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ON "POPULATION CONTROL" WITH REFERENCE TO MOUNTAIN SHEEP AND GOATS

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ABSTRACT ONLY

Before explaining the demography of American mountain sheep and goats, some aspects of conventional population ecology are examined and found wanting. In this discipline basic semantic problems lead to ambiguous, meaningless hypotheses; ambiguous hypotheses cannot be disproven in principle. The inherent logic of language is confused with reality; the term "regulation" is used in 2 unrelated meanings; the term "population" is reified and treated as substantive reality, not as a convenience of language or convenient fiction which it is. Moreover, it is assumed wrongly that the "population" denotes a teleonomic, that is, goal-directed, system. The question "How do populations control themselves?" is not amenable to scientific investigations and cannot be answered in that semantic formulation. Demography can be explained by asking how an individual maximized reproductive fitness in response to varying environments. It is proposed that individuals are to vary number and phenotype of offspring to maximize fitness, taking as their cue the surplus of resources spared from maintenance. The extremes in phenotype development are labelled maintenance and dispersal phenotypes. Attributes of these phenotypes fit respectively with life under resource scarcity and resource abundance, the latter linked usually to colonizing vacant habitat. The amount of resources spared from maintenance toward reproduction is a consequence of the individual's adaptations as exercised against the resistance of the environment. Therefore, a multi-factorial model of 3 basic components is used to explain demography; the mechanism of the individual controlling phenotype strategy; the individual's adaptations; and the environmental factors. What is referred to as "population control" is the statistical consequence of phenotypic reproductive strategies (long-term) plus the resultant of individual (short-term) actions maximizing reproductive fitness versus the resistance of the environment. Species adaptations can be conceived as consisting of 4 layers of constraints: those typical of all individuals, of the sex-age class, of the phenotype, and the day-to-day decision process of the individual. These can be shown to be a variation in resource acquisition or expenditure, and therefore in demography. The only resources consistently available for reproduction are those freed by death of adults. These resources could be used to maintain 2 extremes in population, 1 consisting of maintenance phenotypes, the other of dispersal phenotypes. Such populations would vary only a little in biomass or size, but would vary greatly in demographic characteristics and in their responses to crises. Populations of dispersal phenotypes cannot exist for

long and will gravitate towards maintenance phenotypes. The extreme is a population of unhealthy, incompetent individuals, highly susceptible to environmental vagaries. To predict demographic changes one must go beyond a model that deals only with the properties of numbers as conventional models do. Some populations are able to clearly exhibit mechanisms that stabilize population densities (show "population regulation") namely those consisting of individuals of maintenance phenotypes. Identification of phenotypes permits conclusions about the extent and timing of resource abundance, as well as about environmental stresses, and offers insights into patterns of colonization and extinction. It is concluded that mountain sheep, by adjusting their phenotypic reproductive strategies to available resources, can vary reproduction above and below that needed for maintaining population size. A long history of stability with concommitant shift to extreme maintenance phenotype characteristics, predisposes a population to a sudden decline from any number of causes. Sheep are seen as recent colonizors of North America, best adapted where ever they have access to ancestral alpine landscapes and poorest adapted where they exist on native American flora. Sheep have apparently radiated in response to megafaunal extinction, and their existence in deserts of the American Southwest is precarious due to inadequacies in their adaptations to that environment. One such inadequacy may be their lack of adaptations to defensive plant toxins that co-evolved with the extinct megafauna. The impact of human activities is detrimental, in particular the introduction of desert-adapted exotics as well as "old Americans" such as the genus Equus. Desert sheep characteristics are linked to a new contingency, namely the availability of water in small, discrete, defendable amounts. American sheep are a rare example of an arctic species colonizing southern latitudes. Whereas sheep do not readily respond demographically to weather changes, except by varying reproductive output and phenotype of the young, American mountain goats respond sharply. This is due to adult females defending limited areas of steep cliffs on which they winter. Under conditions of deep snow the aggression of females escalates, subordinate females are evicted by dominant ones, as are yearlings and males, forcing these to move out in search of adequate habitat. In hard winters these sex-age classes suffer heavy mortality; so do kids despite the protection afforded on a secure territory by their dominant mothers. In addition, the reproductive performance of even dominant females declines. Under favorable weather conditions the adult females are quite tolerant, which leads to high survival of subordinates and a high reproduction by all. This makes goat demography highly sensitive to weather, in particular to snowfalls in winter. Since goats can be readily alienated from their home ranges, and since hunting mortality appears to be additive, and since no compensatory reproduction follows the death of adults; a series of hard winters, plus increased human encroachment and hunting, can rapidly depress goat populations. Sheep populations of high density, living in open landscapes are quite resistant to hunting and may show compensatory reproducton in response to decimation. Sheep living as maintenance phenotypes widely dispersed on small patches of habitat within timbered areas are highly susceptible to decimation and will recover only slowly if at all. Their former distribution can only be achieved artificially by reintroductions and various artificial means to extend home ranges of existing populations.