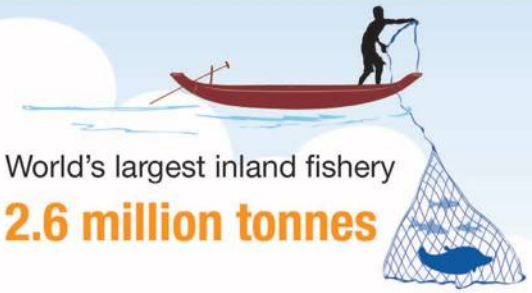
The Future of the Mekong's Aquatic Resources: Bending the Curve for Fisheries and Biodiversity

Dr. Zeb Hogan, University of Nevada, Reno

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.

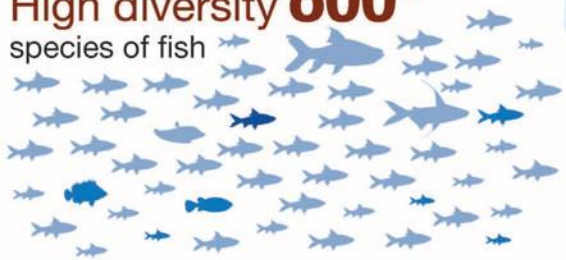
30 - 70%

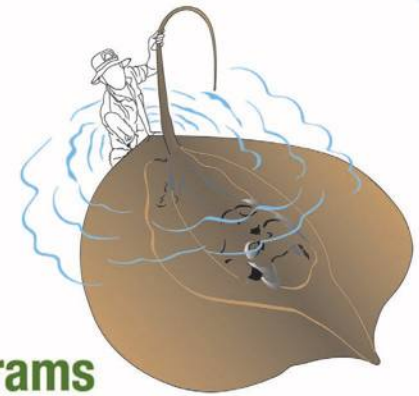
of Mekong fish are migratory

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

High diversity **800+**

species of fish





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

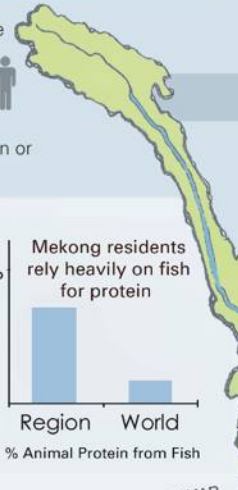
Wonders of the Mekong

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 mainstem Mekong.



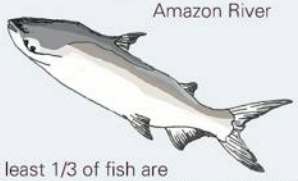
THE WORLD'S LARGEST INLAND FISHERY AT RISK

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

This is 7-22% of global freshwater production

. . . and worth ~ $4.2-7.6 billion

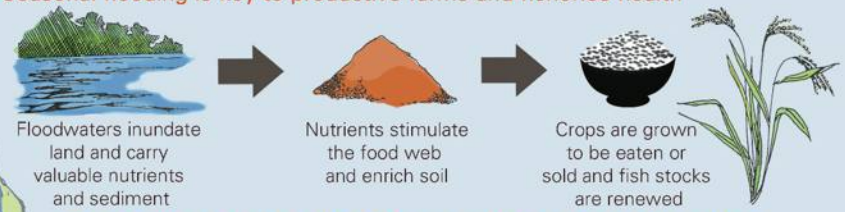
The river's biological diversity is second only to the Amazon River



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



Floodwaters inundate land and carry valuable nutrients and sediment

Nutrients stimulate the food web and enrich soil

Crops are grown to be eaten or sold and fish stocks are renewed

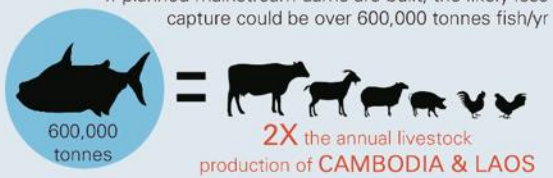
The sediment load of the Mekong could be drastically reduced

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 mainstem 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



Aquaculture can only replace potentially 10% of capture fisheries afffected by dams

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

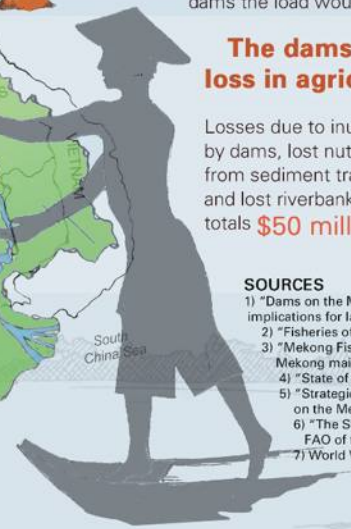
+6-17% increase in water used

-$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



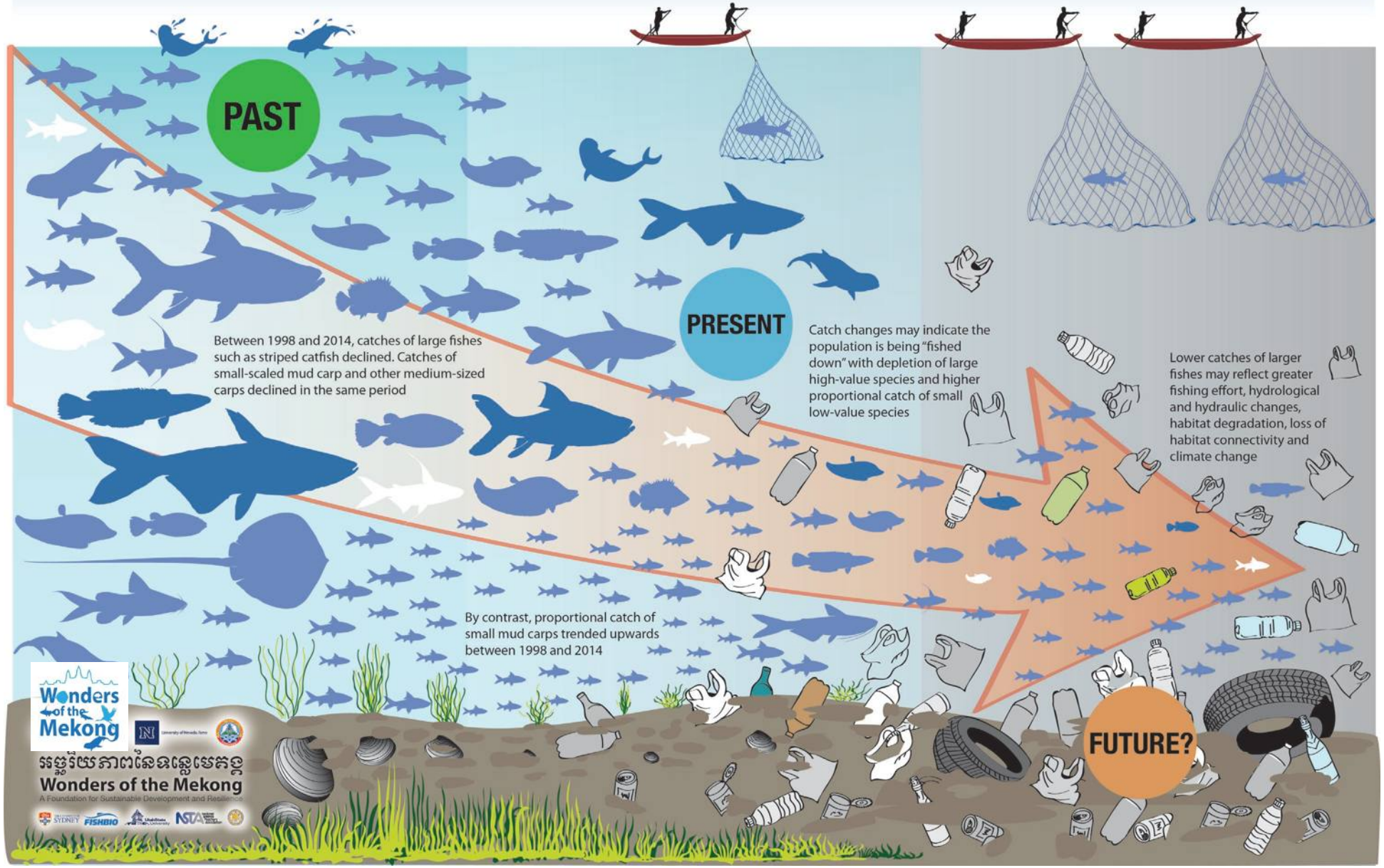
SOURCES

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," Hortle (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

