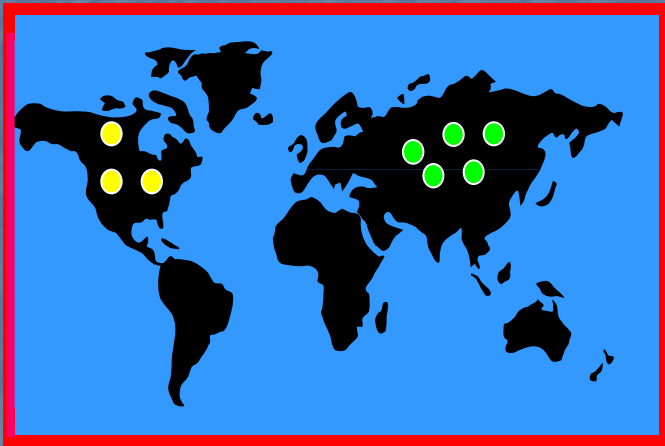


The Importance of Understanding Population Connectivity Throughout the Annual Cycle

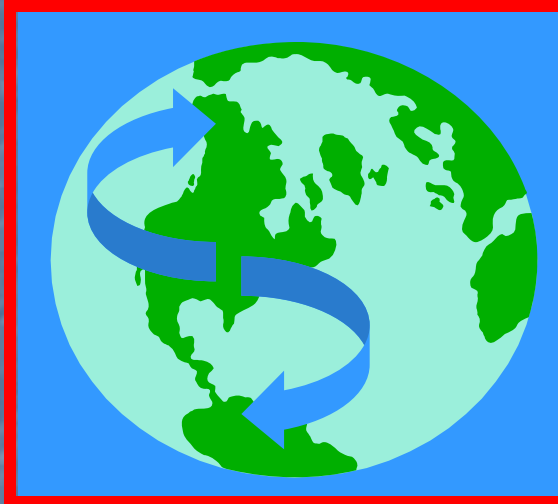
Susan Haig



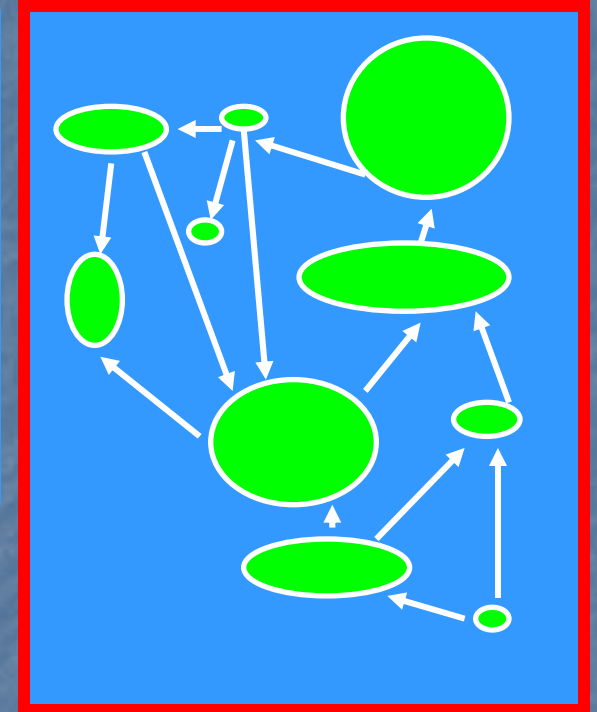
Issues of Connectivity: Depend on Scale



Among Pops,
Species, Subsp.



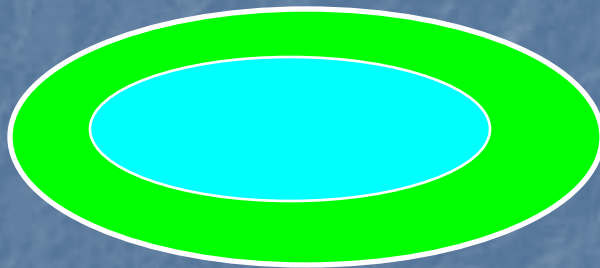
Among Seasons



Within Season

Whose Scale??

Scientist:

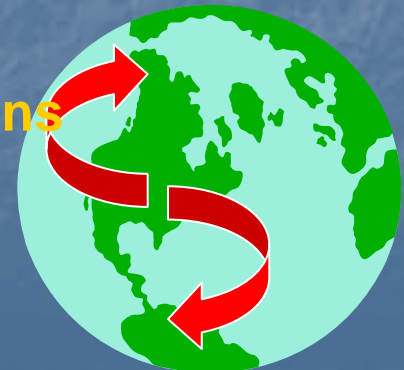


Bird:



Within Season

Between Seasons





To Dream the Impossible
Dream??

Methods for Monitoring Avian Movements And Population Connectivity.



**Stable
Isotopes**
 ^{13}C ^{15}N
 ^{87}Sr

Population Identification

	<u>Pop A</u>	<u>Pop B</u>
1.	10	0
2.	10	0
3.	0	10
4.	0	10
5.	10	0
6.	0	10

Pop/taxon-
specific
markers

	<u>Pop A</u>	<u>Pop B</u>
1.	8	4
2.	10	2
3.	7	8
4.	2	8
5.	1	10
6.	3	8

Prob (A): 0.87
Prob (B): 0.67

Assignment
tests



Bird Genetics SUCKS!

Challenges to Population Identification w/Avian Genetic Markers

Birds fly: high dispersal among pops.

*Don't expect much genetic difference.

N. Am. birds underwent Pleistocene:

*Not enough time for divergence.



Avian Geneticists Approach to Monitoring Populations Using Molecular Markers



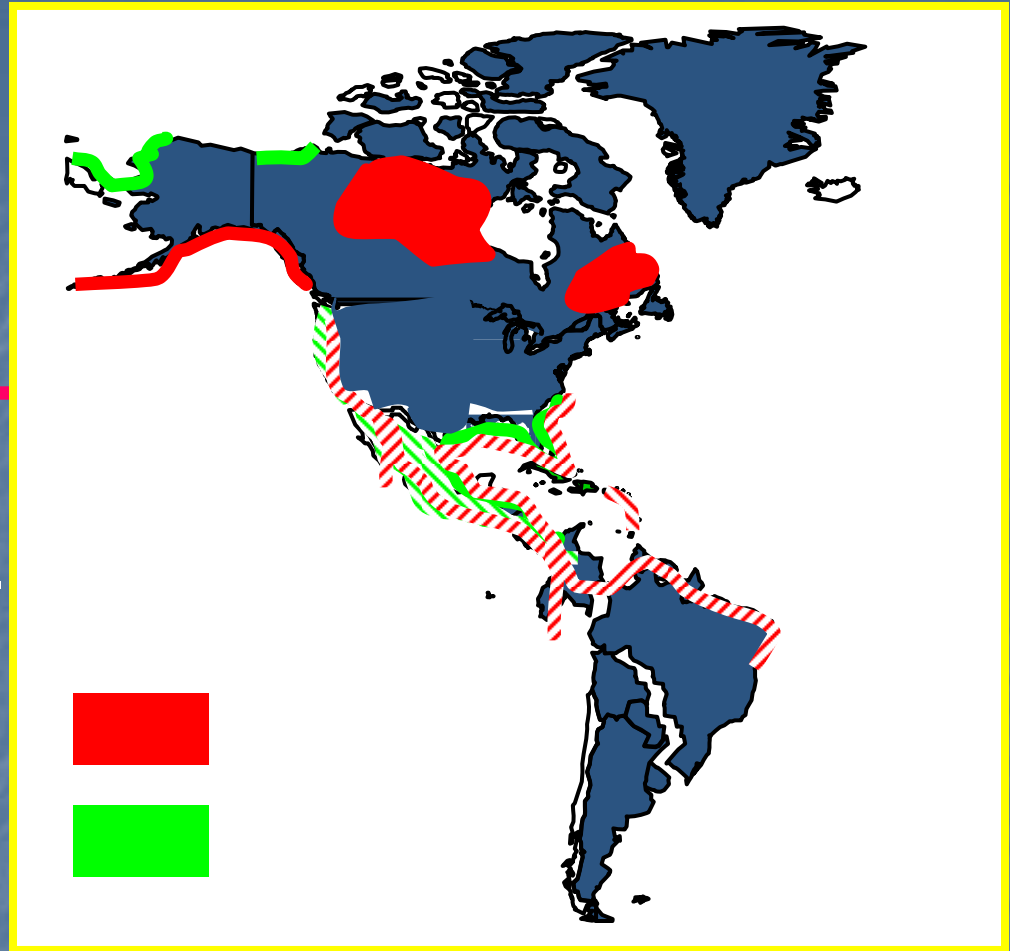
However....

