Name____________________

DATA Nugget

City parks: wildlife islands in a sea of cement

Featured scientists: Remington Moll and Grant Woodard from Michigan State University

Research Background

For most of our existence, humans have lived in rural, natural places. However, more and more people continue to move into cities and urban areas. The year 2008 marked the first time ever in human history that the majority of people on the planet lived in cities. The movement of humans from rural areas to cities has two important effects. First, the demand that people place on the environment is becoming very intense in certain spots. Second, for many people, the city is becoming the main place where they experience nature and interact with wildlife on a regular basis.

Remington and Grant are city-dwellers and have been their entire lives. Remington grew up in Tulsa, Oklahoma and Grant is from Cleveland, Ohio. In Tulsa, Remington fell in love with nature while running on the trails of city parks during cross country and track practices. Grant developed a love for nature while fishing and hiking in the Cleveland Metroparks in Ohio. These experiences led them to study wildlife found in urban environments because they believe that cities can be places where both humans and wildlife thrive. However, to make this belief a reality, scientists must understand how wildlife are using habitats within a city. This knowledge will provide land managers the information they need to create park systems that support all types of species. However, almost all research done on wildlife takes place in natural areas, like national parks, so there is currently very little known about wildlife habits in urban areas. To address this gap in knowledge, Remington, Grant, and their colleagues conduct ecological research on the urban wildlife populations in the Cleveland Metroparks.

The Cleveland Metroparks are a collection of wooded areas that range in size, usage, and maintenance. Some are highly used small parks with mowed grass, while others

Images of wildlife in the Cleveland Metroparks taken by wildlife cameras. From left to right: wild turkey, coyote, & white-taile deer.

NOTE: This Data Nugget module was modified from the original version by April Conkey, Texas A&M University-Kingsville, for use in RWSC 3310 Wildlife Management Techniques, Fall 2017 as part of the QUBES Faculty Mentoring Network.

are large, rural parks with thousands of acres of forest and miles of winding trails. As they began studying the Metroparks, they noticed the parks were like little "islands" of wildlife habitat within a large "sea" of buildings, pavement, houses and people. This reminded Remington and Grant of a fundamental theory in ecology: the theory of **island biogeography**. This theory has two components: size and isolation of islands. The first predicts that larger islands will have higher biodiversity because there are more resources and space to support more wildlife than smaller areas. The second is that islands farther away from the mainland will have lower biodiversity because more isolated islands are harder for wildlife to reach. Remington and Grant wondered if they could address this first part of the theory in the Cleveland Metroparks. These parks come in all different sizes. If the theory holds for the Metroparks, it could help them to figure out where most species live in the park system and help managers better maximize biodiversity. It would also provide an important link between ecological research conducted in natural areas and urban ecology.

Remington prepares to attach the camera to a buckeye tree. He secures them with a heavy duty lock to keep the cameras safe from theft by people using the parks.

To evaluate whether the theory of island biogeography holds true in urban areas, Remington and Grant set up 104 wildlife cameras throughout the parks. These cameras photograph animals when triggered by motion. They used these photographs to identify the locations of wildlife in the parks and to get a count of how many individuals there are, known as their **abundance**. With these data, they tested whether the size of the park would influence biodiversity as predicted by the theory of island biogeography.

One challenge with measuring "biodiversity" is that it means different things to different people. Remington and Grant looked at two common measurements of biodiversity. First, **species richness**, which is the number of different species observed in each park. Second, they calculated the Shannon Wiener Index of biodiversity for each park. This index incorporates both species richness and **species evenness**. Species evenness tells us whether the abundances of each species are similar, or if one type is most common and the others are rare. Evenness is important because it tells you whether a park has lots of animals from many different species or if most animals are from a single species. If a park has greater evenness of species, the Shannon-Wiener index will be higher.

Scientific Reseach Question: How does the theory of island biogeography help explain the distribution of wildlife in the Cleveland Metroparks?

