

< Review >

## The Status and Development Trend of Nature Reserves in Heilongjiang Province, Northeastern China

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**ABSTRACT:** Heilongjiang Province has set up 104 nature reserves, with a total area of 2,641,700 ha, or 5.88% of the total area of the province. These constitute a network of nature reserves comprising most important types of nature reserves, and play an active role for improving the protection of the ecological environment and for the continuous economic and social development of the province. But in the management of these nature reserves, there are still some problems with people's idea, with educating the public, and with capital investment. These problems should be treated seriously. To preserve our natural heritage and biodiversity and to promote the sustainable development of our society and economy, it is projected that by the year 2000, the number of nature reserves in Heilongjiang is to reach 109, covering 6.17% of the total land area of the province. This percentage will be further increased to 8.62% by 2010, at which time the network of nature reserves is to have a proper distribution and comprehend all the important types of nature reserves. This will ensure the healthy development of the cause of nature conservation, with systematic planning, active protection, and sustainable use, so that ecological and social benefits can be developed hand in hand with economic benefits.

**Key Words:** Economic development, Far-Eastern China, Heilongjiang Province, Nature conservation, Nature reserve, Sustainable land-use, Wildlife reserve

### INTRODUCTION

The 20th century is one in which human society has made tremendous progress. But the progress and development of human society have also brought about the worsening of the natural and human environment, which is threatening the survival and development of the human race. Nature reserve is a special area composed of the extinct-feasible biological communities and of typical natural ecosystem controlled by natural processes without man-mediated disturbance in both terrestrial and aquatic systems. It also has a limitation that management and conservation strategies be accomplished by special environmental law. The establishment of nature reserves is an important measure to protect and sustain the natural and ecological environment of regional biota (Spellerberg 1995).

The Ussuri/ Wusuli River joins remote regions of Russia-China in the middle of rapid socio-economic transition, and Heilongjiang Province is located in the western side of the river. Heilongjiang Province is comprising roughly a third of the watershed of the tributary. The Ussuri's watershed of mountain forest, plains,

and wetlands melds two strikingly different ecosystems such as boreal and temperate landscapes. Therefore, this region draws world's attention both for its unique biological diversity and the abundant natural resources that promise a better life for the peoples of both countries (Ecologically Sustainable Development 1996).

Today, economic reform in the regions between the two countries promotes cross-border trade, tourism, new area of natural resource-use and production (Piao 1996). However, yet the regions including Russian area and Heilongjiang Province recognize that many effects of development are not readily controlled at the border and are becoming counter-productive. The holistic environmental problems on total ecosystems, such as polluted water (including stream and river), foul air and wildlife-habitat loss, cause ecological deterioration and landscape fragmentation of this region. Therefore, the hope for regional planning of future regimes for rich ecosystems and sustainable land-use, in ways compatible with economic development, is what motivated the purpose of Nature Reserve establishment in Heilongjiang Province, China (Ecologically Sustainable Development 1996, Piao

1996).

This paper presents the current situation of nature reserves in Heilongjiang which are influenced by increasing socio-economic pressure. It also suggests strategies for conservation and management of nature reserves with sustainable development and suitable land-use perspectives.

### SOCIAL AND ECONOMIC SITUATION

With a population exceeding 36 million, extensive forests and deposits of coal, oil, minerals, and globally significant remnants of the nation's largest wetland, Heilongjiang has long been considered as the Great Northern Wilderness in China. But the province now bustles with economic development, including the famous Daqing oil field, the Shuangyashan and Jixi coal deposits, other mines, major timber production, and petrochemical and other industries along the Songhua River. While China has 131 million ha of forested land, this comprises only 13.6% of its land area (Chinese Environmental Protection Agency 1994). Heilongjiang, the most forested province, is losing forest land at the rate of 1.7% per year. Despite the most ambitious population control measures in human history, China's population, 1.15 billion in 1994, may reach 1.5 billion by 2020 (World Resources Institute 1994). It must feed almost one-fifth of the world's population from one-fifteenth of the world's arable land. Yet the Chinese Academy of Sciences estimates that net cropland area is shrinking by 333,000 ha per year (World Resources Institute 1994), and Heilongjiang is one of the China's key commodity grain production bases. A national goal is to turn Heilongjiang's Sanjiang, sweeping northeast toward Russia through the

Ussuri watershed, into a cultivated field of wheat, corn and soybean. The province plans to double its grain production by 2010 (Heilongjiang Provincial Planning Commission 1994). Chinese agriculture, for centuries the world's most productive and "organic", faces new challenges in this harsh but delicate environment (Table 1).

