Northwest Science Notes

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Amphibian Occurrence in Artificial and Natural Wetlands of the Teanaway and Lower Swauk River Drainages of Kittitas County, Washington

Abstract

In the forest of the eastern Washington, small wetlands are created for recreational purposes, as an unintended consequence of forest management activities, and to provide water for livestock during summer months. However, the role these artificial wetlands play in supporting amphibian populations is largely unknown. In this preliminary study, we described the amphibian community at 8 artificial and 11 natural wetlands in the Teanaway and lower Swauk River drainages of Kittitas Co., Washington during the 1995 breeding season. Artificial wetlands were smaller than natural wetlands but occurred at similar elevations and had similar numbers of gross habitat types. Amphibian species richness at each wetland varied from 0 to 4, but there was no difference in species richness between artificial and natural wetlands, and no clear pattern of species association with either origin type. Small, artificial wetlands, even those designed for livestock watering, may support a similar compliment of amphibian species as small, natural wetlands in this region of Washington State.

Introduction

Amphibian populations appear to be declining worldwide, although there likely is no single cause for population declines (Pechmann et al. 1991). Loss of wetlands has clearly caused reductions in some populations. For example, since the 1700s, about half of the wetlands in the conterminous United States have been lost or severely altered by human activity (Council of Environmental Quality 1989). The number of palustrine wetlands may be increasing in relatively arid, forested areas of eastern Washington as wetlands are created for recreational purposes, as an unintended consequence of road building, and to provide water for livestock during summer months. However, the role that artificial wetlands play in supporting amphibian populations is largely unknown, although recent evidence from Idaho suggested that that artificial ponds, particularly those with no fish, may be important to some amphibian species (Monello and Wright 1999).

We documented amphibian species at 8 artificial and 11 natural wetlands at low to mid-elevations on the eastern flank of the Cascade Mountains in Washington during 1995. Our objectives were to determine the composition of the pond-breeding amphibian community in an area of the state that has received little study, and to provide preliminary observations on the role that artificial wetlands play in supporting amphibians.

Study Area and Methods

The study area was comprised of the Teanaway and lower Swauk River drainages (Figure 1), which are part of the East Cascade Slopes Ecoregion of the Pacific Northwest States (Omernik 1987). The high elevation portion of the study area lies mostly in the grand fir (*Abies grandis*) and Douglas-fir (*Pseudotsuga menziesii*) zone, while the lower portion lies in the ponderosa pine (*Pinus ponderosa*) zone (Franklin and Dyrness 1988). The study area has been selectively logged and grazed by

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livestock since the early 1900s and intensively managed for timber beginning in the 1950s (J. Jones, Boise Cascade Corporation, personal communication).

Wetlands in the study area were identified by consulting with land managers and examining 1985 and 1990 aerial photographs (1:1200) and 1995 digital orthophotographs (1:24,000). We selected wetlands we had permission from landowners to sample and where wetlands were within a day's hike by foot or horseback. We also included two relatively small wetlands, not discernible from aerial photographs, that were encountered in the field. A total of 19 wetlands were sampled; 15 on Boise Cascade Corporation land, 2 on other private land, and 2 in the Wenatchee National Forest (Figure 1).

Wetland characteristics were determined from several sources. Wetland origin (artificial vs. natural) and permanence were determined from field visits, discussion with land managers, and aerial photography. Wetlands were designated as permanent (vs. seasonal) if they had any open water in July or August of 1985, 1990 (as determined

