Natalie Krowitz
12/13/17

Term Project Summary

This short book gives a little bit of information on America's least favorite bird, the feral pigeon. Its origins are not well known and it is often misunderstood as a trash-eating pest. However, the feral pigeon has a long history, starting with its domestication over 5,000 years ago.[1] It has been introduced all over the world and flourishes in cities. Its scientific name is *Columba livia;* otherwise known as the rock dove. Tt roosts on high cliffs and not in trees. For this reason, it's very numerous in modern cities, where high-rise buildings dominate the landscape. The pigeon is one of the most common animals in an urban habitat and the density of pigeon populations often correlate with how highly developed and populated an area is.[2] They are not native to most of their current range, although they are highly adaptable to human environments. In popular opinion, pigeons are considered as harmful to public health, to architecture, and to native species. However, pigeons are also subject to the native predators of their environment, and just like any animal, have adaptations that help them to thrive in their environment. Feral pigeons have not become a separate species, however, due to the continuance of pigeon-racing and the constant escape of domestic pigeons into feral flocks.

The project incorporates several historical facts as well as scientific ideas and facts into its overall review of feral pigeons. First is an understanding of the natural habitat of the wild rock dove, from which feral pigeons are descended. The rock dove lives on cliffs, which makes it naturally predisposed to nesting on tall buildings such as those present in a city. Pigeons have also been domesticated for 5,000 years, giving them enough time to have become at least a little divergent from the true wild population. They've been bred primarily for food and sending messages, and came to most of the countries they now reside in within that context. [3] There are many, many domestic breeds showing a high level of diversity in color, size, pattern, body shape, and abilities. This diversity fascinated Charles Darwin, who not only bred them, but used them as an example of variation under domestication in *The Origin of Species.*[4] A study done on feral pigeons around the world determined that feral pigeon populations in North America had significant input from one breed, the Racing Homer - a very common breed for those who fly their birds long distances. This is corroborated by breeders' accounts that "up to 20% of their birds that start a race do not return," making racing homers likely one of the most active contributing breeds to the feral population in North America, both now and in the past.[5]

Another very general scientific idea touched on in the project is the effect of natural selection on feral pigeon populations, even in urban areas. Predation does occur, much of it by birds of prey such as peregrine falcons. Their method of hunting involves picking off unusually colored or patterned birds, which leads to these birds being a small minority in the general pigeon population. Most pigeons are bar, t-check, or check patterns, with blue or brown coloration. Predation keeps the proportion of dull birds to

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[1] Johnston, Richard F. "Feral Pigeons." The Kansas School Naturalist 45.2 (1998.) Emporia State University. Web. 30 Sep 2017.
[2] Ibid.
[3] Johnston, Richard F. "Feral Pigeons." The Kansas School Naturalist 45.2 (1998.) Emporia State University. Web. 30 Sep 2017.
[4] The Origin of Species (book)
Darwin, Charles Robert. The Origin of Species. New York: Grammercy Books, 1979.
[5] Stringham, Sydney, et. al. "Divergence, Convergence, and the Ancestry of Feral Populations in the Domestic Rock Pigeon." Current Biology 22.4 (2012): 302-308. ScienceDirect. Web. 1 Oct. 2017.

unusual birds at a constant rate.[6] In addition, an as-yet-unknown factor makes it so that the type of plumage that dominates the pigeon population changes with distance from urban centers. Light colorations such as blue bar and barless are more common around suburbs and rural areas, while dark t-check ad check plumages are most common in city centers. This implies that pigeons' plumage, and the traits that come with it, are adapted to different environments.[7] The project illustrates that there is evidence that plumage does come with genetic benefits - dark-colored pigeons have more, healthier offspring,[8] and have better immune systems.[9] The project also brings up the genetic basis of feral pigeons' preference to mate with dissimilar individuals - a behavioral adaptation which protects against genetic illness and chick death, and produces fitter offspring.[10] The consequences of mating with a similar mate may be extreme, as in the lethal homozygosity of the Dominant Opal gene[11], or it may be as simple as producing an offspring which is a little smaller and more prone to parasites than your neighbors' kid from across the street.

The first personal message at the end of the book communicates ideas derived from a French study on people's interactions with pigeons and how it affects, or is affected by, loss of biodiversity in cities and general apathy towards nature. The study was not directly about pigeons, but rather about how normative messages and the circumstances of urban life could cultivate apathy towards pigeons and possibly towards urban nature in general.[12] I was convinced, myself, of the necessity of dispelling these normative, negative messages. It holds very little scientific information on its own, but I feel that it significantly influenced my project.

The work is modeled after a comic book to allow for a lot of text along with the images, and to have a quick succession of ideas presented in just a few pages. A lot of the concepts required extra explanation. Unfortunately, due to time constraints, I was not able to make many of the pages that presented the scientific side of the issue, which makes the text all the more important.

