7 Säugetiere

7.1 Lemmings in the North-Western Taimyr Arctic Tundra: Population Density, Distribution of Territories and Relationships with other Animals

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Introduction

Cyclical lemming densities (3-4 years) have a significant influence on the reproduction rates of both mammalian and bird predators, as well as, an indirect effect (by varying predator pressure) on the breeding success of geese and wader species. Notwithstanding the publication of papers relating to lemming biology (SDOBNIKOV 1957, KUKSOV 1975, ORLOV 1985, KOKOREV and KUKSOV, in press), the siberian lemming *Lemmus sibiricus* and the collared lemming *Dicrostonyx torquatus* , have been very poorly studied, in the Taimyr Peninsula arctic tundra. Therefore, an investigation of lemming dynamics in association with other mammalian and ornithological observations, is timely . The initial results of such a study are presented in this paper.

This paper briefly discusses the problems relating to the association between lemmings and the other inhabitants of the arctic tundra, and the level of lemming abundance during the study period. It was the aim of other scientists in the expedition to make detailed investigations on specific species.

Study area, materials and methods

The study was undertaken in the arctic tundra of north-western Taimyr, situated on the coast of the Pjassina Gulf. The study was part of joint investigations by the 'International Arctic Expedition' of the Institute of Evolutionary Morphology and Animal Ecology, Russian Academy of Sciences. The first research camp was established in 1990 at the mouth of the Lydia River (74 07' N, 86 50' E), the second between 1991-93 moved further north, to Vostochny Cape.

The general study area covered almost 10 km^2, of both coastal mainland and Farvaterny Island, and included 6 main habitat types:

a. Low willow-grass (sedges and grass) tundra (WG); with a high water content. The main plant species: *Salix reptans, Carex concolor, Carex bigelowii, Arctagrostis latifolia, Poa arctica, Sphagnum sp., Caliergon sarmentosum.*

b. Sedge-moss tundra (SM); in lowland areas and on the banks of streams and small rivers. Plant cover consisted of: *Salix polaris, Dicranum elongatum, Polytrichum alpestre, Ptilidium cilliare.*

c. Polygonal swamps (PO); this habitat type, which is poorly represented in the arctic tundra, consists of low (80-100 cm high) moss mounds surrounded by flooded grassy areas. The main species are: various species of *Musci (Sphagnum, Polytrichum, Dicranum)* and *Carex concolor, Eryophorum medium, Dupontia fischeri.*

d. "Hillock" lichen-moss-grass tundra (HI) with Dryas; usually found at the foot of slopes or small elevations. The main plant species: *Carex bigelowii, Dryas punctata, Tomenthypnum nitens, Thamnolia vernicularis*. The "finely hillock" tundra with a predominance of *Cassiopa tetragona, Eryophorum polystachium, Chandonantus setiforme* is considered a variation of this type of habitat.

e. "Spotted" relatively dry lichen-moss-grass tundra (SP) on hills and elevations. The plant cover includes: *Dryas punctata, Salix arcticus, Tomenthypnum nitens, Racomitrium lanugenosum, Thamnolia vernicularis, Caldonia sp.*

f. Stony areas (ST): rocky and stony slopes with prevalence of *Lofphozia sp., Cladonia sp., Cetraria cuculata, Dactylina arctica.*

The study periods were 12 June to 28 June 1990, 10 June to 9 August 1991, 5 June to 1 July 1992 and 7 June to 11 August 1993.

Lemming densities were estimated using both live-trapping and dead-trapping methods, on lines and small sites (0.02-0.25 ha) using a large number (150-200) fast-shutting traps (TUPIKOVA and EMELYANOVA 1975). The traps were placed beside holes which showed signs of habitation, or alongside lemming tracks. The trapping results are expressed both as, numbers of individuals caught per 100 trap-nights and numbers of individuals per ha. The age of live lemmings was determined by weight, and dead lemmings by skull measurements, and the knitting of skull bones (DUNAEVA 1947, KOSHKINA and KHALANSKII 1961, ORLOV 1985).

In order to study the habitat selection of lemmings in previous years, the number of holes and winter nests per m² were estimated in the different habitats. The average values were then calculated based on the results from between 5-10 squares of 5x5 m within each habitat type. Transects of between 8-30 km were set, along which all lemming sightings were noted, and data collected relating to breeding arctic foxes, owls and skuas. Fresh bird pellets were also collected along these transects.

During the entire study period, 33 account plots and 17 trap lines were established. Nearly 17,000 trap-nights were worked. In 1990, 13 siberian lemmings (SL) and 2 collared lemmings (CL) were caught. In 1991, 164 SL and 24 CL and in 1993, 22 SL and 11 CL were caught . Data from the end of June 1992, was obtained by A. MOROZ, who trapped on the first snow free plot near Vostochny Cape, where 3 SL and 3 CL were caught.