Except for limited urban area, common rural electrical use is relatively low, limiting the region's economic development. The shortage of rural energy in these regions harms the rational use of forest and grassland resources. The shortage of energy throughout the year is great, so peasants have no choice but to burn large quantities of stalks, stems, wood, and even pasture grass, which adversely affects soil fertility and agricultural production (Table 2 and 3).

### STEPS FOR NATURE RESERVES ESTABLISHMENT

#### Step 1: Identification of nature reserve type

Identifying the type of nature reserves is for getting information of ecological functions and characteristics of nature reserves. This information plays a large role in evaluating a study site, protecting wildlife, establishing and managing nature reserves (Heilongjiang Provincial Planning Commission 1991). Type of nature reserves in Heilongjiang Province is identified on the basis of development and ecological (or environmental) characteristics of the province. There are five types as follows: (1) Typical natural ecosystem type: Well preserved types against man-mediated disturbance. Landscape system (or ecosystems) composed of various natural resources. This type includes forest, grassland,

Table 1. Changes in the cultivated land area of counties and cities in the Ussuri River Basin (ha)

County or City	1949	1959	1975	1983	1993
Tongjinag	4800	6667	81137	201962	225526
Fuyuan	688	600	21904	55921	161610
Raohe	4157	5597	115072	154552	164162
Hulin	17769	121061	151358	240281	290949
Mishan	64348	174044	156519	187350	271302
Jidong	-	-	52231	53790	101966
Jixi	22326	22683	27021	26328	49769
Muleng	29479	28072	33065	38889	134677
Shuangyashan	4173	7000	10967	10333	29748
Youyi	-	54661	68881	99240	85329
Fujin	34734	111723	187270	271180	462544
Baoqing	32760	135610	191181	255775	380206
Suifenhe	-	-	1976	2333	5909
Dongning	28850	28079	25927	30050	76850
Total under Cultivation	244084	695797	1125509	1627984	2318070
Percentage of Basin Total	3.7	9.0	14.6	21.1	31.5

**Table 2.** Change of biomass consumption of Heilongjiang Province (Unit: 10,000 m<sup>3</sup>)

Region	Year				
	1949	1962	1976	1981	1986
Songhuajiang	14094	18845	30271	20656	19558
Mudanjiang	22713	28724	29681	28594	25432
Hejiang	13471	10707	10037	10390	10049
Shuihua	6357	3056	1251	1545	1438
Nenjiang	-	612	885	1201	1201
Heihe	15382	16496	7447	7590	12779
Yichun	48223	36726	28784	28369	24444
Daxinganling	76324	61361	46292	44022	47069
Total	196564	178728	158232	153641	144630

**Table 3.** Change of forest cover in the Heilongjiang Province (Unit: %)

Region	Year				
	1949	1962	1976	1981	1986
Songhuajiang	29.0	39.2	39.7	38.7	37.8
Mudanjiang	36.5	57.3	49.1	46.3	41.6
Hejiang	19.5	18.7	14.4	13.9	15.3
Shuihua	11.3	6.2	7.3	7.4	7.8
Nenjiang	-	3.6	3.5	5.0	5.8
Heihe	38.4	41.0	35.8	31.8	31.9
Yichun	79.2	79.5	72.9	71.2	70.2
Daxinganling	81.1	80.9	71.8	70.9	71.1
Total	36.8	39.8	36.3	35.0	34.7

riparian vegetation and wetland, etc. (2) Wildlife type: An area including various habitats for endangered wildlife (including aquatic organisms). Nature reserve or wildlife habitats with high economic and protective values. (3) Natural history type: Places where many biological fossils are frequently found. Land form showing special volcanic, geological and geomorphologic features and characteristics. (4) Natural landscape type: Distinct natural landscape with scenic beauties. (5) Ecologically vulnerable area or natural rehabilitating area: Desertification area by loss of water resource and erosion of soil. Ecologically restored area (including hedgerow such as forest strips against wind and sandstorm) after land degradation (Fig. 1a). Retro-succession area of natural grassland.

