Spawning Migration of the European Eel

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Spawning Migration of the European Eel

Reproduction Index, a Useful Tool for Conservation Management

Springer

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Cover picture: European silver eels in swimming tunnels at Leiden University
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Volume Foreword

Freshwater eels are almost infinitely improbable creatures. They spawn and die in the middle of the ocean, often associated with undersea mountains. Their transparent, leaf-like larvae move with ocean currents for months or years until they approach the mouths of freshwater rivers. Then they undergo a dramatic transformation in morphology, physiology and behavior. They move from their planktonic oceanic environment, migrate upstream and live for several years as apex freshwater predators. Then, almost impossibly, as they become sexually mature, they reverse their migration downstream to the ocean and back to spawning grounds to complete their life cycle.

The dramatic changes in their life cycles are incredible. The efforts to unravel the details of their life history have been truly daunting. Much of the past research was the work of dedicated individuals who devoted their lifetime research to these fishes. Freshwater eels merit a separate chapter in almost any textbook dealing with ichthyology, marine biology or animal migration. We know a great deal about some aspects of the biology of freshwater eels. However, our understanding of their biology still resembles a work of art as much as a work of science. To some it appears like the sweeping brush strokes of a Japanese Zen landscape, to others it resembles the work of a French impressionist, and to still others it appears as magic realism. Of course there is art because of the irresistible nature of eels, but there must also be art because there are so many details that science does not yet know. It is a challenge to fit together all the bits and pieces from researchers around the world, on different species, to resolve the details.

This volume is notable because it represents a quantum change in the approach to studies of eel biology. This volume brings together the concerted research efforts of numerous authors, at different institutions in several countries, focused on a single species, the European eel, Anguilla anguilla. For the first time we have an integrated consideration of evidence from the molecular to the ecosystem. The volume goes far beyond the usual collection of papers on a theme or even papers on a species. The research on which all these chapters are based was planned and integrated from the start to address clearly defined questions about the European eel. The research questions were daunting, the approaches had to be creative.

Exactly how do you study the migration of a fish in the depths of the Atlantic Ocean? How can you conduct research on the sexual maturation of eels as they

migrate from rivers into the open ocean? What are the impacts of parasites, chemical contaminants and viruses on eel recruitment? In the end, how could you bring all this information together to deal with broader questions of recruitment and conservation of the eel? It is a remarkable tribute to the ingenuity, originality and perseverance of these authors that they have dealt with all these questions, and more. They are able to address such broad questions as the evolution of continental dispersal, and the evolution of migration in freshwater eels. It is a testament to the underlying project that brought all these researchers together that we have such a wonderfully integrated and synthetic volume.

This volume should be a model, for those who will continue to study freshwater eels, for those entrusted with the conservation and management of freshwater eels, and for those looking for a species and study system rich with future possibilities.

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Preface

The idea for this book was started during the EU project EELREP (October 2001–May 2005), which focused particularly on the capacity of wild silver eels to mature and to contribute to recruitment (EELREP report at: www.fishbiology/silvereel.html). The main goal of this project was to find useful quality parameters for migrating silver eel, indicating their contribution to recruitment. Obviously recruitment is the product of the number and the quality of escaping silver eels. Just counting the numbers, although rather easy, can never be used as a reliable estimate of the number of effective spawners. Remarkably this approach has (and still is) thus far hardly been considered. Quantitative parameters, mainly based on fisheries, showed that the eel populations all over the world were declining since the 1960s, and even more seriously since the glass eel decline in the 1980s. Actually nobody knows the cause for this decline and management measures were thus far only based on quantity and not on the quality of spawners; which means that they are mainly controlling fisheries.

The best quality parameter for silver eels is reproductive capacity. To obtain an impression about reproductive capacity it is not necessary to go through the whole maturation process. This would not have been easy as reproduction of the European eel is still not under our control. It was anticipated that a reasonable estimate for the reproductive capacity would be the responsiveness to hormonal stimulation. Another crucial parameter for recruitment would be the physiological fitness, i.e. the capacity of the European silver eels to swim across the Atlantic Ocean. There are few fish species that swim similar distances to their spawning sites. Salmon, *Oncorhynchus* species, swim up to a few thousand kilometre upstream the rivers, however, the distance to the Sargasso Sea (6,000 km) appears thus far to be the longest distance known for any fish species. Clearly, such a distance requires an enormous effort and in addition a rather large energy store. Evidently migrating eels need to be in great shape, and without such perfect physical condition they would not be able to contribute to recruitment. Clearly poor physical condition can never be compensated by large numbers. Therefore, apart from large numbers of escaping silver eels, we need silver eels that are prone to mature sexually and that are able to swim across the Atlantic Ocean. An integrative approach regarding eel maturation is not a simple one as there appear to be two groups of scientists that

hardly communicate with each other; i.e. ecologists and physiologists. While the former mainly focuses on fisheries and population dynamics, the latter has its focus on reproductive physiology and aquaculture. In this book we included both aspects, and we hope that this approach will help to solve the current problems regarding the collapsing eel population.

The support of Erik Burgerhout was crucial for finishing the book in time; the editors are greatly indebted and like to acknowledge his punctuality and endurance.

February 2008

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