Darwin Initiative Annual Report

Important note:

To be completed with reference to the Reporting Guidance Notes for Project Leaders: it is expected that this report will be about 10 pages in length, excluding annexes

Submission Deadline: 30 April 2011

1. Darwin Project Information

Project Reference	EIDPO041
Project Title	Post Project Funding. **Protecting galaxiids from salmonid invasions in Chile and the Falklands**
Host Country/ies	UK, Chile, Falkland Islands, USA
UK contract holder institution	Swansea University, Aberystwyth University
Host country partner institutions	Universidad de Los Lagos (Chile) Falkland Islands Government (Falkland Islands)
Other partner institutions	Oregon State University (USA), US Geological Survey (USA)
Darwin Grant Value	£179,920
Start/end dates of project	01 April 2010 – 30 August 2012
Reporting period (eg Apr 2010 – Mar 2011) and number (eg Annual Report 1, 2, 3)	Annual Report 1 1 April 2010- 31 March 2011
Project Leader name	Dr. Carlos Garcia de Leaniz
Project website	http://www.biodiversity.cl
Report authors, main contributors and date	Dr. Carlos Garcia de Leaniz (Swansea University) Dr. Sofia Consuegra (Aberstwyth University) Dr. Gonzalo Gajardo (Universidad de los Lagos) Mr. Jose Sanzana (Universidad de los Lagos) Mr. Nick Rendell (Falkland Islands Government) Mr. Dan Fowler (Falkland Islands Fisheries Department) Dr. Jason Dunham (US Geological Survey) Dr. Guillermo Giannico (Oregon State University) 05 June 2011

2. Project Background

Exotic salmonids represent one of the biggest threats to native freshwater fishes in Patagonia, the Falklands Islands and other temperate zones of the Southern Hemisphere. Both the Chilean and Falklands Islands Biodiversity Strategies recognize the need to restore ecosystems as the first step towards reversing the loss of biodiversity by 2010. Furthermore, the Falklands Islands Draft Action Plan for the endangered *Aplochiton zebra* recognizes the need to maintain AZ as a component of its native fresh water fish fauna and to prevent further loss of populations. Our project will help to identify those galaxiid populations most in need of protection from salmonids and will develop and field-test both ex-situ and in-situ proactive measures for galaxiid conservation. Our proposal is thus particularly timely and fully in line with the host countries' Biodiversity Strategies, given the dramatic recent increase in the spread of invasive salmonids and the widespread decline of native galaxiids.

Like Chile, the Falkland Islands have a wealth of biodiversity but limited access to skilled practioners in assessing and managing key biodiversity goals in freshwater environments. With more than 40 endemic freshwater species (most of which are barely known to Science), there is increasing evidence that the widespread decline of native galaxiid fishes such as *Aplochiton*

zebra and *Aplochiton taeniatus* has been triggered by the introduction of exotic salmonids, historically via sport fishing and more recently through accidental escapes from salmonid farming. The Governments of Chile and the Falklands Islands are committed to the implementation of the CBD through the development of Species and Habitat Action Plans for endangered species or geographic areas requiring special protection. Therefore one of the aims of our project is to inform such Action Plans for endangered native galaxiid fishes through the training of local officers on the development of both *in-situ* and *ex-situ* conservation measures.

This post-project award therefore provides a unique opportunity to draw on global best practices for implementing management strategies for protecting native galaxiid fishes from salmonid invasions in both countries, and for addressing a urgent biodiversity crisis. We expect three main key outcomes from the project

(1) an assessment of the current conservation status of threatened native galaxiids, in particular of *Aplochiton zebra* and *Aplochiton taeniatus*,

(2) an implementation of appropriate management practices for a range of stakeholders, including the development of *in-situ* and *ex-situ* conservation programmes, and

(3) education and capacity building through training of Chilean and Falkland officers and exchange of students.

Building on our highly successful Darwin Initiative in Chile and a Scoping Award in the Falklands, we propose to develop practical, proactive measures to help reverse the widespread decline of native galaxiids by:

(1) Identifying those galaxiids populations most in need of protection from salmonid invasions using a novel landscape genetics approach that will integrate (and model) data on salmonid pressure, habitat connectivity, and galaxiid population structuring and gene flow using a combination of molecular markers, stable isotopes, and elemental composition analysis

(2) Developing and implementing a reintroduction and captive breeding programme for endangered Aplochiton zebra and Aplochiton taeniatus based on Recirculation Aquaculture Systems (RAS) and our pooled expertise on ex-situ conservation, environmental enrichment, and conservation genetics

(3) Field-testing novel in-situ approaches to galaxiid conservation based on removal of invasive salmonids from critical habitats, and the implementation of control and legal measures designed to prevent salmonid colonization and encroachment of galaxiid refuge areas

(4) Building capacity, as well as training and education material to draw attention to the conservation needs of galaxiids and the threats posed by salmonid invasions.

3. Project Partnerships

The partnership between the UK lead institution (SU), the UK partner (AU), the host partners in Chile (ULA) and the Falkland Islands (FIG), and the two US partners (USG, OSU) worked well during the first year of the project. As in previous occasions, it benefited from fluent and frequent email and telephone contacts, in addition to increasing use of skype video conferences. We also met in person with some partners during the International Symposium: Advances in the Population Ecology of Stream Salmonids (Luarca, Asturias, Spain 17 to 21 May 2010 - http://onlinelibrary.wiley.com/doi/10.1111/j.1600-0633.2010.00462.x/full) and later with all partners during our first field season in the Falkland Islands, and then in Chile during January 2011.

The two research assistants of the project (Mr. Jose Sanzana in Chile and Mr. Dan Fowler in the Falkland Islands) have also been in regular contact throughout this first year of the project. The Chilean RA visited the Falklands where he learned about recirculation technology and

shared his experience in sampling galaxiids in the field, while the Falklander RA visited Chile where he helped Chilean colleagues to set up the recirculation aquaculture system (RAS) and shared his experience in the captive breeding of endangered galaxiids.

Contacts between partners were also fruitful in several other ways. For example, several partners commented and gave valuable feedback on several manuscripts, four already published (Garcia de Leaniz et al. 2010. *Systematics & Biodiversity* 8: 447-459; Schröder,V. & Garcia de Leaniz, C. 2011. *Biological Invasions* **13,** 203-213. Vanhaecke et al. 2011. *Molecular Ecology Resources* 11: 219-222*;* Consuegra et al. 2011. *Evolutionary Applications* in press. doi:10.1111/j.1752-4571.2011.00189.x), one currently under review (Vanhaecke et al. *Systematics & Biodiversity;* and three to be submitted or resubmitted within the next few months (Vanhaecke et al.; Orellana et al; Vanhaecke et al.). In addition we also submitted two short notes on population connectivity of endangered galaxiids (Sanzana et al. Assessing the impact of barriers on connectivity of endangered native fishes in the face of salmonid invasions in Southern Chile; Fowler & Garcia de Leaniz. Assessing the impact of culverts on population connectivity of endangered galaxiid fishes in the Falklands Islands) to be published as case studies on the book "From sea to source"; Practical guidance for restoration of fish migration. Kroes MJ, Gough P, Schollema PP and Wanningen H (eds) (copies of publications are given in **Annex 3**).

Partners also gave advice on GIS, development of the database, and experimental design. Thus, the USG partner (Dunham) created digital maps of the Island of Chiloe, which were instrumental in directing our sampling effort during the field work in January. Interaction with colleagues from Oregon State University (Giannico) was invaluable in shaping our approach to testing of hypotheses and for interpreting results. Other partnership and collaborations made during the past year also served to develop and improve the Darwin Fish Atlas, and helped to forge joint student projects.

4. Project Progress

The key activity milestone for the first year were the following :

1. Sampling of endangered galaxiids, habitat data, and collection of broodstock,
2. Genetic and isotopic analysis and estimates of effective population size and gene flow
3. Training of Research Assistants and enrolment in MRes in UK
4. Captive breeding and rearing of juvenile galaxiids
5. Assessment of in-situ conservation measures
6. Education and dissemination programmes, presentation of results and media coverage

4.1 Progress in carrying out project activities

Activity 1.1. Sampling of endangered galaxiids, habitat data, and collection of broodstock.

During the past year we continued sampling in Chile and the Falklands, collecting data on habitat distribution, as well as samples for analysis and for broodstock for the captive breeding programme. In total we sampled 3,550 fish in Chile and 268 fish in the Falklands distributed as shown in **Table 1.** These data have all been entered in the fish atlas, are have been the source of several publications.

Table 1. Number of fish sampled during the first year of the Post-project award in Chile and the Falkland Islands.

Location	No. exotic salmonids	No. galaxiids and other native fishes	Total
Chile	1,648	1,902	3,550
Falkland Is.	46	222	268

Figure 1. Sampling endangered galaxiids on the Island of Chiloe (left) and East Falkland (right), January 2011

Activity 2. Genetic and isotopic analysis and estimates of effective population size and gene flow

We developed novel molecular markers for species recognition of the endangered *Aplochiton* sp. (Vanhaecke et al. 2011. *Molecular Ecology Resources* 11: 219-222) and estimated the effective population sizes and extent of gene flow for three native galaxiid fishes: *Galaxias maculatus* (Vanhaecke et al. Source-sink metapopulation dynamics of a diadromous fish impacted by aquaculture, MS under review. **Table 2** below); *Aplochiton zebra* and *Aplochiton taeniatus* (Vanhaecke et al., in preparation), and one exotic salmonid, rainbow trout (Consuegra et al. 2011. Winning the invasion roulette: escapes from fish farms increase admixture and facilitate establishment of non-native rainbow trout. *Evolutionary Applications,* in press).

