BATS
WITHIN THE URBAN GROWTH BOUNDARY OF THE PORTLAND METROPOLITAN AREA 2002-2003

2002-3 GREENSPACES PROGRAM PROJECT # 13420-2-J206A

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Bats are an important component of the most ecosystems as a consumer of nocturnal adult and juvenile forms of insect pests (Bruns 1960, Ross 1967, Constantine 1970, Hill and Smith 1984). Some recognized pests include, but are not limited to: cutworm moths, corn borer moths and larvae, pine bark beetles, crane flies, biting flies and mosquitoes (Ross 1967, Whitaker et al. 1977, Whitaker et al. 1981a, Whitaker, et al. 1981b, Whitaker 1988). An objective assessment of most species' populations and trends is not possible at this time because quantitative and qualitative data are lacking (Machmer and Steeger 1995). Oregon has 15 resident and migratory species, 10 of, which are likely study area residents or species that migrate through the survey area (Table 1). Six of the potential resident bat species were considered federal candidates for listing (*Corynorhinus townsendii, Myotis evotis, M. thysanodes, M. volans, M. yumanensis, Lasionycteris noctivagans),* and are also considered species at risk by the State of Oregon. All 15 Oregon bat species are listed in Table 1, with scientific names, common names and a four-letter designation used in other tables in this report.

At least two bat species *(Lasiurus cinereus, Lasionycteris noctivagans)* are dependent on trees or snags for roosts that have morphological characters primarily found among forest stands or riparian zones where tree age class exceeds 125 yr. (Perkins and Cross 1988). Most bat species which could occur within the Urban Growth Boundary (UGB) and would utilize native riparian habitat for foraging are dependent upon dead or defective trees to provide roosts, and distribution of such potential roosts directly affects bat diversity and distribution (Perkins and Anderson 1996). Other bat species rely on varying roost sites where such trees are absent (cliffs, caves, mines, buildings) (Perkins, 1984). Distribution of individual bats and bat species is non-random and the overlying factor appears to be roost limitation (Perkins 1992, 1995; Perkins and Peterson 1995).

Prior sampling for bats within the UGB occurred in 1982 at three locations: the Audubon Sanctuary, McCleay Park, and at Crystal Springs Rhododendron Gardens. Although these sites were productive, the data is two decades old and only represent a very small portion of potential habitat within the UGB (Perkins field notes).

To effectively manage bat populations, roosts and foraging areas, the minimum data required is at least the species present, reproductive activity knowledge of roost sites, and roost preferences. Here, within the Portland, UGB, little is known about the presence, distribution and abundance of resident and migratory bats. A two year sampling plan was implemented that will provide necessary data.

OBJECTIVES-

1. Mist net or sample with ANABAT detectors at least 60 sites. Focus sites to areas for which migratory bird and vegetative documentation is available.
2. Use statistical analysis to determine if mist net captures are related to the numbers of calls collected while netting.

3. Obtain additional abundance and distribution data for areas adjacent to those sampled by surveying night roosts under bridges and in appropriate buildings within 10 km of the study sites.
4. Statistically compare results of small parks, large parks, most natural areas and wetlands.
5. Map the locations of each sample site, giving precise directions or locations so that the project may be repeated or checked in future years.
6. Map distribution for each species within the Metro area
7. Map those sites where most calls or captures occurred and those sites with greatest bat species diversity
8. Habitat recommendations, which are acceptable to Metro and various city park bureau practices, will be recommended.

SITE DESCRIPTIONS

For purposes of describing the sites I have arbitrarily divided them into four categories: small planned parks (less than 20 acres), larger planned parks and larger natural areas (usually larger than 20 acres), and forested wetlands.

SMALL PARKS:

Apollo Ridge. This park comprises 2.23 acres that are bisected by a perennial stream and are surrounded by urban development consisting primarily of single family dwellings. It is contiguous to Willow Creek Park the only barrier between the two parks being a wide two lane through street. Mature Douglas fir and large maples that cover about 1 of the 2.23 acres provide dominant overstory. The major attraction for the bats is a permanent pond of water on Willow Creek, suitable for drinking and forging for insect.

Bethany Wetlands. This park also is approximately 2.4 acres. There is still open water, a small riparian zone with large trees (Douglas fir, western red cedar and maples) at the west end. Shrubs, the water and extensive grass provide drinking and foraging habitat. The park is surrounded by high-density urban development and is frequently used for informal soccer games and family picnics.

Creston Park. A park of about 14 acres, the only available water is a modest swimming pool. Trees (primarily Douglas fir) are apparently maintained and deadwood removed for safety. Some trees appear to exceed 100 years, when research suggests that some old growth characteristics begin to manifest themselves in tree morphology. The trees are well spaced and more like a planned arboretum than a natural forest.

Grant Park. At slightly less than 20 acres, the resemblance to Creston Park is very similar, with the only available water in the swimming pool and the mature trees are sited for esthetics and shade rather than like a natural forest.

Table 1. Scientific, common names and four letter designations for Oregon bats.

SCIENTIFIC NAME	COMMON NAME	4-LETTER CODE
*Tadarida brasiliensis**	Mexican free-tail	TABR
*Antrozous pallidus**	Pallid Bat	ANPA
Eptesicus fuscus	Big Brown Bat	EPFU
*Euderma maculatum**	Spotted Bat	EUMA
Lasionycteris noctivagans	Silver-haired Bat	LANO
Lasiurus cinereus	Hoary Bat	LACI
Myotis californicus	California Myotis	MYCA
*M. ciliolabrum**	Western Small-footed Myotis	MYCI
M. evotis	Long-eared Myotis	MYEV
M. lucifugus	Little Brown Bat	MYLU
*M. thysanodes**	Fringed Myotis	MYTH
M. volans	Long-legged Myotis	MYVO
M. yumanensis	Yuma Myotis	MYYU
*Pipistrellus hesperus**	Western Pipistrelle	PIHE
Corynorhinus townsendii	Townsend's Big-eared Bat	COTO

*Not recorded from or expected in the study area.

Noble Woods. A newly acquired park in the Hillsboro area, it comprises about 14 acres of woodland with a perennial meandering stream. Douglas fir and western red cedar are the dominant overstory. The riparian zone is primarily native, and most of the stream is covered or shaded with brush. We sampled the only open area we could locate, near the footbridge.

Orenco Woods Golf Course. This is a small golf course (about 40 acres) with approximately 13 of them in riparian zone. The riparian zone (only permanent water source) had a younger dominant overstory and the shrub layer consisted of native and non-native plants. In many areas Himalayan blackberries dominated the shrub layer. The access to the water was extremely cluttered by plant growth and probably provided obstacles for less mobile bat species to forage and drink. The area seemed more like a long neglected urban patch rather than a native remnant.

Hamby Park. A small park of about 2 acres in a Hillsboro urban setting. A small woodland of about 20-30 young western red cedars and Douglas fir comprise the majority of structure outside of new housing that would allow for bat roosts. A small "duck" pond was sampled.

Kane Park. A Gresham park of about eight acres with older second growth and on Kelly Creek, upstream from Mount Hood Community College. The park has approximately 27 snags of 10" dbh or greater and is home to primary and secondary cavity nesters. We sampled at a point where the stream ponds and vegetative clutter is minimal.

Reed College Pond (east and west sites). Reed College is a private liberal arts campus with a meandering stream that is dammed to form a long narrow pond in the center of campus. Most vegetation is manicured excepting the eastern most border of the pond. The area surrounding the campus includes a golf course, botanical gardens (previously sampled) and urban housing.

Salix Park. A small neighborhood park (3.83 acres) that includes a slow moving stream a small number of snags, and a plethora of canary reed grass and Himalayan blackberries. Local use seems to be confined to neighborhood children and dogs.

Willow Creek East and West. Two contiguous parks that are long and narrow morphologically of 11.9 and 2.7 acres that have a perennial stream (Willow Creek) meandering through the center. I found the mix of species in the dominant overstory interesting. Remnant Oregon Ash, Western red cedar, Douglas fir and big-leaf maples were present. The shrub layer was somewhat depauperate and willow planting had occurred to try and restore the riparian zone. These parks lie just east of Apollo Ridge.

LARGER PLANNED PARKS

Beggar's Tick. A wildlife preserve with open, wet meadows and a stand of cottonwoods on the south edge. A pond and meandering stream near the western edge of the reserve is where we sampled. There is a mix of non-native and native shrubs and grasses in the meadow and under the cottonwoods.

Durham. This park is long and narrow following a creek that flows south to the Tualatin River. The park has scattered Oregon ash, younger Douglas fir and alders. Our sample site was away from the river and toward the northern border along the stream. The stream is perennial and has a relatively intact riparian zone.

Colwood Country Club (north & south sites) One of the numerous golf courses in the vicinity of the Columbia River and its various sloughs. Our sample sites were where the Columbia slough and a tributary run through the Golf course. Tree species are primarily Douglas fir, alder and cottonwood. The surrounding habitat is mixed urban and light manufacturing.

Columbia-Edgewater Golf Course. Another golf course in the Columbia River vicinity. This course is smaller than Colwood and with fewer trees. We sample the water hazard just below the clubhouse.

Delta Park. This park is near to the Columbia River and the Columbia Slough. It comprises slightly more than 88 acres. Most of the park is dedicated to ball fields, except for the areas nearest the standing water, where wildlife habitat is preserved. Trees around the water have visible potential roost sites. Those that are scattered through the park again appear groomed. Perennial water is available to the bats via the slough side channel.

Glendoveer Golf Course (west site and east site). Another course near the Columbia river. Again, trees are predominately Douglas fir. We sampled the two ponds constructed as water hazards along the fairways.

Kelly Point Park (Columbia River site and slough site). A park that was created by Columbia River dredging, it sits at the east side of the confluence of the Willamette and Columbia Rivers. Sample sites were along the riparian zone of the Columbia River and at the park entrance along the slough area. Riparian zones along the Columbia River consist mainly of large cottonwoods and some non-native shrubs, particularly Himalayan blackberries. The slough site had some relatively intact riparian shrubs and again was dominated by large cottonwoods. The advantage to the slough site was protection from winds that tend to flow up and down the Columbia River from the Dalles to the ocean.

Laurelhurst Park. This is another planned city park with native and exotic trees. The focal point of the park is a "duck pond" that is populated year round by native and domestic waterfowl. This park is relatively old, and although the trees are tended and pruned, many are old enough to have visible cracks, crevices or limb holes that might serve as a day roost for bats. In addition, may of the large trees that surround the pond have significant solar exposure, providing potential roost habitat for *Lasiurus cinerus.*

Mount Hood Community College Pond. A moderate sized pond formed by an artificial dam along Kelly Creek. It is lined with native and non-native evergreens and deciduous trees. A narrow riparian zone continues for about 1 kilometer below the pond. The school supports a fisheries and a watershed program, so the riparian zone is constantly being tended to remove non-native species and replant native species.

Oregon City Golf Club. A private club on about 40 acres at the edge of the urban growth boundary. It is surrounded to the south by farm and forest and

to the north by the urban edges of Oregon City. The owners attempt to retain some vegetative features that are amenable to native wildlife and have erected numerous bird boxes around the course. Some trees on the course and adjacent to it appear to be mature and show use by woodpeckers and sapsuckers. Many have crack, crevices and exfoliating bark that could provide bat day roosts.

