



Department
for Environment
Food & Rural Affairs



Foreign &
Commonwealth
Office



Department
for International
Development



DPLUS001

Darwin Plus: Overseas Territories Environment and Climate Fund Project Application Form

Submit by Monday 7 January 2013

Please read the Guidance Notes before completing this form
Information to be extracted to the database is highlighted in blue

Basic Data

| | |
|---|---|
| 1. Project Title | Bermuda Invasive Lionfish Control Initiative |
| 2. OT(s) covered by proposal | Bermuda |
| 3. Start Date: | April 2013 |
| 4. End Date: | March 2015 |
| 5. Duration of project (cannot be longer than 24 months) | 24 months |

| Summary of Costs | 2013/14 | 2014/15 | 2015/16 | Total |
|--|---|---------|---------|----------|
| 6. Budget requested | £103,214 | £66,684 | - | £169,897 |
| 7. Total value of Co-funding | £49,168 | £16,520 | | £65,688 |
| 8. Total Project Budget (all funders) | £152,382 | £81,703 | | £235,585 |
| 9. Names of Co-funders | Bermuda Government Department of Environmental Protection; Bermuda Zoological Society; Bermuda Aquarium, Museum and Zoo; Ocean Support Foundation; U.S. National Science Foundation | | | |

| | |
|---|---|
| 10. Lead applicant organisation (who will be responsible for delivering outputs, reporting and managing funds) | Bermuda Zoological Society c/o Dr. Ian Walker BVM&S MRCVS Principal Curator Bermuda Aquarium, Museum and Zoo, Flatts FL04 idwalker@gov.bm / Ph: +1441-293-2727 ext 2149 / Fax: +1441-293-3176 |
| 11. Project Leader name | Dr. Gretchen Goodbody-Gringley |
| 12. Email address | gretchen.goodbody-gringley@bios.edu |
| 13. Postal address | BIOS, 17 Biological Lane, St. George, GE01, Bermuda |
| 14. Contact details: Phone/Fax/Skype | +1441-297-1880 x 249 |

| | | | | | | | | |
|--|---------|--------|-----------|----------|-------------------|--------------------|-----------------------|--|
| 15. Type of organisation of Lead applicant. Place an x in the relevant box. | | | | | | | | |
| OT GOVT | UK GOVT | UK NGO | Local NGO | X | International NGO | Commercial Company | Other (e.g. Academic) | |

16. Principals in project. Please identify and provide a one page CV for each of these named individuals. You may copy and paste this table if you need to provide details of more personnel or more than one main, or other, project partner.

| Details | Project Leader | Project Partner 1 - Main | Project Partner 2 - Main |
|------------------|------------------------|--------------------------|---|
| Surname | Goodbody-Gringley | Eddy | Gleason |
| Forename(s) | Gretchen | Corey | James |
| Post held | Postdoctoral Scientist | Doctoral candidate | OSF Executive Director and Bermuda Lionfish Taskforce Chair |
| Institution | BIOS | BIOS / UMass | Ocean Support Foundation |
| Department | Ecology | | |
| Telephone/ Skype | | | |
| Email | | | |

| Details | Project Partner 3 | Project Partner 4 |
|-------------|---|----------------------------------|
| Surname | Pitt | Smith |
| Forename(s) | Joanna | S. Robbie |
| Post held | Marine Resources Officer | Museum Curator |
| Institution | Bermuda Government | Bermuda Aquarium, Museum and Zoo |
| Department | Environmental Protection – Marine Resources | Natural History Museum |
| Telephone | | |
| Email | | |

17. Has your organisation received funding under the Darwin Initiative before? If so, please provide details of the most recent (up to 3 examples).

| Reference No | Project Leader | Title |
|--------------|----------------|--|
| 9-009 | Anne Glasspool | Development of a Biodiversity Strategy and Action Plan for Bermuda |
| | | |
| | | |

18. If your answer to question 17 was no, provide details of 3 contracts previously held by your institution that demonstrate your credibility as an implementing organisation. These contracts should have been held in the last 5 years and be of a similar size to the grant requested in this application.

Not applicable

Project Details

19. Project Outcome Statement: Describe what the project aims to achieve and what will change as a result. (100 words max)

Controlling the invasive lionfish in Bermuda waters is vital in order to minimise its negative impacts on native fish species and ecosystems, and avoid secondary impacts on fisheries, tourism and public health. This project will gather data on lionfish abundance and distribution that are critical for developing targeted removal plans, and develop a lionfish-specific trap for commercial fishers to facilitate large-scale, long-term removal of this species from deeper waters, thereby reducing the population and its impact. Information on feeding ecology and population dynamics will also contribute to the management plan being developed for the long-term control of this invasive population.

