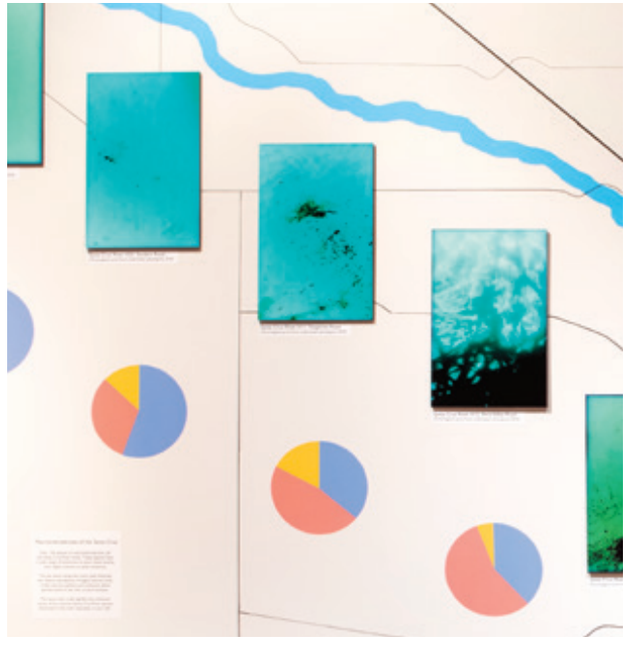
6&6

ARTISTS

SCIENTISTS



Photos by Tim Fuller

6&6

ARTISTS

SCIENTISTS

Benjamin M. Johnson & Benjamin T. Wilder

Heather Green & Taylor Edwards

Charles A. (Chip) Hedgcock & Mark A. Dimmitt

Kathleen Velo & Michael Bogan

Maria Johnson & Eric Magrane

Tom Baumgartner & Scott Bennett

confluencenter for Creative Inquiry

Agnese Nelms Haury Program in Environment and Social Justice

COX

A transdisciplinary collaboration to explore the patterns and processes of the Sonoran Desert and Gulf of California to impart a deeper appreciation of this region

www.nextgensd.com
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Six Artists • Six Scientists

Merging views of the Sonoran Desert

6&6 is about seeing the world through different lenses.

Observation is the catalyst for creativity. Art and science set forth from the same point of departure. A glimpse of an enigmatic chuckwalla on an isolated mountain, pools of fresh water in the midst of a sand sea, the whimsical form of a common plant seen in a new light. Each ignite curiosity, deeper inquiry, and creativity. This is not a new way of thinking. Some of the world's greatest scientists have been artists at their core. Yet, academia has been moving away from an overt partnership with the arts in recent years. Some would argue that hypotheses and emotion don't mix.

If we as a society are to maintain vibrancy of culture and biodiversity through the Anthropocene, we need new ways of seeing the world and what stands to be lost. Storytelling is at the core of what it means to be human. Artists and scientists unravel the stories of nature and experience through different means. United in the creative process, the two can be a powerful force with an even greater capacity to connect, engage, and deepen our understanding and appreciation of the world we live in.

6&6 is an experiment in taking the time to co-create and co-discover. At each step, art influences questions and science drives narrative. These have been honest, real collaborations that have resulted in friendship and have adhered to life's unexpected turns. Transdisciplinary collaboration proceeds on its own time.

We invite you to fully immerse yourself in each of these microcosms of the Sonoran Desert and Gulf of California. After emerging from deep dives into geology, genetics, pozos, plants, bycatch, and rivers, we hope that you will see the desert differently – taking pieces of each pairing as you go forward, feeling more connected to the magnificence of our desert and sea, and your place in it.

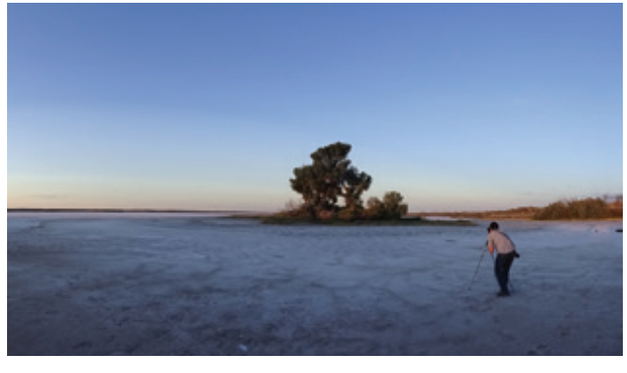
MEDIUM(S): Mixed Media (oil, mesquite, botanical samples, acrylic, video), 2018 • Pozo del Álamo, 2018, triptych, 38”x172”, oil on canvas, mesquite • Time: 2018, video, 5 mins, video, monitor, mesquite • Place: 2018, 25 mins, video, monitor, mesquite • Tornillo; screwbean mesquite, 2016, 18"x13", botanical sample, acrylic, mesquite • Álamo; Fremont's cottonwood, 2018, 18"x13", botanical sample, acrylic, mesquite • Hierba del manso; yerba mansa, 2016, 18"x13", botanical sample, acrylic, mesquite • Carrizo; reedgrass, 2017, 18"x13", botanical sample, acrylic, mesquite. Photo by Tim Fuller.

Hidden Water: *Pozos* of the Gran Desierto

Benjamin M. Johnson & Benjamin T. Wilder

The Gran Desierto de Altar of the Sonoran Desert is the largest extent of sand dunes in North America. Once the interior of the Grand Canyon, these grains of sand excavated by the Colorado River and deposited at its delta dominate the landscape for hundreds of kilometers. Miraculously, an array of freshwater springs – *pozos* – punctuate the sand and salt flats, the only fresh water in any direction. For millennia these enigmatic oases have been a confluence point for culture and life, the destination point for the Tohono O'odham salt pilgrimage. Today, foundational questions remain: What is the age and origin of this freshwater? How have these wetlands changed through time? What is their fate?

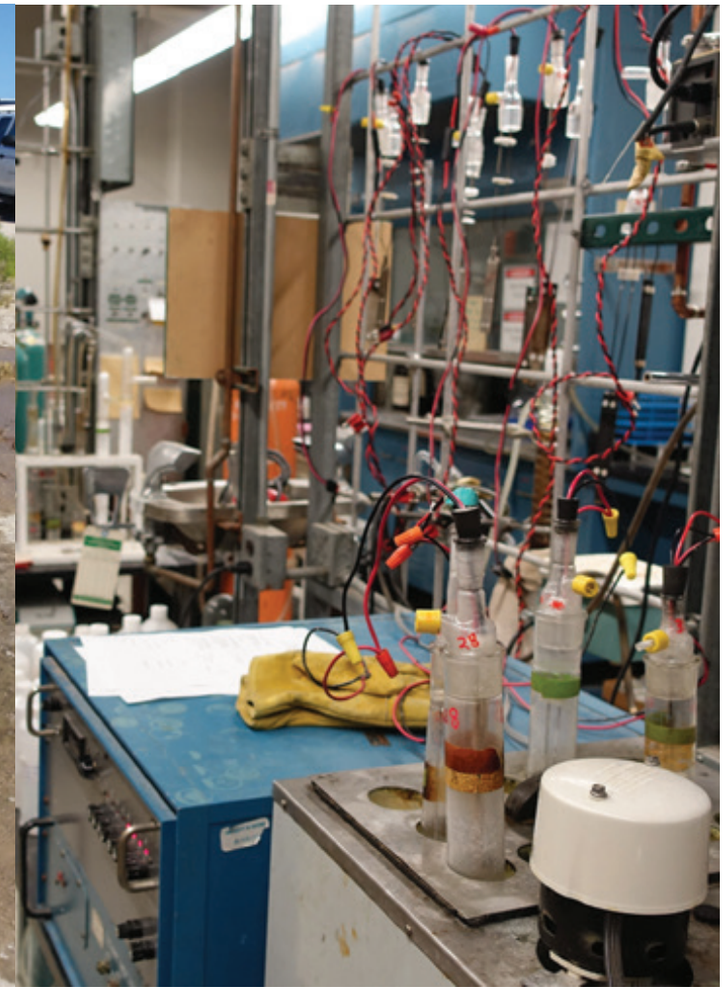
This transdisciplinary collaboration between a botanist, hydrologist (Héctor Zamora), and artist has sought to answer these questions. Through the avenues of scientific research and artistic inquiry, the team has uncovered new truths about the history of these springs. Rather than recent local recharge from winter rains, the *pozos* are fed by ancient Colorado River water over 10,000 years old. This collection of views of the *pozos* sheds light on their complex, interwoven history and gestures towards a future of preservation for this life giving water.



