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Ecology, behavior and reproduction of an introduced population of Scaly-breasted Munias (*Lonchura punctulata*) in Houston, Texas

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Abstract - Results of a citizen-science project are reported to better understand potential impacts of an introduced population of Scaly-breasted Munias (*Lonchura punctulata*) in Houston, Texas. Houston records of munias accounted for 96% of all sightings in Texas. Nearly two-thirds of munias are found in urban habitats, with the remainder in more natural areas, especially parkland. A globose-shaped nest is built with young raised between early April - late September, and several nesting events are described. Munias are non-migratory, with flock size averaging 6.1 (range = 1-30), and three larger 'mega-flocks' are described. Munias are completely unaggressive towards other species and are observed foraging at feeders with 22 other species, of which 32% are other introduced species. The species most frequently associated with munias are House Finches (*Haemorhous mexicanus*) and American Goldfinches (*Spinus tristis*) which combined represented over one-half of all associations. Frequent behaviors included foraging (38%), vocalizing (24%), and perching (16%). The most common of the 25 species of plants used for perching are oak trees (*Quercus sp.*) and crepe myrtle (*Lagerstroemia sp.*), and 60% of the plants are native to Texas, while exotic plants are species both from within (24%) and outside (16%) the munia's native range. General biology is similar between Houston munias, native populations in Asia, and other introduced populations. The alien population in Houston is not firmly established beyond the Houston region in the state of Texas, does not compete with native species, and is not a serious agricultural grain pest, but should continue to be monitored.

An expanding population of an invasive exotic species can exert significant pressure on local ecology and native biota (Lockwood et al. 2007). However, some of these introduced populations can become integrated into a local community of organisms with no harm to the native species (Brooks 2013). A typical pattern of population establishment of introduced species is when cage birds escape or are released, then gather, reproduce, and undergo population expansion (Brooks and Page 2012). However, ecological traits of an introduced species and the native community, as well as abiotic factors and habitat, all may influence population dynamics of invasive species (Eguchi and Amano 2004).

The Scaly-breasted Munia (*Lonchura punctulata,* hereafter referred to as 'munia') is native to southern Asia (Pakistan through Vietnam, southeast China, and the Philippines) and is relatively inexpensive in the global pet trade (Long 1981, Brooks and Page 2012). Due to their popularity in the cage bird market, munias have been introduced to various regions of the globe, including

the United States (California, Florida, and Texas), numerous islands (Mauritius, Reunion, Seychelles, Tahiti, Yap, Palau, Hawaii, Jamaica, and Puerto Rico), archipelagos (Japan and New Zealand), and the east coast of Australia (Long 1981, Garrett 2000, Duncan 2009, Brooks and Page 2012, Pranty 2011). Introduced munias are especially numerous in river drainages (Garrett 2000) and are resilient in wet and mesic weather events (Duncan 2009). In their native range munias are also highly adaptable, occurring in a variety of human-modified habitats (Restall 1997). Consequently, it is likely that ecological plasticity of the munias played a strong role in its successful global invasions.

Munias have been considered a grain crop pest in southeast Asia (Ali 1953, Cheng 1963, Long 1981) and Hawaii where they are invasive (Caum 1933, Hawaiian Audubon Society 1975), as well as a potential competitive threat to native finches where they are invasive (Long 1981). In light of these potential threats, we are interested in determining whether munias are potentially harmful to the environment where they were introduced in Houston, Texas. Moreover, detailed research of introduced populations of munias are lacking, with the exception of studies on ecomorphological competition in Hawaii (Moulton et al. 1992) and reproduction and habitat use in California (Smithson 1997).

To better understand the impacts of introduced munia populations in the Houston, Texas region, this species is included as one of six targeted avian species of the Texas Invasive Bird Project (TIBP), a citizen-science study initiated in 2008. Herein we utilize data generated from TIBP to describe range dispersal, reproduction, ecology, and behavior in this introduced munia population, to determine whether there is currently any negative impact on native species or landscapes in the Houston region. We hypothesize this species is not currently an ecological threat in Houston.

METHODS

To document introduced bird species in the area, we carefully designed a questionnaire to be made available at several local bird watching clubs, annual bird watching festivals, circulated on Texas bird watching internet List-Servs, and posted at the website: hmns.org/InvasiveBirds.doc. The majority of the questionnaire respondents fell into two broad categories: (1) birdwatchers who are familiar with munias, and (2) naturalists who enjoy observing urban wildlife that visits neighborhoods and parks. In cases of wildlife that could not be identified, most of the respondents sought help on the internet which ultimately led to the munia photograph on the questionnaire. When returning the questionnaire, most respondents indicated they were enthusiastic about being able to identify the bird they saw.

Respondents seemed honest and conservative; if they did not know the answer to a given question they left it blank or stated they did not know. In most cases, respondents included voucher photographs and/or a written description of the birds and habitat to confirm documentation. We proofed the citizen-scientist data for accuracy to ensure that birds, plants, habitat, and abiotic parameters were accurately designated and identified by: (1) examining all photographs and (2) ground-truthing ~15% of the sites via direct visits. In some cases, we were able to obtain plant, habitat, and abiotic parameter data from submitted photographs if those portions of the questionnaire were left blank. In a few cases where plants were not obvious, we confirmed species designation with a museum staff botanist (N. Greig).

