EPIZOOTIOLOGY OF THREE DISTINCT BREVETOXIN-ASSOCIATED BOTTLENOSE DOLPHIN MORTALITY EVENTS IN THE FLORIDA PANHANDLE

Joseph K. Gaydos,[1*] Nelio Barrios,[2] Gregory D. Bossart,[3,4] Sabrina Bowen,[5,6] Kathryn Evans,[7] Ruth Ewing,[8] Michelle L. Fleetwood,[9] Leanne Flewelling,[10] Ron Hardy,[11] Cindy Heil,[10] Christine Johnson,[12] Wanda Jones,[5] John Kucklick,[13] Jan Landsberg,[10] Jenny Litz,[8] Tod A. Leighfield,[7] Christina Lockyer,[14] Blair Mase,[8] Wendy Noke Durden,[15] Patricia Rosel,[16] David S. Rotstein,[17,18] Teri Rowles,[19] Lori Schwacke,[7] Trevor Spradlin,[19] Megan Stolen,[15] Michael J. Twiner,[7] and Frances M. Van Dolah[7]

[1]*UC Davis Wildlife Health Center–Orcas Island Office, 942 Deer Harbor Road, Eastsound, WA 98245*

[2]*Mote Marine Laboratory, 1600 Ken Thompson Parkway, Sarasota, FL 34236*

[3]*Harbor Branch Oceanographic Institute Marine Mammal Research and Conservation Stuart, FL*

[4]*Georgia Aquarium, 225 Baker St., NW, Atlanta, GA 30313 (current address)*

[5] *National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, 3500 Delwood Beach Rd., Panama City Laboratory, Panama City, 32408*

[6]*Marine Sciences, Savannah State University, Savannah, GA 31404 (current address)*

[7]*National Oceanographic and Atmospheric Administration, National Ocean Service, Center for Environmental Health and Biomolecular Research, Marine Biotoxins Program, Charleston, SC 29412*

[8]*National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami, FL 33149*

[9]*Armed Forces Institute of Pathology, 6825 16th Street NW, Washington, DC 20306-6000*

[10]*Florida Fish and Wildlife Conservation Commission, Florida Fish and Wildlife Research Institute, 100 8th Avenue SE, St. Petersburg, FL 33701*

[11] *Gulf World 15412 Front Beach Rd, Panama City, FL 32413*

[12] *Wildlife Health Center, UC Davis School of Veterinary Medicine, Davis, CA 95616*

[13]*National Institute of Standards and Technology, 331 Fort Johnson Road, Charleston, SC 29412*

[14]*Age Dynamics, c/o Innelvveien 201, Kaldfjord, N9100 Kvaløysletta, Norway*

[15]*Hubbs-Sea World Research Institute, 3830 South Hwy. A1A, Melbourne Beach, FL 32951*

[16]*National Marine Fisheries Service, Southeast Fisheries Science Center, 646 Cajundome Blvd, Suite 234, Lafayette, LA 70506*

[17]*College of Veterinary Medicine, University of Tennessee, 2407 River Drive, Room A201, Knoxville, TN 37996-4542*

[18] *National Oceanic and Atmospheric Administration/University Cooperative for Atmospheric Research, Smithsonian Museum Support Center, 4210 Silver Hill Road, Suitland, MD 20746 (current address)*

[19]*NOAA Fisheries, Cooperative Center for Marine Animal Health, 1315 East West Hwy Silver Spring MD 20901*

ABSTRACT

Brevetoxins are naturally occurring biotoxins produced by the dinoflagellate *Karenia brevis* (formerly *Gymnodinium breve* and *Ptychodiscus brevis*). While *K. brevis* blooms historically are rare, between 1999 and 2006, 348 bottlenose dolphins (*Tursiops truncatus*) stranded in the Florida Panhandle in association with three distinct brevetoxin-related marine mammal Unusual Mortality Events (UMEs). Between August 5, 1999 and May 20, 2000, 152 bottlenose dolphins stranded, between March 10 and April 13, 2004, 107 stranded and between September 19, 2005 and April 30, 2006, 89 stranded. All of the animals tested were of the coastal morphotype of bottlenose dolphin and likely came from several of the Gulf of Mexico Bay, Sound, and Estuarine Stocks as well as the Northern Gulf of Mexico Coastal Stock.

