

Marine Mammal Unusual Mortality Events 2013-2015 Mid-Atlantic Bottlenose Dolphins



Office of Protected Resources
Greater Atlantic Fisheries Regional Office
Northeast Fisheries Science Center
Southeast Fisheries Science Center
Southeast Regional Office
National Ocean Service
Northeast National Marine Mammal Stranding Network
Southeast National Marine Mammal Stranding Network
Department of Fisheries and Oceans, Canada
Georgia Aquarium
Hubbs SeaWorld Research Institute
Marine Mammal Pathology Services
Mid-Atlantic Bottlenose Dolphin Catalog
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SeaWorld Parks and Entertainment
University of California, Davis, College of Veterinary Medicine
University of Florida, College of Veterinary Medicine
University of Georgia, Athens Veterinary Diagnostic Laboratory
University of Georgia, College of Veterinary Medicine
University of Illinois, College of Veterinary Medicine
University of Pennsylvania, School of Veterinary Medicine
Working Group on Marine Mammal Unusual Mortality Events



Morbillivirus Overview

Members of the genus include:

- Measles (MeV) (humans, primates)
- **Rinderpest virus (cattle)**
- Peste-des-petits ruminants (sheep, goats)
- Canine distemper virus (CDV) (Carnivora = canids, felids, seals)
- Phocine distemper virus (PDV) (pinnipeds)
- Cetacean morbillivirus (CMV) [DMV/PMV/Other]

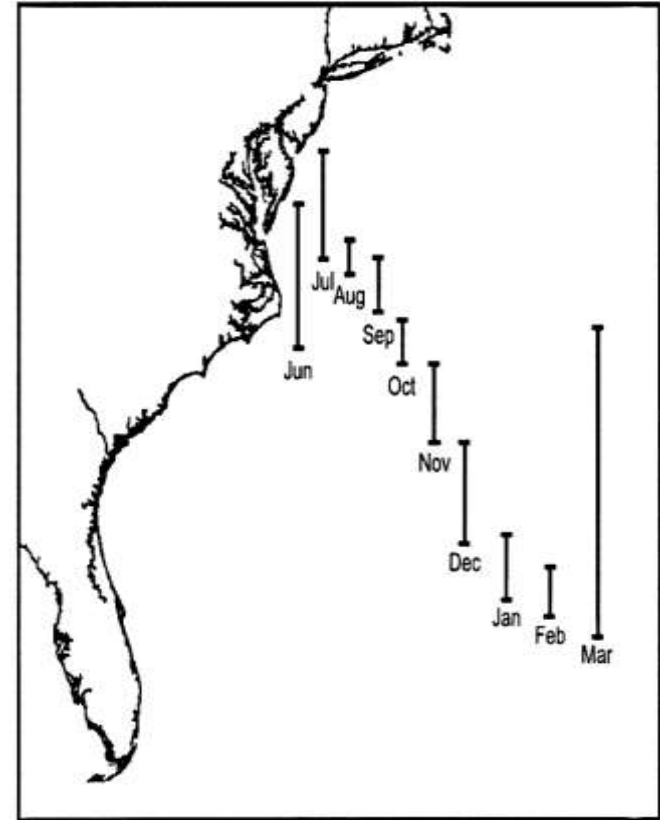
Morbillivirus Outbreaks

Bottlenose dolphins in the Mid-Atlantic
(1987–1988 ~ 700)

Striped dolphins in Mediterranean
(1990-1992 ~1000s)

Bottlenose dolphins in Gulf of Mexico
(1992 ~100s & 1994 ~100)

