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# Agricultural land use and macroinvertebrate assemblages in lowland temporary streams of the Willamette Valley, Oregon, USA

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ABSTRACT

Streams that dry during part of the year are common throughout the world, yet studies of the macroinvertebrate assemblages in these types of streams are rare compared to those in permanent streams; and studies that assess the effects of agriculture on temporary stream invertebrates are even rarer. We studied macroinvertebrate assemblages in lowland temporary streams of a region with high agricultural land use, the southern Willamette Valley, Oregon, USA. Overall assemblages were dominated by non-insects, and invertebrates tolerant of organic pollution. Nonetheless, these invertebrates displayed adaptations to life in temporary habitats, and as such they may be unique to temporary streams and seasonal wetlands, providing an important addition to regional biodiversity. Stream invertebrates are also important as a prey base for native fish and amphibians using these channels. Benthic invertebrate densities were higher at sites with slower water and more in-stream vegetation; to a lesser degree greater agricultural land use was associated with lower densities. Taxon richness was also negatively affected by agriculture, but this was most evident when least disturbed and highly agricultural sites were compared. Sites in watersheds with a lower proportion of their area under agriculture (mostly west of the Willamette River) had a variety of taxa in disturbance-sensitive insect orders Ephemeroptera, Plecoptera, and Trichoptera (EPT), plus flies in the family Simuliidae present. In addition, they had greater relative abundances of 2 types of flies in the family Chironomidae. In contrast, sites in watersheds with high agricultural land use (mainly east of the Willamette River) had greater relative abundances of non-insects, including ostracods, nematodes, and oligochaete worms. In highly agricultural watersheds, when stream-bottom vegetation was abundant, it was associated with greater benthic invertebrate density, but not with higher taxon richness. Our results suggest that increasing stream-bottom vegetation could be useful when food is limiting for native vertebrates. On the other hand, reduced agricultural land use allows for the development of more diverse benthic invertebrate assemblages.



## 1. Introduction

Streams that dry during part of a year are common throughout the world and naturally occur where rainfall is limited or highly seasonal, or where porous geology allows for the loss of surface flow (Dieterich and Anderson, 1995; Paltridge et al., 1997; Uys and O'Keefe, 1997; Meyer and Meyer, 2000; Aguiar et al., 2002; Datry et al., 2014; Mazor et al., 2014). These types of streams can vary in the length and predictability of their dry phase. Some, but not all, have permanently flowing headwaters, and they may or may not be used by fish during the wet phase. The terms ephemeral, temporary, and intermittent have been applied variously to streams that do not flow continuously. Our study focused on temporary streams, defined by Dieterich and Anderson (2000) as streams without permanent headwaters, but with flow persisting for >4 consecutive months per year. Based on the changing conditions in these kinds of systems, the annual cycle can be divided into 3 hydrologic stages: a running water stage with flowing water, a pool phase with standing water, and a terrestrial stage with surface water absent (Williams and Hynes, 1976; Williams, 1996). Our studies were conducted towards the end of the running water stage during late winter/early spring in temporary streams draining grass seed producing lands of the Willamette Valley, Oregon, U.S.A.

Previous studies of temporary streams in the Pacific Northwest region of North America have examined fishless sites within small drainage areas in relatively steep, forested terrain (Tew, 1971; Dieterich and Anderson, 2000; Price et al., 2003; Banks et al., 2007;

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Stewart and Anderson, 2008). In contrast, our study examined lowland temporary streams in a region with high agricultural land use. These streams supported native fish and amphibians during the wet season, serving as nursery grounds for some species (Colvin, 2006; Colvin et al., 2009). As invertebrates are essential prey for these and other vertebrate predators, invertebrate abundance or biomass are considered an important component of habitat suitability for vertebrates (Wipfli and Gregovich, 2002; Taft and Haig, 2005) in these temporary habitats.