20. Background: (What is the current situation and the problem that the project will address? How will it address this problem? What key themes will it address? (200 words max)

In the western Atlantic, the invasive lionfish threatens native populations of economically and ecologically important fish species, and thereby the overall health of coral reef ecosystems. The potential exists for secondary impacts on fisheries, tourism and public health. The lionfish population in Bermuda is growing rapidly but is presently concentrated in deeper waters inaccessible to volunteer cullers. Control of this invasive species is possible if a comprehensive programme is put in place soon. The Bermuda Lionfish Taskforce is developing a control plan, but key data required for its implementation are lacking.

This project will gather data on lionfish abundance and distribution in Bermuda to facilitate targeted removals. Resurveying cleared sites will help determine the optimal frequency of removal activities. Studying the feeding ecology of this species will clarify its impacts on the native fish community and the factors driving its distribution. Modelling population dynamics will inform the plan for long-term control. Developing a lionfish-specific trap will facilitate large-scale, long-term removal of lionfish from deeper waters, while minimising by-catch of native species.

The key theme is control of an established invasive species, but this work will also contribute to the management and conservation of coral reef habitats and associated fish species.

21. Methodology: Describe the methods and approach you will use to achieve your intended outcomes and impact. Provide information on how you will undertake the work (materials and methods) and how you will manage the work (roles and responsibilities, project management tools etc). Give details of any innovative techniques or methods. (500 words max)

Lionfish abundance will be assessed at 20 sites in each of 5 depth zones across the Bermuda platform using SCUBA or appropriate deep diving equipment. A diver using a roving search protocol encompassing cryptic habitats will record the number and estimated size of all lionfish seen, and attempt to **capture each individual** using a pole-spear. **Belt transect surveys of prey fishes** will be conducted concurrently by a second diver. Data from a **towed drop-camera** will be calibrated against the diver surveys, facilitating interpolation between survey sites. A subset of the sites where fish are caught will be resurveyed at intervals ranging from 1 month to 1 year to assess re-colonisation rates. These data will be used to develop an **estimate of population size, a distribution map, and a strategy for removal activities** that will target lionfish in key locations at times that account for seasonal population fluctuations, patterns of movement, as well as the rate of re-colonisation.

To evaluate **lionfish feeding rates and prey selectivity**, stomach contents of captured specimens will be identified, described in terms of number and weight of prey consumed relative to predator weight, and compared to results from the appropriate prey fish surveys. Additionally, **analysis of stable isotopes** of nitrogen and carbon in various lionfish tissues will highlight dietary shifts, provide insight into feeding locations and movements, and establish the trophic position of lionfish. Stable isotope analysis is a novel approach to assessing the feeding ecology of lionfish and provides information that cannot be detected through conventional methods. This study will provide a **baseline assessment of lionfish feeding habits and prey abundance**, clarifying the impact of this invasive species on native fish populations and the role of prey availability in determining the distribution of lionfish in Bermuda. This information can then be used to track the **impact of lionfish over time** and **predict changes in their distribution** to inform the control strategy.

Captured specimens will be measured and standard otolith ageing techniques used to describe the **demographics** and longevity of lionfish in Bermuda waters. Gonads will be weighed and sectioned to determine overall fecundity and the developmental stage of fish relative to size and season, facilitating an estimate of the **reproductive potential** of the population. Settling larvae will be collected using light traps to estimate **recruitment rates**, while **otolith microchemistry** and **population genetics** using highly-variable microsatellite markers will determine larval sources and the rate of immigration to the local population. This information, along with the estimate of population size, will feed into a **population dynamics model** that will inform future actions to control the invasive lionfish population in Bermuda.

A lionfish-specific trap will be developed in collaboration with commercial fishers by modifying standard lobster traps to increase their catch rate of lionfish while decreasing by-catch of lobster and other fishes. Various changes to the structure and deployment of traps will be monitored using time-lapse video to assess catch rates. Integrating lionfish traps into the commercial fishery will contribute to the **long-term control of this invasive population**.

22. How does this project:

- a) Deliver against the priority issues identified in the assessment criteria
- b) Demonstrate technical excellence in its delivery
- c) Demonstrate a clear pathway to impact in the OT(s)
(500 words max)

a) This project will make a significant contribution to the long-term control of the invasive lionfish in Bermuda waters. Control of invasive species is activity K3.4 of the Bermuda Biodiversity Strategy and Action Plan and is included under guiding principle 7 of the Bermuda Environment Charter. Development of a commercial fishery for lionfish is an item in the Department of Environmental Protection's 15-year strategic plan for the sustainable use of Bermuda's marine resources. Defined project outputs, including a map of lionfish distribution with information on spatial and temporal variability, a lionfish-specific trap developed in collaboration with the local commercial fishing industry, and a population dynamics model, will provide tools and data required for the establishment of effective lionfish control strategies and will support ongoing Bermuda Lionfish Control Plan activities.