WATER'S SIGNATURE

Water has an age. Water has a signature. Science is bolstered with ingenious tricks. One of these is stable isotopic chemistry, which we used to determine the age and origin of the waters of the pozos. First, Carbon-14 or radiocarbon (^{14}C) and Tritium (^{3}H) have a natural rate of decay. The amount of the stable isotope left in a water sample is indicative of the time that has passed since the water entered the aquifer. The pozos samples had relatively little ^{14}C left, which correlated to an age of just over 10,000 years old, supported by negligible amounts of tritium. The water is ancient. Where did it come from?

Each water source – summer rain, winter rain, ancient ground water, sea water, and Colorado River water – has a distinct ratio of the values of Oxygen (^{18}O) and Hydrogen (^{2}H, also called deuterium). We collected each of these possible water sources and, like a detective, looked to see which isotopic ratio most closely matched that of the pozos. Surprisingly, rather than being derived from local recharge of winter rainfall, the signature most closely matched that of Colorado River water. We now believe that fossil Colorado River water is perhaps following an ancient path of the river to its previous delta, Bahía Adair, with the pozos popping through the thinner salt flats due to artesian pressure and maintenance by the digging of coyotes.



IN THE STEPS OF CARL LUMHOLTZ (RIGHT)

In January 1910 Norwegian explorer Carl Lumholtz visited the pozos of the Gran Desierto. He captured this view as his horses replenished and rested. That same view today is shockingly similar, possibly with same screw bean mesquite. Yet, just behind the fresh water spring in the dunes is a brand new paved coastal highway linking parts of Sonora to the US-Mexico border. What was once one of the most isolated and significant locations in the desert due to its life giving water is now largely an unseen piece of the roadside landscape. A 24-hour time-lapse video merges Lumholtz's image with the scene today; sand, stars, planes, cars, and… water.

ABOUT THE PAINTING, POZO DEL ÁLAMO

This especially charismatic pozo hosts a stand of cottonwood trees. Its presence is magnetic and energizing. It feels like a true oasis in a vast open flat. There was an intention in painting it to convey that energy. Inspired by painters of the late 1800s collectively known as the Hudson River School, who depicted wild places of America with a dramatic, luminous light, this work situates this humble pozo as an almost mythical monument to abundance in harsh, unrelenting places.


184


MAP
SOUTHWESTERN ARIZONA
NORTHWESTERN SONORA
PAPAGUERIA

DIMENSIONS: Varied. **MEDIUM(S):** Letterpress on handmade paper, engraved mica, glass, steel, found objects, cast plaster and sound. Photo by Tim Fuller.

AUDIO: Michael Henderson. Composed especially for this installation using field recordings from Punta La Cholla. Some of the sounds include song birds, osprey, dirt bikes, ocean lapping on rocks, cactus spines, broken glass from the dumpsite, Mexican radio, insects and fragments of Tohono O'odham music.

Isle of Sauromalus

Heather Green & Taylor Edwards

Punta la Cholla is a granitic outcropping along the narrow headland of La Cholla located in Sonora, Mexico. Nestled within this rocky mountain there exists a rich diversity of life—one side pushes the limits of survival in a severe, arid environment; the other abounds with the Gulf of California's ultramarine shore. Counted among its inhabitants is the common chuckwalla, *Sauromalus ater*, a saxicolous (rock dwelling) lizard that occurs in disjunct, rocky environments throughout the Sonoran and Mojave deserts. Like many of the residents of Punta La Cholla, chuckwallas are naturally isolated here, but in the past had contact with neighboring populations. Heather and Taylor investigated this small, sequestered population of chuckwallas using DNA sequencing to better understand their origins and connectivity to other populations in the surrounding landscape. They found that La Cholla chuckwallas have evolved on a geologic scale; their story is told in the rocks and in their DNA.

Along the walls of the installation, the sequence of La Cholla chuckwalla DNA is engraved upon sheets of mica and pinned to the wall, with the unique letters of the sequence highlighted in orange. A series of nine shelves display open spreads from an artist book, *Isle of Sauromalus*, where Heather and Taylor share a narrative about their experience searching for these elusive creatures, and the increasing impact of human development that is compounding their isolation.

Another smaller book, *A Lexicon for Punta La Cholla*, is located at the end of the vitrine field table, and tells the story of the flora, fauna, and past and present visitors of the mountain where the chuckwalla live. It also serves as a kind of homage to the mountain, or 'isle' itself—describing its magnificent and idiosyncratic natural and cultural history. The paper was made with *Hesperaloe parviflora*, a type of agave. The vitrine field table displays a sampling of natural and man-made objects collected on the headland and also featured in the text, and an ambient soundscape in the background helps portray the setting of Punta La Cholla's unique desert-sea environs and some of the obstructions surrounding it.

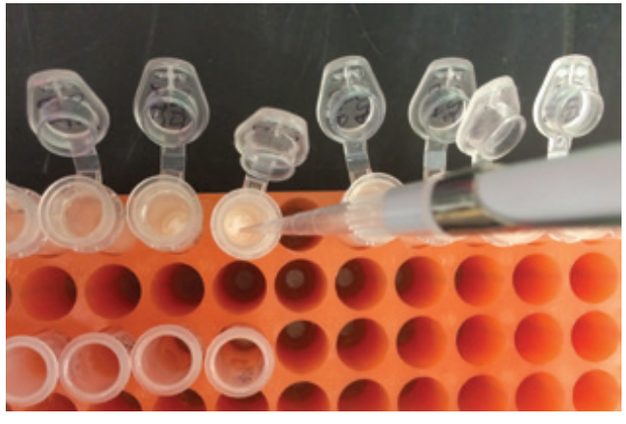
TRACKING CHUCKWALLAS

Our exploration of Punta La Cholla included identifying the organisms that live there, their connection to the land and the sea, and the deep history of use of the area by humans. The hand-made books that are on display record our experiences as captured in our notebooks and journals. So many of the organisms are closely connected together, such as the *Bebbia* flowers that the chuckwallas eat and that are incorporated into the fibers of the books. Through ambient sound, journal entries, images, and found items, we share with the audience the experience of looking for the elusive chuckwalla lizards and finding so much more.

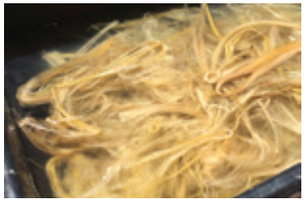
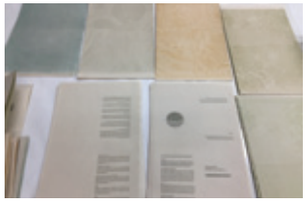
THE CODE OF ISOLATION

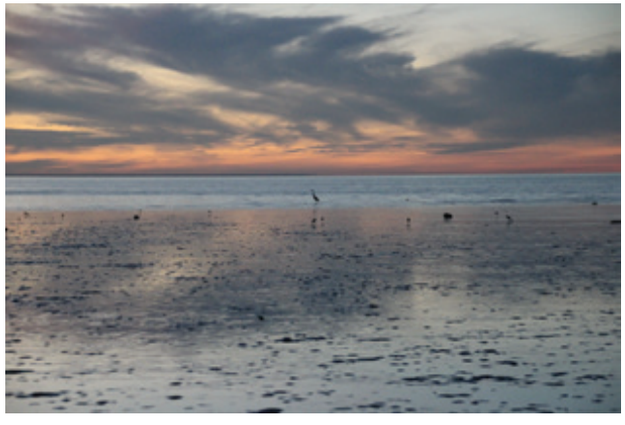
To learn more about the evolutionary history of the isolated population of chuckwalla lizards at Punta La Cholla, we isolated DNA from scat (feces) samples that was analyzed at the University of Arizona Genetics Core laboratory. The resulting DNA sequences are seen etched in mica along the walls. This is part of the mitochondrial sequence of chuckwallas at Punta La Cholla with the unique differences from neighboring populations highlighted. We determined that the Punta La Cholla DNA sequence was slightly different than the sequences found at other populations in the region, which implies that this population of chuckwallas has likely been secluded on this rocky outcrop for thousands of years.


