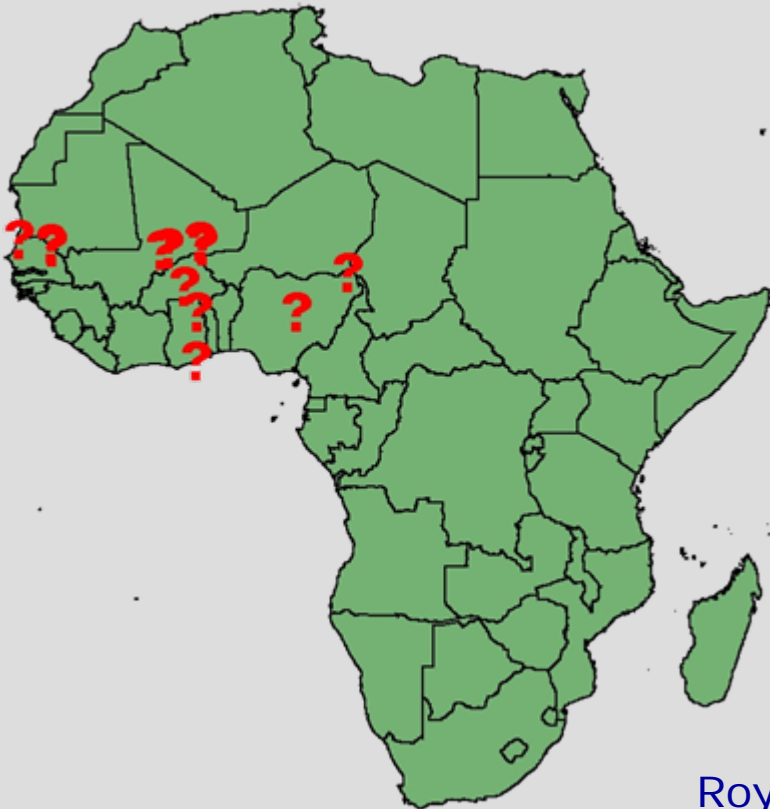




Can we study the winter distribution of Aquatic Warblers with feather isotope analyses?



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Background

- $^{13}\text{C}/^{12}\text{C}$, $^{15}\text{N}/^{14}\text{N}$, and $^2\text{H}/\text{H}$ vary in natural environment
- Feathers resemble isotope ratio of food at time of moult
- Isotope ratios in feathers do not change after moult is complete





Questions

- Do birds from different breeding populations have different feather isotope ratios?
- What proportion of birds caught in Europe winter in Senegal?
- Can we identify other winter regions of Aquatic Warblers?



Methods

- collected tail feathers from birds in Europe and in Senegal – all grown in Africa
- analysed C, N, and H isotope ratios
- tested for differences among populations
- cluster analysis to determine feathers that are isotopically inconsistent with feathers from Senegal

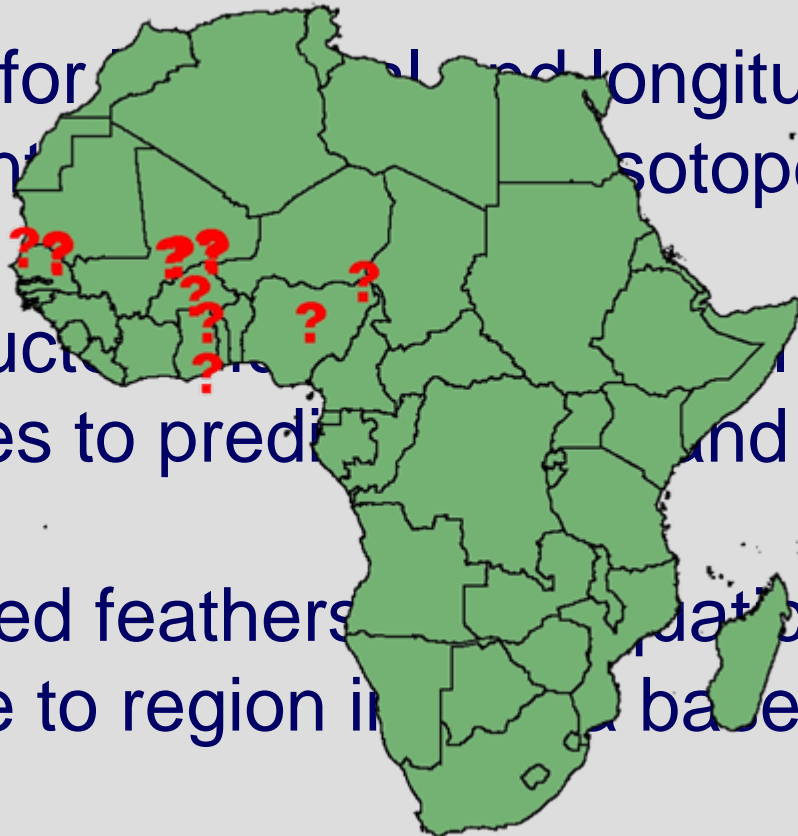
Methods

- collected feathers from resident birds across Africa (Senegal to Nigeria)

