Addressing questions about the wintering distribution of Aquatic Warblers using feather isotope analyses

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Main questions:

1. Do all European birds winter in Djoudj?

2. Is there strong migratory connectivity between breeding and wintering sites?

3. Where could further wintering areas be?

1. Do all birds winter in Djoudj?

Data collection

- isotope samples from tail feathers collected from AQWA in European breeding grounds
- feathers were grown in previous autumn/winter
- feathers reflect environment of moulting area

1. Do all birds winter in Djoudj?

Europe

Senegal

$\delta^{15}N$ (‰)

15
14
13
12
11
10
9
8
7
6
5

-30
-28
-26
-24
-22
-20
-18
-16

$\delta^{13}C$ (‰)

1b. What proportion of European birds moult in Djoudj?

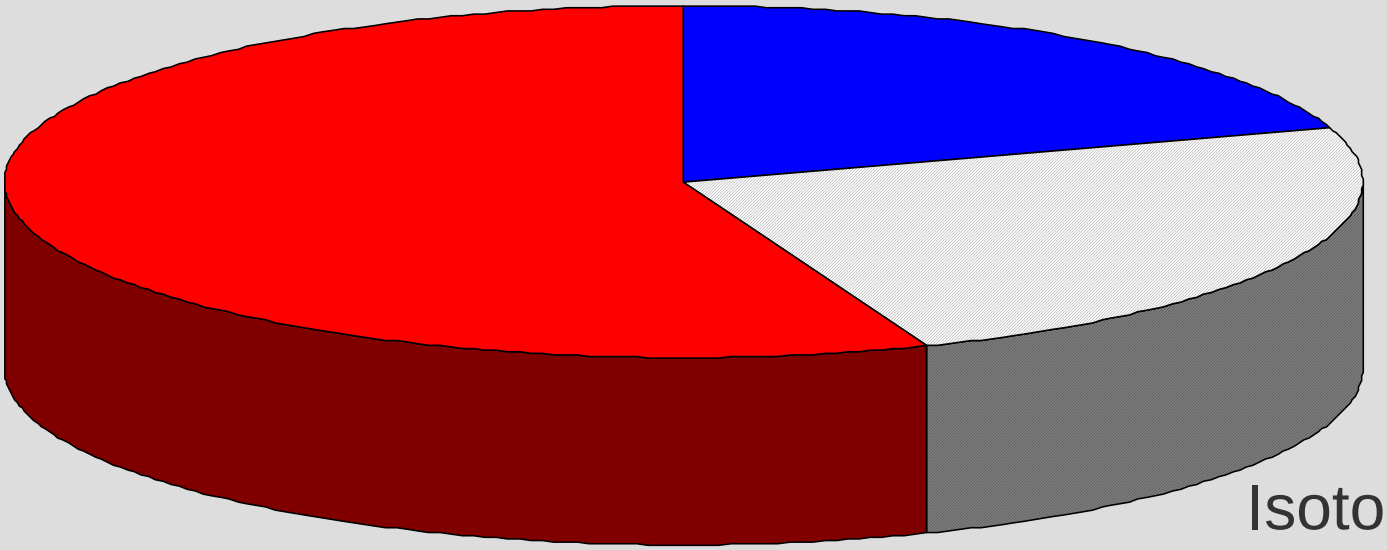
Data analysis

- cluster analysis to divide isotope data into clusters
- optimized for reliable assignment: 6 clusters
- birds from Djoudj fall mostly into 3 clusters

1b. What proportion of European birds moult in Djoudj?

