



DEFRA
Darwin Initiative for the Survival of Species

Final report

June 2003

<i>Project title</i>	Biodiversity in the basement of the food web – Plankton sampling, processing techniques, taxonomy and data-evaluation training in Seychelles and Mauritius and its use in environmental monitoring and management of marine resources and biodiversity
<i>Country(ies)</i>	Seychelles & Mauritius (including Rodrigues)
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Acknowledgments

This project has been successful due to several factors, which as project manager I would like to acknowledge at the start of this final report. First, was the fantastic support we received from the *Shoals of Capricorn* team, both in London and in the host countries. The end of the *Shoals* programme in late 2001 resulted in the logistical management transferring to PML, and at it was only at this point that we fully realised the level of support we had received from the *Shoals* team during the first half of this Darwin project. We are indebted to Juliet and Jessica (London) and the local Shoals teams in Rodrigues, Mauritius and Seychelles for the help and support they gave us and this project.

After our first field visit in September/October 2000 we had met and fully engaged the local host country teams with agreed training and research programmes. The commitment from the authorities in both host countries was, and still is, tremendous and their continued support and development of the work started by this Darwin Initiative project shows how much both countries value their marine environment. The people of Seychelles, Rodrigues and Mauritius made us truly welcome and we will be forever grateful for their friendship and the support we received throughout the field visits in the region. Both countries are beautiful, with rich cultural roots and a strong sense of their responsibility towards the health of the biodiversity within their marine environment. As scientists engaged in the issues of concern for today's marine environment (from climate change to human impacts and the social and economic consequences of both) the opportunity for us to combine setting up work on these issues with committed people locally and in such stunning waters in terms of biodiversity, means that there can be few better places to work.

As a team we are indebted to Dr Annelise Pierrot Bults, from the University of Amsterdam, who accepted our invitation to be the invited speaker at the **final international conference and workshop in April 2003**. The final conference was hosted by the Seychelles Centre for Marine Research and Technology - Marine Parks Authority (SCMRT-MPA), and we thank Rolph Payet (Director General Policy & Planning, Ministry of Environment) for his support for the project and hosting the conference and to Evariste Michel and the SCMRT-MPA team who helped make the conference a success.

My final thanks go to the UK team who set up and delivered so much of the projects aims. In particular I would like to thank Dave Conway, Rowena White and Chris Gallienne for the tireless work they put into setting up the main training programmes and producing the manuals and 'Zooplankton Guide'. Everybody has put in far more time than originally contracted and Rowena White, and Dave Conway in particular, have provided a huge amount of unpaid time to make the final products so impressive. Joanna Hugues Ditt Ciles joined the programme in the latter phase but made such a difference with the final conference, this report and its outputs, and her smile!

It has been a real pleasure to work with the teams across the region.

David B Robins

Plymouth, UK; June 2003

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1. Summary of proposal objectives and (*achievements*)

Biodiversity in the basement of the food web – Plankton sampling, processing techniques, taxonomy and data-evaluation training in Seychelles and Mauritius and its use in environmental monitoring and management of marine resources and biodiversity

The objective of the Project is, for the first time, to identify keystone zooplankton species in the waters around the Seychelles and Mauritius. This will require training and development of techniques for *in-situ* monitoring, thereby building capacity within the host nation countries to sustain a research and monitoring programme leading to domestic use of the data as a basis for long-term resource management strategies and conservation of biodiversity.

The project will comprise two main sections:

1. **Zooplankton taxonomy** – identify the keystone zooplankton species in the waters around Mauritius and Seychelles in order to
 - Provide training in plankton identification, and produce identification guides for the key species for use in future monitoring, management and training initiatives.
(Training completed and guides produced and disseminated freely over the internet).
 - Provide a good north-south data spread and thus information on biogeographical distribution of plankton in the region.
(Data from each field base and cruises collected, analysed and published)
 - Provide the potential for monitoring background environmental issues.
(Monitoring at Times Series stations set up and running for 3 years)
 - Provide information for fisheries stock management.
(Project outputs now being linked to regional projects related to fisheries)
 - Provide data for tracking the potential recruitment of reef-building and other important coral reef species.
(Project outputs being integrated into research on corals and marine protected areas)
 - Support the existing *Shoals* education initiatives, involving local colleges, schools and community groups, to help raise the local understanding of the importance of plankton and their role in the region's living resources.
(Project integrated into Shoals education initiatives with outputs linked to education)

This key-stone species list will provide a basis for long-term plankton monitoring in the western Indian Ocean, and will form the foundation for developing a monograph of plankton species for the region. *(Guide to the coastal and surface zooplankton of the south-western Indian Ocean. 367pp – produced and disseminated)*

2. To utilise the **Optical Plankton Counter** (OPC) technology to collect data on density, seasonal distribution and biomass of plankton, and to develop *in-situ* monitoring techniques for future research in the western Indian Ocean region. The introduction, training and use of new technology into this project will enable the host participants to gain a further understanding of zooplankton community structure (in terms of size spectra) and rapid assessment of total zooplankton stock for long term monitoring. This will not only provide valuable information about the zooplankton population as a whole, but will also give the host programmes added value in disseminating their results internationally. This is innovative technology that, as yet, has never been applied in this important region.
(OPC's sourced at reduced cost, training completed and data being analysed as part of the research and monitoring programme)

2. Project background & rationale

This Darwin Initiative (zooplankton) project was developed to nest within a larger regional research and training initiative, The *Shoals of Capricorn* programme. The *Shoals* programme was initiated by the Royal Geographical Society (with The Institute of British Geographers) in association with the Royal Society and the governments of Seychelles and Mauritius. The programme was designed to investigate the massive submerged Mascarene Plateau which lies between Seychelles and Mauritius in the western Indian Ocean. The programme was also committed to raising public awareness and understanding of the marine environment through research and education, locally and regionally. Through integrated research, training and education the *Shoals of Capricorn* programme worked towards developing the knowledge and skills required to manage this regional ecosystem in the western Indian Ocean, with relevance (both regional and global) for the protection of the biodiversity and marine resources of coastal and oceanic areas.

Shoals of Capricorn Programme – the context

At the generic level, the programme aimed to address problems occurring at the global level: coastal zones and adjacent marine systems are under pressure from human activities and global change scenarios (e.g. climate change). Current and predicted growth of coastal populations world-wide will cause an increased dependency on marine resources, resulting in further depletion of these resources and risking an escalation of extreme poverty in some coastal communities. Globally the problem is further compounded by concentrations of industrial development and the spread of tourism across coastal zones of both developed and developing countries. If the integrity and biodiversity of coastal regions is to be maintained or improved, appropriate proactive management strategies will be required. Where there is pressure on coastal marine biodiversity, increasing the need for further research into marine processes and ecosystems is fundamental for future conservation and environmental management plans.

As mentioned above, this Darwin Initiative project was developed within the framework of the *Shoals of Capricorn Programme*; the resulting collaborative research and education programme will help with the management of the Mascarene Plateau, which can be considered a Large Marine Ecosystem in the western Indian Ocean. The *Shoals* programme was the first multi-disciplinary research project to focus solely on this region. Through its network of field bases, operational between 1998 and 2001, the *Shoals* programme hosted over 200 international scientists from 21 countries, all investigating different aspects of the marine environments of the region.

