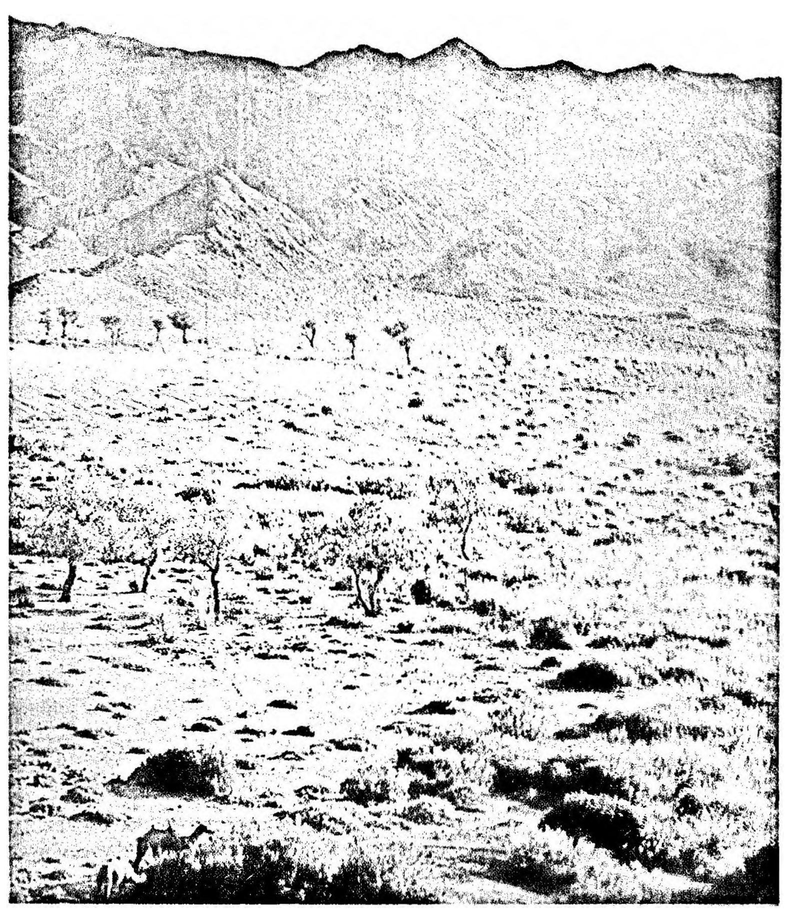
L.V. ZHIRNOV
V.O. ILYINSKY

THE GREAT GOBI NATIONAL PARK- A REFUGE FOR RARE ANIMALS OF THE CENTRAL ASIAN DESERTS



Moscow 1986

United Nations Environment Programme (UNEP)

L.V. ZHIRNOV
V.O. ILYINSKY

THE GREAT GOBI NATIONAL PARK- A REFUGE FOR RARE ANIMALS OF THE CENTRAL ASIAN DESERTS

Edited by Academician V. Ye. Sokolov
Vice-President, International Coordination Committee for Programme on Man and the Biosphere (MAB)

Centre for International Projects, GKNT

Moscow 1986

This volume has been prepared for publication by the Centre of International Projects GKNT within the framework of the project: UNEP /Government of the Mongolian People's Republic "Assistance to Mongolian People's Republic in the Establishment of the Great Gobi National Park, Mongolia".

Published by the USSR/UNEP Project
"Programme of Publication and Informational Support"
Moscow, 1986

Printed by V/O "Vneshtorgizdat" in the USSR, Moscow, 1986

PREFACE

During the past few decades, civilization with its powerful technological resources has developed vast territories and is rapidly expanding its sphere of influence. Such development can cause the disturbance of natural ecosystems and the impoverishment of species, and diversity of the unique world of animals and plants that constitute original biocenoses. Man's presence and activities in deserts affect, in the first place, animate nature, which is especially vulnerable because ecological links between animals and plants can be easily destroyed under the influence of anthropogenic factors. In deserts the life of organisms is constantly endangered owing to the extreme conditions that prevail and conservation of this unique sphere of life is therefore of great scientific and cultural significance. At present, the earth's arid zones are considered by many ecologists as well as by economists as an ecological reserve of the biosphere, which will be actively exploited by mankind in the very near future. The economic importance of arid zones is that much more apparent if one remembers that deserts and semi-deserts occupy about one third of the land mass of the globe.

The World Conservation Strategy, which was developed by the United Nations Environment Programme (UNEP), the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF), sets as one of its tasks the promotion of the protection of representative samples of ecosystems in different biogeographical provinces of the world. This should be undertaken primarily in those regions where there is a real threat of natural ecosystems being transformed under the influence of a widening process of anthropogenic development.

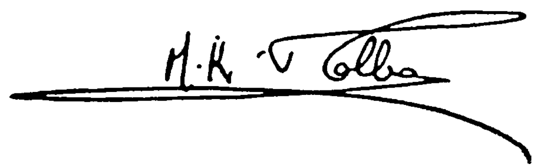
That is why the expansion of protected areas in desert regions is very urgent. The Gobi desert is one of the greatest deserts of the world. It is of world-wide importance as a region of unique landscapes with special fauna and flora. Here one can still find representatives of the ancient surface fauna of Central Asia — wild camel, bears and other animals of the desert. Until recently the Gobi desert was the last refuge of the Asian wild horse — Przewalski's horse. Protection of the original nature of the Gobi desert is of global significance and the decision of the Government of the Mongolian People's Republic to establish the Great Gobi National Park was acclaimed all over the world.

In 1978—1984 the United Nations Environment Programme (UNEP) collaborated with the Government of the Mongolian People's Republic and the USSR in the large-scale project "Assistance to the Mongolian People's Republic in the establishment of the Great Gobi National Park in Mongolia". Within this project, broad scientific investigations were carried out on the territory of the Great Gobi National Park. These studies yielded a large amount of information on the status of animals and plants and their habitats and also on the impact of anthropogenic factors on desert ecosystems. In the Master Plan of the Great Gobi National Park, the results of field investigations on the status of natural resources in the Gobi are summarized and recommendations are given for the protection of rare animals and plants as well as of the unique desert ecosystems, which can serve as models for nature conservation in Central-Asian Deserts. These investigations were supported by a large group of Soviet specialists (bo-

tanists, zoologists, soil scientists, hydrologists and geographers) who took part in the project; their enthusiasm and high professional qualities ensured a high scientific input into all the activities, which were sometimes undertaken under arduous climatic conditions. The authorities of the Mongolian People's Republic provided the necessary finances, together with UNEP, and ensured the participation of Mongolian specialists.

The book by L. Znirnov and V. Ilyinsky — "The Great Gobi National Park — A Refuge for Rare Animals of the Central Asian Deserts — brings to readers' attention the scientifically-based information on the activities undertaken under the UNEP-supported project in Mongolia and represents a great contribution to the promotion of nature conservation efforts in this unique region of the world.

We hope that the establishment of the Great Gobi National Park — one of the largest in the world — will serve as a stimulus for other countries in Asia and other regions of the world to extend their protected areas and in particular, to protect nature and increase our knowledge of arid zones.



Mostafa Kamal Tolba
Executive Director
United Nations Environment Programme

INTRODUCTION

The world strategy of nature conservation adopted by a number of countries in 1980 is intended to encourage an expanding network of nature reserves, national parks and other conservation areas in all natural zones of the world, and particularly in those regions where the ecological situation is threatened.

In the second half of the twentieth century large-scale human development of arid regions began, resulting in a reduction in the genetic diversity of plant and animal desert communities and in some cases in the fundamental transformation of desert ecosystems, leading to the total disappearance of their natural features. Under these circumstances preservation of the virgin desert environment becomes an urgent matter. Because of the extreme conditions of the desert, life exists on the very edge of extinction lending great scientific and practical significance to the preservation of this unique environment. Thus, expansion of the network of protected areas within the desert zone is wholly consistent with the aims and objectives of the world strategy of nature conservation developed under the auspices of UNEP.

The general trend toward the transformation of natural ecosystems and the degradation of wild animal populations has recently begun also to appear in the virgin deserts of Central Asia and in their unique plant and animal communities. In this situation the Government of the Mongolian People's Republic demonstrated its awareness of the importance of preserving the Gobi Desert in its natural state. In December 1976 a decision was taken to designate an area of 5,300,000 hectares in the desert region of the Mongolian People's Republic as the Great Gobi Reserve. * By this action the government formally determined to preserve the unique features of the Central Asian deserts for present and future generations. As a part of the Central Asian desert region the Mongolian Gobi is of world-wide significance because it holds natural populations of the wild camel, wild ass, Persian gazelle, a relict form of the Mazalai bear, and many other animals listed in the Red Book of the International Union for the Conservation of Nature and Natural Resources. This part of the Gobi Desert may also serve as a test area within the global environmental monitoring system to study the state of the biosphere in the Asian desert belt. In this connection the Mongolian Government's decision to set up the Great Gobi Reserve was welcomed all over the world and met with the approval of international nature conservation agencies.

In view of the great importance of the Mongolian Gobi and of its desert and semi-desert ecosystems, which are still unaffected by human activities and have retained unique Central Asian plant and animal species, the United Nations Environmental Programme, in conjunction with the Mongolian Government and the USSR Commission for UNEP, carried out a project to help the Mongolian People's Republic establish the Great Gobi Natural Reserve.

The project was undertaken within the framework of a project document (or agreement) signed by the UNEP Secretariat and the Mongolian Government. This document envisaged overall working expenses equivalent to US$3,950,000, of which $1,650,000 was to be met by UNEP and $2,300,000 by the Government of the Mongolian People's Republic.

The funds provided by UNEP were to be used as follows:

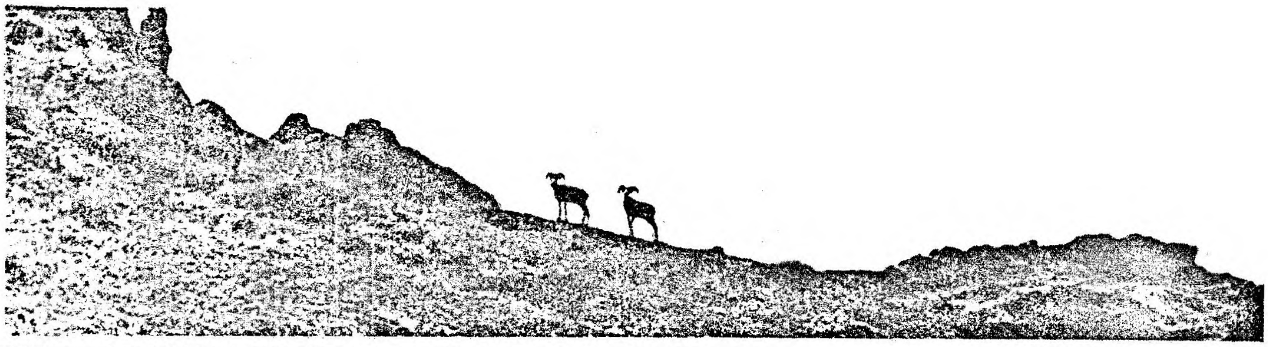
— to carry out a detailed survey of the project area of about 7,000,000 ha (the area of the Great Gobi Reserve and its buffer zone), conducting ecological, hydrological, zoological, geobotanical and veterinary investigations;

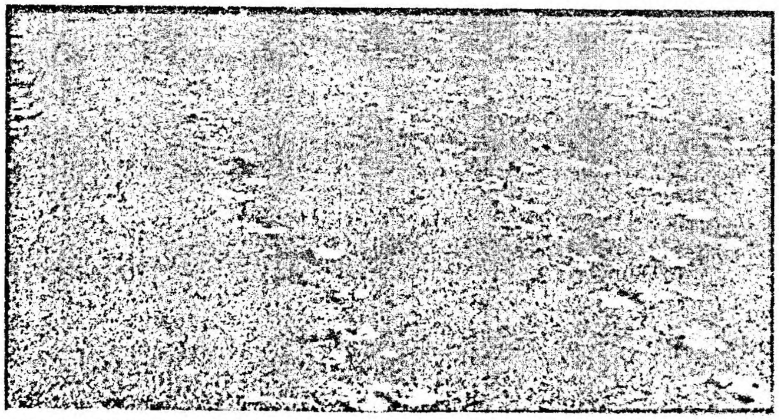
— to develop, on the basis of these data, a scientifically based master plan for the Great Gobi Reserve;

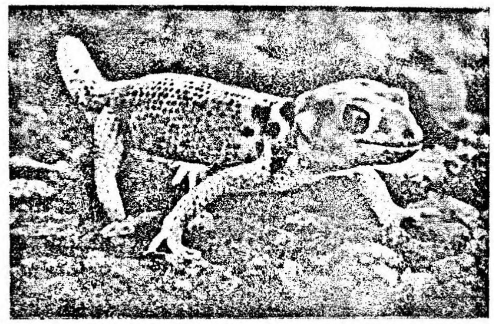
— to train Mongolian personnel by temporary assignments in Soviet nature reserves and by individual work of project experts with their counterparts.

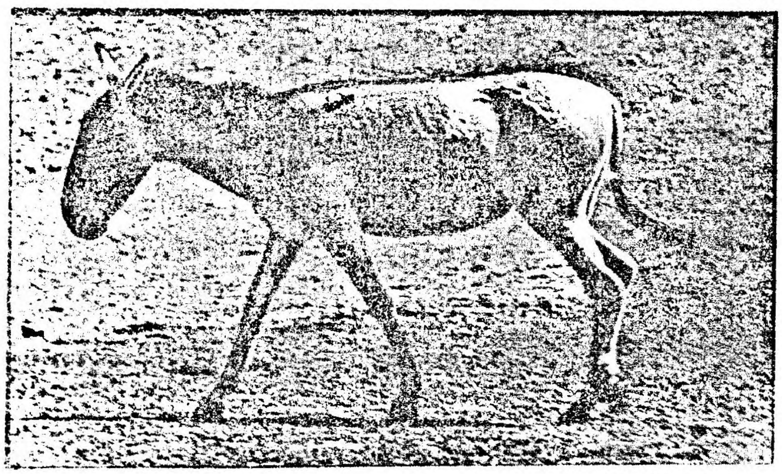
These objectives were put into practice through a subcontract between the foreign trade bodies of the Mongolian People's Republic and the USSR (Compleximport and Selkhozpromexport), which constituted an integral part of the project document. Its total value was the equivalent of $US1,200,000 and was paid by UNEP from the Soviet contribution.

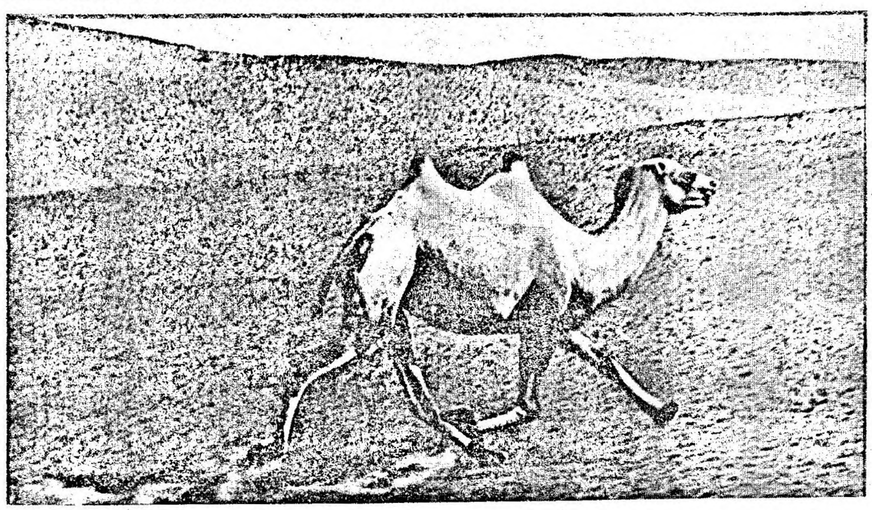
* The official Statute of the Great Gobi Reserve has adopted this designation as corresponding to the English term "the Great Gobi National Park". In all the Project documents in Russian the territory in question is referred to as "the Great Gobi Reserve". We believe this definition is more adequate with respect to the functional significance of the protected area as a strict nature reserve. That is why denomination "the Great Gobi Reserve" (GGR) is made use of throughout the following text.











The subcontract covered the following activities:

— a mission of 12 Soviet experts representing various fields of knowledge to conduct all aspects of the area survey and to develop a master plan for the Great Gobi Reserve;

— delivery of the equipment and means of transport necessary to implement the project (340 items with a total value of 306,000 roubles);

— lease of an aircraft for use during the field work;

— assignment of ten Mongolian specialists to Soviet nature reserves.

Under the terms of the subcontract, working materials, work places and technical staff were provided by the Mongolian side.

It is thus evident that the UNEP contribution to the project to help the Mongolian People's Republic establish the Great Gobi Reserve can be regarded as technical assistance to a developing country that has been funded through the USSR rouble contribution to that international organization.

Implementation of the project in the Mongolian People's Republic began in December 1979 when an administrative office was created in Ulan Bator and a variety of preparatory activities were undertaken. These latter activities continued until June 1980 and included:

— selecting, with the approval of the government, an administrative and research center for the Great Gobi Reserve (Tsogt-Somon in the Gobi-Altai Aimak);

— developing methods and schedules to carry out the detailed survey and draw up a preliminary habitat classification and other initial documents;

— obtaining and reproducing cartographic materials;

— setting up a base camp (Bayan-Tooroi) and temporary field camps, and choosing landing grounds for the chartered AN-2 aircraft with the agreement of the local authorities;

— studying and summarizing literature and official printed materials pertaining to the project area;

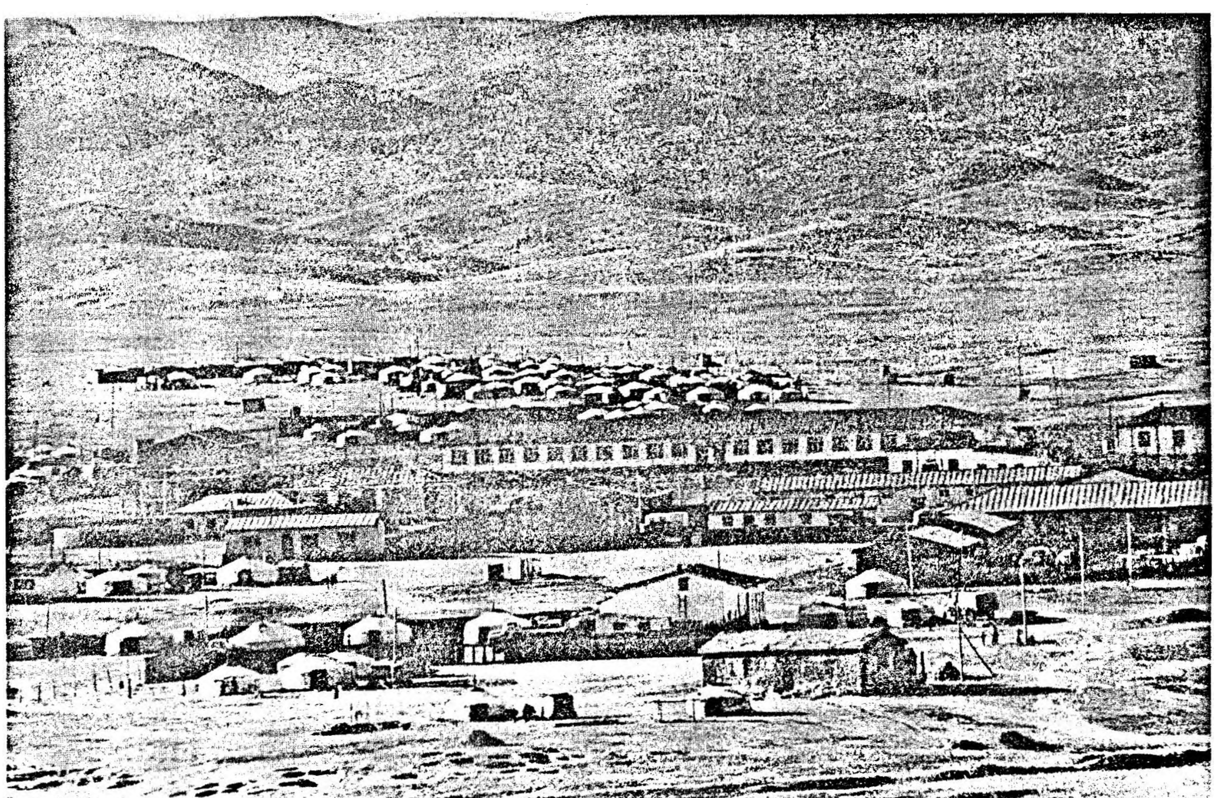
— obtaining and delivering to the project area the equipment needed for the field survey.

The vast region under investigation (over 70,000 sq. km., an area equal to Belgium and the Netherlands taken together), lack of knowledge of the project area, and the complicated state of the roads, the climate and other local conditions in the Gobi Desert account for the wide scope and rather long duration of the preparatory activities.

Field work (ecological, faunistic, geobotanical hydrological and veterinary surveys) in the project area of the Trans-Altai and Dzungarian Gobi was initiated in June 1980 and continued until October 1982. The data obtained formed the basis for the programs of protection and reestablishment of rare plants and animals and natural features, monitoring, professional training of personnel, organization of a ranger service, and implementation of other provisions of the master plan.

During the same period Mongolian specialists were assigned to the Soviet nature reserves where they performed various tasks associated with conservation.

The Mongolian Government's contribution was intended to cover design and development of essential construction in the project area, supply of working ma-



Tsogt-Somon settlement, site of the headquarters of the Great Gobi Reserve terials, participation of Mongolian research institutions and the financing of a number of other activities relating to the creation of the Great Gobi Reserve and the implementation of the subcontract. In addition, the Mongolian Government was responsible for setting up the administrative office of the Great Gobi Reserve, which numbered 25 persons in 1983.

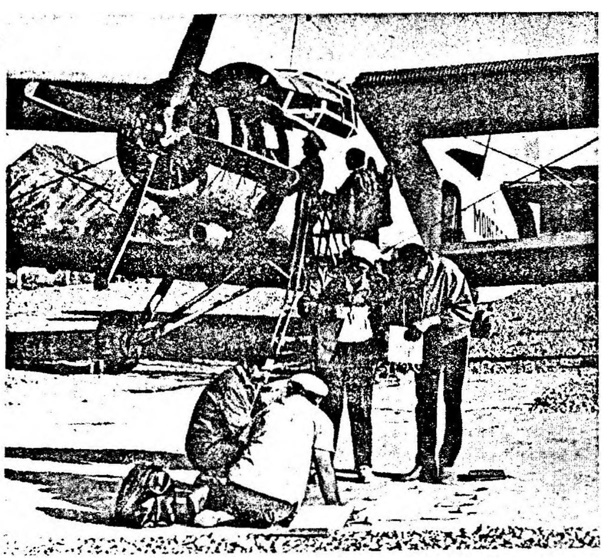
The basic product of the activities carried out in the UNEP project is the master plan for the Great Gobi Reserve based on the results of the detailed field studies and the analysis and assessment of published materials and government documents.

The bulk of data used in drawing up the master plan was obtained during the 1980—1982 field work carried out by a group of Soviet advisers in collaboration with their Mongolian counterparts. This is the first time that such a research program of this scope has been implemented in the project area.

Year-round ecological observations were made several times for all the habitat types in the reserve and its buffer zone. This produced quite reliable data for reaching project decisions on all aspects of the reserve's activities during both the current period and the forthcoming decade (1983—1992).

A basic cross-section of the field studies carried out in the project area is presented below. In early 1980 surveys of the area were made in order to define the reserve boundaries, to collect and collate cartographic materials, to map the main roads, settlements and other features, and to identify areas subject to the impact of human activities. The survey was carried out by motor transects about 3,000 km in length and by aerial reconnaisance. The materials collected made up a basic data set for development of the reserve's infrastructure, the conservation system and immediate measures to reduce the impact of human activities. The survey also determined the location of the administrative center of the Great Gobi Reserve, Tsogt-Somon in the Gobi-Altai Aimak.

The bulk of the exploratory work was done in the second half of 1980 and in 1981—1982. Ecological surveys and the collection of data on the physiographic



A group of UNEP Project experts discuss the next aerial transect

features of the project area were performed in the course of a comprehensive study of natural ecosystems that involved ecozoologists, ecobotanists, soil scientists, hydrologists, veterinary surgeons and specialists in monitoring and land management.

As a result, during a rather short period from 1980 through 1982 the whole area of the reserve and its buffer zone was surveyed several times. The total length of motor and aerial transects amounted to 14,000 and 11,000 km respectively. Follow-up analysis of the materials collected were used in preparing the sections of the master plan that describe the natural conditions of the reserve, viz. "Geographical Location", "Geological Structure", "Relief", "Soils", "Natural Regions". In the course of the botanical survey a herbarium of more than 600 pages was collected and all necessary geobotanical studies were carried out on study plots. The materials thus obtained served as the basis for the sections on "General Description of the Flora", "Plant Cover" and "Characteristics and Productivity of Pastures", as well as a checklist of the higher plants to be found in the Great Gobi Reserve.

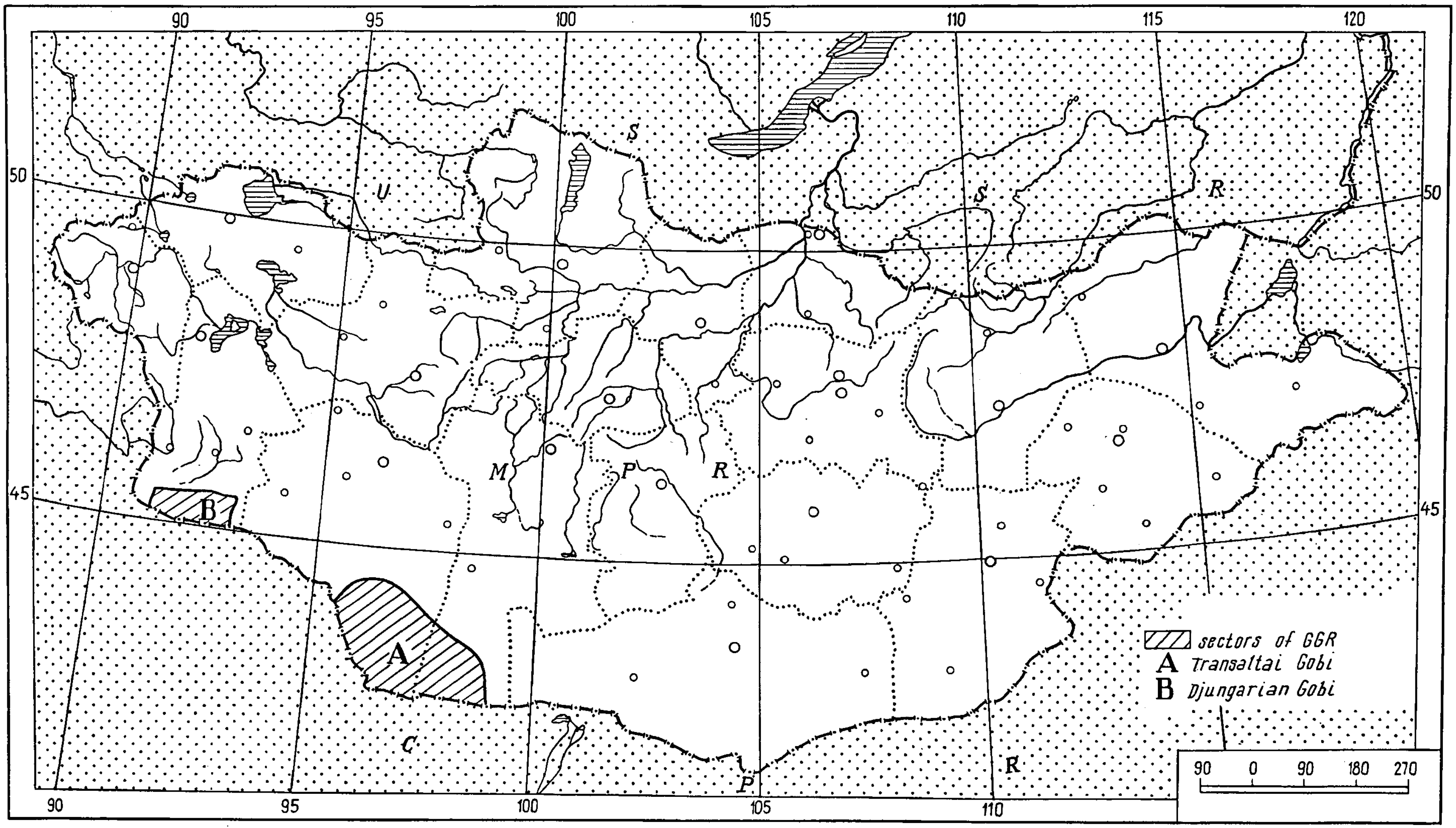
Hydrological observations were made on both motor and aerial transects to locate water sources and oases within the reserve. Sixteen natural water sources and oases were found in Sector A, as well as 16 artificial water sources. In. Sector B there were seven oases and 20 artifical water sources. These data were used to compile sections on "Hydrology and Hydrogeology" and "Measures to Manage Water Resources and Assure a Water Supply for Wild Animals".

A group of inspectors of the Great Gobi Reserve and the Gobi-Altai Aimak veterinary service under the guidance of a project expert was responsible for the veterinary survey. They surveyed places where wild and domestic animals were concentrated along five motor routes laid out for this purpose. These materials were the basis for the sections on "The Epizootic Situation and Diseases of Wild and Domestic Animals in the Reserve" and "Organization of the Veterinary Inspection Service of the Great Gobi Reserve".

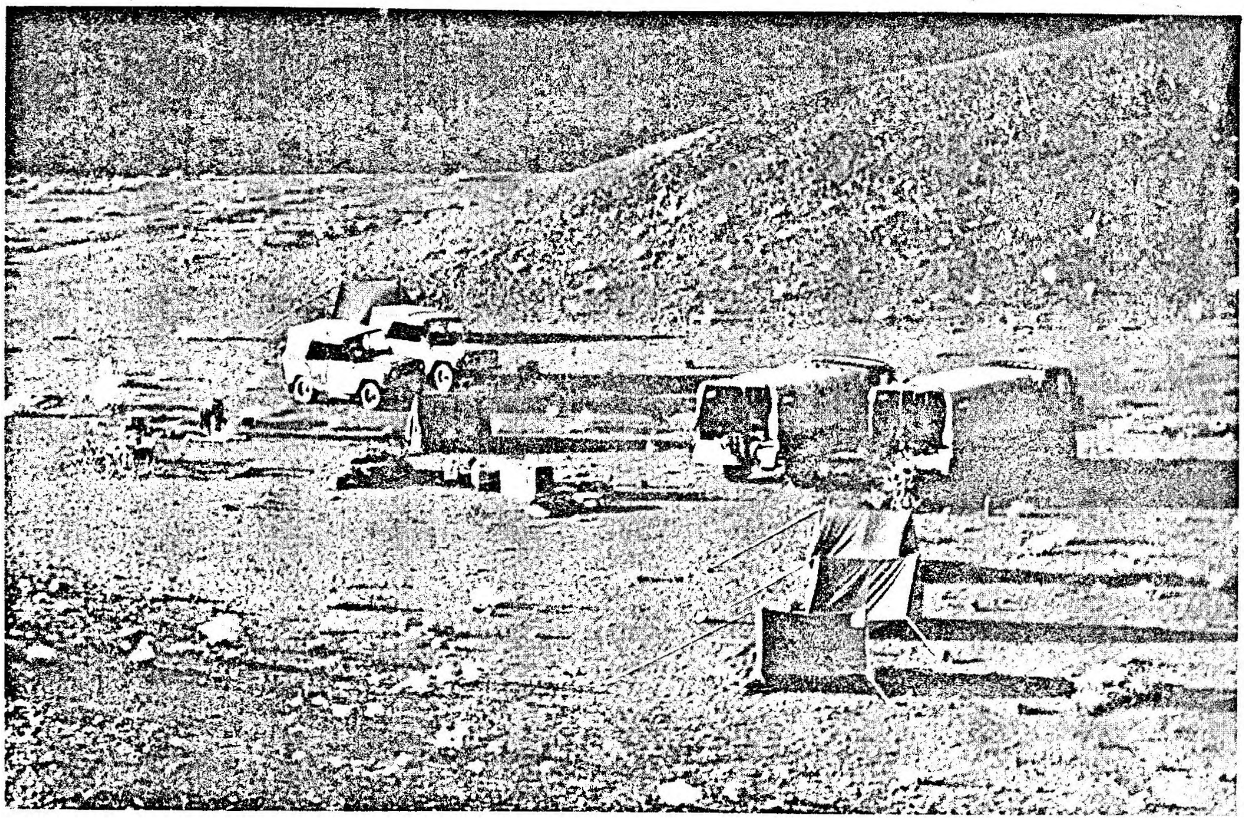
Ecological studies and censuses of rare and common animals were conducted in study plots and along aerial and motor transects of about 14,000 and 11,000 km respectively. These original results were the basis for the sections on "Wildlife of the Reserve", "Census Program and Methods" and "Recommendations for the Protection of Rare Animals", as well as those on land management.

The following Soviet specialists were involved in project studies and in the preparation of the master plan: K. Ye. Bugayev, L. V. Zhirnov and A. I. Sokov, zoologists; Ye. I. Rachkovskaya, botanist; Yu. G. Yevstifeyev, soil scientist; V. Ya. Zelenkov, land management specialist; V. F. Litvinov, veterinary surgeon; L. V. Sabirov, hydrologist; I. P. Aidarov and L. G. Solovjev, monitoring specialists; and V. A. Makarenko, radio engineer. The Mongolian participants included Ch. Timur, Kh. Badam, G. Bazar, O. Dorzharaa, U. Buyandelger, N. Tserengachoo and N. Khurelbator, game biologists.

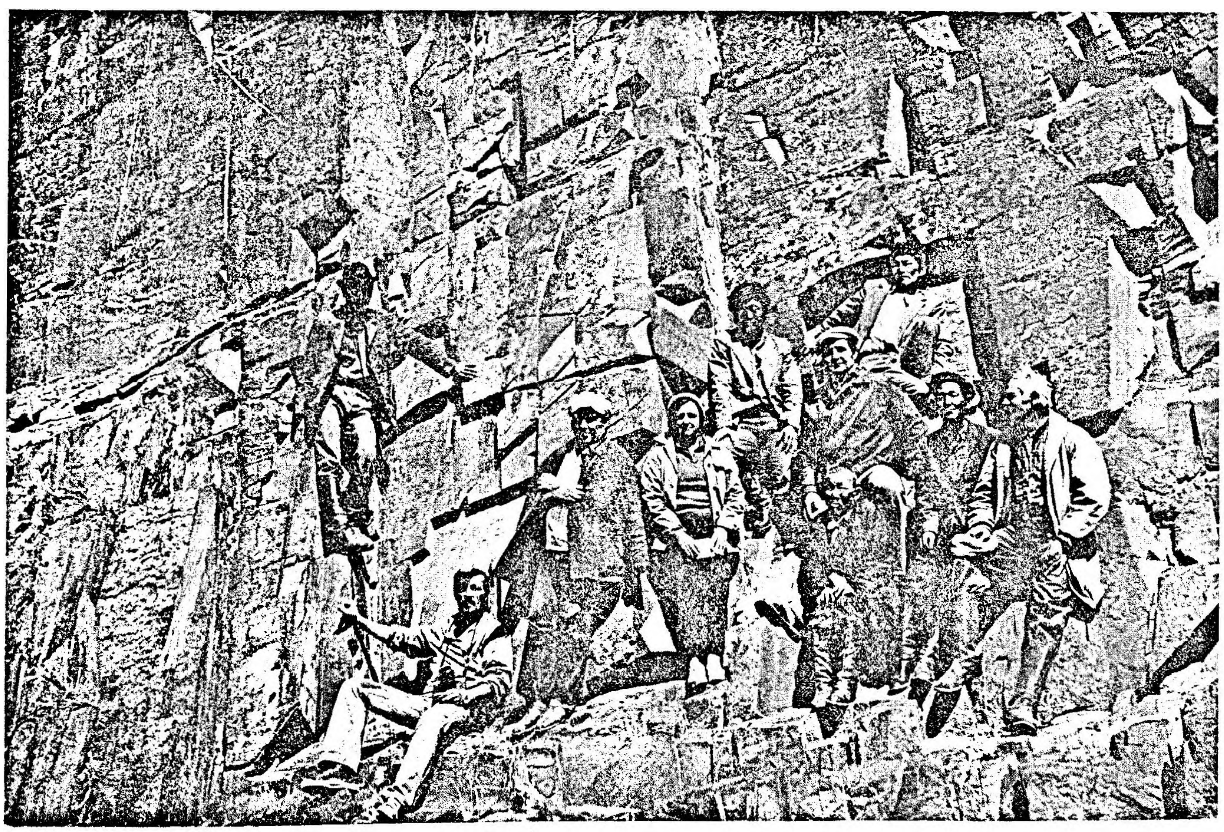
Overall direction of all project activities was provided by V. O. Ilyinsky, the UNEP Project Coordinator, and O. Tavuu, the Mongolian Deputy Minister of Forestry and Timber Industry, who served as National



A sketch-map of geographical location of the Great Gobi Reserve



Field camp of an expedition team. Atas-Ula Mountains, July 1981



Members of an expedition team in a gorge in the Atas-Ula (Album photograph)

Director of the Project. A. M. Borodin, Chief, Department of Nature Conservation, Nature Reserves, Forestry and Game-Keeping of the USSR Ministry of Agriculture, and V. V. Krynitsky, Head of the Nature Reserves Division, were entrusted with general scientific supervision of project activities.

In developing the master plan of the Great Gobi Reserve, official materials were used, including reports on the territory of the reserve by field teams of the Central Council of Mongolian Hunting Societies, the Mongolian Academy of Sciences, the Mongolian State University and other organizations. Of primary importance were the data obtained by the Soviet-Mongolian multi-disciplinary biological expedition led by V. Ye. Sokolov, member of the USSR Academy of Sciences, and O. Shakhdarsuren, corresponding member of the Mongolian Academy of Sciences.

The authors wish to thank all the officials and organizations that rendered assistance in their work and in the resolution of the project decisions. They are especially grateful to all the Soviet and Mongolian experts who were engaged in the project activities, and in particular to Ye. I. Rachkovskaya, botanist, Yu. G. Yevstifeyev, soil scientist, and K. Ye. Bugayev and Ch. Timur, zoologists, for their active and fruitful participation in the field surveys and the preparation of the master plan for the Great Gobi Reserve. The authors are also grateful to A. G. Bannikov and V. L. Rashek for their valuable remarks on the master plan and their advice on various questions relating to natural conservation in the Gobi Desert.

The preparation of the manuscript was distributed as follows. L. V. Zhirnov prepared Chapters 2, 3 and 4. V. O. Ilyinsky wrote Chapter 5. The rest of the text (Introduction, Chapter 1 and Conclusions) was composed jointly by both authors. They also made use of the materials obtained by all the project participants. Relevant references are cited in the text.

All black-and-white and color photographs were made by L. V. Zhirnov unless otherwise noted. Sketch-maps were prepared by K. Ye. Bugayev, L. V. Zhirnov and Ch. Timur

Chapter 1. ECOLOGY AND ENVIRONMENT OF THE GREAT GOBI RESERVE

The Great Gobi Reserve is situated within the Bayan-Khongor, Gobi-Altai and Kobdos Aimaks in the southwestern part of Mongolia. It is comprised of two distinct sectors which differ with respect to their natural conditions.

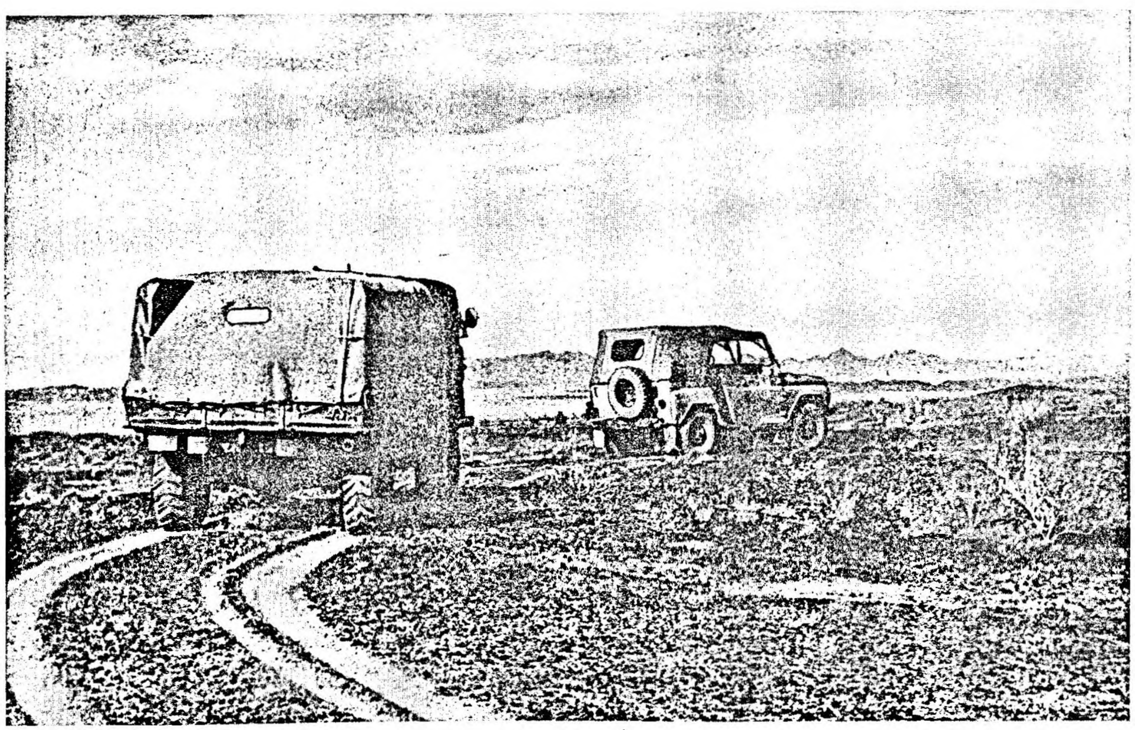
Sector A (Trans-Altai Gobi) occupies an area of 4,419,000 ha between 42°30′N, 95°30′E and 44°20′N, 99°10′E. It lies south-west of the Edrengiyn-Nuru Range and extends as far as the Mongolian-Chinese frontier.

Sector B (Dzungarian Gobi) occupies the very southwestern corner of the Mongolian People's Republic. It covers an area of 881,000 ha between 44°50′N, 92°00′E and 45°40′N, 94°20′E.

Thus, the Great Gobi Reserve occupies a vast area of 5,300,000 ha which embraces a wide range of zonal and altitude types of desert and includes a portion of the dry steppes typical of Central Asia. The protected territory is the northern outpost of the great Central Asian deserts which occupy the southern part of Mongolia and the northern part of China.

According to the most recent studies the desert area of the Asian continent is subdivided into four large physiographic provinces: Irano-Thuranian, Kazah-Dzungarian, Central-Asian (or Mongolian) and Tibetan (Petrov, 1966).

Geographically, the Great Gobi Reserve occupies two separate areas in two physiogeographic provinces: the Kazakh-Dzungarian and the Central Asian. Sector A (Trans-Altai Gobi) is part of the Gobi Desert, which in turn forms the northernmost edge of the Central Asian desert province. The territory of Sector A



Trans-Altai Gobi. The passage of a vehicle leaves surface tracks that last many years is dominated by a unique type of superarid desert with a distinctive flora and fauna typical of the arid zones of Central Asia. The greater part of Sector A reflects the ecology and diverse ecosystems of the Central Asian desert province. Life in the Trans-Altai Gobi, though certainly sparse, has many distinctive features typical of the flora and fauna of the region. In particular, the Trans-Altai Gobi is characterized by ancient endemic and relict flora and fauna as a result of the long period of its continental development under predominantly arid conditions (Murzayev, 1952; Petrov, 1966, et al.). These features account for the unique character of Sector A as a representative region of the biosphere. It should be noted that the value of the Trans-Altai Gobi as a nature reserve is related to the lack of human impact on the ecosystems as a result of the poor economic development of the area. The communities and ecosystems have retained their "virgin" state, thus providing a natural model of all the natural processes which worked together over a long period of time to produce the various components of the desert biogeocenoces. It is also worth mentioning that the Trans-Altai Gobi is relatively rich in such large animals as the wild ass and the Persian gazelle, which have not been adversely impacted by human activity. Their populations seem to exist under essentially natural ecological conditions and do not experience human influence. Finally, the Trans-Altai Gobi is the only region in the world where one still finds the wild ancestor of domestic camels, which is listed in the IUCN Red Book.

Sector B (the Dzungarian Gobi) is the easternmost outpost of the Kazakh-Dzungarian desert province. It also has many distinctive ecosystems formed under the influence of the deserts of Central Asia and Kazakhstan as well as those of Central Asia. It is this geographic location which accounts for the region's intermediate position in terms of the species composition of its flora and fauna and for the distinctive character of its ecological processes. In this respect, the Dzungarian Gobi is of interest as a desert area with "milder" climatic conditions which are reflected in the region's flora and fauna. Thus, Sector B represents a quite different desert type. As far as the state of animal life is concerned interesting big mammals can be seen here. Populations of wild asses and Persian gazelles are more numerous than in the Trans-Altai Gobi, notwithstanding extensive cattle-breeding and a higher level of economic development than in Sector A. Sector B used to be the last natural refuge of the Asiatic wild horse (or Przevalsky's horse), which is of great importance in view of the forthcoming reintroduction of this species into natural ecosystems.

The present chapter will describe comprehensively the physiographic patterns of both sectors of the Great Gobi Reserve with special reference to the suitability of different parts of the reserve for large protected mammals (ungulates and carnivores) and certain bird species typical of the Gobi Desert.

RELIEF AND PRINCIPAL MORPHOLOGICAL FEATURES

The territory of the Great Gobi Reserve, like the whole of the southwestern part of Mongolia, is an upland with a complicated orographic structure and peculiar relief patterns. The present-day relief was formed in the course of a long geological process. Its main stages are discussed below.

In the pre-Cambrian period the territory of southwestern Mongolia, as part of the vast South Mongolian plicate system developed under conditions of a continental climate and rather weak tectonic activity. During the next period, the Lower Paleozoic, tectonic activity embraced almost the whole of southwestern Mongolia, resulting in a number of ruptures and the formation of three facial zones: Barun-Khourai Dzungaria and Gobi Tien-Shan (Sinitsyn, 1956, et al.). The two latter zones experienced land submergence and sea formation. From the late Devonian until the Upper Paleozoic tectonic activity decreased and the region underwent slow uplifting as the area of the seas shrank, although most of the Trans-Altai Gobi remained a sea basin. By the end of the Paleozoic the tectonic activity had ceased and the sea basins had been reduced to shallow lagoons.

A significant part of the Paleozoic layer is composed of sea deposits as thick as 5,000—6,000 m, which points to the submergence of the territory during the period under consideration. This is indicative of the geocyncline stage of development, characteristic of the Paleozoic era as a whole.

The phase of continental development began in the Mesozoic. It was in this period that the current relief of Mongolia began forming.

Orogenic processes continued during the Jurassic. By the end of this period tectonic movements resulted in the appearance of folded relief. Hollows of Cretaceous origin were transformed into lakes. Jurassic and early Cretaceous deposits in the Trans-Altai and Dzungarian Gobi are represented chiefly by lake and lake-alluvial sediments.

At the end of the Mesozoic and beginning of the Cenozoic the tectonic activity decreased. This period is referred to as the platform stage of development. It is to the early Cenozoic era that the origin of the desert landscape of Mongolia can be traced. In the late Cretaceous there was a sharp change in the climate. Dryness increased during the post-glacial period when intermountain lowlands gave refuge to xerophytic plant forms. Although the degree of aridity was not constant, by the second half of the Cretaceous era a dry climate has become an intrinsic feature of Mongolia. This development was fostered by orographic processes that brought about an increase in the average hypsometric level of the area and caused reduction of atmospheric pressure and a further rise in aridity.

The current relief of southwestern Mongolia was formed as a result of alpine tectonic processes and subsequent denudation drastically transforming the mountain massifs and hummocky topography as well as the adjoining plains.

Among the complex and varied relief forms encountered in the project area, three geomorphological relief types are most widespread (Timofeyev, 1980, 1983).

Denudation plains constitute one of the characteristic orographic features of the Trans-Altai and Dzungarian Gobi. Their base is formed by young bending folds that replaced the former polygenic smooth surface. The most elevated central portion of these uplifts serves as the base of the mountain massifs, while

In the superarid deserts the surface of the ground is covered by a dark-violet coat from the desert heat

their major part forms inclined denudation plains, so-called "bels", of various elevations. They are composed of ancient bed-rocks of mainly Cretaceous, Paleogenic and neogenic origin and are covered with Quaternary proluvial sediments, frequently shallow. The inclined plains (bels) constitute the predominant relief-type in the Great Gobi Reserve as far as their total area is concerned, covering 40 and 55% of the area of Sectors A and B respectively. Here the denudation processes take place most intensively. Transient mud-flows change their surface enormously, notwithstanding the extremely low levels of precipitation. All the bels are broken up by a network of dry stream beds (sairs). Along with their intervening watersheds, these dry sairs are a characteristic feature of the meso-and micro-relief. The major part of the inclined plains is occupied by inter-sair watersheds, forming linear flat surfaces oriented along the slopes and covered with a coat of rubbly stone. These watersheds are most distinctly expressed in the superarid desert zone where they are usually devoid of any plant cover and seem black under the desert "tan", their coloration being in sharp contrast with that of the sandy and sandy-stony stream beds.

Land surfaces covered with a rubbly-stony coat are usually referred to in the literature on Central Asia as hammadas (Siniytsyn, 1956; Timofeyev, 1978). This term is also applied to all types of Central Asian stony deserts. In the desert conditions of Mongolia, these hammadas are of great importance in many physio-chemical processes which take place in the soils of the watersheds and the adjoining areas. The filtering capacity of hammadas with respect to atmospheric precipitation is very low, a characteristic which is enhanced both by their rubbly-stony coat and by the underlying water-resistent porous crust. As a result, a pronounced redistribution of atmospheric moisture occurs, resulting in surface wash-out or striated erosion of the watersheds, along with secondary wetting and erosion of the dry stream beds.

The process described is the most significant factor in the current denudation of sloping plains in Central Asia and plays an important part in the formation of micro- and meso- relief, soil and plant cover.

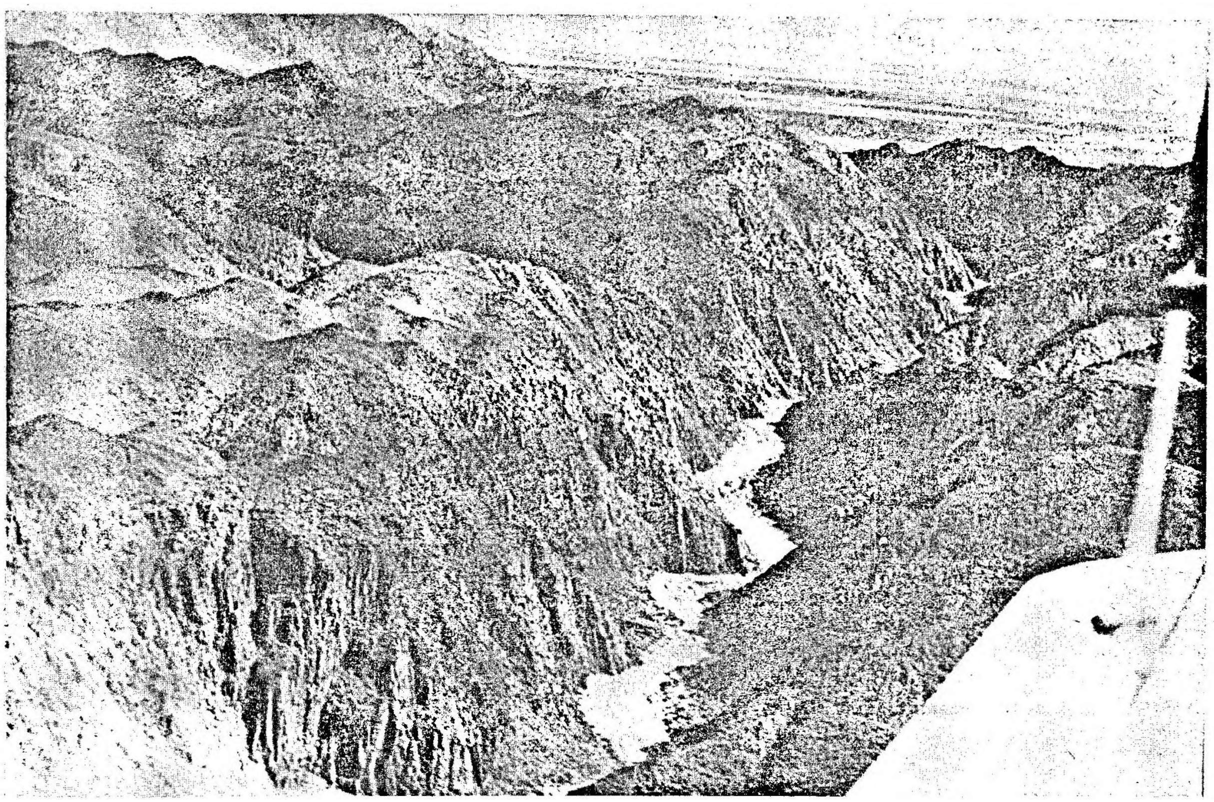
Dry stream beds (or sairs) constitute another significant geomorphological component of the sloping plains. They form a complex system and vary in width and depth, as they extend from mountain massifs or hummocky topography to fault depressions and enclosed hollows.

With respect to size and depth there are several types of these run-off channels. The largest of them, which are often extensions of mountain gorges, are very long and deeply incised into the loose surface of the sloping plains. As a rule the beds of such channels do not easily change their location. These sairs carry the flood waters which periodically wash down rubble that remains within the confines of the bel. The higher portions of the channels adjoining the mountains or hummocks appear to constitute a transit area where only the largest constituents of the debris are deposited.

Another type of dry channel (sair) forms a shallower, but more ramified network. Very often they are extensions of larger channels. They are meandering and frequently change directions. These channels serve not only to transfer and deposit the material carried in the flood waters, but also to wash away and redistribute the surface layer as a result of lateral migration of their beds and undermining of their banks. The smaller channels are the most variable, forming a densely ramified network within the sloping plains. Due to migration across the slopes they produce considerable transformations of the proluvial deposits. The nature of the distribution patterns and dynamics of the channels within the confines of the sloping denudation plains depends on many factors, the most important of these being the amount of rainfall and the slope of the land. Meandering sairs are not only typical of sloping plains but also of interhill plains, wide intermountain valleys, hollows and depressions. There are thus two basic surface types in the meso- and micro- relief structure of accumulative denudation plains: flat watersheds or rubbly stony hammadas, and the dry sair beds which dissect them.

Hummocky topography is another widespread relief type in the Trans-Altai and Dzungarian Gobi that frequently occupies vast areas. It covers as much as 39% of the territory of the Great Gobi Reserve and occurs among sloping plains of different elevations, foothill valleys and depressions.

Hummocks are predominantly the result of wearing down of the former mountain relief under the influence of denudation. Hummocky topography usually consists of alternate hills or groups of hills joined by common saddles, with open or closed plains and valleys lying between them. As a rule the hills have a common elevated base with sloping sides (bels) along their



Northern slopes of the Atas-Bogdo-Ula mountain massif. View from an airplane

periphery. The interhill space is occupied by flat or concave plains of different sizes and elevations. The rocky and rolling hummock topography is very broken up. It is characterized by very steep and sheer slopes, as well as peaked knolls, small interhill plains of various profiles, and narrow and sometimes V-shaped valleys. The more hilly terrains are characterized by smoother relief forms where knolls and groups of knolls alternate with quite large disjointed interhill flats, usually intersected by a thick network of dry channels.

Low-altitude plains adjacent to hollows support granite peneplains in the form of levelled surfaces with occasional isolated low hummocks and hills. Another characteristic relief form found in the Gobi consists of low denudation plains and hollows which coincide with submergence zones (or geosynclines). These plains are generally elongated in a sub-latitudinal direction and slightly sloping.

The lowest central portions of these plains terminate in depressions or enclosed hollows with bottoms supporting a network of undrained takyrs or saltmarshes in which flood waters accumulate.

The slightly sloping plains are dissected by a system of shallow run-off channels, usually with sandy beds. However, large transit channel systems can also be found here, extending for tens of kilometers.

The hollows, and sometimes the low-altitude plains harbor modern aeolian relief forms that arise from the accumulation of sand deposits around shrubs. These relief forms occupy small areas and have the aspect of sand hills. Aeolian sand deposits are also formed in ravines found among the hummocks adjoining the hollows.

Pedestal mountain ridges are characteristic relief forms found in the Gobi Altai and Tien-Shan systems. They can also occur in isolated depressions. Higher mountain ridges and crests comprise a system of narrow mountains separated by fractures running in various directions. This highly disjointed structure results in narrow intermountain valleys and gorges. The mountains have numerous configurations, from flat or inclined with sloping sides to craggy with sharp peaks and steep precipitous drops. They usually stretch in a sublatitudinal direction.

The intermountain valleys and gorges at the sites of old or fresh fractures have distinctive relief patterns. They form complicated interconnected systems along which rocky debris is carried down onto the bels. The intermountain valleys are most typical of the central, often high portions of the mountain massifs. They differ in extent and sometimes give rise to intermountain plains wherever smaller valleys run together.

A thick network of narrow gorges dissect the mountain massifs. They are particularly characteristic of the peripheral areas, where they often become canyons with a large number of taluses and rock slides. Their bottoms are flat sandy channels that pass beyond the mountains and become large deep sairs in the foothill plains.

Pedestal mountains in the bottoms of depressions within the Great Gobi Reserve occur in the form of low isolated massifs.

Table 1

HYPSOMETRIC LEVEL OF VARIOUS RELIEF FORMS AND THEIR AREAS IN THE TWO SECTORS OF THE GREAT GOBI RESERVE

Relief Forms	Sector A Mean altitude above sea level, m	Area, %	Sector B Mean altitude above sea level, m	Area, %
Low plains and hollows	700—1100	17	1100—1200	13
High and foothill plains	1100—1500	43	1200—2000	56
Low hummocky topography	1200—1400	22	1600—1800	7
High and foothill hummocky topography	1400—1800	13	1600—2000	19
Low and mid-altitude mountains	1800—2400	5	2000—2500	5

The forms of relief discussed above are to be found in both sectors of the reserve. However, the orographic patterns of the two sectors differ both in their specific macro- and meso-relief and in the relative occurrence of the main geomorphological structures. The peculiar features of their relief will be discussed in detail in the chapter on "Ecological Regions of the Reserve". Here we will simply refer to Table 1, which distinguishes the two sectors in terms of their relief forms and average elevation above sea level of various points within the sectors, as well as the ratio of areas occupied by different relief forms.

CLIMATE

The Gobi deserts are remote from seas and oceans and isolated from them by mountain ranges. Coupled with the high altitude and rugged character of the relief, these are the main geographic factors affecting the climate of this part of Mongolia.

The basic character of the climate is distinguished by its harsh continental character, the prevalence of sunny weather especially in cold seasons, low humidity, cold snowless winters, spring storms, low precipitation and a wide range of diurnal and annual air and soil temperatures.

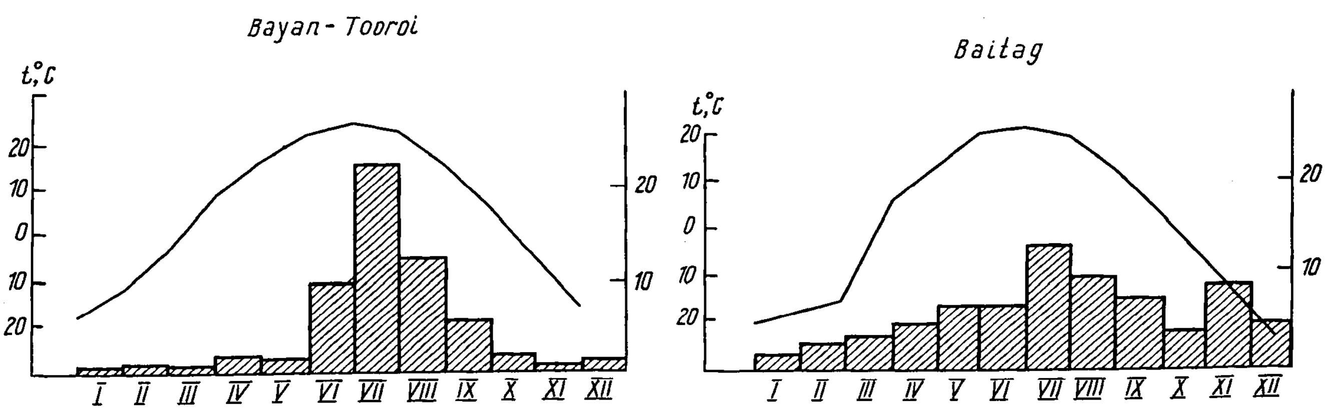
The strongly continental character of the climate is manifested in the extremely sharp fluctuations of its average indices, both in different years and at different observation points.

During a ten-year period from 1970 through 1979, observations were made at the weather stations of Bayan-Toroi and Ekhiyn-Gol (Sector A) and Baitag (Sector B). The data obtained from the two stations in Sector A refer to the climate of the superarid and southern true deserts of the Trans-Altai Gobi, while those from Sector B are indicative of the climatic features of the Dzungarian Gobi.

According to the observations at the Ekhiyn-Gol weather station, the air temperature varies from —34° to +40° C and the soil temperature from —33° to +70° C (Gunin and Dedknov, 1983). Thus, annual fluctuations can exceed 100° C, which attests to the harsh continental character of the climate in this part of Central Asia.

The annual range of average monthly air temperatures within the project area is 37—42° C. On the whole, the mean monthly temperatures in the true desert zones of Sector A are lower than those of the superarid zone, and in the Dzungarian Gobi they are significantly lower than in the Trans-Altai Gobi. Based on the results of the ten-year observation period the average monthly temperatures in Sectors A and B are shown in illustration. The annual temperature range is influenced by low winter temperatures, whereas summer temperatures are not particularly high.

Low temperatures during the winter are caused by the stable winter anticyclone. Maximal and minimal absolute temperatures in different months are shown in Table 2 (1979).



Annual dynamics of air temperature and precipitation as observed at weather stations of Bayan-Toroi (Sector A) and Baitag (Sector B) in 1970—1979

Table 2

ABSOLUTE MAXIMUM AND MINIMUM AIR TEMPERATURES BY MONTH (1979)

January		March		May		July		August		October		December	
max	min	max	min	max	min	max	min	max	min	max	min	max	min
Bayan-Tooroi (Dzakhoi) Weather Station													
3	—34	14	—18	33	—2	33	10	38	6	22	—10	2	—24
Ekhiyn-Gol Weather Station													
2	—31	18	—13	35	—3	36	12	42	7	25	—7	2	—19
Baitag Weather Station													
—2	—38	11	—22	31	—2	31	8	36	2	21	—10	2	—28

Table 3

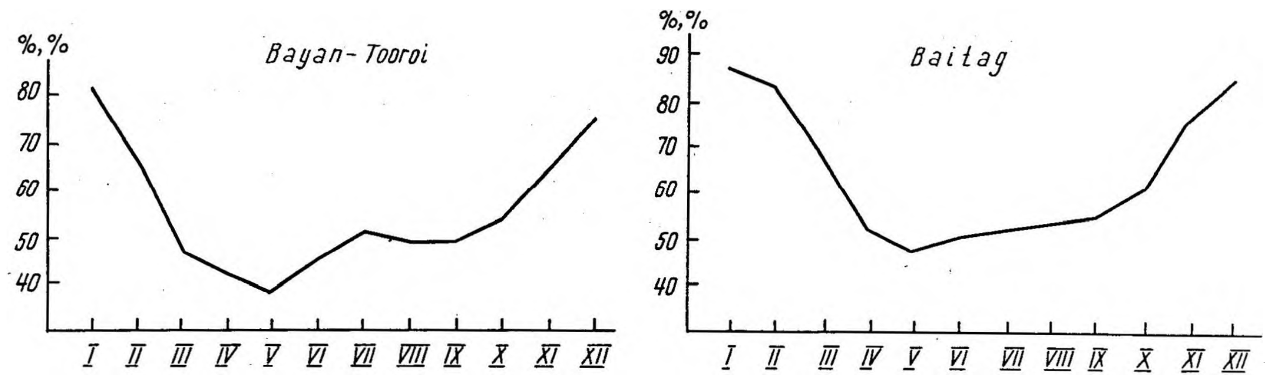
ABSOLUTE MAXIMUM AND MINIMUM SOIL TEMPERATURES BY MONTH (1979)

January		March		May		July		August		October		December	
max	min	max	min	max	min	max	min	max	min	max	min	max	min
Bayan-Tooroi (Dzakhoi) Weather Station													
6	—35	32	—23	61	—4	62	10	65	3	42	—12	11	—27
Ekhiyn-Gol Weather Station													
12	—30	34	—17	53	—4	56	12	61	5	36	—10	6	—11
Baitag Weather Station													
3	—41	27	—23	55	—7	59	5	60	2	35	—12	5	—30

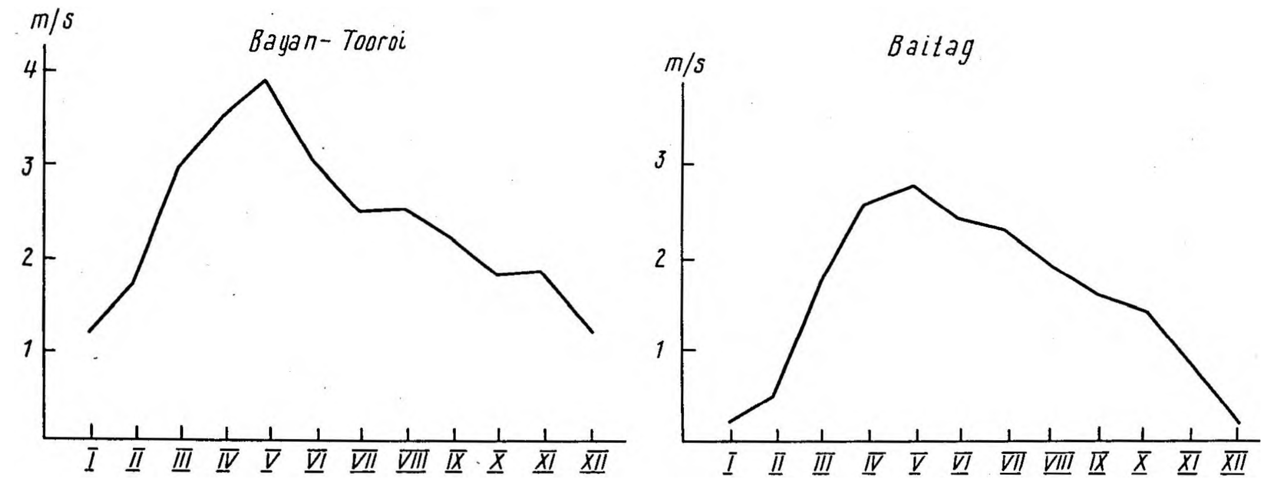
Table 4

DISTRIBUTION OF PRECIPITATION BY MONTH FOR 1970—1979

Year	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Bayan-Tooroi (Dzakhoi) Weather Station													
1970	0	0	0	1.5	0	0.9	14.0	12.3	0	0	0	0	28.7
1971	0	0	2.5	0.1	0	1.2	13.3	24.1	1.5	0	0	1.7	44.4
1972	1.9	1.0	0	0.3	0	24.0	12.7	1.1	4.1	0.3	2.0	0	47.4
1973	0	0.2	1.1	4.9	1.3	5.3	1.3	9.6	16.9	11.4	0	0	52.0
1974	0.4	2.5	0	1.5	0.5	11.5	57.2	57.2	4.7	1.0	0	1.7	138.2
1975	0	6.0	0	0.2	5.4	5.8	6.1	2.0	6.6	0.6	3.5	2.0	38.2
1976	0.5	0	0	4.9	0.7	7.6	11.3	10.9	0.3	0.5	0.6	1.0	38.3
1977	0.4	0	0	0.3	0.2	0.7	39.2	0.2	9.6	0	0	4.0	54.6
1978	0.6	0	0.1	0	4.6	16.1	15.3	1.5	9.3	0.5	0	0	48.0
1979	2.3	0	1.9	3.3	1.9	25.5	56.9	7.3	3.9	0.4	0	0	103.4
Mean annual	0.6	1.0	0.6	1.8	1.5	9.9	22.7	12.6	5.7	1.5	0.6	1.0	59.3
Baitag Weather Station													
1970	0.7	1.9	0	0.5	0.3	6.3	39.4	28.6	0.5	2.6	8.9	12.0	101.7
1971	2.2	4.2	11.7	3.6	6.7	6.8	23.4	0	2.2	0	0	14.9	75.7
1972	3.1	0.4	4.5	0	1.4	2.0	1.8	3.0	8.5	3.0	33.7	5.6	67.0
1973	0.1	1.9	2.3	4.1	3.1	3.2	9.9	8.8	13.8	1.2	0.6	0.1	49.1
1974	0.8	8.7	0	0.5	1.3	0	3.5	10.8	0.3	10.3	16.3	0.1	53.6
1975	0	2.9	0.3	8.8	1.1	5.6	0.6	5.4	0	0.3	9.5	0.9	38.1
1976	0	0.1	3.1	4.7	2.1	6.7	4.0	20.6	3.6	1.0	6.3	6.0	58.2
1977	2.1	1.2	3.4	11.1	24.8	0.8	4.8	4.3	25.7	6.7	0.6	0.7	86.1
1978	0	0.9	5.6	0	13.3	26.1	13.7	0.6	0	5.5	1.3	3.5	70.5
1979	4.4	0.8	0.8	12.0	7.8	2.0	26.7	14.7	16.1	3.8	10.0	0.8	99.9
Mean annual	1.3	2.3	3.2	4.5	6.2	6.2	12.8	9.7	7.1	3.4	8.7	4.6	70.0



Relative humidity in 1970—1979 at weather stations Bayan-Toroi and Baitag



Wind-speed values recorded by different weather stations

These temperature fluctuations have a negative effect on the growth of vegetation. The diurnal temperature range is also great, especially in springtime. For instance, during a single day in May 1928, the temperature in Ulan-Bator changed from 0.3 to 25.9° C (Mourzayev, 1952). This inevitably affects the length of the growing season. A similar effect is exerted on plants by sharp fluctuations in the soil surface temperature. The difference between its maximal and minimal values in some months can be as great as 60° C, according to observations made at the reserve's weather stations. It was 57—65° C in May. Maximal and minimal absolute soil surface temperatures are shown in Table 3.

The length of the frost-free period is about 130 days, although frosts may occur even in the June-August period. The frost-free period is somewhat shorter in the Dzungarian Gobi. Spring frosts overlap the initial month and a half of the total growing season and almost three weeks of the average growing season. Autumn frosts begin as early as a month before the end of the total growing season and $1^1/_2$ to 2 weeks before the end of the average growing season.

The Gobi Desert lies in the westernmost part of the East Asian monsoon zone. Therefore, some characteristics of a monsoon climate are found in this area. These include in particular, spring storms with winds reaching destructive force and summer precipitation maxima. The winters in this region have little or no snow. Only in the mountains is there permanent snow cover, (up to 10—15 cm deep). The bulk of summer precipitation falls as cloud bursts in July and August. Overall annual precipitation is low. Observations made in the Trans-Altai Gobi from 1970 to 1979 showed an average precipitation of 59.3 mm, with an annual range from 28.7 to 138.2 mm. In the Dzungarian Gobi the average was somewhat higher — 70.0 mm — with a range from 38.1 to 101.7 mm. During this period, the dryest years in the Trans-Altai Gobi were 1970 (28.7 mm), 1975 and 1976, and in the Dzungarian Gobi 1975 (38.1 mm). The average number of days with precipitation is 34 and 40 in the Trans-Altai and Dzungarian Gobi, respectively. The distribution of precipitation by month is shown in Table 4. The number of days with precipitation by month for 1979 is presented in Table 5. The snow cover is more stable in the Dzungarian Gobi. Thus, the average number of days with snow cover was 97 in the Dzungarian Gobi, as compared to only 24 days in the Trans-Altai Gobi. The number of days with snow cover in 1979 is shown in Table 6.

The overall low level of precipitation in the Gobi

Table 5

NUMBER OF DAYS WITH PRECIPITATION BY MONTH (1979)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Bayan-Tooroi (Dzakhoi) Weather Station												
3	1	1	2	1	8	8	4	3	1	1	—	33
Ekhiyn-Gol Weather Station												
5	—	3	3	3	9	12	6	4	—	1	—	46
Baitag Weather Station												
4	4	3	4	4	4	9	4	6	3	6	2	53

Table 6

NUMBER OF DAYS WITH SNOW COVER BY MONTH (1979)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Bayan-Tooroi (Dzakhoi) Weather Station												
19	—	2	—	—	—	—	—	—	—	—	—	21
Ekhiyn-Gol Weather Station												
10	—	1	—	—	—	—	—	—	—	—	—	11
Baitag Weather Station												
31	21	—	1	—	—	—	—	—	—	15	2	70

deserts is parallelled by its irregular spatial distribution, which results in a patchy plant cover. But on the whole, the level of summer precipitation determines the dominant plant type and the increment of annual phytomass (Gordeyeva, Anisimova, 1978; Sandzhid, Fedorova, 1983). During the rainy season (July through August) a number of meteorological factors acting together exert a favorable effect upon the development of the plant cover. An increase in low-altitude cloud cover inhibits the incidence of solar irradiation, which results in lower air temperatures and increased humidity next to the ground and in the soil surface itself, making moisture available for plants (Borisova, Gordeyeva, 1981).

The abundance of cloudless days throughout the year is a characteristic of the Mongolian climate. Thus, the average number of cloudy days in the Trans-Altai Gobi is 2 to 12 and in the Dzungarian Gobi 5 to 16. On the average, there are 355—360 sunny days during the year. In 1970, there was not one cloudy day in the Trans-Altai Gobi. In 1971 there were only four cloudy days and in 1973 only two.

The air in the Gobi is extremely dry, which makes it easy to endure both winter cold and summer heat. Seasonal changes of humidity have some characteristic features. The sharp increase in temperature and the low precipitation in spring make the air exceedingly dry. The relative humidity is especially low in the superarid zone. In the Dzungarian Gobi the relative humidity is a little higher than in the Trans-Altai Gobi. The humidity increases in the summer because of heavy precipitation and the significant evaporation caused by high air temperatures. Nevertheless, the air remains dry in the Gobi even in summertime. June is the dryest month, while the wettest is July, when the precipitation is greatest.

Table 7

NUMBER OF DAYS WITH DUST STORMS BY MONTH (1979)

I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Bayan-Tooroi (Dzakhoi) Weather Station												
2	5	12	14	16	10	6	5	5	6	5	3	89
Ekhiyn-Gol Weather Station												
5	6	9	10	9	4	2	6	5	6	8	1	71
Baitag Weather Station												
—	2	7	11	12	8	4	3	4	5	2	—	58

The dryness of the air increases once again in the fall, as the precipitation decreases. The extremely low winter temperatures bring about a sharp rise in humidity. Illustration shows the relative humidity values for 1970—1979.

The dominant winds throughout the Mongolian region are from the north, northwest and west. The highest wind velocities occur in the Gobi. E. M. Murzayev (1952) noted that high winds occur most frequently in spring. In the Gobi, the spring winds attain enormously destructive forces, blowing at speeds of 15—25 mps. Such strong winds are not usual in summer and winter. The diurnal wind distribution is characterized by a velocity maximum between noon and 1 p. m. The wind usually subsides at night. There are usually no winds in the morning. Average monthly wind velocities in the Trans-Altai and Dzungarian Gobi, as recorded at the weather stations at Bayan-Tooroi and Baitag, respectively, are shown in illustration. The total number of windy days per year and the maximum wind speeds are lower in the Dzungarian Gobi than in the Trans-Altai Gobi. Table 7 shows the number of days with dust storms in different districts of the Gobi, based on long-term observations.

Weather conditions in the Trans-Altai Gobi in different seasons are described below on the basis of the data collected by P. D. Gunin and V. P. Dedkov (1983).

The winter season is from November till early March. Low air and soil temperatures are characteristic of this period. The day-time temperature varies from —7° to —18° C. At night the frost usually intensifies, the air temperature falling to —17° to —24° C at night. Soil temperatures during the day range from —7° to —17° C and are as low as —33° C at night. Winter thaws are extremely rare. Winters are dry with little snow. A permanent snow cover does not form every year. Its thickness even in the "snowiest" winters does not exceed 10—20 cm. Winter precipitation makes up about 5—10% of the annual total.

Spring begins in March when the snow begins to thaw and daytime air temperatures are often above 0° C. But it is only in the second half of April that the snow finally disappears in hollows, on plateaux and on southern slopes of mid-altitude mountains. In May, daytime air and soil temperatures may reach 18—22° C and 29—31° C respectively, though frosts are not unusual at night. The spring weather is dry and windy. As in winter, westerly winds predominate, their average velocity being 2 to 5 mps.

Summer lasts from June to early or middle September. The total length of the warmest and wettest period is no more than 90—100 days. The average daytime summer temperature is 25—28° C (maximum 37—40° C), falling sharply to 10—14° C at night. The summer soil temperature is usually very hot, between 33 and 36° C, sometimes reaching 67—70° C.

More than 80% of the annual precipitation usually occurs in the period from the latter half of June till mid-August. The precipitation at this time is in the form of short cloudbursts distributed very locally over the area. For the whole period of our 1980—1982 field work, a soaking rain was recorded only once (July 20, 1981). It occurred on the northern flanks of Atas-Ula and wet the soil in the flat areas to a depth of 8—10 cm. It should be noted that significant yearly fluctuations of precipitation are characteristic of the Trans-Altai Gobi. According to observations from 1974 to 1981, the annual precipitation totalled from 6 to 94 mm in Ekhiyn-Gol which is situated in the superarid desert zone. Data recorded at the Bayan-Tooroi weather station in 1970—1979 ranged from 28.7 to 138.2 mm annually. Although, as we mentioned, precipitation usually occurs in the form of localized showers, it is nevertheless possible to reach a judgement on overall ecological conditions on the basis of annual precipitation totals. Within the period from 1970 through 1982 optimal precipitation was recorded in 1974 and 1979, while 1970, 1975, 1981 and 1982 were dry years in terms of both the total precipitation and its period of occurrence (August, September). Intermediate conditions were reported in 1971, 1972, 1973, 1976, 1977 and 1978 (Gunin, Dedkov, 1983).

Autumn, the transition period leading to winter, usually begins in mid-September and embraces the whole of October. The weather at this time is usually warm, clear and calm. During the day the temperature usually reaches 15—17° C but at night there are acute cold snaps and even isolated frosts down to —3° C. There is little precipitation in autumn, although soaking rains sometimes occur, in contrast to summertime. At the end of September strong winds sometimes occur, turning into dust storms. The winds are generally westerly and northwesterly and usually occur in the afternoon and in the evenings. It should be noted that long-term observations made at the Ekhiyn-Gol weather station and embracing the 170 km north-south line from the Shine-Dzhinat through the Ekhiyn-Gol Oasis to the Tsagan-Bogdo-Ula Mountains, i. e. the eastern part of Sector A and its buffer zone, have revealed significant differences in the micro- and meso- climates of various natural regions (steppe-deserts, true deserts, and superarid deserts) and of various ecosystem types with respect to their altitude and orographic structure. For example, the diurnal soil temperature range was highest in the superarid deserts and the lowest in the steppe-like deserts (42° C and 25° C respectively). The temperatures in the near-ground air layer also differed by 15—16° C in various ecosystems, which significantly affects all living organisms, including large land animals.

SOILS

Over 99% of the Great Gobi Reserve is desert. Seventy-four per cent of the area lies in the superarid desert zone with its extremely dry climate and characteristic regime of ecological processes. These factors have had a considerable effect on the distribution and structure of soils and on soil-formation processes.

Characteristic superarid and grey-brown desert soils are predominant within the area of the reserve. They occur in their respective natural zones, i. e. true and superarid deserts, as well as depressions. Grey-brown soils occur in foothills, plains and on the northern slopes of isolated low mountains (Sector A, the Tien-Shan Gobi). The foothills of the Mongolian Altai and the bordering mountains of Dzungaria (Sector B) as well as the mid-altitude mountains of the Tien-Shan Gobi (Sector A) are the realms of pale yellow-brown desert soils. It is only in the mountains that steppe soils can be found within the boundaries of the reserve. Intrazonal soils are distributed throughout the area, though they occupy only small areas.

The biological activity of the desert soils of Mongolia has a decidedly seasonal character owing to the negligible amount of atmospheric precipitation. The bulk of precipitation falls during the summer and does not penetrate deeply into the soil. Therefore, the role of the sparse plant cover in soil-formation is negligible, and in the superarid deserts has not effect at all. In desert soils humus is formed below the crustal and subcrustal layers, where the hydrological regime is most favorable to biological processes (Yevstifeyev, Pankova, Yakunin, 1983).

Desert soils are notable for the characteristic horizons that form in them, viz. a porous or spongy crust and a fine subcrust of lamellar, foliate or scaly structure. This process is related to the peculiarities of the hydrothermal regime, which is characterized by alternate periods of short-term humidification and desiccation. The turf horizon typical of steppe-type soil-formation is absent here.

The characteristic features of superarid desert soils, as described for the first time by V. A. Nosin (1961) in the foothill region of Kun-Lun, are low biogenic activity and characteristic migration-concentration patterns, water content and physical properties. They were considered to represent the zonal bioclimatic "norm" of superarid desert soil-formation and were designated as primitive superarid soils.

Desert soils of the Trans-Altai Gobi have been referred to as red-pale-yellow gypseous soils (Gerasymov, Lavrenko, 1952). Superarid soils, as a characteristic soil-type, are formed under the influence of a number of bioclimatic factors. The most important of these is low maxima in the summer, when the high temperatures cause evaporation 50—70 times in excess of precipitation. In some years there is no precipitation at all. Therefore, because of the absence of soil-wetting, the period of biological activity is very short. Moreover, since there is usually no vegetation on the watersheds, plant communities develop here principally in run-off channels, where optimal conditions for plant growth depend on the presence of water. Thus, vegetation cannot play a significant role in soil-formation in the region under consideration.

