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Cover: Predation by a Thornscrub Vine Snake (*Oxybelis microphthalmus*) on a Colima Giant Whiptail (*Aspidoscelis communis*), Bosque de la Primavera, Jalisco, Mexico. Photographs by Gerardo Ramos-León.

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Notes on the Herpetofauna of Western Mexico 26: Predation by a Thornscrub Vine Snake (*Oxybelis microphthalmus*) on a Colima Giant Whiptail (*Aspidoscelis communis*) in Bosque de la Primavera, Jalisco, Mexico

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Abstract

During a field trip in February 2020 to Bosque de "La Primavera" in the state of Jalisco, Mexico, we observed a Colima Giant Whiptail (*Aspidoscelis communis*) being preyed upon by a Thornscrub Vine Snake (*Oxybelis microphthalmus*). Although these species are sympatric throughout much of their distributions in Mexico, due to the arboreal habits of *O. microphthalmus* and terrestrial ones of *A. communis* this was an unexpected observation.

Resumen

Durante una salida de campo en el mes de febrero de 2020 en el Bosque de "La Primavera" en el estado de Jalisco, México, observamos un ejemplar de *Aspidoscelis communis* (Cuiji de cola roja) siendo presa de un *Oxybelis microphthalmus* (Bejuquilla del Pacífico). A pesar de que estas son especies simpátricas en gran parte de su distribución en México, esta fue una observación inesperada debido a los hábitos arborícolas de la *O. microphthalmus* y terrestres de *A. communis*.

We conducted a field trip in February 2020, near the locality "Río Caliente" in Bosque de "La Primavera" (20°40'40"N, 103°34'48"W; WGS84; elevation 1529 m). The site is an oak-pine forest with several large areas of secondary vegetation.

On 18 February 2020 we observed a Thornscrub Vine Snake (*O. microphthalmus*) on the ground amidst grass—not a very common sight due to the arboreal habits of the species. The event took place in a clearing in the middle of oak-pine forest. There were no shrubs present, only a few patches of grass, and the rest was rocky soil. The snake was grabbing a Colima Giant Whiptail (*A. communis*) which was still alive, so it is assumed that the snake had just captured it. The event occurred at 10:52 hrs and the snake took 14 minutes to eat the lizard (Figure 1). The lizard was not regurgitated, even when the snake became aware of our presence.

Background: *Oxybelis microphthalmus* (Barbour and Amaral, 1926)

The total length of Thornscrub Vine Snake (Figure 3) can be up to 1520 mm (Lemos-Espinal et al., 2015); the crown of the head and upper face are brown to tan. The upper labials and ventral surface of the head are a uniform cream. The transition in color is separated by a preocular dark brown stripe extending from the nasal scale, under the eye, and onto the anterior body. This stripe may continue as a series of spots onto the body. The first two scale rows on the anterior body are the same yellow color as the ventral surface, and form a ventrolateral stripe. At midbody, the first four dorsal scale rows and the lower half of the fifth scale row are mottled heavily with dark pigment; the upper half or row five and rows 6–8 lack the dense mottling,

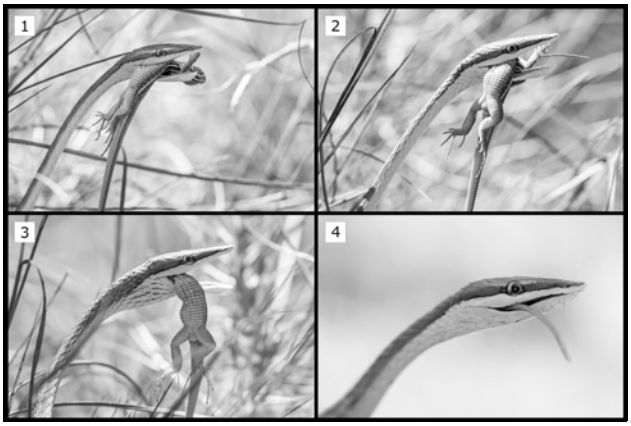

Figure 1. Sequence of the *Oxybelis microphthalmus* feeding on an *Aspidoscelis communis*. Photographs by Gerardo Ramos-León .

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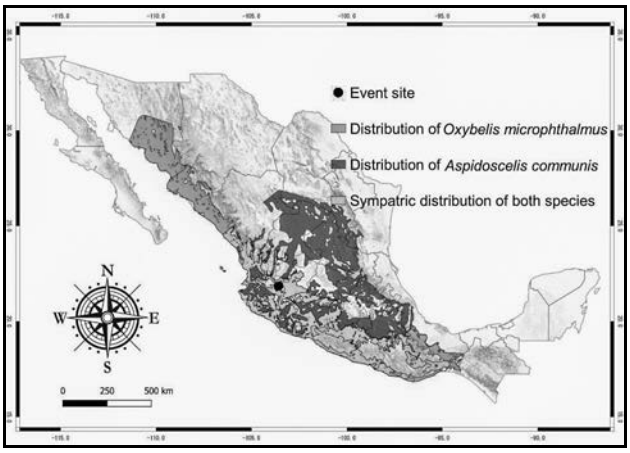

Figure 2. Distribution of the Thornscrub Vine Snake (*Oxybelis microphthalmus*) and the Colima Giant Whiptail (*Aspidoscelis communis*) in Mexico. Map by Andres Rodríguez-López.

giving the overall impression of a series of lateral stripes. On the ventral surface is an indistinct mid-ventral stripe. In comparison with the other species of vine snakes *Oxybelis microphthalmus* has eight (Arizona and Sonora) or nine (remainder of distribution in Mexico) upper labials with three behind the orbit, an eye diameter that is about 0.8 of the internasal (no other species of *Oxybelis* has an eye diameter this small) (Jadin et al., 2020).

Background: *Aspidoscelis communis* (Cope, 1878)

The Colima Giant Whiptail (Figure 4) is a large lizard with a snout–vent length of up to 155 mm. The color pattern of this species changes with age; the back is commonly brown, but in juveniles it has yellow lines; subadults have yellow lines and rows of yellow spots; and adults have rows of spots. The belly is dark brown and the tail is red (García and Ceballos, 1994). This lizard has a triangular head with large and small scales; the belly is light-colored with large scales; the tail is long and strong with quadrangular red scales (Uribe-Peña et al., 1999). Males develop a typical breeding coloration during the rainy season that consists of a light blue belly and white throat (Pardo de la Rosa, 2001).

A. communis is endemic to Mexico and has been recorded along the Pacific coast from Jalisco to Michoacan; it is also found inland in these states (Santiago-Pérez et al., 2012; Cruz-Sáenz, Muñoz-Nolasco et al., 2017). This lizard inhabits tropical deciduous forest, tropical semi-deciduous forest and xerophilous scrub, where it is found on the ground (García and Ceballos, 1994). Cruz-Sáenz, Lazcano and Navarro-Velázquez (2017) documented for the first time the predation on *Aspidoscelis communis* by the striped road guarder, *Conophis vittatus*.

Brief Description of the Study Site

La Primavera is an APFF (Flora and Fauna Protection Area in Spanish) located to the west of Guadalajara, bounded by the coordinates 20°37' – 20°45' N and 103°35' – 103°28' W. It has a total area of 30,500 ha, shared among the municipalities of Zapopan, Tala and Tlajomulco de Zúñiga (SEMADET, 2013). La Primavera has two predominant climates: temperate sub-humid and warm sub-humid, with rain during summer and winter and rainfall totaling 800–1000 mm. The average annual temperature is 20°C (± 6.5°C), and the average annual humidity is 63% (Zalapa-Hernández et al., 2013; Zalapa-Hernández et al., 2014). Plant diversity is influenced by the overlap of two floristic provinces: Sierra Madre Occidental and Transversal Neovolcanic Axis. In turn, these provinces are located in the Mesoamerican Mountain Region, formed by the confluence of two large geographic regions, the Nearctic and the Neotropical (Zalapa-Hernández et al., 2014). The vegetation types are oak-pine forest (predominant); oak forest; pine forest (with low representation in the area); pine-oak forest; tropical deciduous forest (only in the south of the area) and grasslands (SEMADET, 2013; Zalapa-Hernández et al., 2013).

This forest has a diverse fauna, made up of 60 species of mammals, more than 49 of reptiles, 205 of birds, 20 of amphibians and 7 of fish (Zúñiga, 2017).

Discussion and Conclusions

Species of the genus *Oxybelis* are known to have a wide variety of prey, and to hunt by stalking. The diet of *O. microphthalmus* includes birds, frogs, small mammals, some insects and fish (Hetherington, 2006; Cid-Mora and Vásquez-Cruz, 2020), but especially small arboreal lizards, like *Urosaurus*, *Anolis* and *Sceloporus* (Lemos-Espinal et al., 2015). *Oxybelis microphthalmus*, like many other snake species with arboreal habits is limited to wooded or shrubby regions (Lilly-white and Henderson. 1993; Pizzatto et al., 2007; Harrington et al., 2018). It is a very agile snake, but it can remain immobile between branches for long periods of time. It approaches its prey very slowly to avoid detection, moving when the vegetation moves with the wind, until it is close enough to capture its prey with a quick movement (Lemos-Espinal et al., 2015).

Ramírez-Ramírez et al. (2020) report predation by *O.*

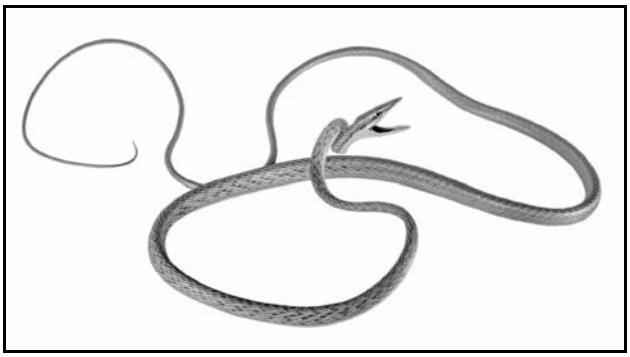

Figure 3. Thornscrub Vine Snake (*Oxybelis microphthalmus*). Photograph by Gerardo Ramos-León.

Figure 4. Colima Giant Whiptail (*Aspidoscelis communis*). Photograph by Gerardo Ramos-León.

microphthalmus on *Aspidoscelis deppii*. As was the case with our observation, on this occasion the snake was on the ground away from any type of shrubby vegetation. We suggest that *O. microphthalmus* tends to actively hunt its prey on the ground in forest clearings.

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We wish to thank Patricia Alitzel Mejia-Villagómez, a friend of one of the authors, who helped during the field trip.

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Notes on Reproduction of Pine Woods Treefrogs, *Dryophytes femoralis* (Anura: Hylidae), from Virginia

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Abstract

I conducted a histological examination of gonads from 27 *Dryophytes femoralis* adults from Virginia consisting of 14 males and 13 females. Males contained sperm from all months examined: April to August and October. The two smallest mature males (sperm in lumina of seminiferous tubules) measured 28 mm SVL and were from April and August, respectively. One female in spawning condition was from May. The smallest mature female (spawning condition) measured 31 mm SVL and was from May. All females contained some atretic follicles. Post-spawning females contained postovulatory follicles from a recent spawning. One female from May and three from June with postovulatory follicles (recent spawning) contained concurrently ripening follicles for an upcoming spawning suggesting *D. femoralis* may spawn a second time in the same year in Virginia.