Results

Spring weather conditions in 1990 were characterised by a rapid snowmelt, and relatively warm mean maximum temperatures during June and July.

In the middle of June, 64% of the territory was snow free, however only the highest areas were dry, containing unflooded lemming holes. Trapping elevated sites revealed an absence of lemmings on rocks (2-3 km) and at Vostochny

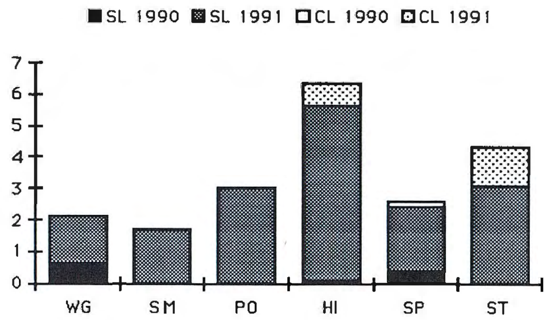


Fig.1. Average lemming densities during 1990 and 1991 in different habitats (number of lemmings per 100 trap-nights). Abbreviations see text.

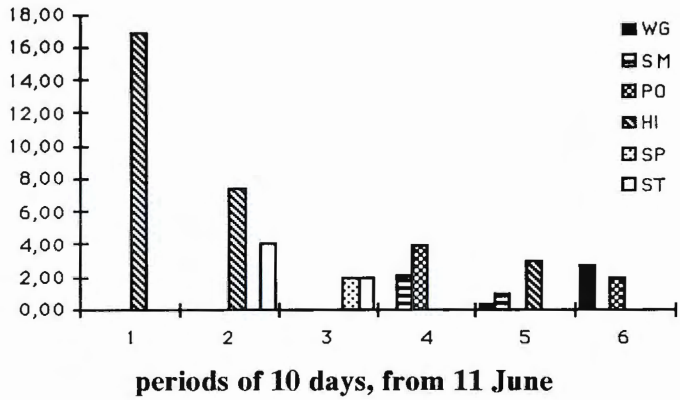
Cape (3km). The first animals (6 SL and 2 CL) were discovered on the hill (1.5 km) in "spotted" tundra habitat. These individuals were marked using both by toe and fur clipping. The lemmings disappeared from the trapping site by the beginning of July. One lemming was caught on the Lydia River coast, 18 days after disappearing from the previous site. This individual moved 3 km and crossed three 10 metre wide rivers. As more areas became snow free, further surveys were carried out on Farvaterny Island (2 km) and on different types of low tundra at varying distances from the camp. Few lemmings were caught. The only group of 5 SL was discovered on the Lydia River coast (1 km) in hillock and join willow-grass tundra. Two SL were caught by hand in a similar biotope. 8 SL were also seen on the long transects. Thus, during the summer of 1990, lemming abundance was low.

Over the total area: 0-1.3 SL individuals and 0-0.4 CL per 100 trap-nights on various sites (Fig. 1).

Other members of the expedition reporting that similar situations existed from various areas on Sibiriakov Island. Only 9 SL were caught during the summer of 1990, and no lemmings were encountered in the delta of Niznia Taimyra River or Sterligova Cape. In the typical tundra of the Pura River area, lemming numbers were described by Norilsk zoologists as moderate.

Greater numbers of male lemmings were caught than females (69.1% for SL and all of the CL). The lemmings weighed between 30 and 62 g, apparently all the individuals were from the spring generations (from March to the beginning of May). Most of the males and all of the females of SL were in active breeding stages,

a.



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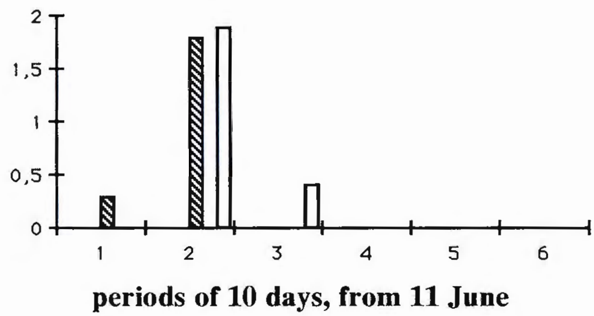

Fig.2. Densities of Siberian lemmings (a) and Collared lemmings (b) during summer 1991 (numbers of individuals per 100 trap-nights). Abbreviations see text.

and one female also had 6 old (April?) placental scars. Data about the predominance of spring generations and intensive summer reproduction led us to assume that lemming numbers, in this region, would increase the next year.

