

REPORT ON THE SECOND INTERNATIONAL CONFERENCE ON MARMOTS - AUSSOIS (FRANCE) 2-6 OCTOBRE 1994

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The Second International Conference on Marmots was held in Aussois, in the Alps of Savoie, from 2nd to 6th October 1994, at the initiative of the Laboratory of Socioecology (EA 631, Claude Bernard University, Lyon).

According to several funding supports it was possible to benefit of very accurate work conditions at the Conference Center of Aussois CNRS House including French-English simultaneous translation of lectures and debates. The collaborative support allowed to invite 30 participants from Central and Eastern Europe and Middle Asia. Thus it is a real pleasure for the organizers to thank the sponsoring organisms: Conseil Général de la Savoie, Conseil Régional Rhône-Alpes, E.D.F. Energie-Alpes, INTAS (European Union), International Science Foundation, Ministère de l'Environnement, Ministère de la recherche (A.C.C.E.S.S.), Municipalité d'Aussois, Parc National de la Vanoise, Université Lyon 1, which contributed greatly to the success of this meeting.

During three days, the delegates discussed around three main topics : *Marmot and People*, *Marmot and Health*, *Marmot Biology*. Three synthesis conferences, 29 oral presentations and 45 posters were discussed. The general schedule of the Conference included a morning poster presentation, then a synthesis conference and during the after noon, oral lectures and discussions. A short abstract of the presented papers is given at the end of the report.

A round table was held on "*Marmots and the law in the world*" which highlighted the great difference of status and of concern of marmots in the World as this rodent is used by people either as game, raw material or recreative animal. The conclusion of the round table was to gather more information on the legal status of the marmots in the different countries according to the different uses and states of conservation, this wild mammal being considered as a typical natural resource which would be proper to manage in a sustainable way. The discussion

let appear that whether some marmot species seemed to be represented by healthy and numerous populations, several species were threatened or endangered, either in relation with a limited distribution area or with too hard extractive activities. The participants suggested to take contacts with IUCN in order to establish a specialist group on marmots. Another conclusion of the roundtable was the interest of networking the research and management activities undertaken by the participants of the different countries in order to optimize their field work methods and use of data. A recommendation on the setting of an International Research Network on Marmot was elaborated.

1. Marmot and People. The first topic was introduced by a synthesis lecture of the senior marmot researcher, Pr. Dimitri Bibikov (Russian Academy of Sciences, co-author V. Rummyantsev) on the "*Current and past relationship between people and marmots in the countries of the former Soviet Union*", followed by five oral and six poster communications, a new topic in a Conference dealing mainly with biological aspects. The papers dealt with management methods and the need to establish accurate methods for numbering marmot populations especially in mountain areas (Cortot *et al.*). Cultural aspects of the relation established between marmots and local peoples were considered as well in traditional hunting strategies (in countries where marmots are used as an extractive resource: Formozov *et al.*, Pole *et al.*) as in the subjective and affective perception of marmots by people (in countries where marmots are a recreative resource: Dousset; Fourcade). In spite of its interest no paper dealt directly with the economics aspects of marmot study, though it is one of the way of promoting a sustainable management of these animals.

2. Marmot and Health. The second topic was introduced by a synthesis lecture of Dr. B. Bassano (Parco Nazionale Gran Paradiso, Italy) dealing with "*Sanitary problems related to*

Marmot-other animals co-habitation in mountain areas". Three oral communications and six posters completed that session which focused on two points: effects of endoparasites on marmot survival at individual and at population level, and role of marmots in the great zoonoses as plague. The importance of monitoring marmot populations in plague sensitive areas (Asia and North America) and the need of observation to improve our knowledge of the role played by marmots in the mountain zoo and anthropocenoses were stressed.

3. Marmot Biology. The third topic on was introduced by a synthesis lecture of Pr. K. Armitage on "*Social dynamics, kinship and population dynamics of marmots*". The subjects presented by the other participants dealt on phylogeny (Zholnerovskaia) and adaptative strategies (Bibikov & Rumiantsev, Rymalov, Saboureau & Lacroix) in the different species. Population dynamics was considered on one of the most rare species, *Marmota vancouverensis* (Bryant). The behaviour of these social animals was considered (Armitage, Nesterova, Nikolskii, Perrin *et al.*) as well as time budget (Bonesi *et al.*), resource use (Bassano *et al.*, Armitage) and space related activities: (Preleuthner, Frigerio *et al.*, Pole, Tongiorgi *et al.*, Bassano & Peracino, Lenti Boero, Zimina). The interactions between topics appeared to be important. Thus this conference could be considered as interdisciplinary as in any country the need to find sustainable patterns of resource use for these species leads to cooperative works and interdisciplinary research programmes.

Publication of the proceedings: entitled *Biodiversity in Marmots*, a volume of bilingual (French-English) proceedings will be published in 1995 as the first publication of the International Research Network on Marmots. According to the proposal of the Russian delegates, the Third International Conference on Marmots will be held in Cheboksary (Russia) in September 1997. Information on that meeting is to be requested to Dr. A.V. Dimitriev, The Ministry of Ecology and Natural Resources of the Chuvash Republic, Lebedeva street 7-56, 428034 Cheboksary, Russia.

The following text was adopted by the participants during the closing session.

4. Conclusions and recommendations from the Second International Conference on Marmots

Ninety-six participants from twelve countries (Austria, Canada, France, Italy, Kazakhstan,

Russia, Slovakia, Spain, Switzerland, Ukraina, U.S.A., Uzbekistan) took part in the Conference held 2nd-6th October in Aussois (France).

As marmots are strongly linked to natural and cultural heritage of the different people in countries where marmots are living,

As our studies suggest that of the 14 current species at least 5 are now threatened, with 2 of them already listed in the IUCN (International Union for the Conservation of Nature) Red Data Book:

- *M. vancouverensis* in Vancouver Island (Canada);

- *M. menzbieri* (the range of which is now divided between four new independent republics of the former Soviet Union, and which have not arrived at consensus on law and conservation strategies).

Other endangered *taxa* are :

- The subspecies *M. m. latirostris* of Alpine Marmot in the Tatra mountains, in eastern Europe.

- The forest-steppe subspecies of *M. sibirica*.

- Some populations of *M. camtschatica*.

Other species such as bobacs (*M. bobac*), living in agricultural landscapes, are also strongly threatened as populations declined dramatically from millions of animals to some thousands in only a few years. The same problem exists for other species, such as *M. sibirica*, which are commercially hunted in some countries.

a) In order to optimize communication between people concerned with marmot research or management, and to improve the scientific cooperation between marmot scientists the participants of the Second International Conference on Marmots decide to create a Marmot International Scientific Network gathering scientists, managers and administrators concerned with this question. The roles of the Network will include development of guidelines for reintroductions, effective protocols for genetic sampling, captive propagation, protection in the wild, marking and monitoring populations, humane harvesting methods, effective hunting regulations, control of disease, and international trade in marmot products. This organization will also foster the development of scientific guidelines for the sustainable management and conservation of biological diversity in genus *Marmota*.

b) The participants of the 2nd International Conference on Marmots recommend the establishment of a Marmot Specialist Group to the IUCN which will promote standards necessary

to ensure marmot conservation. This group will also offer policy advice to international institutions and governments not currently active in marmot work, to support research and sustainable management for their endemic species. In particular, it can assist local governments in promoting appropriate hunting regulations in countries where it is permitted, and to forbid

hunting in the cases where this activity could lead to extinction of the species.

c) The participants of the 2nd International Conference on Marmots decided to meet a Third time at Cheboksary (Russia) in September 1997, according to the proposal of the Russian Commission of Investigation on Marmots.



ABSTRACTS OF THE COMMUNICATIONS

Fleas of the marmots in the plague enzootic areas of Tien Shan and Pamiro-Alai mountains

AGEEV, V.S., POLE, S. B. (*Kazakh Antiplague Research Institute, ALMATY, 480074, Kazakhstan*)

Thirty-six species of *Siphonaptera* were found as a whole on grey and long-tailed marmots and in their nests in the plague foci of Central Tien Shan, Alai, Gissar and Talas mountain ridges as well as in Eastern Pamir where no plague was discovered. From 8 to 21 species occurred in each separate region, but only *Oropsylla silantiewi*, *Citellophilus lebedewi* and *Rhadinopsylla ventricosa*, specific parasites of marmots, were met with everywhere. Number of most parasites depends on mountain altitudinal zones. *Pulex irritans* is also important component of the marmot flea fauna in some foci. The rest of 32 species comprised 0.3 per cent of all collected fleas. Such findings prove a weak parasitic contact between marmots and other animals living in the same habitats.

Use a test of sensitivity marmots to plague for epidemiological supervision in natural plague foci

AIKIMBAEV, A.M., POLE, S. B. (*Kazakh Antiplague Research Institute, ALMATY, 480074, Kazakhstan*)

Four groups of blood were found in population *Marmota baibacina* in Central Tien Shan (Korneev *et al.*, 1971). The sensitivity of marmots with different blood groups to plague microbe were fluctuated from 9×10^2 (IV phenotype), 8.3×10^5 (I and III phenotypes) to 5.3×10^8 (II phenotype) of microbe cells (Aikimbaev *et al.*, 1980, 1981). The analysis of spatial distribution of marmots with different phenotypes in Aksai population of marmots in Central Tien Shan showed that local epizootics of plague were manifested, in the first place, on the territories where the share of marmots with IV-th of blood group was 51% (Aikimbaev *et al.*, 1981). Mosaic spatial distribution of different phenotypes of marmot on territory was due by genetic and ecological factors and give a key to understanding the phenomena of microfoci manifestation epizootics of natural foci of this infection. The test of sensitivity marmots to plague microbes may be use in a system of epidemiological supervision as indicated sign for prognosis of intensive epizoo-

tic when increasing the risk of infection from marmots.