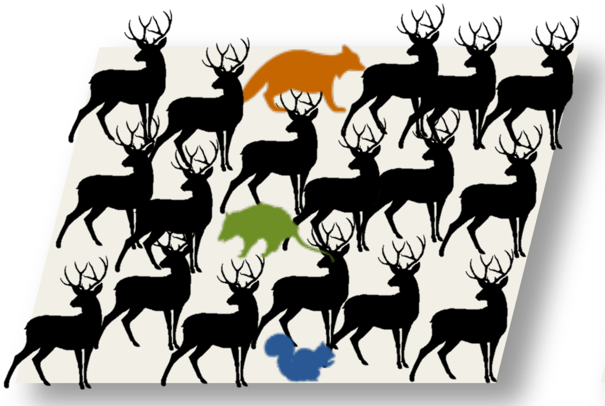
Wildlife camera placed on a tree in the Cleveland Metroparks. Cameras are housed in lockboxes to protect against theft.

The Rocky River runs through several of the Cleveland Metroparks. Remington waded across the river to hang a camera near its far bank.

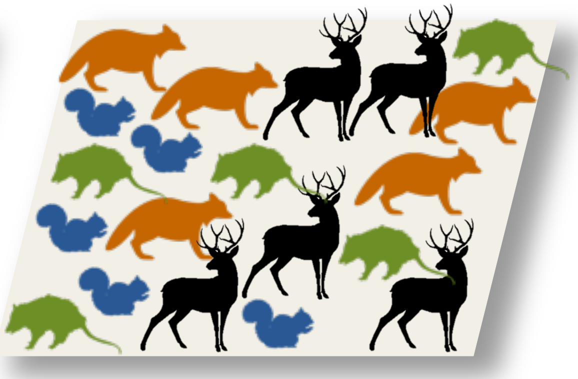
Exploring Measures of Biodiversity:

The scientists used two measures of biodiversity in their study – species richness and species evenness. The Shannon Wiener Index takes into account both of these measures. For example, consider the two **hypothetical parks** below, A and B.

Park A



Park B



Both parks have the same number of individuals and both have four species represented (mule deer, raccoon, opossum, and fox squirrel). But do the two parks have the same level of biodiversity?

Hypothetical Parks Example Name____________________

1. Describe the differences in the parks and which park you feel is more diverse (just by looking at the figures of Park A & B on bottom of previous page).

2. What would the species richness be for Park A? Species richness for Park B?

3. How do Parks A & B differ in species evenness? Which park should have a higher Shannon Wiener Index value based on evenness?

4. Calculate the Shannon Wiener Diversity Index (H') for both parks - use page 5.

5. What conclusion would you make about the mammal diversity in Parks A and B?

6. What does your conclusion tell you, if anything, about the diversity of other taxonomic groups in Parks A and B?

Calculations: Use the data and formulas below to calculate the Shannon Wiener index for both Park A and Park B. Imagine Park A has 85 mule deer, 5 fox squirrels, 5 raccoons, and 5 opossums. Park B has 25 mule deer, 25 fox squirrels, 25 raccoons, and 25 opossums. (*Note: each animal in the Park picture figures below represents 5 individuals of that species.*)

Below, you will find an example of how to calculate a Shannon Wiener Index for the two parks described above. This index accounts for species evenness in the estimate of biodiversity.

	PARK A	**Deer**	**Squirrel**	**Raccoon**	**Opossum**	Total
	Number of Animals	85	5	5	5	**100**
P_i	Species Proportion	85/100=	5/100 =	5/100 =	5/100 =	

	PARK B	**Deer**	**Squirrel**	**Raccoon**	**Opossum**	Total
	Number of Animals	25	25	25	25	**100**
P_i	Species Proportion					

Calculate the Shannon Wiener Index (H’) using the following equation:

$$H' = -\Sigma\,(P_i)\ln(P_i)\text{, where}$$

H’ = the Shannon Wiener Index value

Σ = sum
P_i = species proportion; the proportion of animals of the *i*th species
ln = the natural log

So in this example:
Park A: $H' = -(0.85*\ln(0.85)+0.05*\ln(0.05)+0.05*\ln(0.05)+0.05*\ln(0.05)) = 0.59$
Park B: $H' =$

7. What would be *the hypothesis* of the City Parks study? Use the Research Background section and the scientific research question to help you write the hypothesis.