20-44% of European birds have isotope signature inconsistent with birds captured in Djoudj

Isotope signature matches none of the birds in Djoudj (20%)

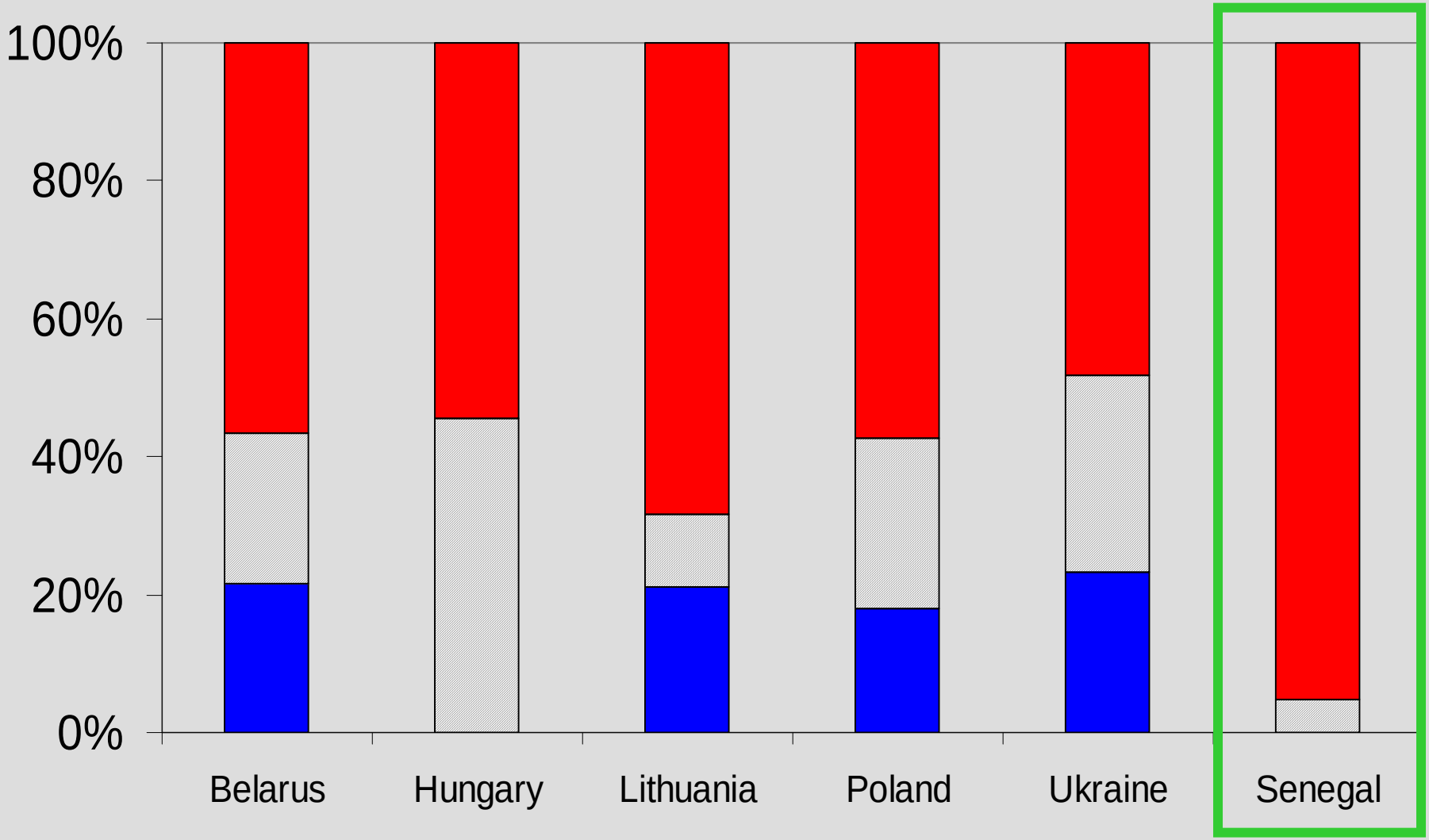


Isotope signature matches most birds in Djoudj (56%)

Isotope signature matches only 3 birds in Djoudj (24%)

