Bulletin of the Southern California Academy of Sciences

Volume 114
Issue 1 *April 2015*

Article 7

7-15-2015

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Cover Page Footnote

Our research was supported by the California Energy Commission-Public Interest Energy Research Program (Contract NO.: 500-09-020), the California Desert District Office of the Bureau of Land Management, U.S. Army Construction Engineering Research Laboratory, and the Desert Legacy Fund of the California Desert Research Program. Research was conducted under permits from the United States Fish and Wildlife Service, California Department of Fish and Game, and the Bureau of Land Management. Vern Bleich provided useful comments on an earlier version of the manuscript. Special thanks are given to A. Muth of the Boyd Deep Canyon Desert Research Center of the University of California, Riverside, for providing accommodations during our research. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

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Bull. Southern California Acad. Sci.
114(1), 2015, pp. 58–62

Nelson's big horn sheep (*Ovis canadensis nelsoni*) trample Agassiz's desert tortoise (*Gopherus agassizii*) burrow at a California wind energy facility

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Research on interactions between Agassiz's desert tortoises (*Gopherus agassizii*) and ungulates has focused exclusively on the effects of livestock grazing on tortoises and their habitat (Oldemeyer, 1994). For example, during a 1980 study in San Bernardino County, California, 164 desert tortoise burrows were assessed for vulnerability to trampling by domestic sheep (*Ovis aries*). Herds of grazing sheep damaged 10% and destroyed 4% of the burrows (Nicholson and Humphreys 1981). In addition, a juvenile desert tortoise was trapped and an adult male was blocked from entering a burrow due to trampling by domestic sheep. Another study found that domestic cattle (*Bos taurus*) trampled active desert tortoise burrows and vegetation surrounding burrows (Avery and Neibergs 1997). Trampling also has negative impacts on diversity of vegetation and intershrub soil crusts in the desert southwest (Webb and Stielstra 1979). Trampling of important food plants and overgrazing has the potential to create competition between desert tortoises and domestic livestock (Berry 1978; Coombs 1979; Webb and Stielstra 1979).

Native ungulates like Nelson's big horn sheep (*Ovis canadensis nelsoni*) co-occur with desert tortoises in portions of the desert southwest. Due to habitat and partial dietary overlap of various annual forbs and grasses at certain elevations (Ernst and Lovich 2009; Oehler et al. 2003), there is potential for contact between these species. Although there are data demonstrating damage and destruction of desert tortoise burrows caused by domestic ungulates (Nicholson and Humphreys 1981; Avery and Neibergs 1997), it is previously undocumented if native sheep like Nelson's big horn sheep are capable of similar impacts to tortoise burrows.

On 29 September 2013, we documented desert tortoise burrow collapse caused by Nelson's big horn sheep trampling at a wind energy facility in Riverside Co., California, USA (33°57′06″N, 116°40′02″W, WGS84). In the summer of 2013 (1 June 2013 to 14 November) 48 Reconyx and Wildgame motion sensor trail cameras were deployed at the entrances of desert tortoise burrows during an ongoing investigation of the effects of wind energy generation on behavior and activity of this species (Lovich et al. 2014). Cameras were mounted on 1.5 m foot tall steel stakes inserted into the ground approximately 1 m from desert tortoise burrow entrances that were known to be occupied or used recently. Cameras were activated by movement of wildlife via an infrared sensor,

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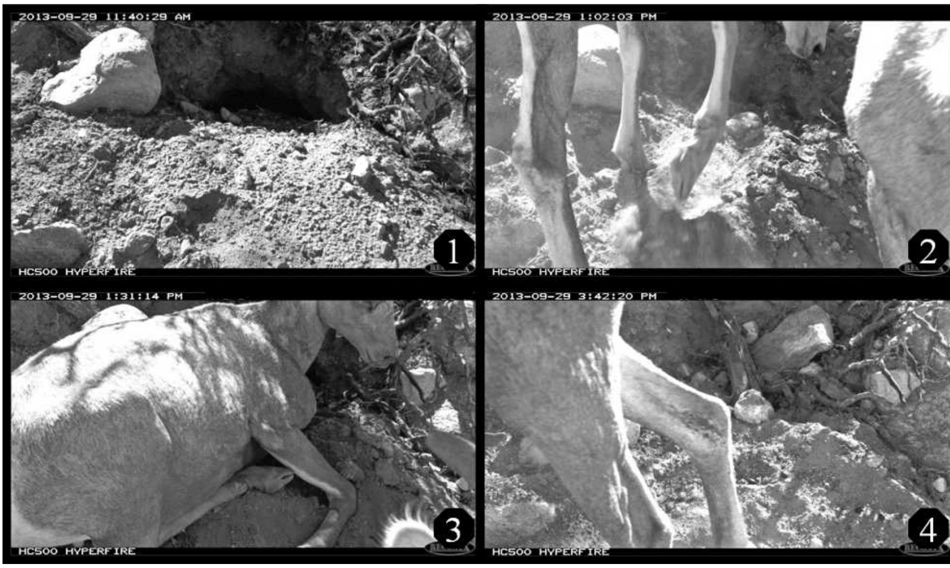

Fig. 1. Active desert tortoise burrow collapse caused by Nelson's big horn sheep in a series of 4 motion sensor camera images.

and programmed to take 1–5 photographs at a trigger speed of 0.2 sec. Each month, an investigator checked each camera and downloaded photos onto a data storage device. Lastly, surface air temperatures were collected every 30 minutes from an onsite Remote Automated Weather Station (WWAC1; accessed via the MesoWest website (http://mesowest.utah.edu/index.html).

