How urbanization and diet influence coyote behavior

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Coyote (*Canis latrans*)

Coyotes are the most common wild *Canis* in North America

Medium-sized
Range 7 – 20 kg

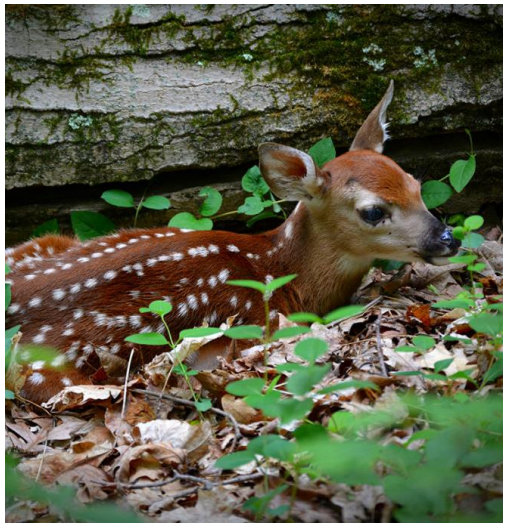
Coyote (*Canis latrans*)

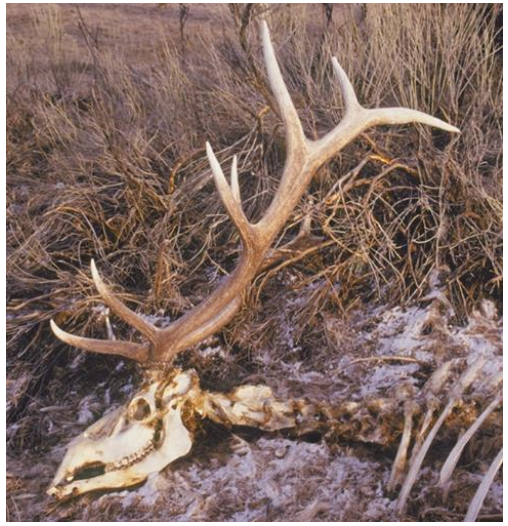
Coyotes are generalists

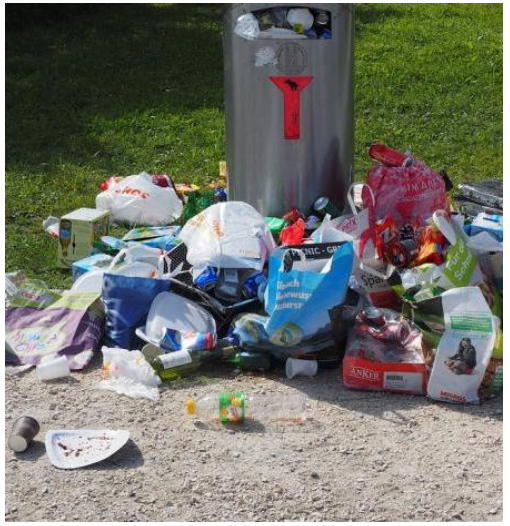
Plant and animal material

Hunt and scavenge

Anthropogenic food







Coyote (*Canis latrans*)

Territorial

Social
-family groups

Coyote (*Canis latrans*)

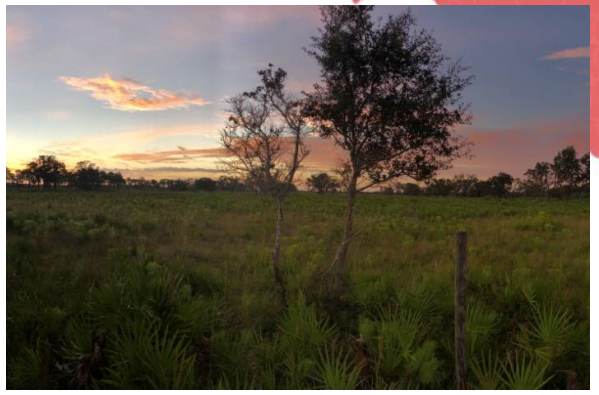
Historically associated with open landscapes

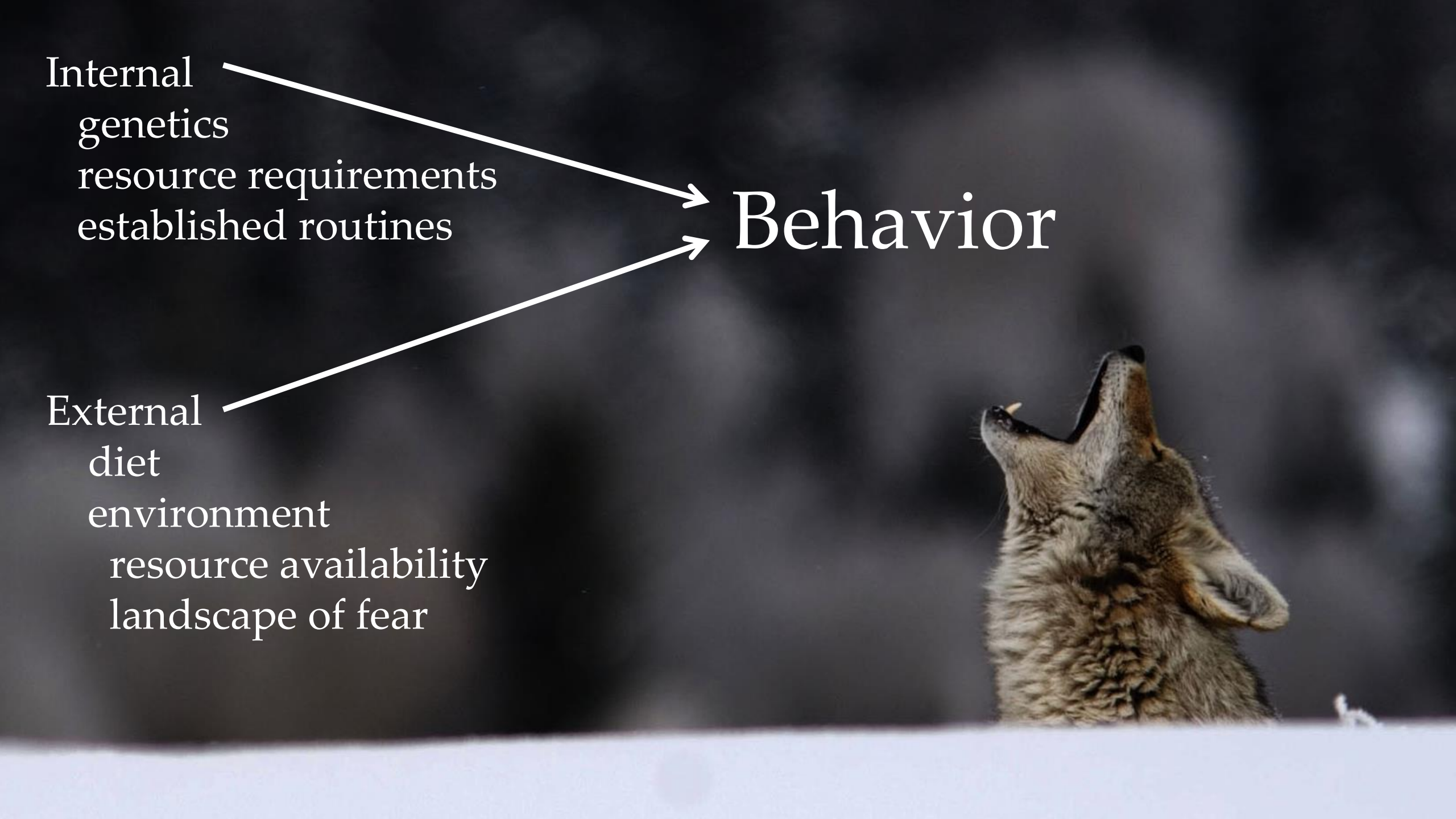
Ecologically similar to golden jackals

Coyote range expansion

Hody, J. W., & Kays, R. (2018). *ZooKeys*, (759), 81.

Coyotes now persist in many different landscapes




Internal
genetics
resource requirements
established routines
Behavior
External
diet
environment
resource availability
landscape of fear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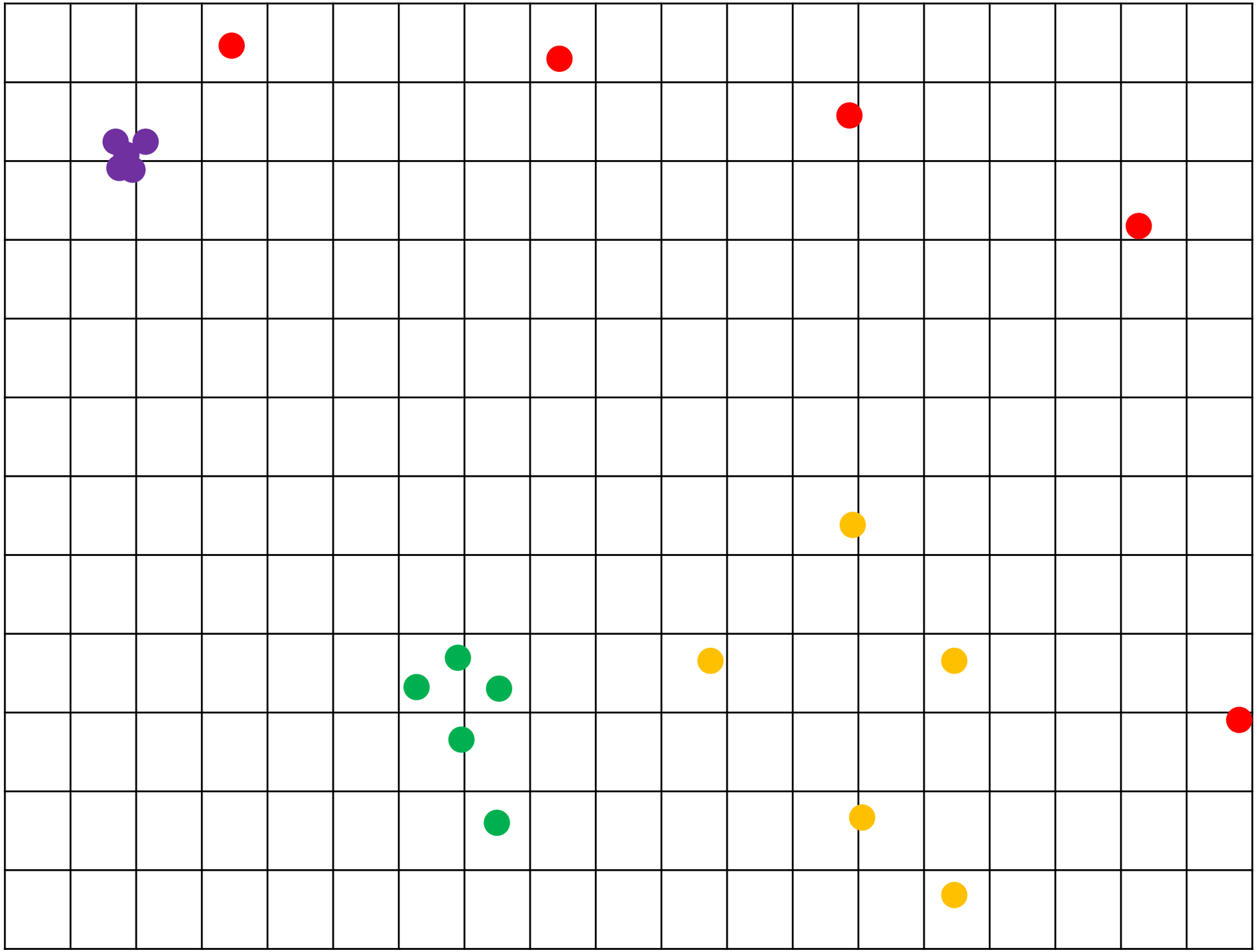
Movement behavior

Encamped
Traveling
Searching
Foraging



Urbanization

1. Natural land cover/food decreases and fragments – as does predictability
2. Anthropogenic land cover/food increases – as does predictability
3. Impermeable land cover increases
4. Human presence increases

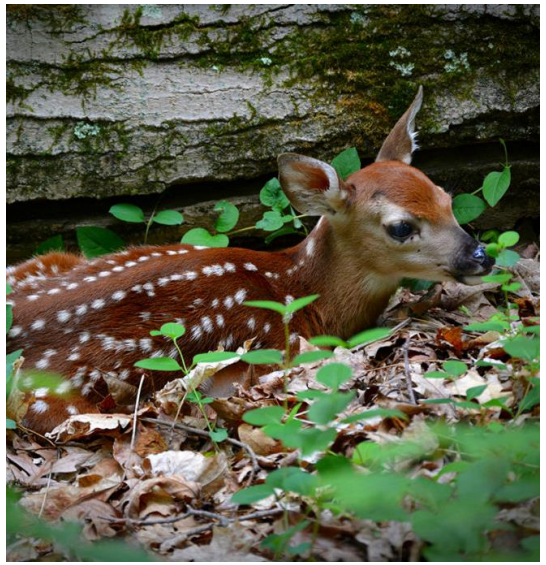
Movement behavior predictions - Urbanization

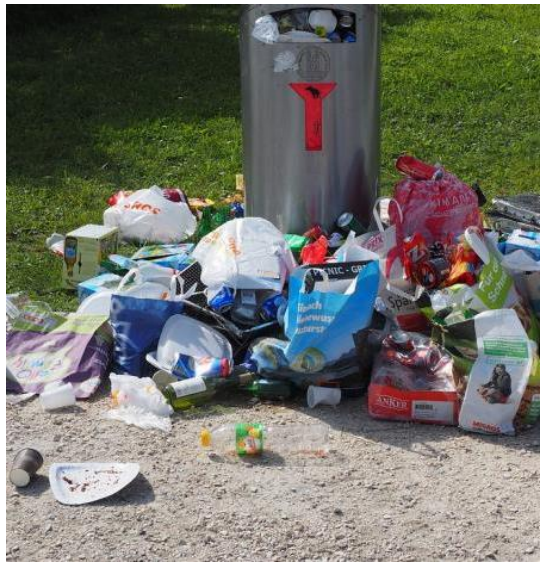
Time spent encamped

Time spent traveling

Urbanization

Movement behavior predictions - Diet



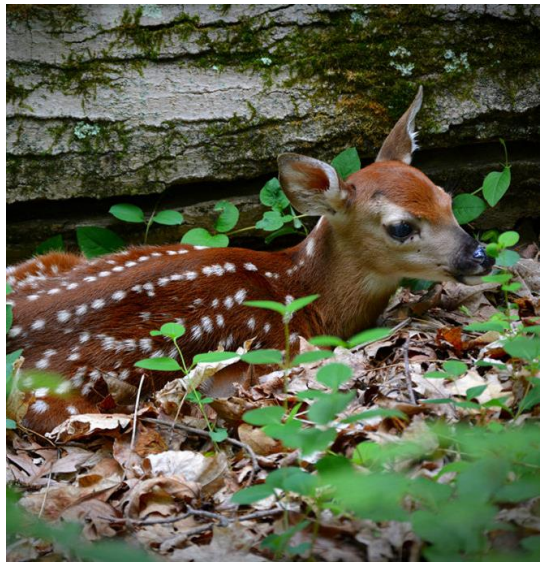


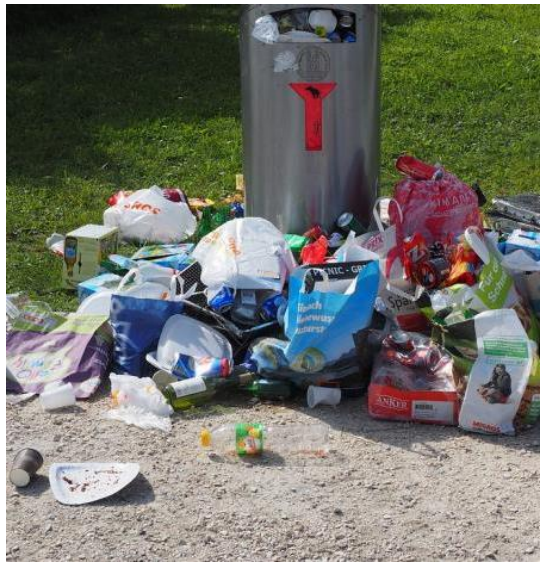
Anthropogenic diet

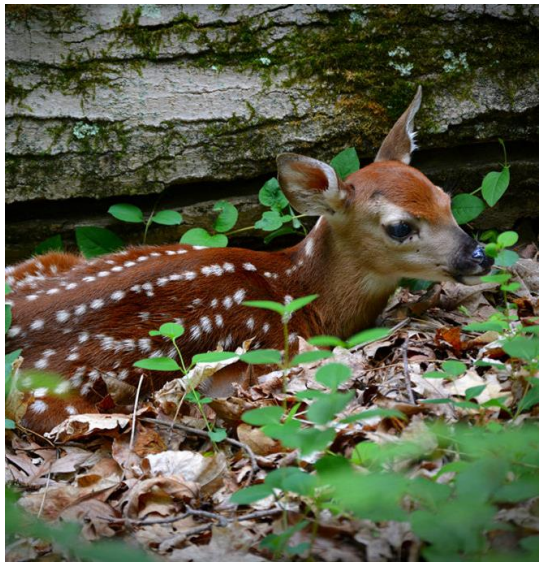
Time spent traveling

Time spent searching relative to foraging

Movement behavior predictions - Diet







Anthropogenic diet

Trophic level

Time spent traveling

Time spent searching relative to foraging

Time spent searching

Time spent traveling

Chicago Urban Coyote Research Project

2000 – present

A comprehensive study of urban coyote ecology in the Chicago Metropolitan Area

- Resource selection
- Space use
- Movement
- Survival
- Other population dynamics
- Diet
- Disease
- Many other aspects of coyote biology and ecology