Reducing the impacts of invasive species also contributes to the conservation of marine habitats and their associated biodiversity, a common theme in the Bermuda Environment Charter and other Multilateral Environmental Agreements that Bermuda is party to, or working towards.

- b) Project team partners and collaborators have extensive experience in planning and applying all scientific techniques relevant to the proposed methods. The effectiveness of the roving-diver survey method for detecting fish in the cryptic habitats preferred by lionfish and the capture methods employed by OSF divers have both been demonstrated. Field work schedules are realistic in terms of workload, safety and weather contingencies. The range of approaches used will ensure adequate data. Investigative components of the project feed directly into the key deliverables that will contribute to long-term control of lionfish in Bermuda: the distribution map with information on spatial and temporal variability, the lionfish trap and the population model. By developing a directed commercial fishery for lionfish in collaboration with the fishing industry, this project seeks to make wide-scale, long-term removals of this invasive species economically viable. The comprehensive and collaborative nature of this project makes it more cost-effective than disparate efforts by multiple agencies and brings added value from the partner organisations.
- c) This project proposal has been developed by a local team of partners in the Bermuda Lionfish Taskforce, which is the officially recognised body addressing the lionfish invasion in Bermuda and is tasked with development of a control plan. The results of this project will be incorporated into the control plan to facilitate the removal of lionfish by indicating where and when they may be found in their highest abundance, as well as developing an effective lionfish trap. BZS, BIOS and OSF all have extensive experience in dissemination of scientific findings, ensuring a broad circulation of results through media channels. Our efforts will include a combination of outreach activities including public talks, local television and radio interviews, and e-Newsletters. Furthermore, our methods will include a multifunctional website, scientific publications and presentations, and flyers to authorities and public bodies. As such, results and implications of the proposed research will reach a wide audience, thereby increasing its impact on management of the invasive lionfish population in Bermuda and other UKOTs.

23. Who are the stakeholders for this project and how have they been consulted (include local or host government support/engagement where relevant)? Briefly describe what support they will provide and how the project will engage with them. (250 words max)

A workshop held in October 2012, with broad stakeholder participation, recognised the need for a comprehensive lionfish control programme, identified a series of key research areas, and led to the formation of the Bermuda Lionfish Taskforce. The Taskforce is the officially recognised body addressing the lionfish invasion in Bermuda waters and is tasked with the development of a control plan. The Taskforce has representatives from all stakeholder groups, including both government departments with responsibilities in the marine environment (Environmental Protection and Conservation Services), the commercial fishery, the dive industry, recreational lionfish cullers and organisations involved in marine research and environmental education activities. This proposal, developed by Taskforce partners, addresses the research needs identified by the stakeholders during the workshop. The Taskforce will utilize the project outcomes to support the implementation of the lionfish control plan and link this project to the other stakeholder groups. Stakeholders from the commercial fishery and the dive industry, along with volunteers from the Ocean Support Foundation and recreational lionfish cullers, will be participating in the fieldwork. Other stakeholders will be providing in kind support, acting in an advisory capacity and helping inform the public of the results. Information will be disseminated to the various stakeholder groups through their Taskforce representatives and key participants from the October workshop.

24. Institutional Capacity: Describe the implementing organisation's capacity (and that of partner organisations where relevant) to deliver the project. (500 words max)

The Bermuda Zoological Society (BZS), formed in 1978, is the support charity for the Bermuda Aquarium, Museum & Zoo (BAMZ), a Bermuda government institution within the Dept. of Conservation Services (DCS). BZS supports resident scientists, and received funding from past Darwin and OTEP projects (e.g., Darwin Initiative 9009, "Development of a Biodiversity Strategy). BZS maintains and operates the 48ft research vessel Endurance, providing it free of charge for this project, except for weekend overtime pay for the boat captain. BAMZ has an extensive seawater facility and a wet lab for specimen dissection. Dr. Struan Smith, Curator of the Natural History Museum, provides taxonomic oversight and the resources of the museum (microscopes, specimen preservation and documentation). The BAMZ/BZS Dive Control Board, in compliance with the BAMZ/BZS Dive Manual, follows the stipulations of the American Academy of Underwater Sciences (AAUS), and vets all diving operations.

The BZS Accounting Office will assist Dr. Walker in monitoring the project budget, all expenditures and the annual financial audits. BZS personnel will ensure timely progress and will assist the project leader with administrative issues related to its implementation. BZS/BAMZ established the first lionfish initiative in 2008, and brings that experience in support of the project's goals

BAMZ was founded in 1926 and is one of the world's oldest aquariums. It is an important centre for science education, research, and species conservation. The Association of Zoos & Aquariums (AZA) has accredited BAMZ since 1994.

