Avian Migration

A. Definition and Descriptions

Migration – 2-way seasonal movements between breeding and nonbreeding areas.

N. America ~ 12 – 20 billion land birds

~ 5 billion migrate each year to Neotropics.

98 of 565 spp winter exclusively in Neotropics

Migrants taxonomically diverse – all major groups represented.

Probably evolved many times & now appears in many forms.

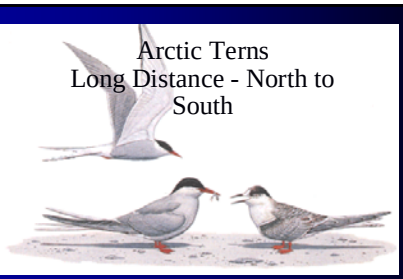
B. Patterns of Migration

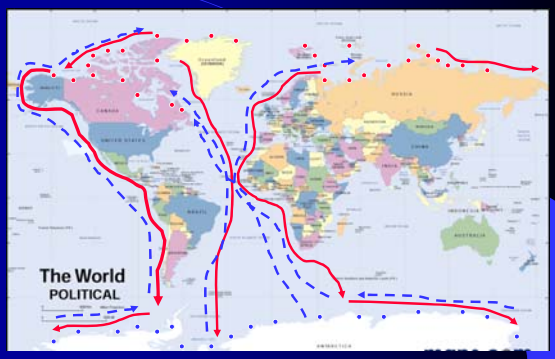
- **Vermilion Flycatchers - South to North**
- **Arctic Terns - North to South**
- **Redwings - East to West**
- **Blue Grouse - Altitudinal Migrants**
- **Snow Geese - Stopover Migrants**
- **Fox Sparrow – Leapfrog Migrants**
- **Evening Grosbeak – Partial Migrants**

Vermilion Flycatcher
South to North Migrant

Breed in the southern summer (Sept - Feb) on pampas of Uruguay and northern Argentina. In fall, migrate north to savannas of Brazil and Columbia.

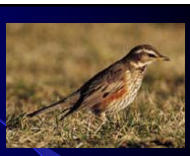
Arctic Terns
Long Distance - North to South





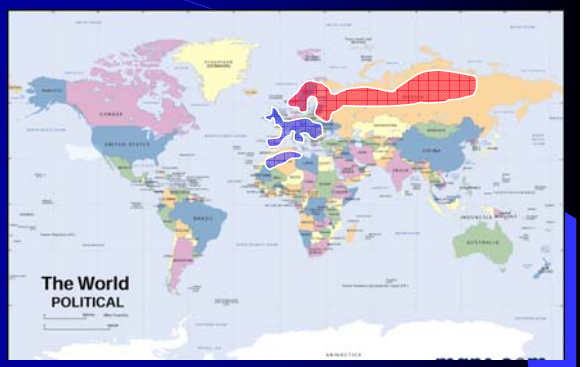
- Roundtrip 18,000 – 25,000 miles
- Oldest banded Tern ~ 26 years ≅ 620,000 miles

Redwing



Redwings are east to west migrants

Breed across Russia and northern Europe.



Blue Grouse

Altitudinal Migrants

Inhabit open coniferous or mixed woodlands within the Rockies. Each year they move vertically ~ 1000 ft in elevation.

Breed at low elevations, feeding on berries and insects. Winter range is higher in elevation where they feed on pine needles.

Snow Geese

Stopover Migrants

Breed in Arctic Canada and Alaska.

Migration interspersed by periods spent at traditional wetland staging areas. Critical for survival during migration and to build reserves for reproduction.

Leapfrog Migration

- Fox Sparrows

Evening Grosbeak

Partial Migrants

Becoming partial migrants in northern portions of range.

C. Evolution of migration or Why do birds migrate?

Better question – Why don't all birds migrate?

Cox 1985. American Naturalist 126:451-474

- Increasing Seasonality
- Optimal Energy Budget
- Intraspecific and Interspecific Competition
- Predation and Food Supply

1. Increasing Seasonality

Seasonality of climate can favor origin of migration.

Aseasonal environment vs. seasonal environments

Behavioral changes favored – reduced site tenacity, habitat shift.

Climatic changes evident through Tertiary and Quaternary

But doesn't account for ability of birds to adapt in morphology and behavior nor disjunct breeding and wintering ranges.

2. Optimal energy budget

Improvement in energy balance related to temperature and photoperiod.