Table 2. Estimates of gene flow and connectivity among nine *Galaxias maculatus* populations in Los Lagos Region (Chile) based on the number of migrants per generation. Sources and sinks were estimated according to the net exchange of migrants for each population. Taken together, Chiloé populations seem to be acting as a net source, and populations in mainland Chile (seno Reloncaví) appear to be acting as a net sink. (Vanhacke et al., under review)

Donor Recipient	RCA	RL	RCZ	RAU	U9	RUM	RUA	RUH	U56A
RCA	*	1.3	1.6	3.3	3.5	5.8	19.7	25.2	12.1
RL	0.74	*	0.78	4.72	4.32	19.35	17.41	13.57	25.90
RCZ	0.92	1.08	*	8.91	13.31	5.42	24.32	41.33	5.31
RAU	13.43	8.10	1.07	*	3.74	1.60	13.13	7.42	2.26
U9	11.99	15.13	12.03	3.09	*	1.10	4.31	2.19	5.91
RUM	15.63	5.00	18.95	0.89	2.56	*	1.22	1.03	1.86
RUA	9.41	11.89	11.09	8.34	1.14	0.94	*	0.52	2.57
RUH	15.69	16.75	23.35	8.26	3.01	0.60	0.45	*	2.60
U56A	12.22	16.68	20.97	4.71	3.31	1.98	2.59	3.99	*
Type	Source	Sink	Sink	Sink	Sink	Sink	Source	Source	Sink

We field-tested methods for the identification of invasive salmonids escaping from fish farms based on their isotopic signatures (Schröder,V. & Garcia de Leaniz, C. 2011. *Biological Invasions* **13,** 203-213) and begun to estimate the extent of resource overlap between native galaxiids and exotic salmonids by comparing the ^{13}C and ^{15}N SIAS under allopatric and sympatric conditions (**Figure 1**). We also collected otoliths of galaxiids for potential analysis of

Sr/Ca ratios by Laser Ablation ICP-MS which might reveal marine signatures, and thus discriminate between diadromous and resident populations.

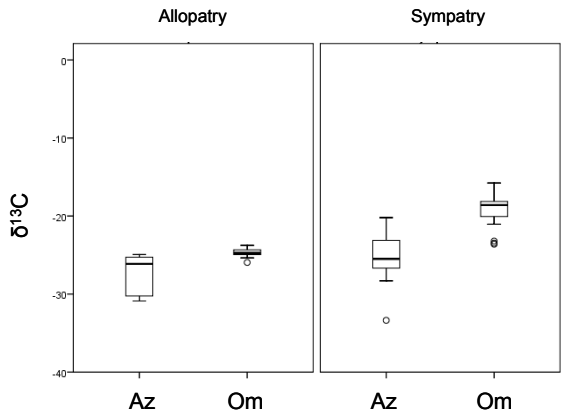

Figure 2. ^{13}C SIS of native *Aplochiton zebra* (Az) and the invasive rainbow trout (Om) living in allopatry or in sympatry in Chile.

Activity 3. Training of Research Assistants and enrolment in MRes in UK

During the visit of the Chilean RA (Mr. Jose Sanzana) to Swansea University at the end of the previous Darwin Project we provided training on Recirculation Aquaculture Systems (RAS) at our Freshwater Research Unit (**Figure 3**). The two RAS systems purchased for the project and now deployed in Chile and the Falklands are identical to the ones used at Swansea, which has considerably facilitated capacity building and the transfer of expertise on these systems. The US and UK partners come down to the Falklands and/or Chile during January 2011 and we provided training to the RA's on sampling techniques and survey methods.

Figure 3. Jose Sanzana, the Chilean RA from U. de los Lagos, at Swansea University where he received training in laboratory techniques and in recirculation technology at Swansea's Freshwater Research Unit.

Both RA's applied for enrolment in the MRes programme in Sustainable Aquaculture and Fisheries at Swansea University
http://www.swan.ac.uk/biosci/postgraduatestudy/mressustainableaquaculturefisheries/
and were given conditional offers for the 2011/12 entry.

One condition for entry for the Chilean RA was achieving a score of 6.5 in the IELTS and he has started taking English classes in earnest. Both RA's applied for government PG scholarships to meet the MRes tuition fees. Dan Fowler was successful in securing the necessary funding in the Falklands, while we await news on Jose's application in Chile

Activity 4. Captive breeding and rearing of juvenile galaxiids

Aplochiton sp. broodstock were collected and maintained in captivity in both Chile and the Falklands (**Figure 4**) before the dedicated Recirculation Systems arrived from the UK on February 2011.

In Chile, 18 *Aplochiton* juveniles (average length 24 cm) were caught with nets with the help of local fishermen in Lake Llanquihue during 2010 and these were brought to the Osorno aquaculture facilities. We also brought 49 juveniles from Rivers Futangue and R. Quiman. These were fed on dried artemia and although they appeared to be feeding properly, all died after 18 days for unknown reasons. More success was achieved on January 2011, when 146 juveniles were transported from R. Blanco to the University Pescado hatchery. There they were fed twice a day on salmon pellets, and many fish have survived now for over two months.

Figure 4. Facilities used for rearing the first *Aplochiton sp.* at the Falklands FIDC station (left) and at the University of Los Lagos (Chile) Pescado hatchery (right).

Rearing of *Aplochiton* in the Faklands has been going on for several years at the FIDC facilities with very good results, and 30 boodstock spawned an estimated 50,000 eggs during 2010. However the problem is still the feeding and survival of juveniles past the initial stages, and the difficulty of identifying the two *Aplochiton* species based on phenotype traits alone (see below).

Figure 5. *Aplochiton* broodstock reared in the Falklands (left and centre), and in Chile (right)

Activity 5. Assessment of in-situ conservation measures

We conducted a review of the main threats faced by galaxiids confronted with salmonid invasions, as well as on the most suitable methods to prevent salmonid encroachment (Garcia de Leaniz et al. 2010. *Systematics & Biodiversity* 8: 447-459). From our analysis, it is clear that exotic salmonids tend to occupy the same trophic level as many native galaxiids, and that the large size of salmonids is probably the biggest threat to the much smaller galaxiids (**Figure 4**)

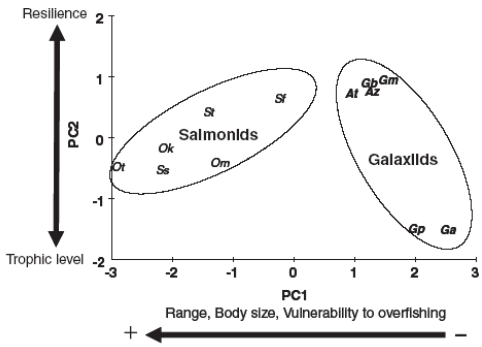

Figure 4. PCA of the first two principal components accounting for 86% of variation in life history traits of invasive salmonids and native galaxiid fishes. Body size, range, and vulnerability to overfishing are the traits that separate the two groups the most.

Table 3. SWOT analysis underpinning the conservation of native galaxiids in the face of salmonid invasions (Garcia de Leaniz et al 2010)

	Beneficial	Harmful
Internal	**Strengths** 1. Galaxiids are local, will benefit from resident advantage 2. Flexible life strategies 3. Widespread 4. High larval dispersal 5. Many are migratory, amphidromous, diadromous 6. Inhabit relatively pristine habitats, often free from other stressors	**Weaknesses** 1. Smaller body size and slower growth rate than salmonids 2. Predation by salmonids very likely 3. Resource overlap with salmonids 4. Smaller distributional range than salmonids 5. Lack iconic/economic value
External	**Opportunities** 1. Competition between salmonids may ease impact on galaxiids 2. Better regulations, moratorium on salmonid introductions 3. Education, increasing awareness and research 4. *In situ* conservation: salmonid eradication, exclusion devices 5. *Ex situ* conservation: captive breeding, reintroductions	**Threats** 1. Most galaxiids are poorly known, data deficient 2. Expansion of salmon farming 3. Salmonid sport fishing, colonization 4. Synergy with other environmental stressors 5. New diseases, pathogens 6. Most galaxiids lack legal protection, while salmonids are in most places protected

As salmonid eradication campaigns are unlikely to be viable (or successful), we concluded that reducing the escape of salmonids from fish farms, stopping the deliberate stocking of salmonids for sport fishing , and preventing salmonids from colonizing galaxiid streams by deploying suitable physical barriers, appear to be the best options available to managers to protect galaxiids from salmonid invasions (**Table 3**).

Over the next year we are hoping to be able to field-test the potential benefits of in-situ measures designed to prevent salmonid colonization. We have found in both the Falklands and in Chile that there is still considerable opposition from anglers to any measures that may impact on salmonids, as they tend to value these fish much more than the native fish fauna. It is therefore possible that the best option to test potential galaxiid conservation measures may need to be initially confined to stream channels, field enclosures, or semi-artificial conditions, rather than in the field.

Activity 6. Education and dissemination programmes, presentation of results and media coverage

During the first year of the post-project award all the partners engaged in a number of dissemination activities, including the publication and presentation of results, and contacts with the media. The latter included articles in *The Wool Press*, *The Penguin News*, and *The Falklands Conservation Newsletter***.** These activities are summarised in **Table 4**, and full details are given in the **Annex** .

Figure 5. Dr. Sofia Consuegra (Aberystwyth University) giving a talk at the Falkland Islands Fisheries Department on the identification of *Aplochiton* species in the project through the application of DNA barcoding, January 2011.

The Wool Press is written for the rural and agricultural community, and is therefore a direct link to the landowners around the Falklands. The Penguin News is the national weekly newspaper of the Falklands, and the submitted articles were an introduction to the project, including an advert to recruit volunteers for the project locally, as well as coverage of the visit to the Falkland Islands by the UK and Chilean project partners. The Falklands Conservation Newsletter is the newsletter of the principal environmental NGO in the region (Falklands Conservation), and the submitted article discussed recent project work.

