

Estimating Hatchling Texas Horned Lizard Survivorship with Harmonic Radar

By Miranda Vespy



Figure 1: Texas Horned Lizard juvenile with an attached diode reflector

Background

The Texas horned lizard (*Phrynosoma cornutum*) is experiencing serious population declines and localized extirpations throughout its range. Thus, researchers and wildlife professionals are seeking ways to boost existing populations and reintroduce horned lizards into suitable habitats. Head-start programs are an attractive and feasible method to address this problem. However, there must be a baseline estimate of wild-born hatchling survivorship, as well as an established method to monitor hatchlings post-release to gauge the success of these programs. The naturally cryptic nature of horned lizards helps protect them from potential

predators, but also protects them from the gaze of searching researchers. Traditional methods of tracking, such as the use of VHF radio-transmitters, are not applicable for hatchlings and juveniles of this species, due to the lizards' small body size and weight. Recently a new method of tracking known as harmonic radar, originally developed for the search and rescue of avalanche victims, is emerging as a light-weight and low-cost alternative. From 2016–2018 we applied this technique to a small, urban population of horned lizards in Oklahoma to gain a better understanding of the population dynamics of hatchlings of this species.

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Study Site

In Oklahoma, the most well-studied population of *P. cornutum* occurs at Tinker Air Force Base (TAFB), a ~2000 ha military base. Texas horned lizard research on TAFB is focused primarily on Wildlife Reserve 3 (WR3), a ~15 ha natural area managed as a prairie grassland for recreational activities. This area contains a healthy, stable population of horned lizards and has been the primary research site for the last 15+ years. Due to surrounding urbanized habitat, this population is considered fairly closed, with minimal immigration and emigration expected from the reserve.



Figure 2. Texas horned lizard hatchling with an attached diode reflector.



Figure 3. Handheld harmonic radar detector model R8 from RECCO.

Methods

Following visual surveys and fortuitous encounters, hatchling and juvenile horned lizards were captured by hand, permanently marked via toe clips for future identification, and had morphometric data measured and recorded. Then, a diode reflector (>0.05g) was attached to the dorsum posterior to the head with a non-toxic silicone adhesive, and individuals were then immediately released to the exact location they were found (Figures 1–2). All reflectors were painted brown to maintain crypsis and the lizard's individual identification number was written on each diode, so they could be returned to the lizard if lost. The diode reflectors work in conjunction with a handheld RECCO model R8 scanning device that serves as both a transmitter and a detector (RECCO Rescue Systems, Lidingo, Sweden; Figure 3). The RECCO device emits a microwave signal at a precise frequency. Upon hitting an animal fitted with a diode reflector, that frequency is then doubled and reflected back to the receiver. The RECCO device then translates this frequency into an acoustic signal heard by the researcher. The detection distance is 5–15 meters. To relocate tagged horned lizards, researchers transected the study site with the RECCO unit 3–5 times weekly from the hatchlings' initial emergence until the end of the active season, defined as when lizards entered hibernation.

Results

We estimated hatchling survival rates of tagged lizards collected during the 2016 and 2018 field seasons at Tinker Air Force Base. Hatchling sample size for the 2017 season was too small for analysis. For a number of individuals, we were unable to determine the fate of the lizard due to either their disappearance from the study area or to the loss of tags following shedding events (Figures 4–5).

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Figures 4&5 : Known fates for hatchlings fitted with diode reflectors for 2016 & 2018 field seasons. Unknown fates are due to three possible events: (1) initial capture only = individual was tagged, but never recaptured; (2) unable to be located = individual was recaptured at least once before disappearing from study site; (3) diode only found = lizard was recaptured at least once, but not recaptured following a diode shedding event

