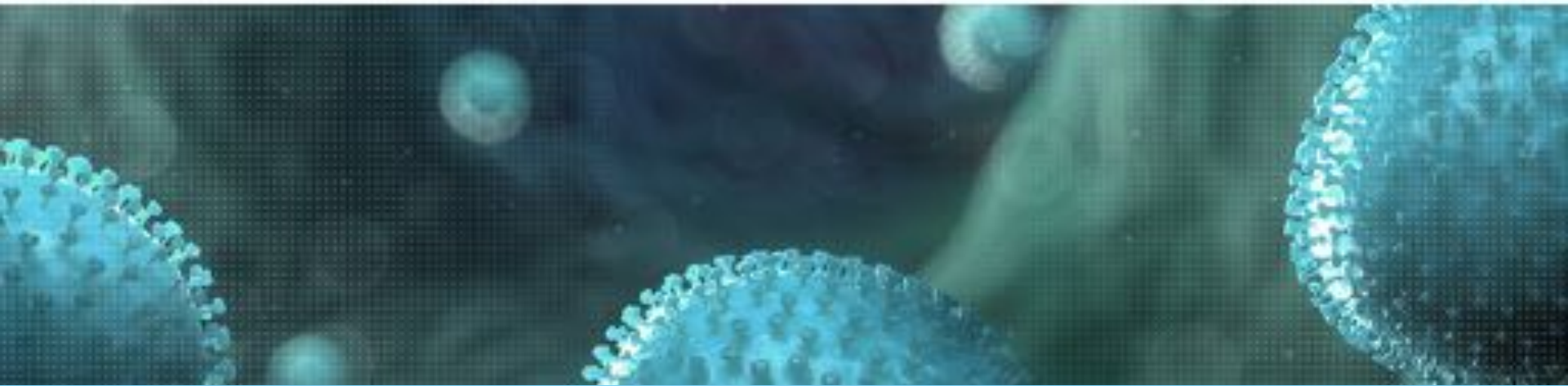




Viroscience lab
WHERE SKILLS MEET TO STUDY & PROTECT

Rome, October 4 2017

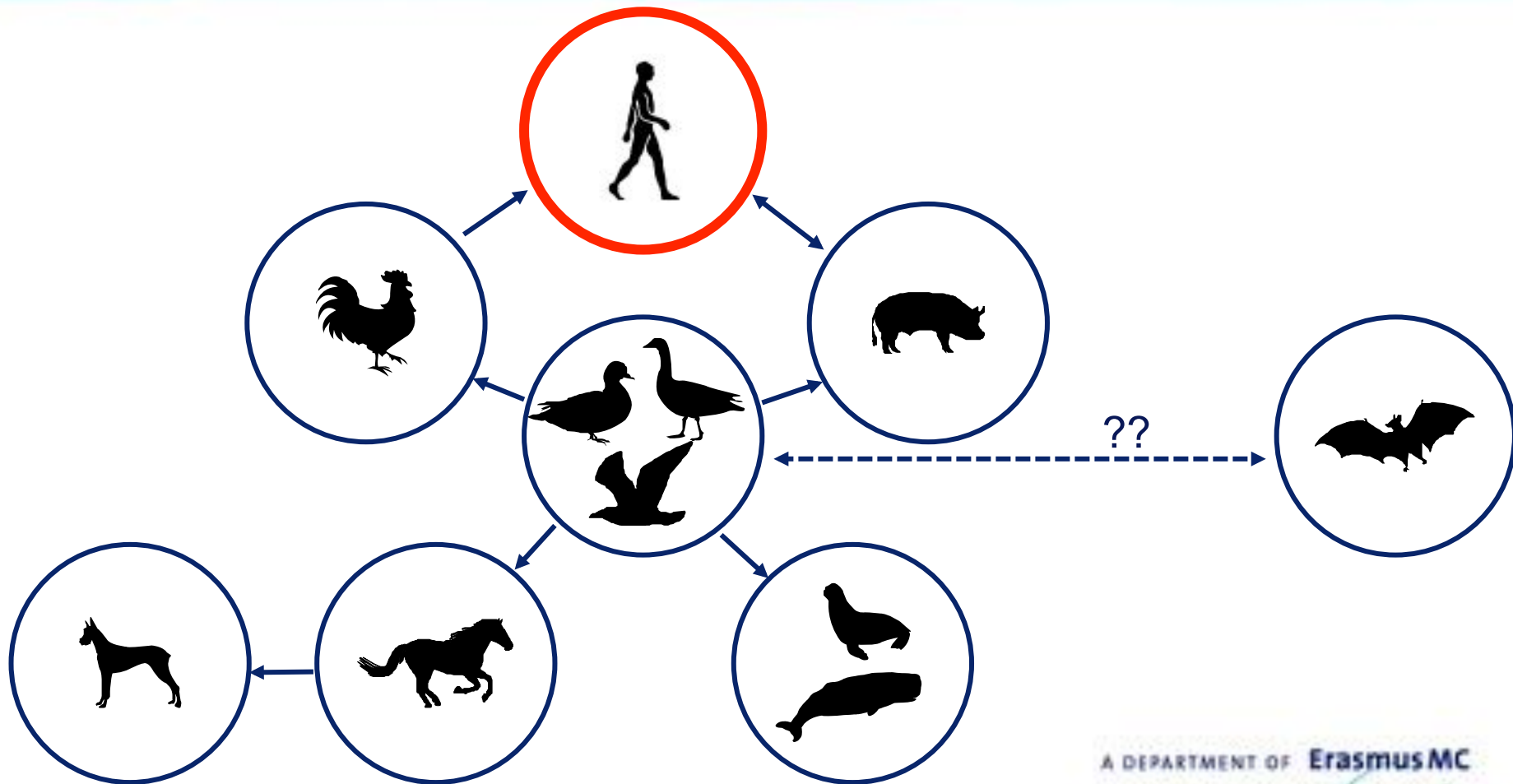


Global perspective on avian influenza in wild birds

Ron A.M. Fouchier
Professor Molecular Virology

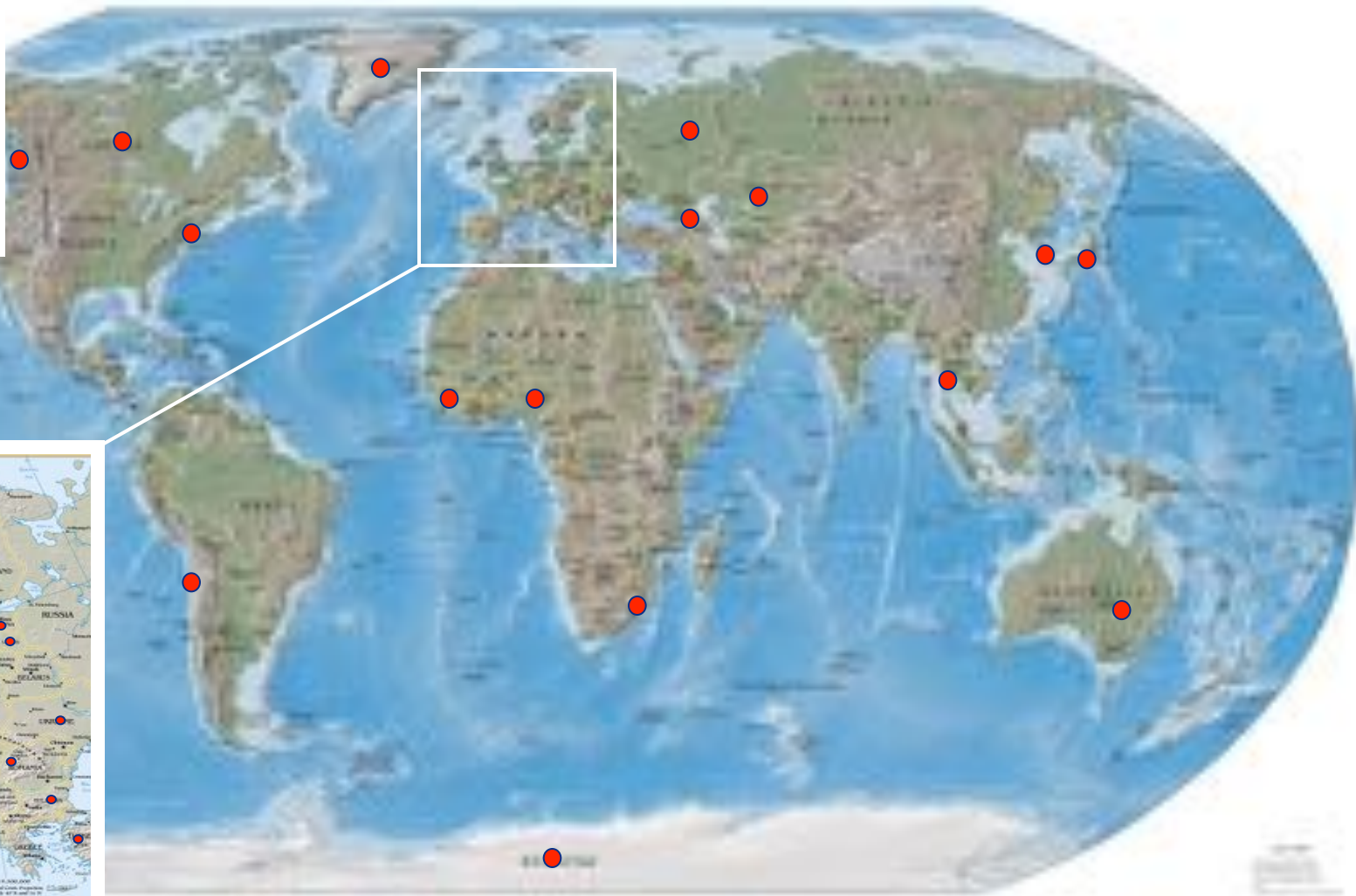
Influenza

- One-health concept -



AI monitoring in wild birds

- Test locations Erasmus MC since 1998 -