Table 4. Summary of main disseminating activities during the first year of the project (excl. peer-reviewed publications, tabulated separately)

Date	Type	Presenter/Author	Location/Publisher	Topic
May 2010	Conference	S. Consuegra	Luarca, Spain	Salmonid invasions
May 2010	Conference	C. Garcia de Leaniz	Luarca, Spain	Galaxiid response to salmonids
Sep 2010	Media	D. Fowler	The Wool Press	Introduction to Project
Oct 2010	Conference	G. Gajardo	Nagoya, Japan	Native gene pools in S. America
Oct 2010	Conference	G. Gajardo	V. Mar, Chile.	Salmonid invasions
Oct 2010	Seminar	S. Consuegra	Cardiff U. UK	Project and Salmonid invasions
Oct 2010	Media	D. Fowler	Penguin News	Introduction to Project, recruitment
Nov 2010	Seminar	S. Consuegra	Swansea U. UK	Molecular markers in invasions
Nov 2010	Seminar	J. Sanzana	U Lagos, Chile	Salmonid impacts on galaxiids
Nov 2010	Seminar	C. Garcia de Leaniz	Swansea U. UK	Biological Invasions
Jan 2011	Seminar	S. Consuegra	Falkland Is.	Molecular identification *Aplochiton*
Jan 2011	Media	D. Fowler	Penguin News	Visit by partners
Feb 2011	Media	D. Fowler	FC Newsletter	Recent project work
Mar 2011	Seminar	C. Garcia de Leaniz	Bangor U. UK	Salmonids as invasives

A project steering group was formed in the Falklands for the purpose of advising the project and help in the dissemination of results to the widest possible number of stakeholders, The group consists of two government fisheries scientists, the CEO of the main conservation NGO in the Islands (Falklands Conservation), the government environmental officer (and project partner), a representative form the aquaculture industry and a representative from the angling community. As in our previous project, Swansea MSc ands MRes students were asked to write Darwin Initiative grant applications modelled on our current project, as part of their course work for a module in Conservation of Aquatic Resources. In total, 42 Darwin grant applications were submitted to a University panel and talks disseminating the various student Darwin Initiatives were given. This has served to disseminate the Darwin Initiative in general, and our project in particular.

4.2 Progress towards project outputs

Overall progress towards achieving project outputs can be considered satisfactory. We continued to collect valuable data and to expand the coverage of the online Darwin Fish Atlas, undertook a thorough review of the main impacts of salmonids on native galaxiids as well as on potential mitigation measures, and started to estimate the connectivity and effective population sizes of galaxiid populations in order to prioritise their conservation. Good progress was made towards developing better and more efficient ways of rearing endangered galaxiids in captivity for conservation. We also made important advances in the development of molecular markers for the conservation of the endangered *Aplochiton* sp. This enabled us to detect the existence of two *Aplochiton* species in the Falkland Islands, and to assess the extent of species misidentification, which we found was widespread. We consider this a timely and important finding of our study, particularly since *Aplochiton zebra, a* species first collected by Darwin in the Falklands and termed “Darwin’s fish”, may have been misidentified by Darwin himself!

Accurate species recognition is essential for conservation because hybrids are unlikely to be fertile in most cases, and there is therefore a real danger that captive breeding could inadvertently impact the very same species is trying to conserve. By publishing and presenting our results we are ensuring that the project is properly disseminated and that the information is freely available to the public. Considerable effort is being spent in the training of students, personnel and volunteers. We are satisfied that the education and dissemination programme is meeting our targets, and that our project continues to deliver the best possible science to inform policy.

4.3 Standard Measures

Table 1 Project Standard Output Measures

Standard Measure	Description	Year 1	Total planned in Project
Training measures			
2	Number of people to attain Masters qualification (MSc, MPhil etc)		2
3	Number of people to attain other qualifications (ie. Not outputs 1 or 2 above)	2	4
4A	Number of undergraduate students to receive training	4	8
4B	Number of training weeks to be provided	8	16
4C	Number of postgraduate students to receive training	2	4
4D	Number of training weeks to be provided	8	16
5	Number of people to receive at least one year of training (which does not fall into categories 1-4 above)	2	2
6A	Number of people to receive other forms of education/training (which does not fall into categories 1-5 above)	1	3
6B	Number of training weeks to be provided	4	8
7	Number of (ie different types - not volume - of material produced) training materials to be produced for use by host country	2	3
Research measures			
8	Number of weeks to be spent by UK project staff on project work in the host country	4	8
9	Number of species/habitat management plans (or action plans) to be produced for Governments, public authorities, or other implementing agencies in the host country		1
10	Number of individual field guides/manuals to be produced to assist work related to species identification, classification and recording		1
11A	Number of papers to be published in peer reviewed journals	4	3
11B	Number of papers to be submitted to peer reviewed journals	3	3
12A	Number of computer based databases to be **established** and handed over to host country	1	1
Dissemination measures			
14A	Number of conferences/seminars/ workshops to be **organised** to present/disseminate findings	1	2
14B	Number of conferences/seminars/ workshops **attended** at which findings from Darwin project work will be presented/ disseminated.	3	6
15A	Number of national press releases in host country(ies)	2	4
15B	Number of local press releases in host country(ies)	4	6
19A	Number of national radio interviews/features in host county(ies)		2
19C	Number of local radio interviews/features in host country(ies)		2
Physical measures			
20	Estimated value (£'s) of physical assets to be handed over to host country(ies)	23,000	23,000
21	Number of permanent educational/training/research facilities or organisations to be established and then continued after Darwin funding has ceased	2	2
Financial measures			
23	Value of resources raised from other sources (ie in addition to Darwin funding) for project work	68,000	139,000

Table 2 Publications

Type	Details
Peer-reviewed journal	Consuegra, S., Phillips, N., Gajardo, G., and Garcia de Leaniz, C. (2011). Winning the invasion roulette: escapes from fish farms increase admixture and facilitate establishment of non-native rainbow trout. *Evolutionary Applications* **(in press)**. online early at http://onlinelibrary.wiley.com/journal/10.1111/%28ISSN%291752-4571/earlyview
Peer-reviewed journal	Schröder,V. & Garcia de Leaniz, C. (2011) Discrimination between farmed and free-living invasive salmonids in Chilean Patagonia using stable isotope analysis. *Biological Invasions* **13**, 203-213.
Peer-reviewed journal	Vanhaecke,D., Allainguillaume, J., Croxford, A., Garcia de Leaniz, C., & Consuegra, S. (2011) Development of 13 microsatellite markers for the threatened galaxiid fish *Aplochiton zebra* (Jenyns, 1842). *Molecular Ecology Resources* **11**, 219-222.
Peer-reviewed journal	Garcia de Leaniz,C., Gajardo, G., & Consuegra, S. (2010) From Best to Pest: changing perspectives on the impact of exotic salmonids in the Southern Hemisphere. *Systematics and Biodiversity* **8**, 447-459.
Submitted Under review	Vanhaecke et al. Misidentification compromises conservation of the endangered galaxiiid fish *Aplochiton* in Patagonia and the Falkland Islands
Submitted Under review	Vanhaecke et al. Source-sink metapopulation dynamics of a diadromous fish impacted by aquaculture
Submitted Under review	Fowler, D. & Garcia de Leaniz, C. Assessing the impact of culverts on population connectivity of endangered galaxiid fishes in the Falkland Islands
Submitted Under review	Sanzana et al. Assessing the impact of barriers on connectivity of endangered native fishes in the face of salmonid invasions in Southern Chile

4.4 Progress towards the project purpose and outcomes

Overall progress towards achieving the project's ultimate goal of protecting native galaxiids from salmonid invasions can be considered satisfactory. The recent downturn in the Chilean salmon industry has served to highlight the inherent risks of farming exotic species in open net cages, and the inability by industry to self-regulate its own growth. Thus, recent problems with the Chilean salmon industry have only served to highlight the lack of sustainability of some farming practices. The basic assumptions of the project hold true and the project indicators seem adequate. On the other hand, the effect of sport fishing on propagating invasive salmonids is much more subtle and less well known and deserves closer attention, which our project is helping to re-address.

In addition, we have engaged in several proactive measures in order to protect galaxiids from salmonid invasions, including *ex-situ* conservation. For this, dedicated recirculating aquaculture systems were sourced from the UK and are now deployed (after some delays) in both Chile and the Falklands (Figure 6). In both countries, space was made available for the systems free of charge, alongside local salmonid aquaculture projects. By working side by side in this way, it is hoped that the current good working relationship with industry stakeholders will be maintained, and the Darwin Project can help guide industry best-practices.

Figure 6. Deployment of the new recirculation system for the captive breeding of endangered galaxiids at the ULA Osorno laboratory. Dan Fowler (left) flew from the Falklands to help the Chilean colleagues (Jose Sanzana, right) with installation of the system during February 2011.

We have also engaged in *in–situ* conservation, beginning with an assessment of barriers to fish migration, in particular in relation to culverts, as these could be used to prevent salmonid encroachment in the future. The effect of culverts and other barriers on the interaction between galaxiids and salmonids is largely unknown but our pilot data in the Falklands suggest that they could have major effects on population connectivity. We consider this topic an important aspect of our project, as barriers could be useful in preventing salmonid invasions, but could also negatively impact on diadromous galaxiids.

4.5 Progress towards impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

As with our previous project, we believe that the most lasting legacy of our project will be the quality and impact of our scientific outputs, the training of students, and the development and endorsement of conservation measures in relation to galaxiid protection in both Chile and the Falklands. The project is going in the right direction to help change attitudes that measure biodiversity solely by immediate economic benefits, without considering medium and long term goals that are needed for sustainability. The project has helped to permeate this vision to stakeholders and students, who see the project filling an empty niche in both Chile and the Falklands.

It is worth pointing out that important officers of governmental bodies, such as CONAMA (Natl. Commission for the Environment) and SUBPESCA (Undersecretariat for Fisheries) in Chile and FIG in the Falklands have continued to express their full support and endorsement of the project. Likewise, support and collaboration from the fish farming industry has been instrumental in our sampling surveys and in helping us develop protocols for the rearing of endangered galaxiids. By liaising with other groups working on protecting local biodiversity we are also ensuring that the results of our project are properly disseminated and transcend the Chilean and Falklands scenarios.

