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Small Mammal Survey in Marsh Habitats Along the Las Vegas Wash

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SOUTHERN NEVADA WATER AUTHORITY

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Las Vegas Wash Project Coordination Team

Prepared for:

Research and Environmental Monitoring Study Team
Las Vegas Wash Coordination Committee

Prepared by:

Marissa E. Foster & Jason R. Eckberg
Southern Nevada Water Authority
100 City Parkway, Suite 700
Las Vegas, Nevada 89106

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ABSTRACT

The Las Vegas Wash has changed greatly since baseline wildlife studies were conducted in the 1970's. The Las Vegas Wash Coordination Committee developed the Las Vegas Wash Wildlife Management Plan as a way to determine impacts on wildlife since the original studies. One of the recommendations of the plan was to conduct a small mammal study focusing on species that were not documented from 1998 to 2007. To meet this recommendation a small mammal study was implemented focusing on the marsh habitats of the Las Vegas Wash. Eight marsh areas along the Las Vegas Wash in Clark County, Nevada, were sampled for small mammals using Sherman live traps for a full year, so that monitoring occurred during all four seasons. A total of 588 captures were recorded over 1924 trap nights and represented ten different species. The little pocket mouse (*Perognathus longimembris*) was the only species captured in this survey that was not document in the 1970's survey. The current study revealed that marsh-woodland habitat abundance has declined for only two species, the western harvest mouse (*Reithrodontomys megalotis*) and the house mouse (*Mus musculus*).

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1.0 INTRODUCTION

The Las Vegas Wash (Wash) carries treated wastewater, storm flows, urban run-off and groundwater from the Las Vegas Valley to Lake Mead. Historically, this was a typical desert ephemeral stream, but as the valley's population grew the Wash became a flowing stream as a result of discharging wastewater flows into the channel (LVWCC 2000). Continually increasing flows and periodic flooding from storms has caused extensive erosion of the Wash's banks. In 1998, the Las Vegas Wash Coordination Committee (LVWCC) was formed to properly manage and protect the Wash. This group brought federal, state, local agencies, businesses, environmental advocacy groups, and citizen members together to address the degradation of the Wash. In 2008, the Las Vegas Wash Wildlife Management Plan (WMP) was approved by the LVWCC. This document included a series of recommendations that were organized into three objectives; protect and enhance wildlife habitats, increase environmental awareness of these resources in the community, and conserve the abundance and diversity of native wildlife species (Shanahan et al. 2008).

Bradley and Niles (1973) conducted baseline small mammal surveys for the different habitats that occur along the Wash. In the woodland-marsh habitat, Bradley and Niles (1973) listed the presence of western harvest mouse (*Reithrodontomys megalotis*) and the house mouse (*Mus musculus*). Since 1972, the habitats and topography of the Wash area has changed drastically (LVWCC 2000). Few small mammal studies have been conducted since the original baseline inventories (Shanahan et al. 2008) with none taking place specifically in marsh habitats. In 2002, a small mammal study in the upland vegetation of creosote bush, salt bush and salt cedar that surrounded the Wash was conducted as the first survey since 1972 (Larkin 2006). These surveys had limited sites in woodland-marsh habitat and although they documented house mouse presence, no western harvest mouse presence was recorded. In an attempt to conserve the abundance and diversity of native wildlife species, the WMP recommends monitoring wildlife that were not adequately inventoried from 1998 - 2007 (Shanahan et al. 2008).

This study specifically evaluated marsh habitats, resulting in a more complete and current inventory of the small mammal habitats along the Wash. The primary goal of this study was to characterize the small mammal community in marsh habitats and contrast the data with past efforts. In addition, environmental data regarding vegetation, open water, and weather characteristics were examined to determine if these variables help explain the presence of small mammal species captured.