The first two pages illustrate the history of pigeons and a tiny bit of their historical and cultural significance using simple, bright illustrations. Several breeds of domestic pigeon are shown together to demonstrate some of the ways in which humans have manipulated pigeon genetics to achieve very specific and bizarre effects. I also bring up Darwin's use of them to support his theory of evolution by natural selection, because their ability to interbreed despite such dramatic differences indicated to him that variation could produce extreme changes in an animal's appearance over generations. The panel that explains the specific breed that forms the majority of American feral populations (the racing homer,) communicates visually the close relationship between ferals and escaped domestics by depicting the birds on the ground as percentages.

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[6] Johnston, Richard F. "Feral Pigeons." The Kansas School Naturalist 45.2 (1998.) Emporia State University. Web. 30 Sep 2017.

[7] Ibid.

[8] Ibid.

[9] Jacquin, Lisa, et al. "Melanin-based coloration is related to parasite intensity and cellular immune response in an urban free living bird: the feral pigeon Columba livia." Journal of Avian Biology. 42.1 (2011.) p11-15.

[10] Johnston, Richard F. "Feral Pigeons." The Kansas School Naturalist 45.2 (1998.) Emporia State University. Web. 30 Sep 2017.

[11] Mümtaz, Arif. "Lethal Genes in Pigeons." *Mumtaztic Loft,* Mumtaztic Loft. http://mumtazticloft.com/a_LethalGenesInPigeons.asp (2012, March.)

[12] On Public Influence on People's Interactions with Ordinary Biodiversity (article) Skandrani Z, Daniel L, Jacquelin L, Leboucher G, Bovet D, Prévot A-C (2015) On Public Influence on People's Interactions with Ordinary Biodiversity. PLoS ONE 10(7): e0130215. https://doi.org/10.1371/journal.pone.0130215 http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130215

The “Natural Selection” section has some more self-explanatory graphics. The page on predation tries to show how a falcon sees a flock of pigeons, with the unusually-colorful or light pigeons standing out the most in a small group. It also shows a process of natural selection on the plumages of a small group of birds over three generations. The first generation has seven birds, two of which are unusually light, four are inconspicuous blue-barred or dark birds, and one which has brown plumage (a color which often presents along with grey and black and which is not very conspicuous.) One of the light birds dies before reproducing, while the other is able to mate. The birds have a 50% chance of passing on their color or pattern traits. The bird with the light plumage passes on its dominant red gene to one of its two chicks, but the chick dies before reproducing. One brown chick is born in this generation, but does not reproduce, although its sibling does. Four other birds are dark grey, one is blue bar. One dark bird also dies before reproducing. In the next generation, 5/6ths of the birds end up dark-colored or grey due to natural selection. This reflects how in real life, pigeon flocks end up being 95% dark or blue-bar due to predation.

The next page illustrates more than one concept which ties plumage color to overall fitness, especially in an urban environment - a graphic shows that dark-colored pigeons tend to be more common in the centers of cities, while light-colored blue-bars make up a larger percentage of the population in suburbs and rural areas. In addition, the illustrations show that pigeons with dark plumage tend to have more robust chicks and are more resistant to parasites. Finally, the page demonstrates why pigeons prefer to mate with individuals that do not have the same plumage pattern as them. Some genes in homozygous form are lethal (such as many domestic mutations like Opal coloration,) while others have little to no negative effects. However, being heterozygous for most genes actually gives a bird an advantage over others.

The illustrations overall are meant as illustrations of the scientific facts and ideas, not as graphic representations of data. This meant that there was significant leeway in how I created my illustrations, especially in relation to the text. Hopefully, they provide a decent visual guide to the concepts and facts talked about in the text boxes.

This work is intended to reach those who are interested in pigeons and those who dislike them. For those who like pigeons, it should just be enjoyable to read. However, for those who dislike pigeons, the book aims to change their opinion to some degree. The essays at the end are meant to highlight the environmental impact of feral pigeons - their invasiveness, but also the way that their presence indicates the destruction of habitats by urban development, and the fact that they are the permanent, and probably indestructible, legacy of our irresponsible actions regarding the environment. Despite the fact that the responsibility for this “pigeon problem” rests on human shoulders, many, especially those who live alongside them, see pigeons as intruders in human society. I believe that hostility is due to ignorance of the historical, social, and environmental significance of domestic and feral pigeons. If we cultivate interest in pigeons and learn about them, we can form more ethical and effective plans to reduce their environmental impact. We can encourage city-dwellers to appreciate the nature around them and spend more time advocating for environmentally friendly buildings, activities and policies within their own communities.

## Annotated Bibliography

The Origin of Species (book)

Darwin, Charles Robert. The Origin of Species. New York: Grammercy Books, 1979.

The Origin of Species, originally published in 1859, was revolutionary in its time as the first take on the theory of evolution by natural selection. This theory explains the diversity of animals on earth as the result of a slow process of change and eventual separation of similar organisms, by methods such as predation, sexual selection, and geographical isolation, to produce new species. The basis for this process is random variation among individuals of a species, which does not make them sterile, and which can be inherited. Darwin believed that pigeons could serve as a "model animal" to illustrate the possibilities of diversity among a single species, as all domestic pigeons are interfertile with one another and with wild rock doves. He used this interfertility as evidence that pigeons were descended from a single wild ancestor (the rock dove,) and that they indeed constituted a single species, despite the extreme variation in phenotype between breeds. He used this variation as support for the possibility of mutations in wild animals as a catalyst for the emergence of separate populations with a unique trait, and eventually, a new species distinct from the ancestor. In the Term Project, this chapter of the book provided the background for the panel mentioning Darwin's interest in pigeons.