FISHING DOWN THE FOOD CHAIN

DECLINES IN CATCHES OF LARGE AND MEDIUM-SIZED SPECIES IN THE MEKONG RIVER BASIN

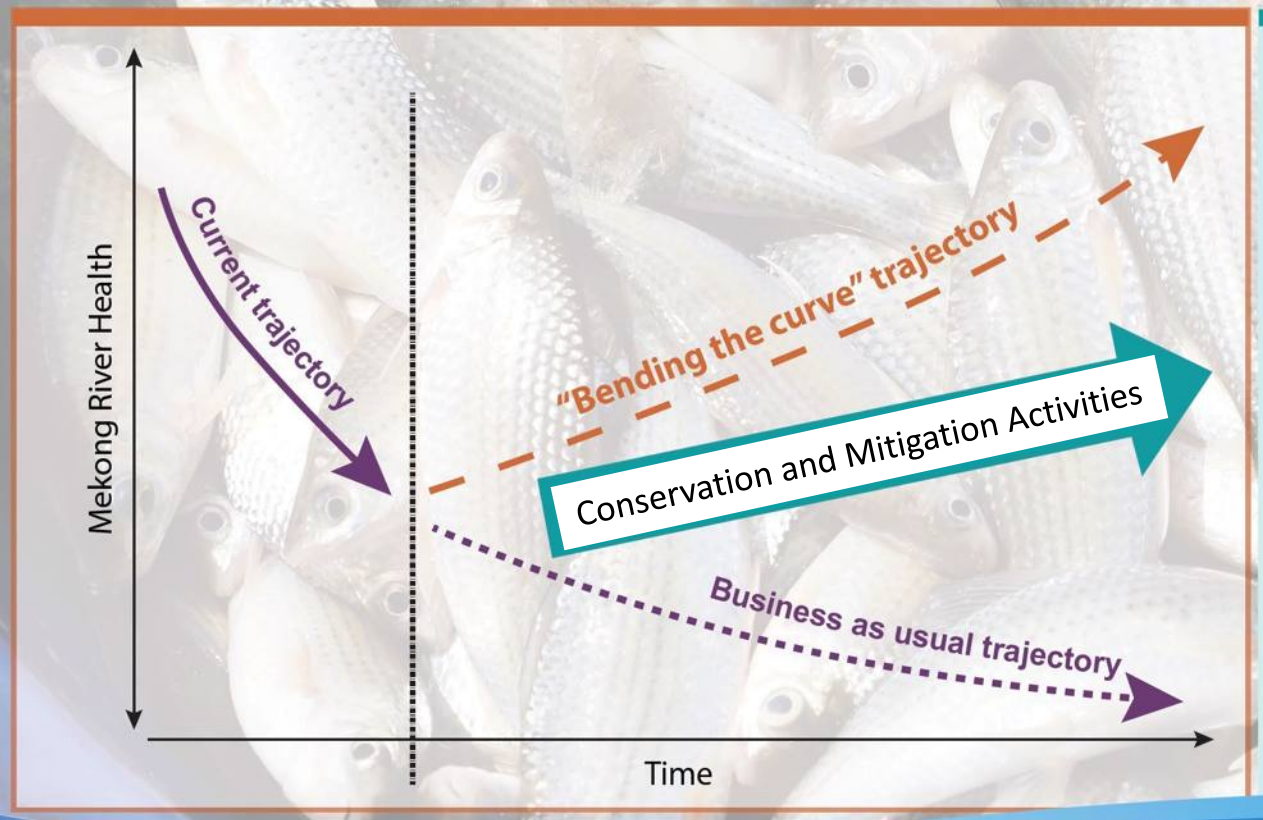


Wonders of the Mekong

University of Nevada, Reno

Wonders of the Mekong

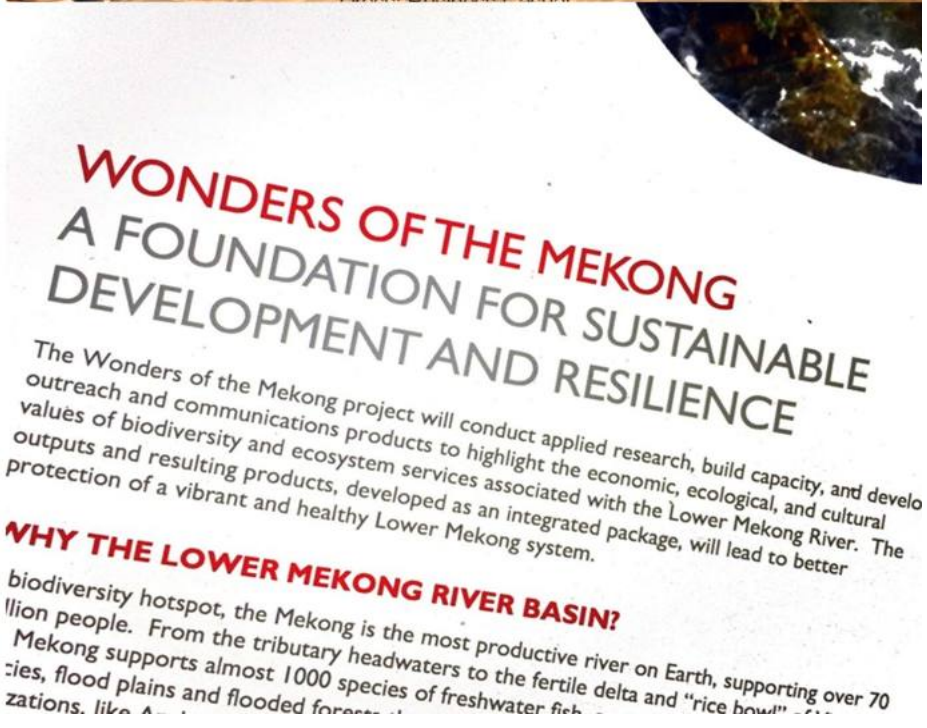
Bending the Curve for Conservation



1. Collaborative science (add knowledge)
2. Community-engaged field research (empower communities)
3. Conservation action (Protect biodiversity)
4. Training and capacity building (develop skills / leadership)
5. Educational exchanges
6. Outreach and media partnerships (local impact / global reach)

Wonders of the Mekong Approach

- Collaborative, community-engaged science
- Training, capacity building (especially university and student support), and exchanges
- Outreach and media products for broader impact



WONDERS OF THE MEKONG
A FOUNDATION FOR SUSTAINABLE DEVELOPMENT AND RESILIENCE

The Wonders of the Mekong project will conduct applied research, build capacity, and develo outreach and communications products to highlight the economic, ecological, and cultural values of biodiversity and ecosystem services associated with the Lower Mekong River. The outputs and resulting products, developed as an integrated package, will lead to better protection of a vibrant and healthy Lower Mekong system.

