

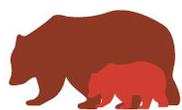
Final Report: The Scandinavian Brown Bear Research Project 2009-2011

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Report 2011:7

from the Scandinavian Brown Bear Research Project
to the Swedish Environmental Protection Agency
and the Norwegian Directorate for Nature Management

www.bearproject.info



Skandinaviska
Björnprojektet



FINAL REPORT: THE SCANDINAVIAN BROWN BEAR PROJECT, 2009-2011

ABSTRACT

The Scandinavian Brown Bear Research Project is a long-term, individual-based project that conducts ecological research, with a focus on research that is relevant for managers. During the project period 2009-2011, the project produced 80 publications, including 34 scientific papers, 20 reports, 8 popular articles, and 16 student theses (including 5 PhD dissertations).

Highlights from the study period include the following. We documented that bears do not react aggressively to hikers and berry-pickers and are, in fact, rarely seen when approached closely. Bears do everything to avoid people, both temporally and spatially and at several scales in both the winter and nonwinter periods. This is important to inform people who are afraid of bears about their behavior, because we documented that fear of bears is increasing.

We have developed and tested a method to monitor bear population size and found that hunting mortality is nonselective and additive to other mortality. Hunting may also be causing selection for life-history traits. We also estimated the population size in Sweden and number of annual bear reproductions in Norway. This is important for managing hunting. We also cooperate in developing better methods to train bear-hunting dogs.

Brown bears are an important predator on moose calves, but not adult moose. Kill rates by individual bears seems to remain stable, even when moose densities decrease, which increases the proportion of calves killed by bears. However, bear predation has a smaller impact on moose populations than hunter harvest or wolf predation, because they almost only take calves. This is important information when managing moose populations where bears are present.

Our research on the effects of capture has resulted in improved methods, such as administering oxygen to some bears. This is important for bear research world-wide.

PURPOSE AND GOALS

The overall purpose of this 3-year project from the Scandinavian Brown Bear Research Project (SBBP) has been to conduct research that will provide managers in Sweden and Norway with solid scientifically based knowledge to meet the present and future challenges presented by the increasing and expanding population of brown bears; which is both an important hunted species and a source of conflict. To do this, we continued to gather and analyze long-term individually-based data on bears with a goal of following females from birth to death. The SBBRP has worked in 4 ways concurrently: 1) research on population dynamics, life-history strategies, and general ecology using the 27-year dataset of individually marked bears (the base project) and additionally, providing infrastructure and marked bears for 2) management-relevant research (eg. baiting, bears reactions to humans), 3) activities important for management, such as training and testing tracking dogs, and 4) associated research projects, such as human medicine.

Our research has focused on the three probably most relevant subjects for bear management in Sweden and Norway; 1) consequences of the increasing bear population for both humans and bears, 2) how to harvest the population to reach management goals, and 3) ethical questions regarding research on bears. Many of the associated projects and activities have supported practical management actions.

Since its start, the SBBRP has produced 406 publications; 126 international scientific papers, 11 books/book chapters, 21 proceedings papers, 82 student theses (including 15 PhD-level theses), 96 reports to management agencies, and 70 popular articles. Thus, it is the world's most productive

carnivore research project, measured in scientific articles or PhD theses. One reason for the high productivity is that the project has systematically collected individually based data for 27 years. This type of research leads to most new insights in ecology, evolutionary biology, management, and conservation (Clutton-Brock & Sheldon, *Trends in Ecol & Evol.* 25:562-573, 2010, Festa-Bianchet & Apollonio, *Animal behavior and wildlife conservation*, Island Press, 2003). This does not explain all of the project's productivity, however, because the SBBRP published almost 5 times more scientific papers than the average of 51 long-term, individual-based field studies of birds and mammals in the UK at the same stage in the project (years 25-27 in the study, i.e. during 2009-2011, Fig. 1).

During the report period, 2009-2011, the SBBRP produced 80 publications; 34 international scientific papers, 1 book chapter, 1 unrefereed scientific paper, 16 student theses (including 5 PhD-level theses), 20 reports to management agencies, and 8 popular articles. These publications are listed under the appropriate headings below. Each heading is from the application on which this report is based. The remaining publications are given at the end of the report.