- tested for latitudinal and longitudinal gradients in stable isotopes

- constructed a model using all 3 isotopes to predict latitude and longitude

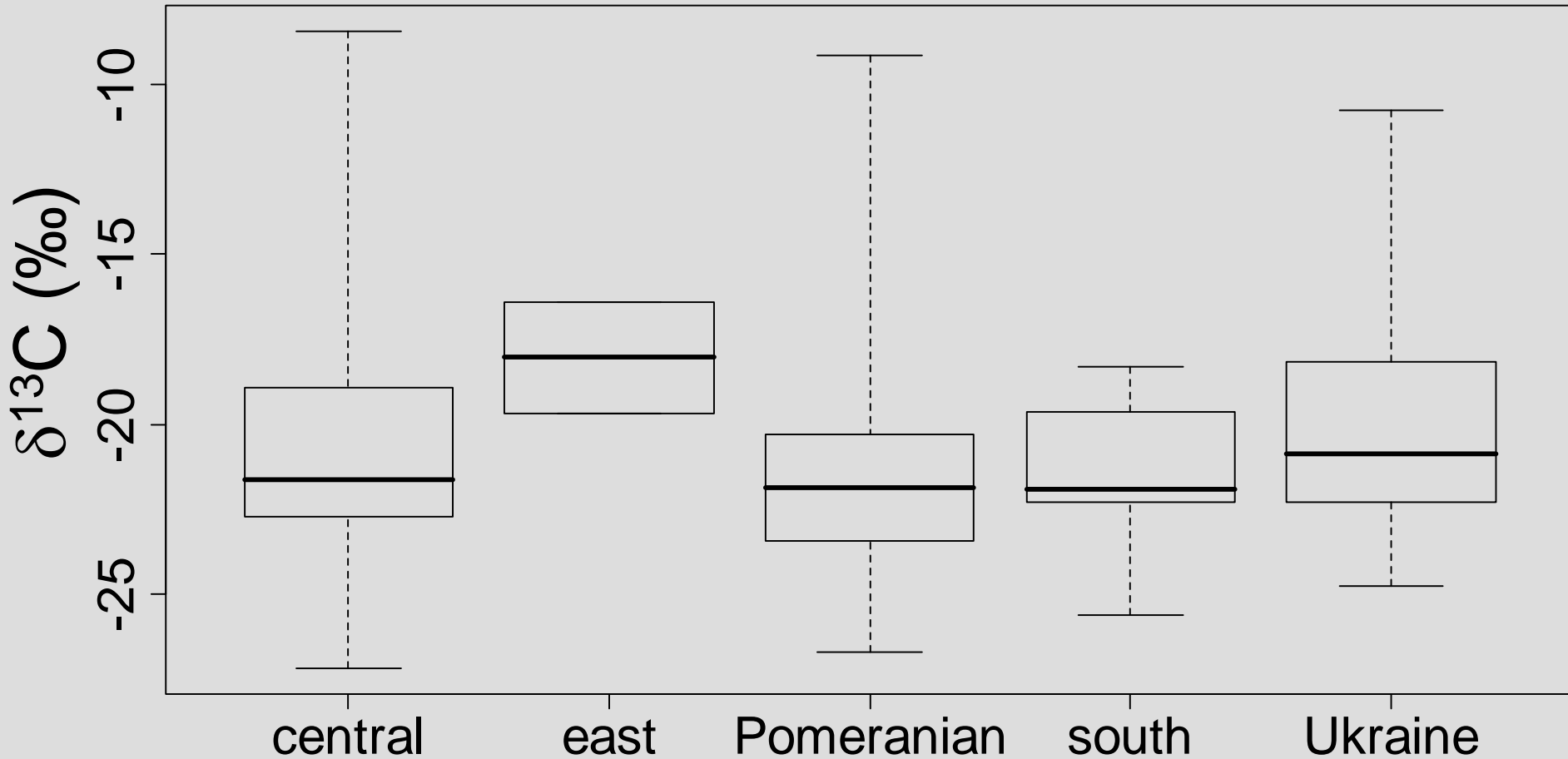
- assigned feathers from European Warblers in Europe to region in Africa based on model





