Effects of Qinghai-Tibet Railway and Highway on Plateau Picas

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*Abstract—Plateau pica (Ochotona curzoniae) is the keystone species on Qinghai-Tibet Plateau. We studied relative densities of the pica using pica holes in roadside habitats in 15 locations along the parallel Qinghai-Tibet Railway and Highway by strip transect method in summer 2009. Five transects (3m*150 m) were censused according to the distance levels from the two roads (D=0 m, 300 m, 600 m, 900 m, 1200 m) in each location. Snow finches which were previously considered as neighbors of the pica living in the same hole were also counted in each transect. Our results showed that no differences in density of pica holes were found among the five distances, but there was a positive relationship between pica holes and snow finches. Our results suggested the Qinghai-Tibet Railway and Highway have no effects on the plateau picas.*

Keywords- Plateau pica; highway; Hoh-xil Nature Reserve; Qinghai-Tibet Plateau; railway; road ecology

I. *INTRODUCTION*

Many studies have been conducted on the road effects on birds and mammals [1, 2, 3]. Most of them showed that road had negative effects on animal richness and abundance [4, 5, 6]. Reasons included noise load, road mortality, air pollution, et al.[2]. However, some other studies gave positive or insignificant results [7, 8, 9].

The Qinghai-Tibet Railway and Highway are the two main roads passing through the Qinghai-Tibet Plateau. The Golmud to Lhasa section of the Railway was built in 2001 and opened in 2006, whereas the Highway was constructed in 1950 and opened in 1954. Xining, the provincial capital of Qinghai Province, is the starting point of both roads. Then they cross the hinterland of Qinghai-Tibet Plateau, and end in Lhasa, provincial capital of Tibet. Some studies have been conducted in evaluating the road effects on mammals, especially on Tibetan antelopes, and found that although these ungulates relocated their activity time budgets in roadsides of the two parallel roads[10], they were getting used to the railway [11, 12, 13]. Besides that, a recent work on ground birds even found the road verge of Qinghai-Tibet Railway and Highway has become an attractive area because of its foraging and nesting convenience [14, 15]. All these studies indicate Qinghai-Tibet roads have no significant negative effects on local animals.

Plateau picas have been found as a keystone species on Qinghai-Tibet Plateau, because they can share homes with plateau birds, provide principle prey for nearly all plateau predators, and even make a better microhabitat for alpine plants [16, 17], so our study objective is to explore whether and how the Qinghai-Tibet Railway and Highway affect plateau picas. Additionally, snow finches (*Montifringillla* spp.) living in the same hole with plateau picas has long been noticed, so we conducted bird survey to explore whether there is a positive relationship between snow finches and pica holes.

II. *METHODS*

Pica surveys were conducted in July 2009 in Hoh-xil National Nature Reserve, Qinghai Province, China, where the average elevation is more than 4600m above sea level. The Qinghai-Tibet Railway and Highway are parallel during most parts of this section. Local climate is dominant by cold, dry and long winters, fierce winds, and strong solar radiation. Mean annual temperature is about – 8° C, and the lowest temperature recorded was – 46.4° C. Vegetation in this area is dominated by alpine meadow and grassland, completely without any trees or shrubs. This area is called no man's land because very few people reside there.

We used the strip transect method for censusing plateau picas. It is difficult to count all individuals in each transect because they are living in underground holes, so we used the number of pica holes as the relative densities of the pica. We randomly totally selected 15 locations along the Qinghai-Tibet railway. For each location, 5 strip transects were set with D = 0 m, 300 m, 600 m, 900 m, 1,200 m parallel to the railway. For each strip transect, we walked 150 m and counted the number of pica holes within 1.5 m for each side. Meantime, we also recorded the snow finches along the transect, which have been considered as lodgers for plateau picas. The census for each transect took no more than 15 min. Detailed censuses were marked as fig. 1. We started the transects at the middle-zone between the parallel Qinghai-Tibet Railway and Highway (D = 0 m), and turned vertically after 150 m's census, and then walked straightly until the distance between stay point and the railway reached 300 m, turned vertically and censused for 150 m, and then repeated the process with distance of 600 m, 900 m, 1,200 m. A range finder and a GPS were used to identify the distance. Sometimes we stopped the censuses due to the bad weather, and so we totally collected 61 transects from the 15 locations.

