

**FULL PROPOSAL**

**INSTRUCTIONS**

**Read the following before developing your full proposal**

All proposals submitted to the fund must have as their main purpose the conservation and/or management of marine and coastal biodiversity and/or ecosystem based adaptation to climate change in the Seychelles.

Refer to the Call for Proposals to see the priorities for funding in the current round of SeyCCAT grants. Do not submit a proposal that falls outside of these identified priorities.

Do not include activities or costs that are defined as ineligible by SeyCCAT.

Proposals must be compliant with Environmental and Social Safeguards applied by SeyCCAT.

Refer to the SeyCCAT website for information on the above: [www.seyccat.org](http://www.seyccat.org)

In the event of specific questions, contact the SeyCCAT Secretariat.

**In preparing your full proposal**

Be clear and concise; stick to the page limit (10 pages maximum).

The budget must be based on real costs (except for subsistence costs and indirect costs). It is, therefore, in the applicant’s interest to provide a realistic and cost-effective budget.

The full proposal should be provided in Font Times New Roman size 11 characters, single spacing.

**SeyCCAT Project Full Proposal**

**PART 1. NARRATIVE (Maximum 10 pages)**

1. **COVER PAGE**

|  |  |
| --- | --- |
| **Title** | Spatial ecology and response to catch-and-release of recreationally targeted fish species on St. François and Alphonse Atolls, Alphonse Group, Seychelles Outer Islands: Implications for conservation and management. |
| **SeyCCAT Strategic Objective – *as listed in the Request for Proposals*** | * Support new and existing marine and coastal protected areas and sustainable use zones; * Empower the fisheries sector with robust science and knowhow to improve governance, sustainability, value and market options; * Promote the rehabilitation of marine and coastal habitats and ecosystems that have been degraded by local and global impacts; * Trial and nurture business models to secure the sustainable development of Seychelles’ blue economy. |
| **Name, contact details and status of lead applicant organisation / individual** | C:\Users\ICS Alphonse\AppData\Local\Microsoft\Windows\Temporary Internet Files\Content.Outlook\S2FY4IHR\Alphonse Foundation Logo.jpg*Organization:* Alphonse Foundation(AF). *Contact details:* Josep Nogués.  *Tel:* (+248) 4229040. *Date of formation:* 28th of January 2008. AF is a Seychelles registered society that brings together Islands Development Company (IDC), Island Conservation Society (ICS), Alphonse Island Lodge (AIL) and the Seychelles Ministry of Environment (SMOE). The AF plays a major/active role in stewardship of natural resources. |
| **Partner organizations (include country if not based in Seychelles)** | *Org.1:* Department of Environmental Conservation, University of Massachusetts Amherst (UMA), United States of America (USA); *contact details:* Dr. Andy J. Danylchuk; <http://eco.umass.edu>  *Org.2:* Institute of Environmental Science, Carleton University (CU), Ontario, Canada; *contact details:* Dr. Steven Cooke [*http://www.fecpl.ca/*](http://www.fecpl.ca/)  *Org.3:* Bonefish & Tarpon Trust (BTT), Florida, USA; *contact details:* Jim McDuffie (president) and Dr. Aaron Adams (Director of Science and Conservation) <https://www.bonefishtarpontrust.org/>  *Org.4*: Seychelles Fishing Authority (SFA); *contact details:* Ronny Renaud; <http://www.sfa.sc/> |
| **Project location** | St. François (STF) and Alphonse (AA) Atolls, Alphonse Group, Seychelles Outer Islands. |
| **Duration – start and end dates** | July 2018 to June 2020. |
| **Total budget requested** | *SR 1,000,000* |
| **Indicative co-financing.** | AF contributes SR 300,000. ICS in-kind contribution of SR 165,000 including staff salaries for preparation of concept note, full proposal and project implementation. UMA contributes SR 1,517,360 including mobile hydrophone (SR 124,000), 23 acoustic receivers (SR 550,000), surgery supplies (SR 20,000), multicore computer for modeling spatial ecology data (SR 62,000) and production of concept note and full proposal (SR 158,000). CU contributes SR 365,500 including accelerometer loggers (SR 50,000) and surgery supplies (SR 20,000). BTT co-finances SC 828,000 per 2 years for PhD candidate, Caitlin McGarigal. AIL: in-kind contribution of 336,800 to cover return domestic plane tickets Mahé-Alphonse, accommodation and meals during the full extent of this proposal. IDC: in-kind contribution to providing island permits for researchers. SFA: prepared to provide SCR 300,000 in terms of co-financing (15 stations) - (*See letters of commitment*). |