### Step 2: Scientific surveying of the site

According to environmental-ecological condition, the following eight categories are decided for the site needed as nature reserve. (1) Typical natural ecosystem, (2) A place including habitats and breeding sites of an endangered wildlife, (3) Water resource area with high ecological value, (4) Natural area with scenic beauties, (5) Area of geological, geomorphologic

value, (6) Lake or forest with special protection, (7) Ecologically vulnerable area, (8) Natural area necessary for protection.

Socio-economic and natural environments are surveyed on the site in the hope of establishing a nature reserve area by local government officials and scientific experts. Major survey items include the past and present history of a target object, identification of biological resource (local biota) data, distribution of biological communities and ecosystems, geographical condition, land-use pattern, landscape structure of boundary and interior part of core area.

### Step 3: Making report

Central government official examines and ratifies the preliminary report framed by scientific expert and local government officials. Content of the report includes the following items: (1) Nature-human condition, biogeographical condition, (2) Identification and decision of the type of nature reserve, (3) Authorization (naming): according to the type of target object and its local name, names are designated as follows: Local name + nature reserve (e.g. Mudanjiang nature reserve) in general nature reserve, local name + target object + nature reserve (e.g. Lissin grassland nature reserve) in biological and historical nature reserve, local name + official rank (national or provincial) + nature reserve (e.g. Liangshui national nature reserve). (4) Framework for zoning and generic planning, and organization establishment for management, budget, etc.

### Step 4: Evaluation criteria of nature reserve

(1) Generality: Uniqueness, representatives, characteristics of targeted reserve should be considered according to characteristics and types of nature reserve.

(2) Rareness: Nature reserve should comprise unique or rare biological communities and ecosystem in the region.

(3) Vulnerability: Ecosystem or species sensibility to environmental change and natural disturbance.

(4) Diversity: It is one of the indices evaluating species composition, community and ecosystem structure of a certain area.

(5) Area (size): Considering a possible human impact and other potential impact, minimum area necessary for conserving target biota is decided.

(6) Naturalness: Intensity of human impact on nature reserve.

(7) Amenity: Economic, cultural and scientific value, landscape beauty, etc.



(a)



(b)

Fig. 1. (a) Ecological restoration of hedgerow (forest strips) against soil erosion by wind and sandstorm in degraded area. Trees for restoration are composed of *Betula* spp. and other economic plants. Yilan, Heilongjiang Province. (b) Natural *Pinus-Quercus* mixed forest in Danginghe provincial nature reserve, Heilongjiang Province (Photo by S.K. Hong).

(8) Potential value: Degraded primary ecosystems of restoring or rehabilitating stages by natural process will be future potential economic suppliers with sufficient biological resources.

(9) Scientific research value

#### Step 5: Discussion and decision of examination committee for nature reserve

(1) Examination of natural environment and resources: it includes geography, geo-morphological characteristics, climate, hydrology, soil, major type vegetation (vegetation map, classification, nomenclature), economic plant species (category, distribution, species number, com-

position, etc.), forest resource (biomass), wild animals (category, territory, number, behavior, distribution, etc.), insect, biodiversity, landscape beauty, a location of natural landscape, etc.

(2) Examination of social and economic factors: social and economic background of the surveyed region, population, major industry, tribes, land-use pattern, direct or indirect human-mediated impact, etc.

(3) Evaluation of establishing nature reserve: decision of type (selection of target object, zoning of core or buffer area, adjustment of nature reserve type), size, naturalness, amenity, potential economic value, scientific value of the nature reserve.

(4) Zoning of nature reserve: selecting size, location, and target object of core and buffer areas, and setting experimental station.

(5) Management organization of nature reserve: development of scientific education system for expert and special official for nature reserve, scientific monitoring system (watching, vegetation or landscape mapping, scientific and historical surveying including biota, hydrobiological and geoecological data collecting, etc.), legislating and acting law.

### THE CURRENT STATUS OF NATURE RESERVES IN HEILONGJIANG PROVINCE

#### Natural environment

Heilongjiang Province is located in north-eastern China, and the total area of the province is 454,600 km<sup>2</sup>. The geo-morphological features of the province are geographically different. Therefore, it includes several types of landscape systems such as high mountains, hill area, plain, river, wetland, and lake with different origin of each landscape (Heilongjiang Provincial Planning Commission 1994, Piao 1996). This region shows continental monsoon in climate condition and has four seasons. Nature reserves such as forest, grassland, and wetland are concentrated in the province, therefore biodiversity is comparatively higher than other provinces in China. More than 590 wild animals and 2,400 wild flowers are listed in the province (Chinese Environmental Protection Agency 1994).

