

Appendix II. Opportunities for research on wetland ecosystems in NW Yunnan

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Across NW Yunnan are many complexes of lakes, marshes, wetlands, and wet grasslands that offer opportunities for basic research in biodiversity and also research at the nexus of biodiversity, hydrology, livelihoods, and governance. One example is the Napahai National Reserve, pictured below. Later in this report there is another figure, and a short discussion, that suggests some of the potential interactions.

Napahai Lake (3270 m alt.) near Zhongdian, Yunnan Province. Black-necked cranes and bar-headed geese flock to the area for winter.

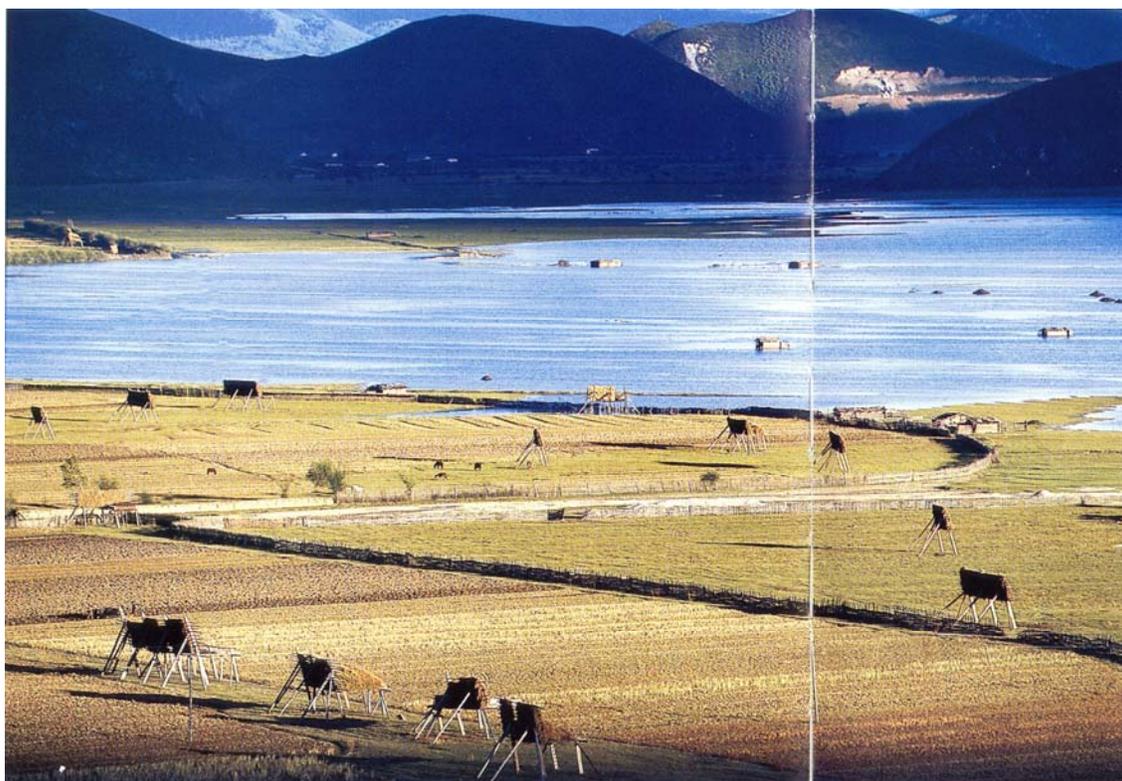


photo source: [Shangrila](#), Foreign Languages Press, Beijing

1. Basic research on biodiversity of aquatic vertebrates

Based on discussions with colleagues at KIZ, basic patterns of biodiversity across these wetlands are not well described. There is probably a natural pattern associated with the elevational gradient, at least as regards amphibians according to Professor Rao Ding-qui (raodq@mail.kiz.ac.cn). Rao works on systematics and evolutionary biology of amphibians and reptiles, and would welcome collaborations with our scientists. Some frog species live on land (breed in water). There is a large group, I think Megophryidae Pelobatidae, with 3 genera that live at very high altitude (1 genus at 4000 m in Himalayas, Tibet plateau, and NW Yunnan).

