Biology from Hawaii Name

2014

**Explaining ‘Amakihi Evolution**

**Introduction**



*‘Amakihi* are little yellow and green forest birds that recently evolved a genetic way to survive when they catch **avian malaria**. This species is endemic to the Hawaiian Islands.

In the past, avian malaria killed many *‘amakihi* in the lowland forests. Birds catch avian malaria when an infected mosquito bites them. *‘Amakihi* were still abundant in the **high elevation forests** where temperatures are too cold for mosquitoes. Today, there are still populations of *‘amakihi* in high elevation forests, and most of those birds cannot survive avian malaria.

Today, populations of *‘amakihi* live in mosquito-infested **lowland forests**, too. These lowland populations are full of birds that can survive avian malaria, something new for this native Hawaiian species.

**Procedure**

By now, your lab group should have an accurate simulation of a reproducing *‘amakihi* population. During the next few classes, modify your simulation to show how **natural selection**, **migration**, and **genetic drift** can cause a population to change.

Part 1: Natural selection

start with your basic simulation

**A** allele (autosomal dominant) allows birds to survive avian malaria

★ *new rule:* each generation, avian malaria kills 50% of **aa** birds before reproducing

produce 20 chicks each generation

Part 2: Migration

start with your basic simulation

★ *new rule:* each generation, 10 **aa** birds join your population just before reproducing

produce 20 chicks each generation

Part 3: Genetic drift

start with your basic simulation

|  |  |  |
| --- | --- | --- |
| **Grading** | points worth | points earned |
| **Results**  record all genotypes  calculate frequency of **A** allele for each generation  graph frequency of **A** allele | **12** |  |
| **Analysis**  compare simulation to reality | **8** |  |
| **Total** | **20** |  |

★ *new rule:*populations only contain 5 birds and produce 5 chicks each generation

pay close attention to random changes

small population P1:



**Aa aa aa**

**aa aa**

**Results**

Record each bird's genotype for every generation; create the appropriate data tables.

Calculate the frequency of the **A** allele for every generation.

Graph the frequency of the **A** allele over 5 generations. Produce a different line for each simulation: basic simulation, natural selection, migration, genetic drift. Make a key.

**Analysis**

1. The high elevation forests of Hawai‘i are mosquito free. Which version of your game (basic simulation, natural selection, migration, genetic drift) simulates reproduction in a mosquito-free habitat? What effect would a mosquito-free habitat have on the frequency of the **A** allele?

2. The lowland forests of Hawai‘i are infested with mosquitoes that transmit avian malaria. Which version of your game (basic simulation, natural selection, migration, genetic drift) simulates reproduction in a malaria-infested habitat? What effect would a malaria-infested habitat have on the popularity of the **A** allele?

3. The high elevation forests of Hawai‘i are full of **aa** *‘amakihi* that sometimes migrate down to the lowlands. What effect would this migration have on the frequency of the **A** allele in lowland *‘amakihi* populations?

4. Most species of native Hawaiian birds did not evolve the ability to survive avian malaria. Many lowland species were already very rare when malaria hit, their populations kept small by invasive predators and habitat destruction. How could small populations lead to extinction of the **A** allele?

5. What actions should humans take for the benefit of native Hawaiian birds? Suggest your own solution to this biological tragedy.