CGACCT
GACCT

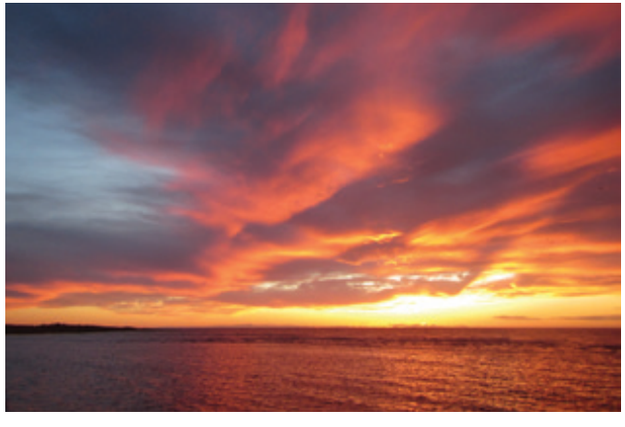






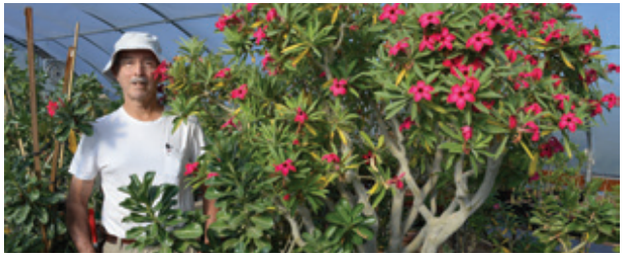




MEDIUM(S): Archival pigmented ink prints on silk with acrylic rods • Leafless desert milkweed (*Asclepias subulata*): 75"x30", from original lumen print, 2018 • Ocotillo (*Fouquieria splendens*) , 75"x30", from original lumen print, 2018 • Skeleton buckwheat (*Eriogonum deflexum*), 50"x34", from original lumen print, 2016/18 • Foothill Palo Verde (*Parkinsonia microphylla*): 50"x36" from original lumen print, 2016/18. Photo by Tim Fuller.

A Desert Veil: Soft Plants in a Harsh Landscape

Charles (Chip) Hedgcock & Mark A. Dimmitt

In his classic text, *The Desert*, author John C. Van Dyke described the desert as a "kingdom of sun-fire" where "every sunbeam falls as a shaft of flame." It's a fascinating contrast that the desert's very harshness has created lifeforms of such delicate beauty as diaphanous plants – plants so sparse in stems and foliage that one tends to look right through them. Scientifically, sparse stems and tiny leaves are adaptations to the excess of sunlight in deserts. (Large leaves can fatally overheat on summer days, and more total leaf surface area results in greater loss of limited water.) Aesthetically, these plants are individually beautiful, and collectively contribute to the visual character of desert landscapes. Just as a veiled face encourages a closer look, these wispy plants invite attention to detail, and then help draw the visitor into the greater landscape.



In *A Desert Veil: Soft Plants in a Harsh Landscape*, Chip and Mark use lumen Prints; a unique, and decidedly experimental process, to investigate diaphanous plant forms of the Sonoran Desert. The images are printed onto silk to create larger than life veils that emphasize the diaphanous qualities of some desert plants. Suspended in space, the veils allow museum visitors to experience the surrounding gallery installations, and each other, through the beautifully adaptive form of diaphanous plants.

Credit is due to landscape architect Iain Robertson (University of Washington) for recognizing this phenomenon that has been overlooked by most desert biologists and artists.

THE ART OF LUMEN PRINTS

This project uses a unique and experimental approach to investigate diaphanous plants: a camera-less photographic process called lumen prints. These images are created by sandwiching plants between photographic paper and glass, and exposing to the sun for several hours. The resulting image is the result of alchemy between the plant, photographic emulsion, and atmospheric conditions, creating subtle colors and a uniquely detailed negative image.

The successful lumen prints are digitized and printed, larger than life, onto sheer silk, creating veils that help translate the diaphanous qualities of desert plants. These diaphanous veils allow museum visitors to experience the beautifully adapted forms of desert plants.

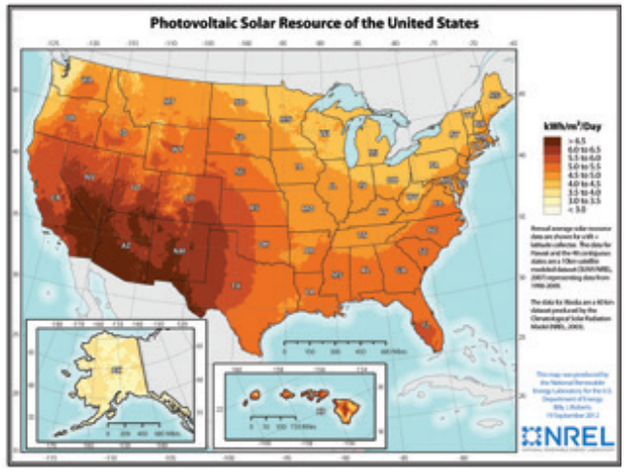
AN ADAPTATION TO A LAND OF EXTREMES

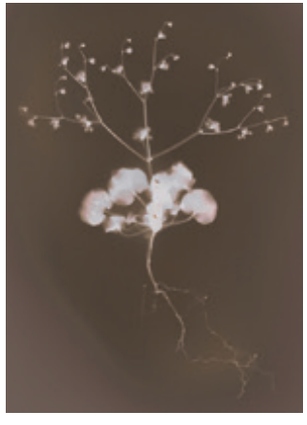
In addition to the other extremes of desert climate–temperatures, droughts and floods, low humidity–desert plants must also cope with extreme solar radiation. In the summer solstice month of June, the sun sears the desert Southwest with twice as much light energy as most other habitats of North America.

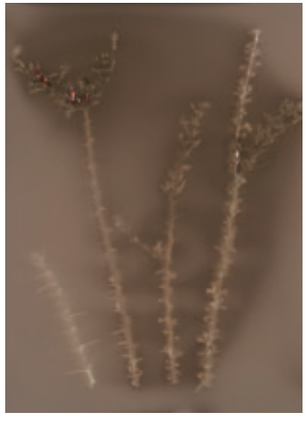
In moist climates plants are adapted to maximize capture of sunlight. More leaf surface area = more photosynthesis = more growth/flowers/fruit. Consequently, most plants have dense canopies of foliage, but deserts impose special challenges to plants.

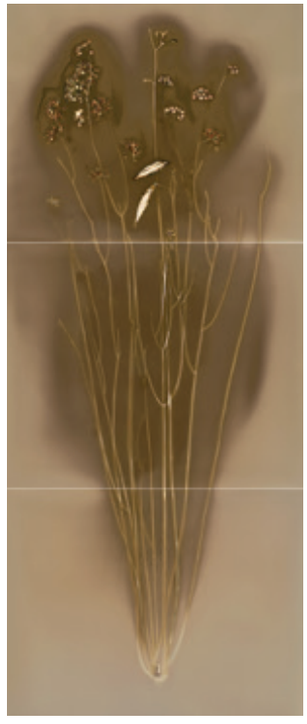
A solution. Some desert plants cope with these challenges by developing a diaphanous lifeform, one that is almost unique to deserts. Diaphanous plants have sparse canopies of very small leaves, or no leaves at all. You can see right through them. They provide little shade or concealment for animals, but they capture enough sun to maintain their life processes while minimizing water loss and avoiding leaf overheating.

