COLLARED LEMMING ABUNDANCE, DIET AND MORPHOMETRICS ON BANKS ISLAND, 1993-1996

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ABSTRACT

Collared lemming (*Dicrostonyx torquatus*) abundance was documented during summers 1993-1996 at two locations on southern Banks Island. Lemming numbers were high in summer 1993 and summer 1996. The highest density was in 1993 when a mean of *ca.* 9 lemmings were caught per 100 trap nights of trapping. Lemmings were virtually absent during summers 1994 and 1995. The years of high lemmings on Banks Island were also years of high lemmings throughout the western mainland of the Northwest Territories. Lemming diet was determined by analyzing plant fragments from stomach contents of animals trapped in July and August 1993. *Dyras integrifolia* dominated the diet in both months. *Salix arctic*, sedge (*Carex* spp.) and various forbs represented the remaining ≤10% of the diet. Twenty-seven males, 25 females, and 1 lemming of unknown sex were trapped during summer 1993-1994, dissected, weighed and measured. Total weights ranged from 18.4-87.1g, gastrointestinal tract (GIT) weights ranged from 4.2-28.1g, total lengths ranged from 8.2-15.8cm, and hind foot lengths ranged from 1.2-1.9cm. There were significant ($P<0.02$) sex effects in pelt weight, male pelts weighed less than female pelts, 2.1-13.8g (median 6.3g) versus 4.7-11.8g (median 9.1g), respectively.

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INTRODUCTION

At the request of local residents and the Hunters' and Trappers' Committee of Sachs Harbour, the then Department of Renewable Resources initiated a 5-year range study in 1993. Its main objectives were to determine the availability of a variety of different forages and habitats, how availability changed on a seasonal basis, and how the two major ungulate species, Peary caribou (*Rangifer tarandus pearyi*) and muskox (*Ovibos moschatus*) utilized the available habitats and forages. One component of the research was to evaluate how other small herbivorous mammals, lemmings and arctic hares (*Lepus arcticus*) may impact available forage. Although both brown (*Lemmus sibiricus*) and collared lemmings (*Dicrostonyx torquatus*) are found on Banks Island only collared lemmings were trapped during the course of the study. Therefore, this report documents the abundance over 4 summers, the summer diet, and the morphometrics of collared lemmings.

METHODS

In June, 1993, two field camps were established on southern Banks Island in areas of low (*ca.* 0.41/km^2) and high (*ca.* 1.64/km^2) muskox density (Fig. 1). Lemming abundance was determined at both sites during mid-July and mid-August (Table 1). At each site a 1 km long index line of traps was set up which consisted of 20 stations located 50 m apart (adapted from Gilbert and Krebs, 1994). Each station contained 3 snap traps baited with peanut butter. Index lines were located in a dry, well drained habitat. *Dryas integrifolia* and arctic willow (*Salix arctica*) were the dominant vegetation.

Traps were set for differing amounts of time, because of variable weather and logistic constraints (Table 2). During August the index lines were moved and ran in a direction approximately 180° from that used in July. The start of each index line was located using a global positioning system so that the lines were located within 10m of the original positions in each successive summer. After a period of one or two nights the trap line was checked. Sprung traps were counted, rebaited, and reset. Trapped animals were identified to species, sexed, and weighed. In 1996 there was evidence of trap robbing by predators. In 5 instances I included a trapped animal for the analysis when no carcass was present. In each case there was fresh blood and/or remnants of hair/paws that had not been there when the trap was previously checked. which indicated an animal had been trapped. Arctic foxes (*Alopex lagopus*), snowy owls (*Nyctea scandiaca*), long-tailed jaegers (*Stercorarius longicaudus*), pomarine jaegers (*S. pomarinus*), and rough-legged hawks (*Buteo lagopus*) were all abundant during summer 1996. All carcasses collected during 1993 were kept frozen prior to being transported to the laboratory in Inuvik where they were further processed. All carcasses collected from 1994 through 1996 were sexed and weighed in the field to the nearest 1g with a pesola spring scale (50g or 100g)

One trap night (TN) was defined as one baited trap being set over one night. Therefore, if all traps were baited and functioning over one night each index line should provide 60 TN. Occassionally broken traps resulted in <60TN on any given night (Table 2). I calculated a density index expressed as the number of lemmings caught/100 TN (Gilbert and Krebs, 1994).

