Second American Dendrochronology Conference

University of Arizona

Laboratory of Tree-Ring Research

AmeriDendro 2013

Midweek Excursions

May 15, 2013

1:00 PM – 8:30 PM

Biosphere 2 and Hohokam Archaeology (blue line): One of the world's most interesting scientific installations, the UA Biosphere 2 is truly unique as a building and as a research center. Our tour of the UA Biosphere 2 will include going inside. Then, Catalina State Park has the Romero Ruin, a classic period Hohokam surface pueblo, and a bosque of mesquite, one of the more important tree species of the Sonoran desert. Owls are possible at dusk.

UA Biosphere 2

Romero Ruin ballcourt

mesquite bosque

Biosphere 2--Catalina State Park Hohokam			time
1:00 PM	2:30 PM	drive to Biosphere 2	1:30
2:30 PM	5:00 PM	tour Biosphere 2, gift shop, photo, yes bathrooms	2:30
5:00 PM	5:30 PM	drive to Romero Ruin	0:30
5:30 PM	6:30 PM	Romero Ruin, no bathrooms	1:00
6:30 PM	6:35 PM	drive to picnic area	0:05
6:35 PM	7:40 PM	dinner, mesquite, sunset 7:15, photo, yes bathrooms	1:05
7:40 PM	8:30 PM	drive to DoubleTree	0:50

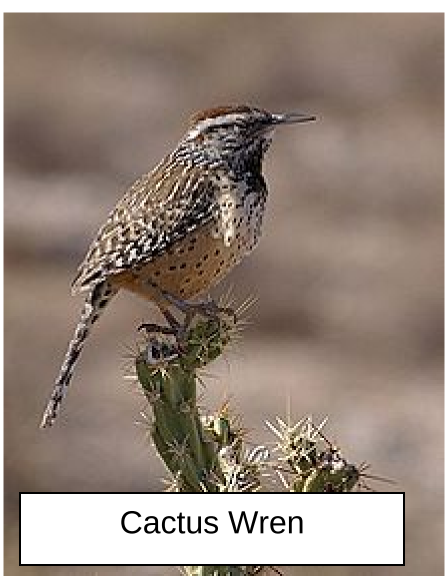
Keep your eyes and ears open for this guy. Harmless when left alone, but dangerous if provoked or stumbled onto.


White-throated Swift


Curve-billed Thrasher


Turkey Vulture


Vermillion Flycatcher


Cactus Wren

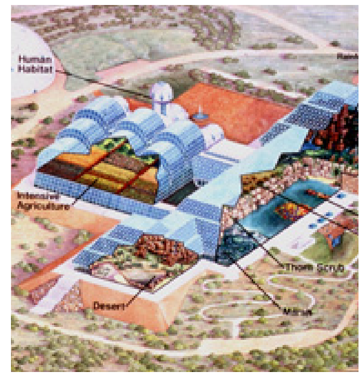
Gambel's Quail

ARIZONA | UA SCIENCE Biosphere 2

www.B2science.com

BIOSPHERE 2: A BRIEF HISTORY

An experiment in place and time



Biosphere 2 is located in scenic high-desert country in Pinal County 20 miles north of Tucson, Arizona. Situated at an elevation of 3,900 feet in the foothills of the Santa Catalina Mountains, Biosphere 2 is at the center of a developed campus that covers 250 acres.

Once a Native American hunting ground, this area was identified for its mining potential in the late 1870s. As more mining claims appeared, a cattle ranch and boarded house were established, and the nearby town of Oracle began to grow.

In the 1920s, a Canadian dentist homesteaded the the Cañada del Oro Ranch, just west of Oracle, on what would become Biosphere 2 property. He lived there until his retirement in 1957, when he sold the to Lady Margaret, Countess of Suffolk. During Lady Margaret's ownership, a Spanish-style home—complete with a pool, servants' quarters and garage—was built. Lady Margaret retained ownership of the ranch until 1968. Today the ranch property surrounds Biosphere 2. The pool has been removed, the house has been renovated as an administration building (Suffolk House), and other structures have been converted to bungalows for faculty and visitor accommodation.

In 1969, after Lady Margaret's death, the estate was sold to Motorola Corporation. Motorola constructed a management training institute featuring an airstrip, guest suites, meeting rooms and a dining area. In 1979 the property was donated to the University of Arizona Foundation. The Foundation used the property for corporate and educational retreats until 1984, when it sold the property to the founders of Biosphere 2 (Space Biosphere Ventures Inc.).

The next ten years were devoted to the design, construction and initial experiment phases of the Biosphere 2 project. The project's early goals called for the design of an enclosed facility with simulated environments that could be occupied by humans to demonstrate the inter-connectedness of humans and the environment. Construction of the main apparatus began in January 1987 and concluded in September 1991. The first mission lasted from September 1991 to September 1993 in which four men and four women lived inside Biosphere 2's sealed, energy-rich environment, growing all of their food and recycling their air, water and wastes. The experiment was an outstanding success in engineering terms but failed as a sustainable planetary ecosystem analog.

