

Project: AFI 6/16
Gene Flow in Antarctic Fishes - larval sampling on the DISCOVERY 2010 cruise.

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Location: DISCOVERY 2010 cruise JR152, on board the RRS *James Clark Ross*.

Fieldworkers are indicated by an asterisk*.

Introduction

Dispersal in marine species with pelagic larvae is an issue central to our understanding of marine ecology, evolution and biogeography, as well as to the management of exploited species and conservation using Marine Protected Areas. The accepted paradigm that many marine populations are demographically “open” with extensive dispersal and gene flow, limited only by pelagic larval duration predicts that species with long larval periods disperse more widely in ocean currents than those with larvae of short duration. However, increasing evidence from population genetics, the spread of invasive species and otolith microchemistry now shows that high dispersal potential does not necessarily promote demographic connectivity between populations. Larval distribution, behaviour and high mortality rates, taken together with local and regional patterns of ocean circulation and complex physical topography, may constrain dispersal and thus gene flow. Considering the theoretical and applied importance of realised dispersal rates, there remains an urgent need for detailed studies of dispersal as a primary determinant of population dynamics and patterns of distribution and diversity of marine biota.

Within this project, we are integrating recent advances in molecular methodology and oceanographic and biological modelling to investigate the relationship between dispersal and gene flow in two species of Antarctic fish (*Champocephalus gunnari*, *Notothenia rossii*) that differ in key aspects of their larval biology (see Table 1). This will permit a test of the relative roles of life history and oceanographic variability (local and regional) on dispersal and genetic structuring. Samples of adults were collected during earlier BAS cruises (e.g. Biopearl) and through collaboration with multiple international organisations to provide baseline genetic data to assess levels of connectivity and genetic structuring in adult stocks, and to allow the assignment of larvae and eggs to their natal populations. Molecular genetic microsatellite and mitochondrial markers are being used to investigate genetic diversity at both circumpolar and regional geographic scales (within the Scotia Sea), which will then be compared with predictions from oceanographic models that take account of the two species’ variation in life history.

Table 1. Comparison of life history characteristics of *C. gunnari* and *N. rossii*

	<i>Notothenia rossii</i> .	<i>Champocephalus gunnari</i>
Egg spawning site & distribution	Pelagic, 15-30 miles offshore	Demersal, deep inshore waters
Egg diameter	5 - 6 mm	3.5 - 4 mm
Larval duration	4 months	6-7 months
Larval distribution	Epi-pelagic to max depth of 200m	Diurnal migration between surface & 100m
Adult distribution:	In & offshore	Within ~7 miles of shore

Field objectives

To obtain samples of approximately 200 larvae from aggregations of *C. gunnari* and *N. rossii* in the following locations for genetic analysis:

- a) at a coarse-scale level across the Scotia Sea, including the area between the southern and northern extremes (South Orkneys and South Georgia/Shag Rocks, respectively) and between South Georgia and Shag Rocks themselves;
- b) at a fine-scale level along the coast of South Georgia, e.g. comparing NW with NE waters, and N coast with SW coast.

Seventy two hours of dedicated cruise time were allocated to the project, to be distributed over two legs, the first (JR152) to target populations around South Georgia and Shag Rocks, and the second (JR161) to specifically sample populations around the South Orkneys combined with opportunistic sampling along the cruise trajectory.

To achieve these objectives a Neuston net was to be deployed to sample larvae aggregating at dawn and dusk in the upper 1m of water and an RMT8 trawl, rigged with two nets, was to be used to target pelagic eggs and larvae at other times or if the seas were too rough to operate the Neuston.

Work at sea during the first leg of the cruise (JR152) (Fieldwork: Dr Bill Hutchinson and Dr Jenny Rock):

Due to poor sea conditions, the neuston net was never deployed. The RMT8 (rigged with paired nets), which was capable of withstanding heavier seas, was deployed a total of seven times on the first leg (Figure 1). Six of these deployments involved fishing each of the paired nets sequentially for approximately 30 minutes per net at depths ranging from 20-90 m; the 7th deployment had to be aborted due to poor weather after only a few minutes fishing. Deployments were made onto or over shelf waters, generally between 100-250 m, and occurred in two locations: Royal Bay (54.30 S, 36.0 W) and Shag Rocks (53.40 S, 41.0 W) (Figure 2).



