

# GLOBAL SWIMWAYS AND MIGRATORY MEGAFISH: PAST, PRESENT, AND FUTURE



Zeb Hogan, University of Nevada, USA



# Monster Fish



**SAWFISH**  
(max. size = 650 cm)



**PIRAIBA**  
(max. size = 360 cm)



**ALLIGATOR GAR**  
(max. size = 3.05 meters)



**GIANT BARB**  
(max. size = 3.0 meters)



**MEKONG GIANT CATFISH**  
(max. size = 3.0 meters)



**ARAPAIMA**  
(max. size = 3 meters)



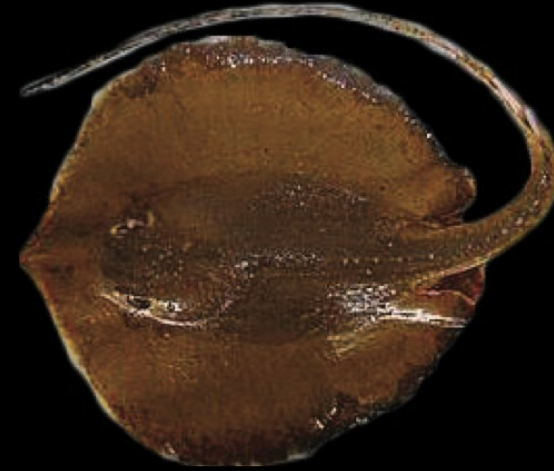
**LAKE STURGEON**  
(max. size 3 meters)



**GOLDEN MAHSEER**  
(max. size = 2.75 meters)



**MISSISSIPPI PADDLEFISH**  
(max. size = 221 cm including paddle)



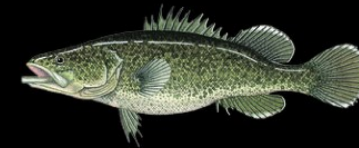
**GIANT STINGRAY**  
(max. size = 2.2 meters disk width)



**TAIMEN**  
(max. size = 2.0 meters)



**GOONCH**  
(max. size = 200 cm)



**MURRAY COD**  
(max. size = 1.8 meters)

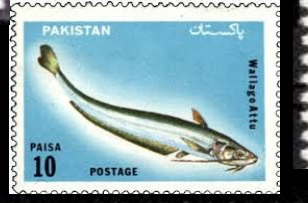
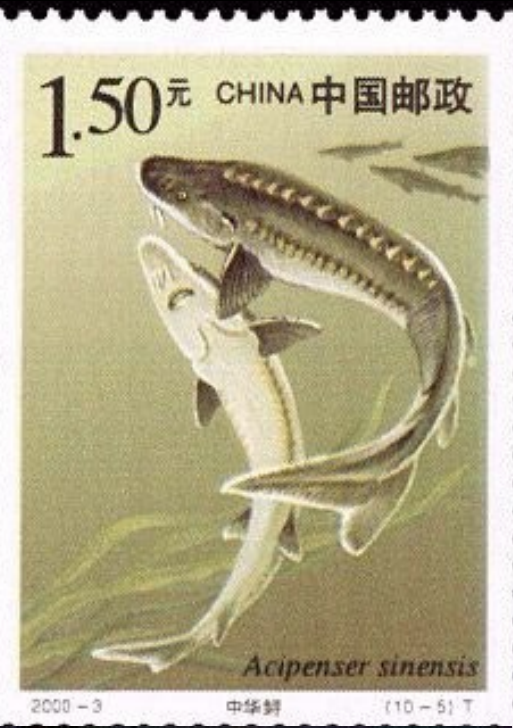
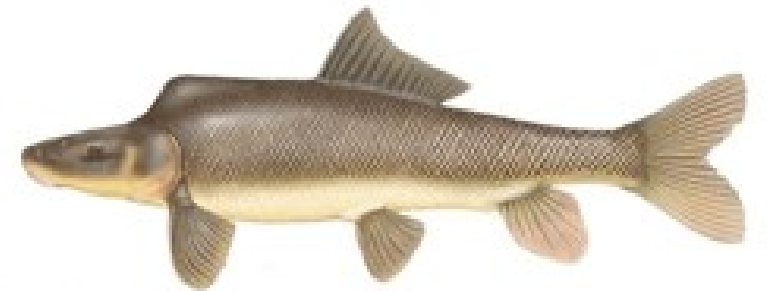




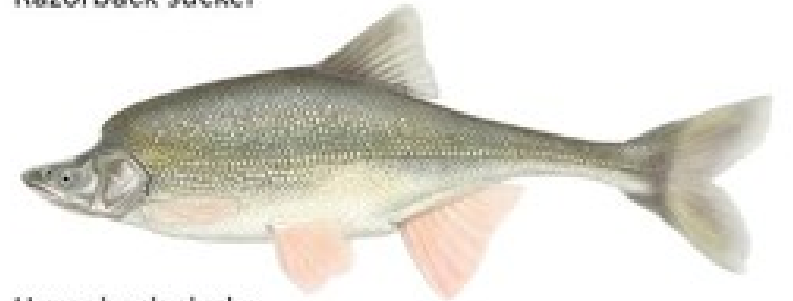
Photo courtesy Grant Kaye



[https://en.wikipedia.org/wiki/Havasu\\_Creek](https://en.wikipedia.org/wiki/Havasu_Creek)



