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Rapid Communication

First wild record of tench, *Tinca tinca* (Linnaeus, 1758) in Tibet, China

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Abstract

The tench *Tinca tinca* (Linnaeus, 1758) was documented for the first time on the Tibetan Plateau. As a freshwater fish species naturally distributed in most parts of Europe and two rivers of Asia (Irtysh River and Ulungur River), *T. tinca* has been widely introduced elsewhere as an aquaculture species. In April 2021, a specimen of *T. tinca* was collected in the Lhalu wetland and identified based on morphological characteristics and via molecular analysis (COI sequence comparison). This species was very likely released into natural waters by humans. We recommend further work to monitor the introduction of *T. tinca* and implement interventions to prevent its establishment and spread in Tibet.

Key words: nonnative species, molecular tool, Lhalu wetland, Tibetan Plateau

Introduction

Anthropogenic activities are leading to the massive introduction of freshwater fish species across the globe, posing a serious threat to the functioning of freshwater ecosystems (Olden and Rooney 2006; Liu et al. 2021). In new areas, nonnative freshwater fishes have caused widespread changes in the species compositions of the recipient communities, as well as remarkable losses in human welfare and economic development. In aquatic ecosystems, fish are among the most commonly introduced taxonomic groups (Gozlan et al. 2010). Among all possibilities of freshwater fish introduction, aquaculture is considered the main vector for the introduction of nonnative fish in China (Xiong et al. 2015, 2017).

The Tibetan Plateau (TP) is commonly known as "the roof of the world" or "the third pole" due to its vast area and high altitude (Zhang et al. 2002). On the TP, the Lhalu wetland (average elevation of 3,645 m and total area of 6.6 km^2) is the largest urban natural wetland and is also the wetland with the highest elevation worldwide (Fan et al. 2011; Chen et al. 2018; Wang et al. 2021). Some studies have reported nonnative fish species in the Lhalu wetland, and the most abundant species are *Carassius auratus*, *Cyprinus carpio*, and *Pseudorasbora parva* (Pubu et al. 2010; Fan et al. 2011).

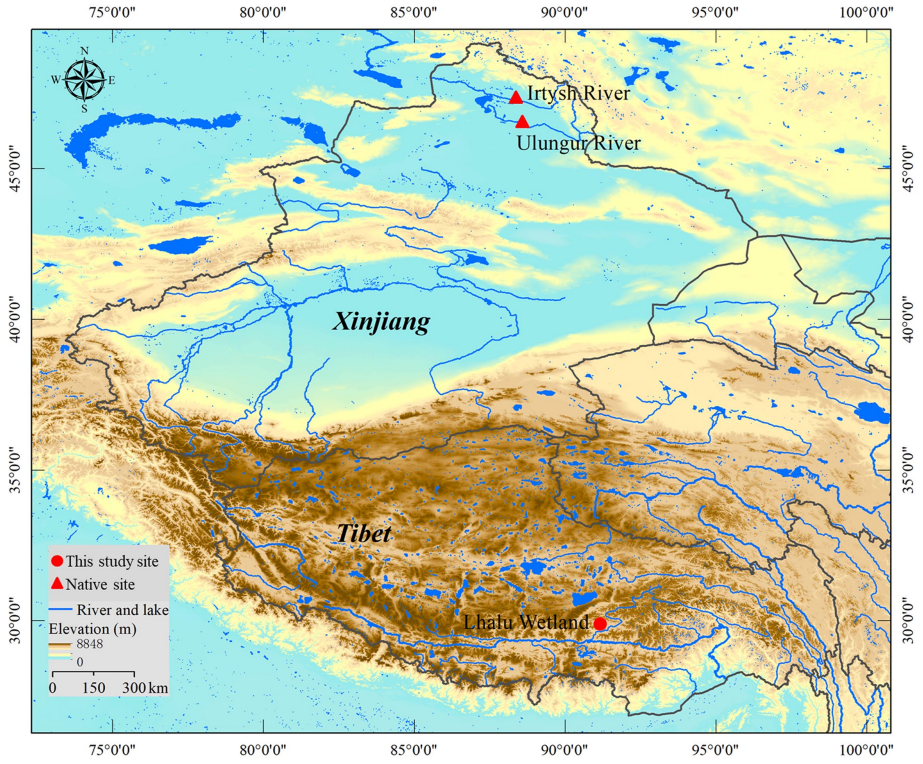

Figure 1. The location of the Lhalu wetland in Tibet.