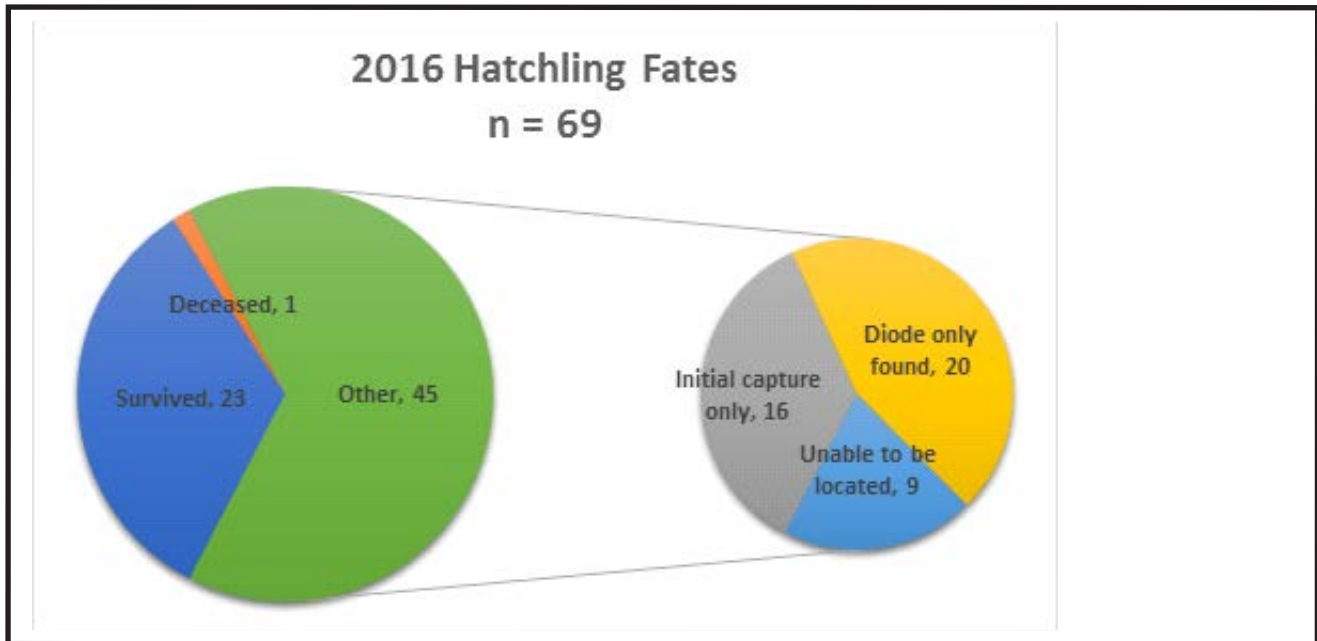


Figure 4: Known fates for tagged 2016 hatchlings

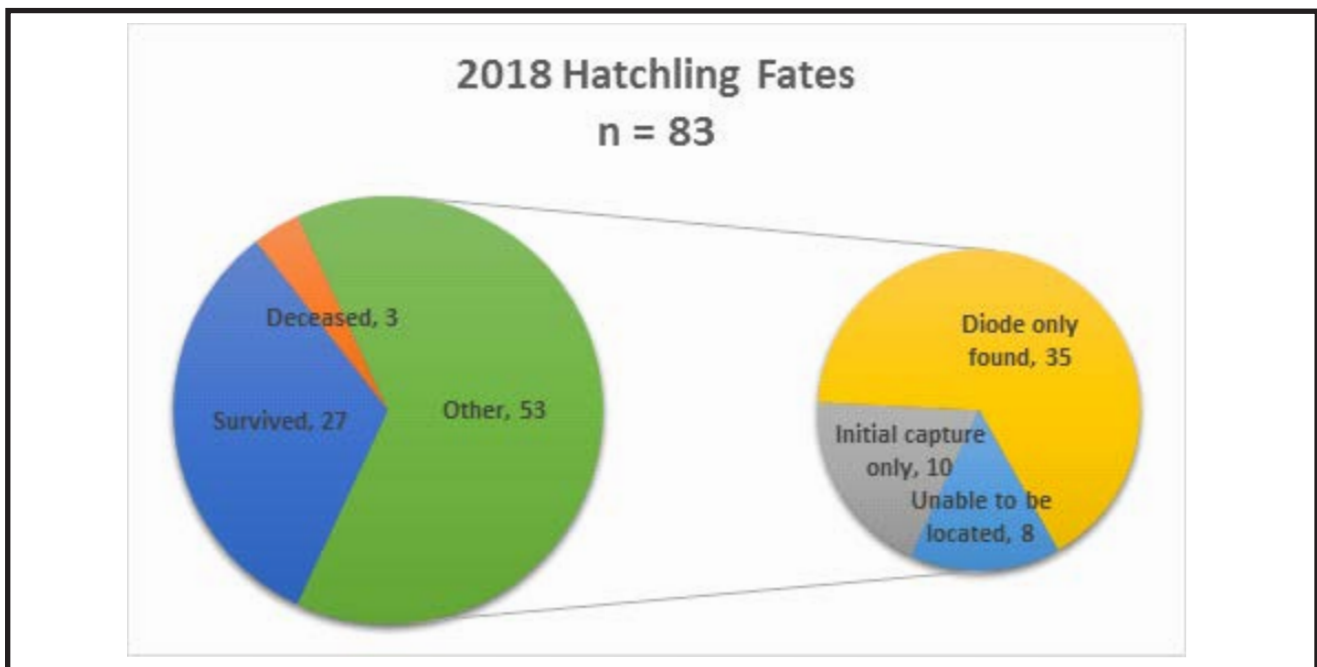


Figure 5: Known fates for tagged 2018 hatchlings.

To account for this, we estimated survivorship in two ways. Category 1 estimates assume all lizards with unknown fates were deceased. Category 2 estimates assume a portion of lizards with unknown fates (i.e. final fate of “diode found only”) had survived following their diode shedding event. We used the Kaplan-Meier survival estimator to form survivorship curves (Figures 6–7). In 2016 and 2018, Category 1 hatchling survival was 33.4% and 27.5%, respectively; Category 2 hatchling survival was 57.2% and 65.2%. Many data-censoring events, such as disappearance from the study site, or shedding of diodes, occurred within the first two weeks of study. This initial two-week window should be viewed as a critically important time for the both the survival and the detection of horned lizard hatchlings in the field.

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Figures 6&7: Kaplan-Meier survivorship analysis curves for the 2016 & 2018 field seasons. Category 1 represents analysis assuming all lizards with unknown fates are deceased. Category 2 represents analysis assuming a portion of unknown fates (“diode only found”) have survived. Survivorship over time shows a large portion of data censoring events happening within the first two weeks following entry into the study.

