AD-A033 072 COLD REGIONS RESEARCH AND ENGINEERING LAB HANOVER N H F/G 6/6
STUDY OF ANTHROPOGENIC EFFECTS ON TUNDRA VEGETATION IN CONNECTI--ETC(U)
NOV 76 V N ANDREEV

UNCLASSIFIED CRREL-TL-557 NL

1 OF 1
AD A033072

END

DATE FILMED
2-77

TL 557

Draft Translation 557
November 1976

13

STUDY OF ANTHROPOGENIC EFFECTS ON TUNDRA VEGETATION IN CONNECTION WITH THE GENERAL TREND IN TUNDRA BIOME DEVELOPMENT

V.N. Andreev

CORPS OF ENGINEERS, U.S. ARMY
COLD REGIONS RESEARCH AND ENGINEERING LABORATORY
HANOVER, NEW HAMPSHIRE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Draft Translation 557	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) STUDY OF ANTHROPOGENIC EFFECTS ON TUNDRA VEGETATION IN CONNECTION WITH THE GENERAL TREND IN TUNDRA BIOME DEVELOPMENT		5. TYPE OF REPORT & PERIOD COVERED 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) V.N. Andreev		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Cold Regions Research and Engineering Laboratory Hanover, New Hampshire		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE November 1976 13. NUMBER OF PAGES 9
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

HUMAN FACTORS
TUNDRA SOILS
ENVIRONMENTAL IMPACT
REVEGETATION
AGRICULTURE

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

As the size of the population increases and northern agriculture intensifies, anthropogenic effects rise. A number of acute problems requiring rapid examination are discussed in this paper. Only overall investigations can create scientific prerequisites for a full, all around and stable development of the biological resources of the north.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(14) CRREL-TL-557

DRAFT TRANSLATION 557

(6)

ENGLISH TITLE: STUDY OF ANTHROPOGENIC EFFECTS ON TUNDRA VEGETATION IN CONNECTION WITH THE GENERAL TREND IN TUNDRA BIOME DEVELOPMENT

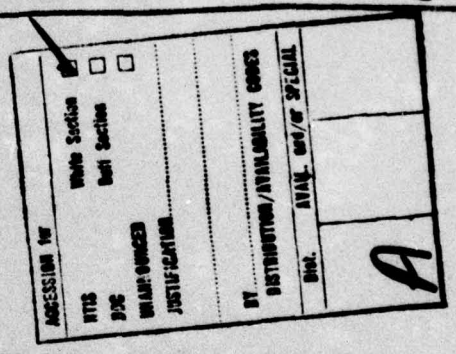
FOREIGN TITLE: IZUCHENIE ANTROPOGENNYKH VOZD ISTVII NA RASTITEL 'NOST 'TUNDRY V SVIAZI S OBSHCHIM NAPRAVLENIEM RAZVITUA TUNDROVOGO BIOMA)

(10) AUTHOR: V.N./Andreev

(11) Nov 76

(12) 12p.

(21) SOURCE: Trans. of Magadan, [redacted] Symposium on Biological Problems of the North (5th) (USSR) p173-179 1972.



CRREL BIBLIOGRAPHY
ACCESSIONING NO.: 30-694

Translated by U.S. Joint Publications Research Service for U.S. Army Cold Regions Research and Engineering Laboratory, 1976, 9p.

NOTICE

The contents of this publication have been translated as presented in the original text. No attempt has been made to verify the accuracy of any statement contained herein. This translation is published with a minimum of copy editing and graphics preparation in order to expedite the dissemination of information. Requests for additional copies of this document should be addressed to the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22314.

1473

037100 LB

STUDY OF ANTHROPOGENIC EFFECTS ON TUNDRA VEGETATION IN CONNECTION WITH THE GENERAL TREND IN TUNDRA BIOME DEVELOPMENT

Magadan POCHVY I RASTITEL'NOST' MERZLOTNYKH RAYONOV SSSR in Russian 1973
pp 173-179

/Chapter by V. N. Andreyev, Institute of Biology of the Yakutsk Affiliate of the Siberian Department of the USSR Academy of Sciences, Yakutsk, from the collection "Pochvy i Rastitel'nost' Merzlotnykh Rayonov SSSR," Data of the Fifth All-Union Symposium "Biological Problems of the North," USSR Academy of Sciences, Far East Scientific Center)

/Text/ Conserving nature and working out efficient methods of developing biological resources require an all-around study of the problem of the activity of man, who directly or indirectly affects the biosphere as a whole, or its individual components. The plant and animal world of the north feels the effect of man's activity to some degree, although the population density is only about 0.2 people per square km. As the size of the population increases and northern agriculture intensifies, anthropogenic effects rise. A number of acute problems requiring the most rapid examination arise.

