

SONORENSIS

Arizona-Sonora Desert Museum

desert
Bounty

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Cover photograph: Anthony Moreno harvesting 60-day corn on the San Xavier
Cooperative Farm. Cover and back cover photos by Josh Schachter.

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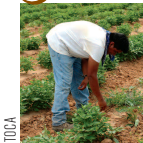
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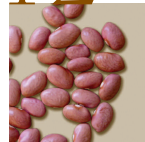
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Josh Schachter

Introduction



TOCA farms

courtesy of TOCA



Cholla (*Opuntia* sp.) buds

photo by Jesús García



Foothill palo verde beans (*Parkinsonia microphylla*)

photo by Mark Dimmitt



Chia (*Salvia columbariae*)

photo by Mark Dimmitt



Desert Museum saguaro-harvest workshop.

photo by Christine Conte

The Desert Museum's mission is to inspire people to live in harmony with the natural world by fostering love and appreciation of the Sonoran Desert Region.

Christine Conte, Ph.D.

Director, Center for Sonoran Desert Studies, Arizona-Sonora Desert Museum

At the Arizona-Sonora Desert Museum, the heart of our mission is to inspire people to live in harmony with the natural world. In pursuit of that goal, the Museum's Center for Sonoran Desert Studies conducts research on and provides educational programs about the natural and cultural heritage of the Sonoran Desert Region. Some of our programs promote the appreciation of local foods and production techniques that support human health and a sustainable environment.

Although a full diet from wild harvesting is not plausible for our modern, large population in the Sonoran Desert, a discriminating harvest from its land, and informed consumption of its sea life, will benefit both our health and our environment. Thus, this issue of *sonorensis* is devoted to describing the benefits of traditional foods and the move toward sustainable production of

the fruits of the Sonoran Desert Region. You'll also find healthful, tasty recipes based on native foods, as well as resources for obtaining or growing your own über-local ingredients.

If what you see here leaves you hungry for more, we invite you to join us in exploring and region tasting the bounty of the Sonoran Desert. Our Sonoran Studies program offers seasonal classes in the harvesting and preparations of saguaro and prickly-pear fruit, as well as "Taste of Place" tours to local farms specializing in traditional foods. Or, check out our "Sonoran Supermarket" classes for kids and adults. For more information on current offerings, visit us on the web at www.desertmuseum.org/sonoranfood/ and keep an eye out for listings in our newsletter. **S**

To your health!

Diet and Health: An Intimate Connection

Mark Dimmitt, Ph.D.

Director of Natural History, Center for Sonoran Desert Studies, Arizona-Sonora Desert Museum

Prior to the seventeenth century, Native Americans found sustenance in the Sonoran Desert. They cultivated agave, corn, beans, and squashes and harvested wild fruits and game. With the arrival of the Jesuit priest Father Eusebio Kino and his compatriots, new crops and cattle arrived, and by the twentieth century modern refrigeration and transportation systems brought a new diet to this new world. While the advantages of that dietary expansion cannot be discounted, the resulting disconnect with the true costs of food and the products of local lands created havoc with the environment and our health—especially for Native Americans, whose traditional diets and lifestyles were conspicuously disrupted. For the Tohono O'odham, that unhealthy disconnect became apparent with a scourge of diabetes. But the detrimental effects of the American diet has now become abundantly clear throughout this country, regardless of culture.

Although the United States spends more money per capita for health care than any other country, it has one of the most unhealthy populations in the developed world. The typical American diet is a major cause of a suite of uniquely Western diseases: heart disease, diabetes, hypertension, several cancers, and obesity, all of which are all largely preventable by proper diet and a modicum of exercise.

Most of the popular literature about diets is a mind-boggling, contradictory jumble of hard facts, outdated information, tentative findings,

misinterpretations, and complete fantasies. The confusion is compounded by a deluge of advertisements for a plethora of diets and health foods, most of which can politely be called misleading. It need not be so. During the last few years scientific knowledge of what constitutes a healthy diet has been condensed to a few simple rules [see sidebar]. Following them provides your best shot at good health.

The 1990 book *Dr. Dean Ornish's Program for Reversing Heart Disease* was the first popular publication to reveal that following a certain lifestyle could reverse heart disease. The Ornish program's recommended lifestyle includes a specific diet, regular exercise, and managing stress. Others, such as Dr. Andrew Weil, founder of the Arizona Center for Integrative Medicine, have also forwarded the concept that most Western diseases are caused primarily by lifestyle.

The clearest and most comprehensive explanation of the relationship between diet and health is presented in Michael Pollan's 2008 book, *In Defense of Food*. After comparing the traditional diets of peoples around the world (where most of the communities were notably healthy), he found only one consistent difference between them and the American diet: much of the food Americans eat is *highly processed*—in other words, chemically altered, liquefied, emulsified, sprayed, adulterated, improved, fortified, fried, preserved, mass-produced or/and packaged for long shelf life.

Something about processing food seems to make it unhealthy, despite the common addition of numerous supposedly healthful nutrients. Pollan's intense research in food production, preparation, and distributions systems in the United States and elsewhere points to a need for greater emphasis on "fresh" and "local" or near-local foods. Bill McKibben, in *Deep Economy*, provides further insight into the health and sustainability of local systems. And Dan Buettner's *Blue Zone*, an in-depth look at communities the world over with especially long-lived people, underscores their diets composed primarily of plants, particularly nuts and grains—with no vitamin and mineral supplements.

The palette for a healthy diet is broad and deep. Sensible and delicious foods are available to us from around the world, but we would do well to stretch beyond the obvious and reach for the plethora of deeply local choices in the Sonoran Desert Region. Across Arizona, we are already seeing a burgeoning interest in wild harvesting and in traditional desert gardens, like those established farms in the Tohono O'odham community and the brand new native garden at the historic Steam Pump Ranch in Oro Valley. In the long run, raising your own is an outstanding option. In the meantime, resource guides and recipes in this *sonorensis* can help steer you to health right here at home, not just for our bodies, but for our communities.

Suggested Reading:

Ornish, Dean. *Dr. Dean Ornish's Program for Reversing Heart Disease: The Only System Scientifically Proven to Reverse Heart Disease Without Drugs or Surgery*. New York, NY: Ivy Books, 1995.

McKibben, Bill. *Deep Economy: The Wealth of Communities and the Durable Future*. New York, NY: Times Books, 2007.

Pollan, Michael. *In Defense of Food: An Eater's Manifesto*. New York, NY: Penguin Press, 2008.

Buettner, Dan. *The Blue Zones: Lessons for Living Longer from the People Who've Lived the Longest*. Washington, D. C.: National Geographic Society, 2008.

Tips for a Healthy Diet

1 Maintain a healthy weight by eating only as many calories as you burn each day. And make sure the calories you take in are nutritious, not *empty* like soda, which has calories, but no nutritional value.

2 Watch your fats 1: Unsaturated fats are healthy. Saturated fats from animals are unhealthy in large quantities. The effects of saturated fats from plants, such as palm and coconut oils, are still not well understood. It's best to use them sparingly. Trans fats (hydrogenated oils) can be deadly; they should be avoided completely.

3 Watch your fats 2: Balance omega-6 and omega-3 fatty acids. Both of these components of unsaturated fats are essential nutrients but they have different physiological effects. Omega-6 fatty acids promote inflammation, which contributes to a wide range of health problems. Omega-3 fatty acids are anti-inflammatory. The Western diet is heavily skewed toward the omega-6, which are abundant in land animals, warm water fish, and most seeds. (Seeds are the embryonic plant: beans of all kinds, peas, corn, nuts, grains—and flour, of course, which is ground from the grains.) The best sources of omega-3 fatty acids are oily cold-water fish, plant parts other than seeds (all kinds of vegetables), and certain seeds such as chia, flaxseed, and hempseed. Healthy ratios of omega-6 to omega-3 range from 1:1 to 4:1; the typical Western diet is more than 6:1.

4 Eat mostly whole foods (for instance, brown rice rather than white rice, and fresh or frozen produce without additives) and minimize consumption of processed foods. Processed foods are low in fiber, often have a high glycemic index (leading to spikes in blood glucose), and probably lack essential nutrients that the food industry and nutritionists don't yet know about. In fact, most studies indicate that adding fiber and nutrients back into processed foods has little or no health benefit.

5 Minimize consumption of simple carbohydrates, especially refined sugars. They cause a spike in blood sugar, which triggers a rapid release of insulin. The insulin quickly lowers the blood-sugar level, leading to hunger shortly after eating the sugary food. This encourages overeating and, hence, obesity. High-fructose corn syrup, another ubiquitous refined sweetener, not only triggers a very rapid sugar spike and inflammatory reactions in our bodies, its production also has an inordinately large environmental footprint. Pay attention when you buy prepared foods and drinks; high fructose corn syrup is added to a *huge* array of processed foods. **S**



Agave (*Agave deserti*)



Corn (*Zea mays*)



Tepary beans close up



Santa Cruz Farmers Market



Squash

The Community Food Bank runs the Santa Cruz and two other weekly farmers markets in Tucson, offering organic and other produce from the Marana Heritage Farm and local home gardens.

Linking Human and Environmental Health through *Desert Foods*

Photos by Gary Nabhan, unless otherwise noted

The local foods movement in the United States has recently increased the percentage of Americans eating fresh, locally-produced fruits and vegetables through farmers markets and community-supported agriculture projects. Local food efforts have been celebrated in a number of recent books, such as Kingsolver's *Animal, Vegetable, Miracle*, and local foods in the desert borderlands, particularly, by Nabhan's *Coming Home*



Alberto Mellado, founder and director of the Comca'ac Native Aquaculture project at Desemboque.

