Niche modelling of Western Palearctic birds migrating within Africa to guide conservation decisions

www.macroecology.ku.dk/africamigrants

Bruno A. Walther

DIVERSITAS

Paris, France

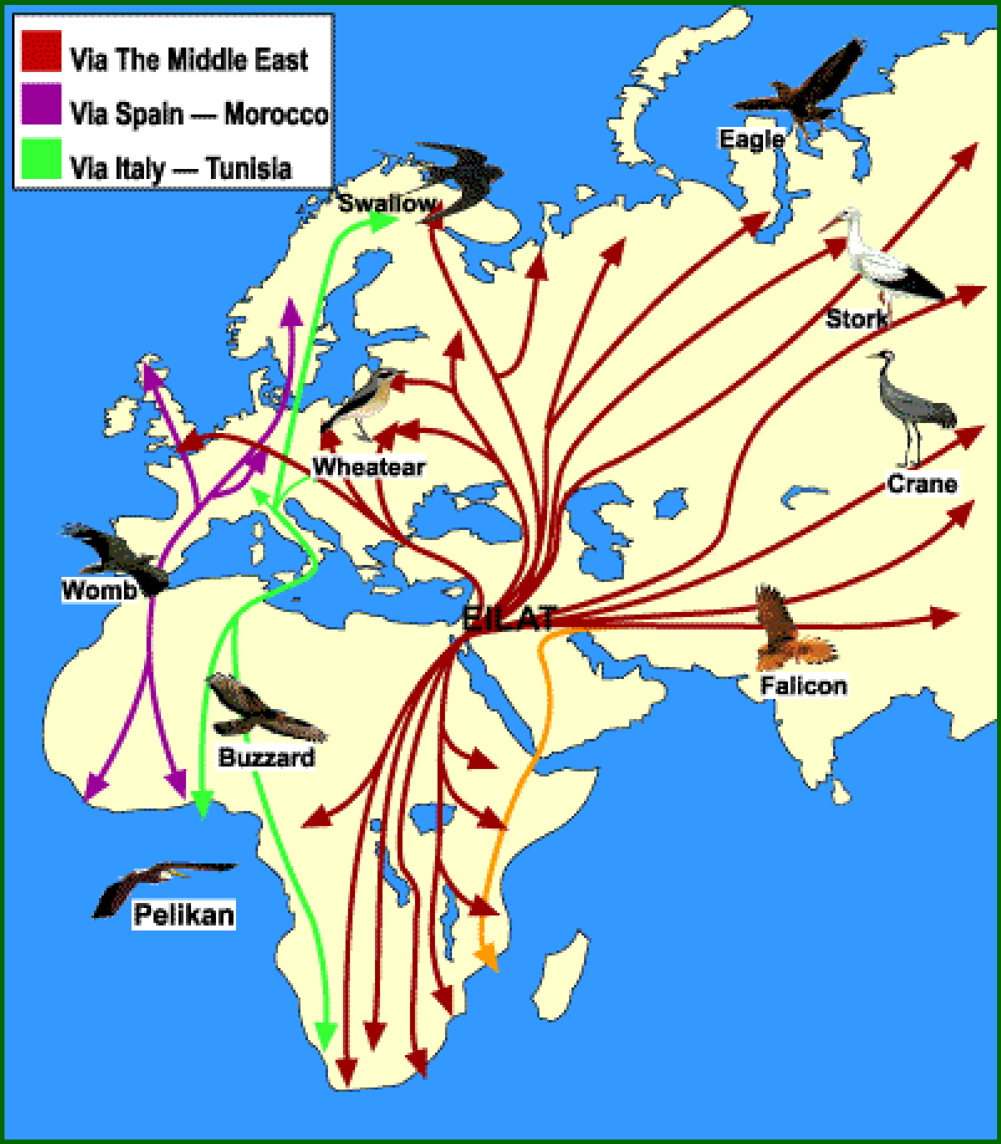

Bird migration is one of the wonders of nature

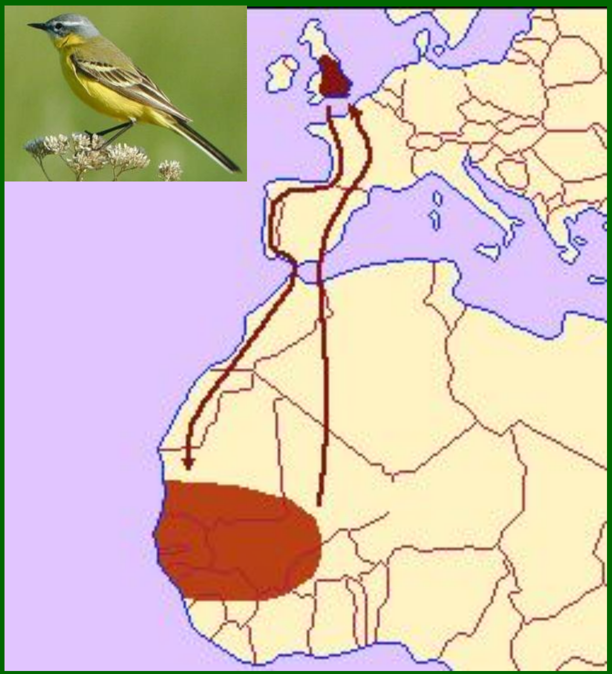
~ 3000 million birds migrate between Africa and Europe*

215 non-passerine and 128 passerine species

*** estimate from Moreau (1972) *The Palaearctic-African bird migration systems***

African distributions poorly known

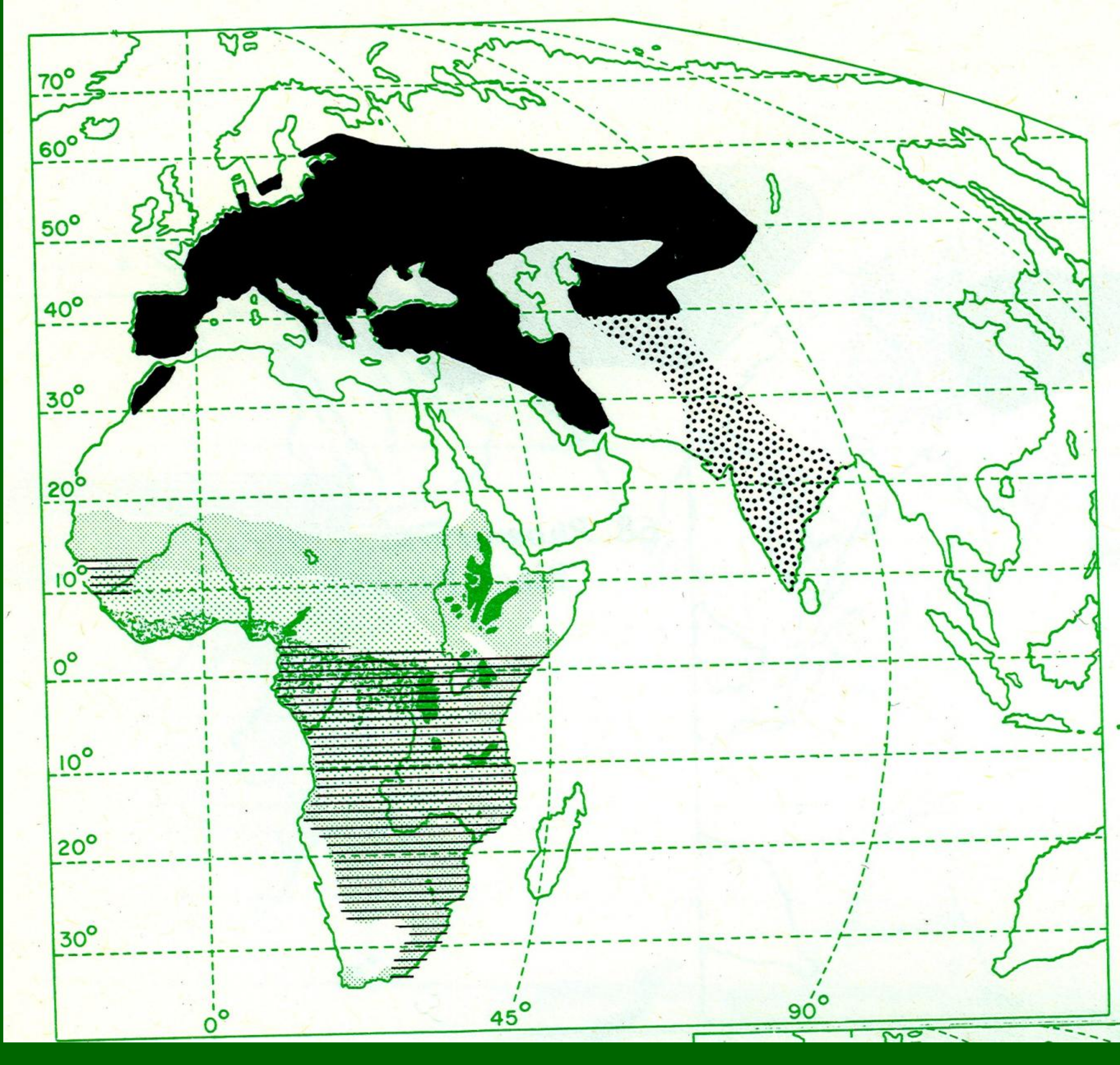




Shown are the migration routes and wintering grounds of the subspecies of Yellow Wagtail that breeds in the United Kingdom.

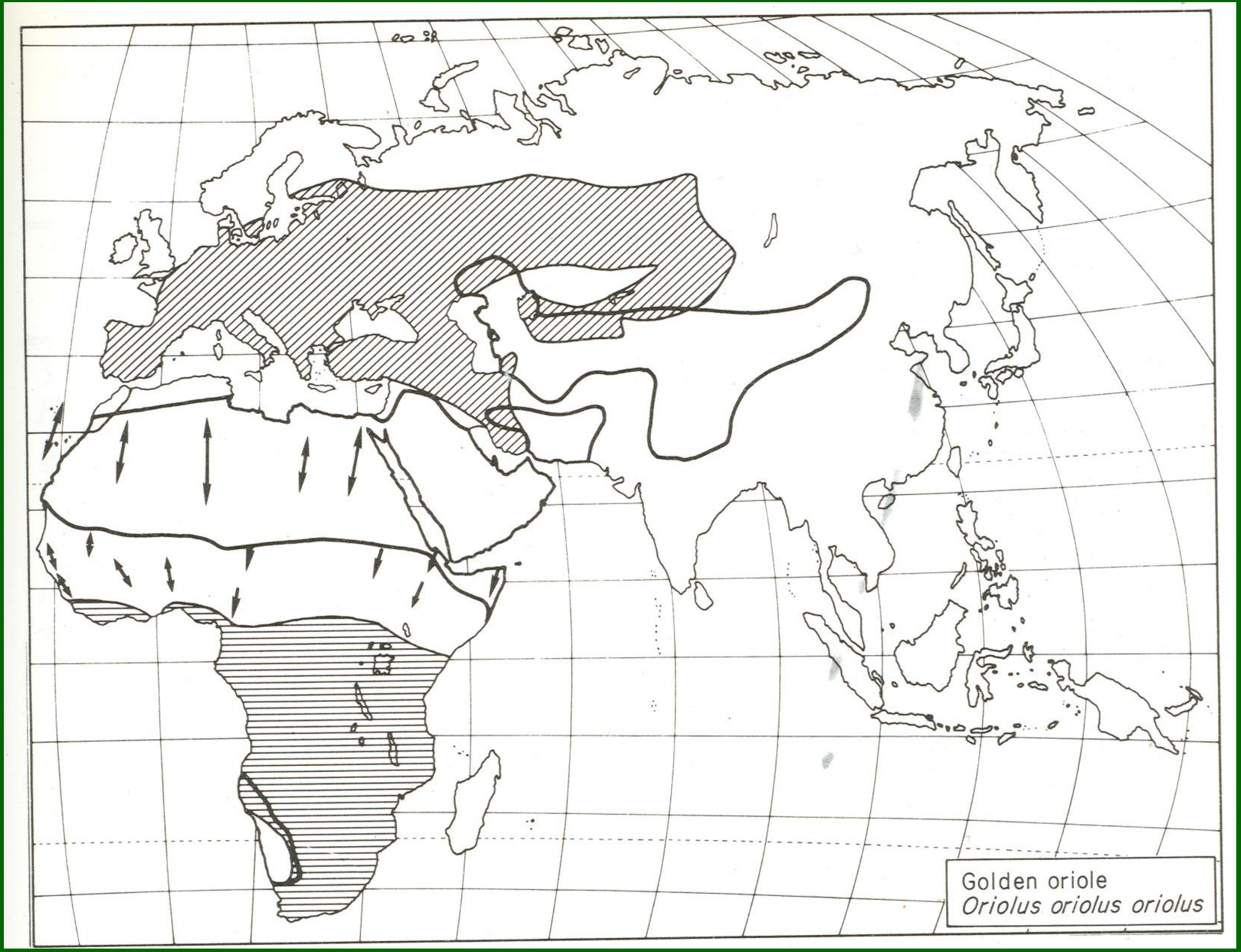
Moreau (1972) *The Palaearctic-African bird migration systems*

