Crowded Mountains
Managing Competition Between Desert Bighorn, Mule Deer, and Aoudad

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However, aoudad populations have exploded nearly as quickly as their popularity. Recent Texas Parks and Wildlife Department (TPWD) surveys counted more than 5,000 animals in three adjacent mountain ranges in a single day. It is not uncommon to see herds numbering in the hundreds along state highways as you go through mountain passes, making the mountains look like brown waves. The sheer abundance of mouths to feed raises concern for the grazing and browsing impacts aoudad have on fragile mountain ecosystems, but their interactions with native desert bighorn and mule deer further complicate matters.

Both desert bighorn and mule deer populations declined in the Trans-Pecos in the early 20th century. Early intervention and natural resilience led to mule deer recovery, but desert bighorn went extinct in the region by the mid-1960s. Fortunately, subsequent reintroduction, habitat improvement, and herd management efforts returned desert bighorn to historic population levels in the Trans-Pecos by the 1990s, representing a resounding conservation success.

Aoudad are a wild sheep native to northern Africa, but have become a popular big game species in the Trans-Pecos. Their propensity for rugged terrain, wariness, and relative affordability make a challenging sheep hunt accessible to many hunters, which has led to an explosion in their popularity. While limited data are available, anecdotal accounts from guides and landowners suggest aoudad hunting is now a significant economic driver in the Trans-Pecos, if not one of the leading ones. Aoudad are becoming culturally emblematic in the region as well, with images of aoudad skulls featured prominently in guide service logos, on hats, and on truck decals.
Desert bighorn, mule deer, and aoudad share many similarities. All three are large, browsing ungulates, though desert bighorn and aoudad can also graze during lean habitat conditions. All three species occupy rugged terrain, though mule deer occupy low mountains and foothills while bighorn prefer high elevations.

Aoudad, on the other hand, are known to use both. Aoudad are also more gregarious than mule deer and harder than desert bighorn. They are resistant to, but known to carry, diseases associated with desert bighorn die-offs, and reproduce much more quickly than the two natives. These similarities and advantages suggest that aoudad could compete with native species and likely outcompete them.

Competition among species is a complicated game where the outcome depends on numerous factors. In addition, there is almost no information on which to base management decisions regarding aoudad.

While their interactions with native ungulates in Spain are well-studied, results were context-dependent, contingent on the available habitat and the species with which they interacted. This means that results from other areas are unlikely to reflect conditions in the Trans-Pecos. While one study suggests aoudad and mule deer may compete in the Texas Panhandle, stark differences between the Caprock and Trans-Pecos limit its usefulness to guide management in the Chihuahuan Desert.

To begin filling the gap, TPWD and Borderlands Research Institute (BRI) partnered in 2018 to study interactions between desert bighorn, aoudad, and mule deer in a co-occupied mountain range in the Trans-Pecos. Again, competition is a complicated game, but comparing how each species uses habitat was a logical starting place.

We did this by comparing each species' niche, which is simply the range of various conditions they can use successfully. The niche is closely tied with familiar terms, such as generalist and specialist; generalists have broad niches, allowing them to use a wide range of conditions, while the opposite is true for specialists.

Figure 1: Niches of desert bighorn (blue), mule deer (green), and aoudad (red). Each point corresponds to an individual animal, while its position reflects how they use resources on the landscape. We see that desert bighorn and aoudad have small, overlapping niches, while mule deer have a much larger niche with minimal overlap with the other two species.
When two species’ niches overlap, they are likely to compete when resources are limited, which is often the case in the desert. This is because they have similar needs, but there is not enough of the resource to go around.

We saw that desert bighorn and aoudad had small but overlapping niches (Figure 1). On the other hand, mule deer had a broad niche that was mostly separated from the other two species.

This suggests that aoudad were likely to compete with desert bighorn but not with mule deer under the conditions we observed. These results are also consistent with what we know about desert bighorn and mule deer behavior; desert bighorn are specialists with a small niche, while mule deer are generalists with a broad one.

However, aoudad are commonly thought of as generalists while their niche suggests they are specialists. But remember, competition is a complicated game.

Species’ niches, which drive competition, change depending on several factors. This is, in fact, the underlying reason why studies in Spain or even the Texas Panhandle are difficult to use; they only show a snapshot of the niche under a particular set of circumstances.

Returning to aoudad’s small niche, the population we studied was relatively small due to active control measures by the landowner before our study. With fewer mouths to feed, individuals within a population experience less competition with each other and can use the best resources available to them. As the population grows, it is easier to use a lower quality resource than compete for the best ones.

This makes a population’s niche density-dependent, getting larger as individuals are forced to make tradeoffs to access resources. Ultimately, this suggests that the aoudad population we observed is small enough that these aoudad are not competing among themselves, and that the species can “act like” a specialist. As the population grows, we would expect their niche to broaden, looking more like that of a generalist.

As any of the three species’ niches changes, so does the competition among them. Competition can make niches shrink, expand, or move as each species tries to adapt to it. Understanding how these niches change as aoudad populations increase is the key to managing them.

Investigating niche processes will allow us to understand how desert bighorn, aoudad, and mule deer interact in more than snapshots, and will answer questions like “How do desert bighorn respond to competition with aoudad?” “Do aoudad compete with mule deer at higher densities?” “How many aoudad can a desert bighorn or mule deer population coexist with?”

Answers to these questions are the key to setting achievable goals in managing issues associated with aoudad. While many advocate for eradicating aoudad, removing them from the landscape is likely impossible. Their sheer abundance in certain areas, rapid reproductive rate, hardiness, and the rough terrain they occupy present insurmountable logistical challenges to such efforts.

Aoudad are also economically important to numerous landowners and stakeholders who also actively manage habitats for native desert bighorn and mule deer, further complicating appropriate management. Recognizing these realities, it is crucial to investigate how competition can be appropriately managed to ensure the persistence of natives alongside their new neighbors.

To that end, TPWD and BRI continue to investigate how these species interact. We are currently researching how desert bighorn, aoudad, and mule deer are distributed on the landscape, how they share resources in time, and how similar their diets are throughout the year. We are also expanding the work presented here to examine how these species’ niches change with increasing aoudad abundance and, ultimately, provide useable management guidelines to conserve our native wildlife in a changing landscape.