DIANE POEHLS

GROUP FITNESS – THE PROBLEM OF ALTRUISM

Context: small - medium size class 10-70 students; Heredity: Evolutionary Ecology & Population Genetics

Key Concepts Previously Covered: fitness, adaptation, types of selection on individual

MATERIALS

6 beaks

6 long feathers for the hair

Invitation

Thought Swap. Discuss with a partner.

What determines the fitness of an individual or a phenotype?

Would a 'hero' have a high or low fitness?

Choose a type of 'hero' and give reasons for having a high or low fitness.

(some examples: firefighter, police officer, emergency rescue worker, etc. Must be a human hero not a superhero with special powers or a superhero with the super human powers stripped away.)

Share some responses with class.

From an evolutionary stand point, if being a hero is heritable, should there be heroes?

If not then why would heroes or altruists exist?

Exploration

Group Discussion

following a discussion map – Example a military scout.

Goal: Understand that the altruist has a risk or cost for its behavior but benefits a group.

Opening broad questions.

How many people have seen a war movie where there are military scouts?

What does the scout do?

How does the scout's job affect their troops?

What would happen if there was no scout report?

Role Play

Apply this idea to a bird acting as a scout for predators.

Have students volunteer to role play: 2 cats, 1 altruist, 6 birds – beaks and feathers.

Have two populations of birds (3 in each) hidden behind a screen in each corner of the room. One of the populations of birds gets an altruist to hang out outside of the home base (screen). The birds must stay at home (behind the screen) unless they see a predator or hear a warning call from their own group member. The predators must find the birds and eat them (touch them). The altruist must send out 3 long caws and can't move until the alarm is sounded.

Instruct the predators to go to the birds without the altruist first. They should be able to touch a few of them. Then go to the population with the altruist. The altruist will

sound an alarm and the birds will fly away to safety – their seats. The predators should be able to touch the altruist though.

Summary Point: the altruist increases the fitness of the group, but increases its own risk.

Introduce the idea of group selection.

Concept Introduction

Non-random distributions of individuals

If large enough class, look at distribution of individuals in seats.

Show that non-random distribution of students.

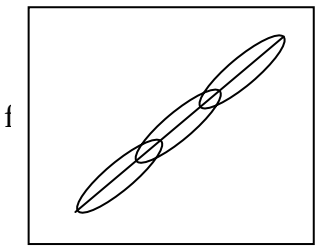
Think about: Who have you talked to since you sat down?

How many people are in your dorm?

How many people do you interact with in your dorm?

Individuals form populations within a metapopulation. This must be taken into account when dealing with fitness. Let's think about fitness as a group.

Different groups of individuals will have different fitness; therefore selection can act upon groups.



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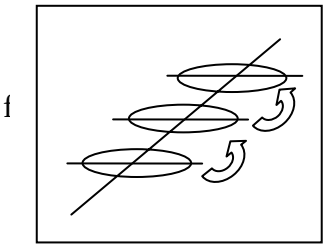

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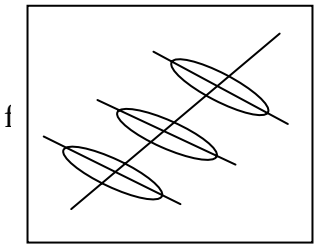

Phenotype (altruism)

You can have a phenotype that has no group selection acting (a). You can have a phenotype that is not selected on at the individual level but is at the group level (b). You can have a phenotype that is selected against at the individual level but helps the group, such as altruism (b).

Construct the last graph as a group. The phenotype is altruism (heroism). Construct a fitness plot for individuals. What happens to the group though? Add multiple groups.

The group may benefit, but it is naïve to believe that if something is good for the species it will evolve. If the cost to the individual is too large then the phenotype will dye out. There has to be a way to maintain altruism within a population.

Kinship

Goal: Fitness is determined by passing your traits (phenotypes and genotypes) on to the next generation. Your traits could be manifested in another individual.

Are you more likely to go into a burning building to save your sister & mother or a stranger?

How could this improve your fitness?

At what point would it be worth the risk to be an altruist?

Inclusive Fitness is the sum of all ‘relatives’ (individuals) that have same alleles.

Selection will favor altruistic behavior when the fitness benefit to the kin is greater than the fitness cost to the individual.

$$(\sum rB) - C > 0$$

Where r is your relatedness, B is the benefit to those relatives and C is the cost to the individual.

So is the hero really a hero?

Incorporation of Inquiry Based Teaching.

I chose this lesson because the subject matter is actually quite interesting, however looking back at my notes, there are pictures, notes to other students, as string of la la la la's and even the comment "THIS IS THE LONGEST CLASS". I thought the best way to add inquiry based teaching into a larger, but not outlandish, sized class was to incorporate questioning strategies and increase discussion. Attempt to bring the students into the lesson through interactions, applications to more familiar scenarios, and role play. I initiate (*invitation stage*) the lecture with review of the concept of individual based fitness and begin them thinking about heroes with a partner. We then explore one example of an altruist in a military context. All the background needed can be found in most war movies, even Disney's Mulan. To bring the concept back to ecology, we have students role play cats hunting birds. Concepts are then more formally introduced but still incorporating group input to come up with conclusions from the lesson.