Redtail Golf Course. A newer course with relatively young trees at fairway edges (most are less than 40 yr old). There is a pocket of woodland near the south end of the courses and near the sampled pond. The surrounding area consists of a major shopping mall complex and mixed housing. The housing ranges from 100 yr old farmhouse to newer row houses. The oldest homes and trees provide potential roost sites for the bats we noted.

Rose City Golf Course. Rose City is one of the oldest public golf courses in the Portland area. Its trees (primarily Douglas fir) are over 100 yr old and numerous on fairway edges. The sample site was the one permanent water hazard in the NE corner of the course.

Tualatin Hills Country Club (river & pond sites). Tualatin Hill country Club is a private course, well maintained, and holes were planned around the oldest trees. One water hazard is a large pond near the club house the other near the entrance is a water feature with a fountain. The pond was sampled. We also sampled along the Tualatin River which borders the course on the north. The riparian zone was choked with Himalayan blackberries making it difficult to sample closely to the river.

Mount Tabor Reservoir # 2 & 5. A large city park of 195 acres, the park also contains three large open reservoirs that provide much of the drinking water for east Portland. The park is situated on a quiescent volcanic vent. Most of the trees are Douglas fir second growth, which are spaced rather than clumped. In prior years crews installed bat boxes on trees in the park to provide additional roost habitat. The only opportunity for open water for drinking and foraging is the reservoirs and some small wet areas adjacent to the impoundments that result from spillage or people using fountains for drinking purposes.

Tryon Creek Fox Creek Bridge & west site. Tryon Creek is an urban State park, much like Forest park, only younger. The remaining trees are mostly less than 50 yr old, and the riparian zone along the creek, which flows through the center of the park, is sparse. English ivy and Himalayan blackberries previously choked out native shrubs, particularly in the riparian zones. Recent effort to remove these plants and plant native willows and perennial native wetland plants should improve the insect population.

Washington Park (upper & lower reservoirs). This park is also situated in the Tuality Mountains of west Portland. It is part of an immense park complex that includes rose test gardens, Japanese gardens, Chinese gardens, the zoo, and hiking trails. Approximate area exceeds 150 acres. The reservoirs are quite large and surrounded by fencing. There is ample opportunities for bats to forage and drink within this complex. Open water and streams exist within the zoo and all the demonstration gardens.

LARGE NATURAL SITES

Audubon sanctuary.. Located in the NW urban area straddling Balch Creek, the sanctuary abuts the Forest Park complex (over 700 acres). An artificial pond has been created within the sanctuary along the creek and it is here that sampling occurred. Excluding some English ivy and escaped annuals, this portion of the urban area is primarily of native vegetation. The overstory in most of Forest Park is second growth Douglas fir and western red cedar in wet sites. The sanctuary trees appear to be approximately 50 or more yrs older than those of Forest Park proper.

Blue Lake Park (east & west sites). Blue Lake Park comprises 64 acres in the east Multnomah county. It is well within the urban growth boundary. The recreational portion of the park contains manicured trees and a few buildings. The west end of the park and the western shore still has a narrow strip of woodland. Dominant trees are cottonwood and western red cedar. There is a known maternity colony of *M. lucifugus*, which has moved from adjacent home to home as it is extirpated or sealed off from the roosts. The lake lies about 500 meters south of the Columbia River main channel.

Burlington Turtle refuge (two sites). Another site that lies along the urban growth boundary. The preserve is sited on the west bank of the Willamette River across from Sauvie Island. Dominant overstory is Oregon ash and cottonwoods. Both species are mature and age of the ash likely exceeds 150 yr. There are two large ponds, both of which were sampled.

Clackamette Park. This park was developed for recreation, camping, boating and picnicking. It is situated at the confluence of the Clackamas and Willamette Rivers. Adjacent to the park is a large golf course, most of which is not in fairways, but wooded, and upstream from the confluence, the riparian zone of the Clackamas River is relatively intact. Many Douglas fir in the area appear to be more than 100 yr old and the cottonwoods are mature and again exhibit characters that would make them excellent candidates for bat day roosts.

Clackamas River @ Clackamas. This site is just east of Clackamas along the Clackamas River. It is below the bluffs that tend to limit human access. A perennial stream entered the river at our sample site, and both the river and stream had a vigorous riparian zone with primarily native species as the dominant overstory and understory.

Carver Bridge. Carver Bridge is over the Clackamas River at the SE edge of the urban growth boundary. This site was previously sampled by ANABAT in 1990. The sample site was just below the bridge on the south side. The riparian zone is reasonably intact, but narrow due to bluff structures to the east and west of the sample site. The urbanized areas consist primarily of pre-1940 homes and barns, which provide potential roost sites for day roosting bats and maternity colonies.

Fernhill Reservoir. This area is at the edge of the urban growth boundary in Forest Grove. It is used as a water treatment area with a large shallow pond at the south end. To the south is a large mature stand of mixed conifers and

alders. It is likely here that day roosts are found for the bats that use the reservoir for foraging and drinking.

Forest Park (2 sites). Forest Park is the largest urban park in North America. It comprises almost one square mile and runs N-S along the Tuality mountain range. The elevation varies from 120 ft-~1400 ft. The area was select-cut logged about 1900. Most of the remaining trees are large Douglas fir, big-leaf maples and alder. Many are beginning to display characters associated with old growth. Excluding Rocking Chair dam, there is no standing water in the park.

Jackson Bottoms (north and river sites). Jackson Bottoms is a wildlife preserve at the edge of the urban growth boundary. It includes open wetlands with scattered trees and a wooded area that forms a riparian zone along the Tualatin River. The dominant tree is older second growth Douglas fir with some western red cedar. The north site was situated near the overlook ponds. The river site was along the north bank just off a trail approximately in the center of the edges of the preserve as it borders the river.

Lewis & Clark State Park. This State Park is located at the east end of the urban growth boundary, along the Sandy River. There is mostly intact riparian, although some shrubby plants have been inundated by Himalayan blackberries. The tree species are primarily Douglas fir, alder and Cottonwood. They are part of a remnant stand. Upstream, most of the Sandy River is protected, and some riparian corridors exist in the sample area.

Smith and Bybee Lakes (NE & NW sites). These two sites were along the north edges of Smith Lake. The dominant overstory is mature cottonwoods with some natural understory and non-native Himalayan blackberries. The stand of trees at the NW site is narrow and the lake edges recede from both sites as summer and early fall progress.

Smith & Bybee Lakes (SE & SW site). These two sites were at ends of the slough, which runs to the south of Smith Lake. Mature Oregon Ash was the dominant overstory, with native shrubs or replanted native willows as the understory. Water through the slough is slow and ponded in most areas. Insects were noticeably abundant during sample times. Overhanging foliage of the overstory ash trees sheltered the flyway used by bats and insects over the slough.

Oaks Bottom (north & south sites). Oaks bottom lies below riverine cliffs and is primarily a seasonal wetland with a large pond. A raised set of railroad tracks provides a buffer on the west between Oaks amusement park and the wildlife area. Dominant overstory includes many native tree species (Douglas fir, western red cedar, cottonwood, willow species). The area has numerous snags that likely provide exceptional opportunities for bats to day roost. In addition, the older homes in the surrounding urban area and the older buildings at Oaks Park provide potential sites for day roosting bats and maternity colonies. The wildlife area is also part of the historic flood plain for the Willamette River (about 300 meters west). Some evidence suggests the historic flood plain was part of a very wide riparian zone that ended at the bluffs to the east.

Mary S. Young State Park (Willamette River site & spring site). This State park is comprised of primarily wooded uplands, dominated by alder and Douglas fir, a riparian zone dominated by cottonwoods, with non-native shrub understory and open ball fields and pet exercise areas. Dominant trees within the wooded uplands appear to be less than 100 yr old. Hikes throughout the park revealed few snags outside the riparian zone. The cottonwoods are mature and exhibit broken tops, cracks and exfoliating bark. Some have woodpecker use. Insect activity was noticeable at both sites. The spring site was situated just east of the ball fields and eastern parking lot. A small pond about 6 meters in diameter was sampled. The river site was at the edge of the Willamette River.

Tualatin City Park. This park lies along the Tualatin River and comprises approximately 27.11 acres. Durham city park and wetland set asides adjoin the park or are immediately across the Tualatin River. The riparian zone, while narrow is lined with mature trees that visually provide multiple cracks, crevices and woodpecker holes for roosting bats. Dominant overstory is primarily big-leaf maples, Douglas firs and western red cedars.

Tualatin Hills Nature Preserve. This park is 219 acres in size with a perennial stream and pond and associated wetlands. Overstory is dominated by young Douglas fir and western red cedar. Several snags and damaged trees are found off the trail system and near the pond edges. Diurnally the park is heavily used in all but the most inclimate weather. Nocturnally the park is closed.

SMALL WETLANDS

Camassia. A medium size plot owned by Nature Conservancy that is dominated by second growth Douglas fir. Understory and nativeness of plants is high. Other than the small wetland we sampled, the nearest standing water is the Willamette River about 0.75 km to the east. We did not notice many snags in our brief search of the preserve.

Forest Park –Rocking Chair Dam. This is a small check dam that holds back a small pond about 4 meters in diameter. The park is large (about 650 acres), but potential roosts for bats are limited as the area was logged around 1900 and the Douglas fir and alder which predominate are generally much younger. Rocking Chair Dam is the only know permanent water. Balch Creek to the south (Audubon Sanctuary or McCleay Park) and the Willamette River to the east are the nearest perennial water.

Fanno Creek. We surveyed an area adjacent to Alpenrose Dairy where some rehabilitation of the riparian zones is occurring. Cottonwoods, alder and willows dominated the overstory with some native and non-native plants comprising the understory. Other than the older buildings at Alpenrose, most of the urban area was constructed post 1954.

Newell Creek. Our sample site here was probably not the best, but we selected a wet meadow, as the creek itself was mostly overgrown by riparian shrubs. The woodland area is long and narrow and borders the creek that runs through a relatively deep ravine. We sampled a wet meadow adjacent to the woodland.

Portland Community College. The Sylvania campus has a restored wetland, but it appears to be dry in the later summer months (at least in 2002). The area is surrounded by a few acres of woodland where non-native understory plants have been removed and replace by native shrubs and herbs. The dominant overstory is primarily Douglas fir and is younger second growth with few or no snags or trees that exhibit a morphology friendly to bats.

Powell Butte. Powell Butte was formerly a dairy farm. It was recently converted to a public park. The sample site was an algae filled pond on the south side of the volcanic Butte on which the park sits. Few trees of usable size are near the pond/wetland. Most trees that could be usable for day roosts are at the south foot of the butte and line the Johnson Creek corridor.

MATERIALS AND METHODS

I chose three methods with mist netting as the primary technique to sample for bats at appropriate sites: ANABAT detectors and night roost surveys. In conjunction with the mist netting, I used ANABAT II detectors, crossing meters and laptop computers loaded with the companion echolocation program while nets were open. This allows direct comparison of bat call detection data with mist net data.

The advantages to mist netting include, but are not limited to: individual bats can be counted, sex, age and reproductive status can be determined, species identification is highly accurate and condition of bat can be determined (normal or greater weight).