The main factor contributing to a dramatic imbalance in oxygen and carbon dioxide was the abundant microbes living in the extremely rich organic soil of the rainforest and farm areas. The soil supported rapid growth of the synthetic model ecosystems and crops in Biosphere 2, with rice yields as good as the world's best. However, the soil's metabolism was so active that it affected the environment's atmospheric composition. Oxygen was absorbed from the air by soil microbes. These released huge amounts of carbon dioxide from the soil back to the air, exceeding the photosynthetic capacity of plants to assimilate it and regenerate oxygen. The excess carbon dioxide was absorbed by the structure's unsealed concrete, and oxygen levels declined rapidly. With a leak rate of less than 10 percent per year, this imbalance of oxygen production, so vital for human life, caused the experiment to become unsustainable. A shorter second mission was carried out in 1993-94.

In April 1994, the project owner, Edward P. Bass, brought in new management to restructure the organization and research focus. He invited scientists from Columbia University to serve in an advisory capacity. In January 1996, Columbia University expanded its role and took full responsibility for research, education, and public outreach activities at Biosphere 2. On December 23, 2003, Columbia University discontinued its management of the Biosphere 2.

In July 2007, the University of Arizona assumed management at Biosphere 2 with a vision of understanding complex environmental systems by engaging both the scientific community and the public, integrating large-scale experimentation with computational modeling, and advancing awareness of the environmental and resource challenges. Four years later, the University of Arizona was gifted the 40-acre Biosphere 2 campus and facilities.

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THE UNIVERSITY OF ARIZONA.

Biosphere 2
Where science lives.

<u>Research initiatives at The UA Biosphere 2</u>

Managed by The University of Arizona, Biosphere 2 in Oracle, Arizona, is a major regional attraction and also serves as a laboratory for controlled scientific studies, an arena for scientific discovery and discussion, and a far-reaching public education center. Research at Biosphere 2 addresses issues of global environmental change using a multidisciplinary approach. B2 Institute, also based on the Biosphere 2 campus, offers a venue for programs to tackle the scientific “Grand Challenges” facing science and society—including issues of global climate change, the fate of water and how energy travels through Earth’s ecosystems.

Research at Biosphere 2 takes advantage of the facility’s unique spatial scale providing a bridge between small-scale, controlled, laboratory-based understandings of earth processes and experiments in field settings where it is difficult to control all environmental conditions. Biosphere 2’s size allows researchers to do controlled experimentation at an unprecedented scale, providing the missing link between the laboratory and the real world.

Initial experiments address interactions between plants and water. Within the facility, three hill slopes have been built, each about 32 yards (30 meters) long and 22 yards (20 meters) wide, to test how water moves down, into and across the slopes.

“The University of Arizona will develop Biosphere 2 into a center for research, outreach, teaching and lifelong learning about Earth, its living systems and its place in the universe,” said Joaquin Ruiz, Dean of UA’s College of Science. “The facilities and resources at this campus will be an inspiring place for researchers to gather and to tackle problems that science and society will face now and in the future.”

In addition, The University of Arizona operates the popular Biosphere 2 tours. The public watch research as it unfolds, Ruiz said. “This is one of the only research facilities that is completely open to the public. When people go on a tour they don’t hear a wonderful description of Biosphere 2’s history. They are able to watch research in action and learn what is going on moment-to-moment.

