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Sterile Salmon Produce Baby Trout

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for National Geographic News

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Salmon parents have created offspring that are 100 percent trout—the first time that a surrogate animal has produced a different species, researchers say.

Researchers took reproductive cells known as germ cells from rainbow trout and implanted them into masu salmon embryos.

The salmon served as hosts—or surrogates—for eggs and sperm made of trout genetic material.

When the adult salmons' egg and sperm were combined via artificial insemination, they produced babies that were fully trout.

Although neither trout nor salmon species is endangered, "this is a novel method for conservation of endangered species in salmon," said lead researcher Goro Yoshizaki of Tokyo University of Marine Science and Technology.

The new work offers hope that the technique could eventually produce other species that are difficult to breed, endangered, or even extinct using host species that are abundant or easily bred in captivity.

Yoshizaki and colleagues report their findings in this week's issue of the journal *Science*.

Large Eggs

Trout and salmon are both part of the same family, the Salmonidae.

In recent decades many salmonids have seen their wild populations plummet, with some species becoming extinct or endangered.

Preserving these species is difficult because viable fish eggs are too large and have too high of a fat content to survive being frozen.

"So we thought freezing progenitor cells of egg and sperm will be a good alternative for egg cryopreservation," Yoshizaki said.

Like stem cells, progenitor cells can develop into different types of cells, although their ability to do this is more limited.

For their experiment, the researchers used germ cells extracted from trout embryos and implanted them into male and female salmon embryos.

The adult male salmon yielded male sex cells of rainbow trout free of any salmon genetic material. Similarly, the adult female salmon yielded trout eggs.

"Further, by artificial insemination of these male and female salmon recipients, we obtained a 100-percent trout population," Yoshizaki said.

A key element of the research was to make the salmon sterile before transplanting the cells, the researchers note.

In previous studies the scientists had transplanted cells into already fertile salmon. The male salmon were able to produce trout sperm, but most of it was salmon-derived.

Salmon females, meanwhile, were not able to produce trout-derived eggs.

"The use of sterile animals is a very elegant approach," said Ina Dobrinski, an animal biotechnology and germ-cell researcher at the University of Pennsylvania who was not involved in the study.

"It makes [sterile animals] the ideal recipients for these transfers, because all the eggs and sperm that this animal can make will be from the donor."

What's more, the resulting trout sperm is small enough to be preserved by being frozen. This means that sperm created for extinct animals could be frozen and later thawed for transplantation into a host species.

Yonathan Zohar is an expert on the fish reproduction at the University of Maryland in Baltimore.

He said Yoshizaki's research "is changing the way that many of us think about fish reproductive biology and the future of seafood production."

Masu salmon reproduce faster than rainbow trout, so if the trout were endangered, the technique could be used to produce trout more quickly than nature could manage.

And the technology is generic, he added, which means it could be made applicable to many other fish species.

"This is especially exciting in the context of the continuous and very alarming decline in fisheries stocks … ," Zohar said.

One beneficiary of the technique may be the bluefin tuna, Yoshizaki said, since the tuna's population has

been declining rapidly due to overfishing.

(See photos of the threats facing bluefin tuna.)

The bluefin is not able to be domesticated and cannot be bred in captivity.

Yoshizaki is now working on applying the cell transplantation technique to bluefins, which weigh as much as 1,300 pounds (600 kilograms), and surrogate mackerel, which weigh less than 2 pounds (1 kilogram).

"By transplanting tuna germ cells into mackerel recipients, we would be able to produce tuna seed in small fish tanks with less cost and labor," Yoshizaki said.

"Eventually, it will help world tuna fisheries."