2.0 MATERIALS AND METHODS

This study focused on marsh and riparian habits, but because of logistical simplicity, surveys were not just limited to these areas. Many areas had a very narrow strip of riparian habitat and then quickly changed into woodland species. These sites were labeled as woodland-marsh habitats. The surveys took placed from January 2010 through November 2010. Eight sites were chosen to represent the marsh habitats found in the Clark County Wetlands Park (CCWP; Figure 1). The sites were monitored once during each season (winter, spring, summer, and fall) for two consecutive nights. The survey dates were determined using the solstice and equinox dates as a

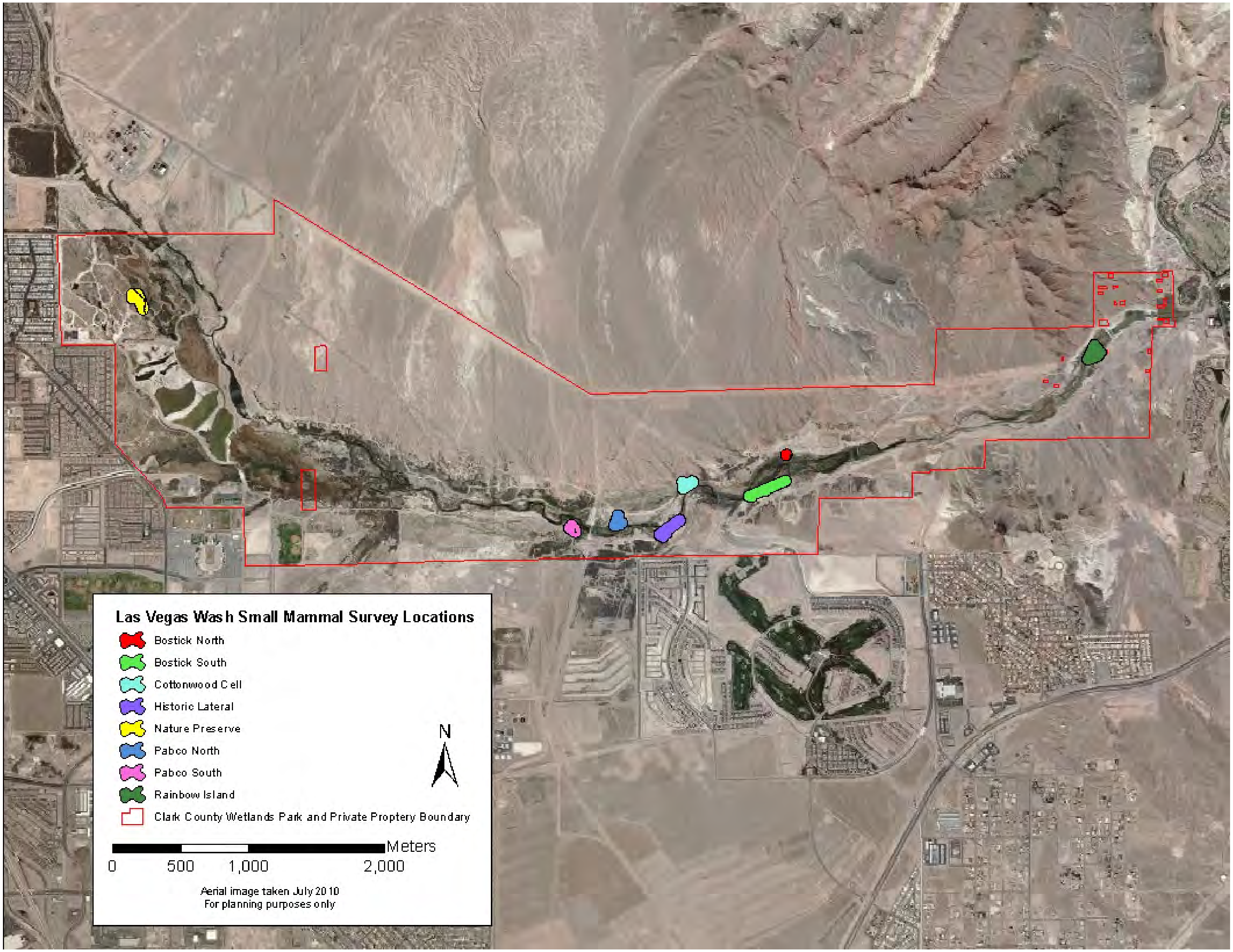

Figure 1. Small mammal survey locations within the Clark County Wetlands Park.

guide. So that monitoring was unbiased of seasonal changes, surveys were not conducted during months that the solstice or equinox occurred.

