

**SeyCCAT Project Full Proposal**

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

1. **COVER PAGE**

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| **Title** | ***First use of satellite telemetry on small pelagic and abundant seabirds (juvenile Sooty Terns) to define potential Marine Protected Areas through identification of foraging areas used during the gaining of independence from their parents*** |
| **SeyCCAT Strategic Objective** | ***Strategic Objective 1:*** *Support new and existing marine and coastal protected areas and sustainable use zones.*  *Cross-cutting theme: Research and development* |
| **Name, contact details and status of lead applicant organisation / individual** | *Dr Rachel Bristol*  *Independent Seychelloise researcher and conservation biologist*  *La Batie, Beau Vallon, Mahé*  *Mobile: 2560841*  *Email:* [*rachelbristol@seyhelles.net*](mailto:rachelbristol@seyhelles.net)  *NIN: 000-0038-6-0-77*  *Proof of Citizenship submitted with stage 1 application* |
| **Partner organizations (include country if not based in Seychelles)** | *Bird Island Eco-Lodge, Seychelles*  *Christine Larose, WildWings Bird Management, Seychelles*  *Prof Chris Feare, WildWings Bird Management, UK* |
| **Project location** | *Bird Island, Seychelles* |
| **Duration – start and end dates** | *24 months: 01 June 2019 - 31 May 2021* |
| **Total budget requested** | *SCR 903,600* |
| **Indicative co-financing** | *Bird Island Eco-Lodge, flights, accommodation and subsistence for project researchers. In-kind support totaling SR 279,040*  *Lead Applicant (RB) in-kind time spend working on project SR 87,500*  *Chris Feare (CF) in-kind time spent working on project SR 162,500*  *James Millett (JM) Independent Ornithologist. On-going policy advice based on his expertise in Seychelles conservation policies SR 16,250*  *Home office costs SR 6,000*  *Seminar/workshop venue SR 4,000 (Wildlife Clubs of Seychelles room at UniSey)*  *Project management fees SR 20,000*  *TOTAL CO-FINANCING SR 575,290* |

