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Sustaining livelihoods and protecting biodiversity through development of pez blanco [whitefish] aquaculture

Project No: 13/011

Final Project Report

April 2004 - March 2007

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Contents:

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Acronyms used:

Acronym	Spanish	English
BD	Biodiversidad	Biodiversity
CBD	Convención en Biodiversidad	Convention on Biodiversity
CIAD Mazatlan	Centro de Investigación en Alimentos y Desarrollo, Mazatlán	
CIBNOR	Centro de Investigación Biológica del Noroeste	Centre of Biological Research of the Northwest
CIC	Coordinación de la Investigación Científica, UMSNH	Coordination of Scientific Investigation, UMSNH
CICESE	Centro de Investigación Científica y de Educación Superior de Ensenada	
COECO	Consejo Estatal de Ecología	State Council for Ecology
COECyT	Consejo Estatal de Ciencia y Tecnología	State Council for Science and Technology
CONABIO	Consejo Nacional de Biodiversidad	National Biodiversity Council
CONACyT	Consejo Nacional de Ciencia y Tecnología	National Council for Science and Technology
CRIP	Centro Regional de Investigación Pesquera	Regional Fisheries Research Centre
DI	Iniciativa Darwin	Darwin Initiative
GOB DEL ESTADO	Gobierno del Estado de Michoacán	State Government of Michoacán
H.CONGRESO DEL ESTADO	Congreso del Estado de Michoacán	Congress of the State of Michoacán
IoA	Instituto de Acuicultura, Stirling	Institute of Aquaculture, Stirling
IIAF (ex – INIRENA)	Instituto de Investigación Agro-Forestales (staff now transferred from Instituto de Investigación sobre Recursos Naturales)	Institute for Research in Agriculture and Forestry
INP	Instituto Nacional de la Pesca (de SAGARPA)	National Fisheries Institute (of SAGARPA)
Municipio de Morelia	Municipio de Morelia	Morelia City Council
PRODUCE-Michoacán	PRODUCE-Michoacán A.C.	State organisation for agricultural development
SAGARPA	Secretaria de Agricultura, Ganadería, Recursos Pesqueros y Acuicultura	Ministry of Agriculture, Farming, Fishery resources and Aquaculture.
SEMARNAT	Secretaría de Medio Ambiente y Recursos Naturales	Department of Environment and Natural Resources
SUMA	Secretaria de Urbanismo y Medio Ambiente	Secretariat for Urbanisation and Environment
UMSNH	Universidad Michoacana de San Nicolás de Hidalgo	University of Michoacán, Morelia

1. Darwin Project Information:

Project Ref. Number	13/011
Project Title	Sustaining livelihoods and protecting biodiversity through development of Pez blanco aquaculture.
Country(ies)	United Kingdom - México.
UK Contractor	University of Stirling
Partner Organisation(s)	Universidad Michoacana de San Nicolás de Hidalgo
Darwin Grant Value	£172,850
Start/End dates	April 2004 – March 2007
Reporting period	1 April 2004 – 31 March 2007 Annual Report number 2
Project website	http://www.aquaculture.stir.ac.uk/GISAP/native-species/
Authors, date	Prof. Lindsay G. Ross, April 2007 Dr. Carlos A. Martínez-Palacios

2. Project Background:

- This project was based in the Mexican Altiplano in the region of the Lake Pátzcuaro basin (Mesa Central of México). The region is home to a unique relict flock of Atherinopsid fishes, the *Chirostoma* group, locally known as whitefish or pez blanco. The pez blanco of Lake Pátzcuaro (*Menidia estor*, formerly *Chirostoma estor estor*) is a key species and a local symbol and has been the basis of an artisanal fishery for several centuries. Because of over-exploitation, change of land use and degradation of water quality in the lake the fish population has declined markedly in a short period and the species must now be considered as endangered.

- Our principal objectives were the implementation of pez blanco aquaculture within the region. The project focused on the transfer of technology for pez blanco aquaculture to community groups and SME's which would have the potential to reduce over-fishing. The associated large scale-hatchery facility, recently completed from complimentary funding, also has the potential to supply juveniles for restocking. Overall, this would help to avoid the constant pressure of fishermen on the natural population of pez blanco, thus protecting biodiversity of this unique resource, and at the same time sustaining rural livelihoods.

3. Project Purpose and Outputs:

- The purpose of this project was to contribute to the conservation of the natural populations of pez blanco (*Menidia estor*) through aquaculture, as well as to transfer the technology already available for its culture. The principal thrust was to enable establishment of small scale aquaculture in the riparian area of Lake Pátzcuaro and other selected locations. The establishment of pez blanco aquaculture would contribute to the rural economy of indigenous people (P'urhepecha ethnic group), due to the high prices of this species in the regional market. At the beginning of the project the peak price of pez blanco was approximately £15/kg at Easter time; it is now £40/kg. Such enormous economic pressure continues to be a major threat to this species and its relatives.

- Principal proposed outputs were: Training of campesinos, SME's and trainers, development of training materials, publication of training manuals, development of hatchery and production sites, assistance with design, operation and securing project funding, increasing awareness of biodiversity issues, publication of core science, investigation of related species, integrated systems, improving livelihoods, developing aquaculture and biodiversity strategy.

- The project objectives were not modified significantly from the original proposal.

4. Scientific, Training, and Technical Assessment

A. Research:

- The research on the species was supported by many projects funded by Mexican agencies as well as by the Darwin Initiative project. The focus was in several key areas (Table 1).

- A broad investigation of the basic biology of the species was necessary to establish the basis for its propagation and husbandry. Many studies addressed this area.

- Closure of the reproductive cycle in captivity was a major milestone is enabling aquaculture without reliance in seed from natural populations and the negative effect of removal of broodstock from the wild. This was successfully achieved at an early stage of the project.

- The feeding mechanisms, habits and nutritional requirements of the species has been thoroughly investigated. This has enabled design of practical, efficient feeding systems and balanced artificial diets for all life stages.

- The environmental physiology of the species was investigated, particularly growth and survival responses to temperature, salinity and dissolved oxygen. Understanding these factors allows optimisation of systems so as to improve husbandry and maximise survival.

- Simple on-growing systems were investigated and developed for all life stages. On-growing systems appropriate for use in communities are particularly important and the trials are continuing in order to explore the range of economic alternatives.

- Developing and operating aquaculture systems within the regulatory framework of fisheries, agriculture and water resource use was investigated. This allowed development of an understanding of the environmental impact of aquaculture activities and coping with the extensive regulatory framework in Mexico.

- Field work, based on PRA methodology, was carried out to better understand the structure of communities so as to enable fruitful interactions between the project and the families involved.

- Project staff developed a discussion document on Aquaculture and Biodiversity strategy, designed to inform the key agencies and stakeholders and to promote development of future policies.

- A large number of INIRENA aquaculture group staff was involved in executing and supporting the research (Table 2). This leaves a strong legacy of workers able to collaborate in a team towards a common BD and aquaculture goal.

Table 1. Summary of research areas and topics developed in the pez blanco project cluster.
Not all sub-projects are shown here

Area	Topic	Study Mode, Location, Name, Nationality
Basic Biology	Feeding mode and structures	B.Sc., INIRENA, MariCarmen Aguilar-V, Mexican
Environmental Physiology	Temperature tolerance and growth	B.Sc., INIRENA. John Taylor, British
	Salinity tolerance and growth	B.Sc., INIRENA, Rosalinda Salgado-G, Mexican. M.Sc., Stirling, Jordi Comas Morte, Spanish.
	Oxygen consumption	M.Sc., INIRENA Begoña Julián, Spanish. B.Sc., INIRENA, Guillermo Corona, Mexican.
	Specific Dynamic Action	Pre-Doctoral. INIRENA. Begoña Julian, Spanish.
	Anaesthesia, Sedation and Transportation	M.Sc., INIRENA, Judith Sanchez-B, Mexican.
Broodstock Management	Tank and Pond trials at INIRENA	Staff Project, INIRENA, Dr Carlos Martinez-P, Mexican
Reproduction	Natural spawning	B.Sc., INIRENA, Odin Santoyo, Mexican.
	Photoperiod Control	B.Sc.. INIRENA, Jose Chavez-S, Mexican.
	Temperature and sex control	M.Sc., UNAM, Patricia Rojas INP, Mexican.
	Sperm motility	Staff Project, INIRENA Antonio Campos-M, Mexican
Nutrition and Feeds	Protein requirements	Ph.D. INIRENA, Gisela Rios Duran, Colombian.
	Fatty acid requirements	B.Sc.. INIRENA/CIBNOR La Paz, Magdalena Monroy-M, Mexican.
	Carbohydrate effects	B.Sc.. INIRENA, WileBaldo Canseco-M, Mexican.
	Vitamin C requirements	Ph.D., UNAM/INIRENA, Gisela Rios Duran, Colombian
	Microdiets	B.Sc.. INIRENA, Jesus López Garcia, Mexican.
	In Vitro digestibility	B.Sc., INIRENA, Ana Avalos-S, Mexican.
On-growing systems	Pond trials	Project Field trials, Ichupio & San Geronimo, Mexico
	Tank trials	Project Field trials, INIRENA, Tarerio & Tecozautla, Mexico
Environmental Impact	Sustainable Capacity	Consultant, Mexico Dr T C Telfer. British
	Regulatory scoping and conformity	Consultant, México, MC Alexandra Gutierrez, Mexican
	GIS study of Biodiversity Management	MSc. Stirling. Neil Handisyde. British.
Community Studies	Participative Rural Assessment	Consultant, INIRENA & Field Dr E Morales Philippino/Stirling
	Research and Development of pond training manual	MSc. Stirling/Field, Victor Peredo-A, Mexican.
Biodiversity Strategy	Research and Development of BD guidelines for Aquaculture	MSc. Stirling/Field, Ajejandra Ahumada, Mexican.

Table 2. Summary of Mexican research staff involved in the pez blanco project.

Name	Role in project	Dates
Dr Carlos A Martinez Palacios	PI, México	2004 - 2007
Dr Antonio Campos Mendoza	Project manager. Year 1.	2004 - 2005
MC Alejandra Ahumada Garcia	Project manager. Years 2-3	2004 - 2007
MC Victor Peredo Alvarez	Project manager. Years 2-3	2004 - 2007
Biol. Antonio Tello Ballinas	Demonstration site support	2004 - 2007
Biol. Jesús Lopez Garcia	Field and facility support	2004 - 2007
Biol. Maria del Carmen Aguilar Valdez	Support to PI. Year 1.	2004 - 2005
Biol. Lidia Ambriz Cervantes	Laboratory manager	2004 - 2007
Biol. AnaRosa Hernandez Tellez	Hatchery manager	2004 - 2007
Biol. Daphne Moreno Bazurto	Hatchery worker (live feeds)	2004 - 2007

- Overall, the Darwin Initiative work, in conjunction with several Mexican-funded projects, has made significant research progress. We are now able to produce juvenile fish for supply to on-growing projects with maximum survival and over an extended period of the year.

- The published research outcomes from this, and related, projects are extensive and have been reported as peer-reviewed Journal Articles, Conference and Seminar Presentations and as Popular Journal articles. These published outputs are summarised in **Appendix 1** and **Appendix 7** contains selected reprints of articles.

