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Super Salamanders

Asia Trail's newest inhabitants aren't pretty faces. But they are a dream come true.

By Caroline Treadway

Ever since curators at the Smithsonian's National Zoo heard about Japanese giant salamanders (*Andrias japonicas*), they've wanted them. Why? Because, as senior curator Ed Bronikowski puts it, "They're big, ugly, and cool as hell."

That zoological fascination fueled a nine-year odyssey that has joined two cultures on opposite ends of the Earth in striving to conserve this incredible amphibian. After nearly a decade of hard work, perseverance, and creative problem-solving, Bronikowski and chief veterinarian Suzan Murray brought six Japanese giant salamanders from the City of Hiroshima Asa Zoo to the National Zoo last December.

The National Zoo hopes to establish a breeding colony of Japanese giant salamanders. *(Mehgan Murphy/NZP)*

What are these supersize salamanders and why did the Zoo want them so badly? Well, the animals' name pretty much sums them up. Native to Japan, these salamanders are huge. They can grow longer than five feet and weigh upwards of fifty pounds. They are rumored to live for more than a century.

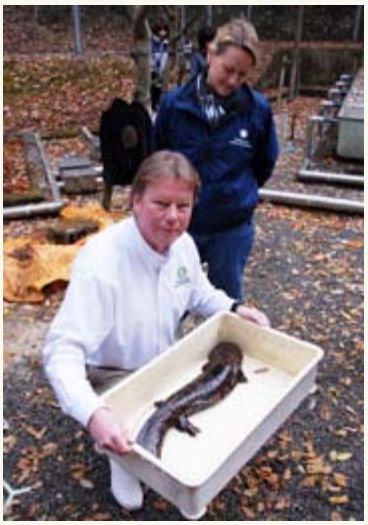
In Japan, these stream dwellers are called *hanzaki*, which means "half change." The Japanese revere their enormous amphibians, honoring them with temples, parades, and songs. They also protect the animals, deemed a "national natural treasure," by law.

Japanese giant salamanders are one of three species of cryptobranchids. Other members of this family are Chinese giant salamanders (the world's largest amphibians, slightly larger than their Japanese cousins) and hellbenders (smaller salamanders native to the southeastern U.S.).

Hanzaki thrive in swift, cold mountain streams that eventually meander through farmland and cities in Japan. These sleek giants are perfectly designed for life in the aquatic fast lane. With wide, flat heads, camouflaged bodies, and rudder-like tails, the salamanders use grippy toe pads to maneuver on slick algae.

Salamander Secrets

What little is known about this exotic icon, American scientists have learned from Kazushi Kuwabara, the “godfather of the Japanese giant salamander.” Since 1974, Kuwabara has scrupulously studied the salamanders, unraveled their intricate breeding secrets, and designed the Asa Zoo’s salamander breeding grounds. The Asa Zoo was the first place in the world to breed Japanese giant salamanders in captivity—a testament to Kuwabara’s salamander savvy.



Senior curator Ed Bronikowski and chief veterinarian Suzan Murray admire a giant salamander at the Asa Zoo in Japan. *(Courtesy of Ed bronikowski)*

Since the Asa Zoo sits smack in the middle of Japanese giant salamander territory, Kuwabara funneled nearby streams through the zoo’s salamander grounds, providing the exact conditions—water quality and temperature—the salamanders would have in the wild. The method worked, and the Asa Zoo has bred hanzaki this way since 1979.

In mating season, Kuwabara has discovered, a male salamander travels to find a cavern in a sandy stream bank and excavates a large oval nest. The “den master,” as scientists call the breeding male, aggressively defends his nest from intruders. But when the right female slithers by, he immediately welcomes her in to mate. Scientists theorize that the den master quickly identifies breeding females by sense of smell, but that’s still a mystery.

In a unique display of external fertilization, the female giant salamander enters the den and lays a string of white eggs, which the male fertilizes with his sperm. The two begin a circular dance around the eggs and sperm, stirring them. The den master then allows other males and females to enter the nest and join the spawning circle.

After fertilization, the others leave, and the den master assumes responsibility for the eggs. He meticulously guards and cares for them. Even months after they hatch, he continues to tend the tiny larval salamanders, forgoing food. Besides humans, adult hanzaki have few predators, but juveniles make a tasty snack for birds, turtles, and snakes.

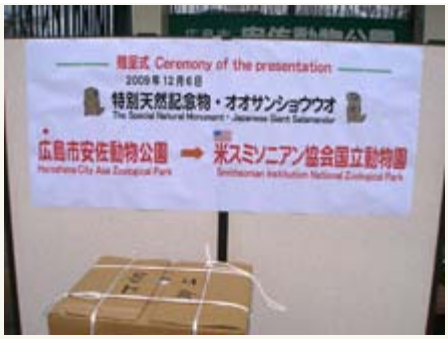
Kuwabara noticed that if the father leaves the nest, the young salamanders’ survival rate decreases dramatically. Does he secrete an anti-fungal chemical that protects his young? This is just one of many questions Zoo scientists hope to explore. “The Japanese giant salamanders are curious animals that live differently from humans,” Kuwabara says. “I hope we can work together to understand their strange lives. I am sure we have a lot to learn about them.”