1. **SUMMARY**

* *The problem and the solution.* The Sooty Tern is the most numerous seabird in Seychelles, nesting mainly in large colonies and ringing, geolocator and GPS investigations have shown that it is also the most highly pelagic. Upon fledgling juveniles remain at sea for up to 5 years before returning to breed. Where they go on first departure from the breeding colony is unknown but is likely to be an important destination with predictable food abundance (fish and squid). As such, it may represent an important area for many top predators and thus an area of high conservation significance for marine resources. We aim to identify this area by tracking departing Sooty Tern fledglings using satellite telemetry.
* *Site description.* Satellite tags will be attached to juveniles just prior to their departure from the large breeding colony on Bird Island, where details of colony biology have been studied for over 40 years and where the island owners are highly supportive of these studies. Birds in this colony nest densely and are very tolerant of researcher disturbance; it is thus an ideal site for this study.
* *Overall outcome, objective(s); outputs(s) and activities(s).* The outcome of this project is to identify Candidate Marine Protected Areas through the identification of highly productive foraging areas or “hotspots” used by juvenile Sooty Terns during the gaining of independence from their parents, and post-independence for the first 2 years of their lives. Juvenile Sooty Terns will be tracked from fledging using satellite telemetry and areas of high use will be plotted and investigated.
* *Rationale for the project approach.* The ringing of over 11,000 juvenile Sooty Terns in Seychelles has provided much information on age at first breeding, mortality between fledging and first return to breed, and on annual mortality during adulthood. However, only two ringed juveniles have been reported during their first year after departure from Bird Island, one each in Sri Lanka and Northern Australia. Ringing thus cannot identify where juveniles feed in their first months of life and other tracking approaches (geolocators and GPS loggers) are inappropriate for tracking juveniles due to the need to recapture devices to download data. Satellite telemetry, using trackers with solar charged batteries that transmit data continuously for many years, represents the only currently-available technique that will provide relevant information.
* *Beneficiaries.* This new spatial data on important Sooty Tern foraging locations can be used to inform new protected area location and designation, thus of direct relevance and use to the current Seychelles Marine Spatial Plan (SMSP) project. This knowledge will also be important to Ministry of Environment, Energy and Climate Change (MEECC), Seychelles Fisheries Authority (SFA), and other bodies, national and international, concerned with marine resource conservation, management and exploitation.
* *Timeline or phases of the project.* The project will begin in June 2019 with trials of attachment of dummy satellite tags to Sooty Terns and working tags will be attached in August 2019. Data will be downloaded continuously up to June 2021 to reveal the location of both (*i*) early feeding sites of recently-fledged dependent juveniles and (*ii*) their subsequent dispersal over the Indian Ocean, post gaining independence from their parents additionally revealing international waters of importance to Seychelles’ Sooty Terns.
* *Alignment with international and national priorities.* This project contributes to national and international conservation and adaptation priorities: (*i*) global SDG 14 (conserve and sustainably use the oceans, seas and marine resources); (*ii*) SSDS 2012-2020 Fisheries and Marine Resources programme (importance of Protected Areas for sustainable fisheries); (*iii*) Seychelles NBSAP 2015-2020 Strategic Goal 3 (enhance biodiversity by safeguarding ecosystems, species and genetic diversity: priority projects 1 (Enable informed extension of PA network) and 5 (Prioritise Management of Endemic Species, Threatened Species and Critical Habitats) and identify and address new conservation priorities (such as keystone species and critical habitats) to meet Seychelles’ CBD obligations; (*iv*) Seychelles Marine Spatial Plan Initiative by providing timely new spatial data on important keystone seabird foraging locations that can be used to inform new protected area location and designation.

1. **Organizational Background and Capacity**

This project team has collaborated since the early 2000’s on Sooty Tern research on Bird Island and more recently to prepare seabird management plans and standardised monitoring protocols for several outer islands (Farquhar, Aphonse, Desroches, Poivre). Within the team we have all the skills required to implement this project to the highest standards.

The Project Lead Applicant Dr Rachel Bristol is a conservation biologist and practitioner with extensive expertise and experience in seabird research, survey, census, monitoring, handling and ringing. Rachel set-up and chaired the Seychelles Seabird Group from 2001- 2006 and brings to this project team good project management, GIS mapping, data analysis and reporting skills.

Co-applicant Prof Chris Feare has been undertaking research on Sooty Terns in the Seychelles including biology, demography, sustainable exploitation, habitat requirements and remote tracking since the 1970s and brings to this project team undisputed Sooty Tern research expertise including previous use of other tracking devices (GPS loggers and geolocators) on Sooty Terns in the Bird Island colony, and excellent teaching and writing skills (both scientific and popular).

Co-applicant Christine Larose has been a key Sooty Tern research and monitoring field assistant for the past 10 years and has excellent seabird field skills including capture, handling, attaching loggers and transmitters to seabirds, retrieving loggers and downloading the data.

Partner organisation Bird Island Lodge has been a key partner and supporter of Sooty Tern research on Bird Island for 30+ years and have consistently provided in-kind logistical (domestic flights, accommodation and subsistence on Bird) and practical (staff time) support enabling this research to be undertaken.

To ensure transparent management of project finances (should this grant application be successful) the lead applicant will open a bank account specifically for this project. Sub-contracts will be drafted and signed between the project lead and the co-applicants ensuring transparency in payment for time worked on the project.

Further evidence of the project applicants’ experience and ability to undertake this project are provided in their CV’s which were submitted to SeyCCAT with the Stage 1 project concept note. They have not been re-submitted with this application due to page restrictions on application length.

