Northern collared lemming

Dicrostonyx groenlandicus

Class: Mammalia
Order: Rodentia

Review Status: Peer-reviewed **Version Date:** 30 January 2018

Conservation Status

NatureServe:	*Agency:*		
G Rank: G5	ADF&G: Species of Greatest Conservation Need	IUCN: Least Concern	Audubon AK:
S Rank: S5	USFWS:	BLM:	

Final Rank

Conservation category: **V. Orange**

unknown status and either high biological vulnerability or high action need

Category	Range	Score
Status	-20 to 20	0
Biological	-50 to 50	-32
Action	-40 to 40	24

Higher numerical scores denote greater concern

Status - variables measure the trend in a taxon's population status or distribution. Higher status scores denote taxa with known declining trends. Status scores range from -20 (increasing) to 20 (decreasing). **Score**

Population Trend in Alaska (-10 to 10) 0

Unknown.

Distribution Trend in Alaska (-10 to 10) 0

Trends over the last 50 years are unknown. Modeling studies estimate that the distribution of collared lemmings in Alaska has decreased since the Last Glacial Maximum (~21,500 years ago; Prost et al. 2013; Hope et al. 2015), and this trend is expected to continue as the climate warms (Prost et al. 2013; Baltensperger and Huettmann 2015a; Hope et al. 2015; Marcot et al. 2015).

Status Total: 0

Biological - variables measure aspects of a taxon's distribution, abundance and life history. Higher biological scores suggest greater vulnerability to extirpation. Biological scores range from -50 (least vulnerable) to 50 (most vulnerable). **Score**

Population Size in Alaska (-10 to 10) -6

Unknown, but suspected large. May be abundant in some years and scarce in others.

Range Size in Alaska (-10 to 10) -10

Occurs throughout western and northern Alaska from the Alaska Peninsula north to Utqiaġvik and east to the Yukon (Macdonald and Cook 2009). Largely absent from interior Alaska south of the Brooks Range (Macdonald and Cook 2009). Island subspecies are now considered as separate species (D. nelsoni on St. Lawrence Island, D. unalascensis in the western Aleutian Islands).

Estimated range size is >400,000 sq. km., based on range map from ACCS (2017a).

Population Concentration in Alaska (-10 to 10) -10

Does not concentrate.

Reproductive Potential in Alaska

Age of First Reproduction (-5 to 5) -5

Can reproduce within a few months of birth (8-12 weeks; Negus and Berger 1998).

Number of Young (-5 to 5) -3

Litter size can range from 1 to 11, and females can have 2-3 litters per year (Krebs 1964; Brooks and Banks 1973). Average litter sizes in the eastern Canadian Arctic was 5.5 and 5.7 (Fuller et al. 1975; Negus and Berger 1998).

Ecological Specialization in Alaska

Dietary (-5 to 5) 1

Consumes mosses, herbaceous plants, and woody plants, but there is evidence of dietary specialization (Batzli and Jung 1980; Batzli and Pitelka 1983; Bergman and Krebs 1993; Baltensperger et al. 2015; Soininen et al. 2015). Salix and Dryas species in particular have repeatedly been noted as important food items, often comprising >70% of their diet (Batzli and Jung 1980; Rodgers and Lewis 1986a; Bergman and Krebs 1993; Soininen et al. 2015).

Habitat (-5 to 5) 1

At a broad scale, restricted to high-latitude, arctic regions. At smaller scales, D. groenlandicus is traditionally considered to prefer dry, upland sites such as heath-shrub, tussock tundra, and rocky or sandy ridges (Krebs 1964; Batzli and Jung 1980; Batzli et al. 1983; Rodgers and Lewis 1985; Negus and Berger 1998). However, observed habitat preferences may vary depending on sex, population density, and competition with brown lemmings (Rodgers and Lewis 1985; Morris et al. 2000). Northern collared lemmings have been observed in a variety of habitat types including wet, lowland sites (e.g. sedge hummocks) and moist transitional zones (Rodgers and Lewis 1986; Krebs et al. 1995). Although not well-studied, snow depth may be an important factor determining winter habitat use (Duchesne et al. 2011; Reid et al. 2012).

Biological Total: -32

Action - variables measure current state of knowledge or extent of conservation efforts directed toward a given taxon. Higher action scores denote greater information needs due of lack of knowledge or conservation action. Action scores range from -40 (lower needs) to 40 (greater needs). **Score**

Management Plans and Regulations in Alaska (-10 to 10) 10

Lemmings are considered unclassified game in Alaska with no closed season or bag limits (ADFG 2018c).

