Wild birds: specificities and study methods

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Kick-Off Meeting GRIPAVI

General understanding: AIV host ecology

✓ **Large diversity of host:** LPAI isolated from **105 wild birds species** (26 bird families)

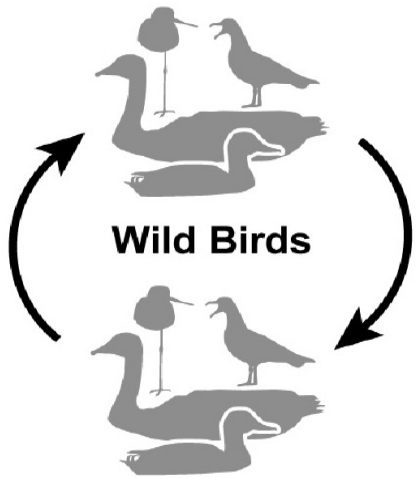
✓ **Wildfowl** (ducks, swans and geese) and **shorebirds** (gulls, terns and waders) = major natural reservoirs of AIV:

- distributed globally (except most arid regions)
- generally long-distance migratory birds

✓ Prevalence LPAI: ducks > swans > gulls > waders > other waterbirds > other birds

General understanding: AIV host ecology

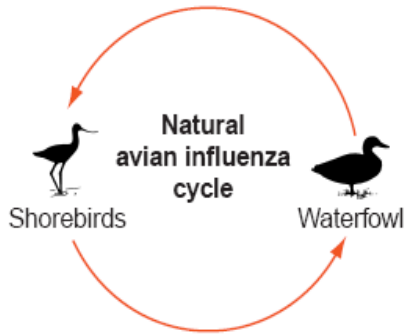
- ✓ **All AIV subtypes** and most HA/NA combinations detected in wild birds
- ✓ Wild aquatic birds harbour all influenza A viruses found in other species
- ✓Generally **unapparent infection**
- ✓**Simultaneous occurrence of various AIV** within groups of birds or within single bird → Ideal situation for reassortment & formation of novel virus



Year-round prevalence observed in wild birds

→ mechanisms for perpetuations?

- **Persistence in frozen wetlands** where migratory birds nest?
  - ✓ isolates from water in Siberia and Alaska (*Zhang et al., 2006*)
- **Continuous circulation in subtropical and tropical regions?**
- **Persistence in ducks alone?** continual low level transmission among ducks?
- Interchange of AIV among bird of various families sharing wetlands:
  - ✓ Difference in prevalence → **shorebirds - duck link** hypothesis?
  - ✓ Limited genetic differentiation → **inter species transmission** ?



HPAI host ecology

- AIV with pathogenic potential: H5, H7, H9 (H3, H6) (Webster, 2006)

- Until recently, HPAI viruses had been isolated rarely from wild birds
  - ✓ apart from tern/S. Africa/61: HPAI H5N3

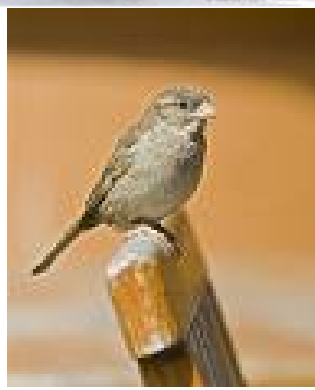
- Usually found in dead or sick wild birds
  - ✓ usually found close to known outbreaks in poultry

- Surveillance in clinically normal wild birds detected no HPAI H5N1viruses
  - ✓ apart from 6 wild ducks in China HPAI H5N1 / 4674 tested (Chen et al., 2005)

→ No wild reservoir has been yet identified for HPAI viruses







Bridge species

✓ H5N1 HPAI have been isolated in **several peri-domestic species**: dead pigeons, crows, mynah, and sparrows (e.g. *Ellis et al., 2004*)

✓ **Experimental infections** on starlings and house sparrows with Hong Kong–origin H5N1 showed relative resistance (*Perkins & Swayne 2003*)

✓ **Healthy tree sparrows** in China harbored and excreted H5N1 HPAI: highly pathogenic for chickens but not for domestic ducks (*Kou et al., 2005*)

✓Chinese scientists reported H5N1 HPAI in **healthy house sparrows**

✓ **Hooded vultures** in Burkina Faso (2006) dead/sick - positive H5N1 HPAI (n=17) (*Ducatez et al., 2007*)

✓ **Daurian Starling** (bird market HK) droppings tested positive - no symptoms of bird flu!