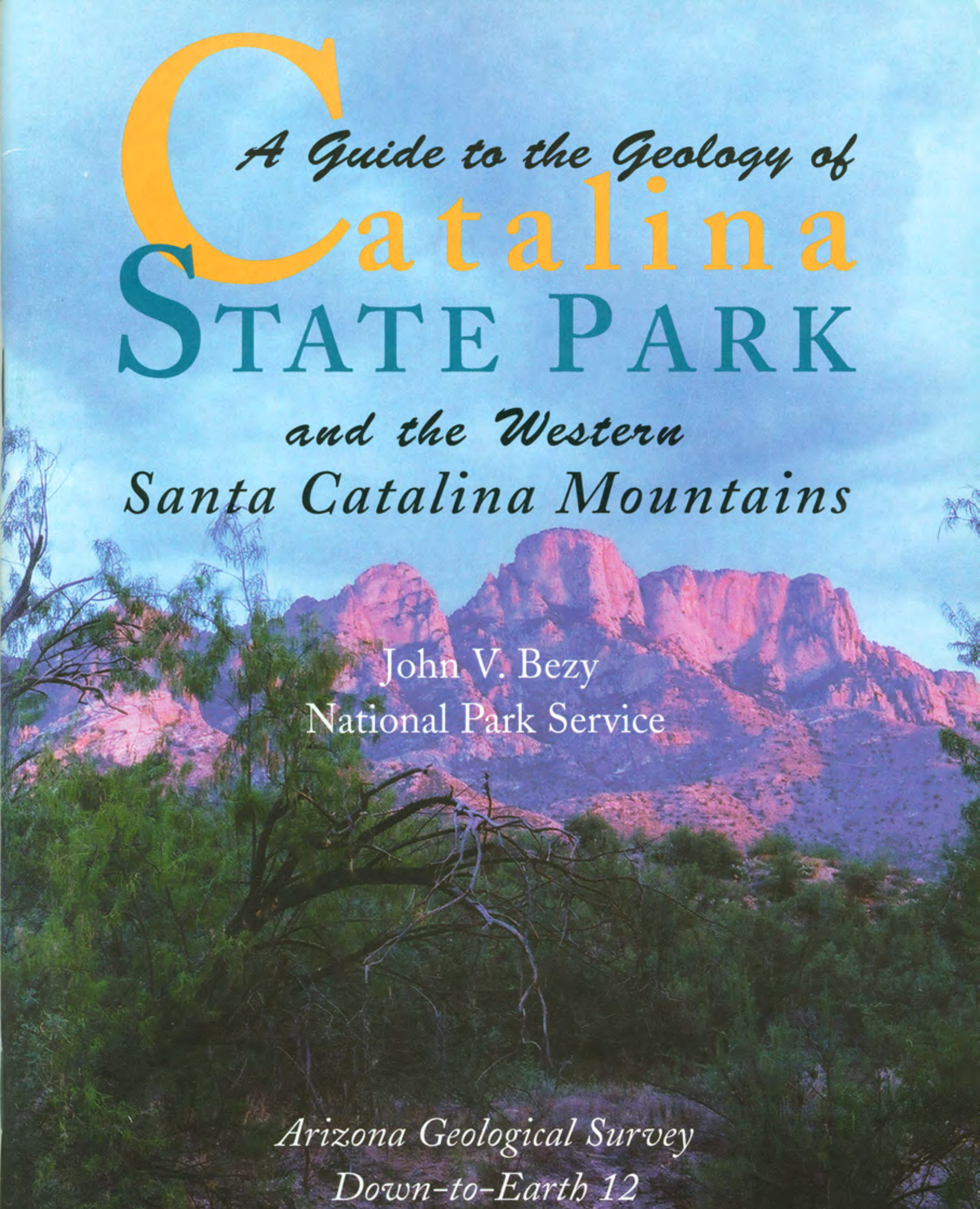
Our programs fall into three categories – (1) <u>Water & Climate</u>, (2) <u>Energy & Sustainability</u>, and (3) <u>Science Education & Teacher Training</u>:

Water and Climate:
(1) The evolution of landscapes as affected by climate and vegetation: *the ‘hillslope’ experiment.* How ecological, hydrological and geological processes all interact is key to predicting the consequences of climate change on our landscapes. Biosphere 2 is the only facility in the world that can evaluate these interactions at a scale that allows for complexity. We are carrying out a massive, interdisciplinary experiment to study how climate and vegetation affect the structure of soils to understand how water is

processed and made available to society. We are constructing one-of-a-kind, large experimental landscape units (hillslopes) that will be used in controlled environment studies to build the next generation of models that describe the ecology, hydrology and geology of our changing world.
(2) Transformative Behavior of Energy, Water and Carbon in the Critical Zone (CZ). With funding from the National Science Foundation, we are developing an interdisciplinary observatory in the southwestern U.S. that will improve our fundamental understanding of the function, structure and co-evolution of biota, soils, and landforms that comprise the earth's "Critical Zone" (CZ). Combined with the 'hillslope' experiment, this will result in a truly unique research infrastructure for the Earth Science community to inform decision makers on the implications of future policy on the water cycle, carbon dynamics and landscape feedbacks to climate change.

Energy and Sustainability:
(1) Biosphere 2 as a model city for innovative energy and water management strategies. We are using the Biosphere 2 campus as an isolated residential, commercial, and industrial scale energy and water demand model, representative of typical municipalities. We are evaluating strategies and consequences of alternative energy generation (solar), storage (battery and hydro) and use. We are also testing cyberinformatic acquisition and delivery schemes that support secure decision-making capabilities needed for smart-grids.

Science Education and Teacher Training
(1) The Arizona Center for STEM Teachers (ACST) and Teacher training. Through support from Science Foundation Arizona we are enhancing the training and retention of STEM teachers throughout Arizona. The ACST supports extended workshops and internships for over 300 teachers statewide over three years, impacting school districts in all regions of the State. ACST provides curriculum development support with the backing of university faculty, graduate students and master teachers, help with the acquisition and development of scientific content, and a portal for bringing active science their classrooms.
(2) The B2 Science and Society Fellowship Program: We are training the next generation of scientists at the University of Arizona who will break-down the barriers between science and society. Our program focuses on developing leadership and engagement skills for our graduate students through exercises in public outreach, media interactions, scientific interpretation and K-12 interactions. This program supports our reciprocal goals of enhancing scientists' communication skills and tackling public scientific literacy.