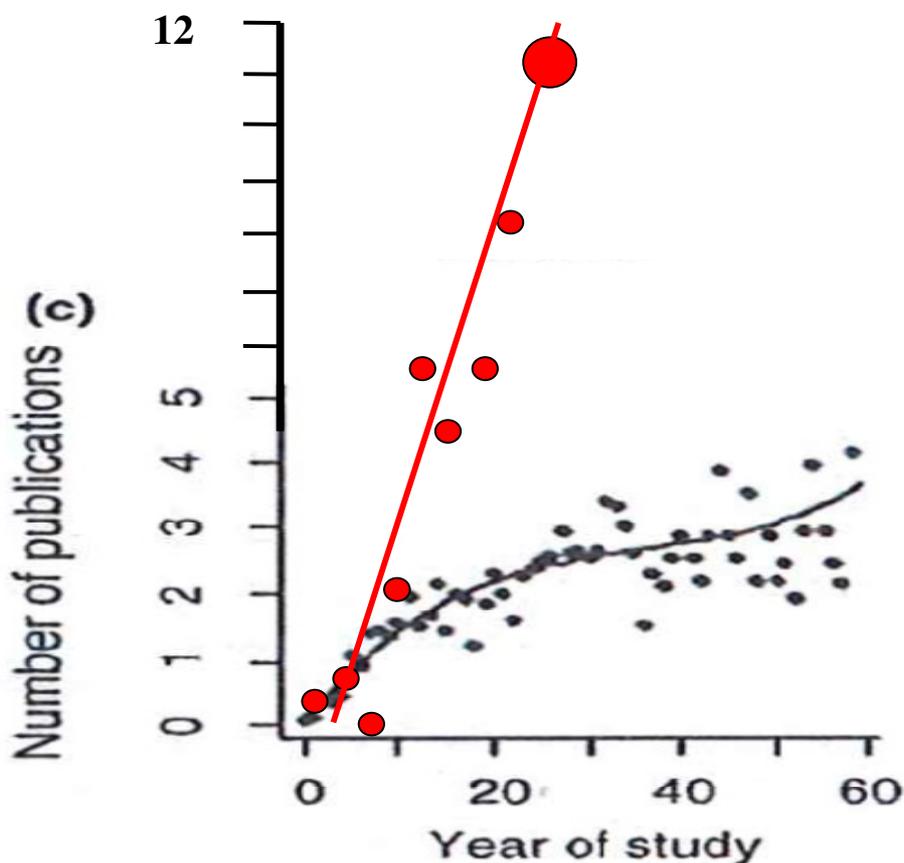


Figure 1. Number of scientific publications per year of study for 51 long-term, individual-based field studies of birds and mammals in the UK (in black; figure from Clutton-Brock & Sheldon 2010) and those of the Scandinavian Brown Bear Research Project, red circles and line, using 3-year averages). The large red circle shows the production of scientific publications for the report period (the SBBRP's years 25-27 of study).

RESULTS, CONCLUSIONS AND RECOMMENDATIONS

1) Consequences of the increasing bear population for both humans and bears

The human dimension of bear-human conflicts when a bear population expands

We have documented that the fear of bears is increasing, especially among people who live in areas with many bears (Ericsson et al. 2010). We have conducted over 300 experimental meetings between single bears and researchers simulating hikers. None of these bears has shown aggressive behavior when a human walked within 50 m and we only observed or heard them in 15% of these meetings. The bears either left their daybed before we arrived, stayed there and left after we had passed, or just remained in their daybed. Adult bears allowed people to approach more closely than subadults (Moen et al. ms). How bears react to meeting humans is an important topic for the public and we have given numerous talks about our results to the public and managers. We have interviewed everyone who has been injured by a bear and reviewed the police reports of those who were killed by bears since 1997. A scientific manuscript about these results will be completed and submitted soon. Although brown bears were very disturbed by meeting humans on the ground, they were less disturbed by direct helicopter approaches, and less so than moose (Støen et al. 2010).

Scientific publications

Støen, O.-G., W. Neumann, G. Ericsson, J. E. Swenson, H. Dettki, J. Kindberg, and C. Nellemann. 2010.

Behavioural response of moose *Alces alces* and brown bears *Ursus arctos* to direct helicopter approach by researchers. *Wildlife Biology* 16: 292-300.

Moen, G. K., O.-G. Støen, V. Sahlén, and J. E. Swenson. Manuscript. Behaviour of single adult Scandinavian brown bears (*Ursus arctos*) when approached by humans on foot. PLOS One, final revision submitted.

Popular science

Moen, G. K., O.-G. Støen, S. Brunberg & J. Swenson. 2009. Björnen går undan för skogsvandrare. *Våra Rovdjur* 2009 (3): 3-7.

Moen, G. K., Støen, O.-G., Brunberg, S. og Swenson, J. 2010. Når mennesker møter brunbjørn i skogen. *Våre Rovdyr* 24 (1): 10-11.

Moen, G. K., Støen, O.-G., Brunberg, S. og Swenson, J. 2010. Når mennesker møter brunbjørn i skogen. *Hjorteviltet* 20: 84-85.

Moen, G. K., Støen, O.-G., Brunberg, S. og Swenson, J. 2010. Når mennesker møter brunbjørn i skogen. *Norsk Skogbruk* 2010 (7/8): 32-33.

Student theses

Moen, G. K. 2009. Responses by Scandinavian brown bears (*Ursus arctos*) to human approaches on foot. Master of Science thesis, Norwegian University of Life Sciences, Ås.

Reports

Støen, O.-G. 2010. Årsrapport—Brown bear behaviour and human perceptions of human bear encounters – implications for management (2009-2012). Kontraktnr: 06040039, 2009. Report No. 2010-7 from the Scandinavian Brown Bear Research Project.

