

NOTES

BIGHORN SHEEP (*Ovis canadensis*) RAM ASSOCIATING WITH A HERD OF Aoudad (*Ammotragus lervia*) AT BIG BEND RANCH STATE PARK, TEXAS

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Abstract.—The native North American Bighorn Sheep (*Ovis canadensis*) and the non-native Aoudad (*Ammotragus lervia*) are known to compete for the same resources and habitat, and they have been recognized to be behaviorally incompatible. At Big Bend Ranch State Park, Texas, a long-term study using camera-traps produced images of an incident that is contradictory to expected behaviors between these two species. Camera-trap images depict an adult male Bighorn Sheep within a group of Aoudad. Behaviors were passive and tolerant among female and immature Aoudad and the male Bighorn Sheep.

Key Words.—camera-traps; behavior; Chihuahuan Desert; social interaction; Trans-Pecos

Bighorn Sheep (*Ovis canadensis*) are distributed throughout mountainous regions in western North America from British Columbia southward to Baja and northern Mexico eastward to the Trans-Pecos region of Texas (Shackleton 1985; Festa-Bianchet 1999). In Texas, populations of the Desert Bighorn Sheep (*O. c. mexicana*), a subspecies adapted to the arid mountain ranges of the Trans-Pecos (Stangl et al. 1994), sustained steep declines through the late 1800s from continuous hunting by railroad crews and mining operations to a point where the Texas State Legislature prohibited all hunting of the species in 1903 (Hailey 1977; Winkler 1977; Kilpatrick 1982). The last of original native Desert Bighorn Sheep in Texas, however, were extirpated from the Sierra Diablo Wildlife Management Area (SDWMA) in 1960 (Hailey 1977; Schmidly 1977; Kilpatrick 1982; Brewer and Hobson 2000). The state of Texas began a reintroduction program during the late 1950s at Black Gap Wildlife Management Area (BGWMA) with Bighorn Sheep transplanted from Arizona (Kilpatrick 1975, 1982; Brewer and Hobson 2000). Once established at BGWMA, reintroductions were made back into SDWMA (Winkler 1977; Kilpatrick 1982), and over the next 40 y, management programs of the Texas Parks and Wildlife Department (TPWD) translocated Bighorn Sheep back into other mountain ranges where the native subspecies had been extirpated, resulting in seven free-ranging populations in the Trans-Pecos region by 2000 (Brewer and Hobson 2000). In 2011, Bighorn Sheep were translocated into the Bofecillos Mountains of Big Bend Ranch State Park (BBRSP) in Presidio County (Hernández 2013, 2017) for the eighth population in the Trans-Pecos. Although some of the first transplanted Bighorn Sheep from Arizona were from the same subspecies (*O. c. mexicana*; Shackleton 1985) that was extirpated from Texas, other reintroductions comprised

sheep from other subspecies. These included *O. c. canadensis* (Rocky Mountain Bighorn) and *O. c. nelsoni*, which are also commonly referred to as Desert Bighorn (Schmidly and Bradley 2016); therefore no subspecific designation is used herein for reintroduced Bighorn Sheep in Texas.

The Aoudad, or Barbary Sheep (*Ammotragus lervia*), is native to the dry mountainous region of northern Africa (Gray and Simpson 1980; Schmidly and Bradley 2016). The species became successfully established in Texas after 44 individuals were released for sport hunting purposes in 1957 and 1958 by TPWD at Palo Duro Canyon State Park in the upper Panhandle (Morrison 1984). Ironically, introductions of Aoudad were initiated as a substitute for diminished hunting availability of Bighorn Sheep. By 1980, free-ranging Aoudad were found across several desert mountain ranges in the Trans-Pecos region and discussions began about control efforts because of the competitive potential of Aoudad with reintroduced Bighorn Sheep (Simpson et al. 1978; Simpson and Krysl 1981; Morrison 1984). In the early 1970s, several Aoudad were released onto private lands that later became parts of BBRSP, however, during a long-term, park-wide survey of mammals, only one individual was sighted (Yancey 1997). Since that work, a 2-y study using remote camera-traps has documented many individuals and sporadic herds of Aoudad throughout BBRSP (Yancey and Manning 2018).

Both Aoudad and Bighorn Sheep typically are gregarious, often forming large herds (Nowak 1999; Krausman and Bowyer 2003). Although there are no accounts of Aoudad herding with other species, groups of Bighorns are known to frequent with Mule Deer (*Odocoileus hemionus*), Elk (*Cervus canadensis*), and Mountain Goats (*Oreamnos americanus*), as well as domestic cattle (*Bos taurus*), sheep (*Ovis aries*), and



FIGURE 1. Ordered sequence of four of 48 camera-trap images taken 12 August 2016 of an adult male Bighorn Sheep (*Ovis canadensis*) associating with a herd of Aoudad (*Ammotragus lervia*) in the Las Cuevas drainage at Big Bend Ranch State Park, Presidio County, Texas. Images A, B, and C indicate the male Bighorn Sheep in the company of adult female and immature Aoudad. Image D shows the last two male Aoudad in the passing herd. Camera images are horizontally complete although for each of the four images, some non-indicative terrain above and below was cropped to save space.

horses (*Equus caballus*; Smith 1954). We herein report an incident of a male Bighorn Sheep associating with a herd of Aoudad at BBRSP, Texas.