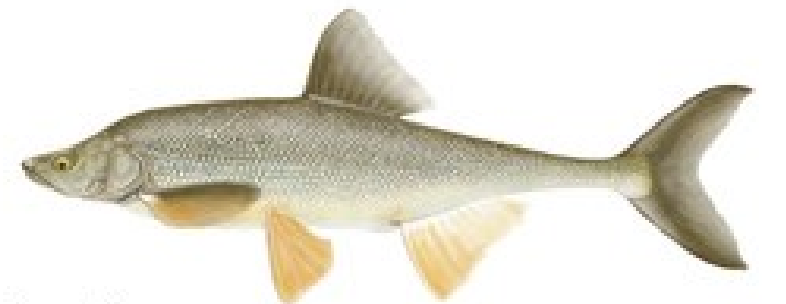
Razorback sucker



Humpback chub



Colorado pikeminnow



Bonytail











Photo courtesy Daniel Rosengren



Larger Flood Pulse = More Fish

# Free-flowing Rivers Sustain Threatened Biodiversity

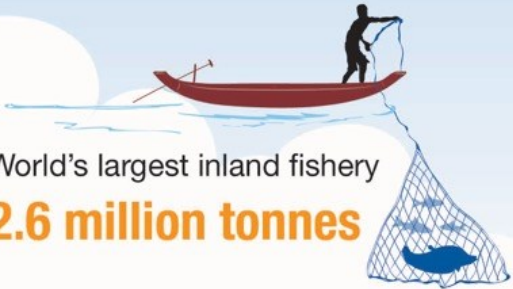
- The life cycles of the endangered species like the Mekong giant catfish and river catfish are adapted to the flood pulse
- Young are born at the beginning of rainy season and carried downstream to flood plain habitats
- Juveniles mature in flood plain habitat adults migrate back the main river to spawn





# THE AMAZING FISH AND FISHERIES OF THE MEKONG RIVER

Sustainable Fisheries and Healthy Rivers Provide for People and Protect Biodiversity



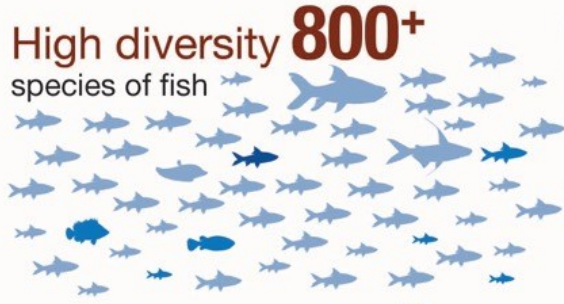
World's largest inland fishery  
**2.6 million tonnes**



Fish provide up to  
**80%**  
of annual protein

The Tonle Sap River is a migration corridor for billions of fish.

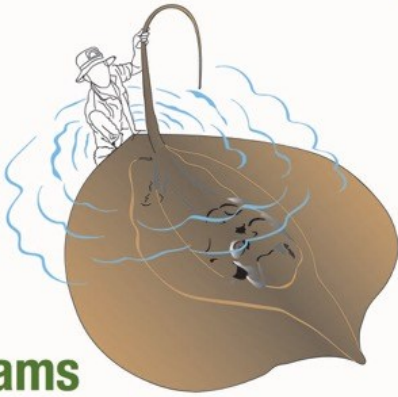
**30 - 70%**  
of Mekong fish are migratory



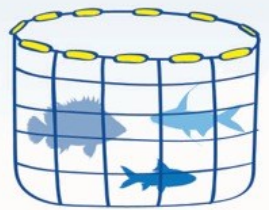
High diversity **800+**  
species of fish



Past civilizations depended on wildlife, rice, and fisheries. Today, the Tonle Sap Lake remains the "beating heart" of Cambodia.



Up to  
**300 kilograms**  
The Mekong is home to many species of giant fish, including the current world record holder for largest freshwater fish on Earth



Booming aquaculture in Vietnam Mekong Delta export to over  
**100**  
countries globally

**\$11 billion**  
value of Mekong fisheries



# The Mekong Feeds Millions

## Dams Threaten Southeast Asia's Vital Lifeline

More than 60 million people live in the Lower Mekong Basin, and half of them live within 15km of the river. The Mekong is a lifeline for over 70 ethnic groups. It is known by many names: near its headwaters it is called the **Turbulent River**. Downstream it is the **Mother of Waters**. And near its delta, it is called the **Nine-tailed Dragon**.



The Mekong is the longest river in Southeast Asia, and the twelfth longest river in the world. **The Mekong supports the livelihoods and food security of 7 in 10 of its basin's inhabitants** through agriculture and one of the most productive and diverse freshwater fisheries in the world. Their livelihoods are threatened by 82 existing dams in the watershed and a further 153 under construction or planned, including 11 dams that would block the lower mainstream Mekong.



