HORNED LIZARD CONSERVATION SOCIETY
Post Office Box 122, Austin, Texas 78767

Phrynosomatics

The Newsletter of the Horned Lizard Conservation Society

Our purpose is to document and publicize the values and conservation needs of horned lizards, to promote horned lizard conservation projects and to assist with horned lizard management initiatives throughout their ranges.

Volume 8, Issue 3 **December 2003**

Remnant Habitat in The Coachella Valley Provides Home to a Unique Population of Flat-tailed Horned Lizards

by Cameron W. Barrows
Southern California Regional Director
Center for Natural Lands Management
photographs by Michael McGrann

Whenever I hear of a species having a small, restricted distribution, my ears perk up. Immediately, I start asking myself questions about what factors restrict its distribution in space and time, whether the range is stable, shrinking or expanding, and if human influences have contributed or caused changes in the species' range. Such has been the case with the flat-tailed horned lizard, *Phrynosoma mcallii*, which has the smallest distribution of any horned lizard species found in the U.S. Flat-tailed horned lizards, or flat-tails, occur in discontinuous desert habitats containing fine sand soils from northwestern Sonora and northeastern Baja, in Mexico, to extreme southwestern Arizona and southeastern California. Flat-tails once reach their northern and western range limits in the Coachella Valley, near Palm Springs California. So, when I first learned about flat-tails, my interest was certainly piqued; but, what about that all-important question, has their range been impacted by humans? The answer is an emphatic yes, but how much of their range has been impacted and how many lizards are still found in relatively stable protected areas are a bit more complicated to understand and enumerate.

The vast agricultural lands of Imperial County and the Coachella Valley were once, almost certainly, prime flat-tail habitat. The lizards' cryptic coloration and behavior have complicated quantifying just how much occupied habitat is left. At the approach of potential threats, including a person on foot, flat-tails hunker down, flattening themselves against the sandy substrate, rather than run and draw attention to themselves as many other lizards

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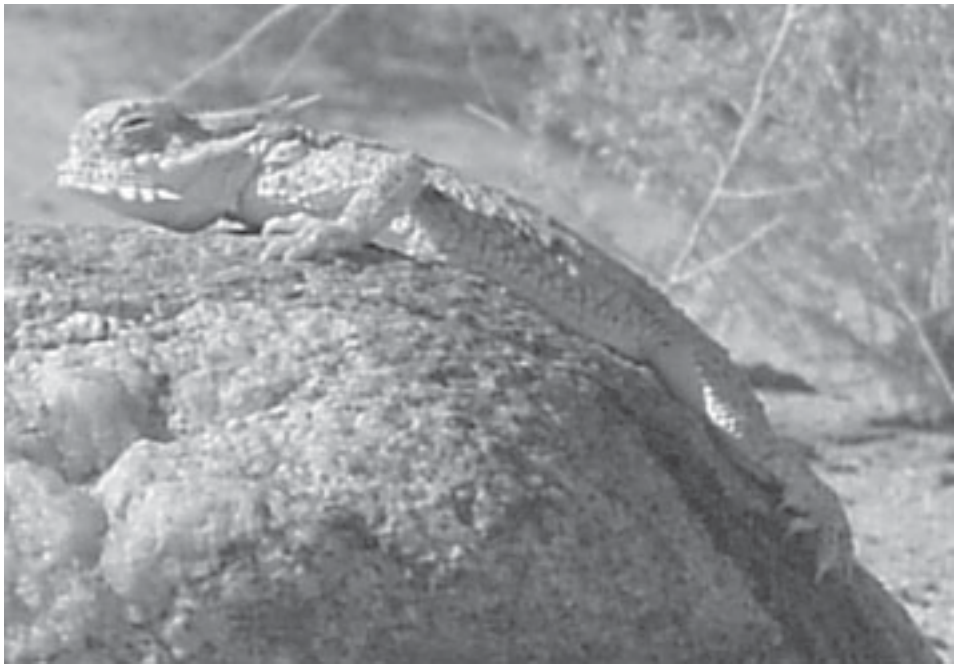

