Biodiversity Sweet Spots for greater protection in Mekong's 3S Rivers Basin

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Outline of case study chapter

1. Introduction – purpose of case study – process overview
2. 3S rivers context – include an ecological description of the river basins using several datasets – river reach rarity, terrestrial ecoregions of the World, elevation and gradient, stream power, seasonal flow regime, sediment transport – relationship with Mekong
3. 3S pressures – land use changes, agriculture, deforestation, hydropower, urbanisation, population density
4. Data and methods to show areas of biodiversity importance – discussion on limitations, relevance and appropriateness of data, IBAT limitations. Refer back to database in Chapter 4
5. Results –
    1. Terrestrial biodiversity maps of PAs, KBAs, species richness, threatened species index
    2. Aquatic biodiversity maps, fish, other aquatic species, fish guilds, fish migration
    3. Impacts and risks of pressures from landuse change, hydropower, reservoirs, fragmentation and connectivity
6. Discussion
7. Conclusions

Note literature references built into each section

Presentation Purpose

To demonstrate how global and regional spatial datasets can be used to identify river-basin catchments with high biodiversity value (sweet spots) and under high pressure (hot spots)

Acknowledgement
This study has been carried out as part of PhD research with University of Edinburgh and in association with ICEM, in Hanoi, Vietnam

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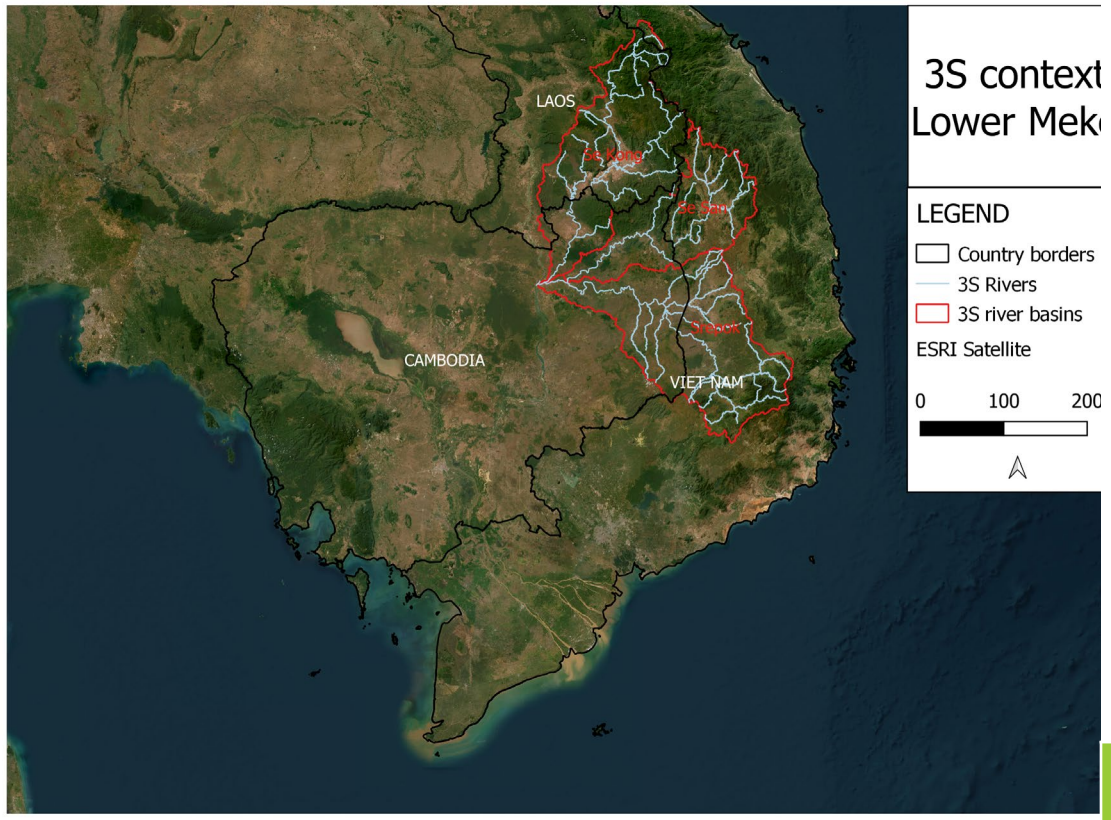
Context – 3S rivers landscape



- 3S rivers - Sekong, Sesan and Sre Pok arising in Annamites and Central Highlands of Vietnam and flowing through Laos and Cambodia.
- Confluence with Mekong at Stung Treng.
- Contributes 17 – 20% of the annual flow in the Mekong
- One of the major migratory fish routes in Lower Mekong – over 330 species of which 141 are migratory
- Main forest types - mixed deciduous in upland areas, dry dipterocarp forests in lowlands

	Total (km^2)	Mainstem length (km)	Mean annual flow (km^3)
Sekong	28,820	425	39.92
Sesan	18,890	399	27.2
Srepok	30,940	487	23.57

Pressures upon biodiversity in 3S Basin

Agriculture – cassava, coffee, cashew, rubber, pepper plantations

Deforestation – Global Forest Watch indicates significant loss of forest cover since 2001, but some re-forestation, especially in Vietnam

Hydropower development – 33 dams >30 MW commissioned or under construction, 17 more dams planned