(Note – Jan Salick told me that there was a herpetologist from US on one of her field trips, looking for high elevation frogs). According to Rao, at a mid elevation lake, like near Shangrila, there might be 2-4 species. Napa Hai has few (it's a grassland), Bitu Hai about 5 species. Lugo Lake about a half dozen, and they are different species than at Shangrila. Lugo Lake also has one introduced frog – *Rana catesbiana* (?) or some North American bullfrog – that may compete with locals. It escaped from a frog farm. None of his students, and no one else, is working on frog biodiversity trends in the lakes and wetlands of NW Yunnan, and much remains to be learned. Rao said that there might be someone at the forestry college of Yunnan Univ. that studies amphibians, fish, etc. Rao says that if there were a student interested in this, he would be happy to work with the student. There is a specimen collection in the KIZ museum on first floor.

Besides the natural elevation gradient, there may be a gradient in disturbance. Lashi hai could have pollution (nutrients, agricultural chemicals), as might Lugo Lake. Rao said Lashi Hai might have relatively more frog species because of its lower elevation, although within Lashi Hai reserve there are actually 4 bodies of water at slightly different elevations. The most polluted lake, Rao thinks, is Er-hai near Dali, from farms, city, and a factory. Cheng hai is another lake between Lijang and Lugo lake. Rao sometimes sees deformed frogs, and I told him about the story emerging from studies in North America. He was unfamiliar with the parasite story, and thought that deformities probably came from chemicals, such as agricultural chemicals.

Besides elevation and possible pollution, another factor affecting biodiversity in these ecosystems is introduced species. This was the focus of discussion with Professor Zunxing Yang, Deputy Director of KIZ (yangjx@mail.kiz.ac.cn). Yang's research is on fish taxonomy, aquatic ecology, and aquaculture. Yang would be happy if we included in our project(s) Lugo Lake, which is near boundary of Yunnan and Sechzuan and was visited by UW members in 2002. It is about 2 km long and 78 m deep. There are macrophytes along the edge, but a narrow littoral zone; 30 m out there is a steep drop-off. There is no fishing or industry, but in fact there is fishing (not much he says) by local Moso ethnic minority. This is the site of growing tourist concessions, and I am told that there are already hotels right at water's edge. The lake has about 10 introduced (nonnative) fish species including grass carp, crusscian carp, and one or more gobi's. The gobi's, introduced in 1980's, eat eggs of native fish species. Carp eat macrophytes including an endemic species *Otcellia*. Consequently, some of the native species are in decline: snow trout (*Schizothorax labrosus*), *S. ninglangensis*, and *S. microstomus*. In 1960's there was lots of production of these endemics, but production has dropped steeply since the introductions. There are not many papers, but he has collected data from the lake monitoring stations – i.e., fishermen report their catch at the stations. Yang has one student that worked for 3 yr at Lugo collecting data from the monitoring station. This student is doing disseration (not in classes), but Yang says that there are no formal courses in fish ecology or aquatic community ecology at the CAS graduate school. I encouraged him to consider having his students come to UW-Madison to sit in on those kinds of courses, including limnology.

Yang says he plans to cultivate the endemic fish (aquaculture) and release fry to restore the population. When I asked him whether the fry would survive, considering the presence of the nonnative species, he didn't seem to know. We discussed studying the interactions in the fish community to guide what actions might be taken. Yang pointed out that the food web needs to

be clarified. Diet information is sometimes from stomach contents. He did say that they might remove some gobis that eat eggs.

