



## Overlooked Plant Biodiversity in Low-Altitude Areas of the Nu River Valley

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The Nu River flows freely through southwestern China, giving life to a surrounding area rich in biological, geological and ethnic diversity. After the “Three Parallel Rivers” was designated as a UNESCO World Natural Heritage Site, and following the publication of the development plan for a large cascade of hydro stations, the river has come into public view and become a topic of heated public discussion.

### Is biodiversity in low-altitude areas of the Nu River Valley worth protecting?

Proponents of hydro development on the Nu River claim that areas in the Nu River Valley with an altitude of 2,000 m or lower have been largely exploited by human activity. They argue that the ecosystem is so greatly damaged, and biodiversity diminished, leaving no value in conserving the area. According to this argument, even if reservoirs submerged the valley, there would be no loss of biodiversity. Has the valley really lost all of its biodiversity value worth protecting?

The Field Museum of Natural History conducted a rapid survey of biological resources in the south section of Gaoligong Mountain in 2002<sup>1</sup>. The survey found that despite forest degradation, there is still rich diversity in areas at altitudes lower than 2000 m, where some species of high research value are narrowly distributed. A botanical survey also found that areas at lower altitudes have more species than those at higher altitudes. Since birds are vertically distributed, ecological destruction at lower altitudes can seriously affect bird diversity. Ten species that inhabit the area are listed as endangered on the IUCN Red List.

A researcher at the Institute of Botany within the Chinese Academy of Sciences (CAS) conducted a long-term study on the diversity of the orchid family in the native vegetation that

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<sup>1</sup> Stotz, D.F., E.J. Harris, D.K. Moskovits, 郝光明, 易绍良, and G.W. Adelman (主编). 快速生物资源调查报告(4)(中国云南省高黎贡山南段). 美国伊利诺伊州芝加哥市: 菲尔德博物馆(The Field Museum)出版社.

remains in the low-altitude areas of the Nu River Valley<sup>2</sup>. The resulting discovery of the orchid family diversity demonstrates the importance of biodiversity protection in the area. In addition, the valley is a corridor for tropical plants to move north, and for temperate plants to move south and adapt to low-altitude areas.

Field research conducted by International Rivers in 2015 found rich plant diversity and high endemism in the low-altitude areas of the Nu River Valley. Botanists identified over ten species endemic to the Nu River Valley or to Yunnan within the few days of the trip. In a valley area about 20 km north of Liuku, they found a legume species (front photo) which might be endemic to the hot-dry valley. A type of *Saxifraga* discovered in Bingzhongluo, which reproduces by bulbils, may even be a new species, but this cannot be confirmed until it flowers. Fluctuating river zones are prone to changing water levels. During the field visit, main plant species identified in fluctuating zones included *Cotoneaster turbinatus*, *Myrsine semiserrata*, and *Photinia tsaii*, among which *Photinia tsaii* is endemic to the Nu.

Some native vegetation remains in the valley although much has disappeared. The vegetation offers opportunities for the understanding of biological geography, evolution, and conservation biology in the area, and is a reference for future protection and recovery. The fragmented native vegetation may provide a platform for migration and spread of valley species, and thus has high value for protection. The existence of vegetation in the fluctuating areas of the Nu region also provides opportunities for the discovery and research of yet undiscovered plant species.

## Plant diversity in the Nu River Valley faces multiple threats

The biodiversity that remains in the Nu River Valley excites scientists and conservationists. However, the Valley's ecosystem now faces multiple threats, which may alter it completely and cause the existing biodiversity to disappear.

### Large hydropower stations present the greatest potential threat

In 2003, the Yunnan provincial government released the Report on Hydropower Planning in the Middle and Lower Reaches of the Nu River that showed that two reservoirs and 13 cascades of hydro stations would be developed on the Nu River. In the 12<sup>th</sup> Five-Year Energy Plan, the

2 金效华,向小果,陈彬. 植物的研究人员对怒江河谷低海拔地区残存的原生植被中的兰科植物多样性. 2011,19 (1):120-123



A Possible New Species

number was reduced to one reservoir and five cascades: Songta (in Tibet), Maji, Yabiluo, Liuku, and Saige. Any hydro development, whether in the form of 13 dams or five cascades, will exert destructive impacts on plants in the valley.