Figure 1. Deployment of the RMT8 trawl rigged with paired nets from the stern of the James Clark Ross. Due to the bad weather and various logistic constraints, the nets could only be deployed during daylight hours and were typically limited to depths greater than 20 m, which is considered suboptimal for sampling larval aggregations. Indeed, catch was extremely low for larvae, as well as for pelagic crustaceans such as krill and amphipods.

At Royal Bay (Fig 2a) two larvae were caught at depths of between 30-50 m, both of these were identified as *Chaenocephalus aceratus* (Figure 3a). At Shag Rocks five larvae and two eggs (Figure 3b) were caught. One larva, captured at approximately 30 m depth was identified as the target species *C. gunnari* (Figure 3c) and measured 33mm total length. Three larvae were identified as putative *Patagonotothen larseni* (these identifications will be confirmed using molecular methods) with total lengths ranging from 27-33 mm. One larva was significantly damaged by the net and will be identified by molecular methods, as will the two eggs. Two opportunistic trawls during the routine survey of the North West Core box (~53°16'S, 50°01'W) yielded no larvae or eggs.

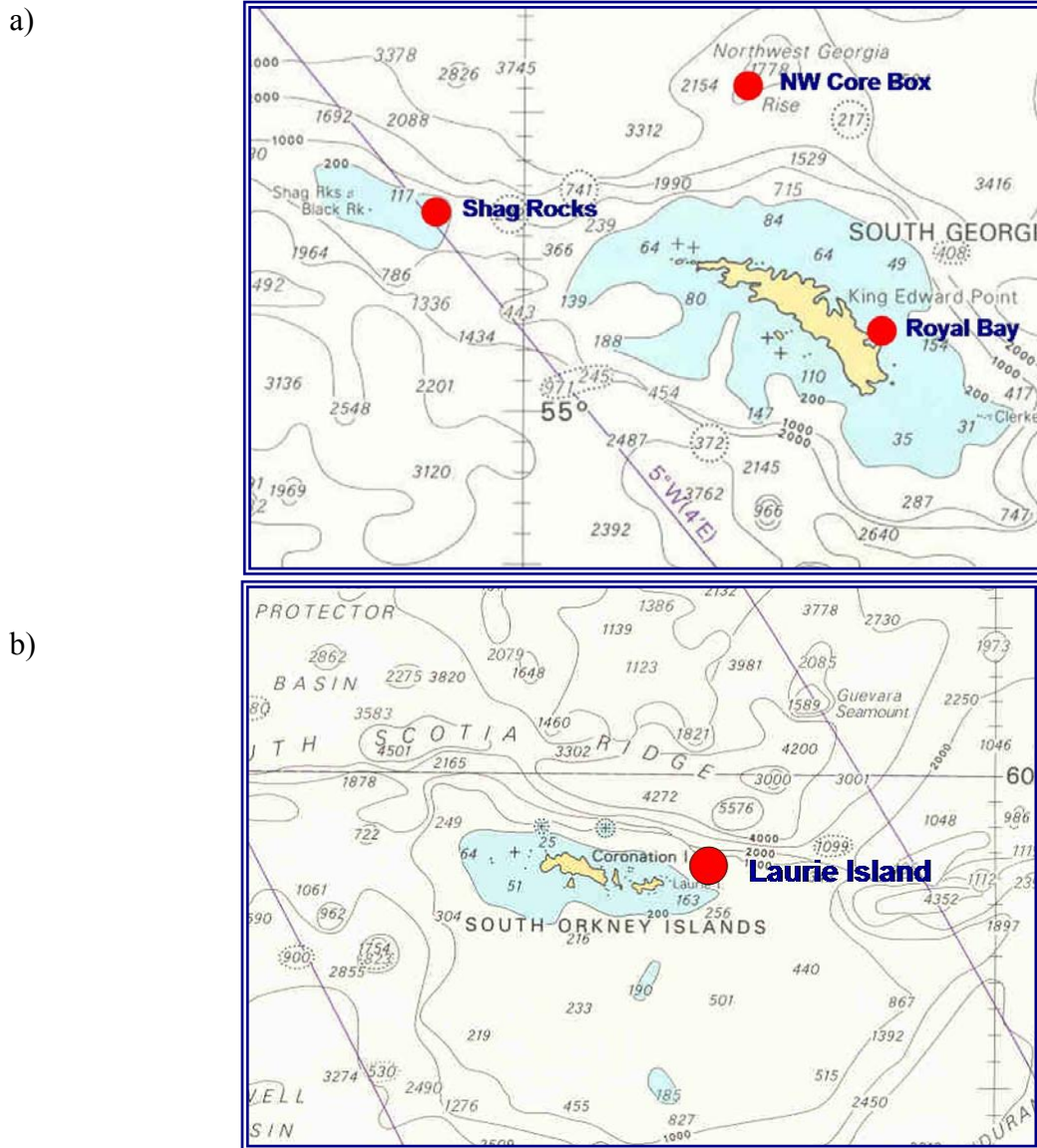
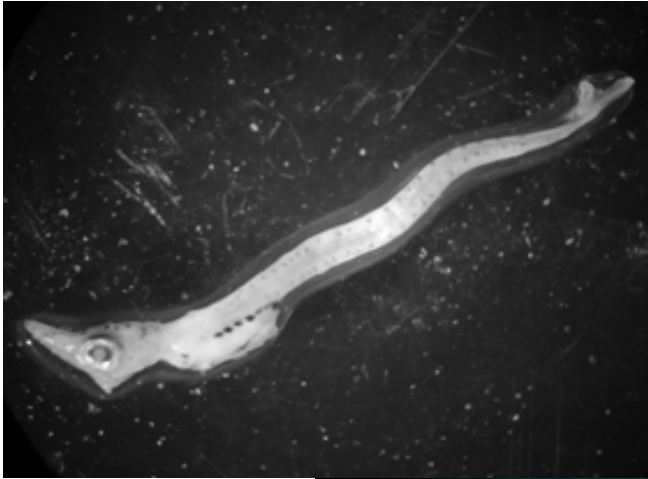