The effect of low lemming numbers on predators such as, arctic foxes, nesting pairs of snowy owls and pomarine skuas, was not evident in the study area. Two nests of long-tailed skuas were registered, however no remains of lemmings were found in the fresh pellets. In contrast, the breeding of geese and waders, as data of the expedition's ornithologists testified, was very successful (SPAANS et al. 1993).

At the beginning of June 1991, SL numbers were high. Animals under snow were ousted by spring water, and congregated on the snow free sites. In hillock tundra on Vostochny Cape the density of this species was between 136-156 individuals per ha, or 16.8 individuals per trap-night (see Fig. 2a).

In comparison to 1990, the snow melt and stable positive temperatures were delayed in 1991, by between 10-14 days. Competition for shelter and the lack of food caused high stress levels and led to mass SL deaths: 0.02 dead individuals per m^2 near Vostochny Cape. The possibility of an epidemy as the cause of this mass death cannot be ruled out as a number of ectoparasites and some pato-anatomic changes to internal organs were found in several individuals. During the last year at Lydia camp, in the damper hillock tundra, actual SL numbers were considerably higher, as was the level of mortality (approximately 2-3 dead SL per ha. at some sites). As a result SL abundance in various habitats was moderate from July until the beginning of August, (16-52 individuals per ha., 1.7-4.1 individuals per 100 trap-nights), and in some places numbers were low (4-12 individuals per ha., 0.3-1.0 individuals per trap-night).

Similar mass deaths were not noted for CL. In June densities of this species around Vostochny camp were between 8-32 individuals per ha., 0.3-1.8 individuals per 100 trap-nights. Later in the study, CL were only caught in stony habitats (0.4-1.9 individuals per 100 trap-nights, Fig. 2b).

The territorial distribution of lemmings during

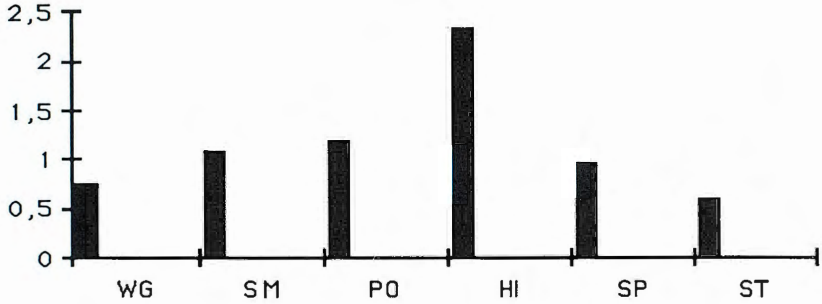

Fig.3. Average densities of lemming holes during 1990 for different habitats (numbers per m^2). Abbreviations see text.

the summer was not stable. As the data on winter lemming nests and observations show, both species prefer to hibernate in low willow-grass tundra with deep snow cover and a sufficent food supply. In the spring the lemmings migrated to higher dry plots, then towards the middle of summer SL concentrated on the low polygonal tundra and hillock habitats along banks and rills (Fig. 2a). In contrast CL moved to stony places (Fig. 2b). Similar seasonal migrations have been described for these species in typical tundra (ORLOV 1980). In typical tundra, however, polygonal swamps were the most preferred summer habitat for SL, whereas in the study region the largest mean SL concentrations were found in hillock tundra. The average density of lemming holes in 1990 confirms this (Fig. 3). Apparently other habitats in the study area were either too damp or lacked sufficient food.

The June 1991 births of SL, were divided into: 23.6% before winter, 54.5% during winter (February- March) and 21.9 % during spring (April- beginning of May). Births of both males and females, were highest in winter, however the survival rate during winter was higher for the males (Fig. 4). 86.4% of the females were impregnated.

The first pregnant female was caught in the third decade of June. Placental scars for between 1-3 broods were identified in 22.7% of the females (Fig. 5). In July 1991 generations born under the snow formed the basis of the SL population (of the females 33.3% were winter births and 47.6% were spring births, of the males 42.9% were winter births and 42.9% were spring births). Also the survival rate of births from before winter was high (78.1% of June's winter births survived). The survival rate was better for females (67.3%) than for males (40.4%). The breeding peak was observed: 92% of the females were either pregnant or lactating, and all males weighting more than 50g were in a state of active spermatogenesis. In the second decade of July reproduction was the most intensive (100% breeding females), as the surviving third decade winter females concluded reproducing, the under snow females breeding levels began to fall. Litter sizes were between 4 and 9, with an average of 6.4. At the beginning of August the first summer young appeared, as the females from the under snow generations decreased (80% were lactating or had finished lactating). No males or old females were caught during this time.

The correlation of births for collared lemmings; before winter, in winter and in spring (36.8%, 47.4% and 13.8% respectively), was similar to siberian lemmings, however winter survival rates were higher, especially for males (Fig 6). The first pregnant female was caught during the third decade of June.

