Avian influenza and the movement ecology of southern African waterbirds

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Outline

1. Introduction

2. Avian Influenza results

3. Movement ecology of ducks

Introduction

Waterbird communities (and those of their parasites & pathogens) are diverse, highly mobile, poorly understood.

Waterbird community ecology influences parasite & pathogen community - how?

Relevance for conservation and management of waterbirds, and for human health?

Focal Questions

Role of environment: are particular habitats less healthy? Valley of death?

Role of bird community: are particular communities, species, or individuals sicker? Typhoid Mary? Does diversity of hosts enhance or reduce opportunities for parasites and pathogens?

Relevance of movement: Does high mobility of waterbirds (and consequences for contact rates, transmission, immune competence, parasite dispersal, etc.) matter? Moving target?

Avian Influenza Virus

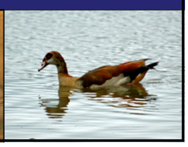
Anatidae (ducks, geese and swans) considered natural reservoir for LPAI

No true indigenous geese or swans in southern Africa

16 Afrotropical duck species in the sub-region

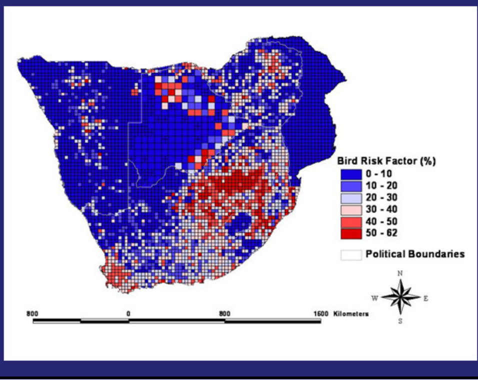
Photo: Callie de Wet

Photo: E.G.Peiker



Species	Range	Abundance	Mobility	Roost	Mixed Flocks	Foraging	Anthro assoc	Risk
Fulvous Duck	2	2.3	3.8	4.3	2.9	3.2	2.8	61
White-faced Duck	2.6	4.4	3.8	4.5	2.9	4.2	3.6	74
White-backed Duck	1	1.5	3	4.5	2.5	2	3	50
Maccoa Duck	2.2	2.3	2.8	3	2.2	1	3.3	48
Egyptian Goose	4.2	5	3.7	5	3.1	5	4.7	87
South African Shelduck	2.8	3.5	3.2	4	2.7	4.3	3.5	69
Spur-winged Goose	3	4	3.3	4	3	5	4	75
Comb Duck	2.2	3.5	5	4	2.6	4.2	2.8	69
African Pygmy-Goose	1.5	2.1	2.9	3	1.8	1.8	2.2	44
Cape Teal	2.9	3.8	3.8	3.7	3	2.7	3.5	67
African Black Duck	3.1	3.2	1.6	1.6	1.2	2.8	2	44
Yellow-billed Duck	3.1	4.4	3.8	4	2.8	3.8	4	74
Cape Shoveler	2.2	3.4	4	4.2	3.2	3	3.8	68
Red-billed Teal	3.5	4.5	4.8	4.5	3.33	3.7	3.9	81
Hottentot Teal	2	3.2	2.8	3.3	2.4	3	2.8	56
Southern Pochard	3	3.2	5	4	2.6	1	3.1	63