Knowledge of Distribution and Habitat in Alaska (-10 to 10) 2

Some knowledge of distribution in Alaska, but poorly documented in some regions e.g. southwestern Alaska (Peirce and Peirce 2005). Habitat relationships have been studied in the northern part of its range near Utqiaġvik and Atqasuk (Batzli and Jung 1980; Batzli et al. 1983). Recent modelling efforts predicted collared lemming distribution with moderate accuracy and provided insights into important geographic-scale environmental variables (Baltensperger and Huettmann 2015a; Hope et al. 2015).

Knowledge of Population Trends in Alaska (-10 to 10) 10

Not currently monitored.

Knowledge of Factors Limiting Populations in Alaska (-10 to 10) 2

The factors limiting populations have been well-studied at the species level, though relatively few studies have been conducted in Alaska. Many populations fluctuate in abundance over several years, but fluctuations may be random rather than cyclical (Pitelka and Batzli 1993; Wilson et al. 1999; Predavec et al. 2001). Predation appears to be the strongest factor regulating both cyclic and non-cyclic populations (Krebs et al. 1995; Reid et al. 1995; Wilson et al. 1999; Gilg 2002; Krebs 2011) and has been identified as the highest cause of mortality across all life stages (Krebs 1964; Krebs et al. 1995; Reid et al. 1995). Other limiting factors that have received less support include food and habitat availability (Krebs et al. 1995; Oksanen et al. 2008). Intraspecific interactions (e.g. infanticide) may be important but have not been well-studied (Krebs 2011).

A summary of major research gaps has been identified by Krebs (2011). Most notably, the winter ecology of collared lemmings remains poorly understood (Korpimäki et al. 2004; Krebs et al. 2011). Winter conditions may play a strong role in affecting survival of adults and juveniles (Reid and Krebs 1996; Reid et al. 2012). Deep snow provides thermoregulatory benefits and refuge from predators (Reid et al. 2012), and influences food availability (Krebs et al. 2011). Studies suggest that both cyclical and non-cyclical populations persist because winter breeding beneath the snow drives population recoveries (e.g. Stenseth and Ims 1993; Krebs et al. 1995; Reid and Krebs 1996; Millar 2001; Gruyer et al. 2010; Krebs et al. 2011).

Climate change carries implications for population persistence via changes in distribution, precipitation patterns, or increased interspecific competition as species' ranges shift (Kausrud et al. 2008; Oksanen et al. 2008; Krebs et al. 2011; Baltensperger and Huettmann 2015a). Several models predict a loss of suitable habitat in Alaska ranging from 6 to 37% by the end of this century (Baltensperger and Huettmann 2015a; Hope et al. 2015; Marcot et al. 2015), though high elevations in southern Alaska may provide new refuges (Baltensperger and Huettmann 2015a). Studies in Greenland suggest that climate change may have profound impacts on the stability of collared lemmings' population cycles by increasing the length of time between population cycles, decreasing maximum densities, and causing more chaotic population fluctuations (Schmidt et al. 2008; Gilg et al. 2009).

Action Total: 24

Supplemental Information - variables do not receive numerical scores. Instead, they are used to sort taxa to answer specific biological or management questions.

Harvest:	Not substantial
Seasonal Occurrence:	Year-round
Taxonomic Significance:	Monotypic species
% Global Range in Alaska:	>10%
% Global Population in Alaska:	<25%
Peripheral:	No

References

Alaska Center for Conservation Science (ACCS). 2017a. Wildlife Data Portal. University of Alaska Anchorage. Available online: http://aknhp.uaa.alaska.edu/apps/wildlife

Alaska Department of Fish and Game (ADFG). 2020a. 2020-2021 Alaska hunting regulations. Alaska Department of Fish and Game. Juneau, AK, USA.