All eight sites differed in size, proximity to the Wash, vegetation richness and diversity, and human impact. Rainbow Island, Bostick South, and Bostick North were susceptible to flooding and flooding did occurr on all three sites within the timeframe of this survey. Bostick South and Rainbow Islands both had large Cottonwood (*Populous fremontii*) and Goodding's willow (*Salix gooddingii*), as well as dense stands of cattails and reeds. Bostick North was dominated by common reed (*Phragmites australis*) and cattails (*Typha domengensis*). Historic Lateral, Pabco South and Cottonwood Cell were within a close proximity to the Wash but did not often have flood impacts. Pabco South and Cottonwood Cell had a good amount of cover provided by mature cottonwood trees. Both of these sites had dense stands of common reed lining areas close to water. Historic Lateral had a very abrupt transition from marsh to woodland. This site has many Goodding's willows as well as dense grass stands along the water but this site also has dense stands of broom baccharis (*Baccharis sarothroides*) and quailbush (*Atriplex lentiformis*). The last two sites were without direct access to water. Pabco North is located on the historical flood plain of the Wash. Part of this site has dense stands of common reed that grow on the edge closest to the water but it has also been revegetated with inland salt grass (*Distichlis spicata*). Nature Preserve includes a small diversion of water from a wastewater treatment plant. This site also has common reed and cattails that grow on the water's edge, as well as large areas dominated by inland salt grass and mesquites (*Prosopis* sp.).

A transect method was used based off of a line configuration by O'Farrell (1994) to sample small mammals. Each site had two generally parallel lines with a maximum of two attached diagonal lines (Figure 2). The trapping array had a maximum of 40 Sherman traps per line. Traps were spaced approximately five meters apart. One parallel line of each array was located as close to the Wash channel as possible given vegetation density. Traps were baited with an oats and seeds mixture that was lightly coated with peanut butter (Harris 2006, Francl et al 2004, and Blaustein and Rothstein 1978). Traps were set in the morning a few hours after sunrise and left overnight. All sites were checked shortly after sunrise the following two days. During winter months, cotton balls were placed in traps to prevent mortality from cold exposure. Surveys were timed in coordination with the new moon.

Captured animals were processed immediately; this included recording the characteristic measurements such as the age, species, sex, reproductive status and weight of the animal. All data were recorded onto a data sheet as well as logged into a handheld Trimble GeoExplorer GPS unit using a data dictionary. On the first day all animals received a hair clipping close to the right hind leg (O'Farrell et al. 1994). Once they were processed, the traps were baited and reset. When documenting captures on the second day, all animals were examined for a hair clipping to determine if they were captured the previous day. If the animal did, it was recorded as a recapture. Field data were processed using Trimble Pathfinder Office and ArcGIS 10.0. Once uploaded, locations and data were spatially corrected.

Diversity was determined by the number of species caught during each season and at each site. The Simpson's Index of Diversity (1-D) calculation (Simpson 1949) was used to analyze diversity among sites (Larkin 2000).

Figure 2. Typical small mammal trap transect layout with 40 m buffer.

Relative abundance was calculated by the number of individuals/1000 trap nights so that data could be compared to Bradley and Niles (1973) data. Absolute abundance (i.e., a population estimate) was calculated from mark-recapture data using the Chapman population estimate (Bookhout 1996). This model was used because of the small sample size.