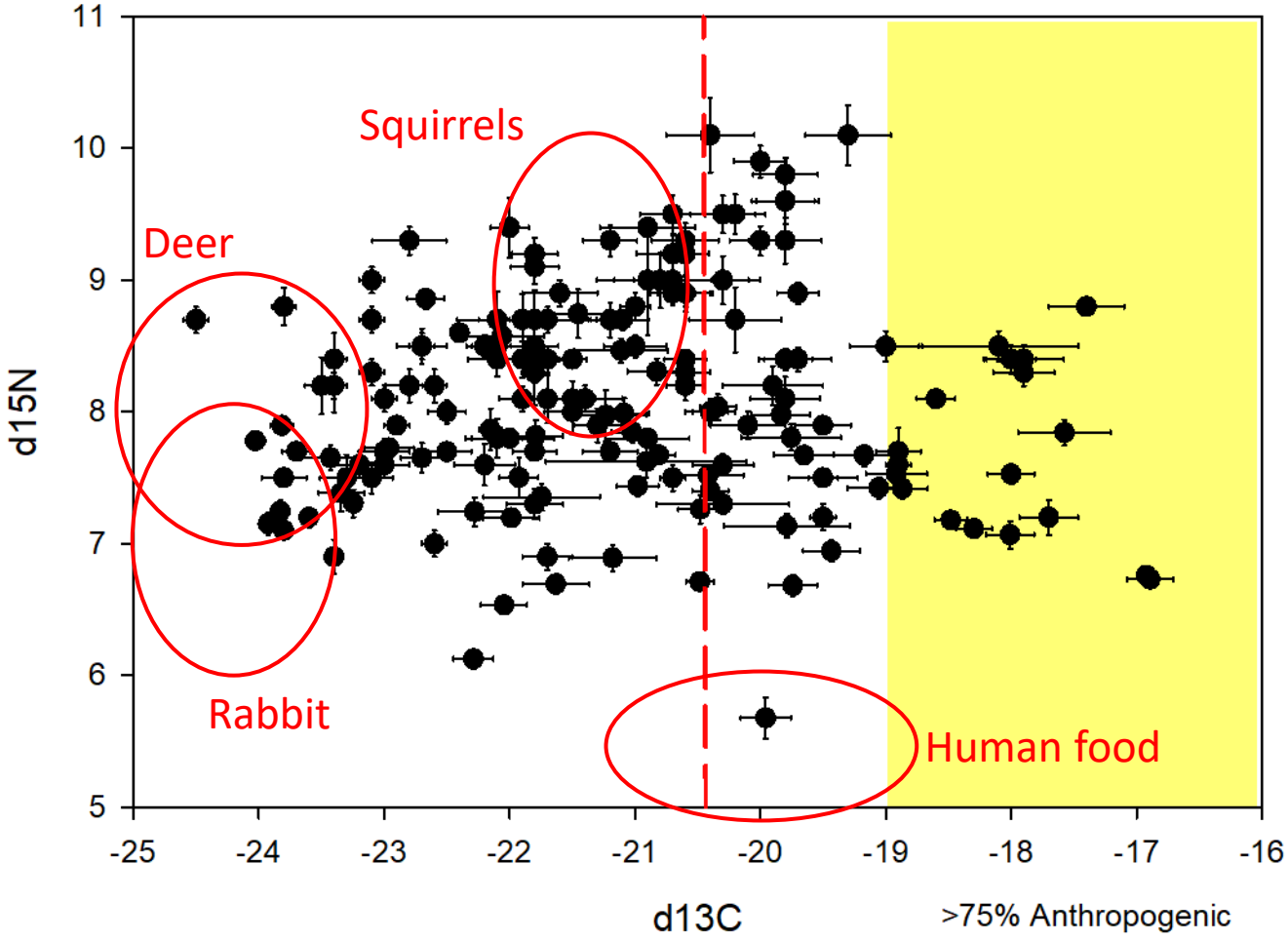
Estimating diet

Whiskers collected when animals were captured (*or recaptured*) and when mortalities were located

cut into 0.2-0.3 mg samples

determine average

$\delta^{13}C$ and $\delta^{15}N$ values and SD(SE)



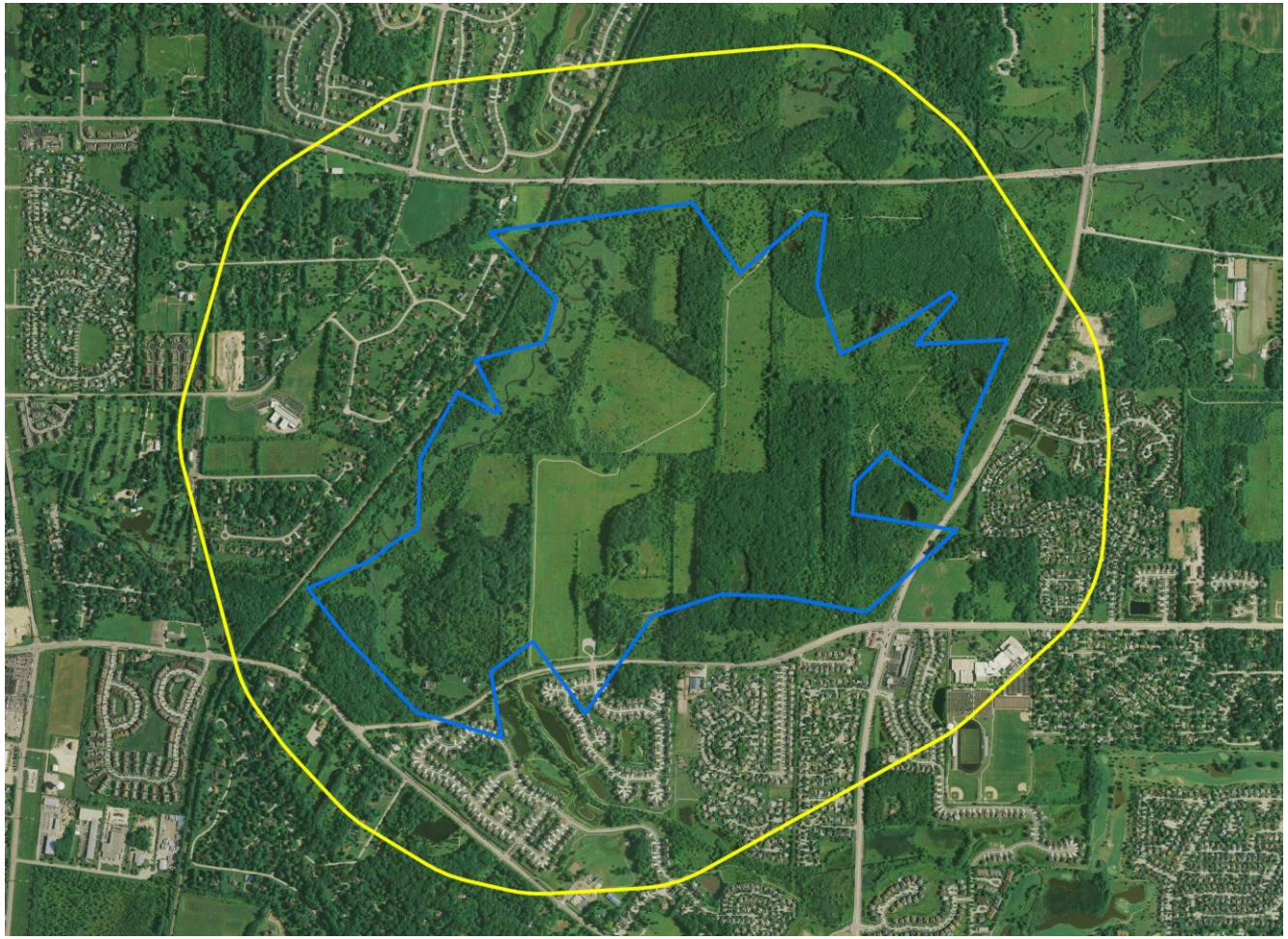
Estimating urbanization

Developed landscape (NLCD 2016)

We measured this at two scales

Landscape the coyote experiences
(95% MCP with 500m buffer)

Landscape the coyote occupies
(95% LoCoH)



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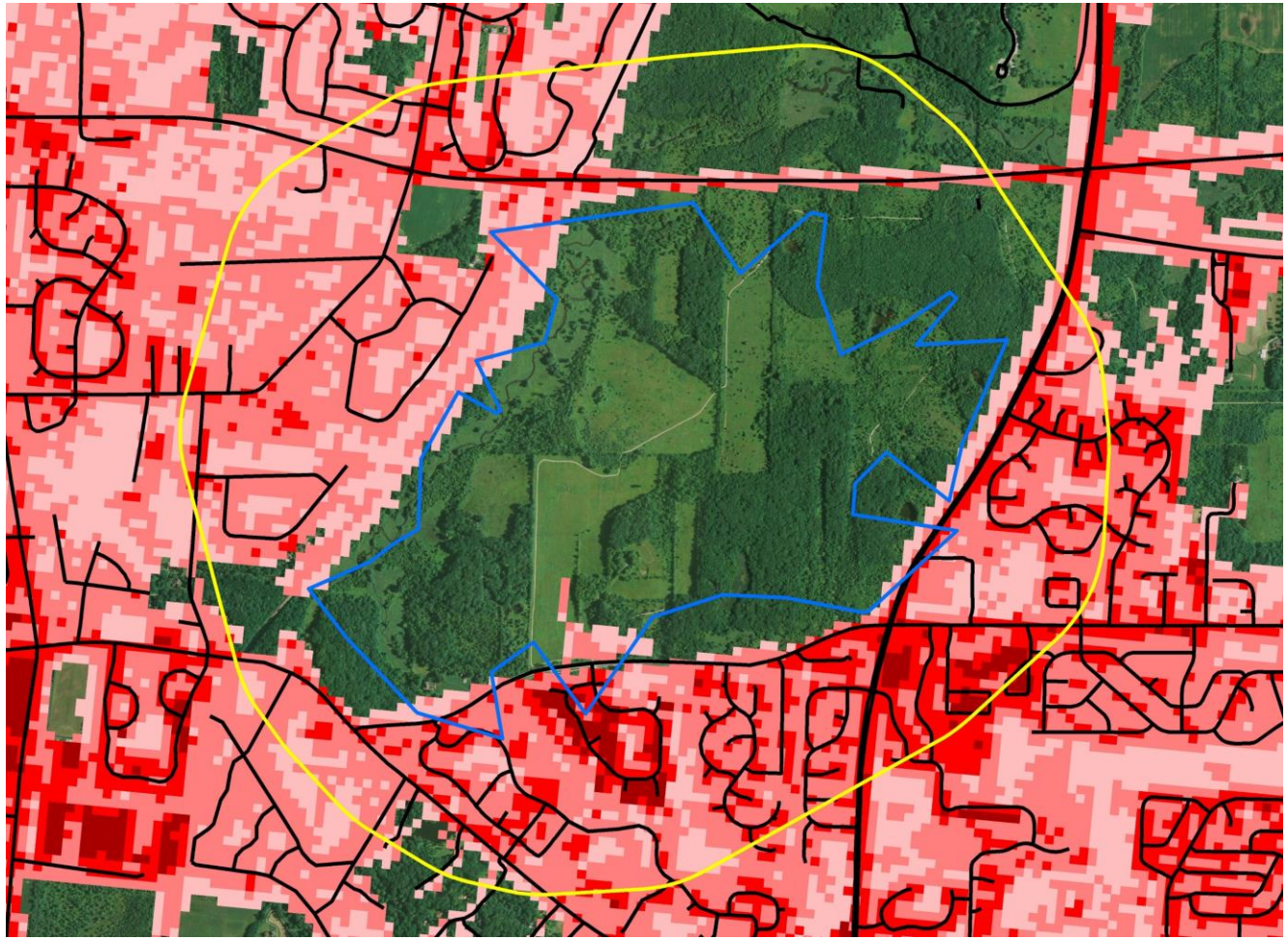

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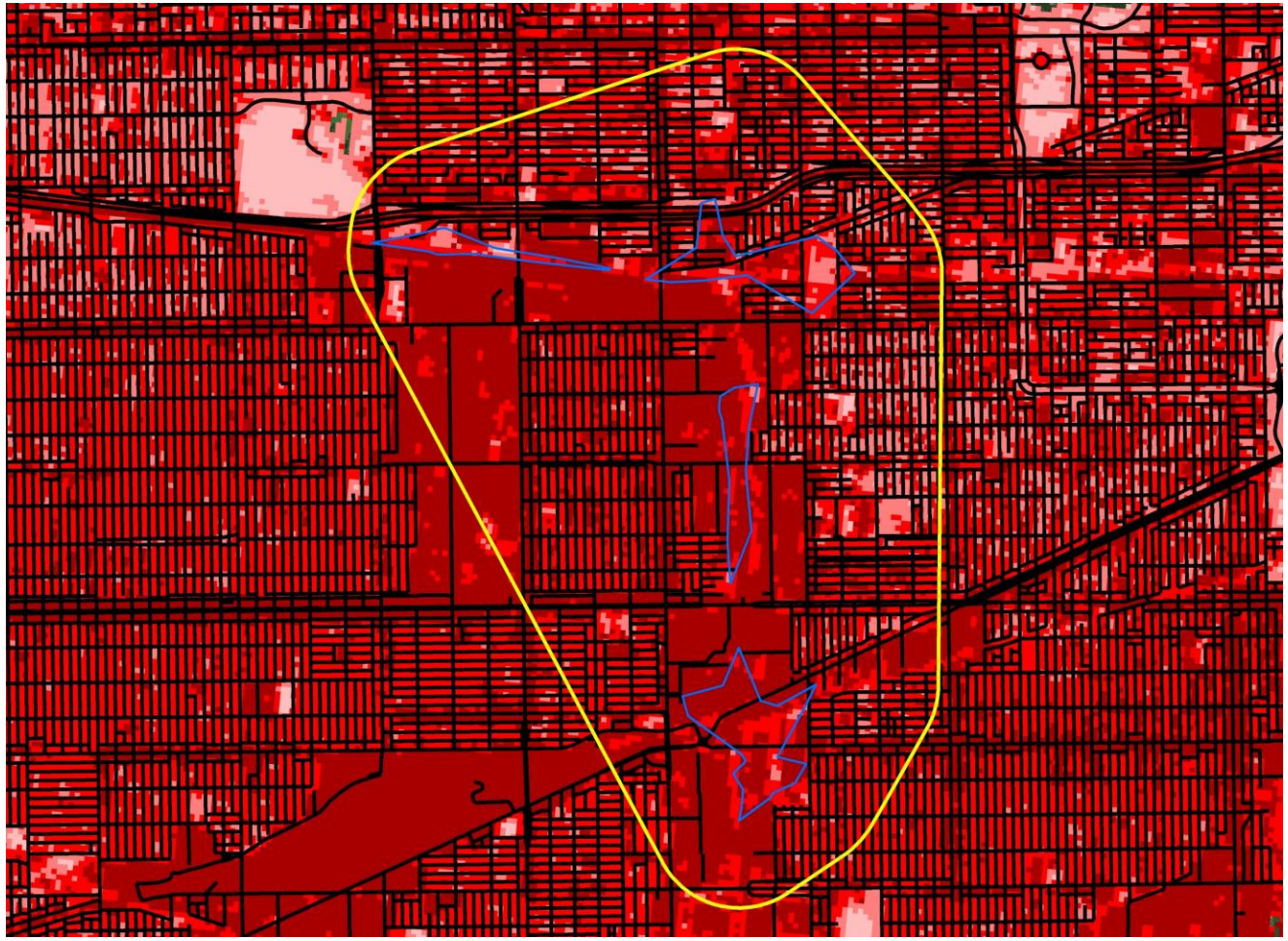


Estimating movement behavior

GPS location data collected every 15min.

