

# Darwin Initiative – Final Report

(To be completed with reference to the Reporting Guidance Notes for Project Leaders  
(<http://darwin.defra.gov.uk/resources/reporting/>) -

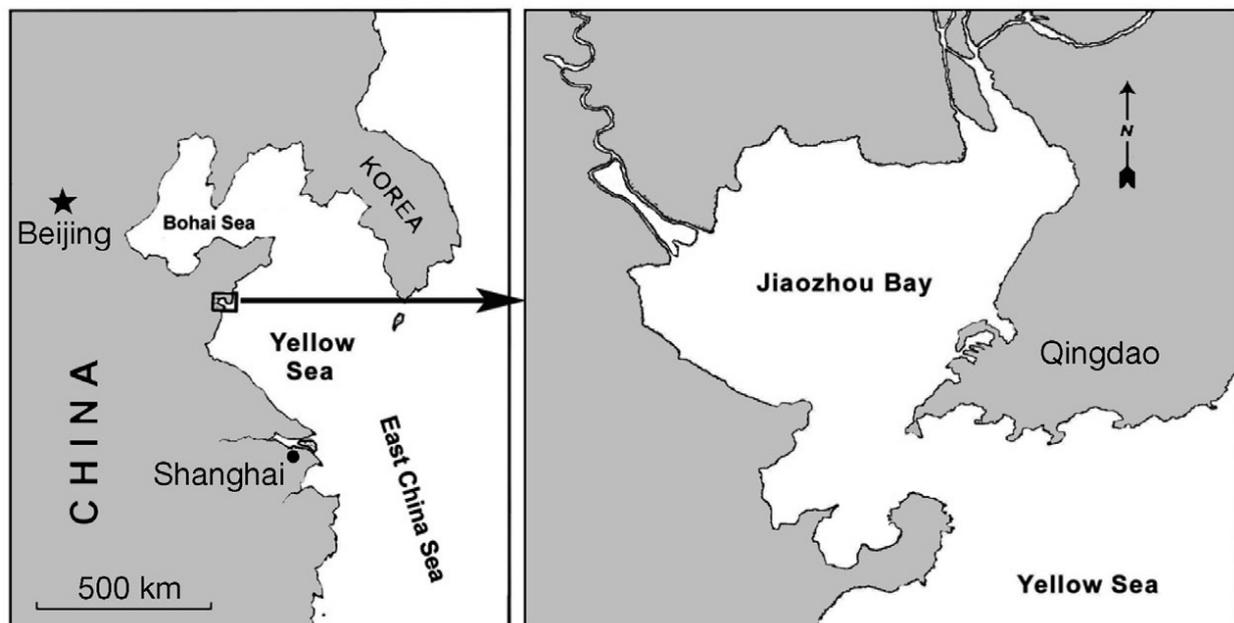
it is expected that this report will be a **maximum** of 20 pages in length, excluding annexes)

## Darwin project information

Project Reference	14-015
Project Title	Conservation of Jiaozhou Bay: biodiversity assessment and biomonitoring using ciliates
Host country(ies)	China
UK Contract Holder Institution	Natural History Museum
UK Partner Institution(s)	n/a
Host Country Partner Institution(s)	Ocean University of China
Darwin Grant Value	£137,897
Start/End dates of Project	1/11/05 – 30/09/09
Project Leader Name	Dr Alan Warren
Project Website	<a href="http://www2.ouc.edu.cn/akfs/ciliate/">http://www2.ouc.edu.cn/akfs/ciliate/</a>
Report Author(s) and date	Dr Alan Warren; Professor Weibo Song. 31 December 2009

## 1 Project Background

Jiaozhou Bay, China, is a major centre for fisheries and mariculture industries, and is listed in China's Biodiversity Action Plan as a potential nature reserve due to its high species richness. However, its water quality is deteriorating due to pollution. This project addresses the problems of biodiversity conservation and fisheries protection using ciliated protozoa. Outputs include: ~320 ciliate species documented; 40 gene sequences analyzed; one book and 40 peer-reviewed papers published; one website established; 45 symposium presentations made; one workshop organised; 6 staff and 31 students trained; 18 PhD and MSc theses submitted; principle of ciliate-based monitoring method established.



Map showing the location of Jiaozhou Bay, NE China. Area of Jiaozhou Bay is ca. 400 km<sup>2</sup>

## 2 Project support to the Convention on Biological Diversity (CBD)

The project supported the **CBD objectives** in a number of ways, as follows.

**Objective 1. The conservation of biological diversity.** In order to determine whether biological diversity is being successfully conserved, baseline data must be obtained and methods must be available for its monitoring. This project seeks to address these issues for Jiaozhou Bay by surveying the ciliate fauna and producing a user-friendly guide to their identification.

**Objective 2. The sustainable use of the components of biodiversity.** The mariculture and fisheries industries are important to the economy of the Jiaozhou Bay region. The development of a ciliate-based method for monitoring water quality should help to ensure a sustainable future for these industries.

**Objective 3. The fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources.** Selected genes of 40 ciliate species were sequenced during the project. All sequences have been deposited in publicly available repositories.

**Objective 4. Appropriate transfer of relevant technologies.** Training in advanced techniques for the study of ciliates and their use as bioindicators was given to 15 local personnel during the project.

Specifically, the project contributed to the following **CBD Articles**.

**Article 7. Identification and monitoring.** A major component of the project was to carry out a systematic survey of the free-living marine ciliated protozoa of Jiaozhou Bay. This revealed the presence of ~320 species, which represents about 20% of the known global marine free-living ciliate biodiversity. Many of these species are known from other locations, such as the seas of Europe and North America. However, 19 are new to science, although it is not known whether they are endemic. This is the most comprehensive survey of free-living ciliates ever undertaken for any habitat in China, and one of the most comprehensive surveys of marine ciliates undertaken anywhere in the world. Our findings confirm the importance of Jiaozhou Bay as an area of high biodiversity, as recognized in the China Biodiversity Action Plan.

In addition to providing baseline data on ciliate biodiversity, a major output of this project is the user-friendly guide to the identification of free-living marine ciliates, both as a printed volume and in electronic format on-line. The objective is to enable the ciliate fauna of Jiaozhou Bay (and elsewhere) to be monitored and recorded more effectively.

The development of method for using ciliates and other protists as bioindicators of marine water quality should, in the long term, help to conserve biodiversity and protect the fisheries and mariculture industries in Jiaozhou Bay. During the project, the principle of the method was demonstrated, especially for monitoring nutrients and assessing levels of eutrophication. The method used, however, is rather laborious and time-consuming so further work is being undertaken to develop a simpler and more rapid version. It is anticipated that the development of this method should be complete by 2011.

**Article 12. Research and Training.** Another major component of this project was the training of local personnel and the promotion of ciliate biodiversity research programmes. Training was given at two levels: (1) training in advanced methods for the study of ciliates, such as molecular techniques (e.g. gene sequencing and phylogenetic analysis, molecular analysis of environmental samples using DGGE, DNA extraction from single cells), and the use of ciliates as bioindicators, which was given to 15 staff and students from OUC; (2) on-the-job training in techniques for the study of ciliates (e.g. isolation, cultivation, identification, morphogenetic and molecular methods, etc.) which was given to 31 postgraduate students at OUC.

Sixteen of the students who gained postgraduate qualifications during the project are now undertaking further research on ciliates at other laboratories, including three who have established independent ciliate research laboratories at different universities and research institutes in China.

The ciliate research programme at OUC has also been enhanced as a result of the project with one additional full-time academic (professor) having been employed, along with one PhD student, to continue work on protist-based methods for biomonitoring marine water quality.

**Article 18. Technical and Scientific Cooperation.** This project promoted international technical and scientific cooperation by several of the methods specified in this Article including: the training of personnel; exchange visits by experts; the development and use of technologies, and; the establishment of a joint research programme relevant to the objectives of the Convention. The details of these are given in the previous two sections.

Other Articles relevant to the project include: **Article 9 (Ex-situ Conservation).** In particular, facilities for research on micro-organisms (ciliates) were enhanced by the procurement of equipment for the OUC Laboratory of Protozoology and the development of the OUC protozoa cell bank and microscope slide collections. **Article 15 (Access to Genetic Resources).** All gene sequences were deposited in publicly available repositories ensuring that they are freely available to both partners and to anybody else who wishes to use them for research purposes.

**Capacity Building.** The partnership supported the host country institution, i.e. the Ocean University of China, to build its capacity to meet CBD commitments in several ways. (1) At the beginning of the project the OUC was completing the development of a new ciliate research complex including three separate laboratories. Funding from the DI project helped to equip these laboratories with essential facilities (see section 4.6.2 for details). (2) As a result of the training during the project, the staff and students of OUC are better able to carry out ciliate-based biodiversity research. (3) Several former students and postdocs, who were involved in the DI project while based at the OUC, have now established their own ciliate research laboratories at the following institutions: South China Normal University (Guangzhou); Yantai University (Yantai); Institute of Coastal Zone Research, (Yantai). Former OUC students have also taken up academic positions in universities at Ningbo (Zhejiang Province), Weihai (Shandong Province) and Xian (Shanxi Province) and each is expecting to establish an independent marine ciliate research programme in due course. Thus, there are already signs that the DI project has been instrumental in the development of a strong ciliate research programme in China.

**CBD Focal Point.** Interaction with host country CBD focal points was restricted to informing the relevant focal point (Professor Da-Wei Huang, Institute of Zoology, Chinese Academy of Sciences, Beijing) of our intention to begin the project (see letter of support from Prof. Huang).

**Main measures for biodiversity conservation.** See Annex 3 for contribution made by different components of the project to the main measures for biodiversity conservation as defined in the CBD Articles to which the project is relevant.

**CMS and CITES.** The project was not relevant to other biodiversity conventions such as CMS and CITES.

### 3 Project Partnerships

The protozoa research groups at the NHM and OUC had been collaborating for about 10 years before the beginning of the project. However, the collaboration had been sporadic and somewhat opportunistic, depending upon the availability of funds. During the DI project the partnership flourished with increased numbers of visits in both directions and a carefully planned strategy for achieving our research aims. This resulted in a highly productive collaboration from which both partners benefited, for example the OUC by the training opportunities and access to the NHM's extensive research facilities, the NHM by gaining access to a species-rich site and the enhancement of its collections. Each partner offered different strengths that were put together to great effect such that they were greater than the sum of their parts.