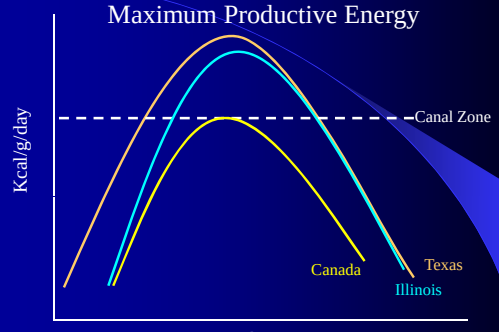
Pole ward spring – increase productive energy budget = higher reproductive success.

Equator fall – reduce energy requirements.

Some support –

Zimmerman 1965 Physiol. Zool. 38:370.

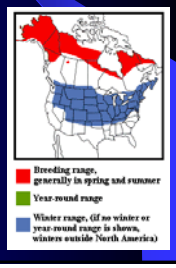
Savings in energy-budget by migrating both spring and fall.



But, not supported for all species.

• American Tree Sparrows – explains southward migration but not return.

• Tropical finches – doesn't explain migrations



Energy budget estimates assumed to apply to species throughout range.

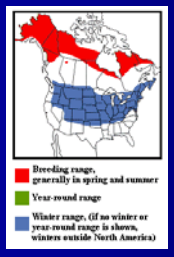
Fails to consider food availability.

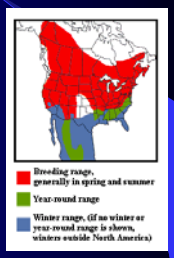
3. Intraspecific and Interspecific Competition

Resources are limiting.

Selection favors movement into areas seasonally favorable for breeding/non-breeding.

Predicts that there is a net gain so long as migratory individuals are not also in competition with residents.





Direct evidence is lacking.

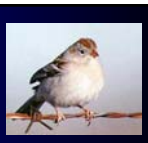
4. Predation and food supply

S. Fretwell (1980. *in* Migrant birds in Neotropics) major selective forces for evolution of migration.

Northern migration – favored by reduction in nest predation.

Southern migration – favored by severe competition for food in the breeding area during winter.

Field Sparrow – North Carolina exhibits local movements.



Nest predation increases with density of breeding population.

Disperse from high density areas in winter to low density areas in spring.

Return in fall to high density areas.

Breeding areas lack sufficient food to support them in winter.

None of hypotheses adequate to explain full range of patterns.

Cox proposes integrated model –

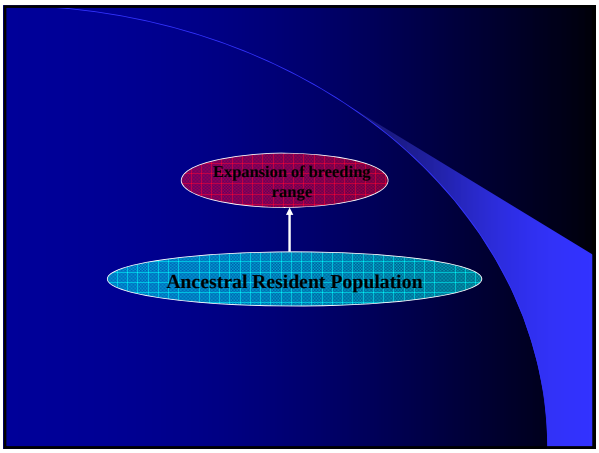
Time Allocation and Competition Model

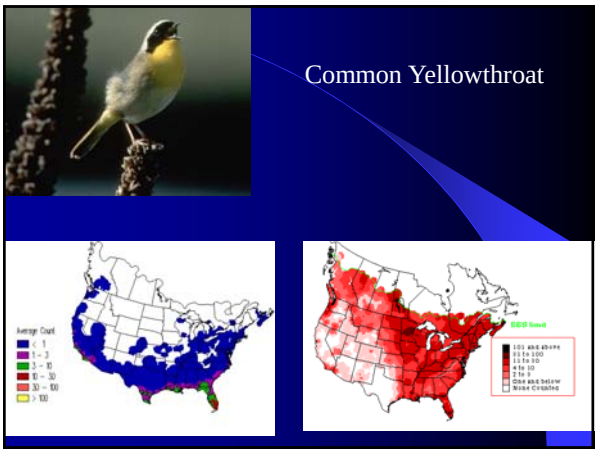
Time Allocation and Competition Model

• selective pressures force species to extend range into seasonal regions

• selective pressures force continued expansion into seasonally favored breeding areas as migrants (partial migrants)

• spread of populations at higher latitudes gradually gives rise to long distance migrants





II. Flight Techniques

A. Energy Efficiency

Birds use energy saving strategies to reduce cost of migration.