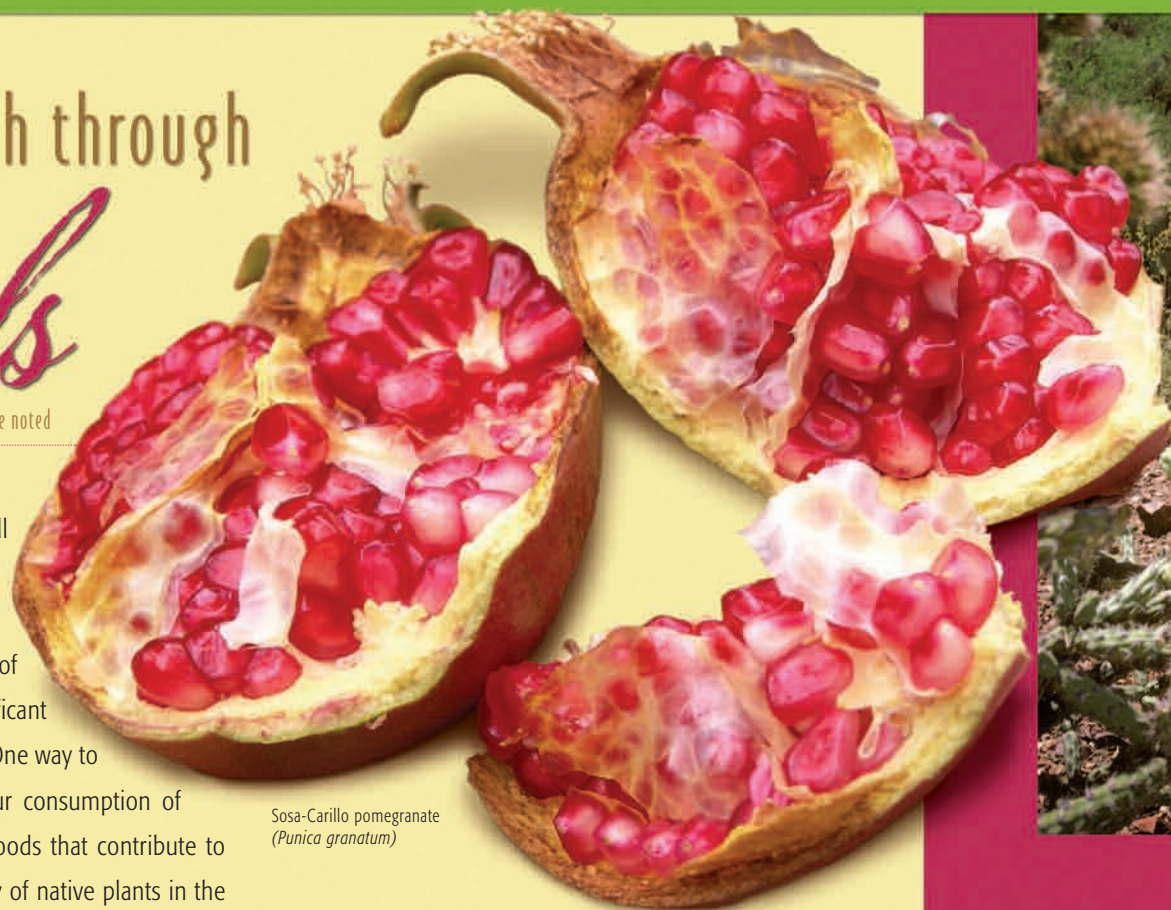
For now, the Seri scallops and oysters are currently sold only wholesale, mainly for market in Kino Bay and Hermosillo, but the project is working toward certification for more direct, sustainable markets, including those in Arizona and California.



to Eat, but there are far fewer small farms in Arizona than nearly any other state of its size. How, then, can Arizonans find an adequate supply of local, seasonal foods that offer significant health benefits when eaten regularly? One way to get those benefits is by increasing our consumption of common, sustainably-harvested wild foods that contribute to good health. In fact, there is a diversity of native plants in the Sonoran Desert, and native fish and shellfish in the Sea of Cortez, that offer such benefits. As we shall see, by carefully harvesting them ourselves or by purchasing sustainably-harvested food products from coastal Sonora, Mexico, we can enjoy terrific flavors and textures while reducing our risk of illness and infirmities such as cancer, cardiovascular disease, diabetes, osteoporosis, and various diseases of inflammation.

A relatively unheralded desert plant, aromatic Mexican oregano (*Lippia graveolens*), is one of the culinary herbs with the highest known concentrations of disease-preventing antioxidants. As drought stress becomes more severe, the leaves of the coastal populations of *Lippia*-oreganos concentrate their essential oils on and near their surfaces to reduce water

Sosa-Carillo pomegranate (*Punica granatum*)



loss; therefore, these oregano leaves become more pungent for culinary use and richer in antioxidants. The Comca'ac, or Seri, communities of Desemboque del Sur and Punta Chueca sustainably harvest this oregano, husbanding the plants in the coastal ranges above the Sea of Cortez, and market this culinary herb in both Sonora and Arizona. Rich in fragrant essential oils known as thymol and cavracol, the Seri ecotype of oregano has been praised by food writers, from Janos Wilder and Betty Fussell to Rick Bayless and Lois Ellen Frank. Because of its distinctive qualities, it has been boarded onto the Slow Food Ark of Taste.



photo by Peter Krasan



photo by Josh Schaefer

Gary Nabhan, Ph.D., Research Professor and Social Scientist, Southwest Studies Center, University of Arizona, Martha Ames Burgess, Ethnobotanist and Desert Foods Instructor, Flor de Mayo Arts, and Laurie Monti, Ph.D., Program Officer, Christensen Foundation



The Seri of Desemboque have also been marketing their fire-roasted mesquite-pod flour through a Slow Food Presidium project supported by Slow Food International. In early July, entire Seri families go out into desert washes to hand-pick pods off mesquite trees, then fire-roast the pods in modified chile roasters until they exude a smoky fragrance. (It is a variation on the traditional Seri method of parching the pods on hot sand heated by coals.) The roasted pods are then ground in a hammer mill, the flour sifted, bagged, and frozen to kill off any insects or microbes. The artisanally-produced mesquite flour offered by the Seri has made its way to the Mitsitam Café in the Smithsonian's new National Museum of the American Indian just two blocks from the Capitol in Washington, D.C. At the same time, fiber- and galactomannan-rich mesquite tortillas are now being offered by



photo by Christine Come

above: Juanita Ahil picking cholla buds. middle: Mesquite flour, tepary beans, native oregano, and other local food products can be found at Native Seeds/SEARCH in Tucson (or online) and some farmers markets. left: Santa Cruz Farmers Market. Farmers markets like this are making more local and native foods available across the Southwest.

Tortilleria Arevalo, via farmers markets, to Tucson residents suffering from diabetes (and others looking for the taste and benefits of mesquite). Tohono O'odham farmers at the San Xavier Coop Association now have a budding industry of locally harvested mesquite meal as well. Sonoran Desert residents who have native species of mesquite growing on their property (not the introduced ornamental species) can get on the health-cookery bandwagon, by gathering their pods from the tree when fully mature, parching them, and taking them to local milling events. For a schedule of borderlands milling, check out www.desertharvesters.org.

These wild plant foods are not the only culinary treasures from our region that offer health benefits and agreeable flavors to our communities. There are also riches in the Sea of Cortez. The Seri are combining traditional knowledge and scientific aquaculture techniques to increase their production of native Sea of Cortez oysters and scallops (*callo de bacha*), while also implementing environmental monitoring. (See <http://comcaacnativeaquaculture.blogspot.com/> for more information.) These shellfish are low in cholesterol and relatively rich in omega-3 fatty acids, which have been shown to reduce our bodies' production of eicosanoids, the hormonelike substances that aggravate arthritis, coronary disease, and inflammation.



photo by Peter Blystone



photo by Peter Blystone

above: Harvesting mesquite pods near Desemboque del Sur.
right: Roasting pods for market.

By supporting Native projects such as those of the Seri and Tohono O’odham that sustainably harvest native wild foods, we are benefiting not only human health, but environmental health as well. Such projects avoid the use of pesticides, antibiotics, and excessive manipulation of the natural environment. What’s more, they are solar-driven, and have a much smaller carbon footprint than most kinds of agriculture. If we want to effect positive change, we should be voting with our taste buds, bellies, and pocketbooks for the kinds of food production that keep human cultures and our environments as healthy as possible.

Widely-heralded studies have recently confirmed that red and purple grapes grown under moderate water stress tend to be richer in antioxidants called phenols than lavishly-irrigated grapes. These phenols not only enrich the flavor of raisins and wines, ingesting them can increase your own capacity to deal with stress because they absorb the free radicals that

aggravate inflammation, pancreatic dysfunction, and other drivers of disease. In his research on longevity for *The Blue Zones*, Dan Buettner found a wood-chopping 103-year-old and other Sardinian centenarians imbibing daily in the local Cannonau wine, which, he notes, contains “two to three times the level of artery-scrubbing flavonoids [phenols] as other wines.” We might well explore the constituents of our local canyon grape, *Vitis arizonica*, landscaping not only for the birds but also for our tables! (Live plants of *Vitis arizonica*, by the way—as well as a blackberry bush, *Rubus arizonensis*, from southern Arizona, and other native and heritage edibles—are available in the Tucson area at Desert Survivors and at other native-plant nurseries around the state.)

Cholla Cactus Flower Bud Nutritional Comparisons

Two species of cholla eaten traditionally by Akimel O’odham and Tohono O’odham people show high content of many important nutrients, including complex carbohydrates and calcium.

Nutrient/Mineral	content per 100g <i>Opuntia</i> sp. (Greenhouse master's thesis 1979)	content per 100g <i>O. acanthocarpa</i> (Greenhouse et al, 1981)	%RDA for females	content per 100g Red-flowered <i>O. versicolor</i> (Burgess, unpub)	content per 100g Yellow-flowered <i>O. versicolor</i> (Burgess, unpub)
protein	10.9 - 12.9g	3.53g	8%	11.39g	10.14g
carbohydrate	70g	21.33g		70.56g	71.28g
sugars				8.0g	5.1g
dietary fiber				46.2g	47.8g
fat	2.2	0.67g		1.06g	0.68g
saturated fat				0.34g	0.28g
cholesterol				0	0
energy	344 calories	106 calories		337 calories	332 calories
sodium		39.96mg		1.8mg	26.9mg
potassium	1455mg	423.36mg			
calcium	2411 - 2811mg	730.08mg	91%	2200mg	3200mg
magnesium		193.32mg	64%		
phosphorus	202mg	58.86mg	7%		
manganese		1.51mg	30-60%		
iron	6.7mg	1.68mg	9%	2.6mg	1.7mg
copper		0.16mg	5-8%		
zinc		0.46mg	3%		
selenium		0.04mg	20-80%		
strontium		6.11mg			
vitaminA				210 IU	170 IU
vitaminC				0	

Data collected and analyzed by Martha Ames Burgess represent *Opuntia versicolor* flower buds collected in April 2006, on the east slope of the Tucson Mountains. The 1979 data are gleaned from the Arizona State University master’s thesis by Ruth Greenhouse; the 1981 data from Greenhouse et al. are gleaned from the journal *Kiva*.