Results: isotope variation among breeding areas

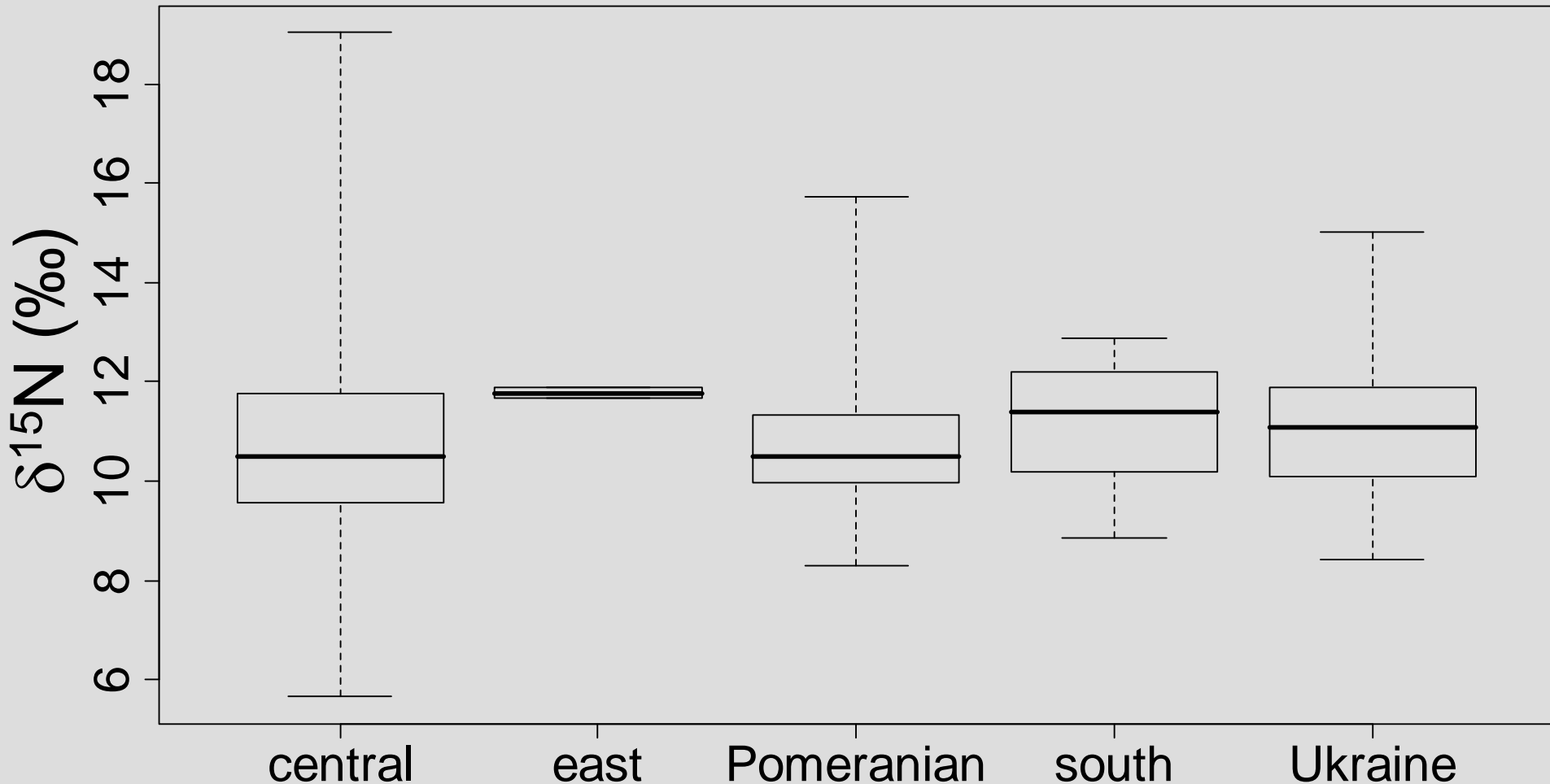
- populations do not differ in $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, or $\delta^2\text{H}$