B. Training:

- Training, at a number of different levels, was a very important part of this project.

- Formal degree training was supported through project work for PhD, MSc and B.Sc. degree students from Mexico and the UK. Degree programmes were accredited by the University of Stirling, the Universidad Nacional Autonóma de Mexico and the Universidad Michoacána de San Nicolas de Hidalgo. In addition to providing training and staff development, this degree project work formed the backbone of the research effort over several years (see 4A, above, and http://www.aquaculture/stir.ac.uk/GISAP/native-species/students.php).

- Training the trainers was intended to boost the skills and knowledge base of the project managers, Ms Ahumada and Mr Peredo, by MSc training in Sustainable Aquaculture at Stirling and by further in-service experiences (see Appendix 4). These staff were appointed by the project PI´s by selection from the potential pool.

- Specialist training was also given to a larger group of young staff who supported the PRA consultant in his field sessions.

- A very substantial range of workshops were provided for communities and families. The content of these was designed to increase awareness of biodiversity issues and pez blanco culture in

particular. Depending upon the target group, topics covered were: BD value and concepts clarification; Menidia estor fishery conservation programs in the past and aquaculture as an alternative for conservation and sustainable use; planning, design and construction of fish farms; fertilisation, boosting productivity and natural supplementary feeds; Time planning; biometrics; transportation and acclimatization; health and prevention; harvesting and markets; sustaining livelihoods. Overall the objectives were to create an understanding the aquatic life cycle and impart simple skills to enable good aquaculture, husbandry and on-growing abilities.

- Considerable training and support was also given to enable communities to apply for their own funding form governmental and state agencies. Simple business structuring and financial concepts were promoted as well as support and confidence in negotiating complex form-completion.

- Training was also provided to groups from SME´s. These were largely auto-selected by their willingness and apparent commitment to develop pez blanco projects. The content delivered was similar to that with communities but emphasis was also given to discussing the potential for hatcheries as a business as well as aspects of business planning.

- The training activities are summarised in **Appendix 2**. Further illustrated examples are also given at http://www.aquaculture.stir.ac.uk/GISAP/native-species/workshops.php.

5. Project Impacts

- The project has, in conjunction with other funded work, built steadily towards achieving the overall objectives and purpose.

- The proposed background research was achieved and much has been published. The practical outcomes from this work have benefited aquaculture of the species and have been widely implemented in all aspects of hatchery work, production of juveniles, transportation and early husbandry in the field.

- The substantial planned training has been completed, with targets exceeded in many cases. While the impact of such training can be difficult to judge, previous experience has shown that the effects will very probably be broad and long-lasting. It is hoped that the biodiversity issues promoted alongside the core science will have a particularly beneficial effect within the host country in coming years.

- The creation of hatchery facilities, and pilot pond sites has had an important effect in attracting attention across the community spectrum. These facilities will endure beyond the Darwin Initiative project and it is expected that they will continue to influence stakeholders and potential stakeholders at all levels.

- The project has clearly demonstrated the feasibility of pez blanco aquaculture and has for the first time produced fish to a marketable size in culture systems totally independent from the lake and from the natural stocks. This achievement is very significant indeed and is a considerable advance on any previous attempts. It is expected and hoped that this news will spread, so further promoting the economic and livelihood benefits of pez blanco aquaculture and providing concrete evidence of opportunities for diversification. This will act significantly to protect the species.

- An aquaculture and biodiversity document was developed and circulated to project partners, national and state agencies, NGO's and stakeholders. Although no guarantee can be given by the project team regarding the likely benefits, it is hoped that this discussion document will help maintain the BD issue firmly on the agenda of the relevant agencies.

- The group continues to promote aquaculture of the species and the DI and BD agenda as far as possible. However, the lack of post-project funding means that further embedding of the progress will be restricted.

- This project has helped the host country to meet its obligations under the Convention on Biodiversity (CBD), in that efforts have been made to **conserve a species** by **equitable access to an exploitable resource,** thereby **improving livelihoods** in the target social groups and showing the way to **open new "green" markets**. These are all stated objectives of the Mexican national responsible agency, CONABIO. It is expected that this could embed further over the coming years especially if the momentum developed by the Darwin Initiative project can be maintained and that the awareness of the BD issues can be perpetuated.

- The approximate contribution made by different components of the project to the measures for biodiversity conservation defined in the CBD Articles is summarised in **Appendix 3**.

- The substantial training and workshop efforts of the project have resulted in a new awareness that it is now possible to culture the species. This had previously been denied by the State fisheries agency. As a result, more people are interested in acquiring the training and advice which the project provided to create systems and to culture the species. More groups are now submitting projects for funding by state and national agencies to obtain the resources to develop their own family or community farms. This can only have a positive on biodiversity and conservation of the species.

- Table 3 gives an indication of the current activities of specific trainees involved with the Darwin Initiative project.

Table 3. Current activities of trainees involved in the pez blanco project.

Name	Project role	Current activity
MC Alejandra Ahumada	Project manager. Years 2 & 3	Now lead biologist, BD and ecotourism project. Michoacán, Mexico. Intends to develop PhD on Ecological Aquaculture, Environmental impact and sustainability, certification, based on FAO programmes, CBD and National Strategies.
MC Victor Peredo	Project manager. Years 2 & 3	Now in PhD programme. Use of GIS for BD planning and management. Stirling, UK
Biol. Antonio Tello	Demonstration site support	Continues in field work support, INIRENA
Biol. Jesús López García	Field and facility support	Continues in field work support & provides training in culture systems.
Biol. Maria del Carmen Aguilar Valdez	Support to PI.	Gained M.Sc. in Maringa, Brazil. Now providing training in added value technology (smoking, filleting, leather)
Biol. Lidia Ambriz Cervantes	Laboratory manager	Continues in this role. Completing M.Sc. in aquaculture.
Biol. AnaRosa Hernandez Tellez	Hatchery manager	Continues in this role & provides training in hatchery management
Biol. Daphne Moreno Bazurto	Hatchery worker (live feed specialist)	Continues in this role & provides training in live feeds.

- Throughout the project there was excellent collaboration between UK and primary Mexican partners. This was based on a long-standing and very productive collaboration between the PI´s and other colleagues extending over many years. The host country team has expanded and consolidated during the period of the project and the UK PI is already involved in a number of new related projects with these collaborators.

- Interaction between national and state governmental agencies and stakeholders did increase during the project. However, it is important to note that the intention of these agencies to become involved was not entirely fulfilled. For example, COMPESCA is only now slowly delivering complimentary funding to projects. The reasons for this lack of follow-through were partly due to the nature of the political structures but also certainly due to some personality issues and possibly some jealousy regarding achievements.

- It is gratifying to record that many of the techniques developed by the project group have been adopted by the Centro Regional de Investigación Pesquera (CRIP) based in Pátzcuaro who have responsibility for implementing national policy and supporting aquaculture. This adoption is a very positive aspect of the Darwin Initiative project outcomes.

- In a very significant recent development, Dr Marco Linné has taken up the post of Director General de Acuicultura of the INP. Influenced by the depth and strength of the work of the group and of the Darwin Initiative project, he intends to adopt the pez blanco as one of the most important species for development of aquaculture in inland waters. This has the potential to dramatically reinforce transfer of technology for the species over the next 6 years by establishment of policy and also by targeting funding from CONACyT-SAGARPA at federal level. Using the pez blanco work as an example, it is clear that INP now wish to prioritise the development of native species for aquaculture as far as possible. Consequently, it is also extremely likely that INP will influence the national regulatory framework in a permanent manner, so that these objectives are perpetuated in future administrations.

- Advisory group meetings were held at intervals. These were considered useful but are not sustainable in the present form. Michoacán is a large state and so an important issue in this context was the travel time and distance for contributors, as well as direct attendance costs and opportunity costs because of the time involved. This cannot be sustained without Darwin Initiative or other formal financial input.

- Because of the training and workshop elements in this project, there are a substantial number of beneficiaries at several levels. The capacity of a large number of staff and students at INIRENA and elsewhere has been increased greatly by exposure to a well- run multifaceted project cluster. There is no question that the long term impact on many of these actors will be high. The community level training is more difficult to quantify in terms of benefits. However, there is no doubt that the community projects now running and in development have opened a range of livelihood alternatives which could have numerous benefits in the future. The community, family and SME groups involved with the project now have a raised awareness of BD issues, some concept of solutions and the ability to produce fish. In the longer term it is expected that this will have livelihood benefits as well as a lasting impact on the local and specific BD issues.

- The First Latin American Conference on Aquaculture of Native Fishes organised by the project in Morelia in 2006 had a massive impact and will have lasting benefit on aquaculture development and BD. This conference gave a strong lead to the sector and already there are follow up national level meetings planned in Brazil (Dourados, August 2007) and Chile (Temuco, October 2007). A very significant and exciting development is the organisation of the Second Latin American Conference on Aquaculture of Native Fishes in Mar del Plata, Argentina in collaboration between IINTECH and the National Aquaculture Centre. These meetings will reinforce the impact of the DI work and it is anticipated will have lasting impact and benefit for many stakeholders.

6. Project Outputs

- In almost all cases, the actual outputs are far greater than those originally envisaged, amply demonstrating the level of effort and commitment of all involved in the work.

- To date, the project has generated 3.6 journal articles per year, a figure which may rise to 5 papers per year once the remaining work is published. This is a very significant achievement. Full details of all publications and material related to the core science that can be publicly accessed are provided in **Appendix 1.** Some work concerning related species has also been published.
  See: http://www.aquaculture.stir.ac.uk/GISAP/native-species/chirostoma-pubs.php

- The extensive and varied series of training events covered training of the trainers, training for National and State agencies, NGO's and academic staff of INIRENA. Many sessions for training of community and family groups were also held, as well as specialised sessions for SME's. Training events are summarised in **Appendix 2.**
  See: http://www.aquaculture.stir.ac.uk/GISAP/native-species/workshops.php

- A wide range of training materials was developed during the project. Practical and classroom based short courses were prepared for workshops on basic aquaculture, pond preparation, pond management and on-growing methodology.

- An illustrated training manual was produced for semi-intensive pond aquaculture, designed for work with low literacy groups and non-Spanish speakers. Short manuals were also generated on live feed production and live fish transportation.
  See: http://www.aquaculture.stir.ac.uk/GISAP/native-species/manuals.php

- A scaled-up hatchery was constructed in late 2004 using complimentary funding. This facility enabled a great deal of empirical research on hatchery techniques to optimise survival and growth. The broodstock area has eight 3m diameter tanks with automatic egg recovery. Egg handling is based on Zug jars and juveniles are reared in a channel system which has a capacity for 1 million animals. Juveniles are grown-on in twenty 2m diameter tanks and are finally transferred to 10m diameter tanks. The hatchery is now able to supply up to 200,000 juvenile fish per year.
  See: http://www.aquaculture.stir.ac.uk/GISAP/native-species/hatchery.php

- Work with communities and families to develop pilot production sites was a very important part of the project and a useful range of on-growing systems types has been developed. The initial pilot site at Ichupio has been very successful using earth ponds as an on-growing system and has been used frequently as a demonstration site and field training location. A range of other sites are now running with varying levels of success. While we would have preferred to see more sites in existence at this stage, there are enough to give proof of concept and we hope that this can be built up in the coming years.
  See: http://www.aquaculture.stir.ac.uk/GISAP/native-species/projects.php

- The field projects required complimentary funding for construction and materials. To enable this, project staff made significant efforts to work with and to train collaborating groups to be able to apply for their own funding from the various responsible agencies. This was a very important factor as there was a need to change from a dependency culture to one which is more self-reliant and has ownership of the projects and the concepts behind them. While there is much more to do, we believe that the Darwin Initiative project made a useful contribution and showed how this could be done.