Superarid desert soils predominant in the reserve area, covering about 87% of the area of Sector A and 10% of the area of Sector B. However superarid deserts of the Central Asian type occupy only the northern part of the Trans-Altai Gobi whereas they are predominant in the territories of Bei-Shan, Kashgaria and eastern Dzungaria (Nogina et al., 1977; Rachkovskaya, 1977, Yevstifeyev, 1980).

The structure of the soil cover in superarid deserts is distinguished by two main components: flat watersheds (plateaux) or true hammadas usually devoid of vegetation and sairs or sair systems where, in addition to the sandy beds of the temporary water courses, primitive sair soils form under the influence of desert vegetation. The sair soils, in contrast to the superarid soils, do not have a crustal and subcrustal horizon. These soils are characterized by low humus content, weak carbonation, the absence of gypsum and low content of water-soluble salts.

Grey-brown desert soils constitute an independent zonal sub-type found in the sub-zone of southern true deserts. This soil sub-zone forms a broad belt of land in the southern part of Mongolia and in terms of area is the second most common in the reserve. Biological processes in these soils are constrained by low moisture content and the quite limited role of vegetation. Humus content is therefore negligible, vegetation is extremely sparse and the reactive cover generally does not exceed 5—10%. Similar to desert soils, these soils are characterized by a sandy or rubbly-sandy "shell" underlain with crustal and subcrustal horizons.

The grey-brown desert soils of the reserve are subdivided into several varieties with different physico-chemical properties. The common grey-brown (non-saline) soils are typical of the sloping plains (bels), the foothills of Sector A and the flat plains. These soils are widely distributed throughout the reserve.

Grey-brown soils of a loose sandy variety occur infrequently, being confined mainly to the area of Sector B. Here they form associations with knobby consolidated sands.

Shallow, poorly developed grey-brown soils of rubbly or stony structure are generally found on hillsides and are widely distributed throughout the reserve.

Grey-brown saline (gypseous) soilsform on sloping plains, and occupy large areas in Sectors A and B.

A number of mountain steppe sub-belts consist of chestnut soils. These soils occur in the mountains of Dzungaria on the boundary of Sector B. They are subdivided into mountain steppe-desert light chestnut soils, mountain dry-steppe chestnut soils and mountain arid-steppe dark-chestnut soils.

The first variety is found on the northern flanks of the Khavtag and Takhiyn-Shara-Nuru Ranges at altitudes of 2,000—2,250 m. The humus layer is of light chestnut coloration and 10—20 cm thick. The humus content is 1.5—2.5%.

The second variety occurs along the northern slopes of the same mountain ranges between 2,250 and 2,500 m above sea level. The chestnut-brown humus layer is 20—25 cm thick. The humus content is 2.5—3.5%.

Finally, the mountain dark-chestnut soils occur above 2,500 m. Their humus horizon is 20—30 cm thick and contains 3.0—4.5% humus in turf horizon A. Mountain black soils occur in some places at elevations above 2,700 m.

The intra-zonal soil type is represented in the reserve by takyr-like soils having a limited distribution within enclosed flat depressions. These soils have low humus content. They are often saline. These soils include heavy argillaceous varieties.

The overall area of takyrs is also small. They occupy flat undrained depressions and appear to be subject to high surface wetting in the period of summer showers. These soils are devoid of vegetation. Their surface is polygonal.

Solonchaks develop in enclosed undrained hollows. They occur either near oases or along ancient dry valleys. Solonchaks occupy small scattered areas within the reserve. Knobby sands also occupy small areas in the reserve. They are mostly of recent origin, developing in the course of alluvial sand accumulation in scrub forest areas.

Hydromorphic soils occur in oases or ancient river deltas in Sector B. They are mainly of desert-meadow and meadow types, less frequently of meadow-swamp types. The desert-meadow soils develop in connection with surface wetting or as a result of the presence of ground waters. Meadow soils are formed in the vicinity of springs and are often saline. The meadow-swamp variety contains a large amount of humus and is formed near springs (Yevstifeyev, Pankova, Yakunin, 1983).

SURFACE AND GROUND WATERS

The problem of water supply under arid conditions is of paramount importance with respect to animal ecology. Thus, it is essential to define the water resources of the Great Gobi Reserve.

The Mongolian People's Republic occupies the part of the Asian continent which serves as the watershed from which rivers flow both into the Arctic Ocean and into the Pacific Ocean, as well as into the undrained basins of Central Asia.

The whole Great Gobi Reserve lies in the basin of the undrained hollows of Central Asia. Poor precipitation and the peculiarities of the surface structure lead to the paucity of surface waters in the Gobi Desert. Permanent waterways are almost totally absent here. It is only after summer rainfalls in July and August that temporary channels are formed along the usually dry gravel and sand beds of the sairs which cut through the mountain massifs or the sloping plains which surround the pedestal mountains and hills.

The formation of such surface waterways in the rainy season is quite a common occurrence in the deserts of Trans-Altai Gobi, but it is observed only rarely. We succeeded only once in observing the formation of these flood waters. On August 18 1980 two motor-vehicles carrying members of a surveying team arrived at the Takhilt-Us spring from the east. It was about 5 p. m. and the southwest portion of the sky was overcast with several thunderclouds hanging over Shevetin-Ula Mountain. It was clearly visible that quite heavy showers were falling there. We pitched camp on the edge of the hilly terrain surrounding the Takhilt-Us depression. About 5.30 p. m. the lowest part of the depression began filling with water before our eyes. Some five or ten minutes later a stream around 8—9 m wide and 40—50 cm deep rushed into the main sair that cut across the depression. Its speed was 1.0—1.5 m/s and the volume was measured at about 3.6 m^3/s. This rate of flow remained constant for about 4 or 5 hours. Later on, the flow of the flood waters began gradually to diminish and ceased completely by 6.30 a. m. the next day. Only small pools of water remained in the channel and these also completely disappeared by 9—11 a. m. by filtration of the water through loose sand and gravel sediments which form the bed of the Takhlit-Us sair. All the flood water brought by the shower was redistributed and accumulated in the depression to the northeast of Takhilt-Us, where it formed a temporary shallow pool on the takyr.

The transient surface run-off following heavy rains which we observed is a characteristic phenomenon is Central Asia. Such surface waters are characterized by the ephemeral nature of the streams, their strictly seasonal occurrence (July-August), and their highly local manifestation which is related to the irregular distribution of precipitation in the region.

This accounts for the secondary role of the transient surface run-off as a source of water supply for desert animals since short-lived shallow basins rapidly disappear because of high evaporation. However, sites in a number of areas have been observed to retain such transitory water sources for as long as 3—8 days and to be available during this time as water holes for wild animals. It should be noted that in granite hills and mountains water can accumulate in transitory ponds in characteristic stone bowls, remaining there for several weeks because of the lack of filtration. For example, there are quite deep granite water bowls in the vicinity of Khatan-Khairkhan Mountains which form distinctive zoocenoses which include crustacea (cyclops, amphipods, etc.). Wild ungulates and some carnivores (wolves, foxes) dig out characteristic small pits in the beds of sairs which accumulate the water from the sub-surface flow following cessation of surface run-off after floods. We have found such animal-made water sources on the southern slopes of the Edergiyn-Nuru and on other mountains and hills. These pits are mostly made by wild asses but they also serve as water holes for Persian gazelles, wolves and foxes. Surface discharge of underground waters constitutes the main source of water for big animals in the deserts of the Trans-Altai and Dzungarian Gobi. There are three types of subterranean waters within the Gobi Desert and within the reserve itself: ground, artesian and interstitial waters (Yevstifeyev, Pankova, Gunin, 1983). They are formed through the percolation of moisture derived from atmospheric precipitation and its accumulation above horizons impermeable to water.

Ground waters from shallow shaft wells are used primarily by man and cattle. But this mode of water supply is not available to wild animals. Hence, the only permanent water source for wild animals is natural springs which are formed by surface outcrops of artesian or interstitial water. Such outcrops of subterranean water are usually found in the fracture zones, where they form permanent natural water sources (springs) of various discharge rates. These springs are fed in the vicinity of upthrusts by metamorphic and magmatic rocks in the fracture zones. It should be emphasized that data available with respect to hydrologic conditions in the Great Gobi Reserve make possible only an approximate evaluation of the state of subterranean water resources.

Subterranean waters are accumulated in Paleozoic and pre-Cretaceous intrusive deposits. These rocks are principally granitoids with low and variable water content. The waters from these rocks have good drinking qualities, low mineral content at concentrations of 0.04 to 1.0 g/l. Because these intrusive rocks are fractured, water-bearing horizons occur sporadically at depths from 3 to 80 m. Therefore, they can be exploited shaft or small-diameter tubular wells in lowlands and depressions or by boreholes at higher elevations. Natural outcrops of subterranean waters from effusive formations are represented by springs of various discharge rates.

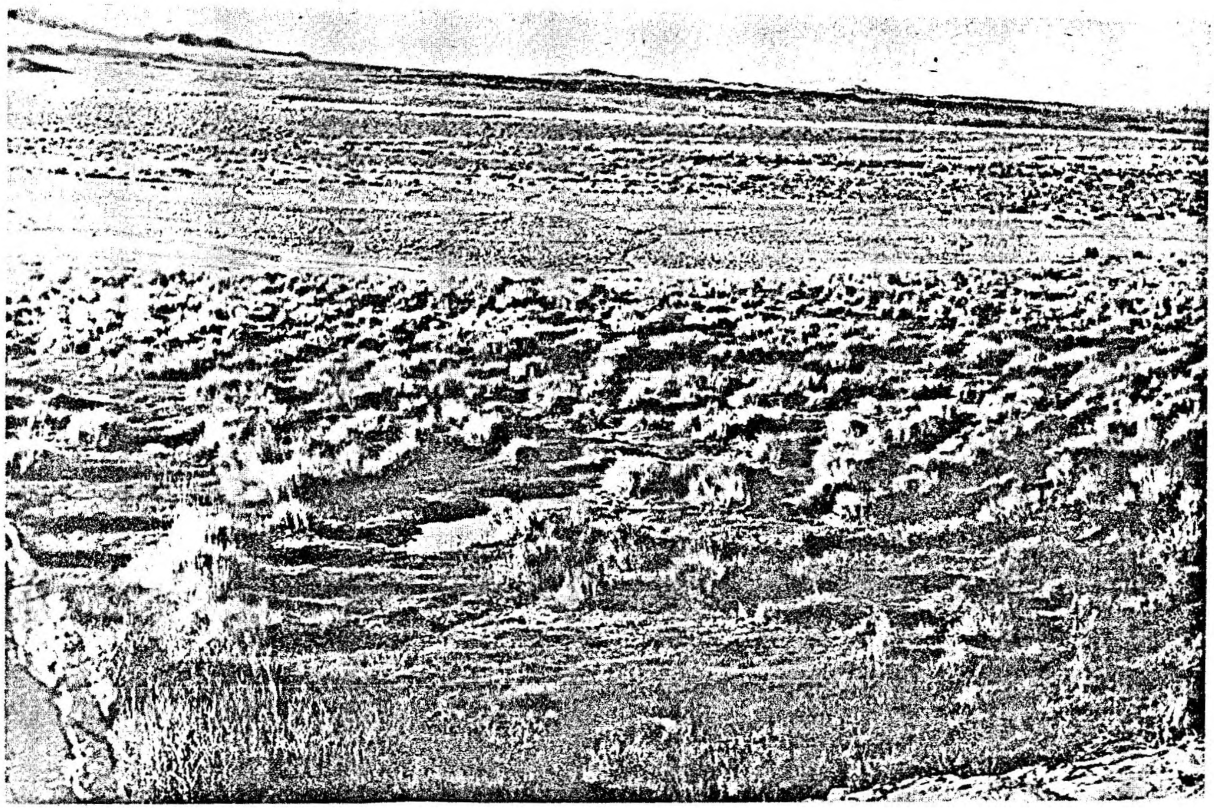
Underground waters are also formed within water-bearing horizons of quaternary sediments made up of sand, gravel and pebbles with constituent particles of different sizes which are situated in the beds of transitory run-off channels among hummocks and mountain massifs.

The water-bearing horizon of lake and lake-alluvial sediments is most widely found in ancient lake beds as well as in the extensions of ancient river valleys. Such subterranean water deposits are most common in the Dzungarian Gobi (Sector B). The subterranean waters in these beds are often strong in mineral content and cannot always be used as a water supply.

Table 8

PRINCIPAL SPRINGS OF THE GREAT GOBI RESERVE

Spring	Discharge Rate l/sek	Spring type
Sector A		
Takhilt-Us	0.500	Ascending
Maikhan-Bulak	0.060	Descending
Otgon-Us	0.033	Descending
Ulan-Chulu	0.001	Ascending
Sairyn-Khushuni	0.056	Ascending
Barun-Sharga	0.009	Descending
Dzun-Sharga	dry	Descending
Shara-Khulsny-Bulak	8.600	Ascending
Tsagan-Burgas-Bulak	2.200	Ascending
Toroin-Bulak	0.167	Descending
Talyn	0.006	Ascending
Talyn-Meltes	0.139	Ascending
Engeriyn-Us	0.006	Descending
Bogts-Tsagan-Dersni-Bulak	0.100	Descending
Khavtagai-Bulak	0.006	Ascending
Dzamyn-Bilgekhu-Bulak	0.150	Descending
Khatan-Sudal	0.100	Descending
Shar-Ustyn	0.028	Descending
Sudzh	0.150	Ascending
Tsagan-Bulak	0.550	Ascending
Tooroin-Shand	0.125	Descending
Talyn-Bulak-Bilkhd	1.000	Descending
Khar	1.500	Descending
Sector B		
Dzeg	0.400	Ascending
Khar-Tolgoi	0.900	Ascending
Khurgiyn	0.330	Ascending
Dzhugent	0.400	Ascending
Dzeren	0.001	Descending
Dzag	0.400	Ascending
Nariyn	0.300	Ascending
Khonin-Us	0.600	Ascending
Tsargin	0.500	Ascending
Tavan-Obo	1.050	Ascending
Tolgoin-Us	0.030	Descending
Gun-Tamga	0.120	Ascending
Takhiyn-Us	0.500	Ascending



Trans-Altai Gobi. Takhilt-U spring, a watering point for wild animals

Aeolian sand deposits of various particle sizes also occur as water-bearing rocks in some areas, where they form low-capacity springs. Examples are the Barun and Dzun-Sharga-Gol springs, which are related to aeolian deposits.

A partial inventory of springs to be found in the Great Gobi Reserve was made in course of our hydrological surveys. Table 8 is a list of the principal springs with their discharge rates.

The total number of springs within the Great Gobi Reserve is quite limited and their distribution is highly irregular.

The water resources of Sector B (Dzungarian Gobi) are considerably greater than those of Sector A (Trans-Altai Gobi). All the natural regions in Sector B have good or satisfactory water supplies, with about one spring per 30,000—40,000 ha. The best water supply conditions are found in the northern, central and southern parts of the Dzungarian Gobi, which has the permanent water sources of Khonin-Us, Takhiyn-Us, and others that constitute the delta portion of the ancient Bidzh-Gol river system. The northern slopes of the Khavtag and Takhiyn-Shara-Nuru Mountains in the southern part of Sector B have a great number of springs used by wild ungulates and large carnivores. The good water supply in the Dzungarian Gobi is assured by more favorable precipitation patterns in terms of both the annual total precipitation and the seasonal distribution.

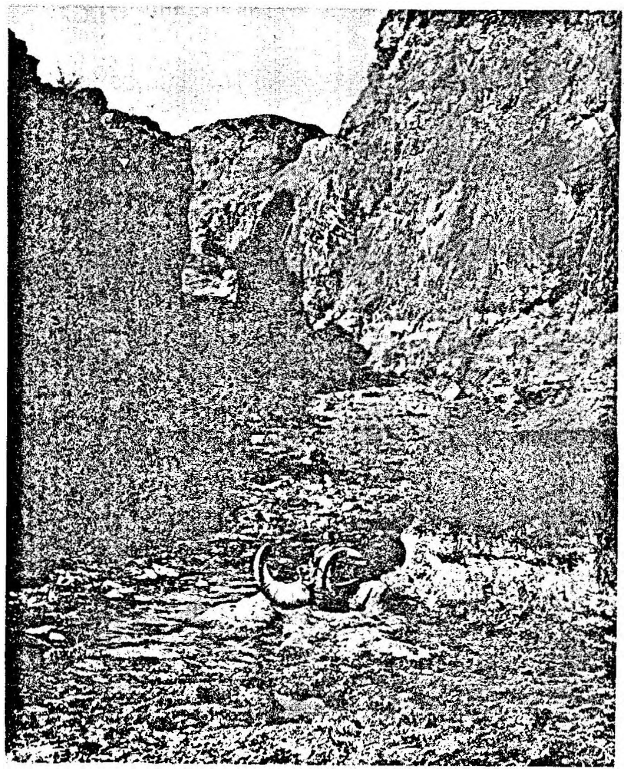
The distribution of springs in the Trans-Altai Gobi is extremely irregular. Their total number within the area of the reserve and the buffer zone is around 40.

The majority of the springs are found in mountain massifs and elevated hummocky topography (Edrengiyn-Nuru, Tsagan-Bogdo-Ula, Atas-Bogdo, etc). Covering about 14% of the reserve area these natural regions have approximately one spring per 40,000 ha (Yevstifeyev, Pankova, Gunin, 1983).

The largest high-output springs are concentrated in these natural regions (Takhilt-Us, Maikhan-Bulak, Otgon-Us, Shara-Khulsny-Bulak, Bogts-Tsagan-Dersny-Bulak, etc). They serve as the main watering places for many large mammals (wild camels, wild asses, etc.) and other desert animals.

However, the considerable part of the Trans-Altai Gobi dominated by sloping plains, hollows, and low hummocks has very few springs and even these are usually low in output. Their number in this portion of the reserve is about one per 150,000 ha as estimated by Yu. Yevstifeyev, which is indicative of the extremely poor water supply conditions in almost 86% of the protected area of Trans-Altai Gobi (Yevstifeyev, Pankova, Gunin, 1983). These ecological conditions significantly constrain the living space available for all large mammals since they can inhabit these parts of the desert only during the period of summer rains or in winter when the snow cover serves as a source of water for the animals.

Thus the well-being of the populations of the principal protected animals depends on the availability of permanent springs. Furthermore, for such animals as the Gobi bear, springs with their scrub forest vegetation constitute the main habitat under the extreme conditions of superarid deserts. Data on the seasonal distribution of populations of wild camels, wild asses, Persian gazelles and other large mammals of Trans-



Otgon-Us spring, watering point of animals in the northern part of the Trans-Altai Gobi

Altai Gobi confirm the great ecological significance of permanent springs. Detailed surveys carried out in 1980—1982 revealed a regular system of trails which link separate springs in some areas of the Trans-Altai Gobi and are used by wild animals, especially ungulates (wild camels, wild asses, Persian gazelles). The most developed trail system, which is many kilometers in length, is that connecting groups of springs in the main areas inhabited by wild camels.

It should be noted that in the regions where there are permanent water sources the most productive desert complexes (ecosystems) are formed in places where the plant communities are represented by riparian scrub forest and characteristic meadows formed from mesophitic grasses. These oases serve as concentration points for many large mammals and other desert animals that constitute multispecies zoocenoses. In other words, under the conditions of superarid deserts springs serve as the basic environmental component forming the most valuable desert ecosystems.

PLANTS

The existence of populations of wild ungulates and other animals is essentially dependent on the species composition, abundance, growing season and total level of phytomass accumulation of the dominant plant types, since the base component of any terrestrial ecosystem is the plant cover, which in the final analysis determines species diversity and the accumulation level of the zoomass of animals and heterotrophic organisms. In this connection the suitability of the reserve as a habitat for animals is determined by the potential food and shelter provided by different plant communities. Thus plant life proves to be one of the leading ecological factors.

The general characteristics of plant life in the Great Gobi Reserve are presented below, along with the classification, productivity and certain ecological characteristics of pasture lands. These data are compiled from the results of the botanical studies of Ye. I. Rachkovskaya under the auspices of the UNEP Project (1982, 1983) the data obtained by the joint Soviet-Mongolian biological expedition in 1975—1980 and from the papers of A. A. Yunatov (1950, 1954, 1975), J. A. Tsatsenkin and A. A. Yunatov (1951). It should be noted that the Gobi desert plant cover has been studied chiefly as pasturage for domestic cattle and virtually not considered at all with respect to the wild animals which occupy the Great Gobi Reserve.

MAIN PLANT TYPES OF THE RESERVE

The distribution of plant communities in the Great Gobi Reserve as in other desert areas of Central Asia depends on a variety of factors including climate, relief, soils, petrographic composition of rocks and the hydrometric characteristics of the environment. The effect of these factors and nature of their manifestation as regards plant life is discussed below.

As one changes latitude in the Gobi, from north to south, the climate gradually increases in aridity and a regular change in natural zones is observed (Berseneva, Rachkovskaya, 1978). Yu. G. Yevstifeyev and E. I. Rachkovskaya (1976) proposed that the Gobi Desert be divided into two zones: the desert zone and the superarid desert zone. Each of these zones is characterized by distinctive patterns of plant cover.

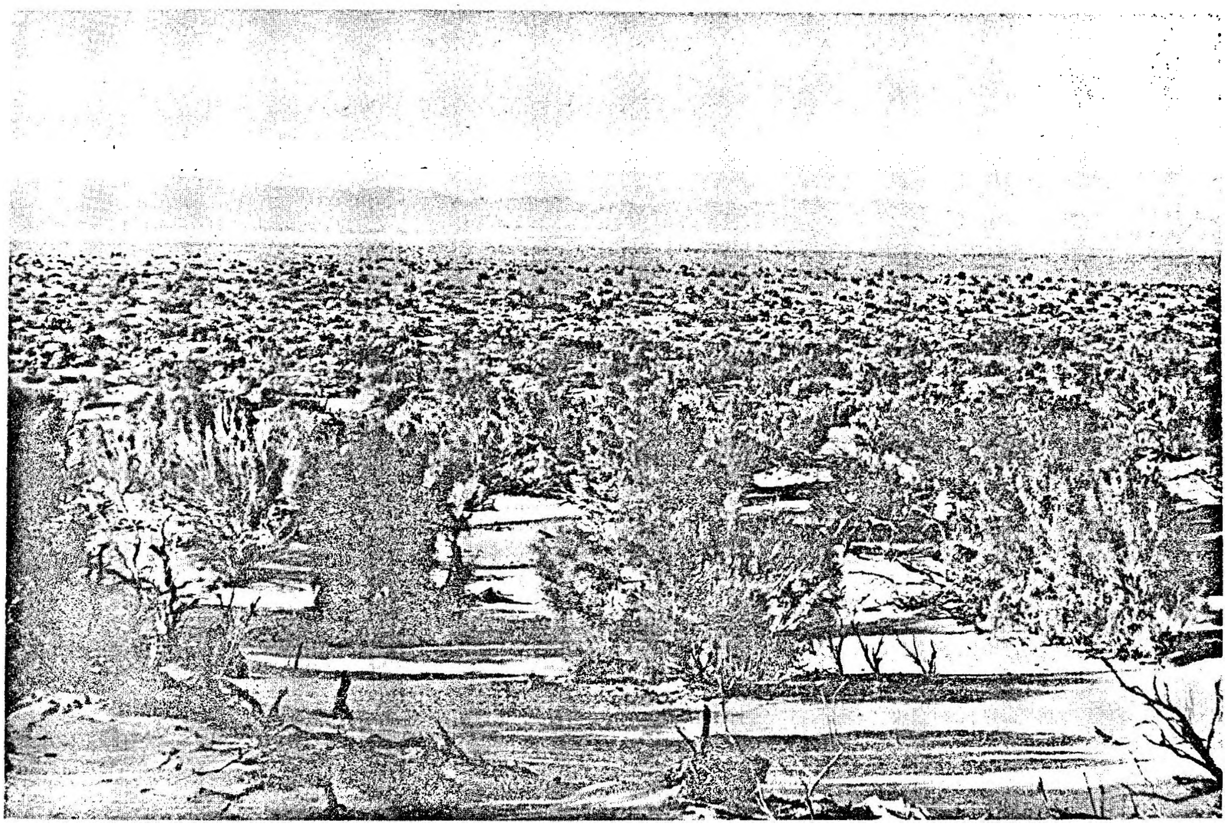
Turf-like feather-grass associations as well as shrubs and semi-shrubs dominate watersheds in the desert zone. The desert zone comprises three sub-zones according to the structure of the watershed communities, as it is physionomically expressed in the ratio of shrubs, semi-shrubs, and turf-forming plants. These are the northern desert (desert grass lands), intermediate desert (grassy deserts) and southern desert (true desert) sub-zones.

Vegetation of the northern desert sub-zone is distinguished by the predominance of fine-leaved turf-forming plants (grasses and onions) on all principal soil varieties (loam and sandy loam). These form cenoses of the characteristic Central Asian grass-lands with their unique structure and composition. This type of desert is endemic to Central Asia and is not found elsewhere within the arid regions of the Palaeartic.

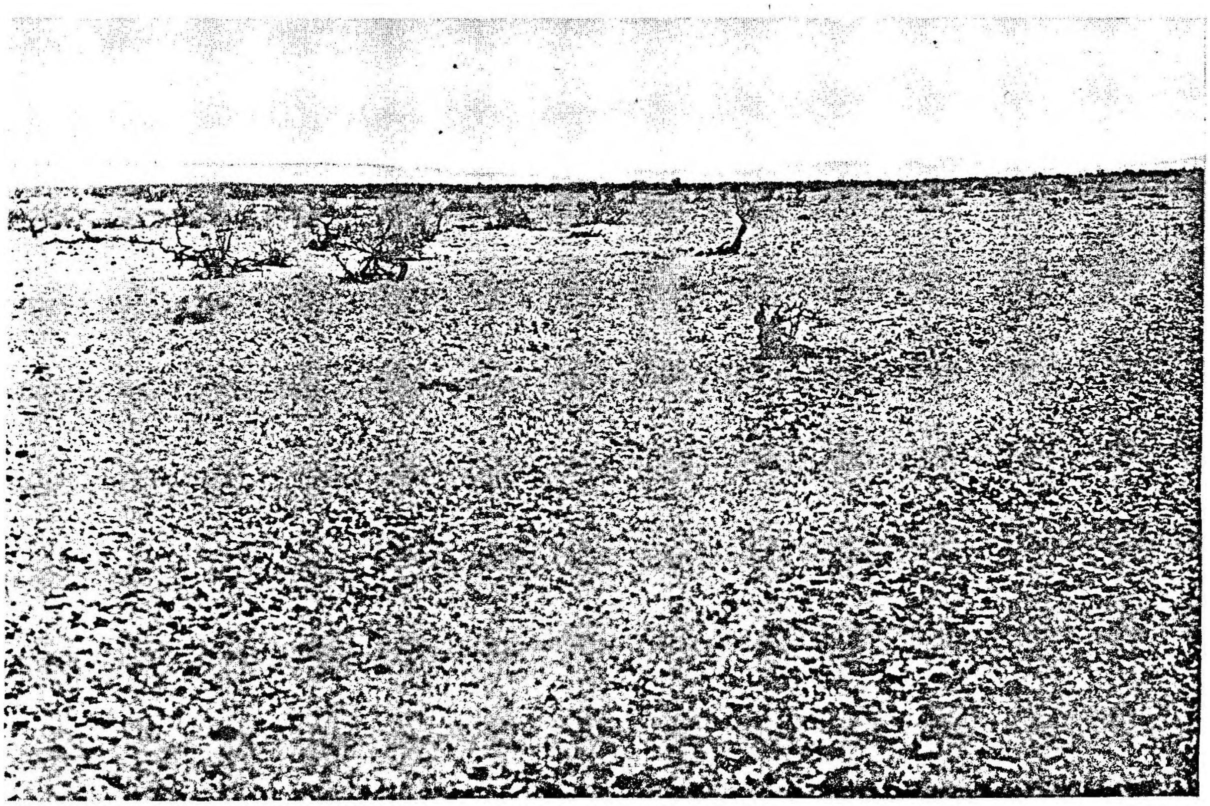
In the sub-zone of intermediate deserts the plains are dominated by communities composed of grasses and semi-shrubs or of grasses and shrubs. As regards their basic structure, semi-shrubs and shrubs are dominant. Alhough grasses and to some extent onions play an active role in the make-up of the communities in this sub-zone, they are not the dominant species.

The southern (true) deserts are distinguished by the total dominance of Central Asian semi-shrubs, shrubs, and scrub in their cenoses. Grasses and onions are absent or occur in very small numbers.

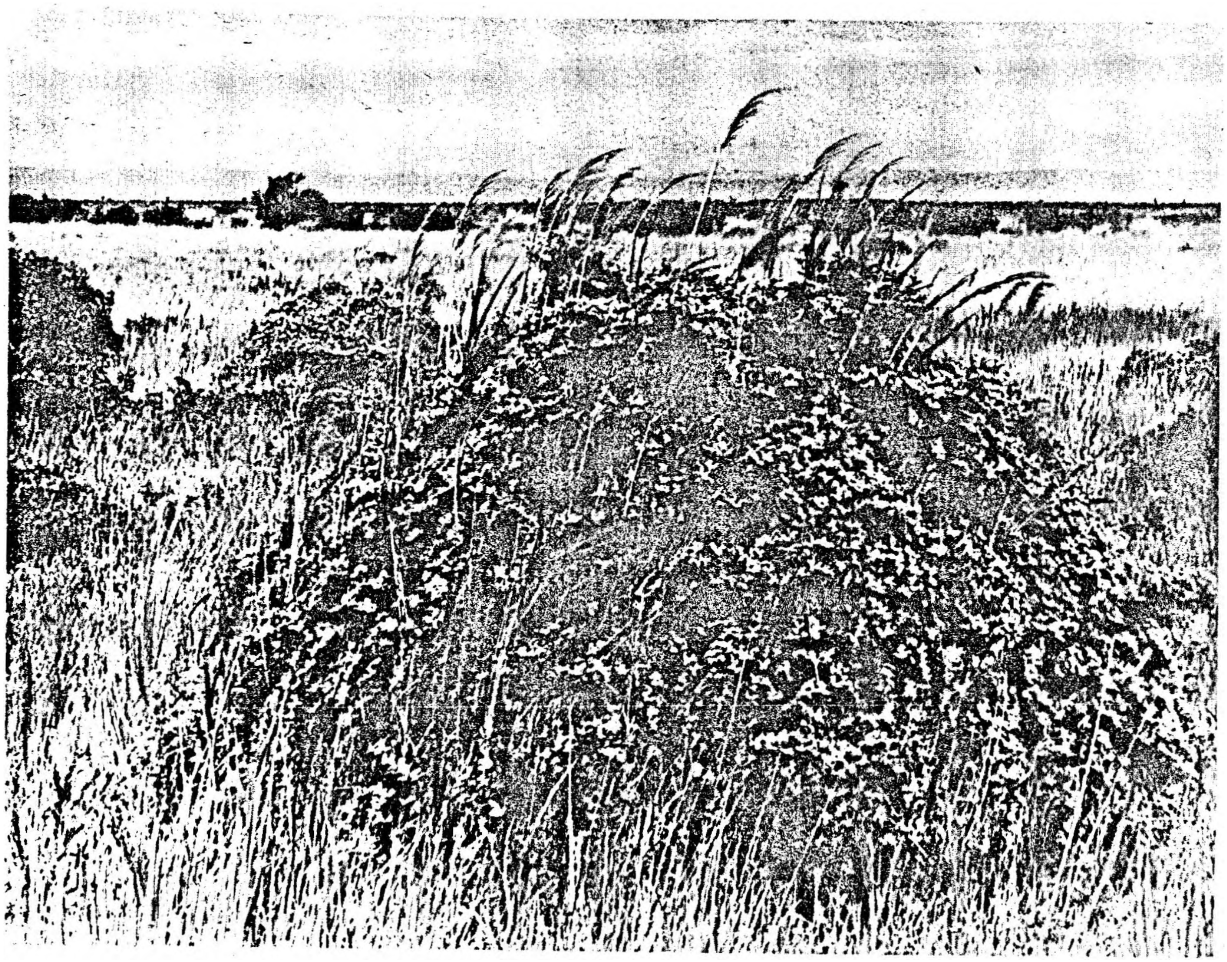
Mongolia has a special zone of superarid deserts, principally within the confines of the Trans-Altai Gobi. Within this zone higher plants are absent on the watersheds. Plant communities are concentrated in various



Barun-Shargyn-Gol oasis. Saxaul stands



Trans-Altai Gobi. Stony desert with sparse stands of stunted saxaul. Wild ass and camel trails



Maikhan-Bulak oasis, Trans-Altai Gobi. Blooming nitrebush in the foreground

types of low areas, especially dry channels of various depths. In the superarid desert zone, the slopes of hills are also devoid of plant communities, these being found only in ravines. No dense communities are found on plateaux in the very dry conditions of the superarid deserts. The zonal succession of vegetation is related to climatic factors in the environment, principally to hydrothermal parameters.

Spatial alternation (or combination) of plant communities is dependent on relief patterns. At present three levels of combinations are distinguished: macro-, meso-, and micro- combinations corresponding to the basic gradations of relief (macro-, meso-, and micro-relief).

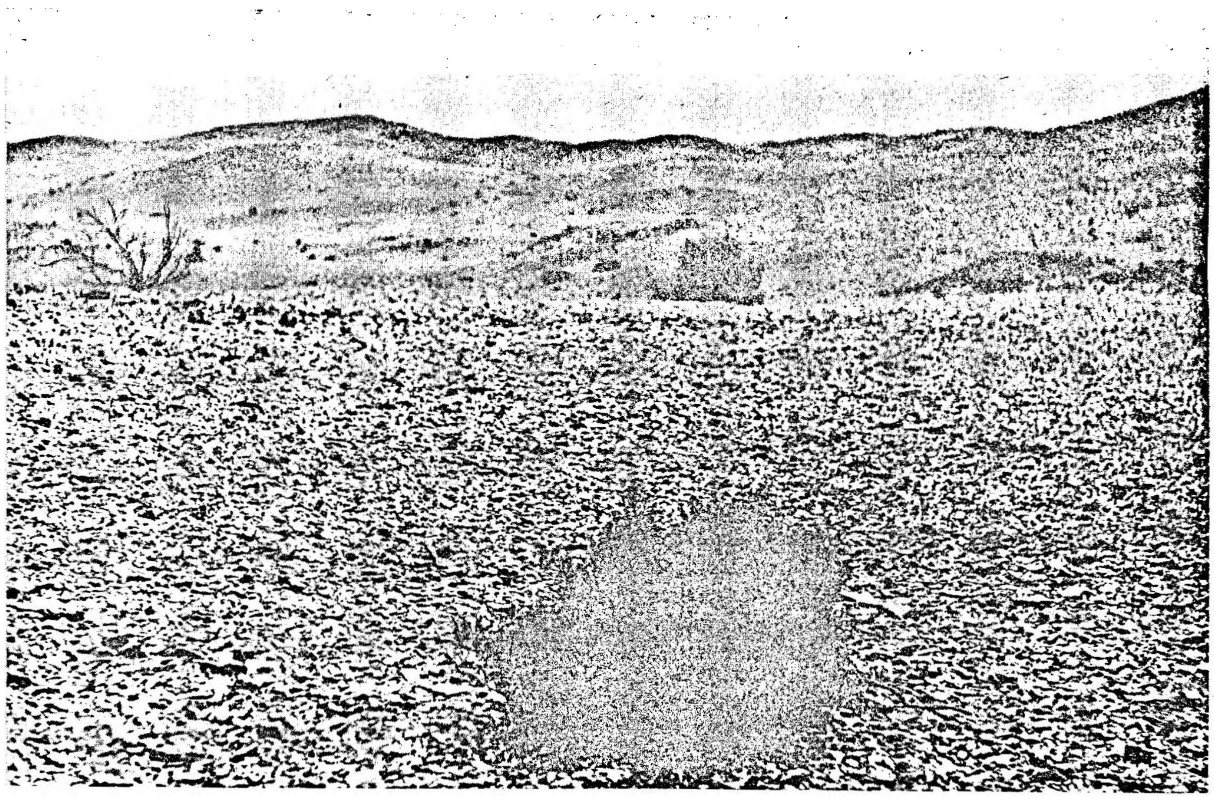
Macro-combinations of plant cover occur in mountain massifs of high, mid, and low elevation. Plant cover on their slopes exhibits an altitudinal belt structure in relation to the increasing absolute height and accompanying alterations in the radiation balance, atmospheric pressure and evaporation, as well as the increase in total precipitation and its local redistribution over macro- and meso- slopes and foothill plains.

A widely distributed meso-combination of plant communities is the "sair" type. One of the features of the Gobi Desert lands is the dissection of sloping plains by the beds of transitory run-off channels (or sairs), which are variable in terms of depth, width and length. This dissection brings about a variety of meso-combinations of vegetation in the sairs and watersheds. This type of soil and plant cover is particularly pronounced in the zone of superarid deserts where sairs serve as the only habitat for plant communities on the plains, whereas the gravel and stone-covered watersheds are devoid of plant communities.

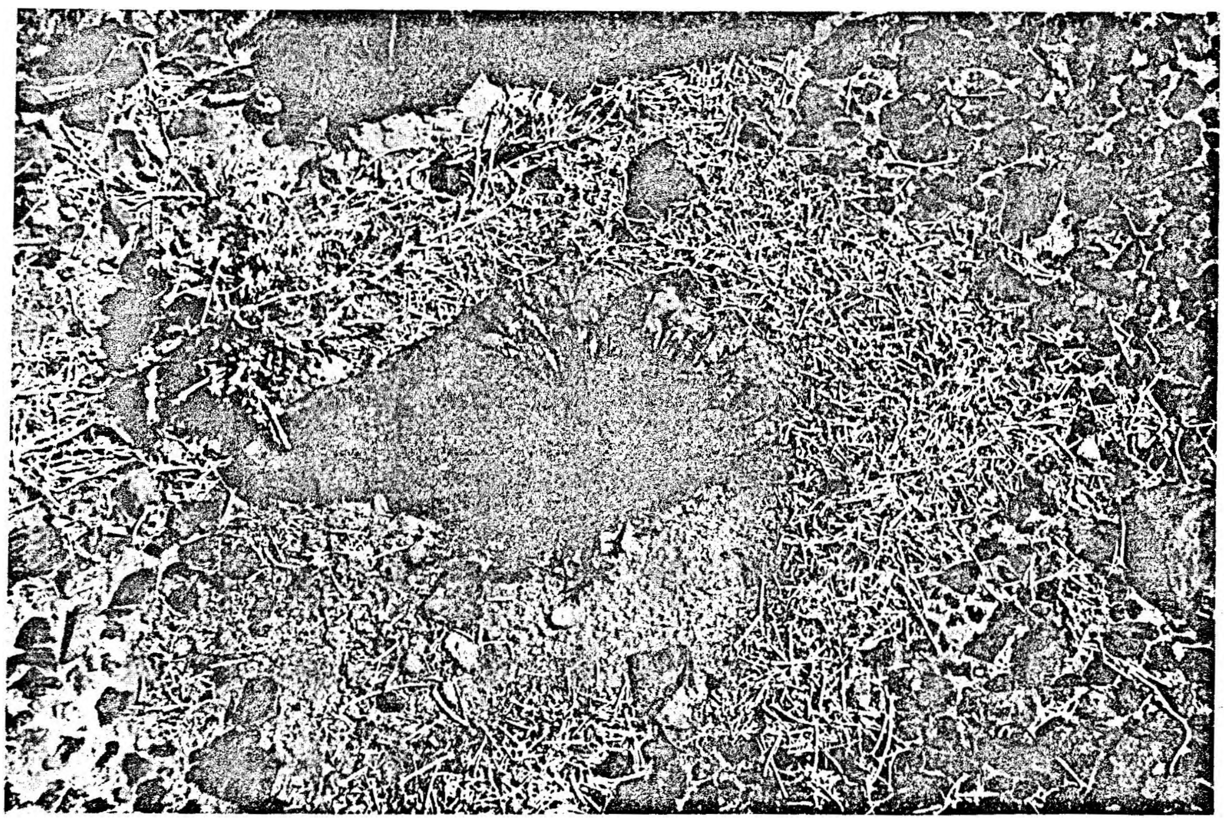
The plains sometimes also manifest a characteristic complex or patchwork plant cover caused by differences in the mechanical make-up of the soil-forming bed-rocks and consequently, non-uniform physico-chemical properties of the soils, leading to considerable variability in the water regime of separate portions of the land.

As the main limiting factor of the habitat, moisture (permanent, periodic or irregular) is of crucial importance for plant communities in superarid desert conditions. Supplementary moisture changes the viability of desert plants and the density of plant communities. Permanent irrigation causes the substitution of riparian scrub forests and meadows for typical desert communities.

Soils are also an important factor in the differentiation of plant cover. The relationship between soils and vegetation in the Gobi Desert is conditioned not only by the morphological and chemical properties of the soils, but also by the regimes of water, salt and heat that affect the distribution of various plant communities under similar climatic conditions. The prob-



Typical landscape of the superarid deserts of the Trans-Altai Gobi. In the foreground an ilyinia semi-shrub, one of the drought-resistant plants of the Central Asian deserts



Trans-Altai Gobi. June 1982, the beginning of the growing season for anabasis. Remains of last year's anabasis twigs can be seen lems of the ecological relationships between the soils and the dominant plant species in the main types of Gobi deserts have been dealt with by Yu. G. Yevstifeyev and Ye. I. Rachkovskaya (1976, 1977).

Many dominant species, for example, saxaul, have a wide ecological amplitude. But on the whole, this species prefers loose soils (sand or sandy loam) with various degrees of salt content.

Non-saline gravel and rock soils of the Trans-Altai Gobi support anabasis and ephedra communities (Anabasis brevifolia, Ephedra przewalskii). Sympegma, characteristic of gravel and stone soils formed on alkaline bed-rocks, is tolerant of the soil's salinity. Reaumuria shows a marked preference for saline soils, while various species of Russian thistle (Kalidium) are found in salt-marshes.

Ilyinia and nitrebush desert associations (Ilyinia regelii, Nitraria sphaerocarpa) form on soils with varying degrees of gypsum content.

Thus, desert-type vegetation is predominant over about 99% of the area of the reserve, comprising communities with euxerophytic and hyperxerophytic scrubs, shrubs, semi-shrubs and turf-forming grasses. Vegetation of this type occupies all the watershed plains and forms the lower belt in the mountain systems. The main desert associations include those composed of saxaul (Haloxylon ammodendron), sympegma (Sympregma Regelii) anabasis (Anabasis brevifolia), ephedra (Ephedra przewalskii), Ilyinia (Ilyinia regelii) and reaumuria (Reaumuria songarica).

Associations of winter fat (Eurotia ceratoides) bean caper (Zygophyllum xanthoxylon), nitrebush (Nitraria sphaerocarpa) and Russian thistle (Kalidium gracile) play a secondary role in the structure of plant cover in the reserve (Rachkovskaya, Fedorova, 1983).

Associations of Nanophyton erinaceum, Caragana bungei, and various species of anabasis are found only in the Dzungarian Gobi.

A characteristic feature of the Central Asian desert flora is the predominance of hyperxerophytic turf-forming grasses (Stipa glareosa, St. gobica). Some authors (Yunatov, 1950, 1974; Lavrenko, 1962) regard them as plants of the desert steppes. Desert grasslands within the reserve occur in the foothills and mountains.

The steppe type of vegetation embraces phytocenoses formed by euxerophytic microthermal turf grasses. Within the reserve steppes are found only in the mountains, where they form the mountain steppe belt (1% of the reserve area). Its basic communities are those of couch-grass (Agropyron cristatum), wheat-grass (Agropyron Nevskii), sheep's fescue (Festuca valesiaca), meadow oat-grass (Helictotriohon desertorum) and (Psathyrostachys guncea). The three latter formations are found only in the mountains of the Dzungarian Gobi.

In places receiving supplementary moisture near springs, in river valleys and in oases there are meadow-type communities that comprise phytocenoses of perennial mesophytic grasses. Swamp meadows support associations of reed-grass (Phraymites communis) and sedges (Carex enervix, C. caespitosa, C. orbiculario, C. songarica).

Halophytic meadow communities are represented by associations of rush (Juncus Gerardii, J. salsuginosus), spreading meadow grass (Puccinellia altaica, P. schischkinii), and barley (Hordeum brevisabulatum). Dry meadows in the vicinity of springs include rye meadows composed of species of lyme-grass (Leymus secalimus, L. angastas, L. Paboanus).

A specific vegetation type called "tugai" is irregularly distributed primarily in the southern part of the Trans-Altai Gobi. In the conditions of the superarid deserts, fragments of tugai vegetation are found in superarid deserts at places where ground water comes up to the surface or the water table is high (oases). Tugai vegetation comprises sparse forests often in the form of gallery distributed along the beds of sairs. The stands include downy poplar (Populus diversifolia), tamarisk (Tamarix ramosissima) and multispecies scrub consisting of Lycium truncatum, Achnatherum splendens and other species.

The tugai type vegetation, along with the meadow and desert types form the characteristic ecosystems of the Trans-Altai Gobi oases that play an important role in the life of the many mammals and birds that inhabit them.

A patchy distribution of another vegetation type is found in the Khavtag Mountains (Sector B.). It is comprised of two sub-types of scrub, xerophytic deciduous dwarf shrubs (Spiraea hypericifolia) and various species of the genera Cotoneoster, Lonicera, Rosa, Tribes and xerophytic evergreen dwarf Juniper stands (Juniperus sabina).

Analysis of plant life in the two sectors of the reserve has revealed both similarities and differences with respect to the composition and structure of the flora. The great majority of the areas of Sectors A and B are occupied by plant communities of the desert type, while steppes occur only in the mountains. The meadow type is associated only with habitats receiving supplementary water. However, tugai communities of downy poplar can be seen only in the oases of the Trans-Altai Gobi and are absent in the Barun-Khuri depression. The scrub type occurs only in the mid-altitude mountains of Sector B. When the regions are compared, considerably greater differences are manifested in the composition and phytocenotic role of the various desert formations of plant cover. Saxaul, anabasis and winter fat associations are common and widespread in both sectors although represented by different types of communities, e. g. sparse and low saxaul scrub in the Dzungarian Gobi. Multispecies sympegma, ilyinia and ephedra formations play a significant role in the plant cover of Sector A. However, these communities are absent or occupy small areas in Sector B. On the other hand, desert communities dominated by nanaphyton, anabasis and wormwoods are encountered only in the Dzungarian Gobi.

With respect to their geofloristic formations deserts typical of the Gobi and the western part of Central Asia occur in the Trans-Altai Gobi, while Dzungarian and sometimes Gobi desert types are found in Sector B. The mountain steppes of Sector A are basically the typical Mongolian type (couch-grass and feather grass communities), while in Sector B sheep's fescue and meadow oat-grass communities of the Eastern Kazakhstan-Western Mongolia type are very widespread, in addition to Mongolian Altai-steppe wheat-grass communities.

Moreover, when characterizing differences in the plant cover, it should be noted that desert phytocenoses of the Dzungarian Gobi are basically polydominant, multicomponent and multistage, while in the Trans-Altai Gobi the desert communities are basically monodominant, floristically impoverished and often very sparse.

The above differences in the structure, composition and distribution patterns of the plant cover in the two sectors of the reserve graphically demonstrate the fact that they belong to different natural and botanical provinces. According to current concepts of geobotanical regionalization the reserve is situated in the Central Asian sub-region of the Sahara-Gobi desert region (Lavrenko, 1962). Sector A belongs to the Central Gobi sub-province of the Gobi province, which embraces — in addition to the Trans-Altai Gobi — Bei-Shan and western Kashgaria (Lavrenko, 1962). Sector B is part of another geobotanical province, the Dzungarian (Rachkovskaya, Volkova, 1977). The latter province also includes northwest China (the northern portion of Sinkiang). Its western border crosses the Balkhash Alakul valley in the USSR and its eastern border passes through the Mongolian Altai and the Khuvtsgiyn-Nuru range in the Mongolian People's Republic.

PASTURES OF THE GREAT GOBI RESERVE

In desert conditions vegetation is the most dynamic component of natural ecosystems subject to seasonal and annual alterations. The species composition of desert plant communities, the ratio among life forms, the numbers of individuals, the structure of communities and the time of onset of phenophases change as a function of various weather conditions, e. g. dry or rainy years (Sandzhid, Fedorova, 1983). These factors determine the productivity of plant communities and thus affect the yield of fodder plants in various types of pastures.

The overall characteristics of the Gobi desert pastures are as follows:

— low overall productivity because of the meager species composition of fodder plants and the sparse and low-growing herbage as a result of extreme environmental conditions;

— variable and unstable yields with respect to different years, seasons and natural regions, depending on the specific weather conditions. In particular, biomass production is sharply reduced in particularly dry years, sharply reducing fodder reserves to extremely low levels;

— maximum values of the above-ground phytomass occur in late summer, which is associated with climatic patterns and phenologic rhythms of the main plant species;

— increase in phytomass takes place within a short span of time, no more than four months, and in the other seasons a process of destruction of fodder grasses occurs as the result of biological and physical factors which lead to a two or three-fold decrease in the fodder reserve from the end of summer to the end of winter and beginning of early spring.

The above characteristics describe the negative side of desert pastures. Among the positive properties of these pastures is the high nutritive value of the main fodder plants, the relatively good state of standing dry herbage and the availability of fodder because of the shallow snow cover or even the complete absence of snow in winter. These ecological features of the rangelands determine man aspects of wild ungulate ecology and must be taken into consideration in developing measures to protect both animals and their habitats.

Seasonal patterns of the Gobi pastures are divided into the following periods:

— the summer-autumn period is four months long, from June through September, and is characterized by maximum yield of the pasturage;

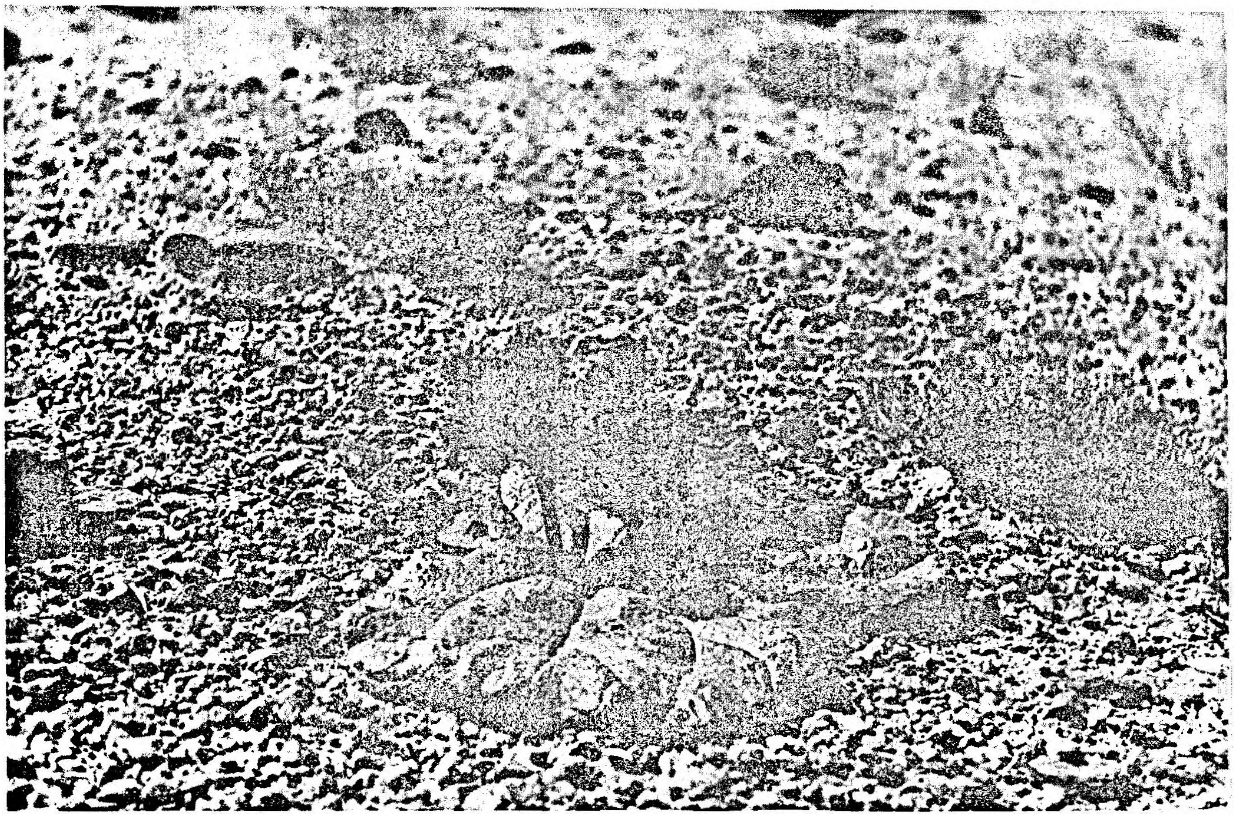
— the late autumn period encompasses October and November when plant growth ceases and grassy plants become desiccated;

— the winter-spring period lasts from December through May and is characterized by the lowest level of fodder reserves on the pastures.

The majority of Gobi pasture types are used year round, although a certain preference for one type or the other is noted in different seasons. Thus saxaul is good pasturage in winter and early summer. Sympegma pastures have high fodder value in summer, mixed shrub pastures in early summer, and ilyinia pastures in winter. Feather-grass pastures are most productive in early spring and winter by virtue of the good preservation of desiccated grasses and their high nutritive value. Dry couch-grass steppes in the mountains also provide good grazing conditions during spring and early summer. However, it should be noted once again that all these pasture types can be used year round. One of the principal tasks of future research is to describe how pastures are used by various wild animals of the reserve.

Characteristics of pastures in the Trans-Altai Gobi. The productivity and distribution of pastures is closely connected to natural conditions, particularly factors of climate and weather. For example, a dry spring causes a late growing season, making this the most stressful period for many wild animals of the reserve.

The summer precipitation maximum makes the summer and early fall period the most productive for the Gobi pastures. However, it should be noted that there is considerable irregularity in the annual rainfall, leading to significant annual fluctuations in pasture productivity. Uneven and local distribution of precipitation is characteristic of the Trans-Altai Gobi. In some areas there is no precipitation for several years in a row, rendering them unsuitable as a habitat for wild ungulates. The winters are cold and windless, with little snow. In these conditions dry fodder keeps well (30—80%), which favors the survival of wild ungulates in this period. Notwithstanding poor productivity of the Gobi pastures, the plants are very nourishing. In winter, protein content in plants totals 3 to 8% of the totally dry matter. Year-round usability seems to be a common feature of pastures in the Trans-Altai Gobi. The most productive desert pastures on the plains, in both the true and superarid desert zones, as those located in sairs. Mountain steppe pastures are also of high productivity. Oasis vegetation of either the tugai or the meadow type constitutes a rich reserve fodder. Plains disected by sairs and hummocky and mountainous relief have led to a complicated distribution of pasture types over the area. More detailed data on the structure of the plant cover are needed to ensure an accurate assessment of the forage resources of the area.



Trans-Altai Gobi. Isolated rhubarb and anabasis plants growing on hammadas are favorite foods of Persian gazelles, wild asses and wild camels

Characteristic pastures in the Dzungarian Gobi (Sector B). Better plant growth and more productive pasturage are found in spring in the Dzungarian Gobi, as compared to Trans-Altai Gobi, owing to more snow cover and the presence of spring rains. However, just as in Trans-Altai Gobi, the greatest productivity of pastures is related to the summer precipitation maximum and occurs in summer and early autumn. Winter and early spring are the hardest for the animals. This is owing to the persistent snow cover and negligible productivity of the pastures in this period. Nevertheless, on the whole, the forage reserves are greater than in Trans-Altai Gobi since plant communities in the Dzungarian Gobi are multistage and multicomponent. Greater areas in this sector are covered by pastures in which grass is present or dominant. On the whole, this sector has many more productive steppe and desert pastures. The presence here of good pastures in the dry mountain and arid steppes is especially noteworthy.

Tables 9 and 10 present general data on the yield of the various pasture types. On this basis the total supplies of edible fodder for the various pasture types are estimated. The basic information on the productivity of the Gobi pastures was assembled by A. A. Yunatov and I. A. Tsatsenkin in "Fodder Plants of Pastures and Hay Meadows of the Mongolian People's Republic" (1954) and "Natural Forage Resources of the Mongolian People's Republic" (1951).

Long-term data on the annual and seasonal yield dynamics and the chemical composition of the basic Gobi fodder plants have recently been obtained at

Table 9

PRODUCTIVITY OF MAIN PASTURE TYPES IN SECTOR A

Eco-system No.	Main pasture types in ecosystem	Max. ckg/ha f.u. per 100 kg dry mass	Minim. ckg/ha f.u. per 100 kg dry mass	Mean ckg/ha f.u. per 100 kg dry mass
1.	Sparse depressed communities in ravines & sairs	$\frac{0.02}{25}$	$\frac{0.004}{10}$	$\frac{0.0002}{0.002}$
2.	Sparse ilyinia pastures in sairs	$\frac{0.06}{35}$	$\frac{0.018}{20}$	$\frac{0.0018}{0.036}$
3.	Ephedra pastures in sairs	$\frac{0.2}{35}$	$\frac{0.06}{20}$	$\frac{0.012}{0.24}$
4.	Impoverished saxaul pastures in sairs	$\frac{0.5}{40}$	$\frac{0.2}{25}$	$\frac{0.05}{1.25}$
5.	Scrub saxaul pastures in sairs	$\frac{0.7}{40}$	$\frac{0.28}{25}$	$\frac{0.084}{2.1}$
6.	Multispecies scrub pastures in sairs	$\frac{0.4}{40}$	$\frac{0.24}{25}$	$\frac{0.06}{1.5}$
7.	Ephedra pastures in ravines	$\frac{0.2}{35}$	$\frac{0.06}{20}$	$\frac{0.0145}{0.29}$
8.	Scrub-ephedra pastures in sairs	$\frac{0.3}{35}$	$\frac{0.09}{20}$	$\frac{0.0145}{0.29}$
	Plant communities among rocks	$\frac{0.1}{35}$	$\frac{0.02}{20}$	$\frac{0.0145}{0.29}$
	Low-growing saxaul stands	$\frac{0.5}{40}$	$\frac{0.2}{25}$	$\frac{0.044}{1.1}$
	Scrub-saxaul stands in sairs	$\frac{0.7}{40}$	$\frac{0.28}{25}$	$\frac{0.044}{1.1}$

Table 9, continued

Eco-system No.	Main pasture types in ecosystem	Max. ckg/ha f.u. per 100 kg dry mass	Minim. ckg/ha f.u. per 100 kg dry mass	Mean ckg/ha f.u. per 100 kg dry mass
9.	Sparse anabasis communities on slopes	$\frac{0.1}{35}$	$\frac{0.04}{25}$	$\frac{0.04}{0.995}$
	Plant communities in cracks & recesses of rocks	$\frac{0.1}{35}$	$\frac{0.02}{20}$	$\frac{0.04}{0.995}$
	Sympegma communities in ravines	$\frac{0.3}{40}$	$\frac{0.09}{25}$	$\frac{0.04}{0.0995}$
	Multispecies scrub sairs	$\frac{0.4}{40}$	$\frac{0.24}{25}$	$\frac{0.04}{0.0995}$
10.	Isolated anabasis populations on slopes	$\frac{0.07}{35}$	$\frac{0.028}{25}$	$\frac{0.0311}{0.77}$
	Plant communities among rocks	$\frac{0.1}{35}$	$\frac{0.03}{20}$	$\frac{0.0311}{0.77}$
	Multispecies scrub in ravines	$\frac{0.4}{40}$	$\frac{0.24}{25}$	$\frac{0.0311}{0.77}$
11.	Sparse anabasis & sympegma associations on northern slopes	$\frac{0.1}{40}$	$\frac{0.04}{25}$	$\frac{0.041}{0.98}$
	Ephedra communities in ravines	$\frac{0.2}{35}$	$\frac{0.06}{20}$	$\frac{0.041}{0.98}$
	Multispecies scrub in sairs	$\frac{0.4}{40}$	$\frac{0.24}{25}$	$\frac{0.041}{0.98}$
12.	Anabasis and sympegma communities	$\frac{0.2}{40}$	$\frac{0.08}{25}$	$\frac{0.0565}{1.405}$
	Multispecies scrub in ravines	$\frac{0.4}{40}$	$\frac{0.24}{25}$	$\frac{0.0565}{1.405}$
	Plant communities on slopes	$\frac{0.1}{35}$	$\frac{0.03}{20}$	$\frac{0.0565}{1.405}$
	Ephedra pastures & wormwood pastures in raviens	$\frac{0.2}{40}$	$\frac{0.06}{25}$	$\frac{0.0565}{1.1405}$
13.	Ephedra pastures	$\frac{0.3}{35}$	$\frac{0.09}{20}$	$\frac{0.096}{1.92}$
	Scrub-ephedra pastures	$\frac{0.4}{35}$	$\frac{0.12}{25}$	$\frac{0.096}{1.92}$
14.	Sympegma pastures on watersheds	$\frac{0.9}{40}$	$\frac{0.27}{25}$	$\frac{0.396}{9.9}$
	Multispecies scrub in sairs	$\frac{1.5}{40}$	$\frac{0.9}{25}$	$\frac{0.396}{9.9}$
15.	Low-growing saxaul stands on watersheds	$\frac{0.5}{40}$	$\frac{0.2}{25}$	$\frac{0.32}{8}$
	Scrub saxaul stands in sairs	$\frac{2}{40}$	$\frac{0.8}{25}$	$\frac{0.32}{8}$
16.	Sympegma pastures on north slopes	$\frac{0.7}{40}$	$\frac{0.21}{25}$	$\frac{0.201}{5.025}$
	Sparse ephedra on slopes other than northern slopes	$\frac{0.5}{40}$	$\frac{0.15}{25}$	$\frac{0.201}{5.025}$
	Multispecies scrub in ravines	$\frac{0.9}{40}$	$\frac{0.54}{25}$	$\frac{0.201}{5.025}$
17.	Anabasis communion northern slopes	$\frac{0.3}{40}$	$\frac{0.12}{25}$	$\frac{0.1095}{2.7375}$
	Plant communities in cracks and recesses of rocks	$\frac{0.2}{35}$	$\frac{0.06}{25}$	$\frac{0.1095}{2.7375}$
18.	Anabasis communities on northern slopes	$\frac{0.4}{40}$	$\frac{0.16}{25}$	$\frac{0.188}{5.12}$
	Sympegma-anabasis communities on slopes other than northern slopes	$\frac{0.3}{40}$	$\frac{0.12}{25}$	$\frac{0.188}{5.12}$
	Winter fat and pea-tree communities in ravines	$\frac{1.4}{60}$	$\frac{0.42}{30}$	$\frac{0.188}{5.12}$
19.	Feather-grass & winter fat communities	$\frac{1.5}{60}$	$\frac{0.6}{30}$	$\frac{0.6}{18}$
20.	Winter fat-grass and ajania-grass	$\frac{2}{60}$	$\frac{1.2}{30}$	$\frac{1.2}{36}$
21.	Feather-grass desert steppes	$\frac{3}{60}$	$\frac{2.4}{30}$	$\frac{2.4}{72}$

Table 10

PRODUCTIVITY OF MAIN PASTURE TYPES IN SECTOR B

Eco-system No.	Main pasture types in ecosystem	Max. ckg/ha f.u. per 100 kg dry mass	Minim. ckg/ha f.u. per 100 kg dry mass	Mean ckg/ha f.u. per 100 kg dry mass
1.	Reaumuria-saxaul communities	$\frac{0.7}{40}$	$\frac{0.28}{25}$	$\frac{0.084}{2.10}$
2.	Anabasis-saxaul communities	$\frac{0.5}{40}$	$\frac{0.2}{25}$	$\frac{0.05}{1.25}$
3.	Annual plant communities combined with saxaul stands	$\frac{0.5}{40}$	$\frac{0.2}{25}$	$\frac{0.03}{0.75}$
4.	Reaumuria communities	$\frac{1.4}{40}$	$\frac{0.42}{25}$	$\frac{0.42}{10.5}$
5.	Wormwood-reaumuria winter fat communities	$\frac{1.6}{40}$	$\frac{0.48}{25}$	$\frac{0.48}{12}$
6.	Wormwood-reaumuria saxaul communities	$\frac{2.0}{40}$	$\frac{0.8}{25}$	$\frac{0.8}{20}$
7.	Low-growing saxaul communities on watersheds	$\frac{0.5}{40}$	$\frac{0.2}{25}$	$\frac{0.32}{8}$
	Scrub saxaul stands in sairs	$\frac{2}{40}$	$\frac{0.8}{25}$	$\frac{0.32}{8}$
8.	Anabasis communities	$\frac{0.7}{40}$	$\frac{0.28}{25}$	$\frac{0.167}{4.17}$
	Ephedra communities	$\frac{0.3}{40}$	$\frac{0.09}{25}$	$\frac{0.167}{4.17}$
	Plant communities in cracks & recesses of rocks	$\frac{0.3}{40}$	$\frac{0.09}{25}$	$\frac{0.167}{4.17}$
	Feather-grass wormwood communities	$\frac{0.8}{40}$	$\frac{0.48}{25}$	$\frac{0.167}{4.17}$
9.	Wormwood peatree communities	$\frac{1.2}{40}$	$\frac{0.48}{25}$	$\frac{0.48}{12}$
10.	Feather-grass anabasis communities	$\frac{1.2}{40}$	$\frac{0.72}{30}$	$\frac{0.72}{21.6}$

Table 10, continued

Eco-system No.	Main pasture types in ecosystem	Max. ckg/ha f.u. per 100 kg dry mass	Minim. ckg/ha f.u. per 100 kg dry mass	Mean ckg/ha f.u. per 100 kg dry mass
11.	Feather-grass-woormwood-reaumuria communities	1.8/60	1.08/30	1.08/32.4
12.	Feather-grass-anabasis-wormwood communities	1.5/60	0.6/30	0.6/18
13.	Feather-grass-anabasis communities	1.5/60	0.60/30	0.78/23.4
	Wormwood-feather-grass communities	2/60	1.2/30	0.78/23.4
14.	Anabasis-feather grass communities	1.2/40	0.72/30	0.74/22.32
	Wormwood-feather grass communities	1.4/60	0.84/30	0.74/22.32
15.	Anabasis-feather grass communities	2.2/60	1.32/30	1.32/39.6
16.	Anabasis-wheat-grass-feather-grass communities	2.3/60	1.38/30	1.26/37.8
	Ephedra-feather-grass communities	2.0/60	1.2/30	1.26/37.8
	Rock vegetation	1.6/60	0.96/30	1.26/37.8
	Scrub-wormwood feather-grass communities	2.4/60	1.44/30	1.26/37.8
17.	Multi-grass steppes on slopes	3.0/80	2.4/40	2.4/96
18.	Anabasis-feather grass-wheat-grass communities	3.5/80	2.8/40	2.8/112
19.	Wormwood-sheep's fescue communities	4.0/80	3.2/40	3.2/128

the research stations of the joint Soviet-Mongolian biological expedition (Gordeyeva, Anisimova, 1978). Studies by T. I. Kazantseva (1980) conducted in the Trans-Altai Gobi on pasture types similar to those found in the reserve are especially valuable.

These sources have been used to estimate the yield and forage reserves of the pastures. Also taken into account were materials collected by project experts. Rachkovskaya. Yu. G. Yevstifeyev and R. Ya. Zelenkov, who also analyzed the data on the capacity of ranges within the Great Gobi Reserve. A few remarks should be made on the various indices in Tables 9 and 10. Maximum yield of edible dry mass in metric centners/ha refers to that available in summer and early fall in years with average precipitation. Minimum yield of edible dry mass in metric centners/ha refers to that available in the winter and spring, taking into account the residual mass present on pastures at this time.

The residual fodder mass is expressed as a percentage of the summer-autumn fodder mass on the pastures. This value depends on the composition of dominant species for the given pasture type. The residual mass of various fodder plants is: onion, no more than 10%; semi-shrubs and shrubs 30%; saxaul 40%; bean caper 60%; etc. Nutritional value of pasture fodder is expressed in feed units (f.u.) with respect to different seasons (Tsatsenkin, Yunatov, 1951). The content per 100 kg of air-dried mass is:

— for grasses, onions, sedges and winter fat: in summer 40 f.u., in winter and spring 35 f.u.

— for saxaul twigs and perennial salt wort: 40 and 25 f.u. respectively.

— for succulent saltworts and ephedra, 35 and 20 f.u. respectively.

The right-hand columns of Tables 9 and 10 represent the average minimum crop yield of the pastures in metric centners of dry edible phytomass per hectare and the average number of feed units for the given type of ecosystem. Maximum and minimum fodder reserves have been determined on the basis of the estimated yield of the given pasture type in metric centners/ha for the area occupied by that pasture type.

Forage resources of terrains of very small extent (sands, oases) have not been taken into consideration. To be sure, oases provide a large and unique stock of reserve fodder. Yet, the structure of their plant cover is characterized by many specific features which require individual estimation of their forage resources. This, however, is a special subject for the future program of study of the reserve's range lands.

The following conclusions may be drawn from the analysis presented in Tables 9 and 10.

The yield of the desert pastures grows as the elevation above sea level increases from the hollows and depressions up the mountain ecosystems with their steppe formation.

The lowest crop productivity is that of the hammada ecosystems on the superarid desert plains.

The yield of the pastures of the Trans-Altai Gobi is significantly lower than that of the Dzungarian Gobi. The average minimum yield is 0.072 and 0.773 metric centners/ha (or 1.78 and 23.5 kg f.u.) in Sectors A and B respectively. This means that the yield of the Dzungarian Gobi pastures in terms of edible phytomass is almost 10 times that of the Trans-Altai Gobi, or 13 times greater if expressed in feed units. The total producing area of the Trans-Altai pastures is 1.392.000 ha or 31.4% of its overall area while in the Dzungarian Gobi the corresponding values are 796.000 ha and 90.4% respectively.

The yields and areas of the main pasture types have been calculated to determine the average annual values of the forage reserves. For the Trans-Altai Gobi (Sector A) these are 725,000 metric centners or 32,000,000 kg f. u. in the summer-autumn period and 30,000 metric centners of 7,540,000 kg f.u. in the winter-spring period. In the Dzungarian Gobi (Sector B) the respective values are 1,272,000 metric centners or 68,802,000 kg f.u. and 656,000 metric centners or about 20,000 kg f.u. (winter-spring).

The above data on the yields and forage reserves of the main pasture types enable us to estimate the capacity of the range lands and the degree to which the dominant large mammals (wild camels, wild asses. Persian gazelles) have saturated the reserve's ecosystems. Leaving aside the computation of the capacity of the range lands, which has been described in detail in the Master Plan of the Great Gobi Reserve, we will note that the overall fodder resources of both the Trans-Altai and Dzungarian Gobi are fully capable of supporting much more numerous populations of these wild ungulates than currently exist on the reserve.

The following conclusions may be drawn from the information that has been presented:

— the level of fodder reserves can provide for an increase in the population levels of the main protected ungulates in the reserve;

— at the levels of forage reserves available even during the "leanest" period (winter-spring), nutrition is not the principal factor limiting population levels of wild ungulates;

— population levels and distribution patterns of herbivorous ungulates depend on a combination of such factors as the nutritional properties of pastures and the conditions of water supply in a given natural region.

These conclusions, although of a preliminary character should nevertheless be borne in mind in developing a strategy for the protection and population management of the main protected species (wild camels, wild asses, Persian gazelles).

Further research should be aimed at studying the foraging capacity of desert ecosystems and the trophic chains of wild ungulates in the different sectors of the reserve.

Chapter 2. ANIMALS OF THE GOBI DESERT

The vast territory of Central Asia, with its high mountains, hot and cold deserts, and their unique plants and animals has long remained a little known part of our planet, "a blank space" for geographers and other naturalists. For many reasons access to this region was in the past very difficult for Europeans and for this reason nature kept its secrets for a long time in Central Asia. Moreover, the study of Central Asia was associated with huge practical difficulties: the severe climatic conditions on the one hand, and on the other, the fact that the local Chinese and Mongolian authorities for political reasons threw up every possible obstacle to access by Europeans. Nevertheless, explorers, geographers and scientists gradually began to penetrate Central Asia, desiring to lift the veil over the natural mysteries of the "heart of Asia".

The animal life of Central Asia evoked the greatest interest since the region was one of the oldest centers of development of terrestrial fauna on the planet. On the other hand, the remoteness of the region and the absence of human population over vast areas contributed to preservation of many large animals extinct in other regions of the globe. These two reasons determined the great interest and attention of scientists to the wild life of Central Asia.

The history of the study of Central Asia's animals dates back to the distant past, and there is no room here to describe in detail even its main features. But we must mention that Russian naturalists were the pioneers and in fact the first students of the unique animal life of Central Asia. A miriad of famous Russian travellers were led by the world-famed scientist N. M. Przhevalsky.

N. M. Przhevalsky's services to zooligical science were indeed inestimable. It would not be an exaggeration to state that N. M. Przhevalsky's immense zoological collections and interesting observations on the life of wild animals made during his many years of journeys throughout Central Asia were the origin of the present-day concepts of the area's fauna. Due to his works zoologists have received a wealth of materials which he collected comprising 702 specimens of mammals and 5010 specimens of birds and other animals.

In paying tribute to this scholar for his services to zoology, it must be noted that he discovered for world science and for all mankind, two new species of big mammals, viz. the wild camel and the well-known Przhevalsky's horse named after its discoverer.

G. N. Potanin, V. I. Roborovsky, M. V. Petrov, and other gifted companions and disciples of N. M. Przhevalsky have also made great contributions to the study of Central Asian fauna. Interesting zoological materials (collections and observations) were obtained for scientific use by virtue of investigations carried out by P. K. Kozlov, an able student of N. M. Przhevalsky, who made several journeys to China and Mongolia in 1899—1926.

In particular, P. K. Kozlov, together with his companions A. N. Kazankov and V. F. Ladygin, collected very valuable data on the unique animals of the Trans-Altai Gobi: the wild camel and the Gobi bear. G. E. Grumm-Grzimaylo (1896) performed special studies on the poorly known Przhevalsky's horse in its indigenous habitat in Dzungaria and made an excellent description of its distribution, appearances and habits.

This list of the geographers and scientists who contributed to the exploration of Central Asia, including the Trans-Altai and Dzungarian Gobi, does not give even an approximate idea of this period of wildlife investigations. Those who have a special interest in the subject should refer to A. G. Bannikov's monograph "Mammals of the Mongolian People's Republic" (1954), which describes in greater detail all zoological studies carried out in Mongolia and the adjoining regions of China from the earliest times to the late 1940s and the early 1950s.

Systematic in-depth ecological studies of a number of big animals were first carried out in Mongolia in the years 1923—1927 after the establishment of the Scientific Committee of the Mongolian People's Republic. Beginning in this period Mongolian scientists working in collaboration with their Soviet colleagues in special expeditions have carried out research on the fauna of many regions of Mongolia, including the deserts. The period of the most fruitful investigations was the 1950s when the Mongolian State University was established and zoological studies were organized under the auspices of its chair of zoology. Knowledge about the wildlife of Mongolia has been considerably expanded as a result of a large volume of field work accomplished by Soviet and Mongolian specialists and the analysis of the data obtained.

A significant contribution to the study of the animal life of Mongolia was made by A. G. Bannikov who published a book on "Mammals of the Mongolian People's Republic" (1954) based on the results of field work, study of zoological collections and analysis of previously published data.

Recent years have seen a new stage of research on Mongolian wildlife, characterized by its expansion in terms of both subject matter and scope. While earlier one-time expeditions to various regions of Mongolia were carried out, studies at fixed stations began to evolve after 1950. It should be noted that in the 1975—1982 period, zoological studies developed on the basis of a close working relationship between the Soviet and Mongolian Academies of Sciences.

Since 1975, special teams of zoologists have been included in the staff of the standing Soviet-Mongolian biological expedition to carry out faunistic and ecological research on many groups of animals. In addition to the expedition teams, fixed-site studies have also been carried out, in particular at the Ekhiyn-Gol desert station where a wide range of comprehensive zoological and ecological research is performed.

The results of the close collaboration between Soviet and Mongolian zoologists have significantly expanded our knowledge of Mongolian wildlife on the whole and of desert animals in particular. These results have been published in the numerous scientific papers of the joint Soviet-Mongolian biological expedition edited by V. Ye. Sokolov and Ye. M. Lavrenko and published by the Soviet and Mongolian Academies of Sciences.

This series of papers on the Gobi Desert wildlife includes interesting information on the fauna, ecology and protection of rare and common mammals of the Trans-Altai and Dzungarian Gobi (Sokolov et al., 1978). The need to establish the Great Gobi Reserve within the Mongolian People's Republic was based on the results of this work. In fact, its establishment is a concrete outcome of the scientific research accomplished in the Mongolian People's Republic from 1950 to 1975. At the same time, the establishment of the reserve will promote further progress in zoological studies of this region.

Great contributions to the study of desert animals have been made in the course of the UNEP Project to assist the Mongolian People's Republic to establish the Great Gobi Reserve. This project has produced accurate data on the numbers, distribution, population structure and ecology of the most common species of the Trans-Altai and Dzungarian Gobi deserts. During the period from 1980 through 1982 repeated ground and aerial surveys were performed to assess the state of the populations of wild camels, wild asses, Persian gazelles and other ungulates, as well as big carnivores (Gobi bear, snow leopard) and some rare and common bird species (houbara bustard, Pallas' sand grouse, Henderson's ground jay).

As a result, the entire area of the reserve and its buffer zone was surveyed several times during the relatively short period, 1980—1982. The overall length of motor and aerial transects amounted to approximately 14,000 km and more than 11,000 km respectively. This included detailed aerial surveys of an area greater than 2,500,000 ha, which was covered five times. This was the first time that such voluminous research has been performed in Mongolia and this has resulted in an objective asessment of the population numbers of wild camels, wild asses, Persian gazelles and the extremely rare Gobi bear.

All these data served as the basis for developing the set of measures employed to protect the unique wildlife of this region. It should be emphasized that in the course of the project comprehensive studies were carried out, including geobotanical, zoological, hydrological and veterinary and soil surveys, which made it possible to evaluate quantitativety and qualitatively the habitat conditions of the protected animals of the reserve as well as the reserve's various natural regions.

Turning now to the description of the wildlife of the Great Gobi Reserve we will first briefly outline some aspects of the development of faunistic complexes, the definition of zoogeographical regions and certain general traits of the ecology of Central Asian desert animals.

The origin of the desert fauna of Mongolia, including the fauna of the Great Gobi Reserve, is closely connected with the history of the formation of landforms and overall natural conditions peculiar to the arid zones of Central Asia.

A general analysis of the fauna of the Great Gobi Reserve is possible only by using the mammal fauna as a basis, since the latter is quite well known compared to other groups of animals.

According to the latest review (Sokolov, Orlov, 1980), the mammal fauna of Mongolia is quite rich, comprising about 124 species belonging to eight orders. This variety of mammal fauna is first and foremost conditioned by the diversity of physiogeographical conditions in Mongolia which is located in the center of the Asian continent and embraces a vast area of around 1.5 million sq. km. including natural regions of mountain taiga, steppes and deserts.

This diversity in natural and climatic conditions is intensified by the mountainous landscape, which causes an even greater diversity with changes in the altitude gradient. Elevated terrains occur almost throughout the country (with the exception of the eastern Mongolian plain), creating quite a diverse mosaic of both plant cover and other components of the environment. Naturally, this results in turn in a mosaic of habitats and leads to the development of diverse faunistic complexes with characteristic groups of species and a selection of dominant species that form the animal population of each individual area.

In Mongolia, the following principal zones and vertical belts may be distinguished: the alpine belt, the mountain taiga zone, the mountain forest-steppe belt, the mountain steppe belt, the true steppe zone, the desert steppe zone and the desert zone.

The desert zone stretches across the southern periphery of Mongolia and occupies approximately 14% of the area of the country. One third of the desert zone of Mongolia is occupied by the Great Gobi Reserve. The species composition of the vertebrates of the Great Gobi Reserve is presented in Table 11.

In considering the data in this table, it should be noted that, although the number of bird species exceeds that of mammals, more than 80% of the bird species were reported only as transitory migrants in the reserve, the total avifauna of the Gobi Desert being quite small. Thus, birds as a vertebrate group do not

Table II

DISTRIBUTION OF VERTEBRATES IN THE TWO SECTORS OF THE GREAT GOBI RESERVE

Class	Number of Species in each Sector		Total
	A	B	
Mammals	47	44	57
Birds	92	55	106
Reptiles	14	6	15
Amphibians	—	1	1

play a significant role in desert zoocenoses (Ryabtsev, Bold, 1983).

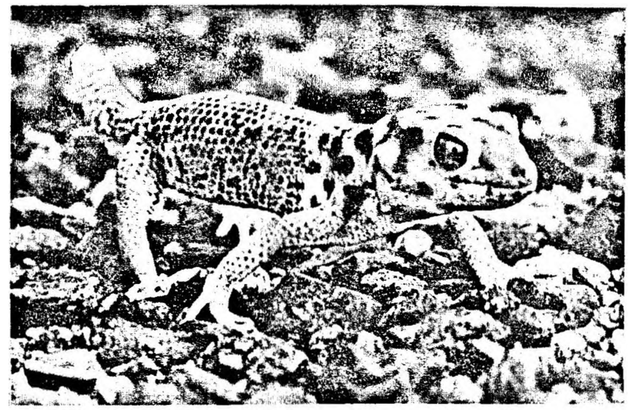
From the ecological point of view, this can be easily accounted for by the extreme environmental conditions, in particular the poorly developed plant cover and monotonous stony desert landscapes of Central Asia. The role of birds is more significant only in oases with scrub-forest cover, or in the mountains, where more favorable feeding, shelter and nesting opportunities are available. In such habitats, the avifauna is richer in terms of both numbers of species and abundance of individuals.

At the same time, the diversity of bird fauna over most of the desert areas is very limited. The most common species in hammadas, i. e. stony deserts, are Pallas' sandgrounse (Syrrhaptes paradoxus), Henderson's ground jay (Podoces hendersoni), the houbara bustard (Chlamydotes undulata), the desert wheatear (Oenanthe deserti) the Isabelline wheatear (Oenanthe isabellina), the desert warbler (Sylvia nana), Kozlov's accentor (Prunella kozlowi) and, of the diurnal birds of prey, the black vulture (Aegypius monachus) (Kozlova, 1975, Ryabtsev and Bold, 1983).

During the 1980—1982 motor transects we regularly encountered all the above birds with the exception of the black vulture, which we failed to observe within the confines of the Trans-Altai Gobi. The houbara bustard was also very rare and only a few sightings were recorded during the two-period. The causes of the decline of its populations will be dealt with in the next chapter.