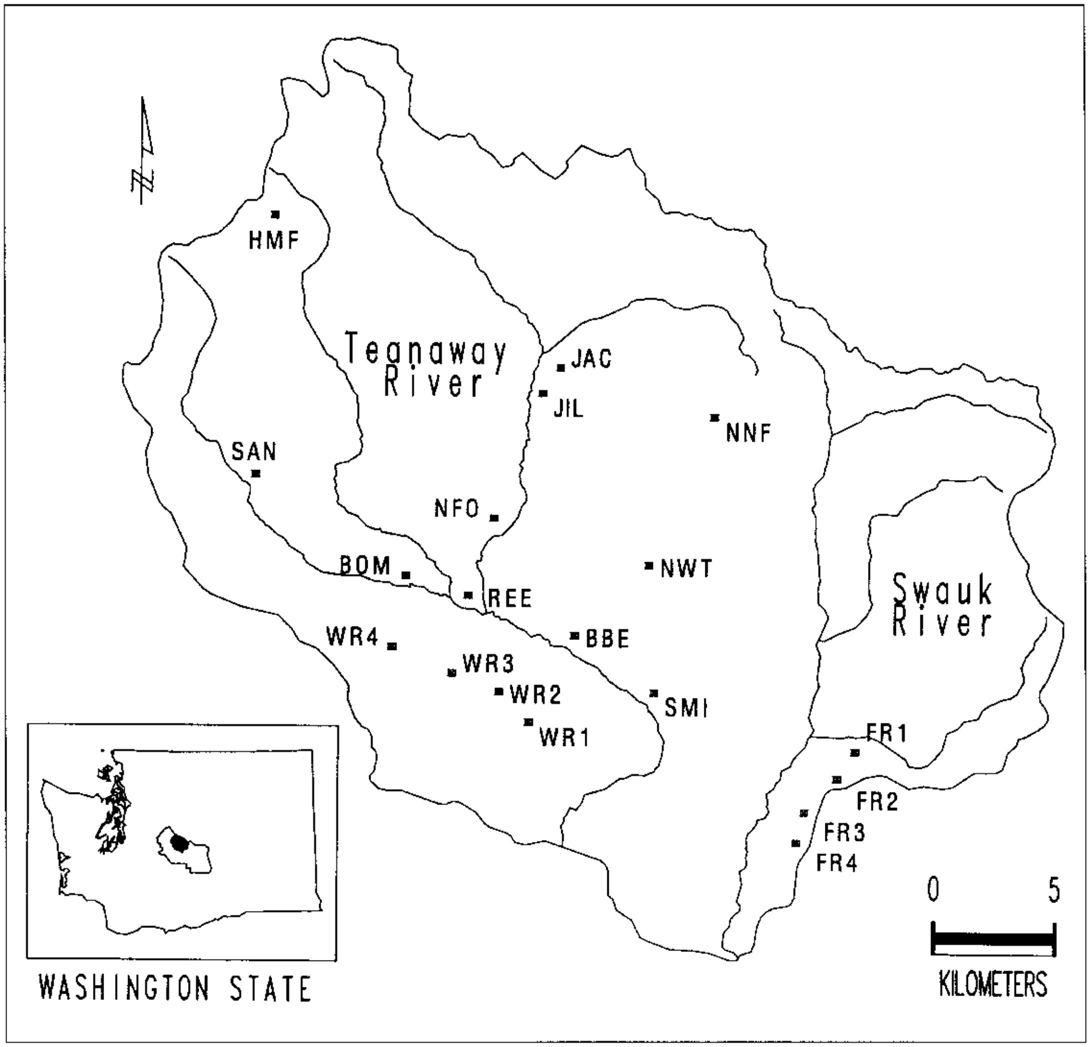

Figure 1. The study area was located in the Teanaway and lower Swauk River drainages, which occur on the east slopes of the Cascade Mountains in Kittitas County, Washington. Wetlands are indicated by three letter codes. Kittitas County is outlined and the study area is colored solid black on the Washington State map.

by aerial photography), or 1995 (as determined by field visit). Wetland elevations were estimated from U.S. Geological Survey 7.5 minute maps and wetland size by digitizing wetland boundaries on digital orthophotographs using ARC INFO. The size of two wetlands, SAN and WR3, were estimated in the field because they were too small to delineate accurately on aerial photographs. Each wetland was categorized into gross habitat types based on vegetative characteristics: canopy (forest or no forest), canopy type (hardwood or softwood), emergent characteristics (woody debris; woody plants; grass, sedge, forb; or none) for a total of 16 (2 x 2 x 4) possible gross habitat types. Thus, each wetland could be comprised of up to 16 habitat types. Habitat complexity was defined as the number of gross habitat types found at a wetland. Eight of the 19 wetlands were artificial (Table 1).

