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## REGULATION OF ECOSYSTEM SERVICES EXPLOITATION FOR POTENTIAL COMPETING STAKEHOLDERS IN INDIGA ADVANCED DEVELOPMENT REGION

### ABSTRACT

Landscape ecological studies supply valuable data for advanced nature management in the Arctic zone of the Russian Federation. The recently adopted State program for advanced economic development of this zone outlined eight regions for such activities. Our study area Indiga belongs to Nenets advanced economic development region. Its landscapes are presented by rolling and hilly plains at the coast of the Barents Sea. Different tundra types are the most typical vegetation cover, but forest-tundra and even northern taiga are also met. Nowadays Indiga is a small settlement in the mouth of the Indiga river which according to the State program will give rise to a new sea port belonging to the Northern Sea Route infrastructure, railway terminal construction. Dominating nowadays traditional nature management will be completed by transport and residential promoting nature management conflicts emerging from joint exploitation of several ecosystem services by different stakeholders. Such conflicts need elaboration of regulation system. Such regulation is of primary importance for ecosystems with low resilience to technogenic impact which may destroy natural processes of ecosystem services pools reproduction. We present a case study demonstrating the procedure of revealing and mapping of ecosystem services using a landscape map. This is the first step for quoting of ecosystem services exploitation.

**KEYWORDS:** Arctic, ecosystem services, landscape structure, mapping

### INTRODUCTION

Landscapes ecological studies nowadays may supply valuable data for advanced environment management. Absence of regulated exploitation of ecosystem services produced by different landscapes/ecosystems types launches environment management conflicts among different stakeholders, degradation of ecosystems and finally – loss of nature capital. Such regulation is of primary importance for ecosystems with low resilience to technogenic impact which may destroy natural processes of ecosystem services pools reproduction. This is true for the Arctic zone ecosystems which exploitation is growing rapidly following the State program<sup>5</sup> of advanced economic development of the Arctic zone of the Russian Federation adopted recently. The goal of this research is to link ecosystems services pools with landscape structure for Indiga region belonging to one of the planned advanced development territories – Nenets.

### STUDY AREA

Indiga is situated in the mouth of the Indiga river at the coast of the Barents Sea in Nenets Autonomous Okrug (Federal region) (fig. 1, 2). It was founded by Mezen Pomors (Russian

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<sup>5</sup> State Program “Social-Economic Development of the Arctic Zone of the Russian Federation up to 2020”. URL: <http://www.pravo.gov.ru>, 24.04.2014

subethnic group nowadays referred to old-settlers) in the XVIII century. Its population number is about 600 people nearly half of them are Nenets. Thus, this territory population belongs to minorities whose right for traditional nature management is protected by the Federal legislation.

This region is situated in Subarctic. Hilly and rolling marine plains are the dominating relief type. Ecosystems are presented by different tundra types, forest tundra and northern taiga to a minor extent (mainly river flood plains). Polygonal peat bogs are also met (fig. 4).

The main economic activities are connected with reindeer breeding, fishing and hunting, presenting territories of traditional nature use (TTNU). Indiga belongs to the so-called territories of advanced economic development according to the on-going Federal program. A new sea port belonging to the Northern Sea Route infrastructure, Belkomur railway terminal are planned to be constructed there. This will cause drastic changes in nature management structure: transport nature management will appear accompanied by enlargement of residential due to the fact that these plans implementation needs labor power. Such changes will greatly increase anthropogenic impact on local ecosystems.



Fig. 1. Indiga at the map of Russia



Fig. 2. Indiga coast of the Barents Sea (photo by I. Mizin)

## MATERIALS AND METHODS OF RESEARCH

The study is based on methods and approaches presented in general ecological-economic publications [Costanza, 2008; De Groot et al., 2002; etc.] regional TEEB publications [The Economics., 2015] supported by recent regional environment investigations<sup>1</sup> and completed by our field data as well as experiences in nature management conflicts mapping in the Arctic zone [Evseev et al., 2018].