### THE WORLD'S LARGEST INLAND FISHERY AT RISK

Inland fisheries in the lower Mekong Basin produce up to **2.5 million tonnes** of fish per year



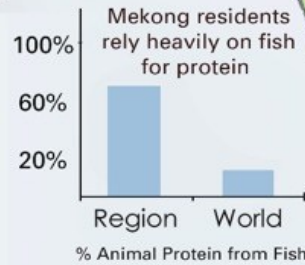
The river's biological diversity is second only to the Amazon River



This is **7-22%** of global freshwater production

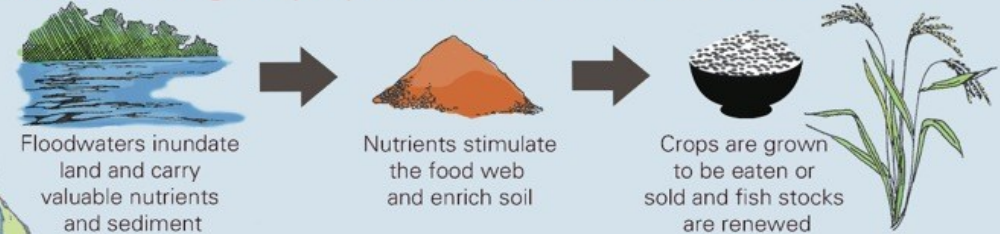
... and worth ~ **\$4.2-7.6 billion**

At least 1/3 of fish are migratory, like the Mekong Giant Catfish



### DAMMING THE FLOW THREATENS FOOD SECURITY

Seasonal flooding is key to productive farms and fisheries health



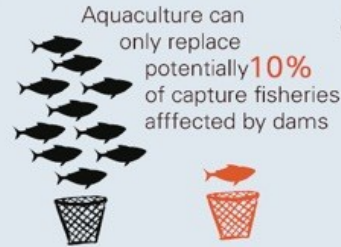
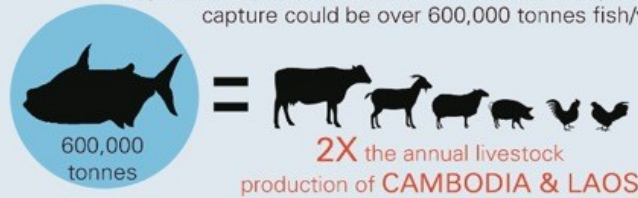
### The sediment load of the Mekong could be drastically reduced

However, hydropower projects in China and the 3S rivers will cut the sediment load (~160-165 million tonnes/yr) by **50%**

With the addition of planned mainstream dams the load would be **halved again**

### Mainstream dams would devastate fisheries . . .

If planned mainstream dams are built, the likely loss in fish capture could be over 600,000 tonnes fish/yr



Huge amounts of land and water resources would be needed to replace lost fish protein and calories with livestock products

**+19-63%** increase in land used

**+6-17%** increase in water used



**-\$274 billion** Losses to ecosystem services from dam development have been estimated as high as \$274 billion, indicating the danger that **huge and unanticipated losses** could occur



### The dams will cause a net loss in agricultural production

Losses due to inundation by dams, lost nutrients from sediment trapping, and lost riverbank gardens totals **\$50 million/yr**



#### SOURCES

- 1) "Dams on the Mekong River: Lost fish protein and the implications for land and water resources," Orr et al. (2012)
- 2) "Fisheries of the Mekong River Basin," Hurtle (2009)
- 3) "Mekong Fisheries and the current situation on Mekong mainstream dams," Chheng Phen (2014)
- 4) "State of the World's Rivers," International Rivers (2014)
- 5) "Strategic Environmental Assessment of Hydropower on the Mekong Mainstream," ICEM (2010)
- 6) "The State of World Fisheries and Aquaculture," FAO of the UN (2014)
- 7) World Wildlife Federation

Source: World Rivers Review 2014

# Mapping the world's free-flowing rivers

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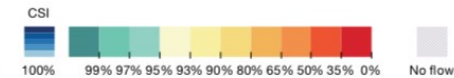
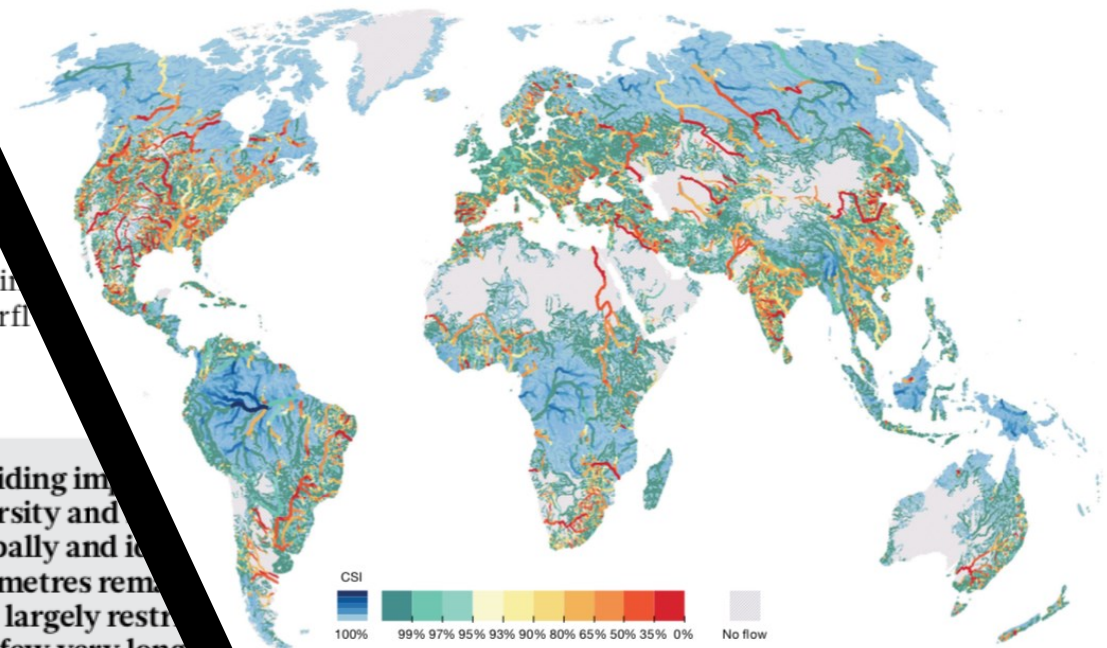
## Free-flowing Rivers and Migratory Megafish