From 1 January 2016 to 26 July 2017, we set camera-traps (model PC8000; Reconyx, Holmen, Wisconsin) at 12 sites in BBRSP. Images of Bighorn Sheep were captured at two sites, whereas images of Aoudad were taken at seven. Both sites where Bighorn images were captured also revealed Aoudad images. On 12 August 2016 from 1503–1506 in the Las Cuevas area of BBRSP (29.494586N, 104.103861W, 1,085 m elevation), a small herd of Aoudad was photographed over 2 min 43 sec. Aoudad were documented moving along a spring-fed creek with 48 total images encompassing 16 triggered

series of three-shot bursts at 1 sec intervals. Imbedded within this group of Aoudad was a single adult male Bighorn Sheep (Fig. 1A-C). At the front of the herd, female and immature Aoudad were in view for 1 min 47 sec. Within this period, the adult male Bighorn first appeared and was visible for 15 continuous images covering 38 sec. After the Bighorn moved away from the camera, two adult male Aoudad traversed across the field of view for only 6 sec (Fig. 1D). These male Aoudad were the last images of the photographic sequence.

The male bighorn always was in images with both adult female and immature Aoudad (Fig. 1A-C), but not in images with any identifiable adult male Aoudad. The bighorn was photographed drinking (Fig. 1B) but

no Aoudad were noted using water; however, along this stretch of the creek, open pools of water outside the field of view were extensive. During the short period of time covered during these photographs, female and immature Aoudad and the male bighorn seemed relaxed as evidenced by an immature Aoudad grazing near the bighorn (Fig. 1A), and the bighorn drinking water while an immature Aoudad was nearby lying on bedrock (Fig. 1B). At the end of the photograph sequence, all individuals left the camera field of view running up the rocky canyon slope opposite to the camera.

We consider these data a single incident of Bighorn Sheep-Aoudad associations that may be occurring within BBRSP. Because Bighorn Sheep segregate into sexual groups outside of the rut season (Shackleton 1985; Festa-Bianchet 1999), it is possible that other males from a bachelor group may have been out of the field of view as numerous pools of open water occur for over 100 m along this part of the spring-fed creek. Given the wandering nature of rams and their continued interchanging between bands (Jones 1950), however, it is likely that the photographed Bighorn Sheep was an individual that strayed from a bachelor herd.

The gregarious nature of Bighorn Sheep is thought to be mostly the result of predator avoidance instinct (Smith 1954), which possibly stimulated the male bighorn to associate with the Aoudad herd at BBRSP. This behavioral choice would mutually reduce predatory risk and enhance foraging. Traveling with an Aoudad herd could benefit the male bighorn because the largest predator in the region, the Mountain Lion (*Puma concolor*), would be less likely to select a large male Bighorn Sheep when he was associating with smaller immature Aoudad. For Bighorn Sheep, the two most important antipredator strategies include group living and the proximity to abrupt escape terrain (Berger 1978; Shackleton 1985). Furthermore, during foraging by solitary and small groups (five or fewer) of Bighorn Sheep, interruptions to scan the environment are frequent and foraging efficiency is poor (Berger 1978).

Although Bighorn Sheep and Aoudad are known to compete for the same resources and habitat (Barrett 1967; Seegmiller and Simpson 1979; Simpson and Krysl 1981; Richardson 2007; Brewer and Hernández 2011) and are noted to be behaviorally incompatible (Richardson 2007; Brewer and Hernández 2011), the images from the camera-trap indicate that there is at least some passive tolerance among some of the individuals of the two species. Similarly, in Death Valley National Park, California, it generally was perceived that burros were causing great harm to native Bighorn Sheep due to competition between the two species (Welles and Welles 1961). Subsequent long-term research concluded that both species were abundant in the area, and that both used resources simultaneously and without strife (Welles and Welles 1961). Further research is warranted

to ascertain the long-term impacts of Bighorn Sheep-Aoudad interactions at BBRSP.

