



Risk-sensitivity among species: A meta-analysis

Paxton E. Ataide, Emily J. Northey, Alyssa L. Peters, Jessica L. Sparks-Stuht & Baine B. Craft
Seattle Pacific University, 2020

Introduction

Risk-sensitive Foraging Theory: the variance of foraging behaviors is observed in two primary ways: a risk-averse choice yields a constant return and a risk-prone choice yields a variable return (Fig 1).

Background: Past studies have looked at

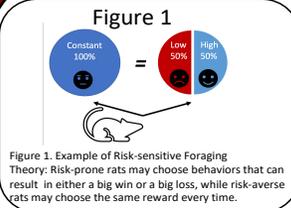
reward amount and reward delay to examine choice behavior, but little has been done to examine the potential wide-scale effects of species differences on Risk-sensitive Foraging. The information collected from individual studies can be used as a predictor for risk sensitivity as it applies to an entire species. For instance, a species' metabolism could factor into their foraging; the amount of time taken to convert food into energy could impact their choices. Another possible factor could be species' lifespan; shorter lifespans could result in less time to forage and determine foraging choices. Sexual maturation for females is also unstudied in choice behavior, but because reproductive fitness is key to survival, sexual maturation could affect females' foraging strategies.

Purpose: The goal of our study is to determine the impact that species differences have on risk-sensitive foraging, by examining three primary areas between species: basal metabolic rate (BMR), lifespan, and sexual maturation of females. By conducting a meta-analysis, we can make further predictions on the impact that these three factors have on determining the general risk-sensitive foraging strategies of entire species.

Hypothesis: The differences in BMR, lifespan and sexual maturation will result in differences to risk-sensitive foraging strategies between species.

Methods

Individual studies were found using keywords to search databases. Each article was coded for information such as species common name, amount of subjects, and methodology. Our on-going meta-analysis examines 109 publications. To date, the data analyzed is collected exclusively from two sources: The University of Michigan Museum of Zoology's Animal Diversity Web (animaldiversity.org) and the Cornell Lab



Methods Cont.

(allaboutbirds.org). An Analysis of Variance (ANOVA) was used to assess the difference between the results from risk-sensitive foraging studies and the mean for each variable (BMR, lifespan, and sexual maturation). Bar graphs were designed to represent any statistically significant difference found for the three different findings (Figs. 2,3,4).

Results

BMR: A test of homogeneity of variance revealed that homogeneity was violated. We used Welch's t test to determine differences between groups and found that metabolic rate significantly differed depending on whether subjects were found to be risk averse ($M = 31.71, SD = 42.49$), risk prone ($M = 33.52, SD = 42.40$), or mixed results (both risk-averse and risk-prone; $M = 7.51, SD = 22.67$), $F(2, 19.53) = 4.13, p = .03$. Post-hoc analysis revealed a statistically significant difference only between subject's metabolic rates when a risk averse bias and mixed results were found. (Fig. 2).

Sexual Maturation: A test of homogeneity of variance revealed that homogeneity was violated. As such, we used Welch's t test to determine differences between groups. The analysis revealed no significant difference in sexual maturation between groups, $F(2, 21.95) = 2.96, p = .07$. (Fig. 3).

Results Cont.

Lifespan: We found that lifespan significantly differed depending on whether subjects were found to be risk averse ($M = 21.33, SD = 19.76$), risk prone ($M = 37.19, SD = 18.63$), or mixed results (both risk averse and risk prone; $M = 12.85, SD = 15.36$), $F(2, 78) = 8.51, p < .001$. Post-hoc analysis revealed a statistically significant difference in subject lifespan when a risk averse bias and risk prone bias was observed as well as when risk prone and mixed results were found. (Fig. 4).

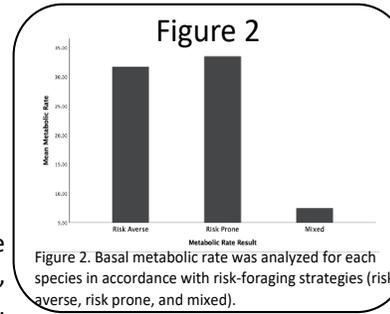


Figure 2. Basal metabolic rate was analyzed for each species in accordance with risk-foraging strategies (risk averse, risk prone, and mixed).

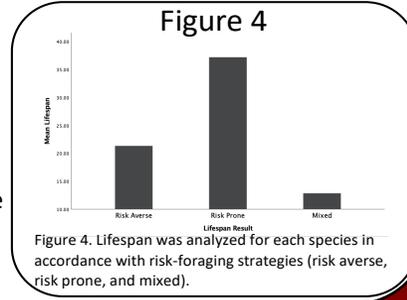


Figure 4. Lifespan was analyzed for each species in accordance with risk-foraging strategies (risk averse, risk prone, and mixed).

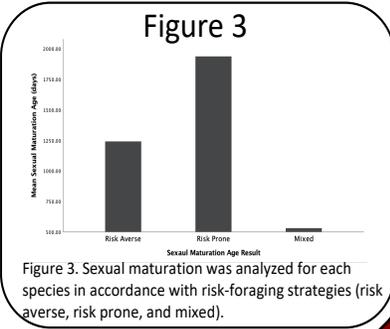


Figure 3. Sexual maturation was analyzed for each species in accordance with risk-foraging strategies (risk averse, risk prone, and mixed).

Discussion

With **BMR**, species with a higher metabolic rate displayed results of solely risk-prone or risk-averse behaviors. Because of its statistical significance, future research should consider their subjects' BMR and the differences in species within their BMR as possible factors in determining risk sensitivity. This difference would support the Daily Energy Budget Theory as the calories burned via metabolism will place the animal in either a positive or negative energy budget and correspond with their choice behaviors in risk. The significance of this BMR difference shows where research needs to shift in order to consider species differences. Although we hypothesized that changes in **sexual maturation** would result in changes in risk behavior, we found no significant difference between sexual maturation and risk sensitivity. On the other hand, **lifespan** was a predominant factor in all studies that concluded risk-prone behaviors, risk-averse behaviors, and mixed results. This indicates that the longevity of the species studied will influence risk-sensitive behaviors. Thus, there will be a difference in behaviors in species with longer lifespans compared to species that have shorter life durations. Future research in lifespan and BMR is needed in order to fully replicate our findings and help contribute to a better understanding of differences in animal behavior between species within Risk-sensitive Foraging Theory.