

Power of a Snapshot Observation: Using iNaturalist To Teach Undergraduates about Ethograms in Animal Behavior

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INTRODUCTION

Among the challenges for science education at undergraduate universities is to increase the ability of students to both think like a scientist, by providing opportunities for students to conduct original research, and to develop their powers of observation of quantifiable data, including how animals behave within an existing course curriculum (1, 2), particularly if ethology or animal behavior is among the upper-level course offerings. To this end, students may lack experience in generating their own data following a hands-on approach. In addition, students are more comfortable working in groups when developing scientific observation skills, with the benefit of conferring with a peer in real time.

Traditional approaches to teaching animal behavior often incorporate field activities where students observe animals or characterize behaviors of animals kept in aquariums in laboratories (3). However, biology courses which often incorporate experiential learning involving live animals can be difficult to disseminate for faculty with limited resources, finances, or if taught using an online format (4). Use of Internet resources to teach animal behavior has been previously utilized by having students analyze databases of audio recordings (5). Moreover, recent research allowed for the creation of ethograms from fossils (6), zoo visits (7), or observations of videos (8, 9). The activity described here provides a novel approach that allows students to generate their own data on ethograms and discuss specific behaviors within the context of an animal behavior undergraduate lecture.

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PROCEDURE

This activity was implemented in an upper-level undergraduate Animal Behavior (ethology) course with 24 students who were junior and senior biology majors at a small, liberal arts university. Prior to lecture, students were informed to bring either a laptop, iPad, or cell phone to class. The instructor presented a brief overview with examples of ethograms (inventories of behaviors or actions exhibited by an animal) or a list of common behaviors noted across representative animal groups and their importance to the field of ethology. The instructor also introduced via a species example the smartphone identifier application iNaturalist (www.inaturalist.org). Students then formed groups of 2 (one partner) and selected a species to investigate on a first-come, first-serve basis, and this was noted in a separate sheet or as a sign-up sheet at the front of the class. Students then followed instructions to search within the state and within their taxonomic entry (species), to ensure that there were adequate numbers of observations listed. (This can be verified prior to class meeting). Students then reviewed the observation images and spent ~15 to 20 min developing an overall list of behaviors observed (their own ethogram). Then, students proceeded to characterize exactly 50 images (the first 50 deemed usable, i.e., clear images with readily observable animals) and assigned only one behavior in their ethogram per image (Fig. 1). Students were encouraged to use a dot tally or tick marks when noting each observation to more easily enumerate the 50 total observations.

Following completion of the activity, all students in groups participated in a discussion, reporting results. Prompts for discussion by the instructor included: “How do your more frequent behaviors relate to either the natural history and biology of the species?” and also, “Was your species nocturnal or roadkill?” and “What are some of the potential issues with assessing behavior from a still image?” Students reported limitations in their analysis, including comments on increasing sample size, urban versus natural habitat, and overall difficulty in categorizing behavior from a single image.

Following completion of the in-class discussion, students completed a series of Likert questions on whether they agreed

Name: _____

Animal Behavior in iNat Partner in class Activity BIO355 2022

PROCEDURE

1. Navigate on your device to <https://www.inaturalist.org/>
2. Select the upper left tab or "Explore"
3. In the Blank next to magnifier, enter North Carolina for the *location* blank. Then enter one of the following taxa (animal groups), then click "Go": (Note you may have to enter one blank at a time like NC first and Go, then enter the other where it says "species" right after the initial search)

CIRCLE WHICH SPECIES YOU SELECTED BELOW!!!

- "Insects"
 - Eastern Tiger Swallowtail, Monarch, Eastern Carpenter Bee, Asian Lady Beetle
- "Reptiles"
 - Common Box Turtle, Common Snapping Turtle, Eastern Ratsnake, Common Watersnake, Green Anole, Common slider, Eastern Copperhead
- "Birds"
 - Northern Cardinal, Great Blue Heron, Eastern Bluebird, American Robin
- "Mammals"
 - Eastern Gray Squirrel, White-tailed Deer, American Beaver, American Black Bear, Gray Fox, Virginia Opossum, Eastern Cottontail, Big Brown Bat, Eastern Red Bat

4. Confirm that your entry (*taxa*) and the state (*North Carolina*) are still there in the blanks.
5. Categorize exactly 50 images for your NC selected animal species and come up with a list of behavioral categories that animals are doing in the image. Only assign 1 category per image. You may need to click on species, then observations. (Note: if person is holding animal, move onto another image, etc..)
6. Enter the behaviors in the table [ETHOGRAM] below. (Examples could include butterfly "feeding" or "foraging", or turtle "basking", or crossing road or "swimming" or bird "flying", or "dead" or "hiding" or "climbing" or "sitting" or a bat "roosting" or bird "perching", etc..... Come up with your own category if needed etc...