The reptile fauna of the reserve is also quite limited, as it is in all the arid zones of Central Asia, and is considerably poorer than in the neighbouring deserts of Central Asia and Kazakhstan (Munkhboyar, 1973). The impoverished reptilian fauna is undoubtedly associated with the severe continental climate and the generally harsh living conditions of the area, particularly the significant length of the period with temperatures below 0°C and the sharp temperature fluctuations even in the hot season from May through September (Borkin, Munkhboyar, Semenov, 1983).

At the same time the reptilian fauna is quite unique, a high level of endemism being its characteristic feature. Thus, six of the 14 reptile species inhabiting the Trans-Altai Gobi are endemic to Central Asia. They include Przhevalsky's skink (Teratoscincus przewalskii) a rather large night lizard to be seen in desert scrub, principally in oases and large sairs with sandy-clay bottoms; the Gobi gecko (Gymnodactylus elongatus) inhabiting precipices, rocks and tali, and the common agama (Agama stoliczkana),



Przhevalsky's skink, a nocturnal lizard of oases. Trans-Altai Gobi. Ekhiyn-Gol oasis. July 1981

Horned lizard, one of the widespread reptilian species of the superarid desert zone. Common in stony deserts

a very large lizard with a bright yellow throat, called the flower lizard by the Mongolians. The agama occurs very locally among large rock-debris and rocks in mountain gorges.

Horned lizards (Phrynocephalus versicolor) are quite numerous on the flat parts of various hammadas frequently where there is no vegetation. This species, very widespread in the arid zones of Central Asia, is a very interesting species that has adapted to the most barren stony hammadas in the superarid desert zone of Central Asia.

Endemic species of Central Asia also include Przhevalski's lizard (Eremias przewalskii), inhabiting fixed sands near oases, and the Mongolian lizard (Eremias argus), a widespread species that is rare in the Trans-Altai Gobi where it has been recorded only in the mountains of Atas-Ula. All the other lizard species (Eremias multioculata. Eremias arguta and Eremias vermiculata) have wide ranges embracing the arid zones of Kazakhstan, Middle Asia and Central Asia.

The sand boa (Eryx tataricus), rat snake (Coluber spinalis), chicken snake (Elaphe dione), sand snake (Psammophis lineolatum) and Pallas' copperhead (Ancistrodon halys) also have similar types of ranges (Kazakhstan-Mongolian). These snakes are distributed very locally, basically keeping to scrub

Table 12

DISTRIBUTION OF MAMMALS BY ORDERS IN THE TWO SECTORS OF THE GREAT GOBI RESERVE

Orders	Sector A		Sector B		Total No. in both sectors
	No. of species	%	No. of species	%	
Insectivores (Insectivora)	2	4.3	2	4.5	2
Bats (Chiroptera)	4	8.5	1	2.3	4
Hares (Lagomorpha)	2	4.3	2	4.5	2
Rodents (Rodentia)	21	44.7	25	56.8	29
Carnivores (Carnivora)	11	23.4	8	18.2	12
Odd-toed ungulates (Perissodactyla)	1	2.1	2	4.5	2
Camels (Tylopoda)	1	2.1	—	—	1
Even-toed ungulates (Artiodactyla)	5	10.8	4	9.1	6
Total	47	100	44	100	57

desert habitats in oases in the desert shrubland or inhabiting mountains, in the case of Pallas' copperhead for example.

During our 1980—1982 field work, we succeeded in seeing sand snakes and copperheads only a few times.

The green toad is the only species of amphibian to be found in the reserve. It penetrates into western Mongolia in the Dzungarian Gobi, where it is extremely rare in isolated oases. In the Trans-Altai Gobi, special searches for amphibians were made in all the oases with springs that we visited, but since they failed to reveal any frogs or toads, they seem to be absent there.

Thus, mammals appear the dominant group among the vertebrates and have adapted to all possible ecological niches of the desert environment. The total number of mammalian species within the confines of the reserve is 57. The mammalian species by order for the two sectors of the reserve are shown in Table 12. Table 13 lists the mammals recorded in both sectors and various types of ecosystems.

Both sectors are dominated by rodents (44.7—56.8%), carnivores (18.2—23.4%) and ungulates (13.6—14.8%). Insectivores and bats are represented by two and four species respectively. Lagomorpha also include two species: Pallas' or the Mongolian pika and the tolai hare *. Only the southern part of the pika's range overlaps the desert zone, while the latter species is widespread in almost all types of deserts, its occurrence being abundant or common both in the Trans-Altai and the Dzungarian Gobi.

* At present many authors (Kucheruk et al., 1980, etc.) consider the tolai and the sand hare to be one species, although the basic reviews of Mongolian fauna consider these hares to be independent species (Bannikov, 1954; Sokolov, Orlov, 1980).

Table 13

LIST OF MAMMALS OF THE GREAT GOBI RESERVE. DISTRIBUTION BY SECTOR AND ECOSYSTEM TYPE

Species	Sectors		Steppe-like desert	True desert	Super-arid desert	Oases	Mountains
	A	B					
Hedgehog (Erniaceus auritus)	+	+	R	C	R	A	—
Pigmy white-toothed shrew (Crocidura suaveolens)	+	+	—	—	—	C	—
Long-eared bat (Plecitus austriacus)	+	—	—	—	—	R	—
Plain-nose bat (Vespertilio savii)	+	+	—	—	—	R	—
Serotine bat (Vespertilio serotinus)	+	—	—	—	—	R	—
Northern bat (Vespertilio nilsonii)	+	—	—	—	—	R	—
Mongolian pika (Ochotona pallasii)	+	+	R	—	—	—	—
Tolai hare (Lepus tolai)	+	+	C	C	C	A	C
Dzungarian Hamster (Phodopus sungorus)	—	+	C	C	—	C	—
Roborovsky's hamster (Phodopus roborovskii)	+	+	R	C	R	—	—
Migratory hamster (Cricetulus migratorius)	+	+	—	—	R	A	C
Chinese hamster (Cricetelus longicaudatus)	+	+	R	—	R	—	—
Mongolian hamster (Allocricetulus curtatus)	+	+	R	—	—	—	—
Northern molevole (Ellobius talpinus)	+	+	R	—	—	R	—
Snow mouse (Alticola argentatus)	+	+	—	—	—	—	C
Przevalski's meadow mouse (Eolagurus przewalskii)	+	—	R	—	—	—	—
Yellow meadow (Eolagurus luteus)	—	+	R	—	—	—	—
Meadow mouse (Lagurus lagurus)	—	+	R	—	—	—	—
Rat-like vole (Microtus limnophilus)	+	—	R	—	—	—	—
Tamarisk gerbil (Meriones tamariscinus)	—	+	R	R	—	—	—
Midday gerbil (Meriones meridianus)	+	+	C	C	C	A	R
Mongolian gerbil (Meriones unguilatus)	—	+	R	R	—	—	—
Great Gerbil (Rhombomys optimus)	—	+	R	R	—	—	—
Asiatic mouse (Apodemus peninsulae)	—	+	R	—	—	—	—

Table 13, continued

Species	Sectors A	Sectors B	Steppe-like desert	True desert	Super-arid desert	Oases	Mountains
House mouse (Mus musculus)	+	+	—	—	—	C	—
Gobi jerboa (Allactaga bullata)	+	+	A	C	—	—	C
Gobi jerboa (Allactaga nataliae)	+	—	A	C	—	—	C
Siberian jerboa (Allactaga sibirica)	+	+	C	C	R	—	—
Small five-toed jerboa (Allactaga elater)	—	+	R	—	—	—	—
Steppe little jerboa (Allactagulus pygmaeus)	+	+	C	C	—	—	—
Common jerboa (Scirtopoda telum)	—	+	C	C	R	—	—
Mongolian jerboa (Scirtopoda andrewsi)	+	—	R	—	—	—	—
Northern three-toed jerboa (Dipus sagitta)	+	+	C	A	A	—	—
Pigmy five-toed jerboa (Cardiocranius paradoxus)	+	+	C	C	—	—	—
Kozlov's dwarf jerboa (Salpinglotus kozlovi)	+	—	—	R	R	—	—
Big-tailed dwarf jerboa (Salpinglotus crassicauda)	+	+	R	R	R	C	R
Long-eared jerboa (Euchoreutus naso)	+	—	C	C	A	R	—
Common wolf (Canis lupus)	+	+	—	—	—	C	C
Red fox (Vulpes vulpes)	+	+	R	R	—	R	R
Tibetan fox (Vulpes ferrilatus)	+	—	—	—	—	—	R
Indian wild dog (Cuon alpinus)	+	—	—	—	—	—	R
Gobi bear (Ursus arctos pruinosus)	+	—	—	—	—	—	R
Stone marten (Martes foina)	+	+	—	—	—	—	R
Alpine weasel (Mustela altaica)	+	+	—	—	—	—	R
Marbled polecat (Vormela peregusna)	+	+	R	R	R	C	—
Snow leopard (Uncia uncia)	+	+	—	—	—	R	C
Lynx (Felis lynx)	+	+	R	—	—	—	—
Passas' cat (Felis manul)	+	+	R	—	—	—	—

Table 13, continued

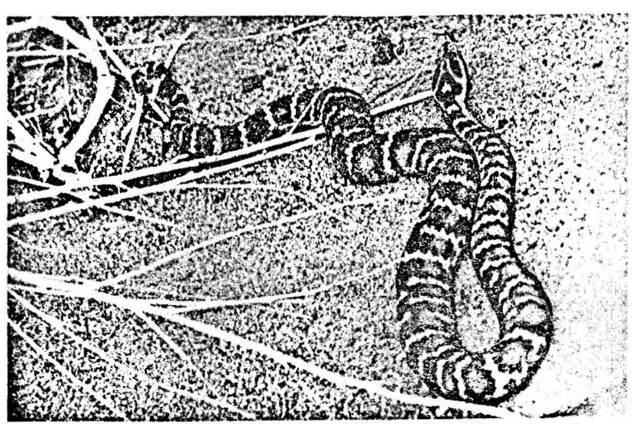
Species	Sectors A	Sectors B	Steppe-like desert	True desert	Super-arid desert	Oases	Mountains
Przhevalsky's horse (Equus przewalskii)	—	+	?	—	—	—	—
Wild ass (Equus hemionus)	+	+	—	C	R	C	R
Wild camel (Camelus ferus)	+	—	—	R	R	R	—
Wild boar (Sus serofa)	+	—	—	—	—	R	—
Persian gazelle (Gazella subgutturosa)	+	+	C	C	R	R	R
Tibetan gazelle (Procarpa picticaudata)	+	—	—	—	R	—	—
Saiga (Saiga tatarica)	—	+	R	—	—	—	—
Mountain goat (Capara sibirica)	+	+	—	—	—	—	C
Asiatic wild sheep (Ovis ammon)	+	+	R	—	R	—	C

Note: Specific names and orders are given in accordance with "Key to Mammals of the Mongolian People's Republic" (V. Ye. Sokolov and V. I. Orlov, 1980).

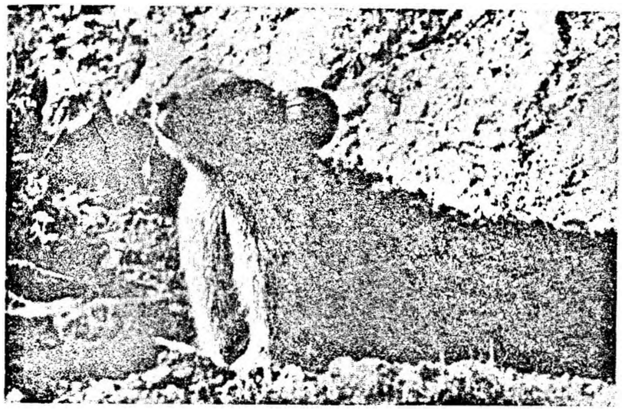
Key: R — rare, C — common, A — abundant, "+" — occurs, "—" — absent.

Insectivores and bats of the Mongolian fauna especially in the desert zone are represented by a small number of species with a low population. This was first pointed out by A. N. Formozov (1929). Low snow cover, severe frosts and sharp temperature fluctuations apparently limit the distribution of insectivores in the desert zone and lead to an impoverished insectivore fauna.

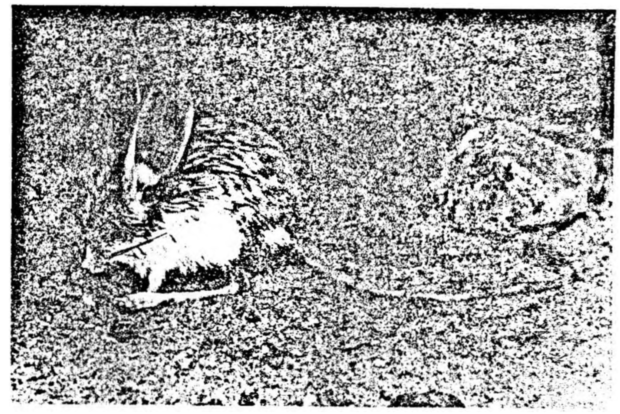
The hedgehog and pigmy white-toothed shrew have extremely limited ranges in the desert environment, their habitat being confined as a rule to oases with scrub forest and desert areas with sandy soils. Outside such biotopes, e. g. in stone-gravel deserts,



Pallas' copperhead, the only poisonous snake of the Gobi Desert. Trans-Altai Gobi. Edrengiyn-Nuru ridge



Mongolian pika, a resident of the stony taluses and rocks of the Mongolian and Gobi Altai



Long-eared jerboa, an endemic of the Central Asian deserts. Trans-Altai Gobi, near the Bayan-Tooroi (Dzakhoi) oasis. September 1980

these animals are unlikely to survive because of severe climatic conditions and lack of food, principally insects.

Cheiroptera are ecologically connected with landscapes where flying insects play an important role, yet their distribution is limited by strong winds and generally low night temperatures, even in summertime. As a rule bats are not numerous and occur only in large oases with permanent water sources and scrub forest vegetation, i. e. where natural conditions provide for reproduction and flight of insects.

The dominant mammal group in the desert zone is clearly rodents, which occupy various ecological niches and all characteristic types of landscapes, including stone-gravel hammadas and desert-type mountain highlands.

The family Dipodidae is of particular interest as a specific group of rodents which has developed in close association with the history of the Palaearctic arid zones. Eleven species of Dipodidae (jerboas) occur in the two sectors of the Great Gobi Reserve. The main group of these jerboas constitutes the endemic species of the Central Asian deserts: the pigmy five-toed jerboa (Cardiocranius paradoxus), Kozlov's jerboa (Salpingotus kozlowi), the Gobi jerboa (Allactaga bullata), the long-eared jerboa (Euchoreutes naso) and the Mongolian jerboa (Scirtopoda andrewsi).

The ecological center of the ranges of these species lies entirely within the desert ares of Central Asia. Only the western portions of the ranges of the pigmy five-toed and Mongolian jerboas extend into the territory of Eastern Kazakhstan. Based on analysis of the geographic distribution and range types of the Dipodidae family in the Palaearctic region, I. A. Kulik (1980) has succeeded in distinquishing a specific Gobi type of jerboa ranges. This again supports the concept of the Central Asian deserts, in particular the Gobi Desert, as being one of the centers of speciation of this group of mammals.

In addition to the jerboa group that is autochthonous and endemic to the Gobi Deserts of the Great Gobi Reserve the fauna includes representative of the jerboa group from the Kazakhstan-Mongolian type ranges: the small five-toed jerboa (Allactaga elater), the northern three-toed jerboa (Dipus sagitta) and the big-tailed dwarf jerboa (Salpingotus crassicauda), all species adapted to the arid zones of Kazakhstan and Central Asia.

Thus, the Great Gobi Reserve is that part of the Central Asian deserts with the most diverse jerboa fauna, and in fact, as the studies of V. V. Kucheruk et al. (1980) have shown, many species of jerboas have large populations in the eastern part of the Gobi desert and play a leading role in the desert zoocenoses. These data show that the small five-toed and northern three-toed jerboas are abundant species in the desert zone while Kozlov's, the big-tailed dwarf and the Gobi jerboas have moderate populations (Kucheruk et al., 1980).

Another numerous group of rodents characteristic of the desert zone comprises the hamsters and gerbils. The midday gerbil (Meriones meridianus) is widespread in both sectors of the reserve, inhabiting all the desert types, but preferring desert areas long sairs and fixed sands with stands of nitrebush, Russian thistle and other desert shrubs.

Approximately the same types of habitats give shelter to colonies of great gerbils (Phombomys optimus) although the central populations of these rodents occur predominantly in deserts with rich stands of saxaul and they clearly avoid hammadas. The Mongolian gerbil (Meriones unguiculatus) is common in the Dzungarian Gobi. The tamarisk gerbil (Meriones tamariscinus) has also made inroads into Sector B in recent years (Sokolov, Orlov, 1980) although the main range of this species lies in the deserts of Central Asia and Kazakhstan.

Roborovsky's hamster (Phodopus roborovskii) and the migratory hamster (Cricetulus migratorius) are also quite common both in typical desert ecosystems and in oases and mountains. The Dzungarian hamster (Podopus sangorus) also penetrates into the desert zone of the Dzungarian Gobi from the semi-deserts to the north. The Chinese hamster (Cricetulus longicaudatus) has also made inroads here in recent years, although its main range lies further to the north, in the steppe and semi-desert zones.

Quite typical rodent species are the yellow meadow mouse and the meadow mouse which inhabit steppe-like deserts of the Dzungarian Gobi. In years when its population increases, the meadow mouse plays a significant role in the zoocenoses of arid zones.

The mammals of the Great Gobi Reserve also include such rodent species as the northern mole-vole (Ellobius talpinus) and the rat-like vole (Microtus limnophilus) which have extremely local distributions, mainly in oases and in desert areas with mesophytic vegetation and a supply of ground-water.

The house mouse (Mus musculus) is also found principally in oases.

When considering the fauna of Mongolia's deserts, the great diversity of ungulates and carnivores should also be noted. The ungulates include representatives of the orders Artiodactyla, Perissodactyla and Tylopoda, consisting of 7 species.

The order Perissodactyla is represented by the wild ass or kulan (Equus hemionus) and Przhevalsky's horse (Equus przewalskii).

The Mongolian People's Republic has the most numerous wild ass population in the world, which occupies at least 100,000 sq. km. (Bannikov, 1981; Sokolov, Orlov, 1980). One of the large population centers in the Mongolian People's Republic is the Great Gobi Reserve, where these animals inhabit all type of deserts and are found both on the plains and in the mountains from the foothills up to the summits (Erdrengiyn-Nuru, Atas-Ula, Tsagan-Bogdo).

Wild asses find their optimal living conditions in uplands and medium-altitude highlands, adjacent to the plains and intermontaine valleys of the desert and semi-desert zones. The main concentrations of wild asses in the Trans-Altai Gobi are situated in the northern regions of true deserts as well as in mid-altitude mountain highlands where vertical belts of feather-grass and other grasses are found.

The 1980—1982 census studies showed a total population of 2,000—2,500 wild asses within the Great Gobi Reserve, including 800—1,000 head in the Trans-Altai Gobi and around 1,500 head in the Dzungarian Gobi, with an average population density of 0.24 to 1.25 head per 1,000 ha. The well-being of the wild ass population under the conditions of true and particularly superarid deserts depends first and foremost on the availability of water sources. The establishment of the Great Gobi Reserve has significantly promoted the conservation of these animals in Mongolia, and in future a further increase in the number of wild asses in this region may be anticipated.

The last refuge of Przhevalsky's horse (Equus przewalskii) existed until recently in the westernmost parts of the Gobi, the Dzungarian Gobi. But at present, this horse is no longer preserved in nature. A few small bands of Przhevalsky's horses were observed in the wild in 1967—1969. But successive years failed to reveal the presence of this horse, despite the work of many expeditions in the Dzungarian Gobi. There is also no reliable information about the animal in China (Murzayev, 1966; Sokolov et al., 1978; Bannikov, Lobanov, 1980). To restore the extinct natural populations, it is planned to begin reintroducing Przhevalsky's horse from breeding farms to the places where it formerly lived in Mongolia.

The Persian gazelle (Gazella subgutturosa) is a common and in places abundant animal of the Mongolian semi-deserts and deserts. Its number south of the Mongolian Altai is at least 20,000 head (Sokolov, Dulamtseren, Khotolkhu, Orlov, 1978), with around 2,500 head in the reserve itself. The population density of Persian gazelle in Dzungarian Gobi (Barun-Khourai) is high — up to 4.5 individuals per 1,000 ha — while in the superarid deserts of Trans-Altai Gobi it is much lower (0.18/1,000 ha). The steppe like deserts and desert scrub in the northern part of the Gobi provide optimal conditions for Persian gazelles.

Asiatic wild sheep (Ovis ammon) and mountain goats (Capra Sibirica) are also present in the reserve inhabiting isolated hummocks and mountain massifs in the Trans-Altai and Dzungarian Gobi. However, nowhere are there great numbers of these species.

Saigas (Saiga tatarica) are known to occur in the western part of the Gobi (Dzungaria). During the 1981 aerial counts ten saigas were recorded on the eastern edge of the Barun-Khourai hollow (Bidzhiyn-Gol). It would not be ascertained which of the two subspecies (nominal or Mongolian) was observed. Penetration of saigas into the Dzungarian Gobi were also recorded in the past (Bannikov, 1954).

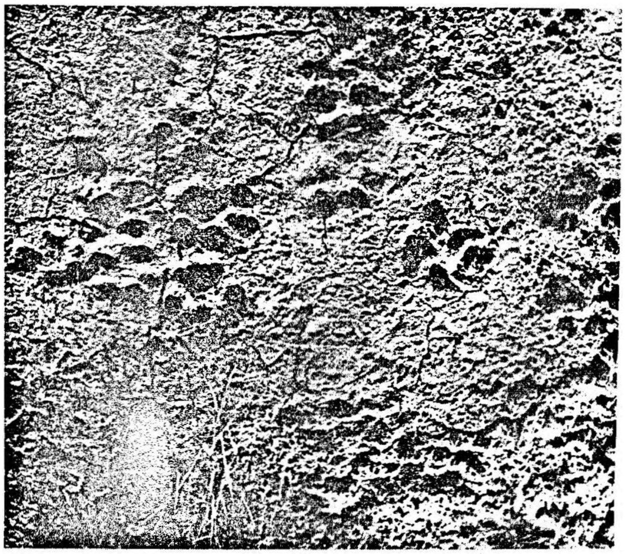
The list of large mammals of the Trans-Altai Gobi also includes the wild boar (Sus scrofa), which in the recent past (1930—1940 and before) occurred in the large oases in the north (Dzakhoi, Dzarman, et al.) but was later exterminated or died out (Bannikov, 1954).

Tibetan gazelle (Procapra picticaudata) sometimes cross over into the southern part of the Trans-Altai Gobi from neighboring Bei-Shan (China) (Bannikov, 1954; Sokolov, Orlov, 1980).

The Trans-Altai Gobi is the only area in the world where a natural population of wild camels (Camelus ferus) still exists. The range of the species embraces the most uninhabited portions of the Trans-Altai Gobi and does not exceed 30,000 sq. km. According to the results of the census studies carried out within the framework of the project to assist the Mongolian People's Republic to establish the Great Gobi Reserve the wild camel population was estimated at 640±140 head and the average density at 0.24 head per 1,000 ha. The main body of the population is located in the superarid desert zone, while the true deserts adjacent to the Edrengiyn-Nuru range are of secondary importance as a habitat of wild camels. Three-year observations have shown that the wild camel population is fully viable in terms of both its numbers and structure and reproductive capacity. The establishment of the Great Gobi Reserve has significantly increased the assurance that the wild camel will be preserved and will not die out. However, to preserve a genetically pure population, urgent measures should be taken to prevent domestic camels from getting into the reserve area and to remove all hybrid individuals from the population.

The order Carnivora is also represented in the deserts of the Great Gobi Reserve by a considerable diversity of species numbering eleven large and small mammals. This group includes, on the one hand, such widespread species as the wolf (Canis lupus) and the red fox (Vulpes vulpes) and, on the other hand, species ecologically associated with mountain or forest habitats such as the stone marten (Martes foina), alpine weasel (Mustela altaica), lynx (Felis lynx) and snow leopard (Uncia uncia), a specialized big cat.

Only the marbled polecat (Vormela pergusna) may be considered a true desert form. It is found as a common species in the Trans-Altai and Dzungarian Gobi (Bannikov, 1954). The Tibetan fox (Vulpes



Takhilt-Us spring. Spoors of wolves, which permanently reside here

ferrilatus) and Indian wild dog (Cuon alpinus) are considered rare species. They penetrate into the Trans-Altai Gobi from the neighbouring areas of China (Bannikov, 1954).

In the 1930's the Indian wild dog was often seen in the southern Gobi from Atas-Ula in the west to Tost-Ula in the east. In August 1943, A. G. Bannikov (1954) observed a pack of eight Indian wild dogs on one of the Tsagan-Bogdo ridges. In 1975 Yu. G. Yevstifeyev noted a single animal looking like an Indian wild dog in the same area.

The wolf (Canis lupus) is a common although sporadically distributed member of desert zoocenoses in the Trans-Altai and Dzungarian Gobi. This predator's central habitat is mountain areas and desert plains with permanent water sources (springs).

The number of wolves is not large, but in 1980—1982 we encountered the animals or traces of their activity in all large oases with springs. Regular sightings of wolves were recorded in the vicinity of the springs of Otgon-Us, Maikhan-Bulak, and Takhil-Us. In the latter oasis litters of wolves were noted, mature animals were seen and the howling of cubs was heard for three successive years; in June, 1982 two wolves were observed in the same oasis engaged in an unsuccessful attempt to hunt down a wild ass stallion. The remains of two wild camel colts killed by wolves were found in the Barun-Sharin-Gol oasis in August 1980. The close ecological links of wolves with springs and oases is accounted for not only by good water-supply but also by favorable conditions for hunting the ungulates that frequent watering-places.

The snow leopard is also characteristic of the desert mountain heights situated within the Great Gobi Reserve. While this large cat is distributed locally, it occurs in all the middle-elevation mountain highlands in the Trans-Altai Gobi — Tsagan-Bogdo, Atas-Ula and Edrengiyn-Nuru. Snow leopards are most often seen in the mountains of Tsagan-Bogdo and Atas-Ula wherever mountain goats, their prey of choice, may be found. However, in the Trans-Altai Gobi snow leopards occur not only in the mountains, but also among hummocks adjacent to oases.

Thus snow leopard tracks have been observed in the vicinity of the Shara-Khulsny-Bulak spring, and in July 1981 the remains of a dead snow leopard were found at the foot of mount Khatan-Khairkhan in the western part of the Dzakhoi oasis. The snow leopard's main prey includes wild goats and sheep, apparently as well as Persian gazelles, on which snow leopard preys in both Mongolia and Sinkiang (Murzayev, 1966).

It should be noted that, even though the snow leopard is basically a mountain species in other parts of its range, in the conditions of the Gobi Desert this predator is also adapted to foothills and even oases within the true deserts. In Central Asia the snow leopard occupies the ecological niche of the leopard, which is absent from this region. According to the literature (Bannikov, 1954, etc.) the lynx was also quite common in the mountain ranges of the Trans-Altai Gobi in the past. The predator was observed both in rocky portions of mid-altitude mountains and in oases with scrub forest (Ladygin, 1900; Koslov, 1923). This large, basically forest-dwelling cat penetrated into deserts and desert-like mountainous terrains depending on the abundance of the tolai hare, its main prey.

The unique large predator of the Great Gobi Reserve is the Gobi bear or mazalai (Ursus arctos pruinosus). The systematic position of the bears of the Trans-Altai Gobi has not been precisely ascertained yet. Some authors regard it as an independent species (Ursus pruinosus) endemic to Central Asia (Bannikov, 1954; et al.). V. Ye. Sokolov and V. N. Orlov (1980) consider it to be a Tien-Shan subspecies of the brown bear (U. a. isabellinus), but the definitive taxonomic position of this bear is subject for further research.

Within Mongolia the Gobi bear is a rare species with a small population and a range confined to the southeast portion of the Trans-Altai Gobi, where it is distributed over an area of 10,000 sq. km. in the mountains of the east of Atas-Ula (Chingiz-Ula, Dzun-Toroin-Nuru, Shara-Khulsniy-Nuru, Boulgan-Khoshuni-Nuru, Tsagan-Bogdo) as far as the Khutsin-Shanda spring east of the Ekhiyn-Gol oasis.

In 1980—1982 fresh traces of the bear's activity (dung, delves and lairs) were observed at 13 points, principally in the vicinity of the Shara-Khulsny-Bulak and Tsagan-Burgasny-Bulak springs. Four animals were noted in three years of field work: a grown female with a cub (Shara-Khulsny-Bulak) and two lone adult males (southwest of Dzamin-Bilgekhu-Bulak spring and on the south bel of the Dzun-Toroin-Nuru ridge).

The total number of Gobi bears in the Trans-Altai Gobi is unlikely to exceed 25—30 individuals (Bold, Dulamtseren, 1981). The Gobi bear is basically vegetarian, its main food consisting of nitrebush berries and wolfberry, fruits and shoots of ephedra and rhizomes of rhubarb and licorice, as well as leaves and sprouts of reed, bean caper and other plants.

The Gobi bear is of great scientific (ecological) interest as a peculiar ecological form of desert bear adapted to woodless biotopes of superarid deserts. Its unconditional protection must therefore be ensured.

Chapter 3. ECOLOGICAL REGIONS OF THE GREAT GOBI RESERVE

On the basis of the ecological conditions discussed above (relief, climate, soils, water resources, vegetation) which define the Great Gobi Reserve as a habitat for wild animals it has been possible to divide the reserve into various natural regions that are uniform in terms of their main ecological characteristics. The division into regions was based on the results of soil, botanical hydrological and zoological research accomplished in the course of the UNEP Project (1980—1982) as well as on the materials obtained by the joint Soviet-Mongolian biological expedition in previous years (Yevstifeyev, Rachkovskaya, 1976; Timofeyev, 1983; Zhirnov, Bugayev, 1983; et al.).

It should be noted that the scheme of ecological (or natural) regions proposed has to a substantial extent a practical significance, since it is based on the need to develop a system of protective measures which will be applied on natural test areas of the Gobi Desert for the preservation in particular of the large animals (ungulates and carnivores) that occupy the summit of the ecological pyramid in the zoocenoses of desert ecosystems.

In view of this final object, in describing the various natural regions of the reserve special consideration has been given to the environmental parameters that characterize a given zone as a habitat for animals. Natural regions are described with reference to the prevailing (or dominant) types of ecosystems which are understood as uniform natural complexes consisting of inanimate matter and communities of functionally related living organizms (Rachkovskaya, Yevstifeyev, Fedorova, Gunin, 1983).

The classification of desert ecosystems is based mainly on climatic, soil and botanical characteristics, since the other components, wildlife in particular, have been insufficiently studied. This classification does not therefore reflect the structural peculiarities of individual ecosystems and, in our view, is quite preliminary in character. Subsequent research at the system level will make the proposed scheme more precise with due regard for the functional relationships between groups of desert animals.

Set forth below is a description of the natural regions of the Great Gobi Reserve with an evaluation of each region's suitability as a habitat for large animals, essentially the mammals which are the main objects of protection in the area under consideration. The physiographic and botanical characterizations in this chapter were prepared by Ye. I. Rachkovskaya and Yu. G. Yevstifeyev, while the zoological characterizations, including distribution and abundance (population density), were prepared by L. V. Zhirnov and K. Ye. Bugayev, who made the necessary calculations on the basis of the results of census studies.

According to current concepts of natural regions the two sectors of the reserve (A and B) are to be regarded as parts of the Gobi (Sector A) and Dzungarian (Sector B) provinces of the Central Asian sub-region of the Asian desert region (Rachkovskaya, Yevstifeyev, 1982). The following is the description of the natural regions of the Great Gobi Reserve presented in the master plan with some abridgements.

NATURAL REGIONS OF THE TRANS-ALTAI GOBI (SECTOR A)

Sector A of the reserve is situated within the Trans-Altai sub-province and involves two latitudinal zonal desert belts, the true and the superarid, as well as a system of altitudinal belts of deserts and dry steppes that lie between the Gobi Tien-Shan on the south and the Gobi Altai on the north. This area is divided into 11 natural regions with uniform ecological conditions.

1. THE SHYVET-ULA REGION

This region occupies 142, 900 ha in the northwest part of the reserve. It has a few low-altitude mountain massifs, Shyvet-Ula. Khar-Kharkhan, etc., surrounded by numerous low hummocks and intermountain plains. Taken together they form a compact massif of hummocks and low-altitude mountains. The relief is very broken and rock-type hummocks are frequently encountered.

The Takhilt-Us spring situated in an ancient river valley lies within the region. In the granite massifs of Shyvet-Ula and other mountains temporary water often forms among the rocks during the period of rains.

The plant cover is dominated by anabasis and sympegma desert associations on the slopes of mountains and hills. The plant life of stony ravines, rocks and tali is quite rich and diverse. Sympegma desert associations are prevalent on intermountain plains.

Mountains above 1,800 m support fragmentary belts of desert grass associations, where abundant feather-grass occurs, in addition to the above-mentioned anabasis, sympegma and winter fat desert associations. The plant cover in the vicinity of springs is dominated by achnatherum growth and tamarisk tugais. Reedbeds, sedge meadows and dry lyme-grass meadows are usually found around water basins.

The region is characterized by a combination of narrow intermountain plains and hummocks and low-altitude mountains, assuring various types of habitats and shelters. Water supply in the region is quite adequate. Pastures are satisfactory in terms of productivity and can be exploited all year round.

The typical ecosystems in this natural region consist of high hummocky topography with dominant communities of anabasis and sympegma that occupy large areas — 66,100 ha or 46.3% of the total area of the region. Highly dismembered sloping plains with dominant ephedra communities comprise 41,600 ha or 29.1% of the area, and low hummocks with dominant sympegma communities 21,900 ha or 15.3% of the area. A negligible area (2,700 ha or 1.9%) of the region consists of depressions with a dominant cover of scrub and succulent saltwort which grow under the continual influence of ground water. However, ecosystems of this type are important for many animals, including wild ungulates, which use the tamarisk, reed, and achatherum growth and lyme-grass meadows on salt flats as pastures.

The combination of intermontaine plains with hummocky topography and low-altitude mountains and the availability of large, active water sources and year-round pastures create optimum habitat conditions for wild animals within this natural region. The infrequent presence of human beings in the region, i. e. the absence of the disturbance factor, is also of no small importance.

Concentrations of wild camels were constantly observed in the region during the summer-fall period of 1980—1981. Their population density at that time reached high levels — individuals 0.3 per 1,000 ha. In winter the camels migrate to the southern part of the reserve.

Wild asses remain in the region the year round. Their greatest concentration is in the summer and autumn (0.6 individuals per 1,000 ha), falling to 0.42 per 1,000 ha in winter and spring (March — April).

Persian gazelles generally stay in the region in summer, when the mean population density is 0.23 individuals per 1,000 ha.

Small groups of Asiatic wild sheep live year round in the Shyvet-Ula mountains and the high hummocks. The wolf is quite common in the neighbourhood of Takhilt-Us spring. Adult animals with a litter were seen at Takhilt-Us spring in the summers of 1980 and 1981.

2. OTGON-US REGION

This region occupies the northern part of Sector A and has an area of 204,600 ha. The predominant type of relief is high-altitude accumulative denudation plains (1,300—1,600 m above sea level) dissected by a network of run-off sairs of various depths. The eastern portion of the region has vast depressions which receive run-off waters from the sairs. Small massifs of low and high-altitude (Otgon-Ula) hummocks composed of alkaline bed-rock are situated in the southern part of the region.

The water-supply of the region is relatively good. There are two large springs — Maikhan-Bulak and Otgon-Us — 50—60 km apart which are regularly used by animals as water holes. During the rainy season water accumulates in small ponds that form on the takyrs in the eastern part of the region.

The region is characterized by a combination of narrow intermountain plains and hummocks and low-on the plains, sparse and low-growing saxaul growth on the watersheds and multispecies saxaul scrub communities in the vast run-off channels with sandy bottoms. Saxaul scrub with reaumuria is very widespread on the lower parts of bels and around depressions.

A vast area of saxaul stands surrounding the Dzakhoi-Dzarman oasis in the reserve's buffer zone adjoins the region from the north. The hummocks are dominated principally by sympegma or sympegma-anabasis types of desert, with the anabasis type prevailing on the highest hummocks. The prevailing plant cover in depressions consists of reaumuria and achnatherum growth though isolated strips of tamarisk tugais are found, as well as bare takyrs sometimes with annual saltworts.

The vegetation in the vicinity of springs is represented by swamp meadows, dry lyme-grass meadows, reedbeds, achnatherum growth and tamarisk tugais. Hummocks and tall saxaul scrub in large sairs offer the only shelter for animals within the region. Water-supply is good due to the presence of springs and transient water holes on takyrs. The pastures are satisfactory, principally in the autumn-winter period, though also in the form of saxaul stands in early summer.

The region is dominated by sloping plains with sparse low-growing saxaul scrub combined with ephedra communities. This type of ecosystem occupies 133,400 ha or 65.2% of the area of the region. Low hummocks with dominant sympegma communities (33,500 ha or 15.9%) and high altitude hummocks with anabasis-sympegma communities and shrubs (pea tree and other species) (27,900 ha or 16.6%) cover almost equal areas of the region.

Small-size oases (Maikhan-Bulak) and takyr-like depressions with scrub vegetation or salt meadows (77,700 ha or 3.8%) which receive additional moisture due to retention of run-off water during rainy seasons or form outcrops of ground-water, play an important role as a food resource for grass-eating ungulates.

Wild asses and Persian gazelles are always numerous in the vicinity of the Maikhan-Bulak and Otgon-Us springs as well as in the areas adjoining the Edrengiyn-Nuru ridge. In the western part of the region herds of wild camels are always present in the summer on the plains between Maikhan-Bulak and Otgon-Us springs. Their average summer density here and in the neighbouring region is 0.3 individuals per 1,000 ha. Wild asses and Persian gazelles form significant concentrations in all seasons of the year, but their numbers are the greatest in winter when the average density reaches 0.48—0.67 per 1,000 ha.

Herds of Asiatic wild sheep are always found in the hummock massifs around Maikhan-Bulak and

Otgon-Us springs. Signs of wolves are also always found here. According to Mongolian zoologists, signs of Gobi bears used to be observed in the neighbourhood of Maikhan-Bulak spring (Tsevegmid, 1970). Our observations in 1980—1982 failed to reveal any signs of the presence of bears within the region.

3. EDRENGIYN REGION

This region occupies a small part of the Edrengiyn-Nuru ridge (its southern macro-slope) totalling 115,600 ha in area. The relief of the main crest is one of low-altitude hummocks approaching mid-elevation mountains. The southern macro-slope is markedly dissected by steep slopes, gorges and canyons. The central portion of the ridge is the most level and has large areas of high interior plains alternating with low and high hummocks sitting on a pedestal 1,800—1,900 m above sea level.

The Edrengiyn-Nuru ridge manifests the phenomenon of vertical belts of soil and plant cover. Ulan-Chulu spring is located where the reserve boundary crosses the ridge and there are also numerous other springs in the buffer zone. A considerable number of temporary pools form during the rainy season in the rocks on the hummocks, where they serve as water holes for animals.

The lower southern slopes of the mountain are dominated by anabasis and anabasis-sympegma true deserts. Anabasis-feather grass communities and more rarely grass-winter fat communities are dominant in the grassy desert belt. Areas with aeolian deposits on intermountain plains have the most productive types of anabasis communities that abound in grasses, onions and annuals. The northern slopes of the mountains support fragmentary parches of desert grasslands (ajania-feather grass deserts). Achnatherum growth is characteristic of the areas in the vicinity of springs.

The region is dominated by the ecosystems of sloping plains with ephedra communities (40,300 ha or 34.9%). Low hummocks dominated by sympegma communities and mid-altitude mountains with prevailing feather grass-winter fat and feather grass-anabasis communities occupy about the same areas (28,400 ha or 24.6% and 27,500 ha or 23.9% respectively).

A peculiar type of ecosystem should be noted in this region: massifs of sand hills with tall saxaul scrub that receive supplementary moisture from residual springs buried under the basement of the sand massifs.

The region contains pastures with sufficient fodder reserves and a yield of 0.7—1.5 metric centners per hectare. The abundance of feather-grass and edible perennial saltworts which persist during the autumn-winter period indicates the presence of a relatively stable forage base. Good early summer pastures are also dominant in the grassy desert belt. In good years the productivity of pastures increases in the summer as a result of increased growth of onions and annuals.

Because of the dissected relief, the Edrengiyn region with its low-altitude mountains and hummocks possesses contrasting ecological conditions with respect to micro-climate (warm southern slopes, shady gorges etc.), abundant shelter (rocks and ravines) a relatively good water-supply and productive pastures available year round.

Wild camels are not found in the region at present, a fact which is apparently determined by the disturbance factor, since people are frequently present especially in winter. Field surveys and questionnaires lead to the conclusion that the Gobi bear is also absent at the present time. Herds of Asiatic wild sheep and mountain goats are common, even if not numerous. However, the snow leopard, a rare species of the Gobi fauna, is known to occur in the region.

During the height of the growing season of annuals and feather-grass, significant concentrations of Persian gazelles and wild asses may be seen on the high interior intermountain plains that alternate with hummocks. The average density of wild asses in the region of the Edrengiyn-Nuru is 0.14 individuals per 1,000 ha in summer and 0.04 per 1,000 in winter. Persian gazelles are also quite numerous in the summer-autumn period. Their density of 0.33 per 1,000 ha is the highest for the whole area of Sector A. Both wild asses and Persian gazelles show a decrease in numbers in winter, a fact which is explained by the disturbance caused by the movement of sheep and other domestic animals towards their winter pastures.

4. BURIN-KHYAR REGION

The region is located on a broad downslope between the Altai and Gobi Tien-Shan mountain systems. Its area is 973,000 ha. Large areas in its eastern part are occupied by an extensive low rolling or rocky hummocks mainly composed of crystalline schists. The western part is dominated by plains dissected by sairs alternating with low hills and hummocks. There are a few small massifs of low pedestal mountains. Sea-level elevations fall from north to south.

The region is arid, transitory waterways occurring only during the rainy season. Each of several ecosystems covers a small area: hammadas with impoverished saxaul communities in sairs (438,300 ha or 45%), areas of low hammada-like hummocks with saxaul growth in sairs and ravines (173,800 ha or 17.9%), low hammada-like hummocks with ephedra communities in ravines (126,700 ha or 13.0%) and foothill hummocks with patches of sparse sympegma and anabasis communities (109,500 ha or 11.3%)

About 3% of the area of the region consists of ecosystems that receive supplementary moisture. They are takyr-like depressions with sparse scrub cover or depressions with dominant scrub and nitrebush growth. There are hollows that consist of depressions with takyrs, among which tamarisk tugais surrounded by reaumuria communities occur.

A distinguishing feature of the region is the presence of large continuous sairs. Their vegetation is always more diverse than that in the beds of the smaller run-off channels. They usually have saxaul scrub communities with diverse species composition, areas of wormwood growth and, in places where the ground-water is near the surface, tamarisk growth.

The region is one of plains and hummocks, with a large amount of shelter. The region as a whole is arid with transitory water holes only here and there in the rainy season. The pastures are poor and may be used mainly in the autumn and winter. This probably is the principal reason that most sightings of wild asses, Persian gazelles and wild camels are recorded in the region only in these seasons.

The occurrence of all three species in the region is about the same, the average density of their populations ranging from 0.02 to 0.012 individuals per 1,000 ha. Asiatic wild sheep are extremely rare. Signs of either snow leopards or Gobi bears in the region have not been recorded.

5. NOMIN GOBI-TSENKHERKHOLOI REGION

This region embraces the harshest deserts within Mongolia. Its total area is 726,300 ha. The region may be considered the eastern edge of the lifeless Nomin Gobi Desert. As a whole, the region consists of a hollow, the central part of the downslope between the Gobi Altai and Gobi Tien-Shan mountain systems.

The average height above sea level varies from 800 to 1,000 m, elevations gradually falling off from the central part of the region to the east and west. In the west the elevation reaches 600 m above sea level. The main relief types are plains and hollows with peneplain-like and low-altitude dissected hummocks.

The water-supply is poor. The only transitory spring is that of Sairyn-Khyshuni-Bulak. In summer rain water is accumulated in takyrs. The plant cover is very sparse. Significant portions of the region are occupied by absolute deserts with vegetation absent even in the sairs. These superarid landscapes are typical of both plains and peneplains. The hollows are oriented latitudinally and their slopes are either slightly dissected by sairs or almost completely free of sairs. The peneplains consist of typical hammadas, i. e. stony deserts. Ravines harbor only isolated communities of ilyinia or saxaul.

Iliynia is the principal fodder plant of the region. There are a few large sair systems cutting across the western part of the region from north to south. There are small concentrations of tamarisk growth and sand knolls with saxaul scrub. The pastures are generally poor and are principally of the autumn-winter type. The transit sairs, sands and tamarisk tugais have local patches of year-round pastures. The region is practically waterless. Only the large sairs and sand knolls can provide shelter.

The main type of ecosystem in this extremely arid desert natural region consists of hammadas with sparse ilyinia communities in ravines and sairs. This ecosystem covers about 85% of the region's area.

The region is the poorest in terms of both species composition and abundance of animals because of the extreme environmental conditions. Even wild camels are very rare here and as a rule occur during seasonal movements in the sairs, which they use as migration routes. They are most often seen in winter south of the Gantimur oasis (0.08—0.12 individuals per 1,000). Persian gazelles are also extremely rare (0.1 per 1,000 ha), individual animals occurring only in the eastern part of the region (0.02—0.25 individuals per 1,000 ha).

6. SHARGYN-GOBI REGION

This region includes the northern bels of the Gobi Tien-Shan and the narrow hollows with takyrs and hummocks which adjoin them from the north. The total area of the region is 331,500 ha. The water-supply is moderate. There is only one small permanent spring. Barun-Shargyn-Gol. Some large sairs contain small oases where outcropping of water may occur in some years during the rainy season. During summer rain may accumulate in takyrs.

The predominant type of ecosystem on plains (sloping mountain bels) consists of gravel-stone hammadas combined with low-growing saxaul scrub along sairs impoverished in terms of species composition. This ecosystem type covers almost 50% of the region. Interhill plains and the lower parts of mountain bels are occupied by loose-gravel hammadas and desert ilyinia communities in straight sairs.

Desert ephedra associations in raviens are characteristic of hummocks composed of acidic effusive bed-rock. Alkaline effusive bed-rock support sparse saxaul growth and ilyinia communities. Granite hummocks have the most abundant plant cover: anabasis associations on the slopes and composite shrub communities in ravines. Quite common here are areas of bare takyrs bordered by reaumuria communities, along with small patches of tamarisk tugais and small sand massifs with saxaul scrub.

The largest oasis in area in the region is Barun-Sharga. Its irrigated portion consists of a small sedge and rush marsh with stagnant water and a poplar gallery forest along the old river bed. Saxaul scrub on sand knolls and reaumuria patches on saline soils are characteristic features of the oasis vegetation.

The region possesses a network of transit sairs and canyons in the high hummocks and mountain massifs which may be used as shelter. The region is warm in the cold seasons and relatively well supplied with water from both permanent and temporary sources.

The region contains main points of wild camel concentration during the winter. The largest and most regular concentrations are found near Barun-Sharga and Dzun-Sharga spring and at Mount Arslan-Khairkhan, their mean density amounting to 0.9 individuals per 1,000 ha. Persian gazelles and wild asses are rare (0.05—0.1 individuals per 1,000 ha). Traces of Gobi bear activity have not been observed.

7. ATAS-CHINGIZ REGION

This region is situated in the western part of the Gobi Tien-Shan. It comprises the mid-altitude massifs of Atas-Ula and Chingiz-Ula together with their adjoining bels. The area of the region is 139,300 ha. The major part of these massifs lacks water, but conditions are present for the accumulation of water during the summer rainy season. Toroin-Bulak spring is situated at the foot of the mountains in the western part of the region, and Bogts-Tsagan-Dersni-Bulak spring on the south bel.

The mid-altitude massif of Atas-Ula is characterized by a succession of two soil-vegetation belts represented by deserts on mountain brown soils and steppes on mountain chestnut soils. The desert belt is subdivided into three sub-belts: true deserts on grey-brown soils deserts with grasses on mountain pale yellow-brown soils, and desert grasslands on mountain brown soils. The steppe belt comprises two sub-belts: desert steppes on mountain light-chestnut soils and dry steppes on mountain chestnut soils (Banzragch, Volkova, Rachkovskaya, 1978).

The mountain pedestals are characterized by a predominance of extremely arid stone hammadas with composite shrub communities in sairs. Anabasis-sympegma and, more rarely, anabasis-petrophytic communities, widespread in the true deserts of the Trans-Altai Gobi, are typical of the foothills of Atas-Ula and the major part of the Chingiz-Ula ridge. A sub-belt of winter fat deserts with grasses is found at the heights above 2,000—2,100 m above sea level. This sub-belt is expressed fragmentarily in the Chingiz-Ula mountains.

In the Atas-Ula mountains several types of winter fat deserts may be distinguished: feather grass-anabasis-winter fat, wormwood-feather grass-winter fat, and couch grass-winter fat.

The mountain steppe belt begins at an altitude of 2,300 m on the northern macroslope and 2,400 m on the southern macroslope. In the Atas-Ula mountains it is represented by feather grass desert steppes up to the very summit on the southern macroslope and dry couch grass steppes on the plateau-like summits and upper reaches on the northern mountain slopes.

The Atas-Chingiz mid-altitude region abounds in habitats with diverse microclimatic conditions and numerous shelters (rocks, caves, canyons). Water is lacking in the mountainous part of the region. Springs can be found only in the foothills.

Pastures are available year round. Moderately productive pastures in the desert belt are of the autumn-winter and early summer types due to the development of grasses. There are productive spring, early summer and winter pastures in the steppe belt. Thus, steppe pastures of the spring and early summer types, which are generally rare in Sector A, are concentrated here.

Main concentrations of wild camels occur in summer and especially in the autumn-winter period. In March 1982 the animals were seen gathering at the northern bel of Atas-Ula mountain. Their average density in the summer-autumn period was 0.27 individuals per 1,000 ha and from December through April 1.5 individuals per 1,000 ha.

The population density of wild asses was 0.05 individuals per 1,000 ha in summer and about 2.0 during the winter-spring period.

Persian gazelles are very scarce and are seen chiefly in the area near the Bogts-Tsagan-Dersni-Bulak spring. Asiatic wild sheep and mountain goats are common in the mountains.

The Gobi bear (mazalai) inhabits the Chingiz-Ula mountains, moving as far to the west as the eastern foothills of Atas-Ula. The snow leopard is also quite common in the same mountains, as well as in the high hummocks. Ya. Dash, a game-biologist, encountered a litter of young snow leopards near Toroi-Bulak oasis in August 1975.

8. CENTRAL GOBI-TIEN SHAN REGION

The region is 780,800 ha in area and is situated in the southwest part of the reserve. The predominant type of landscape is comprised of hummocks and low mountains. Considerable portions of the region are occupied by low mountain ridges of latitudinal extension rising 200—300 m above the level of the plains. There are two well marked parallel chains of the mountain ridges. The low-altitude mountains of Tsagan-Baishin, Dzun-Toroin and Shara-Khulsny-Nuru are situated in the north.

The southern part of the region is framed by another chain of ridges — Bulgan-Khoshuni-Nuru and Khatan-Suudlin-Nuru. The isolated low-altitude massif of Khar-Talyn is situated in the northwest and that of Naran-Sevestiyn-Nuru in the southwest. The mountain crests are rocky, divided by canyons and composed principally of crystalline schists, or more rarely sandstone.

The central part of the region, between the above-named mountain chains, has a vast massif of low granite hummocks.

A vast gently sloping plain forms the eastern end of the region.

Hummocky topography alternating with low-altitude mountains enclosing interhill plains is more typical of the western part of the region. The most characteristic feature of the region's relief is the vast takyr-like depressions usually situated in the lower portions of the mountain bels, as well as among the hummocks.

The water-supply is good. There are many high discharge springs: Shara-Khulsny-Bulak, Dzamyn-Bilgekha, Khavtagai-Bulak, Talyn-Bulak, etc.

Throughout the gorges that cut the Gobi Tien-Shan mountain chains, sometimes all the way through, there are also places where water breaks through the surface or lies near the surface. Considerable water reserves are created during the rainy season in takyrs and among rocks, especially in granite hummocks.

A peculiar feature of the region's plant cover is the petrophytic varieties of low-mountain true deserts that are widespread within the superarid desert zone. The prevalence of anabasis and sympegma communities in petrophytic deserts on the northern slopes of low-altitude mountains distinguishes them from the southern slopes occupied for the most part by stone hammadas.

Significant diversity of plant communities is also characteristic of granite hummocks. Here there are sparse anabasis communities with sympegma associations and multispecies shrub deserts along ravines. The intermountain plains are dominated by hammadas in combination with sparse saxaul deserts along the sairs. Dense saxaul scrub is distributed only in sairs in the eastern part of the region. Large areas of takyrs and Russian thistle and reaumuria communities on solonchaks are common in depressions, though isolated galleries of tamarisk or, more rarely, poplar tugais may also be found.

Oases constitute one of the freguently encountered components of this region's plant cover. They are located around springs and in gorges and hollows, wherever underground waters break through or lie near the surface. Oasis vegetation consists of poplar or tamarisk tugais, achnatherum associations and dry lyme-grass meadows. Meadows (sedge, grass and reed types) are common around water. Many berry bushes (wolfberry, nitrebushes), as well as herbaceous plants (sophora, licorice, etc.), can be found in oases.

Numerous continuous gorges are characteristic of the region. Their dryest and rockiest portions are characterized by dominant ephedra deserts. Almost all the gorges have poplar gallery tugais or sections of tamarisk tugai.

Within the superarid zone this is one of the regions with the most diverse plant communities, including rich year-round pastures. A considerable stable reserve of forage is provided by the numerous oases with their scrub forest vegetation.

Thus, this region of the reserve is also the most varied with respect to the number of ecosystems within it. Of the twelve ecosystem types found here the following ones occupy the greatest areas: high-altitude hammada hummocks with isolated anabasis associations on their slopes (231,400 ha or 29.6%), hammadas with impoverished saxaul communities in sairs (153,500 ha or 19.7%), low-altitude hammada hummocks with complex shrub communities in ravines and sairs (149,500 ha or 19.1%).

No other natural region supports such a large area of ecosystems formed under the influence of supplementary moisture (22,400 ha). The region under consideration contains the main habitats of Gobi bear, which is associated with a large number of oases with shrub growth (wolfberry, nitrebushes and other species) which plays an important role in the diet of the Gobi bear during the summer-autumn period.

A female with cubs was seen in the vicinity of Shara-Khulsny-Bulak spring in 1980 and 1981, which indicates that this region is an optimum area for this species.

It must be noted, nevertheless, that many springs are occupied by human settlement (frontier guards) or crossed by motor roads (Shara-Khulsny-Bulak). The disturbance factor also appears to account for the rare occurrence in this area of wild camels, wild asses and Persian gazelles. The mean density of wild camels and wild asses was 0.07—0.08 individuals per 1,000 ha in 1980—1981.

9. TSAGAN-BOGDO REGION

This region encompasses the large mountain massif of Tsagan-Bogdo with the adjacent foothills, a total area of 191,500 ha. The relief of the region is one of hummocks and low and mid-altitude mountains. The highest part of the massif is centered in the southern part of the region. Here the ridge terminates in an abrupt precipice and turns into steeply sloping plains (bels).

In the north there is a gradual transition from high crests to low mountains and high and low-altitude hummocks. Parallel chains of ridges, low-altitude mountains and hummocks are separated by narrow valleys. The region has a quite good water-supply. In contrast to the Atas-Ula mountains the springs are situated at various elevations.

Plant cover on the hummocks surrounding the massif in the north is composed of sparse anabasis and sympegma communities on the northern slopes together with hammadas on the southern slopes. Ravines and sairs are occupied by ephedra communities. Anabasis deserts occur at heights of over 1,600 m above sea level on the northern slopes and sympegma deserts above the same elevation on the southern slopes. A sub-belt of deserts with grasses occurs above 1,800 m on mountain pale-yellow brown soil.

Thus, in this natural region the following principal ecosystem types are presented: foothill hummocks with patches of sparse sympegma and anabasis communities (79,100 ha or 41.3%); low-altitude mountains with prevailing anabasis and anabasis-sympegma deserts; hammadas; multispecies shrubs in sairs; and mid-altitude mountains dominated by feather grass-winter fat or feather grass-anabasis associations.

Ecosystems which receive supplementary water (complex sair systems with saxaul and shrub communities) cover 1.7% of the region.

When assessing the general suitability of the region's landscape as habitat, it should be noted that the region has good water resources, including both permanent and temporary water sources, as well as shelters (gorges, rocks etc.) for animals in case of foul weather. The pastures are poor, but they can be used year round.

This region is also interesting in that the Gobi bear is most often seen here, as well as in the Gobi Tien-Shan region. The Tsagan-Bogdo mountain massif with its neighbouring oases and other desert areas constitutes an optimum habitat for this species. The abundance of wild sheep and goats in the mountains creates favorable conditions for snow leopards, another large predator quite commonly found in the Tsagan-Bogdo mountains.

As a rule, wild camels are not found in this region. Persian gazelles are also rare. Wild asses concentrate during the winter period on the northern bel of Tumurtiyn ridge, their average density being 0.37 individuals per 1,000 ha according to the 1980—1982 censuses. It should be noted that the natural ecosystems in this region are being affected by human factors (human settlements in oases, motor traffic, grazing cattle).

10. EKHIYN-GOL REGION

This region occupies the southwest part of the reserve. Its area is 489,900 ha. The region is characterized by alternating low-altitude pedestal mountains and hummocks with vast plains, principally mountain bels. The massifs of such pedestal mountains as Undur, Khavtagai, Tsuvlur, Lanzat etc., are situated in this region.

The mountains and hummocks in the eastern part of the region are mostly composed of sandstone. Their height ranges from 1,200 to 1,600 m above sea level, with the highest 100 to 200 m higher. Low-altitude hummocks are less common. The central portion of the region consists principally of gently sloping bels and enclosed depressed hollows. Such relief patterns ensure a great deal of shelter for large animals.

Springs are lacking in the western part of the region. Only springs in the buffer zone can be used as water sources (Ekhiyn-Gol, Toli-Bulak), but they are situated in well populated places.

The most widespread ecosystems on the plains consist of gravel-stone with thick saxaul stands in sairs and stone-hammadas with a composite shrub vegetation also growing in sairs. These forms cover about 25% of the area of the region.

Ecosystems of high-altitude hammada hummocks with isolated anabasis associations on the slopes and low-altitude hammada hummocks with ephedra communities in ravines cover approximately equal areas

(19.8 and 18.2% respectively). Takyr-like depressions with sparse shrub vegetation form an independent type of ecosystem which receives supplementary moisture through the accumulation of rain water. It covers 1.7% of the region (8,100 ha).

Vegetation of the pedestal mountains is quite diverse and depends on their altitude and bed-rock composition. The northern slopes may support isolated anabasis associations, while the southern slopes are often occupied by hammadas. Reaumuria and tamarisk tugais, and sometimes even reedbeds, are common in depressions. Some oases with poplar growth are found. There is much shelter in the region owing to the relief patterns.

The western part of the region is waterless, while the eastern part has a better water-supply. This is one of the most diverse regions in the superarid zone with respect to pasture types. The pastures are poor in terms of productivity but can be used year round, especially in the early summer and autumn-winter periods. Insufficient water-supply accounts for the low wild animal populations in the region.

Wild camels are not found within the region, the main part of the area lying outside the present-day range of this species. Wild asses and Persian gazelles are common, though not numerous, in the northern and eastern parts of the region. The wild ass population density is 0.35 individuals per 1,000 ha in winter, while that of the Persian gazelle is 0.25 individuals in summer. There is evidence of the Gobi bear's presence south of mount Khytsyn-Khar. Results of questionnaires suggest the possibility that the bear is also found in the southeastern part of the region.

11. BEI-SHAN REGION

This region includes vast sloping denudation plains lying at heights of between 1,100 and 1,500 m above sea level, which adjoin Bei-Shan, a large desert area in China. The region is 323,600 ha in size. A significant part of the region comprises the southern bels of Bulgan-Khoshuni, Khatan-Suudlyn and Tsagan-Bogdo mountains. The southern part is occupied by isolated massifs of low-altitude and peneplain-like hummocks with stretches of aeolian sands on the slopes and ravines.

The entire area is dissected by sairs that are sometimes quite vast and complex. The territory is waterless. There are springs only in the adjoining mountain massifs and hummocks. This region, like the first three regions of Sector A discussed in this chapter, has a small number of ecosystem types.

The ecosystem of hammadas with multispecies shrubs or communities in sairs comprises 77.2% of the area of the region (250,000 ha). Hammadas with sparse saxaul communities in sairs holds second place in terms of the area occupied (13%) among the five ecosystem types of this region. It is the only natural region in Sector A that does not include any of the ecosystem types that receive either permanent or temporary supplementary water.

Pastures are poor but usable all the year round, though principally in early summer. The fauna is very poor. Traces of Gobi bear activity are found southeast of the Tsagan-Bogdo mountain system. Wild ungulates were not observed during the field work in this region. However, wild camels may occur during migrations.

NATURAL REGIONS OF THE DZUNGARIAN GOBI (SECTOR B)

This area of the reserve constitutes part of the Dzungarian province and occupies a vast depression south of the Russian and Mongolian Altai.

This sector of the reserve — the Barun-Khourai basin with the mountains adjoining it to the south — is considered a separate sub-province. There are patches of superarid deserts within the Barun-Khurai basin, but most of the basin is occupied by southern true deserts. Intermediate and northern deserts form a semicircle to the north, east and south of these true deserts as the height above sea level increases. In the mountains along the southern border of the reserve there is a sector of altitudinal belts of desert, dry and arid steppes.

Thus, two desert zones are found in Sector B superarid deserts in patches and southern true deserts along with altitudinal sub-belts of intermediate and northern deserts and desert, dry and arid steppes.

Based on its zonal and belt structure Sector B may be subdivided into six natural regions (Yevstifeyev, Rachkovskaya, 1976).

1. BARUN-KHURAI REGION

This region occupies the northwest part of Sector B, 87,300 ha in area, which is the lowest above sea level (1,000—1,200 m). This portion of the Barun-Khurai basin is in the superarid zone, a fact which may be accounted for by the "basin effect".

The northern part of the region, the lowest above sea level (1,000—1,050 m) is occupied by flat weakly dissected plains. These plains are characterized by hammadas on superarid gypseous soils or highly gypseous sandy loams with reaumuria or reaumuria-saxaul communities in sairs. To the south of this small region there are plains of another type: rolling, dissected by sairs, and composed of proluvial gravel deposits underlain with shallow saline rocks of Paleogenic origin. They are associated with gravel-stone hammadas with isolated anabasis associations on the watersheds and anabasis-saxaul communities in straight sairs or anabasis-saxaul sairs in complex sairs.

The region is dissected by an ancient run-off trough that originates at Lake Yelkhon and falls into the Davsan-Khurai saline depression. This central part of the region harbors those types of soil and plant cover that receive supplementary (or more rarely permanent) water. Sandy parcels of the basin are dominated by saxaul scrub. At sites with a high-water table, tamarisk grows on sandy knolls. The basin and the dry lakes have a complex plant cover including reedbeds, lyme-grass meadows, achnatherum and tamarisk growth on saline hydromorphic soils.

Thus, the prevalent type of ecosystem in the region under discussion is one of hammadas with low-growing saxaul scrub in sairs (52,400 ha or 60%). A considerably smaller area is occupied by hammadas with reaumuria-saxaul scrub in sairs (21.5%). Here, as in most of the other natural regions in Sector B, areas with supplementary water-supply, either temporary or permanent, play a significant role in the life of animal populations.

Ecosystems of this type are represented here by complex sair systems dominated by medium and high saxaul growth (1%) and depressions with dominant saltwort growth (3.8%). The water-supply is moderate, its main source being accumulated precipitation. The pastures, which can be used all the year round, are poor. Though they are relatively productive in depressions, these occupy a very small area.

Persian gazelles and wild asses are common inhabitants of the region. Persian gazelles can be seen here the year round while wild asses are resident principally during the summer-autumn period. The average gazelle population density in the summer-autumn period exceeds 3 individuals per 1,000 ha. It reaches its maximum value of 5.4—8.5 individuals in September and October. Wild asses are also common in summer and autumn, but the average density of their population is no more than 0.47 individuals per 1,000 ha. It should be noted that the flat relief does not provide wild asses with suitable shelter in winter. Hence these ungulates avoid the region during that season, whereas Persian gazelles may be found here in winter as well.

2. THE TAKHIYN-KHONIN-US REGION

This region is situated in the central part of Sector B. Elevations in the region range between 1,250—1,300 and 1,500 m above sea level. The total area is 34,300 ha. The relief is predominantly flat, though in places the plains alternate with small massifs of low hummocks. Unbroken dominance of saxaul formations is characteristic of the region.

The central part of the region contains an ancient run-off valley with a sandy bed covered by saxaul scrub. This part of the region also has two very interesting, well irrigated areas: Khonin-Us and Takhiyn-Us. Khonin-Us is the delta of the Bidzh River. Here there are many places where the ground-water breaks through to the surface. Sedge marshes are common next to the water, where they alternate with reedbeds and lyme-grass meadows, with more or less abundant herbaceous halophytes. The dryer portions of Khonin-Us have significant area of achnatherum growth, while Russian thistle and reaumuria deserts grow on solonchaks around the periphery.

Takhiyn-Us spring also appears to be the residual “oasis” of an ancient river system. It has much in common with the Mongolian Altai stream valleys with respect to the floral composition and the structure of plant communities. The basis of the plant cover is tussocky sedge marshland with considerable expanses of reed meadows. The swamp-meadows vegetation is surrounded by a ring of lyme-grass meadows and achnatherum communities. Nitrebush and tamarisk shrubs grow around the periphery. The spring is surrounded by multispecies reaumuria desert.

Thus, almost half of the region’s area is occupied by an ecosystem comprised of a sloping, weakly dissected plains dominated by saxaul growth, with wormwood and reaumuria (165,200 ha or 48.2%). Next in area are sloping, strongly dissected plains dominated by low-growing saxaul (27.9%).

The smallest area is occupied by ecosystems receiving supplementary water, i. e. complex sair systems dominated by medium and tall saxaul growth which receives supplementary water through the redistribution of surface run-off (1.4%), as well as springs with marsh, meadow, shrub and nitrebush vegetation (1.9%) irrigated by shallow ground-water and surface outcropping of spring water.

The region is flat with isolated hummocks and areas of sands, deep sairs and achnatherum communities, providing good shelter for wild and domestic animals. The region has a very good water-supply and pastures with adequate productivity all year (especially good in early summer), making the area attractive for year-round habitation by ungulates — wild asses and Persian gazelles — despite the constant presence in the same places of domestic animals and herdsmen.

The region is notable for the very high average density of the Persian gazelle population in the summer-autumn period which exceeds 6 individuals per 1,000 ha. A particularly high concentration of the animals (up to 15 individuals per 1,000 ha) is found in autumn. Wild asses are also attracted to the springs (Khonin-Us, etc.), where their average density reaches 1—2 individuals per 1,000 ha. The great abundance of ungulates in the region is in the final analysis conditioned by the combination of snowless plains with hummocks and permanent water sources which serve as water holes for the wild animals.

3. NORTHERN FOOTHILL REGION

This region is situated in the north and northeast parts of Sector B. The area of the region is 135,700 ha. The relief is characterized by an alternation of high foothill hummocks and low mountains with vast inter-hill foothill plains which lie at considerable elevations between 1,400 and 1,700 m above sea level.

The overall elevation of the area and the effect of the Mongolian Altai mountains lead to the presence of deserts with grasses, which can be viewed as a manifestation of altitudinal belt zonality. There are two main types of plains: gently sloping foothill plains with pronounced micro-relief and weakly dissected foothill plains with soils of low mechanical strength. The former type is associated with the absolute predominance of feather grass-anabasis deserts, sometimes with a plant vegetation cover that includes feather grass-wormwood-anabasis deserts and grass-pea tree deserts with the participation of wormwood and feather grass.

Deserts of this type cover a particularly large area on the left bank of the Bidzh-Gol River.

The plant cover of the foothill hummocks is of very diverse species composition. The prevailing plant cover type on the slopes is anabasis, but anabasis-feather grass also occurs on the higher parts of the mountains. Pea tree growth is common on rocky slopes. Wormwood-feather grass deserts occur in ravines and on interior concave slopes.

The entire region has 11 distinct types of ecosystems, twice the number of the regions described above. The greatest areas are occupied by foothill plains with prevailing feather grass-anabasis communities (35.8%), foothill rocky hummocks with feather grass-anabasis communities on the slopes and wormwood grasslands in the ravines (18.6%), and sloping plains with pea tree growth and aeolian sand deposits (12.3%).

Areas receiving supplementary water through redistribution of surface run-off and ground-water lying near the surface comprise 2.9% of the whole area (3,500 ha). The region is dissected by longitudinally oriented sair beds, which are the terminal portions of rivers flowing down from the Mongolian Altai. The only active water artery in the region is the Bidzh-Gol River. Its valley harbors swamp meadows, achnatherum growth and tamarisk thickets. The relief forms of the region are plains and hummocks.

The water-supply in the western part of the region is moderate, while that in the eastern part is good. Pastures are productive and usable year round, although they are best in spring and early summer. The combination of foothill hummocks and interhill elevated plains with reduced aridity owing to the influence of the Mongolian Altai mountains produces favorable conditions for the year-round presence of wild asses and Persian gazelles.

The mean population density of wild asses is 0.21 (winter-spring) to 1.42 individuals per 1,000 ha (summer-autumn). The density of the Persian gazelle population is roughly two individuals per 1,000 ha throughout the year.

The significant growth of xerophytic grasses, summer cypress and other valuable semi-desert fodder plants ensure the generally high productivity of pastures and good habitat conditions, for herbivorous animals. Ten saigas were seen in June, 1981 on the foothill plains in the northeast part of the region on the border of the reserve. Since the animals were observed from an aircraft, their subspecies could not be ascertained. In the 19th century and also in the 1920's and 1930's the Dzungarian Gobi (Barun-Khurai basin) was inhabited by the nominal form of the saiga (Bannikov, 1954; et al.).

4. SOUTHERN FOOTHILL REGION

This region embraces two altitudinal levels of foothill plains and hummocks (1,600 and 2,000 m above sea level) situated near the mountain system that adjoins Barun-Khurai basin on the south. The area of the region is 270,400 ha.

It belongs to the desert zone and has two pronounced zonal-altitudinal types of deserts: deserts with grasses on pale-yellow-brown soils and desert grasslands on brown soils. The predominant relief type consists of hummocks alternating with sloping plains (bels) dissected by sairs. Soils are mainly brown or pale-yellow-brown of a gravel-stone variety. Sandy loam soils are rarer.

The common feature of the region's plant communities is the participation of grasses, principally feather-grasses. Their abundance in the desert plant cover increases as the mountains are approached and the elevation becomes greater, until they gradually assume a dominant role.

Two types of foothill plains occur at the lower altitudinal level. Great areas are occupied by sloping plains dominated by wormwood-feather grass-anabasis deserts, sometimes supplemented with abundant reaumuria growth. Wormwood-feather grass or feather grass-wormwood communities of the Dzungarian type are widespread in sairs.

A characteristic element among high-altitude strongly dissected hummocks is the presence of narrow interhill valleys with water outcrops or a high water table. Such topography is characterized by achnatherum growth and feather grass-reaumuria deserts.

The foothill plains of the higher altitudinal level occupy narrow belts of bels directly next to the high mountains. The basic plant cover type here consists of anabasis-wormwood-feather grass types of desert grasslands. This higher level is principally occupied by strongly dissected hummocks and low-altitude mountains. The foothill hummocks are usually strongly dissected often containing canyon-like gorges, steep slopes and tali. Sometimes, however, the relief is smoother, having the aspect of rolling hills. The foothill hummocks are characterized by a quite rich and diverse plant cover.

Foothill rock hummocks with feather grass-anabasis associations on the slopes and wormwood grasslands in ravines constitute the main type of ecosystems (83,400 ha or 30.9%). Foothill dissected hummocks with dominant anabasis grasslands and foothill dissected plains dominated by wormwood feather grass-anabasis associations occupy almost equal areas (21.6% and 20% respectively). Depressions with dominant reed-lyme grass-achnatherum communities (0.3% of the region) are formed under the influence of ground-water.

The plain and hummocky relief of the region provides good shelters for wild animals. Its higher parts have a good water-supply while the lower parts have moderate water resources. The year-round pastures are good in all seasons, but especially so in the winter-spring period.

Wild asses and Persian gazelles are continually present in this region, though not in large concentrations. The average density of wild asses is about one individual per 1,000 ha in summer and autumn, while that of Persian gazelles is 0.75—2.6 individuals per 1,000 ha (winter-spring and summer-autumn periods). A considerable concentratin of Persian gazelles is noted in autumn, when these animals gather on the foothill plains with anabasis and feather-grass communities. Asiatic wild sheep and mountain goats occur in small numbers in the high hummocks adjoining the mid-altitude mountains on the south. Houbara bustards were observed on the foothill plains in October 1981.

5. THE KHAVTAG REGION

This region occupies the northern flank of the Khavtag mid-altitude massif between 2,000 and 2,800 m above sea level. The area of the region is small — 15,000 ha.

The forward mountain chains have steep, often stony slopes with a great number of tali. They are dissected strongly by deep lateral and transverse ravines. The high mountains along the axis of the ridge have flat and rounded summits often with sloping sides, and isolated rock outcrops. The ridge is dissected by numerous poorly developed valleys.

Outcrops of spring water are common in various places, particularly along the periphery of the massif. On the whole the massif is situated in the mountain steppe belt which is divided in turn into three subbelts: mountain desert steppes on mountain light-chestnut soils (2,000—2,300 m above sea level); mountain arid steppes on mountain chestnut soils (2,300—2,500 m); and mountain dry and moderately dry steppes on mountain dark chestnut soils (2,500 m and higher).

The soil and plant cover of the Khavtag mountains is very complicated for a number of reasons and thus constitutes a particularly valuable natural feature of Dzungaria. In particular, the region is a repository of many unique plant species of Mongolia. The dominant ecosystems at elevations of 2,000 to 2,300 m above sea level consist of desert steppes, the occurrence of which corresponds to the most stony, rocky and dissected part of the ridge. The northern meso-slopes of this sub-belt are dominated by wormwood-multiherb steppes.

Above 2,300 m these are replaced by mountain dry steppes. This sub-belt is characterized by the great diversity of its sheep's fescue communities. One of the notable components of this sub-belt's plant cover is shrub stands of spiraea sweet brier and currant located in ravines or shady places under rocks, as well as juniper stands along the southern stony slopes. Lightly dissected convex-concave slopes and flat summits 2,500 m high are dominated by various communities of dry and moderately dry steppes respresented by meadow oat-grass associations.

Oat-grass meadow steppes with plentiful grasses and sedges occur in inter-hill hollows with supplementary water and in the higher portions of the steppe belt.

Thus, there are only two dominant types of ecosystems in the region: mid-altitude mountains with dominant multi-component desert steppes (6,900 ha or 46%) and mid-altitude mountains with dominant sheep's fescue dry steppes (5,200 ha or 34.7%). Other ecosystems, though small in area, play a great role in providing fodder to wild ungulates.

The relief of the Khavtag region abounds in various kinds of shelter and habitat types for animals. Springs are numerous and the region is well supplied with water. A relatively stable snow cover forms in winter. Pastures are very good and fit for year-round use. The most productive pastures can be found in sheep's fescue steppes in spring and meadow oat-grass steppes in summer. The southern meso-slopes provide good winter pastures in all their belts.

The presence of stony and rocky areas with ravines and mountain steppe vegetation in the mid-altitude Khavtag massif creates a favorable environment for Asiatic wild sheep and mountain goats. The census figures for this region are far from complete, but both species are common — at places even abundant — in the ravines of this region. The snow leopard is also not uncommon in the rocky areas of the Khavtag ridge.

The region is a unique repository of flora. This is one of the richest eastern outposts of the steppe flora within the desert zone (Volkova, Rachkovskaya, 1980).

6. TAKHIYN-SHARA-NURU REGION

This region includes several mid-altitude massifs situated along the south and southwest borders of Sector B. Its area is 29,600 ha.

A major part of the region is formed by the mid-altitude Khuryn-Bogdin massif (2,000—2,300 m above sea level). The forward ridges of these mountains are steep and sharply cut by deep ravines. Behind this chain of ridges there is a high longitudinal plain with isolated masses of knolls and rocks. This area is bordered on the south by the Khukh-Undur mid-altitude mountains ranging from 2,300 to 2,500 m above sea level. Their northern macro-slope is quite steep and dissected although the summits are relatively flat.

The Takhiyn-Shara-Nuru massif situated further east rises to a height of 2,527 m above sea level and is also characterized by strongly dissected rocky forward ridges with steep slopes, then more gentle slopes in the upper parts of the mountains and relatively flat summits. All the mid-altitude massifs lie in the steppe belt.

Two steppe sub-belts are clearly distinguishable: a sub-belt of desert steppes on mountain light-chestnut soils and a sub-belt of dry steppes on mountain chestnut soils. The desert steppe belt covers small areas in the region including the whole of the Khuryn-Bogdin massif and the lower part of the northern macro-slope of the Takhiyn-Shara-Nuru Mountains at heights of 2,000 to 2,300 m above sea level. These are generally the most dissected and stony areas within the region. Here, in contrast to the Khavtag Mountains, there is another type of mountain desert steppes, the couch-grass steppes.

The main ecosystem types of the region are mid-altitude mountains dominated by desert couch-grass associations and mid-altitude mountains dominated by sheep's fescue dry steppes (88,200 ha or 11.1% of the area of the region). There are no springs in the western part of the region, while the eastern part (the Takhiyn-Shara-Nuru Mountains) has a relatively good water- supply.

Pastures are used throughout the year. They are especially good in winter and spring. The range-land is quite productive in the desert steppe belt. In winter these areas are supplied with water by winter precipitation in the form of snow.

The region, like the fifth region discussed above, is notable for the abundance of Asiatic wild sheep and mountain goats. Snow leopards are also common. The region of the Takhiyn-Shara-Nuru ridge is of special interest because the last sightings of Przhevalsky's horses in the wild were reported here. In 1947 A. Yunatov came across a herd of horses that numbered six or seven head north of the ridge in desert steppe with feather-grass and nitrebush growth (Bannikov, 1954).

The very last sightings of Przhevalsky's horse were made in the vicinity of the Takhiyn-Shara-Nuru ridge: a solitary male in 1968 and two adults in April 1969 (Dobchin, 1970). Subsequent careful searches have not been successful. The species is believed to be extinct in the wild (Sokolov et al., 1978; Bannikov, Lobanov, 1980).

Chapter 4. POPULATIONS AND ECOLOGICAL CHARACTERISTICS OF THE RARE AND COMMON PROTECTED ANIMALS OF THE GREAT GOBI RESERVE

The Great Gobi Reserve, as a unique region of Central Asian deserts, preserves many interesting species of mammals and birds that are listed in the Red Book of the International Union for the Conservation of Nature and Natural Resources and in the national Red Book of the Mongolian People's Republic. The principal protected species include six species of mammals:

— **The wild Bactrian camel,** a unique representative of the world's fauna and the only member of the Order Tylopoda existing in a wild state in Asia;

— **The wild ass,** an inhabitant of the arid zones of Asiatic continent, whose populations are extinct or drastically reduced in many countries;

— **The Persian gazelle,** a typical representative of the desert fauna. At present only small populations remain over most of its range but the species is still rather numerous in Mongolia;

— **The Asiatic wild sheep,** a separate subspecies of the nominal form that is widespread in the desert mountain massifs of Central Asia;

— **The Gobi bear or mazalai,** a rare endemic of Central Asia, one of the least known species of the world fauna;

— **The snow leopard,** a rare large cat inhabiting peculiar biotopes of the deserts of Central Asia and requiring special protective measures.

Protected birds include the following three species:

— **The houbara bustard,** a rare species of arid zones which is declining in population over its entire range and is in need of protection on a global scale:

— **Pallas' sandgrouse and Henderson's ground jay,** common species of the arid zones of Central Asia that play an important role in the zoocenoses of desert ecosystems.

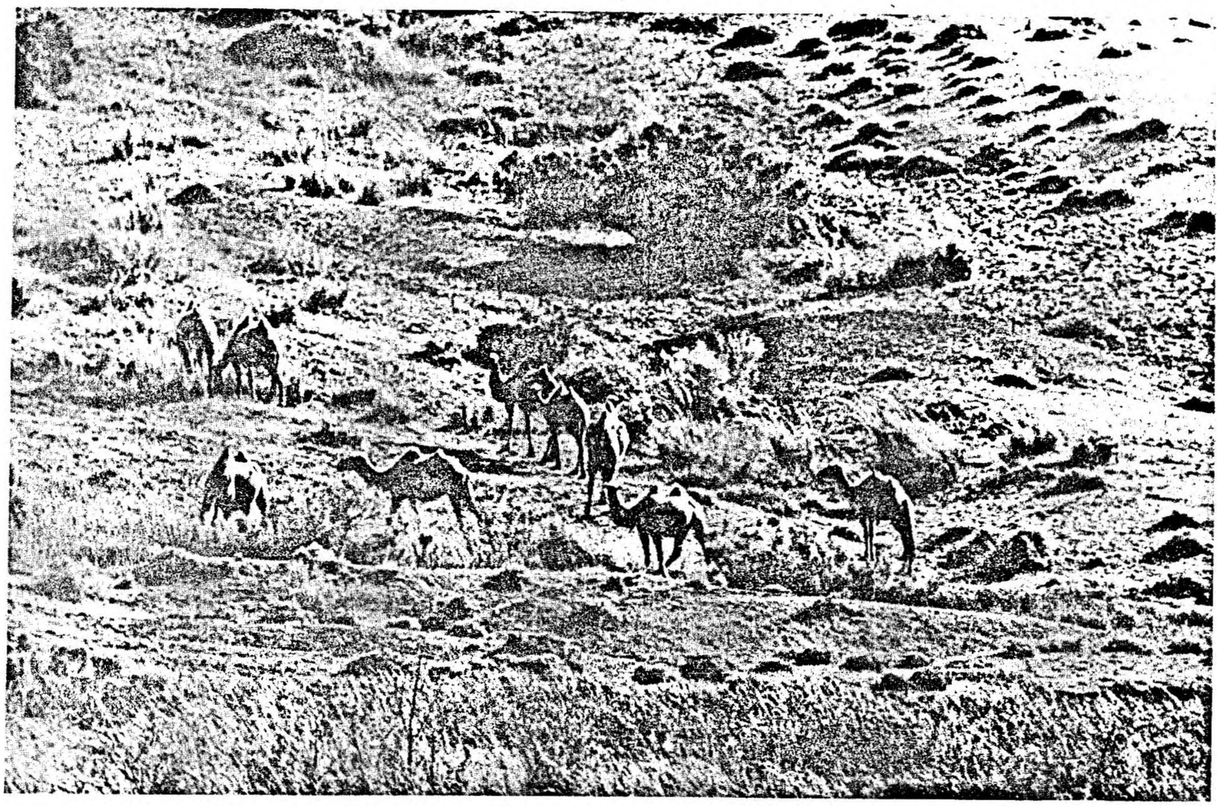
These species are far from representing the diversity of desert zoocenoses but they make up the main body of animal and bird species which it is the overriding task of the Great Gobi Reserve to preserve as an invaluable desert genofund. Below we will describe the population states, ecological characteristics and conservation measures relating to the above bird and mammal species based on the results obtained in the course of the UNEP Project in 1980—1982 and analysis of the literature.