- Global case studies highlight importance of free-flowing rivers and intact swimways to the persistence of most species of iconic, imperiled megafish

Rivers are essential for human and human well-being. For millennia, rivers have provided food, contributed water for domestic use and agriculture, sustained transportation corridors and, more recently, enabled power generation and industrial production<sup>1</sup>. These goods and services generally require built infrastructure, and society has addressed this demand by constructing an estimated 2.8 million dams (with reservoir areas  $> 10^3$  m<sup>2</sup>)<sup>2</sup>, regulating and creating over 500,000 km of rivers and canals for navigation and transport<sup>3,4</sup> and building irrigation and water-diversion schemes. As a result, rivers are exposed to sustained pressure from fragmentation and loss of river connectivity, constraining their capacity to flow unimpeded, affecting many fundamental processes and functions characteristic of healthy rivers<sup>5</sup> and leading to the rapid decline of biodiversity

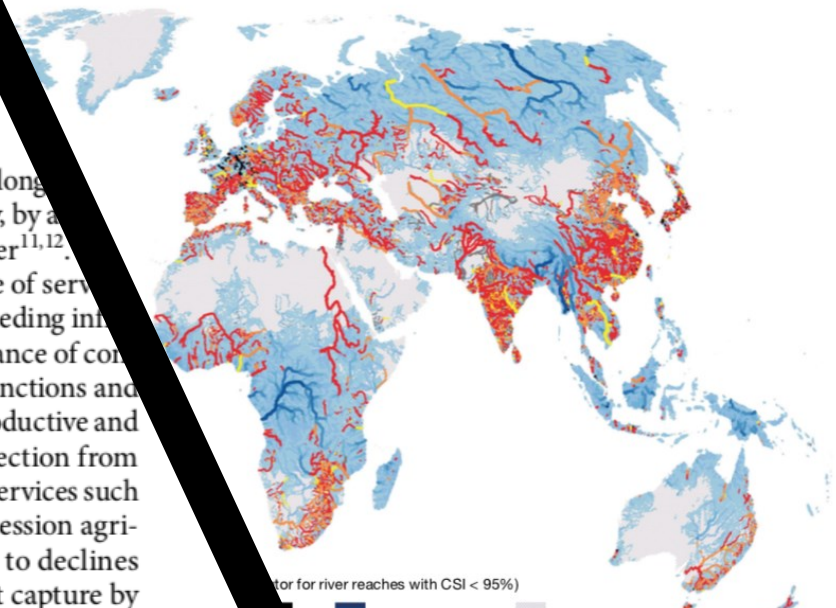
ways, either directly, by placing structures into the long or lateral flow paths, such as dams and levees, or indirectly, by altering the hydrological, thermal and sediment regimes of the river<sup>11,12</sup>. Although it is inherently complex to quantify the value of services provided by FFRs or to measure the devaluing effect of impeding infrastructure, many examples exist that underline the importance of connectivity for the provision of natural riverine ecosystem functions and processes. For instance, floodplains are among the most productive and diverse riverine ecosystems globally<sup>13</sup>, and their disconnection from the upstream catchment or river channel alters ecosystem services such as natural flood storage, nutrient retention and flood-recession agriculture<sup>14</sup>. Built river infrastructure has also been linked to declines in terrestrial and freshwater species<sup>11,15–17</sup>, and sediment capture by

ecosystems globally, providing important system processes, biodiversity and kilometres of rivers globally and id longer than 1,000 kilometres remain an. Very long FFRs are largely restricted to populated areas only few very long rivers and their up- and downstream processes of river connectivity. By applying a



Of the world's river reaches, 8.2% (by number) are impaired by various degrees (CSI < 100%). The blue

shades represent the magnitude of river discharge for river reaches with CSI = 100% (that is, darker shades for larger rivers).



for river reaches with CSI < 95%)