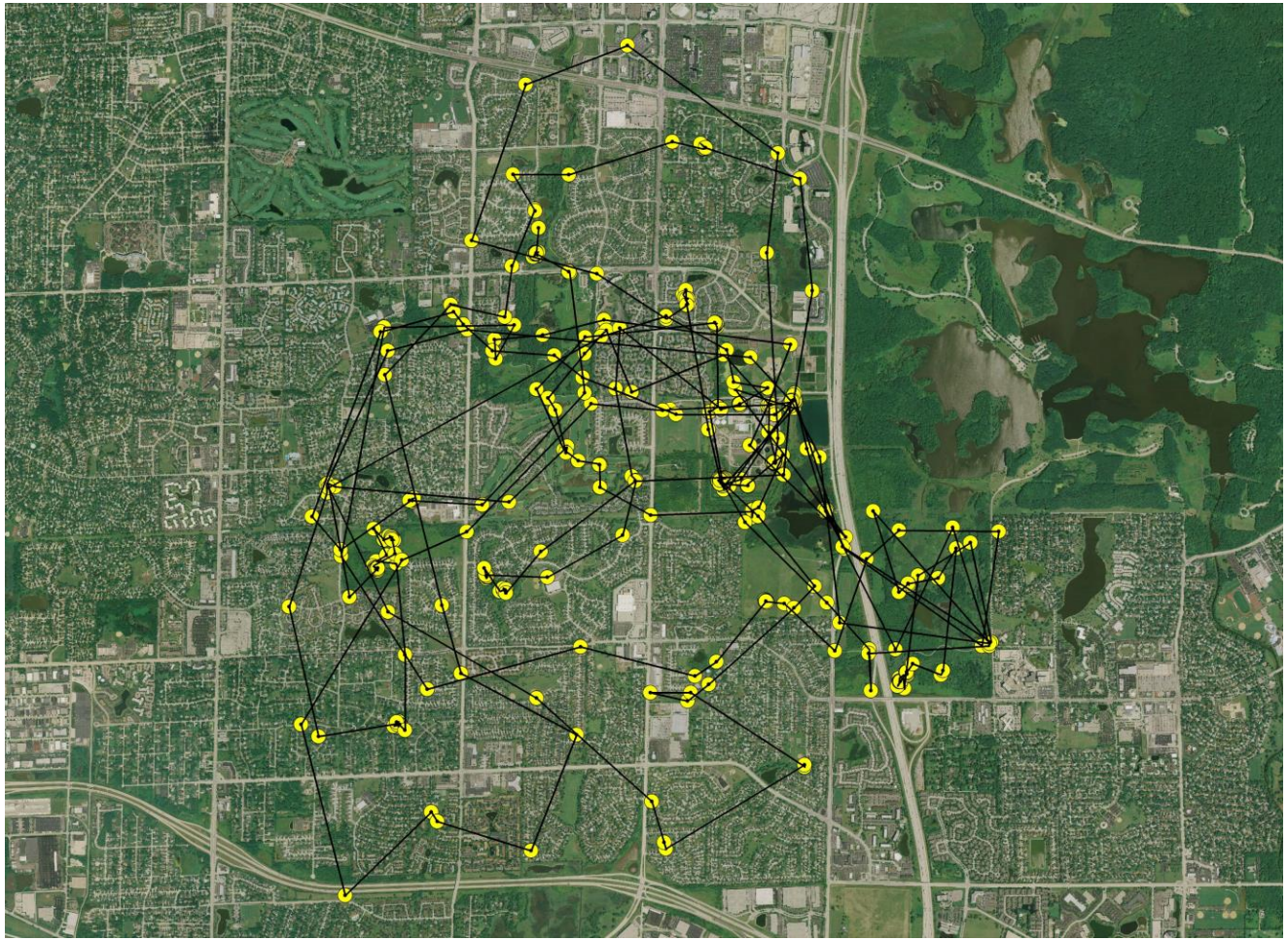
Burst of locations to be > 24 hours

Tolerated some missing data

- no sequentially missing data
- missing rate < 10 %

Estimated four movement states using Hidden Markov models

- momentuHMM in R



McClintock, B. T., & Michelot, T. (2018). *Methods in Ecology and Evolution*, *9*(6), 1518-1530.

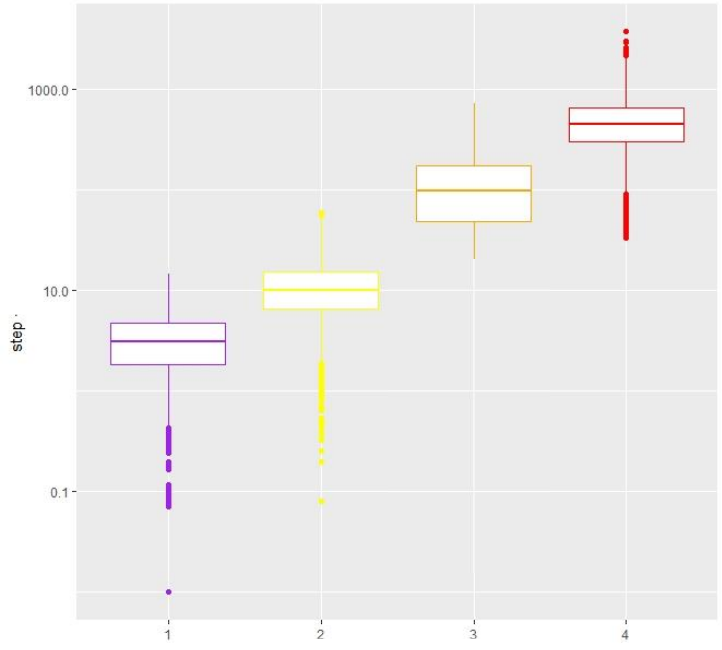
Estimating movement behavior

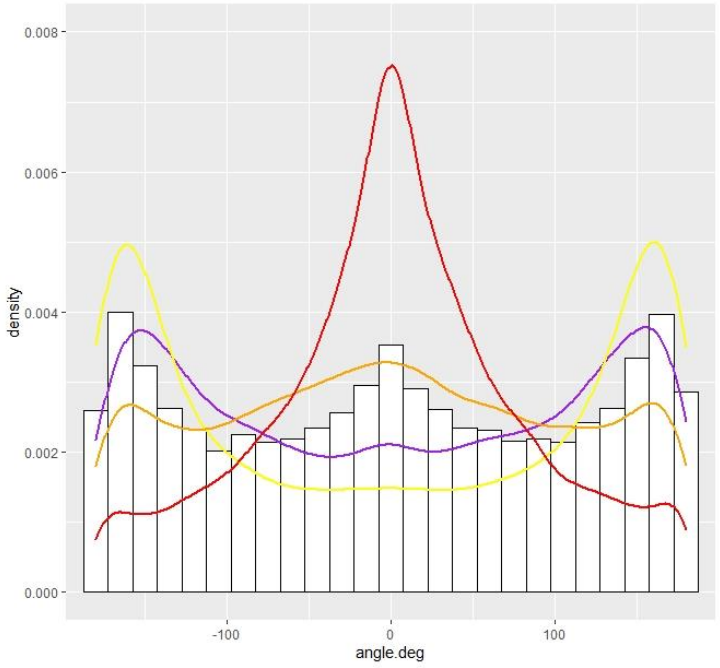
4-state movement state model was:

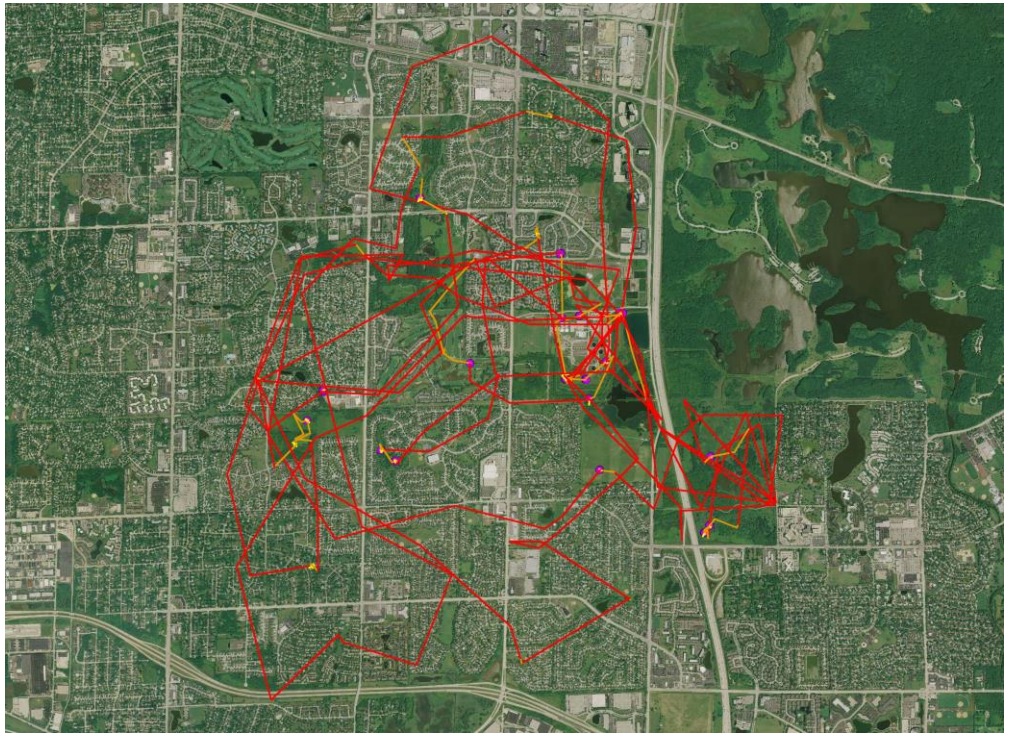
Biologically plausible

Strongly predictive

Outcompeted 2- and 3-state movement state models







Quantifying activity budgets from movement behavior

Used a combination of ratios of time spent in the four behaviors to capture activity budget

Linear regression models including terms related to urbanization and diet

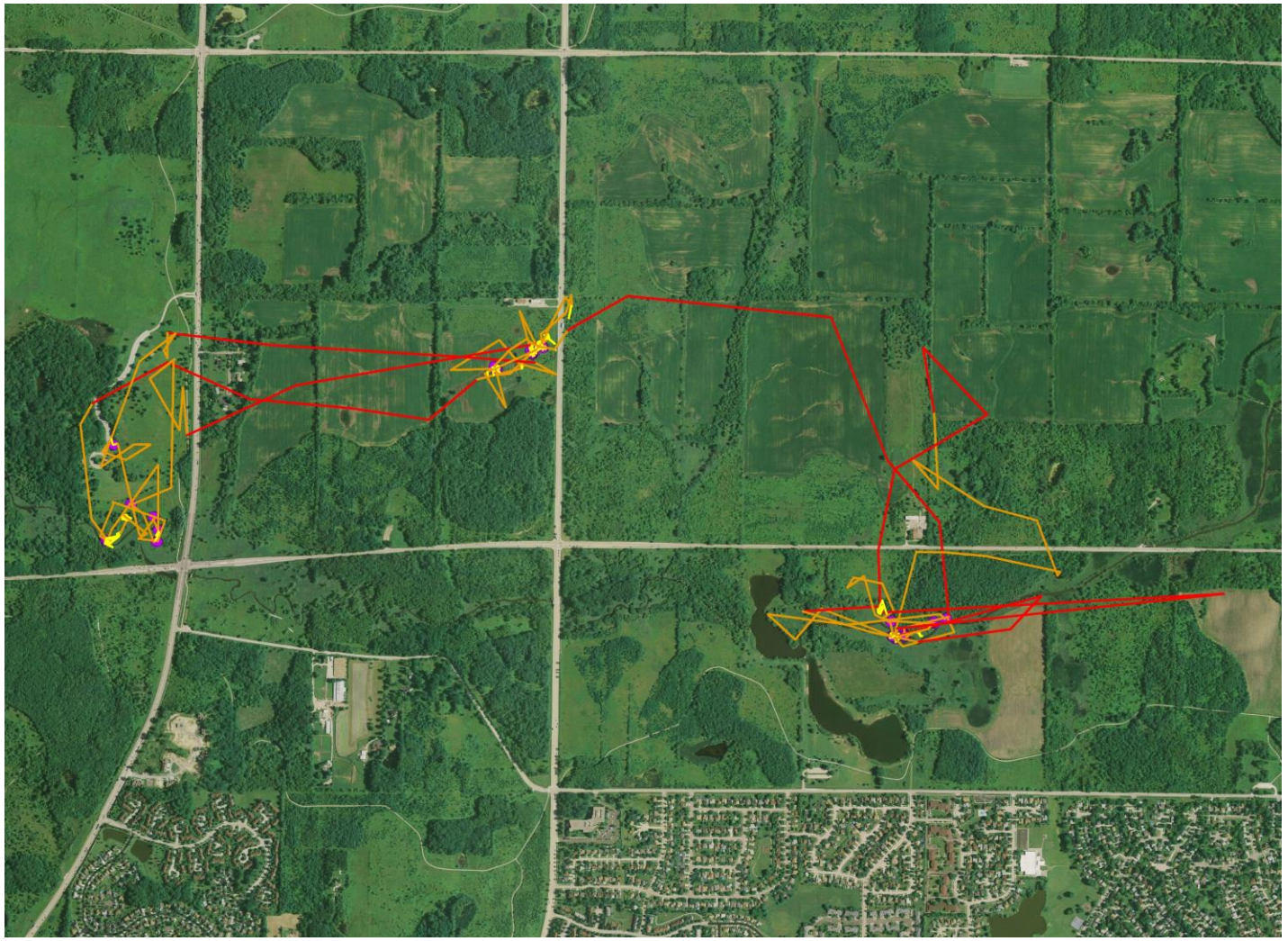
21 estimates of movement behavior-urbanization-diet