Infrastructure - Roads and Transmission Lines

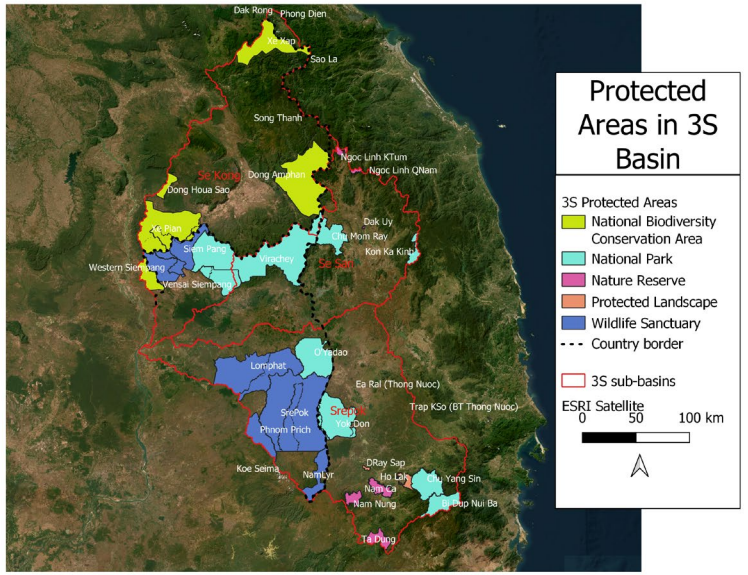
Mining – gold, copper, bauxite, gem-stones

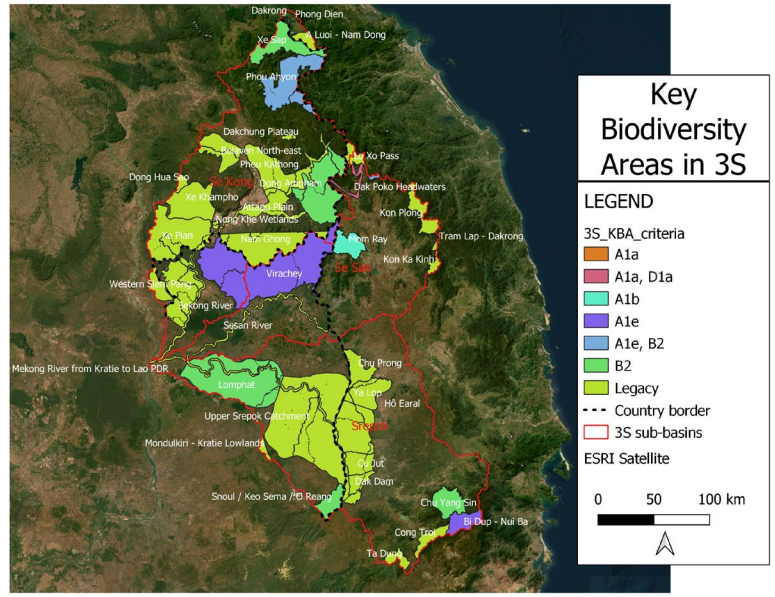
Loss of connectivity and fragmentation

Boeung Kiat Ngong Ramsar site

Biodiversity importance – Protected areas and KBAs

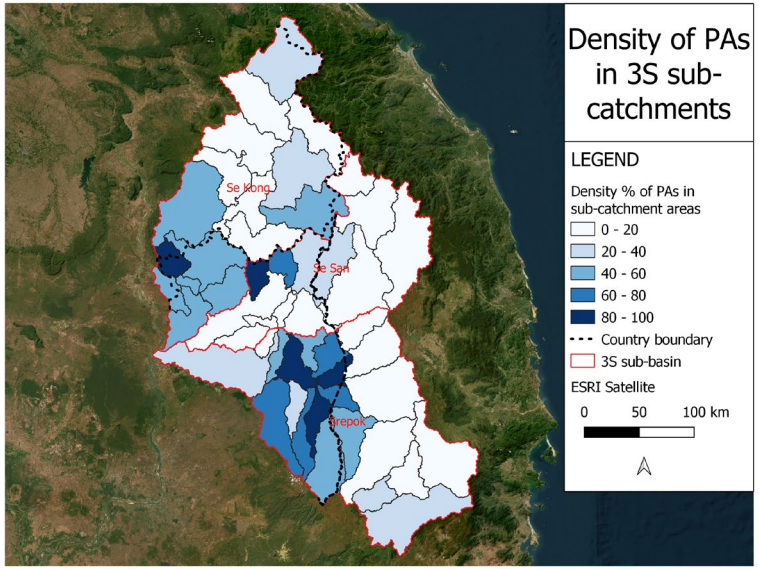
- Key Biodiversity Areas and Protected Areas can be indicators of biodiversity “sweet spots”
- Distinguish –
  - PAs indicate landuse choices for management of forests and biodiversity – do not necessarily have species lists
  - KBAs indicate locations of special biodiversity – habitats for rare and endangered species, migratory & congregatory species
- Criteria for KBAs helpful to identify target biodiversity
  - But many are legacy KBAs, identified by BirdLife before the strict KBA criteria applied
  - Note that some KBAs identify species no longer present, e.g. Tiger, Saola and Siamese crocodile
- Overlay of KBAs and PAs shows where additional protection may be needed for KBAs



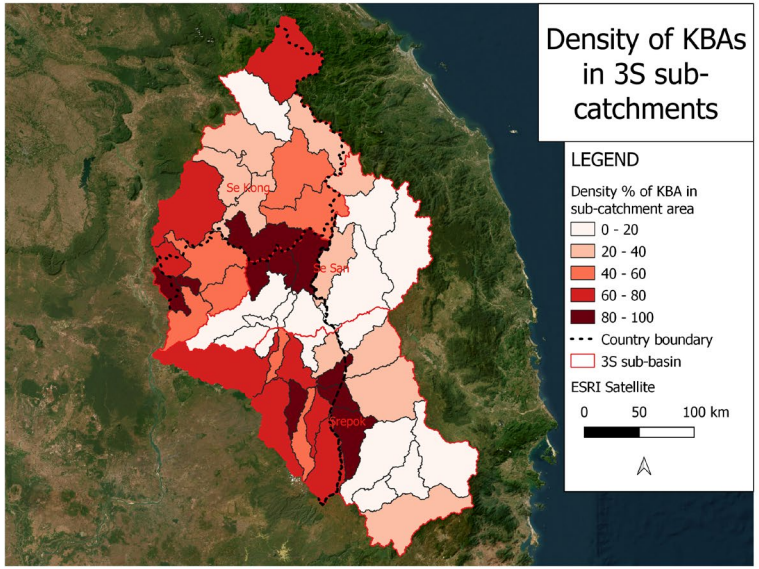


Use density of PAs/KBAs in sub-catchments to identify those with high biodiversity