Postmortem examination of stranded dolphins failed to reveal consistent gross or morphologic pathologic findings, however toxicology revealed widespread exposure to brevetoxin with highest concentrations detected in stomach contents. Mortality was not sex related, which is consistent with the theory that brevetoxicosis in dolphins is mediated via the ingestion of contaminated prey (or via transmammary transfer in the case of neonates and calves). While a higher percentage of length class I animals (neonates / dolphins < 140 cm) strand during non-UME related time periods, a higher percentage of length class IV animals (201-240 cm) stranded during the 1999-2000 and 2005-2006 UMEs and a higher percentage of length class V animals (>240 cm) stranded during the 2004 event. It is likely that a higher percentage of neonates strand during non-UME related time periods due to the usual ecological obstacles to recruitment, while the three brevetoxin-related mortality events affected all length classes equally.

Unlike background strandings of bottlenose dolphins for the Florida Panhandle region, which are higher in March, UME-related strandings did not follow any particular monthly pattern. Excluding the 2004 UME, when no *Karenia brevis* bloom was detected, dolphin strandings were significantly positively correlated with *K. brevis* blooms, although not in real time. When the highest monthly bloom level was used as a proxy for *K. brevis* blooms, it was highly correlated with strandings when bloom data preceded strandings by 1 month. Additionally significant correlations were detected when data on highest monthly *K. brevis* count preceded strandings by 3, 4, and 5 months. Findings were similar when the number of *K. brevis* reports per month was used as a proxy for *K. brevis* blooms, especially when the bloom data were time lagged so they preceded strandings by 1, 3, 4 and 5 months. This suggests that while UMEs can occur in the absence of a detected *K. brevis* bloom, bottlenose dolphin mortality also can lag behind a detected bloom.

The variability in the duration of the three UMEs likely reflects *K. brevis* bloom dynamics and the variety of trophic pathways that brevetoxin can be transferred from *K. brevis* to dolphins. The 1999-2000 and 2005-2006 UMEs lasted approximately 7 or 8 months, while the 2004 UME occurred over the course of about 1 month. The 2004 UME was short, but significant likely because dolphins encountered and fed on planktivorous fish that contained high quantities of brevetoxin in their viscera. Although a *K. brevis* bloom was never detected, large numbers of brevetoxin-contaminated fish were detected in dolphin stomachs, which were greatly distended, suggesting a relatively direct trophic transfer of toxin from dinoflagellate to cetacean over a short time frame. Conversely, during the 2005-2006 UME, and likely the 1999-2000 UME, the

stomachs of stranded dolphins were not as full and contained a greater variety of prey items. Dolphin strandings also lagged behind highest recorded *K. brevis* bloom data by one month for both of these events. Combined, these data suggest that trophic transfer of toxin from dinoflagellate to cetacean was more diverse and consequently occurred over a greater time frame in these two UMEs when compared to the 2004 UME. Fieldwork has shown that the average levels of brevetoxins in fish are higher during or just after red tide event; however, brevetoxins can be sustained in the livers of fish for more than a year after the cessation of a bloom. This supports the concept that more indirect trophic transfer from dinoflagellate to cetacean can occur over a greater time period.

Determining the impact of these UMEs on Bay, Sound and Estuary and/or Northern Coastal bottlenose dolphin stocks is difficult due to the uncertainty that exists regarding the size and structure of these potentially overlapping stocks. It is likely that the three brevetoxin-related UMEs could have substantially impacted small localized estuarine bottlenose dolphin stocks such as those in Choctawhatchee Bay, St. Andrew's Bay and St. Joseph's Bay and also impacted the Northern Gulf of Mexico Coastal bottlenose dolphin stock.

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