Assortative Mating Among Pigeon Morphs

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Introduction:

If all birds looked the same, it would be boring. Luckily, pigeons don't look the same. Feral pigeons are diverse in color and display different morphs. This phenomenon occurs because pigeons mate with each other and diversify their gene pool. Instead of a regular field trip in GEOG/ES&P 330, an alternative, self-guided pigeon watch occurred in various locations. Feral pigeons show sustained morphic diversity around the world, but they or may not engage in assortative mating. Assortative mating occurs when organisms court and mate with other individuals similar to themselves than the rest of the species, therefore reproductive isolation occurs among lineages. With assortative mating, there are limitations towards inbreeding errors. In 1999, Melina S. LaBranche made the argument that pigeons engage in assortative mating which explains the common occurrence for the wild blue-bar morph in Southern California, but that theory will once again be tested through the Geography 330 Fall 2020 students with Project Cornell University's Ornithology lab. Pigeon courting was observed with different types of pigeon morphs for sexual selection for the occurrence for assortative mating. We sought to answer the question, "are male pigeon morphs more likely to engage in assortative mating?" The null hypothesis argues that pigeons do engage in assortative mating. The alternative hypothesis suggests that the pigeons do not engage in assortative mating.

Literature Review:

Several experiments have been conducted to try and express pigeon mating preferences as factors of morph similarity. A study conducted in 2016 (feral pigeons prefer similar mates), measured genetic similarity between blood samples of 70 french feral pigeon courtships and found that mates of similar genetic traits were favored with even some inbreeding trends. When given limited mating options, pigeons chose to inbreed than mate with a pigeon of drastic genetic difference. This study argues that mating with unrelated pigeons can have negative consequences for a population that has a certain gene trait adapted to local conditions. In another study about mate choice and quality conducted in 1977 by the Zoology department of the University of Texas, results found that color is preferred over pattern and the color that is preferred the most is blue and the least ash red. That being said, Blue bar pigeons are more selective in choosing a mate than an ash red pigeon, while all pigeons are selective of who their potential mates will be, male pigeons are the most selective. Lastly, an experiment by University of Kansas Ecologist in 1989, found dis-assortative mating trends just like in Nancy Burley's results. However, in this experiment, pigeon size is used in mating selection criteria as well as plumage preference. The study found that not only are blue-bars of both sexes preferred for mating but so are larger sized pigeons. Interpretation of more than one physical pigeon characteristic insinuates the possibility of multiple influences affecting preference.

Methods:

Since Dr. Rodrigue is fond of pigeons, the class followed Cornell's Project PigeonWatch protocol.Through PDF files, students were given information about identifying morph types and courtship behaviors. Using Cornell's Project PigeonWatch guidelines, students observed a minimum of 30 pigeons in at least 3 different locations for at least 15 minutes. Each location required one tally sheet and one habitat sheet. For the tally sheet, students double counted the amount of pigeons in a flock and counted the morph type. Students observed each pigeon to identify the morph type, and observe the pigeons for courting behavior. If there was courting or copulation taking place, students noted the specific morphs doing the deed and being targets of courtship behavior. Additionally, the coordinates of the location in decimal degrees along with the address of the location was noted. For the habitat sheet, students must identify the temperature, vegetation type, climate, food sources, and any bodies of water. Due to the ongoing pandemic, each individual student conducted their own outdoor pigeon watch independently.

Data:

Once the data was gathered, it was assembled into bar charts to show the results of both queries .The total pigeon population observed results in over 1,500 total pigeons with 89 courtships in total. With simple random sampling, pigeons were separated into their morph type to observe assortative mating.

Figures 1 and 2 share similar variables.The independent categorical variable consists of the seven different pigeon morphs, but they are broken down into the following morphs: wild-type (blue-bar), melanic (spreads and checkers), and odd birds (red-bars and reds and albanics, or pieds and whites). The wild type predominantly consists of the blue bar morphs. The melanic type typically has the melanin across the wing covers. Oddball types consist of the red-bar and red morphs, the white birds with red markings, and pieds or white birds. The dependent quantitative variable consists of the different types of female morphs that male morphs would choose to mate or the number of observed pigeon courting. Each variable is measured at the 95 percent confidence level.