Man's activity in the north should be based on a careful study of these effects and on the development of measures to prevent or soften their negative impact.

In addition to global changes caused by the enrichment of the atmosphere with carbon dioxide, its smoke content and radioactive fallout, local regional effects have a great impact. In their origin and consequences they can be unified in five groups:

1. the consequence of the use of biological resources and their negative results;

2. the effect of construction, transport and the mining industry, which is manifested on a steadily increasing scale;

3. the effect of elemental forces unleashed by man's activity. This includes fire, floods, mudflows, landslides and so forth;

4. the effect of populations of wild animals controlled by man to some extent and, therefore, in principle, reducible to the optimum level;

5. agricultural, fully controlled forms of effect directed toward an improvement in biological resources and their augmentation.

In order to develop the optimum parameters for the utilization of biological resources and the appropriate measures to prevent and fully eliminate negative anthropogenic effects on the plant cover, profound biogeocenological investigations are needed.

All the five groups of effect connected with the investigation of vegetation can be characterized as follows:

1. The effect of reindeer breeding. The systematic grazing of reindeer herds for a number of years has caused vast changes in the vegetation and soil and, essentially, has created new biogeocenoses. Exclusion of a certain part of the above-ground phytomass, mechanical damage to its other part, compaction and enrichment of soil with excrement, destruction of some microrelief forms by reindeer, appearance of new microrelief forms under the effect of intensified thixotrophy and soil solifluction, effect on the water regime, snow cover and a number of other changes lead to the development of plant groupings more or less different from indigenous groupings. On the whole, reindeer grazing leads to a reduction in shrubby lichens, depression of shrubs, a greater development of low bushes and, especially, grasses--primarily cereals (Achti, 1957; Andreyev, 1968; Pegau, 1970). In the reindeer breeding zone, especially in the old regions of its more intensive development, the tundra is covered with grass. Damaging the regrowth of tree species, reindeer hamper the development of forest groupings, especially on the polar and vertical boundaries of their distribution.

About 3 million domestic reindeer in the Soviet sub-Arctic region are some of the powerful factors in the effect on natural biogeocenoses occupying an area of no less than 3 to 4 million square km. By utilizing this factor skillfully, it is possible to control the state of plant resources in the tundra, as well as the rates and scale of their restoration. Therefore, the study of the effect of reindeer on the plant cover is of especially great importance (Klein, 1971).

It is necessary to make a thorough study of the effect of reindeer stock on the types of tundras with their different loads on pastures (optimum, calculated on the basis of the determination of reindeer capacity and exceeding the optimum load twice and four times), different methods of reindeer keeping (free, herd, controlled and fence grazing) and different herd sizes (500, 1,500 and 3,000 head). The percent of exclusion and damage to the phytomass (of the total fodder and gross reserves), as well as the percent of pasture utilization (of the total area), can be taken as the basic

indicators of the intensity of the effect of grazing on a pasture. The results of effect are determined for a number of years on the basis of a study of the changes in the fodder productivity of pastures, the botanical composition and horizontal and vertical structure of phytocenoses and the microrelief, and the physicochemical soil composition. It is necessary to establish fenced control areas where there should be no grazing. Conclusions on the most acceptable system of reindeer keeping for various natural zones can be drawn on the basis of the data obtained. The concept of "reindeer capacity" should be further developed.

Whereas reindeer affect primarily watershed spaces, hay mowing and livestock grazing are powerful factors in river valleys and lake basins. At the same time, meadow groupings undergo significant changes. In many cases the very appearance of these groupings is the consequence of removal of shrubs ("secondary meadows"). As a result of a long-term use of meadows a number of new species appear on them. From 3 to 10 species per 100 square meters are noted on virgin or rarely used meadows in the tundra zone, 25 to 30 species, on systematically used meadows in the tundra zone, and 35 to 40 species, in the forest tundra (Andreyev, Savkina, 1969). The rough bluejoint small reed characteristic of virgin meadows is disappearing under the effect of hay mowing (Savkina, Taz'ba, 1961; Vershinin, 1963). Special anthropogenic meadow groupings are being created. Their composition and productivity depend to a considerable extent on the length and intensity of utilization and methods of clearing (Savkina, 1960). Improvement in meadow grass stands can be attained through the introduction of the hay harvest-pasture turnover, use of chemical treatments and topdressings, undersowing of valuable species and establishment of protective shrub coulisses (Savkina, 1968).

