Typification of coastal transboundary areas in the context of sustainable land use in the Far Eastern Federal District

A.A. Murasheva, P P Lepekhin, E M Chepurin and E P Ananicheva
State University of Land Use Planning, Kazakova str., 15, 105064, Moscow, Russia

E-mail: amur2@nln.ru

Abstract. The article presents a number of proposals on the typification of the transboundary territories of the Far East of Russia, based on the peculiarities of geographic location and access to natural borders. A specialized designation of such regions has been proposed and a number of indicators have been developed that allow a comprehensive assessment of the ecological status of transboundary territories.

1. Introduction
Land use, forest management, the general economic and environmental situation near the common border between the Russian Federation and the People’s Republic of China are characterized by high intensity of use. At the same time, it is necessary to note such an important feature as a general imbalance in the development of the territories of Russia and China. Heilongjiang Province, which borders on the Trans-Baikal Territory, the Jewish Autonomous Region, the Amur Region, the Khabarovsk Territory and the Primorsky Territory, is characterized by a higher degree of urbanization, the level of development of the territory and the man-made load. Based on the above, we note that these features and differences should be considered as specific transboundary gradients and should be taken into account when conducting environmental, economic, social research in the specified region. The article considers some proposals on the typification of transboundary territories for use in conducting a comprehensive assessment of the ecological status of these territories. Article [1] is devoted to the analysis of the development of transport infrastructure in Russia and the Far East, without which we should not talk about the typification of territories in general. An analysis of the patterns of development of transboundary territories, as well as the organizational structure of management of transboundary territories, is presented in article [2].

2. Materials and methods
Immediately before the main part of this article, we will establish the peculiarities of development and cooperation within the border area of the Far Eastern Federal District:

1. The nature of relations between Russia and China is significantly different from the nature of relations between countries in Western Europe, which coordinate joint actions in the framework of such a geopolitical entity as the European Union.
2. When conducting environmental studies, the territory of a single state, either Russia or China, should not be subject to analysis. The environmental situation in the border areas is interconnected and interdependent, and therefore must be viewed through the prism of a single cross-border area.
3. The specificity of the transboundary territories, which we mentioned above, is determined, among
other things, by a complex of natural and economic factors.

4. Potential environmental or economic problems in the region should be solved by the parties jointly, despite the high difference in the types of economic development and the scale of environmental transformation.

Based on the foregoing, the proposals on the typification of the Far Eastern transboundary territories were developed on the basis of the analysis of economic activity, the degree of natural environment, the degree of man-made and anthropogenic loads.

3. Proposals for the typification of the coastal transboundary territory in the far Eastern Federal District

As noted above, the specific transboundary gradients that characterize environmental, economic, social and other conditions are the first indicators. These include: the area of the region, population density, gross regional product, availability of acreage and others. It should be noted that in Heilongjiang province these indicators are significantly higher than in the southern regions of the far Eastern Federal District. Nevertheless, the area of forests in the FEFD exceeds the same indicator of Heilongjiang province according to expert estimates more than 4 times, but the production of wood per 1 hectare of area in China is about 3.5 times more. One resident of the far Eastern Federal district has 10 times more forests, 25 times more protected areas. However, the main indicators of the advantage on the side of the Chinese province. This indicates a higher intensity of resource use and more significant interference in the geo-and ecosystem of the region and can not affect the state of the Russian territories.

Russian researchers P.Ya. Baklanov and S.S. Gansei believes that the most important methodological issue that is resolved when studying and assessing the state of a territory is the question of the principles and approaches to its “division” [3].

Another approach, developed by B. Van der Velde and R. Martin [4], identifies border regions based on ethno-cultural and economic interaction, for example: alienated border regions - in which there are no links due to military actions, religious, cultural, ethnic differences; coexisting border regions - there is some economic and cultural interaction between them; interdependent border regions - there is significant interaction between them; integrated border regions - characterized by free movement of population, capital, goods. Researcher V.S. Korneevets proposes an approach in which we determined: 1) core regions; 2) transitional regions with subtypes: developing, stable, crisis; 3) peripheral resource regions with subtypes: developing, stable, crisis; 4) development corridors; 5) regions of developed cross-border cooperation [5].

