

# SOLSTICE

# Implementation Plan

Version 4

26 March 2018

**Pemba Channel small pelagics: threats and  
opportunities of climate change  
(Tanzanian Case Study)**



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## Document Purpose

The purpose of the SOLSTICE Implementation Plan is to identify key contributions of SOLSTICE partners to research, capacity development and communication objectives of the project and their associated timescales, milestones and deliverables.

This document underpins Institutional Agreements between the Lead Organisation (National Oceanography Centre, UK) and the partner institutions. This document also underpins SOLSTICE Monitoring and Evaluation Plan.

The document is available to project partners and the project Advisory Panel.

SOLSTICE Implementation Plan is an evolving document and subject to regular reviews by the SOLSTICE Leadership Team. Any changes to this document must be approved by the Leadership Team and communicated to all project participants. The latest version of this document can be found on the password-protected SOLSTICE website.

Text shown in red requires updating.

## SOLSTICE project outputs

SOLSTICE Logical Framework v1 (as submitted with the project proposal in May 2017) identifies the following key project outputs:

Output 1: Strong and self-sustaining **scientific transdisciplinary WIO-UK network** producing high quality intensive body of knowledge on ecosystems dynamics, human dependence on them, their future trends and human responses

Output 2: **Capacity developed in WIO** to conduct interdisciplinary ecosystem research that meets the needs of ecosystem approach to fisheries (EAF), policy, industry and markets. **Capacity developed in UK** to meet the needs of official development assistance (ODA) compliant research.

Output 3: Strong body of evidence produced by the network in each **Case Study addressing societal challenges** and providing strategy options co-created with stakeholders and based on ecosystem approach

Output 4: **Transfer of cost saving technologies** underpinning ecosystem research to overcome limited investment into research infrastructure in WIO.

SOLSTICE Logical Framework and Theory of Change are evolving documents and will be revised regularly by the SOLSTICE Monitoring and Evaluation team. All changes to either of the documents (including proposed Outputs above) are subject to approval by the Project Leadership Team (appointment and Terms of Reference for the Project Leadership Team are expected by the end of January 2018).

## Case Study 1: Pemba Channel small pelagics: threats and opportunities of climate change

### 1. Resource summary

Participant short name	NOC-OBE	NOC-MPOC-PHY	NOC-MPOC-RS	NOC-MSM	NOC-MG	NOC-OTE	PML-RS	PML-SE	SA-Rhodes	SA-NMU	SA-SAEON	KEN-CORDIO	TAN-IMS	TAN-TFIRI	TAN-UDSM (EfDT)	TAN-WIOMSA
Person/mon	24	27	24	50	18	20	8	8	16	12	12	12	44	24	12	6

The table above lists all SOLSTICE project partners contributing to the Tanzanian Case study with the number of months funded by SOLSTICE for this Case Study. The table includes only directly funded contributions. Contributions “in kind” and studentships aligned with the project are not included into this table and are listed below. Due to the size and complexity of NOC contribution, NOC departments and groups are listed separately.

IMS – Institute of Marine Science (Tanzania)

TAFIRI – Tanzania Fisheries Research Institute

UDSM (EfDT) – University of Dar es Salaam (Environment for Development Tanzania)

WIOMSA – Western Indian Ocean Marine Science Association

NOC – National Oceanography Centre, UK

NOC-OBE – Ocean Biogeochemistry and Ecosystems (NOC, UK)

NOC-MSM – Marine System modelling (NOC, UK)

NOC-RS – Remote Sensing (NOC, UK)

NOC-MPOC – Marine Physics and Ocean Climate (NOC, UK)

NOC-OTE – Ocean Technology and Engineering (NOC, UK)

NOC-MG – Marine Geoscience (NOC, UK)

PML – Plymouth Marine Laboratory (UK)

PML-RS – Remote Sensing (PML, UK)

PML-SE – Socio-Economics (PML, UK)

HWU – Heriot-Watt University (UK)

SAEON – South African Environmental Observation Network (SA)

Rhodes – Rhodes University (SA)

NMU – Nelson Mandela University (NMU)

CORDIO - Coastal Oceans Research and Development – Indian Ocean (Kenya)

Contributions “in kind” (students and staff effort only)

Mr Masumbuko Semba (PhD student, IMS) Supervisors: Dr. Yohana W. Shaghude - (IMS), Prof. M. Srokosz (NOC), Dr K. Popova (NOC). Title: Analysis of surface current velocities from satellite-tracked observations and satellite altimetry data over the Western Indian Ocean region with focus on Tanzania coastal waters. Start date: **TBC** End date: **TBC**

Mr. Joseph Sululu (PhD student, TAFIRI) Supervisors: Dr Blandina Lugendo (DASFT/UDSM), Dr Benaiah Benno (DASFT/UDSM), ??? (PML/Rhodes?) Title: Reproductive biology, feeding ecology and fishery of *Decapterus microsoma* and *Atule mate* along the coast of Tanzania. Start date: 30/10/2017 End date: 29/10/2020

Mr. F. Rusizoka (PhD student, TAFIRI) Supervisors: Dr Christopher Muhando (IMS/UDSM), Dr Leonald Chauka (IMS/UDSM) Title: Population structure and distribution of the spotted sardinella *Amblygaster sirm* and Commerson’s anchovy *Stolephorus commersonii* in Tanzania. Start date: 12/12/2016 End date: 11/12/2019

Dr.S. Shayo (Research scientist, TAFIRI, 25%): Nature of contribution Field surveys under WP1c (to especially work on chlorophyll, inorganic nutrients, phytoplankton community, zooplankton biomass, species communities and size spectrum). Will be a lead author in one of the SI papers under WP1c.

Mr. P. Matiku (Technician, TAFIRI, 25%): Nature of contribution: Technical assistance in Field surveys under WP1c (including operation of the CTD).

Ms. H. Mulela (Technician, TAFIRI, 25%): Nature of contribution Field surveys under WP1c (small pelagics)

Research Fellow (20%) – EfDT, University of Dar es Salaam - TBC

Research Fellow (20%) – EfDT, University of Dar es Salaam - TBC

??? (PhD student, Rhodes) – Importance of skip jack tuna along the east African coast. Supervisors: W.Sauer (Rhodes), K.Popova (NOC), P.Shaw (Aberystwyth) Start date: **TBC** End date: **TBC**

Willem Malherbe (PhD student, Rhodes) – Social studies Supervisors: S.Aswani (Rhodes) Start date: TBC End date: TBC; WP2 coordinator.

Master student (University of Dar Es Salaam) Supervisors: Prof R. Lokina (UDSM EfDT), Dr E. Papathanasopoulou (PML). Title: Socio-economic impact of changes in fisheries on the local communities of Tanga and Pemba Start date: 01/07/18 End date: 30/06/19

Lydia Kapapa (PhD student TAFIRI), Assessment of BMUs in managing fisheries within a changing climate: Impacts on economy of small pelagic fishers in Tanzanian coast.

## 2. Case Study background

The small pelagic fishery is the 2<sup>nd</sup> most important commercial fishery in Tanzania. It plays a significant role in the social and economic development of communities in coastal areas especially as a source of food security, nutrition, income and livelihood support. The government also benefits through its contribution to foreign exchange earnings especially from the export of anchovies. The demand for products derived from small pelagic fish, especially fishmeal for fish farming, is increasing at a tremendous rate now in Tanzania. The small pelagic species form a vast, valuable and accessible resource for local fishers and there is a demand for fish and fishery products from both domestic and foreign markets. This fishery also plays a key role in marine food webs in many ecosystems because they occupy a key position linking the energy produced by plankton to large-bodied fish, birds and mammals. Usually these forage fish have small body size, rapid growth, schooling behaviour, and strong population responses to environmental variability such as climate change. They have the propensity to form large shoals making them easily detectable and catchable by modern fish catching technologies. The small pelagic fishery is mostly artisanal in nature with fishers using locally made vessels and purse seine nets, scoop nets and ring nets operated by motorized dhows and big boats. One fishing unit may consist up to 20 crew members. The monsoon winds have a pronounced influence on the fish catch. During the northeast monsoon catches are greater since the sea is relatively calm with weaker currents. Due to this effect of monsoons, fishers have a migratory pattern, locally known as 'dago', where fishermen travel and camp, fishing away from their homes during various seasons. The estimated number of people engaged in this fishery is around 10,000 people in both mainland Tanzania and Zanzibar who are directly engaged in the small pelagic fishery and related activities: fishers, porters, boiling and drying workers, processing entrepreneurs, traders, wood and salt suppliers, transporters and food vendors. The governance and management system of the small pelagic fishery in Tanzania faces various weaknesses and shortcomings which need to be addressed. Also there is poor collaborative mechanisms for the management of the shared small pelagic fishery and the need to harmonize fishing regulations, including conditions attached to registration and licensing, to improve fisheries management in a context where the small pelagic fishery can be considered a 'shared' fishery between mainland Tanzania and Zanzibar and to reduce conflicts that are frequently generated by migrant fishers.

