"Regards Croisés" sur l'Influenza aviaire

15-19 / 12 / 2008 • Montpellier • France

Rencontres scientifiques autour de deux projets de recherche :
Scientific meeting around two research projects:
GRIPAVI (CIRAD, MAEE) & ARDIGRIP (AIRD)

Ecology of Avian Influenza Viruses in Afro tropical wild bird populations

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http://avian-influenza.cirad.fr/

Ecology of Avian Influenza Viruses in Wild Bird Populations

HPAI responsible for high mortality in domestic birds do not have a recognised wild bird reservoir

✓ **Before H5N1**, **HPAI viruses had been very rarely detected in wild birds**

- tern/S. Africa/61: HPAI H5N3
- few cases in terrestrial birds associated with poultry outbreaks

✓ Prior 2002, HPAI viruses **were not pathogenic in waterbirds**

✓ **HPAI H5N1** : since 2002, isolated from over **75 species** of wild birds in 38 countries

→ usually found in **dead or sick wild birds**

Ecology of Avian Influenza Viruses in Wild Bird Populations

Origin of HPAI viruses

• A proposed mechanism: considered to **emerge** by mutation **from wild type-LPAI** viruses once introduced and adapted into gallinaceous poultry (Alexander, 2000)

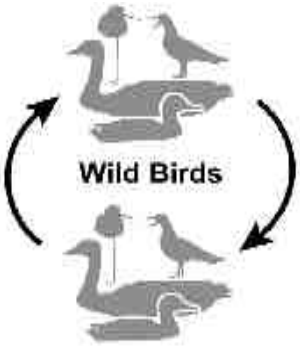
• This theory is supported by:

✓ phylogenetic analysis that demonstrated **shared phylogenetic sub lineages** among LPAI and HPAI (Banks et al., 2000)

✓ identified **precursors** of most HPAI viruses of poultry **in wild ducks** (Campitelli et al., 2004; Munster et al., 2004).

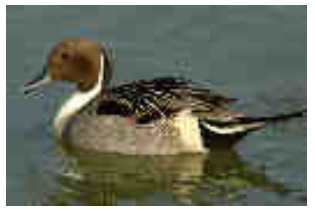
Ecology of Avian Influenza Viruses in Wild Bird Populations

LPAI host ecology



• **Large diversity of hosts:** LPAI isolated from >100 wild birds species (26 families)

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



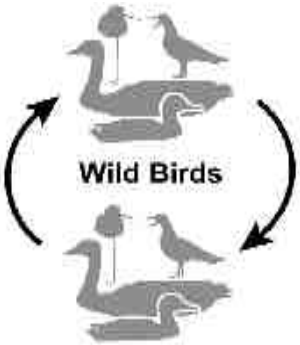
✓ Locally / seasonally high prevalence (up to 40%)

✓ **Wildfowl** and **shorebirds** are distributed globally (except most arid regions)

