

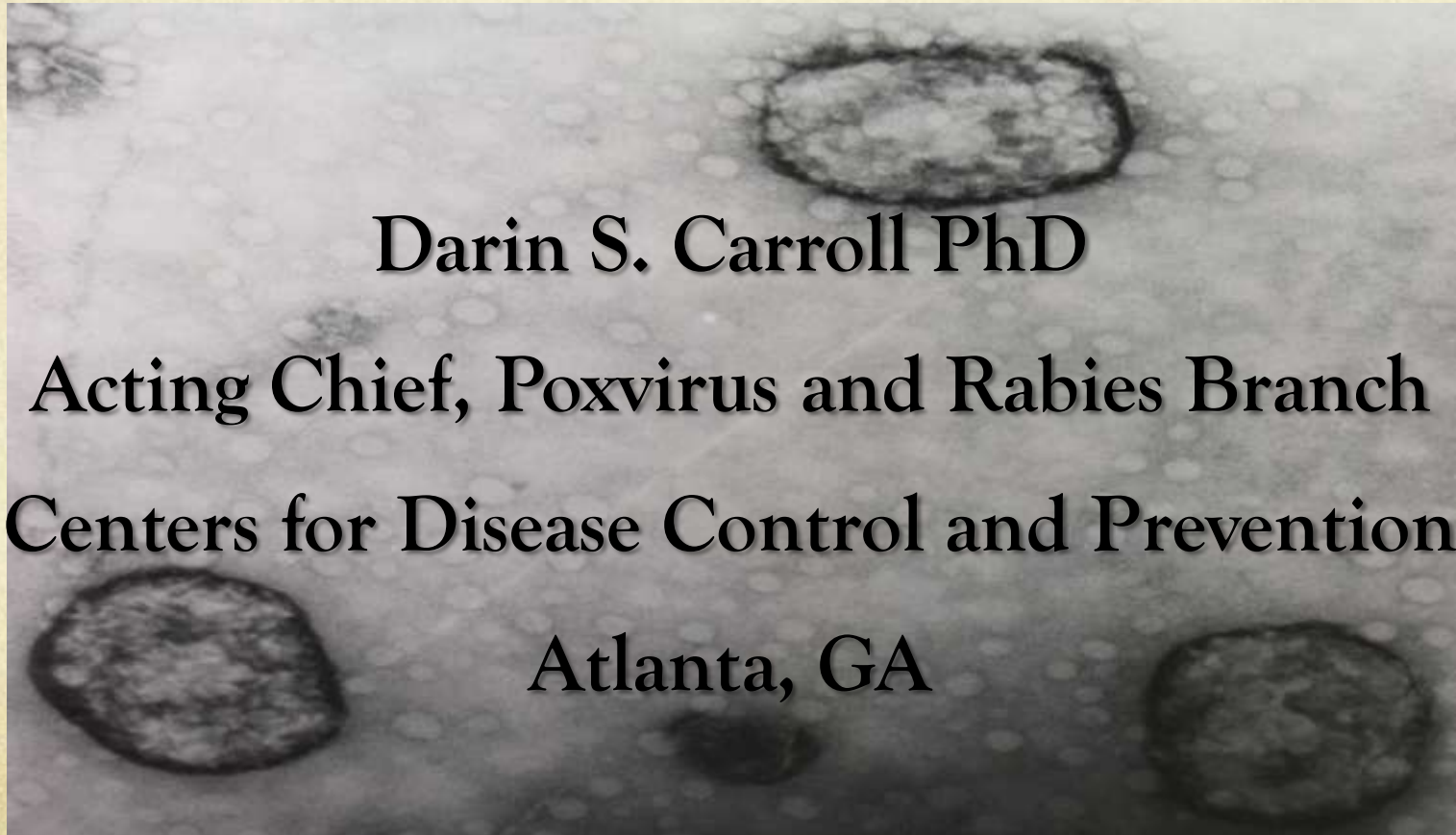
# A One Health and Emerging Poxviruses

**Darin S. Carroll PhD**

**Acting Chief, Poxvirus and Rabies Branch**

**Centers for Disease Control and Prevention**

**Atlanta, GA**



# Two Poxviridae subfamilies



5-6.