The impact of urbanization

Time spent traveling = 0.06

As the landscape becomes more urbanized

1) More time spent traveling

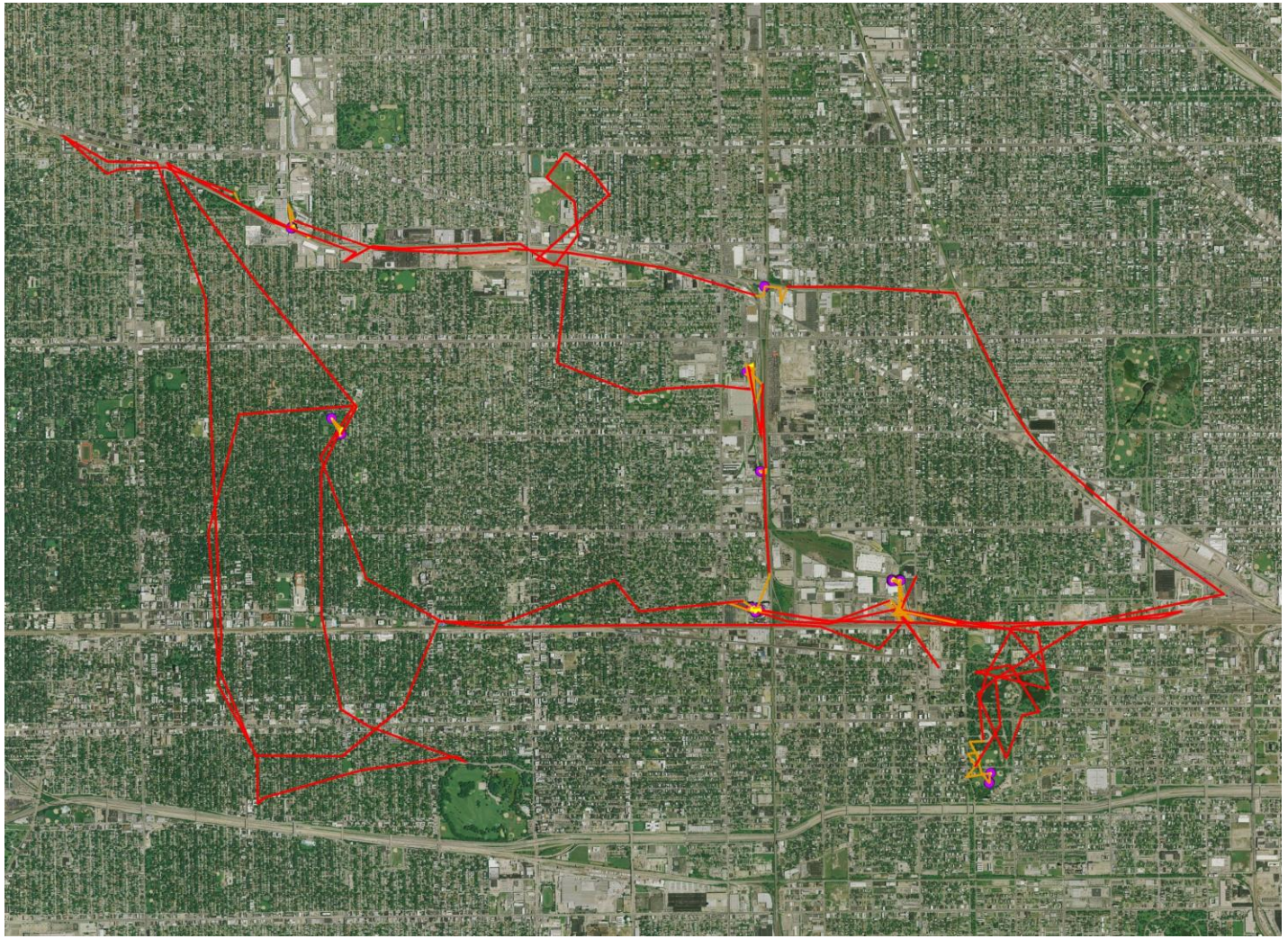


The impact of urbanization

Time spent traveling = 0.27

As the landscape becomes more urbanized

1) More time spent traveling



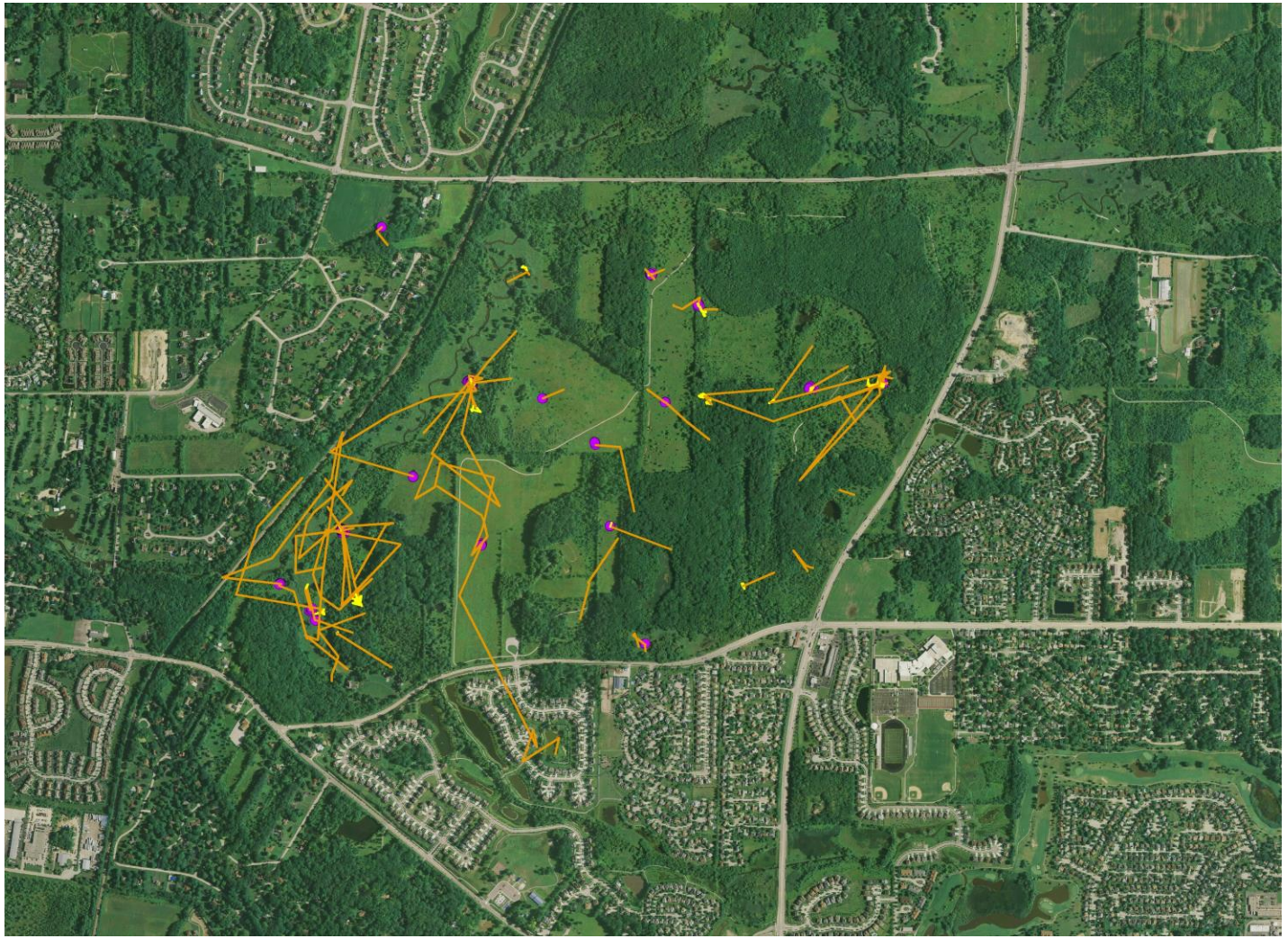
The impact of urbanization

Time spent encamped = 0.27

As the landscape becomes more urbanized

1) More time spent traveling

2) More time spent encamped



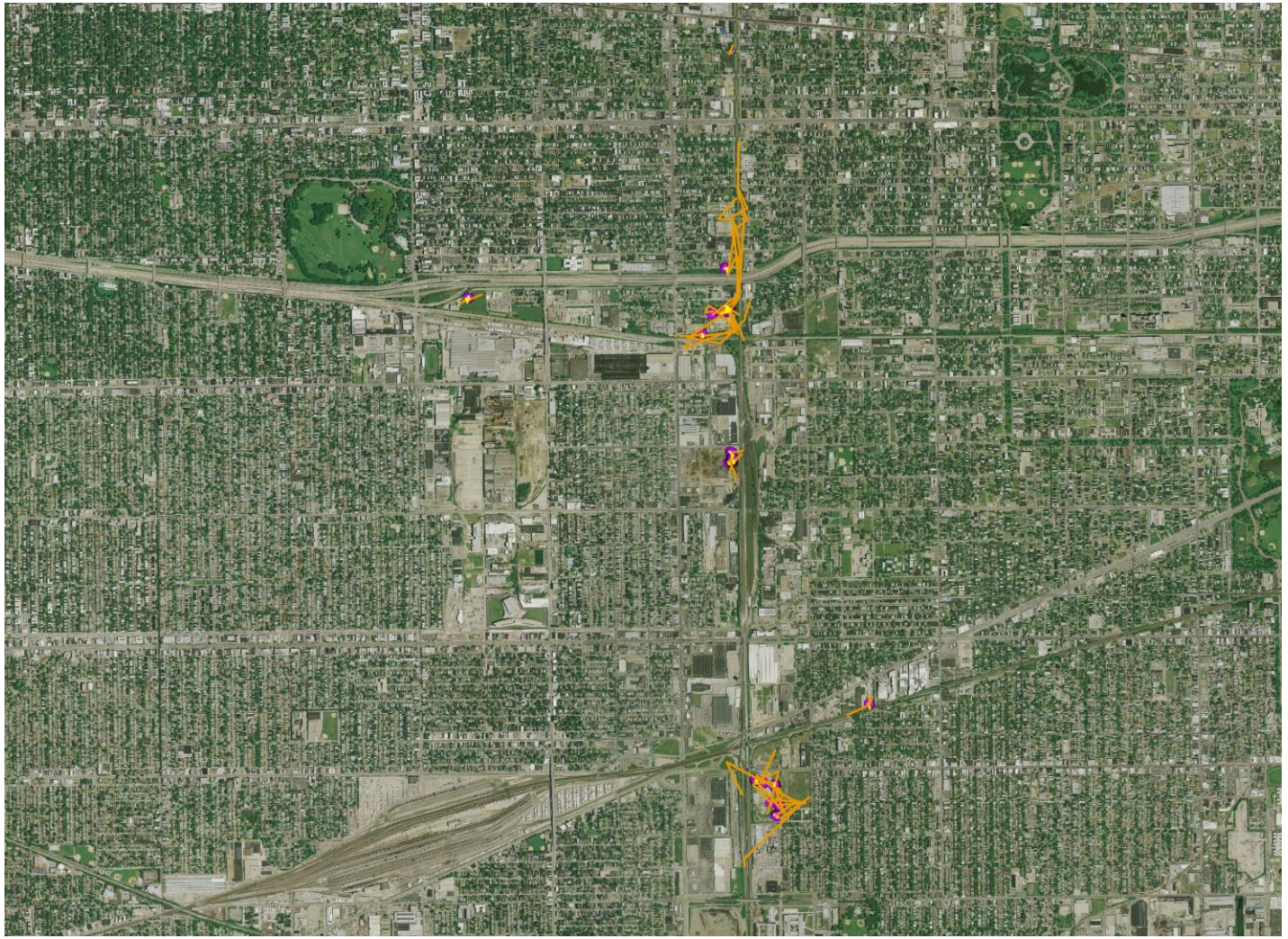
The impact of urbanization

As the landscape becomes more urbanized

1) More time spent traveling

2) More time spent encamped

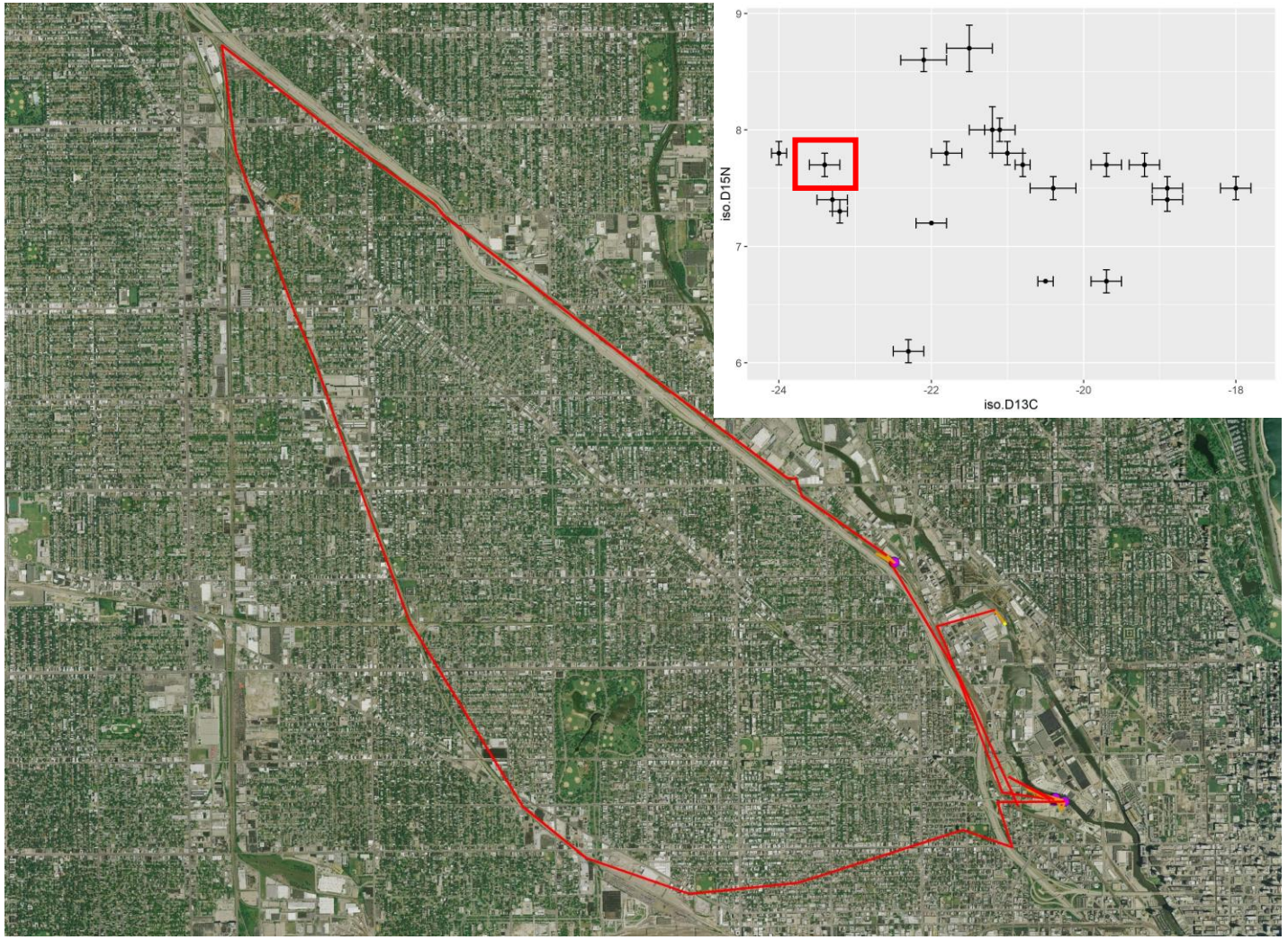
Time spent encamped = 0.50



The impact of diet – anthropogenic ($\delta^{13}C$)

