Transactions on Environment, Energy and Earth Sciences
ISSN: 2960-1924, eISSN: 2960-2300 | Volume 3
GRET 2024

Effect of Climate Change and Loss of Habitat on Migratory Birds

Xinyue Mei*

Vanke Meisha Academy, Shenzhen, Guangdong, China

*Corresponding Author: meixinyue@stu.vma.edu.cn

Abstract. Climate change and habitat loss have influenced many species of organisms globally. Migratory birds are one of the most responsive animals towards climate change and habitat disruption, many species of migratory birds have a rapid decline in population in recent years because of these two factors. The aim of this article is to conclude information among the data available to achieve a better understanding of the challenges faced by migratory birds under the situation of climate change and suggest ways of preserving these species of migratory birds. This paper is mainly focused on the effects on migratory birds, especially from a perspective of a decline in population, caused by climate change and habitat loss caused by both natural and human factors. Causes such as frequent forest fires and early, warm springs are discussed in this paper. The effect on migratory birds by warm springs is causing a mismatch between food availability and breeding peak, causing inefficient breeding in many species of migratory birds, while the habitat loss caused by increasing forest fires is causing a decline in the population of migratory birds by not only decreasing their efficiency in breeding but also forced them to migrate to a less optimum habitat for reproduction.

Keywords: Migratory birds; Climate change; Habitat loss; Bird migration.

1. Introduction

The global surface temperature has been increasing at a rapid speed, particularly in areas of high latitudes [1]. Climate change and loss of habitat are two of the greatest threats to various organisms in this century and have affected their distribution, population and life pattern [2]. There is evidence that various organisms change their original life pattern to adapt to these changes, for example, advanced timing of breeding without any other physical changes in the body of a bird, and affect the length of breeding seasons of many migratory birds at the same time [3]. However, their change in behavior and distribution needs time of a few generations, this lag in response may lead to local extinction for some species [2]. Many decline in the population of migratory birds is also caused by human factors such as expansion in agricultural and urban land use [4].

The global number of migratory populations has declined at a fast rate since 1970, and it is found that the main cause of the decline is that climate change has increased the pressure on the survival of migratory birds [5]. The global distribution of migratory birds also exerted a large change in the past decades [5]. Climate change has made the migratory birds difficult to match their feeding time with the period of amount of food available, causing a decline in the population of migratory birds in Europe [5]. Furthermore, since climate can limit the breeding of birds [6], it can be suggested that a climate change can cause a change in breeding limitation in migratory birds.

The increase in extreme weather caused by climate change also threatens the population size of migratory birds. For example, a forest fire in the United States in 2022 caused the death of a large population of different species of migratory birds [7]. More frequent drought and sudden drops in air temperature also affect the life and behavior largely [7], and also affect their breeding. Research has shown that high temperatures beyond the endurance limit of the birds are a potential cause of an increase in mortality rate because of their activity patterns and small size [4]. There are some papers suggesting that extremely hot weather affects the population of birds in the long term indirectly by decreasing the rate of success in reproduction and hatching [4]. At the same time, the large volume of precipitation in winter may cause thicker snow cover than usual, which could destroy habitats and

nests, decrease food availability, and cause deaths in birds starving or freezing [7]. Although the effect of extreme weather on migratory birds differs from species depending on their region, size and migration strategy [4], there is still a general impact among migratory birds caused by extreme weather.

There are already some studies that have discussed the possible link between climate change and the population trend of migratory birds, but most of them are limited to a specific species or a specific region, which is considered isolated from other areas. For example, the research is done in 2007 by Wilson 2007 among migratory birds in Sweden only. Also, there is not a very large amount of discussion based on how to achieve a better understanding of preserving migratory birds on a global scale. To have a better understanding of global climate change on population among migratory birds, more data on a global scale needs to be collected and analyzed by research. The challenges that migratory birds are facing could also act as a reference for other species worldwide since migratory birds are sensitive indicators of the climate [6].

This paper aims to discuss and conclude the effect of climate change and loss of habitat on migratory birds and try to find out a more general relationship between these two factors, especially in climate change, and the population and life cycle of migratory birds, and suggest some possible solutions in helping global migratory birds to preserve a stable population under the stress of climate change. Some potential further paths waiting to be explored are also listed at the end of this paper. It would help with having a better understanding of how climate change and loss of habitat increase pressure on migratory birds, hence finding a better discussion on how to preserve these organisms that are sensitive to climate change. It can also act as a reference to other similar organisms that are sensitive to climate change.