On Public Influence on People's Interactions with Ordinary Biodiversity (article)

Skandrani Z, Daniel L, Jacquelin L, Leboucher G, Bovet D, Prévot A-C (2015) On Public Influence on People's Interactions with Ordinary Biodiversity. PLoS ONE 10(7): e0130215. https://doi.org/10.1371/journal.pone.0130215

http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0130215

This article reports on an observational study by scientists from France, coming from the Sorbonne and Paris-Ouest La Défense Universities. The scientists passively observed the interactions (or lack thereof) between humans and pigeons in public areas, including tourist spots, parks, and transit stations, in an attempt to judge the effect that health campaigns and myths about pigeons have on the way people react to them. Their belief was that people in urban centers felt a disconnect from nature due to the homogeneity of urban wildlife and so were less environmentally aware. They hypothesized that people would interact with pigeons more often in spaces where nature was important, such as parks. However, their study showed that tourist spots actually had the highest rates of interaction, which led to the conclusion that having a higher level of awareness of one's environment led to more enthusiasm about interacting with pigeons. This information was used in the personal essays at the end to support the idea that knowledge of pigeons and urban wildlife in general is critical to preserving nature in our post-industrial world. It is available for free online.

Feral Pigeons (article)

Johnston, Richard F. "Feral Pigeons." The Kansas School Naturalist 45.2 (1998.) Emporia State University. Web. 30 Sep 2017.

https://www.emporia.edu/dotAsset/a64c88a4-f68a-4691-8419-8609abb3ab59.pdf

This article is an old publication by Emporia State University in Kansas, issued by the Division of Natural Sciences. The author is Richard F. Johnston, Professor of Ecology and Evolutionary Biology Emeritus at the University of Kansas. It provides information on the origins of feral pigeons in the Americas and goes into detail on the genetics of plumage variation and how it relates to reproductive output. It also talks about breeding habits, behavior, and the place of the urban pigeon in today's society. Much information in the project on pigeons' plumages, plumage distribution and advantages, breeding habits, and history of domestication was sourced from this article. Information from this article specifically shows up on page 3, page 5, and page 6.

Stringham, Sydney, et. al. "Divergence, Convergence, and the Ancestry of Feral Populations in the Domestic Rock Pigeon." Current Biology 22.4 (2012): 302-308. ScienceDirect. Web. 1 Oct. 2017.

In this article, scientists from the University of Utah, Salt Lake City, studied the genetic relationships between different breeds of domestic pigeons. The paper was inspired by Darwin's use of the extreme variation of pigeon breeds as a model for the process of divergence in wild populations. The scientists sampled genetic data from geographically diverse populations of domestic breeds and two feral populations in order to determine their relationships. They found surprisingly close relationships between birds with distinct appearances, and also found convergent evolution of traits in several breeds. They found insights into the origins of certain breeds and into the contributions of racing pigeons to feral populations. This article's evidence on the relation of racing homer pigeons to feral provided the information that feral pigeon populations are descended from and continually replenished by escaped domestics. Information from this source shows up on page 4.

Jacquin, Lisa, et al. "Melanin-based coloration is related to parasite intensity and cellular immune response in an urban free living bird: the feral pigeon Columba livia." Journal of Avian Biology. 42.1 (2011.) p11-15. http://web.a.ebscohost.com/ehost/detail/detail?vid=0&sid=604f6db2-7627-4b42-96a2-51aa5735604b%40sessionmgr4007&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#AN=58666293&db=eih

Lisa Jacquin is an associate professor of Ecology and Evolution at Toulouse 3 University. She has written many papers on different aspects of urban pigeons.The paper shows that different plumages in pigeons correspond to different immune responses to parasites. The study revealed that darker individuals had fewer parasites than light individuals and had a stronger immune response, showing a probable genetic link between color and resistance. It raises the idea that parasitism could be a factor that maintains differences in color in pigeon populations, and that differently colored individuals are adapted to different environments according to the presence of parasites. It may be evidence of pigeons coevolving with their environments. This study provides more proof of advantages afforded to feral pigeons by dark coloring, which is most common among ferals and domestics. Infomation from this paper shows up on page 6.

Mümtaz, Arif. “Lethal Genes in Pigeons.” *Mumtaztic Loft,* Mumtaztic Loft. http://mumtazticloft.com/a_LethalGenesInPigeons.asp (2012, March.)

Arif Mümtaz is a hobbyist pigeon breeder from Fort Lauderdale, Florida. On his website, *Mumtaztic Loft,* he writes articles on pigeon biology, breeding and genetics based off of scholarly sources and his own experiences. Many articles present essential information on pigeon genetics in a clear and accessible way. Such is the case with his article, “Lethal Genes in Pigeons,” which identifies and goes into detail about many alleles in pigeons that are lethal in homozygous form - how they are inherited, how they affect a living bird, and how they are lethal to the birds that are homozygous. This article was used for the information on the homozygous lethal *Dominant Opal* gene, which is prized by breeders in heterozygous form for the color that it produces. Mention of this gene appears on page 6.

