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Sexual Selection and Morphic Diversity in Feral Pigeons

Introduction

Feral pigeons, in spite of their global presence and ecological features, have not been of significant interest to the scientific community—chiefly because numerous scientists are doubtful of what feral pigeons could contribute. That being said, feral pigeons have been able to adapt to an anthropogenic terraformed world of suburban parks, beaches, urban cities, and rural countryside and farmland. These populations have been established for extensive periods of time, and despite this, many populations exist in a variety of diverse plumages. This is peculiar, and of great interest (or at least should be) to the scientific community as various established urban populations have never reverted to the plumage of their wild relatives. There are no other wild animals that have been able to keep their domesticated color for longer than the span of a few generations. So why then aren't all pigeons blue-bars, the original color morph of pigeons? It is believed by ecologists that the colors an organism exhibits are matched in some way to their respective environments (LaBranche).

This report discusses sexual selection among urban pigeons as a hypothetical explanation for how they sustain such morphic diversity. The majority of species that are preyed upon and live in congregation appear to be driven by predation to adopt a single common morph, a concept known as stabilizing selection. An organism that does not match its environment (i.e. easy to detect) can be spotted much easier by a predator. Traits that are the most beneficial to survival are more likely to be passed down to future generations. Thus, an organism that does not match its environment, has a trait that is a hindrance to its survival, and so that trait will be less likely to be passed down.

An alternative explanation could be that some colors are preferred to others in terms of mating. In this case, the organism with the preferred color morph will produce more offspring compared to other colored morphs. The basic concept is that the color of the plumage is hereditary, so the colors exhibited in future generations are dependent on what morph has the most offspring—and natural selection and sexual selection are important factors that influence who has the most offspring. There have been many studies that have attempted to explain the wide variety of plumages in feral pigeons. For example, one such study discusses how "the relatively small home range of the pigeons and the dispersion carried out by humans are discussed as possible explanations for the current genetic profiles" (Peñuela, et al). Another study explains how pigeon flocks with denser populations tend to be more melanistic. For instance, urban pigeon populations tend to be more melanistic compared to rural populations (Obukhova). One study investigates whether the color morph of a fledgling affects its survivability into adulthood; the study suggests that "observed changes in plumage morph frequencies are associated with selection episodes taking place between fledging and independence" (Haag-Wackernagel). There is even a study that suggests that melanin-based coloration among pigeons may be linked to the intensity of a parasite and the immune response of said pigeons (Jacquin).

With the aforementioned concepts in mind, we again ask, why do pigeon populations exist in a variety of colors? This question deals with a hypothesis that is complicated to test. It may prove easier to determine the proportions of each color morph in the regional population and what color males are mated to what color females.

This report is testing whether or not sexual selection may be responsible for the diversity of colors seen in pigeons plumages. We are evaluating whether there are certain morphs that are more sexually active than others which could act as a mechanism to sustain diversity in morphs despite stabilizing selection. If this turns out to be the case, then the more sexually active morphs may catalyze and augment shifts in the genes conveyed in following generations. Thus, we are trying to determine if sexual selection among urban pigeons possibly acts as an instrument in sustaining morphic diversity. We are trying to ascertain if certain male morphs initiate more courtships compared to others, and if particular female morphs are targeted for courting more than others. It follows, then, that our null hypothesis is that sexual selection does not sustain morphic diversity in urbanized pigeons. Our alternative hypothesis would be the converse of that: sexual selection does sustain morphic diversity in urbanized pigeons. We will be testing this hypothesis by determining if there is a significant difference in the morphic diversity of the regional urban pigeon population compared to the morphic diversity of courting males, and courted females.

