents a quality assurance rather than a value addition strategy.
- It is impossible with the data collected so far to estimate the impact of oyster harvesting on wild stocks. Qualitative data from the village level suggests that over fishing is going on and is likely to increase (findings in agreement with the project proposal).
- Some traders in Freetown are making use of refrigerators to store surplus goods from one day to the next, but none of the traders in the Bonthe area are doing so (although they are well aware of the value of ice).
- The observation of a much higher price for oysters transported a long distance or where processed further (beyond smoking) supports the basic premise of the Darwin project.



Within the limited resources available to oyster fisherwomen they are trying to “add-value”.

### Further work required

More detailed value-chain mapping, further assessment of market failures (e.g. price collusion) and evaluation of market segmentation and consumer preference to inform potential value-addition strategies

## **Output 4**

### **Activity 4.1 Establishment of project web-site**

A project website is under development and can be accessed at <http://www.stir.ac.uk/aquaculture-mangrove-oyster/>. The site will be continually developed and populated with content as the project proceeds.

## **3.2 Progress towards project outputs**

Travel restrictions have severely delayed delivery of progress against planned project outputs. Some limited progress has been made as follows:

*Output 1. Sustainable production and collective management systems (WP2)*

Community selection and preliminary livelihoods assessment (Annex 6 & 7)

*Output 2. Supply chain enhancement (WP3)*

Review of appropriate cold-chain technology and local cost inventory (Annex 8)

*Output 3. Market promotion and value-addition (WP 4)*

Preliminary value chain market survey (Annex 6 & 7)

*Output 4. Training and dissemination (WP1)*

An initial scoping visit to Bonthe (Annex 6) informed and increased awareness of the upcoming project with key stakeholders (including some of the female oyster collectors, local oyster processors and market traders as well as the local administration, mayor, environmental services, and local armed forces - whose role it is on very low budget to monitor and prevent illegal fishing in the area).

## **3.3 Progress towards the project Outcome**

The project outcome is as follows: *“Incomes of oyster-fisherwomen in at least 40 households of the Sherbro MPA increased by 45% pa and abundance/ mean-size of adjacent wild-oyster populations increased by at-least 18% over base-line levels.”*

Due to travel restrictions we have made very limited progress towards reaching the project outcome described above. Individual beneficiaries i.e. including oyster fisher women and their associated households have yet to be fully engaged. Therefore at this stage we cannot make any reasonable evidence based judgement regarding indicator adequacy and outcome achievement.

## **3.4 Monitoring of assumptions**

Although the Ebola outbreak was not a risk we could have reasonably foreseen prior to the project – further progress is now highly contingent on lifting of travel restrictions linked to the elimination of new cases. Although the situation is much improved on 2014 peak prevalence, sporadic cases continue to occur due to fatigue and fear. We continue to regularly review the situation.

### **3.5 Impact: achievement of positive impact on biodiversity and poverty alleviation**

(As above) we are not yet at a stage within the project where we have an evidence base to substantiate any of our original indicators regarding the higher goal/impact of biodiversity conservation and poverty alleviation.

### **4. Project support to the Conventions (CBD, CMS and/or CITES)**

(As above) we cannot yet provide an evidence base as yet to show positive outcomes towards interacting with and meeting some of the objectives of Biodiversity Conventions

Drs Sankoh and Wadsworth have had some meetings with the Environmental Justice Foundation who's effort to support extensive mangrove oyster culture in a complementary project have also been constrained by the Ebola outbreak.

### **5. Project support to poverty alleviation**

No evidence is yet available to demonstrate poverty alleviation impact

The main intended beneficiaries are the female oyster fisherwomen who will take up new more sustainable mangrove oyster culture. As volumes of oysters from these improved systems increase processors and market traders will also benefit through improved incomes. Both local consumers, mining employees, and later on into Year 3 the project Freetown consumers of the product will benefit from a nutritious more readily available source of protein.

Direct impacts - as indicated above – are expected through the improved incomes of the women producers and the improved well-being of their families.

There are no noticeable achievements yet other than a noted keenness on behalf of most interviewed in the scoping study to get on with the project and for themselves uptake of new more sustainable oyster production systems.

### **6. Project support to Gender equity issues**

The main intended beneficiaries are lower income women subsisting in the Sherbro MPA.

Gender equality impacts are anticipated in terms of providing poorer females (either already married with families or single) incomes for their households. The project will also assess barriers for these women to also become involved in up or downstream value chain activities. This could potentially increase/ secure their incomes by affording more control over their own production and sales

There have been no noticeable achievements in this respect yet.

### **7. Monitoring and evaluation**

A refined M&E plan incorporating appropriate metrics will be developed as an outcome of the scoping work and finalised once all consortium members have completed a joint field visit to gain a shared understanding of the intervention strategy. In the interim UoS has maintained regular contact with the Sierra Leonean coordinating partner Dr Sankoh and Dr Wadsworth (NJU) through email, phone calls and also skype. In terms of financial monitoring receipts and spreadsheet lists of all costs associated with the the scoping and initial markets surveys have been requested and received by the UOS coordinator.

### **8. Lessons learnt**

Initial interactions with some of the communities harvesting oysters indicated a need for closer association to build trust and working relations e.g. through recruitment of local RA's. For



example some were unwilling to divulge the locations of their oyster beds and lays as theft can be a key issue.

In addition to limitations placed on field work through travel restrictions, there is also general reluctance for most rural communities to engage with strangers that unable to regularly associate with them. Prior to the outbreak Sierra Leone had one of the highest GDP growth-rates in Africa, albeit from a low base and much of it associated with large mining concessions. An exodus of foreign workers and the general economic decline due to the Ebola outbreak will clearly impact on demand for the value-added products envisaged by the project. The likely persistence and duration of these changes, short or longer terms are questions to be addressed in on-going market assessments.

If these projects were in high risk Ebola outbreak (or similar epidemic) countries we would countenance more contingency planning for the event of a new outbreak. However, ultimately such epidemics represent force majeure largely beyond the scope of a project such as this to respond. Thus when most pressing need is for humanitarian aid, the most and perhaps only realistic option is for such livelihood & bio-diversity oriented projects to be delayed and restarted when the in country situation is clear in terms of new cases i.e. meeting the WHO designated 42 day clearance period.

A more radical option would be to temporarily shift the focus to a neighbouring (Ebola free) country with specially selected mangrove oyster producing communities there (e.g. Senegal, or Gabon) where there is also a history, culture and development need for artisanal oyster production. This however would clearly represent a significant logistical and design challenge – not least in terms of staff mobility and capacities.

## **9. Actions taken in response to previous reviews (if applicable)**

Not applicable

## **10. Other comments on progress not covered elsewhere**

We hope that once in-country conditions change favourably, will be able to follow the initial design, and GANT chart timeframe as a result of the 12 month extension already granted.

