# Ecological Review; fall birds and bats in the oxbow system, Albany, Oregon

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## I. Introduction

Merlin ecological was retained by the Calapooia Watershed Council to evaluate the avian (bird) and chiropteran (bat) fauna and habitat at the Albany oxbow system along the Willamette River in Oregon in fall 2012 (Appendix A). The watershed councils are a state empowered nongovernmental associations chartered with protecting and enhancing watershed health. While their primary focus to date has been on restoring healthy stream channels for endangered salmonids, the Calapooia Watershed Council has recognized the potential to protect and restore other ecosystem components throughout the watershed, and thus further enhance watershed health. The Calapooia Watershed Council has recently partnered with the City of Albany and potential funders to evaluate the oxbow system for restoration and habitat improvement. In this report we document the current avian and chiropteran fauna and the habitats upon which they depend, and make recommendations for habitat improvement where appropriate.

The oxbow system is a series of small oxbow in the Willamette River floodplain near the city of Albany (Appendix A). These oxbow lakes and surrounding area have been part of an industrial park and wastewater treatment for International Paper and Wah Change. Historically, the oxbow system has been used for log storage and water treatment.

Because of the sites industrial usage, pollution has been a major concern. However, current data show no contamination issues (Vaughn Pieschl, personal communication) and no expectation of entrainment or future issues (Denise Hoffert-Hay, personal communication). Thus, from a bird and bat perspective, the primary issues on site are habitat quality, patch size, availability of food and water, and disturbance.

## II. Methods

### A. Habitat Surveys

We conducted a habitat survey based upon vegetation type and structure. An exhaustive list of plants on site was not conducted because a more intensive vegetation cover survey has been commissioned. Our survey is sufficient for a basic understanding of community structure and the avian and bat species which may occur on site. At each location we recorded dominant landcover type (e.g. forest, woodland, shrub, grassland) and dominant species. Native and non-native species were recorded as observed. Vegetation on site was ground-truthed by recording vegetation at point count locations and walking into nearby habitat patches at least 20 meters to avoid edge effects. Habitat was then extrapolated over the entire survey area by comparison of the survey points with the aerial photo. Habitat types were determined for patches ~20 acres and larger in size. Acreages are approximate.

### B. Bat Surveys

Bat surveys were conducted in accordance with general bat acoustic bat survey protocols as taught by Bat Conservancy International (BCI 2009). Acoustic monitoring is considered a reliable method for non-invasive monitoring of bat activity (O'Farrell and Gannon 1999).

We conducted a stationary bat survey and a mobile bat survey (Appendix B). For the stationary bat survey, we placed an Anabat SD1 acoustic monitor at Pond C, on the northern portion of the property near oxbows 3 and 4. Habitat at this site consisted of a small pond surrounded by tall grasses and herbaceous plants, a single large decrepit cottonwood (*Populus trichocarpa*), and a clump of willow shrub. The pond is surrounded by invasive grasses on three sides and a narrow "finger" of large cottonwoods on the west. The acoustic monitor was set to high sensitivity (just below static interference—equivalent to recording a "finger scratch" at 25ft, or most bat species at 500 ft.), the microphone was mounted 6 ft above the water surface on a pre-existing weir at the southernmost side of the pond, and the acoustic deflector shield was aimed at 45 degrees to capture bat calls over the pond from the north. We recorded from the evening of August 25, 2012 through August 31, 2012.

For the mobile bat surveys we conducted a road survey in the northern area on IP property near oxbows three and four on the evening of September 2nd, 2012 (7 PM until 11:40 PM). In the southern portion (OPRD/Simpson Lumber property leased by Albany Parks Department; hereafter referred to as OPRD), we conducted an auto and foot survey on the evening of September 9th, 2012 (6:00 PM until 10:20 PM; Appendix B). During the mobile surveys, we visited all of the major landscape features and vegetation types in the survey area including: mature forest, willow scrub, wet prairie, open river, pond, and oxbow.

Bat calls were downloaded and compiled using CFCread, file version 0.4.3.19. Bat calls were analyzed in Analook W, version 3.8m. Bat calls were identified to species or "frequency group" based upon frequency and call shape. For identification, we used a reference library consisting of over 800 calls recorded and identified by Chris Corben in 2009. Criteria used to distinguish species include minimum frequency ($f_{min}$), consistency of $f_{min}$, frequency of maximum amplitude, duration between calls, and call "shape". Bat calls were tallied by species, group, hour and night. Surveys and call identification are consistent with those conducted for commercial developments and as taught by Bat Conservation International (BCI 2009). We analyze calls by frequency group (in addition to our species analysis) because some species can be difficult to

distinguish, and visual call identification is controversial between some species (such as between Myotis species or between big brown and silver-haired bats).

Data was adjusted so that all calls occurring within an evening are reported for the calendar day on which the evening starts (i.e. calls occurring after midnight are reported as occurring on the same "date" as those occurring before midnight) so that temporal continuity is maintained and diurnal cycles are preserved in the data reporting.

Weather during the week of bat surveys was relatively stable, with no weather fronts moving through. Winds were low at 3 to 7mph, with gusts from 8 to 15 mph. Temperatures remained stable at 48- 51°F for the nightly lows, and 77-83°F for the daily high temperatures. No rain was reported and visibility remained clear (NOAA 2012).

### C. Avian Surveys

Avian surveys were conducted in accordance with general point count survey methodology (Bibby et al. 1992). Point count surveys have been found to be generally useful as indicators of habitat quality and as a basis for management decisions (Bock and Jones 2004).

Avian surveys consisted of point count surveys for small bird/passerines conducted from dawn until 10:00 AM and raptor/large bird surveys conducted between 10:00 AM and noon. Small bird/passerine surveys documented all birds seen and heard within 10 minutes and 100 meters of the surveyor, while the raptor/large bird surveys documented all birds crow-sized or larger observed within 30 minutes and 800 meters of the surveyor. Passerine/small bird surveys included a total of 9 point counts (Appendix C), with 4 conducted on September 18th, 2012, on the IP portion of the property and 5 point counts conducted on September 21st, 2012 on the OPRD. Of these, 5 were conducted in forest or woodland, 3 were conducted adjacent to a pond, 1 was conducted on the river, and 3 were conducted adjacent to grasslands (note, habitat totals do not equal the number of surveys because all adjacent habitat types were recorded at each point, thus a pond surrounded by grasslands was recorded as both "pond" and "grassland").

Large bird/raptor surveys included a total of 4 surveys (Appendix C), with two conducted on September 18th, 2012 on the IP portion of the property, and 2 conducted on September 21st, 2012 on the OPRD portion of the property.

Survey locations were chosen to offer to span the survey area, represent different habitat types (e.g. woodland, riparian, grassland), provide maximum visibility (See attached map, Appendix D), and be generally accessible.

Weather during the avian surveys was clear to lightly cloudy with low winds on all survey days. Temperatures ranged from 65°F to 85°F on all survey days.

Bird species were identified by sight and sound using Sibley (2000). Rarity and sensitivity to disturbance rankings were based upon personal experience and Audubon's ebird reports (http://ebird.org/content/ebird/about/occurrence-maps). Birds that occur reliably and in large numbers were considered "common" (*e.g.* Robin, Junco, Vulture, Mallard); those that occur reliably in smaller numbers or which may require searching numerous patches of "likely" habitat, and those which are irregular or occasional, but can be reliably found each year are considered "moderate" (*e.g.* Brown creeper, Purple Finch, Swamp Sparrow and Horned Grebe*)* ; and those which occur in small numbers, in specialized habitats, or irregularly are considered "uncommon" (*e.g.* Western Grebe, Black-throated Gray Warbler, Black Phoebe).

Tolerance of disturbance was considered “high” for hose species which are commonly found in urban landscapes or near houses and which persist with regular human activity (*e.g. S*tarlings, House Sparrows, Mallards); “moderate” for those species which may be found in human disturbed areas, but which will leave if disturbed 2-3 times in a day or several times a week (*e.g.* Red-bellied Nuthatch, Black-crowned Night Heron, and American Widgeon), “moderately low” for those species which are not found around human habitation (*e.g.* Red-shouldered Hawk); and “low” for those species which are not typically observed near human habitation and which tend to leave if disturbed (e.g. Cinnamon Teal, MacGillivrey’s Warbler).

## III. Results

### A. Habitat and vegetation

The historic vegetation on site is recorded by the GLO as being oak and fir forest along the riparian corridor (River Design Group 2011), with a large expanse of savanna and prairie immediately adjacent. This habitat type was common along riparian corridors in the Willamette Valley during pre-European settlement days (Christy and Alverson 2011).

The survey area is primarily covered in a mixture of old-growth riparian community (mixed mature forest), second growth shrub-scrub (riparian shrub-scrub and forest shrub scrub), wet-prairie, grasslands (upland prairie), open water, and developed areas (Table 1; Appendix D).

**Table 1. Habitat types and size.**

| Habitat type | Acres |
|---|---|
| Forest shrub/scrub | 69.8 |
| Developed | 12.2 |
| Mixed mature forest | 139.9 |
| Open Water | 51.5 |
| Riparian shrub/scrub | 62.2 |
| Upland prairie | 17.2 |
| Wet prairie | 87.2 |

The old growth riparian community consists of large to very large (36” diameter at breast height (dbh) to 60” dbh) Douglas fir (*Pseudotsuga menziesii*), Oregon white oak (*Quercus garryana*), big-leaf maple (*Acer macrophyllum*), and black cottonwood (*Populus trichocarpa*). This community extends from the northernmost extent of the survey area near oxbow 4 to the southernmost extent near the Talking Waters treatment ponds, and from the westernmost extent of the survey area along the edge of the Willamette River easterly to Railroad tracks in some locations. The canopy forms a “cathedral ceiling” in many areas, and is generally open (e.g. less than 1 stem in each 25 to 50 feet linear distance). The mature forest understory community is dominated by invasive Himalayan blackberry throughout, although a few small trees and shrubs persist.