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

*Problem statement*

Sooty Terns (*Onychoprion fuscatus*,known locally as Golet)are by far Seychelles’ most numerous seabirds, with about 3 million pairs estimated to breed in the archipelago. However, most of these birds nest in four main colonies, one each in the granitic Seychelles, Amirantes, Farquhar and Cosmoledo island groups (Feare et al. 2007, Ostrich 78: 423–434). Their nesting densely (up to 6 nests/m2) on the ground renders them vulnerable to introduced predators, including humans, and in granitic Seychelles and Amirantes eggs are harvested legally from two colonies, Bird and Desnoeufs, with currently over 1 million eggs being collected annually for sale in Seychelles (Feare, unpublished). Within colonies, breeding is highly synchronous, leading adults to require large quantities of food (mainly small [often larval] fish and squid) for themselves and their growing chicks during the breeding season from June-September. This food is collected mainly within 300 km of the colony, but this range can increase to > 2000 km if food is short (Neumann et al. 2018, Marine Ornithology 46: 11-18). The ensuing synchronised departure of young and adults imposes high localised predation pressure on marine resources until adults and their young disperse widely over the Indian Ocean (Jaeger et al. 2017, Frontiers in Marine Science doi: 10.3389/fmars.2017.00394). While flying young are initially fed in the air by a parent (Feare 1975, Condor 77: 368-370)**,** this period of intense localised food demand occurs at a time when young must become independent of their parents, learning foraging skills and avoidance of hazardous conditions, e.g. adverse weather and predation dangers (as captured in Blue Planet II, 2017. BBC Natural History Unit) and avoiding food competition with more experienced adult birds. Very little is known about Sooty Terns’ behaviour associated with the attainment of independence and prior to reaching adulthood due to the scarcity of observation of birds at sea during this stage of their lives (Jaquemet 2010, Ostrich 81: 271-272). Recoveries of juveniles from an Atlantic colony suggested that independence is attained within 2-3 months after fledging (Robertson, 1969, Nature, London. 223: 632-634), while in the Pacific adults with accompanying young have been observed 800 km from the nearest known breeding colony Ainley et al., 1986, Condor 88: 101-102).For young birds this must be a critical phase of their lives, during which much of the high mortality recorded in juveniles (Feare & Doherty 2011, Marine Ornithology 39: 221–226) is likely to occur. To minimise this mortality, we would expect the Sooty Terns to have evolved behaviour that takes adults and dependent young to oceanic regions of predictably high productivity where surface prey are abundant and provide favourable feeding and learning opportunities for juvenile Sooty Terns. Such regions are likely to be attractive to other marine life, perhaps including other seabird species and other marine taxa and represent biodiversity “hotspots”. Identification of these sites is necessary to (a) assess risks to the sites, and thus to the species that use them, from anticipated perturbations likely from climate change, and (b) determine appropriate and feasible protection measures from other anthropogenic disturbances and pressures.

*Project rationale*

The rationale of this project is to identify areas of high marine productivity for potential incorporation into MPA system by identifying (i) where juvenile Sooty Terns feed upon leaving the Bird Island colony for the first 3-5 months of their life during the period they learn to forage for themselves and gain independence from their parent(s) and (ii) the foraging areas used by these juvenile Sooty Terns from independence until 2 years old. Satellite telemetry using trackers with solar charged batteries that transmit data continuously for many years, represents the only currently-available technique that can provide this information.

Other existing remote sensing methodology datasets (e.g. bathymetry, Sea Surface Temperature (SST), productivity (α-chlorophyll) will be used to determine characteristics of these areas that likely contribute to their importance. This will be the first seabird data of this kind to be available to contribute to SMSP process and will permit consideration of conservation measures for these oceanic areas.

Having identified the regions of importance we will share our results with relevant organisations responsible for management planning for these area(s) (SMSP unit, SFA, MCSS, MEECC, SNPA, ICS [responsible for management of Cosmoledo and Farquhar colonies], IDC [management of Desnoeufs] and also discuss collaboration for future studies building on the findings of this pilot research (detailed in section H of this proposal).