American paddlefish, *Polyodon spathula*

Mississippi River Basin

220 cm, 100 kg

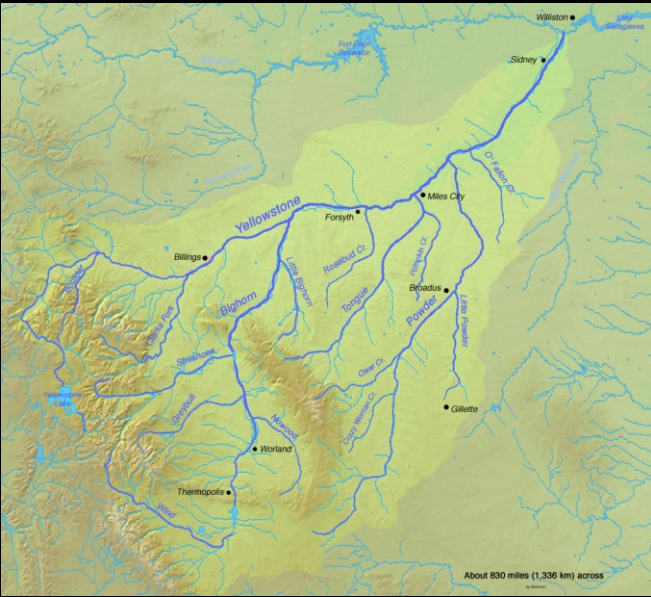






Photo credit: Dr. Wei Qi Wei

Chinese paddlefish, *Psephurus gladius*

Yangtze River

700 cm, 300 kg



Photo Courtesy Wild Salmon Center



© Satoshi Adachi

Sharks, rays,  
and sawfish of  
Northern  
Australia



# Migratory fish: jewels of nature

Large migratory catfish in the Amazon are capable of epic journeys of thousands of kilometers. They are also species highly prized by humans in the region because of their size and economic value. However, the future of these species is at risk because of dams, deforestation, and overfishing. Conserving the aquatic ecosystems on which they depend, as well as managing fisheries throughout the Basin will be crucial to sustaining these fisheries and their status as cultural symbols in the Amazon.

**Up to 5,500 km**

upstream is the distance a *Brachyplatystoma* catfish can travel when migrating from the estuary, where it breeds, to the Andean foothills, where it spawns.



**Madeira dams** have fragmented the migratory routes these fish use to reach their spawning grounds. As a result, their abundance has decreased in recent years in sub-basins such as Madre de Dios, Mamoré, and Beni.

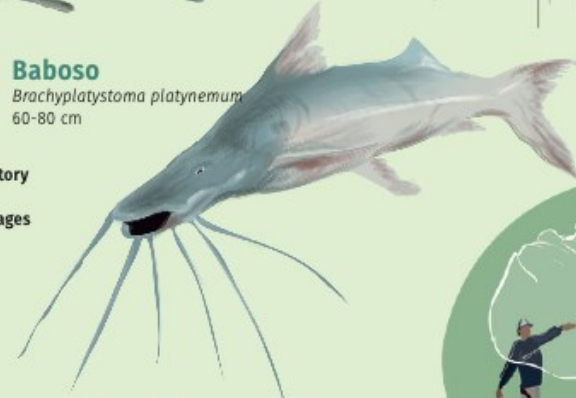
**18-24 months**

is the time it takes for a migratory catfish to journey from the Amazon estuary to the Andean foothills.

**Manitoa**  
*Brachyplatystoma vaillantii*  
40-100 cm

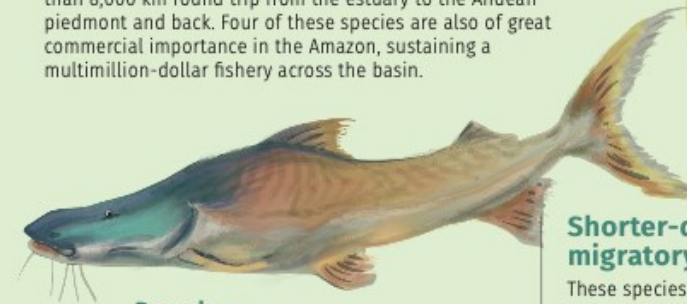


**Baboso**  
*Brachyplatystoma platynemum*  
60-80 cm



## Shorter-distance migratory species

These species make smaller migrations, between 100 and 1,000 km, for reproductive or feeding purposes. Like the large catfish species, they are of great commercial importance throughout the Basin



**Dorado**  
*Brachyplatystoma rousseauxii*  
120-140 cm



**Sorubí**  
*Pseudoplatystoma spp*  
100 cm



**Gamitana**  
*Colossoma macropomum*  
40-100 cm

## A regional plan

Management of long-distance migratory fish species can only be effectively and realistically addressed at a regional scale, through integrated government actions that monitor and assess fish populations, implement fisheries regulations, mitigate infrastructure impacts that affect fisheries, and conserve the habitats that the fish depend on.

**80%**

of commercial fishing in the region is based on migratory species.