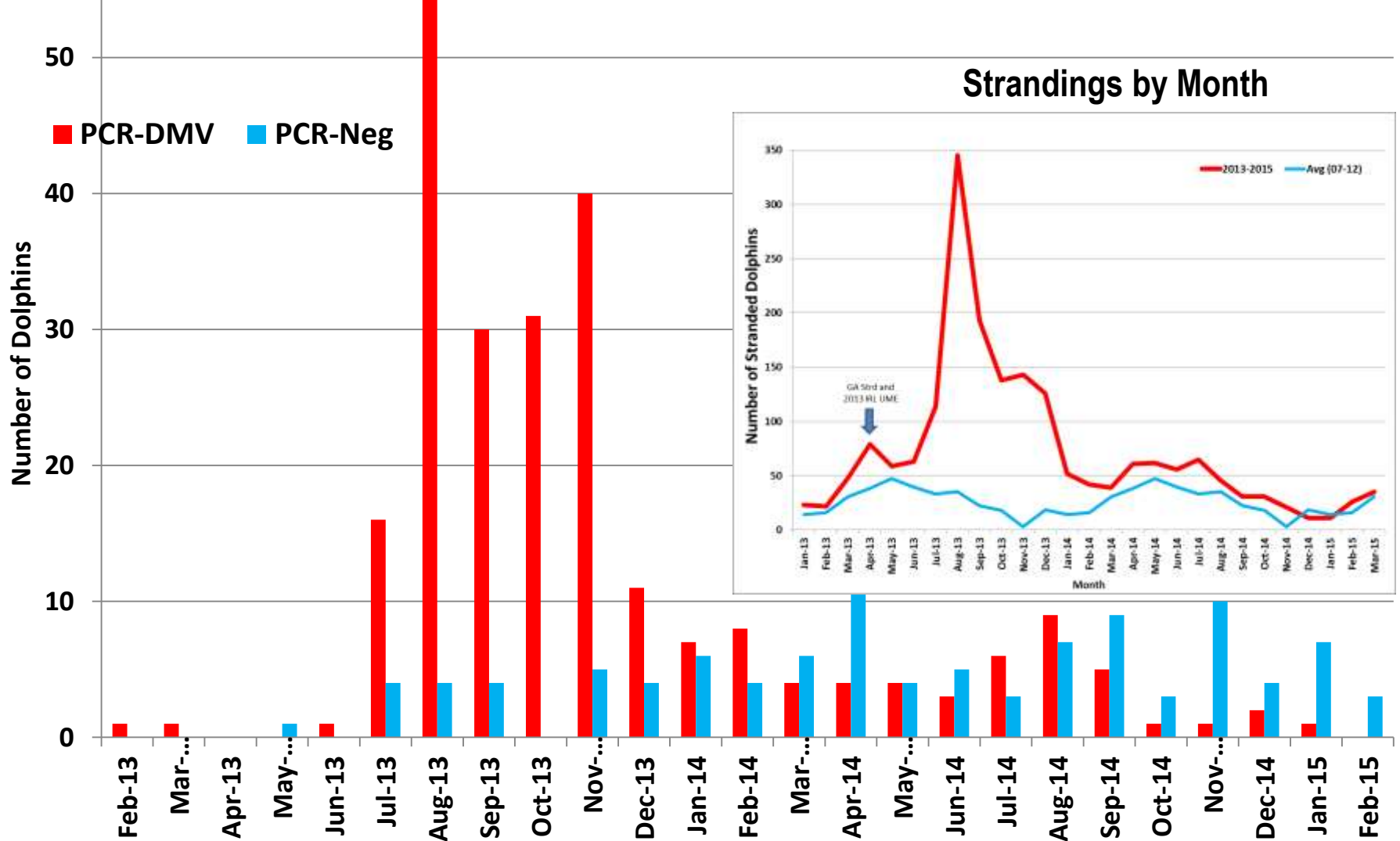
Striped dolphins in Mediterranean
(2007-2008 ~100s)