Grapes, pomegranates, and berries are not the only fruits rich in phenol antioxidants. Purple-fruited prickly pears are also an excellent source of flavonoid phenols such as quercetin and kaempferol. In fact, purple-fruited varieties of prickly pear—our Sonoran Desert is blessed with many folk-taxa—have nearly ten times the fresh weight content of quercetin as some yellow- and green-skinned cactus fruits often cultivated in desert gardens. Quercetins are well known for their health benefits, especially for

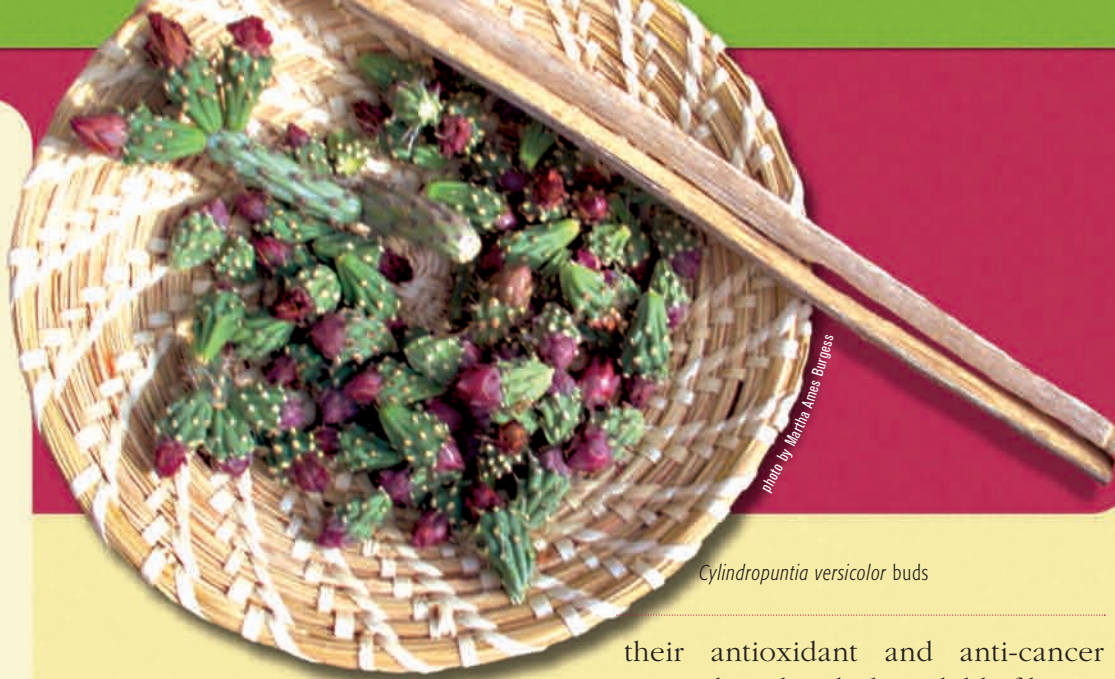


photo by Martha Ames Burgess

Cylindropuntia versicolor buds

their antioxidant and anti-cancer activities. Combined with the soluble fiber in the mucilage of prickly pear fruits and pads, these natural chemicals can play a role in reducing blood sugar and cholesterol levels in people prone to diabetes and heart disease.

Several southern Arizona companies are incorporating locally wild-harvested prickly pear fruits and pads into their products as fruit concentrates, leathers, syrups, and even nopalito salsa. Their products are found at local farmers markets—some are now available commercially farther afield. These companies employ seasonal hand-pickers, whose tread is figuratively light on our fragile desert soil—no plowing or disturbance necessary. Watch for the brands that add no extraneous corn syrups or non-local ingredients; those will be the ones best for our health as well as for the land.

Surprisingly, flower buds from several species of our Sonoran Desert cholla cactus (*Cylindropuntia* spp.) that were gathered traditionally by Native People provided them with major health benefits that are being rediscovered today. Recent nutritional analyses of cooked cholla buds show a whopping 3200 mg of available calcium per 100 g of buds! They also have 71 g of complex carbohydrate and 47 g dietary fiber, both of which balance blood sugar as few other medicines can do. Native groups such as Tohono O’odham Community Action (TOCA) are now wild-harvesting and preparing the buds, making them available through such sources as the ►

The Ark of Taste

Bellota bread

photo by Josh Schachter

Linda M. Brewer, *sonorensis* editor
Arizona-Sonora Desert Museum

Fledged in Italy in 1996, the Ark of Taste is an outgrowth of the Slow Food Movement. It is an extensive effort to catalogue, describe, and promote foods that might otherwise become casualties of modern commercial farming and marketing. Worldwide, it describes more than 500 products from 30 countries. Several native and heritage foodstuffs from the southwest United States and northwest Mexico are already listed, including the O’odham pink bean, the l’toi onion, and yellow-meated watermelon, as well as Navajo-Churro sheep, chiltepin peppers, and “bellota” acorns. Online, at www.slowfoodusa.org/index.php/programs/details/ark_of_taste/, the Ark posts brief cultural, horticultural and/or ethnobotanical descriptions of each, along with outlets where the products can be purchased.

Seri fire-roasted mesquite is not only on board the Ark, its selection as a Slow Food Presidium project provides protection, production, and marketing support for the tree, its product, and the local community. For the Comca’ac (Seri) people of El Desemboque del Sur, the Presidium helped villagers organize the delivery of consistently high-quality pods as well as the standards and processes for toasting and grinding.



Bellota acorns

It also helped them develop special packaging and branding to market the flour at targeted shops and restaurants.

Though not officially on the Ark, many of the native and local foodstuffs we feature in this issue fall into the same category. They are typically low-profile local food resources, raised on or native to neighboring lands and waters, for which a sustainable harvest would offer consumers a less energy-consumptive diet, while providing economic support for local communities and whole, unprocessed foods for better health.



Arizona-Sonora Desert Museum's gift shop, Tohono Chul Park gift shop, and the website www.tocaonline.org. For those who want to know how to benefit from the much-maligned cholla, how to gather it sustainably, protecting person and plants—even how to cultivate the most useful varieties in our landscapes, there are seasonal workshops open to the public sponsored by the Desert Museum, Pima County Parks and Recreation, the Desert Botanical Garden in Phoenix, Baja Arizona Sustainable Agriculture (www.BajaAZ.org), and Flor de Mayo Arts (www.flordemayoarts.com).

Chia seed from our native *Salvia columbariae* provided Mojave, Cocopah, and Tohono O'odham people with sustained energy, blood-sugar balancing, and an edge-up in running long distances. Recent studies show chia's omega-3 fatty acid content is even higher than salmon oil or flaxseed per unit volume! The species used by the Aztec, *Salvia hispanicum*, is now available at farmers markets and retail outlets such as Native Seeds/SEARCH. Thinking locally, we need to be rejoicing in our own desert chia. What a fragrant treat is a spring meadow of blue chia flowers—and what a gift it would be to the desert for chia to be sewn again agriculturally, for the benefit of soil, rodent, quail, and bipedal runner!

above: Tepary bean toss at San Xavier Farm.
middle: Close up of tepary beans and bean pods.
left: Prickly pear.

There are no disconnects in the continuum from environmental health...to healthy local food...to healthy human bodies—each one enhances the next and the next. **S**

Suggested reading:

Ayerza, Ricardo, Jr., and Wayne Coates. *Chia*. Tucson, AZ: UA Press, 2005.

Greenhouse, Ruth, Robert Gasser, and Jannifer Gish, 1981. *Cholla Bud Roasting Pits: An ethnoarchaeological example*. *Kiva* 46(4):227-242.

Kingsolver, Barbara, Camille Kingsolver, and Steven L. Hopp. *Animal, Vegetable, Miracle: A Year of Food Life*. New York, NY: Harper Collins, 2007.

Nabhan, Gary Paul. *Coming Home to Eat: The Pleasures and Politics of Local Foods*. New York, NY: W.W. Norton, 2001.

Chia is high in omega-3 fatty acids.

Try this refreshing drink, or simply add chia seeds to hot breakfast cereal or sprinkle them in a salad.

Chiaberry Slushie

Courtesy of the Desert Rain Café

- 1 tablespoon chia seeds
- 1 cup apple juice
- 2 cups frozen strawberries
- 1 tablespoon agave nectar

Combine all ingredients in a blender. Puree until slushy. [You may also soak chia in juice for a half-hour before blending.]

Makes two 8-ounce servings.



TOCA, Tohono O'odham Community Action,

Creating Hope and Health with Traditional Foods



Mary Paganelli
Project Coordinator, TOCA

Photos by **Josh Schachter**, unless otherwise noted

Until the second half of the twentieth century, the Tohono O'odham were almost entirely food self-sufficient. Using agricultural practices that date back over a thousand years, they grew their own food and harvested the bounty of the desert. As late as the 1920s, the community used traditional ak:chin flood-farming methods to cultivate more than 20,000 acres in the floodplains of the Sonoran lowlands. By 1949, that number had declined to 2,500 acres. Today, traditional farming methods are used on less than ten acres.

In 1930, the Tohono O'odham produced 1.4 million pounds of tepary beans (*Phaseolus acuti-*

folius)—a cultivated native legume that was an important staple in their diets; in 2001, however, they produced fewer than 100 pounds. At the same time, the once-common practice of collecting and storing wild foods declined in an equally dramatic way. In the 1960s, virtually no Tohono O'odham tribal members suffered from diabetes; today, more than half of all Tohono O'odham adults have type II diabetes. This predicament is due primarily to the shift away from a traditional food diet and to significant changes in lifestyle. In response to both ongoing losses of cultural and food traditions and to the resulting nutrition-related disease devastating

the O'odham community, the founders of TOCA, Terrol Dew Johnson and Tristan Reader, joined with other community members to develop projects with the following goals:

- Creating culturally appropriate, agriculturally based economic development within the Tohono O'odham community.
- Reducing the incidence and severity of diabetes among Tohono O'odham through redevelopment of a local food system.
- Revitalizing traditional Tohono O'odham culture and language by redeveloping the material base in which traditions are rooted.



from left to right: Melon toss at San Xavier Cooperative Farm; Noland Johnson, TOCA Farm Manager looking at teparies*; top - Desert Rain chefs prepare healthy foods*; below - Fresh-picked cholla buds*; next to cholla, bottom - Tepary field; above - Squash field; Desert Rain Café's white tepary bean chile with a whole wheat tortilla*; Cissiemarie Juan eats at the Café*; Corn kernels; following page - Roasted corn; Tepary beans close up. *Photos courtesy of TOCA.

Specific projects included redeveloping traditional flood-based farming; implementing a desert-foods collection project; initiating family and village gardens throughout the community; and creating partnerships with schools, hospitals, and other institutions.

To achieve the larger goals, TOCA established a 5-acre traditional ak:chin farm and a 100-acre production farm to grow traditional, healthy Tohono O'odham foods. In 2008, TOCA's farms produced thousands of pounds of white and brown tepary beans, traditional 60-day corn, Tohono O'odham squash, and yellow-meated watermelon. These foods are sold at TOCA's **Desert Rain Gallery** and at grocery and convenience stores within the Tohono O'odham community. Traditional foods are also supplied to the Indian Health Services Hospital and are donated for many special community events.

To provide sustainable economic opportunity, TOCA created the **Tohono O'odham Trading Company** to market traditional foods on a limited basis outside the O'odham community, including outlets like the Arizona-Sonora Desert Museum, Tohono Chul Park, and the Tucson

Botanical Gardens. In addition to packaging food products from the farm, TOCA purchases wild-gathered foods such as cholla buds and saguaro syrup directly from community members, contributing to its goals for a sustainable economy while encouraging the continuation of these culturally significant gathering practices.