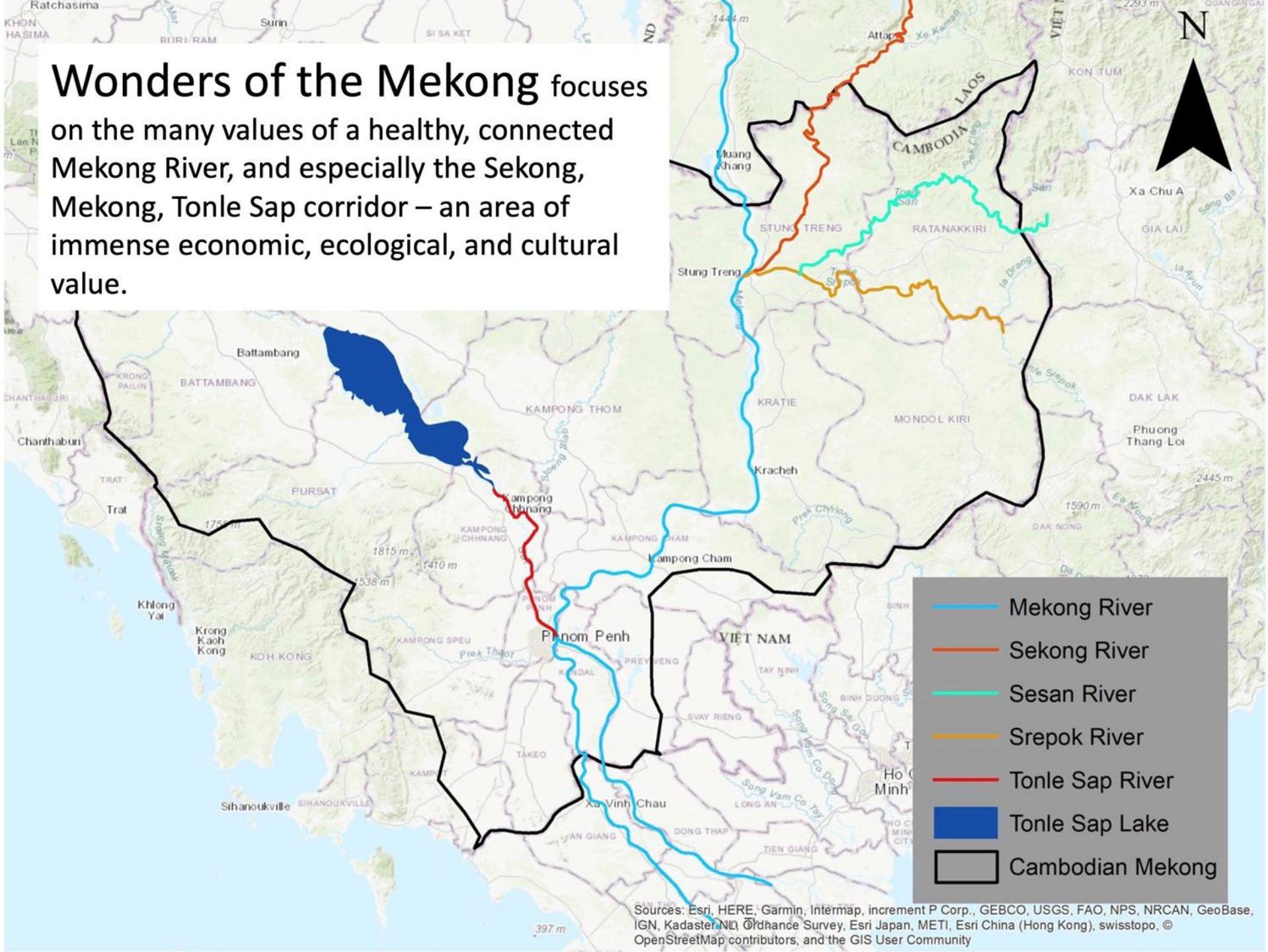
WHY THE LOWER MEKONG RIVER BASIN?

biodiversity hotspot, the Mekong is the most productive river on Earth, supporting over 70 llion people. From the tributary headwaters to the fertile delta and "rice bowl" of Mekong supports almost 1000 species of freshwater fish cies, flood plains and flooded forests zations, like

Wonders of the Mekong

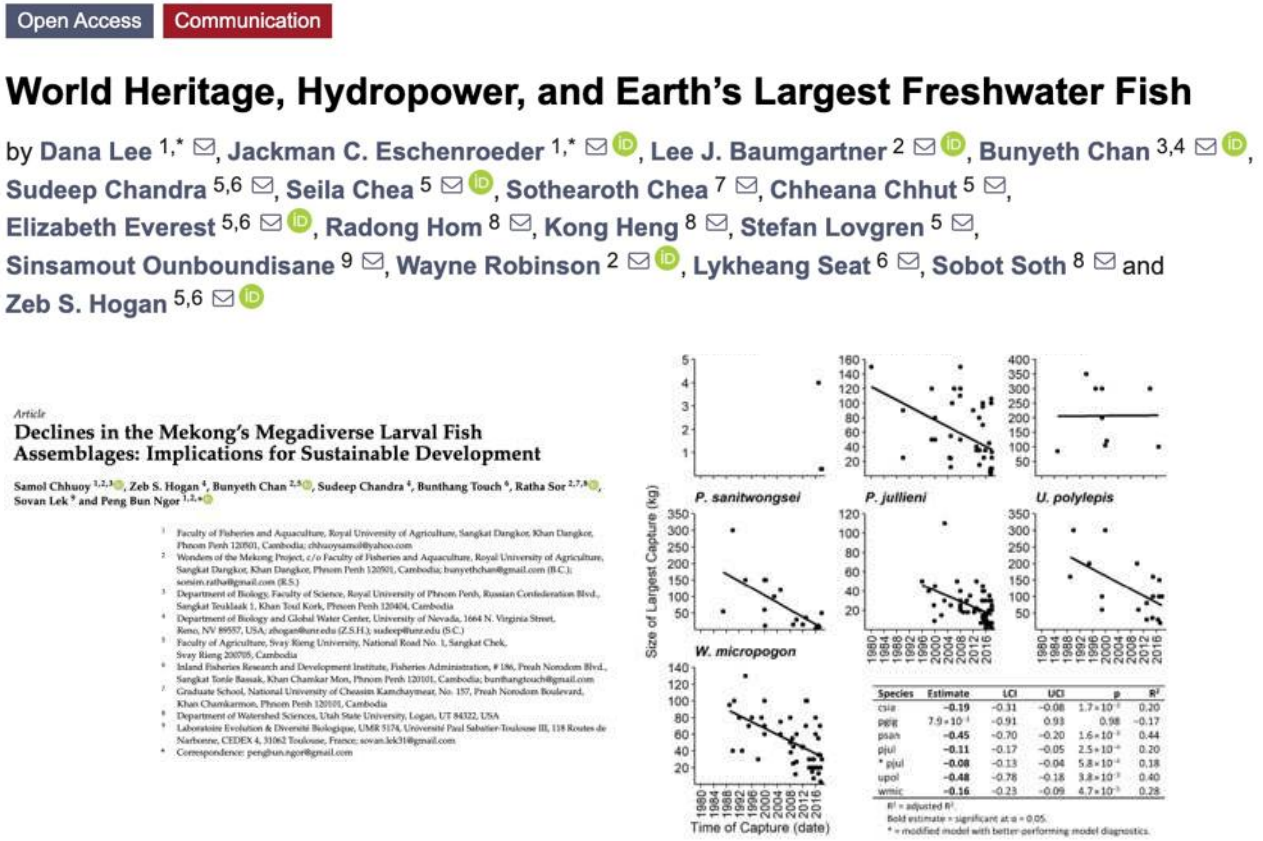
University of Nevada, Reno

1. Increased understanding by the public and government in Cambodia about value of a healthy Mekong River and its watershed and biodiversity;
2. Enriched body of scientific information of the importance of the Mekong's natural ecosystem services and the consequences of their degradation;
3. Improved capacity within Cambodia's educational institutions, government, and civil society organizations to conduct research and promote the active participation of citizen scientists;
4. Increased demonstration the importance of conservation through the development of new and effective ways to mobilize public understanding of and appreciation for the biodiversity values at risk from unsustainable development in the Mekong region.