Ericsson, G., Sandström, C., Kindberg, J. & Støen, O-G. 2010. Om svenskars rädsla för stora rovdjur, älg och vildsvin. Rapport 2010:1. Institutionen för vilt, fisk och miljö, SLU, Umeå.

Støen, O.-G. 2011. Årsrapport fra prosjektet: Brown bear behaviour and human perceptions of human bear encounters – implications for management (2009-2012). Kontraktnr: 06040039, 2010. Report No. 2011-1 from the Scandinavian Brown Bear Research Project.

The effects of human presence on bears

Brown bears use behavioral strategies on fine spatial and temporal scales to avoid people and adjust their behavior to avoid humans in areas where they are present. Within their home ranges, female bears selected areas that minimized the possibility for human-caused disturbance. In addition, they showed greatest selection for slopes during daylight hours, when human activity levels in the forest was highest (Martin et al. 2010). Bears placed their daytime resting sites in denser vegetative cover and farther from human habitation during the summer/autumn, when there is more human activity in the forest, than in spring. They also placed them in more dense vegetation during the day

than at night and chose resting areas in denser vegetation when they were closer to human habitation (Ordiz et al. 2011). This behavior was also seen in the winter. Adult males placed their winter dens farther from permanently occupied houses and plowed roads than other bears. Dens that were abandoned during the winter were closer to plowed roads than those that were used all winter (Elfström and Swenson 2009). In addition, dens that were closer to human roads and settlements were located in areas with more vegetative cover and rough terrain (Sahlén et al. 2011).

Scientific publications

- Elfström, M. and Swenson, J. E. 2009. Effects of sex and age on den site use by Scandinavian brown bears. *Ursus* 20:85-93.
- Martin, J., M. Basille, B. Van Moorter, J. Kindberg, D. Allainé, and J. E. Swenson. 2010. Coping with human disturbance: spatial and temporal tactics of the brown bear (*Ursus arctos*). *Canadian Journal of Zoology* 88:875-883.
- Ordiz, A., O-G. Støen, M. Delibes, and J. E. Swenson. 2011. Predators or prey? Spatio-temporal discrimination of human-derived risk by brown bears. *Oecologia* 166:59–67.
- Sahlén, E., O-G. Støen, and J. E. Swenson. 2011. Brown bear den site concealment in relation to human activity in Sweden. *Ursus* 22:152-158.

Student theses

- Martin, J. 2009. Habitat selection and movement by brown bears in multiple-use landscapes. **PhD thesis**, Norwegian University of Life Sciences, Ås and Université Claude Bernard – Lyon 1 / Université de Lyon, Lyon.
- Sahlén, E. 2009. Brown bear (*Ursus arctos*) den site concealment in relation to human activity in Scandinavia. Undergraduate thesis, Swedish University of Agricultural Sciences, Umeå.
- Berg, S. S. 2010. Small-scale habitat use by male and female brown bears (*Ursus arctos*) in the mating and the hyperphagy season. Master thesis, Norwegian University of Life Sciences, Ås.
- Ordiz, A. 2010. Reproductive patterns and human-influenced behavior in brown bears. Implications for the conservation of large carnivores. **PhD thesis**, Norwegian University of Life Sciences, Ås and Universidad de León, León.

Density-dependent effects on brown bear population ecology and life-history traits.

We have documented high cub mortality in the Scandinavian brown bear population. The reasons for cub loss among primiparous females, which have the highest cub loss, vary between the pre-mating season and the mating season. During the pre-mating season, higher population density and poorer food availability the year before were related to higher cub loss, whereas during the mating season, decreasing age of the primiparous mother and higher turnover of adult males (which predicted sexually selected infanticide) were related to higher cub loss (Zedrosser et al. 2009). However, a comparison of growth rates in Sweden and Alberta, Canada, showed that population density had only limited effects on growth in body mass and size (Zedrosser et al. ms). This subject has been little researched in large carnivores, and we intend to continue to work on this question.

Scientific publications

- Zedrosser, A., B. Dahle, O-G. Støen, and J. E. Swenson. 2009. The effects of primiparity on reproductive performance in the brown bear. *Oecologia* 160:847-854.
- Zedrosser, A., M. Cattet, J. E. Swenson, and G. Stenhouse. Submitted manuscript. One species, two populations, three growth strategies; brown bears in Canada and Sweden.

The problem of nuisance bears—seeking food or fleeing adult bears?

We have completed the field work in this subproject and have conducted some analyses. However, the work on the nuisance bear data has been delayed because PhD student M. Elfström has been on sick leave. We have, however, examined habitat use by bears and cattle on summer farms, which has been a source of conflict, especially in Dalarna. We found obvious habitat separation, with bears avoiding roads, human habitation, and open vegetative cover, and cattle selection these habitat variables (Steyaert et al. in press). This and the low predation rates on cattle by bears in Sweden suggest that brown bears are not a direct threat to traditional summer farming in Sweden.