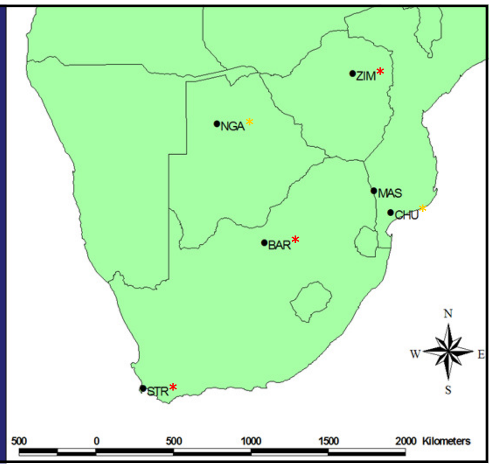
Summed Duck Risk Factors



SA-GAINS Study Sites

*Sampled every 2 months for 2 years

*Sampled every 4 months for 2 years



Catching ducks

Flightless moult

Flightless moult

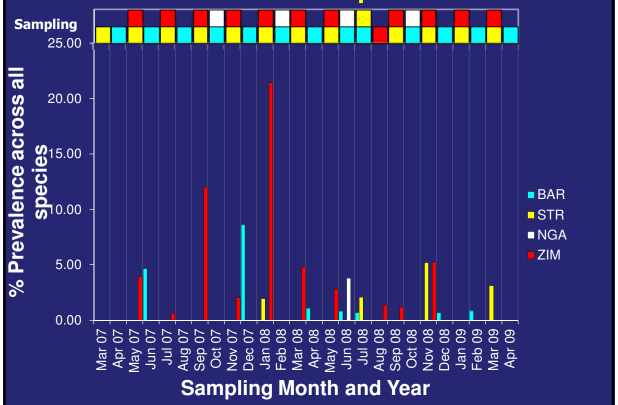
Facts and Figures

- 5 Sites, 42 two-week sampling missions in two years
- 4,977 birds of 165 species captured, ringed, sampled
- 1,252 hours of standardized point counts
- 47 birds tracked with satellite GPS
- 88 field assistants trained in handling, sampling and ringing techniques
- Collaborations: CIRAD and BLZ in Harare, OVI (Pretoria), IZSVe in Italy, Kalahari Conservation Society, BLB, Mozambican Vet Services

Results

- 125 birds positive for Avian Influenza viruses; overall prevalence 2.51%
- No H5N1 detected
- Potentially virulent (notifiable) strains of H5 and H7 were detected
- Strong differences between taxonomic groups, locations, and time of year
- Extremely high variability system

Results: Influenza prevalence

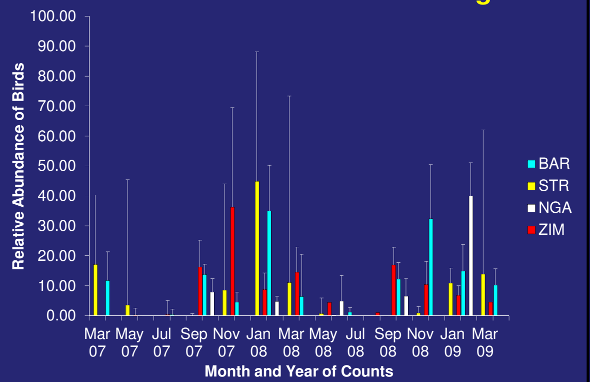


Results

Highest prevalences by family/sf in:

- Alaudidae (larks, n=24, 3 positives, 12.5% prevalence)
- Dendrocygninae (whistling ducks, n=234, 12 positives, 5.15%)
- Scolopacidae (sandpipers and snipes, n=180, 6 positives, 3.33%),
- Jacanidae (jacanas, n=492, 15 positives, 3.05%),
- Ploceidae (weavers, n=165, 5 positives, 3.03%),
- Charadriidae (plovers and lapwings; n=458, 12 positives, 2.62%)
- Anatidae (ducks; n=2168, 52 positives, 2.4%).

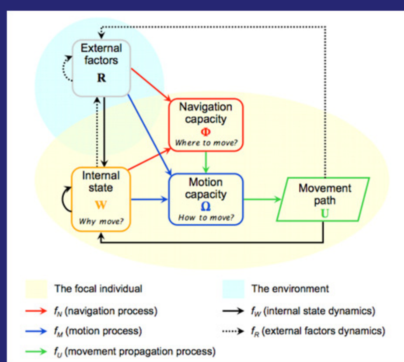
Relative Abundance of Palearctic Migrants



Results

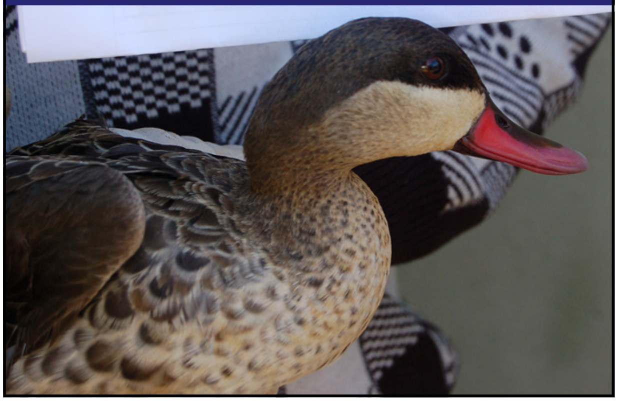
- We recorded 32,153 individuals belonging to 32 different Palearctic migrant species from 12 avian families
- BUT comparing across sampling missions gave NO significant relationship to viral prevalence (Spearman's r=0.039, p<0.8, n=42).
- Viral prevalence also independent of anatid duck numbers (Spearman's r=-0.1, p<0.5, n=42)