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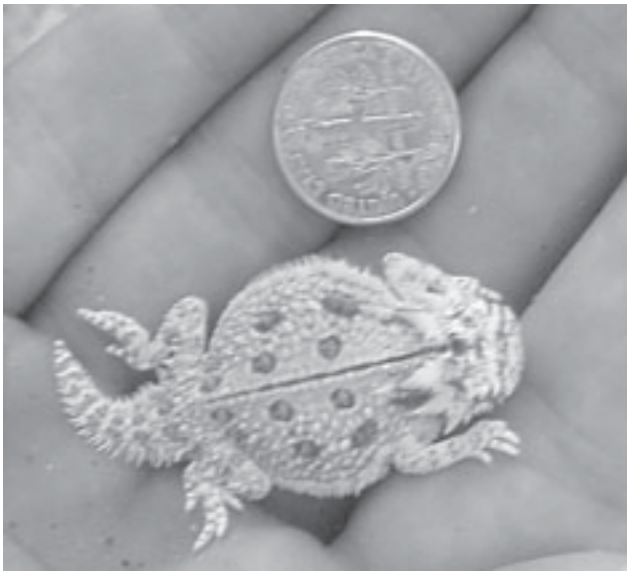
do. The result is that their shadow disappears and they blend almost perfectly with their surroundings. This has made it all but impossible for researchers to accurately assess population numbers. Their behavior in face of danger also means that flat-tails lose encounters with motorcycles and dune buggies.

The lack of accurate population trends has stymied efforts to seek additional federal or state protection for flat-tails. Wildlife agencies have been unwilling to simply equate trends in habitat conditions with population trends even when the habitat is obviously no longer suitable for the lizards. Agencies want hard data on lizard numbers with respect to those habitat conditions. The lack of such definable numbers, especially in the face of competing uses of their remaining habitat, such as off-road vehicle recreation, housing developments, golf courses, agriculture, and military training has led to a quandary for regulatory agencies. They have opted to encourage the designation of flat-tail management areas on federal and state lands; however, those lands are often still open to off- road vehicle play and other landscape scale human disturbances. The question as to whether these lands can continue to support viable populations of flat-tails remains unanswered.

In the Coachella Valley we have a clearer view of just how well flat-tails and their habitat have faired. For one thing we have a pretty good picture of their historical distribution here. Herpetologists such as Robert Stebbins and Bill Mayhew conducted much of their seminal research studying lizards in the Coachella Valley. Their field notes provide an invaluable insight as to where lizards occurred before the tidal wave of country club housing developments hit this region. Research by Al Muth and Mark Fisher has chronicled many contemporary changes to the species and it's range. It is clear that flat-tails were once widespread on the valley's sandy floor, occupying much of the 200+ square miles of the Coachella Valley. Although the cooler, northwestern regions in the Valley may have only supported ephemeral population expansions when conditions were just right, such dynamics in a species' range would be expected at the extreme margins. Today, flat-tails are confined to one, or perhaps two pockets in the central portion of the valley, which represents about 4,000 acres or roughly 2-3 % of the species historic range. Countless roads and developments ensure that dynamic range expansions of this species during favorable years are no longer possible here. Fortunately the Coachella Valley has embarked on a habitat conservation planning process that will provide security for those remaining pockets of flat-tail habitat. Is the remaining flat-tail habitat in the Coachella Valley too little too late? This is an important question that needs an answer.

To answer this question, the first step is to determine how many flat-tails can be supported by the remaining habitat. That little problem of not being able to find and count flat-tails has been overcome in the Coachella Valley where fine, aeolian sands provide an accurate record of anything that runs across it, just like freshly fallen snow. Flat-tail tracks are distinct from those of any of the other lizard species. Find the tracks, determine which way the lizard is heading, and invariably there will be a flat-tail at the end of the path. Using this method I have been able to find, mark and determine the density of several subsets of the flat-tail population on the Thousand Palms Preserve – a preserve originally established to protect the federally threatened Coachella Valley fringe-toed lizard. In three years I have marked over 590 flat-tails at



Thousand Palms using a method developed by Mark Fisher (M. Fisher and A. Muth, Herpetological review 20(2): 45-46, 1989) that involves sewing a unique combination of tiny colored plastic beads on their tails with surgical wire. The lizards

appear no worse for wear just seconds after being released, and survive months and years apparently unaffected by their new adornments.