Wonders of the Mekong focuses on the many values of a healthy, connected Mekong River, and especially the Sekong, Mekong, Tonle Sap corridor – an area of immense economic, ecological, and cultural value.
N
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
Ratchasima
Surin
Attapu
Muang Khang
Stung Treng
Xa Chu A
Battambang
Chanthaburi
Trat
Kampong Chhnang
Kracheh
Kampong Cham
Phnom Penh
Khlong Yai
Krong Kaoh Kong
Sihanoukville
Xa Vinh Chau
Phuong Thang Loi
LAOS
CAMBODIA
VIỆT NAM
KON TUM
GIA LAI
DAK LAK
DAK NONG
RATANAKKIRI
MONDOL KIRI
KRATIE
KAMPONG THOM
KAMPONG CHHNANG
KAMPONG CHAM
PURSAT
BATTAMBANG
KOH KONG
SVAY RIENG
TAKEO
PREY VENG
TAY NINH
BINH DUONG
LONG AN
DONG THAP
AN GIANG
TIEN GIANG

Collaborative Science: Research Results

- 50+ open-access, peer-reviewed studies published since 2017
- Most studies authored by Cambodian scientists
- Most studies involved Cambodian students as part of their degree
- Many studies involved community participation



Open Access Communication

World Heritage, Hydropower, and Earth's Largest Freshwater Fish

by Dana Lee [1,*], Jackman C. Eschenroeder [1,*], Lee J. Baumgartner [2], Bunyeth Chan [3,4], Sudeep Chandra [5,6], Seila Chea [5], Sothearoth Chea [7], Chheana Chhut [5], Elizabeth Everest [5,6], Radong Hom [8], Kong Heng [8], Stefan Lovgren [5], Sinsamout Ounboundisane [9], Wayne Robinson [2], Lykheang Seat [6], Sobot Soth [8] and Zeb S. Hogan [5,6]

Article

Declines in the Mekong's Megadiverse Larval Fish Assemblages: Implications for Sustainable Development

Samol Chhuoy [1,2,3], Zeb S. Hogan [4], Bunyeth Chan [2,5], Sudeep Chandra [4], Bunthang Touch [6], Ratha Sor [2,7,8], Sovan Lek [9] and Peng Bun Ngor [1,2,*]

P. sanitwongsei

P. jullieni

U. polylepis

W. micropogon

Size of Largest Capture (kg)

Time of Capture (date)

Species	Estimate	LCI	UCI	p	R^2
csia	−0.19	−0.31	−0.08	1.7×10^{-3}	0.20
pgig	7.9×10^{-3}	−0.91	0.93	0.98	−0.17
psan	−0.45	−0.70	−0.20	1.6×10^{-3}	0.44
pjul	−0.11	−0.17	−0.05	2.5×10^{-4}	0.20
* pjul	−0.08	−0.13	−0.04	5.8×10^{-4}	0.18
upol	−0.48	−0.78	−0.18	3.8×10^{-3}	0.40
wmic	−0.16	−0.23	−0.09	4.7×10^{-5}	0.28

R^2 = adjusted R^2.
Bold estimate = significant at $\alpha = 0.05$.
* = modified model with better-performing model diagnostics.

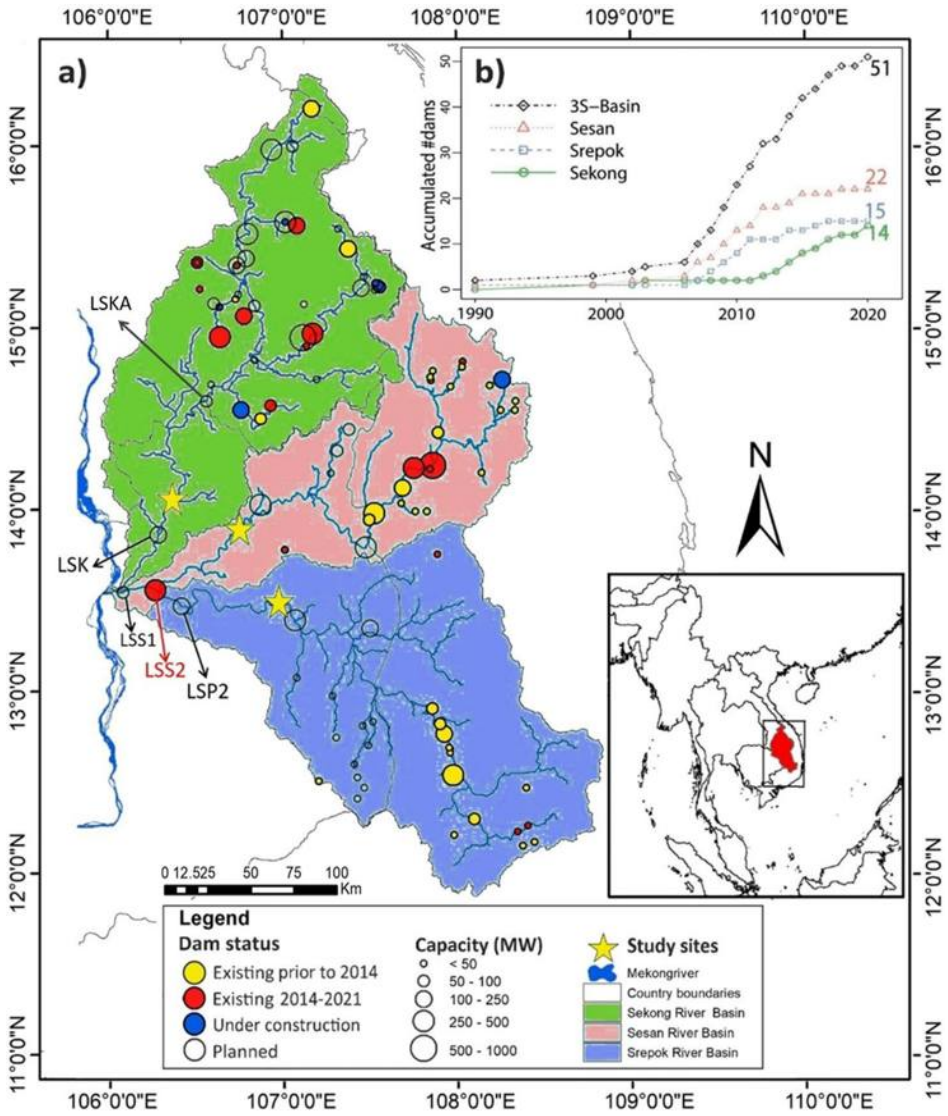


Figure 1. (**a**) Sampling sites and hydropower dams built in the 3S Basin and (**b**) number of dams from 1990 to 2021. Data source: Mekong Dam Monitor platform[13]. Lower Sesan 2 Dam (LSS2) began operations in 2018, and thus did not exist during the study period. (*LSK* Lower Sekong Dam, *LSKA* Lower Sekong A Dam, *LSS1* Lower Sesan 1 Dam, *LSP2* Lower Srepok 2 Dam). Map was created using ArcMap 10.4.1.

Fish biodiversity declines with dam development in the Lower Mekong Basin

2023 Scientific Reports

Ratha Sor[1,2,3]✉, Peng Bun Ngor[3,4], Sovan Lek[5], Kimsan Chann[6], Romduol Khoeun[6], Sudeep Chandra[7], Zeb S. Hogan[7] & Sarah E. Null[1]

