Method for ecological monitoring based on research of ground beetle fauna (Coleoptera, Carabidae).

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Carabidae is a suitable group for conducting ecological monitoring. We proposed the procedure based on our studies carried out at 2007-2008 in flood land territories in the Karmaskalinskiy Region of the Republic Bashkortostan.

Our methods were the following.

1. Choice of biotopes for the investigation.
2. Determination of the basic sources of the anthropogenic influence.
3. Isolation of the individual sections of an investigation, the installation of trap series (Fig. 1).
4. Determination of individual anthropogenic factors and division by effect.

Selected biotopes and anthropogenic factors influencing them are listed in Table 1. Barber's soil traps set as follows: two lines on each biotope at a distance of 20 m from each other by 10-15 m between traps (Fig. 1).

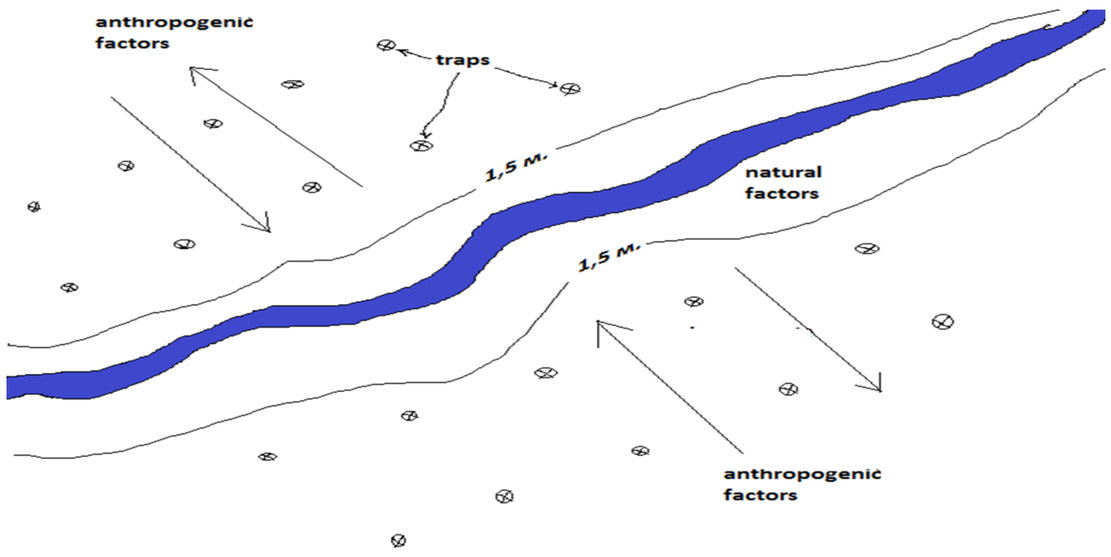

Fig. 1. Installation diagram of soil trapping.

Table 1.

Investigated biotopes.

biotopes	Natural factors	Antropogenic factors
№1	Size 100x40 m. The slope is 1,5 - 2 meters in height The soil is loose. Leached chernozem. Sodding 80%, tall grass. Burdock, nettle, hemp, grasses.	Agriculture: insecticides.
№2	Size 80x60 m. The slope is 1.5 m in height Soil dense. Leached chernozem. Sodding 70-90% The grasses, nettles, thistles, burdock	Landfill: the construction removed the top layer of soil near
№3	Size 80x40 m. The slope is 2 m. The soil is dense, sandy-loamy leached chernozem. Grasses, sedges, horsetail, clover, thistle.	Agriculture: herbicides, insecticides, traffic

Collected beetles were determined, considered an index of occurrence and female index. According to these data identified the dominant and subdominant species (Table 2).

Table 2.

The number of dominant, subdominant and small species on our biotopes in 2008 .

biotop	dominant	subdominant	small
№1	2	1	4
№2	1	4	5
№3	1	4	4

Dominance shifted to one or two species. It has been quite in the biotope № 1. This is caused by negative environmental conditions or rapid changes under the influence of negative anthropogenic factors.