DENSITY OF PA AREAS IN 3S SUB-CATCHMENTS



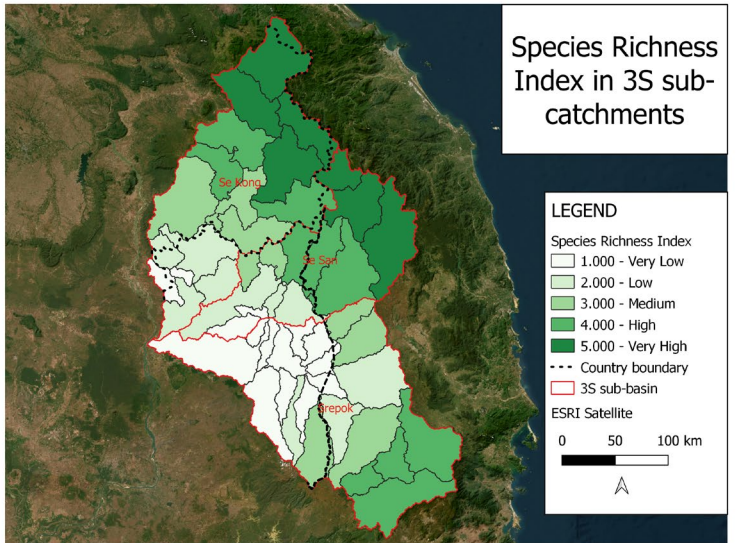
DENSITY OF KBA AREAS IN 3S SUB-CATCHMENTS

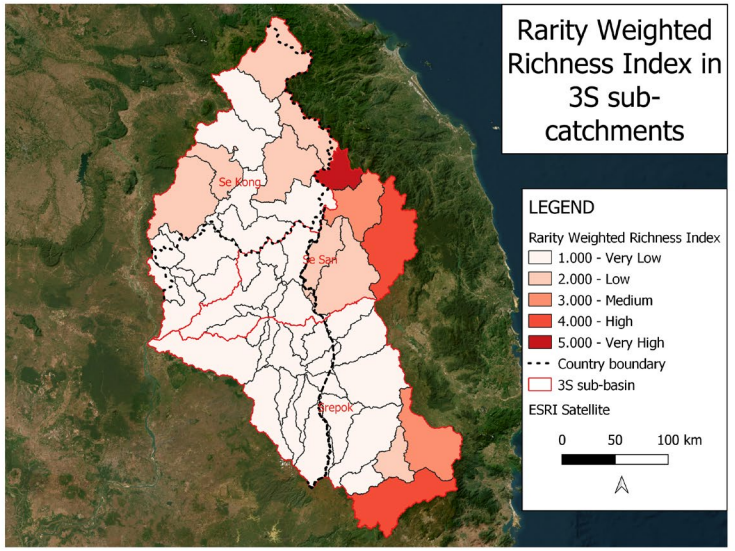


IUCN Redlist Species Richness (SR) and Rarity Weighted Richness (RWR)

- The IUCN RedList website provides open access to two species indicators as rasters in 30 x 30 km polygons
  - Species Richness – total number of terrestrial assessed species
  - Rarity Weighted Richness – weighted numbers of CR, EN and VU species.
- Using the density of the SR index and RWR index in sub-catchments highlights biodiversity sweet spots
  - Upland areas in each sub-basin e.g. in Annamites and on Bolevan plateau in Laos and Vietnam, and Virachey NP and Mondulkiri in Cambodia

Note: More comprehensive of numbers of threatened species in each catchment than KBA target species analysis, because of base upon ranges of Red list assessed species.





But RedList, PAs and KBAs may be out of date!
Do not reflect loss of biodiversity from rapid changes in land use and other developments

Degree of Naturalness - indicator of changes in Land cover

Application to PAs and KBAs to identify areas under pressure

Linear infrastructure density in PAs and KBAs – roads and transmission lines – fragmentation of PAs and reduction of connectivity

Land cover in buffer zones around PAs – condition of biodiversity corridors between PAs


Rubber plantation in Sre Pok


Undisturbed forest in Dong Ampham NBCA, Laos


XeKaman 1 HPP

Degree of Naturalness in 3S Basin

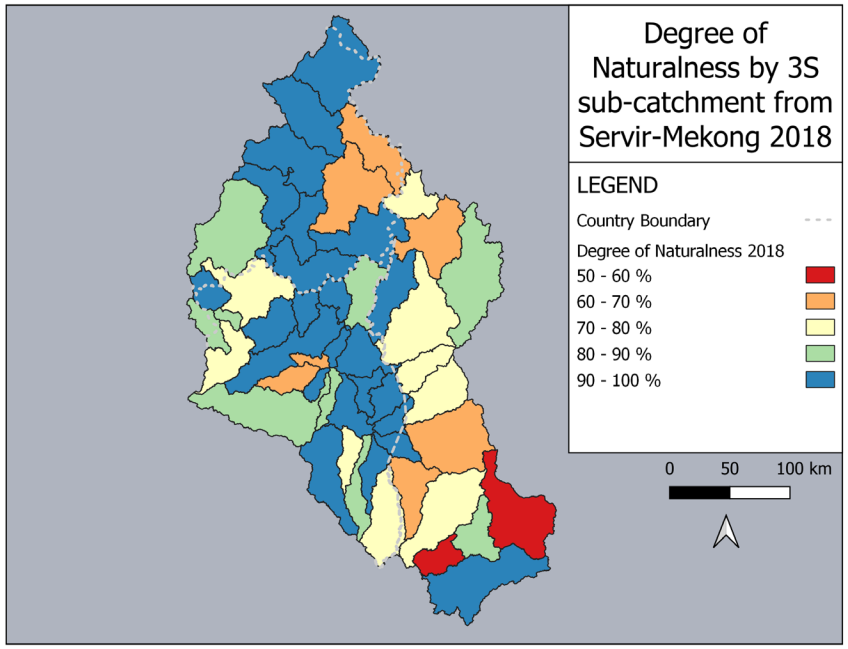
Indicator: Weighted area of landcover units within each catchment **Naturalness Weighting** % multiplied by area of landcover units in each catchment,

