DARWIN INITIATIVE FOR THE SURVIVAL OF SPECIES : APPLICATION FOR GRANT FOR ROUND 9 COMPETITION

Please read the accompanying Guidance Note before completing this form. Give a full answer to each section; applications will be considered on the basis of information submitted on this form. Applicants are asked not to use the form supplied to cross refer to information in separate documents except where this is invited on the form. The space provided indicates the level of detail required but you may provide additional information on a separate sheet if necessary. Copies of this form are available on disk or by e-mail on request. You are asked also to complete the summary sheet attached at the end of this form. Although you may reproduce this sheet in a reasonable font, you should not expand it beyond an A4 sheet (leaving the allocated space for DETR comments to be made) as additional information will not be taken into account.

1. Name and address of organisation

DEPARTMENT OF BIOLOGICAL SCIENCES, UNIVERSITY OF HULL, COTTINGHAM ROAD, HULL, HU6 7RX

2. Principals in project

Details	Project leader	Other UK personnel (if working more than 50% on project)	Main project partner or co-ordinator in host country
Surname	LAWRENCE		KILADA
Forename(s)	ANDREW JOHN		RAOUF
Post held	LECTURER		LECTURER
Institution (if different to the above)			SUEZ CANAL UNIVERSITY
Department	BIOLOGICAL SCIENCES		DEPARTMENT OF MARINE SCIENCES
Telephone			
Fax			
Email			

Please provide a one page CV for each of these named individuals.

3. Project title (not exceeding 10 words)

DARWIN INITIATIVE FOR THE SUSTAINABLE USE OF SEA-CUCUMBERS IN EGYPT

4. Abstract of study (in no more than 750 characters)

The purpose of this project (a partnership between Hull and Suez Canal Universities, the Egyptian Environmental Affairs Agency, the Red Sea Governerate and Southern Red Sea Fishermen Society) is to develop a sustainable holothurian fishery along the Red Sea coast of Egypt. This will be achieved by performing a fishery stock assessment resulting in a management plan with policy recommendations, developing a pilot mariculture system with associated feasibility study, identifying bioactive compounds of potential medical value and training EEAA Rangers and fishermen in stock assessment and mariculture techniques. Results: species list and status, sustainable use plan, potential medical use, will be given to Egypt's National Biodiversity Unit to include in their National Biodiversity Strategy with the goal of helping Egypt meet its obligations under the CBD.

5. Timing. Give the proposed starting date and duration of the project.

25 SEPTEMBER 2001 FOR THREE YEARS

6. Describe briefly the aims, activities and achievements of your organisation. (Please note that this should describe your unit, institute or department within a university.)

Aims It is the aim of the Department to be an internationally recognised source of high quality research, undergraduate and postgraduate education and training in areas of specialist expertise. The two main areas of expertise are the aquatic and molecular biology group and the biomolecular and biomedical sciences group. The Department is developing a distinctive research base in the first of these specifically in the areas of biodiversity, genomics and biotechnology/ chemical communication.

Activities : Teaching at undergraduate and postgraduate level, pure and applied research. For example, the Department offers MSc courses in Global Biodiversity: Monitoring and Conservation and Estuarine and Coastal Science and Management. There is a strong pure and applied research base to the department related to these disciplines.

Also linked with the Department are the Institute of Estuarine and Coastal Studies (IECS) and The Hull International Fisheries Institute (HIFI). These are both contract research organisations. HIFI also runs an MSc in Fisheries Management on behalf of the Department.

Achievements

Provision of research investment by the University has continued to strengthen the aquatic and molecular biology group within the Department with the appointment of a new Professor and tied lectureship in aquatic biodiversity and genomics. This follows recent appointments in chemical communication and molecular ecology. This further underlines the aim of the Department to develop a distinctive research centre in this field. Research income for 1999/2000 was £895, 000 with £242, 976 from HEFCE. The Department, with strong commitment from the University, aims to double this as part of its 6 year plan.

The three MSc courses offered by the Department (Global Biodiversity: Monitoring and Conservation, Estuarine and Coastal Sciences and Management and Fisheries Management) have been very successful since their launch, particularly in recruiting overseas students. The Department currently recruits more overseas students than any other within the Faculty. This reflects the successful marketing of such courses to meet specific needs but also the teaching excellence of the Department, which attained 23/24 in its recent QAA teaching quality assessment.

