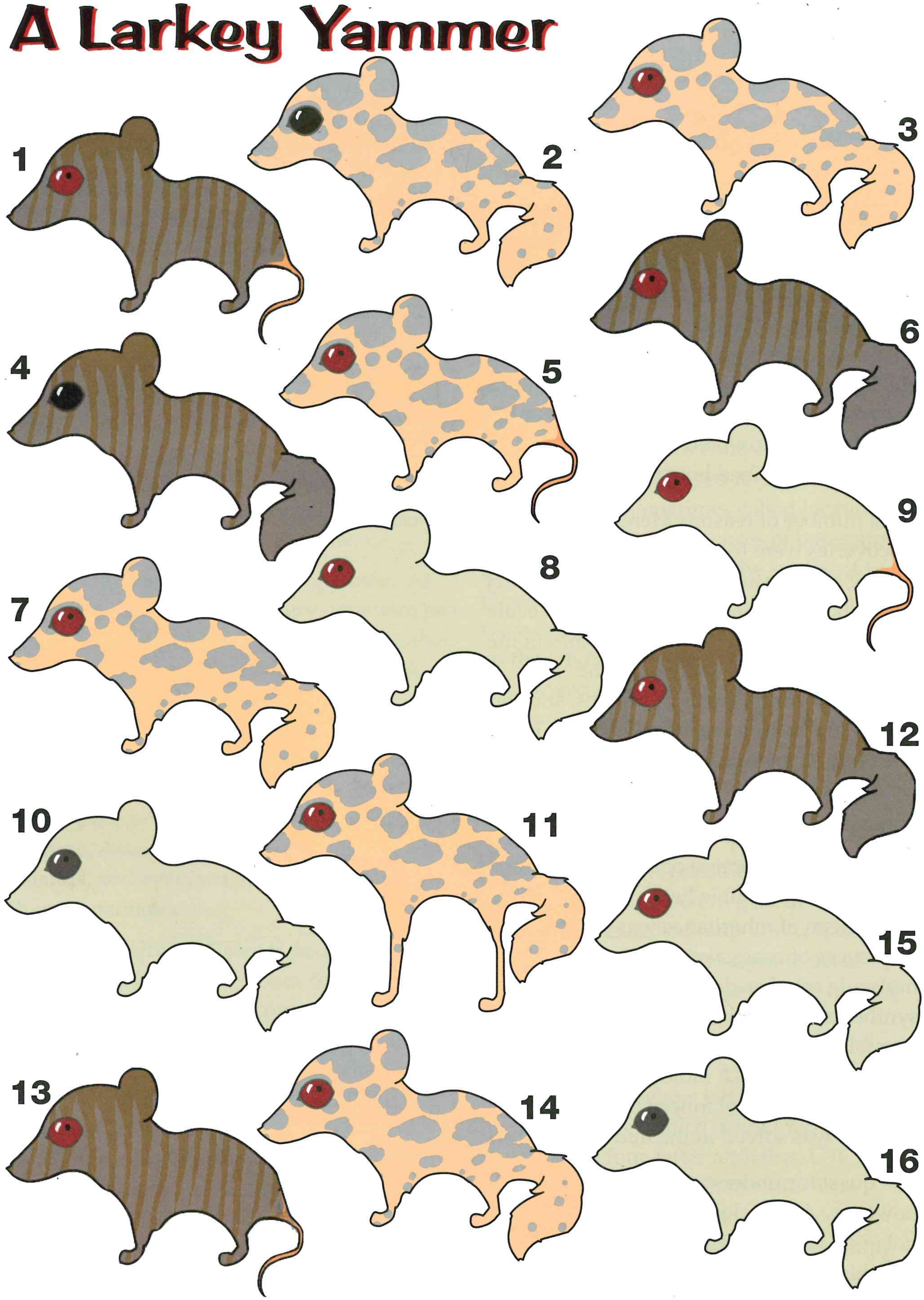