- weighting from Freshwater Health Index by Conservation International

Datasets

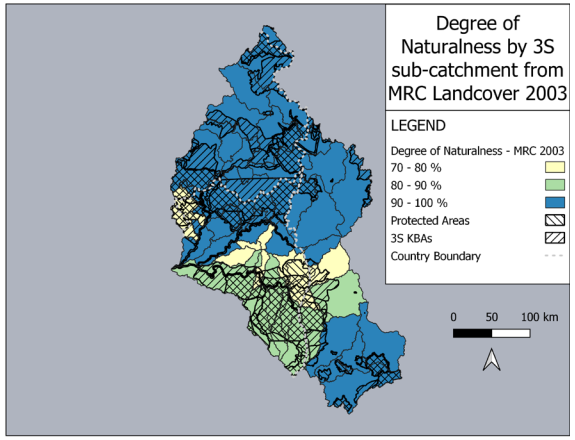
- MRC 2003 and 2010
- Servir Mekong 2018
- ESRI LC 2024

Landcover type	Naturalness Weighting %
Unknown	70
Surface Water	70
Mangroves	100
Flooded Forest	100
Forest	100
Orchard or Plantation Forest	50
Evergreen Broadleaf	100
Mixed Forest	100
Urban and Built Up	10
Cropland	40
Rice	30
Mining	10
Barren	10
Wetlands	100
Grassland	70
Shrubland	70
Aquaculture	10