Even though I can find flat-tails with regularity, determining their population density is still difficult. As high a value as ecologists place on knowing the density of a particular species, especially rare ones, there is little acknowledgement of the dynamic nature of this measure. Through the early spring season, mostly juvenile flat-tails are active on the surface. Later in the spring, adults begin to emerge and the population density increases dramatically. By mid-summer, predation by kestrels, shrikes, roadrunners, and even ground squirrels, and through little understood movement patterns by the lizards, the population density can decrease dramatically. Recent findings indicate that up to 200 meters, about 600ft, from the edges of the preserve, these declines are even more dramatic because of higher predation rates. Kestrel and shrike populations appear to have benefited from the planting of urban trees, which they use for nest sites. They also use power poles to perch, locate lizards and launch their sorties to secure food for their growing broods. Within a few months the flat-tail population can double and then be reduced by that much or more, and the density of flat-tails along up to 200m from the preserve edge can drop to almost zero.

At which point do you report the population density for comparison between years, other habitats and other locations? With no other convention to fall back on, I use their mid-summer density, as that would represent the population of likely breeding adults for a given location. I've found population densities as high as 10-12 flat-tails per hectare in what is the best habitat on the Preserve and as few as 1 per hectare in less suitable habitat. These numbers fluctuate between years apparently related to food availability (harvester and honeypot ants), which in turn is likely related to rainfall and plant productivity. Suitable habitat for a flat-tail seems to be characterized by a combination of high ant abundance, moderate sand compaction and moderate shrub cover (by desert standards).

At a remarkable 10-12 flat-tails per hectare, Thousand Palms is home to a unique population that has the highest known densities ever reported for this species. The Preserve currently appears to have habitat sufficient for a viable, long-term population of flat-tails within the confines of its boundaries. Perhaps an additional line of inquiry should focus on the dynamics of the aeolian sand habitat and occupancy of the habitat with respect to other species. For example, the Preserve is also home to fringe-toed lizards. While there is clearly overlap in habitat preferences, what appears to be the most productive fringe-toed lizard habitat usually has few flat-tails, and where the highest numbers of flat-tails occur, fringe-toed lizards are scarcer. The aeolian sand habitat appears to be in a dynamic flux shifting between different types of microhabitat that favors one species over the other. As long as there is some balance in this dynamic, both species should continue to thrive. Understanding and, if necessary, managing that dynamic will be the challenge for maintaining this last stronghold on the final frontier of the flat-tailed horned lizards' diminishing range in the Coachella Valley.

Morphin' Lizards!

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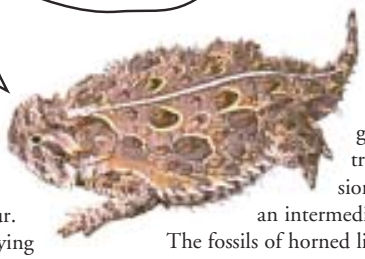
by Mike Gannis



Phrynosoma cornutum

It looks like something from the Mesozoic Era—a squat body covered with sharp spines, head encased in bony armor, dark penetrating eyes, and horns worthy of a *Triceratops* dinosaur. *Phrynosoma cornutum* would indeed be a terrifying sight if you were the size of an ant, its usual prey. But many humans find the docile and harmless Texas Horned Lizard (sometimes called a "horny toad") rather endearing. UC Riverside biologist Wendy Hodges certainly likes the creatures, and has studied horned lizards for a decade. Her latest studies of the reptiles involve an attempt to reconstruct the physical features of the common ancestor of the 13 living species of North American horned lizards.

Assisted by visualization expert Reuben Reyes at the Texas Advanced Computing Center (TACC) at the University of Texas at Austin, a member of the National Partnership for Advanced Computational Infrastructure (NPACI), Hodges is applying advanced computer analysis and graphics techniques to three-dimensional data sets acquired through computed tomography (CT). The results are both scientifically informative and visually striking.