- The cluster of community-based on-growing projects developed well, but at a much slower pace than expected. This was principally due to the very slow bureaucratic processes embedded in some Mexican agencies and was for the most part beyond the control of the project staff. Background Participative Rural Appraisal work was organised by Mr Morales from Stirling and a large group of INIRENA staff were trained as part of this effort. The results were very helpful in

understanding the issues involved at community level.

- Substantial specialised training was given to potential SME groups, as well as considerable assistance with physical system design and business planning. Nonetheless, this aspect of the project did not develop as planned. This was in part due to lack of real commitment by the individuals involved, but also probably because a profitable business case could not yet be clearly established. Work in Tecozautla and Durazno has now shown how successful these projects can be and we believe that this will develop positively in the near future.

- The objective of influencing policy regarding biodiversity and aquaculture development was pursued in several ways. There was communication with the responsible agencies in the state, COMPESCA and SAGARPA. However this was not very fruitful because of political issues which got in the way of progress. Advisory meetings for the Darwin Initiative project were helpful and were instrumental in promulgating the concepts more widely as members of the group passed on the message. There was increasing communication with the national biodiversity agency CONABIO, who were very pleased with this project and who have used it as an example of biodiversity issues in Mexico.
  See: http://www.aquaculture.stir.ac.uk/GISAP/native-species/publicity.php

- A starter discussion document outlining issues for aquaculture development and biodiversity was developed and widely circulated to all national and state agencies with any responsibility in the sector; further feedback is awaited.
  See: http://www.aquaculture.stir.ac.uk/GISAP/native-species/manuals.php

- The overall project outputs are summarised in **Appendix 4**, using the Standard Output Measures coding methodology of the Darwin Initiative.

Dissemination:

- The project outputs and outcomes been widely disseminated in a number of ways with varying target audiences, viz:

- Scientific papers: aimed at the aquaculture research community.

- Popular and Trade Journal articles: aimed at aquaculture practitioners.

- Newspaper articles and TV articles: aimed at influencing hearts and minds in the target region and elsewhere in Mexico concerning biodiversity and pescado blanco.

- Conference presentations. Posters, proceedings, and abstracts: aimed at aquaculture research and practitioners. Disseminating the science, the BD and conservation messages and the Darwin Initiative.

- The work of the project and of Darwin Initiative generally, was featured prominently during the First Latin American Conference on Culture of Native Fishes, held in Morelia during October 2006 and organised by the project team. Not only did this attract massive publicity within the region and in México, but also internationally, specifically in Latin America. Staging this conference has had the major effect of focusing the interest of many key people on the issues of CBD, the use of native species in aquaculture development as well as use of aquaculture as a powerful tool to maintain Biodiversity and Livelihoods. The pressure on nations to comply with CBD is also giving a strong impulsion to indigenous species development, even extending to changes in the law regarding importations. There could be many species currently under threat, even extending to extinction, and a reconsideration of the effects and future role of aquaculture linked to conservation is timely. The approach of the present Darwin Initiative project has given a lead to many Latin American workers who need to contend with this developing situation.

- This event has already spawned further meetings on native fish species for aquaculture in Brazil (August 2007) and Chile (October 2007) as well as the prospect of a series of biennial pan-Latin American meetings to follow up this one, the first of which will be held in Mar del Plata, Argentina, in 2008. This is a very significant measure of success for the Darwin Initiative project and the timeliness of our original concept. We feel that we now have a leading role to play in pushing this agenda forward throughout Latin America and that the Darwin Initiative can be truly proud of this achievement which was supported through the present project.

- The conference website has been transformed into a reporting and linking point for all our colleagues who are interested in this very important topic: http://www.aquaculture.stir.ac.uk/GISAP/Conference/index.php

- This wide dissemination will continue after the current Darwin Initiative project, in that papers on the base science and aquaculture will be published and the BD message will be used as far as possible to influence future aquaculture development in the region and elsewhere. The Darwin Initiative project was the primary focus for popular dissemination and so in the future this will be much reduced as there is no specific source of support or personnel to continue the present effort.

- A summary of all dissemination events is shown in **Appendix 5** and examples are available at http://www.aquaculture.stir.ac.uk/GISAP/native-species/publicity.php

7. Project Expenditure

- The project expenditure based on the DI categories in the original application is summarised in Table 4.

- These data are based on the UK PI´s records and may vary from the final position to be provided by the University of Stirling Finance Office at the end of the accounting period.

- A virement of funds was agreed in Year 1 for purchase of capital equipment.

- Accumulated balances were used in year 2 to address the required audits and will be used similarly at the end of year 3 (see ** in Table 4).

- There was no other substantial variation from the original budget except for minor virements between headings to adapt to circumstances and to maximise outcomes.

- The overall budget was neither exceeded, nor underspent.

Table 4: Project expenditure during the reporting period (April 2004 to March 2007).

Item	Original Budget	Virements	Actual Expenditure	Current Balance

8. Project Operation and Partnerships

- The partners involved in the project are summarised in Table 5, which also indicates the relative involvement of each contributor. Project planning was principally executed by the Principal Investigators, although where necessary advice was taken from others.

- During the project lifetime, there was some consultation with the host country Biodiversity Strategy Office, CONABIO. Ms Ahumada discussed the BD strategy with the director and his inputs were later used to influence our strategy document. CONABIO also featured our project in an article in their newsletter *BIODIVERSITAS* in March/April 2007.

- The agencies responsible for implementation of national strategy at the state level are SUMA and COECO. They developed a local BD strategy just before the DI project began and so we were unable to influence this directly. However, they are aware of our DI work and are involved in collaborating with the strategy discussion document produced from the project.

- Because of the species involved, this project was essentially Mexican and relatively local, backed up by input and expertise from the UK. There was some specific communication between Dr Carlos Strussman, University of Tokyo, and Dr Gustavo Somoza, IINTECH, Argentina, on resolving aspects of reproduction of Atherinids. There was also very useful collaboration with Dra Maria Rodriguez Souza, Universidade de Maringa, Brazil, to develop aspects of post harvest processing and added value.

- The community partnerships developed during the project are continuing. Efforts are being made to attract further funding to sustain these activities.

- These projects are not closely linked with other BD projects within the area. To a large extent the DI project has been a flagship development for the aquaculture community and the agencies alike and it is hoped that the message will perpetuate through emerging policy and strategy in the future.

- There is little doubt that more community participation is needed to embed the technologies transferred and to have the full intended impact on BD. The private sector also has a role and this requires further development over the next few years to boost sustainability. Interest in developing more business-focused packages for pez blanco aquaculture was expressed by

CIE, a business start-up consultant in Morelia. There is considerable scope for further commercial development by collaboration with CIE and similar groups.

Table 5. Contributing partners in the Darwin Initiative project.

Partner	Role	Change from proposal
INIRENA	Principal Mexican research and development partner. Responsible for all aspects of DI project implementation.	None, substantially as planned.
IoA, Stirling	UIK collaborator. Providing advice, guidance and management inputs to all aspects of the project, including associated projects and research.	None, substantially as planned.
COMPESCA	Local state fisheries department. Intended to assist with complimentary funding to support small field projects.	This input was less than expected although some support was provided for excavation work and pond lining at Ichupio and more recently for pond liners in San Geronimo Purenchecuaro.
PRODUCE-Michoacán	State level agricultural development group who fund many projects in the sector. PRODUCE-Michoacán were not originally part of the DI project.	PRODUCE became a very useful partner by funding some complimentary work. Collaboration also extended to joint funding of the field training manual.
INP-SAGARPA	The local office of SAGARPA were originally planned to add to the core DI work through field project support.	SAGARPA provided financial support to a number of our native species projects.
	INP, the National Fisheries Institute influencing development policy at national and state level, through prioritisation of R&D funding managed by SAGARPA, were not directly built into the original project.	INP became involved in the work at an early stage through one of their staff carrying out project work at INIRENA. At the end of the DI project the Director of INP changed and a very important interchange took place in which national policy may be altered to prioritise pez blanco work for the next 6 years and beyond.

9. Monitoring and Evaluation, Lesson learning

- The project performance was evaluated in a number of ways.
- The scientific output of the project was subject to peer review as it was produced and clearly met the standards required for international publication.
- Six monthly and annual reports were evaluated internally and quantitatively, against milestones and indicators established in the initial proposal.
- An advisory group was established which comprised stakeholders, agencies and project staff. The group met at intervals depending on availability.
- The overall performance of the project was reviewed at the end of years 1 and 2 by an independent Darwin Initiative reviewer. The six monthly and annual reports, annual reviews and the responses of the project team to them are available at: http://www.aquaculture.stir.ac.uk/GISAP/native-species/reports.php

[a password is required and will be supplied on request].

- Many of the problems experienced during the project lifetime were specific to the local situation and there is perhaps little to be learned from this. The state fisheries agency, COMPESCA, did not cooperate to the extent originally envisaged or promised although they were approving of the project in general. Support was given, but slowly and at a late stage in the work. Much of this situation developed after the original proposal was made and could not be taken into account at the beginning. This was partly offset by good financial support from SAGARPA and good collaboration with PRODUCE-Michoacán at local level. The more recent positive discussions with INP-SAGARPA at federal level are likely to have a major and lasting effect and so the net result is that most of the project purposes and objectives were achieved.

10. Actions taken in response to annual report reviews

- At each stage, a full response was given to issues raised by reviewers arising from six monthly and annual reports. All the issues in the reviews were discussed fully with the principal partner and the response to the reviews was prepared jointly.

- Where possible, attempts were made to adapt to changing circumstances and to close gaps identified in the reviews.

- The six monthly and annual reports, annual reviews and the responses of the project team to them are available at:
  http://www.aquaculture.stir.ac.uk/GISAP/native-species/reports.php
  [a password is required and will be supplied on request].

11. Darwin Identity

- Throughout the project the Darwin Initiative has been publicised widely, especially in Latin America. Darwin Initiative has been acknowledged in numerous scientific articles as well as in articles in popular and trade journals.

- The Darwin Initiative logo and identity has been used on business cards and leaflets prepared for the project. The logo was also used as a prominent sign on four vehicles used by the project. It was heavily featured in presentations given at meetings in México, Argentina, Brazil, Bali Indonesia, Japan, and elsewhere and will be used again in Istanbul, Turkey, later in 2007 (see **Appendix 4**).

- Substantial coverage was also gained in TV and newspaper features (see **Appendix 5**).

- Darwin Initiative also gained massive exposure through the International Conference held as part of this project. Very strong DI identity was developed though use of the logo, stickers, pin badges, pens etc, as well as direct mention by the opening speaker (LGR). Darwin Initiative was awarded a ”reconocimiento” for its part in sponsoring the event and for the organisational input from local Darwin Initiative project staff and Prof. Ross at IoA, Stirling.