WILD BACTRIAN CAMEL OR KHAVTAGAI
Camelus ferus Przewalskii, 1883

Status. A unique representative of the world's fauna, this species appears in the Red Book of the IUCN and the national Red Book of the Mongolian People's Republic.

Brief history of discovery and study. The wild camel was discovered for science relatively recently. In 1873 N. M. Przhevalsky, the great Russian explorer was the first European to see, obtain and describe the wild camel during his second expedition to Central Asia. Przhevalsky described the range of this little known species and collected data on its habits. "The largest concentration of wild camels are presently found in the Kum-Tag sands east of Lake Lob-Nor. In addition, this animal is sometimes seen in the sands of the Lower Tarim and in the Kurugtag mountains. They occur more rarely in the sands along the Chertchen-Darya River". During his third journey Przhevalsky continued to study the range and habits of wild camels, and thanks to the data he obtained, it was realized that wild camels occupy not only the deserts of the Lower Tarim, Lob-Nor and Khami, but also penetrate into the southern Dzungarian districts north of the towns of Guchen and Manos, in addition to the sands near Syrtym and in the environs of Lake Khuytun-Nor. The wild camels obtained by Przhevalsky were thoroughly studied and described, thus enriching zoology with a new species and causing a sensation in the scientific and public circles of Russia and the rest of the civilized world. The great interest in wild camels did not abate. M. V. Pevtsov, V. I. Roborovsky, G. V. Grumm-Grzhimaylo and P. K. Koslov, Russian explorers and disciples of the great Przhevalsky, continued collecting materials to define more accurately the biological characteristics of these unique animals.

Of all the other European scientific explorers, only S. Gedin, a swede, succeeded in seeing and obtaining two wild camels in the Takla-Makan desert (Gedin, 1899, 1904). It should be noted however, that all the above observations were basically concerned with wild camels in China, and there were no similar data on wild camels in the northern reaches of their



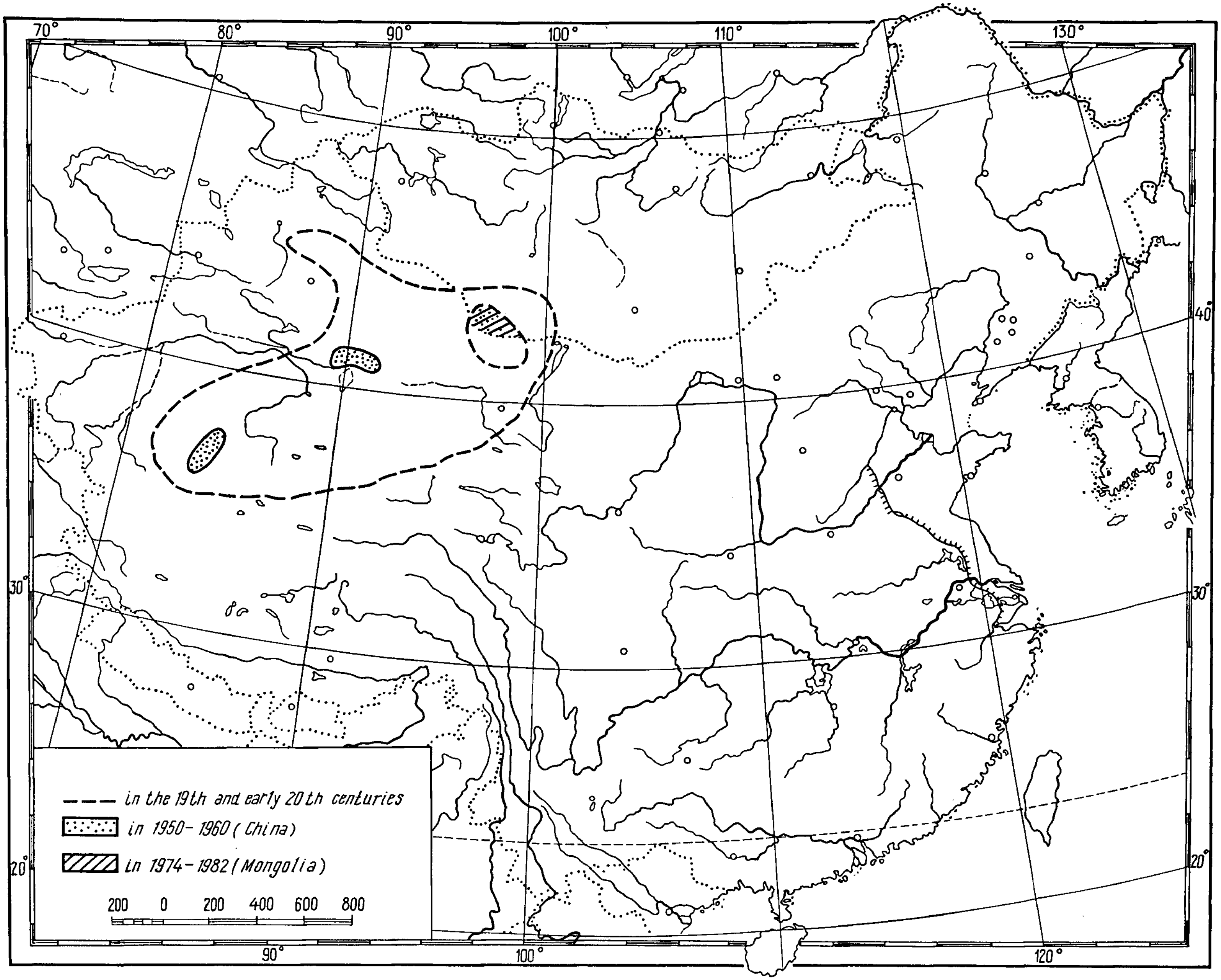
Herd of wild camels grazing at the Toroin-Bulak oasis, Atas-Ula. July 18, 1981

range in Mongolia. The gap was first filled by V. Ladygin (1900) and especially by A. Symukov (1937), who made a comprehensive survey of the Trans-Altai Gobi in 1927 and obtained interesting new data on the distribution, habits and food of wild camels in Mongolia. These data specified the northern limits of the range of wild camels in the Gobi Desert. Subsequent years failed to bring forth any additional evidence of wild camels, and scientists became convinced that the animals were likely to have been exterminated. It is only in 1943 that A. G. Bannikov (1945, 1954) as a member of a multidisciplinary expedition organized by Soviet scientists and the Scientific Committee of the MPR, performed a transect of the Trans-Altai Gobi on which he collected interesting new data on wild camels in this region. In subsequent years, an expedition of Mongolian zoologists including D. Tsevegmid, E. Dagva, N. Davchin, O. Shagdarsuran and others, conducted surveys in the Trans-Altai Gobi which obtained more detailed information with respect to the distribution and population of wild camels in Mongolia (Dagva, 1954; Tsevegmid, 1970, et al.). Further, studies on Mongolian wildlife were continued in the 1960's and 1970's with special reference to the Gobi Desert. They were carried out by joint Soviet-Mongolian expeditions and resulted in publications on the distribution and population of wild camels in the Trans-Altai Gobi (Bannikov, 1975; Sokolov, Dulamtseren, Khotolkhu, Orlov, 1978, et al.).

The data on wild camels and other animals of the Trans-Altai Gobi which the scientists obtained were used as the scientific basis for the decision of the Mongolian Government to establish the Great Gobi Reserve in this region.

Regular studies of the wild camel were subsequently carried out in the course of the UNEP Project to assist the Mongolian People's Republic in establishing the Great Gobi Reserve. The result of the three year studies (1980—1982) carried out by Soviet and Mongolian participants in the Project are presented below.

Distribution. It the past, the range of the wild camel seems to have been confined to the Central Asian deserts, though in the 18th century and before, wild camels may have inhabited some desert areas of eastern Kazakhstan as well. In the 19th century the range, especially in the west, sharply diminished in size and by the turn of the century the animals remained only in the most out-of-the-way corners of Central Asia, i. e. the deserts of Gobi, Tarim, and northern Tsaidam (Bannikov, 1975). In subsequent years, the range continued to decrease and by the 1940's the unified range of the species split into two isolated parts. The northern range occupied the Trans-Altai Gobi, principally within Mongolia, while the southern range was localized in the Lake Lob-Nor Basin and the eastern part of the Takla-Makan desert (lower reaches of the Tarim and Konche-Darya Rivers, the sands of Kum Tag and the Kurug Tag and Altin Tag Mountains). The state of the wild camel populations in these regions of China are at present unknown, but most likely the animals have become very few in number or totally extinct as a consequence of economic development of the area



Range of the wild camel in Central Asia

(Bannikov, 1975). However, two groups of wild camels numbering three and six animals are known to have been observed on the Kurug Tag plateau in 1956 (Bannikov, 1975) and according to E. Murzayev (1966), wild camels were still found in the late 1950's in the very center of the Takla Makan desert along the ancient river beds north of the Keriya oasis. The decline in the population of wild camels in this part of their range is undoubtedly related to the desert development activity carried out in the PRC in the 1950's and 1960's (Petrov, 1966, 1967; Murzayev, 1966).

The present-day range of wild camels is confined to the deserts of the Trans-Altai Gobi. Its boundaries within Mongolia can be defined quite accurately on the basis of the surveys carried out from 1974 to 1982. The northwest animals are regularly seen in the environs of the Takhiltu-Undur-Ula and Shevetin-Ula Mountains. From there, the boundary further extends along the southern bel (foothills) of the Edrengiyn-Nuru ridge, where wild camels most often occur in the vicinity of Dzun-Dzan-Gatu-Ula mountain and to the south of the Khyarin-Guni-Khuduk well. The eastern boundary passes to the west of the Ekhiyn-Gol oasis and then extends southwest to the northwestern and western slopes of Tsagan-Bogdo-Ula mountain, the Khara-Tolgo-Ula ridge and as far as the Chinese-Mongolian frontier. Wild camels are now virtually absent east of this line, only single animals or small groups of them being observed in some years. In August 1976, Ye. I. Rachkovskaya and Uy. G. Yevstifeyev came across a herd of eight camels in the Ingeni-Khabur depression (personal communication). Isolated groups are reported to have penetrated in the late 1960's even further eastward as far as the Noyan-Bogdo and Gurban-Tes Mountains.

The western boundary of the range extends from the Tilym-Meltes-Undur-Obo mountains to the Khyana-Khyn-Khara-Ula, then further westward to the Toroin-Bulak spring (Atas-Bogdo Mountains) and northward to Myagan-Toroin-Bulak spring, and from that point to the northwest slope of Shevetin-Ula Mountain. Outside the area of the main range there is a narrow strip where isolated herds of camels irregularly penetrate. These penetrations are most often seen northwest of Shevetin-Ula Mountain in the hummocks lying southeast of Adzhi-Bogdo and north of the western spurs of Edrengiyn-Nuru ridge in the vicinity of Khatan-Khair-Khan-Ula Mountain. However, these penetrations do not result in extension of the range since these districts are often visited by man and are crossed by busy motor routes. The southern boundary of the wild camel's range in the Mongolian People's Republic lies along the frontier with China, although in some places movements of the animals south of the frontier are noted. Data from questionnaires indicate that small groups of camels wander from north to south and back in the region of the Bulgan-Khoshuni-Nuru and Naran-Sebestei ridges, although it is not known how far they penetrate to the south. According to A. G. Bannikov, (1945, 1954, 1975), the distribution of wild camels in the 1920's was limited by a line extending from Lake Gashun-Nur (China) along the Moringola and then south of the Khanshuy-Nuru upland, turning north at the town of Borul. In subsequent years, wild camels were no longer observed in the vicinity of Lake Gashun-Nur, and the southern boundary of their distribution had apparently shifted to the north after construction of the Menfi-Khami motor route and the Ansi-Khami railway, resulting in complete isolation of the northern (Trans-Altai) and southern (Lob-Nor) wild camel populations.

The total area of the current range of wild camels in the Trans-Altai Gobi is estimated by different authors to be 30,000 to 40,000—45,000 sq. km. Our data indicate that the area of permanent habitation of wild camels in the Mongolian People's Republic does not exceed 28,000 sq. km. There seem to have been no significant changes in their range in this region during the last 20—25 years, though some authors (Bannikov, 1975) have noted some increase, while others (Sokolov et al., 1978) argue that it is decreasing, mainly as a result of its diminishing in the eastern parts of the Trans-Altai Gobi.

The results of thorough studies of the present-day distribution of wild camels, conducted in 1980—1982 show that its main range now lies almost entirely within the confines of the Great Gobi Reserve, which is expected to provide some assurance that the wild camel will be preserved in the future.

Population numbers. The numbers of wild camels in past centuries is hard to judge since Europeans began to penetrate Central Asia only at the end of the 18th and the beginning of the 19th centuries. The first reliable information on wild camels became available to science due to Russian explorers, especially N. M. Przhevalsky who first collected the wild camel and revealed this species to science. According to the descriptions of explorers and geographers in the middle and late 19th century, wild camels were common in many regions of Central Asia and abundant in some of them.

Thus, P. Kozlov (1899), describing his observations of wild camels near the Altyn Tag ridge and in Kum Tag, wrote: "Wild camels are always seen in this depression in great numbers in wintertime", and "... wild camels are common in the desert terrain between the Altyn Tag ridge and the lower reaches of the Cherchen-Darya near the settlement of Vash-Shari principally to the west of it. In the past the animals were abundant here. Herds of scores and even hundreds of camels were common. At present their numbers here are not so great, probably because of increases in the human population and great persecution by hunters".

The first data on the wild camel population numbers in the Trans-Altai Gobi date from the 1940's. Based on the results of the 1943 Gobi expedition and data from questionnaires, A. G. Bannikov (1945) estimated the population to be 300 head at that time. In 1959—1960 this part of the range was inhabited by 400—600 head (Dementyev, Tsevegmid, 1963). These numbers were not the result of specific calculations, but ensued rather from general judgments of the state of camel populations and various observations under natural conditions. In August 1974 28 camels were recorded on a motor transect 600 km long through various parts of the Gobi. Based on these data, their overall numbers were estimated to be 900 head (Bannikov, 1975). In 1975—1976 members of the Soviet-Mongolian biological expedition made estimates of the numbers of wild camels along aerial and motor transects. Twenty-six camels were seen on a 930 km motor transect and 18 camels were counted on a 650 km air transect. Proceeding from these data the number of wild camels was estimated at 400 head (Sokolov, Orlov, 1977; Sokolov, Dulamtseren, Khotolkhu, Orlov, 1978). We believe that the discrepancy between the results of the two censuses ensues from different estimates of the range area rather than from actual differences in population numbers.

In connection with the organization of the Great Gobi Reserve, broader and more systematic censuses were conducted in 1980—1982, particularly to determine the population of the wild camel. The counts were taken chiefly from AN-2 aircraft, although also on motor transects which embraced the major part of Trans-Altai Gobi, except for a 30 kilometer strip along the national frontier.

It should be noted that the detailed study of the Trans-Altai Gobi undertaken in conjunction with the UNEP Project has developed more complete data on the main ecological parameters of wild camel populations, particularly with respect to total numbers, density within the various natural regions, spatial distribution and principal ecological characteristics of this little-known species.

Tables 14 and 15 present the main results of the census studies of the wild camel population obtained by aerial and motor-route counts in 1980—1982.

Census transects exceeding 5,000 km were made in the Trans-Altai Gobi, covering strips of 178,000 ha to 630,000 ha at various periods. A total of 838 wild camels were recorded on six transects during the summer-autumn period. The most productive motor transects were made in July—August 1981 and October 1981 when the maximum numbers of 131 and 151 wild camels were counted. Analysis of these results has shown that the motor-route count carried out in July—August 1981 was the most reliable for calculating the overall population numbers since it covered the largest area involving all regions which wild camels inhabit in the Trans-Altai Gobi. At the same time the population of camels was relatively evenly distributed across the whole of the territory under investigation

Table 14

SUMMARY OF WILD CAMEL CENSUS ON MOTOR TRANSECTS IN THE TRANS-ALTAI GOBI

Census Data	7/1980	8/1980	10/1980	6/1981	7—8/1981	9/1981
Transect length (km)	446	501	902	570	1448	1576
Transect area (000 ha)	178.4	200.4	360.8	228.0	579.2	630.4
Animals sighted	4	19	23	30	131	151
Mean density per 1000 ha	0.02	0.09	0.06	0.1	0.23	0.24

Table 15

SUMMARY OF WILD CAMEL CENSUS ON AERIAL TRANSECTS IN THE TRANS-ALTAI GOBI

Census Data	9/1980	3/1981	6/1981	8/1981	12/1981	3/1982
Transect length (km)	1680	1510	1487	1805	1639	1535
Transect area (000 ha)	504.0	453.0	446.1	487.5	491.7	460.5
Animals sighted	118	31	59	128	269	285
Mean density per 1000 ha	0.23	0.07	0.13	0.27	0.55	0.61

permitting extrapolation of the mean population density of 0.23 individuals per 1,000 ha to the total area of the wild camel's range in the Trans-Altai Gobi.

Aerial counts were performed six times on fixed transects. Their total length was 9,656 km, the area covered by the survey amounting to 28,968 sq. km. A total of 890 camels were recorded during this study. Analysis of the data obtained indicates that the largest numbers of wild camels were observed in September 1980, August and December 1981 and March 1982.

The first two counts give an idea of the population state and distribution of wild camels in late summer and fall. Analysis of aerial sightings shows that the animals are distributed relatively uniformly throughout the area and therefore the figure of 0.23—0.27 individuals per 1,000 ha can be used as the density for purposes of estimating the total population of camels. The winter and spring aerial counts (December 1981 and March 1982) revealed a very interesting distribution pattern. In these months almost all the animals move to the southern part of the reserve. A significant concentration of wild camels is noted in various places, such as the Arslan-Khairkhan, Atas-Ula, Dzun, and Barun-Shargyn-Gol mountains, that serve as regular wintering grounds for the animals. Interesting data on distribution were obtained in December 1981, when almost solid snow cover as thick as 10—15 cm in some places occurred in the northern part of the Trans-Altai Gobi. In these conditions almost all the wild camels moved into the snow-free areas of the reserve further to the south.

In this period several sites of increased concentration were noted outside the zone of solid snow cover. Thus, these data indicate that the total area inhabited by wild camels is diminished in the winter-spring period, when they concentrate in various places where the conditions are more favorable. Consequently, it was in this period that various medium-sized herds, as well as groups of up to 70 animals, were recorded on the southern segments of the transects. It should be noted that in some years the camels appear to move in the winter-spring period to the southernmost areas of the Trans-Altai Gobi which are adjacent to the national frontier and were not covered by the aerial surveys. This is indicated by the results of the March 1981 census, when a total of 31 animals were counted on the aerial transects. Thus, taking into account the irregular patterns of wild camel distribution in the area and the fact that the animals reside mainly in part of the Trans-Altai Gobi during the spring-winter period, we considered it possible to exclude the results of the March count from the estimates and use only data from the summer-autumn aerial census which in our view give a more accurate evaluation of the camel population.

At the same time, the results of the winter-spring census when 269—285 camels were counted are also indicative of the level of the species' population. We attempted to calculate the total population numbers, bearing in mind the above observations (Table 16). Analyzing the census samples taken on the transects and extrapolating for the range area of 28,000 sq. km., we arrived at a statistical population of wild camels in the Trans-Altai Gobi (i. e. within the reserve) of 500—800 head. This population level raises hopes that the species can be preserved in the Trans-Altai

Table 16

ESTIMATES OF THE WILD CAMEL POPULATION OF THE TRANS-ALTAI GOBI

Indices	Sept. 5—13 1980	July 16—Aug. 2 1981
Transect length (km)	1680	1448
Transect width (km)	3	4
Transect area (sq. km)	5040	5792
Number of wild camels observed	118	131
Average density per 10 sq. km	0.23	0.23
Range area (000 sq. km)	28	28
Estimated number of wild camels	644±134	644±139

Gobi provided necessary protective measures are taken within the reserve.

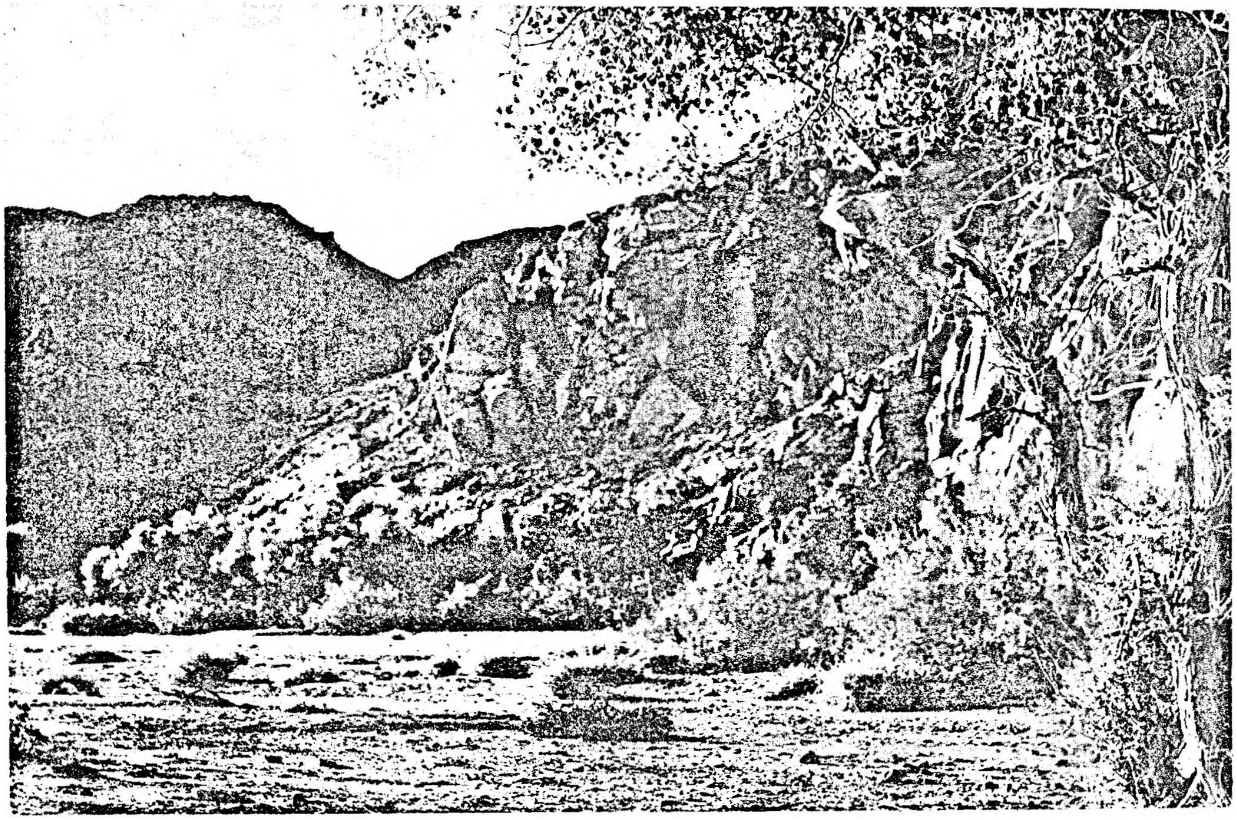
Thus, long-term observations show that the present-day population of wild camels in the Trans-Altai Gobi is fully viable in terms of both structure and total numbers. Sightings of herds of various sizes and of concentrations of animals including females with young in different parts of their range are indicative of the reproductive capacity of the population. Thus far, no signs of its decline have been noted. All this testifies to a certain degree of biological stability in the population and its ability to survive.

Habitat and ecological characteristics. Wild camels inhabit an area that lies entirely within the zones of true and superarid Central Asian deserts. The climate of these zones is characterized by extreme continentality and aridity. Diurnal and seasonal air temperatures range from —33 to +40°C and soil temperatures from —33 to +70°C. Annual precipitation is extremely low, 30—35 mm, and very irregular both temporally and spatially. In some areas there is no rain for two or three years in a row. The precipitation maximum occurs in a short period during the summer, from the second half of July to the middle or end of August. There are three natural and climatic zones in the Trans-Altai Gobi: steppe-like, true and superarid deserts (Rachkovskaya, Volkova, 1977).

The narrow strip of steppe-like deserts stretches through the northenmost part of the Trans-Altai Gobi in the foothills of the Mongolian Altai at an elevation of 1,500 and 1,800 m above sea level. Desert plant communities composed of anabasis with grasses and onions are dominant here. There are presently no wild camels within this zone.

The vegetation of the two other zones consists of dwarf shrub and scrub communities. Perennial grasses and onions occur sporadically or not at all in the phytocenoses. In the true desert zone, which contains only the northernmost part of the present-day camel range, the plains are dominated by saxaul and nitrebush stands, and more rarely, by bean caper associations or communities of ephemeral plants. Anabasis and sympegma communities occur on the hummocks and foothill plains. A considerable part of the Trans-Altai Gobi (about 75% of its area) is occupied by superarid deserts that embrace the basic range of wild camels. This desert type is characterized by an extremely sparse and patchy distribution of plants. As a rule higher plant communities are concentrated only in depressions or in dry water-ways (sairs) of different depths. Watershed plains (meso-plateaux) are devoid of vegetation. In the hummocky terrain, as well as in the low and mid-elevation mountains, plant communities are localized either on northern slopes or in ravines and inter-hill gorges (troughs). Desert shrubs and semi-shrubs are also dominant in this zone. The basic dominant plant species in the hummocks and low-altitude mountains are Zaysan saxaul, nitrebush, Przhevalsky's ephedra, Dzungarian reaumuria, Regel's ilyinia, several varieties of bean caper, Regel's sympegma and anabasis. Occasional sections of steppe-like mountain deserts with winter fat, mountain desert steppes with feather-grass and dry mountain

Herd of camels (more than 60 individuals) from an aircraft. North of Atas-Ula. September 1981. Photograph by K. Ye. Bugayev



Granite hummocks south of the Chingiz-Ula mountain massif. Isolated downy poplars and tamarisk shrubs grow in the ravines. Habitat of the wild camel

steppes with couch-grass occur in the mid-altitude mountains at heights of 1,800 to 2,300—2,600 m above sea level. Hummocky terrain and mountain highlands occupy more than half of the total area of the superarid desert zone. Small oases (2—5 to 30—40 ha) with permanently watered soil occur at the sites of water outcrops both in the plains and mountains. Here there are small groves of downy poplar, tamarisk thickets, nitrebush and desert willow stands, reedbeds, sedges, wood-reed and other mesophytic grasses and various herbaceous plants. There are only a few such sites and they are separated from each other by considerable distances. The majority of oases have small water sources which may be used by wild animals (camels, wild asses, Persian gazelles, Asiatic wild sheep and large carnivores, including wolves and Gobi bears).

Our observations and those of other authors indicate that the main wild camel habitats are found in the following types of terrain: foothill plains with large sairs and troughs, undrained enclosed basins, hummocks, low and mid-altitude mountains with inter-hill troughs and canyons and oases on the plains and in the mountains. We could establish no strict association of wild camels with a given habitat type, although in summer they keep basically to the foothill plains, undrained basins and hummocky terrain, while in winter and autumn they are found more in gorges, inter-hill troughs and oases with scrub forest. Nevertheless, wild camels can be seen in all these habitats in any season of the year. In the summer-autumn period the animals occur with approximately the same frequency on the plains and in the mountains and hummocks. Apparently, they can make use of different habitats within a twenty-four hour period. The association of these animals with a given section of the desert is conditioned not only by the state of the pastures but also by the availability of shelter and the presence of accessible water sources in the form of springs or temporary rain pools.

During the 1980—1982 aerial and terrestrial counts the majority of wild camel sightings occurred in desert areas with permanent or temporary watering-points (springs, outcrops of water on granite, etc.). Indicative of these distribution patterns is the occurrence of wild camels in the period between July 16 and August 2, 1981, as observed on a transect of more than 1,400 km within the Great Gobi Reserve. During this time 17 herds were recorded in different parts of the Gobi (131 animals in all). Half of them were seen in the immediate vicinity of oases, 36% within a radius of 15 km and 14% in a radius of 15—35 km. Heavy rains were recorded in the Trans-Altai Gobi in July and early August 1981. The significance of oases and their water sources for the distribution of wild camels must be even more pronounced in dry seasons (spring and the first half of summer). Oases attract these ungulates not only as water sources and drinking holes, but also as good feeding grounds with a rich selection of scrub and herbaceous vegetation.

The present-day range of the wild camel lies principally within the territory of the Trans-Altai Gobi which has two latitudinally oriented zones of true and superarid deserts and a system of altitudinal steppe and desert belts, mainly within the Gobi Tien-Shan (Atas-Ula, Chingiz-Ula, Tsagan-Bogdo). According to current physiographic concepts, the Trans-Altai Gobi is subdivided into 11 natural regions each with uniform natural conditions. The main habitats of wild camels are situated in the superarid desert zone and only partly in the true desert zone. The 1980—1982 sightings of wild camels in the various natural regions were analyzed with respect to their occurrence in the winter-spring and summer-autumn periods in order to establish general patterns of spatial structure in the wild camel population.

The characteristics of the spatial distribution are shown on the sketch-map and table 17, which give average values of the population density in the various natural regions. Analysis of these data shows that the distribution of wild camels in the Trans-Altai Gobi is very irregular. In 1980—1982 wild camel sightings were regularly recorded in seven natural regions only, while they were absent in four others (Edrengiyn, Tsagan-Bogdo, Ekhiyn-Gol, Bei-Shan). Within the area of permanent habitation, regions of concentration with increased population density are quite clearly defined.

In the summer and autumn months (from June until November) wild camels regularly occur in the northwest part of the reserve (Shivet-Ula and Otgon-Us natural regions). Here, the mean population density reaches quite high values — 0.3 individuals per 1,000 ha. The main relief forms in these regions are low mountains and hummocks (Shivet-Ula) or plains and basins in the vicinity of Otgon-Us spring. Saxaul is widely distributed on the plains, with anabasis and sympegma formations in the hummocks. The pastures have moderate productivity. The water-supply in this region is good owing to the presence of permanent springs: Takhilt-Us in the west, Otgon-Us in the east and Maikhan-Bulak, one of the largest open-type springs in the Trans-Altai Gobi, between them. As seen on the map, the majority of wild camel sightings occurred in the vicinity of these springs. There are also small springs on the southern bel of the Edrengiyn-Nuru ridge. Temporary water sources which occur in the form of temporary pools on takyrs and in granite bowls can also be used by wild camels in the rainy season (July-August). Quite rich succulent vegetation consisting of sedge and dry lyme-grass meadows, achnatherum growth, reedbeds and tamarisk tugais occur in the desert areas near springs (especially Maikhan-Bulak spring). There are good summer-autumn pastures within 25—30 km of the springs composed of multispecies saxaul scrub in sairs and on the periphery of basins and anabasis-sympegma associations on hummocks. Small patches of steppe-like deserts with feather-grass and onion formations occur on high altitude hummocks.

Table 17

DISTRIBUTION OF WILD CAMELS BY NATURAL REGIONS OF THE TRANS-ALTAI GOBI

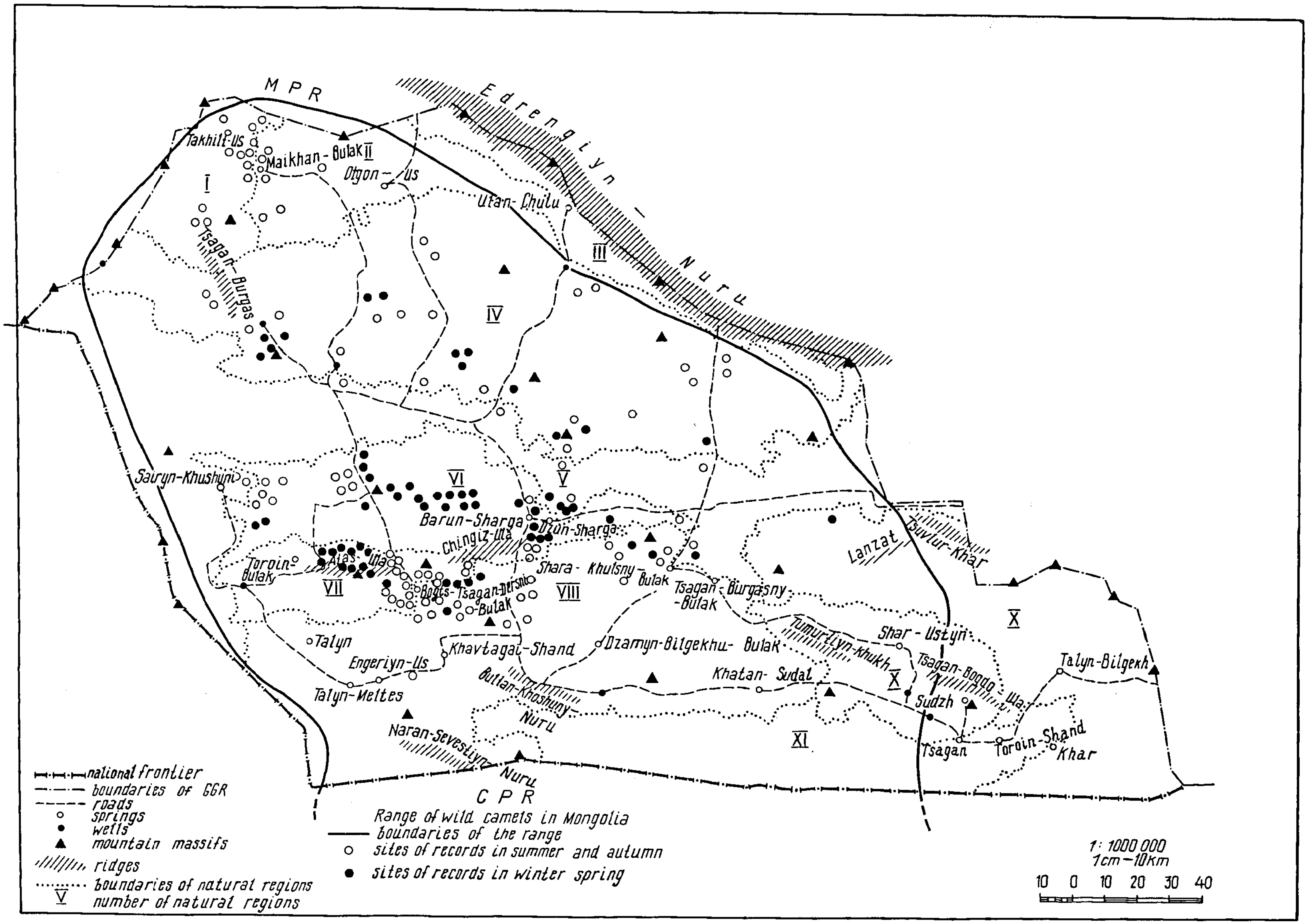
Region	Density of wild camels per 1000 ha	
	summer-autumn	winter-spring
Shivet-Ula	0.30	—
Otgon-Ula	0.30	—
Edrengiyn	—	—
Bouryn-Khyar	0.12	0.08
Nomin Gobi-Tsenkherkholoi	0.04	—
Shargyn Gobi	0.02	0.9
Atas-Chingiz	0.27	1.5
Central Gobi-Tien-Shan	0.07	0.07
Tsagan-Bogdo	—	—
Ekhiyn-Gol	—	—
Bei-Shan	—	—

Thus, good water-supply and diverse pasture vegetation determine the concentration of wild camels in the northwest part of the Trans-Altai Gobi. It should be noted, however, that as a rule, they are absent here in the cold season. In autumn, the flocks move further south apparently under the effect of harsh weather conditions and lack of good shelter (gorges, oases with trees).

The main areas of winter-spring concentration are located in the northern and to some extent in the central portions of the Trans-Altai Gobi. One such area is the Shargyn-Gobi natural region, where significant concentrations of camels regularly occur. Their average population density reaches high levels — 0.9 individuals per 1,000 ha. The most regular winter concentrations of wild camels have been observed in the Barun-Shargyn-Gol and Dzun-Shargyn-Gol oases. This area has a small spring with a rush-sedge marsh. In the low area to the east of the spring there are thick stands of scrub represented by gallery forests of downy poplar along with patches of saxaul scrub and tamarisk stands. There are also small riparian groves in high-altitude hummocky terrain around the Shargyn-Gobi basin. The wild camel concentrations in this region are conditioned not only by the presence of scrub forest vegetation, but also by the milder weather conditions found here during the cold season. During our winter counts, we observed no snow cover here, whereas snow falls are known to occur on occasion in the areas further to the north. The wind regime appears more favorable here as well. We regularly observed concentrations of wild camels at Barun-Shargyn-Gol. For example, eight herds numbering 67 wild camels were observed here in March 1982, and about 200 animals gathered during the winter of 1970 (Bannikov, 1975). More than 150 wild camels were seen near mount Arslan-Khairkhan in December 1981.

Another place of winter concentration of wild camels is the Atas-Ula and Chingiz-Ula mountain massifs. This area has good year-round pastures with multispecies shrubs and anabasis-sympegma associations. The mountains above 1,800 m support a steppe-like desert belt with plant cover represented by feather-grass-anabasis-winter fat and couch grass-winter fat formations. The highest parts of the Atas-Ula massif are occupied by the dry steppe belt with couch grass-feather grass associations (Rachkovskaya, Volkova, 1977). The region has a good water-supply provided by permanent water sources.

Water sources in the Atas-Bogdo-Ula massif are as a rule located in the foothills or the high-altitude hummocky terrain. The largest springs regularly used by wild camels and wild asses are Toroin-Bulak (northwest foothills) and Bogts-Tsagan-Dersni-Bulak on the southeast slope of Atas-Bogdo-Ula. The former



Range and seasonal distribution of wild camels in the Trans-Altai Gobi is situated in a mountain gorge (see photograph) with small groves of downy poplar, tamarisk growth and reedbeds, as well as dry lyme-grass meadows. This oasis is well sheltered from the north and west winds. The Bogts-Tsagan-Dersni-Bulak spring, on the other hand, is situated on an open gently sloping plain in a shallow basin covered by a thick growth of achnatherum, nitrebush and tamarisk. Besides these springs, outcrops of underground waters in the form of small pools are found in some large sairs that cut through the granite hummocks south of the Chingiz-Ula massif. Such places have small riparian groves with individual downy poplar trees and tamarisk bushes as well as sections of saxaul scrub. Good pastures covered by scrub forest and herbaceous plants, along with deep gorge-protected from the wind account for the attachment of wild camels to this natural region. Moreover, these places are remote from roads and infrequently visited by people. The average population density of wild camels in the winter-spring period is 1.5 individuals per 1,000 ha. A group of more than 170 animals was observed on the northern slope of the Atas-Bogdo-Ula and around the Bogts-Tsagan-Dersni-Bulak spring at the end of March and beginning of April 1982. There are also resident concentrations of animals in this region in the summer-autumn period. Thus, from June 1980 until October 1981 herds of camels were regularly recorded here, principally near springs. For instance, 68 camels were counted on September 16, 1980, in the 60 sq. km. area around Bogts-Tsagan-Dersny-Bulak spring. Two herds numbering 21 animals in all were seen at the Toroin-Bulak oasis on July 18, 1981. Five flocks that totalled 56 head were encountered on July 23, 1981, near Mazalai-Bulak and Dzun-Narin-Khundi south of Chingiz-Ula.

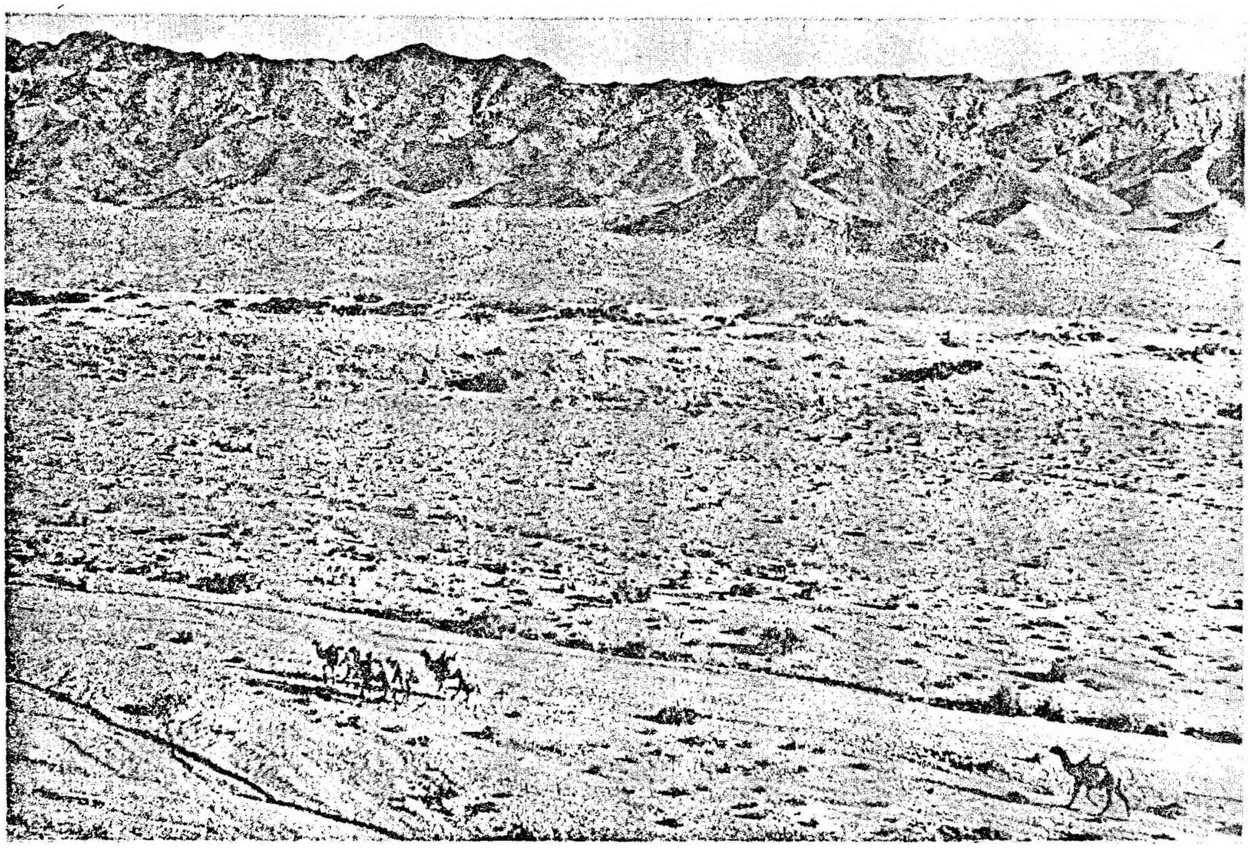
A wide strip of waterless stony deserts lies between the northern and southern areas of wild camel concentration (the Buryn-Khyar and Nomin-Gobi natural regions). Geologically this part of the Trans-Altai Gobi is a downwarp between the Gobi Altai and Gobi Tien-Shan mountain systems. The terrain consists of plains and low hummocks. These regions have no permanent springs and temporary water sources form here and there only in the rainy season (July-August). Pastures are also very poor here. Very sparse saxaul and ephedra growth is concentrated along the beds of sairs, while the major part of this belt of "black sairs" is generally devoid of vegetation, the isolated ilyinia bushes being separated from each other by scores or hundreds of meters. The lack of permanent water sources and the extremely poor fodder resources of the area determine the low population density of wild camels, 0.04—0.12 individuals per 1,000 ha. Camels were observed in this area only during their migrations from the northern to the southern parts of the Trans-Altai Gobi and back. The majority of herds were seen moving along the sairs which cross this area longitudinally. There are distinct wild camel trails stretching for dozens of kilometers over some hammadas.

Wild camels have also been seen quite rarely in the area of the Tsagan-Bogdo massif, as well as in the western part of the reserve near Ekhiyn-Gol oasis. The natural conditions in these areas are on the whole favorable for camels though subject to anthropogenic impact. Many springs are occupied by man (frontier guard posts) and motor routes cross the area in several places, apparently impeding the use of the area by camels.

The data available on the distribution of wild camels indicates significant seasonal variation in the size of the area they inhabit. In summer the herds disperse as they move to the flat country in the northwest part of the Trans-Altai Gobi. We believe that this distribution pattern is accounted for by the necessity of wild camels to spread over as great an area as possible to make use of both permanent (Maikhan-Bulak, Takhilt-Us, Otgon-Us, etc.) and temporary water sources during the hot season.

The area inhabited by wild camels decreases in winter when the animals concentrate in a few desert areas which have oases with scrub forest, in the mountain uplands or in intermountain basins with good shelter. The high density of wild camel populations on their wintering grounds is undoubtedly possible due to a lesser dependence on water sources during the cold period when the key factor affecting their winter-spring distribution is primarily the availability of the scrub forest vegetation which serves as their winter fodder. At the same time it should be borne in mind that the northern part of the Trans-Altai Gobi is inhabited by only a portion of the wild camel population, while the rest of the animals keep to the southern and central parcels of the Trans-Altai Gobi throughout the year.

The extremely sparse and patchy vegetation patterns and the low productivity of desert phytocenoses in the Trans-Altai Gobi are the causes of the considerable mobility of wild camels and their tendency to change their areas of habitation. The great mobility of these animals has been noted by all the authors who have observed them under natural conditions (Bannikov, 1954, et al.). From our aircraft we frequently saw columns of camels moving at speeds of 5 to 10 kmph though they were not pursued. When a herd was approached by men on foot or in a motor vehicle the animals usually left the place where they were grazing or resting and moved dozens of kilometers away. On July 18, 1981, we came across a herd of 18 animals including 6 young. Following these camels on the next day, we ascertained that the group had covered a distance of at least 40 km from 6 p. m. until sunset. On July 18, 1981, the herd was disturbed by people on foot and abandoned the Toroin-Bulak oasis, travelling in a column along a sair until it reached the southern flank of the Atas-Bogdo about 35—45 km away. The experience of domestic camel breeders also confirms the tendency of camels to change their location and move great distances. Domestic camels in Turkmenistan, for example, are known to travel as far as 700 km in winter and spring from "their permanent place of residence" (Baskin, 1978). In the Sahara these animals are prone to migrate distances of hundreds of kilometers away from their previous location (Gotie-Pilters, 1976). Our observations indicate that camels in the Trans-Altai Gobi also move great distances. During an aerial count in September 1980, we encountered a herd of 16 animals in the vicinity of Bogts-Tsagan-Dersni-Bulak spring (southeast of Atas-Bogdo), including one domestic camel (judging by the dark-brown color of its fur). In June 1981 we came across the same herd north of



A marching column of wild camels. Northern slope of the Atas-Ula. July 1981

Maikhan-Bulak spring in the Edrengiyn-Nuru foothills that is, more than 250 km away as the crow flies.

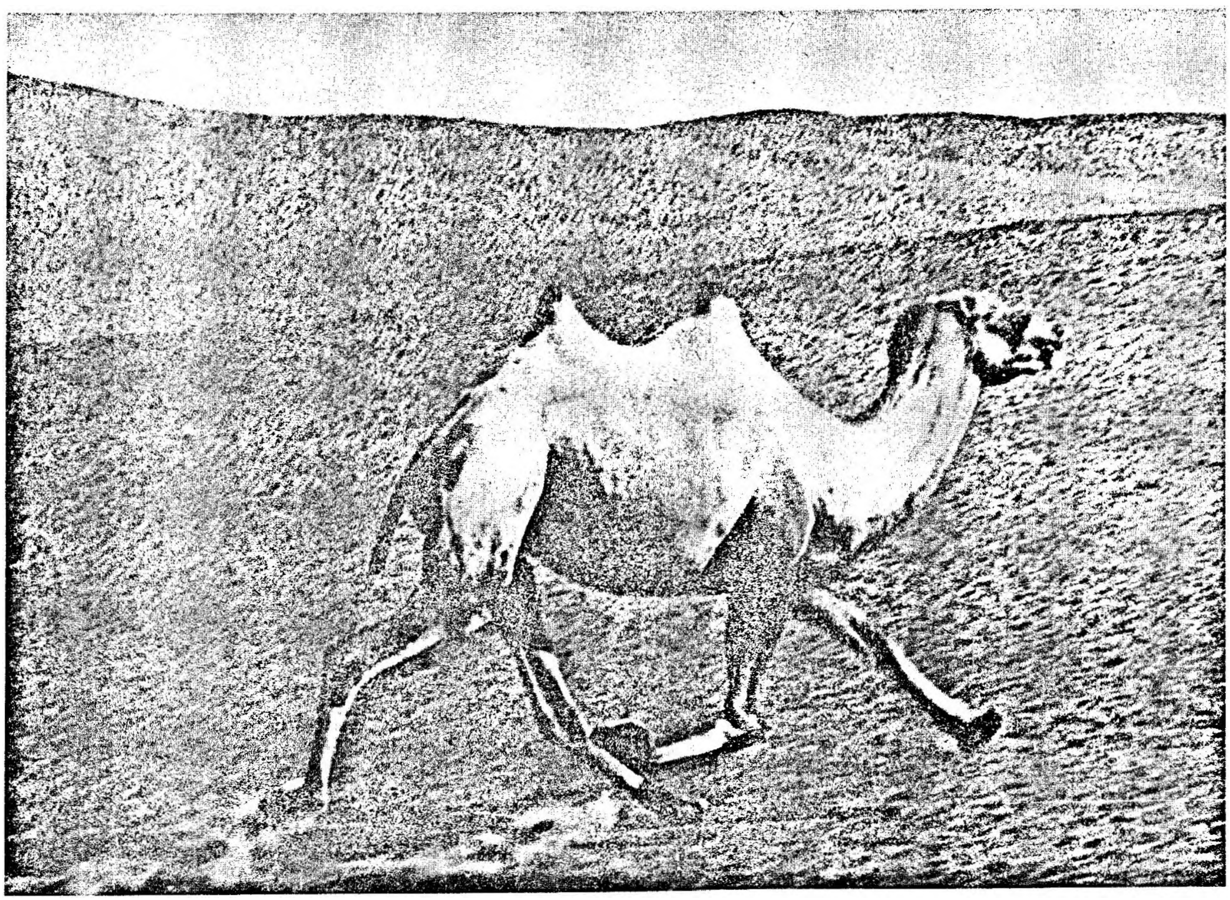
The seasonal land use patterns of wild camels described above are on the whole consistent with the observations made in the past by A. G. Bannikov and reported in his monograph **Mammals of the Mongolian People's Republic (1954).** However, it should be borne in mind that the spatial structure of wild camel populations has actually been little studied. In particular, the problem of broad, seasonal migrations is open to substantial discussion. Long-term experience with domestic camel-breeding shows that a peculiar feature of their ecology is their attachment of a fixed territory or "home" (Baskin, 1978; Gotier-Pilters, 1976). The animals usually wander away from this place, but return to it after a certain time. We share the opinion of L. Baskin, who noted that "in camels mobility is an element in the orderly use of the habitat". (Baskin, 1978).

Our observations in the Trans-Altai Gobi have shown that wherever wild camels reside there is a system of territory use represented by a network of numerous trails regularly employed by the animals that inhabit a certain desert area. Such a system of trails is manifested in areas with broken relief and in areas with permanent water-supplies. In fact, in encounters with herds of wild camels, we always noted that the animals would leave along trails when they were disturbed. Here and there in hammadas such trails stretch for dozens of kilometers and appear to be used by the animals as migration routes or "roads" connecting separate parts of their territory. We drove our motor vehicles along these trails and, as a rule, they ended at a large extended sair or at an oasis with scrub forest vegetation.

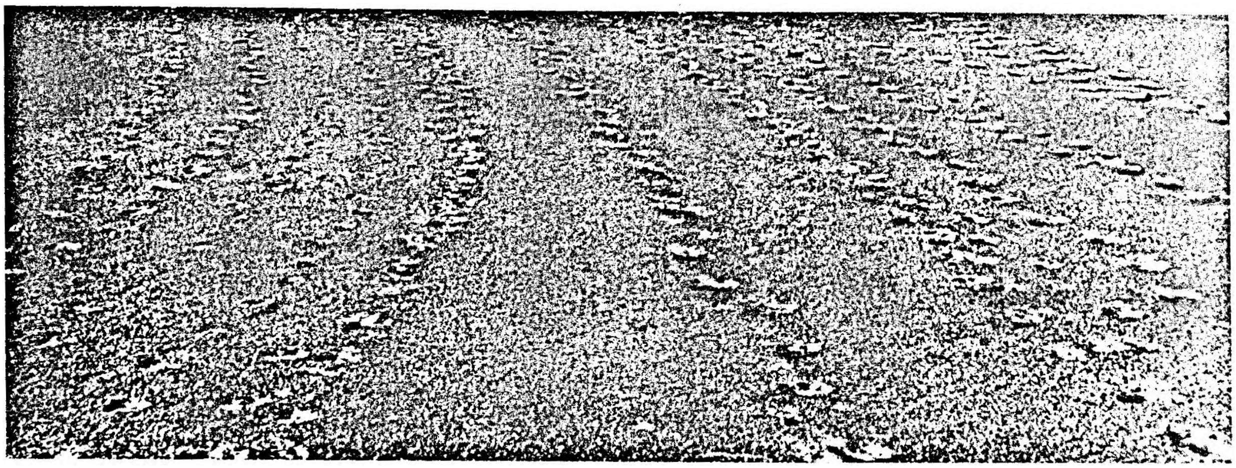
In our opinion, the fact that camels reside in the superarid deserts of the Trans-Altai Gobi, where their food resources are distributed in patches and, above all, their water-supply is limited, determined the need for them to make orderly use of their territory. This way of using the environment is only efficient under the extreme conditions of the superarid deserts. In contrast to the other ungulates of the arid zones that lead a nomadic way of life (saigas and Persian gazelles), camels can make the most effective use of their limited food resources only by successive use of local territories that have suitable plant communities. This characteristic is also indicated by experience with domestic camels, which graze within a limited territory for long periods of time (Baskin, 1978). In this connection, the data on seasonal migrations of wild camels need to be clarified. We believe that camels are capable of moving rapidly from one place (or one region) to another in any season of the year, but that clearly directional seasonal migrations regular in time and involving all the camel populations would not have developed in an environment with the unstable weather and climate conditions characteristic of superarid deserts.

The main sites of wild camel concentrations are thus limited to these desert areas where mountain highlands and hummocky terrain are combined with water sources in oases and large sairs in plains. The animals find these conditions in the northwestern and southern parts of the Trans-Altai Gobi in the mid-altitude mountain highlands of Atas-Bogdo and Chingiz-Ula and in the plains that join them. The spurs of these mountains have permanent and intermittent water sources (the springs of Toroin-Bulak, Bogts-Tsagan-Dersni-Bulak, etc.) near hummocky terrain with deep gorges covered by scrub forest (poplar, tamarisk, etc.) and foothill plains with rich saxaul growth along the sairs. Between the northern and southern areas of concentration there is a belt of almost absolute waterless deserts where camels are found only during migrations.

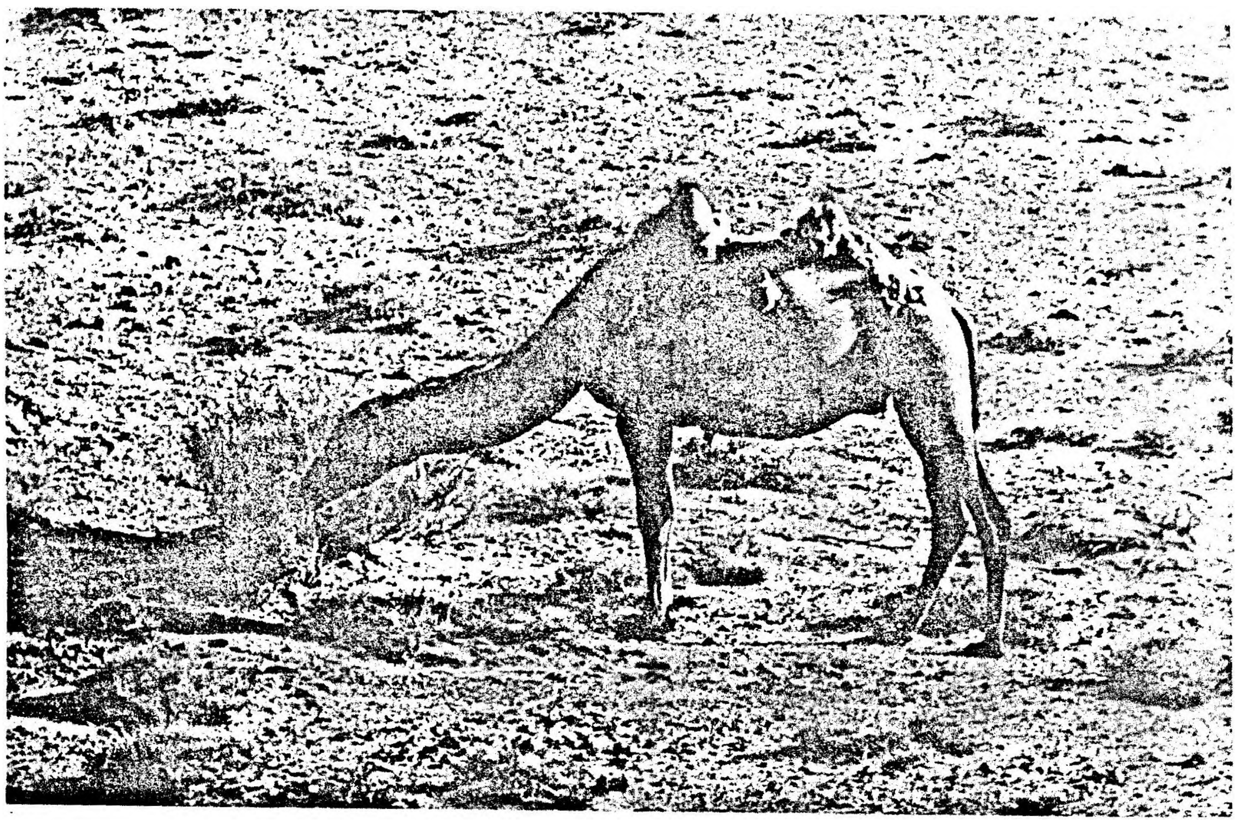
Forage composition and grazing and watering habits. The suitability of a given landscape as a habitat for wild camels and the seasonal patterns of their distribution in different natural regions are determined to a great extent by the composition, abundance and availability of fodder plants and water sources, which are of paramount importance in the ecology of desert animals, especially such large ones as wild camels. It should be borne in mind that this aspect of camel ecology has been studied very little. Thus, the most recent scientific literature (Bannikov, 1954 et al.) contains only isolated observations on the diet of wild camels on their pastures and the most general judgements on their watering habits. Thus, A. G. Bannikov, citing N. M. Przhevalsky (1878), M. Pevtsov (1895) and V. Roborovsky (1900), writes in his monograph **Mammals of the Mongolian People's Republic** (1954) that "halophytic shrubs and semi-shrubs are the main food of wild camels». But on the basis of his direct, on-the-spot observations, Bannikov (1954) concluded that the principal summer fodder plants of the wild camel are anabasis, Mongolian onion, Gobi feather-grass, bean caper, Russian thistle, sympegma and saxaul sprouts. A. Symukov (1935) observed a herd of wild camels in autumn feeding on the fallen leaves of a downy poplar at their pasture in the Toroi-Shanda oasis and this is all the data in the literature on the composition of the wild camel's diet. In the course of our land-based studies we examined all the traces of consumption of plants by wild camels and in some cases made direct observations of grazing animals. On July 18, 1981, we succeeded in observing two grazing herds (21 camels) for two hours (4 to 6 p. m.) at the Toroin-Bulak oasis on the northwest slope of Atas-Bogdo ridge. During this time the camels ate the following vegetation: tamarisk twigs, leaves and twigs of downy poplar, sprouts of saxaul, Russian thistle and reaumuria, twigs and berries of nitrebushes and ears and leaves of lyme-grass. Tamarisk, poplar, reaumuria, Russian thistle and lyme-grass were their favourite foods. At the same period in other places we found traces of the consumption of reed, bean caper, Regel's ilyinia, Siberian nitrebush, dontosemon, sympegma, onion, several species of wormwood and sedge.



Running wild camel. Near Dzun-Tooroin-Nuru. Photograph by K. Ye. Bugayev



Wild camel tracks on a hammada. North of the Atas-Ula Mountains, July 1981



A wild camel grazing. Toroin-Bulak, Atas-Ula. July 18, 1981

Our records of plants consumed by wild camels along with direct observations at their pastures showed that they fed on 27 species in the Trans-Altai Gobi during the summer-autumn period. These included nine grasses and herbaceous perennials: lymegrass (Legmus secolimus), reed (Phragmites communis), Gobi feather-grass (Stipa gobica), shining achnatherum (Lasignostis splendedens), bean caper (Zygophyllum gobicum), rhubarb (Rheum nanum), dontosemon (Dontosemon elegans), pepper-grass (Lepidium obtassum); two species of worm-wood (Artemisia sp.); one species of tree, downy poplar (Populus diversifolia); eight semi-shrubs: short-leaf anabasis (Anabasis brevifolia), Regel's sympegma (Sympegma regelii), winter fat (Eurotia ceratoides), Russian thistle (Calidium foliatum), Regel's ilyinia (Ilynia Regelii), Dzungarian reaumuria (Reamuria songorica) and nine shrub species: Mongolian caligonum (Calligonum mongolicum), Przhevalsky's ephedra (Ephedra przewalskii), yellow bean caper (Zygophyllum xanthorylon), tamarisk (Tamarix), wolfberry (Lycium ruthenicum), Roborovsky's nitrebush (Nitraria roborowskii), Siberian nitrebush (Nitraria sibirica), Zaysan saxaul (Haloxylon ammodendron), white pea-tree (Caragana leucophloen).

Thus, it may be concluded from our observations that the basic food stock of wild camels consists of the drought-resistant shrubs, semi-shrubs and semi-herbaceous halophytes which form the main plant communities of the Central Asian deserts. Grasses, onions and herbaceous plants are consumed only during their short growing seasons and apparently serve only as secondary seasonal fodder. The leaves and twigs of downy poplar as well as the twigs of tamarisk are of particular importance since wild camels will feed on them throughout the year (Yunatov, 1950).

The list of fodder plants we have presented is of course not complete and exhaustive. Nevertheless, it includes the basic Central Asian desert plants that form the principal dominant plant communities. There is no doubt that the list of fodder plants is going to be expanded through the inclusion of species consumed by wild camels in winter and spring for which we have no direct observations. Judgments on the nature of their winter diet can only be gained from indirect data. Thus, in the winter concentration areas of camels, which are generally situated in oases with scrub forest vegetation or in mountain ravines with tamarisk stands, we noted that shoots of downy poplar and tamarisk growth showed signs of systematic gnawing at heights of 2.5—3.0 m. i. e. as high as the animals could reach. Wherever wild camels are for some reason absent as in oases with human population (Ekhiyn-Gol, etc.), the downy poplar groves have a well developed undergrowth of young poplars. These observations indicate that oases with scrub forest vegetation (downy poplar, tamarisk, reedbeds) serve as good reserve foraging grounds during winter. Analysis of the leaves and shoots of downy poplar revealed that they have a high nutritive value compared to such fodder plants as Gobi feather-grass or anabasis (Table 18).

Table 18

CHEMICAL COMPOSITION OF LEAVES AND SHOOTS OF DOWNY POPLAR (PER CENT OF ABSOLUTE DRY WEIGHT) *

Parts of plants	Moisture	Raw fat	Raw protein	Cellulose	Ash	Nitrogen-free extractive substances
Young shoots	8.7	5.7	8.4	32.1	4.9	48.9
Leaves	10.2	4.8	13.6	14.8	10.1	56.7
Old shoots (twigs)	8.7	6.9	7.1	20.4	6.6	59.0
Last year's fallen leaves	10.0	3.3	5.8	17.1	11.1	62.7

* The authors acknowledge the assistance of K. I. Anisimova (Institute of Botany, USSR Academy of Sciences) who performed the chemical analyses.

The ecological structure of the wild camel population is also characterized by adaptations to the conditions of desert habitation. These ungulates live in small groups. The average number of animals in a herd is 7.3, based on the data in Table 19. The number of individuals in a group varies in different seasons, averaging 3.7 in August and 12.8 in December.

Table 19

HERD SIZE IN WILD CAMELS

Month	No. of herds	No. of camels	Average herd size
March	8	49	6.1
May *	25	161	6.4
June	18	98	5.1
July	17	131	7.7
August	13	49	3.7
September	16	118	7.8
October	7	37	5.2
November *	12	96	8.0
December	21	269	12.8

* Observed personally by Ya. Dush and A. Shanyavsky in 1975—77.

Groups of larger size are noted much more rarely and evidently result from temporary joining of small herds during migrations, at oasis watering-points or on some parcels of rangeland. Even greater concentrations of wild camels are also known. For instance in winter, A. G. Bannikov (1975) saw herds of 200 and 60 camels in the Dzun-Shargin-Gol and Dzam-Bilgekhu oases respectively. In October 1977 a concentration of over 100 wild camels, including 15 very young animals, were observed around the Bogts-Tsagan-Dersni-Bulak oasis. We also saw groups of 60—70 animals on more than one occasion. Observations of domestic camels (Baskin, 1978) have established that the most stable groups comprise pregnant females, females with young and unattached males. The same appears to be true of wild camels. Herds are formed on the basis of similar requirements of animals of different ages and sexes for pastures, shelter and apparently protection from beasts of prey. The sex and age composition of wild camel herds has still not been adequately studied. However, our observations indicate that as a rule the most stable herds consist of a few females with young of different ages and one or two adult males, one of which serves as the leader. Thus, the organization of wild camels into small groups is an adaptation to existence under conditions of dispersed food resources and low productivity of desert pastures.

The reproductive patterns and population dynamics of wild camels are almost unknown. Like domestic animals, they seem to reach maturity late, at an age of 3 to 5 years. Females can mate in their third year, while males can do so in their fourth or fifth year (Lakoza, Shchekin, 1964). Rut is from January through March, but most often in February. During this period mature males form harems of females in heat. A male may have as many as twenty or more females in his harem (Przhevalsky, 1876; Bannikov, 1954). Pregnancy lasts for about 13 months. A female gives birth to only one young at a time and suckles it for more than a year. It appears that a female can maintain no more than one young during a period of two to two and a half years. On the whole the reproductive capacity of wild camels is low. In 1980—1982 the number of young we counted in dif-

Table 20

PERCENTAGE OF YOUNG ANIMALS IN WILD CAMEL HERDS

	Total Number of Animals	
	adult and young	young
June—August 1980—1981	182	24—13.1%
September 1981	151	12— 7.9%
December 1981	269	33—12.2%
Total:	602	69—11.4%

ferent herds ranged from 7.9 to 13.1% of the total population of the census (Table 20).

At the same time the regular occurrence of young animals in wild camel herds is indicative of a normal course of reproduction in the given population.

The factors limiting wild camel numbers in nature have not yet been adequately studied. In the Trans-Altai Gobi their natural enemies apparently include the wolf, which is quite common in all the major oases. Remains of a young wild camel killed by wolves were found in August 1980. But wolves are apparently not dangerous to adult camels. Wild camels may become involved in epizootics of certain communicable and parasitic diseases in areas where they come into contact with domestic animals. Thus, according to V. Litvinov, mange was found among the wild camels in the Trans-Altai Gobi in 1975—1977, and cases of the death of wild camels from this disease were observed by members of the reserve staff in the northern part of Trans-Altai Gobi. Considering the high population density observed on their wintering grounds, wild camels must be considered to be in real danger of the spread of mange.

Analysis of the long-term dynamics of the wild camel's range and numbers shows that in the past the population state has been dependent to a significant degree on the direct and indirect effect of anthropogenic factors.

In the past wild camels were regularly hunted throughout their range. Such hunts are described by many authors (Przhevalsky, 1878 et al.). The pursuit of wild camels by hunters resulted in a decline of their population primarily in those parts of the Central Asian deserts where permanent settlements were located or where caravan paths ran. However, the key factor that caused a decline in the numbers and range of the wild camel was the settlement of the deserts during the last 50—60 years and particularly the penetration of men and domestic animals into the oases. The disappearance of wild camels from the southern and eastern parts of their former range is directly related to the settlement of oases within the Mongolian People's Republic and particularly in China. In the period from the 1920's through the 1940's many oases in the Trans-Altai Gobi with good springs (Maikhan-Bulak, Toroin-Bulak, etc.) were occupied by man, principally emigres from China who cultivated secret plantations of the opium poppy (remains of their irrigation systems are still visible in these oases). Wild camels first abandoned those areas of the Gobi where permanent or temporary settlements were established. Gradually their range diminished. Their present day range occupies generally only those parts of the desert which for some reason or the other are still sparsely populated. Wild camels are extremely shy and cannot tolerate human presence. Their behavior is apparently the consequence of their unceasing pursuit by local hunters which has been practised in Central Asia from time immemorial.

The long-term direct and indirect anthropogenic impact upon wild camels over a long period has in the end resulted in the decline of their range and numbers.

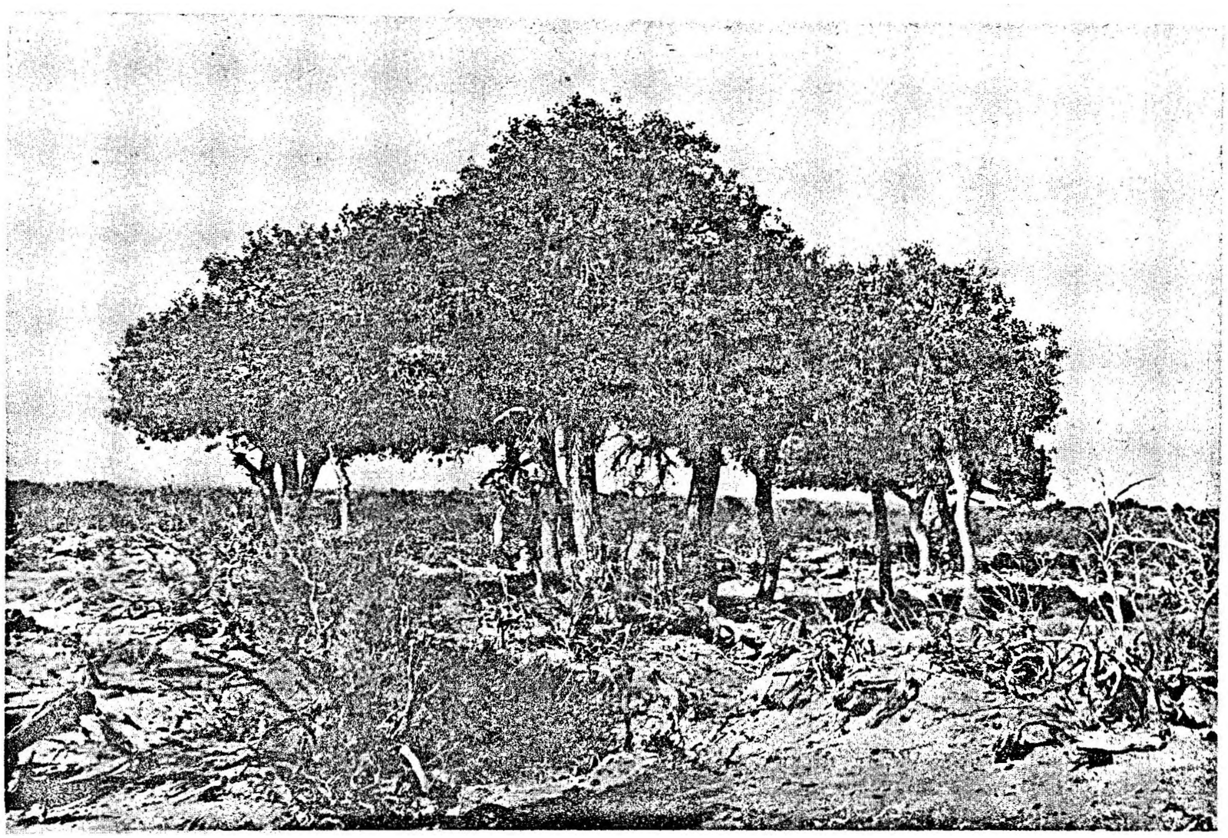
In the Mongolian People's Republic the animals have been protected since the 1940's. However, in the past the prohibition against hunting was generally only enforced formally. The penetration of man into oasis settlements had an adverse effect on the wild camel population and made it very vulnerable. In 1976 the Great Khural of the Mongolian People's Republic adopted a decree to establich the Great Gobi Reserve. The decree has now been implemented and the world's largest nature reserve is now in operation. Its basic goal is to preserve the country's characteristic flora and fauna, as well as the desert landscapes and ecosystems in this natural region of the world. The range of the wild camel is totally included within one of the sectors of the reserve.

The establishment of the reserve has increased assurance that wild camels will be preserved in the Trans-Altai Gobi and reduced the risk of their extinction.

At the same time a deeper insight into the ecology of the species is needed if a scientific basis for the conservation and reestablishment of the species is to be developed. In particular, work needs to be done on the details of the winter distribution pattern, many aspects of the population dynamics and reproduction and relationships between wild and domestic camels in the areas where these species come in contact. Detailed research on the ecology of the wild camel will produce a wealth of data on the mechanisms of the animal's adaptation to its extreme environmental conditions.

The problem of "biological pollution" of the wild camel population. The wild camel described by N. M. Przhevalsky as an independent biological species represents an original wild form of the animal and, as special studies have shown, there is no basis to consider the wild camel a secondary feral form descended from the domestic Bactrian camel (Bogolyubsky, 1929; Khaveson, 1948, etc.).

The wild camel has been shown to be clearly distinct from the domestic Bactrian in terms of its morpho-anatomical structure. The wild camel is more lightly built and more slender; its legs are longer with narrow soles and nails that extend forward. There are no horny pads on the knees. The humps of wild camels are small and of a regular conical shape. The muzzle is narrow and as a whole the head is thinner than in the domestic Bactrian camel. The tuft on the head and the hair under the neck and on the shoulders in males are not as prominent as they are in domestic camels. The hair is as a rule of one color, pale-yellow or dark-yellow. During the day in sunlight wild camels appear very light-colored in contrast to the dark domestic camels (Sokolov, Orlov, 1980). The structure of skull and skeleton in the two species is also different (Khaveson, 1948; etc.). As a result, scientists agree that the Central Asian wild



Barun-Shargyn-Gol oasis, a winter concentration area of wild camels. Downy poplar grove. The lower branches of the poplars have been eaten off by camels

camel discovered and described by N. M. Przhevalsky is an original wild form and should not be considered a derivative of the domestic camel. Mongolian herdsmen make a clear distinction between wild and domestic camels giving the name of "khavtagai" to the former and "teme" to the latter (Dagva, 1954).

At the same time, doubts as to the genetic purity of the population have been raised since the discovery of the wild camel by N. M. Przhevalsky. These have been based on the presence in the population of hybrid individuals produced by crossing wild and domestic animals. The process of hybridization has most often been viewed as follows. In those places where domestic camels enter areas inhabited by wild animals, some female domestic camels in rut are driven off by male wild camels. Then, after the wild male and domestic female mate, the female leaves the area inhabited by the wild camels, withdraws to her own herd and gives birth to a hybrid young. According to Mongolian herdsmen, these hybrids have all the traits of the wild male. Since they are lightly built and are not amenable to domestication the herdsmen usually cull them out (Eregden Dagva, 1954). Theoretically females with hybrid progeny could join the wild camel herd but such a possibility has not been confirmed.

There is fair question as to how often domestic camels join the herds of their wild counterparts and what is the ratio of hybrid individuals in the wild camel population. There are no precise answers to these questions in the scientific literature. The reports published by all the scientists who visited areas inhabited by wild camels (Przhevalsky, 1878; Pevtsov, 1895; Kozlov, 1899, etc.) set out the description given above: that domestic females temporarily join wild herds and then return with their young to the areas of domestic camel-breeding. They give a very indefinite description of how the wild population might be supplemented with domestic camels. Based on these authors' data and the results of enquiries A. G. Bannikov (1954) wrote: "as most of the above investigators we assume that the wild camel population has been supplemented by domestic camels... The instances in which domestic camels have joined wild herds are numerous" *. In subsequent years this author came to a somewhat different view on this question. In 1975 he wrote that "there is no reason to suppose that the present-day population of wild camels is hybrid. The possibility of its being supplemented by domestic camels is negligible and it is correct to regard it as genetically "pure" (Bannikov, 1975, p. 65).

Studies on the genetic "purity" of the Trans-Altai Gobi population of wild camels carried out during the UNEP Project in 1980—1982 showed that there are very few cases in which domestic camels join wild herds. During this period we observed an animal with the appearance of a domestic bactrian in a wild camel herd on only two occasions. As we mentioned already, in both cases the domestic camel was observed in the same wild herd in an interval of about

* A. G. Bannikov, **Mammals of the Mongolian People's Republic**, 1954, p. 191.

one year (September 1980 and June 1981). We failed to see another domestic camel, though during the period of our field work we observed in the wild over 150 wild camel herds totalling 1248 animals. All of them were phenotypically identical to the wild form described above. Nevertheless, two areas of close contact between domestic and wild camels are always found within the range of the wild camel in the Trans-Altai Gobi. One of them is located in the northern part of Sector A along the southern bel of the Edrengiyn-Nuru ridge where numerous herds of sheep, horses and camels winter on the crest of the ridge within the buffer zone and further north. Here, domestic camels penetrate the territory of the reserve, and more than once we saw small groups of Bactrians even in summertime. The other zone of contact lies in the southeastern part of the reserve where domestic camels (about 300 head) are kept at the frontier guard posts at Tsagan-Burgasny-Bulak, Tsagan-Bulak, and other springs. These animals are maintained in a half-wild state, i. e. soldiers who act as herdsmen periodically drive the wandering camels together at water holes or the camels return to the springs by themselves. In this zone, in contrast to the northern part of the reserve wild camels are rarely seen, apparently because of the disturbance factor associated with the presence of the frontier guards.

Results of the inquiries among local herdsmen and frontier guards indicate that in 1980—1982 the total number of hybrid animals in the herds of domestic camels in the vicinity of Edrengiyn-Nuru, Ekhiyn-Gol and places near the frontier did not exceed about twenty individuals. It should be mentioned that these data were not checked in detail and should be confirmed. Nevertheless, all the data we gathered indicate quite reliably that there is no question as to any significant influence of domestic camels on the "purity" of the wild camel population in the Trans-Altai Gobi. In addition, long-term observations of wild camel herds indicate that this population is phenotypically uniform and genetically "pure". Moreover, although hybridization is theoretically possible, it is in fact hampered by the ecological and ethological characteristics of the wild camel population. Hence, at present the wild camel population is not experiencing any perceptible biological pollution. Now that the reserve has been established additional measures should be taken to obviate the possibility of biological pollution. For this purpose, domestic camels must be prevented from penetrating into areas inhabited by wild camels and all the animals with phenotypical signs of the domestic form must be eliminated. Such measures will also prevent development among wild camels of the infectious and parasitic diseases (mange and others) carried by domestic animals. The removal of domestic camels from the reserve will also result in an overall improvement of the wild camel's living conditions and promote a normal grazing and watering regime in the various natural regions of the reserve (Zhirnov, 1982; Sokolov et al., 1983; Zhirnov, Bugayev, 1983).

WILD ASS
Equus hemionus Pallas, 1775

Status. The Mongolian wild ass (E. h. hemionus Pallas, 1775), the largest variety of the wild ass, lives within the Mongolian People's Republic, where it has a well preserved range and a large population. The Mongolian wild ass, as all other subspecies of the wild ass is listed in the IUCN Red Book.

Distribution. In earlier times the range of the wild ass was very extensive and occupied most of the Eurasian arid zones. At the turn of the 19th century there was a general decline in the range and numbers of this animal. For instance, in the 1930's and 1940's the Turkmen subspecies survived only within a small area of the USSR between the Tedzhen and Murgab Rivers south of a line connecting Serakhs-Sary and Yazy. Only the establishment of the Badkhyz wild ass reserve in southeastern Turkmenistan in 1941 assured the preservation within the USSR of the last refuge of this remarkable representative of the family Equidae (order Perissodactyla).

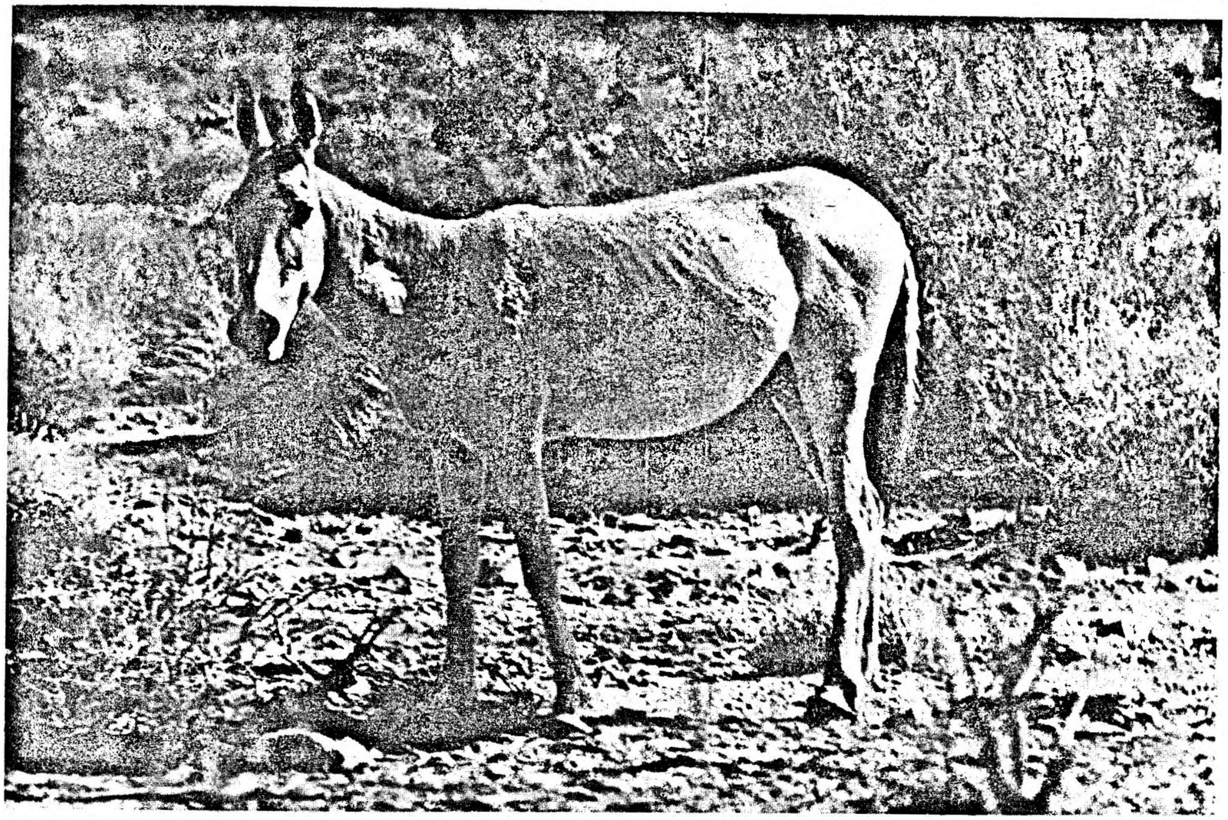
Outside the USSR the range of the wild ass has also sharply diminished. At present only small populations remain in limited areas of Iran, India, Afghanistan, and Nepal. However, in many areas wild asses are extinct. For a long time they have not existed either in Asia Minor or the Arabian Peninsula. The last wild ass was killed in Pakistan in the late 1960's. Wild asses in the northern and central parts of China have apparently suffered the same fate (Bannikov, 1981).