The location - The Mascarene Plateau

The remote Mascarene Plateau is a spectacular submerged plateau dominating the western Indian Ocean, extending approximately 2,000 km between Seychelles (a remnant of the super-continent Gondwanaland) and Mauritius (a volcanic island). Larger than the Great

Barrier Reef and longer than the Red Sea, it is one of the few submerged features clearly visible from space. It covers an area of over 115,000 square kilometres of shallow water with depths ranging from less than 10m to 150m on the plateau, plunging to abyssal depths of 4000m at its edges.

Surprisingly little is known or has been published about the Mascarene Plateau, yet it represents an area where a number of oceanic and physical processes can be studied in close proximity, an interface between deep and shallow waters away from the influence of major land masses and their associated impacts. The local communities on the islands at each end of the plateau are highly dependant on the environmental 'goods and services' the seas provide.

The scientific concept behind the *Shoals of Capricorn* programme was formulated by 120 scientists, many with a particular interest in the Indian Ocean region, at a 2-day seminar in December 1995 hosted by the Royal Geographical Society (with the IBG) and the Royal Society, representing an outstanding breadth of scientific expertise.

The *Shoals of Capricorn* programme was designed to assist the host nations of Seychelles and Mauritius to meet their obligations to the 1992 Rio Convention on Biodiversity. During the Shoals programme the work was carried out from field bases extending from the off lying island of Rodrigues through Mauritius, to Seychelles, with ship based research carried out on the Nazareth Bank and Saya de Malha. These field bases effectively formed a line of Ocean Observatories extending from the Equator to the Tropic of Capricorn providing comprehensive cover of the western Indian Ocean for the long term study and monitoring of oceanic and climatic change, particularly when linked to existing regional and future international activities and facilities.

The *Shoals of Capricorn* programme was also committed to training and education. Training through research and education has helped the regional and local skills-base necessary for future research initiatives, conservation and community-based stewardship for the protection and management of local marine resources and biodiversity. The programme encouraged regional and international links between scientists and institutes necessary for long term skills development in the region. The exchange of expertise and technology is fundamental to achieving these goals. The Darwin Initiative zooplankton project (covered in this final report) was specifically aimed at the exchange of such expertise and technology, and fostering ongoing collaborations within and outside the region.

The Science (Biological Factors – Biodiversity)

In collaboration with host nation scientists, The *Shoals of Capricorn* programme and this Darwin Initiative project, offered an opportunity for marine scientists from multiple disciplines to work together, focusing on one part of the marine system (plankton), addressing important scientific and technical issues. An integrated approach to the science improves our understanding of the interdependence between the physical and biological processes in the marine ecosystem and will have important practical implications in the

development of management strategies for this regional sea with its unique marine biodiversity. The Darwin zooplankton project contributed to an overall approach to study productivity, habitats, marine biodiversity and taxonomy. This was designed to lead to improving the identification of sources and sinks which are linked to reef fish and other important marine larvae, fundamental to sustaining the rich marine biodiversity of reef and coastal ecosystems. Examples of outputs from the project were provided at the final Darwin conference in April 2003 and are included in the appendices.

Training and Education

Marine research will never achieve its full potential if the results remain inaccessible to the community at large. Raising awareness through training and education has therefore been a core element of this Darwin Initiative project and more widely the *Shoals of Capricorn* programme. The programme has been successful in promoting marine scientific research and environmental awareness by training through ongoing research activities, contributing to the regional skills base for the implementation of effective coastal and ocean management strategies and the protection of biodiversity. Training and education techniques developed by the *Shoals of Capricorn* programme have had important applications for training programmes and community education in other programmes. The Darwin zooplankton project benefited from this output from the *Shoals* programme.

Schools education programmes were initially implemented in Seychelles and Rodrigues (Mauritius) as pilot schemes. The schools education programme had two main objectives:

1. To develop awareness of marine science and research in the classroom, and to understand the importance and potential of marine environmental issues for future studies.
2. To encourage community stewardship and co-management of marine resources by developing a three-way exchange of information and interaction between the schools, government authorities and the communities.

The training element within the *Shoals* programme aimed to develop a local and regional training capability by training local personnel as instructors in various field and laboratory techniques including diving, surveying and monitoring, thus providing access to a local skills base for the development of future training initiatives within the region. The Darwin zooplankton project was embedded in the overall *Shoals* approach and was successful in targeting government departments, marine park personnel, schoolteachers, students and the wider community.

Within this Darwin project we successfully developed and implemented a comprehensive field and laboratory training programme, which covered a range of topics as outlined below:-

Training at sea:

- Health and safety considerations. Potential for injury during equipment usage. Handling formaldehyde in a small boat.
- Deploying and recovering nets. Speed and direction of boat, determining length of rope to pay out.
- Reading and recording the flowmeter.
- Attaching and using the conductivity (for salinity), temperature and depth (CTD) probe for environmental monitoring.
- Processing and preserving the sample. Washing down the sample into the cod-end, transferring to the sample jar with preservative.
- Initial cleaning of the net at sea to prevent sample contamination and back at the base to stop progressive clogging.
- Taking and recording associated meteorological and environmental observations: sea state, wind direction, cloud cover, and from the CTD, sea surface temperature and salinity.

4 Training in the laboratory: *SMCF*

- The theory and applications of plankton sampling studies. Aspects of survey design, choice of equipment and net mesh size, frequency and depth of sampling.
- Health and safety. Handling formaldehyde.
- Care and servicing of equipment following sampling.
- Sample handling, removal of formaldehyde from samples before analysis.
- Sample sub-sampling using various techniques.
- Use and adjustment of microscopes.
- Identification techniques and counting of the very diverse range of organisms sampled using taxonomic keys and the guides produced. Handling, manipulating and dissecting organisms to aid in identification.
- Curation of samples. Checking labeling, storage conditions, samples are not evaporating. Maintaining archive records.
- Excel spreadsheeting, processing and data presentation.
- Instruction on general marine biology, the specific biology of the animals found, production processes in the sea, potential applications of the expertise gained in other studies.

Identifying the need for a Darwin project

Through its work in both Seychelles and Mauritius, and through meetings with Government personnel and key stakeholders, the *Shoals of Capricorn* programme identified the real and pressing need for both Mauritius and Seychelles to gain a better understanding of the techniques required for the identification and monitoring of key zooplankton species. Zooplankton are the very small, often microscopic, animals that drift in the world's oceans and comprise many early life stages of living resources for coastal communities and larger more familiar marine life. The zooplankton also play a key role in the oceanic carbon flux and are one of the primary mechanisms for transfer of carbon out of the surface waters and into the deeper waters and sediments. Zooplankton also play a key role in food web dynamics and are important food sources for larval stages of many

commercial fish (a fuller purpose for looking at zooplankton of the region is given in section 3).

