Climate Change: Contributions to Emergence, Reemergence and Spread of Infectious Disease

Lessons from the Wild Kingdom?

Institute of Medicine
December 5, 2005

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Damien Joly
Pablo Beldomenico

Oystercrates

The rule of R_0

“Don’t eat oysters during R naught months”

Marie Curie

“Nothing in life is to be feared, it is only to be understood.

Now is the time to understand more, so that we may fear less.”

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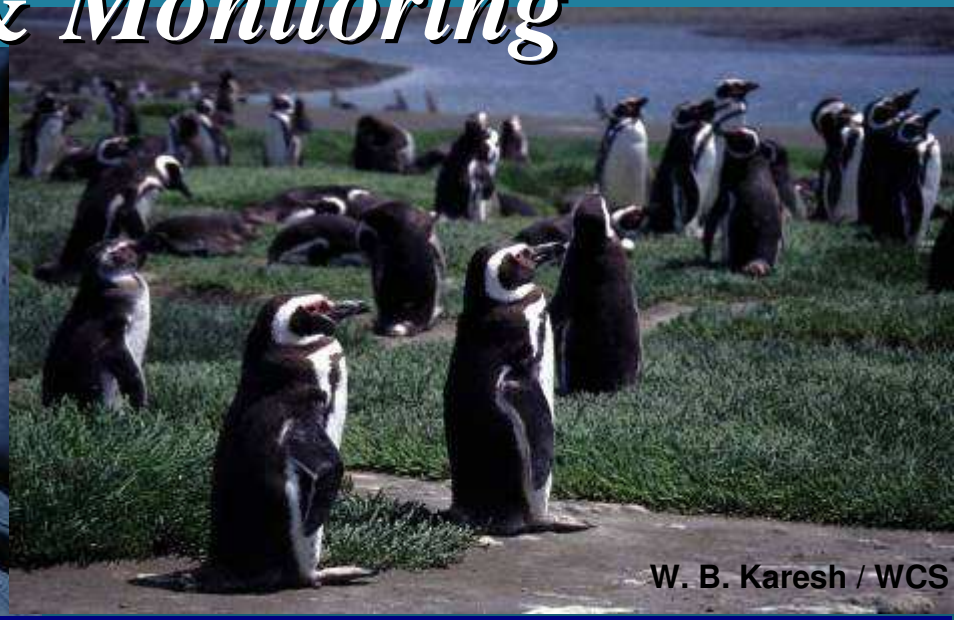
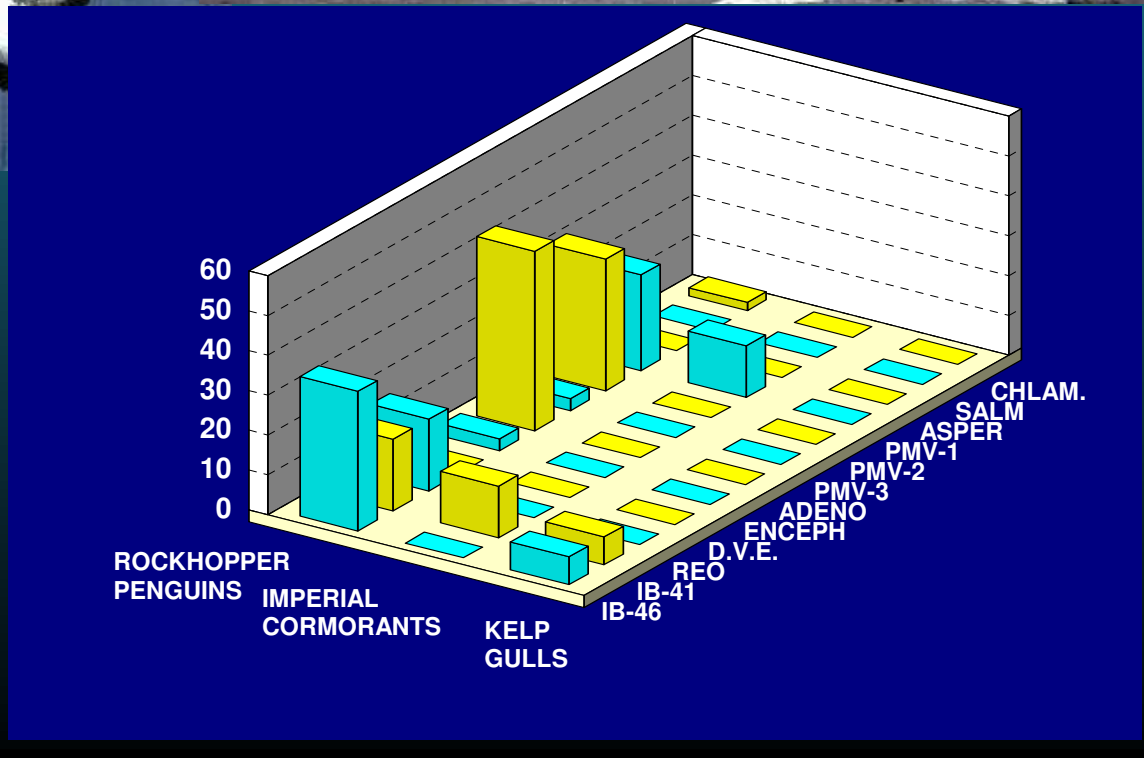
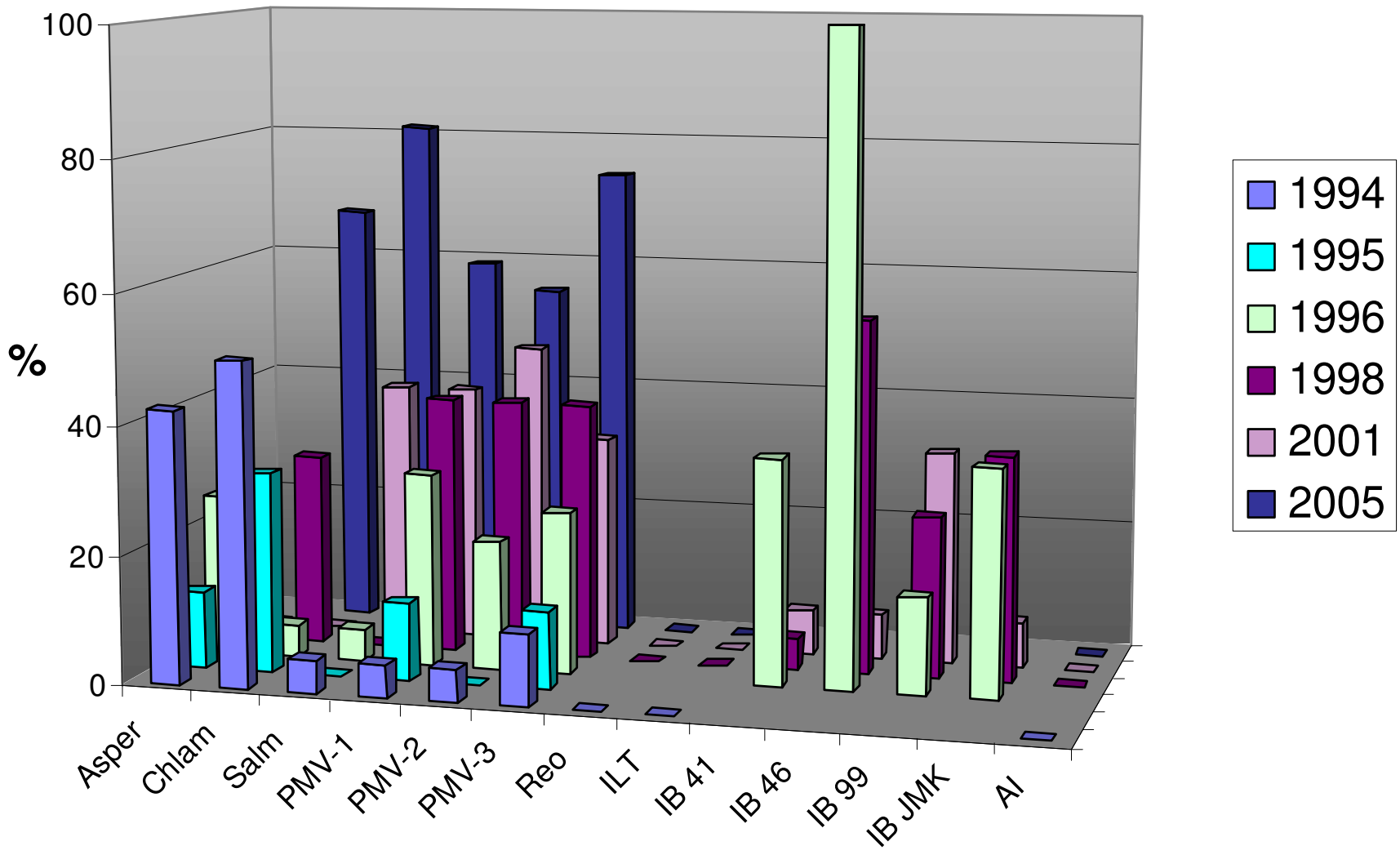
Founded in 1895 as the New York Zoological Society

