

Warm-Temperate Interior Strands

Strand habitats also occur in flood channels of rivers, along banks of streams below hydroelectric dams, along receding reservoirs, and around intermittent fluctuating lakes. Vegetation of these harsh environments is made up of either short-lived successional species or plants adapted to periodic flooding, scouring or soil deposition, and in the case of playa lakes, high salinities or other special chemical conditions associated with evaporation of inland waters. Depending on substrate and frequency and type of inundation, interior strand communities along streams may be composed of sparse, open stands of riparian scrub species (e.g., *Baccharis salicifolia* and *Tamarix chinensis*), seedlings of riparian trees such as willows and cottonwood, or any of a number of characteristic annuals, biennials, and short-lived perennials, or barren except for simple plants such as algae (Fig. 178).

A narrow strand occurs along the mainstream Colorado River, within Grand Canyon, downstream from Glen Canyon Dam, where stability is provided by upstream dams that produce an almost-tidal, daily fluctuation in water levels. Sandbars and other available substrates are vegetated sparsely by Saltcedar, Coyote Willow, Seepwillow, and the introduced Camelthorn. This zone is an example of a remarkable exchange of materials from aquatic to terrestrial systems, with great numbers of aquatic invertebrates, principally the Scud (*Gammarus lacustris*) stranded in drifting algae, feeding ants and other streamside invertebrates as well as a myriad of vertebrates ranging from iguanid lizards (e.g., *Sceloporus magister*, *Urosaurus ornatus*), to insectivorous birds and raccoons.

Upstream from dams, along the margins (strands) of fluctuating reservoirs, Bermuda Grass may occupy a large percentage of the soil surface, growing rapidly downslope as waters are removed for irrigation or power production. It provides meadows heavily used by cottontail, jackrabbits and, in season, flocks of geese and ducks. Flooding of these grassy areas adds substantial nutrients to aquatic systems when high waters occur after snowmelt or summer monsoons. When southwestern reservoirs are relatively stabilized, with daily and annual fluctuations of less than a few meters, clumps of Common Reed (*Phragmites australis*) establish, floating on the water surface on the lakeward side during high water and settling to root at the water's edge when lake levels are down.

A number of shore and other coastal strand birds are equally adapted to interior strands along rivers and reservoirs. These include Spotted Sandpiper (*Actitis macularis*)—rocky stream channels during migration and in winter (grasses and marshlands used for nesting); Killdeer (*Charadrius vociferus*)—open ground, gravel bars; Rough-winged Swallow (*Stelgidopteryx ruficollis*)—cutbanks of streams; and Black Phoebe (*Sayornis nigricans*)—overhanging walls of canyon-bound creeks and rivers. Isolated sand bars are heavily used by wintering Canada Geese (*Branta canadensis*) and other waterfowl as a nighttime resting place and as a source of gravel. Raccoons are otherwise perhaps the most frequent homeotherms occupying inland strands while foraging at night, and a number of other scavengers, as along seacoasts, depend upon this zone for carrion, e.g., the Bald Eagle (*Haliaeetus leucocephalus*) and lesser, stream-dependent raptors such as the Black Hawk.

Inland river strands are also depended upon by the Spiny Softshell Turtle for basking and oviposition, and are similarly



Figure 178. Riparian strand along the San Pedro River within the Chihuahuan Desert south of Cascabel, Cochise County, Arizona. A seasonally inundated mud-sand substratum populated by a few plants of Burrobrush [*Hymenoclea monogyra*] and nightshade [*Solanum* spp.]. Elevation ca. 1,000 m.

used by other aquatic turtles in areas where they occur. Garter snakes, toads (*Bufo woodhousei*, *B. microscaphus*), and other, less aquatic adapted species, forage in strand. Debris and other sparse cover along streams and lakes may be occupied by frogs, principally the Leopard Frog; they are rarely found on open beaches or gravel bars where they would be highly vulnerable to aerial predators. No fishes regularly use the strand zone. However, the substantial nutrients derived from periodically flooded vegetation and debris undoubtedly enhance fishes and other aquatic organisms. Flood-deposited debris is processed by terrestrial reducers in this zone when dry, converting it to smaller particles that can more easily be used by the aquatic system (Bruns and Minckley, 1980).