Moreau (1972) *The Palaearctic-African bird migration systems*

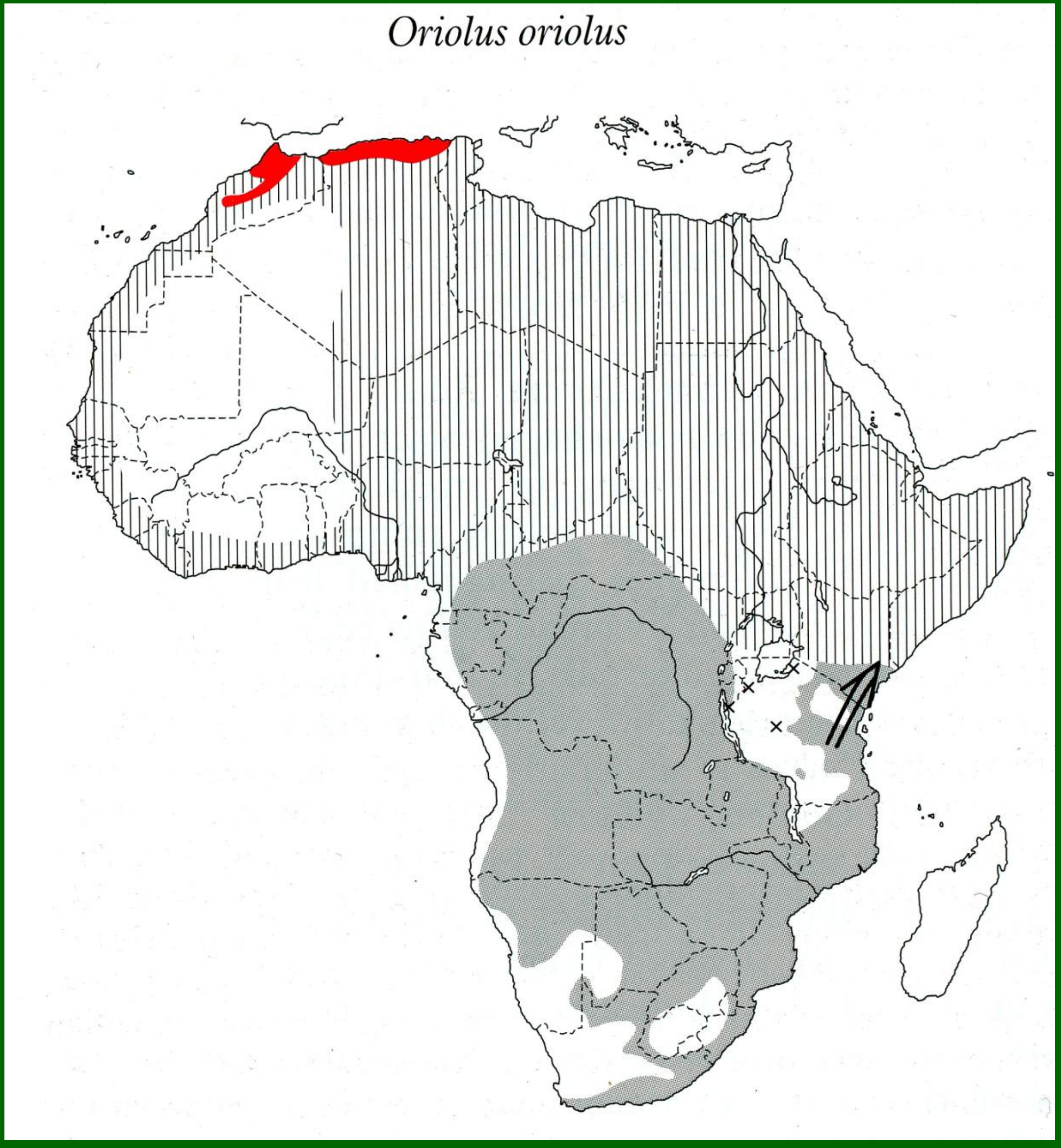


73. *Oriolus oriolus*
Golden Oriole

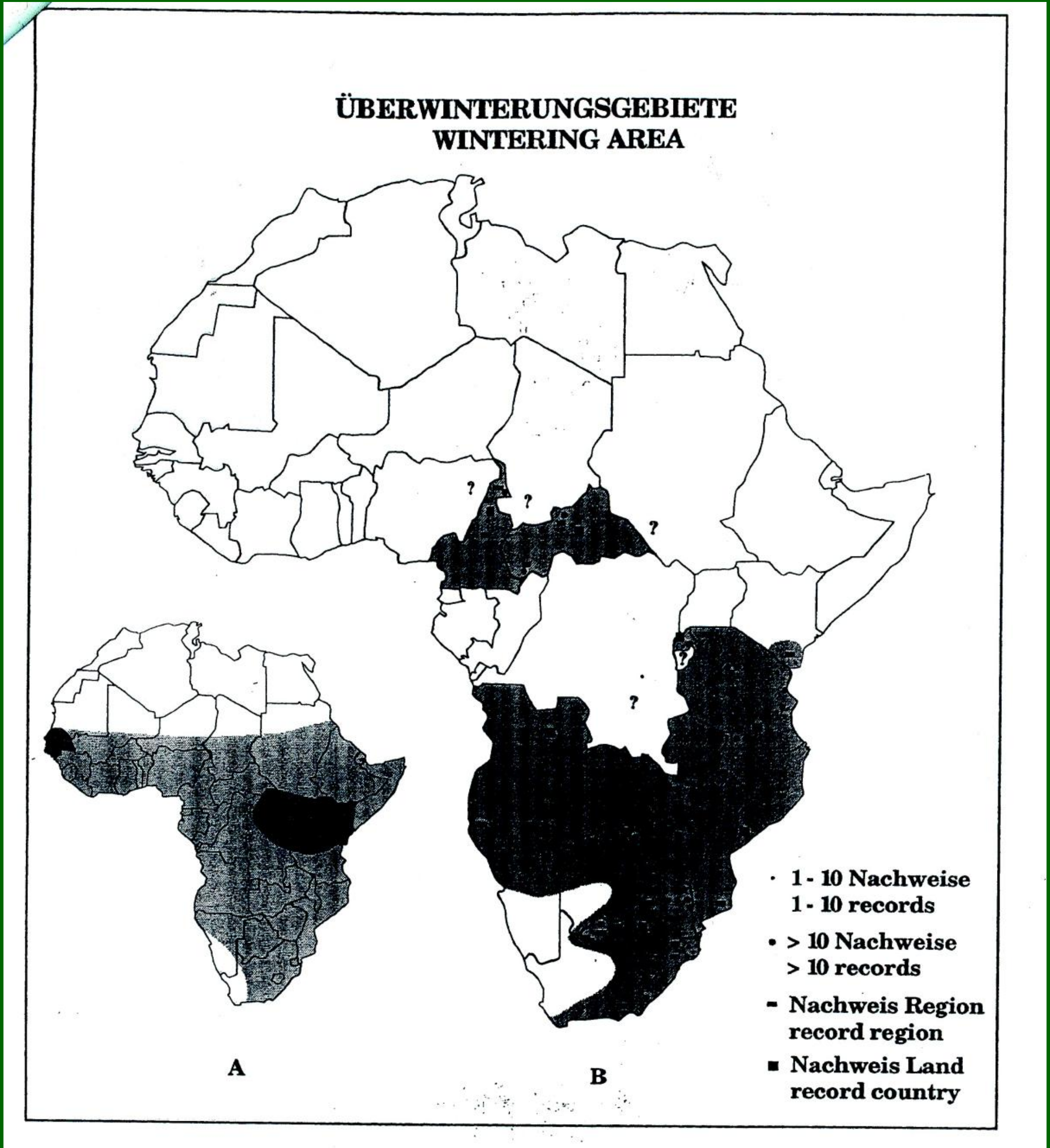
Curry-Lindahl (1981)
Bird migration in Africa



Fry et al. (2000) *The birds of Africa VI*



Baumann (1999) *Phenology of migration and wintering area in the European Golden Oriole**



**Vogelwarte*
40: 63-79

Goals of the database and research

1. **Improve spatial and temporal knowledge of migration, especially of threatened species**

2. **Use modelling techniques to improve distributional maps**

3. **Select conservation priority areas**

Sources of the database

1. Ringing records (EURING, SAFRING, etc.)

2. Specimen data (GBIF, museums, etc.)

3. Published data (books, monographs, etc.)

4. Unpublished data from field ornithologists

5. Internet searches (site lists, trip reports, etc.)

=> ~ 250000 geo-referenced records now

Example for goals 1 & 2: Aquatic Warbler

- until recently, considered one of the most threatened bird species of continental Europe
- one of only 6 globally threatened passerines in Europe
- classified as ***Vulnerable*** by Birdlife International

Acrocephalus paludicola

Protection of breeding sites

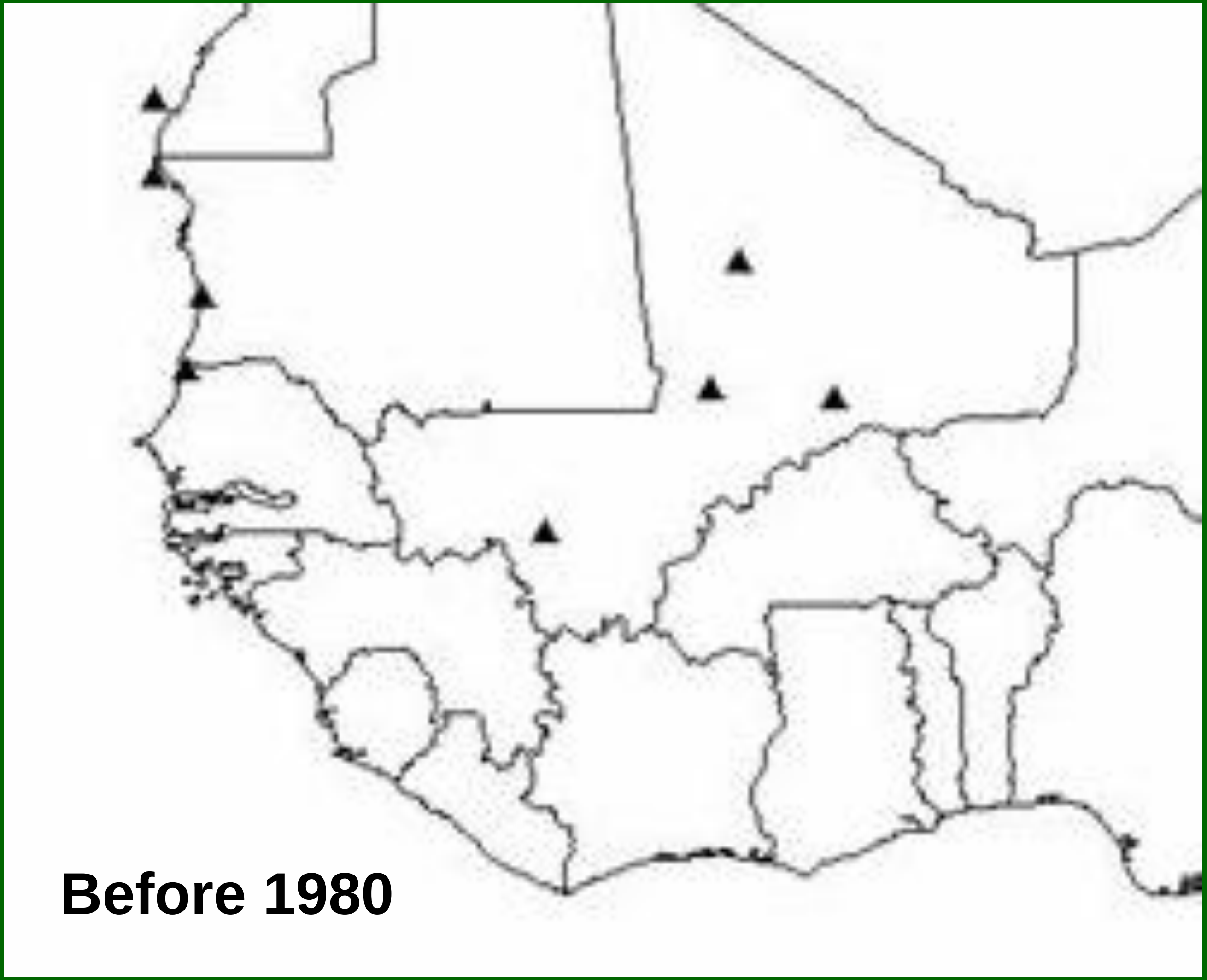
- key breeding sites in Belarus, Germany, Hungary and Poland are protected

- newly discovered and protected populations in Belarus greatly increased known populations (by about 6000 breeding pairs)

But what about wintering sites in West Africa?