Figure 1 shows the mating patterns of the birds based on their morph. The first bar shows blue bars mating preferences and it is shown that they prefer to mate with wild type birds with 24 mating incidences, then melanic types with 17 mating incidences , then the odd types with only 4 mating incidences. The second bar shows melanic mating preferences and it is shown that they prefer to mate with melanics with 20 incidences, followed by wild types with 16 incidences, and then the odd types with 3 incidences. Finally, the third bar shows the mating patterns of odd type birds which shows even mating between odd and melanic which both had 5 incidences, followed by the wild types with 4 incidences.

Figure 2 describes female target morphs chosen for courtship by males. In Figure 2 we use “Wild Type” to describe the Blue Bar morph pattern. Of the 44 total courtships involving wild type males, 24 targeted females of the same morph and 20 targeted females of a different morph. Of the 44 total courtships involving Melanic morphs males, 20 targeted females of the same morph and 22 targeted females of a different morph. Of the 12 total courtships involving Odd morph males, 5 targeted females of the same morph and 7 targeted females of a different morph.

Figures 3-5 reveal the chi-square goodness of fit test through several distribution charts. Through these charts, the observed and expected variables were observed and duly noted within the chi-square goodness-of-fit test. These were compared and contrasted to determine whether or not there was a difference in each category of pigeon morphs.

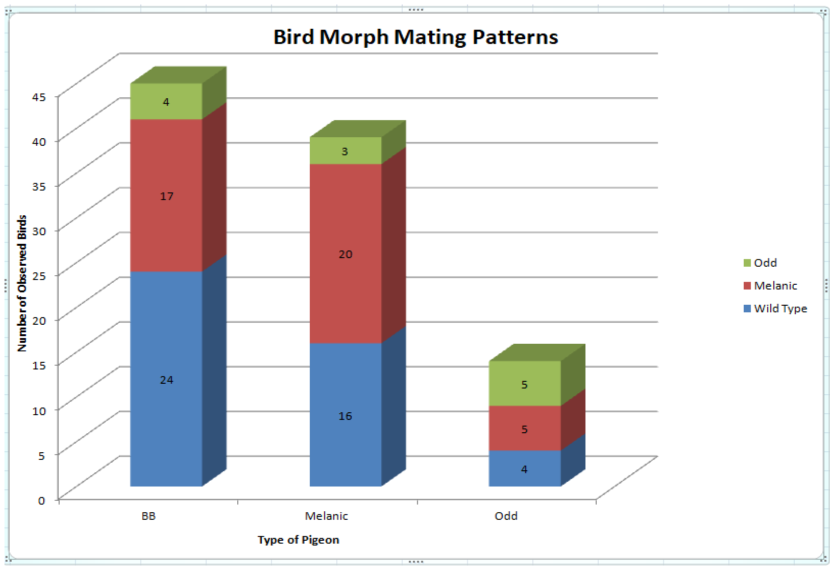

Figure 1: In observation of the bird morph mating patterns with types of pigeons courting with various types of pigeons.

