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RESEARCH ARTICLE

Current global status of taimen and the need to implement aggressive conservation measures to avoid population and species-level extinction

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Abstract. An international effort carried out during 2011-2012 culminated in three completed IUCN status assessments of *Hucho* spp., thus completing assessments for all species in this and a related genus *Parahucho*. These species hold great ecological and evolutionary significance in the salmonid family, and are recognized as the largest salmonids in the world. Specialists have long recognized their precarious status. The reports conclude that all species of taimen are now listed as threatened or Data Deficient on The IUCN Red List of Threatened Species™, and point to a host of ongoing and emerging threats, including habitat loss and overharvest. I summarize the key data used to arrive at the status categories, and emphasize some key conservation measures that must be taken to avoid extinction at both the local population scale and at the species level. I provide some cautionary advice on the use of hatcheries to recover depressed populations and emphasize the need to undertake new research expeditions to assess the uncertain current status of *Hucho bleekeri* Kimura and *Hucho ishikawae* Mori.

Keywords: global protection status, conservation measures, *Hucho*, *Parachucho*, salmonids

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Introduction

Fishes are grossly underrepresented on the IUCN Red List of Threatened Species. Recent efforts are intended to rectify this problem (Kottelat and Freyhof 2007, Tweddle et al. 2009). There is a clear need to better assess freshwater taxa in general considering the disproportionate effect that humans have on freshwater habitat (Vörösmarty et al. 2010).

The species in the genera *Hucho* and *Parahucho* serve as the classic conservation flagship species, serving as sensitive freshwater ecosystem indicators. Their distribution in Eurasia intersects with regions of dramatic land use change from land and water development and intensive natural resource exploitation. Prior to 2012, only two of the species had been assessed by the IUCN (Danube huchen, or *Hucho hucho* (L.), EN, and Sakhalin taimen, *Parahucho perryi* (Brevoort), CR). Through some successful fundraising efforts, I was able to convene a group of specialists in Auckland, New Zealand in the fall of 2011 (in association with the International Conservation Congress organized by the Society for Conservation Biology). Presentations were made, and knowledge and data were shared that made assessments of the remaining species in the genus *Hucho* possible. Here I report the key aspects of the

Figure 1. Historic and current distribution of *Hucho taimen* in Europe and Asia. Range loss has been documented in the western slope of the Ural mountains in Russia, parts of Mongolia, and within the Amur drainage within China. Names of major rivers are included in the range map.

assessments that led to our determination of the current status of these enigmatic species.

Siberian taimen, *Hucho taimen*

In many ways, this was the most challenging of the three assessments. The species occupies an enormous range in Asia, extending from the west slope of the Ural Mountains in Russia all the way east to Khabarovsk, Primorye and the northern tip of Sakhalin Island of the Russian Federation (Fig. 1). The species is listed in a number of different country and regional-level red lists (Fig. 2). The land area (extent of occurrence EOO, of over 12 M km^2) is approximately 1/10 the land area of the earth. Despite this enormous range, very little is known about the species. For the IUCN range-wide status assessment, we estimated the amount of range loss over the past 51 year to be approximately 0.5 M km^2 (Fig. 1, Table 1 and 2). The listing was based on IUCN A criteria (pertaining to population reduction) which we describe in more detail below.

The IUCN criteria used to estimate the population size reduction for a species can include the following: direct observations, indices of abundance, declines in area of occupancy or extent of occurrence and/or quality of the habitat, actual or potential levels of exploitation, or effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites. We relied on four primary sources of information to document declines in population abundance in this species. Below we include documentation of our data sources and our analytical approaches used in each region.

Russia (Amur)

We obtained data on catch of *H. taimen* in commercial fisheries (primarily gill net captures) in the lower reaches of the Amur River (Khabarovsk Krai,

Table 1
Hucho taimen distribution (all range values in square kilometers). Full historic range is the entire natural range of the species (including current distribution and the area of the range lost (since 1980) as a result of local extinctions). All range areas are estimated as extent of occurrence (or EOO, as defined by the Guidelines for Using the IUCN Red List Categories and Criteria).