1. **SUMMARY (max 1 page)**

Among fly anglers, St. François Atolls and Alphonse (STF, and AA, respectively) are legendary. Recreational anglers from around the world travel to its remote habitat to target species such as Bonefish (*Albula glossodonta*), Indo-Pacific Permit (*Trachinotus blochii)*, Milkfish (*Chanos chanos)*, and Giant Trevally (*Caranx ignobilis)*. Pioneering fly-fishing expeditions to AA and STF stated the richness of their waters prior 1999, when the Alphonse Island Lodge became operational. Catch and release (C&R) ecotourism was established early in 2001, but it was not until 2013 when the Alphonse Fishing Company (AFC) took over promising to benefit the fishery through best angling practices, as well as creating livelihood opportunities for people in the region. AFC has exclusive rights to fly-fish the reef flats and the lagoons of these atolls, with fishing effort being controlled through the angling operation and its guides in collaboration with ICS and IDC. Since other ecotourism activities are relatively limited and benign, the terrestrial and marine ecosystems of AA and STF are on the official process of becoming protected areas to ensure the conservation and sustainable use of their terrestrial and marine biodiversity.

Despite C&R fly fishing representing an important income to the economy of the country, it is unknown as to whether C&R recreational angling activities are affecting targeted species and their essential habitats. The ICS has already established long-term monitoring of catch rates for recreationally targeted fish species, as well as established a code-of-conduct to ensure guides and anglers follow conservation guidelines with respect to C&R. Nevertheless, in both cases, very little research has been conducted to scientifically quantify movement patterns and the response of these important fish species to C&R. Recent anecdotes from AFC guides also indicate that the wariness of Giant Trevally (GTs) is changing, and discussions have begun regarding rotating closures of flats to reduce fishing pressure. This presents a rare opportunity to quantify how flats species adjust their spatial ecology and behavior in response to changes in angler pressure – an important step to determining what the carrying capacity of anglers are to specific flats. Addressing such questions will not only inform management decisions on AA and STF, but also act as a model for recreational fisheries throughout the region.

The overarching objective of this multi-year research effort is to examine the spatial ecology and C&R response of GTs on STF and AA. Over a 2 year period, we will track the movements of GTs and their response to changes in angling pressure using acoustic telemetry. An array of 60 fixed acoustic receivers will be distributed strategically on STF and AA to quantity the space use and networks of habitats used by GT (n=50) before, during, and after select flats are closed to fishing. Advanced social network modeling and graph theory will be used to elucidate how GTs alter their behavior and potentially change how they interact with one another as angling effort is modified. For resident GTs on AA, we will use blood physiology, reflex impairment, and accelerometer to quantify how individuals respond to capture stress, post-release activity patterns and impacts of repeat recapture. This data will be used to test hypotheses related to how GTs are being fought and handled by recreational anglers, and if there is a physiological basis for wariness.