AI in wild birds

- Research purposes -



Virus “stamp” collection

- HA/NA library
- Vaccine development
- Develop/validate diagnostics



Virus properties

- Host range
- disease process (pathogenesis)
- Transmission



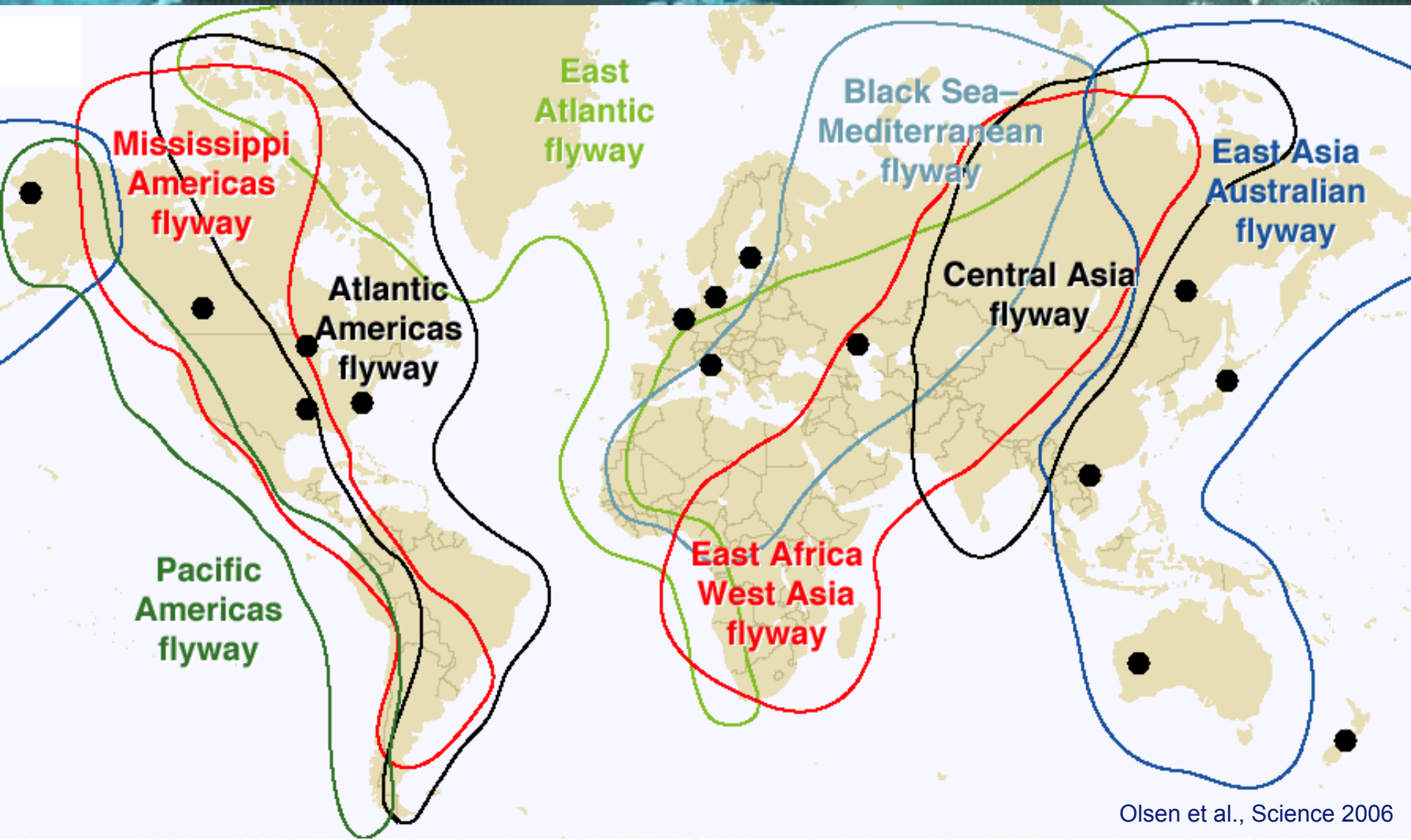
General

- How frequent is AI
- Virus variation (subtypes)
- Host variation
- Epidemiological models (prediction)