## I. Chordopoxvirinae

- Orthopoxvirus
  - variola, monkeypox, cowpox, vaccinia, raccoonpox, camelpox, skunkpox, ectromelia, taterapox
- Parapoxvirus
- Yatapox
- Molluscipoxvirus

## II. Entomopoxvirinae

- Insect poxviruses





# Poxvirus Characteristics and Routes of Exposure

- Poxviruses are stable in a wide range of environmental temperatures and humidity and may be transmitted by fomites.
- Virus may enter the body through mucous membranes, broken skin, or by ingestion, parenteral inoculation or droplet or fine-particle aerosol inhalation.
- Sources of laboratory-acquired infection include exposure to aerosols, environmental samples, naturally or experimentally infected animals, infectious cultures, or clinical samples, including vesiculopustular rash lesion fluid or crusted scabs, various tissue specimens, excretions and respiratory secretions.



# Non-Variola Biosafety Levels



ABSL-3 practices, containment equipment, and facilities are recommended for monkeypox work in experimentally or naturally infected animals.

BSL-2 facilities with BSL-3 practices are advised if vaccinated personnel perform other work with monkeypox virus.

Attenuated vaccinia strains are BSL-1 except in work areas where other Orthopoxviruses are manipulated.

BSL-2 and ABSL-2 plus vaccination are recommended for work with most other poxviruses.





# Enzootic Poxviruses in Animals

- Avipoxviruses
  - e.g. Canarypox, Fowlpox
- Suipoxvirus
  - e.g. Swinepox; mild, louse transmission
- Leporipoxvirus
  - e.g. Hare rabbit and squirrel fibroma, Myxoma

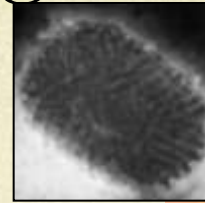


- Capripoxviruses
  - Goatpox, Goats, Asia, Africa, 50%-100% mortality in young
  - Lumpy skin disease; cattle, Africa, high mortality (~ 100%)
  - Sheeppox; Sheep, Asia, Africa, 50-100% mortality in young



# Molluscum Contagiosum

- Molluscum contagiosum virus (MCV) is the only virus belonging to the genus *Molluscipoxvirus*
  - The genome is ~ 190 kbp and consists of four genotypes (MCV 1-4)
  - Certain genotypes dominate geographical locations and clinical groups
- Humans are the only host
- MC is common in young children, young adults, and the immunocompromised
- Transmission occurs through contact with the infectious material via direct skin-to-skin contact, fomites



Images 1&2 from Bernard Cohen/DermAtlas  
Image 3 from Shahbaz Janjua/DermAtlas  
Image 4 from CDC's Public Health Image Library



# On the origin of smallpox: Correlating variola phylogenetics with historical smallpox records

Yu Li<sup>†</sup>, Darin S. Carroll<sup>†</sup>, Shea N. Gardner<sup>‡</sup>, Matthew C. Walsh<sup>†§</sup>, Elizabeth A. Vitalls<sup>‡</sup>, and Inger K. Damon<sup>†¶</sup>



- Worldwide, all live variola virus work is to be done only within WHO approved BSL-4/ABSL-4 facilities:
  - CDC Atlanta
  - The State Research Center of Virology and Biotechnology (VECTOR) in Koltsovo, Russia.
- Variola had a Zoonotic origin (ca. 70000 ybp)
- Variola Major reached Asia by 1600 ybp and started the smallpox pandemic

# Zoonotic Poxviruses

Parapoxviruses

Yatapoxviruses

Orthopoxviruses





# Parapoxvirus



<b>Species</b>	<b>Host</b>	<b>Geographic</b>	<b>Other infected hosts</b>
<b>Ausdyk</b>	<b>Camel</b>	<b>Africa, Asia</b>	<b>Humans</b>
<b>Orf</b>	<b>Sheep goats</b>	<b>Worldwide</b>	<b>Other ruminants, humans</b>
<b>Bovine papular stomatitis virus, pseudocowpox</b>	<b>Cattle</b>	<b>Worldwide</b>	<b>Humans</b>
<b>Red deer parapoxvirus</b>	<b>Red deer</b>	<b>New Zealand</b>	<b>Not known</b>
<b>Sealpox</b>	<b>Seals</b>	<b>Worldwide</b>	<b>Humans, dogs?, cats</b>