Scientific publication

Steyaert SMJG, Støen O-G, Elfström M, Karlsson J, Van Lammeren R, Bokdam J, Zedrosser, A, and Swenson JE. In press. Coexistence of traditional dairy cattle husbandry and a large carnivore, the brown bear (*Ursus arctos*). *Wildlife Biology*

Student thesis

Steyaert, S M. J. G. 2009. Habitat modelling as a predictive tool in human-wildlife conflicts: Brown bear (*Ursus arctos*) and free-ranging cattle in central Sweden. Master of Science thesis, Wageningen University, Wageningen, Netherlands.

Budic, L. 2010. Brown bears in northern and southern Europe: are they seeking food or avoiding dominant bears? Master thesis, Norwegian University of Life Sciences, Ås.

Chemical communication

We documented that brown bears have anal sacs and showed that the secretions may code for sex (Rosell et al. 2011). We have also shown that bears can in fact discriminate between the anal secretion of unfamiliar males and females (Jojola et al. ms). Menges (2011) also documented the seasonal, diurnal, and sex variation in brown bear defecation rates, which will be useful in studying the role of feces in chemical communication.

Scientific publications

Rosell, F., Jojola, S. M., Ingdal, K., Lassen, B.A., Swenson, J. E., Arnemo, J. M., & Zedrosser, A. 2011. Brown bears possess anal sacs and secretions may code for sex. *Journal of Zoology* 283:143-152.

Jojola, S. M, F. Rosell, I. Warrington, J. E. Swenson & A. Zedrosser. Submitted manuscript. Captive subadult brown bears (*Ursus arctos*) discriminate between unfamiliar adult male and female anal gland secretion.

Student thesis

Jojola, S. M. 2011. Social organization and olfactory communication in brown bears, Eurasian beavers, and yellow-bellied marmots. **PhD thesis**, Norwegian University of Life Sciences, Ås.

Menges, V. 2011. Influence of season, sex, age and behaviour on the defecation rate of brown bears (*Ursus arctos*) in south-central Sweden. Master of Science thesis, Edinburgh Napier University, Edinburgh.

The effects of multiple large carnivores

Brown bears are not an important predator on adult moose (Dahle et al. ms). However, they are an important predator of moose calves. Our studies showed similar individual brown bear kill rates of moose calves during periods with quite different moose densities and documented high rates of individual variation in predation rates (Rauset et al. ms). This is important, because it suggests that calf mortality rates due to bear predation will increase if a moose population declines and the bear population remains stable. We also have contributed to studies of the effects of bear predation on moose populations (Gervasi et al. in press, Sand et al. 2011). These studies showed that bear predation has a smaller effect on moose populations than wolf predation, but that the effects depend on ratios of predators to prey, whether bears and wolves occur together, and the productivity of the habitat. We also cooperate with the project studying bear predation on semidomestic reindeer.

Scientific publications

Gervasi, V., E. B. Nilssen, H. Sand, M. Panzacchi, G. R. Rauset, H. C. Pedersen, J. Kindberg, P. Wabakken, B. Zimmermann, J. Odden, O. Liberg, J. E. Swenson, and J. D. C. Linnell. In press. Predicting the potential for top-down impact of predators on their prey: a comparative analysis of two carnivore-ungulate systems in Scandinavia. *Journal of Animal Ecology*.

Dahle, B., J. E. Swenson, K. Wallin, G. Cederlund, I.-L. Persson, and L. S. Selvaag. Submitted revised manuscript. Predation on adult moose and effects on moose harvest by European brown bears. *Wildlife Biology*.

Rauset, G. R., J. Kindberg, and J. E. Swenson. Submitted revised manuscript. Estimating individual brown bear kill rates during a moose calf birth pulse. *Journal of Wildlife Management*.

Student thesis

Cyril Milleret, 2011. Estimating wolves (*Canis lupus*) and brown bear (*Ursus arctos*) interactions in Central Sweden. Does the emergence of brown bears affect wolf predation patterns? Master of Science thesis in Biodiversité – Écologie – Environnement, Université Joseph Fourier, Grenoble.

Reports

- Moen, G. K. og O.-G. Støen. 2010. Statusrapport for prosjektet: Metodeutvikling for studier av bjørners predasjon på klauvdyr. Rapport 2010 – 2 fra Det skandinaviske bjørneprosjektet.
- Steyaert, S. M. J. G. & S. C. Frank. 2010. Wolf-brown bear interactions in Central Sweden; pilot study 05-06 2010. Report No. 2010-6 from the Scandinavian Brown Bear Research Project.
- Sand, H., N. Jonzén, H. Andrén, J. Månsson, J. E. Swenson, & Jonas Kindberg. 2011. Beskattningsstrategier på älg med och utan rovdjur. Swedish University of Agricultural Sciences, Dnr. SLU ua.FE. 2011.1.5-711.

