

Changes in habitat use of American White Ibis (*Eudocimus albus*) along an urbanization gradient in South Florida, U.S.A.

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Background

Degradation of important habitats and natural resources (such as breeding habitats, prey items) following alteration can influence wildlife to seek out alternative habitats. Urban areas with water features in contrast to more natural wetlands complexes can serve as refuges for some species by offering resources that may be difficult to find in natural areas, such as reliable food, water, and shelter.^{1,2} However, individuals using urban resources may experience:

- polluted or nutritionally deficient water and food^{3,4}
- close and frequent contact with con- and heterospecifics^{3,4}
- introduction of novel parasites^{3,4}
- increased reliance on urban resources and reduced use of wildland resources^{5,6}
- abandonment of migratory behaviors and decreased movements across the landscape.^{5,6}

Increased use of urban resources, in terms of intensity of use or number of individuals, can increase risk of negative effects for a population as more individuals are in lower health and the potential for transmission of pathogens from localized populations increases.

The American White Ibis (*Eudocimus albus*; hereafter Ibis) is a wading bird commonly found in the Everglades and surrounding wetlands. Year-round they require tree islands for roosting and shallow water with dense prey populations for foraging.^{1,2} Their foraging requirements are further restricted while breeding as they must primarily feed in freshwater to suit the needs of their young.⁷ Exhibiting nomadic behaviors, Ibis unpredictably and readily abandon their home area throughout their lifetime in search of foraging conditions ephemeraly provided by wetland habitats.^{2,8} However, their populations have been impacted by wetland degradation, demonstrated by reduced populations in the Everglades region, increased dispersal to other regions in their range, and recent use of urban areas.^{9,10} Ibis using urban areas for foraging and/or roosting have been recorded to have increased site fidelity to urban foraging areas and a higher prevalence of *Salmonella* bacteria than their wetland counterparts.

By understanding the intensity of urban resource use and the associated movement patterns, we will better understand its consequences on the health and ecology of urbanizing populations.

Research Question



Figure 1: Ibis with GPS transmitter

What are the effects of urban resource use on the movement behaviors of Ibis in South Florida, U.S.A.?

Hypothesis:

Ibis spending greater amounts of time in using urban resources will exhibit reduced movement behaviors, specifically:

- Smaller home ranges
- Greater site fidelity
- Reduced use of wetlands during breeding seasons

Methods

Ibis were captured and fitted with GPS transmitters at 11 sites within Palm Beach County, Florida (Fig 2).

GPS Tracking: Birds for which the transmitter, aluminum band, and harness is <3% of their body weight received an Ecotone GPS-GSM loggers using a backpack style harness that collect ≤12 locations per day at 2 hour intervals. Locations are downloaded to the Ecotone server via cellular networks. Before analysis, locations are filtered to remove erroneous locations and equalize sampling effort across individual birds.

Roost vs. Daytime Habitat Use:

- Roost locations occur while birds are typically inactive (approx. 18:00 -7:00 EST). Other locations are coded as daytime.
- habitat type was derived from 2011 National Land Cover Data (NLCD) was compiled into 4 classes (Urban, Wetland, Agricultural, and Other)
- Percent of each habitat type (habitat use) for each bird location was derived for a 120x120m window to account for GPS imprecision.

Space Use:

- **Home Range Area** was calculated using locations from December 2015 to February 2016 to create 99% Kernel Density Estimates (KDE).
- **Site Fidelity** was assessed using the 50% KDEs of daytime locations to define each bird's activity center(s), the number and size of which were compared across birds.