#### Current nature reserves

Fenglin nature reserve established in Yichun in 1958 is the first case of nature reserves in the province. Currently, 104 nature reserves with different nature rank have been established for the last 40 years, and they cover 5.88% (2,671,400 ha) of the total province. Especially, Zhalong,

Fenglin and Liangshui nature reserves are focused in international network perspectives of wetland and nature conservation site.

Three national scenic beauty spots and 48 forest parks (18 national parks, 30 provincial parks) were established, and their total area is 875,800 ha (1.96% of the province).

#### Major type of nature reserves in the province

(1) Nature reserves of forest ecosystem type: It is composed of 34 nature reserves which are distributed throughout the province (Fenglin nature reserve in Yichun, Hushan nature reserve in Daxinganling).

(2) Nature reserves of grassland and swamp: 8 nature reserves in Songnen plain and Sanjiang grassland areas.

(3) Nature reserve of wetland and riparian ecosystem types: 32 nature reserves (Zhalong nature reserve, Honghe nature reserve, Jingpohu nature reserve, Xingkaihu nature reserve, Humahé nature reservé, Xunbiela nature reserve).

(4) Nature reserve of wildlife type: 16 nature reserves for animals, 11 nature reserves for plants.

(5) Geological relics: 3 nature reserves (Wudalienzi geological relics).

#### Several typical nature reserves

(1) Fenglin national nature reserve: This area is located in Xiaoxinganling, and core area of natural forest of Korean pine (*Pinus koraiensis*) (18,400 ha) (Paio 1996, Wang 1994).

(2) Huzhong national nature reserve: This area is located in Daxinganling (167,213 ha). The largest area of natural (virgin) forest of the cool temperate zone in the northern China.

(3) Liangshui national nature reserve: Southern area of Xiaoxinganling (12,133 ha). Natural *Pinus-Quercus* mixed forest dominated by *Pinus koraiensis* (Wang 1994).

(4) Zhalong national nature reserve: Bog area in Songnen plain (210,000 ha). All 15 species of crane in the world are found in this nature reserve.

(5) Wudalienchi national nature reserve: This is located between Songnen plain and Xiaoxinganling mountainous ridge (100,800 ha). Volcanic relics and mineral water are natural resources in this reserve.

(6) Honghe national nature reserve: This is located in Sanjiang plain and total area is 21,835 ha. Representative ancient bog in the northern China (Piao 1995).

(7) Xingkaihu national nature reserve: This is located in Wusuli River between Russia and China, and the total area is 222,488 ha. It includ-

es wetland and riparian ecosystem.

(8) Mudanfeng national nature reserve: This is located in the northern part of Laoyeling mountainous ridge and Mudan River, total area is 19,468 ha.

(9) Danqinghe provincial nature reserve: This is located in Yilan region. Total area is 43,933 ha. It includes riparian ecosystem and naturally regenerated *Pinus-Quercus* mixed forest (Fig. 1b).

### EFFECTIVE MANAGEMENT OF NATURE RESERVE

#### Effective management of nature reserve

Fundamental duty and aim of nature reserve establishment is to protect natural environment and to utilize natural resource with sustainable management (Spellerberg 1995). Therefore, effective management needs the strengthening of the management planning continuously. Moreover, on the premise that we realize the fundamental duty and aim, we use, develop, and manage the favorable conditions of original nature reserve appropriately (Chinese Environmental Protection Agency 1994, Piao 1994, 1995).

The first duty of the effective management is preservation, and therefore we must enforce the preservation and develop the nature reserve well. But the preservation is not accomplished by just the closed management maintaining nature reserve as ancient type. Utilization of the reusable resource gaining from the nature reserve is another sustainable resource management. Another important point of nature reserve management is to promote the production and management activity on the basis of the unique natural environment and natural resource types. Artificial raising and training of livestock, sustainable utilization and manufacturing of natural resources, and tourism are good examples of management strategy of the province.