- Early warning HPAI (and LPAI)



Wild birds

- Migratory routes -



LPAl in wild birds

- Historical studies -

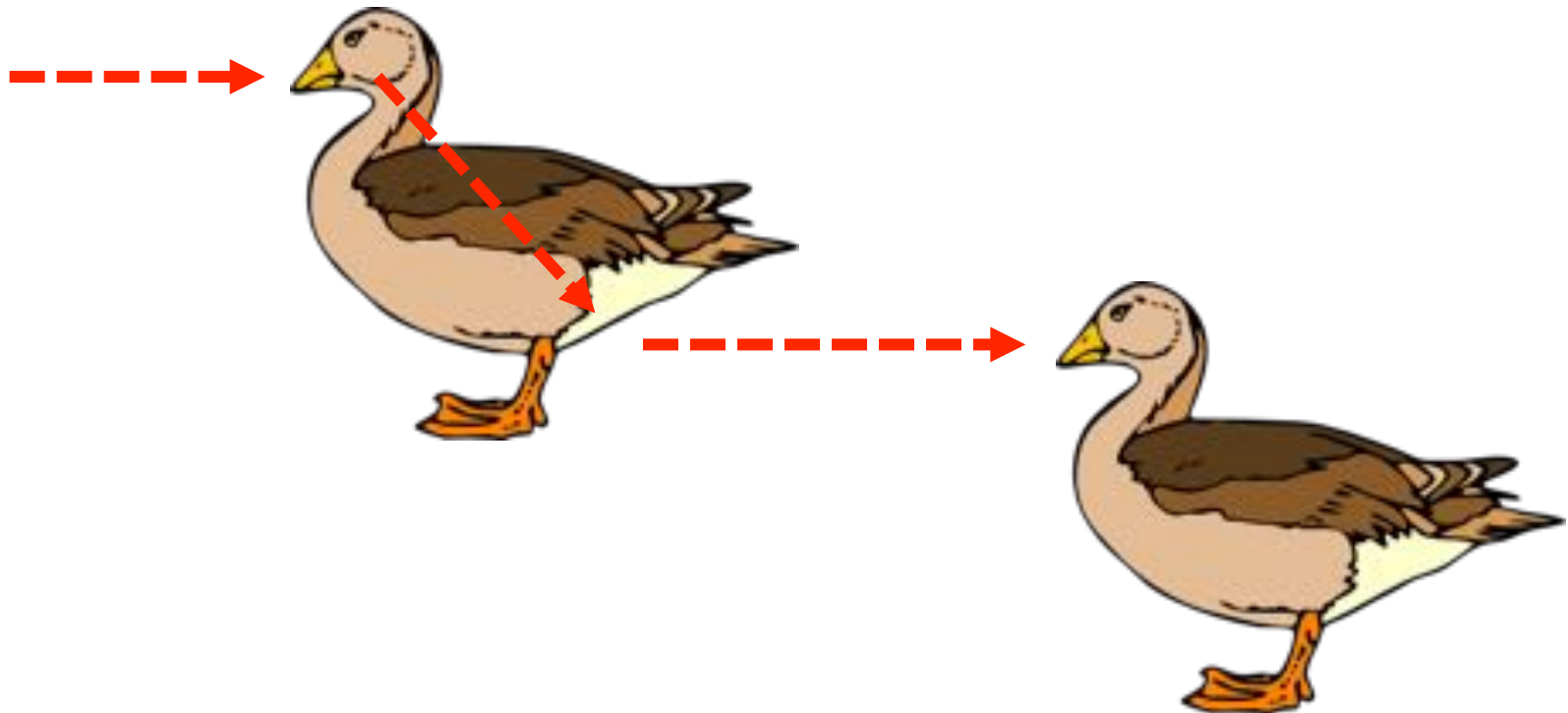


Family	Species (N)	Tested (N)	Positive (N)	Prevalence (%)
Ducks *	36	34503	3275	9.5
Geese	8	4806	47	1.0
Swans	3	5009	94	1.9
Gulls	9	14505	199	1.4
Terns	9	2521	24	0.9
Waders	10	2637	21	0.8
Rails	3	1962	27	1.4
Shearwaters	5	1416	4	0.3
Cormorants	1	4500	18	0.4