Whilst there have been extensive studies into the commercial fisheries in the region, virtually nothing had been done to study the zooplankton, within which are found the early life stages of fisheries species and their food; nor had any key indicator species identification guides been developed and produced which local scientists can use to monitor their reef and lagoon systems in terms of global change and recruitment. The project was therefore developed to provide a local capacity for monitoring change and species recruitment in the marine environment, providing a better understanding of the distribution and density of planktonic biodiversity linked to resources, leading to better management and conservation of these important species in particular and local biodiversity in general

3. Project Summary

Objectives met or modified

Virtually all objectives have been met or exceeded. However we have not fully integrated the project at university undergraduate level in Mauritius. Instead we have focused on building a network with the respective agencies and authorities. This has resulted in a more sustainable legacy to the region, as the Darwin work has been better mapped onto the regional marine capacity building agenda. This has arisen partly because since the start of the project the Darwin team has been working hard to build relations with the authorities in Mauritius. This stemmed from an apparent breakdown between a senior official in the region for the *Shoals of Capricorn* programme and the authorities in Mauritius. As a result the project output linked to students in Mauritius has been refocused at including the Albion Fisheries Research Centre (AFRC), the Mauritius Oceanography Institute (MOI) as well as the University of Mauritius. This has resulted in strong support for the project, which was also essential for the new NGO in Rodrigues and there has been developing collaboration on each field visit to Mauritius with training and short workshop activities, which have subsequently involved students from the University. Therefore our overall outputs on mainland Mauritius have exceeded our initial targets, albeit with a slightly revised priority and focus.

Purpose and objectives

The objective of the project was, for the first time, to identify keystone zooplankton species in the waters of the Mascarene Plateau and around the Seychelles and Mauritius in particular. This required training and development of techniques for *in-situ* monitoring and to build capacity within the host nation countries in order to sustain a research and monitoring programme. This will lead to domestic use of the data as a basis for long-term resource management strategies and conservation of biodiversity.

Zooplankton are floating or weakly swimming animals that rely on water currents to move any great distance. They are usually larger than phytoplankton, ranging from tiny copepods, less than a centimetre long, to jellyfishes and colonial salps that may be metres long. There are two major types of zooplankton: those that spend their entire lives as part of the plankton (called Holoplankton¹), which spend their entire lives as part of the plankton, and those which spend only the larval or early stages of their life as part of the plankton (called Meroplankton²) and spend their adult lives on the reef or adjacent areas.

Importance of zooplankton in tropical marine ecosystems

A single reef can be home for up to 3,000 different animal species. The zooplankton play a truly important role within the coral reef food web as they feed on algae (herbivorous) in the surface waters or prey on other smaller animals (carnivorous). Some of them even switch their diets. Their predators are reef fishes, larger crustaceans or filter feeders that are associated with the coral habitat like mussels or sessile worms and of course corals. Up to 17% of the total coral metabolic requirements may be covered by predation on zooplankton compared to about 71% from primary production by the symbiotic algae within the coral and 12% from absorption of dissolved organic matter present in the seawater.

To support coral reefs with their enormously diverse and dense assemblages of organisms, the input of nutrients and plankton from waters that overflow the reef is necessary. The need for understanding plankton dynamics from the adjacent open ocean is therefore extremely important as this provides a source of zooplankton to the reef, as food for planktivorous fish and filter feeding organisms.

Convention on Biological Diversity (CBD)

(The most relevant Articles to this Darwin Project are presented in Appendix 1).

There are several articles of the CBD which describe the project:

Article 7 is very much integral part of the project in that identification of zooplankton, monitoring, sampling and identification have all been carried out in order to provide in better management tools for the management of the marine resources of Seychelles, Mauritius and the off lying island of Rodrigues.

Article 12: the project principally aimed at research and training of local scientists by focussing on their specific needs. The project not only established programmes for scientific and technical education and training in measures for the identification, conservation and sustainable use of biological diversity and its components and provide

¹ This group includes krill, copepods, various pelagic (free swimming) sea snails and slugs, salps, jellyfish and a small number of the marine worms.

² It includes sea urchins, starfish, sea squirts, most of the sea snails and slugs, crabs, lobsters, octopus, marine worms and most reef fishes

support, but also promoted and encourage research which will contribute to the conservation and sustainable use of biological diversity in particular reef fish species and larval recruitment within reef habitat and neighbouring marine habitats i.e. seagrass beds and mangroves.

Article 13 was also fulfilled as the project promoted public education and awareness and trained a wide range of people in particular in Seychelles from different organisations which brought awareness and interest towards the marine environment and the role of zooplankton.

Articles 16: the project has already seen a transfer of technology in that the zooplankton data and analysis now is used for a national study of the Whale Shark in Seychelles to gain a better understanding of the species feeding behaviour and food sources. And in Rodrigues the transfer of technology has been integrated into their coral research programmes.

Articles 17: The information gathered and collected in Seychelles and Rodrigues will be part of a broader scientific view and will be used for other conservation and biodiversity projects in the future.

Articles 18: This article will also be implemented as the contracting parties in the region have already scoped a regional long term project to study and monitor zooplankton within the Mascarene plateau.

Meeting objectives

The project started well with the first field visit in September/October 2000. In the Seychelles the *Shoals of Capricorn* base on Sainte Anne Island provided the training and workshop facilities. These were in well appointed laboratories within the Marine Parks Authority (MPA) complex on the island and local agencies were very co-operative in releasing people from their departments or agencies for training. The Coast Guards provided boat transportation to ferry people from the island to and from Victoria, where most worked. In the off-lying island of Rodrigues (the main Mauritian base) the *Shoals* base was well appointed with a core team of local staff and trainees. Not as many people were involved, but they were just as co-operative as in the Seychelles.

Progress was been kept to schedule and in keeping with outputs. The main periods of field visits were September / October 2000, February / March 2001, September / October 2001; March / April 2002 September/October 2002 and April 2003. During these field visits training and research workshops were run in both Seychelles and Rodrigues. This was in keeping with the programme framework of fieldwork. On mainland Mauritius we engaged the Mauritius Oceanography Institute (MOI), the University of Mauritius and Albion Fisheries Research Centre (AFRC). This started with meetings in September 2000, a small focused workshop in spring 2001, further meetings in October 2001 and a training workshop in 2002 as well as significant participation in the final conference in April 2003, held in the Seychelles.

Programme Deliverables

The programme consisted of several phases. It started with scoping and sourcing all the equipment needed to set up a practical plankton analysis and research laboratory. The equipment included microscopes and all the sampling equipment needed to collect zooplankton. Once in the region the equipment was commissioned and labs set up before training could begin. Once training started, the research and monitoring aspects were addressed and set up, so that monitoring in the region started at the beginning of the project. This ensured that (a) the time series started at the earliest opportunity, (b) that the trainees had real data to gain experience of setting up and running monitoring projects, and (c) early results would allow the Darwin team to highlight any trends etc that should be factored into future research and training. A check-list of main activities follows:-

- ✓ The equipment and consumables required to carry out plankton monitoring surveys were sourced, delivered to the bases in the region and set up to commission (fit-for-purpose) working zooplankton laboratories.
- ✓ Suitable sampling sites were identified, and collection and analysis programmes initiated.
- ✓ A plankton sampling/sample processing techniques manual was prepared and subsequently updated.
- ✓ Training in the use of the sampling equipment and Optical Plankton Counter, and in plankton identification was carried out in accordance with the agreed timetable and framework outputs.
- ✓ 6 periods of field visits have been made to train and update training, to the level where the capacity to train people locally now exists.
- ✓ A bibliography of research papers for the region was compiled.
- ✓ A preliminary identification guide to the plankton of the region was prepared and subsequently updated.
- ✓ Plankton species lists for the sampling sites were prepared.
- ✓ Production of a detailed plankton identification manual for the region finished, available electronically and on CD Roms.
- ✓ Educational (schools) talks on the project were given in Rodrigues; considerable educational programmes were carried out in the Seychelles, including production of a 'Plankton' poster for all schools.
- ✓ An article was published in the UK through NERC's Planet Earth quarterly journal with a distribution of 14,000 worldwide (a copy of the article is in the appendices).
- ✓ Two articles on the project were published in the Newsletter of the Marine Biological Association of the UK.
- ✓ There has been considerable TV and press coverage in the Seychelles and Mauritius (see appendices).