Recent achievements of the Hull participants are shown on a separate page.

7. Has your organisation received funding under the Initiative before? If so, please give details.

No, However, participants from other Darwin funded projects (from Oxford University and Kew Gardens) have attended modules within the Certificate Programme of our Global Biodiversity MSc as part of their training.

8. Which overseas institutions, if any, will be involved in the project? Please explain the responsibilities of these institutions.

Suez Canal University – Undertake pure and applied research, teach at undergraduate and post-graduate levels, have marine laboratory in Sharm-El-Sheikh. Act as local coordinator, provide facilities for the three research assistants and training courses, assist in holothurian survey, assist in mariculture of holothurians, act as joint Deputy to the Chair of the Scientific Committee

Egyptain Environmental Affairs Agency (EEAA) – Main agency involved in nature conservation and environmental management in Egypt. Will act as Chair of the Scientific Committee, will release 10 rangers for training in holothurian stock assessment techniques, will provide wet laboratories and running systems in Ras Mohammed to develop the pilot mariculture system.

The Red Sea Governerate – Has power to affect policy on fisheries in the Red Sea. Has established an order to stop sea cucumber fishing until the stock assessment is completed and a fisheries policy established. Will act upon the fishery policy developed by the project at a government level, will be member of the Scientific Committee.

The Fishermen Society in the Southern Egyptian Red Sea – Principle organisation coordinating activities and information exchange among fishermen in area. Will send 30 fishermen for training in mariculture techniques based on the pilot mariculture system, will provide a member on the Scientific Committee.

PROJECT DETAILS

9. Define the purpose (main objective) of the project in line with the logical framework.

The principle aim of the project is to develop the first example in the world of sustainable sea cucumber fishery, along the Egyptian Red Sea coast.

The specific objectives are to:

1 Undertake a fishery stock assessment to
   a) gain baseline data on sea cucumber population dynamics along the Egyptian Red Sea coast
   b) estimate the Potential Yield of the fishery
   c) produce a fishery management plan with policy recommendations
2 Develop a pilot mariculture system to
   a) restock depleted reef areas
   b) evaluate the feasibility of the process as a direct source of sea cucumbers/ income for small, community based mariculture systems
3 Examine the potential of farmed sea cucumbers as a sustainable source of bioactive substances
   a) identification of bioactive chemicals and the nature of the activity
4 Develop and run training courses in stock assessment and mariculture to build capacity in Egypt to continue the project beyond the period of funding.

10. Is this a new project or the continuation of an existing one?

This is a new project.

11. What is the evidence for a demand or need for the work? How is the project related to conservation priorities in the host country(ies)? How would the project assist the host country with its obligations under the Biodiversity Convention?

How was the work identified?

The need for the work was initially identified when I met Dr Raouf Kilada at a marine symposium in 1997. We discussed both our interest in holothurians and the problems being encountered in the Red Sea. Further contact lead to the specific problems of over-exploitation of the holothurian fishery and the lack of expertise in the identification, surveying and mariculture of this group in the Red Sea being identified by the Egyptian partners. The proposal was written at a meeting in Suez Canal University, Ismailia, lead by the Egyptian partners, with UK partner expensed paid by the Egyptians and British Council.

How is the project related to conservation priorities in the host country?

As a signatory to the Biodiversity Convention, Egypt is committed to the assessment of biodiversity together with its sustainable use (Article 1, Objectives). Following the signing of the convention, Egypt set up a National Biodiversity Unit (NBU) charged with preparing a countrywide study on the status, costs, benefits and unmet needs of biodiversity conservation and a National Biodiversity Strategy. The study was published in 1995 but the Strategy is still under preparation.

The study contributes baseline information on biodiversity including data on species, habitats and ecosystems. It also looks at the economic value of species and its rational use in Egypt. This is not a complete inventory at the current time. Consequently, the second phase of the National Biodiversity Strategy will consist of continued documentation of ongoing research, scientific monitoring and surveying and expansion of financial support, field research, international cooperation and the development of legislation to strengthen efforts undertaken as part of the NBS. The proposed project clearly falls within this remit and Egypt's obligations.

How will the project assist the host country meet its obligations under the Biodiversity Convention?