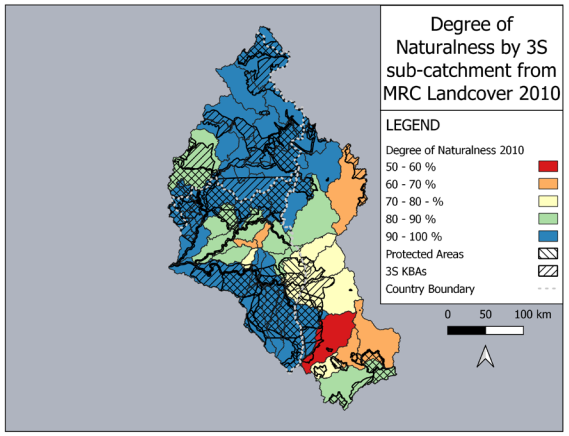


Changes in Degree of Naturalness 2003 - 2022

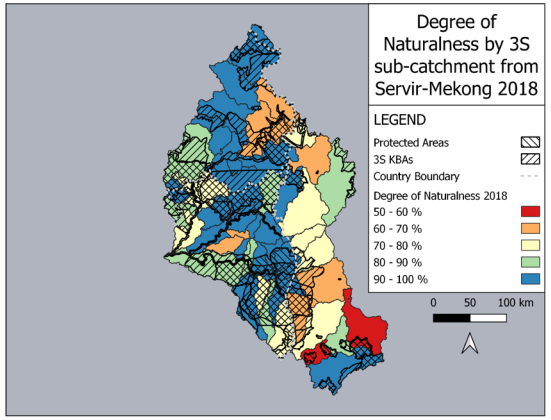
2003



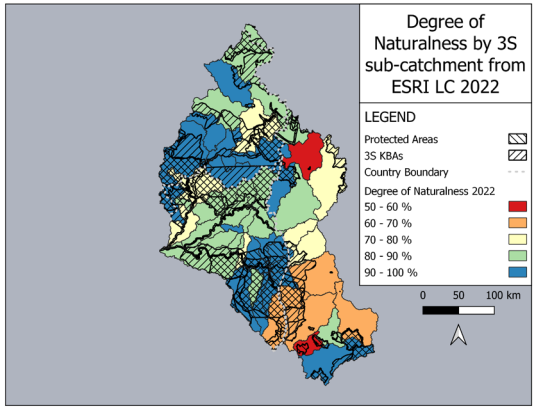
2010



2018



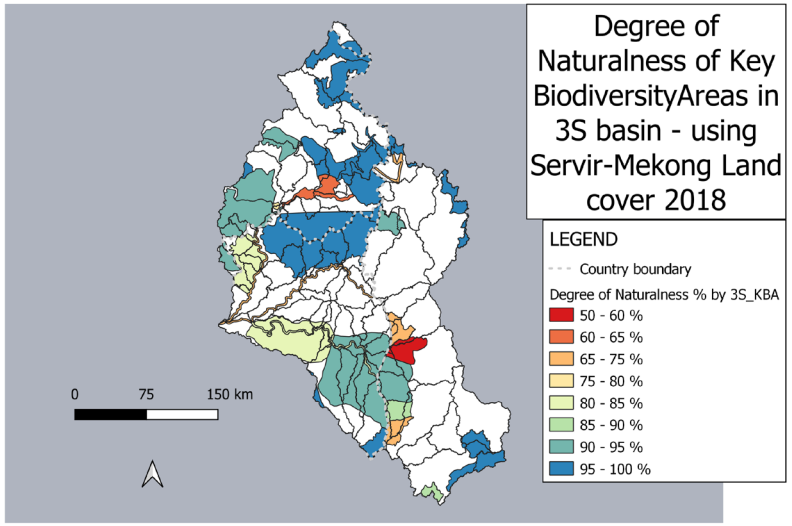
2022



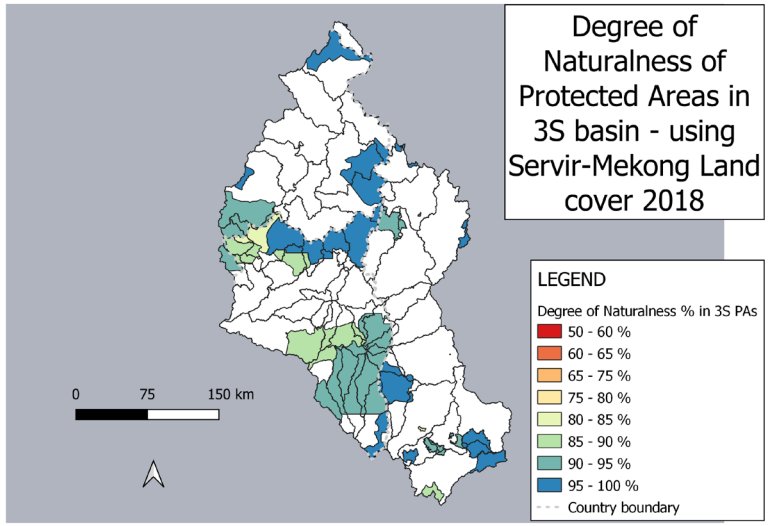
- Time series shows reduction in degree of naturalness over past 20 years, especially in Central Highlands of Vietnam and lower Sesan and Sre Pok in Cambodia
- In 2018 and 2022 loss in some sub-catchments may be due to hydropower and clearance of land for agriculture
- Note differences in the landcover interpretation from satellite imagery between years

Degree of Naturalness in Protected Areas and KBAs in 2018 (LC_Servir_Mekong)

DON IN 3S KBA – some high, others decreasing, including riverine KBAs

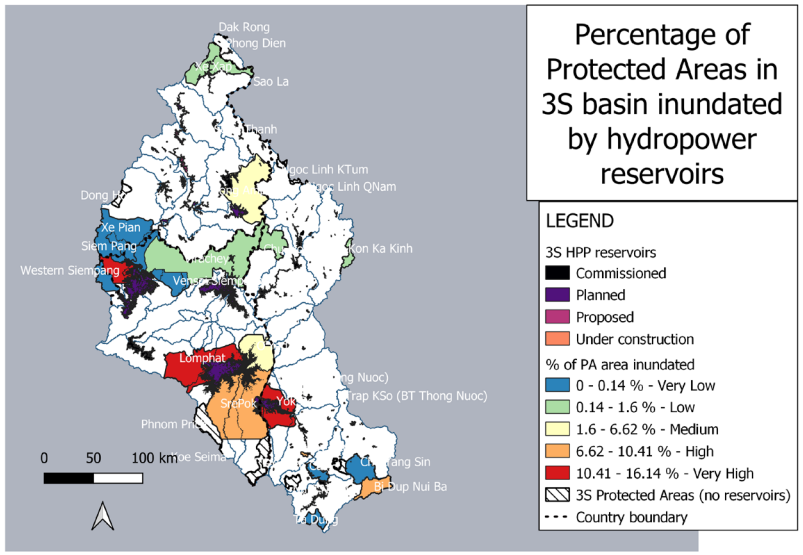


DON IN 3S PA – IDENTIFY PA UNDER PRESSURE – Xe Pian, Western Siem Pang, Lumphat and Sre Pok Wildlife Sanctuaries

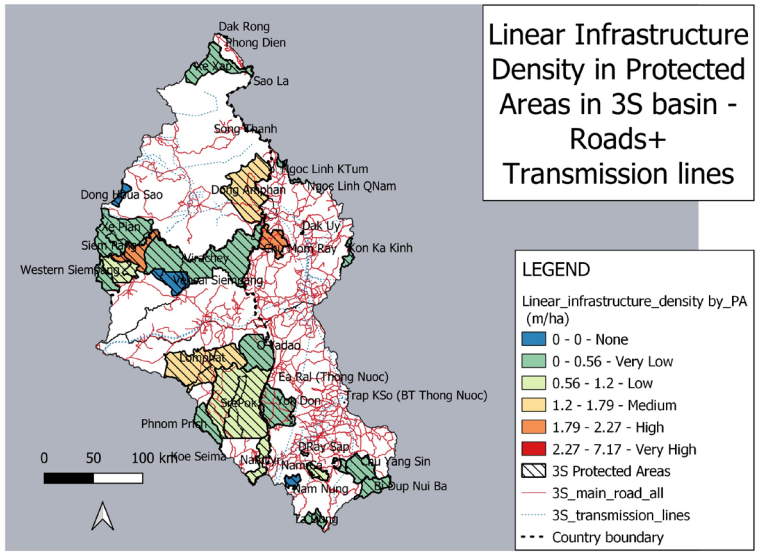


Measures of Fragmentation of Protected Areas - Reservoirs, Roads and Transmission Lines