- ✓ Presentations at two international conferences have been made one in Mauritius and one in London. A presentation has also been made to the Cabinet of the Republic of the Seychelles in the presence of HRH Prince Michael of Kent. See appendices for details. The programme will also be presented at an international conference in early 2004 hosted by the Royal Society in London.
- ✓ A final international conference and workshop was held in April 2003 at the Seychelles Centre for Marine Research and Technology – Marine Parks Authority (SCMRT-MPA), at which presentations were made by groups from Seychelles, Mauritius and Rodrigues.

4. Scientific, Training and Technical Assessment

Capacity building

Training was carried out on each of the six periods of visits to the Rodrigues and Seychelles bases, but because UK personnel sometimes went individually, a total of nine visits were made, plus a separate training workshop held in Mauritius in April 2002. Training has progressed in keeping with scheduled outputs. In the Seychelles and Rodrigues some of the host country participants have gained sufficient experience and expertise that they can help with basic training needs of new participants.

The research started at the beginning of the programme in 2000. Since the first field visit regular sampling has been carried out in Rodrigues and the Seychelles. This has led to a time series of baseline data, which is being used to investigate seasonal patterns of distribution and abundance, never before recorded. These time series are now being collected more regularly and where possible weekly, which at the end of the second year of the project started to produce interannual trends and variability.

Rodrigues

Participating bodies

- Shoals Rodrigues (formerly part of *Shoals*, then a NGO from October 2001)
- Department for Fisheries
- Department of Environment

In Rodrigues, where staff numbers are small, initially two core staff were trained in identification of zooplankton species, identification techniques and data processing. Subsequently two more of the support staff were trained, as well as three local fisheries officers and one Environment Department employee. Training in sample collection at sea and initial processing was given to six staff. The most experienced staff are now training other personnel in sample collection, processing and taxonomy. The expertise gained from the monitoring sampling is now being used in another project, taking plankton samples in association with the regular coral reef surveys. The provision of equipment by the programme and confidence gained in carrying out zooplankton research, has stimulated the Rodrigues team to pursue funding to initiate a regional fish egg and larval sampling research programme. This would be used to identify spawning seasons of the

major commercial and also threatened species results from which could be used to modify fishery policy.

Mauritius

Participating bodies

- University of Mauritius
- Mauritius Oceanography Institute (MOI)
- Albion Fisheries Research Centre (AFRC)

In April 2001 6 Mauritian personnel from the Albion Fisheries Research Centre (AFRC) and one from the Mauritius Oceanography Institute (MOI) attended a week-long zooplankton training workshop at the AFRC laboratory in Mauritius. Training included field sampling, sample processing, taxonomy, counting and data entry, data processing and presentation. One of the staff members from the Rodrigues Shoals base who had earlier received training as part of the programme carried out part of the training. Additional AFRC staff attended a series of lectures on marine processes and monitoring techniques. The Mauritians have now been supplied with equipment as part of the Darwin exit strategy and legacy and are pursuing funding to set up their own plankton biodiversity sampling and monitoring programme, and also studies on fish egg and larval distributions, for use in development of their fisheries policies.

Seychelles

Participating bodies

- Shoals of Capricorn Programme field staff (until the end 2001)
- Seychelles Ministry of Environment
- Seychelles Centre for marine Research & Technology (SCMRT) from 2002
- Marine Parks Authority (before integration with the SCMRT)
- Seychelles Coast Guard
- Seychelles Bureau of Standards
- National Meteorological Service
- PUC – Sewage Division
- EA & PC, Marine Unit (DoE)

In Seychelles, where the sampling programme is much larger, because of the greater pool of personnel available, a core of 6 people have been trained to analyse plankton samples and process the data, although 30 other individuals have completed comprehensive training in sampling and identification techniques. Trainees were drawn from the Seychelles Centre for Marine Research and Technology-Marine Parks Authority (SCMRT-MPA), Public Utilities Corporation, Seychelles Coast Guard, Seychelles Meteorological Office, and Ministry of Environment (Marine Unit). Suitable trainees were nominated by their various agencies, which were all enthusiastic that their staff should develop new skills. Nearly all the people in the Seychelles who were trained work within government departments. This has meant that people from across operational departments gain new understandings and thinking into the biodiversity and pressures on the marine environment. There has been some natural division of labour, with the Coast Guard and MPA collecting samples while representatives from the other agencies processed the

samples. Two of the initial trainees are now training further staff within their departments. The expertise gained in zooplankton sampling in the Seychelles has been transferred to a separate local programme, studying feeding grounds of Whale Sharks. As part of a GEF Programme introductory zooplankton identification courses have also been given to 30 students from the Maritime Training Centre.

The sequential series of visits to the two main bases allowed monitoring of progress, checking that correct procedures were being applied, health and safety recommendations were being followed, equipment was being serviced properly, identification of plankton organisms was being done correctly, samples were being archived / curated properly and that data was being entered and processed accurately. Certificates of achievement were issued to trainees when they attained an appropriate standard of proficiency.

Research

Staff

Research is carried out by a core of two people in Rodrigues and six in Seychelles, with larger numbers of staff providing support and backup. The projects in each country are also being extended to feed into other, related research programmes.

Methodology

A weekly zooplankton sampling schedule is carried out in both Seychelles and Rodrigues. The sampling equipment used is a conical 0.4 m diameter hand net of 125 μm mesh aperture, fitted with a General Oceanics (GO) flow meter. Because the stations are shallow and over coral, the net is towed on a horizontal haul for at least 5 minutes at approximately 5 m depth. Whenever possible, temperature and salinity measurements are taken in association with the hauls and records kept of meteorological conditions. Zooplankton samples are preserved in 4%, borax buffered formaldehyde. Zooplankton is being identified to as precise a taxonomic detail as possible using keys and guides, and counted using sub-sampling techniques.

Counting of samples is also being carried out at both sites using an Optical Plankton Counter (OPC) that also gives zooplankton volumes, which can then be used to estimate biomass. The plankton net mesh size of 125 μm was specifically chosen, as it samples organisms to the lower end of the size discrimination of the OPC. This net also efficiently samples the small copepods, which compose the bulk of the zooplankton biomass at the surface and in the coastal regions of these tropical waters.

In the Seychelles three stations are sampled for zooplankton, one off the capital Victoria (outside the immediate influence of the harbour), the second off the island of St Anne and the third in more open water, outside the small island of Seche. In Rodrigues one station is sampled, in water of 12 m depth, just beyond the reef edge, outside the shipping channel leading into the capital, Port Mathurin. Sampling stations were chosen to be accessible, except in extreme weather, and which were under the influence of both the reefs and open sea. Sampling is carried out, for safety reasons, only during the day and close to high water, to standardise sampling conditions as closely as possible.