Difficulties encountered due to the Ebola outbreak are discussed above. Once the country goes is declared free of Ebola there remains an on-going risk of Ebola reoccurring if it is not eradicated from neighbouring countries (as is currently the concern in Liberia). The WHO has also raised concerns over resurgence in prevalence of other endemic diseases e.g. malaria, typhus etc. for which control measures have been neglected during the Ebola outbreak. Very sadly, the extremely time consuming vetting and isolation for suspected Ebola cases indirectly lead to the loss of a family member of one of our project partners - active on the project.

There remains a risk that low levels of new cases of Ebola could 'rumble-on' for another 6 or 12 months which would prevent the UK partners from being able to collaborate on field-work. However, even if this were the case travel restrictions and the economic situation should improve enough for local partners to better conduct planned activities. Although less ideal, in this scenario – we may consider/ propose the option of conducting collaborative work in a neighbouring disease free country as described above i.e. to develop an integrated approach and shared training of field-staff as necessary.

## **11. Sustainability and legacy**

Not applicable at this stage since the project still to gain significant profile, however the scoping visit to Bonthe clearly demonstrated interest from local stakeholders including administrators.

The original exit strategy of developing standalone financially viable small scale women producers and associated beneficiaries along a chilled value chain to regional markets still applies; if the project is available to develop in an Ebola free country.

## 12. Darwin Identity

Logos and links to the Darwin website have been included on the project website. Other opportunities will be taken as the project progresses

This project was always conceived and the proposal written as a distinct standalone entity.

At this stage the Darwin initiative is well understood by senior individuals in the Department of Fisheries through engagement with Sierra Leonean consortium staff. Understanding will be brought to a wider stakeholder group when the delayed in-country inception workshop can be implemented.

We find Facebook (linked to a Twitter account) in a range of our other developing country projects to be by far the most effective way to disseminate our project outcomes and also create interactive networks with a wide range of (thousands) of international stakeholders working in the same area. This is being incorporated in our website design and we expect to be producing some short instructional videos as project outputs which we will post online.

## 13. Project Expenditure

**Table 1 Project expenditure during the reporting period (1 April 2015 – 31 March 2016)**

<b>Project spend (indicative) since last annual report</b>	<b>2015/16 Grant (£)</b>	<b>2015/16 Total Darwin Costs (£)</b>	<b>Variance %</b>	<b>Comments (please explain significant variances)</b>
Staff costs (see below)	29,779	13,582	54.4	16,217
Consultancy costs	0	0	0	0
Overhead Costs	9,945	2,935	70.5	7,010
Travel and subsistence	14,631	5,057	65.4	9,574
Operating Costs	887	457	48.4	430
Capital items (see below)	13,951	195	98.6	13,756
Others (see below)	3,695	0	100	3,695
<b>TOTAL</b>			<b>69.6</b>	<b>50,858</b>

This significant variance in expenditure shown above is entirely due to delays linked to the Ebola outbreak. We anticipate disbursing this in year 2 when/ assuming the crisis abates. Part of the original Year 1 and Year 2 budget has been shifted to cover costs in the additional 2017/18 year with Darwin agreement.

## 14. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for the Darwin Secretariat to publish the content of this section.

At this stage we have no additional comments to add regarding outstanding achievements – but hope to be able to do so in future reports!.

## Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2014-2015

Project summary	Measurable Indicators	Progress and Achievements April 2014 - March 2015	Actions required/planned for next period
<i>Impact: Environmentally sustainable and pro-poor livelihood opportunities created in Sierra Leone through enablement of community-managed, mangrove-based oyster culture systems with value-added marketing attributes.</i>		(Report on any contribution towards positive impact on biodiversity or positive changes in the conditions of human communities associated with biodiversity e.g. steps towards sustainable use or equitable sharing of costs or benefits)	
<b>Outcome:</b> Incomes of oyster-fisherwomen in at least 40 households of the Sherbro MPA increased by 45% pa and abundance/ mean-size of adjacent wild-oyster populations increased by at-least 18% over base-line levels.	<p>Indicator 1. Annual income of oyster-fisherwomen increased by at least 45% above baseline levels through oyster culture</p> <p>Indicator 2. Contribution of wild-oyster culture to annual income of target-beneficiaries decreased by 50% during first culture cycle and 100% by the second cycle</p> <p>Indicator 3. Adjacent abundance and mean shell-size of wild-oyster populations increased by 18% (along with stable or increased cover of associated mangrove assemblages)</p>	Negligible progress due to Ebola travel restrictions	Engage with and secure commitment from 3-4 community groups in Sherbro MPA to engage in planned action research activities
<b>Output 1. Sustainable production and collective management systems (WP2)</b>	<p>Indicator 1. Technical and economic efficiency of alternative culture systems for at least two mangrove-oyster species (annual yield &gt; 20kg/m2 substrate area)</p> <p>Indicator 2. Spatial mapping and field surveys of wild oyster and mangrove assemblage abundance/ diversity indicating specified improvement above baseline levels</p> <p>Indicator 3. LMC and/ or community area-management and collective production activity</p>	Negligible progress due to Ebola travel restrictions	

	agreements formalised and documented)	
Activity 1.1. Multi-stage sample-design for selection of 6-8 intervention-communities according to social & environmental criteria (e.g. harvesting mangrove oysters along salinity and primary-productivity gradients).		A sample frame of 16 communities currently involved in mangrove harvesting in the MPA has been developed. Further baseline information to be collected for selection of 6-8 communities for two phases of in-depth/ action research over the remaining project duration.
Activity 1.2. Environmental, rapid rural appraisal (RRA) and household livelihood surveys for selection of target-households and establishment of intervention baselines.		Only scoping work completed– systematic households surveys to be developed and implemented in next project year
Activity 1.3. Development of initial oyster artificial-substrate based culture-technology and depuration options.		Field visits by UoS staff required to asses potential for adaptation of low-cost system trialled in Gambia – and alternatives - to local production, social and market conditions
Activity 1.4. LMC and/or community agreements brokered on collective-production activities and extractive-restrictions in adjacent mangrove oyster-nursery areas.		Engagement with local MPA authorities and paramount chiefs initiated – further consultation with these and primary stakeholders required in next phase
Activity 1.5. Initial training of 40 wild-oyster harvesters on oyster-spat collection and culture techniques		No progress as yet – contingent on selection of action-research communities in next phase
Activity 1.6. Adaptation of artificial-substrate based oyster culture techniques (e.g. post, tray, raft, long-line) through two full iterative phases of action research.		No progress – see comments above
<b>Output 2. Supply chain enhancement (WP3)</b>	Indicator 1: Solar-freezer systems procured, adapted, maintained and operated by target-community-groups  Indicator 2: Supply-chain systems operate effectively under seasonal conditions most associated with demand for value-added oyster products	Technologies (and costs) appropriate to ground conditions in Sierra Leone reviewed (with linked Bath MSc project contribution).  Further implementation delayed to next phase
Activity 2.1. Procurement and adaptation of solar powered freezers for transport of oysters from the Sherbro MPA to free town under variable seasonal conditions		Notes produced on prices and operation of solar freezers in Sierra Leone (Annex 8)
Activity 2.2. Training staff/ beneficiaries in operation and maintenance of freezer plant		No progress to date
Activity 2.3. Seasonal testing of freezer systems & cold-chain implementation		No progress to date
<b>Output 3. Market promotion and value-addition (WP 4)</b>	Indicator 1: Sales inventories of producer-groups and buyers increased Freetown compared to baseline levels	No progress to date