## 3. Description of work

### 3.1. Synthesis

#### 3.1.1. *End-to-end literature review and formulation of key hypotheses*

**Deliverable:** Internal project report (M12)

**Milestone:** M8 all contributors identified and agreed



**PIs responsible for delivery:** Y.Shaghude (IMS), S.Mahongo (TAFIRI), K.Popova (NOC)

**Participating institutions:** all participating institutions.

We will produce a comprehensive interdisciplinary literature review for the case study following the structure of the SOLSTICE WPs including main challenges and formulation of the key hypotheses. This review will underpin WP contributions to the case study and design of the field work. It is anticipated that this review will form one of the Special Issue papers. Preliminary hypothesis testing is anticipated by WP1a,b (Remote sensing and modelling).

### *3.1.2. Special Issue (Kenyan and Tanzanian Case Studies)*

**Deliverable:** Collection of peer-reviewed papers (M36)

**PIs responsible for delivery:** SOLSTICE directors (Roberts, Popova) and two guest editors (one from each case study, to be identified by M12)

Milestones:

M12: Full list of potential papers identified, journal agreed, guest editors assigned

M24: Full list of papers finalised

M30: All papers reviewed at the Science Progress Workshop

**Participating institutions:** all participating institutions.

As a main deliverable for Output 3 (“Strong body of evidence”) we will produce a Special Issue (SI) of DSR or a similar journal with socio-economic component. *This is a combined Kenya-Tanzania deliverable.*

### *3.1.3. Synthesis paper(s)*

**Deliverable:** Peer-reviewed papers (post-SI effort, M42)

**PIs responsible for delivery:** SOLSTICE directors (Roberts, Popova) and two guest editors (one from each case study, to be identified by M12)

Milestones:

M30: Paper(s) identified

M36: Paper(s) finalised and lead authors assigned.

M42: Paper(s) submitted

Participating institutions: all participants.

Key end-to-end synthesis paper(s) with strong links to policy recommendations will be based on the SI collection and submitted by Month 42.

### 3.1.4. *Final project Report for Tanzanian Case Study*

**Deliverable:** External Project Report (Month 48)

**PIs responsible for delivery:** SOLSTICE directors (Roberts, Popova), Y.Shaghude (IMS), S.Mahongo (TAFIRI)

Milestones:

M31: Decision if to proceed with the report, its content and alignment with the final project reporting

Participating institutions: all participants.

This report is likely to provide key end-to-end synthesis of the project findings with strong links to policy recommendations. At this stage there is no consensus if such a report is needed/useful. This will be decided by the Project Leadership Team in April 2020, M31). No reporting guidelines have yet been received from the UK project funder (GCRF).

## 3.2. **WP1a Remote Sensing**

### 3.2.1. *Synthesis of the satellite-derived information to identify large scale drivers of ecosystem variability*

Deliverables:

- Contribution to the CS review (Month 12)
- SI paper or contribution to WP1b-led SI paper (Month 24)
- Contribution to MOOC (M30)
- Contribution to synthesis paper(s) (M40)

**PIs responsible for delivery:** M.Srokosz (NOC), Y.Shaghude (IMS), S.Mahongo (TAFIRI)

Milestones:

M12 Preliminary results presented as internal project report (underpinning model verification)

**Participating Institutions:** NOC-RS, NOC-MSM, PML-RS, IMS, TAFIRI, KMFRI

Description:

Analysis of temporal and spatial variability of parameters influencing ecosystem dynamics in the Western Indian Ocean (chl-a, primary production, plankton functional types, ocean currents, coastal altimetry), working with WP1b to support model validation and hypothesis testing and to identify further research questions for investigation in joint African/UK postgraduate research projects. In addition, consider effects of Indian Ocean Dipole (IOD) and monsoon on ecosystem. *This is a combined Kenya-Tanzania study.*

### 3.2.2. *Synthesis of the satellite-derived information to identify local drivers of the Pemba channel ecosystem variability*

Deliverables:

- Contribution to the CS review (Month 12)
- SI paper or contribution to WP1b-led SI paper (Month 24)
- Contribution to MOOC (M30)
- Contribution to synthesis paper(s) (M40)

**PIs responsible for delivery:** M.Srokosz (NOC), Y.Shaghude (IMS), B.Kuguru (TAFIRI)

**Participating Institutions:** NOC-RS (PI: M.Srokosz), PML-RS, TAFIRI, IMS

Description:

The area is characterised by a number small scale upwelling sites and strong currents (no major rivers). As the spatial scale is too small, this study cannot be combined with modelling WP. Some satellite altimeter tracks intersect the Pemba Channel so coastal altimetry data will be used, in addition to chl-a, PFTs, and SST, to study the behaviour of ecosystems in the channel ultimately linking remote sensing to available *in situ* observations on small pelagic fisheries, including possibly FAO data on fish catches and CPUE (catch per unit effort). The oceanographic aspects derived from Masumbuko Semba research project (IMS) will be linked to the ecosystems of the Pemba channel.

### *3.2.3. Real-time support of the fieldwork and optimisation of the cruise strategy*

**Deliverable:** online data base and contribution to the cruise plan (Months 6-20)

**Participating Institutions:** PML-RS (PI: B.Taylor, NEODAAS)

This work will provide the consortium with near-real-time daily ocean colour and SST products at 1km resolution from MODIS and VIIRS satellite sensors to support field campaigns in Tanzania case study region - to cover the 1-month field campaigns and reconnaissance mission + 1 month before fieldwork start and 1 month after field-work finish.

### *3.2.4. On-line / off-line data access: altimetry, chl-a, SST*

**Deliverable:** on-line /off-line database and data discovery tools (Month 12 and on-going)

**Participating Institutions:** NOC-IT (PI V.Byfield), NOC-RS, PML-RS

IT group at NOC will develop a web based system. NOC-MPOC and PML-RS will provide relevant data to populate system. Initially, this could be large-scale data (e.g. ESA CCI altimetry, chl-a, SST) on a  $\frac{1}{4}^\circ$  grid and monthly for the whole WIO over the satellite era (1990s onwards). WP4 (Capacity development) will engage with the WIO partners to identify requirements for remotely sensed data and WP 1a will populate the database accordingly. Any remotely sensed data used in SOLSTICE studies could be added to the database (e.g. 1km high resolution chl-a, SST).

In addition, given that internet links for researchers in WIO countries are limited in bandwidth, an off-line version of the database could be made available to those researchers to ease access. We note that this request is strongly supported by WIO partners and an M&E indicator will be developed to reflect availability of the offline data.

### *3.2.5. Training/capacity development for WP1a (Remote sensing)*

Milestones:

- Student co-supervision and exchange visits identified (M4)
- See additional milestones related to the training courses in Section 3.7.

PIs responsible for delivery: V.Byfield (NOC)

A 2-week remote sensing training course will be run at IMS.

Exchange/training visits dedicated to the remote sensing applications for the Tanzanian case study up to one month duration to NOC and PML (UK) are possible if prioritised by WIO institutions (see Note on Exchange visits).

Co-supervision of the WIO students working on remote sensing data by UK partners is possible if requested.

## **3.3. WP1b Modelling**

### *3.3.1. Model skill assessment*

Deliverables:

Internal project report (M6)

PI responsible for deliverables: E.Popova, NOC

Participating institution: NOC-MSM

We will assess NEMO-MEDUSA model skills in all three case study areas, establish model limitations, identify most promising model applications, and range of possible projects and their costs.

### *3.3.2. Biogeochemical modelling*

Deliverables:

- Contribution to the CS review (Month 12)
- SI paper or contribution (Month 24)
- Contribution to MOOC (M30)
- Contribution to synthesis paper(s) (M40)

PI responsible for deliverables: E.Popova, NOC

**Participating institutions:** NOC-MSM, NOC-RS, NOC-OBE, PML-RS, KMFRI, IMS (Prof Nyandwi), TAFIRI, CORDIO

Description:

We will use NEMO-MEDUSA coupled physical and biogeochemical model at 1/12o (hindcast) and 1/4o (climate change projections for RCP8.5 to year 2099) to constrain the key large-scale drivers of the ecosystem variability at seasonal (monsoon), decadal (ENSO, Indian Ocean Dipole) and climatically driven (RCP8.5) variability along the Kenya-Northern Tanzania shelf. Note that resolution and boundary conditions in the model will not allow addressing impacts of Tana deposition of nutrients (these can be addressed in the lagrangian studies). We will focus on the mechanisms of the marine nutrient supply and in particular dynamics and potential changes of the upwelling. The model will be validated using available climatological data, ARGO floats, remote sensing observations and IMS and KMFRI in-situ observations. The modelling package will assist with optimisation of the fieldwork and synthesis of the observational information. ***This is a combined Kenya-Tanzania study.***

TAFIRI will align George Rushingisha with this WP.