Although temporary streams are less well studied than permanent streams, several patterns have been documented. These systems often have fewer benthic invertebrate taxa during their running phase than permanent streams (Williams, 1996; Williams et al., 2003; Storey and Quinn, 2008; Sanches-Montoya et al., 2010), and taxon richness decreases as the duration of the dry

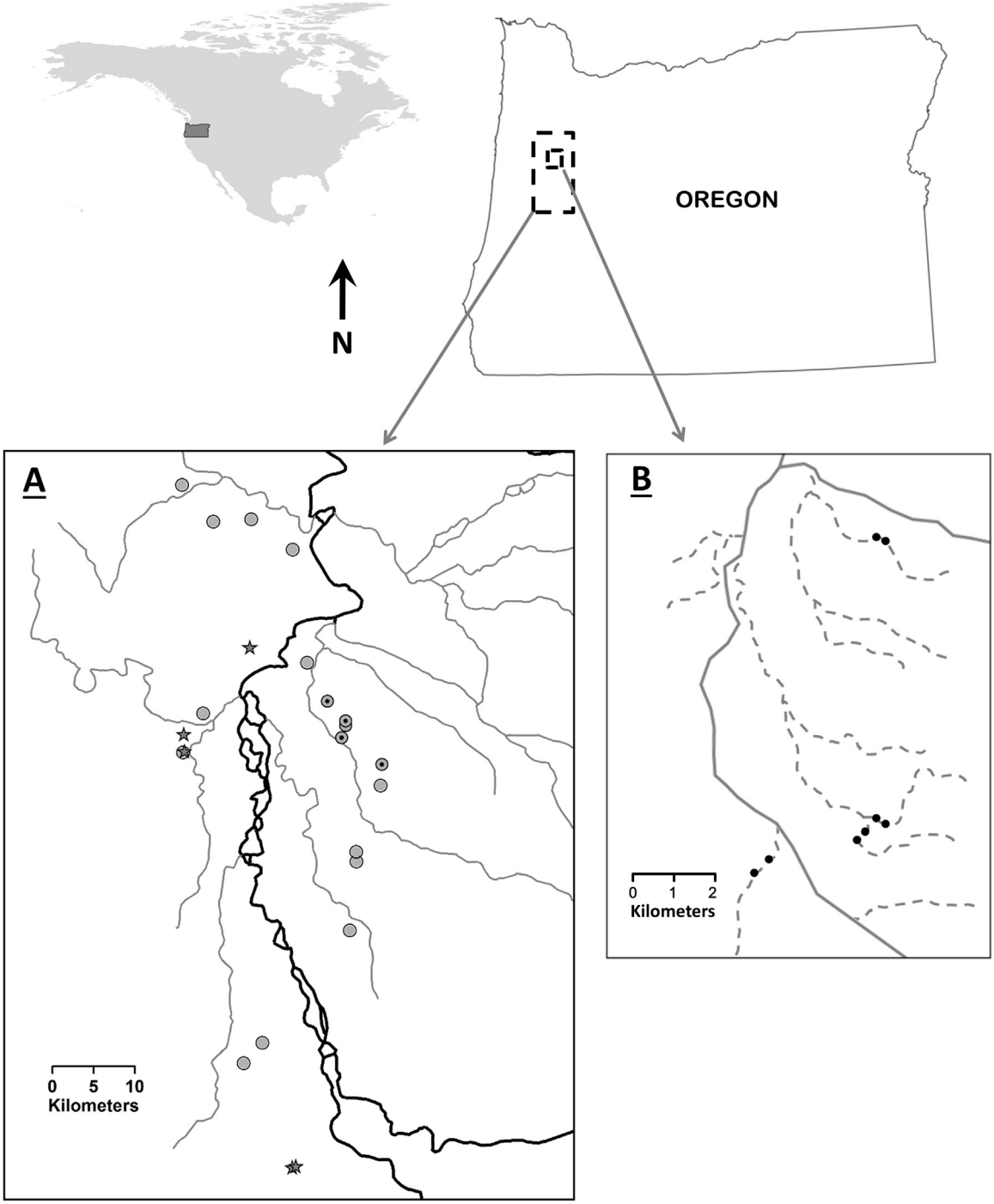


**Fig. 1.** Locations of southern Willamette Valley temporary stream sites sampled in 2002–03 and 2008 in western Oregon (A), and paired vegetated-non-vegetated sites sampled in 2006 (B). Black lines in map A indicate the Willamette River (flowing north). Gray lines are major Willamette River tributaries; dashed lines are temporary streams (not drawn in map A). In map A, filled gray circles indicate sites sampled in the southern valley survey (2002-03); the 5 circles with central black dots are highly agricultural sites that were resampled in 2008 to compare with least-disturbed sites. Stars indicate least-disturbed sites sampled in 2008 only.