

Issues on Sustainable Development in the Lower Tumen River, Southwest Primorskii Krai of the Russian Federation*

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러시아 연해주 남서 지역 두만강 하류의 지속 가능한 개발 문제*

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Abstract : This article aimed to suggest a program for environmental protection and sustainable development in southwest *Primorskii Krai* of the Russian Federation by analysis of Natural conditions, natural resources and current economic activities. Issues relating to protecting unique biodiversity toward economic development are examined. Special attention is given to functional zoning of the Russian part of lower *Tumen River* drainage. Functional zoning is key to protecting the unique biodiversity found in wet and marshlands of the lower *Tumen River*. Recommendations for acceptable economic activity are provided. The major components for a Sustainable Development Program in this area are: to define economically effective and ecologically acceptable types of regional activity (aquaculture; deer farming; recreation) and effective forms of territorial organization; to determine the restrictions on regional industrial and economic development; to organize rational regional land use by carrying out functional zoning and by coordinating this activity with all land users, including restructuring existing protected territories into a single system and include it into an international biospheric network.

Key Words : lower *Tumen River*, sustainable development, functional zoning, wet meadows and wetland landscape, protected zone of biodiversity, South West *Primorskii Krai*

요약 : 본 연구는 러시아 연해주 남서지역에서 이 지역 특유의 생태적 다양성을 보호하면서 경제적 발전을 꾀할 수 있는 지속 가능한 개발 방안을 모색하는데 목적을 두고 있다. 이를 위해 먼저 자연환경 조건과 천연자원 및 현재의 경제활동을 분석하였다. 경제 개발 과정에서 고려해야 할 이 지역 특유의 생물적 다양성을 보호하는 문제에 대해서도 살펴보았다. 특히 두만강 하류 습지대의 생물적 다양성의 보호활동에 중점을 두고 기능지역 구획을 시도하였다. 본 연구 지역의 지속 가능한 발전을 위한 주요 방안은 다음과 같다. 경제적으로 효과적이고 생태적으로 수용 가능한 형태의 활동(양식, 사슴 농장, 휴양지 등)과 효율적인 지역 구획을 규정한다. 지역의 산업이나 경제개발에 제한을 둔다. 모든 토지 이용자와의 협력 하에서 기능지역 구획을 세우고 기존의 여러 보호 구역들을 국제 생태 네트워크에 통합되는 단일 시스템으로 재조정함으로써 합리적인 토지이용 방안을 구상한다.

주요어 : 두만강 하류 지역, 지속 가능한 개발, 기능지역 구획, 습지 경관, 생물적 다양성 보호 구역, 연해주 남서 지방

* Support for this work was provided through the grant of Korea Research Foundation(KRF-2001-042-C00213)

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1. Introduction

The *Tumen* River watershed, in combination with adjacent territories and aquatic zones, is one of the most important natural geographical regions in Northeast Asia, and its lower drainage represents very diverse bio-geographical, socio-economic, and national-cultural structures. This territory possesses a natural integrity and is part of three countries: Russia Federation (RF), People's Republic of China (PRC) and Democratic People's Republic of Korea (DPRK). These countries have varied socio-economic and cultural patterns and at various times in history these differences have led to regional conflict. The global community and three *Tumen* River countries recognize the need to preserve the unique biodiversity and environment of this part of Northeast Asia. Such a goal can be achieved through regional sustainable development patterns that take into account the interests of those countries whose lands configure this unique watershed.

Southwest Primore (SWP), the Russian part of this

region, covers 740,000 ha and has a 200 km border with PRC and DPRK that stretches from the *Razdolnaya* River to the *Tumen* River (Figure 1).

SWP is part of the southern *Primorskii Krai* economic zone, the most developed transportation and industrial zone in *Primorskii Krai*. *Primorskii Krai's* largest cities are located here: *Vladivostok*, *Ussuriisk*, *Nakhodka*. Most of *Primorskii Krai's* population are inhabited in these cities, and most industrial facilities are also. SWP, for its part, has very specific factors – geographic location; port development; fisheries, unique biodiversity – that underscore the need to develop mechanisms to promote sustainable development in the region.

SWP, both a border and coastal region, is part of a larger trans-boundary region, the *Tumen* River watershed. This fact underscores the need to the future of SWP in a sustainable manner. Both integrated land use planning and biodiversity conservation must be considered. The situation in SWP is conditioned by real and potential contradictions between the levels of development.