	Indicator 2: Project and media reports of outcomes of the oyster recipe competitions documented	
Activity 3.1. Analysis of markets for premium oyster-based products (and their substitutes) in Freetown and other regional markets		Initial Market surveys carried out in Freetown and in Bonthe district (further assessment of value-addition options considering Ebola market distortion still required).
Activity 3.2. Staging of regional and national oyster recipe competitions		No progress to date
Activity 3.3. Development and testing of value-added oyster ready meals with super-markets, restaurants and beach-bars in Freetown		No progress to date
Activity 3.4. Evaluation of wider international demand & market-based certification potentials & statutory recommendations for MPA policy-makers		No progress to date
<b>Output 4. Training and dissemination</b>	<p>Indicator 1: Documentation of curricula and attendance at 2 Farmer Field Schools (FFS) and final project workshop</p> <p>Indicator 2: Relevant decision-makers as identified by stakeholder analysis rate usefulness of policy briefs on a five point scale.</p> <p>Indicator 3: At least 2 peer-reviewed primary research papers made available in open access format.</p>	No progress to date
Activity 4.1. Establishment of project web-site (with links to partner web-sites and the regional Sarnissa research network)		Website now up and operational <a href="http://www.stir.ac.uk/aquaculture-mangrove-oyster/">http://www.stir.ac.uk/aquaculture-mangrove-oyster/</a>
Activity 4.2. Extension to neighbouring communities through 2 'Farmer Field-Schools' (in each case for separate female and male groups).		No progress to date
Activity 4.3. Regional best-practice/ policy workshop (inviting participants from comparable initiatives in Benin, The Gambia, local EJP project, MPA representatives)		No progress to date
Activity 4.4. Project reports & publications (x2) on environmental social and economic sustainability outcomes in international peer-reviewed journals		No progress to date

## Annex 2: Project's full current logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p><b>Goal.</b></p> <p>Effective contribution in support of the implementation of the objectives of the Convention on Biological Diversity (CBD), the Convention on Trade in Endangered Species (CITES), and the Convention on the Conservation of Migratory Species (CMS), as well as related targets set by countries rich in biodiversity but constrained in resources.</p>			
<p><b>Outcome.</b> Incomes of oyster-fisherwomen in at least 40 households of the Sherbro MPA increased by 45% pa and abundance/ mean-size of adjacent wild-oyster populations increased by at-least 18% over base-line levels.</p>	<p>Indicator 1. Annual income of oyster-fisherwomen increased by at least 45% above baseline levels through oyster culture</p> <p>Indicator 2. Contribution of wild-oyster culture to annual income of target-beneficiaries decreased by 50% during first culture cycle and 100% by the second cycle</p> <p>Indicator 3. Adjacent abundance and mean shell-size of wild-oyster populations increased by 18% (along with stable or increased cover of associated mangrove assemblages)</p>	<p>Project reports &amp; peer reviewed publications (at least 2)</p> <p>Local media coverage of project initiatives</p>	<p>Containment of the Ebola outbreak will allow local and international project partners full access to project field sites.</p> <p>Sustained &amp; sufficient demand will be exist for value-added ready-meals by consumers in Freetown</p>
<p><b>Outputs:</b></p> <p><b>1. Sustainable production and collective management systems (WP2)</b></p>	<p>1a. Technical and economic efficiency of alternative culture systems for at least two mangrove-oyster species (annual yield &gt; 20kg/m2 substrate area)</p> <p>1b. Spatial mapping and field surveys of wild oyster and mangrove assemblage abundance/ diversity indicating specified improvement above baseline levels</p> <p>1.c LMC and/ or community area-management and collective production activity agreements formalised and documented</p>	<p>1a. Technical efficiency report</p> <p>1b. Biodiversity report (inc. site maps)</p> <p>1c. Livelihoods report and documentation of management agreements</p>	<p>Enhanced oyster culture and negotiated formal/ informal access rights can reduce fishing effort on wild oysters around culture areas.</p>
<p><b>2. Supply chain enhancement (WP3)</b></p>	<p>2a Solar-freezer systems procured, adapted, maintained and operated by target-community-groups</p> <p>2b Supply-chain systems operate</p>	<p>2a. Procurement inventory and training/ operation reports</p> <p>2b. Supply-chain enhancement 'action-</p>	



	effectively under seasonal conditions most associated with demand for value-added oyster products	research' report(s)	
<b>3. Market promotion and value-addition (WP 4)</b>	3a Sales inventories of producer-groups and buyers increased in Freetown compared to baseline levels  3b Project and media reports of outcomes of the oyster recipe competitions documented	3a. Market report inc. testimonials of producer groups, supermarket and food service-sector stakeholders  3b. Coverage by local media and project website	Market demand for value-added oyster products is not significantly depressed by the Ebola outbreak over the project duration.
<b>4. Training and dissemination (WP1)</b>	4a. Documentation of curricula and attendance at 2 Farmer Field Schools (FFS) and final project workshop  4b. Relevant decision-makers as identified by stakeholder analysis rate usefulness of policy briefs on a five point scale.  4c. At least 2 peer-reviewed primary research papers made available in open access format.	4a. Training manual, FFS and workshop reports.  4b. Policy brief evaluation report  4c. Papers submitted to appropriate peer-reviewed scientific journals	

**Activities** (each activity is numbered according to the output that it will contribute towards, for example 1.1, 1.2 and 1.3 are contributing to Output 1)

- Activity 1.1 Multi-stage sample-design for selection of 6-8 intervention-communities according to social & environmental criteria (e.g. harvesting mangrove oysters along salinity and primary-productivity gradients)
- Activity 1.2 Environmental, rapid rural appraisal (RRA) and household livelihood surveys for selection of target-households and establishment of intervention baselines.
- Activity 1.3 Development of initial oyster artificial-substrate based culture-technology and depuration options
- Activity 1.4 LMC and/or community agreements brokered on collective-production activities and extractive-restrictions in adjacent mangrove oyster-nursery areas
- Activity 1.5 Initial training of 40 wild-oyster harvesters on oyster-spat collection and culture techniques
- Activity 1.6 Adaptation of artificial-substrate based oyster culture techniques (e.g. post, tray, raft, long-line) through two full iterative phases of action research
- Activity 2.1. Procurement and adaptation of solar powered freezers for transport of oysters from the Sherbro MPA to free town under variable seasonal conditions
- Activity 2.2. Training staff/ beneficiaries in operation and maintenance of freezer plant
- Activity 2.3. Seasonal testing of freezer systems & cold-chain implementation
- Activity 3.1. Analysis of markets for premium oyster-based products (and their substitutes) in Freetown and other regional markets
- Activity 3.2. Staging of regional and national oyster recipe competitions
- Activity 3.3. Development and testing of value-added oyster ready meals with super-markets, restaurants and beach-bars in Freetown
- Activity 3.4. Evaluation of wider international demand & market-based certification potentials & statutory recommendations for MPA policy-makers
- Activity 4.1. Establishment of project web-site (with links to partner web-sites and the regional Sarnissa research network
- Activity 4.2. Extension to neighbouring communities through 2 'Farmer Field-Schools' (in each case for separate female and male groups).