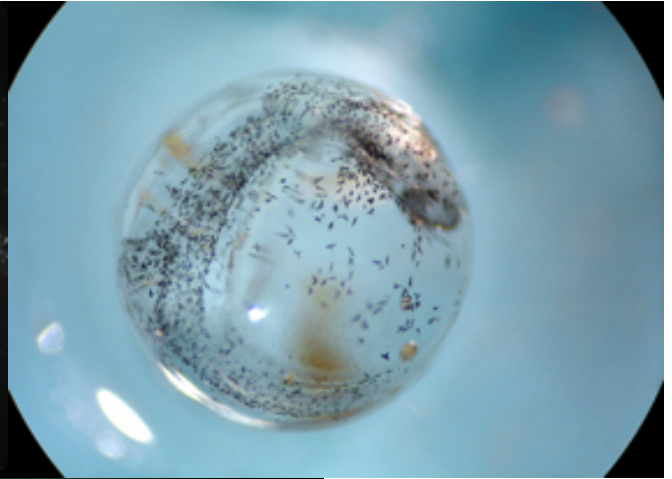


Figure 2. Sampling locations during (a) the first leg of the cruise (JR152) and (b) the second leg of the cruise (JR161).

a.



b.



c.



Figure 3. Samples of (a) *Chaenocephalus aceratus* larva, (b) unidentified eggs, and (c) *C. gunnari* larva collected during the first leg of the cruise.

Work at sea during the first leg of the cruise (JR152) (Fieldwork: Dr Martin Collins):

Once again, rough weather hindered any opportunistic sampling during the cruise south from the Falkland Islands, and upon reaching the South Orkney Islands, ice cover restricted access to the inshore waters. However, the RMT8 was deployed on three occasions to East of Laurie Island (Fig. 2b) and the Neuston net was briefly used before poor weather called a halt to operations. A total of four *C. gunnari* larvae and several *C. aceratus* and *Paralepididae* larvae, which are yet to be identified to species level using genetic methods, were obtained from the RMT8 trawls.

Many thanks go to Dr Martin Collins for braving the ice and rough seas on the second leg of the cruise to collect larvae for our project. We also thank Dr Peter Enderlein and the other scientists and crew on board the JCR who helped with deploying the trawls and recovering the precious few larvae we caught.