**USAID**  
 FROM THE AMERICAN PEOPLE


 University of Nevada, Reno

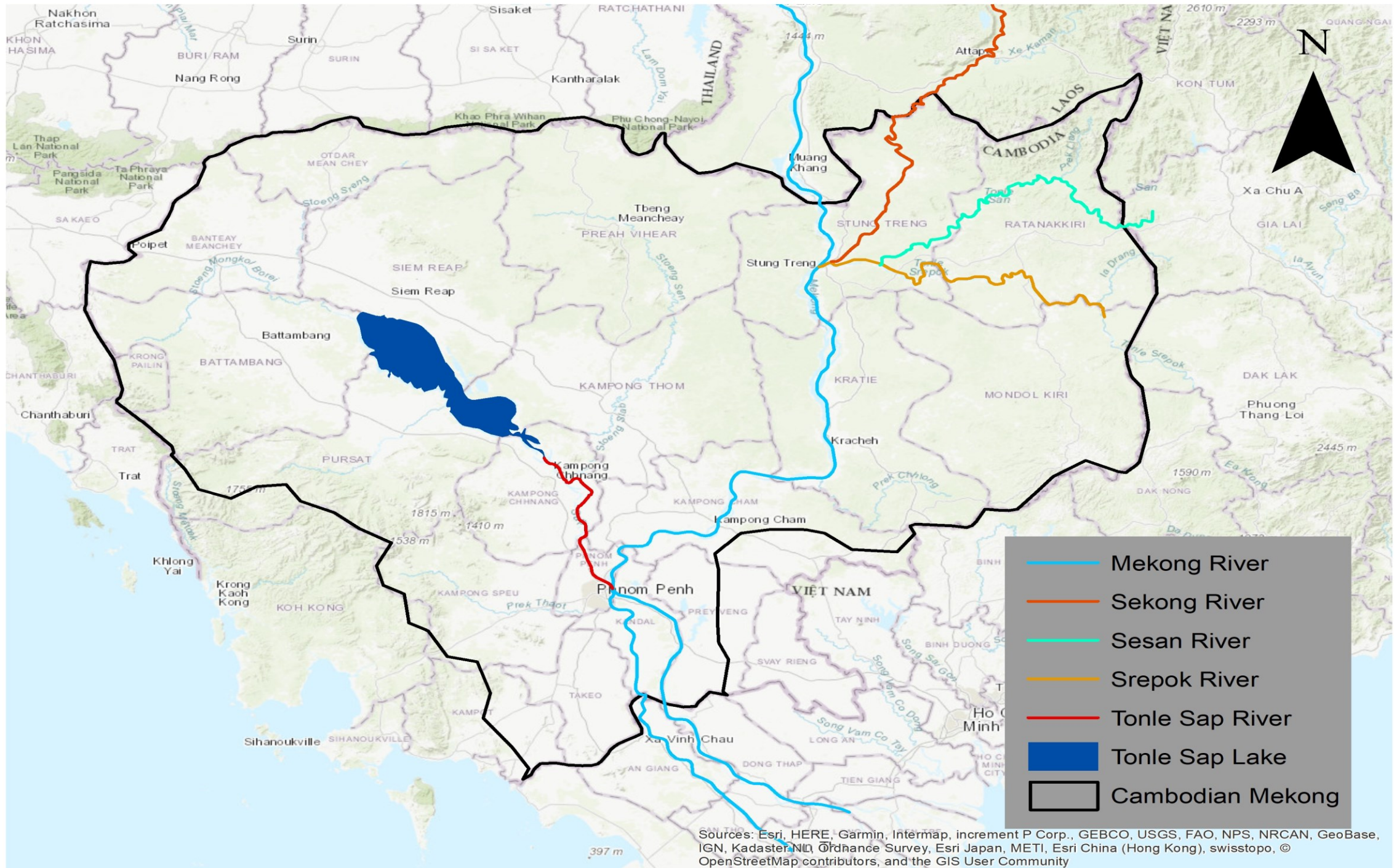
**វិទ្យាស្ថាននៃទន្លេមេគង្គ**  
**Wonders of the Mekong**  
 A Foundation for Sustainable Development and Resilience











- Mekong River
- Sekong River
- Sesan River
- Srepok River
- Tonle Sap River
- Tonle Sap Lake
- Cambodian Mekong

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community









**ក្រសួងរ៉ែ និងថាមពល**  
Ministry of Mines and Energy  
លេខ: ១៧៧ ប.ប. រ.ក

**ព្រះរាជាណាចក្រកម្ពុជា**  
ជាតិ សាសនា ព្រះមហាក្សត្រ  
Kingdom of Cambodia  
Nation Religion King

រដ្ឋបាលខេត្តស្ទឹងត្រែង
លេខ: ៧១២
ចុះថ្ងៃទី ១៧ ខែ ០៧ ឆ្នាំ ២០២២
ប្រើប្រាស់ដល់: ០៧/០៧/២០២២

ថ្ងៃសុក្រ ៣១ ខែ ៧ ឆ្នាំ ខាល ចេត្តាស័ក ព.ស ២៥៦៦  
រាជធានីភ្នំពេញ, ថ្ងៃទី ១៧ ខែ ០៧ ឆ្នាំ ២០២២

**រដ្ឋមន្ត្រីក្រសួងរ៉ែ និង ថាមពល**  
**សូមជម្រាបជូន**

**ឯកឧត្តមអធិបាល វិទ្យាសាស្ត្រស្ទឹងត្រែង**

**កម្មវត្ថុ** ៖ ករណីសំណើសុំការបញ្ជាក់ និងផ្តល់អនុសាសន៍ ចំពោះករណីប្រជាពលរដ្ឋរស់នៅក្នុងមូលដ្ឋាន តាមដងទន្លេបេតុងលើខេត្តស្ទឹងត្រែង មានការលើកឡើងជុំវិញព័ត៌មានអំពីការសាងសង់ទំនប់ វារីអគ្គិសនី។

