

the adaptation of reindeer to emergency feeding. It became clear that the general condition of the animals, before the feeding started, as well as the diet composition, affected the ability of the reindeer to adapt to feeding.

Thesis distribution: Department of Animal Breed-

Robert Bertrand Weladji (b. 1967 in Cameroon) successfully defended his dissertation *Climatic Influences on the Life History and Population Dynamics of a Northern Ungulate, Rangifer tarandus* for the degree Doctor Scientiarum at the Agricultural University of Norway (NLH), Ås, on June 19th, 2003.



Robert Weladji completed his B.Sc. degree in *Wildlife and Forest Ecology* at the Department of Forestry, University of Dschang (Cameroon) in 1994. He then started working for the Department of Wildlife and Protected Areas, Ministry of Environment and Forestry in Cameroon. Thereafter, he joined the NLH where he obtained his M.Sc. degree in *Management of Natural Resources and Sustainable Agriculture* in 1998, at the Centre for International Environment and Development Studies. He started his doctoral work in 1999 at the Department of Animal and Aquacultural Sciences of the NLH, where he is currently a postdoctoral fellow.

The State Loan Educational Fund of Norway (subsistence allowance) and the Norwegian Reindeer Husbandry Development Fund (running costs for the project) provided financial support for the work.

The thesis is based on the following five papers:

- I. Weladji, R.B., Klein, D.R., Holand, Ø. & Mysterud, A. 2002. Comparative response of *Rangifer tarandus* and other northern ungulates to climatic variability. – *Rangifer* 22: 33-50.
- II. Weladji, R.B., Steinheim, G., Holand, Ø., Moe, S.R., Almøy, T. & Ådnøy, T. 2003. Temporal patterns of juvenile body weight variability in sympatric reindeer and sheep. – *Annales Zoologici Fennici* 40: 17-26.
- III. Weladji, R.B., Holand, Ø. & Almøy, T. 2003. Use of climatic data to assess the effect of insect harassment on the autumn weight of reindeer (*Rangifer tarandus*) calves. – *Journal of Zoology* 260: 79-85.
- IV. Weladji, R.B. & Holand, Ø. 2003. Global climate change and reindeer: effects of winter

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weather on the autumn weight and growth of calves. – *Oecologia* 136: 317-323.

- V. Weladji, R.B. & Holand, Ø. 2003. Sex ratio variation in reindeer: a test of the extrinsic modification hypothesis. – *Wildlife Biology* 9: 29-36.

Summary: There are increasing evidence that climate influences life history traits and population parameters of ungulates, and thereby their population dynamics. Climate effects on ungulates may be direct (e.g. increased energetic costs of moving through deep snow and in accessing forage through snow) or indirect (e.g. effect on forage plant biomass and quality, level of insect harassment and associated parasitism). Reindeer inhabit extremely seasonal environment, but has received little attention in the research of climatic effects on large herbivores. Using data from five reindeer grazing districts in Norway, the aim of the thesis was to analyse the relationship between climatic conditions (local and global) and interannual variation in body weight, growth rate and offspring sex ratio in reindeer, controlling for the effect of density. The prediction that summer rather than winter grazing conditions are more important for juvenile body growth in reindeer was also tested. An index of the North Atlantic Oscillation (NAO), the dominant mode of winter climate variability in the North Atlantic region, was used as a measure of large-scale climate. The results showed that autumn body weight of reindeer and sheep, as well as autumn growth rate and offspring sex ratio of reindeer varied between years. Autumn weights of reindeer also varied between populations. Despite sheep being fed indoors during winters, there was a positive relationship between autumn weights of sympatric reindeer and sheep, with no difference in the intrinsic variability of the two co-existing species. Interannual variations in body weight and offspring sex ratio of reindeer were influenced by local weather (winter and summer), global climate (measured by the NAO winter index) and population density. Local summer conditions appeared to be relatively more important than local winter conditions for reindeer body growth. Warm summers negatively affected autumn weight of reindeer calves, suggestively through insect harassment, with females being more vulnerable. The proportion of male calves decreased with increasing summer temperature and precipitation. An increase in the NAO winter index when calves were in utero, negatively influenced reindeer body

weight (summer and early winter), autumn growth rate and the proportion of male calves in the population, so did increasing population density. Finally, increasing population density amplified the negative effect of climate. Consistently, the negative effect of climate and density was mainly attributed to nutritional stress experienced by the calves (*e.g.* foetal development, neonatal growth) or their mother (*e.g.* summer condition before rut, winter condition during pregnancy, post-calving grazing conditions). The results support the following views: (i) patterns in life history traits and population parameters of ungulates vary over space and time, (ii) extrinsic climatic fluctuations and density, as well as their interaction, are important causative factors for the reported variations, their effects being mediated through nutritional stress, (iii) although uncer-

tain, global climate change will have considerable ecological implications, including effect on reindeer population dynamics. For example, reduced body size of reindeer may result from the reported warming trend of the globe, especially in areas where winters will be severe, and this may have consequence on reproductive performance and hence their population dynamics. Through its effect on life history parameters, it is concluded that climate affects population dynamics of reindeer. The implications of the findings for reindeer management are also discussed.

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Stéphanie C. Lefrère, born on July 10th 1972 in France, had a background in ethology and anthropology and had studied moose and wolves in the taiga of Finnish Carelia before she started on her inter-disciplinary PhD study in reindeer behaviour and ethnozoology in 1999 with title: “Seasonal variations of diurnal activities and social interactions of semi-domesticated reindeer *Rangifer tarandus tarandus* in Finnish Lapland. Traditional and modern methods of reindeer husbandry”.

Her PhD work was a cooperation between the animal and human Ethology department of René Descartes University (Paris V/ France) and the Reindeer Research Station (FGFRI) in Kaamanen, Finland. She passed her PhD successfully at Sorbonne in Paris, June 30th 2003. The supervisors have been Professor Jacques Goldberg, director of the animal and human Ethology department of René Descartes University and Dr Mauri Nieminen, director of the Reindeer Research Station (FGFRI). The dissertation was evaluated by the following jury: chairman Pr Pierre Parlebas, sociologist, previous Dean of René Descartes university; Pr Jacques Goldberg, PhD director, biologist, René Descartes University; Pr Raymond Pujol, ethnobiologist at National Museum of Natural History; Pr Franklin Rauski, psychologist at Strasbourg University; Dr Jean-Jacques Lauvergne, genetician, ex-director of animal genetic department at INRA; Dr Mauri Nieminen, PhD supervisor, biologist.

The PhD thesis is a monograph of 297 pages. Its different parts will later be published in the form of articles. The study analysed the activities and social interactions of reindeer through seasons under natural pasture conditions and in experimental condition



in corral. Reindeer were studied from birth to weaning analyzing the mother-calf bond until their separation and consequences on suckling behaviour and milk yield. From summer to the beginning of winter, females' activities and their food selection were studied on pasture. During the rut, the changes in males' behaviour associated to their level of testosterone were investigated. In wintertime, the development of the hierarchy and changes in females' activities related to their cardiac rhythm was completed. The last part of the thesis compares the traditional and modern methods of reindeer management, with the different utilization of reindeer, and it emphasizes how humans have succeeded in controlling partial domestication by adaptation of the reindeer in its environment.

Lefrère's PhD scholarship was granted by CIMO (Centre for international mobility - Finnish Government) for three years.