It is worth comparing proposed development on the Nu River to existing development on the Jinsha River. The Jinsha River Valley, like the Nu River Valley, was also a typical hot-dry valley and a channel for tropical species migration. Hydropower development was a major hindrance to their migration. The water level in Xiluodu Dam on the Jinsha River is 600 m. As the reservoir filled with water, it submerged amphibians and reptiles whose habitats were beneath the new water line. LI Cheng et al.'s research on the amphibians and reptiles living in the Xiluodu reservoir area<sup>3</sup> demonstrated that submergence reduced many tropical species' population sizes. The humidifying effects induced by the reservoirs also decreased the area of suitable habitat for some tropical species. The impact of human activity on biodiversity increased during and after the development of the hydro station. Similar events are likely to occur in the Nu River Region if hydro development goes forward. Hydro development would block migratory channels and upset the current ecosystem balance, reducing biodiversity.

In November 2014, scientists discovered a new species of macaque, now named the white-cheeked macaque (*Macaca leucogenys*) during their field visit in southeastern Tibet<sup>4</sup>. They voiced their concerns that the planned cascade hydro

3 李成等. 溪洛渡水电站对两栖爬行动物多样性影响的预测与保护对策. 应用与环境生物学报. 2001, 7(5):452-456

4 重大科学发现: 大理学院范鹏飞教授在西藏墨脱发现新种猕猴. <http://www.dali.edu.cn/news/zhxw/4777.htm>

stations in Metog would destroy the habitat of the macaque. Not only will the hydro station submerge part of the habitat of the white-cheeked macaque, but the construction process and workers who move into the area will also impact the remaining, non-submerged habitat of the macaque<sup>5,6</sup>.

What impacts do large hydro stations have on ecological systems above the water level of the submerged area? It would be impossible to claim that no ecological impacts exist. Research from the University of East Anglia in the UK shows the huge detrimental impacts that hydro has on tropical rainforests. The Balbina Hydropower Station in the Brazilian Amazon rainforest has one of the largest submerged areas of any dam in the world, covering rainforest and forming a huge reservoir area with over 3,000 manmade islands. The diversity of mammals, birds, and turtles was reduced drastically on the islands despite protective measures put in place. The 26-year isolation has made genetic communication impossible causing a decrease in animal population<sup>7</sup>.

#### Small hydropower stations fragment tributary habitats

Small hydro is often thought to have less impact on the environment than large hydro, but the opposite is actually true. Research conducted by Kelly et al. (2013) on the impact of small hydro<sup>8</sup> shows that the numerous small hydro stations built on the Nu River have had huge cumulative effects on the local ecological environment - greater than the potential impact of large hydro stations. The impact of small hydro on the Nu River and the ecological systems along the riverbank can be observed during short field visits.

118 tributaries from the Nu Prefecture merge into the Nu River. The exploitable ones have had almost all of their water resources exhausted. Most planned small hydro stations have been built and are in operation, but some are still under construction. According to a 2010 geographical diagram of the Nu Prefecture energy grid, there were 82 small hydro stations in the prefecture, 67 of which are located in the Nu River basin and 15 in the Lancang River

5 New primate threatened by old problems. [http://africa.china-daily.com.cn/china/2015-05/01/content\\_20593944.htm](http://africa.china-daily.com.cn/china/2015-05/01/content_20593944.htm)

6 Chinese ecologists call for halt in dam projects in Tibet. [http://zeenews.india.com/news/world/chinese-ecologists-calls-for-halt-in-dam-projects-in-tibet\\_1589302.html](http://zeenews.india.com/news/world/chinese-ecologists-calls-for-halt-in-dam-projects-in-tibet_1589302.html)

7 Hydroelectric dams drastically reduce tropical forest biodiversity <http://www.uea.ac.uk/about/-/hydroelectric-dams-drastically-reduce-tropical-forest-biodiversity>

8 Kelly M. Kibler & Desiree D. Tullos. Cumulative biophysical impact of small and large hydropower development in Nu River, China. WATER RESOURCES RESEARCH, VOL. 49, 1 – 15

basin, with an overall capacity of 1,570 MW. More than half of the Nu River's tributaries have small hydro stations. Some new stations are still under construction, so the numbers of stations and exploited tributaries continue to rise. Over-developed small hydro has and continues to ruin habitats along the Nu River Valley.