As part of our study, we consider it appropriate to offer a typology of border regions according to the type of borders to which these regions go. Table 1 below shows the typification of the regions and introduced an additional type “T”, which indicates access to all types of borders - land, sea, river.

One of the existing classifications of state boundaries divides them into natural and social. The first are including hydrographic. The second are borders that are the result of human activity, in particular the delimitation and demarcation of them on the ground. Thus, the bipro-border and “T”- border regions have a pronounced advantage, which stands out in the form of the presence of natural and artificial borders simultaneously. In view of this, the probability of development of cross-border relations and interactions expressed in cross-border trade and tourism significantly increases. After that, border infrastructure will inevitably be improved.

Table 1. Typification of border regions according to the type of borders to which they reach

| Type of border area | Characteristic |
|---------------------|----------------|
| Land border         | Regions have access only to land state borders. |
| Marine Border       | Regions have access only to maritime state borders. |
| Bipro-border        | Regions have access to both land and maritime state borders, or land and river state borders. |
| "T" border          | Regions have access to land and sea and river state borders |
The border regions of the Amur basin of the Far Eastern Federal District have high potential opportunities for active foreign economic activity. In turn, this causes their high integration and investment potentials. The presence of such a classification sign as bipro-border and "T" border should increase the integration potential of the region. In the Amur basin, the most promising regions are the Amur region, the Khabarovsk Territory, and the Primorsky Territory. The main areas of integration and cooperation in these regions with the neighboring state are represented by such sectors as forestry and energy. Table 2 shows the typification of the regions of the Far East according to the type of borders.

| The subject of the Russian Federation | Land border | Marine Border | River border | Bipro-border | "T" border |
|--------------------------------------|-------------|---------------|--------------|--------------|------------|
| Amur region                          | +           | +             | +            | +            |            |
| Jewish Autonomous Region             | +           | +             | +            | +            |            |
| Primorsky Krai                       | +           | +             | +            | +            |            |
| Sakhalin region                      | +           |               | +            | +            |            |
| Khabarovsk region                    | +           |               | +            | +            |            |

For a number of previous years and today, cooperation and implementation of programs in the field of vegetable production (Primorsky Territory, Amur Region), housing construction (Primorsky Territory), industrial construction (Khabarovsk Territory), joint fishing and fish processing (Primorsky Territory) continue in border regions. We believe that the development of multidimensional cooperation with the APEC countries can reduce tensions in the field of demography, migration, and ecology in the studied region. At a minimum, infrastructure development as a result of cooperation should become one of the benchmarks, due to which catastrophic population decline (natural and migration) will not be observed, but, on the contrary, will create the necessary socio-economic conditions conducive to the sustainable development of the Russian Far East.

The ecological situation of the region under study is significantly influenced by anthropogenic factors, which include industrial, civil, transport construction, agricultural production, the construction of hydrotechnical and transport facilities, mining, and a number of other.

Let us describe the indicators that allow us to draw conclusions about the typification of transboundary territories and their environmental status today. The analysis of these indicators is made on the example of the coastal areas of the Amur river and, we believe, most fully reflects their current environmental condition.

**Indicator 1. Air emissions from stationary and mobile sources of pollution.** The main sources of air pollution in the river coastal areas of the Jewish Autonomous Region are road transport, stationary sources of the manufacturing industry. A significant proportion of emissions from the production and distribution of gas, electricity and water. Air emissions are due to the development of the Amur mining and smelting cluster. In addition, one can single out a contribution to the pollution of the agro-industrial development zone with a specialization in the cultivation and processing of soybean, the activity of the Teploozersk cement plant, and fish-breeding plants. The mining cluster is concentrated in the economically developed part of the Obluchensky district [6].

The air basin of the Jewish Autonomous Region is experiencing anthropogenic pressures not only from regional sources, but also due to the transboundary transport of pollutants from China. Therefore, an important role in shaping the level of air pollution in the transboundary coastal territory belongs to the processes of transboundary transport of suspended particles and pollutants from adjacent territories. At present, the modern monitoring system for transboundary transport is not developed at the proper level and development of measures for its improvement is required.