Between 23 and 30 million years ago, the first North American horned lizards branched off from sand lizards, becoming stockier and spinier and evolving their distinctive crowns of horns. A single common ancestor gave rise to the 13 species of North American horned lizards, each developing a unique set of cranial horns and spikes. But what did this common ancestor look like, and how did the horns develop?

"CT reconstructions enable us to analyze and compare the morphologies of different species, in this case the Texas Horned Lizard, *Phrynosoma cornutum*, and the Mexican Horned Lizard, *Phrynosoma taurus*," Hodges said. "The goal of this project is to visualize the evolution of horns in this group of lizards and to determine how horn number increased through evolutionary time."

In their initial efforts, Hodges and Reyes are applying "morphing" programs and algorithms for computing ancestral states in combination with three-dimensional morphologies from CT scans to visualize an intermediate form between two species.

The fossils of horned lizards and other small desert-dwelling animals are small, fragile, and easily overlooked. The rarity of fossils is one reason for Hodges' and Reyes' efforts to reconstruct ancestral forms through computer-based morphing.

Analysis of DNA sequences plays a key role in determining evolutionary relationships. Over 2,500 base pairs representing four genes from horned lizards were sequenced, aligned, combined with morphological data used in previous studies, and used in phylogenetic analyses to reconstruct the relationships between horned lizard species. But genetic information alone isn't everything—small differences in gene expression during embryonic development can translate into significant changes in adult morphology. Reconstructing and visualizing the ancestral forms of organisms requires the full combination of comparative genetics, phylogenetics, and 3-D morphology, with a major assist from advanced computer modeling.

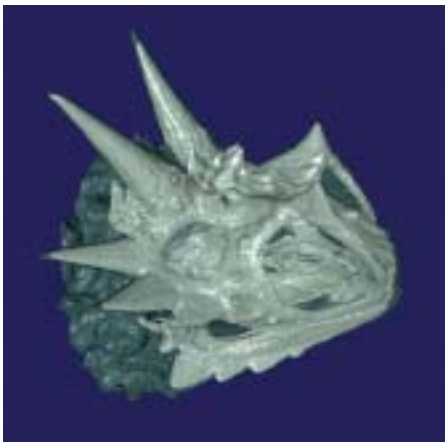
Structural information was acquired from preserved horned lizard museum specimens using a high-resolution CT scanner at the National Science Foundation (NSF)-supported University of Texas High-Resolution X-ray Computed Tomography Facility. The scanner is

BOTH PHOTOGRAPHS: ROBERT POTTS © CALIFORNIA ACADEMY OF SCIENCES

This Coast horned lizard, *Phrynosoma coronatum,* may look ferocious, but it's completely harmless.

comparable to a conventional medical diagnostic CT device, but was custom-built to have greater resolution and penetrating power and was specifically designed to explore the internal structures of natural objects and materials at macro- and microscopic levels. In its five years of operation, this instrument has scanned a variety of specimens, from rocks, meteorites, and fossils to plant and animal structures.

Eventually, images of each horned lizard species' head will be created from the CT data using visualization software, to reveal both the external configurations and the internal structures of the specimens. One visualization application depicts the external skin and internal skeleton using a color-mapping scheme that represents the distance from the skin to the bone, giving some of the lizard head reconstructions a polychromatic, "tie-dyed" appearance.



REUBEN REYES

This rendering of the skull of *Phrynosoma cornutum* is reconstructed from tomography data, with low-density tissues excluded.

The reconstruction and morphing software source code is written in C++ using "Performer" graphics libraries. Computational resources used in the effort included a Silicon Graphics Onyx2 computer with 24 processors, 25 gigabytes of main memory, and six "Infinite Reality2" graphics pipelines, and other NPACI computer resources.

"We're still working on the morphing reconstruction," said Reyes. "After we create visualizations from the combination of data from the Mexican and Texas Horned Lizard species as a test case, we intend to integrate the data for all species. In the future we plan to include non-linear morphing effects, and we hope to be able to visualize how the morphologies varied over time as the various species branched off from one another."