- |               |  |
|---------------|--|
| Activity 4.3. | Regional best-practice/ policy workshop (inviting participants from comparable initiatives in Benin, The Gambia, local EJF project, MPA representatives) |
| Activity 4.4. | Project reports & publications (x2) on environmental social and economic sustainability outcomes in international peer-reviewed journals                 |

## Annex 3: Standard Measures

**Table 1 Project Standard Output Measures**

Cod e No.	Description	Gender of people (if relevant )	National ity of people (if relevant )	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planne d during the project
2	Aquaculture MSc student dissertations	M &/or F	TBC	0	1-2	1-2	0	2-4
6A	Initial training of 40 wild-oyster harvesters on oyster-spat collection and culture techniques	Mainly F	Sierra Leone	0	20	20	0	40
6B	Weeks training on spat collection (above)	Mainly F	Sierra Leone	0	1-2	1-2	0	2-4
6A	Training staff/ beneficiaries in operation and maintenance of freezer plant	M &/or F	Sierra Leone	0	10	10	0	20 (tbc)
6B	Weeks training on freezer plant (above)	M &/or F	Sierra Leone	0	1-2	1-2	0	2-4
6A	Extension to neighbouring communities through 2 'Farmer Field-Schools' (in each case for separate female and male groups)	M & F	Sierra Leone	0	0	40-50	0	40-50 tbc
7	Freezer plant operation training manual FFS training manual	M & F	Sierra Leone, UK	0	1	1	0	2
9	Policy brief on intervention recommendations based on action research outcomes	M &/or F	Sierra Leone UK	0	0	1	0	1
11B	Number of papers to be submitted to peer reviewed journals	M & F	Sierra Leone, UK	0	0	1-2	0	1
12A	Excel database of abiotic, biotic and social mapping survey results - for research areas in Sherbro MPA	M &/or F	Sierra Leone, UK	0	0	1	0	1

14A	Regional best-practice/ policy workshop (inviting participants from comparable initiatives in e.g. Benin, The Gambia, local EJF project, MPA representatives)	M &/or F	Sierra Leone	0	0	1	0	1
14B	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	M &/or F	International – TBC	0	1	1-2	0	2-3
20	Estimated value (£'s) of physical assets (freezer & culture system equipment, to be handed over to host country(ies))	NA	Sierra Leone	0	22,200	25,000	0	47,200
23	In-kind funding (£'s) through UoS MSc student participation	M &/or F	UK (UoS)	0	1000-2000	1000-2000	0	2000-4000
23	West African Regional Fisheries Project (Contribution in kind)	NA	Sierra Leone	5000	5000	5000	5000	5000

**Table 2 Publications**

<b>Title</b>	<b>Type</b> (e.g. journals, manual, CDs)	<b>Detail</b> (authors, year)	<b>Gender of Lead Author</b>	<b>Nationality of Lead Author</b>	<b>Publishers</b> (name, city)	<b>Available from</b> (e.g. website link or publisher)
NA						

There have been no publications as yet

## Annex 4: Ebola Situation Report by NJU August 2014



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Dr Francis Murray  
Institute of Aquaculture  
Stirling University  
Stirling

27<sup>th</sup> August 2014

Dear Francis,

Re: Alternative Livelihoods for Oyster Fisherwomen Project

As discussed at the inception meeting held at Stirling yesterday I can confirm that I think we must suspend all field work in Sierra Leone for at least the next six months.

Since June this year GOSL (the Government of Sierra Leone) has implemented a number of restrictions on movement in response to the continuing geographical spread of Ebola. There is no public discussion of any of these actions; they are just announced over the radio and implemented immediately. The first action was to close down all Loma's (weekly markets), cinemas, football matches and other places where crowds occur; schools and universities are closed initially until November. Check points have been established along all main roads and passengers of all vehicles (except medial NGO's!) are subject to screening; anyone found with a fever is taken away but they are not tested to see if they are suffering from one of the many other conditions that could cause a fever (malaria, dysentery, typhoid, cholera etc and are not treated for any of these conditions). These isolation camps are not safe places to be. Kenema is under quarantine and a curfew is in operation in Bo (the second largest city in the country). Some other towns and villages have been quarantined by armed police, but how many, where and for how long is difficult to ascertain. In view of these issues I feel it would be unwise to plan any field work until the Foreign Office travel advisory improves.

Yours faithfully

A handwritten signature in blue ink, appearing to read 'R. A. Wadsworth', is enclosed in a rectangular box.

Dr. Richard Wadsworth

## Annex 5: Selection of Target Communities

**Introduction:** Selection of target communities and participants within those communities needs to be based on social, economic and environmental factors. Field work within the Shabro River Estuary has concentrated on: problem identification, awareness raising and sensitisation, broad based socio-economic conditions; environmental information has been more limited. Communities in the estuary have been visited in:

- ▲ 2009 (2 days) with the aim of considering the possibility of a biodiversity offset for an earlier project
- ▲ 2013 (4 days) to help refine the project proposal, and confirm certain observations made in 2009
- ▲ 2014 (5 days) to gather baseline socio-economic data and gauge likely participation by communities.

Length of visits and communities visited is strongly constrained by the characteristics of the available boats and how long they can be hired for. Fuel consumption with an outboard engine is high and this combined with boat hire costs, and cost of a captain and assistant make travel costs relatively expensive. Accommodation is available in Bonthe Town (from the very expensive “fishing village”, a moderate guest house and a very cheap local guest house), but there is no hotels or guest houses elsewhere in the estuary.

Motor bike taxis (okadas) operate in Bonthe but otherwise transport is by boat or on foot (Bonthe Island).

**Economic Conditions:** In all communities fishing is the main occupation and trading forms an important component of their lives. Economic and educational opportunities are more limited than in the rest of Sierra Leone. Of the 10 communities visited in 2014 that were separated from Bonthe Town only 2 had schools of these one was closed as the only teacher was on strike in protest of the community not repairing the roof of his school. Despite the lack of schools education is seen as important and many families had sent children to live with relatives in Bonthe Town or further away in Bo and Freetown.

Although some mangrove wood is harvested for firewood and building poles this does not yet appear to be commercialised except very close to Bonthe Town and the weekly markets at Gbangatok and Yagoi). In the Sierra Leone River Estuary firewood and poles (even adobe blocks) are shipped to Freetown, but the Sherbro seems too far from markets for that to be viable for these products. Production of salt is no longer considered to be economic, perhaps because the traditional ways of making salt are inefficient and labour intensive.

Some fish is sold fresh but the majority is smoked before sale. We are unaware of anyone pickling or salting fish. There are several species of fish which appeal to the Far East consumer and some villages have insulated ice boxes where those species are kept chilled until a middle-man comes to purchase them (the middle-man also supplies the ice). (Although the middle-men are described as being “Chinese” by the villagers, it is possible that they are actually Korean, as several of the foreign trawlers are Korean). Villages where we saw ice boxes seemed to be more easily accessible (slightly deeper water close to the village), but this is not certain.