### 3.3.3. Lagrangian modelling

Deliverables:

- SI paper (M36);
- Contribution to synthesis paper(s) (M40)
- Internal report on numerical runs conducted for a number of studies co-designed with WIO participants (M30)
- Contribution to MOOC (M30)

Milestones:

M12 potential studies of interest and Tanzanian collaborators identified

**Participating institutions:** NOC-MSM (PI E.Popova), NOC-RS, IMS, TAFIRI

Description:

A collaborative IMS-TAFIRI-NOC study will use lagrangian tracer approach to constrain key advective pathways, their variability, potential modifications under the impact of climate change and applications to the issues such as marine pollution (micro-plastics, potential oil spills), design of the MPA, invasive and non-native species, and connectivity with upstream areas. Specific list of applications will be identified in collaboration with IMS and TAFIRI. A substantial input from local researchers will be required.

IMS would like to align Mr Masumbuko Semba with this package.

Training/Capacity development:

Hands-on training in model analysis can be provided to NMU modeller if working in parallel on similar approaches in SA case study.

Hands on training in lagrangian approaches can be provided to any PhD student with modelling component as part of their thesis identified by NMU, IMS, TAFIRI and KMFRI. Hands-on lagrangian model analysis is a highly skilled activity and will require 6-9 months of

dedicated time and a one month visit to UK. A lead author paper will be expected as a result of such training.

Training in the use of lagrangian approaches and outputs at any level will be provided as part of the dedicated regional modelling training course.

#### **3.3.4. *Climate change stressors and their uncertainty***

Deliverables:

- SI paper (month 36)
- Contribution to synthesis paper(s) (M40)
- Contribution to MOOC (M30)

**Participating institutions:** NOC-MSM (PI E.Popova), NOC-RS, IMS, TAFIRI, KMFRI

We will analyse CMIP5 and CMIP6 model ensembles for the WIO, identify their predictive skills and evaluate key drivers of uncertainty in future projections of the WIO ecosystem dynamics. We will use the forward run of NEMO-MEDUSA (1/4° resolution or 1/12° if available by M30) to focus on the future projections of upwelling. *This is a combined Kenya-Tanzania study.*

Training/Capacity development:

Hands-on training in analysis of climate stressors will be provided to NMU modeller if working in parallel on similar approaches in SA case study and any PhD student with modelling component as part of their thesis identified by NMU, IMS, TAFIRI and KMFRI. Training in the use of forward projections of ecosystem dynamics at any level will be provided as part of the dedicated regional modelling training course.

#### **3.3.5. *NEMO-MEDUSA data access server***

Deliverable: online data access and user manual (months 18)

Participating institution: NOC (PI H.Snaith)

We will develop a server providing access to the model output with area-extraction capability suitable for low bandwidth. This server will be essential for the wide use of the model by WIO researchers and will underpin Modelling training course.

#### **3.3.6. *Training/capacity development for WP1b (Modelling)***

Milestones:

- Student co-supervision and exchange visits identified (M4)
- See additional milestones related to the training courses in Section 3.7

PIs responsible for delivery: V.Byfield (NOC)

A 2-week remote modelling training course will be run at IMS.

Exchange/training visits dedicated to the modelling applications for the Tanzanian case study up to one month duration to NOC (UK) are possible if prioritised by WIO institutions (see note on exchange visits).

Co-supervision of the WIO students working on modelling by UK partners is possible if requested.

### 3.4. WP1c Marine Robotics and WP1d Fieldwork

#### 3.4.1. Pemba Channel Benthic survey

Deliverables:

- Establish contacts between NOC and identified WIO researchers (M6)
- Fieldwork Plan agreed with WIO (Internal Report; M8).
- Contribution to CS review (M12)
- Field work reconnaissance mission (Tanga-Pemba area; November 2018)
- Fieldwork (Tanga-Pemba-based; c. 3-weeks, June 2019).
- Fieldwork Report (External Report; M24)
- Data (archived. Raw: multibeam, sidescan, visual imagery<sup>1</sup>, associated metadata; shortly after fieldwork. Processed: map products, images, ecological data; completion c. M36, to match contributions to SI. Combination data banking via BODC and NOC RODIN)
- Papers for SI (M36): NOC-lead “Deep-sublittoral habitats and biotopes offshore Tanzania: conservation and sustainability<sup>2</sup>”, plus one or more NOC-assisted publications by partner organisations
- Contribution to MOOC (M30): NOC-OBE will contribute general benthic ecology content. MG will contribute general seafloor and habitat mapping content. OBE + MG will jointly provide content on the identification and description of biotopes for marine spatial planning purposes.
- Contribution to final CS report (External Report M36)

PIs responsible for delivery: B.Bett; T.Le Bas, NOC

Participating institutions:

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<sup>1</sup> The visual imagery refers to photographs of the seafloor and its associated invertebrate and fish fauna, primarily from the AUV Gavia, but also from the mini ROV. We will also obtain photographs in the water column that may provide additional data on pelagic invertebrates (macroplankton) and fish.

<sup>2</sup> Seafloor habitats are of direct relevance to demersal fish stocks and aggregations, and may in some cases also serve as refugia for small pelagic fishes.

NOC OBE, NOC-MG, IMS, TAFIRI, CORDIOA-EA, SAEON

Description:

NOC will offer a highly skilled and experienced interdisciplinary team of marine mappers with a long history of joint venture projects and experienced in the use of the latest technology to produce habitat and biotope<sup>3</sup> mapping of immediate relevance to a variety of marine spatial planning issues (fisheries, conservation, coastal and offshore development). The NOC team will work with local partners to develop a field programme that (i) captures and encompasses existing local knowledge, (ii) builds on that information, and (iii) demonstrates the use of robotic and autonomous technology in tackling local environmental and sustainability concerns (aerial drone, Autonomous Underwater Vehicle (AUV), mini-ROV, Remotely Operated Vehicle, and towed-sidescan). A mutually developed fieldwork programme of c. 2-week duration will be run from the Tanga area, simultaneous with the Pemba Channel pelagic survey (assumed to be Zanzibar-based). The seafloor (benthic) survey work is expected to cover sites and areas within both: (a) the Tanga Coelacanth Marine Park (Northwest Pemba Channel), and (b) the Pemba Channel Conservation Area (Northeast Pemba Channel).

IMS would like to align Dr Christopher Muhando with this package. Dr Muhando is the IMS GIS specialist and Head of IMS GIS Laboratory. He will therefore be used as the key resource person for the physical habitat mapping and other related issues.

TAFIRI will align Patroba Matiku with this WP.

CORDIO will lead two first author papers for the SI as follows:

- Habitat characterization and spatial distribution of photic and mesophotic communities of the Pemba Channel: modelling future climate change scenarios (Osuka PhD study)
  - Quantifying fish populations that span shallow and deep habitats to examine a depth refuge from fishing and climate change (Samoilys lead).
- (These papers will incorporate CORDIO BRUV dataset, and the application of robotic and autonomous technology in tackling local environmental and sustainability concerns).

Training/capacity development:

Training and / or student co-supervision will be offered for WIO researchers in two main themes: (a) marine geology / geophysics related to physical habitat mapping, and (b) marine ecology related to biotope mapping. The NOC team will work with WIO researches to capture and collate existing knowledge in to a single Geographic Information System as a general resource, and as a tool for fieldwork planning. Pre-

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<sup>3</sup> Biotope is defined as a relatively homogeneous fauna (invertebrate and fish) within a relatively homogenous physical habitat. Characterisation requires the joint assessment of the distribution of physical habitat characteristics and species distributions.



fieldwork training and MOOC material development with WIO researchers (c. 1-week) will take place immediately prior to fieldwork phase, and cover detailed survey design and planning. Fieldwork training during the survey (c. 2-weeks) will be provided in practical survey execution (AUV, mini-ROV, and towed-sidescan) and rapid first-pass data assessment. Support will be provided for subsequent data interpretation and publication in SI, this is likely to encompass both the collated existing knowledge and new SOLSTICE field data.

### *3.4.2. Pemba Channel Pelagic and Robotic surveys*

**Participating institutions:** NOC (PI M.Palmer, S.Painter), HW, IMS (Y.Shaghude), TAFIRI (S.Mahongo), NMU

Deliverables:

- Contact with WIO researchers aligned with this WP established (M6)
- Internal report on scoping trip and fieldwork plan (Month 6)
- Reconnaissance mission, including Pemba Channel drifter experiment and community engagement (M8)
- Internal report on the fieldwork plan following recon mission (Month 9)
- Contribution to the CS review (Month 12)
- Pemba Channel fieldwork (2 weeks, Month 20)
- Datasets of chlorophyll, inorganic nutrients, phytoplankton community, zooplankton biomass, species communities and size spectrum, and underwater temperature recording (UTW) submitted to BODC (Month 21 onwards)
- Delivery of physical data (inc. T, S, current velocity and mixing parameters) from month 21 onwards, with final QC delivery by month 27.
- Delivery of small pelagic fish and possibly zooplankton abundance (acoustic) data from month 21, final QC by month 27.
- Assistance with data interpretation and throughput to SI peer reviewed publications based on survey and glider data (Months 21 -37)
- Contribution to MOOC (M30)
- SI papers (Month 36): NOC-lead 'Bio-physical coupling in the Pemba Channel during the South East Monsoon season' with additional co-authored publications describing the physical and biogeochemical process supporting small fish production in Tanzanian waters.
- Contribution to the synthesis papers and CS report (M42)

Note that delivery of this task is highly dependent on our ability to secure a rental of an appropriate boat.

