The development status and evaluation of Hunchun wild Amur tiger reserve and Sino-Russian ecological corridor construction

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Abstract. Jilin Hunchun Wild Amur Tiger Park National Nature Reserve is China's first national-level tiger and leopard nature reserve with the highest number and density of wild Amur tigers and leopards in China. The reserve has become a part of ecological corridor for tigers to freely migrate between China and Russia. China provided a significant protection zone to address the threat of small population of Amur tiger. The solution published in China and effectiveness of the protection zone are discussed in this paper. Even more solutions are planned to be achieved through cooperation between China and Russia.

1. Introduction
Since Jilin Hunchun Wild Amur Tiger Park was approved as a national nature reserve by the State Council of China in August 2010, great achievements have been made in species protection, such as ecological restoration, biological observation, international exchanges, hunting prevention, and standardized construction. The Amur tiger number has shown signs of expansion obviously, and the reserve has become an important part of the Amur tiger international corridor. However, the wild Amur tiger living area is still in an “isolated island” state, and it is urgent to open up the China-Russia’s ecological corridor to provide a good environment for the spread and reproduction of the wild Amur tiger.

2. Methods
The Amur tiger had suffered rapidly decreasing of both population numbers and habitat range due to excessive poaching, habitat loss, and habitat fragmentation [1, 2]. Before 1998, the Amur tiger in China lived in poor condition for a long period. But since China initiated the Natural Forest Protection Program and invested more on Amur tiger conservation, the population and habitat range had improved. In recent years, more and more wild Amur tigers’ transboundary movements are observed and reported. More than one tiger was found to have moved across the Sino-Russian boundary into Chinese territory [3]. A female Amur tiger with three cubs migrated from Russia to China in 2013 [4]. 40 individuals in China and at most 70 in Russia were recorded from 2012 to 2014 [5]. Migration indicated an expanded habitat and low inbreeding probability. A long-distance dispersal of Amur tiger indicated potential to restore the nature ecology between China and Russia.
2.1. Basic information of Hunchun Wild Amur Tiger Park National Nature Reserve
The Hunchun Wild Amur Tiger National Nature Reserve is located at the junction of China, Russia, and North Korea. The geographical coordinates are 130º14'08″~131º14'44″ east longitude and 42º24'40″~43º28'00″ north latitude. The total area is 108,700 hm² (including: core area 50,536 hm², buffer zone 40,571 hm², and experimental area 17,593 hm²). In addition, in accordance with the characteristics of the large range of wild Amur tigers and leopards, which are the main protection targets, combined with the actual conditions of Hunchun City, an outer protection zone of 41,778 hm² was established in the northern part of the reserve.

2.2. Biodiversity contribution
Hunchun Wild Amur Tiger Park National Nature Reserve plays a very important role in protecting biodiversity. According to preliminary survey statistics, there are 537 species of wild plants in the area, including 10 species of wild plants under national key protection; 316 species of common wild animals, including red-crowned cranes, hooded cranes, wild musk deer, and sika deer. There are 10 species of sable, golden eagle, tiger-head sea eagle, and white-tailed sea eagle, 34 species including black bear, red deer, lynx, white crane, hazel grouse, etc. Compared with the data of 3 to 5 Amur Tigers and 2 to 4 Far Eastern leopards obtained in the 1998 survey, it shows a steadily increasing trend, and the range of activities also shows a trend of spreading to the Wangqing area.

2.3. Construction of nature reserve
Under the framework of the open development strategy of the Tumen River area, using the Amur Tiger Nature Reserve as a window to strengthen technical exchanges and create cooperation with international ecological and environmental protection agencies has actively promoted the ecology of key areas such as transnational nature reserves and transnational wetland reserves. International cooperation in construction and environmental protection will gradually realize the internationalization of Hunchun’s ecological and environmental protection, and comprehensively improve the management and protection capacity and construction level of the reserve. Actively seeking national special funds and international funding to accelerate the level of infrastructure, ecological protection, monitoring, and research in the reserve, the reserve has established and gradually improved the ecosystem monitoring network and improved ecosystem early warning capabilities.