Baltensperger, A. P., and F. Huettmann. 2015a. Predicted shifts in small mammal distributions and biodiversity in the altered future environment of Alaska: an open access data and machine learning perspective. PLoS ONE 10(7):e0132054. DOI: 10.1371/journal.pone.0132054

Baltensperger, A. P., F. Huettmann, J. C. Hagelin, and J. M. Welker. 2015. Quantifying trophic niche spaces of small mammals using stable isotopes (δ15 N and δ13 C) at two scales across Alaska. Canadian Journal of Zoology 93(7):579–588. DOI: 10.1139/cjz-2015-0025

Batzli, G. O., and H-J G. Jung. 1980. Nutritional ecology of microtine rodents: Resource utilization near Atkasook, Alaska. Arctic and Alpine Research 12(4):483-499. DOI: 10.2307/1550496

Batzli, G. O., and F. A. Pitelka. 1983. Nutritional ecology of microtine rodents: Food habits of lemmings near Barrow, Alaska. Journal of Mammalogy 64:648-655.

Batzli, G. O., F. A. Pitelka, and G. N. Cameron. 1983. Habitat use by lemmings near Barrow, Alaska. Holarctic Ecology 6:255-262.

Bergman, C. M., and C. J. Krebs. 1993. Diet overlap of collared lemmings and tundra voles at Pearce Point, Northwest Territories. Canadian Journal of Zoology 79(9):1703-1709. DOI: 10.1139/z93-24

Brooks, R. J., and E. M. Banks. 1973. Behavioural biology of the collared lemming [Dicrostonyx groenlandicus (Trail)]: an analysis of acoustic communication. Animal Behaviour Monographs 6(1):1-83.

Duchesne, D., G. Gauthier, and D. Berteaux. 2011. Habitat selection, reproduction and predation of wintering lemmings in the Arctic. Oecologia 167(4):967-980.

Fuller, W. A., A. M. Martell, R. F. C. Smith, and S. W. Speller. 1975. High-arctic lemmings, Dicrostonyx groenlandicus. II. Demography. Canadian Journal of Zoology 53(6):867-878. DOI: 10.1139/z75-100

Gilg, O. 2002. The summer decline of the collared lemming, Dicrostonyx groenlandicus, in High Arctic Greenland. Oikos 99(3):499-510. DOI: 10.1034/j.1600-0706.2002.11989.x

Gilg, O., B. Sittler, and I. Hanski. 2009. Climate change and cyclic predator–prey population dynamics in the high Arctic. Global Change Biology 15(11):2634–2652. DOI: 10.1111/j.1365-2486.2009.01927.x

Gruyer, N., G. Gauthier, and D. Berteaux. 2010. Demography of two lemming species on Bylot Island, Nunavut, Canada. Polar Biology 33(6):725-736. DOI: 10.1007/s00300-009-0746-7

Hope, A. G., E. Waltari, J. L. Malaney, D. C. Payer, J. A. Cook, and S. L. Talbot. 2015. Arctic biodiversity: increasing richness accompanies shrinking refugia for a cold-associated tundra fauna. Ecosphere 6(9):159. DOI: 10.1890/ES15-00104.1

Kausrud, K. L., A. Mysterud, H. Steen, J. O. Vik, E. Østbye, B. Cazelles, ..., and N. C. Stenseth. 2008. Linking climate change to lemming cycles. Nature 456(7218):93-97. DOI:10.1038/nature07442

Kerr, J. and L. Packer. 1998. The impact of climate change on mammal diversity in Canada. Environmental Monitoring and Assessment 49(2-3):263-270.

Korpimäki, E., P. R. Brown, J. Jacob, R. P. Pech. 2004. The puzzles of population cycles and outbreaks of small mammals solved? BioScience 54(12):1071–1079. DOI:10.1641/0006-3568(2004)054[1071:TPOPCA]2.0.CO;2

Krebs, C. J. 1964. The lemming cycle at Baker Lake, Northwest Territories, during 1959-62. Arctic Institute of North America Technical Paper No. 15, Calgary, AB, CAN.

Krebs, C. J. 2011. Of lemmings and snowshoe hares: the ecology of northern Canada. Proceedings of the Royal Society B 278(1705):481-489. DOI: 10.1098/rspb.2010.1992.

Krebs, C. J., R. Boonstra, and A. J. Kenney. 1995. Population dynamics of the collared lemming and the tundra vole at Pearce Point, Northwest Territories, Canada. Oecologia 103(4):481-489. DOI: 10.1007/BF00328687

Krebs, C. J., D. G. Reid, A. J. Kenney, and S. Gilbert. 2011. Fluctuations in lemming populations in north Yukon, Canada, 2007–2010. Canadian Journal of Zoology 89(4):297-306. DOI:10.1139/z11-004

MacDonald, S. O., and J. A. Cook. 2009. Recent mammals of Alaska. University of Alaska Press, Fairbanks, AK, USA.