2) Management dealing with the increasing bear population

Population monitoring—testing of methods

The SBBRP has assisted brown bear management by making major contributions to the system of estimating population size and trends in Sweden and Norway. During this study period, we have published our test of the trend estimation method (Kindberg et al. 2009) and a population estimate for Sweden (Kindberg et al. 2011), along with several providing population estimates for Västerbotten and Norrbotten (Kindberg. & Swenson 2010a, 2011) and revising previous national population estimates based on updated knowledge (Kindberg. & Swenson 2010b). Bischof and Swenson (in press) have provided and published a method to estimate the number of annual reproductions of brown bears in Norway. These population estimates and the model for Norway are used annually in the setting of harvest quotas in Sweden and determination of population size in relation to population goals in both countries.

Scientific publications

- Kindberg, J., G. Ericsson, and J.E. Swenson. 2009. Monitoring rare or elusive large mammals using effort- corrected voluntary observers. *Biological Conservation* 142:159-165.
- Kindberg, J., J. E. Swenson, G. Ericsson, E. Bellemain, C. Miquel, P. Taberlet. 2011. Estimating population size and trends of the Swedish brown bear (*Ursus arctos*) population. *Wildlife Biology* 17: 114-123.
- Bischof, R. and Swenson, J. E. In press. Combining non-invasive genetic sampling and traditional monitoring to aid management of a trans-border population of large carnivores. *Ecological Applications*.

Student thesis

- Kindberg, J. 2010. Monitoring and management of the Swedish brown bear (*Ursus arctos*) population. **PhD thesis**, Swedish University of Agricultural Sciences, Umeå.

Reports

- Kindberg, J., J. E. Swenson and G. Ericsson. 2009. Björnstammens storlek i Sverige 2008 — länsvisa uppskattningar och trender. Report No. 2009-2 from the Scandinavian Brown Bear Research Project.
- Bischof, R. and J. E. Swenson. 2010. Estimating the number of annual reproductions based on the number of female brown bears documented in Norway in 2008 and 2009. Report No. 2010-1 from the Scandinavian Brown Bear Research Project.
- Kindberg, J. & J. E. Swenson. 2010a. Beräkning av björnstammens storlek i Västerbotten 2009. Report No. 2010-4 from the Scandinavian Brown Bear Research Project.
- Kindberg, J. & J. E. Swenson. 2010b. Skattning av björnstammens storlek i Sverige åren 1994 och 2000. Report No. 2010-5 from the Scandinavian Brown Bear Research Project.
- Kindberg, J. & J. E. Swenson. 2011. Beräkning av björnstammens storlek i Norrbotten 2010. Report No. 2011: 6 from the Scandinavian Brown Bear Research Project.

The role of harvesting as a selective pressure in the life history of brown bears

Managing hunting to meet population goals is important for managers. We have documented the magnitude of hunter-caused mortality, that it is mostly nonselective to sex and age, and that it increases proportionally with the harvest quotas (Bischof et al. 2009a). Based on these results, Bischof & Swenson (2009) estimated the harvest rates that would stabilize the growth of the bear population. This is being used by managers to calculate harvest quotas. We also have found evidence that hunting can be a selective pressure in the life history of brown bears and other large mammals (Bischof et al. 2009c,

Mysterud & Bischof 2010, Zedrosser et al. 2011). Illegal hunting appears only to be a problem for Swedish bears in local areas (Swenson et al. 2011).

Scientific publications

Bischof, R., J. E. Swenson, N. G. Yoccoz, A. Mysterud and O. Gimenez. 2009a. The magnitude and demographic selectivity of natural and multiple anthropogenic mortality causes in hunted brown bears. *Journal of Animal Ecology* 78:656-665.

Bischof, R., A. Zedrosser, S. Brunberg, and J. E. Swenson. 2009b. A note on opportunism and parsimony in data collection. *Journal of Wildlife Management* 73:1021-1024.

Bischof, R., A. Mysterud, and J. E. Swenson. 2009c. With or without equations: What are the dos and don'ts of hunting? *Biology Letters* 5:213.

Bischof, R and Zedrosser, A. 2009. The educated prey. Consequences for exploitation and control. *Behavioral Ecology* 20:1228–1235.

Mysterud, A and Bischof, R. 2010. Can compensatory culling offset undesirable evolutionary consequences of trophy hunting? *Journal of Animal Ecology* 79:148-160.

Zedrosser, A., Steyaert, S. M.J.G., Swenson, J. E. and Gossow, H. 2011. Brown bear conservation and the ghost of persecution past. *Biological Conservation* 144:2163-2170.

Student thesis

Bischof, R. 2009. Selective harvesting: short- and long-term consequences for wild populations and their management. **PhD thesis**, Norwegian University of Life Sciences, Ås.

Reports

Bischof, R. and J. E. Swenson. 2009. Preliminary predictions of the effect of increasing hunting quotas on brown bear population growth in Sweden. Report No. 2009-3 from the Scandinavian Brown Bear Research Project.

Swenson, J. E., A. Zedrosser, S. Brunberg & P. Segerström. 2011. Causes of mortality, especially illegal killing, among Swedish brown bears, 1984-2010. Report No. 2011-3 from the Scandinavian Brown Bear Research Project.