Oysters are steamed or smoked. In a few communities the oyster harvest is seasonal, but in most cases harvesting continues all year round. The majority of harvesters are women. Usually processing was done by the harvester, but in one community some women bought oysters by the canoe load and processed those for sale. Three harvesting methods have been described by informants:

- ▲ harvesting from oyster beds that are permanently below water, this was described in only



one community (towards the north of the estuary) and the beds were described as being of “sand” but were said to be too far off to be visited at that time. These beds are harvested by men on the grounds that women lacked the strength to manage an overloaded canoe if the weather turned against them. The empty shells were considerably larger than the shells encountered elsewhere (16cm v 10cm).

- ⤴ Oysters harvested from the mangrove roots and loaded into a canoe. Either the whole root was cut or the shells were cut off the root.
- ⤴ Oysters harvested from the mangrove roots and are carried out in baskets. This method of harvesting gives rise to many injuries by the women stepping on broken shells and getting infected cuts.

Harvesting into a canoe seems to be the most common method.

Each community is, of course, unique, however, certain broad similarities and trends can be detected.

There are, qualitatively three sorts of fishing settlements:

- ⤴ those that are established within the mangrove forest where the inhabitants rely almost entirely on fishing and oyster harvesting, these communities tend to be very low lying and space is limited. Sometimes the land is little more than empty oyster shells.
- ⤴ Similar to above, but with some adjacent mangroves converted to seasonal rice farming (this type of community has only been observed towards the north (freshwater) end of the estuary.
- ⤴ Communities that have access to some dry land so that cassava and groundnut farming are possible.

All communities have problems with fresh water, but especially those in the first two categories.

Environmental conditions

We have only visited these communities in the dry season, this may affect our perceptions, for example we have never encountered strong waves, but we've been informed that some villages are cut off for days during the rainy season as the sea becomes too rough.

Several communities described coastal erosion as being a problem, we are continuing to search for historical data that may help us determine the extent of this and to what extent (if any) it is matched by accretion and expansion of mangroves.

Mangroves seem to be very patchily distributed; the extent that this is due to differences in sprat fall, waves, water quality, harvesting pressure, species of mangrove etc. is unknown. At a broader scale mangrove oysters seem to be restricted to the middle section of the estuary. A similar pattern was observed in the Sierra Leone River estuary where the upstream end, but still tidal end, had no oysters but plenty of large clams in the sea/river bed (which rather confusingly were described to me as oysters and it was only when I saw the shells that I realised they were clams). In both estuaries the distribution of mangrove oysters seems very patchy.

**Conclusions:** Making a final decision on what communities to work with will depend on a better understanding of the environmental suitability of the sites. Socially we think that we'll get good cooperation from any of the communities and although each is unique they share enough characteristics to all efficient extrapolation.

## **Annex 6: Summary report on activities in Sierra Leone up to June 2015**

Darwin Initiative Project 21-013: Alternative Livelihoods for Oyster Fisherwomen in Sierra Leone

Prepared by R. Wadsworth, R.A Kakpindi, S. Sankoh

### **Executive Summary**

In response to the outbreak of Ebola Virus Disease in Sierra Leone the Government of Sierra Leone (GOSL) placed severe restrictions on the movement of people, closed markets and placed a blanket ban on all public meetings. Over the course of the outbreak some restrictions have been gradually lifted, for example, schools reopened in April 2015; however, extreme caution still needs to be taken and the FCO (Foreign and Commonwealth Office) still advises against all travel except for essential and humanitarian missions.

Before restrictions became too severe a joint “fact finding” mission was undertaken by both of the Sierra Leone partners (WARFP and Njala University) to the Bonthe Region. The main purpose of that visit was to:

- make contact with the local elected officials (the Mayor) and traditional authorities (the Paramount Chief),
- make contact with organisations with compatible objectives (such as the Environmental Justice Foundation),
- make contact with community management committees (of the newly established co-management zones in the Marine Protected Area),
- make contact with fourteen communities along a north-south (freshwater-sea water) transect
- to start to understand the economic and technological constraints faced by oyster fisherwomen and their families
- to raise awareness of the project.

As restrictions started to lift two limited market surveys were undertaken to understand the financial value of the traditional oyster products. One survey was in the Bonthe Region and the other along a transect of nine markets from the cultural centre of Freetown (Siaka Stevens Street) through the outskirts of the city as far as Waterloo.

### **Activities**

#### Fact Finding Mission

The mission was undertaken 17<sup>th</sup> – 21<sup>st</sup> April 2014 and was planned as an extended follow-up to the field work undertaken by the Sierra Leonian partners between the first and second stages of writing the proposal. The team consisted of:

- Dr Saliue Sankoh (National Coordinator of the West African Fisheries Development Project)
- Dr Richard Wadsworth (Department of Biological Sciences, Njala University)
- Mz Caroline Kennedy (an MSc student from Bath University, UK, completing her thesis on solar powered desalination for rural communities)

We were assisted in the field by Richard Kapindi who is a Shabro (and acted as interpreter as well as guide). Note that because fishing communities are dependent on trade that Krio (the lingua-franca) is widely understood, but, respondents are almost universally more animated when discussions take place in their own language rather than in the language they use for trade.

The main purpose of the field work was to:

- make contact with the local elected officials (the Mayor) and traditional authorities (the Paramount Chief),
- make contact with organisations with compatible objectives (such as the Environmental Justice Foundation),
- make contact with community management committees (of the newly established co-management zones in the Marine Protected Area),
- make contact with fourteen communities along a north-south (freshwater-sea water) transect
- to start to understand the economic and technological constraints faced by oyster fisherwomen and their families
- to raise awareness of the project.

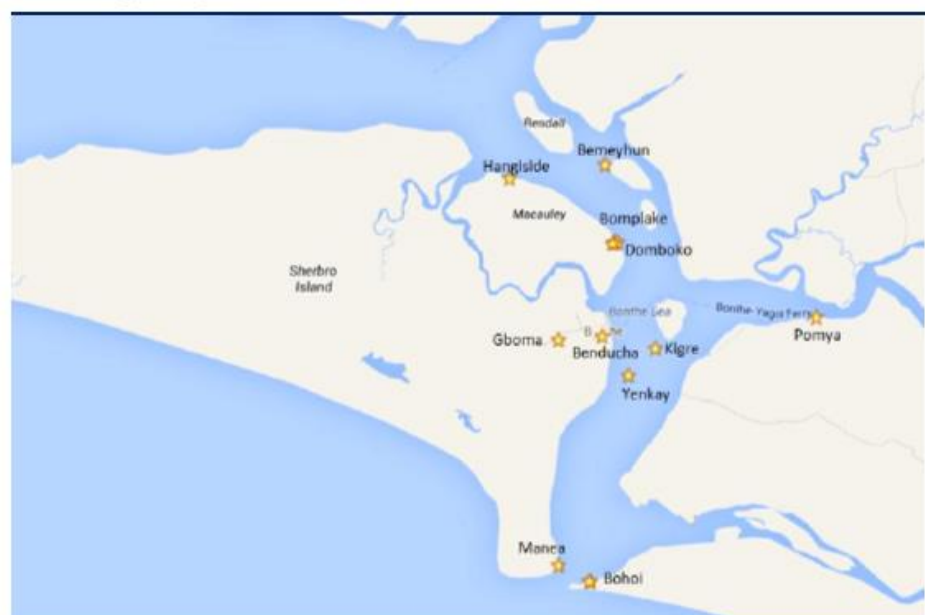
In addition to the specific objectives for the Darwin Initiative project, Dr Sankoh was responsible for liaison with the “Joint Operations Centre” of the RSLAF (Republic of Sierra Leone Armed Forces) who are officially responsible for measures to curb illegal fishing. He was also there to check on whether the ice plant at Bonthe had been successfully rehabilitated and whether it was working. (Government policy is that assets like ice making plant at Bonthe should be run by the private sector; however, there have been some concerns over whether infrastructure was sufficiently developed to enable the plant to operate profitably).