DCS is responsible for managing the Government's field ecology program, and is mandated with the preservation of Bermuda's biodiversity. DCS will support project activities with specialists from the conservation unit and BAMZ, laboratory facilities and will assist with publications and environmental policy/legislation.

The Bermuda Institute of Ocean Sciences (BIOS) is a prominent oceanographic research institution, founded in 1903. It maintains state of the art research facilities for field and laboratory studies that encompass the proposed project activities. BIOS has a fleet of small research vessels for inshore and coastal research, as well as complete dive facilities operating to AAUS standards. These facilities will allow for safe and efficient execution of the field work/sample collection. BIOS maintains laboratory space including instrumentation needed for examinations of feeding and reproductive ecology and a fully equipped molecular laboratory for population genetic assessments.

The Ocean Support Foundation (OSF) is the driving force behind the current lionfish control initiative in Bermuda. OSF's team of technical deep divers will provide technical dive services, working with the project team to survey and collect specimens at depth. OSF has also provided dive support for other projects including the award winning 2011 Texas A&M/NOAA Bermuda Deep Cave Mission, the USVI

grouper research project, and deep coal sampling research.

The Marine Resources Section of the Bermuda Government Department of Environmental Protection (DEP) is responsible for fisheries and marine resources legislation, policy and management. It conducts applied research and monitoring on a wide range of marine species of local, regional, and international importance. The Section also provides extension services to the fishing industry.

25. Expected Outputs

| Output (<i>what will be achieved e.g. capacity building, action plan produced, alien species controlled</i>) | Indicators of success (<i>how we will know if its been achieved e.g. number of people trained/ trees planted</i>) | Status before project/baseline data (<i>what is the situation before the project starts?</i>) | Source of information (<i>where will you obtain the information to demonstrate if the indicator has been achieved?</i>) |
|--|---|---|---|
| 1a. Estimate of lionfish population size and initial map of distribution around Bermuda | Number of diver and drop camera surveys completed; Hotspots and interpolated lionfish density determined from survey results and reports; Total population estimated and Map produced | Distribution of lionfish unknown | Will be performed by team; Online record keeping for all culling activities |
| 1b. Data supporting targeted control of lionfish | Number and location of individuals captured; Hotspots identified; Re-colonisation of culled sites monitored; Reproductive periodicity and movement patterns documented | unknown | Record of dive surveys; Record of re-colonisation of culled sites; Online record keeping for all culling activities |
| 2. Lionfish specific trap prototype | Video monitoring shows modified traps and deployment methods catch lionfish with low by-catch | None | Report outlining results of experimental trap deployments |
| 3a. Lionfish impact assessment based on feeding ecology | Results from gut content and stable isotope analysis | Known in other regions, unknown in Bermuda | Research results by the team |
| 3b. Report outlining lionfish reproductive potential and recruitment capability | Results of gonad analyses, population genetics and otolith microchemistry | Known in other regions, unknown in Bermuda | Research results by the team |
| 3c. Report on lionfish population biology | Growth parameters and demographics described | Known in other regions, unknown in Bermuda | Will be performed by team |
| 3d. Lionfish population model for planning long term control | Demographics, reproductive rate, recruitment rate and immigration rate data combined into a model. | Known in other regions, unknown in Bermuda | Will be performed by team |

| | | | |
|--|--|---|---|
| Output (<i>what will be achieved e.g. capacity building, action plan produced, alien species controlled</i>) | Indicators of success (<i>how we will know if its been achieved e.g. number of people trained/ trees planted</i>) | Status before project/baseline data (<i>what is the situation before the project starts?</i>) | Source of information (<i>where will you obtain the information to demonstrate if the indicator has been achieved?</i>) |
| 4. Dissemination and application of results | Results incorporated into Bermuda Lionfish Control Plan. At least two scientific papers published. Sharing of knowledge with other UKOTs through GCFI and UKOT conservation forum. Local public outreach document developed. | None | Will be performed by team |

26. Expected Outcomes: How will each of the outputs contribute to the overall outcome of the project? (100 words max)

Population surveys will provide estimates of lionfish abundance and distribution, which will provide insight into the extent of the invasion. The number of individuals collected, coupled with the number of new individuals counted on subsequent revisits will indicate persistence of the population. Analysis of feeding ecology, reproductive ecology and recruitment rates will determine the impact of the population on the local environment and suggest levels of recruitment. Finally, specialized traps will assist in long-term management and cooperation with the commercial fishing industry. These results will contribute to a document outlining the threats and providing suggestions to control the population.