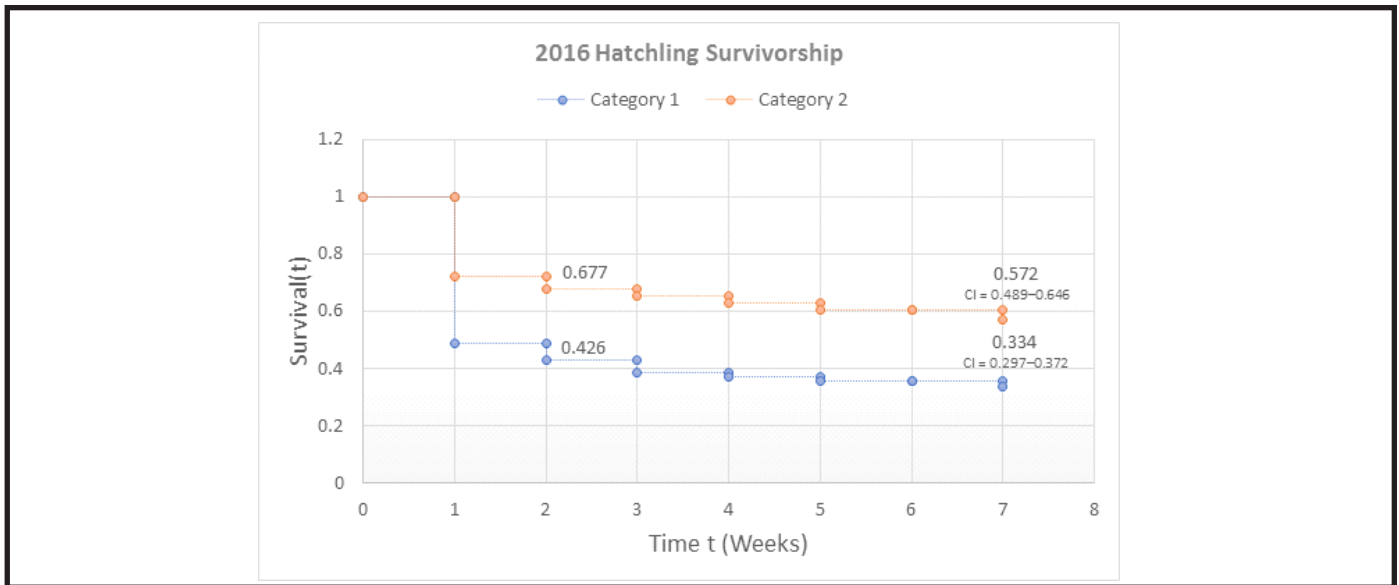


Figure 6: Kaplan-Meier survivorship analysis curves for 2016 field season

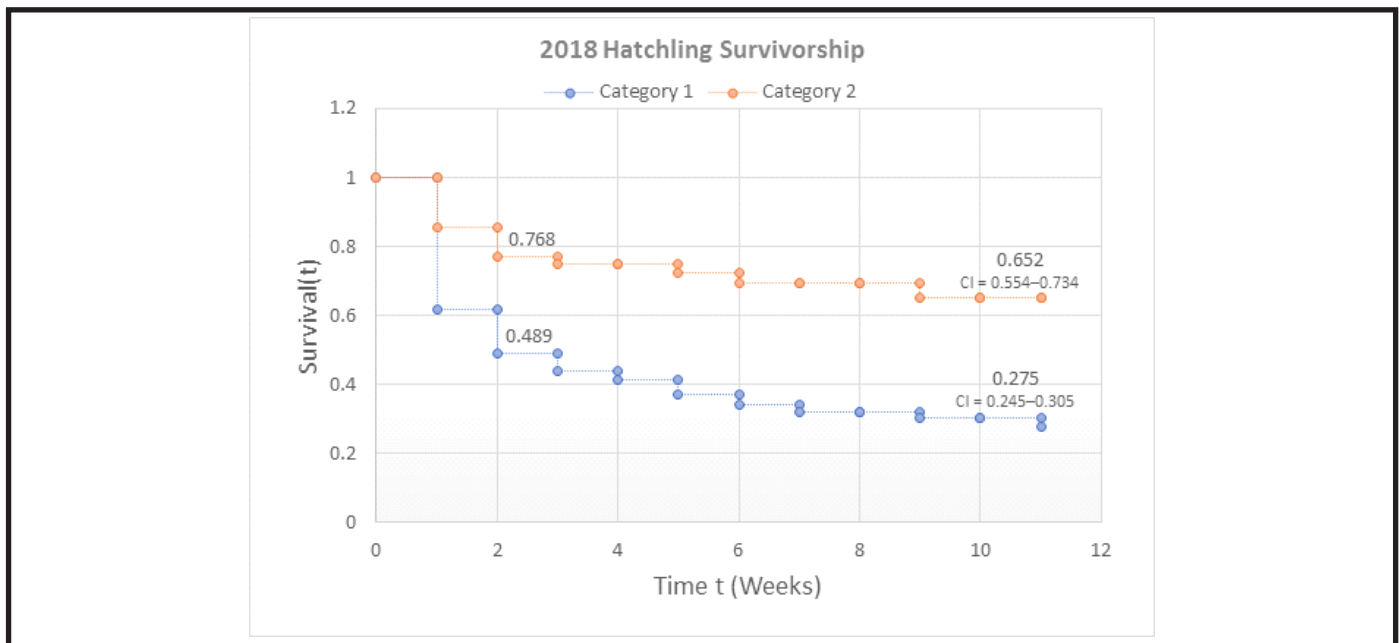


Figure 7: Kaplan-Meier survivorship analysis curves for 2018 field season

As with many species of squamate reptiles, the low hatchling survival rates we experienced in our study are expected for horned lizards. The survival rates we found for wild-born hatchlings will serve as a basis for comparison to captive-reared horned lizard hatchlings to assess the success of head-start programs. The methods described here can easily be applied to other research projects for *Phrynosoma* species.