Within the fluctuation zones of interior playa lakes even greater selection pressures come to bear. Salts accumulated in the vast internal drainage basins of the Southwest, especially in the Chihuahuan Desert where well over 300,000 km² are endorheic, often are sufficiently concentrated to affect water uptake by plants. Because these saline accumulations are periodically inundated, they qualify as strand, and many of the plants occurring there are the same as in maritime

situations. Vegetation, if present, consists of one or a few pioneer species including *Allenrolfea occidentalis*, Salt Grass, Sea-purslane (*Sesuvium verrucosum*), species of *Suaeda* (*S. jacoensis*, *S. palmeri*, *S. fructicosa*), *Salicornia rubra*, and the halophytic Lovegrass [*Eragrostis obtusiflora*]. A single species at low density often comprises the sole vegetation of such areas. Common species on higher, less frequently flooded and less saline habitats include *Atriplex acanthocarpa*, *A. obovata*, and other saltbushes, sacaton grasses (*Sporobolus arioides*, *S. wrightii*) and *Suaeda* spp. Even the most salt tolerant plants often grow at low to non-saline conditions, thus the "pioneers" listed above also live in other communities. *Allenrolfea occidentalis*, although characteristic of playa habitats (Ungar, 1974), is among the desert scrub on bajada slopes where individual plants may reach 2 m in height (Pinkava, 1978). However, severe saline strand habitats appear to have selected for an unique inland flora. Of 40 taxa considered halophytic in the Chihuahuan Desert, 25 (including 3 genera) are endemic to such areas (Henrickson, 1978).

Many species germinate and develop on these saline sites only after rains temporarily decrease soil salts, then die as salinity again increases. Annual grasses in this category



Figure 179. Dune field west of Laguna Grande (see also Fig. 176) in the Cuatro Ciénegas Basin, Coahuila, Mexico. Such dunes of gypsum or other materials are characteristic landscape features downwind of Pluvial lakes and are populated by both gypsophilous-adapted terrestrial and saline-adapted wetland plants. Elevation ca. 750 m.

include *Leptochloa fascicularis* and *L. uninervia*, various *Panicum* spp., *Bouteloua karwinskii*, etc. Herbs, either annual or perennial, are *Allionia incarnata*, *Heliotropium curassavicum*, *Salsola iberica*, *Hoffmanseggia glauca*, and *Tidestromia lanuginosa*, among many others. Aquatic macrophytes are rare. Wigeongrass (*Ruppia maritima*) sometimes becomes dense, but disappears as salinities rise. Other aquatic species (e.g., *Zannichellia palustris* and *Potamogeton pectinatus*) are even more ephemeral, appearing with temporary freshening of these brackish and saline environments.

As along the sea, larger playas have associated dune fields, some of which reflect the special nature of their waters in being of almost pure gypsum (e.g., White Sands, New Mexico, from Pluvial Lake Otero, and dunes in the Cuatro Ciénegas Basin, Coahuila, Mexico; Fig. 179). Under these circumstances, gypsophilous plant species have evolved to complement those especially adapted for existence in saline, interior strand.

Inland playa strands are remarkably inhospitable for animals. Available water is often too salty to drink and plants are

sparse and unpalatable. Black-tailed Jackrabbits (*Lepus californicus*) range into strand to feed when new growth or germination cycles follow freshening. Similarly, seed-eating birds (e.g., Mourning Dove, Black-throated Sparrow, *Amphispiza bilineata*) invade such areas for food, and avoid them when seed production is low (Raitt and Pimm, 1978). Some marsh and shore birds use these habitats, notably Snowy Plover and Avocet, which are characteristic of alkali playas at inland locales, and large flocks of Sandhill Cranes use Willcox Playa and other shallow water "dry" lakes as wintering ground, along with numerous waterfowl.

Shorelines and grassy flats have a small herpetofauna, principally species of whiptail lizards (*Cnemidophorus* spp.) and their predators such as Whipsnake (*Masticophis flagellum*). Fishes rarely occur, but pupfishes (*Cyprinodon* spp.) occasionally invade and form substantial populations in Laguna Grande and Laguna Salada in Coahuila, Mexico (*C. atrorus*; Minckley, 1969), or in shorepools as along the Salton Sea (*C. macularius*; Barlow, 1958).