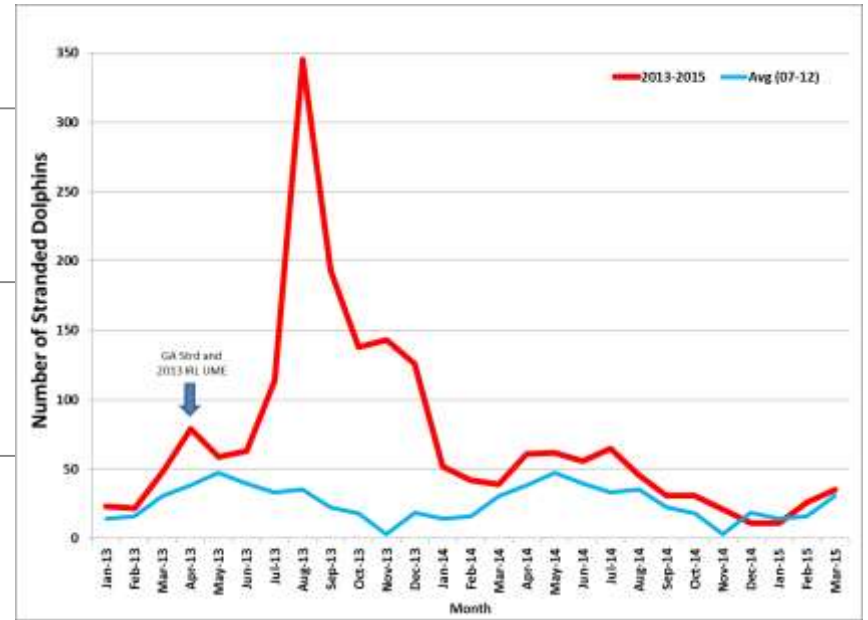
1987-1988 Dolphin CMV Event
From McLellan *et al.* (2002)

Results by Month 2013-March 2015

Morbillivirus Positives by Month



Strandings by Month

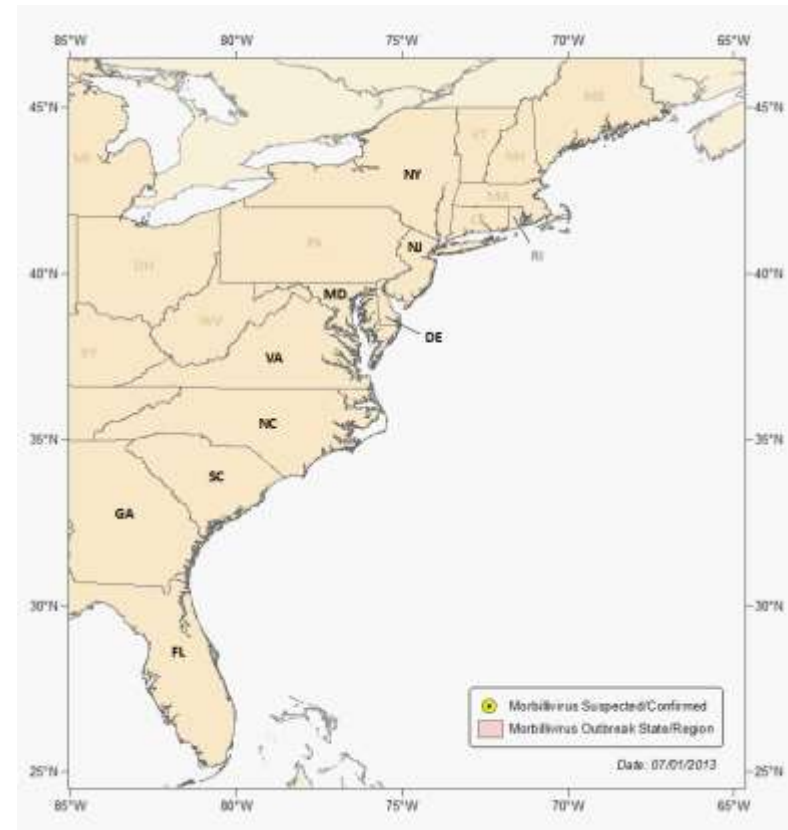


Response

Incident Command System

- Unified Command
- Support from START (Specialty Trained Animal Response Team)
- Safety, Welfare and Science
- States: targeted notification and activation: surveillance, confirmed, post UME monitoring
- Case Definition
- Research sample / data access
- Actions:
 - Required sampling and reporting
 - Rehabilitation restrictions in current facilities
 - Beach triage