These problems are central to several of the current activities of Egypt to meet its obligations under the Convention on Biological Diversity. The species of Holothurians and their population structures in the Red Sea are unknown, they are of economic importance and are being over-exploited and have a very important role in the ecology of coral reef communities. Article 8c of the CBD charges signatories to regulate or manage biological resources important for biodiversity conservation to ensure their conservation and sustainable use whilst Article 11 requires the development of economically and socially sound incentive measures. The Jakarta Mandate (1995) on Marine and Coastal Biological Diversity adopted by the COP requires signatories to ensure the sustainable use of living marine and coastal resources. Furthermore, in it's review of its implementation of Agenda 21 (1997), Egypt considered as very important the integration of programmes on sustainable development for settlements, tourism, fishing, ports and industry affecting coastal areas. However, it has not implemented any activities to achieve this as yet.

12 In what ways can this project be considered a Darwin project? How does the project relate to the Darwin principles? How would the project be advertised as a Darwin project and in what ways would the Darwin name and logo be used?

- **The project is a collaboration** between the Department of Biological Sciences, **Hull University** (with IECS and HIFI), **The Suez Canal University**, Faculty of Science, Marine Science Department and the Institute of Biotechnology, **The Egyptian Environmental Affairs Agency** (EEAA), **The Red Sea Governerate** and The **Fishermen Society in the Southern Egyptian Red Sea**.
- **It will result in the production of a Fishery Management Plan and policy recommendations for sea cucumbers in the Red Sea.**
- The project will **provide essential baseline data** both for **future fisheries management** and the NBU's NBS as well as develop a sustainable use programme through mariculture to restock depleted reefs, and as a direct alternative to fishing, and the identification and application of bioactive substances.
- It will build capacity in the Egyptian partner institutions to undertake this type of study with holothurians in the future.
- **It will result in procedures allowing a sustainable sea cucumber fishery in Egypt**
- It will **empower the local community by training them in mariculture procedures and development of mariculture systems**.
- **It will have a real and lasting impact on the capacity of Egypt to meet its obligations under the Biodiversity Convention**. Through the sustainable use of one of its components, improvement of the biodiversity database of the NBU and improvement of biodiversity and environmental education and awareness of the community.
- **It will act as a catalyst** with the Suez Canal University agreeing to support the project beyond the period of Darwin funding, on mariculture and sustainable use of these and other marine invertebrates in the Red Sea
- **It will have a real impact on poverty eradication within the local community** through the improvement of a sustainable fishery and mariculture of an expensive highly valued product with markets throughout Asia.
- **It will leave a lasting legacy:** a small community based sustainable fishery and mariculture system with the potential to be modelled and developed elsewhere.
- **In accordance with Article 15.7 of the CBD, any benefits from the project will be shared by the paticipating bodies.**

The project is called the Darwin Initiative for the sustainable use sea cucumbers in Egypt. The **Darwin logo will be used in all written communications and publications** resulting from the project. This will include letterheads, national and local press releases, leaflets, reports and scientific publications. Darwin support for the project will also **be acknowledged at all appropriate times**. The logo will also be transferred onto the new truck and boat, and over the pilot mariculture system.

13. Set out the proposed timetable for the work, including the programme's measurable outputs using the attached list of output measures.

Work Programme

1. Fishery Stock Assessment.

A first class honours student will be based at Sharm El-Sheik Marine Laboratory and registered as a research student in the Department of Biological Sciences at the University of Hull. S/he will be supervised by Dr Andrew Lawrence and Dr Mike Elliott with support from Jim Allen (IECS) and Dr Ian Cowx (HIFI). S/he will be trained in Holothurian identification and survey/ stock assessment methods in the UK and in Egypt. Local supervision will be provided by Dr Raouf Kilada with support from his colleagues.

Initially all species of Holothuria found within the study area will be collected and identified. These will be kept and used to create a reference collection which will be maintained in the Marine Science Department in Suez Canal University. A numbering system will be used to denote a species until it is

properly classified.