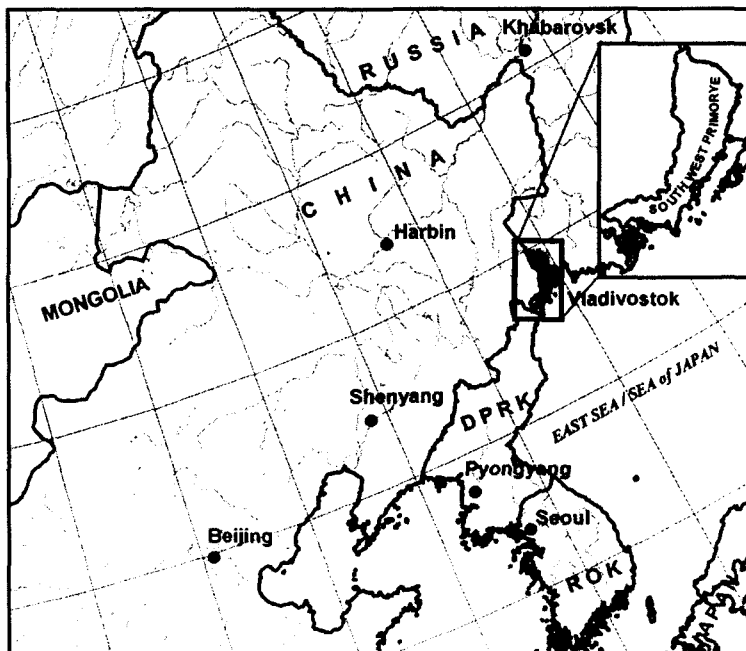


Figure 1. Study Area.

First, low level of regional development indicates, 1) the low standard of living of the population, 2) the potential to use this region's natural resources, 3) its eco-geographic position to achieve sustainable development goals. Second, high level of development in adjacent territories indicates, 1) the high level of biodiversity, 2) the need to protect this biodiversity, 3) the interests of various investor groups.

There are two interrelated problems in achieving sustainable development. First, it is the protection of biodiversity. It's include the needs to preserve regional tiger and leopard populations; to preserve internationally significant wetlands and to recommend them for inclusion on the RAMSAR list, and to preserve the high level of productivity of coastal, lagoon and estuary ecosystems. Second, this is accelerating economic development, in part a response to large international projects such as the UNDP *Tumen River Area Develop Program*, as well as local initiatives to advance recreation potential, aquaculture and deer farms. In our view, the basic steps in a program to preserve regional biodiversity include that the creation of trans-boundary protected territory system, the establishment of sustainable and ecological landuse patterns(including international), and the consideration of guarantees that future.

Functional zoning is one way to achieve these goals. Functional zoning requires an analysis of existing land use patterns in order to identify zones where it is necessary to establish sub-zones to protect tiger and leopard populations. Protection of wetland-marshes for migrating birds and identification of appropriate forms of economic activity are also priorities for the functional zoning of SWP.

2. History of Economic Development

Modern economic development in SWP began in the 1870s. Agriculture was the dominant development pattern in the early 20th century, though it peaked in the 1930s. The population at the beginning

of the 20th century was mostly Korean, with Russians making up only 10%-20%. This population imbalance was compensated for, however, by the Russian Cossacks taking the lead in administering the region while the Koreans remained farmers.

We noted that SWP occupies a special position among southern coastal regions of the Far East. In its early development period, in contrast to other regions, SWP was an agricultural area that used Asian farming methods and that planted Asian seed stock (*Raiony Dal'nevostochnogo kraya*, 1931). Following the resettlement of the Koreans in the 1930s and the repression of the remaining Cossacks, SWP's agricultural patterns shifted radically, especially in southern and central areas. Field cropping declined rapidly and was replaced by deer and pelt farming, for which the *Yankovskii* family provided the impetus at the end of the 19th century.

An analysis of the ecological efficiency of early economic development leads one to agree with *Yankovskii* that development patterns caused serious environmental problems. "... Only sad remnants of former oak groves remain, and the giant ashes, elms, walnuts, maples and others that once lined the rivers all the way to the sea, forests that formed a barrier to winter's northern winds, and in the summer blocked the fogs, not a trace of them can now be found. The Koreans have wiped out the forests and plowed them to make their fields. Now many of these fields are worked out and the Koreans wander from place to place only to again cut down the forests and again plow up the land along every mountain river tributary, all the way to thee crests" (*Garantirovani prirodnikh*, 1992).