Mümtaz, Arif. “Pigeon Genetic Symbols - X-Pigeons (the mutants.)” *Mumtaztic Loft,* Mumtaztic Loft. http://mumtazticloft.com/a_LethalGenesInPigeons.asp (2012, March.)

This page on *Mumtaztic Loft* lists several mutations in domestic pigeons that are commonly manipulated by breeders. Although Mümtaz only finished a few of the articles going into depth about these mutations, he did helpfully provide the genetic symbols on the entrance page. These genetic symbols are used in the illustration that explains pigeons’ preference to mate with different-looking mates on page 6.

# Feral Pigeons

*A brief overview of their history and variation,*

*by Natalie Krowitz*

# ON FERAL PIGEONS:
# Domestication

What is this thing?
It's a feral pigeon. You've probably seen it so often that you don't notice it anymore. They're fun to play with and scare as a kid - but now, you see how dirty and gross they are, right? They're just flying rats.

Well, jokes aside… what IS a pigeon? A pigeon is a bird, obviously - a bird that's so common, few people care to consider where it came from. But the history of pigeons is far more interesting than you would expect.

Feral pigeons (the ones you see on the sidewalk eating popcorn) are descended from the wild rock dove, Columba livia. Rock doves (as they will be called, to differentiate them from pigeons) live on high cliffsides, nesting in crevices. They do swimmingly on high-rise buildings, too. But feral pigeons aren't directly descended from wild ones! Their ancestors were domesticated - and there's a big chance that any pigeon you see on the street is the great-great-grandchild of someone's lost pet.

Let's wind back the clock a tiny bit. It was at least 5,000 years ago that the wild rock dove was domesticated, around the Mediterranean.

They were first bred for food (pigeon was a common food, even a delicacy, up until around the 20th century.)

They've also had religious significance for a long time, to Christianity, Judaism, Islam, Greco-Roman paganism, and other religions.

By at least 3,000 years ago, people had recognized their homing ability, which allows them to navigate back home from unfamiliar places over long distances. This amazing (and not yet understood) skill made them very useful for delivering messages.

Domestic pigeons arrived in North America in 1606 in Nova Scotia with the French, making the feral populations in North America up to 400 years old. However, it's impossible to really tell how long pigeons have been in any particular place, because these populations are not known to be permanent, and there are always new pigeons coming into them.

Racing homer:
Bred for speed and navigation to participate in long-distance races

Tumbler:
Does backflips while flying. Entertaining, but maybe not ethical

Figurita:
One of the smallest domestic pigeons

Giant Runt:
One of the biggest. Bred to produce meat

With the rise of “animal fancy”, pigeons began to be bred for aesthetics and entertainment, resulting in enormous variation within the species. Homing pigeons were bred for increased speed as racing pigeons, while tumblers were bred for tricks, and other breeds were created to show unusual colors and patterns, differing body sizes, and strange shapes.

Cropper:
Inflates its crop to look like it ate a tennis ball. Exhibition breed

Because of the endless variation in pigeon breeds (there are over a thousand breeds,) they were considered by Darwin to be a model animal for his theory of evolution, and are featured in the first chapter of The Origin of Species as an example of how variation under domestication can create morphologically distinct forms while still being under one species. He was also just a pigeon fancier who kept them as pets.

100%

100%

100%

100%

At least one study can trace the genetics of a population of feral pigeons back to their domestic ancestors. North American ferals have heavy influence from racing breeds. According to one study, some breeders report that “up to 20% of their birds that start a race do not return,”

And their results showed that “feral pigeons and racing homers show very little genetic differentiation,”

99.998%

99.976%

99.95%

99.993%

suggesting that racing homer pigeons are the biggest contributors to feral pigeon populations in North America. Neat, right? We know exactly where they came from.

??

The history of pigeons, even apparently “wild” ferals, is intricately linked with human history and is one of the best and most widespread examples of human impact on the environment before the industrial era.

Historically, pigeons have been well-loved: It’s only recently that “pigeon” became synonomous with “pest.”