Catch Per Unit Effort (CPUE) will be predominantly employed to give an estimate of relative abundance of each species. This will be measured as the number of animals caught per diver hour. An Area Survey will be conducted by surveying sites along the whole of the Egyptian Red Sea Coast. These sites will be sampled every three months over the first year. Animals will be surveyed at three stations along a transect, perpendicular to the shore at each site. These stations will be divided by depth ranges between 0-10m, 10-20m and 20-30m. The sites will be selected by randomly dropping an anchor over the side of a boat within the appropriate depth range. Animals will be collected within a 20m radius of the anchor. Stock assessment will also be related to habitat. These will be divided into coral sand, sea grass bed, hard coral, soft coral and mixed habitat types. Animals collected will be used to give an overall estimate of relative abundance of each species along the entire range of the potential fishery together with seasonal fluctuations. The species together will length frequency data, sex ratio, weight and Gonad Somatic Index (GSI)will be recorded at each station.

In the second year CPUE data will be collected from a number of sites on a monthly basis. The sites selected will be based on the most appropriate sites/ habitats surveyed in the Area Survey but will of necessity be closer to the marine station in Sharm El-Sheikh. These samples will be used to produce time-series length frequency data which can be used to estimate population structure (year classes), growth rate by modal progression, maximum size by Ford Walford Plot and mortality rates using length converted catch curves. This length frequency data will be analysed using the computer programme FiSAT. Gonad Somatic Index will also be collected and used to determine the mean length at sexual maturity by graphing the % of mature individuals by length, reproductive season and recruitment period.

In addition, over the two years, a number of sites will be selected in which intensive fishing experiments will be performed (Depletion Experiments). In these, reduction of CPUE against cumulative catch (Leslie Plots) will provide an estimate of stock size and the catchability coefficient (q). In addition, a number of belt transect surveys will be performed, using video, in each habitat type and at each depth to give a measure of absolute abundance. This underwater visual census will be used to compare data from the Leslie Plots. The positions of the transects will be recorded using hand held GPS. This will be used to map the distribution and abundance of species using GIS. Dr Kilada will be trained in the application of remote sensing and GIS to map and estimate holothurian populations for the whole of the Egyptian Red Sea coast and will then train and perform this study with the research student.

The biological parameters collected from each of these studies will then be used to estimate the Potential Yield of the resource following the attached flow chart (Figure 1).

Over the two years a Financial Assessment will also be performed. Financial information will be collected and related to the future commercial exploitation of the resource. This will include estimates of the likely market price and the cost of a commercial fishery. If necessary, this will include trial sales of some of the catch.

In the final 3 months of year two a fisheries management plan will be prepared which will include data on the potential yield of the resource, mechanisms related to the conservation of this resource. This will be submitted to the scientific management committee at the end of the second year.

2. Development of a Pilot Mariculture System.

A mariculture system will be piloted which involves minimum impact on the environment. The aim of the farm is to develop a demonstration system and evaluate the feasibility of farming the target animals. The farm will be used to restock damaged reefs and fishing grounds and later as a direct source of animals for income generation by the local community. The pilot farm will be located in the wet laboratory of the EEAA in Ras Mohammed NP which is well equipped with suitable running systems needed for this work. Members of the local fishing community, selected by the Fishermen Society, will be trained in mariculture to build awareness of community based fisheries management and a stakeholder approach.

A first class student from Suez Canal University will be employed and registered as a research student at the University of Hull but based at the research labs in Suez Canal University and EEAA under the supervision of Dr Lawrence and Dr Cowx (HIFI) with local supervision and support from Dr Kilada and his colleagues. Successful aquaculture of sea cucumbers has been carried out in Japan, China, India and Guam. However, this usually involves taking the larvae from the environment for culture. Whilst following and adapting the limited published literature on holothurian culture, the current project will try to include

seed production (induction of spawning and fertilisation) as part of the culture process. The research student will also be charged with teaching the process to local fishermen so that a real holothurian industry (owned by local fishermen) selling direct to export companies can be developed. Development of the pilot system will involve the following components:

An extensive literature review will be undertaken examining research related to the culture of sea cucumbers. Sources of information will include Japan, New Zealand, USA, Canada and India. Added to this a review of the literature related to the general biology of Holothuria and the specific target species will be undertaken. The information from these reviews will be used to develop a research programme and to optimise conditions for mariculture of these species in this location

In conjunction with the stock assessment study the lifecycle of the target species will be determined for animals in the Red Sea. This will including length of life, reproductive cycle, conditions inducing spawning, feeding preferences of animals ranging from juvenile to adult and environmental conditions preferred by animals from each stage of the lifecycle.