# Deer-associated Parapoxvirus

- January 2009 CDC rec'd a calls from 2 states about a suspected orf cases
  - Both patients were deer hunters, both had nicked their fingers while dressing deer in mid-November
  - Less than a month following exposure both developed lesions
- Genetic typing indicating virus was 'pseudocowpox-like', but sufficiently divergent to be novel
- 1 out of 20 Americans  $\geq$  16 years old\* hunt deer
  - Outreach/education



## Novel Deer-Associated Parapoxvirus Infection in Deer Hunters

Amira A. Roess, et al.

N Engl J Med 2010; 363:2621-2627 [December 30, 2010](#)





# Yatapoxvirus

brick-shaped, G+C 33%, ~ 145 kbp  
primates

- Tanapox (Yaba-like disease virus)
  - Febrile prodrome
  - Self limiting
  - Reservoir host unknown
  - E. Central Africa
  - No human to human transmission
  
- Yaba monkey tumor virus
  - Reservoir host unknown
  - West Africa
  - Human infection of animal handlers



# Genus *Orthopoxvirus*

Orthopoxvirus species	Geographic distribution	Reservoir host	Other naturally infected hosts
<b><i>Eurasian (Old World)</i></b>			
Camelpox	Africa, Asia	Camels	None
Cowpox	Europe, western Asia	Rodents	<b>Humans</b> , Cats, Cows, Zoo animals
Ectromelia	Europe	Rodents	None
Horsepox	Central Asia	<b>Unknown</b>	Horses
Monkeypox	Western, central Africa	<b>Unknown</b>	<b>Humans</b> , Monkeys
Taterapox	Western Africa	Gerbils	None
Uasin Gishu	Eastern Africa	<b>Unknown</b>	Horses
Vaccinia	Worldwide	<b>Unknown</b>	<b>Humans</b> , Rabbits, Cows, River buffaloes
Variola	Worldwide	<b>Humans only</b>	None
<b><i>North American (New World)</i></b>			
Raccoonpox	Eastern USA	Raccoons	Cats
Skunkpox	Western USA	Skunks	None
Volepox	Western USA	Voles	None