1. Thermal Soaring – Most cost effective means of migration. As ground heats in morning more energy absorbed by some areas. Heat differential results in rising column of air.

Birds gain altitude by riding up thermals and convert height advantage into distance by gliding.

Used by – birds of prey, cranes and storks. Long broad wings with slotted primaries.

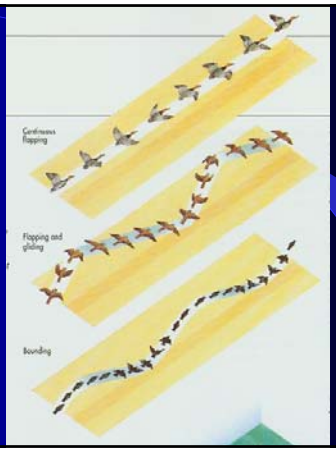
Migration time determined by thermals (usually mid-morning).

2. Continuous flapping, flapping-gliding, flapping-ballistic flight

Continuous flapping – birds with high wing loading

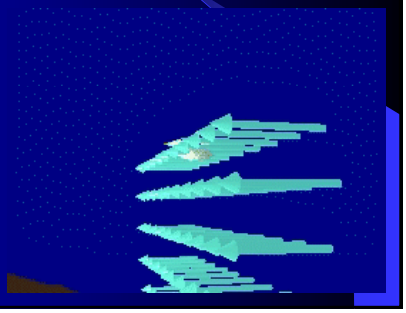
Flapping-gliding – 140g + use flapping interspersed with gliding. Gain hght and speed with flapping.

Flapping-ballistic flight – (bounding flight)
Small to medium sized birds with small broad wings, drag created reduces lift gained if gliding. Fold wings



3. Dynamic Soaring

Problematic if wind not blowing.

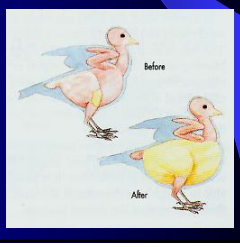


B. Fat Storage

Migrants store fuel for journey

Food intake increases ~ 40%

Lipids can make up 30 – 47% of mass



C. Molt and Migration

Timing of molt depends on several factors

III. Flyways & Migration Routes

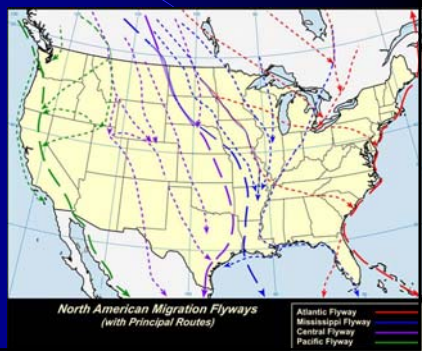
A. Definitions & Flyways

Migration routes - lanes of individual travel from any particular breeding ground to nonbreeding areas

Flyways - broader areas in which related migration routes are associated or blended in a definite geographic region.

There are 4 major North American flyways.

- Atlantic
- Mississippi
- Central
- Pacific

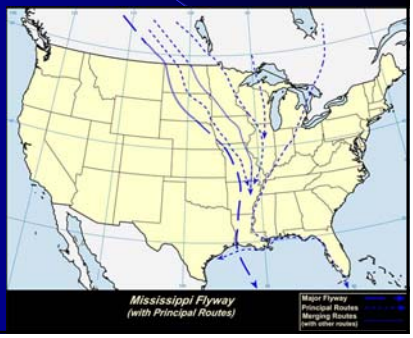


B. Atlantic Flyway

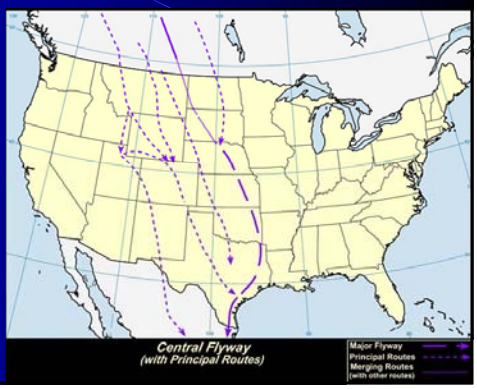
Flyway important to migratory waterfowl that winter south of Delaware Bay.

C. Mississippi Flyway

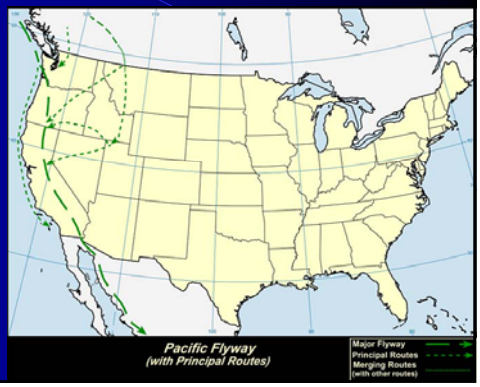
Eastern boundary clearly defined but not western.