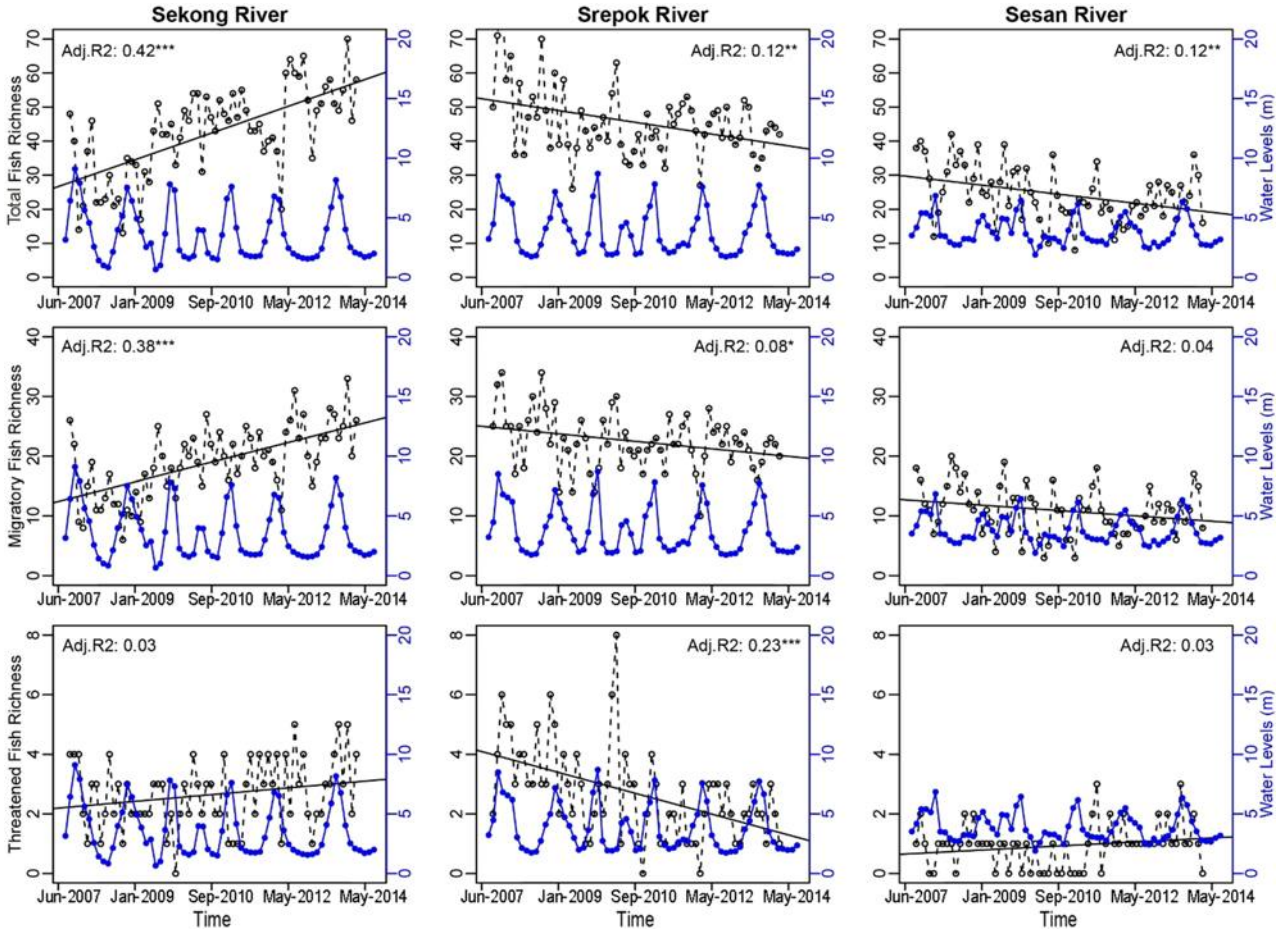
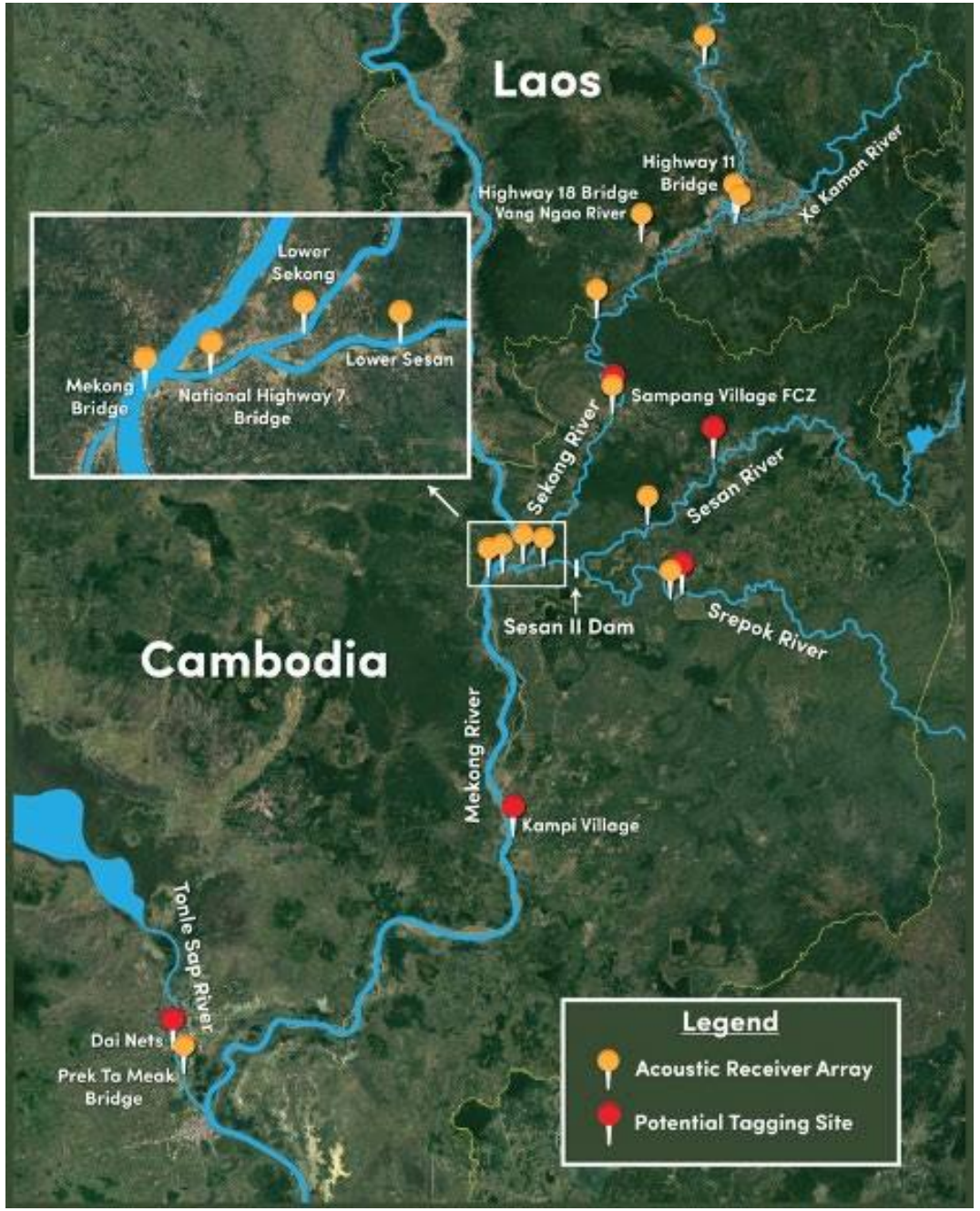


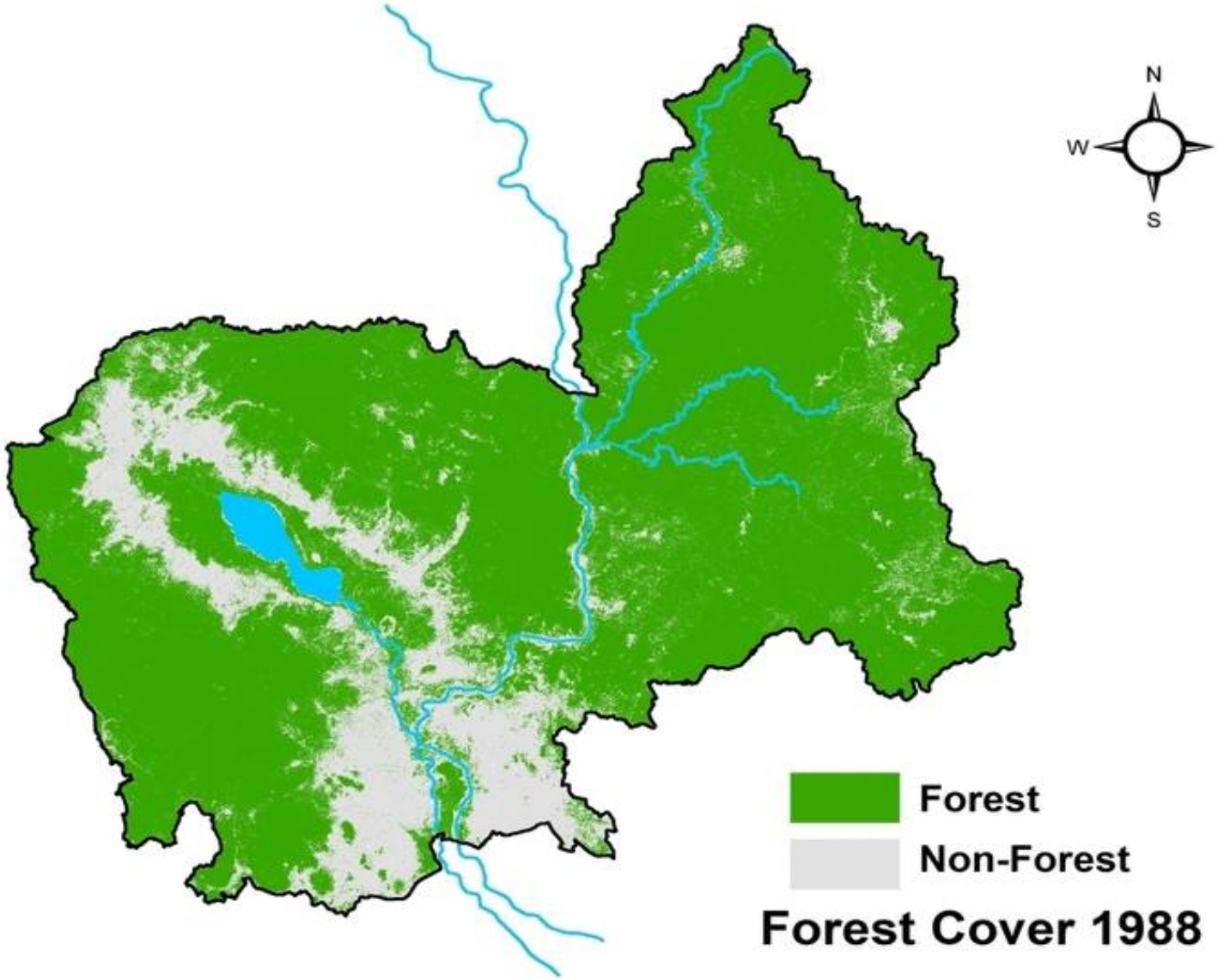
Figure 4. Monthly water levels from 2007 to 2014 (blue lines) and monthly fish biodiversity richness (number of species/sample, black dashed lines) in the Sekong, Srepok, and Sesan Basins. Asterisks $^{*}P<0.05$, $^{**}P<0.01$, $^{***}P<0.001$. Figure was created using R statistical programing language version 4.0.1.