- There is strong awareness of the Darwin project and its significance within the region, due to the massive publicity generated during its lifetime (**Appendix 5**). At state and national level, the agencies with which the project collaborated directly (COMPESCA, INP-SAGARPA, PRODUCE-Michoacán, CONABIO) are fully aware of the existence and objectives of the Darwin Initiative. Many other agencies were also contacted and are well aware of the DI work (SUMA, CRIP-INP, SEMARNAT, H. CONGRESO DEL ESTADO, INP, GOBIERNO DEL ESTADO, COEECO, CONACYT, COECYT, MUNICIPIO DE MORELIA, CIAD-MAZATLÁN, CIBNOR, CICESE and CINVESTAV-MERIDA).

- At the outset, the relevant authorities in Mexico were aware of the vulnerability of the target

species and the need for its conservation. This Darwin Initiative project was local in nature because of the limited distribution of the target species and was a logical and necessary development of fundamental work which had been carried out by the INIRENA group and supported by many sources. The project focused on piloting a number of small scale production trials and demonstrations to promote significant interest from campesinos and small aquaculture producers in the State of Michoacán so as to enable and promote adoption by the target beneficiaries.

12. Attraction of complimentary funding

- Substantial additional funds were granted to the group in Mexico during the lifetime of the Darwin Initiative project. It is not possible to claim credit for all of this, but there is little doubt that the existence and prestige of the Darwin Initiative project had a massive influence on accumulating these additional funds.

- The additional funding obtained by the group is shown in Table 5.

Table 5. Additional project funding grants obtained, to date.

.

Source	Project Title	Amount ($ =Pesos Mexicanos)
FONDOS MIXTOS CONACYT/Gob del Estado	Transferencia tecnológica para el cultivo semi-intensivo del pez blanco de Patzcuaro.	$2,599,000
SAGARPA	Desarrollo de las bases técnicas y científicas para el cultivo del pez blanco de Chapala (Chirostoma promelas) y Pátzcuaro (Chirostoma estor estor).	$4,900,000
PRODUCE-MICHOACAN	Technology transfer for culture of pescado blanco de Pátzcuaro.	$151,031 $150,000 $174,974
PROMEP	Biología reproductiva del bagre del Balsas (*Ictalurus balsanus*), inducción hormonal y ambiental para estimular la actividad reproductiva. Clave PTC-115:	$290,000
CONACYT/Fondos Mixtos	Desarrollo tecnológico para el aprovechamiento e industrialización del pez diablo en la región del bajo Balsas en Michoacán. Clave 37147.	$4,000,000
CONACYT/Fondos Mixtos	Estudio prospectivo del estado ecológico y productivo del embalse Adolfo López Mateos: una propuesta para un adecuado manejo biológico, pesquero y de acuicultura. Clave 53437	$2,100,000
CONACyT	Caracterización enzimática de las rutas biosinteticas (elongación y desaturación) de ácidos grasos en el pez blanco *Menidia estor* de Pátzcuaro: un pez de origen marino que habita en agua dulce y sintetiza ácidos grasos altamente insaturados.	$1,195,000
CIC	Caracterización de la actividad enzimatica digestiva durante la ontogenia del pez blanco *Menidia estor.*	$180,000
CIC	Manipulación del fotoperiodo para estimular la actividad reproductiva del pez blanco de	$40,000

	Pátzcuaro Chapala para incrementar la producción de crías en un sistema de cultivo intensivo.	
CIC & PROMEP	Manipulación del periodo para estimular la actividad del pez blanco de Pátzcuaro de Chapala. Clave 5.13.	$290,000
CIC	Desarrollo de tecnología para la producción de peces nativos bajo cultivo intensivo.	$369,000
CONACyT	Cultivo, alimentación y nutrición de peces	$789,000
TOTAL to date		**$16,938,295**

- Prior to the DI Project, and during the project, the UK PI helped to strengthen the capacity of partners to secure further funds for related work. This applies in the host country and elsewhere and Table 5 shows that the core group at INIRENA have a burgeoning track record of obtaining funding from national and state agencies.

- No attempts made to capture funds from international donors as it was not considered appropriate at this stage. Had the aquaculture implementation been at the full development stage, this would have been an appropriate strategy to investigate.

13. Sustainability and Legacy

- The project achievements most likely to endure are:

The wider awareness of BD	A wider awareness of DI
The published core science	The pilot hatchery
The substantial knowledge base	Field training manuals
Ph.D., M.Sc. & B.Sc. graduates	Training programmes
Community trainee knowledge	Training materials
SME trainee knowledge	Agency and NGO knowledge

- Most Mexican project staff will continue substantially in their present roles. Dr Campos is now managing projects on native catfish and an introduced alien species. MC Ahumada has moved on to manage a biodiversity project in the north of Michoacán and intends to develop a PhD programme from that. MC Peredo has commenced a PhD programme at Stirling on spatial management native fish species. The physical and intellectual resources created during the project will remain with the group.

- The principal UK and Mexican partners will remain in touch as they have a long-standing collaboration and other current projects in which they are collaborating. The Mexican PI and colleagues will continue to be in touch with the DI stakeholder groups regardless of DI funding.

- The project conclusion and outcomes have been disseminated as widely as possible and the results have been taken up by stakeholders as far as possible at this stage. The techniques developed have been adopted by the local CRIP. The field systems are being developed into on-growing projects by communities and SME's. As mentioned earlier, implementation has been hampered by local politics and general slowness of responses but the outcome is generally positive. .

- The legacy of the project could have been improved if the local agencies had been quicker to respond and to collaborate. Nonetheless, this aspect is moving forward now and the recent collaboration with INP is very positive for the future. This evolutionary process would have been more secure if post-project funding had been provided so as to enable embedding of the community work and further bridge-building with agencies.

- Substantial funding has already been obtained for a variety of related projects (see Table 5). The work of the DI project will continue at INIRENA, but at a lower level, so as to complete outstanding projects.

14. Value for money

- In purely financial terms, the project has been completed within budget.
- The complimentary projects funded from Mexican agencies gave great synergy and allowed us to conduct many activities which were not funded directly by the Darwin Initiative.
- Consequently, the project has delivered a great deal, with almost all projected outputs being achieved or, in fact, dramatically exceeded.
- Although some aspects of the work were not fully achieved to our satisfaction, the outputs have been extensive and well beyond those initially proposed.
- Our collaborators and project staff have endeavoured throughout the project to promote the messages linking biodiversity conservation and livelihoods which were the foundation for this work.
- Darwin Initiative exposure and publicity has been excellent and the Darwin Initiative logo and concepts have been promoted at every possible occasion. Darwin initiative also gained massive exposure through the International Conference held as part of this project.
- Overall, the Darwin Initiative support gave a real focus to the work and our staff and collaborators were very proud to be able to be involved.
- In terms of the cores science alone, the outputs were well in excess of that obtained by most development projects.
- Naturally, we consider that the overall value for money from this project was excellent.
- Contact details for future reference are provided in **Appendix 6.**

15. Appendix 1:

Publications

*Items marked with * are included with this report*

Type	Detail	Publishers	Available from: Use left click to follow links	Cost £
Book Chapter	* Martínez-Palacios, C.A., Ríos Duran, Ma. G., Campos Mendoza, A., Toledo Cuevas, M., Aguilar Valdez, Ma de C. and Ross, L.G. 2003. Desarrollo tecnológico alcanzado en el cultivo del pez blanco de Patzcuaro.	In: Historia y avances del cultivo de pescado blanco. p 169-190.	Instituto Nacional de la Pesca. México. Historia y avances del cultivo de pescado blanco. Ed: Patricia Rojas Carrillo. SAGARPA. Instituto Nacional de la Pesca. México. ISBN 968-800-540-1. 290pp	?
Peer reviewed paper	* Martínez Palacios, C.A., Barriga Tovar, E., Taylor, J.F., Ríos Durán, G., and Ross, L.G. 2002. Effect of temperature on growth and survival of Chirostoma estor estor, Jordan 1879, monitored using a simple video technique for remote measurement of length and mass of larval and juvenile fishes.	Aquaculture. 209: 369-377.	Libraries http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper	* Martinez-Palacios, C.A., Rios Duran, M.G., Mendoza, A., Toledo Cuevas, M., Aguilar Valdez, M.C and Ross, L.G. 2002. Progreso en el cultivo del pescado Blanco de Patzcuaro *Chirostoma estor* estor.	Ciencia Nicolaita. 32: 73-90.	Libraries http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper	* Martínez-Palacios, C.A., Comas-Morte, J., Tello-Ballinas, J.A., Toledo-Cuevas, M. and Ross, L.G. 2004. The effect of saline environments on survival and growth of eggs and larvae of *Chirostoma estor estor* Jordan 1880 (Pisces: Atherinidae)	Aquaculture. 238: 509-522	Libraries http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper	* Ross, L.G., Martinez-Palacios, C.A., Rodríguez de Sousa, M.L., y Campos-Mendoza, A., 2006. The Darwin Initiative and the silverside fish *Chirostoma estor estor*: a link between aquaculture, biodiversity and livelihoods.	BIOCELL. 30: 119-120	Libraries http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper	* Martínez-Palacios, C.A., Racotta, I.S., Ríos-Durán, M.G., Palacios, E., Toledo-Cuevas, M, and Ross, L.G. 2006. Advances in applied research for the culture of	BIOCELL 30: 137-148.	Libraries http://www.aquaculture.stir.ac.uk/GISAP/	Nil

	Mexican silversides (Atherinopsidae).			
Peer reviewed paper	* Ríos-Durán, M. G., Hernández-Téllez, A.R., Martínez-Palacios, C.A. and Ross, L.G. 2006. The effect of transportation stress on tissue ascorbic acid levels of mexican silverside (Chirostoma estor estor Jordan, 1979)	BIOCELL 30: 149-155.	Libraries http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper	* Ross, L.G.,[1] Martínez-Palacios. C.A..,[2] Aguilar Valdez, Ma. del C.,[2] Beveridge, M.C.M.[3] and Chavez Sanchez, Ma. C[4]. 2006. Determination of feeding mode in fish: the importance of using structural and functional feeding studies in conjunction with gut analysis in a selective zooplanktivore Chirostoma estor estor Jordan 1880.	Journal of Fish Biology. 68: 1-13.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper	Rodgrigues de Souza, Ma.L., Aguilar Valdez, Ma del C., Ambriz Cervantes, L. y Martinez Palacios, C.A. 2005. Enriquecimiento das tortillas de milho com farinha de pescado difumada e aromatizado com alecrim para o consume humano.	Acuicultura y Pesca. 30-32. (in Portuguese)	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper. 2007, In press	* CA Martínez-Palacios ; L Ambriz-Cervantes; M G Ríos-Durán; LG Ross & KJ Jauncey. Dietary protein requirement of juvenile Mexican Silverside (Chirostoma estor estor Jordan 1879), a stomachless zooplanktophagous fish	Aquaculture Nutrition	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper 2007, In press	* Lindsay G Ross., Judith Sanchez Blanca., Carlos Martinez-Palacios. Ilie. S. Racotta., & Mayra Toledo Cuevas. Anaesthesia, sedation and transportation of juvenile Chirostoma estor estor Jordan 1879 using benzocaine and hypothermia.	Aquaculture Research	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper. 2007, In press	* Carlos. A. Martínez-Palacios., Rosa. L. Salgado-García., Ilie. S. Racotta., Antonio Campos-Mendoza & Lindsay. G. Ross. The effects of salinity on eggs, larvae and juveniles of silverside (*Menidia promelas* Jordan and Snyder 1899) from Lake Chapala, Mexico.	North American Journal of Aquaculture	http://www.aquaculture.stir.ac.uk/GISAP/	Nil

