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Zoological Research

Fish Fauna Status in the Lugu Lake with Preliminary Analysis on Cause and Effect of Human Impacts

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Abstract: The Lugu Lake, shared by Yunnan and Sichuan Province, is a fault lake in the Northwest of Yunnan Plateau in China. Its original fish fauna was composed of 4 species, including three *Schizothorax species* and *Misgurnus anguillicaudatus*. During our surveys to the Lugu Lake in 2001, 2002 and 2004, 518 specimens were collected and the current fish fauna was documented. Besides previous collections and abundant reports, 12 species have been recorded in the Lugu Lake, which belong to 10 genera, Four families and three orders. Change of fish fauna in the Lugu Lake was primarily due to over-fishing and debris flow caused by deforestation.

Key words: Fish fauna; Lugu Lake; Yunnan Plateau

泸沽湖鱼类区系现状及人为影响成因的初步探讨

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摘要: 泸沽湖是位于滇西北的一个断陷湖泊, 为滇川两省共有。文献记录泸沽湖原始的鱼类区系由 4 种鱼类组成, 隶属于裂腹鱼属和泥鳅属。于 2001, 2002 和 2004 年 3 次考察泸沽湖, 进行标本采集和鱼类区系现状调查。查看了采自泸沽湖的鱼类标本 518 号, 结合历史上的采集记录和大量相关文献, 确定泸沽湖记录有鱼类 12 种, 隶属于 3 目 4 科 10 属; 过度捕捞和毁林造成的泥石流是泸沽湖鱼类区系变化的主要原因。

关键词: 鱼类区系; 泸沽湖; 云南高原
中图分类号: Q959.4 **文献标识码:** A **文章编号:** 0254 – 5853(2006)01 – 0094 – 04

The Lugu Lake, formed in the Late Cenozoic (Nanjing Institute of Geography and Limnology, CAS et al, 1989), lies in the Northwest of Yunnan Province at an altitude of 2 680 m above sea level, and with a mean depth of 40.3 m and a maximum depth of 93.5 m (Ji & Fan, 1983). It forms part of the boundary between Ninglang County of Yunnan Province and Yanjing County of Sichuan Province (Fig. 1a). Ichthyological research in the Lugu Lake started from early 1980's. Wang et al (1981) first described three Schizothoracid species as new from Lugu Lake, *Schizothorax labrosus*, *S. ninglangensis* and *S. luguensis*. Chen et al (1982) studied the sympatric speciation in Schizothoracid fishes of the Lugu Lake and treated *S. ninglangensis* as the synonym of *S. microstomus* Huang. Furthermore, they described the fish fauna of the Lugu Lake as the three Schizothoracid species and *Misgurnus anguillicaudatus*. In the present study, fish fauna status in the Lugu Lake was documented mainly on the basis of three surveys from November 16th to

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28th 2001, March 20th to 28th 2002 and June 23th to 25th 2004. Causes of change in the fish fauna were discussed.

1 Materials and Methods

Extending from 27°41′ to 27°45′ N and 100°45′′ to 100°50′ E, the Lugu Lake is about 9.4 km in length and 5.2 km in mean width, it is 48.45 km^2 in surface area and 171.4 km^2 in catchment area (Ji & Fan, 1983). The lake is mainly fed by precipitation and the only outlet is through the Gaizu River, which flows from the southeast corner of the lake into Yalong River (a tributary of Yangtze River). The Lugu Lake is seasonally closed and connected with the Gaizu River mainly in rainy season, without outflow from September to May (Ji & Fan, 1983) (Fig. 1b). The geological evidence indicates that it is one of the youngest fault lakes of Yunnan Plateau (Yang, 1984).

