Clark County Community-Based Amphibian Monitoring Program

Summary of 2008 and 2009 Field Data

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2008-2009 Field Report

Egg finding season
Jelly masses hidden now
Nestled in the reeds

—Jeffrey Graham

1. Background

Worldwide, many amphibian species are experiencing dramatic declines in population abundance and density due in part to habitat alteration, emerging diseases and climate change (Carey and Alexander 2003; Daszak et al., 2003). In addition, many amphibian species that inhabit urban and suburban areas are threatened with habitat loss and degradation caused by increasing urbanization and resulting in declines in amphibian distribution, abundance, and diversity in urban areas (Knutson et al. 1999; Findlay et al. 2001; Dodd and Smith 2003). Understanding the effects development has on amphibian populations is becoming increasingly important so that we may better manage our urban populations and prevent extirpations of species from their natural ranges (Paton and Egan 2001; Mitchell and Brown 2008). Clark County is the fastest growing county in Washington and has already experienced severe range contractions in two of its species, Oregon spotted frogs (*Rana pretiosa*) and Western toads (*Bufo boreas*) (McAllister et al. 1993; Leonard et al., 1993; Richter and Azous, 1995; Hayes et al. 1997). Despite this trend, before the current project began, little was being done to document amphibian species density and population trends through this highly urbanized county.

2. Project Goals

The goal of this project was to collect multi-year population data for five species of pond-breeding amphibians at a highly diverse group of sites around Clark County, WA. These data would then be shared with local and regional entities and used when making important species conservation and management decisions. Further, the project sought to engage the public in wildlife stewardship by utilizing citizen volunteers to survey and monitor these sites for amphibians. The following report details preliminary findings for the 2008 and 2009 survey seasons.

3. Methods

3.1 Volunteers

"Citizen science," using networks of citizen volunteers to collect scientific field data, is rapidly growing in popularity, as it not only allows scientists and professionals to gather large quantities of data, but it also promotes public engagement in the research subject, oftentimes leading to increased stewardship and protection of the local environment (Brossard et al. 2005; Phillips et al. 2005). The Clark County Community-based Amphibian Monitoring Program was designed around recruiting citizen volunteers and training them in pond-breeding amphibian egg mass survey protocols. Special effort was made to ensure that this effort remained volunteer-driven, allowing the participating citizens to form their own survey groups and even choose their survey sites.

Citizen volunteers methodically search a wetland for egg masses.

Volunteers were recruited through newspaper articles and notifications in popular e-mail listservs. Four-hour training sessions were held in late January of 2008 and in 2009 to teach volunteers the survey methods. The trainings included a segment conducted in the field to show volunteers actual egg masses in their natural setting.

3.2 Sites

A total of 53 sites were surveyed from January 2008 through April 2009, with some sites divided into multiple units depending on the size and arrangement of the site (Figure 1). Sites surveyed as part of this project were chosen primarily by the volunteers themselves. In most cases, they surveyed sites that they knew existed and which they believed were likely to support breeding frogs. In cases where citizens did not already have a site identified that they wanted to survey, sites were selected for them using aerial photographs of the county.

Due to the unsystematic method of choosing which sites to monitor as part of this project, the group of sites actually represents a highly diverse set of wetlands, ponds and swales across the county. Sites range in size from small roadside swales to much larger multi-acre wetlands and in amount of surrounding urbanization, with some next to major highways and business complexes and others in much more suburban or rural areas. In addition, there was a fairly even mixture of publicly-owned and privately-owned sites.

3.3 Survey Protocol

The survey protocol used for this project was adapted from one already in use by several jurisdictions in the nearby Portland area, some of whom had been conducting pond-breeding amphibian surveys in NW Oregon since 2006. Using the same protocol as other existing surveys ensures that our data are regionally compatible and that we may eventually be able to combine the separate data sets into a single larger regional data set.

