Article 85

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Dragonfly Naiads as an Indicator of Pond Water Quality

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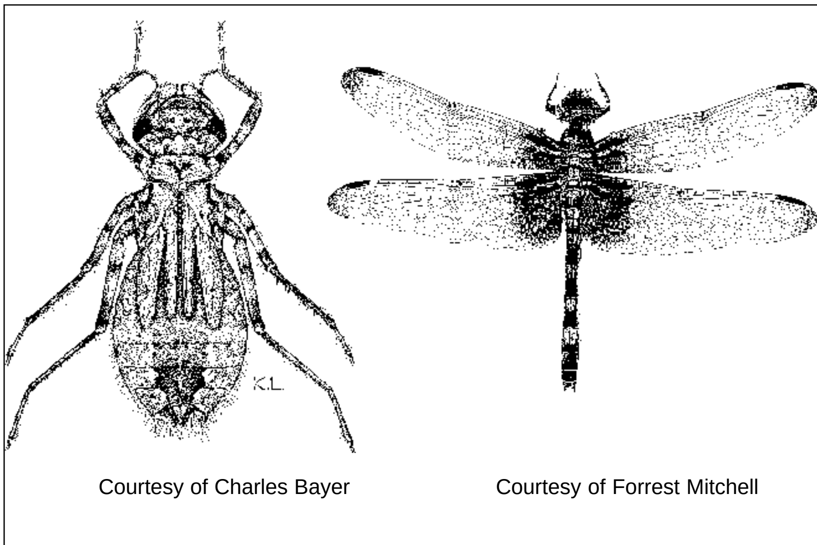
The whir of a dragonfly is a common sound along the edge of freshwater ponds. The adult dragonfly, however, begins its life cycle within the pond. The juvenile stage, known as a naiad, burrows in the mud or lurks within the shoreline vegetation (see Figure 1). Despite their small size, dragonfly naiads are voracious predators, feeding on other aquatic macroinvertebrates and even larger prey items. Given their position in the pond food web, dragonfly naiads could be a useful indicator of pond water quality. A simple way to test their value as an environmental indicator is to compare dragonfly naiads found in undisturbed freshwater ponds with those that inhabit the more stressful conditions of stormwater ponds.

The Lower Colorado River Authority recently examined this issue as part of an intensive biological study of a recently constructed stormwater pond. Wet ponds are generally considered experimental in the semi-arid climate of Central Texas because high evaporation rates often require ponds be augmented with water in order to maintain a permanent pool and sustain an aquatic ecosystem.



Courtesy of Charles Bayer   Courtesy of Forrest Mitchell

Figure 1: Dragonfly Naiad and Adult (Dythemis species)

Indicators for Lentic Systems

The stormwater pond was built in Travis County, Texas, on LCRA property known as the Mansfield Tract. The wet pond captured runoff from a newly constructed bridge over Lake Austin and a roadway. Constructed in a natural depression in the floodplain of the Colorado River adjacent to Lake Austin, the pond was augmented by Lake Austin water. The soils surrounding the wet pond contained alluvial silt and clay. The pond had a drainage area of approximately 9.5 acres, and was 150 feet long, 90 feet wide and five feet deep. The structure was designed with a permanent pool of approximately 0.4 watershed inches.

Since most macroinvertebrates are habitat specific, scientists planted local emergent and submergent vegetation within the wet pond to provide habitat structure. The vegetation was planted around shallow peripheral areas of the pond. Miller *et al.* (1989), Engel (1985) and Dvorak and Best (1982) have shown that aquatic macrophytes are heavily colonized by macroinvertebrates. Among the submergent vegetation planted were two obligate wetland plant species predicted to do well in these types of systems, *Elodea canadensis* (waterweed) and *Myriophyllum spicatum* (eurasian watermilfoil). A third obligate wetland macrophyte, *Najas guadalupensis* (southern naiad) established itself unexpectedly in the middle of the study. All three species are adapted to the low flow velocity and low turbulence associated with lentic areas. Emergent vegetation was also planted, including *Phragmites australis* (common reed), *Scirpus validus* (soft-stem bulrush) and *Saggitaria latifolia* (arrowhead).

Researchers conducted five macroinvertebrate surveys of the wet pond vegetation between November 1994 and July 1996. Organisms were collected qualitatively with a standard 500 micron mesh dipnet. Four one meter "drags" were made through submerged vegetation with the dipnet for one minute. Samples were preserved in the field and later sorted, enumerated, and identified to the lowest possible level using taxonomic keys by Merritt and Cummins (1996).