Temporal/Spatial Distribution



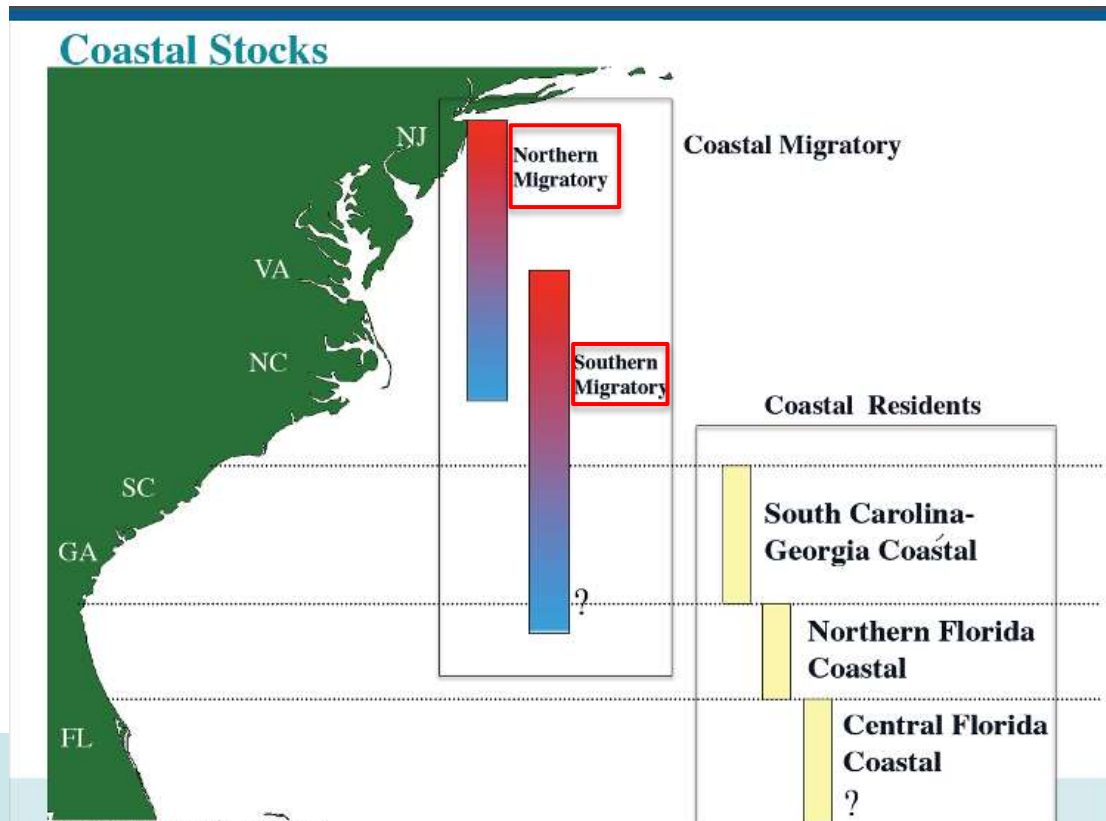