Social dynamics, kinship, and population dynamics of Marmots

ARMITAGE, K.B. (*Department of Systematics & Ecology, The University of Kansas, LAWRENCE, KS 66045-2106, USA*)

Probably the social systems of all marmot species, except *M. monax* are based on kinship and most species have a family with a dominant breeding pair and non-breeding subordinates. Social behavior of closely-related animals is primarily amicable whereas agonistic behavior characterizes the social interactions of more distantly-related or unrelated individuals. All social groups are characterized by reproductive suppression of younger/subordinate animals by older/dominant individuals. Only the solitary *M. monax* lacks reproductive suppression among adults. Population growth occurs when offspring are retained in their natal group. Recruitment of offspring occurs when they are treated cohesively; dispersal is associated with either a lack of cohesive behaviors or the presence of agonistic behaviors. Population saturation probably occurs in all species and the lack of nutritious food is proposed as the limiting factor. Major population decline usually is associated with unusual weather; e.g., drought or prolonged winter. The availability of widespread habitat provided ecological release that permitted *M. monax* and *M. flaviventris* to evolve different social systems as a mechanism for escaping reproductive suppression.

Resource sharing and kinship in yellow-bellied marmots (*Marmota flaviventris*)

ARMITAGE, K.B. (*Department of Systematics & Ecology, The University of Kansas, LAWRENCE, KS 66045-2106, USA*)

Resource sharing, measured as space-use overlap, is directed primarily toward close kin and does not support the proportional distribution of benefits hypothesis in which benefits are distributed in proportion to the degree of relatedness. Matrilineal formation is the social mechanism whereby female yellow-bellied marmots attempt to maximize inclusive fitness by emphasizing the direct fitness component.

Seasonal mass gain in yellow-bellied marmots (*Marmota flaviventris*)

ARMITAGE, K.B. (Department of Systematics & Ecology, The University of Kansas, LAWRENCE, KS 66045-2106, USA)

All age-sex groups of marmots complete mass gain up to three to five weeks before hibernating. The number of days of growth varies among age-sex groups. Males of all age-sex groups grow more rapidly than females. Reproductive females complete post-lactation growth in 6 weeks; all other age-sex groups complete mass gain in no less than 8 weeks.

The religious traditions of the Transbaikalian nations in the marmots protection

BADMAEV, B.B. (Buryatian Institute of Biology, Siberian Division of Russian Academy of Sciences, ULAN-UDE, 670042 - Russia)

There are two species of marmots, with ecological differentiation, in Transbaikalia: *Marmota sibirica*, southern and central steppe areas and *M. camtschatica doppelmayeri*, alpine areas of the northern mountains. *M. sibirica* was an accessible summer food for cattle-breeding Buryats over the long period of time. The Evenk annual life cycle included time for hunting for *M. camtschatica* whose habitats entered in the sphere of their used lands. The traditional religious ideas in the transbaikalian nations were related with the reverence of the spirits-the masters of some localities. There are some systems of bans in such localities and many examples of these ban systems effectiveness at the present time. The banned Khan-Ula mountain in the south-western Transbaikalia is abandoned by the marmots. People are prohibited to hunt marmots there. The isolated marmot localities preserved in the central areas of Transbaikalia exist due such bans. There are similar traditions among the Evenks that represent the deterrent factor of marmots over hunting and that may be used in marmots protection.

Sanitary problems related to Marmot-other animals cohabitation in mountain areas

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The diffusion of the genus *Marmota* is particularly widespread both on the Eurasian conti-

nent and in North America.

The ecological and behavioural characteristics of the marmot create conditions which favour the transmission and diffusion of pathogenic micro-organisms. Over the last 30 years the marmot has often been accused of being an important carrier for infectious diseases, which are often carried by hematophage Arthropods. Both the animal itself and its burrow can serve as a reservoir for infectious agents. From an analysis of the literature relative to the pathology of the genus *Marmota* it emerges that, from 1975 up to the present day, at least 187 works have been published. 65% of these concern parasitosis and parasite diseases; 15.6% concerns bacterial forms and 13.3% viral infections. Most of the studies concerning bacterial and viral infection also relate to the limited number of diseases. Most of the works on the pathology of the marmot (87 out of 187) were published by american and canadian Authors and for the most part concern the species *Marmota monax*.

The most frequently occurring diseases in the American marmots are derived from parasites located in the digestive tract in addition to the presence of ecto-parasites. The bacterial diseases are rarely described and, among those with a viral aetiology, virus-derived hepatitis stands out: 90% of the works published being concerned with the pathogenic aspects of this disease. On the Eurasian continent the presence of foci of Plague ensured that the bacteriological and epidemiological aspects were given precedence. The diseases which marmots can host and which often run their course in these species asymptotically, can also be transmitted to other animals (and to Man) through direct contagion or, rather more dangerous and frequent, by hematophage Arthropods. Most of the diseases described to date were not observed in the Alpine marmot but this fact may be attributed to the lack of specific investigation, not only of a serological type, but also of a bacteriological and virological type. These investigations should be carried out above all in those countries where the species is subjected to hunting activity. About the parasite transmitted diseases, the marmot is the "object" of infection; in other words, the parasitic flora in the genus *Marmota* is strictly specific and does not result in the passage of infectiuos agents to other animal species (apart from fleas and ticks). On the other hand the marmot may be affected by the presence of domestic and wild ruminants in alpine pasture as it is well suited

to housing in its digestive tract or at a pulmonary level, nematodes from hosts which can be far apart in the zoological scale.

Investigation of the internal morphology of the burrows of alpine marmot (*Marmota marmota*, L.)
BASSANO, B. & PERACINO, V. (*Centro Studi Veterinari della Fauna Alpina - Parco Nazionale Gran Paradiso, 10123, TORINO, Italy*)

The development and the internal morphology of 85 Marmot burrows in 15 different burrows systems, situated in different sectors of the Gran Paradiso National Park, have been investigated with the use of a small self-propelled craft equipped with a video-camera. The robot, once introduced into the opening of the burrow, is guided with the assistance of a video-camera connected to an external video-recorder. Information has been gathered on the development and conformation of the burrows, of the internal connection of the various entrances, on tunnels, internal latrines and stores of food. The system has proved to be of extreme use as a way of probing and collecting physical data concerning, for example, temperature, humidity and speed of air.

Diet composition and feeding habits in a family group of alpine marmot (*Marmota marmota*, L.). Preliminary data

BASSANO, B.* , PERACINO, VALENTINA,**, PERACINO, V.* & MONTACCHINI, F. ** (* *Centro Studi Veterinari della Fauna Alpina - P. N. Gran Paradiso, 10123, TORINO, Italy*; ** *Dip. di Biologia Vegetale, Università di Torino*)

The diet composition of one family group of *Marmota marmota* in a sample area of the Gran Paradiso National Park has been investigated on the basis of microscopic analysis of the faeces. The family group has been observed over a period of two years, from the first week in June to mid October. For feeding activity, the sectors located between the two main burrows are favoured. A big preference for Dicotyledons has been observed and especially for the flowering plants. Modifications in the ratio between Monocotyledons and Dicotyledons in the diet have been observed, during the different phases of activity. Some of the most preferred species like *Astragalus alpinus*, *Helianthemum chamaecistus*, *Oxytropis campestris* and *Sempervivum montanum* have showed an extremely low percentage of presence and may even be totally absent in those sectors least used by the family group.

Experiences on capture and marking techniques on Alpine Marmot (*Marmota marmota*)
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During a research on space use of Alpine marmots in the Orsiera-Rocciavè Natural Park (Piedmont, Italy) members of a colony were captured for marking. Two different types of snares were used for capturing marmots: common snares and spring snares. The spring snares are fitted with a trip wire and an elastic line favouring the closure of the cable around the animal. We compared the efficiency of the two systems demonstrating that spring snares are much more efficient than common snares. An other advantage of this method consists in the efficiency of the traps over the entire active season of the marmots. The almost equal ratio between the sexes and the different classes of age of captured marmots enables us to affirm that this does not constitute a system of selective capture. None of the marmots experienced wounding during capture operations. For long range identification, animals were marked with different marking systems: coloured elastic collars, ear tags and pastels. The efficiency of the marking systems evaluated in terms of their persistence and their visibility were compared. The coloured elastic collars clearly stand above the other methods (We are able to recognise some animals marked three years ago).

Space use strategies of Alpine marmot (*Marmota marmota*): preliminary results

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The space use strategies of the members of a colony of Alpine marmot (*M. marmota*) were studied for three years in the Orsiera-Rocciavè Natural Park (Piedmont, Italy). Animals were life trapped and marked with coloured elastic collars. The collars were still visible on 11 animals in the following year and on one animal two years after marking year (n=26 marked marmots). Literature presents only few works about space use strategies in alpine marmots. In these works common home range of all members of family group is considered. The possibility to recognise the individuals for the whole season and in some cases for more years, per-

mitted us to follow the evolution of two family groups (zone A and B) and to define the individual home range of their members. Preliminary results about home ranges of the members of family group in zone A are presented. The estimated common home range of family group in zone A ranged from 0.48 ha in 1993 to 0.62 ha in 1994. The estimated home range is quite smaller than those presented in literature (0.9 - 2.8 ha). The individual home ranges in this family group are very homogeneous both among individuals and over the two years ($\bar{x} = 0.43$, $\sigma_x = 0.02$)

Marking behaviour in Alpine marmots: modalities, functions and chemical analysis

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Several hypotheses were proposed to explain the functional signification of marking behaviour in Mammals, but they are not easy to test directly in the field. Gosling (1982) proposed a new interpretation for marking behaviour in territorial species, with testable predictions. In our field study on Alpine marmot (Natural Reserve of la Grande Sassièrè; French Alps, Savoie), we aimed to verify two of them : - territorial owners would mark preferentially in such places where risks of intrusion by strangers are the greatest; - inside their territory, owners would replace all unknown marks by overmarking. Marking walks of adult resident marmots were followed and marking sites were located inside the home ranges of three familial groups. Marks were deposited on the main burrow systems and also on territory borders, supporting the first Gosling's prediction. To test second prediction, we placed simultaneously two glass tubes in front of a burrow entrance and we recorded behaviour of residents marmots. One tube (test tube) has been previously marked by residents of another group, the other, carefully cleaned, was a control. The number of marks deposited and the probability of marking the tubes were both significantly greater for test tubes than for the control. Then, resident adults tended to overmark unknown odours according Gosling's hypothesis. In Alpine marmots, marking behaviour seems to be important in territorial defence. More of

one hundred of different molecules were present in the marking substance of Alpine marmots. Field tests of different fractions extracted by dichloromethane, ethanol or pentane showed that ethanol tubes induced significantly more overmarking than control ones. Pentane tubes induced some avoidance while dichloromethane tubes were overmarked but differences with control tubes were not significant. Chemical analysis of marking pheromone by gas chromatography and mass spectrometry has begun and will continue in connection with field tests.