Feeding and Growth

Analysis of feeding requirements will be undertaken to promote optimal growth conditions. Likely food substrates will be prepared or collected locally. Initially, animals from different size classes (life cycle stages) will be collected from the wild and cultured in a recirculating system provided by the EEAA at it's Ras Mohammed laboratory. Experiments will be performed to determine optimal feeding requirements, principle components of food required, and the quantities of food required for various stocking densities. Whilst it is known that Holothuria are sediment feeders, digesting associated bacteria, it is envisaged that food types will also include phytoplankton and zooplankton during certain life cycle stages and that these will require separate culture.

Environmental Conditions for optimal growth

Growth rates of animals from different life cycle stages will be examined under a variety of environmental conditions, including changes in salinity, temperature, dissolved oxygen and turbidity. The likely siting of culture systems will also be considered. Whether open or closed systems should be used, or whether cages should be employed sub-tidally. This will give information both on conditions required for optimal growth but also on the tolerance of the animals to environmental extremes.

Egg production, fertilisation and nursery ponds

An important element of this study will be a study to develop egg production and fertilisation techniques together with the maintenance of larval stages in nursery ponds. Analysis of the reproductive cycle, spawning time and spawning conditions will lead to the manipulation of these parameters in an artificial environment. The requirements of the larvae prior to settlement will be determined and these conditions manipulated in nursery ponds.

Assessment of Sustainability

In addition, the feasibility of the system as a sustainable community based activity will be analysed. The value of the product will be estimated based on the value of the species, and the volume of animals cultured. This will be weighed against the cost of the system, equipment, electricity, man power. In addition, the environmental impact will be assessed in relation to the release of nutrients and other pollutants into the environment. Whilst studies will be undertaken to determine optimum growth conditions these will be compared with alternative systems which may not provide optimal conditions but are more sustainable in terms of resources required and impacts.

It is envisaged that this element of the project will take two years but that it will begin in the second year after basic population data has been gathered through the Area Survey.

3. Identification of Bioactive Substances and Assessment of Medical Potential

Holothurians have been exploited as a food source but they are also recognised as a source of bioactive compounds. They have been shown to have curative properties for whooping cough, bronchial inflammation and arthritis. The Red Sea has a high rate of endemism and it is therefore possible that holothurians in this region produce unique secondary compounds not found elsewhere. A first class honours student from Suez Canal University will be registered as a research student at Hull University and supervised by Dr Lawrence and Dr J. Hardege with support from Dr T. Paget. Local support in Egypt will be provided by Dr Kilada and his colleagues. The student will examine the bioactive compounds extracted

from animals in this region. Over two years the work will cover the following five phases:

Phase 1. Extraction of Bioactive Substances.
Tissue will be broken down into small pieces using an ultrasonic homogeniser and then macerated in alcohol for extraction. A partition scheme developed by Kupchan (1973) will be followed to separate polar from non-polar constituents. The alcohol extract will be partitioned between 10% aqueous methanol and petroleum ether. This will be followed by a partition of the methanol residue between 20% aqueous methanol and CCl_4. Finally, the aqueous methanolic residue will be partitioned between 40% aqueous methanol and chloroform. Each of the fractions obtained from this portion scheme will be dried on a rotary evaporator and solubilised in a more appropriate solvent such as DMSO before testing for biological activity.

Phase 2. Testing for Biological Activity
Antitumor activity of extracts will be determined using a range of tumor cell lines, kept in the Department of Biological Sciences, Hull; (breast, colon, lung, head and neck tumours) and primary cultures. Briefly cells will be cultured to confluency then extracts added. The effect of the compounds on cell viability will initially be assayed using microscopy then by dye reduction. This will allow LC50 and LC90 values to be determined accurately.
Antibacterial, antifungal and antiparasitic testing. At this stage a range of medically important bacteria, the protozoan parasites *Giardia*, *Entamoeba* and *Leishmania* will be used to assess the anti-microbial activity of the extracts. Briefly, an organism from each of the groups will be grown in 96 well plates in the presence or absence of extract. Growth and viability will be determined by dye reduction as outlined above. Anti-fungal activity will be determined using the agar well diffusion method.
Phase 3. Extract separation
If the crude extract shows any bioactivity in the primary screening it will be further separated using appropriate liquid chromatographic methods including HPLC.
Phase 4. Testing for Biological Activity
Each fraction of the extract separated chromatographically will again be tested for biological activity using one representative from each of the groups: tumor cell line, bacteria, fungi and parasite. The aim here will be to examine the selectivity of the fraction. If the fraction shows activity on all groups it will be discarded because it shows no selectivity. If it is active on one or two of the groups, it will be further tested using other examples of each of the groups including other cancer cell lines, *Trypanosoma* spp and *Plasmodium falcipan*.
Phase 5. Preliminary Identification and Structure Elucidation.
Preliminary identification of the fraction will take place during the lifetime of the project but final elucidation is expected to occur after the period of Darwin funding. Different spectroscopic techniques will be used including ultra violet and infra red spectroscopy. One and two dimensional NMR will be used to determine the chemical structures of the isolated compounds and computer programmes such as Chem 3D and NMR simulation will be used as needed. Some of this work may be performed in collaboration with the Chemistry Department of the University of Hull.