Peer reviewed paper. 2007, In press	* Martínez-Palacios, C.A., Chávez-Sosa, J.C., Santoyo-Guzmán, V.O., Campos-Mendoza, A., Martinez-Chavez, C.C. and Ross, The effect of photoperiod on reproduction of Pez blanco (*Chirostoma estor estor*) of lake Patzcuaro.	Journal of Applied Ichthyology	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Peer reviewed paper. 2007, In press	Palacios, E., Racotta, I.S., Aparicio, B., Arjona, O. and Martínez-Palacios, C.A. Lipid classes and fatty acids during embryogenesis of wild and captive silverside from Lake Pátzcuaro (Chirostoma estor estor).	Fish Physiology and Biochemistry		Nil
Field Manual	* Victor Peredo Alvarez and Lindsay G Ross. 2006. Manual Ilustrado de Entrenamiento en acuicultura semi intensiva.	IoA, Stirling. ISBN 1 85769 220 0	Libraries http://www.aquaculture.stir.ac.uk/GISAP/	£10
Popular Magazine Article	* Morales. J. Training workshop on Participatory Rural Appraisal (PRA) in Michoacán, Mexico. Work with three communities	Aquaculture News: 32:	http://www.aquaculture.stir.ac.uk/	Nil
Popular Magazine Article	* Ross, L.G. and Martínez-Palacios, C.A. 2004. Working with the natives: Development of aquaculture technology for the Mexican silverside or Pez Blanco, Chirostoma estor estor Jordan.	Fish Farmer. 11: 34-36.	Libraries http://www.aquaculture.stir.ac.uk/	Nil
Popular Magazine Article	* Martinez Palacios, C.A. and Ross, L.G. 2004. Patzcuaro hoy: Rescate del pez blanco.	Ciencia y Desarrollo, CONACYT, México. 30: 24-29.	http://www.aquaculture.stir.ac.uk/	Nil
Popular Magazine Article	* Ross, L.G., and Martinez Palacios, C.A. 2005. Towards a culture technology for pescado blanco *Chirostoma estor estor* Jordan 1880.	Aquaculture News. 31: 2-3.	http://www.aquaculture.stir.ac.uk/	
Popular Magazine Article	* Ross, L.G. and Martinez Palacios, C.A. 2007. First Latin American and Third Mexican Conference on Culture o Native fish species.	Aquaculture News. 33: 10.	http://www.aquaculture.stir.ac.uk/	Nil
Conference paper	Campos-Mendoza, A., Chavez-Sosa, J.C., Santoyo-Guzman, V.O., Martinez-Palacios, C.A. and Ross, L.G. (2004) The effect of photoperiod on reproduction of Pez blanco (Chirostoma estor estor) of lake Patzcuaro.	Jornadas del Pejerrey, IIB-INTECH, Chascomus, Argentina	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference paper	Ross, L.G., Martinez-Palacios, C.A., Rodríguez de Sousa, M.L., y Campos-Mendoza, A., (2004) The Darwin Initiative	Jornadas del Pejerrey, IIB-INTECH, Chascomus,	http://www.aquaculture.s	Nil

	and the silverside fish *Chirostoma estor estor*: a link between aquaculture, biodiversity and livelihoods.	Argentina	tir.ac.uk/GISAP/	
Conference paper	Martínez-Palacios, C.A., Racotta, I.S., Ríos-Durán, M.G., Palacios, E., Toledo-Cuevas, M, and Ross, L.G. 2004. Advances in applied research for the culture of Mexican silversides (Atherinopsidae).	Jornadas del Pejerrey, IIB-INTECH, Chascomus, Argentina	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference paper	Ríos-Durán, M. G., Hernández-Téllez, A.R., Martínez-Palacios, C.A. and Ross, L.G. 2004. The effect of transportation stress on tissue ascorbic acid levels of mexican silverside (Chirostoma estor estor Jordan, 1979)	Jornadas del Pejerrey, IIB-INTECH, Chascomus, Argentina	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Seminar paper	Martinez Palacios, C.A. and Ross, L.G. 2005.	Invited paper. SUMA Seminar. Morelia, Mexico.	n/a	n/a
Conference paper	Ross, L.G., Martinez – Palacios, C.A, and Rodríguez de Souza, Ma. L. Sustainable aquaculture of the Mexican silverside Chirostoma estor estor, Jordan 1879: Transferring the technology to artesanal fishing communities.	World Aquaculture Society Conference, Bali, Indonesia, May 2005.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference paper	Martínez-Palacios, C.A., Rios Duran, Ma,. G., Toledo Cuevas, R.M. and Ross, L.G. Sustainable aquaculture of the Mexican silverside *Chirostoma estor estor*, Jordan 1879: Biotechnical Developments.	World Aquaculture Society Conference, Bali, Indonesia, May 2005.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference paper	Martínez-Palacios, C.A., Toledo Cuevas, R.M., Racotta-Dimitrov, E., Rios Duran, Ma,. G., Palacios-Metchenkov,E., Fonseca Madrigal, J., Campos Mendoza, A. and Ross, L.G. Aspectos nutricionales del pescado blanco de Patzcuaro *Chirostoma estor estor* Jordan 1879.	VIII International Symposium on Aquatic Nutrition. Mazatlan, Mexico. Nov 2006.	n/a	Nil
Conference paper. Magistral	Ross, L.G. Biodiversidad, Conservación y el Desarrollo de la Acuicultura.	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference paper. Magistral	Martínez Palacios, C.A. Rios Duran, M.G., Toledo Cuevas, E.M., Campos Mendoza, A., Fonseca Madrigal, J. and Ross, L.G. Avances	I Latin American Conference on Aquaculture of Native Fishes.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil

	tecnológicos en la acuicultura del pascado blanco (Pises: Atherinopsidae).	Morelia, 2006.		
Conference paper.	Rios Duran, M.G., Reinoso Madrigal, M.E., Toledo Cuevas, E.M. and Martínez Palacios, C.A. Requerimientos de vitamina C en juveniles de pez blanco de Patzcuaro (*Chirostoma estor estor* Jordan 1879).	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Avalos Sánchez, A.M., Martínez Palacios, C.A., Álvarez González, A. and Toledo Cuevas, E.M. Digestibilidad *in vitro* de dietas con diferentes combinaciones de ligantes con extractos multienzimáticos de larvas, juveniles y adultos de pez blanco *Chirostoma estor estor*	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mx. Nov 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Rafael Delgado-Durán, Ilie S. Racotta, Elena Palacios, Olivia Arjona, Carlos A. Martínez-Palacios. Efecto de la salinidad sobre la osmolaridad y la composición bioquímica del pez blanco de Pátzcuaro (*Chirostoma estor estor*)	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	M. Monroy, E. Palacios, I.S. Racotta y C. Martínez-Palacios. Influencia de los ácidos grasos altamente insaturados (HUFA) obre el crecimiento, supervivencia y la capacidad osmoregulatoria del Pez Blanco de Pátzcuaro (*Chirostoma estor estor)*	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Salgado-García Rosa Linda Martínez-Palacios, Carlos Antonio, Racotta-Dimitrov, Illie Sava, Campos-Mendoza, Antonio y Ross, Lindsay G. El efecto de la salinidad en huevos, larvas y juveniles de pez blanco Chirostoma promelas	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Sánchez-Blanco J., Martínez-Palacios C. A. y Lindsay G. Ross. Benzocaína e hipotermia como sedantes para el transporte de juveniles de, *Chirostoma estor estor*, Jordan 1879	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso	http://www.aquaculture.stir.ac.uk/GISAP/	Nil

		Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006.		
Conference Poster paper	Ahumada-García A., Perédo-Álvarez, V.M., Ross, L.G. and Martínez Palacios C.A. La Convención de Biodiversidad y la Iniciativa Darwin como marco para la conservación del pez blanco (*Chirostoma estor estor*)	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Corona Herrera G.A., Martínez Palacios C.A., Julian Fuentes B. and Ross, L.G. El efecto de la salinidad en el consumo de oxigeno y la tasa metabolica con relacion al peso especifico del pez blanco (*Chirostoma estor estor*) Jordan 1879.	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Toledo-Cuevas EM., Herrera-Vargas MA., Tenorio-Patiño C., Martínez-Palacios CA., Álvarez-González CA., Tovar-Ramirez D and Moyano-López FJ. Caracterización inicial de la actividad enzimática digestiva durante la ontogenia de larvas de *Chirostoma estor estor*, un pez zooplanktófago sin estómago	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Saúl Zamora Méndez, Ilie S. Racotta, Mayra Toledo Cuevas y Carlos Martínez Palacios. Respuestas fisiológicas al estrés por hipoxia en pez blanco (*Chirostoma estor estor*).	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	L. W. Canseco-Murillo, M. G. Ríos-Durán y Martínez-Palacios C. A. Efecto del nivel de carbohidratos en la dieta sobre el crecimiento y la supervivencia de juveniles pez blanco (*Chirostoma estor estor*)	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil

Conference Poster paper	Peredo-Alvarez, V.M., Ross, L.G., Ahumada-García A., Martínez-Palacios, C.A y Morales, E. Capacitación de comunidades indigenas de la ribera del lago de patzcuaro, para el desarrollo de la acuicultura de especies nativas; una alternativa para la protección de la biodiversidad	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Cruz-Aguilar,L, Martínez-Palacios, C.A., Racotta-Dimitrov, I. S., Gasca- Leyva, E., Toledo-Cuevas, M[1]. Caracterización de una planta experimental piloto para la producción de larvas y juveniles de pez blanco (*Chirostoma estor estor*)	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Maria del Carmen Aguilar Valdez, Maria Luiza Rodrigues de Souza, Lidia Ambriz Cervantes, Carlos Antonio Martínez-Palacios. Pescado blanco (Chirostoma estor estor) ahumado: aspectos referentes a las características de composición centesimal e rendimento del procesamiento	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Navarrete Ramírez P., Martínez Palacios C. A., Racotta Dimitrov I. S., Palacios Mechetnov E. Determinación del Punto de No Retorno y efecto del enriquecimiento del rotífero *Brachionus plicatilis* en el crecimiento y supervivencia en larvas del Pez Blanco de Pátzcuaro (*Chirostoma estor estor*).	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Hernández González A., Ríos Duran M.G., Martínez Palacios C.A., Toledo Cuevas E.M. Efecto de la densidad de población en el crecimiento y supervivencia de larvas del pez blanco del lago de	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. &	http://www.aquaculture.stir.ac.uk/GISAP/	Nil

	pátzcuaro	II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006		
Conference Poster paper	Peñaloza Camargo M. L., Sotelo López A., Aguilar Navarro J. A., Sánchez Chinchillas A., Martínez Palacios C. A. Determinación del contenido de aminoácidos libres en juveniles del pez blanco de pátzcuaro (Chirostoma estor estor)	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mex. Nov 2006	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Ambríz-Cervantes, L., Ríos-Durán, M. G., Martínez-Palacios, C. A., Ross, L. G. y Fonseca-Madrigal, J. Requerimiento de proteína de juveniles de pez blanco de Pátzcuaro (*Chirostoma estor estor* Jordan 1879)	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mx. Nov 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil
Conference Poster paper	Hernadez Tellez, A., Rios Duran. Ma G., y Martínez Palacios, C.A. Determinación del nivel de vitamina C en tejidos de adultos silvestres de pez blanco (*Menidia estor*) en el compo y después de su captura y transporte.	I Latin American Conference on Aquaculture of Native Fishes. Morelia, 2006. & II Congreso Estatal de Ciencia y Tecnología. Zamora Mich, Mx. Nov 2006.	http://www.aquaculture.stir.ac.uk/GISAP/	Nil