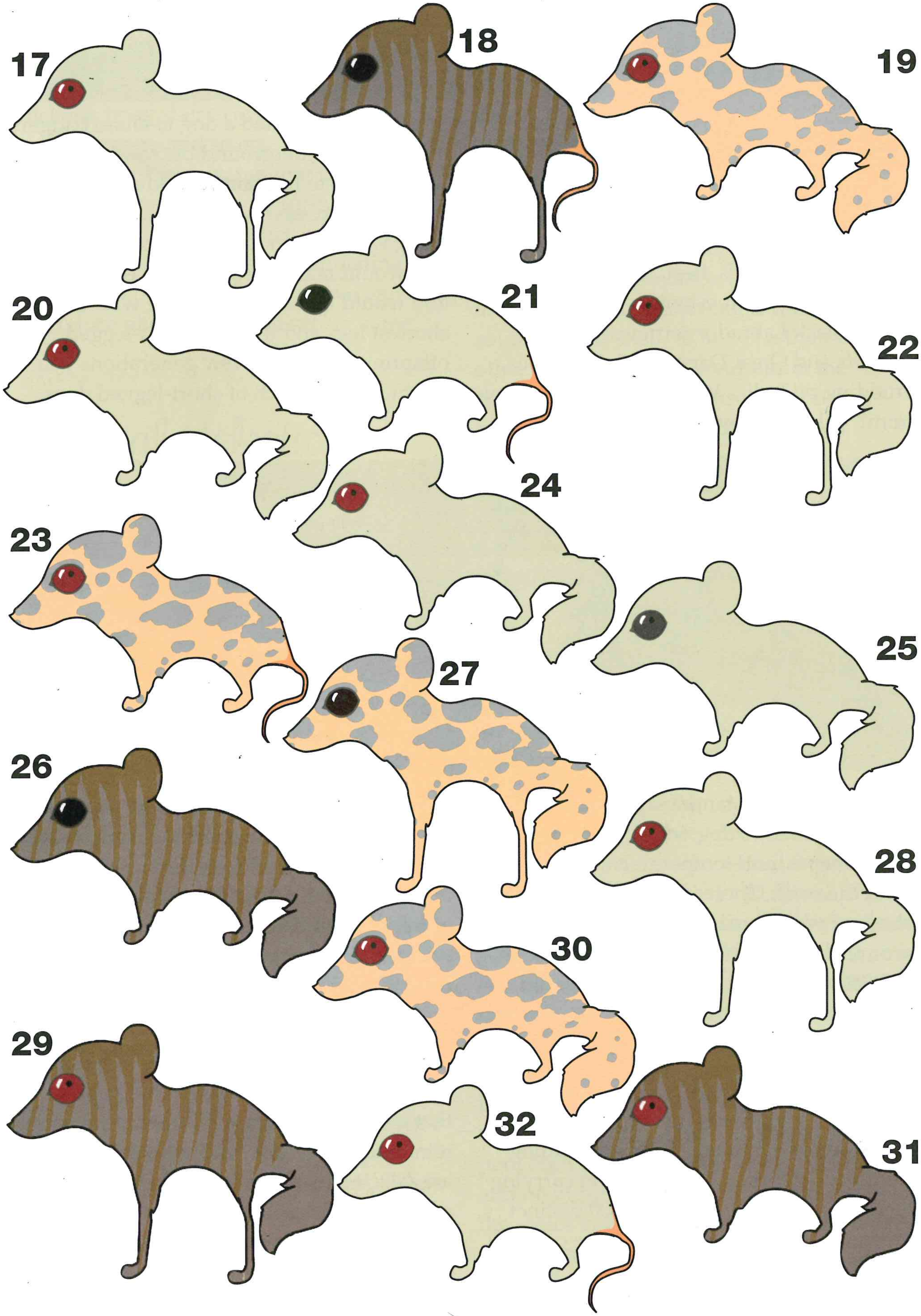
A Larkey Yammer