At sites where mist netting was not appropriate (usually involved bodies of water too large for mist net effectiveness, we relied on ANABAT II data, collected as we did when mist netting. Sites sampled in year two (2003) were all sampled with ANABAT detectors and laptops.

ANABAT II detectors provide some data when mist nets fail. Hayes (pers. comm.) noted that it was not possible to distinguish between *Myotis* species in riparian zones. Betts (*pers.comm.*) noted overlap when *L. noctivagans* and *E. fuscus* are simultaneously present. In addition, unless the bats fly extremely close (about 2 meters) within the bat microphone, it is virtually impossible to detect accurately *C. townsendii* and *M. thysanodes.* Thus, for most of these sites I could end up with two to three groups of species, and an occasionally clear call group that can be positively assigned to an individual species.

Sampling with mist nets and detectors began approximately 15 minutes prior to civil sunset and continue for at least three hours post sunset or 30 min post last bat capture, whichever is longer. Use of ANABAT II detectors was reliant on computer battery storage. Sampling was conducted during evenings when rain was absent and sunset temperatures were greater than 15^0 C. By limiting sampling to the best weather conditions, chances of success were considerably enhanced.

I chose a minimum sample size of 30 for year one (each sampled twice) so that parametric or non-parametric statistical analysis may be applied-. Sampling each site at least twice (as per Perkins and Anderson 1996) will

increase the probability to approximately 75%, that we would capture or detect by ANABAT all species present at each site (Perkins 1996). Sampling twice with approximately the same number of days between each sample for each site will provide a better and broader picture of bat diversity and site loyalty. Using single point data to determine site suitability for wildlife, determine presence, or derive distribution patterns, particularly for mobile species such as bats, is fraught with potential errors.

Sites were selected in consultation with Jennifer Thompson (USF&W). Holly Michaels (ODF&W) and Lori Hennings (METRO).

Surveying night roosts include all suitable bridges within two km of each sample site. Visits to each bridge site prior to night surveys will occur to search for evidence of bat use (guano, insect parts) and suitability of bridges in particular to serve as a night roost (Kunz 1982). Perkins (1984) noted that the bridge infrastructure was the most important character in determining probability of bat use. Surveys of bridges and other appropriate sites for night roosting bats began immediately after mist netting was completed and continued for at least two hours. If guano was present and no bats were found from midnight to 2 am, I returned about 0.5 hrs prior to civil sunrise to check for *M. volans*. Maternity colonies of this species tend to arrive late at night roosts post parturition. Bridge surveys were particularly useful in 1984 in Lane County. The presence of most maternity colonies was first noted at bridge night roosts (Perkins, 1984).

Types of data recorded are noted in Appendix I where sample data sheets are provided.

I tabulated total calls collected and I compared the species list from calls detected that were suitable for species identification, with mist net results. I also statistically compared numbers of total calls collected with total numbers of bats captured at each site using Spearman's rank-order correlation analysis. The purpose of this is to determine statistically if a greater number of calls are likely to indicate a greater number of bats. Thus we can roughly determine bat density and pinpoint those sites with the greatest diversity and those sites with the largest foraging population. To obtain a large enough sample size, I included my data for total calls and total net captures, from sample sites in the Uinta Mountains, Utah, where data collection methods were identical (summer 2002).

We mapped all sites (Figure 1) and indicated by size which sites had the greatest numbers of calls per time unit.

We used correlation tests to determine if there were significant differences in numbers of calls and species diversity between the four categories of sampled sites.

We provide data on known maternity roosts and append historical data from the PNW bat research team's computer library. This information includes most Oregon college and National museum collections and data from reports of bat investigators who work in Oregon.

RESULTS

OVERALL RESULTS

We sampled a total of 15 sites with mist nets and/or Anabat detectors. We used ANABAT II and laptop computers with crossing meters at a total of 67 sites (Tables 2, 3, 4). We captured by net a total of 68 bats, comprising seven species (Table 2), with an average of 2.3 bats/night. We detected calls, likely comprising nine species (Table 3,4). We likely detected two species by Anabat that we did not capture (*M. volans, M. evotis)* and captured one species (*M. thysanodes)* that we did not detect with ANABATS. *M. thysanodes* was a new species for the Metro area. The site where we captured the greatest number of bats was Apollo Ridge (44), and the site where we captured the most species was the Audubon sanctuary (5) (Table 2). At five sites we captured no bats (Table 2). Numbers of species noted by interpretation of ANABAT II calls ranged from one to seven (1-7) (Table3, 4). Mean number of species per category of site is as follows: small parks=2.6. large parks=3.4, natural areas=4.2, and wsetlands=1.9. Numbers of total calls ranged from 1 (three sample nights) to 3,444 (Table 3, 4).

Bridge searches (38 total bridges) revealed the least number of bats (25 individuals, two species-(Table 5). Many bridges had unacceptable infrastructure for use by night or day roosting bats. Those bridges with bat activity were distributed at the edges of the urban growth boundary.

RELATIONSHIP OF CALLS AND NETTED BATS

Spearman's rank-order correlation analysis indicates a high degree of correlation between the numbers of recorded calls and the numbers of bats captured (correlation value=0.529; probability they did not correlate=0.011). This value indicates that sites with more bat calls at a given location within an arbitrarily selected time period have a high probability to have a greater number of bats present than sites with significantly less bat calls.

SMALL PARKS vs. LARGE PARKS vs. LARGE NATURAL AREAS

Small parks had significantly fewer calls than either large parks or large natural areas (correlation = -0.16) and large parks had significantly fewer calls than the large natural areas (correlation = -0.31). Small parks again had significantly fewer calls than the natural areas (correlation = -0.050). Small parks averaged 71 calls per sample unit (two nights), large parks 519 calls per sample unit, wetlands averaged 27.5 calls per sample unit and natural areas 1058 calls per sample unit (Figure 2). There was a significant difference between the small parks per unit results and the wetlands (correlation =0.16)

MATERNITY ROOSTS

We noted or netted at least 5 maternity colonies of three species. The first two were at Apollo Ridge Park and a home on Blue Lake and the species was *M. yumanensis*. The third and fourth were colonies in the vicinity of Redtail Golf Course and at an abandoned home in Hillsboro (now part of the park system). This species was *E. fuscus*. A fifth colony was found in bat boxes at the historic Scottish Presbyterian Church of Hillsboro. That species is still being determined, but is likely *M. yumanensis* or *lucifugus (Figure 3)*.

DISTRIBUTION OF BATS BY CALL NUMBERS.

Mean number of calls per sampling unit was 547. Those sites that produced 500 or more calls per unit (14 sites) were primarily along permanent waterways with relatively intact riparian zones (8) or adjacent to the UGB (3). Only Laurelhurst Park, Redtail Golf Course and Rose City Golf course were well away from the major rivers and creeks drainage within the Metro area (Figure 1).

DISCUSSION

OVERALL RESULTS

There were unexpected data included in the two years of sampling. The lack of bats using bridges was unexpected. In more rural or smaller urban areas, suitable bridges are used by most bat species for night roosts. It may be the large number of buildings provide adequate night roost sites that are more opportunistic and closer to foraging and day roosting area. Another possibility is that the bat density within the UGB is much lower than that of managed forests, so the use at night roost is also lower. In addition, few bridges that had suitable understructure were near the highest concentrations of calls, thus limiting bat use by absence of bridges in high bat population areas. In three areas we sampled I expected a higher level of bat activity-Tryon Creek State park, Durham City Park and Rocking Chair dam in Forest Park. I expected much higher bat activity at those sites, based upon result at the other large forested urban areas. Hennings (*pers. comm.*) indicates bird diversity and abundance is relatively high at those sites. The probable cause is lack of suitable day roosts. This may be attributed to the age of the dominant trees and to the types of structures within the urban area.

One pleasant surprise was the first record for the metro area of the bat species *Myotis thysanodes*. The nearest known occurrence in about 50 miles to the east on the Mt Hood National Forest and about 30 miles to the north near St. Helens, Oregon. This increased documented Metro area bat species to a total of nine.

The wide variation in numbers of calls we noted between sites in this study is not unusual in less urban and more natural settings. On the Wallowa Whitman we had sample ranges from 0-6000+ in about 60 sites sampled 140 times by ANABAT II detectors and recorders.

Table 2. Results of mist netting in Portland, Oregon, summer, 2002.

DATE	SITE NAME	SPECIES	#M	#F	#J	?	TOTALS
7/05	Apollo Ridge	MYYU		44			44
7/27		EPFU	1				1
		MYYU		4			4
7/09	Audubon	EPFU	1				1
		LACI	3				3
		LANO	2				2
7/18		LACI	1				1
		MYLU	1				1
		MYTH	1				1
7/03	Beggar's Tick	No Bats					
7/25	Beggar's Tick	LACI	1				1
		EPFU		3			3
6/26	Burlington	MYCA	1				1
7/17		No Bats					
6/22	Durham North	No Bats					
7/18		No Bats					
6/25	Forest Park Fire Lane	No Bats					
7/15		No Bats					
6/24	Forest Park	MYCA		1			1
	Rocking Chair Dam	MYLU	2				2
7/14		No Bats					
6/15	Hamby Park	EPFU	1				1
7/11		No Bats					
6/14	Kane Rd Park	No Bats					
7/12		No Bats					
6/20	Mary S. Young State Park	MYCA	1				1
7/16		No Bats					
6/29	Powell Butte	No Bats					
7/01		No Bats					
7/06	Salix Park	No Bats					
8/19		No Bats					
6/19	Tryon Creek #1	No Bats					
7/15		No bats					
6/21	Tryon Creek #2	No bats					
7/15		No Bats					
7/05	Willow Creek	No Bats					
7/31		No Bats					

Table 3. Results of ANABAT II detection in Portland, Oregon, summer, 2002.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
7/05	**Apollo Ridge**	MYCA MYVO MYYU	26
7/27	**Apollo Ridge**	EPFU LANO MYVO	26
7/09	**Audubon**	EPFU LACI LANO MYVO	380
7/18	**Audubon**	EPFU LACI LANO MYCA MYVO	218
7/03	**Beggar's Tick**	LACI LANO EPFU	63
7/25	**Beggar's Tick**	EPFU	2
6/26	**Burlington N**	EPFU MYVO MYYU	30
7/17	**Burlington N**	Calls too indistinct	9
6/26	**Burlington S**	LACI LANO EPFU MYCA MYLU MYVO MYYU	70
7/17	**Burlington S**	LANO MYVO MYYU	30
7/11	**Camassia**	LANO MYLU	26
7/28	**Camassia**	MYLU	6
7/11	**Clackamette**	Computer Program Failure	56

Table 3. Results of ANABAT II detection continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
7/28	**Clackamette**	EPFU LANO MYCA MYEV MYLU MYVO MYYU	1573
6/22	**Durham Park**	No Bats	
7/18	**Durham Park**	No Bats	
6/25	**Forest Park-** **Rocking Chair Dam**	MYCA MYYU	8
7/14	**Forest Park-** **Rocking Chair Dam**	MYCA *(note: water dry behind dam)*	2
6/26	**Forest Park** **Fire Lane**	LANO	25
8/21	**Forest Park** **Fire Lane**	Calls Indistinct	1
6/15	**Hamby Park**	EPFU MYVO	30
7/29	**Hamby Park**	No bats	
6/14	**Kane Road Park**	EPFU MYLU MYVO	17
7/12	**Kane Road Park**	No Bats	
6/20	**Mary S. Young #1**	LANO MYCA MYVO MYYU	57
7/12	**Mary S. young #1**	EPFU LANO MYCA MYVO	196
6/20	**Mary S. Young #2**	MYCA	64
7/12	**Mary S. Young #2**	No Bats	
7/01	**Mount Tabor #1**	LANO	15
7/29	**Mount Tabor #1**	No bats	