While Mz Kennedy was primarily concerned with the collection of data relating to the availability of fresh water, she gathered additional livelihood information on household structure, income and attitudes towards natural resources (for example to Shabro proverb that “two things you can’t charge money for are fire and water”).

The figure below (from Mz Kennedy’s thesis) shows the location of the communities visited; note that several of our target villages could not be reached because of the state of the tide as we approached them.

The main oyster zone is in the north-west; the Pomya community has too much freshwater, while Monca and Bohoi are too saline. Only the community at Bemeyhun reported “rock oysters” (that is oysters growing permanently submerged on rocks or gravel), but they were reluctant to show us where there were claiming the beds were “too far off”. Discarded shells were considerably larger (~50% longer) than shells at other communities.

**Figure 4.1** Location of Surveyed Communities



The first day of field work started with meetings with EJF (Environmental Justice Foundation) and the mayor of the Bonthe Municipal council, an ad-hoc meeting was held with the Paramount Chief on the wharf as he was heading upstream at about the time we were planning to head downstream.

#### *Environmental Justice Foundation*

The EJF maintain a small (but fast) semi-rigid inflatable boat at Bonthe. When they receive notification of illegal fishing by trawlers they attempt to intercept and identify the boats (which often hide their markings while fishing). There is a suspicion that the trawlers pay informants to notify them when the EJF boat casts off, thereby allowing them to escape. The EJF boat is not equipped for night operations while the trawlers are. The indigenous fishermen also commonly fish at night, and the combination of illegal fishing by trawlers and unlit dugouts leads to fatalities. The EJF is well integrated with the local communities and is potentially a very useful source of information about many aspects of natural resource usage.

#### *Elected Officials*

The mayor was briefed on the purpose of the visit as being:

1. Inspect the outstation building which has recently been completed,
2. Check on the progress made with CMA formation and management of the MPAs
3. Identify target beneficiaries of the approved Alternatives livelihoods opportunities for MPA fisherwomen.
4. Assessment of the water needs of the Sherbro communities (water for drinking and domestic use) as a pilot project is currently on trial for solar desalination of seawater that may benefit communities in the island.
5. 5 preparatory field work for the mangrove and climate change workshop presentation in Elmina, Ghana

The Mayor was delighted to learn that the project has been approved and that implementation is scheduled to take place shortly. The Mayor thanked the coordinator for considering his people for such a project and hope that the other studies we were going to conduct on solar desalination of seawater would gain funding, so that his people would be assisted to get clean and safe drinking water.

#### *Representatives of the armed forces*

Brief informal discussions were undertaken with the commandant of the local barracks. While willing to help counter illegal fishing he is severely constrained by logistical concerns particularly with fuel.

#### *Paramount Chief*

The PC expressed support for the idea of the project. The relationship between the elected and traditional authorities appears to be somewhat complicated; but we promised to keep him informed of activities and discuss with him activities likely to have an effect on “his” people. The far west of Shabro Island is in another Chieftdom, however, we have not yet made contact with him.

### **Field Visits**

After the curtsey calls and preliminary meetings we used the IPC boat to visit a total of 15 villages in the Sherbro estuary over the next three days. At each location we started with a similar set of questions and then followed up on unique or interesting issues. We always started with a group discussion, to explain why we were there and what we wanted to talk about. More detailed one-to-one interviews were then undertaken with two oyster fisherwomen. Oyster fisherwomen were not selected at random but were volunteered by the communities, in all cases the volunteers were related to the village headman in some way, but in such small communities that is probably unavoidable (one village consists of a man, his four sons and their wives and children). We spent about one hour in each village.

One of the motivations for the Darwin project was the establishment of the Marine Protected Area. Within the MPA communities and groups of communities have been given new responsibilities for management of natural resources and particularly of the fishing effort. This, coupled with the compulsory licencing of all boats (including one-man dug outs) is suspected to result in increased exploitation of some non-fish natural resources. It is important to understand the extent to which the co-management committees are inclusive, when they function in practice and whether there are additional stresses and conflicts between communities. We were lucky to interrupt one CMA meeting, the main topics under discussion had been illegal fishing by trawlers and employment of illegal nets. Several communities complained that their neighbours were using nets as fine as mosquito nets to catch fry (but they themselves would never do such a thing).

Most respondents in most of the communities admitted that fishing is becoming extremely difficult these days as there were more boats now than before and the landing per boat are declining. When asked about marketing opportunities for the fish and oysters, they all said that the majority of the catch went to the weekly markets at Gbangbatok and Yagoi. Smaller quantities were sold at the daily market in Bonthe Town. In villages close to Bonthe town some people travel there every day in the dry season to trade or collect fresh water. Freshwater is a major determinant in the viability of a location of a settlement, and is a major constraint on health and well-being. The Shabro have a proverb that translates, approximately, as “two things you can’t charge money for, water and fire”. This means that there is no easy way to develop better access to clean water, as there would be no culturally acceptable way to charge money for repairs or maintenance. It is however, acceptable, to charge money for the collection and transport of water.

**Figure 2 – man helping to process oysters.**



Harvesting and processing of oysters is primarily considered a female occupation, however, husbands will sometimes help their wives (Figure 2).

This survey indicates that the pattern of harvesting and processing is more varied than originally conceived. Although oyster harvesting is an activity dominated by women, there are communities where men take a leading role. These are communities where a boat is needed to harvest the oysters. In one community only men were allowed to use a canoe to harvest oysters

on the grounds that women had a tendency to over fill canoes and that had led to unfortunate events.

In areas where oysters are harvested by walking in the mangroves the harvesters suffer from a lot of cuts on their feet and legs from broken shells and roots in the mud. These cuts can easily become infected and we met several women who had given up the trade due to health problems. Harvesting times depend on the tides, but usually lasts for 4 to 5 hours.

In many cases processing is done by the harvester, sometimes on the day of harvest sometimes the day after. Some harvesters preferred to sell their catch for someone else to process, negotiating a fair price seemed like a rather tricky business as it involves estimating how much meat could be extracted from a canoe full of shells.