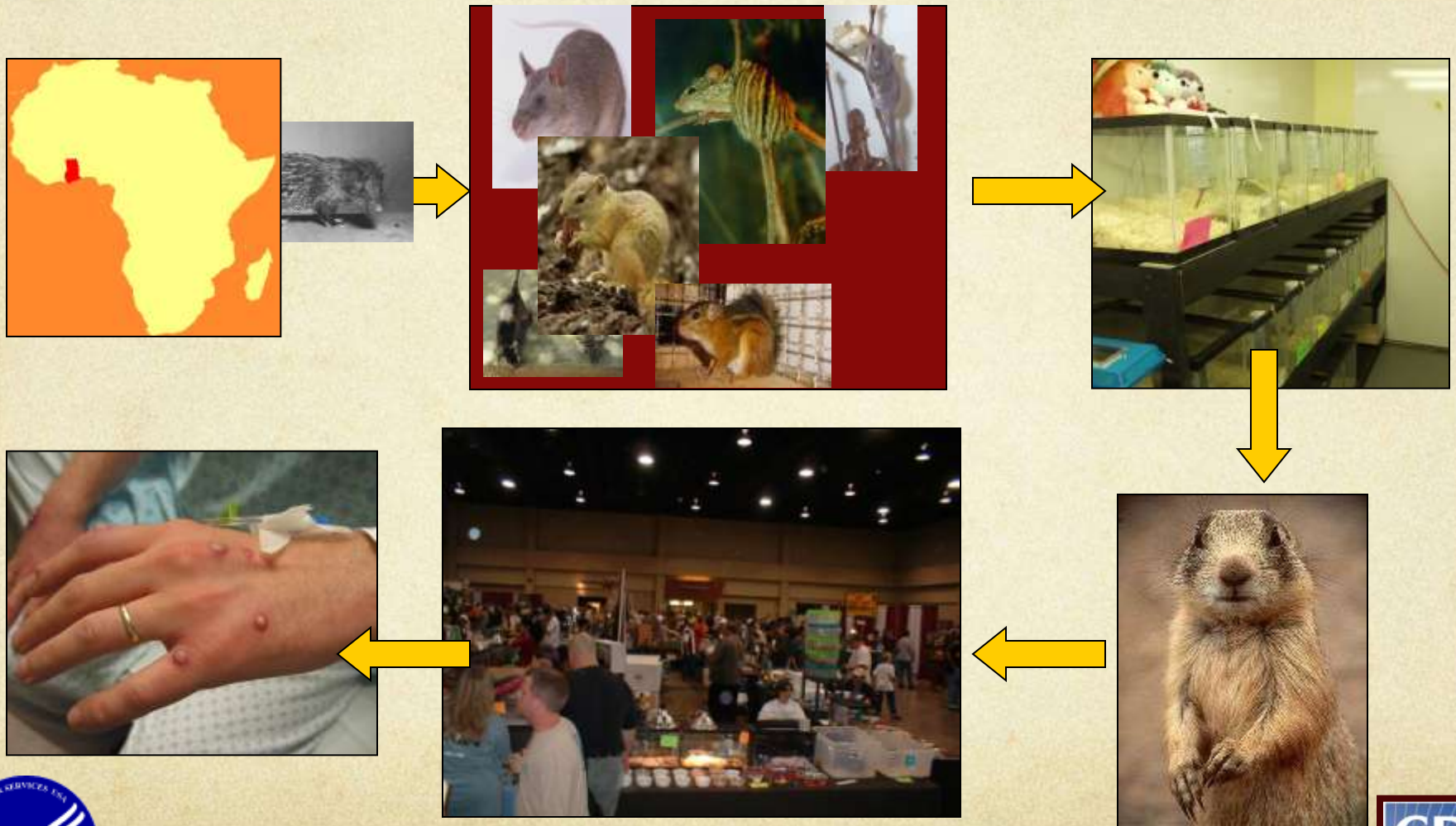


# Monkeypox

- First described in primate outbreak in 1958
- Association with human disease discovered in 1970
- Endemic in Congo basin >90% of cases in DRC



# Monkeypox Importation to the United States, 2003

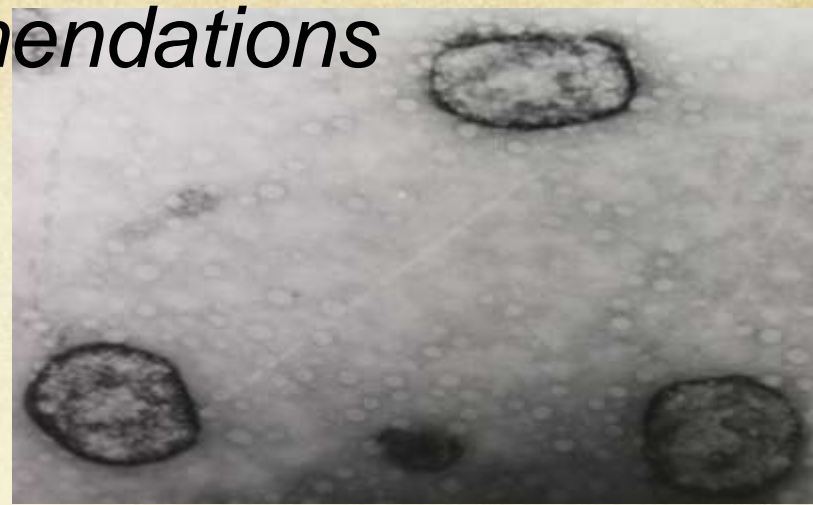








# Vaccination Recommendations



In general, all persons working in or entering laboratory or animal care areas where activities with vaccinia, monkey pox, or cowpox viruses are being conducted should have evidence of satisfactory vaccination.

Vaccination is advised every three years for work with monkeypox virus and every 10 years for cowpox and vaccinia viruses

Neither vaccination nor vaccinia immunoglobulin protect against poxviruses of other genera.