✓ Generally long-distance migratory birds

Ecology of Avian Influenza Viruses in Wild Bird Populations

LPAI host ecology



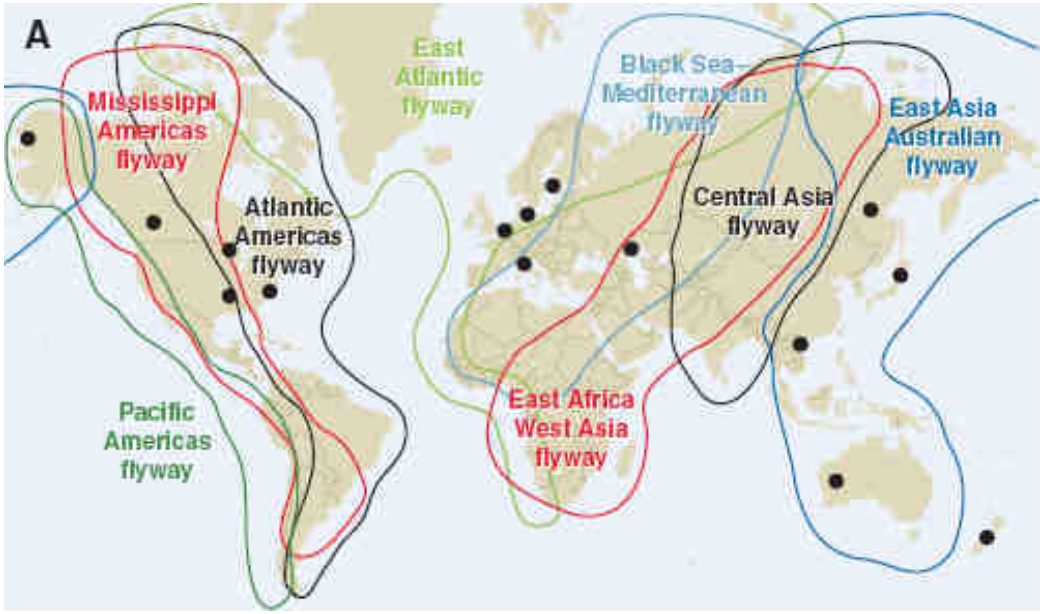
• AIV cause generally **no disease signs** in natural hosts
(but H5N3 HPAI – Common Tern South Africa 1961)

• **co-infection:** simultaneous occurrence of various AIV within a population or within single bird → **Ideal situation for reassortment** & formation of novel virus

A knowledge gap in the host ecology of AIVs in tropical regions

Few multi-year studies available

Most of our current understanding of ecology of AIV in wild birds comes from long-term surveillance in northern hemisphere



- *Main long-term AIV surveillance sites and general migratory fly-ways of birds (waders) (from Olsen et al. 2006)*

→ Knowledge on the circulation of **AIV in different continents and fly-ways** is crucial in estimating **potential of reassortment and spread** of AIV between different areas of the world

Europe-Africa connected through waterbird migration

Afro-tropical regions:

• A seasonal shelter for **Eurasian migratory waterbirds**

e.g. approx. >2 Mo **Garganey**


(*Anas querquedula*)

• Mix and congregate with a community of **Afro-tropical waterbirds**

e.g. approx 4,5 Mo **African ducks**


(*Dendrocygna bicolor*)

✓ Confined to the African continent

✓ Regional to inter-regional movements

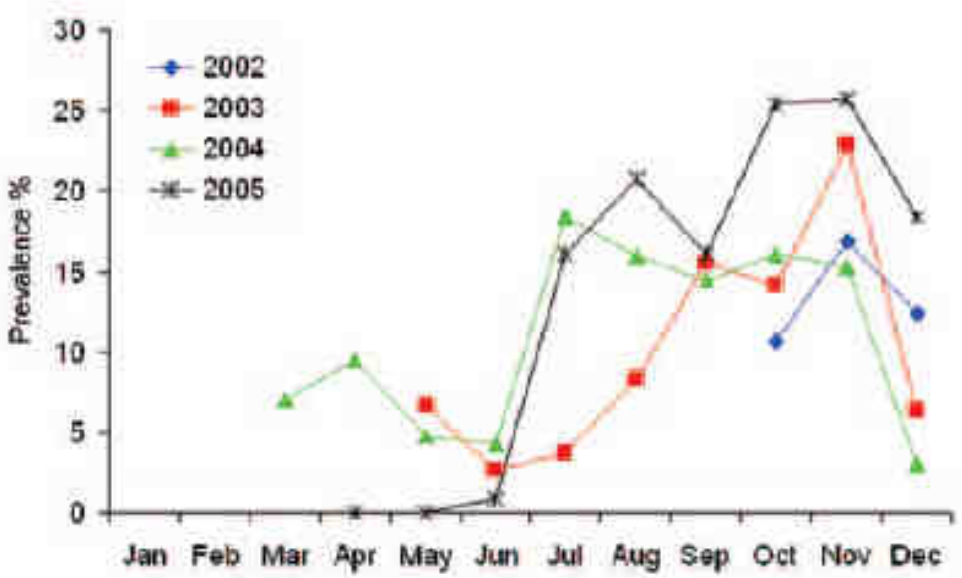
(T. Dodman, in litt; Maps adapted from Scott & Rose. 1996)