Dryophytes femoralis (Daudin, 1800) occurs in the southeastern United States along the Atlantic Coastal Plain from southeastern Virginia to southeastern Louisiana and southwestern Mississippi (Frost, 2021). *Dryophytes femoralis* deposits eggs in pine-barrens pools (Wright, 1932). Large choruses are heard after heavy rains (Mitchell, 2005). In Virginia, *D. femoralis* deposits eggs from May into August (Mitchell, 1986). In the current paper I present data on the *D. femoralis* reproductive cycle from a histological examination of gonadal material from Virginia. The biology of *D. femoralis* is summarized in Hoffman (1988). Utilization of museum collections for obtaining reproductive data avoids removing additional animals from the wild.

A sample of 27 *D. femoralis* from Virginia collected 1940 to 1988, consisting of 14 adult males (mean SVL = 31.9 mm ± 2.5 SD, range = 28–37 mm) and 13 adult females (mean SVL = 35.2 mm ± 2.4 SD, range = 31–40 mm) was examined from the herpetology collection of the Carnegie Museum of Natural History (CM), Pittsburgh, Pennsylvania, USA (Appendix). An unpaired *t*-test was used to test for differences between adult male and female SVLs (Instat, vers. 3.0b, Graphpad Software, San Diego, CA).

A small incision was made in the lower part of the abdomen of the 27 adults and the left testis was removed from males and a piece of the left ovary from females. Gonads were embedded in paraffin, sections were cut at 5 μm and stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman, 1997). Histology slides were deposited at CM.

The testicular morphology of *D. femoralis* is similar to that of other anurans as described in Ogielska and Bartmañska (2009a). Within the seminiferous tubules, spermatogenesis occurs in cysts which are closed until the late spermatid stage is reached; cysts then open and differentiating sperm reach the lumina of the seminiferous tubules (Ogielska and Bartmañska, 2009a). All 14 *D. femoralis* adult males were undergoing sperm formation (= spermiogenesis) in which clusters of sperm filled the seminiferous tubules. A ring of germinal cysts was located on the inner periphery of each seminiferous tubule. By month, numbers of *D. femoralis* males (N = 14) exhibiting spermiogenesis were: April (N = 2), May (N = 1), June (N = 2), July (N = 6), August (N = 2), October (N = 1). The two smallest mature males (sperm in lumina of seminiferous tubules) measured 28 mm SVL and were from April (CM 127523) and August (CM 127999). Wright and Wright (1933) reported adult *D. femoralis* males ranged from 24 to 37 mm in body size.

The mean SVL of *D. femoralis* adult females was significantly larger than that of males ($t = 3.41$, df = 25, $P = 0.0022$). The ovaries of *D. femoralis* are typical of other anurans in consisting of paired organs located on the ventral sides of the kidneys; in adults they are filled with diplotene oocytes in various stages of development (Ogielska and Bartmañska, 2009b). Mature oocytes are filled with yolk droplets; the layer of surrounding follicular cells is thinly stretched. Two stages were present in the spawning cycle (Table 1): (1) "Post-spawning condition," postovulatory follicles present from recent spawning (2) "Ready to spawn condition" in which mature oocytes predominate. The smallest mature *D. femoralis* female (ready to spawn condition) measured 31 mm SVL (CM 128654) and was from May. Wright and Wright (1933) reported adult *D. femoralis* females ranged from 23 to 40 mm in body size.

Atretic follicles were noted in the ovaries of 13/13 (100 %) of the *D. femoralis* females (Table 1). In early atresia the granulosa layer is slightly enlarged and contains ingested yolk granules. In late atresia the oocytes of these females are replaced by brownish vacuolated granulosa cells which invaded the lumen of the oocyte or solid black pigment containing cells. Atresia is a widespread process occurring in the ovaries of all vertebrates (Uribe Aranzábal, 2009). It is common in the amphibian ovary

Table 1. Two monthly stages in the spawning cycle of 13 adult female *D. femoralis* from Virginia; all females contained some atretic oocytes.

Month	*n*	Post-spawning condition	Ready to spawn condition
May	2	1	1
June	6	6	0
August	5	5	0

Table 2. Periods of reproduction for *D. femoralis* from different states.

Locality	Breeding Period	Source
Alabama	April to August	Mount, 1975
Florida	April to August	Carr, 1940
Florida	February to October	Krysko et al., 2019
Carolinas to Virginia	March to October	Beane et al., 2010
Georgia	March to early September	Jensen et al., 2008
Louisiana	April to August	Boundy and Carr, 2017
North Carolina	March to early October	Dorcas et al., 2007
Virginia	May to August	Mitchell, 1986
Southeast	spring through summer, maybe early fall	Dorcas and Gibbons, 2008
No specific locality	April 1 to September 1	Wright and Wright, 1933

(Saidapur, 1978) and is the spontaneous digestion of a diplotene oocyte by its own hypertrophied and phagocytic granulosa cells which invade the follicle and eventually degenerate after accumulating dark pigment (Ogielska and Bartmańska, 2009b). See Saidapur and Nadkarni (1973) and Ogielska et al. (2010) for detailed descriptions of follicular atresia in the frog ovary. Atresia plays an important role in fecundity by influencing numbers of ovulated oocytes (Uribe Aranzábal, 2011). The causes of follicular atresia in non-mammalian vertebrates are not fully understood although it is associated with captivity, food availability, crowding and irradiation (Saidapur, 1978). In amphibians adverse environmental conditions such as starvation and suboptimal lighting may cause atresia of vitellogenic oocytes (Jørgensen, 1992). Incidences of follicular atresia increase late in the reproductive period (Saidapur, 1978). Saved energy will be presumably utilized during a subsequent reproduction.

Times of breeding for *D. femoralis* throughout its range are shown in Table 2. Because I lacked *D. femoralis* female samples from early spring and autumn, the duration of female reproduction in Virginia is not known, although my October male (CM 113942) was producing sperm, indicating breeding would have been possible.

I found histological evidence suggesting that *D. femoralis,* in Virginia, may produce a second clutch in the same reproductive season as indicated by the presence of some ripening follicles (upcoming spawning) and the concurrent presence of postovulatory follicles (recent spawning) (*sensu* Redshaw, 1972) in the same females. These were one *D. femoralis* female from May (CM 128684) and three from June (CM 126509, 126515, 126521). Postovulatory follicles form when the ruptured follicle collapses after ovulation; the follicle lumen disappears and proliferating granulosa cells are surrounded by a fibrous capsule (Redshaw, 1972). Postovulatory follicles are short-lived in most anuran species and are resorbed after a few weeks (Redshaw, 1972).

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Appendix

Twenty-seven *D. femoralis* from Virginia examined by county from the herpetology collection of the Carnegie Museum, (CM), Pittsburgh, Pennsylvania. **Chesapeake:** CM 113942; **Chesterfield:** CM 157712; **Isle of Wight:** 128652, 128654, 128684; **New Kent:** CM 19041; **Southampton:** CM 126726; **Suffolk:** CM 126484, 126509, 126515, 126521, 126524, 126531, 126644, 126646, 126549, 126551, 126655, 126656, 127523, 127992, 127998–128000, 128003, 128004; **Surry:** CM 127957.

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Desert Iguanas from Sand Dunes to Saguaros: Comparing Observations between California and Arizona—Part 2

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Prologue

Now that nearly everything that falls below these words is in place, it is time for me to adjust the beginning. The reader can be grateful that I just deleted the 1500+ words that originally fell under the subtitle "Prologue" in this column. The words that are now gone were almost an apology to the world for daring to call myself an expert on a cool lizard that has been little more than a hobby of mine. We speak of the Desert Iguana (*Dipsosaurus dorsalis*), which I will often call "Dipso" throughout the remainder of this column. Truth be told, any knowledge I acquired on the natural history aspects of wild Dipsos near Tucson, Arizona came from a quiet little semi-urban place that I call "The Hood." While I have been documenting Dipsos there since 2003, it was not until 2017 that I began to really focus my efforts there. My method for observing Dipsos was to slowly road cruise through the place for roughly an hour, during what experience has taught me to be prime time. That would be between the hours of nine to noon, season dependent, on a hot day. I tried to photograph every Dipso I saw. The limited amount of data that I share in this column came as a result of my notes and images. When I look at what the California Dipsomaniacs went through to obtain their impressive dataset, I almost feel guilty. I road cruised for an hour or so and hung my camera out the window, while they . . . well . . . this column describes in great detail what they did. My reason for wanting to publish my observations is that I'm in the process of learning what has never been documented before. There is nothing in print that addresses what Dipsos near Tucson are doing. There is plenty of information from California. As the title of this column implies, all that I am trying to do is compare what they have observed to what I have observed. We in essence compare the sand dune Dipsos to saguaro Dipsos.

Figure 1. A little protein anybody? A Desert Iguana (*Dipsosaurus dorsalis*) ["Dipso"] enjoys the larval / caterpillar form of a white-lined sphinx moth (*Hyles lineata*). Image by Cameron Barrows, Riverside County, California.

As elucidated below, I read many papers about the sand dune Dipsos. In addition, I was actually able to talk with some of the authors. The discussions brought on an onslaught of information about Dipso natural history that was *not* in their papers. Their photos are to die for, and they willingly shared these with me, so that I could share them with you. Last month, I quoted Jim Rorabaugh about Dipsos relishing the caterpillars of the white-lined sphinx moth. And then I received an unexpected email from Dr. Cameron Barrows of a Dipso choking one down! (Figure 1). As this sentence is being written, I am in the latter stages of completing this column. What is said next is *not* meant to be haughty, but I have gained a lot of confidence that despite my small N and minimal effort at data collection, I am reporting good stuff in this column. I have really enjoyed putting it together, and feel inspired to go even deeper with this cool species of lizard. By stepping out of my comfort zone to write about a subject that I know very little about, I have entered a new world—one that I really find to my liking.

Sand Dune Dipsos

I ask the reader to go back to last month's column (Repp, 2021). At the bottom of page 191, you will find Figure 6. The left-hand image is of what is likely the best damn Dipso turf in all of California, if not the world. The right-hand image depicts the eastern fringe of their range, which is my 'winder spot. The image on the left has lots of sand *and* dunes, and very little by way of vegetation. The image on the right is packed with vegetation, but zero sand—at least not the kind that forms dunes. I have to travel 70 miles to the northwest to get to any *real* sand dunes. That place is the Wildcat Dunes, situated on the southwest edge of the Sawtooth Mountains in Pinal County, Arizona. The sand and dunes found there are not anywhere near the magnitude of those found in western Arizona and southeastern California. But the Dipsos *do* flourish there. That left hand image was of Whitewater Floodplain Reserve, which based on the reading I've done, is probably the most densely populated Dipso sweet spot in all of California. Regarding the importance of dunes to Dipsos, I quote one of the historical masters of Desert Iguanas: "Northern *Dipsosaurus* populations seem to be most dense in areas of windblown sand anchored by creosote bushes. Desert iguanas are common over most of the dunes of the Coachella Valley, Riverside County, California" (Norris, 1953). Spot on, Dr. Norris!