Stomach contents from 12 animals were used for the diet analysis, 3 samples from each site/month combination. Lemming stomach contents were thawed, air dried for 24 hours, oven dried at 60° C for 48 hours, and ground through a 1 mm screen with a centrifugal mill. Samples were forwarded to the Composition Analysis Laboratory, Ft. Collins, Colorado for analysis. Diet composition was determined by analyzing plant fragments (Sparkes & Malechek, 1968) according to Hansen *et al.* (1976). Plant fragments were grouped into the following forage classes: sedge (*Carex* spp.), willow (*S. arctica*), grass (Gramineae), rose (*Dryas integrifolia* and *Saxifraga* spp.), legume (Leguminosae), and other (other forbs, moss, and *Equisetum* spp.). The data are presented as mean percent relative density.

Frozen carcasses were thawed, sexed and weighed to the nearest 0.1g on a Mettler electronic balance. Total length, from the tip of the nose to the tip of the tail, and hind foot length was measured to the nearest 1mm. Carcasses were skinned and the pelt weighed to the nearest 0.1g. The gastrointestinal tract was removed and weighed to the nearest 0.1g. The number of progeny (if present) was counted in females, and the testes length of males was measured to the nearest 1mm. I used a Kruskal-Wallis test to determine if there were significant sex differences in any of the weights and measures.

RESULTS

Eighty-two lemmings were trapped during the 4 summers (54 at Site #1 and 28 at Site #2); 41 males, 35 females, and 6 of unknown sex. All trapped lemmings were collared lemmings (*Dicrostonyx torquatus*). Lemming abundance was high in 1993 and 1996, with a denisty index of 8.95 and 3.81 respectively. During both 1994 and 1995 the density index was <0.2 (Table 2); 1 male was caught in each year.

Lemming diet was dominated by *Dryas integrifolia* regardless of month or location (mean 88.8%, SE 1.62, n=12) (Table 3). Dietary willow (*S. arctica*) ranged from *ca.* 1-11% while dietary sedge (*Carex* spp.) ranged from *ca.* 0-12%. Various forbs made up the rest of the diet. Grass and legume use was negligible (Appendix 1). Lemmings from Site #1 tended to have more sedge in the diet than lemmings from Site #2 whose diet was almost exclusively *D. integrifolia* and *S. arctica* (Table 3).

Only pelt weight showed significant ($P<0.02$) sex effects with female pelts weighing more than male pelts, range 4.7-11.8g (median 9.1g) and range 2.1-13.8g (median 6.3g), respectively. Other morphometric measures were: i) total weights, ranging from 18.4-87.1g, median 44.1g, ii) GIT weights ranging from 4.2-28.1g, median 12.3g, iii) total lengths ranging from 8.2-15.8cm, median 11.4cm, iv) hind foot lengths ranging from 1.2-1.9cm, median 1.6cm, and v) testes lengths ranging from 2-8mm, median 3mm (Appendix 2). There was a wide range GIT weight as a percentage of the total weight, 16.8-41.3% (median 25.3%).