27. Main Activities

| | |
|-----------------|--|
| Output 1 | Estimates of species abundance and distribution |
| 1.1 | Survey 100 sites in 5 depth bands from the surface to 200 ft. depth. (Concurrently collect specimens for population biology studies.) |
| 1.2 | Resurvey 50 previously sampled sites where fish were collected to assess re-colonisation rates. |
| 1.3 | Conduct at least 28 drop camera surveys at depths between 100 and 200 ft, overlapping with 6 diver survey sites. |
| 1.4 | Compile and analyse survey data by depth/habitat/season. Use GIS and interpolation algorithms to create a distribution map of lionfish density around Bermuda. Incorporate all data to describe spatial and temporal variability patterns. |
| 1.5 | Estimate total lionfish population in Bermuda waters. |
| Output 2 | Lionfish-specific trap to control species proliferation |
| 2.1 | Attach time-lapse video cameras to modified lobster traps and deploy in conjunction with the lobster fishery. |
| 2.2 | Monitor video of modified traps to determine utility in long-term control. |
| Output 3 | Assessment of present impact and model of potential future impacts |
| 3.1 | Conduct prey fish surveys (in conjunction with lionfish surveys) at 100 sites in 5 depth bands from the surface to 200 ft. depth. |
| 3.2 | Identify and analyse gut contents of each fish collected, and compare to relevant prey fish surveys to determine feeding rates and selectivity. |

| | |
|-----------------|---|
| 3.3 | Analyse stable isotopes in collected specimens to determine trophic level and feeding habitats of lionfish. |
| 3.4 | Weigh and section gonads of collected specimens to estimate maturity, fecundity, reproductive seasonality and reproductive capacity. |
| 3.5 | Deploy light traps for larval collections and estimate recruitment rates. |
| 3.6 | Use DNA microsatellites from small specimens and analyse for potential recruitment patterns. |
| 3.7 | Utilise otolith microchemistry signatures from small specimens to detect the rate of larval input from distant populations. |
| 3.8 | Using collected samples, describe growth parameters and demographics of local lionfish population using standard fisheries biology and otolith ageing techniques. |
| 3.9 | Develop population dynamics model for lionfish in Bermuda. |
| Output 4 | Dissemination and application of results |
| 4.1 | Compile and analyse all data. Look for value-adding opportunities. |
| 4.2 | Use data to suggest optimal times, locations and frequencies for fishing and culling activities and set targets for removals. |
| 4.3 | Present results to the Bermuda Lionfish Control Taskforce for incorporation into the Bermuda Lionfish Control Plan. Meet with stakeholders to discuss how results can assist in implementation of control activities. |
| 4.4 | Publish results in scientific literature. Share results at conferences, especially with other UK OTs. |
| 4.5 | Assist stakeholders with the development of outreach activities and communication materials. |

| 28. Risks | | | |
|---|--|--|---|
| Description of the risk | Likelihood the event will happen (H/M/L) | Impact of the event on the project (H/M/L) | Steps the project will take to reduce or manage the risk |
| Unable to find lionfish | L | H | Dive at as many sites/depths as possible |
| Unable to capture young lionfish | M | H | Deploy light traps as often as possible. Dive at as many sites/depths as possible |
| Unable to dive due to weather | L | H | Prioritize diving when weather is nice |
| Unable to identify gut contents | M | M | Enlist assistance from outside specialists |
| No grant-in-aid from BIOS for extra small boat time | L | L | Deploy light traps in conjunction with survey activities. |

29. Sustainability: How will the project ensure benefits are sustained after the project has come to a close? If the project requires ongoing maintenance or monitoring, who will do this? (200 words max)

This project will generate the tools and data required for the implementation of an ongoing Bermuda Lionfish Control Plan being developed by the Bermuda Lionfish Control Taskforce, providing strategies for government and other stakeholder efforts to control the lionfish population at a level that will mitigate the long-term impact of this invasive species on native fish, reef communities, the island's economy and public health.

Overseen by the Taskforce, local dive operators and volunteers will continue culling efforts on recreational dives sites and sensitive areas of the reef, while OSF volunteers will continue deep dive activities, culling and monitoring lionfish hot spots. The successful creation of a commercial fishery utilizing lionfish-specific traps will promote the continued capture of this invasive species, while simultaneously providing a marketable supply of a sustainable food source. Lionfish and prey species surveys will be conducted at regular intervals by BZS and OSF volunteers to monitor control plan effectiveness relative to the baselines established by this project.

Stakeholders such as BIOS, BZS and OSF will incorporate project findings into their student education and outreach programs to increase awareness of the lionfish invasion and encourage students, the general public and businesses to become engaged in the lionfish efforts.

