Head to Head

Tooth extraction is not an acceptable technique to age live ungulates

By Marco Festa-Bianchet, Pierrick Blanchard, Jean-Michel Gaillard, and A. J. Mark Hewison

Nelson (2001) recommended that researchers extract an incisiform canine from deer captured for ecological and management studies. We contend that removing a biting tooth from an ungulate may have negative consequences. Clearly, accurate information on the age of marked individuals is extremely useful. Ungulate populations are strongly age-structured, and age has major effects on behavior, reproduction, and survival (Gaillard et al. 2000). Indeed, little is known about age-specific reproduction and survival of free-ranging white-tailed deer (*Odocoileus virginianus*) because few studies of this species (Nelson and Mech 1990, Ditchkoff et al. 2001) have monitored a sufficient sample of marked, known-age individuals. Unfortunately, it is impossible to accurately age deer >4 years old by any method other than counting the cementum annuli. While most studies have employed this technique to age dead ungulates (Aitken 1975, Hamlin et al. 2000), Nelson (2001) suggests extraction of biting teeth from live deer. The removal of a biting tooth may reduce bite size, which could affect food intake and hence reduce mass gain, reproduction, and possibly survival of monitored deer. Until this technique is shown to be harmless, tooth removal also raises important ethical questions.

Like other ungulates, white-tailed deer have 6 incisors and 2 incisiform canines that are used to clip vegetation. It is reasonable to assume that if one of these teeth is removed, the average bite size will be reduced, by a proportion that will likely vary according to food type (Gordon et al. 1996). To compensate for the lowered intake, deer will have to increase either the biting rate or the time spent foraging. Red deer (*Cervus elaphus*) increased time spent chewing and modified their intake rate in an attempt to compensate for reduced chewing efficiency associated with changes in morphology of cheek teeth (Pérez-Barberia and Gordon 1998). Individuals experiencing difficult winters, or lactating females, may be unable to make up for the lost biting efficiency (Gordon et al. 1996, Ruckstuhl and Festa-Bianchet 1998, Iason et al. 1999, Gedir and Hudson 2000). Browsers such as white-tailed deer may be less affected by removal of an incisiform canine than grazers such as bison (*Bison bison*) or mountain sheep (*Ovis* spp.) (Shipley et al. 1999), but one cannot simply assume that deer do not need all of their teeth. In addition to browsing, white-tailed deer also graze (Meyer et al. 1984). When grazing, one missing tooth will likely decrease bite size more than when browsing.

Because information on age of marked individuals is extremely useful (Gaillard et al. 2000), uncritical acceptance of tooth extraction may encourage its use with other ungulates. Nelson (2001) stated that tooth removal did not lead to permanent injury and that >90% of deer from which he removed one or more teeth survived at least 1 year. He did not, however, compare age-specific survival of deer with intact incisor bars and deer with missing teeth. It is particularly worrisome that when the attempt to remove a canine resulted in tooth breakage, another canine was pulled, doubling the loss of biting surface. In rare cases, 3 teeth were pulled from the same deer. Even if the central 2 or 4 incisors did most of the biting, it seems unlikely that a deer with 5 teeth will have the same feeding efficiency as one with 8 teeth. Because the effects of

Key words: aging, bite size, ethics, tooth extraction, ungulates

a reduction in bite size may be important but subtle, monitoring short-term deer survival may be inadequate. The missing tooth (or teeth) may have a strong effect on older deer: tooth wear is often suggested as a proximate cause of senescence in cervids (Skogland 1988, Gaillard et al. 1993). Before tooth removal is accepted as an harmless aging technique, we need comparative data on seasonal mass changes, reproduction, and long-term survival (particularly through the senescent stage) of animals with all of their teeth and with some teeth removed.

Wildlife biologists must adhere to a high standard of ethics in the treatment of study animals. Most journals (including the *Wildlife Society Bulletin*) and funding agencies require that studies undergo review by an animal care committee before being considered for funding or publication. We submit that tooth extraction from live wild ungulates cannot be considered as ethical practice (Stamp Dawkins and Gosling 1991) and should not be done as part of routine studies. Further, until the technique is shown to be truly harmless, it risks introducing flaws to long-term studies that may be greater than the problem of not knowing the exact age of adult animals. The onus falls upon those who advocate this procedure to demonstrate that it has no harmful consequences and does not contravene accepted ethical guidelines.

Literature cited

AITKEN, R. J. 1975. Cementum layers and tooth wear as criteria for aging roe deer (*Capreolus capreolus*). Journal of Zoology 175:15–28.

DITCHKOFF, S. S., E. R. WELCH, R. L. LOCHMILLER, R. E. MASTERS, AND W. R. STARRY. 2001. Age-specific causes of mortality among male white-tailed deer support mate-competition theory. Journal of Wildlife Management 65:552–559.

GAILLARD, J.-M., D. DELORME, J.-M. BOUTIN, G. V. LAERE, B. BOISAUBERT, AND R. PRADEL. 1993. Roe deer survival patterns: a comparative analysis of contrasting populations. Journal of Animal Ecology 62:778–791.

