

A Research and Conservation Project on Sakhalin Taimen, a Rare, Anadromous Salmonid in Eastern Asia

By Pete Rand¹, and Michio Fukushima²

¹Wild Salmon Center

²National Institute for Environmental Studies



Spawning pair of Sakhalin taimen in the headwaters of the Sarufutsu River watershed. The male, displaying bright red spawning coloration, is on the left. Photo credit: Satoshi Adachi.

In Hokkaido, the northernmost island of Japan, there is a small river system called the Sarufutsu that holds great significance to both of us.

For Michio, it started with a fishing expedition in the 1980s, when he captured a very unusual fish. For Pete, it started in the spring of 2006, when he traveled to the river for the first time, and got his first glimpse of a large, brightly colored fish in the headwaters. Over the years we've gotten to know each other better, and, through our collaboration, we've gotten to know these unique fish better, too.

The fish, *Parahucho perryi*, is known by a variety of common names, including Sakhalin taimen, *itou* (pronounced "ee-toe"), sea-run taimen, and Japanese huchen. In the indigenous Ainu language, it is called *chirai*. Its species name comes from the U.S. naval officer Commodore Perry, who ended Japan's era of isolation. It is related to four other Asian endemic species in the *Hucho* genus, but recently was placed into its own genus based on evidence of substantial divergence in characteristics of their DNA. This species' habitat includes lower reaches of rivers (including lakes), estuaries, and the coastal shelf. It spawns during the spring in rivers.

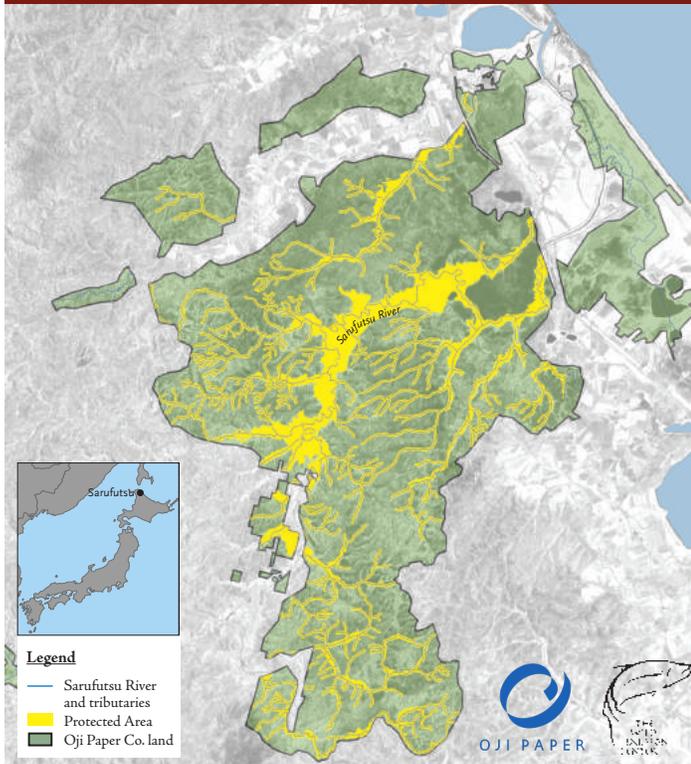
"Why this river, and why this fish?"

We often get this question.

The river, because it is one of the largest undammed river systems in Hokkaido, and it has been spared from much of the river construction and restoration projects that have greatly compromised the ecological integrity of many Japanese rivers.

The fish, because it is unusual, beautiful, and exceedingly rare. It is the only taimen that run to the sea (confirmed in a number of studies, including Arai et al. 2004, Edo et al. 2005, and Zimmerman et al. 2012). Like the other taimen species, the fish is relatively late to mature, can live exceedingly long lives (> 20 years), and can reach enormous sizes—taimen over 2 m long have been captured. In fact, they are recognized as the

Sarufutsu Environmental Conservation Forest



Map of the Sarufutsu River watershed in Hokkaido, with special protected area shown in yellow.

largest salmonids in the world. Their diverse diet is also noteworthy, as it includes small mammals and birds when they present themselves. It is thought that some of the largest individuals are capable of feeding on returning adult Pacific salmon.

