Analysis on the Effect of Habitat Fragmentation And Exploration of Its Solutions

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Abstract. Habitat fragmentation threatens biodiversity and species distribution. The overall objection of this study is exploring the reasons and phenomena of fragmentation and discussing the impact of habitat fragmentation on animal diversity, plant diversity, insect diversity, arthropod diversity and the distribution of species. In order to show the same impact of habitat fragmentation on animals, plants and microorganisms. The study research the similarity and difference of effects of habitat fragmentation to three different organisms. The method used in our study is analyzing the relationship between fragmentation and diversity by using landscape elements. The studies we have reviewed showed that habitat fragmentation has adverse effect on most species, influences interspecies communications. And the fragmentation can be imputed to human activities.

1. Introduction
In landscape ecology, habitat fragmentation refers to the process in which large and continuously distributed natural habitats are separated by other unsuitable habitats-matrices into many smaller patches (fragments) under human activities and natural disturbances [1]. Patches are the basic elements of fragmented landscape, and the shape, size and spatial structure of patches are the direct reflection of the composition, shape and nature of fragmented landscape. Landscape fragmentation is mainly manifested by the increase of patch number and the reduction of patch area, the irregular shape of patches, the reduction of habitat area within patches, the truncation of corridors and the isolation of patches from each other [2]. Liu, Zhizhong used landscape elements to analyze data and concluded that human activities are the main reason that leads to the landscape fragmentation. The research shows that disturbance is the main cause of landscape fragmentation, which can be divided into natural disturbance and artificial disturbance. Natural disturbances include natural fires, invasions of alien species, climate change, etc. However, human disturbances such as deforestation, mining, unreasonable agricultural cultivation and road construction are considered to be the main causes of landscape fragmentation in recent years [3]. It is hard to reduce fragmentation while keep the balance between artificial activities and nature. In this paper, the author interpreted the relationships between habitat fragmentation and diversity. As well as how the fragmentation influences the diversity of plants, animals and insects. By this method, people could have evidence to cope with various problems in different situations.

2. Methodology and Analysis
2.1. Habitat fragmentation and plant diversity
Habitat fragmentation affects plant genetic diversity mainly by affecting gene exchange between plants. Habitat fragmentation can increase the distance between patches, not only reduce the connectivity of
plant population and affect the abundance of population, but also affect pollinators' pollination behavior, thus limiting the spread of plant pollen and seeds. Even with long-distance gene exchange by anemophily and entomophily, plant genetic diversity is affected by habitat fragmentation [4]. Wang determined four morphological indices of individual upper, middle and lower seed layers in 9 plots, and determine the patch area. Seed morphological heteromorphism existed among different patches. Seed size showed small patches < medium patches < large patches.

![Figure 1. Morphological characteristics of seeds of heteroptera in different patches.](image)

The proportion of small seeds was higher in areas with serious disturbance. The proportion of medium-sized seeds was higher in areas with severe disturbance, open areas and areas with slight disturbance. The effect of habitat fragmentation on seed size was higher in open areas.

| size          | Top layer | Middle layer | Lower layer |
|---------------|-----------|--------------|-------------|
|               | Big seeds | Small seeds  | Big seeds   | Small seeds | Big seeds | Small seeds | Big seeds | Small seeds |
| Small patches | 4.44      | 28.89        | 66.67       | 24.44       | 64.07     | 11.48       | 8.15      | 41.48       | 50.37      |
| Medium patches| 7.04      | 40.74        | 52.22       | 37.41       | 52.22     | 10.37       | 12.59     | 38.52       | 49.63      |
| Large patches | 8.89      | 41.85        | 49.26       | 38.89       | 54.44     | 6.67        | 13.7      | 49.63       | 32.96      |
Compared with the wing length of seed appendages, large patches have a large number of large and medium-sized seeds, corresponding to larger wing length; the difference of seed quality between small, medium and large patches is small, and the stability of seed quality between large and large patches is strong [5].

