Sonorensis
ARIZONA-SONORA DESERT MUSEUM

This is how we do Conservation
"Is this a Zoo?"
Debra Colodner
Director of Conservation Education and Science

Zoos and Wildlife Conservation
Craig Ivanyi, Executive Director

Field Conservation:
Desert Museum People Saving Species: In the Wild
Robin Knopp, Education Specialist

Matchmaking at the Museum:
Why Zoos Breed, Why They Don’t, and the Desert Museum as a Leader in Animal Affairs
Catherine Bartlett, Education Manager

Challenge, Choice and Play: Animal Enrichment: adapted from ASDM News, Summer 2019

Conservation Learning at the Zoo
Martin Long
Associate Director, Conservation Education and Science

"Is this a Zoo?"
This was a question from a recent Desert Museum guest when asked to participate in a nationwide survey of zoo visitors. He explained that he didn’t like zoos, but liked the Museum very much.

Well, we are a zoo, and also a botanical garden, natural history museum, art institute and aquarium. Each of these labels carries with it the awesome responsibility of helping to preserve nature’s treasures for future generations, but none so urgently as the label “zoo.” Zoos today are essential partners in wildlife conservation, providing refuge and expertise in captive breeding for critically endangered species, as well as funding and other resources for conservation in the field. This issue of Sonorensis will introduce you to the world of “Zoos and Wildlife Conservation,” with an overview of zoo history, challenges and successes. We’ll see that current conservation practices connect our work in zoos to efforts in the wild. ASDM keepers and scientists describe their important work with field conservation partners in “The Faces of Conservation: Desert Museum People Saving Species in the Wild.” Here you’ll note one important difference between the Desert Museum and many zoos. The Museum places more emphasis on saving plants and habitats than many of its fellows.

Well then take a deeper look into the rapidly evolving field of captive breeding in “Matchmaking at the Museum" and learn about the extensive efforts to keep Desert Museum animals mentally and physically healthy in “Challenge, Choice and Play Animal Enrichment.” The issue concludes with a look at “Conservation Learning at the Zoo.” With over 700 million visitors annually to zoos and aquariums worldwide, these institutions have the potential to shape attitudes toward wildlife and conservation. How to optimize and measure conservation learning is an area of active research at the Desert Museum and zoos around the globe.
Animal menageries have been around for thousands of years. These precursors to the modern zoo flourished on the rare, unfamiliar, and exotic. Their purpose was to amuse, impress, entertain, and to a lesser degree, provide us with subject material for scientific study, often post-mortem. Such collections were only available to the privileged – primarily royalty. They weren’t about education, but about entertainment. Conservation, from the first public menagerie opened in France around 1793, conservation, if applicable at all, was utilitarian in nature. Conserving collected animals benefitted humans by maintaining healthy animals for our entertainment.

Historically, direct conservation work in zoos often occurred as if in a vacuum; even today, a zoo visit does inspire positive change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change. Zoos and Aquariums are working together with researchers to learn how to maximize that change.

Before going deeper into zoo conservation, let’s define what conservation means. For our purposes we include direct, hands-on, in-situ (in the field, in a species’ natural range) and ex-situ (outside the zoo) conservation. Of course, exposure to information doesn’t necessarily translate to action, nor do organizational outputs guarantee meaningful conservation outcomes. This is one of the central questions across fare today: does education result in behavioral change? Although the field of inquiry is still young, research indicates that a zoo visit does inspire positive change. Zoos and Aquariums are working together with researchers to learn how to maximize that change.

In-situ – in their natural habitat, part of their natural population

Ex-situ – in human care, outside of their natural population

DIRECT CONSERVATION

Research, management or policy work to conserve a species either:

Indirect conservation

Work with people to educate them about the importance of conservation for their lives, and what they can do to help plants and animals in the wild.

Partners work in concert to choose species that have no relationship to direct conservation, but instead sustain the animal populations they use to engage their visitors in the conservation stories told by their exhibits. However, this results in a reduction of space available for species that may be of higher conservation priority. Zoo professionals are constantly reminded of this and our need to be judicious in the planning, design and management of their facilities.