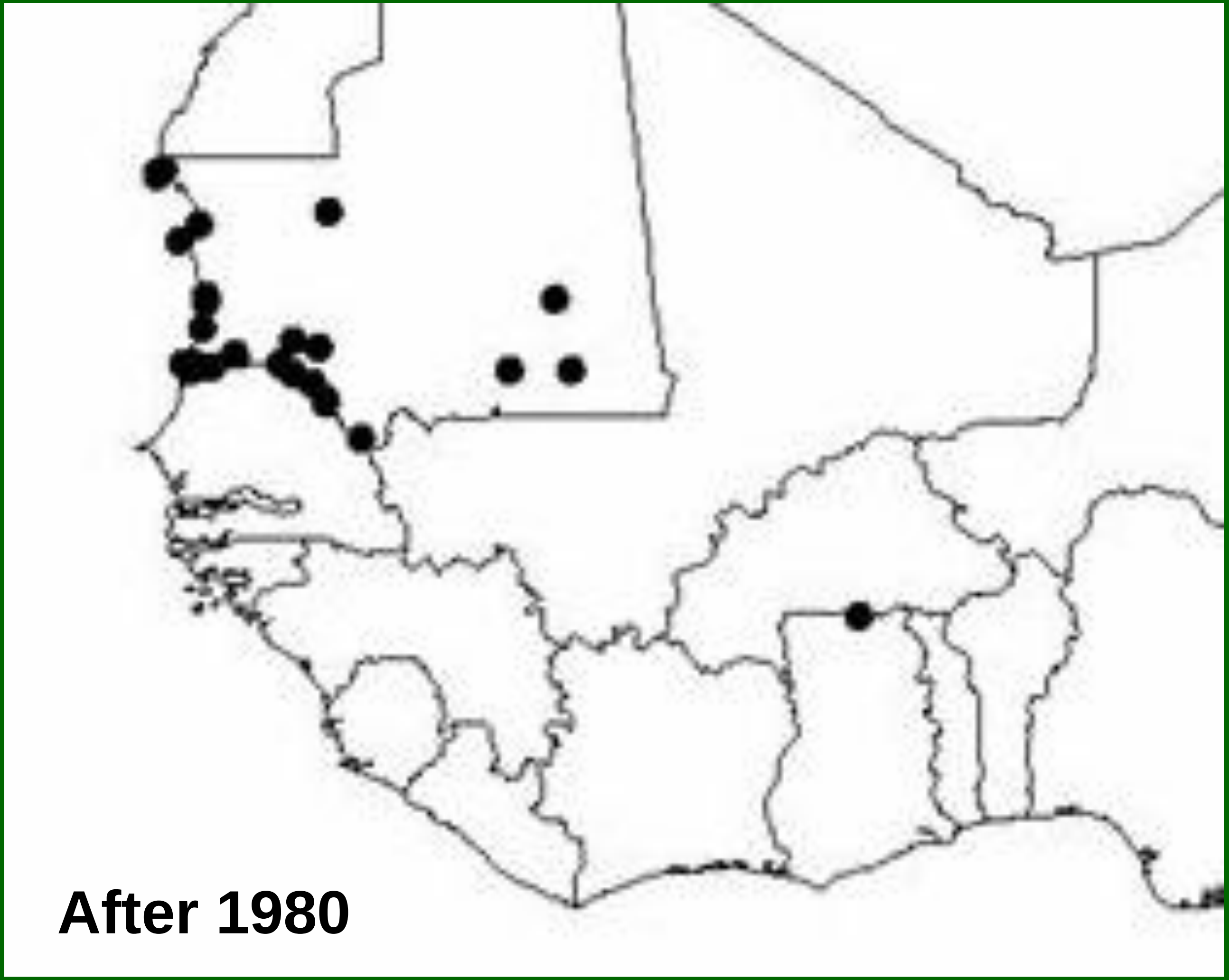
Aquatic Warbler in Africa

Schäffer *et al.* (2006)

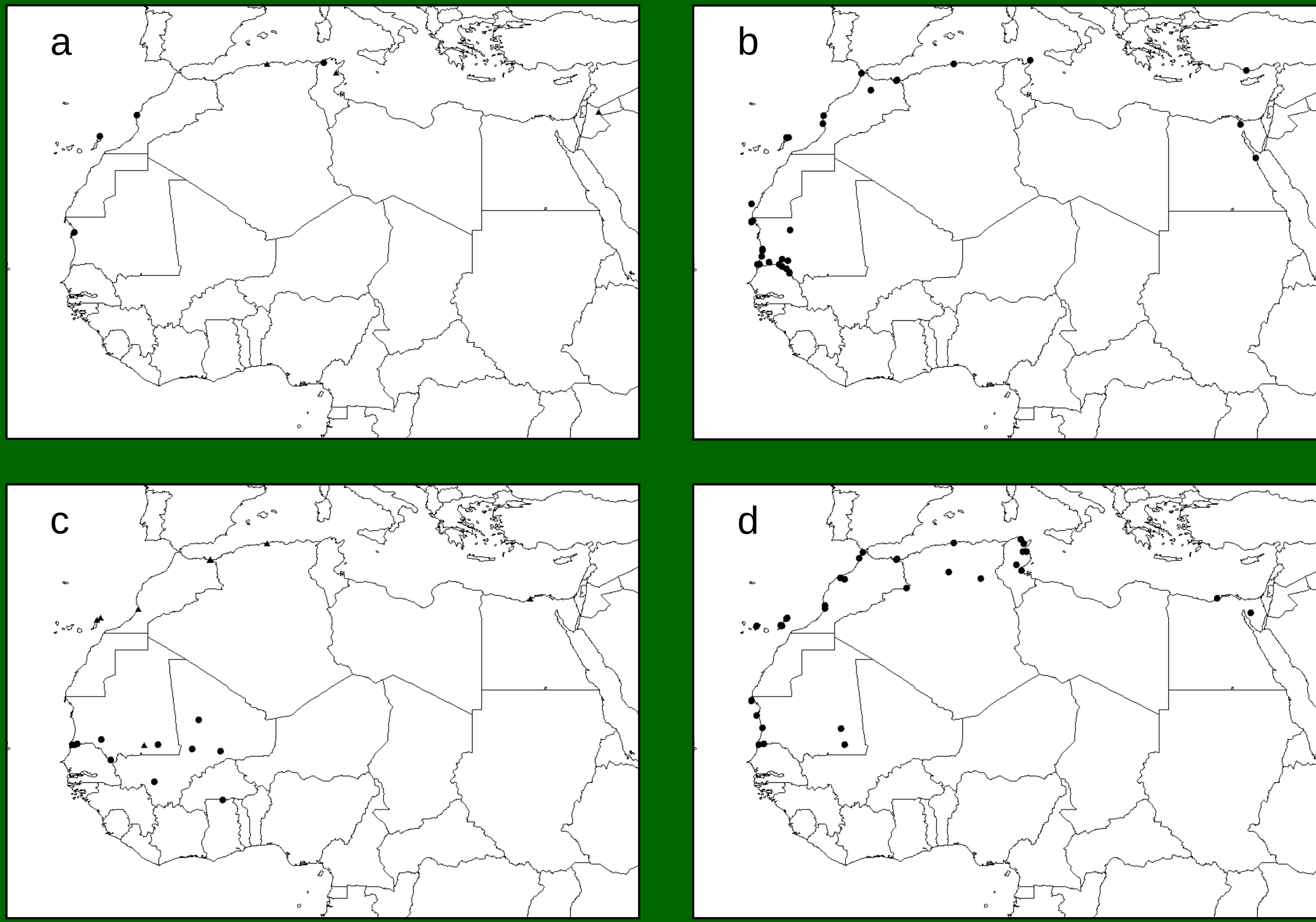


Aquatic Warbler in Africa

Schäffer *et al.* (2006)



May-August **September-October**



November-February **March-April**

Goal 2. Use modelling techniques to improve distributional maps

We often have only a few localities where a species was observed.

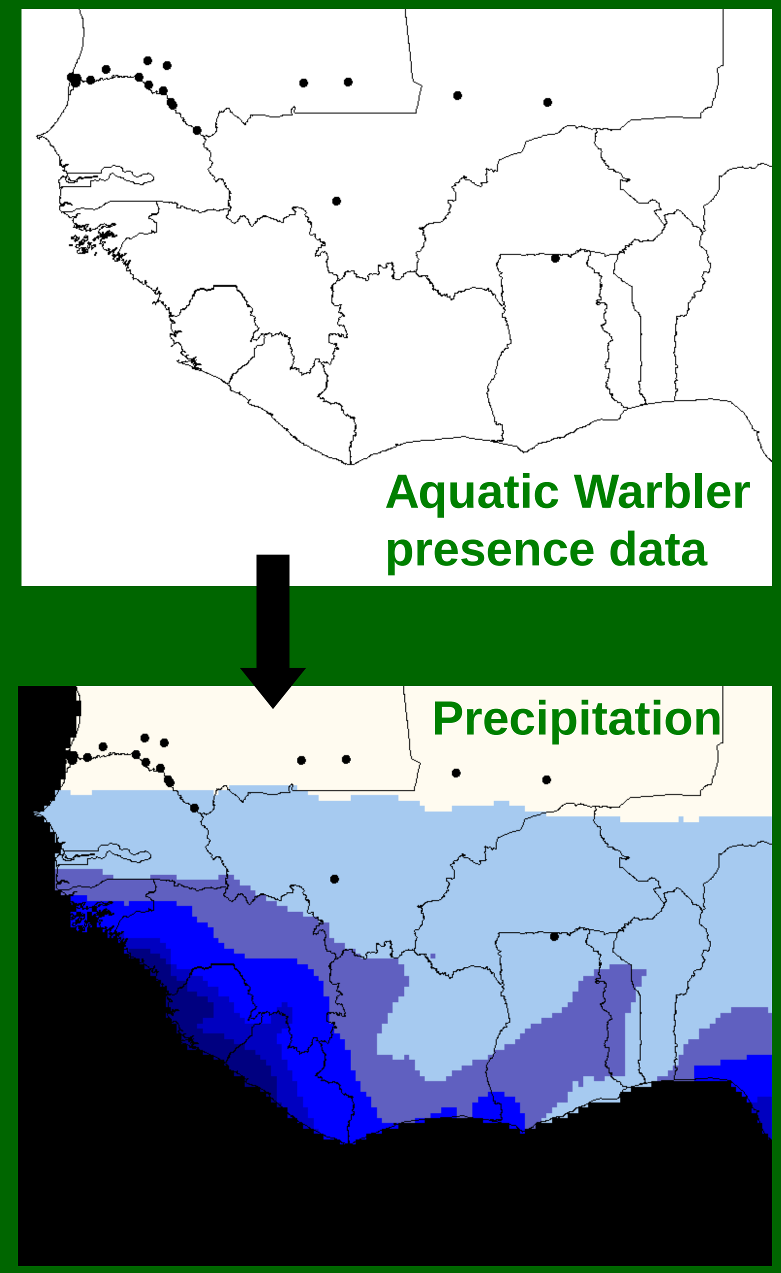
How do we predict in what other places the species is most likely to be found?

An example: the distribution of the Aquatic Warbler *Acrocephalus paludicola* in Africa

BIOCLIM modelling technique

BIOCLIM identifies values for each environmental layer that coincide with the species' point-locality records to calculate environmental envelopes

These predictions are then projected back onto the given geography to generate distribution maps

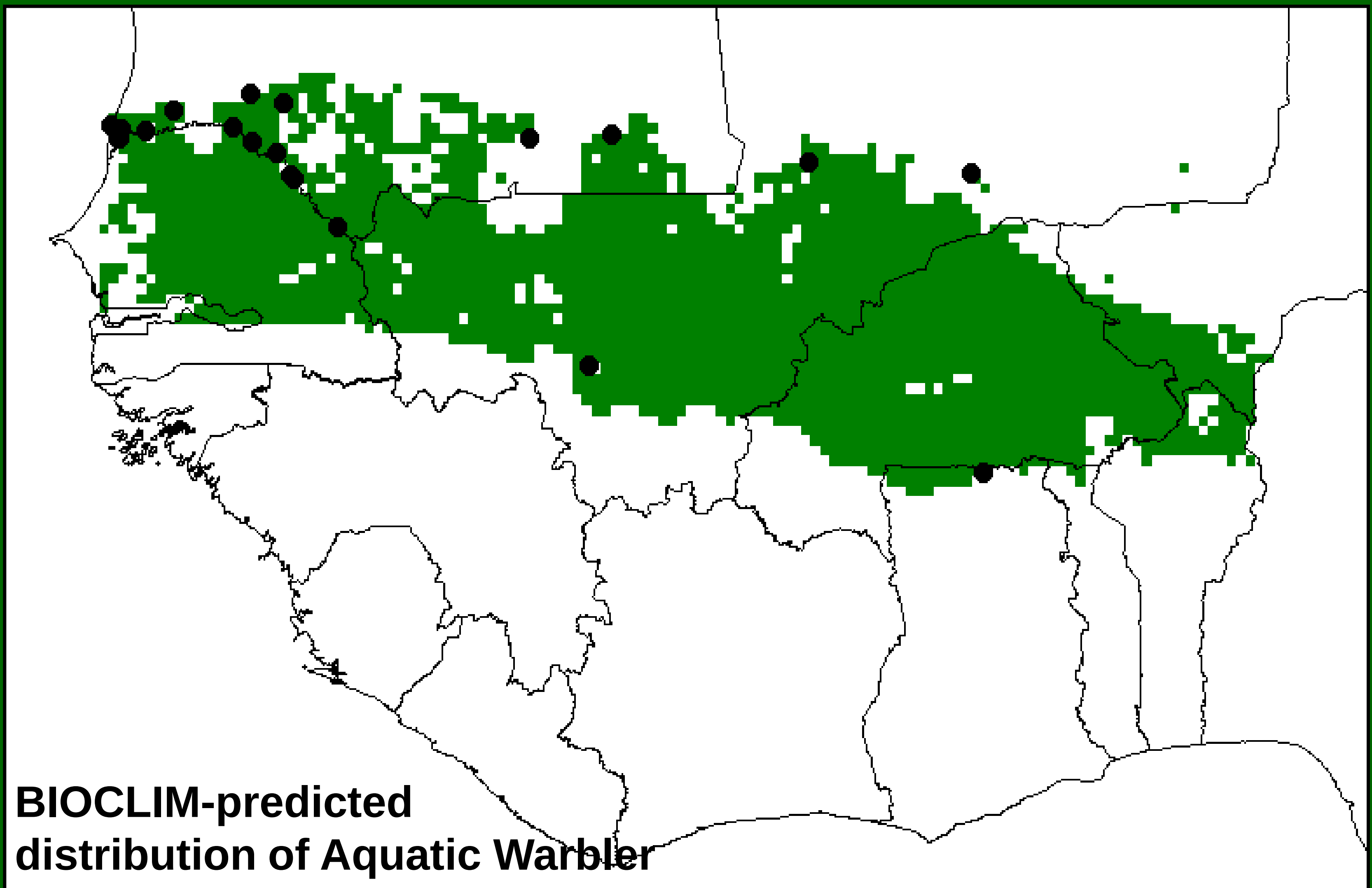


Modelled distribution of Aquatic Warbler (Walther *et al.* 2007)