Table 3. Results of ANABAT II detection continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
7/01	**Mount Tabor #2**	LANO	17
7/29	**Mount Tabor #2**	LANO	13
		MYSP	
7/08	**Oaks Bottoms N**	EPFU	775
		LACI	
		LANO	
		MYEV	
		MYVO	
		MYYU	
7/23	**Oaks bottoms N**	EPFU	447
		LANO	
		MYCA	
		MYEV	
		MYLU	
		MYVO	
		MYYU	
7/08	**Oaks Bottoms S**	EPFU	701
		LANO	
		MYVO	
7/24	**Oaks Bottoms S**	EPFU	408
		LANO	
		MYVO	
		MYLU	
7/01	**Powell Butte**	Indistinct calls	3
7/22	**Powell Butte**	No Bats	
7/18	**Reed W**	LANO	50
7/30	**Reed W**	LACI	25
		LANO	
7/18	**Reed E**	No bats	
7/30	**Reed E**	No Bats	
7/06	**Salix Park**	MYLU	149
		MYVO	
		MYYU	
8/19	**Salix Park**	Indistinct	1
6/21	**Tryon Creek #1**	MYLU	31
		MYVO	
7/15	**Tryon Creek #1**	MYLU	73
		MYVO	

Table 3. Results of ANABAT II detection continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
6/16	**Tryon Creek #2**	MYLU MYVO MYYU	30
7/14	**Tryon Creek #2**	EPFU MYLU MYVO MYYU	105
8/23	**Tualatin Hills Wildlife Refuge**	MYCA MYVO MYYU	101
6/22	**Tualatin City Park**	EPFU LACI MYVO	256
7/18	**Tualatin City Park**	LACI MYCA MYLU MYVO	789
6/30	**Washington Park Upper Reservoir**	No Bats	
7/31	**Washington Park Upper Reservoir**	MYCA MYLU MYVO MYYU	6
6/30	**Washington Park Lower Reservoir**	No Bats	
7/31	**Washington Park Lower Reservoir**	No bats	
7/05	**Willow Creek Park E**	LANO EPFU MYCA MYYU	186
7/31	**Willow Creek Park E**	MYSP	7
7/05	**Willow Creek Park W**	No Calls	
7/31	**Willow Creek Park W**	LANO EPFU	25
6/27	**Vanport Area**	Calls indistinct	1

Table 4. Results of ANABAT II survey in Portland, Oregon, summer, 2003.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
7/14	**Bethany Wetlands**	LANO	139
		EPFU	
		MYVO	
7/30	**Bethany Wetlands**	LANO	118
		EPFU	
		MYVO	
7/15	**Blue Lake E**	LACI	793
		LANO	
		MYLU	
		MYVO	
8/07	**Blue Lake E**	LACI	1572
		LANO	
		EPFU	
		MYLU	
		MYVO	
7/15	**Blue Lake W**	LACI	1584
		LANO	
		EPFU	
		MYVO	
		MYYU	
8/07	**Blue Lake W**	LACI	1184
		LANO	
		EPFU	
		MYLU	
		MYVO	
		MYCA	
7/20	**Carver Bridge**	MYLU	3444
		MYYU	
		MYCA	
8/02	**Carver Bridge**	EPFU	3062
		MYLU	
		MYVO	
		MYYU	
7/20	**Clackamas River**	EPFU	452
		LANO	
		MYLU	
		MYVO	
		MYCA	
8/02	**Clackamas River**	MYVO	617
7/28	**Colwood S**	EPFU	242
		LANO	
		MYLU	
		MYYU	

Table 4. Results of ANABAT II 2003, continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
8/10	**Colwood S**	LACI	747
		LANO	
		EPFU	
		MYLU	
		MYCA	
		MYYU	
		MYVO	
7/28	**Colwood N**	LANO	48
		MYVO	
		MYCA	
8/10	**Colwood N**	LANO	7
		MYLU	
7/19	**Columbia-Edgewater**	LACI	631
		LANO	
		MYLU	
8/18	**Columbia-Edgewater**	EPFU	802
		LANO	
		MYLU	
		MYVO	
7/27	**Creston Park**	LANO	3
8/08	**Creston Park**	UNKNOWN	2
8/18	**Delta Park**	LACI	158
		LANO	
		MYLU	
7/25	**Fanno Creek**	MYVO	6
8/03	**Fanno Creek**	UNKNOWN	1
7/26	**Fernhill Wetlands**	LACI	547
		LANO	
		EPFU	
		MYSP	
7/29	**Glendoveer W**	LACI	14
		LANO	
		MYLU	
8/15	**Glendoveer W**	LACI	3
		LANO	
7/29	**Glendoveer E**	LACI	4
		LANO	
8/15	**Glendoveer E**	LANO	11
		MYLU	
7/21	**Grant Park**	LANO	43
8/12	**Grant Park**	UNKNOWN	2

Table 4. Results of ANABAT II 2003 continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
6/28	**Jackson Bottoms**	LANO	220
		MYLU	
		MYVO	
7/31	**Jackson Bottoms**	LANO	461
		MYLU	
		MYVO	
		MYYU	
7/22	**Kelly Point N**	LANO	25
		MYVO	
		MYYU	
8/16	**Kelly Point N**	NONE	0
7/22	**Kelly Point S**	LACI	403
		EPFU	
		MYLU	
		MYVO	
8/16	**Kelly Point S**	MYLU	3
7/16	**Laurelhurst Park**	LACI	585
		LANO	
		EPFU	
8/08	**Laurelhurst Park**	LACI	242
		LANO	
		EPFU	
7/17	**Lewis & Clark St. Park**	LACI	122
		MYLU	
		MYYU	
8/11	**Lewis & Clark St. Park**	LACI	315
		LANO	
		EPFU	
		MYLU	
		MYYU	
7/17	**MHCC**	LACI	223
		LANO	
		EPFU	
		MYLU	
		MYVO	
8/11	**MHCC**	LANO	231
		LANO	
		MYLU	
7/24	**Newell Creek**	LACI	31
		LANO	
		MYLU	
		MYVO	

Table 4. Results of ANABAT II 2003 continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
8/01	**Newell Creek**	LACI	24
		LANO	
		MYTH	
		MYLU	
7/26	**Noble Woods**	LANO	45
		MYSP (MYTH?)	
		MYYU	
8/10	**Noble Woods**	NONE	0
7/14	**Orenco Golf C.**	LACI	59
		LANO	
		EPFU	
		MYLU	
		MYYU	
7/30	**Orenco Golf C.**	NONE	0
7/24	**Oregon City Golf C.**	LACI	1817
		LANO	
		EPFU	
		MYLU	
		MYVO	
8/01	**Oregon City Golf C.**	LANO	1711
		EPFU	
		MYLU	
		MYVO	
		MYYU	
		MYCA	
7/25	**PCC**	MYSP	22
8/03	**PCC**	NONE	0
6/29	**REDTAIL G. C.**	LANO	1197
		EPFU	
		MYLU	
		MYYU	
8/17	**REDTAIL G. C.**	LANO	902
		EPFU	
		MYVO	
		MYYU	
7/21	**Rose City Golf C**	LACI	375
		EPFU	
		MYLU	
8/12	**Rose City Golf C**	LANO	646
		EPFU	
6/24	**Smith-Bybee Lakes NE**	LACI	18
		EPFU	
		MYYU	

Table 4. Results of ANABAT II 2003 continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
8/05	**Smith-Bybee Lakes NE**	LANO	289
		EPFU	
		MYLU	
		MYVO	
6/24	**Smith-Bybee Lakes NW**	LACI	35
		MYLU	
		MYCA	
		MYYU	
8/05	**Smith-Bybee Lakes NW**	NONE	0
6/25	**Smith-Bybee Lakes SW**	LACI	169
		LANO	
		EPFU	
		MYLU	
		MYCA	
		MYYU	
8/06	**Smith-Bybee Lakes SW**	LACI	361
		LANO	
		EPFU	
		MYLU	
		MYCA	
		MYYU	
6/25	**Smith-Bybee Lakes SE**	LACI	53
		LANO	
		EPFU	
		MYLU	
		MYVO	
8/05	**Smith-Bybee Lakes SE**	LANO	141
		MYLU	
		MYVO	
		MYCA	
7/18	**Tualatin Hills C. C. River**	LANO	67
		EPFU	
		MYLU	
		MYVO	
		MYYU	
8/09	**Tualatin Hills C. C. River**	LACI	64
		LANO	
		MYLU	
7/18	**Tualatin Hills C. C. Pond**	LANO	181
		MYLU	
		MYVO	

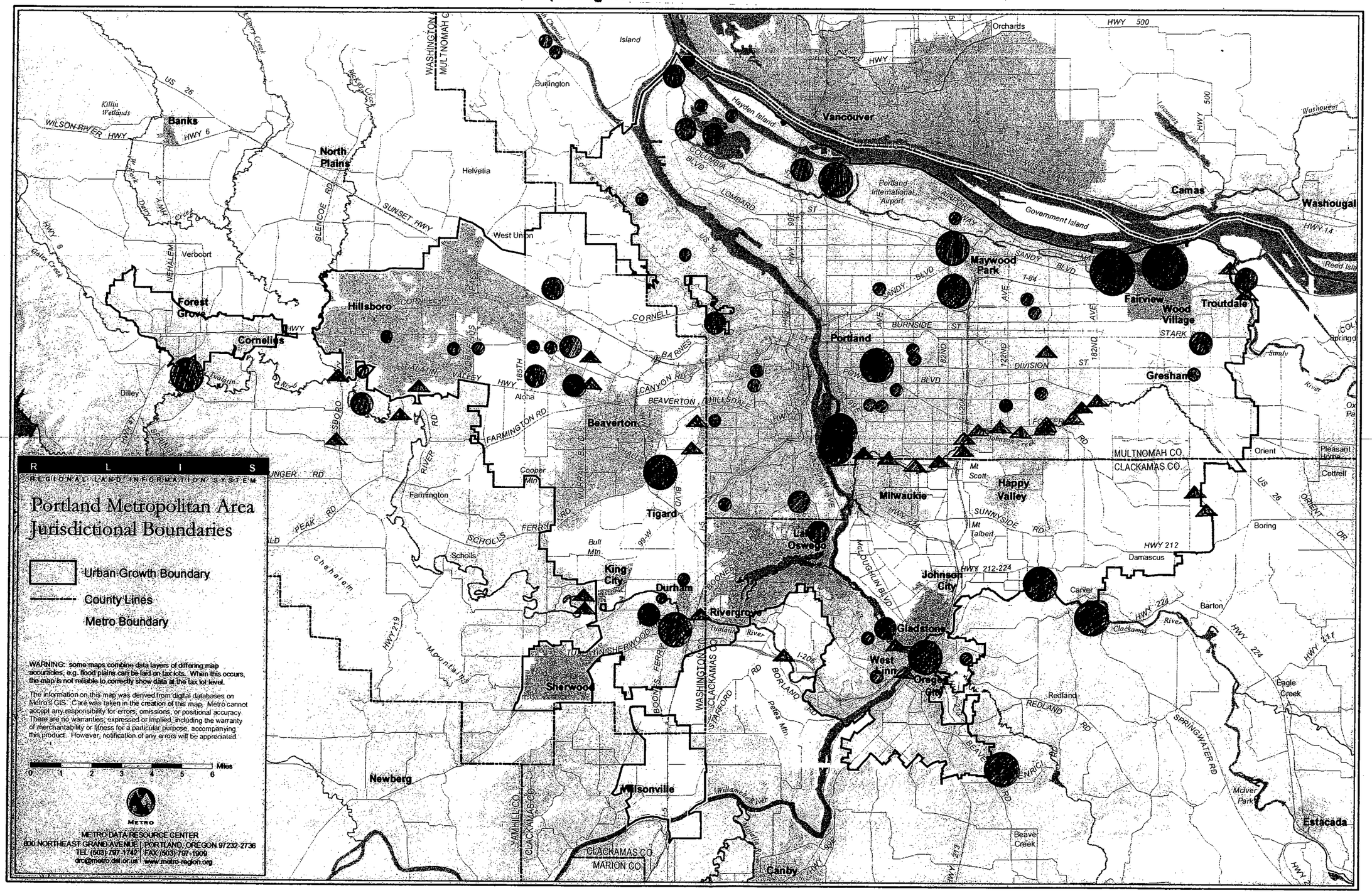
Table 4. Results of ANABAT II 2003 continued.

