Possible conservation methods of sparrows in China

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Abstract. Tree and house sparrows are the most common sparrows in China, but sparrow populations have experienced extreme, man-made declines in history. Sparrows have been listed as beneficial birds in China, but the protective behavior of sparrows is almost invisible. This paper discusses the status of sparrows in China, compares the protection and coping methods of sparrows abroad, and provides possible protection schemes: (1) to provide adequate high-quality food sources in sparrow habitat; (2) to reduce the impact of habitat fragmentation; (3) to reduce unnecessary human intervention on sparrows; (4) to identify sparrow's ecological functionality correctly. Future studies should incorporate more factors to comprehensively assess the need to protect sparrows.

Keywords: Sparrow protection; Tree sparrow; House sparrow.

1. Introduction

Birds play an important role in today's ecosystem. However, with the acceleration of urbanization, many birds are threatened and some have become endangered species. Protecting birds is important in many ways. From a biological point of view, birds can prey on a large number of agricultural and forestry pests, and play an important role in agriculture, forestry and animal husbandry production (Martínez-Salinas et al., 2016). Birds are a big family, and when the owls disappear, the rats will wreak more havoc, reducing human food production (2014). And when birds are gone, many of the animals that feed on them will have a harder time or even go extinct (Bulai and Hilker, 2019). In terms of cultural value, the songs of some birds can relax human beings and stimulate human beings to create more economic value and give the joy to humans. Therefore, it's very important to protect birds.

There are a variety of possible ways to protect birds. By investigating the nesting habits of the endangered superb parrot (Polytelis swainsonii), it was found that they prefer to nest in the holes of eucalyptus trees that regenerate slowly, so it is possible to protect the superb parrot by protecting its habitat (Manning et al., 2004). The use of microsatellite markers can be used for genotyping of a variety of birds, thus enabling genome comparison of species and better identification of potentially endangered species (Dawson et al., 2015). Habitat encroachment by invasive species is a major threat to spotted owls, so management of the invading owl needs to be done, and more continuous forest habitat needs to be preserved (Dugger et al., 2011). Protection laws for bird habitats can also protect birds indirectly, though they are less effective(Flanagan, 2005). It is also possible to involve the public in bird conservation projects, such as using eBird to collect data on bird observations, although the sources are not very scientific (Johnston et al., 2021). Reducing bird deaths from eating pesticide-laced crops can be achieved by controlling pesticide use (Lopez-Antia et al., 2012). In conclusion, there are many ways to implement bird conservation.

There are many problems with bird conservation. The construction of expressway network in China has greatly increased the convenience of transportation, but at the same time, the emergence of expressway has aggravated the fragmentation of bird habitat (Koemle et al., 2018), and the geographical isolation of bird species leads to reduced gene exchange, thus increasing the risk of extinction (Brawn et al., 1996). The rapid rise of human population has correspondingly increased the demand for food production and the use of more and more pesticides, which, however, will cause some of the birds that eat the crops to die from poisoning (Lopez-Antia et al., 2012). The cluster of tall buildings showcases urban development and houses many people but also increases the possibility of birds hitting tall buildings, especially transparent glass windows, causing death (Hager et al., 2013).

In China, sparrows were previously considered as pests because they eat crops and experienced a large-scale population decline, but are now listed in the protection list. Research abroad has mainly

focused on the conservation of sparrows(Field et al., 2008), although in some places sparrows are also treated as invasive species and pests(Ramírez-Cruz and Ortega-Álvarez, 2021). Moreover, there is little research on sparrow conservation in China. This review takes a large-scale population decline as a case study to explore feasible ways to protect existing sparrows in China.

2. Distribution, behavior and ecological function of sparrows in China

Tree sparrows and house sparrows are the main species in China, with a small number of saxaul sparrow, spanish sparrows and russet sparrows (Bao et al., 2020). The former two are the most widely distributed and could be seen nearly everywhere in China, while the latter three are not as widely distributed as the former. Therefore, only tree sparrows and house sparrows are discussed.