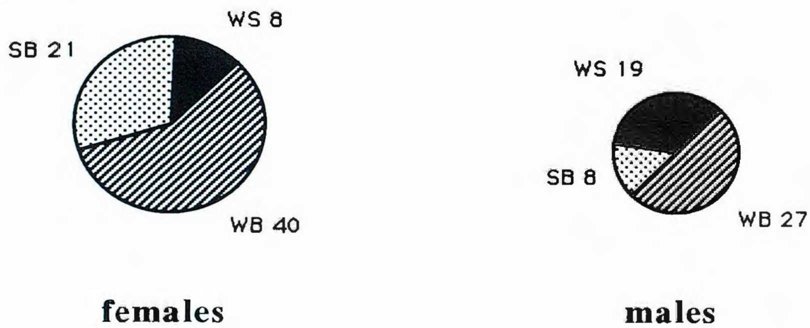

Fig.4. Sex-age structure of Siberian lemmings in June 1991 (WS - winter survivors, WB - winter births, SB - spring births). Abbreviations see text.

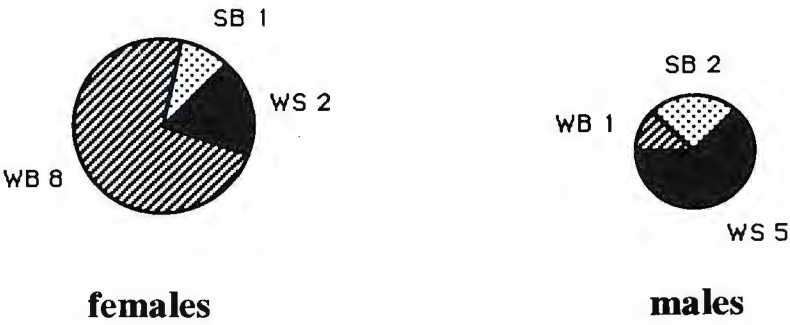

Fig.5. Breeding performance of Siberian lemming females during the summer 1991 (data from dissection). X-axis: periods of 10 day, from 11 June; y-axis: number of females.

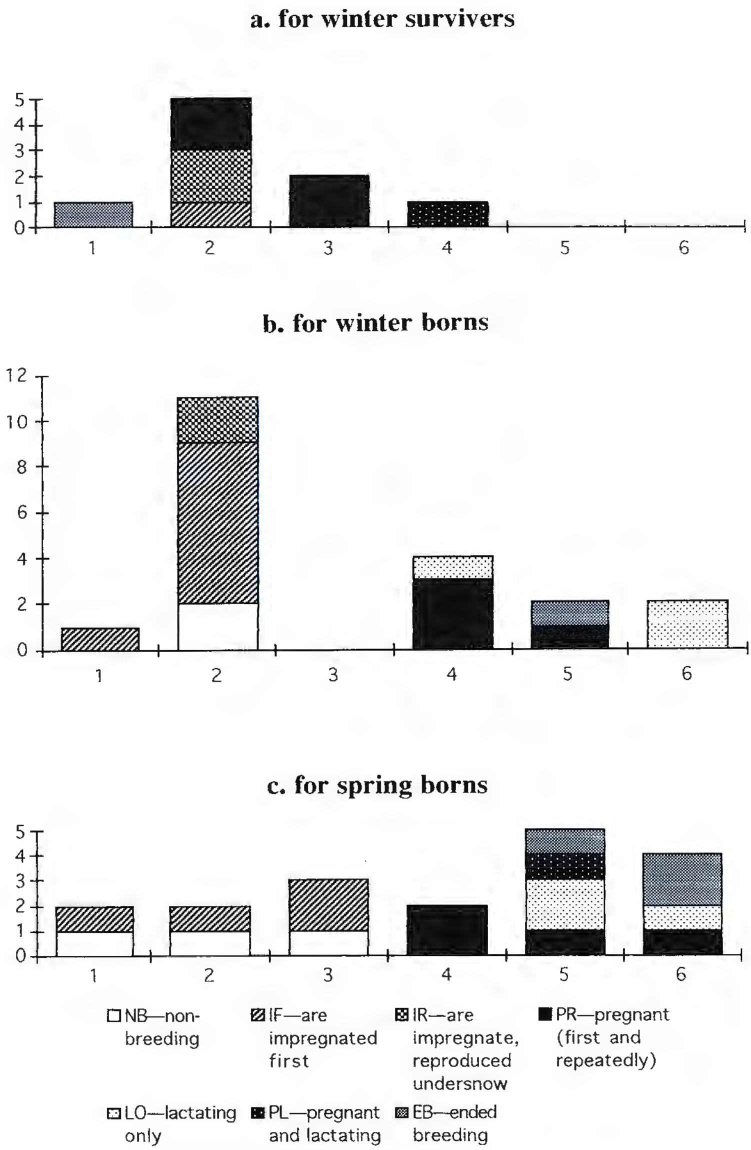

Fig.6. Sex-age structure of Collared lemmings in June 1991 (WS - winter survivors, WB - winter births, SB - spring births). Abbreviations see text.