* Dabbling ducks 10.1%; Diving ducks 1.6 %

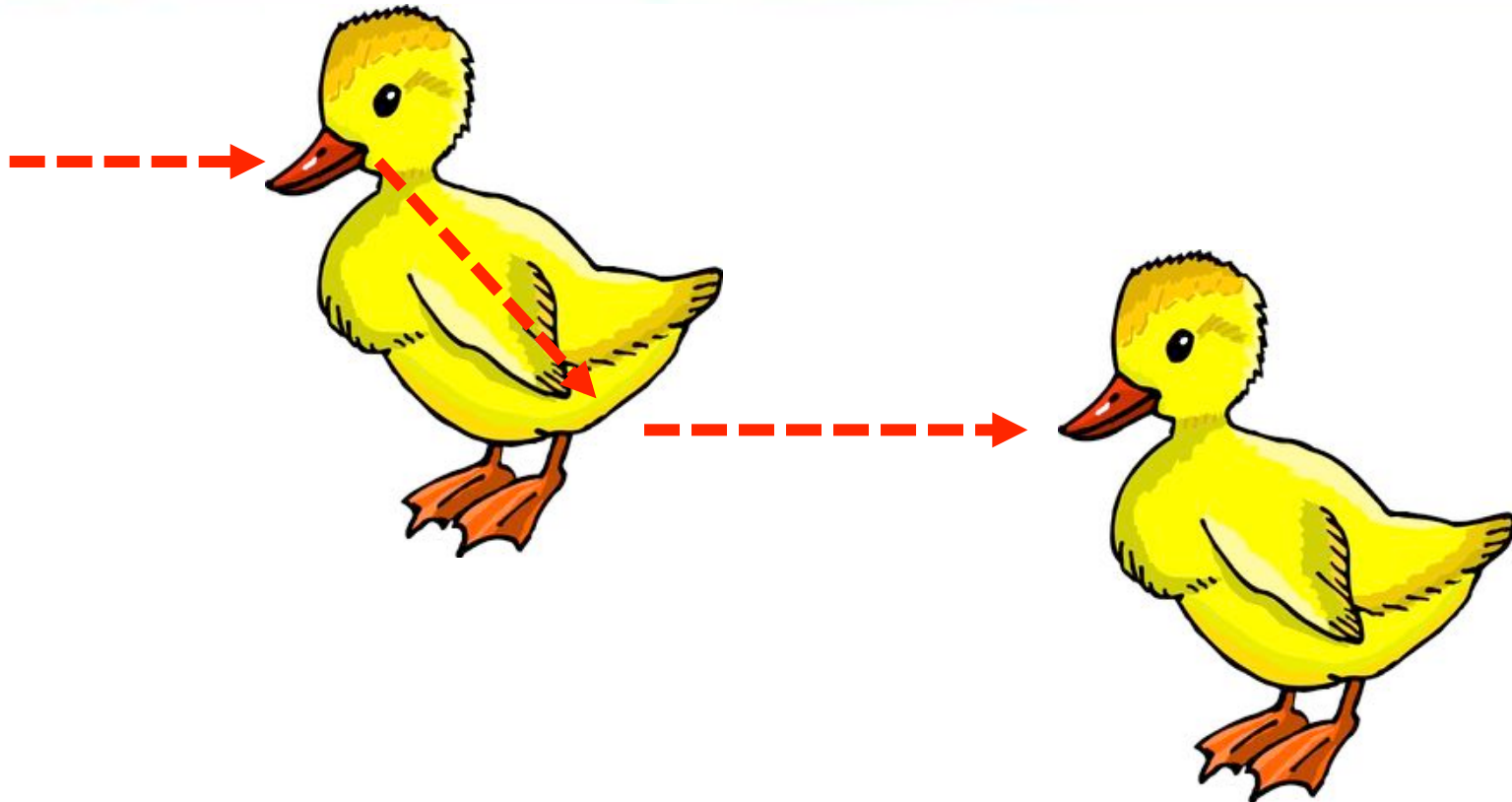
LPAI in wild birds

- Transmission -



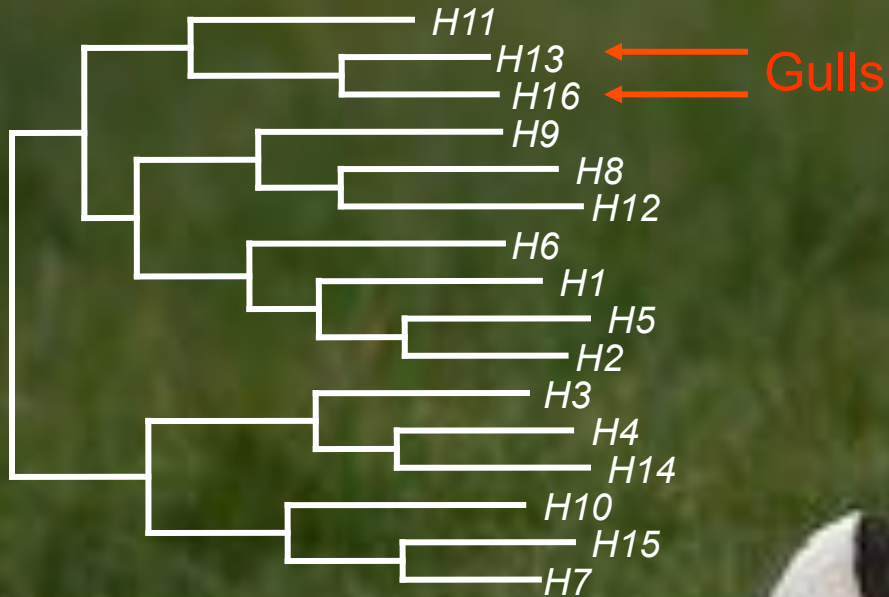
LPAI in wild birds

- Childhood disease? -



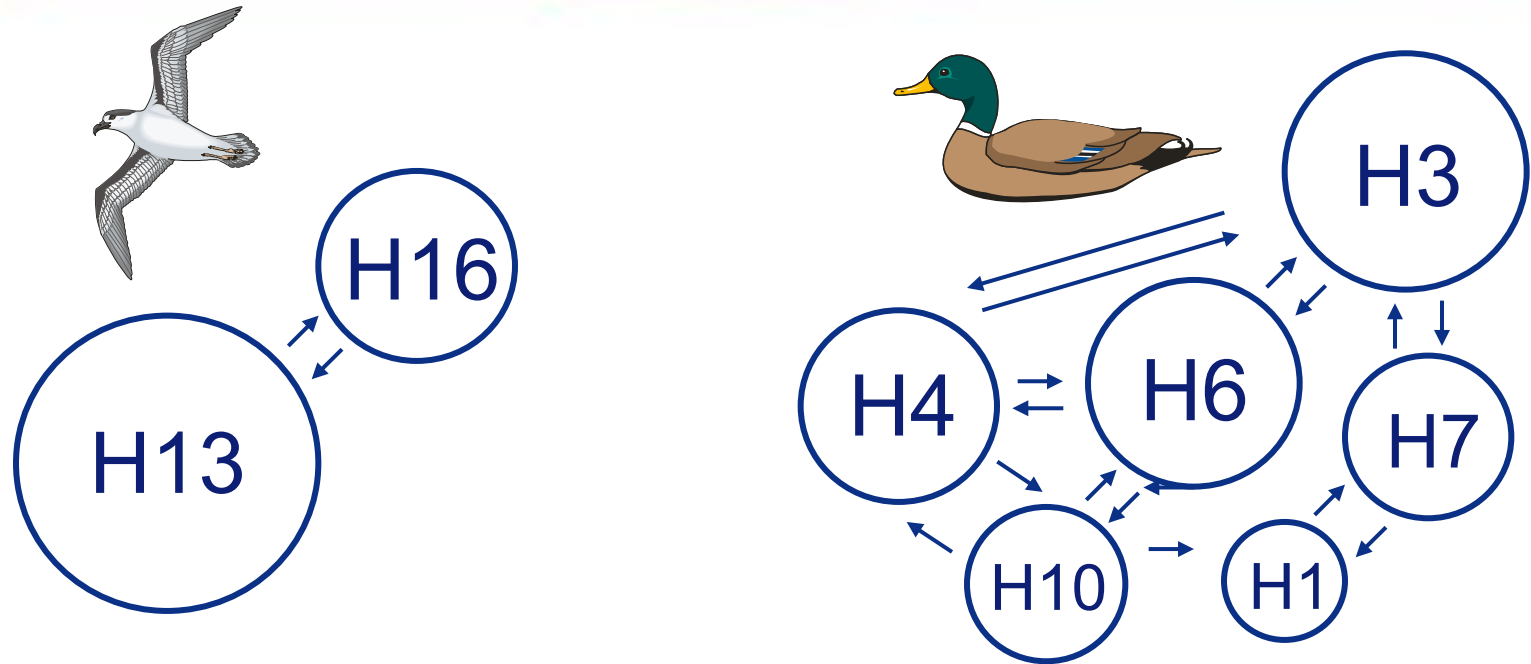
HA subtype H16

- Blackheaded gull (*Chroicocephalus ridibundus*) -



Gulls as a simple LPAI model

- Two virus subtypes. Birds breed locally -



colony

multiple
colonies

regional

worldwide

Link with H5/H7 poultry outbreaks