30. Monitoring & Evaluation: How will the project be monitored and who will be responsible? Will there be any independent assessment of progress and impact? When will this take place, and by whom? (250 words max)

The project will be managed in several ways. The project leader (Goodbody-Gringley) will have regular meetings, on a monthly basis, with all project participants (Gleason, Eddy, Pitt, Smith) to check in on project progress, deal with any methodological issues, and continue assimilation and interpretation of data. Culling activity will be monitored through the use of project dive logs along with written and online lionfish reporting forms. The forms and online system will be accessible to the public, and at least six drop off points for forms and specimens will be located across the island. Drs. Walker and Smith will work with the PI to monitor the scientific progress of the project in terms of specified activities and expected outcomes; Walker and Smith will also provide assistance in reviewing and submitting required project reports in a timely manner. The BZS Accounting Office will assist Walker in monitoring the project budget, expenditures and the annual financial audits. The Bermuda Lionfish Taskforce, Ocean Support Foundation and BIOS will also conduct independent assessments of the project progress and impacts, from the perspective of public stakeholders. Additional independent assessment will also be provided by the international scientific community in the peer-review process of project publications, and in feedback acquired during presentations of project results and implications at international science meetings. Pitt and the Department of Environmental Protection will assess the productivity, specificity, and efficiency of the modified traps to determine their success in capturing lionfish in a large-scale, long-term manner.

The project completion report is **due up to 3 months** after the project is over and is linked to the final payment.

31. Use of information: If your application is successful, the information in this form may be published on the internet or used in publications. If there are any parts of the application which you do not want to be used in this way, please indicate them in the box below.

32. Financial controls: (Who is responsible for managing the funds? What experience do they have? What arrangements are in place for auditing expenditure?)

Dr. Ian Walker and the BZS accounting office, staffed by a certified accountant, are responsible for establishing and maintaining effective internal control over financial reporting and transactions for all funds managed by BZS. Summary and detailed transaction reports are prepared monthly by the BZS accounting office and the BZS Treasurer (a qualified CPA), and distributed to the Program Managers and supervisory staff. Quarterly financial reports are distributed to the BZS Executive committee and Senior Managers.

The independent auditing firm, PriceWaterhouse, audits the BZS accounts annually, as required by Bermuda charities legislation. Their audits are performed in accordance with Canadian auditing standards. They report on their audits to the BZS Executive committee who approve them. BZS financial statements and the audit reports thereon are available.

Please complete the separate Excel spreadsheet which provides the Budget for this application. Some of the questions earlier and below refer to the information in this spreadsheet.

NB: Please state all costs by financial year (1 April to 31 March) and in GBP. **Budgets submitted in other currencies will not be accepted.** Use current prices – and include anticipated inflation, as appropriate, up to 3% per annum. The Darwin Initiative cannot agree any increase in grants once awarded.

33. Value for Money

Please explain how you worked out your budget and how you will provide value for money through managing a cost effective and efficient project. You should also discuss any significant assumptions you have made when working out your budget.

The budget for this proposal was calculated in local currency (Bermuda dollars) and converted to pounds sterling based on the purchase exchange rate of BM\$1.58 to GB£1 published by the Bank of Butterfield on December 31, 2012. It must be assumed that the exchange rate will not change enough to significantly reduce the funds available for the project after conversion. Current purchase rates can be found at http://www.bm.butterfieldgroup.com/Rates/Pages/Foreign_Exchange.aspx.

Value for Money. This proposal requests a total of £169,897, which represents 72% of the total project costs. Funds requested are realistic for the costs of operating in Bermuda, where everything must be shipped into the island and is taxed at entry. Salary support requested for partners associated with BIOS is at the low end of local salary brackets and therefore provides excellent value for money in the Bermuda context. Although BIOS charges overhead on all direct costs, they provide access to a fleet of small research vessels at a reduced cost with duty free fuel. A significant proportion of project costs will be covered by in kind support from multiple channels. Salary support for 14 months for WC Eddy is provided through an NSF Graduate Research Fellowship stipend (£22,153), for one month per year for J Pitt by the Department of Environmental Protection (£10,441), and for 3 weeks for SR Smith by BAMZ (£4,272). BZS will provide the research vessel Endurance in support of the project. Deep dive support will be provided by OSF volunteers. Hiring divers with equivalent training and experience at a daily rate would cost approximately £9,494. Where possible, items imported for the project or sent overseas for analysis will be hand carried to save on shipping costs.

A **detailed breakdown of the costs** in each budget category is provided in the second spreadsheet of the budget Excel file.

Staff costs. Salary support is requested for three months in year one and two months in year two to cover Goodbody-Gringley's project management activities, genetics work, field work and report writing. BIOS is a 'soft money' institution, and researchers are primarily supported from grants and external contracts. Ten months stipend for Eddy is requested in year 2, to continue on from funding already obtained, as he will be committed to the project full time for two years. A small stipend is requested to support Gleason's co-ordination of volunteer divers and administrative contributions throughout the project.