8. Graph the results from the City Parks study. Results on pg. 7 and blank graphs on pg.8. Raw data on page 9 for reference.

9. For the City Park study, what is the independent variable and what is the dependent variable?

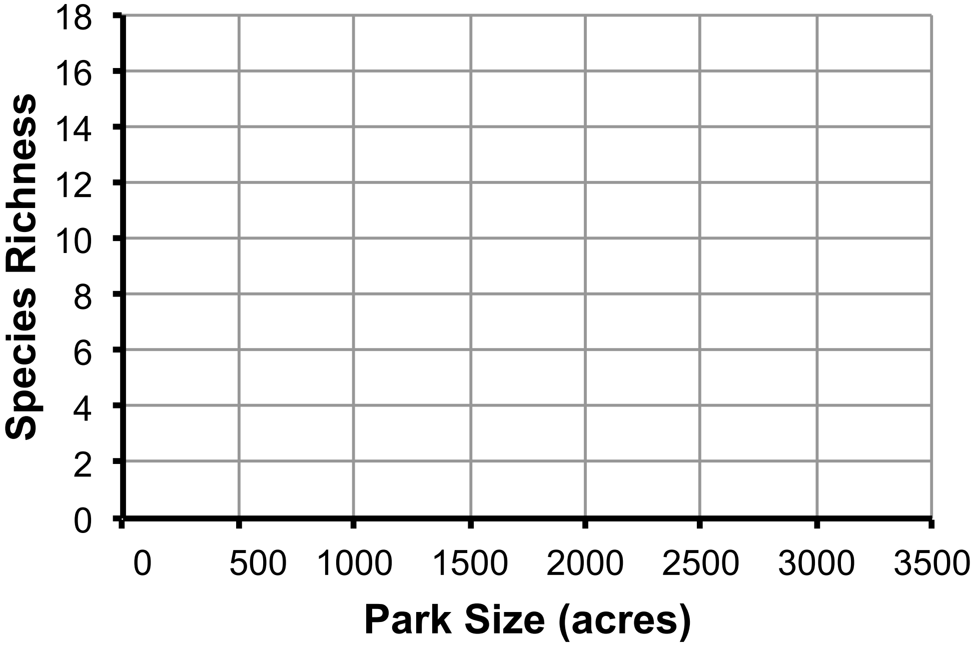
10. Do the results of the City Park study, support your hypothesis? Why or why not? Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about the relationship between park area and biodiversity and the theory of island biogeography.