Vegetation within each sampling area was monitored for total vegetative cover, the relative cover of individual species within the area, and species richness. Random pedestrian transects were traversed at each sampling area to thoroughly document each species. After all species present in the area had been documented, the area as a whole, as well as each individual species, was given a cover class ranking (Table 1). Species were given a classification of forb/herb, graminoid, shrub, subshrub, or tree based on the USDA PLANTS Database (USDA, NRCS 2010). Diversity of vegetative species in each area was calculated using Simpson Index of Diversity (1-D; Simpson 1949). Wetland Prevalence Index (WPI) values from 1 to 5 were calculated according to Wentworth and Johnson (1986) using cover data for each site. Tiner (1999) refers to this as the "wetlandness" of a site with the likelihood that a site is a wetland decreasing as the WPI increases. WPI values are first calculated by attributing wetland indicator status (Reed 1988) values for each species on a site. Indicator values follow Eckberg (2011).

Cover Rank	Value Range	Midpoint
r	<<1%	0.1%
t	<1%	0.5%
1	1%-5%	2.5%
2	5%-25%	15.0%
3	25%-50%	37.5%
4	50%-75%	62.5%
5	75%-100%	87.5%

Table 1. Cover class ranks and corresponding cover ranges and midpoints.

CANOCO 4.5 was used to demonstrate which environmental factors had an impact on the presence of species detected and how strong any correlation was. Environmental data collected included temperature, recent rainfall, cloud cover, and wind. In addition, the combined vegetated, open water, and bare ground area for each capture location was quantified. ArcGIS 10.0 was used to create linear shapefiles for each transect array. Buffers of 40 m were then constructed from the combined transect area to represent the potential habitat of the captured small mammals. Within the buffer area, polygons were created around all vegetation, bare ground and open water using ortho-referenced aerial imagery of the study area taken July 2010. Total acreage and percentage of the total buffer area was calculated using the calculate geometry function within ArcGIS.

3.0 RESULTS

The year long survery resulted in 588 captures of ten different species (Table 2). Cactus (Peromyscus eremicus) was the most captured species throughout the study with a total of 405 captures. This was followed by house mouse which had 60 captures. The other target species, western harvest mouse had 37 captures. There were two Chaetodipus species identified, desert pocket mouse (Chaetodipus penicillatus) and Long-tailed pocket mouse (Chaetodipus formosus) with a combined 52 captures. The cactus mouse was the most captured species in all four seasons. For all species, summer had the most captures at three survey sites, while spring and fall had the highest captures at two sites each. The highest captures for Historic Lateral were during the winter. Combining all sites, summer sampling yielded the most captures having 177, spring and fall both had 155 captures, and 101 captures took place during the winter surveys.

Species	Bostick North	Bostick South	Cottonwood Cell	Historic Lateral	Nature Preserve	Pabco North	Pabco South	Rainbow	Grand Total
Ammospermophilus leucurus		3		4					7
Chaetodipus sp. †		2	9	8	13	6	5	9	52
Dipodomys merriami								1	1
Mus musculus	23	13	7		5	4	1	7	60
Neotoma lepida		1		1	2	1		4	9
Peromyscus boylii		3							3
Peromyscus eremicus	9	63	74	56	53	21	45	84	405
Peromyscus maniculatus		2	2		1				5
Reithrodontomys megalotis	4	6		6	10	3		8	37
Rattus ssp.	1					2		2	5
Unknown*		2		1		1			4
Total Captures	37	95	92	76	84	38	51	115	588
Species Richness	4	8	4	5	6	6	3	7	10
Diversity (D)	0.5571	0.5397	0.3408	0.4424	0.5663	0.6629	0.2157	0.4542	0.5067

† *Includes Chaetodipus penicillatus, C. formosus, and indistinguishable individuals*

* Individuals that escaped prior to identification

Table 2. Small mammal capture quantities by species and survey site.

Rainbow Garden Island was the most active site with 115 animals captured over the entire study. This site was the third largest in size (5.55 acres) and it had more than 10% open water and the second highest number of vegetation species. Bostick South had 95 animals documented and the second most captures. The acreage for this site was 7.63 and the largest area monitored during the study. This site also had the largest amount of open water (more than 13%) and the most open ground. Cottonwood Cell was the third most active site with 92 captures. This site greatly differed from the other two active sites: it had one of the lowest number of plant richness, was one of the smallest sites, and had one of the lowest amounts of open ground. Bostick North and Pabco North were the two least active sites, with 37 and 38 animal captures, respectively. Pabco North is more than twice the size of Bostick North, and it had the most vegetation species while Bostick North had the least amount of vegetation species.

