19 Migration of Fishery Resources in the World's Oceans

Paul G. K. Rodhouse

British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, UK, E-mail pgkr@bas.ac.uk

19.1 Abstract

All fish, and other motile fishery resources, make migrations. These range from tens or hundreds of metres to large-scale oceanic migrations over thousands of kilometres. Migrations are usually cyclical over time scales from diurnal to annual or longer. Diurnal migrations are driven by the light/dark cycle and seem to have evolved to balance the requirement to feed against the risk of predation. The major seasonal migrations have evolved because of the differing habitat requirements for breeding and feeding, and in the oceans these migrations are linked to prevailing current patterns. There is considerable concern in world fisheries about the top-down effects of exploitation of marine resources because approximately one third of the world's fishery resources are either fully or over exploited. However, there are also bottom-up effects, driven by pollution and manifestations of global climate change, which are increasingly recognized to be important drivers of change in the world's fisheries. Changing ocean current systems at the surface which might be caused by global climate change have the potential to cause disruption of migration patterns and prevent the successful completion of life cycles. Bottom-up effects of variable environments on populations of migratory species such as Atlantic cod, Antarctic krill and shortfin squid have been identified and provide different kinds of examples of how changing oceanographic conditions can drive change in exploited stocks. Examples of this kind of variability provide valuable insights into the likely effects of large-scale ecological change on the world's fisheries.

19.2 Introduction

Migration - moving from one place to another - is a fundamental feature of the life style of many, if not all, motile aquatic organisms and has been a subject of research since the early days of fishery science (Meek 1915). Migratory movements include daily changes, often from one depth layer to another, linked to the light-

D. Werner (ed.), *Biological Resources and Migration*

dark cycle, and these seem to have evolved to balance the requirement to feed against the risk of predation. Over longer time scales there are local and seasonal movements, dispersals and substantial movements between widely separated and well-defined areas. It is the last of these, the true migrations defined by Harden Jones (1968), that have most relevance to the management of marine fishery resources. It is these that form the focus of this review.

The major migrations of fishery resources generally follow the pattern in Fig. 1. Feeding grounds and spawning grounds are typically separated geographically. Outside the spawning season, adults on the feeding grounds grow and ripen and then, prior to spawning, commence the migration to the spawning grounds. This is usually against the flow of the prevailing current system. At the spawning ground eggs are released and fertilized and the spent adults then return downstream to the feeding grounds. The young stages, which are frequently planktonic and unable to make headway against the prevailing current, are carried downstream to the nursery grounds. From there the juveniles move downstream again, and recruit to the adult stock on the feeding grounds.

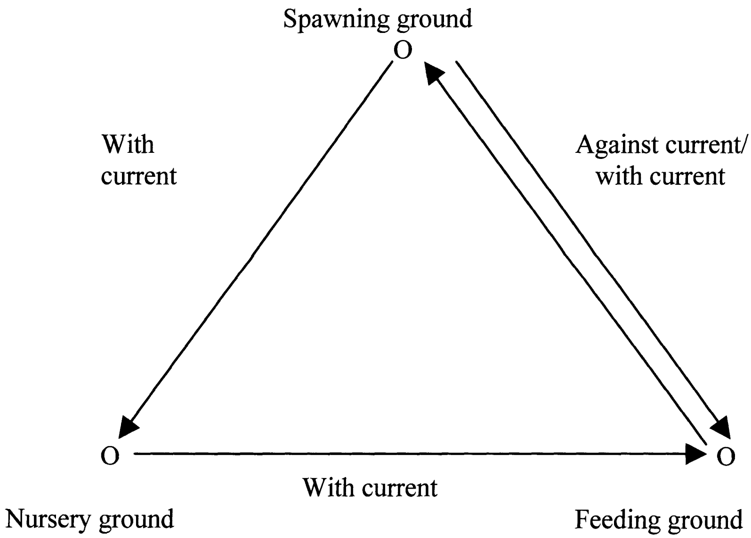

Fig. 1. Generalised migration pattern of marine fish and other fishery resources. (After Harden Jones 1968)

This basic migration pattern has evolved because of the differing habitat requirements of adults, the young stages and juveniles. Larvae are released into the marine production cycle at an appropriate time and place so they grow and avoid predation on the nursery grounds. Species with pelagic eggs and larvae maintain themselves within a particular oceanographic regime because the adults make active, compensatory movements in the opposite direction to which the pelagic stages are carried passively in the prevailing current. The whole process is an adaptation to the growth pattern of fish, which increase in mass by several orders of magnitude over the life cycle (Cushing 1982).