A knowledge gap in the host ecology of AIVs in tropical regions

Spatial and temporal variations in AIV prevalence are consistent in northern hemisphere

e.g. AIV prevalence in ducks peaks in late summer and autumn:

- ✓ in Europe (>25%, Wallensten et al. 2007)
- ✓ in North America (>40%, Krauss et al. 2004)



Mallards in Sweden (Wallensten et al. 2007)

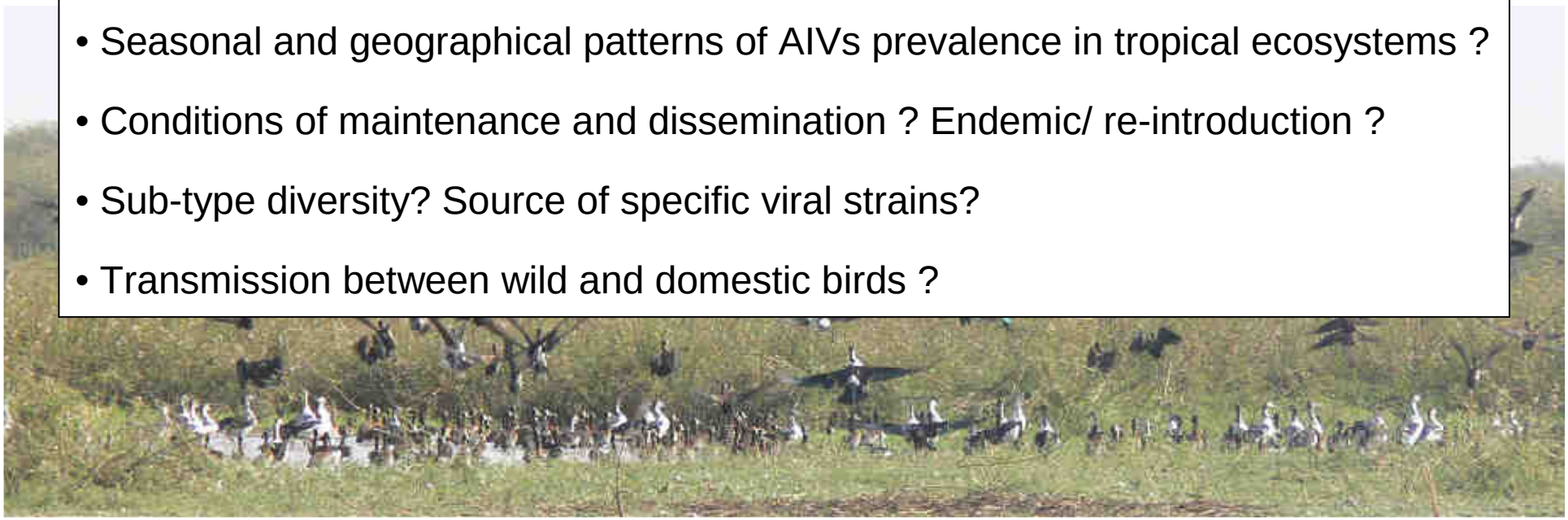
A knowledge gap in the host ecology of AIVs in tropical regions

Distinct environmental conditions in Afro-tropical regions in:

- ✓ climatic constrains
- ✓ waterbird community
- ✓ poultry production systems
- ✓ seasonality
- ✓ migration pattern of Afro-tropical birds

