



Simulation of fish populations in river systems impacted by humans (SIFIM and FishPop)

(Resource ID: 150)

DI DR. Andreas Zitek, MSc

Andreas Zitek

andreas.zitek(at)boku.ac.at

This teaching resource is allocated to following University:

BOKU - University of Natural Resources and Life Sciences Vienna

<http://www.sustainicum.at/en/modules/view/150.Simulation-of-fish-populations-in-river-systems-impacted-by-humans-SIFIM-and-FishPop>



Individual work
Work in pairs



Independent of
the number of
students



Up to 3 lecture
units



Internet
connection
necessary



English

Two software programs (SIFIM and FishPop) allow for a simulation of environmental and anthropogenic effects on fish communities and fish populations. SIFIM (Simplified fish-pressure modelling tool) is a self-contained, web-based online learning environment to support the basic causal understanding of typical effects of human activities on river ecosystems. The focus of SIFIM is on the causal effects of so called 'hydromorphological pressures' (connectivity interruptions, impoundment, water abstraction, hydropeaking and impaired river morphology) on river systems and the associated reactions of fish communities and populations with regard to the EU- Water Framework Directive (EU-WFD). FishPop (Virtual fish population

simulation model for fragmented river systems) is an individual (age class) based population simulation model. Up to 5 river sections with definable habitats can be virtually stocked with a selected amount of fish of a specific species in different age classes, year-to-year survival rates, fecundity and weight. Randomness of environmental conditions and predation are also integrated. Finally, migrations across artificial migration barriers (weirs) can be simulated taking into account the 'permeability' of weirs for fish and potential for injuries during downstream migration. The result is the development of a fish population in a fragmented river system over 50 years.

Two software programs (SIFIM and FishPop) allow for a simulation of environmental and anthropogenic effects on fish communities and fish populations.

This learning activity offers three levels of complexity:

Exploration of the causal physical effects of human pressures on river systems, including a dual choice test on the direction of physical effects (increasing, decreasing) ending with a personalized "Certificate of Achievement" (SIFIM I).

Exploration of the biological effects associated with the physical changes in the river system – here test questions need to be formulated by the teacher for evaluating the learning outcome (SIFIM II).

Expert level simulation of multiple impacts on fish populations in river systems using an individual based simulation program (FishPop).

SIFIM (Simplified fish-pressure modelling tool) is a self-contained, web-based online learning environment to support the basic causal understanding of typical effects of human activities on river ecosystems. The focus of SIFIM is on the causal effects of so called 'hydromorphological pressures' (connectivity interruptions, impoundment, water abstraction, hydropeaking and impaired river morphology) on river systems and the associated reactions of fish communities and populations with regard to the EU- Water Framework Directive (EU-WFD). As the software is designed to be self-explanatory, it comes only with a short documentation and some ideas for learning routes and evaluation.

<http://www.sustainicum.at/sifim/>

FishPop (Virtual fish population simulation model for fragmented river

systems) is an individual (age class) based population simulation model. Up to 5 river sections with definable habitats can be virtually stocked with a selected amount of fish of a specific species in different age classes, year-to-year survival rates, fecundity and weight. Randomness of environmental conditions and predation can also be defined (enhanced survival and mortality, floods with negative effects on larvae and eggs). This allows for an exploration of the potential effects of climate factors like an enhanced unpredictability of catastrophic events (floods). Finally, migrations across artificial migration barriers (weirs) can be simulated taking into account the 'permeability' of weirs for fish and potential for injuries during downstream migration. The result is the development of a fish population in a fragmented river system over 50 years. A slider within the software allows for an exploration of the result of each individual year.

It depends on the preferences of the user, which fish species and how many sections are used within the simulation. Editable .txt files allow for a user based definition of age class based parameters of virtually all types of fish species. One could also start only with one section, and exploring the development of a population in a given habitat, under natural environmental variability. In a next step, more complexity can be added to the simulation, limiting habitats, changing climate factors or adding predation. Finally, FishPop allows for simulating multiple river sections (up to 5) and the effect of 4 connectivity interruptions on population development.

FishPop comes with a comprehensive documentation of the software design, and the possible user interactions. However, it does not contain any basics on population ecology. Therefore, it makes sense to combine the use of FishPop with a basic introduction in population ecology.

<http://www.sustainicum.at/fishpop/>

The development of both simulation tools required strong domain expertise in fish ecology, and special programming skills.

Suitable for use in:

SIFIM: seminars, practica, exercises, lectures

FishPop: seminars, practica, exercise

Previous knowledge/dependence on other resources:

SIFIM: no prior knowledge required

FishPop: requires special knowledge not provided in other resources

Group size/optimal number of students:

FishPop: > 10 students

SIFIM: independent of the number of students

Time required (including time needed by students outside of the course):

SIFIM 1-2 hours

FishPop - 1 semester

Preparation efforts needed for (non-specialized) lecturers:

SIFIM - low

FishPop - high

Teaching Tools & Methods



Computer program



Simulation program



Simulation

Contact details for borrowing physical devices

Konrad-Lorenz-Strasse 24;

A-3430 Tulln;

AUSTRIA

Learning Outcomes

As young people grow up in an already changed environment, the knowledge about pristine natural situations is often not available to them ('shifting baseline syndrome'). Therefore, this learning activity starts with a description of the natural situation of a river system, and allows for a stepwise exploration of human pressures on the fish fauna, especially of the potential negative effects of hydropower production and river channelization. SIFIM hereby provides a simplified simulation environment, to learn about causal effects of typical hydromorphological pressures created by humans on river systems and fish (level I and II of SIFIM II). In addition, FishPop allows an expert view on the behaviour of fish populations under changing environmental conditions over time.

Relevance for Sustainability

As hydropower production is often considered as 'green and ecologically sustainable energy', this learning activity draws attention to the need for a more differentiated view, and the requirement of an integrated management. It introduces the idea of biological indicators for the ecological status of the environment. The EU-WFD is introduced as the currently most powerful management instrument with regard to the maintenance and rehabilitation of river systems.

Related Teaching Resources

- SIFIM: no prior knowledge required - FishPop: requires special knowledge not provided in other resources

Preparation Efforts

Low

Access

Free

Sources and Links

SIFIM: <http://www.sustainicum.at/sifim/>

FishPop: <http://www.sustainicum.at/fishpop/>

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