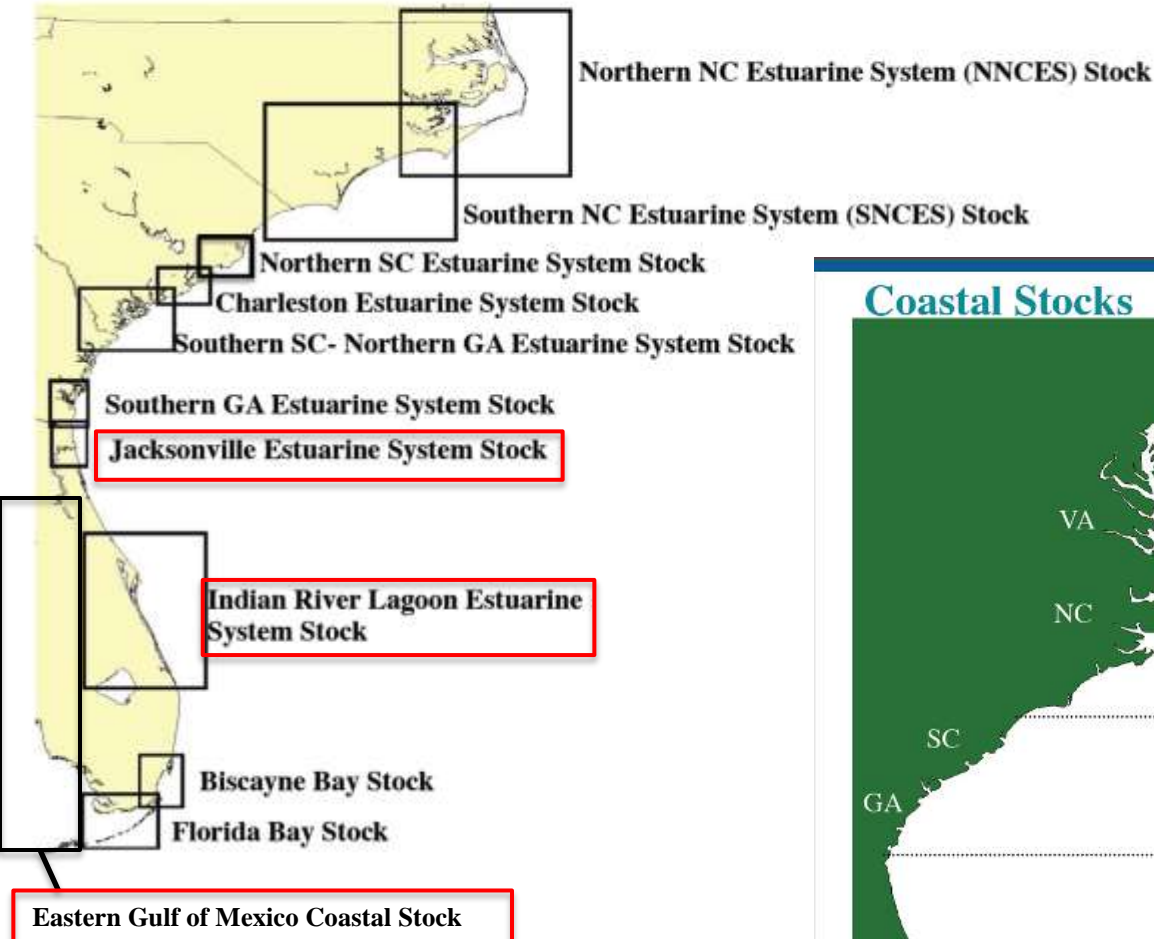
Species Infected with Morbillivirus