## RESULTS OF RESEARCH AND DISCUSSION

The investigated region belongs to “moderate high” vulnerability to anthropogenic impact territories i.e. the third highest position in the assessment scale elaborated by V. Korobov and Yu. Shumilova [2008]. This means that local ecosystem resilience to the planned increase of human impact may cause depletion of local pools of ecosystem services. In order to control this process three principle steps are needed:

- Determining of competing demands for ecosystem services exploitation among the future stakeholders;
- Linking of the most demanded services to local ecosystem structure;
- Assessment of available pools of these ecosystem services for their quoting.

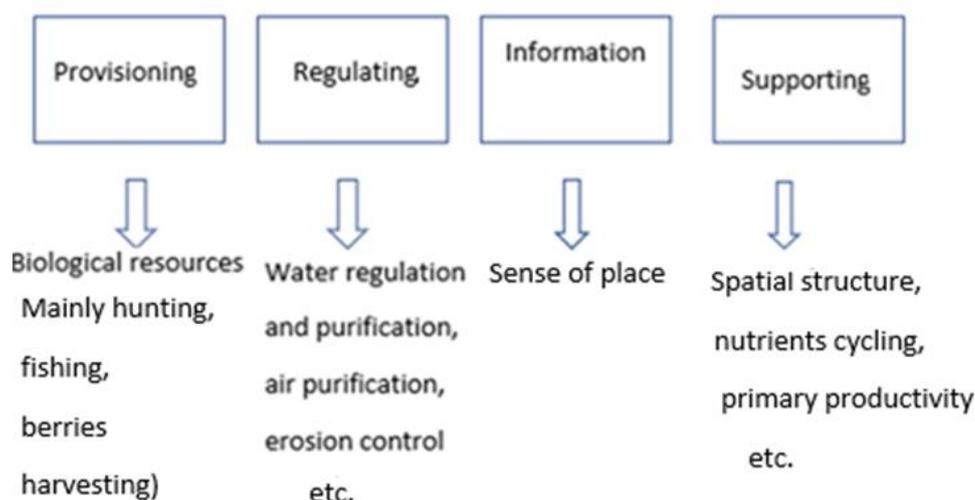


Fig. 3. Ecosystem services provided by local landscapes

Table 1. Landscape-donors of the most demanded ecosystem services

Ecosystem/ Ecosystem service	Flat bogged marine terraces with tundra	Heightened marine and glacial marine terraces with tundra	Rolling and hilly drained marine plains with tundra	River flood plains with northern taiga	Heightened rolling marine plains with forest-tundra	Low marine terraces with northern taiga	Polygonal tundra peat bogs
Regulating	++	++	++	+++	++	+++	++
Provisioning	+	++	++	+++	++	+++	+

<sup>1</sup> IPY-NAO-MODIL, 2008. Web resource: <https://ipy-nenets.npolar.no/main%20pages/frame.html> (accessed 24.05.2018)