Amphibian Sampling

A combination of visual searches, dipnetting, and funnel trapping was used to document amphibian use during the April-July 1995 breeding season. A species was recorded as present if any life stage of that species was found in or immediately adjacent to a wetland. Sampling began at lower elevation wetlands in early April, as soon after ice melt as possible, and at higher elevation wetlands in early May as weather and road conditions allowed. We followed dipnet sampling procedures suggested by Scott and Woodward (1994). Dipnetting occurred along 3, 10 m transects (0 - 2 m in depth) in each habitat type. Transects were placed at randomly determined azimuths and reduced to a minimum of 5 m in length in relatively small wetlands so that they would "fit" in a habitat type. Dipnetting occurred throughout very small wetlands (SAN, WR1, and WR3; Scott and Woodward 1994) rather than along transects. In addition, a visual survey was conducted during each visit by walking the perimeter of each wetland and examining all egg masses, larvae, and adults encountered.

Each wetland was dipnetted at least four times over the course of the breeding season with the exception of four wetlands, FR1, FR2, BOM, and NFO. Dipnetting on these four wetlands was discontinued, because after two visual and dipnet surveys in April, no amphibian activity was detected while other wetlands at similar elevations contained at least two of the following three indicators of amphibian presence: breeding adults, eggs, or larvae.

All wetlands were funnel trapped except NWT, WR3, and SAN which were relatively small and shallow and in our opinion effectively sampled by other means. Ten funnel traps, constructed of 1 liter plastic containers (Richter 1995), were placed at 5 m intervals and to a maximum depth of 1 m in each habitat type. Funnel traps were set at night for at least 12 hours but less than 24 hours to minimize trap mortality. Each wetland was funnel trapped (except the four noted above) once during the spring (usually May), after many amphibian eggs had hatched.

Mann-Whitney tests (Zar 1993) were used to determine if artificial wetlands were different from natural wetlands in terms of size, elevation, habitat complexity, and species richness. The Fisher exact test was used to determine if the proportion of permanent wetlands was the same for artificial versus natural wetlands. A Pearson correlation matrix was calculated for wetland elevation, wetland size, and habitat complexity to determine the relationship between sets of these wetland characteristics.

Because we did not know why 4 of 19 wetlands had no amphibians, we did the analyses described above on two sets of data, one representing all 19 wetlands and another representing the 15 wetlands occupied by one or more amphibian species. Only the analysis of the 19 wetlands is reported here because the statistical conclusions based on these data were identical to conclusions based on the occupied subset of 15. All statistics were considered significant at $P < 0.05$.

Results

We found six species of pond-breeding amphibians but no more than four species in any single wetland (Table 1). There was no evidence of bullfrog (*Rana catesbeiana*) even though its habitat was predicted to occur in the study area (Dvornich et al. 1997). As expected, the Pacific treefrog (*Hyla regilla*) and long-toed salamander (*Ambystoma macrodactylum*) had the highest frequencies of occurrence at wetlands (79% and 53%, respectively; Table 1). The western toad (*Bufo boreas*) and Columbia spotted frog (*Rana luteiventris*) were each represented by a single occurrence, while

TABLE 1. Characteristics and amphibian species of wetlands in the Teanaway and lower Swauk River drainage, Washington. An *E* indicates the presence of eggs, *L* the presence of larvae, and *A* the presence of adults during the 1995 breeding season (April–July).

Wetland						Species[3]						
Name	Origin[1]	Type[2]	Size (ha)	Elevation (m)	No. Habitats	HYRE	AMMA	TAGR	RACAS	BUBO	RALU	Total
JIL	N	P	0.850	862	2	ELA	L	LA			EA	4
BBE	N	P	1.001	738	3	ELA	L	L				3
WR4	N	P	0.442	769	3	ELA	EL	L				3
WR2	A[4]	P	0.165	714	1	ELA	EL	LA				3
WR1	A[4]	P	0.049	640	3	ELA	EL	LA				3
NNF	N	P	0.745	1415	1	ELA	EL		A			3
SAN	A[5]	S	0.0002	923	1	L	L		LA			3
HMF	N	P	3.586	1169	3	L	L					2
FR4	N	P	1.261	985	2	ELA	EL					2
FR3	N	P	0.214	960	1	ELA	EL					2
JAC	N	P	1.077	862	2	ELA				A[6]		2
SM1	A	P	0.130	708	2	LA		LA				2
NWT	A[5]	P	0.042	1009	1	ELA		LA				2
REE	A	P	0.144	646	2	ELA						1
WR3	A[5]	S	0.0008	788	1	ELA						1
BOM	N	S	0.425	677	1							0
FR1	N	P	0.246	868	3							0
FR2	N	P	0.094	862	3							0
NFO	A[5]	P	0.066	714	1							0
Species Occurrence						15	10	7	2	1	1	
Percent Species Occurrence						0.79	0.53	0.37	0.11	0.05	0.05	

[1] Wetlands were artificial (A) or natural (N).