The tench *Tinca tinca* (Linnaeus, 1758) (Cypriniformes: Cyprinidae) is a freshwater fish species naturally distributed in most parts of Europe and two rivers of Asia (Irtysh River and Ulungur River) (Chen 1998; Kottelat and Freyhof 2007). It inhabits lentic or slow-flowing waters and has omnivorous diets (Michel and Oberdorff 1995). In recent years, it has been widely introduced into other parts of China as an aquaculture species, including the Yangtze River basin, Haihe River basin, Pearl River basin and Heilongjiang River basin (Chen et al. 2011; Li et al. 2021). In this communication, we report the finding of *T. tinca* for the first time in natural waters in Tibet.

Materials and methods

The Lhalu wetland (29.66°N; 91.11°E) is a swampy wetland of peat and reeds located in a temperate, semiarid, monsoon climate zone in Tibet. The average annual precipitation is 439.8 mm (most rainfall occurs between July and September), and the average temperature is 7.5 °C (ranging from a high of 30 °C in June or July to a low of −16.5 °C in January). We carried out a fish survey on April 23, 2021 (Figure 1). The fish specimens were captured by plastic cages (length 10 m × width 0.4 m × height 0.3 m; mesh size 4 mm). The total and standard lengths of fish were measured to the nearest mm and weight was weighed to the nearest 0.1 grams. The specimens were euthanized by 60 mg/L benzocaine (Sigma, USA). A small piece of fin tissue was clipped and stored in 75% alcohol, and the specimens were soaked in 5% formaldehyde for six hours and then stored in 70%

Figure 2. Habitat and morphology of *Tinca tinca* (Specimen number: 20210423047; Total length: 95.95 mm; Standard length: 81.52 mm; Total weight: 12.18 g. Photographed by Songhao Ji).

ethanol for long-term preservation. Morphological measurements (based on Kottelat and Freyhof 2007) and molecular sequencing analysis (COI, Knebelsberger et al. 2015) were conducted in the Laboratory of Biological Invasion and Adaptive Evolution, Institute of Hydrobiology, Chinese Academy of Sciences, Wuhan.

Results

In total, the catch collected included two species of native fish (*Triplophysa tibetana* and *T. stenura*) and six species of nonnative fish (*T. tinca*, *C. auratus*, *P. parva*, *Paramisgurnus dabryanus*, *Silurus asotus*, and *Micropercops swinhonis*). A single specimen of *T. tinca* was captured in a shallow pool with dense vegetation. The specimen was morphologically diagnosed according to the following features: body: thickset and laterally compressed; overall colouration: olive-green, at times dark green or almost black, with golden reflections on the ventral surface; skin: thickened and slimy; scales: small and embedded; head: triangular, snout and relatively long; mouth: terminal, small in size with thick lips and a pair of barbells (maxillary); fins: dorsal soft fin with nine rays, anal soft fin with seven rays, and caudal fin with 19 rays; and caudal peduncle: characteristically deep and short (Figure 2). The total length, standard length and total weight of this specimen were 95.95 mm, 81.52 mm and 12.18 g, respectively. The molecular sequences were 100% matched to those of *T. tinca* from the National Center for Biotechnology Information database (NCBI, https://www.ncbi.nlm.nih.gov/, Figure 3).

Discussion

Tinca tinca is an omnivorous fish that can inhabit water bodies even with low oxygen and low temperature. As a popular aquaculture species, it has been widely introduced around the world (Allen et al. 2002). In China, the tench is considered one of the high-risk invasive species in the Haihe River (Li et al. 2021). Hence, the introduction of *T. tinca* to natural waters would further elevate the invasion risks of freshwater fish in Tibet.

Figure 3. Neighbor-joining tree for mitochondrial COI fragments. The red label indicates individuals collected from this study and other sequence information is from the NCBI database (https://www.ncbi.nlm.nih.gov/).