DISCUSSION

Zoltai *et al.* (1980) believed that historical records indicated that lemming populations on Banks Island exhibited periodic "highs", but there was insufficient evidence to postulate a four-year cycle from direct observations. They did note that Arctic fox fur returns appeared to peak in a 3 to 5-year cycle. My data would support their contention regarding periodic highs, but also supports the contention that lemming populations undergo a 3-5 year change in abundance similar to those found in the Eastern Arctic and Scandinavia (Fuller *et al.*, 1975; Scott, 1993). Lemming populations in the Western Arctic, east of the Mackenzie River, have shown similar fluctuations. They were high in 1993, low in 1994, increasing but low in 1995, and high again in 1996 (Gilbert and Krebs, 1994; 1995, C. Krebs pers. comm.). This possibly implies synchrony between island and mainland populations in the Western Arctic of the Northwest Territories. Only continued trapping will verify or refute the cyclical nature of Banks Island lemming populations increases and synchrony with mainland populations.

Abundant assemblages of predators are often associated with lemming highs (Zoltai *et al.*, 1980). This was observed on Banks Island in 1993 and 1996. Long-tailed jaegars (*Stercorarius longicaudus*), pomarine jaegars (*S. pomarinus*), and rough-legged hawks (*Buteo lagopus*) were never seen at either field site during 1994 and 1995, but were nesting and abundant during 1993 and 1996. Snowy owls (*Nyctea scandiaca*) and Arctic fox (*Alopex lagopus*) pups were also abundant during summer 1993 and 1996. Although never absent during 1994 and 1995 their abundances were drastically reduced.

The summer diet of collared lemmings from Banks Island was very similar to that of collared lemmings found on Igloolik Island in the Foxe Basin area of the Northwest Territories. *Dryas*

integrifolia and *Salix arctica* made up 93% of the summer diet in dry habitats (Rodgers and Lewis, 1986). The remainder of the diet was made up of purple saxifrage (*Saxifraga oppositifolia*). *S. oppositifolia* is found in dry habitats on Banks Island, but only a trace (0.3%) of it was found in the stomach contents of 1 lemming from our sample.

The high percentage of *D. integrifolia* in the lemming diet may be related to availability. *D. integrifolia* is found in all vegetated habitats on Banks Island and was present in ≥90% of the over 300 plots clipped in the upland barren habitat from 1993-1996. The lemming traplines run through mostly upland barren habitats. *D. integrifolia* was also readily available on Igloolik Island. In Barrow and Atkasook, Alaska, the only other places where field diets of collared lemmings have been described, the summer diet is dominated by *Salix* spp. which is the most abundant plant (Batzli and Jung, 1980; Batzli and Pitelka, 1983).

If one large lemming can have 25g of food (*D. integrifolia*) in the stomach, high densities of lemmings have the potential to reduce the standing crop of *D. integrifolia* in localized areas. *D. integrifolia* represents a small proportion of the summer diet of other mammalian herbivores on Banks Island, especially arctic hares and muskoxen which rarely utilize it during summer or winter (Larter and Nagy, 1995; N. Larter and J. Nagy, unpubl. data). Peary caribou utilize *D. integrifolia* to some extent during August-October (*ca.* 10%) and to a greater extent during March-April (*ca.*45%) (Larter and Nagy, 1995; N. Larter and J. Nagy, unpubl. data). However, given at worst localized reductions of standing crop and availability, and the mobile foraging behaviour and small population of Banks Island Peary caribou, it is unlikely that even at peak lemming numbers the reductions in *D. integrifolia* would impact the caribou population.

Lemmings were trapped and measured in the Thomsen area of Banks Island during summer

1990. Unfortunately, both brown (*Lemmus sibiricus*) and collared lemmings were trapped, but much of the species identifications went missing. Total lengths (8.1-11.6cm), total weights (24-50g), and hind foot lengths (1.6-2.0cm) of the 5 known collared lemmings were similar to what was found in this study. Comparative data from other collared lemming studies are lacking.

RECOMMENDATIONS

1) Trapping to monitor lemming abundance should continue throughout the course of the range study field program, and in association with any other future summer field research programs, in order to provide as much information on the possible cyclic increases in lemming populations on Banks Island.

2) Unless the trapping program is part of larger research programs the costs incurred may not justify ongoing trapping.

3) Training more local residents may provide short term employment and a more cost effective way of collecting data on lemming abundance when other larger field research programs end.