Within the study area, one snowy owl nest and one rough-legged buzzard nest was found. In the latter, two to four nestlings survived to the end of summer. The density of pomarine skues was, 2 pairs per km^2 (data of P. CHYLARETZKY). Five of the thirteen (46.2%) inspected arctic fox burrows, were occupied (joint data with Y. KOKOREV), the nearest, was inhabited by twelve young. The rapid decline in SL abundance led to an increase in arctic fox predation on other species, including the destruction of 80% of the nests of waders, and the complete annihilation of the brent goose colony at Lydia River (data from Polish and Dutch ornithologists).

Information from verbal reports from other areas on Taimyr Peninsula, indicate that peak densities of SL occurred everywhere. However, although in the arctic tundra on Nizniaa Taimyra River (data of P. TOMKOVICH), at Pronchishcheva Lake (UNDERHILL et al., in press.) and in the typical tundra on Pura River, the high numbers lasted through summer, on Sterigova Cape (data P. PROKOSCH) the spring crash of the SL population was more rapid and extreme, than in the study area.

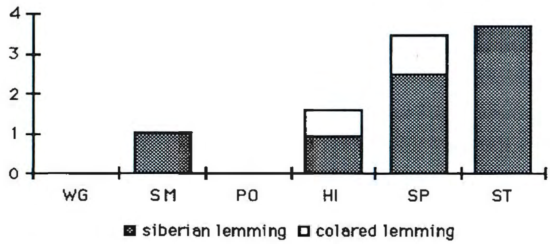

Fig.7. Average densities of Siberian lemmings and Collared lemmings during 1993 in different habitats. Abbreviations see text.

Weather conditions in June 1992 were extremely unfavourable: the mean temperature was minus 3 C, and at the end of June, 90% of the territory was under snow. A decline in lemming numbers was apparent. Only at the end of June were the first animals observed. The density of both SL and CL on the snow free sites, in hillock tundra, were 12 individuals per ha, 0.4 individuals per 100 trap-nights. Between 8 and 12 non-breeding arctic foxes were encountered each day. For most species of birds, nesting was impossible. On Sibirjakov Island, Pronchishcheva Lake and Pura River the lemming situation was similar to the study area (verbal reports from members of the expedition and Norilsk zoologists).

June 1993 was characterised by persistent negative temperatures, a considerable thickness of snow and slow snow melt. Following the release of territory from the snow, inspection of different habitats revealed a relatively low density of both species: 0.78 individuals per 100 trap-nights for SL, and 0.32 individuals per trap-night for CL. The highest numbers of lemmings were caught in hillock habitats (11 of 22 SL and 7 of 11 CL), however catching indices were higher in stony places for SL, and in spotted tundra for CL (Fig. 7). Trapping appears to have undertaken during periods of active lemming migrations to higher levels.

Males were more common than females (59.1% for SL, and 72.7% for CL). During July, all SL males were in a state of active spermatogenesis, and all females were pregnant. Of the females 44.4% had placental scars suggesting relatively intense under snow reproduction. Resorption of embryos also took place in three females. Two of the three CL females were pregnant.

No breeding birds or mammalian predators were noted.

In order to obtain information about lemming abundance and arctic fox hunting, we questioned local fishermen. Despite of the lack of accurate data, it was still possible to determine from both their and our own data, four major phases:

0. Absolute depression: where no lemmings are present.
1. Low densities: few single lemming sightings.
2. Moderate densities: lemmings are common,

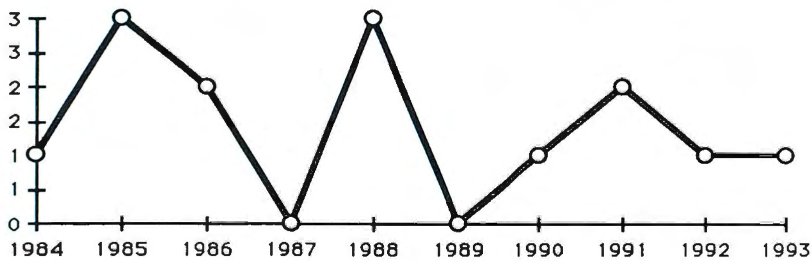

Fig.8. Summer lemming abundance in the Pjassina area (includes both the study results and the fishermen's data)

but number are not high.