There are many other lakes in northwest Yunnan. The large lake at Dali has many of the same problems as Lugo Lake. In Napa Hai up in Shangrila there was a snow trout. The crusscian carp was introduced and the endemic species is extinct. Bita Hai is pristine – the endemic species are there – and this National Reserve (I think) is the site of serious protection (no fishing; scientific collecting OK with permit). Fish ecology has not been studied there much. The Yunnan forestry bureau offered him some financial support to study fish there. He has begun work. They want to know foraging ecology, age and growth, age of first reproduction, etc. He has a student that studied snow trout at Bita Hai and will ask that student to write an abstract in English. The endemic fish species do not do so well in eutrophic waters. So, there may be problems to look at relating to oxygen, ammonia, etc.

2. Waterbirds

Professor Yang Xiaojin (yangxi@mail.kiz.ac.cn) is the leader of a group at KIZ that works on black-necked cranes. According to Yang's student Wu (wuhq01@mail.kiz.ac.cn), they cooperate with Liu Qiang, the student of Dr. Zhu-jianguo. They also collaborate with colleagues at International Crane Foundation (ICF) in Baraboo, WI. Wu has worked at Napa hai in winter, studying feeding ecology and damage to fields. According to Wu, if cranes cause damages then the government will give compensation for damages. Cranes eat buckwheat, oats, during and after harvest. They forage in the grassland and in farmland near the lake. Grazing animals may damage land where cranes feed – no one is studying this according to Wu. It is very easy to watch cranes – they are used to people. They have captured cranes, using snares, in NE Yunnan at the Dashanbao Natural Reserve reserve near Cao Hai .

Rui-Chang Quan also studies waterbirds. He provided us with several of his publications based on work done at Lashihai (Quan et al. 2001; Quan et al. 2002b; Quan et al. 2002a; Quan et al. 2003). He says that you can watch cranes feed with telescope (he thus knows they take animal food), and can collect fecal material. Wu said that Li Fengshan at ICF does fecal analyses of cranes. Rui and Wu both thought it was worth talking with managers at Napa hai about building exclosures to study impact of grazing mammals on the wetland. Rui says he has had some preliminary ideas about this.

Other birds to study – bar-headed geese may be more important according to Rui, because so little is known about this species. Its distribution is unclear (Rui), although most are apparently in Tibet and Quinghai; small numbers in Nepal and Bhutan. Of the estimated 10,000, about 1,000 spend the winter at Napa hai. The birds feed in farmlands, and may share many of same problems as the cranes. Ruddy shell ducks are the most in conflict with humans, due to consumption in farm fields (Rui). About 300 spend winter in Napa hai.