TOCA's newest project, the **Desert Rain Café**, (www.desertraincafe.com) opened in May of 2009 in Sells, Arizona, extending TOCA's mission to bring healthy food options and economic opportunity directly to the community. Staffed by members of the Tohono O'odham community, its menu offers breakfast, lunch, appetizers, and side dishes, with each menu item incorporating at least one traditional food. A few of the distinctive menu selections include: desert granola (with mesquite, agave nectar, and saguaro seeds), chia fruit salad (with seasonal fresh fruit, chia seeds, and prickly pear nectar), cholla pico de gallo (salsa made with cholla buds, tomatoes, and chiles), tepary bean short-rib stew (served with corn bread), and Ha:l Enchiladas (with sautéed O'odham squash, green salsa, and cheese). Both traditional and contemporary recipes are pre-

pared with the utmost respect for the foods that I'toi provided to sustain the People of the Desert. Last June, the Café garnered national attention when it was featured in an "All Things Considered" segment on National Public Radio.

The Desert Rain Café not only provides a place for community members to eat a healthy meal or take home healthy foods for their families, it also offers new ideas about how to incorporate traditional foods into home-cooked meals. Café staff have found that working at the Café has had a positive impact on their lives. Desert Rain prep cook Alice Marquez shared her experience, saying, "This is my first time cooking traditional foods, and I love it because it's real healthy and I'm giving back to my people and showing that our traditional foods are healthy. When I eat fast foods I just get sick, but since working here I've lost weight and I feel healthy."

Taken together, TOCA's production farms, trading company, and Café build upon the assets of the Tohono O'odham community to create a model of sustainable resource use, food-system development, and increased self-sufficiency for Native communities on a path to wellness. **S**



The **Desert Rain Café** is on Main Street in Sells, Arizona, in the Tohono Plaza. It is open Monday through Friday, 7:00 a.m. – 3:00 p.m. Open for breakfast and lunch.

Tohono O'odham Community Action (TOCA), is a 501(c)(3) nonprofit, community-based organization dedicated to creating *community health, cultural revitalization, and sustainable economic development* by building upon the assets of the Tohono O'odham community: a large land-base, knowledge of elders, and cultural traditions. TOCA programs work directly in the service of these goals, focusing on a community food system that contributes to public health, as well as the development of youth leadership. Founded in 1996, TOCA's four major program areas now include: (1) the Tohono O'odham Community Food System, (2) the Tohono O'odham Basketweavers Organization, (3) the Youth/Elder Outreach Program, and (4) the Tohono O'odham Arts and Culture Program.



Cholla buds are high in calcium.

Cholla Bud Salad

Courtesy of Canyon Ranch Resorts in Tucson, Arizona

- 1/2 cup dried cholla buds
- 1/4 cup minced, red onions
- 1/4 cup minced, red bell peppers
- 1/3 cup diced tomatoes
- 2 tablespoons fresh, chopped cilantro
- 2 tablespoons lime juice
- 1 tablespoon extra virgin olive oil
- 2 teaspoons minced, jalapeno peppers
- 1 teaspoon sea salt

1. In a large saucepot filled with water, add dried cholla buds and bring to boil. Reduce heat and simmer until buds are soft (about 1 1/2 to 2 hours).
2. Drain cholla buds, chill, and chop.
3. Combine all remaining ingredients with chopped cholla buds and toss together.

Makes 7 1/3-cup servings.

Tepary beans are a good source of protein.

O'odham White Tepary Bean Stew

Courtesy of Frances Manuel, who always kept a pot bubbling on the stove in San Pedro Village. Tepary beans love slow cooking, and this recipe produces a slightly sweet, delicious rich broth ideal for a crockpot.

- 1 cup of dried white tepary beans, rinsed, and picked through
- 10 cups of water
- 1 teaspoon salt
- 1 pound oxtails, beef short ribs, deer, or rabbit

1. Place beans, water, and salt in a stockpot. Bring to a boil, reduce heat, and simmer, covered, for 1 1/2 hours.
2. Add meat to the bean mixture, cover, and cook for one more hour, or until beans are tender and meat is falling off the bone.

Makes 6 servings.

If using a crock pot, place water and all other ingredients in the pot, cover and set to high. Cook for 8 hours or until the meat is falling off the bone and the beans are tender.



Ancient Seeds for Modern Needs:

Growing Your Own



Suzanne Nelson, Ph.D.
Director of Conservation, Native Seeds/SEARCH

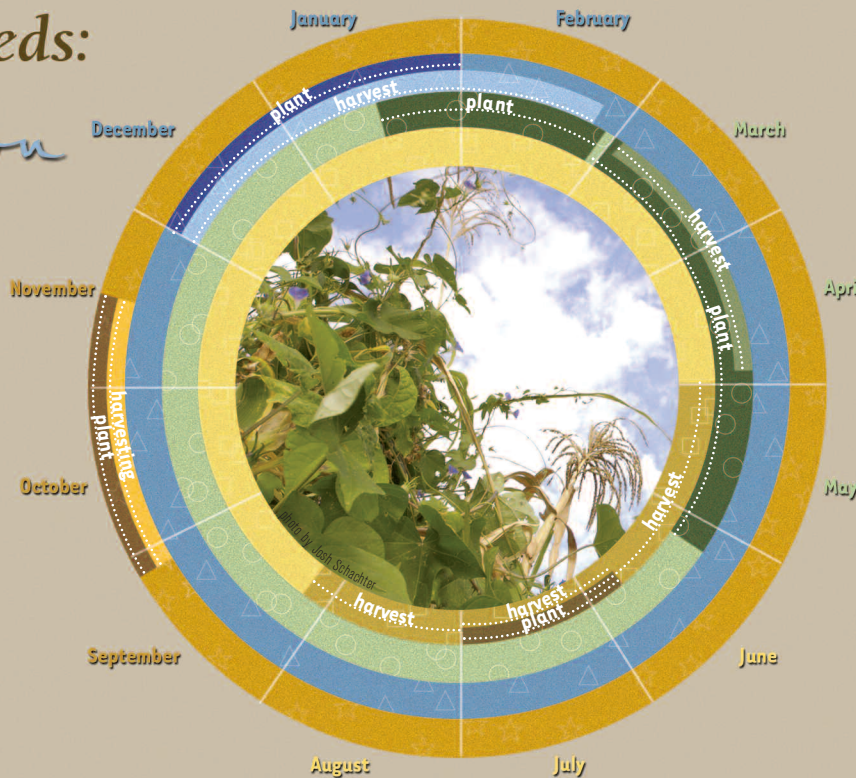
Inspired to grow healthy native foods in your garden but need help getting started?

You can purchase seeds adapted to the Sonoran Desert bioregion and find planting instructions through the Tucson-based organization, Native Seeds/SEARCH (Southwest Endangered Aridlands Resources Clearing House).

Native Seeds/SEARCH (NS/S) is a nonprofit organization that conserves, distributes, and documents the adapted and diverse varieties of agricultural seeds, their wild relatives, and the role these seeds play in cultures of the American Southwest and northwest Mexico. It promotes the use of these ancient crops and their wild relatives by gathering, safeguarding, and distributing their seeds to the public, and it works to preserve knowledge about their uses.

The NS/S seed bank maintains more than 1,800 different collections representative of traditional crops grown by Apache, Akimel O'odham, Chemehuevi, Cocopah, Guarijio, Havasupai, Hopi, Maricopa, Mayo, Mestizo, Mexican, Mexican-American, Mojave, Mormon, Mountain Pima, Navajo, Paiute, Puebloan, Spanish missionaries and explorers, Tarahumara, Tohono O'odham, Yoeme, and other early inhabitants within the region.

In the NS/S Tucson outlet and on-line store, you can buy the seeds of these squashes, corns, beans, greens, onions,



PLANTING (dark bands)			
winter dec - jan white Sonora wheat	spring mar - early june amaranths, corns, Serrano & other chiles, O'odham pink bean, pinto, black & red beans, herbs, squashes, sunflowers, tomatillos & yellow-meated watermelon*	monsoon late june - july amaranths, pinto, black & red beans, white & brown tepary beans, traditional 60-day corn, melons, panic grass, O'odham squash & sunflowers	fall late sept - mid nov desert chia, garlic, greens, l'ittoi onion, O'odham pea & wheat
*(and everything in the monsoon box in the late season)			

The dark and light shades of each color band on the wheel above represent planting and harvesting times for that season for native and heritage annuals and fruiting trees. This guide generally applies to elevations up to 3,000 feet in the Sonoran Desert Region. For perennial plants both traditionally and currently harvested, we have included only the harvest season. We do not include wild species that are especially difficult to find, harvest, or process. For planting at higher elevations, consult your local garden centers. Based on NS/S graphic.

melons, chiles, tomatillos, gourds, grains, herbs, and sunflowers. NS/S also carries mixes, powders, flours, meals, teas, syrups and jellies made from many of these plants. For more information go to: <http://www.nativeseeds.org>. Call or visit the Native Seeds/SEARCH store at 526 North Fourth Avenue in Tucson. **S**

HARVESTING (light)
winter/early spring dec - late feb Mission olives & l'ittoi onion
spring early mar - late apr desert chia, chollas, chuparosa, garlic & greens
late spring/early summer may - june Arizona grape, Arizona blackberries, garbanzos, lentils, Texas mulberry, palo verde, O'odham pea & white Sonora wheat
monsoon late june - july Emery oak "bellotas," l'ittoi onion, velvet & screwbean mesquites, Mission dates & figs, Mission grapes, saguaro fruit & yellow-meated watermelons
late summer aug - early sept O'odham pink bean, chiles, prickly pears, quince & O'odham squash (Most spring plantings will be harvested in late summer/early fall.)
fall late sept - mid nov white & brown tepary beans, chiles, traditional 60-day corn, chiltepines, garbanzo, lentil, Mexican oregano, panic grass, pinyon pine, pomegranate & sunflowers

On our Grounds: *Wild Edibles* at the Arizona-Sonora Desert Museum

George Montgomery, Curator of Botany; Kim Duffek, Horticulturist; and Julie Hannan Wiens, Horticulturist, Arizona-Sonora Desert Museum

A veritable tangle of leaves and thorns are rooted in the soils of the Arizona-Sonora Desert Museum—well over 1,300 species of plants. Of those taxa native to the dry climes of the Sonoran Desert Region, most are thick-skinned, with built-in defenses against predation—not particularly inviting it would seem. But in *Food Plants of the Sonoran Desert*, Wendy Hodgson, a research botanist and curator at the Desert Botanical Garden in Phoenix, describes some 540 species considered edible—an astounding number, nearly 20 percent of the known flora of the

region. And after surveying the Desert Museum campus, we were pleased to discover that about 75 edible taxa grow right here.

