



FULL LENGTH ARTICLE

Gravel pads of powerline towers as human-made habitats for ruderal vegetation in some Mediterranean wetlands of Egypt: Implications for management



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Abstract Despite the widespread of transmission powerlines in many aquatic ecosystems of Egypt, little is known about their ecological impacts. The current study evaluates floristic composition associated with gravel pads constructed for stabilizing powerline towers in the wetlands of Burullus and Manzala. Plant cover was measured for 34 randomly selected in paired gravel pads and adjacent wetlands. Ordination analysis indicated that vegetation on the gravel pads significantly differed from that in wetlands. Thirty-two species were recorded in the gravel pad plots (more than twice the number found in wetlands). Mean species richness was significantly higher in gravel pad plots (3.8 species) than in wetland plots (1.7 species). Gravel pad plots had a significantly lower cover than wetlands of Chenopodiaceae (12.9% vs. 28.7%) and Poaceae (15.7% vs. 32.2%), while Asteraceae showed higher cover in gravel pad plots (25%) than in wetlands (6.7%). Gravel pad plots were consistently occupied by ruderals, weeds and invasive species. Regression analysis showed that total vegetation cover and diversity indices increased significantly with rises in the thickness of the gravel pads. The study highlighted the importance of gravel pad corridors for the abundance of ruderal plant species that could eventually colonize more pristine areas in the adjacent wetlands.

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Introduction

The wetlands of the Mediterranean basin occupy about 3 million ha (Pearce and Crivelli, 1994). These wetlands are

valuable habitats of biodiversity including many rare and endemic species of halophytes, insects, reptiles, fishes and birds (Balletto and Casale, 1991; El-Bana et al., 2002; Cox et al., 2006; Shaltout and Al-Sodany, 2008; Blondel et al., 2010). However, they are among the most threatened ecosystems on earth due to the long history of interactions between humans and biodiversity loss (Zalidis et al., 1999). During the last few millennia, more than half of the Mediterranean wetlands have been totally drained for controlling water-borne diseases,

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creating houses, expanding agriculture and installing urban infrastructures and other human welfare (Zalidis et al., 1999; El-Bana et al., 2000; Parra et al., 2005; Blondel et al., 2010; Robledano et al., 2011). Many of the remaining wetlands are threatened by mismanagement and overexploitation of their natural resources (Pardo et al., 2008; Robledano et al., 2011; Eid and Shaltout, 2013; Moreno-González et al., 2013).

Human activities such as construction and maintenance of transmission powerlines and their associated rights-of-way create suitable conditions for establishment and growth of ruderal plant species that can threaten biodiversity and other ecological services of the nearby natural ecosystems (Weber, 2003; Díaz et al., 2005; Dubé et al., 2011; Wagner et al., 2014). These activities may facilitate the invasion of ruderal vegetation in natural ecosystems through several ways. First, fragmentation of natural habitats and loss of native vegetation increase environmental heterogeneity that facilitates the invasibility and spread of ruderal species (Brothers and Spingarn, 1992; Tewksbury et al., 2002). Second, seeds and propagules of several ruderal species may be transported in constructed soil of pads and foundations for overhead utility line towers and substations (Tyser and Worley, 1992; Cameron et al., 1997). Third, the internal disturbance of native vegetation creates gaps with increased resources that enhance the establishment of less competitive ruderal species (Hessing and Johnson, 1982; Ehrenfeld, 2008). Fourth, establishment and maintenance of transmission line rights-of-way and their connected service tracks closer to access roads may favor seed dispersal and propagules of roadsides ruderal plant species (Tyser and Worley, 1992; Rubino et al., 2002). Fifth, changes in soil physical properties and enhancement of soil nutrients may contribute to the establishment of ruderal plant species which have the ability to grow and thrive in this enriched soil (Grigal, 1985; Cameron et al., 1997).

Researchers have emphasized on the role of establishment and management of rights-of-way when evaluating powerline corridor effects on vegetation composition (Nickerson et al., 1989; Temple, 1996; Clarke et al., 2006; Dubé et al., 2011; Wagner et al., 2014). However, much less is known about the impact of the construction of gravel pads, which is a conspicuous landscape-disturbance feature for supporting powerline towers, and forming a network of linear terrestrial patches in wetlands (Fig. 1). Such spatial configuration of benched and graveled pads may facilitate the invasion and spread of ruderal plants into the intersected wetlands. In addition, the installation of these terrestrial barriers in water may induce sediment deposition and nutrient enrichment which change plant community development and create appropriate microhabitats for the establishment of non-native plants in wetlands (Miller and Zedler, 2003; Mahaney et al., 2004; Dubé et al., 2011).

Although, urbanization and their attendant effects are obvious features in the Mediterranean wetlands, these effects remain insufficiently studied particularly in those of arid and semi-arid environments of North African countries where there is a rapid rate of uncontrolled urban development (Flower, 2001; Zdruli, 2012; Redeker and Kantoush, 2014). In such fragile environments, there are extensive networks of national and international transmission powerlines, but no studies evaluated the ecological changes that occur in natural ecosystems bisected by these transmission powerlines. The current study examines the following two main hypotheses: (1) that gravel pads constructed for stabilizing transmission towers facilitate the establishment of ruderal vegetation in the Mediterranean deltaic lakes of Egypt (Lake Burullus and Lake Manzala) that have high conservation value (Ramsar sites); and (2) differences exist between the benched gravel pads of powerline towers and the surrounding intersected



Figure 1 Photos of constructed and benched gravel pads for stabilizing powerline towers dominated by terrestrial alien plant species in Lake Burullus.

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