The TP has been listed in the "The Global 200 ecoregions" and the biodiversity hotspots for conservation priorities (Olson and Dinerstein 1998; Myers et al. 2000; Jenkins et al. 2013). It is one of the most sensitive areas to global climate change and experiences rising temperatures at a speed twice that of the global mean (Kang et al. 2010). In recent decades, the environmental conditions of Tibet have changed dramatically as a consequence of rapid economic development. Correspondingly, the number of nonnative species in Tibet is increasing very quickly (Xie et al. 2001; Ding et al. 2008). Compared with previous studies, our survey reported two new nonnative fish species in the Lhalu wetland (*P. dabryanus* and *T. tinca*), and *T. tinca* was found in the natural waters on the TP for the first time.

A larger number of nonnative fishes have been introduced through aquaculture in China (Xiong et al. 2015; Wang et al. 2016), and many of those have been accidentally or intentionally introduced to the wild (Xiong et al. 2017; Zhu et al. 2022). However, in Tibet, and for a long period of time, there have been few regulations on the management of fish resources. Local people preserve a culture of releasing fish into rivers as a result of the practice of believing in Buddhism, without attention given to whether fish species are native or nonnative to Tibet (Fan et al. 2011; Tashi Lahm et al. 2017). Therefore, *T. tinca* was very likely bought from the aquatic market and released in the Lhalu wetland.

Nonnative fish introduction has been recognized as one of the main causes of the global decline in biodiversity (Xie and Chen 1999; Vitule et al. 2009). On the TP, fish faunas have adapted to the alpine ecosystem and are vulnerable to invasion by nonnative fish (Liu et al. 2018). Nonnative freshwater fish can compete for food and habitat with native species and even alter the functioning of recipient ecosystems, which could lead to the decline of native species (Xiong et al. 2015). To prevent the establishment and spread of nonnative species, local governments should pay more attention to the monitoring of *T. tinca* populations and should apply appropriate interventions, such as eradication or containment.

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Author contribution

R.Z. and H.S: collected and identified samples from the field and writing the original draft of the manuscript. J.S., X.L. and Y.J: contributed to the methodology and software. X.S.: managed the survey planning and design, contributed to the funding acquisition. All authors contributed to MS draft preparation and review.

References

Allen GR, Midgley SH, Allen M (2002) Field guide to the freshwater fishes of Australia. Western Australian Museum, Perth, 394 pp

Chen FY, Liang WW, Feng PF, Huang GH (2011) Artificial propagation and breeding technology for *Tinca tinca* Linnaeus. *Journal of Southern Agriculture* 42(7): 806–808 [in Chinese]

Chen TT, Lang W, Chan E, Philipp CH (2018) Lhasa: urbanising China in the frontier regions. *Cities* 74: 343–353, https://doi.org/10.1016/j.cities.2017.12.009

Chen YY (1998) Fauna Sinica, Osteichthyes, Cypriniformes II, Cyprinidae. Science Press, Beijing, 531 pp [in Chinese]

Ding JQ, Mack RN, Lu P, Ren MX, Huang HW (2008) China's booming economy is sparking and accelerating biological invasions. *BioScience* 58: 317–324, https://doi.org/10.1641/B580407

Fan LQ, Tu YL, Li JC, Fang JP (2011) Fish assemblage at the Lhalu wetland: Does the native fish still exist. *Resources Science* 33(9): 1742–1749 [in Chinese]

Gozlan RE, Britton JR, Cowx I, Copp GH (2010) Current understanding on non-native freshwater introductions. *Journal of Fish Biology* 76: 751–796, https://doi.org/10.1111/j.1095-8649.2010.02566.x

Jenkins CN, Pimm SL, Joppa LN (2013) Global patterns of terrestrial vertebrate diversity and conservation. *Proceedings of the National Academy of Sciences of the United States of America* 110: 2602–2610, https://doi.org/10.1073/pnas.1302251110

Knebelsberger T, Dunz AR, Neumann D, Geiger MF (2015) Molecular diversity of Germany's freshwater fishes and lampreys assessed by DNA barcoding. *Molecular Ecology Resources* 15: 562–572, https://doi.org/10.1111/1755-0998.12322

Kottelat M, Freyhof J (2007) Handbook of European freshwater fishes. Berlin, 646 pp