*Project* ***Outcome***

Candidate Marine Protected Areas defined through the identification of highly productive foraging areas or “hotspots” used by juvenile Sooty Terns during the gaining of independence from their parents; and post-independence for the first 2 years of their lives.

*The specific* ***objective/s*** *of the proposal*

1. To identify using satellite telemetry where juvenile Sooty Terns from the Bird Island colony obtain their food during the period when they gain independence from their parent(s) within the first 5 months of their lives.
2. To identify where these juvenile Sooty Terns disperse to and feed post-independence from their parents until almost 2 years of age.
3. To relate these feeding areas to other available spatial and temporal data including ocean bathymetry, primary production (chlorophyll concentration) and sea surface temperature (available from web resources) to understand factors contributing to the areas’ importance.
4. To provide results to SMSP and other relevant organisations, within the timeframe of this project, for integration into Marine spatial and management planning initiatives.

*The* ***specific outputs*** *that the project aims to produce*

* Maps and GIS data layers showing the movement patterns and spatial distribution of the juvenile Sooty Terns during the c.3 months after leaving the colony, highlighting areas of concentrated activity that indicate food searching behavior.
* Maps and GIS data layers showing movement patterns and spatial distribution of juvenile Sooty Terns post- gaining independence from their parents.
* Maps and GIS data layers illustrating areas of concentrated juvenile Sooty Tern activity (foraging areas) superimposed on other temporal and spatial marine data, and the Seychelles EEZ boundaries illustrating spatial and temporal overlaps indentifying highly productive feeding areas

*The* ***specific activities*** *that the project will conduct, including a description of their effectiveness*

* 1. Undertake trial of attachment method with dummy PTTs on breeding adult Sooty Terns in June 2019 on Bird Island, using Teflon tape for the attachment. [This will confirm the suitability and efficacy of this material for the PTTs, as already established for GPS loggers.] *To be undertaken by project team members Chris Feare (CF) and Christine Larose (CL) in June 2019.*
  2. Deploy PTTs on 10 juvenile Sooty Terns on the point of fledging on Bird Island in August-September 2019, selecting early and heavy fledglings to minimize the risk of losing PTTs due to fledgling mortality. [Previous research on Bird Island has shown that earlier fledging juveniles with heavier fledging weights (>190 grams) have a significantly higher survival to maturity than later fledging and lower fledging weight chicks. Therefore, to maximise the chances of our fledglings surviving to independence we will attach the PTTs to only heavy early fledging juveniles. [10 PTTs are considered adequate to provide the initial tracking data required to achieve project objectives & outcome, allowing for some PTT loss, and to enable assessment of the need for further data through scaling-up] *CF, CL & Rachel Bristol (RB) in August-Sept 2019.*
  3. (1.3) Download daily location data from the Argos satellite system and plot the distributions of the 10 juveniles over the first c. 2 years of their lives at sea. [These tracks will reveal the changing distribution of the juveniles during their acquisition of independence from their parents (first c.3 months of data) and post-independence from their parents (from c.4 months - 2 years post fledging).] Areas of concentrated activity, identified by area restricted movements rather than long directional flights, will be recorded and plotted. These tracks will reveal the changing distribution of the juveniles during (i) their acquisition of independence from their parents and (ii) post-independence. *CF & RB, August 2019- project end.*
  4. Interpret the changes in distribution in relation to time since fledging and to oceanic characteristics prevailing at the time (e.g. bathymetry, SST, productivity (α-chlorophyll), and compare the time-related movements of the juveniles in this study with the time-related post-breeding movements of adults revealed using geolocators in 2011-2013 (Jaeger et al. 2017, Frontiers in Marine Science doi: 10.3389/fmars.2017.00394). [This will help identify what specific characteristics of these feeding areas make them important.] *RB & CF, Sept- 2019-Dec 2019 for gaining of independence and January 2020- till project end for independent juveniles*.

