Migration

Class Business

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Reading for this lecture

Required. Gill: Chapter 10 (pgs. 273-295)
Optional. Proctor and Lynch: pages 266-273

1. Introduction

A) EARLY IDEAS

People have known for centuries that birds disappear from certain areas for parts of the year. But for a long time it was not recognized that this was because they simply flew somewhere else far away. One early explanation was that small birds such as swallows hibernate through the winter in the mud at the bottom of a pond. Another was that certain geese (which disappeared – to the Arctic – during the summer) were in fact the same species as a type of barnacle. This legend has led to the common names used today: goose barnacles and Barnacle geese. Although these ideas now seem bizarre, they begin to make sense when you realize that they date back to times when the world was believed to be both flat and much smaller than we know it to be today.

B) DEFINITIONS

i) Most ornithologists distinguish between **migration** and **dispersal** and treat them as two distinct types of movements. (But, note that these terms are used differently by other types of biologists – and in some cases the definitions are even reversed!!)

ii) **Migration**: predictable back-and-forth movements, repeated seasonally.

iii) **Dispersal**: usually a unidirectional movement, often with much wandering between start and end points. There are various different types of dispersal. **Natal dispersal**: movement between the site where an individual is born and the site where it first breeds. **Breeding (adult) dispersal**: movement between one breeding site and another. **Postbreeding dispersal**: typically refers to the wandering movements that some birds (e.g., herons) make after they finish breeding, but before they settle at a wintering site.

C) DETERMINANTS OF MIGRATION

i) Seasonally, the timing of migration is influenced by internal "clocks" that are influenced by day length and perhaps also weather. This topic was discussed in the last lecture.

ii) Over shorter time scales, the exact timing of migratory movements is greatly influenced by the weather. Birds tend to move when conditions favor flying in the direction they need to go (e.g., when they have a tailwind, when air turbulence is low, when it is not raining).

iii) Many birds migrate at night. There are several possible reasons for this. (1) The atmosphere is more stable at night than during the day because there are fewer thermals ("updrafts" caused by warming of the Earth's surface). (2) The air temperature is lower, which may make thermoregulation easier; remember that flight generates a lot of heat that birds need to offload. (3) Predation risk may be lower than during the day.

iv) But some species do migrate by day. In particular, large soaring birds such as hawks, storks and pelicans move during the daytime. These birds use thermals to help them travel.

2. Facts and figures

A) DISTANCE

i) Many types of birds travel 1000s of miles during their annual migration. Many others travel much shorter distances.

ii) Champion in terms of distance is probably the Arctic tern. These birds breed in the Arctic, but spend the winter months in Antarctic waters. It has been estimated that these birds travel about 30,000 miles during each year's migration and up to 600,000 miles over their lives.

B) SPEED

i) Flight speeds vary among species and are greatly influenced by the prevailing wind direction.

ii) Speeds of 30-50 miles per hour have been measured in numerous species, and we know that at least some species can sustain these speeds for many hours. For example, a western sandpiper that was fitted with a small radio transmitter (so that it's exact location could be determined) was found to fly from San Francisco Bay to southern Alaska in less than 42 hours. To cover this distance (1900 miles) it had to average over 40 mph.

C) ALTITUDE

i) Most birds migrate at altitudes of about 1500 ft, although some (especially large soaring birds) will fly as high as 20,000 ft.

ii) Many birds adjust their altitude during migration in order to maximize the benefits they can get from the prevailing wind (i. e., by moving to a height that either maximizes the tail wind, or at least minimizes the head wind).

D) NUMBERS

i) If you have any doubt that migration is a very important phenomenon in ornithology, just think about the fact that BILLIONS of birds move back and forth between the temperate zones of Europe, Asia and North America and the tropics each year.

ii) Another estimate suggests that 95% of the birds between 40° and 50° N latitude after breeding are migrants.

iii) Even in purely ecological terms this is a massive movement of biomass between ecosystems.