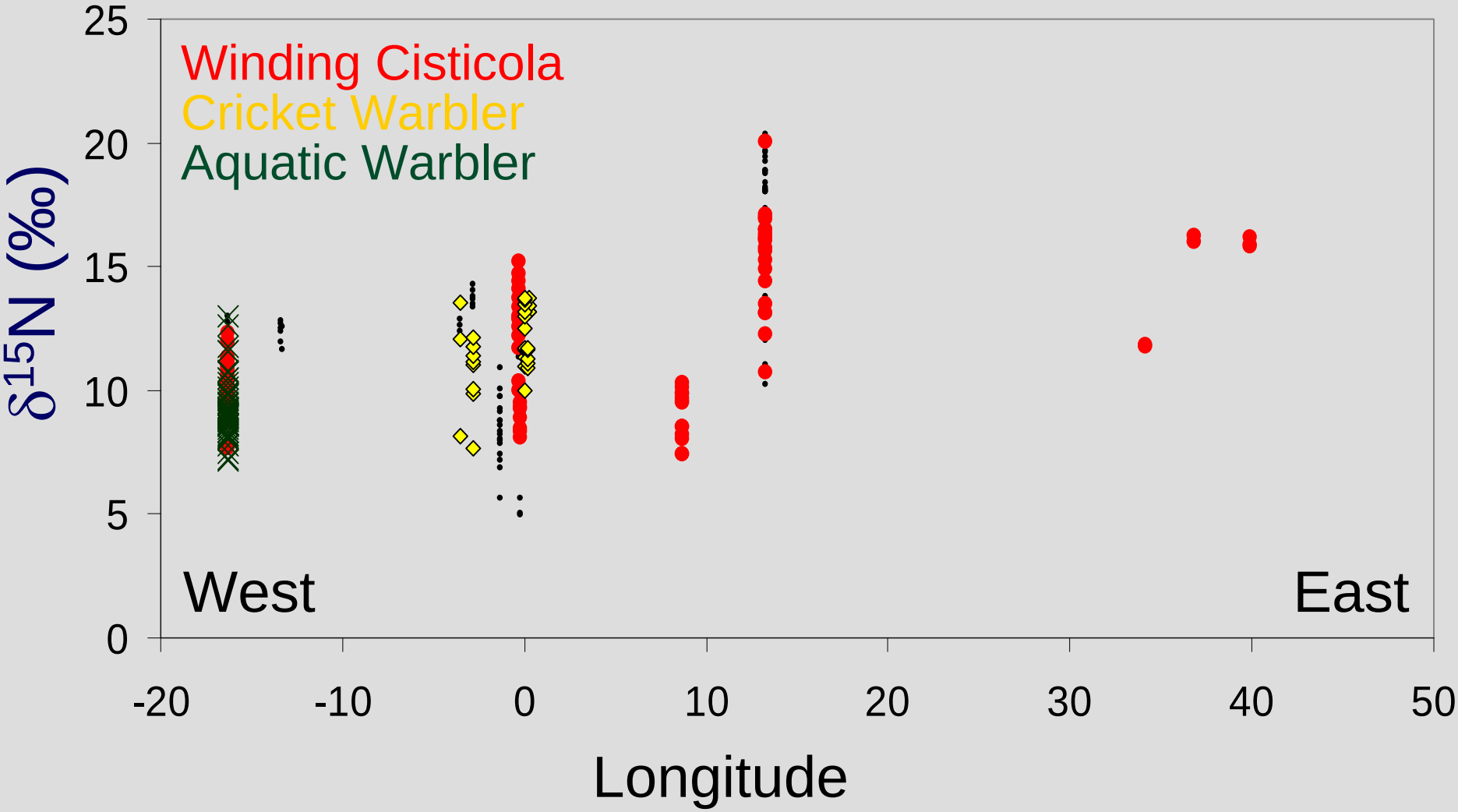
2. Migratory connectivity?

