

Project Update: May 2010

This project began in December 2008 and comprehensive field surveys of the Breede and associated river systems were completed in December 2009. A smaller survey to fill in missing gaps was completed in April 2010. More than 350 sites were sampled in total, collecting ecological data and tissue samples for genetic analysis. The anticipated date of completion of the study is January 2011.

Preliminary Achievements

Discovery of unique genetic lineages, mapping distributions and documenting threats

Two hundred and fifty *Galaxias* and 110 *Sandelia* individuals have been successfully sequenced and data analysis is in progress. Eight historically isolated lineages of the Cape galaxias (*Galaxias zebratus*) were discovered from the study area. This indicates that the Breede and its associated river systems have higher taxonomic diversity than previously thought (currently only one species of *Galaxias* is recognised from South Africa). Unfortunately, seven of the eight newly discovered taxa are at risk of extinction because of their restricted ranges and highly fragmented distribution. Their vulnerability is exacerbated by their specialised ecological requirements: deep pools in lower river reaches with gentle gradient. This makes them highly susceptible to invasion by alien predators from the main stem rivers, habitat degradation and loss through unsustainable agricultural practices (such as bulldozing) and complete water abstraction from the upper river reaches.

There is immense potential for species recovery provided their critical habitats are restored and secured. The current threats and rate of biodiversity loss within the Breede and associated river systems can only be successfully halted through collaboration between land owners and researchers, as well as aggressive promotion of public awareness on the benefits of maintaining healthy functional ecosystems. This is the first aquatic project to engage land owners and communities with the aim of providing guidelines for best farming practices to prevent further loss of the remaining fish populations. We are in the process of initiating a monitoring programme with the farming communities in the study area with the aim of identifying appropriate measures to halt the current range expansion of predatory alien fishes and to promote the restoration and protection of critical fish habitats. This will hopefully allow the indigenous fishes to recover through natural recruitment and dispersal. The aim is to hand this program over to CapeNature (the provincial conservation authority) to implement.

We recommend immediate conservation management actions to halt the range expansion of *Micropterus* species and *Clarias gariepinus* into the tributaries and river reaches which are acting as the refugia for the remaining indigenous populations. This

will not be easily achieved. Building of barrier weirs is one effective way that would prevent further upstream migration of alien fishes but this would be expensive. We have identified some existing barriers that will have to be maintained and some sites where barriers could be constructed. We are also disseminating information to landowners (through informal reports and popular articles) informing them of the detrimental effects of moving alien fish within the system. As mentioned above, alien fish can have catastrophic impacts on indigenous species through predation, competition, hybridisation (if closely related) and even habitat modification. We discourage any translocation of indigenous species, because this could lead to a loss of genetic diversity or hybridisation between closely related species in neighbouring areas.

Manuscripts in preparation:

Amphibious air-breathing adaptations of a newly discovered galaxiid fish

Status: Draft for submission completed

The present study discovered, for the first time, an amphibious air-breathing galaxiid fish (*Galaxias* 'nebula') from Africa. Given that the fish were collected from a highly oxygenated perennial clear flowing temperate mountain stream, one may be tempted to suggest that amphibious air-breathing capabilities could have been overlooked in many species, either because they do not occur in habitats that experience periodic hypoxia or seasonal drying, as currently perceived. The manuscript will be submitted soon to an international peer reviewed journal.

Genetic differentiation of a newly discovered widespread galaxiid fish

Status: In preparation

Galaxias 'nebula' exhibits an unusually wide distribution range, occurring across five major and more than twelve minor river systems from the west coast to the south coast of South Africa. Genetic analyses of *Galaxias* 'nebula' is showing shallow genetic divergence across its distribution range, suggesting relatively recent gene flow between the river systems which are currently isolated from one another by marine and mountain barriers. This could be related to the species' intrinsic ecological attributes which could have allowed it to exploit alternative dispersal mechanisms such as intermittent wet connections following extensive flooding. Detailed genetic analysis is ongoing.

Contribution of project to policy and advisory framework

Preliminary findings on fish distributions and unique lineages have been used to help define national freshwater fish sanctuaries (led by Ernst Swartz, SAIAB) for the Breede and associated systems as part of the National Freshwater Ecosystems Priority Areas (NFEPA) initiative. These sanctuaries will be used to define priority freshwater areas for

conservation in South Africa (led by the CSIR and SANBI in South Africa in partnership with SAIAB). The NFEPA project will be completed in 2011 and it is expected to become a critical tool in future freshwater conservation planning in the country.

Preliminary results of alien fish distributions were used to help define alien fish areas for South Africa's new National Environmental Management: Biodiversity Act. These maps will be used to allow restricted activities to continue in defined areas for certain valuable alien fish species, whilst at the same time prohibiting the occurrence of these species in sensitive biodiversity areas.

We are also providing information for conservation planning and prioritisation to the Breede River Catchment Management Authority, CapeNature's Scientific Services and SANParks. This has already led to a more informed permit evaluation process within CapeNature.

Other projects that emerged from this study

We have successfully established linkages between SAIAB, CapeNature, Rhodes University and University of Cape Town to initiate a project aimed at finding the necessary interventions to prevent extinction of the Barrydale Redfin, a recently discovered and Critically Endangered *Pseudobarbus* species restricted to the Tradou catchment within the Breede River system. This project will act as a species conservation template for CapeNature to implement similar interventions on other threatened fishes in the Cape Floristic Region.

PUBLICATIONS AND PRESENTATIONS

Chakona A, Swartz ER and Magellan K (draft manuscript for submission completed) Amphibious air-breathing adaptations of a newly discovered galaxiid fish. Target: *Journal of Fish Biology* (international peer reviewed journal).

Swartz E, Bloomer P, Chakona A, Ramoeljane M and Skelton P (2009) Ecological differentiation affects population history of two South African redbin species (*Pseudobarbus*, Cyprinidae) from the Cape Floristic Region. 2nd Diversitas Open Science Conference, Cape Town, South Africa.

Swartz ER, Chakona A, Ramoeljane M, Weyl O, Gouws G, Bloomer P & Skelton PH (2009) The role of geological, climatic and habitat preference on the phylogeographic patterns of Cape fishes (Abstract & presentation). 10th Anniversary Conference, Southern Africa Society for Systematic Biology, 25-27 July 2009, Natalia, Illovo Beach, KwaZulu-Natal, South Africa.

Chakona A & Swartz E (2009) Genetic differentiation of a widespread *Galaxias* lineage across currently isolated river systems (Abstract and presentation). 10th Anniversary Conference, Southern Africa Society for Systematic Biology, 25-27 July 2009, Natalia, Illovo Beach, KwaZulu-Natal, South Africa.

Chakona A (2009). Comparative phylogeography, ecology and conservation of *Pseudobarbus*, *Galaxias* and *Sandelia* in the Breede and associated river systems (Popular article). South African Institute for Aquatic Biodiversity Annual Highlights Report, 2008-2009.

Chakona A (2010). Biodiversity field work in the Cape Floristic Region: Experiences and lessons learned from the Breede River expedition of 2008 to 2009 (Newsletter article). South African Biosystematics Initiative students newsletter, March 2010.

Chakona A & Swartz E (2010) Information about fishes of the Heuningnes River system, threats and possible conservation actions (Informal report to stakeholders in the study area).

Chakona A & Swartz E (2010) Information about fishes of the Wolfkloof River, Swellendam, Western Cape, South Africa (Informal report to stakeholders in the study area).