To give the reader an idea of what I'm talking about with dunes being Dipso sweet spots, as quoted in last month's column Al Muth told me (pers. comm.) that he saw 170 Dipsos on one April morning, and 171 on another April morning a year later. Mark Fisher worked closely with the good Dr. Muth for over 35 years at the same place. Mark recently sent me a spreadsheet that contains *just the highlights* of Dipso activity there. In all, he saw

more Dipsos in one morning than I saw in my best *year* a total of *nine times*! (Mark Fisher, unpublished data, 2021). On 14 May 2009, he counted a total of 201. Before going any further with their numbers, I should clarify that by "one morning," or "one day," I basically mean three hours of field effort. Their study grid was 150 meters square, and they stuck to a schedule when they did it. Hence, their numbers signify more Dipsos-per-hour than anything I may have thus far implied. By way of comparison, my best field *year* numbers-wise was in 2018, when I managed to find a total of 137. My best "day" was a total of 19, found in less than one hour on 18 June 2018. One fine day, there will be a more thorough rendering of my own "depauperate" (an Al Muth word) numbers. For now, I will say 19 Dipso encounters on 18 June 2018 will probably be my best numbers day forever. That has nothing to do with ability, but rather location. (Yes, I'm still *all* butt-hurt over the total relentless slaughter I faced at the hands of my California Dipsomaniac friends. I *know* that they must think of me as some kind of herpetological nimrod who couldn't find his butt if it had a foghorn attached! Dammit—I can't count them if they ain't there!)

While I am not yet finished with my outcries against those born with the silver Dipso spoon in their mouths, it is time to lay some obsequious praise at their insufferably modest feet. Without them, I would have *no idea* how little I once knew about the beast. Bob Bezy got me started down the road to Dipso understanding with an article in the *Sonoran Herpetologist* and his species account on the Tucson Herpetological Society (THS) website (Bezy, 2010a, b). The good Dr. Allan Muth then drove the peer review paper stake into my heart by sending me in almost willy-nilly fashion piles of peer-reviewed papers. I finally put my foot down at 14. But even as I proceed onward, I keep seeing more that would greatly behoove me to read—but *I just can't do it*! I have run out of time! The 14 papers that I *have* read—some of them several times—are all listed in the Literature Cited section below. Five of these papers and one spreadsheet that *should* one day become a paper helped me immeasurably in trying to compare Dipsos in the sand dunes with Dipsos under the saguaros.

By far the most enjoyable part of assembling this two-part column was the initial email exchanges among seven lizard-loving dudes. Representing the Sand Duners, we had Al Muth, Jeff Howland, Mark Fisher and Cameron Barrows. Jim Rorabaugh has also had a lot of California experience with Dipsos. Jim has spent a lot of time in Mexico as well. Marty Feldner was also involved, his perspective being that he has herped both the dunes and the saguaros extensively. Representing the Tucson area was yours truly. I'm not much, but I'm all we got! Here in Tucson, we do not come from the land of backup, but rather, the land of "you're on your own, son."

Regarding these email discussions, one of those was six against one (my favor!) over total length. I feel it necessary to enter a relentless tirade over this *nonsense* of Dipsos only attaining a maximum total length of 15.75 inches. When discussing total length, it becomes a matter of how long is the tail? Three different experts give three different ratios for tail length to snout–vent length (SVL), and those ratios are 1.75, 1.86 and 2.0 (respectively: Lemm, 2009; Smith and Brodie, 1982, p. 105; Hulse, 1992). The resulting total lengths of a large adult Dipso measuring 143 mm (5.63 inches) SVL would run anywhere from 393.25 mm (15.48 inches) to 429 mm (16.89 inches) depending on which formula is used. (The 143 mm SVL was snagged from Howland (1988). That length was the largest Dipso that he measured). I understand that lizard people are faced with the problem of tail autotomy, but there has got to be a better way to handle it than to ignore tail lengths when performing lizard metrics. I mean, the effing ruler is right in your effing hands when you measure that effing SVL, and an effing data sheet is right there in front of you. Would it effing kill you to measure and record the effing tail length while you are at it? Apparently so! For crying out loud, you have 17 inches of lizard in your hands—and you call it five point six-three inches? What do you tell the ladies about other important size matters? ***C'mon man*!** The empire strikes back by firing a shot across the bow over this tail length / total length dilemma by showing the images in Figure 2. Do we see what is dangling from the cloaca of this Dipso? The only thing missing in this image is the crock! As the image clearly shows both the snout *and* the vent, it was a simple matter to create a grid to demonstrate that with this image, and many others in my possession, that the tail length *can be* longer

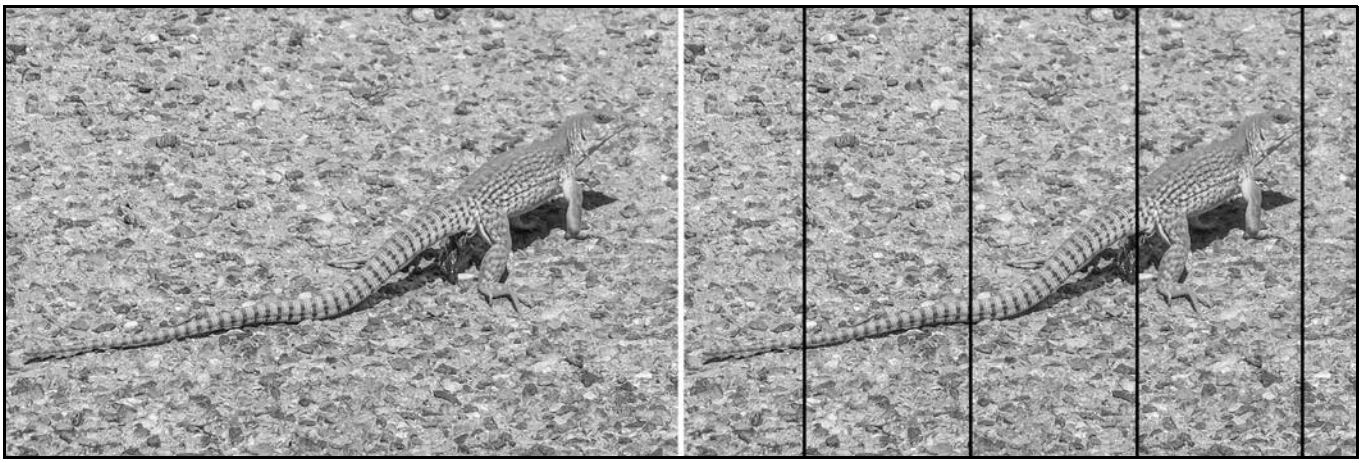


Figure 2. We *all* know that a bear defecates in the woods. What about Dipsos? From this image, we know they defecate on the road. As suggested in the text, this image is also being shown here to fly a little defiance at the suggestions of tail length being 1.75 to 2.0 times the snout–vent length. The reader is invited to look at the accurate grid provided in the right hand image, and see that the tail is *clearly* longer than double the SVL. Image by the author, "The Hood," Pinal County, Arizona.

Figure 3. (Left) Dipso arboreal while feeding on Mojave indigo bush (*Psorothamnus arborescens*) blossoms. Image by Mark Fisher, 17 May 2005, Riverside County, California. (Right) A juvenile Dipso climbs into a Wiggins' croton (*Croton wigginsii*), even though the blossoms are toxic and inedible. We speculate that the reason for going arboreal in this case was to escape the heat of the sand below. Image by Jim Rorabaugh, Pinta Sands, Yuma County, Arizona.

than double the snout–vent length. *If* our defecating Dipso measured the same 143 mm (5.63 inches) SVL as suggested by Howland, and allow for the curvature of the tail, that portion of the tail that is greater than double the SVL would equal half of the SVL. Our 143 mm SVL (5.63 inch) Dipso would be 71.5 mm longer than the 429 mm (16.89 inch) total length given above. Our 429 mm total length Dipso would now be 500.5 mm total length, or 19.7 inches long. ***What I said initially about Dipsos was that some reached a total length of over 18 inches. But n-o-o-o-o say the "experts."*** I would rest my case, but I don't have one because lizard geeks don't measure tails!

Of all the other email discussions that we had, the two that will stick forever in my brain centered on water intake and drought with these thirsty California lizards. As none of you may remember, Part 1 of this column ended with two images of a Dipso drinking near a puddle. The lizard was not drinking from the puddle itself, instead going for the droplets in the mud to one side. This image inspired Jeff Howland (pers. comm.) to say: "I have seen other desert lizards drink, usually from the surface of a rock or wood rather than a puddle. And, disturbingly, I had more than one Desert Iguana avail itself of my urine when peeing within its line of sight, sometimes coming from several feet away to do so. I also had them drink water that I sprinkled on nearby leaves." Oh my—the childish things that I could say about piss-drinking lizards here are legion in number! As one who is totally inept with a noose, I rather like the notion of a "piss and pounce" method of capture. That method would be easier on the scrawny necks of those Dipsos than getting hung from the highest yardarm! And like Jeff, I have on occasion been a bit clumsy with my water bottle. During times of drought, rattlesnakes will drink lustily of such offerings, coiling tightly to capture the fluid and drinking off their bodies. I never thought of using organically recycled fluids to quench reptilian thirst, and look forward to offering other forms of liquid refreshment next June. I already have a column and a title in mind to describe the results. The title will be "Piss on rattlesnakes."

On a more serious note, when speaking of drought, Jeff also offered this: "I had several *Dipsosaurus*, I think about four to six, that sat out the entire year of 1987. The study site got just over an inch of rain from March of 1986 to November or December of 1987, so 1987 was pretty dismal. Only two creosote bushes on my entire 2-hectare study site bloomed that year. One morning I counted something like 12 *Dipsosaurus* up in one of those flowering creosotes, all at the same time" (Jeff Howland, pers. comm.)

Whoa! 12 Dips in one creosote bush? What a sight that must have been! Here in Roger Reppland, there is no way in hell that would happen without at least an attempt at a photo. But in Jeff's defense, these sand dune Dipsomaniacs face ruining a camera every time they yank one out of their pack. The fine sand gets into everything camera-wise. Hence, photos are a risky proposition. Since we have thus far not shown a single Dipso going arboreal for any reason, we include two such images here (Figure 3).

Regarding Dipsos and drought, Jeff went on to say: "Getting back to the disappearing lizards, I never saw them in 1987 and then they showed up in the spring of 1988 looking very skinny. This included at least 2 adults (both females as I recall) as well as 2 subadults that probably hatched in 1985. I can't swear that those individuals never came out in 1988, but these were lizards that I saw most days during a normal active season. I think I spent close to 100 field days on the site in 1987 without seeing them, so their activity was certainly very reduced and my suspicion is that they just stayed underground from late summer of 1986 to spring of 1988" (Jeff Howland, pers. comm.) Heretofore, I thought that Gila Monsters were the estivation champs. It only makes sense that Dipsos also have that capability.

