Supplementary

For the Dendritic Connectivity Index (Cote *et al.*, 2009), the basis for analysis of connectivity is the adjacency matrix. The final summarised river network was used to construct the adjacency matrix for a unipartite network. The adjacency matrix for the DCI metric is described first, followed by a description of adaptations to the formulas made to include the weighting.

DCI adjacency matrix

For the anadromous life cycle, connectivity is considered from one section in the network (i.e., the entrance point of our network) to all other sections and back. Hence, the adjacency matrix describes a unipartite undirected network. Connections between nodes, representing connections between sections, are either present or absent and in the upstream and downstream direction, therefore the adjacency matrix is a square matrix with a value 1 if nodes share a connection and a value 0 if a connection is absent. Moreover, self-connections are included so the diagonal consist of all ones.

Weighting for wetted area

The wetted area was determined for each section in the river network using the following equation:

$$a_i = \sum_{x=1}^{k} l_x \times w_x$$

where a_i (m^2) is the summed area of all 50 m reaches x within section i (n = 9); l_x (m) and w_x (m) represent the length and width of reach x, respectively. The equation for the DCI_d becomes:

$$DCI_{d,WA} = \sum_{i=1}^{n} \frac{a_i}{A} \left(\prod_{m=1}^{M} p_m^u p_m^d \right) \times 100$$

where A (m^2) is the summed total area for sections i; p_m^u (-) and p_m^d (-) represent upstream and downstream passabilities of the barriers m that exist between the downstream section (fixed) and section i. Note that in order to calculate the connectivity of sections within the network ($DCI_{sectional}$), the same formula is used as for DCI_d, but now, in turn, each of the sections is considered to be the origin.

Weighting for spawning habitat

Similar to determining the wetted area, the quality of habitat for spawning was obtained using the equation:

$$q_i = \sum_{x=1}^{k} l_x \times w_x \times qm_x$$

The value for the quality multiplier qm_x (-) depends on reach type and has a value between 0 and 1(see Table 2). The equation for DCI_d becomes:

$$DCI_{d,SH} = \sum_{i=1}^{n} \frac{q_i}{Q} \left(\prod_{m=1}^{M} p_m^u p_m^d \right) \times 100$$

where Q (m^2) is the summed total area for sections i.

Weighting for juvenile production

Finally, the juvenile production was predicted using the salmon fry density model developed by Millar *et al.* (2015) (see Methods). Density estimates were incorporated as river segment weightings using the following equation:

$$d_i = \sum_{x=1}^{k} l_x \times w_x \times dens_x$$

where d_i (N) is the summed juvenile production of all 50 m reaches x within section i (n = 9). The value for the juvenile density is denoted by the variable $dens_x$ (N/m^2). The equation for DCI_d becomes:

$$DCI_{d,JP} = \sum_{i=1}^{n} \frac{d_i}{D} \left(\prod_{m=1}^{M} p_m^u p_m^d \right) \times 100$$

where D (N) is the total production.

References

Cote D, Kehler DG, Bourne C, Wiersma YF. 2009. A new measure of longitudinal connectivity for stream networks. Landscape Ecol, **24**: 101-113. DOI: 10.1007/s10980-008-9283-y.

Millar CP, Millidine KJ, Middlemas SJ, Malcolm IA. 2015. Development of a model for predicting large scale spatio-temporal variability in juvenile fish abundance from electrofishing data. Scottish Marine and Freshwater Science Report, **6**. DOI: 10.7489/1616-1.