Contributing Factors of Avian Net Avoidance at Panola Mountain State Park

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Introduction

- Mist netting is the most common field technique used to estimate avian abundance, the average number of birds located in a region within a specified timespan. It does not, however, reflect a random sample of birds at a location.
- Estimates are biased due in part to net avoidance, the purposeful evasion of mist nets by birds. This is seen when birds change course to swoop above or to the side of nets and/or avoid an area that they have learned a net is located.
- Captures at least partially depend on species. Species that fly more and further tend to be caught in mist nets more often (Remsen and Good 1996). Sparrows have lower net avoidance rates, possibly to be due to lower intelligence (Mayerhofer et al. 2008).
- Weather, net tension, net location, and habitat all affect net visibility and could potentially increase net avoidance (Remsen and Good 1996).

Research Objectives:
- To determine the most common net interactions and quantify their frequencies.
- To determine which environmental conditions at the nets had the greatest influence on net avoidance behaviors.

Methods

Field Data Collection
- We conducted our research at a year-round banding station at Panola Mountain State Park (henceforth Panola) in Stockbridge, Georgia that has operated since 2011 (Figure 1).
- We set up Bird Cam Pros cameras at six 12-meter-long mist nets on three mornings in spring 2020- 2/15, 3/1, and 3/7.
- We equipped each camera with an empty 8G or 16G SD card and set each to time lapse mode, recording 60 seconds every minute starting at sunrise and running until the storage space was filled.
- We set up cameras parallel to the nets, with one on each end of every net to ensure complete coverage.

Video Monitoring
- Each time a bird flew near a net was considered an event (Figure 2). For each event, we recorded the species (if identifiable) and classified events as:
  - *Capture:* The bird hit and stayed in the net
  - *Bounce:* The bird briefly hit and then escaped the net
  - *Avoid:* The bird clearly observed the net and changed course to avoid it
  - *Likely Avoid:* The bird likely observed the net and a change in course likely occurred
  - *Perch:* The bird perched on a pole or net trammel
  - *Flyby:* The bird clearly flew past a net and didn't change course
  - *Likely Flyby:* The bird may have observed the net, but a change in course wasn't obvious

Figure 1: Mist net at Panola

Figure 2: Screenshot of net footage

- We recorded net conditions (net light (yes, no), wind (none, light, moderate, strong), and the presence of captured birds (yes, no)) at the time of each event.
- While cameras were filming, we recorded temperature (from weather.com) and cloud cover (sunny, partly cloudy, mostly cloudy, or cloudy) every hour on the hour.

Data Analysis
- We calculated the following metrics to compare species' abilities to learn to avoid nets:
  - Recapture rate (number of individuals of a species which were recaptured divided by the total number of individuals of that species caught)
  - Recapture percentage at each net (recaptures at a given net divided by the total number of recaptures for all nets)

Results

- Recapture percentages were as follows- net 8: 22%, net 6: 13%, net 4: 12%, net 20: 4%, net 17: 4%, and net 14: 2%.
- Swamp sparrows had the greatest recapture rate at 20%. These were followed by the common yellowthroat (16%), the song sparrow (13%), and the field sparrow (12%), all other species had a recapture rate of under 10%.

Table 1: Time captured at each net at each banding day (hh:mm)

	15-Feb	1-Mar	7-Mar	Total
Net 4	1:07	3:36	0:00	4:43
Net 6	0:00	2:33	0:37	3:10
Net 8	2:21	0:00	0:42	3:03
Net 14	3:17	3:18	1:16	7:51
Net 17	2:55	3:37	3:51	10:23
Net 20	0:00	1:46	0:14	2:00
Total	9:40	16:50	6:40	33:10:00

- We watched 33 hours and 10 minutes of footage (Table 1) and recorded 134 events (Table 2).

Table 2: Occurrences of each type of capture event and both net and event type percentages

	Capture	Bounce	Avoid	Likely Avoid	Perch	Flyby	Likely Flyby	Other	Total	Net %
Net 4	4	0	2	5	0	8	17	3	39	29.1
Net 6	0	0	0	3	0	3	2	4	12	9.0
Net 8	3	0	4	0	0	3	1	2	13	9.7
Net 14	2	1	7	5	3	9	2	0	29	21.6
Net 17	4	1	3	3	2	9	9	5	36	26.9
Net 20	1	0	0	0	0	4	0	0	5	3.7
Total	14	2	16	16	5	36	31	14	134	100
Type %	10.4	1.5	11.9	11.9	3.7	26.9	23.1	10.4	100	

- Cameras recorded 26 events per hour, on average, three of which were captures (Table 3).
- Net 4 had the highest event rate, indicating that it was the "busier" net and there were more birds flying around it.
- Net 20 had the lowest event rate, indicating fewer birds around it.