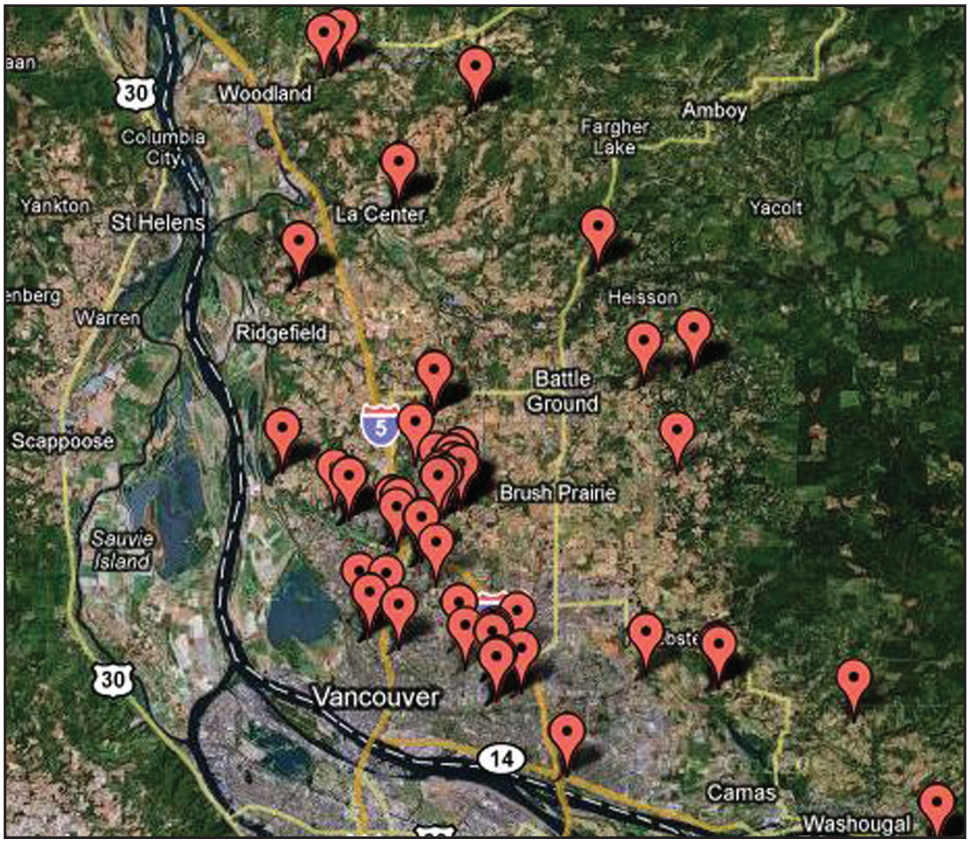


Figure 1: Distribution of all sites surveyed as part of the Clark County Community-based Amphibian Monitoring Program.

Several species were targeted as part of this study, due to their known presence in the region, their status as bio-indicators of environmental health, and their easily identifiable egg masses:

- Western toad (*Bufo boreas*; BUBO)
- Northern red-legged frog (*Rana aurora aurora*; RAAU)
- Northwestern salamander (*Ambystoma gracile*; AMGR)
- Long-toed salamander (*Ambystoma macrodactylum*; AMMA)
- Pacific chorus frog (*Pseudacris regilla*; PSRE)

Documenting sites with breeding Western toads was especially important as this species has been listed by the Washington Department of Fish and Wildlife as a "State Candidate Species" for possible listing as Threatened, Endangered, or Sensitive, as well as federally listed as a "Species of Concern" due to increasing evidence suggesting Western toads are experiencing severe range contractions. Our study of the current extent of this species' range in Clark County would help decision makers decide if Western toads should be State and/or federally listed.

The protocol used is an area-constrained method where each site is surveyed for amphibian egg masses a minimum of two times each spring (Appendix 1). Each survey group slowly walks the entirety of each site, keeping track of the total number of minutes spent searching. When an egg mass is found, it is identified, and in some cases flagged with a bamboo pole and flagging tape. At sites that are likely to be vandalized, the masses are not marked with poles and flagging. While conducting each survey, the survey team fills out a data sheet (Appendix 2), documenting the number of egg masses present for each species. At the conclusion of the survey, the total number of minutes spent searching is recorded and data are entered into an electronic database accessible to each volunteer via the project's web site (http://home.comcast.net/~cportfors/). Each survey team is responsible for entering their data into the electronic forms on the web site.

Red-legged frog (*Rana aurora aurora*)

Russ Kastberg recording field data.

4. Results

4.1 Results of 2008 Surveys

In 2008, approximately 40 citizens spent 9,890 minutes surveying 36 sites throughout Clark County (Table 1). Red-legged frog egg masses were found at 23 sites (63.9%), Pacific chorus frog and long-toed salamander egg masses were found at 17 sites (47.2%) and 15 sites (41.7%), respectively, and

Northwestern salamander (*Ambystoma gracile*) egg mass.

northwestern salamander masses were found at the fewest number of sites (13; 36.1%). Western toad egg masses were not found at any site.

In terms of species richness, there were only 6 sites where no amphibian egg masses were reported in 2008. There were 8 sites where only one species was found. In 5 of those cases, it was the red-legged frog that was found by itself, and in 2 cases the long-toed salamander was the sole species found. There was also one site where Pacific chorus frogs were the only species seen. There were 12 sites where only two species were found, 2 sites with three species and 7 sites with four species. There were no obvious species associations where two (or three) species were found together more often than others. Instead, every different combination of two and three species was found.

4.2 Results of 2009 Surveys

In 2009, approximately 60 volunteers spent 8,587 minutes surveying 35 sites (Table 2; 16 of the sites had been previously surveyed in 2008). Red-legged frog egg masses were again found at a majority of the sites (18; 51.4%), Pacific chorus frog and long-toed salamander egg masses were each found at 16 sites (45.7%), and northwestern salamander masses were again found at the fewest number of sites (9; 25.7%). Western toad egg masses were not found at any of the sites.

In 2009, there were 7 sites where no egg masses were found. There were 9 sites with one species, 5 of those sites exhibiting only red-legged frogs. In addition, at 3 sites Pacific chorus frogs were the sole species found and at 1 site, only the northwestern salamander was found. There were also 9 sites where only two species were seen and 8 sites with three species. Only 2 sites were found to have four species breeding in them. As in 2008, there were no patterns in species associations. Every combination of two and three species was found in at least one site.