Marmot adaptations to live in natural habitats of various quality

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Review of diversity of marmot adaptations shows their likeness for the generality of present Eurasian and American species. The most important is the complex of adaptations to "short summer", which are necessary especially under severe conditions of Extreme North, high mountains and dry plains steppes. Those adaptations are: feeding in early spring; terms of main phenological phenomena; quantity of accumulated fat and rate of its accumulation; incomplete moult; stopping of the young growth for switching of energy toward fat accumulation; delay of breeding; etc.. These adaptations are directed toward provision of marmots with necessary resources of energy. Their expressiveness is depend on proportion of duration of main periods in year cycle connected with concrete environmental conditions. Therefore those adaptations are not specific for concrete species as a rule. Their likeness for different species is equally high as difference inside of each species. Animal body size is directly connected with their energetic and may be included into the list of named adaptations. Therefore using of size as taxonomic feature is limited in most cases.

Marmots in Europe: history, current status, prospects

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There are two marmot species inhabiting Europe - Alpine marmot (*Marmota marmota* L.) and bobac (*M. bobac* Mull.). Much similarity of their histories has been revealed including areas reduction and abundance declining for the space of centuries and their rehabilitation since the middle of current century. Comparison of these species life history dynamics would promote understanding of each species ecology specifics formed in the course of their evolution.

On the size of the Marmots (*Marmota*), their annual cycle and adaptations to the "short summer"

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The difference in the body size and condilobal length of the skull between the marmots of Eurasia and North America is hardly noticeable. Small and large species and subspecies are found on the both continents. No increase in the body size and condilobal length are observed in the northern parts of the range and in the high mountains. The proportion of the duration of the surface activity and hibernation vary in different marmot species; the hibernation period is prolonged in the habitats with the "short summer". Various adaptations make it possible for the animals to live under the extreme conditions and reduced period of the surface activity.

Current and past relations between people and marmots in the countries of the former Soviet Union

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Problem of interrelations between man and marmots is illustrated in two quite separate, but

indissolubly tied sides: 1) importance of marmots in human life, and 2) impact of man activity on marmots. Long history of man and marmots interrelations can be provisionally divided into three periods: prehistoric, historic (the last centuries) and modern (second half of the current century). The problem is discussed in following principal aspects: 1) game and trade hunting; 2) agricultural (marmots in pastures and crop-fields); 3) epizootic (first of all in regards to marmots in natural plague centers); 4) conservation and restoration of populations; 5) other aspects (scientific, cultural, social and so on).

Temporal analysis of activities in alpine marmot (*Marmota marmota* L.)

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Monthly activities of a population of alpine marmots (*Marmota marmota*), living in the Julian Pre-Alps (NE Italy), have been observed and analyzed in order to investigate external and internal factors that may influence their behaviour. Behavioural data have been collected for two consecutive years. Social organization and demography are also described. A summer trend in the distribution of activities is discussed. Among the external factors, meteorological conditions seem to play a major role. Turk and Arnold's (1988) hypothesis about the function of lying in alpine marmot is supported by our data. A hypothesis relating territory defence and probability of meeting dispersing individuals is formulated.

Divergence of the black-capped marmots (*Marmota camtschatica*, Pallas, 1811)

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M. c. camtschatica, *M. c. bungei* and *M. c. doppelmayeri* subspecies have differences in morphology, immunogenetics and in sound signalling. However they have identical karyotypes (2n=40, Nfa=62). We investigated differential staining of chromosomes of *M. c. bungei* and *M. c. doppelmayeri* and metrical and

non-metrical characteristics of skulls of all subspecies of the marmot and features of their fur colour. C-banding of the chromosomes shows low quantity of C-heterochromatin. Ag-Nor-staining revealed polymorphism in number and localization of NORs in their chromosomes. Morphological data confirmed V. Kapitonov (1978) opinion on the presence of significant differences between *M.c.camtschatica* and *M.c.doppelmayeri*. Besides, we found differences in shapes of incisive and choana foramen between these subspecies. By a number of features, *M.c.bungei* occupy an intermediate position between them. A heterogeneity of *M.c.bungei* is revealed: the skulls of Kharaulakh marmots are larger than those of Verkhoyansk ones. A divergence level between *M.c.camtschatica* and *M.c.bungei* probably reaches the interspecific, and between Verkhoyansk and Kharaulakh marmots *M.c.bungei* it exceeds the interpopulational.

Demography of Vancouver Island Marmots (*Marmota vancouverensis*) in natural and clearcut habitats

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I monitored $n=93$ ear-tagged Vancouver Island marmots at 5 natural subalpine and "clearcut" colonies to assess demographic trends. Compared to other *Marmota*, *M. vancouverensis* is slow to achieve sexual maturity and exhibits low reproductive rates. Litter sizes of 1 to 5 were observed ($\bar{x} = 3.16$, s.d. = 0.60, $n=26$), and most females did not breed until age 4. Most mortality apparently occurs during winter hibernation. Significant differences exist between "natural" and "clearcut" marmots. Marmots in clearcuts are typically larger in size, perhaps due to earlier emergence from hibernation. Annual survival rates in clearcuts (50%) are significantly lower than those in natural habitats (>70%). Females born in clearcut colonies have a 9.3% chance of reaching reproductive age (age 4), while females born in natural colonies have a 38.9% chance. Clearcut habitats do not permit *M.vancouverensis* to establish stable colonies. I hypothesize that clearcut logging may have important metapopulation effects because clearcut habitats act as a "sink" for potential dispersers. Clearcutting could slow or prevent the natural recolonization of some historic habitats.

Parasite infestation dynamics and its impact upon body mass change in Alpine marmot (*Marmota marmota*)

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The monitoring of marked marmots in La Grande Sassièrè Nature Reserve during a year cycle allowed to get data on following topics: - The parasite kinetic was evaluated by use of periodic coproscopies during the activity season, showing a high variability of the present species. The parasite cycle ended by an autumn self-purge, the mechanisms of which are unknown. - The body mass increase curve was drawn by periodical weighing of individuals identified by transponders. The setting of two samples (control and deparasited) showed a differential weigh increase induce by parasites. - Parasite outcome centered on Cestodes (the main parasite group of marmots) were made after injection of a specific vermifuge. This study aims to evaluate the role played by parasites on fat accumulation and on winter survival rate in alpine marmots.

Seasonal regulation of lipidic and glucidic metabolisms in marmots (*Marmota marmota*)

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During its seasonal cycle, alpine marmot (*Marmota marmota*) shows a great management of its fat stores. Fat accumulated by marmot during the summer period constitutes the only energy supply for winter season. Hormonal regulation of lipolysis in this hibernating is not much understood yet. The aim of this work is to study the seasonal hormonal sensitivity and response of white adipocyte from two different sites: intraperitoneal and subcutaneous white adipose tissues. Lipolytic hormones used are norepinephrine and corticotrope hormone (ACTH) which are largely responsible for the hormonal control of adipocytes lipolytic activity in mammals. By the use of Adenosine Deaminase (ADA), we also studied the effects of Adenosine (ADO) as local inhibiting factor of lipolysis. Simultaneous study of lipolytic

effect of these hormones in the two adipose sites shows that the lipolytic rate of subcutaneous adipose tissue is higher than the one of peritoneal tissue during hibernation season and the two months following the spring arousal. Results obtained with ADA show the existence of an important control of basal lipolysis by ADO and that the stimulation of lipolysis is higher during hibernation and spring in subcutaneous than in intraperitoneal fat cells. Marmots are able to use selectively these two adipose sites, according to the season. Subcutaneous fat appears as the main energy supplier during medium and late hibernation and early spring. This phenomenon disappears when marmots regain a daily food rhythm and subcutaneous fat shows a decrease in this lipolytic rate during the summer period. By this way, marmots can reconstitute their subcutaneous fat stores before the next hibernation season. These results point to a surprising and important contribution of subcutaneous fat in the mobilization of energetic substrates during the process of hibernation.

Development of a census method of Alpine marmots in the Ecrins national Park

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Management of marmot populations, affecting mountain farming, needs to know their demographic evolution. We develop a census method of Alpine marmot population in Charnière plateau (Hautes-Alpes, France). The sunny side of the plateau (50 ha) was demarcated in four zones. Two observers scanned each zone, from the shady side, during a period of 15 minutes repeatedly and alternately with rest period of 15 minutes. In the course of a scan period, each observed animal was located on a photography of its zone. Two counting sessions were realized in 1993 (in April, emergence from hibernation and in July, emergence of young marmots) and 1994 (in April at one week interval). The number of observed marmots in each zone varied strongly according to the time of the day and the month. However, the maximum of counted animals was always between 9.30 and 11.00 a.m. during the period after complete emergence from hibernation.

Localization of the animals made possible to know their spatial distribution and its evolution. Marmots were as numerous in cultivated areas as in waste lands though most of their principal burrows were located in waste lands, except when land was snow-covered where they were more numerous around their principal burrow. In 1993 and 1994, the population was stable, but its spatial distribution changed from one year to the other following evolution of the number of marmots in each family group. Finally, a corrective ratio was defined through a long term observation of this population to appreciate its real number.