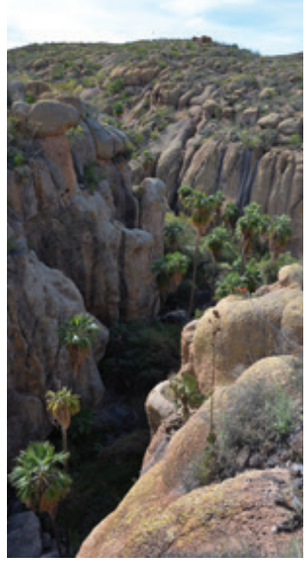
It's a fascinating contrast that the desert's harshness–its hard rock landscapes, relentlessly dazzling sunlight, blast furnace heat, and mummifying aridity–has created life forms of such delicate beauty.

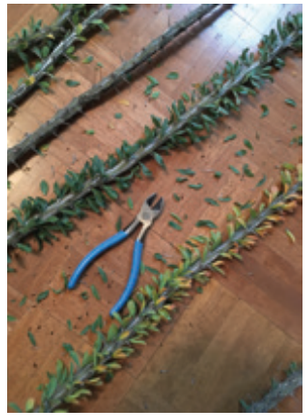

Photovoltaic Solar Resource of the United States
NREL

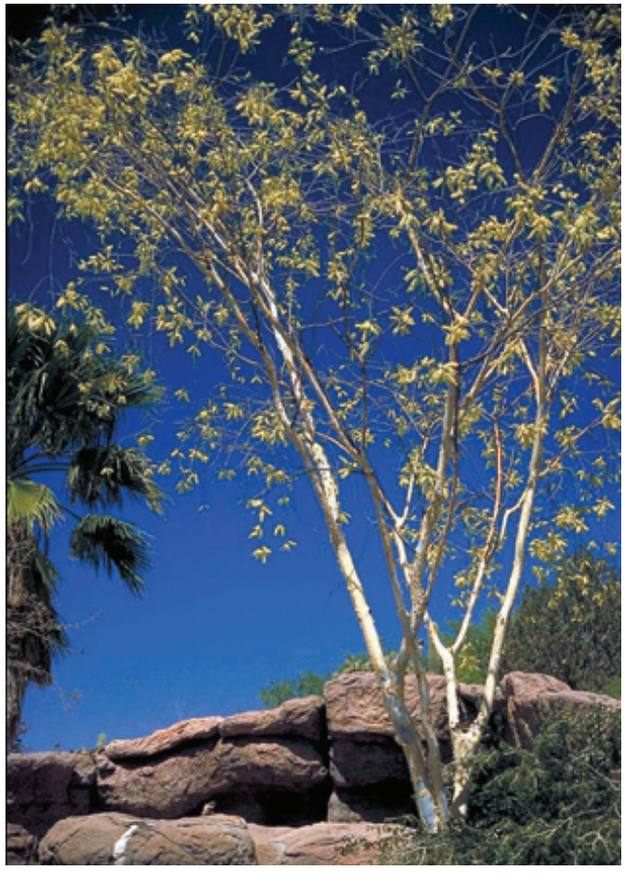


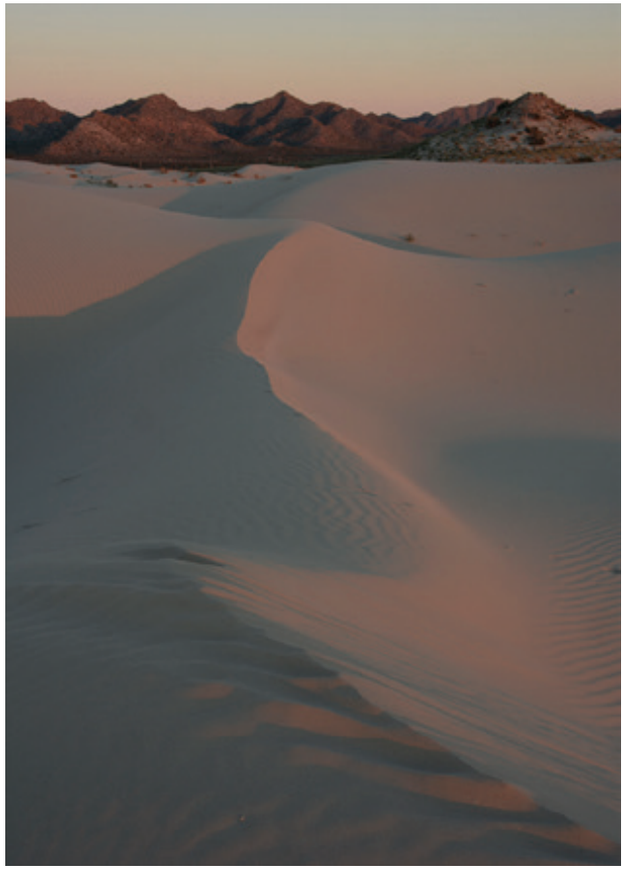












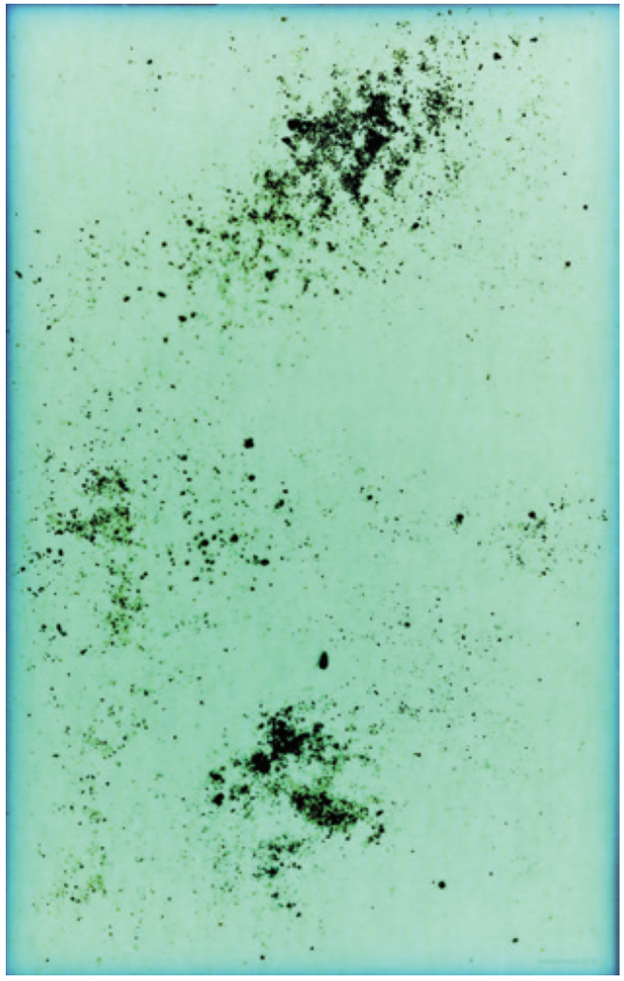
MEDIUM(S): Eight 16”x 10” C Prints (chromogenic Prints) • Two 10"x 10" C Prints • Six 8"x 6" photos printed on acrylic • Four 4"x6" color photographs • Ten pie charts, 9" diameter, printed on Phototex. Photo by Tim Fuller.

Living River: Flow of Life in the Santa Cruz

Kathleen Velo & Michael Bogan

The Santa Cruz River has its headwaters in southeastern Arizona, flows south into Sonora, but then turns sharply north, flowing through Tucson on its path toward the Gila River near Phoenix. Historically, portions of the Santa Cruz River had perennial flow, allowing the city of Tucson to develop in the dry Sonoran Desert. However, drought and overuse of water caused it to dry up in the early 20th century. Thanks to treated wastewater, the Santa Cruz now has perennial flow again; however that flow is vulnerable to competing demands for water and changes in human values.

Using scientific study and photographic based visual art, Michael and Kathleen investigated perennial, temporary, and reborn waters of the Santa Cruz River basin near Tucson. Specifically, they looked at how the reliability and source of water (treated wastewater vs snowmelt) affects the look, feel, and aquatic biota of a given stream reach. The collaborators considered how the human history of a given reach affects the flow and biota and what it means to 're-create' an ecosystem. Do the reborn waters of the Santa Cruz River need to look and feel like the original ecosystem? What future can we envision for the river that gave birth to Tucson?