4. Development of Training Courses.

Training courses will be developed for individuals from the Fishermen Society interested in becoming involved in a sea cucumber fishery and mariculture. Training of the local community in mariculture methods and systems will be undertaken by the Research Student involved in this element of the project supported by Drs Lawrence and Kilada. It is envisaged that this will lead to the development of small scale community based mariculture systems following the completion of the pilot scheme. Numbers of participants are estimated to be 30 overall and courses will take place in the conference rooms in the Marine Science Department in Ismailia and Sharm El-Sheikh. In addition, practical training will take place at the wet laboratories of the EEAA where the pilot scheme is set up.

In addition, Rangers from the EEAA will be trained in the identification and assessment of the holothurian stocks. These people will then be involved in the continued monitoring and assessment of the stock as the fishery develops, beyond the time of the Darwin project. The training will be provided by the

research student with responsibility for this stage of the project. It is envisaged that 10 Rangers will be trained and that the course will take place in the conference rooms in the Marine Science Department in Sharm El-Sheikh. It is anticipated that the principal survey method employed at this stage will be under water video surveillance because of its speed and cheapness compared to dive methods. Preliminary agreement has been given by EEAA to release people for the course.

These courses will provide direct skills training but will also raise awareness of the problems of the fishery and its impact on the environment. From this it is hoped to build awareness of community based fisheries management and a stakeholder approach. As such the courses will assist the protection of the reef system along the Egyptian Red Sea coast and help to maintain their value for the tourist industry.

5. Output Measures

Training Outputs

Code 2 - 3 Egyptian Research Students

Code 6A/6B – Dr Kilada to receive 1 month training in remote sensing and GIS (Module from Biodiversity MSc)

Code 6A – 40 Egyptians (10 rangers from EEAA and 30 fishermen from Fishermen Society, training in stock assessment and mariculture respectively.

Code 6B - 8 weeks provided (2 weeks for EEAA Rangers training and 3 x 2 weeks for fishermen)

Code 7 - 2 Training manuals to be produced

Research Outputs

Code 8 - Total 18 weeks (January 3x2 and July 3x4)

Code 9 - One sustainable fisheries management plan for The Governerate of the Red Sea, one holothurian dataset for NBU's NBS

Code 10 - One fieldguide to Holothuria of the Red Sea

Code 11A - 12 peer review papers

Code 11B - 12 papers submitted

Code 12A – 1 computer database/ GIS system to be established

Code 13A - One species reference collection to be established

Dissemination Outputs

Code 14A – One final seminar to be organised

Code 14 B – One European conference (year 2) and one international conference (year 3) to be attended and papers presented

Code 15A – 6, at the time of each visit

Code 15B – 6, at the time of each visit

Code 15C – 6, at the time of each visit

Code 15D – 6, at the time of each visit

- Beche-de-Mer (Newsletter) to be sent 6 updates
- Echinoderm Society to be sent 6 updates

Code 17A – 1 (developed from the Scientific Committee)

Code 19A – 1 or 2 possible

Code 19D – 1 or 2 possible

Code 20 – £28, 200

Code 23 – £170, 308 (£82, 612 from Egyptian partners, £87, 696 from Hull partner)

14. Do you know of any other individual/organisation carrying out similar work? Give the details of the work, explaining the similarities and differences.