#### Content and method of effective management

- To investigate and understand the fundamental circumstances of nature reserve
- Establishment of management organization
- To ensure the fund supply
- To make a plan and design of nature reserve
- To build the law
- To accomplish advertisement and education
- To enlarge the scientific research
- To enlarge the domestic or international joint work

#### Major current problems

Government attaches great importance to

building and management of nature reserve in Heilongjiang Province, then distributes the guideline of "Nature Conservation and Management Method in Heilongjiang Province" (Piao 1996). It includes management of nature reserves by protection act (or law) and management instruction with responsibility under the whole control of the Environmental Protection Agency. However, there are still some problems of understanding and advertisement such as misunderstanding the meaningful importance of establishment and management of nature reserve and contradicting between development and preservation of the nature.

Size, distribution and pattern of current nature reserves are not enough to satisfy the need of nature preservation and protection (Spellerberg 1995). And it is still disadvantageous to accomplish high biodiversity and to keep continuous nature reserve plan. Limitation of education system for the experts and building act (law) also decreases the effect on the capability of nature conservation program. These are the emerging important problems to be solved urgently (Chinese Environmental Protection Agency 1994).

#### FUTURE DEVELOPMENT GOAL OF NATURE RESERVE IN HEILONGJIANG PROVINCE

The development of nature reserve is necessary for developing the sustainable society in the near future. Under the consideration of current natural environment and resources in Heilongjiang Province and people's economic development, it is necessary to extend nature reserve in the province. Moreover, it should be composed of completely connected system to enhance the ecological effectiveness of network system between nature reserves (Piao 1994, 1995, 1996).

#### Plan

The number of nature reserves will be 109 (6.17% of the total province) by the year 2000, and will increase to 147 by the year 2010 (8.62% of the total province).

#### Management

- To institute a complete Nature Reserve Protection Act
- Management organization and expert
- Complete protection and management strategy
- To accomplish the total generic plan of each nature reserve.

- To establish model nature reserve for effective management.

#### Scientific research

- (1) Biological diversity protection
  - To enlarge the investigation of ecosystem, species and genetic resource and enforce the classification of animals and plants. Completion of biological diversity list of the nature reserve in the province.
  - To build the database and information system of the nature reserve.
  - To monitor the natural resource and environment.
- (2) Management of nature reserve
  - To build the protection law and policy.
  - To study an effective management model.
  - Discussion on ecological functioning of nature reserve.
  - Discussion on changes of nature reserve and socio-economic development.

#### CONCLUSIONS

To build protection law of nature reserve is more important than to establish nature reserve. Improving people's consciousness on ecology and natural system has also emerging importance in the province (Chinese Environmental Protection Agency 1994). Moreover, we must strengthen scientific study and effective management of nature reserves and reinforce the experts in training and education (Piao 1996). We make high management level using modernized scientific technology. Finally, we accelerate the establishment of nature reserve in Heilongjiang through the international joint work and cooperation, in order to develop the ecological, social and economic advantage and effect at the same time. The process of establishment of nature reserves will contribute to the development of both human and environmental systems in the province and Far-East regions.

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## LITERATURE CITED

- Ecologically Sustainable Development. 1996. A Sustainable Land Use and Allocation Program for the Ussuri/ Wusuli River Watershed and Adjacent Territories (Northeastern China and the Russian Far East). Ecologically Sustainable Development, Inc. Elizabethtown, NY. 94 p. map.
- Chinese Environmental Protection Agency (CNEPA). 1994. CHINA: Biodiversity Conservation Action Plan. Beijing, PRC. 106 p.
- Heilongjiang Provincial Planning Commission. 1991. General Plan for Land Development and Renovation (Management) in Heilongjiang Province. Heilongjiang Provincial Planning Commission, Harbin, 23 p.
- Heilongjiang Provincial Planning Commission. 1994. Evaluation of Sustained Use of Resources in the Ussuri River Basin Soil Resources. Special Report 2, Heilongjiang Provincial Planning Commission, Harbin, PRC. 7 p.
- Piao, X.W. 1994. Scientific Research Report for Heilongjiang Mishan nature reserve. Heilongjiang Province.
- Piao, X.W. 1995. Research Report for Heilongjiang Honghe nature reserve. Heilongjiang Province.
- Piao, X.W. 1996. Heilongjiang Provincial Nature Environment and Conservation. Harbin Institute of Technology Press. Harbin. 340 p.
- Spellerberg, I.F. 1995. Evaluation and Assessment for Conservation. Chapman & Hall. 260 p.
- Wang, Y. 1994. Korean Pine Studies (I). Northeast Forestry University Press. 238 p.
- World Resources Institute. 1994. World Resources 1994-1995. Oxford University Press, New York.

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