Tree sparrow (Passer montanus) is a short, plump, brown-gray passerine bird with a short tail and a stubby beak. Tree sparrows are widely distributed and have a large number in China. They are one of the common birds in houses and courtyards in urban and rural areas in China. They live with human beings and have a very close relationship with them. Since tree sparrows mainly feed on crops such as grain, especially during the maturity of grain in autumn, large groups of dozens, hundreds or even thousands of sparrows often fly to the farmland to peck grain, which has a great impact on the harvest of crops (Han et al., 2012). Tree sparrows are sold in pet bird markets in many Chinese cities and are mainly used by Buddhists to release birds.

House sparrows are mainly inhabiting human habitats, belonging to omnivorous birds (Tang et al., 2013). They like to form groups, except during the breeding period alone or in pairs, most of the other seasons in small groups. They are endemic to towns and villages in the far west and northeast of China, in barren areas, desert oases and marginal areas (Zhu et al., 2009).

Tree sparrows and house sparrows can be regarded as a species when considering protection or control strategies because of their similar feeding habits and high degree of overlap in distribution, which means that they both live close to human beings.

3. Analysis on the status and causes of sparrows' protection

The Chinese government has legislated to protect sparrows, which are land wildlife of important ecological, scientific and social value under state protection, and their capture is a criminal offence (Lü et al., 2020). At the beginning of the COVID-19 outbreak in early 2020, it was widely believed that eating bats caused the spread of the virus (Rehman et al., 2021). Therefore, the Chinese government banned hunting game and increased punishment, thereby protecting sparrows as a wild animal.

Sparrows are everywhere, but few people want to kill them. The slingshot used to kill sparrows was a toy for many children at the beginning of the 20th century, but in 2020 it will be almost gone. Most sparrows observed in towns prefer to nest in the eaves of houses or in the crevices of tall buildings, making them almost inaccessible to humans. In rural areas, sparrows can also be seen everywhere in farmland. This is because most of the people left in rural areas are the elderly, they cannot move easily enough to drive away sparrows. Besides, since China's reform and opening up, people's living standards have improved significantly and urbanization has accelerated, so most people choose to leave the countryside. Farming is not the main source of income, though a few remain in the countryside. So no one is going to spend their energy controlling sparrows because the benefits of protecting crops are not as good as working in cities. It is possible that some people do not know that it is illegal to hit sparrows, but the current status is that sparrows are largely ignored.

4. Case study of sparrow population collapse event

4.1 Four pest campaign influence

Due to many years of wars in China, the living standard of farmers in the early days of the founding of New China was still very low, and they relied on crop output to earn income. However, crop production would be reduced due to the influence of pests, so the four pest campaign was born, among which sparrows were one of the four pests. Eurasian tree sparrows were the most high-profile targets of this campaign.

Sparrows were killed by destroying their nests, destroying their eggs and killing their young. Groups of people beat drums to make noise and keep sparrows away from their nests until they died of exhaustion. Children hit sparrows with slingshots, adults with guns.

This movement killed hundreds of millions of birds (mainly tree sparrows) in 1958-1962, but also many other less common species, which began to urbanize around 1960. Some species still have very small populations today because of this event (Møller et al., 2019).

The fundamental purpose of the campaign was to increase food production, but the elimination of sparrows reduced production even more. The extinction of sparrows upset the ecological balance, as the number of locusts and insects surged due to the lack of natural enemies, destroying crops (Bell, 2017). With no sparrows to eat them, locusts proliferate across the country, exacerbating ecological problems already caused by the Great Leap Forward, including widespread deforestation and the abuse of poisons and pesticides. Eventually, the Chinese government had to reconstruct the sparrow population from the Soviet Union using 250,000 sparrows (Li, 2013). Therefore, most sparrows seen in China today are from the Soviet Union introduced in the 1960s.

4.2 Effects of pesticides and herbicides

The sparrow decline was also directly related to the abuse of pesticides and herbicides though there is no official record of sparrow population decline. In order to improve crop yield, the use of pesticides in China has been developing towards high toxicity and high dose since the 1970s (Li et al., 2018). In addition to the use of highly toxic pesticides such as Organo-phosphate and parathion to kill insects, a variety of herbicides were also used to remove weeds in farmland. Pesticides and herbicides polluted the environment sparrows depend on. Moreover, people used pesticides mainly from March to September, which was the breeding season of sparrows. Adult sparrows and young sparrows died as they ate poisoned insects or weeds and seeds contaminated with pesticides (Mora et al., 2017). In addition to the deaths caused directly, the reproductive capacity of sparrows might also be affected by the ingestion of herbicides (Rivers et al., 2019).