Movement: central to the problem

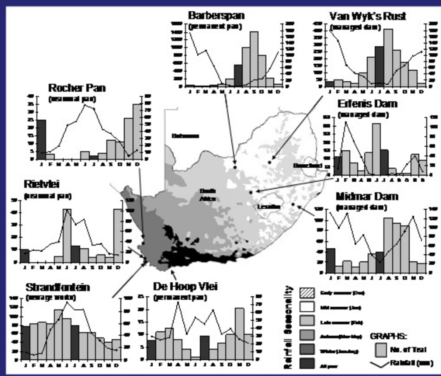


Nathan et al., PNAS 2008: A movement ecology paradigm for unifying organismal movement research

Red-billed teal

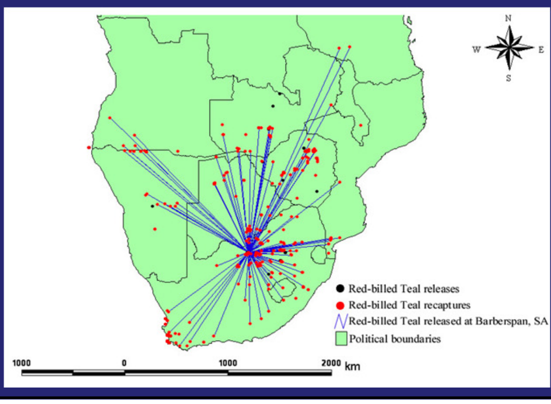


Red-billed teal numbers

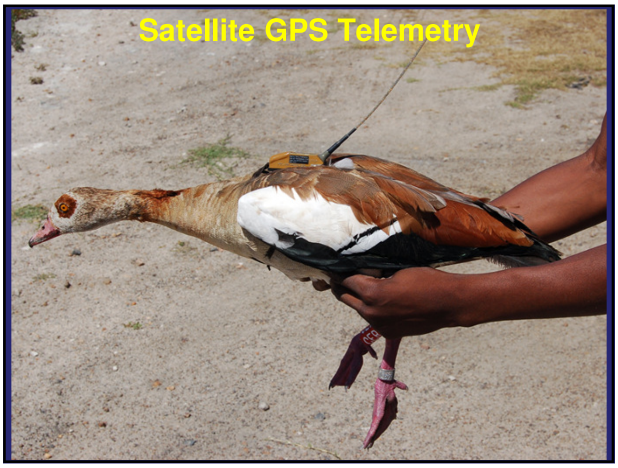


Map: Hannah Thomas, MSc thesis

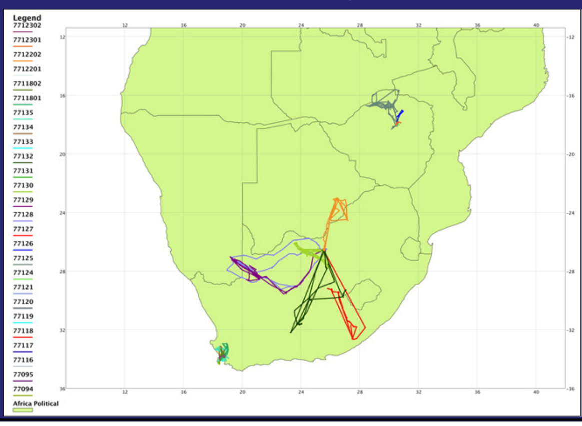
Red-billed teal movements



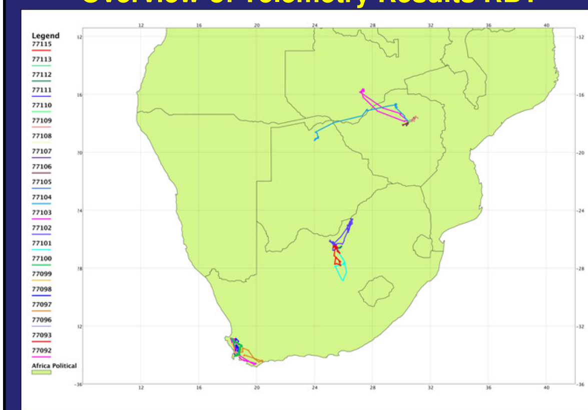
Satellite GPS Telemetry



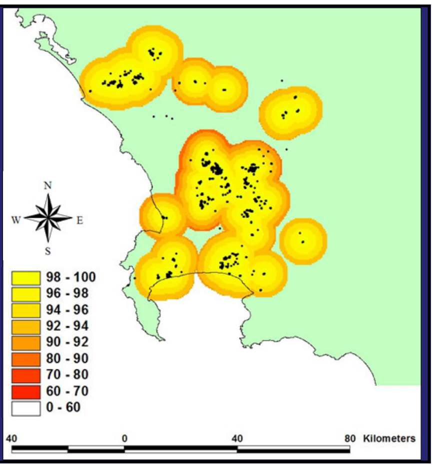
Overview of Telemetry Results EG



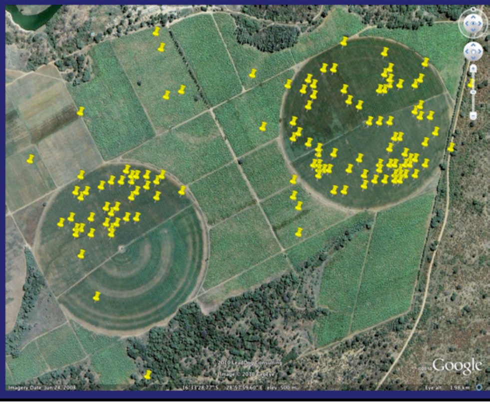
Overview of Telemetry Results RBT



Medium scale: polycentric home range



Fine scale: clear habitat preferences

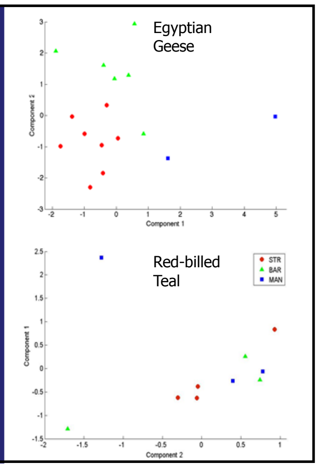


Latitudinal Comparison

Movement paths compared between three sites using MANOVA on path-related variables extracted from movement data (e.g., rates, angles, autocorrelation).

Egyptian Geese p<0.0004

Red-Billed Teal NS



Conclusions

- Avian influenza prevalence in southern Africa is LOW
- Variation in LPAI is HIGH (both space and time)
- Causes of variation in bird community composition poorly understood
- Water bird movements – especially as driven by rainfall and life histories - are of central importance in avian influenza epidemiology
- Problem is multi-scale in nature and we don't yet understand interactions between fine- and broad-scale dynamics

Recent Publications

Cumming, G. S., Caron, A., Abolnik, C., Cattoli, G., Bruinzeel, L. W., Burger, C. E., Cecchettin, K., Chiweshe, N., Mochotlhoane, B., Mutumi, G. L., and Ndlovu, M. (2011). The ecology of influenza A viruses in wild birds in southern Africa. EcoHealth XX:xx-xx. (on line first, DOI: 10.1007/s10393-011-0684-z).