For all sites combined, summer had the highest diversity and winter had the lowest. Comparing all sites over the entire study, Pabco North had the highest diversity with 0.6629 and Pabco South had the lowest diversity with 0.2157. The other six sites had a diversity index ranging from 0.3408 to 0.5663, not showing a significantly high or low diversity. When diversity was calculated by season for each site, the index numbers showed a clear fluctuation throughout the year. Most sites had the lowest diversity during winter and the greatest diversity during summer. Pabco North had a 0.859 diversity index during the summer survey. This was the highest diversity value documented for a single site during any given season. Pabco North, Cottonwood Cell, and Bostick South all had the lowest diversity index recorded during winter.

Bradley and Niles (1973) captured one species that this study did not, the little pocket mouse (*Perognathus longimembris*). In contrast, this study captured three species that Bradley and Niles (1973) did not; the brush mouse (*Peromyscus boylii*), deer mouse (*Peromyscus maniculatus*), and the desert pocket mouse. The relative abundance for most species increased from the baseline studies to the current study (Table 3). Only two species, the western harvest mouse and house mouse, had their relative abundance value decrease (Table 3).

Scientific Name	Common Name	Foster and Eckberg 2010 Capture (1833)	Bradley and Niles 1973 (5000)
Perognathus longimembris	Little pocket mouse		0.1
*Chaetodipus penicillatus**	Desert pocket mouse		-
*Chaetodipus formosus** (*Perognathus formosus*)†	Long-tailed pocket mouse		1.3
Chaetodipus spp.*	Pocket mouse species	24.55	
Dipodomys merriami	Merriam's kangaroo rat	2.18	0.33
Peromyscus eremicus	Cactus mouse	122.2	33
Peromyscus boylii	Brush mouse	0.55	-
Peromyscus maniculatus	Deer mouse	61.1	-
Mus musculus	House mouse	31.64	62.2
Neotoma lepida	Desert woodrat	4.91	2.3
Reithrodontomys megalotis	Western Harvest Mouse	17.46	47.5
Ammospermophilus leucurus (*Citellus leucurus*)†	White-tailed antelope squirrel	2.18	0.33
Rattus spp.°		2.73	
TOTAL		271.14	147.1

†Scientific name is parentheses indicate previous name used by Bradley and Niles (1973)

**Chaetodipus penicillatus or C. formosus, features of these two species were to similar to identify in the field*

°Rattus spp. Was either rattus rattus or rattus norvegicus

Table 3. Comparison of relative abundance (number of individuals/1000 trap nights) between Bradley and Niles and current study. Number of trap nights in parentheses.

Population estimates varied among seasons (Table 4). Three sites had no recaptures on the second day resulting in an inability to calculate population estimates for those sites. Although Bostick South had a recapture rate of zero in the winter, there were very few total captures so this population estimate stayed low. Pabco North and Bostick North both had no recaptures in the most active season. This resulted in large population estimates.

	Population Estimate			
Site	**Winter**	**Spring**	**Summer**	**Fall**
Bostick North	NA	3	142	41
Bostick South	3	46.5	37.86	45
Cottonwood Cell	18.25	32.6	59	18.6
Pabco South	NA	53	26.5	49
Rainbow	28.71	16.14	50	78.2
Historic Lateral	29.22	16.86	13	7.33
Nature Preserve	26	23	35.67	43.2
Pabco North	9	7	53	16.5
Pabco South	NA	53	26.5	49
Rainbow Island	28.71	16.14	50	78.2

Table 4. Population estimates by site and season for eight marsh sites along the Las Vegas Wash.

Trends in relative abundance and population estimates were generally similar. Rainbow Garden Island had a higher summer estimate and a lower fall estimate with the Chapman model. Nature Preserve and Pabco North both had spring estimates that were greater than the winter estimates when the Chapman model was used.

