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STUDY OF THE DEGRADATION OF THE LENTIC ECOSYSTEMS IN PANTELIMON LAKES (BUCHAREST, ROMANIA)

Alexandru I. Petrisor, University of South Carolina
Alexandru I. Petrisor, USC, School of Public Health, ENHS Department, Sumter St., Columbia, SC 29208

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ABSTRACT

The degradation of the community characteristic to Pantelimon Lakes represents an important problem, due to the local economical value of the area. This study is investigating the evolution of the quality of the lentic ecosystems in the area by comparing the community across the period 1994-1998, based on sportive fishing data.

The statistical analyses compared the diversity of the communities, expressed as entropy, and the frequency distributions of the species in the community across the study period, using the χ^2 test for the goodness of fit of two empirical distributions.

The computation of the values of the informational entropies did not reveal any obvious trend of diversity loss. The comparison of the informational entropies demonstrated a certain decreasing tendency of the diversity, indicating the simplification of the community. The comparison of the frequency distributions of the species in the community indicated significant changes in the structure of the community. The limitations of this study are first related to the use of sportive fisherman data. The power of the tests that were used was sufficient to detect any possible difference.

The significant changes in the structure of the community characteristic to Pantelimon lakes confirm the hypothesis of the degradation of its quality through the loss of species diversity. In this case, further research is recommended, as well as promoting environmental protection and reconstruction measures at the local level.

INTRODUCTION

Pantelimon lakes represent a complex of man-made lakes, originating in the damming of Colentina River. The lakes present a merely recreational value, being designed for the local tourism (Lake Pantelimon II, situated close to Lebada Hotel), and for sportive fishing. The phenomena of environmental deterioration were observed in the case of these ecosystems in the last tens of years. Chemical pollution situates on the first place, and is due to the use of pesticides in agricultural farms situated around, and due to the dumping of household wastes by the inhabitants of the adjacent districts. These phenomena affect the diversity of the communities [5, 7], expressed as entropy and measured using Shannon's diversity index [1, 2, 4, 5, 6]. The study of data obtained from sportive fishermen represents a possible source of information about the structure of the communities [1], and, implicitly, if these data cover a period sufficiently wide to surprise eventual changes, can furnish useful information about the deterioration of the ecological systems.

The purpose of this study is to determine the evolution of the quality of the lentic ecosystems in Pantelimon area by comparing the communities during the period 1994-1998, based on sportive fishing data.

MATERIALS AND METHODS

This study uses data coming from an only person, in order to minimize the errors due to subjectivity [1] and the errors in recording data in the case of interviewing more people. Data refer to eleven species and cover the period 1994-1998 (**Table 1**).

Name	'94-'95	'95-'96	'96-'97	'97-'98
Carassius auratus	254	37	5	0
Alburnus sp.	171	8	25	18
Pelecus cultratus	151	71	24	6
Perca fluviatilis	77	368	145	171
Rutilus rutilus	70	151	174	92
Scardinius erytrophthalmus	68	15	26	1
Rhodeus sericeus amarus	66	5	67	1
Lepomis gibossus	9	4	2	0
Carassius carassius	1	0	0	0
Gobius kesleri	6	5	1	1
Alburnus alburnoides	2	0	7	1

Table 1. Fishing data obtained for the period 1994-1998 - Pantelimon lakes

Statistical analyses compared diversities expressed as entropies [4], and species frequency distributions across the study period, using the χ^2 test of goodness of fit of two empirical distributions [3]. Data were analyzed using SAS® (Copyright 1989-1996, SAS Institute Inc., Cary, NC, USA).

Informational entropy is defined by the formula [1, 2, 4, 5, 6]:

$$h = -\sum_{i=1}^{s} p_i \ln p_i \text{, where:}$$

h is the informational entropy, expressed, in this case, ***nits***;

p_i represents the relative frequency of species i;

s represents the total number of species in the community.