The north-central portion (by 3rd and 4th oxbow) of the property was divided into water treatment ponds by IP, the landowner. These have largely converted spontaneously to wet prairie during disuse. These areas are dominated by non-native Reed’s canary grass (*Phalaris arundinacea*), barnyard grass (*Echinochloa crus-galli*), small black cottonwood, and sedges (*Carex sp*.).

A small area of upland prairie/scrub occurs just south of 3rd oxbow just downhill of and on the treatment pond burm. This area is entirely disturbed and dominated by invasive grasses and forbs such as Reed's canary grass and teasel (*Dipsacus fullonum*).

The riparian shrub-scrub community occurs along the banks of the Willamette River, near oxbows 1 and 2, and in patches among the treatment ponds. This community consists largely of willow, emergent grasses and sedges (including rice cutgrass, *Leersia oryzoides*), and several early successional species such as beggar's ticks (*Bidens aristosa)*.

The forest shrub/scrub area that we have identified from aerial photos was very difficult to penetrate. This area is more open and trees generally appeared smaller than in the mixed mature forest. The understory component was thick with blackberries, small trees and shrubs. This area is likely to be the old riverbed.

Native herbaceous cover includes both native early successional species such as beggar's ticks and water hemlock (*Cicuta maculata*) along the pond and river edges, to mountain brome (*Bromus carinatus*) in the upland areas. Non-native invasives such as teasel, thistle (*Cirsium sp*.), and common tansy (*Tanacetum vulgare*) dominated upland herbaceous cover. Very few native grasses were observed at all. Some brome-grass (*Bromus carinatus*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) were observed at the woodland edges.

### B. Bat Activity

In all, we recorded a total of 1536 bat call sequences in 7 nights, between 7:00 PM and 5:00 AM Pacific Standard time during the week of August 25$^{th}$ through August 31$^{st}$, 2012 (Table 3). Species acronyms in tables and figures are as listed in Table 2. We observed 8 of the 12 species previously recorded within the Willamette Valley (Table 2). Of those not observed, 2 species (pallid bat and Townsend's big-eared bat) are unlikely to be recorded in audio sampling because of they do not vocalize loudly during hunting. The fringed myotis is not expected to occur in this area because it occurs in grassland habitats or woodlands at higher elevations. The long-legged myotis, also not observed, prefers open woodlands in mountainous terrain.

Most of the calls (616 call sequences) were identified as little brown bats, with Yuma myotis the next most common (404 call sequences), followed by hoary bats (268) and big brown bats (126 calls). Relatively rare were California myotis (33 calls), silver-haired bat (29 calls), western red bat (5 calls), and long-eared myotis (3 calls), A total of 22 call sequences in the 40-50 Khz range (myotis complex) could not be reliably identified to species, and 10 calls in the 20-30 Khz range (hoary/big brown/silver-haired bat complex) were identified as belonging to either big brown or silver-haired bat, but could not be reliably assigned to either species. Calls were relatively uniform across nights (Table 3), for all species (Appendix E) with a slight decline in calls toward the end of the recording period (Fig. 1).

## Table 2. Bat species observed on site.

| 4-letter code | Scientific name | Common name | Observed | Willamette Valley |
|---|---|---|---|---|
| **ANPA** | Antrozous pallidus | pallid bat | No | Likely, but unlikely to be heard (1,3) |
| **COTO** | Corynorhinus townsendii | Townsend's big-eared bat | No | Possible, but unlikely to heard (2,3) |
| **EPFU** | Eptesicus fuscus | big brown bat | Yes | Common (1.3) |
| **LABO** | Lasiurus blossevillii | western red bat | Yes | Possible, but uncommon (1,3) |
| **LACI** | Lasiurus cinereus | hoary bat | Yes | Common migrant (1,3) |
| **LANO** | Lasionycteris noctivagans | silver-haired bat | Yes | Common migrant (1,3) |
| **MYCA** | Myotis californicus | California myotis | Yes | Possible (3) |
| **MYEV** | Myotis evotis | long-eared myotis | Yes | Very possible, but quiet calls (3) |
| **MYLU** | Myotis lucifugus | little brown myotis | Yes | Common (3) |
| **MYTH** | Myotis thysanodes | fringed myotis | No | Unlikely due to habitat (1) |
| **MYVO** | Myotis volans | long-legged myotis | No | Possible (3) |
| **MYYU** | Myotis yumanensis | Yuma myotis | Yes | Likely (3) |

**1) Barbour and Davis 1969. 2) BCI 2012, 3) Oregon Department of Fish and Wildlife 2012.**

## Table 3. Bat activity by species and date.

| | EPFU | EPFU LANO | LABO | LACI | LANO | MYCA | MYEV | MYLU | MYYU | UNKN | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **8/25/2012** | 3 | 2 | 5 | 51 | 3 | 10 | 1 | 90 | 66 | 3 | **234** |
| **8/26/2012** | 29 | 2 | 2 | 33 | 5 | 5 | | 110 | 72 | 14 | **272** |
| **8/27/2012** | 40 | 3 | | 51 | 10 | 9 | | 104 | 50 | 3 | **270** |
| **8/28/2012** | 20 | 1 | 4 | 51 | | 5 | 1 | 71 | 69 | 1 | **223** |
| **8/29/2012** | 12 | 2 | 7 | 25 | 2 | 1 | | 90 | 40 | | **179** |
| **8/30/2012** | 8 | | 4 | 28 | 4 | 2 | | 72 | 47 | | **165** |
| **8/31/2012** | 14 | | 3 | 29 | 5 | 1 | 1 | 79 | 60 | 1 | **193** |
| Grand Total | **126** | **10** | **5** | **268** | **29** | **33** | **3** | **616** | **404** | **22** | **1536** |

Bats were most active during the early evening and predawn hours (Figure 1), with most early evening bats identified as big brown bats, and most predawn bats identified as little brown bats. Other species were relatively uniform throughout the night (Appendix F).

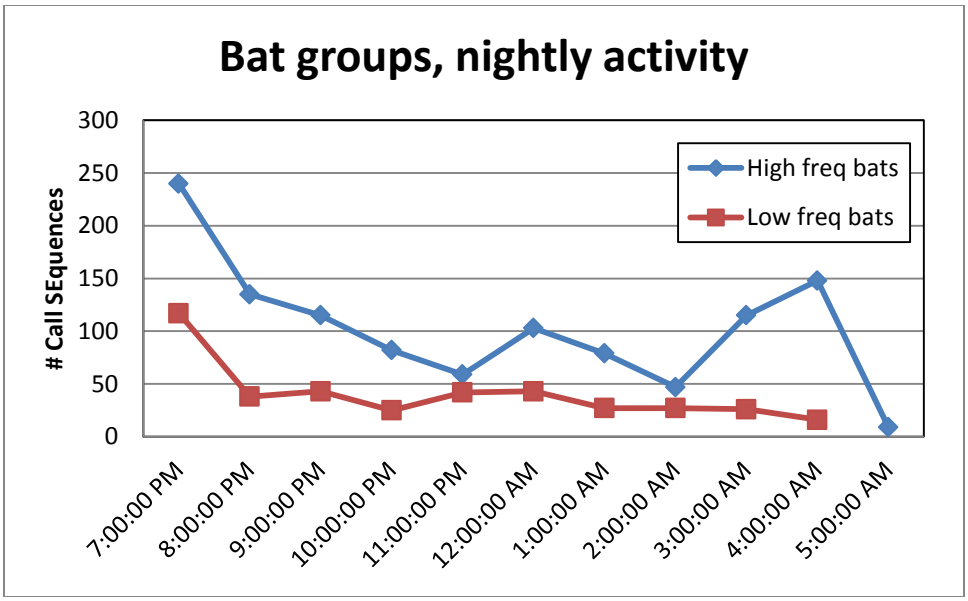



**Figure 1. Bat activity throughout the night.**

No additional bat species were observed during the mobile surveys. However, species were observed in specific habitats, and some locations reliably had bats of certain species. For example, several fast moving and apparently "commuting" hoary bats were observed flying south over the Willamette River (commuting calls can be distinguished from foraging calls by their relatively low amplitude and steady, slow, pulse rate). A single hoary bat was observed foraging on several days near the south end of oxbow 1 and the Talking Waters Garden. This may either represent a single resident (winter resident?) individual, or particularly good foraging habitat visited by sequential migrating bats. A group of 5 little brown bats were observed foraging for a lengthy period of time in a small clearing between several large big-leaf maple trees near the north end of oxbow 2. Several big brown bats were observed foraging widely over the forest canopy near oxbow 2 and 3.

### C. Avian activity

Avian surveys revealed a large number of migrants and potential residents or overwintering birds. In all, we observed a total of 559 birds of 49 species in 210 minutes of surveys. No threatened or endangered species (OFW 2008) were observed on site. Overall, we observed 29 year-round resident species (59%), 9 summer resident species (18%), 5 winter resident species (10%), 4 entirely migrant species (8%) and 2 "occasional" species (4%; Appendix G; Sibley 2000).

We observed a large number of waterfowl species, including an unusually large population of Wood Ducks. The ducks observed on-site all belong to the "dabbling ducks"—those specialized for feeding in shallow water. American Widgeon, Blue-winged and Cinnamon Teal may all be observed in the extensive shallow wetlands in farm fields, but the Wood Duck is an almost

exclusively woodland bird that is often found on the shallow oxbows along riparian corridors. The high density of large and "decrepit" trees in this area likely contributes to the high numbers of Ducks observed. Wood Ducks are migratory, but are observed year round in Oregon. These ducks may stay through the breeding season and use natural cavities as nesting sites. Most of the ducks were observed in oxbow 1 near Talking Waters Garden, perhaps because this site is less shaded and may have warmer water and better foraging opportunities..