Table 3: Rates of each event (number of events per hour) C: Capture, B: Bounce, A: Avoid, LA: Likely Avoid, P: Perch, F: Flyby, LF: Likely Flyby, O: Other

	C Rate	B Rate	A Rate	LA Rate	P Rate	F Rate	LF Rate	O Rate	Event Rate
Net 4	0.8	0.0	0.4	1.1	0.0	1.7	3.6	0.6	8.3
Net 6	0.0	0.0	0.0	0.9	0.0	0.9	0.6	1.3	3.8
Net 8	1.0	0.0	1.3	0.0	0.0	1.0	0.3	0.7	4.3
Net 14	0.3	0.1	0.9	0.6	0.4	1.1	0.3	0.0	3.7
Net 17	0.4	0.1	0.3	0.3	0.2	0.9	0.9	0.5	3.5
Net 20	0.5	0.0	0.0	0.0	0.0	2.0	0.0	0.0	2.5
Total	3.0	0.2	2.9	2.9	0.6	7.6	5.7	3.0	26.0

- Net 8 had the highest capture rate along with the highest avoidance rate (Table 3).
- We positively identified 31 of the 134 events; 19 were Eastern Bluebirds, nine were sparrow sp., one was a swamp sparrow, and one was a song sparrow (Figure 3).
- Of the 19 Eastern Bluebird events, seven were avoidances (Figure 7). Additionally, 15 of the identified bluebird events occurred at net 14 (Figure 4).
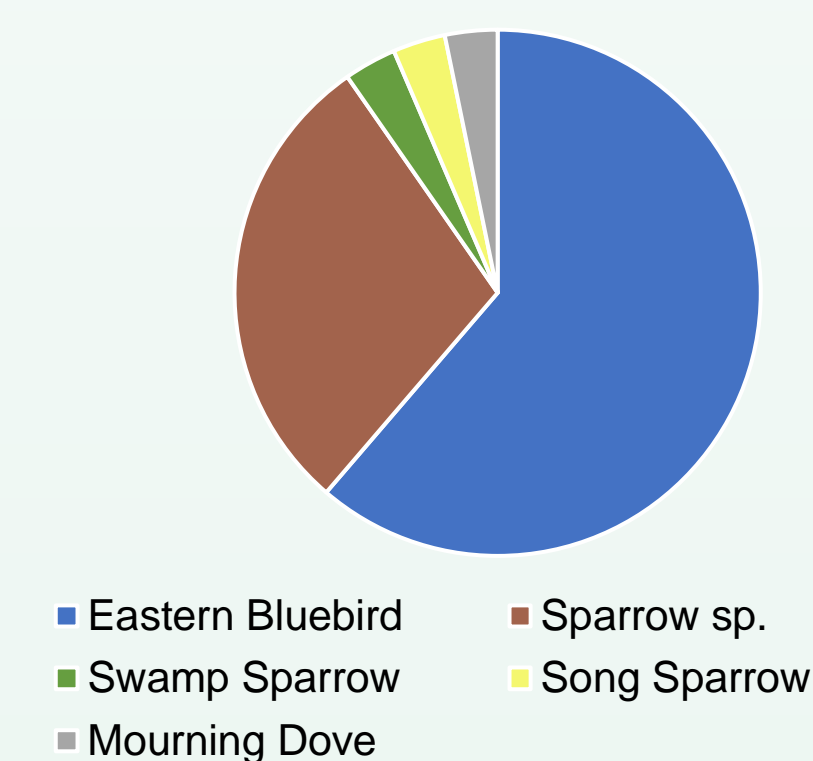