We are making some progress!



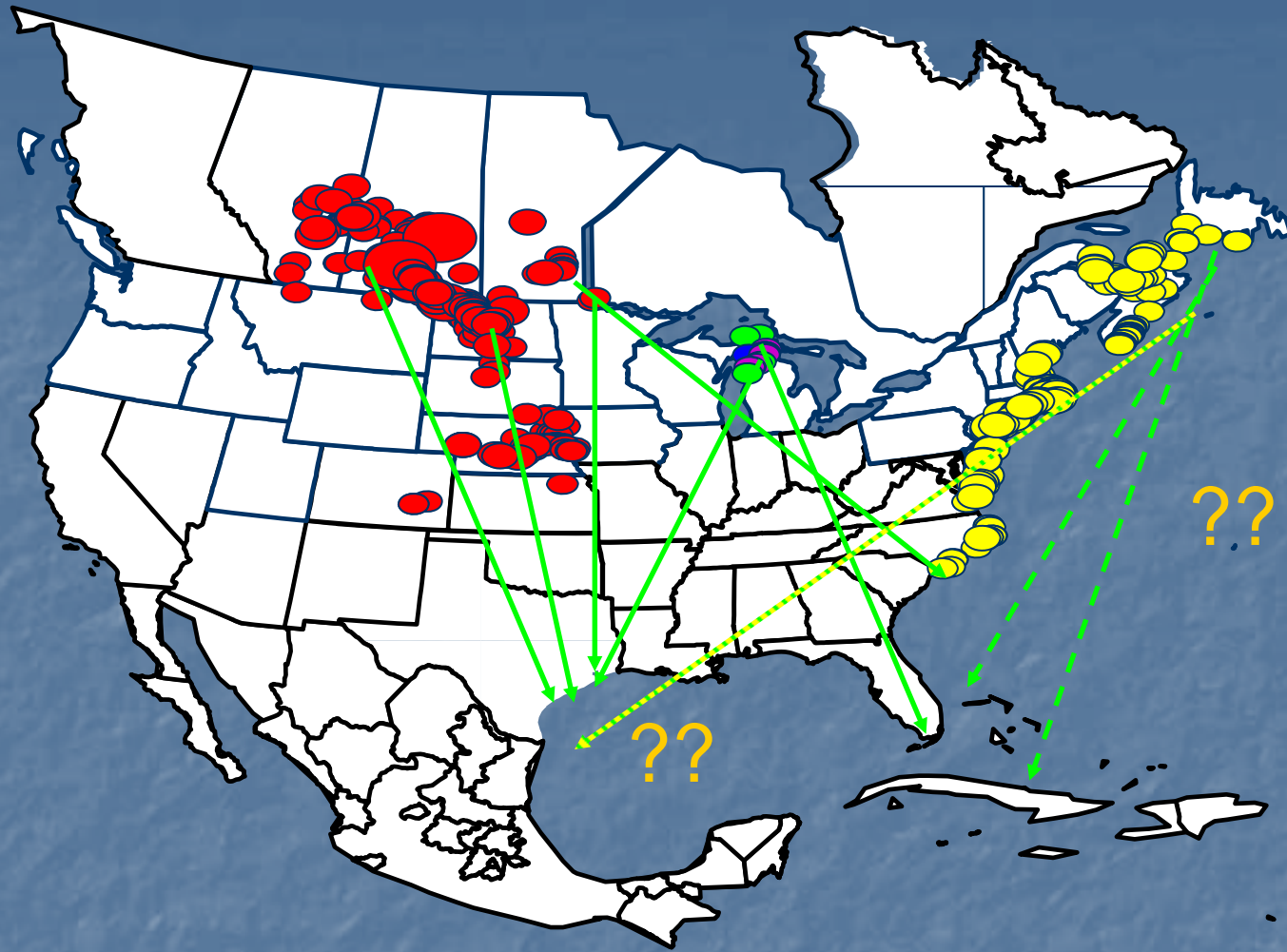
Identification of Cryptic Species: Long- and Short- billed Dowitchers

- Used 10 RAPD bands they shared in common.
- 5 bands differentiated species.
- Helped differentiate species going through Big Quill Lk, SK on migration.



Among Subspecies and Major Pops: Tracking Movements of Piping Plovers





Piping Plover Movements in Winter

- Populations mix.
- Birds appear to be site faithful.
- Need to know where specific pops winter.

NE1
NE1
AR5
ND10
ND2
ND3
ND4
AB6
AB6
MN1
ND6
SK10
ML12
ML12
NY6
NY6
NY4
NY2
QB2
BY2
MD3
MD9
DE2
MD2
MD7
MD3
MD3
MD8
MD12
QB1
QB1
PU1
PU2
PU3
PU3
PU3
PU3
ME2
NY2
NY7
NY9
NY4
NY2
NY6
NY1
NY2
NY3
NY3
ME4

Prairie and Great Lakes

Maximum Likelihood

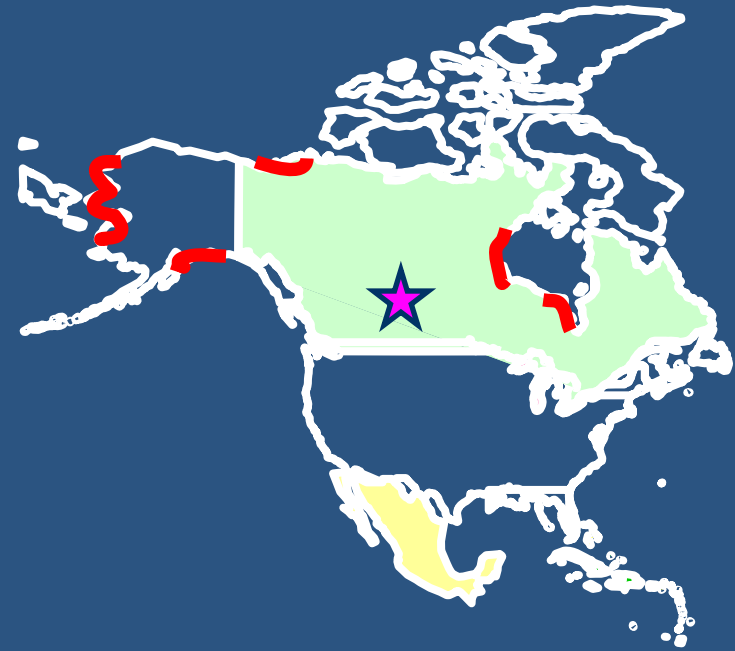


Summary

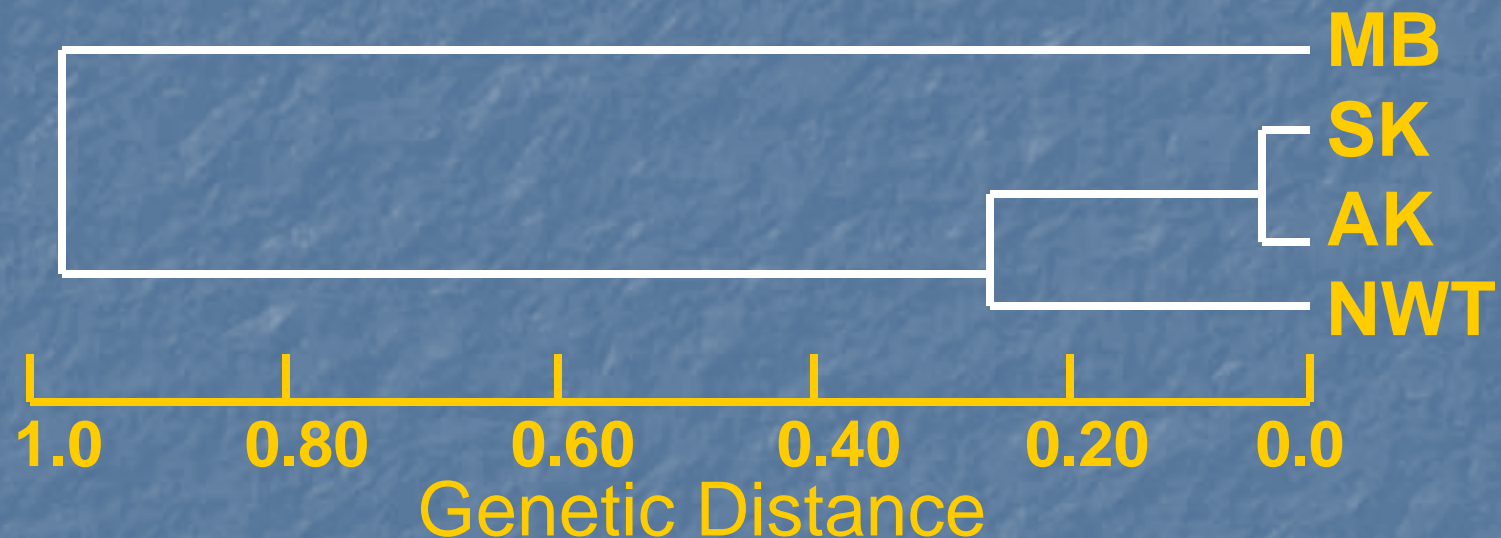
- MtDNA provides identification of subspecies in winter.
- Microsats may be better, although...
- Adding analysis of Sr or another isotope may clarify.