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Natural and Unnatural Selection

If you rounded up all the dogs in your neighborhood or town, you would see an amazing diversity of critters. There could be little yappy Yorkshire terriers and skinny Chihuahuas, low-slung dachshunds and corgies, silky collies, fleet, long-legged greyhounds, grumpy-looking pugs, water-loving black Labrador retrievers, huge mastiffs and Great Danes, and dangerous, brooding pit bulls. Where did they all come from? Why do they look so different?

Suppose you wanted a dog to chase badgers out of their underground burrows. The dog would have to be short-legged and armed with an impressive set of teeth. If there was a dog with shorter legs in the community, you would make sure it produced offspring. You would breed the offspring with the shortest legs and then the short-legged offspring again. In a few generations you might have a bunch of short-legged dogs.

There is now substantial scientific evidence that the domestic dog, in all its interesting sizes, shapes, and temperaments, evolved from the wolf. There is evidence that one strain of wolves may have started hanging around human settlements as much as 135,000 years ago. These wolves would not qualify as lapdogs at that time, but they were comfortable around humans.

The modern history of dogs starts about 2500 years ago. Several kinds of dogs played roles in human culture, including hunting, defending livestock, and carrying loads. Today there are about 400 distinct breeds of dog, most of which have come into existence in the last 200 years. Why so many? Selective breeding.

Among them you would look for the ones that were apt to plunge into burrows to take on the ill-tempered badger. You would breed those with the right shape and attitude about badgers to produce offspring with those characteristics. This might have been the process that produced the dachshund.

Humans decide which qualities in a dog are desirable, find individuals in the population that have those traits, and breed them to reinforce those traits. Individuals that breed are selected by humans, not by natural processes. This **selective breeding** of organisms to produce offspring with desirable traits is also known as artificial selection.

Selective breeding has been used to produce the hundreds of breeds of dogs, breeds of horses for different uses, breeds of cats, chickens, hogs, dairy cows, wheat, rice, tomatoes, corn, and so on. The desirable traits can vary widely, ranging from aesthetic appeal, rate of maturity, season of production, yield of product, and so on. Humans are very good at manipulating the genotype of organisms by selective breeding to produce phenotypes that satisfy some need.

Natural Selection

In nature, nobody consciously selects the individuals that will breed to produce offspring. Even so, some individuals are selected to reproduce, and some are not. Who or what does the selecting? The answer is the environment.

Life is usually a struggle. Limited resources, food supply, predators, weather, and access to mates all put pressure on organisms all the time. Individuals in populations that are adapted to the environment in which they live have ways to respond to the pressures. Because all populations have variation, some individuals will be better at responding to each source of pressure than others. Some will be better at getting resources, others will be more efficient at finding food, and some will have better strategies for avoiding the effects of weather.

Some individuals will be better at finding a mate and breeding, thereby passing heritable traits on to more offspring. Bright coloration, large antlers or horns, the ability to defend a territory, or the performance of courtship displays are examples of structures or behaviors (features) that make the males of some species more attractive to mates. When the adaptive feature is enhanced by female choice, it is referred to as sexual selection. This is a selective pressure that influences populations.

A change in the environment might apply new pressure on a population. The change might be a new predator, a drought, increased competition for a favored food source, a cold snap, or any of a thousand other things. Some individuals in the population will be, because of variation, better able to withstand the increased pressure. They will be more likely to reproduce and leave offspring with the traits that allow them to deal with the pressure. If the pressure persists, in time the population will have different traits than it did before the pressure.

An interesting study was conducted on a guppy species in South America. A biologist, John Endler, found that guppy populations along one river were isolated from one another by waterfalls. The guppies in pools higher up in the river had few predators. In these pools the males were brightly decorated with different numbers and sizes of colored spots. The female guppies were plain. But the males in pools downriver where there were large numbers of predators were not colorfully decorated, but rather had small spots and few of them. Endler planned a study to investigate the pressures on the guppies. He moved a population of 200 guppies from downriver (with aggressive predators) to a pool high up that had no severe predators and no guppies. In 2 years (14 generations) the males in the population, which had been plain, were brightly colored with big spots.