We compared the coefficients of the quantitative and faunistic similarities (Table 3). These data show biotopes number 2 and number 3 is close between the species composition, but differ on the quantitative indicators, which indicate the proximity of biotopes number 2 and number 1. Species composition depends more on natural factors: the distance between biotopes and opportunities of migration of ground beetles from other biotopes. A quantitative evidence of the negative impact of anthropogenic factors. Summarizing the above data on the dynamics of relative abundance, we concluded that biotope № 3 is experiencing very strong negative impact of anthropogenic factors. Data on the number of dominant and subdominant species indicate that the strong influence exerted on biotope № 2. Both biotopes are within agriculture and are exposed to insecticides and herbicides. Biotope № 3 exposed to agricultural traffic, it causes soil compaction and reduces the number of herpetobions. It is almost no litter-soil burrowing species of ground beetles in the collections for this biotope .

Female index - Is, N-number the species caught in the area, Nf - number of females of species caught in the area.

$$Is = \frac{Nf}{N}$$

The coefficient of faunistic similarity - Kf
A - the number of species on the first section.
B - number of species on the second section.
C - number of species common to the first and the second section.

$$Kf = \frac{C}{A + B - C}$$

Coefficient of quantitative similarities - Kn
ΣA - number of specimens collected on the first section;
ΣB - number of specimens collected on the second section;
ΣCmin - minimum number of specimens of species found at both sites.

$$Kn = \frac{\sum Cmin}{\sum A + \sum B - \sum Cmin}$$

Table 3.

Comparing the coefficients of faunistic and quantitative similarities in 2008 in different biotopes.

biotop	A	∑A	B	∑B	C	∑Cmin	Kf	Kn
№2: line 1 & line 2	8	181	9	147	7	108	0,70	0,49
№3: line 1 & line 2	8	78	8	40	6	26	0,60	0,28
№2 & №3	10	328	10	118	9	85	0,82	0,24
№2 & №1	10	328	7	203	6	121	0,55	0,30
№3 & №1	10	118	7	202	6	48	0,55	0,18

Table 4.

Comparing the coefficients of faunistic and quantitative similarities in different years, biotopes №1 and №2.

biotop	A	∑A	B	∑B	C	∑Cmin	Kf	Kn
№1 (2007)&(2008)	7	118	7	145	5	64	0,56	0,32
№2 (2007)&(2008)	12	141	10	210	5	29	0,29	0,09

These data (Table 4) show the rate of change in the ground beetle fauna. Changes in the biotope № 1 are faster.

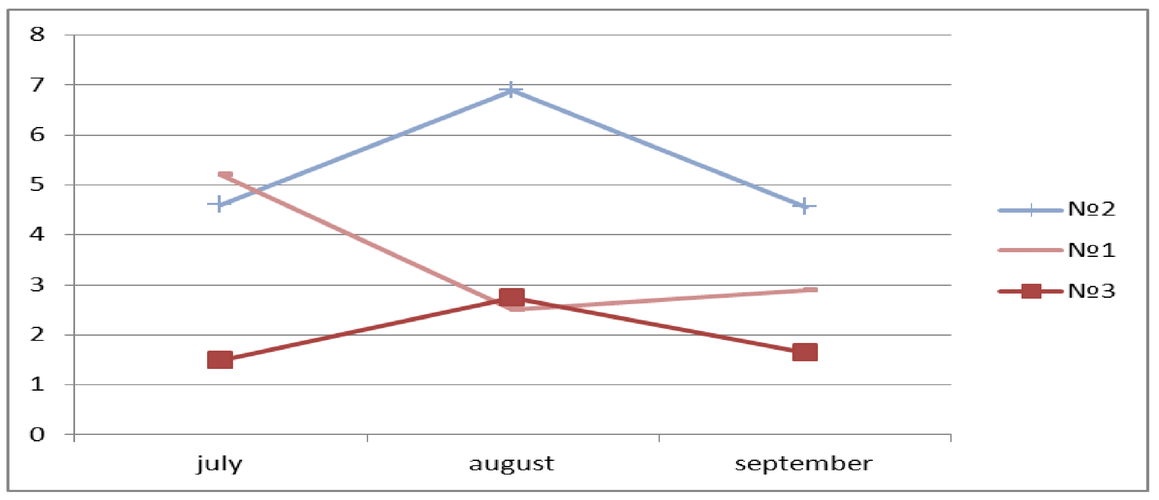

Fig. 2. Changing the relative abundance of ground beetles in the studied biotopes in 2008

An analysis was conducted on the relative abundance in all three habitats in 2008. Presented a chart (Fig. 2.) shows the relative strength of higher in the biotope № 2, and least of all in the biotope № 3.