4.3 Comparison of level of urbanization and amphibian abundance

With rapid urbanization of Clark County, it is important to assess this impact on amphibian populations. Pacific chorus frogs are the most abundant frog in the Pacific NW, as they have less strict habitat requirements and are therefore more tolerant of habitat alteration (Leonard et al., 1993). Consequently, they can be found breeding in almost all environments, given there is enough water present. Long-toed salamanders are also relatively tolerant to disturbance or habitat alteration although they are not typically found in the most highly developed areas (Leonard et al., 1993). Northwestern salamanders and red-legged frogs

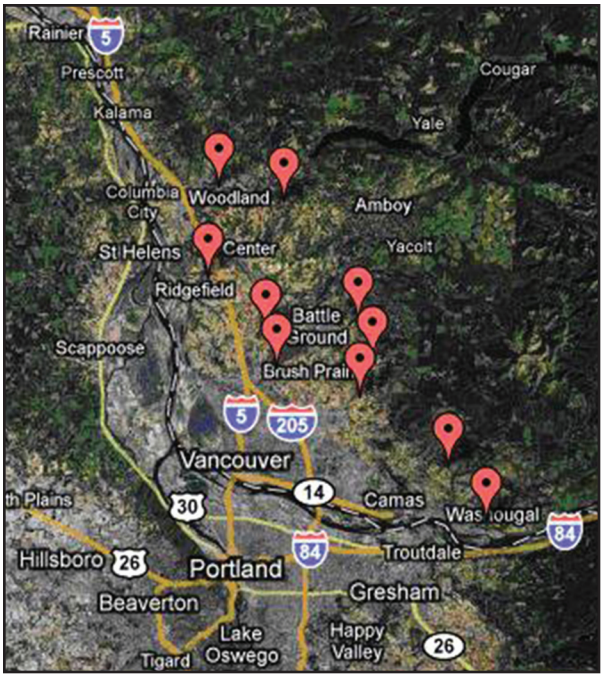
Pair of red-legged frogs (*Rana aurora aurora*) breeding.

have stricter habitat requirements, and are therefore more sensitive to habitat alteration, especially when associated upland habitat is destroyed or disconnected from their breeding ponds (Nussbaum et al., 1983; Oregon Conservation Strategy, 2006). Therefore, we compared the occurrence and abundance of these latter two species between urban and less developed sites in order to determine if any trends exist between presence of these two species and level of urbanization around a breeding site.

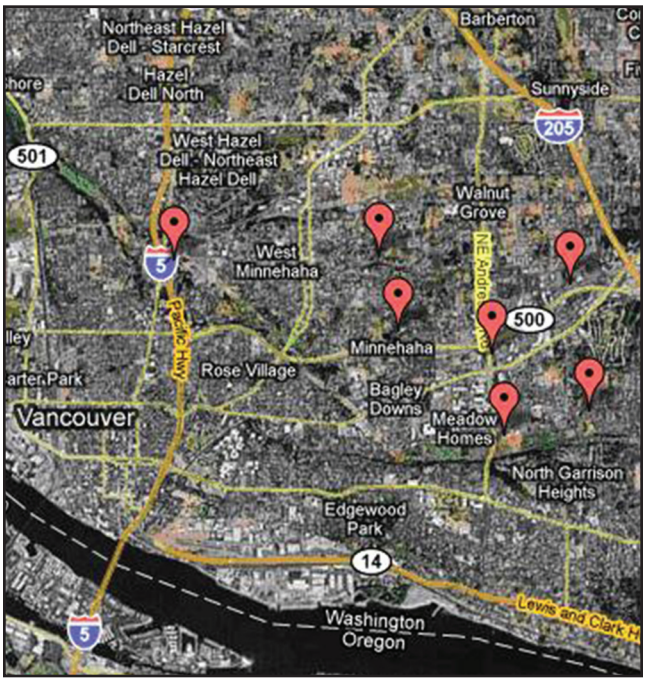
Ten sites in outlying less developed areas and 7 sites located within the urban core were randomly selected (Figure 2a and b). Red-legged frog egg masses were found in 80% (n = 8) of the less developed sites while egg masses were found in 57% (n = 4) of urban sites. Of the sites with egg masses, there were significantly more red-legged frog egg masses ($p<0.01$) in less developed areas. The mean number of red-legged egg masses for less developed sites was 53.9 (standard deviation 41.0) while the mean number of egg masses for urban sites was 9.0 (standard deviation 10.1). Northwestern salamander egg masses were found in 60% (n = 6) of less developed sites while egg masses were found in only one (14%) urban site. Of the sites with egg masses, there was no significant difference in the number of egg masses found. The mean number of Northwestern salamander egg masses for less developed sites was 9.0 (standard deviation 9.5) while the only urban site had 14 egg masses. These data suggest that levels of urbanization around a breeding site may affect the presence and abundance of some amphibian species.

4.4 Patterns across both years

There were 16 sites surveyed in both 2008 and 2009 (Table 3). Despite moderate differences in survey timing and search effort, the diversity of species found at a site was consistent between years for 8 of the 16 sites. For the remaining 8 sites, significant differences in species assemblages were seen (Figure 4). Below, we used details of each year's survey for the sites in order to suggest possible explanations for the observed differences:



A: less-developed sites



B: urban core sites

Figure 2: Locations of urban core sites and less-developed sites used to assess urbanization's impact on amphibian presence and abundance.

- **21406 NE 167 Ave (Upper Pond)** - Surveyors for upper pond at NE 167th Ave found only red-legged frog and Pacific chorus frog masses in 2008 and only northwestern and long-toed salamander masses in 2009; however, in 2008 there was only one survey conducted and it occurred in early February. This was likely too early for the northwestern salamanders to be breeding and the lack of long-toed salamanders could be explained by there being very few individuals of this species around this pond, as is evidenced by surveyors finding less than 20 long-toed salamander egg masses in 2009. Another possible reason for finding chorus frog egg masses in 2008 and long-toed salamander egg masses in 2009 could be misidentification of the masses. The egg masses of these two species are very similar and it is possible that they were misidentified in the field.