Harvesting a bear population—modeling effects of infanticide

This subproject received a setback when we had to change PhD students, but the field work is now completed and data analysis is underway. Zedrosser et al. (2009, see density dependence) documented that primiparous females had higher cub loss than multiparous females and that reduced age of primiparity and increased male turnover (a variable predicting infanticide) increased cub mortality during the breeding season. A review of the mating system of brown bears will soon be published (Steyaert et al. in press).

Scientific publications

Steyaert, S. M.J.G., A. Endrestøl, K. Hackländer, J. E. Swenson, and Andreas Zedrosser. In press. The mating system of the brown bear *Ursus arctos*. *Mammal Review*

Student thesis

Haberkorn, D. 2011. Master of Science thesis, Spatio-temporal analysis of brown bear (*Ursus arctos*) interactions in the mating season, Wageningen University, Wageningen, Netherlands.

Popular science

Zedrosser, A. 2009. L'infanticide à des fin de reproduction. *Chasse et nature* 2: 32-34.

Genetics studies to support many subprojects

The SBBRP has continued to support genetics studies, including a new sex determination method for bears (Pagès et al. 2009), a new barcoding method to determine the diet of herbivores (Valentini et al. 2009), and a description of using powerpoles to collect bear genetics samples (Karamanlidis et al. 2010). We also participated in building a compatible database for all genetics samples of brown bears from Sweden and Norway (Aarnes et al. 2009). We published an invited review of the conservation genetics in European brown bears, which documented how important this research on bears has been for developing methods for studying and conserving rare species (Swenson et al. 2011).

Scientific publications

Pagès, M., C. Maudet, E. Bellemain, P. Taberlet, and S. Hughes. 2009. A system for sex determination from degraded DNA: a useful tool for palaeogenetics and conservation genetics of ursids. *Conservation Genetics* 10:897-907.

- Valentini, A, C. Miquel, M. A. Nawaz, E. Bellemain, E. Coissac, F. Pompanon, L. Gielly, C. Cruaud, G. Nascetti, P. Winker, J. E. Swenson, and P. Taberlet. 2009. New perspectives in diet analysis based on DNA barcoding and parallel pyrosequencing: the *trnL* approach. *Molecular Ecology Resources* 9:51-60.
- Karamanlidis, A. A., E. Drosopoulou, M. de Gabriel Hernando, L. Georgiadis, L. Krambokoukis, S. Pllaha, A. Zedrosser and Z. Scouras. 2010. Noninvasive genetic studies of brown bears using power poles. *European Journal of Wildlife Research* 56:693-702.
- Swenson, J. E., P. Taberlet, and E. Bellemain. 2011. Genetics and conservation of European brown bears. *Mammal Review* 41:87-98.

Report

- Aarnes, S. G., E. Bellemain, H. G. Eiken, and I. Wartiaenen. 2009. Interlaboratory comparison of genetic profiles of brown bears from Sweden (Laboratoire d'Ecologie Alpine) and Norway (Bioforsk Svanhovd). *Bioforsk Report* Vol. 4, No. 133.

3) Ethical questions regarding research on bears

The effects of capture, immobilization, and implanted transmitters on brown bears

We have documented the physiological effects of our present drugs to anesthetize bears (Fahlman et al. 2011) and baseline electrocardiogram data for anesthetized bears (Gandolf et al. 2010). An important finding was that many anesthetized bears need oxygen (Fahlman et al. 2010, in press), which we now provide routinely, as was documenting the winter capture methods (Evans ms, Brunberg et al. 2010).

Scientific publications

- Fahlman, Å., Pringle, J., Arnemo, J. M., Swenson, J. E., Brunberg, S., and Nyman, G. 2010. Treatment of hypoxemia during anesthesia of brown bears (*Ursus arctos*). *Journal of Zoo and Wildlife Medicine* 41:161-164.
- Fahlman, Å., N. Caulkett, J. M. Arnemo, P. Neuhaus, and K. E. Ruckstuhl. In press. Efficacy of a portable oxygen concentrator with pulsed delivery for treatment of hypoxemia during anesthesia of wildlife. *Journal of Zoo and Wildlife Medicine*.
- Gandolf, A. R., Å. Fahlman, J. M. Arnemo, J. L. Dooley, and R. Hamlin. 2010. Baseline normal values and phylogenetic class of the electrocardiogram of anesthetized free-ranging brown bears (*Ursus arctos*). *Journal of Wildlife Diseases* 46:724-730.
- Fahlman, Å., Arnemo, J. M., Swenson, J. E., Brunberg, S., Pringle, J., and Nyman, G. 2011. Physiologic evaluation of capture and anesthesia with medetomidine-zolazepam-tiletamine in brown bears (*Ursus arctos*). *Journal of Zoo and Wildlife Medicine* 42:1-11.
- Evans, A., V. Sahlén, O.-G. Støen, Å. Fahlman, S. Brunberg, K. Madslie, O. Frøbert, J. E. Swenson, and J. M. Arnemo. Submitted manuscript. Capture, anesthesia and effect of handling of free-ranging brown bears (*Ursus arctos*) during hibernation.