Santa Cruz River #22: Hardin Road

THE SHADOW OF WATER

Both of these photograms were created in the Santa Cruz River, by submerging color photographic paper underwater in the dark of night, and exposing the paper to a brief flash of light. The water contents, texture, movement, and viscosity are captured in the resulting image. The color of the photogram is a result of the alchemy of the photographic emulsion and whatever is in the water as a result of agricultural or pharmaceutical chemicals and general runoff.

The photogram, *Santa Cruz River #15: Avra Valley* Road was created at high flow, when higher levels of water were discharged from the water treatment facility, for example during a period of time when households were using more water; the photogram, *Santa Cruz River #22: Hardin Road*, was created at low flow during periods when water use was low.

Santa Cruz River #15: Avra Valley Road

A GRADIENT OF TOLERANCE

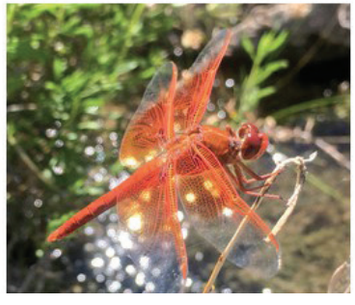
Over 150 species of macroinvertebrates call the Santa Cruz River home. We chose to illustrate six common species from the river that exhibit a range of tolerances to poor water quality. The amphipod *Hyalella* and midge *Chironomus* (in red) thrive in poor water quality and are most abundant closest to wastewater treatment plants. The water strider *Rhagovelia* and moth *Petrophila* (in yellow) have moderate tolerance of poor water quality and can be found throughout the river. The mayfly *Fallceon* and caddisfly *Nectopsyche* (in blue) are relatively intolerant species, and reach their highest abundances far from treatment plants, where water quality improves due to natural filtration and remediation.



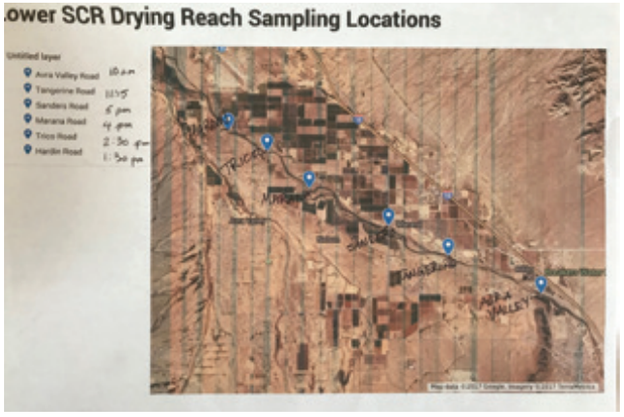






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Avra Valley Road 10 a.m.
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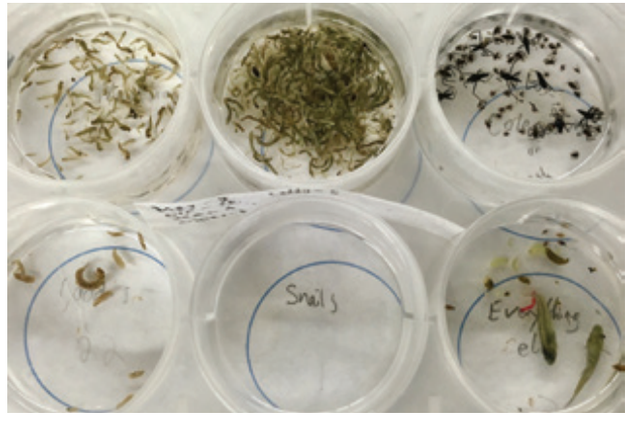

Snails

DIMENSIONS: Varied. **MEDIUM(S):** Ink on Bristol board, video, installation, trading cards, poetry. Photo by Tim Fuller.

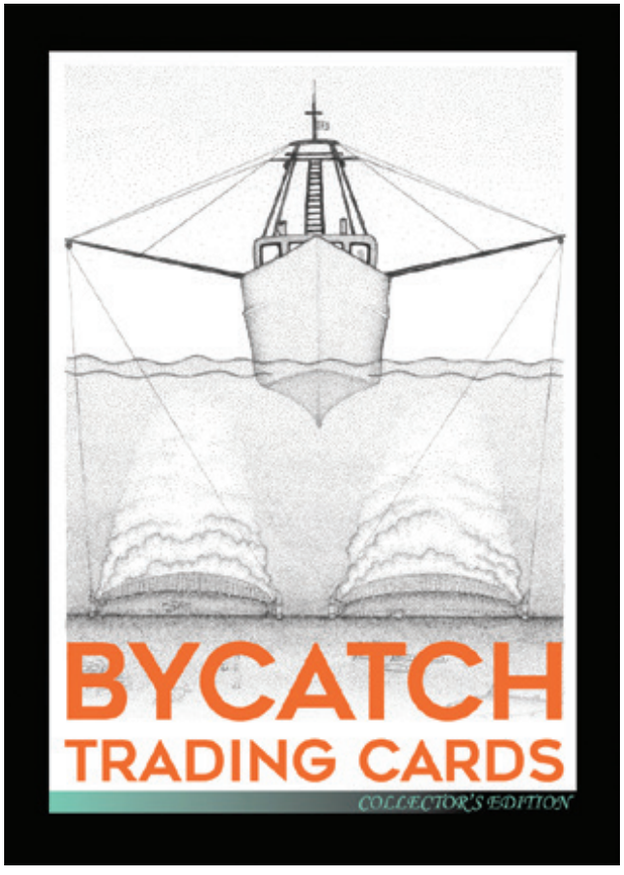
Bycatch

Maria Johnson & Eric Magrane

In *Bycatch*, Eric Magrane and Maria Johnson present an exploration of the shrimp trawling fishery in Mexico's Gulf of California. Every night from September through March, hundreds of boats traverse the water dragging hundred-foot long nets across the seafloor after a quarry of shrimp. About 85% of the total weight captured is not shrimp and is made up of over 200 other species; this is called "bycatch."

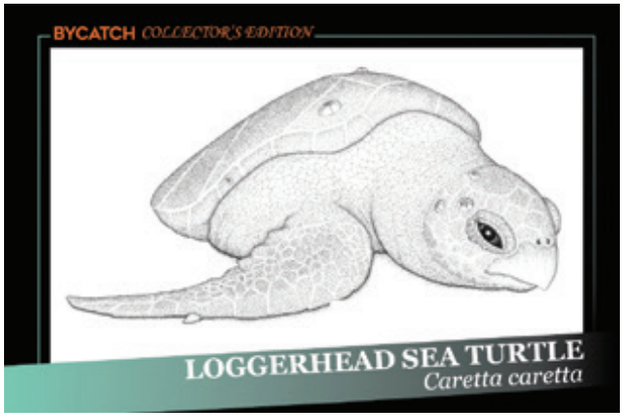
Combining video, installation, drawings, and poetry based on overnight field research aboard shrimp trawlers, *Bycatch* gives the viewer a taste of what it feels like to be knee deep in this overwhelming pile of bycatch on the deck of a boat. The shrimp caught in the fishery is destined for international markets, primarily to consumers in the U.S. The exhibit makes a visceral connection between this fishing practice and individual food choices, and points to the intertwining of food systems, ecology, and economics.

