Riparian habitat disturbed by reservoir management does not function as an ecological trap for the Yellow Warbler (Setophaga petechia)

S.P. Quinlan and D.J. Green

Abstract: Ecological traps arise when anthropogenic change creates habitat that appears suitable but when selected reduces the fitness of an individual. We evaluated whether riparian habitat within the drawdown zone of the Arrow Lakes Reservoir, British Columbia, creates an ecological trap for Yellow Warblers (Setophaga petechia (L., 1766)) by investigating habitat preferences and the fitness consequences of habitat selection decisions. Preferences were inferred by examining how habitat variables influenced settlement order, and comparing habitat at nest sites and random locations. Males preferred to settle in territories with more riparian shrub and tree cover, higher shrub diversity, and less high canopy cover. Females built nests in taller shrubs surrounded by a greater density of shrub stems. Habitat preferences were positively associated with fitness: nest sites in taller shrubs surrounded by higher shrub-stem densities were more likely to avoid predation and fledge young, whereas territories with more riparian cover, higher shrub diversity, and less high canopy cover had higher annual productivity. We therefore

Arrow Lakes, Colombie-Britannique, forme un piège écologique pour les parulines jaunes (Setophaga petechia (L., 1766)) en étudiant les préférences d'habitat et les conséquences pour la fitness des décisions de choix d'habitat. Nous déduisons les préférences en examinant comment les variables d'habitat influencent l'ordre des établissements et en comparant l'habitat des sites de nidification à celui de sites choisis au hasard. Les mâles préfèrent s'établir dans des territoires qui ont une couverture riveraine plus importante de buissons et d'arbres, une diversité plus élevée de buissons et une densité moins grande du haut couvert forestier. Les femelles construisent leur nid dans les buissons plus élevés, entourés par une densité plus importante de tiges de buissons. Il y a une association positive entre les préférences d'habitat et la fitness; les sites de nidification dans les buissons plus élevés entourés d'une densité plus grande de tiges de buissons sont plus susceptibles d'échapper à la prédation et de permettre l'envol des petits; les sites avec une couverture riveraine plus dense, une diversité plus grande des buissons et un haut couvert forestier moins dense ont une productivité annuelle plus forte. Nous ne trouvons donc aucune indication que l'habitat riverain affecté par le fonctionnement du réservoir agit comme piège écologue. Les décisions actuelles de choix d'habitat peuvent être associées à la fitness parce que les parulines jaunes sont adaptées à se reproduire dans un milieu hétérogène sujet à des inondations périodiques.

Mots clés : habitat riverain, paruline jaune, Setophaga petechia, sélection d'habitat, piège écologique, réservoir.

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Introduction

Models of habitat selection tend to assume that individuals have evolved to recognize and settle preferentially in the highest quality habitat available (Fretwell and Lucas 1969; Fretwell 1972). Settlement decisions are therefore thought to be influenced by environmental cues that reliably predict reproductive success and survival (Clark and Shutler 1999; Stamps and Krishnan 2005). For example, individuals may select habitat based on food availability (Morris and MacEachern 2010), the risk of predation (Parejo and Avilés 2011) or the density of brood parasites (Forsman and Martin 2009). However, in many cases the factors that determine productivity or survival may not be evident at the time habitat is selected, forcing individuals to use indirect cues to evaluate habitat quality. In recently modified environments, indirect cues can become uncoupled from the true quality of the habitat so that preferred habitats are less productive than other habitats available, creating an ecological trap (Dwernychuk and Boag 1972; Gates and Gysel 1978; Robertson and

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S.P. Quinlan and D.J. Green. Centre for Wildlife Ecology, Department of Biological Sciences, Simon Fraser University, 8888 University Boulevard, Burnaby, BC V5A 1S6, Canada.

Corresponding author: D.J. Green (e-mail: djgreen@sfu.ca).

Hutto 2006). Nonideal habitat selection decisions in modified environments may also arise if individuals show no preference among habitats that differ in quality (equal-preference traps; Robertson and Hutto 2006) or actively avoid high-quality habitat (perceptual traps; Patten and Kelly 2010).

Ecological traps are thought to be more common in modified environments where human activities introduce new competitors or predators, change agricultural practices, or change other types of land use (Gates and Gysel 1978; Schlaepfer et al. 2002; Battin 2004). Ecological traps may therefore contribute to population declines of species occupying disturbed habitat (Battin 2004), and theoretically can lead to local extirpation if initial population sizes are low (Pulliam and Danielson 1991; Delibes et al. 2001; Donovan and Thompson 2001; Kristan 2003). However, strong empirical evidence for the existence of ecological traps remains limited. This may be because ecological traps are rare and restricted to heavily modified environments (Robertson and Hutto 2006). Alternatively, the lack of evidence for ecological traps has been attributed to difficulties in measuring habitat preferences of individuals (Robertson and Hutto 2006), the need to link apparent cues to reliable fitness estimates (Arlt and Part 2007), or because the links between habitat preferences and fitness outcomes are measured at the wrong spatial scales (Kristan 2003).

The majority of empirical studies investigating the concept of ecological traps in birds have used relative density or use-availability data to infer habitat preferences and nest success to estimate fitness (Robertson and Hutto 2006). However, using relative density to determine habitat preferences has been

to 30-year-old cottonwood forest adjacent to upland coniferous forest, willow-dominated scrub, and isolated patches of

habitat variables, shrub stem density and substrate height, helped discriminate between points centred on nests and random points (model Wilksλ = 0.77, $\chi^2_{[2]}$ = 34.8, P < 0.001).

however, we found no evidence that habitat selection decisions by Yellow Warblers could create a situation in which riparian habitat within the drawdown zone of the Arrow Lakes would function as an ecological trap.

Equal-preference traps, where no habitat preferences are exhibited despite differences in habitat quality (e.g., Robertson and Hutto 2006; Powell et al. 2010), or perceptual traps,