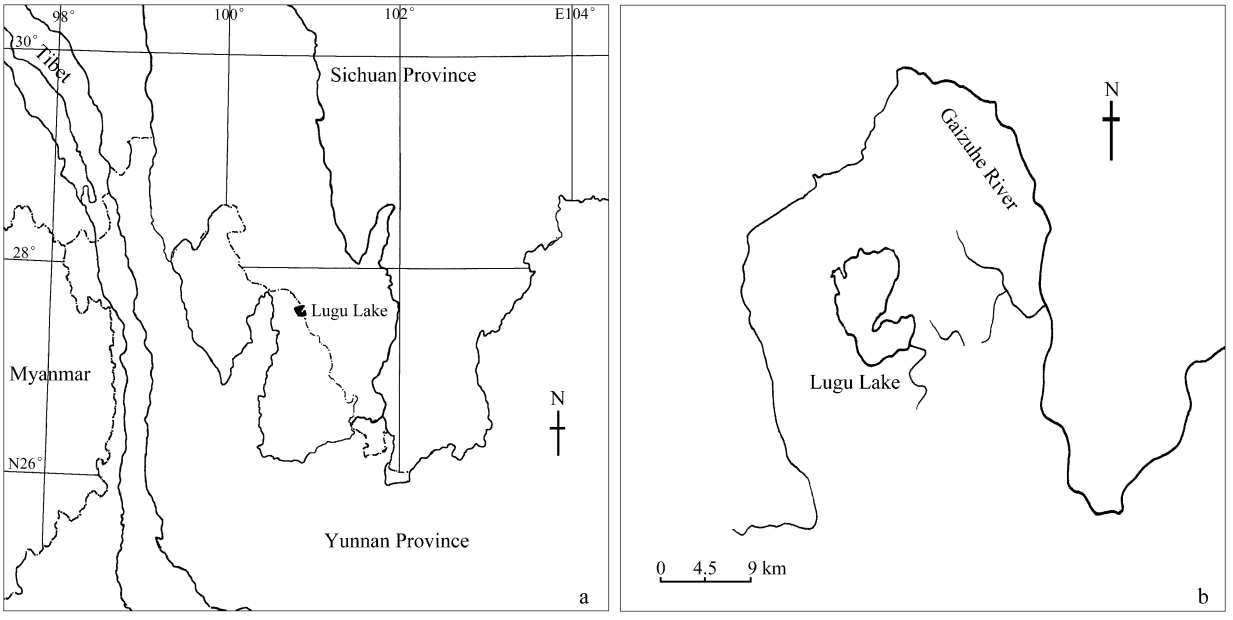

Fig. 1 a, b　Map showing location of the Lugu Lake

Gillnets are widely used in fishing in the Lugu Lake, length and width as well as mesh of the nets varies according to requirements. Gillnets were usually set at different sites and depth in the lake at 4 to 6 o'clock in the afternoon and pulled out at 7:30 to 9:30 the next morning. Fish specimens were purchased from the catches of fishermen around the lake except for those caught by our dipnets. Specimens were fixed in 5% formaldehyde. Previous collecting records were reviewed and local fishermen were interviewed. Identification of fish species follows Chu & Chen (1989, 1990), Chen (1998), Zhu (1995) and Yue (2000). Direct observations and dip net collection were performed by boating around the lake during each survey period.

2 Results and Analyses

2.1 Fish fauna status in the Lugu Lake

On the basis of the three surveys, together with data from existing records (Chen et, 1982), a total of 12 fish species belonging to 10 genera, Four families and three orders were recorded in the lake (Tab. 1). In addition to the four indigenous species reported by Chen et al (1982), eight exotic species were discovered and reported in this study. The fish assemblage in the Lugu Lake has changed greatly during the past two decades. Eight exotic species have been introduced gradually while three of the native species have become endangered (Wang & Xie, 2004). Presently, the fish fauna in the lake is dominated by exotic species, and the crucian carp (*Carassius auratus auratus*) and icefish (*Protosalanx hyalocranius*) are the main commercial species.