- **Andresen and 500** - Surveyors found no egg masses in 2008, but found red-legged masses in 2009. However, this site is divided up into multiple units and it is likely that the unit with red-legged frogs in 2009 was not surveyed in 2008.

- **North Gabbert** - In 2008, surveyors at the North Gabbert site found red-legged frog, Pacific chorus frog, northwestern salamander, and long-toed salamander masses, but in 2009, they found only red-legged frog, northwestern salamander and long-toed salamander masses. However, the 2009 surveyors noted that the long-toed salamander masses were "too many to count", and as Pacific chorus frog egg masses are small and look very similar to long-toed salamander masses, it is likely that some were present in 2009, and were simply misidentified as long-toed salamander masses.

- **Salmon Creek Greenspace** - Long-toed salamander masses were found in 2008, but not in 2009; however, this is an earlier breeding species (begin breeding in December of the previous year) and the surveys in 2009 were not conducted until mid-March. It is likely that this species was breeding in this pond, but that the eggs had all hatched by the time the first survey was conducted.

Volunteers observing frogs in the field.

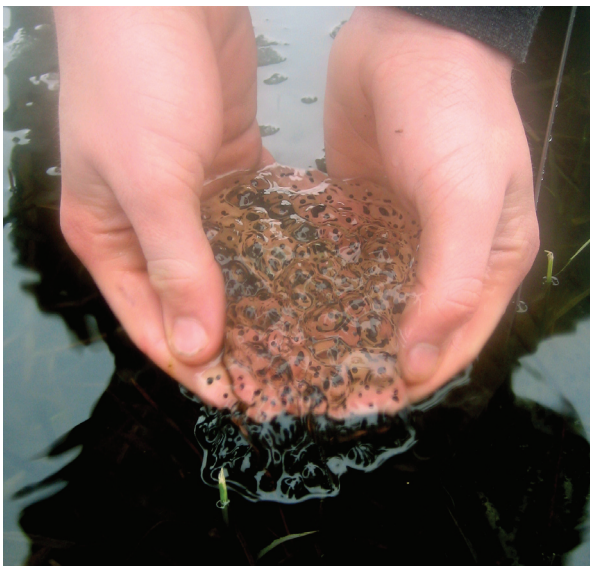
- **Salmon Creek Pond** - In 2008, four species of amphibians were found to be breeding at this site, but in 2009, only northwestern salamander egg masses were found. However, the surveyors mentioned that there were thick grass mats present around the edges of the pond which severely limited the number of masses they were able to see. It is likely that egg masses of other species were present and just not seen during the surveys.

- **Thomas Wetland** - In 2008, four species of egg masses were seen, but in 2009 only Pacific chorus frog and long-toed salamander masses were identified. However, the surveys were only conducted once each year and the survey in 2009 was done in mid-February, which is too early for northwestern salamanders and red-legged frogs to be breeding.

- **Whipple Creek Greenbelt** - In 2008, red-legged frog and northwestern salamander masses were found, but in 2009 long-toed and northwestern salamander masses were found. This site was only surveyed once each year and the surveyors in 2009 mentioned that ice covered the shallow edges of the pond, making it difficult to see the egg masses. In addition, survey effort varied greatly between years. In 2008, only 92 minutes were spent searching, whereas in 2009, 360 minutes were spent searching.

- **WSU Barn Pond** - In 2008, red-legged frog and northwestern salamander masses were found, but in 2009 red-legged frog, Pacific chorus frog and long-toed salamander masses were found. There is no obvious explanation for the differences as search time and the timing of the surveys were consistent between years. In 2008, the surveyors did report a lot of beaver activity at the pond, so it is possible that the water was deeper in 2008, making it less desirable for Pacific chorus frogs and long-toed salamanders as breeding habitat.

- **WSU Bookstore Pond** - In 2008, only red-legged frog egg masses were found, but in 2009, red-legged frog, Pacific chorus frog and long-toed salamander masses were found. The difference may be due to the timing of the surveys. In 2008, the surveys were conducted in mid-February and mid-April, whereas in 2009 the surveys were done closer together in mid-February and mid-March. The surveyors for the 2008 survey in mid-February reported very turbid water, making it difficult to see egg masses and by the time the second survey was conducted in April, many of the masses that likely were present had probably already hatched.



Red-legged frog (*Rana aurora aurora*) egg mass.

Pacific Chorus frog (*Pseudacris regilla*).

4.5 Non-target Species Observed

In both 2008 and 2009, species other than those targeted were observed. In 2008, surveyors reported seeing adult rough skinned newts (*Taricha granulosa*) at County Restoration site, Pleasant Valley Park and Whipple Creek. In 2009 newts were observed at Steigerwald NWR, Pleasant Valley Park and Woodin Creek Headwaters. In addition, bullfrogs (*Rana catesbeiana*) were seen and heard in 2008 at Burnt Bridge Creek and Andresen and in 2009 at North Gabbert and at Steigerwald NWR. As bullfrogs are an invasive species known to prey on our native amphibians, documenting which sites they inhabit is an important aspect of this project.