Population Origin of Hudsonian Godwits on Migration

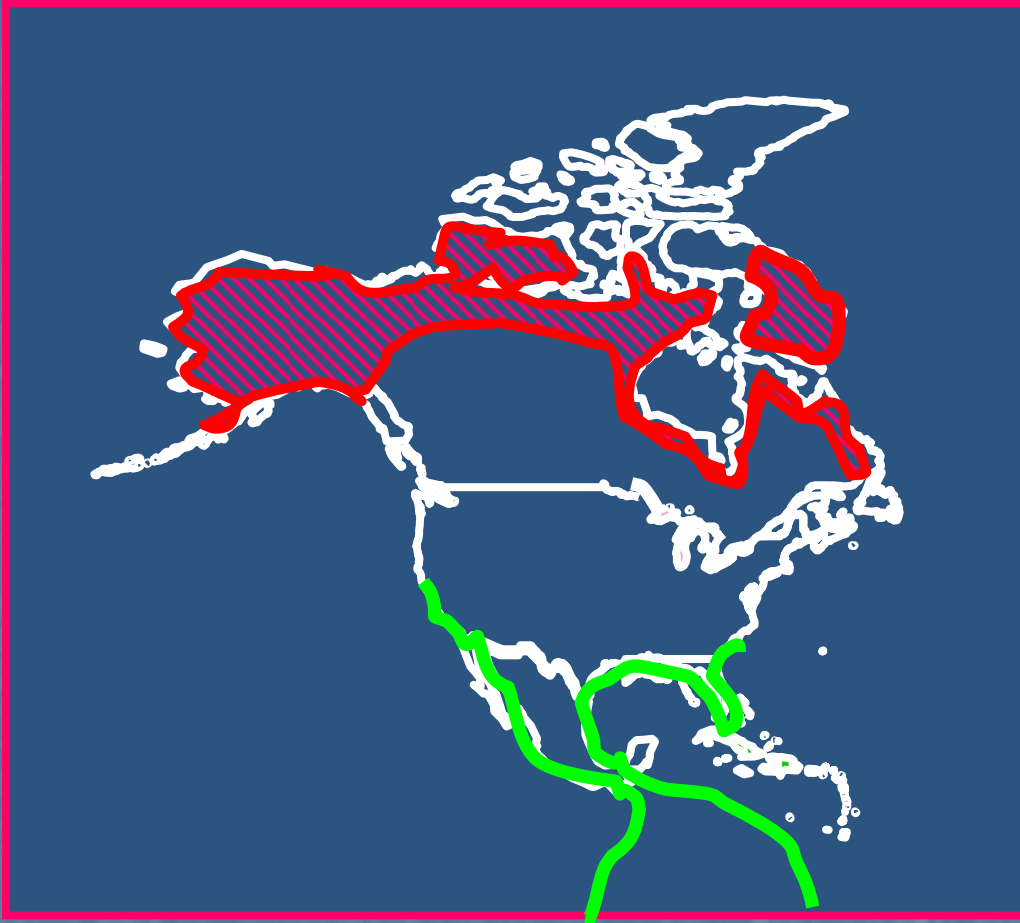
- What is migration route for each population?
- What is phenology of migration?



Hudsonian Godwits



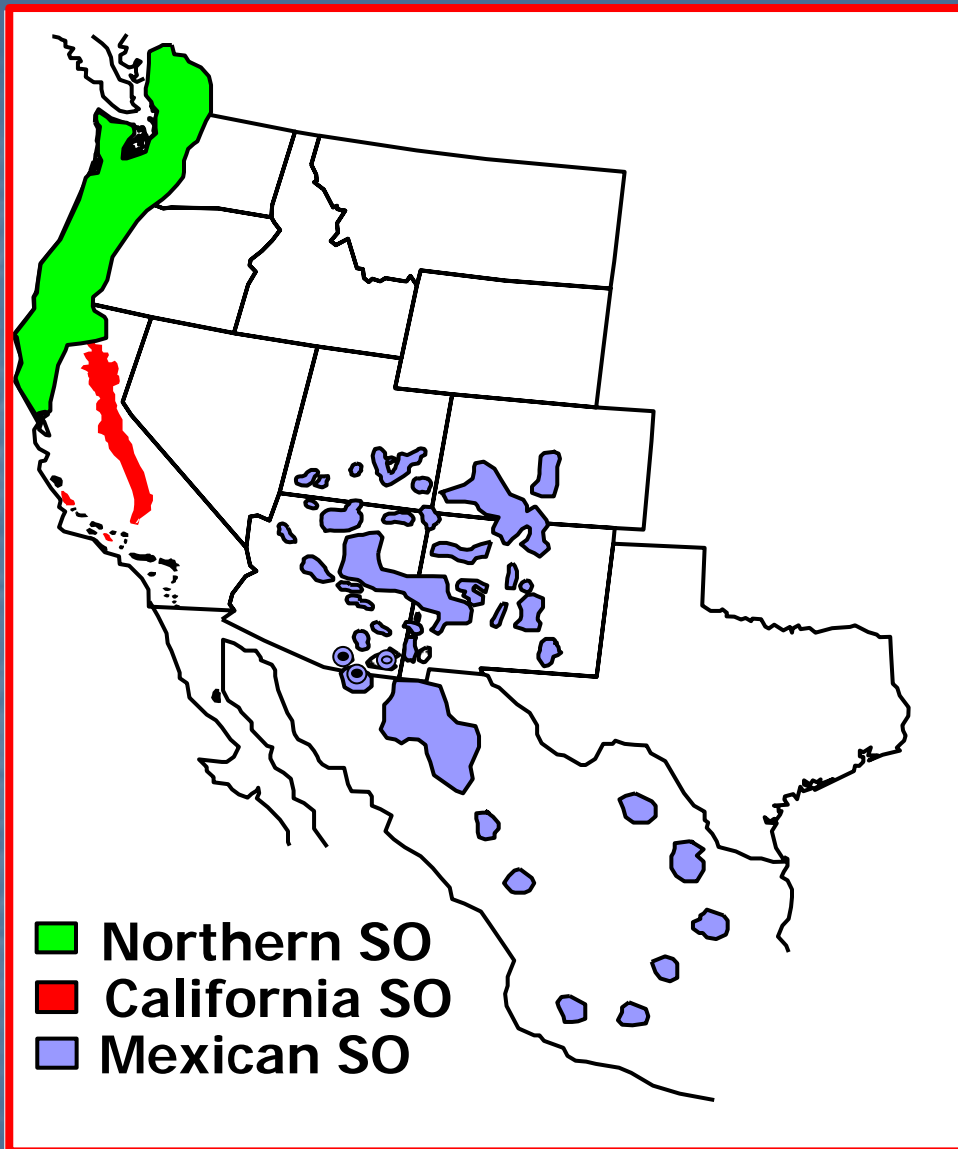
- 5 bands differentiated MB and NWT/AK birds.
- 1 band differentiated AK and NWT.
- SK migrants share more bands with AK birds.