Marmota bobac in the Chuvash Republic

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Seven large colonies of *Marmota bobac* were in 1930-1932 in Batyrevski and Yalchiksky districts of the Chuvash Republic. A reserve of *Marmota bobac* was organized on a one thousand hectares territory. Three colonies remained in 1935-1936 (Ljvova, 1936) and only one in the following year (Ljvova, 1952, Oliger *et al.*, 1966; Voronov, 1979, 1985, 1990). This colony, in the Batyrevsky district, and fragment of relict steppe biogeocenosis were described by Ljvova (1936). *Marmota bobac* lived there long (Eversmann, 1850) and zoologists paid attention to that relict colony. On the base of the colony the Chuvash republic Council of Ministers organized on October, 19th 1961 Batyrevo *Marmota bobac* colony with the territory of 25 hectares. Re-acclimatization work was made in Chuvash Republic in 1982-1990. *Marmota bobac* were brought from Starokulatsky district of Ulianovsky region and Khvalinsky district of Saratov region. There were 13 releases with the number of 920 specimens (Dimitriev, 1993 b). As a result there appeared new colonies in 8 administrative districts of the republic. In 1991 under State Committee of Nature (now Ministry of Ecology and Nature resources) orders registration of *Marmota bobac* was made. The chairmen of committees of nature protection and members of hunters' and fishermen's societies were drawn into the work (Dimitriev, 1993 a). The Kanash, Tsvil'sk, Yadrin settlements in the Chuvash Republic are successful. The indi-

cator of reproduction and the number of families with a brood is the biggest there. *Marmota bobac* settle further from these colonies. For example, a colony settles in 1993 in the neighbourhood of the village Bailarge coming from the village Tatarsky Suguty or from the settlements situated in the environs of the town of Buinsk from the Republic Tatarstan. Perhaps, the artificially formed settlements unite in this place. The programme of developing the system of specially protected nature territories established by the resolution of Council of Ministers of the Chuvash Republic in 1993 provides for *Marmota bobac* in Vurnary, Tsvilsk, Tatarsky Sugut, Toburdanovo and Yadrin and widening of borders in Batyrevo. Work for their organization has begun.

A structural transformation: evolution of the relationship between man and marmot (*Marmota marmota*) in the French Alps

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Various transformations in the relationship between man and the marmot have taken place during the last decades in the French Alps. While the animal was, some twenty years ago, part of the local food diet and exploited for its grease, it has, nowadays, mostly lost its traditional value and passed, with the touristic development, into another type of relationship between man and the animal. Structural anthropology enables to show this evolution. So, the marmot has passed from a relationship of "friendship / hostility" into a relationship of the "metaphor-type", what charges the animal with food and sexual taboos expressed through sexual allusions incorporated in anthropomorphic representation and literature. While the first type of relationship is found among farmers and hunters, the second one concerns tourists and local habitants living on tourism. While the first ones are complaining about damages caused by the marmot, the second ones do not confirm these damages and enhance the general value of the animal. Fieldwork shows that the conflict between this two types of relationship is more a conflict about the future economic development than about the marmot itself.

Peculiar case of predation on Alpine marmot (*Marmota marmota*) by Golden eagle (*Aquila chrysaetos*)

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The authors documented on video-tape the capture of a marmot by a juvenile Golden eagle and the particular behaviour of the bird with its pray. The eagle carried the marmot about 100 m above ground. Here the eagle started to "play" with its pray letting it fall and catch again in fly 17 times. This behaviour went on for about 6 minutes. The eagle was disturbed first by a couple of imperial crows (*Corvus corax*) and then by an *Accipiter* sp. and so finally lost its pray.

Coadaptation of marmots and Mongolian hunters

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When hunting marmots, Mongolians wear an unusual costume - white pants, jacket and hat with hare-like ears and a 15-20 cm tassel (*daluur*) made from a white horse or yak tail - designed to elicit their alarm call. The tradition of shooting mainly calling marmots may be seen as a means of avoiding marmots with the plague. The alarm call response decreases sharply in infected marmot populations (Bibikov, 1967). Meanwhile, Mongolian marmots have adapted somewhat to this hunting method. Although their alarm call response to the *daluur* remains strong, many flee when they see a man as far as 2-4 km. away (Seredneva, pers. comm.). To understand how this change has influenced the age structure of samples selected by hunters, we studied 1,346 Mongolian marmots from 6 samples (3 *daluur*, 3 not) using Klevezal-Kleinenberg's (1967) method. The 3 *daluur* samples differed sharply from the 3 other. Marmots over 4 years old in Khentei and over 5 in Khangai had learned to avoid hunters with *daluurs*. Thus, the traditional method of hunting marmots harms the population less than other methods and its broader use will promote sustainable use of this vital resource for Mongolia.

Traditional aspects and cultural changes about current practices concerning Alpine Marmot (*Marmota marmota*) in France.

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As an emblematic animal in the Alps, Alpine Marmot (*Marmota marmota*) was particularly susceptible to be affected by social and cultural changes that have taken place in mountain societies for the last twenty or thirty years. The status and image of Alpine Marmot have moved in French mountain areas and social groups. Old-time cultural practices, especially concerning marmot-hunting, disappeared or are less and less common. In the same time, using, or rather exploiting, the image or the name of marmot has grown up. Our ethnological enquiries have brought out that considerable social and cultural changes have occurred in the ways Alpine Marmot is exploited and managed. However, it can be said modern representations, artefacts, advertising and walking tours linked to marmots are not ever mere innovations. Some of them, like toys, were attested in the XIXth century, whenever their forms or their social significance or use were different. Certain ancient practices that have endured until nowadays, like catching and taming of the young marmots, have often lost their original meaning. In a lot of current cultural practices, even if they seem quite new, the marmot embodies the regional or local identity, as it used to be in the past, and people refer to this animal to reassert their sense of regional identity and tradition.

Alpine marmot (*Marmota marmota*) in the Orobian Alps: analysis of ecological parameters

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This work is part of a research project finalized to collecting information about the ecology of alpine marmot; its purpose is to determine which are the environment preferences of this animal, relating to the environment availability. The researches have taken place in Brembana Valley (Bergamo district), in the same area studied in a previous research. The work is composed of two stages. In the first one it has been ascertained the parameters necessary to the description of marmot population

ecology (altitude, exposure, slope, sun-exposure); it has been measured the environment availability. In the second stage data been collected on the territory by compiling data cards. The elaboration of the collected data allowed to obtain the following information about marmot's environment preferences. A preliminary analysis of the colony distribution relating to their density and a further statistical inquiry, have permitted to establish that there are not significant preference about exposure. No preferences too towards the different altitude and sunny places, but great difference is made by the slope. The analysis of the data cards compiled on the field shows how these animals do not like the forest zones, but their preferences are given to stony places. They colonize better the environment which are sheltered by rocky walls, while the wood is generally left below the colony.

Hiking impact on feeding behavior in Alpine Marmot

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Foraging in Alpine Marmot, an hibernating rodent, is a vital activity as marmots are active only during six months per year in order to insure the energy intake for active period and fat accumulation for winter period. In summer, perturbation due to an increasing hiking pressure could possibly affect marmot behaviour. Effect of different hiking pressures on foraging behaviour of marmots were investigated in two family groups during three different months. In each group of marmots, diet has been described and quantified using the micrographic technique for faecal analysis. Activity rhythm has been assessed by scan sampling. Vigilance (look-ups while feeding) and tolerance to human presence (flight distance and time spent in the burrow after being disturbed) has been quantified by focal animal sampling. Marmots under the higher human pressure, on the contrary of the others, showed: 1) in August, - a less selective diet especially for Fabaceae; - a decrease of feeding activity coinciding with daily tourist rush hours and during other periods an increase of this activity near the burrows. - a higher frequency of look-ups while feeding. 2) in September, - an original behaviour pattern: feeding on plants growing

under stones. Tolerance to human presence by these marmots was always higher. Anthropogenic pressure seems to induce a qualitative and quantitative fall of diet through an increase of vigilance and a decrease of diet selectivity due to the difficulty to exploit their whole home range. These negative effects on marmot survival could be balanced by the increased tolerance to human presence.

Parasites of the digestive system of Alpine marmot (*Marmota marmota*) in South Western Pyrenees: preliminary data

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The translocation of wild animals has an impact on the sanitary state of wild and domestic animals that share their habitat with the translocated animals. The sanitary study of Alpine marmot in the Pyrenees is particularly important because it is an introduced species, that has recently colonized this mountain range and could have introduced several parasitic, viral, bacterial and fungal diseases which could also be new species for this area. Alpine marmots could also be affected by Pyrenean diseases coming from other Pyrenean vertebrates that share the same environment. The preliminary coprological analysis of 62 drops and 12 necropsies indicates the presence of: *Coccidia* (*Eimeria* sp. similar to type 2, described by Bassano *et al.* 1992), *Trematoda* (non identified *Digenea*); *Cestoda* (*Ctenotaenia marmotae*); *Nematoda* (*Ascaris* sp., *Capillaria hepatica*, *Trichuris* sp. and *Tricostrongilidae*). The number of taxa is low compared to the results of Alpine studies even if a loss of some parasites can occur in translocated populations. Other non specific species found in the Alps are missing. Parasites which are new for Alpine marmots appear: *Capillaria hepatica* and an unidentified *Trematoda*.

Behavioural tactics analysis in young Alpine Marmots

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Behavioural ontogenesis is one of the determining factors of individual feature. So, it represents an essential source of phenotypic variability in natural populations. Therefore, it is an important part of the individual fitness. Since Bateman (1948) and Trivers (1972) it is largely accepted that males and females differ in their reproductive strategies. We investigated for early differences in behavioural tactics of young marmots, during the first year of life, which could affect the both sex reproductive strategies. Our study mainly dealt with time-budget and space occupation. Five litters were observed in the valley of la Grande Sassièrre (French Alps), during four periods: I - from 0-15 days; II - from 15-30 d; III - from 30-60 d after emergence (young) and IV - the next spring after the first hibernation (yearling). Fifteen minutes of focal animal sampling and scan animal sampling (Altman-1974) were used to collect data, respectively on time-budget and space occupation. More than 250 h of observation allowed us to get 297 focals and 1769 scans. We performed on the first data set (time-budget) a correspondence analysis under period and sex constraints, whereas two-way ANOVA and χ^2 tests were performed on the second (space occupation). Time-budget analysis revealed the same pattern of seasonal modifications for both sexes. Moreover, the great importance of interactions (allo-grooming and allo-sniffing) characterized females as early as the first period whereas males were characterized by play only the spring after the first hibernation. Space occupation analysis supports such a great period effect and gives us some indications for an inter-sex rapprochement. Finally we examined play functions and their social implications for Alpine Marmots

Radioresistance among rodents of the subfamily marmotinae

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It is shown that the radioresistance of 7 species of *Marmotinae* after acute total irradiation is less than the average one for all 44 investigated species of rodents and for majority other taxa (hamsters, voles and gerbils). This subfamily is more heterogeneous for this characteristic, as compared to mice, hamsters, voles and gerbils. It should be noted that extreme by radioresistance species (*Citellus undulatus*, *Marmota monax*) differ from other species in some of ecological peculiarities.