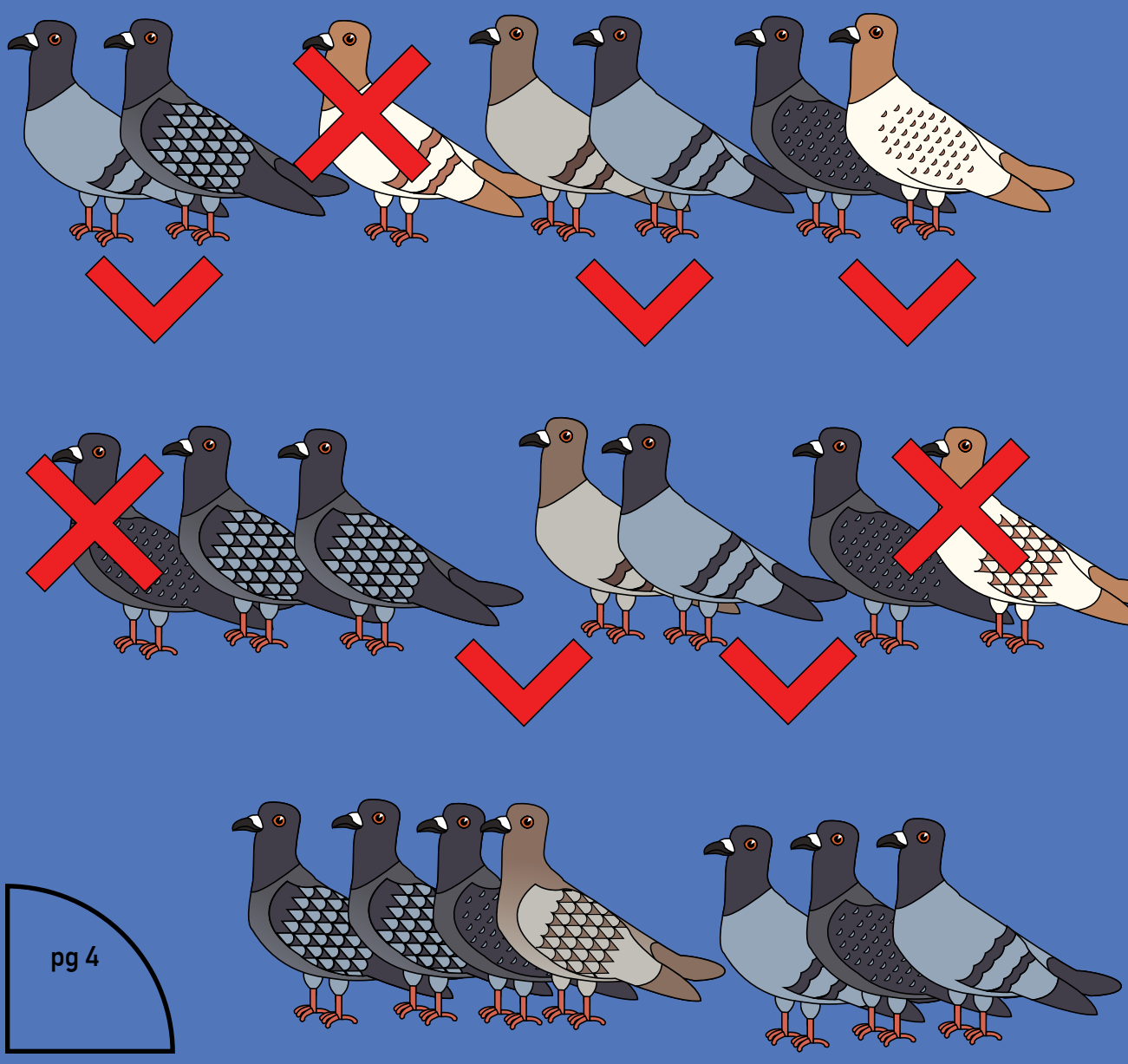
# Natural Selection

One might assume that because there seems to be so little wildlife in the city, urban pigeons have no predators.

THAT'S UNTRUE!

Birds of prey such as Peregrine Falcons (pictured above, left) exist in cities, and they are known as the pigeon's biggest predator (outside of humans.)

Pigeons tend to travel in large flocks, where birds that look alike are harder to separate from the rest. Flying predators such as hawks look for light-colored or otherwise unusual pigeons to hunt.