Wildlife Health Pr

Assessment & Monitoring







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El Niño Event 1991-1992

El Niño Event 1991-1992

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Pinzon, et al., Am. J. Trop Med Hyg, 2004

On the ground detection for early warning

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Adaptation

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In the face of climate change

Our goal is to prevent or control the spread of diseases that threaten wildlife, human, and livestock health

To accomplish these goals

Use science to understand and predict how how host, pathogen, and environment responds to climate change

Batrachochytrium dendrobatidis

Blamed for global amphibian declines

- 93 species 5 continents
- 43 species in 7 Latin American countries
- 14 species in eastern Australia

Only recently identified as vertebrate pathogen

Emerging infectious disease

Amphibian declines

- Chytrid fungus (*Batrachochytrium dendrobatidis*) is one of the prime suspects
- However, the fungus appears to have spread beyond it's endemic range in the 1930s
- Reason for decline now?

Amphibian declines

Amphibian immune response is sensitive to climate

Has climate change increased susceptibility of amphibians to the chytrid fungus?

(Carey, et al. Dev Comp Immunol 23:459)

Amphibian declines

Pounds et al. (Nature 439: 161)

"propose that temperatures at many highland localities are shifting towards the growth optimum of (chytrid fungus), thus encouraging outbreaks."

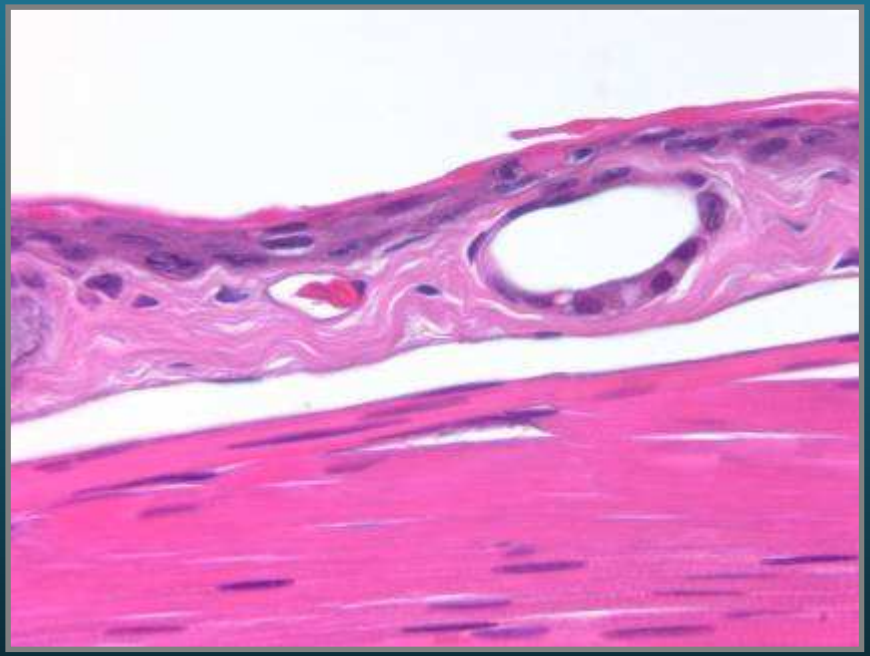
Amphibian declines

Climate change causes the expansion in the distribution of some species with the subsequent expansion in the distribution of the chytrid fungus (Seimon, et al., Global Change Biol 13:288)

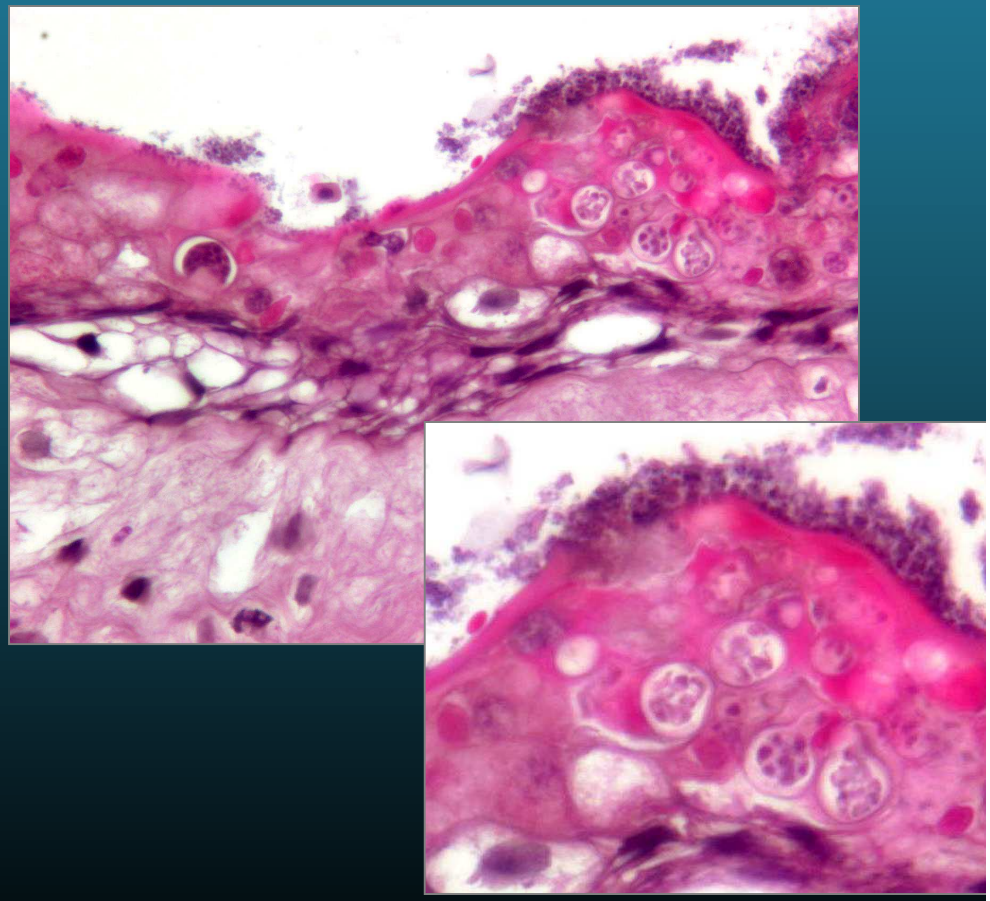
Kihansi Spray Toad

Kihansi Spray Toad

Normal Skin



Abnormal Skin



Batrachochytrium dendrobatidis

Climate change and pathogen ecology

When parasites expand their distribution,
they might meet unprepared hosts

Philornis downsi is introduced in Galapagos, jeopardizing Darwin Finches' survival (Fessl, et al., 2006)