Evaluating transboundary migration of species

- Examine fish migration patterns in the Mekong River and important tributaries in the 3S Basin
- Formed a Telemetry Working Group to facilitate transboundary collaboration and data sharing across Cambodia and Laos PDR
- Tag fish with acoustic transmitters and detected at acoustic receiver arrays located throughout the study area
- Capacity building and training components to promote future use of telemetry infrastructure



41% loss of forests since 1998 in the lower Mekong river basin with a major loss of flood forest and conversion to crops in the Tonle Sap Lake Basin



2020 Water

Wonders of the Mekong

University of Nevada, Reno

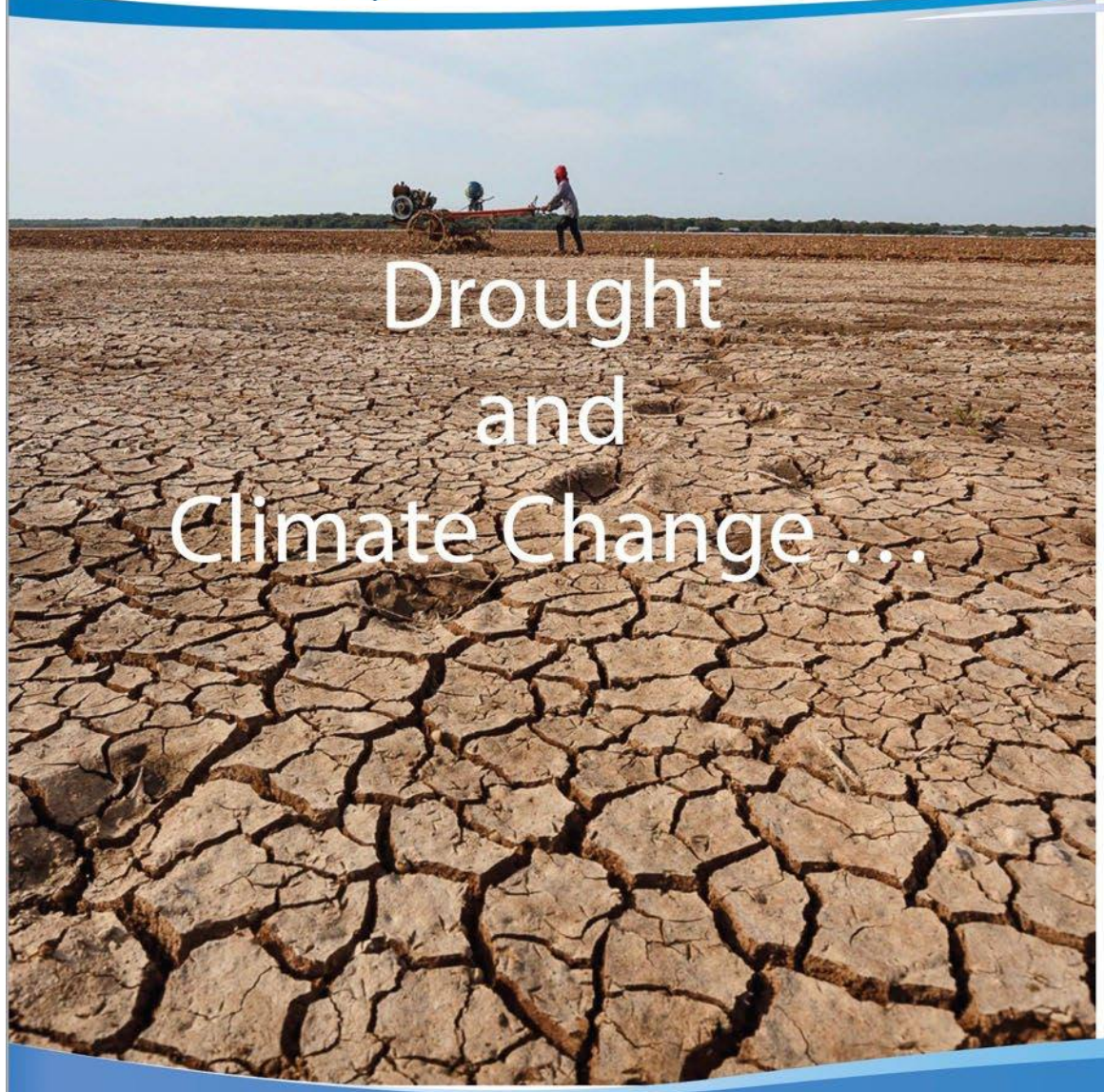
Larger Flood Pulse = More Fish

Free-flowing Rivers Sustain Threatened Biodiversity

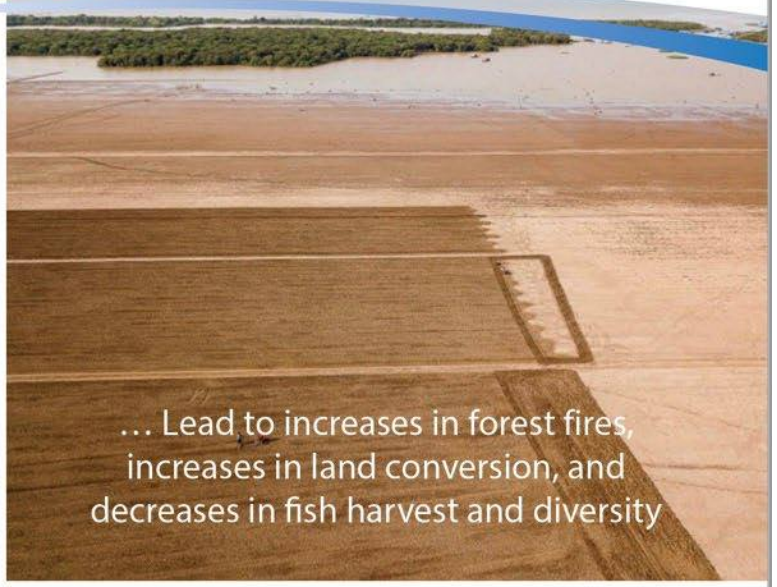
- The life cycles of the endangered species like the Mekong giant catfish and river catfish are adapted to the flood pulse
- Young are born at the beginning of rainy season and carried downstream to flood plain habitats
- Juveniles mature in flood plain habitat adults migrate back the main river to spawn