Milestone:

Reconnaissance mission by M8 (one year prior to the field work)

Description:

A spatial survey of the region will be undertaken using both ship based instrumentation and ocean gliders to better understand both the horizontal and vertical variability in physical forcing and the subsequent distribution of phytoplankton (chlorophyll) and nutrient pools. Ship based instrumentation will include CTD with rosette for collecting water samples for nutrient and chlorophyll sampling and a downward-looking ADCP. Zooplankton data will include zooplankton biomass, species communities and size spectrum. Small pelagic fish stocks will be assessed using acoustic sensors deployed on autonomous vehicles. Four UTRs will also be deployed at a depth of 25 m to monitor potential upwelling in selected areas. Broad scale coverage of the channel using this combined platform approach will enable links to be made between regional and open-ocean circulation and coastal dynamics, and the biological responses and consequences.

Dr Baraka Sekadende, Dr Salome Shayo, Mr Patroba Matiku and Ms Holloh Mulela will be aligned to this WP from TAFIRI. Dr Sekadende and Dr Shayo will lead two papers in phytoplankton and zooplankton community structure along the Pemba Channel.

IMS would like to align Mr Christian Hillary Matemu with this package. Mr Matemu has been employed at IMS as a Marine Engineer and is currently undertaking his MSc studies and expected to complete his MSc studies by June 2018.

IMS would like to align Mr Barnabas Tarimo/Mr Mtumwa Mwadini with this package. Mr Tarimo is Fisheries biologist currently doing his PhD training Mr Mtumwa Mwadini is a Laboratory Technician, with BSc qualifications and has some basic skills on water quality analyses

Dr M. Noyon (NMU) and Dr J. Mwaluma (KMFRI) offers to train TAFIRI and IMS researchers, technicians and students (collaborative work with the IIOE2-SA Agulhas II cruises) on zooplankton species identification

#### Training/capacity development:

SOLSTICE will provide hands-on training for IMS and TAFIRI in the areas of nutrient chemistry, pelagic biogeochemistry, hydrography and physical oceanography, as well as technical areas relating to developing capability with marine robotics. SOLSTICE plans to upskill researchers through cooperative fieldwork in the Pemba Channel region and via subsequent assistance in delivering the results of this fieldwork into peer-reviewed literature.

SOLSTICE proposes to fund 1 month training visits to Liverpool for two physical sciences or technically focused researchers during 2018. Visits will be designed to overlap with planned glider deployments in AlterEco to enable hands-on seagoing training. Additional 1 month visits to UK in 2019 can be provided for data processing and analysis leading to a SI publication. Exchange visits will be funded from SOLSTICE central budget if prioritised by WIO institutions (see note on exchange visits).

SOLSTICE proposes to fund 1 month training visits to Southampton for two biogeochemistry-focused researchers during 2018 including one day training cruise on

Calisto. Additional 1 month visits to UK in 2019 can be provided for data processing and analysis leading to a SI publication. Exchange visits will be funded from SOLSTICE central budget if prioritised by WIO institutions (see note on Exchange visits).

### 3.5. WP2 Socio-economic studies

#### 3.5.1. *Multi species fish modelling*

Deliverables:

- Contribution to the CS review (Month 12). Dependant on collected data regarding fish and fisheries.
- SI paper (Month 24 paper identified and content finalised; Month 36 paper submitted to SI)
- Contribution to MOOC (Month 30). No specific Fish modelling contribution to the MOOC schedule, but will participate and help during the MOOC
- Contribution to synthesis paper(s) (Month 30, 36 paper(s) identified and finalised; Month 42 paper submitted)
- Fish model outputs (Month 15-18) made available to partners along with short description of the outputs and how to use them. Plus delivery of model outputs for further work within WP2 (specific data type and format).
- Report on the model outputs (Month 24) with case study specific aspects highlighted. Plus comparison to available data.

Milestones:

M6 Lead contacts for fish related enquiries identified by IMS and TAFIRI.

M6 NEMO-MEDUSA data received from NOC

M7 list of main fish species of interest for the case study agreed on by case study partners.

M8 Additional data (where needed) for model parameterisation provided by partners or gathered from literature

M10-15 Data on fish catch to validate the model output

Participating institutions: PML (PI: Sévrine Sailley), NOC, IMS, TAFIRI (Holloh Mulela, Joseph Sululu), CORDIO

PI responsible for delivery: Sévrine Sailley, PML

Description:

The fish modelling will make use of the SS-DBEM model to obtain projections regarding possible changes of fish species distribution and potential catch within the century. The model projections will target key fish species for the case study (both in term of subsistence and

economic value) and make use of NEMO-MEDUSA model outputs to look at changes of distribution and abundance due to change in climate. There will also be additional run(s) to look at effect of fishing and different management approaches (whether the fishing is at or above the Maximum Sustainable Fishing Yield). Model outputs will be made available to project partners, and a report will be produced to highlight the major findings regarding the sustainability of current targeted fishes and possible alternatives.

Although the model and report deliverables will be specific to this case study, the model domain and some of the fish species will overlap across all three SOLSTICE case studies (Kenya, Tanzania, and, South Africa).

IMS/TAFIRI will identify lead contacts for queries regarding fishing (e.g. main fish species, landing data). These people don't have to have the needed information/data but would be the main/first point of contact for any query.

Joseph Sululu and Holloh Mulela are identified by TAFIRI as key contacts.

Sevrine Sailley and CORDIO (Kennedy and Melita) have initiated contact on possible use of Melit' UVC (shallow – to 30m) coral reef fish abundance and biomass data – however, it is WIO wide, and in Tanzania it is from Zanzibar, Mafia and Mnazi Bay, and some from Kisite in Kenya just north of Tanga. This will be further discussed for M7 milestone.

Training/Capacity development:

No specific Fish modelling contribution to the MOOC schedule, but will participate and help during the MOOC. Could mentor a PhD student.

### *3.5.2. Small pelagic fisheries research*

**Participating institutions:** IMS, TAFIRI (Holloh Mulela), SAEON, NOC, PML, UDSM(EfDT)

PI responsible for delivery: S.Mahongo (IMS)

Deliverables:

- Key contribution to the CS literature review (M12)
- Lead author identified, contributions agreed (M18)
- SI paper submitted (M 30)

Description:

This is a key “foundation” study demonstrating what we know about the fishery, why its sustainable management is critically dependent on understanding of the marine environment and biophysical drivers; why do we expect strong sensitivity to climate change impacts. This study should result in the SI “setting the scene” paper (a compulsory requirement of the SI).

This is a “mission-critical” contribution to SOLSTICE.

### 3.5.3. *Wider engagement with fisheries: Importance of skip jack tuna along the east African coast*

Participating institutions: Rhodes, NOC, PML, TAFIRI

**PI responsible for delivery:** W. Sauer (Rhodes), K. Popova (NOC)

Deliverables:

- Detailed research plan presented including sampling program (M12)
- Project progress report (M24)
- SI paper (Month 36)

Milestones:

- Rhodes student identified (M6)
- Timing of the exchange visit agreed (M6)
- Deliverables agreed (M12)
- Input into policy identified (M24)

Description:

The project will address importance of skip jack tuna along the east African coast – synthesis of current biological knowledge, understanding population structure, and potential impacts of climate change. This project was created on request of the DSFA and is aligned with projects in the University of Aberystwyth (UK, Prof. P. Shaw) and Rhodes. The project will include synthesise available biological info (desk top), understand population structure, lagrangian modelling of the ocean circulation related to tuna movement with emphasis on climate change, and provide management advice. The project will include field trips to collect genetic samples - South Africa, Tanzania (mainland, Zanzibar and Pemba Island), Kenya; collection of genetic samples across the area.

Patroba Matiku and Catherine Mwakosya (TAFIRI) will be aligned to this WP

Capacity development:

The following exchange visit will be offered to the Rhodes student (funded from NMU budget): Visit to the UK for 3 months, 1 months to NOC (Ocean circulation models and lagrangian analysis), Genetic analysis: - 2 month Aberystwyth (funded by Aberystwyth).