Results: isotope variation among breeding areas

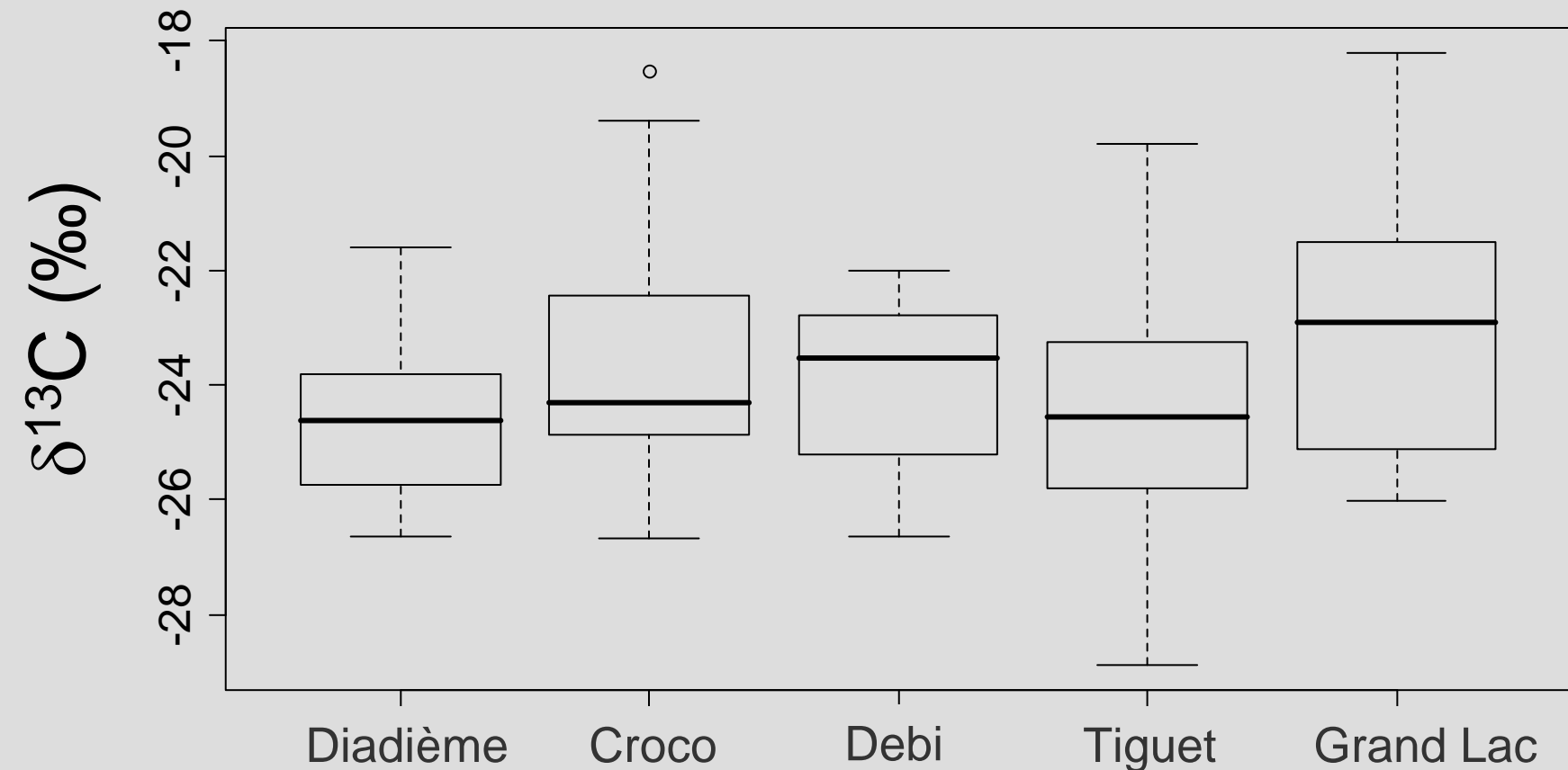
- populations do not differ in $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, or $\delta^2\text{H}$





Results: isotope variation in Senegal

- large range of isotope ratios in birds captured within Djoudj National Park
- differences among capture sites within Djoudj NP






Results: isotope variation in Senegal

- presumably result of small-scale vegetation composition:

	Photosynthetic pathway	Expected $\delta^{13}\text{C}$
Scirpus littoralis Scirpus maritimus Oryza longistaminata	C3	-26‰
Sporobolus robustus	C4	-10‰
Eleocharis mutata	C3-C4	???

 Large isotopic variation within Djoudj makes identification of other wintering sites very difficult!

Results: isotope gradients across Africa

- found statistically significant latitudinal and longitudinal gradients for all 3 isotopes
- gradients explained <15% of variation, and are not useful for prediction