As the diet becomes more anthropogenic

1) Less time spent traveling

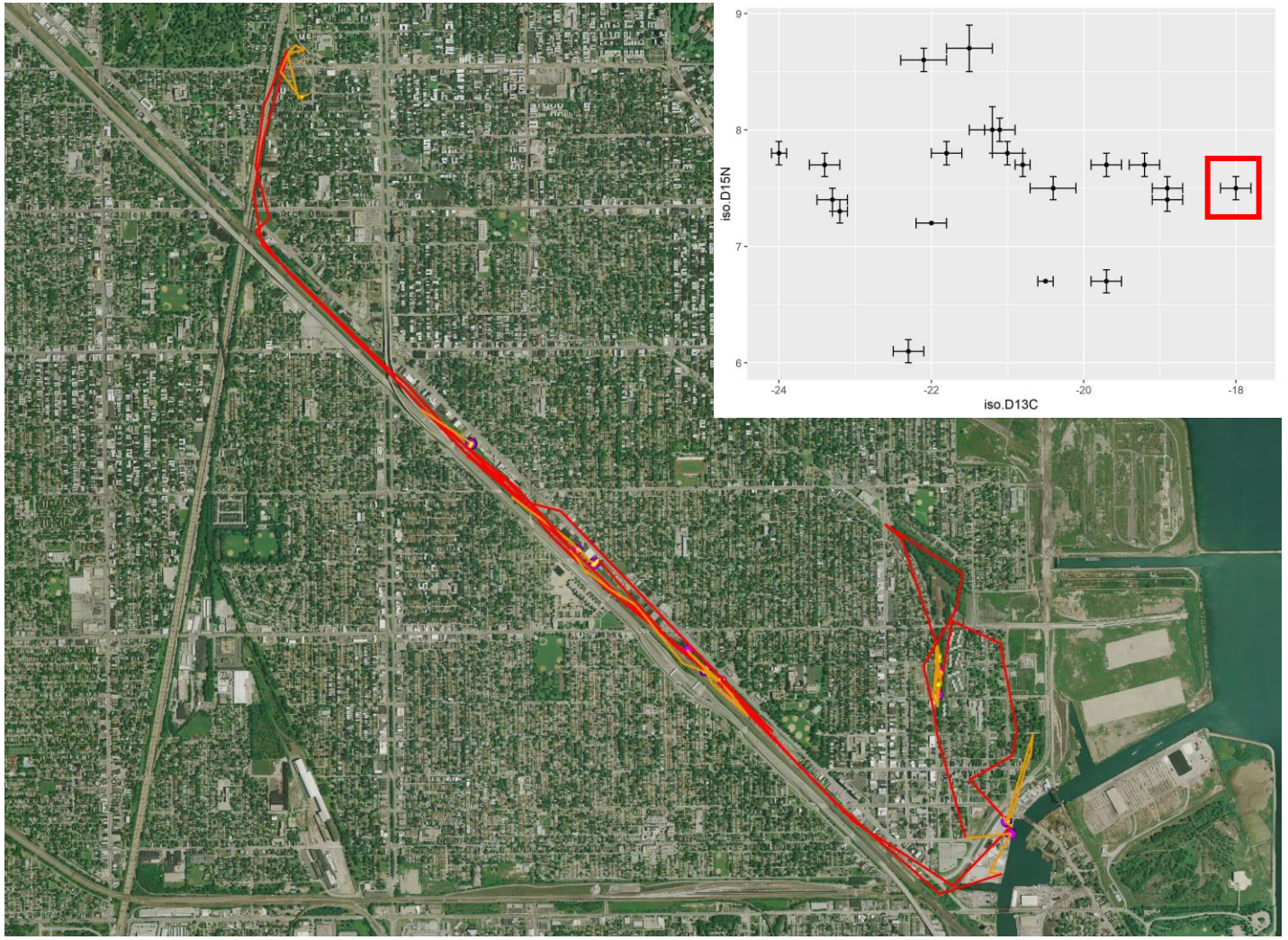


Time spent traveling = 0.31

The impact of diet – anthropogenic ($\delta^{13}C$)

As the diet becomes more anthropogenic

1) Less time spent traveling



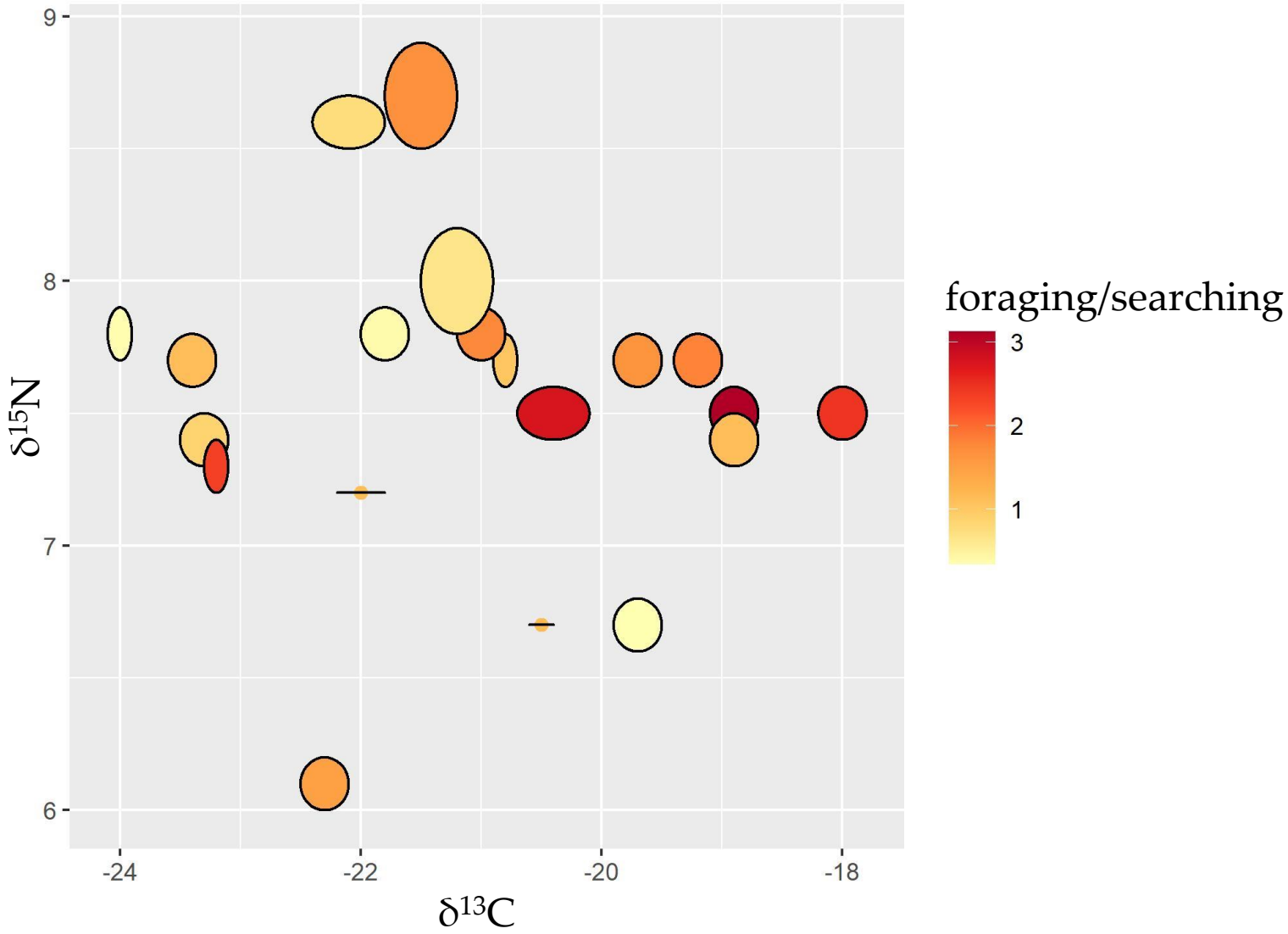
Time spent traveling = 0.14

The impact of diet – anthropogenic ($\delta^{13}C$)

As the diet becomes more anthropogenic

1) Less time spent traveling

2) More time spent foraging than searching



The impact of diet – anthropogenic ($\delta^{13}C$)

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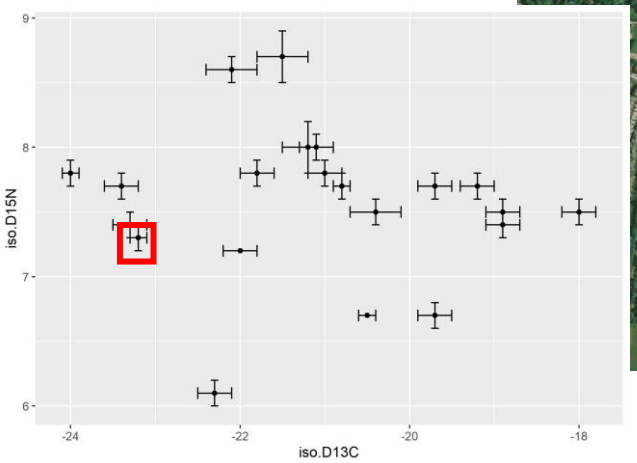
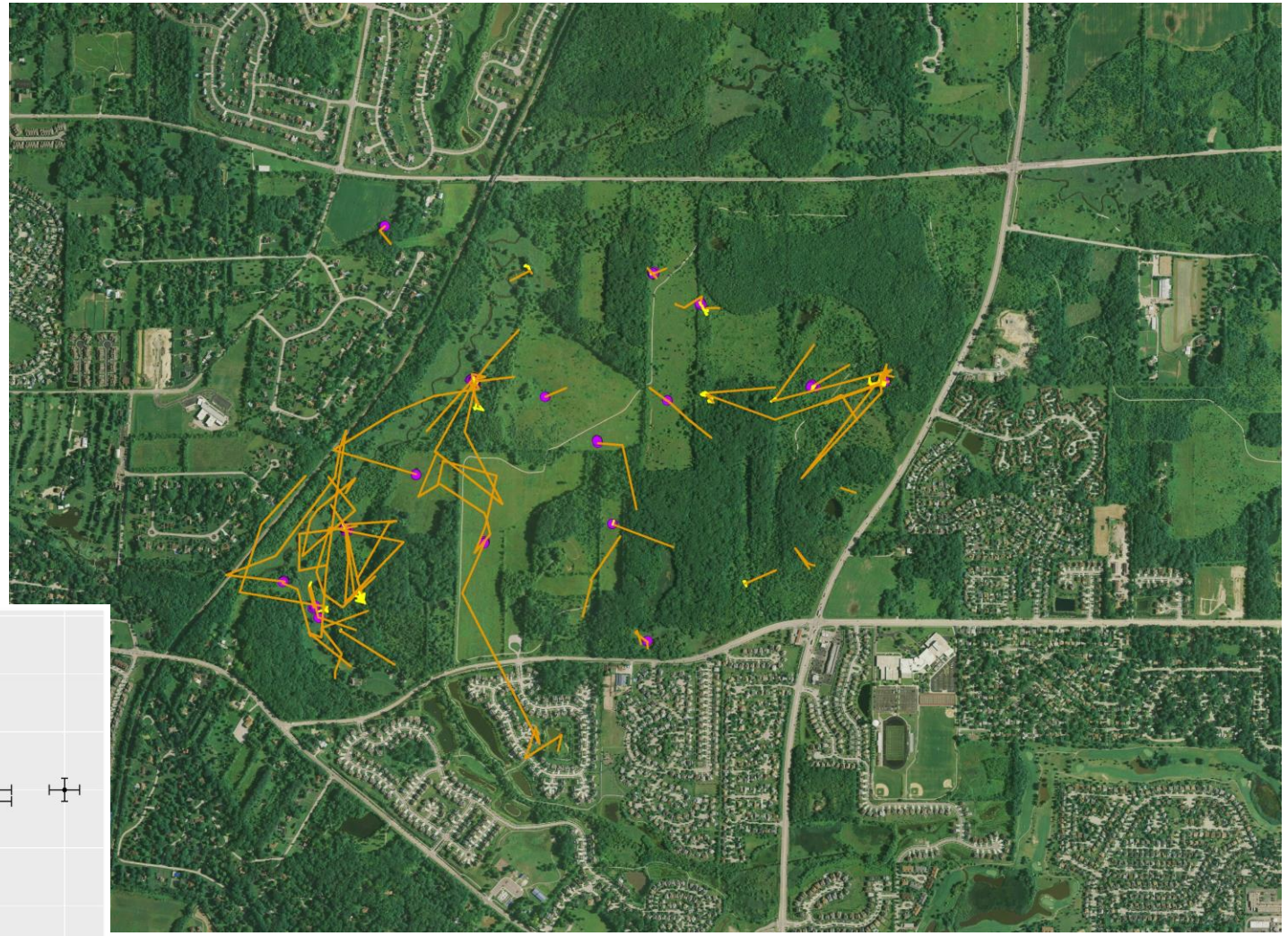
1) Less time spent traveling

2) More time spent foraging than searching





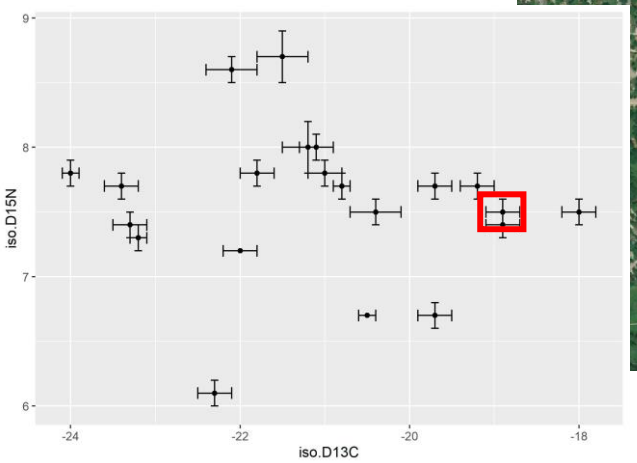
Time spent foraging = 0.22

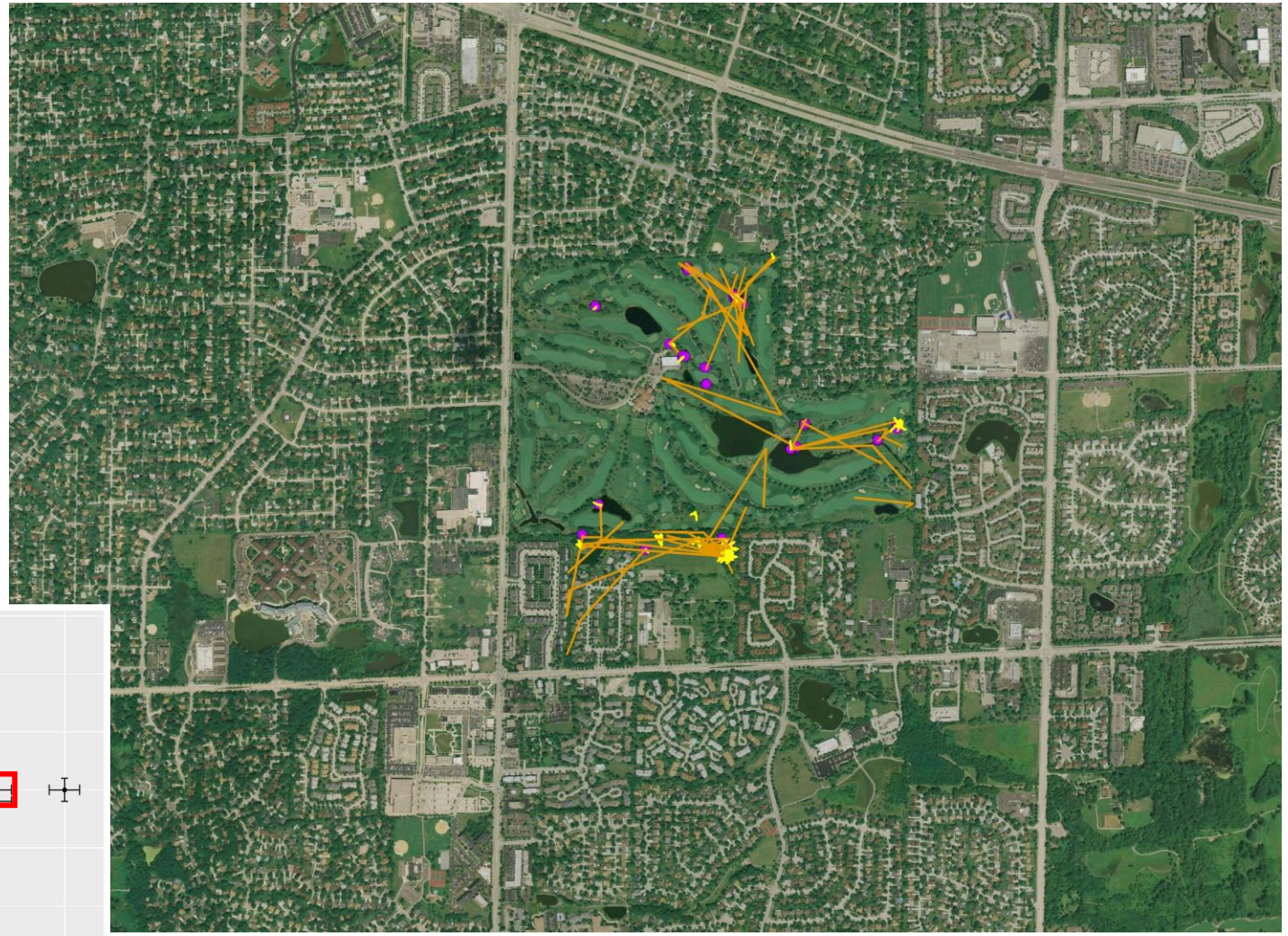
The impact of diet – anthropogenic ($\delta^{13}C$)