Collectively, this work will enhance our knowledge of the spatial ecology of GTs, help identify their essential habitats, and provide valuable insights as to how they respond to the potential pressures imposed by recreational angling. This work will provide the foundation for conservation and management actions, such as rotating flats and being strict with how GTs are handled and released after angling. Given that the pressures to target GTs are increasing not only in The Seychelles but throughout their range, information provided by our study will have a broad relevance. Given that recreational angling can promote both economic prosperity and the conservation of healthy ecosystems, the benefits radiate out from the atolls where recreational angling occurs to entire regions reliant on their natural resources.

1. **Organizational Background and Capacity**

The AF brings together the above mentioned organizations to work together for the conservation, rehabilitation and enhancement of AA and STF Atolls ecosystems in harmony with sustainable, low impact human development and eco-tourism and to raise funds for this purpose. The AF Board of Trustees is formed by a minimum of 6 Trustees nominated as: 2 by ICS, 2 by AIL, 1 by IDC and 1 by MOE. Positions include the Chairman, Vice-Chairman, Secretary and Treasurer. AF assesses conservation achievements against agreed targets on a regular basis; approves annual programmes and appropriate budgets proposed by ICS; and establish a permanent Endowment Fund to support the funding of conservation activities solely on the Alphonse Group and their surrounding marine environments. ICS also seeks project funding from external sources for projects agreed by all parties.

* ICS, a Seychelles NGO established in April 2001, has the objective to promote the conservation and restoration of island ecosystems, sustainable development of islands, and awareness of their vulnerability and vital importance to the planet’s biodiversity. ICS employs 25 staff between head office and the islands. ICS is member of the International Union for Conservation of Nature (IUCN).
* IDC, a parastatal company registered in April 1980, has been entrusted with the management and development of the outer islands owned by the Government of Seychelles. IDC is committed to working towards ensuring that development activities are done in a sustainable manner and to continuously support environmental conservation and protection of species and ecosystems of the outer islands of the Seychelles. IDC employs a total of 140 staff between head office and the islands.
* AIL is a private limited corporation that operates the only tourist resort in the Alphonse Group. Since taking over the existing infrastructure in 2013, AIL is responsible for ecotourism and recreational fly-fishing activities, and has increased guest numbers while working to minimize the environmental impact of any changes in line with government policy. AIL contributes funds to the AF to support the Conservation Programmes implemented and managed by ICS. AIL employs a total of 101 staff including the AFC guides.
* Ministry of Environment, Energy and Climate Change is charged with ensuring the constitutional right of every person to live in and enjoy a clean, healthy and ecologically balanced environment, the provision of a reliable, affordable and safe water and energy supply and build resilience against climate change and disasters. The Ministry undertakes to: i) take measures to promote the protection, preservation and improvement of the environment, and ii) contribute towards the sustainable socio-economic development of Seychelles through a judicious use and management of its resources.

The SFA, represented by Mr. Ronny Renaud, is a parastatal organization which functions as the executive arm of Government for fisheries and related matters. The Authority, created in August 1984 by the SFA (Establishment) Act, is part of this project in order to support their goal of developing the fishing industry to its fullest potential and to safeguard the resource base for sustainable development. Discussions with SFA and AF/ICS are ongoing to look at best possibilities of collaboration as sharing specific equipment (acoustic arrays) and developing a training program during the first 2-3 months of the project to build capacity for SFA staff. Results of our research will also enlighten the organization toward their long-term policy objectives for the fishing industry in terms of sustainability, responsible fisheries development and optimization of the benefits from this sector for present and future generations.

The UMA is represented by Dr. Andy J. Danylchuk, an Associate Professor of Fish Conservation of the Department of Environmental Conservation. His research focuses on evaluating the potential impacts of recreational angling on fish populations and working with stakeholder groups to develop best practices for the recreational angling community. Andy is also a Research Fellow for BTT. Dr. Danylchuk will be the first supervisor of PhD candidate, Caitlin McGarigal, on our proposal *‘Spatial ecology and response to catch-and-release of recreationally targeted fish species on STF and AA’*.