Red sand has high genetic diversity and is an important vegetation type in arid areas. Four metapopulations of red sand were selected from Qipanjing habitat fragmentation area of Ordos, and ISSR Molecular markers were used to analyze the genetic diversity of populations. The results showed that 296 bands were amplified by 13 ISSR primers, and the polymorphic loci were 99.66%.

Table 2. Sequence of ISSR and amplification results.

| Primer  | Sequence of primer (5, —3’) | Total bands | Polymorphic bands | Percentage of polymorphic bands (%) |
|---------|-----------------------------|-------------|-------------------|------------------------------------|
| UBC810  | GAGAGAGAGAGAGAGAT           | 22          | 22                | 100                                |
| UBC811  | GAGAGAGAGAGAGAGAC           | 20          | 20                | 100                                |
| UBC817  | CACACACACACACACAA           | 15          | 15                | 100                                |
| UBC825  | ACACACACACACACACT           | 27          | 26                | 96.30                              |
| UBC834  | AGAGAGAGAGAGAGAGYT          | 29          | 29                | 100                                |
| UBC840  | GAGAGAGAGAGAGAGAYT          | 22          | 22                | 100                                |
| UBC841  | GAGAGAGAGAGAGAGAYC          | 28          | 28                | 100                                |
| UBC844  | CTCTCTCTCTCTCTCTCTR         | 24          | 24                | 100                                |
| UBC848  | CACACACACACACACARG          | 20          | 20                | 100                                |
| UBC859  | TGTGTGTGTGTGTGTGRC          | 12          | 12                | 100                                |
| UBC864  | ATGATGATGArGArGArG         | 22          | 22                | 100                                |
| UBC880  | GGAGAGAGAGAGAGAGA           | 32          | 32                | 100                                |
| UBC888  | BDBCACACACACACACA          | 23          | 23                | 100                                |
| totality|                             | 296         | 295               | 99.66                              |

The total Nei genetic diversity index and Shannon information index of 4 populations were 0.2221 and 0.3597, respectively. The genetic variation mainly existed in the population, only 11.14% of the variation existed between populations, and the gene flow between populations was 3.9878. Habitat fragmentation led to the decrease of the genetic diversity of red sand population, which resulted in the decrease of population genetic diversity. There was genetic differentiation, but there was still frequent gene exchange between different populations, and there was no significant correlation between genetic distance and geographical distance.[6]

2.2. Habitat fragmentation and animal diversity
Habitat fragmentation has direct or indirect effects on wildlife distribution, activity, population size, community structure and behavior. In addition, bio-environmental factors, abiotic environmental factors and human activities continuously affect wildlife or their habitats, leading to changes in the relationship
between wildlife and habitats [7]. Sang determined that the main destructive factors of habitat fragmentation in Dabao mountain are wind erosion or water erosion, which is due to the distance from the runway (sidewalk) and the inconvenience of tourists and horse gangs, thus the degree of habitat fragmentation is low and the degree of disturbance is small. The above results show that the impact of human activities decreases with the increase of the distance between free lanes (sidewalks), and the fragmentation of habitats also decreases [8].

Nadia our, Erik Matthysen and Andre A. Dhondt conclude that the effect of habitat fragmentation depends on the composition of the local predator community [9]. Habitat type influenced arthropod species abundance, diversity and composition with greater abundance in fragments but greater diversity in continuous forest. According to trophic guilds, coleopteran herbivores were more abundant in continuous forest and overall omnivores in fragments [10].

Erik Matthysen, Frank Adriaensen and Andre A. Dhondt conclude that fragmentation causes an increase in natal dispersal distance but no discernible change in the number of territories between birth and establishment. However, fragmentation does effectively induce isolation once the young birds have settled [11]. The ranges of motion of birds is limited. Fragmentation causes birds in different patches can not communicated with others and small-scale mating in every patch, then lead to isolation and the increase of natal dispersal distance.