The reason for the sharp decrease in the number of sparrows in 1950s was that people did not correctly recognize the behavior of sparrows preying on pests and wrongly estimated the ecological function of sparrows. Moreover, people do not realize that the large amount of pesticide added to contaminate the sparrow's food indirectly killed the sparrow. Both reductions demonstrated the need for a clear understanding of the ecological functions and behaviour of sparrows, and the destruction of every part of the food chain had an impact on sparrows' population.

5. Discussion on the treatment of sparrows abroad

5.1 Food resource influence

From the perspective of food resource, tree sparrows are more likely to inhabit farmland ecosystems because they provide abundant invertebrates as prey. To protect tree sparrows, conservation measures include providing habitat and invertebrate groups as a food source during the breeding season (Field et al., 2008). However, other studies have reported that tree sparrows showed a strong preference for nest sites close to wetland habitats (Field and Anderson, 2004). Different habitats on the edge of wetlands are common places for adult birds to forage and feed their nestlings

(Field and Anderson, 2004). For tree sparrow population persistence, seed food resources may play a role on a larger spatial scale because tree sparrows have greater mobility during non-breeding seasons (Field and Anderson, 2004). In general, an adequate supply of seed food and invertebrate food resources is important for the protection of tree sparrows.

5.2 Human influence

From the perspective of human influence, the acceleration of urbanization has brought a lot of man-made disturbances to sparrows. Studies have reported that artificial light at night may damage birds' health by disrupting their circadian rhythms, inhibiting the release of melatonin and altering their gut microbiota (Jiang et al., 2020a). Urbanization is also further fragmenting of sparrow habitats, and as the urban landscape is highly managed, the basic tool for increasing urban sparrow populations will be to protect Mosaic habitats, giving priority to proper design and management of private gardens and distribution (Nath et al., 2019).

5.3 The bird itself influence

In terms of sparrows themselves, sparrows also come into regular contact with humans, and studies have shown that birds have shown a reduced fear response to people wearing masks during the COVID-19 pandemic (Jiang et al., 2020b). This could be because constant exposure to people wearing masks may produce rapid adaptive behavioral changes, even though birds only have about six months to adapt to people wearing masks (Jiang et al., 2020b). The sparrow's learning ability allows them to adjust their behavior to this subtle change in their environment. When competing with other birds, intensive farming practices allow sparrows to benefit from abundant nesting sites (farm buildings) and food resources (grains) in dense landscapes, both suggesting that sparrows have a wide range and are adaptable, and may not require much human intervention (Robillard et al., 2012). In some countries, tree sparrows are even an invasive species because they are so adaptable that there is an urgent need to reduce their numbers (Ramírez-Cruz and Ortega-Álvarez, 2021). In short, from the sparrow's own point of view, because of their ability to learn and adapt, they don’t need intervention.

Table 1. Protection methods of sparrows abroad and their advantages and disadvantages

possible method	strength	weakness
provide food	direct method	need lots of experience
reduce the interference	lowest cost	
optimize town planning	Reduce habitat fragmentation	May not be a priority
identify ecological function of sparrow	Assist to properly protect sparrows	requires a lot of long-term monitoring and research

In general, refer to the treatment of sparrows abroad as shown in Table 1. The protection of sparrows requires adequate high-quality food. Where, how much and when food is dropped requires a lot of research and experience, but it's a straightforward way to protect sparrows. Human had better reduce the interference of the sparrow although the sparrow's ability to adapt quickly, and less interference is also the least costly way to protect. Human also had better optimize town planning, reduce the impact of habitat fragmentation. But whether people really prioritise birds in land planning, or whether human needs always come first, needs more research. Then to combine the sparrow itself, analyses the ecological function sometimes sparrows are also likely to become invasive species damage to the local ecological system structure. Systematic assessment of the ecological functions of sparrows in one place may require long-term monitoring studies, such as sparrows performing different ecological functions in different seasons.

