Post-doctoral position
18 months

Spatially explicit individual-based modelling of three predator fish species population dynamics in a reservoir

Starting date : around October 2017
Duration : 18 months
Place :
Irstea, UR RECOVER
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Possible visits to Chatou (Paris suburb) and Bordeaux

Gross monthly salary : 2 560 €/month

To apply, send a CV and a covering letter to samuel.westrelin@irstea.fr

Fish habitat use is a key driver of population dynamics (Hayes et al., 2009), essential knowledge for predicting how populations are likely to respond to management rules (Koster et al., 2015). The littoral zones of lakes host a high biodiversity (Schmieder, 2004) and provide resources available nowhere else in the lacustrine ecosystem (Zohary and Gasith, 2014). Most fishes use them during their entire life cycle for feeding, refuge or reproduction (Winfield, 2004). Reservoirs experience anthropogenic water level fluctuations (WLF) that affect the littoral habitats and their availability. The fish fauna can be impacted in several ways by WLF: loss of refuge areas (Kaczka and Miranda, 2014), loss of spawning habitats (Hudon et al., 2005) and loss of potential prey (Winfield, 2004). Though statements on their impact are frequent, quantification of WLF effects on biological communities remains little documented (Wantzen et al., 2008).
The Bariousses reservoir (France) is a hydroelectric impoundment with WLF. To study the spatial distribution of fish and the influence of environmental variables, the Bariousses reservoir was equipped with an acoustic telemetry system (Roy et al., 2014). During a 2-year experiment, adult individuals of pike, perch and pikeperch were tagged and tracked (a theoretical position every ~2min) (Roy, 2014). Littoral habitats (substrate type, vegetation) and bathymetry were mapped; the water level and a temperature profile at the deepest point were continuously measured. Hence, movements, habitat use and selection by each individual and their variations with environmental variables have been analyzed in detail; they mainly highlighted seasonal and diel activity cycles and a high individual variability.

The proposed work aims to develop a spatialized simplified fish population model, in order to identify the part of each of these environmental variables on the global population dynamics of these three species that have contrasting life histories.
Based on the habitat preferences and movement characteristics of the three species inferred from the telemetry and habitat dataset, completed by a detailed review and the collection of expert knowledge data on their life-history traits, adult individual movement decision rules will be built. A first step will be to implement these rules in an individual-based model, the architecture of which already exists, to simulate the fish movements over annual cycles (e.g. Baetens et al., 2013). This movement model will be rigorously validated with available data on the Bariousses reservoir. In a second step, based on the detailed review (e.g. Dahlberg, 1979; Doka, 2004; Jones et al., 2003; Souchon and Tissot, 2012) and expert knowledge, the choice of spawning site by adults, eggs and larvae survival and juvenile growth dependent on the habitat type (Clark et al., 2008) will be plugged in the model. Then, simulations will be run to test the effect of different hydrological management rules or climatic scenario on the three species populations.

The model will be developed in Java using the"SimAquaLife" framework (Dumoulin, 2007) which is an individual-based, process-oriented toolkit for aquatic life simulation (http://trac.clermont.cemagref.fr/projets/SimAqualife/wiki).

Supervising committee :
Samuel Westrelin (IRSTEA Aix-en-Provence, Main supervisor)
Laurence Tissot (EDF R&D Chatou, Main supervisor)
Patrick Lambert (IRSTEA Bordeaux, Main supervisor)
Christine Argillier (IRSTEA Aix-en-Provence, Fish ecologist)
Hervé Capra (IRSTEA Lyon, fish ecologist)
Nicolas Dumoulin (IRSTEA Clermont-Ferrand, Computer scientist)
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