A relatively intact and quite large population of wild asses still exists in Central Asia, mainly within the Mongolian People's Republic, where some estimates put the total area inhabited by wild asses at over 100,000 sq. km. (Bannikov 1981).

In the late 1940's the range of wild asses within the Mongolian People's Republic encompassed the desert and semi-desert zones south of the Mongolian Altai and south and east of the Gobi Altai. The northern limit passes along the Bulgan River and then along the Mongolian and Gobi Altai as far as the Bahangiyn-Nuru ridge (lat. 100°E). Beyond the hummocky terrain of this desert ridge, the boundary extended northward into the basin of Lake Nogon-Nur, rounded Bokhor-Ula Mountain and then extended to Bon-Tsagan-Nur and Biger-Nur Lakes.

In some years, according to A. G. Bannikov (1954), wild asses spread through Shargiyn-Toba and Khuysini-Gobi as far as Lakes Durga-Nur and Khara-Usu-Nur. From the basin of Lake Bon-Tsagan-Nur the boundary stretched east via the lower reaches of the Baidarin and Tuin-Gol Rivers and then further to the southeast (south of the settlement of Dalandzagatad) to the Khurkhu Mountains and then along meridian 108°E to the frontier. Further east isolated penetrations were known as far as 112—116°E (Bannikov, 1954). In later years the range of the wild ass decreased to some extent, principally because the animal disappeared from the north and northeast parts of its range. Since it no longer is found in the semi-deserts and dr steppes, the wild ass now inhabits the desert south of the Mongolian Altai ridge and both south and east of the Gobi Altai ridge. The most recent data on the distribution of the wild ass in the Mongolian People's Republic are presented in a report by V. Sokolov and V. Orlov (1980).

Wild asses occupy practically the whole area of the Great Gobi Reserve (Sector A, Trans-Altai Gobi, and Sector B, Dzungarian Gobi) although their distribution is extremely non-uniform. The detailed patterns



Wild ass. Trans-Altai Gobi. Near Toroin-Bulak oasis. July 1981

of distribution in the various natural regions of the reserve will be discussed below.

Population numbers and density. In the past large herds of wild asses were found in many steppe, semi-desert and desert areas of Central Asia, Kazakhstan and Middle Asia. However, intense pursuit of the animals, along with economic development of the arid zones, resulted in a decline in their numbers to a critical level throughout their range. For instance, the species was brought to the verge of extinction in the USSR. One of the subspecies of the wild ass, the Kazakhstan wild ass which inhabited central and eastern Kazakhstan, completely disappeared by mid-1930's. Another subspecies, the Turkmen wild ass, was also near extinction. Its population did not exceed 200 animals in 1941 when the Badkhyz Nature Reserve was set up in southeast Turkmenistan. Appropriate protective measures assured the survival of this subspecies of the wild ass. Since 1956 the number of wild asses has been gradually increasing. In 1957 the Badkhyz herd already numbered 592 head, in 1962 700—800 head, and in 1979—80 as many as 2,000 head (Geptner et al., 1961; Bannikov, 1981). The introduction of wild asses onto Barsakelmes Island in the Aral Sea was also successful. After a three to four-year period of acclimation, the wild asses began reproducing well in 1957 and their numbers began to increase. By 1975 the wild ass population was 135 per head, in 1977 it was 157, and in 1980 it was more than 200. Thus, the total number of wild asses in the USSR amounted to only 2,200 head in 1980, notwithstanding many years of intensive protection. This population level offers only some degree of assurance that the species will be preserved in the USSR and then only if there is further resettlement with a view toward establishing reserve populations in Kazakhstan and Turkmenistan. The state of the wild ass populations outside the USSR varies. There were around 700 wild asses in India (Katch Rann Minor) in 1976. However, in recent years their total number has suffered a 4—5-fold decrease, and it appears that restoration of the population will be impeded by the lack of suitable habitats. In the early 1970's Iran had about 1,300 wild asses. No remaining self-sustaining population of wild asses exists in Afghanistan, and only small herds of wild asses can be seen in the northern part of the country where they penetrate from the USSR. There are no data available on the numbers of wild asses within the PRC (Tibet) and Nepal, but apparently there could only be small populations within these countries (Solomatin, 1973; Bannikov, 1981).

As we noted, the most numerous remaining populations of wild asses exist in Mongolia the home of the largest subspecies, the Mongolian wild ass. In the 1940's the overall number of wild asses within the Mongolian People's Republic was estimated to equal tens of thousands of animals. A. G. Bannikov (1954, 1981) has estimated that the present population totals 15,000. Based on the results of the 1975—1976 counts, V. Ye. Sokolov et al. (1978) considered that no more than 4,000 head resided in Mongolia. We believe that no more than 6,000—7,000 wild asses inhabit Mongolia.

Census studies within the Great Gobi Reserve, where significant portion of the wild ass population lives, have revealed about 2,000—2,500 animals in an area of 50,000 sq. km. The mean population density in the Trans-Altai Gobi, based on the results of aerial and motor counts, does not exceed 0.21 and 0.17 individuals per 1,000 ha respectively.

The other sector of the Great Gobi Reserve, the Dzungarian Gobi, supports a greater concentration of wild asses, averaging 0.68 and 1.45 individuals per 1,000 ha, based on aerial and motor-route counts respectively. The population density of wild asses in different years and seasons, as well as in different natural zones, is shown in Tables 21—25.

Aerial and motor censuses together with research on annual and seasonal distribution patterns have indicated that the total number of wild asses in the Trans-Altai Gobi is about 800 head and that in the Dzungarian Gobi (Sector B) it is about 1,500 head which brings the total size of the population of wild asses within the reserve to approximately 2,300 animals. The significant discrepancy between the results of the aerial and motor-route counts, aggravated by errors intrinsic in the transect technique, does not allow estimation of the annual population changes during the 1980—1982 period. Nevertheless, they give an idea of the abundance of the two territorial groups of wild asses in both sectors of the reserve.

The wild asses of Trans-Altai Gobi inhabit the superarid deserts where natural conditions (water-supply, yielding capacity of pastures, plant cover and the occurrence of fodder plants) are especially rigorous and consequently have a depressing effect on total population numbers. The Dzungarian Gobi on the other hand, possesses a diversified plant cover due to the variety of climatic conditions and relief forms in the different natural regions (a combination of plains, hollows and mid-altitude uplands). This, along with the presence of available water sources (Khonin-Us, Takhiyn-Us and other springs), creates more favorable conditions for wild asses in Sector B than in the Trans-

Table 21

SUMMARY OF CENSUSES OF WILD ASSES ON AERIAL TRANSECTS IN THE TRANS-ALTAI GOBI

Census data	9/1980	3/1981	6/1981	8/1981	12/1981	3/1982
Transect length (km)	1680	1510	1487	1805	1639	1535
Transect area (000 ha)	504.0	453.3	446.1	487.5	491.7	460.5
Animals seen	91	42	36	72	251	200
Average density per 1,000 ha	0.18	0.09	0.08	0.15	0.51	0.43

Table 22

SUMMARY OF CENSUSES OF WILD ASSES ON MOTOR TRANSECTS IN THE TRANS-ALTAI GOBI

Census data	7/1980	8/1980	10/1980	7/1981	7—8/1981	9/1981
Transect length (km)	446	501	902	570	1448	1576
Transect area (000 ha)	178.4	200.4	360.8	228.0	579.2	630.4
Animals seen	114	74	74	36	55	25
Average density per 1,000 ha	0.6	0.4	0.2	0.16	0.09	0.03

Table 23

SUMMARY OF CENSUSES OF WILD ASSES ON AERIAL TRANSECTS IN THE DZUNGARIAN GOBI

Census data	9/1980	3/1981	6/1981	8—9/1981	12/1981	3/1982
Transect length (km)	270	180	172	221	215	209
Transect area (000 ha)	81.0	54.0	51.6	66.3	64.5	62.7
Animals seen	6	31	121	121	182	12
Average density per 1,000 ha	0.07	0.57	2.3	1.8	2.82	0.19

Table 24

SUMMARY OF CENSUSES OF WILD ASSES ON MOTOR TRANSECTS IN THE DZUNGARIAN GOBI

Census data	9/1980	8/1981	10/1981
Transect length (km)	461	463	430
Transect area (000 ha)	184.4	186.2	172
Animals seen	110	7	252
Average density per 1,000 ha	0.6	0.03	1.5

Table 25

DISTRIBUTION OF WILD ASSES BY NATURAL REGIONS

Region	Density of wild asses per 1,000 ha	
	summer-autumn	winter-spring
Sector A		
Shivet-Ula	0.60	0.42
Otgon-Us	0.23	0.30
Edrengiyn	0.14	0.04
Burin-Khyar	0.02	0.25
Nomin Gobi-Tsenkherkholoi	0.10	0.40
Shargyn-Gobi	0.10	—
Atas-Chingiz	0.05	2.0
Central Gobi-Tien-Shan	0.08	0.07
Tsagan-Bogdo	0.08	0.37
Ekhiyn-Gol	—	0.35
Bei Shan *	—	—
Sector B		
Barun-Khourai	0.47	—
Takhiyn-Khonin-Us	0.98	2.19
Northern foothill region	1.42	0.21
Southern foothill region	0.90	—
Khavtag *	—	—
Takhiyn-Shara-Nuru *	—	—

* These regions were not covered by aerial surveys.

Altai Gobi, even though the effect of anthropogenic factors is more pronounced in the Dzungarian Gobi (cattle grazing, permanent presence of people and motor traffic).

The results of the wild ass census taken within the Great Gobi Reserve in 1980—1982 are practically identical to those obtained by V. Sokolov et al. (1980) in 1975—1976. These authors recorded a summer concentration of about 300 wild asses in the vicinity of Maikhan-Bulak spring (Sector A). A total of 35 wild asses were seen on 1,740 km of motor transects through the rest of the Trans-Altai Gobi, thus leading to an estimate of no more than 800 head in all in the western part of the Trans-Altai Gobi. In 1975—1976 local concentrations of wild asses were also observed within a radius of 20 km around solonchaks in the Dzungarian Gobi (450 animals around Khonin-Us and 300 around Takhiyn-Us). Seventy-four wild asses were recorded on a transect 925 km long across the rest of the Dzungarian Gobi, and subsequently their total number in Sector B was estimated at 1,250. These data suggest once more that the overall number of wild asses within the Great Gobi Reserve is approximately 2,300—2,500 head. Such a population size is believed to be close to optimal with respect to the main indices of its state (average density percentage of young animals and herd structure) and the productivity of pastures (see Chapter 1).

Thus, the Mongolian population of wild asses is at present fully viable in terms of both its numbers and range-size, notwithstanding the overall decline of the range and number within the Mongolian People's Republic. The establishment of the Great Gobi Reserve has significantly improved protection of these animals in the Mongolian People's Republic, one may hope, not simply for their preservation, but also for an increase in their population within Mongolia.

Ecological characteristics of wild asses. The vast area occupied by wild asses in the past testifies to the great ecological flexibility and adaptive potential of the species.

The ecological flexibility of wild asses is first and foremost manifested in the great variety of habitat types occupied by these animals. In fact, judging from their past distribution wild asses were widespread in steppe grasslands, semi-deserts, various types of deserts and high plateaux (Geptner et al., 1961; Bannikov, 1981). For example, in the European area wild asses inhabited the southern steppes edging the Azov and Black Seas, the semi-desert area between the Volga and the Urals, the dry steppes of the Turgai tableland, the desert uplands of Ust Urt and Betpak-Dala and desertified foothill areas of Kopet-Dag and Tien-Shan. In Central Asia wild asses were common not long ago, in the steppes of Trans-Baikal and Eastern Mongolia and in various types of Central Asian deserts. They also reached high into the mountains, up to 5,000 m above sea level in the Tibetan Highlands.

Wild asses found the most favorable conditions in those parts of the arid zones where sections of desert-steppe vegetation combined with readily available water sources, suitable shelter (gorges, ravines) and shallow snow cover. The best conditions for wild asses were in the foothills and mid-altitude mountain highlands bordering on plains or in intermontaine depressions in the desert and semi-desert zones. In contrast to other ungulates of the arid zones (saigas, Persian and Tibetan gazelles) wild asses choose to keep to very rugged country among hummocks and mountain highlands, which has caused some scientists to regard them as a peculiar life-form of desert and semi-desert foothills and uplands (Rashek, 1973). For example, in the Trans-Altai Gobi they occur both on plains and in mountains. We saw these ungulates or traces of their activity on all the summits and slopes of such mountain highlands as Edrengiyn-Nuru, Atas-Bogdo and Tsagan-Bogdo.

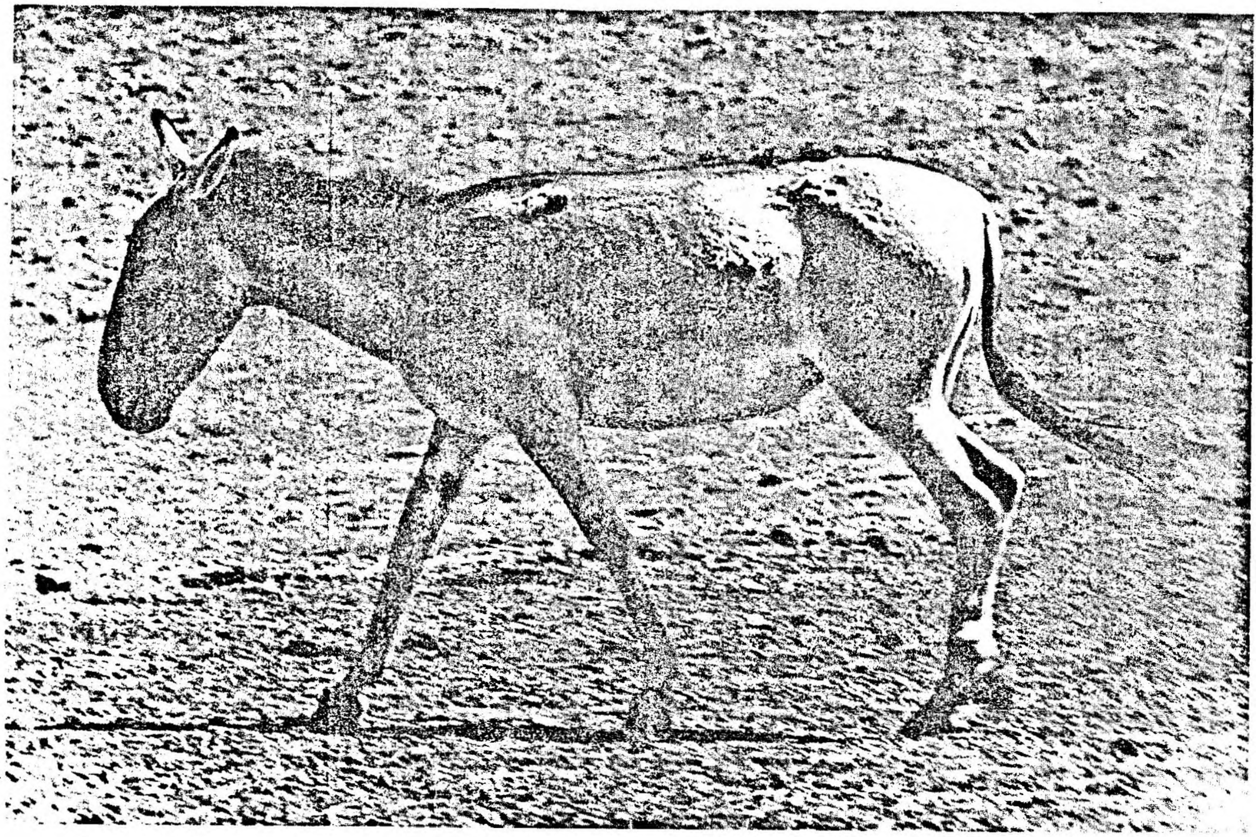
The distribution of wild asses in different habitats and their land use patterns (spatial structure of the population) are significantly related to their foraging behavior, food preferences and watering habits.

The most detailed studies of the wild ass's feeding habits have been carried out in the Badkhyz reserve and on Barsakelmes Island (USSR) and to some extent in Mongolia (Bannikov, 1954; Solomatin, 1973; Rashek, 1977).

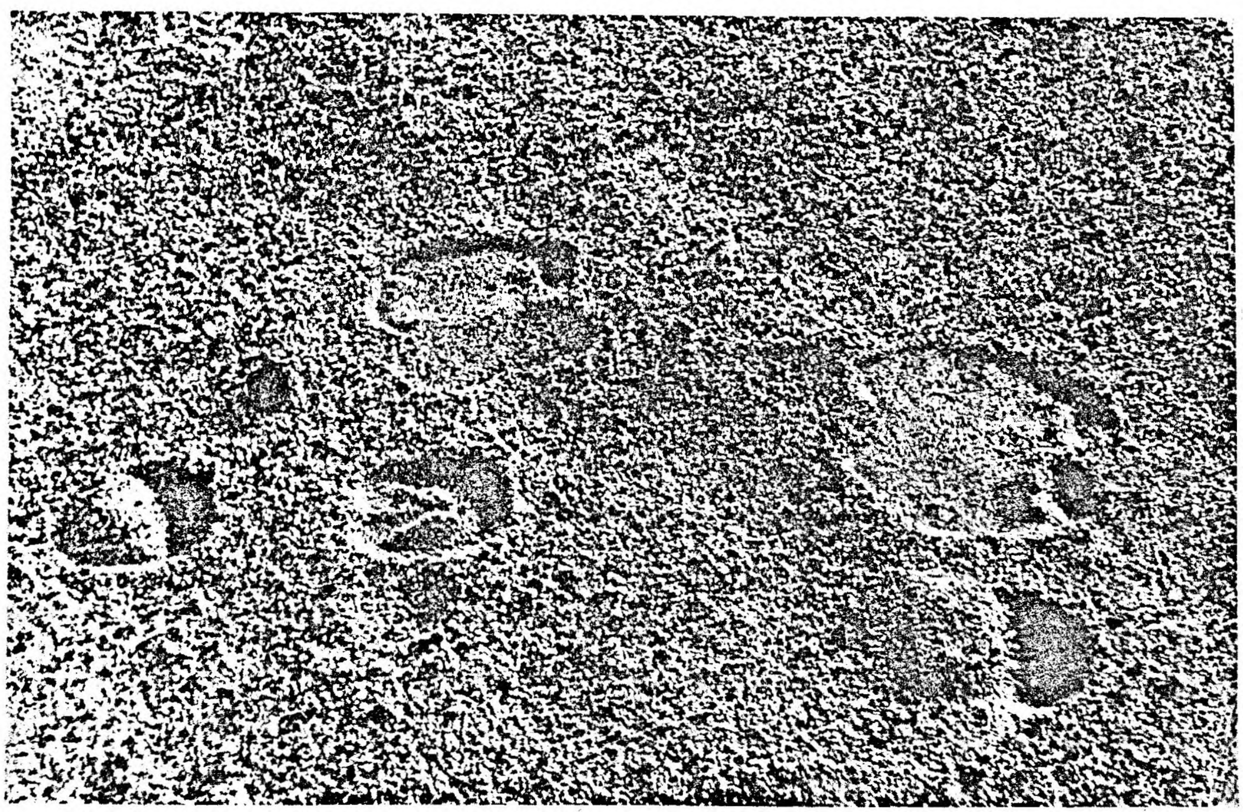
The list of fodder plants consumed by wild asses in Badkhyz comprises 109 species including 14 shrubs, 10 semi-shrubs, 40 perennial herbs and 45 annual herbs. Wild asses eat the most diverse selection of fodder plants in spring and early summer,when they consume 71 plant species. However, the basic food stock consists of ephemeral grasses and sedges together with some halophytic shrubs, ferulas, cousinia species and thick-stalked herbaceous plants. The number of plants eaten by wild asses in summer is reduced considerably to 29 species, including 17 annual grasses and 10 perennial grasses, while shrubs and semi-shrubs are represented by only two species.

In the first half of summer the basic forage consists of grasses and sedges (up to 90% by volume), but as these plants get dry, wild asses move to the pastures with the most succulent thick-stalked herbaceous plants (cousinia, etc.) which serve as a source of water for the animals. In autumn the selection of forage plants considerably decreases, depending on the weather factors that determine plant growth conditions. After rainfall there is a secondary growth of ephemeral grasses and sedges, which wild asses eat. Wormwoods and nitrebushes also serve as important constituents of the diet, because like ephemers they begin growing rapidly as soon as the heat abates and autumn rains begin. Winter food includes 31 plant species, half of which are shrubs and semi-shrubs (8 and 7 species respectively) while the rest are represented by perennial and annual grasses (10 and 6 species).

In winters with little or no snow, which are characteristic of Badkhyz, the basic diet consists of low-lying herbaceous plants (the green parts of sedges, grasses, wormwoods and salt-worts, and thick-stalked plants are of secondary importance. When the snow cover is 10—30 cm thick and low-lying herbaceous plants are unavailable to the animals their basic diet consists of such thick-stalked plants as wormwoods, cousinia, halocnemum, milk vetch and carline thistle. Shrubs (saxaul saltworts, calligonum, bean caper, ephedra pistache) are of secondary importance in the winter diet of wild asses. Twigs of saxaul, tamarisk, halocnemum and other shrubs are dominant in the diet of wild asses only when the snow cover is deeper than 40 cm. Plant growth in autumn and winter ensures biologically adequate



A running wild ass. Trans-Altai Gobi. June 1980



Tracks of a wild camel and a wild ass on coarse-grained sand. Trans-Altai Gobi. July 1981 nutrition for wild asses even during the cold season. Wintering conditions allow the animals to alternate their consumption of twigs and herbs.

The feeding habits of wild asses on Barsakelmes Island were studied in detail by V. Rashek (1977) who employed the unique methodology of visually observing the grazing wild asses and estimating quantitatively the time they spent in consuming each species of fodder plants during each season of the year.

The list of fodder plants consumed by this island population comprises 93 species, including 65 herbaceous species (73.2%) and 28 shrubs and semishrubs (26.8%). The greatest variety of the plants consumed has been recorded in spring (56 species in May), while the number of fodder species falls to 21 in summer. However, the list of basic fodder plants consumed in all seasons of the year is limited to approximately 20 species. The main food consists of herbaceous plants, predominantly grasses (couch-grass, eremopyrum, meadow-grass, broomgrass, etc.). Next are anabasis, wormwoods, goosefoot and other herbaceous plants while shrubs and semishrubs are supplementary or rare (Rashek, 1977).

The selection of fodder plants in Mongolia is more limited. For this region, the consumption of 12 to 15 species has been reported, but this may be accounted for chiefly by lack of data on the ecology of Mongolian wild asses (Bannikov, 1954). Feathergrass, anabasis and onions are the main constituents of their food in summer and early autumn. Rhubarb, reaumuria, Russian thistle, bean caper, ephedra and certain other desert shrubs constitute supplementary fodder.

The winter feeding habits of Mongolian wild asses have not been studied, nor have the seasonal and annual dynamics of their trophic links. The food of the wild asses in the Great Gobi Reserve has not been specifically studied and there are isolated observations of grazing wild asses as well as reports of consumed plants on their forage grounds. On the whole these observations accord with those of A. G. Bannikov (1954).

Seasonal dietary patterns of wild asses depend on both the nutritive value of fodder plants and their moisture content, which is essential for animals inhabiting arid zones.

In Badkhyz, for example, wild asses begin to search for and selectively consume succulent plants (ferula, poppy and other succulents) as the vegetation gets dry in spring and early summer. As the moisture content in the fodder plants decreases to 50—55% wild asses must obtain their water needs while drinking. The watering regime of wild ass populations varies in different parts of their range. It should be recalled that the watering regime of wild asses in the Gobi Desert is completely unknown and needs to be studied. On Barsakelmes Island the wild asses drink from the sea in all seasons of the year until the littoral becomes frozen. During the warm season Barsakelmes Island wild asses visit their watering places almost daily. In Badkhyz, where available water holes are more limited in number and the selection of forage plants on pastures is significantly greater, the wild asses regularly visit watering places (rivers and springs) principally in the dry and hottest period from May and June until October. In spring, autumn and winter wild asses will also visit watering places, but not so regularly. During snowless winters, especially when early frosts occur, wild asses may experience a water shortage. There are observations to the effect that in winter wild asses obtain their water requirements not only from the water in fodder plants but also from eating ice and snow (Bannikov, 1954). In Mongolia, for example, wild asses congregate in places with snow cover in winter when the air is very dry. In particular, they migrate from the plains to the mountains, where isolated patches of snow can be found on the summits and northern slopes (Trans-Altai Gobi). As compared to other ungulates that inhabit arid zones, e. g. Persian gazelles, wild asses must have recourse to watering places during dry periods, since these large animals are unable to gather as many sappy plants as they need in case of drought. Studies of the feeding and watering habits of wild asses have revealed the paramount ecological importance of watering places for these animals. It has been correctly suggested that availability of water sources not only determines to a substantial extent the territorial distribution, circadian rhythm and behavior of wild asses, but may also be the key factor limiting the numbers of wild asses in certain regions. The decline of many populations and the disappearance of wild asses from a number of arid zone regions are associated primarily with the development and occupation of open water sources by man, which has led to the animals' ruin (Bannikov, 1981, etc.).

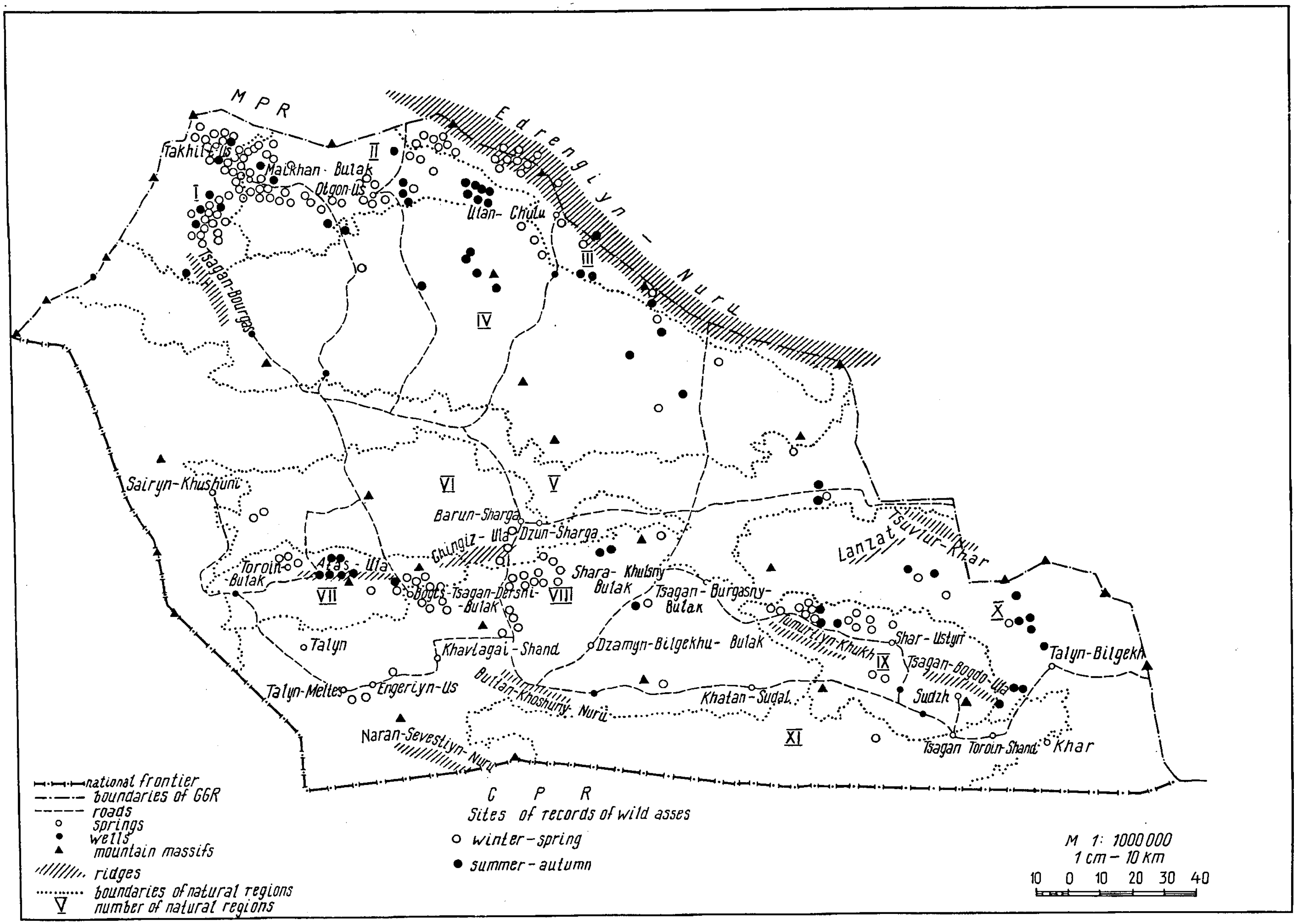
Patterns of land use depend on the distribution of pastures and the presence of available water sources, which wild asses regularly use in the hot dry season, in addition to the effect of anthropogenic factors.

Long-term surveys (1980—1982) of the territory of the Great Gobi Reserve by means of the strip transect technique have revealed that wild asses use different regions of the reserve in different ways.

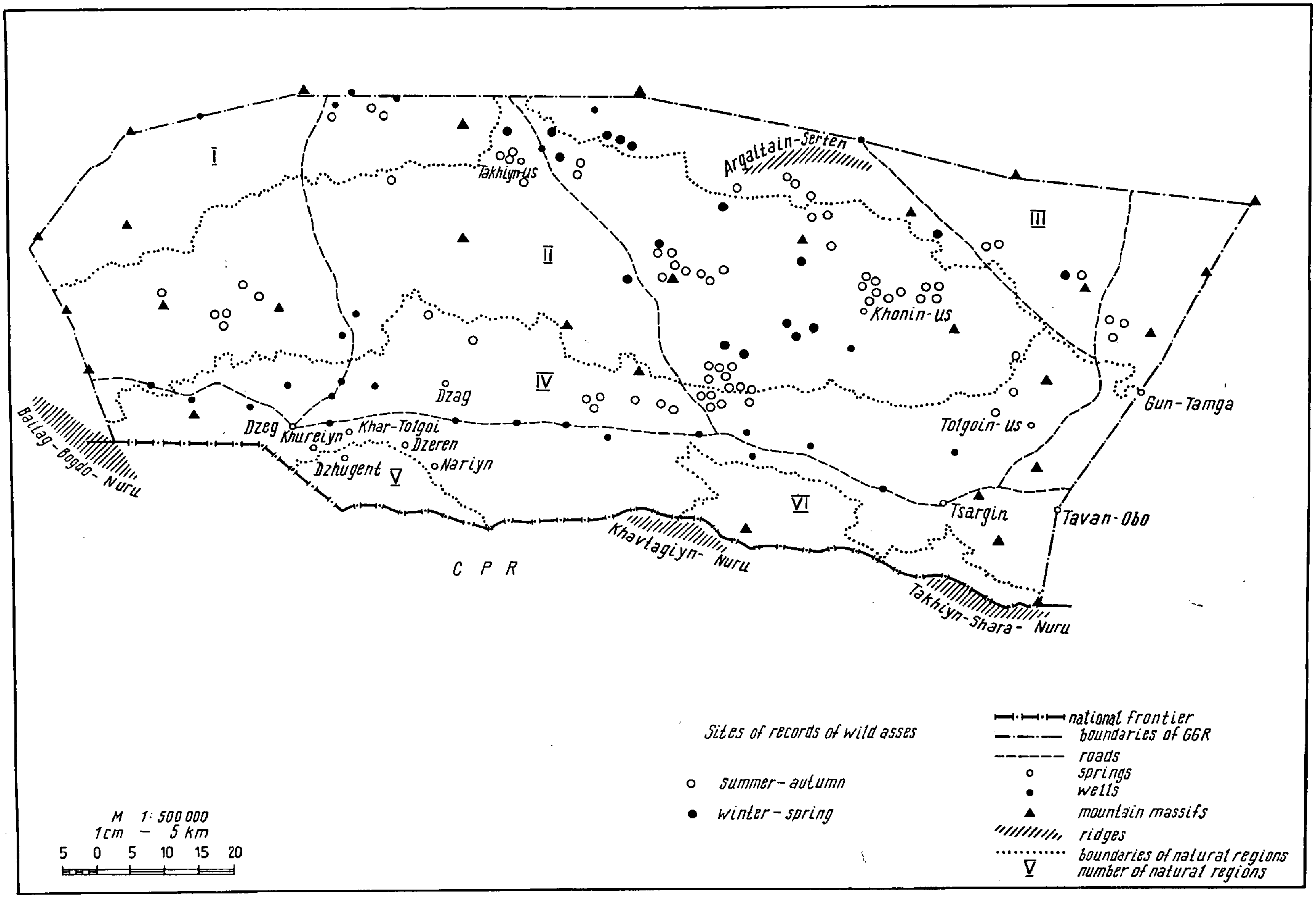
To study the general rules of the spatial distribution of wild ass populations, the population density (expressed as the number of individuals per 1,000 ha) was analyzed for each of the natural regions into which the reserve is divided. Average densities were obtained on the basis of both aerial and motor transects, and these densities were related to the ecologically valid periods of winter-spring (December-March or April) and summer-autumn (July-October).

Data on the distribution of wild asses within the great Gobi Reserve are shown in Table 25.

In accordance with the accepted physiographic scheme, the entire area of the reserve lies within the special Gobi province, which includes two subprovinces, the Trans-Altai and the Dzungarian, which is divided in turn into 17 natural regions. The major part of the reserve (Sector A) lies entirely within the Trans-Altai sub-province and is divided into 11 natural regions. This sector embraces two latitudinal zones of true and super-arid deserts and a system of desert and steppe altitudinal belts (especially within the Gobi Tien-Shan, Atas-Ula, Chingiz and Tsagan-Bogdo mountain systems).



Seasonal distribution of wild asses in the Trans-Altai Gobi (Sector A)



Seasonal distribution of wild asses in the Dzungarian Gobi (Sector B)

The data on the distribution of wild asses in Table 25 show that in 1980—1982 these animals occured in 10 of the 11 natural regions. They were absent only from the Bei-Shan region, where the habitat conditions are unfavorable for all ungulates, including wild asses, since there are practically no intermittent or permanent water sources and the pastures are very poor.

Wild asses are found in all the other natural regions, but with varying population densities. The greatest number of wild asses occur in the northernmost regions, Shevet-Ula and Otgon-Us, where the average populations density ranges from 0.23 to 0.6 individuals per 1,000 ha. These regions have large active water sources (Takhilt-Us, Maikhan-Bulak, Otgon-Us) adjacent to the intermontaine plains, considerable areas of hummocky terrain and low-altitude mountains with productive pastures containing sympegma, anabasis and saxaul associations. Such a combination creates favorable conditions for wild asses in all seasons of the year. Therefore, these regions should be considered the main habitat for wild asses in the Trans-Altai Gobi.

Another area of concentration of wild asses is situated principally within the Gobi Tien-Shan system of mountain highlands. An increased density of wild asses is found in the Atas-Chingiz and Tsagan-Bogdo natural regions, where the animals are most numerous in the winter-spring period (December through March). Thus, the density of wild asses in Atas-Ula in the winter of 1981 reached a maximum value of 2.0 individuals per 1,000 ha.

The Tsagan-Bogdo mountain system is also a winter concentration point for wild asses, but here the average population density is only 0.37 individuals per 1,000 ha. Local winter concentrations of wild asses have also been noted on the plains, as for example in the basins in the western part of the Nomin-Gobi region, or in the hummocky terrain of the Ekhiyn-Gol region. There are no large concentrations of wild asses in the summer-autumn period except for those already mentioned in the Shevet-Ula and Otgon-Us regions, the population being represented by small groups or individuals scattered over a large area. Consequently their population density is low, ranging from 0.05 to 0.14 individuals per 1,000 ha.

Such population densities are indicative of the depressed state of the population under the generally unfavorable natural conditions found in the superarid deserts of the Trans-Altai Gobi.

This conclusion is reached by comparing the above data with the population densities of wild asses in the other sector, the Dzungarian Gobi. As we already noted, the average population density of wild asses in this sector is considerably greater than that in the Trans-Altai Gobi. Within Sector B the Takhiyn-Khonin natural region represents a clearly marked area of summer and winter concentrations of wild asses. Permanent water sources (Takhiyn-Us, Khonin-Us), which should be viewed as the major remains of an ancient river system, create special conditions for the growth of mesophytic vegetation (lyme-grass meadows, etc). and the presence of productive pastures in the surrounding countryside (anabasis, ephedra and feather grass-wormwood associations). All these factors taken together create a good habitat for wild asses and contribute to a high population density (from 1.0 to 2.19 individuals per 1,000 ha). Good conditions for wild asses also exist in the neighbouring Northern Foothill region, which is dominated by hummocky terrain and elevated plains covered by desert steppes (feather grass-anabasis associations) which provide high-productivity pastures, especially in the summer-autumn period.

The area lying in the northwestern part of the Dzungarian Gobi, in the Barun-Khurai natural region, is the lowest part of a basin. Wild asses occur here primarily in summer, when the average population density is 0.47 individuals per 1,000 ha. The flatness of the terrain and the poor pastures (sparse saxaul growth) lead to the absence of winter concentrations within this natural region.

Summer-fall concentrations of wild asses with an average density of 0.9 individuals per 1,000 ha have been recorded in the Southern Foothill natural region (Dzungarian Gobi), where plant communities with grasses are predominant in the hummocky terrain with sloping plains dissected by sairs. The small extent of census transects undertaken in this natural region did not make it possible to assess objectively the importance of the region for wild asses. The same is true of the northern macroslopes of the mid-altitude massifs of Khavtag and Takhiyn-Shara-Nuru. These regions are characterized by their broad steppe belt, in the higher part of which there are very productive pastures dominated by herb-sheep's fescue-meadow oat-grass and herb-sheep's fescue steppes. Occasional observations indicate that mountain-dwelling ungulates such as wild sheep and goats are prevalent in these regions, while wild asses seem to avoid them because large areas here are covered by rocks and steep slopes.

Thus, the habitats of wild asses are primarily associated with low sloping mountains and hummocky terrain with grasses, wormwoods and halophytic herbs in the plant cover. Permanent and intermittent water sources are essential in summer habitats. In true and superarid deserts (the Trans-Altai Gobi) wild asses also clearly prefer hummocks and mountain highlands dominated by semi-desert phytocenoses or plains with shrub vegetation. The dietary patterns and habitat distribution of wild asses show that they find ecologically optimal conditions in moderately arid regions, i. e. in semi-deserts and steppe-like deserts. This conclusion ensues from analysis of the population states of the wild asses inhabiting the Trans-Altai and Dzungarian Gobi, which differ in aridity and pasturage conditions.

It should also be borne in mind that the current distribution of wild asses is to a great extent determined by anthropogenic factors. This is demonstrated with particular clarity in the distribution of wild asses throughout Mongolia with respect to landforms and zones. While in the past centuries, and even until the 1940's and 1950's, wild asses frequented steppe areas and were common in deserts and semi-deserts, at present domestic livestock and land cultivation have led to their being confined principally to the low-population portions of the desert zone. According to the observations of A. G. Bannikov (1954), more than 95% of all wild asses recorded in 1943—1945 were in semi-desert habitats, while only 4% of them were in the true and superarid desert zones, where they occurred in areas either completely unused by man or used only intermittently. For instance, the northern boundary of the current range of wild asses in the Trans-Altai Gobi (the Edrengiyn-Nuru ridge) coincides exactly with the southern border of domestic livestock raising in the Central Asian desert zone.

The spatial structure of wild ass populations has been very poorly studied owing to the severe overall decline in their numbers and range. Regular seasonal migrations were characteristic of many wild ass populations in the past when the seasonal nature of their destribution was basically dependent on natural factors. Thus, they would move from their summer grounds in northern Kazakhstan to wintering grounds in the Betpak-Dala Desert. Winter concentrations were also observed in the areas of Ust-Urt that experienced little snow. Wild asses were also known to migrate from the right bank of the Syr-Darya to wintering grounds in the Kyzylkum Desert. Such regular southward movements of wild asses were also observed in some other parts of Central Asia and Kazakhstan (Geptner et al., 1961).

In Central Asia the winter migrations occurred primarily in a northward direction, the wild asses leaving the semi-deserts and steppes of Eastern Mongolia and migrating northward to the Trans-Baikal steppes (Bannikov, 1954). Today the scale and intensity of the wild ass migrations have been significantly reduced. In all the remaining populations there are only insignificant seasonal movements associated with the local relocation of herds from summer to winter pastures.

According to A. G. Bannikov's data (1954), which relates to the years 1943—1945, wild asses in Mongolia prefer to keep to semi-deserts dominated by feather-grass and onion communities. Such pasture habitats occur both in the plains and among hummocks and mountain uplands. Wild asses congregate in these habitats primarily in late summer and autumn and to some extent in winter. The presence of grasses and abundant onions supplied the animals with good forage. Semi-desert anabasis communities and desert shrublands were of secondary importance to wild asses. A significant population of wild asses wintered in desert shrublands, where they had come from the anabasis semi-deserts to the north. However, A. G. Bannikov (1954) believed that there were no clearly expressed migrations in Mongolia in those years, only short local movements within a limited territory. We observed similar local movements in 1980—1982. The nature of the movements of wild asses in the Trans-Altai Gobi is basically determined by the local distribution of precipitation and the consequent state of pastures. Thus, in July 1981 concentrations of wild asses were seen on the western spurs of the Edrengiyn-Nuru, where they could find plentiful sappy fodder due to the growth of onions and grasses following summer rainfalls. In this period the wild asses clearly ignored the springs of Maikhan-Bulak and Takhilt-Us. In 1980, on the other hand, concentrations of wild asses were seen around these springs, the majority of sighting being made within 15 to 20 km of the water sources. In August 1974, when the weather in the Trans-Altai Gobi was cool and rainy, the wild asses were widely scattered over the plains, large sairs and hollows. Similar distribution patterns also occur in the Dzungarian Gobi. In the rainless summer season the main herd is concentrated at Khonin-Us and Takhiyn-Us where there are open water sources of the kind the wild asses regularly use (Sokolov et al., 1978). The wild asses do not appear to be so closely linked to permanent water sources in autumn and winter. For example, the March 1981 aerial count in the Dzungarian Gobi revealed no more than 20 wild asses in the vicinity of the Khonin-Us and Takhiyn-Us springs, while there were 135 of them within the same area in July. In autumn and winter the main body of wild asses usually moves to the mountains, where there is snow on the slopes and the pastures are more productive, supporting grasses, wormwoods and saltworts. Moreover, the wild asses find good shelter in the mountains and hummocks during bad weather.

Regular seasonal migrations were apparently characteristic only of the populations of wild asses living in the north, at the junction of the steppe and semi-desert zones. The pattern of snow cover was one of the main factors inducing extensive seasonal migrations. Even the past centuries this was not a significant feature in the deserts and semi-deserts, where there is normally little snow in winter. In the deserts and semi-deserts the wild asses are prone to be more sedentary, and here there are only short local movements connected with seasonal changes of pastures or concentration around watering points. In rich pastures with good water sources wild asses lead an exclusively sedentary way of life. It has been observed that in areas with good pastures a band of wild asses could maintain itself on an area not exceeding 20—25 sq. km. while in areas with poor pastures the required land increased significantly to 100 sq. km. (Bannikov, 1981).

Wild asses characteristically live in groups. The size of bands and herds varies significantly both with the season and the overall population numbers, as well as with living conditions in various parts of the range and under different ecological conditions.

The main organizational unit of the wild ass population is the band, which consists of a mature male leader and a group of females with their young. At foaling time pregnant females withdraw from the band and keep to themselves. Some of the stallions and some immature colts also keep apart from the band in small groups or alone. During the autumn-winter period and in some places in summer, the bands are seen to merge into herds and concentrations, which usually fall apart into independent bands again in spring. According to Solomatin (1973), the average group size in the Badkhyz population of wild asses varied from 11.0 to 13.4 depending on the season of the year. Long-term studies of the Badkhyz population have shown that most of the population (over 86% of the total) consists of herds comprising from 2 to 50 animals, while the most usual groups comprise 21 to 50 individuals (35% of the total population). However, herd size varies somewhat with the season of the year. Herd size significantly increases in winter when herds have been seen to merge into concentrations of as many as 300 animals. In spring, when rut and foaling are in progress, the frequency of lone animals or small groups increases. A tendency toward enlarged groups of wild asses is also seen in summer in connection with local concentrations of the animals around a few water sources. In autumn the wild asses disperse over a wide area in search of fodder plants, basically keeping to groups of 2 to 20 individuals (about 60% of the total population). According to A. G. Bannikov (1981), the average size of a band in Badkhyz is 8.7 animals, and this size seems to be typical of the ecological structure of the population in this region. In Mongolia, according to data of the 1943—1945 census, the average group size was around 11, usually equalling 12 to 15 animals in semi-desert areas and smaller groups of 3 to 4 animals in typical desert shrublands. The average group size in the superarid deserts of the Trans-Altai Gobi in August, 1974 was 2.3 individuals, one-third of them represented by single animals. According to the 1980—1982 census, the average group size in the Trans-Altai Gobi was 1.7 in June. In the Dzungarian Gobi (July 1981) the average group size was considerably greater, 3.7, the maximum value being 48 individuals. The increased size of the wild ass groups in the Dzungarian Gobi was related to a higher population density and concentration around springs.

A small group structure is thus generally typical of the wild ass population, with the majority of the population living in bands of about 10 animals each. These groups may be enlarged or diminished in size depending on the productivity of pastures, weather conditions and local concentration of wild asses within limited areas, generally around water or in good sections of pasture. The effect of weather conditions and plant productivity upon herd size has been well studied for the wild ass population on Barsakelmes Island. Here the wild asses are usually found in bands of 12 to 18 animals, which merge into larger groups in winters with little snow. However, when the pasturage is poor after a drought, as it was in the severe winter of 1963—1964, the wild asses kept to small groups of 2 to 7 or as individuals (Rashek, 1965). Such flexibility in group organizitions has signs of being an adaptation to the variable environmental conditions of the arid zones.

The characteristics of propagation and reproduction of the species are as follows. Females reach maturity at 2 to 3 years of age and in favorable years first give birth to young in the third year of their life. In times of poor forage caused by drought or heavy snowfall sexual maturity may be held back for a year longer. The total length of the reproductive period of females is around 10 years, so that normal reproduction is observed between the ages of 3—4 and 13—14 years. Many females can give birth for each of 5 or 6 successive years if the conditions are favorable, as on Barsakelmes Island (Rashek, 1973). Males become mature later, usually in their fourth or fifth year. The herd life of mature males, and consequently their participation in reproduction, is more limited than that of the females and lasts around five years. At 9 or 10 years of age the males lose the ability to lead bands and are replaced by younger (over 4 years of age) and stronger stallions. Rut in the Badkhyz wild asses takes place from mid-April until late May, while on Barsakelmes Island it lasts from May through July. In Mongolia rut is usually observed from June until the end of July. During rut the male leader drives out of the herd all other males older than one year. Pregnancy in females averages about 342 days (Barsakelmes). Wild asses give birth in spring, the best growth period of plants. The time of birth varies somewhat in different populations. In Badkhyz the basic period of birth occurs in the second half of Aprill. In Mongolia the females give birth later, from the middle of May through the end of July. Each female produces one young. Some females have been seen to suckle two foals, but these mares apparently had taken orphaned colts (Rashek, 1973). The average fertility index of wild asses (the number of young born by each adult female) is 0.66 (Barsakelmes Island). However, actual fertility under natural conditions varies greatly depending on living conditions and the physiological state of the females. It is maximal in favorable years, while the number of dry mares increases and the onset of maturity is delayed in years when the pasturage is poor and the animals are undernourished. The significant variability in the fertility of females and the differing levels of mortality in young animals account for differences in the growth rate of various populations. In Badkhyz the population increased annually by 19% with annual variations of 10 to 38% (Solomatin, 1973). The growth rate of the Barsakelmes Island population was about the same: 21.4% on the average, with variations of 14.7 to 38.1% (Rashek, 1973).

The sex and age composition of wild ass populations has characteristic parameters. In Badkhyz and on Barsakelmes Island the sex ratio among newborn foals is one male per 0.8—0.9 females. In older age-groups, especially after the first 3 or 4 years of life, the percentage of females increases sharply, to one male per 4.5 females. This change results from the increased mortality of young males aged 1 to 3 or 4 years, which are driven out of the bands and live alone. There are more adult females than males in the Mongolian population as well, the ratio being 3.8 to 1 (Bannikov, 1981).

Thus, taking into consideration the relatively high fertility of females, polygamy and the overall life expectancy of wild asses, these animals typically have a quite high reproductive capacity, sufficient to assure a stable level of population size, provided ecological conditions are favorable.

The dynamics of wild ass populations and the factors which limit the overall population of these animals are very poorly understood. Among the natural factors limiting population size the most significant is the mass mortality occurring in times of poor winter forage or when the ground is covered by ice-crusts and deep snow, when the animals perish from starvation or cold. Great losses of wild asses and a sharp drop in population numbers are observed in periods when there is a solid snow-cover 30—40 cm thick. For example, the severe winters of 1879—1880 and 1891—1892, which led to a sharp decrease in the wild ass population of Kazakhstan, and over large areas to its total disappearance, are considered to be one of the main causes of the extinction of the Kazakhstan subspecies. In Turkmenistan and Mongolia the death of wild asses during winters with heavy snow has also been reported (Sludsky, 1963).

A considerable number of wild asses also die in hot weather. When their regular watering habits are disrupted and they drink too much water at one time, they develop haemorrhagic gastroenteritis and die. Such cases account for about 15% of the overall mortality of wild asses recorded in Badkhyz between 1934 and 1962 (Solomatin, 1973). Solomatin also described instances of massive epizootics and deaths of wild asses caused by pathogenic trypanosomes. The source of this illness was domestic asses and horses.

In June 1982 we observed two wolves chasing a male wild ass at Takhilt-Us spring. They attempted to overcome the stallion for about 25 minutes, but he actively defended himself, repulsing the attacks of the predators with his front and back legs. In the end the wolves gave up and withdrew. Large beasts of prey, which in the past included not only wolves but cheetahs in Middle Asia, have not had a significant effect on wild asses since only sick or feeble individuals could fall prey to them.

Human impact, both direct and indirect, is one of the key factors affecting the state of the wild ass population. Different ways of hunting these animals are described in some detail in the literature (Solomatin, 1973). We believe that the turning-point in the sharp decrease in many wild ass populations coincided with the period when the hunters obtained long-range rifles in the second half of the 19th century, which rendered helpless even such fleet-footed and hardy animals as the wild ass. Economic development of the area was not the least of the factors bringing about a decline in the wild ass's range. Of crucial importance was the occupation by man and domestic cattle of the few water sources used by wild asses during hot and dry seasons. Wild asses were intensively hunted in the places where they regularly came to drink. For instance, in the recent past each permanent spring in the Trans-Altai Gobi had a stone blind from which hunters regularly shot wild asses and other wild ungulates. In 1974 we had occasion to chat with a hunter at the settlement of Dzakhoi (now Bayan-Toroi), who told us that in past years he had killed at least three hundred wild asses from such blinds at the Takhilt-Us and Maikhan-Bulak springs. All this confirms the primary importance of hunting and economic development of the arid zones as the main causes of the decline of wild ass populations.

The data available on the ecology and population state of wild asses show that these animals are well adapted to life in various natural zones with varying degrees of aridity. The adaptive features with respect to life in semi-desert and desert areas are clearly manifested in the morphoanatomical structure of various organs and systems including hair cover, legs, teeth, hearing organs, etc. The wide range of habitat types, the vast area of their former range and the great diversity of geographical varieties (8 subspecies) are signs of the considerable viability and ecological adaptability of wild asses (Bannikov, 1981).

The overall decline of their range and numbers in the 20th century has resulted from the oppressive impact of human factors which can now be regulated and guided in light of the ecological characteristics of the various populations of wild asses. In this respect a system to protect and restore the wild ass populations must include the following measures: protective reserves must be established and maintained; in areas settled by man sections of pasture land with accessible water sources must be set aside for the wild asses; in order to restore extinct populations wild asses must be bred in semi-natural conditions and subsequently released into natural habitats; finally, wherever population density is high, as in some parts of Mongolia, methods of catching wild asses should be developed experimentally so animals can be resettled in areas where for some reason wild asses do not occur. All these measures of conservation and restoration are urgent, even for Mongolia.

The system of protective measures with respect to the Great Gobi Reserve must include enforcement of the reserve regulations with special reference to the areas with permanent water sources which must be made available for wild asses. All other forms of adverse anthropogenic impact should be prevented. In particular, the illegal shooting of wild asses appears to persist even today in the Dzungarian Gobi since this population is very shy compared to that of the Trans-Altai Gobi. Environmental education of the local residents is therefore needed along with support for the reserve ranger service in their efforts to resist any violation of the protective regulations.

PERSIAN GAZELLE
Gazella subgutturosa Gueldenstaed, 1780

Status. The Persian gazelle, an ungulate of the arid zones of Asia, is declining in number. A large population is still found in the desert and semi-desert areas of the Mongolian People's Republic. It is a common animal in the desert habitats of the Great Gobi Reserve.

Distribution. The range of the Persian gazelle embraces the open deserts and semi-deserts of Southwest and Middle Asia, Kazakhstan, Central Asia and northern Tibet. Not long ago (up to the 1940's and 1950's) Persian gazelles were widespread in the Mongolian People's Republic, inhabiting the deserts and semi-deserts south of the Mongolian Altai and south and east of the Gobi Altai, as well as the Great Lakes basin in the northwest, where in some years (up to 1935) they reached as far as the Lake Ubsa-Nur far to the north. At present the southern boundary of the Persian gazelle range in the Mongolian People's Republic generally coincides with the frontier between Mongolia and China from the lower reaches of the Bulgan River in the west to long, 112°E in the east. From that point the northern boundary runs in the direction of Baishint and then across the Ergin-Tala plain, where the animals extend as far north as 46°N and in some years even further north to the Usuni-Tsagan, Ulan-Gobiyn and Gobiyn-Tsagan. From there, the boundary passed along the latitude of Choire and then turned a little to the south of Mandal-Gobi. It then proceeded to the northwest right after crossing the River Ongyin-Gol to reach the Gobi Lakes basin. Further to the northwest Persian gazelles inhabited Shargiyn and Khusiyn-Gobi along the foothills of the Taishiri and Khasagtu-Khairkhan ridges. In the Great Lakes basin the boundary approached the eastern edge of the Lake Khirgiz-Nur, where the animals were found up to the year 1935. They were common in the basin of the Lakes Khara-Usu, Khara-Nur and Durge-Nur. From here the boundary rounded the main ridge of the Mongolian Altai along the ridges of Khara-Adzirga, Burgakh-Budda and Bayan-Tsagan and ran southward as far as the pass between Tsetsen-Khairkhan and Bakhar Mountains to reach the basin of the Lake Nogon-Nur. It then extended further west along the southern slopes of the Mongolian Altai to the lower reaches of the Bulgan River (Bannikov, 1954).

By the late 1970's the northen border of the Persian gazelle's range had shifted to the south, and now the animals are absent from the Great Lakes basin. North of the Mongolian Altai Persian gazelles still occur in the Gobi Lakes basins in Shargyn-Gobi and Khoisyn-Gobi (Sokolov, Orlov, 1980). In the Great Gobi Reserve Persian gazelles are widespread over most of both the Trans-Altai and Dzungarian Gobi, with the exception of the mid-altitude mountains with rocky slopes in the mountain ridges of Khavtag and Takhiyn-Shara-Nuru (Dzungaria) or the Atas and Tsagan-Bogdo Mountains (Trans-Altai Gobi). The southwestern part of the Persian gazelle's range, which comprises one-third of the total range within the Mongolian People's Republic is situated within the Great Gobi Reserve. It should be borne in mind that the largest single area inhabited by the species lies within the Mongolian People's Republic. The rest of the former range has at present only small and disjointed residual sections with small numbers of Persian gazelles.

Population numbers and density. In past centuries, up to the beginning of the 20th century, Persian gazelles were one of the most numerous ungulates in the open habitats of the Asian arid zones. Thus, for example, there were hundreds of thousands of them in Central Asia and Soviet Kazakhstan at the turn of the 19th century (Geptner et al., 1961). However, their populations suffered a sharp decline everywhere beginning in the 1940's and 1950's, and this trend has been gaining momentum as many desert and semi-desert regions have been subject to active economic development. Not only has the direct impact on the population been intensified through shooting, but their habitat has been transformed by settlements, gas pipelines, railroads, highways, etc. As a result, by the late 1970's the total number of Persian gazelles in Central Asia and Kazakhstan had sharply decreased to an estimated ten thousand head at most. Viable populations remained only within limited areas, chiefly within protected reserves or sanctuaries, while in the rest of their range they had either disappeared entirely or been reduced to extremely small numbers (Zhirnov et al., 1978). The sharp decline in the range and numbers of Persian gazelles is also seen in other Asian countries, such as Iran and Afghanistan. The Persian gazelles inhabiting Southwest Asia have been listed in the IUCN Red Book as an endangered subspecies.

In this context, measures to protect Persian gazelles within the Mongolian People's Republic, where they form the largest population in the world, assume even greater importance. In estimating their numbers within the Great Gobi Reserve, it should be borne in mind that the number of Persian gazelles has been decreasing during the last 20 to 25 years even in some parts of Mongolia. In particular, the population has suffered a significant reduction in the desert steppes and deserts of several aimaks, including Eastern Gobi and Southern Gobi. The main cause was shooting of the animals, which grew more intense after motor vehicles had appeared in increasing numbers. At the same time, there are still numerous and flourishing populations of Persian gazelles within a number of desert and semi-desert regions of Mongolia. These include the Dzungarian Gobi, as well as the northwestern part of the Trans-Altai Gobi. The estimated number of Persian gazelles in Dzungaria exceeds 13,000 head (Sokolov et al., 1978). Herds of tens and even hundreds of animals are not uncommon here. The desert steppes and deserts of the northwestern Trans-Altai Gobi also support a high-density population. Here as many as 30 Persian gazelles may be seen on a motor transect of 100 km. The total number of Persian gazelles in the Trans-Altai Gobi south of the Mongolian ridge is estimated to be at least 5,500 head (Sokolov et al., 1978).

Special census studies carried out in the Great Gobi Reserve in 1980—1982 have provided a more accurate assessment of the number of Persian gazelles in this region.

The results of the census surveys are shown in Tables 26, 27, 28 and 29. According to the 1980—1982 aerial surveys the average population density of Persian gazelles in the Trans-Altai Gobi varies from 0.08 to 0.36 individuals per 1,000 ha. The data obtained by motor transects have values of 0.24 to 1.7 individuals per 1,000 ha. Statistical analysis of these data extrapolated over the entire area occupied by Persian gazelles in the Trans-Altai Gobi sector of the reserve (about 4,000,000 ha) gave us an estimated population for this sector of 800 to

Table 26

SUMMARY OF PERSIAN GAZELLE CENSUS ON AERIAL TRANSECTS IN SECTOR A

Census data	9/1980	3/1981	6/1981	8/1981	12/1981	3/1982
Transect length (km)	1680	1510	1487	1805	1639	1535
Census area (000 ha)	504.0	453.3	446.1	487.5	491.7	460.5
Animals seen	74	94	36	175	102	48
Average density per 1,000 ha	0.15	0.24	0.08	0.36	0.21	0.1

Table 27

SUMMARY OF PERSIAN GAZELLE CENSUS ON MOTOR TRANSECTS IN SECTOR A

Census data	7/1980	8/1980	10/1980	6/1981	7—8/ 1981	9/1981
Transect length (km)	446	501	902	570	1448	1576
Census area (000 ha)	89.2	100.2	180.4	114.0	289.6	315.2
Animals seen	148	68	132	96	136	77
Average density per 1,000 ha	0.7	0.7	0.7	0.8	0.5	0.24

Table 28

SUMMARY OF PERSIAN GAZELLE CENSUS ON AERIAL TRANSECTS IN SECTOR B

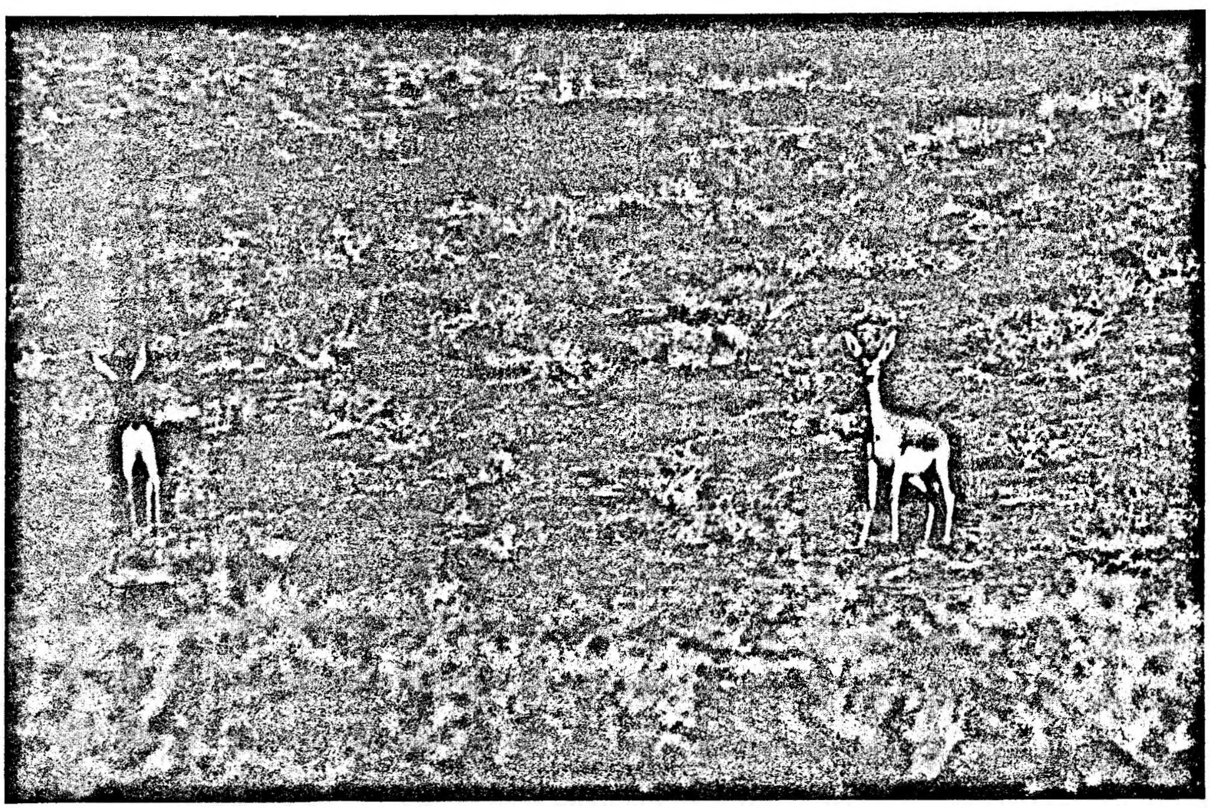
Census data	9/1980	3/1981	6/1981	8—9/ 1981	12/1981	3/1982
Transect length (km)	270	180	172	221	215	209
Census area (000 ha)	81.0	54.0	51.6	66.3	64.5	62.7
Animals seen	79	177	31	265	153	386
Average density per 1,000 ha	0.97	3.27	0.6	3.9	2.37	6.13

Table 29

SUMMARY OF PERSIAN GAZELLE CENSUS ON MOTOR TRANSECTS IN SECTOR B

Census data	9/1980	8/1981	10/1981
Transect length (km)	461	463	430
Census area (000 ha)	92.2	92.4	86.0
Animals seen	363	189	653
Average density per 1,000 ha	3.9	2.0	7.6

1,000 head. The number of Persian gazelles is far greater in the Dzungarian Gobi, where the population density ranged from 0.97 per 1,000 ha in September 1980 to 6.13 per 1,000 ha in March 1982, according to the results of aerial surveys. The analogous values from terrestrial counts were 2.0 and 7.6 per 1,000 ha. It can be inferred from the above that the overall population of Persian gazelles in Sector B is approximately 2,000 to 2,200 animals. The greater population density in the Dzungarian Gobi is accounted for by a better supply of fodder as compared to the Trans-Altai Gobi, which is dominated by superarid deserts. The census studies together with research on the distribution of Persian gazelles in the two sectors of the reserve indicate that the species finds ecologically optimal conditions in true deserts, as well as in desert steppes in plains or low-altitude intermountain valleys. The overall patterns of Persian gazelle distribution



Persian gazelles, a common species of the Gobi Desert. Edrengiyn-Nuru ridge. August 1980

Table 30

DISTRIBUTION OF PERSIAN GAZELLES BY NATURAL REGIONS OF THE TRANS-ALTAI GOBI

Region	Density of Persian gazelles per 1,000 ha	
	summer-autumn	winter-spring
Shivet-Ula	0.23	—
Otgon-Us	0.21	0.57
Edrengiyn	0.33	0.15
Buryn-Khyar	0.10	0.10
Nomin Gobi-Tsenkherkholoi	—	0.10
Shargyn Gobi	0.10	0.05
Atas-Chingiz	0.01	—
Central Gobi-Tien-Shan	—	—
Tsagan-Bogdo	—	0.14
Ekhiyn-Gol	0.25	—
Bei Shan	—	—

Table 31

DISTRIBUTION OF PERSIAN GAZELLES BY NATURAL REGIONS OF THE DZUNGARIAN GOBI

Region	Density of Persian gazelles per 1,000 ha	
	summer-autumn	winter-spring
Barun-Khurai	3.36	1.0
Takhiyn-Khonin	6.52	2.72
Northern Foothill region	2.10	2.20
Southern Foothill region	2.60	0.75
Khavtag	—	—
Takhiyn-Shara-Nuru	—	—

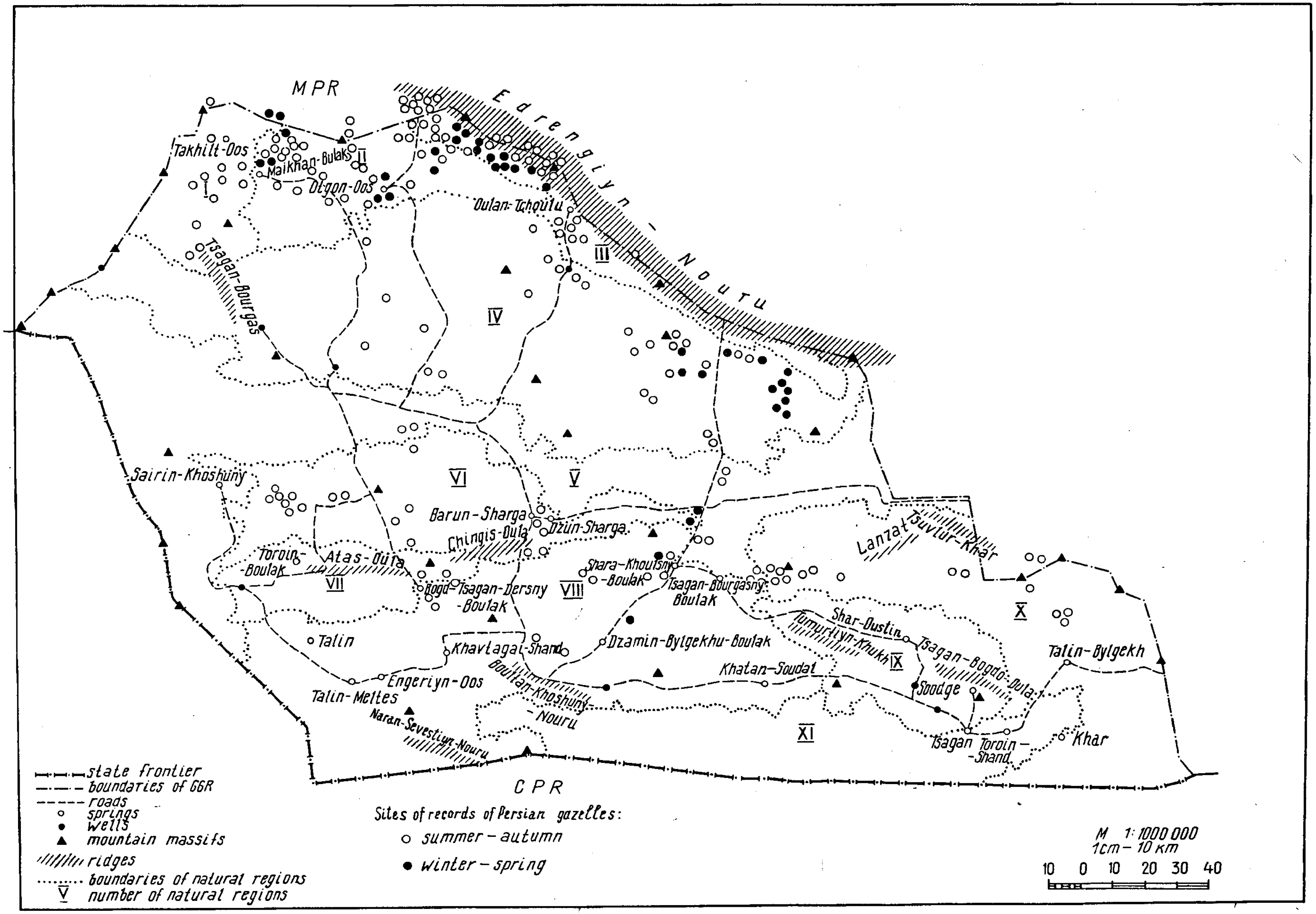
can be easily followed from the results of census studies in the various natural regions of the Great Gobi Reserve. Tables 30 and 31 give the average population density of Persian gazelles calculated on the basis of aerial and motor transects carried out in 1980—1982. Density indices are given for two periods: winter-spring (December through April) and summer-autumn (June through October).

Ecological characteristics. Persian gazelles inhabit desert areas with shrub, semi-shrub, wormwood and saltwort vegetation, as well as grass and saltwort semi-deserts on plains or in dissected hill country with hard clay-sand or gravel soil. Persian gazelles also inhabit the periphery of sand massifs, keeping chiefly to fixed dunes. They also follow desert foothills and intermountain valleys to reach quite high altitudes in the mountains: up to 3,000—3,500 m above sea level in Mongolia and China (Geptner, Nasimovich, Bannikov, 1961).

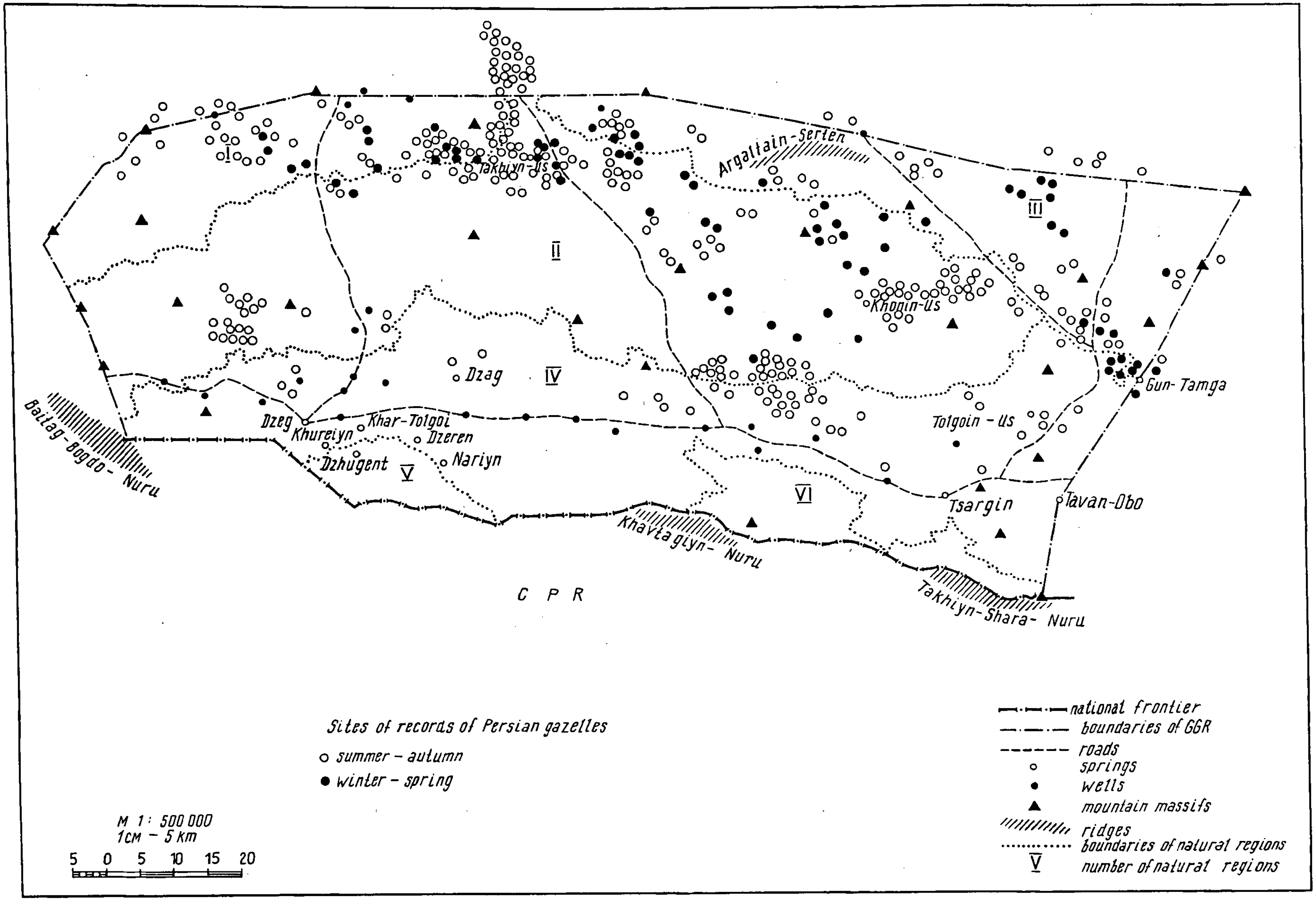
The main portion of the species's range lies in desert plains or low hills, only the periphery of the range overlapping the semi-desert zone. Persian gazelles can be seen in all kinds of desert habitats: from Central Asian hammadas with their extremely stunted and sparse vegetation to the peculiar foothill deserts of Kopet-Dag, Hissar and other mountain uplands of Asia that are covered with lush grass in springtime. With some exceptions, the range of the species corresponds to the area of occurrence of desert plant formations. Throughout all parts of their range the main food plants of the Persian gazelle inevitably include as a rule drought-resistant shrubs, semi-shrubs and semi-herbacious halophytes (anabasis, wormwoods, summer cypress, winter fat, saxaul, etc.), with other plant forms (ephemerous or ephemeroid plants such as blue grass, feather-grass, onions, etc) playing a significant role in their diet for only a short period during the rainy seasons.

In spring and summer, and even to some extent in autumn, Persian gazelles keep to themselves or form small groups of 2 to 4, or more rarely 5 to 9, individuals. This ensures that the population can make the most effective use of the extremely dispersed desert food resources with minimum daily movements. While in spring and early summer the Persian gazelles remain quite dispersed, since their spring fodder is usually rich in moisture and the animals generally do not go to their watering holes, as the vegetation gets drier and more succulent fodder becomes scarcer on the plains and in other habitats, the Persian gazelles change pastures with the onset of the summer drought, moving on the one hand nearer to accessible water sources and on the other hand to areas with halophytic shrub vegetation (ephedra, saxaul, etc.), where they can find succulent fodder. Thanks to their solitary and small-group way of life and to their morphological and ethological adaptations, Persian gazelles can survive in totally waterless desert areas in the height of the summer heat, this apparently being the rule and not the exception. Such observations have been made in both Central Asia and Mongolia (Minervin, 1944; Bannikov, 1954; Geptner, 1956 et al.). During the hot season Persian gazelles occupy, either individually or as groups, a special territorial area. Some authors estimate these summer territories of Persian gazelle groups to be several tens of square kilometers in size (Bannikov, 1961). As the weather grows cooler in September the small groups and single animals begin to gather into larger groups of 10 to 30 or more head. In late autumn and winter Persian gazelles generally form ever larger herds, though the herd tendency in Persian gazelles is less pronounced than it is in saigas or Tibetan gazelles. Even winter herds of Persian gazelles do not as a rule exceed several dozen animals. Hundreds of them assembled within a single herd have apparently been observed on extremely rare occasions in the past and that only in certain areas (Badkhyz and some other regions) with relatively rich pastures and a large overall population (Bannikov, 1954; Kostin, 1955; Geptner, 1956; et al.). There is no doubt that the increase of herd size in the autumn-winter period is related to seasonal migrations, which are most evident on the one hand at the northern limits of the range where Persian gazelles are seen moving from the snowy zone to the more snow-free areas to the south, and on the other hand in the foothill regions where Persian gazelles congregate to find better pastures. However, distinct autumn migrations involving the majority of the population have never been recorded in typical deserts (Ustyurt, Kyzyl-Kum, etc.)

Thus, land use in Persian gazelles is generally such that in spring and summer they occupy specific individual or group territories that are most favorable in terms of food supply, while in the other



Seasonal distribution of Persian gazelles in the Trans-Altai Gobi (Sector A)



Seasonal distribution of Persian gazelles in the Dzungarian Gobi (Sector B) seasons their links with a specific territory grow weaker and the animals lead a slightly nomadic way of life, carrying out small migrations in larger herds. Thus, the specific type of land use of Persian gazelles is related to the impoverished plant cover and the specific structure of desert phytocenoses. The overall low productivity of desert pastures means that a successful search for food, particularly succulent pasturage during summer droughts, is possible only when the population as a whole is dispersed. Thus, the population structure of Persian gazelles is characterized principally by organization into small groups.

The reproductive rate of Persian gazelles is low in comparison with saigas and subject to annual and regional fluctuations. The majority of females reach maturity at the age of 1.5 years (18 or 19 months). Only a negligible number of females can take part in the rut when they are 7 or 8 months old. Males become mature in their second year (at an age of 18 or 19 months), but they are usually not involved in reproduction until they are at least 2.5 years old (Geptner, 1956; Sludsky, 1956; Gorelov, 1972). Female fertility is high. They bear 1 or 2 and very rarely 3 or 4 young at a time (Mambetdzhumayev, 1970). The majority of females in Kazakhstan (75%) bore two young and around 14% bore one, while three young were very rare (0.4%) (Sludsky, 1956). Fertility is lower in other regions. Females of the Transcaucasian and Mongolian populations most often give birth to a single young (Vereshchagin, 1947; Bannikov, 1954). In Kazakhstan and Mongolia 11—12% of the females were reported to be barren. Data on the sex ratio in different populations are quite contradictory. A. Sludsky (1956) writes that the number of mature males is around 20% of the population, and may be reduced to no more than 5.5% as a result of mass mortality in the year following a winter with heavy snow. A. Bannikov, (1954) on the other hand, states that the number of males and females is approximately the same in Mongolian populations that are biologically healthy and structurally intact. Increased elimination of males seems to take place under the influence of both natural and man-made factors. However, a relative increase in the number of females does not appear to result in a rise in the productivity of Persian gazelle populations, since polygamy in this species is not as pronounced as it is in saigas (Ishunin, 1961; Gorelov, 1972).

When the number of males in a population is reduced, the reproductive process is disrupted, leading to an increase in the number of barren females. This results in Persian gazelles having a slower rate of reproduction. The maximum population growth has been recorded in Kazakhstan, where the population numbers are increased by 70—80% in autumn due to new births.

Of all the factors that limit the size of the Persian gazelle population in nature, the most destructive are the winters with heavy snowfall which sometimes occur in the deserts and lead to massive mortality in Persian gazelles. Shortage of winter fodder has strong impact on the numbers of Per-

A young Persian gazelle. Near Dzarman. June 1981 sian gazelles. A decrease in the number of Persian gazelles after winters with heavy snow has been reported in every part of the Persian gazelle's range (Sludsky, 1963, et al.). The effect of severe winters is more destructive to Persian gazelles than it is to saigas. We share the opinion of A. Sludsky (1963) and other authors who ascribe this to the inability of Persian gazelles to withstand deep snow cover, particularly in view of their low proclivity to migrate. For example, in Kazakhstan and elsewhere the Persian gazelle population has been significantly reduced over a large area after winter famines, the animal disappearing for 5 to 7 years and longer. However, it should be pointed out that winters with snowfall are much rarer in the deserts than they are in the semi-deserts and steppes. The effect of natural enemies on the number of Persian gazelles is virtually unknown. The main natural enemies of the Persian gazelles are the wolf and the cheetah (Sludsky, 1962), although only the cheetah was known in the past to prey regularly on these animals (in Turkmenistan), while snow leopards hunted them in Sinkiang (Murzayev, 1966). There are 18 species of helminths common to Persian gazelles and domestic animals. In some places Persian gazelles are severely parasitized by subcutaneous gadfly larvae which tire the animals out. The low reproductive rate and the distinctive type of land use in Persian gazelles make them vulnerable to anthropogenic factors. Intensive economic development of desert areas, the influx of human population and the appearance of a great number of motor vehicles in formerly remote parts of the desert have had an extremely negative effect upon living conditions for Persian gazelles over most of their range. Vast desert areas are being subjected to development, including land-reclamation and ploughing of virgin lands to grow cotton and other crops, resulting in direct destruction of the Persian gazelle's habitats (Transcaucasus, Ferghana and other districts of Central Asia). In other areas livestock force out Persian gazelles by occupying their watering spots, especially in summer. It should be borne in mind that throughout the Persian gazelle's range intensive development of the deserts has heightened the disturbance factor and forced the animals to retreat to unsuitable habitats with poor forage potential but inaccessible to motor vehicles (foothill areas, hummocky terrain, masses of drift sands, ravines).