- **Tested 19 different cetacean species to date**
 - (6 species positive; 13 species negative)
 - **Bottlenose Dolphins**
 - 274/292 (93%) positive
 - **Fin Whales**
 - 1 of 3 (33%) Probable Case (PCR/IHC/Histo)
 - **Humpback Whales**
 - 3 of 6 (50%) Suspect/Probable Cases (PCR/IHC/Histo/Sequence)
 - **Minke Whales**
 - 1 of 7 (14%) Suspect Case (PCR/Histo/IHC Pend)
 - **Pygmy Sperm Whales**
 - 3 of 24 (13%) Suspect Cases (PCR/IHC/Histo/Sequence)
 - **Striped Dolphins***
 - 1 of 2 (50%) Confirmed Case (PCR/IHC/Histo/Sequence)
- *No confirmed clinical disease in any other positive whale or non-Tursiops species, except for the one Striped Dolphin based upon criteria defined for Delphinid morbillivirus
- **Serology titers ranged from 32 to 8192**

Bottlenose Dolphin Stocks at Risk

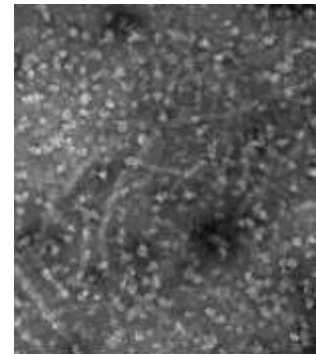
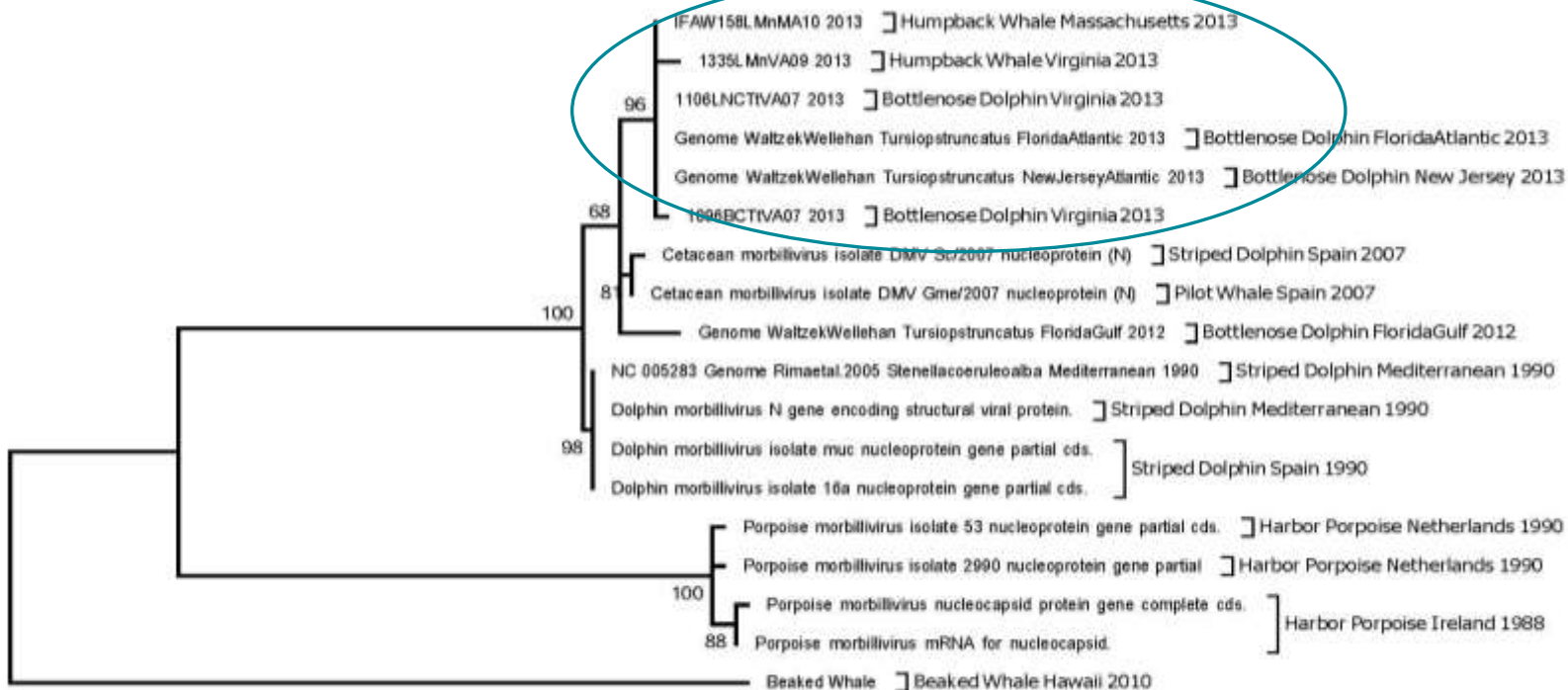
Estuarine Year-Round Resident Stocks