- Mallard (*Anas platyrhynchos*) -



Ireland '95 (H7N7)
England '96 (H7N7)
Italy '97 (H5N9)
Italy '97-'98 (H5N2)
Italy '99-'00 (H7N1)
Italy '01-'02 (H7N3)
Netherlands '03 (H7N7)
England/Germany '15 (H7N7)

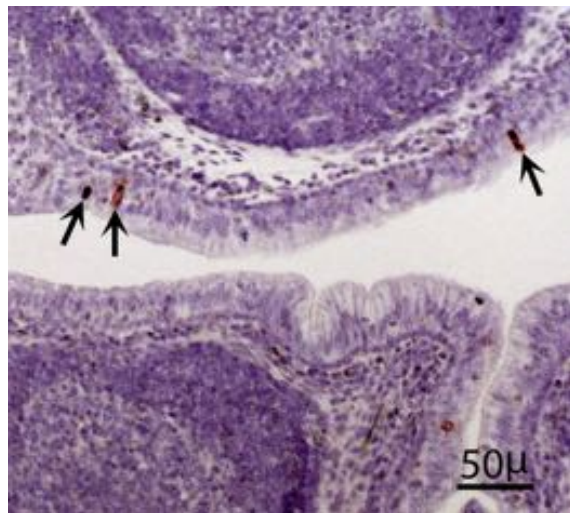
LPAI in wild birds (ducks & gulls)

- non-pathogenic -

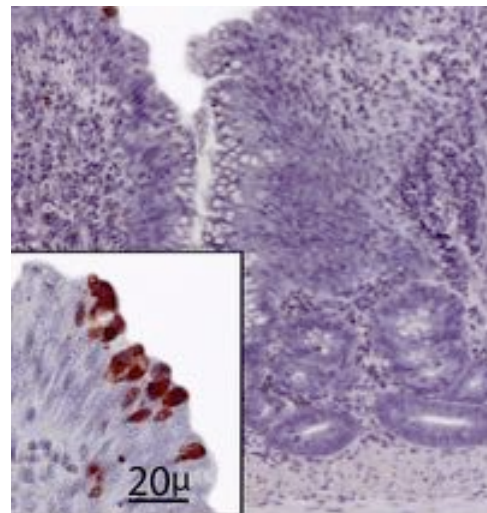


- Virus replication (primarily) in the digestive tract
- No inflammation associated with local virus infection
- No serious disease signs