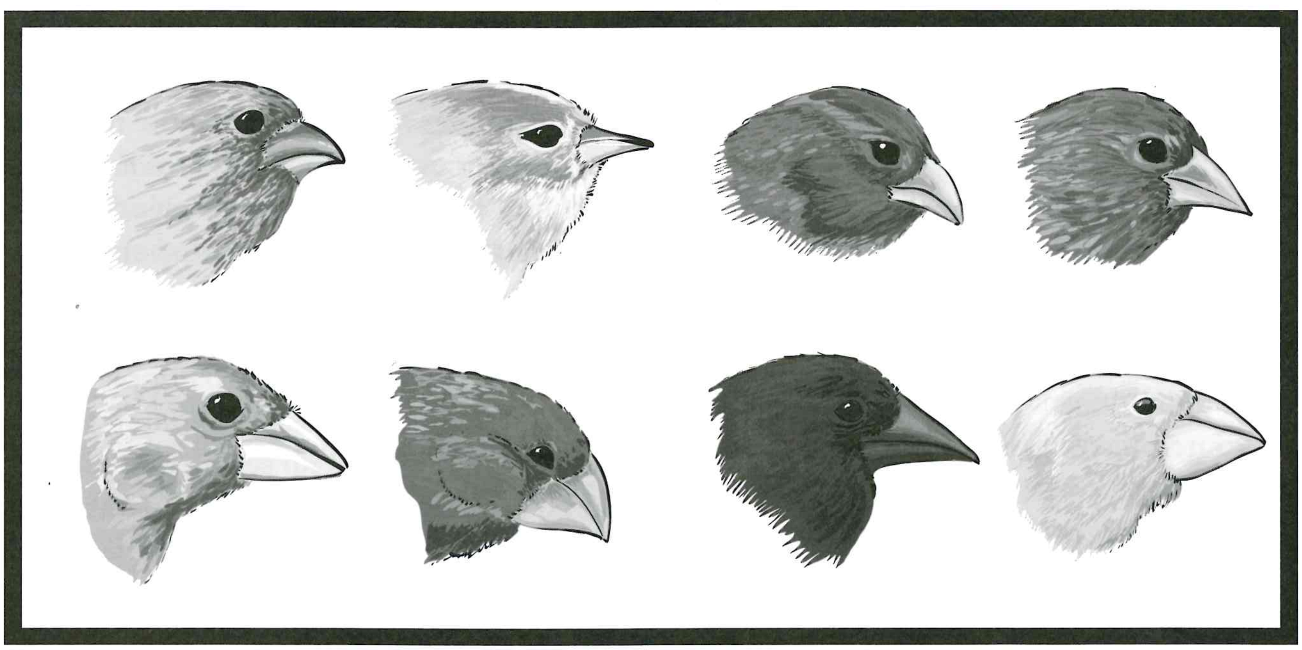
The biologist reasoned that this might be evidence of the interaction of two selective pressures. Female guppies prefer to mate with brightly decorated males. But these brightly colored males were more easily seen by predators and removed from the population in the lower pools. Without the pressure of the predators in the higher pools, after several generations the males displayed bright colors and large spots. Variation in male guppy coloration existed in the population and the selective pressure acted on it. The females' choice of the more brightly colored males was a selective pressure and resulted in brightly colored male offspring but only when the pressure of predators was gone.

Who selected the individuals that would reproduce to pass along their traits? Ultimately, the environment! When the biotic and/or abiotic environment changes, it places selective pressure on the organisms in that environment. Those individuals that are adapted to withstand the pressure will reproduce; those who can't take the pressure will not reproduce. The genes of the survivors are passed to the next generation, and with them the adaptive traits. That's **natural selection.**

When Charles Darwin visited the Galápagos Islands in the 1830s, he noticed a diverse community of finches. He reported that each kind had a modified beak that served its lifestyle. After extensive study of Darwin's finches, it is now understood that all 13 different finches on the Galápagos Islands are descendants of one species of finch that arrived on the islands thousands of years ago. How did one species of finch evolve into 13?

Darwin imagined that a flock of finches was blown out to sea during a big storm in the distant past. The flock landed, not on the South American mainland, but on a ragtag collection of relatively new volcanic islands. The islands had none of the familiar food sources and nesting sites. The small finch population was in a radically different environment.

The islands had a number of potential food sources. Seeds of several sizes grew on grasses, shrubs, and trees. The finches undoubtedly tried to use all sources as food.



Because there was variation in beak size in the population, individuals with larger, stronger beaks could crack large seeds; individuals with smaller beaks could not. On the other hand, finches with smaller beaks could easily gather large numbers of small seeds; individuals with large beaks could not.

Finches that fed on large seeds mated with one another and produced offspring with large, strong beaks. The larger, stronger beaks allowed the large-beaked finches to survive when large seeds were plentiful. Isolation from the other finches, due in this case to food preference, produced, over a long time, enough differences between the large-beaked finches and the small-beaked finches that they could no longer mate to produce offspring. They had evolved into two new species.

This same process of eating different foods based on beak size and shape produced other divisions in the populations. Over time, divisions into subpopulations resulted in 13 different species.

What would happen to the large-beaked finches if the large nuts became very scarce? They would have to turn to other food sources. Within the population of large-beaked finches would be individuals with smaller beaks. The small beaks would give those individuals a feeding advantage. They would survive and reproduce. Their offspring would inherit the trait of smaller beaks. The selective pressure of food source would shift the population toward smaller beaks. The environment rules. Those with phenotypes that allow them to survive pass their genes to the next generation, and with them their traits.

Darwin's Finches Today

Recently the environment on the Galápagos Islands has changed. This time it was caused by a fly. The larval stage of the fly is parasitic on finch nestlings. The larvae, also called maggots, burrow into a chick's body, weakening and sometimes killing the host finch. The parasitic fly larvae are recent arrivals in the Galápagos Islands, probably accidently transported by ship or plane from North America.

The pressure imposed by the parasite is new, so it is not clear whether individuals in the finch populations have adaptations for defending against the deadly maggot or whether the invader will exterminate one or more of the populations of Darwin's finches.