### 3.5.4. *Input-output tables*

Deliverables:

- Contribution to the CS literature review (Month 12)
- SI paper (Month 12, 24 paper identified and finalised; Month 36 paper submitted to SI)
- Contribution to MOOC (M30). Regionalising input-output tables and its application to fisheries under climate change scenarios
- Contribution to synthesis paper(s) (Month 30, 36 paper(s) identified and finalised; Month 42 paper(s) submitted)

- Regional input-output data table and user document made available to partners and wider community (Month 24)

Milestones:

M6: Data required for regional input-output tables identified and agreed with UDSM(EfDT), TAFIRI, IMS, Rhodes

M21: Data collated for regional input-output table in collaboration with UDSM(EfDT), TAFIRI, IMS

M18: Fish model outputs received from PML-fisheries

M30: Results of economic assessment produced and used in writing SI and synthesis papers

**Participating institutions:** PML (PI: E. Papathanasopoulou), UDSM(EfDT), TAFIRI, IMS

Description:

Regionalised input-output (RIO) tables will be produced for the case study areas. These will be developed using earlier productions of the table at a national level and scaled down by regional data available through statistical records and collected by local partners. The RIO tables will be used to estimate the direct and indirect economic impact on the local economies from changes in fisheries due to climate change. The direct and indirect impacts provide insight into the wider economic impact of the reliance on natural resources and can prove useful for structural regional development that aims to ensure resilience and adaptive capacity. These impacts will be estimated in revenue and employment units.

TAFIRI PhD student Lydia Kapapa will be aligned with this project. Objectives of her PhD are as follows:

1. To identify factors that influences the scale and nature of BMU participation in marine fisheries resources.
2. To assess the effectiveness of BMU participation in management of marine resources in Tanzanian coast. aspects to be considered including conflict resolutions, decision making, information sharing)
3. To assess the challenges and weaknesses of BMU participation in managing marine fisheries resources.
4. To identify factors explaining persistence of Illegal and Unreported fishing despite of BMUs participation in management of marine pelagic fisheries
5. Examine how impacts of climate change affects local economy and community participation in managing small pelagic fishery

Training/Capacity development:

Co-supervision of a master/PhD student would be welcomed. PML would also be happy to host the student for a UK visit if funds from the project or their institute were available. Training during their visit would include wider applications of input-output tables, exposure

to fisheries modelling and marine spatial planning. TAFIRI aligns Lydia Kapapa (Phd student) with this WP.

### *3.5.5. Considering climate change as part of resilient Marine Planning & Ecosystem Based Management for Tanzania*

**Participating institutions:** PML (PI: A. Queirós), NOC, University of Dar Es Salaam, TAFIRI, IMS, CORDIO

Note: this study will go ahead if the associated Milestone at M9 (data scoping) has a positive outcome.

Deliverables:

- Contribution to the CS review (Month 12)
- SI paper (Month 36 paper submitted to SI)
- Report geared towards policy communicating main findings of spatial analysis providing advice for resilient use of different gear fisheries & other wild capture resources, as well as conservation resources based activities in Tanzania, within the context of climate change and ecosystem based management. (Month 42).
- Contribution to synthesis paper(s) (Month 42 paper submitted)

Milestones:

M6: Spatial data on relevant marine sectors required co-mapping identified with UDSM, TAFIRI, IMS, CORDIO & others (e.g. SYKE, Finland).

M9: Data scoping: feasibility assessment of the Marine Spatial Planning study

M12: Spatial data delivered or holder identified with UDSM, TAFIRI, IMS & others.

M18: Climate modelling projections for physics, biogeochemistry and fish models received from PML-fisheries and NOC-modelling, ready for use in spatial meta-analysis.

M36: Results of spatial meta-analysis data finalised and delivered as manuscript to SI

M42: Report summarising results in less technical language and geared towards policy delivered, with input from partners.

Description:

The main outcome of this task will be to provide: 1) a greater anticipatory capacity for communities dependant on living resources given the analysis of the viability of their

activities under climate change and marine space shared with other sectors; 2) highlighting potential opportunities for growth and resilience for their activities that may result from potential changes in the distribution of resources, and/or of key areas that may support their productivity, as climate change unfolds in the region; 3) anticipate potential conflicts with other sectors using the marine space, given those changes.

The contribution of local institutes will consist of: the provision of GIS data; support in the liaison with other local partners that may hold available data (pending data availability); co-development of the work through advice in the understanding of the local blue economy context; and participation in publications & dissemination as appropriate.

It has been noted that TAFIRI does not have the required GIS data; they are engaging in the rest of the work plan and are advising on any other relevant data that can be available from external partners.

Note that without sufficient availability of GIS data this task cannot go ahead. TAFIRI and IMS are assisting in finding contacts in other institutions who may have this data (WWF Tanzania, Marine Parks & Reserves Unit).

We will assess the resilience (and vulnerability) of current economic sectors dependant on living resources to climate change, in the Pemba Channel and encompassing waters, as well as their distribution. The analysis will take into account the current distribution of activities (gear specific fishing grounds, e.g. pelagic cf. bottom trawling) and co-located economic sectors (e.g. spatial data on seaweed farming, tourism, MPAs), as well as projected changes to their associated environment and target resources (species specific), based on modelling projections to the end of the 21<sup>st</sup> century undertaken by PML and NOC (NEMO-MEDUSA and SS-DBEM).

The completion of this activity will be dependent on the availability of spatial data for co-mapping (local partner engagement) and model projection availability.

Capacity building for this task will be achieved through the collaboration in all aspects of the work, co-design of the study and one-to-one/small team coaching on the methodology and result interpretation. The main capacity building outcome is the analysis as a product for use by the local partners in their marine management engagement and advice to government in Tanzania.

### *3.5.6. Social studies (TBC, S. Aswani, Rhodes)*

Deliverables:

- Contribution to the CS review (Month 12)
- SI papers (Month 36)
- Contribution to MOOC (M30)
- Contribution to synthesis paper(s) (M40)

Milestones:

- (!) Ethical approval of relevant Tanzanian, UK and SA panels are to be obtained prior to any work with the communities. Clarification on ethics to be provided by NOC by 1<sup>st</sup> March 2018 (instructions from funder are currently unclear).
- Deliverables confirmed (M12)



- Collaboration with Tanzanian partners confirmed (M12)
- Contribution to science-into policy material identified by M36

PI responsible for delivery: S.Aswani (Rhodes)

**Participating institutions:** Rhodes, IMS, Participation by other Tanzanian partners to be confirmed by S.Aswani.

Description:

Proposed research will document the coastal socioeconomic, governance, and local knowledge systems of Tanga and Western Pemba fishing communities to understand local resource use patterns and local responses to social, economic, political, and ecological. We will integrate this community-level knowledge with other SOLCISTE scientific research to assess the vulnerability of local communities to climate change and establish participatory, just, and sustainable management of natural resources in the Pemba Channel coastal aquatic and marine environment.

The research will take a holistic approach to investigating communities in the Pemba Channel by studying and documenting the following dimensions:

1. Coastal Indigenous ecological knowledge systems and avenues for integration with scientific ecological research as equivalent knowledge systems
2. Tanzania traditional coastal governance systems for understanding indigenous rights and claims regarding coastal space
3. Pemba Channel coastal livelihoods (foraging and economic provisioning/coping strategies across genders) under climate change threats
4. Ecological characteristics of the marine resources harvested, to investigate the spatial and temporal dynamics and interplay between natural and human factors
5. Local perceptions of coupled natural and human systems under climate change.
6. Pemba Channel coastal vulnerability and ecosystems services trade-offs in the context of environmental and climate change

The broad impact of this research are: (1) It will build on decades of in-country research and management experience from Tanzania ministries and institutes to establish an environmentally just system of management that integrates local communities into Tanzania's broader management and conservation strategies; (2) it will document indigenous understandings of environmental and climatic change, and measure their livelihood responses to develop participatory adaptive measures that are matched with local scientific research; and 3) it will develop the capacity of the Tanga and Pemba people, particularly the youth and women, to undertake future assessments of climate change on their livelihoods and better manage their coastal resources into the future. In sum, this research will result in a broad socio-ecological understanding of local socioeconomic and cultural systems that not only generate novel information of coastal Tanzanian indigenous systems, but also lead to improvements in the capacity of local coastal communities to respond to environmental and climate change related transformations.

#### ***3.5.7. Social studies (N.Jiddawi, IMS; Rose Mwaipopo, UDSM/TAFIRI)***

Deliverables:

- Contribution to the CS review (Month 12)
- SI paper (Month 24) or Project Report (M24) – TBC by M12
- Contribution to MOOC (M30)
- Contribution to synthesis paper(s) (M40)

**Participating institutions:** IMS (N.Jiddawi), DR Rose Mwaipopo (UDSM)

Description:

A report will be produced which will discuss the socio economic importance of the small pelagic fishery in Tanzania. This will include the status of the fishery, importance to community livelihoods, processing techniques used and export of the fishery products. TAFIRI PhD student Lydia Kapapa will be aligned with this WP.