Most environmental problems were not the result of just agricultural activity but were a result of other activities: fires, poaching. And the economic development that followed caused its own, no less environmentally serious problems. The situation in SWP can be described as follows that 1) after 1930, old agricultural fields abandoned and new ones opened up, 2) dispersed settlement and agricultural devel-

opment patterns shifted to concentrated one.

After the decline in the use of Korean agricultural methods, deer farming also declined, and in place of farming that emphasized a variety of activities, many farmers shifted to single, specialized activities, such mink raising. Deer farms and pelt farms were a concentrated land use pattern by the 1960s.

When considering new economic models for SWP, the focus should be to revive historic patterns: deer farming, pelt raising. Deer farming should rely on existing grazing capacities and should shift to on-site primary processing of products. We believe it is ecologically and economically wise to retain existing, concentrated development patterns and to find ways to restrict them to development zones to guarantee protection of SWP's biodiversity.

3. Economic Geographical Resources

SWP's key resource is its unique economic-geographic condition. The area's eastern line, a 250 km stretch of coastline, stretches along the ice-free East Japanese sea. Its western line extends along the border with the PRC; its southern line - the border with DPRK. SWP's northeastern lands are part of the Russian Far East's largest population hub, *Vladivostok*; these lands contribute to the large socio-economic and scientific-educational potential of that hub. A branch of the Trans-Siberian Railway crosses the region from north to south and has terminals into PRC and DPRK. There is also a north to south highway which branches to *Vladivostok* and which intersects the *Chita - Khabarovsk - Nakhodka* highway. This road leads into the PRC in the south. There are three ice-free ports with a great potential to service international traffic.

1) Minerals

There are currently 70 mineral deposits in SWP; all are commercially exploitable. The following minerals have commercial volumes: porcelain, sand

quartz (glass manufacture), coal (bituminous and brown), titanium, marble, sea shell, various sources of fresh water (underground, river, lake), peat, building stone, building sand, sand-gravel mix, limestone, brick loam, zeolite, perolite, etc. (Baklanov, P. Ya and V. Karakin, eds., 2002).

Mining is not a serious environmental threat and mining pollution from is concentrated at small sites. An increase in demand for building materials (building stones, sand, limestone, brick loam, marble) should be expected with an improved economy. Selection of specific deposits and mine sites should consider environmental norms and restrictions.

2) Agricultural Resources

Agro-climatic conditions are conditioned by latitude, the barrier effect of the Chernyi Gory and proximity to the sea. SWP is favorably disposed to raise *Primorskii Krai's* basic cultures, including thermophilic.

The region's animal husbandry numbers are low. Deer farming, at 3,600 head, compares to numbers in the 1930s. In the 1981-1991 period, peak deer numbers were 22,000-23,000. Improved agro-economics could stimulate an increase to these earlier numbers. The collapse of deer farming as a land use type could have a negative impact on regional biodiversity and first of all on leopards. There are two interrelated features of work here: the leopard's prey base will decline and the number of unemployed will increase, adding to the poaching problem.

Mink numbers have declined from the peak 1989-1991 period by almost 380,000 head.

The basic cultivated agricultural crops in region are: various grain crops (without rice), soy, potatoes and some vegetable, including thermophilic. Grains account for 55% of the crop lands. Soy covers 24%. The remaining lands are potatoes and vegetable.

3) Coastal Resources

Recent trends indicate point to a promising future for aquaculture in SWP. Currently, coastal fisheries,

both in SWP and in Primorskii Krai, take only 10% of the potential catch. The current take of mollusks is 26%, sea urchins - 14%, holothurian - 5%, shrimp - 5%.

SWP's natural and climatic conditions make it the best region in the Far East to develop aquaculture. In the mid 1980s, the experimental aquaculture facility "Poset" developed bottom and suspended mussel cultivation technologies, suspended oyster technologies, techniques for growing Far Eastern sea cucumber seed material on the sea bottom. The firm "Slavyanka" grew commercial mussels in Severnaya Bay using seed material from the Poset facility. Two experimental salmon facilities operated in Primore. Two fish hatcheries were opened to raise cherry salmon, coho, sockeye and other salmon species.