There are the very well known edible species, several of which are highlighted in the Desert Museum's public programs—**chollas** (*Cylindropuntia* spp.), **prickly pears** (*Opuntia* spp.) and **saguaro** (*Carnegiea gigantea*). These species are widely distributed through the Museum (and the region) and can't be missed by our most casual visitors. Species less obvious or less familiar to visitors range from the common **beargrass** (*Nolina microcarpa*, the seeds of which were ground into flour) to the rarer **saiya** (*Amoreuxia palmatifida*, whose roots are edible), both native to the grasslands of southern Arizona. Touring the paths of the Desert Museum, we encounter edible plants, some with multiple ethnobotanical uses, in almost every exhibit area.

Looking south from the entrance patio at the magnificent view toward Sonora, our visitors can easily see large shrubs called **jojobas** (*Simmondsia chinensis*) scattered across the grounds. The pistillate (female) individuals of this dioecious shrub produce a seed in the late summer that is nutlike in appearance and texture. This seed has been used by Native Americans in the Southwest as a food and beverage (though the Seri consider it a fare for survival only). The oil, a true wax, is indigestible.

Saguaro flowers



Saguaro fruit

photo by Christine Conte



Saiya

photo by T.R. Van Dewater



Jojoba

photo by Rick Williams



Prickly pear

photo by Donald Knight



Ocotillo

photo by Mark Dimmitt



Palo verde

photo by Mark Dimmitt



Mesquite

EO



Beargrass

photo by Mark Dimmitt

In early April, the **ocotillo** (*Fouquieria splendens*) comes into full flower across the museum, and deep inside its long, red, tubular flowers nectar forms. This nectar is gladly sipped by hummingbirds, which are its main pollinators, but both the nectar and flowers are also edible for humans, with the flowers brewed into a tea. In addition, ocotillo seeds can be roasted and ground to a meal.

Visitors to the Desert Museum will also encounter two very important leguminous tree species—**palo verde** (*Parkinsonia* spp.) and **mesquite** (*Prosopis* spp.). While the tastiness and nutritional value of mesquite pods are fairly common knowledge in the Southwest, the food value of palo verde is probably less well known. Foothill palo verde (*P. microphylla*) begin flowering in mid April, fruiting soon afterward. The narrow pods are constricted between the seeds and easily opened along the long axis to yield the sweet seeds, reminiscent of peas. This is one of the easiest and tastiest natural snacks the local desert offers in the spring. An excellent source of protein, it is well described by ethnographers as being eaten raw when pods and seeds are young, and roasted when they are mature and hard. The pods of the blue palo verde (*P. florida*) are wider and flatter than the foothill palo verde and, though rather bitter, are also edible. Because palo verdes, mesquites, and saguaros can be in fruit together, traditionally these food sources have been mixed into gruel, meal, or flour.

Across Museum grounds you'll find numerous other edible native species. Here are another half-dozen of the most noteworthy.



Chia

photo by Mark Dimmitt

Chia

(*Salvia columbariae*)

A member of the mint family, chia is an herbaceous annual that grows in the desert from February through April. Its tiny grey seed is used as food or in drinks. A good source of calcium with

protein and omega-3 fatty acids, the nutty-tasting seed and its mucilaginous properties were highly valued by indigenous people of the Sonoran Desert Region. You may see this *Salvia*, with its discs of miniature blue flowers, in the wild-flower gardens on Desert Museum grounds.



Chuparosa

photo by Mark Dimmitt

Chuparosa

(*Justicia californica*)

This jumble of stems and sparse leaves forms a shrub that can bloom throughout the year in the lower desert areas.

Its tubular reddish-orange flowers taste similar to cucumbers. We are told that traditionally, for a treat, Tohono O'odham people would pick the flower and suck the nectar from its base. The chuparosa can be found outside of the Museum's hummingbird exhibit and in the desert garden.



Dátil

photo by Mark Dimmitt

Dátil

(*Yucca baccata* var. *brevifolia*)

Yuccas flowers have become popular lately as soup and salad components, although the petals can tend to bitter. The pulp of the dátil's fleshy fruit can be eaten raw or cooked for longer storage. Good examples of dátil can be seen near the Museum's cave overlook.

Pearlberry

(*Vallesia glabra*)

Lush, green shrubs naturally occurring in Baja California Sur and in the vicinity of Tiburon Island in Sonora and southward, these plants bear small, fragrant white flowers followed by translucent pearly white fruit with a faint flavor of lychee fruit that can be bitter when less than fully ripe.

The pearlberry can be found alongside Nacapule jasmine (*Vallesia laciniata*) in the southeast corner of our walk-in aviary. Nacapule jasmine bears less flavorful fruits.



Pinyon pine

photo by Mark Dimmitt

Pinyon Pine

(*Pinus edulis*)

These long-lived pine trees occur at elevations of 4500 to 7500 feet, and for many centuries people have made special treks to procure their seed. A little smaller than candy-corn, these white nuts are actually high in protein and fat, and are used today in salads and pestos. Native people typically roasted them prior to storing. The nuts can be eaten whole, but can also be ground into flour and boiled to make gruel. Unfortunately, this tree has declined due to the recent prolonged drought in the Southwest. A good example of a pinyon pine can be seen at the upper end of the Museum's life zones exhibit and in the mountain woodlands exhibit.

Texas Mulberry

(*Morus microphylla*)

Texas mulberry is a small tree found along some drainages in the southwestern United States and northern Mexico. When the drupelets were available, these tasty reddish-purple fruits were eaten by Native peoples throughout its range. On Museum grounds, Texas mulberry can be found in the mountain woodland exhibit.



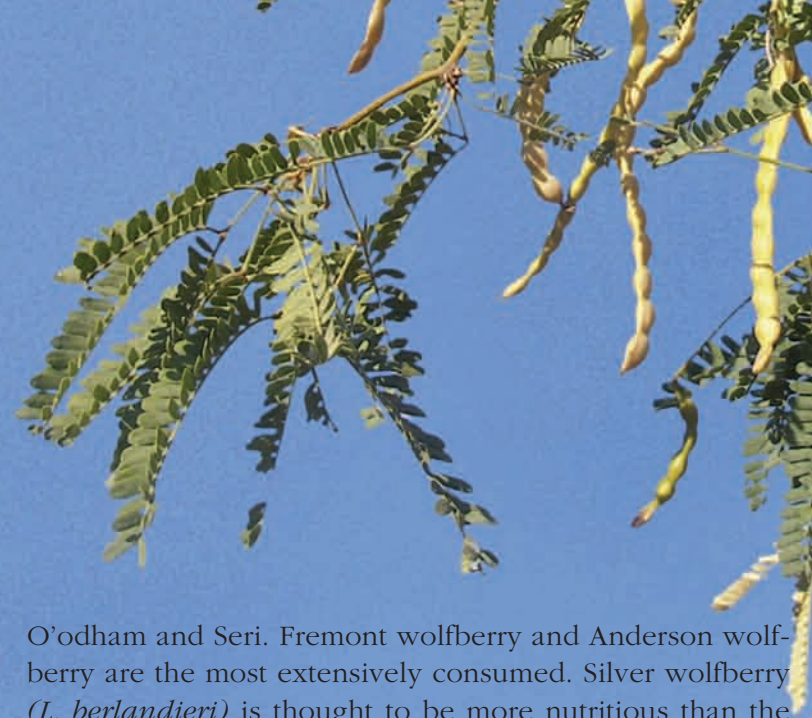
Wolfberry

photo by Mark Dimmitt

Wolfberry

(*Lycium fremontii*, *L. berlandieri*, *L. andersonii*, *L. brevipes*, *L. pallidum*, *L. exertum*, and others)

These thorny desert plants are in the same family as the tomato, and have been heavily harvested by all desert peoples, from the Navajo and Hopi to the



On Our Grounds

Many edible plants served several ethnobotanical purposes for early residents of the Southwest. For example, **pinyon pine** was used for medicinal and spiritual purposes by tribes of the Four Corners region. Its sap was used to protect skin wounds, as well as to waterproof clay pots and baskets. The greasy meal of the nuts conditioned shoe leather.

The wood of the **Texas mulberry** was highly prized for the making of bows, and for making an orange dye. Its use in making dye sparked a commercial enterprise, with wood shipped from Mexico to the United States to feed the trade.

Suggested Reading:

Hodgson, Wendy. *Food Plants of the Sonoran Desert*. Tucson, AZ: UA Press, 2001.

SABORES SIN FRONTERAS/ FLAVORS WITHOUT BORDERS:

FRUIT DIVERSITY IN DESERT AGRICULTURE OFFERS
RESILIENCE IN THE FACE OF CLIMATE CHANGE

GARY NABHAN, PH.D.
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SOUTHWEST STUDIES CENTER,
UNIVERSITY OF ARIZONA,
AND JESÚS GARCÍA,
EDUCATION SPECIALIST,
ARIZONA-SONORA
DESERT MUSEUM



Tumacácori Mission



pomegranate

AGRICULTURE IN THE SONORAN DESERT
BEGAN MORE THAN FOUR THOUSAND YEARS AGO
WITH THE INTRODUCTION OF SUCH FOOD CROPS AS
MAIZE, TEPARY BEANS, AND CUSHAW SQUASH FROM
FARTHER SOUTH IN MEXICO. IT WAS ENRICHED IN
THE LATE 1600S BY THE JESUIT INTRODUCTION OF
FRUIT TREES, GRAINS, AND GARDEN CROPS

ALREADY ADAPTED TO THE
CONDITIONS IN DESERT OASES.
MANY OF THESE CROPS ARE STILL
CELEBRATED AS OUR UNIQUE, PLACE-BASED
HERITAGE FOODS—FOODS SUCH AS SERRANO
CHILES, TEPARY BEANS, MISSION FIGS, OLIVES,
GRAPES, QUINCES, AND POMEGRANATES. AND YET,

EVEN AS WE CELEBRATE
OUR RICH BINATIONAL AGRICULTURAL
HERITAGE, WE MUST BE AWARE THAT ANOTHER
MAJOR SHIFT IN OUR FOOD SYSTEM HAS BEEN
INITIATED, AS GLOBAL WARMING, MORE FREQUENT
HURRICANES, FLOODING, AND DROUGHT HAVE
BEGUN TO AFFECT OUR FARMS AND RANGLANDS.



photo by Jesús M. García



photo by Gary Nabhan



photo by Jesús M. García



photo by Gary Nabhan



upper left: Quince from Oracle.
top middle: Lemons
top: Farm in Baja California Sur, Sonora.
cut out: Sosa-Carillo black mission fig (*Ficus carica*).
above: Olive tree orchard.
right: Harvested and cured olives.



photo by Suzanne Nelson

Of the many ways that climate change is affecting the shared food system of the U.S.-Mexico borderlands, three effects are particularly worthy of our concern:

1 Winter warming trends, which may keep certain kinds of trees from bearing fruit for lack of enough “chill hours” during the colder months;

2 Summer warming trends, which may not only increase water requirements for summer crops, but may also kill the pollen of some beans and vegetables, reducing their yields;

3 Increased saltwater intrusion from the Sea of Cortez, salinizing aquifers, and even flooding coastal farmlands.

In order to fend off these threats, we need a diverse and more water-conserving agriculture, one that is resilient, able to adapt to changing conditions. We will never pump as much fossil fuel and fossil groundwater out of the ground as we have during the last eighty years. Because

both groundwater and the energy to pump it may be limited, we may have to reconsider more arid-adapted crops such as the ones which Sonoran Desert farmers have relied upon for centuries. We may also have to return to sun-based productivity of grass-fed and grass-finished beef rather than relying on the feedlots that are fueled more by gas and electricity than by solar energy. Furthermore, we may have to rely on more locally-produced food for our nourishment, since about a quarter of all the energy used in our food system is invested in transporting, cooling, and keeping foodstuffs moist after they have been harvested.