Marcot, B. G., M. T. Jorgenson, J. P. Lawler, C. M. Handel, and A. R. DeGange. 2015. Projected changes in wildlife habitats in Arctic natural areas of northwest Alaska. Climate Change 130(2):145–154. DOI: 10.1007/s10584-015-1354-x

Millar, J. S. 2001. On reproduction in lemmings. Ecoscience 8(2):145-150. DOI: 10.1080/11956860.2001.11682639

Morris, D. W., D. L. Davidson, and C. J. Krebs. 2000. Measuring the ghost of competition: Insights from density-dependent habitat selection on the co-existence and dynamics of lemmings. Evolutionary Ecology Research 2(1):41-67.

Negus, N. C., and P. J. Berger. 1998. Reproductive strategies of Dicrostonyx groenlandicus and Lemmus sibiricus in High-Arctic tundra. Canadian Journal of Zoology 76(3):391-400. DOI: 10.1139/z97-226

Oksanen, T., L. Oksanen, J. Dahlgren, and J. Olofsson. 2008. Arctic lemmings, Lemmus spp. and Dicrostonyx spp.: integrating ecological and evolutionary perspectives. Evolutionary Ecology Research 10:415-434.

Peirce, K. N., and J. M. Peirce. 2005. Occurrence and distribution of small mammals on the Goodnews River, southwestern Alaska. Northwestern Naturalist 86(1):20-24. DOI: 10.1898/1051-1733(2005)086[0020:OADOSM]2.0.CO;2

Prost, S., R. P. Guralnick, E. Waltari, V. B. Fedorov, E. Kuzmina, N. Smirnov, T. van Kolfschoten, M. Hofreiter, and K. Vrieling. 2013. Losing ground: past history and future fate of Arctic small mammals in a changing climate. Global Change Biology 19(6):1854–1864. DOI: 10.1111/gcb.12157

Reid, D. G., and C. J. Krebs. 1996. Limitations to collared lemming population growth in winter. Canadian Journal of Zoology 74(7):1284-1291. DOI: 10.1139/z96-143

Reid, D. G., C. J. Krebs, and A. J. Kenney. 1995. Limitation of collared lemming population growth at low densities by predation mortality. Oikos 73(3):387–398. DOI: 10.2307/3545963

Reid, D. G., F. Bilodeau, C. J. Krebs, G. Gauthier, A. J. Kenney, B. S. Gilbert, …, and E. Hofer. 2012. Lemming winter habitat choice: a snow-fencing experiment. Oecologia 168(4):935-946. DOI: 10.1007/s00442-011-2167-x

Rodgers, A. R., and M. C. Lewis. 1986a. Diet selection in Arctic lemmings (Lemmus sibiricus and Dicrostonyx groenlandicus): Forage availability and natural diets. Canadian Journal of Zoology 64(8):1684–1689. DOI: 10.1139/z86-253

Rodgers, A. R., and M. C. Lewis. 1986b. Diet selection in Arctic lemmings (Lemmus sibiricus and Dicrostonyx groenlandicus): Demography, home range, and habitat use. Canadian Journal of Zoology 64:2717-2727.

Schmidt, N. M., T. B. Berg, M. C. Forchhammer, D. K. Hendrichsen, L. A. Kyhn, H. Meltofte, and T. T. Høye. 2008. Vertebrate predator-prey interactions in a seasonal environment. Advances in Ecological Research 40:345–370. DOI: 10.1016/s0065-2504(07)00015-3

Soininen, E. M., G. Gauthier, F. Bilodeau, D. Berteaux, L. Gielly, P. Taberlet, ..., and N. G. Yoccoz. 2015. Highly overlapping winter diet in two sympatric lemming species revealed by DNA metabarcoding. PLoS ONE 10(1):e0115335. 10.1371/journal.pone.0115335

Stenseth, N. C., and R. A. Ims. 1993. Population dynamics of lemmings: Temporal and spatial variation. An introduction. Pages 61-96 in Stenseth, N. C., and R. A. Ims, eds. The biology of lemmings. Academic Press Inc., San Diego, USA.

Wilson, D. J., C. J. Krebs, and A. R. E. Sinclair. 1999. Limitation of collared lemming populations during a population cycle. Oikos 87(2):382-398. DOI: 10.2307/3546754

Alaska Center for Conservation Science
Alaska Natural Heritage Program
University of Alaska Anchorage
Anchorage, AK