The Red Crowned Crane has always lived and bred in the reed marsh without smoke. At least, there should be no obstacles and human activities between 2km and 3km. At present, the first adaptive choice for breeding Red Crowned Crane in Panjin is to nest and breed in a relatively small area. The investigation shows that the nest area of Red Crowned Crane in Panjin is 40% - 60% smaller than that in the original natural state, i.e. 1 / 4-1 / 6 of the area in the natural state, especially some red crowned cranes nest 100 meters away from the well platform, which is more sufficient to prove that the red crowned cranes adopt the adaptive selection of reducing the breeding area to adapt to the new environment in order to adapt to the environment of habitat fragmentation. Slow environmental change provides time for species to adapt, while severe environmental change will harm the survival of species, especially those species who are sensitive to environmental change [12].

2.3. Habitat fragmentation an insect diversity

Under the condition of artificial ecology, agricultural land use forms a mosaic pattern of landscape patches. This fragmented patch pattern can cause changes in insect species and population density, thereby affecting changes in biodiversity. Generally, the area-sensitive species, narrow-feeding species and rare species which inhabit in patch will decrease or even disappear in fragmented landscape, while the distribution and population dynamics of broad-feeding species, common species are almost unaffected, and the number of some species will increase [13].

Habitat fragmentation caused by human disturbance can significantly reduce the species diversity of butterflies in this area, and there is a risk of the reduction or even extinction of endemic butterfly species [14].

Small space, low connectivity and over fragmentation of space and assemblage communities are not conducive to the stability and sustainability of prey-predator system.

Patch fragmentation increased and the patch area decreased, the number of natural enemies of seed pests decreased, and the damage rate of seed pests increased [15].

Fragmentation of habitats reduces the dynamic stability of some predator-prey interactions and prevents spatial tracking [16].

Qiandao Lake is a typical fragmented landscape caused by water storage. Lu Kun used the sequence of COI gene fragment of mitochondrial DNA as molecular marker to study the genetic diversity of Dendrolimus punctatus population collected from 23 sample islands in Qiandao Lake area.
Table 3. Haplotype, nucleotide diversity and Tajima’s neutrality test in different island population of Dendrolimus punctatus based on COI.

| population | H  | Hd   | Pi    | K     | Tajima’s D | Statistical Significance |
|------------|----|------|-------|-------|------------|--------------------------|
| I14        | 14 | 0.95789 | 0.01027 | 5.13684 | 1.10452 | Not significant, P > 0.10 |
| I15        | 13 | 0.95906 | 0.01111 | 5.55556 | 1.10097 | Not significant, P > 0.10 |
| I31        | 14 | 0.93676 | 0.00957 | 4.78261 | -0.07046 | Not significant, P > 0.10 |
| I32        | 13 | 0.90909 | 0.00777 | 3.88312 | 0.03968 | Not significant, P > 0.10 |
| I33        | 16 | 0.97895 | 0.01284 | 6.42105 | 1.57502 | Not significant, P > 0.10 |
| I34        | 11 | 0.92398 | 0.01078 | 5.39181 | 0.66944 | Not significant, P > 0.10 |
| I35        | 14 | 0.93676 | 0.00659 | 3.29644 | -0.46334 | Not significant, P > 0.10 |
| I36        | 14 | 0.95425 | 0.01161 | 5.80395 | 0.94564 | Not significant, P > 0.10 |
| I37        | 11 | 0.88933 | 0.01032 | 5.16206 | 1.27678 | Not significant, P > 0.10 |
| I43        | 18 | 0.97835 | 0.01008 | 5.03896 | 1.1158 | Not significant, P > 0.10 |
| I50        | 14 | 0.93676 | 0.01051 | 5.25692 | 0.51149 | Not significant, P > 0.10 |
| I63        | 13 | 0.96667 | 0.00848 | 4.24167 | 0.31886 | Not significant, P > 0.10 |
| I72        | 14 | 0.94372 | 0.01256 | 6.28139 | 1.56602 | Not significant, P > 0.10 |
| I73        | 15 | 0.95652 | 0.00756 | 5.77866 | 0.25508 | Not significant, P > 0.10 |
| I74        | 12 | 0.92641 | 0.01248 | 6.24242 | 1.53377 | Not significant, P > 0.10 |
| I75        | 11 | 0.94167 | 0.00923 | 4.61667 | 0.08335 | Not significant, P > 0.10 |
| I77        | 14 | 0.90119 | 0.01015 | 5.0751 | 0.88759 | Not significant, P > 0.10 |
| I78        | 15 | 0.90476 | 0.00968 | 4.83983 | 0.13829 | Not significant, P > 0.10 |
| I113       | 16 | 0.96104 | 0.01353 | 6.76623 | 1.6488 | Not significant, P > 0.10 |
| I117       | 14 | 0.85375 | 0.00772 | 3.85771 | -0.18125 | Not significant, P > 0.10 |
| IB6        | 19 | 0.98268 | 0.01313 | 6.5671 | 0.96151 | Not significant, P > 0.10 |
| IB7        | 11 | 0.91053 | 0.01339 | 6.69474 | 1.80057 | Not significant, 0.10 > P > 0.05 |
| IJSD       | 19 | 0.89744 | 0.00991 | 4.95547 | 0.99982 | Not significant, P > 0.10 |
| Totality   | 14.13 | 0.9347 | 0.01055 | 5.2769 | -0.21779 | Not significant, P > 0.10 |