Hodges' and Reyes' efforts are conducted in coordination with the University of Texas Digital Morphology Group, an informal association of students, researchers, and educators from many different universities that collaborate to develop useful computer-based tools and exploit digital technologies for research and education. The research is funded in part by the NSF through a Postdoctoral Fellowship in Biological Informatics to Hodges; Ted Garland of UC Riverside is the primary sponsor and Tim Rowe of UT Austin is a co-sponsor. Funding for CT sections is provided through NSF support to Rowe. Additional support for Reyes is provided through TACC. ▼

Species of horned lizards can be identified by the configuration of horns and spikes on their heads.

WENDY L. HODGES

PROJECT LEADERS
WENDY L. HODGES, *University of California, Riverside*
REUBEN REYES, *Texas Advanced Computing Center, University of Texas at Austin*

Mike Gannis is a senior science writer at the San Diego Supercomputer Center.

A morphing program applied to volume data sets of two *Phrynosoma* species to derive an intermediate configuration.

REUBEN REYES

www.npaci.edu/envision/v19.2

PHRYNOSOMA FACTS

- In addition to horns, these lizards have another defense–they can actually squirt blood from their eyes; coyotes and foxes apparently dislike the taste and drop them.
- Horned lizards are specialized for eating ants. They are very difficult to feed in captivity, and often die of starvation.
- Being cold-blooded, horned lizards bask in the sun to warm up and cover their bodies with sand to avoid temperature extremes.
- Females of some species lay eggs, while females of others bear live young, which is thought to be an adaptation for cold environments.
- Several species exhibit "rock mimicry," in which they change the shape of their bodies to mimic the stones in their habitat.
- They drink during rainstorms by "rain harvesting," standing with hind legs up and head down, allowing water to drip into their mouths.
- Horned lizards tend to stay within a moderate home range, but sometimes go on long walkabouts, moving hundreds of meters in a day. They have been known to move total distances of up to a mile.

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Phrynosoma coronatum

Pentagon Now Defends Creatures Big and Small: Military is looking out for endangered wildlife at taxpayer expense

by Michelle Rushlo

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(note: This article original appeared in May, 2000; therefore, specific budget information may no longer be current.)

BARRY M. GOLDWATER RANGE, Ariz. (AP) - Bryan Morrill is methodically scanning back and forth, peering at the badly rutted paved road. Suddenly, he slams on the brakes.

"Did you see it?" he says excitedly, pointing to what looks like little more than a piece of brush growing in sand.

He carefully swings the pickup truck's door open and creeps toward the brush, pointing to its shady base. A tiny rough triangular tail is barely visible. It's owner, a flat-tailed horned lizard, had just darted from the road and hidden itself in the sand.

For Morrill, this is part of the daily routine - looking for lizards on the road, recording their favorite ground temperatures and performing other reconnaissance for, of all government agencies, the military.

Once responsible for nothing more than defending U.S. interests, the Department of Defense is increasingly being asked to also defend something else: wildlife.

The Defense Department is responsible for overseeing roughly 25 million acres of U.S. soil, and so far, 220 federally recognized endangered and threatened species have been identified on that land. (The flat-tailed horned lizard had been considered for federal listing, but the military and other government agencies agreed to conserve the lizard without the official listing.)

"We just kind of woke up one morning and found ourselves stewards of a lot of endangered species," said Ron Pearce, the Marine Corps range management director in Yuma.

The Defense Department spent roughly $27.6 million on threatened and endangered animals and plants, according to figures being submitted to Congress for the fiscal year that ended Sept. 30.

A study by the Nature Conservancy found that Defense Department land contains the highest number of federally protected species per acre of any federal agency's holdings.

Pearce and others say part of the reason is that military installations have become de facto wildlife refuges, the sole patches of open land surrounded by urban civilian development.

In the West, the military also controls vast stretches of land like the Barry M. Goldwater Range, said William Millan of the Nature Conservancy.