2. Case Study

A study conducted by Wilson in 2007 showed that due to the global temperature rise caused by climate change, migratory birds may use higher temperatures as an indication of the start of their migration [8]. Kullberg et al. conducted a study in 2015 on the changes in arrival times of migratory birds in different regions of Sweden caused by climate change [9]. The study compared recorded data between the arrival times of migratory birds in the past and recent years. The research results show that compared to now, all species of birds in southern and northern Sweden arrive at their destination earlier than the historical record nowadays [9]. and due to the different characteristics of these two types of migration, climate change has a greater impact on the arrival time of short distance migration than long distance migration [9]. At the same time, the research indicates that although there are some minor differences in northern latitudes and southern latitudes, an earlier increase in temperature, in other words, an early start of spring, caused by climate change has an influence on migratory birds in Sweden [9].

The forest fires in the United States in 2020 led to a decline in the number of migratory birds [7]. Increase in forest fires is a cause of climate change and is causing more frequent habitat loss to migratory birds. The local migratory bird species were significantly affected by this forest fire and were forced by the fire to abandon their original nesting and feeding area [7]. The local migratory birds were also forced to migrate to a further distance looking for an alternative area for feeding. This process put them under an extreme condition of starvation and dehydration, at the same time the food in their newly found habitat is often relatively more scarce than their original habitat, leading to a higher mortality rate during the process of migration [7].

In a word, both of these cases are examples of a decline in success rate in the breeding of migratory birds under the effect of climate change and habitat loss, and the main challenge faced by migratory birds is the lack of food sources. There are more details to be discussed in the following parts.

3. Effect of Climate Change and Loss of Habitat on Migratory Birds

3.1. Climate Change

Although there is a hump-shaped relationship between the highest breeding productivity and an increase in temperature [6], according to Pulido et al.'s research, many bird populations changed their migratory behavior under the effect of climate change and a large number of bird populations are undergoing microevolution [1]. Climate change has also chosen to shorten migration distances and may lead to some migrations and even changes in living conditions, which may be caused by the global temperature rise caused by climate change [1]. Due to the shortened migration distance, populations that expand their breeding areas to further northern regions may also face the same problem [1]. However, in some long-distance migratory species, the arrival time of spring did not change with the advancement of hatching dates, resulting in a decrease in population size [1].

This preference for shorter migration distances has led to earlier arrival times at destinations and earlier hatching dates [1]. Early hatching can lead to untimely early winter migration and lower the age of the individual's first migration [1]. Due to the mismatch between breeding dates and peak food supply, early hatching seasons will face challenges such as food supply, resulting in less successful breeding and a decline in population size. Climate change can also lead to habitat loss, especially in areas with unstable winter habitats, resulting in disadvantages for long-distance migratory species, which is the reason for the increase in migration distance.

The increased risk of extinction caused by climate change may pose a greater threat to a few migratory birds, leading to a high rate of evolutionary change. Extreme weather conditions such as hot weather and cold winters can also affect the population of migratory birds [4]. The richness and population size of migratory bird species are negatively correlated with the increase of high-temperature days [4], and birds in areas with the least number of high-temperature days are most sensitive to temperature rise.

From the perspective of food and resting places, changes in winter weather conditions can also affect the survival rate of migratory birds and the availability of habitats in different regions. Although early spring arrival can provide an advantage for birds in mate selection, early arrival may lead to a mismatch in their food supply. These two factors together limit the arrival date of migrating birds [10]. A wider food choice gives the population more chance for an early arrival in spring. The research also stated that species that feed on vegetation are more affected by climate change due to the effect of early spring on the plants as their food source [10]. This mismatch between food available is causing them to be the most sensitive species and the first to show declines in their population [10].

However, there is also research that suggests that some species of migratory birds have arrived later than expected according to the temperature of the year in some of the years, which indicates that there is a larger mismatch between the behaviour of migratory birds and the change in global climate [11]. It is also found that species with a larger delay in arrival have a larger population decline throughout the year, compared to the species that arrived at the expected time in the year [11]. This implies that a mismatch of arrival may be one of the factors that cause a decline in the population. Some species of birds may be limited in the flexibility of coping with the change in global climate by their timing of life cycle [11].