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PERSONAL COMMUNICATIONS

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Figure 1. The location of the study site where lemmings were counted and collected, Banks Island.

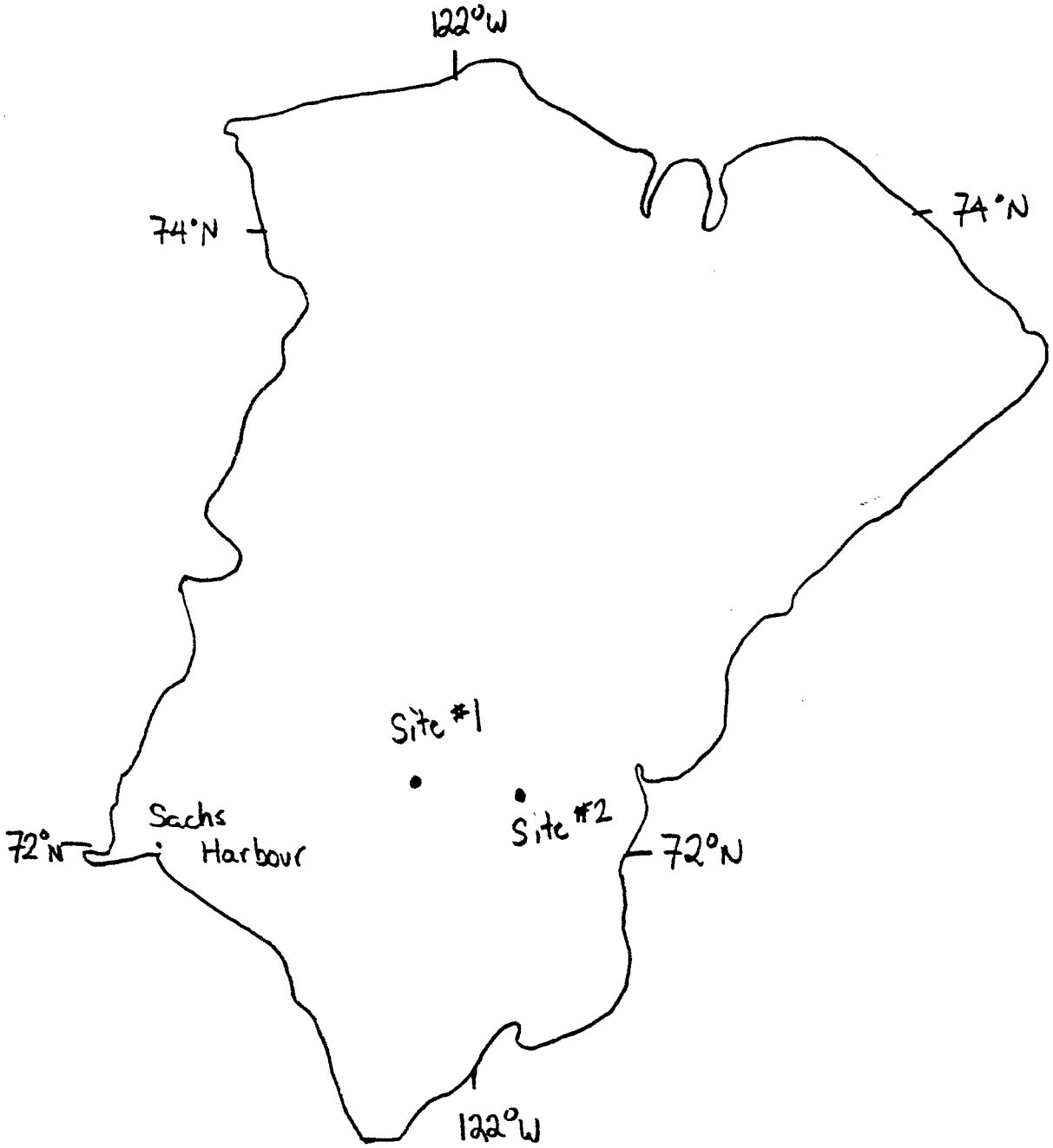

Table 1. The dates lemming traps were set and the dates lemming traps were checked at each of two study sites from 1993-1996.

