Wikiprint Book

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2.5 Dealing with open system problems

Species and fisheries that cross system boundaries

For almost every defined Ecopath study area, there will be some species that have life cycles that take them outside the defined area for at least part of each year. Movements (exchange) of biomass across the area boundary can be of two types: dispersal, involving unidirectional movement of organisms to and from sink and source populations outside the study area; and migration, involving regular, repeated movements into and out of the area by the same individuals. These are fundamentally different processes, with very different policy consequences. Dispersal acts as an extra mortality-agent and recruitment-source independent of fisheries and other impacts in the study area, while migration exposes organisms from the study area to particular risks and opportunities for part of the time, without acting as a ?permanent? drain or source of those organisms.

Dispersal can be represented in both Ecopath and Ecosim by setting immigration and emigration rates in the Other Production form in Ecopath. These rates are used in the Ecopath mass balance and are treated in Ecosim as unidirectional (non-migratory) dispersal rates. True migration is more complex to deal with, and Ecosim will give misleading answers if migration is represented only by immigration/emigration rates from Ecopath.

There are two broad options for dealing with directed migration to and from the Ecopath study area so as to avoid misleading predictions in Ecosim:

> The ?diet import? approach: for species that migrate to/from the study area for part of each year, include all fisheries/catches that impact the species, independent of whether these are taken within the study area. In the Diet Composition form, set the diet import proportion to the proportion of time spent outside the system, and set remaining diet proportions to the diet proportions while in the system times the proportion of time spent in the system. Using this convention, Ecosim then will allow policy exploration of all fisheries that may impact the migratory species, and will treat the food intake rate (per biomass) as constant over time for the time spent feeding outside the system. Ecopath and Ecosim will ?automatically? account for reductions in prey impacts caused by the species for the proportion of time that the species spends feeding in outside areas. Note that the list of fisheries impacting migratory species can involve splitting fleets into ?inside? and ?outside? fishing components (which can be varied or ?managed? separately in Ecosim), to represent possible policy changes in where/when the migratory fish are harvested.The ?model expansion? approach: If it is considered unsafe to assume that food consumption rates obtained while outside the system (by migratory species) will remain constant in the future, then Ecosim must be provided information on possible changes in food organism populations in those outside areas. That is, the outside areas must be ?internalized? as part of the modelled system, by adding functional groups representing the outside food web structure. Often, adding such groups may simply mean replicating the initial Ecopath group structure, with the second set of groups labelled ?outside species X? and with diet matrix entries set so that the added groups feed on one another but not on the ?inside? groups.

A good modelling tactic is to try both approaches and see whether they give different answers. However, note that the first approach can lead to misleading answers upon entry to Ecospace, if the Ecospace mapped area includes the ?outside? system: in that case, the model will continue to ?import? part of the diet and food consumption of migratory species. Thus when the model development plan includes use of Ecospace to represent a larger spatial system, the functional group organization for that larger system needs to be included in the initial Ecopath/Ecosim? model definition (approach 2).

It is possible to incorporate migration in Ecospace by defining which groups migrate and where their concentration is by month, see Representing Seasonal Migration in Ecospace? for further information.