However, wide-scale shooting of Persian gazelles from motor vehicles must be recognized as the decisive factor in the decline of their range and numbers. This mode of hunting results in the rapid elimination of the ungulates over large areas, leading to the destruction of the spatial structure of various populations and acute dispersion of the overall population, forces Persian gazelles into unsuitable habitats and increases their natural mortality. Headlight shooting by night leads to intensive selective killing of adult males because of their large size and beautiful antlers, which disrupts reproductive mechanisms in the population and slows down the rate of population growth.

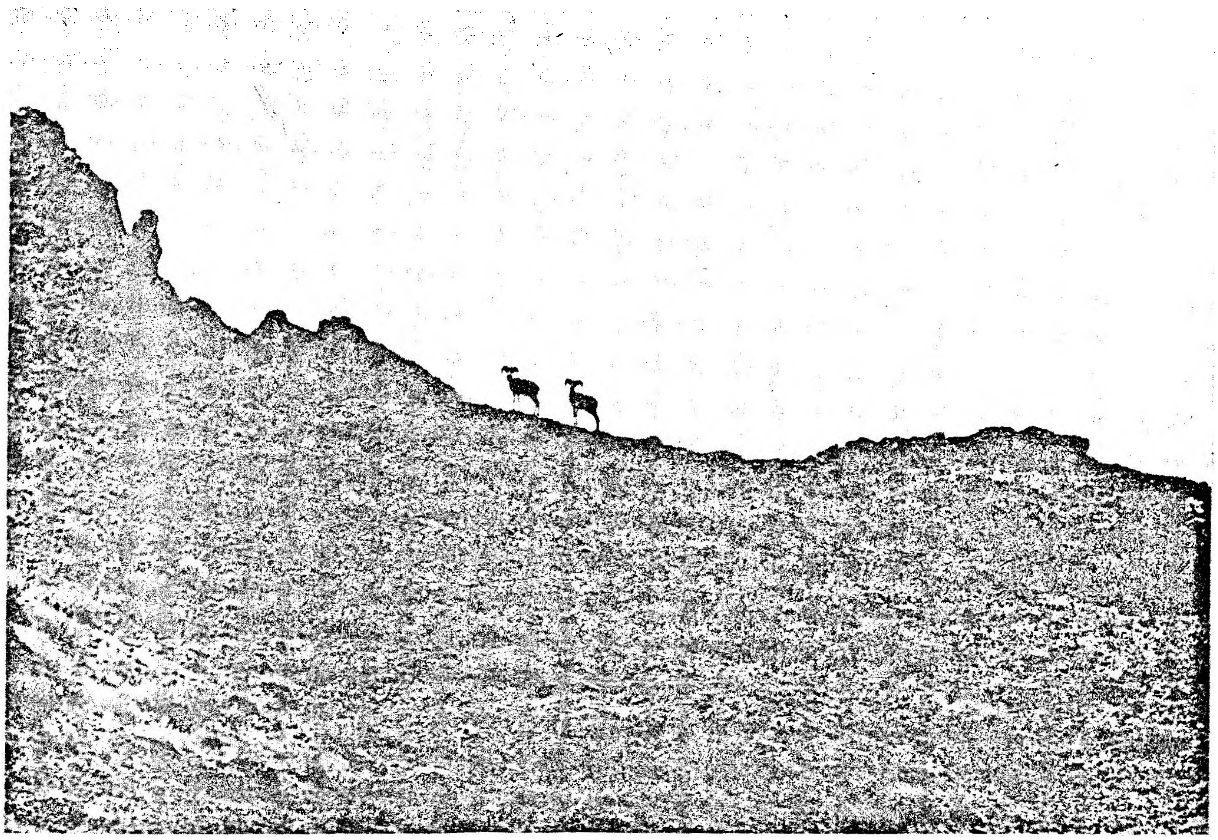
It should be noted that the population of Persian gazelles in the Mongolian People's Republic are in a relatively favorable state as compared to other portions of the animals' range. This is indicated by their numbers and the size of their range within Mongolia. To insure the conservation and further growth of the Persian gazelle in the Gobi Desert the rules of the reserve must be observed not only within its boundaries but in the buffer zone, where instances of illegal hunting still occur. Within the reserve no other protective measures are needed. However, as preliminary studies have shown, most of the Persian gazelle population in the Trans-Altai Gobi is concentrated in the northern part of the reserve and in the buffer zone. In view of this, areas of their seasonal concentration and, in particular, their lambing sites must be defined and, based on these concrete conditions, a protective regime developed to assure the most favorable conditions for reproduction and to insure the population's survival during the "tight" seasons, winter and spring. In the Dzungarian Gobi the protective system must also include scientific methods of population management which will regulate the relationships between wild and domestic ungulate populations that use the same pastures and water sources.

ASIATIC WILD SHEEP OR DARWIN'S ARGALI
Ovis ammon darwini Przewalskii, 1883

Status. This is one of the least known subspecies of the wild sheep which inhabit the arid zones of Central Asia. It is endemic to the Gobi Desert.

Systematics. The systematic position of the wild sheep found in southern Mongolia and adjacent parts of northern China has until recently been obscure. A. G. Bannikov wrote in his book **Mammals of the Mongolian People's Republic** (1954) "It is still an open question whether the wild sheep living in the Khurkhu Mountains (eastern Gobi) and the adjoining hummocky terrain is the form O. a jubata or the form with a less developed neck skinfold described by N. M. Przevalsky as O. a. darwini. Nevertheless all authors have assigned an independent subspecies status to the wild sheep that occurs south of the Mongolian Altai (Nasonov, 1923; Tsalkin, 1951; Bannikov, 1954). They have also emphasized the significant differences between this variety and the nominal form, the Siberian sheep or argali (O a. ammon), which is widespread throughout the major part of Mongolia. A recent review of the species O. ammon has enabled a clearcut differentiation of the wild sheep that inhabit the Mongolian People's Republic south of the Mongolian Altai and their assignment to an independent subspecies, Darwin's argali (Ovis ammon darwini Przewalskii, 1883) (Sopin, 1982). N. M. Przevalsky (1875) first described wild sheep shot on the spurs of the Khurkh-Ula (Khurkhu) ridge in the eastern Gobi as an independent species (Ovis darwini), but it turned out that these sheep are entitled only to subspecies status, though they are still called Darwin's argali (O a. darwini) (Sopin, 1982).

Numbers and distribution. As we have noted, the Asiatic wild sheep occurring south of the Mongolian Altai occupy many mountain ranges and hummocks in the arid zones of southern Mongolia, specifically the Gobi Altai and the Gobi Tien-Shan. V. Ladygin (1900) and A. Simukov (1937) gave a quite complete picture of the distribution of wild



Darwin's argali. Trans-Altai Gobi. Edrengiyn-Nuru ridge. August 1980

sheep in the Trans-Altai Gobi. According to their data, the animals were common in the Trans-Altai Gobi in the mountains of Edrengiyn-Nuru, Tsagan-Bogdo, Atas-Bogdo-Ula and Shara-Khulsny-Ula, as well as in the mountain highlands of Ultseitu-Ula, Khuchik-Ula and Bogdo-Ula, extending as far as Dzamin-Ude in the east. V. Kazakevich (1924) referred to wild sheep inhabiting the ridges of Nomoton, Khurkhu, Argalinte and Shara-Khada as far to the east as Soloig-Khere. Wild sheep are also found in the hummocky terrain of the Bordzon-Gobi (Bannikov, 1954). Based on the results of field observations and inquiries in the early 1940's (1943—1945), A. G. Bannikov confirmed and defined more precisely the area of wild sheep distribution within the Gobi region, particularly in the Trans-Altai Gobi, where he noted that the animals occurred "everywhere, except perhaps in basins". They were common in the Tsagan-Bogdo and Atas-Ula Mountains, the entire hummocky region surrounding them, and in the ridges of Edrengiyn-Nuru, Bayan-Undur, Shibetu, Altak-Ula, Bumbu, Ongon-Ula, Khabu-Agaitu, Khukhu-Tumurte, Nanashe-Nuru and Dzara-Khairkhan. In short, wild sheep inhabited the entire complex system of mountain massifs and adjoining hummocky terrain referred to as the Gobi Altai in the north and the Gobi Tien-Shan in the south, along with the system of elongated valleys that dissect the mountain massifs of the Trans-Altai Gobi. Along the southernmost chain of arid mountains and hummocks which constitute the Gobi Tien-Shan they penetrated as far to the east as the Khutag-Ula Mountains, i. e. up to latitude 110° E (Bannikov, 1954; Sokolov, Orlov, 1980).

West of the Edrengiyn-Nuru ridge Asiatic wild sheep also inhabit the mountain massif of Adzhi-Bogdo, the plateau-like structure which is separated from the Gobi Altai and Gobi Tien-Shan by desert hollows, plains and fields of hummocks. Further to the west of Adzhi-Bogdo wild sheep are very common in the southern part of the Dzungarian Gobi (Sector B) in the mountains of Takhiyn-Shara-Nuru, Ikh-Khavtagiyn-Nuru (Khavtag) and Baitag-Bogdo as was shown in the course of the 1980—1982 UNEP Project.

Aerial and motor-vehicle counts failed to give an accurate assessment of the population numbers of Asiatic wild sheep within the Great Gobi Reserve because of the drawbacks inherent in the transect technique.

In the Trans-Altai Gobi Asiatic wild sheep are most commonly observed on the Edrengiyn-Nuru and Tsagan-Bogdo ridges. Several herds numbering 10—15 sheep each can be seen here during a 4 to 5-hour walk. In the other mountain massifs and hummocks the animals keep to themselves or to smaller groups (2 or 3 animals each) and consequently the probability of encountering them in these areas is quite small. The population of Asiatic wild sheep in the Edren-giyn-Nuru and Tsagan-Bogdo regions (the Trans-Altai Gobi population) may be estimated to total roughly 250 or 350 individuals with an average density of about 0.5—0.6 per 1,000 ha of optimal habitat.

Observations made by K. Ye. Bugayev and Ch. Timur in the Dzungarian Gobi indicate that the local population density can reach even higher values of 0.8 individuals per 1,000 ha in the most suitable terrains in the southern mountain massifs of Takhiyn-Shara-Nuru and Ikh-Khavtagiyn-Nuru (intermountain valleys and gently sloping hillsides in the dry mountain steppe belts). However, estimation of the total population numbers in this region is difficult because of the lack of census data.

Ecological characteristics. As we already noted, the basic habitats of wild sheep in the Trans-Altai and the Dzungarian Gobi are found in intermountain highlands or hummocky terrain situated in the desert zone. Typical habitats of the Asiatic wild sheep combine open areas of desert-steppe vegetation with well-sheltered places, such as ravines and small gorges, where the animals can shelter from bad weather or hide from predators. However, unlike true mountain-dwelling ungulates, such as the Siberian mountain goat, Asiatic mountain sheep prefer slightly rugged open landscapes. They inhabit hummocky terrain, mountain plateaux or the sloping flanks of mountain highlands, but the height above sea level is not an important factor. In the Trans-Altai Gobi Asiatic wild sheep may be found among sloping residual mountains rising 100 to 300 m above the surrounding desert terrain or among the vast fields of hummocks. On the other hand, wild sheep occupy the most elevated mountain massif in the Edrengiyn-Nuru, where areas of uplands alternating with gently sloping intermountain valleys are well represented. Flat mountain summits are used by the animals for pasturage and rest. In rocky mountain areas Asiatic wild sheep prefer to keep to wide sairs. In the Trans-Altai Gobi, however, they are frequently found among typical desert plains covered with saxaul, ephedra and saltworts. Thus, in our travels in motor vehicles we frequently saw herds of wild asses, Persian gazelles and Asiatic wild sheep at the same time in typical saxaul-saltwort deserts. As distinct from Persian gazelles and wild asses, wild sheep generally avoid vast desert basins, although they may sometimes be found there as well when they are migrating or wandering.

Winters with little snow and steppe pastures where the animals can graze on herbaceous fodder plants in winter are essential elements of any geographic region where Asiatic wild sheep live. As a rule, wild sheep avoid vast plains and rocky mountains. However, with the passage of time domestic livestock are increasingly occupying the best pastures and forcing Asiatic wild sheep into locations with poor pastures on steep rocky slopes or into deep gorges where they experience shortages of forage, water and shelter. The present habitats of wild sheep in different parts of their current range can not therefore be considered adequate in terms of the animals' ecological requirements. This constitutes one of the causes of population decline in many forms of wild sheep, since they are constrained to select unsuitable pastures for the season of the year. This kind of adverse impact of anthropogenic factors on the distribution of wild sheep also occurs within the Great Gobi Reserve and the buffer zone. For example, the best winter pastures in Edrengiyn-Nuru are occupied by cattle thus forcing the wild sheep to move to hummocky terrain or the southern foothill plains lying in the superarid desert zone. The distribution of wild sheep in desert terrains depends to a great extent on the availability of intermittent or permanent water sources. As we observed, wild sheep visit their water holes more or less regularly in the period from June through September. Wild sheep, mountain goats, Persian gazelles and wild asses were all seen together one day in June 1982 at one of the springs on the southern slope of Edrengiyn-Nuru. We found tracks of watering wild sheep at almost all the springs in the Trans-Altai Gobi.

The animals seem to be able to manage without visiting watering places only in the cool season of the year or when they are grazing on pastures with succulent vegetation, particularly in the good growing time of onions and grasses during the rain season (July-August). It should be borne in mind that the ecology of Asiatic wild sheep in the Gobi Desert is very poorly understood and in fact we have a very poor idea of the basic trophic links and population structure of the wild sheep populations which live under the superarid conditions of the Gobi Desert. Our observations have revealed a limited number of fodder-plants consumed by Asiatic wild sheep. They include feather-grass, sheep's fescue, onions, anabasis, summer cypress and wormwoods. The animals also eat leaves and small twigs of pea trees, ephedra, winter fat and bean caper. Analysis of fodder plant composition in different geographic regions indicates that wild sheep prefer grasses and forbs, while twigs are of secondary importance and play a negligible role in the animals' diet. The choice of fodder plants in the Central Asian deserts depends also on their water content. Judging from isolated observations of grazing wild sheep they actively select the most sappy plants available in the desert plant cover. The Mongolian herdsmen even gave the name "argali brew" to bean caper, which the animals like to eat (Bannikov, 1954).

Other biological features of the Asiatic wild sheep may be deduced from those of the related subspecies inhabiting Central Asia, Kazakhstan, the Altai and northwestern Mongolia. The animal is most similar to the Siberian wild sheep with respect to its environmental characteristics.

Asiatic wild sheep live in herds. The average annual herd size in Tuva is nine. Organization into small groups is also typical of the Trans-Altai Gobi population, where herds of more than 10 to 12 head are very rare. Based on summer census counts males constitute 40% of the population, females 52% and yearlings 8%. Females reach maturity in the third year of their life and males in the fourth year. During the rut period males have harems of 8 to 13 females. Mature females evidently do not mate every year. A female most often produces one lamb. In southern Mongolia the youngs are born in late April and early May. A. Simukov (1927) reported seeing a female with two new-born lambs at Artsa-Bogdo at the end of April. In the Trans-Altai Gobi we saw a herd of Asiatic wild sheep with young aged about one month in June 1982. The complicated age structure and low reproductive capacity of wild sheep populations account for the slow annual rate of population growth. Coupled with growing human impact, this is leading quite rapidly to a decline in their overall numbers in various regions and to the extinction of local populations.

The natural enemies which affect population numbers include wolves, which mainly take old males and young. In the Gobi Desert the predatory activities of wolves occur during the period when the wild sheep regularly visit springs, and this is where the wolves are most successful. In other parts of their range old males and sometimes females appear to fall prey to wolves basically in winter when they can easily catch the sheep at places with thick snow cover (Sopin, 1975, et al.). Increased mortality from starvation is also observed in winter in years when the ground is covered with snow or ice, preventing the sheep from getting to their fodder. The adverse effect of severe winters is most pronounced today when the best winter pastures are occupied by livestock. Moreover, Asiatic wild sheep find themselves in close contact with domestic sheep when they share natural pastures and are then prone to catch a number of infectious and parasitic diseases. For instance, sheep scab mites and other dangerous parasites cause considerable mortality or exhaustion of wild sheep, leading in turn to a decline in their population.

However, the key factor in the decline of wild sheep populations has been hunting, which in the past was practiced regularly and on a large scale. Earlier wild sheep were hunted for food, but recently the animals have been shot to obtain the horns of large males as trophies.

Today, hunting wild sheep in the Mongolian People's Republic is strictly regulated and is restricted to special game-keeping enterprises that issue hunting licenses to foreign sportsmen.

The increased burden of hunting combined with extensive livestock-breeding over large areas in the mountainous regions have in the final analysis led to a sharp decline in the number and range of wild sheep in many countries (Zhirnov, Vinokurov, Bychkov, 1978).

All this lends still greater importance to the problem of protecting wild sheep as uniquely valuable objects of sport and commercial shooting. It should not be forgotten that all the varieties of wild sheep constitute a uniquely valuable genetic resource for creating new lines of domestic sheep. Cross-breeding of the local forms of wild sheep with domestic sheep is of great interest, since new strains may have valuable economic characteristics and high adaptability to living in the severe conditions of high mountains or deserts.

In view of this, conservation of such desert varieties of the wild sheep as Darwin's argali, which is perfectly adapted to superarid desert environments, is of great scientific importance in studying ecological and morphological adaptations to the continental climate of the waterless Gobi deserts. Hence, the preservation of the viable natural populations of Asiatic wild sheep within the Great Gobi Reserve is of worldwide importance in providing a "gene bank" of a distinctive wild sheep variety adapted to the environment of superarid deserts.

The 1980—1982 studies of the wild sheep populations in the Trans-Altai and Dzungarian Gobi indicate that they have not been adversely affected by human activities. However, their further existence can be assured only if the protective regime in Sectors A and B of the reserve is strictly observed. The guard service must reinforce control over observance of the ban on hunting wild sheep in the buffer zone and establish proper veterinary inspection of domestic livestock kept within the buffer zone and other districts bordering on the Great Gobi Reserve in order to prevent introduction of the most dangerous infectious and parasitic diseases into the wild sheep population. The scientific staff of the reserve must discover and map the concentration points of wild sheep and then perform annual censuses of their population to evaluate population trends under conditions of total protection (Sector A) or in areas where domestic livestock are let out to range (Sector B).

GOBI BEAR OR MAZALAI

Ursus arctos pruinosus Blyth, 1854 *

Status. This is a rare Mongolian species with a limited range and a small population. It is listed in the IUCN Red Book.

Numbers and distribution. The earliest references to an unknown species of bear in the desert mountains of the Trans-Altai Gobi occur in the notes of V. Ladygin (1900) and A. Simukov (1937). They discovered its tracks along with numerous delves made to obtain rhubarb rhizomes in the Tsagan-Bogdo region and the neighbourhood of Tsagan-Burgasny-Bulak and Shara-Khulsny-Bulak. But the bear itself was not seen.

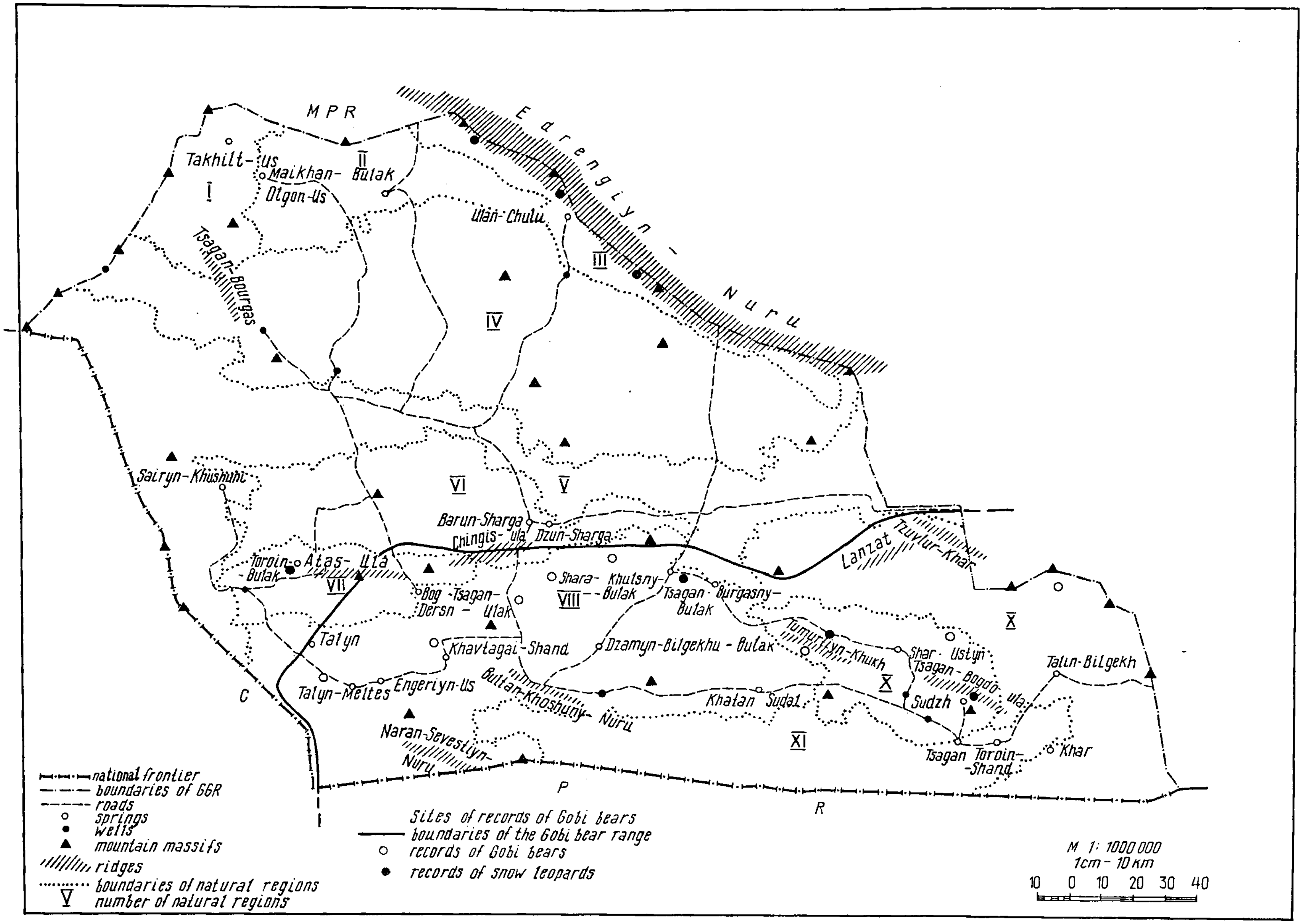
In subsequent years the literature only has isolated notes on the occurrence of bears in the Trans-Altai Gobi, based principally on the results of inquiries. More detailed data were obtained as a result of the 1943 expedition organized by the Science Committee of the Mongolian People's Republic.

The results of this work, along with details on the distribution and ecology of the bears in the Trans-Altai Gobi, were published by A. G. Bannikov (1945, 1954). E. M. Murzayev, a geographer, and A. A. Yunatov a botanist, who participated in the 1943 expedition, were the first scientists who succeeded in observing a wild Gobi bear under natural conditions.

On August 4, 1943, they were returning from the Ekhiyn-Gol basin to their field camp in the Tsagan-Bogdo mountain massif, accompanied by a Mongolian guide. Then, as E. M. Murzayev describes the encounter, "... at last we saw a Gobi bear in a wide dry sair which crossed the length of the hummocky terrain in the northern foothills of the Tsagan-Bogdo. Its fur was dark brown with patches of lighter moulting hair protruding from the dark coat. The bear was running unhurriedly with its nose down, evidently searching for food. The plants in

---

* The taxonomic status of the Gobi bear of the Trans-Altai Gobi conforms with that in **Mammals of the Soviet Union**, vol. 2, part 1, Moscow, 1967, ed. by V. G. Geptner and N. P. Naumov. However, as we have already said, the systematic position of this bear has not yet been definitively settled.



Distribution and sites of records of Gobi bears and snow leopards in the Trans-Altai Gobi (Sector A) the area included ephedra, wormwood, pea-tree, calligonum and saltworts.

The camel which A. A. Yunatov, the expedition botanist, was riding cried out when its rider sprang to the ground. The bear heard the sound and became alert, standing with its front legs over the edge of the channel bed it was running in. For a moment the bear examined us attentively as rare and unexpected objects in the desert surroundings. It then ... turned around and began to run away from us, clambering up the valley slopes with amazing agility and speed. The animal soon disappeared behind the desert knolls.

So far as we noticed, the bear was not particularly large in size, smaller than a brown bear, but it ran with surprising ease and climbed the hill splendidly, running away at a gallop then stopping for a moment to look in our direction. The Mongolians told us that the bear was very fond of rhubarb and knew how to find it and dig it up."

That was how naturalists came to see for the first time the rare Gobi bear, a hermit of the Gobi Desert. E. M. Murzayev (1948) correctly noted that Gobi bears ... "have survived in the Gobi as relict animals, living witnesses of another climate and another landscape which used to exist in Central Asia. The former climate and landscape of the Gobi was apparently more suitable to animals such as bears that require either forests or distinctly zonal mountains, as for instance in Tien-Shan, rather than deserts." (Murzayev, 1948, p. 195).

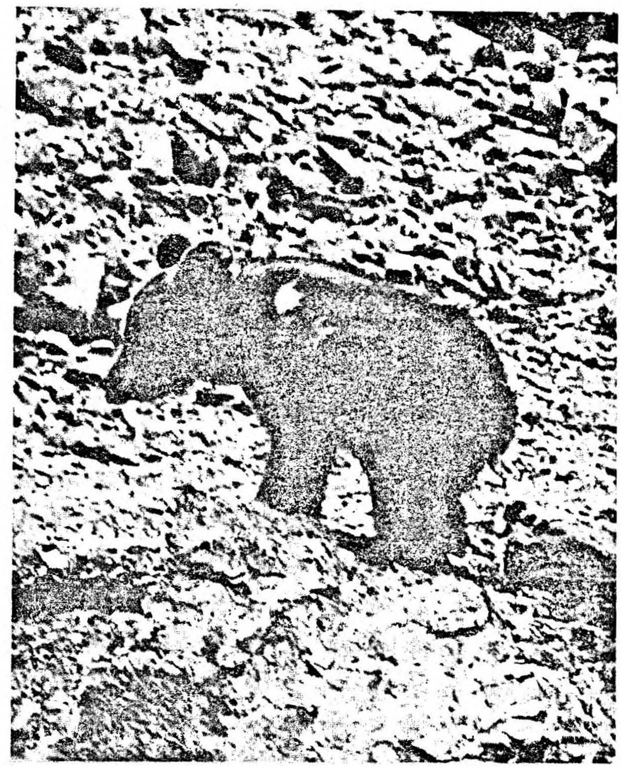
Based on the results of field observations and inquiries, A. G. Bannikov (1954) gave a more detailed definition of the Gobi bear's range in southwestern Mongolia.

The range of the Gobi bear embraced the southeastern regions of the Trans-Altai Gobi, an area about 15,000 sq. km. in size. The northern boundary stretched along a line connecting Baga-Ulan-Nuru and Ikhe-Khobtsogain-Nuru, then to the oasis of Shara-Khulsny-Bulak and the mountains of Dzara-Khairkhan, Chingiz-Ula and Atas-Ula, which served as the western limit of the bear's distribution. Within the Atas-Ula mountain system the boundary extended to the mountains of Khaltkhe-Shandani-Khoitu-Nuru and Bulgan-Khoshuni-Nuru and then along the Khoton-Sudal Ridge to the southern foothills of Tsagan-Bogdo, thus forming the eastern boundary of the range.

As A. G. Bannikov (1954) noted, in the past the bear also occurred further east as far as the Tost-Ula mountains.

Isolated sightings were also reported further north, in the mountain massifs of Edrengiyn-Nuru and even in the Adzh-Bogdo mountains.

For example, A. A. Yunatov (1951) found tracks of the bear in the Khotul-Khairkhan Mountains 60 km west of the Dzakhoi oasis (Bannikov, 1954). In his description of the Gobi bear's range in the Trans-Altai Gobi, D. E. Dagva (1954) also placed the northern boundary of its distribution along the Edrengiyn-Nuru ridge, including the mountain system of Adzh-Bogdo. Specifically, he reported seeing a female with two cubs at a spring in the Ezhe-Khatan-Khair-Ula mountains in 1952. This is approximately the same as the range descrided in later



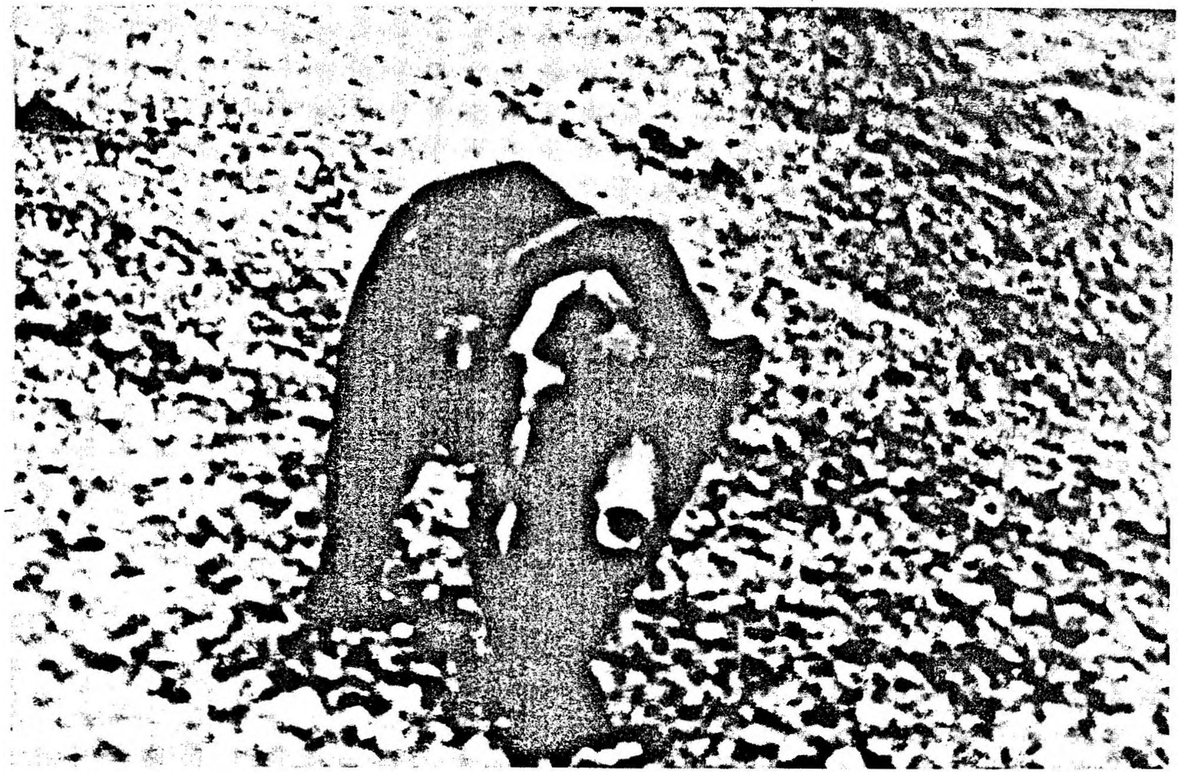
Shara-Khulsny-Bulak oasis. Bear cub.
August 1, 1981. Photograph by Ch. Timur

publications of Mongolian zoologists (Shagdarsuren, 1962; Bold, 1967; Khotolkhu, 1969; Tsevegmid, 1970).

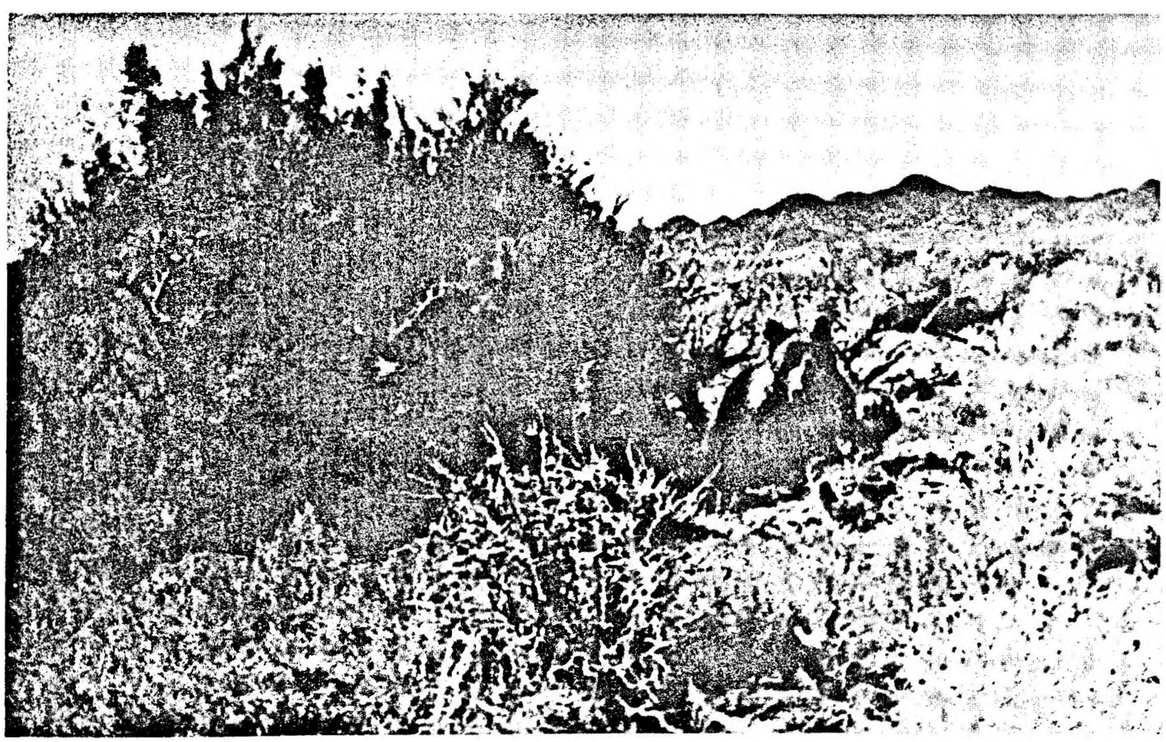
All the areas within this reserve assumed to harbor Gobi bears were surveyed from June through October 1980. Traces of bear activity were found in many places within the range described above, but the greatest number of fresh bear signs were observed in October 1980 in the vicinity of the Shara-Khulsny-Bulak spring and in the hummocks of Ushgiyn-Ulan northwest of the Ekhiyn-Gol oasis.

In 1980 these areas had a good growth of rhubard, the rhizomes of which the bears prize as food. The search for the animals was continued in 1981 on the ridges of Dzun-Toroin, Bulgan-Khoshuni-Nuru and some other ridges in the border area that had not been previously surveyed. These careful searches were a great success, since the zoologists were able to observe live bears under natural conditions four times, taking photographs and uncovering the secrets of this relict desert hermit of the Gobi.

The first encounter with a bear occurred on August 1, 1981, in the Shara-Khulsny-Bulak oasis, where the zoologists had established an around-the-clock watch. At twilight K. I. Bugayev noticed an adult bear moving rapidly through the nitrebush stand on the southern edge of the spring. The bear was at a distance from the observer, but it was possible to make out some details. The animal was of small size, no more than 100—120 cm tall at the withers. Its body fur was light in color with a sandy hue; the head was darker. The bear was of



Adult male Gobi bear. North slope of Dzun-Toroin-Nuru ridge. September 18, 1981. Photograph by K. Ye. Bugayev



Adult male Gobi bear roused from its lair in worfberry and tamarisk thickets. Tsagan-Shaal, southwest of Dzamyn-Bilgekhu-Bulak spring. September 20, 1981. Photograph by Ch. Timur a lean build with a slender trunk. It moved very easily and fast.

That same evening (August 1, 1981) when it was dark (about 11 p. m.) K. I. Bugayev, L V. Zhirnov and Ch. Timur heard a cub crying. These cries were heard at short intervals until midnight. During this time the cub was rapidly moving through the nitrebush stand. over an area of 150—200 sq. m. Its cry was heard again at dawn the next morning.

The next day Ch. Timur and L. V. Zhirnov succeeded in observing the cub at a distance of 20—50 m when it emerged from the oasis thickets and made for the mountains after feeding on nitrebush berries. At 6 p. m. L. V. Zhirnov heard a crackling of branches and reeds in the oasis, and a few minutes later a cub emerged from the thicket and rapidly climbed onto a stony ledge. Here it halted, sat back on its hind legs and began to look around. When an attempt was made to crawl up to it, the cub began to run along the rocky ravine with unexpected speed and was soon hidden among the rocks.

Ch. Timur happened to see the cub in the same circumstances and even take a number of photographs of it in various poses.

On the evening of August 2 the cub came down to the oasis again and its abrupt "barking" cries were heard at night.

On the morning and afternoon of August 3 the cub was not seen at the oasis. By that time it had apparently found its mother and left the area with her.

The third sighting of a bear was recorded at 7 p.m. on September 18, 1981, by K. I. Bugayev, Ch. Timur and A. I. Sokov during a motor transect along the northern slope of the Dzun-Toroin Ridge. The animal was foraging for food, apparently eating the shoots and seeds of bean caper. It was possible to approach within 8 or 10 m of the feeding bear in the motor vehicle and photograph it.

The photograph shows clearly a large well-fed male with a fur glossy after moult. It had well-defined white spots of irregular shape on its neck and shoulders. The claws were light in color and straight.

The fourth bear was found on September 20, 1981, at Tsagan-Shaal southwest of the Dzamyn-Bilgikhu-Bulak spring. At 2 p. m. during his walk through a small hollow with thickets of box-thorn and tamarisk, Ch. Timur almost stumbled into a male bear sleeping at the base of a tamarisk bush among quite dense box-thorn growth.

The zoologist succeeded in photographing the animal, which was frightened by the unexpected encounter with man. This adult animal was thin and in full moult. Clumps of its light-brown hair with a pinkish undercoat were hanging all over the shrubs around where it lay. Judging by the dung, the animal had eaten many box-thorn berries.

Finally, one more observation should be mentioned, though it is not absolutely reliable. V. F. Litvinov, one of the census observers, reported seeing a bear in June 1981 during an aerial census in the hummocks on the southeast slopes of the foothills of Chingiz-Ula ridge, though other observers did not confirm the sighting. However, the results of landsurveys in this area make it quite possible that a bear was seen.

It thus appears that the current range of Gobi bears is restricted chiefly to the southeastern part of the reserve. More precisely, the northern boundary of its range seems to run from the eastern bel of Atas-Ula Mountain along the northern bel of the Dzun-Toroin ridge to Dzara-Khairkhan Mountain, and then from Alag-Under Mountain to the Tsuvlur-Kharyn ridge where it crosses the eastern boundary of the reserve north of Khutsyn-Khar Mountain.

In the east the range extends somewhat beyond the eastern boundary of the reserve. Specifically, bears regularly occur within the isolated small mountain massif of Khutsin-Shanda east of the Ekhiyn-Gol oasis, where good springs are available. The eastern boundary of the range then stretches through the foothills of the Tsagan-Bogdo, where the animals are also found. The southern limit of the range coincides with the frontier between Mongolia and China, though the animals apparently occur on Chinese territory as well.

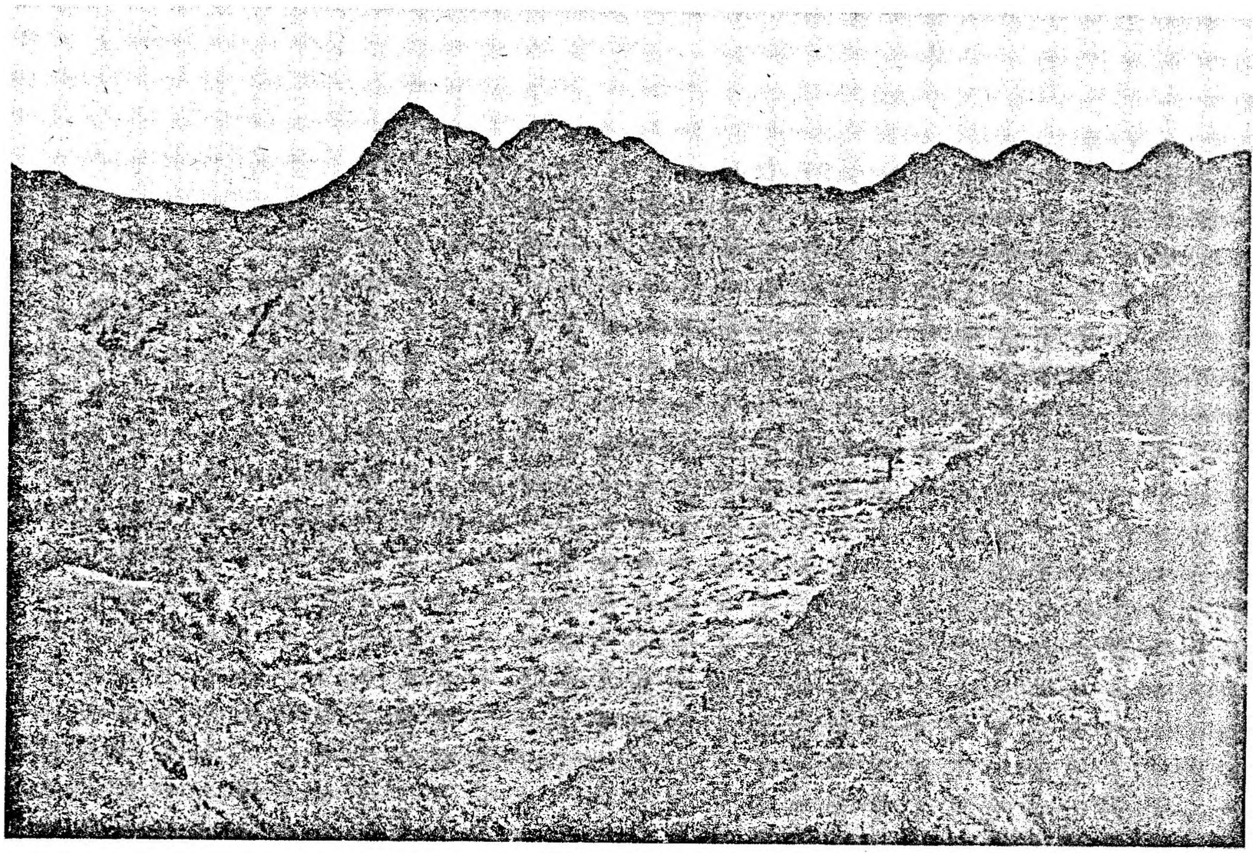
The western boundary runs from the Naran-Sevesten-Nuru ridge south, and also north as far as the eastern foothills of the Atas-Ula. We did not observe any traces of the Gobi bear either on the southern or northern slopes of this massif.

The total area of the bear's range within the Trans-Altai sector of the reserve does not appear to exceed 10,000—15,000 sq. km. Within this area there are two distinct centers of residence: the area of the Tsagan-Bogdo mountain massif with the adjacent springs and hummocks and the area of the Tsagan-Burgasny-Bulak and Shara-Khulsny-Bulak springs with the neighbouring mountains and hummocks.

The sketch-map shows the places where bears and traces of their activity were found in the Trans-Altai Gobi during the 1980—1982 period. These occur in the following localities: the springs of Shara-Khulsny-Bulak (July and August 1980—1981), Khoton-Us (September 1981), Tsagan-Burgasny-Bulak (August 1981), Dankh (July and August 1981), Khavtagain-Shand (September 1981), Tsagan-Shaal (September 1981), Mazalai-Bulak (July and September 1981), Bogts-Tsagan-Dersny-Bulak (September 1981, Tamyn-Meltes (September 1981), Bayan-Sair (July and September 1981, Sukhain-Bon (August- September 1981), Toroi (September 1981), Ushgiyn-Ulaan (October 1980 and September 1981).

Detailed surveys of the reserve showed that the current bear population in the Trans-Altai Gobi is extremely small, as it was in past years. The population density is very low. According to estimates by members of the 1980—1982 UNEP expedition the total population of bears does not exceed 25—30 individuals. Mongolian zoologists who worked in the Trans-Altai Gobi have given similar estimates (Bold, Dulamtseren, 1981).

As described above, we located 13 places where the animals or fresh traces of their activity were recorded during 1980—1982. Based on these data and on the fact that these animals generally live alone or in families, a minimum of one or two individuals lived in each inhabited place. Thus, the total number of 25—30 bears is a valid estimate of the population of bears in the Trans-Altai Gobi.



Trans-Altai Gobi. Shara-Khulsny-Bulak oasis. Gobi bears reside here. Photograph by K. Ye. Bugayev

Since the overall area of the bear's range is 15,000 sq. km., the average population density must be 0.002 individuals per 1,000 sq. km. We consider this low value can reflect the very poor conditions in which the species exists in the zone of superarid deserts where suitable habitats are very disjointed, being associated with specific oases or mountain massifs.

There are as few data today on the ecological characteristics of the Gobi bears as there were at the time of N. M. Przhevalsky and P. A. Kozlov. The basic habitats of the animal are apparently associated principally with two types of terrain: oases with scrub forest, on the one hand, and mid-altitude mountain massifs or high-altitude hummocky terrain, on the other.

Our observations showed that the majority of animals and fresh traces of their activity were found in oases at mid-elevations or in high hummocky terrain. The most representative habitat of the Gobi bear is the Shara-Khulsny-Bulak oasis, which is surrounded by low rocky mountains dissected by sairs in the form of mountain gorges with typical desert vegetation: pea-trees and ephedras, as well as scattered plants of rhubarb, anabasis and bean caper.

Scrub-forest vegetation forming small groves of downy poplar and tamarisk with stands of nitrebush, box-thorn and reeds is well represented in oases with surface outcrops of ground-water. These desert areas with outcrops of ground-water in combination with mountains are apparently the optimum habitats for the Gobi bear in the superarid deserts of the Trans-Altai Gobi.

The Gobi bear's attachment to oases is most probably determined by the nature of its diet. Examination of the plots where bears forage and analysis of their dung has revealed that their basic diet during the summer-autumn period consists of rhizomes of rhubarb, berries of nitrebush, box-thorn and liquorice, sprouts and seeds of Przhevalsky's ephedra and leaves and shoots of Potanin's bean caper.

In oasis reedbeds we sometimes found that the youngest and juiciest reed stems had been eaten, We would quite often find delves made by bears digging for rhizomes of rhubarb, which are the animal's favorite food in years when there is good growth of these plants., From July through September the animals are very content to keep to oases with fruitbearing nitrebushes. Thus, the berries of this plant were the main constituent of 22 dung samples collected in the summer of 1981 in terms of both volume and frequency.

These data indicate that the bears of the Trans-Altai Gobi are mostly herbivorous, although A. G. Bannikov (1954) found a very small amount of the remains of insects, lizards and rodents in the dung of the animals inhabiting the Tsagan-Bogdo mountain massif.

Track of Gobi bear on a solonchak. Shara-Khulsny-Bulak oasis. August 1981

While studying food habits of Gobi bears in the Tsagan-Bogdo, K. Rogovin (1980) observed that their basic diet consists of the stems and roots of rhubarb, nitrebush berries and reed rhizomes, as well as insects. As to the role of insects in the bear's diet, Rogovin does not consider it likely that rodents (midday and great gerbils, jerboas, snow voles, migratory hamsters and house mice) could be important components in the Gobi bear's diet since their numbers are not great in the Trans-Altai Gobi deserts.

At the same time, there is direct evidence in the older literature (Przhevalsky, 1883; Kozlov, 1899) that pikas were the basic item of the diet of bears in Tibet. For instance, P. A. Kozlov (1899) wrote: "The stomachs of all seven bears we shot contained nothing but pikas..., there were 25 of them in the stomach of one bear killed while it was still hunting."

It appears that these animals, which lived in more humid mountain massifs with an abundance of pikas were more inclined to a carnivorous diet. We did not find any reliable instances of bears attacking wild ungulates (Persian gazelles or wild asses), and the local residents told us that Gobi bears eat only the carcasses of dead ungulates.

In rare cases bears may ravage the food stores of herdsmen or frontier quards. For instance, in July 1981 a bear appeared in the Tsagan-Burgasny-Bulak oasis at night and broke into a supply tent, where it began to eat flour and sugar. It left the supply tent and went off into the mountains only after vigorous efforts by the frontier guards.

According to the literature (Kozlov, 1899; Bannikov, 1954; Rogovin, 1980) and our own observations, Gobi bears can be active both during the day and at night. In the Trans-Altai Gobi hibernation begins in November and ends in February or March. The dens are usually situated in thick stands of nitrebush or tamarisk among sandy knolls or in caves on southern mountain slopes. The rut is from May through August (Khotolkhu, 1969).

Our inquiries indicate that in the Trans-Altai Gobi the female is usually seen with one cub, though N. M. Przhevalsky (1883) in Tibet usually observed two young with one female, one of which might have been a yearling.

Data on the ecology of this unique animal are oobviously very incomplete. As a special ecological form inhabiting superarid desert environments, it is of great scientific interest and requires special protective measures.

Field surveys have shown that all the areas where Gobi bears permanently reside, primarily the oases of Shara-Khulsny-Bulak, Tsagan-Burgasny-Bulak and Mazalai-Bulak should be designated zones of absolute protection with the total exclusion of any negative anthropogenic influences (human presence, vehicular traffic, grazing cattle, etc.). Specifically, the motor road through the Shara-Khulsny-Bulak spring must be shifted further to the east which can be done with no financial outlays.

Another preventive measure is increased information activities among the local population, frontier guards and participants in expeditions visiting the Trans-Altai Gobi with respect to the protection of Gobi bears. Although this species has been under the formal protection of Mongolian law for some time, the last decade has seen several instances of illegal hunting of Gobi bears, which in light of their small numbers can lead to a marked decline in their population.

Finally, along with other unique species of the world's fauna (the wild camel, etc.) the Gobi bear should be listed in the IUCN Red Book as a rare and poorly known species, even though its taxonomic position has still not been finally settled.

With the establishment of the Great Gobi Reserve, it is necessary to formulate a special research program with respect to this species, using methods of observation that would preclude an unfavorable impact on the animals.

SNOW LEOPARD
Uncia uncia Schreber, 1776

Status. The snow leopard, a highly specialized large cat, is of a great scientific and educational value and requires a special status and strong protective measures. As an endangered species of the world fauna, the snow leopard is now listed in the IUCN Red Book and fully protected in the USSR, India and Pakistan (Zhirnov et al., 1977; 1978; Bold, Dulamtseren, 1981).

Numbers and distribution. The snow leopard is quite widely distributed both in the mountain areas of Asia (the Pamirs, Tien-Shan Russian Altai, Tarbagatai and Saur) and in the Mongolian and Gobi Altai, the Khangai, and the mountain regions of Tibet (the Himalayas and Hindu-Kush).

The northernmost part of the snow leopard's range lies within Mongolia. The animals occur in Mongolia in certain mountain massifs surrounding Khubsugul Lake and on the Khangai ridge, though their distribution in these places is extremely spora-

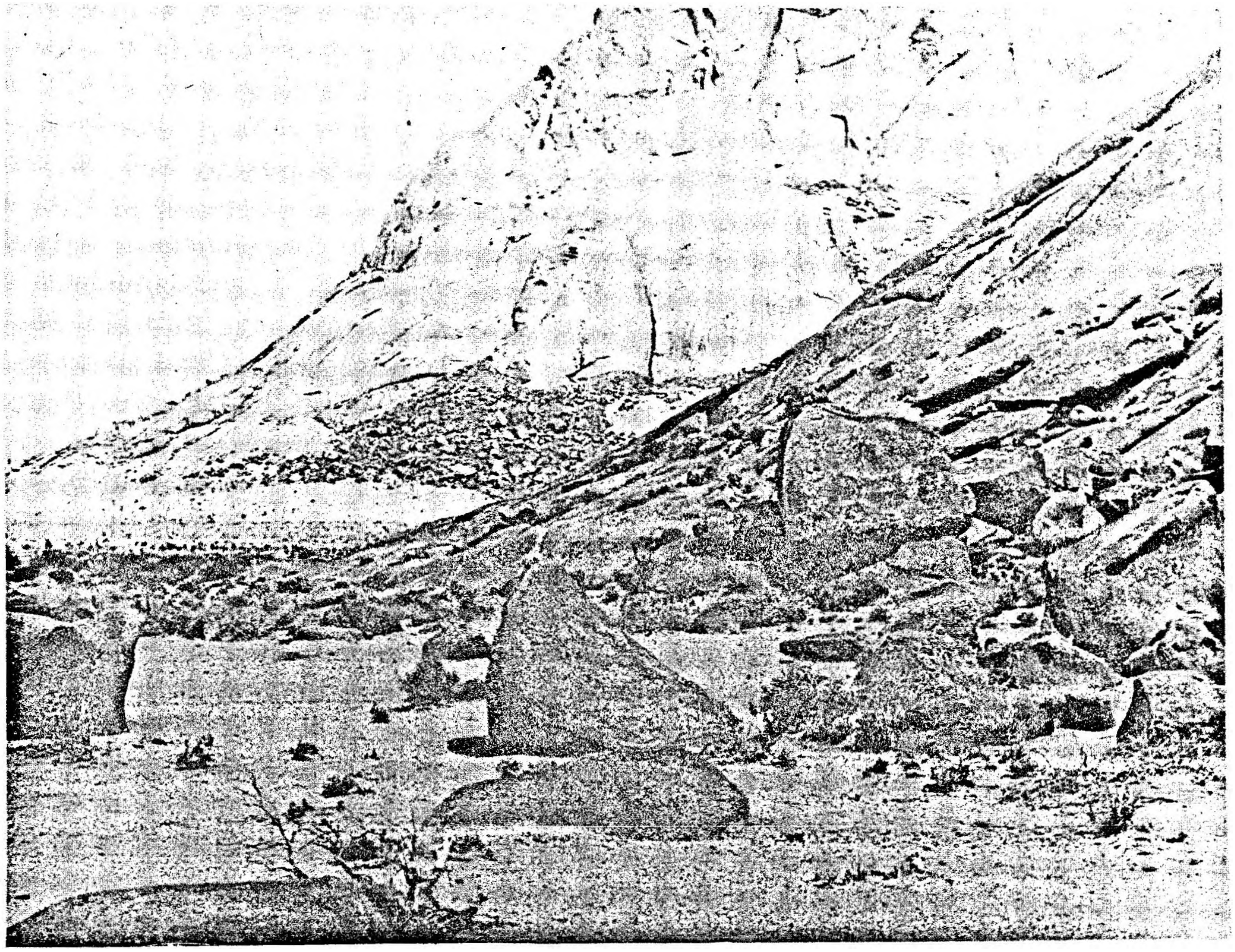
A rare find — skull and other remains of a snow leopard on Khatan-Khairkhan Mountain (buffer zone of Section A). July 16, 1981

dic and their numbers are small (Sokolov, Orlov, 1980). The snow leopard's range also includes the mountain systems of the Mongolian and Gobi Altai as well as some isolated mountain systems and high-altitude hummocky terrain in the Trans-Altai Gobi. The most detailed description of the range and population state of the snow leopard in southern Mongolia is found in the paper "Report on Snow Leopards in the Southern Spurs of the Gobi Altai", by A. Bold and S. Dorzhzunduy (1976). According to this report snow leopards are found in the South Gobi aimak of the Mongolian People's Republic in many small mountain massifs that form the southeastern spurs of the Gobi Altai and the Gobi Tien-Shan. Specifically, A. Bold and S. Dorzhzunduy reliably established that these animals live in the mountains of Altan-Ula and Sevrei-Ula (the Nemget-Ula ridge), Gurban-Saikhan, Tost-Ula, Bayan-Boryn-Nuru, Barun-Zoolon, Dzun-Zolon, Khuren-Khanyn-Khets and Erdene. The total area of the snow leopard's range in the mountains of the South Gobi aimak was set at around 6,600 sq. km., where the authors thought the population was 220±30 individuals. Results of field studies and inquiries of the local population indicated that the average population density within these mountain

Skull and other remains of a snow leopard on Khatan-Khairkhan Mountain

ridges and isolated mountains of the Tost-Ula was 4.4 individuals per 100 sq. km. It is worth mentioning by way of comparison that the population density of snow leopards in the valleys of the Aksu and Dzhebagly Rivers (the Aksu-Dzhebagly Nature Reserve in Talass-Alatau of the western Tien-Shan) was only 1.5—2.0 individuals per 100 sq. km., i. e 6 to 8 animals were counted at one time in an area of 40,000 ha (Geptner, Sludsky, 1972).

In the view of A. Bold and S. Dorzhzunduy (1976), the high population density in the mountains of the South Gobi aimak was related to an overall tendency of the snow leopard population to increase as a result of the total ban on their hunting after the passage of the 1972 Game Law in the Mongolian People's Republic. They also thought that the high density was a function of the high local concentrations of wild ungulates (mountain goats and sheep) in isolated mountain massifs. Another indicator of the large overall population of snow leopards was the frequent incidence of snow leopard attacks on domestic livestock, especially during severe droughts when the numbers of wild ungulates decreased. Under these conditions the carnivores were quick to master methods of hunting domestic animals, killing 387 head of domestic livestock in the Tost-Ula and Khanan-Khets-Ula mountains in 1971—1976. Their victims were mainly sheep and goats, though horses and camels were also killed. A. Bold and S. Dorzhzunduy (1976) infer from these data that the snow leopard population has considerably increased in southern Mongolia throughout the entire Altai mountain system (the Mongolian Altai, Gobi Altai and Gobi Tien-Shan), while at the same time it has remained small in the Kosogol and Khangai areas and shown no tendency to grow. The estimated number of snow leopards in Mongolia is roughly 700±200 individuals (Bold, Dorzhzunduy, 1976). The results of field surveys and inquiries establish reliably that within the confines of the Great Gobi Reserve snow leopards occur in the Trans-Altai Gobi (Sector A) in the mountains of Edrengiyn-Nuru, Tsagan-Bogdo, Atas-Ula, Chingiz-Ula, Dzun-Toroin-Nuru and Shara-Khulsny-Nuru. In March 1981 K. Bugayev, a zoologist, discovered tracks of two snow leopards that had crossed the central sair in the Shara-Khulsny-Bulak oasis from north to south. Another reliable case of the snow leopard's presence was reported in the buffer zone of Sector A, where the remains of a dead snow leopard were found in the northern foothills of Khatan-Khairkhan Mountain on July 16, 1981. The remains (a skull with a well preserved fell, and fragments of the extremities and vertebrae) were located in an area of large stones at the foot of the mountain. There was a quite spacious cave-like recess containing numerous Persian gazelle droppings 5—6 meters further up the slope. This cave evidently served as a regular place of shelter for the gazelles during the heat of summer and here the snow leopards lay in wait for them. Mount Khairkhan is a small mountain system in the true desert zone and saxaul scrub, which is often frequented by gazelles, grows right up to the foot of the mountain. We failed to observe any other ungulates there, i. e. wild sheep or wild goats. Inquiries have indicated that snow leopards are quite common



Habitat of the snow leopard in the Trans-Altai Gobi Khatan-Khairkhan Mountain

in the Tsagan-Bogdo Mountains and on the northern slopes of the Atas-Ula. Here in August 1975, according to Ya. Dash, a litter of snow leopards (an adult female with three young) was seen on the northwest slopes at Meltsin-Nuru.

The 1980—1982 surveys in Dzungarian Gobi (Sector B) showed that snow leopards occurred in Takhiyn-Shara-Nuru and Ikh-Khavtag-Nuru Mountains. We were told by the residents that they were the most common animals at the sites where mountain goats used to gather in large numbers.

Ecological characteristics. Rocky areas of the mid- and high-altitude mountain zones are the main habitats of snow leopards, though they range in elevation from 1,000 to 1,500 m above sea level in the desert mountains of the southern Gobi to 5,400—6,000 m in the Pamirs and Himalayas. Ecologically, the habitats are of the same type throughout the snow leopard's range, i. e. dissected mountain terrain with rock outcrops where there are concentrations of mountain goats and other ungulates.

In the Pamirs and Tien-Shan snow leopards prefer to spend their summers in the subalpine and alpine belts close to herds of mountain goats. In winter the snow leopards migrate with the goat herds to the southern slopes at lower heights covered by mountain forests and juniper stands. As a rule, however, in winter they prefer spruce forests at the timber-line, for example in the Tien-Shan. In a number of places snow leopards also inhabit lower-elevation uplands, such as the spurs of the Dzungarian and Zailyiskiy Alatau, or the Ketmen at elevations of 600—1,500 m, where mountain goats graze on desert-steppe pastures among rocks and tali. We have already mentioned the presence of snow leopards in desertified hummocky terrain and low-altitude mountains in southern Mongolia. Furthermore, our observations and those of other zoologists (Bannikov, 1954; Murzayev, 1966, Bold, Dorzhzunduy, 1976) have shown that in the Trans-Altai Gobi and other arid regions of Central Asia, snow leopards can also be found in oases with scrub forest vegetation in those areas where the oases are surrounded by rocky hummocks or low-altitude mountains. This is true, for example, in the center of the superarid deserts of the Trans-Altai Gobi in the area of Shara-Khulsny-Bulak spring. It should be emphasized that, although the snow leopard is basically an animal of the high mountains over most of its range, in the Gobi it also inhabits low-altitude desert mountains and even oases in the middle of low deserts. In fact, in Central Asia they occupy the ecological niche of the leopard, which is absent from this region.

The distribution of snow leopards by habitat type depends on the abundance of wild ungulates, especially mountain goats and more rarely wild sheep, roes and other animals that make up this predator's diet. In the Trans-Altai Gobi their diet is based on mountain goats and to a lesser extent on wild sheep and Persian gazelles. We failed to confirm the statement by A. G. Bannikov (1954) that snow leopards attack wild asses at their watering places in oases. At the same time A. Bold (1976), noting instances when snow leopards had killed domestic animals, principally goats and sheep, referred as well to the killing of horses. Their other prey in the Trans-Altai Gobi includes sand hares, the most numerous animals in both deserts and mountains, as well as blue hill-pigeons, rock partridges and snow cocks. According to A. Bold (1976) the excrement of snow leopards has also been found to contain the remains of locusts, which they appear to eat from time to time at places where these insects congregate. Nevertheless, we agree with A. A. Sludsky (1972) that "throughout its range the snow leopard is truly stenophagous, since it predominantly preys on mountain goats, and only in a few places eats wild sheep, roes and other animals."

The reproduction of snow leopards under natural conditions has been poorly studied. More extensive data on their reproduction comes from zoos where they are kept. The animals reach maturity at the age of 2 to 3 years. Pregnancy lasts for about 3.5 months. In the wild the young are born in May or June. The litter can have up to 5 cubs, but the usual number is 2 or 3. Apparently the young remain with female for a year or more.

Wolves are essentially the only enemies of snow leopards. Diseases in the wild have never been studied, though cases of rabies have been reported. In zoos young snow leopards often die of infectious enteritis (Sludsky, 1972).

The population dynamics of snow leopards has also never been studied. However, the available materials permit us to establish a direct connection between the size of the mountain goat population and variations in the number of snow leopards. For example, an increase in the population of snow leopards was observed to parallel that of mountain goats in a number of areas of the Soviet Tien-Shan in the late 1940's and early 1950's. After the 1960's a decline in the mountain goat population caused by an epizootic of mange and direct hunting of the animals initiated a sharp decrease in the number of snow leopards. Moreover intensive economic development of mountainous regions during the same period naturally resulted in direct extermination of snow leopards. For a long time there was an unfounded belief that the snow leopard was an enemy of domestic animals and its shooting was encouraged by bounties adversely affecting the snow leopard population in different areas of the world. Moreover, in recent years the trapping of a large number of snow leopards to fill the zoos has also impacted many populations. When the animals are caught, principally in spring traps, many are mutilated and die. Moreover, the intensive development of animal husbandry in many areas has decreased the population of wild ungulates, hence undermining the food base of snow leopards and leading to decreases in their population.

Snow leopards are now strictly protected in many countries and are listed in the IUCN Red Book. Moreover, in order to prevent excessive trade in live snow leopards, this species is listed in Appendix I of the Convention on International Trading in Endangered Species of Wild Fauna and Flora. The snow leopard is also protected by law in the Mongolian People's Republic and is listed in the Mongolian national Red Book. If the protective regime is observed, the snow leopard requires no special protective measures within the Great Gobi Reserve, but it is necessary to intensify the fight against illegal hunting of wild ungulates and of snow leopards themselves in the buffer zone. Moreover, because of the small number of snow leopards in the Great Gobi Reserve, the catching of live leopards within the reserve and in the buffer zone must be strictly prohibited.

HOUBARA BUSTARD
Chlamydotis undulata Jazquin, 1784

Status. The houbara is one of the rarest birds of the Mongolian fauna. As a specially protected species, it is listed in the Red Book of the Mongolian People's Republic (Bold, Dulamtseren, 1981). The bird is also listed in Appendix I of the Convention on International Trading in Endangered Species of Wild Fauna and Flora.

Numbers and distribution. The range of the houbara bustard embraces the arid zones of North Africa, the Arabian Peninsula, Southwest, Middle and Central Asia and Western Hindustan. In the recent past the houbara bustard was quite widely distributed in the USSR, occupying a large part of Kazakhstan as far west as 48°W and extending eastward to the Zaysan Basin. It also occurred around the Aral Sea and north of Lake Balkhash. It was recorded between the Ural and Emba around the Kamysh-Samar Lakes, in the Ust-Urt and throughout the plains of Turkmenistan. The breeding area also included the eastern parts of Iran and Iraq, as well as the southern areas of the Arabian Peninsula. The houbara bustard is widespread in North Africa, inhabiting the intermountain valleys of the Atlas Mountains and the Canary Islands.

Only the northeasternmost part of the bird's range lies within the Mongolian People's Republic. Here the eastern subspecies, **C. u. macqueeni Gray,** 1834, occurs. As we already noted, at present the houbara is one of the rarest birds of the Mongolian fauna. In the recent past, however, the houbara was distributed quite widely in the western part of Mongolia and its numbers were considerably greater than they are today. Thus, Ye. Kozlova (1975) describing the population state of the houbara bustard in the 1920's, wrote: "The houbara is not a rarity in the Great Lakes Basin of Mongolia, especially in its western part, nor in the Trans-Altai Gobi", and continued as follows: "...this bustard is common on the northern edge of the Gobi Altai in the region of Lake Ban-Tsagan-Nur and all over the semi-desert area reaching Lakes Khirgiz Nur Achit-Nur and the Chuysky steppes. In Northwestern Mongolia it is even abundant. It is found no less frequently in the Trans-Altai Gobi, where it occurs as far east as the Gurvan-Sai-Khan Mountains". At present, judging from our own observations and the data of Mongolian ornithologists, the species is preserved only in isolated areas with extremely low populations. The causes of this population decline in Mongolia are not completely clear. It should be noted that recent decades have seen a tendency for the houbara's total population to decline and its range to shrink throughout the whole area where it occurs, from Africa to Kazakhstan. Specialists believe that many populations of the houbara bustard are on the verge of extinction and this tendency is intensifying with each year (Ponomareva, 1979; Flint et al., 1982). The main cause of the decline in the bustard population is intensive hunting at the bird's wintering grounds (the Arabian Peninsula, Iran and Baluchistan). Hunting houbara bustards with falcons is a traditional sport in many Arab countries, and now that the hunters have cross-country vehicles at their disposal, this sport hunting has resulted in the destruction of these bustards in the most remote desert areas, where the birds found winter shelter in the past. The population state of the houbara bustard has also undoubtedly been affected by the increase in indirect anthropogenic impacts related to the economic development of the arid zones, which have caused the destruction of habitats in breeding areas and an increase in the disturbance factor during the breeding season. In particular, the degradation of habitats in the nesting areas of Middle Asia and in other areas where the deserts are under intensive development has caused the decline and extinction of houbara bustard populations.

Within Mongolia the houbara bustard has not experienced the detrimental effect of hunting since the birds have been of no interest to local hunters. Furthermore, vast desert and semi-desert areas have up to now been undeveloped. Apparently, therefore, the declining number of houbara bustards in Mongolia is related to worsened ecologocial conditions in Iran, Pakistan and other countries that serve as wintering grounds for the Mongolian birds.

The results of the 1980—1982 surveys showed that houbara bustards are a very rare species sporadically distributed in the Great Gobi Reserve. During this period only a few sightings of houbara bustards were recorded in the northern-most parts of the Trans-Altai Gobi (Sector A). One bird was observed at the western edge of the Bayan-Toroi oasis on the eastern slopes of Khatan-Khari-Khan Mountain in August 1980 and another on the northern bel of the Edrengiyn-Nuru 20—25 km east of the Bayan-Toroi settlement in June 1981. The latter bird behaved as if it were nesting, but neither eggs nor brood were observed. In July 1981 we observed another bird in the vicinity of Khatan-Khairkhan. One bustard was also reported in the takyr of Tsagan-Shal in the southwest part of the Trans-Altai Gobi. Six birds were seen in the Dzungarian Gobi (Sector B) during 1980—1982. Three of them were observed in the lower reaches of the Bodong River in the buffer zone, two near Kaltar Mountain, and one south of the Nukheni ridge.

These data indicate that the houbara bustard is a very rare species within the Great Gobi Reserve. All the sightings show that the houbara stays in the regions of the true desert zone situated in the northernmost part of the Trans-Altai Gobi and in the Dzungarian Gobi. The birds clearly avoid the superarid zone because of its rigorous environmental conditions.

Ecological characteristics. Judging from our rare sightings and from data in the literature the main habitats of houbara bustards are located in desert or semi-desert plains of saline clays with a low-growing herbaceous cover (wormwoods, saltworts, grasses) and scattered tamarisk and saxaul bushes, in low knolls of fixed sands with saxaul, and at the edges of solonchaks and takyrs with camel's thorn and saltworts (Gavrin, 1962; Kozlova, 1975; Ponomareva, 1979; et. al.). Plains and hilly deserts or semi-deserts occupied by the growth of pea-tree, ephedra, reamuria, and other saltworts constitute favourite habitats of houbara bustard in Mongolia as well as desert foothill areas on gentle slopes covered with wormwoods, feather-grasses and onions.

In northern deserts with a continental climate (Middle and Central Asia) the houbara populations carry out regular seasonal migrations to their wintering grounds in the southern areas of the arid zones, where they also prefer open landscapes. The birds arrive en masse in late March and early April in Central Asia and Kazakhstan. In Mongolia they appear somewhat later, at the end of April and the beginning of May. They live in small flocks of 4 to 5 individuals immediately after their arrival and a week later they break up into pairs. The fall migration to the wintering grounds occurs in September.

The breeding season usually lasts for about 2 months. After the courtship period, the pregnant females lay 2 or 3 eggs in a primitively constructed nest consisting of a small pit on the bare ground surrounded only along the periphery by a small cushion of twigs. The females hatch the eggs and also take care of the fledglings. Males take no part in these activities and during the nesting period live alone or in small groups. The diet consists principally of insects and their larvae (darkling, burying and snout beetles, locusts). The birds can also catch small desert lizards and small mouse-like rodents. Secondary food sources include shoots of wormwoods, saltworts and grasses, and onion and garlic bulbs. In the hot southern deserts, for example in the Arabian Peninsula, houbara bustards regularly visit watering places, but in other less dry deserts, as in Kazakhstan, houbaras do not use watering places, relying on the water they consume with insects and other food (Gavrin, 1962).

It is easy to recognize houbara bustards in the field by their behavior. When a man or vehicle appears, the birds bend down to the ground and run away in a twisting curve, looping behind the bushes and then lying down on the ground and hiding. They flush only after being chased several times. The houbara is silent and no zoologist has heard the bird cry or sing.

The factors limiting the houbara's population numbers in the wild are almost unknown. Cold weather during the period of nesting and raising the young results in the chicks' death. Foxes are the most ruinous of the bird's predators, destroying both eggs and young chicks. Adult birds may fall prey to falcons, especially saker falcons, as well as large eagles (Gavrin, 1962). But the main factor limiting the number of houbaras is direct and indirect human impact. The study of this species's ecology has shown that the houbara has poor ecological adaptivity compared to the great bustard or the little bustard, which makes it impossible for them to adapt to man-made alterations in their habitats. These ecological features also account for the great vulnerability of the species in its nesting areas, on its wintering grounds and during migration. By using the experience of conservation and restoration of the houbara in the USSR and other countries, the problem of preserving this species within Mongolia can be solved by adopting a number of measures. The present state of population and distribution and the ecology of the Mongolian houbara populations must be studied in order to provide a scientific basis for the development of protective measures that will stabilize the population size and then restore extinct populations. A legal basis must be provided to preserve both the animals and their habitats. As a rare species, the houbara bustard is now listed in the Mongolian Red Book and fully protected within the Mongolian People's Republic. Yet, this alone will not guarantee the survival of the natural houbara populations without effective protection of the species's main habitats. The territory of the Great Gobi Reserve, and that of Sector A in particular, does not provide ecologically optimal conditions for the species, since the houbara tends to prefer semi-desert areas. Therefore, once the survey activities have been concluded, protected territories with the status of special sanctuaries should be designated in the Dzungarian Gobi (north of Sector B) and the Great Lakes Basin of western Mongolia. The scientific staff of the Great Gobi Reserve should collect comprehensive information about all sightings of houbara bustards within the reserve to develop a clearer pattern of the population state of the houbara in this part of Mongolia. Ornithologists should study the experience of raising houbara bustards in enclosures in the USSR and other countries with a view to establishing artificial populations that will preserve the species within the Mongolian People's Republic.

Investigations are presently in progress in the USSR and some other countries to raise houbara bustards in captivity for the purpose of working out methods of incubation, rearing and maintaining bustards in enclosures and subsequently reintroducing the artificial population into the wild or creating a rather large semi-natural houbara population which can serve as a basic repository of the genofund of this endangered species (Flint et al., 1982). It would appear worthwhile to begin similar activities to raise houbara bustards in enclosures in Mongolia.

In developing and establishing this system of protective measures it should be emphasized that the conservation and re-establishment of such a migratory species as the houbara bustard are possible only with the cooperation of UNEP, IUCN and other international bodies and the efforts of all Asian countries within which the houbara occurs.

PALLAS' SANDGROUSE
Syrrhaptes paradoxus Pallas, 1773

Status. Pallas' sandgrouse is a common and widespread representative of the Order Grouses (Pterocletes) inhabiting open landscapes of the Asian desert and semi-desert areas.

Numbers and distribution. The range of the species encompasses a significant area of the Asian arid zones, from the Lake Buir-Nur and the Kerulen River in the northeast to the lower reaches of the Ural River in the west. The nesting range in Central Asia stretches as far north as the foothills of the Khentei and Khangai. In Northwest Mongolia sandgrouse is quite common in the basin of the Lake Ubsu-Nur, in the vicinity of the Lake Achit-Nur and in the Kobdo River valley. To the south the range of the sandgrouse extends to Tsaidam and Ala-Shan (China) (Kozlova, 1975). Periodic eruptions beyond the basic nesting range are characteristic of the sandgrouse. In some years migrations result in the bird's appearance in many areas of the European USSR and even in Western Europe (Dementyev et al., 1951).

In Mongolia Pallas' sandgrouse is a common breeding bird in the Great Gobi Reserve. In some years it occurs in great numbers in both the Trans-Altai and Dzungarian Gobi. The 1980—1982 census studies within the reserve showed that the spatial distribution and abundance of the sandgrouse undergoes sharp annual fluctuations as a function of weather and climate conditions and the state of plant growth.

Sandgrouse was quite common in many parts of the Trans-Altai Gobi in 1980. Large flocks were regularly observed from June though August of that year in the northwestern parts of the Trans-Altai Gobi, as well as in the buffer zone in the valley lying between the Gobi Altai and the Edrengiyn-Nuru. Thus, in June 1980 large concentrations of hundreds and thousands of sandgrouse were recorded in the vicinity of the oases of Maikhan-Bulak, Takhilt-Us and Otgon Us, which have permanent water sources. The banks of the springs and the adjacent desert floor were literally coated with a layer of feathers and dropping from the sandgrouse. During this period flocks on the wing and concentrations of feeding birds could be seen in both the southern and northern regions of the Trans-Altai Gobi. Particularly large flocks of sandgrouse were recorded in June in the area of the Maikhan-Bulak, Takhilt-Us and Otgon-Us oases. The birds were also seen regularly arriving at the springs of Shara-Khulsny-Bulak and Bogts-Tsagan-Dersni-Bulak and some other springs as far as the southern boundary of the reserve.

Detailed studies of sandgrouse distribution in 1980 showed that the main concentrations of the birds were in the northwest part of the reserve on sloping plains south of Edrengiyn-Nuru ridge, where the average incidence was 1.3 birds per 10 km of transect. Significant concentrations of sandgrouse were also observed in the buffer zone near the oases of Bayan-Toroi and Dzarman, where flocks of sandgrouse arrived in an endless stream to drink in the morning and evening. The average incidence on transects in the buffer zone was almost double that in the reserve, 2.7 individuals per 10 km. Beginning with the first days of August the number of sandgrouse in the reserve clearly began to decrease. While flocks of hundreds of birds were regularly observed in June, by August such concentrations were no longer seen and flocks consisted of 10—20, and more rarely up to 50 individuals. Apparently the concentrations of sandgrouse had dispersed throughout the area after the rains which occured in late July and early August, while a part of the populations had migrated to the semi-deserts and dry steppes in the more northern parts of the Gobi.

The total population number of sandgrouse within the reserve experienced a sharp reduction in 1981—1982. Sandgrouse was practically absent from the greater part of the reserve (the Trans-Altai Gobi) and as a matter of fact, in those years the sandgrouse would have to be considered a rare species. Only isolated sightings of single birds or small flocks of 10 to 20 individuals were recorded in motor-transect censuses during this period at various places in the reserve, mainly to the north and south of Edrenguyn-Nuru ridge. Thus in the period June—October 1981 only three flocks of 10—20 individuals were observed in the buffer zone of Sector A in the vicinity of the Bayan-Toroi, Dzarman and Ekhiyn-Gol oases.

This sharp decline in the numbers and distribution of sandgrouse is explained by the fact that weather conditions in the Trans-Altai Gobi in 1979—1980 favored the growth of annual halophytes (Echinopsilon divaricatum, Halogeton gloweratus, Halogeton arachnoideus) wormwoods and other plants which sandgrouse consumes in its basic diet. This ecological situation resulted in very favorable feeding possibilities for sandgrouse in the Trans-Altai Gobi, which led to an increased concentration of the birds in this area during the breeding season (April—May) and after the fledglings took wing (June). In 1981—1982 weather conditions did not favor the growth of annual halophytes, causing a mass migration of sandgrouse to areas beyond the reserve. Analysis of the literature (Dementyev et al., 1951) shows that such annual fluctuations in population numbers and distribution patterns constitute a characteristic ecological feature of this species of sandgrouse which should be viewed as an adaptation to environmental conditions in arid zones, where the ecological parameters are extremely variable. In this connection it is interesting that the irregular migrations of sandgrouse from its basic range to areas beyond the arid zones of Eurasia are well known, although the mechanisms of these ecological eruptions are still unexplained. This ecological feature of sandgrouse is apparently a particular case of a general ecological phenomenon found in many animals of the arid zones. As weather conditions begin to become unfavorable, diminishing the feeding possibilities in various regions of the arid zones, there are mass movements of animals to neighbouring natural regions thus assuring the survival of populations in years of ecological anomalies (Zhirnov, 1982).

Ecological characteristics. The main habitats of Pallas' sandgrouse are dry steppes, semi-deserts and deserts in flat or hilly areas with a low-growing sparse plant cover composed of halophytes, fine turf-grasses, wormwoods, onions and scattered shrubs of pea-tree, winter fat, saxaul and other desert shrubs. The birds prefer steppes or deserts with gravel or clay soils and avoid drift sand. While sandgrouse does not nest in typical zonal steppes (with grasses and forbs), mass movements to such areas are possible for short periods. Following wide desert valleys, sandgrouse reaches quite high elevations up to altitudes of 3,250 m above sea level in the central Tien-Shan. In Mongolia sandgrouse normally nests on desert plateaux and intermountain basins up to 1,850—2,400 m above sea level in the mountain massifs of the Mongolian and Gobi Altai (Kozlova, 1975). They prefer open landscapes, especially in snowless areas, both in winter and summer. During snows sandgrouse occupies those areas in the dry steppes and deserts where wild and domestic ungulates are grazing since these animals trample and destroy the snow cover, making surface plants and their seeds accessible to the birds. Sandgrouse is a specialized herbivorous species. They feed throughout the year with seeds, leaves and shoots of certain steppe and desert plants. In Mongolia the basic diet includes seeds, leaves, shoots and racemes of saltworts, wormwoods, onions, grasses and certain leguminous plants (milk vetch, sweetclover etc.). The birds collect only those seeds that have fallen to the ground while other parts of the plant (leaves, shoots) are consumed from the living plant. The second half of winter and early spring seem to be the most difficult period for sandgrouse because food reserves (mainly seeds) from the past year's crop are exhausted. It is at these times that the sandgrouse engages in mass movements from certain areas of its nesting range.

Being a herbivorous animal, sandgrouse must visit watering places in hot weather. The flocks regularly fly to their watering places twice a day, in the morning and afternoon. Our observations in the Trans-Altai Gobi showed that the flocks flew to the springs of Maikhan-Bulak and Otgon-Us from areas within a radius of at least 50 km, and perhaps from even more remote desert localities. The most numerous flights to watering places occur between 8 and 9 a.m. when the flocks arrive one after another. The birds usually land at some distance from the open water and cover the last 10—15 m on foot. They drink very fast and after a short rest fly off in the opposite direction. In the breeding season the sandgrouse regurgitates water from their crop and gullet to water their young. Springs and intermittent pools with open edges usually serve as watering points, although in the Trans-Altai Gobi sandgrouse also visits mountain springs. In June 1980, for example, large flocks of sandgrouse flew to the Otgon-Us spring, which is situated in a quite narrow canyon.