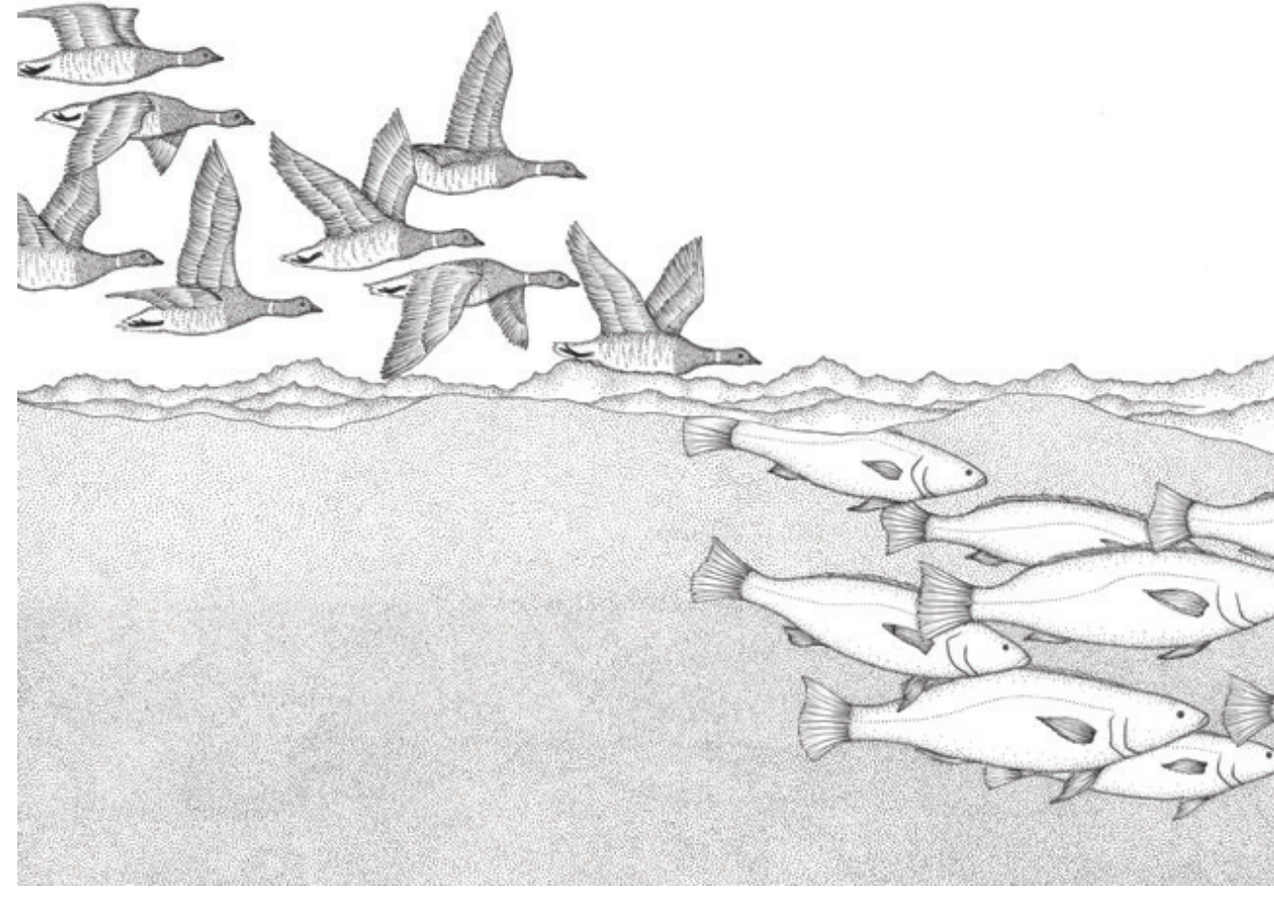
While the human dimensions of the shrimp fishery are complex, in this exhibit Eric and Maria have focused primarily on the non-human bodies affected by the practice. They introduce you to some specific individuals—such as a Shame-faced Crab, Pacific Snake Eel, and Sonora Scorpionfish—caught in the nets. *Bycatch* sheds some light on a key conservation issue in the Sonoran Desert's sea, the Gulf of California.



DOCUMENTING BYCATCH

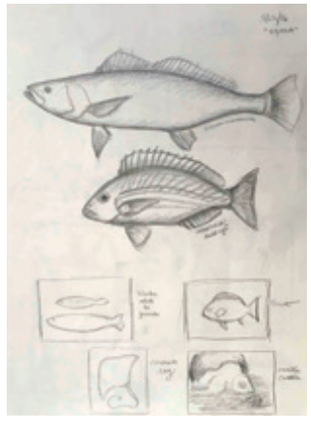
'Bycatch' draws on a long-term research project conducted by the Prescott College Kino Bay Center for Cultural and Ecological Studies in the Gulf of California, ongoing since 2003. Researchers gather data—including documenting species of concern and measuring the quantity of bycatch—onboard shrimp trawlers that fish during nights in September through March. Results of this study have shown the average amount of bycatch by weight is about 85%; this is made up of over 200 species of fishes, invertebrates, and the occasional sea turtle. Most of what is captured is thrown overboard after having perished. A small percentage is retained for personal consumption or used for bait.

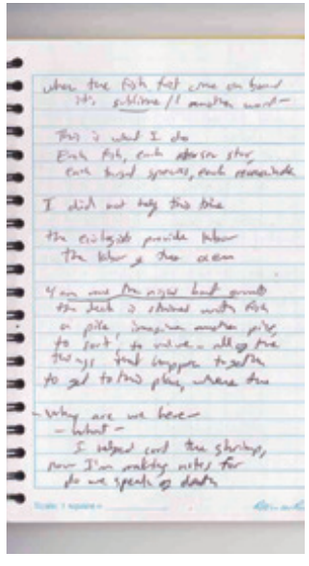


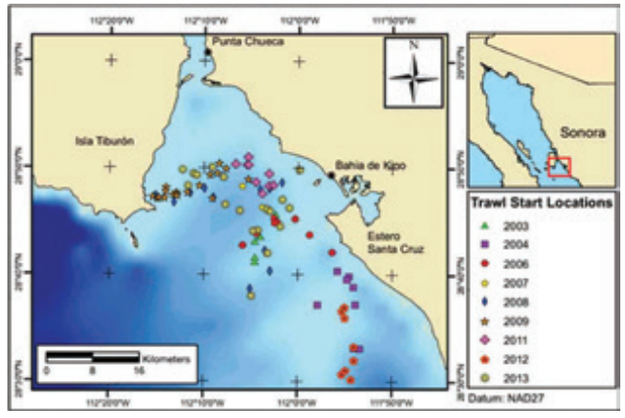


THE TOLL OF TRAWLING

A number of the species captured as bycatch are particularly sensitive to the impact of trawling, are listed as threatened or endangered, and/or are commercially important to local small-scale fishers. Additionally, many species are "data deficient," meaning sufficient research is lacking, which makes it difficult to quantify the impact on a particular population. The Shovelnose Guitarfish, for example, is a particularly sensitive near-threatened species frequently captured as bycatch. Trawling overlaps spatially and temporally with gravid (pregnant) females, adding an additional impact to the species. Small-scale fishers who also target this species recognize and are affected by the decline.






Punta Chueca
Isla Tiburón
Bahia de Kipo
Estero
Santa Cruz
Sonora
Trawl Start Locations
2003
2004
2006
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2011
2012
2013
Kilometers
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8
16
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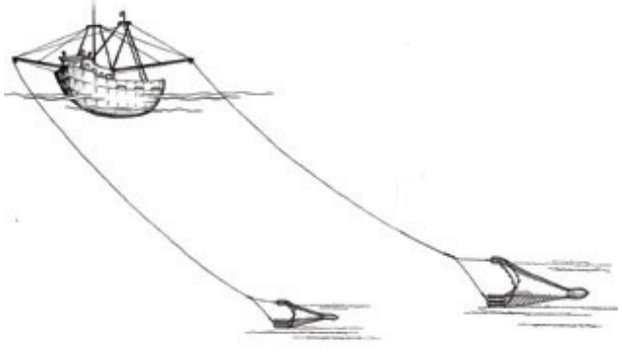


DIMENSIONS: Approximately 19ft wide x 7ft high. **MEDIUM(S):** Fluorescent light boxes, inkjet on plex. Photo by Tim Fuller.