[2] Wetlands were permanent with open water year-around (P) or seasonal (S).

[3] HYRE = Pacific treefrog (*Hyla regilla*), AMMA = long-toed salamander (*Ambystoma macrodactylum*), TAGR = rough-skinned newt (*Taricha granulosa*), RACAS = Cascade frog (*Rana cascadae*), BUBO = western toad (*Bufo boreas*), and RALU = Columbia spotted frog (*Rana luteiventris*).

[4] Wetlands created for livestock.

[5] Wetlands created as an unintended result of road building.

[6] A single adult western toad (but no other life stage) was found within 100 m of JAC Wetland.

TABLE 2. Size, elevation, number of gross habitat types, and amphibian species richness of artificial (n = 8) and natural wetlands (n = 11) in the Teanaway and lower Swauk River drainages, 1995.

Wetland attribute	Wetland				Mann-Whitney[1]	
	Artificial		Natural			
	Mean	SE	Mean	SE	*U*	*P*
Size (ha)	0.08	0.02	0.83	0.30	6.0	0.002
Elevation (m)	767	47	924	63	22.0	0.069
No. habitat types	1.50	0.27	2.18	0.26	25.0	0.094
Species richness	1.88	0.40	1.91	0.42	43.0	0.932

[1] Results of Mann-Whitney test comparing artificial and natural wetlands.

the Cascade frog (*Rana cascadae*) was found at two wetlands. There was no evidence of fish in any wetland.

Difference in elevation ($U = 22.0$, $P = 0.069$), the number of gross habitat types ($U = 25.0$, $P = 0.094$), or species richness ($U = 43.0$, $P = 0.932$) between artificial and natural wetlands were not significant (Table 2). Artificial wetlands were smaller ($U = 6.0$, $P = 0.002$) than natural wetlands (Table 2). The proportion of permanent wetlands was not different between artificial and natural wetlands (Fisher exact test, two-tail, $P = 0.546$). Pearson correlation coefficients were generally weak ($r < 0.5$) between wetland characteristics.

Discussion

We found all native pond-breeding species expected to occur in this area of Washington State (Dvornich et al. 1997), although the western toad, and Cascade and Columbia spotted frogs were relatively rare. Species richness was similar in artificial and natural wetlands, although sample sizes may have been too small for differential species-use patterns to emerge. In addition, our habitat typing was coarse and we only sampled 19 wetlands that were readily accessible. Nonetheless, preliminary observations suggest that the western toad, Cascade frog, and Columbia spotted frog occur infrequently in small wetlands on the east slope of the Cascade Mountains, and that amphibian occurrence was unrelated to wetland origin in the 19 wetland we sampled.

Study results should be interpreted cautiously and conclusions about the role of artificial wetlands in supporting amphibians in our study area should be based on further study. We provide comparisons of wetland physical characteristics between artificial and natural wetlands as a way of demonstrating potential differences between wetlands of these origin types and to help formulate specific research hypotheses for future studies. In particular, research should explicitly consider wetland permanence and elevation as experimental design criteria. Wetland permanence is often one of the best predictors of amphibian community composition (Wellborn et al. 1996) and elevation, which is closely associated with levels of precipitation, may determine the suitability of uplands to support amphibian species (Aubry 1997).

While artificial wetlands in the inland Northwest may support some amphibian species, purposefully creating wetlands to support a particular species will require a better understanding of that species' habitat requisites (Monello and Wright 1999). In particular, large scale and long-term studies are needed to understand how habitat factors at different temporal and spatial scales affect amphibian population dynamics (Beebee 1981, Laan and Verboom 1990). The creation of artificial wetlands in Eastern Washington offers the opportunity to test predictions about amphibian habitat requirements.

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