6. Conclusion

Combined with the case study of the historical sharp drop in the number of sparrows in China and the methods of dealing with sparrows in foreign countries, the possible plans for sparrow protection in China are: (1) to provide adequate high-quality food sources for sparrows; (2) to optimize town planning, reduce the impact of habitat fragmentation (3) to reduce unnecessary human intervention on sparrows despite their strong adaptability; (4) to identify sparrow's ecological functionality correctly.

Future studies should explore different protection measures for sparrows in different habitats in China, strengthen public awareness of sparrows protection, and discuss whether it is necessary to protect sparrows based on the status of sparrows and crop yield.

References

[1] 2014. South Africa: Owls fight rat problem in townships. International pest control, 56, 296.

[2] Bao, X., Zhao, W., Liu, F., Li, J. & Ma, D. 2020. Egg investment strategies adopted by a desertic passerine, the Saxaul Sparrow (Passer ammodendri). Avian research, 11, 1-8.

[3] Bell, L. S. 2017. Sigrid Schmalzer. Red Revolution, Green Revolution: Scientific Farming in Socialist China. Chicago: Oxford University Press.

[4] Brawn, J. D., Collins, T. M., Medina, M. & Bermingham, E. 1996. Associations between physical isolation and geographical variation within three species of Neotropical birds. Molecular ecology, 5, 33-46.

[5] Bulai, I. M. & Hilker, F. M. 2019. Eco-epidemiological interactions with predator interference and infection. Theoretical population biology, 130, 191-202.

[6] Dawson, D. A., Bird, S., Horsburgh, G. J. & Ball, A. D. 2015. Autosomal and Z-linked microsatellite markers enhanced for cross-species utility and assessed in a range of birds, including species of conservation concern. Conservation genetics resources, 7, 881-886.

[7] Dugger, K. M., Anthony, R. G. & Andrews, L. S. 2011. Transient dynamics of invasive competition: Barred Owls, Spotted Owls, habitat, and the demons of competition present. Ecological applications, 21, 2459-2468.

[8] Field, R. H. & Anderson, G. Q. A. 2004. Habitat use by breeding Tree Sparrows Passer montanus. Ibis (London, England), 146, 60-68.

[9] Field, R. H., Anderson, G. Q. A. & Gruar, D. J. 2008. Land-use correlates of breeding performance and diet in Tree Sparrows Passer montanus. Bird study, 55, 280-289.

[10] Flanagan, E. R. 2005. It's the "supreme law of the land": using the Migratory Bird Treaty Act to protect isolated wetlands left high and dry by SWANCC. Pace environmental law review, 22, 175-175.

[11] Hager, S. B., Cosentino, B. J., McKay, K. J., Monson, C., Zuurdeeg, W. & Blevins, B. 2013. Window area and development drive spatial variation in bird-window collisions in an urban landscape. PloS one, 8, e53371-e53371.

[12] Han, Y., Hou, G., Jiang, W., Han, C., Liu, S., Chen, J., Li, J., Zhang, P., Huang, B., Liu, Y. & Chen, J. 2012. A survey of avian influenza in tree sparrows in China in 2011. PloS one, 7, e33092-e33092.

[13] Jiang, J., He, Y., Kou, H., Ju, Z., Gao, X. & Zhao, H. 2020a. The effects of artificial light at night on Eurasian tree sparrow (Passer montanus): Behavioral rhythm disruption, melatonin suppression and intestinal microbiota alterations. Ecological indicators, 108, 105702.

[14] Jiang, X., Liu, J., Zhang, C. & Liang, W. 2020b. Face masks matter: Eurasian tree sparrows show reduced fear responses to people wearing face masks during the COVID-19 pandemic. *Global ecology and conservation,* 24**,** e01277-e01277.

[15] Johnston, A., Hochachka, W. M., Strimas-Mackey, M. E., Ruiz Gutierrez, V., Robinson, O. J., Miller, E. T., Auer, T., Kelling, S. T., Fink, D. & Fourcade, Y. 2021. Analytical guidelines to increase the value of community science data: An example using eBird data to estimate species distributions. Diversity & distributions, 27, 1265-1277.

[16] Koemle, D., Zinngrebe, Y. & Yu, X. 2018. Highway construction and wildlife populations: Evidence from Austria. Land use policy, 73, 447-457.