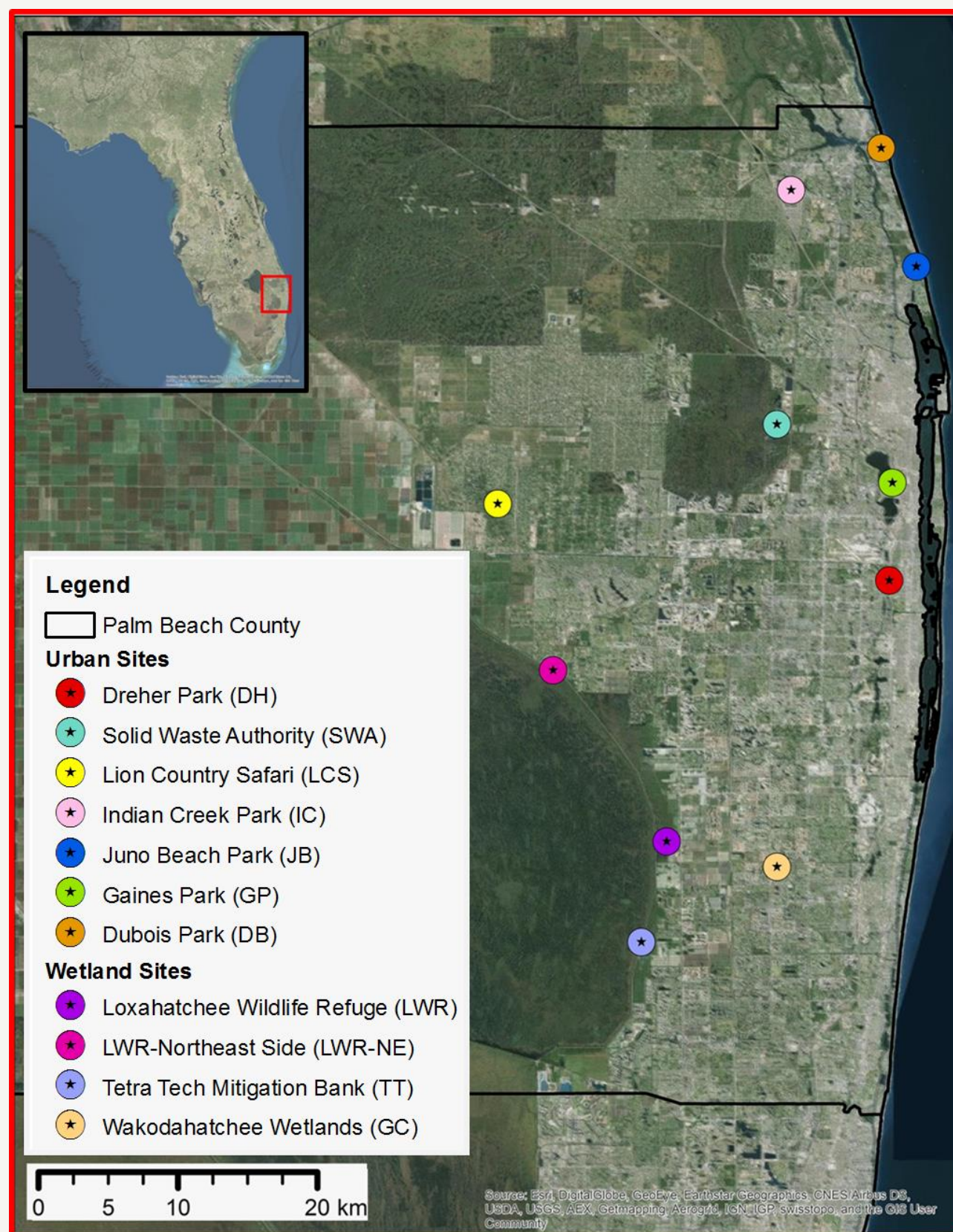


Figure 2: Capture locations in Palm Beach County, FL.

Current Progress: Winter 2015 Data

GPS Transmitters: In October-November 2015, 15 GPS transmitters were successfully deployed in urban (n=13) and wetland (n=2) capture sites. Filtered location data had approximately 595 locations per bird (min: 390, max: 723; Fig 3).