7 uncorrelated variables:

- **mean annual temperature**
- **minimum temperature of the coldest month**
- **maximum temperature of the warmest month**
- **annual growing-degree days**
- **annual sum of precipitation**
- **mean annual potential evapotranspiration**
- **human footprint**

Modelled distribution of Aquatic Warbler (Walther *et al.* 2007)



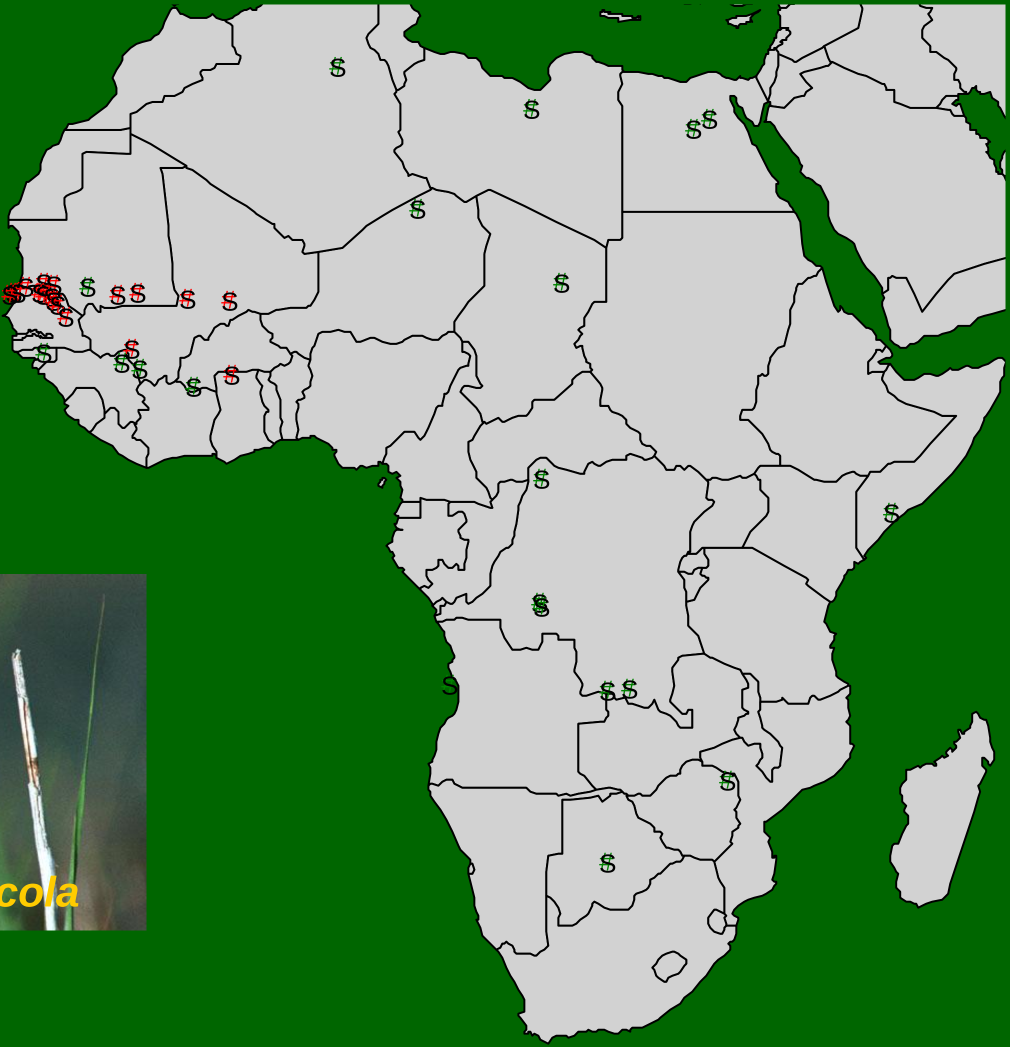
How to use more powerful presence-absence models?

- **Complex distribution models using both presence and absence records are more powerful than presence-only models***

- **If absence records are lacking, generate so-called pseudo-absences**

*** Elith *et al.* 2006. Novel methods improve prediction of species' distributions from occurrence data. *Ecography* 29: 129-151**

20 presences and 20 pseudo-absences

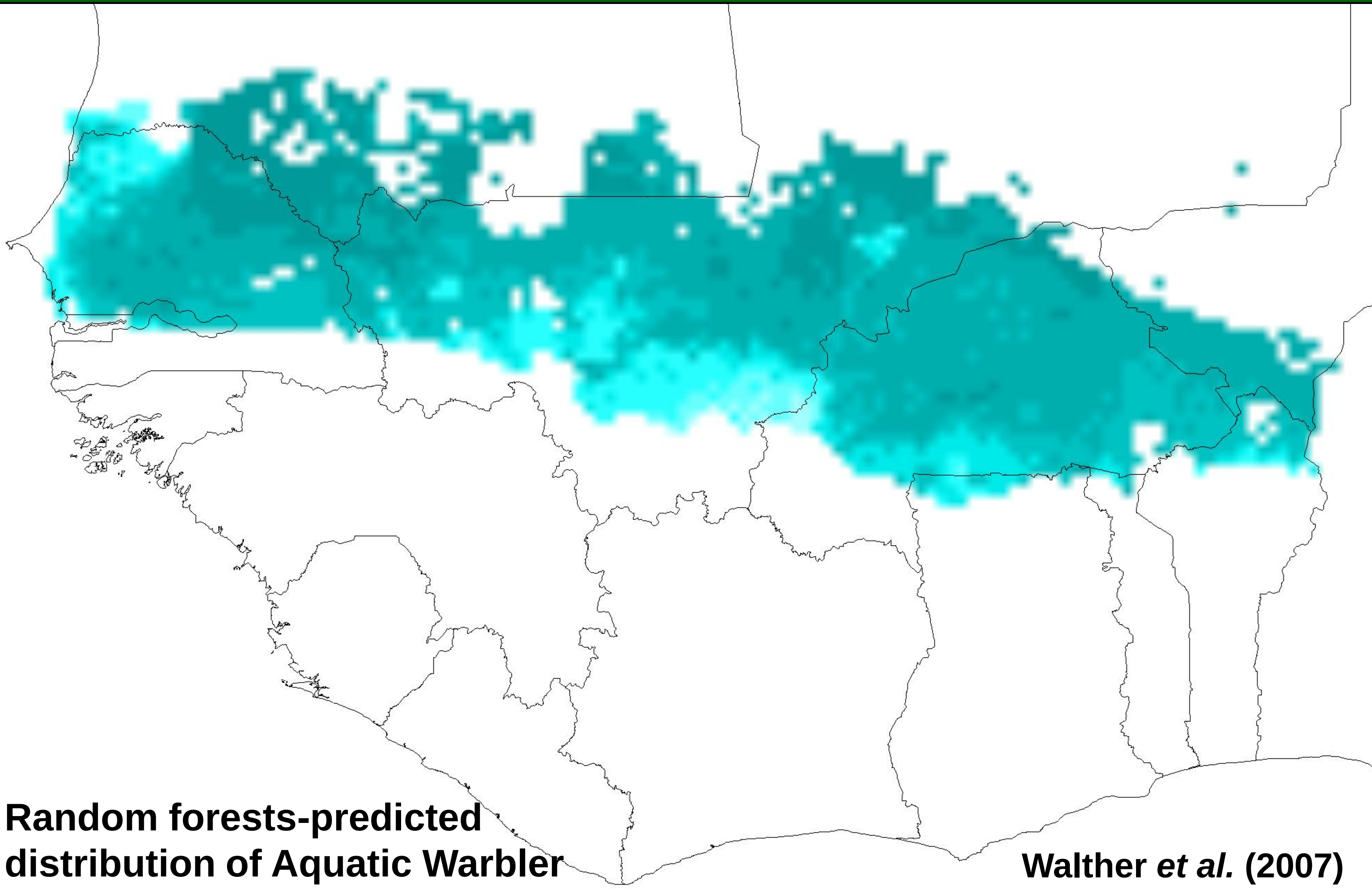


Best model selected from 9 models

- artificial neural networks
- classification tree analysis
- generalized additive models
- generalized boosting models
- generalized linear models
- multiple adaptive regression splines
- mixture discriminant analysis
- Breiman and Cutler's random forests for classification and regression
- surface range envelope (BIOCLIM)

=> BIOMOD (Thuiller *et al.* 2003) chooses best model using the AUC score evaluation technique

Best model selected from 9 models



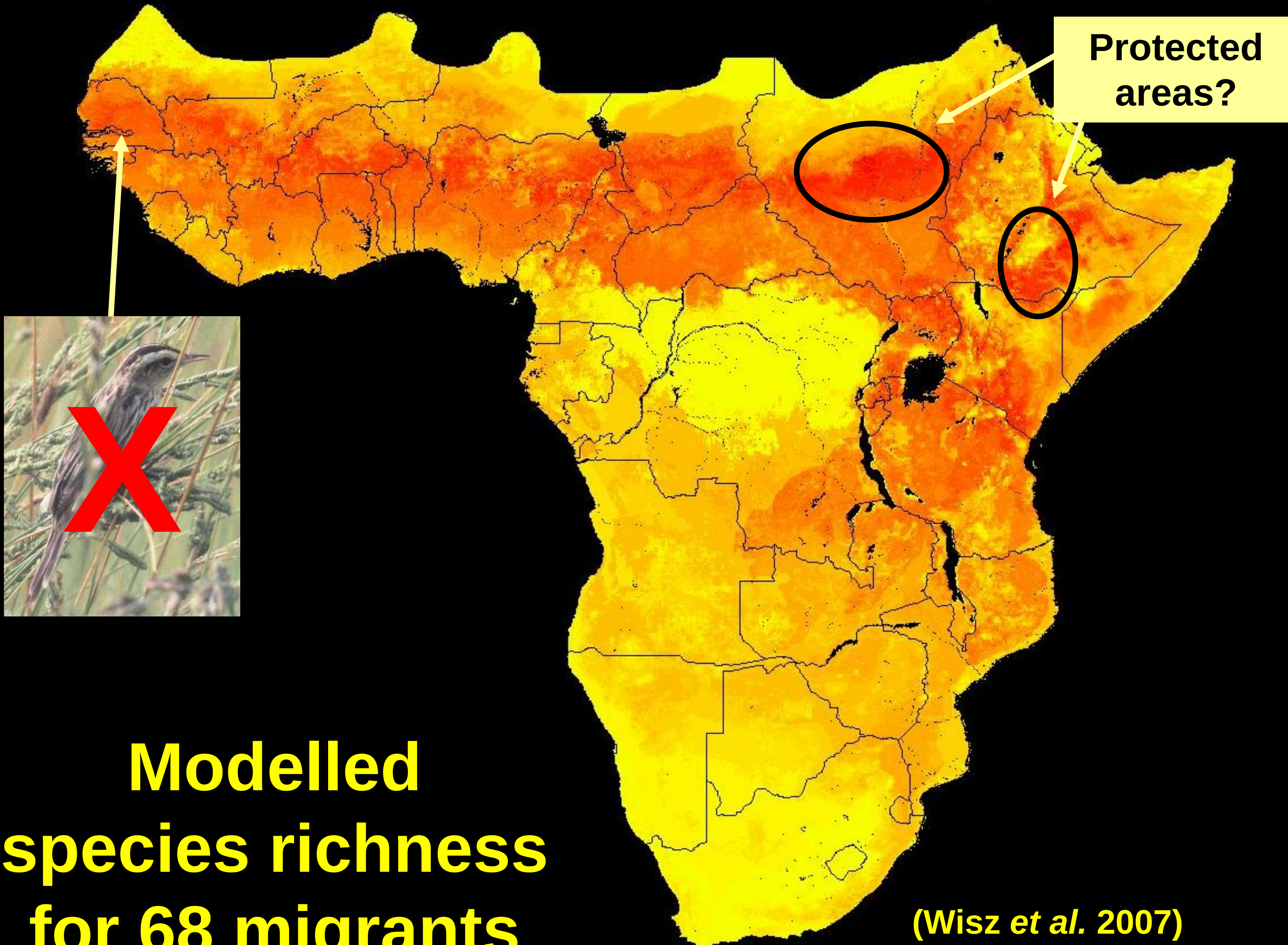
Random forests-predicted distribution of Aquatic Warbler