3.2. Habitat Destruction

Climate change also causes a decline in the population of migratory birds indirectly by changes in their habitats. This effect is particularly obvious in the mangrove areas according to research done [12]. With the decline in mangrove trees in their habitats, typhoons interrupt the reproduction process by destroying their nests, which decrease their effectiveness in reproduction, causing a population decline. The rise in sea level caused by climate change also causes a deficiency in reproduction to species that nest on low-lying cays because the nests of these species would have a higher chance to be flooded by increasing sea level [12]. Change in food sources available in the habitat caused by

climate change is also a fact that reduces the population of the birds. For example, a decline in the population of invertebrates as a vital source of food for waterbirds due to climate change would increase the chance of waterbirds, especially younger individuals of waterbirds to be starved to death during breeding [12]. Research done by Chen and Khanna in 2024 also shows that there is a significant negative impact on the biodiversity of birds, and the birds are required to adapt to the rapid change in their habitat, while species with a restricted range population have a larger chance to be affected by this change in their habitat [4]. With temperature change caused by climate change, the optimum habitat of the migratory birds also shifts [5], causing a potential overlap between human habitat and habitats of migratory birds, which would lead to a compression in the living space in migratory birds. Moreover, a decline in the population and change in habitat could make the migration process more difficult since some species of migratory birds now need to travel a longer distance to look for an optimum area as their habitat, and for some species of migratory birds, they do not have the ability to travel a longer distance and will have a risk of increase in death rate [5].

More frequent forest fires caused by climate change have affected the biodiversity and quantity of migratory birds. The forest fire in 2020 in the USA has had a major impact on the decline in the population of local migratory birds [7]. The forest fire not only killed some of the population of migratory birds directly but also brought heat of high temperature to the rest of the population, forcing the migratory birds to abandon their original habitat and take the risk of traveling away for a longer distance to look for suitable habitats, while the new habitat is often relatively scarce in resources such as food and water for the population [7]. This process not only decreases the success rate in breeding in the perspective of abandoning the original nesting area but also increases the death rate in the process of traveling a longer distance to look for new habitat, facing the challenges of starvation and extreme dehydration[7].

Human factors can also have a negative impact on the biodiversity and quantity of migratory bird populations. In Aurangabad City, the Salim Ali Lake which is polluted by human activity is visited by a decreasing amount of migratory birds throughout the years [13], which would cause a distortion in the local food chain. Also, the collapse of habitat of migratory birds and human activity area may cause conflicts between humans and migratory birds[5]. There is also a possibility that migratory birds, especially young migratory birds would consume toxic or inedible materials accidentally when the two habitats collapse, causing an increase in death rate and a decrease in reproductive effectiveness.

4. Preserving Migratory Birds

There are multiple ways of helping migratory birds to keep their population number. For example, several researches in Europe and China have shown that setting a legally protected habitat for birds can help increase local birds' population [14]. Although it is difficult to reverse the effect of climate change, legal regulation on nearby industrial areas on the emission of wastewater and fumes can help with the living conditions of the migratory birds in nearby habitats. Making sure of the connectivity between the habitats of migratory birds can also help in increasing the population and population density of migratory birds [14]. Since it is difficult to totally separate habitats of migratory birds and areas with human activities, it would be helpful to have constructions in cities that are beneficial for nesting migratory birds. For example, although clearing off nests on electricity towers that are built on the cable that affect the functioning of the tower seems applicable, building artificial structures of nest bases on electricity towers, so the nests can be built in safe areas on the towers, and will not affect the functioning of the tower. Education towards local people about basic knowledge of not disturbing wildlife including migratory birds is also an effective way to protect the migratory birds from human disturbance [14].

5. Conclusion

In light of the above, migratory birds in global areas is meeting a challenge from climate change and habitat disruption. The warm and early spring caused by climate change is causing a mismatch between breeding dates and availability of food, causing a decline in the population of migratory birds. Some species of migratory birds are also forced to travel a longer distance that is beyond their capable ability to search for an optimum habitat for nesting and breeding. At the same time, more frequent forest fires in global areas is causing a decrease in habitat for migratory birds, decreasing their reproduction efficiency. Overlap between the habitat of migratory birds and human activity areas also causes conflicts between humans and birds. This paper can be a conclusion for many of the research results in the area of the relationship between climate change, habitat loss and migratory birds, and point out a direction for further study on better preservation of migratory birds.