The ancient struggle for survival continues. Because the environment is constantly changing, the organisms that survive and thrive are constantly changing as well. When the change in the environment is so fast or so extreme that no individuals in a population survive, the entire population will die, a condition called **extinction.** Extinction is the condition of most of the life-forms that lived on Earth at one time. The 10–30 million species living on Earth now are a tiny fraction of the total number of species that once graced the planet. And they came into being, had their day in the Sun, and died off, all as a result of natural selection.

Where Are the Checkers and Spreads?

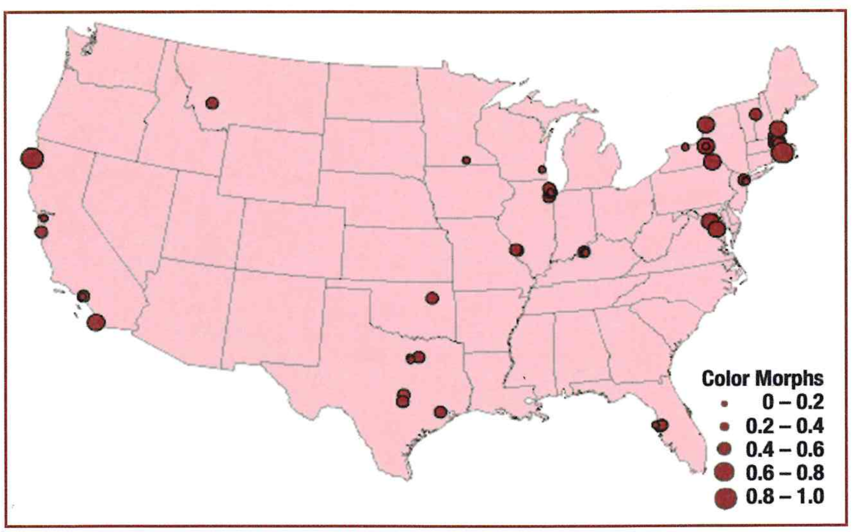
By Melinda S. LaBranche

CORNELL LAB of ORNITHOLOGY

Project PigeonWatch participants are helping us answer the question: How are various pigeon color morphs distributed across the continent? In Europe dark-colored pigeons are more common in the cool, northern latitudes. Perhaps the dark colors help the pigeons to absorb more heat from the Sun. Is this the same pattern we see in the United States?

Project PigeonWatch participants record the number of pigeons in each of the seven different color morphs as well as the total number of pigeons in every flock they observe. From these data, we calculate the proportions of each color morph and examine the distributions of those proportions over large areas. Checker and spread color morphs are called melanic because of the black-colored melanin pigments in their feathers. All flocks in this data set had at least one melanic pigeon, so I examined the distributions of melanics by latitude and longitude for 110 pigeon flocks across the United States.

Flocks at high latitudes (northern) and western longitudes had higher proportions of melanic pigeons than flocks in the southern and eastern United States. The distribution of melanic pigeons can be seen below. The size of the red circles indicates the relative proportions of melanic birds in a flock—notice that the largest circles (and thus the largest proportions of melanic pigeons) are in the Northeast and in California.



Because white feathers reflect some of the Sun's heat, you might expect to have more white pigeons in the South. I examined the proportions of white pigeons in these 110 flocks and did not find any significant effect of latitude or longitude.

Feral pigeon flocks in northern and western cities had higher proportions of melanic pigeons than flocks in the southern and eastern United States.

We might conclude that a pigeon's home city and its color will affect how well it survives and reproduces. Over time, dark pigeons in the North may have more offspring than dark pigeons in the South, causing northern flocks to have higher proportions of melanic pigeons than southern flocks. But we have to make this conclusion with caution, because this sample is very small. As indicated on the map, many cities and states are not represented in the data. Even within each city represented, we do not have data from all the flocks. We need data from more flocks and from more cities and states. Sign up for Project PigeonWatch and help us unravel this color-morph mystery.

Project PigeonWatch is an international research project that involves people of all ages and locations in a real scientific endeavor. People participate by counting pigeons and recording courtship behaviors observed in their neighborhood pigeon flocks. Participants send their data to the Cornell Lab of Ornithology, where scientists compile the information and use it to examine two questions of scientific interest:

1. *Why do city pigeons exist in so many colors (morphs)?*
2. *What color mate does a pigeon choose?*

To join PigeonWatch, contact http://birds.cornell.edu/ppw/.

Pigeon morph illustrations by Julie Zickefoose