A Guide to the Geology of Catalina State Park and the Western Santa Catalina Mountains

John V. Bezy
National Park Service

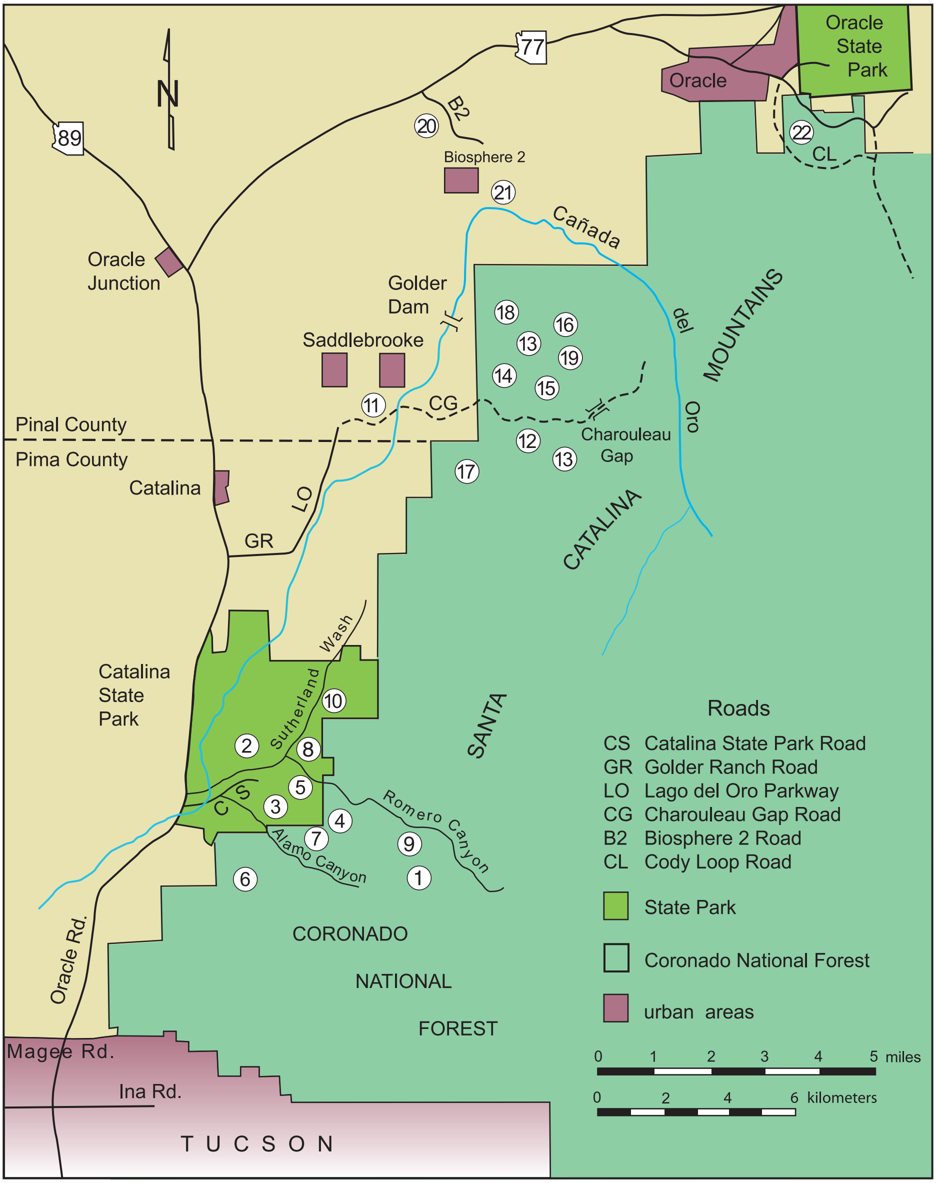
Arizona Geological Survey
Down-to-Earth 12

NATIONAL PARK SERVICE

ARIZONA GEOLOGICAL SURVEY
AZGS

Arizona State Parks

Satellite image of the western Santa Catalina Mountains



MAP A

Index map and location of geologic features (circled numbers)

Feature -1- Granite Pinnacles

Location: These features are best viewed along the Alamo Canyon Trail at Catalina State Park (Map C).

1.1

Catalina State Park is best known for the dramatic granite pinnacles (Figure 1.1) that have developed in the upper, cliff-forming unit of the Wilderness Suite granite in this part of the Santa Catalina Mountains. These towering spires are the products of surface weathering and erosion by running water guided by deep joints (cracks, see Feature 15) in the rock.