	July, Site#1	July, Site #2	August, Site #1	August, Site #2
Traps Set 1993	16-20	16-20	10-12	13-15
Traps Checked '93	17, 19	18, 19	11, 12	14, 15
Traps Set 1994	16-19	16-19	13-16	16-19
Traps Checked '94	17, 18, 19	17, 18, 19	14, 15, 16	17, 18, 19
Traps Set 1995	17-20	18-21	24-28[1]	24-28[1]
Traps Checked '95	18, 19, 20	19, 20, 21	25, 26	25, 26
Traps Set 1996	18-22	20-22	20-24	22-24
Traps Checked '96	19, 20, 22	21, 22	21, 22, 24	23, 24

[1] Traps were covered by a blizzard on 27 August and not all traps could be located or recovered by 28 August.

Table 2. The number of collared lemmings caught, the number of nights trapped (TN), and the density indices (lemmings caught/100 TN) for each trapping period and the annual values. Values in parentheses in 1996 represent the number of robbed traps included in the calculations.

Location	Time	# Caught	TN	Density Index
Site #1	July	20	177	11.30
Site #2	July	3	178	1.69
Site #1	August	15	120	12.50
Site #2	August	15	117	12.82
1993		53	592	8.95
Site #1	July	1	180	0.56
Site #2	July	0	177	0.00
Site #1	August	0	180	0.00
Site #2	August	0	180	0.00
1994		1	717	0.14
Site #1	July	1	180	0.56
Site #2	July	0	180	0.00
Site #1	August	0	120	0.00
Site #2	August	0	120	0.00
1995		1	600	0.17
Site #1	July	9 (1)	240	3.75
Site #2	July	4 (1)	118	3.39
Site #1	August	8 (3)	240	3.33
Site #2	August	6 (0)	111	5.41
1996		27	709	3.81

Table 3. Mean diet composition (percent relative density) ± SE of collared lemmings pooled over time (n=6) and over time and location (n=12).

	Sedge	Willow	Grass	Rose	Legume	Forbs	Moss
Site 1	4.62±1.72	5.59±1.52	0.37±0.29	85.45±2.39	0.28±0.26	3.59±1.11	0.10±0.05
Site 2	0.99±0.58	6.19±1.23	0.00	92.17±1.03	0.00	0.66±0.55	0.00
Pooled	2.80±1.05	5.89±0.98	0.19±0.15	88.81±1.62	0.14±0.14	2.12±0.75	0.05±0.03

APPENDIX

Appendix 1. Diet composition (mean percent relative density) of the various forage classes from 12 collared lemmings trapped on Banks Island during summer 1993.

Site	Month	Sedge	Willow	Grass	Rose	Legume	Forbs	Moss
1	Jul.	2.18	4.36	0.31	88.06	1.70	3.39	0.00
1	Jul.	7.62	0.96	0.00	91.12	0.00	0.30	0.00
1	Jul.	4.89	9.12	1.93	79.33	0.00	4.46	0.27
1	Aug.	12.12	6.24	0.00	75.69	0.00	5.95	0.00
1	Aug.	0.91	11.20	0.00	87.59	0.00	0.00	0.30
1	Aug.	0.00	1.65	0.00	90.93	0.00	7.42	0.00
2	Jul.	0.42	4.24	0.00	95.34	0.00	0.00	0.00
2	Jul.	0.00	7.64	0.00	92.36	0.00	0.00	0.00
2	Jul.	0.00	10.93	0.00	89.07	0.00	0.00	0.00
2	Aug.	0.65	6.23	0.00	93.12	0.00	0.00	0.00
2	Aug.	4.12	6.95	0.00	88.63	0.00	0.30	0.00
2	Aug.	0.73	1.15	0.00	94.47	0.00	3.65	0.00

Appendix 2. The location (site#1 or #2), date trapped, sex, and total weight (g) measurements of all lemmings trapped on Banks Island from summer 1993 to summer 1996, and all available pelt weights (g), gastrointestinal tract (GIT) weights (g), total lengths (cm), hind foot lengths (cm), and testes lengths (mm) from lemmings trapped during summer 1993.