Blue-winged and Cinnamon Teal are almost exclusively migrants in this area, as is the Western Grebe, while the Gadwall, Mallard and Horned Grebe are year round residents. The American Widgeon is a winter resident in the area (Sibley 2000).

The insect eaters (swallows, swifts, and warblers) are all summer residents. The enormous number of Vaugh's Swifts, Violet-green and Cliff Swallows on site indicated a major staging area. Staging areas are places where migrants stop either before or during migration to feed and put on weight for their migration. The swallows and swifts were present during the extent of our visits (from August 25th to September 21st), but were gone by mid October. The large number (up to 1500 birds on site during a single visit) is the largest single concentration we have observed of these species in the valley.

Black-throated Blue Warblers are only rarely observed. In the Pacific Northwest, they may breed in lowland forests dominated by hardwoods. Throughout the rest of their range they are typically found in arid woodlands, but may be found in riparian forests during migration (Dunn and Garrett1997). McGillivray's Warbler is a ground nester and most often found in "dense shaded thickets" near oak woodlands or willow thickets, or prefer dense undergrowth beneath conifers, whether during the breeding season or during migration. The Yellow Warbler is a much more common bird often found in willow thickets, or other riparian trees such as alders or cottonwoods. These birds often nest in riparian thickets and early successional vegetation. This species is less "tied" to pristine woodlands than any other of the neotropical woodland warblers. Because of the earliness of the species migration (peaking in mid September), the bird observed was likely a migrant from Canada, although nesting birds are possible in this habitat (Dunn and Garret 1997).

Of the raptors, we observed an unusual concentration of Turkey Vultures on site. These birds were observed numerous times outside of survey points and times. They were observed several times in the early morning prior to typical "active" times, and were often perched and observing the surveyor. We thus think there may be a nest or roost site on location.

We also observed several Red-tailed Hawks on site, a single Cooper's Hawk and a single Red-shouldered Hawk. Red-tailed Hawks are common in Oregon. Cooper's Hawks are less common, but populations are increasing and they may be frequently observed in woodland habitats. Red-shouldered Hawks are uncommon in the valley. The birds typically occur in California and southward, but their range is currently expanding northward. Red-shouldered Hawks are most often found in mixed and riparian woodlands.

Other unusual birds on site include the Black Phoebe, a traditionally more southern species that appears to be moving northward with global climate change. This species is very habitat specific, preferring weedy or shrubby wetlands.

Overall, 30% of avian species in the US are in decline. Our data review (1966-2010 data from Patuxent; Sauer et al. 2011) revealed that Oregon birds dependent upon the habitats in the survey area are, for the most part, in decline (Table 4). Grassland birds are facing the most

significant decline in Oregon, followed by birds that breed in early successional scrublands, wetlands, and woodlands in that order. Wetland birds have had a recent upswing (2000 to 2010; Sauer et al. 2011), while grassland birds continued to show strong declines in population. Bird populations in urban areas (dominated by a few species of non-native invasive species such as European Starling and House Sparrow), in contrast, are actually growing. The population growth in urban birds is largely fueled by the enormous increase in Eurasian Collared Doves in the last few years (Sauer et al. 2011). Species in decline, habitat types, and patch-area need is listed in Appendix H.

**Table 4. Avian population trends by habitat type (data from Sauer et al 2011).**

| Oregon | # species | Trend | Proportion declining species |
|---|---|---|---|
| Grassland Birds | 11 | -1.47 | 0.83 |
| Wetland Breeding | 43 | -0.85 | 0.76 |
| Successional scrub | 33 | -1.3 | 0.89 |
| Woodland Breeding | 59 | -0.18 | 0.73 |
| Urban | 9 | 6.91 | 0.72 |

## IV. Discussion

### A. Bat community and habitat

*Species list*

The species identified on this site are an almost complete representation of the bat biota of western Oregon (Maser and Cross 1981). Our finding of 8 species is remarkable and most likely is a result of survey timing (during late fall migration), habitat, and proximity to the Willamette River.

Many bat species migrate during fall, either to warmer areas where insects are more abundant, or to hibernacula where they overwinter, reducing energy loss via torpor during months when insects are scarce. Migration during fall typically peaks around late July and early August, but continues into October in other parts of the country (Kurta 1982). Migration has not been well studied in Oregon. Our surveys, conducted towards the latter part of September, were timed to capture a portion of the migratory period when most species would be present.

Western Oregon also remains relatively warm in winter and many bat species may overwinter here. Some bats, such as the big brown bat, will roost in human dwellings throughout the year. However, many bat species will migrate short distances to optimal overwintering habitat. For forest bats, these may be lower elevation sites with good roosting locations (e.g. hollow trees), or simply sites far enough south for critical hibernating temperatures. Several species remain somewhat active in the winter, coming out of hibernation when the temperature rises above 55'F (Tuttle 1991). Our surveys could have captured resident, migrating and overwintering bats.

Western Oregon has particularly mild temperatures, and few caves which offer good hibernating conditions. Few bats in western Oregon may actually go into true hibernation, instead bats may overwinter in roost trees, coming out when temperatures are conducive to foraging. This is consistent with the observation that hibernacula appear to be underutilized in Oregon in comparison with east coast and Midwestern hibernacula (Perkins et al. 1990). At least 2 bat species (hoary and silver-haired) have been documented to overwinter in western Oregon (western red bats, in contrast, have not been documented this far north in winter; Cryan and Veilleux 2007). In Europe, tree bats have been found roosting in trees during winter (Cryan and Veilleux 2007). However, very few studies have been conducted on bats, or overwintering bats in particular, in Oregon (Perkins et al. 1990).

The extremely high diversity of species observed at this location is at least partly due to the concentration of large and decrepit conifer and hardwood tree species. All of the species expected to occur in western Oregon are "tree roosting" bats, meaning they spend some of their time roosting in trees. Tree roosting bats typically specialize in roost location, roosting in cavities, under bark, or in foliage, and may specialize in conifers or hardwoods. The mix of tree species on site contributes to the excellent roost habitat for all species of bats.

Insectivorous bats (such as those found in Oregon) often also specialize on the ecosystem in which they forage, preferring either open water, forest openings, forest edges, or gleaning over the canopy. Our shorter-eared Myotis forage almost exclusively over water, while longer eared Myotis tend to forage within the trees (Lacki *et al.* 2007). Unlike birds which are often habitat specialists requiring large uniform habitat patches, bats are very wide ranging and appear to be less affected by habitat patchiness than birds (although patchiness and urbanization do affect bat specie abundance and diversity; Johnson et al. 2008).

The high diversity of bat species on site is also encouraged by the presence of large water bodies—both stagnant pools and running water. Bats must hydrate frequently, and are often found over water-bodies. Wetlands also harbor a large number of insects, which are fed upon by bats. Indeed, the large number of insects on site is corroborated by the huge flock of mixed swallows and swifts on site during the day (although it is worthwhile to note that few mosquitoes or other human pests were observed during our surveys).

Finally, the proximity to the river likely affects the number of species observed on site. While birds have been shown to migrate in broadly dispersed fronts, bat migration remains somewhat of a mystery. At least one author has found evidence that bats migrate along riparian corridors (Coberly et al. 2011), and bat mortalities at wind farms strongly suggests that bat migration is not uniform (Arnett et al. 2008). Consistent with this hypothesis, we observed a number of bats "commuting" down the river corridor. If bats in the Pacific Northwest commute along the river, then high quality roosting and foraging habitat, such as is found at this location, is especially critical for population stability throughout the west coast.

*Species activity*

Bat activity levels were consistent with activity levels that we have monitored at other sites (e.g. central Michigan and Florida; Coberly 2009 and Coberly et al. 2012) Bat activity was relatively uniform across nights—with an average or 224 calls per night, and a range of 272 down to 165 calls per night (typically in the midwest and east coast, with weather fronts, bat activity may vary 10 or 100 fold between successive evenings). Bat species activity levels were also relatively uniform, with mot calls belonging to little brown bat, Yuma myotis, hoary bat and big brown bat. Bat call tapered off slightly during the week, suggesting that either migration was diminishing, or colder temperatures were reducing bat activity levels. Weather during the survey period likely

contributed to the stable activity level, as bats are typically less active during “weather events” and migrants often push through (with consequent surges in activity levels) just prior to weather fronts.

*Caveats*
While identification of bat calls to species is not as reliable as identifying bats in hand, this method provides a reliable, repeatable, and relatively inexpensive and non-invasive method for sampling bat activity. Species identification should be considered “probable” rather than “confirmed”.

*Recommendations*
Because of the high quality of roost trees on this site (large old trees with hollows and/or peeling bark), the general absence of large old growth and decrepit trees in the larger landscape, this site is of particularly high value for bats. In addition, the proximity to high quality foraging habitat (over forest and ponds), and the access to potential migration corridors make this site stand out as one of extremely high importance for bat species in the valley.

Little is known about the value of understory vegetation or prairie vegetation for bat species. Presumably, because all of the bat species occurring in Oregon are insectivorous, those plant species that contribute to insect abundance and diversity are good for bat populations. Bats eat a wide variety of insects—from beetles to soft bodied insects such as aphids and mosquitoes.

