



HAL
open science

Weirs cause aggregation of Atlantic salmon redds

Cédric Tentelier, Cyril Piou

► **To cite this version:**

Cédric Tentelier, Cyril Piou. Weirs cause aggregation of Atlantic salmon redds. *Advances in the Population Ecology of Stream Salmonids*, May 2010, Luarca, Spain. 1 p. hal-02814799

HAL Id: hal-02814799

<https://hal.inrae.fr/hal-02814799>

Submitted on 6 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Weirs cause aggregation of Atlantic salmon redds



Cédric Tentelier & Cyril Piou

UMR INRA-UPPA Fish behavioural ecology and population biology
St Pée / Nivelle, France
cedric.tentelier@univ-pau.fr



Introduction

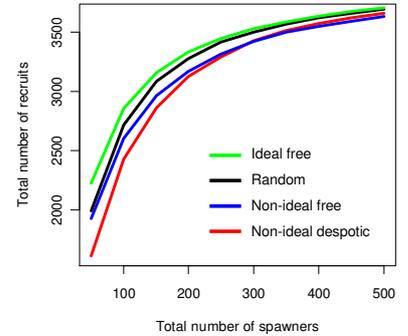
In most populations, competition for resources is local, so aggregation in suboptimal sites curtails population growth rate¹. If aggregation in suboptimal sites increases at low density (non-ideal despotic distribution), small populations may suffer Allee effects².

Atlantic salmon juveniles undergo local competition for food and shelter. Juvenile distribution is greatly determined by the choice of spawning site, made by mothers^{3,4}. This choice may in turn be constrained by obstacles to upstream migration.

→ Is the distribution of Atlantic salmon redds influenced by obstacles?

→ Does the density of spawners modulate this influence?

Simulated productivity vs. density for various spatial distributions



Methods

Study site: Nivelle river main stream + Lurgorrieta (main tributary), 27.4 km accessible to salmon, 5 weirs > 1.5 m.

Database: map of hydromorphic units suitable for spawning, number of spawning females (estimated from captures at fishways) and location of redds between 1992 and 2006 (weekly census during spawning season).

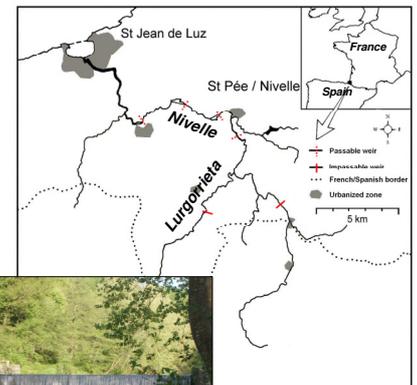
Analysis: Bivariate point pattern analysis: density of redds within r suitable hydromorphic units downstream from weirs.

$$K(r, y) = \frac{1}{W \times R_y} \cdot \sum_{i=1}^W \sum_{j=1}^{R_y} \delta_{ij}(r)$$

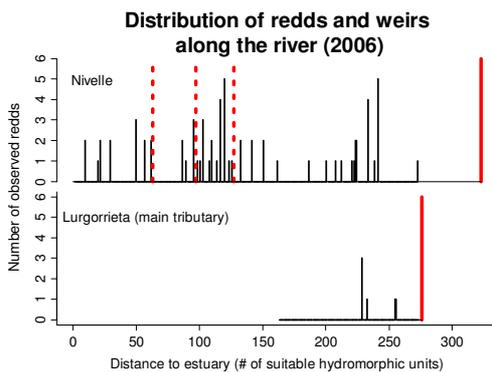
W = total number of weirs
 R_y = total number of redds on year y
 $\delta_{ij}(r) = 1$ if distance between i and $j \leq r$
 $\delta_{ij}(r) = 0$ otherwise

→ compare to 99th centile of 999 random distributions within suitable habitat

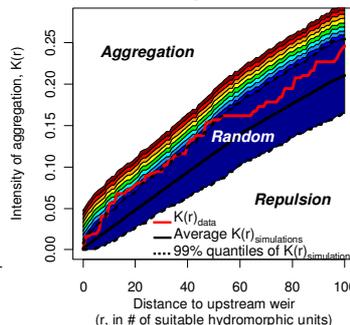
The Nivelle river and its weirs



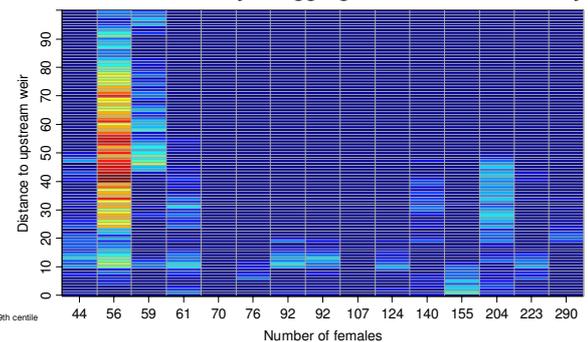
Results



Intensity of redds aggregation vs. distance from upstream weir (2006)



Scale and intensity of aggregation vs. female density



- Redds usually aggregated in the first 15 suitable hydromorphic units below weirs.
- Aggregation occurred almost every year, at all densities of spawning females in the river.

Discussion

Implications for population dynamics: fish accumulation below obstacles is known⁵, but the aggregation of redds below weirs is a new result. This aggregation may lead to high local densities of juveniles, thereby increasing density-dependent effects on population growth.

Habitat restoration: if fish prefer to spawn just below obstacles, habitat improvement should be directed to these zones. Also, opening access to a long stretch of river at one go may lead to aggregation at the new upstream limit and underuse of intermediate zones.

References

- Law et al. 2003, *Ecology* **84**: 252-262
- Kokko & Sutherland 2001, *Evol. Ecol. Res.* **3**: 537-551
- Foldvik et al. 2010, *J. Anim. Ecol.* **79**: 501-509
- Einum et al. 2008, *J. App. Ecol.* **45**: 930-938
- Garcia de Leaniz 2008, *Hydrobiologia* **609**: 83-96

Funding