Cloacal bursa



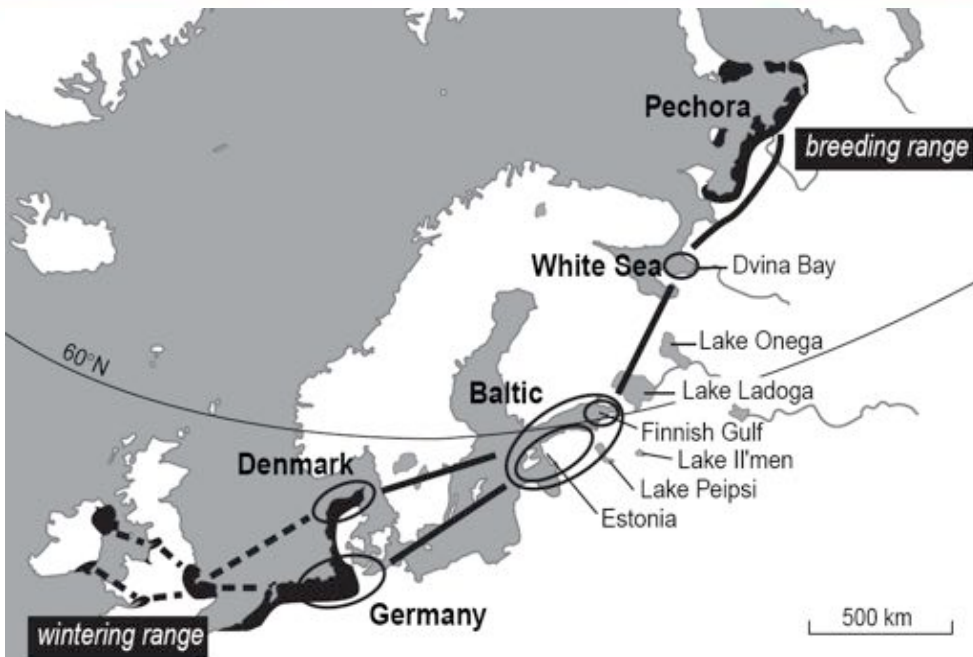
Colon



(Daoust et al. 2011 J Wildl Dis)

LPAI in wild birds

- Annual cycle studies, e.g. Bewick's swan-



LPAI in wild birds

- Wader projects-



Delaware Bay USA, May (every year)

Peak prevalence : ~50%

Numerous (all?) virus subtypes



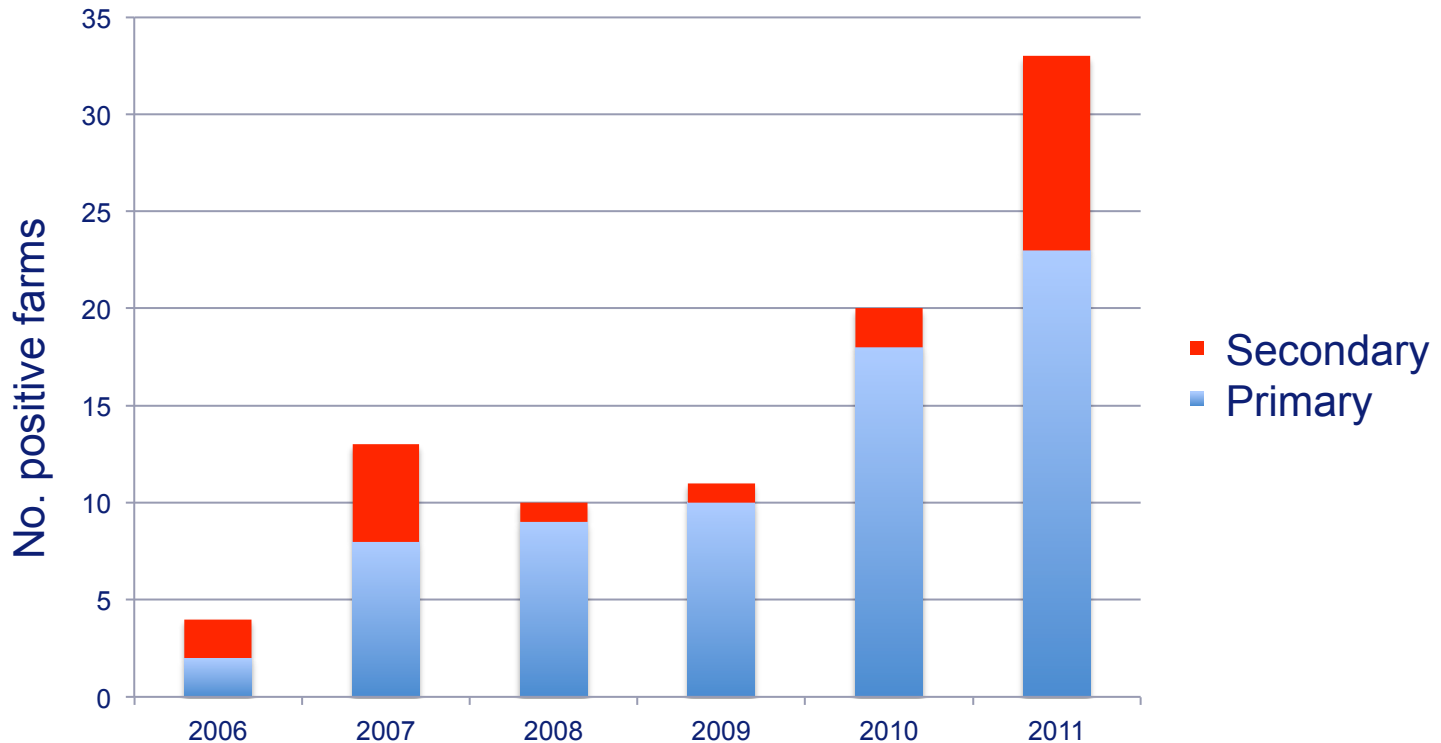
But: waders in Europe, Africa: no evidence of massive infections

