Quote of the Day:

The evolution of the gull appears capricious, undirected. The more, however, her character suffers as a loiterer, the more it is raised in picturesque value, by her continuing long before the eye; and in displaying, in her elegant sweeps along the air, her sharp-pointed wings, and her bright silvery hue. She is beautiful...giving life and spirit to a view.

William Gilpin
Remarks on a Forest Scenery
London 1794

Competition in the Air: Birds & Aircraft

- Bird-aircraft collisions
- 350 deaths; $$ damage
- USAF aircraft incur 2500 strikes annually
- Civilian aircraft had 5000 strikes in 1999

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Why do Collisions Occur?

- Airfields provide attractive resources
- Species differ in ability to evade planes
- Individuals wary of planes but may become acclimated to low traffic & less vigilant
- Quieter, larger, faster aircraft more often hit

Which Birds hit Planes?

- Gulls, especially juveniles
- Juveniles “naïve” to danger
Is There a Dangerous Time?

• Time: morning
• Weather: clear
• Season: migration periods especially when juveniles are present

Minimizing the Problem?

• Pilot awareness …
  1. Scan skies, don’t take off into sun
  2. Lights on in areas of high bird density
• Airport management …
• Aircraft design …
  1. Windshield thickness
  2. Number of engines

Lecture Outline

• Aerodynamic principles
  1. Lift, drag, thrust, gravity
  2. Physics of lift
• Types of flight:
  1. Gliding
  2. Soaring
  3. Flapping

Physics of Flight

• Weight – gravitational pull
• Lift – generated by wing & tail
• Thrust – provided by primaries
• Drag – resistance from:
  • Surface friction =
  • Profile =
  • Induced =
**Wing Shape & Lift**
- Cambered shape
- Unequal distances of air traveling over dorsal & ventral surfaces

**How Lift is Generated**
- Static pressure = atmospheric
- Dynamic pressure = kinetic energy of wind
- Bernoulli’s Law
- Static + dynamic = constant

**Airplane Parts**

**Take-off & Landing**
Gliding Flight

- Glide ratio = horizontal distance:vertical distance
- 100 m distance: 10 m drop in elevation
- Common Murre on cliff with & without wind

Types of Drag

- Surface friction = leading edge of wing and front of body
- Profile = body shape
- Induced = pressure differences at wing tips

Aspect Ratio

- Ratio of wing length to width
- Adapted to habitat & type of flight
- Variation

Wing Loading

- Mass relative to surface area of the wing
- Bad Gliders?
- Good gliders?
- Vulnerability of migrants with high fat loads
Soaring Flight

- Upward air movement counters downward glide of bird
  1. Thermals
  2. Mountains
  3. Ocean waves

Flapping Flight

- Powered by:
  - Down stroke of perctoralis major
  - Recovery stroke of supracoracoideus

Wing Morphology & Function

- Primaries = thrust
- Secondaries = lift
- Coverts = protection

Hummingbird Flight

- 180° shoulder rotation of humerus
- Dorsal & ventral wing surfaces generate lift
Conclusions

- Aerodynamics of flight similar to planes
- Lift & thrust countered by gravity & drag
- Species morphologies vary with lifestyle
- Gliders, soarers & flappers