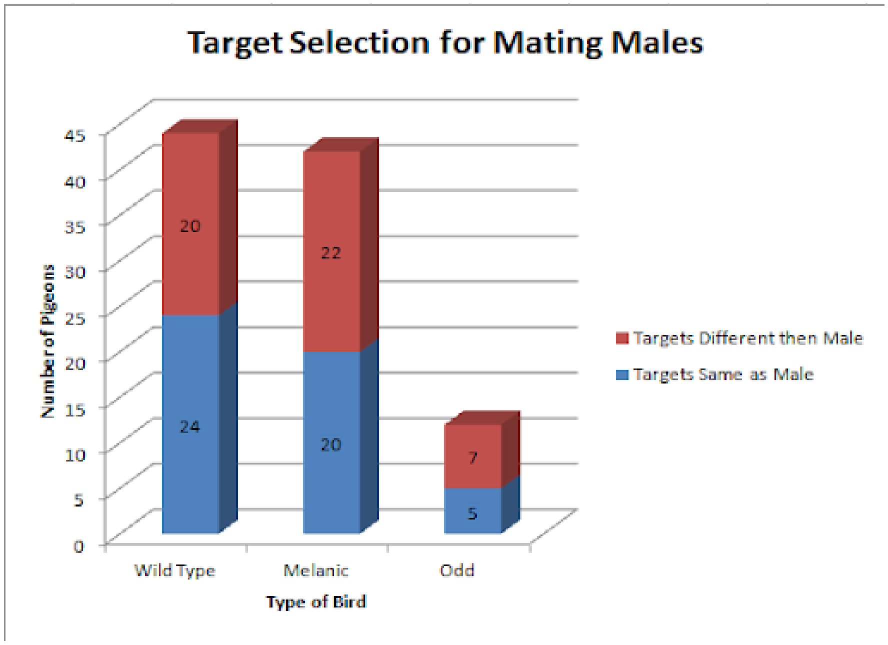

Figure 2: The male morphs showed their target selection for female morphs.

A	B	C	D	E	F	G	H	I	J	K	L	M	N
X^2	Enter data and *alpha* in yellow cells only								Outputs in blue cells				
VAR 1		VAR 2					*		Cell	O	O sq.	E	O sq./E
	a		b		c								
Obs	24		16		4		44		a	24	576	20.204	28.509
Exp	20.204		17.510		6.286				b	16	256	17.510	14.620
	d		e		f				c	4	16	6.286	2.545
Obs	17		20		5		42		d	17	289	19.286	14.985
Exp	19.286		16.714		6.000				e	20	400	16.714	23.932
	g		h		i				f	5	25	6.000	4.167
Obs	4		3		5		12		g	4	16	5.510	2.904
Exp	5.510		4.776		1.714				h	3	9	4.776	1.885
									i	5	25	1.714	14.583
*	45		39		14		98						
													108.130
												X^2_{calc}	10.130
												alpha	0.05
												df	4
	Percentage of expected counts < 5				22.22 %							X^2_{crit}	9.488
	(if > 20%, collapse data rows)											prob	0.038
	Number of expected counts ≤ 1				0								
	(if there are any, collapse rows)											k (min r or c)	3
												(effect size measure) Cramér's V	0.227
												(effect size measure) φc or w	0.322
												Noncentrality (λ)	5.065
β/α: ratio of Type II to Type I error probability					7.257								
												Estimated power (1-β)	0.737
												Corrected power (Rodrigue)	0.722

Figure 3: In comparison between the observed and the expected values, figure 1 is depicted through the chi-square distribution chart for pigeon morph mating patterns.

	A	B	C	D	E	F	G	H	I	J	K	L
1	X^2	Enter data and *alpha* in yellow cells only							Outputs in blue cells			
2	VAR 1		VAR 2			*		Cell	O	O sq.	E	O sq./E
3		a		b								
4	Obs	24		20		44		a	24	576	22.000	26.182
5	Exp	22.000		22.000				b	20	400	22.000	18.182
6		c		d				c	20	400	21.000	19.048
7	Obs	20		22		42		d	22	484	21.000	23.048
8	Exp	21.000		21.000				e	5	25	6.000	4.167
9		e		f				f	7	49	6.000	8.167
10	Obs	5		7		12						
11	Exp	6.000		6.000								
12												98.792
13	*	49		49		98					X^2_{calc}	0.792
14											*alpha*	0.05
15											df	2
16											X^2_{crit}	5.991
17		Percentage of expected counts < 5				0.00 %					prob	0.67294
18		(if > 20%, collapse data rows)										
19		Number of expected counts ≤ 1				0					k (min r or c)	2
20		(if there are any, collapse rows)									(effect size measure) Cramér's V	0.090
21											(effect size measure) φc or w	0.090
22											Noncentrality (λ)	0.792
23	β/α: ratio of Type II to Type I error probability					1.315						
24											Estimated power (1-β)	0.089
25											Corrected power (Rodrigue)	0.115
26												
27												
28												

Figure 4: In comparison between the observed and expected values, figure 2 is depicted through the chi-square distribution chart for male morph target selection.