Frequent communication, mainly by e-mail, was maintained between the partners throughout the project and this helped to ensure that the number of misunderstandings was kept to a minimum.

The host country partner was responsible for identifying the needs for: (1) the work; (2) enhancing the facilities at OUC, and; (3) training of local personnel. The partnership was one of equality and both partners were involved from the outset in formulating and agreeing the project planning and decision-making processes.

**MoU.** An MoU was established at the outset of the project (see attached).

**Partnership achievements and involvement with other bodies.** As a result of this partnership, spin-off research projects have been developed between the NHM and OUC. These include two Marie Curie Research Fellowships for OUC personnel hosted by the NHM. One (Dr Jun Gong) was completed in 2009 and the other one (Professor Xiaozhong Hu) is due to begin in 2010. Applications were also made to the Newton Fellowship scheme (unsuccessful) and the Chinese Council Scholarship Program (pending) to allow further work on ciliates to be carried out at the NHM by OUC students/postdocs. A Royal Society Joint Projects award was made to enable the NHM and OUC to carry out preliminary work on mangrove ciliates. Finally, a number of NSFC awards were made to the OUC that have helped to support students working on the project.

## 4 Project Achievements

### 4.1 Impact: achievement of positive impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

The project was not designed to have a direct impact on biodiversity. Rather it was to have a longer-term impact on biodiversity conservation and fisheries protection in Jiaozhou Bay by: (1) improving awareness of stakeholders in the value of a little-known group of micro-organisms, namely ciliates, as bioindicators of environmental quality; (2) increasing knowledge and understanding of the biodiversity of Jiaozhou Bay by documenting the diversity of free-living marine ciliates; (3) increasing the capacity of the host country to research and monitor free-living ciliates. The latter two objectives have effectively been achieved and good progress has been made towards achieving the first, with the expectation that this will also be brought to a successful conclusion once work on the rapid ciliate-based method of monitoring has been completed.

China's response to the CBD is enshrined in the China Biodiversity Action Plan CBAP). The project has helped, or will help, with the implementation of the CBAP by contributing to the following objectives and activities (C – Chapter; O – Objective; A – Action);

#### **C3, O2, A1: helping to provide a clear description of the health of a protected area.**

Jiaozhou Bay is one of only 7 estuarine wetland ecosystems listed in the CBAP as requiring priority conservation attention. It is also identified in the same document as a potential nature reserve due to its high species richness. During the project data on 16 environmental variables were collected at 8 sites on 96 occasions over a 24-month period. This constitutes a wealth of data that has helped to characterize the health of Jiaozhou Bay in terms of its water quality. The data have been circulated to relevant stakeholders, including: Institute of Oceanology, Chinese Academy of Sciences; Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences; The First Institute of Oceanography, State Oceanic Administration China.

#### **C3, O3: demonstrating that indicator species can be used to monitor ecosystem change.**

Although the rapid biomonitoring method is still under development, the concept and utility of ciliates as bioindicators of marine water quality has been demonstrated. In particular, it has been shown that the community structure of planktonic ciliates (and other protists) can be used as reliable indicators of eutrophication (nutrient concentrations) in Jiaozhou Bay.

**C4: conducting biodiversity surveys.** This project constitutes the most comprehensive survey of ciliated protozoa of any habitat in China, and one of the most comprehensive of marine ciliates of any habitat worldwide. Over 320 ciliate were recorded including 19 that are new to science and numerous others were previously only poorly known.

**C3, O6: providing biological information pertaining to micro-organisms,** In addition to documenting the ciliate biodiversity of Jiaozhou Bay, we have also described morphogenetic processes in 14 species and provided gene sequence data for 40 species. Taken collectively, these data have helped to determine the phylogenetic relationships among a number of ciliate taxa of different ranks, from species to order, and will thus underpin a more robust taxonomy.

**C4 increasing international, and improving bilateral, co-operation (A – to Ensure Implementation).** Prior to the beginning of the DI project, the NHM and OUC had already been collaborating for about 10 years but in a sporadic and somewhat opportunistic fashion. The DI project has helped to formalise the collaboration (as evidenced by the MoU) and to allow longer and more frequent visits in each direction. This has resulted in a stronger and more productive collaborative partnership that has yielded: (i) the publication of 40 peer-reviewed articles and one book; (ii) the establishment of a website; (iii) the training of 15 OUC personnel; (iv) the successful completion by 10 PhD and 8 MSc students; (v) 45 symposium presentations; (vi) the generation of additional funding for further collaborative research.

## **4.2 Outcomes: achievement of the project purpose and outcomes**

**Original logframe.** The original purpose of the project was to “Enhance biodiversity conservation and sustainable use of Jiaozhou Bay”. There were four measurable indicators listed in the original logical framework document (Annex 2A) and progress was made towards achieving each of these as listed below:

- 4.2.1 Ciliate biodiversity of Jiaozhou Bay described.** With ca. 320 species documented, including gene sequence and morphogenetic data for 40 and 14 species respectively, we believe that the ciliate diversity, at least of the most common and abundant species, has been described.
- 4.2.2 Ciliate-based tool for assessing water quality developed.** The utility of ciliate-based biomonitoring, especially for nutrients and eutrophication, has been established. However, the method used is considered too time-consuming and laborious for routine use. A more rapid method is therefore being developed at OUC as part of our exit strategy.
- 4.2.3. Enhanced capacity for ciliate biodiversity and water quality assessment.** Significant progress was made in this respect: (1) 15 OUC personnel received training in advanced methods of protistology; (2) 31 students at OUC received on-the-job training in the study of ciliates; (3) the number of qualified personnel increased with 10 PhD and 8 MSc awards during the life of the project; (4) the facilities at OUC were enhanced by the procurement of essential equipment and the development of the slide and culture collections.
- 4.2.4. Tools for ciliate identification provided.** A guide to the identification of ~320 species of free-living marine ciliates was published and is also available on-line. Further details are also included in the 44 papers that have been published or accepted for publication.

**Final logframe.** The purpose of the project was revised as follows: “Capacity of Jiaozhou Bay stakeholders to understand and use ciliated protozoa for assessing biodiversity status and ecosystem health in management-making increased”. There were two measurable indicators:

- 4.2.5. Principle of including ciliate-based methods for assessing/monitoring biodiversity and ecosystem health adopted by management decision-makers.** Significant progress was made in establishing the principles of using ciliate-based methods for assessing/monitoring biodiversity and ecosystem health. However, the ciliate identification guide was not available until autumn 2009 and the method for biomonitoring marine water quality is still under development. Therefore these systems have yet to be adopted by management decision-makers.
- 4.2.6. Ciliate-based methods for biodiversity conservation and ecosystem protection included in China’s BCAP and/or local coastal marine management plan.** For the reasons given above there has not been time for this to happen.

### 4.3 Outputs (and activities)

**Original logframe.** Four outputs were listed in the original logical framework. Of these, three were achieved and one was partly achieved (with work still ongoing and the expectation that it will be achieved by 2011). These are:

**4.3.1. Ciliate biodiversity of Jiaozhou Bay characterized; biodiversity assessment programme established.** The survey of Jiaozhou Bay has yielded ~320 species, 19 of which are new to science. Although work is still continuing, we anticipate that all of the most common and most abundant (and therefore probably the most ecologically important) species have been recorded. In terms of measurable indicators, all three were exceeded (predicted numbers followed by actual outcomes in parentheses): PhD theses submitted 6 (10); number of MSc theses submitted 7 (8); number of papers published 20 (40). Likewise, all activity milestones were exceeded.

**4.3.2. User-friendly guide to the identification of ciliates in Jiaozhou Bay produced.** The guide, which provides descriptions and illustrations of 320 ciliate species, was published in autumn 2009 and an electronic version is mounted on the OUC website. It is too soon, however, for the guide to be tested by non-specialists. All activity milestones were met.

**4.3.3. Training for OUC personnel and for stakeholders delivered.** A total of 31 postgraduate students at OUC were given on-the-job training in methods for studying ciliate biodiversity and 15 OUC personnel received advanced training in special techniques (mostly molecular and web-based methods) at the NHM. A small number of personnel from other institutions, namely the Yellow Sea Fisheries Research Institute, the Chinese Academy of Fishery Sciences, the First Institute of Oceanography (State Oceanic Administration China) and the Shandong Provincial Mariculture Institute, also received training in protozoological techniques at OUC. The total number of personnel who received training therefore exceeds the number specified in the measurable indicators (30). All activity milestones were met except the training of stakeholders, this being due the delay in the development of the ciliate-based bioindicator method.

**4.3.4. Ciliate-based tool for water quality assessment and monitoring developed.** This output has been partly achieved in the sense that the principle of using ciliates as indicators of marine water quality, and of eutrophication in particular, was established. However, the method used is too laborious and time-consuming for routine use by non-specialists. Work is therefore continuing on the development of a rapid method. In order to carry out this work, the OUC has employed a full-time academic at professor level with expertise in protest ecology, and has also obtained an NSFC grant to support a PhD student to work on the project.

**Final logframe.** In the revised version of the logical framework the outputs and measurable indicators were revised as follows:

**4.3.5. Biodiversity assessment programme established and functioning.** The measurable indicator was "Ciliate biodiversity better known amongst academics and other stakeholders". The main evidence that this has been achieved is by citation of published papers and of the identification guide. Taxonomic papers are usually cited over long time periods, nevertheless there is evidence that this is already happening. In addition, gene sequences deposited in publicly accessible databases are being used by other researchers to aid phylogenetic studies of ciliates. The ciliate guide has been distributed to various academic colleagues and stakeholders, several of whom attended the workshop at OUC.

**4.3.6. Ciliate-based tool for water quality assessment and monitoring developed and being used.** For the reasons stated above this outcome has been partly achieved and work is ongoing with the aim of producing a more rapid biomonitoring method.