Site	Date	Sex	Total wt. (g)	Pelt wt. (g)	GIT wt. (g)	Total len. (cm)	Hind Foot len. (cm)	Testes len. (mm)
1	7/93	F	83.4	11.7	22.3	13.4	1.7	n/a
1	7/93	M	57.3	9.6	14.4	13.2	1.6	4
1	7/93	M	18.8	2.9	4.2	8.6	1.4	2
1	7/93	F[1]	73.8	11.1	18.5	14.9	1.7	n/a
1	7/93	M	82.7	13.8	16.0	15.8	1.8	6
1	7/93	F[2]	78.7	8.7	16.6	13.1	1.5	n/a
1	7/93	F	87.1	9.1	28.1	13.9	1.8	n/a
1	7/93	M	30.2	4.8	7.6	10.6	1.4	4
1	7/93	M	44.7	8.3	7.5	11.4	1.5	4
1	7/93	M	77.4	13.1	13.5	13.6	1.8	6
1	7/93	F	60.4	9.0	14.1	13.3	1.8	n/a
1	7/93	F	28.1	4.8	6.4	9.1	1.2	n/a
1	7/93	M	26.6	4.4	4.5	9.8	1.4	2
1	7/93	U	n/a	n/a	n/a	n/a	n/a	n/a
1	7/93	M	27.6	2.7	8.1	9.4	1.5	3
1	7/93	M	75.7	9.6	27.3	13.5	1.8	6
1	7/93	M	26.6	4.1	5.6	9.5	1.5	3

Site	Date	Sex	Total wt. (g)	Pelt wt. (g)	GIT wt. (g)	Total len. (cm)	Hind Foot len. (cm)	Testes len. (mm)
1	7/93	F	30.3	5.2	5.8	9.4	1.4	n/a
1	7/93	M	37.0	6.3	9.3	10.9	1.6	8
1	7/93	M	32.0	4.6	7.6	11.2	1.7	3
2	7/93	M	24.1	2.8	6.3	10.3	1.5	4
2	7/93	M	48.5	6.7	13.4	12.3	1.4	5
2	7/93	F[3]	65.7	9.1	14	14.0	1.9	n/a
1	8/93	F	62.3	n/a	15.9	13.2	1.4	n/a
1	8/93	M	38.3	6.7	8.4	12.0	1.7	2
1	8/93	F	44.2	7.4	12.2	11.8	1.8	n/a
1	8/93	F	72.7	10.6	19.6	15.5	1.7	n/a
1	8/93	F	73.2	n/a	15.3	14.1	1.8	n/a
1	8/93	F	54.1	n/a	14.4	12.8	1.5	n/a
1	8/93	F	34.5	n/a	7.6	9.9	1.4	n/a
1	8/93	F	64.1	11.8	10.9	13.7	1.8	n/a
1	8/93	M	41.5	6.0	12.8	11.1	1.6	3
1	8/93	F	53.8	n/a	14.1	12.5	1.9	n/a
1	8/93	F	36.5	n/a	8.3	11.4	1.4	n/a
1	8/93	M	35.0	5.8	8.2	10.1	1.6	2
1	8/93	M	64.2	9.0	14.7	12.5	1.8	6
1	8/93	M	38.6	n/a	7.8	10.9	1.4	3
1	8/93	F	53.4	n/a	14.3	12.1	1.4	n/a
2	8/93	F	27.6	4.7	8.7	9.3	1.4	n/a