As the diet becomes more anthropogenic

1) Less time spent traveling

2) More time spent foraging than searching



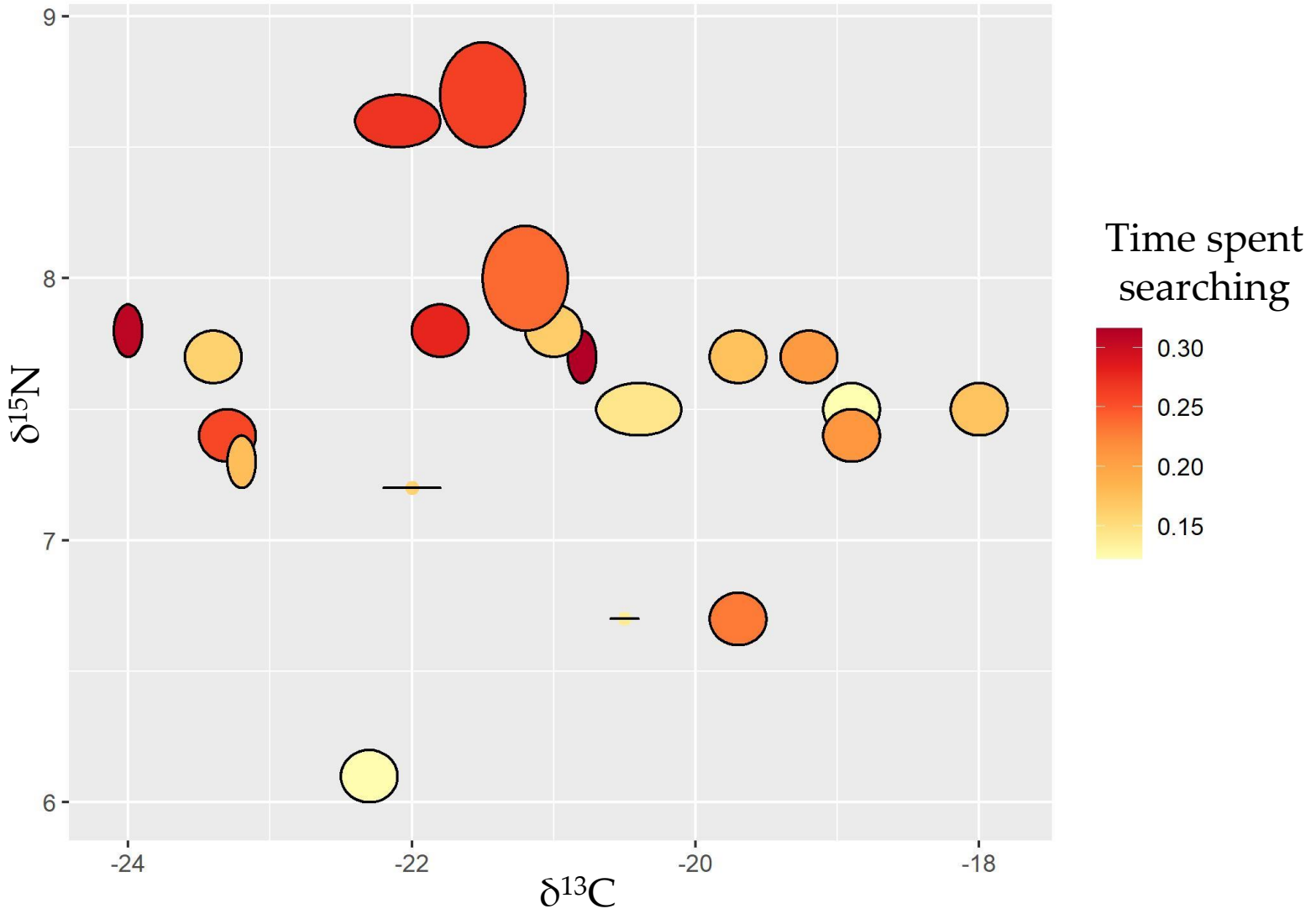


Time spent foraging = 0.38

The impact of diet – trophic level ($\delta^{15}N$)

As coyotes feed at a higher trophic level

1) More time searching



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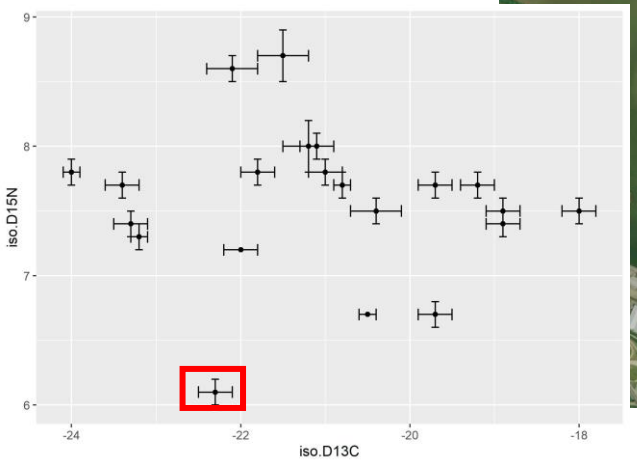
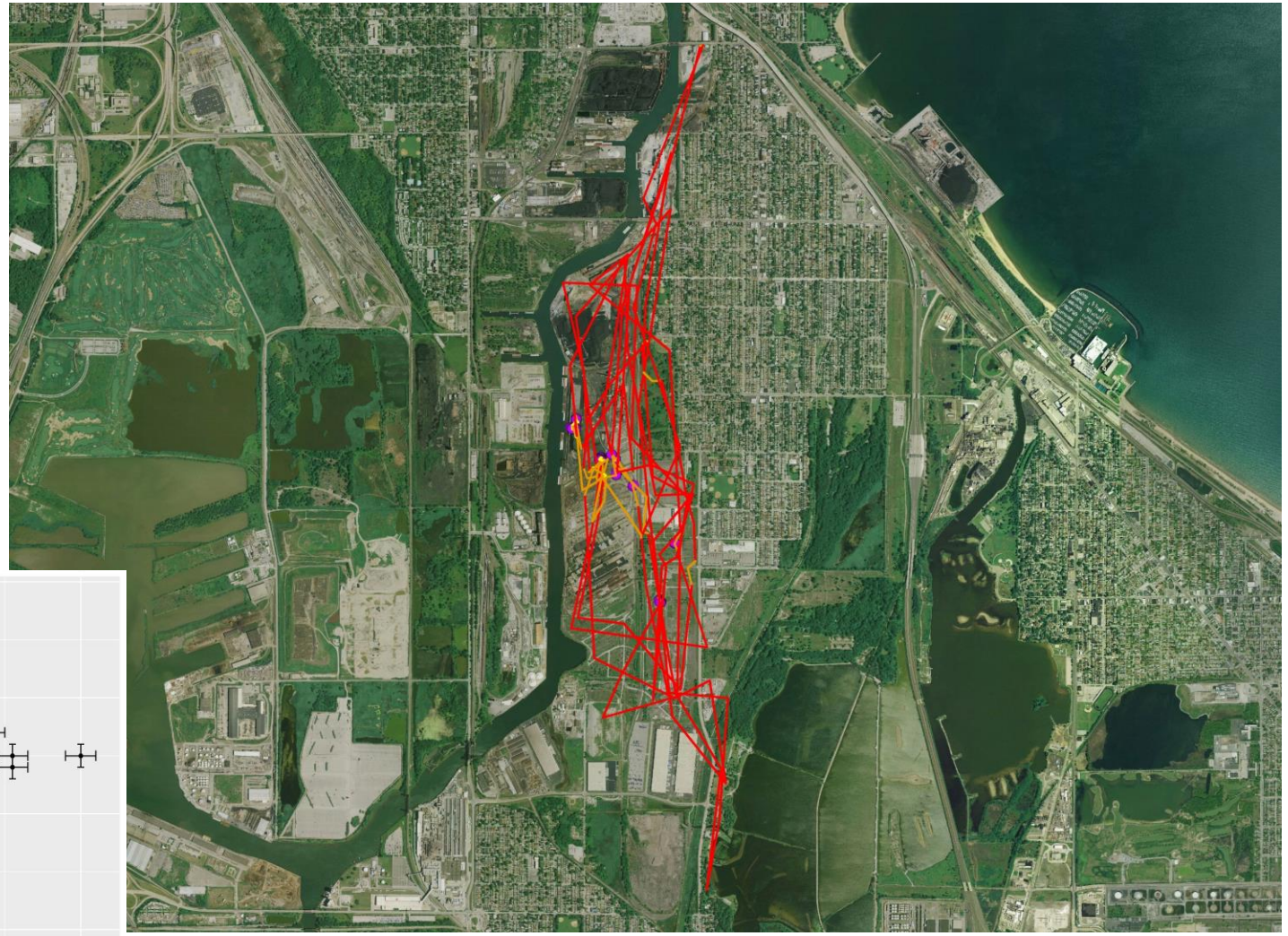


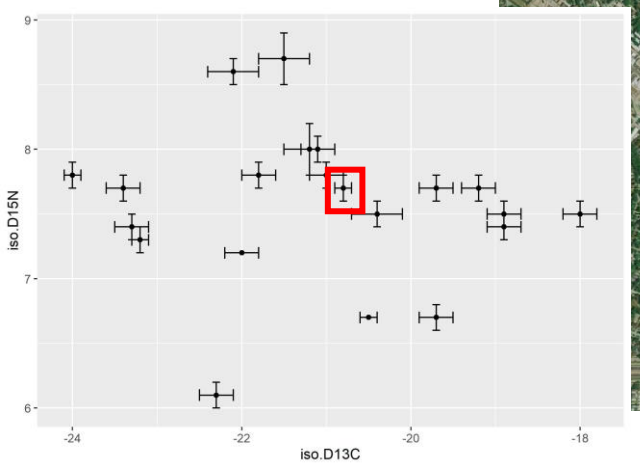


Time spent searching = 0.12

The impact of diet – trophic level ($\delta^{15}N$)

As coyotes feed at a higher trophic level

1) More time searching



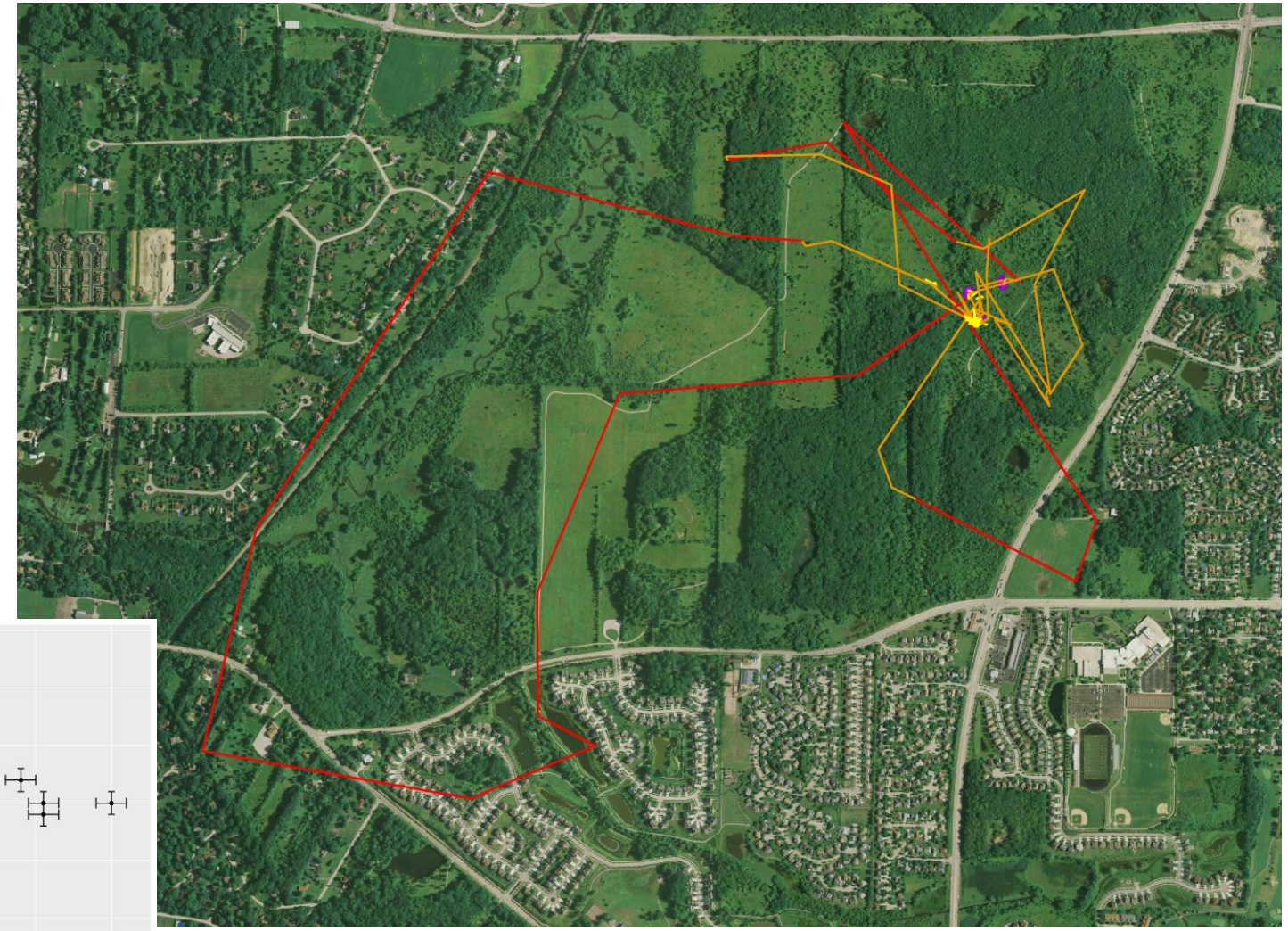
Time spent searching = 0.32

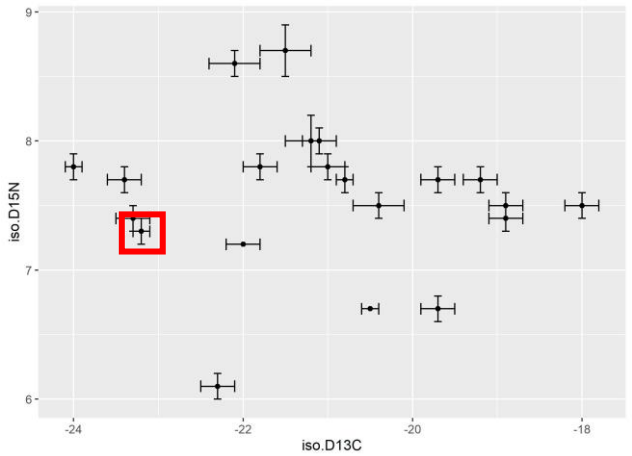
The impact of diet – trophic level ($\delta^{15}N$)