Most European breeding areas have birds from all isotope clusters – weak “migratory connectivity”



3. Where are other areas?

No predictable gradient in $\delta^{15}N$ across sampled areas



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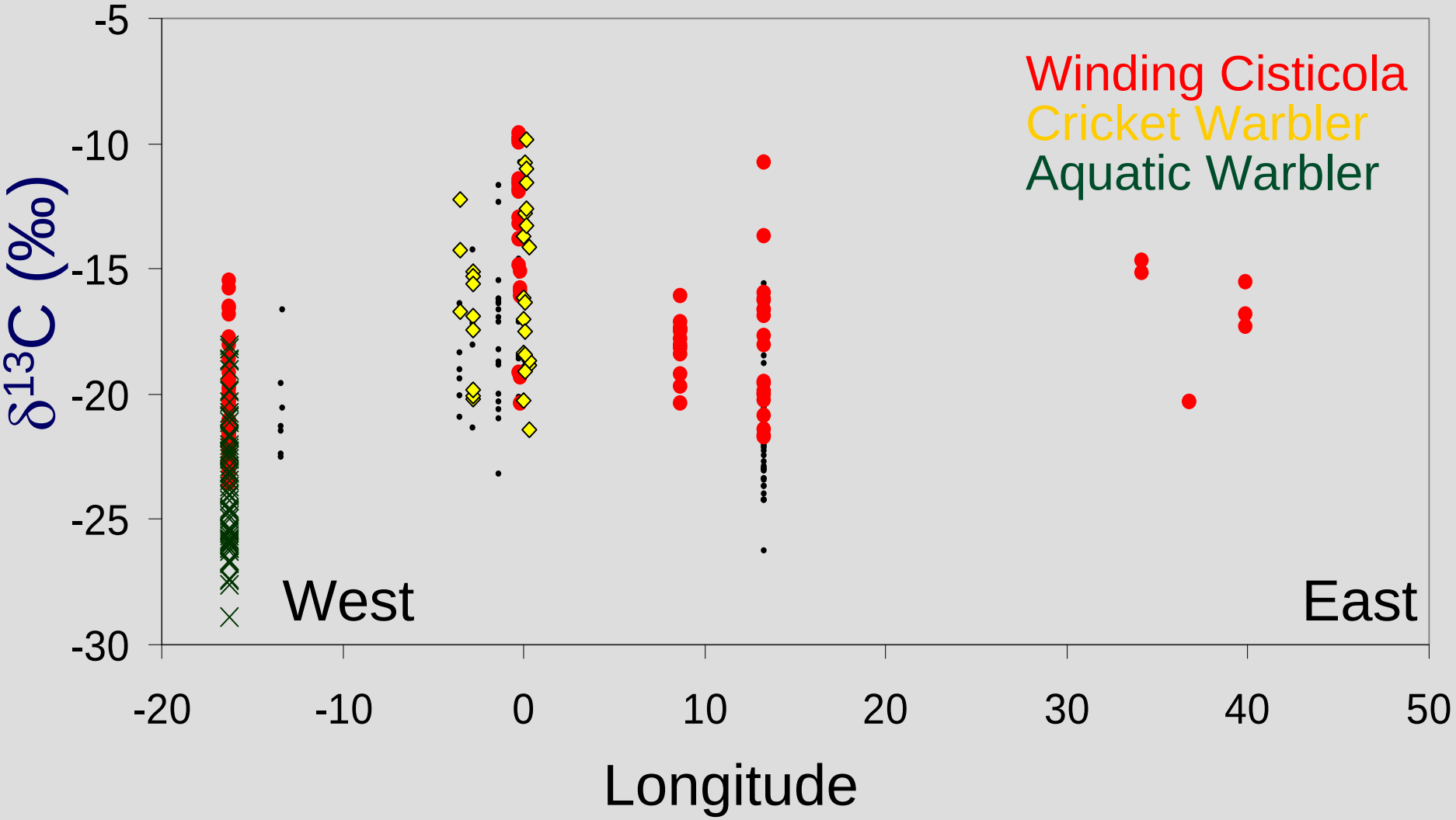