→ **Role of bridge species in virus transmission unclear**

A knowledge gap in the ecology of IAV in tropical regions

Conditions and patterns of AIV circulation in tropical regions?

- ✓ Can AIV persists in tropical ecosystem ? in wild bird populations ?
- ✓ How is it maintained in tropical ecosystem ?
- ✓ How is it transmitted between wild and domestic birds ?

Large-scale wild bird surveillance program in Africa

TCP FAO: Evaluate the AIV carriage, in particular HPAI, among wild bird populations

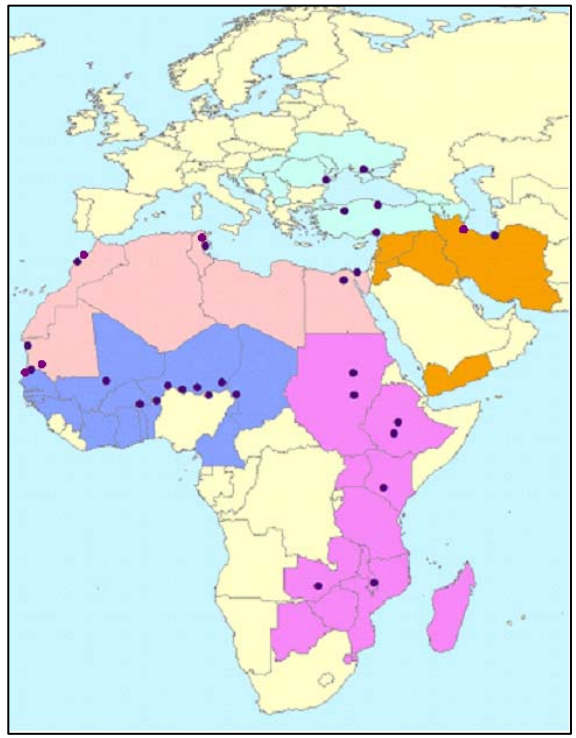
> 17,500 samples collected in 19 countries, >12,000 birds tested

<u>Preliminary results</u>:

→ no positivity for H5N1 has been detected so far

→ LPAI virus detection (RT-PCR gene M): 2 %

→ Virus isolation: 12 isolates obtained so far …



New insights on the host ecology of AI virus in tropical regions

✓ LPAI virus have been detected and isolated in wild birds in several major wetlands of Northern, Western and Eastern Africa

→ **Environmental conditions in Afro-tropical ecosystems are favourable to the persistence and transmission of AIV**

Eurasian migratory birds:

→ AIV can persist in wild duck populations all year round through a continuous circulation – potential for transmission

→ New detection in waders

Afro-tropical species:

→ potential persistence of IAV in the African ecosystems

→ potential dissemination over Africa through intra-African migratory birds

New insights on the host ecology of AI virus in tropical regions

✓ Type A+ prevalence in Eurasian migratory ducks in West Africa (6.6%) similar to European survey in winter (*Wallenstein et al., 2007*)

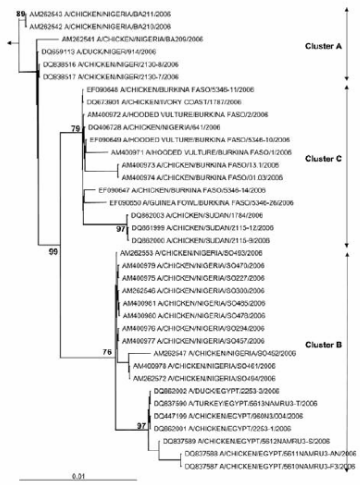
✓ Virus isolation rate very low: 4.5% (isolate / RT-PCR+) while in Europe = 20 to 50%

→ few subtypes characterized and few strain available for phylogeny

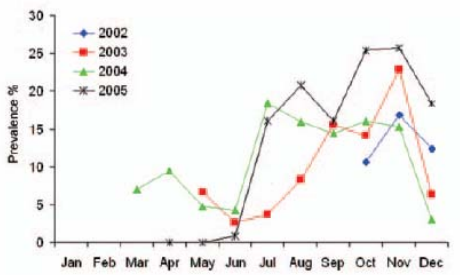
Which variable to monitor? Which data to expect?