As coyotes feed at a higher trophic level

1) More time searching

2) More time encamped





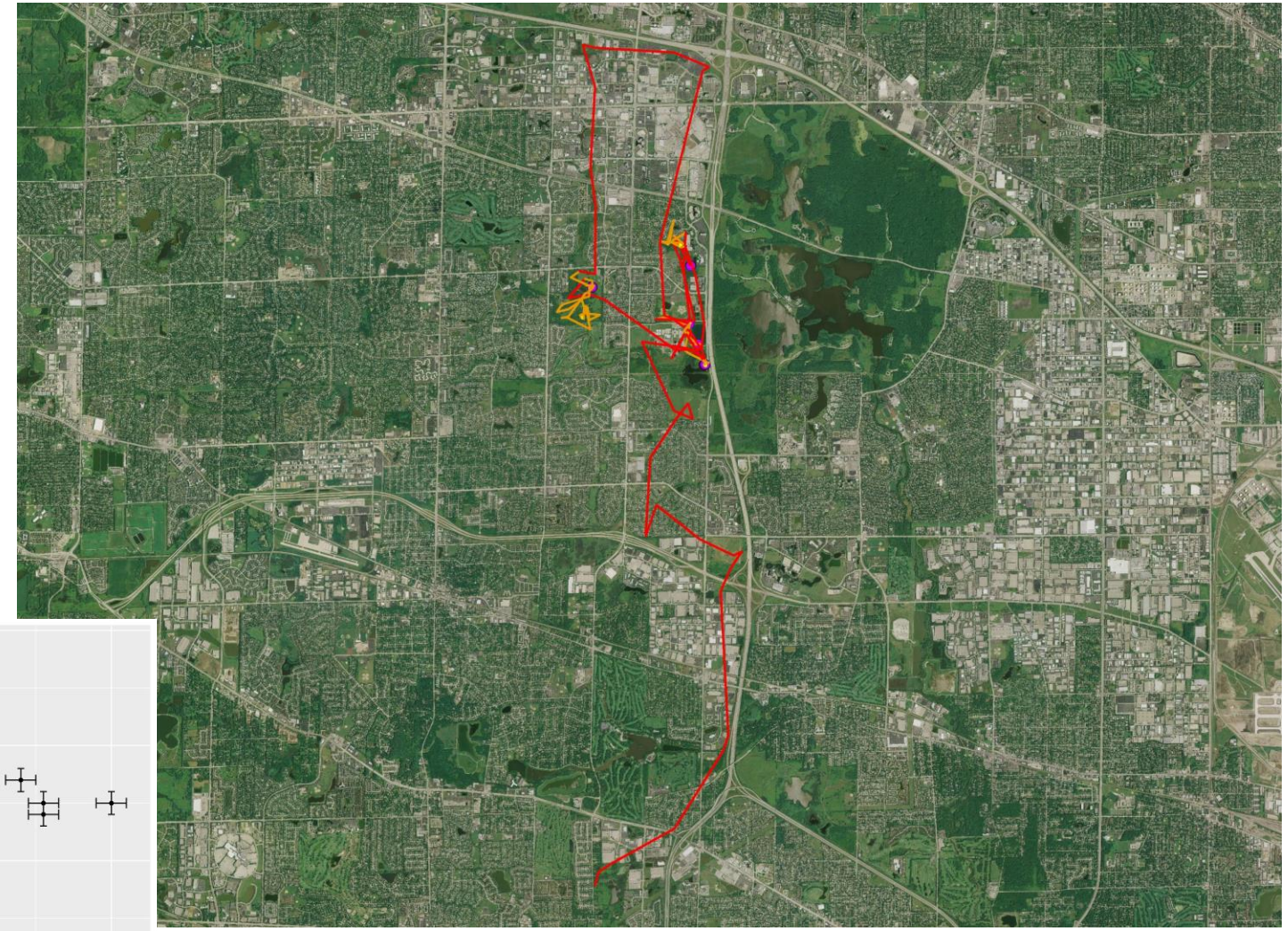
Time spent encamped = 0.16

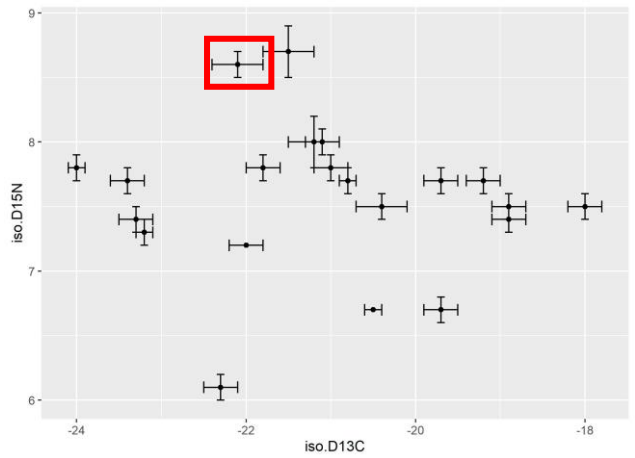
The impact of diet – trophic level ($\delta^{15}N$)

As coyotes feed at a higher trophic level

1) More time searching

2) More time encamped

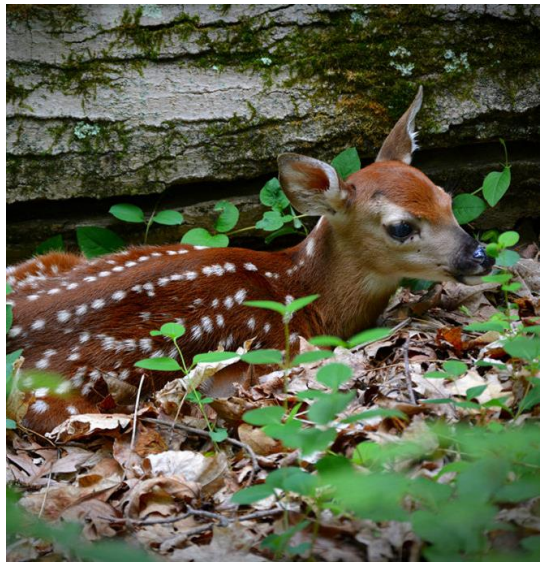


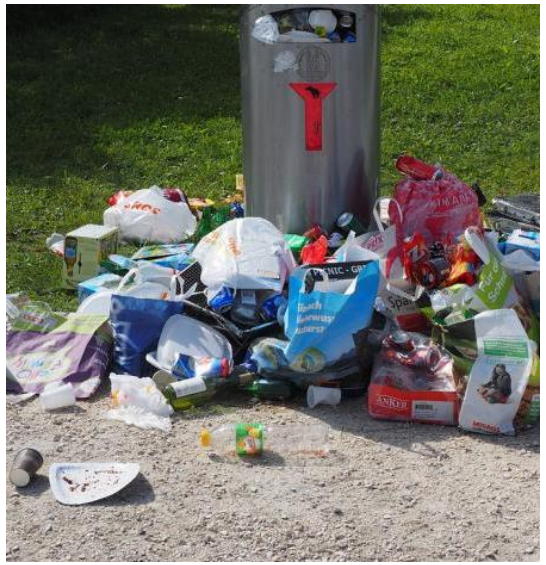


Time spent encamped = 0.37

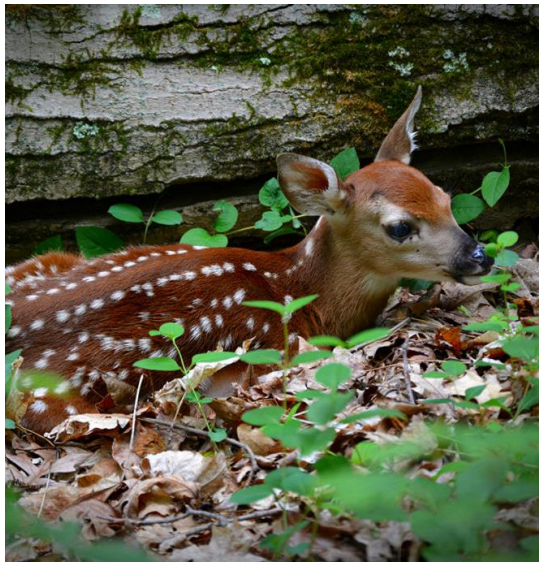
Summary

Summary





Anthropogenic diet

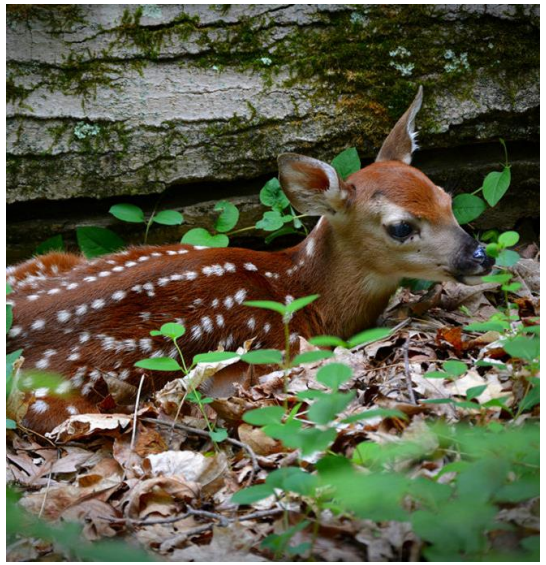


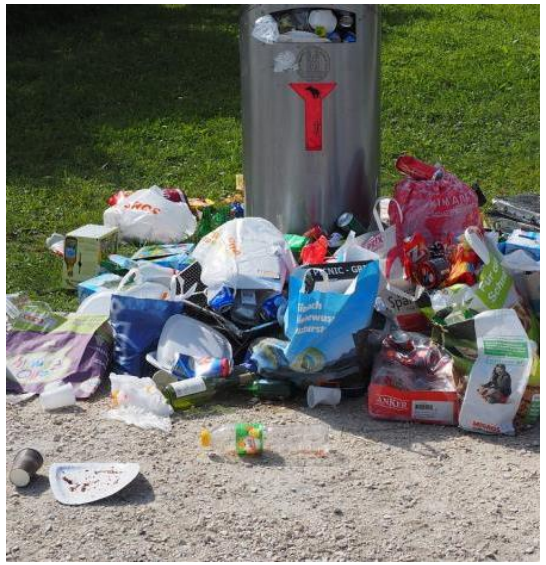
Trophic level

- Time spent traveling
- Time spent searching relative to foraging

- Time spent searching
- ~~Time spent traveling~~

Summary





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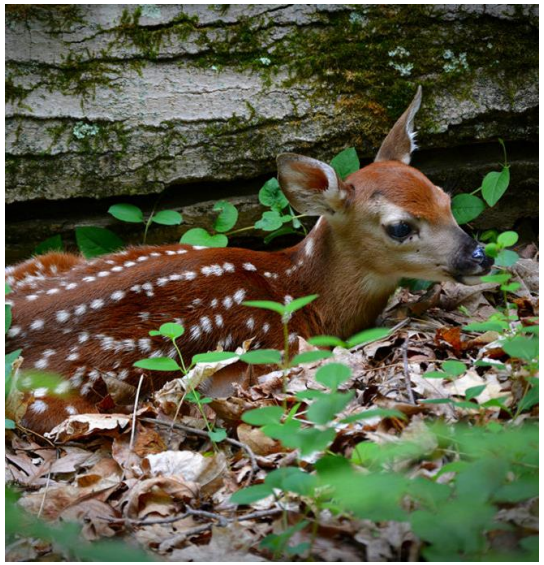

Trophic level

- Time spent traveling
- Time spent searching relative to foraging
- Time spent searching
- Time spent encamped

Next Steps

Diet specialization

Can we distinguish food waste from animals that consume food waste in coyote diet?

How does a coyotes diet change over time (seasonally) and how might that impact behavior and resource selection?

Resource selection within specific behaviors

What features are coyotes that consume mostly natural food sources in highly urbanized landscapes using while searching?

What features are coyotes that consume mostly anthropogenic food sources in more natural landscapes using while foraging?

Thank you!

Chris Anchor
Shane McKenzie
Erin Koen
Forest Preserves of Cook County
Many students, technicians, and staff