**Semipalmated
Plover**

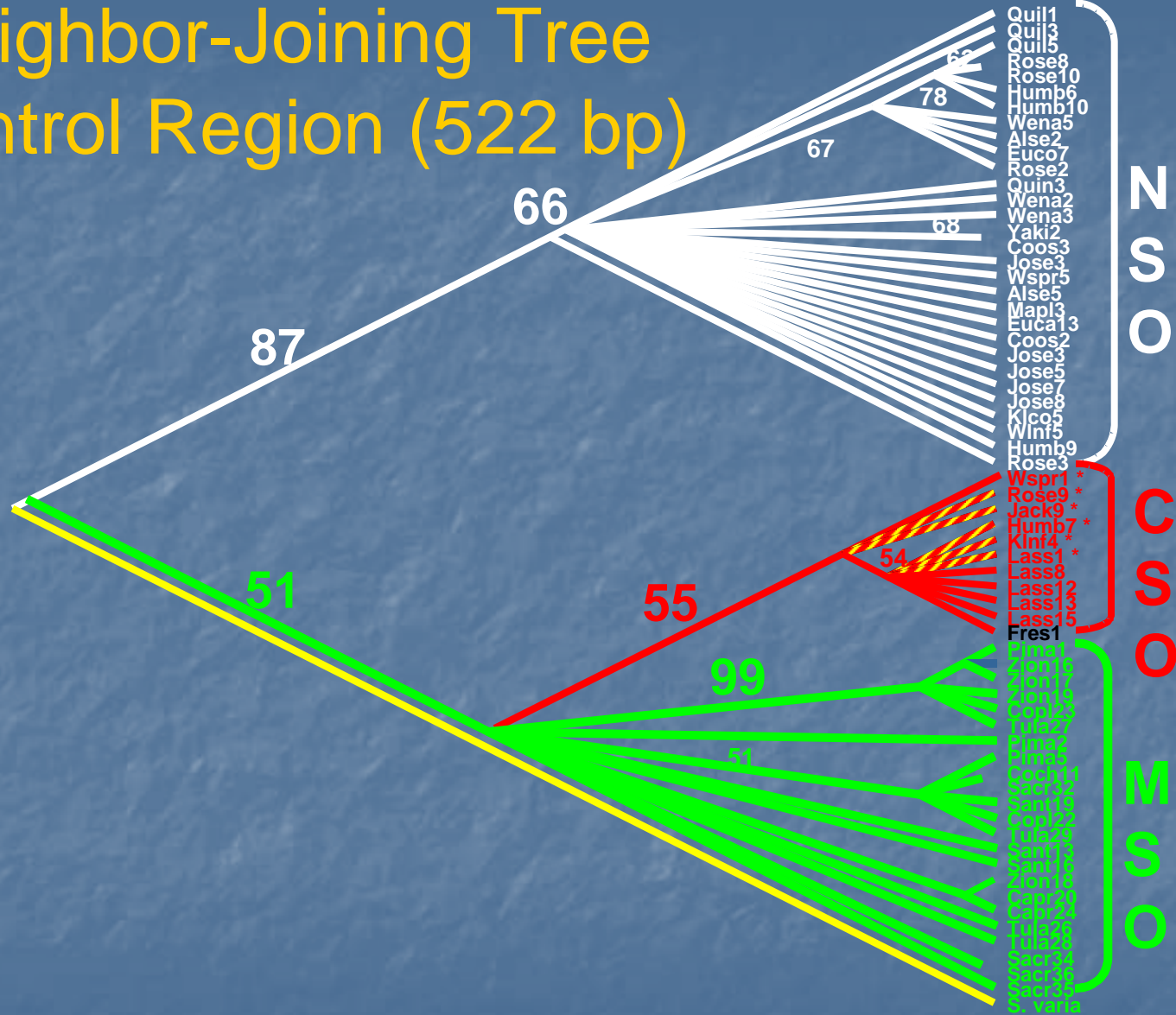
Relative Population Assignment: Semipalmated Plovers

	AK vs NWT		AK vs MB		NWT vs MB	
Alaska	90	10	100	0	97	3
NWT	5	95	75	25	96	4
Manitoba	6	94	0	100	10	90



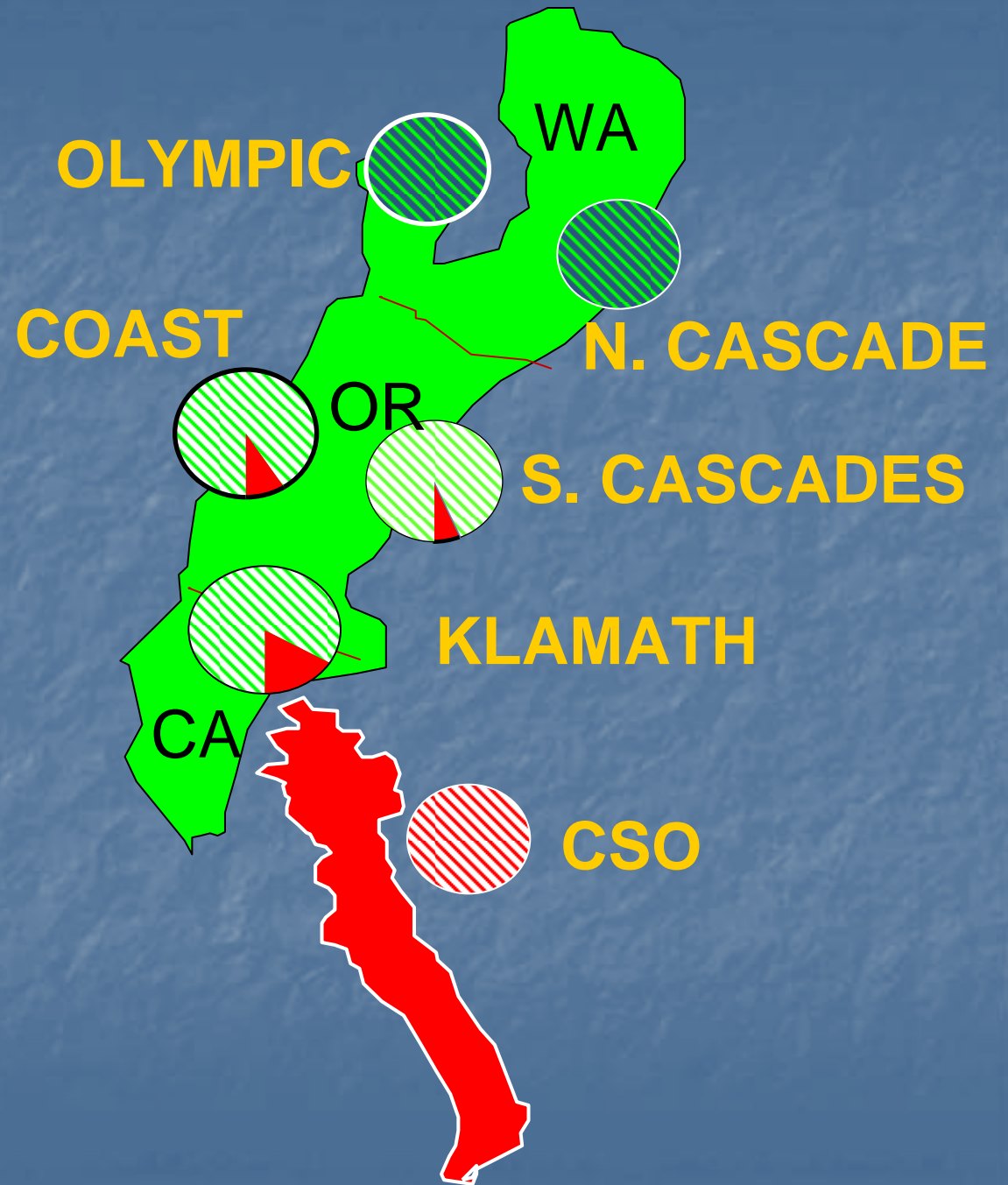
Tracking (Cryptic) Subspecies

Neighbor-Joining Tree Control Region (522 bp)





MIXING OF NSO and CSO HAPLOTYPES



Population Identification Via a Non-avian Source

Rintamaki et al., Bensch et al.