4) Recreational Resources

The region's recreational potential is commercial hunting, health resort and scientific tourism, and "beach" recreation. The region's recreational resources can support 80-100 thousand people per year.

SWP has an opportunity to promote hunting tourism, but current housing and service infrastructures remain at a low level. Roe deer, spotted deer, wild boar, red deer, brown and Himalayan bear are trophy targets in SWP. Waterfowl, pheasant and quail are birds of interest.

Beach capacity is 11,500 single time visitors. The average beach season (water temperature above 18°C; wave action below three) is the longest in the Far East and runs from 80-100 days (late May to September) (Baklanov, P. Ya and V. Karakin, eds., 2002). Optimal heliotherapy and thalassotherapy conditions are August and September. Estimated maximum beach load is 130 persons per kilometer.

Eco-tourism in SWP is promising, because of the SWP have biodiversity, picturesque landscapes, recreational wetland, numerous protected territories, and other natural resources.

The low level of industrial development, the low level of impact from main industries and the small

number of communities underlie the relatively high environmental quality in SWP.

5) Biodiversity Resources

SWP have the highest level of flora and fauna diversity of any region in the Russian Federation. There are 86 species of mammals, of which 23 are rare, and include endemics such as the large Japanese mole, giant shrew, the Far East leopard, the Amur tiger, the Far East forest cat (Land of the Leopard..., 2002). The Russian portion of the lower Tumen River is the most important migratory waterfowl zone along the East Asian flyway. 370 species of birds have been identified. About 50 species are on the International and Russian Red books. These include the Japanese and Daurian crane, Bera diver and sea eagle (Baklanov, 2001).

SWP has 1,500 vascular plant species, 166 of which deserve protection. Unique forest formations include dark fir forests, coniferous-broad leaf deciduous forests with iron birch. Kirkazon and Manchurian vines are encountered in broad leaf deciduous forests (Baklanov, P. Ya and V. Karakin, eds., 2002). SWP's forests have multi-canopy, multi-species woody communities; their understory and non-canopy vegetation has rich species composition and closely resemble forests in southern Korea and China. The relatively broad altitude range (coastal hills to 900 asl and higher), the heterogeneity of the relief, of climatic features, and the continuous influence of the sea give rise to a diversity of flora that although has changed under the influence of human activity, still retain the natural features characteristic of this habitat type. Korean pine broad leaf deciduous forests are the largest, most diverse and are found on the slopes of high river terraces. More than 100 plant species are classified as non-timber forest products.

4. Modern Economic Use of Territory

1) Industrial Sector

In 1990 there were five small regional industrial

centers: *Slavyanskii*, *Zarubinskii*, *Kraskinskii*, *Primorskii* and *Posetskii*. These centers have large and average size industrial and transportation enterprises. *Slavyanskii* specializes in ship repair, food production and services, *Zarubinskii* - marine transport, harvest and processing of marine resources, *Primorskii* - equipment repair, *Kraskino* and *Khasan* - domestic and international cargo handling, transport services, Poset provides port and transport services. During the 1990s a large number of small, private industrial and service enterprises opened; these are located in southern half of SWP. The northern half of SWP is industrially undeveloped; economic activities are forestry and agricultural.

Large enterprises in SWP include ship repair, harvest and processing of marine resources. The region is not, however, industrially developed and has a low industrial output. Its economic density (gross regional product relative to the size of the region) is at least eight times lower than the economic density for average sized municipal regions in *Primorskii Krai*. Both government policy in border areas and recent economic crisis are factors.

This low level of economic development is not characteristic of its high economic-geographic potential: transportation opportunities, high volumes of natural resources, especially, marine bio-resources, bays suitable for port development and aquaculture, tourist and recreation development.

2) Transportation

A railroad and highway connect SWP to the general *Primorskii Krai* transportation network and to the Russian Federation (RF), People's Republic of China (PRC) and Democratic People's Republic of Korea (DPRK) transportation networks. *Khasanskii* Raion has seaports at *Poset*, *Zarubino* and *Slavyanka*. These ports have become new centers of foreign trade operations since 1992.

The *Baranovskii - Khasan* railway connects to the

Trans-Siberian Railway. This line links not only southern ports, fishing enterprises and ship-repair facilities, it also connects Russia with China and North Korea. A possible development scenario is to move freight from South Korea via the Russian railway system.