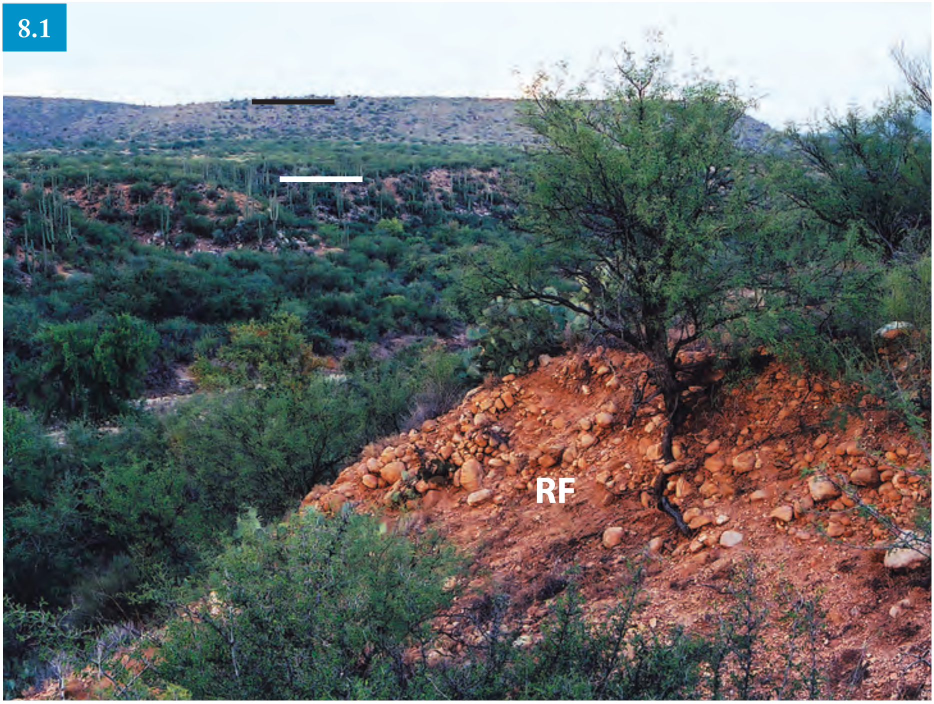
The Wilderness Suite granite differs from the Oracle and Catalina granites that make up the western face of the range in that it is dominated by widely spaced, vertical joints. These fractures serve as avenues along which chemical and physical weathering and erosion penetrate the granite. Rock shattering, caused by ice expansion, wedging by plant roots, and chemical decomposition, enlarges the joints. Water from rain and snowmelt is channeled into the joints, cutting them into ravines and canyons. Joints actually control the location of most streams crossing bedrock. This concentrated action of weathering and erosion eventually widens and deepens the ravines and canyons, leaving the massive granite in between standing as towering pinnacles.

The pinnacles at Catalina State Park are impressive testimony to the important role that rock structure—in this case joints—plays in the development of the landscape.

Feature -8- Stream Terraces

Location: Follow the Romero Canyon Trail for about 350 yards (320 meters) to a bench on the edge of a flat, step-like surface overlooking Sutherland Wash Valley.

8.1



These flat, step-like surfaces are **stream terraces** (Figure 8.1, dashed lines). They consists of silt, sand, gravel, cobbles and boulders deposited by running water. Note that tumbling in a stream during flash floods rounds the gravel-, cobble-, and boulder-sized rock fragments (RF).

Stream sediment was once much thicker in this area. Over the last several hundred thousand years, however, Sutherland Wash cut its valley into this sedimentary fill (Figure 8.2, A). Lateral erosion and deposition by the wash built a floodplain in the floor of the valley. Later, the wash cut its channel down into the floodplain (B), leaving remnants of the former valley floor as high standing stream terraces. Repeated episodes of sediment deposition and downcutting have produced a flight of terraces along Sutherland Wash (C) that are visible from this vantage point.

Stream terraces stand above the flash flood zones of valleys and have long been preferred locations for human settlements, agricultural fields, roads, and railroads. Romero Ruin, a 12th century Hohokam village, for example, was built on one of these terraces. For more information on the development of stream terraces see Feature 11.