In lotic (running waters) systems, macroinvertebrates have been widely used as reliable water quality indicators (Shackleford, 1988; Plafkin *et al.*, 1989). This is not true for lentic systems (ponds and lakes). Indicators for lentic systems such as wet ponds are still under development. In the absence of such indicators, scientists frequently adopt metrics developed for flowing systems on lentic environments (Karouna-Reiner, 1995). This approach may provide a meaningful synopsis of the ecological condition of a wet pond, but it is still viewed as controversial.

Stormwater runoff quality entering the wet pond was also characterized during 21 storm events, although due to drought, only three pond outflows were recorded. Average TSS concentrations to the pond were 125 mg/l, which are comparable to other sediment monitoring data in the Austin area for developed areas (LCRA 1991). Baseflow TSS concentrations in the wet pond were 23 mg/1, which again were comparable to a study of other wet ponds sampled in the same region (Mitchell *et al.*, 1995). Impacts of suspended and deposited sediment to the aquatic environment are well documented. Deposited sediment can impact the benthic macroinvertebrate community by causing physical smothering. Suspended sediment impacts the epiphytic macroinvertebrate community by limiting light penetration to macrophytes and reducing habitat.

Research on stormwater wet pond insect assemblages in semi-arid climates is limited at best. Indicator organisms for lentic systems are also lacking. Because of this dilemma, Mitchell and his colleagues (1995), proposed using dragonfly naiads as possible indicators of lentic system water quality. In preliminary studies, Mitchell showed that some dragonfly naiads, like *Tramea* sp., *Celithemis* sp. and *Dythemis* sp., may prefer cleaner-water ponds.

Table 1 compares the dragonfly naiad species collected from the LCRA wet pond study to a pair of stormwater ponds and an unimpacted freshwater reference ponds previously sampled by Mitchell *et al.* (1995). All data were collected during the fall of 1994 and 1995 using comparable methods. The table summarizes the presence and absence of the three dragonfly naiads species that are thought to be clean water indicators.

Celithemis sp., *Dythemis* sp., and *Tramea* sp. were either absent or present in very low numbers in stormwater wet ponds, including the Hwy. 620 wet pond. These genera were also absent or nearly absent in the other three surveys at the LCRA pond. In contrast, the three dragonfly naiad species were numerous in unimpacted reference ponds. This suggests that *Celithemis*, *Dythemis*, and *Tramea* species could be possible indicator organisms for pond water quality.

The initial trend seen in the dragonfly surveys was thought to be due to the input of pollutants from stormwater runoff. Other factors, however, could have produced this trend, such as seasonal change, early pond succession, continual augmentation by lake water and water level fluctuations. Because of the short term nature of the study (19 months), it was not possible to isolate the factor or factors that caused the disappearance of the dragonfly naiad species. To confirm study findings, additional research with long-term monitoring is recommended.

Table 1: Comparison of Dragonfly Genera in Impacted and Unimpacted Wet Ponds

Collection Period	Dragonfly Genera	Hwy. 620 Wet Pond	Mitchell Wet Ponds average	Mitchell Ponds average
No. of individuals collected		Impacted [a]	Impacted [b]	(Unimpacted) [b]
Oct-Nov 1994	*Celithemis* sp.	0	0	45
	Dythemis sp.	1	0	38
	Tramea sp.	2	0	9
Oct-Dec 1995	*Celithemis* sp.	0	0	19
	Dythemis sp.	0	0	19
	Tramea sp.	0	0	31

[a] Collection method: Four one-meter D-net drags through submerged vegetation. Duration of each drag equaled one minute. Wet pond is perennial, augmented by Lake Austin water. LCRA wet pond receives mostly highway and bridge runoff *(Saunders and Gilroy 1997).*

[b] Collection method: Five two-meter D-net drags through submerged vegetation and other pond material. All wet ponds are perennial. The two impacted wet ponds, Mule Pasture and Upper Wetlands, receive agricultural runoff; whereas the unimpacted reference ponds, Hort and Peanut Irrigation, are augmented by well water *(Mitchell et al. 1995, Lasswell et al. 1997).*

In summary, this study reinforced Mitchell's finding that some dragonfly naiads may be potential indicator organisms for lentic systems. Because little research has been done on lentic system indicators to date, this research provides an encouraging start for scientists attempting to identify cost-effective biological indicators for measuring water quality impacts in ponds and lakes. Determining if *Celithemis* sp., *Dythemis* sp., and *Tramea* sp. are possible indicator organisms for stormwater wet ponds warrants further investigation.

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