The Chilean partner secured a grant from the Chilean government (FONDEF D09I1256) which will provide facilities for the rearing of aquatic larvae. This complements well the recirculation facilities provided by the Darwin project since larviculture (the reliable production of larvae) relies heavily on good diets and the genetic quality of broodstock. On the other hand, this project offers a possibility to sustain the impact and legacy of the original and actual Darwin project while additional funding is secured.

5. Monitoring, evaluation and lessons

We still see the main challenges and difficulties of the project in the logistics, which in Southern Chile and the Falklands are particularly complicated, and the extreme difficulty of sampling remote aquatic ecosystems, particularly in autumn and winter. The acquisition during the last project of a 4WD vehicle by ULA in Chile and the availability of a similar vehicle in the Falklands (generously put to use in the project by Dan Fowler) have greatly facilitated the field work, increasing our capacity for more extensive sampling and surveying. In addition, the skills gained during the previous project, and the help of volunteers and personnel have contributed to make our work more efficient.

However, there have also been some drawbacks, most notably with the late arrival of the recirculation system from the UK, the breakdown of the electro-fishing gear in the Falklands, and the difficulty of recruiting local volunteers in the winter. Sampling has been conducted in a number of sites across the Falkland Islands since receiving the appropriate licenses. Failure of the electro-fishing equipment delayed sampling towards the end of the summer field season. The situation was rectified, but the project lost a month of sampling time. Finding local volunteers in the summer season also proved difficult, but this did not unduly hinder the sampling campaign.

Through our fieldwork we have begun to identify watercourses with populations of *Aplochiton zebra* and salmonids, and these have been highlighted as high-risk populations. The unexpectedly early spawning season and lack of proper RAS during 2010 meant that the project had not established an adequate system for egg rearing. In the interim, we organised temporary use of experimental aquaculture facilities which were adequate, but far from ideal. This, coupled with the local unavailability of commercial antifungal agents, resulted in an very high mortality of eggs in the early stages. Despite this, a substantial number of fry (~2000) hatched out which served to highlight the difficulty of getting the larval fish to feed successfully.

The discovery that there are two species of *Aplochiton* in the Falklands (and not just one as it was widely believed, see our recent MS Vanhaecke et al. **Annex 3**) makes the rearing of these species in captivity particularly challenging as most hybrids are probably non-viable and therefore care must be taken not to cross them. This has forced us to rethink the captive breeding programme, to develop novel markers for rapid species identification, and to search for reliable phenotypic differences, as our results have indicated that misidentification is common.

We have continued to attract highly motivated international volunteers, and after initial delays, we have also succeeded in recruiting local volunteers to work in the field. There are also a number of students helping at the Osorno Laboratory in Chile. Finally, we have continued to react to opportunities using the Darwin Initiative as leverage for securing additional funding and support for the project, and to encourage joint supervision of research students working on the project with colleagues in Chile and elsewhere. In this sense, we were able to attract a valuable post-doctoral researcher who brings her own funding (Dr. Caty Monzón-Argüello) to work on the molecular side of the project with us in Wales, and we also have established contacts with several researchers to share samples and undertake joint analysis.

6. Actions taken in response to previous reviews (if applicable)

Not applicable as this is the first Annual Report

7. Other comments on progress not covered elsewhere

None are required

8. Sustainability

Data deficiency was highlighted by all stakeholders during our previous project as one of the most important threats to achieving sustainability in the Chilean salmonid industry, and the management of invasive species in general. Thus, the success of our project will largely depend on the quality of our data. This, we believe, will in turn generate trust and interest and foster capacity for biodiversity. As invasive salmonids continue to spread, the project will capitalize on the need to produce systematic and reliable science - not currently available to attack this problem. On the occasion of the 10th conference of CBD parties (COP) held in Nagoya, Japan, October 18, 2010, the Chilean partner gave a talk on a side event organized by the Swedish delegation (Ministry of Environment), who took this opportunity to discuss the North-South experience on alien species, thus representing a clear and direct involvement of our project in the CBD.

9. Dissemination

Dissemination activities during the first year of the project were substantial and included 14 events (**Table 4**), including presentations at seminars, conferences, and articles in magazines and newspapers (**Annex 3**). Progress in disseminating our project to the scientific community were also very successful: four peer-reviewed papers were published, four are under review, and three more are in the final stages of preparation. We submitted abstracts and will speak at three major international conferences in the following months. Thus, Dr Gajardo will speak at *World Aquaculture 2011* on July at Natal (Brazil), https://www.was.org/WasMeetings/meetings/Default.aspx?code=WA2011 the US and UK partners will give talks at the *American Fisheries Society 141st Annual Meeting* (Seattle, USA, Sep 2011, http://afs2011.org/), and the UK partners will later give oral presentations of the project's results at Aquaculture Europe 2011 (http://www.easonline.org/component/content/article/180)

10. Project Expenditure

Table 3 project expenditure during the reporting period (1 April 2010 – 31 March 2011)

Item	**Budget** (please indicate which document you refer to if other than your project application or annual grant offer letter)	**Expenditure**	**Variance/ Comments**
Staff costs specified by individual			
Overhead costs			
Travel and subsistence			
Operating costs			
Capital items/equipment (specify)			
Others: Consultancy			
Others (Workshop/ Seminars)			
TOTAL			

The main difference in the balance lies in the under-expenditure for Capital equipment due to the high cost of purchasing and transporting the chiller from the UK (a heavy piece of equipment) which motivated the Chilean partner to source it locally, and the over-expenditure due to the high costs of import duty and transport of the RAS systems from the UK to Chie and the Falklands (these are included in operating costs). Expenses for travel and subsistence were also higher than anticipated but these represented a substantial concerted field effort by all partners in Chile and the Falklands during 2 weeks in January 2011. Salaries were also slightly higher than expected due to insurance and benefit costs. These are preliminary figures, subject to final auditing.

11. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes

I agree for LTS and the Darwin Secretariat to publish the content of this section (please leave this line in to indicate your agreement to use any material you provide here)

We reproduce below the abstract of the MS submitted for publication to *Systematics & Biodiversity*

Misidentification compromises conservation of the endangered galaxiiid fish Aplochiton in Patagonia and the Falkland Islands

Delphine Vanhaecke, Carlos Garcia de Leaniz, Gonzalo Gajardo, Kyle Young, Jose Sanzana, Gabriel Orellana, Daniel Fowler, Paul Howes and Sofia Consuegra.

Abstract. The galaxiid fishes *Aplochiton zebr*a and *Aplochiton taeniatu*s are endemic to Patagonia (and for *A. zebra* the Falkland Islands), where they are threatened by invasive salmonids. Conservation of *Aplochiton* is complicated because the two species are ecologically and morphologically similar and include resident as well as migratory ecotypes that may confound identification. We used DNA barcoding (COI, cytochrome b) to discriminate between *A. zebra* and *A. taeniatus* and to assess their distributions and relative abundances in Chilean Patagonia and the Falkland Islands. Results from both DNA markers were 100% congruent and revealed that phenotypic misidentification was widespread, size-dependent, and highly asymmetric. While all the genetically classified *A. zebra* were correctly identified as such, 79% of *A. taeniatus* were incorrectly identified as *A. zebra*, the former species being more widespread than previously thought. Phenotypic misidentification was more likely to occur amongst small than amongst large individuals. Our results reveal, for the first time, the presence of both species not only in Patagonia, but also in the Falkland Islands where *A. taeniatus* had not been previously described. The two species occur sympatrically across their range but are more likely to appear in sympatry in the Falkland Islands than in Chilean Patagonia. *A. taeniatus* had a more streamlined body and attained a larger body size than *A. zebra*, which may make it more resilient to salmonid invasions. More generally, our study provides the necessary genetic baseline for the identification of *Aplochiton* and will aid conservation efforts by ensuring accurate assessment of presence/abundance and eliminating the risk of accidental hybridisation in captive breeding programs. .

Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2010-2011

Project summary	Measurable Indicators	Progress and Achievements April 2010 - March 2011	Actions required/planned for next period
Goal: *To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve* The conservation of biological diversity, The sustainable use of its components, and The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources		*See also* *www.biodiversity.cl*	
Purpose To develop practical, proactive measures to help reverse the widespread decline of native galaxiids in Chile and the Falkland Islands caused by salmonid invasions	1. Data on salmonid pressure, habitat connectivity, and galaxiid population structuring and gene flow is generated to prioritize galaxiid populations for conservation 2. Ex-situ captive breeding programme for endangered galaxiid is tested 3. Field-testing of in-situ measures to prevent salmonid colonization and encroachment of galaxiid refuge areas and (subject to stakeholder consent) eventual removal of invasive salmonids at selected sites. 4. Capacity building and training to on conservation needs of endangered galaxiids	Continuing development of Darwin Fish Atlas and additional data on salmonid pressure, and population connectivity. Four peer-review papers published and four other submitted for publication. Ex-situ conservation programme under way, making now use of molecular species diagnostic kit. Culvert survey started to provide assessment of barriers as potential salmonid exclusion devices (in –situ conservation) . Continuing capacity building and training of RA's, students and volunteers.	Improvements in ex-situ conservation with new RAS systems and trial of different rearing methods. Development of phenotypic criteria for the reliable identification of *Aplochiton* . Continuation of barrier study, and field-testing of in-situ conservation methods. Enrolment in MRes by 2 RAS and successful completion of first part of the course. Continuing capacity building and training.
Output 1. Estimates of effective population size, genetic variation, degree of isolation, and risk of salmonid encroachment for target galaxiid populations in Chile and the Falklands Islands	Results published in Consuegra et al 2011. Evolutionary Applications (in press). Schröder,V. & Garcia de Leaniz, C. (2011) Biological Invasions 13, 203-213. Vanhaecke,D. et al. (2011) Molecular Ecology Resources 11, 219-222. Garcia de Leaniz,C et al. (2010) Systematics and Biodiversity 8, 447-459. also in MS under review (see Annex)	Estimates obtained of effective population size, genetic variation, and degree of isolation in *Galaxias maculatus*, Rainbow trout, and *Aplochiton.* Estimates also obtained of risk of salmonid encroachment (based on salmonid propagule pressure) for target galaxiid populations in Chile. Estimates for the Falkland Islands planned for next year.	
Activity 1.1. Sampling of endangered galaxiids, habitat data, and collection of broodstock.		Good progress continues to be made. Data on abundance and habitat distribution of exotic and naturalized salmonids incorporated into Darwin Fish Atlas. Additional collection of broodstock planned for year 2.	
Activity 1.2. Genetic and isotopic analysis and estimates of effective population size and gene flow		Estimates obtained for three species in Chile. Estimates for the Falklands planned for year 2.	
Output 2 Deployment of 2 Recirculation Aquaculture Systems (RAS) for captive breeding of endangered galaxiids in the host countries (one in Chile, one in Falklands).	RAS systems in place in both Chile and the Falklands after some delay in shipping .	Ex-situ captive breeding programme expanded in year 2. Testing of new diets and treatments planned to improve post-hatching alevin survival.	