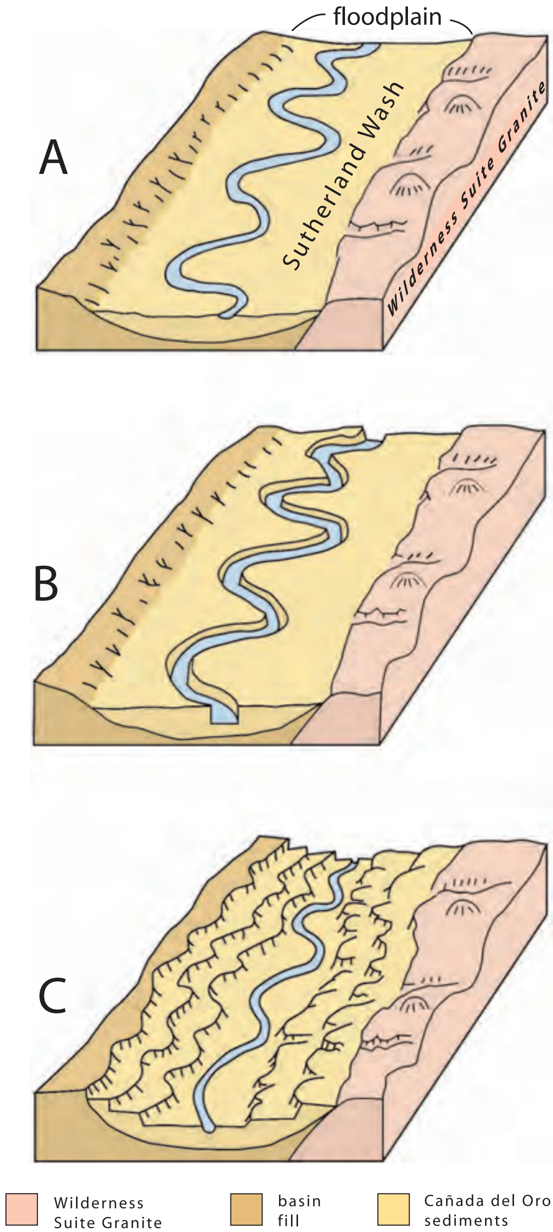
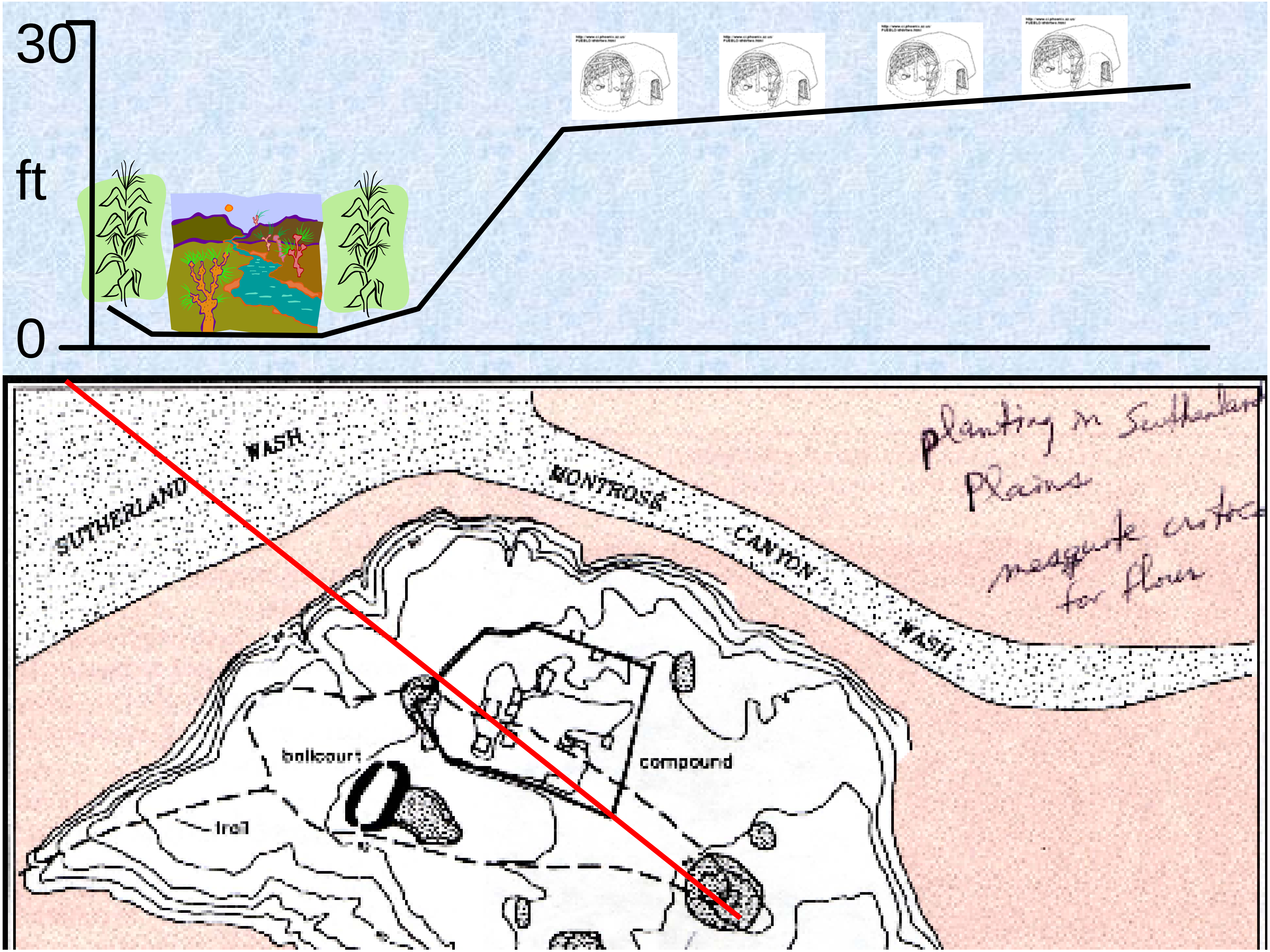