Behavioral Category	# of observations

Notes: any additional observations on your ethogram? What was the most common behavior you observed/quantified? Was it mostly day or night? Alive vs dead? Was it easy to develop ethogram? **Discuss**

FIG 1. An example worksheet, page 1, with instructions handed out to students following a brief introductory lecture on ethograms and iNaturalist.

with a series of statements (scale from 1 to 5, with 1= strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree) on the worksheet to assess the activity. These questions included the following:

- Q1 "Making my own ethogram helped me understand more about animal behavior."
- Q2 "Developing an ethogram for a local North Carolina species helped me understand how the species behaves."
- Q3 "This activity helped me understand how iNaturalist can be used to study animal behavior."
- Q4 "This was a fun, engaging activity for an animal behavior class."

Finally, students were asked to provide additional written comments to clarify any of the previous questions and overall to elaborate and provide feedback on the activity. Student responses were collected, and data from responses

on worksheets were entered anonymously, with student names removed.

Overall behaviors identified in student ethograms ranged from 4 to 10 behaviors, with a mean (\pm standard deviation) of 6.57 ± 1.87 behaviors and a median of seven behaviors, characterized for their species of choice when reviewing iNaturalist. Feeding and foraging were among the most observed behaviors across taxa in student ethograms, with birds noted to be "preening" and "bathing" and many reptiles noted to be "basking" or box turtles "nesting," "mating," and even "hiding" (see Appendix S1 in the supplemental material). Mammals such as the American black bear were noted to be "playing" or practicing parental care of offspring, and both species of bats examined by students were noted to be "roosting," "grouping," and "in flight." Several animals observed in images (i.e., fox, bat, turtles, etc.) were noted to be "dead" or roadkill, leading to further in-class discussion on conservation biology. Student feedback on the activity was overwhelmingly positive, with the following median responses: for

TABLE I
Representative feedback comments provided by students as part of this activity

Taxonomic group	Representative responses and feedback on activity
Insects	"This was an interesting activity that was very helpful in understanding ethograms."
	"This activity helped me realize that I could make ethograms which included insects feeding, which is great because they are pollinators and important to plants."
Reptiles	"I liked this activity, it was a great way to incorporate iNaturalist and animal behavior."
	"I feel this activity really helped me understand animal behavior better. I really found this to be both interesting and cool."
	"I think this was a great activity. iNaturalist is a great way to learn about species and their behavior. This activity helped me understand ethograms because I had to make up my own behaviors and count them."
	"Overall I thought it was neat to work with peers and make judgment calls about the behaviors."
Birds	"It was fun to do but I think a 30–40 second video would benefit the behavior analysis."
	"I liked this activity! It was a good change from a typical lecture and helped me understand behavior through photos."
	"This was an awesome activity that helped me realize how much we can learn about animals just from a photo."
	"This activity helped me to see that birds spend much of their time perching and foraging during the day."
Mammals	"I already knew a lot about the bird, so nothing was new to me."
	"This activity helped me understand what an ethogram is and how it relates to the behavior of bats. Very fun activity!"
	"Making our own ethogram was an excellent activity because it allowed us to observe animals in more than just one category or behavior. Doing activities like this are very beneficial and I would enjoy more of them"
	"Creating an ethogram helped me understand gray fox typical behavior and how they are active at night."
	"Pictures can only show so much, but I feel we could take a better look with more than pictures, maybe videos."

Q1, 4 on the scale; Q2, 4; Q3, 5; Q4, 5. Ranges for Q1, Q2, and Q3 were 3 to 5, and the range for Q4 was 4 to 5. Student written responses were also positive and included various descriptions of their observed animal being active either during the day or at night, with many comments expressing excitement, a desire to learn more about iNaturalist, and an understanding for the complexity of making decisions when categorizing an animal's behavior from an image (Table 1). However, some written responses included more neutral or critical comments on the activity (Table 1). No safety issues were identified as part of this activity, as it was performed in class using digital devices or cell phones.

CONCLUSION

This activity incorporates group learning, using readily available, free data sets of animal observations, and it engages students about animal behavior as they build their own ethograms. Having students take ownership and develop their critical thinking skills alongside their powers of observation require practice in problem solving. Instructors can help guide students through the process, especially during the initial phases of students working through their first 5 to 10 images and as they decide on behavioral categories for their ethogram. Moreover, instructors could include a visual presentation, include more invertebrates, and include further discussion on the conservation impacts of this activity, as several mammals and reptiles were frequently observed as roadkill images in iNaturalist.

Ethics statement

I followed protocols of the Wingate University Biology Research Review Board for this study.

SUPPLEMENTAL MATERIAL

Supplemental material is available online only.

SUPPLEMENTAL FILE 1, PDF file, 0.9 MB.

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