Of great interest are the hardly studied problems relative to the consequence of the procurement of various plant resources. The extremely slow rates of their restoration and excessive exploitation (which takes place near settlements) cause a reduction in reserves and even their complete destruction. The felling of forest islands in the tundra, as well as the procurement of shrubs (willow, alder and so forth) for fuel, lead to an expansion of treeless areas and to a reduction in standing bushes. As a result of the procurement of nuts, berries and edible, medicinal and decorative plants without regard for their reserves and periods of restoration, the distribution of a number of species was reduced considerably and some of them disappeared completely. The procurement of peat without the appropriate drainage measures causes a degradation of the frozen ground and flooding of quarries, whereas they can be utilized as agricultural land through the establishment of cultivated hayfields and pastures. It is necessary to study the behavior of individual species and the state of plant groupings under the effect of various procurements through stationary observations based on a calculation of the specific composition and phytomass and to use the questioning of the local population on the state of reserves and changes under the effect of procurements and on their duration and volume. This will serve as the basis for the development of proposals on the most optimum volumes, periods and methods of procurements.

The accumulation and distribution of new plants can be conditionally included in this group of effects. This process, which plays a certain role in the formation of anthropogenic groupings, has been studied extremely poorly. In the aspect of florogenesis it was observed in Finnish Lapland (Achti, Hamet-Achti, L., 1971). A number of interesting data on USSR tundras were gathered (Dorogostayskaya and Tikhomirov, 1957; Tikhomirov, 1968).

2. The effect of construction, transportation and the mining industry, in particular, polygons remaining after the utilization of mineral resources, quarries and construction sites. In connection with the expanded scale of development of the regions of the Far North this effect increases annually.

It is very important to observe the forms of impairment of the soil and plant cover and the micro- and nano-relief under the effect of the traffic of tractors and cross-country vehicles, as well as the periods and characteristics of overgrowth of damaged places. According to our observations, in the Far North-East hummocky marsh sedge-cotton grass tundras are restored approximately 8 to 10 years after the damage is done. However, the structure and composition of restored groupings differ from the previous ones (observations and experimental data by researchers of the Canadian North and Alaska--Tundra Biome, 1972).

Measures to regulate the traffic of country-cross transport in the tundra zone should be developed and proposals on structural changes softening the destructive effect of caterpillars on the soil and plant cover should be made.

The "industrial" associations and successions on exposed tundra expanses have not been studied at all. In a number of cases by sowing perennial grass on exposed expanses it is possible to establish valuable fodder land for reindeer and other farm animals.

3. Elemental effect. Among the elemental forces unleashed by man fire, whose consequences have not yet been studied sufficiently, is of the greatest importance. It is widespread in the zone of contacts of polar forests and open woodland with tundras (Fire in the Northern Environment, 1971). In the area of the treeless tundra fire is of a narrow focal nature and is noted primarily in continental climate regions. "Pyrogenic tundras" on the place of burnt light forests are widespread on considerable areas in the forest and southern tundras. The process of soil formation several decades after fire led to the formation of gley peat soil and to the development of the mound forming sedge family (Eriophorum vaginatum, Carex wiluica, C. lugens) in combination with sphagnum and mesohydrophytic green mosses. The pyrogenic groupings that have emerged hamper the restoration of tree species. In some cases fire has an effect on the position of the polar boundary of woody vegetation.

4. The effect of wild animals. Until recently the role of wild animals, which have a serious effect on the plant cover of the Arctic and sub-Arctic regions, in particular, that of the northern reindeer, has not been fully taken into account. The long-term effects of the populations of wild reindeer, especially during the period when they gather into herds of many thousands, on pastures, do not remain without traces. For example, in 1946 on the treeless tops of the "Wolves' Tundras" (Kola Peninsula) reindeer moss 3 to 4 cm tall covered 80 percent of the 12,600 hectare area. These tundras, which proved to be not for farm use, became the favorite place for grazing wild reindeer. Over a period of 10 to 15 years reindeer moss was destroyed to a considerable extent. A recalculation made in 1968 by means of the same method disclosed the presence of reindeer moss only on 12 percent of the area. At the same time, its height did not exceed 1.5 cm. A sharp reduction in fodder reserves has been noted in northern Yakutiya, where pastures are greatly overloaded as a result of their use by wild reindeer. Apparently, the absence of reindeer moss in the subzone of the Arctic tundra (to which many investigators drew attention) is the result of an intensive grazing of wild reindeer in this subzone.