INUNDATION BY EXISTING AND FUTURE RESERVOIRS



LINEAR INFRASTRUCTURE DENSITY (M/HA)- ROADS AND TRANSMISSION LINES



Aquatic biodiversity

Fish catch in Boeung Kiat Ngong Ramsar site

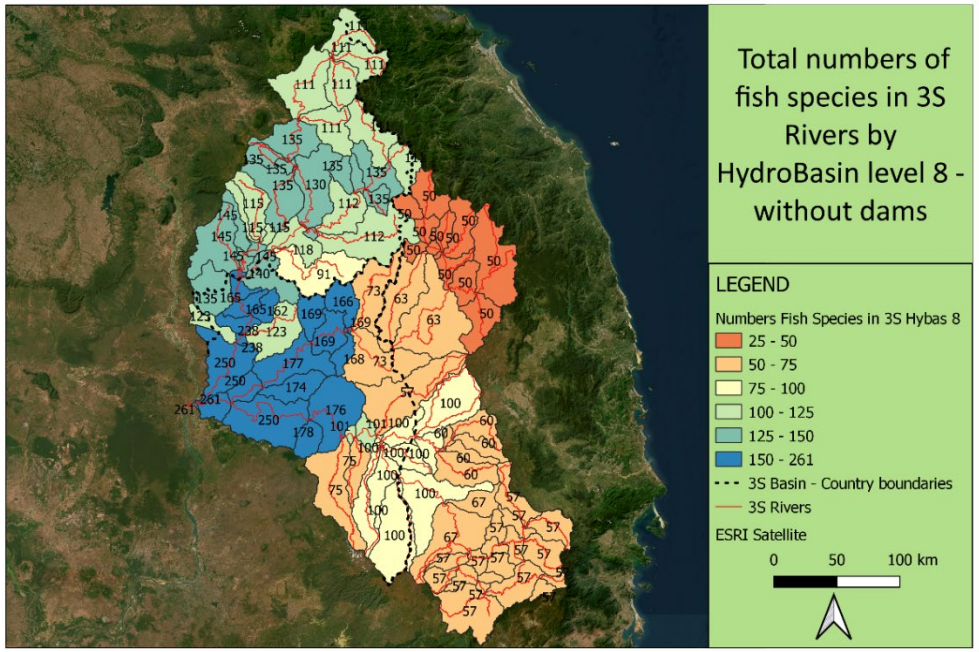
Sand mining on Sekong river

- Use of IBAT Freshwater assessments by HydroBasin level 8 in 3S Basin (Integrated Biodiversity Assessment Tool)
- Species likely to be present in each catchment – Fish, Turtles, Odonata, Molluscs and Aquatic plants species assessed IUCN Redlist
- Estimate numbers of species in each catchment
- Calculate Species Rarity Index – weighted numbers of CR, EN and VU fish species
- Use fish guilds to identify migratory fish species within each catchment
- Shannon Diversity Index of all aquatic species groups in each catchment

