Partial migration: individual causes and population genetic consequences

Reporting

Project Information

STAY OR GO

Grant agreement ID: 272764

Project closed

Start date
1 August 2011

End date
25 February 2014

Funded under
Specific programme "People" implementing the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007 to 2013)

Total cost
€ 193 766,40

EU contribution
€ 193 766,40

Coordinated by
MAX IV Laboratory, Lund University
Sweden

This project is featured in...

Final Report Summary - STAY OR GO (Partial migration: individual causes and population genetic consequences)

Understanding the causes and consequences of migratory behaviour is of fundamental importance in animal ecology and evolution, and is a question of great applied importance in many other fields. This project investigated the causes and consequences of migration in a species of freshwater fish, the roach. Each year during the winter roach migrate from lakes to streams. However, not all of the fish migrate, some remain resident (a phenomenon known as partial migration), which makes this species an excellent 'natural experiment' in which we can ask questions about the costs and benefits of migration, and, further, the consequences for the system.

The project focused upon two primary questions:
1. Do individual behavioural or ecological differences between fish determine which individuals migrate and which stay?
2. What are the consequences of partial migration for gene flow between migrants and residents?

In addition, the fellow worked on projects to identify the costs and benefits of migration versus residency in this system, and also collaborated to analyse long-term data to ask questions about whether individual fish are consistent in their migratory behavior. Our analyses showed that migratory strategy is highly consistent: in other words migratory fish tend to migrate every year, whilst residents rarely migrate (Brodersen, Chapman et al. 2014, PLoS One). Furthermore, many other aspects of migratory behavior are consistent at the individual level, for example migratory destination and timing (Brodersen, Chapman et al. Biol. Letters 2012).

In the proposal the fellow hypothesised that fish migrate to avoid predators in the winter when food is low, and so migrants may gain a survival benefit (lower predation rates), but pay a cost of reduced food availability and therefore a reduction in growth opportunities. His work during the Marie Curie grant provided support for these hypotheses: with a group of Danish researchers he showed that resident fish have a significantly higher probability of being predated upon by cormorants (Skov, Chapman et al. Biol Letters 2013), and also that migrants pay a foraging cost as the streams are poor food environments compared with the lake (Chapman et al. 2013 PLoS One).

So if migrants can reduce predation risk, might this help us predict which individuals should migrate? In the proposal the fellow suggested that risk-prone, bold individuals should have a higher migratory tendency. By assaying fish for their behavior and linking this to their movements in the wild, he has shown that bold fish indeed have a higher migratory probability than shy fish (Chapman et al. 2011 Ecology Letters). A second project investigated whether migratory fish occupy a different feeding niche than residents (the trophic polymorphism hypothesis). To investigate whether migrants have a different feeding specialism than residents the fellow carried out geometric morphometric analyses of body shape, and also stable isotope analysis and a comparison of feeding morphology. Comparisons of body shape showed that fusiform fish were more likely to migrate, which provided some circumstantial support for the trophic polymorphism hypothesis. Furthermore, migrants differed from residents in their feeding morphology and diet (quantified using gill raker morphology and stable isotope analyses), but in a sex-specific way, providing support for this model for male roach (Chapman et al unpub. data). The fellow also tested a complementary hypothesis, whereby variation in body shape could be linked to increasing hydrodynamism and reducing the costs of migrating into flowing streams. To test this the body shape of fish was compared from multiple lake populations of two types: lakes with connecting streams which allowed the possibility of migration, and lakes from which migration was not possible as there were no inlet or outlet streams. The prediction was that fish from lakes with the possibility to migrate would be on average more fusiform than fish from lakes without the possibility to migrate, and we found evidence to support this (Chapman et al. unpub. data). Finally, using molecular techniques, the fellow investigated whether migrants and residents breed with each other, or whether they are effectively different breeding populations. The lab work is complete here and the AFLP data has been received. Work to analyse these data is continuing and will be completed over the coming months. To conclude, the project has been a great success and has significantly advanced our understanding of the evolution of partial migration, an extremely widespread phenomenon of significant ecological importance (Chapman et al. 2011; 2012a).

Last update: 17 December 2014

Permalink: https://cordis.europa.eu/project/id/272764/reporting