Country/Region	Full historic range (km^2)	Full historic range (%)	Current range (km^2)	Current range (%)	Lost range (km^2)	Total lost range (%)
China (Amur)	781,036	6.3	726,780	6.1	54,256	12.2
China (Altai)	12,873	0.1	12,873	0.1	0	0.0
Mongolia	462,935	3.7	374,283	3.1	88,652	19.9
Russia (Volga, Ural, Arctic drainages)	9,507,989	76.7	9,205,927	77.0	302,062	67.9
Russia (Amur)	879,068	7.1	879,068	7.4	0	0.0
Kazakhstan	760,431	6.1	760,431	6.4	0	0.0
Total	12,404,332	100	11,959,362	100	444,970	100
				Range Reduction:		3.6%

Table 2
Percentage of range lost for *Hucho taimen* within specific regions.

Country/Region	Loss within region (%)
China (Amur)	6.9
Mongolia	19.1
Russia (Volga, Ural, Arctic drainages)	3.2

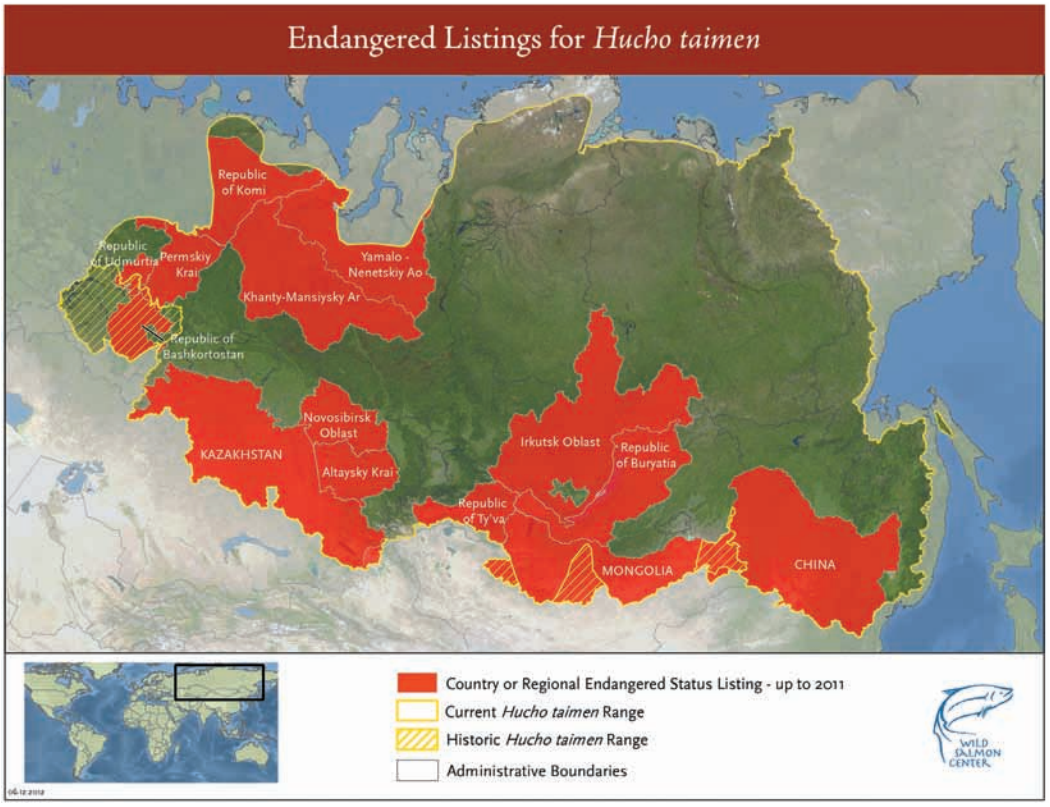

Figure 2. Endangered listings for *Hucho taimen* through its natural range in Europe and Asia. Historic and current range of the species is displayed.

Zolotukhin et al. 2000). Data are reported as weight (in MT) of landed biomass of taimen (Fig. 3). It is important to note here that reporting of catch over this entire period has not been consistent, and much of the catch has gone unreported, particularly in recent decades (see Zolotukhin et al. 2013, this volume). We acknowledge that the data used in this analysis are very uncertain. We fit the data to an exponential model and determined loss rate of the regional population to be 4.2% yr^{-1} or 90.0% loss over 51 years or three generations for the species (Fig. 3, Table 3).