**Indicator 2. The volume of wastewater discharged into surface water bodies.** The main polluters of the water basin of the coastal areas of the Jewish Autonomous Region are objects of various types of economic activity in the region, among which industrial and domestic wastewaters of large populated
areas, agriculture, forestry and mining have a significant impact. The most important factor affecting the quality of water in the rivers of the region for a long time remains the transboundary transfer of pollutants from the territory of the PRC (the river Sungari) [7].

A significant impact on coastal river ecosystems has their intensive development, which leads to an increase and, consequently, an increase in pollution discharges. The urbanization centers of Birobidzhan, Amurzet, Leninsk and Nizhneleninskoe villages have the most adverse environmental impact on the aquatic ecosystem, since these settlements have the largest amount of raw water discharges per inhabitant.

**Indicator 3. The danger of endogenous and exogenous processes.** As a result of the assessment of the risk of manifestation of endogenous processes (earthquakes), it was established that the territory under consideration is characterized by a very high degree of danger of their manifestations (Table 3).

**Table 3. Evaluation of the risk of endogenous processes**

| Hydrographic unit to which the catchment area belongs | Maximum seismicity of the area (points on the MSK-64 scale) | Degree of danger | Evaluation score |
|-------------------------------------------------------|-------------------------------------------------------------|------------------|-----------------|
| Amur river from the mouth of the r. Bureya to the mouth of the r. Ussuri | 10,0 | very high | 10 |
| Total | | | 10 |
| Number of indicators | | | 1 |

The results of determining the degree of danger of exogenous manifestations (EM) in the territory under consideration are summarized in Table 4, from which it can be seen that the most dangerous types of exogenous geological processes here are channel processes (coastal processing) and flooding.

**Indicator 4. The nature of the hydrochemical state of the river.** Within the framework of the joint Russian-Chinese and Russian state monitoring of the quality of transboundary water bodies in the territory of the Jewish Autonomous Region, since 2007, hydrochemical observations have been carried out in the Pashkovo, Amurzet, Nizhneleninskoe, and Nizhnespasskoye settlements. In addition, hydrological observations are conducted on the left tributaries of the Amur: B. Bir, Bijan, Samara, Arkhara and Khingan [8]. Observations of the quality characteristics of bottom sediments are practically not conducted.

**Table 4. Estimation of the risk of exogenous geological processes**

| The main types of EM characteristic of the territory in question | The degree of danger of manifestations of EM | Evaluation score |
|---------------------------------------------------------------|---------------------------------------------|-----------------|
| landslide | Moderate | 4 |
| mudslide | Moderate | 4 |
| karst | practically absent | 1 |
| submergence | Moderate | 4 |
| gully erosion | Moderate | 4 |
| shore processing (channel processes) | high | 7 |
| cryogenic | Moderate | 4 |
| flooding | very high | 10 |
| Total | 38 |
| Number of indicators | 8 |

The qualitative composition of the waters of the Amur River is formed by the influx of substances from the waters of its major tributaries - the Zeya and Bureya rivers in the territory of the Russian Federation and the Sungari river in the territory of the PRC. In this regard, starting from 2007, Russian and Chinese experts have been conducting joint monitoring of the quality of water in the r. Amur. The
waters of the Amur River are characterized mainly as "dirty", quality class 4 "a".

The obtained criteria, which characterize the level of pollution of bottom sediments and soils, the danger of manifestation of endogenous and exogenous processes, made it possible to carry out an integrated assessment of the ecological state of the territory under consideration (Table 5).

Table 5. Integral assessment of the ecological state of the basin

| Total number of indicators | The total estimated points | Average rating score | Ecological condition corresponding to the level of pollution of bottom sediments and soils | Ecological state based on the results of the assessment of the level of pollution of bottom sediments and soils |
|---------------------------|----------------------------|---------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| 13                        | 70                        | 5.38                | Unfavorable                                                                          | Very unfavorable                                                                    |

The average score, calculated taking into account all available indicators, allows one to estimate the ecological state of the research area as "unfavorable". However, the ecological status of this territory should be assessed as "very unfavorable" regardless of the results of the assessment on the average score due to the fact that for certain areas of the territory and the riverbed of the Amur river, in accordance with the information of the Amur basin, an "extremely dangerous" degree of chemical pollution of soils and bottom sediments was revealed [8].