The regression analysis of genetic diversity and island attributes showed that there was a significant positive correlation between genetic diversity and island area and island shape, but not with island isolation distance[17].

3. Analysis Summary and Discussion
From the above, the paper summarized the following points. First of all, habitat fragmentation has a negative impact on the vast majority of organisms, affecting interspecific communication. At the same time, habitat fragmentation has a significant impact on the quality and quantity of offspring. The number of offspring decreases and the quality decreases. Moreover, the main factor leading to habitat fragmentation is human activities. In order to develop the economy, human beings vigorously develop the wild environment. Industries like tourism, construction industry increase the distance between environmental fragments, thus reducing the range of activities of species, reducing gene and species richness. Habitat fragmentation does not adversely affect all species. For some organisms, such as omnivores, habitat fragmentation is beneficial to their survival. Habitat fragmentation will increase the incidence of pests and diseases, which is not conducive to environmental protection and agricultural production. Fragmentation can also lead to changes in predator-prey relationships, affecting their stability. Which means that governments should pay attention to the human activities. For example, reducing the number of industrial factories, restricting the increase of population and limiting reclamation of lakes, forests and meadows. A lot of species of animals and plants need sufficient and
continuous space to mate, breed and move. Fragmentation impedes the communication among different species by affecting predation and competition and other interspecific relationships. It also affects intraspecific relationship. In a species, fragmentation could restrict organisms’ communication and even cause inbreeding. Inbreeding is a huge reproductive problem, and it could lead to the organism quality decline. And it finally put a threat to ecological system and human living. On the other hand, the governments need to resume some unnecessary artificial projects in order to reduce habitat fragmentation. it is useful for habitat protection to set up natural preserves and gene pool. It can protect valuable gene resource and cope with the problems which come from genovariation. There are many endangered animals like panda, leopard and tiger. They need sufficient natural space to satisfy their demands of activity rather than artificial environment. Too much exoteric help will obliterate wild nature, which is bad for their lives. Governments should make efforts to protect them with suitable approaches, increase biodiversity and slow down species extinct.

4. Conclusion:
We have demonstrated in this paper that human activities cause habitat fragmentation dramatically and habitat fragmentation lead to the decline of diversity. In this paper, the author just discussed the effect on the number of diversities, but they did not talk about the effect on diversity quality. The scientists should continue study the effect of fragmentation on diversity quality. For example, the life expectancy of organisms, the birth rate and death rate and the physical condition of organisms. The scientists should pay attention to how to improve diversity quality. High diversity with artificial ways is not permanent. Essentially it is not real protection. High diversity quality can maintain the stability of ecological system and reduce the degeneration of natural landscapes. By studying the effects and factors of habitat fragmentation, people could find that fragmentation is a huge problem. People should make effort to find out how to reduce fragmentation and protect diversity. Establishing natural reserves is a good method to protect diversity. How to establish reserves correctly and protect local species with suitable ways. The decrease of diversity will cause the ecological system become unstable and put a threat to human daily life and even essential survive.