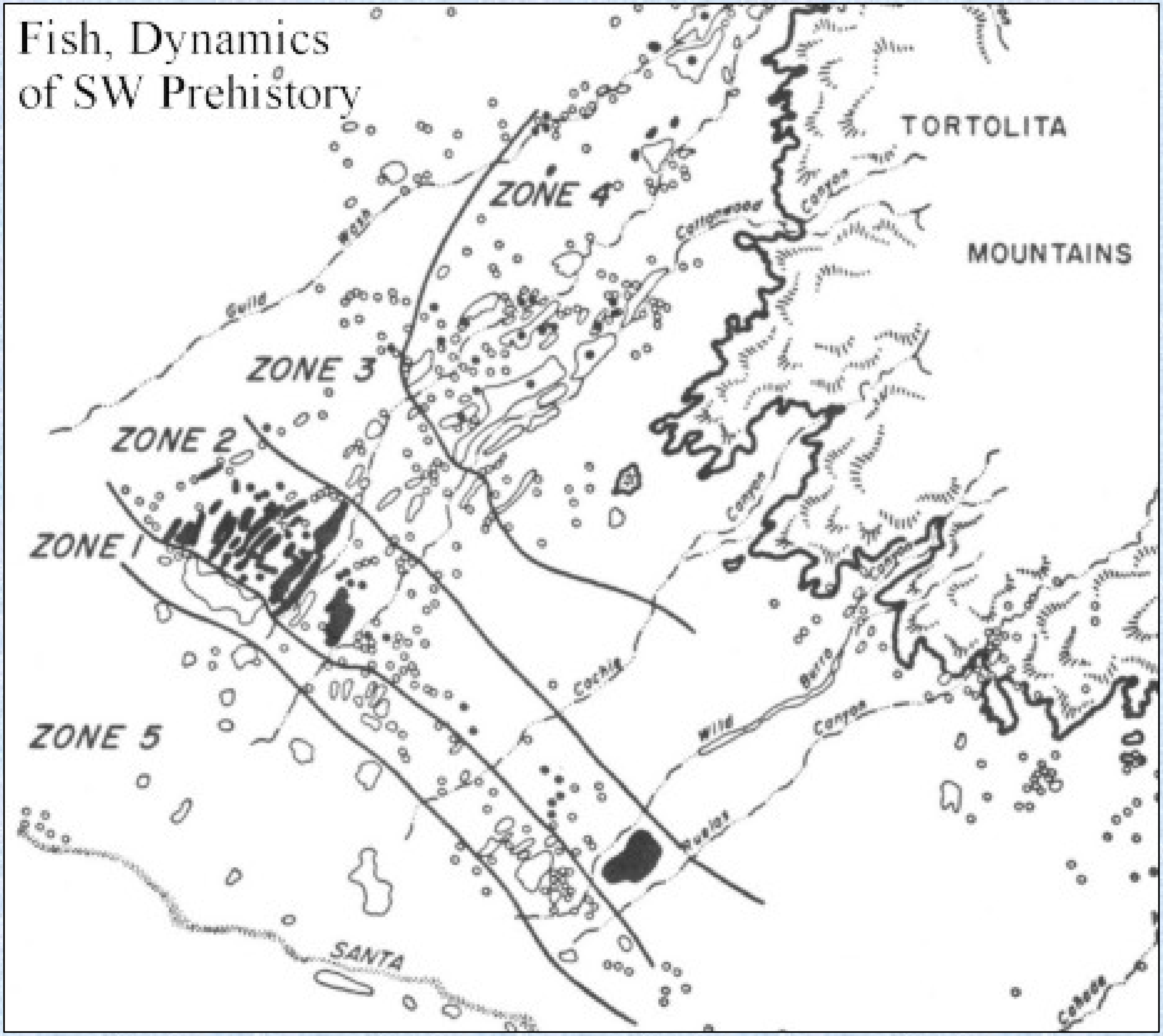