4.1 Meet with TNC-SMSP team to detail collaboration (e.g. detail data sharing modalities, determine most useful formats to provide data for inclusion into SMSP database and analysis, etc) to ensure maximum value to SMSP initiative is obtained from this research. *(CF and RB June 2019, December 2019, June 2020)*

4.2 Provide 1st set of maps and data layers on locations of important Sooty Tern nursery feeding areas to SMSP/TNC team in early 2020 so they can be incorporated into dataset informing Seychelles Marine Spatial Planning initiatives. *RB & CF, January 2020.*

4.3 Organise and run a workshop/seminar on Mahé presenting the project and results to stakeholders and the wider Seychelles conservation community in lay-friendly terms. [Media (TV, radio and journalists) will also be invited to the workshop to ensure wide dissemination of project and findings across Seychelles.] *CF, CL and RB, July,2020.*

* 1. Present the results to stakeholders on Bird Island and on the Bird Island website and info board. *CF & CL, June- July 2020 and ongoing on website.*
  2. Write paper on the results of this study for publication in a scientific journal, drafting to be completed by project end. [This ensures that the results and findings of this study are widely and publicly available.]  *CF & RB draft complete and submitted to appropriate journal by project end.*
  3. Provide 2nd set of maps and data layers to SMSP/TNC in 2021 showing key juvenile Sooty Tern dispersal and feeding areas post gaining independence. [First tracking data showing dispersal and habitat use of juvenile Sooty terns worldwide.] *RB& CF by May 2021 (project end).*
  4. Disseminate the results of this study to the relevant organisations/bodies in Seychelles (e.g SeyCCAT, MEECC, SMSP initiative-TNC, SNPA, ICS, MCSS) and potentially beyond\*. We do not yet know all relevant organization as depends on where the areas of high activity are located, but once identified, we will meet with the relevant Seychelles organisations personally. [This will ensure that the information gets to the management organisations/bodies that can use it to inform their management decisions.] \*Foraging areas used after independence probably extend into international waters. *CF, RB, CL & JM, by project end.*

*Expected results*

By project end we expect to have obtained the first data indicating where juvenile Sooty Terns from the Bird Island colony feed during the time that they gain independence from their parent(s). These are probable oceanic areas of predictably high productivity and biodiversity values, and this will be the first seabird data of this kind to be available to contribute to marine spatial planning considerations. These areas are also important for the maintenance of stable and healthy Sooty Tern populations in Seychelles and will permit consideration of conservation measures for these oceanic areas that are necessary, feasible and take account of predicted changes in oceanic conditions with the continuation of global warming. We expect to have provided this data to the SMSP-TNC unit for inclusion in SMSP process, and to other relevant organisations,

Secondly by project end expect to have obtained the first spatial data on where juvenile Sooty Terns from Bird Island colony disperse to and where they forage for the first 2 years of their lives. These findings will be provided to the relevant organisations (locally and internationally) by project end and will provide new data for consideration of conservation measures for these oceanic areas (many are likely to fall outside Seychelles jurisdiction, and will require inter-governmental discussions/consultations.

*Location*

The satellite transmitters (PTTs) will be attached to juvenile Sooty Terns in the breeding colony on Bird Island, which is the most accessible of Seychelles’ large Sooty Tern colonies and where most research has been undertaken since 1973.

*Scaling-up and replication.* The potential for scaling-up and replication of this project is described in section H under the heading **“Sustainability and Potential for replication and scaling-up”**

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

The project activities and their effectiveness are described in detail in section D above under the heading “The **specific activities** that the project will conduct, including a description of their effectiveness” including project team members who are responsible for implementing each activity, and therefore are not repeated here.