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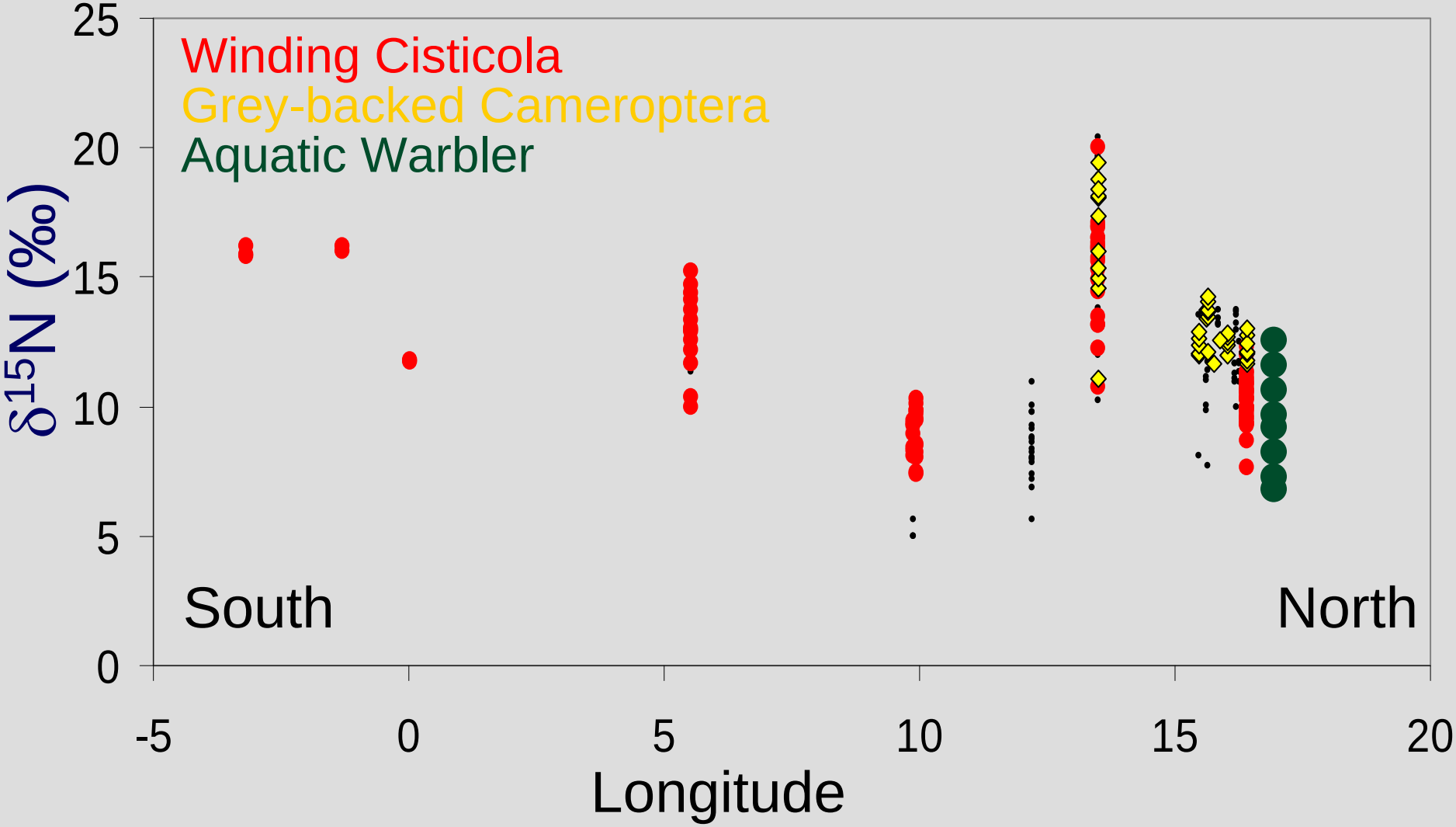