DATE	SITE NAME	PROBABLE SPECIES	TOTAL CALLS
8/09	**Tualatin Hills C. C. Pond**	EPFU	64
		MYLU	
		MYCA	
6/28	**Tual. Hills Wildlife Area**	LANO	164
		EPFU	
		MYLU	
		MYVO	
		MYYU	
8/20	**Tual. Hills Wildlife Area**	LANO	442
		EPFU	
		MYLU	
		MYVO	
		MYYU	

Table 5. Results of bridge searches for night roosts, summer, 2002-3.

DATE	SITE NAME	LOCATION	SPECIES	TOTAL #'S
6/10	Minter Bridge Road	T1S,R2W,S18	EPFU	20
			MYSP	1
6/10	Rood Bridge Road	T1S,R2W,S16	NO BATS	
6/10	Rock Creek Bridge	T1S,R2W,S08	MYLU	2
6/12	Scholls & Allen Blvd.	T1S,R2W,S23	NO BATS	
6/12	Scholls Fry & Fanno Crk	T1S,R1W,S34	NO BATS	
6/12	SW 170th & Cedar Creek	T1S,R2W,S07	NO BATS	
6/12	TV Hwy & Fanno Creek	T1S,R1W,S13	NO BATS	
6/12	Nature Preserve Bridge	T1S,R1W,S08	NO BATS	
6/13	Jackson Bottoms Bridge	T1S,R2W,S06	EPFU	2
6/13	Brookwood Bridge	T1S,R2W,S04	NO BATS	
6/14	Sandy River Bridge	T1N,R3E,S25	NO BATS	
6/14	Burlingame Creek Bridge	T1N,R3E,S25	NO BATS	
6/29	Over Johnson Creek & SE 174th	T1S,R3E,S18	NO BATS	
6/29	Johnson Creek & Deardorff	T1S,R2E,S23	NO BATS	
6/29	Leach Botanical Gdns	T1S,R2E,S15	NO BATS	
6/29	Johnson Creek & Flavel	T1S,R2E,S21	NO BATS	
6/29	Johnson Creek & 92nd	T1S,R2E,S21	NOBATS	
6/29	I205 Bridge over Foster	T1S,R2E,S21	NO BATS	
6/29	Johnson Creek & 108	T1S,R2E,S22	NO BATS	
6/29	Johnson Creek & Johnson Creek Blvd (2 bridges)	T1S,R2E,S30	NOBATS	
6/29	Johnson Creek & Tacoma	T1S,R1E,S25	NO BATS	
6/29	Johnson Creek & 112	T1S,R2E,S22	NO BATS	
6/29	Johnson Creek & 162	T1S,R2E,S24	NO BATS	
6/29	Johnson Creek & 82	T1S,R2E,S29	NO BATS	
6/29	Johnson Creek & 142	T1S,R2E,S23	NO BATS	
6/29	Johnson Creek & 146	T1S,R2E,S24	NO BATS	
7/01	Springwater creek	T2S,R3E,S19	NO BATS	
7/01	Springwater Road	T2S,R2E,S13	NO BATS	
7/01	Kellogg Creek & SE Oatfield Road	T1S,R2E,S06	NO BATS	
7/11	I205 Bridges over Tualatin River	T2S,R1E,S28	GUANO	
7/11	Old Oregon City Bridge	T2S,R2E,S30	NO BATS	
7/11	I205 Bridges near Camassia Conservancy	T2S,R2E,S30	NO BATS	
7/11	I205 Bridge, West Linn	T2S,R2E,S30	NO BATS	
7/13	Chicken run Creek	T2S,R1W.S19	MYLU	2
7/13	Tualatin river & Elsner road	T2S,R1W,S18	GUANO, URINE STAIN	
7/19	Beef Bend Road	T2S,R1W,S06	NO BATS	

Figure 1. Map of sampled sites and bridges, summer 2002-2003. Triangles=sampled bridges; small circles=0-100 calls/2 sample nights; medium circles=100-500 calls/2 sample nights; and large circles=greater than 500 calls/2 sample nights.



The mean numbers of species parallels that of mean numbers of calls, (see below), in that the least diversity was forest wetlands, the greatest diversity was natural areas.

RELATIONSHIP OF CALLS AND NETTED BATS

Results from comparing ANABAT calls collected to netting effort were perhaps the most rewarding part of year one. At the least, the statistics confirm that a plethora of bat calls at one site likely indicates that there are more individuals present than at a site with significantly fewer calls. Unfortunately, I am not yet able to develop indices beyond this. I still cannot say how many bats it takes to collect 1573 calls, but the probability is great that the number is significantly higher than a site where 273 calls are collected.

SMALL PARKS vs. LARGE PARKS vs. LARGE NATURAL AREAS

There is adequate evidence in the literature to suggest that available day roosts (see introduction above) likely limit local bat distribution. These results were no surprise that most bat activity was concentrated in the larger, more natural areas sampled. I had presumed that bat activity would be high at Kane Park in Gresham. A small park, but numbers of potential roost sites and available water and insects seemed to suggest that bat activity and diversity should have been higher than recorded. Perhaps the creek is not available to the bats for drinking throughout the summer and the potential lack of water also likely indicates a lack of insects upon which to forage.

MATERNITY ROOSTS

I am concerned at the low numbers of maternity colonies encountered. We did not advertise for locations as I did in 1981. In 1981 I was only told about the colony at Blue Lake (since moved to a new "home") and the *M. lucifugus* colony at the old Diak place on the Little Sandy River. That site is outside of the UGB so I did not include it in this report. A maternity colony of *P. townsendii* also resides a few miles outside the eastern edge of the UGB, and one hibernaculum is now within the UGB.

DISTRIBUTION OF BATS BY CALL NUMBERS.

Bat distribution and concentration of activity appears to be focused within the parklands with the greatest geographic area and in particular along major perennial waterways (Columbia, Willamette, Tualatin, and Clackamas Rivers, and Balch Creek). This is likely due to the consistent availability of insect populations, water to drink, and a wide variety of potential nearby roosts. In managed forest and wilderness areas throughout the Pacific northwest, most bat activity is recorded at or adjacent to water sources. This is probably due to the fact that 90% of the insect biomass is concentrated around water and therefore predation would conceivably be easier and opportunities more diverse.

RECOMMENDATIONS

The species diversity within the UGB is relatively high for a highly urbanized area. As noted in this report one major factor is the plethora of parks and wildlife sanctuaries within the boundary. Most provide some habitat for the local bat species. However as always there are some areas for improvement.

I believe that Metro and the involved local governments should be concerned about the status of bats within the UGB. The concerns are: the shortage of reproductive sites (maternity roosts), continued encroachment within critical riparian zones of the major waterways (some rehabilitation is being undertaken to improve potential salmon bearing streams), the removal of desired roosts (dead and diseased trees) and the fact that urbanites strive for a relatively low insect population (at least the pestiferous and noxious species). I suggest below some ideas that may help exacerbate these problems and actually continue the concentration of bat populations in the large and more natural parks where impact with most humans will be minimized.

Maternity Roosts. It is possible to provide additional roost in such sites as Smith and Bybee Lakes, Tryon Creek and Mary S. Young State Parks, and more remote areas of Forest Park. The first step would be to erect proper bat boxes, to provide interim roosting habitat. This is a low cost alternative to hiring someone to "reshape" existing trees to create a better roosting morphology. Some sites that might be applicable are : Smith and Bybee Lakes, some public golf courses, and selected sites in Forest Park. The second step would be to allow snags and broken trees that are out of the usual pathways of the public and exceed 10" dbh to remain for wildlife use. Based on USFS research approximately 130 of the 549 resident vertebrate species (this counts for fish too) use larger dead trees or downed logs at some point in their life cycle.

Riparian Zones. The initial work to remove non-native plant species, particularly the shrubby type, and to repair eroded banks will provide both improved water temperatures for the endangered salmonids and improved water temperature for aquatic insects. Many of these insects provide food in the water for resident fish and as adults fly within the riparian zone and provide food for birds, amphibians and bats. This is an area where roost trees, or in the interim bat boxes, will drastically improve the potential for increases in bat diversity and populations.

Insect Mass. The presence of a native shrub layer within parks, lake edges and riparian zones will likely improve nocturnal moth populations, a major prey base for bat species. Susan Smith, a USFS entomologist from northern California relays that where shrubby understory is native and close to natural density, moth populations west of the Cascades are at or near their peak (*pers. Comm.)*.

Wetland Improvements (long term). This study and the one at Smith and Bybee Lakes indicate Oregon ash is a likely roost tree for bats. Populations of this species are minimal at best. I would like to see plantings of these trees in wetlands to provide future roosts for birds and bats within the metro area. In

addition, the natural gross morphology of this species is broad, branching and pleasing to the eye. Their shape and impact, to me, is reminiscent of either African Baobab trees or southern Cypress.

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APPENDIX I

MAPS OF INDIVIDUAL SPECIES DISTRIBUTION

&

SAMPLE DATA SHEETS

&

HISTORIC DATA

Figure 2. Distribution of *E. fuscus.* Circles indicate ANABAT detection, triangles, live captures.