Morbillivirus Genetics

Morbillivirus viral isolation and whole genome sequencing

- Virus isolated from 13 cetaceans
- Whole Genome Sequencing (on tissues/isolates)
 - NY (1), NJ (1), VA (3), FL (2) Tursiops
 - MA (1), VA (1), NC (1) Humpback Whale
 - VA (1), NC (1) Pygmy Sperm Whale; NC (1) Striped Dolphin
- All 2013-2014 sequences 99.9% similar to each other



0.02

100x
1000x
10000x
100000x
1000000x

100x
1000x
10000x
100000x
1000000x

Ongoing Investigations

- **Dolphin Risk Factors**
 - Pending Analyses-Contaminants; Biotoxins; Behavior; Genetics
- **Understand Morbillivirus Infection in Dolphins**
 - **Host Factors/Response:**
 - Characterization of Gross and Histopathologic Findings included Secondary/Co-Infections
 - Comprehensive study to examine Tissue Distribution and Transmission/Shedding routes
 - Impacts and virus in survivors
 - **Virus Factors:**
 - Continued Whole Genome Sequencing of DMV from Other Species
 - Comparison of 2013-2015 DMV Sequence to GOM, MED, Hx Sequences
 - Dynamics of DMV outbreak and transmission- modeling efforts
 - **Retrospective Investigation to Identify Carrier Species or Sources of the Virus in the North Atlantic**
 - **Post UME monitoring:**
 - Stranding response
 - Planned health assessments –July 2015 IRL (GAq); Sept 2015 GA (MMHSRP/NCCOS)



Photo VAQ

Ongoing Research

Understand the impacts of the UME on each stock

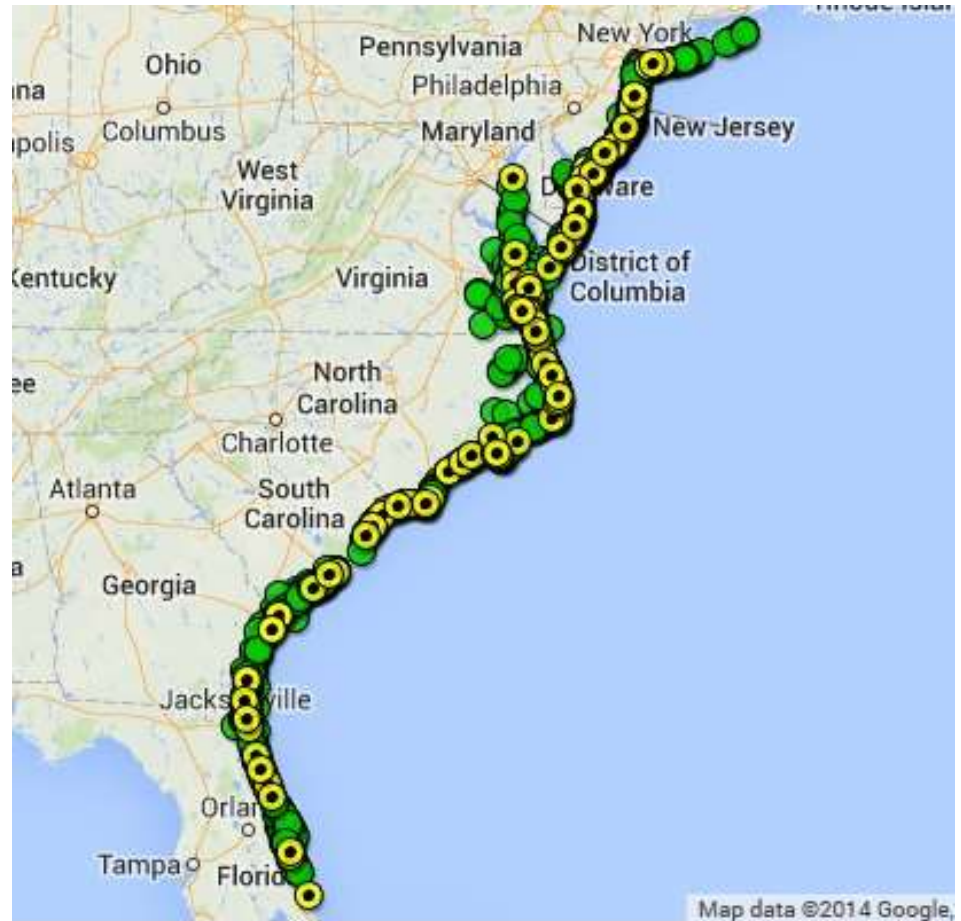
- Attribute each stranding to its stock (genetics, photo-id)
- Estimate mortality rates
- Estimate the effect on reproductive population (maturity state of stranded animals)