3. Kinds of migration

A) LATITUDINAL MIGRATION

i) Most people think of migration as a north-south movement and this is perhaps the most common pattern. There are, however, various other types of migration (more on this below).

ii) In North America, north-south movements make sense because this mirrors the variation in climate patterns and because most geographical landforms that influence migration (mountain ranges, large rivers) run in this direction. (In contrast, migrants in Europe have more of an east-west component.)

iii) Although the general pattern is north-south, not all birds follow the same route north as they do when heading south. Lots of birds follow an elliptical pathway, which allows them to make the most of prevailing winds and good feeding opportunities at different times of the year. Hence, many birds take a northward route through the center of North America during the spring migration, but head south along a more easterly route in the fall.

B) ELEVATIONAL MIGRATION

i) Another common form of migration occurs up and down the slopes of mountains.

ii) Just like latitudinal movements, these migrations occur because birds that breed at high elevations need to leave in winter to avoid harsh conditions.

C) MOLT MIGRATION

i) Some birds move to a specific area to molt, then continue on their migration to somewhere else to spend the winter.

ii) Certain waterbirds, in particular, are well known for making these movements. The behavior is most common in species that become flightless while molting their flight feathers. These birds typically move to large lakes or bays where there is abundant food (to provide energy to grow feathers) and where they can easily stay far from shore (and predators).

D) SEABIRD MOVEMENTS

i) Although some seabirds – especially those that nest near the poles – do make north-south movements, many take less obvious routes during migration, e.g., travelling east-west across the oceans.

ii) The reason for these differences is that food availability in the oceans is not as dependent on climate as it is on land. Instead oceanography plays a big role in determining where food is most abundant.

E) IRRUPTIVE MOVEMENTS

i) In some species the degree of migratory movement (the distances traveled, the proportion of the population that moves, etc.) can vary hugely from year to year.

ii) These species are usually those that have food supplies that fluctuate widely from year to year and include many northern or montane species (e.g., various finches, some owls). In an "irruption" year, these birds can be very common far south of their typical winter range.

4. Why do birds migrate?

A) ADVANTAGES

i) Enables birds to take advantage of good feeding conditions.

ii) Provides nesting opportunities that would not be available if the bird stayed on its wintering grounds (e.g., seabirds).

iii) Allows birds to avoid climate extremes.

iv) Reduces competition with other species during the breeding season.

v) May also allow birds to avoid parasites (??).

B) DISADVANTAGES

i) Energetically very costly.

ii) High risk associated with long flights, often over harsh terrain or through poorly known areas (especially for young birds).

C) ORIGINS OF MIGRATION

i) Over the millennia, birds have spread north as glaciers have treated. Thus, it is probably better to think of latitudinal migration as a move away from the tropics during summer, rather than a move to the tropics in winter.

ii) For example, birds that lived in the tropics but which started to move north during the breeding season would have encountered very rich food supplies, fewer competitors, etc. This could have enhanced their breeding success compared to what they would have achieved had they stayed in the tropics. Such selection would have then favored the further evolution of migration as a behavior.

5. What biological capabilities does migration require?

A) PHYSIOLOGY

i) Birds lay down fat prior to migration and use it as fuel. Fat makes a good fuel for several reasons: it produces more energy per gram than carbohydrate or protein, it produces a lot of water as a metabolic by-product (this water is useful for avoiding dehydration), it can be mobilized at low temperatures, and it can easily be stored in the bird's body without interfering with the bird's aerodynamic shape.

ii) Some birds also undergo a major reorganization of their internal organs prior to migration, reducing the size of some body parts in order to accommodate increases in the size of other parts. For example, some shorebirds reduce the size of their digestive system during migration.

B) NEUROLOGICAL

Birds also have to have an amazing ability to find their way around in order to migrate thousands of miles, often returning to exactly the same place year after year. More on this next lecture.

6. Conservation implications of migration

Migration makes it exceedingly difficult to conserve rare and declining bird populations, because effective conservation can require protection of multiple sites, often 1000s of miles apart.