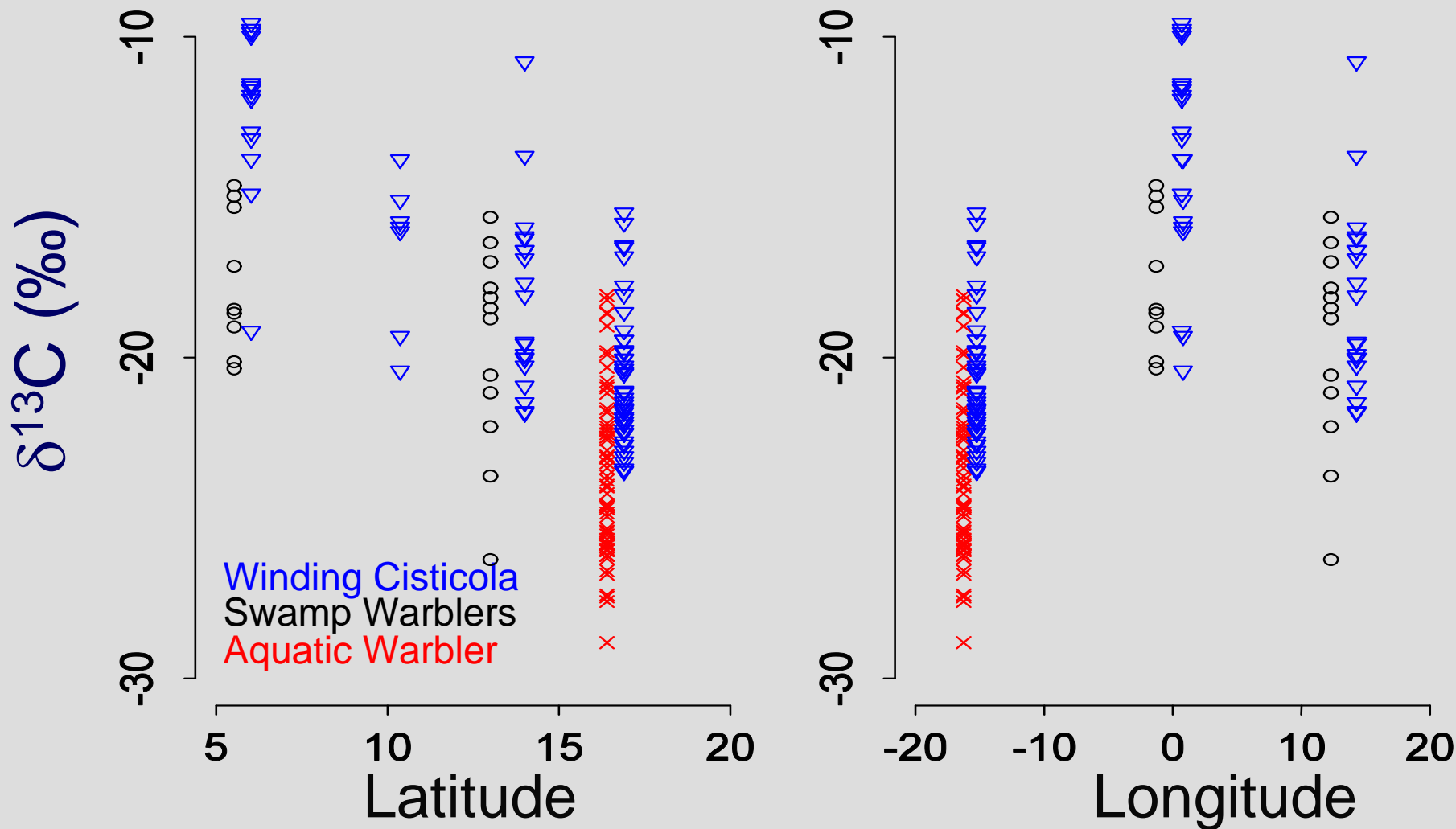
Lesser Swamp Warbler



Winding Cisticola

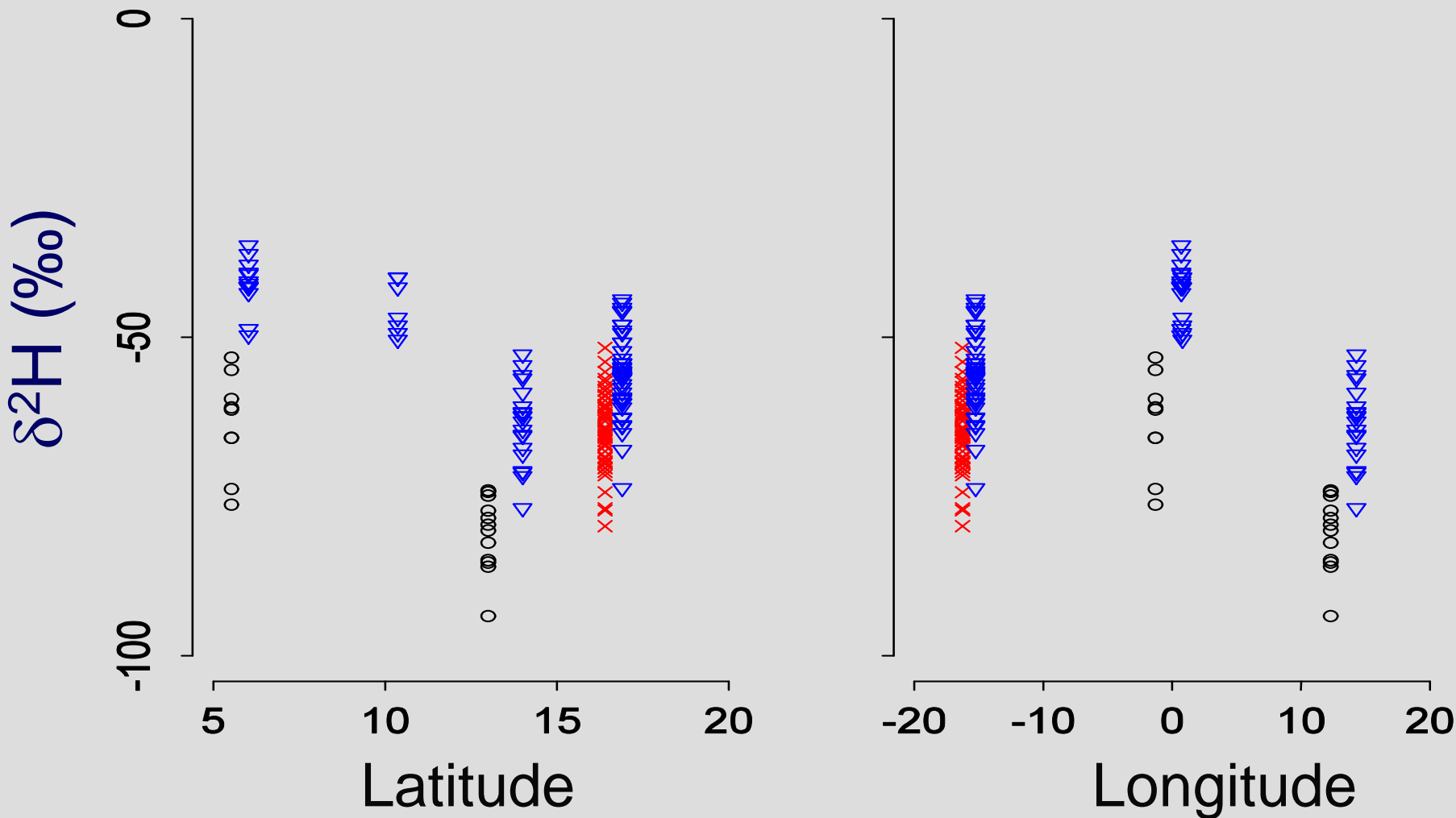


