Revista Práxis Educacional

e-ISSN 2178-2679

**ARTIGO**

https://doi.org/10.22481/praxisedu.v15i34.5806

# "ENERGY APPROACH" FOR CALCULATING THE ECONOMIC ALUE OF BIORESOURCES OF THE HUNTING FARM "SVIYAZHSKOE"

"ENFOQUE ENERGÉTICO" PARA CALCULAR EL ALOR ECONÓMICO DE LOS BIORECURSOS DE LA GRANJA DE CAZA "SVIYAZHSKOE"

"ABORDAGEM ENERGÉTICA" PARA O CÁLCULO DO VALOR ECONÔMICO DOS RECURSOS BIOLÓGICOS DA FAZENDA DE CAÇA "SVIYAZHSK"

***Renat I. Zamaletdinov***
Kazan Federal University, Kazan – Russia

***Yuri I. Pavlov***
Management on protection and use of fauna objects of the Republic of Tatarstan, Kazan – Russia

***Guzel R. Gazilova***
Kazan Federal University, Kazan – Russia

***Regina I. Mikhailova***
Kazan State Academy of Veterinary Medicine named after N.E. Bauman, Kazan – Russia

***Irshat S. Shigapov***
Kazan Federal University, Kazan – Russia

**Resumo:** O papel dos animais no ecossistema é determinado por uma ampla gama de fatores. Este é, antes de tudo, o número, a biomassa e a natureza da alimentação. Devido ao fato de que a taxa metabólica em diferentes grupos de animais não é a mesma, o indicador mais importante de sua importância no funcionamento do ecossistema é o fluxo de energia que passa pela comunidade (energia transformável). O artigo apresenta dados sobre o uso de energia transformável para avaliar os recursos de espécies terrestres de vertebrados nas condições da fazenda de caça "Sviyazhskoe. A abordagem implementada pode ser aplicada a diferentes territórios. Uma limitação fundamental pode ser apenas a ausência de dados sistemáticos sobre os registros de todos os grupos.

**Palavras Chave:** fazenda de caça, energia transformável, valor econômico.

e-ISSN 2178-2679

**Abstract:** The role of animals in the ecosystem is determined by a wide range of factors. This is, first of all, the number, biomass and nature of feeding. Due to the fact, that the metabolic rate in different groups of animals is not the same, the most integral indicator of their significance in the functioning of ecosystem is the energy flow, passing through the community (transformable energy). The article presents data on the use of transformable energy for assessing the resources of terrestrial vertebrate species in the conditions of the hunting farm "Sviyazhskoe. The implemented approach can be applied to different territories. A fundamental limitation can only be the absence of systematic data on the records of all groups.

**Key words:** hunting farm, transformable energy, economic value.

**Resumen:** El papel de los animales en el ecosistema está determinado por una amplia gama de factores. Este es, en primer lugar, el número, la biomasa y la naturaleza de la alimentación. Debido al hecho de que la tasa metabólica en diferentes grupos de animales no es la misma, el indicador más integral de su importancia en el funcionamiento del ecosistema es el flujo de energía, que pasa a través de la comunidad (energía transformable). El artículo presenta datos sobre el uso de energía transformable para evaluar los recursos de las especies de vertebrados terrestres en las condiciones de la granja de caza "Sviyazhskoe. El enfoque implementado puede aplicarse a diferentes territorios. Una limitación fundamental solo puede ser la ausencia de datos sistemáticos sobre Los registros de todos los grupos.

**Palabras Clave:** granja de caza, energía transformable, valor económico.

## Introduction

At the present time, the concept of sustainable development is widespread. The concept of sustainable development includes three main approaches: economic, environmental, and social development. They are closely interrelated and complement each other (Ciegis et al., 2009).

Biological diversity is one of the criteria for a sustainable ecosystem. Preservation of biological diversity also has an economic effect. Reduction of biological diversity can lead to irreversible consequences (Devall, 2006).