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| **Project title:** First use of satellite telemetry on small pelagic and abundant seabirds (juvenile Sooty Terns) to define potential Marine Protected Areas through identification of foraging areas used during the gaining of independence from their parents | | | | | | | | | | **Project start & end dates:** June 2019-May 21 | | |
| **Project Outcome:**  Candidate Marine Protected Areas defined through the identification of highly productive foraging areas or “hotspots” used by Sooty Terns during the gaining of independence from their parents, and post-independence for the first 2 years of their lives. | | | | | | | | | | | | |
| **Specific Objective No. 1.**  To identify using satellite telemetry where juvenile Sooty Terns from the Bird Island colony obtain their food during the period when they gain independence from their parent(s) within the first five months of their lives. | | | | | | | | | | | | |
| **Activity** | **Responsibility for implementation** | **Timeline of activity** | | | | | | | | | | |
| Yr1 (June 2019-May 21) | | | | | Yr2 (June 2019-May 21) | | | | | **Notes** |
| **Q1** | **Q2** | **Q3** | **Q4** | **Q1** | | **Q2** | **Q3** | | **Q4** |  |
| 1.1 Undertake dummy PTT attachment trials | CF & CL |  |  |  |  |  | |  |  | |  |  |
| 1.2 Deploy PTTs on 10 early heavy and early fledging Sooty chicks on Bird I | CF, CL & RB |  |  |  |  |  | |  |  | |  |  |
| 1.3 Download daily location data from Argos satellite system | CF & RB |  |  |  |  |  | |  |  | |  |  |
| **List indicators for each activity:** 1.1PTT trials completed in by month 2; 1.2 10 PTTs successfully deployed by month 4; 1.3 (see 2.1 below) | | | | | | | | | | | | |
| **Specific Objective No 2.** To identify where these juvenile Sooty Terns disperse to and feed post-independence from their parents until almost 2 years of age. | | | | | | | | | | | | |
| 2.1 (1.3) Download daily location data from Argos satellite system | CF & RB |  |  |  |  |  | |  |  | |  |  |
| **List indicators for each activity:** 2.1 (a) Tracks successfully recovered from Argos (Initially daily while juveniles are still in the colony, then weekly until month 3, monthly from month 4 to project end); (b) minimum of 50% of tracked juveniles continue to provide tracking data post-independence till project end. | | | | | | | | | | | | |
| **Specific Objective No 3.** To relate these feeding areas to other available spatial and temporal data including ocean bathymetry, primary production (chlorophyll concentration) and sea surface temperature (available from web resources), to understand factors contributing to the areas importance. | | | | | | | | | | | | |
| 3.1 Interpret juvenile Sooty Tern distribution in relation to time since fledging, prevailing oceanic conditions and other relevant datasets | RB & CF |  |  |  |  |  | |  |  | |  |  |
| **List indicators for each activity:** 3.1 temporal and spatial meta-analysis of data layers reveals factors contributing to foraging areas importance | | | | | | | | | | | | |
| **Specific Objective No 4.**  To provide results to SMSP and other relevant organisations & people for integration into marine spatial and management planning initiatives within the timeframe of this project | | | | | | | | | | | | |
| 4.1 Meet with TNC-SMSP team to detail collaboration | RB & CF |  |  |  |  |  | |  |  | |  |  |
| 4.2 Provide1st set of maps and data layers to SMSP unit | RB & CF |  |  |  |  |  | |  |  | |  |  |
| 4.3 Run workshop on Mahé presenting project and results | CF, CL & RB |  |  |  |  |  | |  |  | |  |  |
| 4.4 Present results on Bird Island | CF & CL |  |  |  |  |  | |  |  | |  |  |
| 4.5 Write paper on results of this study | CF & RB |  |  |  |  |  | |  |  | |  |  |
| 4.6 Provide 2nd set of maps and data layers to SMSP unit | RB & CF |  |  |  |  |  | |  |  | |  |  |
| 4.7 Disseminate the results of this study to relevant organisations/bodies in Seychelles and potentially beyond | CF & RB |  |  |  |  |  | |  |  | |  |  |
| **List indicators for each activity**: 4.1 minutes of meetings (months 1,7&13); 4.2 & 4.6 spatial data and maps provided to SMSP in month 8 (Jan 2020) (4.2) and month 24 (4.6); 4.3. Mahé stakeholder workshop completed in month 14; 4.4 results presented on Bird Island info screen and website by month 14; 4.5 Paper drafted and submitted to peer reviewed scientific journal by month 21; 4.7 (a) 6-monthly and annual reports to SeyCCAT in months 6, 12 18, 24, (b) results disseminated to relevant organisations/bodies by month 24, (c) records of meetings with relevant stakeholders; (d) results posted on WildWings Blog (regular updates), (e) results shared with Indian Ocean Seabird Group (by month 24), (f) and in popular articles (x2 during project). | | | | | | | | | | | | |