Thankfully, today’s efforts generally follow the One-Plan approach. Related conservation partners work in concert to choose species that can benefit from ex-situ conservation, and to coordinate this work with in-situ efforts. Of course, zoos still care for and breed species that have no relationship to direct conservation, but instead sustain the animal populations they use to engage their visitors in the conservation stories told by their exhibits. However, this results in a reduction of space available for species that may be of higher conservation priority. Zoo professionals are constantly reminded of this and our need to be judicious in the planning, design and management of their facilities.

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A Fish is a Fish, or is it? A Cautionary Tale…

When species are on the brink of extinction, knowing how to care for and breed them is of critical importance. Generally, it’s better to acquire this knowledge long before it is needed (before a species is rare), but this isn’t always possible. Perhaps nowhere is this more obvious than with the vaquita, a species with fewer than 10 individuals left. Unfortunately, husbandry for this species was never established and now it is too risky to bring them into human care (one already died during an attempt). Instead, zoos and aquariums figured that out before, maybe we would be having a different conversation about this species’ future.

Similarly, the Yaqui catfish is almost gone. Perhaps not as well known as a vaquita, the only native catfish west of the continental divide is endangered and now it is too risky to bring them into human care (one already died during an attempt). Knowing how to care for and breed them is of critical importance. Generally, it’s better to acquire this knowledge long before it is needed (before a species is rare), but this isn’t always possible. Perhaps nowhere is this more obvious than with the vaquita, a species with fewer than 10 individuals left. Unfortunately, husbandry for this species was never established and now it is too risky to bring them into human care (one already died during an attempt). Instead, zoos and aquariums figured that out before, maybe we would be having a different conversation about this species’ future.

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Courtney Christie: Herpetology, Ichthyology and Invertebrate Zoology (HIIZ) Keeper

Courtney Christie attributes her career choice to her childhood love of pet snakes, tortoises, and “a few fuzzy things.” Courtney is a passionate learner. Her first degree was in government and public policy from the University of Arizona, but after a few years, she realized that she really wanted to work directly with animals. She went back to school for a second degree in Ecology and Evolutionary Biology. Courtney made time during school to volunteer and intern at wildlife organizations, a prerequisite for people who want jobs in this field. One of those internships was at the Desert Museum, which opened a door to temporary, part time, and finally a full-time position. She had truly found her niche! One of Courtney’s favorite parts of the job is working with Sonoyta mud turtles. “I really enjoy this because I am learning so much about the turtles. They are elusive and charismatic.” (Whoever said that small, scaly creatures aren’t charismatic?)

Project Species: Sonoyta mud turtle

Sonoyta mud turtles are dark brown, medium-sized aquatic turtles with
the ones who will keep them going.”

Additional pressure on turtles and their habitat, we are expected to bring long-term drying to the region, putting some species at risk. Sonoyta mud turtles are among the species at risk.

Besides a few researchers who have a couple of years’ experience experimenting with various substrates for egg-laying, there are also increasingly rare, as groundwater pumping, surface water diversion, and 20 years of drought have reduced their tenure bases. Sonoyta mud turtles were listed as Endangered in 2017. With this listing, state, federal, and University biologists erupted to protect their habitat and stabilize their population in the U.S. Mexican biologists are also working to protect the species in Sonora.

The Desert Museum was first entitled to keep a species population of Sonoyta mud turtles while Quiriquina Spring underwent needed repair and restoration in 2015. We learned a great deal about how to care for these turtles. Today we keep an assurance mandate to breed them. Park officials continue to monitor water levels in the pond experimentally.

Mexican garter snakes. The information we collect is about diet and behavior complements observations of years ago, three babies hatched here, the very first in human care. We house most of the turtles in separate quarters, but four live in an outdoor habitat built by the Arizona Game and Fish Department to replicate wild conditions. Two years ago, these lizards hatched here, the very first in human care. In 2005, we learned a great deal about how to care for these rare turtles.

We know more of the turtles in separate quarters, but four live in an outdoor habitat built by the Arizona Game and Fish Department to replicate wild conditions. Two years ago, these lizards hatched here, the very first in human care. In 2005, we learned a great deal about how to care for these rare turtles.