Output 3. Development and implementation of captive breeding and reintroduction programmes for endangered galaxiids in host countries	Captive breeding programme under way	
Activity 2.1. Captive breeding and rearing of juvenile galaxiids		Considerable progress was made on keeping broodstock during year 1 in Chile, benefitting from past experience in the Falklands. Many fish spawned successfully, but for year 2 alevin survival needs to be improved in order to produce enough individuals for reintroduction into the wild at the end of the project
Output 4. Field-testing of in-situ salmonid control measures designed to prevent salmonid colonization and encroachment of galaxiid refuge areas	Pilot data submitted for publication as case studies in Fowler, D. & Garcia de Leaniz, C, ; Sanzana et al.	Continuation of surveys planned for year 2.
Activity 5. Assessment of *in-situ* conservation measures		Continuation of surveys in the Falklands and in Chile to assess potential impacts and benefits of barriers as salmonid exclusion devices. Additional field-testing of in -situ conservation measures planned for year 2 subject to consent and stakeholder support.
Output 5. Capacity building, training and education to draw attention to the conservation needs of galaxiids and the threats posed by salmonid invasions	Dissemination activities, publications	Dissemination activities during the first year of the project included 14 events including presentations at seminars, conferences, and articles in magazines and newspapers. Progress in disseminating results to the scientific community were also very successful with four peer-reviewed papers published, four are under review, and three more are in the final stages of preparation.
Activity 3. Training of Research Assistants and enrolment in MRes in UK		Training provided to two RA's. who were both accepted at MRes programme in Sustainable Aquaculture & Fisheries at Swansea University for 2011/12 entry. Falklander RA secured PG scholarship . Outcome of Chilean funding application pending.
Activity 6. Education and dissemination programmes, presentation of results and media coverage		Wd will continue with our successful dissemination campaign, prepare additional scientific papers and speak at three major international conferences on year 2.

Annex 2 Project's full current logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Goal: Effective contribution in support of the implementation of the objectives of the Convention on Biological Diversity (CBD), the Convention on Trade in Endangered Species (CITES), and the Convention on the Conservation of Migratory Species (CMS), as well as related targets set by countries rich in biodiversity but constrained in resources.			
Sub-Goal: Endangered galaxiid populations in urgent need of protection from salmonid invasions are identified, screened, and targeted for conservation efforts in both host countries	Four project components are completed successfully, as per outputs below	Project reports, publications in peer-reviewed journals. independent DI review and checking against outputs and deliverables	
Purpose The purpose of the project is to develop practical, proactive measures to help reverse the widespread decline of native galaxiids in Chile and the Falkland Islands caused by salmonid invasions	1. Data on salmonid pressure, habitat connectivity, and galaxiid population structuring and gene flow is generated to prioritize galaxiid populations for conservation 2. Ex-situ captive breeding programme for endangered galaxiid is tested 3. Field-testing of in-situ measures to prevent salmonid colonization and encroachment of galaxiid refuge areas and (subject to stakeholder consent) eventual removal of invasive salmonids at selected sites. 4. Capacity building and training to on conservation needs of endangered galaxiids	1. Project reports, presentations, and publications in peer-reviewed journals 2. Records of captive breeding programme 3. Documentation and correspondence, field results 4 Records of educational programme and training. Staff trained under programme meet agreed standards and achieve qualifications	Increasing public awareness of the impact caused by invasive salmonids on endangered native galaxiids will lead to more support for the conservation of native freshwater fishes and the development of more proactive measures
Outputs (add or delete rows as necessary) 1. Estimates of effective population size, genetic variation, degree of isolation, and risk of salmonid encroachment for target galaxiid populations in Chile and the Falklands Islands	Field sampling and genetic/isotopic analyses completed in year 1. Conservation status assessed by year 2	Project reports, presentations, and publications in peer-reviewed journals	Molecular and isotopic markers prove informative, resolve population structuring and uncover degree of connectivity

2. Deployment of 2 Recirculation Aquaculture Systems (RAS) for captive breeding of endangered galaxiids in the host countries (one in Chile, one in Falklands)	Acquisition and installation of RAS by mid year 1	Project reports, correspondence, auditing	Availability of suitable sites and required infrastructure is in place
3. Development and implementation of captive breeding and reintroduction programmes for endangered galaxiids in host countries	Reproduction of endangered Aplochiton in captivity, survival and development of larvae, release of first juveniles by year 2	Project reports, correspondence, media coverage, presentations	Collection of galaxiid broodstock , reproduction, and rearing in captivity are successful
4. Field-testing of in-situ salmonid control measures designed to prevent salmonid colonization and encroachment of galaxiid refuge areas	Assessment of effects of barriers to salmonid migration and removal measures during year 1 and 2	Project reports, media coverage, presentations, and publication in popular and peer reviewed journals	Stakeholder consent to salmonid control measures at selected pilot sites
5. Capacity building, training and education to draw attention to the conservation needs of galaxiids and the threats posed by salmonid invasions	Presentations to schools, two appointed RA enrolled in MRes/MSc programmes by year 1. Theses submitted by year 2. Results of projected presented at conference by end of year 2	Project reports, correspondence, achievement of training benchmarks, and academic qualifications (MRes/MSc)	Public awareness is maintained and stakeholders remain engaged over the course of the project
Activities (details in workplan) 1.1 Sampling of endangered galaxiids, habitat data, and collection of broodstock 1.2 Genetic analysis and estimates of effective pop size and gene flow 1.3 Isotopic & elemental analysis for estimates of connectivity 1.4 Modelling and integration of ecological/genetic data for landscape approach with help from US partners 1.5 Training on RAS technology, molecular and isotopic techniques and enrolment in MRes in Aquatic Ecology and Conservation in UK 1.6 Captive breeding and rearing of juveniles in host countries 1.7 First reintroductions of captive bred galaxiids in host countries 1.8 Assessment of in-situ conservation measures to prevent salmoinid dispersal and encroachment 1.9 Education and dissemination programmes, presentation of results and media coverage			
Monitoring activities: Indicator 1 Number of samples collected, collection and analysis of data Indicator 2 Genetic estimates Indicator 3 Isotopic & elemental analysis estimates Indicator 4 Connectivity estimates and quantification of salmonid impact risk Indicator 5 PG Enrolment and completion of training during term 1 Indicator 6. Production of galaxiids Indicator 7. Reintroductions figures for galaxiids Indicator 8 Fiel sampling and analysis of results Indicator 9. Number of presentations, articles and dissemination outputs			

Dan Fowler Studies Zebra Trout

Falkland Islander Dan Fowler has been working on the Darwin Initiative-funded project 'Protecting Galaxiids (native fish) from Salmonid invasion in Chile and the Falkland Islands' since September 2010. The project objective is to identify and protect at-risk populations of Aplochiton zebra *and* Aplochinton taeniatus *through management of habitat and captive breeding in the Falklands. Simultaneously, project partners in Chile are working on the same thing, with the same fish species, but based around Puerto Montt and Chiloe. Dan tells us about the last few months work...*

A small zebra trout or A. taeniatus ***caught in Chile.***

Having spent a week in Chile this January seeing how the other side of the Darwin Initiative 'Galaxiid Research Project' works, I feel lucky to be working where I do. With only four freshwater fish species in the Falklands we lack the biodiversity of Chile, and with many of the waterways here being peaty streams meandering slowly to the sea, we lack the variety of habitats they have, but I'd swap all these things for rivers *without* submerged logs, *tabanos* (big black horseflies) or industrial grey water flowing in from fish processing plants!

Before I went to Chile, several of the project partners came to the Falklands to see how things operate and help look for fish. As well as increasing the workforce, these two weeks were important to get all the project partners together. I had met the project co-ordinator (Carlos Garcia de Leaniz) and his wife and project geneticist (Sonia Consuegra) several years ago when they came to the Falklands, but had only spoken to them by phone since the beginning of the project. Similarly, I had never met the other project partners or my Chilean counterpart. Getting to know your project partners is always good, and spending time with other conservation workers is always valuable too. We spent a lot of time discussing different problems, and the different approaches that could be used.

As a group we had an educational few days around North Arm and Walker Creek of East Falklands – me learning more about fish sampling, and the others learning about working in the Falklands with a constant wind (lots of chasing after paper, equipment and labels). In one stream we were excited to find over fifty shiny blue zebra trout, all about 10cm long. We've found a few of these fish before; they could be zebra trout that recently moved up from brackish water, or they might be a different species, *Aplochiton taeniatus*.