The comparison of two empirical entropies was achieved using the following statistical test [1, 4, 5]:

$$t = \frac{h_1 - h_2}{\sqrt{\text{var}(h_1) + \text{var}(h_2)}} \text{, where:}$$

$$\text{var}(h) = \frac{\sum_{i=1}^{s} p_i (\ln p_i)^2 - \left(\sum_{i=1}^{s} p_i \ln p_i\right)^2}{n} - \frac{s-1}{4n^2}$$

It was proved that under the null hypothesis the test follows a *t* (Student) distribution, with the following number of degrees of freedom [1, 4, 5]:

$$df = \frac{\left[\text{var}(h_1) + \text{var}(h_2)\right]^2}{\frac{\left[\text{var}(h_1)\right]^2}{n_1} + \frac{\left[\text{var}(h_2)\right]^2}{n_2}}$$

The χ^2 test was computed based on the formula [3]:

$$\chi^2_{n-1} = \sum_{i=1}^{s} \frac{(O_i - R_i)^2}{R_i} \text{, where:}$$

χ^2_{n-1} is the test statistic; under the null hypothesis, its distribution is χ^2 with n-1 degrees of freedom;

R_i is the frequency of species i, in the reference period;

O_i is the frequency of species i, in the studied period.

In this case, the null hypothesis is "the two distributions do not differ", and the alternative hypothesis refers to "any possible difference".

RESULTS AND DISCUSSION

The computation of the informational entropy does not reveal any obvious trend of diversity loss (**Table 2**). However, the comparison of informational entropies indicated differences between any pair of two randomly selected periods. The tendency of diversity is to decrease, indicating the simplification of the community, except for the periods 1995-1996 and 1996-1997 (**Table 3**). All the tests are significant ($p \leq 0,05$).

Period	Entropy (*nits*)
'94-'95	1.89
'95-'96	1.31
'96-'97	1.62
'97-'98	1.01

Table 2. Evolution of informational entropy of the community of Pantelimon lakes during period 1994-1998

The comparison of species frequency distributions also indicated significant changes in the structure of the community. Significant differences ($p \leq 0,05$) can be observed between any pair of randomly-selected periods (**Table 3**). As it was shown in the previous section, the sense of these differences cannot be specified.

Period	'95-'96	'96-'97	'97-'98
'94-'95	$t_{1527}=6.7^*$ $\chi^2_{11}=1677.3^*$	$t_{1056}=2.7^*$ $\chi^2_{11}=738.2^*$	$t_{761}=9.2^*$ $\chi^2_{11}=532.5^*$
'95-'96		$t_{964}=-3.1^*$ $\chi^2_{10}=1014.6^*$	$t_{690}=3.2^*$ $\chi^2_{10}=220.0^*$
'96-'97			$t_{747}=5.7^*$ $\chi^2_{10}=969.9^*$

* significant ($p \leq 0,05$)

Table 3. Comparison between species diversity of the community of Pantelimon lakes, expressed as informational entropy during the period 1994-1998

These results indicate significant changes in the structure of the community across the study period. The comparison of species diversities permits the specification of their sense, indicating the tendency of loss of diversity, i.e. the degradation of the quality of the investigated community.

The limitations of this study are first due to the use of data from sportive fishermen. Even if they represent a valuable source of information, these kinds of data are susceptible to have errors due to subjectivity in their

recording. Even though, the data cover a sufficiently large period, and, due to the fact that all come from only one person, it is possible that the inherent errors to be reduced. The tests of goodness of fit, as the χ^2 test used in this study, have sufficient power to detect differences even if the sample size is reduced. In this case, the problem is related to the existence of more alternative situations, and the rejection of the null hypothesis does not furnish, in this study, information that could justify the conclusion of environmental deterioration.

The relevance of sportive fishing data is as questionable as whether fish species are representative for the entire community.

CONCLUSIONS AND RECOMMENDATIONS

The analysis of sporting fishing data indicated significant changes in the structure of Pantelimon lakes community, confirming the hypothesis of the degradation of its quality by the reduction of species diversity. In this case, further research is recommended, as well as promoting environmental protection and reconstruction measures at the local level.

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