2.2 Analysis of causes of fish fauna change in the Lugu Lake

Commercial fishing in the Lugu Lake started from 1958 (Hydroelectric Bureau of Ninglang Yi Autonomous County & History and Records Office of Ninglang Yi Autonomous County, 1995). In the following years, the fish yield increased rapidly and reached its peak of 500 t in 1966 (Zhuang et al, 1987). However, with the application of trawl nets and

Tab. 1 Fish fauna status in the Lugu Lake

Species	Family	Origin	Status
1 *Misgurnus anguillicaudatus*	Cobitidae	Native	+
2 *Schizothorax labrosus*	Cyprinidae	Native	Endangered
3 *Schizothorax ninglangensis*	Cyprinidae	Native	Endangered
4 *Schizothorax microstomus*	Cyprinidae	Native	Endangered
5 *Cyprinus (Cyprinus) carpio*	Cyprinidae	Exotic	+++
6 *Ctenopharyngodon idellus*	Cyprinidae	Exotic	++
7 *Carassius auratus auratus*	Cyprinidae	Exotic	+++
8 *Pseudorasbora parva*	Cyprinidae	Exotic	+++
9 *Abbottina rivularis*	Cyprinidae	Exotic	+++
10 *Rhodeus sinensis*	Cyprinidae	Exotic	+++
11 *Ctenogobius giurinus*	Gobiidae	Exotic	+++
12 *Protosalanx hyalocranius*	Salangidae	Exotic	+++

+ Existing species, temporarily no specimens but its existence was proven by local fishermen;
++ Existing species, temporarily no specimens but discovered in our surveys;
+++ Existing species with specimens collected in our surveys.

improvement of traffic access, fish resources in the lake suffered from overexploitation. Large trawl nets were used in spring, summer and autumn and gill nets in winter without closed fishing seasons (Hydroelectric Bureau of Ninglang Yi Autonomous County & History and Records Office of Ninglang Yi Autonomous County, 1995). Consequently, fish yield in the Lugu Lake dropped to 30 t in 1980 (Fig. 2). Currently the Schizothoracid fishes in the lake are at the edge of extinction and no specimens were collected in the three surveys. According to the local fishermen, only several individuals could be caught per year recently.

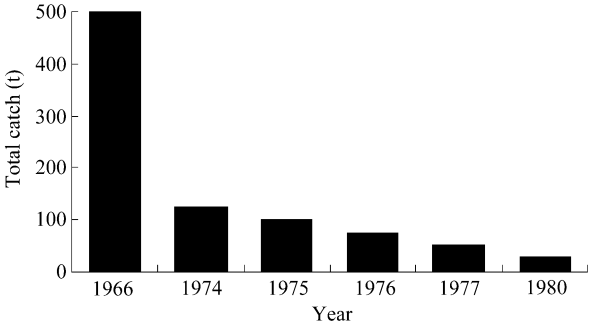

Fig. 2 Total catch of the commercial fisheries in the Lugu Lake from 1996 to 1980

Data of total catch of 1966, 1974, 1977 and 1980 from Zhuang et al, 1987; and data of 1975 and 1976 from Hydroelectric Bureau of Ninglang Yi Autonomous County & History and Records Offiee of Ninglang Yi Autonomous County, 1995.

Large scale deforestation for commercial use of the timber and houses building has occurred twice around the Lugu Lake. The first period started at the beginning of 1970's and the second from 1980 to 1992. (Wan & Guo, 1997). As a result, debris flow silt from erosion that followed the clearing of forests happened frequently in the streams and poured into the lake. From 1980 to 1990, siltation had advanced 100 m into the lake just in the Da-Yu-Ba River estuary (Wan & Guo, 1997), which led to the loss of many spawning habitats of the three *Schizothorax* fishes and consequently to the decrease in their stocks.

Discussion

When analyzing the factors responsible for ichthyofauna change in the Lugu Lake, it is worth to note that besides over-fishing and habitat loss, introduction of exotic species into the lake was also one of the leading reasons. Exotic fishes competed with indigenous fishes for food and habitat, and some exotic species devoured eggs of the indigenous fishes (Yang, 1996). Populations of native species in the Lugu Lake have declined due to their diminished reproductive success chance by over-fishing, habitat loss caused by debris flow silt and exotic fishes invasion since the late 1960s. For the sake of conservation, intensive investigations should be performed in the future study to elucidate the population status of the three Schizothoracid species in the Lugu lake.