We recommend that the trees on site be maintained in their present condition, with minimal pruning conducted (only as absolutely necessary) for safety. The oxbows and ponds on site all likely contribute to insect life, and should not be drained or otherwise “cleaned” if possible, as emergent vegetation provides safe rearing spaces for many insects. It is important to maintain both open water and some emergent vegetation in order to promote insect diversity and survival. We see no deleterious consequences to restoring connectivity to the oxbows provided some of the ponds and oxbows remain unconnected during low flows in summer. In fact, restoring flows may reduce the number of warm water fish, and thus improve insect (and consequently bat) habitat values.

### B. Avian community and habitat

Oregon is within the Pacific Flyway (BIrdnature 2012). As such the Willamette Valley is known for the large numbers of waterfowl that migrate through the area every fall. Passerine and other small birds are less abundant in western Oregon than in the east and midwest, perhaps because of prevailing wind direction during fall (*e.g. windmap http://hint.fm/wind/)*. Habitat during migration, as well as breeding and overwintering habitat, is critical for bird population health. Recent declines in grassland and successional shrub species have been attributed to increasing intensity of agriculture (Wells 2007) and increased “tidiness” in suburban landscapes.

Our survey was timed to occur during “peak” migration. While this varies somewhat by species we selected dates based upon Oregon Birding Association and Audubon historical data (Geier and McGie 2009) to capture the greatest number of species. Our results—with a mix of winter residents, summer residents, and migration-only species indicates that we were able to capture the peak transition/migration window (Appendix G).

Of the over 500 species which are known to occur in Oregon, only 220 or so are expected to occur in the Willamette Valley in fall. Of these, only about 120 are expected to occur in the

habitats (small grasslands, small wetlands, forest and riparian areas) of the project site. Several of these have low detection probability (e.g. snipe or rails), and several are likely to occur on migration either earlier or later than the survey period. Our survey numbers diversity and abundance are actually fairly high for the small amount of time spent on site. For comparison, in one survey in Florida, with over 3 times the number of survey points, we only observed a few more species (55 species in Florida, as compared to 49 here) during fall migration (Coberly et al. 2012). In Michigan, in a major migration corridor, we observed 67 species in 30 surveys and 97 species in 161 surveys with similar protocols (Coberly 2010). Our detection of 49 species is thus within expectations considering the low number of hours spent on site, and is consistent with this site offering moderately good habitat during migration.

Not surprisingly, our surveys were dominated by common, easy to detect, and for the most part, disturbance-tolerant species (Table 5). However, compared to urban or urban park environments, we had a surprisingly large number of uncommon and disturbance intolerant species such as MacGillivrey's and Black-throated Gray Warbler.

The large number of disturbance-tolerant species that we observed is likely to be due to the small patch size of the habitats on site, the proximity to the urban environment, and the generally low quality (heavily impacted by non-native species) of the understory and wet prairie vegetation on site. The relatively large number of disturbance *intolerant* species observed on site is likely to be a function of the lack of disturbance in this area (all human visitation is restricted by the landowner in the northern portion of the property, and in the southern portion of the property remains moderately inaccessible wild-parklands due to the single point of entry and restricted access on most sides); the presence of intact mature forest, which provides good foraging and roosting for forest species; and large water-bodies which provide good loafing places for waterfowl and waterbirds, and good foraging for many species.

**Table 5. Bird species rarity and tolerance to disturbance.**

| | | Abundance/rarity | | | |
|---|---|---|---|---|---|
| | | Common | Moderate | Uncommon | *Total* |
| **Tolerance to disturbance** | High | 16 | 3 | 0 | 19 |
| | Moderate | 5 | 5 | 3 | 13 |
| | Moderate to low | 0 | 1 | 1 | 2 |
| | Low | 1 | 8 | 6 | 15 |
| | *Total* | 22 | 17 | 10 | 49 |

Increased urbanization has been shown to reduce native species density and diversity, with some disturbance-sensitive or habitat specialists dropping out with very little environmental manipulation (e.g. Hennings and Edge 2003). Because the disturbance-sensitive species are generally the most threatened throughout the US, we recommend that disturbance be minimized and habitats maintained or restored to near-natural conditions where possible. Pets are of particular concern for birds, especially ground nesting species. Cats are notorious for wildlife predation, killing upwards of 30 birds per cat per year in some studies (*e.g.* Lepczyk et al. 2003; Kays and DeWan 2004). Dog impacts, while less bloody, are perhaps as severe through simple disturbance effects (Banks and Bryant. 2007). Feral cats are also a major concern, and should be controlled when possible (Nogales et al. 2004).

Habitat patch size is an important conservation topic, in general because larger habitat patches support more species (*e.g.* Conner and McCoy 1979*).* Most of the habitat patches on site are relatively small (<50 acres), and thus unlikely to support large-patch specialists such as Meadow Lark and Horned Lark. In general, habitat specialists typically require >50 acres of contiguous habitat for optimal breeding density. However, enlarging habitat patches in this area is unfeasible, and would degrade the habitat value for other species (*e.g.* bats). For example, it would take decades or even hundreds of years to convert the wet prairie into mature mixed forest, if it is possible at all. And, while patch size is important for some species, it appears to be less important during migration. Minor changes can be made to enlarge the grassland/wet prairie habitats by removing blackberry thickets along the roads. This is unlikely to increase the grassland habitat patch size sufficiently to provide habitat for Meadow Larks, but may increase patch size to accommodate Savannah Sparrows (Appendix D).

Increasing the value of the wetland prairie for native species may be best accomplished by reducing the density of vegetation cover and returning the area to native cover with native wetland grasses such as tufted hairgrass (*Deschampsia cespitosa)* and forbs. Increasing the value of the woodlands may be largely done by decreasing invasive species such as HImalyan blackberry and replacing with native shrubs, particularly berry-producing shrubs that maintain fruit late into the winter.

When considering overall management plans, several options are likely to be discussed by any planning group. The two most important considerations for improving and maintaining quality habitat for birds in this area are controlling disturbance and optimizing vegetation. The options, are listed in order of preference from an avian habitat perspective (#1 is most preferred: 1) Creating a wildlife preserve and limiting human intrusion to the minimum necessary for maintenance, preserving and restoring natural vegetation characteristics. 2) Creating a wilderness educational park, with limited access, preserving and restoring native vegetation. 3) Developing a recreational wilderness park that retains native vegetation, with unrestricted human access and restricted pet access (e.g. pets on leash only), and 4) developing a recreational park with lawns and other non-native vegetation selected for aesthetics, safety, and recreational access. There are, of course, many other possibilities. However, from a bird perspective, the first 2 or 3 options preserve and improve the habitat quality.

In general, the northernmost areas of the survey area may be easiest to retain in a wild or semi-natural preserve state simply because of the limited access. If parkland or formal garden areas are considered, we recommend that, that the following areas be considered, in this order, for development first: developed area, upland prairie, or wet-prairie. These areas are primarily within the central and northern portions of the survey area, which we have recommended remain undisturbed. While developing these areas for human use would bring visitors closer into the northern portion of the site, these areas have already been highly disturbed and are very weedy. Careful design of parklands and formal gardens could control human traffic through careful use of trails and plantings.

For avian species, we recommend that habitats be preserved and/or restored as much as possible. Snag density on site is likely adequate, and no new snags need to be made. However, snag removal should be kept to a minimum for safety. Weeds, especially Reed's canary grass and Himalayan blackberry should be removed and replaced with wet-prairie/tufted hairgrass community and riparian understory community (respectively) where possible. Riparian communities including willow-shrub, duckweed emergent grasses and sedges (cutgrass, sloughgrass) should be encouraged and cattails discouraged. Human disturbance should be limited, especially in the northern-most portion of the survey area.

### C. Habitat and vegetation

The current mix of species on site appears to be a mixture of two historical wetland forest types identified by Christy and Alverson (2011), in that it contains both deciduous component (big leaf maple, white oak and black cottonwood) and conifers (grand and Douglas fir). Christy and Alverson (2011) report that the riparian forest is greatly reduced in the Willamette Valley compared to historical conditions. There is no savanna component nearby, and the nearby prairie has been converted to farmland. The small amount of wet-prairie on site has been degraded by invasive weeds and likely does not function as prairies once did in the region. The degradation of wetland prairie is of particular conservation concern because only 2% or less of this historical vegetation type currently exists in the valley (Christy and Alverson 2011).

The presence of a complex multi-species forest of large trees with a large proportion of "decrepit" trees makes this area high value and somewhat rare habitat for bats and birds. The close proximity of this site to the river adds additional habitat value, as does the presence of backwater ponds (the oxbow lakes) and open marshy areas.

Several species of birds are dependent upon snags for successful breeding, particularly violet green swallows, wood ducks, nuthatches and woodpeckers (Scott *et al*. 1977). Values vary across forest types, but in general retaining 4 to 7 good quality snags per acre is considered appropriate (Scott *et al*. 1977) in forestry practices. We recommend retaining at least twice this number in a preserve to err on the side of caution.

Many forest bats, which predominate among Oregon's bat species, are dependent on loose bark or hollow trees for roosting places (Barclay and Kurta 2007). Several species overwinter in hollow trees or under bark. Decrepit trees have been removed from much of the overall landscape due to safety concerns or to "improve" the health of the forest. These trees are thus underrepresented in the landscape and are thought to be critical to maintaining healthy bat populations. Most US bats forage within forests, although a few species prefer foraging in openings (Carter and Menzel 2007).

The proximity of this habitat to water, and in particular to the riparian corridor, is important to both bat and bird populations. Water is a limiting resource in the summer months for many Oregon species. Even in the winter months, when water is seemingly plentiful, Oregon is host to an enormous number of overwintering waterbirds. Most of the avian species come from the north, where their preferred habitats are frozen over and insects are unavailable. Wintering habitats for waterbirds can be limited, as wetlands have been drained across the nation. In the summer months, birds within Oregon are found in high concentrations near stable water-supplies. The relatively fast running Willamette River and the slow-moving pools provide a variety of habitats which increases habitat quality for individual species (e.g. foraging and loafing areas for ducks) as well as meeting the basic needs of specialist species (e.g. warblers which rely on riparian shrub/scrub habitat).

