



By George L. San Miguel

The Turner River is a small meandering stream that emanates from the cypress swamps of southwestern Big Cypress National Preserve (BICY). The 9 mile long river empties into the Chokoloskee Bay estuary among the mangrove swamps of northwestern Everglades NP. The primary significance of the Turner River stems from the scarcity of such streams in south Florida. Its upper course is the only natural channel of fresh water available for recreational fishing and canoeing. At its south end, the Turner River Canoe Trail joins Everglades NP's 100 mile long Wilderness Waterway boat trail.

Prior to the 1960 construction of the Turner, Birdon, and Wagon Wheel roads, the river attracted tourists to Turner River Jungle Gardens, which offered boat trips along its course. After construction reduced the river's flow stages, small boat and fishing activities became limited to the dull, straight channel of Turner Canal. The canal was dug to provide elevating fill material for the road.

Construction of Turner Road and Turner Canal severed the Turner River from its upper drainage basin. Similar impacts were suggested for the Deep Lake Strand drainage in the northern part of the Turner Road and Canal construction area. Surface water, which normally contributed to the river's natural stages and discharges, bypassed the river, making much of the natural stream virtually unusable. River waters became shallow and stagnant. The stream bed began filling with detritus, promoting the growth of emergent thickets of giant cutgrass (*Zizaniopsis miliacea*) and cattail (*Typha domingensis*) and subsurface tangles of exot-

ic hydrilla (*Hydrilla verticillata*), while surface waters became clogged with floating mats of water lettuce (*Pistia stratiotes*).

Congress authorized BICY in 1974. Peter Rosendahl and David Sikkema, hydrologists from Everglades NP, began field investigations in 1978 to determine the possible hydrologic consequences of restoring Turner River. Their 1981 final report became the driving force behind restoration efforts.

The excavation of Turner Canal and the filling of Turner Road resulted in several undesirable hydrological and biological consequences, affecting about 18,000 acres of wetlands. The area's canals lowered the groundwater table by up to a foot for about 600' on either side of the canals by draining groundwater during the dry season. Even such seemingly minor alterations in water tables can lead to major vegetation changes in a less wetland-oriented community and shift the local fire regime to a more flammable condition.

The area's canals shunt surface waters from north to south during the rainy season, thus raising southern area water levels and lowering northern area water levels during the summer and fall. Surface waters that naturally flowed into the Deep Lake Strand and Turner River were quickly diverted down the Turner Canal. The damming effect of the roads caused higher than natural stages to the east and lower than natural stages to the west. These new local conditions would lead to opposite long-term changes in vegetative communities and fire regimes on either side of the canal.

By cutting off much of the Turner River's water sources, the channel's depth was decreased. Shallower waters experienced high-

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er temperatures, less dissolved oxygen, and different successional processes in and along the river. All of these consequences also influenced the river's aquatic fauna.

So little water was reaching the Turner River's channel that there was virtually no discharge from December through May and the otherwise diminished flow was measurable only 38 percent of the year. Reduced fresh water discharging into the river's tributary system would have a local effect of favoring salt tolerant species in an area where such had not been the case.

Diminished flows and lower velocities caused the otherwise suspended sediments to settle out of the water column and build up on the stream bed. In combination with changing water quality and quantity, the stream channel was colonized by plants atypical of the normally free river channel. As the river became choked with vegetation, flows began backing out of the river and into the canal during the high water season even after flow restoration was completed in 1989.

The hydrostatic head of fresh water flowing to the southwest normally prevents salt water from infiltrating much closer than a few miles from Tamiami Trail. After the construction of Turner Canal, the migrating wedge of salinity was able to reach the hydrological monitoring stations along this highway during the spring low water season. The stage recorder at the intersection of Tamiami Trail and Turner Canal even recorded a slight tidal effect! Water quality tests detected salt water at the station during about 12 percent of the days in a year, resulting in drastic changes in fish populations including periodic displacement or mass die-off of fresh water species.

All these effects tended to feed back on one another and worsen conditions. It was feared that the Turner River was dying and eventually would fill in and become shrouded by vegetation. The river's ability to serve as a recreational and natural resource in BICY and Everglades NP was in jeopardy.