The largest obstacle encountered with this tracking methodology is the loss of tags following shedding events. We continue to investigate better, safe techniques for the attachment of diode reflectors. Despite this, harmonic radar has proven to be an effective method of study. The largest expense with this system is the purchase of the RECCO detector, however diode reflectors are affordable, reusable, and do not rely upon batteries. We thank the Horned Lizard Conservation Society for the generous support of a HLCS grant which funded the purchase the much needed additional diode reflectors for this study in 2016



HLCS Board Meeting Summary

by Dalton Neuharth and Leslie Nossaman



HLCS Board members from left to right: George Perry, Ryan Zach, Leslie Nossaman, Mason Lee, Dalton Neuharth, and Lynn Seman

The new HLCS Board for 2019-2020 met on January 19, 2019 for an all-day kick-off and team building meeting at the San Antonio Zoo. All board members were in attendance.

Finances

Previous to 2018 the general increase in funds was around \$1000 per year. In 2018 there was an increase of around \$4500 for the year. This was due to increased sales and donations in late 2018. General account funds are \$28,219 and the sales account for tax purposes is \$4,333. Sales have decreased each year since 2008 until the metal engraved straw campaign in 2018. Thank you for all of you who purchased a straw or a straw set.

The Board voted on spending level approvals: \$>0-100 Treasurer, \$100-500 President, and \$500+ Board.

The Board voted to have the store website redone to take off products we no longer stock, to reword product descriptions, have new photos, and reorganize the product listings. The catalog and order form also need to be updated. The Board decided to have the store items assessed on those that need to be discontinued and develop a strategy on how they will be discontinued and to look into new products.

Educational materials

The Board decided to update our brochure with new information and to make it more North America focused. It was also decided that there is a need to create new educational materials.

Storage Unit

The HLCS storage unit was cleaned and reorganized for the first time in 28 years in 2018. Currently

it is a 5'x10' size but is so full even after the storage unit clean-out with new educational materials, sales items, and archived items, the Board voted to purchase a larger 10'x10' storage unit. We will also require the additional space to allow for growth including more educational, sales, and archival items.

Membership

HLCS will hold a biennial meeting in conjunction with the 30th anniversary timing in 2020. Location and date to be determined. The Board voted to remove the Corporate Sponsorship as an advertised membership type to simplify the membership process and will still accept funds as corporate donations or exchange memberships.

Social Media

The Board voted to shut down the old Facebook group page <https://www.facebook.com/groups/hornytoads/> and create a members only group page. The purpose for the members only group page is to deliver more value to our dues paying members by providing more communication and interaction between the board and the members and between members. See the article titled *Announcing a new Facebook Member Group Page!* in this newsletter. HLCS had two public pages with the old group page and the regular public page which had similar purposes, goals, and posts which was difficult to maintain so for all these reasons it was decided to only have the member group page and the one public page.

Please move to the public page and the member group page if you have not done so already. Our official HLCS Facebook pages are:

The Public page - <https://www.facebook.com/hornedlizard/>

The Member group page - <https://www.facebook.com/groups/HLCSmembers/>

The Board is very excited by all the ideas we have and would like to implement to support the HLCS mission.



HLCS Sponsored Survey at the White Ranch, Texas

HLCS would like to announce a field survey for Texas horned lizards on the private property of the White Ranch southwest of Mason, Texas. It is scheduled for Saturday, June 15. The purpose is to reconnaissance locations and numbers of Texas horned lizards on the property before planned ranch improvements in 2020. This survey is for dues paying members only and for people 12 and older. If you are interested in attending, contact Leslie Nossaman at peoranun07@gmail.com. We will need people to sign up by June 3 to plan accommodations at the ranch.



Announcing a new Facebook Member Group Page!

HLCS has created a new method for communicating between members and the HLCS Board. This new page will allow the Board to keep you updated with the latest news and activities and allow you a forum to post your photos and stories and ask others, including the Board, questions and make comments. This page is for the dues paying members and the objective is to provide more value to you!

If you are on Facebook and are dues paying member, look for the page to be a part of this group. Go to this page and ask to become a group member: <https://www.facebook.com/groups/HLCSmembers/> It is easy to sign up and it is fun! Hope to see you there!



Learning from Lizards; horned, that is

by Joyce Gibson Roach

A number of young readers, include What Dogs also cats, horses, other animals, the last few years. Illustrated with work. Each has counsel drawn ticed by humans phize animal be-benefit of homo have been guilty voice to animals hoofed, and for children, but



books, mostly for with titles that in-Have to Teach Us, longhorns, and have appeared in They are lavishly il-photos and/or art good advice and from the habits no-who anthropomor-haviors for the sapiens. Yes, I of giving human horned, fanged, winged in a book not much more.