During the course of our animal care, we are often approached by people who own pet lizards as well as large, charismatic mammals, but the Desert Museum makes a significant impact on educating biodiversity by working with these smaller species. The Desert Museum’s Animal Experiences, led by Desert Museum Animal Experiences Director (AZGFD) and the US Fish and Wildlife Serv- ices (USFWS), conservationists.

Conservation efforts for her species have been made. “It’s a relief that I am contributing to the health and conservation of species in the wild. The garter snake project is just one piece of a larger effort to save this unique species,” says Clare Steinberg. “The other agencies can keep at least a part of the population. AZGFD biologists also choose release sites to help maintain genetic diversity within our breeding population. AZGFD biologists also choose release sites.

Conservation of reptiles and amphibians doesn’t draw as much attention as large, charismatic mammals, but the Desert Museum makes a significant impact on educating biodiversity by working with these smaller species. The Desert Museum’s Animal Experiences, led by Desert Museum Animal Experiences Director (AZGFD) and the US Fish and Wildlife Services (USFWS), conservationists.

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Understanding Future Change: Another reason floristic surveys are important, John says, ‘is that they give us a baseline to monitor changes in the future.’ With climate change, for example, climate models predict that our region will experience increased temperatures and changes in precipitation patterns. Climate data from the last several decades reflect these trends; over the last twenty years, annual rainfall has decreased in the Tucson area, while average temperatures have increased almost 2°F. What kind of impacts will this have on regional ecology? Scientists have predicted that in mountainous regions, increased temperatures and decreased precipitation will lead to plant communities shifting uphill. Mountain studies can be continued with repeat surveys to elucidate changes and corroborate or refute predictions.

Revisiting Whittaker: Fifty Years Later: Many Tucson residents are familiar with the drive up to Mt. Lemmon in the Santa Catalina Mountains, where in the last several decades, the desert floor, grasslands, and oak woodlands, and arrive in the cool, evergreen forests on the summit. Precipitation increases and temperatures decrease with the ascent, and the plants reflect these conditions. In 1963, the ecologist Robert Whittaker and his colleague William Steiner performed a detailed study of the plants growing at different elevations along the Catalina Highway. Their data provided a snapshot of the elevations where common plant species were found over five decades ago. In 2015, John, along with Museum Director Emeritus Dr. Richard Brusca, and a team of ecologists and entomologists, replicated the Whittaker study. Their findings confirmed the model predictions—many plants’ lower elevation boundaries had significantly shifted upward. Climate science often works with models, but these depend on ground-truthing with observations in the field.

Future Contributions to Conservation: The Botany department contributes to field conservation efforts in other ways as well. They work with the USFWS to add species survival plants for regional endangered plant species. One, the Huachuca water fescue, is a native plant that has limited distribution and can easily hybridize, so findings on pure specimens is a challenge. Decades old survival plans have placed these species in a variety of locations, but the team’s recent work confirmed that the vulnerable Ajo oak is only found in a few spots in the mountains in Organ Pipe Cactus National Monument. Seed material was collected for propagation, and an Olm Tree biologist was able to send seed for Museum staff to propagate. Seedlings have been sent to the Huntington and other arboreta. As climate change warmers species to more species like the Ajo Oak upwards, these may become less available to go. With this work, the species are not lost forever.

"This collaboration of individuals, organizations, and government agencies can benefit everyone by protecting rich biodiversity and recreational resources in perpetuity."
The Power of the CWMA: Collective Work Means Action

For the last decade, stakeholders in Pima County gathered under the Southern Arizona Buffalo Coordination Center (SABCC) to confront buffelgrass threats to ecosystems and public safety. When Kim joined the science team, she participated on SABCC's board and buffelgrass working group. SABCC had a coalition of land managers, utilities, agencies and non-profits, poised to take on this widespread multi-jurisdictional challenge. The Museum backed Kim when she volunteered to take the lead. She spent the first six months just talking to different places in order to understand their needs and the challenges they face. “I understood the importance of bringing people together so they don’t feel like they are working in isolation, because that is a trap.”