The *Razdol'noe-Khasan* highway runs parallel to the railroad for 217 km. The road has international significance for connects to the Chinese road network. The road could be extended to North Korea. The road is currently being upgraded.

Positive factors defining the region's economic future include: unique geographic and an eco-geographic location, the variety of natural resources, especially renewable, land based and marine resources and its infrastructures: road network, energy supply, ports and so on. The regional development priorities have been identified, in light of these favorable factors and the environmental restrictions.

A shift to sustainable development will lead to economic, social, and environmental improvements (Baklanov, 2001). Gross national product must be increased significantly (up to 10-15 thousand dollars a year per person), the population must be stabilized and ways found to increase total population (150-200 thousand), the standard of life must also be increased. The region must also address its environmental problems and protect its high quality environment.

5. Key Environmental Issues and Mechanisms

Improving the *Razdolnoe - Khasan* highway will increase the reliability of communications and improve environmental conditions by decreasing the amount of dust along the current road. It will also increase the volume of traffic, with an increase in unorganized tourism and increased load on recre-

ational resources.

Adjacent industrial areas represent an environmental threat to SWP: the *Vladivostok - Ussuriiskaya* Industrial Zone and the *Khunchun* Industrial Zone in PRC. Pollution moves along the *Razdolnaya* and *Tuman* Rivers, as well via the atmosphere. Municipal wastes by *Vladivostok* and its suburbs enter bays untreated.

Poaching, especially along the south coast of the Russian Far East, is an old profession. Mollusks and other marine resources, part of traditional Asian cuisine and medicine, were harvested in significant volumes even before Russian settlers appeared in the Russian Far East. The Far Eastern sea cucumber is by far the most popular marine resources poached in the SWP.

Fires in SWP have an annual impact on most species of fauna, cause declines in their numbers and degrade habitat quality. Fires have caused natural vegetation to shift over a significant territory to secondary, as a rule, pyrogenic vegetative communities.

Protected territories. A dispersed system of protected territories helps maintain the level of regional biodiversity; more than 40% of the region is protected. Regional protected territories include the *zapovednik* (closed reserve) "*Kedrovaya Pad'*", the federal *zakaznik* (reserve) "*Barsovyi*", the regional *zakaznik* "*Borisovskoe Plateau*" where hunting is forbidden. There is the nature park "*Khasanskiy*" where hunting is allowed across most of its grounds and where hunting tourism will be developed. The Far East Marine Biospheric Reserve is the only marine reserve in the Russian Federation. The reserve has more than 3,300 species of marine flora and fauna, and more than 900 species of land flora. These species are found outside the reserve, but only here are they concentrated and protected. Russia, China and North Korea must coordinate their environmental protection efforts, especially the effort to create an international biospheric reserve.

There are two core areas in SWP for ecological reserves. One is the northern forest reserve, focused

primarily on protecting the Far Eastern leopard and the Amur tiger. The other is the southern wetland marsh that protects bird communities. Our research focuses on the functional zoning of the southern core with an area of 500,000 km.

Southern Protection Core Area. This core area has the most important wetland marshes in the lower Tumen River and is adjacent to the Tumen River. The wetland marshes are located between the Tumen River and Poset Bay, the junction of the borders with China and North Korea.

This area, together with adjacent territories and aquatic zones, has high bird diversity. More than 300 species are found here during migrations, nesting (breeding) and wintering, 32 of which are listed in the International Red Data Book. The area is on the East Asian flyway and thousands of waterfowl and shorebirds stop here to feed and rest during migration. Large flocks of birds gather here to feed in the wetland marshes. There are salt lagoons and small, slow flowing rivers, sandy and pebbly beaches, shallow inlets and the Tumen River delta. Aquatic areas in the plain are highly productivity (Migratory Birds..., 2001; Transboundary Diagnostic Analysis, 2002).

Lagoons provide basic feeding grounds for migrating ducks. Small basins extend for hundreds of meters. Some of the lagoons are permanent, while others are temporarily connected to the sea during heavy rains and storms. The water level, oxygen content and salinity of these water bodies vary in different seasons and depend on precipitation, wind direction and seas. Lagoons typically freeze in mid-November and become ice free between early March and late April. Water bodies freeze to the bottom in some locations. Lack of water and varied water levels are reasons why lagoon vegetation shows weak species composition. There are reed thickets at certain locations. Benches in these aquatic zones are usually vegetation free.