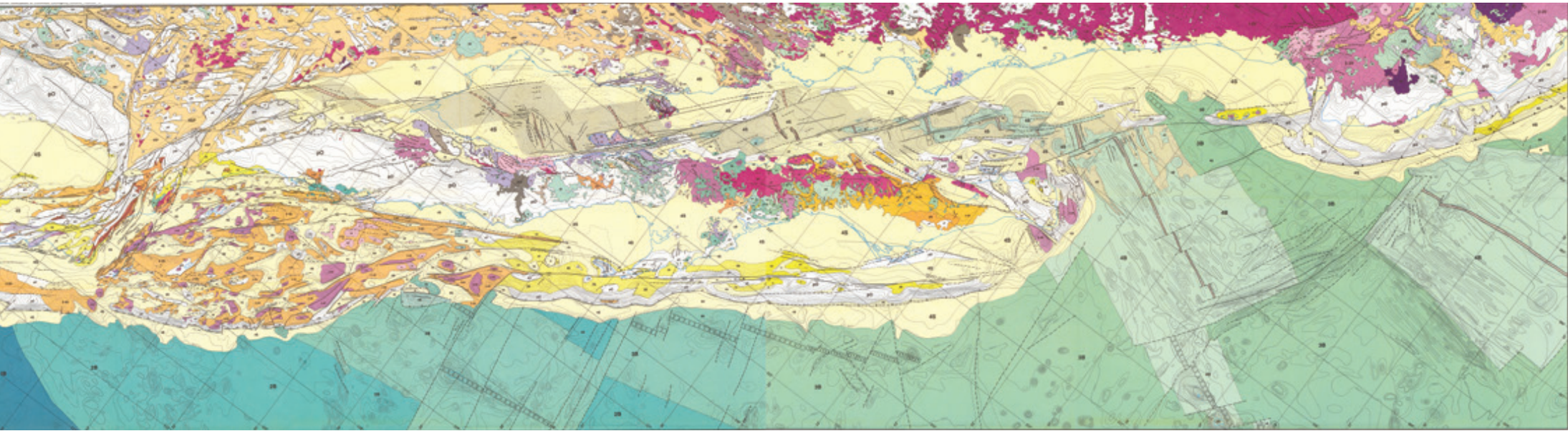
Paleogeographic Rendering of the Ancient Gulf of California

Tom Baumgartner & Scott Bennett

The Sonoran Desert is host to a dynamic and evolving landscape. Plate tectonics help form features such as mountains that seem to be permanent parts of the environment, when in fact they are undergoing a pattern of constant change. Over millions of years, mountains can be uplifted and eroded and in the case of our region, seas are born.

Natural science, especially geology, shows us that the Sonoran Desert landscape came about as a result of a long chain of events, stretching millions of years into the past. These tectonic motions tilted mountain ranges, produced extensive valleys, and formed a long narrow trough into which the Gulf of California gradually flooded. These forces created the Sonoran Desert landscape we know today, which serves as the canvas for biologic, ecologic, and anthropologic patterns. The Gulf of California seaway is host to the richest estuary on the planet, with marine diversity comparable to the rainforest and a magical paradoxical intersection of teaming ocean life and a harsh desert.

To create an approximation of topographic features that existed millions of years ago, Scott supplied Tom with paleo-tectonic maps. These maps summarized key geologic aspects of the Gulf of California rift, including active and past faults, locations of ancient marine fossils, and rock formations that used to stretch across the Gulf of California before rifting began. These artistic maps, created manually in Adobe Photoshop, are glimpses into the past that created the Sonoran Desert of today.



Fenby, S. S., Gastil, R. G., Dauphin, J. P., & Simoneit, B. R. T., 1991, Geologic-tectonic map of the Gulf of California and surrounding areas. *The Gulf and Peninsular Province of the Californias: American Association of Petroleum Geologists, Memoir, 47, 79-83.*

MAPPING BAJA

Plate tectonic reconstructions used in this paleogeographic exhibit are the result of collaborative research between geologists with the U.S. Geological Survey, University of California Davis, Northern Arizona University, and the University of Oregon. Their paleo-tectonic maps were created in Geographic Information Systems (GIS) software and synthesize several decades of research by scores of Earth scientists.

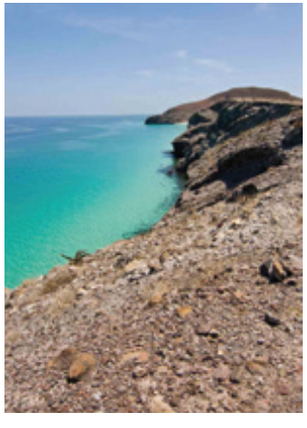
One of the core elements that went into this study was the examination of ancient seafloor spreading around the globe, which is used to estimate how continents have moved relative to each other through time. This global-scale data was combined with the results from countless local studies to constrain the activity of numerous faults and the movements of hundreds of mountain ranges over the past ~10 million years across western North America.

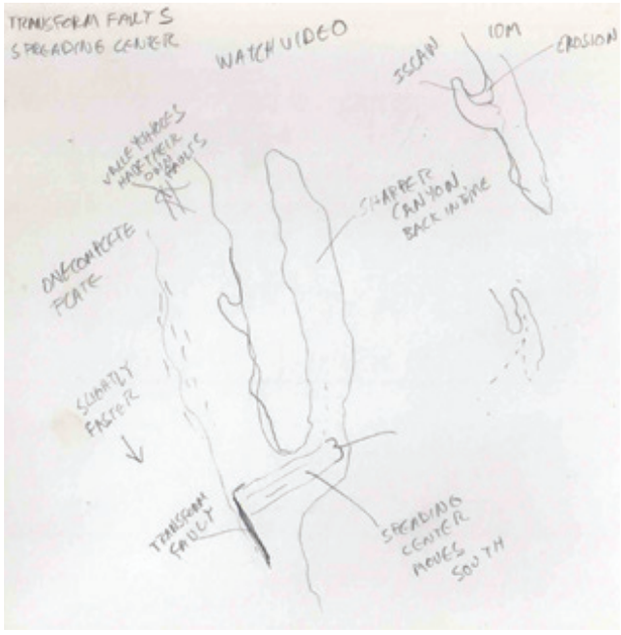
These paleo-tectonic reconstructions help illustrate that the Gulf of California did not open up like a zipper. Rather, the Gulf formed due to the oblique motion of Baja California towards the northwest and away from mainland Mexico. The Pacific Ocean flooded northwards along this fault system from ~8 to 6 million years ago, forming the Gulf of California seaway. This fault system continues towards the northwest and links with the southern San Andreas fault. Collectively, faults in the Gulf of California and the San Andreas fault work together to move Baja California and the coastal sliver of California west of the San Andreas fault towards the northwest approximately 2 inches every year, creating thousands of earthquakes each year.

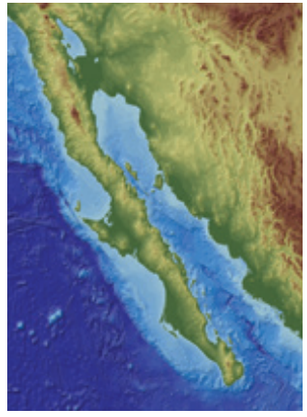
DRAWING BAJA

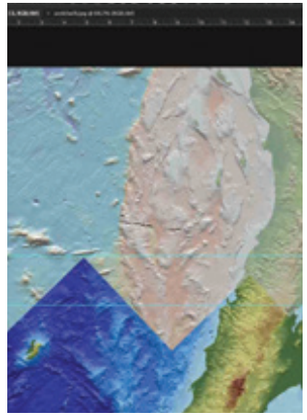
Figure painters study the skeletal structure and musculature when trying to achieve an accurate portrayal of the human form. To create accurate paleotopography, it was necessary to understand the geologic processes that form what we see on the surface.