With funding from the National Fish and Wildlife Foundation, she founded the Sonoran Desert Cooperative Weed Management Area (CWMA). CWMAs are partnerships that collectively manage invasive plants in a geographic area. Buffelgrass is the CWMA’s primary focus. “It’s the weed that brings us all together.” But the CWMA also confronts other important invasive species. Quarterly meetings unite local, state, tribal and federal land managers, Darsey-Terrell Air Force Base and other military installations, as well as academia, agencies, nonprofits, utilities, businesses, and volunteers who dig up buffelgrass. “This diverse group of people comes together to talk about buffelgrass and collectively tackle, ‘How do we solve this problem?’ We actually have a long coffee break in the middle so people can connect – it’s the only time of the year that people get to see each other. We share information on treatments, action opportunities, priorities, and funding strategies.” The power of the CWMA results in the number of acres treated, in saguaro saved from fire, in slopes once dense with the invader restored to their diverse Sonoran Desert vegetation. For Kim, the most gratifying part of her work is mobilizing people and helping to influence the direction her community takes with conservation. “As an academic, I never thought I would be able to talk to decision makers like the mayor, council members, county supervisors or department heads and help them see buffelgrass ability to transform our desert into a completely different ecosystem. But we are making progress. People comprehend the extent of the problem and want to help.”

But first, some Zingo (Zoo Lingo)

TAG, Taxon Advisory Group: “TAGs determine the conservation needs of entire taxa and recommend development of population management and conservation based upon the needs of the species and AZA-accredited institutions.”- Association of Zoos and Aquariums (AZA). TAGs involve academic, agency, non-profit, utility, business, and volunteer experts who work together to develop action plans and specify the optimal way to manage populations. There are currently over 500 Species Survival Plans. SSPs “…strive to manage the in-situ populations of select and typically threatened or endangered species.”- AZA. SSPs develop a Breeding and Transfer Plan for each species to restore a healthy and genetically diverse population. They are currently overseen by 50 Species Survival Plans. Studbook Keeper: An individual who works directly with TAG and SSP Programs to maintain accurate records of all individual animals in ex-situ and zoo populations. By serving as an expert for the species, scientists and track all births, deaths, and transfers. Informer, A person who reports information to the institution. Please, make it make sense! Ok! As an example, the AviD TIG covers all avian breeding programs, including the Ocelot SSP for which there is an individual Studbook Keeper in charge of breeding recommended. The recommendation is published in SSPs.

The battle with buffelgrass will never be completely won, but cumulative victories that protect our desert are possible. Success is measured in the number of acres treated, in saguaros saved from fire, in slopes once dense with the invader restored to four diverse Sonoran Desert vegetation. For Kim, the most gratifying part of her work is mobilizing people and helping to influence the direction her community takes with conservation. “As an academic, I never thought I would be able to talk to decision makers like the mayor, council members, county supervisors or department heads and help them see buffelgrass ability to transform our desert into a completely different ecosystem. But we are making progress. People comprehend the extent of the problem and want to help.”

Some of the most important conservation work at a zoological or botanical garden is achieved right here on the 50 acre grounds, from a visit to the blunts to the gallery to a story to protect natural wild places.
One of the Desert Museum holds this assurance population in case of emergency. In the wild, these lizards are found on Isla San Esteban, a remote island off the coast of Mexico. They’ve hatched in our care.

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During the program’s start, 337 San Esteban Chuckwallas have been bred. In the wild, the Chuckwalla is a very rare and endangered species. In the wild, these lizards are found on an island in the Gulf of California known as Isla Santa Clara. They’ve hatched in our care.