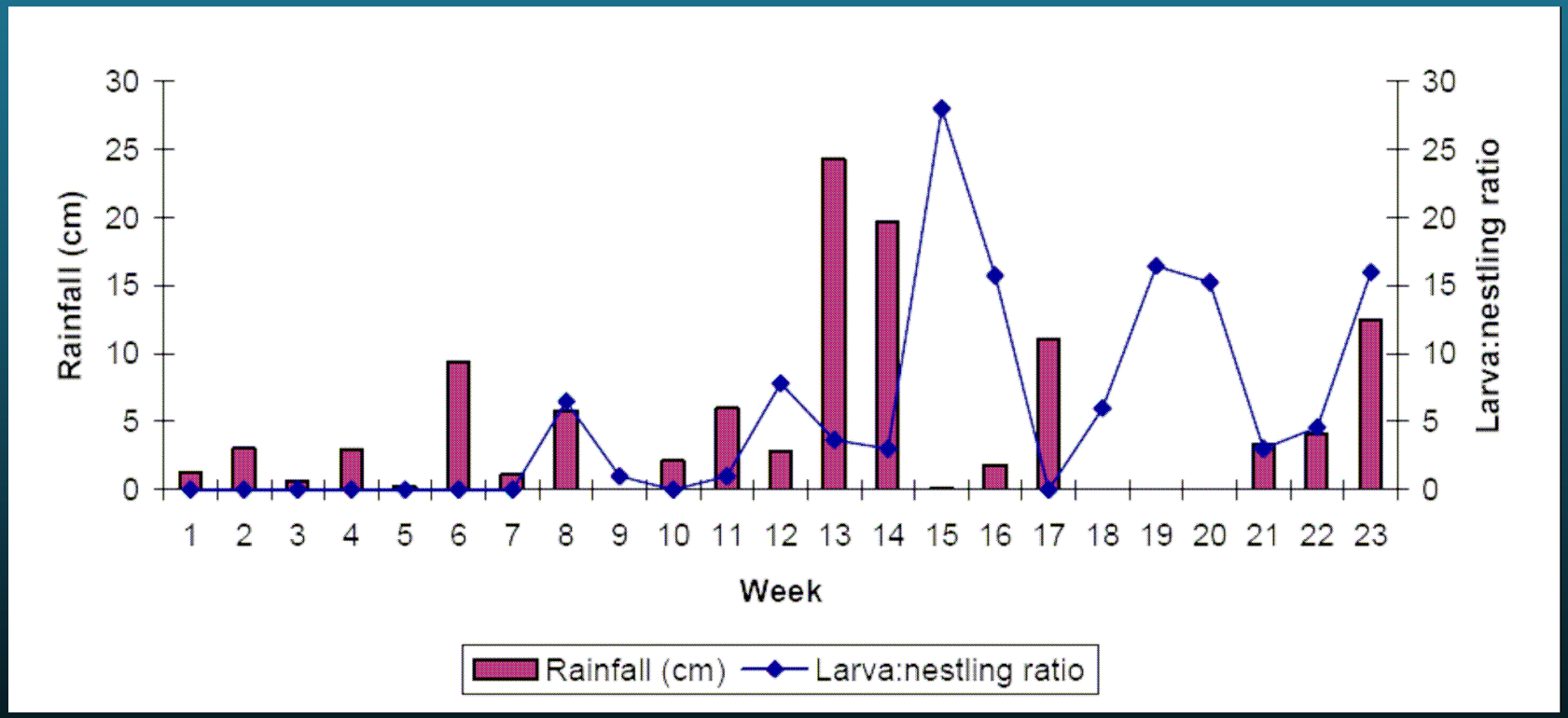
Climate change and pathogen ecology

What if southwards expansion of these parasites finds immunologically unprepared bird species?

Anecdotal evidence suggests that this parasitism has become more frequent in southern S.A.