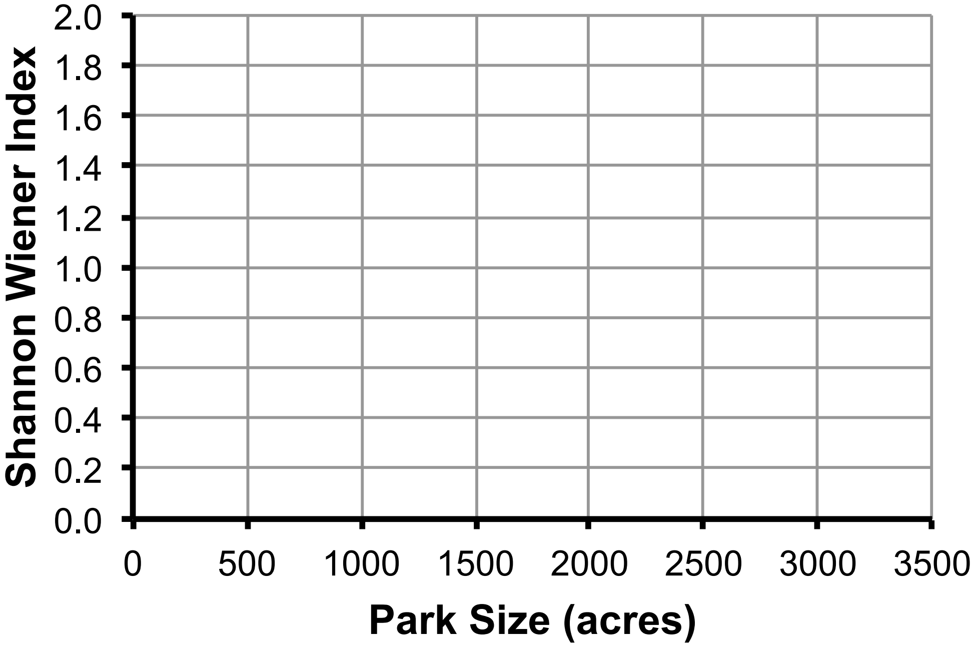
<u>Results</u>:

Use the City Park results below to test your hypothesis. Raw data on page 9.

Park Name	Park Size (acres)	Species Richness	Shannon Wiener Index
Brookside	145	9	1.740
Bradley Woods	795	12	1.310
Hinckley	2682	17	1.687
Huntington	103	9	1.455
Mill Stream	3189	16	1.418
Ohio and Erie Canal	312	8	1.314
West Creek	278	10	1.199

<u>Draw your graphs below</u>: Identify any changes, trends, or differences you see in your graphs. Draw arrows pointing out what you see, and write one sentence describing what you see next to each arrow.