Our motion sensor cameras recorded three Nelson's big horn sheep approach a north facing active desert tortoise burrow (previously occupied by an adult male desert tortoise on 13 June 2013) at 1140 h. From 1241 h to 1303 h, several Nelson's big horn sheep gathered below the entrance of the burrow, brushing loosened soil around the entrance of the burrow with their hooves, eventually causing the outer walls to collapse (Fig 1.). Three different Nelson's big horn sheep then proceeded to lie down and in the process compact the soil, rocks and sticks on top of the newly collapsed entrance from 1304 h to 1429 h.

Fig. 2. Nelson's big horn sheep at the entrance of desert tortoise burrow. Nelson's big horn sheep may have been eating tortoise feces or soil, or simply investigating the burrow.

Fig. 3. Domestic cattle walking past the entrance of a desert tortoise burrow.

Several Nelson's big horn sheep remained standing at the burrow from 1430 h to 1542 h. During these observations ambient air temperature ranged from 30.56 C to 32.50 C.

Over the course of the camera-trapping study, Nelson's big horn sheep were also recorded walking past or standing at the base of seven different desert tortoise burrows at various other locations throughout the study site. Photographs also revealed what appeared to be Nelson's big horn sheep grazing near the mouth of the burrow (Fig. 2). Since few plants grow in the mouth of active tortoise burrows, the sheep may have been eating soil or possibly the fresh feces of desert tortoises that are comprised mostly of partially digested grass and forbs. In addition to big horn sheep, domestic cattle were captured by motion sensor cameras walking past the base of four desert tortoise burrows (Fig. 3).

The images we recorded are the first documented evidence of Nelson's big horn sheep trampling a desert tortoise burrow and subsequently collapsing the outer walls of the burrow in the process. Nelson's big horn sheep employ various strategies of seeking shade and cooler soil for bedding (Cain et al. 2008), and it appears that north-facing slopes (location of collapsed tortoise-burrow) may provide such a site. Alternatively, previous studies of big horn sheep have documented extensive movement and occasionally large descents from mountain ranges to use mineral licks at lower elevations, as they provide sodium which is crucial to physiological functions (Bangs et al. 2005; Holl and Bleich 1987; Watts and Schemnitz 1985). Since most terrestrial plants have low concentrations of sodium (Weeks and Kirkpatrick 1976), Nelson's big horn sheep may be mining essential minerals brought to the surface by tortoises through excavation of their burrows (Ernst and Lovich 2009; Turner et al. 1984). One study demonstrating soil ingestion, or geophagy, by bighorn sheep (*Ovis canadensis*) in Alberta, Canada found their feces contained as much as 30% soil in some samples (Skipworth 1974). Ingestion of desert tortoise burrow soil may be important to Nelson's big horn sheep as it could be a source of certain minerals (Beyer et al. 1994). Lastly, we hypothesize that relatively high plant productivity at the site (Ennen et al. 2012b; Lovich et al. 2015) attracts ungulates (Oehler et al. 2003), both domestic and native to the study area. Moderate winter precipitation produces an abundance of annual food plants for both desert tortoises and big horn sheep at the study site.

Trampling and collapsing active desert tortoise burrows may entomb resident individuals (Loughran et al. 2011; Nichols and Humphries 1981), although in the majority of observed burrow collapses at the site, tortoises were able to excavate themselves (Loughran et al. 2011). In light of our observation, trampling may have greater impacts to slope dwelling rather than valley dwelling desert tortoises. Furthermore, female desert tortoises nest at the entrance and within burrows (Agha et al. 2013; Ennen et al. 2012a); consequently, trampling may negatively impact tortoise egg clutches or entomb emerging neonates (Berry 1978). Entombment of desert tortoises within burrows can cause physiological stress to the animal (Loughran et al. 2011), thereby leading to potential mortality (Lovich et al. 2011). We are unaware of any cases where bighorn sheep behavior resulted in mortality of desert tortoises and suspect that such interactions between the species are rare in comparison to interactions involving domestic ungulates.

Acknowledgements

Our research was supported by the California Energy Commission-Public Interest Energy Research Program (Contract NO.: 500-09-020), the California Desert District Office of the Bureau of Land Management, U.S. Army Construction Engineering Research Laboratory, and the Desert Legacy Fund of the California Desert Research Program. Research was conducted under permits from the United States Fish and Wildlife Service, California Department of Fish and Game, and the Bureau of Land Management. Earlier versions of the manuscript benefited greatly from comments offered by Vernon Bleich. Special thanks are given to A. Muth of the Boyd Deep Canyon Desert Research Center of the University of California, Riverside, for providing accommodations during our research. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Literature Cited

Agha, M., J.E. Lovich, J.R. Ennen, and E. Wilcox. 2013. Nest-guarding by female Agassiz's desert tortoise (*Gopherus agassizii*) at a wind-energy facility near Palm Springs, California. The Southwestern Naturalist, 58:254–257.