Understanding the threats and working to address them

In 2006 we contributed to a range-wide assessment of the species conducted by the International Union for Conservation of Nature (IUCN) Salmonid Specialist Group. In addition to Hokkaido, the species can also be found in the southern Kurile Islands and Primorye, Khabarovsk, and Sakhalin in the Russian Federation. We concluded, largely based on the rate of decline in bycatch in the coastal salmon trap net fisheries in the Russian range, that the species was highly threatened, and the status of the species was characterized as Critically Endangered, the highest level of threat used by IUCN (Rand 2006). We explored the risk of population extinction and the factors driving it in a later publication (Fukushima et al. 2011).

In the IUCN assessment, we described a series of research and conservation activities needed to better understand and protect the species. In Japan, our focus has been on the Sarufutsu River, pursuing a variety of different activities. Spearheaded by Brian Caouette at the Wild Salmon Center, a precedent-setting agreement was made in 2009 to place over 2500 ha of riparian and floodplain forest land under permanent conservation protection—habitat critical to the future of this species. In that year, the Sarufutsu Biodiversity Conservation Forest was created on land owned by the largest paper company in Japan, Oji Paper (for more, see http://wildsalmoncenter.org/press/OJI_Sarufutsu.php)

In recent years, we have collaborated on designing and implementing a new monitoring program to provide vital information on the status of this population, likely the largest one in Japan.



Mitsuru Kawahara, an active member of *Sarufutsu Itou no kai*, volunteers every year to count taimen redds (nests), the traditional way of monitoring the abundance of the population.
Photo credit: Pete Rand

Monitoring the passage of adults with sonar

Much of the current monitoring work involves hiking along the river and counting the number of spawning nests created by the fish. This work is currently undertaken by a small band of highly dedicated volunteers in Hokkaido. This survey method was advanced by Michio through his Masters work in the late 1980s and early 1990s (Fukushima 1994). Hard work indeed, given the nearly impenetrable stands of dwarf bamboo (*Sasa*) that line the river banks in this region. Through early discussions, we began to explore the idea of using sonar as an alternative monitoring method.



To see taimen and count redds, it is often necessary to navigate through very thick dense riparian vegetation dominated by *Sasa*, dwarf bamboo.
Photo credit: Pete Rand

There is now a long history of using sonar to count Pacific salmon in rivers (Maxwell 2007). We felt it might be valuable to apply this approach to counting adult taimen along their migration to the spawning grounds in the headwaters of the Sarufutsu River. We embarked on a two-year study to investigate the feasibility this approach.

We began our project in 2013 in what turned out to be a very cold, wintry spring period in Hokkaido. With help from the local conservation group, *Sarufutsu Itou no kai*, we made our way to our study site, a major tributary of the Sarufutsu River, using snow mobiles and sleds.

We chipped through the ice and snow, constructed a frame to support the sonar, and set out to monitor the passage of fish by the site for four weeks. The sonar system, produced by Sound Metrics in the USA, is an imaging system that produces a highly resolved video image by emitting and receiving sound from many small transducers. This method of monitoring has some limitations (notably, it is difficult to determine species), but it has many advantages over other methods, particularly its ability to produce reliable images, regardless of the level of light or water turbidity, and it is capable of producing accurate estimates of fish length. Because taimen are much longer than other species in the river at the time of our sampling, we were able to overcome the limitation of species identification by relying on fish size to discriminate taimen from other fish passing our site. And, of course, this sampling requires no handling of the fish, which is an important consideration given the species' threatened status.