The problem of preservation and study of biological diversity is particularly acute today. There are different ways to solve it. It is also possible to implement them in urbanized areas (Mingazova et al., 2015; Zamaletdinov et al., 2016; Jahagirdar et al., 2018).

As natural reserves, a number of authors call hunting farms. Hunting farms play a vital role in preserving of biodiversity, in maintaining the nature as the basis of human life and vital resources. The advantage of such territories is the regulation of the number of species with parallel preservation of non-commercial species. In this case, the question is not just about preserving species. It is possible to preserve habitats and specific ecosystems (Franklin, 1993).

The modern approach to natural resources is expressed through the so-called "ecosystem services". In other words, we are talking about an attempt of economic assessment of natural resources (Bobylev & Zakharov, 2009). In this regard, an adequate assessment of biotic component of ecosystems in different territories is required.

Recently, more and more attention has been paid to issues of economic value of resources. The question is not just about traditional approaches, based on assessment of market or commercial value. In recent years, alternative methods have been widely used, which allows to assess adequately the real significance of individual ecosystem components.

One of the most promising areas nowadays is considered to be the assessment of the economic value of biological resources, through the index of solar energy, transformed through individual components of ecosystems. At present, there are many different approaches to assessing the biotic component of ecosystems. The most frequently, the assessment is carried out for rare and endangered species (Red Data Book of the Republic of Tatarstan, 2016). The assessment itself is carried out to determine the degree of damage.

For hunting farms, the assessment of resources is based on the costs of licenses for the bagging of commercial species. Accordingly, the cost of non-commercial species is not taken into account here.

An alternative approach is the assessment, which is based on transformable energy. It is believed, that the transformable energy can serve as an indicator of the economic value of the bioresource component of ecosystems. V.N. Bolshakov and his co-authors proposed a simplified assessment of the economic value of bioresources in units of capacity (energy consumption per unit of time for maintaining the state) of all the main components of the ecosystem. As the equivalent unit, the authors took the most approximate way to taking the sunlight by the plants - the method of energy generating with the help of solar power plants.

This method of calculating the value can be effectively used in practice, taking into account the climatic conditions (Bol'shakov et al., 1998).

Carrying out of such kind of researches is possible only at carrying out of large-scale researches during a minimum of one season.

This article is an attempt to estimate the economic value of the biological resources of terrestrial vertebrate species, inhabiting the territory of the hunting farm "Sviyazhskoe" (Zelenodolsky Municipal District of the Republic of Tatarstan).

## Material And Methods

The material for this article was collected during the field seasons in 2014-2016 within the natural boundaries.

Standard methods of counting various groups of vertebrate animals were used for variety control: amphibians (Heyer et al., 2014); reptiles (McDiarmid et al., 2012), birds (Bystrack, 1981), mammals (Wilson et al., 1996).

Counting was conducted individually within each type of natural boundary. Then the results were defined as a number of individuals per 1 km2.

Within the considered hunting farm, the following types of natural boundaries are represented:

- Pine young forest growth and pole woods;
- Larchen, spruce young forest growth and pole woods;
- Leafy young forest growth and pole woods;
- Mature forests with predominance of coniferous species;
- Mature forests with predominance of broadleaved species;
- Mature deciduous forests (oak forests, alder forests, linden trees, willow trees);
- Forest openings (clearing in the woods), pastures and hayfields;
- Arable lands;
- Water areas;
- Industrial lands.

To estimate the economic value of vertebrate species in the territory of various natural boundaries of the hunting farm "Sviyazhskoe", we used the formula for calculating the transformed energy of vertebrate animals by allometric equations, taking into account their

number, the biomass of one individual, the period of activity, per one hectare of area (Ivliev et al., 2004).