However, there are still limitations in this paper. This paper only concludes the results of other papers, and has no primary data collected. Also, due to limitation of the fund, several access to more specific or more accurate data is limited. Future research can be based on the effect of the mismatch between the arrival and nesting time of migratory birds and their breeding effectiveness. More specific data on the direct relationship between increasing global temperature and early springs and the success rate in a reproduction of different species of migratory birds globally should be collected to achieve a better understanding of the challenges that migratory birds are facing. It is also suggested that a longer term of research should be carried out, especially a tracing of track on several typical species and groups of migratory birds, under international cooperation to find out a more precise pattern of influence on migratory birds by climate change. Another direction of research is to find out more effective methods for controlling forest fires as a way of decreasing habitat loss through forest fires.

Reference

[1] Pulido, F., & Berthold, P. (2010). Current selection for lower migratory activity will drive the evolution of residency in a migratory bird population. Proceedings of the National Academy of Sciences, 107(16), 7341–7346.

[2] Schaefer, H.-C., Jetz, W., & Böhning-Gaese, K. (2007). Impact of climate change on migratory birds: community reassembly versus adaptation. Global Ecology and Biogeography, 0(0), 071106211200001-

[3] Halupka, L., & Halupka, K. (2017). The effect of climate change on the duration of avian breeding seasons: a meta-analysis. Proceedings of the Royal Society B: Biological Sciences, 284(1867), 20171710.

[4] Chen, L., & Khanna, M. (2024). Heterogeneous and long-term effects of a changing climate on bird biodiversity. Global Environmental Change Advances, 2, 100008–100008.

[5] Liang, J., Peng, Y., Zhu, Z.et.al. (2021). Impacts of changing climate on the distribution of migratory birds in China: Habitat change and population centroid shift. Ecological Indicators, 127, 107729.

[6] Hanzelka, J., Tomáš Telenský, Jaroslav Kolečeket.al.,(2024). Climatic Predictors of Long-Distance Migratory Birds Breeding Productivity Across Europe. Global Ecology and Biogeography.

[7] Irannezhad, M., Tahami, M. S., Ahmadi, B.et.al. (2022). Compound climate extreme events threaten migratory birds' conservation in western U.S. Sustainable Horizons, 3, 100023.

[8] Wilson, W. H. (2007). SPRING ARRIVAL DATES OF MIGRATORY BREEDING BIRDS IN MAINE: SENSITIVITY TO CLIMATE CHANGE. The Wilson Journal of Ornithology, 119(4), 665–677.

[9] Kullberg, C., Fransson, T., Hedlund, J.et.al. (2015). Change in spring arrival of migratory birds under an era of climate change, Swedish data from the last 140 years. AMBIO, 44(S1), 69–77.

[10] Wilson, W. H. (2009). Variability of Arrival Dates of Maine Migratory Breeding Birds: Implications for Detecting Climate Change. Northeastern Naturalist, 16(3), 443–454.

[11] Saino, N., Ambrosini, R., Rubolini, D. et.al. (2010). Climate warming, ecological mismatch at arrival and population decline in migratory birds. Proceedings of the Royal Society B: Biological Sciences, 278(1707), 835–842.

[12] Kumar, L., da silva, P., None Gyanpriya Maharaj, et.al. (2024). A comprehensive review on the impact of climate change on the ecology, breeding seasonality, abundance and distribution of birds and possible approaches to address and conserve bird populations. International Journal of Science and Technology Research Archive, 6(2), 021–044.

[13] Mukund Nalawade, P., Solunke, K. R., Late, A., et.al. (2009). Dying Lake: A Loosing Habitat of Migratory Birds-A Case Study from Aurangabad City. 12th Wolrd Lake Conference.

[14] Williams, D. R., Child, M. F., Dicks, L. V. et.al.(2018). BIRD CONSERVATION. In L. V. Dicks, N. Ockendon, W. J. Sutherland, S. O. Petrovan, & R. K. Smith (Eds.), What Works in Conservation: 2018 (1st ed., Vol. 3, pp. 95–244). Open Book Publishers.