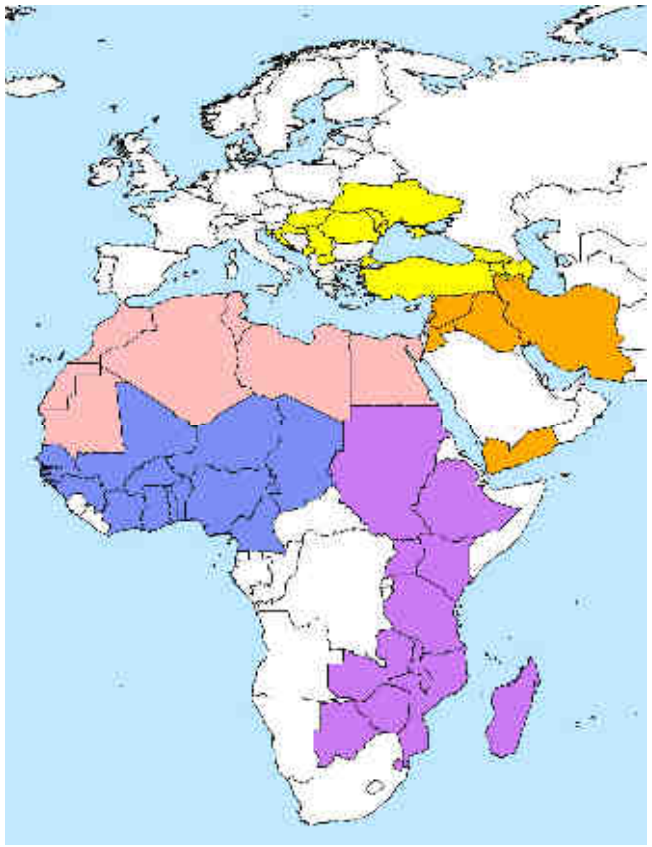
Conditions of AIV circulation in wild birds in Afro-tropical regions ?

- Seasonal and geographical patterns of AIVs prevalence in tropical ecosystems ?
- Conditions of maintenance and dissemination ? Endemic/ re-introduction ?
- Sub-type diversity? Source of specific viral strains?
- Transmission between wild and domestic birds ?



Large-scale wild bird surveillance program in Africa

- FAO-TCP: AIV surveillance program in wild birds (2006-2007)
- Coordinated by CIRAD & Wetlands International
- Collaboration with National Veterinary & Wildlife Services and International Wildlife Institutions
- Diagnostic at CIRAD and IZS-Ve laboratories