Figure 5: A chi-square distribution chart depicted at the 95% confidence level for pigeon morph cumulative data from figure 1; wild type versus other.

Discussion:

According to the chi-square goodness-of-fit results, male morphs were more likely to engage in assortative mating within the wild-type pigeons more than the melanic and oddball types.

Through graphs, Figure 1 and Figure 2 observe the male morph courting behavior. Figure 1 reveals the number of observed bird mating patterns. For the wild-type and melanic pigeons, male morphs predominantly chose female morphs with the same type. From this graph, we can see that with blue bars, 53.33% mate with wild types, 37.77% mate with melanic types, and 8.88% mate with odd types. When it comes to melanic types, 41.02% mate with wild types, 51.28% mate with melanic types, and 7.69% mate with odd types. Finally the odd types mated 28.57% with wild types, and 35.71% for both melanic and odd types.

Figure 2 reveals the male morph target selection occurs more likely between the same female morph types. From this graph, we can see that with blue bars, 54.55% select wild types, and 45.55% select other types. When it comes to melanic types, 52.38% select other morphic types, 47.62% select melanic types. Finally the odd types mated 28.57% select other morphic types, and 71.43% select odd types as well.

Through Figures 3-5, the observed and expected variables were very similar. Categories with a large difference between observed and expected values make a larger contribution to the overall chi-square statistic. The charts for Figure 4 and 5 indicate that the observed values for each category have a small difference to the expected values for each category; therefore the male pigeon morphs engaged in assortative mating.

Through the observed variables for bird morphing patterns, Figure 1 chi-square goodness-of-fit test was examined through Figure 3. At the 95 percent significance level, the p-value at 0.038 is less than the significance level, therefore we reject the null hypothesis in favor of the alternative hypothesis and the result is statistically significant.

Through the observed variables for male pigeon target selection, Figure 2 chi-square goodness-of-fit test was examined through Figure 4. At the 95 percent significance level, the p-value at 0.673 is greater than the significance level, therefore we fail to reject the null hypothesis and the results are statistically insignificant (n.s.).

Through the observed variables for male wild-type pigeon morphs, chi-square goodness-of-fit test was examined through Figure 5. At a 95 percent significance level, the p-value at 0.122 is greater than the significance level, therefore we fail to reject the null hypothesis and the results are statistically insignificant (n.s.). The alternative hypothesis can not be accepted. There is a tendency for assortative mating. No relationship exists on the categorical variables in the population; they are independent.

However, based on our observations, we do not have enough data to conclude that this is an actual correlation with the amount of data that we have. Therefore, we cannot conclude that the observed proportions are significantly different from the specified proportions. We need a greater sample size to conduct a more accurate chi-square goodness-of-fit test.

Conclusion:

Having enough statistical evidence to deduce a tendency for pigeons to favor assortative mating does not necessarily solidify a correlation. The inconclusive results could be due to lack of pigeon observations.The observed pigeons used in the data are mostly from Southern California in a predominantly urban/city setting during the year 2020. Pigeons in these areas get their food scavenging through left out human food, food handouts or food scraps from trash.

During the 2020 year, humans experienced reduced outdoor activity due to the Coronavirus Pandemic that more than likely made food scarce for the dependent pigeons. Student recorded pigeon sightings this year were low compared to previous years possibly due to students staying home as universities nationwide closed in person instruction in response to the Pandemic. Less food from human activity that is available means pigeons must look elsewhere for food. It is not known at this time the direct impact the Coronavirus Pandemic has on pigeon scarcity but can be a good indicator to why the data was inconclusive.

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