Effect of temperature on growth and survival of *Chirostoma estor estor*, Jordan 1879, monitored using a simple video technique for remote measurement of length and mass of larval and juvenile fishes

Avances en el Cultivo del Pescado Blanco de Pátzcuaro *Chirostoma estor estor*

The effects of saline environments on survival and growth of eggs and larvae of *Chirostoma estor estor* Jordan 1880 (Pisces: Atherinidae)

16. Appendix 2:

Training events

Campesino sessions:

- Workshops on Biodiversity issues and community participation, species and fisheries, aquaculture and programs on BD.
- Training in basic aquaculture concepts.
- Training in Pond construction and management
- Training for formation of Cooperatives:
- World Bank workshop to explore support.
- Family and Community members from: Ichupio, Erongarícuaro, San Jerónimo, Janítzio, Yunuén, Pacánda, Ukasanastacua, Pátzcuaro, Cd. Hidalgo, Villa Madero, Tzítzio.+ PRODUCE & UMSNH staff.

SME sessions:

- Workshops on biodiversity, general aquaculture, systems and husbandry. 5 staff from a trout farm, Ciudad Hidalgo, Mich.
- Groups from Tzitzio, Cd.Hidalgo, Tecozautla.
- Family restaurateurs from Zirahuén.

National and State Agency and NGO sessions:

- Training for staff from SAGARPA, Atizapan el Alto, Jalisco state.
- Training for aquaculture staff from Government of Jalisco.
- Training for COMPESCA staff, Michoacán.
- Training in pez blanco aquaculture, aquaculture economics and pond management
- Governmental Staff seminars on Biodiversity strategies in México, CBD implementation process, aquaculture strategies and participation.
- NGO´s staff seminars on BD and aquaculture strategies, Governmental agencies, communication and participation of different stakeholders and Pez blanco Aquaculture as a BD conservation strategy.

Training the trainers:

- INIRENA Academic Staff seminars on Biodiversity strategies, Sustainable management of aquatic species in Michoacán, Participation and Aquaculture as a strategy for CBD.
- July 2006: MC Alejandra Ahumada and MC Victor Peredo, received training on Project support and Dissemination Networks by MC Alexandra Gutierrez.
- August, 2006: MC Alejandra Ahumada. Attended course on Financial support from International Agencies. AECI, EU, U.S.A., Canada, Japan, etc.

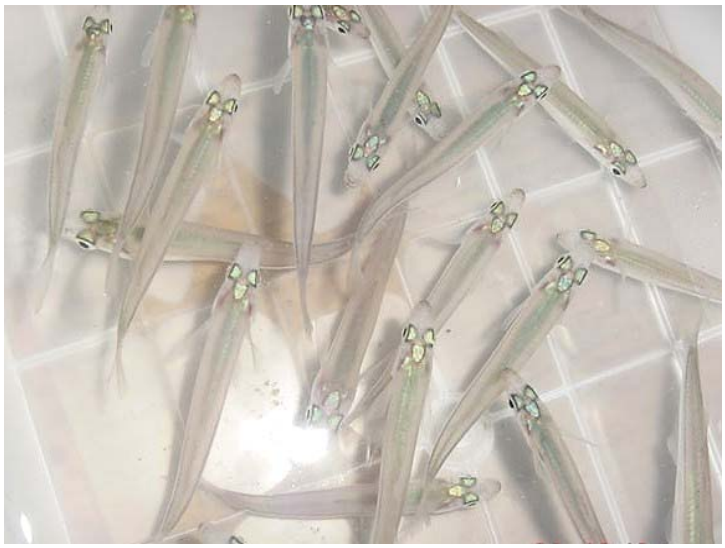
17. Appendix 3:

Project Contribution to Articles under the Convention on Biological Diversity (CBD)

Many project activities fall into several categories, so this is necessarily a very simplified scoring against articles of the CNBD.

Article Number and Title	Project %	Article Description
6. General Measures for Conservation & Sustainable Use	20	**Develop national strategies that integrate conservation and sustainable use.**
7. Identification and Monitoring	0	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	10	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 resource**s.
9. Ex-situ Conservation		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	40	**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	0	Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity.
12. Research and Training		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	10	**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	0	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 redress of international damage.
15. Access to Genetic Resources	10	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 f**air and equitable way of results and benefits.
16. Access to and Transfer of Technology	10	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	0	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	0	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.
Total %	100	



18. Appendix 4:

Project Output Summary.

According to Standard Darwin Initiative Output Measures.
↑ = outputs greater than plan ↔ = outputs same as plan

DI Code Number	Quantity Projected	Quantity Achieved	Δ?	Description
Training Outputs				
1B PhD	1	1	↔	• Efectos de la vitamina C sobre la reproducción, crecimiento, supervivencia y respuestas al estrés en el pez blanco de Pátzcuaro *Menidia estor.* Gisela Rios Duran. Thesis submitted January 2007. Viva pending.
2 M.Sc.	6	7 + 6	↑	• Effect of temperature on sex determination in *Menidia estor.* Patricia Rojas. M.Sc. in Biology. Facultad de Ciencias, UNAM. December 2004. • Development of an aquaculture plan for *Menidia estor* and other species based on ther CBD. Alejandra Ahumada García,.Mexican, M.Sc. in Sustainable Aquaculture, Institute of Aquaculture, Stirling. July 2005. • Design and evaluation of a field training manual for aquaculture technology transfer in Michoacán. Victor Peredo Alvarez, Mexican, M.Sc. in Sustainable Aquaculture. Institute of Aquaculture, Stirling. July 2005. • Oxygen consumption of *Menidia estor.* Begonia Julian. Spanish, M.Sc. Institute of Aquaculture, Stirling. July 2006. • El uso de benzocaine e hipotermia como sedantes para el transporte de juveniles de pez blanco (Menidia estor). Judith Sanchez Blanco, Mexican, M.Sc. in Aquaculture and Limnology, UMSNH, Mexico. March 2006. • Hatchery design and economics for pescado blanco aquaculture. Lazaro Cruz Aguilar, Mexican, M.Sc. in Aquaculture and Limnology, UMSNH, Mexico, November 2006. • Determinación de los requerimientos de proteína de juveniles del pez blanco. Lidia Ambriz, Mexican, M.Sc. in Aquaculture and Limnology, UMSNH, Mexico. June 2006. M.Sc. students still in progress • Functional histology of gut responses to dietary Vitamin C level in *Menidia estor*. Maria Eugenia Reynoso Madrigal, M.Sc. in Aquaculture and Limnology, UMSNH, Mexico. Completing late 2007. • Determinacion de los requerimientos de aciodso grasos en larvas y juveniles de pez blanco. Ana Rosa Hrenandez Tellez. M.Sc. in Aquaculture and Limnology, UMSNH, Mexico.

				Completing March 2008. • Efecto de de la sustitución de harina de pescado ensilado y harina de pez blanco de pez diablo *Liposarcus multiradiatrus* de la presa Adolfo López Mateos. Pamela Navarrete Ramirez. M.Sc. in Aquaculture and Limnology, UMSNH, Mexico. Completing December 2007. • Evaluación de la calidad espermática de reproductores cultivados de pez blanco, *Menidia estor*. Lizbet Peñalosa Camargo. M.Sc. in Aquaculture and Limnology, UMSNH, Mexico. Completing December 2007. • Influencia del fotoperiodo en el crecimiento y reproducción de pez blanco. Juan Antonio Tello Ballinas. M.Sc. in Aquaculture and Limnology, UMSNH, Mexico. Completing March 2008. • Evaluación de la digestibilidad in Vitro de proteínas, carbohidratos y lípidos en peces. Ana Mauricia Avalos Sanchez. M.Sc. in Aquaculture and Limnology, UMSNH, Mexico. Completing December 2007.
3 B.Sc. qualific´ns	8	13 + 2 + 2	↑	• Efecto de cuatro diferentes ligantes en las propiedades físicas de una dieta diseñada para larvas de pez blanco *(Menidia estor)*. Jesus López García, Mexican, B.Sc. at UMSNH. March 2004. • Características morfometricas y estructuras bucofaringeas de larvas, juveniles y adultos de pez blanco, *Menidia estor,* y su relación con los mecanismos de alimentación. Maria del Carmen Aguilar Valdez, Mexican, B.Sc. at UMSNH. March 2004. • Efecto de la salinidad en la sobrevivencia de huevecillos y eclosión de larvas de pez blanco (*Menidia estor*). Juan Antonio Tello Ballinas, Mexican, B.Sc. at UMSNH. August 2004. • Determinación del nivel de vitamina C en tejidos de adultos silvestres de pez blanco (*Menidia estor*) en el compo y después de su captura y transporte. Ana Rosa Hernandez Tellez, Mexican, B.Sc. at UMSNH. August 2004. • Efecto del enriquecimiento del rotífero *Brachionus plicaltilis* (Muller 1786) en el crecimiento y supervivencia de larvas de pez blanco *Menidia estor*. Zumac Tzitziqui Carranco, Mexican, B.Sc. at UMSNH. December 2004. • The effects of stress on gill Na/K ATP-ases in *Menidia estor.* Rafael Delgado Duran, Mexican, B.Sc. at UMSNH. December 2005. • Efecto de la salinidad en larvas y juveniles de pez blanco de Chapala (*Menidia promelas*). Rosa Linda Salgado Garcia, Mexican, B.Sc. at UMSNH. January 2006. • Crecimiento y reproducción de pez blanco