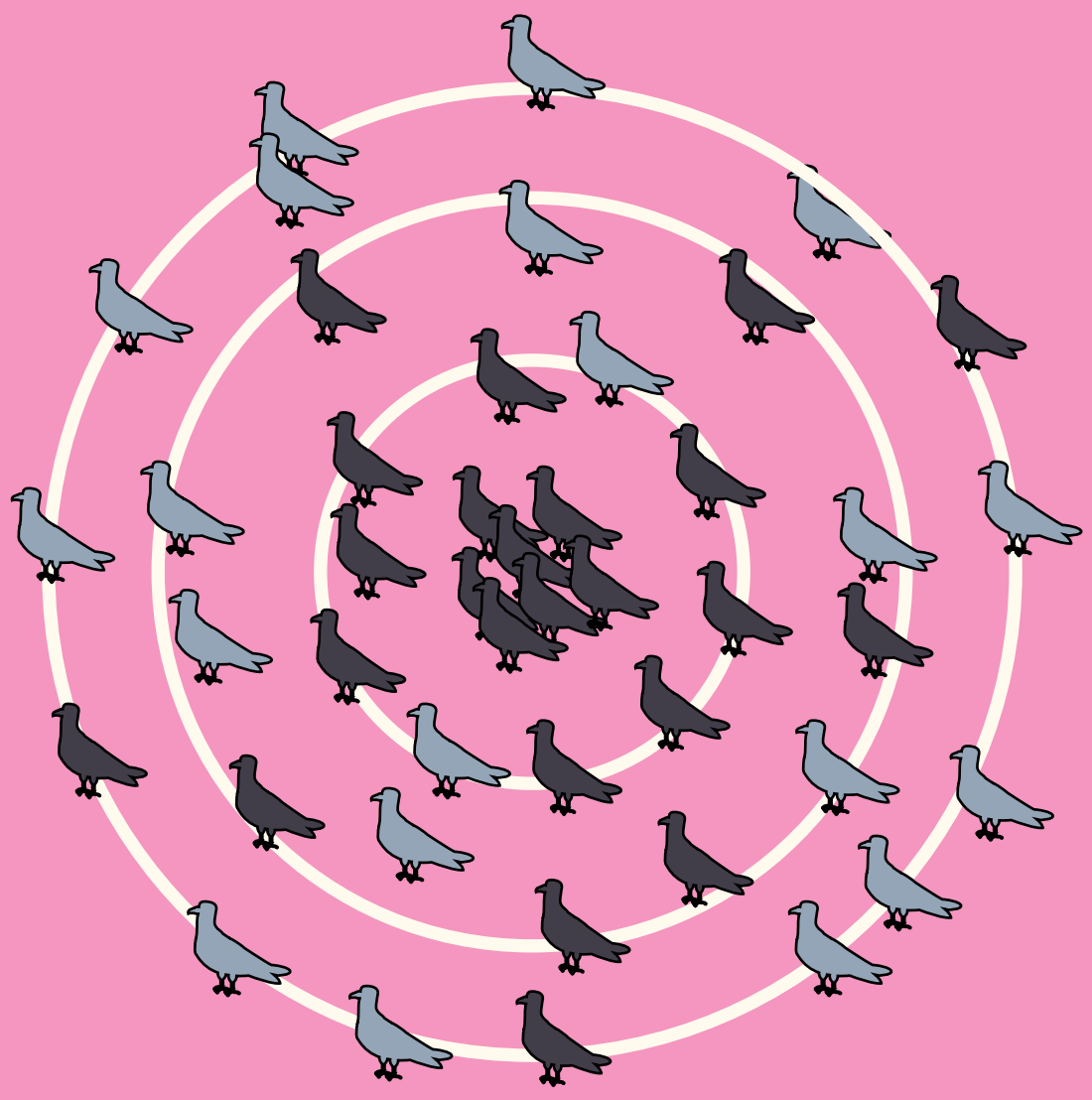


This is a form of natural selection, where light colors such as white, ash-red, and certain patterns are more likely to die due to predation. Therefore, these birds reproduce less in their lifetimes, passing on fewer of their genes.

This causes the majority of pigeons to be of certain colors and patterns: Bar, T-check and check patterns are the most common, and most birds in any given flock will be blue, with a smaller amount having some brown plumage. However, there will always be a small population of red, mostly brown, white, or oddly-patterned birds.

# Natural selection in pigeons isn't only due to predation.

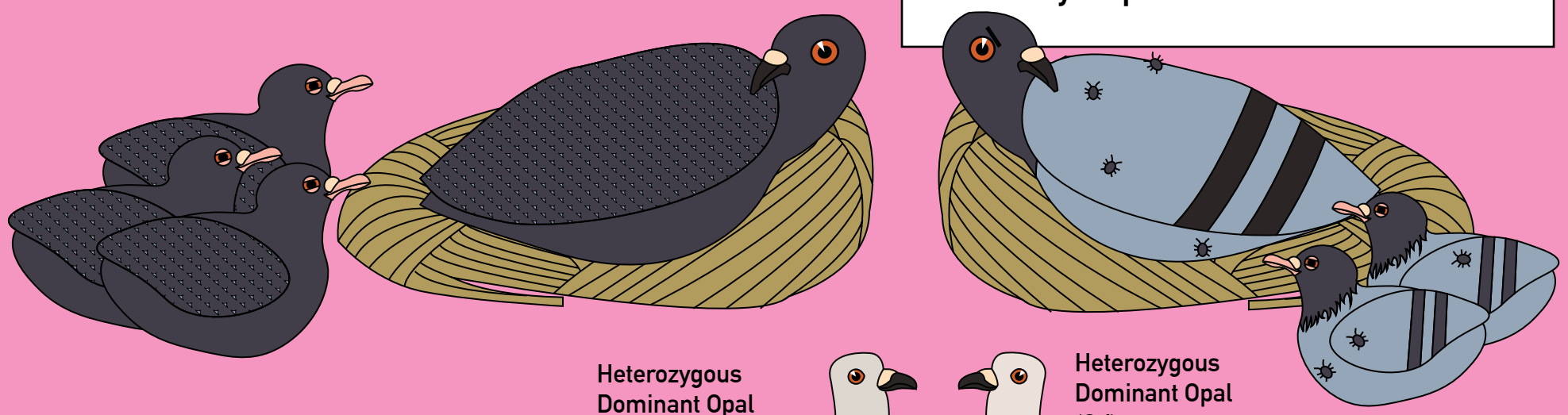
## Due to the many effects of the protein melanin in the body, the color of a pigeon can affect its fitness as an organism!