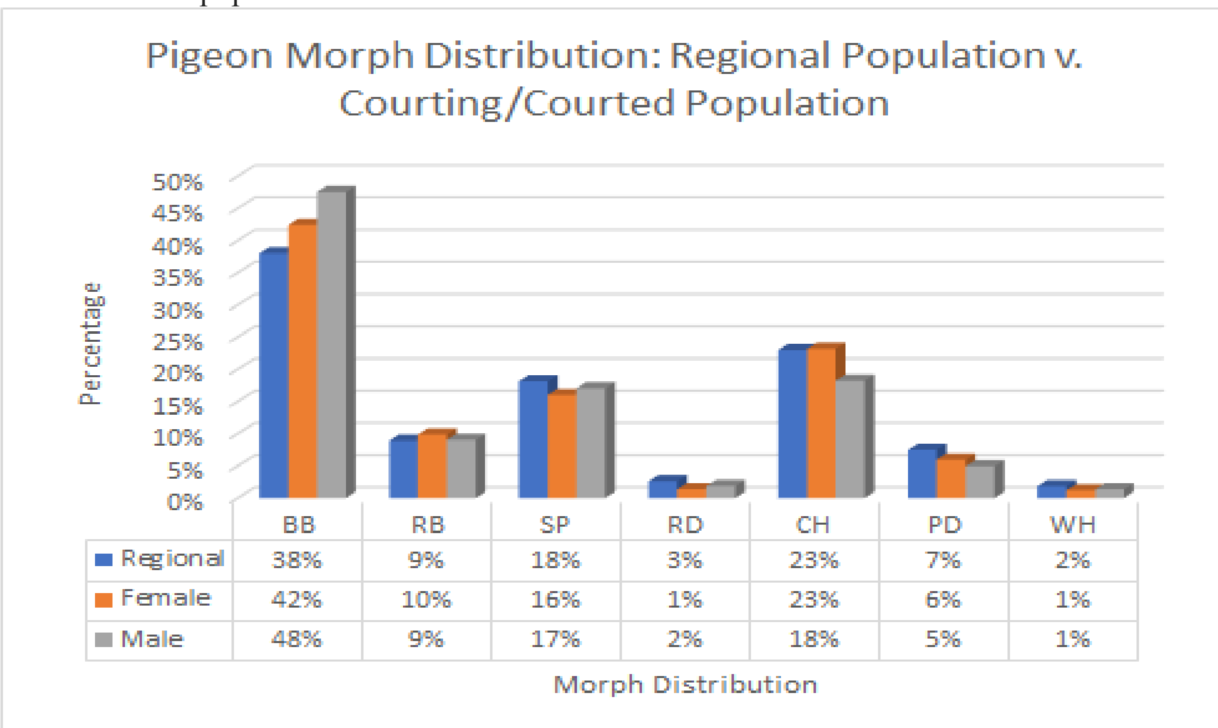
We are using data collected by students across nearly two decades in various areas including suburban parks, beaches, urban shopping centers, cities, and rural settings. The majority of these data were collected in Los Angeles, Long Beach, and Orange Counties. These data may yield significant information that will assist in shaping how color morphs are dispersed and whether pigeons select mates that are similar or different from themselves; moreover, these data will assist in determining if mate choice is influential to morphic diversity.

Data and Methods

As mentioned before, we are using data collected by students across nearly two decades in various areas including suburban parks, beaches, urban shopping centers, cities, and rural settings. The students went out into the field and chose a study area of a size approximating one city block. They noted their GPS coordinates, and began counting the size of the flock of pigeons in their study areas. After an initial count, the students began counting and tallying the various color morphs they observed, and watched for any courting behaviors. If they observed a courting behavior the students noted what bird was performing the courting behavior and what bird was the target. The students then sent in their data to Dr. Rodrigue, who compiled all the data into a spreadsheet that illustrated the total number of birds in each respective color morph, and the number of courters and courtees in each respective color morph. Our team extrapolated the data from Dr. Rodrigue's spreadsheet, and input the relevant data into VassarStats, a website that computed a table illustrating observed versus expected values, standardized residuals, chi square values and p-values. We used the data tables yielded from VassarStats to create bar graphs juxtaposing the morph distribution of the regional pigeon population to that of the courting male and courted female populations. The downside of using VassarStats is that it did not yield effect size, or post-hoc power achieved. However, given the size of the data, we can assume that the P-value is enough to give us significance.