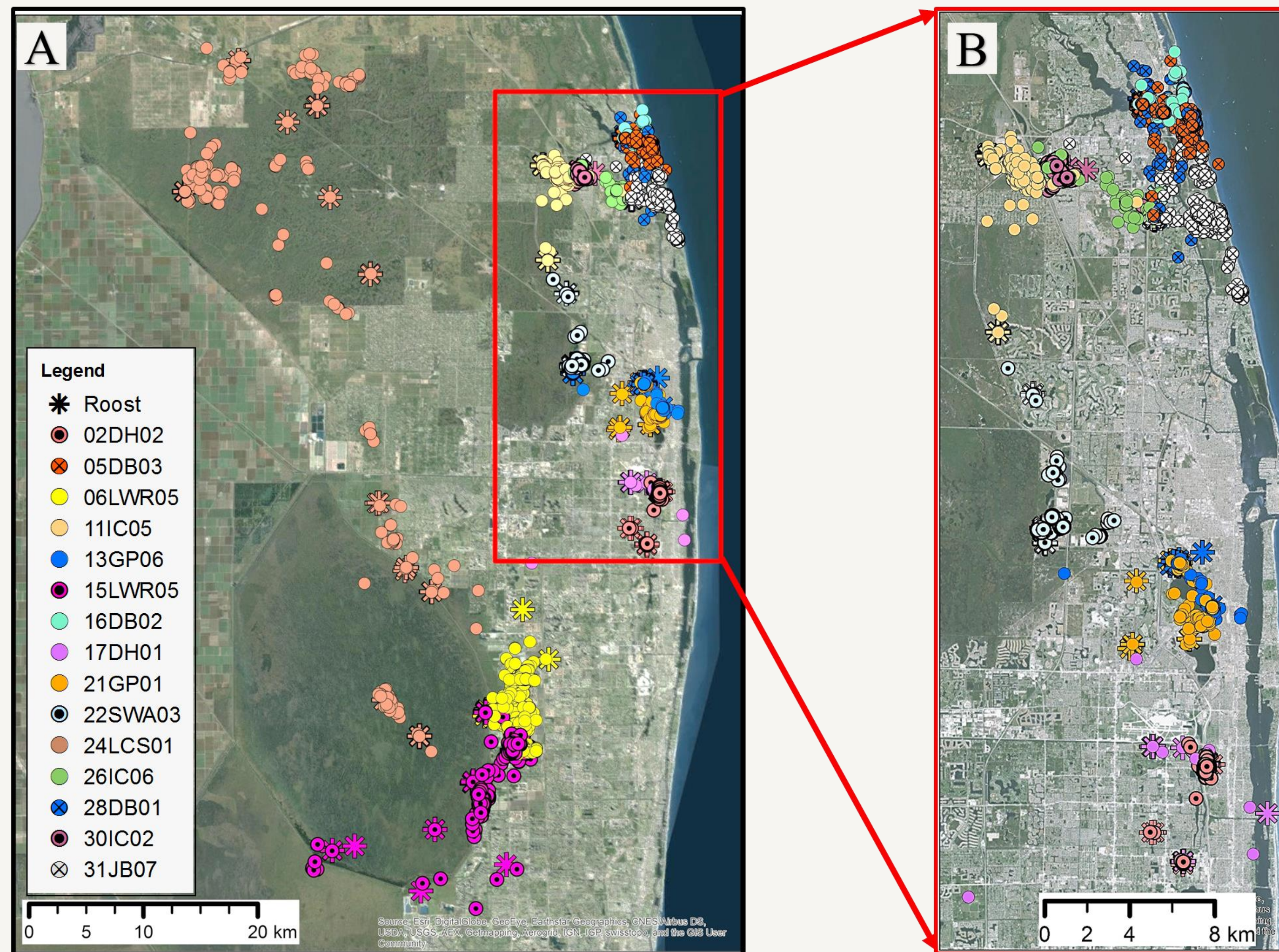


Figure 3: Ibis Winter (December 2015-February 2016) Locations:

- Daytime (circles) and roost (asterisk) locations are displayed to show the movements of GPS tagged Ibis during the Winter season. Each color represents an individual bird with a code corresponding to capture site. The locations for birds captured at LCS and LWR are more widespread and occupy less urban development than birds captured at other sites.
- Ibis displayed within the inset occur more often in urban areas. Locations for these birds overlap more frequently and occur in smaller clusters than locations of birds spending more time in non-urban areas.

Roost vs. Daytime Habitat Use: Wilcoxon signed rank tests showed that habitat use differed between roost and daytime activity for all land use classes (Urban: p<0.01, Wetland: p<0.01, Agricultural: p<0.01, Other: p<0.05). Most birds increased their use of “Wetland” and “Other” areas from daytime to roosting (Fig 4).