A medium zebra trout or A. taeniatus ***caught in the Falklands.***

To date, the project has confirmed (through genetic analysis) that *Aplochiton taeniatus* is present in the Islands, but studies of the morphological differences between different life stages of these two species are patchy. For now, we rely on genetics to differentiate between species and await the results to determine which fish we found. Excitingly, we found similar coloured fish in Chile, but only 4cm long. We've yet to find the purple/blue fish of that size in the Falklands, but they might be out there waiting for us.

For more information on the project go to www.biodiversity.cl

Dan seine netting for zebra trout in Chile

THE WOOL PRESS

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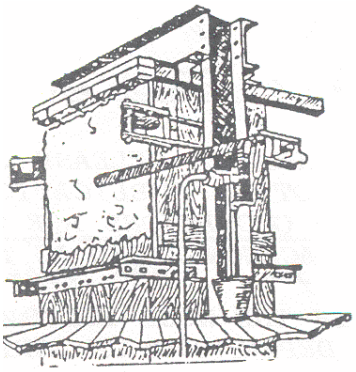
In this issue...

Plus all the usual features and more!



Edited by Siân Ferguson
Printed by The Print Shop, Stanley
Produced by the Department of Agriculture, Falkland Islands Government

EDITORIAL

What magnificent early lambing weather we have had in September capped off by a relatively mild winter - lets hope it continues.

Ian Campbell has come up with six excellent reasons why if you don't have a well constructed set of sheep or cattle yards that are easy to hold and work livestock in that you can ask FIDC for a loan to construct yards. They must be part of the development of the farm business and information on these loans is through direct contact with FIDC.

Susan Campbell has written a thought provoking article explaining why it is preferable to spey or castrate working dogs that are not going to be bred from. If they are not neutered both bitches and dogs need to be regularly checked for cancer, chronic pain and other ailments which they are generally more prone to than neutered dogs.

Our travelling correspondent Tony Mills has written a travelogue of his visits to two highly productive performance tested Merino studs with sheep that are producing genetic material suitable for incorporation into the National Stud Flock. He also writes about his training in the use of the ultra sound for assessing carcase characteristics of live cattle and attendance at a major sheep industry seminar that was very relevant to the improved sheep meat and wool productivity issues the DoA staff and farmers are working on here.

Our long awaited 'epistle from the apostle' in the Shaky Isles is in this month's Wool Press. Andy P. has provided an amusing account of his adventures surviving the earthquake, the after-shocks and the dreaded DB lager. Despite all the distractions of the Bledisloe Cup rugby, husband crèches for women who want to shop alone Andy assures us he is working hard at his Lincoln University studies.

Dan Fowler has produced an interesting piece on the Darwin Initiative cooperative project that he is the Falkland's research leader for. The project which is researching ways of reducing the impacts of the invasive brown/sea trout on our native zebra trout hopefully will produce practical ways of protecting and growing the remaining populations of zebra trout.

Tony Mills has in his inimitably quiet, reserved manner asked a few key questions about why improved sheep reproduction rates haven't been achieved across the Islands. Also why are brassica and other crops not being used more extensively on more farms? Tony is genuinely interested in discussing these issues with farmers; on farm; in the DoA office; at smoko; lunch; supper or even sharing a drink to find solutions to help farmers produce more meat, wool and profits.

Zoë Luxton has written the third article in a series on injuries to dogs. This article looks at bone fractures and how initial bandaging of these injuries should be done when dogs are to be transported prior to being treated.

Ian Campbell has prepared an interesting item on what is happening around the world as far as organic wool marketing is concerned. Wool is one of the very few organic agricultural products that haven't boomed but market analysts are still optimistic about its future.

Sam Cockwell has written about progress with his interesting raptor/livestock interaction project and Farrah Peck has introduced herself as the new office administrator and 'Jill of all trades' at Falklands Conservation.

There are a couple of contributions on care of calving cows and conservation to complete this information packed edition. Ring Katrina on 27355 to make contact with DoA staff if you need more information or want to discuss any issues raised.

Enjoy your read.

Best regards,

Mac McArthur
Senior Agricultural Advisor

AN UPDATE ON THE DARWIN PROJECT

By Dan Fowler

Scientific interest in zebra trout first began in the 1830s when Charles Darwin collected an unnamed fish during his trip to the Falklands. Some time later in Britain, a man named Leonard Jenyns studied Darwin's specimen, christening the fish the zebra trout (scientific name *Aplochiton zebra)*. We know now that it is not a proper trout, (a member of the salmonid family) but is in fact a galaxiid, making it a member of the same family as the Falklands minnow (*Galaxias maculatus*).

It took over 160 years before anyone showed any further scientific interest, when Dr Robert (Bob) McDowall visited the Islands in 1999 with his co-workers to survey the zebra trout in the Falklands and investigate their abundance (incidentally, I'm pleased to say Bob still has an interest in the Falklands and has agreed to be an advisor to the new project). His brief survey suggested that an introduced salmonid (the brown/sea trout) was taking over what was previously zebra trout territoty. Later work by FIDC's Aquaculture Project and Dr Katherine (Frin) Ross confirmed that this is the case; brown trout are spreading and zebra trout are declining. Sadly, no-one ever found the money to do more than conduct brief surveys highlighting the decline of zebra trout. Until now…..

As of last month, a new project was born. FIG teamed up with Swansea University, Universidad de Los Lagos (Chile) and Oregon State University to put together a successful bid for a two-year project entitled, 'Reducing the impacts of invasive salmonids on native galaxiids'. Fittingly, the funding has come from the Darwin Initiative, a scheme which assists countries rich in biodiversity but lacking in sufficient financial resources. Chile was awarded an equivalent sum of money and is running a similar project on galaxiids there (zebra trout and minnows are found in Patagonia too). By working together we're hoping to learn from each other and maximise the conservational benefits.

Juvenile zebra trout

Frin Ross electrofishing on the West in 2008

I've been appointed as the project's Falklands researcher and it is my goal to fully understand the current plight of galaxiids and to find practical ways to protect the remaining healthy populations of zebra trout. We're looking at captive breeding of zebra trout for release, keeping brown trout out of certain areas, and creating refugia - areas where zebra trout can live free from the threat of brown trout.

To understand what the zebra trout are up against, we'll need to understand the brown trout population and the interactions between the two species. Aside from protecting the zebra trout, as an occasional fisherman I'm hoping the work we do on brown trout can improve the fishing. Sea trout fishing in the Islands is good, but I'm reminded of a farmer who approached me wanting guidance on river management, as he felt his fishing river was not achieving its full potential. At the time, I didn't know too much about river management, and truth be told I still don't, but as the project moves along this will change, and I'm keen to pass this knowledge on to anyone that is interested. Whilst protecting galaxiids is my first priority, for better or worse sea trout will forever be a part of the Falklands environment, so we should maximise the economic and recreational benefits it can bring to the Islands where responsible to do so.

All the previous work has given me a rough idea of where zebra trout and minnows can and can't be found, but there are still a lot of knowledge gaps. Over the next six months I'll be out and about in the Falklands, wading through streams, speaking to farmers, exploring, and probably getting lost and bogged, all in an attempt to bring everybody's knowledge together to build the complete picture. I can't wait.

Periodo de prácticas
Crespe Camille

Universidad de
los Lagos

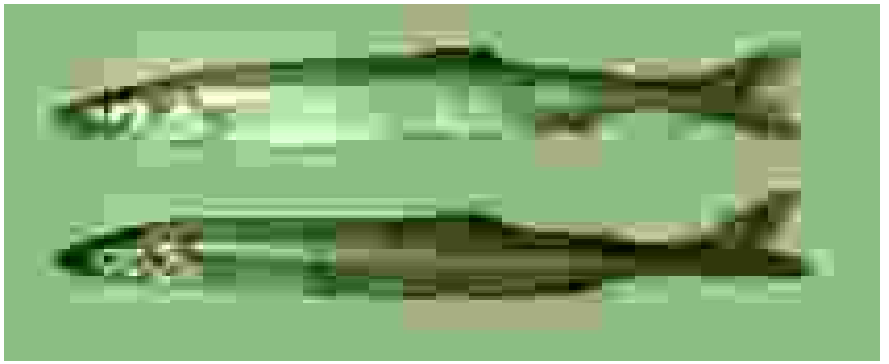
Laboratorio de Genética y Acuicultura
Proyecto Darwin II

Febrero de 2011

El proyecto Darwin II :**Protegiendo a los galaxidos de las invasiones de salmónidos en Chile**

Primer proyecto: Reducir el impacto de acuicultura exótica sobre la diversidad acuática y nativa de Chile

Segundo proyecto :Protección de una especie en vías de desaparición → Aplochiton zebra o Peladillas



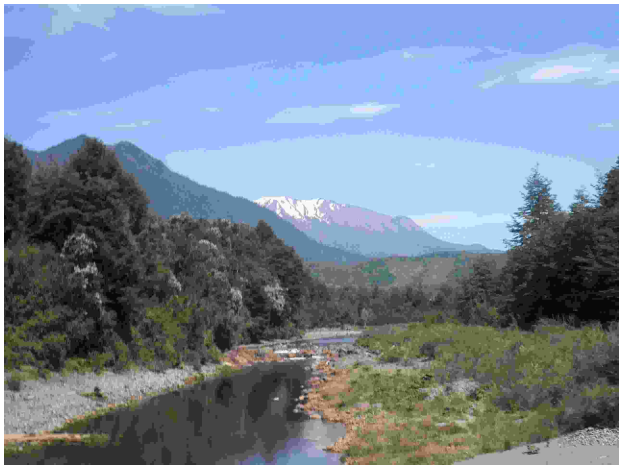
La elección de una región

Una región donde la presión de la acuicultura es fuerte

Una región donde los ríos son abundantes y adaptados a la toma de muestras

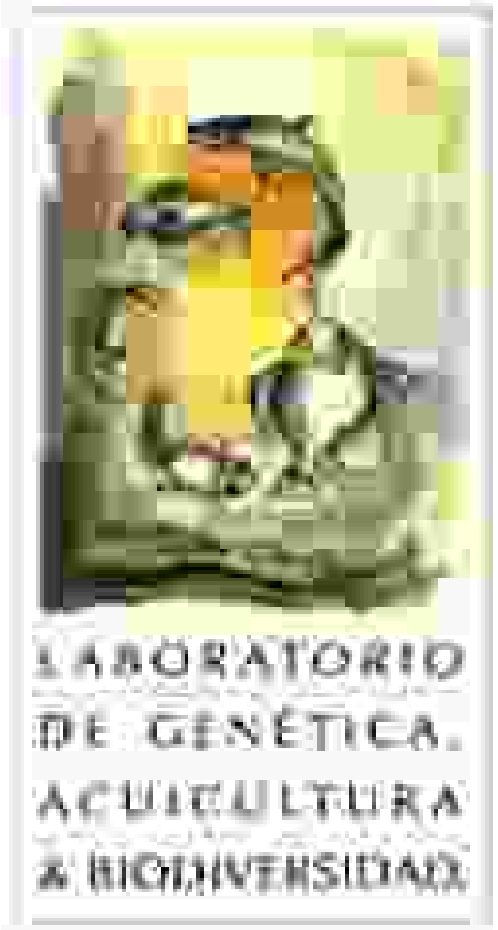
Durante la practica → Chiloé y la región de Puerto Montt