Popular science

- Brunberg, S., O.-G. Støen & V. Sahlén. 2010. Capturing denning brown bears in Sweden. *International Bear News* 19(4):13.

Report

- Arnemo, J. M., A. Evans & Å. Fahlman, (editors), Ahlqvist, P., Andrén, H., Brunberg, S., Liberg, O., Linnell, J. D. C., Odden, J., Persson, J., Sand, H., Segerström, P., Sköld, K., Strømseth, T. H., Støen, O.-G., Swenson, J. E & Wabakken, P. 2011. Biomedical protocols for free-ranging brown bears, wolves, wolverines and lynx. **Report.** (<http://www.rovviltportalen.no/content/500039688/Sok-etter-mer-informasjon-om-rovvilt>)

Other management-specific research: quality of tracking dogs.

We documented poor performance of tracking dogs following bear tracks, which shocked managers and hunters and encouraged similar research on moose, with similar results. This resulted in a measurably better training program, which the SBBRP participates in.

Popular science

- Vang, S., A. Zedrosser, S. Brunberg & J. Swenson. 2011. Bjørnhundar behøver bättere träning. *Svensk Jakt* 2011: 185-188.
- Vang, S., A. Zedrosser, S. Brunberg & J. Swenson. 2011. Eittersøksekvipasje ikke gode nok. *Jakt og Fiske* 2011 (1-2): 64-68.

Student theses

Vang, S. 2009. Factors affecting the ability and accuracy of dogs (*Canis familiaris*) to track brown bears (*Ursus arctos*). Master thesis, Norwegian University of Life Sciences, Ås.

Reports

Vang, S., A. Zedrosser, J. Swenson and S. Brunberg. 2009. Sporing av bjørn—en empirisk studie av ettersøksekvipasjer på bjørn sommeren 2007 og 2008. (In Norwegian: Tracking bears; an empirical study of tracking bears by dog-man teams in summer 2007 and 2008. Report No. 2009-1 from the Scandinavian Brown Bear Research Project.

Vang, S., Zedrosser, A., Swenson, J.E., and Brunberg, S. 2009. Sporing av bjørn. En empirisk studie av ettersøksekvipasjer på bjørn sommeren 2007 og 2008. Unpublished report for Statens Naturoppsyn and Svensk Jägareförbundet, 42pp.

Other: Human medicine. Our cooperation in the human biology project, using the brown bear as a medical model, has already been extremely productive and has yielded promising applications for human medicine and space travel. In addition, we are beginning to understand more about bear hibernation. This project used SBBRP infrastructure, but was funded externally.

Scientific publications

Fröbert, O., K. Christensen, Å. Fahlman, S. Brunberg, J. Josefsson, E. Särndahl, J. E. Swenson, J. M. Arnemo. 2010. Platelet function in brown bear (*Ursus arctos*) compared to man. *Thrombosis Journal* 8:10

Fink, T., J. G. Rasmussen, J. Emmersen, L. Pilgaard, Å. Fahlman, S. Brunberg, J. Josefsson, J. M. Arnemo, V. Zachar, J. E. Swenson, and O. Fröbert. 2011. Adipose-derived stem cells from the brown bear (*Ursus arctos*) spontaneously undergo chondrogenic and osteogenic differentiation in vitro. *Stem Cell Research* 7:89–95.

Vestergaard, P., O.-G. Støen, J. E. Swenson, L. Mosekilde, L. Heickendorff, and O. Fröbert. 2011. Vitamin D status, bone and connective tissue turnover in brown bears (*Ursus arctos*) during hibernation and the active state. *PLOS One* 6 (6): e21483.

Arinell, K., B. Sahdo, A. L. Evans, J. M. Arnemo, U. Baandrup, and O. Fröbert. In press. Brown bears (*Ursus arctos*) seem resistant to atherosclerosis despite highly elevated plasma lipids during hibernation and active state. *Clinical and Translational Science*

Other: North American cooperation. We have initiated a close cooperation with three research groups in North America; the Foothills Grizzly Bear Project in Alberta, Université de Sherbrooke, and grizzly bear researchers with the Alaska Department of Fish and Game. The cooperation with the Alberta project is the most comprehensive, involving comparisons of life history traits, habitat use, and the effects of human disturbance and resource extraction on the well-being, survival, and reproduction in brown bears. Several manuscripts are in progress, one of which has been submitted (see “Density-dependent effects” above). We envision a continued and greater cooperation with the Alberta group in the future. Our cooperation with the Université de Sherbrooke group involves the analysis of life-history and reproductive strategies. Two manuscripts have been submitted with this group. Cooperation with the Alaska group has begun. By combining our data with theirs, we have constructed the most comprehensive dataset on life-histories of individual free-ranging large carnivores in the world. We look forward to analyzing this dataset in the coming years.

COMMUNICATION EFFORTS

The SBBRP's has exceeded its communication plan goals. The production of publications is summarized on pages 2-3. We conducted one manager-oriented seminar each year. During the report period, project personal gave over 150 presentations to managers, politicians, and the public and interviews to the media. They also provided guidance and advice to managers at the national and local level and contributed to ongoing political policy efforts regarding bears in both Sweden and Norway.