We tabularized results in a database for analyses. When responses were anthropomorphic, we interpreted the information accordingly (e.g., “a couple of birds popping food in the mouths of smaller brown guys” = “a pair feeding their young”). In cases where reports provided numerical data in feet or inches, we converted the data to m or cm. When numerical data were provided as a range, we used the average between the minimum and maximum (e.g., perched 3–5 feet = 4 feet = 3.3 m). We did not include insufficiently completed questionnaires in analyses.

Sampling dates spanned nearly seven years (June 2008 - February 2015), and information is still being collected for possible future analyses. Older dates preceding the initiation of the study (June 2008) were obtained from respondents and E-bird reports (eBird 2015).

For the distribution portion of the study, location coordinates were obtained using Google Earth, and each was digitized on a map using ArcGIS (2014). Each location was grouped by year and assigned a greyscale symbol, with earlier sightings shown in black to the most recent shown in white. Habitat association, nest biology and age structure were analyzed by combining collated data and photos. For flock dynamics, data on unusually large flocks ($\geq$ 50) were excluded from analyses and described separately since all but three flocks observed were $\leq$ 25 individuals. The large flock from West Houston contained two munias that presented with yellow bands on the right leg, which allowed us to address seasonality by accounting for their presence over time. Interspecific interaction and activity patterns were analyzed by collating data.

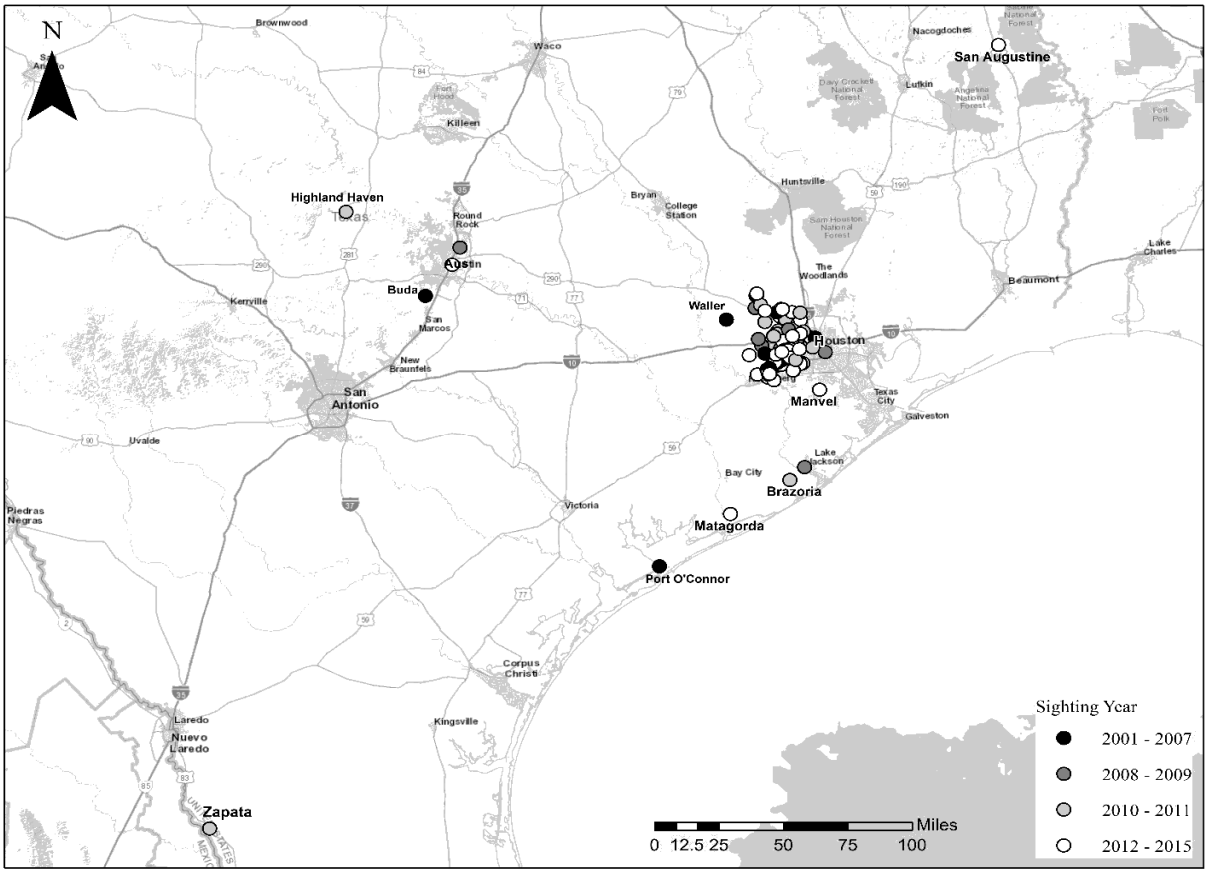

Figure 1 - Distribution of Scaly-breasted Munias in the state of Texas, data collected Oct 2004 - Feb 2015.

RESULTS

Distribution

Only 4% (N = 220 different sites) of all records are from other parts of the state outside the Houston area. These areas are centered around Austin (n = 4), the upper-mid Texas coast (n = 4), and single records near the Big Thicket and in the upper Rio Grande Valley (Fig. 1).