**4.3.7. Training and advocacy for OUC personnel, decision makers and for stakeholders delivered in the contribution of ciliate monitoring to ecosystem management.** The measurable indicators refer to 30 staff and students at OUC and at stakeholder institutions trained and an advocacy event held. Both were met, although with the objective of improving the capacity to study and understand ciliate biodiversity rather than biomonitoring.

## 4.4 Project standard measures and publications

See Annexes 4 and 5 for details.

## 4.5 Technical and Scientific achievements and co-operation

**Research information: methodology and main findings.** The collaborative research undertaken during this project constitutes the most comprehensive survey of ciliated protozoa of any habitat in China, and one of the most comprehensive of marine ciliates of any habitat worldwide. The discovery of ~320 species is significant in that it represents ~20% of global marine free-living ciliate diversity. It thus adds further support for the recognition of Jiaozhou Bay as biodiversity hotspot and confirms it as an area that should be given priority conservation attention as stated in the China Biodiversity Action Plan.

Of the 320 ciliate species, 19 are new to science and 11 are re-assigned to different genera. Numerous others were previously only poorly known and have been redescribed using modern techniques such as silver impregnation, studies of morphogenesis and molecular analyses. The latter two techniques in particular have helped to throw new light on phylogenetic relationships among several groups and have led to the creation of 3 new families, suborders and orders. These studies have already been cited in several taxonomic articles including major taxonomic revisions such as Lynn (2008).

While the use of ciliates as bioindicators of water quality is well-established for freshwater habitats, there have been very few studies of their utility as indicators of marine water quality. The present study constitutes one of the most comprehensive such studies ever undertaken with 360 samples collected in a 24-month period and analyzed for ciliate (and other protist) communities and 16 environmental variables. Methods of collection include plankton nets (for planktonic forms) and the immersion in the bay of artificial substrates, such as microscope slides (for periphytic forms) and polyurethane foam units (for planktonic and periphytic forms), for varying periods of time to allow the protists to colonise. The substrates were then retrieved and taken to the laboratory for analysis. The results showed that protist community structure can be used as a reliable bioindicator of marine water quality, particularly with respect to eutrophication (nutrients). However, the methods employed, with immersion times of 3 to 14 days are regarded as too time-consuming so a more rapid method, with an immersion time of just one day, is currently being developed. An additional member of staff (Professor Xu), who is an expert in protist ecology, has joined the protozoa research group at OUC and has been given primary responsibility for completing this work. Further funding has been obtained from the NSFC which has enabled PhD student to be taken on to work on this aspect of the project. It is expected that the work will be completed in 2011.

**Peer review.** A total of 40 papers have been published in peer-reviewed journals with another 4 accepted for publication (see Annex 5 for details). In addition, a guide to the identification of free-living marine ciliates has been published in both hard copy and electronic formats (see Annex 5). All publications are jointly authored by personnel from both partner institutions.

## 4.6 Capacity building

The capacity of the host country for further biodiversity work has been increased in a number of ways, either directly or indirectly, as a result of this project.

**4.6.1 Collections.** The microscope slide collection at OUC has been enhanced significantly by the deposition of 850 new specimens during the course of the project. Registration numbers of all slides with new or redescribed species deposited in this collection are included in the published articles in order that other researchers can access them.

The cell bank (ciliate culture collection) at OUC has also been enhanced by the addition of 10 species that have been brought into stable culture. One of the main barriers to progress in ciliate systematics is the lack of cultures of well-characterized species. Therefore, these cultures are likely to represent a significant legacy for future ciliate biodiversity research.

Finally, gene sequence data for 40 species have been deposited in publicly accessible databases. This brings the total number of gene sequences submitted by OUC and partners to 278, which represents 70% of all marine ciliate sequences currently available worldwide.

Taken together, the slide collection, cell bank and gene sequences represent an important set of resources that should be highly valuable for future marine ciliate biodiversity research in China and beyond.

**4.6.2 Equipment.** At the beginning of the DI project, the Laboratory of Protozoology at OUC was still in the process of being commissioned. Using funding from the DI, essential equipment was obtained to ensure the laboratory is fully functional. This includes: a deionised water system; two centrifuges, a PCR machine, a thermostatic water bath; a sterilizer and filter; an ice-making machine; a UV cross-linker; a laminar flow cabinet; a micro-pipette; 9 stereo microscopes. This has helped to ensure that the facilities at OUC are state-of-the-art for carrying out ciliate biodiversity research.

**4.6.3 Human resources.** Fifteen staff and students from OUC were given training in advanced techniques for protistological research during the project. This includes: (1) molecular techniques, such as the analysis of molecular data from environmental samples (DGGE), real-time PCR and gene sequencing from single cells, and techniques for phylogenetic analysis. Molecular data are now routinely collected when describing new species and are used increasingly in phylogenetic analyses, studies of ecology and biogeography, and even in species identification. The publications list in Annex 5 shows the increase in the use of molecular data over the life of the project. (2) The use of web-based systems (Scratchpads) for processing and disseminating biodiversity data. Those needing access to biodiversity data will increasingly rely on the internet to access these data. Further training will be extended to one key member of the OUC team over the next two years as part of our exit strategy. During his Marie Curie Fellowship that will begin in 2010, Prof. Hu (OUC) will compile much of the data on marine benthic ciliate generated during the DI project into a database within a Scratchpad, which is a tool developed at the NHM that promotes the availability of biodiversity data on the web.

On-the-job training was given to 31 postgraduate students during the course of the project. This will help to ensure that there is a pool of well-trained scientists with appropriate expertise to carry out future research on ciliate biodiversity in China.

Among the postgraduate students who were engaged in working on the project 10 have gained their PhD, and 8 have gained their MSc, qualification. A further 5 are expected to gain their postgraduate qualification in the next 12 to 18 months. This is significant since only qualified scientists are able to pursue further research as postdocs and establish independent research projects. The DI project has helped to ensure that there is a strong cohort of qualified scientists able to undertake future ciliate biodiversity research work in China.

**4.6.4 New Research Laboratories.** Among the OUC students and postdocs who worked on the project, three have established new ciliate research laboratories at universities and research institutes in China, namely: Yantai University (Yantai), Yantai Institute of Coastal Zone Research (Yantai), and South China Normal University (Guangzhou). As these laboratories build their research programmes, more students will be taken on and thus the capacity of China to carry out further ciliate biodiversity research will increase.

**4.6.5 New Collaborations.** During the course of the project the OUC and NHM have developed collaborations with scientists from other countries who share an interest in ciliate biodiversity. These include: Saudi Arabia (King Saud University), Russia (Penza State University) and USA (North Carolina Central University). In the case of the latter two, former OUC undergraduates have undertaken postdoctoral research projects based in the countries in question. This will lead to further enhancement of the skills of the ciliate research community when these postdocs return to China.

**4.6.6 Additional Funding.** The DI project has stimulated the acquisition of additional funding for ciliate biodiversity research at the OUC. This includes £170k from the NSFC, which has helped to support many of the students working on the project, and £36.5k from the Center of Excellence in Biodiversity Research (Saudi Arabia), to carry out collaborative work on marine ciliate biodiversity in China. A major grant from the NSFC has recently been obtained by OUC to continue work on marine ciliate biodiversity research for the next 4 years. It is unlikely that this additional funding would have been secured had the DI project not been established.

**4.6.6 Capacity Building in the UK.** The capacity of the NHM to be an effective project partner has increased in several ways, including: (1) The collections at the NHM have been enhanced by the deposition of 40 slide specimens of organisms collected from Jiaozhou Bay, several of which are likely to be cosmopolitan in their distribution. (2) The NHM has benefited/will benefit by hosting two Marie Curie Research Fellows from OUC, one 2007-2009, the other 2010-2012, both of whom collaborated on the DI project. A main objective of both fellowships is the development of new techniques to enhance knowledge and understanding of ciliate biodiversity, using molecular techniques on the one hand and web-based taxonomy on the other. (3) The expertise of NHM personnel has increased, particularly in the use of silver impregnation techniques that have been developed and refined at OUC in recent years.

## 4.7 Sustainability and Legacy

**Endurance of project achievements.** The guide to the identification of free-living marine ciliates, which was published in autumn 2009, is likely to be of value for many decades. Very few major species-level guides to marine ciliates have been published, and those that are tend to be cited long after their publication, e.g. Kahl (1930-1935) which is still frequently cited in papers on ciliate taxonomy. Perhaps of even greater value in the long term will be the electronic version of our ciliate guide which is hosted on the OUC website. The advantages of the electronic guide are that it is freely available to anyone with an internet connection, and that it can be amended as new data become available so it should never be out of date.

The culture collection at OUC and the gene sequence data should provide a valuable resource for future ciliate biodiversity research. Likewise, the microscope slide collections at OUC and NHM should survive in perpetuity and remain available to anyone for generations to come with an interest in marine ciliate biodiversity.

**Project staff and resources.** All OUC and NHM staff members engaged on the project have 'permanent' contracts with their respective institutions and so will continue to carry out ciliate biodiversity research for the foreseeable future. Furthermore, several of the students at OUC who worked on the project have established independent research laboratories, secured university teaching positions, or taken up research fellowships at various laboratories worldwide (see sections 3 and 4 for details).

The equipment procured for OUC at the beginning of the project (see section 4.6.2 for details) will continue to be used in support of ciliate biodiversity research until it needs to be replaced.

**Project partners.** The project partners will continue to collaborate on ciliate biodiversity research projects for the foreseeable future. Funding has already been secured from the EU (Marie Curie Research Fellowship scheme) and the Royal Society (Joint Projects scheme) to support this work. Further applications will be made to the Chinese Council Scholarships Programme and to the Newton Research Fellowship scheme to allow OUC students/postdocs to carry out ciliate biodiversity research at the NHM. It also planned that future collaborative projects between the NHM and OUC will be carried out given the availability of funds. We therefore expect the current level of contact between the partners to be maintained or even to increase.

## 5 Lessons learned, dissemination and communication

**Key lesson.** The key lesson from the experience of this project is that to be more realistic in what can be achieved within the life of the project in terms of impact. Basically, the amount of time and effort needed to deliver the two main outputs, namely the guide to the identification of ciliates and the ciliate-based method for marine water quality, were significant. This left too little time for their impact (in terms of the assessment and use of these outputs by stakeholders) to be felt within the life of the project. Nevertheless, the project partners will continue to collaborate for the foreseeable future and we believe we have an effective exit strategy that gives us a realistic prospect of bringing these aspects of the project to a successful conclusion.