The flat-tailed horned lizards, which are only found in the western Sonoran Desert, live primarily on the Goldwater range, a 2.7 million-acre combat practice range shared by the Air Force and the Marine Corps.

Only one paved road runs from the range's edge to the targets used by the Marines. And though it seems like little more than a pothole-pocked strip to the military personnel and civilians that drive it, it's something of a Club Med for the cold-blooded lizards in spring.

As the pavement heats up and gets warmer than the sand, the round reptiles, which can grow to be 4 1/2 inches in length, sunbathe on the road - a life-threatening pursuit for the lizards when trucks drive through.

That's why Morrill, the flat-tailed horned lizard coordinator for the Marine Corps Air Station Yuma, religiously records roadway sightings of the protected lizards and the temperatures they prefer. "In June, July and August, we get 100 degrees and the people leave. The lizards love it," he said.

The range managers try to determine when the prime lizard sunbathing hours are so they can keep traffic off the range road during those times, he said.

Military personnel who drive the road are warned to watch out for the spiky headed lizards and are given business-card sized leaflets with the lizard's photo and the message, "Don't tread on me!"

Range managers have even tried experiments to see if they could fence the lizards away from the road. Morrill said they found that if the holes in the fence were small, the lizards simply crawl over the fences. Bigger holes in the fence trapped the lizards halfway through, sometimes killing them. Morrill said he also found that brush and sand would build up against the fences, creating

natural ladders for the lizards to climb over.

All this for a lizard - on a bombing range?

"Certainly, this has evolved. This has not been traditionally thought of as the military mission," Doug Ripley, natural resources manager at Air Force headquarters, said of the military's environmental sensitivity. "We blow stuff up. But (conservation) truly is a part of it. It's an important part of it."

Still, not everyone is convinced the military is doing enough.

Environmentalists like Peter Galvin of the Center for Biological Diversity concede the military has achieved a few environmental successes, but he said it is still not doing enough to protect the wildlife on its land.

"They are probably doing more than they were, but that has to be taken in the context that until recently, they paid zero attention and the plight of some of the species we're talking about has gotten so much worse," Galvin said.

He points to low-level flights, devegetation and storage of hazardous materials.

"They have a huge legacy of pollution," Galvin said. "Rhetorically, they've changed their tune, but we haven't seen that much on the ground."

A look at threatened and endangered species on Department of Defense lands:

Number of U.S. acres controlled by the DOD - 25 million.

Number of endangered and threatened species found on those lands - 220.

Total number of federally listed species - 1,181.

Amount spent to protect threatened and endangered species on DOD lands for the fiscal year that ended Sept. 30:

Army - $12.1 million.