Water is also a critical resource for bats. Bats, as mammals, have a different physiology from birds and must rehydrate frequently. Water sources also provide a concentrated source of food, since many insect larvae are aquatic.

The lack of high quality grasslands in the area and the overgrowth of Himalayan Blackberry in the understory of the forest are the predominant vegetative concerns. Himalayan blackberries

provide good cover from predators and good forage during late summer and fall for berry and insect eating birds. However, blackberries appear to provide low-quality nesting habitat for native bird species. Some data has been found for this, with almost twice as many birds and bird species in areas not infested with blackberries (Astley 2011). Blackberries tend to shade out low-growing native plants such as bluebunch wheatgrass that provides important forage for seed eaters. Snowberry and other native plants may also provide more stable food source throughout the winter.

Grassland habitats are important for a number of species of birds. Grassland birds are among those with the greatest declines in the past 10 to 40 years (Sauer et al. 2012. Very few of our grasslands are in the public ownership, and so protections are not guaranteed. Preservation and restoration of native grasslands is thus very important. Finally, grasslands and wet prairie in specific have recently been fund to sequester large amounts of carbon and store large amounts of water (e.g. Farley et al. 2004; Rawls et al. 2003), reducing "hydric bounce" and keeping water cool.

Reed canary grass arguably has less wildlife value than native species (e.g. Spyreas et al. 2010). Certainly, our experience using trained bird dogs is that native wet prairie harbors more species of birds, particularly grassland sparrows and meadowlarks (which are listed as threatened by USFWS in Oregon) than similar expanses of Reed canary grass in Oregon. We have found particularly high concentrations of birds in tufted hairgrass (*Deschampsia cespitosa*) communities.

We recommend removing blackberry in the woodland areas, with aggressive planting of Indian plum, thimbleberry, salmonberry, snowberry, black twinberry and possibly California blackberry (*Rubus ursinus*) to create a multilayered habitat with foraging and nesting potential. We also recommend replacing the Reed's canary grass meadows with tufted hairgrass, native sedges and rushes (such as *Carex obnupta, Juncus balticus*), and native forbes such as *Bidens aristosa*, and the native sunflowers (*Helianthus annus)*.

## V. Literature Cited


Arnett, E. B., W. K. Brown, W. P. Erickson, J. K. Fiedler, E. L. Hamilton, T. H. Henry, et al. 2008. Patterns of Bat Fatalities at Wind Energy Facilities in North America. Journal of Wildlife Management 72: 61–78. doi: 10.2193/2007-221.

Astley, C. 2011. How does Himalyan Blackberry impact breeding bird diversity? A case study of the Lower mainland of BC. Invasive Plant Council Research Forum. Available at static.ow.ly/docs/111003%20IPCBC%20presentation_oxj.ppt.

Banks, P.B. and J.V. Bryant. 2007. Four-legged friend or foe? Dog walking displaces naïve birds from natural areas. Biology Letters 3(6):611-613.

Barbour, R.W. and W. H.Davis. *Bats of America*. University Press of Kentucky. Lexington, KY. 1969.

Barclay, R. M. R., and A. Kurta.. 2007. Ecology and behavior of bats roosting in tree cavities and under bark. Pages 17-59 *in* Bats in forests: conservation and management (M. J. Lacki, J. P. Hayes, and A. Kurta, eds.). Johns Hopkins University Press, Baltimore, Maryland.

BCI. 2009. Workshop on audio monitoring of bat species, conducted in Portal Arizona with Chris Corben and Joe Szewczak.

BCI. 2012. Species accounts. http://www.BCI.com/

Birdnature. 2012. Migration flyways. http://www.birdnature.com/allflyways.html *Accessed* 9/20/2012.

Bock, C.E. and Z. F. Jones. 2004. Avian Habitat evaluation: should counting birds count? Frontiers in Ecology and Evolution 2(8); 403-410.

Carter, T.C. and J.M. Menzel. 2007. Behavior and day-roosting ecology of North American foliage roosting bats. Pages 61-82 *in* Bats in Forests Conservation and management. (M.J. Lacki, J.P. Hayes, and A. Kurta. Eds.). Johns Hopkins University Press, Baltimore, MD.

Christy, J. A. and E.R. Alverson. 2011. Historical vegetation of the Willamette Valley, Oregon, circa 1850. Northwest Science 85(2):93-106.

Coberly, L. C. 2009. 2009 Report on Bat Activity in Huron/DTE Wind Development Area Huron County, Michigan. Report submitted to DTE, Detroit, Michigan.

Coberly, L. C. 2010. Huron West Arc Wind Development Area; Statistical Analysis Avian Data. Report submitted to DTE, Detroit, Michigan.

Coberly, L.C., M.J. O'Farrell, and D.W. Walsh. 2011. Bat Activity at FWS Refuges and Agricultural Areas: Implications for Conservation and Development. The ND Wildlife Society Meetings, Bismark, ND.

Coberly, L.C., W. Pranty, K.D. Doherty. 2012. Ecological Review; Ridgeline Energy, Glades County, Florida Development Area. Report submitted to Ridgeline Energy, 407 Lincoln Road, Suite 12C Miami Beach, FL 33139, USA.

Conner, E.F. and E.D. McCoy. 1979. The statistics and biology of the species area relationship/ American Naturalist 113:791-833.

Cryan, P. M. and J. P. Veilleux. 2007. Migration and use of autumn, winter and spring roosts by tree bats *in* Bats in Forests Conservation and management. (M.J. Lacki, J.P. Hayes, and A. Kurta, Eds.). Johns Hopkins University Press, Baltimore, MD.

Dunn, J. and K. Garrett. *A Field Guide to Warblers of North America*. Houghton Mifflin Company, New York. 1997.

Farley, K.A. E.F. Kelly, R.G.M. Hofstede. 2004. Organic carbon and water retention after conversion of grasslands to pine plantations in the Ecuadorian Andes. Ecosystems 7: 729–739 DOI: 10.1007/s10021-004-0047-5

Johnson, J. B., J. E. Gates & W.M. Ford. 2008. Distribution and activity of bats at local and landscape scales within a rural–urban gradient. Urban Ecosyst 11:227–242. DOI 10.1007/s11252-008-0055-x.

Kays, R. W.and A.A. DeWan. 2004. Ecological impact of inside/outside house cats around a suburban nature preserve. Animal Conservation 7:1–11.

Geier, J. and A. McGie. 2009. Fall migration phenology. Birds over Portland. http://birdsoverportland.wordpress.com/fall-migration-phenology/ *Downloaded* 08/12/2012.

Hennings , L.A and W.D. Edge. 2003. Riparian bird community structure in Portland, Oregon: Habitat, urbanization, and spatial scale patterns. The Condor 105:288-302.

Kurta, A.. 1982. A review of Michigan bats: seasonal and geographic distribution. Michigan Academician 14:295–312.

Lacki, M.J. S.K. Amelon, and M.D. Baker. 2007. Foraging ecology of bats in forests *in* Bats in Forests Conservation and management (M.J. Lacki, J.P. Hayes, and A. Kurta Eds.). Johns Hopkins University Press, Baltimore, MD.

Lepczyk, C. A., A.G. Mertig, and J. Liu. 2003. Landowners and cat predation across rural-to-urban landscapes. Biological Conservation 115:191-201.

Maser, C. and S. Cross. 1981. Notes on the distribution of Oregon bats. Pacific Northwest Forest and Range Experiment Station Research note 379.

Nogales, M., A. Martin, B. R. Tershy, C.J. Donlan, D. Veitch, N. Puerta, B. Wood, and J. Alonso. 2004. A review of feral cats eradication on islands. Conservation Biology 18(2): 310-319.

NOAA 2012 National Weather Service weather data. *accessed* October 2012. http://w1.weather.gov/obhistory/KSLE.html.

Oregon Department of Fish and Wildlife. 2008. Oregon Department of Fish and Wildlife Sensitive Species: Frequently Asked Questions and Sensitive species list. Http://www.dfw.state.or.us/wildlife/diversity/species/docs/SSL_by_taxon.pdf.

Oregon Department of Fish and Wildlife. 2012. Oregon Wildlife species. http://www.dfw.state.or.us/species/mammals/bats.asp. *Accessed* 9/20/2012.

O'Farrell, M.J. and W. L. Gannon. 1999. A comparison of acoustic versus capture techniques for the inventory of bats. Journal of Mammalogy. 80(1):24-30.

Perkins, J.M. J.M. Barss and J. Peterson. 1990. Winter records of bats in Oregon and Washington. Northwestern Naturalist 71(2): 59-82.

Rawls, W.J., Y.A. Pachepsky, J.C. Ritchie, T.M. Sobecki, and H. Bloodworth. 2003. Effect of soil organic carbon on soil water retention. Geoderma 116: 61 – 76.

River Design Group. 2011. Calapooia River - Albany assessment and project implementation plan. http://www.riverdesigngroup.com/pdf/CalAlbanyAssessmentReportFinal0042911Compressed.pdf.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link.. 2011. The North American Breeding Bird Survey, Results and Analysis 1966 - 2010. Version 12.07.2011 USGS Patuxent Wildlife Research Center.

Laurel, M.D., Scott, V.E., K.E. Evans, D.R. Patton, and C.P Stone. Cavity-Nesting Birds of North American Forests. Forest Service U.S. Department of Agriculture. Agriculture Handbook No. 511 November 1977.

Sibley, D. A. *The Sibley Guide to Birds*. Chanticleer Press. New York, NY.2000.