Results: isotope gradients across Africa

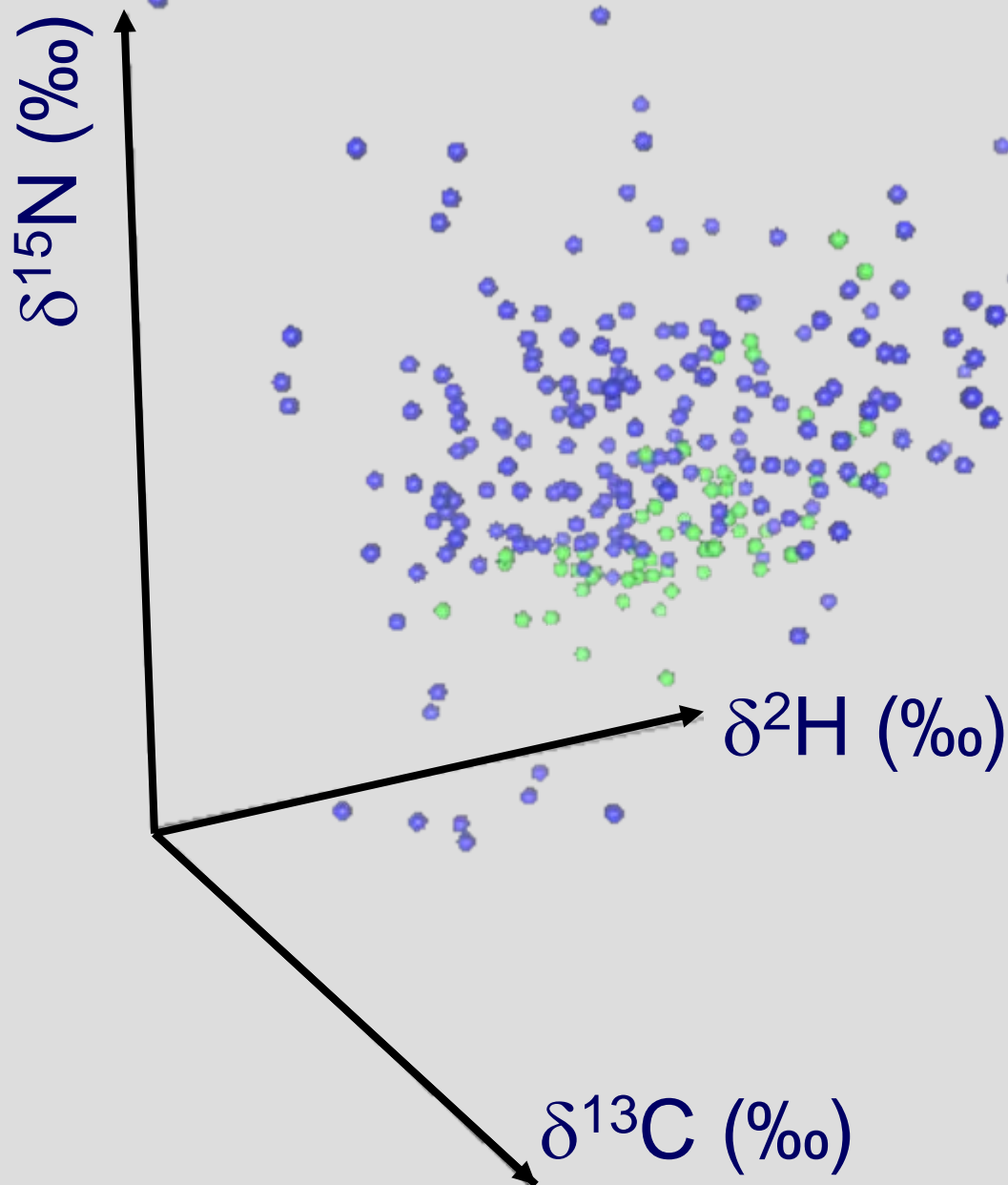




Results: isotope gradients