The reproductive biology of sandgrouse in the Gobi Desert has not been fully studied. The breeding season usually begins very early. In 1980, for instance, clutches of 2 to 3 eggs were observed in nests on March 8. At this time pairs are formed and after mating the females lay 2 or 3 eggs in their nest, which is placed on the ground in the form of a shallow depression either lined with a sparse lining of grass stubble or totally unlined. It is quite interesting that breeding pairs form distinctive colonies in which the nests are placed quite compactly, at a distance of two or three meters from one another. For example, such a colony was found in March 1980 in a depression with sparse vegetation southeast of the Dzarman oasis. It comprised some 300—350 nesting pairs in an area of around 2,500 sq. m. Both males and females sit on the eggs. The incubation period is about a month long. The young leave the nest immediately after hatching. Though they are soon able to feed themselves independently, both parents stay with the brood and take care of it, regularly watering the young and apparently feeding them with regurgitated pellets. The young are able to fly independently by May or early June. Beginning from this time the birds form large flocks which gradually begin abandoning the nesting grounds and leading a more active nomadic life.

The ecology of Pallas' sandgrouse as described shows that the species is well adapted to living in the arid zones which is also reflected in the morphological structure of their wings, legs and other systems. For instance, the wing shape and the structure of the remiges and other feathers marks Pallas' sandgrouse as a good and tireless flyer, a feature of great importance in conditions of dispersed food resources and infrequent desert water sources. The structure of the legs is also adapted to the sandgrouse's habitat. They are short with the toes completely fused and have thick pads on their lower surfaces, which undoubtedly serve to protect them from burns which the birds might receive in moving over the scorching (50—60°C) gravel surface. Moreover, the shortness of the legs permits the birds to survive in open desert landscapes where strong protracted sandstorms occur frequently, especially in spring. During such storms Pallas' sandgrouse not only can hide in shallow pits and depressions but also continue to forage by moving around on their short and sturdy legs. All this explains the great interest naturalists show in Pallas' sandgrouse as a distinctive ecological form adapted to the open landscapes on the Central Asian arid zones. As a common bird of the Central Asian deserts, Pallas' sandgrouse does not require special protective measures. The establishment of the Great Gobi Reserve makes it possible to set up research stations to study the ecology, long-term population dynamics and spatial distribution of Pallas' sandgrouse and its role in ecosystems of the Central Asian deserts.

HENDERSON'S GROUND JAY
Podoces hendersoni Hume, 1871

Status. Henderson's ground jay is a common avian species endemic to the Central Asian deserts (Kozlova, 1975).

Numbers and distribution. The range of this species covers a vast desert area in Central Asia, including Mongolia, Kashgaria, Dzungaria, Tsaidam and Gunsu. The northern and northeastern portions of the range lie within the Mongolian People's Republic. Henderson's ground jay occurs as far north as Lakes Ubsu-nur and Achit-Nur and the Suon River in the northwest part of the country. In the east its range extends somewhat to the north of the Gobi Altai ridge to 45° N (Kozlova, 1975).

South of the border between Mongolia and China the range extends to southern Tsaidam, the foothills of Kun-Lun, the Ala-Shan Desert and Northern Ordos. The range of Henderson's ground jay coincides substantially with the Central Asian desert zone, where the bird finds suitable habitats. Ground jays occur almost everywhere in the Great Gobi Reserve, from the vast depressions, basins and plains to mountain massifs with wide intermountain valleys and sairs. Surveys from motor vehicles have shown that Henderson's ground jay is a very common bird in all the natural regions of the reserve. In the Trans-Altai Gobi Henderson's ground jay follows wide intermountain valleys and sairs to elevations of 2,000—2,100 m above sea level. However, most often ground jays keep to plains and low-altitude hummocky terrain, where 2—3 to 5—7 birds are seen per 10 km motor transect.

Ecological characteristics. Henderson's ground jays typically inhabit flat watersheds or low-altitude hummocky terrain with gravel and stone soils and a shrub plant cover of saxaul, ephedra, pea-tree and sometimes wormwoods and saltworts. On foothill plains and desert mountains the birds prefer wide sairs with a sparse growth of saxaul pea-tree, Russian thistle and other desert shrubs. In the oases of the Trans-Altai Gobi, e.g. in Bayan-Toroi (Dzakhoi) or Dzarman, they are found along the periphery of the oasis on sandy knolls covered by tamarisk and achnatherum. The ground jay clearly avoids dense scrub vegetation, preferring to stay in the desert terrain on the edge of the oasis. Our observations showed that the ground jay frequents desert shrublands. This distribution pattern is explained by the bird's food habits. The basic diet consists of insects (darkling beetles and other coleopters) and berries. The ground jay moves rapidly along the ground in search of insects. It can also dig them up out of the ground, especially from under bushes where concentrations of invertebrates and their larvae may be found. When digging up insects and larvae from the sand, ground jays can make quite deep holes with their beaks (Kozlova, 1975). During the warm period in spring and summer ground jays are mainly carnivorous, changing in autumn and winter to a plant diet consisting of the seeds and berries of nitrebush, ephedra, pea-tree and other desert shrubs. A mixed ration seems to be normal since food supplies in the desert are limited. It is interesting that in superarid desert habitats ground jays show an inclination for human settlements. For example, in the Ekhiyn-Gol oasis in July 1981 ground jays would appear regularly around the tents of our scientific base camp, feeding in small groups of 2—3 birds on food scraps from our rubbish pit. Ground jays are year-round residents of the Central Asian deserts. During the nesting season ground jays lead a sedentary life, each pair occupying a set nesting territory, which it appears to defend actively. During the rest of the year ground jays lead a nomadic life. Small flocks of 3 to 5 birds roam from place to place for forage visiting various types of terrain in search of food. Little is known of the reproductive habits and other ecological characteristics of Henderson's ground jays. Observations made in Kashgaria and Bei-Shan (China) indicate that ground jays mate quite early, at the end of March, but the mating season is protracted. Thus, in Kashgaria some pairs already had young in the first days of May while others had just begun breeding, judging from the size of their gonads (Sudilovskaya, 1937). In 1981 in the Trans-Altai Gobi we observed fledglings as large as an adult bird at the end of June in the vicinity of the Edrengiyn-Nuru ridge. Ground jays construct their nests either in dense shrubs or on the ground. Thus, M. Divnogorsky (Sudilovskaya, 1936) observed a nest on the ground in the shelter of a bush. It was quite strong, resembling a crow's nest. On the outside the nest was constructed of twigs, pieces of roots and leaves. The cup, 15—16 cm wide, was lined with camel's hair. The clutch usually consists of 3 or 4 eggs. Only the female sits on the eggs, although the male always stays near the nest. In case of danger, Henderson's ground jay runs rapidly along the ground, agilely manoeuvring among the shrubs and stones. When running on open ground they usually make long strides of 30—35 cm, holding their body erect with the head up and the breast forward. Observant Mongolians call the ground jay "pacer-bird" because of its fast and beautiful gate. It flies only a short distance, 70—100 m, keeping low to the ground in a distinctive wavy flight. In its usual environment Henderson's ground jay is a very cautious bird. Although it may approach close to a man or a vehicle, it will then run or fly away rapidly. On the other hand, at oasis settlements, such as Ekhiyn-Gol, the birds frequently appear near yurts and tents and will approach a man sitting still as near as 3—5 meters and skillfully forage for insects or gather food scraps from the camp.

Henderson's ground jay is undoubtedly of great scientific interest as an endemic species of Central Asia and an ecological form that has adapted to the extreme conditions of superarid deserts. Special protective measures are not needed. In light of the poor state of knowledge of the bird it would be useful to conduct special research on its ecology in the Great Gobi Reserve, studying both the populations that inhabit natural ecosystems and the groups that live in oases with permanent human settlements.

Chapter 5. THE ECOLOGICAL BASIS FOR MANAGING ANIMAL POPULATIONS AND THE ESTABLISHMENT OF A CONSERVATION REGIME

The Presidium of the Great People's Khoural of the Mongolian People's Republic adopted a decree establishing the Statute of the Great Gobi Reserve in December 1976. This legislation defines the main objectives of the Great Gobi Reserve.

Article 1 of the Statute designates the Great Gobi Reserve as "a single administrative and research establishment consisting of two separate territorial units differing in terms of the classification of protected areas".

Sector A (the Trans-Altai Gobi) is proclaimed a strict conservation zone within which any form of economic exploitation is prohibited and a special protective regime established with the following basic objectives:

a) Permanent maintenance in a natural state of the undisturbed biocenoses of the Central Asian deserts as invaluable natural features;

b) Full protection of typical Central Asian natural communities for the purpose of preserving a genofund of plants and animals of world-wide importance and assuring conditions for their normal and natural reproduction;

c) Promotion of research on virgin and undisturbed biogeocenoses and development of scientific and practical recommendations with respect to environmental conservation;

d) Development of uses of unique natural environments for recreational, esthetic and educational purposes and their preservation for future generations.

In addition to points (a) through (d) the management of Sector B (the Dzungarian Gobi) should include studies on inter- and intrapopulational relationships of the main animal species, along with theoretical studies which could form a scientific basis for the use of pastures by both domestic livestock and wild animals.

Thus, the establishment of the Great Gobi Reserve has the following main objectives:

— To maintain and preserve the genetic and cenotic resources of the Central Asian desert environment;

— To set up a network of representative areas of typical desert ecosystems which could be used as a scientific base for comparative study with other desert areas subject to economic exploitation;

— To use the protected area as a testing ground to monitor natural phenomena with a view to projecting future trends.

Approaches to the attainment of these goals were elaborated in the course of the UNEP Project to assist Mongolia in the establishment of the Great Gobi Reserve, which was carried out with the close cooperation of UNEP, the Mongolian People's Rupublic and the USSR.

Project decisions were included in the Master Plan of the Great Gobi Reserve, which defines the tactics and strategy for preserving the natural resources of this region of the Central Asian deserts. In this monograph we have dealt principally with the preservation of animal life in the Great Gobi Reserve. Accordingly, we will address in this chapter only those parts of the Master Plan that relate directly or indirectly to this problem.

Boundaries of the Reserve

Definition of the boundaries of the protected areas is a very important matter if the activity of the Great Gobi Reserve is to be ensured in conformity with its aims and purposes.

Decree No. 283 of the Presidium of the Great People's Khoural of December 30, 1976, defined the exact boundaries of the two protected areas, as well as those of the buffer zone, which was established to exclude an adverse anthropogenic impact upon the natural features of the reserve.

The boundaries of Sector A (Trans-Altai Gobi) were defined as follows*: from the № 161 frontier post northeast through elevations 955, 8—971, 0—1054, 8—1105, 4—Urgust-. Bulag—1342, 10—1886, O—Shivat-Ulan-ul. 2162, 8—1824, 0—1735, 0—Tanelt-Undur-ul. 1994, 5—1819, 0—1807, 0—1493, 0—Talyn-Shovkh-ul. 1500, 6—Burgiyn-Khudag, Buriyn-Khar-ul. Khavtsgait-ul. 2011, 5-yumt-ul. 2076, 0—Khukh-Tolgoin-Khudag 1808, 0—1843, 0—Ulan-Khyar 1844, 0—1943, 0—1767, 0—1641, 0—1807, 0—1635, 0—1638, 0—1628, 0—1846, 0—Gurvan-

* All the geographical names of mountains, oases, etc. are given in correspondence with their spelling on the maps of Mongolia. (L. Zhirnov.)

Khudag 1661, 0—1529, 0—1549, 2—1680, 3—1563, 0—1609, 0—1545, 0—1387, 1—1310, 0—Tarog-Khudag 1162, 6—957, 2—878, 7—1021, 0—1138, 0—1151, 1—999, 0—Khutsyn-Mandyn-Khyar 1193, 4—911, 0—1101, 0—1204, 6—1141, 1—3 km east of № 1 frontier post — Ukher-Ulan-ul. 1376, O—Talyn-Ovo 1166, 0—1240, 3 — to № 204 frontier post and then to the northwest to № 161 frontier post.

In order to prevent negative anthropogenic impact on the protected area of Sector A, a special buffer zone with the following boundaries has been designated: northeast from Bulgantyn-Bzuun-Sair, through Ayurshand spring and Khol-Khudag well to San-Zhityn-Khyar 1571, then east via Shirin-Khyar-Ula 1368, Argalyn-Balag spring 1558, Khongor-Ula, Somon-Khairkhan-Ula ridge, then southeast via Tsenkeryn-Koloin-Khondei and height 1496, Nozhin Gobi, Tsub-Kur-Khara-Nuru ridge, height 1209, then south to Shilin-Ula.

Sector A lies within the aimaks of Bayan-Khongor and Gobi-Altai. At its closest point the boundary of the protected area of Sector A lies around 1,100 km from Ulan-Bator, the capital of the Mongolian People's Republic. The total protected area within the above limits is 4,419,000 ha.

Sector B (Dzungarian Gobi), the other protected portion of the Great Gobi Reserve, has the following boundaries: along the national frontier to height 1628, then to height 4—1688, 9—Baga-Khavtag-Chon-Chig 1379, 0—1180, 0—Eren-Tolgoi 1146, 1—Khalain-Khoren-Tolgoi 1147, 8—Khalzan-ul 2105, 7 — east to Chantug-Khudag-Khundlen-ul. 1978, 0—Dut-ul., Gashun—Bulag, Gun-Tamga" Tavan-Ovosny-Bulag southwest along the national frontier 2357.0 to landmark 1628.4.

This sector also has a special buffer zone with the following boundaries: northeast from Elkhon to Bavsan-Khurai, Bor-Tsonzh, Khyassa-Bayan-Ula 1607, east via Serteng-Ula ridge 1867, Uvchuugin-Serteng-Ula 2065, thence south via 3738 Alag, Khairkhan-Ula, Ugalzyn-Ula 2939, Uvchin-Khuru ridge 2675, Uvchin-Nuru ridge 2675, Nogon-Tolgoi 1944 to Tsakhirin-Toroi.

Sector B and its buffer zone lie within the aimaks of Kobdos and Gobi-Altai and cover a total of 881,000 ha. At its closest point Sector B is about 1,300 km from Ulan-Bator, the national capital.

The disposition of the above boundaries within the Trans-Altai and Dzungarian Gobi is ecologically valid from the viewpoint of preserving unique and common animal species and conserving representative portions of the Central Asian desert environment. The definition of the reserve's boundaries was also determined by the overall social and economic conditions in the region which existed at the time the reserve was established.

While human impact upon the ecosystems of the Trans-Altai Gobi has been negligible and restricted to small areas (roads and some oases), the Dzungarian Gobi is an area where open-range livestock raising has been developed. These factors were also taken into consideration in determining the boundaries, areas and configurations of the protected territory.

As we have already noted in Chapters 2 and 4, the ranges of such rare species of the world fauna as wild camels and Gobi bears lie principally within the protected part of the Trans-Altai Gobi, while both sectors of the reserve harbor viable populations of other characteristic species of the Central Asian deserts (the wild ass, Persian gazelle, Asiatic wild sheep, snow leopard, houbara bustard, Pallas' sandgrouse, Henderson's ground jay and others) along with a selection of those habitat types that satisfy each species's ecological needs.

This testifies to the fact that the boundaries and area established for the reserve are ecologically sound and responsive to the task of safeguarding not only individual species of animals but also representative zoocenoses of the Central Asian deserts. Moreover, the removal from economic use of a vast territory of more than 4,000,000 ha in the Trans-Altai Gobi, embracing mountain massifs and the adjacent undrained basins and plains watersheds, is a substantial guarantee that many types of desert ecosystems will develop in the "virgin" state of their ecological communities and environment.

CHARACTERISTICS OF THE PROTECTIVE REGIME

Preservation of the genetic diversity of biota and representative natural features of the Central Asian deserts represented in the Great Gobi Reserve requires a system of regulations to control the interactions between man and nature, i.e. a set conservation regime for both animate and inanimate natural systems in the protected area.

The Statute of the Great Gobi Reserve, which was developed to carry out the system for managing natural resources determined in the Master Plan, sets out the scientific and organizational principles of a protective regime aimed at assuring conditions necessary for the natural development of the reserve's biota.

So there can be no misinterpretation of the protective regulations adopted for the Great Gobi Reserve, we will quote Articles 5 and 6 of the Statute:

"ARTICLE 5. LAND USE REGULATIONS

"7. In accordance with Article 33 of the Land Use Act of the Mongolian People's Republic, all forms of economic use of the land are prohibited in Sector A of the Great Gobi Reserve.

"8. The collection of plant samples and the taking of wild animals for purposes of scientific research is authorized only with the permission of the Council of Ministers of the Mongolian People's Republic in accordance with the purposes and under the direction of administration of the reserve and on the basis of an application setting forth scientific controls, amounts and methods of collection which will not disrupt natural biogeocenoses.

"9. Sector A comprises two zones:

"a) A zone of absolute protection access to which is granted only by special permission under conditions that will not harm natural communities;

"b) A recreation and tourist zone, where controlled visits that avoid harm to natural communities are permitted.

"10. In accordance with the Law on the Protection of the Frontiers of the Mongolian People's Republic, necessary measures may be conducted within a 25-km zone provided all possible limitations are placed on damage to natural communities.

"11. In addition to two zones similar in purpose to those set out in Paragraph 9(a) and (b), Sector B will include an agricultural use zone. It will include:

"a) a winter pasture area in the vicinity of Takhiyn-Shar, Nuru-Khukh and Un-Durgiyn-Nuru-Baga-Khavtag ridges, during the period from October 25 until May 1;

"b) livestock may be driven by the following routes and for the following periods:

"— from Uench somon in Kobdos aimak via Ereen-Tolgoi and Elkhon-Kholoi, October through May, 20 days;

"— from Altai somon in Kobdos aimak via Takhiyn-Us and Naima-Bulag, October through April, 20 days;

"— from Tankhil somon in Gobi-Altai aimak to Khuren-Del via Khonin-Us, October through April, 20 days;

"— from Bugat somon in Gobi-Altai aimak along the eastern boundary of Sector B and at a distance of at least 5 km from the reserve via Gashun-Bulag-Gun-Tamga and Tavan-Ovony-Bulag, October through April, 20 days.

"12. The width of livestock drives across the territory of the Great Gobi Reserve in accordance with Paragraph 11(b) may not exceed 10 km. It is stipulated that the number of livestock pastured in the above areas may not exceed a level that could endanger the state of the pastures.

"ARTICLE 6. PROTECTIVE REGIME

"It is specified that:

"13. Admittance to the territory of the reserve is permitted only in areas specially designated for the purposes of tourism and recreation and under the control of the reserve administration.

"14. Being present on or travelling through the absolute protection zone is allowed only in accordance with established procedures and with appropriate documentation.

"15. In Sector B herdsmen and their families are allowed to stay at winter pastures within the areas defined by the land register or on the livestock-drive routes during the periods specified in Paragraph (11(a) and (b).

"16. Agricultural and other enterprises having livestock must enter into an agreement with the administration of the Great Gobi Reserve to drive livestock through its territory to reach wintering grounds, specifying the number of animals and the times when the drive will begin and end.

"17. Any persons on business within the territory of the Great Gobi Reserve may move about within the reserve only with the permission of the administration and on designated routes.

"18. The regulations in Paragraph 17 also apply to Article 4, Paragraph 6.

"19. The ranger service of the Great Gobi Reserve will establish a system of interior roads for official use. The list of roads for general and special use will include the following routes:

"— In Sector A

"1. Tsagaan-Bulag, Khatan-Suudal, Zambilgekh, Talin-Meltas, Khonkhor-Sukhaityn-Khudag, Nariyn-Tooroin-Khudag, Orgost, Tsagaan-Bulag, Tooroin-Shand, Toirom-Bilgakh-Bulag;

"2. Tsagaan-Bulag, Tsagaan-Deroniy-Khudag, Ekhiyn-Gol;

"3. Khyaryn-Gun, Nariyn-Khar, Sharzh-Khulsny-Khavtsal-Zam-Bilgekh.

"— In Sector B

Tsagaan-Gol, Gashuun-Bulag, Gun-Tamga, Khairkhan-Bulag, Tsariyn-Us, Baigan-Khudag, Mergen-Khotol, Argalshand, Zeegiyn-Khudag, Baga-Khavtgain-Us.

"20. The construction of any buildings, structures or construction sites within the territory of the Great Gobi Reserve is subject to the direct approval of the Council of Ministers of the Mongolian People's Republic.

"21. Within the territory of the Great Gobi Reserve it is prohibited:

"a) Within Sector A, to engage in exploitation of mineral resources, livestock grazing, agriculture mowing, gathering of saxaul or any other plant products, any other form of economic activity and shooting and trapping of all species of animals;

"b) It is prohibited for any civilian, with the exception of employees of the Great Gobi Reserve in the performance of their official duties and other persons with special permission, to be present on the territory of the reserve (including pasture areas) and its buffer zone in possession of any type of firearm or any apparatus for trapping wild animals;

"c) Roads for general and special use should traverse the reserve outside the watering points of wild animals, and staying the night near such watering points is prohibited;

"d) Within the Great Gobi Reserve all persons without exception are prohibited to stop to rest or spend the night, to build fires, to let oil run out of a vehicle or to engage in any environmental pollution or any other activity that may impede normal functioning of natural ecosystems;

"e) Throughout the reserve it is prohibited to construct any buildings or structures with the exception of special frontier guard installations in Sector B, camps for herdsmen and wells in pasture areas, and scientific base camps. However, none of the above structures may be built at the watering points of wild animals;

"f) In order to preserve the integrity of natural biogeocenoses within the reserve it is prohibited to introduce or import new animal and plant species not previously resident on the reserve."

Thus, the fundamentals of the protective and land-use regime envisaged by the Statute fully satisfy the requirements of the currently accepted integral approach to nature conservation in natural conditions, i.e. they are responsive to the strategy of nature reserve management aimed at preserving all natural features, both animate and inanimate under conditions approaching natural ones.

At the same time, the Great Gobi Reserve is peculiar in that its two sectors differ in forms of their functions and their corresponding protective regimes.*

Sector A has the highest classification of protected territory, which is defined functionally as total (or absolute) protection of representative sections of the Gobi Desert with their typical animal and plant life and ecosystems capable of independent development.

Sector B (Dzungarian Gobi) belongs to a lower category of protected area and basically functions as a wildlife sanctuary where, in addition to protection of fauna and other natural features, limited economic activity is permitted in the form of domestic livestock grazing in some parts of the protected territory.

This multifunctional organization of the Great Gobi Reserve, as we have already mentioned, reflects the actual economic situation that has developed in different parts of the reserve in the past. It should be noted in this connection that an ecological concept of arid zone development is currently evolving that would approach arid zones as a depository of ecological resources of the biosphere which could be actively used in development in the future.

Such an approach implies development of a scientifically based strategy of both conservation and exploitation of natural resources, for example the conservation of wild ungulates alongside the development of livestock ranges and limited agriculture in the arid zones. In this respect the Dzungarian Gobi should serve as a model of arid area where wild ungulates and domestic livestock breeding would not be in conflict, but on the contrary would promote an increase in the economic productivity of arid zones in conditions of ecological equilibrium and realization of the regenerative potential of desert ecosystems.

Project decisions to this effect are substantially reflected in the Master Plan of the Great Gobi Reserve, which has defined the strategy and tactics of conserving natural resources in this region of the Central Asian deserts.

ANTHROPOGENIC IMPACT AND MEASURES TO REDUCE IT

It is generally known that desert animals, and particularly large mammals, are the most vulnerable component of "fragile" desert ecosystems that are subject to direct anthropogenic impact. It is for this reason that in developing the project decisions of the reserve's Master Plan special attention was paid to research on the effect of man-made factors on natural ecosystems and on the state of the rare animal populations. In our surveys of the reserve area we studied all kinds of human activity which directly or indirectly affect natural ecosystems as a whole or wild animals in particular.

It was found in the course of our field surveys that various parts of the reserve are subject to different forms of human impact, including livestock grazing, exploitation of natural water sources and oases by human and domestic animals, and visits to the reserve by various groups of people who use motor vehicles to drive off the public roads.

On the basis of our extensive on-site investigation we have evaluated the anthropogenic burden upon natural ecosystems in different parts of the reserve and then proposed a system of measures aimed at reducing and completely eliminating human impacts so as to ensure normal functioning of the Great Gobi Reserve.

SECTOR A — TRANS-ALTAI GOBI

Livestock grazing. Around 24,000 head of domestic livestock winter each year on the northern edge of the buffer zone of Sector A on the Edrengiyn-Nuru ridge. Here there are frequent instances of livestock entering the reserve. Various groups of domestic animals (mainly camels) penetrate quite far into the reserve, reaching Maikhan-Bulak and Otgon-Us springs along the southern bel of Edrengiyn ridge.

During winter there is also a constant influx of domestic livestock into the reserve in the eastern part of Sector A bordering the Ekhiyn-Gol oasis. About 300 domestic camels belonging to the frontier quard service are constantly present around Tsagan-Burgasny-Bulak and Tsagan-Bulak springs in the southeastern part of the reserve.

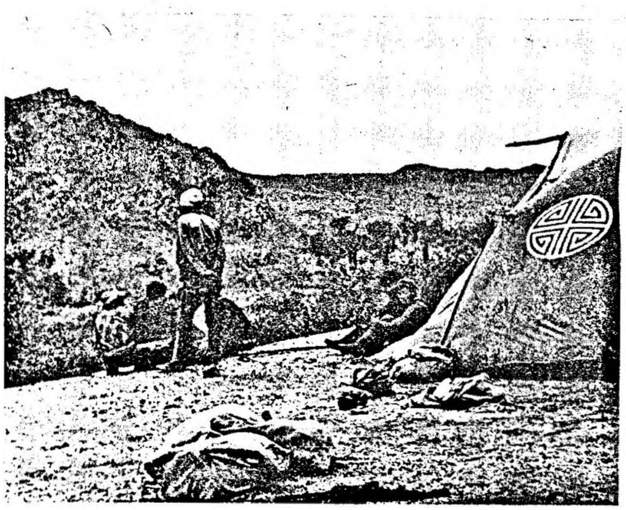
By using the grazing areas listed above, domestic livestock not only alter the pastures to some extent, but oust wild animals from them; the people and transport vehicles that accompany the livestock constitute stress factors for wild animals, leading to a deterioration of living conditions for the Gobi bears, wild camels, Persian gazelles and wild asses that are the principal protected species in the Great Gobi Reserve.

Exploitation of natural water sources. This form of anthropogenic impact is fraught with extremely negative consequences for both the wild animals and the natural ecosystems of the reserve. Nevertheless, instances of short-term and even long-term exploitation of natural water sources in the protected area have up to now occurred quite frequently.

These sources are used as watering points for domestic animals in the areas where livestock penetrate into the reserve. The livestock also use the best pastures that adjoin natural water sources. The numerous research teams and various field groups that visit the project area also make camps for various periods of time at natural water sources, frightening away the wild animals and disturbing the oasis plant communities.

Frontier guards permanently occupy a number of natural water sources within the protected territory. The motor roads regularly used by both frontier guards and other people visiting the reserve pass in the immediate vicinity of Maikhan-Bulak and Shara-Khulsny-Bulak springs. The obstruction of natural water sources by human activities is the most deleterious anthropogenic factor affecting the population state of all the large mammals of the reserve.

* According to the current classification of protected territories adopted by the International Union for the Conservation of Nature and Natural Resources, Sector A (Trans-Altai Gobi) should be considered as an area in the highest protected class (scientific reserve/strict nature reserve), while Sector B (Dzungarian Gobi) is in the fourth class (nature conservation reserve/wildlife sanctuary). Sector A is referred to as a "National Park" in the Statute of the Great Gobi Reserve, but in our opinion this classification is not accurate in light of the basic functional objectives of this area. (L. Zhirnov.)



Shara-Khulsny-Bulak oasis. Before the establishment of the Great Gobi Reserve. Mongolian herdsmen would come here every year to gather reeds. Photograph made in August 1974

Uncontrolled motor-vehicle use within the protected territory is carried on by a number of exploratory groups of various kinds, as well as other visitors to the reserve. A considerable number of such persons follow routes of their own choice instead of using the roads established by the Statute.

This uncontrolled driving across the protected territory causes considerable damage because the tire tracks destroy the soil cover and remain on the desert floor for long periods (five years or longer, depending on the soil type and plant cover), leading to wind erosion and destruction of plant communities. Moreover, all wild animals are afraid of motor vehicles and move away for considerable distances, abandoning their habitat areas.

This form of anthropogenic impact has become more and more noticeable in recent years. As noted above, when we were conducting our aircraft censuses, we recorded all tire tracks and roads we saw on the transects. Their average number in Sector A was about 0.5 per 100 km of transect, but this number reached 2.3—4.7 in some areas (around the Edrengiyn-Nuru ridge, along the western boundary of the reserve etc.).

It should be noted that poaching and saxaul felling for fuel, two of the grossest violations of the protective regime practiced quite widely in the recent past, are now extremely rare occurrences in Sector A. It is safe to say that the ranger service of the reserve is now in total control of Sector A and such violations are rarely observed.

To reduce anthropogenic impact the following measures are necessary:

— Strict observance of the protective regime set out in the Statute of the reserve;

— Regular environmental education activities at all the somons situated on the boundaries of the protected territory as well as directly with the herdsmen who winter their livestock in the vicinity of Ekhiyn-Gol oasis and on Edrengiyn-Nuru ridge;

— Publication of materials in periodicals on the importance of the reserve and the protective regime, especially in aimak newspapers, as well as regular radio appearances by the reserve staff and the issuance and distribution among local residents of leaflets and posters urging observance of the protective regime.

To combat violations in connection with visits to the protected area or occupation of natural water sources, it is necessary to:

— Give detailed instructions to all visitors to the reserve (including scientific-research groups) and, when necessary, provide them with guides from the reserve staff;

— Limit the duration of stays at or in the immediate proximity of natural water sources to a few hours, strictly prohibiting overnight stays or establishment of camps near water sources;

— Assure constant oversight in areas where penetration by domestic livestock may occur, preventing the use of natural water sources for drinking and grazing;

— Common-use roads should not pass near natural water sources. In this connection the roads from Maikhan-Bulak and Shara-Khulsny-Bulak springs should be moved 10 to 15 km.

To combat uncontrolled motor traffic within the protected territory the following steps should be taken:

— Require mandatory registration of all vehicles entering the reserve and provide drivers with regular instruction;

— Signs and notices bearing information about driving regulations within the protected territory should be posted at the entrances to the reserve, along common-use roads and in the adjoining somons;

— The ranger service of the reserve should increase its monitoring of motor-vehicle traffic within the protected area and apply appropriate sanctions to violators.

SECTOR B — DZUNGARIAN GOBI

As noted above, the Statute of the Great Gobi Reserve permits use of the territory of Sector B for winter grazing and driving domestic livestock. Around 60,000 domestic animals wintered there in 1980—1982, accompanied by about 300 herdsmen and members of their families.

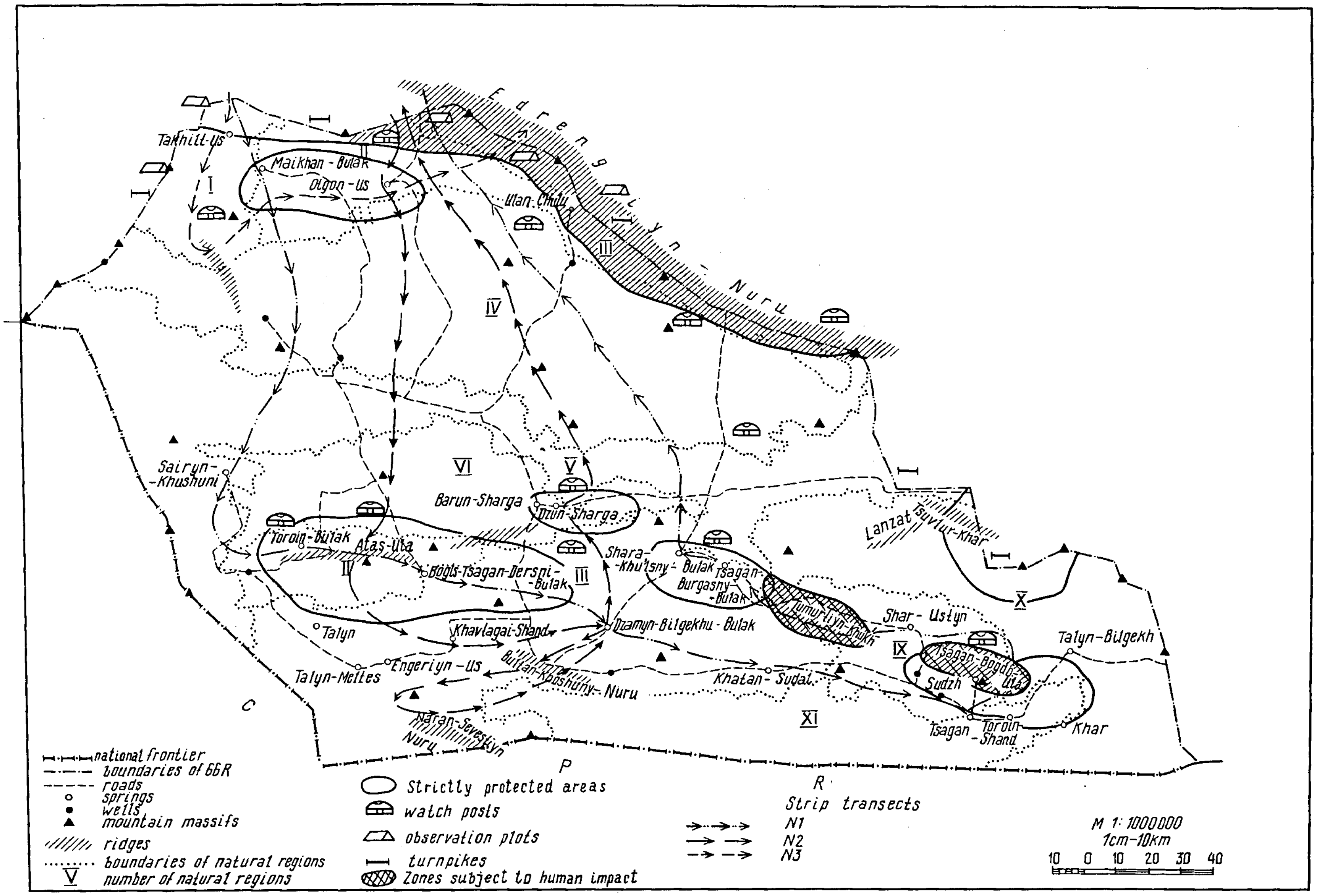
Notwithstanding such intensive human use of the territory of Sector B, the population density of wild ungulates in most of the natural regions of Sector B is higher than in Sector A, which as noted above is a consequence of better environmental conditions in Sector B.

Some forms of human activity are, however, quite harmful to the ecosystems of Sector B and directly to the wild animals. The most harmful activites, in our view, are uncontrolled motor-vehicle traffic (we recorded 10—12 motor roads and vehicle tracks per 100 km of aerial transect in Sector B) and shooting of wild animals by poachers, cases of which still take place.

To reduce the adverse effect of human impact in Sector B it is necessary to:

— Prohibit an increase in the number of livestock that winter in the sector;

— Assure that motor vehicles travel only on authorized roads, prohibiting uncontrolled motor traffic



Infrastructure map of the Great Gobi Reserve, Sector A (Trans-Altai Gobi) within the protected territory. The common-use road passing through Takhiyn-Us oasis should be moved west along the sair which passes 15 km from the oasis;

— Intensify the fight against poaching and do away with illegal hunting of ungulates.

— Observance of the protective regime can be assured by widespread educational activities on nature conservation among local residents through the distribution of leaflets and posters in all the settlements and herdsmen's camps in the areas adjoining Sector B.

Based on the field data and on an assessment of the population state and habitats of wild animals and overall natural ecosystems, the Master Plan of the Great Gobi Reserve sets out a detailed project for the reserve's infrastructure, including the functional classification of various protected areas and zones of total protection, the use of roads and fixed transects for scientific research, and the organization of scientific and educational tourism, which is provided for on a limited scale in the Statute of the reserve.

BOUNDARY MARKING AND THE SYSTEM OF ROADS AND CENSUS TRANSECTS

The boundaries of the reserve should be readily distinguishable to prevent violations of the protective regime. For this purpose, boundary markers of uniform design (stone cairns etc.) were to be erected on elevated places along the entire perimeter of the reserve (mountain summits, hills, heights). At least 150 of these border markers were set up in Sector A and around 50 of them in Sector B. This work was completed in 1983.

Ten roads pass from the buffer zone into Sector A of the reserve, but the Statute permits the use of only three of them. Barrier gates are to be installed on all these roads in order to improve control and limit entry into the area. The barrier gates are to be set up on the boundary of the reserve in ravines and other suitable places. The roads not listed in the Statute are to be blocked. Ten barrier gates are to be built in 1983—1984.

Signs and notice boards containing information on the protective regime, warnings against its violation etc. are to be erected at all entrances to the reserve, in somons and work camps along its boundaries, at frontier posts and throughout the reserve itself, especially near springs. There should be 50 signs and 20 notice boards in color in Sector A and 20 signs and ten notice boards in color in Sector B. The work is to be completed in 1984. In subsequent years the signs should be regularly repaired and replaced.

Advisers to the Project developed a traffic plan for Sector A and "Rules for Visitors to the Reserve", which are binding on all persons and organizations that visit the reserve.

The Statute of the reserve provides for general traffic on three roads in Sector A which may be used by visitors with the permission of the reserve administration. These three roads, which pass through Ekhiyn-Gol, Tsagan, Dzamyn-Bilgekhu-Bulak, Shara-Khulsny-Bulak and Dzarman are quite sufficient to satisfy all requirements for passage through the protected territory, including those of frontier guards. Research teams, inspection groups and ranger patrols may use the system of trails as shown on the infrastructure map of Sector A.

The three fixed census transects in Sector A (see infrastructure map) are to be used for terrestrial censuses and other field studies, and to some extent for organized scientific tourist groups. The total length of these transects is around 1,500 km. The common-use roads and fixed census transects described above cross all the natural regions and desert types of Sector A. Thus, they are completely adequate for collecting any scientific information or making any observations, as well as for purposes of scientific tourism. Bearing this in mind, we consider that travel by scientific groups on other routes in Sector A is not needed and should be prohibited.

Ranger posts. The large area of the reserve and its remoteness from population centers make it necessary for conservation personnel and scientific workers to remain within the protected area for long periods. For this reason, construction of ranger posts (or shelters) at the main entrances to the reserve and within its territory is contemplated to offer normal living facilities for people staying in the reserve. The ranger posts should be in the form of yurts or small shelters built of stone or some other available material. They should be situated no further than 1.5—2.0 km from water sources. Twelve ranger posts are to be built in Sector A during 1983—1985. They are to be built only in Sector A. Their construction in Sector B is not foreseen since there is a considerable number of temporary and permanent agricultural buildings which may be used for these purposes. The location of barrier gates, signs, boundary markers and shelters are indicated on the infrastructure map of Sector A and the map of the natural regions of Sector B.

Tourist routes and observation areas. One of the aims of establishing the Great Gobi Reserve was to develop the present and future possibilities of using the protected territory for science education. For this reason, the Master Plan of the Great Gobi Reserve includes several proposals on developing scientific tourism, but these are of a preliminary character, since the effect of tourism on desert ecosystems is quite complex and needs special study.

In light of these considerations, the Master Plan gives only general recommendations with respect to the development of scientific tourism on a limited scale, principally with the aim of learning about the desert environment within the buffer zone and in some peripheral parts of the protected area.

The Gobi Desert environment attracts zoologists, ecologists, geobotanists, soil scientists, geologists, geomorphologists and experts in other fields, as well as those who simply love nature. Visitors to the reserve may learn about the unique environment of the Gobi Desert, including true and superarid deserts and the natural ecosystems of low and mid-altitude mountains, sloping plains and hummocky terrain. In their trip to the reserve, visitors will have the opportunity to see Bayan-Tooroi oasis, the largest oasis in the Trans-Altai Gobi, and observe such desert animals as wild asses, Persian gazelles, Asiatic wild sheep, mountain goats, Pallas' sandgrouse, rock partridges and other vertrebrates. In the buffer zone visitors can familiarize themselves with measures to develop the true deserts in the area of the Bayan-Tooroi oasis and around Khatan-Khairkhan.

Six observation areas will be established in the reserve and the buffer zone to assure that visitors can observe the landscape and familiarize themselves with its ecosystems. These areas will be located in the following places:

1. Khatan-Khairkhan Mountain in the buffer zone west of Bayan-Tooroi (Dzakhoi) oasis.

2. Shivet-Ula Mountain on the northwestern boundary of the reserve at an altitude of 2,162 m.

3. Takhilt-Undur Mountain on the northern boundary of the reserve at an altitude of 1,994 m.

4. Tsagan-Ders well on the Edrengiyn-Nuru ridge near the central entrance to the reserve.

5. Khuren well on the Edrengiyn-Nuru ridge where the reserve boundary crosses the administrative border between the Gobi-Altai and Bayan-Khongor aimaks.

6. Ulan-Chulu spring on the Edrengiyn-Nuru ridge on the northeastern boundary of the reserve.

Large-scale visits to the protected area would cause definite damage to its ecosystems, the more so since the desert environment is very vulnerable and regenerates slowly over a long period of time. Large-scale and frequent visits will destroy the soil cover, trample vegetation and disturb and flight wild animals.

The establishment of observation areas on the periphery of the reserve will significantly reduce adverse human impact upon the flora and fauna. However, the possibility of receiving even a small number of scientific tourists is presently very limited since there are neither hotels nor camping grounds at any of the settlements situated near the reserve.

TERRITORIAL DIVISIONS AND ORGANIZATION OF THE RANGER SERVICE

The territory of the reserve is divided into three sectors to increase the effectiveness of protection. Each of the sectors is divided into various patrol zones under the responsibility of rangers.

Sector B (Dzungarian Gobi) is a separate portion of the reserve with distinctive physiographic, climatic and other natural features. The Statute of the reserve makes provision for economic use of this sector. These conditions lend this sector its own functional role and make it necessary to regard it as a separate territorial subdivision of the reserve. The administrative center of the sector is to be located at the Bor-Uzur settlement in the Altai somon of the Kobdos aimak.

Since the area of Sector A (Trans-Altai Gobi) is 4,400,000 ha it is divided into two protective zones, the Altai division within the Gobi-Altai aimak and the Bayan-Undur division in the Bayan-Khongor aimak.

The two divisions are separated by the administrative border between the two aimaks. The administrative center of the Altai division will be in the Bayan-Tooroi settlement in the Gobi-Altai aimak and that of the Bayan-Undur division will be in the Bayan-Undur somon of the Bayan-Khongor aimak. A superintendent is in charge of each division. The overall supervision of the ranger service will be the responsibility of an assistant director of the reserve with headquarters in the Tsogt somon of the Gobi-Altai aimak, the administrative center of the Great Gobi Reserve.

The remoteness of the administrative center from the protected territories makes the management of the ranger service difficult and means that the division superintendents will have real autonomy in the practical work of the rangers.

The remotest, most out-of-the-way and most inaccessible portions of the reserve and the part of the reserve in the border zone do not require constant surveillance. The areas most subject to various violations of the protective regime are those adjacent to the northern, northwestern and northeastern boundaries of Sector A and the winter pastures and livestock-drive routes in Sector B, the Dzungarian area.

Each division has a regular patrol zone and a special patrol zone. The regular patrol zone is 40—50 km wide along the boundary between the reserve and the buffer zone. In order to assure observance of the protective regime, the regular patrol zone is divided into circuits. Seven such circuits are planned: the Dzungarian division has two circuits, the Altai division, three circuits, and the Bayan-Undur division, two circuits. The average size of the circuits is 200,000—220,000 ha in the Altai division, 300,000—350,000 ha in the Bayan-Undur division and around 200,000 ha in the Dzungarian division. The area of the regular patrol zone is about 2 million ha, or some 40% of the total area of the reserve. The special patrol zone embraces the remote areas in the central and southern parts of the reserve and the frontier area.

Systematic patrols are organized in the regular patrol zone. Absolute protection zones, oases, springs and entrances to the reserve receive first priority. Regular patrolling is also carried out during the winter period of livestock grazing along the boundaries of Sector A and within Sector B. On the various circuits senior rangers and rangers carry out regular patrolling on motorcycles or other means of transport at their disposal.

Mobile groups are organized to perform guard duties in the special patrol zones. These groups include members of the reserve staff reinforced, in case of need, by research workers and public representatives (members of the National Society for the Conservation of Nature). These teams patrol the territory of the reserve in automobiles (UAZ-469 and GAZ-66). They patrol throughout the reserve in order to discover and eliminate poaching, unauthorized livestock grazing and other violations of the protective regime. In carrying out their patrol duties the mobile teams are to give special attention to absolute protection zones, the areas adjacent to oases and springs and areas subject to human impact.

Protection of the reserve should also involve more broadly members of the aimak and somon branches of the National Society for the Conservation of Nature, along with frontier guard detachments quartered on the territory of the reserve.

Based on the size of the reserve staff in 1982—1983, the ranger service was to number 18 members, consisting of the assistant director responsible for the ranger service, three division superintendents, seven senior rangers and seven rangers.*

The protection of each circuit is the continuing responsibility of two persons, a senior ranger and a ranger. Group patrolling in the circuits is necessary because of safety considerations for field work in waterless deserts and the need for all members of the ranger service to carry out their responsibilities conscientiously.

Systematic surveillance of the reserve area is impossible without a well-organized system of radio communication since the reserve occupies a very large area and its various territorial subdivisions lie at considerable distances from both the administrative center and the settlements which surround the reserve.

The Master Plan considers all questions relating to supplying the reserve with means of transportation, radio stations, rifles, field-glasses and other field equipment.

The structure of the reserve area established in the course of the UNEP Project assessed the role of the different natural regions from the viewpoint of maintaining viable populations of large animals and for the purpose of conserving natural ecosystems that represent the environments of the Gobi Desert.

Strict protection zones. According to the project there are to be five strict protection zones, all of them in the Trans-Altai Gobi:

1. The region of Maikhan-Bulak and Otgon-Us springs, about 140,000 ha in area. This zone is situated in the true desert zone. The plant cover near the springs is represented by various meadow types — sedges, reeds and lymegrass — along with achnatherum and tamarisk tugais.

Maikhan-Bulak spring has slightly saline water and a discharge rate of 0.06 l/s. The watercourse is 350 m long. The approaches to the watercourse are marshy. The water from this spring is used by wild animals all year round. Otgon-Us spring is situated in a gorge on Otgon Mountain. It has fresh water and a discharge rate of 0.03 l/s. The length of the watercourse is 250 m. Wild animals use the water all year round.

The pastures in this zone are generally available all year round, but they are most productive in spring and early summer. We observed concentrations of wild camels in this zone several times in spring and summer. Concentrations of wild asses numbering 100—150 head are seen here year round. Persian gazelles are also always present. Asiatic wild sheep are seen in the region of Otgon-Us spring. A large concentration of sandgrouse was reported here in 1980.

2. The strict protection zone in the region of the Atas-Ula and Chingiz-Ula Mountains comprises both of these mid-altitude mountains with the adjoining superarid desert plains. The area of this zone is approximately 250,000 ha. It includes the springs of Bogts-Tsagan-Dersni-Bulak, Toroin-Bulak, Ubur-Meltes and Tsagan-Tolgoi. The springs provide water all year round and are regularly used by wild animals.

The plant communities of this region are very diverse, from watershed hammada complexes to desert and dry mountain steppes. Most of the area of this zone is occupied by the sloping plains which adjoin the mid-altitude massifs of Atas-Ula and Chingiz-Ula. Two types of superarid desert pastures are found in these sloping plains. In the north there are barren hammadas together with impoverished saxaul communities along the sairs, while in the south the hammadas are combined with multispecies types of pastures along the sairs.

The plant cover has distinct altitudinal belts within the mid-altitude mountain massifs of Atas-Ula and Chingiz-Ula proper. There are two distinct belts: a desert belt and a steppe belt. The desert belt is characterized by a succession of pasture types. Sympegma and anabasis formations occur up to 2,000 m altitude, winter-fat grasslands and winter fat-feather grass associations up to 2,300 m and a steppe belt above 2,300 m, which is dominated desert steppes with feather-grass pastures and patches of dry couch-grass steppe pastures.

The mid-altitude massifs are dissected by narrow canyons, in the bottoms of which there are numerous small local oases formed by the eruption of ground-water. The oases are rich in shrub growth, with tamarisk and nitrebush-tamarisk tugais occurring in places.

This zone is a principal winter concentration site of wild camels. We found them here regularly in late autumn and winter of 1980—1981. The total number of wild camels in this area was as much as 150—200 head (September 1980, September 1981 and December 1981). Wild asses, Persian gazelles, snow leopards, wild sheep and mountain goats are also resident here.

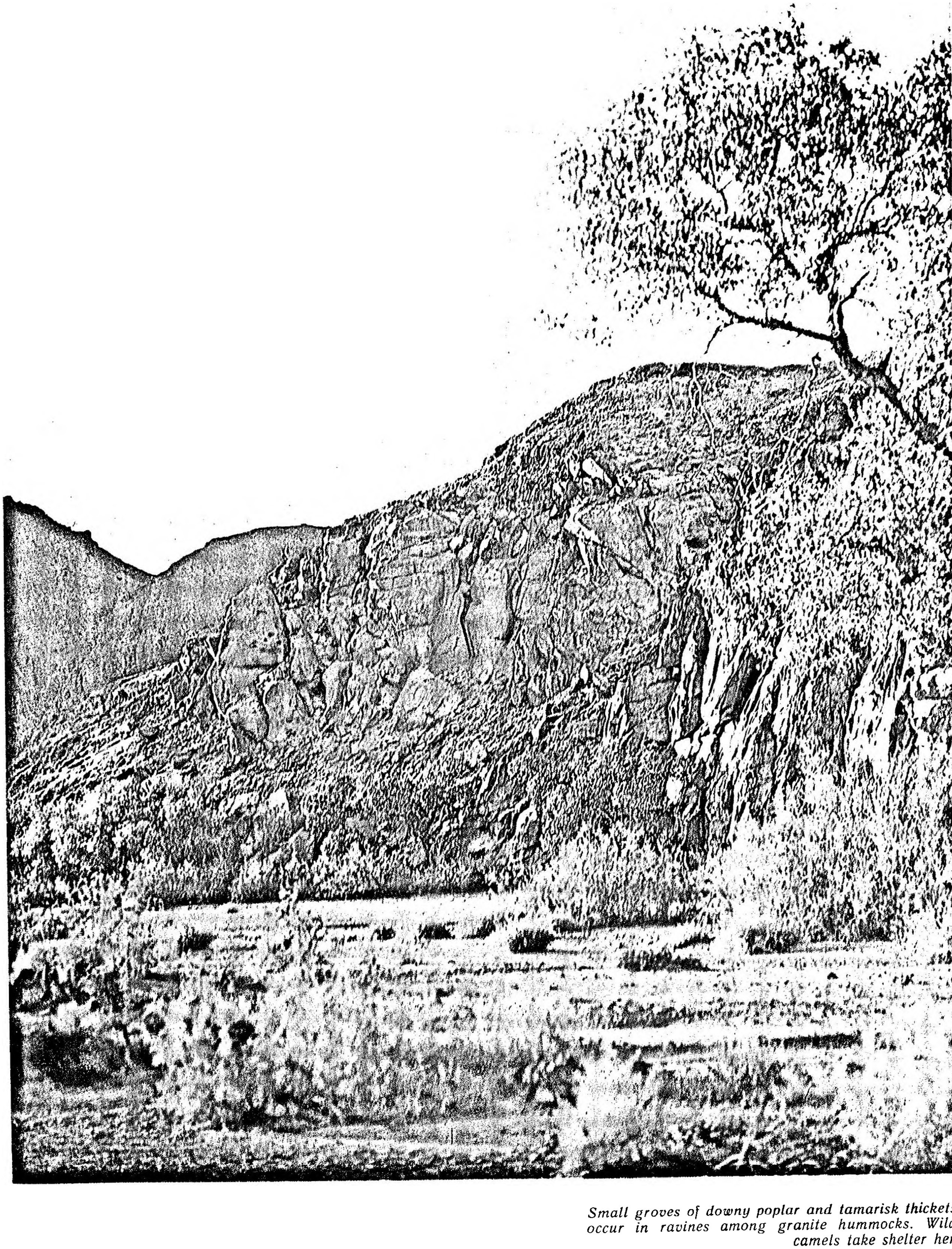
3. The strict protection zone in the area of the Barun-Shargyn-Gol and Dzun-Shargyn-Gol oases is situated in the Shargyn Gobi Basin. The area of this zone is about 30,000 ha. The springs are small pools and their slightly saline water is used by wild animals in the summer-autumn period. The Barun-Shargyn-Gol and Dzun-Shargyn-Gol springs are presently drying up. The former, which has more water, is a small pool with a very small discharge of slightly saline water.

A complex succession of plant communities occurs here. Swamp meadows and reedbeds prevail in the immediate proximity of the springs. Around the springs, especially in the ancient dry channels, there are poplars surrounded by tamarisk tugais. Massifs of sand hills support saxaul scrub, come plants reaching a height of 5 meters with a diameter of 40 cm at the root collar.

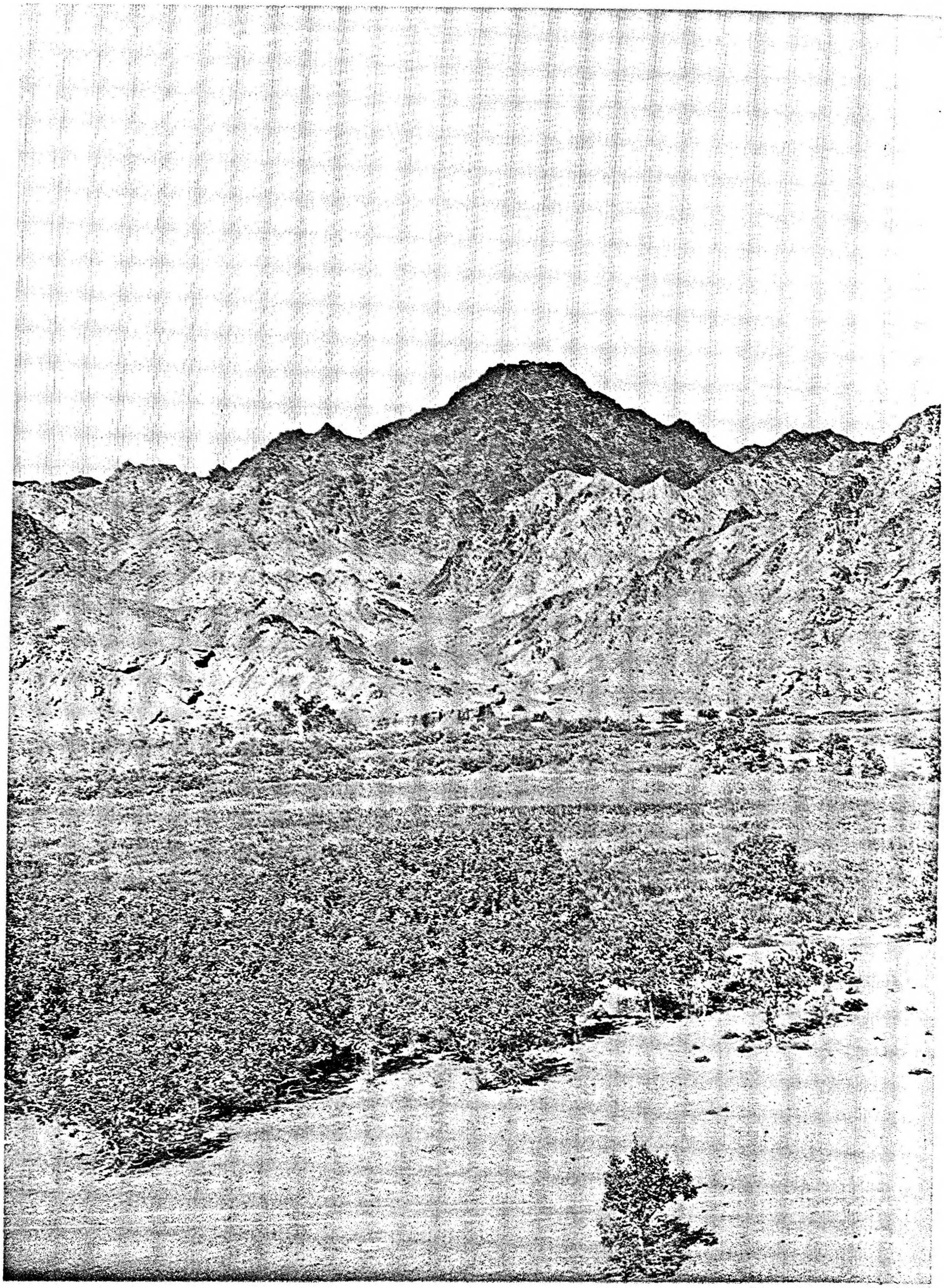
The rich plant cover of the oases proper is surrounded by the very barren superarid deserts characteristic of the lowest plains of the Trans-Altai Gobi, the floors of the basins. The main pasture types surrounding the oases are impoverished saxaul or ilyinia communities growing in the occasional run-off channels crossing the hammadas, or sparse plant communities in ravines and depressions or stony peneplains. The region of these springs is remarkable in that the tallest saxauls in the Trans-Altai Gobi grow here.

4. The strict protection zone in the region of the Shara-Khulsny-Bulak and Tsagan-Burgasny-Bulak springs lies in an area of hummocks and low moun-

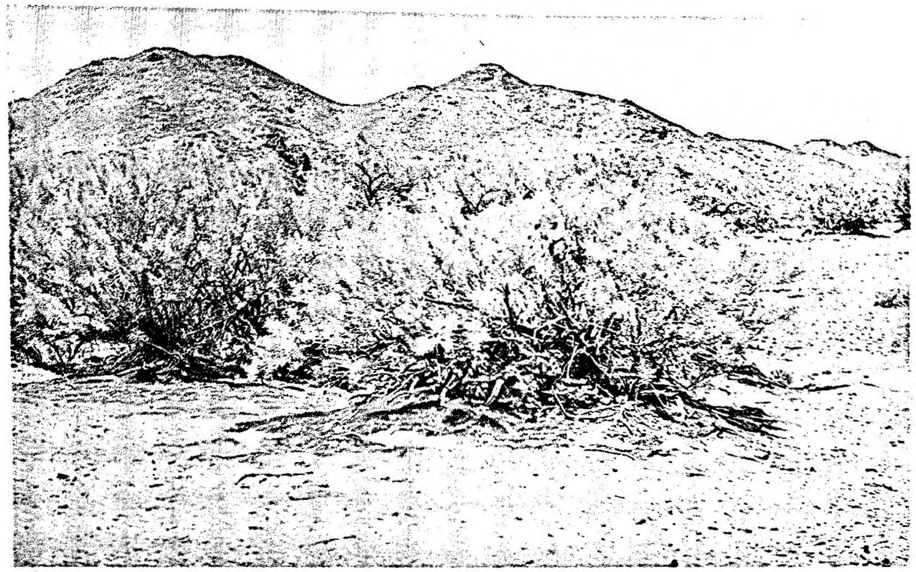
* Taking into account that field work is hampered by severe climatic conditions and the great size of the protected areas, at least a three-fold increase of the staff is undoubtedly necessary.



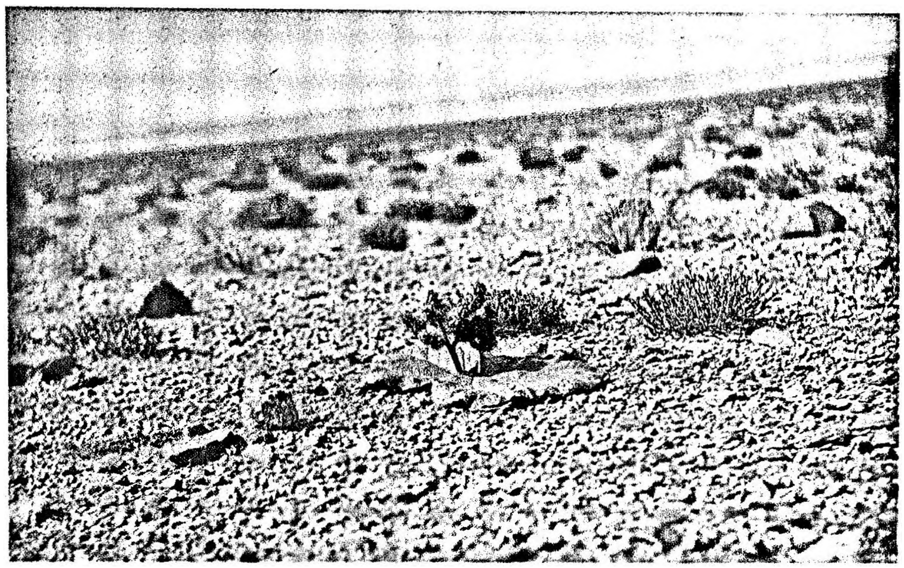
Small groves of downy poplar and tamarisk thickets occur in ravines among granite hummocks. Wild camels take shelter here



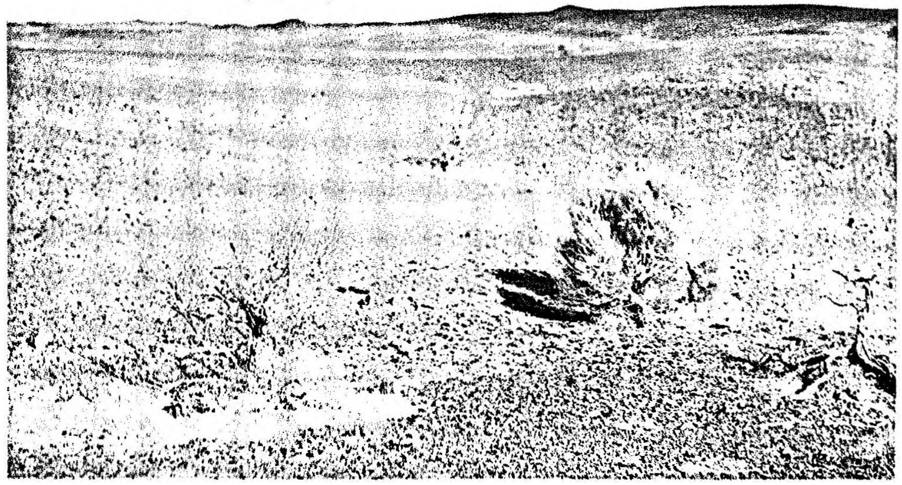
Shara-Khulsny-Bulak oasis, a recorded habitat of the Gobi bear in the Trans-Altai Gobi



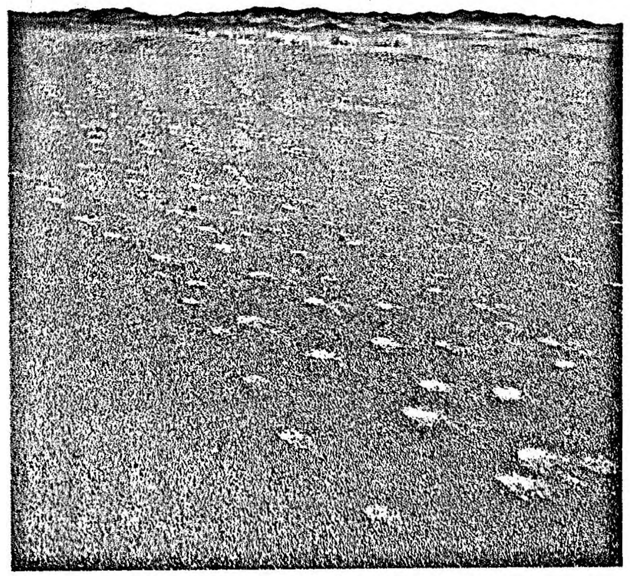
Tamarisk thickets occur along large sairs in the Gobi Desert



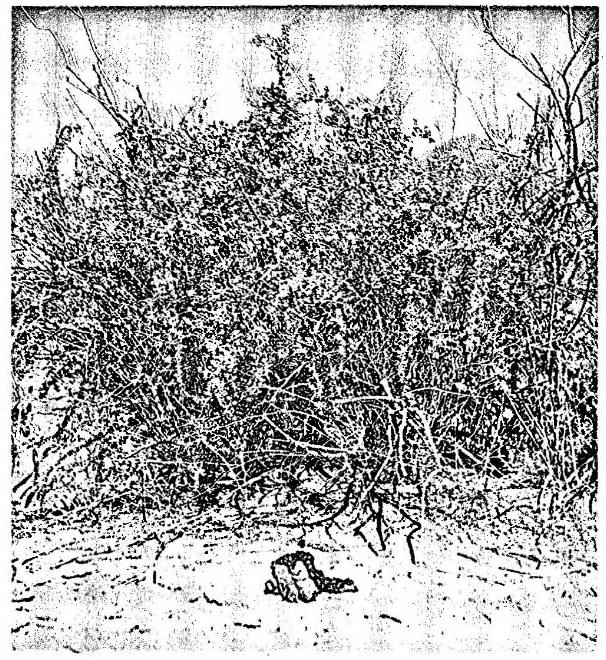
Rhubarb and anabasis, favorite food of wild ungulates, grow on watersheds in the true desert zone of the Northern Trans-Altai Gobi



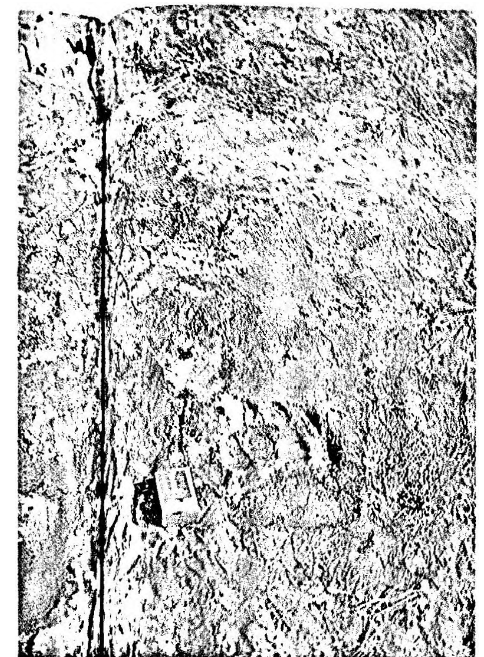
Even saxaul dies on watersheds in the superarid deserts of the Trans-Altai Gobi



Tracks of wild camels on a hammada



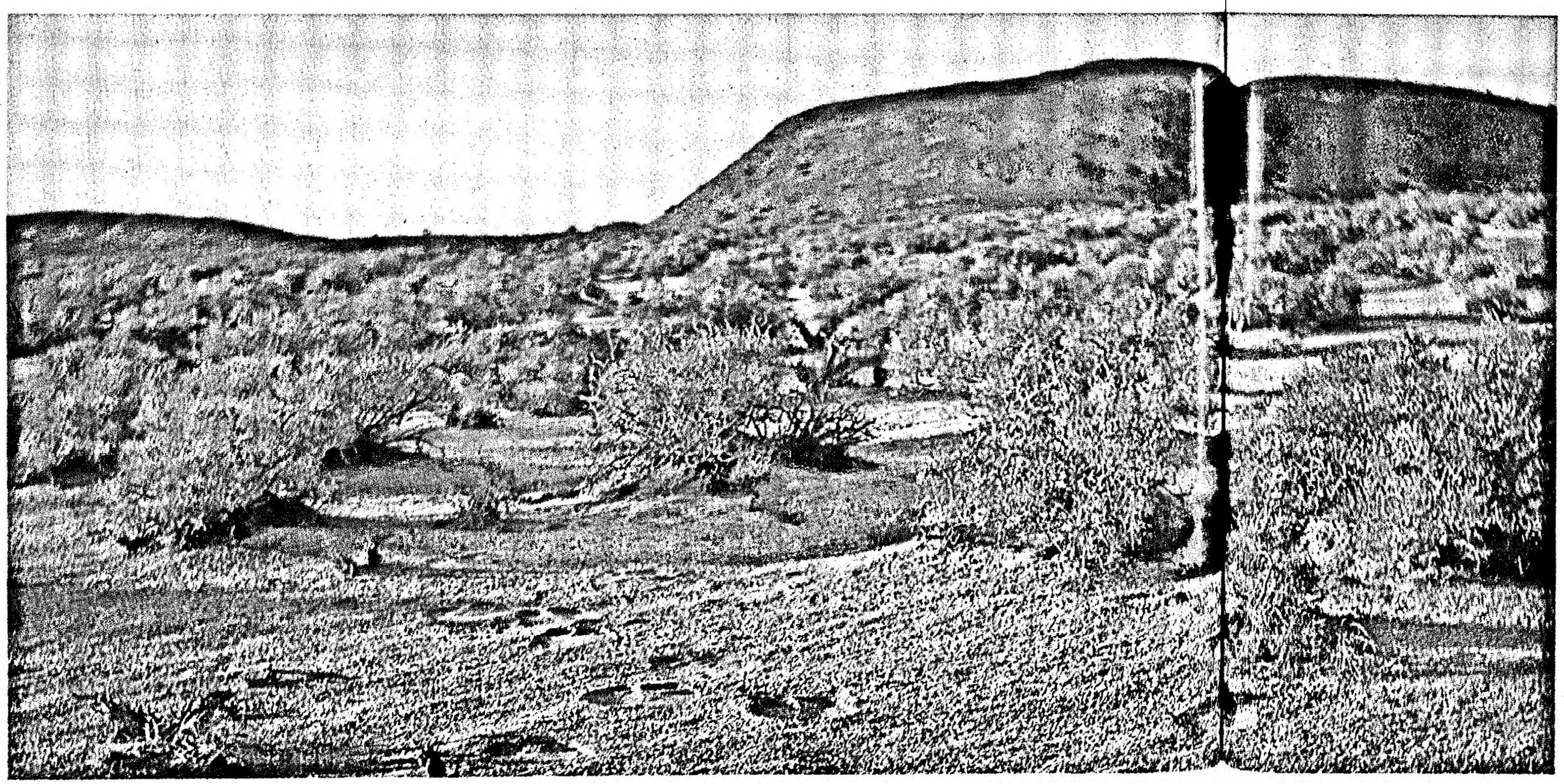
Thickets of wolfberry, the berries of which are eaten by Gobi bears

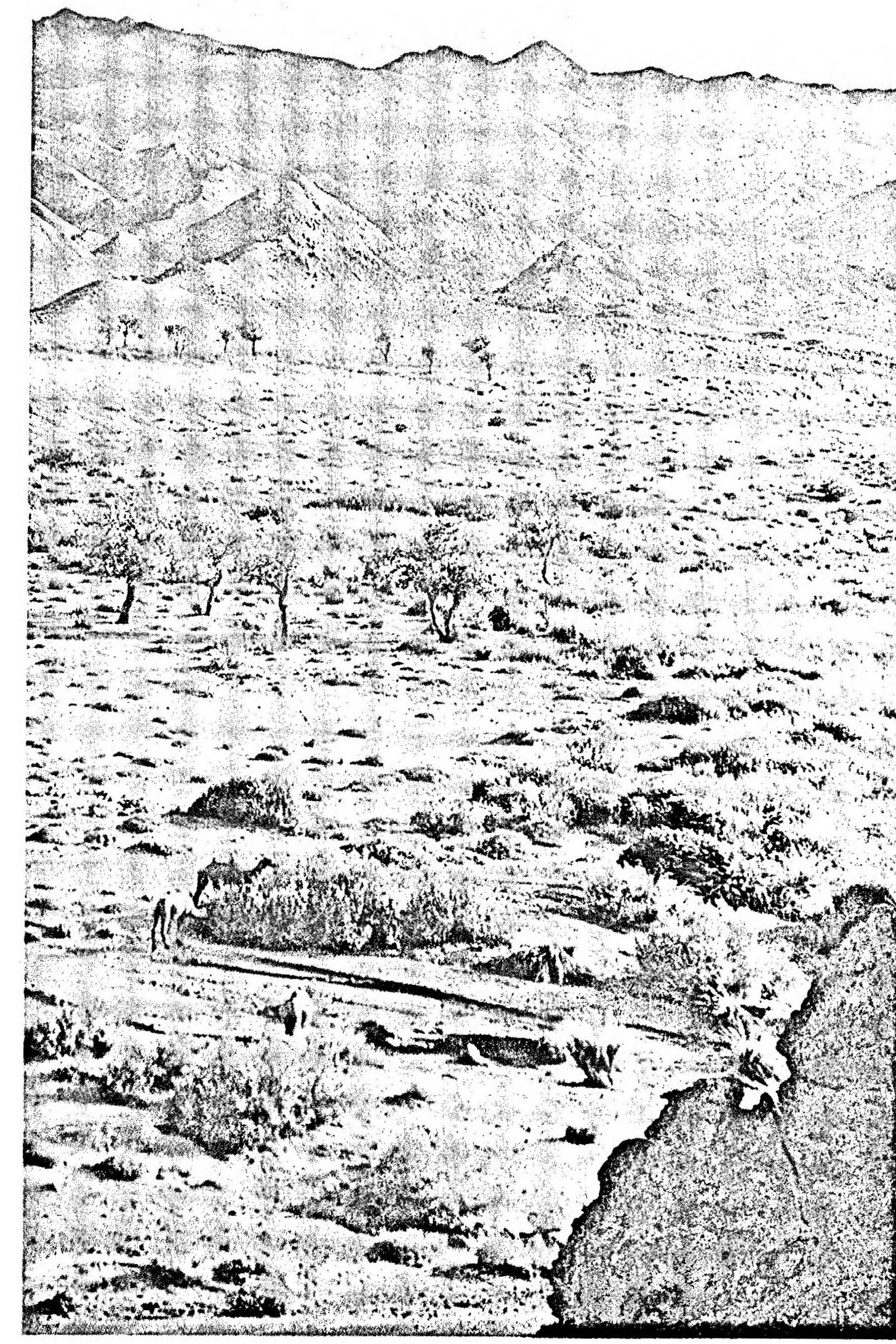


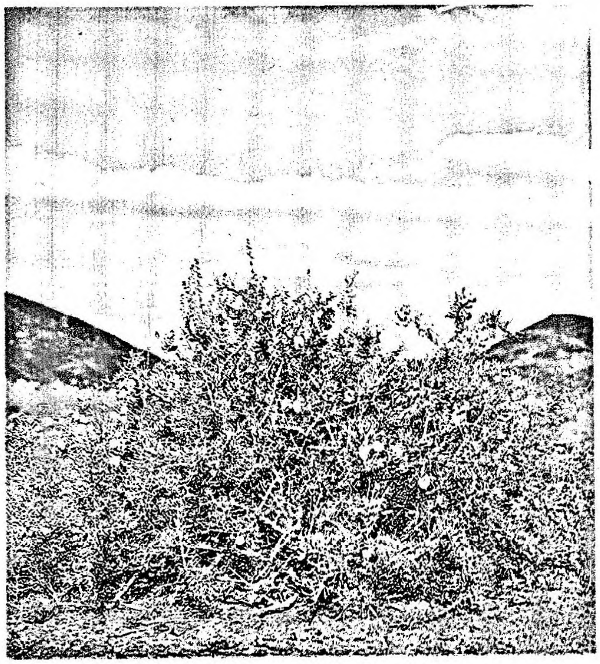
Track of a bear on a solonchak. Kutsin-Shanda oasis

Herd of wild camels in Toroin-Bulak oasis, Atas-Ula. July 18, 1981

Tracks of wild camels on sand in a sair

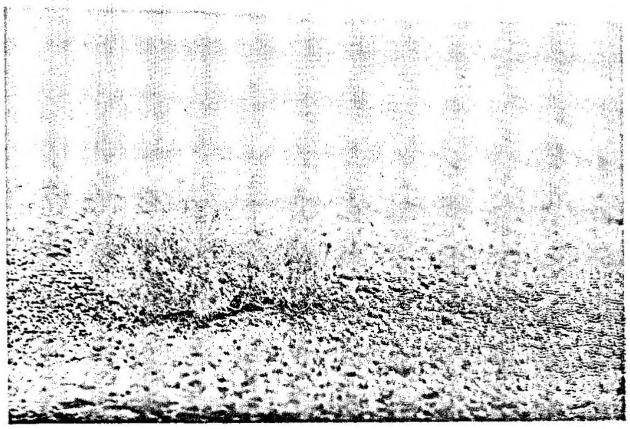






Bean caper occurs along sairs

Bean caper with its distinctive fruits, a favorite food of Asiatic wild sheep

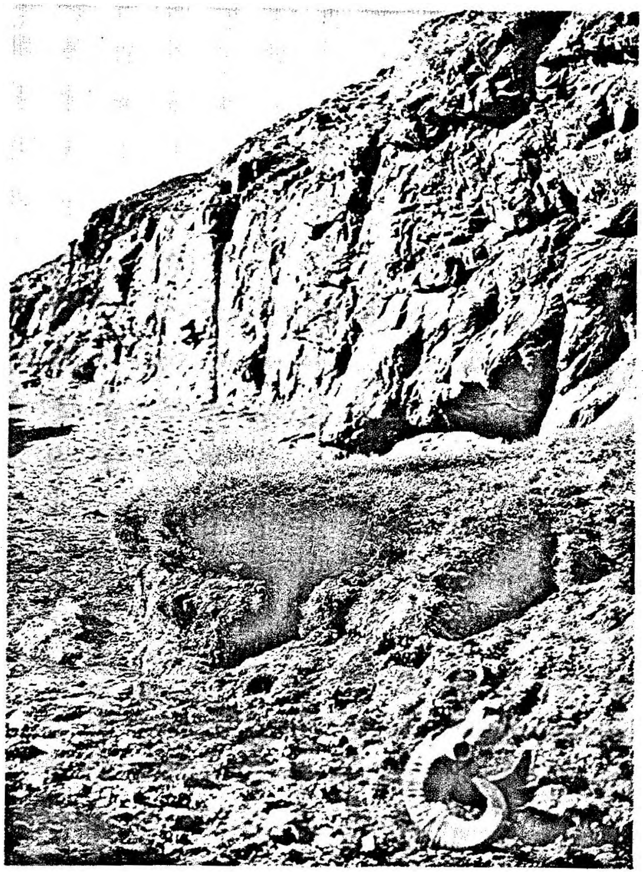


In the superarid desert zone plant communities are very sparse. The most frequently encountered plant is the ilyinia, one of the most drought-resistant plants of the Central Asian deserts

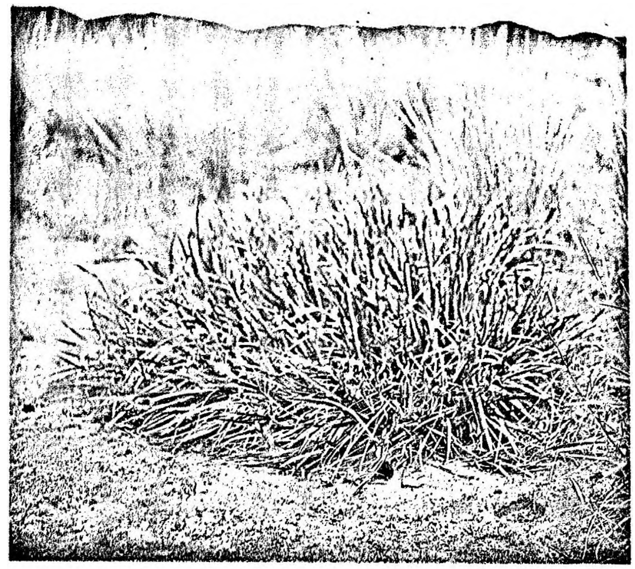
Southern slope of Edrengiyn-Nuru ridge. Limoneum chrysoeomum in bloom

Ulan-Chulu spring, southern slope of Edrengiyn-Nuru. Reed and achnatherum growth

Spring in Takhilt-Us oasis, one of the main watering points of wild animals in the Northern Trans-Altai Gobi

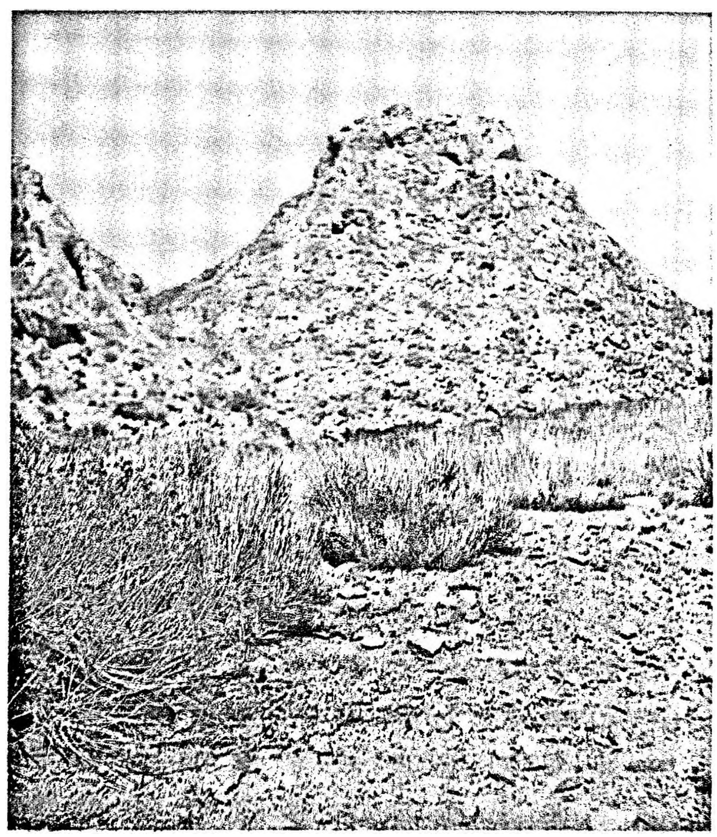


Spring in the Otgon-Us ravine. Trans-Altai Gobi



Takhilt-Us spring. Iris (Iris lactea) in bloom

Thickets of Przhevalsky's ephedra occur along sairs, where moisture conditions are more favorable



tains lying in the Gobi Tien-Shan range and the area of sloping plains (bels) adjoining them to the north. The total area of the zone is about 90,000 ha.

This zone contains the most abundant sources of fresh water in the reserve. The discharge rate of the Shara-Khulsny-Bulak spring is 8.6 l/s, while that of Tsagan-Burgasny-Bulak is 2.2 l/s. Diverse and luxuriant vegetation flourishes around the springs: reeds, achnatherum, tamarisk, downy poplar and saltworts. The knolls and interhill depressions support an abundant growth of rhubarb, one of the main foods of the Gobi bear. Deep gorges constitute a characteristic feature of the relief. Along their bottoms there are small oases with growths of poplar, tamarisk, rea-tree and nitrebush.