A few paragraphs ago, I mentioned that there were five papers and a spreadsheet that were instrumental in helping me to better understand what I was seeing. The scope of work that went into the front end of each of these efforts was considerable, and the results reveal a lizard that is above average in many ways. What I will do with each of these studies is pick them off one at a time, in historical order, and lay out some of what these fine herpetologists discovered for us.

We start with Kenneth S. Norris, whose paper was published in 1953. To be sure, other work with Dipsos pre-dated his, but Norris was a true pioneer in every sense of the word. From 1947 through 1950, he traveled extensively throughout the range of Dipsos (Baja California, Sonora, California, Arizona and Southern Nevada), and introduced many methods of study that became the standards for everything to follow. He came along at the time when use of the Schultheis rapid-reading cloacal thermometer was in its infancy, and like all who followed, he put that to good use. Quoting Bezy (2010a,b), Norris "had the fortitude to conduct and publish the first thorough study of the ecology of this thermophilic herbivorous lizard." "Thorough" indeed came to mind as I read his masterful work. His stomach content work discovered some Dipso scales (another cannibal Dipso!), as well as fragments of a Flat-tailed Horned Lizard (*Phrynosoma mcallii*) in the gut. He also learned that wasps, bumblebees, honeybees, caterpillars, sand, gravel and fecal pellets were ingested. (This author is quite impressed with the notion of a herbivorous lizard choking down a wasp! *And how in the hell do they eat bumblebees?*) He was also able to determine seasonal dietary shifts in the plant matter ingested—from flowers in the spring to leaves in the summer. He described such wonders as the communal sharing of burrows, with up to three Dipsos simultaneously occupying the same burrow. He performed cutting-edge reproductive studies, measuring gonads and ova and determining that some females do not reproduce every year. He noted a huge drop in the number of Dipsos with large ova by late June to mid-July, and determined they went underground to oviposit during that time. He extensively mapped microclimate details of every possible variety; from inside the burrows to under the canopy of cover bushes to above them and into the burning hot substrata that surrounds them. He even described how basking Dipsos will dig under the surface of very hot sand in order pile cooler sand to rest upon; and how the lizards backfill their burrows by utilizing their forelimbs to scoop and pack the sand around themselves. To limit a description of his efforts to these few sentences is downright criminal!

In 1961, Charles Carpenter published a paper about the patterns of social behavior with Dipsos. He made a collecting trip to Arizona and California in April, and brought some home to Oklahoma with him. These were kept in a large enclosure until an outdoor arena could be built for them. Said arena was 15 feet square and open at the top. From six inches to three feet of sand were spread on the bottom, forming two "dunes" in the process, and some logs and cinder blocks were added. (Woof! I'm getting tired just *thinking* about doing all this stuff.) On 10 June 1960, nine males and five females (all toe-clipped and identified by unique paint patterns) were released into this arena, and behavior was carefully monitored between the hours of 0800 to 1100, and again 1600 to 1800 hours daily. Carpenter mentions that they "adjusted readily" to their new situation, digging their own home burrows, etc. He enlisted the help of a gentleman named Harold Cleveland, and they not only watched and reported what they saw, they also used video to record and analyze their observations. They were fascinated by the many display postures (who wouldn't be?) between the larger alpha-males, and established criteria of eight categories to consistently document the ritualism involved. Said criteria consisted of "site,

Figure 4. The anti-parallel alignment of the early phase of Dipso combat. Note the tail-biting by both participants. It's about to get brutal! Image by Mark Fisher, Riverside County California, 18 May 2018.

position, posture, movement type, parts moved, units of movement, sequence and cadence." A couple months ago, this author described a language of sorts involving snakes. There is also body language involved with them, but as any master of lizard behavior will tell you, to varying degrees lizards communicate in a much more consistent and obvious manner. They certainly understand each other. Where male Dipsos are concerned, the display often precedes combat, and Dipsos perform their *impressive* displays with a style unmatched by most other lizard species. Carpenter's description of the display is elegant, but lengthy (look who's talking!) In short, they squat low, stand tall, arch their bodies, raise and lower their dewlaps, and in some cases, extend their bodies laterally. Many more times than not, the display is enough to drive off a would-be opponent. When that happens, one flees while the other chases, and if the scared one becomes trapped, he often uses a display of a certain type to surrender. I call this surrender posture the "bend over" display of submission. Of course, there are times when neither participant backs down. Combat follows that, and because we can, we include Figure 4 in order to demonstrate the early "anti-parallel" (Jeff Howland term, pers. comm.) phase of that sort of event. As described last month, these bouts can become quite violent, with tails broken off and limbs shredded or even torn off (Repp [quoting Howland], 2021). Carpenter adds yet another element to both combat *and* reproduction by introducing the reader to the tail slap. A nine-frame series of sketches depicting this is included in this paper. But I'm going to use four sentences to describe it. Basically, the slapper and slappee face each other. The slapper gets in close to the body of the slappee, cocks its little Dipso hips in the opposite direction of the slappee, and the tail follows the general direction of those hips. The slapper then whips its little Dipso ass toward its opponent, and with great velocity the long tail accelerates as it follows the hip motion—and like the crack of a whip—smack! Carpenter witnessed males doing this to other males, females to other females, and even females to males. "Eye *said* I'm not in the mood, dammit!" And speaking of that, when not literally bitch-slapping any would-be boyfriends, contrary to the expressed opinions of a few members of the Dipsomaniacs mentioned above, females also use the "display." While there was no actual mating observed in this study, there *were* several "missionary position" (vent-to-vent)

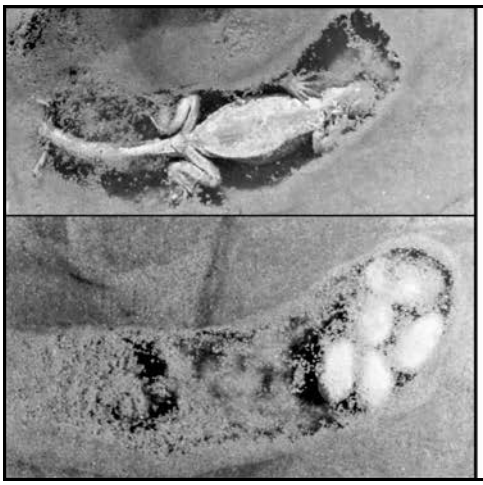
attempts—and not only between males and females. Yup—you got it! There was a little bit of gaiety going down in that enclosure. We shall revisit this vent-to-vent stuff soon. For now, I will simply say that the Carpenter study ended on 15 August 1960, with a total of 20 five-hour observational days spent.

In 1977, Al Muth published the results of his reproductive study on Dipsos. Said results still have relevance today, and that is why this paper is just as important now as it was then. As evidenced by my words of today, the data from this study continues to be cited. Nobody will ever do anything like this again, which is a sad reflection on what does and doesn't get funded these days. For *whatever reason*, the world of academia is *much* more interested in genomes and DNA than the much more fascinating battle of survivorship that herps specifically, and wildlife in general, face. As one who values natural history observations above all else, and is acutely aware of the impact that climate change is introducing, I fail to see how knowledge of tiny pieces of cellular chemistry will do anything to help to save the plants and animals that inhabit this planet. Stepping down from my soapbox, I continue. What Dr. Muth did was establish a colony of Dipsos. They were kept for over a year in an environment similar to that which wild Dipsos inhabit. There were 20 males and 17 females in this colony. He was eventually able to obtain and incubate 16 fertile eggs, 15 of which hatched. From oviposition to hatching took 43 to 45 days. The dates the eggs were laid was from 28 April 1975 to 26 June 1975. Clutch size was four to five. At hatching, the young measured from 4.6 cm (1.81 inches) to 5.0 cm (1.9 inches) SVL. The mass of the hatchlings ranged from 3.55 g to 5.1 g. The last piece of data that I will share with the reader from Muth (1977) is that one of his females double-clutched. Five fertile eggs were dropped on 4/28, and four more from the same female on 5/26. Dr. Muth's double-clutch seems to be the only evidence in all of the current literature that would suggest more than once-a-year oviposition. We all agree that if the best of everything life has to offer Dipsos were to occur, they might pump out more than one clutch in a year. But all the field data points to one clutch maximum. While we're on the topic of Muth's study, he wanted me to report that he routinely fed his Dipsos pinky mice. Nice, plump, tender, juicy little wiggling screaming blobs of protein down the hatch. I'm personally ready to double-clutch just thinking about it! Our own Dr. Gery Herrmann also checked in to say that he also fed his "pet" Dipso pinkies. He also mentioned that he kept this Dipso "several years" (Gery Herrmann, pers. comm.). While speaking of several years, and captive longevity, last month I quoted Jim Rorabaugh as saying that he kept one for over eight years (Jim Rorabaugh, pers. comm, in Repp, 2021). Bezy (2010a,b) cites Bowler (1977) as stating that a specimen survived over 14 years in captivity.

At my request, Dr. Allan Muth (often called "Al") sent me a packet of photos that represent a very thorough history of the early phases of this project. When I looked through these photographs, I realized that I was looking at something that closely mimicked the last 30 years of my own working career. I earned my paycheck by adding my own skill set to assist the science of astronomy. But that skill set was but a bit part in the enormity of the finished product. (I had to explain the "bit part" to my prima donna coworkers on a number of occasions. Those who didn't understand that notion often crossed swords with our scientific staff. That was often a career-ending move. Conversely, those who understood the importance of science, engineering and fabrication techniques behind our final product are *still* working there.) Moving back to Al and his grad student-to-Ph.D. projects, the University of Wisconsin–Madison ran a very well-funded zoology department. Al was surrounded by skilled-trades people who *knew* it was their job to please the scientist. As the scientist, Al needed enclosures that could house his Dipsos. These enclosures needed to be thermally controlled. Al went to engineer Dick Ganje with his ideas, Mr. Ganje designed it all on his drawing board, and then it all went into the fabrication phase. There were machinists, carpenters, and electronics folk involved in the build phase. In the end, his Dipsos laid their eggs in these cages, and by utilizing the clear acrylic bottoms on these cages, Al could see both the nesting lizards as well as their eggs. The project followed the normal flow of any academic effort by starting and ending with the scientist. By ending with the scientist, I mean that papers had to follow. In astronomy *or* zoology, the finished product is *always* the paper. In Al's case, there were several. Those cages have survived several moves across the country, and are still in use today (see Figures 5 and 6).

