

Cause-Specific Average Annual Mortality in Low-Elevation Rocky Mountain Bighorn Sheep

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Abstract: In August 1998, 16 adult and 7 lamb Rocky Mountain bighorn sheep (*Ovis canadensis*) were transplanted to the Manzanos Mountains, New Mexico to augment a low-elevation herd with <20 bighorns. One additional ram was translocated in December 1998. All translocated adults were radiocollared. This herd is located southeast of Albuquerque in a canyon vegetated with juniper (*Juniperus* spp.) and pinyon pine (*Pinus edulis*). Bighorns sheep were released in Monte Largo Canyon (n=14), and approximately 26 km south near the confluence of Sand and Abo Canyons (n=10). A single track railroad runs through Abo Canyon. In January 1999, 9 bighorns occupying the mountain before the 1998 release were captured and radiocollared in Sand Canyon. From 1998 to 2003, sheep were monitored from the ground and during fixed-wing flights. When mortality signals were received, carcasses were collected and assessed for cause of death. We used the nested survival model in program MARK to analyze annual herd mortality rates and cause-specific mortality rates from mountain lion (*Puma concolor*) predation and train strikes. Overall average annual mortality for the herd was 0.29 (SE = 0.01). Mortality resulting from mountain lion predation (0.11, SE = 0.01) was greater than train strikes (0.07, SE = 0.01). Average annual mortality was greater for translocated (0.36, SE = 0.02) than extant sheep (0.20, SE = 0.01), and greater for males (0.36, SE = 0.02) than females (0.27, SE = 0.01). The cause-specific average annual mortality from mountain lion predation was greater for translocated (0.16, SE 0.01) than extant bighorns (0.04, SE = 0.01), and greater for rams (0.23, SE = 0.02) than ewes (0.07, SE = 0.01). Cause-specific mortality rates from train strikes were greater for extant (0.17, SE = 0.01) than for translocated bighorns in Sand Canyon (0.09, SE = 0.01). The population in autumn 2003 was approximately 20 bighorn sheep. Unless management programs are developed to reduce mountain lion predation and train strike mortality, the Manzanos bighorn population may go extinct.

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