GAILLARD, J. M., M. FESTA-BIANCHET, N. G. YOCCOZ, A. LOISON, AND C. TOÏGO. 2000. Temporal variation in fitness components and population dynamics of large herbivores. Annual Review of Ecology and Systematics 31:367–393.

GEDIR, J. V., AND R. J. HUDSON. 2000. Seasonal foraging behavioural compensation in reproductive wapiti hinds (*Cervus elaphus canadensis*). Applied Animal Behavior Science 67:137–150.

GORDON, I. J., A. W. ILLIUS, AND J. D. MILNE. 1996. Sources of variation in the foraging efficiency of grazing ruminants. Functional Ecology 10:219–226.

HAMLIN, K. L., D. F. PAC, C. A. SIME, R. M. DESIMONE, AND G. L. DUSEK. 2000. Evaluating the accuracy of ages obtained by two methods for Montana ungulates. Journal of Wildlife Management 64:441–449.

IASON, G. R., A. R. MANTECON, D. A. SIM, J. GONZALEZ, E. FOREMAN, F. F. BERMUDEZ, AND D. A. ELSTON. 1999. Can grazing sheep compensate for a daily foraging time constraint? Journal of Animal Ecology 68:87–93.

MEYER, M. W., R. D. BROWN, AND M. W. GRAHAM. 1984. Protein and energy content of white-tailed deer diets in the Texas coastal bend. Journal of Wildlife Management 48:527–534.

NELSON, M. E. 2001. Tooth extraction from live-captured white-tailed deer. Wildlife Society Bulletin 29:245–247.

NELSON, M. E., AND L. D. MECH. 1990. Weights, productivity, and mortality of old white-tailed deer. Journal of Mammalogy 71:689–691.

PÉREZ-BARBERIA, F. J., AND I. J. GORDON. 1998. The influence of molar occlusal surface area on the voluntary intake, digestion, chewing behaviour and diet selection of red deer (*Cervus elaphus*). Journal of Zoology 245:307–316.

RUCKSTUHL, K. E., AND M. FESTA-BIANCHET. 1998. Do reproductive status and lamb gender affect the foraging behavior of bighorn ewes? Ethology 104:941–954.

SHIPLEY, L. A., A. W. ILLIUS, K. DANELL, N. T. HOBBS, AND D. E. SPALINGER. 1999. Predicting bite size selection of mammalian herbivores: a test of a general model of diet optimization. Oikos 84:55–68.

SKOGLAND, T. 1988. Tooth wear by food limitation and its life history consequences in wild reindeer. Oikos 51:238–242.

STAMP DAWKINS, M., AND M. GOSLING. 1991. Ethics in Research on Animal Behaviour. Academic Press, London, UK.

Address for Marco Festa-Bianchet and Pierrick Blanchard: Département de biologie, Université de Sherbrooke, Sherbrooke, PQ, J1K 2R1, Canada; e-mail for Festa-Bianchet: mbianche@courrier.usherb.ca. Address for Jean-Michel Gaillard: Université Claude Bernard, Lyon 1, Unité Mixte de Recherche "Biométrie et Biologie Evolutive," 43 boulevard du 11 novembre 1918, 69622 Villeurbanne, France. Address for A. J. Mark Hewison: Institut de Recherche sur les Grands Mammifères, Institut National de la Recherche Agronomique, BP 27, 31326 Castanet-Tolosan, France.

Marco Festa-Bianchet is professor of ecology at the Université de Sherbrooke, Québec. He has a Ph.D. from the University of Calgary and was a NATO Science postdoctoral fellow in Cambridge, United Kingdom. His research examines the factors affecting reproductive success and population dynamics of ungulates. He chairs the IUCN Caprinae Specialist Group and the Terrestrial Mammals Specialist Group of the Committee on the Status of Endangered Wildlife in Canada. He is a member of the Wildlife Committee of the Canadian Council on Animal Care, charged with developing guidelines for the ethical treatment of wildlife in research and management. ***Pierrick Blanchard*** is a Ph.D. candidate in a co-direction program at the Universities of Sherbrooke, Canada, and Lyon, France. His research examines how changes in population density affect nutrition and offspring sex ratio of roe deer and bighorn sheep. ***Jean-Michel Gaillard*** completed a Ph.D. at the Université de Lyon and is a Research Director with the Centre National de la Recherche Scientifique in Lyon, France. He studies population dynamics of ungulates, particularly the effects of weather and population density, and their interactions with age-specific changes in survival and reproduction. ***Mark Hewison*** is a full-time researcher in a population ecology team at IRGM-INRA Toulouse, France. He obtained his Ph.D. from Southampton University in 1993 and then completed several postdoctoral fellowships. He studies the variability of life-history traits in ungulates, particularly the roe deer, and is currently working on dispersal behavior and population processes in relation to landscape heterogeneity.