

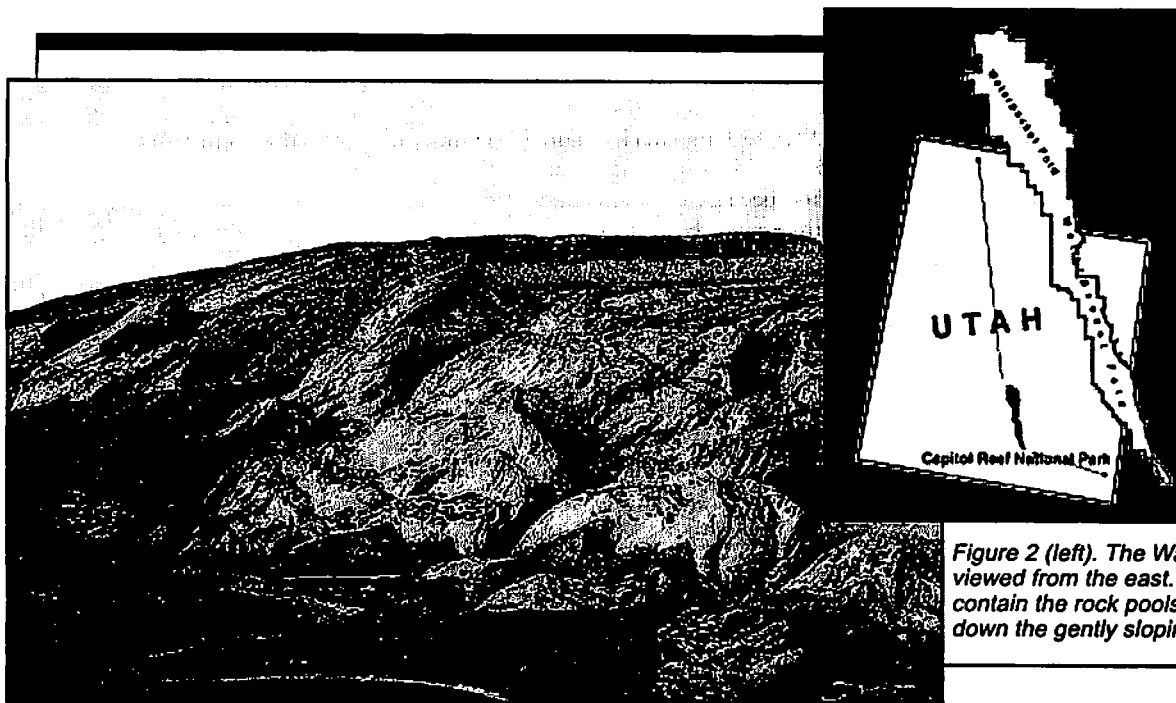


Figure 1. Located in southeastern Utah, Capitol Reef National Park nicely frames the Waterpocket Fold, a ridge that runs nearly the entire length of the park. The study took place in the southern end of the park in drainages that cut laterally across the feature.

Figure 2 (left). The Waterpocket Fold viewed from the east. Drainages that contain the rock pools cut across the fold down the gently sloping eastern side.

AN INTENSIVE STUDY OF DESERT ROCK POOL SYSTEMS IN CAPITOL REEF NATIONAL PARK

By TOBEN LAFRANCOIS

ALTHOUGH LOCATED IN ONE of the most arid regions of the Colorado Plateau, Capitol Reef National Park, Utah, contains very unusual aquatic systems. The park is located in Wayne and Garfield counties of South-Central Utah, 40 km (64 mi) west of Hanksville on highway U.S. 24 (fig. 1). The 125,000-ha (308,750 acre) park encompasses the Waterpocket Fold, a 62.5-km long by 1.25-km wide (100 mi x 2 mi) ridge of Navajo sandstone. The Waterpocket Fold contains many drainages cut laterally across its width due to water erosion (fig. 2). Within these drainages are rock pools, which form in series down the drainages (fig. 3). These rock pools are also called *tinajas*, which translates from Spanish as "water jug or tank." As a result of the specific geomorphology of the Waterpocket Fold, these rock pool systems are the best developed in the region (Spence et al. 1993). The Waterpocket Fold contains 80 major drainages including 460 tinajas (Berghoff 1994).

Rock pools in arid systems have received scant attention in the scientific literature, yet they may be the most susceptible of all aquatic habitats to hu-

man influences (Dodson 1988). Desert rock pools of the American Southwest are important ecological systems due both to their relative scarcity and their critical functions. Rock pools retain water in otherwise arid systems and are of focal importance to terrestrial wildlife; they also support unique plant communities (Dodson 1988; Spence and Henderson 1993; Van Haverbeke 1990) and are important for use in monitoring ecosystem health. Aquatic macroinvertebrates, which are the major component of Capitol Reef rock pool communities, are often excellent indicator organisms. They are important for monitoring such factors as water quality, anthropogenic disturbances, and other changes that affect the surrounding terrestrial system.

In the park, tinajas range from small, ephemeral pools to larger, permanent pools. Some have accumulated enough sediment to support wetland plant species (fig. 4) including cattails (*Typha* sp.), wetland grasses (*Phragmites* sp.), and black willow (*Salix nigra*). Against the backdrop of one of the most arid regions of the

Colorado Plateau, the presence of small wetlands offers a startling contrast.