Our study site, under winter and spring conditions.
Photo credit: Pete Rand



During our first field season, we needed to travel to our study site using snowmobiles and sleds.
Photo credit: Pete Rand



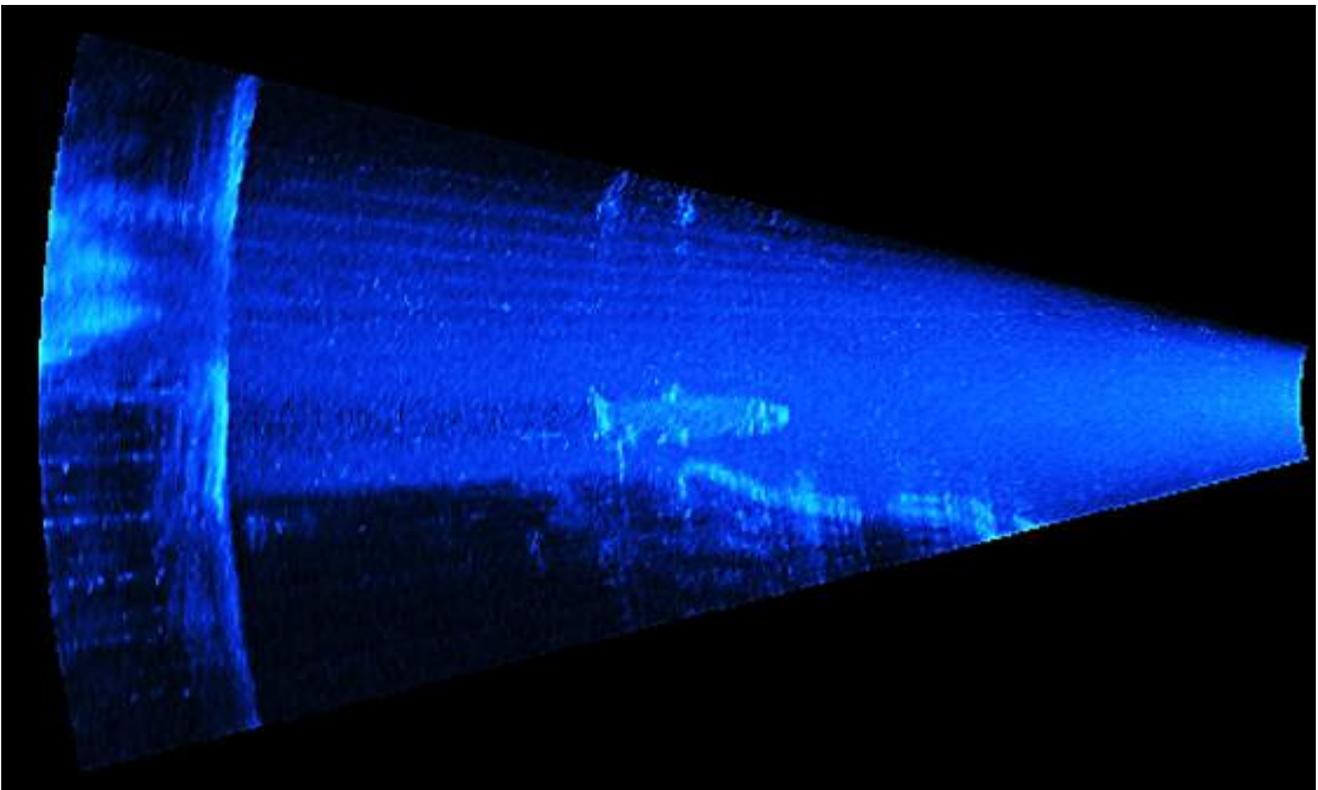
With the help of members of *Sarufutsu Itou no kai*, we built a frame to support the sonar system.
Photo credit: Pete Rand

We repeated the study again in the spring of 2014, which turned out to be a much warmer spring.