Health and safety

Appropriate safety hazard sheets have been posted in rooms where formaldehyde is being used. Instruction has been given in how to avoid contact with formaldehyde solution and to use protective gloves, either disposable or washing up, when necessary. Handling, especially of 40% formaldehyde (wear safety glasses), is carried out in well-ventilated areas. All containers and wash-bottles containing formaldehyde are clearly marked and wash bottles with red tops, indicating they contain a hazardous solution are used. Eye wash facilities are available (eye wash bottle or tap water supply) in any area where formaldehyde is being used. The bases are also implementing their own health and safety procedures.

Plankton analysis methods

Before analysis is started on the sample, formaldehyde is filtered off, using gauze of the same size as the net (or preferably slightly smaller), folded into a cone and placed inside a funnel to act as a filter. The formaldehyde is returned to the sample jar for re-use with the same sample. The sample is then rinsed with fresh water while it is on the gauze in the funnel, to remove any remaining formaldehyde, then, washed off the gauze with fresh water using a wash bottle, into a graduated beaker. The samples contain many more organisms than can possibly be counted, so they are being sub-sampled, either with a graduated ladle, or a Stempel plunger pipette.

Findings

Rodrigues - the sea temperature only varies by around 8 °C over the year (22-30°C), with the minimum in August/September. The pattern is quite consistent between the three years of the study, although there were some problems with loss of data due to equipment failure.

In common with tropical regions in general, the zooplankton biodiversity is considerable. There have been 136 species and groups recorded to date, but this list does not indicate the full species range, as some groups such as the eggs and larvae of fish, larvae of crabs and shrimps and larva of other bottom living organisms such as shellfish and sea cucumbers etc. can only be identified by a specialist. The species list is continually growing.

The largest group sampled is crustaceans, especially copepods, of which there are over 79 species, mainly of 3 Orders. Other crustaceans include the larvae of barnacles, shrimps and crabs. Most of the crustaceans are ones that have been recorded in the general area before. However, we have already found one new copepod species in Rodrigues (*Tortanus insularis*), and there are almost certainly other new zooplankton species to be found. Another interesting find is a curious crustacean larva (Facetotectan), related to barnacles, which has only previously been recorded from European, North American and Japanese waters.

Fish larvae and eggs have not been identified, but this would be a useful area to research. It has been puzzling that there have been relatively few echinoderm larvae sampled, even

though the adults are an extremely common invertebrate. The reason for this is currently being investigated.

In general, highest zooplankton numbers occur at times when temperatures are highest, early and late in the years. Differences between years are found, and it is interesting that highest numbers of organisms were found in late 2000, the year in which temperatures were lowest at this time of year and numbers were lowest in late 2002 when temperatures were highest out of the three years. The reasons for this needs closer consideration, but may be related to the optimum temperature for reproduction of many of the organisms.

Copepods are one of the most important groups in the samples, small crustaceans, in the same group as crabs. Most are herbivores, feeding on the tiny plants (phytoplankton) in the sea, so are at the base of the food web, transferring energy upwards. At most times they represent over 70% of total organisms. It is difficult to identify seasonal changes, but there is an indication that copepods are slightly less important during the colder months.

Meroplankton is the name we give to larval organisms that spend only part of their life in the plankton. Meroplankton includes larvae of shrimps, crabs, sea urchins, starfish, shellfish, barnacles and even fish eggs and larvae. All these organisms when they reach a certain size settle on the bottom and develop into adults, or in the case of fish become independent of tides and currents. In 2000, meroplankton numbers appeared to be high at the end of the year, while in 2001 high numbers were at the beginning and also the end of the year, periods when temperatures were highest. In 2002 however, numbers were consistently low, without any obvious trends. It is possible that changes in numbers of these larvae may be related to changes in numbers of adults between years.

The eggs and larvae of fish were not identified, as they require a detailed study on their own. Many of the eggs and larvae of the wide range of fish species that occur in reef areas have not been well described, although it is possible to separate them into general groups. Fish larval numbers were almost always higher than egg numbers, probably because egg development time is short, while the larval stage is much longer. Larval numbers were high in late 2000 and early 2001, but at other times were low, especially in 2002.

Seychelles - The samples for the three year sampling period have been analysed, but data is still being entered and detailed analysis of results is not yet fully available.

Sea-surface temperature is at its lowest in June at around 26°C, rising slowly to a peak in April of 29°C, so the annual changes are very small. Surface salinity varies from around 34.5 to 35.7 over the year. The range of species is similar to Rodrigues with some distinct variations. There have been 132 species and groups recorded to date, but again, this list does not indicate the full species range and the list is continually growing.

Over 60 species of copepod have been identified. A new species of copepod has been found at Cap Ternay, beside the SCMRT-MPA base. It is of the same genera (*Tortanus*) as the new species found in Rodrigues, and its description will be published as soon as drawings are prepared. This same new species has subsequently been sampled by us in Mauritius and Madagascar, and the new species we found in Rodrigues has also been

found to occur in Madagascar. *Tortanus* is generally considered to be a coastal species of the continental fringes, and these records around isolated offshore islands have interesting zoogeographical implications. We have collected specimens of all the new species from their various locations and these will be analysed genetically to explore interrelations and to see whether their distributions can be related to the ancient Indian Ocean current systems. The results of this will be published once genetic analysis is completed. Facetotectan larvae have also been sampled in Seychelles, another new distribution record.

Main documents produced

Conway DVP, White RG, Hugues-Dit-Ciles Joanna, Gallienne CP, Robins DB (2003). Guide to the coastal and surface zooplankton of the south-western Indian Ocean. 367pp. Marine Biological Association. No. 15.

Gallienne, C.P., Conway, D.V.P., Robinson, J., Naya, N., Williams, J., Hooper, T. & Meunier, S. (In Press). Epipelagic mesozooplankton distribution and abundance over the Mascarene Plateau and Basin, southwestern Indian Ocean. Journal of the Marine Biological Association of the United Kingdom.

Ohtsuka, S., Conway, DVP (2003) A new species of *Tortanus* (*Atorus*) (Copepoda: Calanoida: Tortanidae) from Rodrigues Island, Mauritius. Journal of the Marine Biological Association of the United Kingdom, 83: 355-360.

Papers in production by staff at bases

Meunier, S. *et al.* Seasonal changes in zooplankton abundance off Rodrigues Island (Mauritius) in relation to environmental conditions.

Naya, N. *et al.* Species diversity and seasonal changes in the inshore zooplankton of the Seychelles

Further papers planned (provisional titles)

A new species of *Tortanus* from Seychelles, Mauritius and Madagascar.

The genetics of the Genus *Tortanus* in the Indian Ocean, and their distribution in relation to the ancient current systems.

“Zooplankton dynamics around the Mascarene Plateau”. To be published as proceedings from the Royal Society’s Scientific Discussion Meeting “*Atmosphere-ocean-ecology dynamics in the Western Indian Ocean*”; January 2004.

Peer review of research

The plankton guide (Conway *et al.*, 2003) has not been peer reviewed, although suggestions from various experts have been included. Once it has been circulated internationally, we have asked for feedback which can be incorporated in future revisions. Because the guide covers so many different groups of organisms, this is a more appropriate procedure than sending it to a few individuals who may only be specialised in restricted groups of organisms. All other papers produced, or in production, have gone, or will go through the normal peer review procedures of the individual journals.

