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## Overwinter Survival of Carfentanil-immobilized Male Bison

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**ABSTRACT:** A problem with studies that examine immobilization-related drug effects on large mammals is that no true control group exists because untreated (non-captured) animals in the same population have not been examined. We present data to show that overwinter survival in male bison (*Bison bison*) immobilized with carfentanil was the same as untreated bison. This unique experimental design allows us to conclude that the drug had no long-term effect on male bison overwinter survival.

**Key words:** *Bison bison*, chemical immobilization, carfentanil, experimental design, field study, control groups.

The long-term effects of different capture or immobilization practices on the survivorship of wild ungulates have rarely been reported due to a combination of statistical and logistical problems (Berger et al., 1983). For example, although mortality data can be gathered by follow-up surveys after animals have been handled, it is difficult to decide what mortality might have resulted in the absence of such treatments. This is understandable because there are few data on the survival probabilities of identifiable but unmarked (or non-handled) individuals and, thus, there is no true control group. Fortunately, because of unique conditions at Badlands National Park (South Dakota, USA; 40°50'N, 102°20'W), we were able to evaluate the effects of carfentanil-mediated chemical restraint on wild bison. Here we report overwinter survival in 51 known individuals, 21 of which had been immobilized with carfentanil in the fall of 1986 (Kock and Berger, 1987) and 30 of which were identifiable (by horn and fur characteristics; Berger, pers. obs.) but were not immobilized. These latter animals served as controls.

Bison have been observed from March 1985 to December 1987 for about 5,400 hr as part of a broader study on the ge-

netics of isolated populations at Badlands National Park. Details of the capture and immobilization are given in Kock and Berger (1987). Briefly, free-ranging animals were restrained with carfentanil (Wildnil, Wildlife Laboratories, Inc., Fort Collins, Colorado 80525, USA) during the fall of 1986 although the overwinter survivorship of these individuals had remained unknown. However, because the identities of >100 non-restrained individuals (56 had prior ear tags) were known also, it was possible to determine whether carfentanil had any long-term demographic effects by contrasting overwinter survival in treated and untreated animals. To minimize errors arising from possible misidentifications of non-tagged, untreated animals, we selected bulls with the most distinguishable worn horns and head hair patterns. These characteristics had changed little between 1985 and 1987, and had been correctly identified by the field team and one of us (JB) more than 99% of the time. Of these 30 untreated bulls used as the control group, 10 had ear tags, but all were compared to similar-aged treated bulls. While we immobilized 26 animals (Kock and Berger, 1987), we report here only on the fates of 21 immobilized bulls; omitted from the data in this paper are contrasts with cows and young animals simply because our small samples for these categories cannot be compared statistically.

Of the 21 bulls immobilized in September 1986, 18 were observed between April and August 1987, which yielded a minimum overwinter survival rate of 86%. In contrast, of the 30 untreated bulls 28 (93%) were re-sighted during the same period. There was no statistical difference between the two samples ( $\chi^2 = 0.17, 0.90 > P > 0.75$ ).

These results indicate that carfentanil

had no long-term negative effect on the survival of bull bison in Badlands National Park in the winter of 1986–1987. This is important because of problems resulting from renarcotization (Kock and Berger, 1987) which in ruminants can lead to mortality 12 to 24 hr postimmobilization (Franzmann et al., 1984; Jessup et al., 1985). Perhaps under different density or climatic conditions, the effects of the treatment would have been exacerbated. Although our results indicate no long-term influences of carfentanil, additional research should focus on whether different restraint methods conducted under varying ecological conditions and ambient temperatures (Spraker, 1982) affect long-term survival in bison and other species.

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