Abolnik, C., G. H. Gerdes, M. Sinclair, B.W. Ganzevoort, J. P. Kitching, C. E. Burger, M. Romito, M. Dreyer, S. Swanepoel, G. S. Cumming, and A. J. Olivier (2010). Phylogenetic analysis of influenza A viruses (H6N8, H1N8, H4N2, H9N2, H10N7) isolated from wild birds, ducks and ostriches in South Africa from 2007 to 2009. Avian Diseases 54: 313-322.

Caron, A., Abolnik, C., Mundava, J., Gaidet, N. Burger, C.E., Mochotlhoane, B., Bruinzeel, L., Chiweshe, N., Garine-Wichatitsky, M. de & Cumming, G.S. (2010.) Persistence of low pathogenic avian influenza virus in waterfowl in a Southern African ecosystem. EcoHealth.

Caron, A., De Garine-Wichatitsky, M. Gaidet, N., Chiweshe, N. and Cumming, G. S. (2010). Estimating dynamic risk factors for pathogen transmission using community-level bird census data at the wildlife/domestic interface. Ecology and Society 15(3): 25. [URL: http://www.ecologyandsociety.org/vol15/iss3/art25/]

Cumming, G. S. (2010). Risk mapping for avian influenza: a social-ecological problem. Ecology and Society15(3): 32. [URL: http://www.ecologyandsociety.org/vol15/iss3/art32/]

Cumming, G.S., Hockey, P.A.R., Bruinzeel, L.W., and Du Plessis, M.A. (2008). Wild bird movements and avian influenza risk mapping in southern Africa. Ecology and Society 13(2): 26. [online] URL: http://www.ecologyandsociety.org/vol13/iss2/art26/.

Ndlovu, M., Cumming, G. S., Hockey, P. A. R., and Bruinzeel, L. (2010). Phenotypic flexibility of a Southern African duck during moult: do northern hemisphere paradigms apply? Journal of Avian Biology 41: 558-564.

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IZSVe: support from the Italian Ministry of Health and a grant from the Food and Agriculture Organization of the United Nations (FAO).
Cirad: "Mesures d'Urgence" and GRIPAVI projects funded by the French Ministry of Foreign Affairs and the scientific and logistical support of the Research Platform Produce and Conserve in Partnership (RP-PCP).