Varios sitios para tomar muestras



Actividades en terreno y en laboratorio

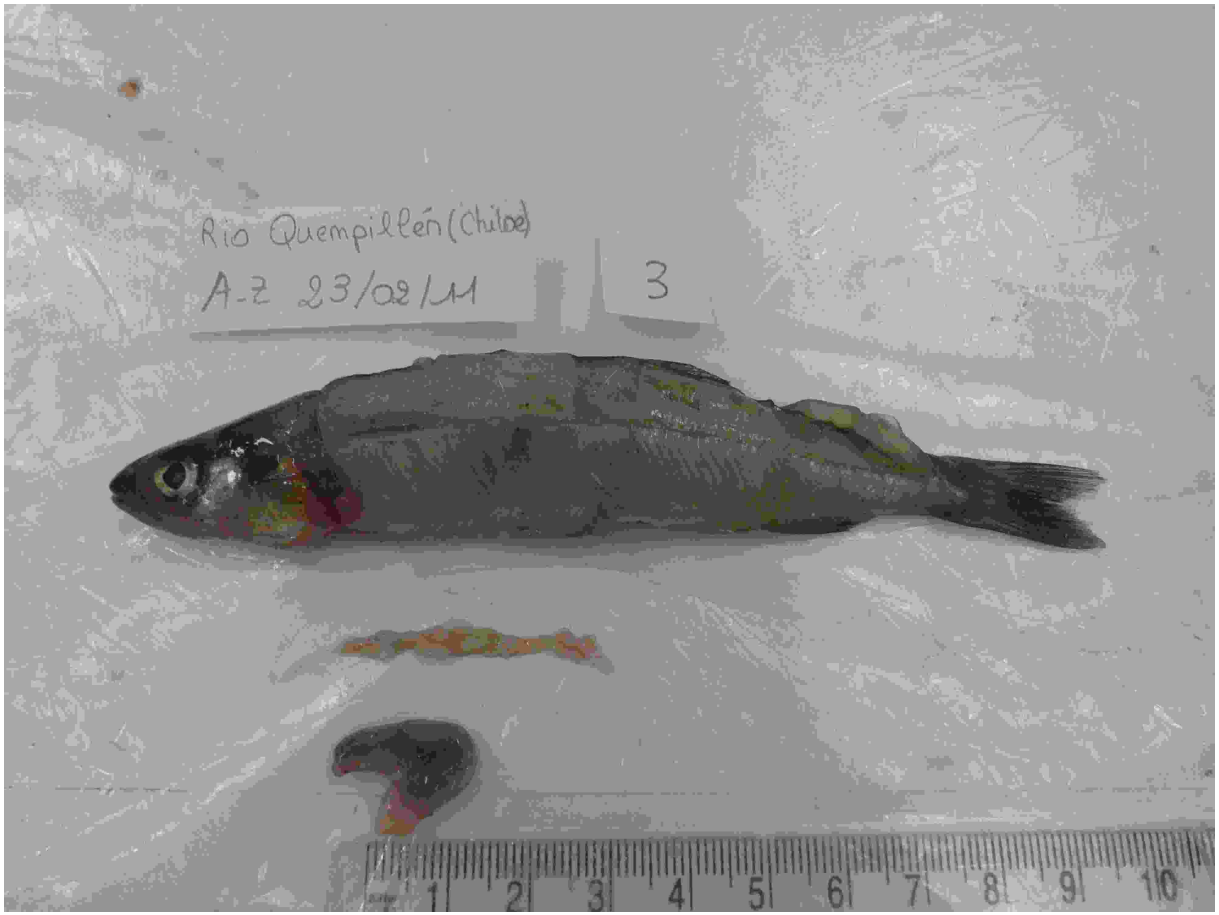


Toma de datos morfometricos, de la alimentación y la elaboración de datos genéticos

Toma de muestras de peces en los rios, evaluación de la distribución de las especies y caracterización del sitio de muestreo

Preparación de muestras

- **Morfométria**
- **Contenido stomacal**
- **Gonadas**
- **ADN**
- **Registro fotografico**



Los parametros de los rios

- **Sitio** : nombre, fecha, tiempo de pesca
- **Ubicacion** : coordenadas, clima
- **Descripción del sitio** : transparencia del agua, velocidad del corriente, ancho de rio, profundidad, pozones, porcentage de material vegetal sumergido y sobre el rio, presencia de aves
- **Calidad de agua** : temperatura, conductividad, oxigeno disuelto, pH, solidos disueltos

La pesca

- La pesca electrica para tomar muestras de animales sin matarles

- La pesca con la red

Algunas especies encontradas

Galaxias maculatus

Galaxias platei

Trichomycterus areolatus

Salmo trutta fario

Oncorhynchus mykiss

Geotria australis

Comparación de dos salmónidos

- ***Salmo trutta fario* (= Trucha café):**

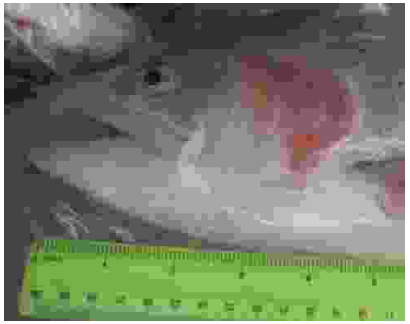
-puntos rojos sobre todo el cuerpo

-color café más o menos oscuro

-aleta adiposa con borde naranja

- *Oncorhyncus mykiss* (= Trucha arcoiris):

-línea lateral de color rosada
-puntos negros sobre la cola
-color más plateado que la Trucha café
-puntos negros sobre la aleta adiposa