Aquatic species by catchment

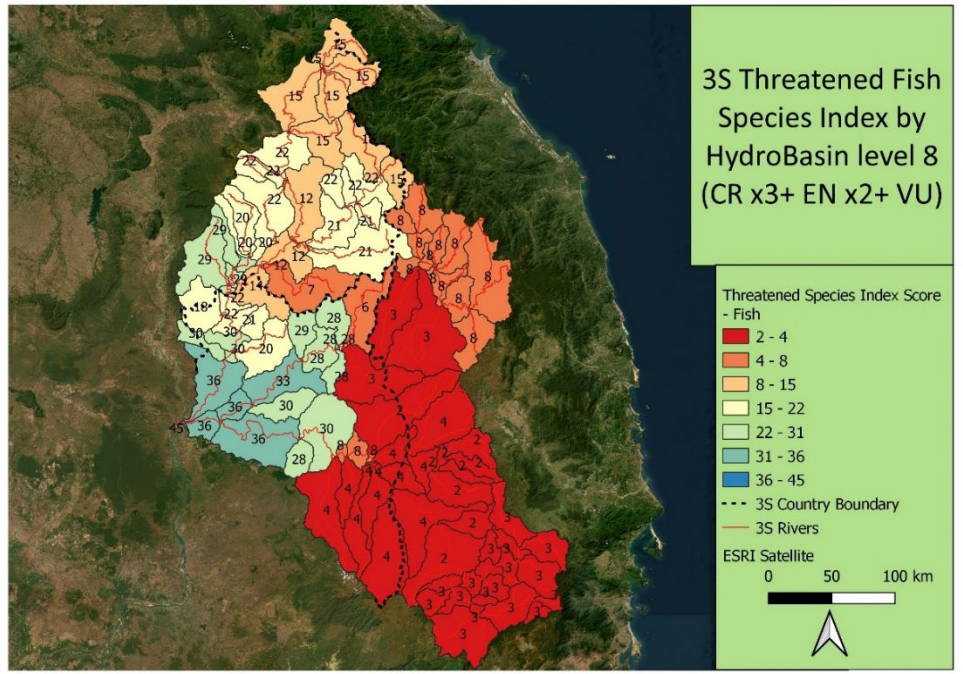
FISH SPECIES NUMBERS BY CATCHMENT –

- Note species numbers decrease from confluence with Mekong



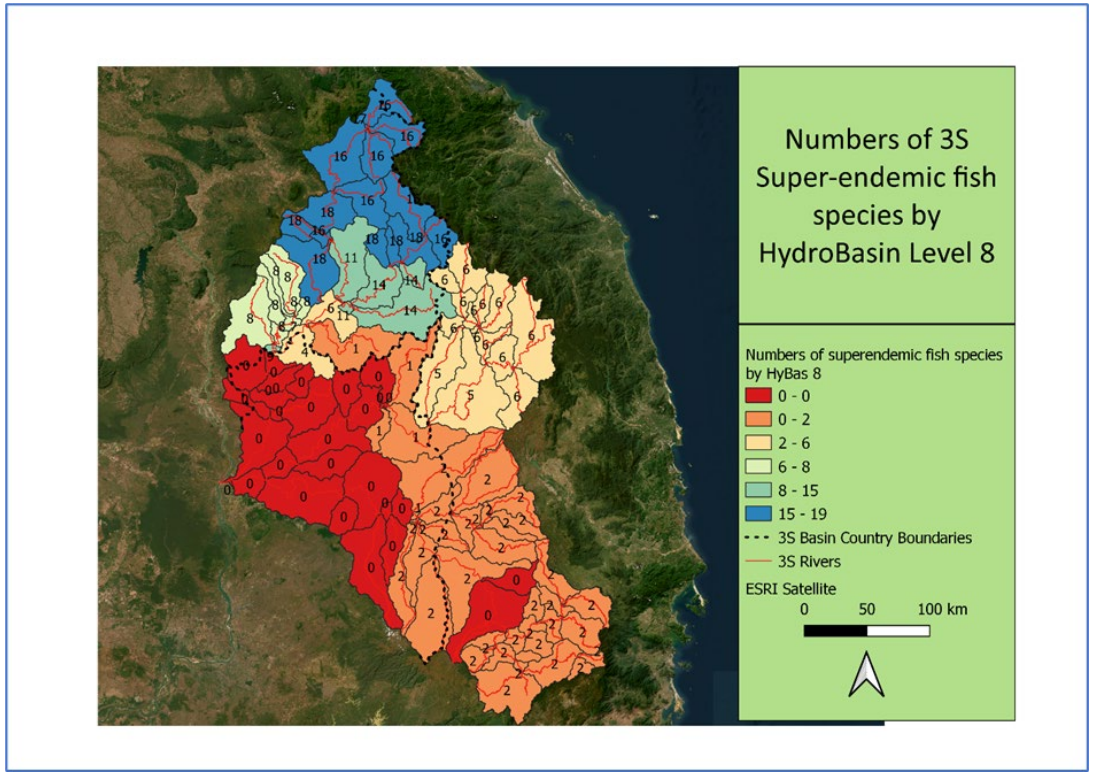
THREATENED FISH SPECIES INDEX BY CATCHMENT –