One necessary step toward a more diverse, sustainable, and resilient food system in the Sonoran Desert is assessing which food crops are unique to this region, and how they can best be conserved and used. From white Sonora wheat to Mission figs, from Corriente cattle to Churro sheep, the borderlands states have many unique food resources. Some products, like chiltepines, bacanora (a liquor), quince (membrillo), and prickly pear jelly are celebrated in our airport gift shops and community festivals;



photo by Gary Nabhan

A variety of huge squash grown in Baja, California.

other foods such as cholla buds, prickly pear (fruit and pads), palo verde beans, and mesquite beans and flour remain obscure to the general public, but are deeply valued by traditional desert communities.

In the fall of 2008, the Southwest Studies Center of the University of Arizona began a new borderlands foodways alliance called *Sabores Sin Fronteras/Flavors Without Borders*. With members in seven of the eight borderland states, including Arizona and Sonora, this binational, multicultural alliance seeks to document, celebrate, and promote the unique folkways associated with farming, ranching, and food preparation in our region. It lets farmers, ranchers, chefs, and cooks speak out about the new pressures and challenges facing them. It organizes researchers into teams that track a desert food from its producer to its buyer, to customs broker at the border, and on to the marketplace, chef, or home cook. And it seeks to document and re-tell the stories of our food and farming folkways through both traditional and non-traditional means. Last July ranchers, cooks, and educators from both sides of the border came together at a meeting sponsored by Sabores Sin Fronteras to discuss ways of putting grass-fed beef directly in the consumer's hands—for example, promoting the sale of carne asada tacos from organic grass-fed beef and making that an educational experience. Sabores Sin Fronteras has sponsored poetry

readings, documentary films, live music, and dance performances that encourage appreciation of Sonoran culinary traditions and the purchase of unique products from our region.

One of our most exciting collaborations was initiated by Jesús García, born in Magdalena, Sonora, Mexico, and now a bilingual environmental educator at the Arizona-Sonora Desert Museum. Jesús asked a simple question: How many of the fruit varieties originally introduced to the Sonoran Desert by Padre Kino and his fellow Jesuits still persist on one side of the border or the other? After several years of sleuthing he rediscovered a number of these “forgotten fruits” in southern Arizona and northern Sonora; six of us from three institutions recently searched for them in twelve desert oases in Baja California, where Father Kino and other Jesuits were stationed between 1698 and 1768. To our surprise, we found that the thriving desert agriculture of the peninsula's ranchero culture maintains at least 16 of the original “Kino-introduced” fruits, including Mission grapes, pomegranates, figs, dates, quinces, olives, sapotes, passion fruits, and guayabas. They range from extremely arid habitats receiving less than four inches of rainfall a year, to subtropical habitats in the Cape Region near La Paz, Baja California Sur. The extant diversity of these crops—if conserved and exchanged between traditional oasis orchard-keepers—could help buffer them from the vagaries of climate change.

Heirloom pears (Pyrus Communis)



photo by Jesús M. García

These cultivated fruits may also provide heritage products for sale to cultural, culinary, and eco-tourists, who already seek out dates from the oases palms, olive oil made from Mission olives, *vino generoso* made from Mission grapes, and goat cheese from the *sierra*. With collaborators at the Universidad Autónoma de Baja California Sur, Sabores Sin Fronteras participants from Sonora and Arizona have joined the RIDISOS network (an interdisciplinary network for sustainable and integral development of the oases of Baja California Sur) providing assistance to farmers in these desert oases. We hope that this living history—the trees and agricultural systems remaining since Kino's era—will continue to nourish and refresh us over the coming decades. **S**

TO BECOME A PARTICIPANT OR LEARN MORE ABOUT SABORES SIN FRONTERAS, SEE THE ARTICLE IN *Edible Phoenix*, SPRING 2009 (www.ediblephoenix.com), OR <http://swctr.web.arizona.edu/folklore/sabores>.

SUGGESTED READINGS:

RYDER, TRACEY. FLAVORS WITHOUT BORDERS/SABORES SIN FRONTERAS, *Edible Phoenix*, SPRING 2009.

NABHAN, GARY (ED.). *Renewing America's Food Traditions: Saving and Savoring the Continent's Most Endangered Foods*. WHITE RIVER JUNCTION, VT: CHELSEA GREEN PUBLISHING, 2008.

FOR A COMPREHENSIVE GUIDE TO SOURCES OF LOCAL AND HERITAGE FOODS, BEVERAGES, MARKETS, AND RESTAURANTS IN SOUTHERN ARIZONA, VISIT THE SANTA CRUZ HERITAGE ALLIANCE WEBSITE: SANTACRUZHERITAGE.ORG/DIRECTORY.



photo by Christine Conde



photo by Jesús M. García

above: Dr. Robert Emanuel, of the Kino Tree Project, with a century-old quince tree in Oracle, Arizona.

top: Jesús García in front of a 250-year-old olive tree in San Javier, Baja California, Sur.

right: A century-old black Mission fig tree in San Ignacio, Sonora.

below: A black Mission fig tree at the Sosa-Carillo Fremont house in Tucson, Arizona.



photo by Jesús M. García



photo by Jesús M. García

NATIVE MESQUITE PODS ARE HIGH IN DIETARY FIBER AND PROTEIN.



photo by Christine Conde

MESQUITE SNACKERS

A favorite from the Museum's Coati Kids Club pantry.

- 3/4 CUP FINELY GROUND AND SIFTED MESQUITE MEAL
- 1 CUP WHOLE WHEAT FLOUR
- 1/4 CUP SESAME SEEDS
- 1 TEASPOON SALT
- 2 TEASPOONS AGAVE NECTAR
- 2/3 CUP WATER
- 1/3 CUP OIL

COMBINE DRY INGREDIENTS IN A BOWL. ADD OIL, WATER, AND AGAVE NECTAR. MIX UNTIL THE DOUGH FORMS A BALL AND CLEANS THE SIDES OF THE BOWL. ROLL IT OUT ON A FLOURED BOARD UNTIL IT IS ABOUT A QUARTER-INCH THICK. CUT THE DOUGH INTO SQUARES OR RECTANGLES. LIGHTLY GREASE A COOKIE SHEET. BAKE FOR 25 TO 30 MINUTES AT 350 DEGREES.

MAKES ABOUT 75 SNACK CRACKERS.



photo by Suzanne Nelson

upper left: Date palm left: Close up of dates.



right: Vendor selling fresh quinces and pomegranates.

below: Local products on market shelves.



photo by Jesús M. García



Seafood and the Sea of Cortez: An Ecological Bouillabaisse

Nutritionists have known for decades that seafood is a premier source of top-quality protein, minerals, and vitamins (especially the important B-complex vitamins). Also, seafoods are low in fat and contain all nine essential amino acids—those that our bodies cannot manufacture on their own. And, ocean fishes contain 17 to 25 percent protein by weight. While that percentage is less than most meats, the protein in seafood is more readily broken down and absorbed than the protein in red meats and poultry. Furthermore, seafood contains substantial amounts of omega-3 fatty acids, a crucially important fatty acid that we can only obtain from the foods we eat. Omega-3 fatty acids help keep our bodies from developing arthritis, asthma, heart disease, stroke, and related disorders. Recent studies indicate that eating seafood can decrease your risk of heart attack, stroke, obesity, and hypertension. So, for *Homo sapiens* there is no question seafood contributes significantly to a healthful diet. But, what about the health of the marine environment and the impact that seafood harvesting has on marine ecosystems? Here in the Southwest, much (perhaps most) of our seafood originates south of the border, from the rich waters of the Sea of Cortez, or Gulf of California.

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Senior Director,
Science and
Conservation,
Arizona-Sonora
Desert Museum

photos by R. C. Brusca,
unless otherwise noted



*In this narrow gulf—as in all the world’s oceans—
up to 90 percent of the population
of most predatory fish species has disappeared
due to overfishing.*



For thousands of years this saltwater heart of the Sonoran Desert harbored what seemed to be an inexhaustible supply of seafood. The legendary productivity (and fishing) of the Gulf inspired the likes of John Steinbeck, Ed Ricketts, Thor Heyerdahl, Jacques Cousteau, Edward Abbey, Ofelia Zepeda, David Quammen, John Janovy, Jr., and Ann Zwinger to explore and celebrate its natural wealth. With a watery surface of some 100,000 square miles, the Sea of Cortez reaches within 50 miles of California and Arizona. Many North Americans eat from this wild but increasingly imperiled ecosystem, whether they realize it or not.

Since prehistoric times, seafood and shells from this great sea have been harvested and traded throughout the Southwest. In historic times, traditionally captured large predatory fishes near the top of the food chain—sea basses, groupers, corvinas, snappers, sharks, and the like—were harvested with no concerns for sustainability, as if their abundance could never be depleted. Thirty years ago, when I first started working in the Sea of Cortez, this was still the assumption. But no longer; given the dramatic fish depletions here and in the rest of the world’s seascape, we can no longer delude ourselves with the myth of unending abundance.

previous page: Lobster dinner; The Sea of Cortez (Gulf of California) from space. Photo courtesy of NASA.

left cut-out: The giant sea bass (*Stereolepis gigas*), like most large predators, was once abundant but is now greatly diminished in number and average body size in the Sea of Cortez. Photo by Jennifer Rupnow.

middle cut-out: The Panamic fig shell (*Ficus ventricosa*) lives at the same depths dragged by shrimp nets in the Sea of Cortez; it has been decimated by years of bottom trawling and is becoming rare.

right top: Industrial shrimp boat bycatch. For every pound of shrimp dragged from the seabed, 10 to 40 pounds of bycatch are killed.

right middle: Shrimp for sale in a Mexican market. Most shrimp from Mexico is now farm raised, although rarely in ways that are environmentally friendly.

right: The popular seafood market on the Ensenada waterfront (Baja California) sells locally harvested fish and shellfish to both residents and tourists.





As a result of over-fishing, populations of large predators are now a mere shadow of what they were 40 years ago.