Vegetation data collection took place in August and September of 2010. All sites had very high total cover values (Table 5). All but one site had the maximum cover rank of five, Bostick North had a rank of four. All eight sites would be considered facultative wetlands using the WPI scale despite a wide variety of plant types and plant species richness (Table 5). The plant type composition varied greatly between sites; two sites were dominated by graminoids (grasses), one by shrubs, and the remaining five by trees.

House mouse, deer mouse, and long-tailed pocket mouse were associated more with sites that had a higher percentage of vegetated areas compared to sites with more bare ground and open water (Figure 3). However, the association isn't very strong. The remaining species were associated more with open water or bare ground. Cactus mouse and western harvest mouse were most associated with sites that had higher percentages of bare ground, but their association was very weak and would more accurately be described as having no preference in terms of site characteristics.

Western harvest mouse was most commonly captured in locations that had high amounts of graminoid species (Figure 4). Long-tailed pocket mouse was primarily captured where trees were dominant. Deer mouse, brush mouse, and house mouse were not associated with any specific plant type.

Site	Forb/Herb Cover (%)	Graminoid Cover (%)	Shrub Cover (%)	Subshrub Cover (%)	Tree Cover (%)	Species Richness	Diversity (1-D)	WPI
Bostick North	0.3	62.6	1.0	0.1	5.0	10	0.18	2.00
Bostick South	3.5	38.6	30.0	0.5	49.7	32	0.83	2.16
Cottonwood Cell	5.9	0.5	17.6	0.1	100	17	0.48	2.09
Historic Lateral	5.3	37.5	75.0	2.5	45.3	30	0.88	2.46
Nature Preserve	0.2	65.0	20.0	0.6	57.5	13	0.72	2.89
Pabco North	14.4	53.6	59.9	0.2	79.2	38	0.85	2.27
Pabco South	2.4	38.0	18.7	0.5	70.6	23	0.67	1.98
Rainbow Island	18.1	5.3	23.3	1.0	40.1	34	0.75	2.00

Table 5. Vegetation characteristics for small mammal capture locations along the Las Vegas Wash.

