EFFECTS OF NEAR SHORE DEVELOPMENT ON LAKE ECOSYSTEMS
INDIANA DIVISION OF FISH AND WILDLIFE

Decisions about near shore development, which includes piers, seawalls and beaches, should take into account the cumulative effects of shoreline development on the fishery. The percentage of the lakeshore that can be developed should depend on the lake bathymetry, trophic status, and fish community found within the lake. Currently, the widespread shoreline development of Indiana lakeshores is degrading the quality of the fishery resources within the lakes.

Habitat complexity is necessary in order to support a healthy fishery. As part of the development of Indiana's lakes, piers, seawalls, and beaches have been created and are now found to dominate the shoreline in many of the lakes. As the lake shorelines and riparian areas are developed, the cumulative effects of this development have contributed to the loss of habitat complexity due to the removal of aquatic macrophytes and complex woody debris (CWD) that characterize the habitat necessary for a quality fishery resource (Christensen et al. 1996; Brazner and Beals 1997). In addition, simplified shorelines also create energetically unfavorable shoreline conditions that allow for damage such as erosion resulting from wind-wave action (Wilson and Keddy 1986; Randall et al. 1996; Höök et al. 2001).

Shoreline development has a significant negative impact on the lake ecosystem, in particular, predator-prey interactions. The loss of complex prey refuge habitat resulting from shoreline development represents a disadvantage to larval and juvenile fish recruitment as well as other prey species. In the absence of complex habitat, structure-oriented ambush predators, such as largemouth bass, can be found around piers and have the advantage over prey species, such as bluegill, because there is no habitat present that would enable bluegills to effectively evade predation from the bass (Crowder and Cooper 1982; Werner et al. 1983a; Lynch and Johnson 1989). While this may be good news for anglers upon first inspection since bass growth would initially increase, it is bad news in the long run. In general, sustainable predator-prey interactions require the existence of prey refuge to prevent the elimination of the prey organism, i.e., if largemouth bass decimate the bluegill population, the condition and growth of bass ultimately declines, thereby decreasing the quality of the fishery.

The development of lakeshores by the installation of piers, seawalls, and beaches, has been documented from several studies to degrade fish communities by simplifying the littoral zone habitat (Beauchamp et al. 1994; Ward et al. 1994; Jennings et al. 1999; Jennings et al. 2003). Growth rates of two species of juvenile fish maintained in cages under piers in the Hudson River estuary exhibited negative growth rates compared to juveniles of the same species maintained in cages deployed in the open water (Duffy-Anderson and Able 1999). These growth rate differences resulted because of fewer feeding opportunities available under piers than in open water, demonstrating that areas under piers are less productive and provide inadequate habitat for juvenile fish survival. In Lake Baldwin, Florida, piers have been shown to provide habitat for some largemouth bass in the absence of aquatic macrophytes; however, piers do not provide enough complex habitat and fish are forced to move around more frequently than those bass that are typically found associated with aquatic macrophytes (Colle et al. 1989). Substrate embeddedness increases along developed shorelines, leading to a decrease in interstitial spaces necessary for larval and juvenile fish habitat and prey refuge (Schlosser 1987; Lynch and Johnson 1989; Beauchamp et al. 1994; Jennings et al. 2003). Bulkheads and seawalls do not provide any interstitial spaces and are also detrimental because they reduce the availability of

shallow water habitats used by larval fish (Hall and Werner 1977; Beauchamp et al. 1994; Ward et al. 1994). Beaches simplify the available littoral habitat by eliminating aquatic vegetation and providing no complex habitat for prey fish species (Brazner and Beals 1997).

In general, aquatic macrophytes and complex woody debris increase the structural complexity of the littoral habitats, thereby increasing fish species richness and density, and providing a quality fishery for Indiana residents to enjoy (Crowder and Cooper 1982; Savino and Stein 1982; Werner et al. 1983b; Christensen et al. 1996; Randall et al. 1996; Höök et al. 2001). Permits for new piers, seawalls, and beaches should be considered more carefully and before they are approved, the effects of cumulative shoreline development on the lake ecosystem should be understood and accounted for in the process.

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