Amphibian Appetites

In the wild, hanzaki are ambush predators that blend into their surroundings and wait for a fish or crab dinner to swim by. When it does, the salamanders deploy lightning reflexes. A mouthful of sharp, tiny teeth grasp the prey, which is swallowed whole.

“They’re really adorable until you think about putting your hand in front of their face,” says Zoo biologist and keeper Rick Quintero, who’s spent nearly every day with the salamanders in quarantine since they arrived at the Zoo. “Especially when you see them eat a fish. It’s a violent attack on anything near their face.”

But hanzaki can’t



A box containing Japanese giant salamanders awaits shipping to the U.S. *(Courtesy of Ed Bronikowski)*

thank their tiny, lidless eyes for dinner. The salamanders hunt with a sixth sense akin to touch. Like most amphibians and fish, Japanese giant salamanders are wired with a web of motion sensors running down their sides. This "lateral line system" is studded with nerve endings that detect movement and electromagnetic fields. Heavily concentrated around the face and mouth, this heightened sensitivity makes hunting a snap, literally.

"If something is moving, they know it's there, no matter how tiny it is," says keeper Robin Saunders, who specializes in hellbenders. "And not only do they know it's there, they know exactly where it is, how big it is, and how fast it's moving."

Hanzaki aren't picky eaters. They forage on fish, crabs, invertebrates, and anything else that comes within reach, including mice, snakes, and occasionally each other. According to Saunders, salamanders near cities sometimes mistake plastic bags and other inedible items for prey.

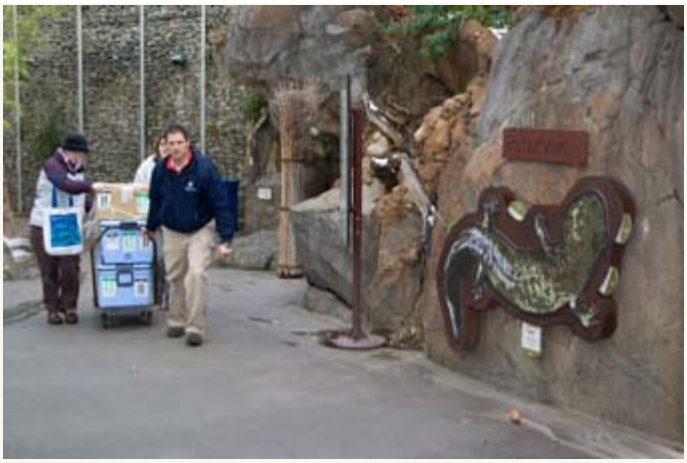
Salamanders might eat trash in the wild, but certainly not at the Zoo, where nutritionists design strict diet plans based on weight and natural feeding habits to avoid obesity and disease. Each week, the hanzaki get a ration of raw fish—capelin, herring and smelt. As denizens of cold water, Japanese giant salamanders have slow metabolisms and don't need to eat every day.

Salamander SOS

Hanzaki haven't escaped the habitat destruction, pollution, and disease devastating amphibians worldwide. In a recent article, Smithsonian salamander specialist Jennifer Sevin wrote that the species is "susceptible to extinction by potential environmental fluctuations, and requires extensive conservation measures."

But scientists responding to the global amphibian crisis have primarily focused on frogs. "The prettier the frog, the more attention it gets," says Bronikowski. "And we support frog conservation at the National Zoo. But we also want to focus on salamanders because not enough zoos, facilities, and aquariums are focusing on salamanders." To meet this challenge, the Zoo has joined the Association of Zoos and Aquariums' Cryptobranchid Interest Group and hopes to take a lead role in salamander science and breeding in the U.S.

The salamanders' slippery skin is a key part of the problem. Highly permeable and vascular, it allows for underwater breathing but also makes the animals extremely vulnerable to pollution. Zoo pathologist Tim Walsh says that even low levels of contaminants, over time, can cause problems for amphibians that are constantly bathed in toxins. "We worry about any kind of runoff that's getting into streams—herbicides, pesticides, or fertilizers around farms," he says. "And in cities, a whole mixture of chemicals just washes off the street into streams, whether it's oil dripping from cars—petroleum products—or whatever's associated with nearby industry: heavy metals, organochlorines, and various chemicals."