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LITERATURE CITED

- Barrett, R.H. 1967. Some comparisons between the Barbary Sheep and the Desert Bighorn. *Desert Bighorn Council Transactions* 11:16–26.
- Berger, J. 1978. Group size, foraging and anti-predator ploys: an analysis of Bighorn Sheep decisions. *Behavioral Ecology and Sociobiology* 4:94–99.
- Brewer, C.E., and F. Hernández. 2011. Status of Desert Bighorn Sheep in Texas, 2009–2010. *Desert Bighorn Council Transactions* 51:76–79.
- Brewer, C.E., and M.D. Hobson. 2000. Desert Bighorn Sheep management in Texas - a 100 year review. *Desert Bighorn Council Transactions* 44:31–34.
- Festa-Bianchet, M. 1999. Bighorn Sheep *Ovis canadensis*. Pp. 348–350 in *The Smithsonian Book of North America Mammals*. Wilson, D.E., and S. Ruff (Ed.). Smithsonian Institution Press, Washington, D.C., USA.
- Gray, G.G., and C.D. Simpson. 1980. *Ammotragus lervia*. *Mammalian Species* 144:1–7.
- Hailey, T.L. 1977. Past, present, and future status of the Desert Bighorn in the Chihuahuan Desert Region. Pp. 217–220 in *Transactions of the Symposium on the Biological Resources of the Chihuahuan Desert Region, United States and Mexico (1974)*. Wauer, R.H. and D.H. Riskind (Ed.). *Transactions and Proceedings Series, No. 3*, U.S. Department of Interior, National Park Service, Washington, D.C., USA.
- Hernández, F. 2013. Desert Bighorn Sheep state status report - Texas, 2011–2012. *Desert Bighorn Council Transactions* 52:35–39.
- Hernández, F. 2017. Status of Desert Bighorn Sheep in Texas, 2015–2017. *Desert Bighorn Council Transactions* 54:67–70.
- Jones, F.L. 1950. A survey of the Sierra Nevada Bighorn. *Sierra Club Bulletin* 35:29–76.
- Kilpatrick, J. 1975. Bighorn transplant in Texas. *Desert Bighorn Council Transactions* 19:38.
- Kilpatrick, J. 1982. Status of Desert Bighorn Sheep in Texas - 1982. *Desert Bighorn Council Transactions* 26:102–104.
- Krausman, P.R., and R.T. Bowyer. 2003. Mountain Sheep (*Ovis canadensis* and *O. dalli*). Pp. 1095–1115 in *Wild*

- Mammals of North America: Biology, Management, and Economics. 2nd Edition. Feldhamer, G.A., B.C. Thompson, and J.A. Chapman (Ed.). Johns Hopkins University Press, Baltimore, Maryland.
- Morrison, B.L. 1984. Status of Aoudad in North America. Desert Bighorn Council Transactions 28:37–38.
- Nowak, R.M. 1999. Walker's Mammals of the World. Johns Hopkins University Press, Baltimore, Maryland.
- Richardson, C.L. 2007. Status of Desert Bighorn Sheep in Texas, 2006–2007. Desert Bighorn Council Transactions 49:71–75.
- Schmidly, D.J. 1977. The Mammals of Trans-Pecos Texas, including Big Bend National Park and Guadalupe Mountains National Park. Texas A&M University Press, College Station, Texas.
- Schmidly, D.J., and R.D. Bradley. 2016. The Mammals of Texas. 7th Edition. University of Texas Press, Austin, Texas.
- Seegmiller, R.F., and C.D. Simpson. 1979. The Barbary Sheep: some conceptual implications of competition with Desert Bighorn. Desert Bighorn Council Transactions 23:47–49.
- Shackleton, D.M. 1985. *Ovis canadensis*. Mammalian Species 230:1–9.
- Simpson, C.D., and L.J. Krysl. 1981. Status and distribution of Barbary Sheep in the southwest United States. Desert Bighorn Council Transactions 25:9–15.
- Simpson, C.D., L.J. Krysl, D.B. Hampy, and G.G. Gray. 1978. The Barbary Sheep: a threat to Desert Bighorn survival. Desert Bighorn Council Transactions 22:26–31.
- Smith, D.R. 1954. The Bighorn Sheep in Idaho: its status, life history, and management. Bulletin No. 1, Idaho Department of Fish and Game, Boise, Idaho. 154 p.
- Stangl, F.B., Jr., W.W. Dalquest, and R.R. Hollander. 1994. Evolution of a Desert Mammalian Fauna: A 10,000-year History of Mammals from Culberson and Jeff Davis Counties, Trans-Pecos Texas. Midwestern State University Press, Wichita Falls, Texas.
- Welles, R.E., and F.B. Welles. 1961. The Bighorn of Death Valley. Fauna of the National Parks of the United States, U.S. National Parks Service. Fauna Series 6:1–242.
- Winkler, C.K. 1977. Status of the Texas Desert Bighorn program. Desert Bighorn Council Transactions 21:4.
- Yancey, F.D., II. 1997. The Mammals of Big Bend Ranch State Park, Texas. Special Publications No. 39, Museum of Texas Tech University, Lubbock, Texas.
- Yancey, F.D., II, and R.W. Manning. 2018. Update on the mammals of Big Bend Ranch State Park and Chinati Mountains State Natural Area, with additions to the verified mammalian faunas and a current checklist for each site. Natural Resources Program of the Texas Parks and Wildlife Department, Austin, Texas. 50 p.



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