The goal of the restoration project was to reverse the negative impacts caused by the Turner Road and Canal and allow natural processes to return conditions in the river to a state more closely resembling preconstruction. It was predicted that year-round discharge could be returned to the river with a measurable flow 88 percent of the year and about a 35 percent increase in the channel's depth.

From 1986 to 1989, a combination of federal, state, and county funds was used to modify the surface water flows that meet the Turner, Birdon, and Wagon Wheel roads

at Big Cypress Preserve

The "Aquamog" clears vegetation from Turner River. (Photo by T. Pemas).

and their respective borrow ditch canals. Early estimates ranged up to \$1 million as the price for restoration. The cooperative venture was able to keep the federal costs to about one quarter of this.

Each of these dirt roads is owned and maintained by Collier County. Little thought was given at the time of construction to the environmental repercussions of the design used. The priority in 1960 was to encourage homesteading, recreation, and commercial and industrial activities in this huge "worthless" swamp. In time, even the inadequate set of culverts that were emplaced were neglected and allowed to become clogged with debris and hidden by vegetation. As part of the restoration project, the county agreed to clear the old culverts.

The main component of the project was the installation of 21 canal plugs and 23 new culverts along 28 miles of county roads and canals. The work was performed in-house by the BICY maintenance staff. The plugs were designed to back up water flowing down the canals and build up the hydrostatic head behind these small earthen dams. The greater pressure provides the water with enough force to be flushed through the culverts that were installed behind the plugs. The culverts direct the water under the roads, where it then disperses back into sheet flow and finds natural channels such as Deep Lake Strand and Turner River.

The plugs were constructed of native limestone. Minerals then precipitated from the calcium-rich swamp waters into the pores of the plugs. This natural cementing process changed the loose fill into a concrete-like substance known as caliche, greatly increasing the impermeability of the structures. Vegetation was planted and large boulders were placed on top of the plugs to discourage off-road vehicles.

Numerous piles of rock were left over from the excavation of the canals. These artificial "uplands" and the filled road shoulders had been invaded by dense thickets of Brazilian pepper (*Schinus terebinthifolius*), an invasive exotic shrub. No one was able to see over or through the dense pepper hedges to view the natural Big Cypress landscape. BICY obtained \$70,000 of wetlands violation fine funds from the Florida Department of Environmental Regulation, which paid for labor and heavy machinery to scrape the pepper hedges into piles for drying and burning. Debris left over from the burns, together with 800,000 cubic yards of spoil rock, were more or less evenly spread out and dumped back into the canals. The outcome was dramatic; these road segments are becoming the finest scenic and wildlife viewing drive in BICY.



While flows improved in Turner River and subsided in the area's canals, the river channel remained clogged with aquatic vegetation. The river's obstructed condition limited the success of previous restoration efforts and severely inhibited its capacity as a recreational resource.

In 1992, the South Florida Water Management District volunteered the use of its "aquamog" and operator for several weeks. The aquamog was essentially a floating backhoe with interchangeable tool heads. It scooped up aquatic and emergent vegetation by the roots and chopped overhanging branches of encroaching woody vegetation. With the river's channel opened up to the mangrove fringe, the stream's greater velocity will keep the channel clear and halt or even reverse the sedimentation problem.

More urgent needs currently take priority, but quantitative hydrological analysis of the restoration project is likely in the near future. Some impediments to surface flow still exist in the Turner River area including small canals and abandoned roads. None of these structures has been mitigated, though they are on a long list of currently unfunded reclamation needs. An assessment also is needed of the effects that changing stages may be having on the various inhabited inholdings along Birdon Road and Turner Road.

There will continue to be dry season fish kills in the now stagnant canal waters. These fish kills are not considered to be a serious resource issue since the canal habitats are artificial, as are the fish populations that live in them. Additionally, as long as the terminus of Turner Canal remains unplugged it will continue to experience seasonal incursions of salt water.

Due to the persistent problem of exotic vegetation, there may need to be periodic retreatment of the area. Monitoring the condition of the plugs, culverts, water level, water quality, biota, and private properties will be an ongoing responsibility.

The Turner River restoration was the first project to be completed in the State of Florida's "Save Our Everglades Program." The project earned BICY's restoration crew a unit citation for excellence of service.

San Miguel is a Resource Management Trainee with the Resource Management Division at Big Cypress National Preserve.

Supporting Literature

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