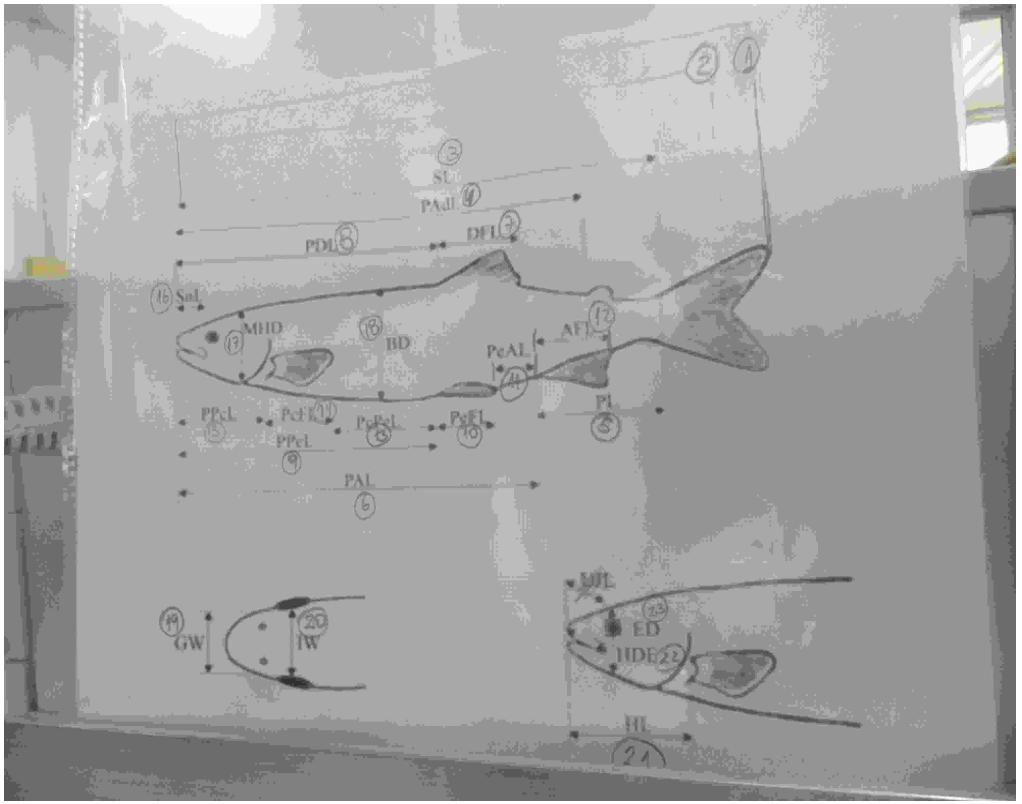
Manchas y línea roseada

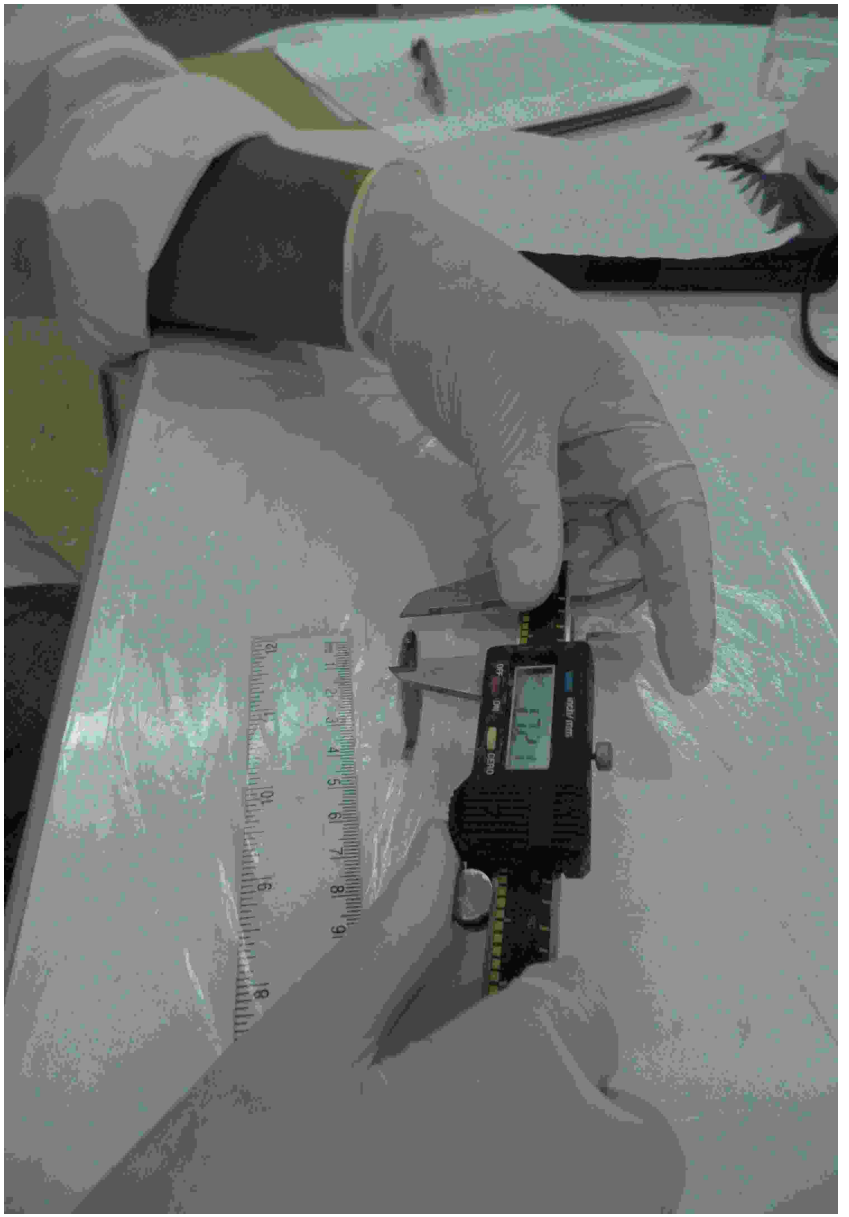
Las primeras medidas

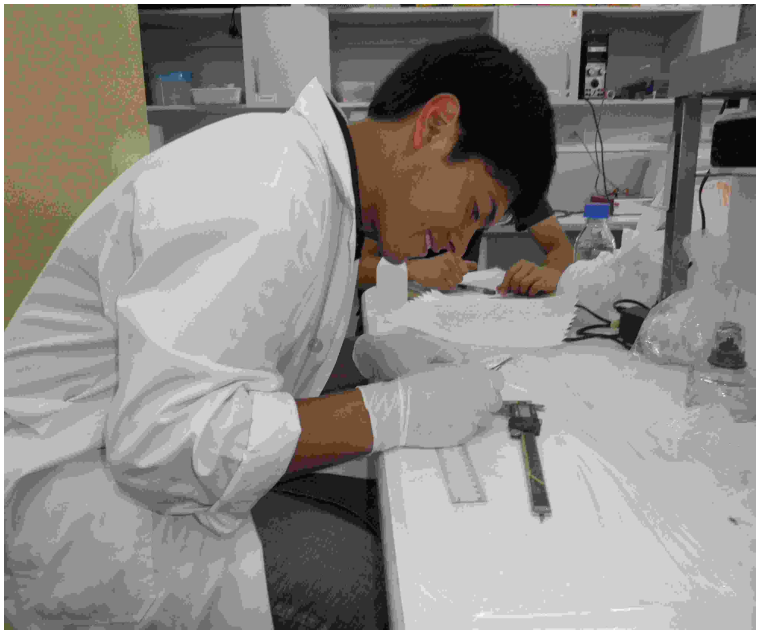
- Proporción de cada especie
- Longitud y peso de las especies exóticas
- Muestrario de las peladillas
- Toma de aletas, o de peces enteros

Las características morfológicas

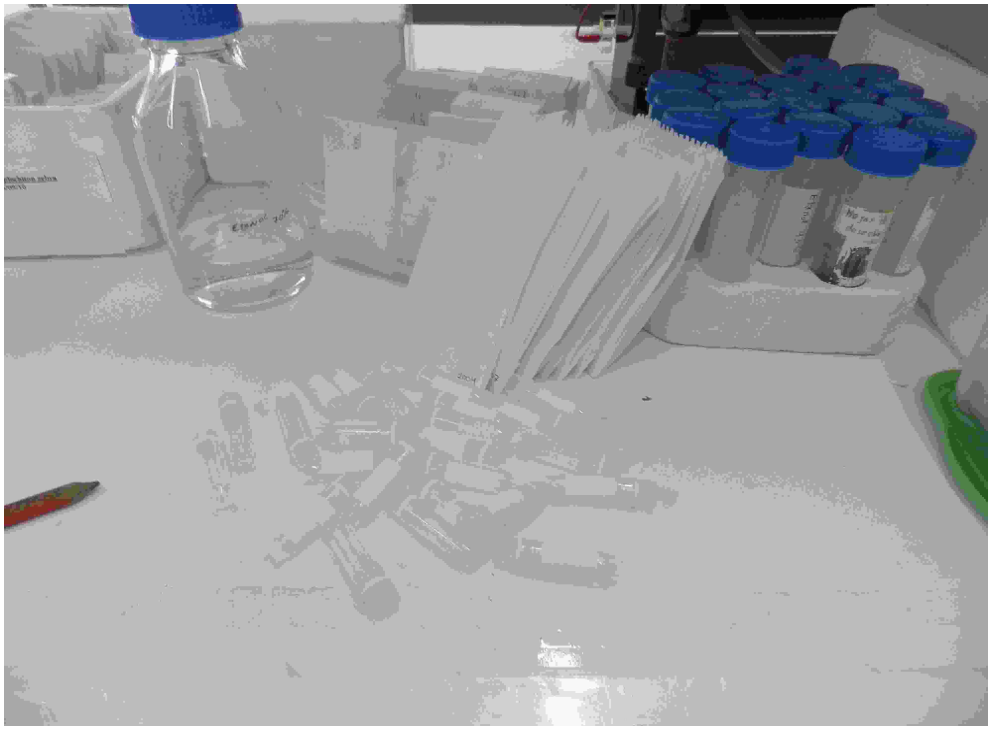
→ 23 medidas por pez







- **Un trabajo menucioso**
- **Un trabajo necesitado de la concentración**
- **Un trabajo a veces difícil**



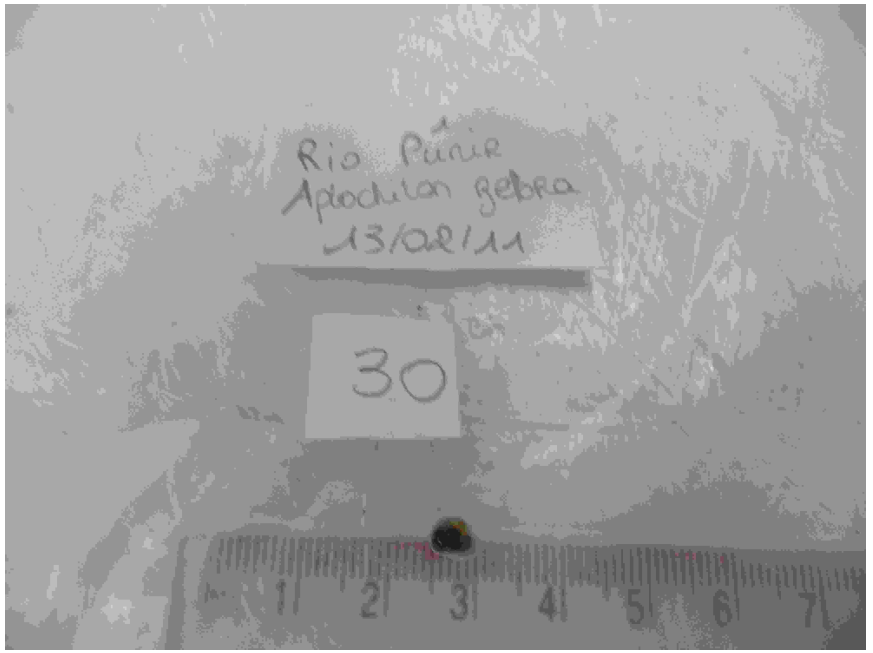
Toma de muestras

→ **musculos, en sal y en etanol**

→ **aletas pelvicas o anales**

→ **estomagos**

→ **gonadas**



Conclusión

Muchas
Gracias
Para todo

Checklist for submission

	Check
Is the report less than 5MB? If so, please email to Darwin-Projects@ltsi.co.uk putting the project number in the Subject line.	Yes
Is your report more than 5MB? If so, please discuss with Darwin-Projects@ltsi.co.uk about the best way to deliver the report, putting the project number in the Subject line.	
Have you included means of verification? You need not submit every project document, but the main outputs and a selection of the others would strengthen the report.	Yes
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