3. Peak: lemming numbers are at a maximum everywhere.

The fishermen's information related specifically to SL, as CL numbers are relatively low in this region. Comparing the fishermen's information with our own data, enabled us to propose a three year cyclic pattern for SL population dynamics (Fig. 8). The lemming depressions were in 1984, 1987 and 1989, peak densities occurred in 1985, 1988, 1991. In 1990 and 1992 gradually increases in the SL population were observed.

The decline in SL abundance in 1989 was aggravated by a spring flood. The amplitude of CL density changed during these years and never achieved the range of the SL population. Breeding of arctic foxes followed the SL population fluctuations, and it was noted that fox hunting was not successful during the winters of 1984/85, 1987/88 and 1989/90 after lemming depressions. In the late autumn of 1989 and 1992 migration of arctic foxes to the taiga regions was noted. In contrast during the winters of 1985/86 and 1988/89 after high spring and summer SL densities, hunters trapped high numbers of arctic foxes.

Discussion

Comparing results obtained in our region with the literature, we observed one lemming cycle during the study period, both beginning and ending at a stage of increasing population. For the most part demographic indices during 1990-93 showed a great similarity to those described for our species (DUNAEVA 1947, KUKSOV 1975, CHERNJAVSKY 1979; CHERNJAVSKY and THACHOV 1982, ORLOV 1985, ORLOV et al., 1986) as well as for other species with fluctuating populations (KREBS 1966, KREBS et al., 1969, KOSHKINA 1974, BASHENINA 1977, BEACHAM 1980, WIGER 1982, and others). The prevalence of under snow generations, intense spring and summer reproduction and the early pubescence of young animals were registered in phases of low density with a tendency to increase (1990, 1993). However, the main augmentation occurred in the winter-spring period (1990/91), when a high proportion of under snow generations (in June 1991) and the presence of placental scars from different broods in females of both species, were noted. The determining role of winter lemming breeding for the achievement of peak numbers has been demonstrated by a number of authors (DUNAEVA 1947, MULLEN 1968, CHERNJAVSKY 1975, CHERNJAVSKY and THACHOV 1982, ORLOV 1985).The reproductive possibilities in tundra lemmings, was also shown to precede large increases in densities in a season under snow (KUKSOV 1975). Similar rapid growth of SL populations were observed in 1991 in both the study area and the Niznia Taimyra River. Although in this area, peak densities were not as high as those described for both typical and bushy tundra in the Taimyr (KUKSOV 1975, ORLOV 1985). Apparently this situation in combination with a sharp crash in the spring of 1991, was the basis of a prolonged reduction in the SL population, and was reflected in the continuation of relatively intensive breeding for all age groups in the summer of 1991. The data relating to early cessation of reproduction indicated, on the other hand, the comming population decline, which was confirmed by the data of June 1992.

The territorial distribution of lemmings at any specific time depends to a significant degree on changes in external conditions, such as: rate of snow melt, temperature, accessibility and quantity of food and shelter. Seasonal, not distant migrations, in V. FLINT's (1977) opinion, allow us to mark out special (cyclic) space structures for SL and CL populations. Some of the data obtained showed differences in habitat selection compared to other areas in Taimyr (SDOBNIKOV 1957, KUKSOV 1975, ORLOV 1980, 1985), and indicated poor habitat variety and harsher weather conditions in this region. Distinctions between SL and CL habitat preferences observed both by us and by other authors may be considered one of the important mechanisms which promote species coexistence in a common territory, especially during peak years. This mechanism has been described in detail for voles (RYKHLIKOVA 1988). Other asynchrony in both dynamics and demographic characteristics between CL and SL described in other areas (CHERNJAVSKY & TKACHOV 1982, ORLOV 1985), were also noted in the study area. A comparison between our results and both data collected at the same time in other areas, and in earlier studies (KUKSOV 1975, ORLOV 1985, KOKOREV and KUKSOV, in press.) shows that 3-year cyclisity in lemming densities are peculiar to arctic tundra, such as typical tundra, whereas 3-4 year fluctuating cycles are characteristic for bushy tundra. The period of peak numbers repeats exactly, although the timing and the duration of the other periods vary in different areas and different years. Since the duration of the study was short, it would be premature to draw any conclusions about the reasons for cyclic periodicity in lemming cycles, however we provisionally agree with opinions expressed about the predominant role of internal (self-regulating) mechanisms in this process (CHITTY 1960, KREBS 1964, KREBS and MYERS 1974, KOSHKINA 1974, CHERNJAVSKY 1979, ORLOV 1985). CHERNJAVSKY & TKACHOV (1982) studied CL and SL on Wrangel Island between 1964-1980, tested the hypothesis of endocrine control (CHRISTIAN 1950) and described the importance of the endocrine complex (a factor of the individual organism, which changes at the same time as the demographic indices in the population) in the establishment of lemming cycles. External conditions such as, weather, food supply, predators etc., have a significant influence on the mortality rate of lemmings, especially during the peak years. These factors can also promote or prevent synchrony in the phases of the cycle for different areas (KREBS and MYERS 1974, ERLINGE et al., 1991). In the study area the decline in SL numbers in 1989, was, for example, accelerated by the spring flood. The peak phase in both the study area and Sterigova Cape, in comparison to other areas, was shorter and numbers were not as high. This appeared to be explained by the extremely unfavourable spring conditions, consisting of a combination of low temperatures and snow melt which in turn led to the formation of ice crusts in most parts of the habitat. This led to the concentration of SL on the open small plots with it's associated scarcity of food and shelter. Lemmings were also easy prey for both arctic foxes and birds.