Lake and lagoon fauna is very diverse. The region's lake and lagoon productivity is divided into

three types: high (all lagoon type water bodies), average (freshwater lakes) and low (growing-over fresh-water lakes) (Karedin, 1966).

Fauna populations in lagoons show sharp seasonal variation. In winter, when water is shallow and ice thick, there are massive fish die offs. However, with spring thaws water conditions return to normal and fish and crustaceans fill the lagoons (Karedin, 1966).

The high productivity of lagoons supports large numbers of birds. In addition to many migratory duck species, many other bird species feed here from early spring to the first ice. They feed on the dead fish freed as ice melts. Migratory sandpipers feed here in May, and July through October. Shallow inlets in Poset Bay and the *Tumen* River delta are also very important for waterfowl. Flocks of geese stop on river islands every year during migration to use the beaches and lagoons that stretch for kilometers to the northeast of the *Tumen* River mouth (Vishkvartsev and Lebedev, 1986).

6. Functional Zoning in the the Lower *Tumen* River

There are two aspects to “functional zoning.” The first is to identify distinct natural geo-systems that are both in a natural state and that have undergone human impacts. The second is to designate priority zones with specific natural resource use restrictions to establish the functional specialization of the territory. Two interrelated zoning stages follow. The first stage serves as the basis for a second stage that applies data on changes in territorial organization to develop forecasts and to recommend approaches for natural resource use.

The main feature of functional zoning is to choose, from possible variants, an optimal, sustainable natural use model for the territory, where the natural potential of the geo-system corresponds, in large part, to its socio-economic functions. An evaluation of economic development options for specific territo-

ries occurs at this stage. A series of evaluation and forecast maps for the territory consider priority and allowable types of natural resource use. Maps used at this stage include protected territories, maps showing ecological conditions for forest, aquatic, wetland and other geo-systems, maps showing potential anthropogenic change to geo-systems with different types of economic activity. A ‘zero-option’ map is included that shows options when recommended restrictions on natural resource use are rejected.

A.G. Isachenko defines three main principles for optimizing landscape systems (Isachenko, 1980). Optimized landscape systems (1) Introduce a protection regime; (2) Combine resource use regulations with measures to maintain ecological balance; (3) Prevent negative impacts to the environment and humans. The cartographical embodiment of such recommendations is a map of the functional zoning of the territory. This maps reflects a scientifically grounded basis for land distribution based on different functions and on natural resource use regimes (Mikheyev, 2001). Sustainable natural resource use assumes that the natural and resource potential of the territory will be preserved, or even improved. Thus, functional zoning should define the prioritized, permissible and forbidden types of economic activity for a given territory.

There are several stages to compiling a functional zoning map (Figure 2). This map is derived from data on land classification, on land districting and on thematic maps. The structural organization of geo-systems and their functional patterns are identified at this stage.

We analyzed and used the following materials and data during the zoning process: relief type; hydrologic system (rivers and lakes); landscape features, land use types; road system; boundaries for land users and hunters; protected territories; territorial zoning for the *Khasanskii* nature park; locations of bird concentrations; recreation use. Land development patterns and possible future uses are taken into

account.

A "land use" layer, with landscape features and the location of concentrations of rare species, served as the baseline to identify and analyze zoning variants. These data were obtained by deciphering Landsat 7 satellite images that were field checked at several locations. Composite satellite images, as well as individual channels, reflect the synthesized characteristics of the landscape and land use plan. This significantly increases their value in evaluating territorial status and in carrying out target zoning. Four RS-scenes were analyzed: September 1999; May 2000; September and October 2001. The semi-automatic, interactive deciphering mode of the Image Analysis platform ArcView GIS was applied. Ten types of sites were identified with confidence. An

increase in the number of classification types leads to excessive detail and complication of the contours and to a duplication of attributes.

The following landscape types were identified during research: low mountain and hilly coniferous forests; low mountain and hilly mixed forests; low mountain and hilly broad leaf deciduous forests; meadow and bush foothills and plains; meadow foothills and plains; wet meadows; wetland marsh landscapes; heartlands; lake and channels communities. Most of the area is covered in wet meadows and wetland landscapes.

At the final stage the borders of functional zones were checked against the borders of existing protected territories as well as land users and hunting units (Figure 3).

