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Evolution by Natural Selection Lab Report

Assessment of Natural Selection Acting Upon Individual Characteristics of the *Precis coenia* Butterfly[1]

Abstract:

The purpose of this experiment was to determine if natural selection was acting upon a certain characteristic of the buckeye butterfly, *Precis coenia*.[2] In order to do this the area of the base of the wing was measured for 40 butterflies, the area of the base of the wing of 40 offspring was measured, and a predation event was simulated to determine which butterflies would survive.[3] The result was that the coefficient of variation was 0.10218 and the response to variation was 0.238310397. Which demonstrated that this trait did not have very much variation originally so that natural selection was… from the parental to offspring generations was so small that natural selection was not acting on the trait.[4]

Introduction:

Natural selection occurs in an organism when that organism is evolving. Organisms tend to produce more offspring than their environment can support which leads to competition. This competition causes the offspring… For example, certain colors or sizes of something may cause that organism to be more easily targeted and killed off by a predator than organisms without the

[1] Brief title (about a sentence long) describing what the experiment was about.
[2] States the purpose of the experiment so the reader knows what the experiment was trying to accomplish.
[3] Brief description of methods: tell what was done but specifics of what tools, time, etc. are not needed.
[4] Final conclusion: readers will read the abstract to determine if they want to read the whole paper, so the final conclusion is necessary to have in the abstract.

trait for that color or size (Ruiz-Rodriguez and others, 2013).[5] Thus causing certain traits to be passed on to the next generation and others to not. Over time natural selection… Also, natural selection can uphold and stabilize genetic differences between species (Gratton and others, 2013). However, natural selection cannot occur if there is no or little variation.[6]

By using calculations and observations of parental and offspring of the butterfly, *Precis coenia*, it can be determined what characteristics are be acted upon by natural selection and to what degree the natural selection is acting.[7] Will the area of the base of the wing be acted upon by natural selection? My hypothesis was that no natural selection would not act upon this characteristic because examining the wing it could be seen that there were many other characteristics that would more easily draw a predator, other than the size of the base of the wing.[8]

Method and Materials:

The wing and all the characteristics of a common buckeye butterfly, *Precis coenia*, were examined. The area of the base of the wing was the characteristic selected to be measured… A histogram was created from the data in order to find the mean and the standard deviation. Using the mean and standard deviation the coefficient of variation was calculated CV=SD/mean. The average of the area…

[5] Example of a source citation: include name of first author "and others", year.
[6] Background information about natural selection, what it is, and what it does. This paragraph explains the background information that the reader will need to know in order to understand the experiment and the importance of it.
[7] Explanation of the experiment and how it serves to answer the objective. Briefly describes what was done in order to reach the purpose or objective of the experiment.
[8] State the hypothesis or hypotheses (sometimes a null hypothesis and a biological hypothesis are required).

For the predation analysis 10 plates each with 20 wings were used. Each plate was viewed for 3 seconds and the wing that caught your eye was recorded. The number of times each wing was selected was recorded under Predation. Using the predation of each wing… The proportion eaten=the number of predation events for that individual/the total number of predation events. Then the survival of each butterfly was calculated. Survival=1-proportion eaten. The survival was the… Then the average of the 20 survival values was taken and the fitness was calculated. Fitness=individual survival value/average survival value. The fitness value represented how the phenotype of each butterfly should compare to the average.[9]

The fitness values of the 20 individuals were compared… In order to quantify this the selection differential (how much the mean trait value shifts after natural selection) was calculated. First the weighted value was calculated for each individual, weighted value=trait value x fitness value. Then the average of all the weighted... Finally the original mean trait value was subtracted from the post-selection mean trait value to find the selection differential.

Next the offspring and the parents were compared. The area of the base of the wing for all 40 of the offspring (two from each set of parents) was measured. From each set of parents there were two offspring… The average of the parent trait value for each set of parents and the average of the offspring trait value for each set of parents was compared in order to determine the heritability of the character (h). The response to selection was calculated using the h value and the S value. R=S x h^2.[10]

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[9] These two paragraphs describe the methods for data collection. When describing the methods that were used for data collection, be sure to include enough information that someone else can recreate the experiment but leave out unnecessary details.

[10] These two paragraphs describe the methods for data analysis. It is necessary to name all the values calculated, how they were calculated, what was compared, and how this comparison was done.

Results:

The fitness value compared with the trait value of each individual butterfly does not change much between the individual butterflies. The slope of the line is -0.00009 indicating that the fitness level does not…(Figure 1).