5. Conclusions

Citizen science programs have been largely successful across the country as a way to collect scientific data while at the same time educating

citizens about natural resource issues and encouraging them to feel a sense of stewardship for plant and wildlife populations in their local environment (Brossard et al. 2005; Phillips et al. 2005). The Clark County Community-based Amphibian Monitoring Program has been extremely successful in engaging over 100 citizens in monitoring their local amphibian populations. The feedback from the volunteers has been overwhelmingly positive with many who participated in 2008 coming back to continue surveying in 2009. These volunteers enjoy learning about species that had been a mystery to them and they feel a sense of pride and ownership in helping to document the wildlife living in their neighborhood wetlands and ponds.

Volunteers learning how to identify amphibian egg masses

In addition, this project has collected sound data on the presence/absence of species at a fairly representative sample of sites around Clark County. The sites were chosen in a fairly random manner by allowing the surveyors to select what sites would be included in the project. The result is that the 53 sites surveyed between the two years represent the entire continuum of site sizes, shapes and water depths. In addition, both public and private sites were surveyed, including many private ponds that we otherwise would not have had permission to survey had the owners of those sites themselves not been invited to participate in the project as surveyors.

Red-legged frog (*Rana aurora aurora*).

In comparing the data from this project to similar efforts being made in the region, we can conclude that the patterns of species found in Clark County are consistent with those found around other parts of the region (L. Guderyahn, unpubl. data; Rombough and Trunk 2008). Pacific chorus frogs and long-toed salamanders are fairly prevalent throughout the area and are consistently found at sites with shallow margins and good water quality. Red-legged frogs and northwestern salamanders require slightly deeper water and are consistently found at sites with good emergent vegetation on which adults can attach their eggs and that are connected to upland forest tracts. It is not surprising that Western toads were not found at any of the sites as this species is experiencing severe range contractions in much of its historical range (Richter and Azous, 1995; Leonard et al., 1993). According to the Washington Department of Natural Resources, of 21 historical sites along the lower Columbia River below the Bonneville Dam, only 1 site is currently known to host a population of Western toads.

The results of these surveys have important management implications as well. Many of the sites surveyed for this project are public areas currently being managed by various jurisdictions. It may be possible to alter management practices at these sites to better accommodate known amphibian populations. For example, altering mowing regimes to avoid key breeding and migration times of the

year could reduce mortality. In addition, summertime herbicide spraying should be avoided in and near sites with amphibians present; instead these sites should be treated during the winter months, when amphibians are overwintering out of the ponds.

In addition, these data do suggest that levels of urbanization around a breeding site may affect the

> *The days are still cool*
> *Maybe they are still sleeping*
> *Snuggled deep in mud*
>
> *—Karen Varshock*

presence and abundance of amphibian species with stricter habitat requirements. A more rigorous comparison of the elements defining urban areas (i.e. percent impervious surface, nearness of roads, nearness to forested upland habitat, etc.) is needed to determine if this trend truly exists in Clark County, and if so, which components of urban areas are most correlated to making a breeding site unfavorable to these amphibians. Geospatial analyses computing the percent impervious surface within a specified distance of a breeding site, as well as calculations of distance to major roads and upland forest should be done and matched with the survey data to determine if these elements play a role in the spatial distribution of breeding populations of amphibians in urban areas. Research into whether amphibian species were present at these sites historically would also give an idea as to whether increasing urbanization has resulted in the extirpation of species from historic breeding sites. If urbanization is found to be having a significant effect on amphibian species in Clark County, management of those sites with breeding populations present should include the creation of protective buffers around the site as well as maintaining connectivity to associated upland forested tracts.

6. Recommendations

While much can be said with confidence about species presence/absence at these sites, small changes could be made in the way data is collected and reported in order to make it even more valuable to decision makers. The first suggested change is to standardize and make clear to the volunteers how the egg masses are counted and reported from one survey to the next. In reviewing the data and comments made by the surveyors, it was apparent that while some volunteers reported the total number of egg masses found on each survey (i.e., if they found 5 masses the first survey and on the second survey found the 5 old masses plus 3 new ones, they reported finding 8 masses for the second survey), other volunteers reported only the new masses found on subsequent surveys. This makes comparing population densities between surveys and between years extremely difficult.

Ann Kastberg at La Center.

A second suggestion is to have surveyors collect and report more information about the site itself. For example, knowing how deep the water is during the survey would help document the hydroperiod of each site, a factor that is especially important for determining if a site holds water long enough during the year to allow time for the amphibians to complete metamorphosis and escape onto land before the site dries in the summer. In addition, collecting estimates of the site's size (length and

width) would help make comparisons of survey effort between surveys and between years possible. If less time is spent surveying during the second visit to a site than the first, we could determine if this is because the water level went down and the site was smaller and it took less time to survey or if there were fewer people and therefore less of a search effort during the second survey.

In addition, ensuring that sites are surveyed at least twice a year (and preferably three times) is vital. At several sites for this project, surveys were done only once during the year, likely missing the breeding window of several species. In order to adequately assess a site, it should be surveyed at least once in February and once in March and with at least 2-3 weeks in between surveys. If possible, a final survey in mid-April is recommended because, depending on the severity of that year's winter weather, some species may not begin breeding until mid-March (as happened in 2009). Also, the variability in species presence at some sites between 2008 and 2009 suggests that each site should be surveyed for several years (4 minimum) in order to accurately determine which species are using a site. If possible, the coordinators of this project should make every effort to continue this study for at least 2 more survey seasons in order to collect enough data on each site so that small inconsistencies resulting from less than optimal visibility conditions or misidentification of egg masses will have less of an effect on the quality of the data set.

