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RESEARCH ARTICLE

The Influence of Landscape Composition on the Biotic Community of Constructed Depressional Wetlands

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Abstract

To increase wetland acreage and biodiversity, state agencies constructed more than 220 depressional wetlands throughout Delaware. We investigated effects of landscape composition within 1,000 m and 5,000 m of 20 Kent County, Delaware constructed wetlands on their avian, macroinvertebrate, and vegetative communities. Using digital orthophotography and geographic information system (GIS), we quantified agriculture, early successional, forest, development, freshwater wetlands, roads, and streams within concentric buffers. We also calculated distance to nearest forest, wetland, and paved road edge from the wetland's center. In 2004 and 2005, we surveyed the biotic communities and regressed richness and diversity values against landscape variables. Proximity of nearest forest edge was the most important variable in explaining avian and vegetative richness and diversity. We detected negative relationships with distance to nearest forest and bird richness, bird diversity, total plant richness, facultative wetland plant cover, and native, exotic, and obligate wetland plant richness and cover. Furthermore, bird richness and diversity increased with forest area within 1,000 m and bird diversity increased with forest area within 5,000 m. To optimize biodiversity, managers should consider proximity to forest for wetlands constructed in agricultural landscapes.

Key words: birds, Delaware, macroinertebrates, vegetation, wetland restoration.

Introduction

Wetlands are among the most diverse and productive ecosystems because they are transitional habitats, able to support species from both terrestrial and aquatic systems; however, wetlands are dependent upon, and critical to, the surrounding landscape for biological exchange (Mitsch & Gosselink 1993). Wetland construction is a common practice for compensatory mitigation and wildlife management. Unfortunately, constructed wetlands often fail to support biotic communities comparable to those in similar, naturally occurring wetlands (Galatowitsch & Van Der Valk 1996; Zedler & Callaway 1999; Brown & Veneman 2001; Campbell et al. 2002; Balcombe et al. 2005; Spieles 2005; Petranka et al. 2007). Therefore, efforts are needed to identify wetland construction techniques that improve the ability of constructed wetlands to support diverse biotic communities (Alsfeld et al. 2009). Since the work of Brown and Dinsmore (1986), which demonstrated that decreased marsh isolation was an important determinate of marsh bird richness, a plethora of research concerned with landscape effects on wetland communities has been conducted (Findlay & Houlahan 1997; Knutson et al. 1999; Mazerolle & Villard 1999; Hall et al. 2004; Houlahan et al. 2006).

Although the effects of landscape components may vary depending on taxon and landscape type (Naugle et al. 1999; Shriver et al. 2004), general trends have been identified. For example, the amount of surrounding wetland area and proximity to the nearest wetland often increased wetland bird richness (Brown & Dinsmore 1986; Craig & Beal 1992; Fairbain & Dinsmore 2001). In addition, landscape features that increase habitat connectivity and movement corridors, such as forests (Laan & Verboom 1990; Gibbs 1998) and streams (Carr & Fahrig 2001; Houlahan et al. 2006), positively affected bird (Findlay & Houlahan 1997; Mazerolle & Villard 1999; Stevens et al. 2003), and vegetative communities (Houlahan et al. 2006).

Many studies have detected decreasing trends of wetland biodiversity with proximity to anthropogenic disturbance. Because wetlands give and receive energy from the surrounding landscape, human development that increases the amount of nutrients and pollution can negatively affect wetland biotic communities. For example, the amount of urbanization surrounding a wetland was associated with decreased bird richness (DeLuca et al. 2004) and vegetative richness (Houlahan et al. 2006). Furthermore, sessile macroinvertebrate richness

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