Japanese giant salamanders from Hiroshima arrive at the National Zoo. *(Mehgan Murphy/NZP)*

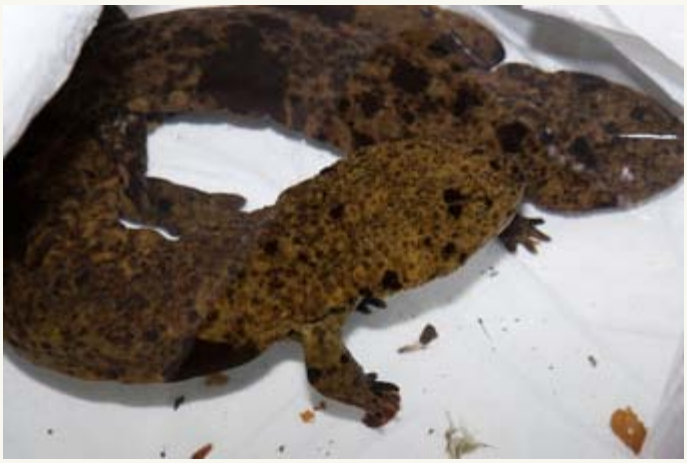
Japanese giant salamanders must also contend with hybridization. Japanese farmers once imported the bigger, more aggressive Chinese giant salamander to raise for its valuable meat. (One giant salamander can reportedly sell for $1,000.) Some Chinese salamanders escaped into the wild, where they both interbreed and compete with their Japanese cousins.

As salamander numbers dwindle, these iconic animals and their habitat need all the help they can get. In Japan, communities have begun to modify cemented irrigation ditches and dams that prevent breeding and foraging, making them more hanzaki-friendly.

With so many threats facing the Japanese giant salamander, the Asa Zoo and National Zoo have teamed up on a bold project—creating a breeding colony outside of Japan. Toward that end, the Asa Zoo gave six of its salamanders to the National Zoo. Will the animals agree to breed half a world away from home? Bronikowski hopes so. “We are keeping our fingers and toes crossed,” he says. “Giant salamanders are like the giant pandas of the amphibian world.”

Mike Davenport's Dream

The salamanders’ arrival fulfilled a deeply held dream of Mike Davenport, a former curator. He helped design Asia Trail and desperately wanted it to include Japanese giant salamanders. In 2000, Davenport drew up a curatorial agreement with the Asa Zoo. But endless permitting hiccups and delays prompted the Zoo to borrow a salamander from the Cincinnati Zoo for the exhibit’s debut. Visitors loved the 50-year-old female salamander, but she soon died from chronic liver disease, despite painstaking efforts to save her. Keepers were heartbroken. And when Davenport retired in 2009, the Zoo was giant salamander-less.



These and four other Japanese giant salamanders were gifts from the Asa Zoo in Hiroshima. *(Mehghan Murphy/NZP)*

Senior curator Ed Bronikowski inherited the “giant” challenge. He reinvigorated relations with the Asa Zoo and patiently forged through a jungle of red tape alongside registrar Laura Morse. “The amount of labor that goes into all this is just incredible,” Bronikowski says. “And that’s on both sides of the ocean. They’re zoo people just like we’re zoo people. Permitting is a necessary part of conservation to be sure, but it can be quite tedious.”

While permits inched toward approval, Bronikowski had time to build the Zoo’s entire salamander facility. He tweaked the Asia Trail exhibit, guided the installation of new quarantine tanks, and built a brand-new salamander breeding facility at the Reptile Discovery Center. This state-of-the-art system mimics key features of the Asa Zoo’s. “It’s really exciting to think outside the box and try to re-create environmental conditions from a natural stream that’s halfway around the world,” Quintero says.

Keepers release Japanese giant salamanders into their new habi*tat (Mehghan Murphy/NZP)*

Bronikowski and Quintero crafted every detail of each tank, plumbing system, and exhibit. They aimed to match the salamanders’ wild environment in hopes of promoting future breeding success. The breeding facility alone required a panoply of mechanical, biological, chemical, and UV filters; new external plumbing; redundant water chillers; insulated reservoirs; and three independently operational tanks connected with tubes perfect for salamanders to wriggle through.

In the new facility, the salamanders enjoy the seasonal temperature variation and water flow they’d have in Japan. That’s not all. Bronikowski brought stream samples back from Japan, as templates for water chemistry in the Zoo’s new facility. After reverse-osmosis filters strip D.C.’s city water of everything but hydrogen and oxygen, the water is then reconstituted to match the Japanese stream samples.

Building Relationships

Japanese giant salamanders are more than just a cultural icon or a symbol for struggling amphibians. The salamanders bring two distinct cultures, with different scientific practices, together in the fight for conservation.

“Whether it’s giant pandas, golden lion tamarins, Przewalski’s horses, or any of the other endangered species we work with, we are building relationships,” says Bronikowski. “That’s what the National Zoo does.”

—Freelance photojournalist Caroline Treadway is a former Smithsonian Zoogoer *intern.*

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