Another suggestion might be to make tadpole surveys a part of this project since the small size of the egg masses of the Pacific chorus frogs and long-toed salamanders and the poor visibility conditions some surveyors reported (due to extreme glare, turbid water and dense floating vegetation) made it likely that the egg masses of some species were present and simply were not seen. Therefore, if possible, returning to the sites in mid-May and mid-June to conduct dip-net and metamorph surveys would help to determine if species were truly absent during the egg mass surveys or if their egg masses were simply not seen. An added benefit of returning to the sites later in the season is that it provides an opportunity to gauge recruitment into the population for each species. Knowing that amphibians are breeding at a site is valuable information, however, knowing if those embryos make it past the egg stage and all the way through metamorphosis is even more important from a population dynamics perspective. Returning to a site to gauge tadpole and metamorph densities as well as hydroperiod will allow us to determine

each site's value as quality breeding habitat for the species using it.

Further, in order to increase confidence that volunteers are producing high quality data, there needs to be an aspect of quality assessment and control in this project. A subset of the sites should be randomly selected (as time and resources allow) and surveyed by a third party within days of being surveyed by the regular volunteers in order to ensure that the data being reported is accurate and egg masses are not being over- or under-counted. The same should also be done with entering the data into a spreadsheet. Currently, volunteers are able to access and enter their data into an electronic spreadsheet set up for them via the project web site. However, in reviewing all the data, it appears that some data is missing and other data were entered incorrectly. For example, on several occasions a survey was recorded as the second survey of the year, yet there was no data from a first survey recorded in the database. In addition, on one occasion, the comments section from a second survey referenced egg masses found in the first survey, and yet the data from the first survey did not match those comments. One solution to this problem would be for surveyors to collect information on paper data sheets which they would then send to one person who would enter all the data. Another option would be to review the entered data periodically (on a weekly basis, perhaps) to catch errors and have them corrected immediately.

Sucked into the mud
Searching through the waters
Masses will be found

—Andrew Graham

Amphibian eggs
Cold, swampy, algae cover'd
Make poor caviar

—Dave Newcomb

Jelly masses laid
Waders sucking deep in mud
Searching for the prize

—Elizabeth Koch

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Tables

Table 1: Species presence for all sites surveyed in 2008.

Site	RAAU	AMGR	PSRE	AMMA	BUBO
21406 NE 167 Ave (Upper Pond)	X		X		
Andresen & 500					
Backyard Pond	X				
Beaver Pond		X	X		
Bull Frog Pond I-5	X				
Burnt Bridge Creek and Andresen	X			X	
Burnt Creek Trail					
Chilton Pond	X	X			
Columbia Springs			X		
County Restoration Site	X	X	X	X	
Ellen Davis Trail			X	X	
Green Lake	X	X	X	X	
Hayes Rd Pond					
Klineline Turtle Pond					
La Center Bottoms	X	X	X	X	
Meadow Pond	X	X	X		
Meadowbrook Marsh Ponds	X			X	
NE 134th Ave & NE Salmon Creek St	X				
North Gabbert	X	X	X	X	
Pleasant Valley Park					
Private Pond	X		X		
Private Property	X		X		
Queens Pond					
Ridgefield Green Lake Wetlands	X	X	X	X	
S. pond @ Hockinson	X		X	X	
Salmon Creek Greenspace	X	X		X	
Salmon Creek Pond	X	X	X	X	
Shilipoo Unit Vancouver Lake					
Steigerwald NWR				X	
Stewart Glen Burnt Creek Greenway				X	
SW Detention Pond			X	X	
Thomas Wetland	X	X	X	X	
Whipple Creek Greenbelt	X	X			
WSU Barn Pond	X	X			
WSU Bookstore Pond	X				
WSU Pond North of Basketball Hoops	X		X		

Table 2: Species presence for all sites surveyed in 2009.

Site	RAAU	AMGR	PSRE	AMMA	BUBO
10716 NE 36th Ct	X		X	X	
21406 NE 167 Ave (Lower Pond)	X		X	X	
21406 NE 167 Ave (Upper Pond)		X		X	
28th & 90th St	X				
Andresen & 500	X				
Backyard Pond	X				
Brown East Pond	X		X	X	
Burnt Bridge Creek and Andresen	X			X	
Chilton Pond	X	X			
Fred Farmer Site 1					
Fred Farmer Site 2					
Fred Farmer Site 3					
Fred Farmer Site 4			X		
Goodwin & Ingle pond			X	X	
Green Meadow Golf Course Ditch					
Heritage Trail Parking			X		
Jorgenson Park					
La Center Bottoms	X	X	X	X	
NE 134th Ave & NE Salmon Creek St	X				
North Gabbert	X	X		X	
Pleasant Valley Park					
Red Robbin Pond					
Salmon Creek Ave & 134th St	X				
Salmon Creek Greenspace	X	X			
Salmon Creek Pond		X			
Shilipoo Unit Vancouver Lake			X	X	
Steigerwald NWR	X	X	X	X	
Thomas Wetland			X	X	
Washougal Oaks			X		
Whipple Creek Greenbelt		X		X	
Woodin Creek Headwaters		X	X	X	
WSU Barn Pond	X		X	X	
WSU Bookstore Pond	X		X	X	
WSU Pond North of Basketball Hoops	X		X	X	
WSU South Detention Pond	X		X		

Table 3: Species assemblage comparison between years for sites surveyed both in 2008 and in 2009.