[17] Li, J., Yuan, G.-L., Duan, X.-C., Sun, Y., Yu, H.-H. & Wang, G.-H. 2018. Organochlorine pesticides in the sedimentary core of the southern Tibetan Plateau: The missing pieces induced by lateral remobilization. Environmental pollution (1987), 233, 340-347.

[18] Li, X. 2013. Pantsov, Alexander V.: Mao: the real story.(Book review). American Library Association CHOICE.

[19] Lopez-Antia, A., Ortiz-Santaliestra, M. E., Mougeot, F. & Mateo, R. 2012. Experimental exposure of red-legged partridges (Alectoris rufa) to seeds coated with imidacloprid, thiram and difenoconazole. Ecotoxicology (London), 22, 125-138.

[20] Lü, Z., Chen, Z., School of Law, T. U. B. S. o. L. Z. A. & F University, H. 2020. Revision of the Law of the People's Republic of China on the Protection of Wildlife: Background, issues and suggestions. Sheng wu duo yang xing, 28, 550-557.

[21] Manning, A. D., Lindenmayer, D. B. & Barry, S. C. 2004. The conservation implications of bird reproduction in the agricultural "matrix": a case study of the vulnerable superb parrot of south-eastern Australia. Biological conservation, 120, 363-374.

[22] Martínez-Salinas, A., DeClerck, F., Vierling, K., Vierling, L., Legal, L., Vílchez-Mendoza, S. & Avelino, J. 2016. Bird functional diversity supports pest control services in a Costa Rican coffee farm. Agriculture, ecosystems & environment, 235, 277-288.

[23] Møller, A. P., Xia, C., Zhou, B., Che, X., Chu, X., Feng, C., Laursen, K., Morelli, F., Li, W., Liu, J., Quan, Q., Zhang, M., Zhang, Q., Zhan, Q., Ma, L., Wang, H., Zou, F. & Liang, W. 2019. Comparative urbanization of birds in China and Europe based on birds associated with trees. Current zoology, 65, 617-625.

[24] Mora, A. R., Firth, A., Blareau, S., Vallat, A. & Helfenstein, F. 2017. Oxidative stress affects sperm performance and ejaculate redox status in subordinate house sparrows. Journal of experimental biology, 220, 2577-2588.

[25] Nath, A., Singha, H., Haque, M. & Lahkar, B. P. 2019. Sparrows in urban complexity: macro and micro-scale habitat use of sympatric sparrows in Guwahati City, India. Urban ecosystems, 22, 1047-1060.

[26] Ramírez-Cruz, G. A. & Ortega-Álvarez, R. 2021. Identifying management guidelines to control the invasive House Sparrow (Passer domesticus) within natural protected areas through the estimation of local colonization and extinction probabilities. Biological invasions, 23, 3767-3776.

[27] Rehman, H. A., Ramzan, F., Basharat, Z., Shakeel, M., Khan, M. U. G. & Khan, I. A. 2021. Comprehensive comparative genomic and microsatellite analysis of SARS, MERS, BAT-SARS, and COVID-19 coronaviruses. Journal of medical virology, 93, 4382-4391.

[28] Rivers, J. W., Verschuyl, J., Schwarz, C. J., Kroll, A. J. & Betts, M. G. 2019. No evidence of a demographic response to experimental herbicide treatments by the White-crowned Sparrow, an early successional forest songbird. The Condor (Los Angeles, Calif.), 121, 1-13.

[29] Robillard, A., Garant, D. & Bélisle, M. 2012. The Swallow and the Sparrow: how agricultural intensification affects abundance, nest site selection and competitive interactions. Landscape ecology, 28, 201-215.

[30] Tang, Y., Diao, Y., Yu, C., Gao, X., Ju, X., Xue, C., Liu, X., Ge, P., Qu, J. & Zhang, D. 2013. Characterization of a Tembusu Virus Isolated from Naturally Infected House Sparrows (Passer domesticus) in Northern China. Transboundary and emerging diseases, 60, 152-158.

[31] Zhu, W., Dong, J., Xie, Z., Liu, Q. & Khan, M. I. 2009. Phylogenetic and pathogenic analysis of Newcastle disease virus isolated from house sparrow (Passer domesticus) living around poultry farm in southern China. Virus genes, 40, 231-235.