**Dissemination of results and target audience.** Hard copy versions of the guide to marine free-living ciliates have been distributed to: (1) key institutions and stakeholders in the Jiaozhou Bay area, including the Institute of Oceanology, Chinese Academy of Sciences; Yellow Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences; The First Institute of Oceanography, State Oceanic Administration China; (2) the Chinese government organisation, Qingdao Ocean Bureau; (3) ciliatologists worldwide, including those in Austria, Canada, Germany, Italy, Korea and USA. Taken collectively, these constitute the target audience for the project outputs.

Details of how to access the web-based version of the guide have been distributed to the same target audience, and will be distributed more widely via web-links (e.g. on the NHM and OUC websites and on protistological websites such as the British Society for Protist Biology and the International Society of Protistologists) six months after publication of the print version (as agreed with Science Press).

Other routes by which the findings of the project have been disseminated include: (1) 45 presentations at 9 seminars in both partner countries and at international seminars elsewhere; (2) publication of 44 papers in international and national peer-reviewed journals.

**Dissemination of results after project completion.** Dissemination will continue after the project completion with further presentations at symposia and with the publication of further papers in peer-reviewed journals. Once the development of the rapid biomonitoring method has been completed the details will be sent to key stakeholders.

## 5.1 Darwin identity

The Darwin Initiative was acknowledged in every presentation, both oral and poster, at seminars, meetings and workshops where the project results were presented. The support of the DI was also acknowledged in every article published in peer-reviewed journals.

The DI logo was included on: (1) the hard copy version of the guide to the identification of marine free-living ciliates, both on the spine and on the title pages; (2) the website with the on-line version of the ciliate guide; (3) on the title slide and on the poster of every presentation of the DI project results; (4) the programme distributed to participants of the DI project workshop held at OUC, Qingdao, China, 16 October 2009.

Also, at the DI project workshop in Qingdao, the UK Project Leader gave a talk on the DI Programme in general, with special emphasis on DI projects in China.

## 6 Monitoring and evaluation

**Logframe.** The logframe was amended in 2007 based on the recommendations from the review of the previous annual report. The changes, which include the purpose, outputs and measurable indicators, are apparent when the revised logframe (Annex 2) are compared with the original (Annex 2A).

**Activities.** Looking back over the life of the project it is evident that the amended (final) logframe was too ambitious in terms of the timescales within which the outputs of the project could be applied and thus their impact measured. We began this project from a very low starting base in terms of knowledge and understanding of ciliate biodiversity in Jiaozhou Bay and of the utility of ciliates as bioindicators of marine water quality. Therefore, the vast majority of the time working on the project was dedicated to gathering data, data analysis, dissemination of results and training. In the case of the ciliate guide, for example, this was not published until autumn 2009, partly because of the high ciliate biodiversity of Jiaozhou Bay with ~320 species, many of which were either very poorly known or new to science, and therefore had to be fully characterized. Similarly, in the case of the development of the ciliate-based method for water quality assessment, significant amounts of time and effort were invested in successfully proving the principle, but the method was considered too laborious and time-consuming for routine use by non-experts. Further work is ongoing with the objective of developing a simpler, more rapid method. Thus the full impact of this work will likely become apparent in the 2 years or so after the project end date.

**M&E system.** The monitoring and evaluation system has been useful in the sense that it helped to focus our attention on the applicability of the work. For example, while we were very pleased with our success in proving the principle of using ciliates as bioindicators of marine water quality, the revised measurable indicator emphasized the importance its utility for routine monitoring, its adoption by stakeholders and its inclusion in management plans. It was partly with this in mind that the OUC employed Professor Hu, and acquired further funding from the NSFC, to continue work on the development of the method after the project end date. We therefore consider this a positive outcome of the monitoring and evaluation system.

**Evaluations.** The main evaluations of the work during the project were the reviews of the annual and half-year reports to the DI and the reviews by referees and comments by editors of papers submitted for publication in peer-reviewed journals. The annual and half-year reviews were generally positive and most included various suggestions, comments and questions. A summary of these is included in 6.1. These reviews were generally helpful, especially in the sense that they encouraged us to keep in mind the wider context of the work. The reviews of papers submitted for publication were almost without exception positive overall, while at the same time including suggestions for further improvement. This is evidenced by the fact that all project-related papers submitted so far have been published or accepted for publication, albeit after minor revision (in most cases) or major revision (in one or two cases).

## **6.1 Actions taken in response to annual report reviews**

**6.1.1.** There was only one specific recommendation from the review of the 2005/06 annual report (action taken in italics):

- Purpose level indicators need refining and specific monitoring for reformulated indicators may be needed. There is scope for substantially revising the logical framework to make it clearer and more readily used as a monitoring tool. Assistance can be given with this if required. *The logical framework was revised with the assistance of the reviewer.*

**6.1.2.** There were no specific recommendations from the review of the 2006/07 annual report.

**6.1.3.** Relevant extracts from review of 2007/08 annual report. Project Leader responses (in italics) as supplied in the 2008/09 half-year report.

- Will both project partners participate in the analysis of the collected data?  
*Yes, both partners will participate. Primary data analyses will be carried out at the OUC and then verified at the NHM*
- Will the usefulness of using ciliates as indicators of water quality in comparison to traditional parameters be addressed fully as part of the project, including a financial comparison? In this regard, do you think that data on sufficient other parameters have been collected to make a meaningful comparison?  
*We will investigate the possibility of carrying out a comparison between our ciliate-based method and traditional (conventional?) methods for monitoring marine water quality. In order to make a financial comparison, the cost of the ciliate-based method will be calculated in terms of staff time and consumables. An estimate of the capital costs (i.e. of essential equipment) will also be made. Equivalent costings for conventional methods of carrying out such monitoring will be estimated based on data obtained from regulatory authorities, assuming such data are made available. Failing this, it may be possible to estimate the costs of conventional monitoring based on the data-gathering exercises carried out during the current project.*
- I see that data on heavy metals (copper in particular is toxic to marine life) and phosphorus, for example has not been collected. I note that increased industrial activity and inadequate wastewater treatment is compromising marine water quality and it would be informative to know more about the nature of the effluents which are likely to cause pollution and whether survey design has taken account of point sources. Are samples taken at different points within the water column?

*There were some omissions in the 2007-08 annual report concerning water quality monitoring. In fact, data on six heavy metals (Zn, Hg, Pb, Fe, Cr and Cu) and on phosphorus were routinely collected throughout the period of sampling. Furthermore, samples were taken at three different depths within the water column at each site: 0.5 m (surface), 2 m and 8-9 m (sea bed). The main sources of pollution in Jiaozhou Bay are run-off from the land surrounding the bay, illegal discharges of industrial and domestic wastewaters, poorly treated municipal sewage effluents, and intensive mariculture activities.*

- I realise that there may not be sufficient time in the present project to fully address these issues, but will recommendations be made for future stakeholder monitoring?

*We need to complete our analyses before we can decide what (if any) recommendations to make for future stakeholder monitoring*

- In the Phase 2 grant application 6 PhD and 7 Masters theses were listed as a project output. It is not clear whether this is still an intended output.

*The successful completion of PhD and MSc theses are still an intended output. Currently there are 12 PhD students and 8 MSc students engaged in work on the project. Of these 8 are expected to complete their theses in 2009/10. An additional metric has been added to the Project Standard Output Measures (Table 1) giving data for PhD and Masters theses.*

#### **6.1.4** Comments and queries from review of 2008/09 annual report. Project Leader response in italics.

- Will/has weather events be taken into account in data analysis i.e. water dilution (reduction in salinity and possibly ciliate concentration) as a result of heavy rain/floodwater?

*There were no unusual rainfall patterns or flooding events during the life of the project. At any given location the salinity varied only by about 3‰. This relatively minor variation will almost certainly have had no measurable effect on the ciliate communities. Ten main rivers enter Jiaozhou Bay. Dagu River is by far the largest and accounts for about 85% of the freshwater input.*

- Will seasonal agricultural practices be documented in accounting for nutrient/heavy metal concentrations?

*The heavy metal inputs are almost certainly due to industrial effluents rather than agriculture. The main agricultural practice is growing cereals. There are typically two crops per year, one in spring and the other in autumn. We did not document fertilization regimes etc. though this would have interesting. We will investigate whether it is possible to obtain such information both retrospectively and in future as work continues on the development of the biomonitoring method.*

- Will industrial sources of pollutants be documented and recommended actions listed for decision-makers?

*The Environment Protection Bureau is aware of the sources of pollution and we believe action was taken to improve the situation in Jiaozhou Bay with respect to industrial pollution prior to the 2008 Olympic Games (Qingdao hosted the sailing events).*

- It would have been interesting to learn more about the background regarding trialling a rapid biomonitoring protocol (advantages).

- Should the developed monitoring protocol prove cost effective, rapid and reliable – could a comment be made on the global applicability of this methodology. How widespread are the species that have been documented already – would further extensive research be needed to make this work applicable in different parts of the world?

*Any ciliate-based monitoring protocol should be applicable worldwide, at least for temperate waters, without further extensive research as most of the ciliate species encountered are thought to be cosmopolitan. Knowledge of tropical and sub-tropical marine ciliate biodiversity is scant so it is not known whether it would be applicable in these environments.*

- Will questionnaire/interviews with decision makers take place towards the end of the project as originally planned? This would prove valuable feedback.

*The ciliate guide has only been available for a few months and work on the ciliate-based biomonitoring method is not complete. Therefore it is probably premature to seek such feedback. Nevertheless, those who attended the workshop in Qingdao in October 2009 were universally positive about the work of the project. Letters to this effect were sent by the Yellow Sea Fisheries Research Institute, Qingdao, and the Institute of Oceanology, Qingdao (see copies attached). Further feedback will be sought from other stakeholders.*

In the General Assessment, the reviewer also noted that “What remains as a result of the data analysis is whether ciliate-based biomonitoring is a useful and practical methodology based on the costs, practicalities and necessary skills involved”, and, “Involvement of stakeholders and decision-makers is a critical part of the process and sufficient emphasis should be given to this aspect within the remaining 6 months of the project”.