A group in Alaska are currently developing a South East Alaska Sea Cucumber Management Plan in which they are trying to produce a guideline harvest level based on population estimates from the departments

biomass assessment. Whilst similar to the fishery stock assessment that will be undertaken here, and indeed, useful in terms of comparing/ applying techniques and mathematical methods the project is different in the following ways:

1 It (most likely) is looking at different species which exist in very different environmental conditions. Therefore, population densities, growth rates, reproductive rates, age at first sexual maturity and maximum size etc will all be different. Consequently, Potential Yield estimates will be very different

2 The Management Plan does not include an element examining Mariculture for stock replenishment/ direct sale

Several groups are examining and developing mariculture techniques for sea cucumbers. However, the complexity of these techniques is generally low and involves simple collection of juveniles and growth in caged enclosures (India, Indonesia and Philippines). Other groups are looking at fertilisation and larval growth/ feeding requirements (New Zealand, Japan). This work, however, is of a more academic nature (New Zealand) or results of the work are generally unavailable (Japan).

Again, in all of these cases, information regarding fertilisation, feeding, rearing and growth techniques is useful and will be applied in this study. But, again it is likely that these groups are working on different species, or (possibly) the same species adapted to very different environmental conditions to those found in the Red Sea.

15. Will the project include training and development? Please indicate how many trainees will be involved, from which countries and what will be the criteria for selection. How will you measure the effectiveness of the training and will those trained then be able to train others? Where appropriate give the length of any training course.

Dr R. Kilada will receive 1 months training in remote sensing and GIS at the University of Hull. This will be taken from one of the modules from the Biodiversity MSc coordinated by Dr Lawrence. He will complete the assessment for the MSc module. He will then pass these skills on to the research student undertaking the fishery assessment. Together they will map the distribution of Holothuria along the Egyptian Red Sea coast.

There will be training of the three research students by A. Lawrence (and colleagues) both in Egypt, and at The University of Hull in appropriate research skills. In addition, the assistants will undertake the **Certificate in Post-graduate Training**, offered by the University when they begin their project. This includes modules in safety, IT and numerical techniques, using information resources and project writing as well as a taught module of particular relevance to their area of research. They will also take some modules from the **University's Higher Education Teaching Certificate**, to prepare them for the training that they will deliver in Egypt. All of these modules are assessed and the students will have to pass them. On completion of the project each student will present an MSc thesis for examination in the UK.

The first assistant will develop and deliver a short course in holothurian stock assessment which will be given to Rangers from the EEAA. It is anticipated that 10 people will be trained in these techniques.

The second assistant will develop and deliver short training courses in sea cucumber mariculture techniques which will be delivered to members of the Fishermen Society. These training courses will train 10 participants at a time and it is envisaged that they will be run of three occasions (total 30 members of the fishing community). Certificates of attendance will be given to those undertaking the training courses.

Totals: One person (Kilada) trained in remote sensing and GIS for one month
Three (3) Egyptian Research Students (MSc by Research with Certificate in Post-graduate Training and some training in teaching skills)
Ten (10) Rangers from the EEAA trained in Holothurian Fishery Stock Assessment Techniques
Thirty (30) Egyptian members of Fishermen Society in Mariculture Techniques

16. How will trainee outcomes/destinations be monitored after the end of the training?

Training of the research students will be monitored through their continued career development in

Academia at Suez Canal University or the Egyptian fishery industry.

Training of EEAA Rangers will be monitored through their application of the stock assessment techniques as part of a continuous monitoring programme which will continue after the project has been completed.

Training of the fishermen will be monitored through the application of the skills into the development of community based mariculture schemes

17. How is the work of the project expected to continue after the end of grant period? A clear exit strategy must be included.

The Suez Canal University will support the project beyond the lifetime of Darwin Funding. This will result in further development and application of the pilot mariculture system within small fishing communities on the Red Sea coast.

The results from the fishery stock assessment will result in a fishery management plan for sea cucumbers in the Red Sea. This will be passed to the Governerate of the Red Sea who will build the recommendations of the management plan into future fisheries policy before reopening the fishery.

The work with the bioactive substances will be continued with further development of any suitable biomedical compounds. The benefits of the development of these products will be shared between the partner institutions (see attached letter).

Two of the three research students will be appointed as staff members in the Department of Marine Sciences in Suez Canal University and will assist with the further development of the mariculture and fishery management projects beyond the lifetime of Darwin funding.

The third research student is likely to be appointed to the Institute of Biotechnology, Suez Canal University and further develop the bioactive substances project.