Russia (Volga, Ural, Pechora, Ob, Yenisey, Lena, Tugur and Uda Rivers)

Abundance of *H. taimen* in most of this region has been declining (primarily from unregulated catch, both commercial and recreational), but there are no reliable indices of adult abundance trends to quantify the decline. A review of taimen status was conducted in 57 river basins within the Russian Federation (including the Amur River, M. Skopets,

Table 3
Estimates of population decline over past three generations for *Hucho taimen* by region

Country/Region	Abundance loss (%)	Full historic range (%)	Weighted (%)	Source of abundance loss estimates
China (Amur)	95	6.3	6.0	Guang-xiang Tong, Heilongjiang Fisheries Research Institute, pers. com.
China (Altai)	87	0.1	0.1	Guang-xiang Tong, Heilongjiang Fisheries Research Institute, pers. com.
Mongolia	50	3.7	1.9	Tsogosaikhan Purev, Mongolian Ministry of Nature, Environment and Tourism, pers. com.
Russia (Volga, Ural, Arctic drainages)	30	76.7	23.0	Igor Knizhin, Irkutsk State University, pers. com.
Russia (Amur)	90	7.1	6.4	Sergei Zolotukhin, Khabarovsk TINRO, pers. com.
Kazakhstan	Unknown	6.1	Unknown	
Weighted loss over 3 generations			37.4	

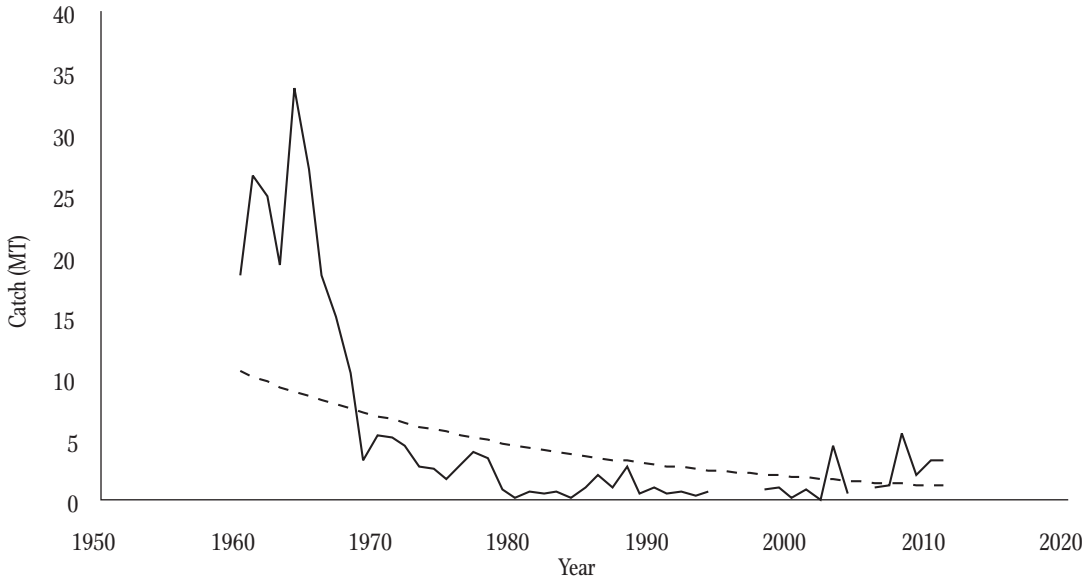

Figure 3. Catch of Siberian taimen (*Hucho taimen*) in the lower Amur, Khabarovsk Krai, Russian federation during 1960-2011, representing three generations for the species. Data were fit to an exponential model (dashed line). Data source: Zolotukhin et al. 2000, S. Zolotukhin, Khabarovsk TINRO, unpublished data).

unpublished data). Populations were divided into four categories: nearly extirpated, significant decline (i.e. more than 50%), moderate decline (i.e. between 30-50%), and healthy (less than 30%). Skopets found that taimen populations have been extirpated or have undergone significant decline in 39 of 57 river basins and only a few populations could be still considered stable, primarily due to their remote, inaccessible locations. Skopets categorized taimen populations as at moderate risk in over half of Russian river basins and at high risk in all rivers west of the Ural mountains. Even in some very remote areas (such as mountainous rivers of the Urals) taimen populations have declined by over 50% (M. Skopets, personal communication).