*We agree entirely with this assessment and it is unfortunate that we were unable within the life of the project to produce a method that fulfils these criteria. Nevertheless, we have an effective exit strategy in the sense that additional personnel and funding have been obtained by OUC in order to continue work on the biomonitoring method and bring it to a successful conclusion. Also the collaboration between OUC and NHM is planned to continue for the foreseeable future. When this work has been completed stakeholders and decision-makers will be consulted and encouraged to give the method their most serious consideration.*

## 7 Finance and administration

### 7.1 Project expenditure

	Award	Expenditure	Balance
Salary			
Rent, rates, cleaning, overheads			
Travel and subsistence			
Printing			
Conferences, seminars etc			
Capital items/equipment			
Audit			
Administration fee levied by OUC			
Balance			

The total cost of publishing the ciliate identification guide (~£15k) was significantly higher than originally anticipated (Printing: £5k). Additional funds totalling ~£7.4k were raised by the Host Country Project Partner to help meet this higher cost, leaving only an additional £2.6k to be met by DI.project funds. Approval for this additional expenditure was granted by the DI office in December 2008. Most of this additional cost was off-set by the underspend of ~£2k on capital items/equipment, a consequence of favourable deals being negotiated by Host Country Project Partners with their suppliers.

The OUC administration fee (~£6.1k) was not included in the original budget because the Host Country Project Partner had not been made aware that this was payable until after the project had started. It transpired that the OUC charges a 10% administration fee on all international grant income. We were able to meet this unforeseen additional cost by reducing our Travel and Subsistence budget (by ~£7.2k), mainly by raising funds from other sources to help fund some visits and minimising the costs of visits to the NHM, particularly the accommodation costs. Again, the DI office was made aware of this situation and a solution agreed in May 2009.

## **7.2 Additional funds or in-kind contributions secured**

Additional funds were obtained by OUC from three sources to carry work on ciliate research. Only a proportion of each award, however, was used specifically for DI project work. These are: £170k from the NSFC (mainly to support students); £45.5k from the Ministry of Education of China; £36.5k from the Center of Excellence in Biodiversity Research (Saudi Arabia). The former two were mentioned in the original (Stage 2) application.

An additional in-kind contribution was secured in the form of the employment by OUC of a full-time professor (Prof. Henglong Xu) to carry out work on ecological aspects of the work for the final eighteen months of the life of the project.

## **7.3 Value of DI funding**

The DI funding enabled the project partners to enhance the capacity of the host country to carry out research on ciliated protozoa and to meet their CBD obligations and CBAP objectives by: (1) carrying out collaborative research; (2) making exchange visits; (3) delivering training; (4) publishing the web-based guide to free-living marine ciliates in Chinese coastal waters; (5) establishing the web-based guide to the ciliates; (6) attending national and international meetings and symposia to present results and establish new contacts; (7) procuring equipment to help establish the OUC Laboratory of Protozoology as a well-found laboratory; (8) enhancing the microscope slide collection and the ciliate culture collection at OUC, and the international gene sequence database, by the deposition of new material; (9) proving the concept of the utility of ciliates as useful bioindicators of marine water quality. In addition, the DI funds also enabled the UK partner to increase its capacity to carry out ciliate research, present the results of the project at national and international scientific meetings, and enhance the NHM microscope slide collection.

## Annex 1 Report of progress and achievements against final project logframe for the life of the project

Project summary	Measurable Indicators	Progress and Achievements	Actions required/planned for next period
<p><b>Goal:</b> To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve</p> <ul style="list-style-type: none"> <li>• The conservation of biological diversity,</li> <li>• The sustainable use of its components, and</li> <li>• The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources</li> </ul>		(report on any contribution towards positive impact on biodiversity or positive changes in the conditions of human communities associated with biodiversity e.g. steps towards sustainable use or equitable sharing of costs or benefits)	(do not fill not applicable) n/a
<p><b>Purpose</b> Capacity of Jiaozhou Bay stakeholders to understand and use ciliated protozoa for assessing biodiversity status and ecosystem health in management decision-making increased</p>	<p>1. Principle of including ciliate-based methods for assessing and monitoring biodiversity and ecosystem health adopted by management decision-makers</p> <p>2. Ciliate-based methods for biodiversity conservation and ecosystem protection included in China's BCAP and/or local coastal management plan.</p>	Progress towards achieving the project purpose detailed below under individual activities	n/a
<p><b>Output 1.</b> Biodiversity assessment programme established and functioning</p>	<p>1. Ciliate biodiversity better known amongst academics and other stakeholders.</p> <p>2. Ciliate biodiversity data included in coastal marine management decision-making process</p>	The number of publications has significantly exceeded the target, likewise the number of gene sequences deposited in databases. The ciliate identification guide was published and the website established in autumn 2009. The inclusion of ciliate biodiversity data in coastal marine management decision-making processes is unlikely to happen until the decision makers have had the chance to assess the project results, including the refined version of the ciliate-based method for predicting marine water quality.	
<p>Activity 1.1 Describe new and poorly known ciliates; determine morphogenetic processes of selected species; analyze gene sequences of selected taxa and deposit in publicly available databases</p>		Forty four papers were published or accepted for publication including: detailed descriptions and redescrptions of 61 species; morphogenetic processes of 14 species; molecular phylogeny of 50 species. Gene sequences of 40 species were deposited in publicly available databases.	
<p>Activity 1.2, Produce user-friendly guide to the identification of marine</p>		Identification guide published and web-based version established in autumn 2009.	

ciliates		
Activity 1.3. 3 Establish reference collection of ciliates at OUC and make available		850 slides added to OUC collection. Details, including registration numbers, included in relevant publications
<b>Output 2.</b> Ciliate-based tool for water quality assessment and monitoring developed and used	System adopted for monitoring marine water quality	Data-gathering and analysis completed for 360 samples. Ciliates found to be effective indicators of eutrophication (concentrations of nutrients). However, system too slow and labour-intensive for routine monitoring. Indicator therefore inappropriate as system is not yet ready for adoption.
Activity 2.1. . Monitor ciliate communities at selected sampling sites on a regular basis for a minimum of 12 months		Ciliates in each sample identified and enumerated providing 24 months worth of data.
Activity 2.2. . Monitor water samples for a range of physico-chemical parameters on a regular basis for a minimum of 12 months.		Physico-chemical parameters monitoring carried out giving a total of 24 months worth of data.
Activity 2.3 Analyze data and develop protocol for biomonitoring marine water quality		Data analysis completed. Rapid biomonitoring system being developed, expected completion summer 2011. Biomonitoring protocol likely to be based on the latter.
<b>Output 3.</b> Training and advocacy for OUC personnel, decision makers and for stakeholders delivered in the contribution of ciliate monitoring to ecosystem management	Minimum of 30 personnel at OUC and at stakeholder institutions trained  Advocacy event(s) held	Training of OUC personnel exceeded the target, both for on-the-job training and advanced training.  Workshop held October 2009 at OUC, Qingdao, China. Attended by 40 participants including representatives from 6 institutes other than OUC and NHM (see report).

## Annex 2 Project's final logframe, including criteria and indicators

### LOGICAL FRAMEWORK

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p><b>Goal</b></p> <p>Biodiversity conservation sustainable use of Jiaozhou Bay enhanced</p> <p>Levels of biodiversity (e.g. species diversity) and water quality (e.g. concentrations of pollutants)</p> <p>Biodiversity loss and degradation of water quality both reduced</p> <p>Those responsible for coastal and management agree to implement assessment and monitoring programmes and take remedial action when necessary</p>			
<p><b>Purpose</b></p> <p>Capacity of Jiaozhou Bay stakeholders to understand and use ciliated protozoa for assessing biodiversity status and ecosystem health in management decision-making increased</p>	<p>Principle of including ciliate-based methods for assessing/monitoring biodiversity and ecosystem health adopted by management decision-makers</p> <p>Ciliate-based methods for biodiversity conservation and ecosystem protection included in China's BCAP and/or local coastal marine management plan</p>	<p>Questionnaire/interviews with decision makers</p> <p>Review of plans</p>	<p>Decision-makers agree that assessment/monitoring of coastal marine biodiversity and ecosystem health should be carried out and that ciliate based methods are appropriate/useful</p>

<b>Outputs</b>			
1. Biodiversity assessment programme established and functioning	Ciliate biodiversity better known amongst academics and other stakeholders	Review of minutes and reports, papers, biodiversity action plan	Priority is given to biodiversity conservation in management of coastal marine environments by stakeholders
2. Ciliate-based tool for water quality assessment and monitoring developed and being used	Ciliate biodiversity data included in coastal marine management decision-making process	Interview/reports by teachers	Ciliates prove to be reliable bioindicators of marine water quality; stakeholders adopt the ciliate-based monitoring system
	System adopted for monitoring and training purposes	Training reports and attendance lists	Active participation of stakeholders in training; OUC staff and students free to attend UK-based training
3. Training and advocacy for OUC personnel, decision makers and for stakeholders delivered in the contribution of ciliate monitoring to ecosystem management	Minimum of 30 staff and students at OUC and stakeholder institutes trained  Advocacy event(s) held		

## **Activities**

### **Output 1. Ciliate biodiversity assessment programme established and functioning**

- 1.1 Describe new and poorly known ciliates; determine morphogenetic processes of selected species; analyze gene sequences of selected taxa and deposit in publicly available databases
- 1.2 Produce user-friendly guide to the identification of marine ciliates
- 1.3 Establish reference collection of ciliates at OUC and make available

### **Output 2. Ciliate-based tool for water quality assessment and monitoring developed and being used**

- 2.1 Monitor ciliate communities at selected sampling sites on a regular basis for a minimum of 24 months.
- 2.2 Monitor water samples for a range of physico-chemical parameters on a regular basis for a minimum of 24 months.
- 2.3 Analyze data and develop protocol for biomonitoring marine water quality

### **Output 3. Training and advocacy for OUC personnel, decision makers and for stakeholders delivered in the contribution of ciliate monitoring to ecosystem management**

- 3.1 Training of OUC personnel carried in the form of on-the-job training at OUC and training in advanced techniques at NHM
- 3.2 Advocacy event(s) held

### **Activity Milestones (Summary of Project Implementation Timetable)**

Data for guide assembled (by 03/08); guide compiled and tested by stakeholders (by 07/08); guide submitted for publication and mounted on OUC website (by 01/09)

Ciliate community data and water quality data gathered (Yr 1, 2, 3); assessment tool developed and functionality of assessment tool verified (by 10/08); submitted to publisher (by 02/09).