Jeff Howland's 1988 paper is the last that I will pick off in this fashion. Howland's study plot was located near the town of Desert Center, roughly 71 miles southeast of Palm Springs, California (where the Fisher et al. [2020] study transpired). His paper, entitled "Natural History of the Desert Iguana *Dipsosaurus dorsalis*," was presented at the 1988 Southwestern Herpetologists Conference, and is a recap of his work from 1984 to 1987. During that time period, he captured, toe-clipped and put

Figure 5. Good science often relies on many skill sets to implement. Young scientist Allan Muth needed assistance to help him achieve the results of his Dipso hatching papers and future Ph.D. projects. (Left) Al approached engineer Dick Ganje, who designed the cages to Al's specifications. (Center) An example of one of the many cages built by the University of Wisconsin–Madison's machine shop. (Right) A look at Al's cage room, ready to rock! Photographs courtesy of the University of Wisconsin Photo Lab, 1977.



Ecology, 61(6), 1980, pp. 1335–1343

PHYSIOLOGICAL ECOLOGY OF DESERT IGUANA (*DIPSOSAURUS DORSALIS*) EGGS: TEMPERATURE AND WATER RELATIONS[1]

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Abstract. The soil environment imposes constraints on the timing of oviposition and the location of suitable sites for egg burrows of the desert iguana (*Dipsosaurus dorsalis*). The effects of temperature and water potential on the developmental period and hatching success of eggs were determined. Eggs hatch normally between 28° and 38°C at environmental water potentials between −50 and −1500 kPa. Predictions were derived for the timing and placement of egg clutches based on soil water potential and temperature profiles measured in the field and on the results of laboratory incubation experiments. The results suggest that egg burrows should be located at depths >22 cm in washes or possibly in sparsely vegetated areas away from creosote bushes.

The biogeography of desert iguanas within the United States is discussed in relation to soil environments and tolerances of eggs. The physical factors affecting incubation may limit the geographical range of desert iguanas.

Key words: biogeography; Dipsosaurus dorsalis; *incubation; lizard eggs; oviposition; soil temperature; soil water potential.*

Figure 6. (Top left): The clear acrylic bottoms on these cages allowed the young Dr. Muth to monitor what the Dipsos were doing in their cage-bottom burrows. Here we see a gravid Dipso who has not yet laid her eggs. (Bottom left): Success! Six Dipso eggs can be viewed through the clear acrylic cage bottom. These puppies are ready for the incubator! (Right): Even though a lot of thinking, effort and craftsmanship went into building these cages, they were not the finished product. In the end, the finished product was the paper that followed. This 1980 publication was one of several that the good Dr. Muth published as a result of the handiwork of skilled-trades people. But like any academic project that requires several different skilled trades to build, this project began and ended with the scientist. The natural progression of this academic-based project went from "smart to art to part and back to smart again." Without that last "smart again"—the resulting paper—this effort would have been a complete waste of time, people and money. The papers that followed continue to be cited today, which is a huge measure of the overall success of this effort. (Left) Photographs courtesy of the University of Wisconsin Photo Lab, 1977. (Right) Image courtesy of the University of Wisconsin–Madison, the author and Steve Barten, 2021.

a dab of paint on individual Dipsos (and other lizard species as well). The words "Natural History" in the title were what drew me to this paper. It was the first one that I read, and Jeff was the first California "Dipsomaniac" whom I spoke with about all Dipso-related topics. His paper is every bit as thorough as the work of Norris, and Jeff was highly conscientious about combining what he learned on the ground with the works of those who went before. As with everything else thus far, I almost feel guilty about having to pick off just a few observations, while leaving an entire banquet on the table. Jeff compared population densities between his plot and others. His may have been as "low" as 15 to 20 per hectare, while other locations may go as high as 300 to 700! Yehaw—that's quite a spread! His paper discussed the size a male and female need to reach to be sexually mature. Those numbers are 125 mm (4.92 inches) SVL male, and 120 mm (4.72 inches) SVL female. It was his estimation that it takes a Dipso 33-45 months to mature. He compared lizard size across the span of other studies. I will list his numbers here for maximum size attained. Males reach 143 mm (5.63 inches) SVL, and females 133 mm (5.24 inches) SVL. By far the most useful data set (for me, anyhow) was contained in his Table 2. The table lists egg clutch size, frequency, and the time of year for oviposition across the span of five studies. Clutch sizes ranged from 2 to 8, with oviposition occurring any time between late April to mid-August. Dr. Howland also highlighted the fact that despite the intake of protein, a number of studies indicate that over 90% of their intake is vegetative.

The fifth paper is Bob Bezy's (2010a,b) handiwork. As that work has already been heavily discussed, and is easily accessible, we move on. But not without telling the reader that if you wish to know more about Dipsos, Bezy's masterpiece is the place to start. The website link to this article can be found in the Literature Cited section below.

In the early going of our email discussions, I asked Mark Fisher if he could provide some key dates for some natural history observations that he, Al Muth and Cameron Barrows witnessed in their Fringe-toed Lizard study near Palm Springs. I should make it clear that Mark et al. did not handle and process their Dipsos, but they did faithfully count them. Almost two weeks after I asked Mark for his help, I had almost given up. I was not going to bother him again. And then, out of the blue, I received a spreadsheet from him. This spreadsheet, entitled "*Dipsosaurus* sightings," had 144 rows of observations, dating from June 1985 through September 2019. While this effort was *way* beyond what I expected of him, you won't hear me complaining. Mark's spreadsheet is so thorough that I could easily dump everything else and just report with great confidence what I'm seeing by matching my own observations to his. I already used several of Mark's entries by discussing diet and predators in Part 1. But I *do* see the chance to slip in one of Mark's cooler photos here (Figure 7). I divided the remainder of Mark's spreadsheet into seven categories. Category 1: Highest number of sightings per survey. The good Dr. Muth was kind enough to tell me that the surveys lasted three hours. Hence, there were 11 three-hour surveys on Mark's spreadsheet where over 110 Dipsos were encountered, and the highest total number of 201 sightings occurred on 14 May 2001. Category 2: First Dipsos of the year. There are 11 entries in this category, the earliest being 25 February, the latest being 22 March. Number 3: Latest of the year, or last sighting. Altogether, 28 dates are listed. The earliest date of "the last man standing" was 24 September, and the champ for latest was November 8. Category 4: Copulations. A total of 15 are recorded! The earliest in the year this was recorded was 13 May, and the latest was 30 July. Category 5: Oviposition (egg laying). These are judgment calls on Mark's part. They are very thin females in emaciated condition that likely had indeed oviposited. In all, there are seven dates listed, ranging from 13 June to 6 September. On the latter date, Mark reports seeing *five* females in this condition. And on 28 August,

Figure 7. Too good not to share! The skull of a Dipso is all that remains in the branches of this shrub. This is doubtless the handiwork of the loggerhead shrike (*Lanius ludovicianus*), also appropriately called "butcherbird." Image by Mark Fisher, Riverside County, California, 26 August 2014.

two females in that condition were noted, one of which was being actively courted by a male! Category 6: First hatchlings observed. In all, there are 23 dates mentioned, all except one of them in August. The one and only hatching event in September happened on 1 September, and Mark was able to actually witness the wee ones wiggling out of the sand. And on this day, one of his *nasty* Fringe-toed lizards snagged and ate one of these. What a great life that poor little Dipso had! Claw your way out of confinement only to be swallowed alive by a carnivorous *Uma*! "Freedom! No, no…*not* that…GAAAA!" And just like that, the poor little shit is being dissolved by *Uma* stomach acid! What a harsh world those sand dunes can be! I am going to devote a full paragraph to Category 7 on Mark's spreadsheet.

We speak of a vent-to-vent courtship incident.

Vent-to-vent courtship

Before plunging too deeply into the subject matter, I would like the reader to deeply ponder what animals in nature might use the "missionary position" for reproduction. Can you come up with any? Humans of course do it this way. It is only through my accidental association with horned lizard people that I know that two species of horned lizard do it this way. They are the Coast Horned Lizard (*Phrynosoma coronatum*), and the Giant Horned Lizard (*Phrynosoma asio*). Based on what I'm about to report, Desert Iguanas might be another possibility. But all three lizard types also use the more conventional approach, as indicated in Figure 8.

I am going to guess that around the year 2017, I received an email from Robin Llewellyn that contained a video of vent-to-vent courtship with Dipsos. It appears that she lost this email, which makes us even in that regard. *Irretrievably lost*! But the details of the video are vividly burned in my brain. Three times, the male stood proud while the (presumed) female flipped herself over onto her back, slid underneath him, and briefly rubbed vents with him. She did this each time in left-to-right fashion. Each time she slid all the way under him, righted herself, circled behind him, and repeated the process. The male was quite content to stoically endure the effort. On 24 June 1993, Mark Fisher reported seeing something comparable. His recollection was that the female approached the male while performing a series of head bobs, to which the male responded with head bobs of his own. That progressed to her initiating the vent-to-vent behavior "at least" three times. We both think this to be a form of pair bonding.

Carpenter (1961) witnessed similar behaviors, which he calls "Mutual Abdominal-Contact Behavior;" a total of six times. One such incident was a male-to-male interaction. One variation of this behavior is that the male uses his head to get under the body of the female to flip her over. There was one instance where the male passed over top of the female a total of 12 times, and the male appeared to expose his hemipenis during one such pass. Carpenter probably came close to witnessing missionary posi-

Figure 8. Dipsos mating. (Left) Note that the Dipso closest to you is a male. He has a larger head and more robust body than his female counterpart. With adult Dipsos, these are the characters that we looked for in sexing Dipsos from The Hood. Image by Jeff Howland, likely in the month of May, Riverside County, California. (Right) Dipso love on the dunes of Riverside County, California. Image by Mark Fisher, 13 May 2009.

Figure 9. Mark Fisher witnessed this Sidewinder (*Crotalus cerastes*) emerge and return to its burrow several times before it could drag its prey item inside to devour it. It was a hot day, and that sand had to be burning hot! Image by Mark Fisher, Riverside County, California, 2 July 2007.

tion intromission here. Perhaps further observations and research will produce more revelations in this regard.

Consistency and confusion: Transitioning from sand dunes to saguaros

The papers on California Dipsos are consistent in a number of ways. All state the importance of soil types, with emphases on fine, windblown sands that form dunes being heavily indicative of dense populations. But they *do* exist in other soil types, as evidenced by those near Tucson. The constant that remains consistent with both places is the presence of creosote bushes. Another constant that was not mentioned anywhere is the presence of Sidewinders (*Crotalus cerastes*) as an indicator species (Figure 9). Where you find one you will likely find the other. That is especially true at the eastern edges of their ranges. Both cease to appear at the eastern edges of their distributions within the distance of a tape measure reading. All the California papers suggest that Dipsos hibernate, and are the last lizard species to become active in the spring. Their active months of March through October are the same in both California and Arizona, but all indications are that they become active earlier in California than here in Tucson, and stay active later. The earliest I have seen them active here is 30 March, and the latest is 22 October. Both Howland and Fisher record seeing individuals in February, and Fisher suggests as late as November. That only makes sense given the elevational differences. This author admits to being greatly confused by some of the contradictory dates of hatchling appearances given. Yet nearly every paper mentioned above, and a few *not* mentioned (Mayhew, 1971; Parker, 1972) strongly suggest August as the month the hatchlings appear on the landscape. But I have seen a gravid female as late in the year as 20 August! And if we look at Fisher's incident of *five* spent-looking Dipsos on September 6, we are looking beyond mid-October for the hatchlings to appear. Mayhew (1971) was also confident that mid-August was when hatchling-sized Dipsos appeared. But he became confused when hatchling-sized Dipsos were found in April and May. He offers four scenarios for the why of this, which are (direct quote): "Several explanations are possible for the presence of small lizards in the spring population: (1) these animals grew at the same rate as the rest of the juveniles, but were smaller when they hatched; (2) there were 'slow growers' and 'fast growers' as in the *Amphibolurus ornatus* population described by Bradshaw (1965); (3) they came from late-hatching clutches; or (4) embryos in eggs laid late in the year overwintered in the egg. I do not know which explanation is correct." If a master Dipsomaniac like Mayhew is confused, I think it is ok for me to be in the same state of mind. But I like his thought patterns in points 3 (late hatching) and 4 (overwintering in the egg). I can't find any mention of long-term sperm storage in any of the papers that I have read.