D. Central Flyway



E. Pacific Flyway

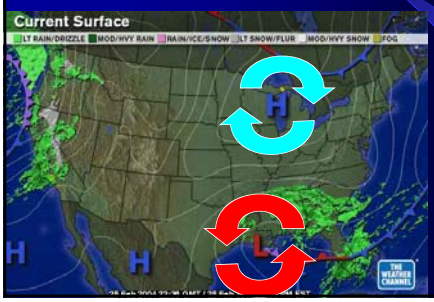


IV. Weather and Migration

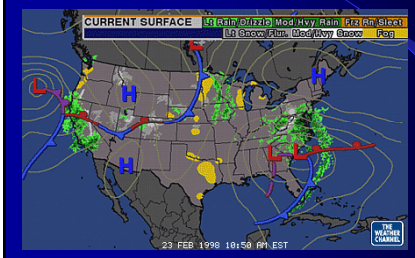
Weather plays a very important role in bird migration.

Features of a weather map - **H's** and **L's** represent high and low pressure centers (areas of swirling air).

The air around a high pressure center circulates **clockwise**
The air moves **counter-clockwise** around a low pressure system.



The colored lines represent fronts, dividing lines between cold and warm air.



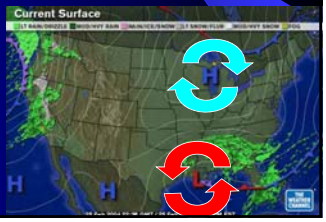
Blue – cold fronts

Red – warm fronts

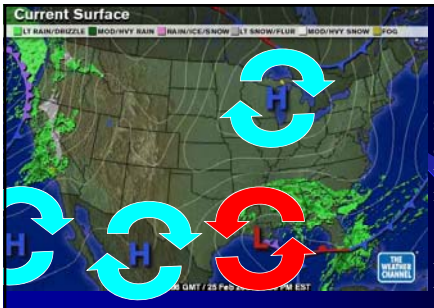
Birds want to fly with a tailwind to help them travel farther.

Spring - winds moving south to north.

headwinds, bad weather, such as heavy rain, force birds to land.

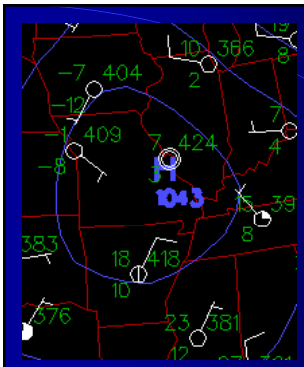


Highs follow cold fronts, birds will be forced to land immediately following the passage of a cold front. After the high has moved east, usually a day or two later, the birds have tailwinds and take off.



- On the **right** side of a high pressure system, the winds are coming from the **north**, so migrants land.

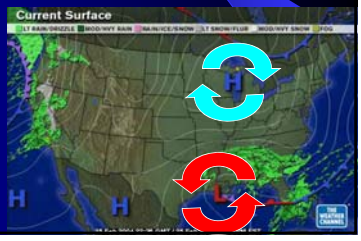
- On the **left** side, the winds are from the **south**, so birds take off to continue



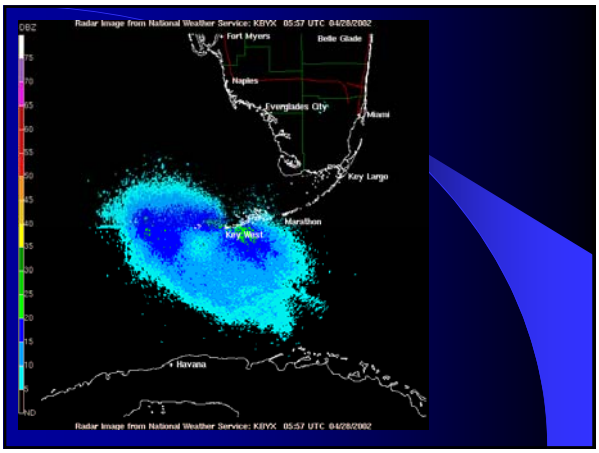
Flags indicate direction wind is blowing from

Birds don't use low pressure systems

Why?
The reason is that low pressure systems often bring bad weather with them, so even though the winds may be right, flying conditions are not good.



Is today good for migration?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