Munias were observed at 210 sites in the Houston area, mostly concentrated in the southwest region along the border of Harris and Ft. Bend counties (Fig. 2). Major reservoirs include northern Addicks Reservoir/Bear Creek Park (northwest, Fig. 2, inset 1), central Cullinan Park (southwest, Fig. 2, inset 2), and Willow Waterhole Greenway (southeast). The earliest recorded sighting (October 2004) was at Arthur Storey Park. Overall, it appears that the population is slowly moving northeast, towards sites closer to the city (Fig. 2).

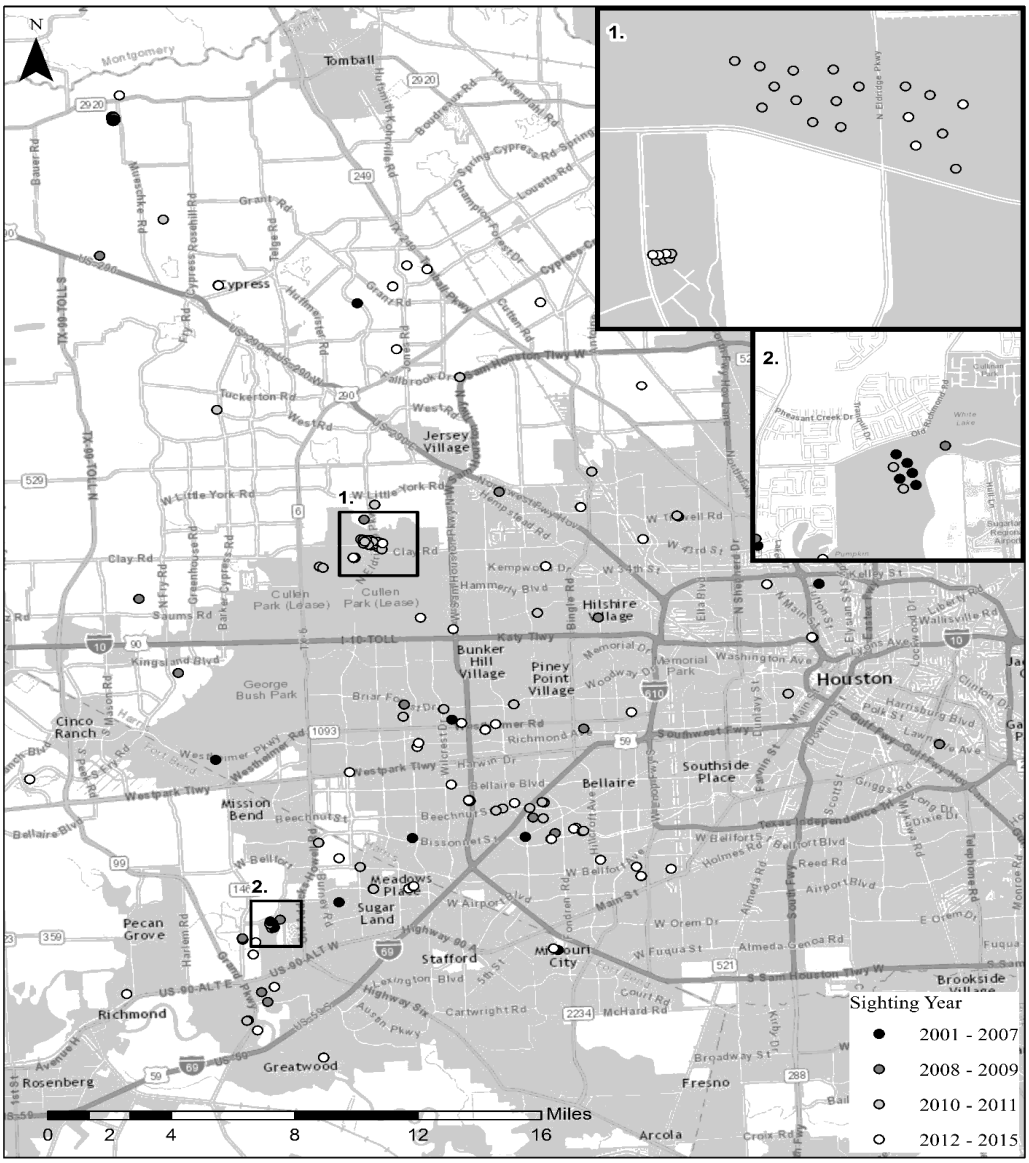

Figure 2 - Distribution of Scaly-breasted Munias within Houston, Texas (shaded) and surrounding areas

Habitat
The majority of munias (n = 470) are in urban habitats such as backyard gardens with bird feeders. Other sightings in more natural areas included vast areas of parkland (N = 282), including Kleb Woods Nature Preserve (n = 190), Addicks Reservoir/Bear Creek Park (n = 74), Arthur Storey Park (n = 10), and various reservoirs and drainage basins (n = 8).

Nest Biology
The munia nest is an enclosed globose ball made of plant material (e.g., leaves, twigs, grass, N = 4), has a mean diameter of 30 cm (range = 28-32.5 cm, N = 2), and height off the ground ranges 1.8-4.0 m (mean = 3.2 m, N = 4). Of 11 observations involving nesting activity, eight are of adults gathering nest material and nest building (early April to late September), two of an active nest (May and August) and one of a nearly abandoned nest (mid-September). Details of five different nests are described below (chronologically by month).

