Phytomass of urban ecosystems as the basis for attraction of desirable and undesirable organisms

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Introduction

The aim of work is to consider relations of urban plants – urban pests basing on fundamental ecology. Under increase of pressure on nature, many organisms have adapted to a new environment and began an active attack on new ecosystems. Urbanized communities are part of biosphere and live according to the fundamental laws of ecology. According to general ecology, having 100 units of plant mass unit, we will get 1 unit of plant eating pests in biocenosis. According to data of ICUP (1993 – 2014), 3 important processes during the 22 years took places: 1. Development of fundamental knowledge about urban pests. 2. Development of practical methods of pest control. 3. Ecological and evolutionary processes in pests that allowed them to take extensive ecological niches. The latter process was carried out most rapidly and efficiently, and the pests have proved to be stronger than program of pest management. Why some organisms in the urban environment were more populated than their ancestors in the wild? The answer on this question is toward understanding of main ecological processes in urban environment. An important aspect of pest management must be accorded to UN policy of "green economy". Accordingly, the fight against plant pests and pathogens for humans can only be effective based on the latest achievements of scientific ecology and on control of their resources.

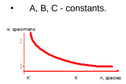
Methods

- The base of methods was comparative analysis of morphological state of urban phyto mass in relation to vulnerability for urban pests. A mathematical device letting to analysis the state of population using easily measured characters: quantity, the variability of morphological characters, and level of morphological assymetry. There are 2 types of ecological models available for prediction – dynamic and static. Dynamic ones are based on temporal line of data, modeling trends and prognosis. Static are based on one moment analysis of population or ecological system. Phenogenic indication is a variant of static modeling. Analysis is based on check of phenogenic criteria.
- Sex ratio. The quota (part) of males (Pm) under normal condition must be 0.5 – 0.55. The mean 0.55 – 0.65 suggests on genetic instability of population. Under Pm more than 0.65 the adaptive possibilities of species are over. Organisms having such a character are not serious pests.
- Quantitative variability is measured by variation coefficient
- **CV = σ /μ**
- **σ** is square deviation, **μ –** the mode. Under normal ecological conditions CV is between 0.05 and 0.1. The mean equal to 0.1 – 0.2 suggests to unstable state of population. Under CV overtaking 0.2 adaptive possibilities of population are over. Some animals, e.g, dogs have CV more than 0.2. City garden pest – aphid *Megoura viciae* have CV on length of body and other morphological characters close to 0.1. Under introduction to urban state the mean increases to 0.2 – 0.3. During adaptation to urban state the mean returns to 0.1. (see results).
- Variability on qualitative traits. Under control state wild population has about 5% of abnormal specimens. The fact is accorded to use of significant probability 0.05 (0.95) within biological statistics. That is 95% of organisms are normal under control state. Increase of mean to 0.1 – 0.2 suggests that population is toward suffocation.
- The rate of genetic damage of population may be checked by float asymmetry:
- $Sd^2 = \Sigma(a_{ri} - a_{li})^2 / N\text{-}1$
- where a_{ri} and a_{li} are means of symmetrical characters at right and left sides of organisms. The overtaking of standard data for species suggests that species is under high ecological press. Morphological variability of both plants and pests was assayed in different regions of St. Petersburg and subparts was checked. Biological diversity was checked by distribution of insects in forests surrounding St. Petersburg.

Results

- The general theory of biosphere was suggested by of Vernadsky. According to theory,
- 1. The biosphere mass is constant, about M_b = 250 000 000 000 ton.
- 2. Biosphere is organized as ecological pyramid. The pyramid is relation of mass of organisms belonging to different trophical levels. That is relation between producers (plants) and consuments (plant eating animals), predators, parasites. Every next floor of pyramid has mass less 10 - 100 times.
- 3. The range distribution of species within orders and classes is asymmetrical. That is, majority of species belongs to some orders. The distribution of specimens within species is asymmetrical too.
- The theoretical image of such a distribution is demonstrated in fig.1. The distribution is accorded to formula :

- $F(n) = A+Be^{-Cn}$
- A, B, C - constants.



- Fig1. Theoretical distribution specimens/species.

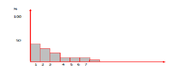


Fig. 2. Pattern of different orders insects in field catching - own data.

1 - *Heteroptera*, 2 - *Diptera*, 3 - *Homoptera*, 4 - *Coleoptera*, 5 - *Hymenoptera*, 6 - *Orthoptera*, 7 – *Lepidoptera*

- The empirical example of such a distribution in relation to insects is demonstrated at fig. 2. Minimal number of specimens needed for stable population is Nk. $N_{K'}$ would be minimal number of specimens needful for recurrent detection of species in nature. Species from K' to K would be hidden species. Between hidden and dominant species rare species exist too.
- According to general ecology, having 100 units of plant mass unit, we will get 1 unit of plant eating pests in biocenosis. Having 1 unit of animal mass we will have 1 unit of animal eating mass pests. Hence, presence of any pests is inevitably in every ecological system. Absolute suffocation of pests is impossible. The real task is getting optimal relation between pests and humanity. The ideas are useful for consideration of pest adaptation dynamic for urban environment.
- The following tree damage were studied – dichotomy, trichotomy, trunk biological damage – see fig. 3.

Fig. 3. Variants of three damages

Active struggle against such urban pests as aphids increased their variability and tempo of adaptation – table 1. The state of city trees as basis for reproduction of urban pests is demonstrated in table 2.

Table 1. Effect of JHA treatment of plant (pea) on phenotypical variability of aphids *M. viciae*

Variability measure	Var. coef. lenght of body	Var. coef. of width of body	% of organisms with color abnormality
Variant			
Control	0.06	0.06	5± 1
Treatment	0.18	0.13	30±4

Table 2. The state of city trees in relation to pollution and pest invasion.

# points	N trees	Trunk damage, %	Dried, %	Leaves float asymetry	Detected aphids invasion, %	Detected xylophagous invasion, %
1	19	32	16	0.6	20	20
2	46	20	13	0.2	15	15
3	35	69	0	0.1	6	3
4	37	11	11	0.2	11	11
5	53	25	4	0.1	34	6
6	35	43	69	0.2	46	60
7	41	12	0	0.6	17	63
8	49	20	4	0.2	24	6
9	41	10	2	0.2	15	2
10	43	33	7	0.4	37	11
11	36	53	3	0.6	55	11
12	30	10	0	0.6	20	23
13	35	11	9	0.2	14	29
14	139	26	1	0.1	28	3
15	30	37	0	0.1	53	7
16	35	46	3	0.2	48	9

Correlation trunk damage – aphid invasion is 95%, correlation dried trees - xylophagous invasion is 92%. Correlation with float asymmetry is not significant, because this mark deals only with mutagens. This is important because of Fucusima and other incidents.

Conclusions

Urban phyto mass is factor of attraction of pests. The rate of attraction depends on the state of city plants. Pest control can be effective only under condition of its regularity, the development of an international integrated programs, including basic research, practical action, the system of training and exchange of experience for professionals and education of wide layers of the population. The settlement of the urban ecosystems is in accordance with the fundamental laws of ecology. Accordingly, the fight against plant pests and pathogens for humans can only be effective based on the latest achievements of scientific ecology.

Future research

Theoretical basis of future researches must be principles of fundamental ecology. Primary law of ecological pyramid dealing with relation plants – xylophagous – parasites. Model basing on such principles may predict main characters of ecological development of urban area. Phenogenetic indication must become perspective cheap methods of regular monitoring. Political base of struggle with urban pests must be “green economy” suggested by UN.

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