Quality Assurance

For the purposes of this project, for which the scientific component throughout and the project management for the second half, was run by Plymouth Marine Laboratory, we have adopted the PML QA policy, which is reflected in the PML QA statement below:

“PML undertakes all of its research activities according to strict scientific standards. It employs recognised and reproducible procedures whenever possible, and ensures that all data and samples are sufficiently archived and protected. The Laboratory embraces the Joint Code of Practice for Research issued in 2003 by the Biotechnology and Biological Sciences Research Council, the Department for Environment, Food and Rural Affairs, the Food Standards Agency and the Natural Environment Research Council, and complies with it as far as is reasonably practicable.”

For accreditation see appendix XI

5. Project Impacts

We have achieved the project purpose. We have provided training and education on zooplankton taxonomy and research which has resulted in a skill base that can sustain the current activities and has the capacity to bid for new funding and projects, or to integrate the plankton work into other programmes. Some evidence of this already exists, for example with the Whale Shark programme in Seychelles, the coral reef work in Rodrigues and fisheries work in Mauritius. Routine zooplankton analysis is being completed and Time Series data sets are being developed, with some initial trends being shown. This will form the basis of monitoring programmes, which is one of the aims and initial analysis is now being done within the region.

An additional impact was integrating the project into an international scientific workshop on the marine biodiversity of Rodrigues (September 2001). Fourteen international experts from seven countries were invited to lead research to produce a taxonomic inventory of nine major taxa. The international delegates were joined by scientists from Rodrigues, Mauritius, Madagascar, Seychelles and Comores, who brought their own expertise to the workshop and had the opportunity to receive training in the identification of species with which they were less familiar. The other scientists came from England, Belgium, America, Australia and South Africa.

Additional outputs and unexpected impacts:

Coastal and Island states such as the Seychelles and Mauritius are potentially susceptible to a new threat from international trade. The introduction of non-native or "invasive" species can cause irreversible harm to delicately balanced ecosystems. By far, the biggest source of invasive species is the ballast water that ships take on and discharge as they sail around the world. This water provides balance and weight to ships when they are not carrying cargo, and is important to safety and performance. It can contain all sorts of

microscopic marine life, including eggs, cysts, larvae, and bacteria. Some invasive species can create significant problems to the balance of indigenous biodiversity. Hence it is extremely important to be able to detect the earliest signs.

Research and monitoring into invasive species is being implemented in both Seychelles and Mauritius. So this is an additional output of this Darwin programme.

6. Project outputs

The primary output from this project is a highly trained and motivated team of people in each country. These teams have demonstrated a sustainable collective skill base to carry out the fundamental work programme put in place to monitor and research the coastal plankton biodiversity. A more detailed description and quantification of the capacity building work outputs is contained elsewhere in the report. The Darwin project has created a database of biodiversity and associated data in each country as a basis for ongoing and future monitoring of biodiversity.

One of the primary outputs is the “Guide to the Coastal and Surface Zooplankton of the South-Western Indian Ocean”. This work output has already received much acclaim and has attracted attention from adjacent regions (e.g. India) whose marine scientists see the product as a wider regional resource – with all the accompanying prestige and publicity for the Darwin programme.

The project resulted in very significant press coverage in each country. In many cases we have been unable to collect examples (e.g. TV and radio recorded to tape). However on each of the six main field visits the Darwin project attracted national attention – some examples are included in the appendices or are described in section 9. This has given the Darwin Initiative and this zooplankton project a very high profile in the region, with both Governments fully engaged in the implementation and legacies.

The project outputs are summaries in Appendix II.

The design of the project has been enhanced.

In April – May 2001 we extended the scope of the programme (at no extra costs to the Darwin project) by one of the UK team, with host country participation, extending the research field to the whole length of the Mascarene Plateau. The cruise of the RSV Zuza was the *Shoals of Capricorn* programme’s first research cruise to the remote banks along the length of the Mascarene Ridge. RSV Zuza is a 20m sailing research vessel which was loaned to the *Shoals of Capricorn* programme by Last Chance Expeditions, and skippered by Mr. Deon Erasmus.

The cruise of RSV Zuza between Mauritius and the Seychelles was planned to augment the data being gathered in the Seychelles and Rodrigues bases, and to set it in the wider context of the Mascarene Plateau and Basin. Originally planned to depart from Rodrigues Island for the Seychelles, the northbound leg of the cruise was to concentrate on geological aspects of the ridge, whilst the southbound leg was to concentrate on hydrographic and biological studies, providing much-needed bathymetric data, a benthic survey of the shoals along the plateau, and a survey of pelagic zooplankton along the ridge system. Due to unforeseen delays and technical problems, the vessel was late leaving Rodrigues, and apart from some successful geological survey work in Rodrigues, the geological survey of the ridge had to be cancelled. The northbound leg of the cruise to the Seychelles was therefore utilised by Dr. Chris Gallienne for a survey of the distribution of open ocean zooplankton to provide a comparison with distributions along the ridge system on the southbound leg.

Research papers will be published from the Zuza cruise (one is already in press with the Journal of the Marine Biological Association of the UK) and a short summary report with preliminary data is included in the appendices. Dr Gallienne also participated in a UK NERC research cruise to the region in May 2002. This will provide useful background and reference data for the 'off-bank' zooplankton distributions which will be handed over the host country teams for future reference, providing valuable geographic information.

Dissemination of Information

The dissemination was an important output from the project and was consistently maintained throughout the programme. This was done via press releases and resultant press coverage, national radio and television coverage and other materials explaining the Darwin Initiative zooplankton project. Examples of the dissemination can be found in Appendix VIII. Dissemination was (and still is) also occurring through proactive engagement with other regional bodies such as NGO's and government agencies to ensure that the Darwin projects outputs are integrated into wider host country and regional initiatives. Dr Dave Conway's invitation to act as an invited speaker in Goa (India) is further evidence of this policy, see section 9 for Goa project description.

One of the primary outputs from the project is a comprehensive "Guide to the coastal and surface zooplankton of the South-Western Indian Ocean". This 367 page identification manual to the biodiversity of zooplankton in the South-Western Indian Ocean is the first of its type for the region and has already been recognised as a major contribution to the wider Indian Ocean as a whole (reference the participation in the Goa conference and workshop). The zooplankton guide is available in hardcopy, but to aid dissemination it will be mainly distributed as an electronic version. This is either on CD (with printed cover etc.) which is limited to 150 copies; or it can be downloaded via the PML web site. To further aid dissemination, the project is described on the PML web site at http://www.pml.ac.uk/pml/sharing/Plankton_Mascarene1.htm. The guide itself can be downloaded from http://www.pml.ac.uk/pml/sharing/Darwin_Guide.htm.

Also Dr Chris Gallienne will be presenting a paper at the Royal Society in January 2004. Dr Gallienne's talk, which draws on the Darwin work, is entitled "Zooplankton dynamics

around the Mascarene Plateau". It will be presented at the Royal Society's Scientific Discussion Meeting "*Atmosphere-ocean-ecology dynamics in the Western Indian Ocean*" on 19th & 20th January 2004.

We have also promoted the Darwin initiative by the distribution of bookmarks and pens with the Darwin logo and the programme title. This can be found in Appendix IX, which highlights the promotional material.

In Rodrigues, dissemination will continue as part of Shoals Rodrigues general environmental education initiatives (e.g. they have an Open Day on November 8th 2003 which will include a display on the Darwin Plankton Project on plankton) and they produce a regular Newsletter, a copy with an article highlighting this project can be found in the Appendices.