Site	Date	Sex	Total wt. (g)	Pelt wt. (g)	GIT wt. (g)	Total len. (cm)	Hind Foot len. (cm)	Testes len. (mm)
2	8/93	M	45.9	n/a	12.8	11.3	1.7	2
2	8/93	F	64.6	9.8	19.5	13.7	1.7	n/a
2	8/93	M	43.9	n/a	12.7	12.5	1.6	3
2	8/93	M	51.4	n/a	14.8	11.9	1.8	3
2	8/93	M	39.3	6.8	6.6	11.5	1.9	3
2	8/93	M	46.4	6.3	14.8	9.7	1.8	4
2	8/93	F	40.6	n/a	14.0	10.4	1.6	n/a
2	8/93	F	38.2	n/a	10.6	10.2	1.5	n/a
2	8/93	M	34.1	4.7	12.4	9.7	1.6	4
2	8/93	F	25.9	n/a	6.2	9.5	1.5	n/a
2	8/93	M	44.3	6.6	12.0	11.4	1.5	4
2	8/93	F	18.4	n/a	6.1	8.8	1.9	n/a
2	8/93	M	24.6	2.1	9.2	8.2	1.3	3
2	8/93	F	24.2	n/a	10.0	9.1	1.4	n/a
1	7/94	M	40.0	n/a	n/a	n/a	n/a	n/a
1	7/95	M	58.0	n/a	n/a	n/a	n/a	n/a
1	7/96	M	85.0	n/a	n/a	n/a	n/a	n/a
1	7/96	F	72.0	n/a	n/a	n/a	n/a	n/a
1	7/96	F	77.0	n/a	n/a	n/a	n/a	n/a
1	7/96	M	68.0	n/a	n/a	n/a	n/a	n/a
1	7/96	F	48.0	n/a	n/a	n/a	n/a	n/a
1	7/96	U	n/a	n/a	n/a	n/a	n/a	n/a

Site	Date	Sex	Total wt. (g)	Pelt wt. (g)	GIT wt. (g)	Total len. (cm)	Hind Foot len. (cm)	Testes len. (mm)
1	7/96	M	51.0	n/a	n/a	n/a	n/a	n/a
1	7/96	F	57.0	n/a	n/a	n/a	n/a	n/a
1	7/96	F	26.0	n/a	n/a	n/a	n/a	n/a
2	7/96	M	61.0	n/a	n/a	n/a	n/a	n/a
2	7/96	M	16.0	n/a	n/a	n/a	n/a	n/a
2	7/96	M	15.0	n/a	n/a	n/a	n/a	n/a
2	7/96	U	n/a	n/a	n/a	n/a	n/a	n/a
1	8/96	M	34.0	n/a	n/a	n/a	n/a	n/a
1	8/96	M	78.0	n/a	n/a	n/a	n/a	n/a
1	8/96	F	36.0	n/a	n/a	n/a	n/a	n/a
1	8/96	U	n/a	n/a	n/a	n/a	n/a	n/a
1	8/96	M	52.0	n/a	n/a	n/a	n/a	n/a
1	8/96	M	70.0	n/a	n/a	n/a	n/a	n/a
1	8/96	U	n/a	n/a	n/a	n/a	n/a	n/a
1	8/96	U	n/a	n/a	n/a	n/a	n/a	n/a
2	8/96	F	36.0	n/a	n/a	n/a	n/a	n/a
2	8/96	F	37.0	n/a	n/a	n/a	n/a	n/a
2	8/96	F	42.0	n/a	n/a	n/a	n/a	n/a
2	8/96	M	40.0	n/a	n/a	n/a	n/a	n/a
2	8/96	F	45.0	n/a	n/a	n/a	n/a	n/a
2	8/96	M	37.0	n/a	n/a	n/a	n/a	n/a

[1] Total weight included 2 unborn weighing 3.3g

[2] Total weight included 5 unborn weighing 14.2g

[3] Total weight included 1 unborn, weight n/a.