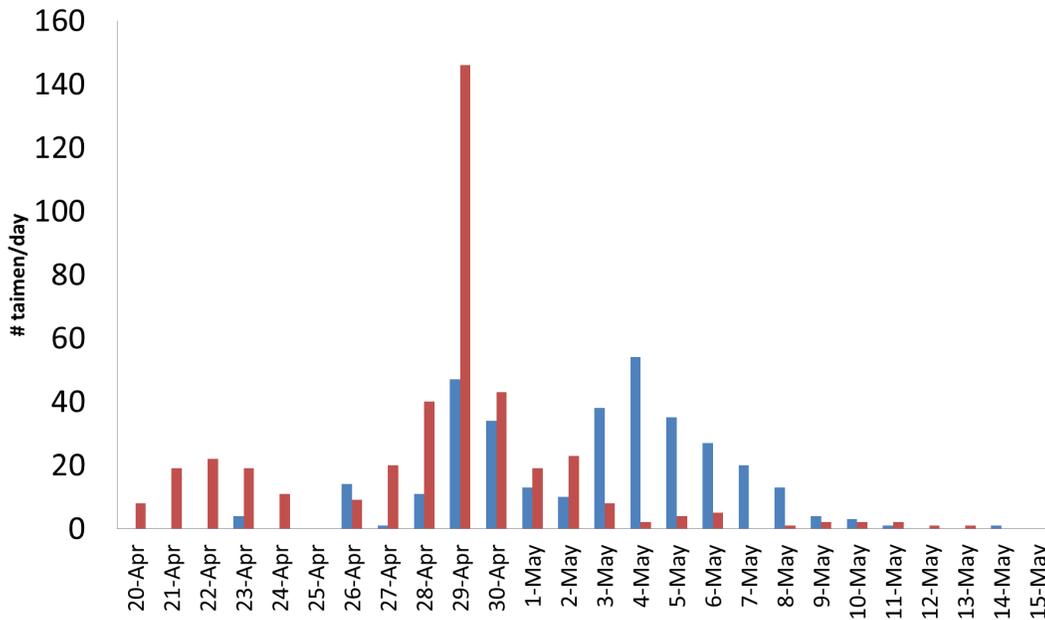
Preliminary results

As we compile and analyze the data and work toward scientific publication, we can report a number of interesting early results.

The important “bottom-line” of our monitoring work is the total number of adults counted in the spawning run. We estimated approximately 330 individuals in 2013, and over 400 individuals in 2014, representing a 20% increase. Knowing the number of redds enumerated in past years, these population estimates are indeed much higher than we expected. Thus, our work is producing good news for the future of this population.



A sonar image of a Sakhalin taimen swimming by our site.
Photo credit: Katsunori Mizuno, University of Tokyo.



A plot of daily counts of Sakhalin taimen passing our site in 2013 (blue, cold year) and 2014 (red, warm year). The taimen arrived earlier in 2014, presumably because of warmer weather conditions. We counted 20% more taimen in 2014.

Other patterns in our data allow us to draw some conclusions about factors influencing migration and passage rate. In both years we observed an early and (larger) late peak in the run. The data we collected on environmental conditions during the run suggested that the run was split in 2013 as a result of a cold front that passed through the region, resulting in critically low river temperatures. Conversely, in 2014, we observed an early spring thaw that resulted in a short duration flood period that likely slowed the migration rate of the fish and split the run into an early and late component. Of course, we cannot rule out a genetic component that may produce this pattern in migration timing.

The Future

It is our hope that this work will help inspire other efforts to monitor taimen and other wild populations of fishes in this critically important region. The Wild Salmon Center has been working closely with Russian colleagues over the years in neighboring Khabarovsk, Sakhalin, and Primorye, and we hope this approach will be applied in key river systems in those areas in the future.

Taimen are a so-called umbrella species—their presence and status is an indicator of river and coastal ecosystem health. By safeguarding taimen, we can better conserve Pacific salmon and many other fishes and aquatic life. Indeed, through our experience in monitoring taimen

in the Sarufutsu River, we have come to recognize and appreciate the importance of the river in supporting wild populations of a variety of other salmonids, including white spotted charr, and cherry, chum, and pink salmon.