The SBBRP was awarded the “Prize for Dissemination of Research” by the Norwegian University of Life Sciences (Forskingsformidlingsprisen) in 2011. Both Andreas Zedrosser and Richard Bischof were awarded the “Prize of the Prof. Anton Kurir Foundation for exceptional habilitation or doctoral theses” at the University for Natural Resources and Applied Life Sciences, Vienna for their PhD theses.

OTHER PUBLICATIONS NOT GIVEN ABOVE

Scientific publications

- Strömquist, A., Å. Fahlman, J. M. Arnemo, and A. Pettersson. 2009. Dental and periodontal health in free-ranging Swedish brown bears (*Ursus arctos*). *Journal of Comparative Pathology* 141:170-176.
- Kübber-Heiss, A., Zedrosser, A., Rauer, G., Zenker, W., Schmidt, P. and Arnemo, J.M. 2009. Internal hydrocephalus in a wild-born brown bear cub. *European Journal of Wildlife Research* 55:539–542.
- Ordiz, A., O-G. Støen, L. G. Langebro, S. Brunberg, and J. E. Swenson. 2009. A practical method for measuring wildlife horizontal cover. *Ursus* 20:109-113.
- Nawaz, M. A., J. E. Swenson, and V. Zakaria. 2009. Recovery of brown bears in northern Pakistan. *Current Conservation* 3:12-13.
- Fernández-Gil, A., A. Ordiz and J. Naves. 2010. Are Cantabrian brown bears recovering? *Ursus* 21:121-124.
- Karamanlidis, A. A., A. Sanopoulos, L. Georgiadis, A. Zedrosser. 2011. Structural and economic aspects of human – bear conflicts in Greece. *Ursus* 22:141-151.

Book chapter

- Martin, J., V. Tolon, B. van Moorter, M. Basille and C. Calenge. 2009. On the use of telemetry in habitat selection studies. Pp 37-55 in D. Barculo and J. Daniels, eds. *Telemetry: research, technology and applications*, Nova Science Publishers Inc, New York, USA.

Papers in nonrefereed publications

- Karamanlidis, A., Georgiadis, L., and Zedrosser, A. 2009. The "Southwestern Balkans Bear Register": a tool in the conservation of brown bears in the southwestern Balkans. *International Bear News* 18: 13-14.

Master of Science level theses

- Sahlén, E. 2010. , Master thesis, Do grizzly bears use or avoid wellsites in west-central Alberta, Canada? Swedish University of Agricultural Sciences, Umeå.
- Frank, S. 2011. Master of Science thesis, Bears, clear-cuts and ants: predicting bear use and movement among and within clear-cuts in Sweden during summer, University of Freiburg, Freiburg, Germany.

Reports

- Nygård, T., Brainerd, S. M., Brøseth, H., Bertsen, F., Bjørnes, E., Kvam, T., Nilsen, E. B., Pedersen, P. H., Stokke, S., Sørensen, O. J. & Swenson, J. E. 2009. Bjørn i Nord-Trøndelag. (In Norwegian: The brown bear in Nord-Trøndelag, central Norway). Norwegian Institute for Nature Research, NINA Rapport 472.
- Karamanlidis, A., and Zedrosser, A. 2009. Status of brown bears (*Ursus arctos*) in Albania and FYROM. Final report of a project supported by a research and conservation grant from the International Bear Association (IBA) on the status of brown bears (*Ursus arctos*) in Albania and the Former Yugoslav Republic of Macedonia (FYROM), 53pp
- Bischof, R. and J. E. Swenson. 2010. Estimating the number of annual reproductions based on the number of female brown bears documented in Norway in 2008 and 2009. Report No. 2010-1 from the Scandinavian Brown Bear Research Project.
- Swenson, J. E., O.-G. Støen, A. Zedrosser, J. Kindberg, S. Brunberg, J. M. Arnemo & V. Sahlén. 2010. Bjørnens status and økologi i Skandinavia. Report No. 2010-3 from the Scandinavian Brown Bear Research Project.
- Swenson, J. E. & J. Kindberg. 2011. Arealkrav til en hunnbjørnbestand med 20 ynglinger årlig i Norge. Report No. 2011-2 from the Scandinavian Brown Bear Research Project.
- Støen, O.-G. 2011. Statusrapport for prosjektet: Metodeutvikling for studier av bjørners predaasjon på klauvdyr. Report No. 2011-4 from the Scandinavian Brown Bear Research Project.
- Swenson, J. E. & J. Kindberg. 2011. The management and conservation of large carnivores in Sweden and Norway. Report No. 2011-5 from the Scandinavian Brown Bear Research Project.

Popular publications

- Swenson, J. E. 2010. Faktaark brunbjørn *Ursus arctos* truet art. Artsdatabankens faktaark ISSN1504-9140 nr. 101 (Fact sheet, brown bear, *Ursus arctos*, endangered species: in Norwegian).