It is here that tracks of a female bear and a cub were discovered in 1980. In August 1981 we succeeded in seeing a female bear and cub at the Shara-Khulsny-Bulak spring as the result of a round-the-clock watch. The areas around this spring are apparently a breeding territory of Gobi bears, which makes them especially valuable and necessitates their strict protection.

Persian gazelles and wild asses are also residents in the territory. Wild camels occur here in spring, summer and autumn, and snow leopards occur in the mountains. At present, however, a 24-hour motor road passes through Shara-Khulsny-Bulak, linking the Dzamyn-Bilgekhu frontier post with Dzarman and Bayan-Tooroi settlements.

5. The strict protection zone in the region of the Tsagan-Bogdo mountain system occupies an area of about 160,000 ha. The highest point of the Tsagan-Bogdo massif is 2,480 m above sea level. The mountain system has a relatively large number of natural water sources and wells. One of the largest of these is Tsagan-Bulak spring. It produces fresh water and has an output of 0.55 l/s. The spring is used by wild animals all year round.

This region has a wide variety of plant communities, from hammada complexes to desert feather-grass and dry couch-grass steppes. The mountain massif is remarkable for its rich flora and constitutes a unique repository of the desert flora of the Trans-Altai Gobi.

The mountains and hummocks of this zone are also main habitats of the Gobi bear. Our observations and inquiries indicate that the bear is a permanent resident here. Snow leopards, mountain goats, Asiatic wild sheep, Persian gazelles and wild asses also reside in this zone. Indian wild dogs may also appear in the Tsagan-Bogdo region.

Thus, all the zones described above are vitally important for such rare wild animals as the Gobi bear, the wild camel and the snow leopard, the protection of which is the main function of the reserve.

Furthermore, these are the key areas for carrying out ecological, geobotanical, hydrological, veterinary and other observations to study the state of natural complexes in the Trans-Altai Gobi. The special protective regime in these zones includes:

a) A total prohibition on issuance of permits to visit these zones;

b) A prohibition on protracted and overnight stays at all seasons of the year;

c) Strict surveillance over the roads leading from the buffer zone to these areas;

d) Warning signs should be placed on the approaches to these zones stating: "Special zone! Entry without special permission prohibited!";

e) The protection of these zones is the priority task of the rangers who patrol closed areas and circuits;

f) In cases of natural calamities steps to rescue wild animals should first of all be taken in the strict protection zones, which serve as ecological centers for seasonal concentrations of many large mammals in this region.

SYSTEM OF MEASURES TO MANAGE WATER RESOURCES

Open water is one of the principal factors enabling many animals to exist under desert conditions. The distribution of ungulates, carnivores and other groups of animals, their seasonal concentration sites and the directions of their migrations depend to a substantial degree on the availability of water sources. Surveys of the water resources of the Great Gobi Reserve have shown that the network of permanent and intermittent water sources is the basic ecological factor that determines the well-being of all large animals in the reserve. Thus, the management of water resources in order to assure their efficient use and conservation constitutes an important component of the system of measures aimed at preserving the natural complexes of the reserve.

The main measures to manage the water resources of the reserve include systematic surveillance of the state of existing permanent and intermittent natural water resources and the conduct of hydrological and hydrogeological studies within the reserve.

Observations of the state of natural water sources constitute an important component of the reserve's research activities.

To systematize the data on permanent water sources, a fact sheet should be prepared on each of them, including the name, location, type (ascending or descending), discharge rate, water quality (chemical composition), length, width and depth of the watercourse, characteristics of the surrounding vegetation (species composition and area coverage) etc. These parameters should be entered in the fact sheet for all seasons of the year (winter, spring, summer and autumn).

The data sheet should also include available observations on the use of springs and other permanent water sources by wild animals, including the species and the frequency of use, in order to evaluate the role of the water source in the lives of protected populations, principally large carnivores and ungulates.

An inventory of water sources must also include a list of intermittent water sources that form in the period of summer rain showers. The formation of intermittent water channels, shallow lakes, pools of water in granite bowls etc. should be described in detail. The lifetime of such intermittent water sources in depressions, stone bowls, takyrs etc. is also of great interest.

As a result, a catalog of all active water sources to be found in the various natural regions of the reserve, both permanent and intermittent, is to be compiled in the next years (1984—1986), along with an evaluation of their ecological role in desert ecosystems, and in particular their importance for the survival of protected populations of wild animals.

The compilation of this catalog will make it possible to find ways and means to improve the state of permanent water sources.

The Master Plan of the Great Gobi Reserve includes preliminary measures to improve the technical characteristics of natural water sources. In particular, recommendations are made to construct capture troughs at water sources in order to increase their output and improve sanitary conditions, while assuring their accessibility for wild animals. Improvement of natural water sources is to be initiated in 1983—1985 at Takhiyn-Us and Tolgoin-Us springs (Sector B) and Ulan-Chulu spring on the south slope of the Edrengiyn-Nuru ridge (Sector A). Work on the other water sources can be performed only in later years on the basis of the experience gained in improving the technical characteristics of these three springs.

The Master Plan of the Great Gobi Reserve proposed to create artificial water sources in the Dzungarian Gobi (Sector B) with the aim of improving the water-supply in regions used by both wild and domestic animals. The siting of these artificial watering points must be correlated with the feeding capacity of pastures in areas of concentration of wild and domestic ungulates.

Shaft and small-tubular wells of the type widely used to water pastures in other parts of Mongolia are also recommended for these artificial water sources (Chogdon, 1980).

Wherever the water table is not lower than 30 m, such wells may be equipped with an NV-ZM pump fed by a Tsiklon-6 turbine, which is currently undergoing operational tests in Mongolia. This wind-energy unit is designed to operate in low-maintenance conditions, i.e. with only periodic service. The water is lifted by an electric pump attached to a wind-propelled generator.

The wind-electric system consists of a metal tower 5 m high with a twin-blade fan 6 m in diameter. It is designed for a wind velocity of 7 m/sec in the range of 3—50 m/sec. The system pumps 6 cu. m. per hour. The water is delivered to the watering point through a discharge tube. It is recommended that the watering point be situated no closer than 150—200 m from the water source.

In the Dzungarian Gobi (Sector B) the water-supply to pastures can also be improved by creating artificial reservoirs fed by high water during heavy summer rains. Dams will be built in the beds of various dry sairs to enable the accumulation of water-supplies to be used by domestic and wild animals during both hot periods and in winter when ice may form.

However, when appraising these recommendations realistically, it is necessary to make allowance for the lack of reliable data on hydrological and hydrogeological features of both the Trans-Altai and Dzungarian Gobi. For this reason the Master Plan provides for such surveys to be done in 1991—1992.

To conclude, it should be noted that these water-supply projects should be carried out with all possible care that the natural complexes of the reserve are maintained in a natural state. Large-scale construction of artificial water-works may lead to a large concentration of people and construction machinery, which may in turn entail environmental pollution by combustion wastes and to the withdrawal of wild animals, the destruction of plants and soils etc.

It must be strongly emphasized that the construction of all artifical water sources (wells, ponds) must be strictly prohibited in the Trans-Altai Gobi as this area is under total protection with all human influences on natural ecosystems completely prevented to the extent possible. Improvement of the water-supply is possible by providing limited water points only in the pastures of the buffer zone of Sector A (the northern slopes of the Edrengiyn-Nuru ridge), in this way reducing the burden on some of the natural springs in the northern part of the reserve.

VETERINARY INSPECTION SERVICE

Diseases may constitute an important factor in the state of wild animal populations. Therefore, study and evaluation of epizootic conditions among wild animals, control of diseases and conduct of preventive measures are important components of the system of conservation and augmentation of the rare and valuable wild animal populations of the reserve.

In this connection a veterinary inspection service must be organized in the reserve to pursue the following objectives:

a) To collect data on the infectious and parasitic diseases of wild and domestic animals;

b) To study health conditions on livestock-drive routes, watering points and pastures and determine their possible role in the spread of diseases in the reserve and surrounding areas;

c) To discover the most common diseases of wild animals, including those dangerous to man and domestic livestock;

d) To discover cases of diseases of wild animals transmitted from domestic animals to wild animals and vice versa at places of possible contact (pastures, watering points, livestock drives etc.);

e) To study comprehensively the carcasses of all wild and domestic animals found in the reserve or its buffer zone;

f) To set up a system of notification of cases of disease in wild animals in the reserve;

g) To control the number of stray dogs.

The veterinary inspection service is responsible for establishing an efficient notification system to provide information about the epizootic situation in the reserve and the adjacent territories of the Gobi-Altai, Bayan-Khongor and Kobdos aimaks. Specifically, all cases of infectious diseases in wild animals must be urgently reported to the local and higher authorities. The veterinary inspectors in conjunction with the local veterinary service should then evaluate the epizootic situation and work out a system of organizational, quarantine and anti-epizootic measures to wipe out the foci of the disease.

All these activities should be specified in the annual plans of the administrative and research work of the reserve.

To attain the above goals a veterinary laboratory must be included in the research division of the reserve with its location at Tsogt somon, the administrative center of the reserve. It should be furnished with all necessary equipment, instruments, medicines and reagents in the quantities normally envisaged in the plans of such laboratories.

Veterinary field surveys will be carried out through the use of a mobile laboratory mounted on a UAZ-469 vehicle. The veterinary laboratory will be manned by a veterinary surgeon and an assistant. Members of the veterinary inspection service of the reserve will plan and carry out their activities in close cooperation with the staffs of the aimak and somon veterinary services. They will also take part in periodic inspections and examinations of domestic livestock wintering in the reserve and the buffer zone, as well as in various therapeutic and preventive measures. One of the main tasks of the veterinary inspectors in the reserve is the timely discovery of cases of disease and death of wild animals. The members of the ranger service, research personnel and other members of the reserve staff will be involved in this task. Every staff member is required to notify a veterinary inspector and the administration of the reserve of every case of disease or death of wild animals. A veterinary specialist will participate in planning, development and performance of biotechnical and other measures aimed at preserving and increasing wild animal populations.

The practical success of the veterinary service depends to a significant degree on the extent of real participation in its work by the local population (herdsmen) and experts of the local agricultural departments. For this purpose it is necessary to develop a public information system using leaflets, posters and other means to provide notice of all diseases of domestic and wild animals and of the necessary measures for their control and prevention. The performance of the above tasks by the veterinary inspection service will contribute to a significant increase in the effectiveness of measures directed toward preserving wild animal populations and will prevent the occurrence of mass deaths of valuable animal species.

PRINCIPAL RESEARCH THRUSTS IN THE GREAT GOBI RESERVE

The Great Gobi Reserve meets all the criteria of a biosphere reserve, i.e. its large area of 5,300,000 ha and its geographical location in the Gobi Region of Central Asia ensure natural regulation of typical desert ecosystems while the very diversity of ecosystem types has great value in providing cross-sections of the biosphere typical of the Asian arid zones (Vtorov, Vtorova, 1983). As noted above in describing the natural conditions and wildlife of the Great Gobi Reserve, the special value of the ecosystems of this region in their natural state, which includes undisturbed desert zoocenoses containing populations of unique large animals (the wild camel, wild ass, Gobi bear), representative landscapes, the greatest possible diversity of living communities and extremes of environmental conditions. These conditions which define the Great Gobi Reserve as a true biosphere reserve require the development of a research program directed at the formulation of a scientific basis for managing natural communities so that representative ecosystems are preserved, along with constant monitoring of the dynamics and functioning of ecosystems in relation to the global and local fluctuations in the natural environment. These are the overall planned goals of research in the Great Gobi Reserve. The section of the Master Plan dealing with "Future Themes of Scientific Research" lays down the main research thrusts and outlines specific research themes for the period of 1983—1992. In connection with the establishment of a network of biosphere reserves in the desert regions of Asia, the creation of a special program on "The Development of Ecological Bases for Nature Conservation and the Rational Use of Natural Desert Ecosystems" has been proposed (Gunin, Neronov, Veysov, 1983). This program was presented to the First International Congress on Biosphere Reserves (Minsk, September 26 — October 2). It envisages comprehensive research to develop the ecological bases for preserving the genetic diversity of desert ecosystems, conserving rare ecosystems and studying their role in maintaining genetic diversity; the control of populations of common species; the preservation of typical ecosystems and the organization of research to study the adaptive mechanisms of organisms living in the extreme conditions of natural and disturbed ecosystems of the arid zones.

The entire program encompasses a number of issues concerning the functional dynamics and conservation of rare and common ecosystems of the Central Asian deserts. Within these issues the thrusts and individual themes that are directly or indirectly connected with the conservation of wildlife in the Great Gobi Reserve should be distinguished.

The scientific themes that the staff of the Great Gobi Reserve should now develop include:

— Development of ecological principles for the preservation and restoration of populations of rare mammals listed in the IUCN Red Book and the national Red Book of the Mongolian People's Republic (the wild camel, wild ass, Gobi bear and snow leopard).

— Development of a scientific basis for the re-establishment of natural populations of Przhevalsky's horse in the Great Gobi Reserve and adjacent areas of Mongolia.

— The oases of the Trans-Altai Gobi (within the confines of the Great Gobi Reserve) and their role in the preservation of natural populations of rare and common mammalian and avian species.

— Study of the population structure and dynamics of the dominant (common) species of vertebrates and their role in the functioning of typical desert ecosystems.

— Study of biomorphological and ecomorphological adaptations to the extreme conditions of the superarid deserts of the Trans-Altai Gobi in different groups of vertebrates and invertebrates.

— Investigation of the extent and nature of anthropogenic impacts upon the wild animal populations of the Trans-Altai and Dzungarian Gobi (wild ass, Persian gazelle, Asiatic wild sheep, mountain goat and wild camel).

— Elaboration of ways and means of increasing the productivity of desert ecosystems that are used as common pastures by wild and domestic animals in the Dzungarian Gobi (Sector B).

Besides the development of these basic themes of nature conservation directed toward the study of the ecological principles for preserving the rare and common species of desert animals, the research program should include work on the problems of inventorying the fauna of the Great Gobi Reserve. Up to now faunistic surveys have generally been carried out only during short-term expeditions to the Trans-Altai and Dzungarian Gobi. Therefore, the establishment of the Great Gobi Reserve has made it possible to set up research stations to gain more precise knowledge of all the animal groups found in faunistic complexes.

Further studies of the faunistic structure are indispensable to detailed research into the role of animals in the structure and function of desert ecosystems.

Particular emphasis should be placed on the need to treat the problems of wildlife conservation in parallel with the development of research on general questions of reserve management, including the elaboration of scientific approaches to the integral protection of natural ecosystems. Hence, the same basic theme should be developed in the Great Gobi Reserve as that followed in the reserves of the Soviet Union: "study of the natural phenomena and processes taking place in the reserve's ecosystems", which should be carried out in accordance with the "Chronicle of Nature" program (Krasnitsky, 1983). Research on this theme is carried out by all the research personnel of the reserve*, who work to ensure continuity of observations with respect to annual and seasonal changes of the environment and its main components. Experts in different fields (geobotanists, soil scientists, zoologists, hydrologists etc.) must develop a cross-section of the basic natural phenomena and natural features, as well as a selection of model sites which typify all Gobi Desert ecosystems. These must then be combined into a specific program to keep a "Chronicle of Nature" of the Great Gobi Reserve. It is very important to emphasize that all of the reserve staff, including the rangers who go out on patrols, should collect data for the "Chronicle of Nature". For this reason, there should be a standard method for making observations that encompasses all the natural phenomena characteristic of the Gobi Desert.

At present there is a desert biological station in the buffer zone of the reserve at Ekhiyn-Gol, established under the auspices of the joint Soviet-Mongolian Biological Expedition, which carries out in-depth fixed and transect-type studies on the climate, wildlife, soils and plant cover at six main test-plots which represent the main types of desert ecosystems found in the true and superarid desert zones. The results of these studies may be used for the scientific planning of conservation measures not only for the Great Gobi Reserve, but for the entire desert region of Mongolia.

In view of the voluminous data already obtained in the course of investigations at the Ekhiyn-Gol biological station, a long-term plan of nature research in the Great Gobi Reserve should be developed to involve both scientific personnel of the Great Gobi Reserve and experts from the joint Soviet-Mongolian Biological Expedition. This cooperation is made necessary by the fact that the scientific staff of the reserve is still small and made up basically of young Mongolian specialists, who should learn modern methods of ecological research. This would facilitate environmental research in the Great Gobi Reserve and, in the end, provide a scientific basis for the development of regional programs of conservation and efficient use of the arid zones of Mongolia and the neighbouring countries of Central Asia.

The organization of long-term interdisciplinary studies leading to an inventory of natural communities and large-scale environmental monitoring would place the Great Gobi Reserve in the worldwide network of biosphere reserves involved in the international program on "Man and the Biosphere".

* In 1983 the research staff of the reserve included only zoologists, botanists and veterinary surgeons.

CONCLUSIONS

The Gobi Desert, one of the great deserts of the world, is of world-wide significance as a unique region of inimitable landscapes and a distinctive flora and fauna. It still harbors extremely interesting representatives of the ancient terrestrial fauna of Central Asia — the wild camel, Gobi bear, wild ass and other unique animals. Eastern Dzungaria was until recently the last refuge of the Asiatic wild horse, Przhevalsky's horse. The preservation of this unique fauna in the context of natural desert ecosystems has great scientific and practical significance since in our century civilization and its powerful technical tools have constantly spread their influence to all the natural regions of the world, including the deserts of Central Asia. It is for this reason that the decision of the Mongolian government to create the Great Gobi Reserve has met with world-wide approval.

The United Nations Environmental Programme (UNEP), in close cooperation with the Mongolian People's Republic and the USSR, sponsored extensive exploratory and planning activities within the framework of a special international project to promote the establishment of the Great Gobi Reserve in the Mongolian People's Republic. In the period 1979—1982 highly qualified Soviet and Mongolian experts, including zoologists, botanists, soil scientists, geographers, hydrologists and veterinary surgeons, took part in this project. Their great efforts have now come to an end. A Master Plan of the Great Gobi Reserve has been compiled to summarize the results of field studies on the state of natural resources and to give recommendations as to the conservation of flora, fauna and unique ecosystems representing typical features of the Central Asian deserts.

Covering an area of 5,300,000 ha, the Great Gobi Reserve is one of the largest nature reserves in the world. It consists of two separate areas in southwest Mongolia that include a broad spectrum of zonal and altitudinal deserts and dry steppes characteristic of the northern part of Central Asia. The Great Gobi Reserve encompasses the southern true deserts that stretch from the Caspian Sea to Khingan and the distinctive superarid deserts characteristic only of Central Asia. The large area of the protected territories and the special position of the reserve in the Gobi Region of Central Asia ensures that the typical desert ecosystems are self-regulating, while the very diversity of ecosystem types provides a valuable model of the biosphere. In light of these factors, the Great Gobi Reserve can be considered a biosphere reserve. The special value of the ecosystem types in the reserve lies in the virgin state of the typical ecosystems, including undisturbed desert zoocenoses that support populations of unique large animals (the wild camel, wild ass, Gobi bear and others), the representative nature of the protected territories, and the great diversity of biocenoses existing under extremely variable environmental conditions. All of these factors justify considering the Great Gobi Reserve as the largest desert biosphere reserve in Asia having all the requisites to preserve a unique flora and fauna and at the same time to develop large-scale research on ecosystems within the framework of the international "Man and the Biosphere" program. The planning and exploration activities accomplished through the UNEP Project and by the joint Soviet-Mongolian Biological Expedition have laid the scientific foundation for a system of managing these natural resources which gives rise to the hope that the unique natural biocenoses of the Gobi Desert will be preserved for future generations.

In the course of the UNEP Project consideration was also given to the problem of restoring Przhevalsky's horse, a unique species of the world's fauna and an endemic to Central Asia. This problem, however, was not resolved in connection with the establishment of the Great Gobi Reserve.

The last natural habitat of Przhevalsky's horse was in that very part of the Dzungarian Gobi (in the eastern part) where one of the protected areas of the reserve, Sector B, was established. The last small bands of Przhevalsky's horse found in the wild lived in the region of the Takhiyn-Shara-Nuru and Baitag-Bogdo mountain massifs and in the adjacent plains between 1967 and 1969. In later years wild horses could not be found within the Mongolian People's Republic, notwithstanding many expeditions that visited the Dzungarian Gobi. Surveys in the course of the 1980—1982 UNEP Project also had negative results: Przhevalsky's horse had not survived in the wild in Mongolia. Reliable information on the occurrence of wild horses in Chinese Dzungaria is also lacking. As a result specialists are now of the opinion that Przhevalsky's horse, a unique representative of the world's fauna, is extinct in the world (Murzayev, 1966; Sokolov et al., 1978; et al.).

Therefore, keen attention has been given to the question of restoring a natural population of Przhevalsky's horse to its original habitat in Central Asia. The loss of the last natural population of the only representative of the true horses has naturally caused great concern in the world's scientific community. The progeny of wild horses brought at various times from Central Asia are now kept in 70 zoos and breeding farms in many countries of Europe and America. The total number of these animals exceeds 300 head due to long experience in breeding them in captivity. However, the state of the Przhevalsky's horses bred in captivity raises great concern for the fate of the species (Sokolov et al., 1978; Bannikov, Lobanov, 1980; Klimov, Orlov, 1982; et al.). Careful analysis of these populations has shown that raising them in small groups has led to progressive inbreeding, leading to the appearance of such undesirable traits as increased homozygosity, reduced viability and lower reproductive capacity in many of the micropopulations found in various zoos and breeding farms. Moreover, raising these horses in captivity has led to the development of tendencies toward domestication as a consequence of the "mild" surroundings, changes in diet, hypomotility and other peculiarities of their living conditions. Domestication is manifested in the appearance of morphological and physiological changes from the species norms found in the horses in natural populations (Klimov, Orlov, 1982). In the light of this situation the question of reintroducing Przhevalsky's horse into its native habitats as the best way of preserving it as a taxonomic entity has been considered at three international symposia on Przhevalsky's horse (Berlin, 1965; Munich, 1976; Marwell, 1980).

The last of these symposia (the fourth one), held in Marwell, Great Britain, in 1980, again focussed on two courses of action: on the one hand, the creation of purebred blood lines through a program of exchanging breeding stock between the leading zoos, and on the other hand, a program to reintroduce Przhevalsky's horse into the natural ecosystems of Central Asia. After long discussion, the fourth symposium recommended in particular the creation of a breeding farm in Askaniya-Nova (USSR) to raise purebred Przhevalsky's horses and take responsibility for working out the problems of their re-acclimatization, so that Askaniya-Nova could serve at the same time as a transit point for the horses on their way from Europe and America to Mongolia (Klimov, Orlov, 1982). In their consideration of problems of re-acclimatization, the specialists of many countries having significant populations of wild horses agreed to transfer the necessary number of animals (30 head) to Mongolia and the International Union for the Conservation of Nature and Natural Resources agreed to cover the expenses of the transfer.

Recognizing the reintroduction of Przhevalsky's horse as an urgent and important task, the Mongolian government agreed to undertake the necessary preparatory steps to initiate a re-acclimatization program in Mongolia. Some practical steps toward realizing this complex task were undertaken. Specifically, experts participating in the 1980—1982 UNEP Project suggested in 1980 that implementation of a reintroduction program should constitute the second stage of the project. The interested parties came to a preliminary understanding with respect to this matter but for a number of reasons realization of this second step was postponed.

The delay in carrying out the program to reintroduce Przhevalsky's horse into Mongolia was in particular the result of differing opinions regarding practical steps to be taken in carrying out the program. Some scientists believe that the first stage of the re-acclimatization program must be initiated at a special center in that part of Mongolia which the horses inhabited until recently, i. e. in the Dzungarian Gobi, particularly in Sector B of the Great Gobi Reserve. This view encountered objections to the effect that it would be difficult for the Mongolian scientists to establish a breeding farm in this region and, most important, it would be impossible to conduct a normal breeding program in open-air enclosures because of the lack of competent veterinary organizations to exercise daily monitoring of the horses brought into Mongolia from other countries. Moreover, the Dzungarian Gobi (Sector B) would not be the right area in which to begin releasing Przhevalsky's horses into natural ecosystems because all the suitable habitats are already occupied by domestic livestock and the release of Przhevalsky's horses would be doomed to failure in advance. It should be emphasized that that part of Dzungaria which was the last refuge of these animals in the wild was located in the border regions (Takhiyn-Shara-Nuru, Baitag-Bogdo etc.), where border conditions make it impossible to create a breeding farm or to plan the release of horses. The other sector of the reserve, the Trans-Altai Gobi, is also unsuitable for breeding and releasing Przhevalsky's horses since most of its area is occupied by superarid deserts which are not suitable for this species.

Under the circumstances it was proposed to set up a breeding farm on part of the Bogdo-Ula Nature Reserve near Ulan-Bator in the forest-steppe zone of Mongolia. Here Mongolian specialists planned to initiate the first stage of reintroducing horses brought from Europe. No serious technical obstacles to the construction of open-air enclosures exist here and the availability of a well established veterinary service should safeguard survival of the imported horses. After a sufficient number of horses have been accumulated in the open-air enclosures, it should be possible to proceed to the second stage of the project, returning the horses to the natural ecosystems of Mongolia. In future the optimum region for a free habitat might be the steppe areas near the mountain highlands of Eastern Mongolia or certain areas in southern Khangai and the Eastern Gobi which lie on the boundary between the steppe and desert zones. In our view they might be released in the vicinity of the Nomgon-Ula, Khurkhu-Ula or Bordzon Gobi where there are very good year-round pastures as well as permanent water sources in the form of springs. However some experts categorically object, denying that it would be possible to set up a breeding center outside the Dzungarian Gobi. They are particularly opposed to siting a breeding center in the Bogdo-Ula Reserve because the animals have never occurred here in historical times. It should be borne in mind, however, that although Eastern Dzungaria (Baitag-Bogdo, Takhiyn-Shara-Nuru in the Mongolian People's Republic and the vicinity of Guchen in China) was the last refuge of Przhevalsky's horse in the wild, it was hardly an optimal habitat for these animals. The literature published in the later 19th and early 20th centuries shows that Przhevalsky's horse was actually forced into this area by man. Indeed, as we can now see, it was here that the wild populations of the species began to decline quite rapidly and in the end ceased to exist.

The differences of opinion with respect to the tactics for reintroducing Przhevalsky's horse into Central Asia can be settled by the joint efforts of such international organizations as UNEP and the IUCN with the help of specialists from the concerned countries (Mongolia, the USSR, Czechoslovakia, the German Federal Republic, etc.), who have already given approval in principle to the idea of reestablishing a natural population of Przhevalsky's horse in Mongolia and are prepared to cooperate to this end. It is now generally understood that the only way to restore and maintain a viable population of Przhevalsky's horse is to transfer some animals from Europe to Mongolia, where a center will be established to breed a pure strain of wild horses and then release them into the natural ecosystems of Central Asia.

BIBLIOGRAPHY

Bannikov, A. G., "Data on the biology and geographical distribution of the wild came", **Zool. zh.,** v. 24, 3, 1945.

Bannikov, A. G., **Mammals of the Mongolian People's Republic,** Moscow, 1954, 669 pp.

Bannikov, A. G., "The wild camel", **Priroda,** 1975, No. 2, pp. 63—69.

Bannikov, A. G., **The Wild Ass,** Moscow, 1981, 120 pp.

Bannikov, A. G., and Lobanov, N. V., "Przhevalsky's horse: concerns and hopes", **Priroda,** 1980, 3, pp. 100—105.

Bannikov, A. G., Murzayev, E. M., and Yunatov, A. A., "Nature sketches of the Trans-Altai Gobi within the Mongolian People's Republic", **Izv. VGO,** 1945, No. 3.

Banzragch, D., Volkova, Ye. A., and Rachkovskaya, Ye. I., "Plants of the mid-altitude massif of Atas-Bogdo-Ula in the Trans-Altai Gobi", in **Geography and Dynamics of the Plant and Animal Life of the Mongolian People's Republic,** Moscow, 1978, pp. 30—34.

Baskin, L. M., **The Behavior of Ungulates,** Moscow, 1978, 295 pp.

Beresneva, I. A., and Rachkovskaya, Ye. I., "Zonal factors in the Southern Mongolian People's Republic", **Problemy osvoyeniya pustyn,** 1978, No. 1, pp. 19—29.

Bogolyubsky, S. N., **The Origin of Camels,** Alma-Ata, 1929.

Bold, A., and Dorzhzunduy, S., "Report on snow leopards in the southern spurs of the Gobi Altai", in **Proceedings of the Institute of General and Experimental Biology,** Ulan-Bator, 1976, No. 11, pp. 27—43.

Bold, A., and Dulamtseren, S., "Rare animals and birds of Mongolia", **Nauka i zhizn,** 1981, No. 6, pp., 25—27.

Borkin, L. Ya., Munkhbayar, Kh., and Semenov, D. V., "Fauna: amphibia and reptilia", in **General Characteristics of Desert Ecosystems of the Trans-Altai Gobi,** Pushchino, 1983, pp. 52—56.

Chogdon, Zh., **Watering of Pasture Lands (as Practiced in the Mongolian People's Republic),** Moscow, 1980, 255 pp.

Dagva, E., "Rare animals of western Mongolia", **Priroda,** 1954, No. 4, pp. 105—106.

Dobchin, N., New data on the takhi, Przhevalsky's horse" in **Proceedings of the Ninth International Congress of Game Biologists,** Moscow, 1970, pp. 858—860.

Dementyev, G. P., "Ornithogeographical sketch of the Mongolian Gobi Desert", **in Ornithology,** 1962, No. 4.

Dementyev, G. P., Shagdarsuren, O., and Bold, A., "Zoogeographical review of the Mongolian Gobi Desert", **Uch. zapiski MGU,** 1966, v. 9, No. 2.

Dementyev, G. P., and Tsevegmid, D., "The wild camel in Mongolia", **Priroda,** 1963, No. 1, p. 47.

Flint, V. Ye., Ponomareva, T., and Prilipko, G., "Great bustards in an open enclosure", **Okhota i okhotn. knozyaistvo,** 1982, No. 5, pp. 14—15.

Formozov, A. N., "Mammals of Northern Mongolia: collections of the 1926 expedition", in **Materials of the Research Commission on the Mongolian and Tannu-Tuva People's Republics,** Leningrad, 1929, No. 3, 144 pp.

Gavrin, V. F., "The order Otides", in **Birds of Kazakhstan, Alma-Ata,** 1962, v. 2, pp. 5—39.

Gedin, S., **In the Heart of Asia: Pamir, Tibet, East Turkestan,** St. Petersburg, 1899, 450 pp.

Gedin, S., **Tarim-Lob-Nor-Tibet: a Journey through Asia, 1899—1902,** St. Petersburg, 1904, 385 pp.

Geptner, V. G., **Vertebrate Fauna of Badkhyz (South Turkmenistan),** Ashkhabad, 1956.

Geptner, V. G., Nasimovich, A. A., and Bannikov, A. G., **Mammals of the Soviet Union: Artiodactyla and Perissodactyla,** Moscow, 1961, v. 1, 776 pp.

Gerasimov, I. P., and Lavrenko, Ye. M., **Principal Natural Features of the Mongolian People's Republic,** Izv. AN SSSR, (ser. geogr.), 1952, v. 1.

Gordeyeva, T. A., and Anisimova, K. N., "Phytomass and chemical composition of plants of the desert-steppe communities of Mongolia", **Problemy osvoyeniya pustyn,** Ashkhabad, 1978, No. 1.

Gorelov, Yu. K., "Reproduction in Persian gazelles and the problem of restoring their population in Badkhyz", **in Teriology,** Novosibirsk, 1972, pp. 420—424.

Gotye-Pilters, Kh. "The camel: miracle of the desert", **Priroda,** 1976, No. 3, pp. 128—137.

Gunin, P. D., and Dedkov, V. P., "Ecological conditions: general characteristics of the climate", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi,** Pushchino, 1983, pp. 11—13.

Gunin, P. D., Neronov, V. M., and Veysov, S. V., "The development of a network of biosphere reserves", **Problemy osvoyeniya pustyn,** Ashkhabad, 1982, No. 4, pp. 7—24.

Grubov, V. I. "The geobotanical regions of Central Asia", in **Plants of Central Asia,** vol. 1, Moscow — Leningrad, 1963, pp. 5—69.

Grubov, V. I., and Yunatov, A. A., "Principal features of the flora of the Mongolian People's Republic with reference to its regional occurrence", **Botan. zh.** 1952, v. 37, 1.

Grumm-Grzhimaylo, G. Ye., **Description of a Journey to Western China,** Moscow, 1948, 684 pp.

Ishunin, G. I., **Fauna of the Uzbek SSR: Mammals (Predators and Ungulates),** Tashkent, 1961, v. 3.

Kalinina, A. V., **Basic Pasture Types of the Mongolian People's Republic,** Leningrad, 1974, 183 pp.

Kazantseva, T. I., "Productivity and dynamics of the above-ground desert phytomass", **Problemy osvoyeniya pustyn,** Ashkhabad, 1980, No. 2.

Kazantseva, T. I., "Flora and vegetation: the productivity of certain plant communities of the Trans-Altai Gobi", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi,** Pushchino, 1983, pp. 37—40.

Khaveson, Ya. I. "Wild and domestic forms of the camel", in **Problems of the Origin, Evolution and Breeding of Domestic Animals,** Moscow — Leningrad, 1940, pp. 291—358.

Khaveson, Ya. I., "Cranial differences between wild and domestic Bactrian camels", **Dokl. AN SSSR,** 1948, v. 60, No. 6.

Klimov, V. V. and Orlov, V. N., "Current state of Przhevalsky's horse and problems of its preservation", **Zool. zh.,** 1982, v. 61, No. 12, pp. 1862—1868.

Kostin, V. P., "Materials on the ecology and economic significance of the Persian gazelle", **Trudy In-ta zoologii AN Kaz. SSR,** 1955, v. 4, pp. 67—82.

Kozlov, P. K., **Mongolia and Amdo and the Dead City of Khara-Khoto,** Moscow — Leningrad, Gosizdat, 1923, 328 pp.

Kozlov, P. K., **Mongolia and Kam,** 1905, v. 1, 2nd ed., Moscow, 1947.

Kozlov, P. K., **Proceedings of the Expedition of the Imperial Russian Geographic Society to Central Asia in 1893—1896 under the Leadership of Roborovsky,** 1899, v. 2.

Kozlova, Ye. V., **Birds of the Zonal Steppes and Deserts of Central Asia,** Moscow, 1975, 249 pp.

Krasnitsky, A. M., **Problems of Nature Reserve Management,** Moscow, 1983, 190 pp.

Kucheruk, V. V., Tupikova, N. V., Dobrokhotov, B. P., Lebedeva, N. N., and Baranovsky, P. M., "Population grouping in small mammals and their territorial distribution in the eastern half of the Mongolian People's Republic", in **Current Problems of Zoogeography,** Moscow, 1980, pp. 115—151.

Kulik, I. A., "Distribution and range types of jerboas (Dipodidae, Rodentia)", in **Current Problems of Zoogeography,** Moscow, 1980, pp. 152, 167.

Ladygin, V. F., "Crossing the Gobi from Dalan-Turu to Su-Chzhou", **Izv. RGO,** 1900, v. 36.

Lakoza, I. I., and Shchekin, V. A., **Camel Breeding and the Fundaments of Ass and Mule Breeding,** Moscow, 1964, 158 pp.

Lavrenko, Ye. M., **General characteristics of the Botanical Geography of the Eurasian and North African Deserts,** Moscow — Leningrad, 1962.

Lavrenko, Ye. M., and Yunatov, A. A., "Natural oases in the deserts of the Trans-Altai Gobi (Mongolian People's Republic)", in **Problems of Evolution, Biogeography, Genetics and Selection,** Moscow — Leningrad, 1960.

Marinov, N. A., **Materials on the Geology of the Mongolian People's Republic,** Moscow, 1966.

Murzayev, E. M., **On Unbeaten Trails,** Moscow, 1948, 222 pp.

Murzayev, E. M., **The Mongolian People's Republic,** Moscow 1952, 470 pp.

Murzayev, E. M., **Nature in Sinkiang and the Formation of the Central Asian Deserts,** Moscow, 1966, 382 pp.

Nasonov, N. V., **The Geographical Distribution of Old World Wild Asses,** Petrograd, Izd-vo Akad. nauk, 1923, 255 pp.

Nogina, N. A., Yevstifeyev, Yu, G., and Ufimtseva, K. A., "Steppe soils of low-altitude mountains and plains", in **Arid Soils, their Genesis, Geochemistry and Use,** Moscow, 1977.

Nosin, V. A., "Soils of the southern edge of the Tarim Basin and Western Kun-Lun", in **Kunlun-Tarim,** Moscow, 1961.

Petrov, M. P., **The Deserts of Central Asia,** Moscow — Leningrad, 1966, v. 1, 271 pp.; 1967, v. 2, 285 pp.

Pevtsov, M. V., "Description of a journey through Mongolia", **Zapiski Zap.-Sib. otd. RGO,** 1883, v. 5, 2nd ed., Moscow, 1951.

Pevtsov, M. V., **A Journey through Eastern Turkestan, Kun-Lun, the Northern Edge of the Tibetan Plateau and Dzungaria,** 1895.

Pevtsov, M. V., **A Journey to Kashgaria and Kun-Lun,** Moscow, 1949, 325 pp.

Ponomareva, T., "The houbara bustard (current state and prospects for preservation)", **Okhota i okhotn. khozyaystvo,** 1979, No. 11, pp. 26—27.

Potanin, G. N., **The Tanguto-Tibetan Borderland of China and Central Mongolia: a Journey from 1884 to 1886,** St. Petersburg, 1893, 567 pp.

Przhevalsky, N. M., **Mongolia and the Land of the Tanguts,** St. Petersburg, 1875, 330 pp.

Przhevalsky, N. M., "From Kuldzhi beyond Tien-Shan to Lob-Nor", **Izv. RGO,** 1877, v. 13, pp. 263—329.

Przhevalsky, N. M., "The wild camel", **Priroda i okhota,** 1878, v. 1., pp. 100—105..

Przhevalsky, N. M., **From Zaysan through Khami to Tibet and the Upper Reaches of the Yellow River,** St. Petersburg, 1883, 406 pp.

Przhevalsky, N. M., **From Kyakhta to the Upper Reaches of the Yellow River: Studies of the Northern Borders of Tibet and a Journey through Lob-Nor along the Tarim Basin (Fourth Journey in Central Asia,** St. Petersburg, 1888, 366 pp.

Rachkovskaya, Ye. I., "Superarid deserts of the Trans-Altai Gobi", in **Problems of Ecology, Geobotany and Floristics,** Leningrad, 1977.

Rachkovskaya, Ye. I., and Volkova, Ye, A., "Plants of the Trans-Altai Gobi", in **Flora and Fauna of Mongolia,** Moscow, 1977, pp. 46—74.

Rachkovskaya, Ye. I., Yevstifeyev, Yu, G., Fedorova, I. T., and Gunin, P. D., "Ecosystems of the Great Gobi Reserve and the profile of a scientific station" in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi,** Pushchino, 1983, pp. 73—84.

Rachkovskaya, Ye. I., and Sanzhid, Zh., "Flora and vegetation: life forms of plants", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi, Pushchino,** 1983, pp. 28—30.

Rachkovskaya, Ye. I., and Fedorova, I. T. "Flora and vegetation: plant communities", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi,** Pushchino, 1983, pp. 30—33.

Rashek, V. A., "The wild ass as a life form of the deserts and semi-deserts", **Trudy VSKhIZO,** 1973, No. 63, pp., 45—51.

Rashek, V. A., "Seasonal characteristics of the diet of wild asses on Barsakhelmes Island", **Byull. Mosk. Ob-va ispytateley prirody. Biol.,** 1977, v. 82, No. 2, pp. 5—18.

Rashek, V. A., "Reproduction and behavior of wild asses during rut on Barsakhelmes Island", **Byull. Mosk. ob-va ispytateley prirody. Biol.,** 1973, v. 54, No. 5, pp. 9—18.

Roborovsky, V. I., **Proceedings of the Imperial Russian Geographic Society,** St. Petersburg, 1900—1901.

Roborovsky, V. I., "Journey to Eastern Tien-Shan and Nan-Shan", **Tr. eksped, Russk. geogr. o-va po Tsentr. Azii v 1893—1895,** Moscow, 1949, 492 pp.

Rogovin, K. A., "The Gobi bear in the Mongolian People's Republic", **Okhota i okhotn. khozyaystvo,** 1980, No. 9, pp. 42—43.

Rogovin, K. A., and Surov, A. V., "Fauna: rodent communities of the southeastern part of the Trans-Altai Gobi", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi,** Pushchino, 1983, pp. 62—65.

Ryabtsev, I. A., and Bold, A., "Fauna: birds", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi,** Pushchino, 1983, pp. 56—57.

Sanzhid, Zh., and Fedorova, I. T., "Flora and vegetation: the dynamics of the species composition and the characteristics of phenological development in the plants of desert communities", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi**, Pushchino, 1983, pp. 33—37.

Simukov, A. D., "Through the deserts of the Western Gobi", **Sovremennaya Mongoliya**, 1937, No. 6; 1938, No. 1.

Simukov, A. D., "Travel notes on Khangai and the Gobi in the winter of 1937" **Sovremennaya Mongoliya**, 1938, No. 2.

Sinitsyn, V. M., **The Trans-Altai Gobi**, Moscow — Leningrad, 1956.

Sinitsyn, V. M., **Central Asia**, Moscow, 1959, 455 pp.

Sludsky, A. A., "Winter famines in the European steppes and deserts", **Trudy in-ta zoologii AN Kaz. SSR**, 1963, v. 20, pp. 5—88.

Sludsky, A. A., "Reproduction in the Persian gazelle", **Trudy in-ta zoologii AN Kaz. SSR**, 1956, v. 6.

Sokolov, V. Ye., Dulamtseren, S., Khotolkhu, N., and Orlov, V. N., "Rare ungulates of the Great Gobi Reserve (Mongolian People's Republic): current state and prospects", in **Geography and Dynamics of the Flora and Fauna of the Mongolian People's Republic**, Moscow, 1978, pp. 7—11.

Sokolov, V. Ye., and Orlov, V. N., **Key to the Mammals of the Mongolian People's Republic**, Moscow, 1980, 349 pp.

Sokolov, V. Ye., Zhirnov, L. V., Orlov, V. N., Lobachev, V. S., Bugayev, K. Ye., and Timur, Ch., "Current state of the wild camel population in Mongolia" **Dokl. AN SSSR**, 1983, v. 271, No. 4, pp. 1017—1021.

Solomatin, A. O., **The Wild Ass**, Moscow, 1973, 144 pp.

Sopin, L. V., "Conservation of the Asiatic wild sheep in Southern Siberia", in **Ungulates of the USSR**, Moscow, 1975, pp. 280—281.

Sopin, L. V. "The intraspecific structure of the Asiatic wild sheep Ovis ammon (Artiodactyla, Bovidae)", **Zool. zh.**, 1982, v. 61, No. 12, pp. 1882—1892.

Sudilovskaya, A. M., **The Birds of Kashgaria Based Principally on the Collections of M. N. Divnogorsky**, Moscow — Leningrad, 1936, 117 pp.

Terentyev, P. V., and Chernov. S. A. **Key to Reptiles and Amphibians**, Moscow, 1949, 340 pp.

Timofeyev, D. A., "Ecological conditions: relief", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi**, Pushchino, 1983, pp. 8—10.

Timofeyev, D. A., "The hammadas of southern Mongolia", in **Problems of Climatic Geomorphology**, Vladivostok, 1978.

Timofeyev, D. A., "The geomorphological outline of the meridional profile Shine — Dzhinst — Ekhiyn-Gol — Tsagan-Bogdo", **Zhurn. problemy osvoyeniya pustyn**, Ashkhabad, 1980, No. 2.

Tsalkin, V. I., **Wild Sheep of Europe and Asia**, Moscow, 1951, 343 pp.

Tsatsenkin, I. A., and Yunatov. A. A., "Natural forage resources of the Mongolian People's Republic: the Eastern Gobi", in **Transactions of the Commission on Mongolia of the USSR Academy of Sciences**, Moscow, 1951, No. 40.

Tsevegmid, D., "The rarest animals of Mongolia and their current state", in **Proceedings of the Ninth International Congress of Game Biologists**, Moscow, 1970, pp. 872—874.

Vereshchagin, N. K., **Mammals of the Caucasus**, Moscow, 1959, 703 pp.

Volkova, Ye. A., and Rachkovskaya, Ye. I., "Map of the flora of the Dzungarian Gobi", in **Geobotanical Mapping**, Leningrad. 1980.

Vtorov. P. P., and Vtorova, V. N., **Representative Ecosystems (Problems of Selection and Conservation)**, Moscow, 1983, 203 pp.

Yevstifeyev, Yu, G., "Superarid soils of the Gobi", **Problemy osvoyeniya pustyn**, Ashkhabad, 1980, No. 2.

Yevstifeyev, Yu, G., and Rachkovskaya, Ye. I., "The problem of the interrelationship between the soil and the plant cover in Southern Mongolia", in **Structure and Dynamics of the Principal Ecosystems of the Mongolian People's Republic**, Leningrad, 1976.

Yevstifeyev, Yu. G., Pankova, Ye. I., and Gunin, P. D., "Ecological conditions: surface and ground water", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi**, Pushchino, 1983, pp. 13—17.

Yevstifeyev, Yu. G., Pankova, Ye. I., and Yakunin, G. N., "Ecological conditions: the soil cover of the Trans-Altai Gobi", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi**, Pushchino, 1983, pp. 17—21.

Yunatov, A. A. "Basic characteristics of the plant cover of the Mongolian People's Republic", **Trudy Mongolskoy komissii**, Moscow — Leningrad, 1950, No. 39, 223 pp.

Yunatov, A. A. "Fodder plants of the pastures and hay meadows of the Mongolian People's Republic", **Trudy Mongolskoy komissii AN SSSR**, 1954, No. 56.

Yunatov, A. A., **Desert Steppes of the Northern Gobi in the Mongolian People's Republic**, Leningrad, 1974, 130 pp.

Zhirnov, L. V. "Ecological principles of the conservation of ungulates of the Eurasian desert zones", **Trudy MVA**, 1978, v. 97, pp. 36—55.

Zhirnov, L. V., **Return to Life (the Ecology, Conservation and Exploitation of Saigas)**, Moscow, 1982, 223 pp.

Zhirnov, L. V., Bolshova, L. I., and Bychkov, V. A. **Foreign Experience in the Conservation of Mammals (Disappearing Mammals of the World and their Protection)**, Moscow, 1977, 68 pp.

Zhirnov, L. V., Vinokurov, A. A., and Bychkov, V. A., **Rare and Disappearing Animals of the USSR: Mammals and Birds**, Moscow, 1978, 303 pp.

Zhirnov, L. V., and Bugayev, K. Ye., "Fauna: large mammals", in **General Characteristics of the Desert Ecosystems of the Trans-Altai Gobi**, Pushchino, 1983, pp. 57—62.

APPENDICES

APPENDIX 1

LIST OF THE AMPHIBIANS, REPTILES AND BIRDS OF THE GREAT GOBI RESERVE

A=Sector A (Trans-Altai Gobi)
B=Sector B (Dzungarian Gobi)

AMPHIBIANS (AMPHIBIA)

Green toad (Bufo viridis)
B — Ushin-Us. Rare

REPTILES (REPTILIA)

Przhevalsky's skink (Teratoscincus przewalskii)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak, etc. Common
Small gecko (Alsophylax pipiens)
A — Common
B — Rare
Gobi gecko (Gymnodactylus elongatus)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak, etc. Rare
Common agama (Agama stoliczkana)
A — Rare
B — Rare
Horned lizard (Phrynocephalus versicolor)
A — Common
B — Common
Eyed lizard (Eremias multiocellata)
A — Common
B — Common
Gobi lizard (Eremias przewalskii)
A — Dzakhoi. Rare
Mongolian lizard (Eremias argus)
A — Atas-Ula. Rare
Sand lizard (Eremias arguta)
B — Khonin-Us, Zagiynt
Multi-colored lizard (Eremias vermiculata)
A — Ekhiyn Gol, Khutsyn-Shand, etc. Common
Sand boa (Eryx tataricus)
A — Ekhiyn-Gol, Nogon-Tsav Toroin-Nuru, etc. Rare
Rat snake (Coluber spinalis)
A — Dzakhoi, Dzarman. Rare
Desert snake (Psammophis lineolatum)
A — Ekhiyn-Gol, Tsagan-Bogdo, Shara-Khulsny-Bulak. Common
Chicken snake (Elaphe dione)
A — Tsagan-Bogdo. Rare
Pallas' copperhead (Agkistrodon halys)
A — Rare
B — Rare

BIRDS (AVES)

Great crested grebe (Podiceps cristatus)
A — Ekhiyn-Gol oasis, during migration. Rare
Grey heron (Ardea cinerea)
A — Ekhiyn-Gol, Dzarman and Dzakhoi oases, during migration. Rare
B — Khonin-Us and Takhiyn-Us oases, during migration. Rare
Whooper swan (Cygnus cygnus)
A — Dzarman and Dzakhoi oases, during migration. Rare
Ruddy shelduck (Tadorna ferruginea)
A — Dzarman and Dzakhoi oases, nests. Ekhiyn-Gol oasis, on migration. Rare
B — Khonin-Us and Takhiyn-Us oases, during migration. Rare
Mallard (Anas platyrchynchos)
A — Dzakhoi, Dzarman and Ekhiyn-Gol oases, during migration. Rare
B — Khonin-Us and Elgen-Us oases, during migration. Nests at the mouth of Bodonchiyn-Gol. Rare
Garganey teal (Anas querquedula)
A — Dzarman and Dzakhoi oases, during migration. Rare
Gadwall (Anas strepera)
A — Ekhiyn-Gol, Dzakhoi and Dzarman oases, during migration. Rare
European wigeon (Anas penelope)
A — Ekhiyn-Gol and Dzarman oases, during migration. Rare
Northern pintail (Anas acuta)
A — Dzarman oasis, during migration. Rare
Northern shoveler (Anas clypeata)
A — Dzakhoi, Dzarman and Ekhiyn-Gol oases, during migration. Rare
Common teal (Anas crecca)
B — Khonin-Us oasis, the lower reaches of the Bidzh-Gol, during migration. Rare
Common pochard (Aythya ferina)
A — Dzarman oasis, during migration. Rare
Black kite (Milvus korschun)
A — Nests at Ekhiyn-Gol Shara-Khulsny-Bulak and Dzarman oases, Edrengiyn-Nuru ridge. Tsagan-Bogdo mountain. Rare, sometimes common
B — Buffer zone. Lower reaches of the Bidzh-Gol, Otgon-Us oasis. Nests. Rare
European sparrow hawk (Accipter nisus)
A — Edrengiyn-Nuru ridge, Tsagan-Bogdo Mountain, Otgon-Us oasis, on migration. Rare
B — Khonin-Us oasis, on migration. Rare
Upland buzzard (Buteo hemilasius)
A — Ekhiyn-Gol, Dzakhoi, Dzarman and Shara-Khulsny-Bulak oases. Nests. Rare
B — Khonin-Us oasis, Unegtey, vicinity of the Bidzh-Gol. Nests. Rare
Golden eagle (Aquila chrysaëtos)
A — Tsagan-Bogdo, Edrengiyn-Nuru ridge, Shara-Khulsny-Bulak oasis. Nests. Rare
B — Takhiyn-Shara-Nuru ridge, Bidzh-Gol. Nests. Rare
Bearded vulture (Gypaëtus barbatus)
A — Edrengiyn-Nuru ridge, Tsagan-Bogdo. Nests. Common (?)
B — Takhiyn-Shara-Nuru ridge. Nests. Common (?)
Cinereous vulture (Aegypius monachus)
A — Edrengiyn-Nuru ridge, Tsagan-Bogdo. Nests. Rare
Marsh harrier (Circus aeruginosus)
A — Dzakhoi and Dzarman oases. Nests. Rare
B — Shar-Khuv oasis. On migration. Rare

Saker falcon (Falco cherrug)
B — Bidzh-Gol, Bortsonzhiyn-Gov. Nests. Rare
Peregrine falcon (Falco peregrinus)
A — Tsagan-Bogdo. On migration. Rare
European hobby (Falco subbuteo)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak, Dzarman and Dzakhoi oases, Tsagan-Bogdo. Nests. Common in oases
Merlin (Falco columbarius)
A — Toroin-Bulak oasis, on migration. Rare
B — Bidzhiyn-Gol, on migration. Rare
Common kestrel (Falco tinnunculus)
A — Edrengiyn-Nuru, Atas Chingiz and Tsagan-Bogdo ridges, Ekhiyn-Gol, Shara-Khulsyn-Bulak and other oases. Nests. Common
B — Takhiyn-Shara-Nuru ridge, Khairkhan-Bulak, Elgen-Us, Khonin-Us, Bidzh-Gol. Nests. Common
Lesser kester (Falco naumanni)
A — Tsagan-Bogdo. Nests. Rare
Altai snowcock (Tetraogallus altaicus)
A — Tsagan-Bogdo. Nests. Rare
Rock partridge (Alectoris graeca)
A — Tsagan-Bogdo, Khatan-Khairkhan, Edrengiyn-Nuru, vicinity of Ekhiyn-Gol oasis. Nests. Common
B — Takhiyn-Shara-Nuru ridge. Nests. Common
Demoiselle crane (Anthropoides virgo)
A — Dzarman oasis, on migration. Rare
B — Bodonchi, Bidzhiyn-Gol, on migration. Rare
Grane (Grus grus)
B — Mouth of the Bidzhiyn-Gol River, on migration. Rare
Common coot (Fulica atra)
A — Dzakhoi and Dzarman oases, on migration. Rare
Houbara bustard (Chlamydotis undulata)
A — Dzakhoi and Dzarman oases, Tsagan-Shal, Buryn-Khar. Nests. Rare
B — Khonin-Us oasis. Nests. Rare
Little ringed plover (Charadrius dubius)
A — Ekhiyn-Gol oasis, on migration. Rare
Greater sandplover (Charadrius leschenaultii)
A — Ekhiyn-Gol oasis, on migration. Rare
American golden plover (Pluvialis dominica)
A — Ekhiyn-Gol oasis, during migration. Rare
Northern lapwing (Vanellus vanellus)
A — Ekhiyn-Gol, Dzakhoi, Dzarman and other oases, during migration. Rare
B — Shar-Khuv oasis, during migration. Rare
Common redshank (Tringa totanus)
A — Ekhiyn-Gol, Dzarman and Dzakhoi oases, Tsagan-Bogdo Mountain, Tsagan-Bulak. Nests. Rare
B — Shar-Khuv oasis, during migration. Rare
Green sandpiper (Tringa ochropus)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak, Dzarman and other oases. Nests. Common (?)
B — Bodonch, during migration. Rare
Polynesian tattler (Heteroscelus brevipes)
A — Tsagan-Bogdo, during migration. Rare
Long-toed stint (Calidris subminuta)
A — Dzarman, Dzakhoi and Tsagan-Bulak oases during migration. Rare
Temminck's stint (Calidris temminckii)
A — Dzarman oasis, during migration. Rare
Curlew sandpiper (Calidris ferruginea)
A — Tsagan-Bogdo and Tsagan-Bulak, during migration. Rare
Broad-billed sandpiper (Limicola falcinellus)
A — Dzun-Mod oasis, during migration. Rare
Common sandpiper (Actitus hypoleucos)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak and other oases, on migration. Possibly nests also. Rare.
Northern phalarope (Phalaropus lobatus)
A — Dzarman oasis, on migration. Rare
Snipe (Gallinago gallinago)
A — Dzakhoi and Dzarman oases, on migration. Rare
Common snipe (Gallinago stenura)
A — Ekhiyn-Gol and Dzakhoi oases, Tsagan-Bogdo Mountain, Tsagan-Bulak spring, on migration. Rare
Black-tailed godwit (Limosa limosa)
A — Dzakhoi oasis, on migration. Rare
Little curlew (Numenius minutus)
A — Dzun-Mod oasis, on migration. Rare
Black-headed gull (Larus ridibundus)
A — Ekhiyn-Gol oasis on migration. Rare
White-winged black tern (Chlidonias leucoptera)
A — Ekhiyn-Gol oasis, on migration. Rare
Pallas' sandgrouse (Syrrhaptes paradoxus)
A — Abundant in some years. Nests in the vicinity of Dzarman oasis and other places
B — Nests in the vicinity of Bodonchiyn-Gol, Elkhon and Elgen-Us. Common in some years.
Eastern rock pigeon (Columba ruprestris)
A — Edrengiyn-Nuru ridge, Tsagan-Bogdo. Nests. Common
Rufous turtle dove (Streptopelia orientalis)
A — Dzakhoi oasis, on migration. Rare
B — Elgen-Us, Bodonchiyn. Nests. Rare
Northern eagle owl (Bubo bubo)
A — Atas-Ula and Otgon-Us. Nests. Rare
Little owl (Athene noctua)
A — Tsagan-Bogdo, Edrengiyn-Nuru ridge. Nests. Rare
B — Takhiyn-Shara-Nuru ridge. Nests. Rare
Common swift (Apus apus)
A — Ekhiyn-Gol, Dzarman and Dzakhoi oases, on migration. Rare
B — Bodonchiyn-Gol vicinity, on migration. Rare
European nightjar (Caprimulgus europaeus)
B — Nests in the vicinity of Bodonchiyn-Gol. Rare
Common hoopoe (Upupa epops)
A — Tsagan-Bogdo. Nests. Rare
Crested lark (Galerida cristata)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak, Dzarman and Dzakhoi oases. Nests. Common
Common skylark (Alauda orvensis)
A — Dzakhoi and Dzarman oases. Nests. Common
Short-toed lark (Calandrella cinerea)
A — Tsagan-Bogdo. Nests. Rare
B — Bodonchiyn-Gol. Nests. Common
Lesser short-toed lark (Calandrella cheleensis)
A — Dzakhoi and Dzarman oases. Nests. Rare
Horned lark (Eremophila alpestris)
A — Shara-Khulsny-Bulak, Ekhiyn-Gol and Dzakhoi oases. Nests. Common
B — Kharuul-Us, Elgen-Us and Khonin-Us oases, Takhiyn-Shar Mountain. Nests. Common.
Sand martin (Riparia riparia)
A — Ekhiyn-Gol, Dzarman and Dzakhoi oases, on migration. Rare
Crag martin (Ptyonoprogne rupestris)
A — Tsagan-Bogdo, Atas-Ula and Chingiz-Ula, Edrengiyn-Nuru ridge. Nests. Common
Richard's pipit (Anthus richardi)
A — Tsagan-Bogdo, Dzakhoi and Dzarman oases, on migration. Rare
B — Bortsonzhiyn-Gobi, on migration. Rare
Tawny pipit (Anthus campestris)
A — Ekhiyn-Gol, Dzarman and Dzakhoi oases. Nests. Common
B — Bortsonzhiyn-Gobi, on migration. Rare
Petchora pipit (Anthus gustavi)
B — Khairkhan-Bulak, on migration. Rare
Yellow wagtail (Motacilla flava)
A — Ekhiyn-Gol, Dzarman and Dzakhoi oases, on migration. Rare
B — Barunsh-Khurain and Khonin-Us, on migration. Rare
Yellow-hooded wagtail (Motacilla citriola)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak, Dzarman and Dzakhoi oases, Tsagan-Bogdo. Nests. Common (?)
B — Bodonchiyn-Gol, on migration. Rare
Gray wagtail (Motacilla cinerea)
A — Tsagan-Bogdo, Tsagan-Bulak, on migration. Rare
B — Bodonchiyn-Gol, on migration. Rare
White wagtail (Motacilla alba)
A — Shara-Khulsny-Bulak and Dzakhoi oases, on migration. Rare
B — Takhiyn-Shara-Nuru ridge, Yarchiyntyn-Us, Elgen-Us, on migration. Rare
Brown shrike (Lanius cristatus)
A — Shara-Khulsny-Bulak, Ekhiyn-Gol and Toroin-Bulak oases. Nests. Common
Red-backed shrike (Lanius collorio)
A — Tsagan-Bogdo, on migration. Rare
B — Flood-plain of the Bodonchiyn-Gol, on migration. Rare
Northern shrike (Lanius exubitor)
A — Ekhiyn-Gol, Shara-Khulsny-Bulak and

other oases. Nests. Common
B — Shara-Khuv and Khonin-Us oases. Nests. Common
Desert wheatear (Oenanthe deserti)
A — Widespread in mountains and oases (Ekhiyn-Gol, Dzarman etc.). Nests. Common
Isabelline wheatear (Oenanthe isabellina)
B — Widespread in mountains and plains. Nests. Common
Great reed-warbler (Acrocephalus arundinaceus)
A — Ekhiyn-Gol oasis, on migration. Rare
Great whitethroat (Sylvia communis)
A — Ekhiyn-Gol, Dzakhoi, Dzarman and Shara-Khulsny-Bulak oases. Nests. Common
B — Buffer zone (Borukhureyn-Gov), on migration. Rare
Desert warbler (Sylvia nana)
A — Tsagan-Bogdo, Shara-Khulsny-Bulak. Nests. Common
B — Elgen-Us, Khonin-Us. Nests. Common
Barred warbler (Sylvia nisoria)
B — Flood-plain of the Bodachiyn-Gol, on migration. Rare
Lesser whitethroat (Sylvia curruca)
A — Shara-Khulsny-Bulak, Dzakhoi, Dzarman and Ekhiyn-Gol oases, Tsagan-Bogdo. Nests. Common
Stonechat (Saxicola torquata)
A — Ekhiyn-Gol oasis, on migration. Rare
Northern wheatear (Oenanthe oenanthe)
A — Ekhiyn-Gol, Dzakhoi and Dzarman oases. Nests. Common
B — Takhiyn-Shara-Nuru ridge, Ergantyn-Us, Khairkhan-Bulak, on migration. Rare
Pied wheatear (Oenanthe pleschanka)
A — Dzakhoi and Dzarman oases, Tsagan-Bogdo Mountains. Nests. Rare
B — Khonin-Us, on migration. Rare
Saxaul sparrow (Passer ammodendri)
A — Ekhiyn-Gol, Dzakhoi, Dzarman, Shara-Khulsny-Bulak and other oases. Nests. Common
Eurasian tree sparrow (Passer montanus)
A — Ekhiyn-Gol, Dzakhoi and Dzarman oases. Nests. Common
B — Elgen-Us. Nests. Common
Rock sparrow (Petronia petronia)
A — Tsagan-Bogdo. Nests. Rare
B — Takhiyn-Shara-Nuru ridge. Nests. Rare
Eurasian snow finch (Montifringilla nivalis)
A — Tsagan-Bogdo and other mountain massifs. Nests. Common
Mongolian finch (Rhodopechys mongolica)
A — Tsagan-Bogdo, Atas-Ula and other mountains. Nests. Common
B — Takhiyn-Shara-Nuru ridge, Khairkhan-Bulak, Khonin-Us. Nests. Common
Common rosefinch (Carpodacus erythrinus)
A — Ekhiyn-Gol oasis, on migration. Common
Hawfinch (Coccothrautes coccothrautes)
A — Shara-Khulsny-Bulak oasis, on migration. Rare
Black redstart (Phoenicurus ochruros)
A — Tsagan-Bogdo, Edrengiyn-Nuru and other mountains. Nests. Common
B — Takhiyn-Shara-Nuru ridge. Nests. Common
Eversmann's redstart (Phoenicurus erythronotus)
B — Takhiyn-Shara-Nuru ridge, on migration. Rare
Rock-thrush (Monticola saxatilis)
A — Tsagan-Bogdo, on migration. Rare
Black-throated thrush (Turdus ruficollis)
B — Elgen-Us, on migration. Rare
Bearded tit (Panurus biarmicus)
B — Khonin-Us. Nests (?) Rare
Penduline tit (Remiz pendulinus)
B — Khonin-Us. Nests(?) Rare
Pallas' warbler (Locustella certhiola)
A — Ekhiyn-Gol oasis, on migration. Rare
Pine bunting (Emberiza leucocephala)
B — Mouth of the Bidzhiyn-Gol River, Takhiyn-Shara-Nuru ridge, on migration. Rare
Common reed bunting (Emberiza schoeniclus)
B — Mouth of the Bidzhiyn-Gol River, Khonin-Us, on migration. Rare
White-cheeked starling (Sturnus cineraceus)
A — Ekhiyn-Gol oasis, on migration. Rare
Common starling (Sturnus vulgaris)
A — Dzakhoi oasis, on migration. Rare
Eurasian golden oriole (Oriolus oriolus)
B — Flood-plain of the Bodonchiyn-Gol, on migration. Rare
Henderson's ground jay (Podoces hendersoni)
A, B — Widespread and common. Nests
Red-billed chough (Pyrrhocorax pyrrhocorax)
A — Tsagan-Bogdo, Shara-Khulsny-Nuru. Nests. Common
Common raven (Corvus corax)
A — Dzakhoi, Dzarman, Shara-Khulsny-Bulak oases, Edrengiyn-Nuru, Tsagan-Bogdo and other mountains. Nests. Common in the northern oases.
B — Bodonchiyn-Gol and Bidzh-Gol flood-plains, Khurul-Us and Yargaityn-Us oases. Nests. Common
Daurian jackdaw (Corvus dauricus)
A — Tsagan-Bogdo, on migration. Rare

Note: In compiling this list of the amphibians, reptiles and birds of the Great Gobi Reserve we used the unpublished data on the fauna of the Mongolian People's Republic prepared for the Master Plan of the Great Gobi Reserve by Kh. Munkhbayar, herpetologist, and A. Bold, ornithologist. A. A. Vinokurov also provided valuable notes of the bird list. The authors are deeply grateful to these persons.

APPENDIX 2

STATUTE OF THE GOBI RESERVE

Article 1. Terminology

1. The Great Gobi Reserve (or "The Gobi National Park" in English) constitutes a single administrative and research establishment comprising two separate territorial units differing in terms of classification of the protected areas.

They are: a) The Trans-Altai Gobi, referred to below as Sector A. It meets the internationally adopted criteria of a national park and is officially named "The Trans-Altai Gobi National Park";

b) The Dzungarian Gobi, referred to below as Sector B. Its territory cannot be totally exempt from economic use and is thus officially named "The Dzungarian-Gobi Wildlife Sanctuary".

Article 2. Principal Objectives of the Great Gobi Reserve

2. Sector A

The following are the principal objectives of Sector A:

a) Permanent maintenance in a natural state of the largely undisturbed biogeocenoses of the Central Asian desert as invaluable representative ecosystems;

b) Total protection of natural communities typical of the Central Asian Region with the aim of preserving a genofund of plants and animals of world importance and assuring conditions for their normal and natural regeneration;

c) Promotion of research on virgin and transformed biogeocenoses and development of scientific and practical recommendations on environmental conservation;

d) Formulation of possible uses of unique natural landscapes for recreational, esthetic and educational purposes and their preservation for future generations.

3. Sector B

The objectives of Sector B (the Dzungarian Gobi), in addition to those set out in paragraph 2(a), (b), (c) and (d), will include study of the intra- and interpopulational relationships of the main animal species.

4. Theoretical study and scientific substantiation of the possible combined use of pastures by both domestic and wild ungulates in the areas of Takhiyn-Shara-Nuru, Ikh-Khavtag and Khonin-Usyn-Gobi ridges.

Article 3. Boundaries of the Great Gobi Reserve

5. The boundaries of Sector A are defined as follows: from the N 161 frontier post northeast through elevations 955, 8—971, 0—1054, 8—1105, 4-Urgust-Bulag-1342, 10—1886, 0-Shivat-Ulan-ul. 2162, 8—1824, 0—1735, 0-Tanelt-Undur-ul. 1994, 5—1819, 0—1807, 0—1493, 0-Talyn-Shovkh-ul. 1500, 6—Burgiyn-Khudag, Buriyn-Khar-ul., Khavtsgait-ul. 2011, 5—yumt-ul. 2076, 0-Khukh-Tolgoin-Khudag 1808, 0—1843, 0-Ulan-Khyar 1844, 0—1943, 0—1767, 0—1641, 0—1807, 0—1635, 0—1638, 0—1628, 0—1846, 0-Gurvan-Khudag 1661, 0—1529, 0—1549, 2—1680, 3—1563, 0—1609, 0—1545, 0—1387, 1—1310, 0-Tarog-Khudag 1162, 6—957, 2—878, 7—1021, 0—1138, 0—1151, 1—999, 0 — Khutsyn-Mandyn-Khyar 1193, 4—911, 0—1101, 0—1204, 6—1141; 1—3 km east of N 1 frontier post — Ukher-Ulan-ul. 1376, 0—Talyn-Ovo 1166, 0—1240, 3 — to N 204 frontier post and then to the nortwest to N 161 frontier post.

The boundaries of Sector B are defined as follows: along the national frontier to height 1628, then to height 4—1688, 9—Baga-Khavtag-Chon-Chig 1379, 0—1180, 0—Eren-Tolgoi 1146, 1—Khalain-Khoren-Tolgoi 1147, 8—Khalzan-ul. 2105, 7—east to Chantug-Khudag-Khundlen-ul. 1978, 0-Dut-ul., Gashun-Bulag, Gun-Tamga, Tavan-Ovosny-Bulag, southwest along the national frontier 2357.0 to landmark 1628.4.

Artiсte 4. The Buffer Zone

6. Taking into account that the reserve is inhabited by animals that engage in regular migrations and move beyond its boundaries, the following buffer zones are established:

Sector A: northeast from Bulgantyn-Bzuun-Sair, through Ayurshand spring and Khol-Khudag well to San-Zhityn-Khyar 1571, then east via Shirin-Khyar-Ula 1368, Argalyn-Balag spring 1558, Khongor-Ula, Somon-Khairkhan-Ula ridge, then southeast via Tsenkeryn-Koloin-Khondei and height 1496, Nozhin Gobi, Tsub-Kur-Khara-Nuru ridge, height 1209, then south to Shilin-Ula.

Sector B: northeast from Elkhon to Bavsan-Khurai, Bor-Tsonzh, Khyassa-Bayan-Ula 1607, east via Serteng-Ula ridge 1867, Uvchuugin-Serteng-Ula 2065, thence south via 3738 Ulag-Khairkhan-Ula, Ugalzyn-Ula 2939, Uvchin-Khuru ridge 2675, Uvchin-Nuru ridge 2675, Nogon-Tolgoi 1944 to Tsakhirin-Toroi.

Article 5. Land Use Regulations

7. In accordance with Article 33 of the Land Use Act of the Mongolian People's Republic, all forms of economic use of the land are prohibited in Sector A of the Great Gobi Reserve.

8. The collection of plant samples and the taking of wild animals for purposes of scientific research is authorized only with the permission of the Council of Ministers in accordance with the purposes and under the direction of the administration of the reserve and on the basis of an application setting forth scientific controls, amounts and methods of collection which will not disrupt natural biogeocenoses.

9. Sector A comprises two zones:

a) A zone of absolute protection, access to which is granted only by special permission under conditions that will not harm natural communities;

b) A recreation and tourist zone, where controlled visits that avoid harm to natural communities are permitted.

10. In accordance with the Law on the Protection of the Frontiers of the Mongolian People's Republic, necessary measures may be conducted within a 25-km zone provided all possible limitations are placed on damage to natural communities.

11. In addition to two zones similar in purpose to those set out in Paragraph 9(a) and (b), Sector B will include an agricultural use zone. It will include:

a) a winter pasture area in the vicinity of Takhiyn-Shar, Nuru-Khukh and Un-Durgiyn-Nuru-Baga-Khavtag ridges, during the period from October 25 until May 1;

b) livestock may be driven by the following routes and for the following periods:

— from Uench somon in Kobdos aimak via Ereen-Tolgoi and Elkhon-Kholoi, October through May, 20 days;

— from Altai somon in Kobdos aimak via Takhiyn-Us and Naima-Bulag, October through April, 20 days;

— from Tankhil somon in Gobi-Altai aimak to Khuren-Del via Khonin-Us, October through April, 20 days;

— from Bugat Somon in Gobi-Altai aimak along the eastern boundary of Sector B and at a distance of at least 5 km from the reserve via Gashun-Bulag-Gun-Tamga and Tavan-Ovony-Bulag, October through April, 20 days.

12. The width of livestock drives across the territory of the Great Gobi Reserve in accordance with Paragraph 11 (b) may not exceed 10 km. It is stipulated that the number of livestock pastured in the above areas may not exceed a level that could endanger the state of the pastures.

Article 6. Protective Regime

It is specified that:

13. Admittance to the territory of the reserve is permitted only in areas specially designated for the purposes of tourism and recreation and under the control of the reserve administration.

14. Being present on or travelling through the absolute protection zone is allowed only in accordance with established procedures and with appropriate documentation.

15. In Sector B herdsmen and their families are allowed to stay at winter pastures within the areas defined by the land register or on the livestock-drive routes during the periods specified in Paragraph 11 (a) and (b).

16. Agricultural and other enterprises having livestock must enter into an agreement with the administration of the Great Gobi Reserve to drive livestock through its territory to reach wintering grounds,

specifying the number of animals and the times when the drive will begin and end.

17. Any persons on business within the territory of the Great Gobi Reserve may move about within the reserve only with the permission of the administration and on designated routes.

18. The regulations in Paragraph 17 also apply to Article 4, Paragraph 6.

19. The ranger service of the Great Gobi Reserve will establish a system of interior roads for official use. The list of roads for general and special use will include the following routes:

— In Sector A

1. Tsagaan-Bulag, Khatan-Suudal, Zambilgekh, Talin-Meltas, Khonkhor-Sukhaityn-Khudag, Nariyn-Tooroin-Khudag, Orgost, Tsagaan-Bulag, Tooroin-Shand, Toirom-Bilgakh-Bulag;

2. Tsagaan-Bulag, Tsagaan-Deroniy-Khudag, Ekhiyn-Gol;

3. Khayaryn-Gun, Nariyn-Khar, Sharzh-Khylsny-Khavtsal, Zam-Bilgekh.

— In Sector B

Tsagaan-Gol, Gashuun-Bulag, Gun-Tamga, Khairkhan-Bulag, Tsariyn-Us, Baigan-Khudag, Mergen-Khotol Argalshand, Zeegiyn-Khudag, Baga-Khavtga-in-Us.

20. The construction of any buildings, structures or construction sites within the territory of the Great Gobi Reserve is subject to the direct approval of the Council of Ministers of the Mongolian People's Republic.

21. Within the territory of the Great Gobi Reserve it is prohibited:

a) within Sector A, to engage in exploitation of mineral resources, livestock grazing, agriculture, mowing, gathering of saxaul or any other plant product, any other form of economic activity, and shooting and trapping of all species of animals;

b) It is prohibited for any civilian, with the exception of employees of the Great Gobi Reserve in the performance of their official duties and other persons with special permission to be present on the territory of the reserve (including pasture areas) and its buffer zone in possession of any type of firearm or any apparatus for trapping wild animals;

c) Roads for general and special use should traverse the reserve outside the watering points of wild animals, and staying the night near such watering points is prohibited;

d) Within the Great Gobi Reserve all persons without exception are prohibited to stop to rest or spend the night, to build fires, to let oil run out of a vehicle or to engage in any environmental pollution or any other activity that may impede normal functioning of natural ecosystems;

e) Throughout the reserve it is prohibited to construct any buildings or structures with the exception of special frontier guard installations in Sector B, camps for herdsmen and wells in pasture areas, and scientific base camps. However, none of the above structures may be built at the watering points of wild animals;

f) In order to preserve the integrity of natural biogeocenoses within the reserve, it is prohibited to introduce or import new animal and plant species not previously resident on the reserve.

Article 7. Rights and Responsibilities of the Ranger Service

22. The main task of the ranger service and other personnel of the Great Gobi Reserve is to discover all forms of violation of the Statute and the Law on the Protection of Natural Resources of the Mongolian People's Republic. When on the territory of the reserve members of the ranger service enjoy the rights of state inspectors in accordance with the regulations in force.

23. In special cases, the rights of militiamen will be extended to rangers and other members of the reserve staff while on the territory of the reserve.

24. The rights and duties of the staff of the ranger service are as follows:

— To examine the documents of all persons found within the reserve and to inspect automobiles, motorcycles and other means of transportation, as well as personal belongings;

— In case persons without satisfactory documentation or persons attempting to flee are found within the reserve, to deliver them to the appropriate authorities or inform such authorities with a view to detaining such persons;

— To apply appropriate measures to those violating current legislation on hunting, forestry, land and water use;

— To shoot stray or half-wild domestic camels or hybrid wild-domestic camels within the confines of Sector A to prevent dissemination of diseases and maintain the genetic purity of the wild camel population.

Article 8. Management and Security

25. The main headquarters of the Great Gobi Reserve will be established in the Gobi-Altai aimak.

26. The administration of the reserve is divided into a management division, a scientific division and the ranger service. The administration of the reserve is responsible for the executive and research activities of the reserve and reports directly to the Ministry of Forestry and Forest-Products Industry of the Mongolian People's Republic.

27. The scientific work of the reserve is carried out in cooperation with various research and higher educational institutions.

28. Research programs and methods are developed with the prior approval of higher organizations and establishments and included as appropriate in the annual and five-year plans of the national economy.

29. Aimak and somon executive committees, frontier guard detachments and government and public bodies associated with the preservation and use of natural resources will support the conservation activities of the reserve.

30. Serious damage to the natural resources of the reserve is regarded as plundering of state property and subjects the offender to criminal prosecution.

31. The administrative, research and protective services of the reserve are financed from the resources of the National Society for the Conservation of Nature and the Ministry of Forestry and Forest-Products Industry of the Mongolian People's Republic.

Article 9. Amendments and Authority

32. The original of the present Statute is in the Mongolian language.

The Russian and English translations attested by the Council of Ministers of the Mongolian People's Republic are equally authentic.

33. This statute can be amended only by the Great People's Khoural of the Mongolian People's Republic.

Article 10. Legal Aspects

34. The present Statute is based on the following laws and decrees:

1) The Constitution of the Mongolian People's Republic, 1960.

2) Land Act of the Mongolian People's Republic, 1971.

3) Game Law of the Mongolian People's Republic, 1972.

4) Law on the Defense of the State Frontier of the Mongolian People's Republic, 1973.

5) Forestry Law of the Mongolian People's Republic, 1974.

6) Water Management Law of the Mongolian People's Republic, 1974.

7) Decree of the Great People's Khoural, No. 84, April 14, 1975, "On the Establishment of the Great Gobi Reserve".

8) Resolution of the Council of Ministers of the Mongolian People's Republic on "Regulation of the Nature Reserves of the Mongolian Peoples's Republic, No. 146, March 21, 1975.

9) Resolution of the Tenth General Assembly of the International Union for the Conservation of Nature and Natural Resources on the definition of the "national park" concept, adopted in New Delhi, India, November 1969 (confirmed by the Second International Conference on National Parks, Yellowstone, USA, 1972).

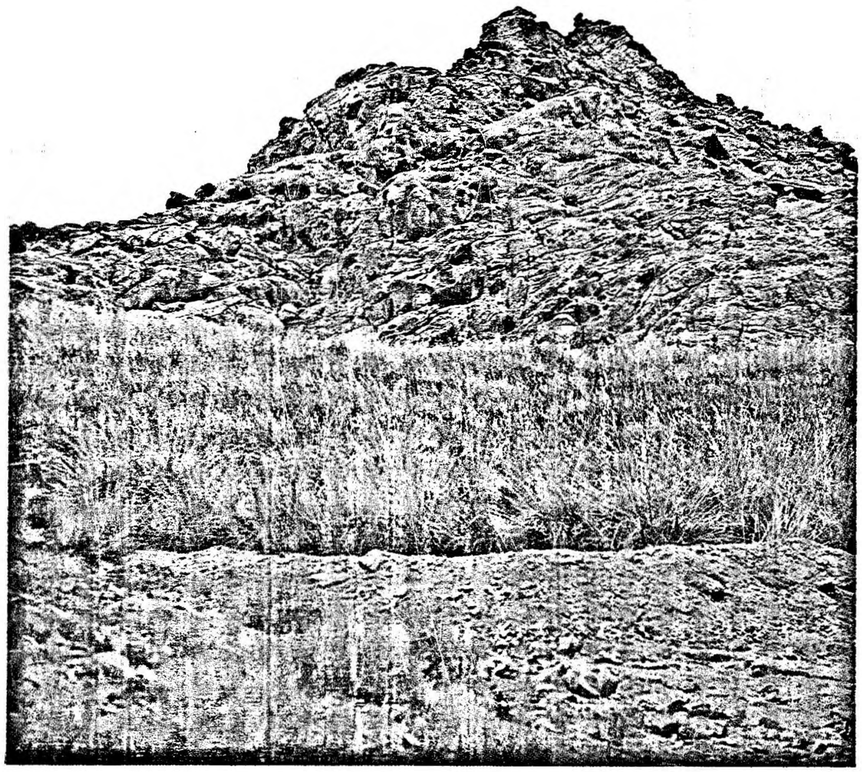
10) Resolution of the joint mission of the FAO, IUCN, UNEP and Mongolian experts, 1976.

City of Ulan-Bator

Ratified by the Great People's Khoural
of the Mongolian People's Republic
December 31, 1976

CONTENTS

Внешторгиздат. Изд. 9942А
ВТИ. Зак. 385



The Gobi Desert, with its extremely severe climatic conditions, is of paramount scientific importance as a portion of the Central Asian deserts which still retains unique repesentatives of the world's fauna: the wild camel, the wild ass and the Gobi bear. Until recently it was also the last refuge of Przhevalsky's horse. The Gobi Desert constitutes the northernmost outpost of the great deserts of Central Asia. The Gobi possesses unique natural features and a variety of endemic and relict species of flora and fauna. In the second half of the twentieth century civilization began making inroads in these arid zones, creating an urgent need to protect the unique features of this desert environment and its characteristic plant and animal life. The Government of the Mongolian People's Republic, reflecting its understanding of the importance of preserving the Gobi Desert in its natural state, decided to set up the Great Gobi Reserve, which would have both national and international significance. In the years 1979—1982 UNEP carried out a project to help the Mongolian People's Republic establish the Great Gobi Reserve. This resulted in scientifically based recommendations for the protection of plants and animals along with the unique desert ecosystems which are characteristic natural features of Central Asia. This book, The Great Gobi National Park — a Refuge for Rare Animals of the Central Asian Deserts by L. V. Zhirnov and V. O. Ilyinsky, describes how the reserve was created and discusses the problems encountered in protecting the unique wildlife of the Gobi Desert. The authors participated personally in the implementation of this international enterprise, and their book comprises both the results of their own observations and those obtained by other participants in the Great Gobi Reserve project.

The book is intended for a wide circle of readers, particularly for conservationists, ecologists and zoologists who are interested in the problems of wildlife conservation and the management of natural reserves. The book is illustrated with color and black-and-white photographs, maps and drawings.