### *Discussion*

All the indications are that the fishing communities are among the poorest segment of a poor country, they are eager for change but for the most part function on a very hand-to-mouth existence. They are often in debt for loans used to boats and nets and as such are unable to switch to other occupations as easily as they might otherwise do.

While education is valued by the communities only one of the 10 outlying villages (those with no land connection with Bonthe Town) had a functioning school (a second village had a school but the single teacher was on-strike until the community patched the thatch roof of his one room school). Levels of literacy are therefore likely to be lower here than in the general population.

The distribution of oysters is predictable at the broadest spatial scale, where sites that are too riverine or too marine have few oysters (but other shellfish take their place). At a finer spatial scale the distribution of oysters seems very difficult to predict. It is unclear whether the patchy nature of the distribution represents past exploitation or environmental variables. More detailed mapping of bio-physical characteristics is required.

It appears that the idea of co-management committees to oversee the exploitation of natural resources in the estuary is accepted, and perhaps, welcomed. However, there are indications that strict no-take zones may cause friction between adjacent communities where one is affected and the other is not.

### *Outputs*

Results gathered during the field work:

- were presented in Ghana at the Mangrove and climate change workshop.
- helped confirm the conclusions reached by the reconnaissance survey.
- contributed to the successful completion of Caroline Kennedy's MSc thesis on solar power and desalination.

### Market Surveys

In January 2015 two small market surveys were undertaken. These surveys were designed as a preliminary assessment of the trade in traditional oyster products, as a follow up of the perspectives of the oyster fisherwomen.

### Shabro Estuary Processors

Fourteen respondents in nine communities were interviewed. All respondents live in communities close to Bonthe Town; travel restrictions making field work difficult. The average price of a cup of oysters was very similar for all merchants except for two (Le 1,000 / cup fresh and Le 1,500 or Le 2,000 cup dried / smoked). The similarity in expected price is a feature of many commodities in Sierra Leone markets where there are many people selling similar



(undifferentiated) products. Differences in quality are probably represented more in the speed with which the produce is sold rather than the price.

Two respondents were planning on selling for much more than the standard amount (in both cases for Le 5,000 / cup). One was planning on selling “far inland” at Mano Dasse and the other in Freetown after processing them as a snack (presumably fried with onion and peppers).

**Table 1 - Price of Oysters at different markets:**

Name of respondent	Community	Market	Price Per Cup		Comment
			Steamed	Smoked	
Kadie Umoru	King Jimmy	Matru Jong	-	Le 2000	
Frances Konneh	King Jimmy	Bonthe Town	Le 1000	Le 1500	
Musu Abu	Keigbe	Bonthe - Yargoi	Le 1000	Le 2000	
Konima Beakai	York Island	York Island - Yargoi	Le 1000	Le 2000	
Fatmata Bangura	Gbembgehun	Mano Dasse	-	Le 5000	Far Inland
Mamie Koroma	Gbembgehun	Yargoi	-	Le 2000	
Fatmata Vonjoe	Bomplake	Freetown	-	Le 5000	Value addition
Mamie Rogers	Bomplake	Bonthe - Yargoi	Le 1000	Le 2000	
Fatmata Rogers	Gbongboma	Bonthe Town	Le 1000	-	
Iye Baun	Bontibai	Bonthe Town	Le 1000	Le 1500	
Miata Abu	Kabai	Bonthe Town	-	Le 2000	Far from market

Although dried / smoked oyster achieve a higher price in the local market compared to fresh / steamed, the number of oysters in the cup more than doubled, table 2.

**Table 2. Statistics on the Survey:**

ACTIVITY	RESULT
Weight of steamed oyster per cup	356 gm
Number of steamed oyster meat per cup	130
Average weight of steamed oyster	2.7 gm
Weight of dried (smoked) oyster meat per cup	174 gm
Number dried oyster meat per cup	293
Average weight of dried oyster	0.6 gm

#### Freetown Area

A transect of nine markets from the very centre of Freetown through to a satellite town were visited. All markets in this survey operate at least 6 days per week and most operate 7 days per week. (Weekly markets such as Yargoi and Gbangatok are much more a feature of rural areas). Oysters for sale in Freetown were mainly sourced from the Sierra Leone River Estuary; however, three respondents (out of 18) sourced their oysters from either Gbangatok or Bonthe.

Prices were remarkably static along this gradient, everyone charging Le 2,000 or Le 2,500 except for one respondent in Dove Cut, selling for Le 3,500 (these were sourced from Bonthe), therefore the ability of the respondent in Bonthe to sell processed oysters for Le 5,000 / cup might be optimistic.

#### *Outputs*

Developing data base of market conditions for traditional products.

#### *Discussion*

Processing and harvesting chains are more complex than originally thought but selling in the market is predominantly a female occupation (24 of the 26 respondent).

The supply chain between mangrove and market was more complex in the Freetown markets with some traders being approached by processors and others going to processing centres. Markets in Freetown are open 6 or 7 days per week so traders need constant supply and are more likely to think of the market as their main occupation.

The consistency in price across all markets is surprising and possibly indicates an efficient if unofficial transmission of price data, or a desire to reduce complexity by adopting a standard price until the whole market moves.

Although smoked oysters command a higher price per cup in all markets the increase in value does not adequately cover the increased number of oysters needed to fill a cup, nor would it cover the extra time and effort needed to smoke the oysters. However, the advantage of the smoked oysters is that they are much easier to transport.

It is impossible with the data collected so far to estimate the impact of oyster harvesting on wild stocks. Qualitative data from the village level suggests that over fishing is going on and is likely to increase (findings in agreement with the project proposal).

Some traders in Freetown are making use of refrigerators to store surplus goods from one day to the next, but none of the traders in the Bonthe area are doing so (although they are well aware of the value of ice).

The observation of a much higher price for oysters transported a long distance or where processed further (beyond smoking) supports the basic premise of the Darwin project. Within the limited resources available to oyster fisherwomen they are trying to “add-value”.

#### Further work

We have only a qualitative understanding of the distribution of oysters in the mangrove swamps; we need to understand whether the observed patterns are predominantly driven by harvesting or abiotic and biotic factors.

We have qualitative information on the risk of over fishing, but we lack long-term quantitative information on how much is being harvested; the simplest way to gather this information might be to monitor the size of the shell-midden.

We currently lack data on the value of oysters in the hospitality sector (bars and hotels), we urgently need some information on how this sector operates.

Oysters that are further processed or transported “far” inland are expected to command a higher price, suggesting that the premise of our proposal is still valid. The observation that nearly 25% of oysters traders in Freetown make use of refrigerators to store surplus products confirms a potential role for solar freezers.

## **Annex 7: Survey of Oyster Harvesters in the Sherbro River Marine Protected Area**

Implemented by Institute of Marine Biology and Oceanography Fouray Bay College University of Sierra Leone.

Primary report by R A Kakpindi Community Organiser Bonthe.

