RUSSIAN ACADEMY OF SCIENCES
SIBERIAN BRANCH

BIODIVERSITY AND DYNAMICS OF ECOSYSTEMS IN NORTH EURASIA

VOLUME 5

Part 3: BIODIVERSITY AND DYNAMICS OF ECOSYSTEMS OF NORTH-EASTERN ASIA

Novosibirsk, Russia
August 21-26, 2000

IC&G, Novosibirsk, 2000

Δ-DIVERSITY OF NATURAL TERRESTRIAL ECOSYSTEMS

Ravkin Ju.S., Sergeev M.G., Sedelnikov V.P.

Institute of Systematics and Ecology of Animals
Central Siberian Botanical Garden SB RAS
11 Frunze Str., 630091, Novosibirsk, Russia
Fax: +7 (3832) 17–09–73, e-mail: zm@zoo.nsk.su
* To whom correspondence should be addressed

Keywords: *biodiversity, terrestrial ecosystem, animal community, phytocoenosis, biomass, thermal zone, bioclimatic region.*

Abstract

Parameters of phytocoenosis productivity, phytomass, zoomass (separately for invertebrates and vertebrates) are evaluated on the basis of published data. The main trends of ecosystem changes are described for biomass. Relations of their heterogeneity and ecological factors, natural conditions and ecosystems parameters are calculated.

Introduction

General phytocenotic heterogeneity is usually described by general parameters of thermal zones, bioclimatic regions and soil-vegetation cover (Bazilevich et al., 1970). However, this approach accounts about 20% of dispersion of ecosystem similarity indices for phytomass, vertebrate and invertebrate masses. Thus, this heterogeneity can not explain using only this approach. However, if we shall use other parameters we shall be able to explain almost full heterogeneity.

Data and Methods

We analyzed 106 soil-vegetation formations distributed over 5 thermal zones, from the polar zone to the tropical one. Jaccard's index (Jaccard, 1902) was used for quantitative parameters (Naumov, 1964). Ecosystem classification based on one of the claster analysis approach (Trofimov, 1976). The similarity pattern created on the base of intergrouping relations at the superclass level. The method of correlation groups was used (Terent'ev, 1959). This pattern was oriented in space of ecological factors correlated with evaluated ecosystem trends. Relation intensity and similarity was estimated by the linear qualitative approximation on evaluated grades of ecological factors (Ravkin et al., 1978).

Results

An analysis of data collected shows that, in humid and semiarid ecosystems, the phytomass (relative to an area unit) decreases from the tropical zone to the polar one, in the arid ecosystems, it decreases from the subtropical zone to the tropical and subboreal ones. In the semiarid and arid landscapes, phytocoenotic productivity changes in the same way as the biomass. In the humid regions, it decreases from the subtropical zone with evident increasing in the boreal area. In the semiarid and arid regions, the zoomass reaches its maximum in the subtropic area, in the humid regions, its maximum is situated in the subboreal zone.

These changes are evidently associated with difference of optimal relations of thermal conditions and precipitation for plants, invertebrates, and vertebrates. The another reason is the difference of their adaptations. Thus, if precipitation is enough or surplus plants prefer warm areas. If heat flow is enough they prefer the most moisture habitats. Invertebrates prefer intermediate levels of temperatures and precipitation, because they are strictly limited by these parameters. If at least one of these parameters has maximal significance habitat attractiveness decreases. In the case of high levels of temperatures and precipitation, invertebrate biomass descreasing seems to be associated with plant productivity decreasing, first of all with the part of this production which could be used without issues for general productivity. Vertebrates usually use a small part of plant production. Besides, they are associated with temperatures and precipitation in the lesser extent. As a result, in the humid and semiarid regions, they prefer habitats with maximal temperature levels. If temperatures are not enough vertebrates become nomads relative to ephemeral resources of plants and invertebrates. This results in the temporal increase of biomass in the subpolar areas during summer. Regardless of thermal difference, the arid regions are almost equally unfavourable for vertebrates in general.

The usual way to distinguish phytocoenoses and ecosystems of natural landscapes is by their positions relative to thermal zones and inside these zones – by the precipitation levels – into bioclimatic reagions. Typological similarity of phyto- and zoomasses allows us reasonably to divide ecosystems accordingly vegetation cover types: forest, desert, and other open and mosaic communities. Hereafter their differentiation conforms to the peculiarities of hydrothermal conditions and adaptive potential of plants and animals. Increase of aridity and physiological dryness results in the biomass decreasing regardless of thermal and precipitation conditions (see figure and table). This approach allows us to get a three times more information as the conventional one.

Intensity and similarity of the relation of heterogeneity of biomass, territory attractiveness, for plants, invertebrates, vertebrates, with ecological factors and ecosystem parameters (natural terrestrial landscapes).

Factor, conditions, parameter	Dispersion accounted, %	
Vegetation type	52	} 69
Hydrothermal conditions	28	
Precipitation	21	
Forestation	20	
Moisture content	12	
Thermal resources	6	} 18
All factors	60	
Classification conditions	43	
Structure conditions	45	
All factors and conditions	66	
Conventional explanation	19	
General	66	

All results are characterized in our book (Valtuh et al., 1999).

References

1. Bazilevich N.I., Rodin L.E., Rozov N.N. Geographical aspects of biological productivity studies // Materialy V S'ezda geographicheskogo obstshestva SSSR. L., 1970.
2. Jaccard P. Lois de distribution fiorale dans la zone alpine // Bull. Soc. Vaund. Sci. Nat. 1902. V. 38: 69–130.
3. Ravkin Ju.S., Kupershtoh V.L., Trofimov V.A. Spatial organization of bird communities // Ju.S. Ravkin. Birds of the forest life zone of Priob'e. Novosibirsk, 1978. 253–269.
4. Terent'ev P.V. Method of correlation groups // Vestnik Leningradskogo universiteta. Ser. Biol. 1959. 9: 137–141.
5. Trofimov V.A. Models and methods of a quantitative and factor analysis of a relation matrix // Problems of an analysis of discrete information. Novosibirsk, 1976. V. II: 24–36.
6. Valtuh K.K., Krivenko A.P., Ravkin Ju.S. et al. Information theory of a value and system economic estimations of natural resources. Novosibirsk, 1999.