The CU is represented by Dr. Steven Cooke, a Full Professor and Canada Research Chair of Environmental Science and Biology. His research focuses in the field of fish ecology and conservation physiology, and he is a Research Fellow for BTT. Dr. Cooke will be the second supervisor of Caitlin McGarigal.

The BTT, represented by Jim McDuffie and Dr. Aaron Adams, is a non-profit, science-based membership organization dedicated to conserve and restore bonefish, tarpon and permit fisheries and habitats through research, stewardship, education and advocacy. BTT has committed to partially sponsor the PhD. A Memorandum of Understanding (MoU) will be produced between the AF/ICS, UMA, CU, BTT and SFA.

See details of past and current projects relevant to the proposal in **Attachment 3.1**.

1. **Project outcomes, Objectives and Expected Results**

*Background and Rationale*

Recreational fishing is highly popular worldwide, is the dominant use of many fish stocks (Cooke & Cowx 2004), and generates hundreds of billions of dollars in economy activity (World Bank 2012). While recreational fisheries were traditionally harvest-dominated, C&R has become a major practice in many developed countries, and is growing in popularity in developing countries due to a combination of increasing harvest regulations and shifting angler priorities (Cowx 2002; FAO 2012; Freire et al. 2012; Brownscombe et al. 2014a). C&R angling is a management and conservation strategy that assumes a large proportion of released fish survive and experience limited fitness consequences. However, fishing-related stressors (hooking, handling, exhaustive physical exercise, air exposure) often elicit physiological disturbances, physical injuries, and behavioural impairments that can lead to delayed mortality or reduced fitness (Davis 2002; Arlinghaus et al. 2007; Cooke and Schramm 2007). It is also assumed that angling effort, even if C&R, does not influence the basic ecology, movement patterns, and behavior of targeted fishes. It is therefore essential to understand the mechanisms that contribute to these negative effects, and develop conservation-minded angling practices to ensure the sustainability of recreational fisheries and the conservation of exploited fish species.

The fate of angled fish upon release is primarily determined by angler behaviour, and therefore adopting certain angling practices can improve fish survival and reduce fitness consequences. While much research has gone into developing ‘best angling practices’ for recreational angling (Bartholomew & Bohnsack 2005; Casselman 2005; Cooke & Suski 2005; Pelletier et al. 2007), generating a simple set of best practices for anglers to minimize their impacts on released fish is challenging since each fish species has distinct physiology, morphology and behavioural tendencies, while every environment has unique conditions that moderate angling stressors, making the development of best angling practices complex (Cooke & Suski 2005). There has also yet to be a study that examines what level of angling pressure can be sustained before disturbances cascade up to population-level effects, such as changes in movement patterns and the use of essential habitats. Meshing movement ecology with detailed approaches to understanding the response of fish to recreational angling, all within a social-ecological framework that includes stakeholders (Danylchuk & Cooke 2011, Danylchuk et al. 2011), can result in a win-win situation when it comes to conservation and sustainable economic development.

*Problem Statement*

Although GT is a mainstay target species of AFC and their clients on AA and STF, recent anecdotes indicate that the wariness and distribution patterns of GTs are changing. To date, there has not been a study that has examined how GTs respond to C&R. Filling this knowledge gap is critical for honing conservation and management actions on AA and STF, and will serve as a guidepost for other C&R recreational angling activities throughout their range such as Astove and Cosmoledo.

*Specific Activities*

The overarching objective of this multi-year research effort is to examine the spatial ecology and C&R response of GTs on AA and STF. Acoustic telemetry will be used to measure movement patterns of GTs, as well as and post-release behavior following recreational angling. This aspect of the study will be focused on STF where we will be able to examine movement patterns and habitat use between actively fished and closed areas. On AA, will use high-resolution activity rates, blood physiology, and reflex indices to quantify how GTs respond to stresses imposed by capture and repeat capture, and how this dovetails with broader scale movement patterns.