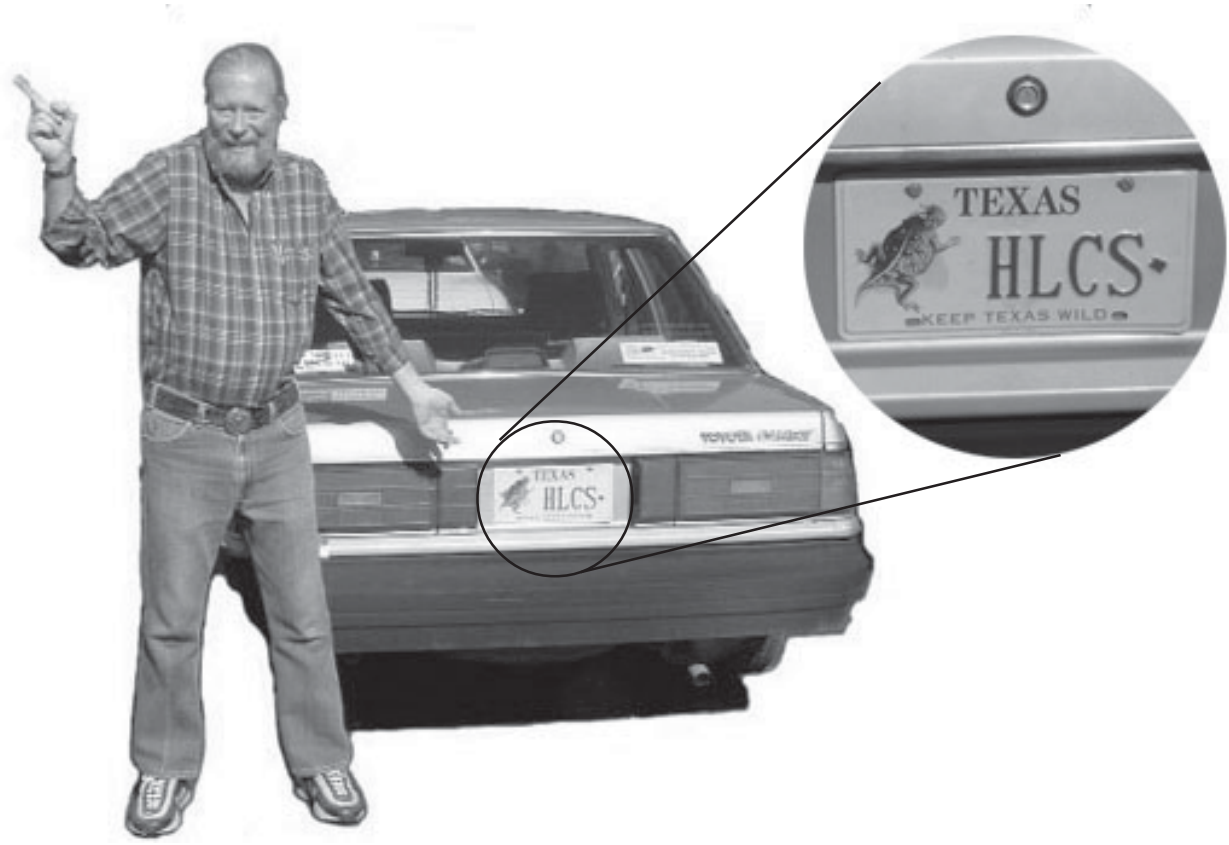
Navy - $4.3 million.

Marine Corps - $5.7 million.

Air Force - $5.5 million.

Total - $27.6 million.

Source: Threatened and endangered species reports filed by the military departments to Congress for the fiscal year that ended Sept. 30.



Texas Chapter President Bill Brooks showing off his license plate.

National News

National News

New Members and Donors

The HLCS would like to welcome our two new lifetime members, Marika and Jonathan Schoolar from Austin, TX. We would also like to thank them for their generous donation on top of lifetime memberships.

HLCS also thanks Paul, Kearby and John Roy Wisdom of Carrollton, Texas, who donated $25 in honor of Larry Wisdom.

Elections

In the last issue of *Phrynosomatics*, a call for nominees was made for two National Board of Directors positions, President-Elect and Treasurer. All but one nominee declined running for office. The NBOD met with the Election Committee to hear their recommendations and the elections will be postponed until early spring 2004 to seek new nominees. If you would like to nominate anyone, please contact Cheryl Franks, Cheryl.Franks@med.ge.com.

Recent Meetings

National HLCS officers cosponsored with the Texas Chapter two meetings in Austin, Texas, the National Headquarters of the HLCS. At the October 18th meeting, HLCS National President, Dr. Wendy Hodges, gave an interesting and informative talk about the ecology and natural history of all thirteen species of horned lizards. At the December 6th meeting, Chip Ruthven, a wildlife biologist with the Texas Parks and Wildlife Department, gave a fun and educational talk about the impact of range management on the Texas Horned Lizard at the Chaparral Wildlife Management Area. On December 6, the National Board of Directors also met to discuss changes to the Bylaws, National Elections, Chapter involvement and how to boost membership and member participation.