Walther *et al.* (2007)

- **Thuiller, W. 2003. BIOMOD - optimizing predictions of species distributions and projecting potential future shifts under global change. *Global Change Biology* 9: 1353-1362.**

- **Araújo, M. B. & M. New 2006. Ensemble forecasting of species distributions. *TREE* 22: 42-47.**

=> like for climate-change scenarios, achieve more robust forecasting by calculating mean and variation over many simulation runs using various models within a ensemble forecasting framework



Modelled species richness for 68 migrants

(Wisz *et al.* 2007)

Goal 3. Select conservation priority areas

- **Uses the concept of complementarity, i.e. species still missing from areas already chosen are complemented when another area that contains the missing species is added to the total area selection**

Species A and B	Species A and B	Species C

- **Many different area selection algorithms for different objectives**

BIOLOGICAL CONSERVATION 136 (2007) 531–540

Pre-emptive conservation versus “fire-fighting”: A decision theoretic approach

Daniel A. Spring[a,*], *Oscar Cacho*[b], *Ralph Mac Nally*[a], *Regis Sabbadin*[c]

Assessing the Effectiveness of Reserve Acquisition Programs in Protecting Rare and Threatened Species

WILL R. TURNER,*§ DAVID S. WILCOVE,*† AND HILARY M. SWAIN‡

Conservation Biology Volume 20, No. 6, 1657–1669

ELSEVIER
Review
TRENDS in Ecology and Evolution Vol.22 No.11 2007
Full text provided by www.sciencedirect.com
ScienceDirect

Conservation planning in a changing world

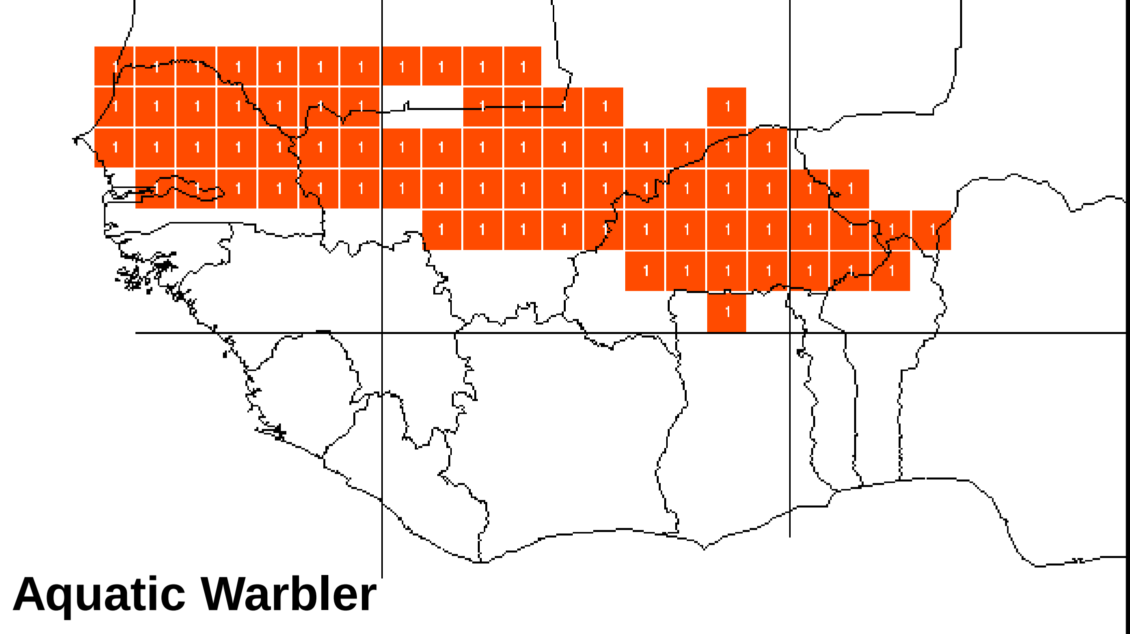
Robert L. Pressey[1,2], Mar Cabeza[3], Matthew E. Watts[1], Richard M. Cowling[4] and Kerrie A. Wilson[1]

Diversity and Distributions, (Diversity Distrib.) (2006) 12, 125–137

BIODIVERSITY RESEARCH

Incorporating multiple criteria into the design of conservation area networks: a minireview with recommendations