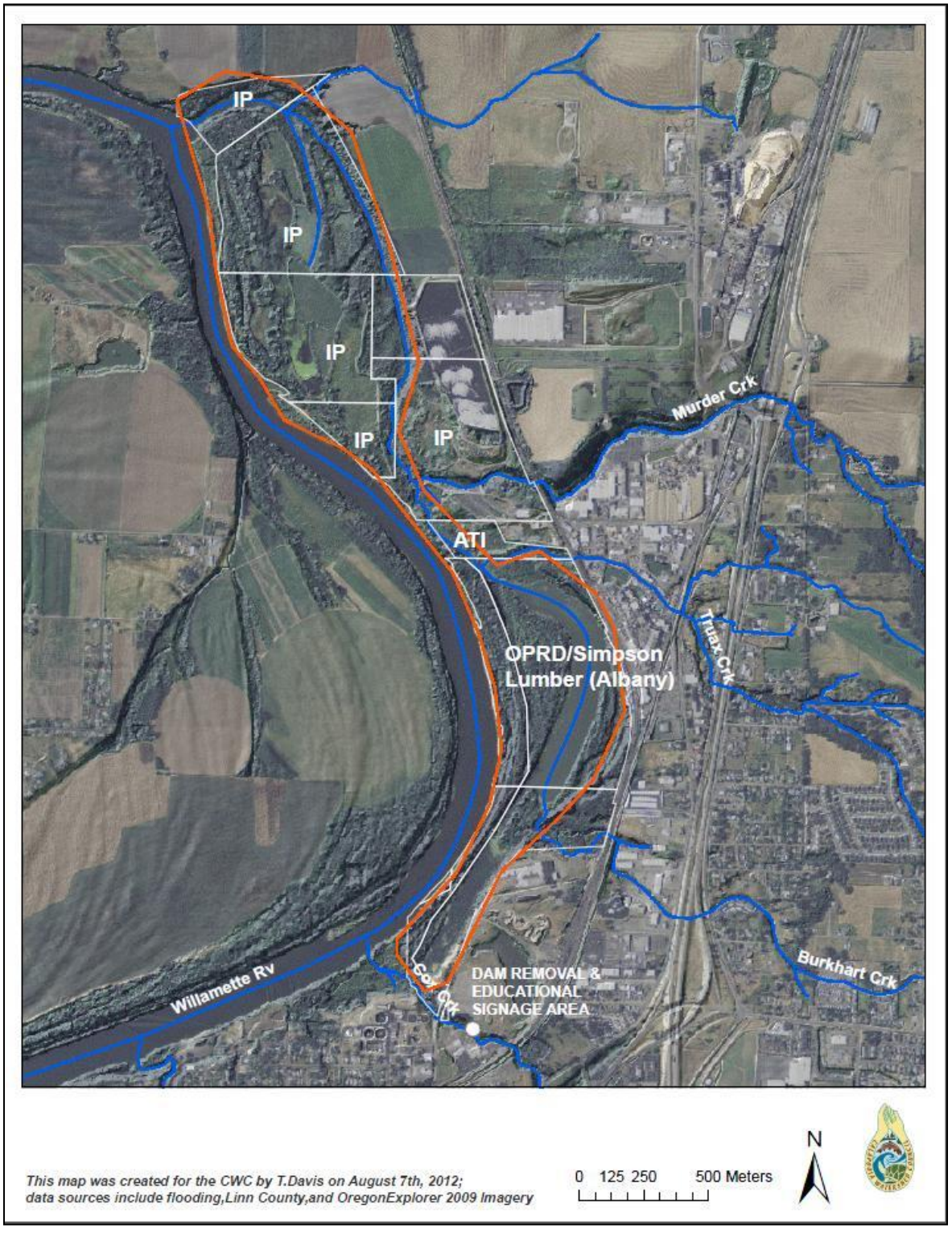
Spyreas, G. B.W. Wilm, A.E. Plocher, D.M. Ketzner, J.W. Matthews, J.L. Ellis, and E.J. Heske. 2011. Biological consequences of invasion by reed canary grass. *Phalaris arundinacea*.. Biological Invasions 12(5.: 1253-1267.

Tuttle, M. D. 1991. How North America's Bats Survive the Winter BATS magazine 9:3. http://www.batcon.org/index.php/media-and-info/bats-archives.html?task=viewArticle&magArticleID=503.

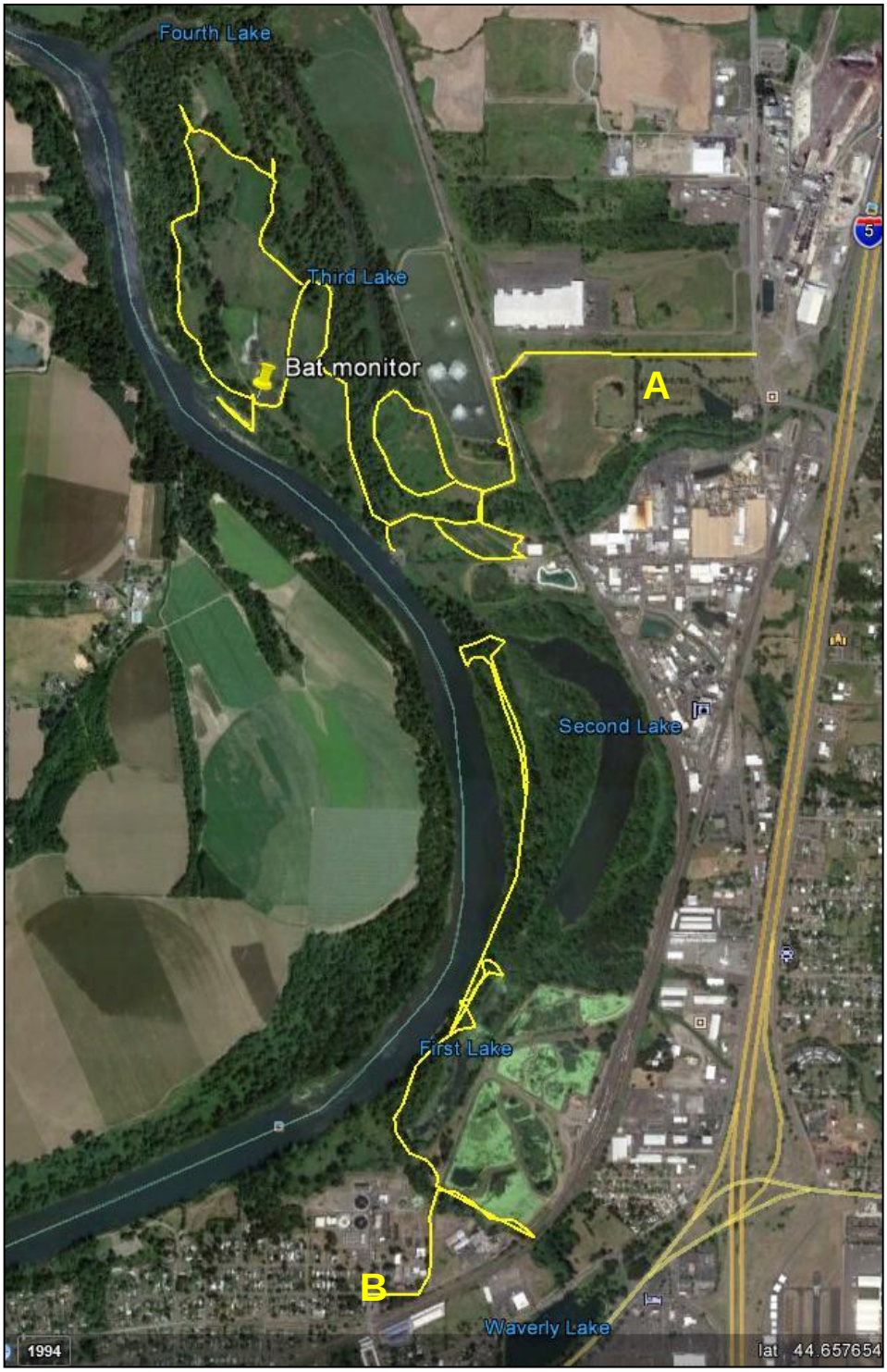
Wells, J. V. *Birder's Conservation handbook*. Princeton University Press. Princeton, NJ. 2007.