While on the subject of hatchlings, it is clear to me that the California Dipsomaniacs see *way* more on their turf than I do on mine. I have only seen 11 hatchlings since 2017, when I slowed down enough to notice them. One was viewed in "The Hood" on 14 September 2017, nine more were seen on 22 September 2017 at my 'winder spot, and the last one was observed in The Hood on 28 September 2018. The nine viewed on September 22 were all clustered along the berm of a dirt road, within 100 meters of each other. While my "N" is tiny, it does lead one to think that maybe they push their young out a little later near Tucson. I ended last month's column with two images of a spent female that all experts agreed had recently laid her eggs. The date on that one was 11 July 2017. If we use Muth's 43–45 days to hatching scenario, her eggs would hatch around 24 August. I would be a fool if I tried to suggest definite dates that hatchlings appear on the landscape based on so few observations and so much confusion from the experts. I can only present the data, and follow the tradition of Mayhew by admitting that I don't know everything either. It is clear that more work on reproduction needs to be done across the range of sand dunes to saguaros. I think it is fair to say that we are *all* a bit confused.

The Hood, and ramping into my personal reproductive knowledge on Dipsos near Tucson

The reader is invited to look at the two aerial images, and carefully read the captions provided for Figure 10. As the right hand image shows, The Hood is roughly one square kilometer in area. As the left hand image clearly depicts, The Hood is an island pocket of Dipso habitat that is being consumed to the south by urban development. The west has been ag fields for decades, the north has some habitat remaining, but is mainly the grounds of the Portland Cement Plant and accompanying gravel pits. To the east is the unsuitable rocky habitat of the northern Tucson Mountains. Cutting diagonally from the southeast to the northeast section of The Hood is the longest above ground conveyor system in the world. It stretches across Dipso habitat for over two miles, and connects a massive limestone quarry to the Portland Cement Plant. While the conveyor is an eyesore, it is above ground, and hence, it would not stop a determined Dipso from crossing under it. It is in all actuality a Godsend to the Dipsos in The Hood. The right of way to either side of the conveyor is the largest chunk of prime Dipso habitat in the region. As the aerial maps also show, there are large swaths of good habitat scattered throughout The Hood, interspersed with ramshackle mobile homes and inhabitants who could best be described as minimalists when it comes to landscaping. *Everything* within its boundaries is infested with creosote bushes. The location of the place is less than five minutes from my house,

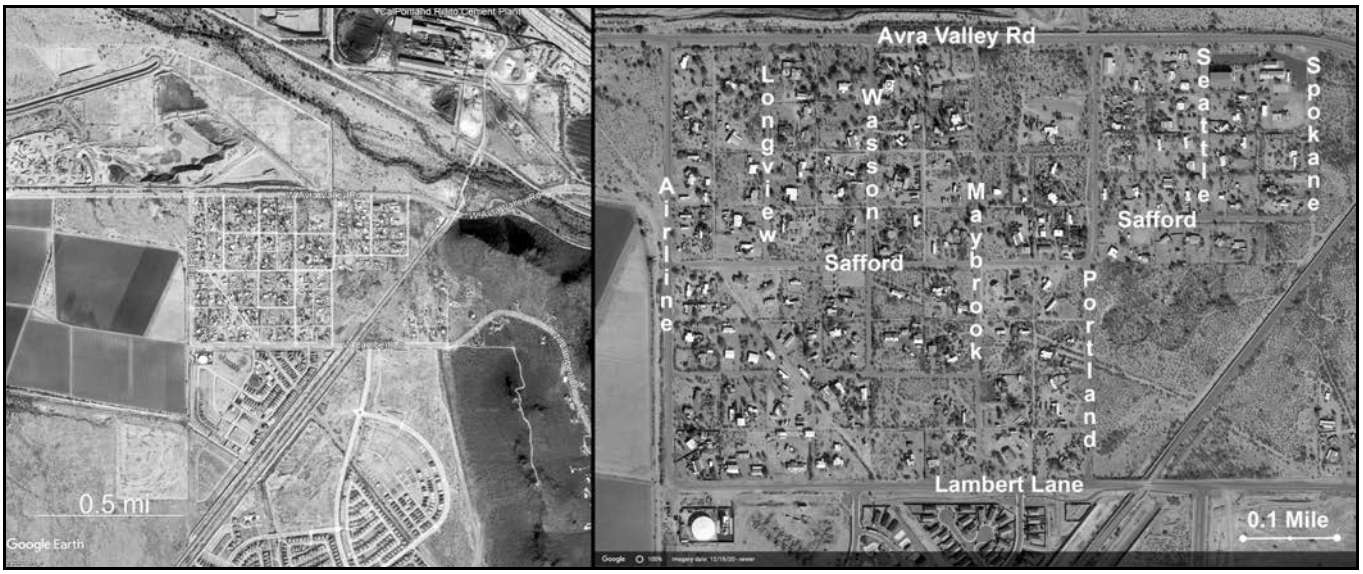

Figure 10. Aerial maps of The Hood. (Left) As this map clearly shows, The Hood is an isolated rectangle of Dipso habitat that is surrounded by new home construction, agriculture, gravel pits and unsuitable rocky hillsides. (Right) A closer look at The Hood, with street names included. Note Lambert Lane to the south. From 2017 to mid 2018, Lambert Lane was my number one sweet spot for seeing large numbers of Dipsos. Maybrook and Portland also contributed heavily to Dipso sightings. Due to construction and increased traffic, Lambert Lane has been wiped out, and the numbers from Maybrook and Portland have plunged dramatically. Only the quieter side streets like Longview, Wasson and Safford continue to produce consistently.

which makes it all quite convenient for quick herpetological rocket runs.

Had my wife Dianna and I known of The Hood in 2003 when we purchased our home, I'm sure we would have tried to settle there instead of the other side of the ridge. Nestled in the northwest crotch of the Tucson Mountains, it was a quiet place, with very little traffic and fantastic vistas. I'm sure the people who lived there at the time knew that they had a sweet location. By 2007, the land to the south was zoned for housing, and construction began on a development that would one day be known as Mesquite at Saguaro Bloom. The first houses went up well to the south of The Hood, and were not even visible from there. The crash of 2008 froze everything in place until 2018, when suddenly they could not build new homes quickly enough. Though I knew Dipsos could be found in The Hood within one month of purchasing our new home, it was not until 2017 when I began to seriously go after Dipsos there. By 2018, it was perfectly clear that Mesquite at Saguaro Bloom would soon be densely packed with homes that start at $300,000. I can only imagine the ire and fear that the inhabitants of The Hood feel about their new vista. Their ire is over paradise lost, the traffic has increased exponentially, and the ambiance is no longer that of a quiet and quaint little neighborhood. Their fear is that of increased property taxes, and the foreboding sense that Mesquite at Saguaro Bloom will jump across Lambert Lane, which is the southern-most east-west road that separate the two very different places. Once that starts, and that is inevitable, Saguaro Bloom will blossom even further, and drive the poor folk out. No wonder they are so grumpy! And you know what? It pisses me off too! I too am losing paradise, as the images in Figures 11 and 12 below demonstrate. I am going to stop all negativity here, and move on to the positive events that my cruises in The Hood have given me. And no matter what may happen to The Hood in the future, it is highly likely that Dipsos will still be

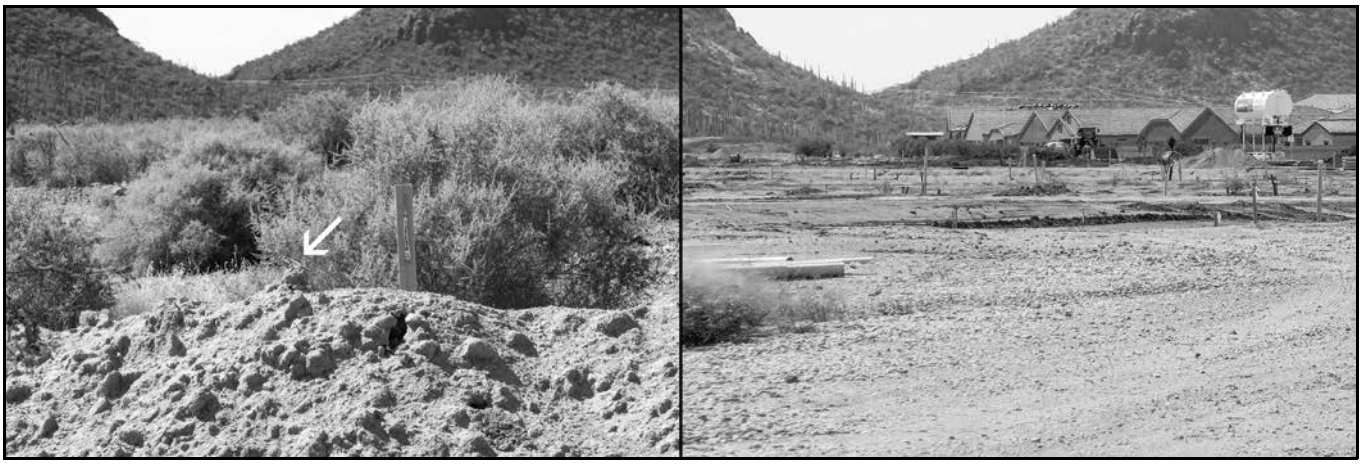

Figure 11. (Left) 5 August 2017. An arrow highlights a Dipso basking on the berm of a 100-meter-long dirt mound on the south side of Lambert Lane. Note the construction marker nearby, and the abundance of habitat behind the lizard. From 2017 through 2019, the mound was the author's number one sweet spot, and as many as six Dipsos could be viewed basking along the length of it. (Right) 4 September 2021. The mound and all of the habitat has been bladed away. Result: zero Dipsos documented from the south side of Lambert Lane in over two years. These and all remaining images are by the author.