Application of a Geographic Information System to determine habitat selection by Alpine marmot (*Marmota marmota*)

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The study area was a western Pyrenean valley's headwater of 1200 ha, with a predominant southern exposure firstly colonized by marmots during the seventies. The vegetation is mainly supraforest grassland used by livestock and chamois during the summer. We located twelve different marmot colonies in the area. To ascertain if marmots selected different geographic variables to localize their colonies we used topographic and vegetation maps both at a 1:10.000 scale. We considered an area of approximately 50 m of radius around the main burrow of the colony to estimate marmot activity area. Using a Geographical Information System we determined the frequency distribution of five variables (altitude, exposure, slope, vegetation cover and community) in the available and in the colony surfaces. To determine whether there was a significant difference between expected and observed utilization of the variables, chi-square tests were used. If a statistical significant difference resulted, Bonferroni simultaneous confidence intervals were used to determine which categories were utilized more or less than expected. Results indicate that marmots selected: southern slopes; altitudinal layers between 1.600 and 2.000; slopes between 0 and 30% and pastures with high vegetation cover and nutritional value as *Primulion*, *Mesobromion* and *Polygonium-*

Rumicion. The use of GIS to study alpine marmot habitat selection seems to be a useful tool and could be used to determine the suitability of new areas for translocations or natural expansions.

Recently acquired genetic variation in wild populations of marmota detected by DNA fingerprinting

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Allozyme studies suggest a severe genetic bottleneck, as indicated by the reduced number of variable genes and the loss of rare alleles. The aim of the present study was to evaluate the variation found at VNTR-loci for assaying the differentiation at the population level. Samples were taken from 6 locations in Switzerland (2) and Austria (4): autochthonous populations from Bern (B), Graubünden (G), and Verwall (V), re-introduced populations from Zillertal (Z), Kreuzeck (K), Eisenerz (E). Genomic DNA from liver samples was digested with *Hinf*I. Southern blots were hybridized with the DNA-probe (ATCC)₄. Nine variable bands (4-22 kb) were found with 19 different pattern types among 50 individuals. Three pattern types are rather widespread, the other patterns occurred either once (10) or twice (6). All 6 populations were polymorphic. Autochthonous populations G and V and the westernmost re-introduced population Z were genetically similar. Population B is differentiated from the rest of the autochthonous populations. The 2 re-introduced populations K and E are genetically distinct. The common types represent an ancient polymorphism whereas the rare types may have been generated by mutations at the specific locations.

Space use in alpine marmot (*Marmota marmota* L.): data from a long term research

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Five social groups of individually identified marmots were observed at Gran Paradiso National Park, Italy from Summer 1985 to 1988. Home range size varied from 12,500 m² to 28,125 m² (mean = 18,977). Core areas,

were at least 10% of fixes were found had a mean size of 1,818 sm. In each home range only one hibernating burrows utilized across years by different social groups was found, mean number of burrows used during summer was 2.81 (range 1 - 6). Spotting points, that is rocks or logs without burrows varied from 2 to 13 (mean 5.64%) and were located at the periphery of the home ranges. No relationship was found between number of animals in a social group and home range sizes or between home range sizes and number of observation places. Behavioural plasticity in use of spatial resources and the social and ecological factors influencing dimensions of home ranges and number of other resources is discussed.

Number of the black-capped marmot (*Marmota camtschatica* Pall.) in Yakutia

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In 1950s the number of black-capped marmot was being estimated as 80.000 individuals in the Northern-Eastern Yakutian mountains. The density of their population was characterized by a mean value which is equal to 25 individuals on 100 km² of relative natural territory (Kapitonov, 1978). The received results of investigations show that *M. Camtschatica* populations density is very low: 9 individuals on 100 km². These data are evidence of the fact that only about 30.000 marmots dwell in Northern-Eastern Yakutia. The marmot number is no more than several hundreds in Southern Yakutia. So it turned out that the present number of black-capped marmot is lower for 2-3 times on the whole than it had been named to be 4 decades ago. The species number lowering is to be observed almost everywhere. It is evidence of obvious degradation of black-capped marmot Yakutian population.

Age-dependend alarm behaviour and response to alarm call in bobac marmots (*Marmota bobac* Mull.)

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Play-back experiments were carried out in 1986-1988 in "Strel'tzovskaya steppe" Reserve (Ukraina). Tape-recordings of adult-variation of alarm call and juvenile one were broadcast in natural population. Bobac marmots' alarm signal represents the sequence of sounds with intersound intervals up to severals, and every

sound consists of the low and high-frequency components. The latter has higher dominant frequency and longer duration in juveniles signal. We made two model variants of signal, consisting of 3 times repeated sound of adult and juvenile marmots, respectively. Marmots' responses were assessed by 5 chosen types of postures. Playback experiments have shown significant differences in responses of adult animals and juveniles: the latter alerted strongly, with shorter latent period, but they quicker resumed normal activity. And all marmots responded twice often to adult-variant. Moreover, alerting to juvenile-variant was significantly shorter. The results have shown that marmots can distinct signal age-variants. Juvenile marmots, having higher acoustic activity and reactivity on the whole, use to call to nondangerous objects; thus, it seems the benefit for marmots to pay less attention to juveniles' alarm calls.

Species specificity and interspecies parallelisms of alarm call in Eurasian Marmots

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The alarm call of Eurasian Marmots was tape-recorded in field condition. The dynamic spectrum (sonograms) is species specific whereas the rhythmic organization is not. The rhythmic organization corresponding to the landscape relief manifests the interspecies parallelisms and intraspecies divergence. The increase of the vertical division of the relief is accompanied by reduction of the periods of pulse recurrence. The analysis of dynamic spectra suggests that *M. caudata* and *M. menzbieri* were isolated earlier than other species. The alarm call dynamic spectrum in *M. camtschatica* has intermediate features between those of Eurasian and American species. The interspecific variability of the structure of alarm call in *M. sibirica*, *M. baibacina* and *M. bobac* bears the character of stepped cline. The signal these three species ("group bobac") has similar low-frequency component. *M. marmota* signal is more similar by its structure to the signal of American species.

The analysis of different methods of poaching with special reference to *Marmota bobac* in the southern Urals

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The poaching as a method of influence on *M. bobac* population in Bredy Reserve (Cheliabinsk region) and its vicinity is analyzed. Before the protection status (1975), the marmot population was estimated in this place to 5-6000 individuals. Our estimations (Le Berre *et al.*, 1994) for 1992: 40,890 marmots in the reserve area and 450,000 animals in the district (calculation for the whole area). The supposed number of animals withdrawn (by poaching) equals approximately to 15,000 individuals. It is less than 1/6 of the marmot's general number in this district. The analyzed different ways of poaching: are fire-arm, loops, traps, nets, pincers, etc.

Some considerations on marmot population expansion in Brembana Valley (Orobic Alps)

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During the years 1985-1987 and 1992 in the same geographical area we carried out two research campaigns whose data have been collected following the identical methodology. Afterwards collecting data concerning population distribution and density have been processed with regard to four ecological parameters: altitude, exposure, slope, duration of sunlight exposition. The comparison between the two periods considered permits to focus on some aspects concerning the population evolutive trend. It is a young fully expanding population whose environmental choices have change as a result of the different available habitats. The distribution trend, related to the four parameters considered, has showed an extension in variation intervals; increasing density has caused an environment colonization in adverse condition as far as the exposure and the slope.

Social behavior of alpine marmots: seasonal, group and individual variability

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Composition and social interactions of three family groups of *Marmota marmota* were observed during a study in the Vanoise National Park (French Alps) from mid-June to late September. Interactions between members of the same group were mainly cohesive, which confirms the social nature of this species. Social interactions between marmots from different family groups were rare and agonistic. The rate of social interactions decreased as the season progressed, probably in relation to a shift in energy allocation to preparation for hibernation. Some cohesive interactions increased just before immergence when marmots restricted their activity to the main burrow system. Rates of social interactions differed between groups and between individuals. Fewer agonistic acts, more play-fighting and its persistence in late season among the immatures suggest the influence of an ontogenetic component. The most agonistic of the studied groups included an adult male that had recently immigrated. He focused most of his agonistic acts on three 2 year old males, of which two dispersed during the season. Social events characteristic of each group, individual variability and level of familiarity between group members can influence the quality of social interactions and the dispersal of immatures. Social relationships between familiar individuals are amicable and can facilitate the retention of immatures in their natal group as well as their recruitment by emigrant adults.

Real state of *Marmota menzbieri* population in Kazakhstan

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M. menzbieri Kasch. is an endemic of Western Tien Shan and has been included in the Kazakhstan Red Data Book (3-rd category status). Its range in Kazakhstan embraces the Ugamsky and Karzhantau mountain ridges and covers 400 km² Because of intensive hunting taking place in those years the numbers of *M. menzbieri* decreased already in the middle the

forties to 40-50 thousands specimens, with an average density of 100-120 animals per 1 km² (Yanushko, 1951). This level also remained in the sixties, but ten years later it was restricted by one third (Kapitonov, Lobachov, 1977). In 1990 the almost complete disappearance of the species was reported: with an average density of 4 marmots per 1 km², only 1.5-2.0 thousand specimens would have remained in Kazakhstan (Vyrypaev, Obidina, 1990). Our investigations were carried out in 1990-1992 in the western, central and eastern parts of Karzhantau (total registered area 44 km²). It was ascertained that the marmot density equalled 54-94 (average 70) specimens per 1 km², with a maximum in western part (upper reaches of Badam River). A reduction of the marmot range was registered everywhere. Therefore the present numbers of this species in Kazakhstan (20-25 thousands specimens) amounts to no more than a half of the level of the forties. The main causes of this phenomenon are overgrazing and poaching. Thus, the state of *M. menzbieri* population in Kazakhstan is not so disastrous now as it had been supposed before, although it is either not very optimistic.