- No pop-specific markers found for Willow Warblers.
- Willow Warblers and 12 other Passerines were tested for specificity of parasites in genera *Plasmodium* and *Haemoproteus*.
- Species differences in *Plasmodium* allowed for identification of Willow Warblers on migration and in winter.

Avian Molecular Markers: the Good, the Bad, the Ugly



Molecular markers are helpful in tracking:

- Cryptic species and subspecies.
- Highly differentiated populations.
- Genetic variability within/between pops.
- HOWEVER, they could be better if we screened markers with pop. id in mind.

Molecular markers are not that helpful (so far) in:

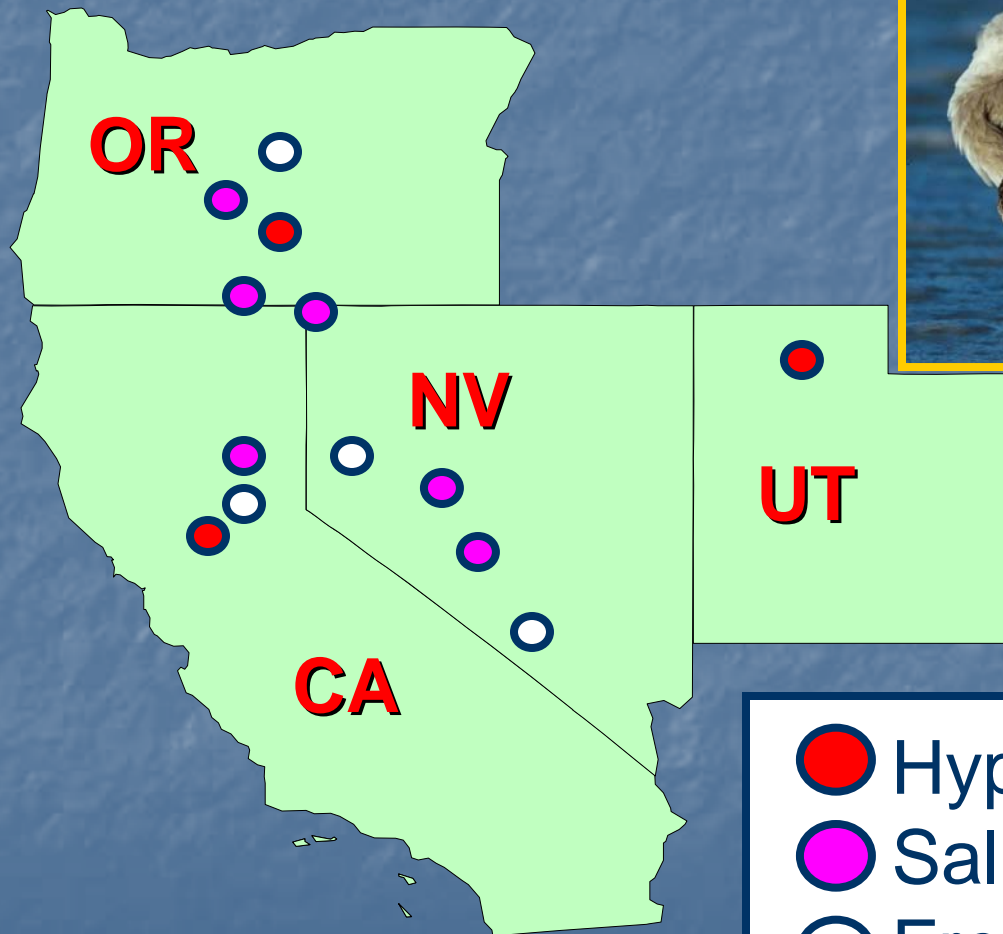
- Differentiation of nearby populations.
- Other methods are needed to help fill this gap.