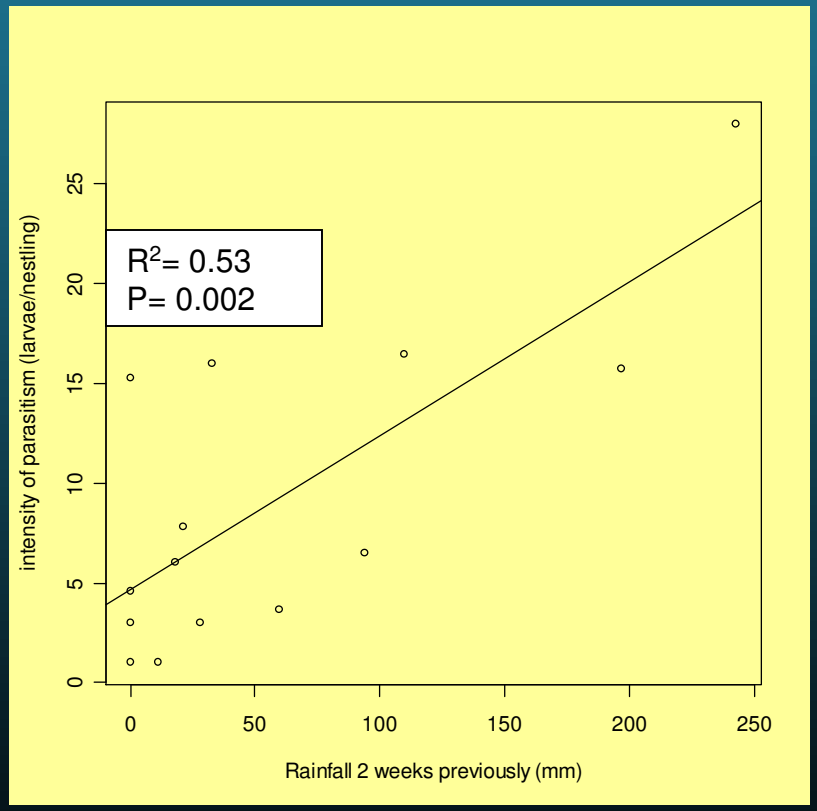
Climate change and pathogen ecology

Heavy rainfall is followed by heavy parasitism



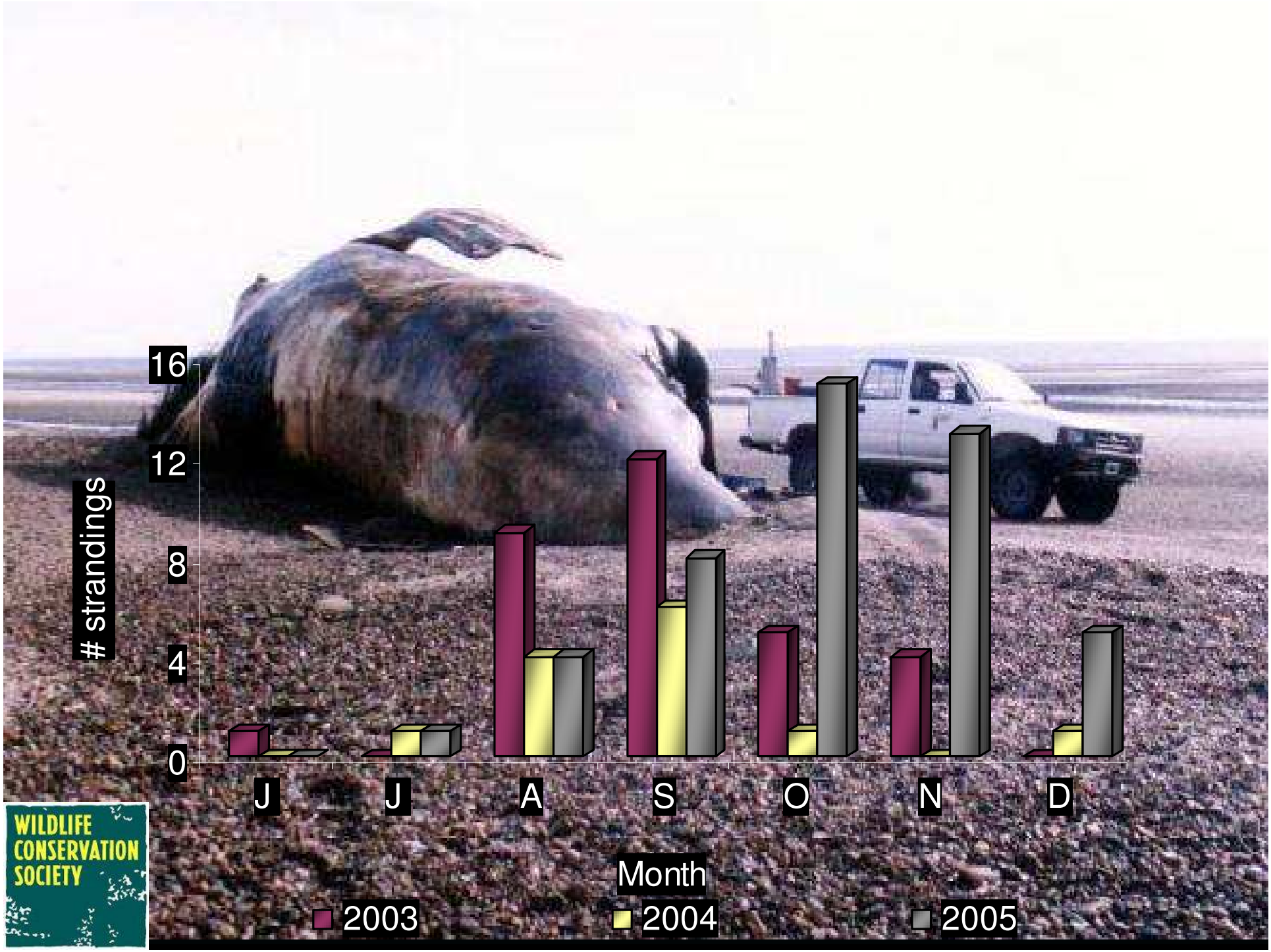
Climate change and pathogen ecology

The severity of this parasitism was found to be correlated with rainfall:



Climate change and pathogen ecology

Precipitation has been increasing in southern S.A.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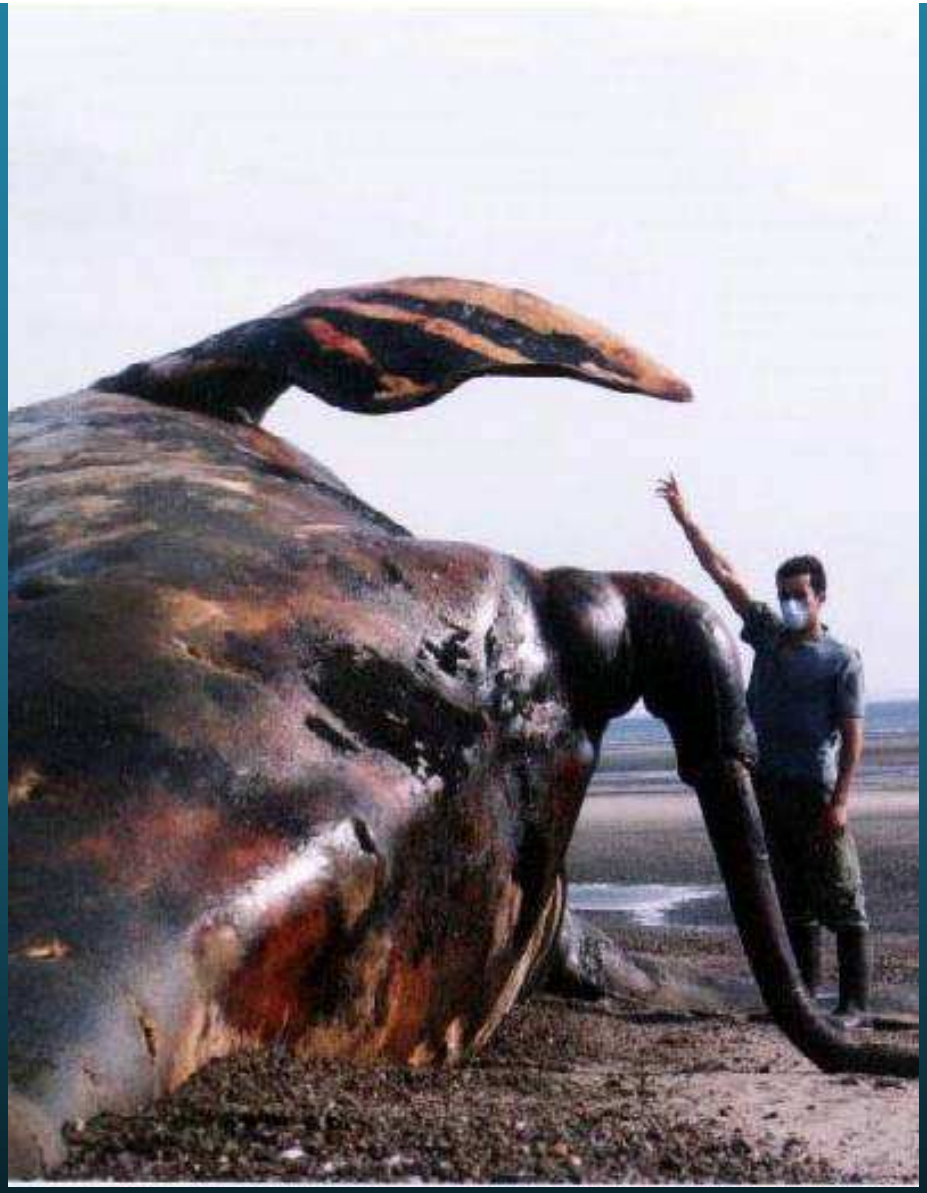
Climate change and Environmental Health

Unusual number of strandings of right whales, Peninsula Valdés, Argentina (Oct 2007)



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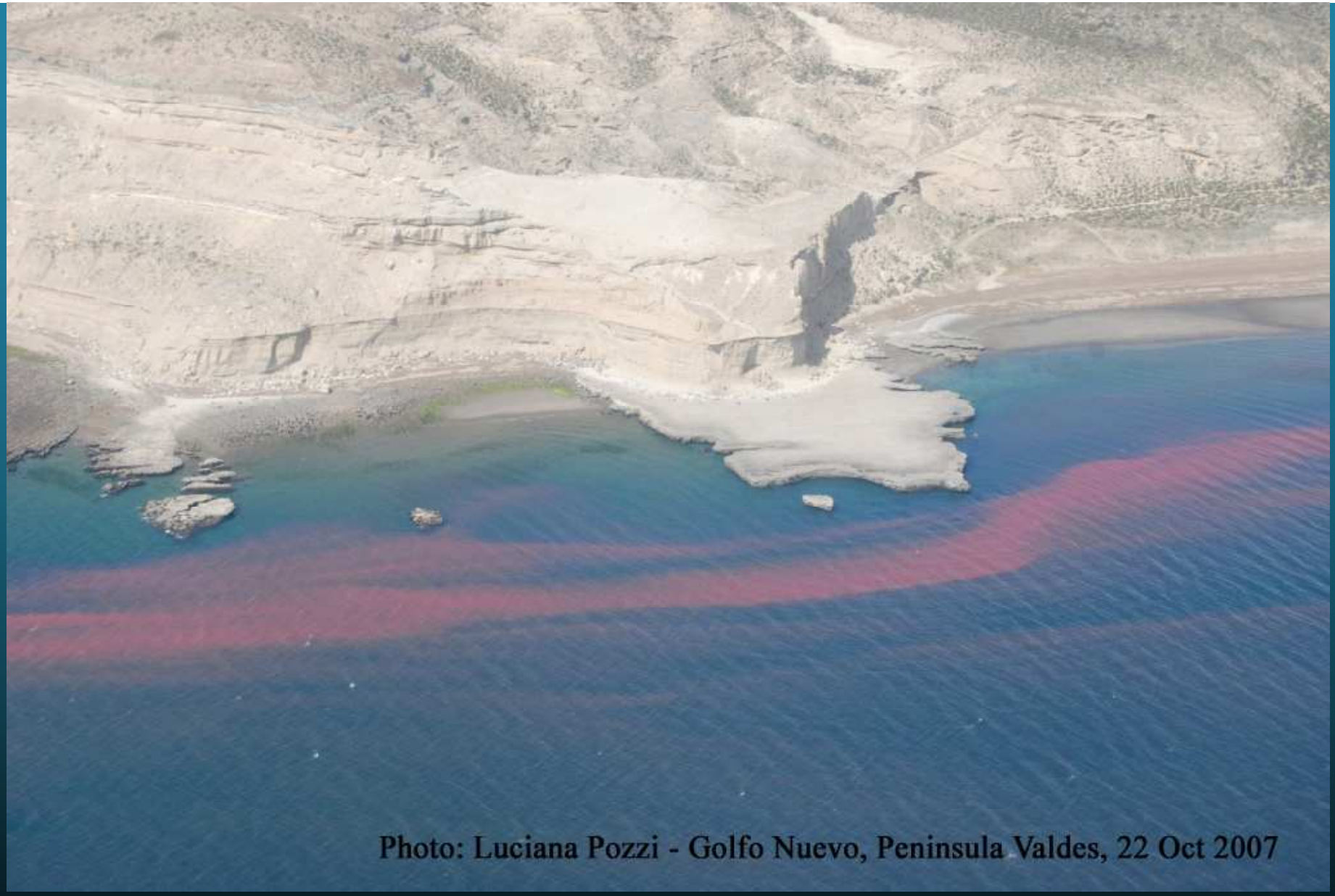
Photo: Luciana Pozzi - Golfo Nuevo, Peninsula Valdes, 22 Oct 2007