> 5000 samples, >45 species, 8 years: 4 positives



LPAL in poultry

- Netherlands 2006 - 2011 -



A DEPARTMENT OF Erasmus MC

Erasmus

Viruses linked to (local) wild birds, but “bridge” species unknown

LPAI in poultry

- High risk: turkey, duck & outdoor chicken -



Table 1. LPAIV surveillance data collated from poultry farms, the Netherlands, 2007–2013*

Type of farm	No. farms positive	Total no. farms	Median time at risk, mo	Median distance to wild water bird areas, m	Median distance to medium-sized waterway, m†	Probability of introduction‡	RR§
Indoor-layer	60	5,600	7.3	4,227	769	0.001	1
Outdoor-layer	143	2,549	6.3	3,996	670	0.009	6.0
Layer-breeder	14	2,174	9.5	4,157	738	0.001	0.5
Broiler	2	5,409	1.2	3,292	576	0.000	0.2
Broiler-breeder	14	2,718	8.5	4,002	824	0.001	0.4
Meat-turkey	30	469	3.7	3,208	1,042	0.017	11.7
Turkey-breeder	2	18	5.7	2,035	659	0.019	13.1
Meat-duck	16	267	1.2	3,477	1,180	0.050	33.9
Duck-breeder	14	70	5.8	4,107	767	0.034	23.4

- 6 fold higher risk for outdoor ranging poultry
- 11-13 fold higher risk for turkeys
- 23-34 fold higher risk for ducks

Highly Pathogenic Avian Influenza H5

- 1997-present -



- >20 years enzootic
- Genetic lineages
- Antigenic variation
- Reassortment

H5N1

H5N2

H5N5

H5N6

H5N8

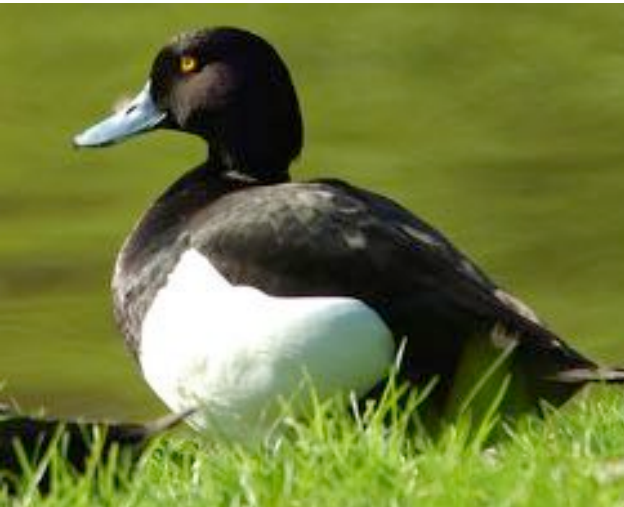
- Spill over to wild birds
- Incursions worldwide



(Verhagen et al., Science 347:616-7 (2015))