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My name is Christina Tietz and I work as the Director of Animal Husbandry and Conservation at the Desert Museum in Tucson, Arizona. I’ve always loved fish but I also love Icthyology and Invertebrate Zoology. With paperwork and signatures from the Research Committee and the Curator of Mammalogy and Ornithology. With paperwork and signatures from the Research Committee and the Curator of Mammalogy and Ornithology. With paperwork and signatures from the Research Committee and the Curator of Mammalogy and Ornithology. With paperwork and signatures from the Research Committee and the Curator of Mammalogy and Ornithology. With paperwork and signatures from the Research Committee and the Curator of Mammalogy and Ornithology.
NEW TWISTS ON OLD BEHAVIORS

Javelina are, surprisingly, quite the artists. If you can be
lucky, the animals enjoy pressing their noses against cans
covered in non-toxic paint to create their own artistic
masterpieces! Painting enrichment is designed to mimic
the act of rooting in the ground with their noses for food.
Likewise, if you’ve ever opened empty cardboard boxes
in an exhibit, have no fear—they harbor lots of track of the
recycling! Our trash truly is like treasure to many of the
animals—adding them to their habitats provides hours of enrichment.

CHANGE OF SCENERY

While some animals benefit most from having different objects introduced into their habitats, others enjoy a change of scenery. Reptiles, for instance, are given access to their very own enrichment
rooms and/or veterinarians record, rate, and review all enrichment sessions to keep track of whether reactions are
positive, negative, or neutral. It should be noted that an ad
vanced reaction may reasonably fail; the goal is for animals to
have a natural range of experiences. For instance, a stake’s
shell might be placed in the middle of a spacious enclosure;
interactions with a predator’s scent may not be pleasant for the
packrats, but it is certainly something they would encounter
in the wild. That said, not all enrichment activities replicate
experiences animals would have in their natural environ-
ments. Some are quite novel, as you’ll soon read.

PLAY DATE?

One common misconception among people is that all
animals would be happier with a playmate or two in their
enclosures. While this is true for some animals, it is not true
for others, who are naturally solitary. Black bears, mountain
lions and river otters are examples of animals that enjoy
the company of others, such as tortoises and birds, which
interact with different people. Even the more introverted
animals would be happier with a playmate or two in their
enclosures. While this is true for some animals, it is not true
for others, who are naturally solitary. Black bears, mountain
lions and river otters are examples of animals that spend
most of their lives alone, unless they are mothers raising
young. It would be stressful and dangerous to introduce
another animal into their territory.

EYE ON THE TARGET

While ASDM animals are at work helping to save their species and habitats in the wild, their individual
health is of primary importance. Thanks to dedicated zookeepers and veterinarians, every animal—tiger
from mountain lions and prairie dogs to snakes and birds—receives top-notch veterinary care, extending their lives long beyond what might experience in the wild. Psycholog-
ical health is just as important. Enrichment activities create variety, and challenge our animals to solve problems, just as they would in the wild. Giving ani-
mals choice and control, and allowing them to flex their muscles—both physically and cognitively—prevents frustration and bove-
dom, and enhances their overall health.

PRACTICE MAKES PERFECT

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Animal enrichment

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from mountain lions and prairie dogs to snakes and birds—receives top-notch veterinary care, extending their lives long beyond what might experience in the wild. Psycholog-
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mixed-species habitats where slow feeders co-mingle with voracious eaters. In this case, certain fish are conditioned to move to a specific area in their habitat when a target is presented. The fish’s behavior is reinforced with a food reward and, before you know it, the fish have been trained to feed in a specific location so that everyone is guaranteed a full belly at the end of mealtime.

**MEAL TIME**

Many other food related activities can be used as enrichment. In the wild, animals are not presented with perfectly prepared meals, and that’s not necessarily best when in human care either. It’s both physically and mentally stimulating for an animal to have the opportunity to make an effort to get their meal. Food puzzles similar to those available for domestic dogs and cats are a great tool. Food is sometimes hidden around the animal’s habitat so they have the opportunity to forage. Zookeepers and volunteers also make puzzle-like items with food inside, giving the animals the chance to work to open it. It’s often observed that when in human care, an animal is given the challenge to use their skills to access food, such as with a food puzzle, and that same food item is readily available, they will choose the option that requires an effort.