Molecular characterisation > sub-type Identification > A+ prevalence > seroprevalence

Phylogenetic analysis > HI, NI test > RT-PCR > serology



Subtype	N1	N2	N3	N4	N5	N6	N7	N8	N9	Total
H1	6.0	1.2				0.3	0.3	0.3		8.1
H2	0.6	0.3	4.2		0.6		0.6		1.5	7.8
H3		0.6	0.3		0.3	2.1		6.3		9.6
H4		1.5	0.6			**13.6**			0.3	16.0
H5		3.0	1.8			0.3			2.4	7.5
H6	1.8	**9.9**	0.3		0.3	0.3		5.1		17.8
H7			0.3				**10.5**		0.3	11.1
H8				1.8						1.8
H9		1.5								1.5
H10		0.9		0.3	0.3	0.6	1.2	0.6	0.9	4.8
H11	0.3	0.9	1.5			0.3	0.3	0.6	4.8	8.7
H12					1.2			0.3	0.6	2.1
H13						0.3		1.5		1.8
H16			1.2							1.2
Total	8.7	19.9	10.2	2.1	2.7	17.8	13.0	14.8	10.8	



Order	Family	Species	*n* Samples
Sphenisciformes	Spheniscidae	3	190
Procellariiformes	Procellariidae	1	107
Pelicaniformes	Pelecanidae	1	64
	Phalacrocoracidae	2	1,202
Anseriformes	Anatidae	28	20,901
Falconiformes	Accipitridae	5	70
Galliformes	Phasianidae	10	50
Gruiformes	Rallidae	3	1,029
Charadriiformes	Alcidae	4	907
	Laridae	11	4,099
	Scolopacidae	36	2,754
	Haematopodiae	3	109
	Charadriidae	8	296
Columbiformes	Columbidae	7	109
Passeriformes	Sylviidae	25	1,138
	Alaudidae	3	177
	Turdidae	10	939
	Estrildidae	13	211
	Emberizidae	11	121
	Paridae	9	400
	Corvidae	7	57
	Motacillidae	8	204
	Prunellidae	1	123
	Sturnidae	4	220
	Muscicapidae	17	204
	Timaliidae	2	188
	Ploceidae	9	178
	Pycnonotidae	5	97
	Regulidae	2	195
	Troglodytidae	1	88
8 other orders	35 other families	74	382
Total: 18	65	323	36,809

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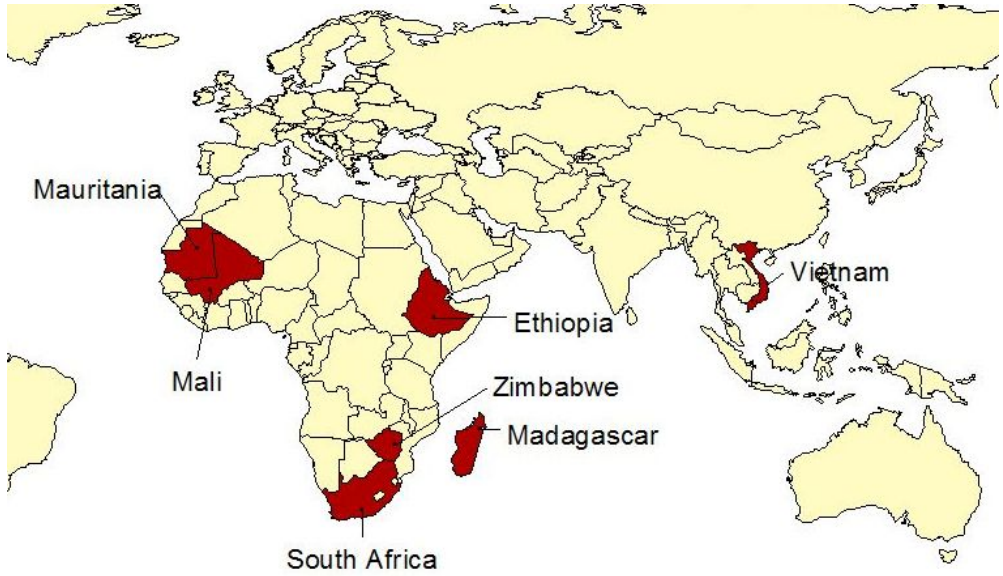
6 observatories:



→ Specific protocols for specific questions in each observatory according to the local context

→ Shared protocols for generic questions through comparison between observatories

Conditions and patterns of AIV circulation in tropical regions?