It was my intention to note the worthy attributes of horned lizards in this essay, but when numbering the traits that offer life lessons, the list was slim to none. They bluff to protect themselves—puff up, raise up on their front legs, squirt blood, dart and run hunting for camouflage—hibernate through winter; lay eggs but don't stay around to see them hatch; live off ants mostly; and are part of the food chain for a few animals and birds. Horned lizards behave according to the dictates of weather and land because they are reptiles and therefore cold-blooded.

Moving out of the romantic climate surrounding the animals noted above, it must be admitted horned frogs don't have much of anything to teach anybody. The title, Learning from Lizards is personal and has only to do with what horny toads have taught me in the last ten or twelve years since joining HLCS.

You don't have to call them by their scientific name, *Phrynosoma cornutum*, or by their identification in Español—sopa con quernitos, or chameleon—or even horned lizard. Other identifications already used are just fine.

Those who enjoy, study, survey, popularize, advertise, advocate, remember them, and just plain like them aren't all alike either. Some are biologists, naturalists, artists, photographers, folklorists, historians, veterinarians, lawyers, writers, students, old, and young.

I can only speak for myself, then, about what I've learned from lizards and it has little to do with the tiny, elusive creatures, themselves.

In the companionship of Society members out in the vastness of West Texas mostly, I have learned to look at the ground with care and curiosity about grasses, wildflowers, things that crawl and/or fly. Some names I've learned; some not except to notice colors shaded and blended on single petals, repetition of shapes; patterns of variety on insects, their work ethic as the seasons roll. Scientific

identification is mostly bugs and blossoms, colors never noticed until observed at ground level, sunshine on tiny wings, or spotlighting grass moving in the wind. Before, my view of the ground was a wider perspective that stretched as far as the land was unbroken—the entire sweeping panorama of the beloved prairie and plains.

I couldn't see the trees for the forest—yes, I said it right, for me at least—the various veining and colors of leaves as seasons change; the fruits and nuts that appear, or don't according to wind, weather, and water; the size and shape of trees—even the smell of oak and prickly ash in the inferno of summer. Few names except for the most obvious are important to me now at this stage of my life even though there is plenty of time to learn.

And birds that occupy the trees and grasses! Raptors are my favorites now. Perhaps it's because I can see them more easily than the smaller ones, and know their general names—hawks, owls, eagles now and then—and their calls. It's their eyes that please me most—fierce, unafraid, confident. I have learned a few of the names of smaller birds by their call, although never see them—the Phoebe for one.

In spite of this late-life epiphany as clear as ever the three wise men experienced, I have no want to become a birder, a master naturalist, wildlife expert, or sage. Having always had the big picture, so to speak, the wider, all encompassing view of the natural world, I am satisfied with the endless bits and pieces of Place close up, knowing I belong there and it in me. To paraphrase Walt Whitman, I have seen the world in a blade of blue stem, am a person of small perspectives at home in the world.

Without hunting for *Phrynosoma*, horned lizards, horny toads, and horned frogs in the company of others of like mind, I would have missed one of the most important lessons of life, on earth as it is.

This is a reprint at the request of Joyce Roach from the HLCS 20th year anniversary issue.



Nature Nights in Austin, Texas

By Bill Brooks

On June 14, 2018, Bill Brooks displayed the wonderful horned lizard exhibits created by Larry Wisdom at the Lady Bird Johnson Wildflower Research Center in Austin, Texas for their Nature Nights event. The exhibits were admired by hundreds of people



of all ages that evening. This special event was attended by Bill and Beth Bennett who brought their whole family to the program. Beth is Larry Wisdom's daughter. HLCS would like to thank Beth for allowing us to use and share these exhibits with others.

Left to Right: Claire Arneson, Rebecca Bennett, Nick & Erica Cochrum, (children: Clara and Nolan Cochrum), Beth & Billy Bennett, (children in stroller: Kylie and Levi Ackley), Laura & Scott Ackley, and Michael Couch



Harmonic Tracking Devices for Horned Lizards

by Bill Brooks

Researchers have a relatively “new” device for tracking horned lizards. The harmonic direction finders have several advantages over the older radiotelemetry device they used to attach to adult horned lizards.