Despite differences views on the role of predators in lemming fluctuations, the interdependence of the two factors is evident (DUNAEVA & OSMOLOVSKAIA 1948, PITELKA et al.,1955, YAKUSHKIN 1964, CHERNJAVSKY and DOROGOI 1981, DOROGOI 1983, LITVIN & BARANJUK 1989). During the study period, predators only bred well in the year of high lemming density (1991). Also successful arctic fox hunting only occurred in the winter following the lemming peak. During this period a large portion of the arctic fox population perished due to tundra rabies and others migrated to the taiga zone after the lemming crash. An estimation of lemming under snow reproduction (from accounts of the stomach contents of arctic foxes in January - March) may be used as a method to determine fox numbers for the following year (DUNAEVA & OSMOLOVSKAIA 1948). A close relationship between predator bird breeding and lemming densities is obvious from the data (50% death of young rough-legged buzzards after a sharp lemming decline, and the absence of nesting birds in years of low lemming numbers). A similar dependence has been noted from Pronchischeva Lake (UNDERHILL et al., in press.). Periods of low lemming numbers can be very critical for the breeding success of waders and geese (CHERNJAVSKY 1967, SYROECHKOVSKY 1972, SUMMERS 1986, SUMMERS & UNDERHILL 1987), however the whole complex of natural factors should be examined in order to predict the a bird's reproduction success (EBBINGE 1989, EBBINGE et al. 1982, GREENWOOD 1987, SYROECHKOVSKY et al. 1991).

In conclusion, the estimation of demographic indices of lemming populations together combined with weather conditions during critical periods and the intensity of predator breeding, can be used for short-term estimation of lemming abundance.

Acknowledgements

This study was supported by the Institute of Evolutionary Morphology and Ecology of Animals, of the Russian Academy of Sciences. We thank Professor. E. E. SYROECHKOSKY for providing us with the possibility to undertake this work. We are also grateful to B. EBBINGE, B. SPAANS and S. DAAN for valuable discussions about the data. Prof. V.B. KUVAEV is thanked for help in the botanical descriptions of habitats. We also thank B. SCHEFTEL, A. MOROS, K. BURSKAIA and H. SCHMAUDER for their assistance in fieldwork. Lastly D.M. FLEET and J. G. KELLER for editing the English version.

Summary

The ecology of the siberian lemming (SL) *Lemmus sibiricus* and collared lemming (CL) *Dicrostonyx torquatus* was studied during the summers of 1990-1993 in the arctic tundra of north-western Taimyr, situated on the coast of the Pjassina Gulf (74 07' N, 86 50' E). SL numbers greatly exceeded CL. In 1990 SL abundance was low: 0-1.3 individuals per 100 trap-nights. During the following year there was a trend towards an increased population. However, the peak in 1991 was extremely short, as during June in the snow melt period, there was a sharp decrease from peak to moderate densities (from 16.8 individuals per 100 trap-nights to 0.3-4.1 individuals per 100 trap-nights until the beginning of July). A massive SL spring mortality due to unfavourable spring weather conditions was observed. In 1992 the decline in numbers continued. In 1993, for SL an increasing phase occurred: with average numbers of 0.78 individuals per trap-night. CL numbers were low during all years: 0.3-1.9 individuals per 100 trap-nights with fluctuations never achieving a high amplitude. Seasonal migrations of both species relating to environmental changes were marked. SL preference for hillock tundra, and CL for stony habitats was recognised. Demographic indices in relation to each cycle phase was studied in detail. The importance of under snow reproduction for lemming abundance was confirmed. Arctic foxes and birds of prey bred only during 1991. A comparison of data with other areas on Taimyr, and information from fishermen from the previous year allowed us to conclude that a 3 year lemming cycle existed, with a constant peak but with variations in the other phases.

Резюме

Лемминги в арктической тундре Северо-Западного Таймыра: численность популяций, распределение территории и взаимоотношение с другими животными.