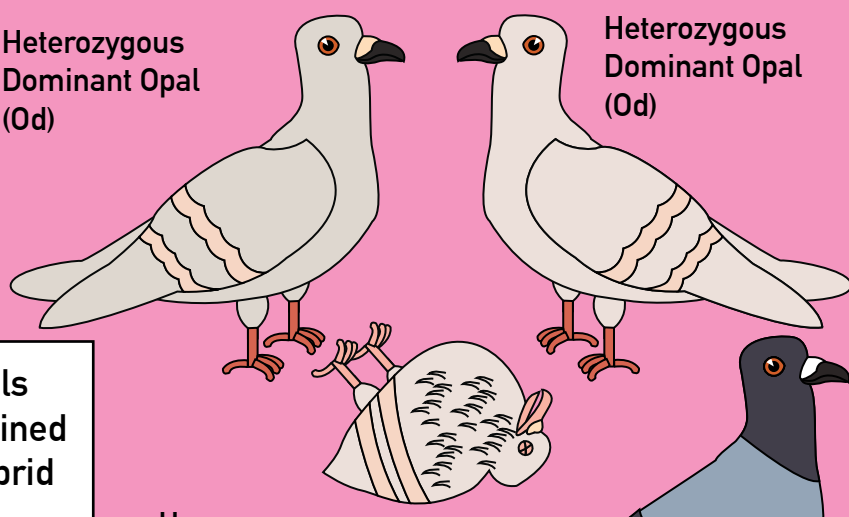


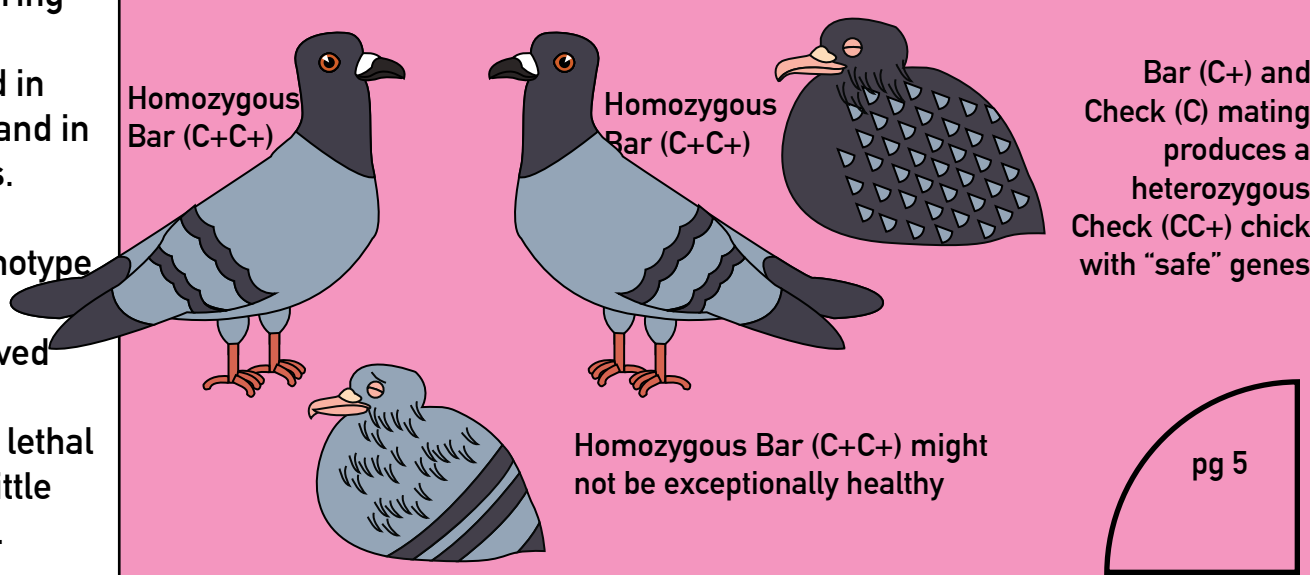
Studies have shown that dark-colored pigeons with t-check or spread alleles are more common in inner-city environments, while the proportion of birds with bar or barless patterns increases with distance from the city center. The reason for this is unknown, but it does show that different environments favor certain patterns and colors.

It's also been shown that dark colored pigeons tend to have more, and healthier, offspring than lighter colored pigeons.

And another study shows that having more melanin gives them better immunity to parasites.