Match between WAM 671 (4 Sept 2013) recovered by the UNCW Marine Mammal Stranding Program, and DUML ID 75220 photographed on 2 Aug 2011; Male, 216 cm. Confirmed DMV.



In summary,

- **Largest morbillivirus epidemic** in cetaceans in North America
- Rapid and sustained collaborative response
- **Capacity building** in network enabled a more robust and prolonged response
- **Collaborative efforts** leading to significant new information on morbillivirus dynamics, risks, and management
- Stock specific impact assessment possible for some stocks
- **Leveraging** of resources critical to success





Building partnerships



Photo: MMSC

Examples of **public-private partnerships**

from the 2013-2015 Mid-Atlantic Bottlenose Dolphin UME

The Investigative Team

Chicago Zoological Society/Sarasota Dolphin Research Program, Clearwater Marine Aquarium, Georgia Aquarium Conservation Field Station, Georgia Aquarium, Harbor Branch Oceanographic Institute, Hubbs-SeaWorld Research Institute, International Fund for Animal Welfare, Marine Animal Rescue Society, Marine Mammal Conservancy, National Aquarium, MERR Institute, Mid-Atlantic Bottlenose Dolphin Catalog, Mote Marine Laboratory, National Marine Mammal Foundation, New Jersey Marine Mammal Stranding Center, Riverhead Foundation for Research & Preservation, Virginia Aquarium and Marine Science Center

Marine Mammal Pathology Services

Delaware Department of Natural Resources and Environmental Control, Department of Fisheries and Oceans, Canada, Florida Fish and Wildlife Conservation Commission, Georgia Department of Natural Resources, Maryland Department of Natural Resources, National Ocean Service-Hollings Marine Lab, National Park Service, New Jersey Department of Agriculture, NOAA Fisheries Greater Atlantic Fisheries Regional Office, NOAA Fisheries Northeast Fisheries Science Center, NOAA Fisheries Office of Protected Resources, NOAA Fisheries Southeast Fisheries Science Center, NOAA Fisheries Southeast Regional Office, North Carolina Department of Environment and Natural Resources, North Carolina Maritime Museum, Smithsonian National Museum of Natural History, South Carolina Department of Natural Resources, USDA-APHIS National Veterinary Services Laboratories

Investigative Team (Continued)

Coastal Carolina University; Duke University; North Carolina State University; Oxford University; Princeton University; University of California, Davis, School of Veterinary Medicine; University of Connecticut; University of Florida, College of Veterinary Medicine; University of Georgia, Athens Veterinary Diagnostic Laboratory; University of Georgia, College of Veterinary Medicine; University of Illinois; College of Veterinary Medicine; University of North Carolina at Wilmington; University of Pennsylvania, School of Veterinary Medicine

Additional Funding and Support

Georgia Aquarium, Marine Mammal Unusual Mortality Event Fund, New Jersey Department of Agriculture, NOAA Fisheries Emergency Prescott Grant Program, NOAA Fisheries Northeast Fisheries Science Center, NOAA Fisheries Office of Protected Resources, NOAA Fisheries Prescott Grant Program, NOAA Fisheries Southeast Fisheries Science Center, Princeton University; University of California, Davis, School of Veterinary Medicine