Results

Below are the tables yielded from VassarStats, and a clustered bar graph comparing the morph distribution between the regional pigeon population, courting male population, and the courted female population:



Males							
	Observed frequency	**Expected frequency**	**Expected proportion**	**Percentage deviation**	**Standardized Residuals**		Chi-sqr = 27.29
BB	279	223.11	0.38008971	25.05%	3.74		
RB	53	52.36	0.08919945	1.22%	0.09		df = 6
SP	100	106.34	0.18115942	-5.96%	-0.61		P = 0.0001
RD	11	15.39	0.02622498	-28.53%	-1.12		
CH	107	134.9	0.22981367	-20.68%	-2.4		
PD	29	43.95	0.07487923	-34.02%	-2.26		
WH	8	10.94	0.01863354	-26.87%	-0.89		

Females							
	Observed frequency	**Expected frequency**	**Expected proportion**	**Percentage deviation**	**Standardized Residuals**		Chi-sqr = 11.85
BB	249	223.11	0.38008971	11.60%	1.73		
RB	58	52.36	0.08919945	10.77%	0.78		df = 6
SP	94	106.34	0.18115942	-11.60%	-1.2		P = 0.0654
RD	8	15.39	0.02622498	-48.02%	-1.88		
CH	136	134.9	0.22981367	0.82%	0.09		
PD	35	43.95	0.07487923	-20.36%	-1.35		
WH	7	10.94	0.01863354	-36.01%	-1.19		

deviation for blue-bar pigeons is 25.05% and the standardized residual is +3.74 which is extremely high; thus, illustrating that blue-bar pigeons are driving much of the courting attempts. Conversely, pied pigeons are under-represented, illustrated by their percentage deviation of -34.02% and their standardized residual of -2.26, which is a significant departure. We can deduce with some certainty that blue-bar pigeons are heavily overrepresented in terms of courting while pied morphs are underrepresented.

Focusing on the females now, our data suggests that there is not a significant difference in morphic distribution between the female morphs and the regional population. The female P-value is 0.0654 which is just above the .05 standard, which means that our data did not yield significant results. While there are some females that had significant percentage deviations (red morphs were -48.02 and white morphs were -36.08) their standardized residuals stayed within one z-score, illustrating no significant departures from the regional herd. The female morphs are represented fairly proportional to the regional herd.

Our results show male blue-bar pigeons being overrepresented, and male pied morphs being underrepresented. Moreover, our data indicates female pigeon morphs are represented proportionally to the regional herd. Therefore, accepting or rejecting the null hypothesis becomes quite complicated. Blue-bars, which are the original wild type morph, are the most abundant morph in terms of the regional population and courtships. Moreover, the other color morphs (with the exception of red-bars) are actually underrepresented in terms of courtships. These data show (significantly in terms of the male pigeons) that the wild-type blue-bar morph is more often involved in courtships, almost as though sexual selection may be reinforcing stabilizing selection toward the wild-type; therefore, we can conclude that there must be some other factor that sustains morphic diversity. Thus, sexual selection probably is not what is sustaining the domesticated morph plumages, and so we would probably have to accept the null hypothesis: sexual selection does not sustain morphic diversity in urbanized pigeons.

Conclusions

With this study, we attempted to determine whether or not sexual selection is playing a role in maintaining the morphic diversity in which feral pigeons exhibit. We found that the wild-type morph, blue-bar, was the most abundant morph; which seems as if it would be reinforcing stabilizing selection. Therefore, there must be another factor responsible for sustaining the morphic diversity of feral pigeons.

Some potential problems that may have affected this study may tie back to the data collection. This project focused mainly on males initiating courting behavior rather than successful courtships with females. Students were required to observe the pigeons for 15 minutes, which can be considered a small window for observing any courting behavior. While observing pigeons after they eat can be great for observing courting behaviors, 15 minutes may not be enough of a window to allow the birds to eat and then exhibit said behavior. For future research purposes, observing pigeons for longer than 15 minutes may prove beneficial. Moreover, in processing the data, we utilized VassarStats to yield our results. However, there were some weaknesses with this website; for instance, it did not yield an effect size, or post-hoc power. Due to the size of the data, we were able to assume the P-value was telling of significance, but for future data processing it may prove beneficial to be able to calculate effect size and power.

References

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