1749-1823

## *Edward Jenner: The father of modern vaccination*



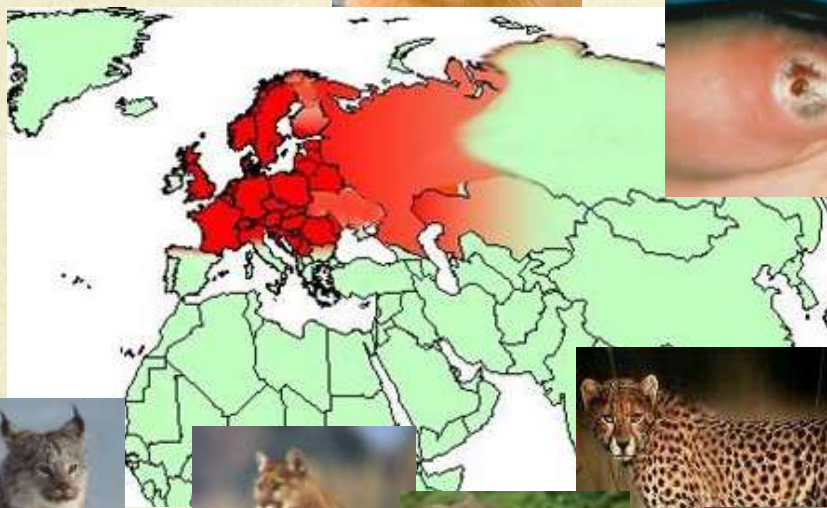
“In the present age of scientific investigation it is remarkable that a disease of so peculiar a nature as the cow-pox, which has appeared in this and some of the neighboring counties for such a series of years, should so long have escaped particular attention”

*Edward Jenner June 21<sup>st</sup> 1798 a letter to his friend C.H. Parry of Bath*





# Cowpox: Where is it now?





# Vaccinia in Brazil

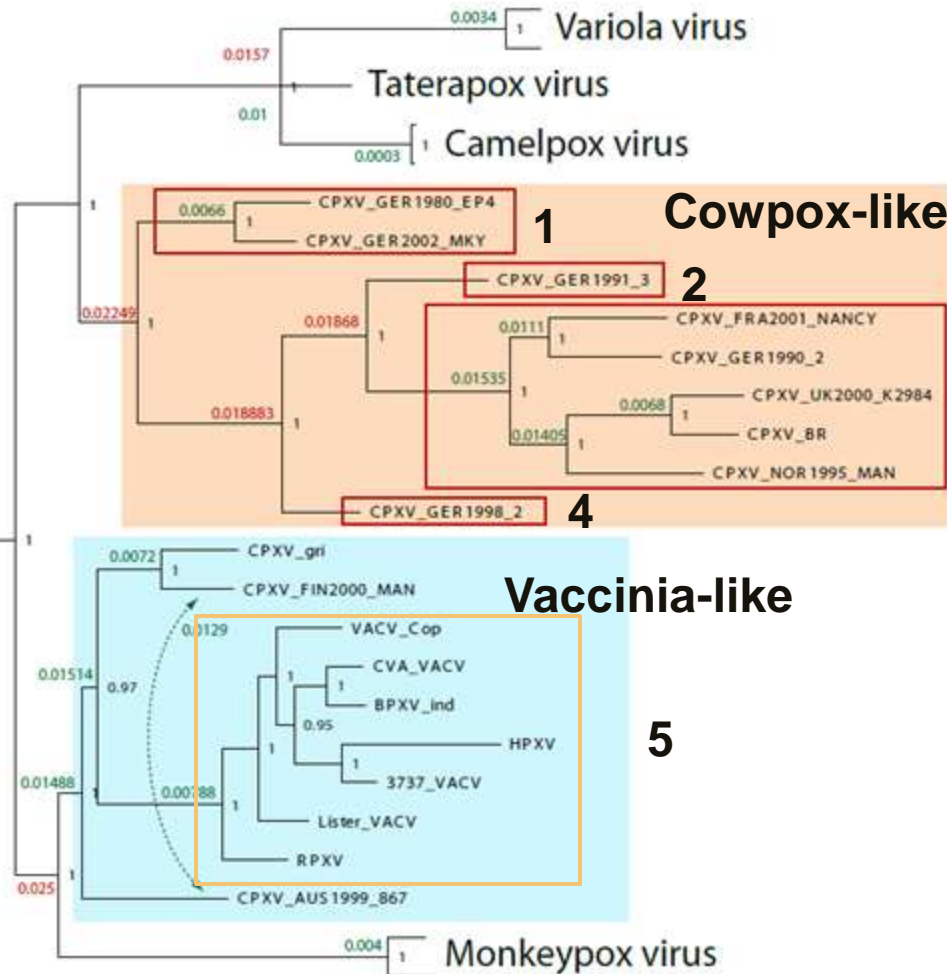
- Manual milking
- Milkers travel from farm to farm