QO2=2a Mk24N X/1000,

Where QO2 is the active exchange of all individuals of one taxonomic group during the activity period per hectare (W/season); a – is the coefficient, individual for each group of invertebrates, reflecting the standard exchange of 1 gram of the animal (mW/g) (Zotin & Zotin, 1999); M - is the mass of one individual in grams of fresh weight calculated for each taxon; k - is the coefficient of dependence of oxygen consumption on temperature in poikilothermal and homeothermal animals (Zotin & Zotin, 1999); X - is the number of individuals per ha; 2 – is the coefficient of re-calculation the standard metabolism into the active one; 24 – is the number of hours in a day; N – is the number of active days per year; 1000 – is the conversion factor of mW in W.

The standard metabolism was calculated by obtaining the values of the oxygen consumption rate in mW/h, using the formulas of A.I. Zotin and A.A. Zotin (Zotin & Zotin, 1999). This indicator was measured for inactive individuals (at rest), whereas actual or active metabolism (transformable energy) for all groups of animals is twice more than the standard one.

The biomass of various groups of animals was taken from the reference data (Dunaev & Orlova, 2012; Ryabitsev, 2002; Popov, 1960; Özer, 2018). The number of active days per year was defined in the process of material collection, as well as from literature data (Popov & Lukin, 1971; Karimpour et al., 2016; Sernadela et al., 2016).

The coefficients of allometric equations for the calculation of standard metabolism of individual taxonomic groups of vertebrate species were taken from the monograph of A.I. Zotin and A.A. Zotin (Zotin & Zotin, 1999).

Having made simple mathematical calculations, we obtained the value of transformable energy or the work, carried out by vertebrate species, within various natural boundaries of the territory under consideration. The results were converted to dollars, then to rubles at the dollar exchange rate of CB. The dollar exchange rate of the Central Bank of the Russian federation was 56.60 rubles for June 1, 2017.

e-ISSN 2178-2679

## Results And Discussion

The table 1 presents the amount of energy, transformed by vertebrate species.

**Table 1:** The amount of energy, transformed by terrestrial vertebrate species in the territory of the hunting farm "Sviyazhskoe" on average for a year, W/season

| **Natural boundaries** | **W/season** |
|---|---|
| Pine young forest growth and pole woods | 31,075,572 |
| Larchen, spruce young forest growth and pole woods | 25,590,054 |
| Leafy young forest growth and pole woods | 47,193,661 |
| Mature forests with predominance of coniferous species | 19,383,358 |
| Mature forests with predominance of broadleaved species | 62,544,705 |
| Mature deciduous forests (oak forests, alder forests, linden trees, willow trees) | 118,054,496 |
| Forest openings (clearing in the woods), pastures and hayfields | 67,190,893 |
| Arable lands | 4,738,206 |
| Water areas | 21,761,223 |
| Industrial lands | 27,560,267 |

According to the obtained results, during the season the largest share of energy is transformed by mature deciduous forests (oak forests, alder forests, linden trees, willow trees) (118,054,496 W/season). The minimum values of the transformed energy are characteristic for the arable lands (4,738,206 W/season). For such natural boundaries as leafy young forest growth and pole woods (47,193,661 W/season), and pine young forest growth and pole woods (31,075,572 W/season) average values of the transformed energy are characteristic.

## Deductions

Thus, the most "energetically valuable" natural boundaries in the hunting farm "Sviyazhskoe" are the following:

- 28% - mature deciduous forests (oak forests, alder forests, linden trees, willow trees);
- 16% - forest openings (clearing in the woods), pastures and hayfields;
- 15% - mature forests with predominance of broadleaved species.

This can be due to a number of reasons:

- Uneven species diversity;
- High number of individual groups of vertebrate species;
- Large biomass of individual groups of terrestrial vertebrate species.

Table 2 presents the economic value of vertebrate species per 1 hectare of land within various natural boundaries of hunting farm "Sviyazhskoe".