Летом 1990-1993 гг. в арктической тундре на побережье дельты Пясины (74°07' с.д. и 86°50' в.ш.) на северо-западном Таймыре были проведены исследования экологии популяций сибирского лемминга Lemmus sibiricus и копытного лемминга Dictrostonyx torquatus. Сибирский лемминг постоянно наблюдался значительно чаще чем копытный лемминг. В 1990 году наблюдалась лишь небольшая плотность сибирских леммингов, 0-1,3 отловленных особей/100 лов.-ноч. В последующие годы популяция возросла, но максимальной численности достигла лишь на короткое время. Уже в июне, во время снеготаяния, численность популяции резко сократилась (с 16,8 особей/100 лов.-ноч. до 0,3-4,1 особей/100 лов.-ноч. в начале июля). Наблюдаемая весенняя смертность сибирского лемминга была очевидно связана с неблагоприятными погодными условиями. В 1992 году продолжалось снижение численности популяции. В 1993 году наблюдался вновь период оправления численности популяции сибирского лемминга, со средней численностью 0,78 особей/100 лов.-ноч. Численность копытного лемминга была в течение всех этих лет низкой, с незначительными отклонениями: 0,3-1,9 особей/100 лов.-ноч. Далее были исследованы и сезональные миграции обоих видов в зависимости от изменений, происходящих в местах обитаний.

При этом было установлено явное предпочтение сибирскими леммингами кочковой тундры в отличие от копытных леммингов, обитающих чаще в каменистых местах. Также были приняты во внимание и демографические факторы, возможно играющие определённую роль во время различных популяционных фаз. При этом было вновь подтверждено особое значение размножения, происходящего под закрытым слоем снега.

Песцы и дневные хищные птицы размножались в районе исследований лишь в 1991 году. При сравнении с данными других регионов Таймыра и информацией, полученной от местных рыбаков, напрашивается вывод о том, что пик в развитии популяций леммингов наступает в регулярном 3-х годичном ритме (что сопровождается " хорошими" годами песца и дневных хищных птиц), но при этом могут промежуточные фазы быть очень различными.

Zusammenfassung

Studien zur Populationsökologie des Sibirischen Lemmings *Lemmus sibiricus* und des Halsbandlemmings *Dicrostonyx torquatus* wurden in den Sommern 1990-1993 in der arktischen Tundra an der Küste der Pjassina Mündung (74 07' N, 86 50' E) in Nord-West Taimyr durchgeführt. Zu allen Zeiten waren Sibirische Lemminge wesentlich häufiger anzutreffen als Halsbandlemminge. 1990 kamen Sibirische Lemminge mit 0-1,3 gefangenen Exemplaren/100 Fallen-Nächte nur in geringer Dichte vor. Im Folgejahr wuchs die Population, erreichte aber nur für kurze Zeit Spitzenwerte. Bereits im Juni, zur Zeit der Schneeschmelze, sank der Bestand wieder rapide ab (von 16,8 Exemplaren/ 100 Fallen-Nächte auf 0,3-4,1 Exemplare/100 Fallen-Nächte Anfang Juli. Die beobachtete hohe Frühjahrs-Mortalität Sibirischer Lemminge hing offenbar mit ungünstigen Witterungsbedingungen zusammen. 1992 setzte sich die Bestandsabnahme fort. 1993 wurde mit durchschnittlichen Werten von 0,78 Ex./100 Fallen-Nächte wieder eine Erholungsphase der Sibirischen Lemming-Bestände beob-

achtet. Die Anzahlen von Halsbandlemmingen war in allen Jahren niedrig: 0,3-1,9 Exemplare/100 Fallen-Nächte mit nur geringen Abweichungen. Ferner wurden auch saisonale Wanderungen beider Arten in Abhängigkeit von Veränderungen im Lebensraum untersucht. Dabei wurde ein deutliche Bevorzugung bultiger Tundra durch Sibirische Lemminge im Gegensatz zu steinigen Habitaten durch Halsbandlemminge festgestellt. Demographischen Faktoren, die während der verschiedenen Bestandsphasen eine Rolle spielen können, wurde ebenfalls nachgegangen. Dabei wurde die besondere Bedeutung der sich unter geschlossener Schneedecke abspielenden Reproduktion erneut bestätigt.

Polarfüchse und Greifvögel brüteten im Untersuchungsgebiet nur 1991. Vergleiche mit Daten aus anderen Gegenden Taimyrs und Informationen von örtlichen Fischern legen den Schluß nahe, daß in regelmäßigem Rhythmus von 3 Jahren ein Bestandshoch der Lemminge (begleitet von guten Fuchs- und Greifvogeljahren) eintritt, die Zwischenphasen aber sehr unterschiedlich sein können.

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