# Helping biodiversity conservation with modelling

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## Professor Guillaume Blanchet from Université de Sherbrooke discusses how modelling can aid in the conservation of biodiversity

The copper redhorse is a fish species found only in a few rivers near and around Montréal (Québec, Canada). The only place it is known to spawn is in the Richelieu River, commonly used for recreational activities (e.g. sport fishing and waterskiing). In short, the copper redhorse lives in an area where there is a lot of human activity. As far as we know, it would be surprising if more than a thousand adults of the copper redhorse existed. Needless to say, the copper redhorse is not doing well; it is endangered of extinction.

Actually, the number of individuals in the copper redhorse population has been monitored regularly for a few decades, and we know that it has been declining. For this reason, since the early 2000s, tremendous efforts have been put in place to help it recover. The most notable effort has been to stock (artificial add) many thousands of copper redhorse fry (baby fish) in the Richelieu River. Even if this has been done for over 20 years, the copper redhorse population is still declining.

The situation of the copper redhorse is not unique in conservation biology; conservation biologists have put a lot of effort into ensuring species do not go extinct. We simply have to look at the Kākāpō Recovery program or Monarch Watch for two examples of what is being done to protect biodiversity. It is also important to realize that this is often done with surprisingly few resources. So, it is important to use the little resources we have to be as efficient as possible to conserve biodiversity.

### Why is it so difficult to conserve species?

When we aim to save a species from going extinct, biologists typically look at two aspects of the biology of a species: how it reproduces and survives. Answering these two questions usually requires many observations that are typically difficult to gather, often in uncomfortable settings. However, this knowledge is crucial to move forward. For example, a colleague who did her PhD on Arctic Fox spent eight hours a day for many weeks outside in the cold looking at the behaviour of foxes to better understand how these animals reproduce and survive.

Knowing how many offspring (or seed) are produced by an individual, how often they reproduce, how long individuals of a species typically live, what they eat, etc., is the basis for good conservation practice. This knowledge can only be gained in the wild. When we have answered these questions, to conserve a species best, we need to decide the best

way to take action to increase the reproducibility and lengthen the species' survival. This is usually where things get more complicated because no unique solution works for every species.

Some species, like the kākāpō, have been moved to islands where there are no cats to increase their chance of survival, while others, like the sea turtle, have been successfully protected through ecotourism that helps reduce poaching and protect their eggs. If the reverse had been done for these two species, we would likely not have had the same positive outcome we have seen so far.

Increasing reproduction and survival is often not easy, as a combination of factors often endangers a species. If we get back to the copper redhorse, it could be that the arrival of a new predator in the river combined with warmer and more turbid water, an increase in waterskiing activities, a decrease in a specific type of algae, etc., have together caused the species to be endangered. We have yet to determine it.

## Biodiversity conservation: A way forward through modelling

When working at conserving endangered species, our margin for error is extremely narrow because these species have only a few individuals. Making the wrong decision could lead to the extinction of the species. A way forward is to rely on models to study different scenarios about how to conserve a species. Mathematical and statistical ecologists specialize in building well-adapted models to understand better how to conserve species.

Models are a quite an interesting set of tools for biodiversity conservation because they can be used to propose how an endangered species will be affected by different practices. In other words, models can be used to understand better how different scenarios would impact a species if it were put in place. Using models can also evaluate the impact of making a mistake.

For example, using models that study the impact of different stocking strategies for the copper redhorse, we have shown that we would need to stock many more larvae and fry than what is currently being done. Aside from being beyond the capacity of the current infrastructure, even if we could do it, it would, likely be a bad use of the resources available. Learning this with models is much more cost-effective than learning it through practice.

It is common to give a bit of financial support to work in conservation in the field. However, the modelling part is rarely considered. The expertise in modelling the impact (positive and negative) of conservation practice is desperately needed but seldom done by experts in ecological modelling in part because little to no resources are available, leading to often suboptimal results and, as such, to suboptimal practices.

Carefully developed models designed to help conservation practices should be done more often following intimate discussions between ecological modelers and field conservation biologists. It is a practice that has all the potential to galvanize and stimulate

conservation practices and help biodiversity conservation. To really have an impact, it is also vital for modelers to have at least some training in ecology for the link between conservation biologists and modelling be as efficient as possible.

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