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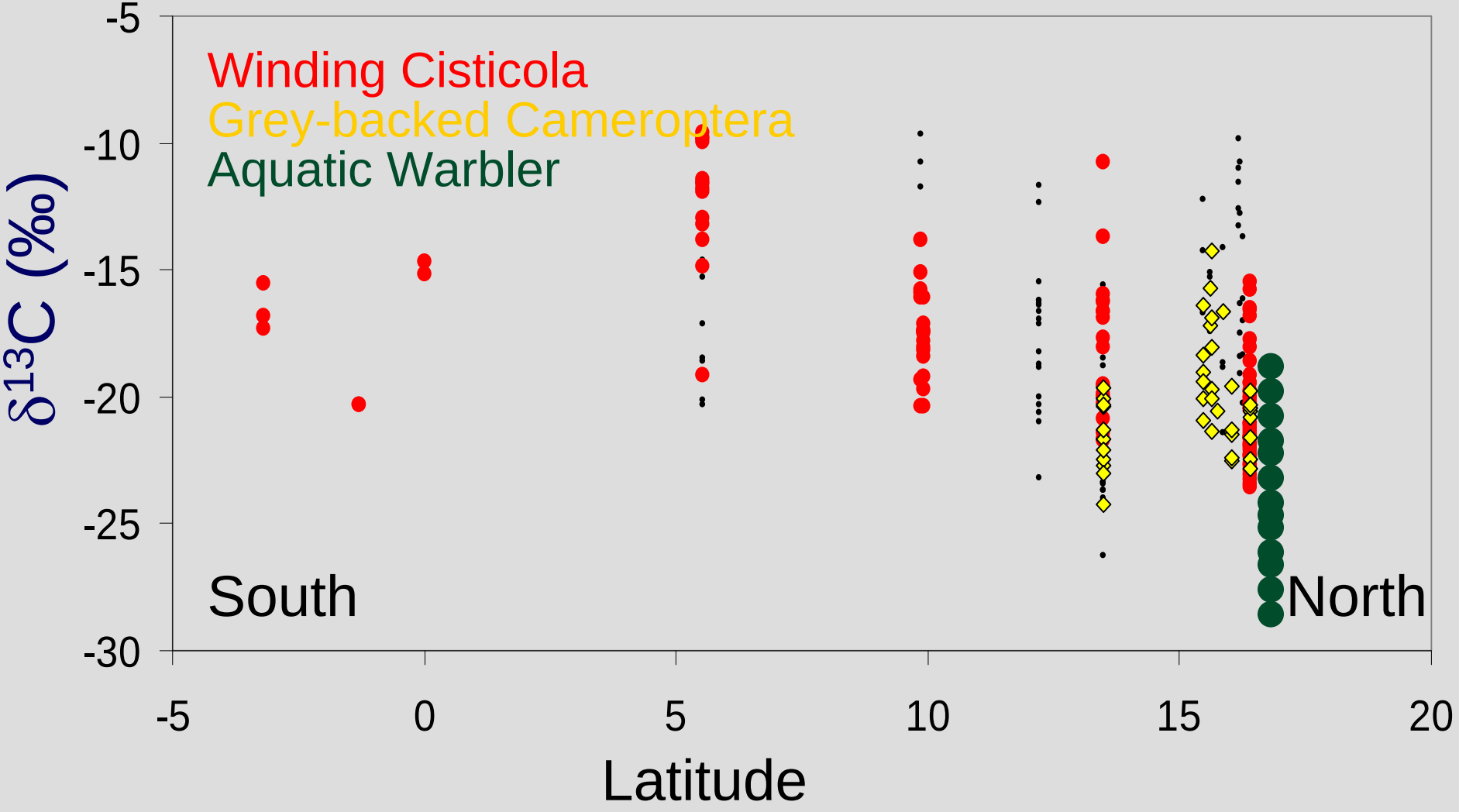
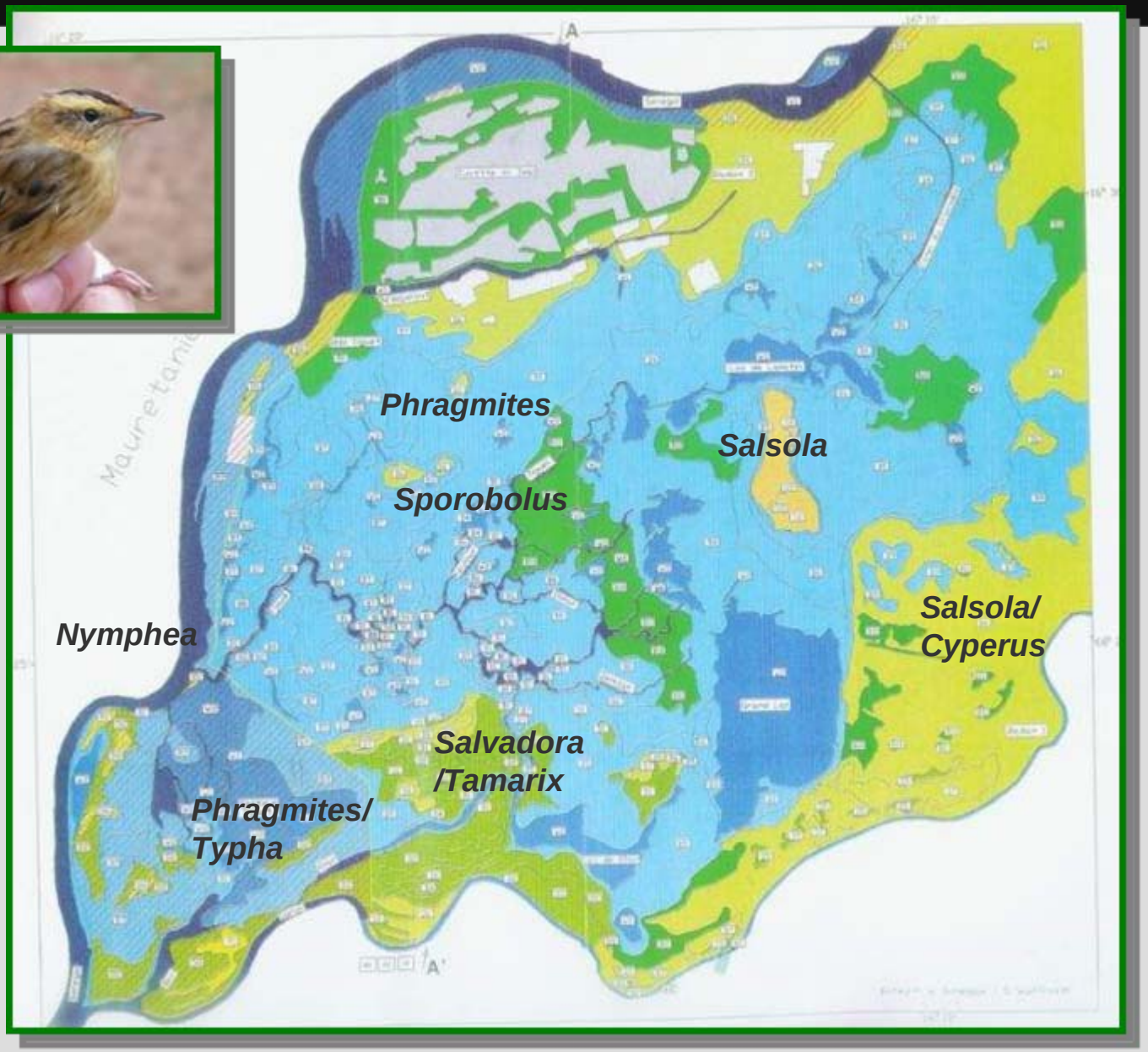