**HELPING US HELP THEM**

Cats and other mammals are “crate” trained, parrots are “t-perch” trained, and birds of prey are “glove” trained. Teaching birds and mammals these behaviors is not only mentally stimulating for them, but it is extremely helpful when zookeepers or veterinarians need to examine an animal or move it from one habitat to another. Luca, one of our military macaws has learned to spread his wings on command. While this display is certainly beautiful and elicits plenty of oohs and ahhs, the behavior actually serves a practical purpose as it allows us to see the condition of his feathers. Along the same line, Strawberry the block bear has learned how to present her forearm for a blood draw, and the mountain lion, Cruz, has learned to navigate to a specific spot in his night holding area to present his tail for the same purpose. The goal of this type of training is to make the animal’s treatment as low invasive as possible so that veterinarians need to perform these checkups on a less traumatic basis.

**HOW YOU CAN GET INVOLVED**

If you’d like to directly contribute to the psychological health of the Desert Museum’s animals, please consider making a donation online at desertmuseum.org/support. Be sure to select “Animal Care & Enrichment” under the designation and your donation will help create enriched experiences to keep animals happy!
WHY DO ZOOS AND AQUARIUMS MATTER? It’s an important question to ask not only ourselves, but our guests and community members. Over the last 100 years, the role of zoos has evolved drastically, and today zoos are expected to be leaders in the field of global conservation. Zoos connect not only to their local communities, but also to a world network to tackle everything from ocean pollution, invasive species, and climate change. Zoos and aquariums continue to offer important spaces to learn and connect with a larger, more wild, world. Zoos and aquariums prompt individuals to reconsider their role in environmental problems and solutions. Three examples of initiatives where AZA institutions have identified endangered animals for which they believe collective action on conservation and education can make a difference (see p. 4).

In 2007, the Arizona-Sonora Desert Museum, along with 92 other AZA-accredited zoos, participated in a 3-year nationwide study of the impacts of a visit to an accredited zoo or aquarium funded by the National Science Foundation. Results of the ‘Why Zoos and Aquariums Matter’ (WZAM-3) study provided important insights into how zoos and aquariums contribute to public understanding of animals and conservation. The findings also improved zoos’ capacities to provide meaningful and effective conservation education programming.

**.key results from the study included:**

- Visitors arrive at zoos and aquariums with specific identity-related motivations and these motivations differ depending on the meaning they derive from the experience.
- Visitors believe they experience a stronger connection to nature as a result of their visit.
- Visitors believe zoos and aquariums play an important role in conservation education and animal care.
- Visitors believe they have a higher-than-expected knowledge about animals and conservation.
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**Visits to accredited zoos and aquariums prompt individuals to reconsider their role in environmental problems and solutions.**
SEAFLOOR WATCH: Docents and stingray volunteers at Stingray Touch and the Trifid Aquarium educate guests about the Sea Floor Watch Program. This program, out of Monterey Bay Aquarium, provides wallet-sized cards purchased by visitors about the Seafood Watch Program. This program, which partners across Pima and Maricopa Counties to bring attention to the threats of buffelgrass. This invasive plant out-competes native plants for space, nutrients, and water and is an existential threat to iconic plants like saguaros. As buffelgrass replaces native vegetation, there is also less nutrition for desert animals. Buffelgrass also threatens native plants as well. For more information see pages 11-12 of this issue.

YOUTH CONSERVATION LEADERSHIP: According to the AZA Education Committee, AZA-accredited zoos and aquariums are unique venues for students to engage in problem-solving and critical thinking, with student experiences for real life applications. This means science centers, and nature centers, AZA-accredited zoos and aquariums primarily use informal education to engage learners of all ages. Informal education, or self-choice learning, gives the visitor control and choice over their experience, leading to motivation, persistence and personal learning outcomes. Research by our colleagues at the Ocean Project has shown that children and youth are the most effective conservation educators, not only informing, but inspiring changes in behavior.

On the conservation education forefront, the Museum has expanded its Laurel Clark Earth Camp (a summer camp inspired by the Columbia Space Shuttle Astronaut) to a school-year program for high school students. The new program, funded by the National Forest Foundation, Arizona Game and Fish Department and private funders, is designed for urban youth in Tucson, to introduce them to the mission and the value of public lands. In this coming school year, the Museum will be working with students and teachers in TUSD’s Career and Technical Education Program.