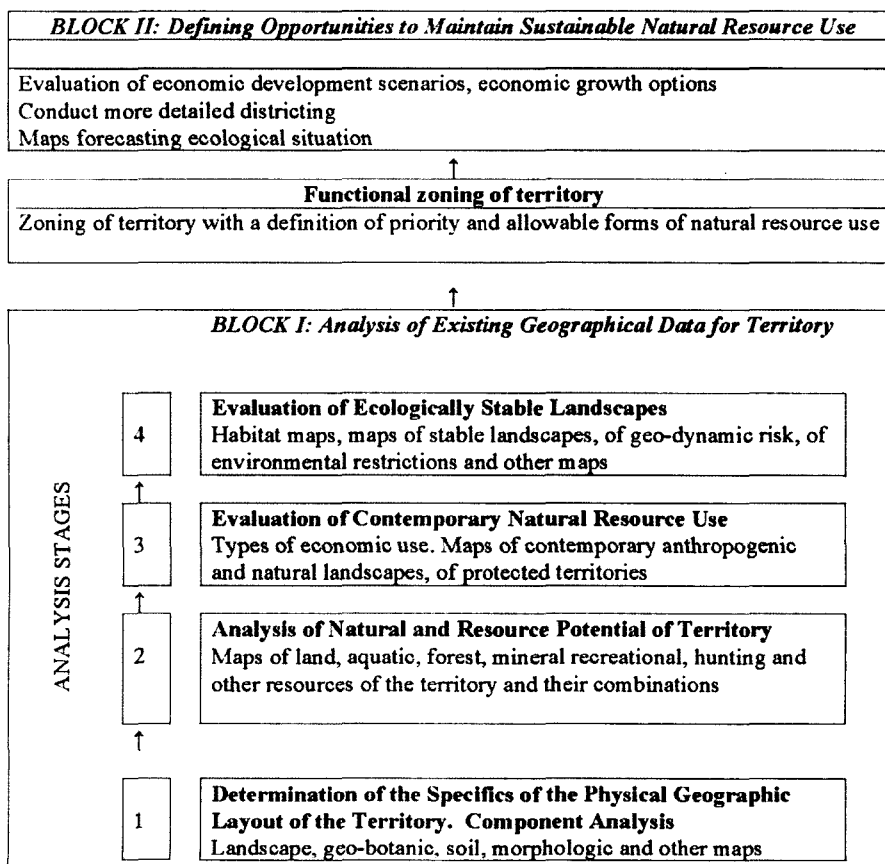


Figure 2. Diagram for transboundary diagnostic analysis, functional zoning, and mapping.

The most valuable wetland marsh landscapes, with the largest concentrations of rare species, are included in the core protected zone. The southern core zone runs to the mouth of Tuman River. Both migratory and nesting birds - waterfowl, cranes, vultures - are concentrated in wetland marsh landscapes. The middle of the territory abuts Lake Ptiche on the south; it is the largest lake in the research area and has enormous waterfowl diversity. Lake Mramornoe and its environs, one of the largest lotus patches in *Primorskii Krai*, is directly north of the core zone. Identification of a northern and southern link coincides with the official zoning for the *Khasanskii* nature park. Monitoring and practical scientific research is proposed for the center of the core zone since its landscapes, flora and fauna communities have not undergone any anthropogenic impact.

Wetland marsh landscapes, with a large concentration of bird species, are included in the buffer core zone that has a less rigid protection regime. There are a number of reasons why it is difficult to establish a reserve system in this zone. Its landscapes are partially transformed, are regularly visited (usually in transit) and are at risk from fire. They are largely contiguous to the core zone, providing the latter additional protection. This zone includes a narrow, five hundred meter wide strip of coastline that is part of the buffer zone for the Far East Marine Biospheric Reserve. In addition to practical scientific research and education in the buffer zone, it can be used for moderate tourist activities, primarily ecotourism, and recreational activities that leave little trace.

The remaining area in southern SWP is included in a cooperative zone (external buffer zone). This zone is divided into several sub-zones with various possible and recommended types of activity. Lands with low mountain and hilly forest landscapes form a tourist / recreation sub-zone. Wetland marsh landscapes, historically used for bird hunting, are part of a hunting sub-zone. Reclaimed landscapes, now abandoned, are part of a possible agricultural sub-

zone. A built-up area / industrial sub-zone includes communities and nearby lands open to freight handling and associated activities. The territory on the state border, because of its environmental and protection status, is included in a special sub-zone. Its usage regime needs clarification. All lands in this cooperative need stakeholder support to ensure that environmental norms will be upheld.