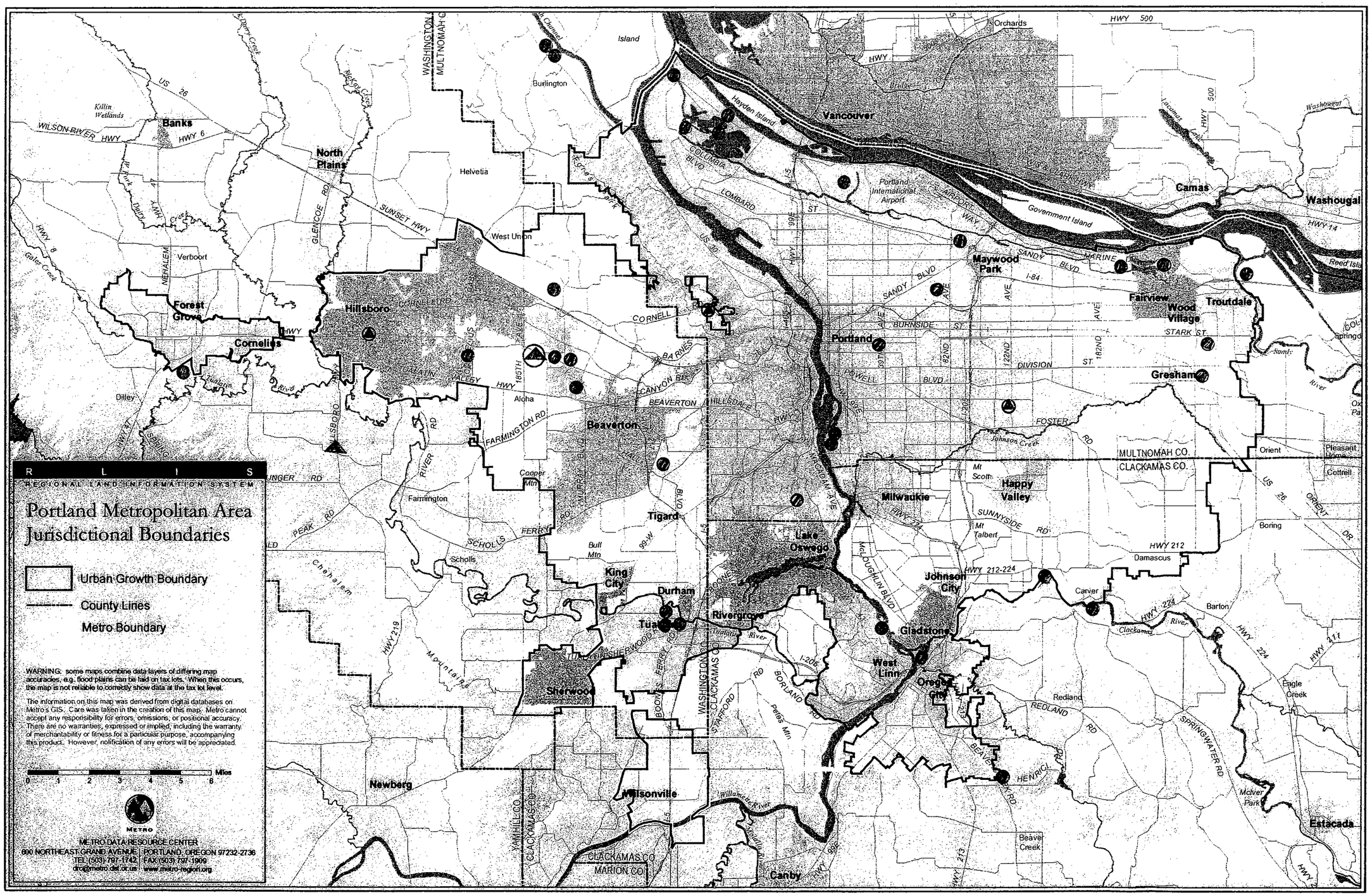

Figure 3. Distribution of *L. cinereus*. Symbols as in figure 2.

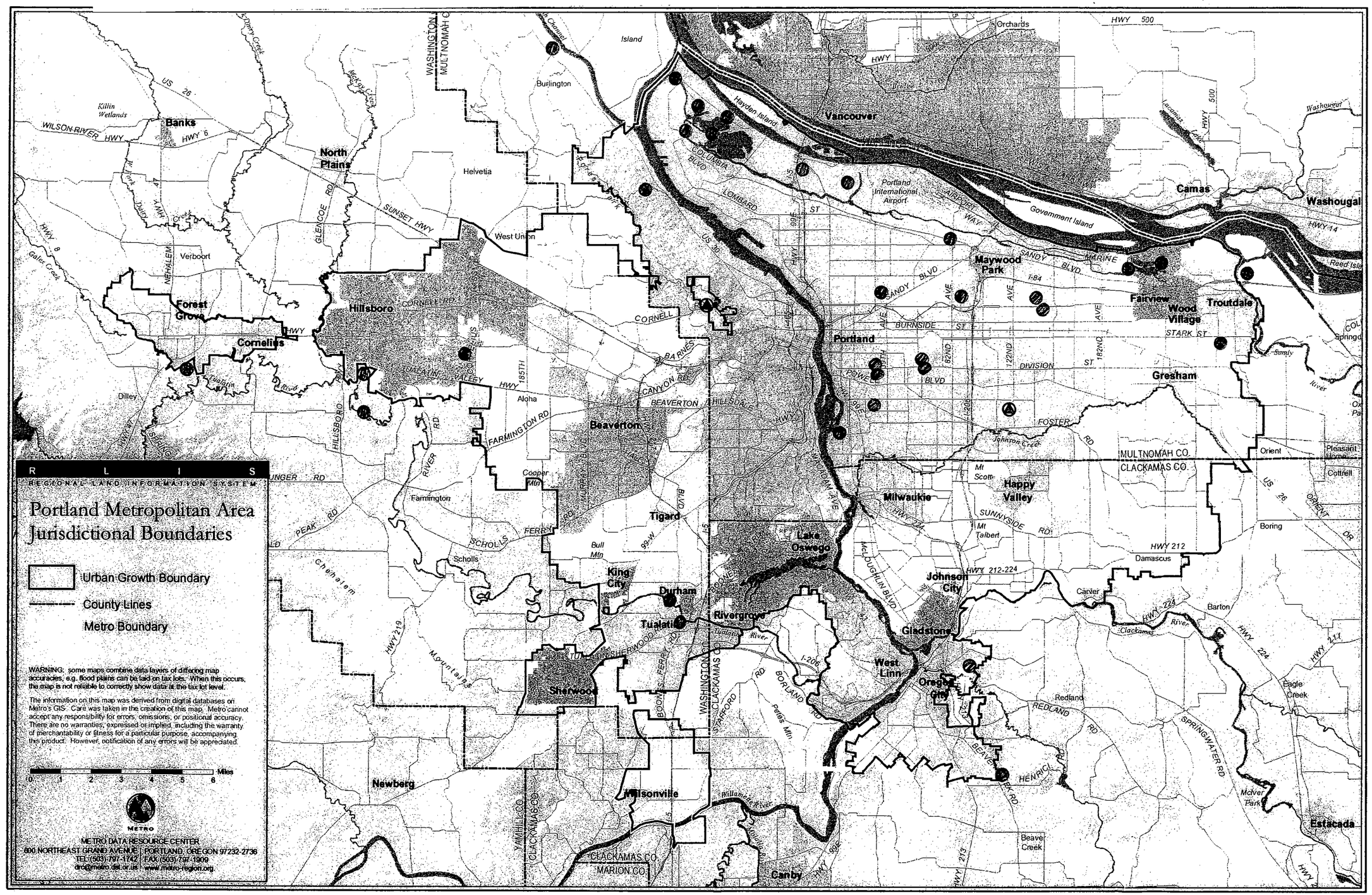

Figure 4. Distribution of *L. noctivagans*. Symbols as in figure 2.

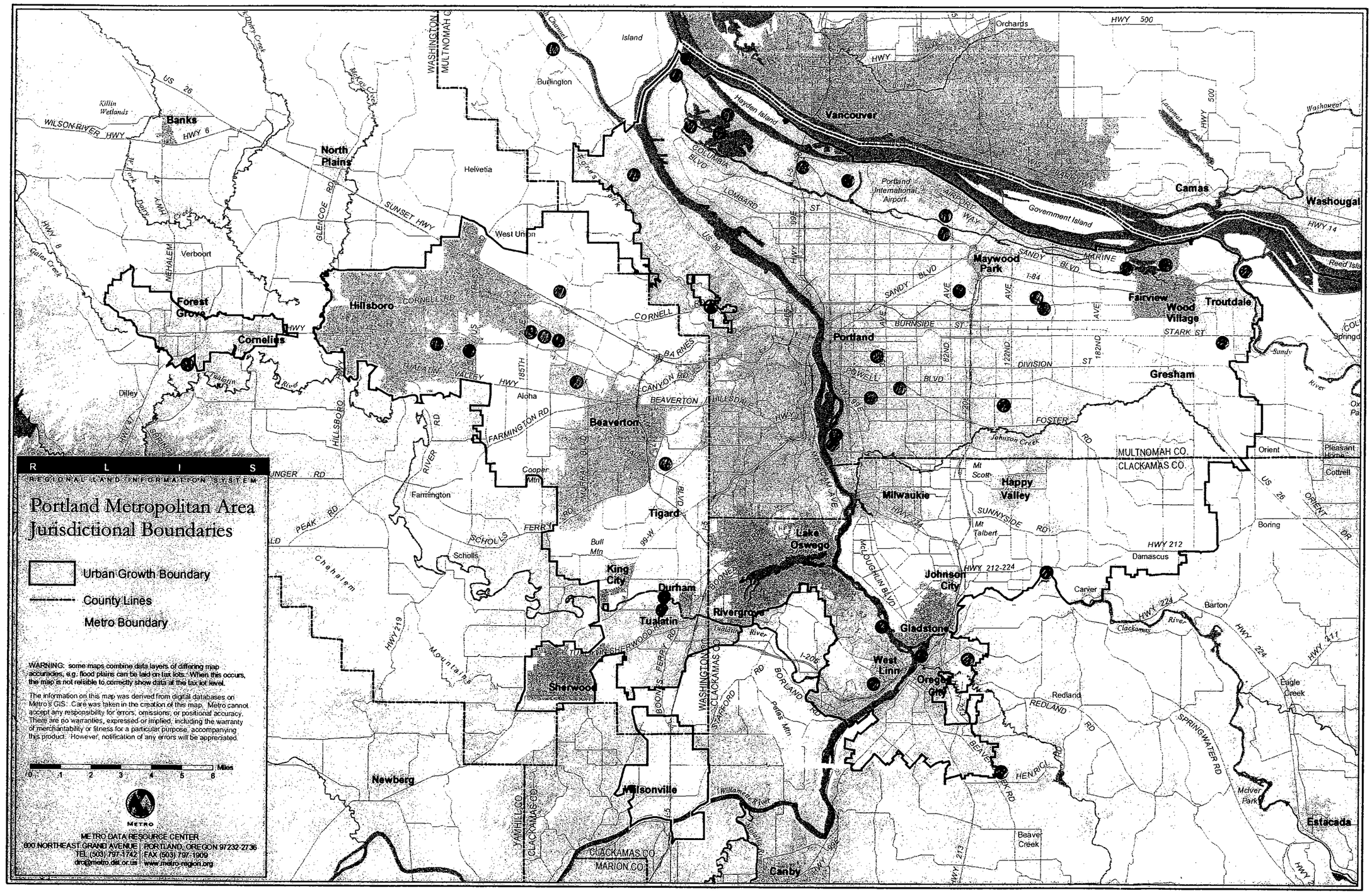

Figure 5. Distribution of *M. californicus*. Symbols as in figure 2.