across Africa



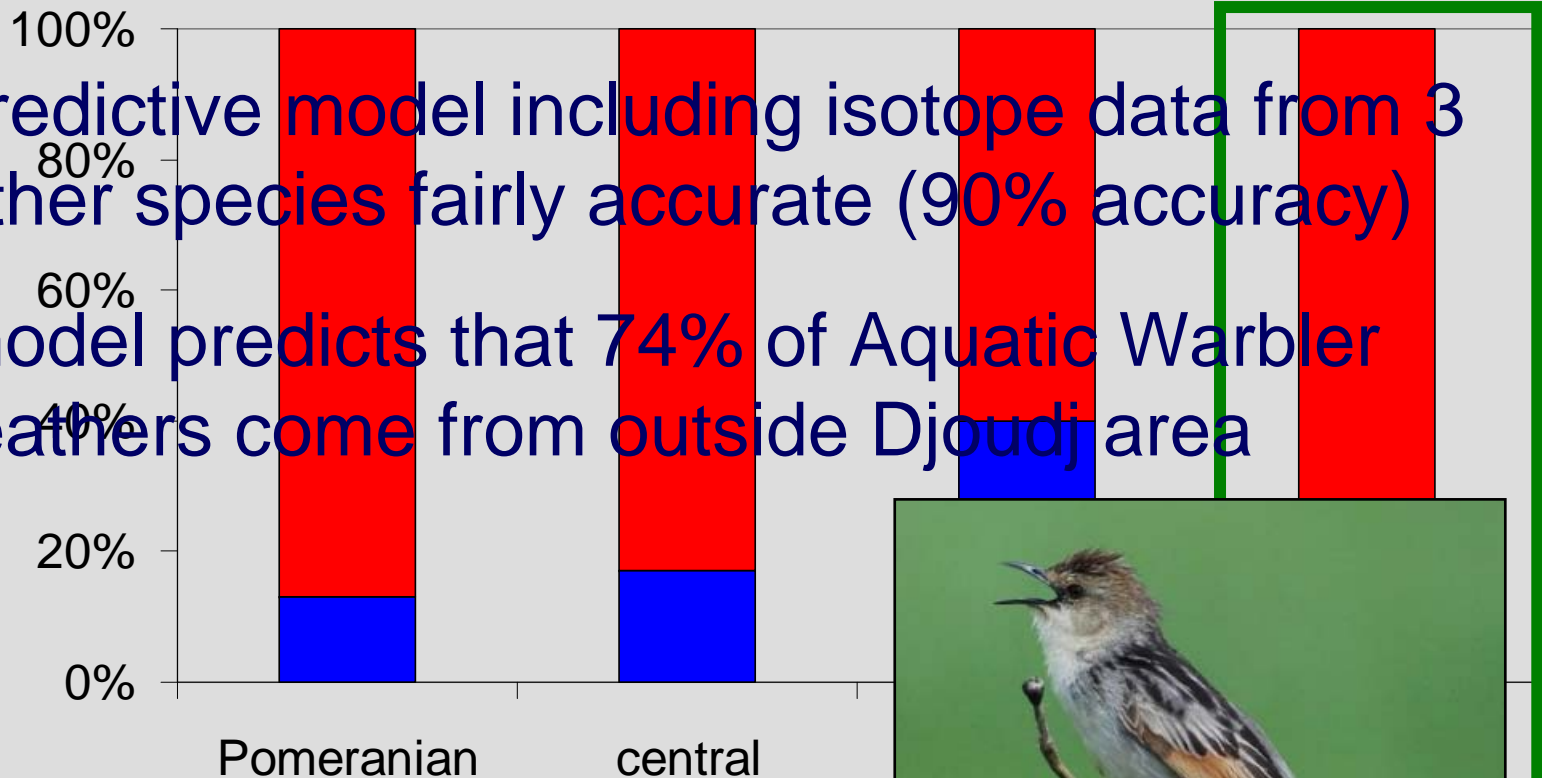
Results: classification of feathers based on isotopes