3. Results and discussion
3.1. Implementing measures in the protected area
The functional positioning of the important ecological function reserve is to ensure regional ecological safety, promote harmony between humans and nature, protect and restore the ecological environment, provide ecological products as the primary task, develop suitable industries that do not affect the main functional positioning according to local conditions, and guide the overloaded population gradually and orderly. According to the plan, several measures have been implemented in the reserve at present:

1) Regional partition plans as core area, buffer area, and experiment area have been developed, and a district management system has been implemented.

2) The indigenous population has been gradually transferred out of reserve. A part of the population has moved outside the nature reserve, and a part of the population has been transferred to the management and protection personnel of the nature reserve.

3) Infrastructure construction has been removed out of protected areas, and new roads and railways have been re-planned to avoid crossing the core areas.

4) A joint monitoring mechanism and many legal documents for creating a safe ecological environment for wildlife have been established. Joint inspection for illegal selling of wild animals and relative products has been organized by cooperating with local administrative departments.

5) A joint research work has been conducted for protecting tigers, leopards, and prey animals.
6) The ecological culture has been promoted and public awareness of ecological protection has been raised by running public communication through touring exhibitions, delivering lectures, promoting ecological literature, and publicity art activities on public media.

3.2. Effects of implementations
Because of the reservation’s unique geographical location advantages, it has connected the free migration of wild animals between China, Russia, and North Korea, and has maintained an ecological channel for creature reproduction. A multinational ecology corridor improved the increasing condition of population. Supporters suggested that wild Amur tiger in Russia was a critical source for recovery of Chinese tigers [6]. In 2020, more Amur tigers were encountered by civilians and reported [7, 8]. It can also shorten the distance between the reserve management bureau and the people in the forest area.

3.3. Establishing a Sino-Russian Ecological Corridor
The Chinese Amur tiger stud in the northern region of the Changbai Mountain, mostly distribute along the Sino-Russian border, next to Primorye. The linkage between Hunchun and Primorye is crucial for the persistence of the Amur tiger. Ning et al. studied the condition of the Amur tiger within Northern Changbai Mountain and support the urgent need for an ecological corridor between China and Russia [9]. Meng et al. analysed many potential corridors and confirmed the importance of Sino-Russian ecologic corridor as it can help to avoid inbreeding and excessive competition [10]. To improve free migration of Amur tiger, China and Russia should cooperate on those areas:

1) Recovering natural forest
In some key corridor areas and neighbour places, large areas of forest are not preferred by Amur tigers and leopards for living in, such as the Larix olgensis plantation. Low distribution of prey was insufficient for wild Amur tiger to settle. Gradual change in the forest type of a single tree species to a mixed forest type for meeting the needs of various animal living requirement also meets the prey requirements for the survival of the Northeast tiger and leopard.

2) Reducing negative impact of human activities and partition
There are some villages and a small number of forest farm residential areas in the key corridor area, and their frequent human activities interfere with the migration of Amur tigers and leopards. Both sides of the border should dredge the migration corridors and solve the problem of reserve partition and fragmentation caused by border wire fences, towns, villages, and farmland. The existing roads should be renovated to provide ecological channels for the migration of Amur tigers and the negative impact of human activities should be reduced.

3) Establishing a transnational coordination mechanism
China and Russia should establish an official coordination mechanism including regular information exchanging, staff training, fund raising, and organising the international conferences. It will not only help protecting Amur tiger, but also give an example to other countries.

4. Conclusion
The Amur Tiger amount in the Sino-Russian border area has entered a period of peak breeding and rapid growth, but habitat quality degradation and fragmentation are still challenging the protection of tigers and leopards. Cooperation on Amur tiger between China and Russia has a long history. In 1998, the Forestry Department of China’s north-eastern province of Jilin invited Russian biologists to conduct a survey of tigers remaining in its forests. China and Russia signed a memorandum of understanding for further cooperation on Amur tiger’s transboundary movement and protection in 2019. Opening up the Sino-Russian ecological corridor requires joint cooperation in policies, personnel and funds. It is recommended that China and Russia strengthen their attention, carry out international cooperation, improve the ecological corridor, and explore the harmonious relationship between the Sino-Russian border ecology as soon as possible.
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