Consultancy costs. Funds are requested in years 1 and 2 to cover the costs of deep diving support, including boat captain, fuel, dive tanks and technical diving breathing gas (50 dives conducted over 25 days at \$1,750 per day). Divers will be volunteering their time. Two-thirds of these expenses fall in year 1, and one-third in year 2. Funds are also requested to hire a dedicated technical diver to assist with field work for three months in year one and two months in year two.

Overhead costs. BIOS has an indirect cost rate of 55.01% on all direct costs. This overhead covers utilities charges, maintenance of facilities, and support from IT, finances, lab operations and outreach/development offices.

Travel. In year 2, funds are requested for Eddy to present project results at the Gulf and Caribbean Fisheries Institute (GCFI) annual meeting, an important gathering of fisheries scientists, managers and fishers from the region affected by the lionfish invasion, and for Goodbody-Gringley to present at the International Society for Reef Studies (ISRS) European conference.

Operating costs. Funds are requested to cover dive tanks (\$10 x 90), boat fees and fuel for shallow water dives (60 dives conducted on 30 trips at \$400 per trip), and boat captain's wages for mid-depth dive trips and drop camera surveys on the BZS vessel (40 dives conducted over 20 days, plus 7 days of drop camera surveys, at \$400 per day). Two-thirds of these expenses fall in year 1, and one-third in year 2. BIOS facilities fees for C Eddy are split across the two years of the project (\$520 x 16 months).

Other costs. Funds are requested for a set of dedicated technical diving equipment (\$9,375), a basic drop camera to extend the area covered by diver surveys (\$2,000), genetics reagents and sequencing (\$9,500), time-lapse underwater video cameras (12 x \$1,250), basic light traps (6 x \$1,000), consumables and shipping costs for stable isotope and otolith work. All costs factor in shipping and import duty.

Provide a project implementation timetable that shows the key milestones in project activities. Complete the following table as appropriate to describe the intended workplan for your project (Q1 starting April 2013)

| Activity | No of Months | Year 1 | | | | Year 2 | | | | Year 3 | | | |
|--|--------------|--------|----|----|----|--------|----|----|----|--------|----|----|----|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| Output 1 Estimates of species abundance and distribution | 24 | X | X | X | X | X | X | X | X | | | | |
| 1.1 Survey 100 sites in 5 depth bands from the surface to 200 ft. depth. (Concurrently collect specimens for population biology studies.) | 15 | X | X | X | X | X | X | | | | | | |
| 1.2 Resurvey 50 previously sampled sites where fish were collected to assess re-colonisation rates. | 6 | | | | | X | X | | | | | | |
| 1.3 Conduct at least 28 drop camera surveys at depths between 100 and 200 ft, overlapping with 6 diver survey sites. | 4+4 | X | X | X | | X | X | X | | | | | |
| 1.4 Compile and analyse survey data by depth/habitat/season. Use GIS and interpolation algorithms to create a distribution map of lionfish density around Bermuda. Incorporate all data to describe spatial and temporal variability patterns. | 9 | | | | | | X | X | X | | | | |
| 1.5 Estimate total lionfish population in Bermuda waters. | 1 | | | | | | | | X | | | | |
| Output 2 Lionfish-specific trap to control species proliferation | 12 | | | X | X | | | X | X | | | | |
| 2.1 Attach time-lapse video cameras to modified lobster traps and deploy in conjunction with the lobster fishery. | 4+4 | | | X | X | | | X | X | | | | |
| 2.2 Monitor video of modified traps to determine utility in long-term control and write report on findings. | 4+4 | | | X | X | | | X | X | | | | |
| Output 3 Assessment of present impact and model of potential future impacts | 24 | X | X | X | X | X | X | X | X | | | | |
| 3.1 Conduct prey fish surveys (in conjunction with lionfish surveys) at 100 sites in 5 depth bands from the surface to 200 ft. depth. | 15 | X | X | X | X | X | X | | | | | | |
| 3.2 Identify and analyse gut contents of each fish collected, and compare to relevant prey fish surveys to determine feeding rates and selectivity. | 18 | X | X | X | X | X | X | | | | | | |
| 3.3 Analyse stable isotopes in collected specimens to determine trophic level and feeding habitats of lionfish. | 18 | X | X | X | X | X | X | | | | | | |
| 3.4 Weigh and section gonads of collected specimens to estimate maturity, fecundity, reproductive seasonality and reproductive | 18 | X | X | X | X | X | X | | | | | | |