**យោង** ៖ លិខិតលេខ ២២៣/២២ ល.ស ចុះថ្ងៃទី០១ ខែមិថុនា ឆ្នាំ២០២២ របស់រដ្ឋបាលខេត្តស្ទឹងត្រែង។

សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុ និងយោងខាងលើ ខ្ញុំសូមជម្រាប ឯកឧត្តម ជ្រាបថា ក្រសួងរ៉ែ និង ថាមពល បានអនុញ្ញាតឱ្យក្រុមហ៊ុន China (Cambodia) Rich International Co.,Ltd. ធ្វើការសិក្សាបុរេសមិទ្ធិ លទ្ធភាព និងសមិទ្ធិលទ្ធភាពគម្រោងវារីអគ្គិសនីស្ទឹងត្រែង ដើម្បីទទួលបានព័ត៌មានច្បាស់លាស់ អំពីសក្តានុពល គម្រោងនេះ។ បន្ទាប់ពីសិក្សាចាត់ ក្រុមហ៊ុនក្រសួងរ៉ែ និងថាមពលនៃការសិក្សានេះ ជូនក្រសួងរ៉ែ និងថាមពល ដើម្បីពិនិត្យ និងរក្សាទុកជាឯកសារ និងពុំមានការអភិវឌ្ឍគម្រោងវារីអគ្គិសនីនៅលើដងទន្លេបេតុងឡើយ។ ទន្ទឹមនេះ លទ្ធផលនៃការសិក្សាផែនការអភិវឌ្ឍន៍វិស័យថាមពលអគ្គិសនីដែលគណៈកម្មការអន្តរស្ថាប័ន បានសិក្សាក្នុងក្របខ័ណ្ឌជំនួយបច្ចេកទេសរបស់ធនាគារអភិវឌ្ឍន៍អាស៊ី (ADB) ក៏ពុំមានគម្រោងវារីអគ្គិសនី ស្ទឹងត្រែងនេះស្ថិតក្នុងបញ្ជីបេតុងគម្រោងដែលត្រូវអភិវឌ្ឍន៍ផងដែរ។

អាស្រ័យដូចបានជម្រាបជូនខាងលើ សូម ឯកឧត្តម ជ្រាប តាមការកូរ។  
សូម ឯកឧត្តម ទទួលនូវការរាប់អានដ៏ជ្រាលជ្រៅ ពីខ្ញុំ។



**ស៊ីឌីស ត្រីសេដ**



**Office of Cambodian PM** 🇰🇲  
**@PeacePalaceKH**

World's Largest Freshwater Fish  
Found in Cambodia [akp.gov.kh/post/detail/25...](http://akp.gov.kh/post/detail/25...)







# United Nations Convention on Migratory Species (CMS) 2024 Report Highlights Poor Status of Migratory Freshwater Fish and Need for Improved Management and Conservation



CONVENTION ON MIGRATORY SPECIES

# COP 14

# SAMARKAND

UZBEKISTAN 12-17 FEBRUARY 2024

## STATE OF THE WORLD'S MIGRATORY SPECIES



Convention on the Conservation of  
Migratory Species of Wild Animals

## A Key Milestone for the Conservation of Amazon Migratory Fish: Dorado and Piramutaba Included in CMS Appendix II

Hi Resolution Catfish Images [Here](#)

SAMARKAND , UZBEKISTAN | FEBRUARY 17, 2024



Dorado Catfish. Photo credit: Michael Goulding ©WCS

Samarkand, Uzbekistan, Feb. 17, 2024 -- At the Fourteenth Meeting of the Conference of the Parties to the Convention on the Conservation of Migratory Species of Wild Animals (CMS COP14) held in Samarkand, Uzbekistan, Brazil's proposal to include the dorado (*Brachyplatystoma rouseauxii*) and the piramutaba (*Brachyplatystoma vaillantii*) in the CMS Appendix II was approved.





SUMMIT LAKE LAHONTAN CUTTHROAT TROUT  
*Oncorhynchus clarki henshawi*

Truckee River restoration and fish passage:

- TR Operating Agreement restores flow for endangered fish
- Derby dam - new fish passage for LCT spawning
- Original strain of LCT reintroduced into Pyramid Lake to bolster recreational fishing and local economy

Walker Basin restoration:

- Walker Basin Conservancy established in 2015
- \$100 million committed to restoring flow in the Walker River
- Water levels increasing in Walker Lake to restore populations of endangered LCT

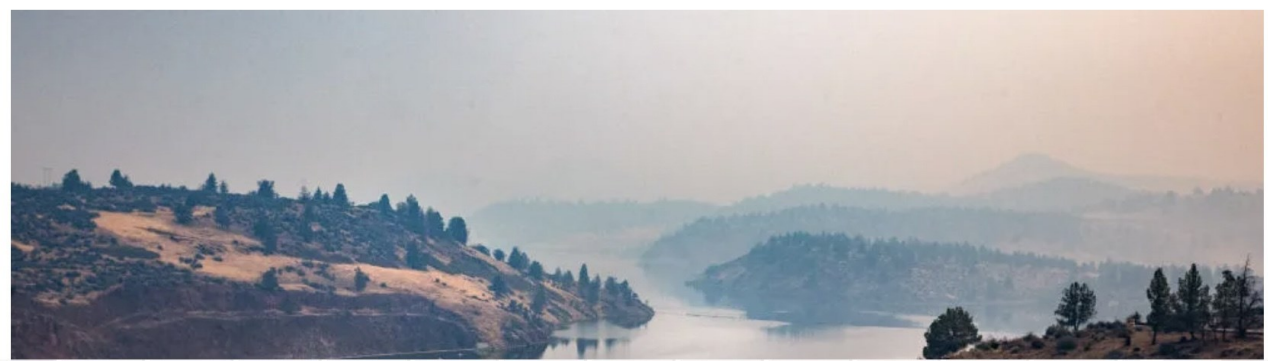
SMART NEWS

# The Largest Dam Removal Project in U.S. History Begins Final Stretch, Welcoming Salmon Home

After being impeded by dams for more than a century, the Klamath River will be restored to its historic channel this year