Figure 12. (Left): 21 May 2018. A sexual pairing of Dipsos basking at a place I named "The Boulders." The male is the rearmost of the two. The Boulders consistently produced Dipsos until the land across Lambert Lane was bladed. (Center) 25 June 2018. The author put his back to The Boulders and took this image. The Boulders stopped being productive as soon this happened. (Right): 11 September 2021. One picture worth thousand words. Thus endeth *everything* on The Boulders.

there long after I am gone.

My very first official road cruise of The Hood occurred on 11 July 2017. I had just endured a surgery to replace my right kneecap, and sticking close to home and staying in the vehicle just made good sense. And on this very first cruise, I not only observed the Dipso drinking from a puddle described in Part 1 of this epic, it turns out this particular Dipso was a female who had just laid her eggs. With that Dipso, I had my first hint of when oviposition occurs. Before we go any further into the reproduction of Hood Dipsos, I need to acknowledge the efforts of Al Muth in helping me to sex Dipsos from photographs. When he and I disagreed, we called upon Mark Fisher and Marty Feldner to help. Before we go any deeper over who wears the pants and who is the boss in Dipso-land, please direct your eyes back to Figure 8 above. Both images depict a male and female *in copula*. In both images, the male is obviously the Dipso in the foreground. Note the larger head and more robust body size of these males. That was the criterion we used in working my images of individuals, pairings, perceived courtships, displays and combat. There is a gestalt to doing it this way, and the differences are pronounced enough to assure a high degree of accuracy. Any uncertainties are usually in younger animals, and those were eliminated from any of the reproductive data about to be relayed. Since I did not process anything from The Hood, the surefire method of checking the femoral pores was not an option.

In California, a good indicator of how numbers of Dipsos explode once the hatchlings appear can be found in Howland (1988). He estimates a low of 15 Dipsos per hectare before a hatch, and 60 after. While we're on the subject of population density I will say up front that my highest number of Dipsos was 19 in just under an hour in The Hood. That completely stomps any other place I go. But knowing that The Hood is close enough to call it one square kilometer would mean that Howland's low figure of 15 per hectare might indicate there are 1500 Dipsos living there. Maybe, but I don't really think so. If we take his 60 per hectare post-hatching, we derive that 6,000 Dipsos are in The Hood. That I would find impossible to believe. And the estimates of other places of 200–500 per hectare—*no effing way*! I'm not even going to work the math! I am not calling Howland or any of the others a liar. I am showing the difference between sand dunes and saguaros where Dipso population densities are concerned. The Hood is good for Tucson—the best place I've found within 50 miles. But for some reason—most likely soil types—the sand dunes of Riverside County totally dominate anything Tucson can come up with numbers-wise. Oddly, when it comes to that other strong indicator—creosote—I'd say that we have a lot more of them here than they do there. And on top of that, ours seem to flower at will, season independent. In short: More food here, but bad dirt! And maybe not enough heat.

Before plunging any deeper into reproduction here in T-town, I wanted to share the only image I have that proves the Dipsos here are actually eating (Figure 13, but see also Figure 2). I find it interesting that this particular Dipso is foraging on a plant flowering on the ground directly below a flowering creosote. For every passable image of one or more Dipsos in my collection, there are ten others that are either blurred beyond usefulness, or don't exist at all. The squirrely things do not often stay still for long enough to get an image, and even when they do, I might either muff the chance or be so lazy as not to try taking an image at all. Traffic often wrecks photo ops as well. I will use this paragraph to describe some of the cooler behaviors I have seen with them, but the images are too crappy to share. An example of this sort of thing occurred on 21 May 2018. A male and a female were viewed at a distance of about 20 meters apart. As the male began to close the gap between the pair, the

Figure 13: 20 August 2021, Safford Street. A ground-feeding female Dipso browses on woolly tidestromia (*Tidestromia lanuginosa*). It is interesting to note that she is ignoring the flowers on the nearby creosote bush.

female tried to wander away. This caused the male to hasten to her side. As soon as he got close to her, she displayed her displeasure with his presence. She arched her back and gaped at him. It looked all the world like she wanted to puke on him! Then she ran off into the distance, and the very next image came out crystal clear. (How in the hell can two identical snaps of the shutter yield such different results?) In the last image of this event, the lonely male stands there, all pie-eyed and broken-hearted, gazing longingly in the direction of his lost love. I could have sworn I heard him singing "Yesterday." Even though the first three images of this pairing are not good enough to share, they *are* good enough to count as a sexual pairing, as enough detail for sexing these two Dipsos exist. As the reader is about to learn, I need every sexual pairing that I can get! On 18 June 2018, I was able to pull abreast of a male Dipso and a male Zebra-tailed Lizard (*Callisaurus draconoides*) peacefully basking within inches of each other on top of boulder roughly the size and shape of a large watermelon. (I have not seen *anything* like this before or since.) Along came another male Dipso, moving directly toward the boulder, about to T-bone it. The Dipso up top completely freaked out, and displayed. (Body puffed up, dewlap out, back arching up and down, etc.) This drove the intruding Dipso away, while the Zebra-tail seemed totally unimpressed and did not flinch even a millimeter. The first few images I took show all this, but are not good enough to share. Meanwhile, I still had a chance at photographing the commensal basking going down, when I saw a gravel truck burning up behind me. I tried to wave him around me, hollering "Come around, idiot!" He instead parked behind me, and got out. The driver was curious and friendly. He wanted to chat with me. He saw lots of Dipsos at this job site, and went out of his way not to run them over. How nice. Meanwhile, my one-time crack at a most unusual photo-op ended as soon as my new friend got out of his truck. The *exact* same thing happened with me with a great photo-op of one of the two hatchlings seen in The Hood. In case I haven't made it clear, once anybody steps out of a vehicle—***zoom***—they are gone. With the hatchling incident, it was another friendly and curious gravel truck driver. Weren't these guys supposed to be working?

Before we wrap this rascal up, I wanted to share the most exciting potential reproductive event that I have seen to date. It happened on 6 August 2017, which was the early phase of my Dipso-watching. Gordon Schuett had spent the night, and we whiled away the morning dreaming up titles for papers that would never be written. When we needed a break (me more than him), I told Gordo about what was going down with Dipsos in The Hood. Thankfully, he wanted to give it a go. We headed out the door at precisely 0900 hours. We returned exactly one hour later, when I noted the weather data. There sky was cloudless; the humidity was 38%, with a calm wind speed of 0-3 miles per hour. The ambient temperature was 32.5°C (90.5°F). This is highlighted to emphasize that there is *none of this 40+ degrees C shit here* (104°F+). It does get that hot in the afternoons, but like everything else herpetological in nature here, Dipsos have called it a day *hours* before it gets that hot. On this one hour outing, we had encountered 15 Dipsos, 4 Tiger Whiptails (*Aspidoscelis tigris*), 3 Desert Spiny Lizards (*Sceloporus magister*), and two Zebra-tailed Lizards (*Callisaurus draconoides*). (As this list serves to indicate, it is normal to see more Dipsos in The Hood than all other probable lizard species combined. That happens only rarely any other place that I go.)

The main event on this day occurred at 1043 hours. We were southbound on Maybrook Road, and noticed four adult Dipsos gathered together on the northwest corner of an intersecting road named Maybrook Place. Both roads are paved, and the four Dipsos stood out like the proverbial goat turds in the milking pail. At a distance of roughly 30 meters away, we stopped and watched.

Two of these Dipsos were huge dandies, obviously big males, and they were both all sorts of pumped up, circling each other, head bobbing, and generally displaying their displeasure with each other. While we watched on, one of the two smaller lizards broke out of the group, and ran directly toward us. He wound up stopping directly outside Gordon's passenger window. I handed Gordon my camera, and he dutifully took over, capturing an image of the smaller male Dipso who was obviously more terrified of those two circling monsters than he was of us. We then began to inch forward, with Gordon continuing to fire away with my camera. It was all over sooner than we liked, but ended when one of the circling males fled the scene, leaving the other male with the one female involved (Figure 14).

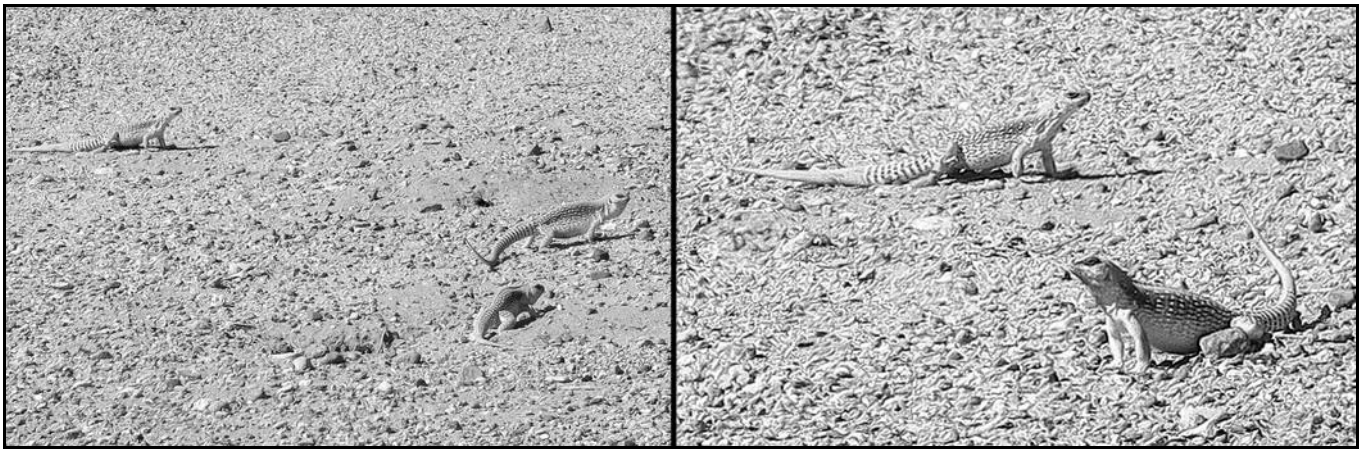

Figure 14. 6 August 2017. (Left) Two male Dipsos display their displeasure with each other, while a female in waiting watches with great interest. (Right) One of the males succeeds in driving the other off, and is the "winner" of this bout. See text for more details. Images by Gordon Schuett with the author's camera.