### **3.6. WP3. Science into policy and wider stakeholder engagement**

#### ***3.6.1. Stakeholder engagement Action Plan***

**Deliverable:** Project Report (Month 9)

Participating institutions: TAFIRI, IMS, NOC (SOLSTICE directors), PML, WIOMSA (policy), CORDIO, UDSM(EfDT)

**PIs responsible for delivery:** J.Francis, Y.Shaghude, S.Mahongo, K.Popova, M.Roberts

**Milestones:** Science into Policy working group established and PIs responsible for delivery identified (M7)

Description:

We will produce a report identifying key stakeholders in the following groups: policy, industry, communities, and academia. The report will contain a detailed engagement plan including plans for profiling (M&E indicators, surveys and interviews), identification of stakeholder capacity development needs, stakeholder engagement events, and links with MOOC-light.

David Obura (CORDIO) will contribute to this WP. He is strongly involved in regional policy development in the WIO especially the northern Mozambique channel area.

### *3.6.2. Community engagement events regarding robotic deployments in Tanga, Pemba and Zanzibar*

**Deliverable:** Community engagement events in June-July 2018 (M8)

Milestone:

M6 Detailed plan for the engagement is produced (internal project report) and PR plan developed

Participating institutions: NOC, IMS (Pemba and Zanzibar), TAFIRI (Tanga)

Description:

During WIOMSA symposium, SOLSTICE discovered a lot of concerns among local marine resource management organisations about deploying marine robotics in vicinities or artisanal fishing grounds. We will aim to address these concerns and promote awareness of cutting-edge marine technologies among communities, managers and researchers. We will run community engagement events between National Oceanography Centre and a wide range of organisations and communities in Zanzibar, Tanga and Pemba (supported and facilitated by the ODA Centre of Excellence comprising the Institute of Marine Science, Zanzibar and Tanzanian Fisheries Research Institute, Dar es Salaam).

### *3.6.3. Technology demonstration/stakeholder engagement event*

**Deliverable:** Robotics operation (real time) demonstration event in Zanzibar (Months 22, July 2019)

**Milestone:** Detailed plan for the engagement is produced (internal project report) and PR plan developed (M12, after recon mission)

Participating institutions: NOC, PML, IMS, (SOLSTICE Directors, WP leads), SAEON

Description:

Robotics operations room will be set up at the new IMS equipped with screens showing real time robotics data as well as modelling and RS information. This room will work as a main

hub and stakeholder engagement and training space in all three technologies. This is the main high profile project event where participation at the ministerial level and representation of GCRF and World Bank is anticipated. This event will focus on the Tanzanian Case Study (as Kenyan CS does not have robotics component), however we will utilise this even to engage with key Kenyan stakeholders as well.

#### *3.6.4. Policy and practice notes*

**Deliverable:** Policy and practice information pack (M42)

Participating institutions: WIOMSA, TAFIRI, IMS, UDSM(EfDT), Rhodes, NOC (SOLSTICE directors), PML

Milestones:

M9: Science into policy framework and action plan developed; Examples of Policy and practice notes from previous project reviewed.

M36: Full list and layout of Policy and practice notes identified

Description:

We will produce policy and practice notes aiming at key groups of stakeholders (Management of LMR, Policy, Businesses and Industry, Technology, Communities).

#### *3.6.5. Final stakeholder presentation event*

**Deliverable:** Workshop [One or two day event M44, May 2021]

Participating institutions: WIOMSA, TAFIRI, IMS, UDSM(EfDT), NOC (SOLSTICE directors), PML

We will run a targeted stakeholder information event on the key deliverables of the project, and its legacy. We will present Policy and Practice information pack. We will use this event for the final stakeholder related indicators for M&E profiling (interviews, surveys).

### **3.7. WP4. Capacity Development**

#### *3.7.1. Full capacity development plan for Kenya and Tanzania*

**Deliverable:** Project report and outcome/impact indicators (M9)

**Participating institutions:** NOC (Byfield), WP leaders 1a,b,c and 2, KMFRI, CORDIO, IMS, TAFIRI, EfDT

We will produce a project report outlining the following:

- Institutional capacity baseline, including overview of facilities and expertise

- All project MSc/PhD studentships including UK-WIO supervisors, training needs, participation in the project events and exchange visits and contribution to the key deliverables.
- Institutional capacity development requirements in technologies (modelling, remote sensing, robotics) and field work, key outcome indicators, baseline assessment of these indicators, and capacity development plan.
- Stakeholder capacity development needs
- NOC/PML capacity development needs in application of core expertise in ODA arena
- GCRF might require additional activities on baselining of institutional capacity (TBC).

### 3.7.2. *Training courses*

Deliverable: Training courses and associated material (M12, M18, M30)

Description:

We will run three 2-week training courses: Applications of remote sensing, Applications of ocean modelling, and Science communication. This will be available to junior staff and post-graduate students at participating institutions, including at least one person from each of the supporting partners in the wider WIO.

Course 1: Applications of marine remote sensing (M12)

**Deliverables:** Training course brochure (M8), delivery (M12); course report (M13); course lectures and tutorials available on line (M13).

Participating: NOC-RS (PI V.Byfield), IMS, TAFIRI, PML-RS, CORDIO, SAEON, Rhodes?

**Milestones** (main milestones for wider distribution in bold)

**M8:** Course brochure for publication to partner institutions,

**M12:** Delivery of the training course

**M13:** Course report with analysis of student feedback

Course 2: Modelling training course (M24)

**Deliverables:** Training course brochure (M14), delivery (M18); course report (M19); course lectures and tutorials available on line (M21).

Participating: NOC-MSM (PI E.Popova), NMU, PML

Milestones:

**M20:** Course brochure for publication to partner institutions,

**M24:** Delivery of the training course

**M25:** Course report with analysis of student feedback

**M28:** On-line availability of course material (lectures and tutorials) on SOLSTICE web site

Course 3: Science communication& MOOC production workshop (M30)

The aim of this training course is to develop skills for communicating science to different audiences through participatory training exercises and produce SOLSTICE MOOC material based on the case studies.

**Deliverables:** Training course brochure (M25), delivery (M30); course report (M19); course lectures and tutorials available on line (M21), additional outreach resources on line (M24).

**Participating:** NOC-MPOC (PI V.Byfield), IMS, TAFIRI, Imperative Space, NOC Coms, all partners

**Milestones** (main milestones for wider distribution in bold)

**M30:** Delivery of the training course;

**M19:** Course report with analysis of student feedback

**M21:** On-line availability of communication material developed during the course and refined by participants in the following months.

### ***3.7.3. Fieldwork hands-on training***

Fieldwork hands-on training and its scientific deliverables are described in the Fieldwork package.

**Responsible:** WP4 lead, Field work lead Co-Is and main contact in each partner organisation participating in the field work

Additional deliverables

M9, M21, M30: Support for filming to provide outreach material and content for the SOLSTICE MOOC (Mentors and trainees; NOC Coms, V.Byfield supported by 2-3 volunteers to film field activities, including under-water).

M12, M30 Report on the effectiveness of the fieldwork capacity development activities based on feedback from participating mentors and ‘trainees’, as contribution to an M&E report.

### 3.7.4. MOOC

**Deliverables:** course content (M36) and screening (Months 37, 42, 48)

Provisional title: “Sustainable use of living marine resources: case studies from the Western Indian Ocean”

**PI:** V.Byfield

Description:

The MOOC will run on the FutureLearn (Open University) platform. Following its first screening, an offline version will be made available for use by the partners, and other organisations in the WIO in their course activities. The MOOC will build on research activities in WPs 1, 2 and capacity development resources developed in 4.2, using examples from each of the three case studies, and from SOLSTICE stakeholder engagement activities. The content will address selected capacity development needs of partner institutions and stakeholders, as identified in the capacity development plan. It will run over 6 weeks, each week covering a major theme in SOLSTICE research and stakeholder engagement. Content will include:

- video of field work (including robotics),
- interviews with experts and selected stakeholders, transcript of interviews,
- model and satellite animations,
- brief background text and figures with references to further information on the SOLSTICE web site and elsewhere on-line,
- short Q/A exercises to test student understanding,
- forum where students can discuss the topic, ask questions, and share information.

**All Co-Is in the UK and WIO are expected to contribute in areas of their expertise,** and encourage their students and junior scientists to engage with the MOOC development.

Contributors are expected to:

- facilitate and/or contribute to the filming of fieldwork videos,
- give interviews about their work and area of expertise,
- provide background text and references, figures, images and/or animations for the MOOC content, related to their research and area of expertise
- follow the MOOC on-line while it runs to answer questions related to their area of expertise.