In June 2013 a pair of munias was observed building a nest at the entrance to Arthur Storey Park in southwest Houston. One bird was initially observed in a reed bed at the southernmost edge of the lake stripping off and carrying reed slivers to the nest. Both adults wove the slivers into the nest opening for at least 20 min to reinforce the 4 cm entrance hole located on the bottom half of the nest. The nest was a globose mass 30-35 cm diameter, comprised of non-leaf plant material such as dried reed slivers, grasses, and twigs. It was approximately 4 m above ground level in a small Yaupon tree that contained several Great-tailed Grackle (*Quiscalus mexicanus*) nests. One of the nests located $\leq$ 0.65 m from the munia nest was active with a grackle nestling. A Northern Mockingbird (*Mimus polyglottos*) was also seen entering and exiting the same tree.

In late July 2012 a munia was observed carrying nesting material to a nest at a semi-urban residence in Tomball, TX. The nest was located approximately 3.3 m above ground level in a tall pine tree (*Pinus sp.*).

In August 2006 a pair of birds built a nest in a Pineapple Pear tree (*Pyrus communis*) in a rural homestead yard in Waller County. The nest was a globose mass of small twigs built in the crotch of the tree approximately 1.8 m above ground level. The munias were observed on several occasions perched in the tree, as well as entering and leaving the nest area.

In September 2009 a pair of birds were building a nest in a Crepe Myrtle adjacent to a 0.2 Ha pond near an office park in West Houston. The nest was a 28 cm diameter globose mass of dried leaves from Crepe Myrtle and Juniper (*Juniperus sp*.), and the munias often perched 0.7-1 m above the nest. The height of the Crepe Myrtle tree supporting the nest was 3.8 m, with the base of the nest 3 m off the ground, and the thickest DBH of the tree 9 cm. After one week the nest was thought to be abandoned until a single bird was observed flying from the nest two weeks after the initial observation, although fledglings were never observed.

In late September 2011 a pair of munias were building a nest in a small Live Oak (*Quercus virginiana*) near a small cluster of strip-shops in semi-rural Sugarland. One of the birds was carrying a long blade of grass to a large globose nest.

Age Structure

Adult munias outnumber juveniles in 55% of sightings, juveniles outnumber adults in 32% of sightings, and adults and juveniles are in equal proportions in 14% of sightings (N = 22). During the year the number of juveniles slowly increased, beginning in June, until ratios of adults to juveniles are equal in the fall. There is a slight decrease in juveniles during November, perhaps accounting for younger birds adjusting to the first cold temperatures of the year. The ratio of adults to juveniles increased progressively from winter through spring until only birds in breeding plumage are observed by the beginning of the breeding season in April (Fig. 3).