Site	Year	Search Time (minutes)	RAAU	AMGR	PSRE	AMMA
*21406 NE 167 Ave (Upper Pond)	2008	28	X		X	
	2009	23		X		X
*Andresen and 500	2008	180				
	2009	861	X			
Backyard Pond	2008	45	X			
	2009	15	X			
Burnt Bridge Creek and Andresen	2008	386	X			X
	2009	935	X			X
Chilton Pond	2008	62	X	X		
	2009	22	X	X		
La Center Bottoms	2008	2842	X	X	X	X
	2009	900	X	X	X	X
Salmon Creek Ave & 134th St	2008	15	X			
	2009	25	X			
*North Gabbert	2008	120	X	X	X	X
	2009	160	X	X		X
Pleasant Valley Park	2008	15				
	2009	25				
*Salmon Creek Greenspace	2008	250	X	X		X
	2009	216	X	X		
*Salmon Creek Pond	2008	320	X	X	X	X
	2009	138		X		
*Thomas Wetland	2008	339	X	X	X	X
	2009	226			X	X
*Whipple Creek Greenbelt	2008	92	X	X		
	2009	360		X		X
*WSU Barn Pond	2008	125	X	X		
	2009	115	X		X	X
*WSU Bookstore Pond	2008	134	X			
	2009	118	X		X	X
WSU Pond North of Basketball Hoops	2008	15	X		X	
	2009	28	X		X	X

*Denotes sites where clear differences in species assemblages were seen between survey years.

Appendices

Appendix 1: Survey protocol developed by METRO and adapted for use with the Clark County Community-based Amphibian Monitoring Program.

Metro Regional Parks and Greenspaces

AMPHIBIAN EGG MASS MONITORING PROTOCOL

- Assessing and tracking wetlands habitat quality and restoration effectiveness using pond-breeding amphibians as a bio-indicators

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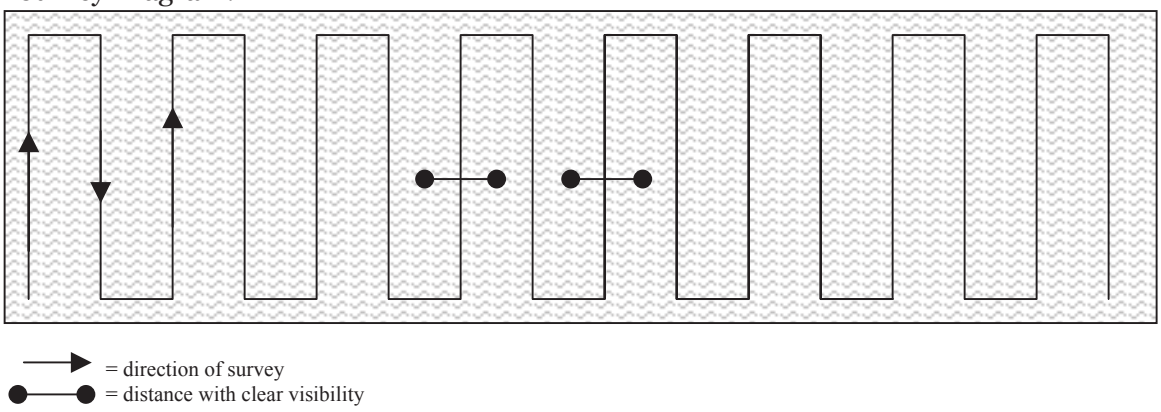
BASICS:
To assess and track wetland ecosystem quality and the impacts and effects of Metro's restoratic projects by monitoring egg masses from target amphibian populations

TARGET HABITATS:
Emergent wetlands, Shrublands and open ponds

TARGET SPECIES:
- Northern red-legged frog (*Rana aurora aurora*) = RAAU
- Pacific chorus frog (*Pseudacris regilla*) = PSRE
- Northwestern salamander (*Ambystoma gracile*) = AMGR
- Long-toed salamander (*Ambystoma macrodactylum*) = AMMA
- Bullfrog (*Rana catesbeiana*)* = RACE *non-native species

METHODS:
Visual Encounter Survey: Conducting visual surveys within assigned wetland units, keeping track of the amount of time spent actively searching for egg masses (e.g., not including time spent writing data as search time).
1. Visit your assigned wetland unit.
2. Pick a logical starting point in unit (usually a corner of the unit).
3. Start stopwatch/chronometer function on watch.
4. Move slowly and methodically through study area, walking from one end of the unit to the other. It will take several back and forth passes to survey the full unit and each pass should be separated by an appropriate distance to allow you to survey the entire wetland unit without missing portions (i.e. because the passes are spaced too widely) or double-counting the same egg mass (i.e. because you spaced passes too closely).

