

## Motivation

- Loss of river longitudinal connectivity and degrading fish resources in the upper Yangtze River Basin due to extensive hydropower exploitation <sup>[1]</sup>



Fig. 1 Distribution of planned cascade dams in the upper Yangtze River basin<sup>[1]</sup>

- Late revitalization of fish pass development in China<sup>[2]</sup>

## Study Area

- 14 cascade hydropower stations are planned and/or constructed in the Middle and Lower reaches of the Jinsha River

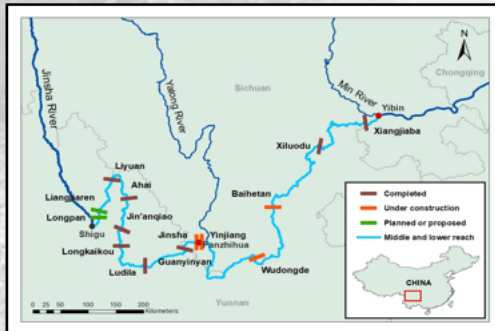


Fig. 2 Location and status of the cascade hydropower dams in the middle and lower reaches of the Jinsha River

- Insufficient fish migration facility installed: only 1 fishway has been constructed (not in operation yet) among 14

## Methods

### 1. Longitudinal connectivity assessment

- Passability check: fish pass planned or constructed? Type?
- Assumed passability value assigned to each of 14 hydropower dams
- Dendritic Connectivity Index (DCI) for potamodromous fish<sup>[3]</sup>

$$DCI_p = \sum_{i=1}^n \sum_{j=1}^n c_{ij} \frac{l_i l_j}{L} \times 100 \quad c_{ij} = \prod_{m=1}^M p_m^u p_m^d$$

### 2. Target species identification

- Fish resources researches + biological studies
- Consideration: vulnerability + socio-economic value

### 3. Analyses of state-of-the-art fish pass designs

- Case studies of fish pass projects in China, Europe and America
- Similar geographical or hydrological condition to the study area

### 4. Restoration measures

- Exemplary fishway design proposal in the Middle and Lower reaches of the Jinsha River
- Based on European and American design guidelines (DWA, FAO/DVWK, BMLFUW and USFWS)

### 5. Questionnaire

- Professional opinions from Chinese researchers in related fields (n=60)
- Online questionnaire platform link sent via E-mail

## Results and Conclusions

- DCI value of the Middle and Lower reaches of the Jinsha River: **13.757** out of 100  
 → **Severely disturbed longitudinal connectivity status**  
 → **Basin-scale restoration for the upper Yangtze River basin**
- 8 target fish species



Fig. 3 Photos of the eight target fish species<sup>[4][5]</sup>

- Vertical-slot fishway (VSF) being mostly adopted at high-head dams in China, combined with fish lift and fish carrying boats for extreme heights
- Feasible VSF design proposed at the Jinsha Hydropower Dam, determining species: *Acipenser dabryanus*
- 24 responses of the questionnaire recovered: 58.3 % agree with the necessity of constructing fish pass to improve the current situation of degrading fish resources  
 → **VSF is suitable for continuity recovery in the study area**  
 → **Combination with other technologies (fish lock, fish lift, trap-and-truck system) to overcome extreme dam heights**  
 → **Compensational measures are necessary**

## References

- [1] Lin, et al. (2019). Current Status and Conservation Planning of Fish Biodiversity in the Upper Yangtze River Basin in the Context of Hydropower Development. *Acta Hydrobiologica Sinica*, 43: 130-143.
- [2] Shi, X., Kynard, B., Liu, D., Qiao, Y., & Chen, Q. (2015). Development of Fish Passage in China. *Fisheries*, 40(4): 161-169.
- [3] Cote, D., Kehler, D., Bourne, C., & Wiersma, Y. (2009). A New Measure of Longitudinal Connectivity for Stream Networks. *Landscape Ecol*, 24: 101-113.
- [4] Li, M., Lin, P., Gao, X., Liu, F., & Tang, Q. (2014). The Elves of the Torrent — Endemic Fish in the Upstream of Yangtze River. *China Nature*, 2: 20-23.
- [5] Retrieved from Institute of Hydrobiology, Chinese Academy of Sciences: [http://english.ihb.cas.cn/pic\\_eihb/ea/](http://english.ihb.cas.cn/pic_eihb/ea/)