Harmonic tags are very small. The rule is that researchers can’t attach any device to a lizard that weighs over 10% of the animal’s weight. Anything heavier restricts the movement of the animal. With these small tags researchers can now track juvenile horned lizards which they couldn’t do in the past.

They are simple to apply, either with a silicon belt or cotton string. It can be glued onto the lizard, but it falls off when the animal sheds.

They don’t require batteries, so they last longer in the field. They are also cheap, costing around \$2- when a radio transmitter can cost around \$100-. This is an important consideration with a limited research budget.

The technology for these devices came from avalanche rescue systems designed to find skiers buried in the snow. It was invented by Magnus Granhed in 1980. His commercial version of the system for skiers is called the RECCO system. A handheld RECCO detector can locate a buried skier by sending out a radio wave that bounces off a small diode tag attached to an antenna. The harmonics of an RF energy incident (the second tone is usually the stronger of the two) is produced by a nonlinear device, usually a diode.

This device was first used to track insects almost 30 years ago, starting with the pioneering work of Mascanzoni and Wallin (1986). Honey bees, butterflies, and some beetles have been tracked this way. In the early 2000s it was used to track small frogs.

Now researchers are using the system to track hatchling horned lizards. Diane Barber, curator of ectotherms at the Fort Worth Zoo, was at the Mason Mountain Wildlife Management Area (in Texas) as MMWMA staff attached diodes to hatchling horned lizards. In September 2018 the Wildlife Management staff tracked 10 of the 139 hatchlings released at Mason Mountain Wildlife Management Area. A month into the project, 5 were still trackable. For the first time researchers can track juvenile horned lizards. In the spring they will find out how they fared over winter.



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President's Message *by Leslie Nossaman*

The Board had a successful kick-off meeting back in January and have been working on many new ideas since. You may have noticed the new Facebook member group page as one of our new activities. If you have not seen it yet and you are on Facebook, please check it out and join. See the announcement in the newsletter to learn more. We also increased our grant program this year to include more awards than ever before.

Some of our projects are to build a stronger infrastructure to become a more successful organization. One of our big projects is to find all old documentation including all newsletters and find an effective long-term solution for archival storage. We will also be looking into new products to sell which will help round out and complement what we currently offer.

We will also be looking for ways to save money to better focus what we have. One way to save some of our funds is to ask our members who are receiving the paper newsletter by post mail to change to having it delivered by email instead. To make the change, contact Lynn Seman, the HLCS Membership Services officer. I am very optimistic for all that HLCS can do in the future!



2019 Grant Recipients

HLCS has granted six awards in 2019 and we are very excited by their work plans which are briefly described here. Look for updates on our HLCS Facebook public page - <https://www.facebook.com/hornedlizard/>

Ian Clifton - The aim of the study is to characterize the thermal ecology and thermal environment of the Greater Short-horned Lizards (*P. hernandesi*) in the Abajo Mountains in southeast Utah to model the effects of climate change on a vulnerable horned lizard population.

Cecilia Aguilar-Morales – This project will update the distribution and understand the population of the understudied Rock Horned Lizard (*P. ditmarsii*) in the Sierra Baviacora area and probably 50 km north to Arizpe in Mexico. The data will be used to potentially nominate this species for protection in Mexico.

Jessica Heckman – The study which will take place at the Crossbar Management Area north of Amarillo, Texas will be to provide insight into the microhabitat selection by Texas Horned Lizards (*P. cornutum*). The investigation will be at two scales, one with powder tracking at a fine scale and radio telemetry on a coarser scale.

Kyla Garten – This study will investigate a new method called photo identification for the mark-recapture technique for the Flat-tailed Horned Lizard (*P. mcallii*) in southeastern California and/or southwestern Arizona.

Paul Bunker – The study will train a dog in techniques in horned lizard detection as a pilot project to assess the capabilities. The study will take place in central Texas and will work with the San Antonio Zoo and Texas Horned Lizards (*P. cornutum*).

Teal Taylor – Just outside Butte, Montana there is a Superfund site to remediate the soils and vegetation after significant mining in the area. The study will focus on surveying this area for a Greater Short-Horned Lizard (*P. hernandesi*) population and the potential effects of this remediation on the lizards.





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