Figure 8.2 Sutherland Wash cut a floodplain in the basin fill west of the Pirate Fault (A). Sutherland Wash cut its bed into the sediment previously deposited along its floodplain (B). Repeated cycles of cutting and filling by Sutherland Wash produced step-like terraces along the margins of the valley (C).


30
ft
0
SUTHERLAND
WASH
MONTROSE
CANYON
WASH
ballcourt
compound
trail
planting in
Plains
mesquite
for flour



Microsite zonation by Hohokam

Paul's mesquite pancakes

1 cup (8 oz.)	mesquite meal
1 cup (8 oz.)	baking mix
1-2 cups	milk
2	eggs

Sift meal and mix together. Add eggs and milk and stir batter well. Cook on hot griddle.

Makes 1.0 scads of 2-in.-diameter pancakes.

Serve with mesquite- and/or prickly pear-flavored jelly.

Enjoy on a sunny but cool afternoon within a tranquil mesquite bosque, in the shadow of a majestic mountain range, in the neighborhood of a long-lasting but mysteriously abandoned Hohokam village, in the presence of a bold male Vermillion Flycatcher flashing his very very redness, all the while contemplating the essence of sense of place.

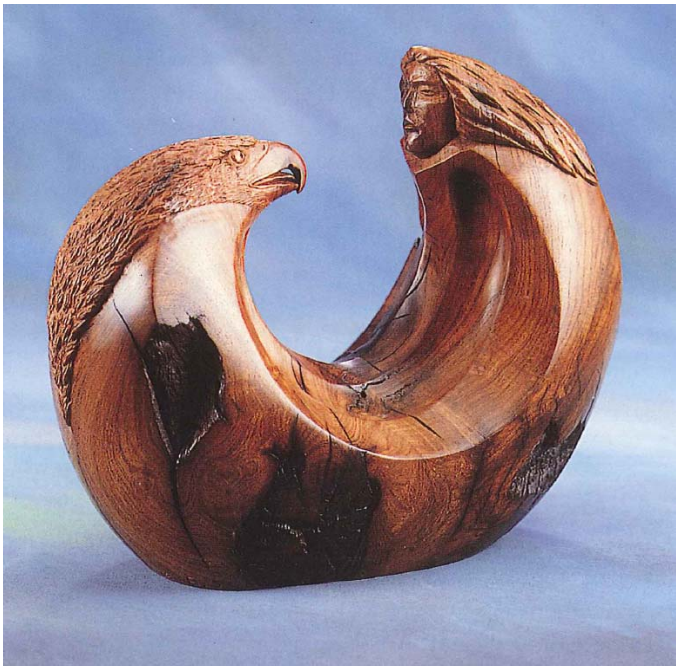
See other mesquite recipes in "Eat Mesquite!: A Cookbook," by Desert Harvesters.

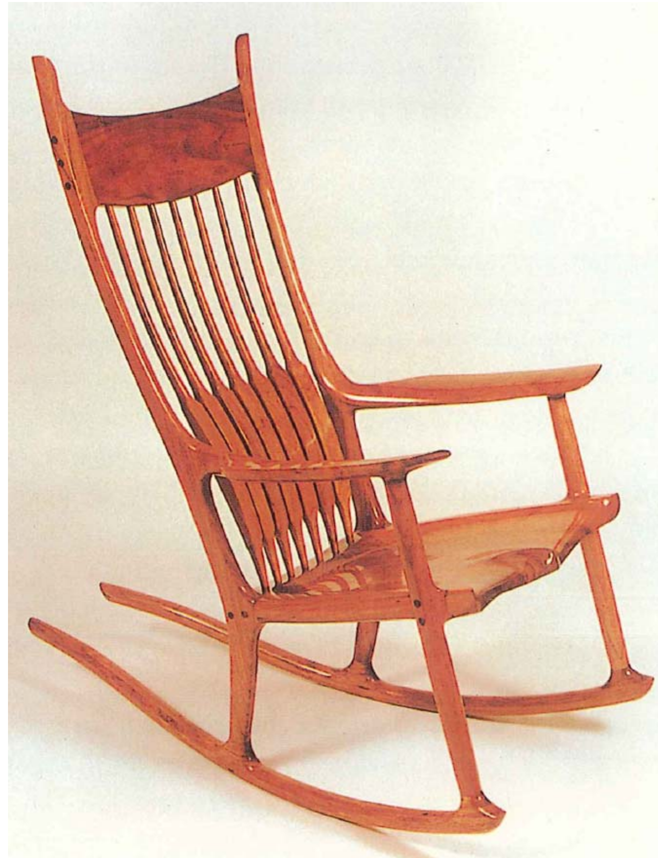
Current Uses of Mesquite in the Southwestern United States

- Fine solid wood products
- Carvings, turnings, sculptures, flooring, jewelry, boxes, paneling, veneers, pens/pencils, clocks, humidors, lumber, fireplace mantles, rocking chairs, tables, doors, desks, other furniture.
- Ornamental landscape specimens
- Firewood and stovewood
- Fenceposts
- Cooking and smoking wood
- Chips, chunks, flakes, mini-logs, compressed chip-logs, sawdust
- Foods and flavorings
- Liquid smoke, jellies, honey, pod flour
- Livestock fodder and shade
- Wildlife habitat food, cooling shade and cover (deer, turkey, quail, dove, etc.)

Nitrogen Fixation and Mesquite

Mesquite, like most plants of the bean family, interacts with bacterial microbes in the soil called *Rhizobium* which attach to the mesquite's roots, causing the mesquite to form nodules. The nodules appear on mesquite as swelling of the roots somewhat like root tubers. Current and past research suggests that at these nodules, in a symbiotic relationship with the mesquite, these microbes take atmospheric nitrogen from the soil and convert it to ammonia in a process called nitrogen fixation (Bailey 1976; Baird et al. 1985; Felker and Clark 1980; and Jenkins et al. 1989). This is a very ecologically significant process, as higher-level plants such as grasses and trees cannot use atmospheric nitrogen but can use ammonia (also an essential part of common commercial fertilizer). Through nitrogen fixation, the mesquite and the *Rhizobium* bacteria enrich the soil under the mesquite's canopy, thus enhancing the health and productivity of Southwest rangelands. Nitrogen fixation has been observed on mesquite trees both in the research laboratory and on the rangeland, although for many years the presence of *Rhizobium* nodules on mesquite's roots eluded researchers. Explanations for this difficulty in finding mesquite nodules were that their presence is highly dependent on soil conditions, root depths, and moisture conditions, and that they are present only during certain parts of the growing season. Given these factors, mesquite nodules have been hard to locate; basically only in the past decade have nodules been found on mesquite roots deep in the soil near the water table in a number





Mesquite wood products