THE STUDY

The chemistry, biology, and ecology of the Capitol Reef rock pools were studied by Dr. Jill Baron (National Biological Service), Dr. Boris Kondratieff (Colorado State University), and Toben Lafrancois (graduate student, Colorado State University). We gave special attention to the responses of these systems to disturbance. Park resource managers required baseline biological and chemical data on the rock pools for use when making policy and management decisions and when designing educational programs about the park.

We began the study in September 1993 and continued field work until the following September, concentrating on 20 rock pools in five different drainages along the Waterpocket Fold. We sampled the pools on a weekly basis from May to late August 1994. Although intensive, the sampling was nondestructive. We collected macroinvertebrates and anurans (members of an amphibian order that includes

frogs and toads) using a 1 mm² mesh standard D-net, field identified to the lowest possible taxonomic level, and ranked according to abundance categories. Physical and water chemistry data gathered at each pool included volume, temperature, pH, conductivity, and major ions. We also collected rainfall amount from two rain meters in each study drainage on a weekly basis. Chemical data from this project have also been analyzed.



Figure 3. Rock pools, or tinajas, form in a series down the drainages of the water-pocket fold.

Figure 4. Some tinajas collect sediment to support wetland plant species such as cattail.



ROCK POOL FAUNA

Several different groups of aquatic animal species common to the Colorado Plateau can be found in the park rock pools. Of these, most have a highly vagile (free-moving) adult stage, capable of dispersal over large areas. A large number (62) of macroinvertebrate and anuran species occur in the rock pools, about twice what has been reported from other rock pool studies in this area.

Aquatic insects are a major component of the rock pool communities. All typical groups of lentic (standing water) insects are found here, often represented by com-

mon and geographically widespread species. The northern case-making caddisfly (*Limnephilus taloga*), the small minnow mayfly (*Callibaetis pictus*), and many common dragonfly species were abundant in the rock pools. Aquatic beetles were particularly diverse and abundant. Water beetles commonly found ranged from the minute predaceous diving beetle (*Liodes affinis*) to the gigantic water scavenger beetle (*Hydrophilus triangularis*). Water bugs such as water boatmen (*Graptocorixa abdominalis*), giant water bugs (*Lethocerus americanus*), water striders (*Aquarius remigis*), and backswimmers (*Notonecta kirbyi*) also can be seen in the rock pools, along with mosquito (*Culex tarsalis*) and chironomid midge larvae (*Phaenopsectra dyari*). These examples represent some of the major groups of aquatic insects in the rock pools, but only a small fraction of the 62 inhabitants recorded to date.

Vertebrates in these pools are represented by frogs and toads, such as the canyon tree frog (*Hyla arenicolor*) and the spadefoot toad (*Scaphiopus intermontanus*). Some crustaceans found in the rock pools were fairy shrimp (*Streptocephalus texanus*)

and tadpole shrimp (*Triops longicaudatus*). These crustaceans are well-adapted to aquatic life in arid regions.

The animals that compose these rock pool communities are common, hardy organisms that are well dispersed across the Colorado Plateau. Many adult

beetles and waterbugs are capable of flight, while other groups such as the crustaceans and spadefoot toads are physiologically adapted to unstable habitats. These characteristics of the rock pool communities suggest that they would recover rapidly from such natural disturbances as floods or drought. During the summer of 1994, floods that occurred due to cloudburst storms did not significantly affect the rock pool communities. Furthermore, we observed no major difference between a rock pool community before a pool dried up and the community that appeared when the same pool was refilled

by rain. Rock pools that are components of wetlands, however, support a greater number of species than other rock pools (Lafrancois 1995) and can be expected to act as refugia from natural disturbances. The effects of human disturbances on these systems remain unknown.

BENEFITS OF MONITORING

Several advantages accompany intensive (weekly) sampling of aquatic resources. The number of rock pool species found in this study is over twice the previous park record. The relatively high number of sampling periods provided opportunity to statistically analyze aspects of the rock pools (such as presence or absence of surrounding wetlands) that affect the biological community. Understanding the natural variation of a community, which also requires frequent sampling of the system, is important when developing a data set that will be used as a baseline for a monitoring program. This research provided resource managers with necessary baseline information concerning uncommon and unknown systems. Data regarding the basic biology and ecology of the rock pools are necessary for future ecosystem monitoring and current management and education programs.

REFERENCES

- Berghoff, K. 1994. Capitol Reef National Park wetland survey summary report. Resource Management Division, Capitol Reef National Park, Utah.
- Dodson, S.I. 1988. Aquatic resources at risk. In Acid Rain and Air Pollution in Desert Park Areas, Proceedings of a Workshop, May 16-18, 1988, and Management Recommendations. Tucson, Arizona. National Park Service Technical Report NPS/NRAQD/NRTR-91/02.
- Lafrancois, T. 1995. Biology and ecology of rock pools in Capitol Reef National Park, Utah. M.S. Thesis. Graduate Degree Program in Ecology. Colorado State University. Fort Collins, Colorado.
- Spence, J.R. and N.R. Henderson. 1993. Tinaja and hanging garden vegetation of Capitol Reef National Park, southern Utah, U.S.A. *Journal of Arid Environments* 24: 21-36.
- Van Haverbeke, D.R. 1990. Physico-chemical characteristics and ecology of ephemeral rock pools in northern Arizona. M.S. Thesis. Department of Biology. Northern Arizona University. Flagstaff, Arizona.

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