Survey Diagram:

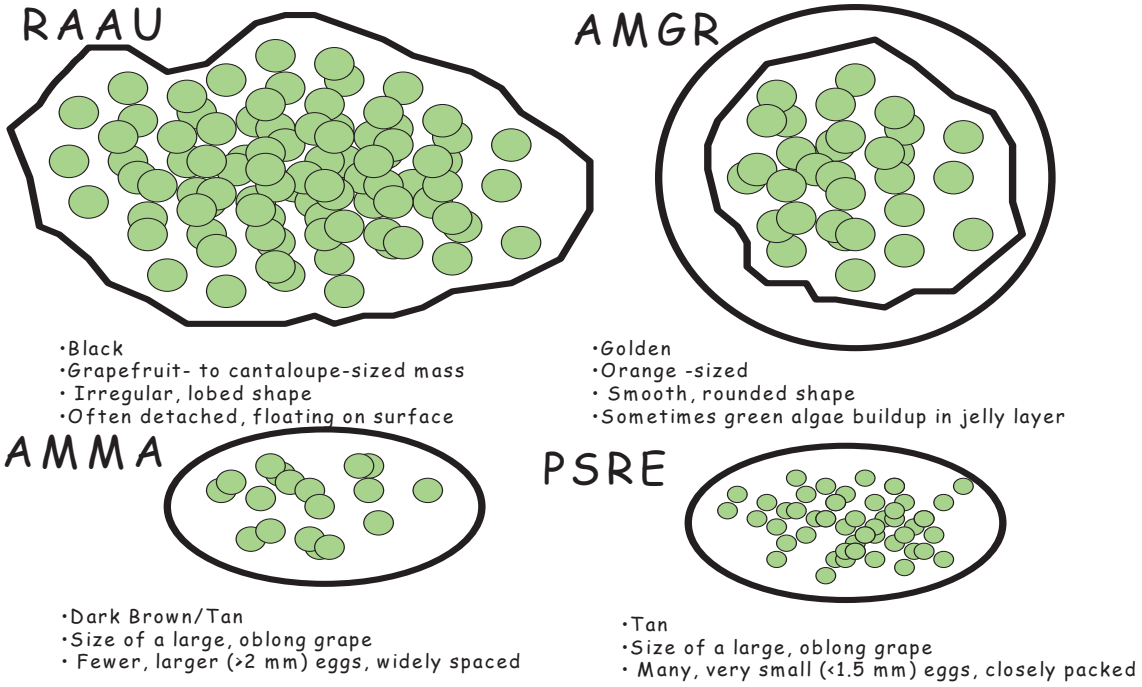


Appendix 1: Page two of survey protocol developed by METRO and adapted for use with the Clark County Community-based Amphibian Monitoring Program.

5. Move slowly enough to prevent stepping on egg masses and walking slowly to avoid stirring sediment.
6. If an egg mass is encountered, stop the clock.
7. Mark the egg mass by flagging a piece of nearby vegetation (or using a bamboo pole if necessary). We will only be marking northwestern salamanders (AMGR) and northern red-legged frogs (RAAU).
8. Mark on unit map where the egg mass was found with red (RAAU) or blue (AMGR) sharpie
9. Record data on datasheet.
10. Restart stopwatch when search resumes.
11. Survey as much of the unit as possible. After entire area is surveyed or when you have completed the portion of the survey planned for that visit:
    - mark the end time (equal to total search time) showing on your stop watch in the box entitled "Total Search Time".
    - Mark the real time (AM/AP time) in the box entitled "End Time".
12. Rate Subsurface visibility.
13. Rank none/few/many for chorus frogs (PSRE) and long-toed salamanders (AMMA).

Note: Handling amphibians/eggs

- Make sure there is no suntan lotion or insect repellent on your hands
- Keep your hands wet during handling
- Make sure that you keep egg masses in cold water, or in a cold, wet environment
- Do not detach individual eggs from the mass, nor the mass from the supporting vegetation



NOTE: Due to the ease of transferring exotic diseases and invasive species between sites on survey equipment, all waders, nets, etc. must be disinfected and sterilized between sites. See Pilliod and Wind, 2008 for disinfecting technique details.

Appendix 2: Sample data sheet used for the Clark County Community-based Amphibian Monitoring Program.

Clark County Volunteer Egg Mass Survey Data Form *Sheet _____ of _____*

DATE:	**OBSERVERS:**	**SITE**	
		Unit # or Quadrat #:	
START TIME:	**TOTAL TIME: _____hr_____mm**	**Subsurface Visibility[a]:**	**PSRE: 0 <20 >20 >100**
	- PROCESSING TIME: ____hr_____mm		
END TIME:	**= TOTAL SEARCH TIME: _____hr_____mm**	**Poor / Fair / Excellent**	**AMMA: 0 <20 >20 >100**

FIELD NOTES: (e.g., weather, waterfowl/human disturbance, oil sheen/algae)

_____

_____

[a]**Visibility**: **Poor** = less than one foot down **Fair** = less than two feet **Excellent** = greater than two feet

Time on stopwatch	Flag	Species	# of Egg masses	Stage[b]	Attachment vegetation[c] (if known)	Water Depth (ft)	Field Notes
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
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		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		
		RAAU AMGR		R T H	G W O N		

[a]Visibility: Poor=less than one foot down, Fair=less than two feet, Excellent=greater than two feet

[b]Stages:1. Round embryo (R) , 2. pre-hatch embryo with tail feature (T), 3. hatching (H)

[c] Attachment vegetation: Grass or grass-like plant (G). Woody plant (W), Other (O), No Attachment (N)

[d] Round "water depth" to nearest foot. Write "0" here only if the mass is above the waterline, otherwise use 1 or greater.