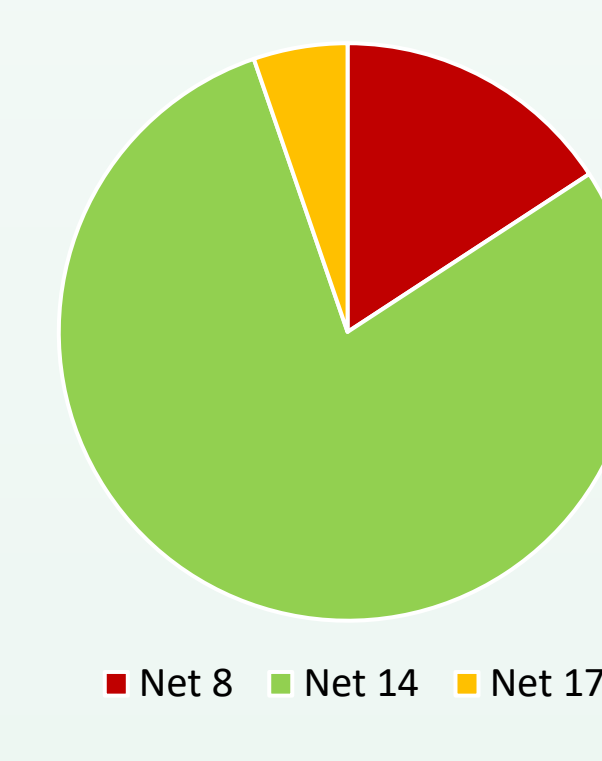Figure 3: Breakdown of the number of events (excluding captures) by species

Figure 4: Breakdown of net location of Eastern Bluebirds events

Figure 5: Eastern Bluebird in the hand

- Environmental Factors
  - 91 of 134 events occurred when nets were lit by the sun.
  - 92 of 134 events occurred more without a bird captured in the net.
  - 65 of 134 events occurred under light wind conditions; 15 of 134 events occurred under strong wind conditions.
  - 107 of 134 (85%) events occurred between 32°F and 36°F (0°C and 2.2°C).
  - 107 of 134 events occurred on sunny days; 27 of 134 events occured when it was partly cloudy.

Discussion

- Based on our finding that there were more avoidance events than captures, we can conclude that mist netting has a sample bias.
  - Captures accounted for only approximately 10.4% of events, and avoidances for 11.9% of events. If you include likely avoidance and perching events, that percentage increases to 27.6%. Over one-quarter of the birds that approached the nets likely saw the nets and actively evaded capture.
- Flybys were the most common, accounting for 26.9% of events (Figure 6). If the likely flybys are included, this increases to 50% of events. While these birds didn't appear to change their behavior, they may have changed their flight pattern out of camera's limited frame before approaching the nets.
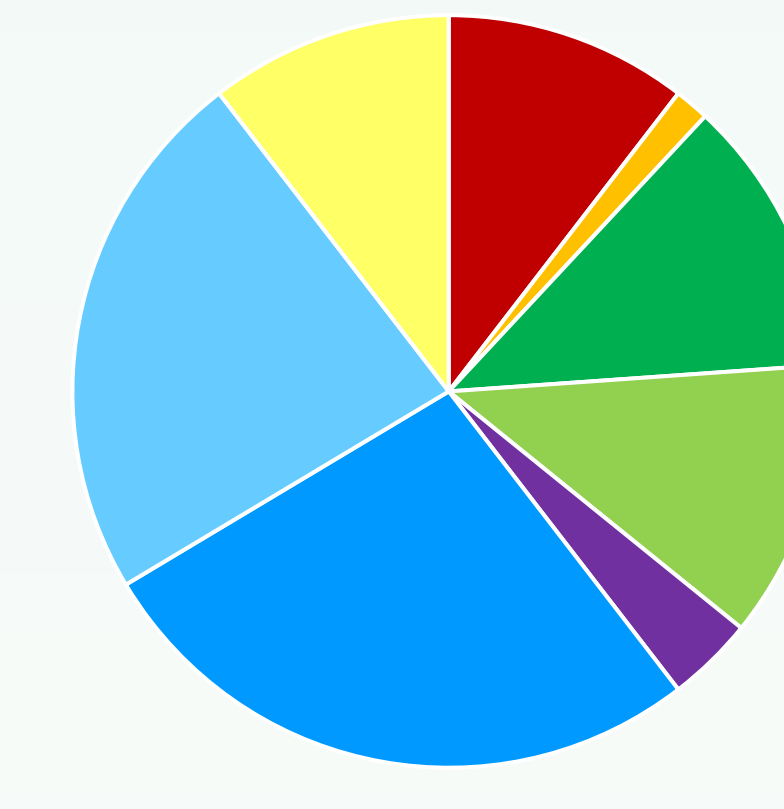