**Christian Thorsberg**  
Daily Correspondent  
January 22, 2024



DAMS

# Lower Snake River dams closer to coming down with new agreement

*After decades of litigation, the historic initiative among states, tribes and the federal government signals a dramatic change for the region.*

**Anna V. Smith** December 15, 2023

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*A juvenile salmon capture and transport structure at Lower Granite Dam, one of the four Lower Snake River dams. Despite such efforts, multiple salmon runs on the river are veering toward extinction.*

**Kiliii Yuyan**

PHOTO DIARY

# World Fish Migration Day: Celebrating a Decade of Building Community Around Fish and Rivers

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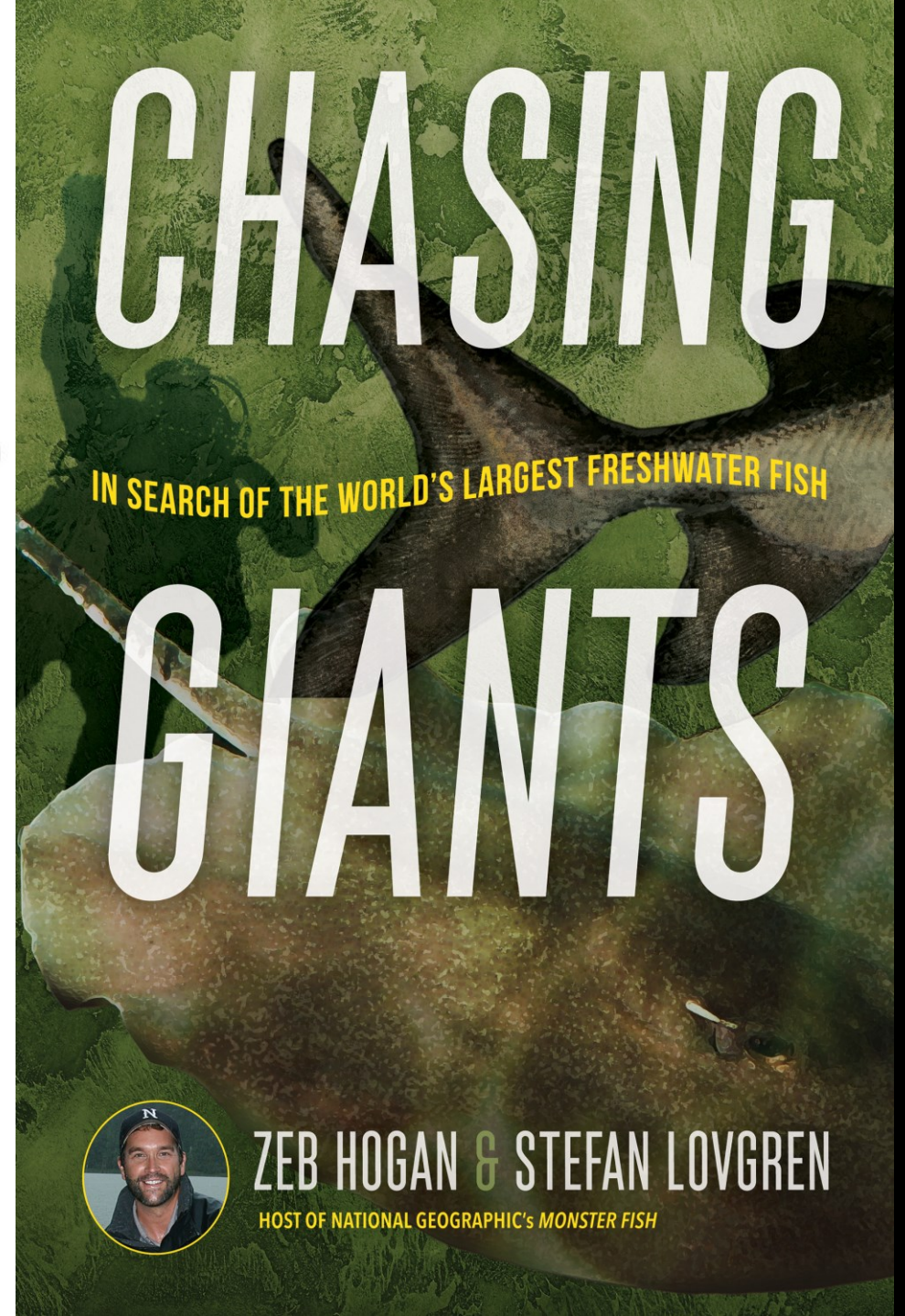
**Beatrice Alducci** | World Fish Migration Foundation, Laan Corpus den Hoorn 300, 9728 JT, Groningen, The Netherlands



For more information:

- Wonders of the Mekong Facebook page (<https://www.facebook.com/MekongWonders>)
- National Geographic website
- Open-access research – special issue of the Journal Water
- Fishbio's Mekong Fish Network
- Contact me: [zhogan@unr.edu](mailto:zhogan@unr.edu) or [zebhogan@gmail.com](mailto:zebhogan@gmail.com)

THANK YOU!



# CHASING

IN SEARCH OF THE WORLD'S LARGEST FRESHWATER FISH

# GIANTS



ZEB HOGAN & STEFAN LOVGREN

HOST OF NATIONAL GEOGRAPHIC'S MONSTER FISH