

## TOP-DOWN AND BOTTOM-UP REGULATION OF BIGHORN SHEEP POPULATIONS IN NEW MEXICO, USA

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*Abstract:* Rocky Mountain bighorn sheep (*Ovis canadensis canadensis*) populations restricted to alpine ecosystems year-round, exhibit classic bottom-up population regulation related to density-dependence. Rocky Mountain bighorn sheep reintroduced into alpine ecosystems increase quickly, generally doubling every 3 years, and then stabilize. Growth curves of alpine bighorn populations in NM generally asymptote at densities of ~6 bighorn/km<sup>2</sup> of total range of ~23 bighorn/km<sup>2</sup> of winter range. Seasonal habitats are most constricted during winter and annual fluctuations in populations are correlated with winter severity. Annual mortality is skewed toward lamb and yearling cohorts. No mortality due to predation was documented during monitoring of 85 radiocollared bighorn, between 1993 and 2002. Desert bighorn sheep (*O. c. mexicana*) populations, in Chihuahuan desert ecosystems of New Mexico, are controlled by mountain lion (*Puma concolor*) predation in classic top-down population regulation. Reintroduced populations generally increase very slowly if at all. Populations generally do not exceed 0.5 bighorn/km<sup>2</sup>. Despite long term lamb:ewe ratios in desert bighorn populations that are predicted to resulting moderate growth, most populations have declined or gone extinct due to high adult mortality attributed primarily to mountain lion predation. If lamb losses due to predation are added to the metric, resulting lamb:ewe ratios should result in substantial population growth. Monitoring 172 radiocollared desert bighorn sheep, between 1992 and 2002, documented a minimum of 70 mortalities due to lion predation. Mean density of a free-ranging (not supplementally fed) bighorn population in a large (5.6 km<sup>2</sup>) fenced facility in the Chihuahuan desert has been 40-times greater ( $19 \pm 3.1$  bighorn/km<sup>2</sup>) than that documented in nearby wild desert bighorn populations ( $0.48 \pm 0.1$  bighorn/km<sup>2</sup>). Lethal control of both mountain lions and coyotes (*Canis latrans*) is implemented at this facility. Lions are subsidized predators in desert ecosystems, and top-down control may be a function of this phenomenon. Evidence that both top-down and bottom-up regulatory mechanisms control populations of the same species within New Mexico is presented.

*Key words:* bighorn, *Ovis Canadensis*, *Puma concolor*, *Canis latrans*, lethal control, top-down, bottom-up population regulation