Milestones:

M9: MOOC outline agreed, all contributors identified,

M12: detailed MOOC outline developed, presenter/interviewer identified for each country (Kenya, Tanzania, South Africa, UK)

M13: MOOC promotional video produced (NOC, IMS)

M18: MOOC CS1 &2 layout finalised (following fieldwork completion)

M24: MOOC CS3 layout finalised (following fieldwork completion)

M34: MOOC outline completed and advertised on Future Learn

M35: Full MOOC content compiled

M36 – Published on FutureLearn platform

**M37:** MOOC Run 1 (Oct 2020)

**M40:** Off-line version of MOOC available on SOLSTICE web site (Jan 2021)

**M42:** Off-line version on Ocean Teacher

**M42:** MOOC Run 2 (Apr 2021)

**M48:** MOOC Run 3 (Sep 2021)

**M39,M44, M50** Short reports with statistics on MOOC uptake and user profiles for inclusion in M&E reports

### ***3.7.5. MOOC Light***

**Deliverables:** M39 MOOC Light; M48 report on community testing

**PI:** V.Byfield

Description:

The MOOC Light will be designed for use in schools and as informal education tool to promote ocean literacy. Covering the main themes addressed by the MOOC, it comprises video, informative brochures and a selection of guided education activities to promote understanding of local habitats, the global interconnectedness of the oceans, and of the productivity that supports larger marine animals, including species important to local fisheries. It will be available in English and Swahili.

Milestones:

M12: recommendation from Science-to-policy WGs on MOOC content received

M30: MOOC Light layout agreed (following CS 1, 2 and 3 fieldwork) and

M39: Content compiled in English and Swahili



M45: MOOC light tested with local fishing communities (KMFRI, IMS, TAFIRI, NMU, SAEON, SASMIA, WWF, other participants involved in community engagement activities)

### 3.8. WP5 Communication

#### 3.8.1. Regular channels of communication:

- Project website (external): Fully operational by 15<sup>th</sup> December 2017
- Project website (internal): Fully operational by 1<sup>st</sup> march 2018
- Project newsletter (internal): every 3 months starting 1<sup>st</sup> December 2017
- Project newsletter (external, summary for stakeholders): every 6 months, starting 1<sup>st</sup> April 2018
- Project newsletter (external, impact summary for funders): every 6 months, starting 1<sup>st</sup> April 2018

#### 3.8.2. One-off communication material:

- SOLSTICE banners (M1)
- SOLSTICE brochure (M1)
- Notes for partners on community engagement regarding the use of robotics (in preparation for reconnaissance mission in June 2018): M5 (February 2018)
- Community engagement leaflet on the use of robotics for Tanzanian newspapers: M7 (April 2018)
- Video on robotics for Tanzanian schools / community engagement (M7)
- SOLSTICE promotional video: M9
- SOLSTICE MOOC promotional video: M12
- SOLSTICE MOOC sample lecture (video): M12
- Training course leaflets
- MOOC leaflets (M32)
- Infographics for the Case Studies (M42)
- Policy and practice notes for the Case Studies (M42)
- SOLSTICE: summary of outcomes and impacts leaflet

## 4. Monitoring and evaluation

#### 4.1.1. Network profiling

**Deliverables:** survey and basic analysis tools (M6)

Participating institutions: NOC (Popova, Alexiou), PML, all partners

Milestones:

M5 questionnaire finalised

M6 survey returned

M6 methodology and indicators finalised

We will use a modified GULLS survey (social network analysis) to profile the network strength and growth parameters (baseline, midterm and end term). International transdisciplinary network is the key delivery of the GCRF Grow call, thus this survey is of extreme importance and should clearly reflect our key success indicators.

#### *4.1.2. M&E strategy*

Participating institutions: NOC (Popova), PML

Deliverables: Project Report (M6)

In consultation with GCRF we will produce a strategy document detailing a complete M&E approach including logframe, theory of change, profiling surveys and methods of qualitative information collection.

#### *4.1.3. Monitoring and evaluation reports*

Participating institutions: NOC, PML

**Deliverables:** Project Report (M12, M30, M51, long term impact TBD)

**Milestones:** M&E indicators will be collected every six months

M&E will consider four evaluation categories: i) impact of capacity development both in WIO and UK; ii) benefits, costs and practicalities of employing the new technologies and recommendations; iii) societal impact of case study outcomes; and iv) strength and impact of UK-WIO transdisciplinary networks.

Towards the end of the project we will secure additional funding for the post-project M&E when the highest impacts are expected to be achieved (GCRF additional funding, NC, national and public good are the most obvious routes).

## **5. Alignment with key regional programs**

### **5.1. PEACC**

Acronym: [PEACC](#) (Productivity in the EACC under Climate Change)

[Pronounced 'peace' – calling for mankind to be at peace with the environment]

Duration: 24 months (1 July 2016 – 30 June 2018)

Project Reference: MASMA/OP/2016/02

Budget: US\$ 252 753

Engagement: We will engage with PEACC via partners in the project e.g. in synthesis: Dr Issufo Halo and Majuto Manyilizu (modelling, Dodoma University and Cape Peninsular

University of Technology), Dr Rose Mwaipopo (socio-economics, UDSM) and Dr Albogast Kamukuru (fisheries, UDSM)

## 5.2. IIOE-II

[IIOE-II](#) (Second International Indian Ocean Expedition (IIOE-2))

Engagement: We will engage with Mika Odido from IOC sub-commission for Africa and the adjacent island states and with Ben Milligan (via SOLSTICE Advisory Panel).

## 5.3. The Western Indian Ocean Upwelling Research Initiative (WIOURI)

[WIOURI](#) (Western Indian Ocean Upwelling Research Initiative)

Engagement via WIOURI PI Mike Roberts

## 5.4. ACCORD

ACCORD (Addressing Challenges of Coastal Communities through Ocean Research for Developing Economies) is a four year UK National Capability Program

Engagement via K.Popova involved into both project.

## 5.1. 5.5 SAPPHIRE

SAPPHIRE (The Western Indian Ocean Large Marine Ecosystems Strategic Action Programme Policy Harmonisation and Institutional Reforms). **Engagement routes to be established by Science into Policy WGs.**

## 6. Key events and workshops (preliminary list)

March 2018, Zanzibar

- Science-into-policy Working Group (or in June 2018)

16,17 April 2018, London

- Annual Leadership team meeting
- Annual Advisory Panel meeting

September 2018, Zanzibar

- Remote Sensing training course

June-July 2018, Zanzibar

- Science into policy working group meeting (1 day)
- Science project meeting (2 days)
- Field work reconnaissance mission (North Zanzibar, Pemba) and UWR deployment
- Information events for communities in each location

November 2018, Tanga

- Fieldwork reconnaissance mission and community engagement

April 2019, Mombasa (TBC)

- Annual Leadership team meeting
- Annual Advisory Panel meeting

June-July 2019, Zanzibar

- Field work (benthic, Tanga, 4 weeks)
- Field work (Pemba Channel pelagic and robotic, base in North Zanzibar, 4 weeks)
- Operations room and stakeholder engagement event during robotics mission (2 weeks)

September 2019, Zanzibar (preliminary date)

- Modelling training course

November 2019, Location?

- 11<sup>th</sup> WIOMSA symposium
- SOLSTICE exhibition and special session (if WIOMSA is run in one of the SOLSTICE countries)

April 2020, Zanzibar (TBC)

- Annual Leadership team meeting
- Annual Advisory Panel meeting

May 2020 (preliminary date)

- Communication training course

March 2020, Zanzibar (preliminary date)

- Science progress workshop in preparation to SI submission

December 2020

- Science into Policy WG meeting (preliminary date)

May 2021, TAFIRI, Dar es Salaam, (preliminary date)

- Synthesis workshop
- Science-into-policy and evaluation workshop

October 2021, Location?

- 12<sup>th</sup> WIOMSA symposium
- SOLSTICE exhibition and special session (if WIOMSA is run in one of the SOLSTICE countries)
- SOLSTICE science-into-policy workshop with stakeholders

## 7. Institutional Contributions to the Case Study

### 7.1. IMS/TAFIRI

The fieldwork activities carried out in Tanzania mainland (Tanga in particular) will be supervised by TAFIRI, and those in Zanzibar/ Pemba be supervised by IMS.

IMS (together with SOLSTICE directors M.Roberts and K.Popova) will coordinate the Case Study synthesis publications (literature review M12 and CS final report). IMS and TAFIRI will jointly lead and coordinate contribution to the SI foundation paper for the Tanzanian case study.

IMS and TAFIRI researchers will assist NOC in organisation of the reconnaissance mission and community engagement events (July 2018, North Zanzibar, Tanga and Pemba) on the use of robotics (arranging meetings with the community, Swahili translation, communication leaflets) – as was discussed during the kick-off meeting speed dating sessions.

TAFIRI researchers will contribute / assist in the reconnaissance mission to Tanga in 2018 by sharing their experience and data of seabed operations in the area. Personal experiences, and any unpublished or local report published information will be extremely valuable.

IMS researchers will contribute any similar information / data, to central SOLSTICE Tanzania seafloor Geographic Information System (GIS) that NOC will generate and make available to all partners.

IMS/TAFIRI researchers will contribute to detailed planning of July 2019 fieldwork. Liaison with government / management authorities of (a) the Tanga Coelacanth Marine Park (Northwest Pemba Channel), and (b) the Pemba Channel Conservation Area (Northeast Pemba Channel) may be particularly important and provide added value outputs for SOLSTICE (e.g. develop and produce material of relevance to those authorities).