The project formed the basis of a 2 page (A4) article in NERC's quarterly journal "Planet Earth". The possibility of getting something into Planet Earth was initiated by the Darwin team and then translated into an invitation from the NERC Planet Earth Editors to contribute a full article. Planet Earth is a high quality UK research council publication, which is sent to senior British policy makers, and which has a worldwide distribution of 14,000; a copy of the article is included in the Appendices and is available from the NERC website: <http://www.nerc.ac.uk/publications/documents/pe-wnt02/mascarene.pdf>.

7. Project Expenditure

Final budget report

Total fund Available to PML £73315.5	Expected Spent over 18 months since PML took over in £	Actual spent
Rents, rates, heating, lighting		
Postage, stationary		
Travel and subsistence		
Printing		
Conferences and seminars		
Capital items: Optical plankton counters, PCs and parts		
Other equipment, bench fees and insurance		
Salaries		
Total		

Variation in budget

The project delivered its primary outputs on time and on budget for DEFRA. However, there was an overspend on salaries as the project required a lot more work from the UK scientists involved in order to deliver high quality outputs, publications and manuals. The

UK salary component was cut significantly before the project started when the Darwin panel asked for cost reductions. This excess cost has not affected the Darwin Initiative programme and has been absorbed by Plymouth Marine Laboratory or the individuals concerned in their own time. Only the extra time put in by Dr Chris Gallienne shows in the finance table. The extra time put in by other UK team members is not recorded within the report, but amounts to over one man year of effort with a full economic cost in the region of £50,000. That should be taken into account in the value for money consideration! There were also recurrent, travel and subsistence costs which were absorbed outside of the project finances. Within the projects finances we reprofiled some budget lines to ensure funds were available for the final conference and workshop. Some printing was done in-house to reduce costs to the project. The additional costs arose for several reasons. First, with the end of the *Shoals* programme the Darwin project staff incurred accommodation costs in Mauritius, where *Shoals* had previously received free accommodation at Sun International hotels. That concession was not available to the Darwin project after 2001. The project also started to incur accommodation costs in Rodrigues, which were not catered for in the proposal. Although we maintained a concessionary airfare agreement with Air Mauritius, this fell within a generally increasing fare price during the life of the project. By the end of the project air fares had risen to significantly above the proposal budget of £625 per person for a UK to Mauritius to Seychelles round trip. This was in part a result of September 11th impact on airlines and costs. Many UK travel costs were also allocated outside of the project.

The final conference and workshop developed into a significant opportunity to cement regional partnerships and so we increased the funding for this by adjusting the project funding profile to enable the most effective use of resources. The result was a hugely successful conference which had representatives from all stakeholders within Seychelles, Mauritius and Rodrigues. The final conference was hosted by the Seychelles government through the SCMRT-MPA and the Minister for the Environment officiated at the opening ceremony. The result was a conference which justified the increased funding profile within the existing budgets. Legacies of equipment was not affected by reprofiling spend.

8. Monitoring and Evaluation, lesson learning

Positive feedback came from delegates from NGOs such as the Shark Trust and the Marine Conservation Society, who were independent from the Darwin project and who evaluated the project outputs in relation to regional projects. The UK Darwin team met regularly to review progress and communicated via email with people in the host countries. This enabled a mechanism to monitor and evaluate how the programme was delivered, to identify successes and any changes required to the ongoing programme of work. David Robins as project manager undertook regular internal project reviews to ensure the quality and timeliness of project deliverables. He also visited the region annually to monitor progress and standards and to review the overall project milestones and ensure that the project was meeting host nation expectations. This required regular contact between the Darwin team and local stakeholders. For the first half of the project, the Darwin project reported to the *Shoals of Capricorn* Seychelles National Co-ordinating

Committee, which was chaired by Rolph Payet, Director General Policy and Planning at the Ministry of Environment. After the handover of *Shoals* legacies to the new SCMRT, the Darwin team liaised closely with Mr Payet and the SCMRT. The project team also kept in close contact with the Mauritius Oceanography Institute and reported progress on a regular basis to evaluate local stakeholder requirements.

We recommend that a workshop is funded in September 2005 to bring together the existing scientists involved from Seychelles, Mauritius and Rodrigues programmes and potential collaborators in the wider Indian Ocean region, to review the programme, specifically to look at the work that has undergone in the intervening 1-2 years. One of the aims of that conference would be to have further external evaluation and training to help map out further integration within the region. The proposed conference will be a tool to assess how the host countries are pursuing the zooplankton sampling and monitoring programme and would allow further monitoring on data collection and analysis, skills and training as they relate to scientific research programmes supporting the CBD. If we could get the funding for setting up this conference, it would enable the Darwin team to help the host countries extend the scope of their research and its applications where necessary.

9. Darwin Identify

The Darwin Initiative was publicised extensively throughout the period of the zooplankton programme. The Darwin logo can be found in all the Royal Geographical Society's publications relating to the programme, as well as on all the publications aimed to the public and other promotional materials (See Appendix VIII).

The understanding of the Darwin identity in the host countries was strong. In Seychelles and government officials and the High British commissioner were fully aware of the programme, as they attended throughout the duration of the programme each conference. The shoals initiative had a very high profile in the country and Darwin was clearly identified as part of that initiative. This was made evident in press releases and TV coverage.

The project received strong press coverage throughout the three years. Examples are given in the appendices. Other examples from TV coverage are described below. It proved impossible to get TV coverage recorded onto video. However photographs in Appendix X, show TV coverage at the start of the project, again during HRH Prince Michael of Kent's visit in October 2001 and at the final conference and workshop.

On the 16th April 2002 Mauritius TV reported comprehensive coverage of the opening ceremony for the plankton training workshop in Mauritius that was run by Dr Dave Conway. The Darwin team included a member of staff of Shoals Rodrigues, Sabrina Meunier, who had been trained within the Darwin project and was now training others. The coverage included a general interview on the purposes of workshop and importance of environmental research to the economy of Mauritius. The TV company covered the ceremony and speeches by Dr Conway and the Mauritius Fisheries Minister. They also

covered the training in progress. The article was broadcast twice on the television news programme and once in greater depth in a weekly roundup programme.

During October 2002 Seychelles TV aired comprehensive coverage of the Darwin project to help the Seychelles Centre of Marine Research and Technology (SCMRT) which wanted to publicise their laboratory so arranged a press visit during the Darwin teams 2 week training session. General interviews were given on the type of training and who was being trained and why. As well as the importance of zooplankton, in relation to global warming. Press coverage included interviews by SCMRT staff and trainees and shots of training in progress. Articles were televised 3 times – in English, Creole and French during the following weeks. An article was also published in the Seychelles Nation newspaper on September 30 for that field visit.

In Rodrigues, general awareness of the Darwin identity is good, and very good amongst people who have directly been involved in this or other the Darwin projects (e.g. Shoals, MOI, Ministry of Fisheries and Mauritius Wildlife Foundation). Shoals Rodrigues (as has SCMR&T in Seychelles) has got the Darwin logos around their centre on project equipment such as the OPC, the microscopes and also on the newsletter /website.

In all press coverage the Darwin name and identity was strong. Examples of news paper articles in the appendices demonstrate the strength of the Darwin identity.

10 Leverage

During the life time of the project, host country support was consistent and valuable, for instance free accommodation at SCMR&T / SCMR&T-MPA in the Seychelles, with matched funding from some transfers.