**Table 2:** The economic value of vertebrate animals in the territory of various natural boundaries of the hunting farm "Sviyazhskoe" of the Republic of Tatarstan, million dollars * ha/season

| **Natural boundaries** | **Economic value** |
|---|---|
| Pine young forest growth and pole woods | 0,90 |
| Larchen, spruce young forest growth and pole woods | 0,74 |
| Leafy young forest growth and pole woods | 1,37 |
| Mature forests with predominance of coniferous species | 0,56 |
| Mature forests with predominance of broadleaved species | 1,82 |
| Mature deciduous forests (oak forests, alder forests, linden trees, willow trees) | 3,44 |
| Forest openings (clearing in the woods), pastures and hayfields | 1,96 |
| Arable lands | 0,14 |
| Water areas | 0,63 |
| Industrial lands | 0,80 |

Excluding the lag, very high values were obtained (from $ 0.14 to $ 3.44 for the season per ha). The cost of vertebrate species varies from 8 million rubles per hectare in arable lands to 194 million rubles per hectare in mature deciduous forests (oak forests, alders forests, lime trees, willow trees).

For an objective assessment of the cost of resources of terrestrial vertebrate species, we converted it into rubles. When converting the cost from dollars to rubles, we found, that the economic value of all vertebrate animals of the hunting farm "Sviyazhskoe" is 11 billion 34 million 454 thousand 971 rubles, without including the separate cost of animals, listed in the Red Data Book of the Republic of Tatarstan.

## Conclusions

So, we have shown the possibility of using the data on the number of different groups of vertebrate species to estimate the economic value of the biological resources of the territory.

The calculations of the economic value of terrestrial vertebrate resources for the territory under consideration can be estimated as 11,034,454,971 rubles. The most significant natural boundaries are mature deciduous forests (oak forests, alder forests, linden trees, willow trees) (101,841,200 rubles/season), the least significant are larchen, spruce young forest growth and pole woods (781,440 rubles/season).

The implemented approach can be applied to different territories. A fundamental limitation can only be the absence of systematic data on the records of all groups of terrestrial vertebrate species.

## Acknowledgements

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.

## REFERENCES

1. Ciegis, R., Ramanauskiene, J., & Martinkus, B. (2009). The concept of sustainable development and its use for sustainability scenarios. *Engineering Economics*, *62*(2).
2. Devall, B. (2006). Conservation of biodiversity: Opportunities and challenges. *Human Ecology Review*, *13*(1), 60-75.
3. Mingazova, N. M., Zamaletdinov, R. I., Derevenskaya, O. Y., Palagushkina, O. V., Nabeeva, E. G., Pavlova, L. R., ... & Zaripova, N. R. (2015). The impact of XXVII summer Universiade on the environment in Kazan. *Mediterranean Journal of Social Sciences*, *6*(1 S3), 470.
4. Zamaletdinov, R. I., Mingaliev, R. R., & Kiseleva A. A. (2016). The Terrestrial Vertebrate Fauna of Valuable Natural Areas in Kazan. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, *7*(6), 2850-2855.
5. Franklin, J. F. (1993). Preserving biodiversity: species, ecosystems, or landscapes?. *Ecological applications*, *3*(2), 202-205.
6. Bobylev, S. N., & Zakharov, V. M. (2009). Ecosystem services and economics. -M.: LLC "Tipografiya LEVKO", Institute for Sustainable Development. Center for Environmental Policy of Russia. 72p.