Avery, H.W., and A.G. Neibergs. 1997. Effects of cattle grazing on the desert tortoise, *Gopherus agassizii*: nutritional and behavioral interactions. In Proceedings: Conservation, Restoration, and Management of Tortoises and Turtles-An International Conference, 13–20.

Bangs, P.D., P.R. Krausman, K.E. Kunkel, and Z.D. Parsons. 2005. Habitat use by female desert bighorn sheep in the Fra Cristobal Mountains, New Mexico, USA. European Journal of Wildlife Research, 51:77–83.

Berry, K.H. 1978. Livestock grazing and the desert tortoise. In Transactions of the North American Wildlife and Natural Resources Conference (USA), 1978:505–519.

Beyer, W.N., E.E. Connor, and S. Gerould. 1994. Estimates of soil ingestion by wildlife. Journal of Wildlife Management, 58:375–382.

Cain, J.W., B.D. Jansen, R.R. Wilson, and P.R. Krausman. 2008. Potential thermoregulatory advantages of shade use by desert bighorn sheep. Journal of Arid environments, 72:1518–1525.

Coombs, E.M. 1979. Food habits and livestock competition with the desert tortoise on the Beaver Dam Slope, Utah. Proceedings of the Desert Tortoise Council, 1979:132–147.

Ennen, J.R., J.E. Lovich, K.P. Meyer, C. Bjurlin, and T.R. Arundel. 2012a. Nesting Ecology of a Population of *Gopherus agassizii* at a Utility-Scale Wind Energy Facility in Southern California. Copeia, 2012:222–228.

Ennen, J.R., K. Meyer, and J.E. Lovich. 2012b. Female Agassiz's desert tortoise activity at a wind energy facility in southern California: The influence of an El Niño event. Natural Science, 4:30–37.

Ernst, C.H., and Lovich, J.E. 2009. Turtles of the United States and Canada. Johns Hopkins University Press.

Holl, S.A., and V.C. Bleich. 1987. Mineral lick use by mountain sheep in the San Gabriel Mountains, California. Journal of Wildlife Management, 51:383–385.

Lovich, J.E., D. Delaney, J. Briggs, M. Agha, M. Austin, and J. Reese. 2014. Black bears (*Ursus americanus*) as a novel potential predator of Agassiz's desert tortoises (*Gopherus agassizii*) at a California wind energy facility. Bulletin of the Southern California Academy of Sciences, 113: 34–41.

———, J.R. Ennen, K. Meyer, M. Agha, C. Loughran, C. Bjurlin, M. Austin, S. Madrak. 2015. Not putting all their eggs in one basket: bet-hedging despite extraordinary annual reproductive output of desert tortoises. Biological Journal of the Linnean Society, 115.2:399–410.

———, J.R. Ennen, S.V. Madrak, and B. Grover. 2011. Turtles, culverts and alternative energy development: an unreported but potentially significant mortality threat to the desert tortoise (*Gopherus agassizii*). Chelonian Conservation and Biology, 10:124–129.

Loughran, C.L., J.E. Ennen, and J.E. Lovich. 2011. *Gopherus agassizii* (Desert tortoise). Burrow collapse. Herpetological Review, 42:593.

Nicholson, L., and K. Humphreys. 1981. Sheep grazing at the Kramer study plot, San Bernardino County, California. In Proceedings of the 1981 symposium of the Desert Tortoise Council, 163–194.

Oehler Sr., M.W., R.T. Bowyer, and V.C. Bleich. 2003. Home ranges of female mountain sheep, *Ovis canadensis nelsoni*: effects of precipitation in a desert ecosystem. Mammalia, 67:385–402.

Oldemeyer, J.L. 1994. Livestock grazing and the desert tortoise in the Mojave Desert, p. 95–103. In R. B. Bury and D. J. Germano (eds.), Biology of North American tortoises. U.S. Dept. Int. Natl. Biol. Surv. Fish Wildl. Res. 13.

Skipworth, J.P. 1974. Ingestion of grit by bighorn sheep. Journal of Wildlife Management, 38:880–883.

Turner, F.B., P. A Medica, and C.L. Lyons. 1984. Reproduction and survival of the desert tortoise (*Scaptochelys agassizii*) in Ivanpah Valley, California. Copeia, 1984:811–820.

Watts, T.J., and S.D. Schemnitz. 1985. Mineral lick use and movement in a remnant desert bighorn sheep population. Journal of Wildlife Management, 49:994–996.

Webb, R.H., and Stielstra, S.S. 1979. Sheep grazing effects on Mojave Desert vegetation and soils. Environmental Management, 3:517–529.

Weeks Jr., H.P., and C.M. Kirkpatrick, 1976. Adaptations of white-tailed deer to naturally occurring sodium deficiencies. Journal of Wildlife Management, 40:610–625.