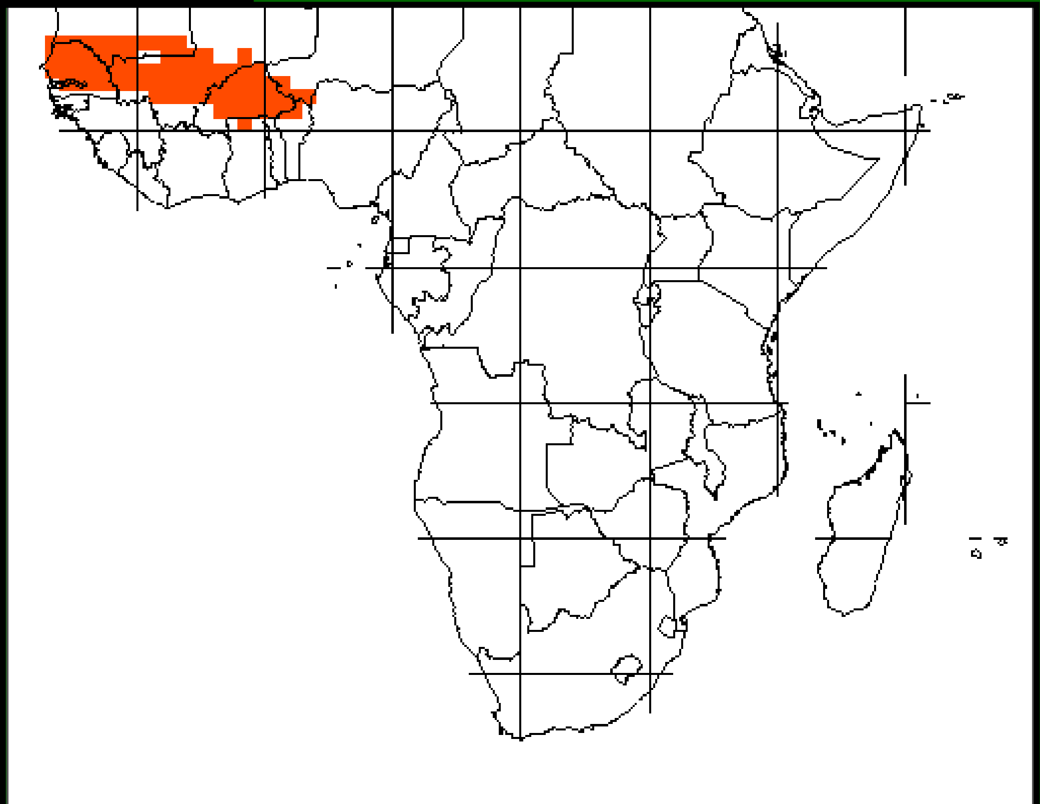
Alexander Moffett and Sahotra Sarkar*

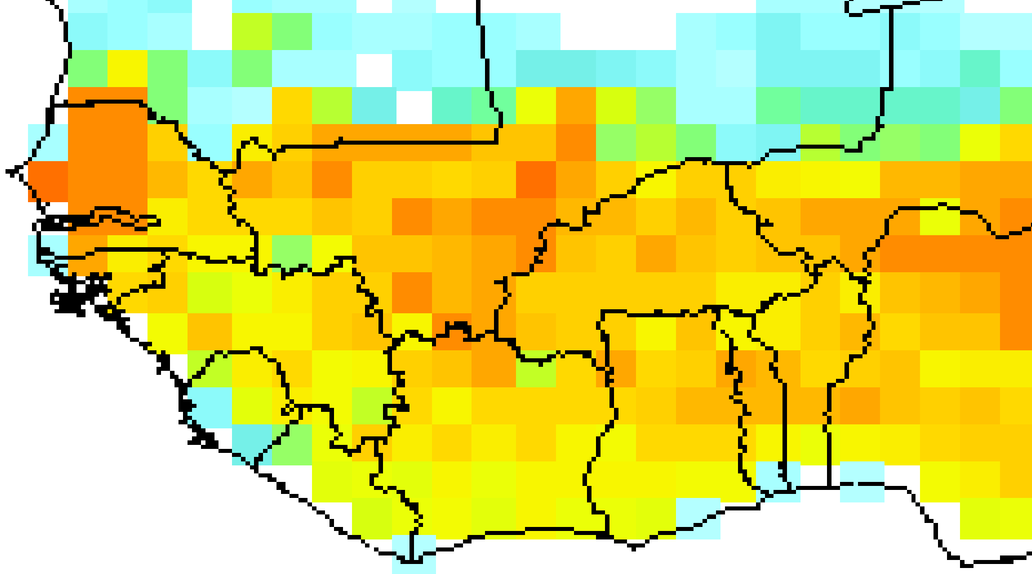


Entering one species into WORLDMAP

Species richness

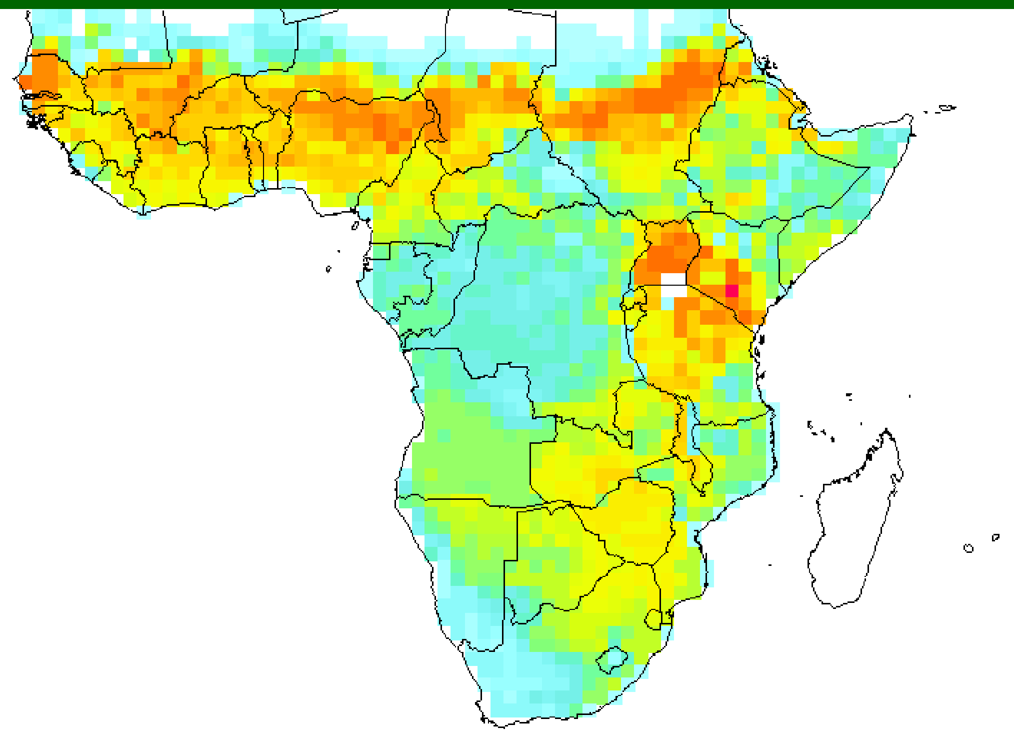
= 1





All passerine migrants

Entering all species into WORLDMAP

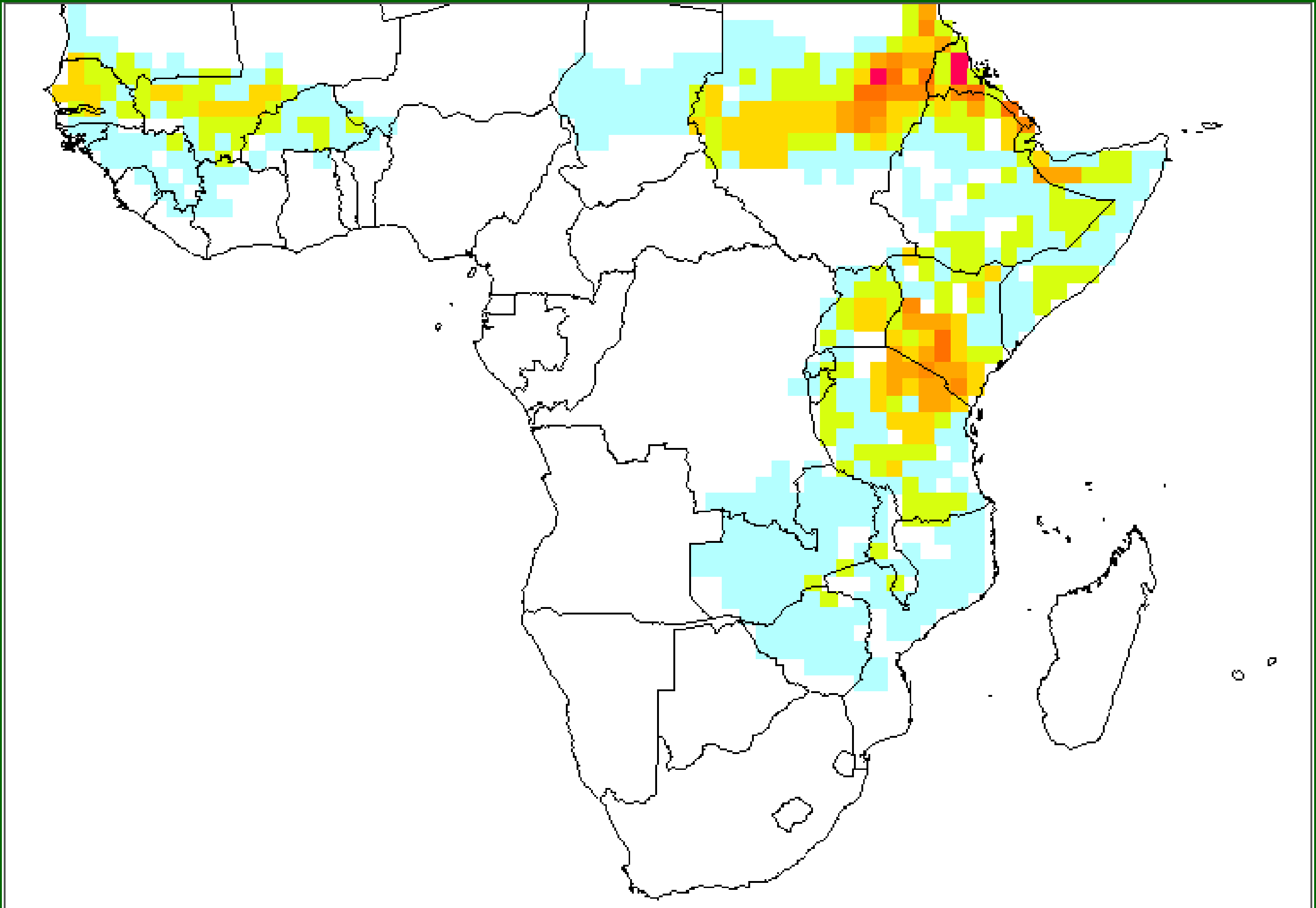


Walther *et al*. (unpublished)

Species richness

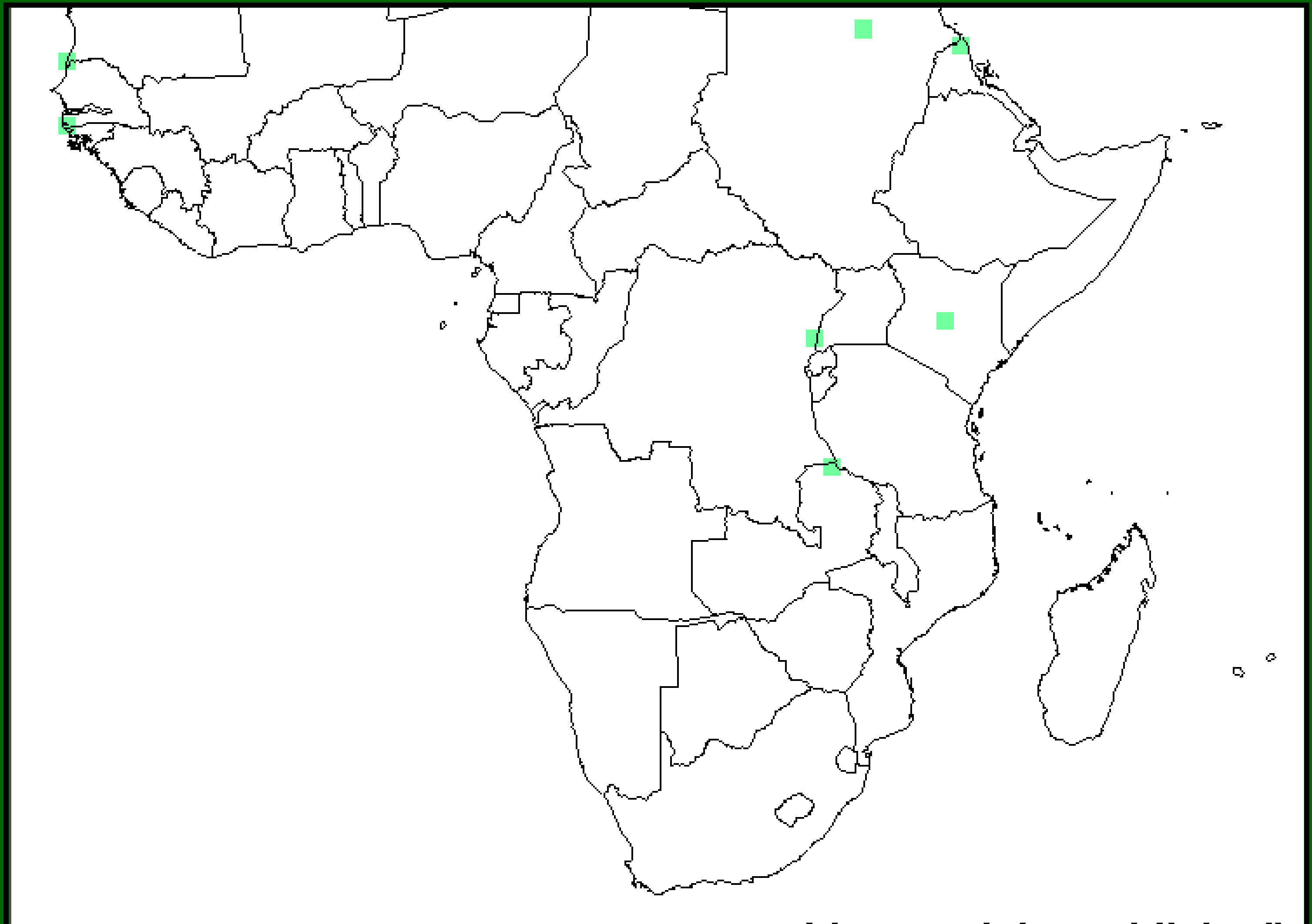
= 68

Rare-quartile richness
(species richness of 25% rarest spp.)



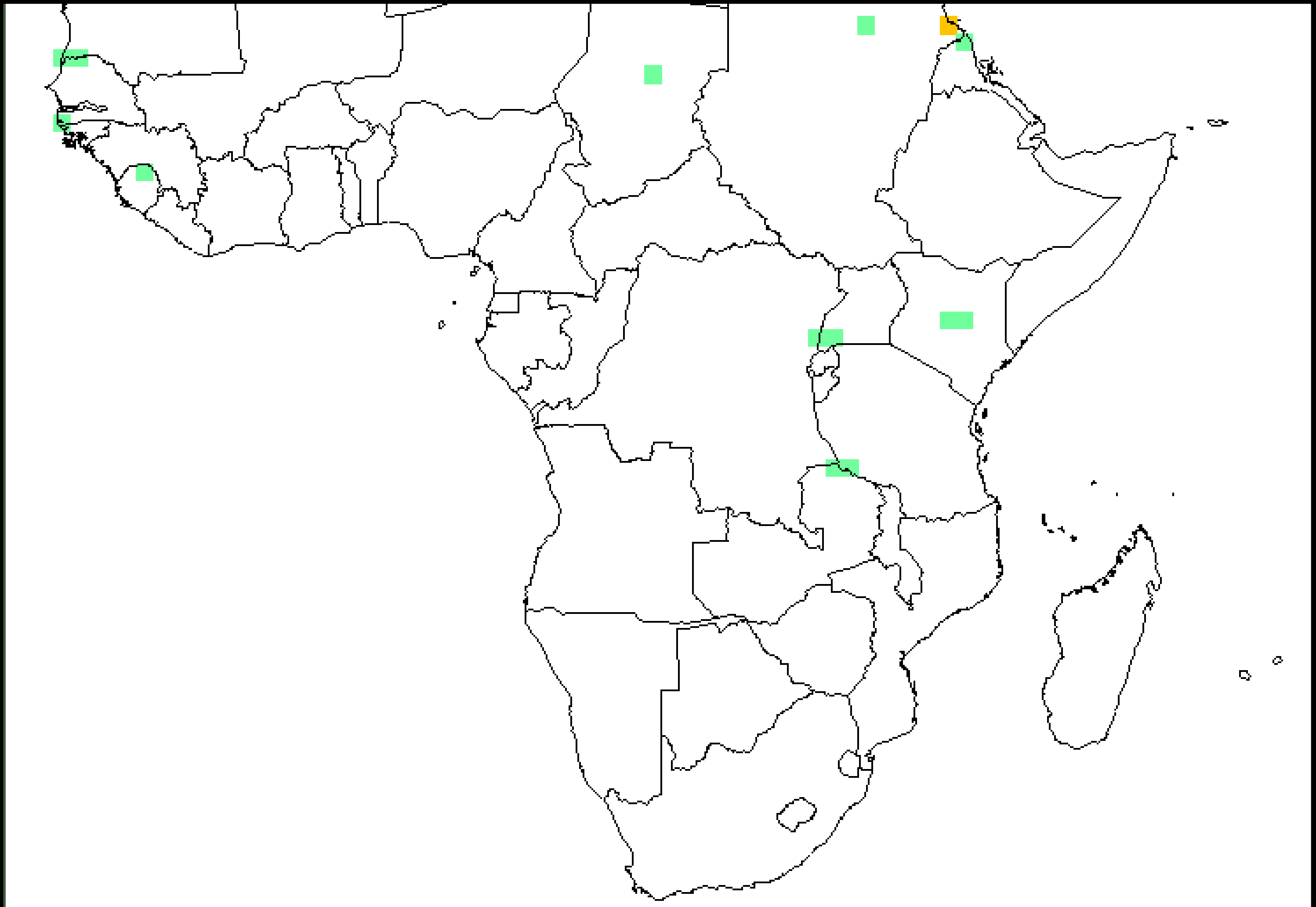
Walther *et al*. (unpublished)

Near-minimum set
(1 representation of each taxon)



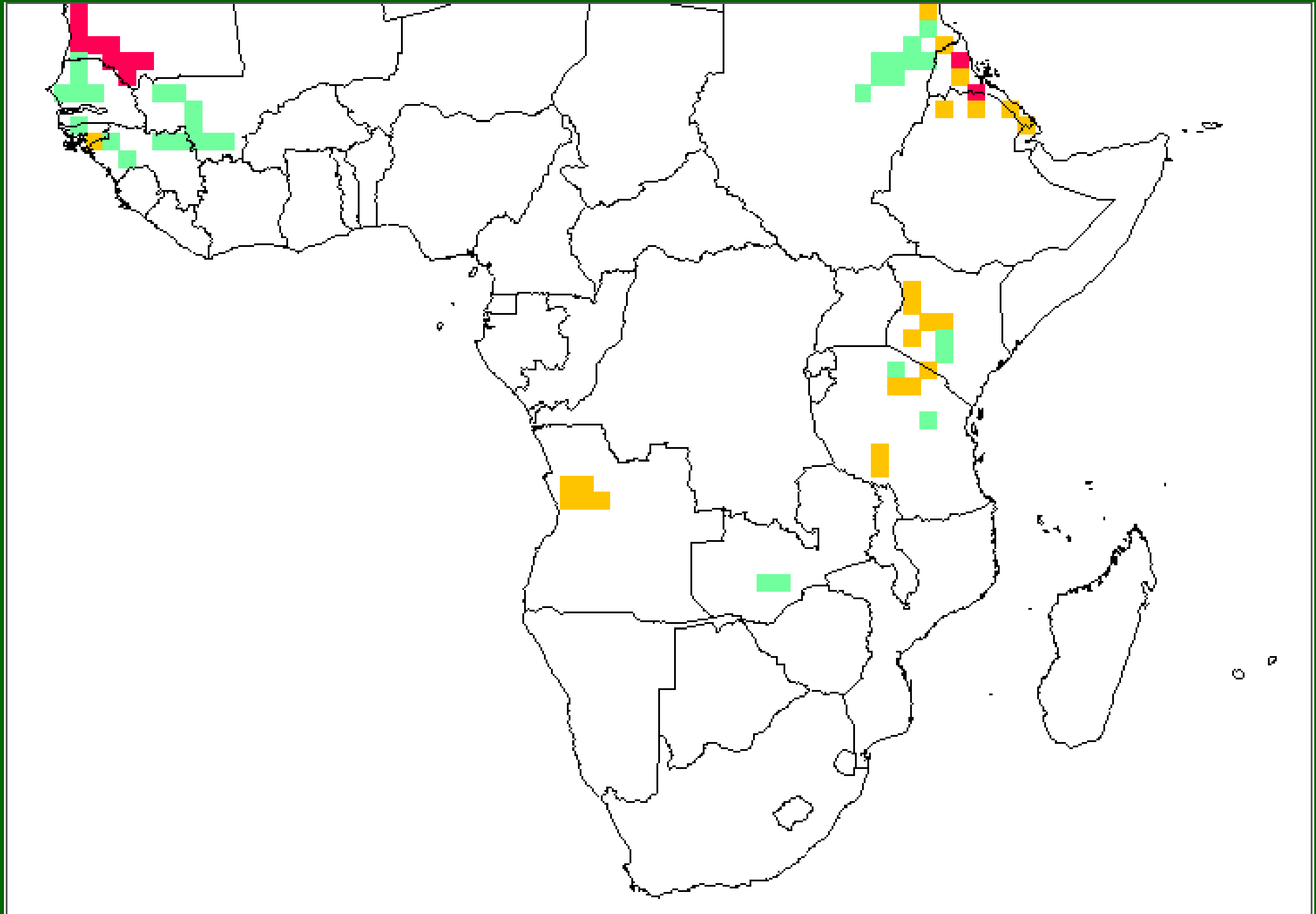
Walther *et al*. (unpublished)