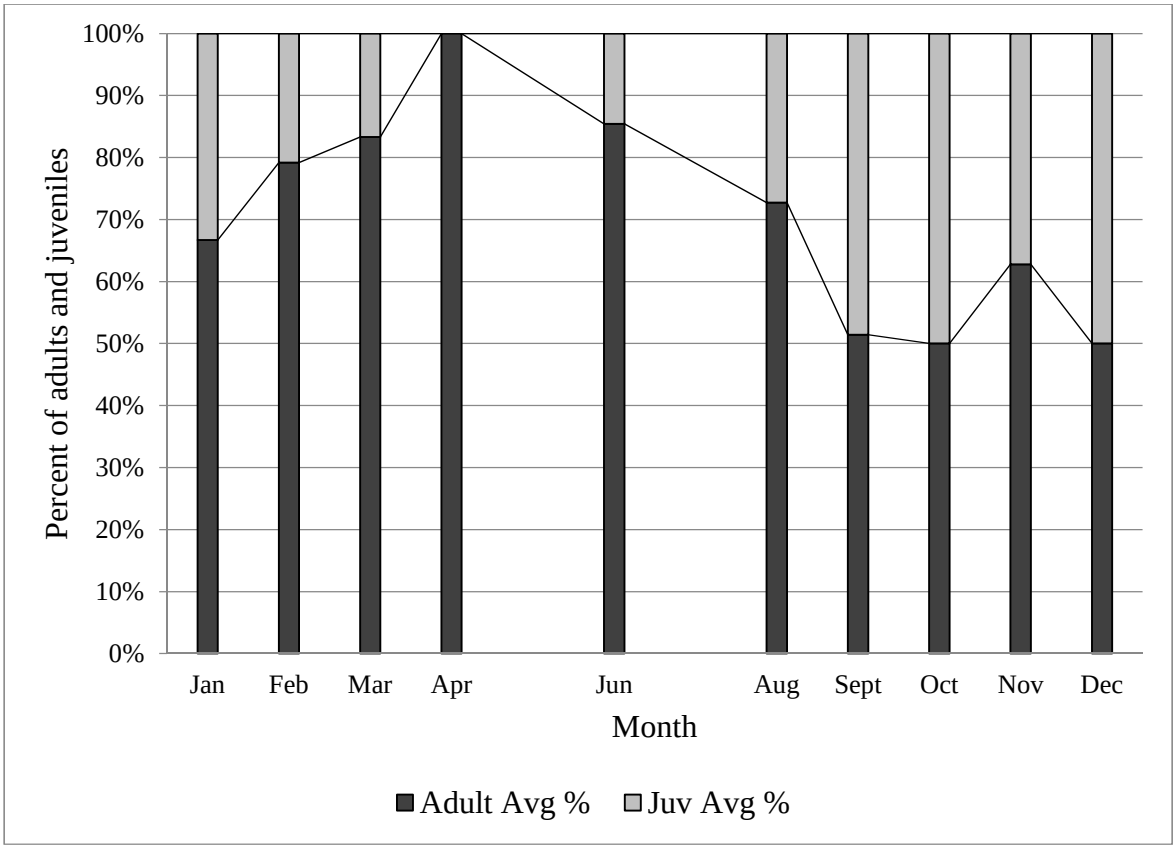

Figure 3 - Ratio of adult to juvenile Scaly-breasted Munias by month

Flock Dynamics

Flock size averages 6.1 birds/flock, (mode = 2, range = 1-30, N = 204). The largest flocks occur from mid-winter through early spring (January – March, Fig. 4). The peak observation month is March with a mean flock size of 8.8 birds. Data on unusually large flocks ($\geq$ 50 birds) were recorded in three situations, described below.

From August 2008–2011 a flock peaking at > 2000 individuals was recorded in a large grassy field in Southwest Houston. Several smaller groups comprising $\leq$ 25 juveniles and adults arrived throughout the day, accumulating into a very large mega-flock by the afternoon, and leaving during evening so that no birds remained in the area overnight.

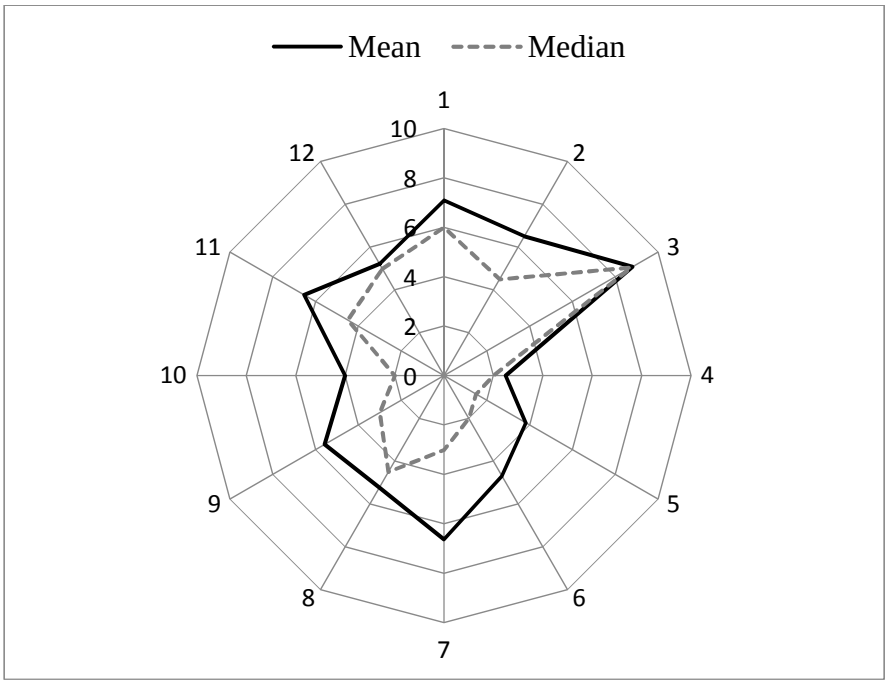

Figure 4 - Scaly-breasted Munia flock size by numeric month

A flock of 100-150 munias living with House Sparrows (*Passer domesticus*) was observed at a suburban apartment courtyard with various trees and shrubs in West Houston from March 2011 – February 2013. In an effort to deter persistence of the flock, the feeder and plants were removed and replaced with Italian Cypress trees (*Cupressus sempervirens*) in October 2012. Despite abrupt changes to foliage and feeder removal, the flock maintained population size until a domestic cat arrived in early 2013. The two banded individuals in this flock were present until the final observation of one in late April 2012. Both banded individuals apparently bred (juveniles were observed with them) and were present year-round as non-migratory residents.

A flock of 50-70 munias was observed in a suburban backyard habitat comprised of mature oak trees, Red-tip Photinias, and Wax-leaf Ligustrums (*Ligustrum japonicum*). The flock foraged on the ground surrounding an elevated feeder, at times with other species, including: Budgerigars (*Melopsittacus undulatus*), Mourning (*Zenaida macroura*) and White-winged (*Z. asiatica*) Doves, Northern Cardinals (*Cardinalis cardinalis*), House Sparrows, and Blue Jays (*Cyanocitta cristata*), none of which were aggressive toward the munias**.**

Interspecific Interactions

Munias are completely nonaggressive towards other species, and were observed foraging at feeders with 22 other species, of which seven (32%) are also introduced species (Table 1). In terms of functional guilds, these represent 12 species (55%) of primarily granivorous passerines and three species of doves (14%; Table 1).