Invasive Species: The Desert Museum has launched the ‘Save our Saguaros’ campaign, working with partners across Pima and Maricopa Counties to bring attention to the threats of buffelgrass. This invasive plant is changing our desert landscapes to a sea of grass. It out-competes native plants for space, nutrients, and water and is an existential threat to iconic plants like saguaros. As buffelgrass replaces native vegetation, there is also less nutrition for desert animals. Buffelgrass also threatens native plants and is an existential threat to iconic plants like saguaros. As buffelgrass replaces native vegetation, there is also less nutrition for desert animals. Buffelgrass also threatens native plants and is an existential threat to iconic plants like saguaros.

American’s spend only 5% of their waking lives in School. The rest of learning happens outside of school. According to a study in the school year 2010/2011, children and youth are the most effective conservation educators, not only informing, but inspiring changes in behavior.

Explorers: Are curious-driven and seek to learn more about whatever they might encounter. Children are almost always Explorers. Over the last few years, the Museum has expanded hands-on experiences specifically for children to explore the natural world. Adult Explorers tend to have a focus on sites and areas other than zoos, and get involved as volunteers. The Desert Museum has expanded the ‘Volunteer and Internship Program, creating many new volunteer positions to allow broader participation by over 600 volunteers.

Facilitators: Are those who focus primarily on sharing their experience with others, often passing up opportunities to experience the education. The Museum’s new family focused exhibits include Stingray Touch and the Packrat Playhouse. Where children and adults can make personal connections with stingrays, learn about ocean conservation and make a conservation pledge. Packrat Playhouse is another new experience specifically designed for families, offering an indoor (air-conditioned) play space allowing families to discover the desert through the eyes of a packrat. Adult family members are using the knowledge of these audience motivations to develop relevant, impactful, and enjoyable experiences for our guests.

WHAT MOTIVATES YOU? Another key result of the 10th Arizona Aquariums Matter study was a new approach to understanding our audience based on their motivations for visiting. Based on their answers to a series of questions, visitors could be grouped into one of five categories: Explorers, Facilitators, Professionals/Hobbyists, Experience Seekers and Browsers. Zoos and other informal education institutions are using the knowledge of these audience motivations to develop relevant, impactful, and enjoyable experiences for our guests.

The Museum’s Junior Docents have also taken on the task of educating visitors about the problem of single-use plastics, and good alternatives. With participation by volunteers, they created an innovative art piece, “The Blue Saguaros”, a tapestry made from small squares cut from aluminum cans. This beautiful artwork speaks to the connections between the ocean and our desert. Junior Docents use the interpretive opportunity to explain how we can help protect the oceans and deserts by refusing and replacing single-use plastic to revitalize our ecosystems. They have been recognized for their work by the Ocean Heroes program, and presented their work at a conference in British Columbia.

AZA SITES CAN BE LENDERS IN INFORMAL EDUCATION: America’s spend only 5% of their waking lives in School. The rest of learning happens outside of school. As outdoor classrooms and hands-on learning experiences, where interdisciplinary presentation of information is inherent to education programming, many zoos and aquariums are ideal places to launch life-beginners. AZA-accredited zoos and aquariums have informal education programs staffed by experienced education professionals who align their teaching with formal and informal education standards. Desert Museum Educators visit about 300 school children throughout the Tucson community annually. Another 300/400 children visit the Museum on field trips. Recently, the Flowing Wells Unified School District made the decision to integrate Desert Museum outreach programs and field trips into their 5th and 6th grade curricula to help engage their students more deeply with the science skills and concepts, and the Museum is excited to work with them this year.

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and friends groups also visit together, many with strong so-
cial motivations. The Society note has a wide selection of after-
hours events throughout the year designed to provide
more social experiences for adults.