## VI. Appendices

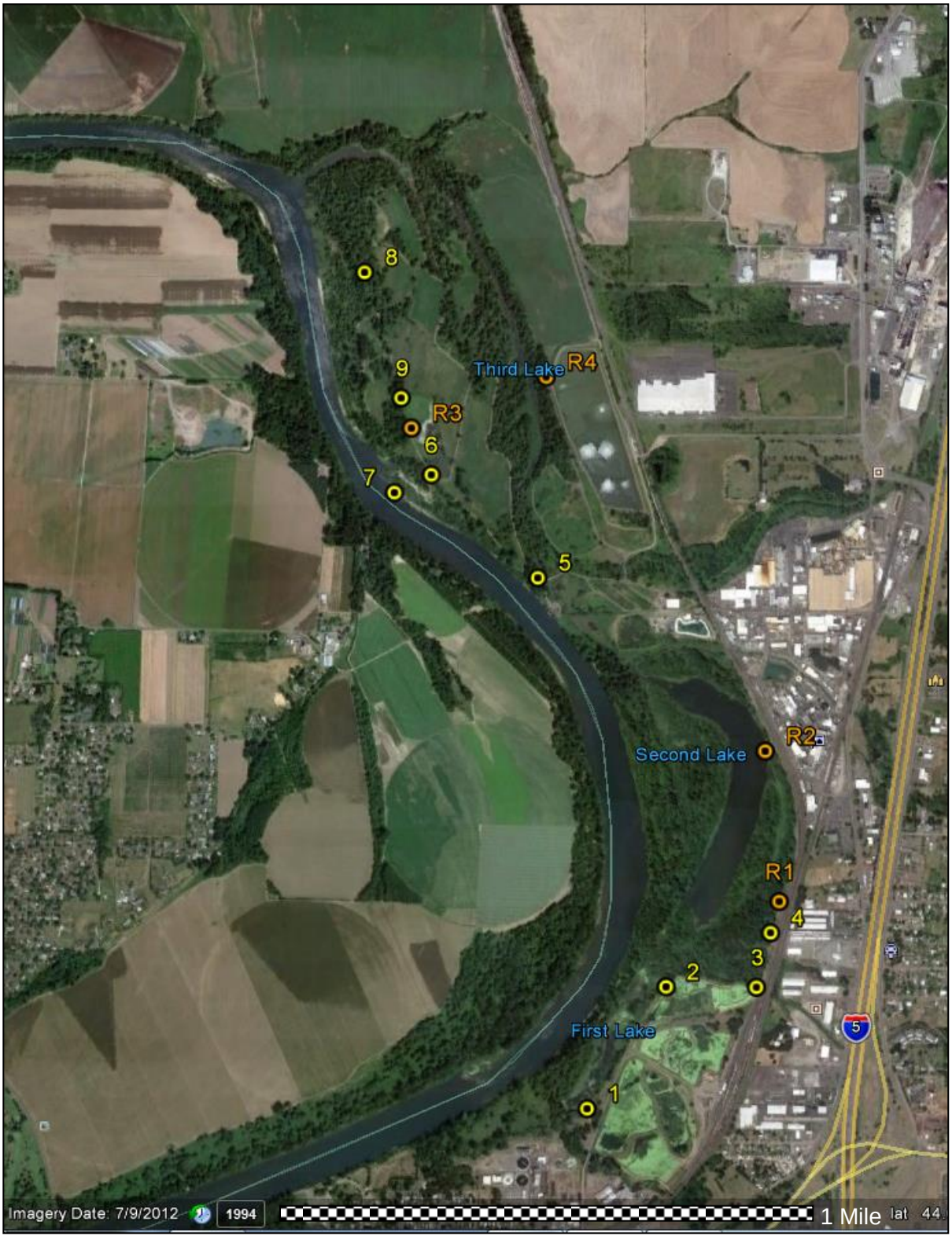
### A. Survey area



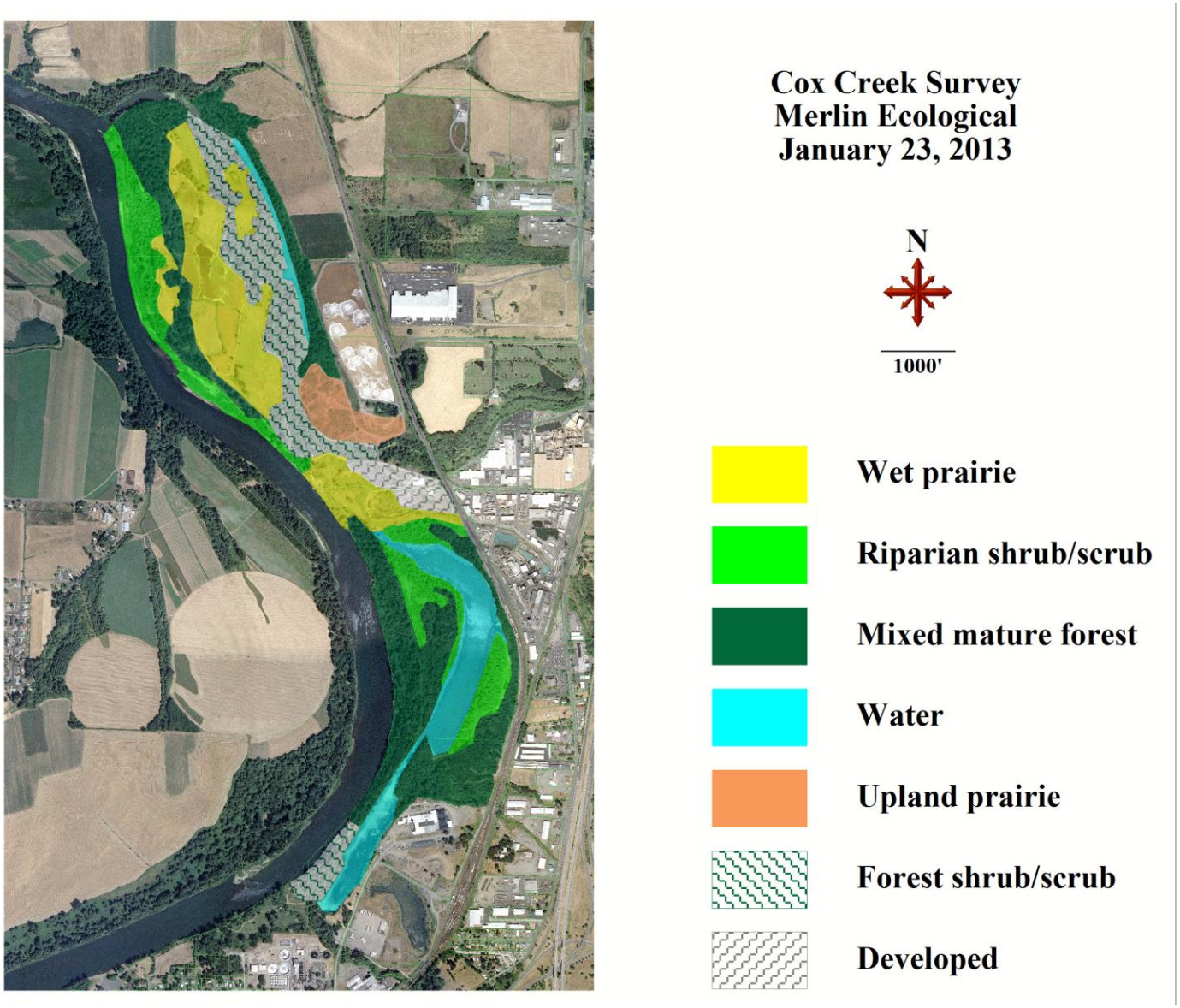
**B. Bat monitoring station and mobile routes. Image from GoogleEarth ™. A) Mobile survey conducted 9/02/2012. B) Mobile survey conducted 9/09/2012. Bat monitoring station marked with push-pin in area A.**



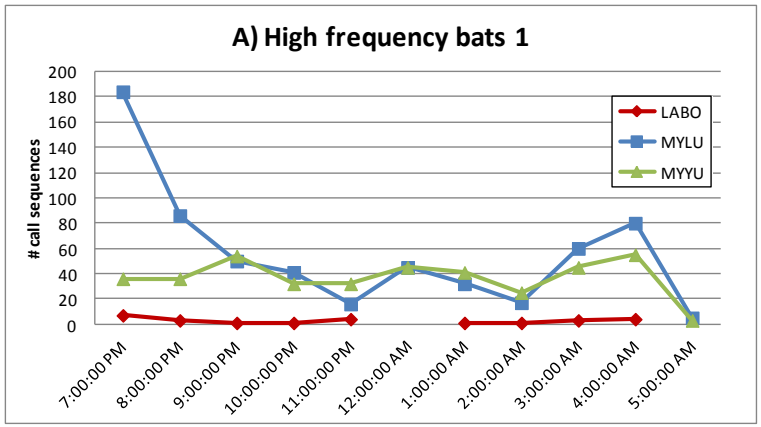
## C. Avian Survey locations

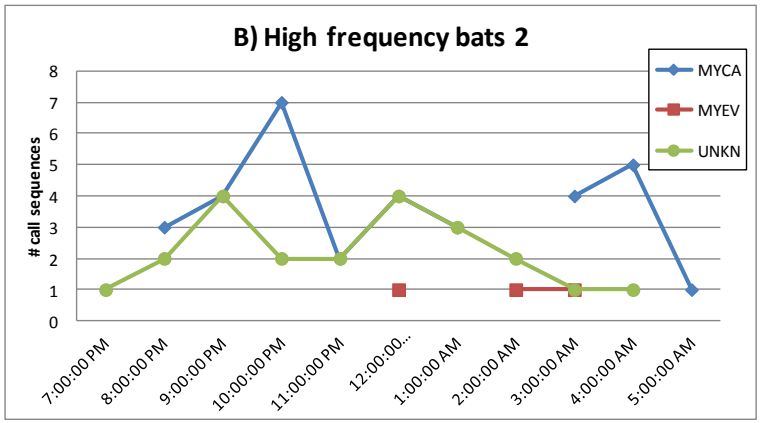


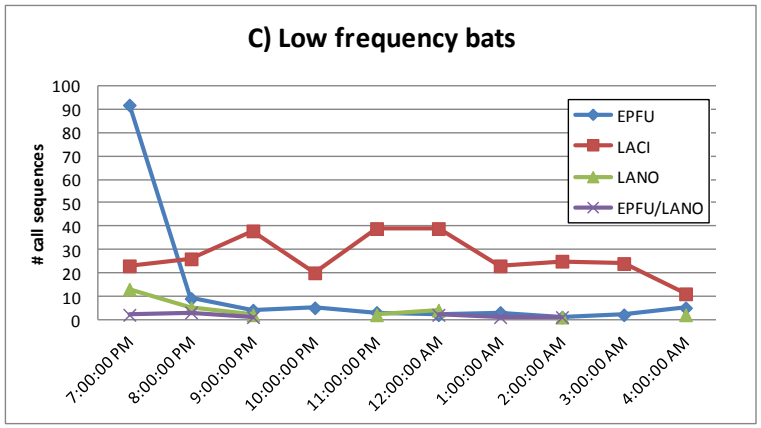
## D. Habitat types



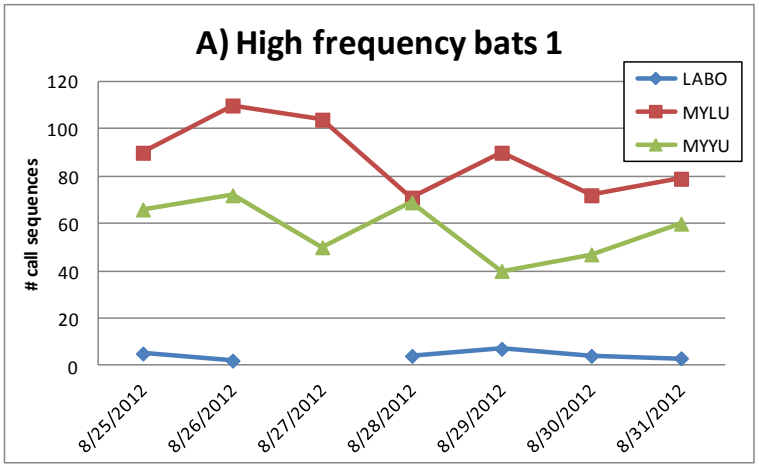
## E. Nightly bat activity by species. (Acronyms are as given in Table 1).