Other species were observed foraging at feeders with munias on 96 occasions (Table 1). Species most frequently associated with foraging munias include House Finches (*Haemorhous mexicanus*) on 26 occasions (27% of all events), American Goldfinches (*Spinus tristis*) 24

occasions (25%), three species of doves (*Streptopelia decaocto*, *Zenaida asiatica*, and *Z. macroura*) 16 occasions (17%), and House Sparrows 10 occasions (10%; Table 1).

All species were mutually passive towards munias except for a single case of European Starling (*Sturnus vulgaris*), which caused munias to disperse when it approached the feeder, a behavior also elicited when Northern Cardinals approached the feeder area (Table 1). The three species of doves were occasionally agonistic at feeders, and munias would occasionally not approach feeders if House Finches or House Sparrows were present (Table 1).

Predatory species such as hawks are rarely seen in the vicinity of feeding munias. A single Cooper's hawk (*Accipiter cooperii*) was observed during two consecutive days at the same site, and a single Red-shouldered hawk (*Buteo lineatus*) was seen once. Although these raptors elicited no response from the munias, a single hawk (species unidentified) caused the munias to disperse once.

Table 1 - Species that are passive and agonistic towards Scaly-breasted Munias (*Lonchura punctulata*) when feeding

Common Name	Latin Name	N	Passive	Agonistic
dove (unspecified)		13	X	X
Eurasian Collared Dove[1]	*Streptopelia decaocto*	1	X	
White-winged Dove	*Zenaida asiatica*	1	X	
Mourning Dove	*Zenaida macroura*	1	X	
Budgerigar[1]	*Melopsittacus undulatus*	2	X	
Blue Jay	*Cyanocitta cristata*	1	X	
Black-capped Chickadee	*Poecile atricapillus*	1	X	
Tufted Titmouse	*Baeolophus bicolor*	1	X	
Eastern Bluebird	*Sialia sialis*	1	X	
Northern Cardinal	*Cardinalis cardinalis*	4	X	X[2]
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	1	X	
Chipping Sparrow	*Spizella passerina*	1	X	
Savannah Sparrow	*Passerculus sandwichensis*	1	X	
White-throated Sparrow	*Zonotrichia albicollis*	1	X	
Song Sparrow	*Melospiza melodia*	1	X	
Red-winged Blackbird	*Agelaius phoeniceus*	1	X	
European Starling[1]	*Sturnus vulgaris*	1		X[2]
House Finch	*Haemorhous mexicanus*	26	X	X[3]
American Goldfinch	*Spinus tristis*	24	X	
House Sparrow[1]	*Passer domesticus*	10	X	X[3]
Orange-cheeked Waxbill[1]	*Estrilda melpoda*	1	X	
Bronze Mannikin[1]	*Lonchura cucullata*	1	X	
Pin-tailed Whydah[1]	*Vidua macroura*	1	X	
TOTAL	**22 species**	**96**		

[1] Introduced

[2] Munias sometimes flew away when this species arrived

[3] Munias sometimes waited until this species left feeder before feeding

Activity Patterns

The most frequent behaviors are foraging/feeding (n = 210), calling/vocalizing (n = 130), and perching/resting (n = 86; Fig. 5), which account for 78% of observed munia activity.

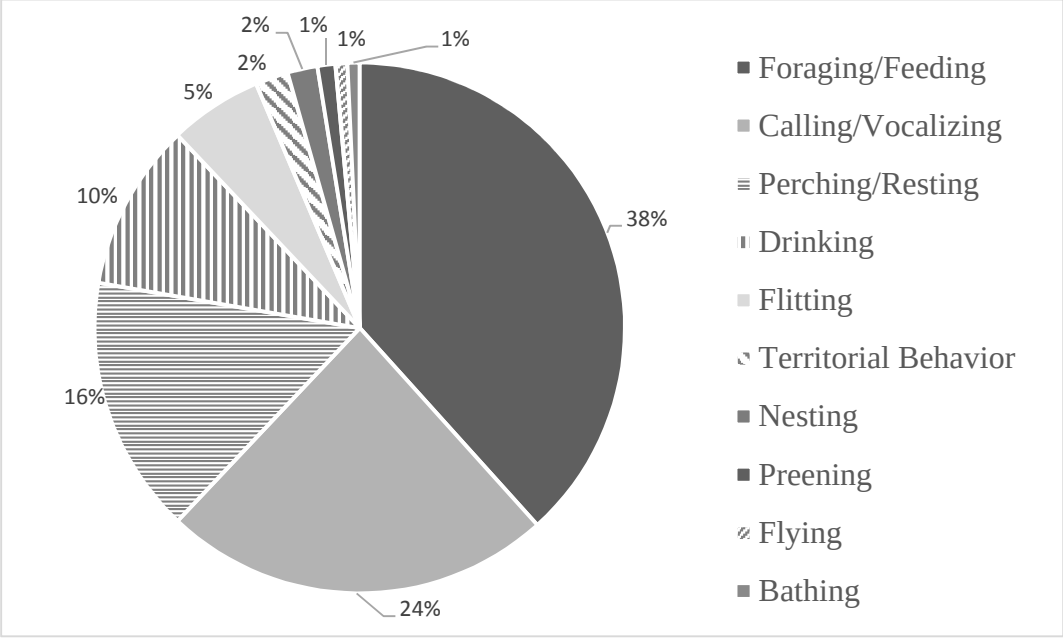

Figure 5 - Scaly-breasted Munia frequency of observed activity pattern in Houston, Texas