The Desert Museum serves our PROFESSIONAL /
HOBBIIST visitors by providing in-depth classes and
interpretations, books in the Gibbons and online, and
through our volunteer program, mineral and plant sales
and art. For example, Michael Malone resident photo-
class and sells minerals for amateur and expert collectors,
and inspires visiting collectors with family friendly
mineral activities. The Art Institute offers classes connecting
directly to conservation through the visual arts. Feedback
from student evaluations has shown that almost half of
the participants sign-up for an art class with no specific in-
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Our top 10 museums and public gardens in the United States,
as rated in various polls over the last decade. When de-
signing exhibits, staff is cognizant of these groups who are
often eager for photo opportunities. Major innova-
tions have occurred with the cactus and agave gardens,
which are showstoppers when the plants are in bloom,
along with the new addition of Boojum Hill, a garden
that has been incorporated into exhibits to provide take-
home memories. A few examples include bat house display
in the Earth Sciences Center. The image in the Story
Tour Exhibit and visitor’s voyage in the Vulture Culture exhibit.

Direct and non-host surveys indicated that some
visitors make significant gains in understanding of both
biodiversity and ecosystem so that we can focus our messaging where it
is most likely to be effective. Research tells us that sim-
ply learning about a conservation issue does not change
behavior. We are still learning how zoo and aquariums
might best participate in larger societal efforts to foster sus-

erable development.

For example, a study conducted by the National Optical-Infrared Astronomy
Research Laboratory. The class explores color through art
and science, everything from learning why flowers have
colors that do, to learn basic art and reading the colors
to understand how zoo and aquariums
might best participate in larger societal efforts to foster sus-

erable development.

ZooWise is another multi-institutional collabora-
tive focused on measuring visitor learning at zoo.
It focuses on learning about biodiversity and ben-
onded projects and achievements on our global ecosystem.
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ol survey “Why Zoos & Aquariums Matter Part 3” to bet-

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the concept of biodiversity and what they can do to protect biodiversity. These knowledge gains appear to persist and even improve over two years following the zoo visit. Much more research is needed in this young and complex field of study in order to fully understand the impact of a visit, and how to design it to encourage and empower visitors to live in better harmony with nature. The Desert Museum will be joining the ZooWise and ZooWise+ programs next year, with funding support from the Flinn Foundation.

**CONSERVATION LEARNING THROUGH ACTION.** Based on evaluation with guests and community members, we are striving to create more opportunities to participate in conservation research and action for the public. Community members and volunteers can be part of the solution with the Southeastern Montana Study, where volunteers tag mammals and collect data to better understand migration patterns. Community groups are organizing bulb-gathering trails to control invasive species and students and volunteers are collecting breaks to create a baseline inventory of species. We have found that when guests have the opportunity to see science in action, they are more likely to ask about it, want to learn more and participate. We also have launched a few interpretive games as a test to engage visitors and empower them to take action with visitors who might not have been thinking about their environmental impacts, and learn more about the environment. We have also learned that many visitors are not gaining conservation knowledge that they feel they can use in their own lives. There could be several reasons for this. For example, maybe people didn’t come with the motivation, maybe they already had a high level of conservation literacy, maybe they came from a very different place with different conservation issues and needs, or maybe we do not do a good job of providing this information. As a learning institution, we will still use new approaches over the next several years, guided by the latest research and best practices to assure that the Desert Museum is even more of a source of conservation inspiration and knowledge for our visitors in the future.

**INTRINSIC IMPACT RESULTS**

In another project funded by the Flinn Foundation, the Desert Museum is working with WholeEats Cultural Consultations to measure the impacts of a visit via surveys. These are helping us better understand our current audit: the drivers for their visit, and the messages they do not want to hear and the messages that visitors leave the Desert Museum with a deeper appreciation for the Sonoran Desert and its role in connecting to the natural world. They are inspired to spend more time in nature, be more thoughtful about their environmental impacts and learn more about the environment. We have also learned that many tourists are not gaining conservation knowledge that they feel they can use in their own lives. There could be several reasons for this. For example, maybe people didn’t come with the motivation, maybe they already had a high level of conservation literacy, maybe they came from a very different place with different conservation issues and needs, or maybe we do not do a good job of providing this information. As a learning institution, we will still use new approaches over the next several years, guided by the latest research and best practices to assure that the Desert Museum is even more of a source of conservation inspiration and knowledge for our visitors in the future.

**Let’s Explore the Desert: Family Go-Guide**

**Gardening for Pollinators in the Desert Southwest**

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**A Natural History of the Sonoran Desert, 2nd Edition**

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