				Menidia estor en un sistema cerrado de recirculación de agua. Victor Odin Santoyo Guzaman, mexican, B.Sc. at UMSNH. June 2006. • Digestibilidad *in vitro* de dietas con diferentes combinaciones de ligantes diseñados para larvas y juveniles de pescado blanco del lago de Pátzcuaro., *Menidia estor*. Ana Mauricio Avalos Sanchez, Mexican, B.Sc. at UMSNH. August 2006. • Influencia de los ácidos grasos altamente insaturados (HUFA) sobre el crecimiento, la supervivencia y la capacidad osmorreguladora en larvas de pez blanco. Magdalena Monroy Mendoza, Mexican, B.Sc. at UMSNH. August 2006. • Determinación de punto de no retorno y efecto del enriquecimiento del rotífero *Brachionus plicatilis* en el crecimiento y supervivencia en larvas del pez blanco *Menidia esotro*. Pamela Navarrete Ramirez, Mexican, B.Sc. at UMSNH. October 2006. • Requerimientos de amino ácidos en dietas de *Menidia estor.* Lizbet Peñalosa Camargo. Mexican, B.Sc. at UMSNH. February 2007. • Efecto de la densidad sobre de población en el crecimiento y supervivencia de larvas del pez blanco *Menidia estor.* Alejandra Hernadez Gonzalez. Mexican, B.Sc. at UMSNH. February 2007. Thesis work in submission: • Effects of hypoxia on stress and gill ATP-ase in *Menidia estor.* Saul Zamora Mendez, Mexican, B.Sc. at UMSNH. • Effects of Salinity, Temperature and Photoperiod on oxygen consumption. Guillermo A. Corona Herrera, Mexican, B.Sc. at ITBOCA, work at UMSNH. Theses still to be completed: • Effects of hypoxia on oxygen consumption in *Menidia estor*. Edgar Eduardo Rodríguez Ayala, Mexican, B.Sc. at UMSNH. • Effects of photoperiod on spawning of *Menidia estor.* Jose Concepcion Chavez, Mexican, B.Sc. at UMSNH.
4A u/g trainees	0	21	↑	• Project training for 17 B.Sc. qualifications – see above. • PRA training for 5 INIRENA undergraduates. • Citlalic Acosta Pimentel. “Servicio social”. Training on work with stakeholders, record-keeping, work with communities. • Collaboration with 2 Architecture undergraduates working on ecotourism • Undergraduate lectures referencing DI, BD and

				aquaculture work. Many students.
4B u/g weeks	0	1 10 10	↑	• PRA 1 week • "Servico Social" 10 weeks. • Undergraduate courses 8 weeks
6A Other Training Numbers Training Campesino groups	55	45 + 122 + 51 contacts over 12 sessions	↑	Campesinos sessions 2004/5: • 10 campesinos from Ichupio • 30 campesinos from San Jeronimo and Purechecuaro • 5 campesinos from Pacanda Campesino sessions 2005/6: • 10 campesinos from Ichupio • 30 campesinos from San Gerónimo • 48 community members: Ichupio, Janítzio, Erongarícuaro, San Jerónimo, Tzítzio and Morelia. Workshop on testing the training manual on aquaculture. • 34 Community members: San Jerónimo, Islands (Yunuén, Pacánda & Janítzio) and Tzítzio. Workshops on Biodiversity issues and community participation, Species and fisheries, aquaculture and Programs on BD. Campesino sessions 2006/7: • Training for formation of Cooperatives: Part 1. March 2006, 11 people, San Jeronimo. • Training for formation of Cooperatives: Part 2. April 2006, 11 people, San Jeronimo. • World Bank workshop to explore support: August 2006, 11 people + WB and DI staff. San Jeronimo Purenchecuaro. • Aquaculture starter training: June 2006, Ichupio. Attended by 30 participants from Ichupio, San Jeronimo Purenchecuaro, Tarerio, Ukasanastakua, Cd. Hidalgo, Patzcuaro, Villa Madero, + PRODUCE & UMSNH staff. • Aquaculture phase 2 training: September 2006, Ichupio. Attended by 10 participants from Ichupio, San Jeronimo Purenchecuaro, Tarerio.
6A Other Training Numbers Training SME staff		15 contacts 6 sessions	↑	SME sessions: • Tzitzio aquaculture group. • 5 staff from a trout farm, Ciudad Hidalgo, Mich. • Further work with Tzitzio group. • 1 campesino farmer/restaurateur and family from Zirahuén • Work with group from Tecozautla, Hidalgo.
6A Other Training Numbers Training		21 contacts 3 sessions	↑	• 5 Staff of SAGARPA - Jalisco were trained in pez blanco aquaculture; 10 day course. • 10 Staff including COMPESCA were trained on aquaculture economics and pond management • 6 Governmental Staff seminars on Biodiversity

National and State Agency staff				strategies in México, CBD implementation process, aquaculture strategies and participation.
6A Other Training Numbers Training NGO´s		2		• 2 NGO´s staff seminars on BD and aquaculture strategies, Governmental agencies, communication and participation of different stakeholders and Pez blanco Aquaculture as a BD conservation strategy.
6A Other Training Numbers Training Training the trainers		8 2 1	↑	• INIRENA Academic Staff seminars on Biodiversity strategies, Sustainable management of aquatic species in Michoacán, Participation and Aquaculture as a strategy for CBD. • July 2006: MC Alejandra and MC Victor Peredo, received training on Project support and Dissemination Networks by MC Alexandra Gutierrez. • August, 2006: MC Alejandra A. Attended course on Financial support from International Agencies. AECI, EU, U.S.A., Canada, Japan, etc.
6B Other Training Weeks	8	26	↑	• Training weeks for all 6A items.

7 Training materials developed	1	1	↔	• Theoretical and Practical training programmes developed for:
				  • Preparing Ponds
				  • Pond Management
				  • On-growing methodology
				• Workshop materials produced::
				  • Victor Peredo Alvarez and Lindsay G Ross. (2006). Manual Ilustrado de Entrenamiento en acuicultura semi-intensiva. ISBN 1 85769 220 0. See website: http://www.aquaculture.stir.ac.uk/GISAP/native-species/manuals.php
				  • Manual on live feed production
				  • Manual on fish transportation

Research Outputs:				
8 Weeks UK staff in México	24	27	↑	• Eight visits of Prof. Lindsay Ross to Mexico (Project leader UK) • One visit of Mr. Ernesto Mariano Morales (PRA specialist) to México. • One visit of Dr T Telfer (Environment specialist) to México.
n/a Weeks Mexican staff in UK	0	4	↑	• Two visits of Dr. Carlos Martinez-Palacios to UK (Project leader Mexico).
9 Mangment	1	1	↑	• Biodiversity and Aquaculture Strategy for discussion. Resulted from M.Sc. project: BD

plans				strategy planning for aquaculture in Michoacán by Alejandra Ahumada García.
10 Manuals	0	3	↑	• Manual Ilustrado de Entrenamiento • Live feed manual. • Transportation manual.
11A Journal Papers	5	12	↑	• **See Appendix I.** • 7 papers published • 4 papers in press • 8 papers in preparation
11B Other Articles	6	7	↑	• **See Appendix I**. • Several articles in popular/trade journals • Numerous conference presentations published as abstracts.
12A Computer Databases	1	1	↔	• GIS Database on *Menidia* species distribution: Completed July 2005.
12B Databases enhanced	0	1	↑	• GIS Software and database installed in Mexico. Currently basis for PhD programme, by Mr Victor Peredo.
14A Conf' organised	1	1	↔	• 1st Latin American and 3rd Mexican Conference on Native Fish Species for Aquaculture. October 2006. • See web site repórts: http://www.aquaculture.stir.ac.uk/GISAP/Conference/
14B Conf' & Seminars attended for DI disseminati on	2	15 events 23 present´ns	↑	Mexican Ichthyological Society (Villahermosa, Tabasco) • Presentation: Martínez-Palacios, C.A., and Ross, L.G. The silverside fishes of Patzcuaro and Chapala lakes. Advances on their research and culture. • Presentation: Growth and reproduction of Pez blanco Chirostoma estor estor, in a closed recirculation system. Seminars at Maringa University (Maringa, Brasil) • Presentation: Aspects of fish feeding and the use of microagregates. Symposium on Pejerrey Biology (Chascomus, Argentina). December 2004. • Presentation: Ross, L.G., Carlos A. Martínez-Palacios., Antonio Campos-Mendoza., y Maria Luisa Rodríguez de Sousa. 2004. La Iniciativa Darwin y el Pescado Blanco Chirostoma estor estor : un vinculo entre la acuicultura, la biodiversidad y el bienestar social. Invited paper. Jornadas de Biología del pejerrey. Aspectos básicos y acuicultural. IIB-INTECH, Chascomus, Argentina. • Presentation: Martínez-Palacios, C.A., Ross,

				L.G., Racotta-Dimitrov, I, Ríos Durán, M., Campos Mendoza, A., Palacios Metchenov, E. y Toledo Cuevas, M. 2004. Los peces blancos Mexicanos de los Lagos de Pátzcuaro y Chapala y el avance en su investigación y cultivo. Invited paper. Jornadas de Biología del pejerrey. Aspectos básicos y acuicultural. IIB-INTECH, Chascomus, Argentina. • Presentation: Campos-Mendoza, A., Chávez-Sosa José C., Santoyo Guzmán, V. O., Martínez-Palacios C. A. y Ross, L G. 2004. Efecto del fotoperiodo en la reproducción del pez blanco del Lago de Pátzcuaro Chirostoma estor estor. Jornadas de Biología del pejerrey. Aspectos básicos y acuicultural. IIB-INTECH, Chascomus, Argentina. • Presentation: Ríos-Durán, Ma, G., Hernández-Téllez, A.R., Martínez-Palacios, C.A. and Ross, L.G. 2004. The effect of transportation stress on tissue ascorbic acid levels of Mexican silverside (Chirostoma estor estor Jordan, 1979). Jornadas de Biología del pejerrey. Aspectos básicos y acuicultural. IIB-INTECH, Chascomus, Argentina. Invited Seminar: Secretary of Urbanism and Environment (SUMA, Morelia, Mexico) • Presentation: Martínez-Palacios, C.A., Ross, L.G. Applied science and technology development to allow the conservation of pez blanco from Pátzcuaro lake. World Aquaculture Society meeting, Bali, Indonesia, May 2005. • Presentation: Sustainable aquaculture of the Mexican silverside, Chirostoma estor estor, Jordan 1879: Transferring the technology to artesanal fishing communities. Lindsay G Ross*, Carlos A Martínez Palacios & Maria Luisa Rodríguez de Souza. • Presentation: Sustainable aquaculture of the Mexican silverside, Chirostoma estor estor, Jordan 1879: Biotechnical developments. Carlos A Martinez Palacios, Ma Gisela Rios Duran, E Mayra Toledo Cuevas and Lindsay G Ross. Instituto Tecnológico de Morelia (Morelia, Michoacán, México). • Presentation: Academic Seminar for Engineering B.Sc. students: “Technology transference” MSc. Alejandra Ahumada G. Invited Seminar: CIDEM [Centro de Investigacion y Desarrollo del Estado de Michoacán]. • Seminar: “Sustainable aquaculture: Generating an activity which improves the quality of life”. MSc. Alejandra Ahumada G Invited Seminar: CIDEM. • Seminar: “Sustaining livelihoods and protecting