Furthermore, elks, hares, muskrats and waterfowl, whose populations are controlled by man, have a significant effect on the plant cover. Mouse-like rodents and invertebrate animals, especially insects, also have a vast, but unsufficiently studied, effect on vegetation (Tikhomirov, 1959, 1970).

Despite the obvious and well-known relationships among the animal, plant and abiogenetic components of biogeocenoses, in practice, they are often forgotten and various measures implemented on one of the components do not take into account the possible consequences for others and the entire combination as a whole.

The enthusiasm for lake drainage also has a pernicious effect. Often, for the sake of obtaining a short-term fodder area, fish reserves are ruined and the habitats of waterfowl are destroyed. The establishment of long-term fodder areas on drained lakes is a problem that has not yet been sufficiently worked out biologically or agriculturally and it must be seriously studied before the formed valuable biogeocenoses are disrupted.

5. The effect of special agricultural measures of decisive importance for the cause of development of the Far North. This includes aerial chemical treatment with arboricides, herbicides and growth stimulants and the effect of mineral foliar and root top dressings. The study of the effects of this procedure is basically the task of agromelioration. However, biologists should also take an active part in its solution.

A change in vegetation under an anthropogenic effect can cause a profound reorganization of the structure and composition of plant groupings. At the same time, other effects often recede, as it were, into the background, but the set of natural factors retains its fundamental importance under any conditions. The anthropogenic effect is only imposed on a natural basis.

Among natural factors of special importance is the set of climatic effects basically determining the present state and ways of development of biogeocenoses.

Understanding the general trend of natural shifts and tendencies of their modern dynamics is of great importance for a correct evaluation of the anthropogenic effect and development of measures for the utilization and conservation of biological resources. If the scheme of taxons of classification and regionalization of vegetation proposed by V. B. Sochava (1968) is taken as the basis, in our opinion, the level of subzones and categories of formations corresponding to them is most important for studying this problem. The effect of climatogenic causes on vegetation is most clearly manifested at the subzonal stage and at lower levels this effect is suppressed by orografic and edaphic nonzonal factors.

The methods adopted by us lie in investigating boundary groupings in which structural types (stages, parcels and synusiae) of adjacent subzones are combined. A study of the state and interaction of the elements belonging to various subzones within one grouping makes it possible to draw a conclusion on the success of a specific element and, therefore, on its priority developmet and certain tendency in the shift of subzonal boundaries. This method does not claim to be innovative. Many authors, who studied the dynamics of the polar and upper vertical boundary of woody vegetation, resorted to a study of the state and vitality of trees and forest parcels in boundary mosaic groupings--open woodland near tundras--which combine various elements of the southern tundra and light forests. The noted success of forest types in these groupings served as one of the proofs of the advance of forests to the tundra during the modern era. Apparently, the data on the cyclic development of forest groupings on the northern boundaries of woody vegetation published by V. V. Kryuchkov (1970) should be considered an individual case.

Islands of young light forests with unchanged tundra soil and grass-shrub covers and comparatively young trees--Larix dahurica--(20 to 50 years) are detected in the lower reaches of the Kolyma in the region of contact of light forests and the southern sub-Arctic tundra. Numerous isolated larches from shoots to trees 3 to 4 meters high are found farther, 30 to 40 km to the north. The forest component in the communities of the southern sub-Arctic tundra is active and successful.

The extensive development of shrubby willows (Salix pulchra, S. fuscescens, S. lanata, S. galuca, S. alaxensis and so forth) possessing a wide ecological amplitude is a characteristic feature of the middle sub-Arctic tundra. The absence of shrubby willows and the development of primarily hypoarctic species--Ledum decumbens, Vaccinium uliginosum, V. vitis-idaea--on the /plakory/ of low bush tundras is characteristic of the northern sub-Arctic tundra. An active settling of willows in the microdepressions of

low bush tundras and the absence of any signs of suppression of willow parcels at the northern boundary are observed in the boundary zone between these subzones. Distinctive small-node boundary tundras in combination with Arctic and sub-Arctic elements are widespread between the northern sub-Arctic tundra and the Arctic subzone tundra. The former include Diapensia obovata, Dryas punctata, Salix polaris and so forth, and the latter, ledums, blueberries and cowberries. Observations attest to the great vitality of sub-Arctic types and suppression of Arctic types by them. The settling in the Arctic tundra of white peat moss characteristic of sub-Arctic subzones, where deposits of sphagnum peat have been noted, is noteworthy. In the Arctic subzone their settling is of an island nature, the layer thickness not exceeding 15 to 20 cm. All this attests to the present expansion of southern elements and to the shifting of zonal and subzonal boundaries to the north, which to a certain extent can occur regardless of climatic fluctuations.