Population Origin of Great Basin Shorebirds



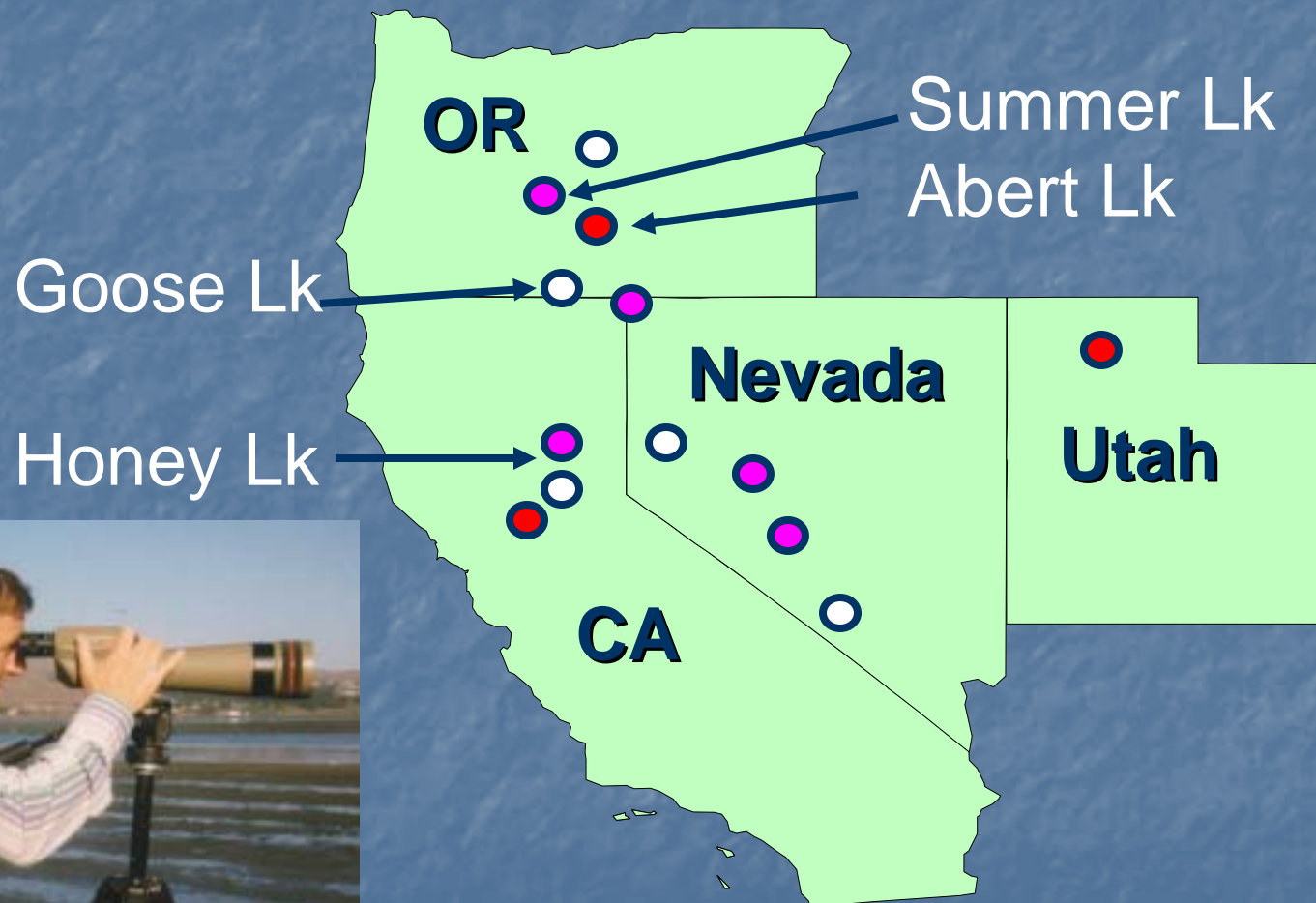


Major Great Basin Wetlands



-  Hypersaline
-  Saline
-  Fresh

Monitoring Breeding Shorebirds

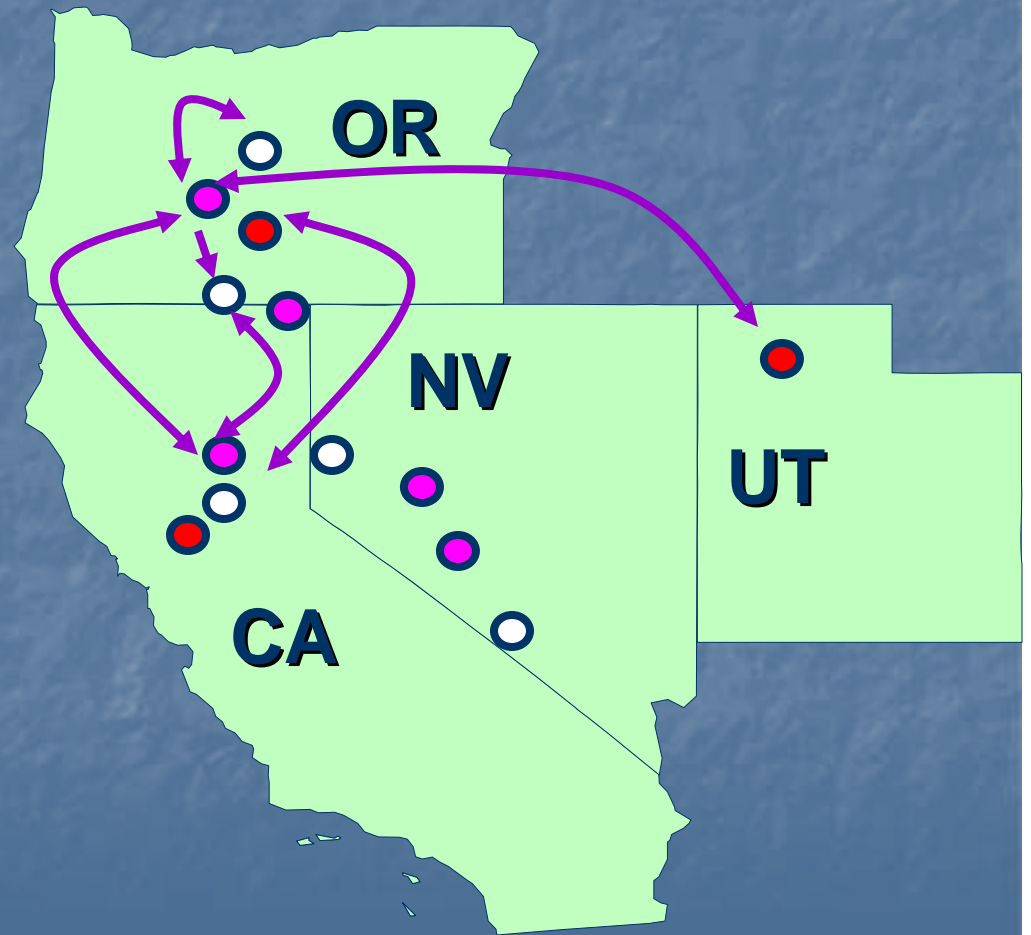


Avocet Movement in the Great Basin



- Adult avocets were detected at 2.1 sites (r: 0-6).
- 74% of adults were found at more than 1 site.
- 22% of 185 radioed birds moved (north) > 200 km.
- Males and females did not differ in patterns.

Movements of Local Avocets In the Great Basin



Who are all those Avocets at Abert?

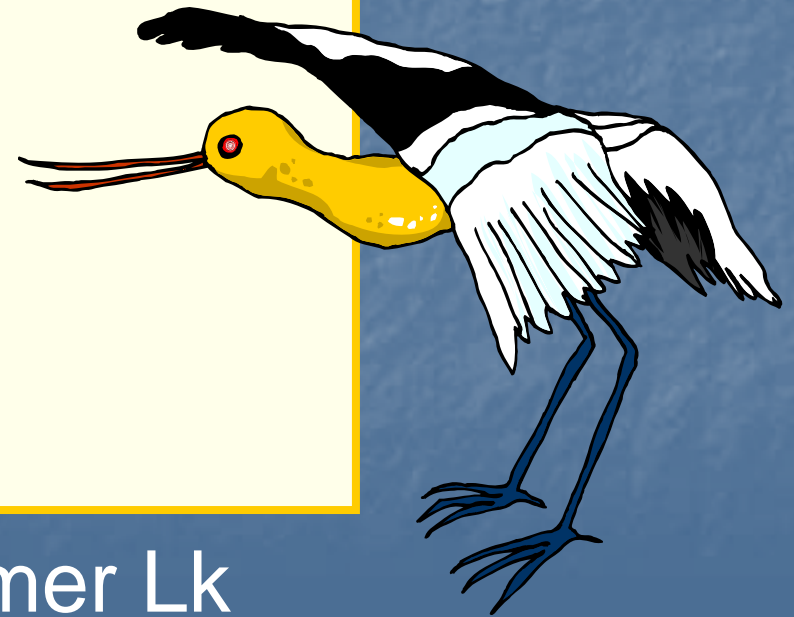
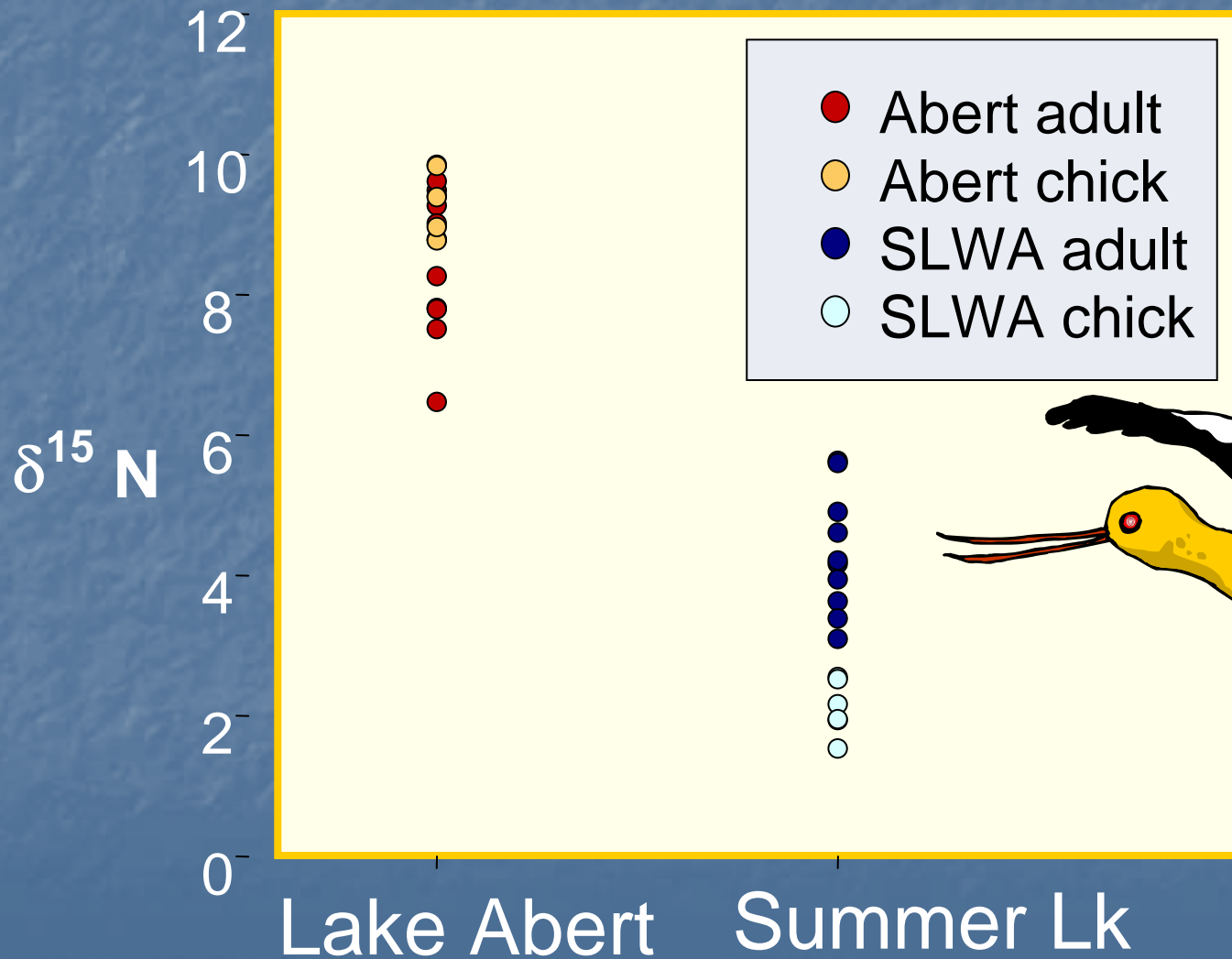
- Hemispheric site
- Thousands migrate
- Few AMAV breed
- Very little RS
- No one worries about status of GB AMAV as a result.