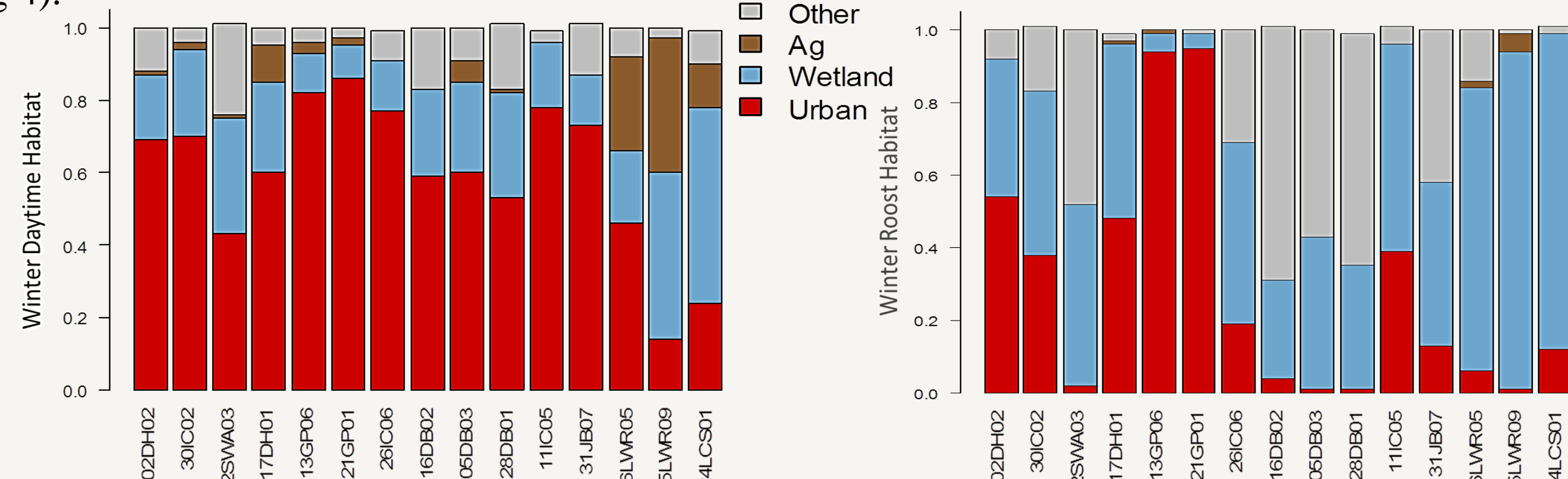


Figure 4: Winter habitat use varied between daytime and roosting. Birds are arranged in order from smallest home range to largest home range based on 99% KDEs and show that birds using more urban habitat (red) have smaller home ranges than birds using more wetland habitat (blue) during the day.

Space Use:

- **Home Range per Individual:** Home range sizes (HR) ranged from 0.43 km² to 849.5 km² (GM: 5.68 km²).
- **Site Fidelity:** Activity centers (AC) encompassed 0.45% to 15.51% of total home ranges (GM: 2.76%). The ratio of 50% KDE to 99% KDE is an indication of how large the AC is with respect to HR size. This is a measure of site fidelity as smaller percentages represent greater amounts of time spent in a smaller portion of the HR.
- **Relationship to Habitat Use:** Pearson's correlation tests were used to examine how space use is related to habitat use. Log Home range size was significantly correlated with urban use during the day (cor=-0.61, p<0.05), wetland use during the day (cor=-0.62, p<0.05), and wetland use during roosting (cor=-0.65, p<0.01). Site fidelity was significantly correlated with wetland use for roosting (cor=0.54, p<0.05).