Ecological and morphophysiological heterogeneity of grey marmot populations in central Tien Shan

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Grey marmot (*Marmota baibacina*) in Central Tien Shan lives in altitudes from 1.200 to 4.500 m occupies meadow-forest-steppe, in subalpine and Alpine belts. There are wide diversity of ecological (climatic and biotic) factors within the range of local populations. It is one of the main reasons of high level heterogeneity marmot populations maintaining on different ecological and morphophysiological signs. Ecological signs of marmot population heterogeneity are showed as a features of spatial and age structure, changes a dates of awakening and hibernating, as two strategies of reproduction and some other signs. Morphophysiological signs of marmot population heterogeneity was noted in marmots of different sex and age groups and from different parts of areas and altitude belts, and correlated with density level of population (Pole, 1974; 1993). Inherited diversity of population was found as polymorphism of blood groups and epigenetic signs of cranium and baculum

(Aikimbaev *et al.*, 1981; Pole, Bibikov, 1991; 1992; Pole, Zverev, 1993). This must be taken into account when comparing data secured in different altitude zones and from various parts of marmot area.

Spreading, numbers, protection and hunting of marmots in Kazakhstan

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Four species of marmots are found in Kazakhstan: *Marmota bobac*, *M. baibacina*, *M. caudata* and *M. menzbieri*. Forty years ago total resources of marmots were more than 3 millions of individuals but this quantity was gradually decreased. In 1990 in Kazakhstan the project "Marmot" was accepted. This plan includes measures for strengthening protection, yearly calculation, settling and the most efficient use of marmots resources. As showed the calculation in 1990-1993 a total resources of marmots in Kazakhstan are fluctuated during this period from 1,450 to 1,887 thousand individuals (84% *M. bobac*, 15% *M. baibacina* and about 1% *M. caudata* and *M. menzbieri*). Accordance with the project in 1991-1993 were settled 1,837 marmots in 6 regions of Republic. During 1961-1976 in Kazakhstan average laid in about 125 thousand marmots a year (Sludskii, 1980); in 1990-1993, 61 thousands a year. Besides skin, in 1966-1968 yearly of marmot fat was laid in from 12 to 28 tons, considerable part of which was exported in France and Australia (Sludskii, 1980). On condition of right organization, the hunting and trapping quantity of marmots may be twice increased without prejudice to populations.

Perspective of discovery of compound of plague foci (marmot-ground squirrel and marmot-vole) on peripheral areas of Tien Shan

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The first serious ground for revision the traditional views on the extremely Alpine dependence, primitive biocenotic structure of the Tien Shan and Alai plague foci was discovery in 1975-1980 of the plague epizootics zone at the altitude of 1500 to 2800 m on the northern

slopes of Alai and Talas Mountain ridges. The plague microbe in population red marmot, wood mouse, Royle's mountain vole, grey hamsters and their fleas were found. These facts proved to be the ground for the supposition of the existence of compound plague foci in the mid-altitude zone of the Tien Shan and Alai (Tulembaev *et al.*, 1982). In the western (mid-altitude) part of the Alai Valley in 1988-1989 discovered plague epizootic in Royle's mountain vole, wood mouse, red marmot and their ectoparasites (Serjakov *et al.*, 1992). After a long period of time reconnaissances on Dzhungar mountain range in 1990-1991 first were found specific antibodies to capsular and somatic antigen of plague microbe from 5 species of rodents (Bezverkhni *et al.*, 1992). Thus, the investigation of the last 17 years makes us come to the conclusion of possible discovery of new plague foci in Kirgiz, Ketmen, Kungei and Transil peripheral ranges of Tien Shan.

History of the recent marmot colonization in the Eastern Alps

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The recent distribution of *Marmota m. marmota* in Austria was determined by a census carried out through 1990-91. The occurrence or absence of marmots was recorded by local hunters. Almost all massifs of the alpine zone are inhabited by marmots except some of the isolated lime stone mountains at the northern and southern margins of the distribution range. The distribution of 38 excavation sites of fossil remains was also recorded. The majority of these sites is found along the margins of the present range. Most of the fossils stem from the Upper Pleistocene, 1 from the Middle Pleistocene and 1 (identified as *M. primigena*) from the Lower Pleistocene. After the last glaciation marmot populations colonized the entire region of the inner Alps. In the eastern part of Austria (east of Sill and Eisack) marmots got extinct, only the western part harbours autochthonous populations. From about 1860 attempts were made to re-establish marmot populations in these areas. 119 re-introduction efforts could be documented for the period between 1860 and 1990. Although the number of individuals released in particular areas was quite low (median = 5) most of the re-intro-

ductions proved successful and stable populations developed quickly.

Electrophoretic analysis of 15 wild marmot populations reveals an ancient bottle neck

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Allozyme variation at 50 loci was studied in 15 populations of the alpine marmot (*Marmota m. marmota*). Four samples (1 from Switzerland, 3 from the western part of Austria) represent autochthonous populations. The rest of the samples was taken from areas in the central and eastern part of Austria. These populations originate from repeated re-introduction efforts since 1860. Only 2 loci (*Pep-1* and *Sod-1*) were found polymorphic. Average heterozygosity was 1.2%. No rare alleles could be detected. Autochthonous and re-introduced populations are genetically differentiated. Allele frequencies are more heterogeneous among the non-autochthonous populations. At the *Sod-1* locus there is a trend towards fixation of the fast allele. The polymorphism's at *Pep-1* and *Sod-1* are probably conserved by selective forces. In *Pep-1* genotypes differ with respect to their degree of infestation by the endoparasites *Citellina alpina* and *Ctenotaenia marmotae*. No deviations from Hardy-Weinberg equilibrium were observed. The population structure is not affected by inbreeding. Diminished genetic variation, the absence of rare alleles, and the geographic pattern of the allele frequencies at the two variable loci can be best explained by a bottleneck after the last glaciation.

Infestation by endoparasites in different Austrian populations of *M. marmota*

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The gastrointestinal tracts of 162 marmots from 13 different locations were examined for endoparasites. Three populations are autochthonous, the rest has been re-introduced. The locations are arranged along a west-east gradient through the alpine region of

Austria. The most common parasites were the cestode *Ctenotaenia marmotae* (90.1% infested) and the nematode *Citellina alpina* (62.3%). Beside these marmot specific parasites there was a number of different nematodes, e.g. *Ascaris laevis* (10.5%), *Trichuris* spp. (24.1%), and *Trichostrongylus* spp. (20.4%). There is a clear differentiation in the west-east direction. The marmot specific parasites *Ctenotaenia marmotae* and *Citellina alpina* are most abundant in the autochthonous populations. In the re-introduced populations the frequency decreases gradually to the east. The same is true for *A. laevis* and the genus *Trichuris*. Infestation with *A. laevis* is rather common in the autochthonous populations, but almost absent in the re-introduced populations. With *Trichuris* there is also a slight decrease from the west to the east. Founder events could explain the trends towards a loss of parasite species. An opposite trend is observed for the genus *Trichostrongylus*.

Mapping ecological factors and marmot population in Mount Valier Nature Reserve Pyrenees, France

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The aim of this programme, written in BASIC, is to draw symbolic representation of data on previously drawn maps. The original map, obtained by use of a drawing programme (such as Mac Draw or Canvas), is in a Pict file, with maximal dimensions of 240x240 mm. Data, which represent an array having n1 columns (variables or presence-absence of some characteristics) and n2 rows (longitudes for instance), are stored in a text file. Each cell of the array corresponds, for instance, to a 200 x 200 meter quadrat in the field, which could be represented as a 4x4mm square on the map (scale: 1/50,000). The square could be black or white or in-between, according to the value of the variable corresponding to the column. Three predefined scales for the squares are available and one other scales can be defined. Presentation of data can be realized in black and white or in colours, under each option either with variation of intensity or symbols. Eight different densities of points can be used in black and white presentation and two tints, a back-

ground colour and a fore-colour, with 8 possible colour (white, black, red, blue, yellow, magenta and cyan) and with 5 possible gradations of the background colour, in coloured presentation. In both cases (black and white or colours), presence-absence can be represented with symbols (a marmot for instance in the quadrat where marmots are found. The symbol must be in a Pict file. The map is drawn on the screen and can be printed and/or saved in a Pict file and can be modify using Mac Draw for instance. This programme has been run to study the characteristic parameters of the spatial distribution of the marmot population of Mont Valier.

Ecological and morphological aspects of reproduction of bobac (*Marmota bobac*) in Orenburg Province

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Now the bobac distribution in South Ural foothills is restricted by the comparatively dissected relief of Obshchiy Syrt and Gubernskiy Mts. as well as more flat territory of Orsk Plain and Tobol Plateau. Our investigations in 1980-1994 show that there are no continuous bobac settlements in Orenburg Province. The Orsk Plain is covered by *boutans* (rammed ground heaps near marmot holes), which relative age is about 3.000 years. The research of age structure of bobac populations showed that duration of bobac life was more 8 years. Two and three-years old individuals prevailed among collected animals. According to the number of placental spots the average number of babies per one litter is six. The maximal depression of spermatogenesis is marked in June. The ducts resemble a testicle in the period of the late embryogenesis. Some intensification of the differentiation of spermatogenous epithelium takes place in July. The endocrinocyte population between the breeding periods is more or less heteromorphic. The cytoplasm of Leydig's cells is acidophilic and contains pigmentary inclusions. Morphological and functional analyses of testes show that in June the number of androgen-producing cells lowest.