Sooo....

- Where are these birds from?



Isotope Identification of American Avocets



Willet Movements And Population Connectivity

We took a nested approach to addressing issues of connectivity in Western Willets:

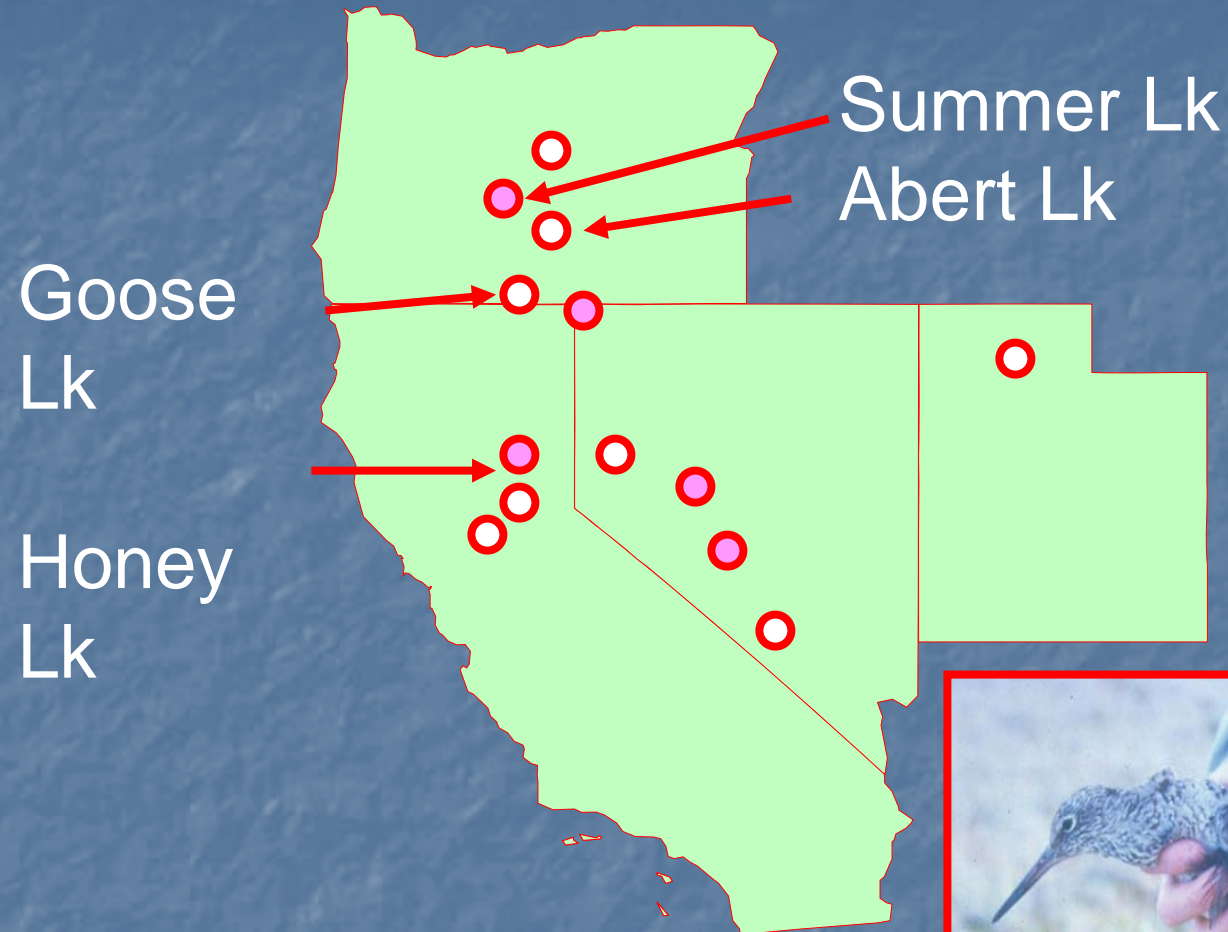
- Within seasons
- Between micro-phases of the annual cycle.
- Between major phases of the annual cycle.



Breeding Connectivity



Monitoring Breeding Willets



Willet Breeding Life History



Breeding Phenology

Arrive: ~15 April

Nest init: 12 May

Depart: ~27 June

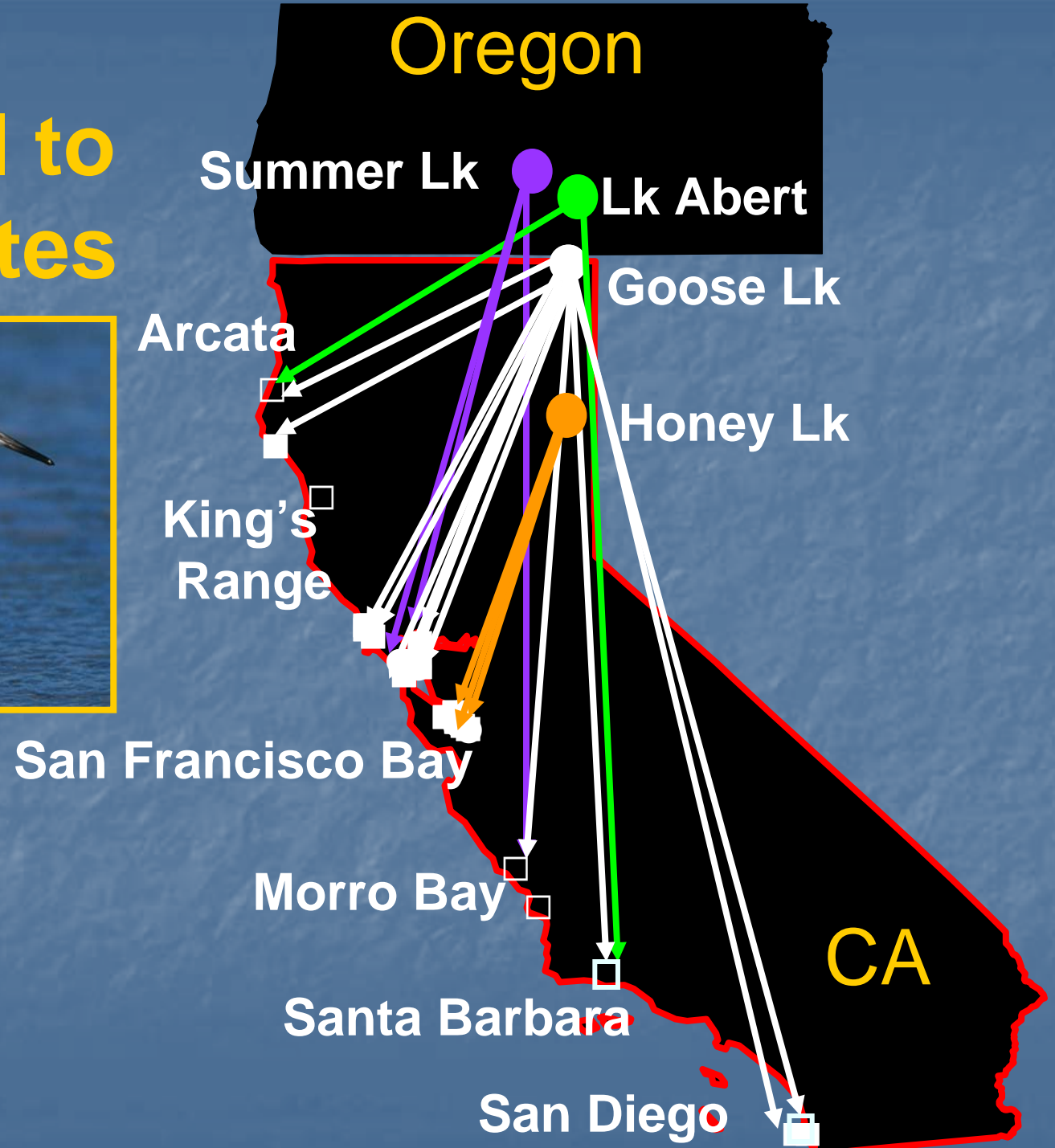
Breeding Summary

1. Willets spend relatively little time in the Great Basin.
2. They do not move on a large scale during the breeding season.
3. Adults move from fresh to more saline water on a daily basis.

