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CONTRIBUTION TO THE STUDY OF THE HIGH-MOUNTAIN ECOSYSTEMS OF THE NORTHERN URALS, USSR (Abstract)*

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The mountains of the northern Urals are situated in the western (Atlantic) sector of the boreal (taiga, coniferous forest) zone of the USSR. The vegetation belts (vertical zones) of mountain taiga, mountain low forest meadow, mountain tundra, and high-mountain cold desert may be distinguished on their slopes. The largest part of the northern Urals belongs to the mountain taiga belt. The high-

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mountain belts (low forest meadow, mountain tundra) occupy a much smaller area, appearing as isolated islands or as a more or less discontinuous strip which stretches along the crest of the mountain system.

The main types of ecosystems in the high-mountain sections of the northern Urals (Table 1) are the following:

(1) High-mountain cold deserts occupy the areas of accumulation of block fields at the highest altitudinal levels. The vegetation cover is very poorly developed (total projective coverage is about 10%) and consists almost entirely of mosses and lichens.

(2) Stony mountain tundras are located on steep slopes with skeleton soil. Mosses and some species of dwarf shrubs predominate; total projective coverage is about 40 to 50%.

(3) Dwarf shrub moss mountain tundras are developed on gentle slopes, with a 10-cm surface stratum of fine soil. Dwarf shrubs and green mosses predominate and the total projective coverage is about 60 to 75%.

(4) Shrub-moss mountain tundras are situated on very gentle slopes or flat surfaces with the surface stratum of fine soil to a depth of 20 cm. There are inclusions of pebbles and rocks in the soil. This ecosystem is rich in shrubs (mainly *Betula nana* with occasional *Salix* spp.); green mosses form a clearly developed layer. Total projective coverage is 80 to 95%.

(5) Herbaceous-moss mountain tundras occupy horizontal surfaces with the layer of fine soil up to 30 cm deep. Cryopsychrophilous herbs (mainly *Carex hyperborea*) and green mosses are the chief components. Total projective coverage is 80 to 90%.

(6) Low mountain forests are developed on slopes of varying steepness. The canopy of the arboreous layer is usually open (projective coverage 20 to 30%); the trees are low, often with tortuous stems and flag-shaped crowns. Total projective coverage is 85 to 95%.

The majority of bird and mammal species recorded in the high-mountain part of the northern Urals is associated with the mountain taiga belt. The faunistic differences between the specific altitudinal belts are quantitative rather than qualitative; many species occur in adjacent belts. For example, squirrel (*Sciurus vulgaris*), ground squirrel (*Eutamias sibiricus*), white hare (*Lepus timidus*), brown bear (*Ursus arctos*), hazel hen (*Tetrastes bonasia*), and nutcracker (*Nucifraga caryocatactes*) are associated mainly with the mountain taiga belt, but they extend to the low forest meadow belt, and sometimes to the mountain tundra belt. Wild reindeer (*Rangifer tarandus*), which are now rare in this area, dwell in summer in tundras but descend in winter to the mountain taiga belt. Mole (*Talpa europaea*) penetrates into the mountains up to the upper forest limit. The complex of small mammals without seasonal migrations (for example, forest voles, *Clethrionomys*), is more closely connected with specific altitudinal belts and even with specific types of ecosystems. Red vole (*Clethrionomys rutilis*) inhabit mainly the mountain taiga and low forest-meadow belts, but extend to the shrub-moss tundra. The distribution of bauk (*C. glareolus*) is limited to the mountain taiga and low forest-meadow belts; this species does not penetrate to the mountain tundra. Red-backed vole (*C. rufocanus*) is the characteristic animal species for stony mountain tundras; it penetrates along the block streams in the low forest-meadow and mountain taiga belts. The distribution of small mammals and insects in mountain tundras is discontinuous: they are more numerous in shrub-moss tundras. Among the birds, rock ptarmigan (*Lagopus mutus*) is more closely connected with mountain tundras. Willow ptarmigan (*Lagopus lagopus*) occurs in this area but is not regular; its characteristic range is low high-mountain forest with patches of mesophilous meadows.

Vertical migrations of many animal species, caused by seasonal fluctuations of availability of forage, depth of snow cover, as well as sharp changes of meteorological conditions, are very characteristic for the high-mountain areas of the northern Urals. In autumn, when the seeds of *Pinus silvestris* and juicy fruits of some shrubs and dwarf shrubs are ripe, a number of taiga animals (*Ursus arctos, Sciurus vulgaris, Eutamias sibiricus, Nucifraga caryocatactes, Tetrao urogallus* and others) move to the upper forest limit and even extend onto the mountain tundras. In winter almost all mammal species (with the exception of small rodents and insects) as well as birds evacuate mountain tundras and move to the lower altitudinal belts.

TABLE 1
Principal ecosystems of the northern Urals

Belt	Type of ecosystem	Dominant plant species	Phytomass ($g\ m^{-2}$)		Important animal species		
			Aboveground	Belowground	Birds	Large mammals	Small mammals
High mountain cold desert	High mountain cold desert	*Umbilicaria pennsylvanica, Rhacomitrium lanuginosum, Rhizocarpon geographicum*	15	3	*Oenanthe oenanthe*		*Clethrionomys rufocanus*
Mountain tundra	Stony mountain tundras	*Cladonia alpestris, C. silvatica, Alectoria ochroleuca, Dicranum congestum*	650	800	*Anthus pratensis, oenanthe*	*R. tarandus*	*C. rufocanus*
	Dwarf shrub-moss mountain tundras	*Vaccinium uliginosum, Empetrum hermaphroditum, Dryas octopetala, Hylocomium splendens*	680	3000	*Lagopus mutus*	*R. tarandus*	
	Shrub-moss mountain tundras	*Betula nana, Salix* spp. *Hylocomium splendens, Pleurozium schreberi*	1000	7500	*Lagopus mutus*	*R. tarandus*	*Clethrionomys rutilus, Microtus agrestis, Sorex araneus*
	Herbaceous-moss mountain tundras	*Carex hyperborea, Hylocomium splendens, Aulacomnium turgidum*	750	6100	*Lagopus mutus*	*R. tarandus*	*M. agrestis, S. araneus, S. caecutiens*
Mountain low forest meadow	Low mountain forest	*Betula tortuosa, Larix sibirica* var. *sukaczewii, Pinus sibirica, Picea obovata*	1100	900	*Phylloscopus nitidus, Phoenicurus phoenicurus, Prunella atrogularis, Emberiza pusilla, Anthus trivialis, Lagopus lagopus,* etc.		*C. rutilus, M. agrestis, Sorex* spp.