| Activity | No of Months | Year 1 | | | | Year 2 | | | | Year 3 | | | |
|---|--------------|--------|----|----|----------|----------|----------|----------|----------|--------|----|----|----|
| | | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| capacity. | | | | | | | | | | | | | |
| 3.5 Deploy light traps for larval collections. Process samples and estimate recruitment rates. | 8+6 | X | X | X | | X | X | | | | | | |
| 3.6 Use DNA microsatellites from small specimens and analyse for potential recruitment patterns. | 3 | | | | X | X | X | | | | | | |
| 3.7 Utilise otolith microchemistry signatures from small specimens to detect the rate of larval input from distant populations. | 3 | | | | | X | X | | | | | | |
| 3.8 Using collected samples, describe growth parameters and demographics of local lionfish population using standard fisheries biology and otolith ageing techniques. | 18 | X | X | X | X | X | X | X | | | | | |
| 3.9 Develop population dynamics model for lionfish in Bermuda. | 6 | | | | | | | X | X | | | | |
| Output 4 Dissemination and application of results | 15 | | | | X | X | X | X | X | | | | |
| 4.1 Compile and analyse all data. Look for value-adding opportunities. | 15 | | | | X | X | X | X | X | | | | |
| 4.2 Use data to suggest optimal times, locations and frequencies for fishing and culling activities and set targets for removals. | 6 | | | | | | | X | X | | | | |
| 4.3 Present results to the Bermuda Lionfish Control Taskforce for incorporation into the Bermuda Lionfish Control Plan. Meet with stakeholders to discuss how results can assist in implementation of control activities. | 1 | | | | | | | | X | | | | |
| 4.4 Publish results in scientific literature. Share results at conferences, especially with other UK OTs. | 9 | | | | | | X | X | X | | | | |
| 4.5 Assist stakeholders with outreach and communication. | 9 | | | | | | X | X | X | | | | |

CERTIFICATION 2013/14

On behalf of the trustees of the
Bermuda Zoological Society

I apply for a grant of £169,897 in respect of **all expenditure** to be incurred during the lifetime of this project based on the activities and dates specified in the above application.

I certify that, to the best of our knowledge and belief, the statements made by us in this application are true and the information provided is correct. I am aware that this application form will form the basis of the project schedule should this application be successful. *(This form should be signed by an individual authorised by the lead institution to submit applications and sign contracts on their behalf.)*

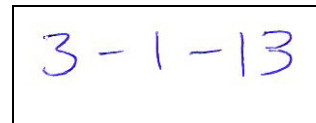
I enclose CVs for project principals and letters of support. Our most recent audited/independently verified accounts are also enclosed. Annual reports are not produced but organizational activities can be viewed at <http://www.bzs.bm>:

| | |
|-------------------------------------|------------------|
| Name (block capitals) | RICHARD WINCHELL |
| Position in the organisation | President |

Signed



Date:



Application Checklist for submission

| | Check |
|---|-------|
| Have you provided actual start and end dates for your project? | X |
| Have you provided your budget based on UK government financial years i.e. 1 April – 31 March and in GBP? | X |
| Have you checked that your budget is complete , correctly adds up and that you have included the correct final total on the top page of the application? | X |
| Has your application been signed by a suitably authorised individual? (clear electronic or scanned signatures are acceptable in the email) | X |
| Have you included a 1 page CV for all the principals? | X |
| Have you included a letter of support from the <u>main</u> partner(s) organisations? | X |
| Have you included a copy of the last 2 years' annual report and accounts for the lead organisation? An electronic link to a website is acceptable. | X |
| Have you read the Guidance Notes? | X |
| Have you checked the Darwin Plus website immediately prior to submission to ensure there are no late updates? | X |

Once you have answered the questions above, please submit the application, not later than midnight GMT at the end of Monday 7 January 2013 to Darwin-Applications@ltsi.co.uk using the first few words of the project title **as the subject of your email**. If you are e-mailing supporting documentation separately please include in the subject line an indication of the number of e-mails you are sending (e.g. whether the e-mail is 1 of 2, 2 of 3 etc). You are not required to send a hard copy.

DATA PROTECTION ACT 1998: Applicants for grant funding must agree to any disclosure or exchange of information supplied on the application form (including the content of a declaration or undertaking) which the Department considers necessary for the administration, evaluation, monitoring and publicising of Darwin Plus. Application form data will also be held by contractors dealing with Darwin Plus monitoring and evaluation. It is the responsibility of applicants to ensure that personal data can be supplied to the Department for the uses described in this paragraph. A completed application form will be taken as an agreement by the applicant and the grant/award recipient also to the following:- putting certain details (i.e. name, contact details and location of project work) on the Darwin Initiative and Defra/FCO/DFID websites (details relating to financial awards will not be put on the websites if requested in writing by the grant/award recipient); using personal data for the Darwin Initiative postal circulation list; and sending data to Governor's Offices outside the UK, including posts outside the European Economic Area. Confidential information relating to the project or its results and any personal data may be released on request, including under the Environmental Information Regulations, the code of Practice on Access to Government Information and the Freedom of Information Act 2000.