Global Avian Influenza Network for Surveillance (GAINS) for Wild Birds

USAID FROM THE AMERICAN PEOPLE

CDC

FAO FIAT PANIS

USDA

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USGS science for a changing world

CMS

Department of Defense Global Emerging Infections System

CIRAD

BirdLife INTERNATIONAL

WETLANDS INTERNATIONAL

IUCN The World Conservation Union

THE NATIONAL AVIARY

FRIEDRICH-LOEFFLER-INSTITUT FLI Bundesforschungsinstitut für Tiergesundheit Federal Research Institute for Animal Health

Cargill

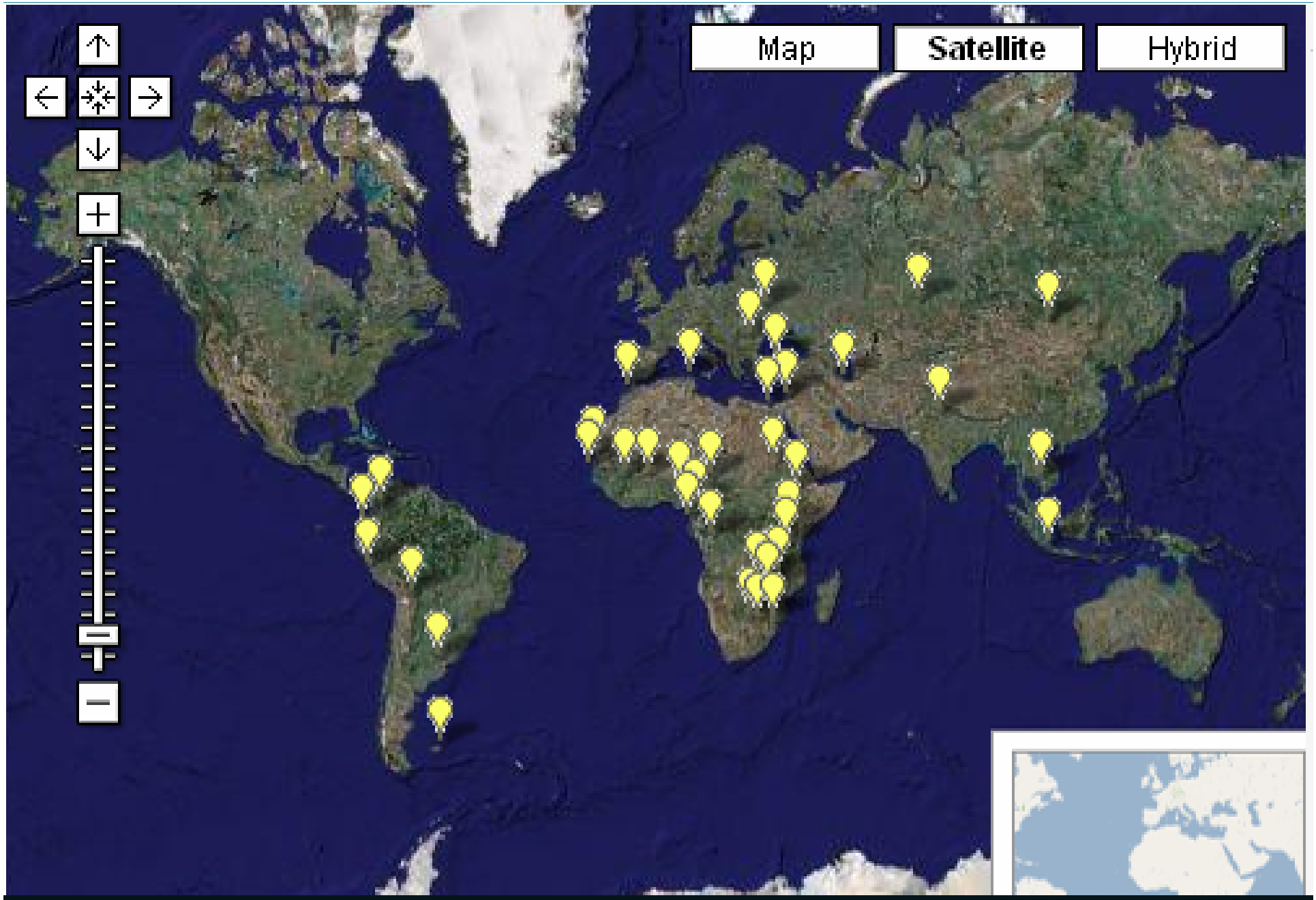
AEWA

NMRC Detachment - Peru

Schubot

Percy FitzPatrick Institute of African Ornithology University of Cape Town

UCDAVIS School of Veterinary Medicine WILDLIFE HEALTH CENTER


Map
Satellite
Hybrid

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- Mongolian National Academy of Sciences
- Institute of Veterinary Medicine
- State Central Veterinary Laboratory
- Ministry of Food and Agriculture Veterinary Department
- Ministry of Health