Foraging at birdseed feeders is the most frequent mode of foraging (n = 141 observations, 67%, N = 210). In terms of location at the feeder, feeder perches (n = 131, 93%) are used significantly more than ground-foraging at feeders (n = 10, 7%; X^2 = 102.85, df. = 1, P = 0.0001). Other records of food items include (n = 1 each unless otherwise noted): unspecified grass (n = 5), Bristle grass (*Setaria sp.*), Johnson grass (*Sorghum halepense*), Chinese pampas grass (*Miscanthus sinensis*), garden weeds, Hungarian broom corn (*Sorghum sp.*), sunflowers (*Helianthus sp.*; n = 2), and tree buds. Feeders are also the most frequently observed abiotic perch (84%, N = 38, Table 2).

Munias perched on 25 species of plants (Table 2). The most frequent species for perching are oak trees (*Quercus sp.*, n = 7) and crepe myrtle (*Lagerstroemia sp.*, n = 4). Of the 25 species of plants perched on, 60% (n = 15) are native to Texas, 24% (n = 6) are exotic species (primarily trees and shrubs) from within the range of the munia, and 16% (n = 4) are exotic species (primarily grasses) from outside the range of the munia (Table 2). Munias significantly preferred perching in native Texas vegetation than plants species introduced to Texas (X^2 = 4.16, d.f. = 1, P = 0.04). Mean perch height is 2.86 m, and the number of individuals (n = 21) that perched low in the tree (<5 m high) is significantly greater (X^2 = 48.21, d.f. = 1, P = 0.0001) than the number (n = 6) perching high (>5 m).

Table 2 - Biotic and abiotic perches of Scaly-breasted Munia (*Lonchura punctulata*)						
Latin Name	**Plant/Object**	**Origin**	**N**	**Height (m)**	**≤5 m**	**>5 m**
Salix sp.	Willow	N	1	1.07	1	
Pinus sp.	Pine	N	3	3.5	1	
Quercus sp.	Oak	N	4	4.5	1	
Quercus nigra	Water Oak	N	2	0.61	1	
Quercus virginiana	Live Oak	N	1	3.05	1	
Lagerstroemia sp.	Crepe Myrtle	EM	4	0.3	1	
Magnolia sp.	Magnolia	EM	2	7.62		1
Morus sp.	Mulberry	EM	1	3.96	1	
Carya illinoinensis	Pecan	N		2.13	1	
Pyrus communis	Pineapple Pear Tree	N	1	1.8	1	
Ilex vomitoria	Yaupon	N	1	3.96	1	
Vitex agnus-castus	Lilac Chastetree	EO	1			
Myrica cerifera	Wax Myrtle	N	1	3.05	1	
	dead tree		2	3.35	1	
Nerium oleander	Oleander	EM	1	2.74	1	3
Helianthus argophyllus	Silver-leaf Sunflower	N	1			
Helianthus sp.	Wild Sunflower	N	1	1.82	1	
Setaria sp.	Bristle Grass	N	1			
Hibiscus sp.	Hibiscus	EM	1	0.3	1	
Saccharum sp.	Cane	N	1			
Gossypium sp.	Cotton	N	1		1	
Ipomea sp.	Morning Glory	N	1		1	
Photinia x fraseri	Red-tipped Photinia	EM	1			
Sorghum halepense	Johnson Grass	EO	1		1	
Sorghum vulgare	Hungarian Broom-corn	EO	2	1.68	1	1
Miscanthus sinensis	Japanese Pampas Grass	EO	1	1.07	2	1
	Abiotic Perches					
	fencepost		1	1.82	1	
	feeder		32	1.3	1	
	birdbath		5	0.03	1	

N = Native Texas plant
EM = Exotic plant whose native range lies within the native distribution of the munia
EO = Exotic plant whose native range lies outside the native distribution of the munia

DISCUSSION

Comparisons with Munias in their Native Range

In their native range munias are found from 0 - 3000 m in scrubby grassland, rice paddies and other crops, forest edge, parks, and gardens (Clement et al. 1993, Payne 2010). Most Houston munias are observed in residential gardens, with the only other cases being populations in more rural parkland. Moreover, populations appear to be moving towards increasingly urban areas inside the city (Fig. 2). These results support the model of invasive species succeeding in human-altered environments where ecological niches are available that remain unexploited by native species (c.f., Lockwood et al. 2007).

Munias breed from April - June in regions such as Indonesia (Verheijen 1964), although they can breed during any month of the year considering the global natural population (Restall 1997, Payne 2010). Houston munias bred from April – September, reflecting the more temperate location of this population. The globose nests are typically found in trees and bushes 4-13 m high (Payne 2010). While the shape and architectural attributes of the nest for Houston munias are similar to the description of Payne (2010), the overall height of the nest in the tree is lower, never exceeding 4 m in height.

Clement et al. (1993) indicated munias are highly social, and frequently found in small flocks, although flocks of up to several hundred may occur. Similarly, Houston munias typically ranged in small flocks $\leq$ 25 individuals, although three much larger flocks were recorded. Benefits of group foraging, particularly decreased vigilance and enhanced seed search and handling time, often increase with flock size (Beauchamp et al. 1997).

