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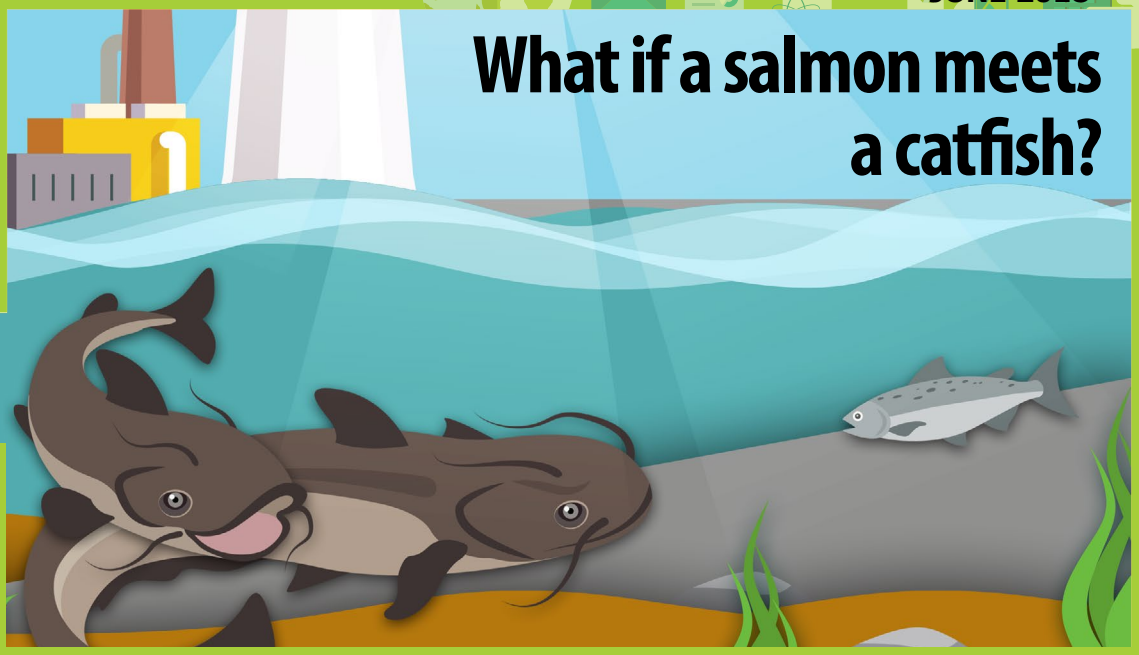
What if a salmon meets a catfish?



Authors:
Stéphanie Boulêtreau, Adeline Gaillagot, Laurent Carry, Stéphane Tétard, Eric De Oliveira and Frédéric Santoul
Associate Editors:
Gogi Kalka & Madeleine Corcoran

Abstract

Do you like to eat salmon? If so, you're not alone. European catfish, a large freshwater fish introduced into Europe for sport fishing, has also developed a taste for it. We wanted to know what happens when salmon and catfish meet in rivers that humans have changed (for instance: by building a power plant). We picked a big river with a power plant, the Garonne in South-West France, to address this question. With the help of video and acoustic cameras in a special waterway for fish around the power plant, as well as *radio-transmitters* attached to individual fish, we can confidently say that catfish prey on salmon in these altered parts of the river. In fact, they seem to even shift the time they're active (from night time to more daylight hours) to increase their chances of catching salmon. And while salmon populations are declining in Europe, catfish seem to be doing better and better.

Introduction

Atlantic salmon, also called the king of fish, are truly majestic animals (Fig. 1a). They are one of the largest of salmon species and can be found in the salty waters of the Atlantic Ocean, but also in the rivers that flow into it (making it a great example of an *anadromous fish*).

This is because each year, adult salmon embark on an epic journey (called *migration*) from the sea to areas far upstream (mostly returning to where they were born) to lay eggs. This journey can be hundreds or even thousands of kilometers long.

The baby fish then hatch in the river, grow into teenagers, and migrate back to the sea where they grow into adults.

Atlantic salmon used to be very common in European waters, but now they are at the brink of extinction. Unfortunately, this is mostly due to human actions: water pollution, overfishing, destruction of their habitat, presence of dams and other barriers, and climate change. But we might have added yet another threat: a new predator.

Catfish were introduced to European freshwaters as a sport fish (Fig. 1b). They can live for over 50 years and are much bigger than salmon (up to 2.7m in length and 130 kg in weight). With big size comes big appetite: Catfish eat lots of other creatures, such as insects, crayfish, even birds, and of course, lots of other fish. Could salmon also be on their menu? We wanted to find out what happens in rivers where catfish and salmon meet.