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References:

Chu XL, Chen YR. 1989. The Fishes of Yunnan, China, Part Ⅰ[M]. Beijing: Science Press. (in Chinese)

Chu XL, Chen YR. 1990. The Fishes of Yunnan, China, Part Ⅱ[M]. Beijing: Science Press. (in Chinese)

Chen YY. 1998. The Fishes of the Hengduan Moutains Region[M]. Beijing: Science Press. (in Chinese)

Chen YY, Zhang W, Huang SY. 1982. Speciation in schizothoracid fishes of Lake Lugu[J]. *Acta Zoologica Sinica*, **28**(3): 217 – 225. (in Chinese)

Hydroelectric Bureau of Ninglang Yi Autonomous County, History and Records Office of Ninglang Yi Autonomous County. 1995. Records of irrigation works in Ninglang Yi Autonomous County[M]. Kunming: Yunnan University Press. (in Chinese)

Ji J, Fan YQ. 1983. Preliminary analysis on the hydrologic characteristics of Lake Lugu[A]. In: The Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, Chinese Academy of Sciences. Qinghai-Xizang Plateau Research, Hengduan Mountains Expedition. Series One[C]. Kunming: Yunnan People's Publishing House, 214 – 225. (in Chinese)

Nanjing Institute of Geography and Limnology, CAS, Lanzhou Institute of Geology, CAS, Institute of Geochemistry, CAS, Nanjing Institute of Geology and Paleontology, CAS. 1989. Environments and Sedimentation of Fault Lakes, Yunnan Province[M]. Beijing: Science Press. (in Chinese)

Yang JX. 1996. The alien and indigenous fishes of Yunnan: A study on impact ways, degrees and relevant issues[A]. In: Wang S, Peter JS, Xie Y. Conserving China's Biodiversity (Ⅱ)[C]. Beijing: China Environmental Science Press, 129 – 138. (in Chinese)

Yang LF. 1984. The preliminary study on the original classification and distribution law of lakes on the Yunnan Plateau[J]. *Transactions of Oceanology and Limnology*, **1**: 34 – 39 (in Chinese).

Yue PQ. 2000. Fauna Sinica, Osteichthys, Cypriniformes Ⅲ[M]. Beijing: Science Press. (in Chinese)

Wan Y, Guo LX. 1997. Crisis factors and control approaches of the special natural-social ecological system of the Lugu Lake Area[J]. *Resources and Environment in the Yangtze Valley*, **6**(3): 211 – 215. (in Chinese)

Wang YH, Zhuang DD, Zhang KX, Gao LC. 1981. Descriptions of three new schizothoracid fishes from Lake Luguhu of Yunnan Plateau, China[J]. *Acta Zootaxonomica Sinica*, **6**(3): 328 – 333. (in Chinese)

Wang S, Xie Y. 2004. China Species Red List, Vol. Ⅰ, Red List. [M]. Beijing: Higher Education Press. (in Chinese)

Zhu SQ. 1995. Synopsis of Freshwater Fishes of China[M]. Nanjing: Jiangsu Science and Technology Publishing House. (in Chinese)

Zhuang DD, Gao LC, Guo QZ. 1987. Preliminary studies on the resources of fresh-water fishes in Yunnan and their evaluation[A]. In: Xiao JQ. Symposium on reasonable exploitation of biological resources in Yunnan[C]. Kunming: Yunnan People's Publishing House, 228 – 234. (in Chinese)

《动物学研究》2006 年封面动物简介

倭蜂猴(*Nycticebus pygmaeus*, Pygmy slow loris)俗名小懒猴，隶属于灵长目(Primates)懒猴科(Lorisidae)。属国家Ⅰ级重点保护野生动物。

成体体重一般为 400 ~ 700 g，头体长 24 ~ 26 cm。头圆，尾极短，头面部和体背棕红色。因其憨态可掬，常作为宠物饲养。

栖息于热带、亚热带常绿阔叶林中。树栖，善攀爬，单独活动。夜行性，白天蜷缩成球状在树洞中睡觉，行动迟缓，故又称“懒猴”。以果实为食，亦喜食昆虫、小鸟和鸟蛋。

中国科学院昆明动物研究所的科研人员曾对其进行驯养繁殖研究，并取得成功。

印度支那地区特有种，国内仅分布于云南南部和东南部，国外分布于越南和老挝。数量稀少。

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