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INTRODUCTION

The littoral zone of a lake is ripe with complex interactions that contribute to the overall health of the aquatic ecosystem. Every level of the food chain from bacteria and invertebrates to fish and waterfowl are dependent upon the aquatic plants present in the littoral zone to some degree for their survival (Engel, 1985; Wetzel, 2001). Plants provide food and shelter for other organisms. Photosynthesis and respiration are important in maintaining clear waters (Engel, 1990; Lombardo and Cooke, 2003). Aquatic plants also absorb wave action which in turn prevents turbidity caused by suspended sediments. Light penetration, excess nutrients from pollution, wave action and lake morphometry all affect the plant community of the littoral zone (Barko 1988; Duarte and Kalff, 1986) There is a growing body of evidence that suggests water level fluctuations also have a profound effect on littoral zone communities (Haxton, 2008; White, 2008). Whether these fluctuations are caused by natural phenomena or human disturbance, exposure to atmospheric conditions and ice scouring in winter can have catastrophic effects including shoreline erosion, decreased aquatic plant biomass and degraded habitat.

Drawdowns of impoundments are used to generate power, for flood control and for irrigation (Kaster and Jacobi, 1962). They are also used in many instances to control aquatic plant growth. Controlling aquatic plant growth through drawdowns can be a useful tool for nuisance plants, however, it can also impede establishment of native species (Nichols, 2008, Cooke, 2007). Weighing the benefits of nuisance control versus protection of native species is one of the many factors that need to be considered when contemplating drawdowns as a management technique. Because of the number of variables that affect the aquatic plant community it is difficult to assess one factor's role in shaping the littoral zone community. Studies aimed at this goal are often contradictory in their results (Leira, 2008). Nonetheless, most studies point to an overall loss of biomass and biodiversity on bodies of water that experience water level fluctuations. Because of the variations in results, it is important to assess each body of water before and after major management decisions are put into practice.

Lake Wissota is an impoundment that was created in 1917 with the creation of a hydroelectric dam on the Chippewa River. Lake Wissota was historically drawndown 10-15 feet every winter in anticipation of the spring thaw and to sustain power-production. This drawdown was maintained for several weeks annually (Chippewa River Settlement Team, 2001). The Lower Chippewa River Settlement Agreement was established in 2001 as part of the FERC licensing procedure. One issue raised was concern over the effects the winter drawdowns were having on the Lake Wissota ecosystem. As outlined in this agreement, Lake Wissota drawdowns were reduced from the 10-15 ft norm to a 3 ft maximum maintained for a maximum of seven days. Given the documented effects of extended periods of drawdown it is expected that the reduction in the drawdown resulted in a change in the aquatic plant community of Lake Wissota.

A survey of the aquatic plants in Lake Wissota was conducted during August of 1989 and August of 1990 by Water Resources staff from the Western District Wisconsin Department of Natural Resources office (WDNR). The study was funded by the WDNR

and Northern States Power Company (now Xcel Energy) in anticipation of re-licensing of the Lake Wissota dam scheduled to occur in 2000. The purpose of this survey was to provide baseline aquatic plant information needed to make management decisions for fish and wildlife habitat improvement and water resource regulations.

The 1989/90 survey was repeated in 2005 (Heuschele, 2006) and 2009 by researchers from the Beaver Creek Reserve Citizen Science Center to assess changes that have occurred in the aquatic plant community as a result of the reduction of the winter drawdowns. These studies were funded by the Xcel Energy Natural Resources Fund and WDNR Lake Management Planning Grants. The results of comparisons of data from all three years' studies are presented in this report.