*Arq. Bras. Med. Vet.*  
*Zootec., v.57, n.4, p.423-429,*  
*2005*



# Defining Cowpox Species



## Genetic distance

- Variola virus vs Taterapox virus
- 5 possible species
- 4 Cowpox-like
- 1 Vaccinia-like

Carroll DS, Emerson GL, Li Y, Sammons S, et al. (2011) Chasing Jenner's Vaccine: Revisiting Cowpox Virus Classification. PLoS ONE 6(8): e23086.

doi:10.1371/journal.pone.0023086

<http://www.plosone.org/article/info:doi/10.1371/journal.pone.0023086>





# Just when you think you have things figured out.....

## Brand New Smallpox-Related Virus Emerges In Country Of Georgia

The Huffington Post by [Amanda L. Chan](#)

•Posted: 05/01/2014 11:31 am EDT Updated: 05/01/2014 11:59 am EDT



Published Date: 2014-05-02 19:00:10

Subject: PRO/AH/EDR> Novel Orthopoxvirus - Georgia: potential biohazard?

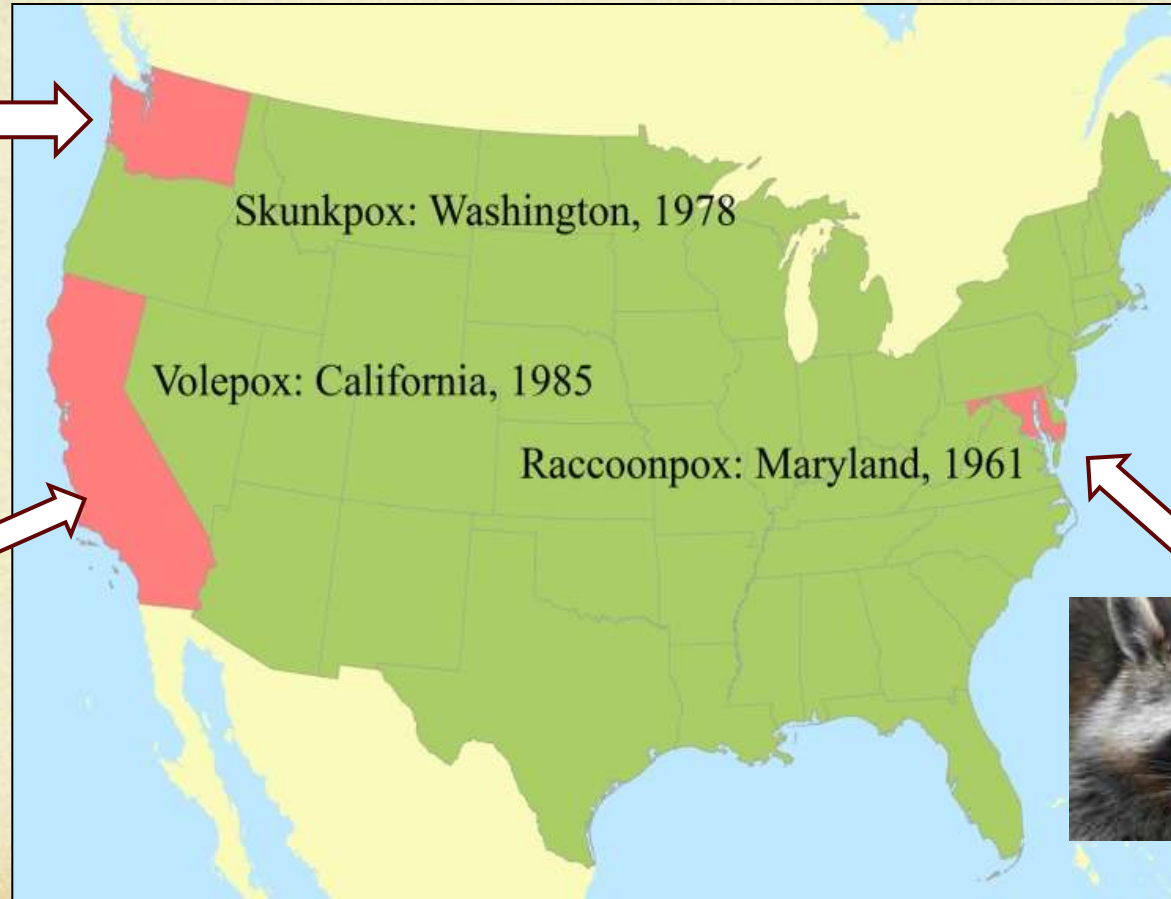
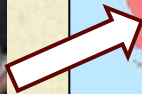
Archive Number: 20140502.2445865