In a region so dramatically transformed by land use development and river engineering, it seems to us especially important to protect both the river and the fish it supports so future generations can enjoy this natural wonder as much as we have over the years.

Acknowledgements

The research described here was supported by fellowships to P. Rand from the Japan Society for the Promotion of Science (2013) and Fulbright Japan (2014). Additional support came from the Sumitomo Foundation, the Mohammed bin Zayed Conservation Fund, and the Taiwan Bureau of Forestry.

References

Arai, T., A. Kotake, and K. Morita. 2004. Evidence of downstream migration of Sakhalin taimen, *Hucho perryi*, as revealed by Sr:Ca ratios of otoliths. *Ichthyological Research* 51:377-380.

Edo, K., Y. Yawaguchi, M. Nunokawa, H. Kawamura, and S. Higashi. 2005. Morphology, stomach contents and growth of the endangered salmonid, Sakhalin taimen *Hucho perryi*, captured in the Sea of Okhotsk, northern Japan: evidence of an anadromous form. *Environmental Biology of Fishes* 74:1-7.

Fukushima, M. 1994. Spawning migration and redd construction of Sakhalin taimen, *Hucho perryi* (Salmonidae) on northern Hokkaido Island, Japan. *Journal of Fish Biology* 44: 877-888.

Fukushima, M., H. Shimazaki, P.S. Rand, and M. Kaeriyama. 2011. Reconstructing Sakhalin taimen *Parahucho perryi* historical distribution and identifying causes for local extinctions. *Transactions of the American Fisheries Society* 140(1):1-13. DOI 10.1080/00028487.2011.544999

Maxwell, S. 2007. Hydroacoustics: Rivers. In: *Salmonid Field Protocols Handbook: Techniques for Assessing Status and Trends in Salmon and Trout Populations*. Editors: David H. Johnson, Brianna M. Shrier, Jennifer S. O'Neal, John A. Knutzen, Xanthippe Augerot, Thomas A. O'Neil, and Todd N. Pearsons. American Fisheries Society, Bethesda, MD. 478 pp.

Rand, P.S. 2006. *Hucho perryi*. In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.2. <www.iucnredlist.org>. Accessed 10 June 2014. URL: <http://www.iucnredlist.org/details/61333/0>

Rand, P.S. 2013. Current global status of taimen and the need to implement aggressive conservation measures to avoid population and species-level extinction. *Archives of Polish Fisheries* 21:119-128.

Zimmerman, C.E., P.S. Rand, M. Fukushima, and S.F. Zolotukhin. 2012. Migration of Sakhalin taimen (*Parahucho perryi*): evidence of freshwater resident life history types. *Environmental Biology of Fishes* 93(2):223-232.



Pete Rand received a BA from Colgate University in Hamilton, New York, and an MS and PhD from the State University of New York College of Environmental Science and Forestry in Syracuse, New York. He was a postdoc at the University of British Columbia and a professor at North Carolina State University. He is now the Senior Conservation Biologist at the Wild Salmon Center in Portland, Oregon, and serves as the Chair of the IUCN Salmonid Specialist Group. In his current position he has

devoted his time to studying and conserving wild salmonids and their rivers in the North Pacific region, particularly in Russia and Japan. He recently served as editor for a special publication entitled "Ecological Interactions Between Wild and Hatchery Salmon", published by Springer Academic Press in 2012.



Michio Fukushima is a senior researcher at the National Institute for Environmental Studies, Japan. He has been a member of the IUCN Salmonid Specialist Group since 2007. He received his BA and MS from Hokkaido University, Japan, and PhD in Fisheries from the University of Alaska Fairbanks.

His current research focuses on freshwater fish migration, ecosystem services, and the effects of hydroelectric dam development in the Mekong River in Southeast Asia.