4.5 Predicting spatial fishing patterns

EwE works with multiple fishing fleets, with fishing mortality rates (*F*) initially distributed between fleets based on the distribution in the underlying Ecopath base model. In Ecospace the *F'* s are distributed using a simple 'gravity model' where the proportion of the total effort allocated to each cell is assumed proportional to the sum over groups of the product of the biomass, the catchability, and the profitability of fishing the target groups (Caddy, 1975; Hilborn and Walters, 1987). This profitability of fishing includes factors such as the cell-specific cost of fishing.

Assuming that there are *N* cells representing water areas, each fleet k can cause a total fishing mortality rate $N \cdot F_k$. For each step in the simulation this rate is distributed among cells, c, in proportion to the weights G_{kc} based on:

$$G_{kc} = O_{kc} \cdot U_{kc} \cdot \frac{\sum_i p_{ki} \cdot q_{ki} \cdot B_{ic}}{C_{kc}} \quad \textbf{Eq. 68}$$

where *Okc* is 1 if cell *c* is open to fishing by fleet k, and 0 if not; U_{kc} is 1 if the user has allowed fleet *k* to work in the habitat type to which cell *c* belongs, and 0 if not; p_{ki} is the relative price fleet k receives for group *i* fish, q_{ki} is the catchability of group i by fleet k (equal to the F_{ki} in the Ecopath model); B_{ic} is the biomass of group i in cell c; and C_{kc} is the cost for fleet *k* to operate in cell *c*. Based on the weights in Eq. 68 the total mortality rate is distributed over cells according to

$$F_{kc} = \frac{N \cdot F_k \cdot G_{kc}}{\sum_c G_{kc}} \quad \textbf{Eq. 69}$$

while each group in the cell is subject to the total fishing mortality

$$F_{ic} = \sum_k F_{kc} \cdot q_{ki} \quad \textbf{Eq. 70}$$