NOVEL ORTHOPOXVIRUS - GEORGIA: POTENTIAL BIOHAZARD?

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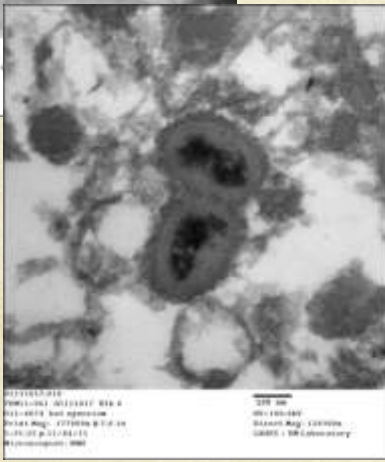
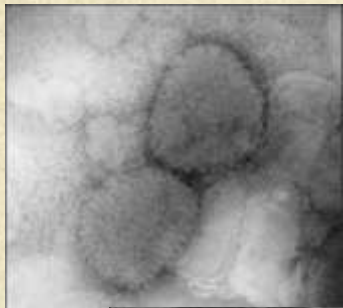
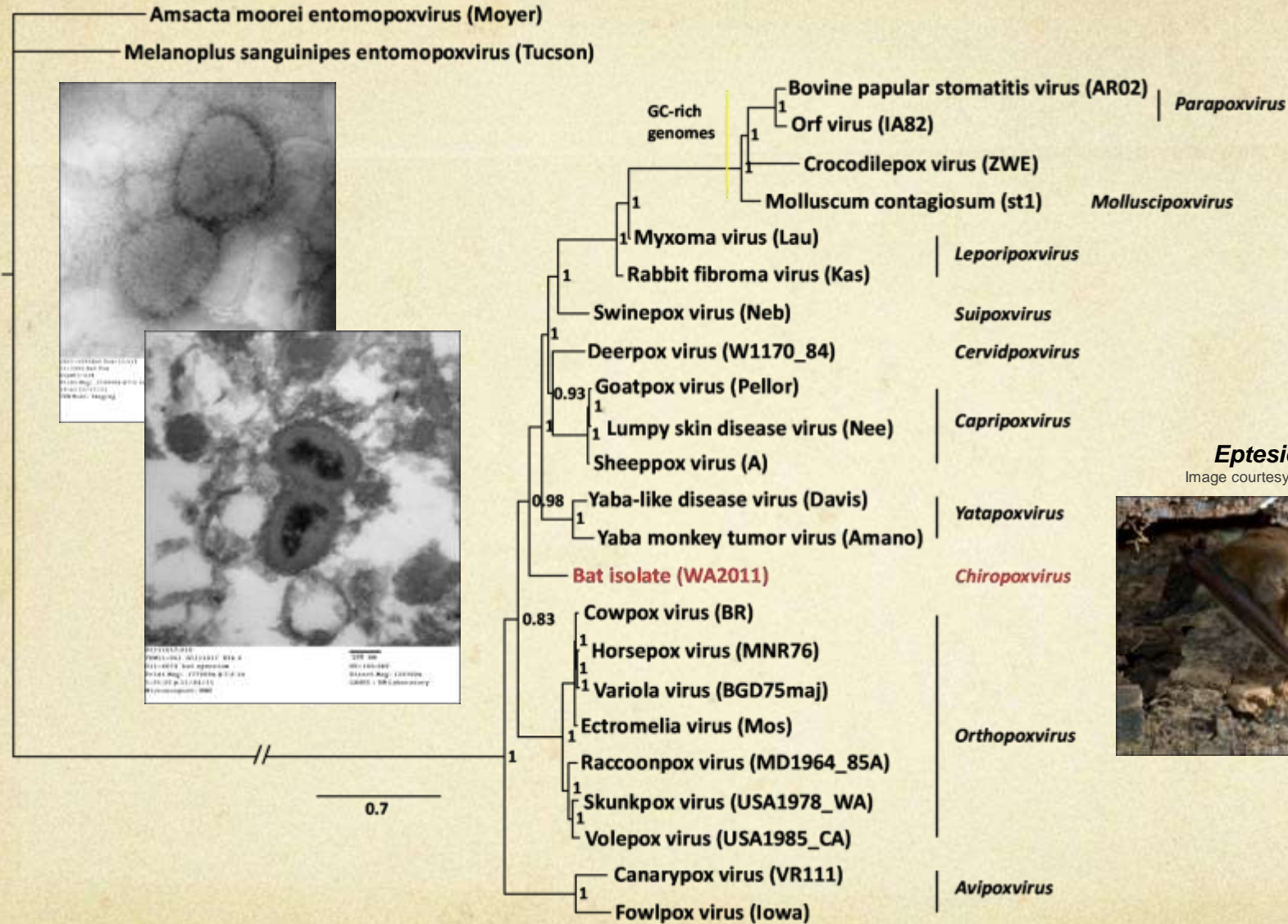