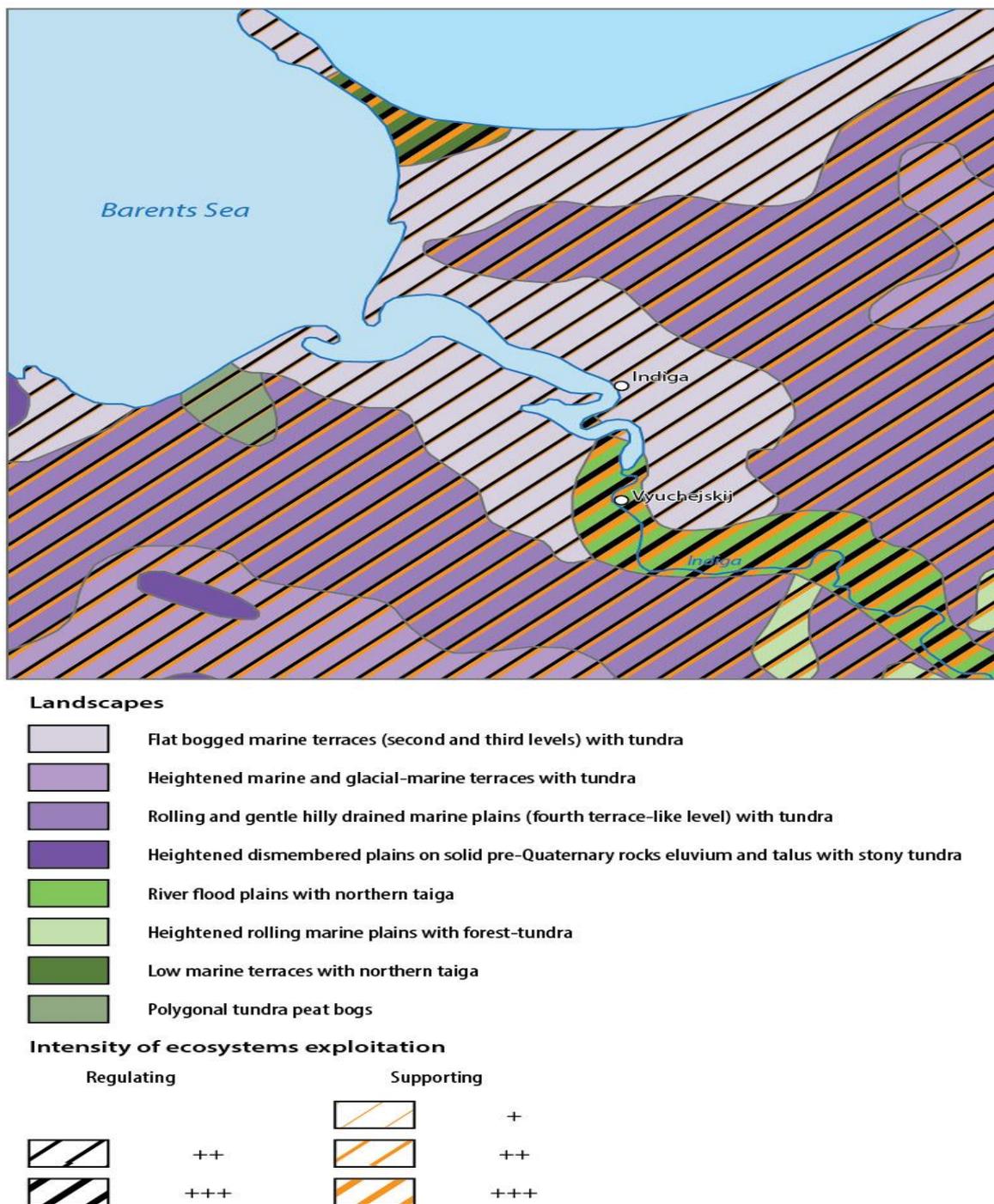


Fig. 4. Landscapes/ecosystems structure and its elements presenting regulating and supporting ecosystem services

Regarding the planned economic activities, the most typical case for joint ecosystem services exploitation by different stakeholders at the studied area are regulating services controlling ecosystem resilience to human impact and provisioning services to a minor extent. The spectrum of ecosystem services according to GEO-5<sup>1</sup> classification is presented at fig. 3.

<sup>1</sup> GEO-5. Global Environment Outlook. 2012. UNEP. Web resource: [http://www.unep.org/geo/pdfs/geo5/GEO5\\_report\\_](http://www.unep.org/geo/pdfs/geo5/GEO5_report_) (accessed 24.05.2018)

We tried to link the most demanded in future ecosystems services to modern landscape structure (table 1) to reveal landscapes which ecosystem services pools may need quoting among different stakeholders.

Then using a landscape map, we showed ecosystems-“donors” of these services and marked the future intensity of their exploitation (fig. 5). Quantitative assessment for quoting may follow when development plans are presented. Ecosystem services pools quantitative assessment is the next step of our research.

## CONCLUSIONS

Landscape/ecosystem studies form the basis for advanced management of ecosystem services exploitation in case of joint use by different stakeholders. They enable to assess existing pools of ecosystem services using ecological experimental data. The following procedure is quoting of these pools regarding that according to the Arctic Council recommendations unless 30% of the developed territory should be left as ecological buffer (nature protected territories, “sparing”-adapted to environment, ex.-TTNU) to provide ecosystem services natural reproduction. If to ignore these two important issues ecosystems degradation is inevitable or additional expenditures for environment rehabilitation will be necessary. The mentioned above State program of advanced economic development of the Russian Arctic zone declared correspondence to sustainable development goals. The primary importance of nature conservation and TTNU support in during economic development were mentioned in this document. The suggested ecosystem services exploitation regulation presents one of the mechanisms to provide sustainable nature management.

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