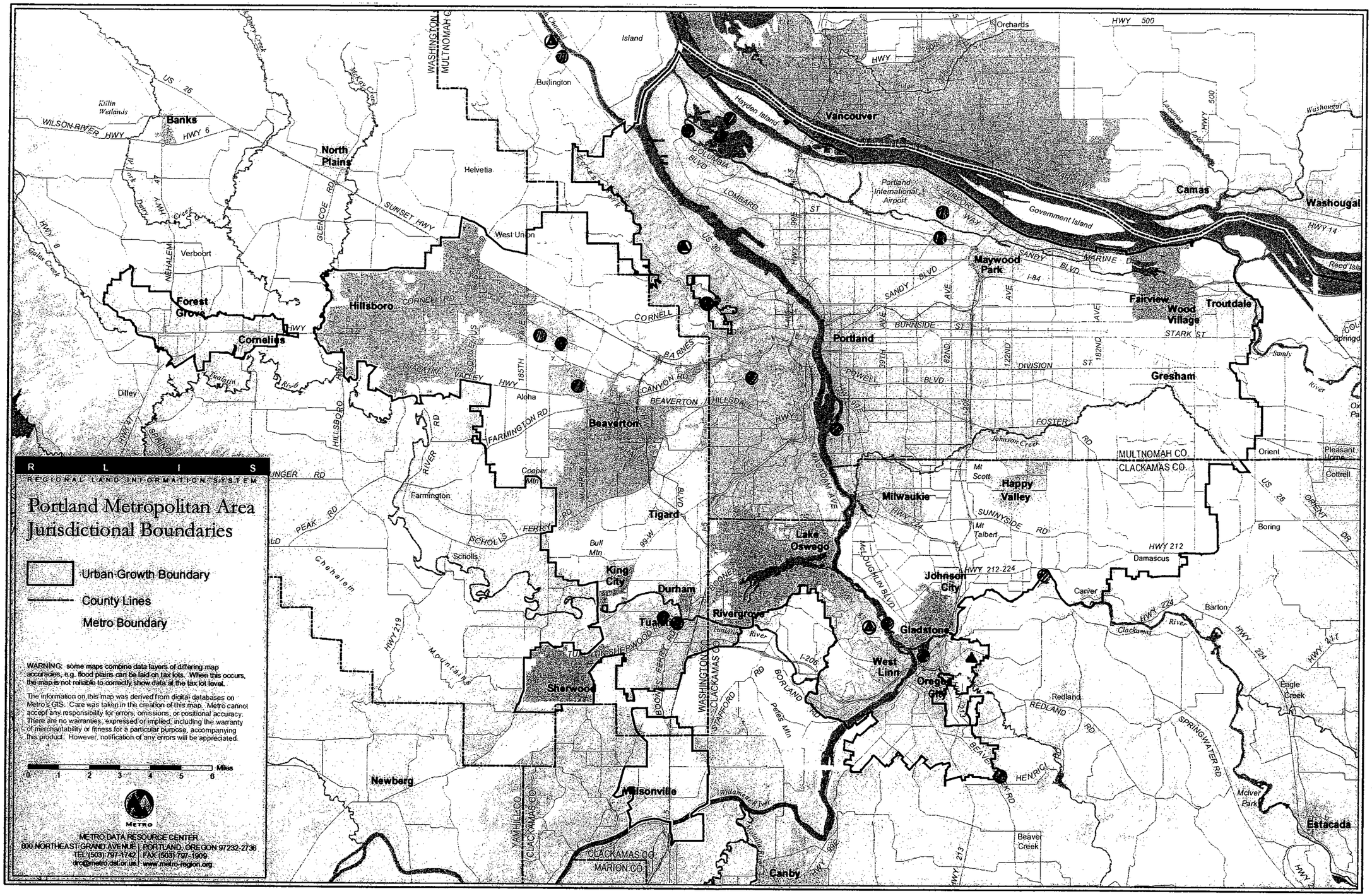

Figure 6. Distribution of *M. evotis* & *M. thysanodes.* Circles represent *M. evotis*, triangles *M. thysanodes.*

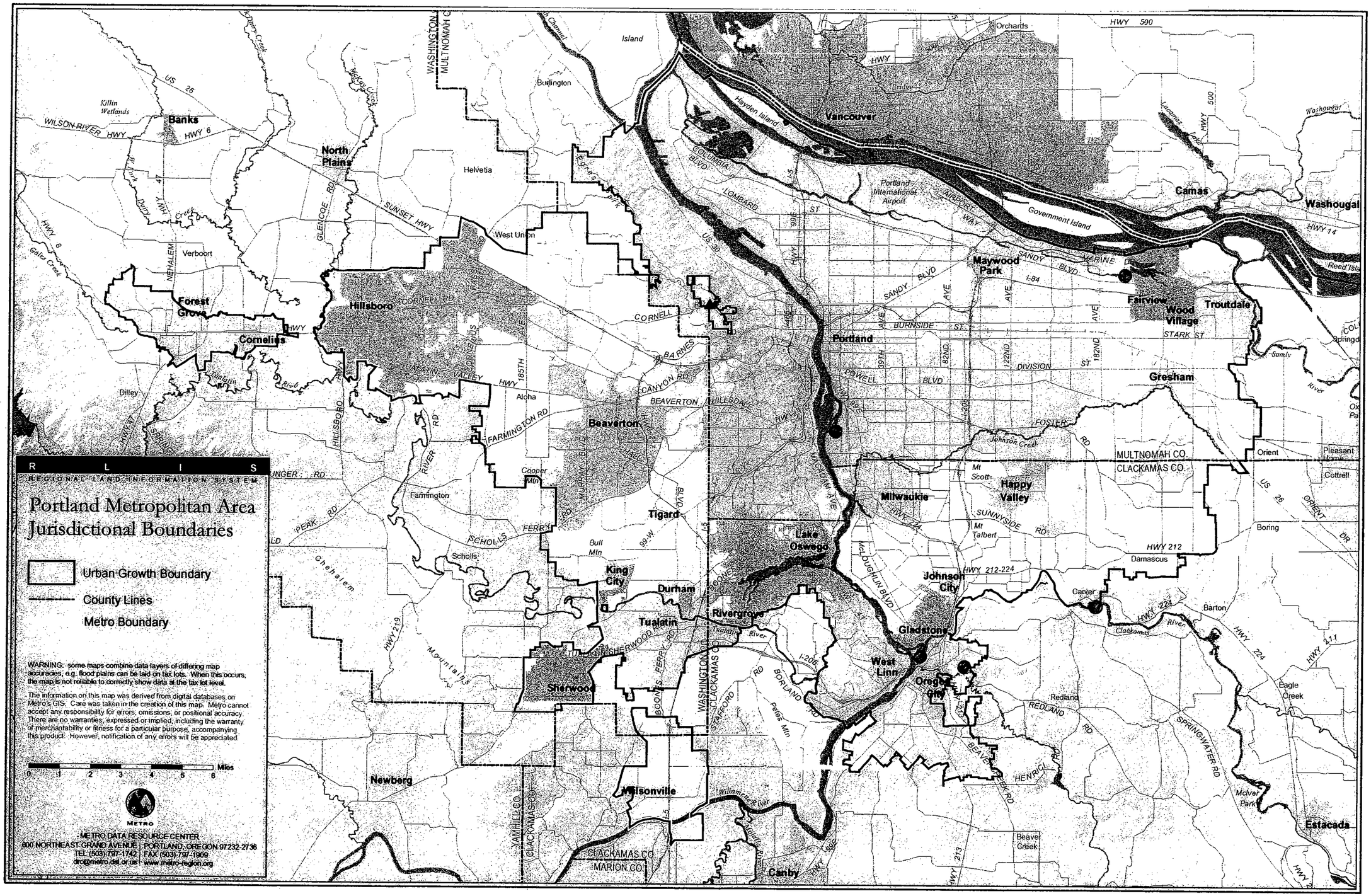

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Figure 7. Distribution of *M. lucifugus*. Symbols as in figure 2.

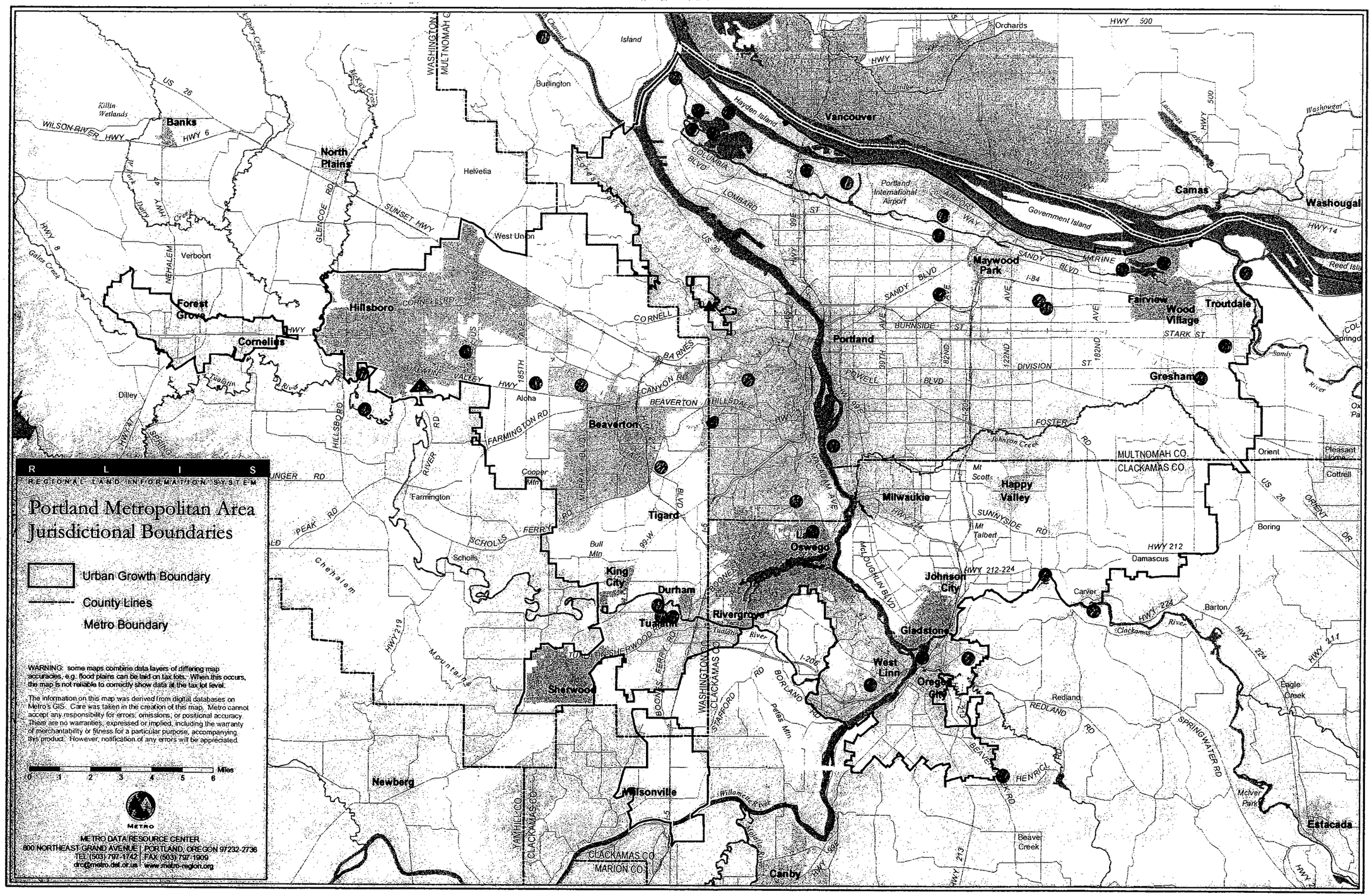


Figure 8. Distribution of *M. volans*. Symbols as in figure 2.