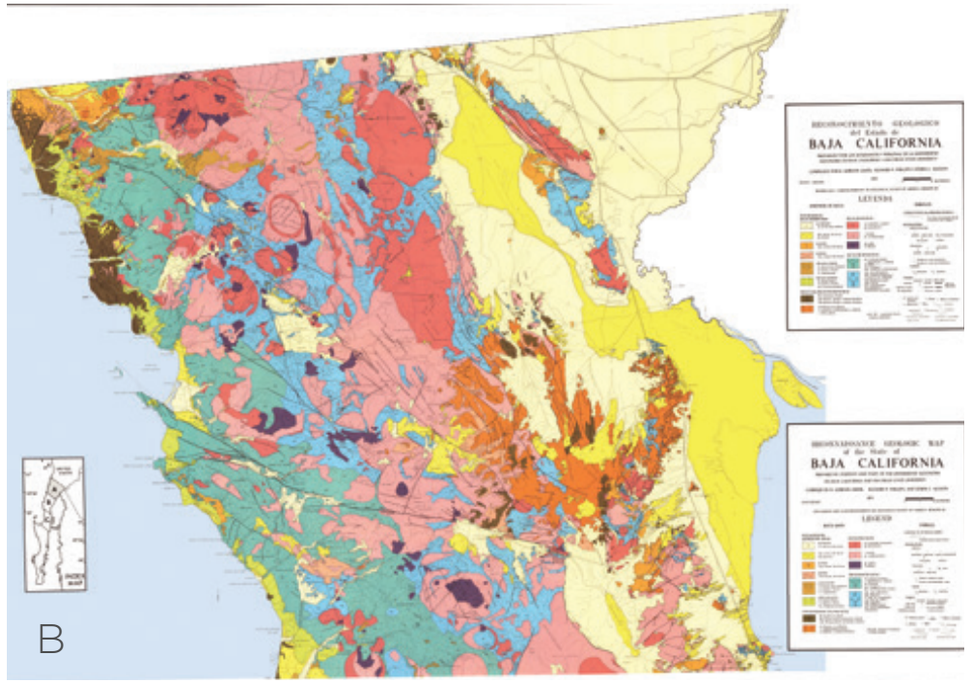
Using the present day topographic rendering as a starting point to go back in time, each piece of the landscape was manipulated in Adobe Photoshop using the geologic map overlays as a guide. This process also had to take into account mountain and shoreline erosion, rises and falls of separate plates and the effects of ocean water appearing in the new sea.

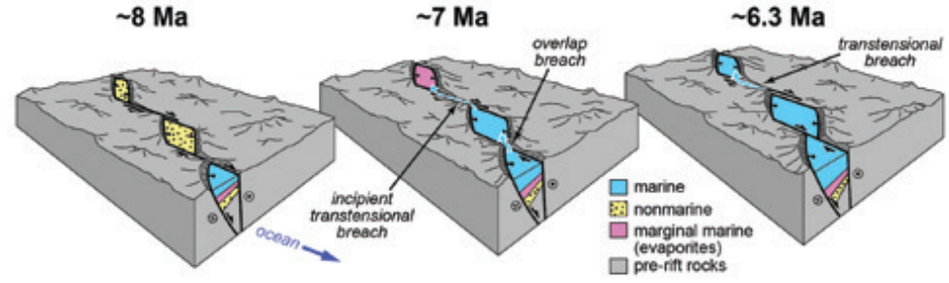












A source: Blakey, Ronald and Ranney, Wayne. Southwest North America 5 Ma Miocene-Pliocene. See: deeptimemaps.com (2013).

B source: Gastil, Phillips, Allison. Reconnaissance Geology of the State of Baja California. See: https://doi.org/10.1130/MEM140-p1 (1975).

Thomas (Tom) Baumgartner is a designer and artist who works in a variety of digital and mixed media, including oiling. With more than 20 years experience in print design and information technologies, Tom is the Creative Director and Senior Web Designer for Ridgewood Associates in Tucson. A life-long nature lover, his art focuses on animal metaphors, the desert landscape, automatic writing and manmade infrastructure in the natural environment.

Scott E.K. Bennett is a geologist, tectonicist, and earthquake scientist with the U.S. Geological Society (USGS) in Menlo Park, California. His current research is focused on geologic mapping, structural geology, neotectonics, and geomorphology of the Pacific Northwest region and desert Southwest Regions of the United States. Scott has been involved in numerous interdisciplinary, collaborative research projects in the Cascadia subduction zone of the Pacific Northwest, on both margins of the Gulf of California oblique rift, along the San Andreas fault system, and in the Rio Grande Rift.

Michael Bogan is an aquatic ecologist in the School of Natural Resources and the Environment at the University of Arizona in Tucson. His research focuses on how disturbance and dispersal processes shape local and regional biodiversity patterns in aquatic and riparian ecosystems, including the impacts of drought on arid-land streams. Most of his work focuses on invertebrates in Madrean Sky Island streams, Sonoran Desert oases, and coastal drainages of California.

Mark A. Dimmitt is a botanist and vertebrate biologist. Mark worked at the Arizona-Sonora Desert Museum in Tucson from 1979 to 2011, first as Curator of Botany, and then as Director of Natural History. He is the author of more than 50 scientific and popular publications about ecology and horticulture, and is a Fellow of the Cactus and Succulent Society of America. Mark's ongoing vocation is as a plant breeder and he has introduced more than 50 cultivars.

Taylor Edwards is a herpetologist, evolutionary biologist and conservation geneticist at the University of Arizona Genetics Core in Tucson. Taylor is a leading expert on tortoise genetics and his Ph.D. work led to the description of a new species of tortoise and the preservation of crucial habitat in Mexico. Taylor serves as an Advisory Board member of the Turtle Conservancy, Scientific Advisor for the Turner Foundation (Bolson Tortoise Captive Breeding and Repatriation Project), and is a NatGeo Expert with National Geographic Expeditions.

Heather Green is an artist whose projects and installations examine historical and ecological narratives of the Northern Gulf of California and Sonoran Desert, specifically Cholla Bay. Through the collaborative nature of her art she has allied with a diverse range of individuals including scientists, poets and fishermen. Her work has been shown in México, Uruguay, and in museums and galleries both regionally and across the United States. A native of Tucson, Heather currently works in Tempe as Assistant Professor of Book Arts at Arizona State University.

Charles (Chip) Hedgcock is a black and white fine art photographer as well as a professional photographer in life sciences and medicine, working most recently in the Department of Entomology at the University of Arizona. Chip is a Registered Biological Photographer (RBP) and a Fellow of the BioCommunications Association. He is primary photographer for the GreaterGood.org Madrean Discovery Expeditions (MDE) and travels to remote mountain ranges in Southern Arizona, Northern Sonora and Chihuahua Mexico to document the habitats and diversity of life found there.

Benjamin M. Johnson is a visual artist and curator, whose work reflects his love of the natural world while weaving together resonant themes of history, science, spirituality, and culture. Benjamin works in traditional and new media and exhibits nationally. Originally from New Jersey, he studied at the Pennsylvania Academy of the Fine Arts and is a prior Curator of Exhibitions with Tohono Chul Park. He is currently based in Tucson, Arizona.

Maria R. Johnson is a visual artist and marine scientist. Her areas of research include fisheries, art-science, and coupled human-ecological systems. For many years, she worked as a Research and Conservation Fellow at the Prescott College Kino Bay Center in Bahía Kino, Sonora where she studied shrimp trawler bycatch. Her artistic works explore ecology and strive to connect people to place through ink, watercolor, and photography. She is currently a Master of Science candidate in Marine Resource Management at Oregon State University.

Eric Magrane is a poet and geographer. He is an assistant professor of geography at New Mexico State University in Las Cruces. The co-editor of *The Sonoran Desert: A Literary Field Guide*, he has also served as poet in residence at the Arizona-Sonora Desert Museum in Tucson. His research areas include creative geographies, the geographies of art and science, science communication, environmental humanities, and narratives of climate change and the Anthropocene.

Kathleen Velo is a photographic artist and fine art studio artist who is interested in the interaction of humans with the natural world. As a process-driven artist, Kathleen created a technique to maximize her interaction with the natural alchemy of light, chemistry, and space, using camera-less, pinhole and plastic camera techniques to capture her imagery. Her work has been exhibited in galleries and museums nationally and internationally, including the Palace of the Governors Museum in Santa Fe, Tucson Museum of Art, Southeastern Museum of Photography, and The Center for Fine Art Photography. Her work focuses on water quality issues in the Southwest.

Benjamin T. Wilder is a desert ecologist and botanist. Director of the Desert Laboratory on Tumamoc Hill at the University of Arizona, and Director and Co-Founder of the Next Generation Sonoran Desert Researchers (N-Gen), Ben utilizes multiple approaches to connect science to conservation. As a biogeographer, Ben's research spans time and space in arid regions to establish baselines that offer a better understanding of modern biodiversity.

N • G E N

INVESTIGADORES DEL DESIERTO SONORENSE

SONORAN DESERT RESEARCHERS