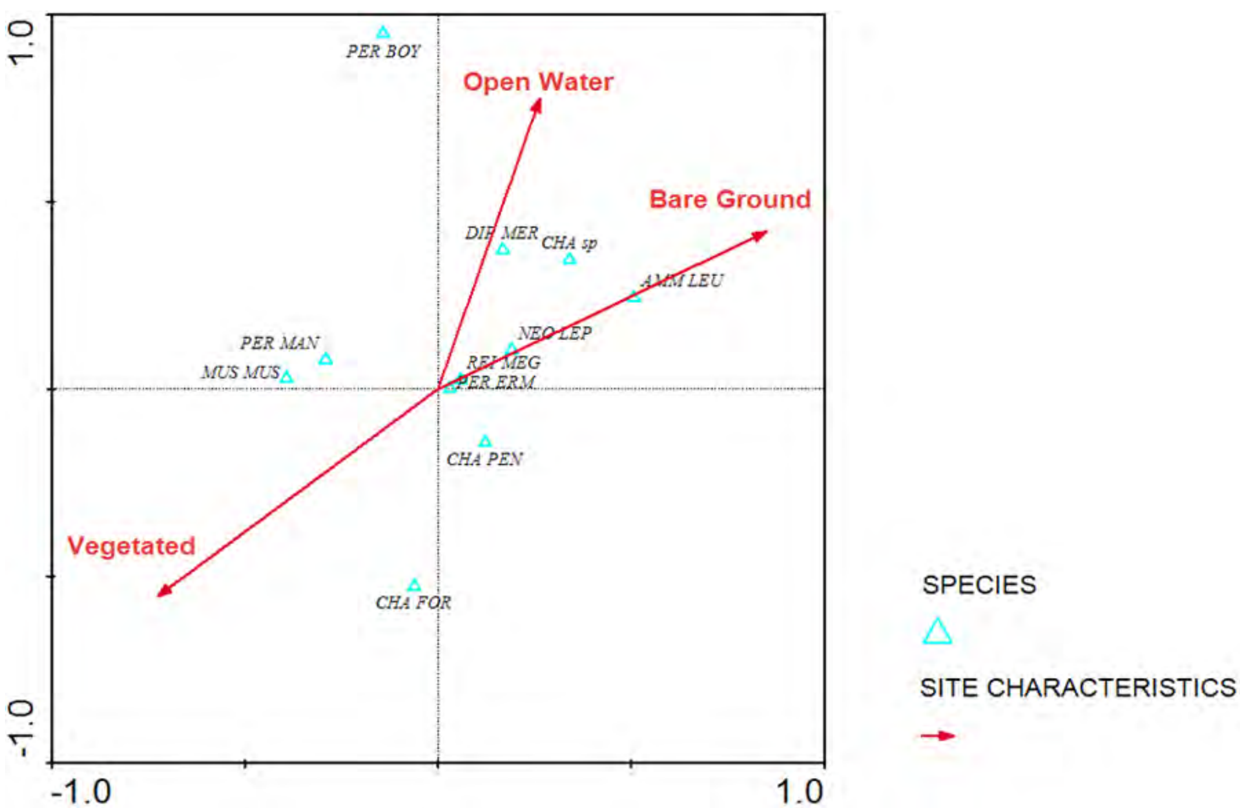

Figure 3. Biplot of data based on canonical correspondence analysis of small mammal capture data in association with site characteristics of survey areas.

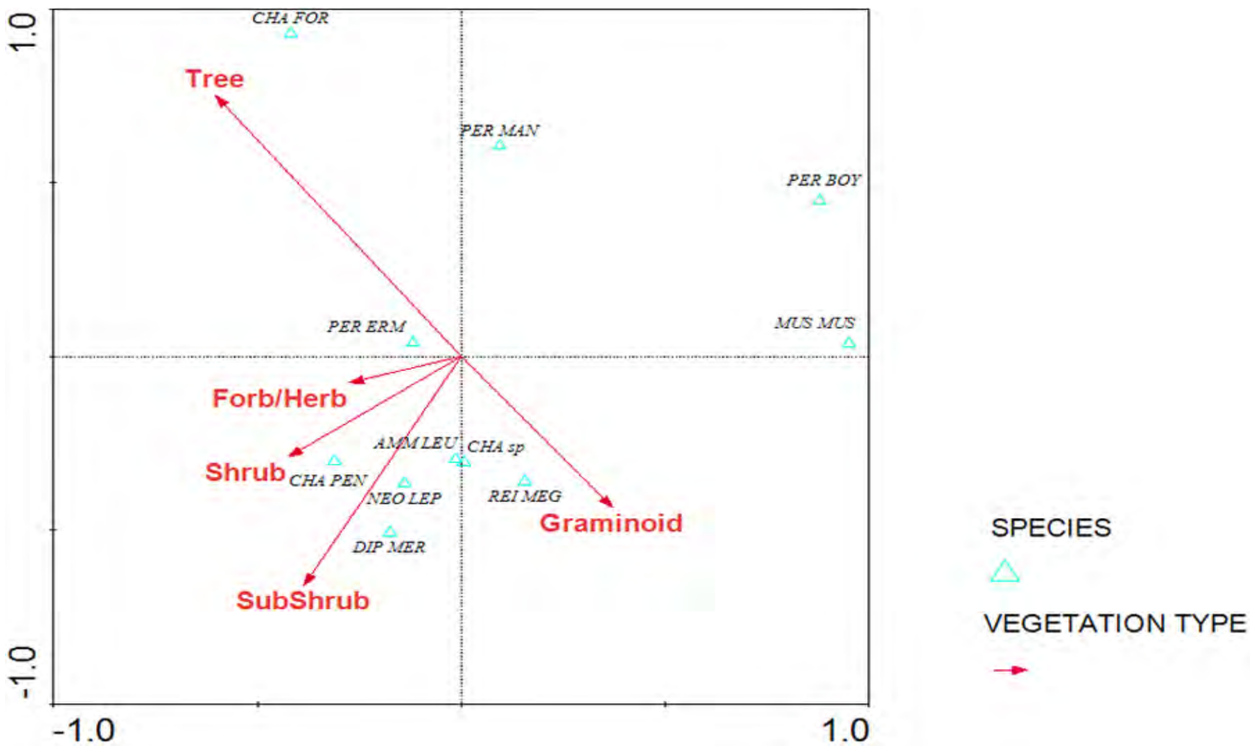

Figure 4. Biplot of data based on canonical correspondence analysis of small mammal capture data in association with vegetation inventory of survey areas.