*Expected Result*

Combining acoustic telemetry with stress physiology is powerful for examining both short-term and long-term impacts of capture on recreational fishes. The acoustic telemetry of GTs on STF will shed light on seasonal variation in movement and habitat use as reveled by patterns quantified using network analyses. We predict that GTs are sensitive to the regular presence of anglers, supporting the management action of rotating closed areas. We also predict that the work on AA will reveal that certain elements of the angling event (e.g., air exposure) and frequent repeat capture will cause greater physiological stress, impaired reflexes, and reduced swimming activity post-release.

*Outcomes, Specific Outputs, Linkages to Local and Regional Solutions*

Collectively, the results of our research will feed into shifts in recreational fisheries management plans for STF and AA. These plans will support managers to ensure that natural resources are protected responsibly for the future. We will build capacity with ICS/SFA training their staff in recreation fisheries science and conservation. We will produce at least three peer-reviewed scientific papers in high profile journals; multiple presentations at scientific conferences; education and outreach material for STF/AA, and broader C&R best practices recommendations for The Seychelles.

1. **Description of the Activities and their Effectiveness**

**PROJECT ACTIVITIES**

Over a 2 year period, we will track the movements of GTs and their response to changes in angling pressure using acoustic telemetry (***Broad Scale Telemetry***). To examine how GTs respond to the acute and potential chronic effects of C&R, we will use a combination of measures of reflex impairment, blood physiology, and fine-scale activity (***Response to Angling Stress***).

**METHODOLOGY**

***Broad Scale Telemetry***

*Fixed Receiver Array*

Movement patterns of tagged GTs will be monitored through the use of a fixed remote receiver array (VR2W receivers, Vemco Inc., Halifax, NS). A total of 60 receivers will be deployed; 45 receivers strategically placed on STF flats and 15 receivers on AA (see figure below) to measure movements between the neighboring atolls, as well as quantify the activity rates of GTs in response to repeat capture (see Response to Angling Section below). The entire receiver array will be deployed at the onset of the study and maintained for two years (longer if funding permits). Individual receivers will be secured to a short piece of rebar anchored into a concrete pad; similar moorings have been used in the Western Atlantic and are relatively inexpensive, easy to build and maintain, and less subject to disturbance than surface moorings (Murchie et al. 2012). Receivers will be positioned vertically in the water column and a GPS will be used to mark the location of each mooring at initial deployment to facilitate relocating moorings for maintenance and downloading of receivers. Temperature loggers (Hobo Pendant MX) will be attached to 30 receivers in a range of habitats and water depths to collect ambient water temperature data. Water depth (at low and high tide) and habitat type at each receiver will also be determined. Detection probabilities for a subset of locations will be determined through the use of reference tags (n=15) set at 50 m away from the receivers. As a precautionary measure, all receivers will be downloaded quarterly to ensure preservation of tag detections.

*Transmitter Deployment*

Beginning in October 2018, we will acoustically tag 50 GTs captured from across STF, and 10 GTs from AA. All GTs will be caught using rod and reel, with all attributes of the angling events documented (e.g., fight duration, hook location). Once landed, fish will be secured in a cradle suspended in the water. The fish will then be rotated on its side for the surgery. Transmitters and surgical tools will be cleaned with Betadine and the surgeon will wear surgical gloves. To implant transmitters, a small incision (2-3cm) will be made to the right side of the ventral midline, posterior to the pectoral fin girdle. The GTs on STF will be implanted with V16P-1L coded acoustic transmitter tags (16mm diameter, 98mm length, 17.3g in air, min max delay 60-120s, battery life 1910 days; Vemco Inc., Halifax, NS, Canada), while GTs on AA will be implanted with V13AP coded accelerometer transmitters (12.2g, 45-135s transmission delay, ±3.43g acceleration range, 323 day battery life, 5Hz sampling frequency). Care will be taken to insert the transmitter through the incision, and slide it gently towards the pectoral fins. The incision will be closed with 3-4 interrupted sutures (Ethicon 3-0 PDS II, monofilament absorbable suture material, Johnson and Johnson, New Jersey), and the total length of the fish (to nearest mm) measured. The entire surgical procedure will take less than 5 minutes. Fish will held for up to 30min in flow-through holding pens *in situ* prior to release.