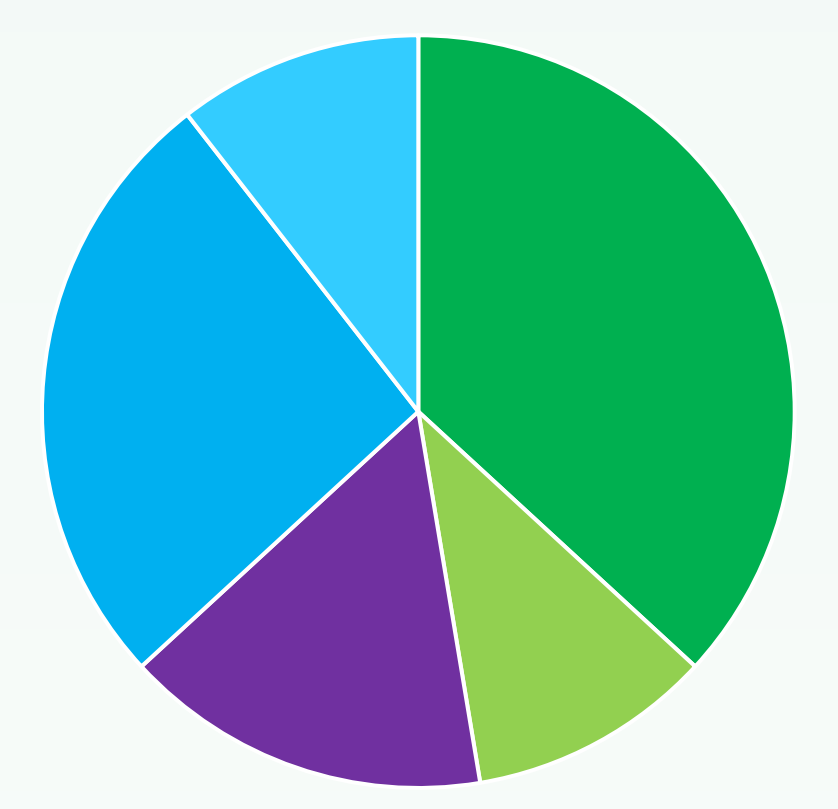Figure 6: Breakdown of event types for all species

Figure 7: Breakdown of event types for Eastern Bluebirds

Avoidance Patterns by Net Location
- Net 4 was in a location with the most bird activity (captured or not) but had low capture rates compared to other nets. This likely means that the microhabitat surrounding the net was favorable, but the mist net was more visible due to some of the environmental factors.
- Net 8 had the highest capture rate and the highest avoidance rate. This indicates that the microhabitat likely made the net more visible and birds got closer to the net before being able to react to it.

Avoidance Patterns by Environmental Factors
- Overall, environmental conditions may affect captures. The percentages of captures that occurred during the individual conditions no net light, no captured bird present, light wind, and 34°F were greater than the percentages of combined events during those conditions.

Avoidance Patterns by Species
- Sparrow species tended to have the greatest recapture rates, indicating that they were likely less able to learn the positions of mist nets and avoid them in the future. This supports previous research suggesting that sparrows have lower intelligence (Mayerhofer et al. 2008).
- Eastern Bluebirds avoided nets more than average for all species (Figure 7), indicating that they are better able to observe, quickly process, and react to mist nets. They may also display a preference in microhabitat surrounding the nets since approximately 78.9% of the identified Eastern Bluebirds were seen at net 14 (Figure 4).

Conclusion

- Mist netting captures only account for a small fraction of the birds that fly around a net (10.4%).
- Avoidances were slightly more common than captures, and flybys were over twice as common as either.
- Approximately 27.6% of birds were likely to have seen the net while 61.9% of birds likely didn't.
- Avoidance frequency and type varied by net location, likely based on the microhabitat surrounding the net.
- Species vary in their ability to avoid nets and in their preference of microhabitat surrounding the net.

References

Mayerhofer, M.S., M.R. Hudson, and M. A. Gahbauer. 2008. Net avoidance in passerine birds.
Remsen Jr., J.V. and D.A. Good. 1996. Misuse of data from mist-net captures to assess relative abundance in bird populations. The Auk 113:381-398.