- Note pattern of aquatic species is opposite of terrestrial species

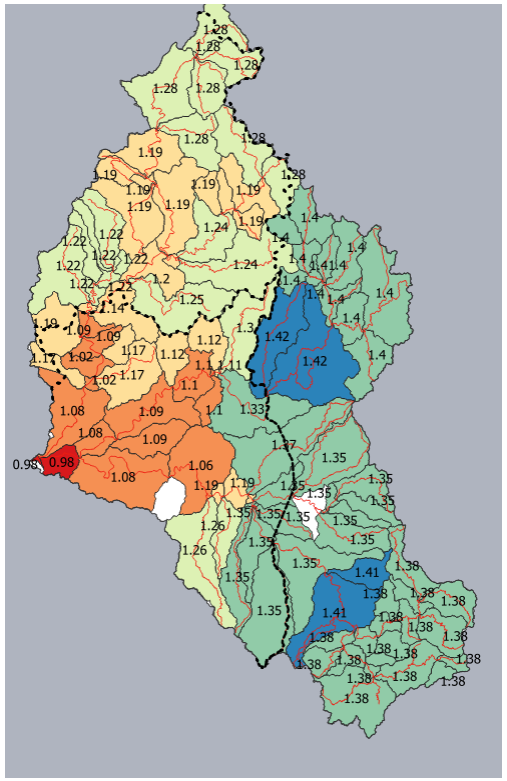


Migratory fish species and Aquatic species diversity

SUPER-ENDEMIC FISH SPECIES – only found in 3s – often rithron resident species



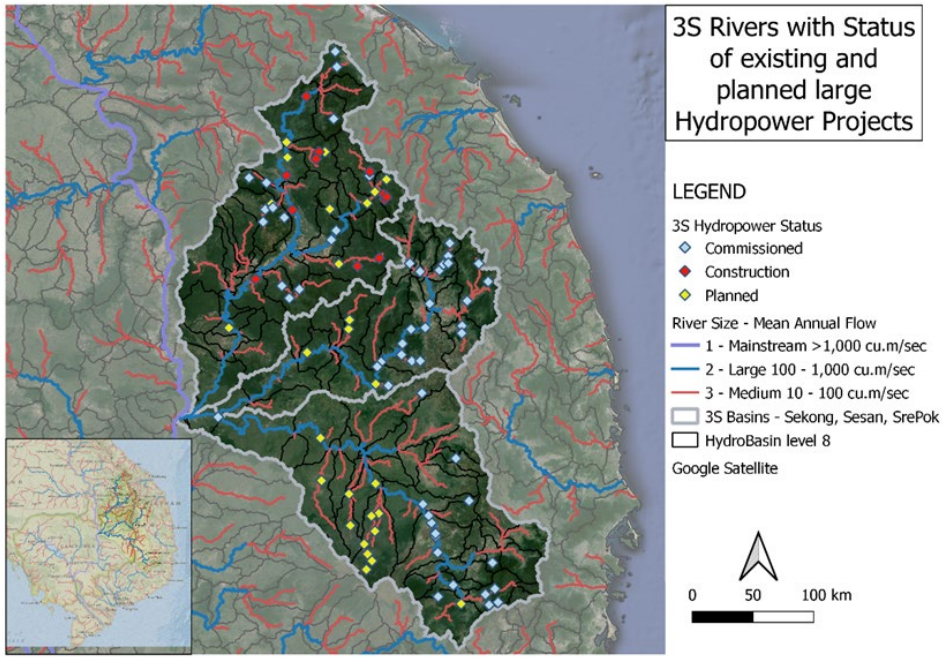
AQUATIC SPECIES DIVERSITY INDEX



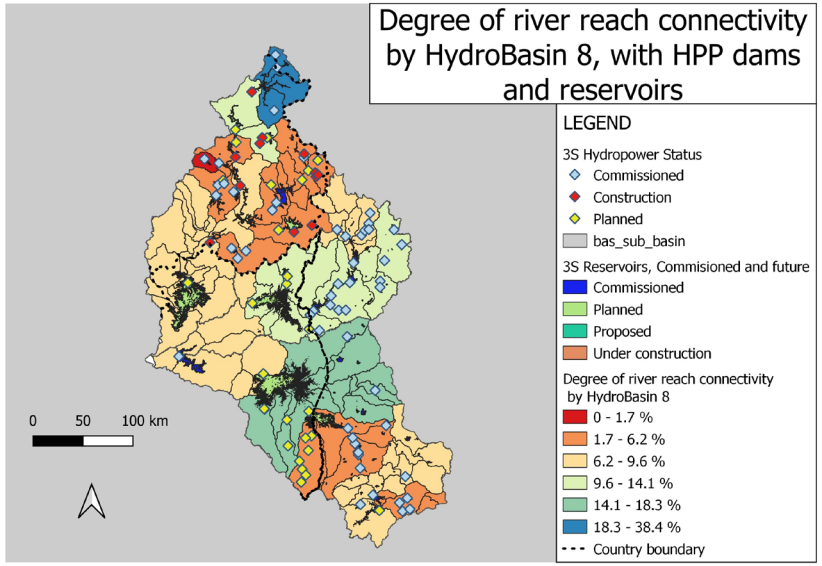
Shows decreasing number of fish and mollusc species and increasing number of odonata, turtles and plant species with distance upstream

Pressures on Aquatic Biodiversity

STATUS OF EXISTING AND PLANNED HYDROPOWER PLANTS

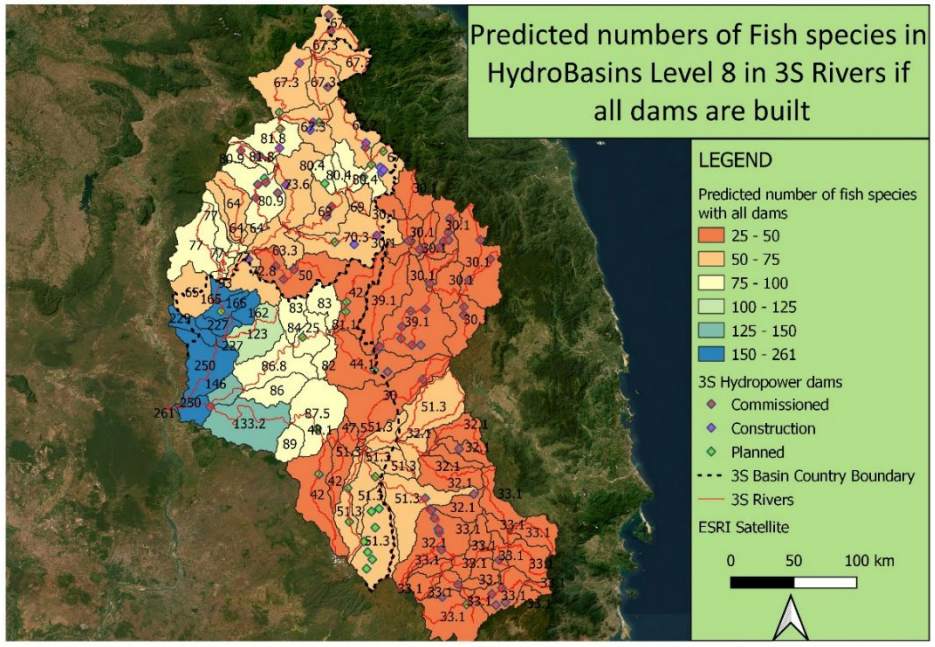


EXISTING HDP RESERVOIR AREA % BY CATCHMENT WITH COMM (RED) AND PLAN (BLUE) RESERVOIRS

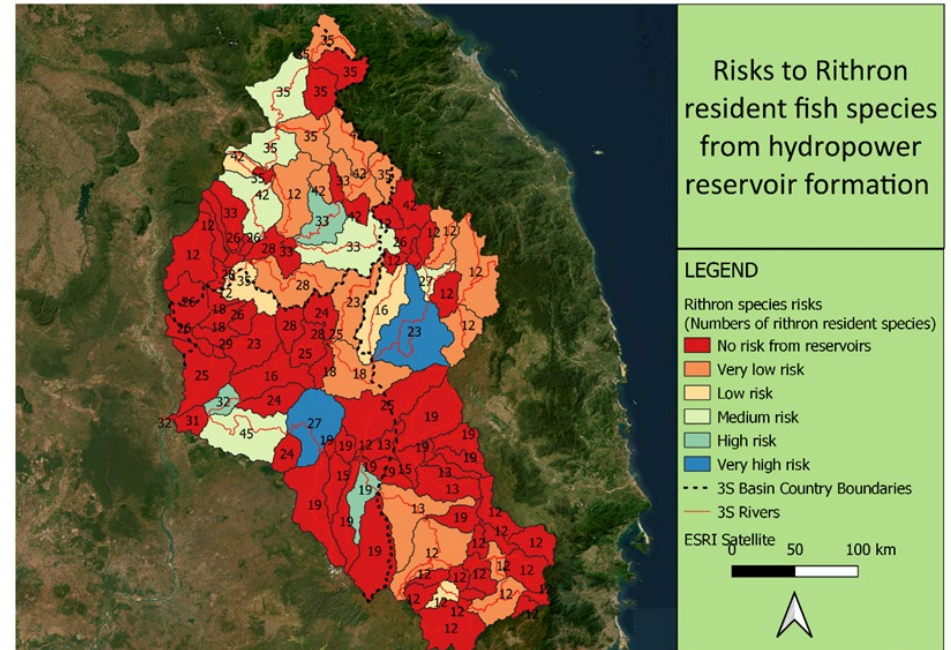


Predicting numbers of species if all dams are built

Many migratory fish guilds cannot pass fish passages, so numbers of species decline



Rithron residents - Fish living in fast flowing streams are at risk when reservoirs are formed



Fisherman on Boeung Kiat Ngong Ramsar site

Bousra waterfall, Mondulkiri, Cambodia

In conclusion – Readily accessible spatial datasets can be used to identify biodiversity “sweet spots” and high pressure “hot spots” and predict changes in biodiversity. These would need to be confirmed by field survey

Let’s continue the conversation!

Post questions and comments in the IAIA24 app.

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