Identification of functional zones with a specific purpose and that manage anthropogenic load places serious limitations on intensive economic activities in the southern part of SWP. A small area adjoining the community of *Khasan* and a linear belt 2-5 km wide running along the highway and railway is where economic activities can occur without environmental restrictions. Under certain economic development scenarios this area is adequate to meet regional needs. The main priority is to assure its transportation-transit function. *Khasan*, as a transportation hub, could support a population of 50,000 since most of the transportation and energy right-of-ways are located in this narrow belt. The remaining territory would be for recreational, tourist, education activities and for pursuit of environmental protection and biodiversity conservation agendas.

7. Conclusion

Achieving environmental protection and sustainable economic development in SWP through a program that combines interests of economic development and biodiversity protection is a realistic goal.

The major components for a Sustainable Development Program in Southwest Primorskii Krai of the Russian Federation are: firstly to define economically effective and ecologically acceptable types of regional activity (aquaculture; deer farming; recreation) and effective forms of territorial organization; secondly to determine the restrictions on regional industrial and economic development; and thirdly to organize rational regional land use by carrying

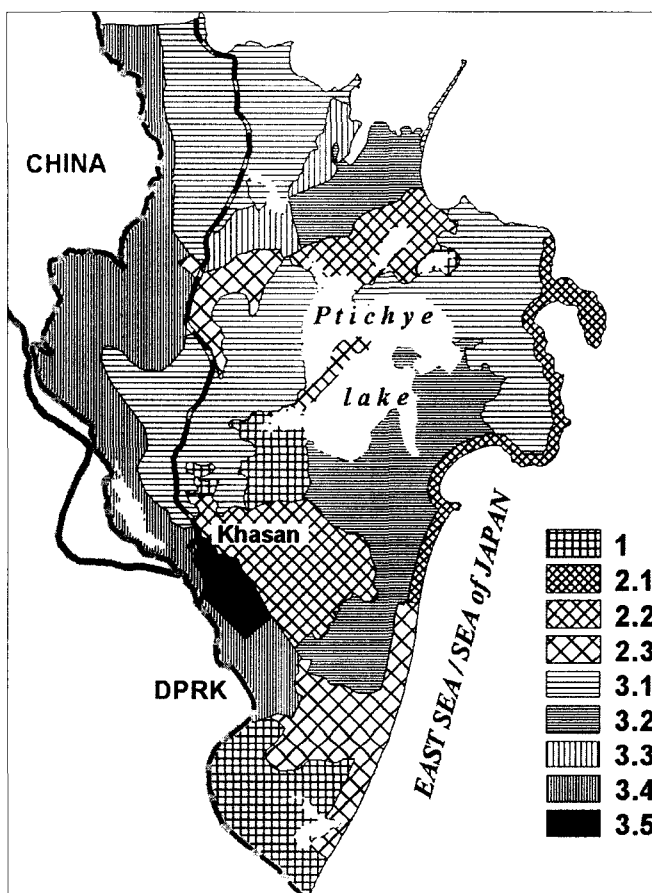


Figure 3. Functional Zoning of the Lower *Tumen* River:

1. Core zone;
2. Buffer zone(2.1 Subzone of marine reserve; 2.2 Subzone of protection for water-flow; 2.3 Subzone of protection for cranes);
3. Outer Transition zone (3.1 Subzone for recreation; 3.2 Subzone for hunting; 3.3 Subzone for agriculture; 3.4 Subzone for special protection; 3.5 - Subzone for settlement.)

out functional zoning and by coordinating this activity with all land users, including, restructuring existing protected territories into a single system and include it into an international biospheric network.

Implementation of this program will assure (1) long-term survival of Amur tiger and Far Eastern leopard populations, (2) that protection of biodiversity (leopards; wetland marsh communities and birds; marine bio-resources) and promotion of socio-economic development will be based on mutual interests, and (3) that a rationale for natural resource

use variants based on different development scenarios will be available to regional decision makers.

Acknowledgement

The authors are grateful to Misha Jones for his translation of this article into English.

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Received March 6, 2004

Accepted June 12, 2004