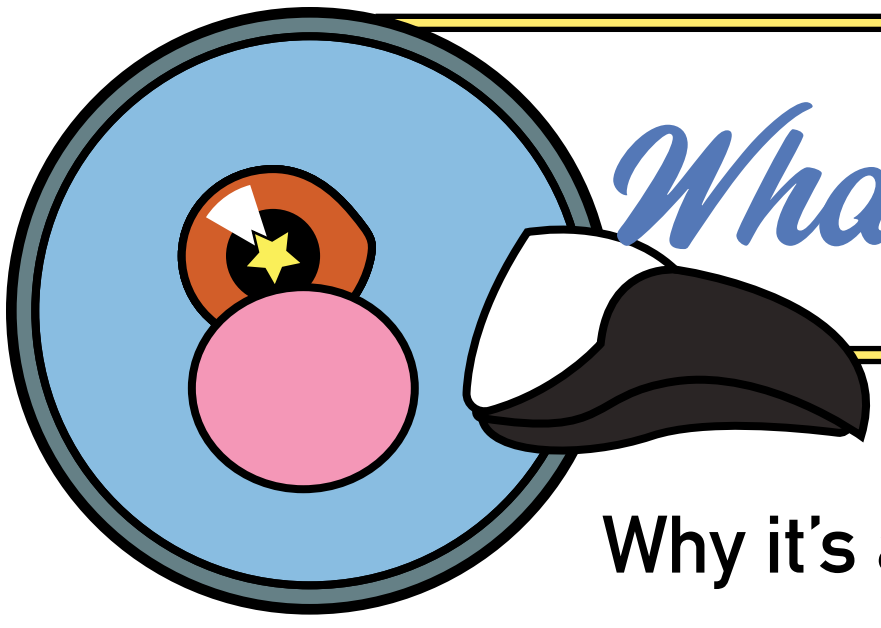




## *Sexual Selection ;)*

Feral pigeons also prefer to mate with individuals who look different from them. This can be explained by an effect called heterosis, also known as "hybrid vigor," in which an individual that is hybrid or heterozygous for a certain gene has higher fitness than its parents.

If a gene in its homozygous form kills an offspring either before or after hatching, it's considered lethal. Many genes that are carefully cultivated in domestic pigeons would be lethal in the wild, and in homozygous form are also lethal to domestics.

Breeding with individuals with a different phenotype lessens the risk of offspring dying from lethal mutations. It's possible that this behavior evolved due to the fact that feral pigeons come from domestic pigeons, who carry many potentially lethal genes. "True wild" rock doves, who have had little interbreeding with ferals, lack this preference.



# What's Not to Like?

## Why it's a good idea to like pigeons:

Feral pigeons, despite being an invasive species, are nonetheless an example of interesting, harmless, and valuable city wildlife; that study of feral pigeons enriches our understanding of genetics and ecology, and is an especially valuable resource for education and awareness in nature-impoverished cities; and that pigeons, as feral animals, are our responsibility to protect and regulate.

Cities are as much a part of nature as any forest or desert. Disdain for urban wildlife and ignorance of its adaptability, complexity and continuing evolution leads to ignorance about nature in general. In urban environments, not only wildlife, but also flora, water resources, air quality and other natural features are constantly threatened by development which ignores environmental concerns.

If residents and authorities of cities don't understand the nature that exists right in front of them, they will not make an effort to preserve or nurture it. Aside from moral considerations, caring about and understanding pigeons, and more generally, urban ecosystems, is in our best interest if we intend to reduce the effects of pollution, destruction of forests, and other ecological issues.

Pigeons are like people. They're diverse, sometimes ugly, sometimes beautiful. They commute, like we do; they live with their mates, like many people; they like popcorn They always find a way to survive and to flourish, despite all the ways we try to hold them back, pen them in, cull them. Pigeons are of as many colors and patterns as the humans who live alongside them, and are capable of just as much clumsiness, or as much grace.

In times like these, some of our most pressing issues are those of unwanted citizens - refugees and immigrants are branded as criminals, and their right to reside in the U.S, their right to citizenship, and their dignity as human beings is challenged at every turn.

One could also draw parallels between anti-pigeon devices (spikes, wire netting, et cetera) and the cruel and short-sighted devices installed in public places to prevent homeless people from sleeping there, such as spikes and bench blockers.
This is not to place the welfare of pigeons (which is admittedly not an urgent issue) over the welfare of immigrants, refugees, the homeless, and other oppressed people. Pigeons are doing quite well at the moment, in fact. But to understand the pigeon, to learn its history, to empathize with it and appreciate its beauty, is to show a basic level of respect for a being often thought of as a dangerous intruder. We've created the issue of pigeons here, through our own actions, just as the racial, gender, and class divides of the United States, along with xenophobic foreign policy, have indirectly and directly caused the appearance and growth of homeless, refugee, and immigrant populations.

And of course, pigeons are a symbol of all wildlife in New York City. I'm sure that's true for many cities - pigeons are common across the world, and they're especially suited to the modern urban environment. Along with English Sparrows and European Starlings, they form a triad of highly adaptable, populous, invasive urban birds. Other birds are rare in the city, even confined to parks. We can decry this homogeneity of urban bird species, and lament the pushing-out of native ones - but the fact is that this ecological transformation isn't on the invasive species. It's on us, the ones who introduced them in the first place, and made the habitat unlivable for the previous residents. The Bird Triad, as I like to call it, is a profound evidence of human impact on the environment, of how drastically our buildings, our pets and flocks and poetic flights of fancy can change the world. To understand how the pigeon spread across the world, and how it came to be one of the most numerous species around, is an important piece of knowledge for the study of ecology, and serves as a lesson for the future.

If you can't open people's minds to Syrian refugees - maybe you could start with a bird. I chose pigeons as the topic for this zine not just because I love them as animals, but because I believe it's important to treat everything and everyone in a humane and respectful way. So I care about pigeons, as a matter of fascination, and as a matter of principle.

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