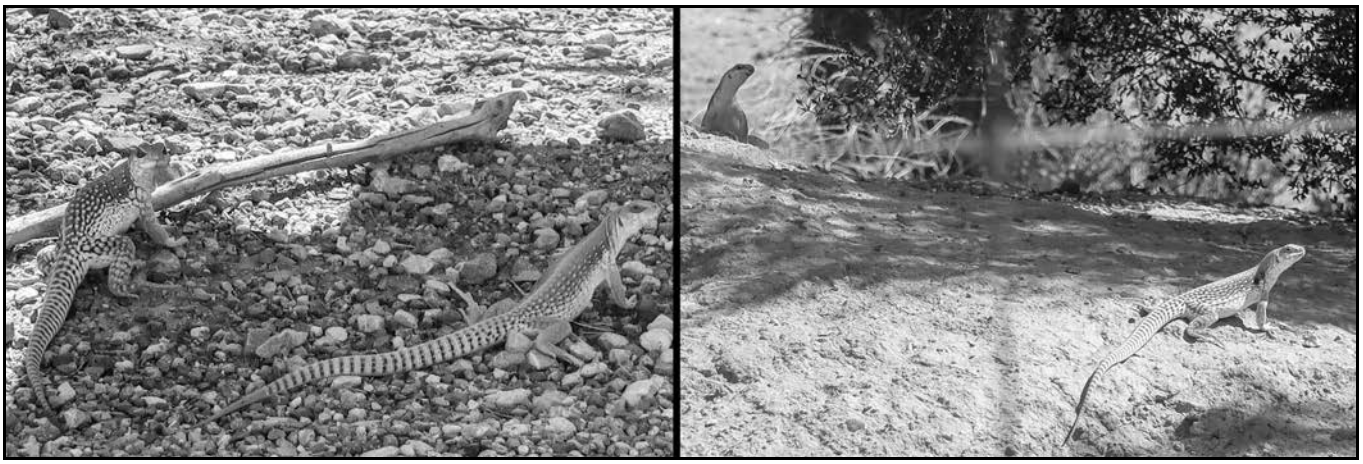

Figure 15. (Left) 18 June 2018. Male is on the left. This pair was in active courtship when the author pulled up alongside them. The pair then split and froze, and the male seems to be giving the author the stinkeye. (Right) "I've got my eye on you, sonny boy!" An adult male eyeballs a younger male who has witlessly entered his turf. Note the black spot above the shoulder on the lizard in the foreground. That spot signifies it to be a younger male, and will disappear as he ages.

At that point an oncoming vehicle destroyed the opportunity to see what would happen next. I am pleased to share these images, all the more so because I've begged all over the place for better images of Dipsos displaying, and have searched through hundreds of images of them on websites. **Nothing!** While I don't think of displaying as being rare in nature, it just seems to be rarely photographed. One more thing about displaying—sometimes the Dipsos will do it in defiance of me personally.

Dipso Reproduction in The Hood

As has been beaten to death in this column, where Dipsos near Tucson are concerned, I'm on my own. The only local herper who could have possibly helped me was Phil Rosen, and he is no longer with us. Having prefaced my knowledge thusly, it is time for me to proceed in fast and furious fashion to the finish line. My work with rattlesnakes has taught me what to look for in reptilian reproduction. At the front end of fecundity, I look for sexual pairings, courtship, male-to-male combat, and mating. At the tail end, I look for signs of gravid females, spent, emaciated females, nest digging and emergence of hatchlings. I can only look for such things in photographs, and promise the reader that every effort was made to eliminate any uncertainties.

I have accumulated a total of nine images of sexual pairings, three of which involved courtship, and one of which involved the vigorous displays that precede combat. The first historic sexual pairing in my hands is from an image that Marty Feldner sent me from near our Suizo Mountain Study site. That one occurred on 10 August 2013. The other eight are all from The Hood, and the dates they happened are 6 August 2017 (3 males one female); 10 April 2018 (my earliest in the year ever); twice on 11 May 2018, one of which was courtship (the rejected male); one on 21 May 2018 which was courtship; two on 18 June 2018—both of which were courtship, and one of these courtships can be seen in Figure 15. The companion right hand image in Figure 15 has been added because it is an example of a male pairing. There have been a *lot* of those, but as one might expect, zero observations of female pairings. (This also seems to be the case with female Gila Monsters and rattlesnakes.). There was one other pre-combat display incident on 18 June 2018 (the observation with the Zebratail / Dipso commensal on the boulder). Looking at the other end of reproduction, recruitment seems to be extremely low. While I will admit that I am probably missing much, I still think if there was more action here, I would have more to report. I have not seen any mating. I have only found two females who appeared to be gravid. As previously discussed, the date that each was observed was on 21 May 2018, and 20 August 2021. Again as previously discussed, the only evidence of egg-laying I have is the spent female shown in Figure 7 of Part 1, and the date of that occurrence was 11 July 2017 (Repp, 2021). Seeing a female actually digging a nesting burrow has not happened—yet. The *real* evidence of low reproduction is in the paucity of hatchlings observed. I have observed a total of 11, all in mid to late September. If there were more to be had, I would have racked 'em up. I'm not missing much at 5 miles per hour.

Leaning toward the positive information gathered from The Hood, I *have* seen many young of the previous year, and many more Dipsos in the immature phase. In looking to the future, writing this column has inspired me to hit The Hood with everything I have. The monsoon this summer was the third best in our 130 plus year weather history. If we are lucky enough to get a wet winter /spring, 2022 might be the best year ever for me to give it another go. It is my sincere hope that by this time next year, I can write another column about this above average lizard of ours, and throw a greater N behind the reproductive events. To say that I look forward to the effort would be a vast understatement. Stay tuned, there is more to come! This here is Roger Repp, signing off from Southern Arizona, where the turtles are strong, the snakes are handsome, and the lizards are above average.

Epilogue: Larry "the lizard guy" Jones and his Tucson-based telemetry study

Toward the end of writing this piece, Jim Rorabaugh informed me that Larry Jones was doing a radio-telemetry study on Dipsos and Leopard Lizards west of the Tucson Mountains, roughly ten miles south of anything that has been discussed here. I totally respect this man, and *know* that any such study

under his generalship will result in sound and thorough science. This was righteously good news to me, but I simply couldn't do a damn thing about it. Larry has thus far published the results of his preliminary 2020 study (Jones, 2020). He has two other papers in preparation, and is edging toward really ramping up in 2022. Larry is probably best known for his part in co-editing the *excellent* book entitled *Lizards of the American Southwest, a Photographic Field Guide* (Jones and Lovich, 2009). As outstanding as this book is, it is just the tip of the iceberg where his local accomplishments are concerned. I am stoked to know that Larry is working with these two very cool lizard species. It couldn't be in better hands!

Acknowledgments

The author is forever indebted to the six other Dipsomaniacs who shared their insights, photographs, and papers. By name, in alphabetical order, they are Cameron Barrows, Marty Feldner, Mark Fisher, Jeff Howland, Allan Muth and Jim Rorabaugh. Dale Turner and Julia Fonseca assisted me with plant identification. Dale DeNardo obtained the aerial maps and several papers for me. I also thank Larry Jones, not necessarily for what he did to help here, but for what he is *about* to do. I am *always* grateful for my two front line editors, Mike Dloogatch and Joan Moore, as well as the cheerful and professional assistance of our photo editor Steve Barten. May they *all* live forever, and long live the *Bulletin* and the CHS as well.

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Minutes of the CHS Board Meeting, October 15, 2021

A virtual meeting of the CHS board of directors via Zoom conference video/call was called to order at 7:45 P.M. Board members Stephanie Dochterman, John Gutierrez and Amanda Pollock were absent. No nonmembers of the board were present. Minutes of the September 17 board meeting were read and accepted.

Officers' reports

Treasurer: Rich Crowley went over the September financial report. Fund-raising ideas were discussed.

Media secretary: No immediate update. However, Stephanie is overwhelmed at the moment, especially with Facebook. She has asked if each board member could help out by taking a day and checking in on our Facebook page and removing any inappropriate content.

Membership secretary: Mike Dloogatch read the list of those whose memberships have expired, and reported membership holding steady.

Sergeant-at-arms: Tom Mikosz reported that 19 people logged in on the Zoom webinar, while another two attended via Facebook, and 13 viewed the online recording.

Committee reports

Adoptions: Margaret Ann Paauw and Stephanie Dochterman are receiving a lot of adoption requests. They urge everyone to check out the adoption page on Facebook.

New Business

Grants: It was the unanimous consensus of the board that we do not have the financial resources to give out grants in 2022.

Citizen science: John Archer feels that a citizen science project could provide a way for members to get involved. Many groups looking for volunteers to assist with projects. If enough interest maybe the CHS can form a group or team to participate.

The meeting adjourned at 9:22 P.M.

Respectfully submitted by recording secretary Gail Oomens

NEW CHS MEMBERS THIS MONTH

Samuel Cabindol
John R. Jackson
Alexander Jameson
Lina Kelly
Myles Masterson
Gary J. Sibio

Advertisements

A MESSAGE FROM THE CHS PRESIDENT

The last two years have been difficult for your society. Many of our normal activities were interrupted and we've had problems keeping things running smoothly. (Well, that's not a new problem but a matter of degree.) In light of the complexities with nominating and electing officials, all of the current board members have agreed to stay in office for 2022. If we have members that would like to run for office, we need to know so that we can arrange for an election. This can be done online, but is difficult for those who don't use computers. If you really want to serve on the board, let me know by November 30. Elections will then be held in December. Otherwise, the current board will serve in 2022.

I apologize for this departure from our normal protocol. **–John Archer**

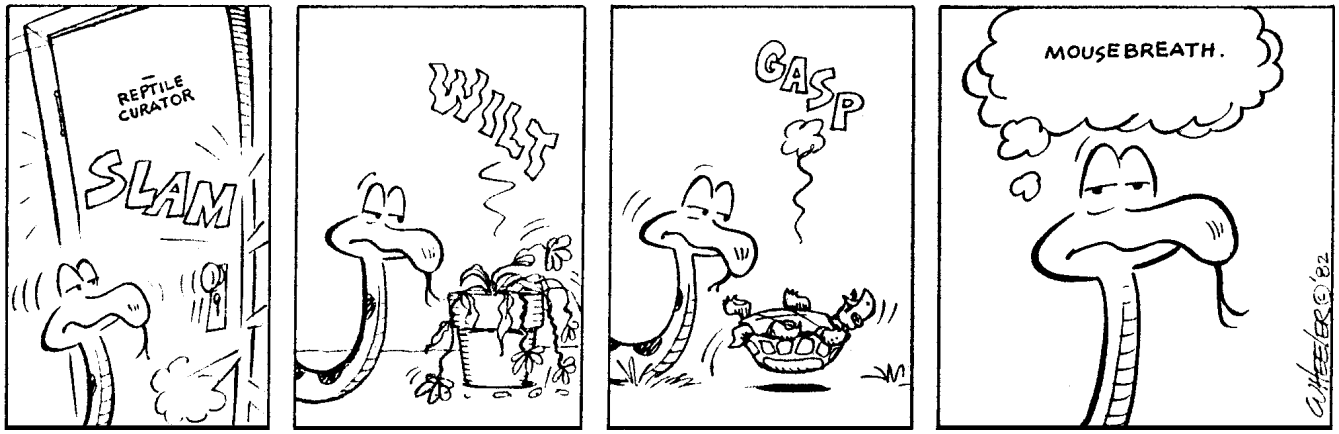
UPCOMING MEETINGS

Please try to join us *in person* for the next meeting of the Chicago Herpetological Society, to be held at 7:30 P.M., Wednesday, November 24, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. **Masks will be required for all attendees.**

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting will be held online. If you wish to take part, please email: mdloogatch@chicagoherp.org.

THE ADVENTURES OF SPOT



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