Hibernation and breeding of *Marmota bobac*

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The endogenic mechanisms of termination of hibernation connected with breeding influence all steppe marmots except very weak ones. They cause the increasing of arousals and the mean body temperature in the second part of winter. In that period animals prepare for breeding. In pre-breeding period testicles of males and vaginas of females enlarge. The cells, typical for oestrus, sometimes are found in vaginal smears. Adult animals which weight losses during the hibernation were not great, increase their body temperature to the constant high level in 2-3 weeks. Meanwhile the oestrus of females becomes constant and testicles of males reach the maximal development. These marmots support the high and constant level of metabolism during 1-2 months without any food, even in the period when their body mass becomes less in comparison with nonbreeding animals. The young marmots and adult animals, which weight losses during hibernation are large, are characterized by the unstable body temperature, underdeveloped testicles and broken oestrus during some time. In this period the mean index of their body temperature is rather high. Afterwards they fall in the deep hibernation again.

Seasonal endocrine profiles in the alpine marmot (*Marmota marmota*)

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The seasonal cycles of body mass, hibernation, reproduction and thyroid function were studied in Alpine marmots maintained in outdoor enclosures, in Western France (C.E.B. Chizé [46°07'N, 0°25'W]). Plasma hormone concentrations (sexual steroids, LH, thyroxin) were measured monthly by radioimmunoassays. In adult marmots, a clear seasonal body mass cycle was observed with a maximum in early autumn (increase: 27-43 %) and a minimum in April (loss: 15-21%). The hibernating period occurred from November to mid-March. In the male, plasma testosterone concentrations were high (>0.8 ng/ml) from March to June-July and low (<0.4 ng/ml) from August to February.

A short peak of LH occurred during the testicular recrudescence. In females, the absence of oestradiol and progesterone variations led us to the hypothesis of an induced ovulation. In both sexes, thyroxinemia was maximum from the end of spring to mid-autumn (140-160 ng/ml) and decreased from early winter until April (110 ng/ml). The regular seasonal cycles, observed in captive marmots, seems to be consistent with the data available at the present time in the alpine habitat, and are essential for next investigations.

Space and time use in a population of *Marmota marmota* of the northern Apennines

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From 1989 to 1992, an ethological study on the introduced population of Alpine marmot has been carried out in an area of 5 ha where all the burrows were marked. For two-four consecutive days in alternate weeks from May to September, the position and activity of marked marmots was recorded every 15 min from dawn to dusk. The basic social structure is clearly identifiable as separate and territorial families. Both the families of the study area reproduced twice consecutively, afterwards a period of two or three years without litters followed. The two families reproduced alternately, from 1988 to 1993 we never observed the contemporaneous presence of yearlings in the two families. The quantitative assessment of the use of any burrow let to identify a system of main burrows, a system of secondary burrows and scattered burrows. The adults and the young's utilize all the systems of burrows, the yearlings concentrate their activities on some of those. The frequency of foraging increases from the burrows situated on higher and steeper slopes (3%) to those dug in lower and flatter areas (46%). Notwithstanding considerable demographic variations, there have been no significant changes in the extension and structure of the settlements.

A 32-year demography of the yellow-bellied marmot (*Marmota flaviventris*)

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Yellow-bellied marmots (*Marmota flaviventris*) in the East River Valley of Colorado were annually live-trapped and individually marked from 1962 to 1993. We used the pooled data from this population to produce an average demography and life-table of marmots for these years. Females have significantly better survivorship than males beyond the first year age class. Factors that cause mortality act evenly on all age classes as shown by the constant rates of survivorship. Principal sources of mortality are unsuccessful hibernation and predation. Females produced litters from ages 2 to 10 yr.; litter sizes did not differ significantly among age classes. Female generation length at 4.49 yr. was three times the life expectancy and median survivorship. The net reproductive rate (R_0) was 0.67, yet the population did not continually decline. Reproductive values (V_x), were approximately equal across the reproductive ages and identified no life stage as part of a reproductive strategy. This marmot population is regulated by the extrinsic forces of energy availability and predation and by movement into and out of the study area.

Anthropogeneous influence on *Marmota bobac* Müll

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Marmota bobac Müll. of the Saratov region is considered as a biological model to study ecological mechanisms of animal population transformations under anthropogeneous effects. Researches on determining the influence of intensive economic activities on marmots conducted for many years (1960-1993) have allowed to reveal multiple adaptations of this animal to living in anthropogeneous landscapes. The way of marmot distribution within the region given and its biotop have been changed. Locations of marmot dwelling are associated with lands unsuitable for agriculture. Progressive growth of gully-type places of dwell-

ling has been noted; forest biotops and locations of uninhabited farms and villages are being developed. When virgin lands are ploughed up marmots concentrate at the borders of areas under crops and at the sides of field roads and density of their population reaches 9.6-10.8 individuals per hectare. Damages of crops caused by marmots have been observed. While studying marmot biotopic populations of different level of anthropogeneous influence differences in the spatial structure of populations, morphophysiological indicators, ways of daily and seasonal activities, feeding, family composition and ethology have been found. The studies conducted allow to assume consolidation of ecological features being studied at the population level and formation of adapted *Marmota bobac* Müll. populations on anthropogeneous territories.

The black-capped marmot (*Marmota camtschatica* Pall.) in Yakutia

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The black-capped marmot is represented in Yakutia by two subspecies: *M. c. bungei* dwells in Northern-Eastern Yakutia in Verkhojan, Chersky and Momski mountain ranges. *M. c. doppelmayeri* dwells in Vitim-Ollokminsky highlands, Charo-Tokkinsky country between two rivers, in the Aldan, the Chulman and the Iengri rivers-heads on Zverev mountain-ridge as independent populations. In historical time the species area was more broad. It is known that during last sixty years the independent kondakovsky population had disappeared in the lower reaches of the Indigirka-river, in last 30 years the colonies had been destroyed near the lakes Sutorokha and Ozhogino in Abuisky region and on a considerable part of Momski mountain range. *M. camtschatica* future depends on man, his efforts on protection of existing population, on considered actions on its reacclimatization.

Situation variability of alarm call spectral structure of some marmot species

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More in detail we investigated situation variability of steppe marmot's (*Marmota bobac*)

alarm call. Alarm call of this species consists of single notes. We decided, that situation variability in case of increasing danger is expressed by change of notes parameters from the beginning of a vocal sequence to its end. Five parts of alarm call can be distinguished by expression of their production when observer approaches to marmot. They are the following: 1. initial notes; 2. notes at the middle of sequence; 3. last notes before going into a burrow; 4. notes at the moment of going into a burrow; 5. notes from a burrow. Nine parameters of the notes from different parts of sequence were compared. The pause between high- and low-frequency components; the beginning of fundamental frequency and characteristic of frequency modulation of high-frequency component appeared to be the most stable in different situations while maximum, terminal and dominant frequencies of fundamental of high-frequency component and duration of high- and low-frequency components are the most variable. When danger increases the alarm call changes in the following way: maximum, terminal and dominant frequencies of high-frequency component decrease as well as its duration; dominant frequency of low-frequency component decreases, decreases its duration in the parts of 1, 2, 3, and increases in the parts of 4, 5. Notes in the distinguished parts of alarm call significantly differed from each other.

Present specificity of marmot habitats in Southern Russia

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Marmota bobac, disappeared almost totally in the mid of XX century, became the background species again in some parts of Southern Russia (Voronezh and Rostov Regions) from the beginning of 70th, where the marmot colonized all habitats being favourable more or less: 1. retained natural steppe areas; 2. their pasture modifications; 3. fields of food-grass and technical crops, in less degree-of wheat; 4. protective areas of some industrial objects; 5. deserted villages and borderlands of habitable ones. All those types of habitats, except for the first one constituting only about 1% of total area, are connected with anthropogenic elements of landscape. The type 2 -main present

type of marmot's habitat-cover about 20% of the area, is populated with high density- $0.75\pm 30\%$ families / ha, as well as the type 1. The type 3 is populated with the density of about 10 times lower in average, but total amount of marmots is big because of the fields great area (about 65% of total area). The types 4, 5 are often populated more of 1.5-2 times than natural habitats due to favourable conditions regarding to the food and refuges.

Geographical variability of body size in marmots

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Collections of the Zoological Museum of the Moscow University, the personal collections by Galkina (Novosibirsk), Pole (Alma-Ata), Petrov (Yugoslavia) and literary data were processed. From 27 localities differing in terms of geographical latitude and elevation above the sea level, the mass and body size were studied in *Marmota bobac* (Kursk Region, Russia, Tatarstan, Kazakhstan, n = 306), *M. baibacina* (Kirgizia, Jungaria, Altai, n = 165), *M. sibirica* (Mongolian Altai, Tuva, Khangai, n = 160), *M. camtschatica* (Trans-Baikal Region, Yakutia, Kamchatka, n = 34), *M. menzbieri* (Tien Shan, n = 64), *M. caudata* (Pamir, Kirgizia, n = 260). In the analysis of geographical variability the sex, age and seasonal forms of variability were considered. The data were treated statistically. The body mass and body size (without the tail) in each species increase from the south to the north and also with elevation above the sea level. The established variability patterns were analyzed in terms of ecogeographical variability rules. The variability pattern is in conformity with the Bergman rule.

Biology, behaviour and breeding of black-capped marmots (*Marmota camtschatica*, Pall.) in captivity

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The study of the settlements of black-capped marmots in Kamchatka carried out in 1980-1993 has shown that their home ranges include two necessary elements (two subranges): alpine

meadows and massive accumulations of large boulders and scree. The first subrange provides marmots with high-quality food till mid-September, practically, right up to the onset of hibernation (late September). Each family possessed 1 to 2 winter burrows, 5 to 7 summer burrows and 15 to 20 temporary ones. The overall length of a branched net of passages of a winter burrow excavated by us was 54 m, the depth of their location being 0.7 to 1m. The dimensions of the nest chamber located approximately in the geometric center of the burrow were 51 x 51 x 74cm. Refuge burrows have usually one passageway 1.5 to 2 m in length. A small marmot breeding farm was organized in 1991 at the base "Vershinskaya". Initially there were formed 20 pairs of marmots captured by us in the Sredinny ridge, 13 of them being pubescent. In 1992 four and in 1993 three of them had litters. The number of pups in a litter was 2 to 8.