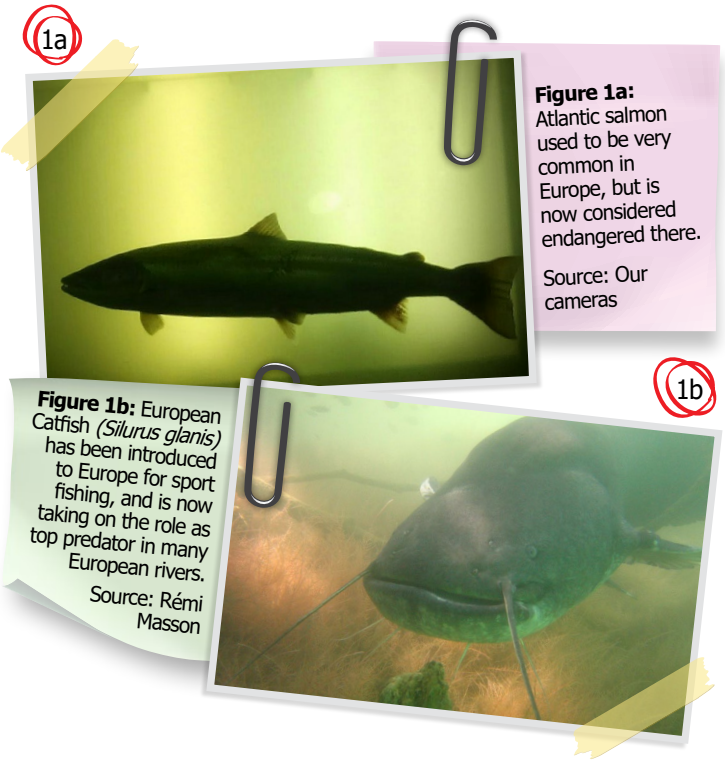


Figure 1a: Atlantic salmon used to be very common in Europe, but is now considered endangered there.
Source: Our cameras

Figure 1b: European Catfish *(Silurus glanis)* has been introduced to Europe for sport fishing, and is now taking on the role as top predator in many European rivers.
Source: Rémi Masson

Methods

We were particularly interested to see what happens in rivers that humans had altered because we thought that structures such as man made channels or power plants could increase encounters between catfish and salmon.

That's why we picked the Garonne river in South-West France for our study. It runs over 580 km from its source in the Pyrenees Mountains to the Atlantic Ocean, and has a hydropower station (the Golfech-Malause hydroelectric complex) along its course (about 270 km upstream from the mouth of the river).

This is the first barrier that migrating fish along the river might encounter. To make the journey easier for them a so-called fishway was added to the power plant (Fig. 2). Fish swimming upstream enter a holding pool and are then trapped in a tank which is raised up (a "fish-lift"). The fish-lift is then emptied upstream of the power plant into a canal, allowing the salmon to continue their journey.

The fishway has a fish counting station that records all the fish swimming through using a video camera. We analyzed daily fish counts of salmon and catfish using the fishway from 1996 through 2016, and hourly fish counts for these two fish species from 2004 to 2016.

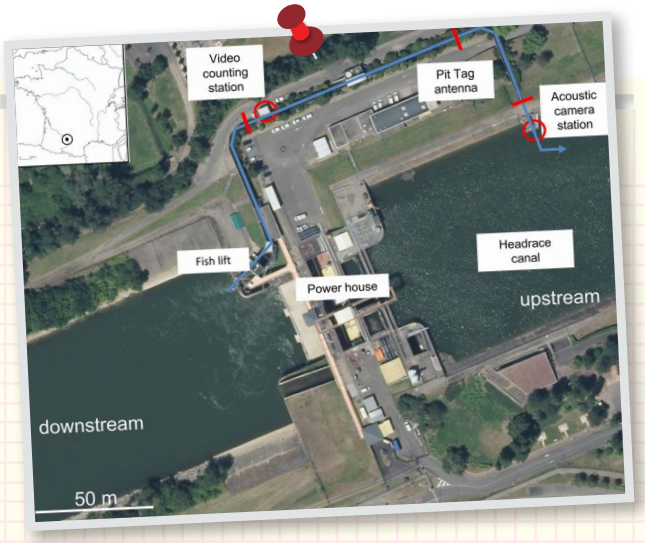


Figure 2: Overview of the fish lift and fishway at the Golfech Hydropower station on the River Garonne. Note the location of both cameras (video and acoustic) we used for our study.

We also looked at 2 months of data from 2016 from a temporarily installed *acoustic camera* at the upstream exit of the fish canal that can identify fish and their movements even in deep and murky water.

Finally, we also caught and equipped 35 catfish with little radio-transmitters to monitor their behavior inside the fishway.

Results

Here's what we found out:

- More and more catfish started to swim through the fishway from 1993 to 2016 (Fig. 3a)
- Almost 95% of all catfish passed through between April and July, which also coincides with the time salmon migrate (although salmon start a bit earlier, in March) (Fig. 3b)
- Until 2008, catfish made only a few downstream passages through the fishway. After 2008 we see more and more catfish traveling back and forth in the fishway.
- We also see salmon going back and forth between the fish counting station in later years.
- Salmon travelled through the fishway primarily during the day (between 8am - 9pm), while catfish prefered to do so at night (between 11pm - 9am). However, in the most recent 3 years, we observed that more catfish pass through at the end of the day (between 5pm -10pm).
- In the absence of catfish, salmon passed directly through the fishway without spending much time inside. However, when catfish were present, salmon started swimming back and forth and spent more time inside.