All above data were put into excel and tested with one-sample Kolmogorov-Smirnov test for normality. Numbers of pica holes were not normally distributed, so nonparametric tests (Kruskal–Wallis tests) were used to compare the differences between distances (D = 0 m, 300 m, 600 m, 900 m, 1,200 m). We used spearman's correlation method to analyze

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relationship between snow finches and pica holes. All analysis was conducted with SPSS 13.0, and the significant levels were set at P = 0.05.

III. RESULTS

Totally 61 transects (150m*3m) were walked, and the pica holes averaged 36.59 ± 4.99. The holes of plateau picas did not vary among distances to Qinghai-Tibet Railway and Highway ($\chi 2$=1.197, df=4, P=0.879, Fig 2).

A total of 4 snow finch species was detected in our field surveys. The list included Rufous-necked snow finch *Montifringillla ruficollis*, White-winged snow finch *M. nivalis*, White-rumped snow finch *M. taczanowskii*, Plain-backed snow finch *M. blandfordi*. Rufous-necked snow finch is the dominant species, making up to more than 60% of the total individuals (73). The abundance of pica holes was positively related to the snow finch numbers (r=0.491, P<0.001, Fig 3).

IV. DISCUSSION

Many studies have found that due to increased traffic noise, air pollution, collision mortality, and heavy metal pollution, roads have significant negative effects on bird abundance [2, 3]. For example, breeding density of grassland birds in Netherlands was reduced adjacent to the roads, and the reduction of bird density was mainly caused by traffic noise [18, 19]. However, other studies implied opposite results, some small animals prefer road areas, because they can provide suitable feeding or nesting habitats, for example, Stephens' kangaroo rat (*Dipodomys stephensi*), was more common in road edges because they could gain larger foraging opportunities [20].

Our study gives non-significant results, neither positive nor negative. This indicates Qinghai-Tibet roads do not alter the distribution or population of the plateau picas. Reasons might be that even if the railway has put in many visitors, most parts of the parallel roads are still no man's lands, and thus human disturbance is still very low. Traffic load on the Qinghai-Tibet highway was less than 1000 cars a day [11, 12], far lower than a common road. Additionally, plateau picas are living underground, thus the aboveground roads cannot easily influence their underground activities[21]. In the other aspect, unlike the ground birds such as snow finches, concentrating on the road verges [14], picas do not feed on materials abandoned by visitors, therefore roads do not provide essential resources for them. So plateau picas are not affected by Qinghai-Tibet roads.

Snow finches living in the same hole with picas have been noticed long times ago [21]. Our results also confirm the mutualism by snow finches and plateau picas. Qinghai-Tibet Plateau is famous for its extreme climate, the high elevation, strong radiation, low oxygen, cold temperature, and thus called the third pole of the planet [22]. Animals living in the plateau have usually evolved a lot of anti-plateau living strategies to adapt the cruel environments. For these endemic snow finches, living in a pica hole can no doubt reduce their heat loss, and save energy to other activities. Additionally, as small birds, they are usually vulnerable to predators, such as Eurasian eagle owl (*Bubo bubo*) and Upland buzzards (*Buteo hemilasius*) [23], and pica holes could thus provide an effective shelter to escape from enemies.

In conclusion, we did not find Qinghai-Tibet roads have significant effects on plateau picas. For management and conservation, as suggested by Smith and Foggin (1999), due to the many ecological functions, plateau picas, as well as other small mammals, should not be massively controlled, so as to maintain the ecological balance of the Tibetan grasslands.