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References
[1] Liu, M., Cai, P. (2011) Impact of habitat fragmentation on insect diversity. J. Anhui Agricultural Science, 39 (26): 16017-16019.
[2] Tang, J., Tan, F., Zhou, L. (2018) The impact of landscape fragmentation on species diversity. J. Green Technology, 24: 158-161.
[3] Liu, Z., Chen, H., Yi, N. (2009) Patch Characteristics of Landscape Elements in Meihua Mountain Nature Reserve. J. Fujian Forestry Science and Technology, 36 (1): 130-133.
[4] Yu, W., Wu, B., Liu, Y. (2019) Advances in research on the effects of habitat fragmentation on genetic diversity of animals and plants. J. Journal of Applied and Environmental Biology, 25 (03): 743-749.
[5] Wang, H., Duan, C., An, J., Wu, L., Zhang, X., Wang, S. (2015) Study on morphological characteristics of seeds of Heteroptera Heteroptera in desert patch habitats. J. Seeds, 34 (05): 17-21.
[6] Song, X., Yang, J., et al. (2014) The effect of fragmented habitat on the genetic diversity of red sand meta. J. Chinese Journal of Grassland Science, 36 (06): 29-33
[7] Zhang, M., Ma, J. (2014) Discussion on the theory of wildlife habitat fragmentation. J. Journal of Wildlife, 35 (01): 6-14
[8] Sang, Z., Yang, S., Wu, Y., et al. (2013) Habitat Fragmentation Investigation and Research of Dashanbao Black-necked Crane Nature Reserve in Yunnan Province. J. Soil and Water Conservation, China, 11: 63-65.

[9] Nour, N., Matthysen, E. and Dhondt, A. A. (1993) Artificial Nest Predation and Habitat Fragmentation: Different Trends in Bird and Mammal Predators. J. Ecography, 16(2):111-116.

[10] Benítez-Malvido, J., Dátillo, W., Martínez-Falcón. A. P., Durán-Barrón, C., Valenzuela, J., López, S., Lombera, R. (2016) The Multiple Impacts of Tropical Forest Fragmentation on Arthropod Biodiversity and on their Patterns of Interactions with Host Plants. J. PloS one, 11(1).

[11] Matthysen, E., Adriaensen, F. and Dhondt, A. A. (1995) Dispersal Distances of Nuthatches, Sitta europaea, in a Highly Fragmented Forest Habitat. J. Oikos, 72(3):375-381.

[12] Li, Z. (2003) Effect of habitat fragmentation on Red Crowned Crane. J. Liaoning urban and rural environmental science and technology, 1:39-41.

[13] He, D., Zhao, Z., Zhang, D. (2009) Responses of insect communities and populations to habitat fragmentation in grassland landscape. J. Journal of Grassland Science, 18 (06): 235-241.

[14] Yang, H., Liu, Y., Sang, J. (2016) Impact of habitat fragmentation on butterfly species diversity in Xiaolongshan forest region of Gansu. J. Forestry Science and Technology Newsletter, 5:3-7.

[15] Zhang, D., Zhang, S., Ma, Z. and Wu, G. (2019) Effects of habitat fragmentation on the number and damage rate of seed pests of Sophora alopecuroides. J. Ecology Science, 38(02): 31-35.

[16] He, D. (2009) Agricultural Landscape and Pest Population Control. J. Plant Protection, 35 (03): 12-15.

[17] Lu, K. (2018) Effect of landscape fragmentation on genetic diversity of Dendrolimus punctatus population in Qiandao Lake. D. Hangzhou: Zhejiang agricultural and Forestry University.