CIRAD

WETLANDS INTERNATIONAL

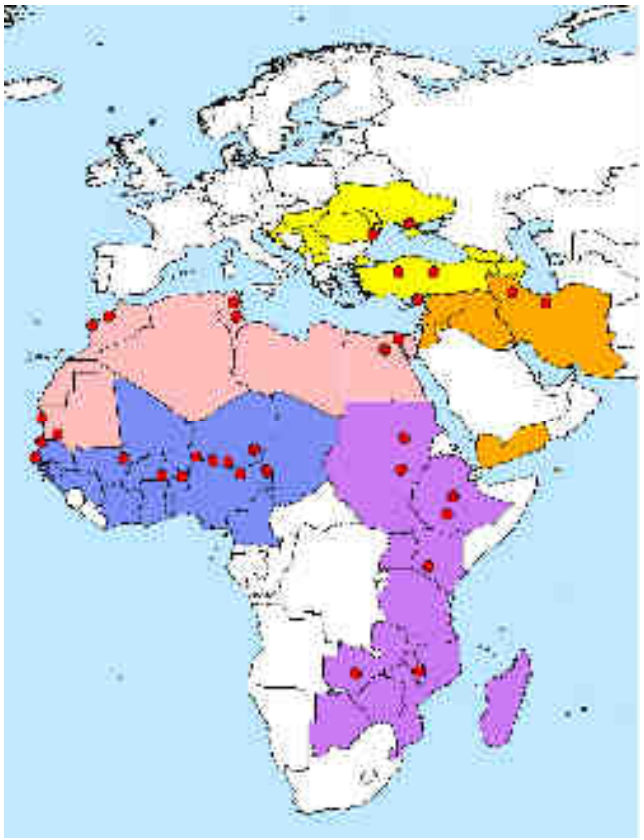
FAO FIAT PANIS

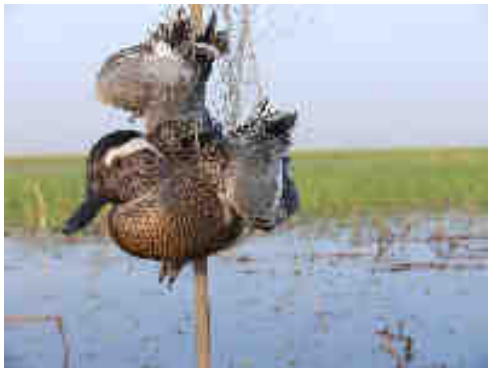
IZSVe Istituto Zooprofilattico Sperimentale delle Venezie

Large-scale wild bird surveillance program in Africa

- **30 field operations** were conducted in **19 countries,** including 12 countries in sub-Saharan Africa

- **>15,000 samples** >**11,000 birds** tested
  - ✓ mostly ducks (58%) and waders (26%),
  - ✓ both Afro-tropical and Eurasian migratory birds





Global surveillance results: ecology of AIV in tropical regions

✓ no positivity for HPAI H5N1 has been detected

✓ LPAI virus were detected (RRT-PCR) and isolated in wild birds:

- detected in a wide range of species (n= **42 species**, 29% of all species tested)
- in **both Eurasian and Afro-tropical birds**
- in **all regions** of Africa, in almost all countries surveyed (17/19)

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

Gaidet et al. Emerging Infectious Diseases, 13 (4), 2007

Eurasian Ducks

✓ **Relatively high prevalence** (4.3%) in Eurasian ducks wintering in West Africa

✓ **Locally high** prevalence in Garganeys: **15%** in Mauritania and 14% Senegal (n= 225 and 121 birds)

→ **Contrast with low prevalence (≤1%)** generally reported during **winter** in Anatidae **in Europe** (Munster *et al*. 2007) or **North America** (Stallknecht *et al*. 1990; Ferro *et al*. 2008)

→ **Role of Afro-tropical wintering grounds in the persistence cycle of AIV across continents?**

Gaidet et al. Emerging Infectious Diseases, 13 (4), 2007

African Ducks

✓ LPAI virus have been **detected** (up to 13%) and **isolated** in Afro-tropical waterfowl who do not move out of the African continent

✓ In both **Dry** season (Sahel region) and **Wet season** (Austral region)

→ **AIVs can potentially be perpetuated in the African bird reservoir**

→ **Dissemination over Africa** through intra-Africa migratory water birds?

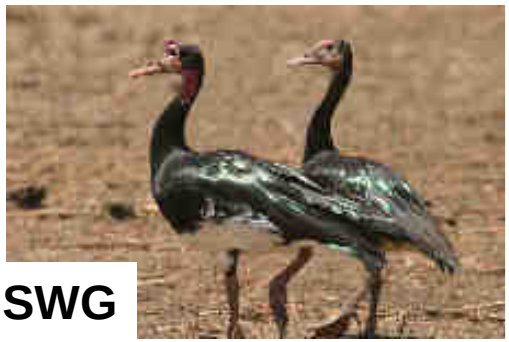
→ Existence of a **tropical reservoir** for AIVs?

