The Effect of Synthetic Estrogen on Male Zebra Finch (*Taeniopygia guttata*) Courtship Behavior

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Abstract: Estrogen plays an important function in the establishment of pair bonding and communal relationship behavior, as well as the development of reproductive organs in birds. Therefore, if the amount of estrogen is altered within an individual it could cause a change in the behavior or reproductive abilities of the finches. 17α-Ethinylestradiol (EE2) is a form of synthetic estrogen in oral contraceptives that has been found to enter waterways via water treatment plants, and has been known to bind to estrogen receptors in the same way as natural estrogen. Because of this ability to bind to estrogen receptors, I tested the effects of various levels of EE2 exposure on the reproductive behaviors of male Zebra Finches (*Taeniopygia guttate*). In order to determine the effects of EE2, we divided zebra finch males into three treatment groups (control, 4 ng EE2 and 100 ng EE2) and used a video camera to record the courtship behavior of the different male treatment groups when exposed to female Zebra Finches. EE2 exposure did not appear to alter male courtship behavior, but after observing the males we were able to establish a relationship between male mounting and female tail fluttering during normal courtship.

Keywords: Zebra Finch, Synthetic Estrogen, Courtship Behavior

Introduction

Modern oral contraceptives contain a chemical compound known as 17α-Ethinylestradiol (EE2), which is a synthetic estrogen. This chemical compound has been found to enter waterways via water treatment plants, and because it is a synthetic estrogen it has the potential to interact and disrupt endocrine systems (Kasper and Witzel 1985) when contaminated water is ingested (Muller et al. 2008). Current research indicates that exposure to EE2 can alter the physiology of exposed aquatic species, such as disruption and malformations in male reproductive organ development of exposed minnows (Kidd et al 2007). Current research has also indicated a link between EE2 exposure and behavioral changes of aquatic species such as fathead minnows (*Pimephales promelas*), including a decrease in offspring maintenance and care, and territorial defenses compared to non-exposed males (Salierno and Kane 2009). Despite these findings very little research has been performed to determine the effects of environmentally relevant EE2 exposure on terrestrial species.

In order to determine the effect of EE2 exposure on terrestrial species, research is being conducted on male Zebra Finches exposed to EE2 to determine if it affects Zebra Finch courtship and mating behavior. My research was designed to contribute to the overall research project by focusing on the courtship behaviors displayed by male Zebra Finches after being treated with EE2.

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Methods

This experiment was designed to measure the effect of different levels of EE2 exposure on male Zebra Finch courtship behaviors. The male finches were divided into three experimental groups: a control group with no EE2 exposure, a 4 ng EE2 exposure group, and a 100 ng EE2 exposure group. The males in each treatment group were treated orally every other day for three weeks prior to exposure to females in the courtship trials.

After the males were treated they were exposed to a female Zebra Finch for twenty minutes and any courtship behavior displayed by the male or female was recorded. A video recorder was used in front of the cage in order to record the behaviors without human interference, and the behaviors were scored using Behavioral Observation Research Interactive Software (BORIS; Friard and Gamba 2016). The behaviors that were scored for the males were beak wiping and mounting, the courtship behavior that was recorded for females was tail fluttering. Each time that an individual behavior was displayed it was scored. The results from scoring the videos were analyzed using SPSS software. Since the data were not normally distributed the behaviors were analyzed with a Kruskal Wallis test in order to

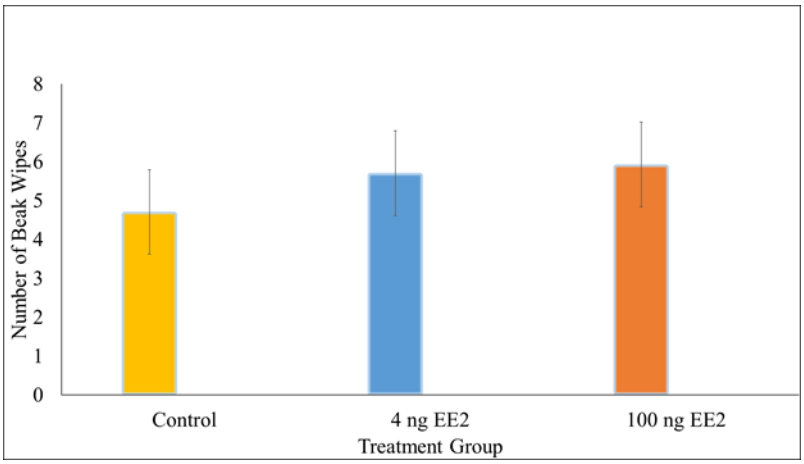

Figure 1 - Average number of beak wipes displayed by the male per treatment group ± standard error.