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

Identify and list the major risk factors that could result in the project not producing the expected results. These should include both internal factors (for example, the technology involved fails to work as projected) and external factors (for example, changes to laws or regulations).

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| **Risk/Factors** | **Risk category** | **Potential level of impact** | **Risk mitigation measures** |
| Mortality of tagged juvenile Sooty Terns | Environmental | High | Select birds for tagging: earliest birds to fledge, and minimum body mass of 190g (see detailed explanation in section D activity 1.2 description) |
| Breeding failure of the colony in 2019 related to ENSO & Indian Ocean Dipole | Environmental | High | Check for trends indicative of serious anomalies in both factors; delay start of project 12 months if necessary (at present NOAA are predicting warming of the Indian Ocean between Oct 2018 -Feb 2019 but severity not indicated) |
| Failure of juveniles to adapt to PTTs | Behavioural | Low-medium | Unlikely in light of adults’ acceptance of GPS tags using same method. But scenario differs for the new studies: age of birds (juvenile vs adult); mass of tag (5g vs 3g, although still within accepted safety range re bird body mass); duration of deployment (months vs 2-3 weeks). No mitigation possible other than extreme care during attachment. |
| Desertion by nesting birds due to unforeseen temporary fall in food availability | Environmental | Low | Cannot be predicted and has proved to be rare in > 30 years study. |
| Microwave Telemetry (MT) unable to produce PTTs of correct design | Technological | Low | We have discussed requirements in detail with MT providers and both MT and our team believe we have a suitable PTT design |
| Seychelles Bureau of Standards/MEECC approve project | Legal/political | Low | SBS has already approved Sooty Tern project to 2020, including tracking using GPS loggers; needs a straightforward addition to the approval – will be sought as SeyCATT application progresses |
| Failure of Bird Island management to support the project | Political/ organisational | Low | Support already agreed including “in-kind” contribution of travel logistics, accommodation and facilities |
| Health and Safety of project team | Personal/social | Low | Team in good health. Bird Island Lodge has comprehensive health and safety protocols in place and staff trained in first aid. Scheduled daily plane flights Mahé-Bird-Mahé. Helicopters can be chartered in case of emergency. Thus, Bird cannot be considered a remote island in terms of health and safety considerations. Project fieldwork not physically challenging. Sufficient team members to cover for each other if needed |

**G. EVALUATION AND INDICATORS**

The project team will track and evaluate project progress via monthly monitoring of project indicators and activities as set out in the project logframe table to ensure the project is progressing in the manner and timeframe planned. The project lead applicant will submit 6-monthly reports to SeyCCAT, compiled with input from the whole project team, using SeyCCAT’s reporting template.

Project impact will be assessed by sequentially completing each project activity in the manner and timeframe indicated. Our project logic has been designed in a step-wise manner whereby completion of activities in the manner and timeframe planned ensures objectives are met, which in turn ensures Outcome is achieved. RB and CF have project time specifically allocated for regular project M&E and to ensure regular assessment of project progress.