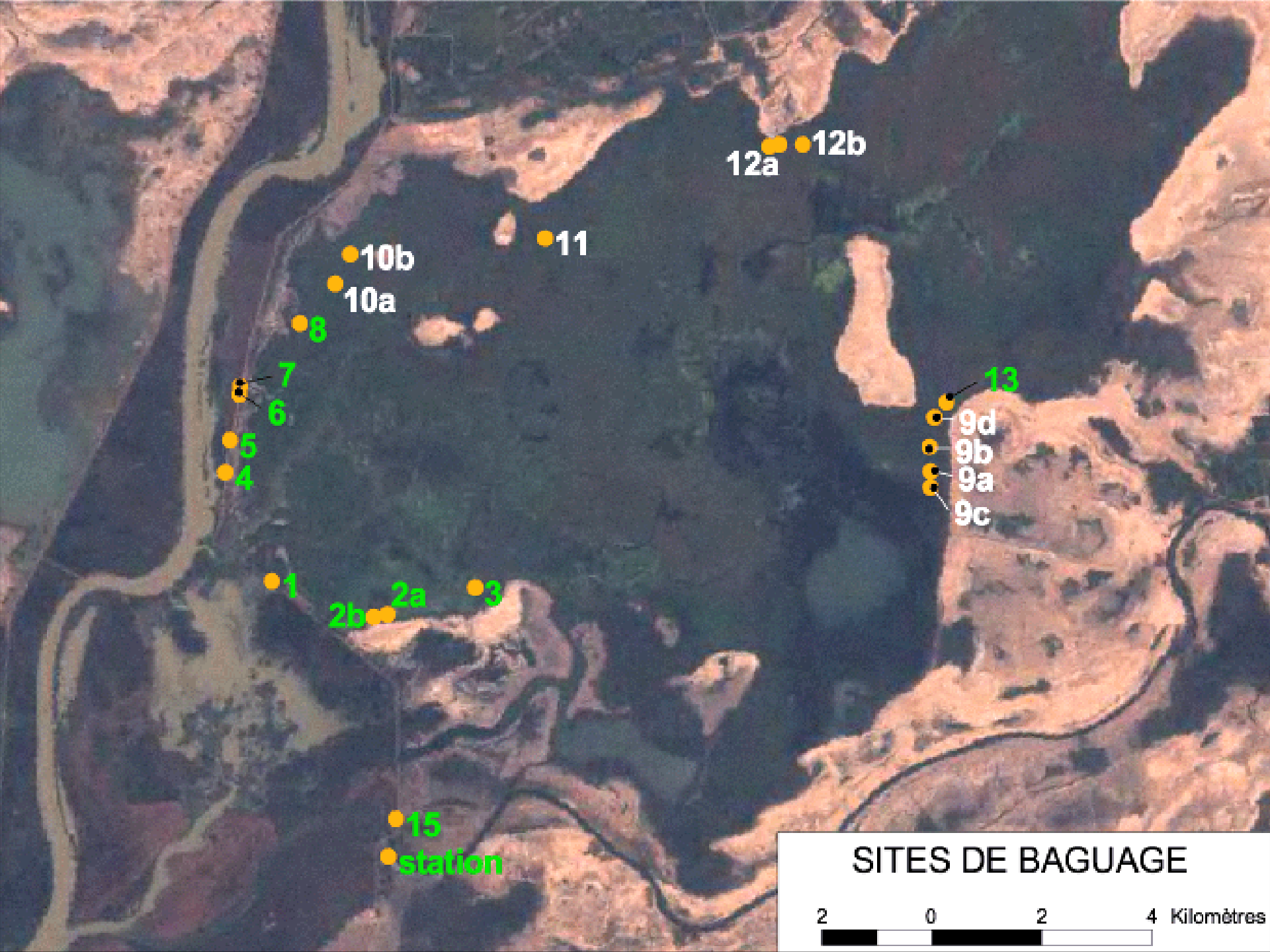
3. Where are other areas?

Likely reason for intra-site variation is heterogeneous composition of Aquatic Warbler habitat:

	Photosynthetic pathway	Expected $\delta^{13}C$
Acacia nilotica Tamarix senegalensis Salvadora persica Scirpus maritimus Scirpus littoralis Typha australis	C3	–26‰
Sporobolus robustus	C4	–10 ‰
Oryza longistaminata Phragmites australis	C3-C4	???

Vegetation map of Djoudj National Park (Schwöppe 1994)




12a
12b
11
10b
10a
8
7
6
5
4
13
9d
9b
9a
9c
1
2b
2a
3
15
station
SITES DE BAGUAGE
2
0
2
4
Kilomètres

Important lessons

- if intra-site variation vastly exceeds large-scale gradient then geographic assignment is extremely complicated
- consider isotopic range at each site rather than just mean values
- pattern recognition is much easier than accurate prediction

2b Temporal consistency in isotope signatures?