Wonders of the Mekong

University of Nevada, Reno



Drought and Climate Change …



… Lead to increases in forest fires, increases in land conversion, and decreases in fish harvest and diversity

- Loss of habitat for fish and biodiversity
- Decreases in abundance of traditional food sources and livelihoods
- Less resiliency to future environmental shocks

Wonders of the Mekong

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Capacity Building

Building one of the largest groups of Mekong experts in the world and the largest cohort of female scientists studying aquatic resource management in the region

Students have participated in grant programs, received international fellowships, served as invited experts at international meetings and workshops, and now serve in leadership positions within government and civil society

Future envionmental leaders of Cambodia and other Mekong countries

Capacity Building:
Training for over 5000 students, NGO staff, community-members, and government staff

"training, tools, and technology to support science-based natural resource management"

University Partnerships and the Center Center of Excellence on Fisheries and Aquatic Science for Sustainability (CEFASS)

Mekong conservation heroes recognised

NATIONAL

Publication date
02 November 2022 | 20:21 ICT

Reporter : **Ry Sochan**

More Topic

Six Cambodian environmentalists recognised as Mekong Conservation Heroes. MEKONG FISH NETWORK

Six Cambodian conservationists have been recognized as “Mekong Conservation Heroes” by the Wonders of the Mekong project for their environmental activities. Their actions include work on endangered species such as the Irrawaddy dolphin, Mekong giant catfish, and giant softshell turtle, as well as outreach and community-based efforts to protect Cambodia’s globally significant forests and fisheries.

An award ceremony to honor the heroes will be held on November 3 at the Himawari Hotel in Phnom Penh. It will recognise each hero, by screening a short video about each of their work.

The heroes programme was developed by the USAID-funded Wonders of the Mekong project to shine a light on inspiring individuals who are working in the lower Mekong basin to study, protect, or raise awareness about the its unique ecosystem, biodiversity, habitats, and cultural heritage.

A healthy Mekong is necessary to support communities, wildlife, and economic activity across Cambodia, US Ambassador W. Patrick Murphy said.

Ms. Chea Seila
2018 Mekong Conservation Hero

- NexGen Fellow
- International Visitor Leadership Program Participant
- PhD Candidate
- Expert on Mekong issues
- Leader of Endangered Fish Program
- Community Outreach
- IVLP Impact Award Recipient

Wonders of the Mekong Communications Products

Goal: Increase the public and government's awareness of the Mekong River, its ecosystems, and biodiversity

Wonders of the Mekong

NATIONAL GEOGRAPHIC

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National Geographic Partnership

LOCAL VOICES, GLOBAL REACH

WONDERS OF THE MEKONG

Can the Amazon of Southeast Asia Be Saved?

▷ WATCH

ENVIRONMENT
WONDERS OF THE MEKONG

Southeast Asia May Be Building Too Many Dams Too Fast

≡ READ

WONDERS OF THE MEKONG

Enormous Fish Make One of the World's Largest Migrations

▷ WATCH

WONDERS OF THE MEKONG

Angkor Wat's Collapse From Climate Change Has Lessons for Today

▷ WATCH

ENVIRONMENT WONDERS OF THE MEKONG

River sanctuaries help giant fish recover in Southeast Asia

≡ READ

ANIMALS
WONDERS OF THE MEKONG

Cambodia's river dolphins at highest population in 20 years

▷ WATCH

ANIMALS WILDLIFE WATCH

How the world's largest snake hunt hurts Southeast Asia's bigge...

▷ WATCH

ENVIRONMENT
WONDERS OF THE MEKONG

Baby Giant Mekong Catfish are Hard to Find

≡ READ

ANIMALS
WONDERS OF THE MEKONG

In Cambodia, giant turtles come back from the brink

▷ WATCH

Wonders of the Mekong

Wonders of the Mekong

University of Nevada, Reno

Stingray Case Study

Combining research, capacity building, and communications for local, regional, and global impact

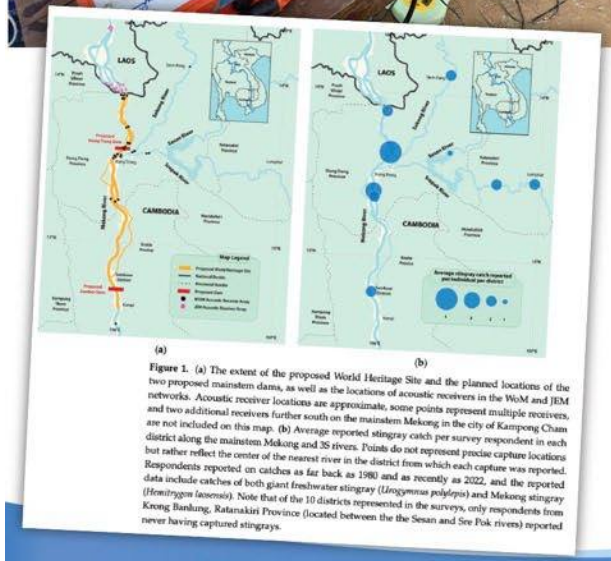
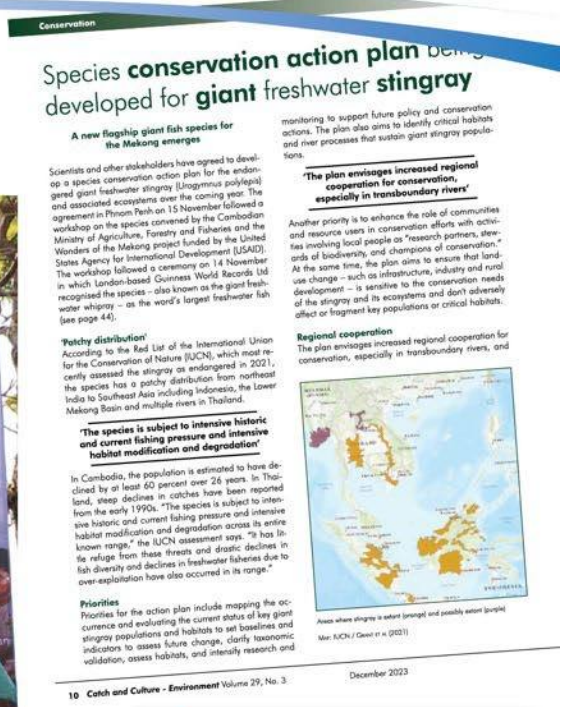


Figure 1. (a) The extent of the proposed World Heritage Site and the planned locations of the two proposed mainstem dams, as well as the locations of acoustic receivers in the WeM and JEM networks. Acoustic receiver locations are approximate, some points represent multiple receivers, and two additional receivers further south on the mainstem Mekong in the city of Kampong Cham are not included on this map. (b) Average reported stingray catch per survey respondent in each district along the mainstem Mekong and 3S rivers. Points do not represent precise capture locations but rather reflect the center of the nearest river in the district from which each capture was reported. Respondents reported on catches as far back as 1980 and as recently as 2022, and the reported data include catches of both giant freshwater stingray (*Urogymnus polylepis*) and Mekong stingray (*Hemitrygon laosensis*). Note that of the 10 districts represented in the surveys, only respondents from Krong Banlung, Ratanakiri Province (located between the the Sesan and Sre Pok rivers) reported never having captured stingrays.



Conservation

Species **conservation action plan** developed for **giant** freshwater **stingray**

A new flagship giant fish species for the Mekong emerges

Scientists and other stakeholders have agreed to develop a species conservation action plan for the endangered giant freshwater stingray (Urogymnus polylepis) and associated ecosystems over the coming year. The agreement in Phnom Penh on 15 November followed a workshop on the species convened by the Cambodian Ministry of Agriculture, Forestry and Fisheries and the Wonders of the Mekong project funded by the United States Agency for International Development (USAID). The workshop followed a ceremony on 14 November in which London-based Guinness World Records Ltd recognised the species – also known as the giant freshwater whipray – as the world's largest freshwater fish (see page 44).

'Patchy distribution'

According to the Red List of the International Union for the Conservation of Nature (IUCN), which most recently assessed the stingray as endangered in 2021, the species has a patchy distribution from northeast India to Southeast Asia including Indonesia, the Lower Mekong Basin and multiple rivers in Thailand.