Near-minimum set
(2 representations of each taxon)



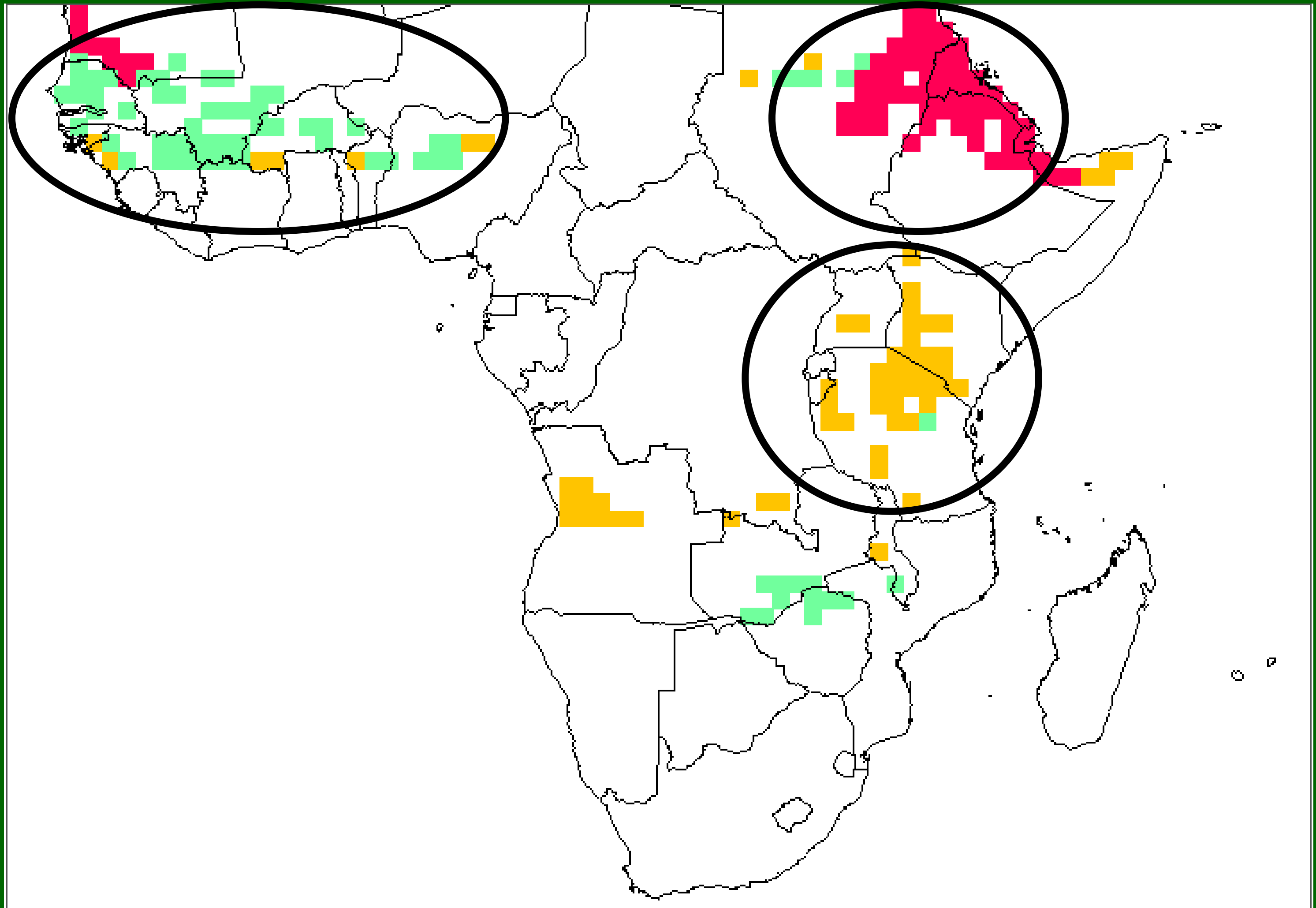
Walther *et al*. (unpublished)

Near-minimum set
(10 representations of each taxon)



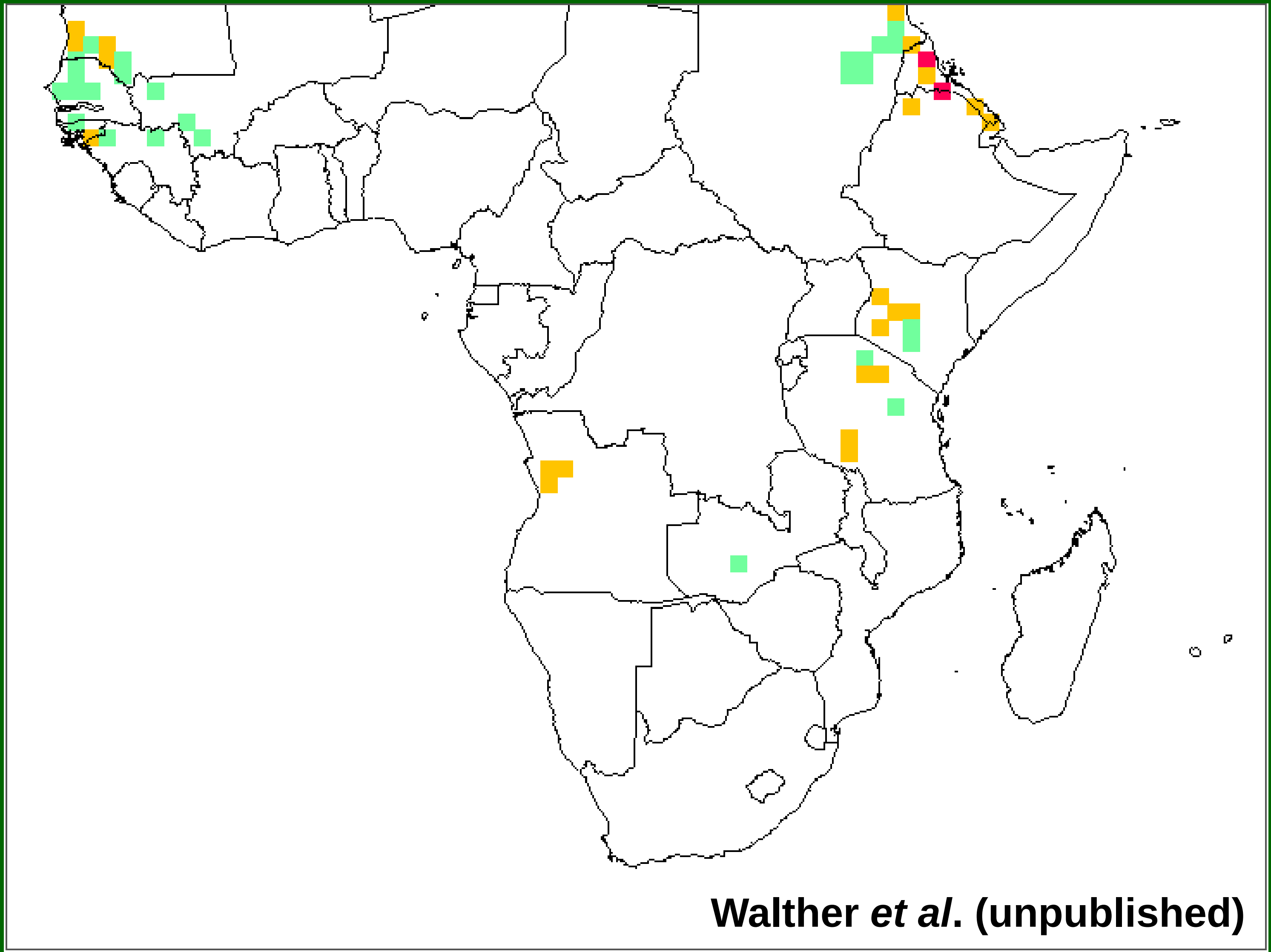
Walther *et al*. (unpublished)

Near-minimum set
(30 representations of each taxon)

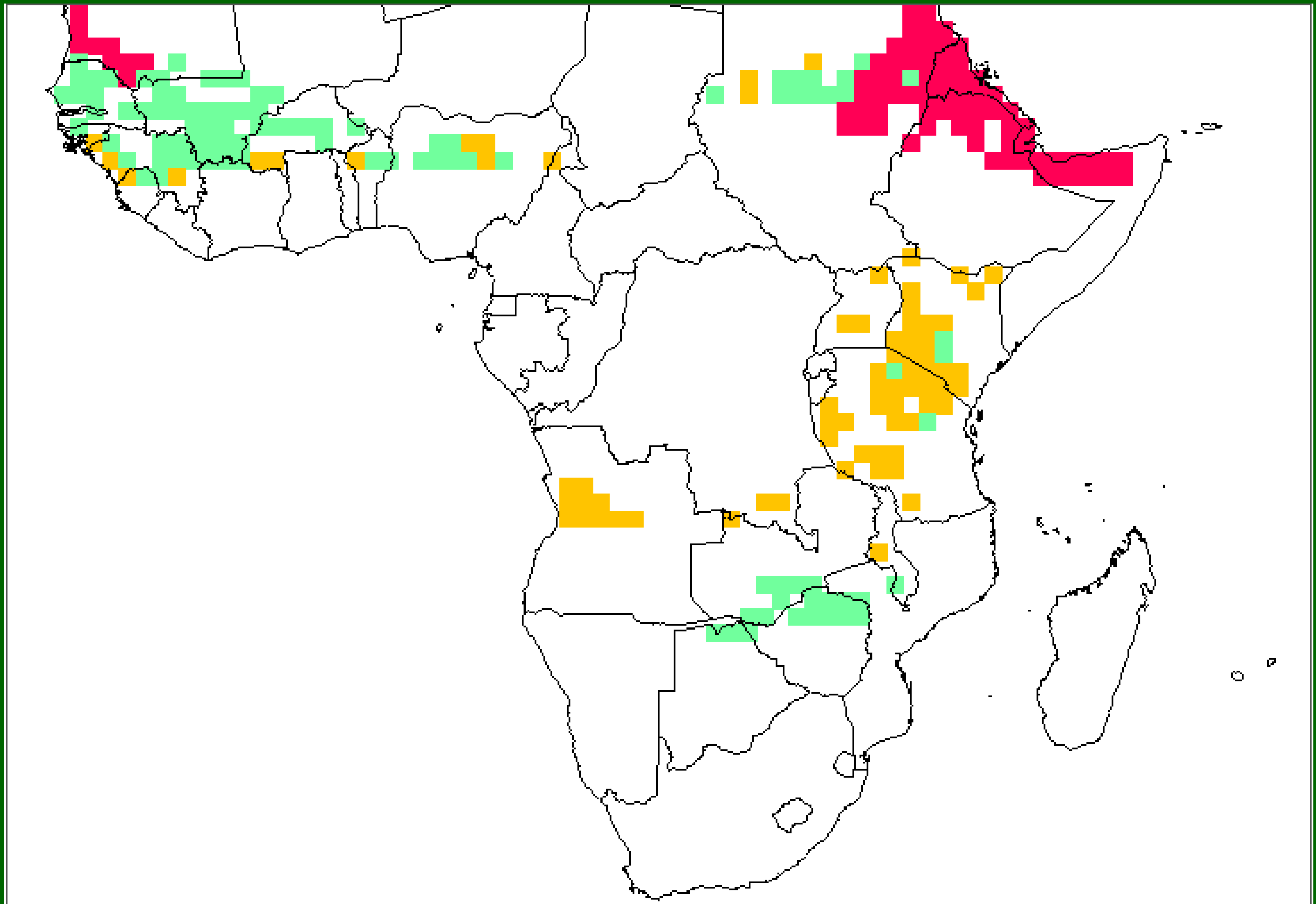


Walther *et al*. (unpublished)

Near-maximum-coverage set (50 representations of each taxon)