In central Siberia (including the Baikal region) the species has undergone decline, but the rate of decline of the adult population is very uncertain (I. Knizhin, Irkutsk State University, pers. comm.). The actual level of exploitation (illegal harvest) is thought to be significant throughout this region. The species is expected to continue to decline by at least 30% over the next three generations (51 years) within this region (I. Knizhin, Irkutsk State University, pers. comm.). Unregulated catches is the primary threat to the species in this region, although a growing concern is dam building underway or planned in major river systems. We assumed for this assessment that that the rate of decline in adult abundance in this region was 30% over the past three generations (Table 3). We acknowledge that this is a very uncertain number (this trend is suspected based on A2cd criteria), but we are reasonably confident that the loss rate has been at least 30%.

Mongolia

In Mongolia, *H. taimen* distribution has decreased by about 60% since 1985 suggesting a population decrease of at least 50% (Ocock et al. 2006). For this assessment, we estimate range loss (estimated as EOO) to be 27% (Tables 1 and 2). There are continuing declines in the quality of habitat due to mining, and in the number of mature individuals. It is suspected that the population will decrease by over 60% in the next 20 years as demand increases from China and Russia and from non-catch and release angling (Ocock et al. 2006). In Mongolia, fish have disappeared from rivers near town centers and downstream of mining areas. Stable populations still occur in more remote areas but these populations are vulnerable as mining, overgrazing, and fishing become more common in Mongolia. There is also illegal, international trade to China, but the scale of this trade is uncertain.

Based on available data and a Mongolian Red List assessment that was conducted in 2006 (the species was listed as Endangered in Mongolia, Fig. 2), we estimate a loss of 50% in overall abundance over the past three generations for the species (Table 3). The only quantitative estimate of taimen abundance in Mongolia is for a river (the Eg-Uur) which is thought to be one of the least impacted populations in Mongolia (Jensen et al. 2009). Therefore, this abundance estimate (19 adult taimen per km) is not thought to be representative of population status in Mongolia as a whole.

China

H. taimen occur in two regions in China. One is in the Altai mountain region in Xinjiang Province (including Kanas Lake and the Burqin River, headwaters of the Irtysh River) and the other is in the Amur River drainage in Heilongjiang Province. The species is listed as Endangered in China (Fig. 2). The species in both regions are thought to be in decline (Guang-xiang Tong, Heilongjiang Fisheries Research Institute, pers. comm.). Based on limited catch data in field surveys, the rate of decline over the past 3 generations (~51 years) is approximately 87% and 95% in Xinjiang and Heilongjiang Provinces, respectively (Tong, pers. comm., Table 3). There is still a small breeding population of taimen in Kanas Lake in Xinjiang Province. The abundance trend of some more remote, inaccessible river populations in

Heilongjiang Province are still considered stable, including tributaries in the north of Daxinganling Prefecture, upstream of Nen River and tributaries in the south of Daxinganling Prefecture, and the Song Acha River in the upstream of the Ussuri River. Taimen no longer make up a significant percentage of commercial catch and only a few fish are reported from the Amur River each year in Heilongjiang Province. Based on recent survey data, we estimate loss of range (estimated as EOO) within Heilongjiang Province at 7% of the historic range (Table 1 and 2). We are not aware of any loss of range in Xinjiang Province.

Combined Population Reduction Across Entire Range

Following the IUCN guidelines, we determined the overall abundance loss to the species by weighting factors. We include estimates reported in 1-4 above by region (Tables 1-3). All range areas are calculated as EOO. Data limitations precluded us from estimating aquatic habitat area.

Most of the historic range of the species is contained in the Russian Federation (83.8% of total). The species historic, natural range extends into China (6.4% of total), Kazakhstan (6.1% of total) and Mongolia (3.7% of total, Table 1). We estimate a total natural range reduction of 3.6% (Table 1). Loss in range for specific regions vary from 3.2% within Russia (in the Volga, Ural and Pechora Rivers), 6.9% within China (in the Amur River basin), and 19.1% within Mongolia. We acknowledge that percent loss of range calculated as area of occupancy (or AOO) would likely be much higher than this, considering many populations, particularly along the southern extent of their distribution, have become significantly fragmented as a result of localized impacts from land use change and fishing pressure. However, we lack the data to generate reliable estimates of AOO for this species throughout most of its natural range.