✓ Is there a seasonal pattern in prevalence of AIV in wild birds in tropical ecosystems?

✓ Is there a geographical / latitudinal variation in prevalence of AIV in wild birds?

✓ What are the variations in prevalence of AIV between different wild birds groups?

→ Complementary bird groups?

→ Specific role of waders in virus maintenance in the tropics?

✓ Are there any bridge species that allows the maintenance and dissemination of AIV?





A bird reservoir community

Migratory Waterbirds

Domestic Birds

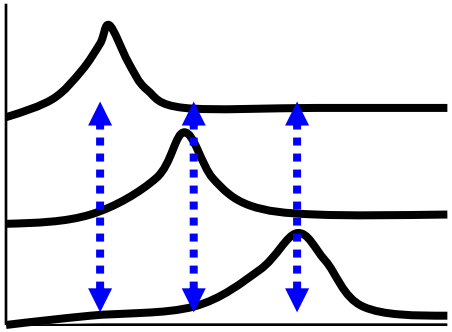
Sedentary Waterbirds

Peri-domestic Wild Birds

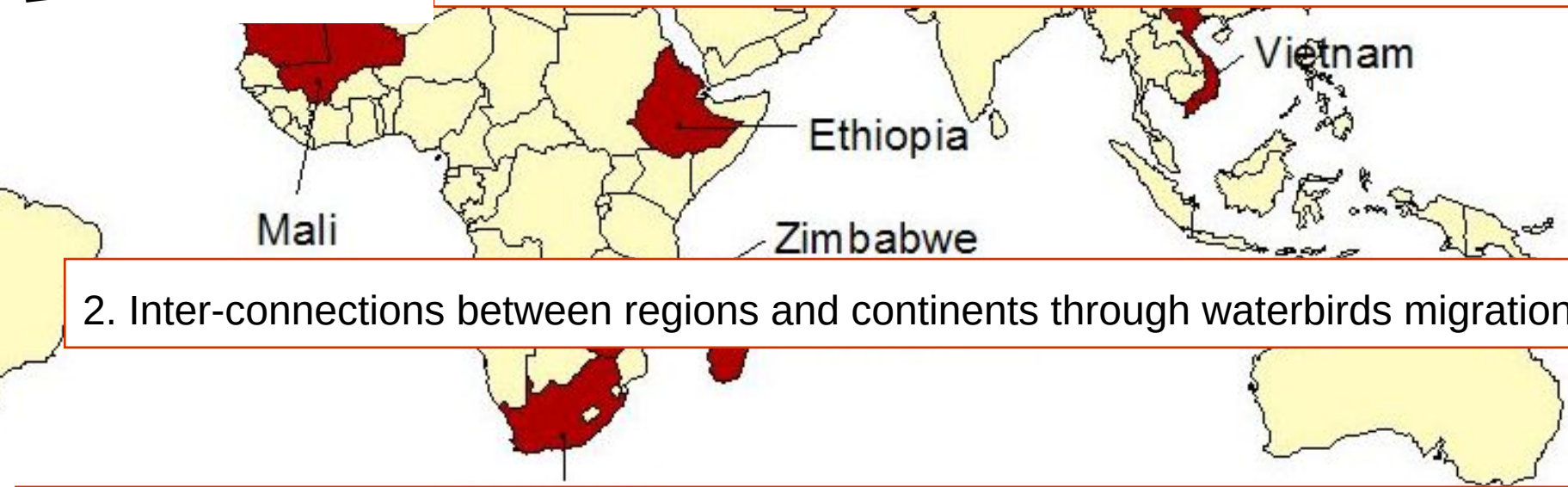




1. Complementary networking – timing asynchrony between regions in:



- ✓ Environmental conditions (wet / dry seasons)
- ✓ Wild bird community composition (sedentary / migratory birds)
- ✓ Timing of breeding season (production of young immunologically naïve birds)



2. Inter-connections between regions and continents through waterbirds migration

→ **Mechanism of maintenance, dissemination and reassortment of AIV in nature**


Merci, Thank you