City Parks Study

Park	Park Size (Acres)	Camera Code	CATDOM	CHIPMK	COYOTE	DEER	FLYSQL	FOXSQL	GRYSQL	MINK	MLGSQL	OPOSSM	RABBIT	RCOON	RDFOX	REDSQL	SKUNK	TURKEY	WDCHUK
Brookside	145	BK1152	15	0	4	15	0	19	0	0	0	1	2	19	12	0	2	0	0
Brookside	145	BK1200	0	0	0	21	0	47	0	0	0	0	0	45	30	0	9	0	0
Bradley Woods	795	BW1114	2	0	3	112	0	12	0	0	0	0	0	26	0	0	1	0	0
Bradley Woods	795	BW1134	1	0	4	98	2	26	2	1	0	3	0	97	0	1	1	0	0
Bradley Woods	795	BW1178	1	0	0	84	0	22	0	0	0	16	0	14	0	0	6	0	0
Bradley Woods	795	BW1198	0	0	1	40	0	26	0	0	0	1	0	46	6	0	0	0	0
Hinckley	2682	HI1101	0	0	4	18	0	220	23	0	30	1	1	123	4	0	2	1	0
Hinckley	2682	HI1117	0	0	4	19	0	70	0	0	5	0	0	69	0	0	0	0	0
Hinckley	2682	HI1130	3	1	28	3	0	1	0	6	0	4	6	10	0	0	2	0	0
Hinckley	2682	HI1133	0	0	52	48	0	23	0	0	0	0	37	42	0	0	0	0	0
Hinckley	2682	HI1146	0	0	12	44	0	102	1	0	0	0	0	52	0	0	0	1	0
Hinckley	2682	HI1149	2	1	3	77	0	71	0	0	0	0	1	121	0	0	3	0	0
Hinckley	2682	HI1162	2	1	10	10	0	143	7	7	0	5	0	165	1	1	7	6	3
Hinckley	2682	HI1165	1	0	2	0	0	8	0	3	0	0	1	16	0	0	0	0	0
Hinckley	2682	HI1181	0	0	1	7	0	2	0	1	1	0	0	13	1	1	0	0	0
Hinckley	2682	HI1194	0	0	9	14	1	17	37	0	18	0	4	74	0	0	6	0	0
Hinckley	2682	HI1197	0	0	11	45	1	36	2	0	0	0	0	18	0	0	0	0	0
Huntington	103	HU1195	3	0	1	9	0	20	2	1	0	3	0	42	2	0	0	0	0
Mill Stream	3189	MS1103	0	0	15	15	0	168	25	0	11	0	0	9	0	2	0	6	0
Mill Stream	3189	MS1115	0	0	6	47	0	86	0	0	1	0	0	21	0	0	2	0	0
Mill Stream	3189	MS1126	0	0	2	27	0	37	3	0	0	3	0	47	1	0	6	2	0
Mill Stream	3189	MS1131	0	0	6	137	0	119	0	2	0	4	0	25	17	0	1	13	2
Mill Stream	3189	MS1135	0	0	8	49	0	113	0	0	0	8	0	39	0	0	2	1	0
Mill Stream	3189	MS1147	0	0	3	21	0	102	1	0	1	0	0	69	0	0	0	1	0
Mill Stream	3189	MS1151	0	0	8	139	1	228	1	0	0	2	1	63	1	0	2	10	0
Mill Stream	3189	MS1163	0	0	11	31	0	232	0	1	0	2	3	5	1	0	1	0	2
Mill Stream	3189	MS1167	4	0	35	130	0	39	0	0	0	1	1	5	4	0	1	1	0
Mill Stream	3189	MS1179	1	0	7	39	0	110	0	0	0	7	0	84	1	20	2	0	0
Mill Stream	3189	MS1190	1	0	2	149	0	29	0	0	0	4	0	39	2	0	0	15	0
Mill Stream	3189	MS1199	0	0	8	108	0	296	0	0	0	8	0	31	0	0	0	0	0
Ohio / Erie Canal	312	OE1116	0	0	11	35	0	57	0	0	0	2	69	0	0	0	0	0	0
Ohio / Erie Canal	312	OE1180	0	0	7	55	0	90	0	0	0	2	41	1	1	0	0	1	0
West Creek	278	WC1008	1	0	6	154	0	43	0	0	0	0	0	29	1	0	0	0	0
West Creek	278	WC1376	0	0	7	60	0	55	0	0	0	0	0	11	2	0	0	0	0
West Creek	278	WC1388	1	0	2	116	0	61	0	0	0	1	0	69	1	0	0	0	2
West Creek	278	WC3420	2	0	2	73	0	106	0	0	0	2	0	34	5	0	0	0	0
West Creek	278	WC3596	0	1	1	85	0	67	0	0	0	1	0	19	0	1	0	0	0
West Creek	278	WC3668	0	1	3	17	0	53	0	0	0	0	0	10	0	0	0	0	0

http://wildlife.ohiodnr.gov/species-and-habitats/species-guide-index/mammals

	Data code	Common name
Species list	**CATDOM**	domestic cat
	CHIPMK	eastern chipmunk
	COYOTE	coyote
	DEER	white-tailed deer
	FLYSQL	southern flying squirrel
	FOXSQL	eastern fox squirrel
	GRYSQL	eastern gray squirrel
	MINK	American mink
	MLGSQL	melanistic eastern gray squirrel
	OPOSSM	Virginia opossum
	RABBIT	eastern cottontail rabbit
	RCOON	raccoon
	RDFOX	red fox
	REDSQL	red squirrel
	SKUNK	striped skunk
	TURKEY	wild turkey
	WDCHUK	woodchuck (groundhog)

This Data Nugget module was modified from the original version by April Conkey, Texas A&M University-Kingsville, for use in RWSC 3310 Wildlife Management Techniques, Fall 2017 as part of the QUBES Faculty Mentoring Network.