To arrive at a population reduction estimate for the species to evaluate against IUCN A criteria, we used our abundance loss estimates for each region (described in 1-4 above), weighted by the percent of the range in each region, as prescribed by IUCN Red List Guidelines (Version 9.0, Table 3). We were unable to obtain an estimate of population trend within Kazakhstan, so we excluded this region from our range-wide analysis. The analysis yielded a population reduction of 37.3% (Table 3). It is important to acknowledge that this estimate is influenced most significantly by the abundance reduction we applied to the majority of the species range in Russia (Volga, Ural, and the Arctic and Sea of Okhotsk river drainages, Table 3). Based on A2 criteria, this results in a status of VU (Vulnerable) for the species based on b (index of abundance appropriate to the taxon), c (a decline in AOO, EOO and/or habitat quality) and d (actual or potential levels of exploitation).

Sichuan taimen, *Hucho bleekeri*

This species, known as Sichuan taimen, currently occupies a very restricted range in the Upper Yangtze in the Sichuan Province of China (Fig. 4). We relied on information and best expert judgment of Zhoabin Song at Sichuan University in Chengu, China. We concluded the species is threatened, based on a combination of declining abundance, restricted range and small population size. Below is a description of our data sources and assessment approach in applying IUCN A, B and C criteria.

Criteria A: Population Reduction

The IUCN criteria used to estimate the population size reduction for a species can include the following: direct observations, indices of abundance, declines in area of occupancy or extent of occurrence and/or quality of the habitat, actual or potential levels of exploitation, or effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites. Because causes of decline are not complete understood, and threats have not ceased, we assessed

Figure 4. Range map for Sichuan taimen *Hucho bleekeri*.

status using A2 criteria. No direct estimates for adult abundance or trends exists for the species. Reduction in population abundance, based on expert judgment, has been in the range of 50% to 80% over the past three generations (based on c, an observed decline in AOO, EOO, and/or habitat quality and d, actual or potential levels of exploitation). Population is projected to decline by 50% in the next three generations (based on c, a projected decline in AOO, EOO, and/or habitat quality and d, actual or potential levels of exploitation). Thus, the species qualifies for listing as Critically Endangered (CR A2cd).

Criteria B: Geographic range

We estimated the total historic range (EOO) to be less than 5,000 km^2 (Fig. 4). Current EOO is now less than 100 km^2. The species range is now severely fragmented (a), and in continuous decline (b) as measured by EOO (i), area and/or quality of habitat (iii) and number of mature individuals (iv). This qualifies this species for listing as Critically Endangered (CR B1ab (i,iii,iv)).

Criteria C: Current population size

Very little data exists on absolute population sizes for this species. The number of mature individuals of the species is thought to be in the range of 2000-2500, and the population is estimated to be in continuous decline at a rate of at least 20% over the next 2 generation (34 years). This qualifies the species for listing as Endangered (EN C1). After considering these three IUCN Criteria, the species was added to the IUCN Red List as Critically Endangered (CR).

Korean taimen, *Hucho ishikawae*

This is indeed the most enigmatic species in the genus. Originally described by a Japanese naturalist Tamezo Mori in 1928, we are not aware of any recent