4.0 DISCUSSION

Weather and vandalism problems may have impacted the survey results described here. Since the marsh areas are located in close proximity to the Wash, many of the sites were in flood prone areas. Storm events and the flooding that followed caused Bostick North to be submerged for an extended period of time. Therefore, Bostick North was unable to be surveyed during the winter season. It is therefore unclear whether or not flood inundation impacted facultatively riparian species as would be expected (Andersen et al. 2000)

Many of the traps were moved from the time of placement to the following morning when they were retrieved. Some of this can be attributed to predator activity by coyotes or raccoons as there were claw marks observed near the trap location. However, some traps were stolen, including 44 from Bostick South during the final survey of this site in the fall. In addition, some vegetation was necessary to be removed from Rainbow Islands to improve the efficiency of the Rainbow Gardens Weir. The use of heavy machinery to do this resulted in altering the topography of the site. This may have impacted the overall species abundance and diversity on this site.

Rainbow Island, Bostick South, and Cottonwood Cell were the three most active sites. These data were expected due to all three of these sites having well established mature marsh habitats. Bostick North was expected to have high capture rates because of its mature common reed, cattail population, and small amount of bare ground but instead had the least number of captures of all sites surveyed. The lack of open ground made it difficult to put a large amount of traps in this area. Bostick North had an average of 14 traps per survey night, compared to Bostick South which had an average of 54 traps per night. Pabco North had the second lowest animal activity with 38 captures. This site is four meters above the Wash channel on the historical flood plain and was chosen because it has a large number of plant species, including large inland saltgrass areas. However, this was also the youngest of all survey sites. The majority of the area was planted in the spring of 2009. In addition, it was the furthest from a water source making it more woodland than marsh. Nature Preserve also had a limited amount of water, but the small amount that was available was easily accessed by target species because the vegetation density was controlled near the water's edge. The inland saltgrass on this site was mature and formed dense stands as opposed to the more patchy areas at Pabco North.

There were two pocket mice identified (*Chaetodipus formosus* and *Chaetodipus penicillatus*). Field identification was not always possible due to a lack of distinguishing characteristics, so all *Chaetodipus* captures were combined for analysis purposes. This is consistent with Larkin (2006).

Although many species are not active in the winter, this study was conducted year round to understand the western harvest mouse, which is known to be active year round (Burt and Grossenheider 1980). There were five species that were active during the winter months: western harvest mouse, house mouse, cactus mouse, desert woodrat, and pocket mice. Cactus mouse and western harvest mouse were the two most active winter species. The winter season accounted for 17.17% of all captures that occurred during the study.

Larkin (2006) reported a decline in the relative abundance for house mouse and no activity for western harvest mouse when compared to Bradley and Niles (1973). The WMP says that these results may have not properly reflected the relative abundance of these two species because the studies conducted had limited survey sites in woodland-marsh habitat (Shanahan 2008). In an attempt to make this as similar to Bradley and Niles as possible, data for 2010 has been divided into original captures and recaptures (Table 3). This study focused on marsh and riparian habitats of the Wash in order to determine if the relative abundance of these two species has actually declined. By comparing the Bradley and Niles inventories with this study, it was confirmed that the relative abundance for *M. musculus* and *R. megalotis* has decreased. However, this study also affirmed that the western harvest mouse was still present at the Wash despite not being detected since 1972. In fact, all species documented by Bradley and Niles in 1972 have also been identified by either Larkin (2006) or this study. There were three species captured in this study that were not documented in the Bradley and Niles (1973) survey.

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