Gaidet et al. Emerging Infectious Diseases, 13 (4), 2007

Detection of H5N2 viruses with a highly pathogenic viral genotype

- In north **Nigeria**, Feb. 2007
- In apparently **healthy birds from two African waterfowl species**
  - ✓ White-faced Whistling Duck *Dendrocygna viduata*
  - ✓ Spur-winged Geese *Plectropterus gambensis*
- RRT-PCR, no virus isolated
- **Sequencing**:
  - ✓ **H5N2 subtype** in four birds (1WFWD, 3 SWG)
  - ✓ Multiple basic amino acid motif at HA cleavage site (7 AA) consistent with **highly pathogenic avian influenza**

WFWD



SWG

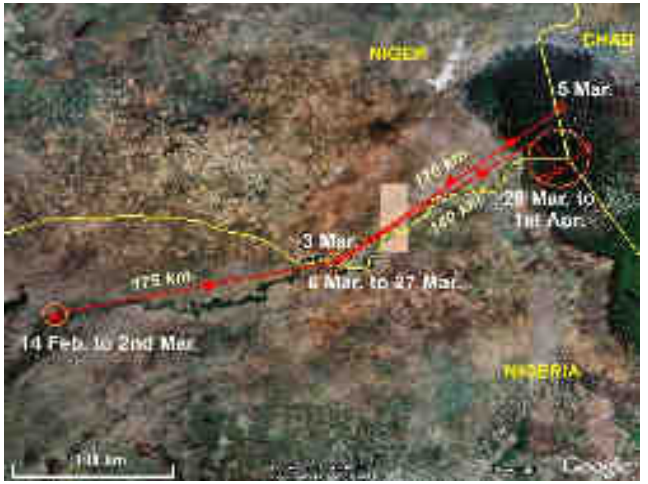
Gaidet et al. PLoS Pathogens, 4(8), 2008

Survival and movements of one of the H5N2 infected duck was monitored through satellite telemetry

- A concomitant **satellite survey** in **Nigeria**

- **H5N2 Infected WFWD fitted with a transmitter:**
an adult male, no clinical signs

- **Tracked for 47 days**
  - ✓ 2.5 weeks close to capture site
  - ✓ flew to Chad, 140-175 km/day
  - ✓ **covering >650km**



→ Evidence of a non-lethal natural infection by an AIV with a HP genome in wild birds