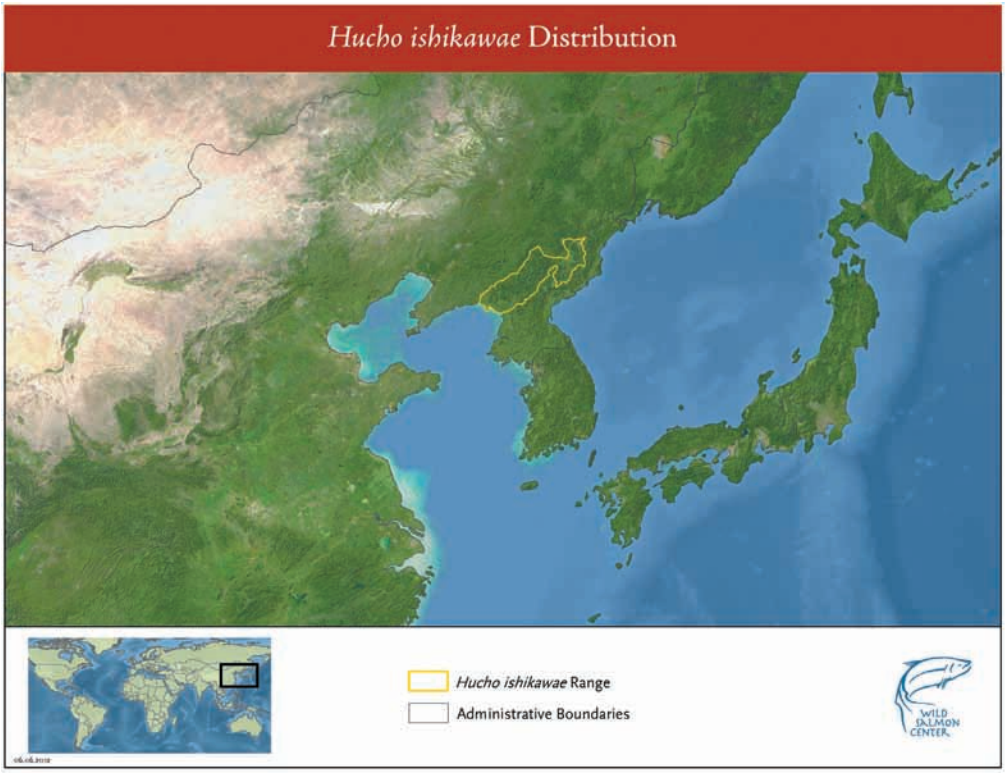

Figure 5. Range map for Korean taimen *Hucho ishikawae*.

observations or studies (at least in the past several decades) on the species. Based on some available distribution information (North Korea in Am-nok river, Dok-ro river, Weon-ju river and Jang-jin river), we constructed a simple range map for the species (Fig. 5). It was decided that there was not sufficient data to categorize the species' status. We added the species to the IUCN RL in 2012 as Data Deficient.

Concluding Remarks

One of the most important conclusions from our work is that we now recognize that all species in the genus *Hucho* and *Parahucho* are now considered either threatened or Data Deficient. The time is now to invigorate research and conservation efforts to protect these species. One of the conservation approaches discussed at the Lopuzna Symposium was hatcheries. While there has been some investment in "conservation hatcheries" in other salmonids around the world, there is only limited evidence that hatcheries can successfully recover endangered species. Recent scientific reviews have been increasingly critical of the role of hatcheries in recovering threatened salmonids (Myers et al. 2004, Naish et al. 2008, Rand et al. 2012). Hatchery approaches are in no way a substitute to protecting or restoring habitat and instituting new, proactive conservation laws and policies, and should only be used as a last resort.

One of the most effective means of conserving these species is to create freshwater protected areas. Still a relatively new concept in conservation (see Abell et al. 2007), there is a strong justification for focusing on freshwater habitat conservation given the disproportionate impact humans have had on these ecosystems (Vörösmarty et al. 2010). The Wild Salmon Center has been working closely with our partners in Russia and Japan to create protected areas to benefit Sakhalin taimen. A new protected area was created in 2009 in the Sarufutsu River in Hokkaido, Japan through a Memorandum of

Understanding between the Wild Salmon Center, a major Japanese paper company (Oji Paper, Inc.) and a local conservation group (Itou No Kai). This effort resulted in over 2,500 ha placed under permanent protection, including critical riparian and flood plain habitat. Further, the Wild Salmon Center worked with a partner NGO in Russia (Khabarovsk Wildlife Foundation) and the Khabarovsk Regional Government to create a much larger protected area (>38,000 ha) for Sakhalin taimen in the upper Koppi River watershed. This protected area provides habitat protection and special fishing regulations that control the amount of fishing pressure. New anti-poaching monitoring has been implemented, and scientific surveys (including a tagging program for taimen) are now underway.

These two recent conservation success stories provide some optimism for the future of these fishes and the freshwater ecosystems that support them. It should go without saying that we know precious little about the current status of Sichuan taimen *H. bleekeri* and Korean taimen *H. ishikawae*. We just cannot afford to lose. There is a strong need to mount two expeditions to survey the current status and distribution of these species. This could provide critical new information on the species, and help inform conservation planning to ensure these species will continue to persist in the wild.

At the Lopuzna Symposium, we learned about conservation initiatives for *H. hucho* within their natural range. With perhaps only a dozen viable, wild populations left in existence, it is going to take a concerted effort to avoid further loss in this species. Given mounting pressure now on renewable, green energy, the hydropower industry is now poised to further fragment and degrade huchen river systems, a theme that was discussed repeatedly at the symposium. Other threats are also important, including overfishing, land use practices, and climate change. At the close of the symposium, Andrzej Witkowski put it simply (perhaps paraphrased a bit by the author!): "We need to take conservation action now. If not, the only way future generations will see huchen is in a museum!". There is mounting pressure to modify and degrade the great rivers of Eurasia. This was made clear in the proceedings from the last huchen symposium (Holčík et al. 1988). We need to reinvigorate our research efforts and help society make smart decisions, emphasizing the need to conserve biodiversity. We should also not wait another 25 years to hold the next special symposium on huchen!

