Spring 2019

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What is Known About Flight:

- Most birds only produce lift on the downstroke, hummingbirds are an exception3,4.
- Changes in surface area can be used to alter speed4.
- Wing morphology varies across different bird species and affects flight3.
- Flight follows a ‘U’ shaped power curve meaning it is least expensive in the middle3.

What is Know About the Tail During Flight:
The tail is known to produce lift and drag during avian flight2,3.

Specific Aim:
This study will focus on the comparative role of the American Goldfinches tail feathers in solo flights vs. bird-to-bird interaction.

Potential Questions I hope to answer along the way:
- Does the tail play an active role in lift generation during one mode of flight compared with the other?
- What is the drag to lift ratio that the tail is producing for each method of flight, and how do they compare?
- Is the tail utilized in one method more than the other?

Methodology:
Figure 1 is an image of how the three synchronized high speed cameras will be set up. The cameras will be filming at 500 frames per second. The feeder serves not only as a focal point for the cameras, but also as a tool to draw in birds.

Figure 2:
Figure 2 is a representative image of an American Goldfinch (Spinus tristis)5.

Figure 3:
Figure 3 is a photo of the Argus software dashboard that the 3D tracking of the birds, in the high speed videos, will be conducted1. The XYZ data files that come from use in the clicker application will be the data off which the statistical analyses are conducted. Variables that will be compared between flights are: tail fan angle, tail depression angle, and tail angle of attack.

Citations:
5. https://d1ia71hq4oe7pn.cloudfront.net/og/75242471-1200px.jpg

Potential Pitfall:
- A lack of adequate American Goldfinch flights for conclusive statistical analysis.

Potential Conclusions:
- Tail usage in the two methods of flight:
  - Are NOT statistically different.
  - ARE statistically different.

Importance and Future Directions:
- Specific details about tail usage in flight is unknown- novelty
- Could lead to improved airplane design and improved robotics
- How do airflow vortexes work around the tail as compared to the wings?
- Do the conclusions of the study carry over across different birds?