Population dynamics and *Marmota bobac* number in Ukraine

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Since the beginning of the 20-30-ties of our century the *M. bobac* area in the Ukraine extended at a rate of 15-20 km every 20 years. There is observed a rapid growth of Kharkov population, where the number of animals increased from several tens of specimens at the beginning of our century to tens of thousand individuals. A similar splash in the animal number and the area territory is observed in Lugansk region. *M. bobac* number in Lugansk region achieves 54.000 specimens. The All-Ukrainian reserve of the species is about 100.000 individuals. Three zones are observed in each population. First of them is the center of the area with the radius of 15-20 km where all suitable territories are occupied by *M. bobac* home ranges. The population density in this zone is more than 0.4 fam/ha. The second zone occupies next 10-15 km of the territory and is characterized by an incomplete population, its density being from 0.1 to 0.4 fam/ha. The third zone is the border of the area 5-8 km wide where one can find *M. bobac* in small groups (the density <0.1 fam/ha). Besides the *M. bobac* population in Kharkov and Lugansk region there are two more populations in the Ukraine. They are dislocated in the reservation "Askania-Nova" (Kheron region) and Nicolayev region.

Marmots populations in Russia: perspectives of preservation and management

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Four species of marmots dwells in Russia. They occupy regions with different climate conditions, social-economic situation and so on. The strategy of preservation and exploitation of marmots populations needs in special approaches. *M. camtschatica* live in regions of North-East of Asia. Here density of people is low and the most of marmots settlements do not feel anthropogenic influence. At the same time perspectives of their hunting exploitation are insignificant. The number of *M. sibirica* in Russia is not great. Some populations of this species were exterminated during unplug measures. The populations of *M. baibacina baibacina* need the more exact registration for optimal preservation and hunting exploitation. *M. baibacina* is the endemic of Western Siberia. This subspecies live in agricultural landscapes. Data of marmots number and dwelling are meagre and need in more detailed investigations. *M. bobac* was exterminated in the first part of the century. It dwells in regions of intensive agriculture. Now its number restores in some regions. Here marmots destroy crops and their number needs in regulation. At the same time the most part of area is free from animals.

Distribution of *Marmota camtschatica camtschatica* Pall. in the Kamchatka peninsula

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During field studies carried out in Kamchatka in the period from 1980 to 1993, marmot colonies were mapped: 46 home ranges on the territory of 1460 ha at the Upper Jurtinnaya river and 23 home ranges on the area of 2400 ha at the Upper Bystraya (Kharyuzovka) river in the Sredinny ridge; in the region of Vershinskaya mountain, 6 to 7 home ranges (only 3 of them

were inhabited) on the territory of 100 ha; in the Kronotsky reserve 45 colonies were found (among them 35 inhabited) on the area of 964 thousand ha; in the north-eastern part of Kamchatka (in the vicinity of Tolmatshew lake) 17 home ranges were mapped (6 inhabited ones) on the territory of 1200 ha. Not a single marmot settlement was found in a littoral zone along the south-eastern sea coast. Typical marmot habitats are mountain ridges and shallow valleys, sea-facing slopes of coastal terraces and mountain river valleys.

The current status of black-headed marmot population on Kamchatka

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The black-headed marmot is distributed in mountain areas from south to northward of the Peninsula. The ice circuses, volcanic plateaus and ancient lava streams, rocky seashores are the main marmot habitat. The population density in the favourable sites is more than 20 individuals per 1 km², in contrast with less than 10 individuals in the unfavourable sites. The available area for marmot habitat on Kamchatka is about 15.000 km². The total number of marmots is not more than 100.000 individuals occurred 10%-70% of available habitat. One marmot family consists of 3 to 12 individuals, average 8. The number of juveniles is 3-7 individuals per family, that is 54-56% of marmot colony. Population increase is limited by feed resources, late thawing, disease invasions, catastrophic eruption. Now, the grazing of domestic caribous and non permitted hunting are the major limiting factors. Commercial and sport hunting are conducted only in few sites. To protect the black-headed marmot and for rational management optimal terms of hunting and harvest of not more than 20-25% of total abundance are established. One refuge and 3 protective areas are organized on Kamchatka.

Body temperature and metabolism level in hibernating marmots (*Marmota camtschatica* Pallas, 1811)

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In experimental conditions the body temperature of hibernating marmots was always below + 5. 0°C. The temperature of front body part fluctuated from 1.8 to 5.5°C when the rectal temperature was 0.9-3.5°C. The body temperature increasing during arousal is irregular. Rectal temperature began to increase when the intersoulder blade temperature reached 27-28°C. The body temperature decreasing during entrance into hibernation proceeded now slowly, now rapidly for approximately 24 hours. Average daily and annual energy expenditures in juveniles were lower than in year-old and adult animals. It is known that marmots hibernate together. In our experiments, the energy expenditures in single individual independently of sex and age and at the same ambient temperature were higher than in group from 4 animals. If the body mass reduction in a single marmot was 46, 26-50, 37%, the animals keeping in group reduced their body mass only by 24, 34-34, 09% .

The density and demographic structure of the black-capped marmot (*Marmota camtschatica* Pall.) in the North-Eastern Yakutia

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The main centres of the black-capped marmot habitats in Yakutia are situated in Verkhoyan, Chersky, Minsky mountain ranges. Population density varies from 3 to 19, average species number is 9 individuals per 100 km². Marmot concentrations reach 13 individuals per 10 km² in the most favourable places of Kharaulakh mountains (S=54 km²) and 9 individuals in Central Verkhoyan (S=72 km²). Quantity of one colony is 8-23 mammals of different ages. The basis of colony are 1-5 families. The marmot's family consists 3-6 individuals (average number 4.6) in Kharaulakh mountains and 2-7 (average 4.5) in Central Verkhoyan. 42% of all marmots live one by one or in pairs in Kharaulakh, and 57% in Central Verkhoyan. Adults form 35.6% of the colonies, marmots older, than 2 years old, but

sexually immatures: 10,2%; individuals at one year old: 10,2%; and juveniles: 44% of the colonies in Central Verkhoyan. Only 2-4 cubs (average 2,9) survive at the end of summer in Kharaulakh mountains, 1-5 cubs (average 2,8) in Central Verkhoyan. Maximal registered age of the marmot in Kharaulakh mountains is 6 years old.

Spatial structure of the Kamchatka marmot (*Marmota camtschatica*) in the Far North-East of Russia

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The Kamchatka marmot is related to the mountain inhabiting the Far North-East (FNE) in the higher mountain Zones (Zheleznov, 1981, 1991, 1993). The landscape distinction of the region determines the differentiation of phytocenosis. And it in its turn determines the marmots' location in the mountain elements and vegetation zones. In the boreal taiga zone, in the forest tundra the Kamchatka marmot biotopes are placed in the mountain ranges (Koriakia, Kamchatka, Magadanski and Yakutia) mainly higher than the forest belt or on its borders, and within 600 or 1.200 m above sea level, and it coincides with the snow sheep zones. In the mountain tundra area (Chukotka) the marmot populations have been observed within 400-500 m of the *goltsy* and *sub-goltsy* zones' borders. Next to the Arctic ocean coast the altitude space goes to 400 or 200 m and farther to the south (Okhotomorie) the marmot inhabits the subalpine region. All over these areas the spatial structure of the marmot population only presents a mosaic pattern. When the young grow up, they begin to settle in the nearest suitable territories. In this case the mosaic type of the spatial structure changes for a diffusional one. Then it transforms back and the settlement area broadens.

Immunodiffusion difference between *Marmota menzbieri* and palearctic marmots

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The degree of relatedness of the *Marmota menzbieri* to the other Palearctic marmots was estimated by the method of immunodiffusion with the use of antiserum against five marmot

species. It was established that *M.menzbieri* is closely related to the red marmot from Kazakhstan, somewhat different from the grey marmot from Koch-Agach and that it has little in common with *M.camtschatica* from the Baikal, bobac from Uljanovsk and tarbagan from Tuva with respect to the antigenic structure of serum proteins. Use of blood samples from marmots from 22 geographical sites allowed us to identify differences in geographical forms within all the studied species. In the present study, by means of absorption of antiserum with the serum of marmot *Menzbieri*, immunodiffusion differences were established for the first time between bobacs from three distribution ranges and between two populations of red marmots. Distinct differences were detected between three subspecies of *M.camtschatica*, between these marmots and animals from northern and southern Yakutia.

The role of Marmots in landscape transformations since Pleistocene till present times

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In all parts of its area *Marmota* form specific zoogenic landscapes that remain stable throughout hundreds and thousands of years. Pleistocene Marmot fossils are widespread in the south of Eurasia. In late Pleistocene marmots were more common than now. Abundant Marmot remains and evidence of burrowing activities have been preserved in Periglacial zone. In ancient settlement areas and zones densely populated by Marmots a specific landscape is created whose morphologic forms, microclimate, soils and vegetative communities are determined by Marmot burrowing activities. These activities are very intense. Different types of Marmot activities lead to formation of hills (*butans*), specific dug-up "Marmot soils". This results in diverse and complex plant associations that differ from native ones.

The behaviour of Alpine marmots (*Marmota m. marmota*) under different hiking pressures

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In the region of Grindelwald/First in the Swiss Alps some behavioural aspects of alpine marmots were studied under different hiking

pressures. Due to the stop of the chair-lift in the study site, the two situations of high and low hiking pressure could be compared. It was found that different hiking pressures have a distinct impact on the behaviour of alpine marmots, in terms of a different amount of animals staying out of their burrows and also of a different amount of animals foraging. In another analysis the distances of the marmots from the hiking path in the early morning, before the first hikers appear, were compared with those later in the morning, when the hiking path is highly frequented. The results showed that early in the morning the animals stay closer to the hiking path than later in the morning, under a high hiking pressure.