Training of OUC students ongoing throughout project; training given in UK for a total of ca. 15 staff and students from OUC amounting to ca. 20 man-months (by 09/08); training course (3 days) given at OUC for ca. 20 Jiaozhou Bay stakeholders (by 03/09)

## Annex 2A. Original logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p><b>Goal:</b></p> <p><b>To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve</b></p> <ul style="list-style-type: none"> <li>• the conservation of biological diversity,</li> <li>• the sustainable use of its components, and</li> <li>• the fair and equitable sharing of benefits arising out of the utilisation of genetic resources</li> </ul>			
<p><b>Purpose</b></p> <p>Enhance biodiversity conservation and sustainable use of Jiaozhou Bay</p>	<ol style="list-style-type: none"> <li>1. Ciliate biodiversity of Jiaozhou Bay described</li> <li>2. Ciliate-based tool for assessing water quality developed</li> <li>3. Enhanced capacity for ciliate biodiversity- and water quality assessment</li> <li>4. Tools for ciliate identification provided</li> </ol>	<ol style="list-style-type: none"> <li>1. Results published</li> <li>2. Water quality monitoring system adopted by stakeholders</li> <li>3. Input from OUC personnel and from stakeholders using the system</li> <li>4. User-friendly ciliate identification guide published and used</li> </ol>	<p>Participants will work collaboratively and students will remain in their institution.</p> <p>Marine ciliates will prove useful as bioindicators in Jiaozhou Bay.</p> <p>A publisher will agree to publish the ciliate guide.</p>
<p><b>Outputs</b></p> <p>Inventory of ciliate biodiversity; biodiversity</p>	<p>6 PhD and 7 Masters theses</p>	<p>PhD and Masters theses successfully</p>	<p>Students complete their degree programmes and use the skills acquired; manuscripts</p>

assessment programme established and functioning	submitted. At least 20 papers published by Yr 3.	defended; Reprints of papers sent to DI	processed by journals in a timely fashion.
Ciliate-based tool for water quality assessment and monitoring developed	Method published. System adopted for monitoring and training purposes	Reprints of papers sent to DI. System adopted by OUC for teaching and by stakeholders for monitoring	Ciliates prove to be reliable bioindicators of water quality within Jiaozhou Bay
Training for OUC personnel and for stakeholders delivered	Minimum of 30 staff and students at OUC and stakeholder institutes trained	Training reports and attendance lists sent to DI	Active participation of stakeholders in training; OUC staff and students free to attend UK-based training
User-friendly guide to the identification of ciliates in Jiaozhou Bay produced	Field guide tested by non-specialists; manuscript submitted and electronic version mounted on web (Yr 3)	Feedback from non-specialist field-testers. Reports from referees. Copy sent to DI	Agreement can be reached with publisher over publication details (cost, quality, timescales etc.).

Activities	Activity Milestones (Summary of Project Implementation Timetable)
Ciliate biodiversity characterization	Yr 1-3: 6-8 papers submitted for publication each year (total ca. 20 by 03/08); 5 papers presented at conferences each year (total ca. 15 by 03/08); Yrs 2,3: gene sequences of 3 taxa submitted each year to gene bank (total 6); Yr 3: reference collection established at OUC.
User-friendly ciliate identification guide	Yr1: data for guide assembled; Yr2: guide compiled and tested by stakeholders; Yr3: guide submitted for publication and mounted on OUC website
Ciliate-based tool for water quality assessment and monitoring	Yr1: ciliate community data and water quality data gathered; Yr2: data gathering continues, assessment tool developed; Yr3: functionality of assessment tool verified, tool tested and adopted by stakeholders.
Training	Training of OUC students ongoing throughout project; Yrs 1,2,3: Training in UK (for approx. 2 months) for 2 OUC personnel each year; Yrs 2, 3: training courses (3 days each) for 20 stakeholder personnel

## Annex 3 Project contribution to Articles under the CBD

### Project Contribution to Articles under the Convention on Biological Diversity

Article No./Title	Project %	Article Description
6. General Measures for Conservation & Sustainable Use		Develop national strategies that integrate conservation and sustainable use.
7. Identification and Monitoring	50%	Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data.
8. In-situ Conservation		Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources.
9. Ex-situ Conservation	5%	Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources.
10. Sustainable Use of Components of Biological Diversity		Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector.
11. Incentive Measures		Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training	35%	Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations).
13. Public Education and Awareness		Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes.
14. Impact Assessment and Minimizing Adverse Impacts		Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage.
15. Access to Genetic Resources	5%	Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits.

<b>Article No./Title</b>	<b>Project %</b>	<b>Article Description</b>
16. Access to and Transfer of Technology		Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies.
17. Exchange of Information		Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge
19. Bio-safety Protocol		Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research.
Other Contribution	5%	Smaller contributions (eg of 5%) or less should be summed and included here.
Total %	100%	Check % = total 100

## Annex 4 Standard Measures

Code	Description	Totals (plus additional detail as required)
<b>Training Measures</b>		
1a	Number of people to submit PhD thesis	10
1b	Number of PhD qualifications obtained	10
2	Number of Masters qualifications obtained	8
3	Number of other qualifications obtained	2
4a	Number of undergraduate students receiving training	10
4b	Number of training weeks provided to undergraduate students	40
4c	Number of postgraduate students receiving training (not 1-3 above)	6
4d	Number of training weeks for postgraduate students	20
5	Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification( ie not categories 1-4 above)	2
6a	Number of people receiving other forms of short-term education/training (ie not categories 1-5 above)	2
6b	Number of training weeks not leading to formal qualification	4
7	Number of types of training materials produced for use by host country(s)	0
<b>Research Measures</b>		
8	Number of weeks spent by UK project staff on project work in host country(s)	10
9	Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s)	0
10	Number of formal documents produced to assist work related to species identification, classification and recording.	1
11a	Number of papers published or accepted for publication in peer reviewed journals	44
11b	Number of papers published or accepted for publication elsewhere	0
12a	Number of computer-based databases established (containing species/generic information) and handed over to host country	0
12b	Number of computer-based databases enhanced (containing species/genetic	0

Code	Description	Totals (plus additional detail as required)
	information) and handed over to host country	
13a	Number of species reference collections established and handed over to host country(s)	0
13b	Number of species reference collections enhanced and handed over to host country(s)	1
<b>Dissemination Measures</b>		
14a	Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work	1
14b	Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated.	9 seminars/conferences; 45 presentations made.
15a	Number of national press releases or publicity articles in host country(s)	0
15b	Number of local press releases or publicity articles in host country(s)	0
15c	Number of national press releases or publicity articles in UK	0
15d	Number of local press releases or publicity articles in UK	0
16a	Number of issues of newsletters produced in the host country(s)	0
16b	Estimated circulation of each newsletter in the host country(s)	n/a
16c	Estimated circulation of each newsletter in the UK	n/a
17a	Number of dissemination networks established	0
17b	Number of dissemination networks enhanced or extended	0
18a	Number of national TV programmes/features in host country(s)	0
18b	Number of national TV programme/features in the UK	0
18c	Number of local TV programme/features in host country	0
18d	Number of local TV programme features in the UK	0
19a	Number of national radio interviews/features in host country(s)	0
19b	Number of national radio interviews/features in the UK	0
19c	Number of local radio interviews/features in host country (s)	0
19d	Number of local radio interviews/features in the	0

<b>Code</b>	<b>Description</b>	<b>Totals (plus additional detail as required)</b>
	UK	
<b>Physical Measures</b>		
20	Estimated value (£s) of physical assets handed over to host country(s)	£24.5k
21	Number of permanent educational/training/research facilities or organisation established	0
22	Number of permanent field plots established	0
23	Value of additional resources raised for project	
<b>Other Measures used by the project and not currently including in DI standard measures</b>		

## Annex 5 Publications

Type *	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Book	Song, W., Warren, A. And Hu X. (2009). <i>Free-living Ciliates in the Bohai and Yellow Seas, China</i> . Science Press, Beijing	Science Press, Beijing	www.sciencep.com	£15
Website	Song, W., Warren, A. And Hu X. (2009). <i>Free-living Ciliates in the Bohai and Yellow Seas, China</i> . Science Press, Beijing	Website hosted at OUC. Intellectual property rights jointly held by OUC and NHM	<a href="http://www2.ouc.edu.cn/kfs/ciliate/">http://www2.ouc.edu.cn/kfs/ciliate/</a>	
Journal	Chen, X., Warren, A. And Song, W. (2009). Taxonomic studies on a new marine ciliate, <i>Apocolaps magnus</i> gen. nov., spec. nov. (Ciliophora, Colepidae), isolated from Qingdao, China. <i>Journal of the Ocean University of China</i> . 8: 317-321	Ocean University of China	<a href="http://www2.ouc.edu.cn/bywb/english/index.asp">http://www2.ouc.edu.cn/bywb/english/index.asp</a>	
Journal	Shao, C., Song, W., Warren, A. and Al-Rasheid, K.A.S. (2009). Morphogenesis of <i>Kiitricha marina</i> Nozawa, 1941 (Ciliophora, Spirotrichea), a possible model for the ancestor of hypotrichs s. l.. <i>European Journal of Protistology</i> 45: 292-304.	Elsevier, Amsterdam	<a href="http://shop.elsevier.de/ejop">http://shop.elsevier.de/ejop</a>	
Journal	Li, L., Zhang, Q., Hu, X., Warren, A., Al-Rasheid, K.A.S., Al-Khedheiry, A.A. and Song, W. 2009. A redescription of the marine hypotrichous ciliate, <i>Nothoholosticha fasciola</i> (Kahl, 1932) nov. gen., nov. comb.(Ciliophora:Urostylida) with brief notes on its cellular reorganization and SSrRNA gene sequence. <i>European Journal of Protistology</i> 45: 237-248.	Elsevier, Amsterdam	<a href="http://shop.elsevier.de/ejop">http://shop.elsevier.de/ejop</a>	
Journal	Ji, D., Xu, H., Choi, J.K., Warren, A. and Song, W. (2009). Taxonomic Characterization of Three Marine Peritrichous Ciliates from China: <i>Zoothamnium alrasheidi</i> spec. nov., <i>Z. marinum</i> Kahl, 1933 and <i>Z.vermicola</i> Precht, 1935 (Ciliophora: Peritrichia). <i>Acta Protozoologica</i> 48: 171-183.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	