Acknowledgements. I would like to sincerely thank Andrzej Witkowski for carrying out his vision to bring us all together to discuss huchen. He provided generous symposium support and gracious hospitality in beautiful Lopuzna, Poland. He is clearly inspiring a new generation of "huchen lovers" that will help ensure that we continue to learn more about these unusual fishes and protect them in their wild state for the enjoyment of future generations. I would also like to thank the many specialists who contributed to the IUCN assessments described herein, including especially Sergei Zolotukhin, Igor Knizhin, Zhaobin Song, Olaf Jensen, Zeb Hogan, Misha Skopets, Nina Bogutskaya, Guang-xiang Tong, Tsogotsaikhan Purev, and Dima Lajus. I greatly appreciate the ongoing support for taimen research and conservation from the National Geographic Society, Mohamed bin Zayed Conservation Fund, Ocean Park Conservation Fund Hong Kong, Taiwan Forestry Bureau, Sweetwater Travel, Oji Holdings, Inc., United States Fish and Wildlife Service Wildlife Without Borders and Chester Zoo. I thank Amber Gladieux for producing the distribution maps of the species.

References

Abell R., Allan J.D., Lehner B. 2007 – Unlocking the potential of protected areas for freshwaters – Biol. Conserv. 134: 48-63.

Holčík J., Hensel K., Nieslanik J. Skácel L. 1988 – The Eurasian huchen, *Hucho hucho*, largest salmon of the world – Dr W. Junk Publisher, Dordrecht-Boston-Lancaster, 239 p.

Jensen O.P., Gilroy D.J., Hogan Z., Allen B.C., Hrabik T.R., Weidel B.C., Chandra S., Vander Zanden M.J. 2009 – Evaluating recreational fisheries for an endangered species: a case study of taimen, *Hucho taimen*, in Mongolia – Can. J. Fish. Aqua. Sci. 66: 1707-1718.

Kottelat M., Freyhof J. 2007 – Handbook of European freshwater fishes – Kottelat, Cornol, Switzerland and Freyhof, Berlin, Germany, 646 p.

Myers R.A., Levin S.A., Lande R., James F.C., Murdoch W.W., Paine R.T. 2004 – Hatcheries and endangered salmon – Science 303(5666): 1980.

Naish K.A., Taylor J.E., Levin P.S., Quinn T.P., Winton J.R., Huppert D., Hilborn R. 2008 – An evaluation of the effects of conservation and fishery enhancement hatcheries on wild populations of salmon – Adv. Mar. Biol. 53: 61-194.

Ocock J., Baasanjav G., Baillie J.E.M, Erbenebat M., Kottelat M., Mendsaikhan B., Smith K. 2006 – Mongolian Red List of Fishes. Regional Red List Series Vol. 3 – Zoological Society of London, London.

Rand P.S., Berejikian B.A., Bidlack A., Bottom D., Gardner J., Kaeriyama M., Zhivotovsky L.A. 2012 – Ecological interactions between wild and hatchery salmonids and key recommendations for research and management actions in selected regions of the North Pacific – Environ. Biol. Fish. 94: 343-358.

Tweddle D., Bills R., Swartz E., Coetzer W., Da Costa L., Engelbrecht J., Smith K.S. 2009 – The status and distribution of freshwater fishes – In: The status and distribution of freshwater biodiversity in southern Africa (Eds) W.R.T. Darwall, K.G. Smith, D. Tweddle, P. Skelton, IUCN, Gland, Switzerland and SAIAB, Grahamstown, South Africa: 21-37.

Vörösmarty C.J., McIntyre P.B., Gessner M.O., Dudgeon D., Prusevich A., Green P., Davies P.M. 2010 – Global threats to human water security and river biodiversity – Nature 467(7315): 555-561.

Zolotukhin S.F., Semenchenko A.Yu, Belyaev V.A. 2000 – Taimen and Lenok of the Russian Far East – Khabarovsk, 128 p.

Zolotukhin S., Makeev S., Semenchenko A. 2013 – Current status of the Sakhalin taimen *Parahucho perryi* (Brevoort) on the mainland coast of the Sea of Japan and the Okhotsk Sea – Arch. Pol. Fish. 21: 205-210.