**Indicator 5. State of the nature reserve fund of coastal areas.** According to the State report "On the state and environmental protection of the Russian Federation in 2017" in the Russian Federation there were about 12 thousand protected areas of Federal, regional, local significance with a total area of 232.7 million hectares. the total area of protected areas from 2010 to 2018 increased by 25.4 thousand hectares. the far Eastern Federal District is characterized as the region with the largest share of protected areas in its territory. According to the report, protected areas occupy up to 58 % of the total area of the region, and the total area is equivalent to 123 258.8 thousand hectares [9].

**Indicator 6. Flood risk level of river coastal territory.** Assesses the risk of occurrence of one of the most serious regional hydrological risks in the far Eastern region – flooding, which clearly demonstrated the highest and longest for the last 150 years summer-autumn flood in the Amur river basin in the summer of 2013.

This indicator is one of the most significant, and under certain conditions (the passage of catastrophic floods) can be the main and only indicator characterizing the state of river coastal areas.

**Indicator 7. Frequency of occurrence of tree halls.** This phenomenon in the basin of the river. Cupid is not well understood, there are only brief descriptions of it. One of the leading scientists of the Far Eastern Branch of the Russian Academy of Sciences, AN. Makhinov notes that logging and fires cause an increase in the uneven flow of water in the river, which leads to the intensification of channel re-formations, erosion of the banks and even more intensive influx of trees into the river beds with intensive formation of creases. For the considered section of the river transboundary territory, the occurrence of wood cleats is estimated as average [10].

4. Conclusion
We believe that on the basis of the above proposals on the typification of a coastal transboundary territory, as well as indicators that form the basis for studying the ecological status of territories to a greater extent, a model of an integrated approach to the study of transboundary territories of the Russian Federation can be developed that can ensure their sustainable development condition and respond flexibly to technological, environmental or economic challenges and threats.

References
[1] Pugachev I, Kulikov Y and Yarmolinsky A 2018 Current trends in development of the transport infrastructure of large cities of the Far East, Russia *Transportation Research Procedia* **36** 622-626 Available at: https://doi.org/10.1016/j.trpro.2018.12.144.
[2] Shiuh-Shen Chien and Dong-Li Hong 2018 River leaders in China: Party-state hierarchy and transboundary governance *Political Geography* 62 58-67 Available at: https://doi.org/10.1016/j.polgeo.2017.10.001.

[3] Baklanov P Ya and Hansei S S 2004 Concepts and types of border and transboundary territories *Izvestiya of Russian Academy of Sciences. Geography Series* 4 27–34

[4] Van der Velde V and Martin R 1997 So Many Regions, so Many Borders. A Behavioural Approach in the Analysis of Border Effects *37th European Congress of the European Regional Science Association* Rome (Italy), August 26-29, 1997

[5] Korneevets V S 2010 *Transnational and transboundary regions as specific forms of the territorial organization of society*, doctoral dissertation (St Petersburg)

[6] State report "State and environmental protection in the subjects of the Russian Federation," available at: http://ecogosdoklad.ru/

[7] Makhinov A N and Shuguang L 2013 *Formation of the relief of river beds and river banks* (Khabarovsk: FEB RAS)

[8] Vdovenko A V and Kim A V 2015 On the issue of zoning and regulation of economic activities in coastal areas *Bulletin of the Pacific State University* 1 51–57

[9] Murasheva A A and Vdovenko A V 2016 Optimization of the use of the coastal area taking into account the transboundary features of the basin. Amur *Electronic scientific publication "Uchenye Znakie PNU"* 7(3) 81-85 No. 383 in the list of HAC (2015-2018)

[10] Bernard F 2013 *Geography and Tourism* (Kazimierz Wielki University) 1 49–56