'The species is subject to intensive historic and current fishing pressure and intensive habitat modification and degradation'

In Cambodia, the population is estimated to have declined by at least 60 percent over 26 years. In Thailand, steep declines in catches have been reported from the early 1990s. "The species is subject to intensive historic and current fishing pressure and intensive habitat modification and degradation across its entire known range," the IUCN assessment says. "It has little refuge from these threats and drastic declines in fish diversity and declines in freshwater fisheries due to over-exploitation have also occurred in its range."

Priorities

Priorities for the action plan include mapping the occurrence and evaluating the current status of key giant stingray populations and habitats to set baselines and indicators to assess future change, clarify taxonomic validation, assess habitats, and intensity research and monitoring to support future policy and conservation actions. The plan also aims to identify critical habitats and river processes that sustain giant stingray populations.

'The plan envisages increased regional cooperation for conservation, especially in transboundary rivers'

Another priority is to enhance the role of communities and resource users in conservation efforts with activities involving local people as "research partners, stewards of biodiversity, and champions of conservation." At the same time, the plan aims to ensure that land-use change – such as infrastructure, industry and rural development – is sensitive to the conservation needs of the stingray and its ecosystems and don't adversely affect or fragment key populations or critical habitats.

Regional cooperation

The plan envisages increased regional cooperation for conservation, especially in transboundary rivers, and

Areas where stingray is extant (orange) and possibly extant (purple)

Map: IUCN / Cavot et al. (2021)

10 Catch and Culture - Environment Volume 29, No. 3 December 2023

The New York Times

Science

CLIMATE SPACE & ASTRONOMY HEALTH MORE

Watch a Giant Stingray's Safe Return to Its River Home

The Mekong River is home to enormous and endangered aquatic life. A 400-pound fish's release shows how some conservation efforts in Cambodia are paying off.

Office of Cambodian PM

@PeacePalaceKH

World's Largest Freshwater Fish Found in Cambodia akp.gov.kh/post/detail/25...

Wonders of the Mekong

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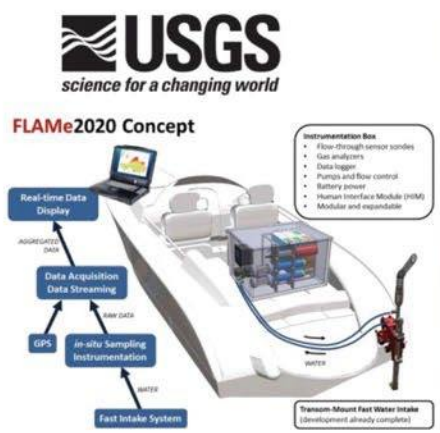
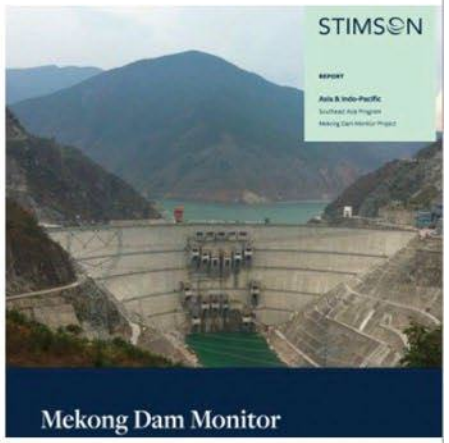
"Forge innovative partnerships to leverage resources and skills that can magnify results"





Wonders of the Mekong: Conservation and Policy Impacts

- Increased enforcement of fishing regulations, actions against land grabbing, reiteration of commitment not to build mainstream dams on the Mekong.
- Development of a program to recognize fishermen who release endangered fish, increased community participation in science and conservation.
- Statement to communities Stung Treng section of the Mekong would not be developed for hydropower.
- The PM and other government minsters shared posts and commented on Wonders of the Mekong social media multiple times.
- Through social media, local communities now raise concerns about enforcement issues and the government has been responsive, holding press conferences and meeting with communities to resolve issues.
- The Cambodian and Cambodian media regularly use Wonders of the Mekong as a source of scientific information and unbiased environmental stories.

Wonders of the Mekong

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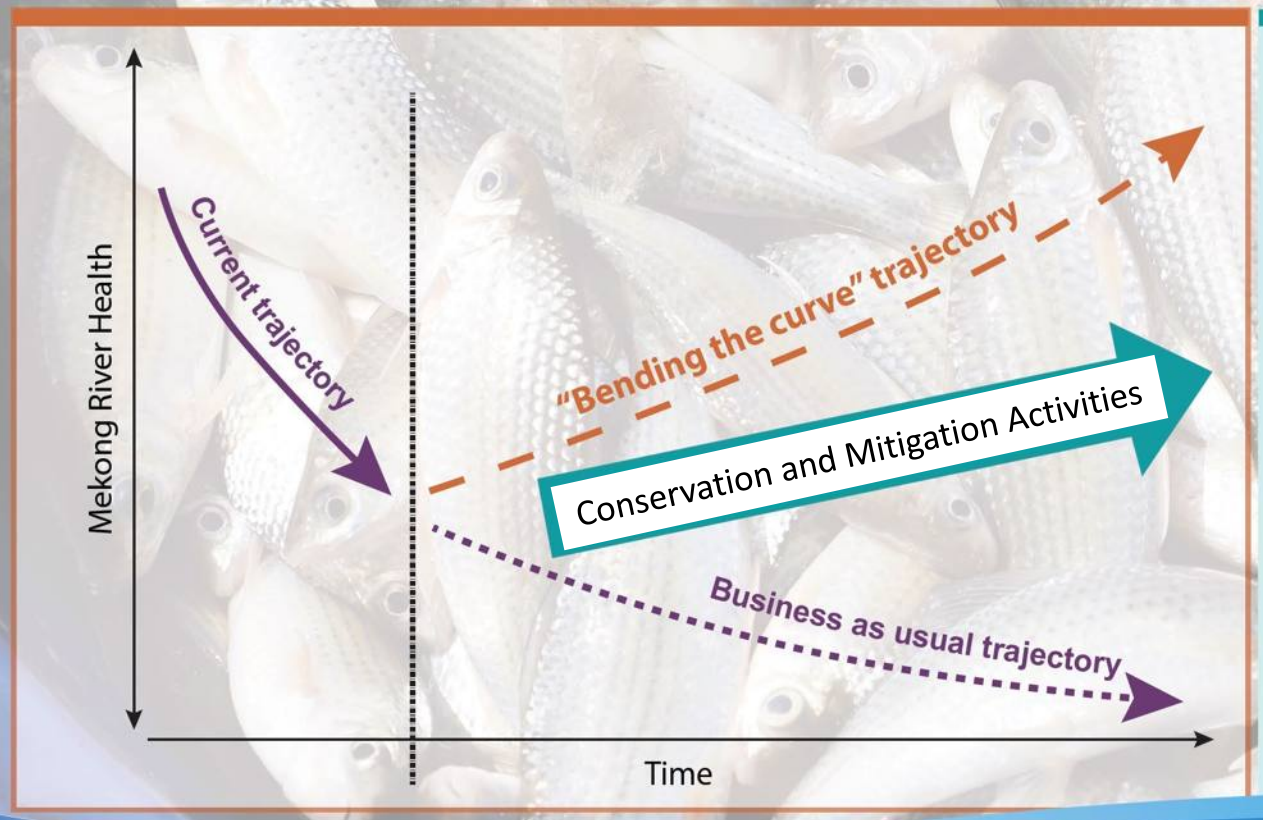
Wonders of the Mekong

Bending the Curve for Conservation



1. Collaborative science (add knowledge)
2. Community-engaged field research (empower communities)
3. Conservation action (Protect biodiversity)
4. Training and capacity building (develop skills / leadership)
5. Educational exchanges
6. Outreach and media partnerships (local impact / global reach)

Wonders of the Mekong: Science and Conservation Surprises

2022 - World's Largest Freshwater Fish

2022 - Rediscovery of presumed extinct fish

2022 - New Species

2023 - Most reports of Mekong giant catfish ever

Increasing fish catches 2020-2023

Growing awareness and pride about Mekong River

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 or zebhogan@gmail.com

THANK YOU!