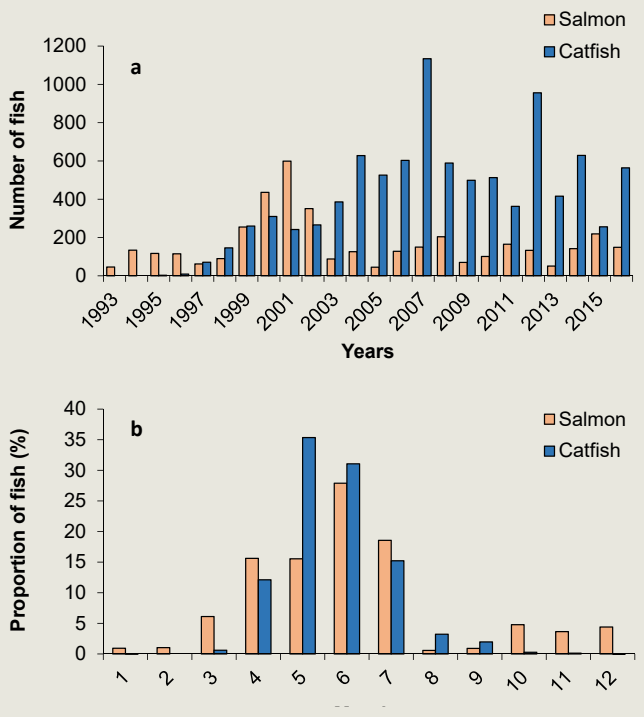


Figure 3: a) Number of Atlantic salmon (pink) and European catfish (blue) passing through the fishway in the River Garonne per year
b) Proportion of each type of fish passing through in each month of the year

- Catfish tended to hang around the exit of the fishway.

  The acoustic camera indicated that a few specialized catfish individuals caught 35% of all salmon swimming through the fishway in 51 days in 2016. Among the salmon that managed to exit, 72% were attacked but managed to get away.

- We also observed catfish eating salmon directly in front of the camera (see our video on sciencejournalforkids.org)

Discussion

Most Atlantic salmon populations are declining in Europe, while catfish populations are increasing. In the Garonne river, the numbers of salmon are low, despite many conservation efforts over the years. We believe that catfish are a significant threat to salmon in this and other rivers.

Interestingly, catfish are not migratory themselves, but they seem to follow the salmon's migration (as well as those of other fish) in order to prey on them. The catfish also appeared flexible in their timing and shifted from being nocturnal to being more active during daytime hours in order to catch more salmon.

The changes humans have made to the river by constructing the power plant and the fishway are probably making it easier for catfish to catch salmon because they can ambush them in the narrow passages of the fishway.

What's more, climate change looks set to make things more advantageous for the catfish and even worse for the salmon.

Conclusion

Humans put salmon (and other *native* fish) under a lot of stress. We change their rivers, pollute their ocean water, overfish their populations, alter their water temperature, and then on top of all this we have introduced them to a gigantic predator that targets them during their migrations.

So what can we all do to protect salmon and other fish? Here are some ideas:

- Reduce our energy consumption to minimize our impact on the climate.
- Keep rivers and oceans clean.
- Don't overfish vulnerable fish populations and eat *sustainably sourced fish* instead.
- Don't introduce more *invasive species* into rivers as they will turn into threats for native fish.

Glossary of Key Terms

Acoustic cameras - a device that uses microphones and other sound detecting equipment to create a reading or visualisation of sound sources (such as a catfish or salmon swimming in the river).

Anadromous - this term describes fish that hatch in freshwater and then migrate to saltwater and spend most of their lives there.

Invasive species - Any kind of living organism that is not native to an ecosystem and causes harm to the environment and other animals that live there.

Migration - A seasonal movement of an entire population of animals from one place to another.

Native species - Species that naturally occur in a particular ecosystem and that are not brought in through human activity.

Radio-transmitters - a little device that can be attached to animals which means their movements can be tracked with a receiver.

Spawning - the process of fish releasing eggs and sperm into the water for reproduction.

Sustainably sourced fish - Fish that is either caught or farmed in ways that considers their long-term survival and the well-being of their habitats. For more info, check out www.seafoodwatch.org

Telemetry (radio tracking/radio telemetry) - a technique to track animals from a distance. A transmitter is attached to the animals and sends radio signals to a receiver (usually a handheld antenna). The person holding the receiver usually has to follow the animal around to record its position.

Check your understanding

1. What does anadromous mean? And what is the advantage of an anadromous lifestyle for salmon?
2. Why is the Atlantic Salmon endangered in Europe?
3. How did the catfish get into European waters?
4. Why is this a problem for salmon?
5. Why can artificial changes to waterways make the catfish problem worse for salmon?
6. How did we see that catfish were preying on salmon?

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