7. Red Data Book of the Republic of Tatarstan (animals, plants, mushrooms). (2016). 3rd ed. - Kazan: Publishing house "Idel-Press". 760p.
8. Bol'shakov, V. N., Korytin, N. S., Kryazhimskii, F. V., & Shishmarev, V. M. (1998). A new approach to estimating the cost of biotic components of ecosystems. *Russian journal of ecology*, *29*(5), 297-305.
9. Heyer, R., Donnelly, M. A., Foster, M., & Mcdiarmid, R. (Eds.). (2014). *Measuring and monitoring biological diversity: standard methods for amphibians*. Smithsonian Institution.
10. McDiarmid, R. W., Foster, M. S., Guyer, C., Chernoff, N., & Gibbons, J. W. (Eds.). (2012). *Reptile biodiversity: standard methods for inventory and monitoring*. Univ of California Press.
11. Bystrack, D. (1981). The North American Breeding Bird Survey. *C. J. Ralph and J. M. Scott, editors. Studies in Avian Biology*, 6, 34-41.
12. Wilson, D. E., Cole, R. F., Nichols, J. D., & Foster, M. S. (1996). *Measuring and monitoring biological diversitystandard methods for mammals* (No. 599.05248 M4).
13. Ivliev, V. G., Shafigullina, S. M., Korchagina, T. A., Boyko, V. A., Belyaev, A. N., & Zamaletdinov, R. I. (2004). Bioresources and their role in the energy of terrestrial ecosystems (State of the issue and the prospects for practical implementation). Resource efficiency and energy saving in the current conditions of management. Proceedings of the IV International Symposium. – Kazan:550-555.
14. Zotin, A. I, & Zotin, A. A. (1999). Direction, speed and mechanisms of progressive evolution: Thermodynamic and experimental bases. - Moscow: Nauka, - 320p.
15. Dunaev, E. A., & Orlova, V. F. (2012). Amphibians and reptiles of Russia. Atlas-determinant. - Moscow: Fiton,– 320p.
16. Ryabitsev, V. K. (2002). Birds of the Urals, Cisurals and Western Siberia: Reference book - determinant. - Yekaterinburg: Publishing house of the Ural University, - 608p.
17. Popov, V. A. (1960). Mammals of the Volga-Kama region. Kazan: Academy of Sciences of the USSR, Kazan branch, 467p.
18. Popov, V. A., Lukin, A. V. (1971). Animal world of Tatarstan. - Kazan: Tatar Book House, 467p.
19. Karimpour, S. N., Rostami Bairagh, L., & Hajjabbari, S. (2016). Investigation of Noise Pollution in Khalkhal Town in winter and Summer Using Analysis of Statistical Data. *UCT Journal of Research in Science, Engineering and Technology*, *4*(2), 12-16.
20. Sernadela, P., Lopes, P., & Oliveira, J. L. (2016). A knowledge federation architecture for rare disease patient registries and biobanks. *Journal of Information Systems Engineering & Management*, *1*(2), 83-90. https://doi.org/10.20897/lectito.201615
21. Özer, G. (2018). The impact of serum vitamin D concentration on median nerve conduction. *Journal of Clinical and Experimental Investigations*, *9*(2), 63-66.
22. Jahagirdar, V. L., Davane, M. S., Aradhye, S. C., & Nagoba, B. S. (2018). Candida species as potential nosocomial pathogens--A review. *European Journal of General Medicine*, *15*(2).

SOBRE OS AUTORES:

**Renat I. Zamaletdinov**
Kazan Federal University, Kazan, Russia. E-mail: info@ores.su
http://orcid.org/0000-0003-2708-928X

**Yuri I. Pavlov**
Management on protection and use of fauna objects of the Republic of Tatarstan, Kazan, Russia. E-mail: belova-t@ores.su
http://orcid.org/0000-0001-7884-798X

**Guzel R. Gazilova**
Kazan Federal University, Kazan, Russia. E-mail: ssv@ores.su
http://orcid.org/0000-0003-3114-7120

**Regina I. Mikhailova**
Kazan State Academy of Veterinary Medicine named after N.E. Bauman, Kazan, Russia. E-mail: editor@ores.su
http://orcid.org/0000-0002-2348-8999

**Irshat S. Shigapov**
Kazan Federal University, Kazan, Russia. E-mail: info@ores.su
http://orcid.org/0000-0002-5339-6833

Recebido em: 15 de outubro de 2019
Aprovado em: 11 de novembro de 2019
Publicado em: 25 de novembro de 2019