During the construction of small hydro, check dams and diversion canals are built to divert the river way and block river sections below the dam. Species that inhabited the river way and have a lower migration ability, and species which rely highly on the original habitat, will go extinct. Such species include the demersal Sisorinae (a fish group) that prefers rapids, as well as a number of plant species. Small hydro obstructs the naturally formed connections between a river's main stream and its tributaries. Additionally, transforming free-flowing water into piped water channels changes the micro climate within the river basins, affecting the habitats of all species in the area. For example, animals that drink from tributaries lose their water supply when they tributaries are piped. The construction of check dams and tunnels for pressure pipes, as well as roads for material shipping and the earthwork, will also directly affect surrounding habitats.

#### Chemical factories: time bombs for rivers

Due to the overproduction of electricity, the Nu Prefectural government has built a potassium perchlorate factory with a capacity of 15,000 tons in Guquan Village, Fugong County, and plans to build another chemical factory with a capacity of 60,000 tons in Gongshan County. These bring huge environmental risks to the ecological environment of the Nu River. According to field research conducted by the Southwest Forestry University in 2015, the potassium perchlorate factory in Fugong County, near the Nu tributary Guquan River, is now operational. Guquan River is the source of drinking water for local residents. Once chemicals pollute the River, the health of local residents will be in danger and the local ecological environment will be contaminated. In addition, there are grave risks in transporting the chemicals. Newly built roads have exacerbated landslides. If vehicles carrying chemicals fall into the river by accident, the Nu will be severely polluted.

#### Agriculture crowds out native plants

Local people in the Nu Prefecture subsist on low incomes and rely on cash crops as a main source of income. The regions south of Liuku have a good climate for tropical fruits, so most arable land is used for cash crops. Native



Cao guo grows in mountain

vegetation in the river valley is therefore seriously damaged.

In recent years, the Nu prefectural government has been encouraging the cultivation of a medicinal plant called amomum tsaoko (cao guo) in Lushui, Fugong, and Gongshan. The acreage for cao guo reached over 400,000 mu (267 km<sup>2</sup>) in the Nu Prefecture by the end of 2014. The plan is to plant another 600,000 mu (400 km<sup>2</sup>), which will make the overall acreage exceed a million mu by 2017. Cao guo plantations have brought substantial economic benefits for local people, but there is little research on its local ecological impact. Cao guo prefers shade, so much vegetation near the Nu River Valley has been destroyed for large-scale planting. Cao guo can grow at altitudes over 2,000 m, so some primeval forests at high altitudes have also been affected.

#### Over-collection prevents successful wildlife protection

Trade of animals and plants that are rare or have medical value has always been a huge problem for wildlife protection. The Nu River Valley has nurtured a great diversity of orchids: 35 genus of 77 species of orchids are on record so far, among which three are endemic to the Nu River basin and nine are critically endangered. Orchids, referred to as

“gentleman of flowers”, are hardly seen in the fields. Most wild orchids living at low altitudes are taken home by local people, and some are even sold illegally. Wild Dendrobium and Huperziaceae are over-collected and sold because of their medical value.

### Preserving plant biodiversity in the Nu River Valley

Research on plant diversity at low-altitudes of the Nu River Valley is still scarce, as many unknown plant species remain yet to be discovered or studied. There is little research on plants in the Nu River Valley in general, and the basic data that has been collected so far is insufficient. The government should encourage background surveys on the plant diversity at low-altitudes of the Nu River Valley, so that basic data generated from the surveys can provide scientific support to local ecological protection and economic development.

The biggest issue the Nu region faces continues to be poverty reduction. When local residents still struggle with basic human needs, ecological protection is not a governmental priority. What industry cash crop plantations or ecological tourism- could promote the sustainable development of the local economy? Is hydro the only major resource that the region owns? What is needed in order for a plan for sustainable economic development to be put in place?

An internationally prestigious kayak and canoe freestyle championship was held on the Nu River in March 2015. All kayaking experts came to the Tiger Beach just for the rapids on the Nu River. Mr. LI Jiheng, party secretary in Yunnan, said at the Chinese People’s Political Consultative Conference (CPPCC) meeting in January 2016 that Yunnan will no longer pursue any small hydro development on the Nu. Instead, Yunnan will file an application to establish a national park in the Nu River Valley in order to promote local tourism. This exciting news maybe a sign that decision makers are beginning to appreciate the ecological value of the Nu. At the same time, this one of the China’s free-flowing rivers now attracts tourists from all over the world. Preserving biodiversity on the Nu will preserve the river’s natural beauty. A well-protected natural environment is one of the most valuable gifts that we can pass on to our future generations.

Front photo: A legume species in Nu River valley, Credit: LI Xiaolong