There has not been any additional funding associated with the project, however the scientific team involved in the zooplankton programme have given an enormous amount more of their own time than originally scheduled, which can count as match funding

Some effort has been made to raise the profile of the Darwin project with international funding agencies such as World Bank, GEF and European Union. This may yet result in leveraging new funds to extend the scope of the work started within the Darwin Initiative. Both Seychelles, Mauritius and Rodrigues are involved in GEF and World Bank driven programmes and thus are directly involved in the conservation of biodiversity and further programme proposals for those countries are in the pipeline. An EU regional funding programme of about 200 Million Euro is intended with marine related projects expected to attract about one third of the money. The host countries could thus benefit from capacity building resulting from the Zooplankton programme and potential following work.

There has been tangible evidence that the project has been effective in developing valuable and much needed outputs for the region as a whole.

Zooplankton taxonomic workshop in Goa

After learning of the taxonomic work carried out in the Indian Ocean during the Darwin Zooplankton Project, we were approached by the Indian National Institute of Oceanography in Goa, asking if it would be possible to run a plankton identification training workshop. In recent years there has developed a shortage of people, both in India and worldwide, with zooplankton taxonomic skills, making it difficult for countries to engage in zooplankton biodiversity research.

Dr Dave Conway agreed to hold a course in Goa from 24 November - 8 December 2003. Twelve participants from different laboratories in India will attend, to learn all aspects of zooplankton sampling, laboratory techniques, sample processing and curation, species identification, data recording and processing. In addition a series of lectures on marine processes and monitoring will be given.

International zooplankton biodiversity workshop in Goa

From 12-16 December the NIO Goa laboratory is hosting a workshop, with participants from all the Indian Ocean rim and island countries. This meeting is supported by the Census of Marine Life (CoML), Intergovernmental Oceanographic Commission (IOC) and the Partnership for the Observation of the Global Oceans (POGO) and will focus on gaining a better understanding of the current state of coastal and open-ocean marine habitats, identify new projects and new mechanisms to advance studies in marine biodiversity. It is hoped, as part of the IOGOOS initiative, to set priorities and develop plans for a research programme and sustained observations on marine biodiversity in the Indian Ocean region.

Dr Dave Conway will present a paper at the workshop, to be published in the Indian Journal of Marine Sciences:

Conway, D.V.P., Gallienne, C.P. Zooplankton biodiversity of the island coastal and surface, shallow water regions of the south-western Indian Ocean.

This paper will draw on zooplankton biodiversity data gathered during the Darwin Zooplankton Project. It will highlight the importance of studying the zooplankton biodiversity of the oceanic islands and shallow region, especially the comparative speciation and genetics of the inshore organisms in understanding zoogeography, past dispersion mechanisms and forecasting future dispersion and changes in biodiversity as a result of global warming.

11. Sustainability and Legacy

In Mauritius:

The Darwin Initiative zooplankton project has resulted in the training on plankton identification. Some specific projects are now emerging. The Mauritius Oceanographic Institute have confirmed that the collection and identification skills gained resulting from the Darwin initiative project will be used in new projects as this has triggered a deeper

interest in the status of zooplankton in Mauritian waters. Furthermore, a project on invasive species in ballast water will provide data for broader base project for the region.

In Rodrigues

The skills developed under the project will be very useful for the future, Shoals Rodrigues is looking to develop projects with more specific scientific applications (e.g. spawning periods and egg/larval transport for important commercial species) and so the skills and resources provided under this project will also be very useful for extending their research.

In Seychelles:

At SCMRT-MPA staff will continue with the zooplankton sampling and analysis and build up on the amount of data in order to better detect any changes/trend in zooplankton population and use it as a management tool for a number of related projects.

The work SCMRT-MPA is fitting in with the national biodiversity strategies. There is also developing cooperative work on fish larvae and spawn aggregation between the Seychelles Fishing Authority and SCMRT-MPA. In 2001, the Marine Conservation Society Seychelles started to collect and analyse plankton samples for the study of feeding behavior of whale sharks. Presently MCSS plans to review current plankton sampling and analysis techniques, with the aim of setting up a long-term monitoring programme along the west coast of Mahé. This will be based on the Darwin initiative zooplankton sampling programme and should result in the MCSS collaborating more closely with the staff at SCMRT-MPA. There are also plans to integrate the Darwin zooplankton work with projects looking at recruitment into and out of marine protected areas.

Improving the legacy

The legacy could be significantly improved by having a conference and/or workshop in 2005 to follow up host country progress and provide more support to the host country teams. It is likely that such a conference/workshop could be extended to several other countries in the region. By the end of the project teams throughout the region from Shoals Rodrigues, University of Mauritius, Albion Fisheries Research Centre (AFRC), the Mauritius Oceanography Institute (MOI) as well as the Seychelles Centre for Marine Research and Technology – Marine Parks Authority (SCMRT-MPA) were looking at ways to work together to extend the project aims, in terms of research and monitoring. This extended to exchanging best practice on projects such as invasive species and recruitment in and out of marine protected areas.

Therefore, there may be significant scope to extend the project through the Darwin Initiative extension programme.

12. Value for money

This programme was cut in terms of original budgets, with the Darwin panel asking for reductions in the UK salary element. This was duly reduced to the current contract budget.

It was therefore a modest programme financially with a mix of costs for salary, travel and recurrent for the host countries.

We believe that the Darwin Initiative received very good value for money from this project. As outlined in the Section 7, (project expenditure) significant additional time was spent on this project by the UK team. The result is a set of outputs that certainly have made a significant impact in the region, and which is already having an impact in the wider Indian Ocean rim. Additional outputs were included, such as the Zuza cruise and UK Darwin cruise which involved more than an extra 8 weeks in the field for Dr Chris Gallienne, with resulting publications and feedback into the regional partners and their programmes. One practical example where the figures did not stack up from the start, David Robins was costed for 5% of his time over the three years (i.e. 11 days per year) and in fact he spent more than 11 days in the region each year visiting each base and conducting meetings with host country partners. That does not even take into account the time spent in the UK on organising and running the project as well as writing up annual reports, articles and feedback to Darwin. Dave Conway has worked an additional 4 months of his own time on the project while Dr Rowena White has worked an additional 3 months. Their time and effort shows considerable value for money for the project and as enable the delivery of a very high quality zooplankton identification guide for the Mascarene Plateau.

On equipment and other recurrent, we sourced the best value possible. In the case of the two Optical Plankton Counters, bought from Focal technologies in Canada, we negotiated a much reduced purchase price to allow the purchase within the agreed budget and so we are indebted to Focal Technologies for their sponsorship of part of the costs of the equipment.

We therefore rate the project “Excellent” in terms of value for money, considering costs, the range of outputs and benefits to the region.

Conclusions

- The project was realistically costed at the proposal stage and as a result of pressure to reduce costs at that stage, significant costs have been incurred by individuals and organisations without affecting project finances or deliverables.
- The project has achieved all its objectives and exceeded some.
- There is a strong case to follow up the project with a regional conference/workshop. This would provide a timely evaluation of progress and performance and also facilitate wider scientific input to strategy for the host countries at local and regional levels.
- The end of the Shoals of Capricorn programme mid way through the Darwin project unexpectedly transferred more work and costs than anticipated, which coupled to significant organisational changes at PML and a change in the project manager’s role at PML (all at around the same time) created some difficulties; not least of these was timely delivery of reports – apologies for that!