**H. SUSTAINABILITY AND POTENTIAL FOR REPLICATION AND SCALING-UP**

During project development we met with the TNC-SMSP Process and Science Lead (Dr Joanna Smith) and the Project Manager (Ms Helena Sims) twice. We are aware that (*i*) the SMSP phase2 ends in December 2020 and that (*ii*) the designated MPAs will be monitored for effectiveness and the MSP will be reviewed and revised periodically. We agreed (a) the first phase of results from this proposed study will provide useful data to SMSP in early 2020 in time to be included in meta-analysis to select MPAs and (b) our second phase of results, and any future repetitions of this satellite tracking research would provide useful data to contribute to monitoring of PA effectiveness (for both biodiversity and climate change resilience targets), especially when related back to Sooty Tern survival and breeding success.

*Potential for replication and scaling-up.* Once this pilot study has been completed, and the technique of using satellite telemetry to determine where juveniles feed during their first months of life has been demonstrated to be efficient, this project is ideal for scaling -up. A larger sample of juveniles could be marked on Bird Island to confirm the findings from 2019. Furthermore, the technique could be extended to the other three large colonies in Seychelles, aiming to identify all the areas important for juvenile Sooty Terns during their acquisition of independence from their parents, and thus likely hotspots of productivity for other taxa in the archipelago. The technique also offers the possibility of extending the investigation to other Seychelles seabirds of appropriate size and behavior.

In the longer term, these studies could be repeated at pre-determined time intervals, or when changes in oceanic conditions are known to have occurred, to investigate the impacts of these changes on the birds’ behavior and recruitment of young birds to the main breeding colonies. This could aid decisions on breeding colony management, setting egg harvest limits, or managing harvests of marine resources as discussed with TNC-SMSP unit.

*Sustainability beyond project end.* This juvenile satellite tracking study forms a new part of a very long-term (30+year) study on the Bird Island Sooty Tern breeding colony. It is our aim to continue to monitor and research breeding success, adult and juvenile survival and at-sea distributions of adults and juvenile Sooty Terns for the long-term. This data combined has the power to answer many important questions about the sustainability of the Sooty Tern population, and importantly will have to potential to provide timely and rigorous data for the long-term assessment of management effectiveness of any marine protected areas encompassing the Sooty Tern foraging areas including monitoring their resilience to climate change (whether inside or outside designated MPA’s).

The PTTs have integrated solar panels and theoretically last the lifetime of the bird. It is our intention to seek funding to pay Argos satellite system to continue to record, process and relay to us via Internet the location and activity data from the PTTs post project-end for as long as the transmitters continue to provide data. We do not envisage difficulties in obtaining funds for this purpose as the tracking devices themselves are the main expense; the data procurement from Argos satellite system is much more affordable, and the data is valuable.

Having identified the regions of importance for juvenile Sooty Terns we plan to enlist collaboration of other relevant organisations (SMPS, SFA, MCSS, MEECC, ICS [responsible for management of Cosmoledo and Farquhar colonies], IDC [management of Desnoeufs]) to assess their importance to other taxa and identify any special characteristics and their vulnerability to climate change and other anthropogenic activities with a view to (a) predicting the impact of anticipated climate change on the birds’ food abundance and distribution, (b) controlling potentially damaging human activities in these regions, (c) assessing risks to Sooty Tern juvenile survival and potential impacts on the Sooty Tern population and on the traditional egg harvest and its management.

*Knowledge transfer to stakeholders.*  Knowledge and learning will be transferred to stakeholders via (i) workshop on Mahé presenting this project methods and results where all relevant stakeholders, the wider Seychelles conservation community and the media will be invited (ii) WildWings BlogSpot where methods and findings will be regularly posted (iii) project/study presented on Bird Island and on Bird Island website and info board (iv) findings will be provided to relevant organisations/ bodies responsible for managing or management planning for important Sooty Tern foraging areas identified via email correspondence and personal meetings.