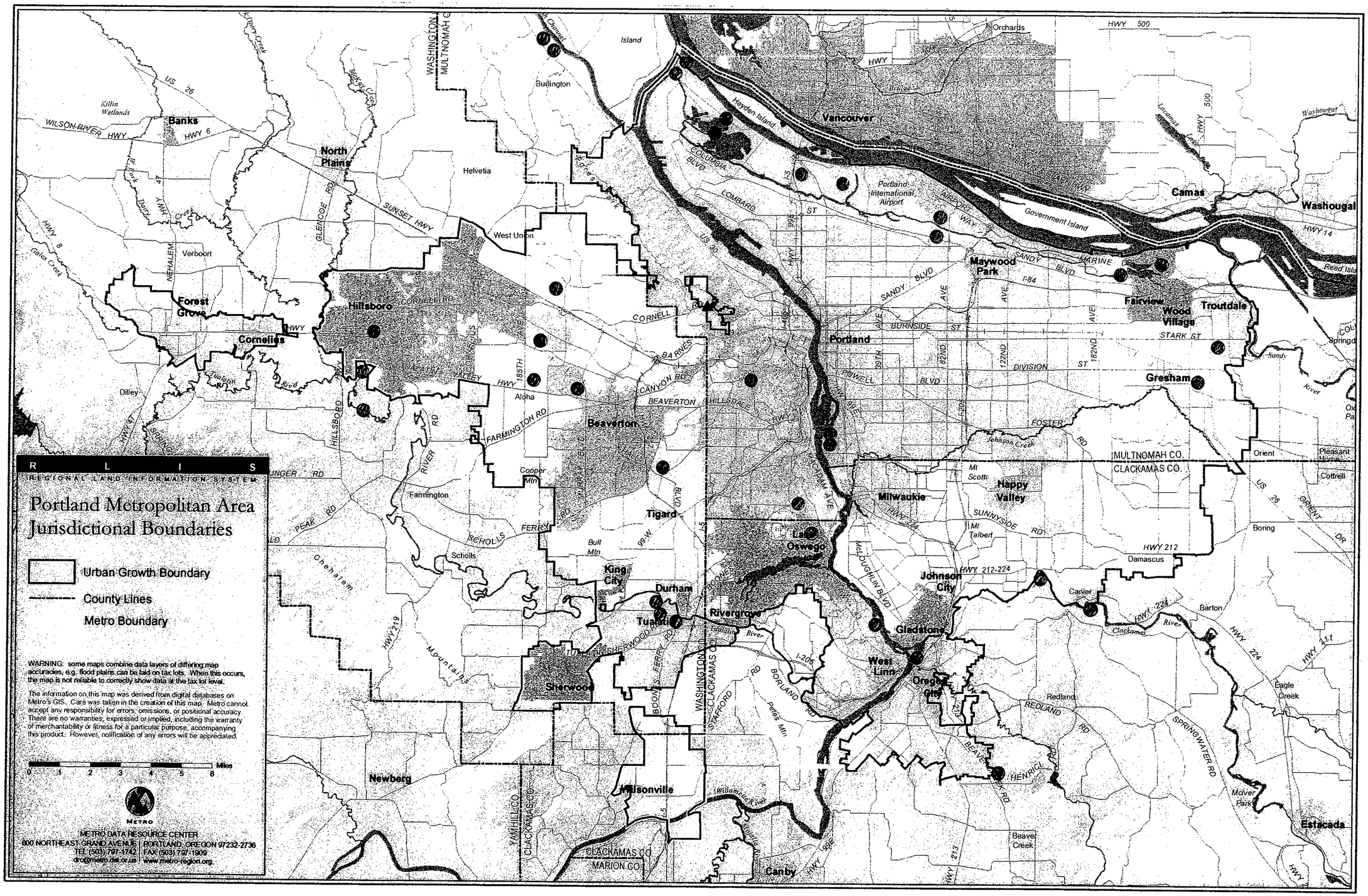
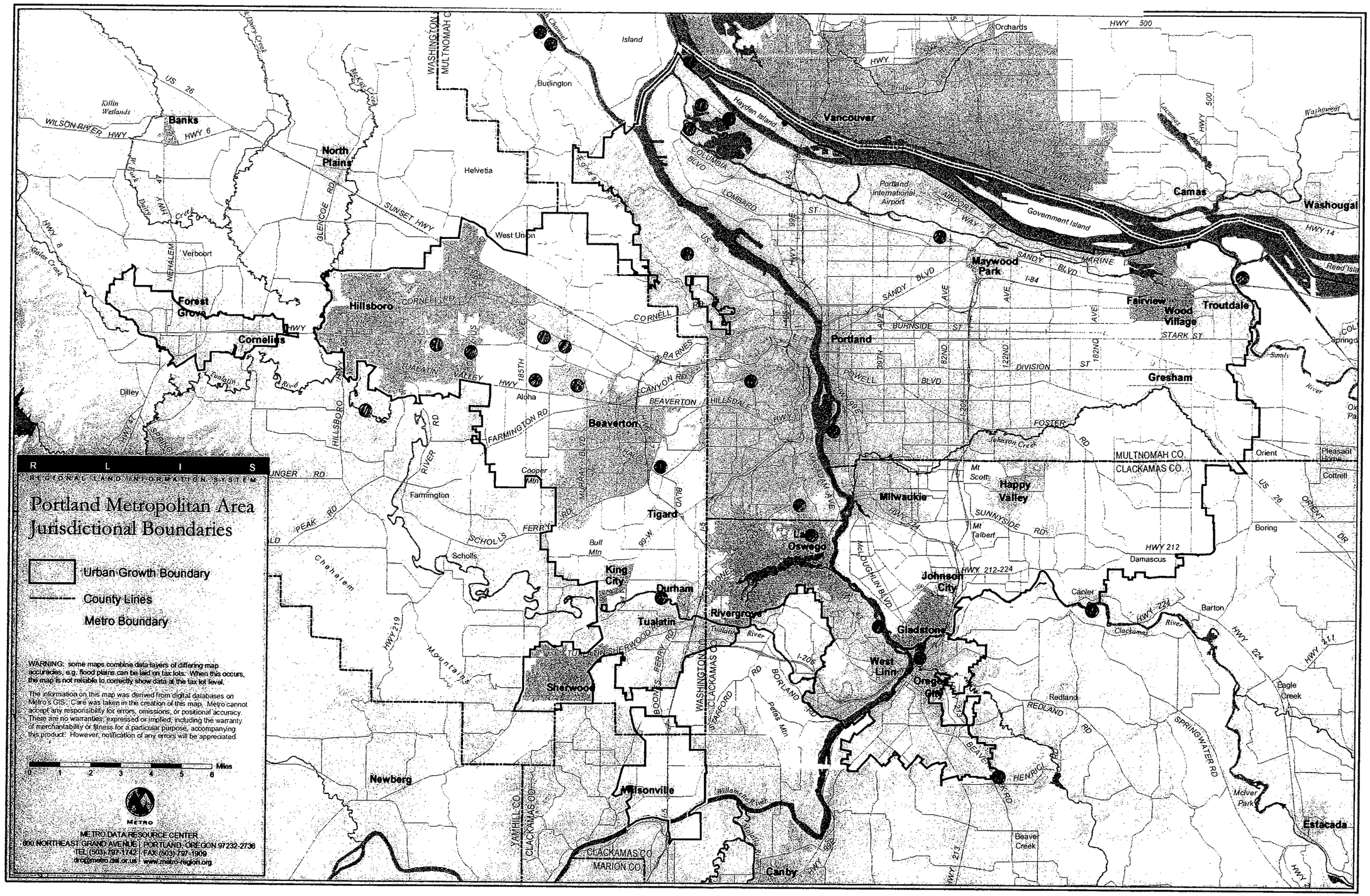


Figure 9. Distribution of *M. lucifugus*. Symbols as in figure 2.



SITE NAME_____

DATE (M/D/Y)_____NET #_____PREC (%)_____CLOUD COVER (%)_____
LOCATION_____

ELEV_____WIND SPD & DIR_____PUB SNST_____ACT SNST_____ MOON PHASE_____
ST TEMP_____END TEMP_____NETS OPEN_____NETS CLOSED_____
HABITAT_____

NAME:

TIME	SPECIES	SEX	AGE (A/J)	BAND MARK	TEMP	FA	COMMENTS	
								1
								2
								3
								4
								5
								6
								7
								8
								9
								10
								11
								12
								13
								14
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								16
								17
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								21
								22
								23
								24
								25
								26
								27
								28
								29
								30

NUMBER OF SPECIES:_____

ANPA:_____LANO:_____MYLU:_____PIHE:_____
EPFU:_____MYCA:_____MYTH:_____PLTO:_____
EUMA:_____MYCI:_____MYVO:_____TABR:_____
LACI:_____MYEV:_____MYYU:_____OTHER:_____

ROOST SURVEY

Date:____________________

ST:________ CO:__________________________________ T______,R______,S______,1/4______

Directions:____

____

Roost Structure:________________________________ Roost Type:______________________________

Amb Temp:____________ Roost Temp:____________ Time:______________ Elev:________________

Species	#M	#F	#?	Tot#	WT	FA	Band	Notes

Nearest H_2O:________________________________ Young Present: Y N Age:____________

Other Animal Species Noted:____

Notes:____

JMP & JRP- 1994

Table 6. Summary of historic data.

COUNTY	DATE	LOCATION	SPECIES	SEX	TOTAL
Clackamas	7/12/82	West Linn	MYEV	F	~50
Clackamas	7/27/82	West Linn	MYLU	F	1
Multnomah	6/17/82	Audubon	LACI	M	7
Multnomah	6/17/82	Audubon	LANO	M	4
Multnomah	6/17/82	Audubon	LANO	F	2
Multnomah	6/17/82	Audubon	MYLU	M	1
Multnomah	8/17/82	Audubon	MYLU	M	1
Multnomah	7/10/82	Troutdale	EPFU	M	1
Multnomah	7/15/82	Gresham	EPFU	F	~15
Multnomah	7/15/82	Diak's Place	MYLU	F	~250
Multnomah	7/17/52	McCleay Park	EPFU	M	1
Multnomah	7/17/82	McCleay Park	LANO	M	2
Multnomah	8/20/82	Burlington Store	MYLU	F	~200
Multnomah	9/13/87	SW Portland	LANO	M	1
Multnomah	3/22/90	Mountain Park	LANO	M	1
Washington	7/?/75	Sherwood	EPFU	M	1
Washington	8/11/82	Hillsboro	EPFU	F	~50