As the average area of the base of the wing goes up for the parents, the rate at which the average area of the base of the wing goes up for the offspring is very small, 0.04453 (Figure 2).[11]

CV=SD/mean

SD=standard deviation=45.646

Mean=446.725

CV=coefficient of variation

CV=45.646/446.725

CV=0.10218

R=S x h^2

S=average survival=0.535168196

h^2=heritability=0.4453 (slope of Figure 2)

R=response to selection

R=S x h^2

R=0.535168196 x 0.4453

R=0.238310397[12]

[11] When writing the results section, you simply want to state the data; interpreting it will happen in the conclusion. Describe the important parts of the figures as if the figures weren't there, and include any other necessary values.

[12] Calculations for results may be represented differently depending on your T.A., but be sure to include all relevant values.

Discussion:

The results for this experiment… These results also provide support for my hypothesis.[13] The coefficient of variation was calculated to be 0.10218, which was to be expected, because the standard deviation was very small compared to the size at which the areas were. The small coefficient of variation supports… And with little variation with in this characteristic makes it harder natural selection to occur. When the fitness value was compared… Indicating that no natural selection was acting on this character because if natural selection were acting then the individuals with a higher or lower area of the base of the wing size would also have higher or lower fitness values.[14] There would be a correlated relationship between the fitness value and the area of the base of the wing because natural selection would be acting for one extreme. Comparing the average of the sets of offspring with the average of the sets of parents shows that as the parents averages of the area of the base of the wing went up the offspring's averages went up very slowly. This comparison gives you h^2 (heritability) which is the slope of the line, 0.4453. And using h^2 and S, R, response to selection was calculated to be 0.238310397. Again supporting that natural selection… The phenotype of this characteristic in this population should not change much over time because there is little variation to begin with, the heritability is very small, and there is no correlation between… So based on this trait, which butterflies would live in die is dependent on chance.

These results support current knowledge of natural selection. Not all characteristics are acted on by natural selection. The characteristics that are acted upon… And the area of the base

[13] Support or reject the hypothesis. Never talk about the data "proving" your hypothesis; you always want to use "supports" or "rejects" (does not provide support) when talking about your hypothesis.

[14] This section interprets results by discussing what they mean, how they are connected and how they lead to the conclusion. This is important because they reader needs to see how the conclusion was reached.

of the wing did not show much variation supporting that natural selection would not act on a characteristic with little variation.[15] However, a different interpretation of this data could be that humans are not a realistic predator for the butterflies or that there where not enough generations studied to determine if natural selection occurred. So that these results would have to be developed further to understand if natural selection was acting upon this trait.[16] Further extensions of this research could be to examine how natural selection affects this trait not just after 1 generation but also after 50 or 75 generations, or to re-create the predation simulation using a different predator that is not a human. Another possibility would be to examine the color patterns of the wings and the effect natural selection has on this, because many other organisms have distinct color patterns to help them remain hidden from their predators (Ruiz-Rodriguez and others, 2013).[17]

[15] Discuss how the conclusions relate to current work. Do they support or negate current work? How or why?

[16] Discuss possible sources of error; every experiment will most likely have some source of error. Discussing this may help people that recreate the experiment avoid these mistakes, and the reader will know of these possible errors when viewing your data and results. This also lets your T.A. know that you are thinking about what you did in the experiment and how it could be improved.

[17] Describe what other research could be done in the future to help further these results. This shows the T.A. that you are not only recognizing possible sources of error but also recognizing how to fix them. In addition, it lets the reader know what else could be done in the future to improve the knowledge about this topic.