In this narrow gulf—as in all the world’s oceans—up to 90 percent of the population of most predatory fish species has disappeared due to overfishing. Today, *all* of the traditionally fished species from the Sea of Cortez have been overharvested to the point of collapse, or near-collapse, of their commercial fisheries. Traditionally preferred finfish have been so reduced in numbers that many Mexican fishers now take virtually any fish they can catch, of any edible size. Decades of shrimp extraction have not only decimated shrimp populations, but also severely disrupted the seafloor ecosystem in much of the Gulf.

In the northern Gulf, the commercial finfish and wild-shrimp fisheries have essentially collapsed, and tourists in beach towns like Puerto Peñasco (Rocky Point) are now just as likely to be served cod or pollock, shipped frozen from Alaska or Europe, as a fresh local fish. Species once regarded as “trash fish” or “bycatch”—such as triggerfish, parrotfish, and skate—are now routinely sold in and restaurants. How did we get here and what can we do about it?

Ancient harvests from the **Sea of Cortez**

What were early inhabitants of the Gulf’s desert coastlines consuming, and are those edible species still abundant? Archeological excavations of prehistoric kitchen middens (dining-site trash dumps) indicate they were feeding on shellfish, finfish, crabs, and sea turtles from coastal lagoons and the open coast, although they also captured some terrestrial reptiles, mammals, and birds that lived along the coast. They relied most heavily on clams and blue crabs, and a few fish species taken from coastal lagoons and estuaries. Thus, many of the seafood traditions that began in the Sea of Cortez in prehistoric time continue to this day in western Mexico, while others, such as the ritual harvest of sea turtles, have all but disappeared as the animals themselves have dramatically declined over the last century.

above: Pre-Hispanic shell middens (dining refuse sites) can be found near virtually every coastal wetland in Sonora.

Filled venus clams (*Chione undatella*) and Panamic cockles (*Trachicardium panamense*) for sale today on the malecón at Kino Bay. Archeological excavations indicate these species were also popular with Native American inhabitants along the Sea of Cortez.



above: Artisanal (panga) fishers on the coast of Sonora.

cut-out: The Eastern Pacific pearl oyster (*Pteria sterna*) is the first species to be over-exploited in the Sea of Cortez, by Spanish colonists in search of pearls.



Most wild shrimp are captured by bottom trawling, “dragging” with heavy equipment that levels the seafloor—the undersea equivalent of clear-cutting forests.

The Ecological Depletion of the **Sea of Cortez**

Primary producers, algae and seaweeds that capture the sun’s energy at the base of marine food webs, are especially abundant in this semi-enclosed sea. This high primary productivity is driven by year-round strong solar input, upwelling of nutrient-rich bottom waters continuously drawn into the Gulf from the open Pacific, and good circulation. And, this productivity has supported one of the world’s most important concentrations of small oceanic fishes (such as anchovies, sardines, and mackerels), which in turn has provided critically important food sources for larger predatory fishes, jumbo squid, sea birds, marine mammals, and, eventually, humans. Beginning in the 1930s, however, a strong commercial fishery developed in this rich marine ecosystem, with some regrettable ecological impacts.

Remember John Steinbeck’s little gem of a novel, *The Pearl*? The first fishery in the Sea of Cortez to be over-fished was the pearl oyster fishery of the La Paz-Cape Region, which drew Spanish colonists to the area in the 1600s and 1700s. Today, every commercial species in the Gulf is probably overfished, except perhaps jumbo squid, which only recently arrived in the Gulf of California in numbers large enough to harvest. Artisanal fishers today take about 80 species of finfish and shellfish, using long-lines, gillnets, cast nets, hook-and-line, pots, and traps. An estimated 50,000 artisanal fishers operate 25,000 pangas in the Gulf today. And, another 10,000 fishers work on some 1,280 indus-



above: The jumbo squid (*Dosidicus gigas*) is thought to have become abundant in the Sea of Cortez as top-predator finfish have been decimated by over-fishing—the squids are presumably moving in to fill the “empty niche.” Photo by A. Kerstitch

right: Long-lines are one of the most destructive and indiscriminant fishing devices ever developed. They kill sea birds, marine mammals, and marine turtles, as well as having a high fish bycatch.

trial boats. Gulf waters are also subjected to fishing pressure from sportfishing by American tourists.

Today, the most important species for artisanal fishers are shrimp, jumbo squid, and clams. For the industrial fishery, the Pacific (or Monterey) sardine is the most important species, followed by shrimp, tuna, and squid. As traditionally sought large predatory fish and shrimp have dwindled, industrial fishers have shifted increasingly to sardines and jumbo squid.

The shift in primary target species has had significant socioeconomic impacts, but it could have even more profound ecological repercussions. Sardines and anchovy, and jumbo squid, are key elements of the Gulf’s oceanic ecosystem. They represent species very near the bottom and top of the oceanic food chain, respectively. Their population sizes have direct effects on the rest of the food web, including the reproductive success of seabirds. There is a real danger that their over-exploitation could result in fundamental changes in the oceanic ecosystem.

More than one-third of the seafood consumed in the world is now farm raised.



cut-out: The increasingly rare regal murex (*Chicoreus regius*) is a large, beautiful snail consumed locally in the Gulf. This species is often brought up in shrimp trawls and other bottom nets; the shells end up in curio shops.

right: Gill net from a panga fisher, with bycatch of snails and crabs.



Unsustainable fishing, bottom trawling, and environmentally unfriendly shrimp farming are perhaps the most serious threats to the ecological integrity of the Sea of Cortez today. As a result of over-fishing, populations of large predators are now a mere shadow of what they were 40 years ago. The devastated populations include sea basses and groupers, sharks, some snappers, and even some jacks. Due to overfishing, some spawning aggregations of these and others large species—especially the goliath grouper and giant sea bass—may have entirely disappeared from the Gulf.

Many less visible invertebrate species, also once-abundant, are also now rare here. Most wild shrimp are captured by bottom trawling, “dragging” with heavy equipment that levels the seafloor—the undersea equivalent of clear-cutting forests. The heavy chains on traditional trawl nets dig 15 to 30 centimeters into the seabed. For every kilogram of wild shrimp trawled, 10 to 40 kilos of additional bycatch is killed! Shrimp trawlers produce an inordinate percentage of the global bycatch—capturing less than two percent of the world’s seafood by weight, but one-third of the world’s bycatch. Worldwide, every year an estimated 150,000 endangered sea turtles are caught and dragged in shrimp nets until they drown. Shrimp trawlers kill more sea turtles than all other causes combined. ▶



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a challenge for **Shrimp Lovers**

Almost everyone loves shrimp, and almost every restaurant has at least one shrimp dish on their menu. But, the large shrimps typically marketed as “jumbo shrimp,” “Gulf shrimp,” or “Guaymas shrimp” are some of the most unsustainably harvested seafoods in the world. So, what is a shrimp-loving consumer to do? Well, here’s the deal.

First of all, shrimp come in two varieties. The big boys (“jumbo shrimp”) belong to a group known as the penaeid shrimps—technically, the *Dendrobranchiata*. The smaller shrimps, an inch or less in length and usually marketed as “bay shrimp,” “rock shrimp,” “northern shrimp,” or “salad shrimp,” belong to a group known as the caridean shrimps (technically, the *Caridea*). They are all crustaceans, but the two groups are only distantly related.

No need to worry about the small shrimp; they are by and large sustainably harvested. But jumbo shrimp is another story altogether. Traditionally, they are trawled from the seabed with gigantic nets—a process that literally destroys the seabed and all the life that lives there. Bottom trawling for shrimp is the most destructive fishing practice on Earth. In the United States there are regulations that require shrimp fishers to use better designs of bottom trawls, so the damage from U.S. trawlers is somewhat less than seen in most of the rest of the world. Even so, they still cause an unacceptable level of seafloor damage. One fishing operation in the Sea of Cortez (*Pesquera Delly*), has been trying to lead the way in Mexico by using these less-destructive net designs; however, the future of this effort is



left previous page: Gulf cleaner shrimp (*Lysmata californica*); above: Shrimp in fish market; Industrial shrimp boat bycatch; Coastal mangrove lagoons are critical nursery habitats for commercial shrimps.

unclear. So, right now, the only good choice for wild-caught jumbo shrimp is the artisanal shrimp fishery of Mexico’s Sea of Cortez, which uses small boats (pangas) powered with outboard motors, and floating nets rather than bottom trawls. However, since there is not yet a certification process that tells consumers the origin of the Mexican shrimp sold in our markets, it is best to avoid all Mexican shrimp, and also all U.S. wild-caught shrimp.

For now the consumer’s best choice for sustainably produced **jumbo shrimp is U.S. farm-raised.**

The alternative to wild-caught shrimp is farmed shrimp. Almost all shrimp farming takes place in earthen lagoons dredged along coastlines in the world’s tropics, where environmental regulations are typically weak or unenforced. Coastal environmental impacts are especially high in Southeast Asia, e.g., Thailand, Vietnam, and Bangladesh. (These are the only three countries of origin I saw on a recent frozen-shrimp search at my local Trader Joe’s market!). Endangered habitats such as mangrove forests are being destroyed or degraded in all of the tropical countries where shrimp farming is taking place. And, once the shrimp ponds are in place, the operations flush directly into the sea, polluting it with wastewater, a variety of chemicals (pesticides, antibiotics, powerful disinfectants), escaped exotic shrimp, and exotic strains of shrimp diseases that infest local wild populations.

But, there’s good news. U.S. shrimp farmers must adhere to strict regulations that circumvent most of the above problems. For example, U.S. shrimp farms are not allowed to drain directly into the sea. And, more and more U.S. farms are using largely vegetable-based feeds

that produce shrimp at close to a 1:1 ratio of fish-food to shrimp production, as opposed to fish pellets made from wild-caught fish, requiring a 3:1 ratio (an actual net loss from the sea). A fine example of good shrimp farming practices is the Desert Sweet Shrimp Farm in Gila Bend, Arizona (www.desertsweetshrimp.com). In Mexico, in just the past few years, new federal and state regulations on shrimp farming have also been improving the situation. Some farms are

moving inland, away from the fragile coastal environment, and in Sonora these new shrimp farms often use land that was long-ago ruined by too many years of intensive agriculture—barren land is thus being recycled and put to good use. These inland shrimp ponds still drain to the sea, but the long canals (up to several kilometers) quickly develop a natural flora and fauna of their own that helps to “filter” the discharge water before it reaches the coast. A good example of these improved practices in Mexico is the La Borbolla shrimp farm, south of Kino Bay. La Borbolla has roughly a 1:1 ratio of fish-food to shrimp production, and can produce 25 to 35 shrimp per square meter of pond. In 2008, the operation produced over two million pounds of Pacific white shrimp. But, these kinds of shrimp farms are still rare in Mexico.