### **Programme of events**

- 29-01-15: Information sharing with target communities.**
- 30-01-15: Bonthe City Oyster Harvesters and Traders.**
- 31-01-15: Yenkeh, Keigbe and York Island Oyster Harvesters and Traders.**
- 01-02-15: Gbembahun and Bomplake Oyster Harvesters and Traders.**
- 02-02-15: Gbomgboma Oyster Harvesters and Traders.**
- 03-02-15: Bontibai Oyster Harvesters.**
- 04-02-15: Editing Questioners.**
- 05-02-15: Report Writing.**
- 06-02-15: Return to Freetown.**

### **Introduction:**

Survey of this kind is very cumbersome and difficult to target the most appropriate harvesters to produce a very significant result due to the terrain. Informing the targeted oyster communities in advance will be in the right direction for any remarkable survey.

The survey commenced on the 30<sup>th</sup> January 2015 in the morning targeting Bonthe Town Oyster Harvesters at King Jimmy section and the leading harvester Kadie Umaru was my first respondent who was processing wild harvested mangrove oysters (*Crassostrea rhizophora*) together with the family unit removing the meat from the clutch which have been steamed. This was a big opportunity for me to carry out an excellent interview with all what I am looking for was right in front of me.

At the end various parameters were conducted as follows; using an electronic scale the average weights of one cup steamed oyster was weighed and a single meat followed by counting individual in a cup. This procedure was implemented throughout my exercise during the five days at different oyster harvesting communities within the survey perimeter.

Below is the statistical result obtained in the field as follows: See **Table 1 Annex 6**

Price of Oyster meat at different markets: See **Table 2 Annex 6**

### **Observations:**

- Most of the wild mangrove oysters harvested in canoes long distance from the community settlements and which sometimes last for over (4 – 5) hours and processed the following day by all the household members. At completion, the younger members of that household take the processed meat for sale to the nearest urban town hawking to make money as a livelihood for the entire household.
- The head of the household mostly the husband play a leading role in the harvesting using his canoe.
- Large quantity of dried oyster meats present in the markets at Yargoi and Gbangbatoke come from communities far from Bonthe City but unfortunately the Ebola ban on all Bazaars made it impossible for me to interview some of them.
- Oyster meat for sale far away from the harvested area into the hinterland yield good dividend.

- High oyster yield communities i.e Gbembahun if provided with solar freezers as means of preservation and seek bigger urban markets and super markets in metropolitan areas the idea of value addition will be achieved and the better for these rural poor communities.
- The entire oyster communities which we have visited more than twice are anxious for this project to commence soon.

**Conclusion:**

The exercise even though time consuming but is very vital for fishing communities within the Marine Protected Area as a means of alternative livelihood to reduce the heavy stress on the fisheries stock. Thanks for the financial support to conduct this survey.

## Annex 8: Some notes on freezers in Sierra Leone

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### Notes

There are several commercial producers of ice who sell large blocks (of about 20kg) or broken ice (in a few supermarkets). Some fishermen purchase ice blocks to take to sea and some fish mongers sell limited amounts of fresh fish which they chill with ice. Several ice making plants have been established at large fishing centres by the Ministry of Fisheries (with external funding) but it has proved difficult to keep them running and the latest proposal is to let the private sector run them. There is a strong market for cold drinking water; especially during the long dry season.

Access to mains electricity is extremely limited. Production of biofuels (bioethanol and biodiesel) is extremely limited so that running generators in a “renewable” manner. (Biodiesel is not commercially viable due to problems of sourcing methanol and the relatively high price of palm oil for cooking, bioethanol is not produced for local consumption).

Second hand domestic freezers are fairly widely available for sale in Freetown, most are 240 volt AC systems but the ones from the USA run on 110 volts AC; some new Chinese built freezers are for sale. The efficiency of these devices will vary considerably with size, age and condition but there are no “energy efficiency labels” (except those that might have survived the shipping process). The authorities in Ghana have implemented moves to restrict the sale of second hand freezers to try and slow the increase in demand for mains electricity by promoting more energy efficient devices (reported on the World Service). A few 12 volt DC freezers exist; I have run two from solar PV panels for the last two years; these are run as a micro-enterprise selling cold water. I'm aware of several other 12 volt freezers.

In the context of small scale rural food processors (including cold water business)

- a) second hand conventional domestic freezers run from 12 volt batteries through an inverter. The batteries charged by solar panels through a charge controller.
- b) high efficiency 12 volt freezers run from 12 volt batteries charged from solar PV panels through a charge controller.

12 volt freezers are very expensive but are more efficient and so need fewer panels. Our Stecca 166 liter freezers with two 90 watt solar panels can cool about 30 liters of water from 30 C to 10 C between 8am and 2pm (the freezers were sold together with one 90 watt panel, one charge controller, one 75 Amp hour battery, but we had to double up the panels and batteries to meet the demand for cold water). We haven't tried freezing but I'd expect that to produce a usable amount of ice / cooling that you'd need to double up again the around 400 Watts. As watts = joules / seconds then 400 watts over 6 hours equals:

$$400 * 6 * 60 * 60 = 8,640 \text{ kJ}$$

the latent heat of freezing is 334 kJ / kg

= 25 kg of ice (minus the energy needed to cool the water from 25 or 30C to zero of 4.2 kJ/kg/C which would need 2 panels of 90 W, based on our experience).

So to produce 25kg of ice per day probably need 600 W, to allow for cloudy and hazy weather, maybe 800 or a 1,000 watts (1kW).

The main operating problem I've found with the solar freezers was the batteries being run flat, this was usually caused by people filling the freezer in the evening rather than the morning (so all the power to cool the water is coming from the batteries not the panels)..

Lightening can damage solar PV systems, both my freezers are not working for the last few weeks after a lightning strike “fried” the micro-chips controlling the system. The diodes in the

solar panels had to be replaced and we found someone to do that. But I've been unable to find anyone who can diagnose (let alone fix) the problem with the micro-chips. It is possible to get conventional freezers maintained, my mother-in-law (in Freetown) has had a chest freezer serviced and the cooling gas/fluid replaced. She runs her freezer on mains electricity when it's available and sometimes from a small (2KVA) petrol generators (but not often, only when she anticipates a strong demand for cold water and iced drinks).

Many people use small desk top style electric fans to blow air across the compressor. It should be noted that outside air temperatures are usually in the mid-20's (the lowest night time temperature in Freetown is 19C, higher than any other capital in Africa). Humidity is high most of the year. Because of fears about theft there is often only limited natural ventilation in rooms where freezers are kept, so the temperature in those rooms can be (much) higher than outside temperatures.

I run invertors for charging small devices (phones and laptops etc.) I have found them (the invertors) to be very unreliable. The typical problem is someone blowing the fuses by connecting it the wrong way around, and the other is trying to draw too much power out of it.

### **Conclusions**

The capital costs of the two alternatives (second-hand 240 volt AC freezer v 12 volt DC freezer) are roughly comparable, what you save on the cost of the freezer you spend on more solar PV panels. The invertor is likely to cause problems but they can be replaced in country. On the other hand there is more chance of being able to repair a conventional freezer. The best option may be to establish both systems and see what in practice works better

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