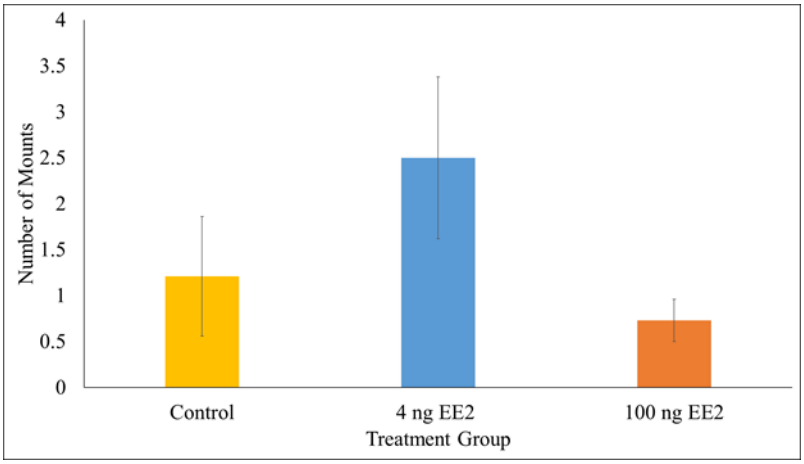

Figure 2 - Average number of mountings displayed by the male per treatment group ± standard error.

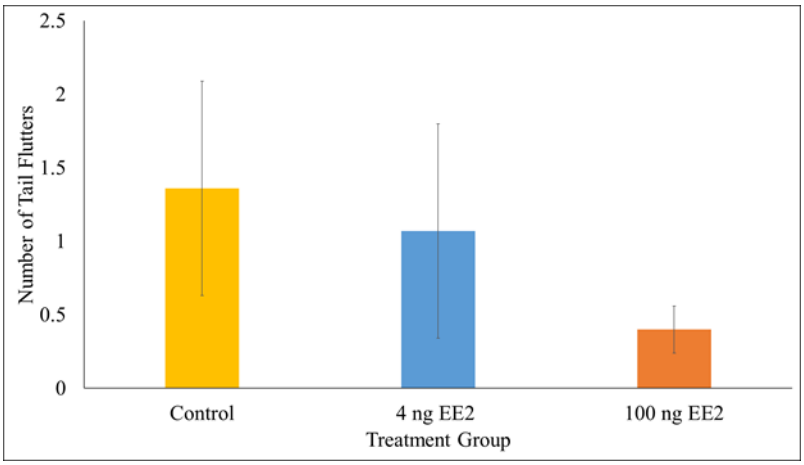

Figure 3 - Average number of tail fluttering by the female per male experimental group ± standard error.

compare results across all of the treatment groups.

Results

Analysis of the results for the number of male beak wipes using SPSS software indicated that male beak wiping did not differ among the three treatment groups ($p = 0.841$, Chi-Square=.346; Figure 1). Analysis of the number of male mountings across the three treatment groups indicated that exposure to EE2 did not significantly affect the number of times males mounted ($p = 0.399$, Chi-Square=1.837; Figure 2). There also was no significant effect of EE2 exposure levels on the average number of female tail flutterings ($p = 0.914$, Chi-Square = .181; Figure 3). However, there was a significant positive correlation between the number of male mountings and the number of female tail flutterings ($p < 0.001$; Figure 4).

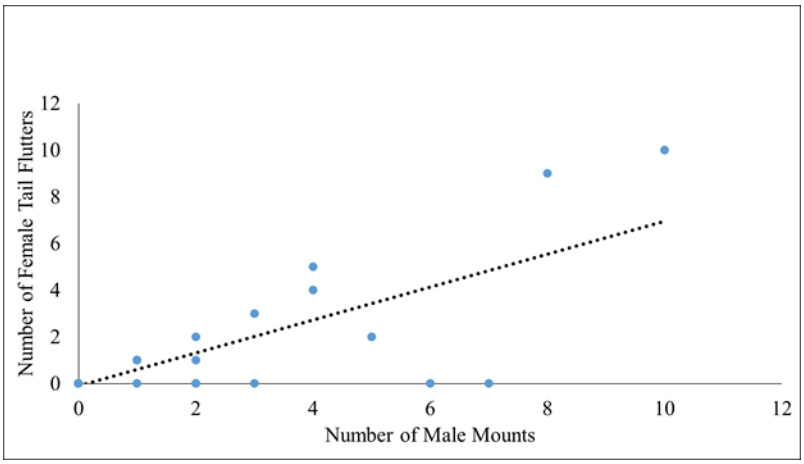

Figure 4 - Correlations between male mountings and female tail flutters during courtship trials.

Discussion

Exposure to EE2 appears to not directly influence the male courtship behaviors that were recorded, or indirectly influence female courtship behaviors. EE2 exposure may affect behaviors other than courtship and mating, as current research indicates that exogenous estrogen exposure may affect nurturing ability such as nest building (Rochester et al. 2008), or male reproductive infertility (Rochester et al. 2010). The results indicating that there is a correlation between male mounting and female tail fluttering could be used to help research other courtship behaviors for Zebra Finches, as this would indicate that a female fluttering her tail feathers is receptive to the male as a mate or potential pair bond partner.

Future Work

In the future, I would like to study the offspring of the exposed males in order to determine if there is a cross-generational effect of EE2 exposure, such as lesser fertility or endocrine system defects of the offspring of treated males. I would also like to study the nurturing ability of exposed males to determine if that behavior is altered by EE2 exposure.

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