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Paek, Woon kee / NSM Korea

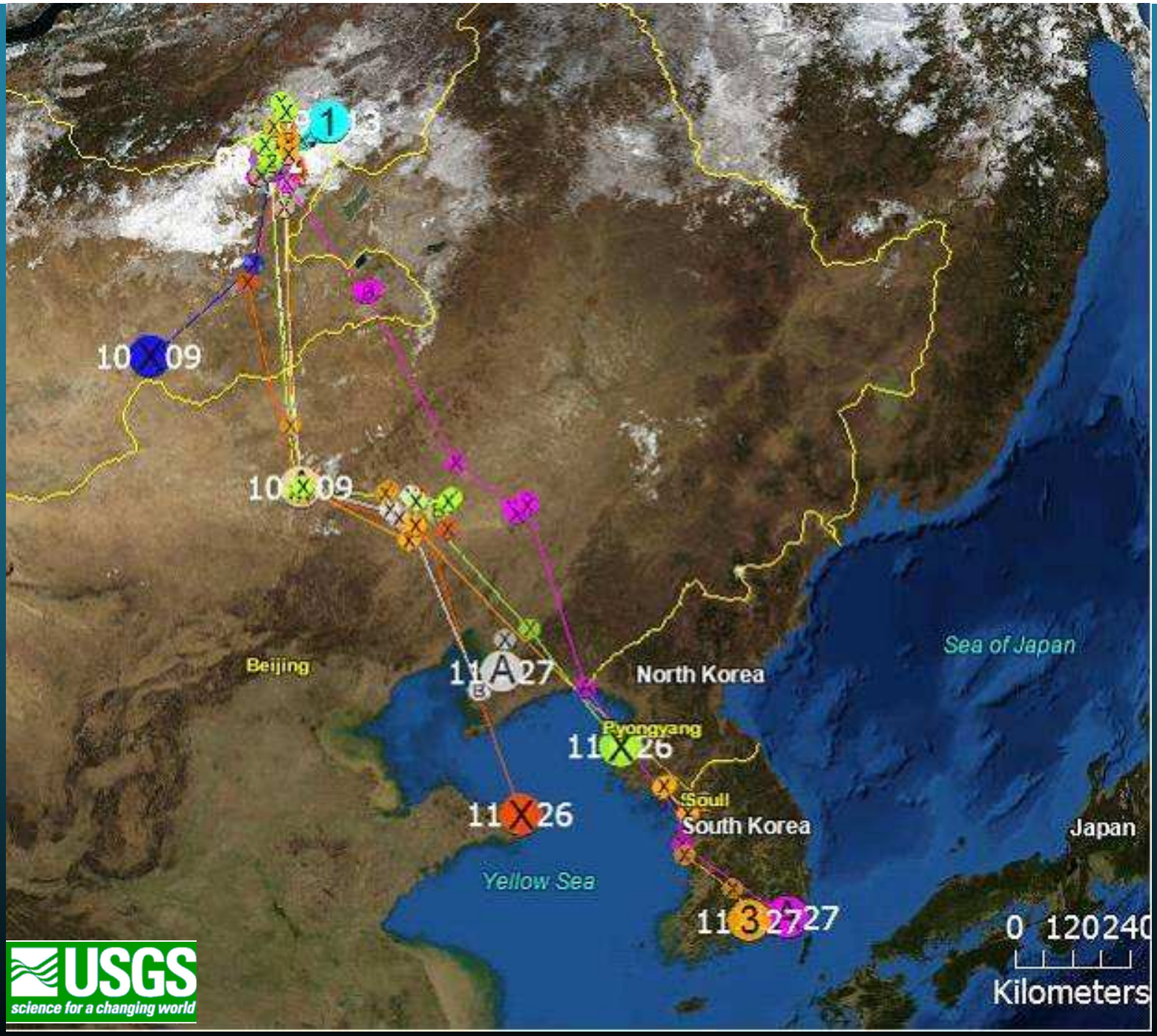
Beijing
North Korea
Pyongyang
Seoul
South Korea
Sea of Japan
Japan
Yellow Sea
0 120240
Kilometers
USGS
science for a changing world

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Photo by Quanhai Li[A20]
17th Nov 2007
liqh2213@163.com
Sanmenxia city,Henan province,China
(34°47'38.71"N, 111°14'9.40"E)

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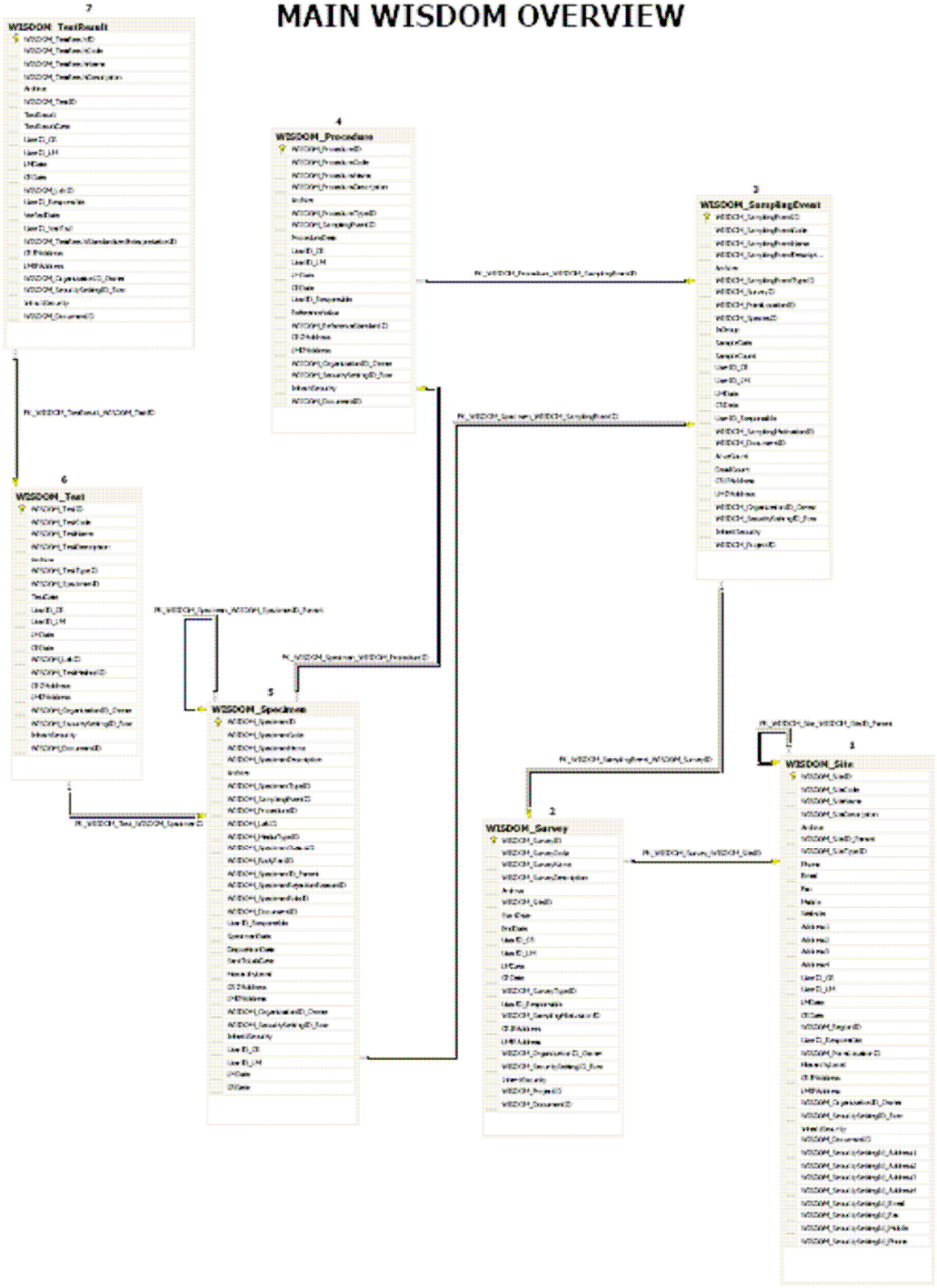
GAINS to Date