The last few decades have seen the description of three OPXV's from North America named after the species in which they were originally isolated: *Raccoonpox virus*, *Skunkpox virus*, and *Volepox virus*





# A Novel Poxvirus Isolated from Big Brown Bats in Northwestern United States



EID 19:6—June 2013

Novel Poxvirus in Big Brown Bats, Northwestern United States



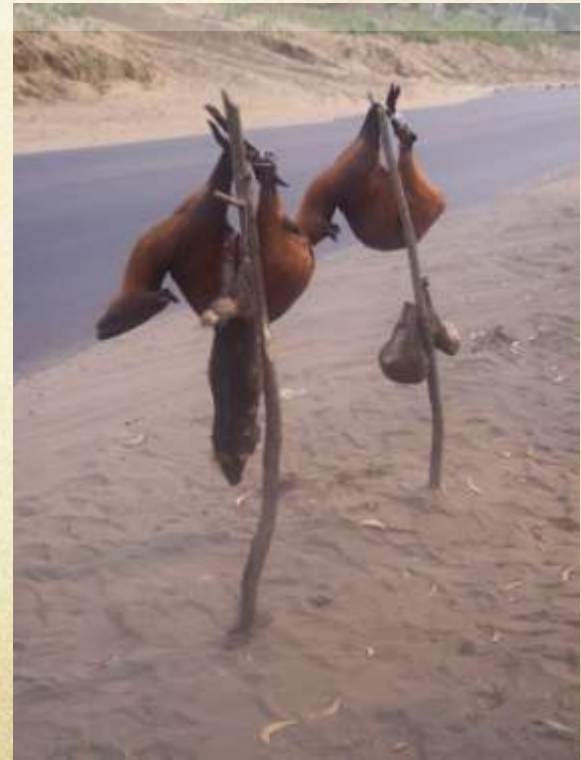


# Field Research Challenges

Effective use of PPE

Knowledge of protocols (and biology of the relevant diseases)

Knowledge of local culture (myths, customs)





# Always use protection!



<http://www.flowjo.com/newsletter/newsmail18c.html>

Darin S. Carroll PhD  
dcarroll@cdc.gov



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