Li XJ, Tang WQ, Zhao YH (2021) Risk analysis of fish invasion in Haihe River Basin caused by the central route of the South-to-North Water Diversion Project. *Biodiversity Science* 29: 1336–1347, https://doi.org/10.17520/biods.2021130

Liu CL, Diagne C, Angulo E, Banerjee AK, Chen YF, Cuthbert RN, Haubrock PJ, Kirichenko N, Pattison Z, Watari Y, Xiong W, Courchamp F (2021) Economic costs of biological invasions in Asia. *NeoBiota* 67: 53–78, https://doi.org/10.3897/neobiota.67.58147

Liu J, Miline RI, Cadotte MW, Wu ZY, Provan J, Zhu GF, Gao LM, Li DZ (2018) Protect third pole's fragile ecosystem. *Science* 362: 1368, https://doi.org/10.1126/science.aaw0443

Michel P, Oberdorff T (1995) Feeding habits of fourteen European freshwater fish species. *Cybium* 19(1): 5–46

Myers N, Mittermeier RA, Mittermeier CG, Da Fonseca GA, Kent J (2000) Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858, https://doi.org/10.1038/35002501

Olden JD, Rooney TP (2006) On defining and quantifying biotic homogenization. *Global Ecology and Biogeography* 15: 113–120, https://doi.org/10.1111/j.1466-822X.2006.00214.x

Olson DM, Dinerstein E (1998) The Global 200: A representation approach to conserving the Earth's most biologically valuable ecoregions. *Conservation Biology* 12: 502–515, https://doi.org/10.1046/j.1523-1739.1998.012003502.x

Pubu, Lhagdor, Basang, Tsering (2010) Study on Species Diversity of Vertebrates in the National Reserve of Lhalu wetland, Lhasa. *Journal of Tibet University* 25: 1–7, https://doi.org/10.16249/j.cnki.54-1034/c.2010.01.005 [in Chinese]

Tashi Lahm, Lv HJ, Zhang C, Zhou JS, Pan YZ, Chen MQ, Yao WZ (2017) Problems and solutions of fish release in Tibet. *China Fisheries* 9: 32–35 [in Chinese]

Vitule JRS, Freire CA, Simberloff D (2009) Introduction of non-native freshwater fish can certainly be bad. *Fish and Fisheries* 10: 98–108, https://doi.org/10.1111/j.1467-2979.2008.00312.x

Wang H, Wang Q, Bowler PA, Xiong W (2016) Invasive aquatic plants in China. *Aquatic Invasions* 11: 1–9, https://doi.org/10.3391/ai.2016.11.1.01

Wang H, Xie D, Xiong W, Tang W, Wu ZG, Xiao KY, Wang Q (2021) Current status and future prospects of Lhalu wetland on the Tibetan Plateau. Eco mont - Journal on Protected Mountain Areas Research 13: 58–61, https://doi.org/10.1553/eco.mont-13-2s58

Xie P, Chen YY (1999) Threats to biodiversity in Chinese inland water. *Ambio* 28: 674–681, https://www.jstor.org/stable/4314981

Xie Y, Li Z, Gregg WP, Li D (2001) Invasive species in China - an overview. *Biodiversity and Conservation* 10: 1317–1341, https://doi.org/10.1023/A:1016695609745

Xiong W, Shen C, Wu Z, Lu H, Yan Y (2017) A brief overview of known introductions of non-native marine and coastal species into China. *Aquatic Invasions* 12: 109–115, https://doi.org/10.3391/ai.2017.12.1.11

Xiong W, Sui XY, Liang SH, Chen YF (2015) Non-native freshwater fish species in China. *Reviews in Fish Biology and Fisheries* 25: 651–687, https://doi.org/10.1007/s11160-015-9396-8

Zhang YL, Li BY, Zheng D (2002) A discussion on the boundary and area of the Tibetan Plateau in China. *Geographical Research* 21: 1–8, https://dx.doi.org/10.3321/j.issn:1000-0585.2002.01.001 [in Chinese]

Zhu R, Chen K, Cai XW, Li GJ, Chen YF, Shen ZX (2022) The first wild record of invasive redhead cichlid, *Vieja melanura* (Günther, 1862), in Hainan Island, China. *BioInvasions Records* 11: 244–249, https://doi.org/10.3391/bir.2022.11.1.25