

Water Quantity

Water quantity is arguably the most serious DOI issue about water resources in the Mexican Highlands subarea. If sufficient water quantity is not available, the issue of water quality becomes academic. During the early part of the 20th century, surface water in the subarea was almost fully appropriated, thus further augmentation of water supplies has had to depend almost entirely on ground-water resources. Extensive development of ground water depletes streamflow, captures natural discharge, and lowers water levels in the aquifer, resulting in reduced stream flows and spring flows and decreased riparian habitat (fig. 3).

The Santa Cruz and San Pedro Rivers (figs. 4-5) are the dominant streams in the subarea. Their flows largely depend on precipitation in the mountains in Arizona and Mexico. Near their headwaters, certain reaches of these rivers flow continuously, but their flows decrease dramatically as the rivers travel northward. For example, the Santa Cruz River near Nogales, Sonora, generally flows continuously. Typically, however, the natural flow in the river does not reach the Nogales International Wastewater Treatment Plant (located along the river about 6 miles north of Nogales, Arizona). Flow downstream from the treatment plant is composed entirely of effluent return, and this water rarely flows past the Santa Cruz County line (located about 12 miles downstream from the treatment plant) before it completely seeps into the subsurface.

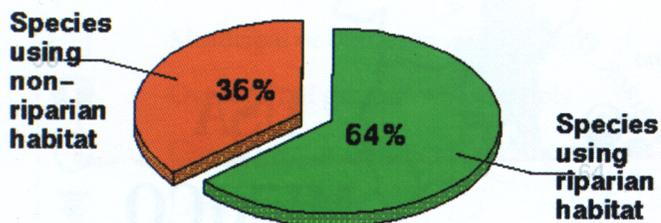


Figure 3. Percentage of threatened and endangered species in the subarea that use riparian habitat (data from the Arizona Game and Fish Department).

The conflicts resulting from competition for the region's limited water resources are well illustrated in the Santa Cruz River Basin. Competing water needs and uses include municipal and domestic, industrial, agricultural irrigation, riparian habitat (fig. 2), and fish and wildlife. The withdrawal of ground water, the subarea's principal source of supply for municipal, industrial, and agricultural activities, is greater than natural basin recharge. The two largest population centers in the subarea occur in this basin: Tucson (about 579,155 people) and the sister cities of Nogales-Nogales (about 136,795 people). As a result, more than 75 percent of the people in the subarea live in the Santa Cruz River Basin. The Nogales-Nogales area also supports one of the largest maquiladora clusters along the U.S.-Mexico border. About 26,000 acres of agricultural lands are irrigated in the basin upstream from Tucson, including about 2,300 acres in Mexico.

Overdraft of ground-water supplies is a major concern to the DOI, because of the rapid growth rates in this region of the border. Increased ground-water withdrawal from the Tucson Basin has resulted in increased well pumping costs, reduced ground-water quality, decreased well capacities due to the consolidation of sand in the aquifer, and the potential for land-surface subsidence. Ground water-surface water interactions in the area are poorly understood, but as ground-water withdrawals exceed natural recharge, greater volumes of surface flows from the Santa Cruz River will be drawn into the aquifer and eventually the river will run dry. Subsidence and aquifer overdraft also concern Federal land managers, and the results on wetlands and springs could directly affect the DOI's ability to protect ecological resources.

Water in the San Pedro River is supplied by flow from Mexico and by discharge from the adjacent aquifer. The San Pedro Riparian National Conservation Area (fig. 2) is a narrow corridor of riparian habitat hosting a wide variety of plant and animal species (Jackson and others, 1987; Hereford, 1993). The water requirements of the San Pedro Riparian National Conservation Area, municipalities, industry, the military, and agriculture in the San Pedro Basin must all be met from the same, limited resource. The issues of the San Pedro Basin include: (1) maintenance of sufficient river flows for the protection of the riparian environment, (2) resolution of conflicting water-use interests and the legal determination of water rights, and (3) identification of the effects of water-resource development in the basin within the upper reaches in Mexico.



Figure 4. San Pedro River (photo courtesy of San Pedro Riparian National Conservation Area Office, BLM).

These water-quantity issues are exacerbated by problems associated with insufficient data for the San Pedro River system. At present, there is a poor understanding of the origin of surface flows, ground water-surface water interaction, and the importance of the riparian system. We are only beginning to understand the significance of large riparian cottonwood and willow forests to the biological health of the river system. Knowledge of the ecologic, economic, and hydrologic characteristics of such complex riparian systems is critical to fulfilling many DOI objectives.