				biodiversity through development of Pez blanco aquaculture". MSc. Víctor M. Peredo Álvarez. Segunda Feria Ambiental Pátzcuaro 2006. • Darwin Initiative Stand: "Pez blanco and technology transference: A conservation project". MSc. Alejandra Ahumada G & MSc. Víctor M. Peredo Álvarez Invited Seminars: CIDEM. • Seminar: Applied science and technology development to allow the conservation of pez blanco from Pátzcuaro lake. Martínez-Palacios, C.A., Ross, L.G. • Seminar: Control de la reproducción en peces. Campos-Mendoza, A. • Seminar: Biodiversity strategy for developing aquaculture. Ahumada Garcia, A. • Seminar: Desarrollo de manuales para la capacitación en acuicultura rural. Peredo Alvarez, V.M. Invited Seminar: AMENA.[Asociación Mexicana de Expertos en Nutrición Animal]. • Seminar: Advances in nutrition of C. estor estor. C.A. Martínez-Palacios. Invited Seminars Tokyo University of Fisheries and Biotechnology: • Seminar: Advances in culture and nutrition of C. estor estor. Martínez-Palacios. C.A. • Seminar: Sustainable aquaculture of the Mexican silverside, Chirostoma estor estor, Jordan 1879: Transferring the technology to artesanal fishing communities. Lindsay G Ross*, Carlos A Martínez Palacios & Maria Luisa Rodríguez de Souza. Invited Seminar: CIECO. [Centro de Investigaciones en Ecosistemas] Universidad Nacional Autónoma de México., • Seminar: Campos-Mendoza, A. El control de la reproducción en peces. XII International Symposium of Fish Nutrition and Feeding. Biarritz. • Ambriz Cervantes, L., Rios Duran, Ma.G., Martínez Palacios, C.A. Ross, L.G. y Fonseca Madrigal, J. 2006. Dietary protein requirement of juvenile Mexican silverside *Menidia estor,* a stomachless zooplanktivorous fish. AQUA 200: European Aquaculture Society, Florence: • Presentation: Martinez Palacios, C.A., Avalos Sanchez, A., Alvarez Gonzalez, C.A., Toledo Cuevas, M. and Rios Duran, Ma.G. 2006. In vitro digestibility of diets with different combinations of hydrocolloid and proteins by multienzymatic extracts of juvenile *Menidia*

				estor larvae and juveniles. • Presentation: Martinez Palacios, C.A., Salgado Garcia, R.L., Racotta Dimitrov, I., Campos Mendoza, A. and Ross, L.G. 2006. The effect of salinity on eggs, larvae and juveniles of the silverside *Menidia promelas* from Lake Chapala, Mexico. • Presentation: Toledo Cuevas, E.M., Tenorio Patino, C., Herrera Vargas, M.A., Alvarez González, C.A., Tovar Ramírez, D., Martínez Palacios, C.A. ay Monyano López, F.J. 2006. Initial characterization of the digestive enzymatic activity during the early ontogeny of *Menidia estor*, a zooplanktivorous, stomachless fish. 1st Latin American and 3rd Mexican Conference on Native Fish Species for Aquaculture. October 2006. • Presentation: Ross, L.G. Keynote address. Biodiversidad, Conservación y el Desarrollo de la Acuicultura. • Presentation: Martínez Palacios, C.A. Rios Duran, M.G., Toledo Cuevas, E.M., Campos Mendoza, A., Fonseca Madrigal, J. and Ross, L.G. Keynote address. Avances tecnológicos en la acuicultura del pascado blanco (Pises: Atherinopsidae). • Presentation: Rios Duran, M.G., Reinoso Madrigal, M.E., Toledo Cuevas, E.M. and Martínez Palacios, C.A. Requerimientos de vitamina C en juveniles de pez blanco de Patzcuaro (*Chirostoma estor estor* Jordan 1879). • Plus 17 posters prepared by our group and collaborators (see Appendix I). European Aquaculture Society meting, Istanbul, Forthcoming; October 2007. • Presentation: Ross, L.G., Martínez-Palacios, C.A., Morales, E. Peredo Alvarez, V.M. and Ahumada, A. Aquaculture of the endangered species *Menidia estor* Jordan 1879: developing sustainable systems in rural communites. • Presentation: Carlos A. Martínez-Palacios, Antonio Campos Mendoza and Lindsay Ross. Reproduction, broodstock and hatchery management for aquaculture of two endangered Mexican silversides. • Presentation: Carlos A. Martínez-Palacios, Gisela Ríos Durán and Lindsay G Ross. Establishing the nutritional requirements of the selective zooplanktivore *Menidia estor* Jordan1880, and the design of practical diets for its culture. • Presentation: Carlos Martinez Palacios, Carmen Aguilar Valdez, Philip Scott, Lindsay Ross Tentative solutions to an alien species invasion from aquarium aquaculture:

				developing viable industries to exploit and control *Liposarcos multiradiatus* Hancock 1828 in Mexico.
15A Mexican National Press	0	7	↑	• Article in La Jornada (National news paper) • Article in La Jornada (National news paper) Hatchery finished. April 2005 • Article in La Jornada, Investigación y Desarrollo. April 2005 • Article in Procuraduría Agraria. April 2005 • Article in ANIA. April 2005 • Article in La Jornada Project Networking. May 2005. • Article on the Native Species Conference; La Jornada. Oct 2006.
15B Mexican Local Press	3	5	↑	• Articles in La Voz de Michoacán • Articles in Cambio de Michoacán. • Many newspaper articles on the Native Species Conference; La Voz de Michoacán, Provincia, Cambio de Michoacán. Oct 2006
15C/D UK Press	3	1	↔	• 2004: Press release in the UK (Local newspaper) • 4 Articles in popular press. See Appendix I.
17A Networks established	1	1	↔	• Establishment of Project and BD Advisory Group. March 2005. • Members: Professor Lindsay G Ross (Project leader, UK) Dr. Carlos A. Martinez Palacios (Project leader México) Sra. Cardiela Amezcua (NGO) Dr. Edmundo Diaz Pardo (University of Queretaro) Biol. Sergio Cortez (SAGARPA) MC. Catalina Rosas Monje (COMPESCA) Sr. Leopoldo Pérez García (SME, Tzitzio) Sr. Francisco Arregui Mendoza (SME, Catfish aquaculture) Sr. Mauricio Dolores Ponciano (Campesino) Ex oficio: Dr. Antonio Campos Mendoza (Project Manager) MC Alejandra Ahumada (Project manager) MC Victor Peredo (Project manager)
17B Networks enhanced	0	1	↔	• Continuation of Dissemination Network and Consultative group on conservation of biodiversity.
18A Mexican National TV	0	3	↑	• Article on national TV (TV AZTECA) about pez blanco aquaculture. Can be seen on our website. (TV AZTECA). • TV Programme 30 minute Special on Pez blanco and Darwin Initiative. Dr Martinez-Palacios & Prof. Ross. RADIOFORMULA for CONACYT. Broadcast November 2005. Available on CONACyT website. • TV article on conference; Canal 3 [Televisa]

18C Mexican Local TV	3	3	↔	• Local TV feature, MaravatioTV. • TV interview on DI with Dr Mendoza, CBTV, August 2006. • Local TV articles on conference.
19C Mexican Local radio	0	3+	↑	• Radio Michoacan. Dr Martinez. Oct 2006. • Radio Michoacan. Dr Ross. Nov 2006. • Several short radio interviews on the conference.
N/A	1	1	↔	• Large-scale hatchery site created at UMSNH, based on complementary funding. Can be seen on our website.
Physical Outputs				
20 Physical assets	0	4	↑	• HP Printer. £ • Overhead used as contribution towards purchase of a pick up. • Enhancements to Darwin Office in México (Office partitioning and equipment). • Large-scale hatchery site created at UMSNH, based on complementary funding. Can be seen on our website: http://www.aquaculture.stir.ac.uk/GISAP/native-species/hatchery.php
21 Training facilities	0	1	↑	• Substantial Outreach Training Facility completed at Ichupio.
22 Field plots	0	3	↑	• Rustic pond at El Durazno established. • Pond array at Ichupio completed. • Pond array at San Geronimo completed. • Pond array at Camecuaro completed. • Tank array at Tarerio completed. • Tank array at Tecozautla completed.
23 Additional resources	unknown	4	↑	• FONDOS MIXTOS “Transferencia tecnológica para el cultivo semi-intensivo del pez blanco de Pátzcuaro”. • SAGARPA “Desarrollo de las bases técnicas y científicas para el cultivo del pez blanco de Chapala (Chirostoma promelas) y Patzcuaro (Chirostoma estor estor)”. • PRODUCE-MICHOACAN $120,000 Pesos Mexicanos. “Technology transfer for culture of pescado blanco de Pátzcuaro”. • PROMEP, Clave PTC-115: $290, 000.00 Pesos Mexicanos. "Biología reproductiva del bagre del Balsas (*Ictalurus balsanus*), inducción hormonal y ambiental para estimular la actividad reproductiva"

19. Appendix 5:

Examples of Dissemination events:

Newspaper articles: There have been many newspaper articles published on the work of the project, ranging from local to national. This was a deliberate policy so as to give the DI project a high profile in the region and to help embed the ideas behind use of aquaculture as a means to conserve biodiversity. The newspapers in Michoacán were of particular relevance as the pez blanco is specifically locate there and is a symbol of the region, even acting as a logo fro the Pátzcuaro football team..

Trade Journals: Several articles were written for aquaculture trade journals and these were used to good effect to advertise the DI project and to promote biodiversity concepts while at the same time allowing industry development. Articles appeared in Aquaculture News and in Fish Farmer in the UK, as well as in Ciencia y Desarrollo in Mexico. Fish Farming International gave particular prominence to the International Conference on Culture of Native Fish staged as part of the project.

Leaflets: A DI project leaflet was developed to publicise the work within the region. This was used on many occasions and distributed widely.

Add scan/photo of leaflet front page

Television: Many short TV interviews were held throughout the project as events developed. . A pre-project highlight was the visit of the BBC and Barnaby Bear to make a programme for young viewers.

TV Azteca broadcast a useful article on seeding the ponds at Ichupio and a substantial programme was recorded for CONACyT by RadioConCiencia involving Dr Martinez and Prof Ross.

Radio interviews: Radio has been a useful tool in promoting the project and concepts behind it. There were many short interviews at different stages on a number of radio stations including Radio del Lago – a station broadcasting in the P'urhepecha language of the region. Longer, whole programme interviews were also broadcast and these were excellent vehicles for the work of the project.

Environmental Fair: The project team developed a display stand at the Pátzcuaro Environmental Fair in 2006. This was attended by thousands of residents and children from the region and was an excellent showcase for the project and BD issues.

Conferences attended: Project staff and associated students attended many different conferences during the project period to present research results and DI concepts. Staff will continue to do so beyond the end of the project and the next major set of presentations will be at the European Aquaculture Society meeting in Istanbul in October 2007.

Conferences staged: The work of the project and of DI generally, was featured prominently during the First Latin American Conference on Culture of Native Fishes, held in Morelia during October 2006 and organised by the project team. Not only did this attract massive publicity within the region and in México, but also Internationally, specifically in Latin America.

20. Appendix 6:

Darwin Contacts.

To assist us with future evaluation work and feedback on your report, please provide contact details below.

Project Title	**Sustaining livelihoods and protecting biodiversity through development of pez blanco aquaculture.**
Ref. No.	**13/011**

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Role within Darwin Project	UK Principal Investigator
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21. Appendix 6:

Reprints of published work.

Other publications are available at:

http://www.aqua.stir.ac.uk/GISAP/native-species/chirostoma-pubs.php