*Detection Data Analyses*

GT acoustic telemetry data will initially be filtered to remove false detections as per Pincock (2008). Using remaining reliable detection data, detection probabilities will corrected for variation in the detection efficiency of the telemetry system based on reference tag detection data following the methods of Payne et al. (2010). Corrected GT detection data will then be used to characterize GT movement patterns using centers of activity analysis (COA; Simpfendorfer et al. 2002) to establish GT home range sizes, as well as network analysis (Finn et al. 2014) to define spatial connectivity between regions. We will then apply generalized linear mixed effects models to COA (home range) size and network connectivity metrics (e.g., node and edge connectivity) to examine which factors influence GT space use over time, including when flats are closed or open to recreational fishing, as well as season, diel period, tide, and fish size. Similar models will also be used to analyze activity levels for GTs implanted with accelerometers, and this data will be combined with fine-scale data related to the response to capture (see below).

***Response to Angling Stress***

*Reflex Impairment*

For all GTs caught by recreational anglers and guides, GTs will be assessed for four reflex impairment tests at the time they are landed and released. Measuring reflex impairment has proven to be highly predictive of behavioural impairment and survival with many fish species (Raby et al. 2012; Brownscombe et al. 2013, 2014b). The four reflexes to be measured will be: Equilibrium loss, tested by inverting the fish upside down and observing if can right itself and maintain upright posture; Tail grab, by grabbing the fish’s tail and observing if it attempts to escape; Head complex, by holding the fish in water and observing for regular opercular beats; and Vestibular-ocular response, by rolling the fish side to side while observing whether the fish’s eye tracks level. Cumulatively, the number of reflexes impaired provides a relative measure of fish condition that is highly predictive of post-release behaviour impairment and survival. Testing for reflex impairment has also been proven to be an excellent tool that anglers and guides can use to determine whether fish need recovery prior to release. For individual indicators, binary RAMP scores of 0 (reflex present) and 1 (reflex absent) will be used. Indicator scores will then be converted to a proportional impairment score ranging from 0-1, where a cumulative score of 0 indicated no overall impairment and a score of 1 indicated total impairment.

*Blood Physiology*

For GTs caught on AA, non-lethal blood samples will be taken immediately following angling capture. Once landed, GTs held in a supine position in a cradle for blood sampling. Approximately 1.5mL of blood will be drawn from the caudal vessels using a 21-gauge needle into a 4mL vacutainer containing lithium heparin (BD vacutainer, ref#367962). Time to draw blood will be less that 30sec. Lactate and glucose levels will be measured immediately by adding 10µl of whole blood to handheld glucose (ACCU-CHEK glucose meter, Roche diagnostics Corp., Indianapolis, IN) and lactate (Lactate Plus portable lactate analyzer, Sport Resource Group, USA) meters. Appropriate standards and calibrations will be used with meters prior to analysis as per manufacturer guidelines. Both glucose and lactate meters have previously been validated for use with fish (Cooke et al. 2008). Blood glucose and lactate values will be compared against RAMP scores to examine physiological underpinnings for impaired reflexes, including for GTs that are caught multiple times and those implanted with accelerometer transmitters and/or outfitted with accelerometer loggers (see next section).