>30 Developing Countries

>850 people trained

>100,000,000 birds in database and mapping system

MAIN WISDOM OVERVIEW



Global Avian Influenza Network for Surveillance

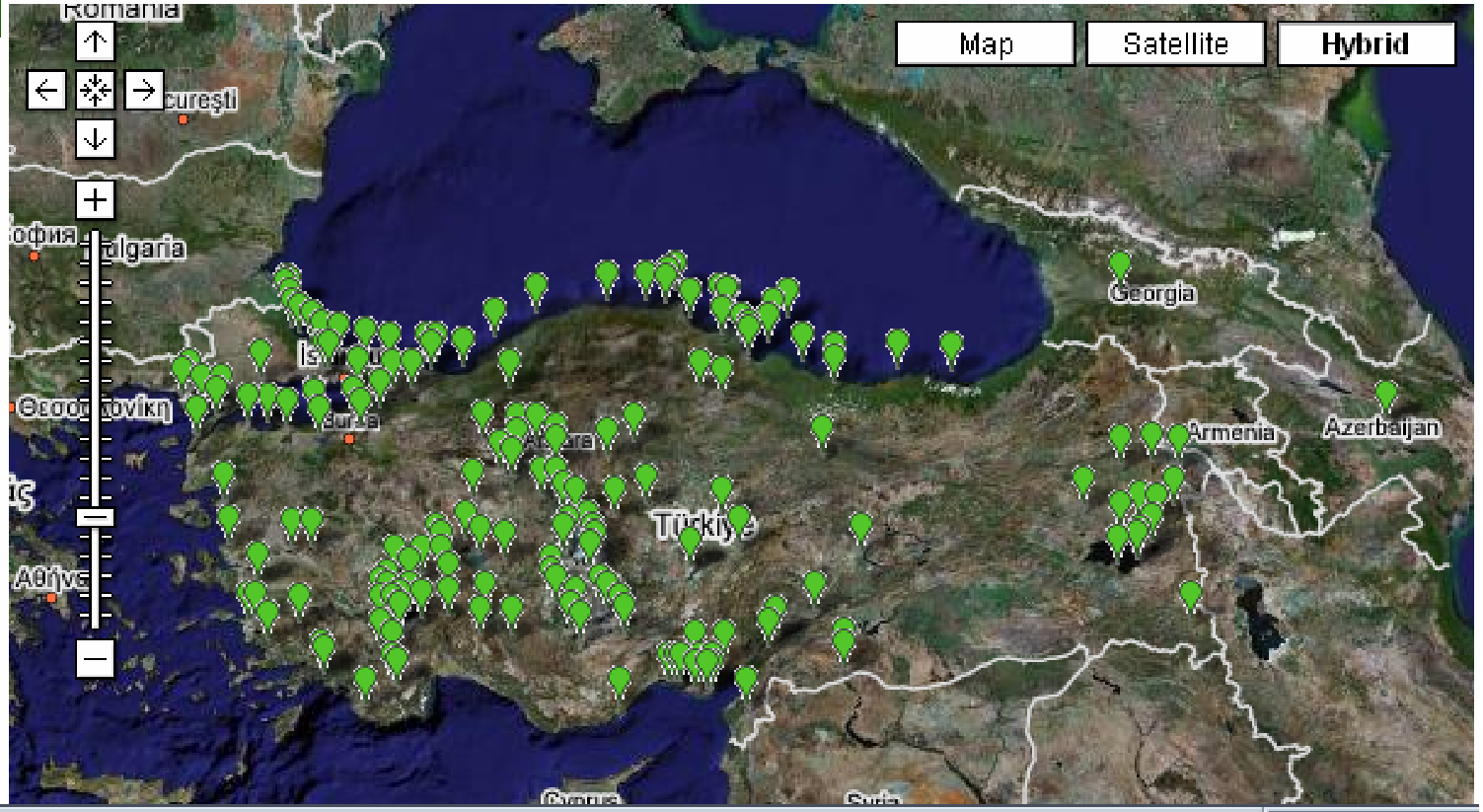
- Home
- Europe
- Azerbaijan
- Russian Federation
- Turkey
- Other Countries

Location: Locations & Mapping » Europe » Turkey

Billy Karesh Logout

Wild Bird Global Avian Influenza Network for Surveillance (GAINS)

During the early stages of GAINS, field activities will be focused where existing relationships with organizations and government agencies allow for implementation. Additional organizations and agencies are welcome to share information on current or previous activities and results related to the monitoring of wild birds. Please register with this site by clicking here if you are interested in contributing to the GAINS initiative.



- Azerbaijan
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- Turkey
- Other Countries

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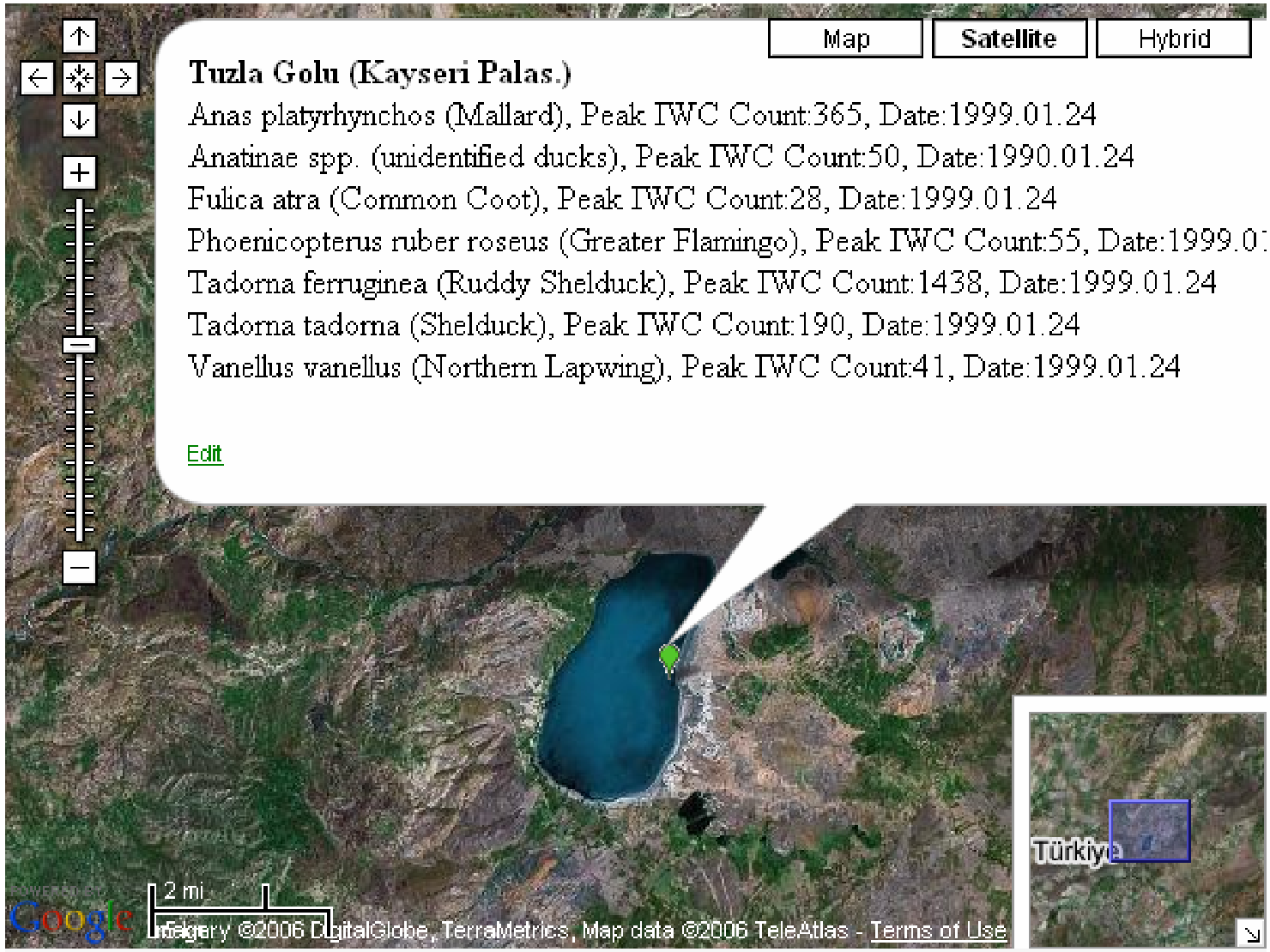
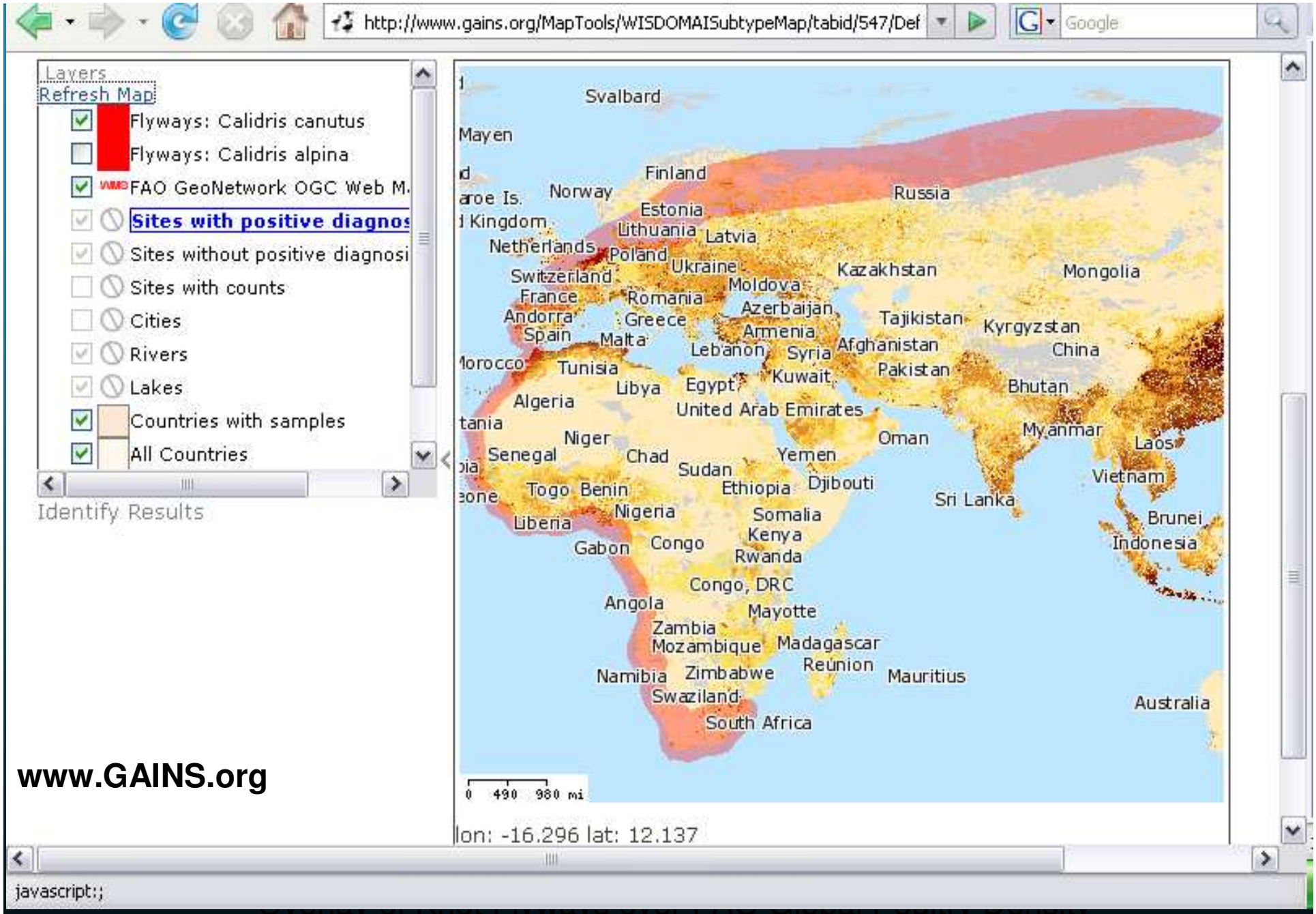