Terrestrial Wildlife Ecology Laboratory

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

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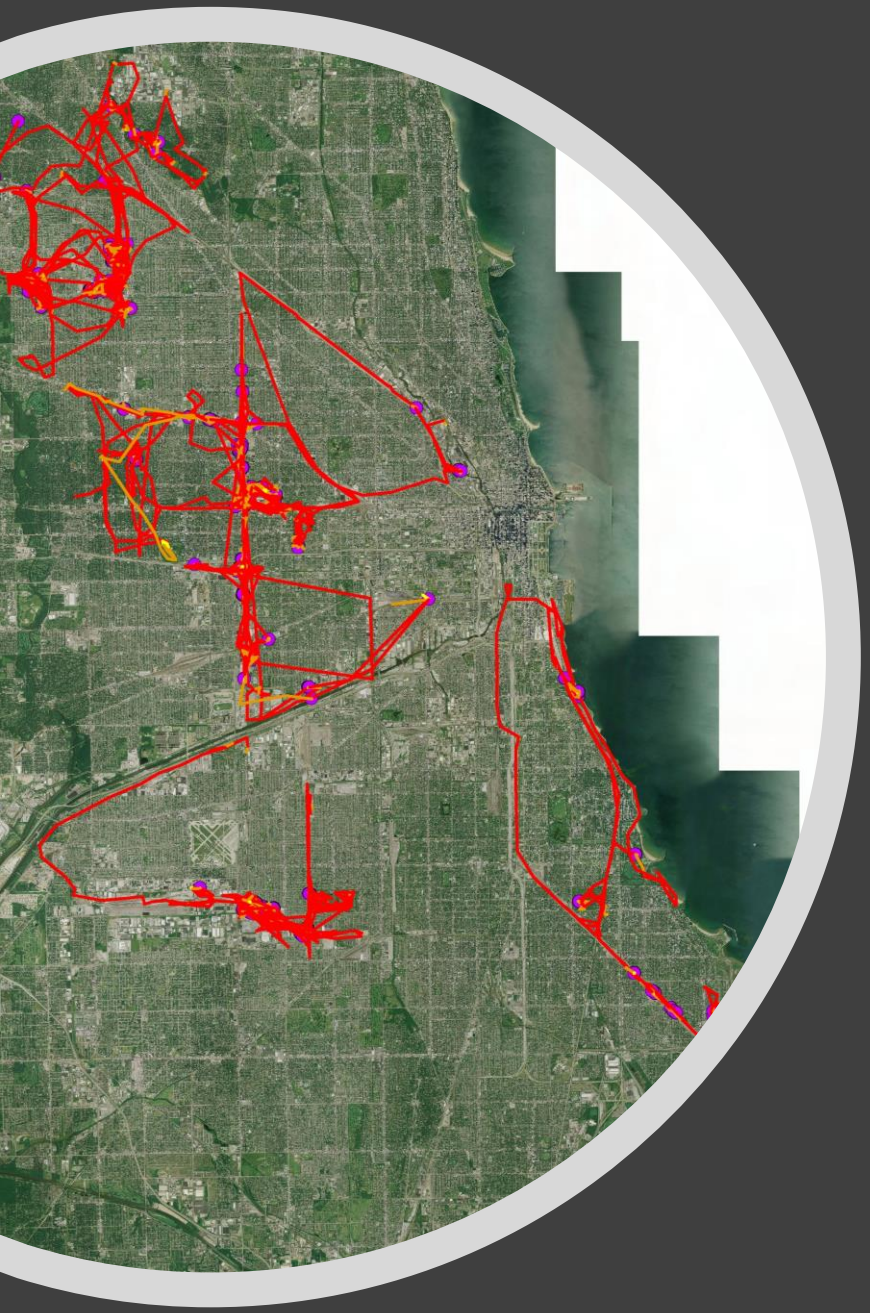
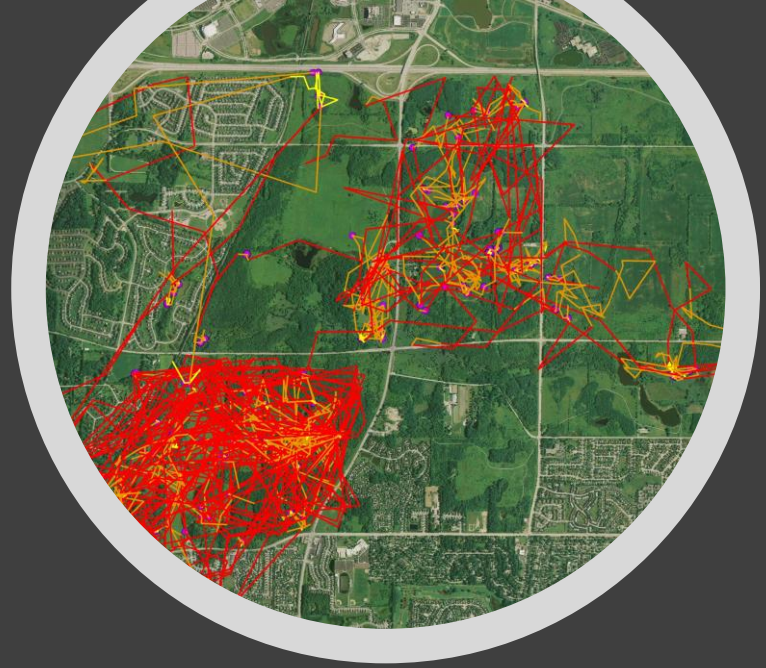
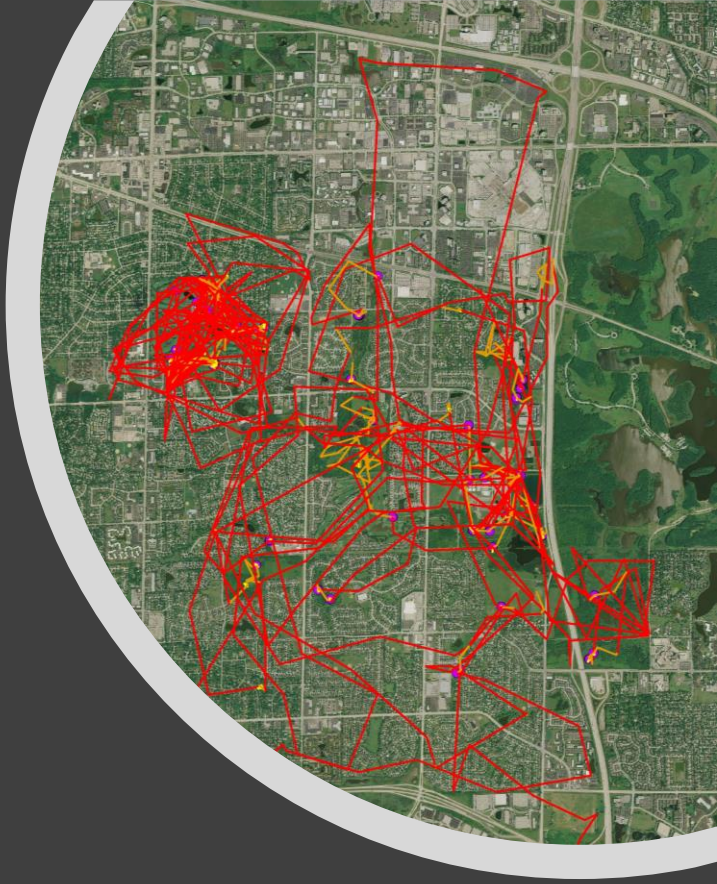
FOREST PRESERVE DISTRICT OF COOK COUNTY

WILDLIFE FOUNDATION MAX McGRAW

This work is also supported by the USDA National Institute of Food and Agriculture, Hatch project 1026189, Conservation and management of rangeland wildlife in natural and agricultural landscapes







Questions?

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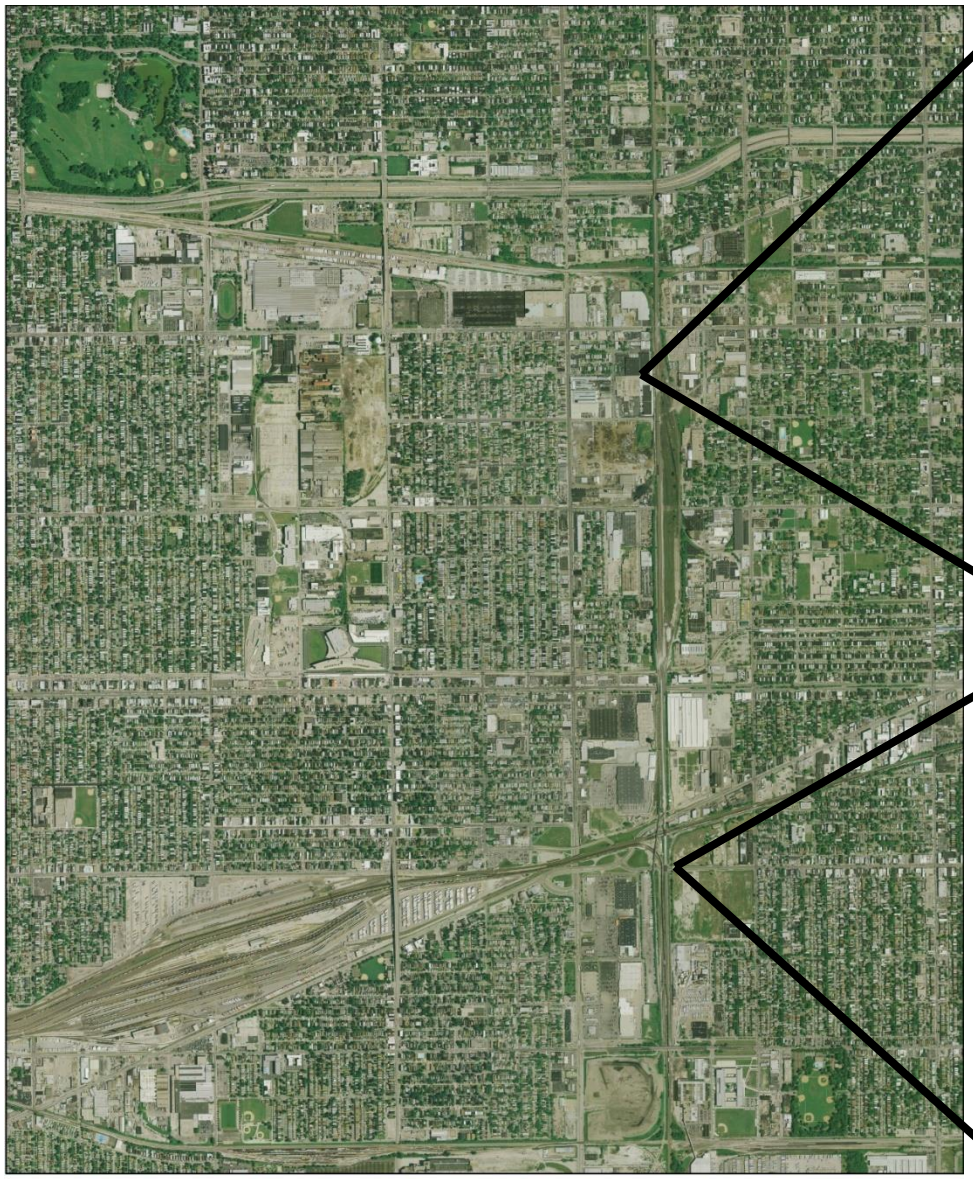
e.ellington@ufl.edu
https://www.ufwildlifeontherange.com/


0
0.3
0.6
1.2
1.8
2.4
km


Bushnell
CH 07
64°F 17°C
11-02-2016 07:49:22


PRIMUS

Hypothesis: Coyotes will respond synanthropically to suburban habitat but misanthropically to highly urbanized habitat

Urbanization

Urbanization

Synanthropic

1) Home range size ↓
2) Time spent encamped —
   but
3) Home range complexity ↑

Misanthropic

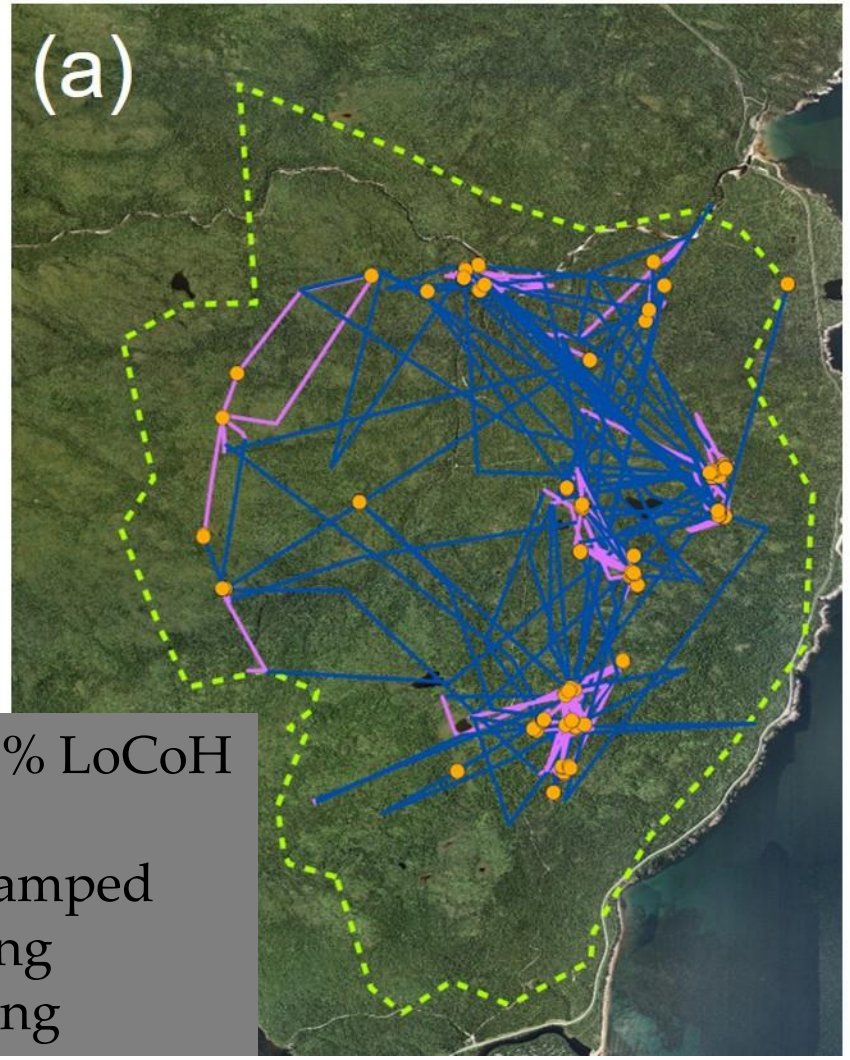
1) Home range size ↑
2) Home range complexity ↑
3) Time spent encamped ↑
   but
4) Ratio of foraging to traveling ↑

How much time do coyote spend foraging?

Cape Breton, Nova Scotia, Canada

Coyote spent about a

1/3 of their time foraging



Green dashed – 95% LoCoH

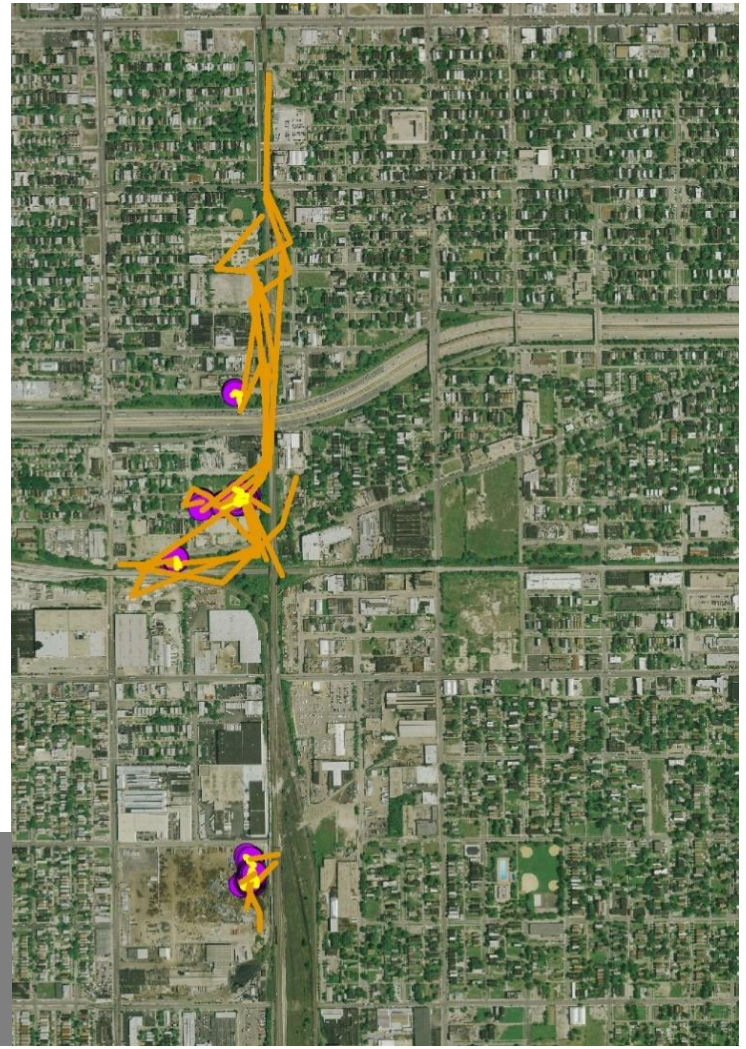
Orange dots – encamped
Pink lines – foraging
Blue lines – traveling

How much time do coyote spend foraging?

Chicago, Illinois

Coyote spent about a

1/4 of their time foraging



Purple dots – encamped
Yellow lines – foraging
Orange lines – searching

When did foraging behavior occur?

All times of day and night, but most frequently at dawn and dusk

Where did foraging behavior occur?

It depends on time of day, except for one general rule:

"close but not too close" strategy to roads and trails

Where did foraging behavior occur?

During the day

Prefer open areas without trees

Where did foraging behavior occur?

During the dawn and dusk

Avoid open areas

Prefer the forest edge

Prefer landscapes with a mixture of forest, open, wetland, etc.

Where did foraging behavior occur?

During the night

Avoid open areas