Wanted: *Phrynosomatics* Editor

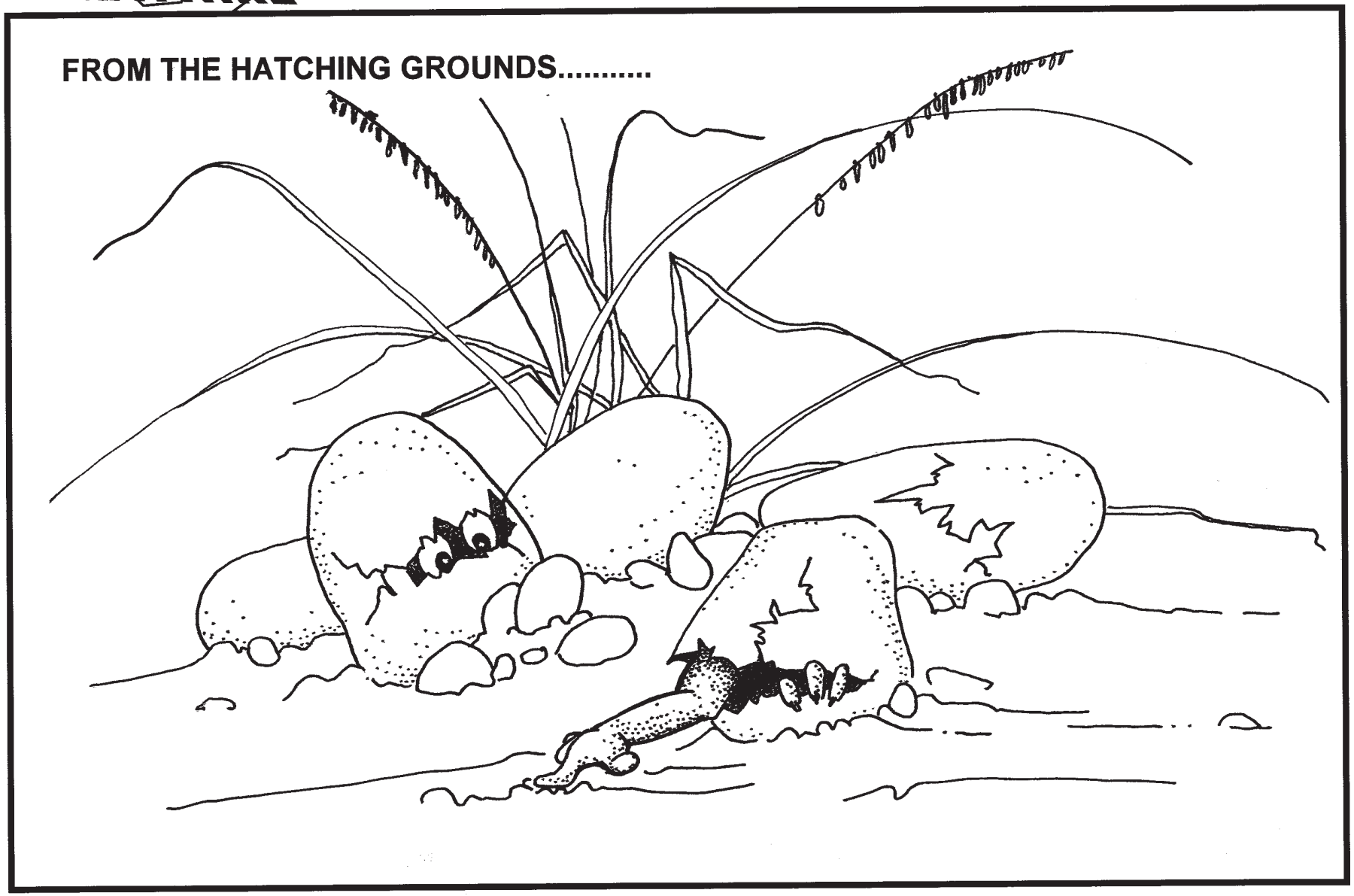
At the end of 2003, Scott Messec, will be stepping down as the *Phrynosomatics* editor. If you are interested in applying for the editor position, please contact Wendy Hodges at the information listed on page 2 (or wendyh@ucr.edu).

Texas Chapter News:
Bumper Sticker Contest Winner:

Of the submitted entries, the design by Ruthann Panipinto of The Woodlands, Texas, was selected as the winner, see design below. The bumper sticker is available for $2. To purchase, contact Bill Brooks at the information listed on page 2.

HAYWIRE

by M. Hawley



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