MONITORING AND EVALUATION

18. Describe how progress on the project would be monitored and evaluated in terms of achieving its aims and objectives, both during the lifetime of the project and at its conclusion. How would you ensure that it achieves value for money? What arrangements will be made for disseminating results? If applicable, how would you seek the views of clients/customers?

A **Scientific Committee** will be formed of participants from each of the partner institutions. It will be Chaired by **Dr Mustafa Fouda, Director of the Natural Conservation Sector of the EEAA**. He will be supported Dr Andrew Lawrence and Dr Raoul Kilada who will act as Joint Deputy Chairs. The role of the Board will be to monitor progress during the period of the project, check that work is progressing at the right pace and meeting targets, via the following mechanisms:

1 Quarterly written progress reports will be submitted to the Deputy Chairs by the Research Students
2 There will be 6 monthly meetings between the Research Students and the Co-Chairs (January & July)
3 There will be an annual meeting of the Scientific Committee to monitor progress (July)
4 A final meeting of the Committee will include a one day seminar in which the results of the project are disseminated to a wider audience.
5. A final report will be produced by the Scientific Committee.

19. Logical framework. Please enter the details of your project onto the matrix using the note at Annex B of the Guidance Note.

Project summary	Measurable indicators	Means of verification	Important assumptions
Goal To help Egypt, a country rich in biodiversity but poor in resources, meet its obligations under the Biodiversity Convention.	• After 12 months provide checklist of holothuria. • From 1-24 months, one species reference collection • After 24 months provide recommendations for sustainable fishery and biomedical properties • After 36 months, 10 EEAA rangers and 30 locals trained in stock assessment/ mariculture	• Information included in NBUs NBS • Fieldguide to Holothuria of the Red Sea • Computer database and GIS system • Final Report of project Scientific Committee • 3 MSc theses • Publications in scientific literature • Minutes and reports of all progress meetings	• EEAA to continue monitoring beyond Darwin funding • Mariculture not only to prove viable but local communities to develop and operate their own systems based on training • Additional funding/ sponsor found to support work on bioactive substances
Purpose To develop the first example of a sustainable sea cucumber fishery along the Red Sea coast of Egypt	• After 24 months, fishery management plan • After 24 months, primary analysis of biomedical benefits completed • After 36 months, pilot mariculture system in operation/ feasibility study completed • After 36 months, trained rangers and fishermen	• Sea cucumber management plan • 3 MSc theses related to the fishery resource, mariculture and biomedical compounds • Publications in the scientific literature • Final report of project scientific committee • Press releases/ newsletter articles	• Recommendations are accepted and incorporated into policy • Information generated ie: species, economic value, rational use accepted and incorporated into NBU's NBS • Mariculture to offer a viable alternative to fishing for local communities
Outputs • Produce a fishery management plan for sea cucumbers • Produce a pilot mariculture system • Identify secondary compounds of potential biomedical value • Train EEAA rangers and local fishermen in stock assessment and mariculture respectively	• After 12 months species list and reference collection established • After 24 months stock assessment, database and GIS system established • After 24 months bioactive compounds and their activity identified • After 36 months, pilot mariculture system operating	• 3 MSc theses • Field guide to Holothuria of Red Sea • Papers published in scientific literature • Final report of Scientific Committee • Minutes and reports of all progress meetings • Press releases/ newsletter articles	• Recommendations of the management plan accepted/ incorporated into policy • EEAA to continue monitoring beyond Darwin funding • Mariculture to prove economical and therefore expanded by the trained fishermen
Activities • Stock assessment for Holothuria along Red Sea • Development of mariculture system for sea cucumbers • Isolation of bioactive compounds and their specific activity • Training of Egyptian scientists, EEAA rangers and local fishermen	• £160, 700 requested from Darwin Initiative • £170, 308 donated by partner institutions • species list and collection established • After 24 months database and GIS system established • After 24 months bioactive compounds and activity identified • After 36 months, pilot mariculture system operating	• Cost statement for grant will be available from Hull University Research Office • Minutes and reports of all progress meetings • Press releases/ newsletter articles • Final report of Scientific Committee • Papers published in scientific literature	• Secondary compounds with potentially useful bioactivity are found • In vitro fertilisation and culture of plankton stages proves successful in mariculture