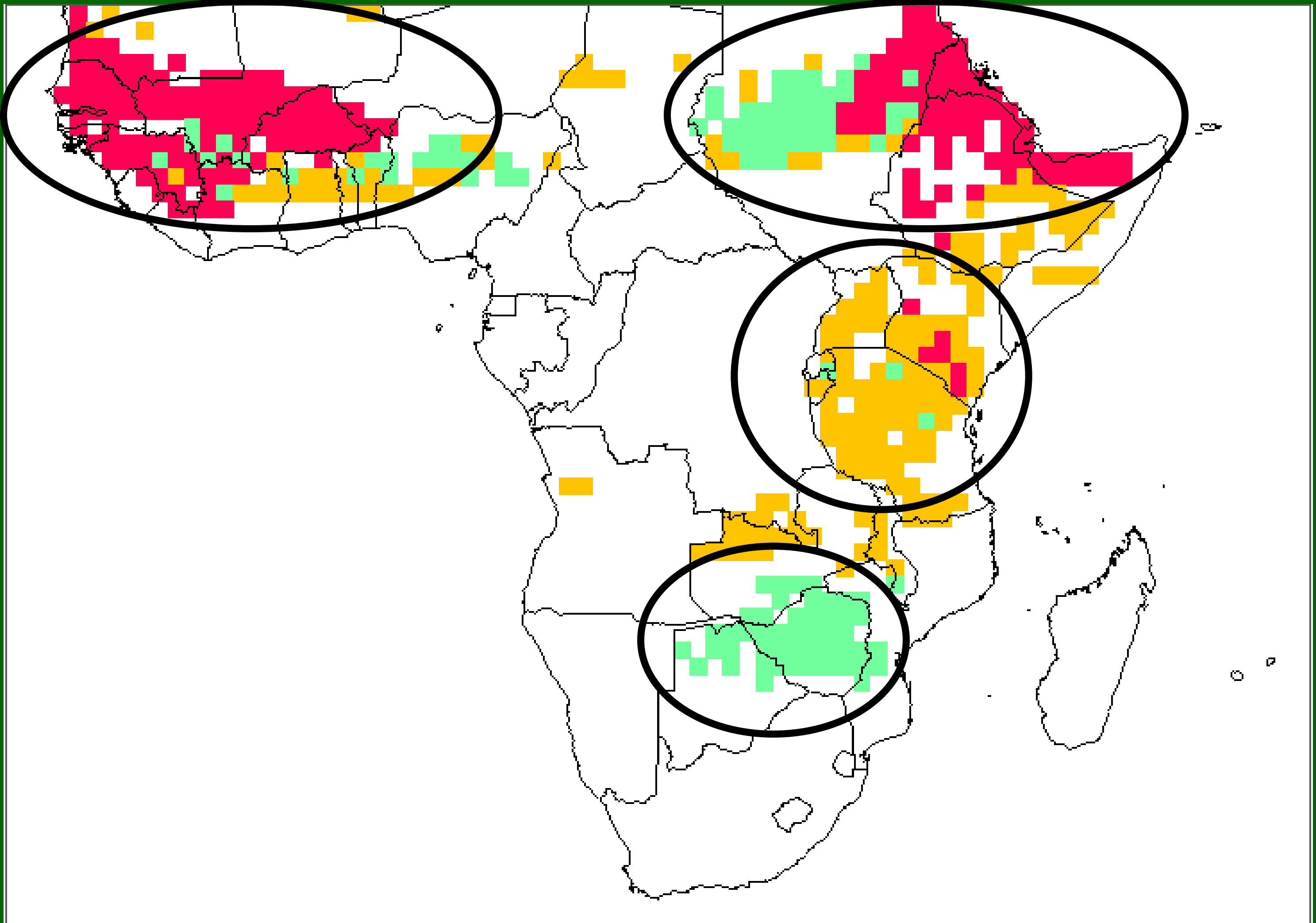


Near-maximum-coverage set (250 representations of each taxon)



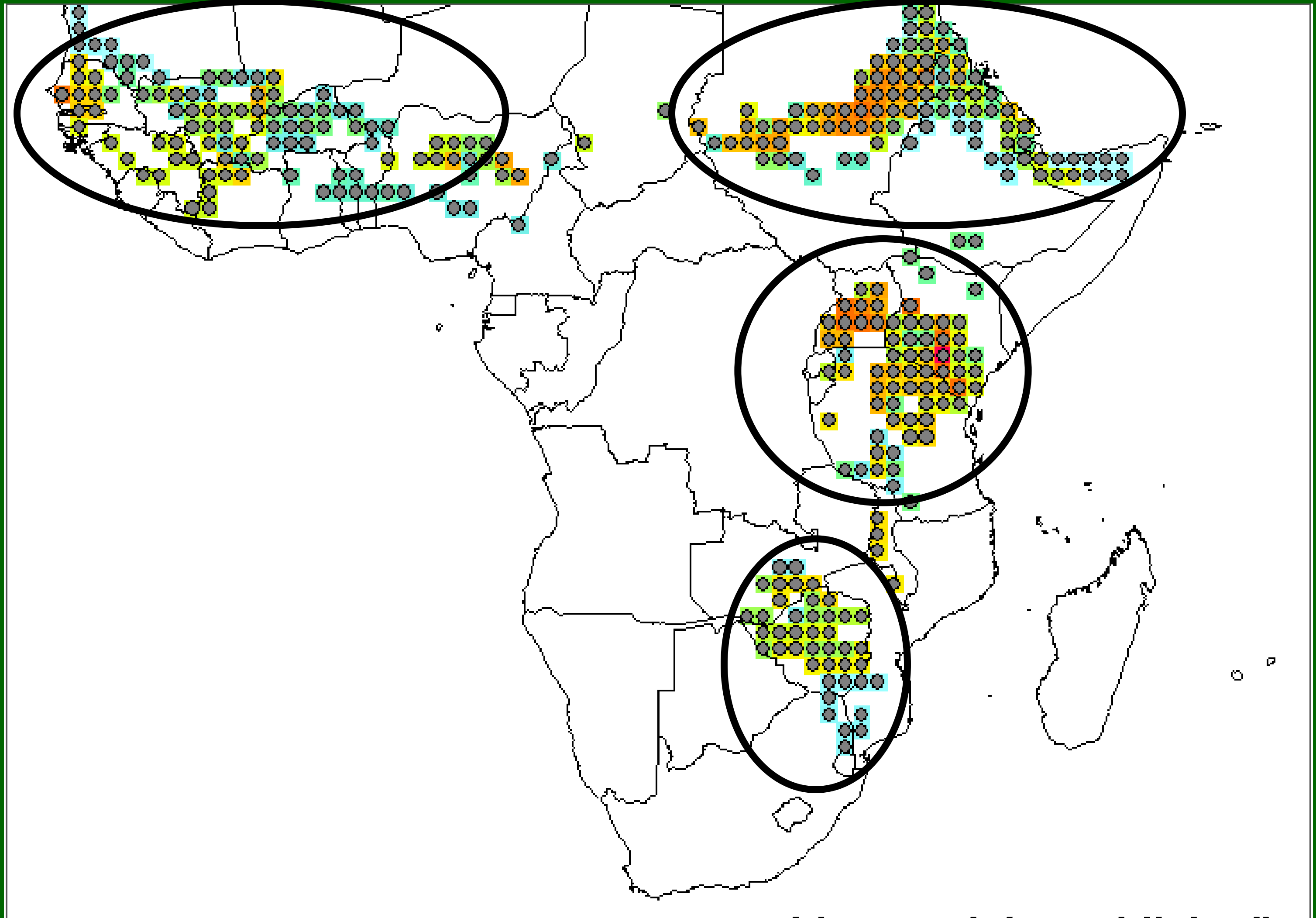
Walther *et al*. (unpublished)

Near-maximum-coverage set (500 representations of each taxon)



Walther *et al*. (unpublished)

Greedy set
(50 representations of each taxon)

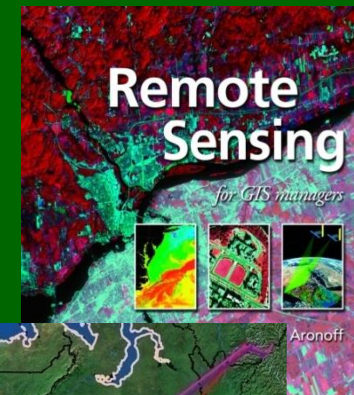


Walther *et al*. (unpublished)

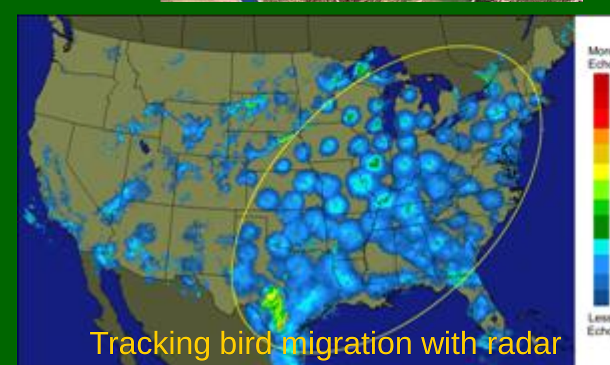
Integration of novel monitoring techniques with databases, remote sensing and geographic information systems

Swainson's Thrush

Remote control camera



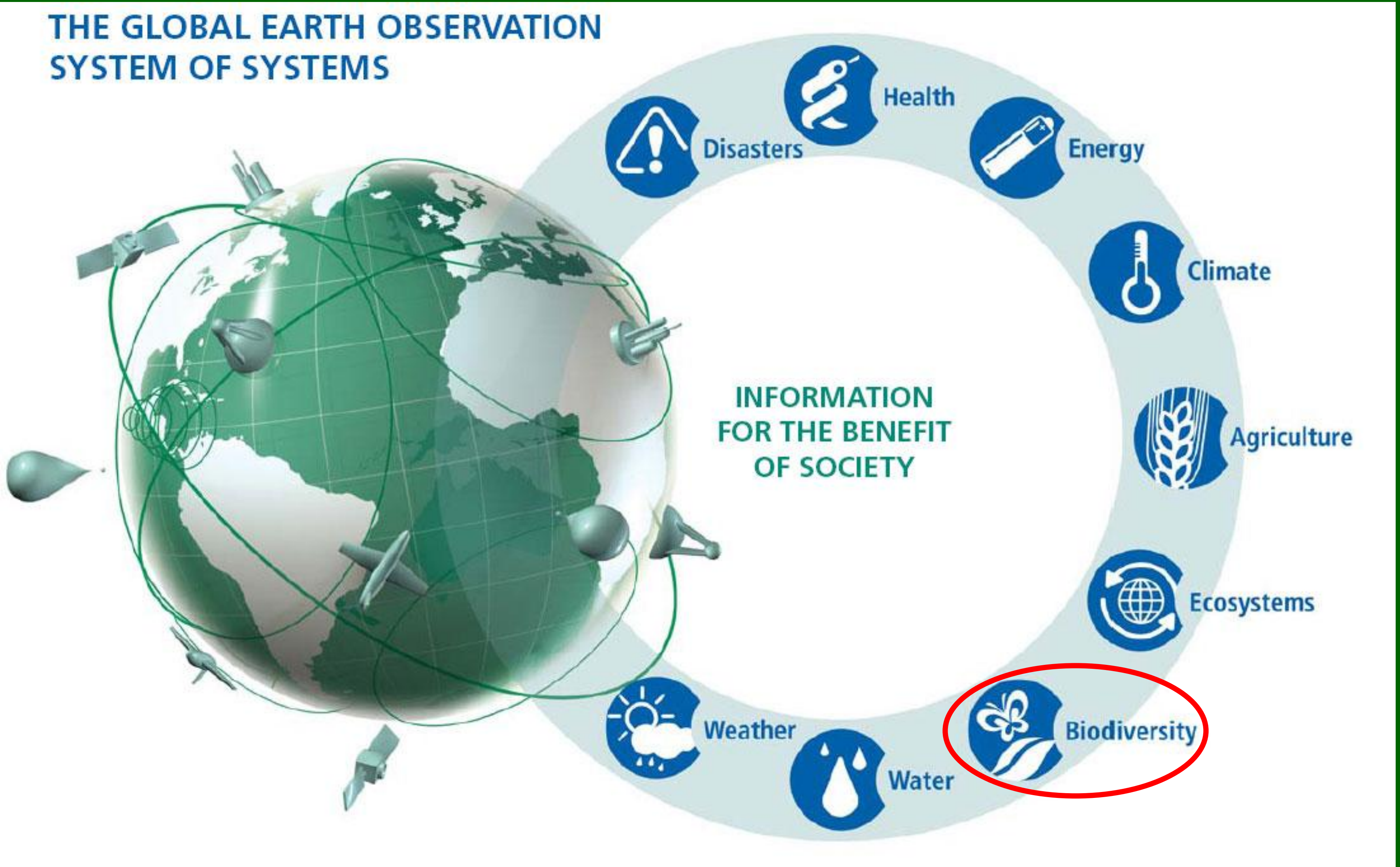
Lesser White-fronted Goose



Tracking bird migration with radar

The context of GEO BON

GEOSS addresses nine Societal Benefit Areas



Allows internet users to enter as well as download for observations of Palearctic migrants in Africa

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Database of Western Palearctic birds migrating within Africa to guide conservation decisions

*Principal Investigators: **Bruno Walther** and Carsten Rahbek*

The conservation of migratory bird species poses special problems associated with their annual movements which often span continents because species survival is dependent on the conservation of not only breeding grounds, but also stop-over sites and wintering grounds. For the over 300 species breeding in the Western Palearctic region which migrate to their African wintering grounds (see species list), we know their breeding grounds and principal migration routes through Europe and the Mediterranean quite well, but knowledge concerning the distribution of these migrants in Africa is still fragmentary (Walther & Rahbek 2002). However, such information is essential for the successful conservation of Palearctic migratory birds which are essentially African and European birds.

Therefore, this research project provides a database on the geographical distribution of Western Palearctic migratory birds in Africa. The information in this database will hopefully enhance our understanding of the whereabouts of migrants in Africa as well as to guide conservation decisions.

The data is a collection of various published and unpublished sources (e.g. museum specimens, grey literature, personal communications, etc.). The user can search the database as well as enter new data into the database. All point-locality data are geo-referenced with decimal coordinates, so that they can be easily displayed with any GIS software (e.g. ArcInfo, Idrisi, DIVA, etc.).

Internet

Thank you!

Our studies can be downloaded from my webpage **www.bruno-walther.de**