Type * (eg journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Journal	Yi, Z., Song, W., Gong, J., Warren, A., Al-Rasheid, K. A. S., Al-Arifi, S. and Al-Khedhairi, A. A. (2009). Phylogeny of six oligohymenophoreans (Protozoa, Ciliophora) inferred from small subunit rRNA gene sequences. <i>Zoologica Scripta</i> 38: 323-331.	Wiley-Blackwell	<a href="http://www.wiley.com/bw/journal.asp?ref=0300-3256&amp;site=1">http://www.wiley.com/bw/journal.asp?ref=0300-3256&amp;site=1</a>	
Journal	Song, W., Shao, C., Yi, Z., Li, L., Warren, A., Al-Rasheid, K. and Yang, J. (2009). The morphology, morphogenesis and SSrRNA gene sequence of a new marine ciliate, <i>Diophrys apoligothrix</i> spec. nov. (Ciliophora; Euplotida). <i>European Journal of Protistology</i> 45: 38-50.	Elsevier, Amsterdam	<a href="http://shop.elsevier.de/ejop">http://shop.elsevier.de/ejop</a>	
Journal	Wang, Y., Song, W., Warren, A., Al-Rasheid, K.A.S., Al-Quraishy, S.A., Al-Farraj, S.A., Hu, X. and Pan, H. (2009). Descriptions of two new marine scuticociliates, <i>Pleuronema sinica</i> n. sp. and <i>P. wilberti</i> n. sp. (Ciliophora: Scuticociliatida), from the Yellow Sea, China. <i>European Journal of Protistology</i> 45: 29-37.	Elsevier, Amsterdam	<a href="http://shop.elsevier.de/ejop">http://shop.elsevier.de/ejop</a>	
Journal	Yi, Z., Song, W., Shao, C., Warren, A., Al-Rasheid, K.A.S., Roberts D.McL., Miao, M., Al-Quraishy, S.A. and Chen, Z. (2008). Phylogeny of some systematically uncertain urostyloids – <i>Apokeronopsis</i> , <i>Metaurostylopsis</i> , <i>Thigmokeronopsis</i> (Protozoa, Ciliophora, Stichotrichia) estimated with small subunit rRNA gene sequence information: discrepancies and agreements with morphological data. <i>European Journal of Protistology</i> 44: 254-262.	Elsevier, Amsterdam	<a href="http://shop.elsevier.de/ejop">http://shop.elsevier.de/ejop</a>	
Journal	Chen, S., Song, W., Li, L., Warren, A., Al-Rasheid, K.A.S. and Lin, X. (2008). Systematic position of <i>Discocephalus</i> -like ciliates (Ciliophora: Spirotrichea) inferred from ontogenetic and SS rRNA gene information. <i>International Journal of Systematic and Evolutionary Microbiology</i> . 58: 2962-2972.	The Society for General Microbiology	<a href="http://ijs.sgmjournals.org/">http://ijs.sgmjournals.org/</a>	

Type *	Detail	Publishers	Available from	Cost
(eg journals, manual, CDs)	(title, author, year)	(name, city)	(eg contact address, website)	£
Journal	Xu, H., Song, W., Warren, A., Al-Rasheid, K.A.S., Al-Farraj, S.A., Gong, J. and Hu, X. (2008). Planktonic protist communities in a semi-closed mariculture pond: structural variation and correlation with environmental conditions. <i>Journal of the Marine Biological Association of the UK</i> 88:1353-1362	Cambridge University Press	<a href="http://journals.cambridge.org/action/displayJournal?jid=mbi">http://journals.cambridge.org/action/displayJournal?jid=mbi</a>	
Journal	Chen, X., Miao, M., Song, W., Warren, A., Al-Rasheid, K.A.S., Al-Farraj, S.A. and Al-Quraishy, S.A. (2008). Redescriptions of two poorly known marine suctorian ciliates, <i>Ephelota truncata</i> Fraipont, 1878 and <i>Ephelota mammillata</i> Dons, 1918 (Protozoa, Ciliophora, Suctoria), from Qingdao, China. <i>Acta Protozoologica</i> 47: 247-256.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	
Journal	Li, L., Song, W., Al-Rasheid, K.A.S., Warren, A., Roberts, D., Gong, J., Zhang, Q., Wang, Y. and Hu, X. (2008). Two discocephalid ciliates, <i>Paradisocoephalus elongatus</i> nov. gen., nov. spec. and <i>Discocephalus ehrenbergi</i> Dragesco, 1960, from the Yellow Sea, China (Ciliophora, Hypotrichida, Discocephalidae). <i>Acta Protozoologica</i> 47: 353-362.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	
Journal	Wang, Y., Miao, M., Zhang, Q., Gao, S., Song, W., Al-Rasheid, K.A.S., Warren, A. and Ma, H. (2008). Three marine interstitial scuticociliates, <i>Schizocalyptra similis</i> sp. n., <i>S. sinica</i> sp. n. and <i>Hippocomos salinus</i> Small and Lynn, 1985 (Ciliophora: Scuticociliatida), isolated from Chinese coastal waters. <i>Acta Protozoologica</i> 47: 377-387.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	
Journal	Hu, X., Warren, A., Song W. (2008). Stomatogenesis and morphological redescription of the marine ciliate, <i>Philasterides armatalis</i> Song, 2000 (Protozoa: Ciliophora: Scuticociliatida). <i>Journal of the Marine Biological Society of the UK</i> . 88: 29-34.	CUP, Cambridge	<a href="http://www.cambridge.org/journals/journal_catalogue.asp?historylinks=ALPHA&amp;mnemonic=MBI">http://www.cambridge.org/journals/journal_catalogue.asp?historylinks=ALPHA&amp;mnemonic=MBI</a>	n/a

Type *	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Journal	Miao M, Warren A, Song W, Wang S, Shang H, Yang G, Chen Z. (2008). Analysis of the Internal Transcribed Spacer 2 (ITS2) region of scuticociliates and related taxa (Ciliophora, Oligohymenophorea) to Infer their evolution and phylogeny. <i>Protist</i> 159: 519-533	Elsevier, Amsterdam	<a href="http://shop.elsevier.de/ejopp">http://shop.elsevier.de/ejopp</a>	n/a
Journal	Yi Z, Song W, Chen Z, Warren A, Roberts D, Miao M, Gao S, Li L (2008). Comparison of three closely related <i>Pseudokeronopsis</i> species (Ciliophora, Urostylida) at inter- and intra-specific levels inferred from SS rDNA gene and ITS1-5.8S-ITS2 region sequences. <i>Journal of Zoology</i> 275: 268-275	Wiley-Blackwell, Oxford	<a href="http://www.wiley.com/bw/journal.asp?ref=0952-8369">http://www.wiley.com/bw/journal.asp?ref=0952-8369</a>	n/a
Journal	Wang Y, Song W, Hu X, Warren A, Al-Rasheid KAS (2008). Descriptions of two new marine species of <i>Pleuronema</i> , <i>P. czapikae</i> sp. n. and <i>P. wiackowskii</i> sp. n. (Ciliophora: Scuticociliatida), from the Yellow Sea, north China. <i>Acta Protozoology</i> 47: 35-45.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Li L, Shao C, Yi Z, Song W, Warren A, Al-Rasheid KAS, Al-Farraj SA, Al-Quraishy SA, Zhang Q, Hu X, Zhu M, Ma H (2008). Redescriptions and SSrRNA gene sequence analyses of two marine species of <i>Aspidisca</i> (Ciliophora, Euplotida), with notes on the morphogenesis in <i>A. orthopogon</i> . <i>Acta Protozool.</i> 47: 83-94.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Shao C, Miao M, Song W, Warren A, Al-Rasheid KAS, Al-Quraishy SA, Al-Farraj SA (2008). Studies on two marine <i>Metaurostylopsis</i> spp. from China with notes on the morphogenesis of <i>M. sinica</i> nov. spec. (Ciliophora, Urostylida). <i>Acta Protozoology</i> 47: 95-112.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Lin X, Song W, Li J, Warren A (2008). Taxonomic studies on three marine pleurostomatid ciliates, <i>Litonotus bergeri</i> nov. spec., <i>L. blattereri</i> nov. spec. and <i>L. petzi</i> nov. spec. (Ciliophora, Pleurostomatida) from north China. <i>European Journal of Protistology</i> 44: 91-102.	Elsevier, Amsterdam	<a href="http://www.sciencedirect.com">www.sciencedirect.com</a>	n/a