So, for now the consumer’s best choice for sustainably produced jumbo shrimp is U.S. farm-raised. Hopefully, in the near future Mexican farmed shrimp will be equally sustainably produced. Sticking to conscientious choices will be a challenge for shrimp-lovers, but it is one we must confront.



Seafood

Is Aquaculture the Answer?

More than one-third of the seafood consumed in the world is now farm raised. Aquaculture has the potential to relieve pressures on declining wild seafood populations and create waste-free sustainable production—*if it is done right*. Unfortunately, this rarely happens, especially in the developing world (where most of our farmed seafoods originate). Most of the world's saltwater farming (mariculture) actually threatens wild fish stocks and disrupts or destroys natural habitats.

The cultivation of carnivorous fish and shellfish (e.g., salmon, shrimp) has traditionally depended on catching wild fish to feed them, and these farms rely on huge quantities of wild-caught seafood. It can take over three kilos of wild-caught fish to raise one kilo of farmed salmon or shrimp, resulting in a *net* loss of fish from the sea. Today, about a quarter of all seafood caught in the wild is converted into fishmeal to feed farmed fish and shrimp.

In addition, farmed fish and shrimp, whose place of origin is typically not local, frequently escape into the sea, polluting the gene pools of native species and introducing exotic diseases. For all these reasons, marine species that are low in the food chain and subsist on a plant diet (herbivores) and will breed in captivity (e.g., catfish, trout, tilapia), are the best options for aquaculture.

The first commercial shrimp farms in the Sea of Cortez were constructed in coastal Sonora in the 1980s. As of 2007, more than 150 shrimp farms had been built on the Sonora shoreline alone, covering an area of 100,000 hectares. Today, Mexico is the second largest producer of farm-raised shrimp in the Western Hemisphere, but by the Mexican government's own reckoning a few years ago, few of the shrimp farms gain high marks for sustainable practices.

In Mexico, shrimp are typically raised in dirt ponds bulldozed out of coastal habitat. Until very recently, these sites were typically placed in or next to critically important coastal wetlands, threatening habitat and rare or endemic marsh plants. Many of the Gulf's mangrove forests and tidal

Avoid these seafoods, at least for now. They come from sources that are overfished or are caught or farmed in ways that harm other marine life or the environment.

Chilean sea bass/toothfish*, corvina, groupers*, king crab (imported), mahi mahi/dolphinfish (imported), marlin, monkfish, orange roughy*, red snapper, salmon (farmed, Atlantic), sharks*, shrimp (all wild-caught, all imported), spiny lobster (Caribbean), swordfish (imported), totoaba, tuna (all tuna species caught by longline)*, tuna (bluefin, caught by any method)*

* Limited consumption also advised due to concerns about mercury or other contaminants.

Best Choices: These fish are abundant, well managed, and caught or farmed in environmentally friendly ways.

Arctic char (farmed), barramundi (U.S. farmed), bay scallops (farmed), catfish (U.S. farmed), clams (farmed), cod (Alaska line caught)*, crab: dungeness, stone, king, blue (U.S.), flounder and sole (Pacific U.S.), halibut: Pacific, herring: Atlantic/sardines, lobster (wild-caught from Pacific Baja* and Maine), mahi mahi/dolphinfish (U.S.), mussels (farmed), octopus, oysters, pollock (Alaska wild-caught), rainbow trout (U.S. farmed), salmon (Alaska wild-caught), shrimp (U.S. farmed), squid, striped bass (farmed), swordfish (U.S.), tilapia (U.S. farmed), tuna (pole-caught albacore, bigeye, yellowfin, skipjack), yellowtail (U.S. farmed)

*certified as sustainable to the Marine Stewardship Council standard (msc.org).

marsh ecosystems have been severely damaged due to a variety of coastal development, including the rapid growth of shrimp farms. In addition to habitat destruction, Mexico's coastal shrimp farms usually flush to the open sea. In doing so, huge nutrient loads from uneaten food, shrimp feces, and dead shrimp wash out to the coast—along with antibiotics, added vitamins and hormones, other chemicals used in the ponds, and, often, introduced (exotic) microorganisms from other regions that are imported with the shrimp that are introduced into the ponds.

Today, U.S.-farmed shrimp is your best choice because it meets strict



Consumer power is enormous! In restaurants, supermarkets, and fish markets, ask about the source of the seafoods you buy; ask if it is farmed or wild-caught (and, if caught, where and how it was caught).

far left: Estero Soldado (San Carlos) is one of the last remaining mangrove wetlands in Sonora that has not felt the impacts of shrimp farming.

left: Oyster farm at Kino Bay. Most oyster farms in the Gulf are small scale, open water, sustainable operations.

government environmental guidelines. Fortunately, the situation in Mexico is now beginning to improve and soon, hopefully, Mexican farm-raised shrimp will be on the recommended list. For now, one of the best places to purchase seafood is your local Wal-Mart. In 2006, the company made a pledge to America that their U.S. stores would sell only sustainably harvested seafoods, relying heavily on recommendations of the Marine Stewardship Council and Aquaculture Certification Council. Because Wal-Mart is the world's largest retail seller of seafood, this decision has had a powerful and positive impact on global seafood markets. In addition, the Walton Family Foundation provides hundreds of millions of dollars annually for marine conservation efforts; they are especially active in protecting the Gulf of California.

What is Being Done?

The rise of the conservation movement in Mexico over the past 20 years has led to significant increased pressure on federal agencies, and meaningful steps are now being taken to protect the Sea of Cortez for the future. Since the landmark declaration of two biosphere reserves

in northwestern Mexico in 1993—the Alto Golfo de California y Delta del Río Colorado, and the El Pinacate y Gran Desierto de Altar Biosphere Reserves—hard work and steady lobbying has resulted in the establishment of 15 more protected areas on the Baja California peninsula and in the Sea of Cortez.

Creating change in fisheries management has been harder. However, because of declining fisheries catches, pressure from environmental organizations, the rise of sustainable seafood initiatives, and new political leadership, things are starting to change. There is reason to believe that the government of President Felipe Calderón recognizes the need for better fisheries management. Some positive first steps are being taken. New federal and state laws in Mexico are establishing environmental controls over coastal aquaculture, including shrimp farming. New coastal wetland protections are forcing shrimp farms inland, away from sensitive coastlines, and regulations on the import of exotic “seed” shrimp and on aquaculture pond discharges are now appearing. One of the best examples of sustainable mariculture are the oyster farms that have sprung up in most of Sonora's coastal lagoons over the past 20 years or so; these farms use no additives and do not pollute or negatively impact the environment.



*We don't need to stop eating seafood;
people lived in a balance
with the sea for thousands of years, until only recently.*

What Can You Do?

Because we are now aware of the depletion of the seas, we have a greater responsibility, not just for the sake of the marine environment but also for our own selfish interests, to pay attention to the sources of our seafood. And we now have a wealth of information about what to buy and what to avoid to help prevent the overharvesting and degradation of the Sea of Cortez and other ocean environments.

In restaurants, supermarkets, and fish markets, ask about the source of the seafoods you buy; ask if it is farmed or wild-caught (and, if caught, where and how it was caught). As evidenced by the history of tuna fishing, **consumer power** is enormous. Express your interest in sustainably harvested products, and don't buy finfish and shellfish whose populations are being decimated. The status of these fish may change over time, so keep up-to-date via websites like those at the end of this article. In the meantime, use the lists on these pages to guide your purchases. The Marine Stewardship Council lists supermarkets and restaurants worldwide that carry the council's sustainable certification, as well as sustainable seafood sources for your business.

top: Floating tuna farms off the Pacific coast of Baja California.

middle left: Seafood market, Baja California.

middle right: Gulf giant hermit crab (*Petrochirus californiensis*).

left: the long-beaked common dolphin (*Delphinus capensis*) occurs in pods of up to hundreds of individuals in the Sea of Cortez. They are frequently killed by drowning in gill nets that indiscriminately kill anything that gets trapped in their mesh.

For more comprehensive coverage on sustainable seafood choices, visit:

Arizona-Sonora Desert Museum
(desertmuseum.org/center/seafood.php)

Monterey Bay Aquarium Seafood Watch Program
(mbayaq.org/cr/cr_seafoodwatch)

Marine Stewardship Council: (www.msc.org)

Oceans Alive (oceansalive.org)

Seafood Choices Alliance (seafoodchoices.com)

We don't need to stop eating seafood; people lived in a balance with the sea for thousands of years, until only recently. Fish from the Sea of Cortez, our Sonoran Desert ocean, remains an excellent choice for local healthy food. But we need to better manage our harvests and our consumption to prevent catastrophic collapse of marine ecosystems.

A Special *flea* to Southern Arizona Restaurateurs

Please consider doing what the Ironwood Food Service's restaurants do at the Desert Museum—make a pledge to serve only sustainable seafoods. It's easy. Just dedicate your menu to seafoods in the "best choices" list in this issue of *sonorensis* (or the "best choices" listed by Monterey Bay Aquarium's Seafood Watch program). Delicious preparations are easy—think farmed bay scallops, Alaskan salmon and flounder, Pacific halibut, Maine or Baja lobster, U.S. mahi mahi, U.S. farmed shrimp and tilapia, and farmed mussels, oysters, and trout. In Monterey, California, over two dozen restaurants are now serving 100 percent sustainable seafoods. If they can do it, so can Arizona. Go sustainable, and let the Desert Museum help promote your good work! **S**

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Pineapple & Rum Marinated Shrimp

Shrimp is high in protein and vitamins B12 and D.

with mango-papaya relish

*Courtesy of Nick Ruman, Executive Chef,
Ironwood Food Services,
Arizona-Sonora Desert Museum*



16 jumbo shrimp

marinade

- 4 tablespoons lime juice
- 1 teaspoon pureed chipotle (no seeds)
- 6 ounces pineapple juice
- 2 ounces rum
- 1 teaspoon minced garlic
- 1 ounce prickly pear syrup
- 1/2 teaspoon salt

relish

- 1/2 mango, diced
- 1/2 papaya, diced
- 1/2 green pepper, diced
- 1/2 red pepper, diced
- 1/3 red onion, diced
- 2 ounces pineapple juice
- 2 tablespoons lime juice
- 2 tablespoons red wine vinegar
- 1 teaspoon minced fresh ginger
- 1 teaspoon minced garlic
- 1/2 teaspoon salt
- optional – 1/2 seeded and chopped serrano chili

1. Devein the shrimp by making a shallow slit down the back and picking out the vein.
 2. Marinate shrimp on their skewers for 2 to 4 hours only, not more or the shrimp will get tough.
 3. Mix all relish ingredients and let stand for 2 or more hours.
 4. Grill shrimp over medium, not hot heat, turning once, for 2 to 4 minutes on each side. Remove *as soon as* the outer skin has changed color from gray or bluish to orange or pinkish. **Do not overcook!**
 4. Put relish on plate and top with grilled shrimp.
- Serves 3 to 4 people.
- Fried yam matchsticks make a nice garnish.



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