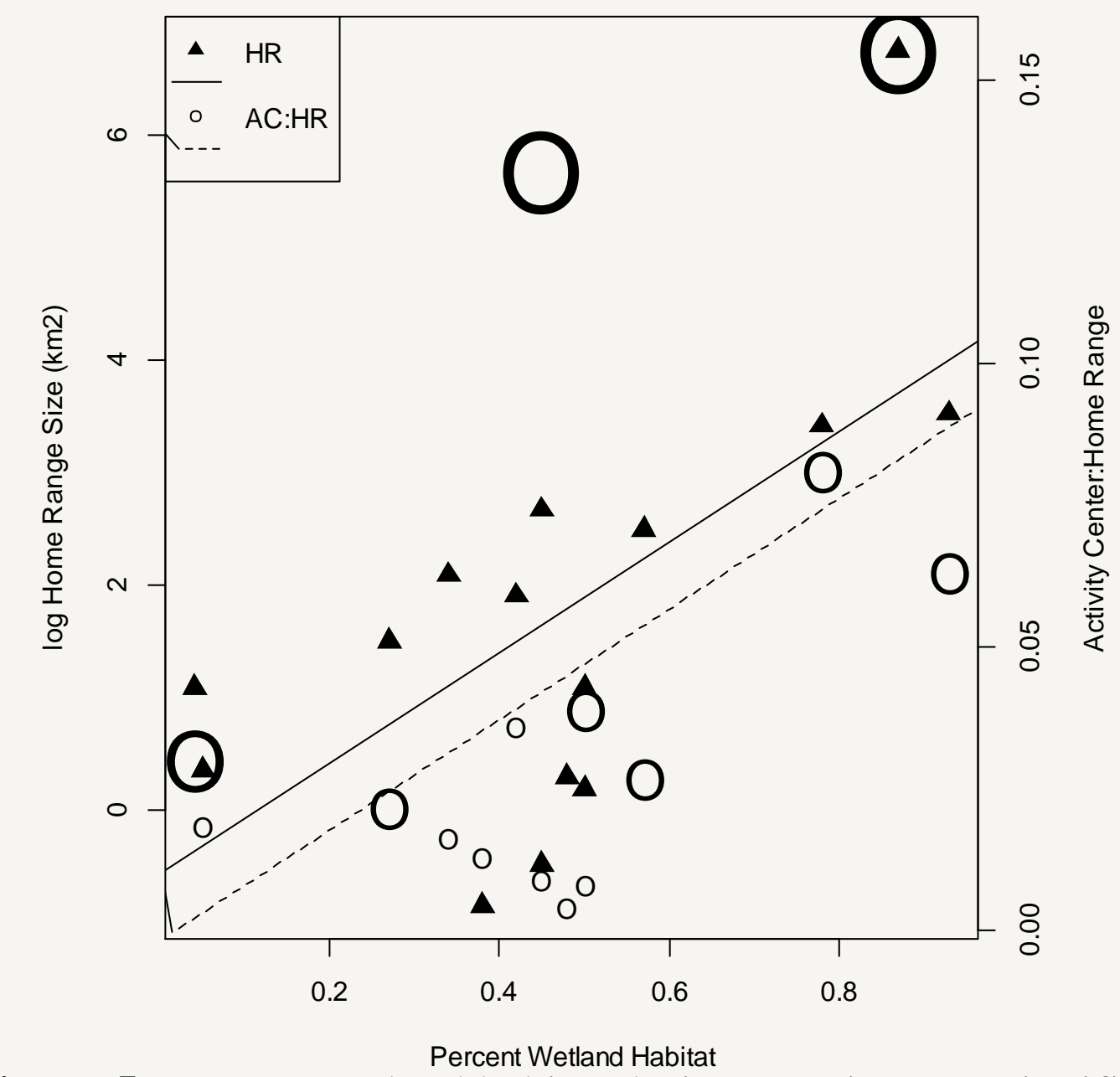


Figure 5: Percent wetland habitat during roosting was significantly related to both home range size and site fidelity. Here, triangles and the solid line (r²=0.42) show the relationship between log HR and wetland use. Circles and the dashed line (r²=0.29) represent site fidelity as the ratio of AC to HR. Circle sizes reflect the number of ACs from 1-4. Positive trends exist between wetland use for roosting and reduced site fidelity and larger home ranges.

Discussion

Ibis using greater amounts of urban habitat during the day have smaller home ranges and greater site fidelity. Birds with larger home ranges spend more time in wetland and agricultural areas. Agricultural lands are an anthropogenic land use, but may serve as a non-urban resource for non-urbanized Ibis when wetlands are insufficient implying the importance of an urbanization gradient from dense urban areas to wildland, or human-influence free, wetlands.

However...

- The current sample size is too small to adequately compare urban vs wetland using birds.
- Only a single season is represented, which may not be representative of Ibis behaviors throughout the year.

Upcoming Results

Incoming Data:

An additional 17 transmitters were deployed in February-March 2016 (Urban: n=5; Wetland: n=12), while previously deployed transmitters have continued collecting data. This data will allow us to compare habitat use and movements between birds using wetland habitats, urban habitats, or some combination of habitat types in future analyses. We will also be able to assess how habitat use and movements change throughout the year in response to seasonal needs.