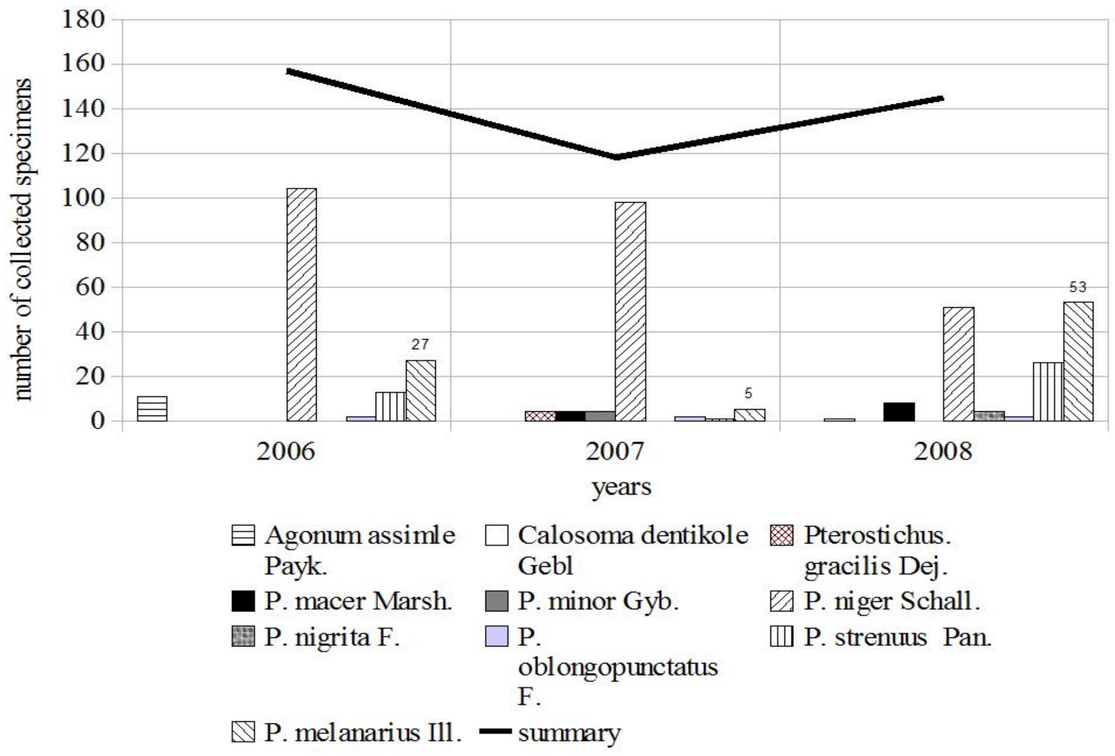

Fig. 3. The dynamics of the relative abundance of ground beetles in the biotope № 1.

Noteworthy is the trend, which can be seen in this biotope (Fig. 3). Similar changes with a shift of dominance in the direction of 2-3 species showed positive changes in the biotope.

Thus it is possible to build such a number on the extent of human impacts on habitats:
Biotope № 3 is experiencing the strongest negative anthropogenic impact, which can be divided into mechanical (agriculture traffic) and chemical (insecticide and herbicide treatment).
Less anthropogenic pressures experienced habitat № 1. It also is handling insecticides.? But the agriculture traffic isn't. It can be argued that this factor gives a strong negative effect on habitat areas № 3. Ground beetle fauna in the biotope № 1 is rapidly changing.
The smallest impact is experiencing biotope № 2. In terms of its findings can be judged that the human impact is not an important factor for ground beetles.