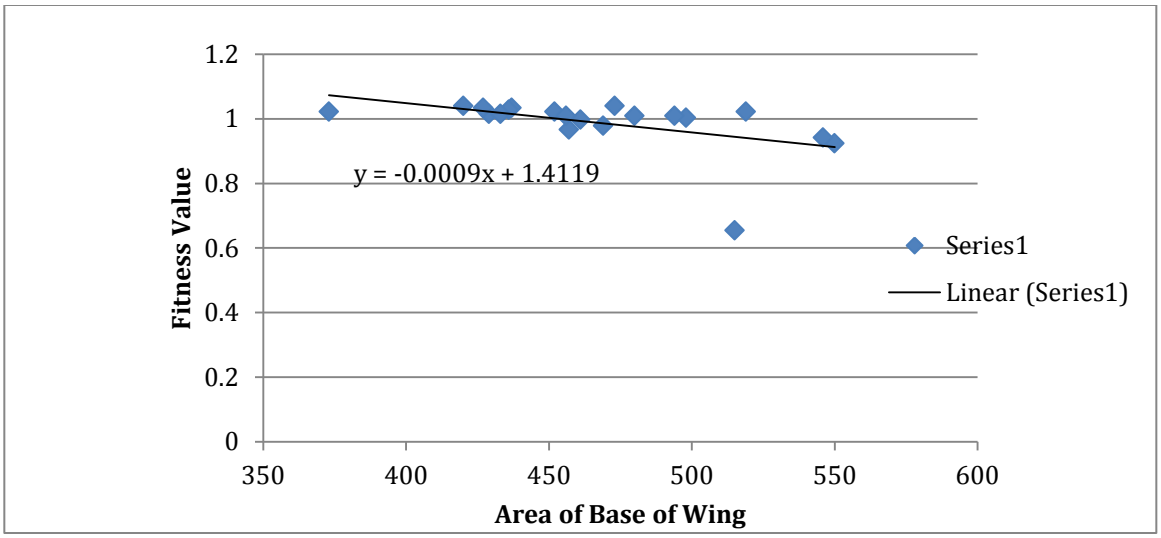

Figure 1 Relationship between the area of the base of the wing and the fitness level.[18]

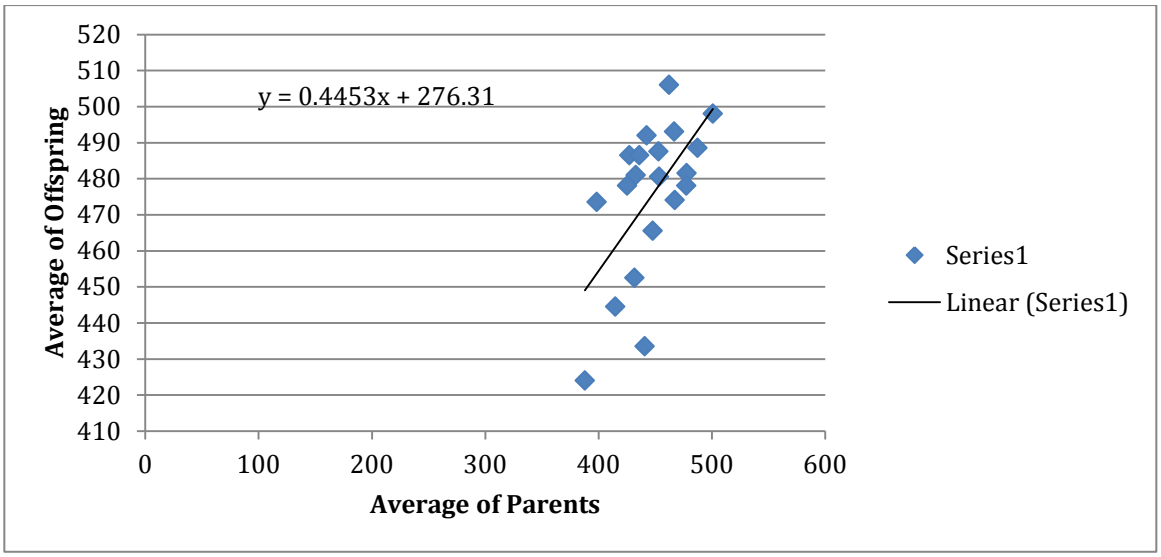

Figure 2 Relationship between the average area of the base of the wing for each set of parents and each set of offspring.[19]

[18] Caption: these captions simply describe what is in the figure in one sentence.
[19] Place figures at the end unless otherwise directed by your T.A.

Works Cited[20]

Gratton P, Allegrucci G, Gandolfi A, Sbordoni V. 2013. Genetic differentiation and hybridization in two naturally occurring sympatric trout Salmo spp. forms from a small karstic lake. Journal of Fish Biology 82(2):637-57.

Ruiz-Rodríguez M, Avilés JM, Cuervo JJ, Parejo D, Ruano F, Zamora-Muñoz C, Sergio F, López-Jiménez L, Tanferna A, Martín-Vivaldi M. 2013. Does avian conspicuous colouration increase or reduce predation risk?

[20] Outside sources cited using the name-year system. Usually sources are used in the introduction when background information is provided on the experiment or in the conclusion where it is discussed how the conclusions relate to current work.