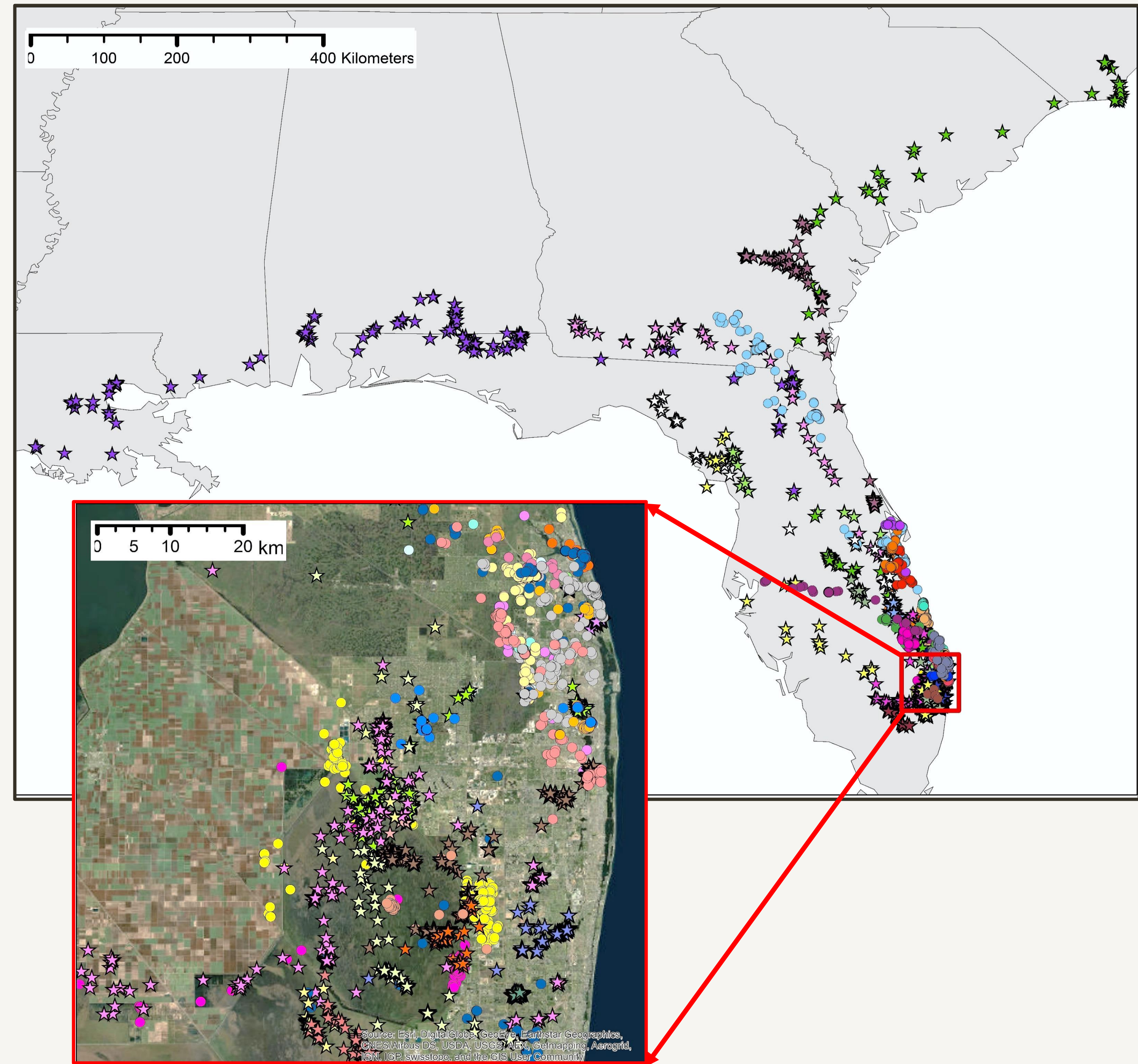


Figure 5: Ibis Spring (March – May 2016) locations:

Each color represents an individual as previously reported with stars indicating transmitters deployed in February and March. Many Ibis appear to exhibit dispersal patterns typical of the breeding season onset, leaving the Palm Beach Co. area to go northward. However, some travel long distances while others stay relatively sedentary. Future analyses will explore these behaviors.

Future Directions

We will continue to use this data to:

- Build resource use and movement statistics for additional seasons.
- Better understand the role of an urbanization gradient related to Ibis habitat use
- Improve our understanding of Ibis movements across the Southeastern region.
- Study the impacts of anthropogenic resource use on the ecology of the South Florida Ibis population.

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