

Biotic Fluxes of Matter and Energy Between Aquatic and Terrestrial Ecosystems

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Abstract—This paper is an introduction to a special issue of the journal. A brief historical delineation of the question of studying interfaces between adjacent ecosystems (ecotones) is presented. High biodiversity of ecotones and their vulnerability to natural and anthropogenic impacts, including invasions of alien species, are noted. It is supposed that there is no contradiction between the ecotone and river continuum concepts. The important ecological role of amphibiotic animals and plants in interactions and functioning of the adjacent ecosystems is emphasized. The issue of studying the quantitative parameters of fluxes of matter and energy between ecosystems in conjunction with their qualitative parameters (chemical elemental and biochemical compositions) is considered in the present paper.

Keywords: ecotone, amphibionts, biological invasions, biodiversity, fluxes of matter and energy, water–land interface

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The determination of the borders between separate uniform systems has always been one of the most complicated tasks of ecological studies. First and foremost, the difficulties relate to the openness of these systems and to the high mobility of their borders. However, at any scale of the ecological divisions, from natural–climatic zones and natural–landscape complexes to biotopes and habitats, the studies necessitate determinations of the borders between these complexes.

Starting from the research by Clements (1905), as early as in the beginning of the last century it was shown that the borders between any ecosystems represent in fact separate ecosystems. It was Clements who proposed to call these systems “ecotones.” According to the modern concept, ecotones are defined as transit zones between adjacent ecological systems having a set of characteristics uniquely determined by spatial and temporal scales and forces of interactions between these adjacent systems.

As in many other fields of science, in the case with ecosystem borders, the approaches and terms proposed in the first third of 20th century started to be used in specific studies only after a known period of time. An analysis of published papers reveals that in our country this happened in the middle of the 1970s

(e.g., Armand, 1975; Zaletayev, 1976, 1979; Sochava, 1978); in western countries this began in the late 1980s (e.g., Hansen et al., 1988; Holland, 1988; Naiman et al., 1988a). By that time it became accepted that studies on bordering zones of ecosystems (ecotones) may be useful in many respects. The ecotones may be treated as “membranes” regulating fluxes of matter and energy between adjacent spots of a resource. In addition, it became obvious that communities within ecotones are especially sensitive to changes in a landscape which relates to instability and vulnerability of these bordering systems. The latter property becomes especially important upon an assessment of the levels of anthropogenic impact changing both the character of system and its heterogeneity as determined by the number of ecotones per unit of space. Interest in studies on transit zones rose owing to the wide use of the “biodiversity” concept, since quite often the number of species in these zones is higher than in the adjacent ecosystems. It was shown that relatively high number of species in the ecotones is facilitated not only by the presence of species from adjacent ecosystems, but also by the processes of morpho-ecological and genetic diversification of organisms, along with the higher vulnerability of ecotones to the invasion of alien spe-