HPAI H5N1 in wild birds

- Experimental infections -



Tufted duck

*Infection +
Disease +*



Eurasian pochard

*Infection +
Disease +*



Mallard

*Infection +
Disease -*



Common teal

*Infection +
Disease -*



Eurasian wigeon

*Infection +
Disease -*

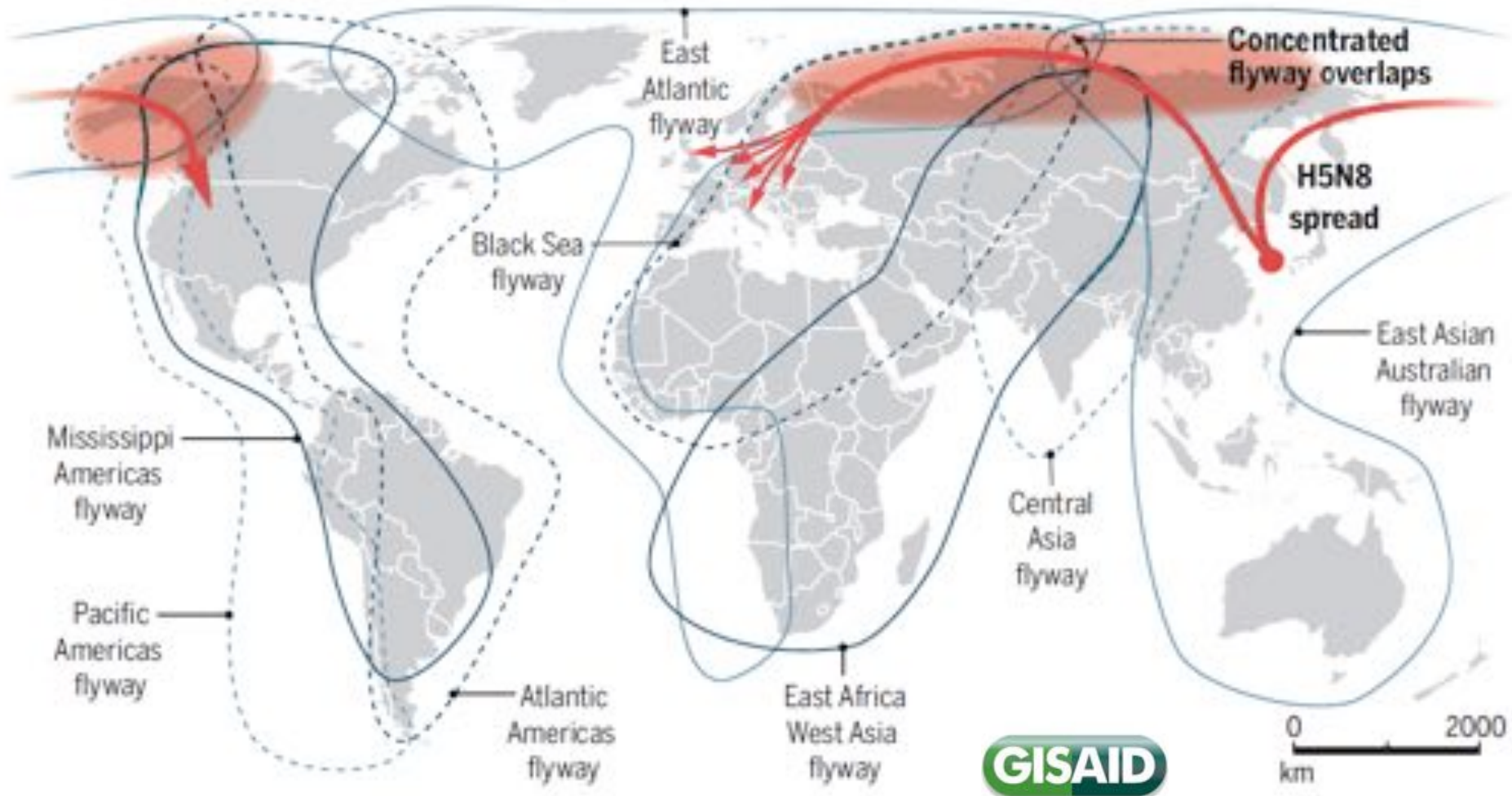


Gadwall

*Infection +
Disease -*

HPAI H5N8 in poultry & wild birds

- 2014 - present -



HPAI H5N8 in wild birds

- 2014 - present -



Eurasian wigeon



2014

- Infected
- No disease
- Long distance migrant
- Vector?

Tufted duck

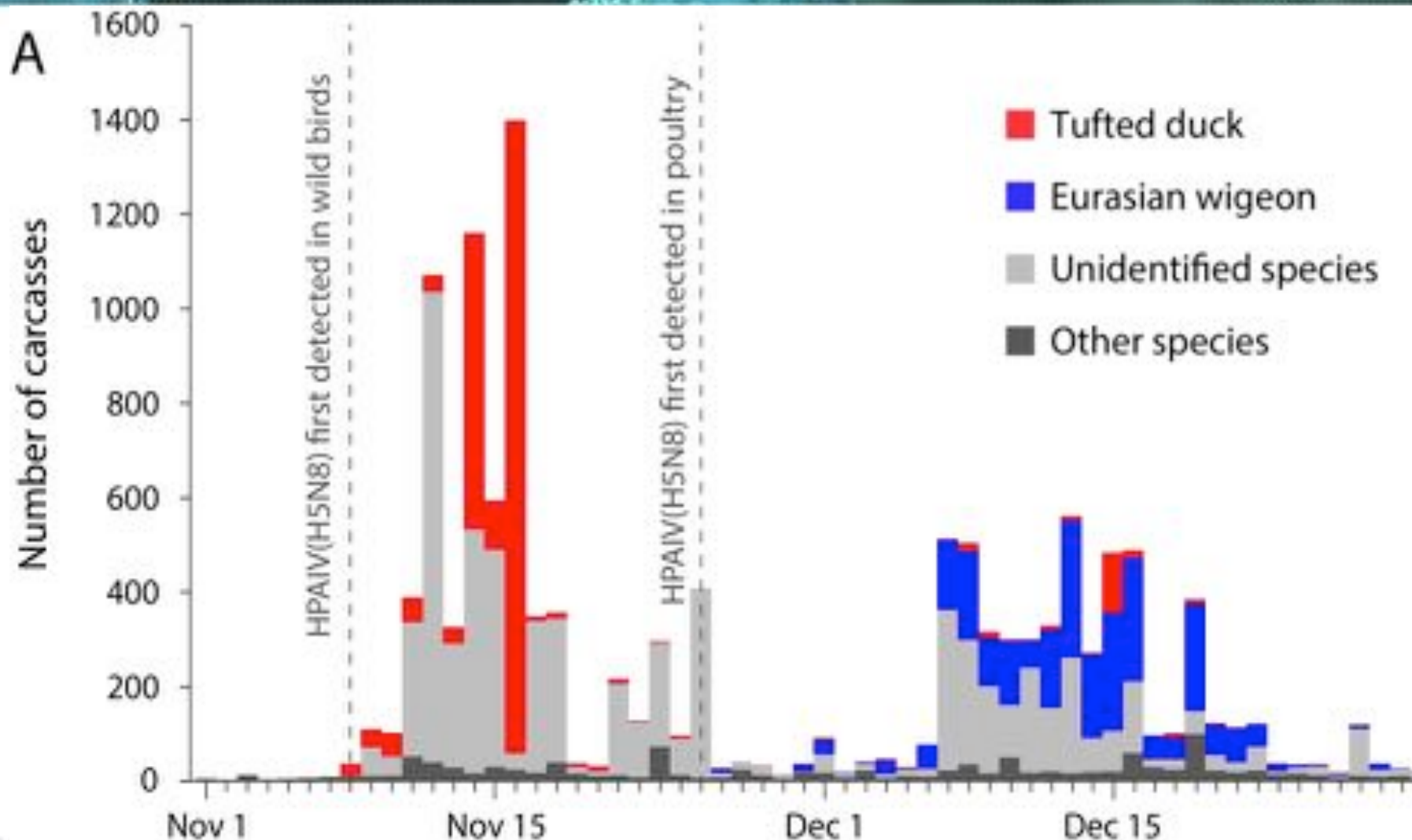


2016

- Die-offs
- Sentinel?

HPAI H5N8 in wild birds

- 2016; birds found dead (NL) -



Avian influenza in wild birds



- We know a lot, but (too) many questions remain-

- How are AI viruses maintained in wild aquatic birds globally?
- What is the role of various species, age categories, migratory behaviour?
- Can we develop sustainable, cost-effective (active) surveillance systems?
- Can we prevent spill-over from poultry to wild birds, how?
- Can we prevent introductions from wild birds to poultry, how?
- What are the “bridge species” between wild and domestic birds?
- Can we identify hot-spots for early HPAI detection (Qinhai Lake, Uvs Nur)?
- Can we forecast LPAI/HPAI outbreaks?
- How/why do HPAI viruses emerge from LPAI, why only H5/H7?
- Why are turkeys and ducks more sensitive to AI?
- Why are some AI viruses infecting humans, other mammals?
- Will zoonotic viruses like H5N6, H7N9 follow the routes of H5N1 and H5N8?



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