Senegal
Europe

Results: predicted origin of European feathers

- cluster analysis: 20% of birds not from Djoudj NP



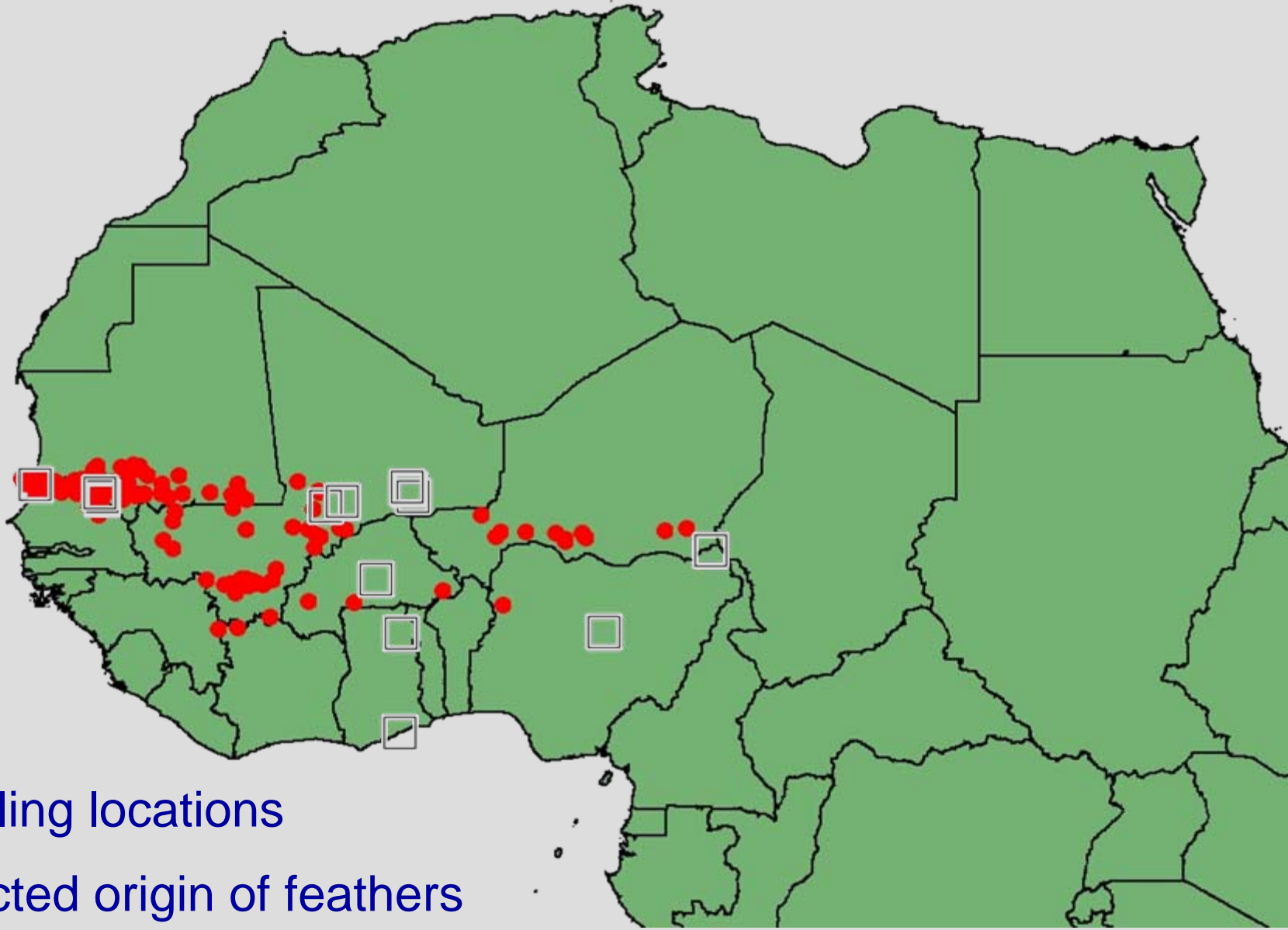
- predictive model including isotope data from 3 other species fairly accurate (90% accuracy)

- model predicts that 74% of Aquatic Warbler feathers come from outside Djoudj area





Results: predicted origin of European feathers



□ sampling locations

● predicted origin of feathers

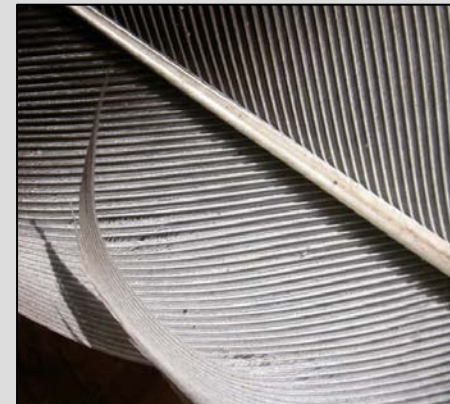


Results: how reliable is predicted origin?

- Latitude and longitude predicted independently, but may be confounded in nature
- Aquatic Warbler samples come only from Djoudj
- moulting area not necessarily wintering area
- isotope ratio of feathers from interior of Djoudj remains unknown

Conclusions

- some Aquatic Warblers moult in different places than the birds captured in Senegal (20 – 74%)
- possible other wintering area in Mali?
- isotope results alone unreliable – combine with habitat predictions to identify areas for ground searches





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