The problem of studying anthropogenic effects on the vegetation against the background of the developing tundra biome constitutes a very promising basis for combining the representatives of a wide circle of biological sciences, engineering and technical personnel, investigators of agricultural specialization and physicogeographers. Only overall investigations can create scientific prerequisites for a full, all-around and stable development of the biological resources of the north.

BIBLIOGRAPHY

1. Andreyev, V. N., "Problems of an Efficient Utilization and Improvement of Reindeer Pastures." In the collection: "Problemy Severa" /Problems of the North/, Issue 13, Moscow, 1968.

2. Andreyev, V. N., and Savkina, Z. P., "An Efficient Utilization and Improvement of Hayfields and Pastures in the Tundra and Forest Tundra." In the book" "Senokosy i Pastbishcha" /Hayfields and Pastures/, Leningrad, Kolos, 1969.

3. Vershinin, I. G., "Change in the Grass Stand of Inundation Meadows and Lower Reaches of the Yenisey Under the Effect of Their Utilization," TR. NIISKH KRAYNEGO SEVERA, Vol 14, Noril'sk, 1963.

4. Dorogostayskaya, Ye. V., and Tikhomirov, B. A., "Penetration of New Plants Into the Flora of the Arctic Region in Connection With the Development of Agriculture," IZV. AN SSSR, SER. BIOL., No 5, 1957.

5. Dorogostayskaya, Ye. V., "The Anthropophilic Flora of the Far North," BOT. ZHURN., 1968, No 11.

6. Kryuchkov, V. V., "Forest Communities in the Tundra, Possibility of Their Emergence and Dynamics," EKOLOGIYA, 1970, No 6.

7. "Vegetation and Industrial Pollution." In the collection: "Okhrana Prirody na Urale" /Conservation of Nature in the Urals/, Issue 7, Sverdlovsk, 1970.

8. Savkina, Z. P., "Coulisse Clearing of the Floodplains of Rivers in the Far North Covered With Bushes for Hayfields." In the collection: "Voprosy Senokosno-Pastbishchnogo Khozyaystva" /Problems of Hayfield-Pasture Farming/, Izd. Leningr. S/Kh In-ta, 1960.

9. Savkina, Z. P., and Taz'ba, S. M., "Meadows in the Lower Reaches of the Pechora River and Their Utilization and Improvement," TR. NIISKH KRAYNEGO SEVERA, Vol 10, Noril'sk, 1961.

10. Savkina, Z. P., "Problems of Increasing the Productivity of the Natural Fodder Base in the Far North." In the collection: "Problemy Severa," Issue 13, Moscow, 1968.

11. Sochava, V. B., "Plant Communities and Dynamics of Natural Systems," DOKL. IN-TA GEOGRAFII SIBIRI I DAL'NEGO VOSTOKA, Issue 20, Irkutsk, 1968.

12. Sukachev, V. N., "The Problem of the Immediate Tasks of Studying the Vegetation of the Kola Peninsula." In the book: "Raboty Organizovannogo Geograficheskim Institutom v 1920 g. Kol'skogo Pochv. Bot. Otryada Severnoy Nauchno-Promysl. Ekspeditsii" /Works of the Kola Soil and Botanical Detachment of the Northern Scientific Fishing Expedition Organized by the Geographical Institute in 1920/, Petrograd, 1921.

13. Tikhomirov, B. A., "Problems of an Experimental Study of the Plant Cover." In the collection: "Osnovnyye Problemy Sovremennoy Geobotaniki" /Basic Problems of Modern Geobotany/, Moscow, Nauka, 1968.

14. Tikhomirov, B. A., "Vzaimosvyazi Zhivotnogo Mira i Rastitel'nogo Pokrova Tundry" /Relationships Between the Animal World and Plant Cover of the Tundra/, Moscow, Izd-vo AN SSSR, 1959.

15. Tikhomirov, B. A., "Characteristics of the Zoological Components of Tundra Biogeocenosis." In the collection: "Teoreticheskiye Problemy Fitotsenologii i Biogeotsenologii" /Theoretical Problems of Phytocenology and Biogeocenology/, Moscow, 1970.

16. Shcherbakov, I. P., and Chugunova, R. B., "Classification of Forest Areas Cleared by Fire in South-West and Central Yakutiya," IZV. SO AN SSSR, No 1, 1960.

11,439
CSO: 9244