Winter and Migratory Connectivity



Dispersal to Winter Sites

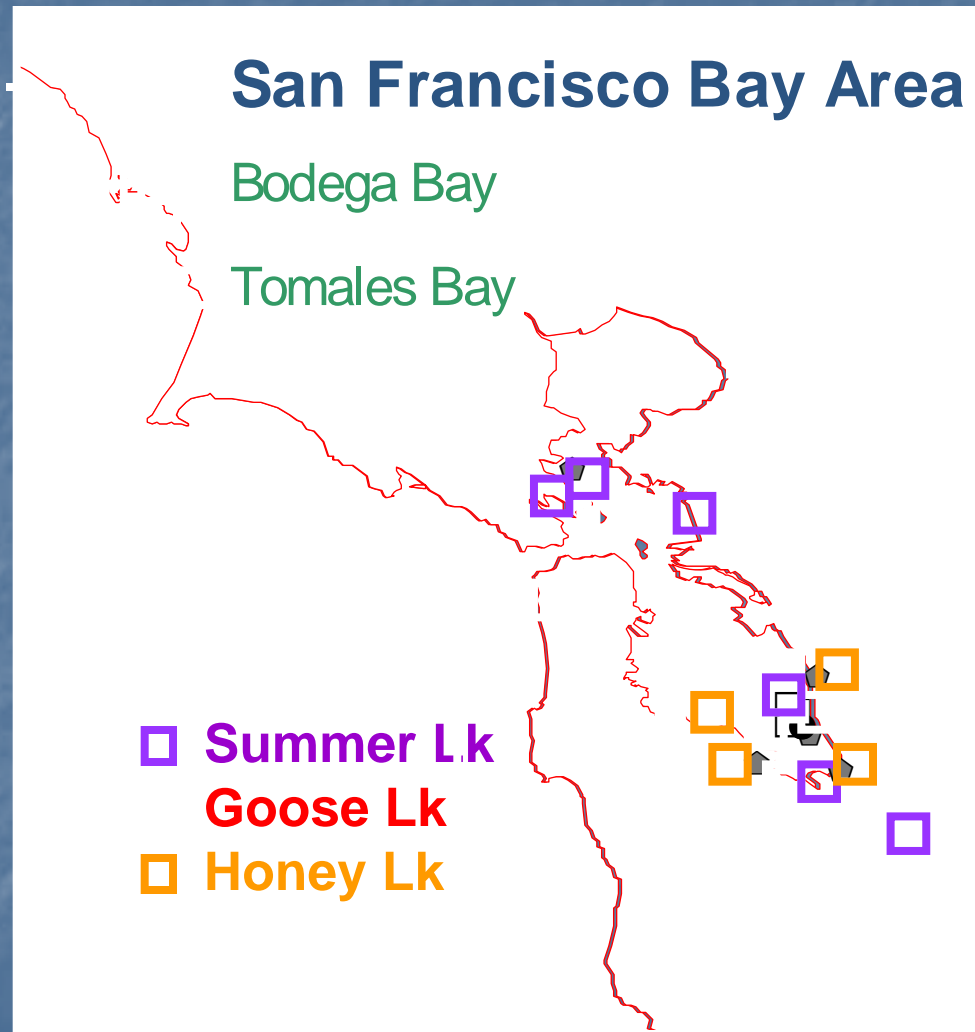


Winter Home Range in Willets

Among 34 adults, 4 juv. **no segregation** based on: sex, age, breeding site, mate location.

Small home range:
no general movement out of local area. 80% (55/69) of movements were less than 10 km from origin.

Philopatric among years.

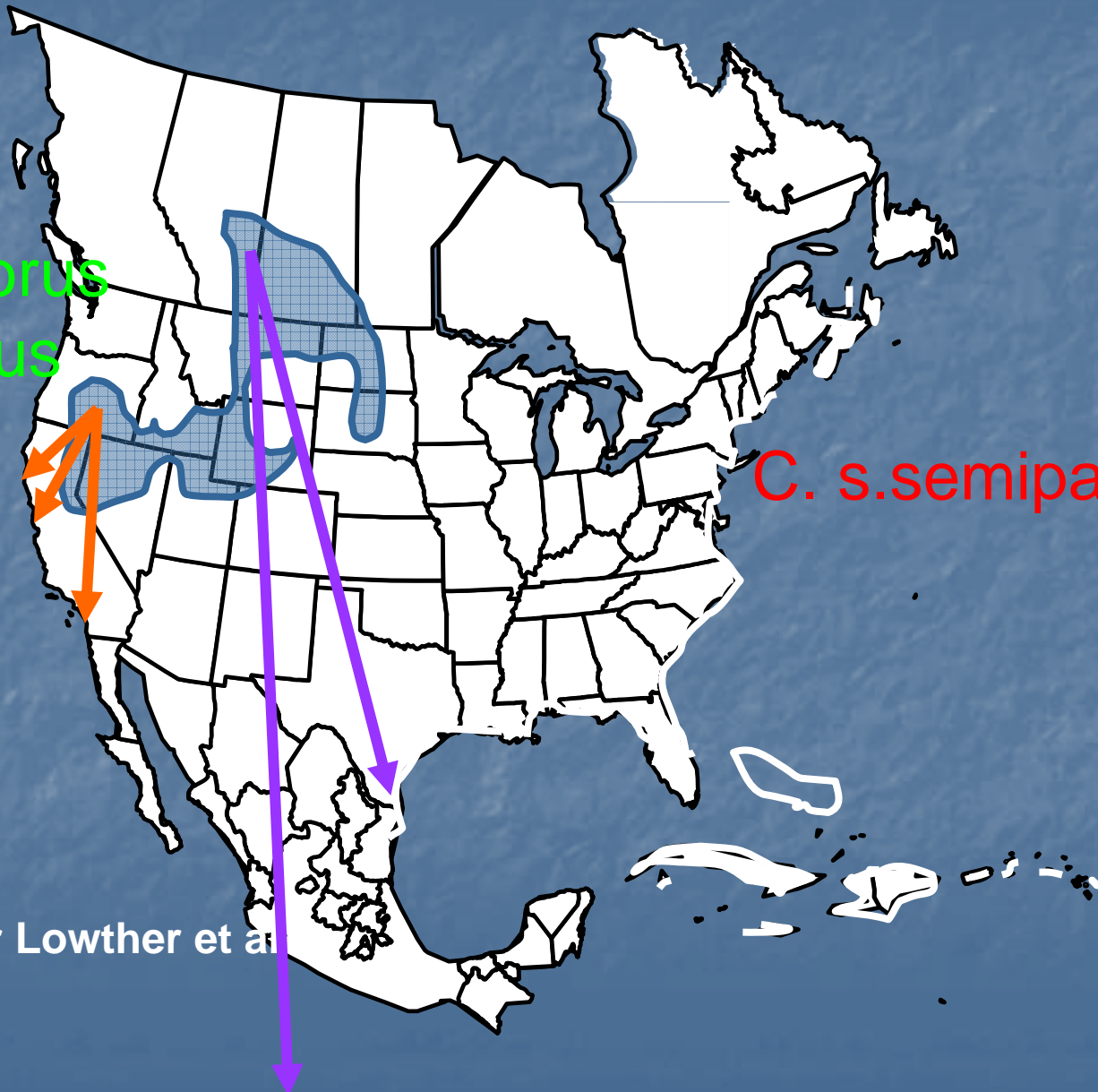


Willet Subspecies

Catoptrophorus
semipalmatus
inornatus

C. s.semipalmatus

Range map after Lowther et al.
Willet BNA.



Winter Summary

- Similar to breeding birds, winter birds have a small home range: specific sites may be quite important.
- Pairs do not stay together in winter.
- Willets spend most of the year at winter sites.
- There may be population segregation in winter within Western Willets.

Summary

- Western Great Basin Willet movements and space use within and among phases of the annual cycle is somewhat conservative.
- Western Great Basin Willets may form a separate subspecies from birds further east.
- A seasonally-nested, comparative approach can provide a more complete picture of population and landscape connectivity.



Studies of Connectivity

- Need to be carried out at the proper
 - Temporal Scale
 - Spatial Scale
 - Technological Scale
 - Due to extreme dispersal possibilities, multiple methods may be necessary to answer avian movement questions.
 - Monitoring non-avian target species may end up being the best approach
- Therefore...be flexible in your approach.