The above will be coordinated by both IMS and TAFIRI, where TAFIRI will specifically focus on (a) and IMS will focus on (b).

IMS/TAFIRI researchers will participate in the field work in July 2019, associated training/exchange visits and publication of results for the following areas: All fieldwork activities will be done in collaboration and support from NOC.

IMS/TAFIRI researchers will participate in fieldwork associated MOOC content development and provide liaison with local communities and local authorities. (IMS will coordinate).

IMS will serve as Tanzania-host / lead for archival of SOLSTICE field data and data products, e.g. GIS, other maps, seafloor image library

IMS will assist with running Operations Room during robotics survey which will serve as demonstration and stakeholder engagement event.

IMS researchers will contribute to MOOC and participate in filming of the material dedicated to the case study. In particular, Dr.N.Jiddawi will act as a “MOOC introducer” of the case study (featuring in videos describing challenges facing local communities).

IMS will assist in running regional training courses by providing training room for lectures and hands-on computing exercises, and take responsibility for local organisation of catering, transport for course participants, and recommend/arrange for local accommodation of course participants not resident in Zanzibar.

Y.Shaghude (IMS) and S.Mahongo (TAFIRI) will serve as members of the SOLSTICE Leadership Team reporting annually to the Advisory Panel.

## **7.2. University of Dar es Salaam (EfDT)**

Professor Lokina will help to identify and facilitate access to the economic and value-chain information required to regionalise the input-output tables for Tanga and Pemba (WP2, Task 3.5.4). He will provide advice in understanding the IO outputs for local and regional research and local communities. His expertise and knowledge of the policy arena will also be used in translating the findings from science to policy (WP3 Tasks 3.6.1, 3.6.3, 3.6.5).

Professor Lokina will contribute to SI and synthesis publications and supervision of any master/PhD students aligned with the SOLSTICE project. He will also contribute to MOOC where required.

### 7.3. WIOMSA

Dr. Julius Francis will lead WP3 (science into policy) and coordinate activities of the SOLSTICE Science into Policy working group. Under J. Francis's leadership this group will discuss Science into Policy framework (March 2018), produce Science into Policy Action Plan (July 2018) and work towards producing Policy and Practice notes/report (M42).

Dr. Julius Francis will advise and guide SOLSTICE Science into Policy working group on identifying and engaging with the key groups and stakeholders throughout the project.

Dr. J.Francis will serve as a member of the SOLSTICE Leadership Team reporting annually to the Advisory Panel.

### 7.4. CORDIO

Dr Melita Samoilys will coordinate contributions from CORDIO to the Pemba Channel surveys and modelling, with Mr Kennedy Osuka playing a lead role in the data analysis and modelling and other staff contributing where suitable - GIS, benthic mapping and oceanographic modelling. Dr David Obura will contribute to the science to policy working group.

CORDIO will contribute / assist in the reconnaissance mission to Tanga in November 2018 by sharing their experience and data of seabed operations in the area (e.g. BRUV camera operations) and any similar information / data, to central SOLSTICE Tanzania seafloor Geographic Information System that NOC will generate and make available to all partners. CORDIO also proposes to conduct a shallow water SCUBA based survey (by Melita Samoilys) to collect benthic and fish biomass data in the NE monsoon, however availability of extra funding for such a survey will only become clear after the boat is secured for the main July 2019 mission.

CORDIO will participate in July 2019 fieldwork and associated MOOC content development

CORDIO will lead two first author papers for the SI as follows:

- Habitat characterization and spatial distribution of photic and mesophotic communities of the Pemba Channel: modelling future climate change scenarios (Osuka PhD study)
- Quantifying fish populations that span shallow and deep habitats to examine a depth refuge from fishing and climate change (Samoilys lead).

(These papers will incorporate CORDIO BRUV dataset, and the application of robotic and autonomous technology in tackling local environmental and sustainability concerns).

CORDIO can contribute content on fisheries training course on fisheries information for improved artisanal fisheries co-management.

## 7.5. SAEON

The Egagasini Node for marine-offshore systems is an observation site of the South African Environmental Observation Network (SAEON) that is hosted by the new Oceans and Coasts branch of the Department of Environmental Affairs (DEA), and also works closely with the Fisheries Branch of Department of Agriculture Forestry and Fisheries (DAFF). The node works with a wide range of partners to combine data, resources and knowledge of the oceans surrounding South Africa, their ecosystems and biodiversity to comprehend and fully appreciate their role in climate change as well as the impact of climate change on the oceans' resources.

The Egagasini node of SAEON is particularly interested in the proposal because of the application of leading edge marine technologies and capacity development to address critical problems facing vulnerable coastal communities. SAEON also hosts the secretariat for the Indian Ocean Rim Association academic group and the proposed research aligns itself well to the projects within this. Lucy Scott would represent SAEON on the project.

She is pleased to be able to contribute to the proposal and would make a contribution to the capacity development and marine science components of both study sites based on her experience in:

Capacity development; she has had experience throughout the Western Indian Ocean region, including in the Pemba channel study area, covering many topics including the deployment of oceanographic sensors and participatory mapping in support of two-way information exchange with local fishing communities.

Bathymetry mapping projects and Geographic Information Systems development in both South African and Tanzanian study areas.

Area(s) of expertise and input into the project

Her main contributions to the project would be in the areas of:

- Sourcing, collating and making available data and information from previous studies in the Tanga and Pemba regions of Tanzania.
- Furthering research objectives of the field expeditions in the same areas with a view of producing a first-author publication for SOLSTICE SI.
- Assisting with two the remote sensing training course in September 2018 and providing materials for the MOOC/s.
- Working closely with IMS/UDSM and TAFIRI partners as well as others, in developing and delivering the Tanzanian Foundation paper (Special Issue) by October 2019.

## 7.6. NMU

Dr. M. Noyon will participate in the Pemba Pelagic survey in July 2018 and 2019 (plankton productivity measurements) and will contribute to a publication of the results to SI.

Dr M. Noyon will lead a training session on plankton ecology at IMS in June 2018 with a special focus on plankton collection, identification and measurements in collaboration with



HWU and KMFRI. The workshop will include looking at samples that have been collected or will be collected during various cruises (Nansen program and IIOE2).

Dr M Noyon can co-supervise Tanzanian students working on the pelagic Pemba Channel biological samples

B. Godfrey will participate in the South African and Pemba Pelagic surveys to acquire adequate training in gliders deployment, maintenance and piloting.

B. Godfrey and Prof Roberts will also deploy 4 UTRs in 2018 in the Pemba Channel to add to the existing NMU long term monitoring network. B. Godfrey will also help in the deployment and recovery of the moorings

Prof. Roberts will serve as a member of the SOLSTICE Leadership Team reporting annually to the Advisory Panel.

### **7.7. Rhodes**

Prof. W Sauer will lead on SOLSTICE wider engagement with the WIO fisheries and DSFA (with links to tuna) in particular.

Prof. W Sauer will strongly contribute to the Science into Policy working group activities and in particular to the production of final Science into Policy briefings and material.

Prof. S. Aswani will lead community scale studies of the WP2, coordinating fieldwork surveys, analysis and vulnerability assessments for the communities of Pemba and the mainland Tanzania. S.Aswani will lead publication of the results in the SI in collaboration with IMS (N.Jiddawi).

Prof. Sauer will serve as a member of the SOLSTICE Leadership Team reporting annually to the Advisory Panel.

### **7.8. PML**

PML will take the lead on WP2 (Socio Economics, PI: E. Papathanasopoulou) and contribute to: the Remote Sensing component of WP1 (Remote Sensing, PI: D. Raitsos), WP3 (Science to Policy), WP4 (Capacity Development) and M&E.

PML will take a lead on the following WP2 tasks: Fish modelling; Input-Output tables; and Marine Spatial Planning. It will also strongly contribute/lead WP1 tasks: synthesis of satellite information to identify large scale drivers, local drivers, real-time support of fieldwork, on-line/off-line remote sensing access; WP3: all relevant activities; WP4: 2-week remote sensing training course and MOOCs.

PML will be involved in co-supervising master and PhD students aligned with the Tanzania case study, particularly through the WP2 Input-output task (E. Papathanasopoulou).

E. Papathanasopoulou will serve as a member of the SOLSTICE Leadership Team reporting annually to the Advisory Panel.

#### **7.9. NOC**

NOC as a lead organisation has overall responsibility for delivering the project. NOC PI is identified in every WP with two exceptions: Social Studies 3.4.7 and 3.4.8.

## 8. List of abbreviations

AUV - Autonomous Underwater Vehicle

BGC - Biogeochemistry

CS – Case Study

EAF - ecosystem approach to fisheries

GCRF – Global Challenges Research Fund, UK (Project Funder)

MOOC – Massive Online Open Course

M&E – Monitoring and Evaluation

ODA - official development assistance

ROV - (Remotely Operated Vehicle)

RS – Remote Sensing

SI – Special Issue

WG – Working Group

WP – Work Package