*Activity and Behavior*

Ten (n=10) ‘resident’ GTs will be caught near the boat mooring area in the lagoon of AA, within close proximity to a small network of fixed receivers. All elements of the angling events will be documented. These fish will be those implanted with accelerometer loggers (see *Transmitter Deployment*). Prior to surgery, reflexes will be tested, and blood drawn. Following surgery, fish will be allowed to recover in a floating net pen for 30min. Prior to release, fish will be outfitted with a custom accelerometer logger harness on the caudle peduncle, similar to one we have used on GTs in Kiribati. Logger harnesses will be affixed using a galvanic release set to pop off after a 48-72 hrs. Loggers will be set to measure movement on three axes at 25Hz – a frequency that exceeds that of the accelerometer transmitters, but having both will allow us to cross validate general activity patterns between the two devices. Data from the accelerometer loggers will also be used to quantify how activity patterns change post-release, providing indications of when fish may recover from the angling event. Given that these fish are habituated to the area, we will continue to actively fish and capture them at regular intervals. At each time of capture, reflexes and blood physiology will be measured, and an accelerometer logger package attached. Data from all three components will be compared to examine the influence of capture and repeat capture on the fine scale activity and physiology of GTs. Given that these fish will be implanted with accelerometer transmitters, we will also be able to map their broader scale movement patterns related to the activities of the lodge (e.g., boat traffic). With angling season ceasing between May and October, we will be able quantify whether these GTs disperse and use other part of AA, or if they stay near the point of capture. The combined receiver array of AA and STF we will also shed light on connectivity between these two atolls, especially in light of season closures and even site-specific closures on STF.

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| **Project title:**  Spatial ecology and response to catch-and-release of recreationally targeted fish species on St. François and Alphonse Atolls, Alphonse Group, Seychelles Outer Islands: Implications for conservation and management. | | | | | | | **Project start and end dates:**  July 2018 to June 2020 | | |
| **Project Outcome(s):** Support new and existing marine and coastal protected areas and sustainable use zones; Empower the fisheries sector with robust science and knowhow to improve governance, sustainability, value and market options; Promote the rehabilitation of marine and coastal habitats and ecosystems that have been degraded by local, regional, and global impacts; Trial and nurture business models to secure the sustainable development of Seychelles’ blue economy. | | | | | | | | | |
| **Specific Objective No. 1: Establish a telemetry array to solve most of the mysteries surrounding the recreationally targeted Giant Trevally.** | | | | | | | | | |
| **Activity** | **Responsibility for implementation** | **Timeline of activity** | | | | | | | |
| **Year 1** | | | | | | **Year 2** | **Notes** |
| **Q1** | **Q2** | | **Q3** | **Q4** | |
| 1.1 Equipment acquisition, including purchase, importation to Seychelles, clearing from customs and receive them to Alphonse Island. | AF-ICS/UMA/CU  July-Aug 2018 |  | X | | X |  | |  |  |
| 1.2 Deployment of underwater receivers to set the telemetry array network. | AF-ICS/UMA  October 2018 |  |  | | X |  | |  |  |
| 1.3 Capture and surgically implant acoustic tags in GTs on STF | UMA/AF-ICS-AIL  October 2018 |  |  | | X | X | |  |  |
| 1.4 Download and Maintenance of the array | UMA/AF-ICS-AIL |  |  | |  | X | | X |  |
| 1.5 Data Analyses (core use areas, spatial networks, response to changes in angling pressure (i.e., closed areas) | UMA/CU/AF-ICS-AIL |  |  | |  | X | | X |  |
| **List indicators for each activity: 1.1 Adequate coordination amongst parties; 1.2 Adequate skills for effective management and planning; 1.3 Individuals are appropriately skilled for the job and fish survival rates to capture-mark-recapture; 1.4 Successful data gathering from arrays; 1.5 Appropriate expertize and adequate oversight mechanisms set in place.** | | | | | | | | | |
| **Specific Objective No 2: Response of GTs to C&R.** | | | | | | | | | |
| 2.1 Equipment acquisition, including purchase, importation to Seychelles, clearing from customs and receive them to Alphonse Island | AF-ICS/UMA/CU  July-Aug 2018 |  | | X | X |  | |  |  |
| 2.2 Capture and surgical implant of accelerometer transmitters in resident GTs on AA | AF-ICS/UMA/CU |  | |  | X | X | |  |  |
| 2.3 Repeat capture of GTs, blood physiology, reflex impairment, and accelerometer logger deployment/retrieval | UMA/CU |  | |  | X | X | | X |  |
| 2.4 Data analyses (relationship between angling metrics and physiology and behavior, changes with repeat capture) | UMA/CU |  | |  | X | X | | X |  |
| 2.5 Stakeholder meetings, discussions of conservation implications of results, adapt management plans as needed. | AF-ICS-AIL/UMA |  | |  |  | X | | X |  |
| **List indicators for each activity: 2.1 See 1.1; 2.2 and 2.3 See 1.3; 2.4 see 1.5; 2.5 Management plans are implemented in a timely manner effectively achieving their objectives - see objective 3 below** | | | | | | | | | |
| **Specific Objective No 3: Stakeholder Consultation and Management Adaptation.** | | | | | | | | | |
| 3.1 Project update meetings with local and regional stakeholders. | AF-ICS-AIL/UMA |  | |  |  | X | | X |  |
| 3.2 If needed, revision of produced code of conduct based on C&R results | AF-ICS-AIL/UMA |  | |  |  |  | | X |  |
| 3.3 Local (AA) and regional (Mahé) workshop on recreation fisheries science and application, in collaboration with SFA | AF-ICS-AIL/UMA/SFA |  | |  |  |  | | X |  |
| 3.4 International outreach via websites and scientific papers | AF-ICS-AIL/UMA |  | |  |  |  | | X |  |
| **List indicators for each activity: 3.1 Institutions are effectively led; 3.2 see1.5; 3.3 Appropriate systems of training, mentoring and learning in place; Overall: Human Resources are well qualified, motivated and committed.** | | | | | | | | | |