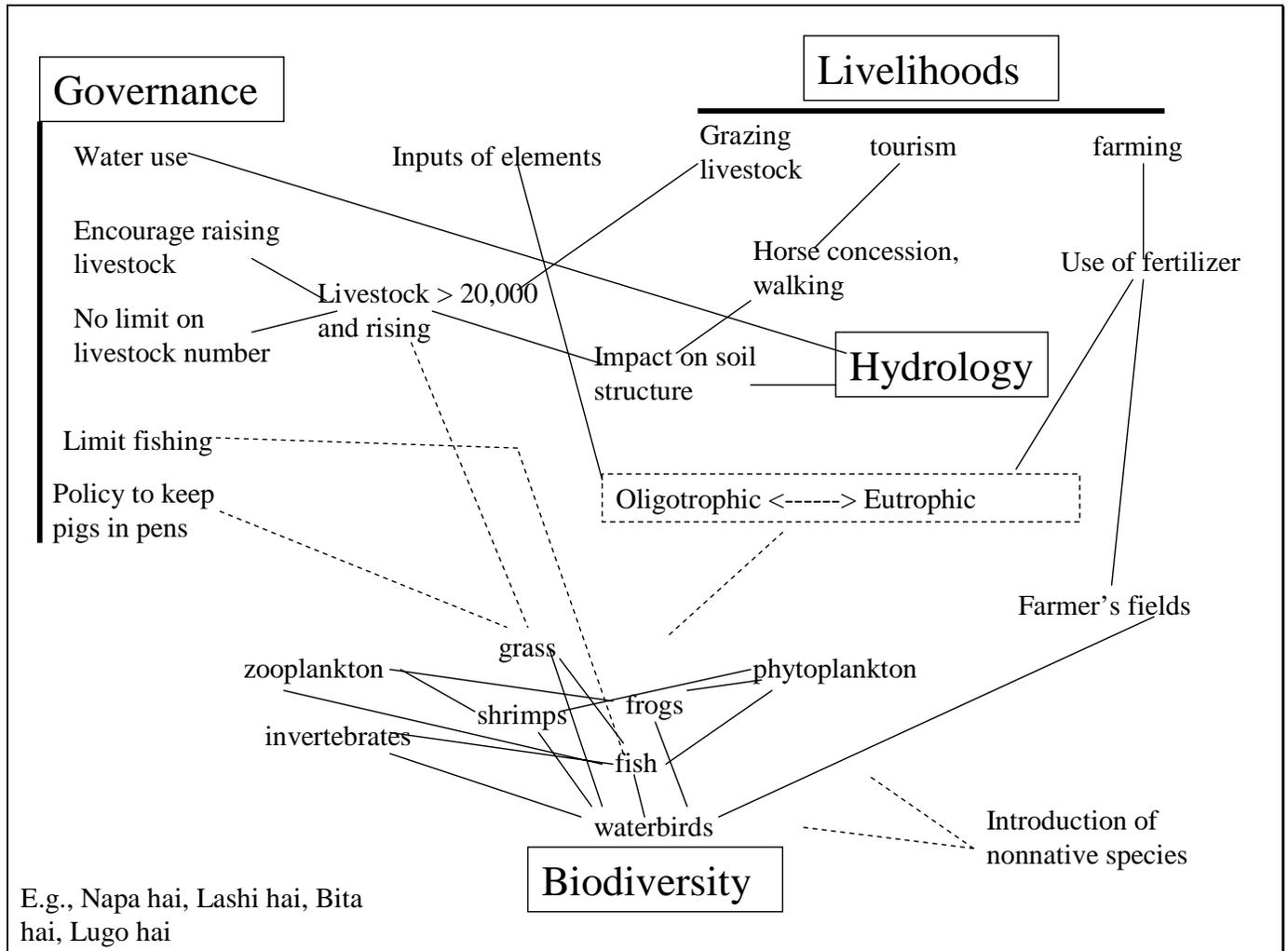
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3. Research model at the nexus of biodiversity, hydrology, livelihoods, and governance

The figure below organizes some of the relevant interactions for one particular site, Napahai (see photograph on page 1). This is the seasonal lake and wetland which is a National Reserve outside of Zhongdian. In winter, the area of the lake exceeds that at Lashi hai.



As an example of interactions, consider the situation of grazing. This is an important component of the livelihood of farmers living adjacent to the Reserve. There are 17 villages around the reserve, and the livestock belong to them. There are no limits to how many a family can own. Villagers consume milk and meat, and they market some meat and cheese curd. The price of meat has been steady over last few years. The government has encouraged raising livestock and numbers are increasing. This has not caused a conflict at Napahai, but conflicts are increasing at high elevation (summer pasture). There are >20,000 livestock grazing at Napahai (cattle, yak, goat, sheep) excluding pigs, which may number 4000-5000. In winter, the pigs dig roots of the grasses. The digging may make it easier for cranes to get at the grass roots as well, but the digging degrades the wetland and is detrimental to the birds over the long term. Last year the

government instituted a new policy of keeping pigs in pens, off the grassland, but it was not effectively enforced.

The impact(s) of grazing have not been studied directly. Sam Kung speculates that the large number of livestock, along with riding of horses and walking by tourists, may have an impact on soil structure and hence the local hydrology. One might also speculate that the grazing reduces biomass of grass for waterbirds, such as black-necked cranes. Other possible impacts of human activities on the web of biotic interactions are suggested in the figure. The impacts of grazing on hydrology and biodiversity might be usefully studied using exclosures.