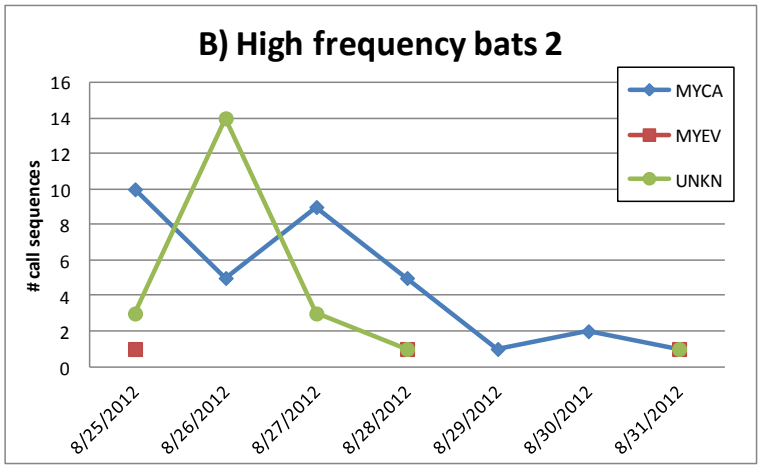


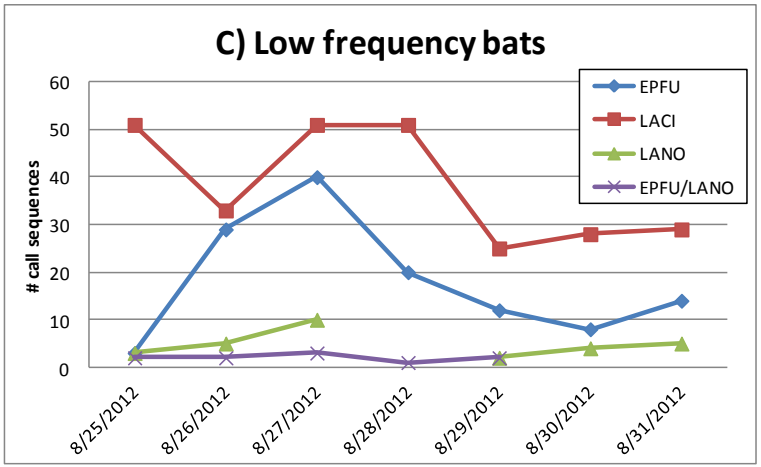



## F. Weekly bat activity by species.



## G. Avian species abundance, observed[a].

| *Group* | *Common name* | *per 10 min[b]* | *Total[b]* | *Migratory/ Resident* |
|---|---|---|---|---|
| **Blackbirds** | Red-winged blackbird | 12.78 | 115 | YR |
| | Unknown Blackbird | 0.11 | 1 | -- |
| **Chickadees and Nuthatches** | Black-capped Chickadee | 0.44 | 4 | YR |
| | *Brown Creeper* | *0.083* | *1* | YR |
| | Golden-crowned Kinglet | 0.11 | 1 | YR |
| | *Red-bellied Nuthatch* | *0.83* | *1* | YR |
| | Wrentit | 3.78 | 34 | YR |
| **Corvid** | American Crow | 0.22 | 2 | YR |
| **Finches** | American Goldfinch | 1.22 | 11 | YR |
| | Lesser Goldfinch | 0.44 | 4 | YR |
| | *Purple Finch* | *0.88* | *8* | YR |
| | Red Crossbill | 3.33 | 30 | YR |
| **Flycatchers** | *Black Phoebe* | *0.083* | *1* | O |
| **Gamebird** | *California Quail* | *0.6* | *6* | YR |
| **Herons and Cranes** | Black-crowned Night Heron | *0.083* | *1* | SR |
| | Great Blue Heron | 0.11 | 1 | YR |
| | Green Heron | 0.11 | 1 | SR |
| **Icterids** | Eurasian Starling | 0.89 | 8 | YR |
| **Jays** | Scrub Jay | 0.89 | 8 | YR |
| | Stellar's Jay | 0.33 | 3 | YR |
| **Raptors** | Cooper's Hawk | 0.22 | 2 | YR |
| | Red-shouldered Hawk | 0.11 | 1 | O |
| | *Red-tailed Hawk* | *0.03* | *3* | YR |
| | Turkey Vulture | 0.56 | 5 | SR |
| **Shorebirds** | *Long-billed Dowitcher* | *0.083* | *1* | WR |
| **Sparrows** | Dark-eyed Junco | 0.11 | 1 | YR |
| | *Golden Crowned Sparrow* | *0.33* | *3* | WR |
| | Song Sparrow | 2.56 | 23 | YR |
| | Spotted Towhee | 0.22 | 2 | YR |
| | Swamp Sparrow | 0.33 | 3 | WR |
| | White-crowned Sparrow | 0.22 | 2 | WR |
| **Swallows and Swifts** | *Cliff Swallow* | *11* | *150* | SR |
| | Vaugh's Swift | 11.22 | 101 | SR |
| | Violet-green Swallow | 9.44 | 85 | SR |
| **Thrush** | American Robin | 0.22 | 2 | YR |
| **Warblers and Vireos** | *Black-throated Gray Warbler* | *0.083* | *1* | SR |
| | MacGillivrey's Warbler | 0.22 | 2 | SR |
| | *Yellow Warbler* | *0.08* | *1* | SR |

### *H.* Avian species abundance, con't.

| *Group* | *Common name* | *per 10 min* | *Total* | |
|---|---|---|---|---|
| **Waterfowl** | American Widgeon | 1.56 | 14 | WR |
| | Blue-winged Teal | 1.00 | 9 | M |
| | Cinnamon Teal | 0.22 | 2 | M |
| | Gadwall | 1.22 | 11 | YR |
| | Horned Grebe | 0.67 | 6 | M |
| | Mallard | 7.56 | 68 | YR |
| | Pied-billed Grebe | 0.33 | 3 | YR |
| | *Western Grebe* | *0.08* | *1* | M |
| | Wood duck | 2.33 | 21 | YR |
| **Wren** | Bewick's Wren | 0.11 | 1 | YR |
| **Other** | Belted Kingfisher | 0.22 | 2 | YR |
| | Cedar Waxwing | 0.33 | 3 | YR |
| | Unknown Passerine | 0.22 | 2 | -- |
| | *Total* | 66 | 591 | |

## I. Declining species in the Willamette Valley (Sauer et al 2011).

| Declining species | Habitat | Patch-size Sensitive |
|---|---|---|
| Horned Lark | Grassland | Yes |
| Vesper Sparrow | Grassland | Moderate |
| Savannah Sparrow | Grassland | Mild |
| Western Meadowlark | Grassland | Yes |
| Long-billed Curlew | Grassland | Yes |
| Black-crowned Night Heron | Wetland | No |
| Cinnamon Teal | Wetland | No |
| Widgeon | Wetland | No |
| American Bittern | Wetland | No |
| Red-winged Blackbird | Wetland | No |
| Spotted Sandpiper | Wetland | No |
| Wilson's Snipe | Wetland | Yes |
| Willow-Alder Flycatcher | Successional scrub | Small patches preferred |
| White-crowned Sparrow | Successional scrub | No |
| Yellow Warbler | Successional scrub | No |
| American Goldfinch | Successional scrub | No |
| Orange-crowned Warbler | Successional scrub | No |
| House Wren | Successional scrub | No |
| Black-throated. Gray Warbler | Successional scrub | No |
| MacGillivray's Warbler | Successional scrub | Some evidence |
| Song Sparrow | Successional scrub | No |
| Wilson's Warbler | Successional scrub | No |
| Spotted Towhee | Successional scrub | No |
| Rufous Hummingbird | Woodland | No |
| Golden-crowned Kinglet | Woodland | No |
| Ruby-crowned Kinglet | Woodland | No |
| Olive-sided Flycatcher | Woodland | No |
| Pine Siskin | Woodland | No |
| Evening Grosbeak | Woodland | No |
| Red-eyed Vireo | Woodland | No |
| Pacific-slope Flycatcher | Woodland | No |
| Varied Thrush | Woodland | No |
| Dark-eyed Junco | Woodland | No |
| Yellow-rumped Warbler | Woodland | No |
| Western Wood-Pewee | Woodland | Small patches preferred |
| Swainson's Thrush | Woodland | No |
| Purple Finch | Woodland | No |