**Note: Expand the table rows as appropriate for your project.**

**F. RISKS TO SUCCESSFUL IMPLEMENTATION AND MITIGATION MEASURES**

|  |  |  |  |
| --- | --- | --- | --- |
| **Risk/Factors** | **Risk category** | **Potential level of impact** | **Risk mitigation measures** |
| All tagged GTs swim away or die | Environmental | Low | Evidence from other studies using acoustic telemetry on GTs shows excellent post-surgery recovery and survival |
| Mortality after angling | Environmental | Low | Fish in the jack family have proven to be robust to angling |
| Acoustic receivers move | Technological/Environmental | Low | Mooring for receivers will be robust; clear waters of The Seychelles will simplify locating receivers. |
| Acoustic receivers, acoustic tags, and loggers fail | Technological | Low | Acoustic tag/receiver technology is robust; out of 1000’s of these devices we have deployed, they rarely fail. |

**G. EVALUATION AND INDICATORS**

Our PhD student (C. McGarigal) will produce monthly progress reports detailing progress regarding receiver array deployment and maintenance, tagging details, and any preliminary summary of data obtained. These progress reports will be reviewed by the core science team and then circulated to project partners for questions and comments. Tracking progress at this frequency will allow for adaptation in effort and ensure there is no drift from the desired outcomes.

**H. SUSTAINABILITY AND REPLICATION**

Knowledge gained through our research will help shape recreational fisheries management plans on AA and STF, as well as other atolls used by AFC. Documenting the response of GTs to C&R will be used to adapt the code of conduct already in place. This knowledge can also be used to help shape broader, regional conservation and management efforts for recreational fisheries. To facilitate this, we will use a stakeholder workshop, as well as share what we have learned through our collective and vast social media channels. If the budget permits, we may also produce a short video product to be actively shared. The model of our science can also serve as a template for GTs at other locations, as well as other targeted species (e.g., Milkfish, Permit and Triggerfish).

**LITERATURE CITED**

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