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(eg journals, manual, CDs)	(title, author, year)	(name, city)	(eg contact address, website)	£
Journal	Li L, Song W, Warren A, Shin MK, Chen Z, Ji D, Sun P. (2008). A phylogenetic investigation of five peritrich genera, <i>Vorticella</i> , <i>Pseudovorticella</i> , <i>Epicarchesium</i> , <i>Zoothamnium</i> and <i>Zoothamnopsis</i> (Protozoa; Ciliophora; Sessilida) and related taxa, based on small subunit rRNA gene sequences. <i>Journal of Eukaryotic Microbiology</i> 55: 448-456.	Blackwell Publishing, Oxford	<a href="http://www.blackwellpublishing.com/journal.asp?ref=1066-5234">http://www.blackwellpublishing.com/journal.asp?ref=1066-5234</a>	n/a
Journal	Shao C, Song W, Li L, Warren A, Al-Rasheid KAS, Al-Quraishy SA, Al-Farraj SA, Lin X (2008). Systematic position of Discocephalus-like ciliates (Ciliophora: Spirotrichea) inferred from ontogenetic and SS rRNA gene information. <i>International Journal of Systematic and Evolutionary Microbiology</i> 58: 2962-2972.	SGM, Reading	<a href="http://ijs.sgmjournals.org/misc/about.shtml">http://ijs.sgmjournals.org/misc/about.shtml</a>	n/a
Journal	Li L, Song W, Warren A, Al-Rasheid KAS, Roberts D, Yi Z, Al-Farraj SA, Hu X. (2008). Morphology and morphogenesis of a new marine ciliate, <i>Apokeronopsis bergeri</i> nov. spec. (Ciliophora, Hypotrichida) from the Yellow Sea, China. <i>European Journal of Protistology</i> 44: 208-219.	Elsevier, Amsterdam	<a href="http://www.sciencedirect.com">www.sciencedirect.com</a>	n/a
Journal	Chen X, Song W, Warren A, Al-Rasheid KAS, Gong J (2008). Redescriptions of two marine suctorian ciliates, <i>Ephelota gemmipara</i> (Hertwig, 1876) Bütschli, 1889 and <i>Ephelota crustaceorum</i> Haller, 1880 (Protozoa, Suctoria). <i>Acta Protozoology</i> . 47: 113-124.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Song W, Wilbert N, Al-Rasheid K, Warren A, Shao C, Long H, Yi Z, Li L. 2007. Rededescriptions of two marine hypotrichous ciliates, <i>Diophrys irmgard</i> and <i>D. hystrix</i> (Ciliophora, Euplotida), with a brief revision of the genus <i>Diophrys</i> <i>Journal of Eukaryotic Microbiology</i> 54: 283-296.	Blackwell Publishing, Oxford	<a href="http://www.blackwellpublishing.com/journal.asp?ref=1066-5234">http://www.blackwellpublishing.com/journal.asp?ref=1066-5234</a>	n/a

Type *	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Journal	Wang R, Qiu Z, Chen J, Warren A, Song W. 2007. Morphogenesis of the freshwater ciliate <i>Neokeronopsis spectabilis</i> (Kahl 1932) Warren et al., 2002, based on a China population (Ciliophora : Urostylidae) . <i>Journal of Eukaryotic Microbiology</i> 54: 184-190	Blackwell Publishing, Oxford	<a href="http://www.blackwellpublishing.com/journal.asp?ref=1066-5234">http://www.blackwellpublishing.com/journal.asp?ref=1066-5234</a>	n/a
Journal	Gong J, Song W, Warren A. Lin X, Roberts D.McL. 2007. Microscopical observations on four marine <i>Dysteria</i> species (Ciliophora, Cyrtophorida). <i>European Journal of Protistology</i> 43: 147-161	Elsevier, Amsterdam	<a href="http://www.sciencedirect.com">www.sciencedirect.com</a>	n/a
Journal	Shao C, Hu X, Song W, Warren A, Al-Rasheid K. 2007. Morphogenesis in the marine spirotrichous ciliate <i>Apokeronopsis crassa</i> (Claarède & Lachmann, 1858) n. comb. (Ciliophora: Stichotrichia), with the establishment of a new genus <i>Apokeronopsis</i> n. g., and redefinition of the genus <i>Thigmokeronopsis</i> . <i>Journal of Eukaryotic Microbiology</i> 54: 392-401.	Blackwell Publishing, Oxford	<a href="http://www.blackwellpublishing.com/journal.asp?ref=1066-5234">http://www.blackwellpublishing.com/journal.asp?ref=1066-5234</a>	n/a
Journal	Long H, Song W, Warren A, Al-Rasheid K, Gong J, Chen X. 2007. Two new ciliates from the north China seas, <i>Schizocalyptra aeschtae</i> nov. spec. and <i>Sathrophilus holtae</i> nov. spec., with new definition of the genus <i>Sathrophilus</i> (Ciliophora, Oligohymenophora). <i>Acta Protozoologica</i> 46: 229-245	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Chen X, Song W, Al-Rasheid K A S, Warren A, Long H, Shao C, Al-Farraj S A, Hu X. 2007. The morphology of three heterotrichous ciliates, <i>Condylotentor auriculatus</i> (Kahl, 1932) Jankowski 1978, <i>Condylostoma minutum</i> Bullington, 1940 and <i>C. spatiosum</i> Ozaki & Yagiu in Yagiu, 1944 (Ciliophora: heterotrichida). <i>Acta Protozoologica</i> 46: 289-309.	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a

Type *	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Journal	Shao C., Song W., Li L., Warren A. & Hu X. (2007). Morphological and morphogenetic redescrptions of the stichotrich ciliate <i>Diaxonella trimarginata</i> Jankowski, 1979 (Ciliophora, Stichotrichia, Urostylida). <i>Acta Protozoologica</i> <b>46</b> : 25-39	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Xu D., Song W. & Warren A. (2006). Morphology and infraciliature of two marine oligotrich ciliates, <i>Parallelostrombidium armatum</i> (Bürger, 1908) nov. comb. and <i>Strombidium montagnesi</i> nov. spec. (Ciliophora: Oligotrichida) from China. <i>Journal of Natural History</i> <b>40</b> :1287-1299	Taylor & Francis, Abingdon	<a href="http://www.tandf.co.uk/journals/titles/00222933.asp">http://www.tandf.co.uk/journals/titles/00222933.asp</a>	n/a
Journal	Ji D, Song W & Warren A. (2006). Redescrptions of three marine peritrichous ciliates, <i>Zoothamnium alternans</i> Claparède et Lachmann, 1859, <i>Z. sinense</i> Song, 1991 and <i>Z. commune</i> Kahl, 1933 (Ciliophora: Peritrichia), from North China. <i>Acta Protozoologica</i> <b>45</b> : 27-39	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Xu D., Song W. Lin X. & Warren A. (2006). On two marine oligotrich ciliates, <i>Spirostrombidium agathae</i> n. sp. and <i>S. schizostomum</i> (Kahl, 1932) n. comb. from China, with a key to the identification of seven well-characterized Spirostrombidium spp. (Ciliophora: Oligotrichida). <i>Acta Protozoologica</i> <b>45</b> : 433-442	Jagiellonian University Press, Krakow	<a href="http://www.eko.uj.edu.pl/ap/">www.eko.uj.edu.pl/ap/</a>	n/a
Journal	Shang H., Song W., Warren A., Li L. & Chen Z. (2006). Phylogenetic positions of two marine ciliates, <i>Metanophrys similis</i> and <i>Pseudocohnilembus hargisi</i> (Protozoa, Ciliophora, Scuticociliatia), inferred from complete small subunit rRNA gene sequences. <i>Progress in Natural Science</i> <b>16</b> : 374-378	Taylor & Francis, Abingdon	<a href="http://pub.nsf.gov.cn/pins/en/ch/currentissue.aspx">http://pub.nsf.gov.cn/pins/en/ch/currentissue.aspx</a>	n/a

Type *	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Journal	Song W., Warren A., Wang Y., Ma H., Hu X. & Chen Z. (2006). Phylogenetic position of the marine ciliate, <i>Cardiostomatella vermiforme</i> (Kahl, 1928) Corliss, 1960 inferred from the complete SSrRNA gene sequence, with establishment of a new order Loxocephalida n. ord. (Ciliophora, Oligohymenophorea). <i>European Journal of Protistology</i> <b>42</b> : 107-114	Elsevier, Amsterdam	www.sciencedirect.com	n/a
Journal	Song W., Warren A., Roberts D., Wilbert N., Li L., Sun P., Hu X. & Ma H. (2006). Comparison and redefinition of four marine, coloured <i>Pseudokeronopsis</i> spp. (Ciliophora, Hypotrichida), with emphasis on their living morphology. <i>Acta Protozoologica</i> <b>45</b> : 271-287	Jagiellonian University Press, Krakow	www.eko.uj.edu.pl/ap/	n/a
Journal	Ma H., Song W., Warren A. Roberts D., Gong J. & Al-Rasheid K. (2006). Redescription of the marine scuticociliate <i>Glauconema trihymene</i> Thompson, 1966 (Protozoa; Ciliophora): life cycle and stomatogenesis. <i>Zootaxa</i> <b>1296</b> : 1-17	Magnolia Press, Auckland	http://www.mapress.com/zootaxa/	n/a
Journal	Sun P., Song W. & Warren A. (2006). Taxonomic characterization of two marine peritrichous ciliates, <i>Epicarchesium corlissi</i> n. sp. and <i>Pseudovorticella jiangi</i> n. sp. (Ciliophora: Peritrichia), from northern China. <i>European Journal of Protistology</i> <b>42</b> : 281-289	Elsevier, Amsterdam	www.sciencedirect.com	n/a
Journal	Shao C., Song W., Warren A., Al-Rasheid K., Yi Z. & Gong J. (2006). Morphogenesis of the marine ciliate, <i>Pseudoamphisiella alveolata</i> (Kahl, 1932) Song & Warren, 2000 (Ciliophora, Stichotrichia, Urostylida) during binary fission. <i>Journal of Eukaryotic Microbiology</i> <b>53</b> : 388-396	Blackwell Publishing, Oxford	http://www.blackwellpublishing.com/journal.asp?ref=1066-5234	n/a

## Annex 6 Darwin Contacts

<b>Ref No</b>	14-015
<b>Project Title</b>	Conservation of Jiaozhou Bay: biodiversity assessment and biomonitoring using ciliates
<b>UK Leader Details</b>	
Name	Dr Alan Warren
Role within Darwin Project	UK Partner Project Leader
Address	Dept. of Zoology, Natural History Museum, Cromwell Road, London SW7 5BD
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<b>Other UK Contact (if relevant)</b>	
Name	
Role within Darwin Project	
Address	
Phone	
Fax	
Email	
<b>Partner 1</b>	
Name	Professor Weibo Song
Organisation	Ocean University of China
Role within Darwin Project	Host Country Project Leader
Address	Laboratory of Protozoology. Ocean University of China, Qingdao 266003, China
Fax	
Email	
<b>Partner 2 (if relevant)</b>	
Name	
Organisation	
Role within Darwin Project	
Address	
Fax	
Email	