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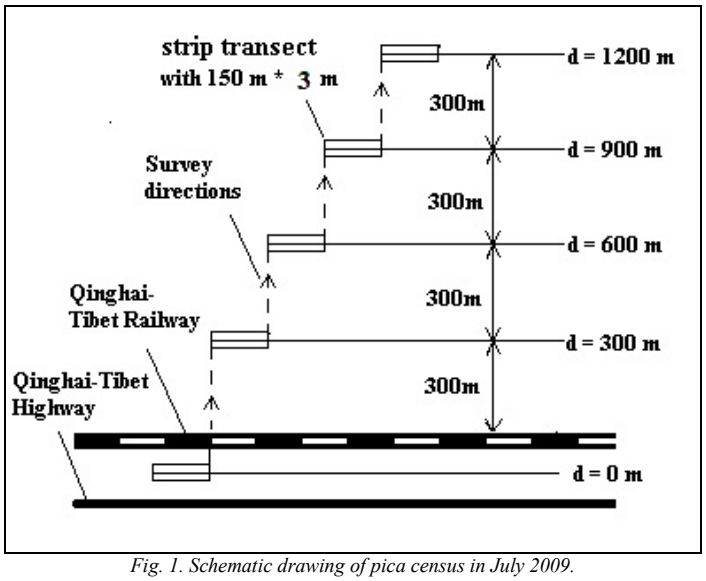

Fig. 1. Schematic drawing of pica census in July 2009.

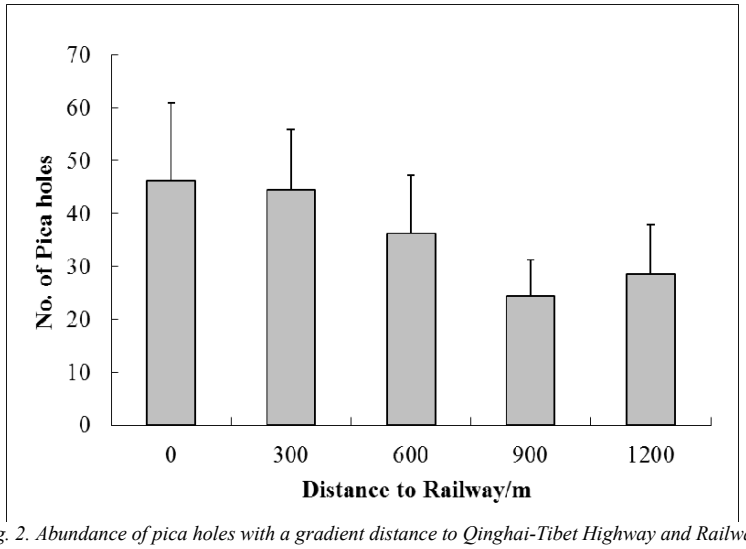

Fig. 2. Abundance of pica holes with a gradient distance to Qinghai-Tibet Highway and Railway.

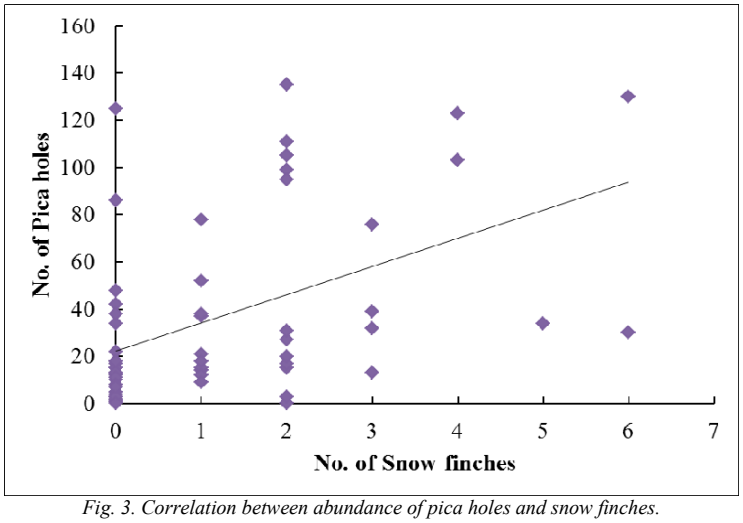

Fig. 3. Correlation between abundance of pica holes and snow finches.