Lon: **35.8300018310547** Lat: **39.0200004577637**

The GAINS team is excited to release prototype maps like the one above using Google technology. We are in the process of developing more advanced mapping components that will be released at the start of 2007. If you have any feedback or



www.GAINS.org

Overlay of Wild Flyways over FAO Global Poultry Density

Going Forward

Wild Bird GAINS →

Wildlife Global Animal Information Network for Surveillance

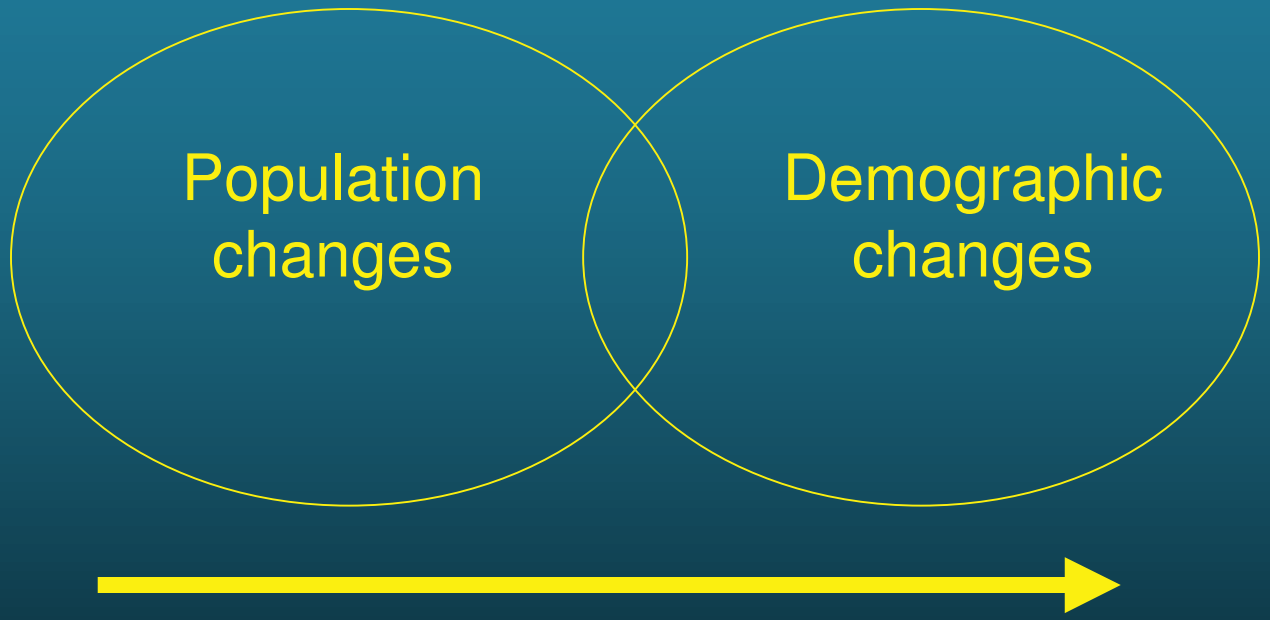
Monitoring of wildlife

Can provide anecdotal evidence to inform hypothesis driven research into more effective monitoring schemes, model development, and possibly mitigation strategies.

Ecological Appropriate Time Scales

Most wildlife have short generation times, so changes in environment could quickly be reflected in wildlife population dynamics.

Early Observations



Inter-Generational Interval

We know what's normal …

for many wildlife populations there exist good baseline data, particularly hunted or endangered populations

Elk and deer

Ducks and geese

“Balance of nature”

Wildlife and their pathogens in or near evolutionary stasis

Almost axiomatic: if there is a “wildlife disease” problem, there is human-induced disturbance

Wildlife as System Integrators

Wildlife population dynamics reflect the sum total of their environmental influences. So, changes in environment are "integrated" and translate into changes in population dynamics

Challenges in the science of climate change and ecosystems

- Complexity of ecological systems, and logistical constraints make experimental approaches very difficult to implement.
- Funding constraints associated with the necessary long-term studies
- Variability in ecological systems may mask the most important factors lying behind incremental changes in prevalence and severity of certain diseases.
- Thresholds (tipping points)

Long-term vision

- Move towards a better understanding of causal relationships between climate change and wildlife disease abundance, rather than rely on correlations
- Fundamental need for mitigation, adaptation, or compensatory action

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one world • one health