Munias are present year-round in Houston, confirmed by the presence of two banded individuals for > 1 yr. Clement et al. (1993) also stated that munias are year-round residents in their native range. Two banded individuals recovered at 5 and 17 km in the Malay Peninsula suggest there may be very local seasonal movements tracking grain crop blooms (Payne 2010), however in Texas munias are not found in rural crop monocultures.

Munias are specialists of seeding grasses (Clement et al. 1993, Restall 1997, Payne 2010). Payne (2010) provided a list of several species of seeds consumed and indicated that *Spirogyra* algae and small insects may be taken as well. Similarly, Houston munias are observed foraging in various grasses (exclusive of offered bird seed) in most foraging observations.

Houston munias used a diverse array of plants as perches, and significantly preferred perching in native Texas vegetation than plants species introduced to Texas, including six species found in their natural range. These findings corroborate those of Sharma et al. (2004) that munias in India adapt quickly and successfully to urbanized habitat, and prefer nesting in introduced trees in urban areas more than native trees in natural habitats.

Comparisons with other Introduced Populations of Munias

As with Houston munias, other introduced populations are found in residential areas, including Florida (Duncan 2009), California (Smithson 1997; Garrett 1998, 2000), and Australia (Whatmough 1981, Jones and Wieneke 2000). Although fewer Houston munias are found in urban parks and flood basins, these habitats are also shared with munias in Hawaii (Moulton et al. 1992) and California (Smithson 1997, Garrett 1998). While Collins (2015) noted a proclivity for drainage ditches and retention ponds, these habitats were only recorded for Houston munias on four and two occasions, respectively.

Nesting in California is noted from February - November (Smithson 1997), whereas in Houston munias bred from April - September. Houston munias nested in tree species from their native range, as well as species of trees from Texas and Europe. In California most nests are in pine trees, but also in other exotic species of trees (Smithson 1997). While the nest structure is similar between California (Garrett 1998) and Houston munias, in California the mean nest height is overall higher than in Houston.

In contrast to Houston munias, those in Oahu are more common during summer than winter due to more resources available during summer (Moulton et al. 1992). Nonetheless naturally occurring populations of munias are year-round residents, concordant with the finding of Clement et al. (1993).

As is the case with munia populations in Houston, those in Hawaii (Moulton et al. 1992) and California (Smithson 1997) fed exclusively on grass seeds, as well as commercial bird seed provided at feeders (Garrett 1998).

Are Introduced Munias a Threat in Houston?

In southeast Asia munias are known as 'rice birds' and are used by Buddhists for religious purposes (Clement et al. 1993). In Houston they are often used during Asian religious ceremonies such as weddings, where large numbers of the birds are released instead of throwing rice (Collins 2015). It is probable that munias in other parts of the state are the result of similar releases.

The introduced populations may be cyclic, where numbers will build up only to decline during a hard freeze (Restall 1997). Duncan (2009) noted that the population in Pensacola, Florida has survived at least two Category 3 hurricanes with winds nearly 200 km/hr, as well as several freezes, including temperatures below 0^0 C. Pensacola is about 1^0 north of Houston, and has fairly mild winters, often freezing only once or twice per winter for $\leq$5 hr/night. Consequently, the deaths due to freezing described by Restall (1997) do not occur in Houston and the population is likely expanding.

Long (1981) suggests invasive munias could be a serious threat to numerous species of endemic Estrildid finches, especially in Australia. In Houston however, there are no native Estrildid finches or other avian species with a similar niche (i.e., small granivore occupying weedy fields low to the ground), perhaps part of the reason the munias are so successful in this region. Agonistic aggression was never witnessed towards other species at feeders in Houston, likely owing to the small size and non-aggressive nature of the munia.

Historically munias in their native range were considered primarily rice and other grain crop pests in China, India, and the Philippines (Ali 1953, Cheng 1963, Long 1981). Although munias were formerly considered a pest on rice and sorghum crops in Hawaii (Caum 1933, Hawaiian Audubon Society 1975), this is no longer the case since these crops are not grown as frequently (Long 1981). While Garrett (1998) identifies munias as a potential grain pest threat in California, he provided no data to demonstrate this. Moreover, other introduced munia populations are not currently identified as a potential threats (e.g., Eguchi and Amano 2004, Duncan 2009, Pranty 2011). In Houston, munias are mostly restricted to residential regions and none are observed in monocultures of grain crops. Therefore, it is unlikely that munias could be currently considered an agricultural grain pest.

Munias have not exploded in other regions of the state, and closely related species such as Bronze Mannikin (*L. cucullata*) are not nearly as abundant and have already experienced a population crash since the publication of Brooks and Page (2012, Brooks unpubl. data). Houston

munias are not known to outcompete populations of native birds, or deplete native plants for consumption. The leading factors attributing to the success of *L. punctulata* in the Houston region are likely non-prolonged freezing temperatures combined with the prevalence of feeders (Brooks and Page 2012). Diminishing the number of active feeders would likely diminish expansion of the current munia population.

Careful monitoring has been recommended for other invasive species in the region (e.g., Callaghan and Brooks 2016). Although it appears that the introduced Houston munia population is not currently a threat, they should be closely monitored in light of potential grain pest issues.

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