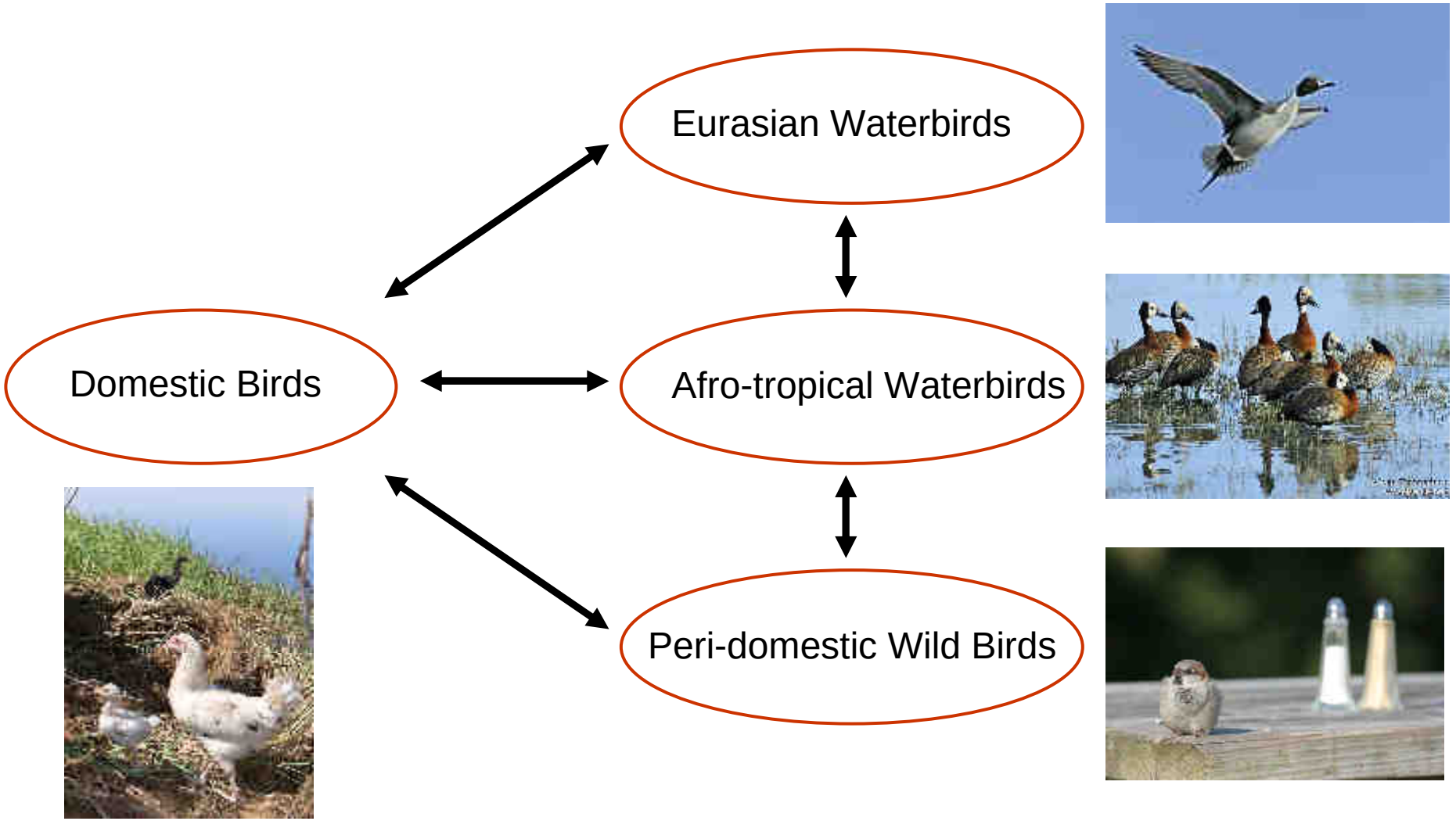
Current Initiatives

GRIPAVI

Conditions and patterns of AIV/ NDV persistence and transmission in tropical regions?

- 6 observatories
- Wild and domestic birds
- AIV and NDV

A bird reservoir community



GRIPAVI

→ **Specific protocols / questions** in each observatory according to local contexts:

- 2 longitudinal surveys of a community of wild bird reservoirs
  - ✓ 2 PhD Mali: Eco-epidemiology & Ornithology
  - ✓ 2 PhD Zimbabwe: Eco-epidemiology & Ornithology
    - → >3000 samples collected
- Specific protocols in Mauritania, Madagascar and Viet Nam

→ **Shared protocols** for generic questions through comparison between observatories

Conditions and patterns of AIV/NDV circulation in tropical regions?

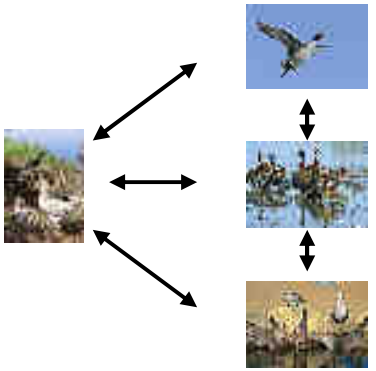
✓ **Describe the seasonal and geographical variation** in prevalence of AIV/NDV in wild birds in tropical ecosystems?

✓ Investigate the role of different bird species and compartments in the **maintenance and dissemination** of AIV/NDV?

→ Description of bird community composition and dynamic

→ Measurement of AIV/NDV prevalence in different birds groups (wild & domestic)

→ Relation among strains circulating within various bird groups




Thank you
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