National Wildlife Health Center
Wildlife Health Bulletin 2016-03

Batrachochytrium salamandrivorans (*Bsal*): An Emerging Disease of Salamanders

To: **Natural Resource/Conservation Managers**
From: **Dr. Jonathan Sleeman, Center Director, USGS National Wildlife Health Center**
Date: **April 7, 2016**

Batrachochytrium salamandrivorans (*Bsal*) is an emerging pathogen capable of causing significant morbidity and mortality in salamanders. The U.S. has the largest diversity of salamanders in the world and introduction of *Bsal* to North America could have severe impacts on biodiversity and amphibian conservation. The USGS National Wildlife Health Center (NWHC) is collaborating with multiple federal and state partners, including the multi-agency *Bsal* Task Force, to conduct diagnostic investigations and monitor for *Bsal* to better understand the fungus and to raise awareness about this threat to our native salamanders.

In 2013, unexpected mortalities of captive and wild fire salamanders (*Salamandra salamandra*), ultimately attributed to *Bsal*, were first observed in Belgium and the Netherlands, leading to significant salamander population declines. Since then, *Bsal* has also been detected in captive salamanders in the United Kingdom and Germany. Studies suggest that *Bsal* is likely endemic to Asia and may have been introduced into Europe through the global pet trade. Subsequent spillover from captive to wild populations is strongly suspected. From 2010 to 2014, over 750,000 salamanders were imported into the U.S., creating a high probability that *Bsal* could be introduced into the U.S. The USGS developed a risk assessment to predict the potential distribution of *Bsal* invasion within the U.S. and analyzed the potential consequences of an introduction (Richgels et al., 2016). The assessment identified that the total risk of *Bsal* introduction into the U.S. is greatest for the Pacific coast, southern Appalachian Mountains, and mid-Atlantic regions. Overall, the total risk is highest throughout the eastern U.S.

In response to the threat posed by the potential introduction of *Bsal*, the *Bsal* Task Force has identified ways to prevent introduction of this pathogen to the U.S., including: restricting imports, instituting quarantine, treatments and health certificate requirements for imported animals, establishing procedures for proper waste treatment by those who house captive salamanders, and conducting awareness campaigns. Accordingly, the U.S. Fish and Wildlife Service used risk assessments published by the USGS and Yap et al., 2015 to support an interim rule published in January 2016 that lists 201 species of salamanders that may harbor *Bsal* as injurious wildlife species under the Lacey Act. The interim rule prohibits importation or interstate transport of the listed salamander species and samples derived from the listed species unless a permit has been issued.

Currently, the NWHC is providing technical and diagnostic support for an intense surveillance effort in collaboration with the USGS Amphibian Research and Monitoring Initiative (ARMI). The NWHC and ARMI plan to screen approximately 10,000 salamanders in 2016 for the presence of *Bsal*. Sampling will focus on sites where the probability of introduction is highest and on salamander species that are most susceptible to the disease. In addition to the surveillance project, unusual morbidity and mortality events involving salamanders should be reported to the appropriate state or federal agency or to the NWHC (see contact information at the end of this bulletin). To facilitate this ongoing work, the NWHC has a permit that allows us to accept diagnostic specimens and samples from within the U.S.

To date, approximately one-third of all amphibian species are threatened by extinction making amphibians the most globally threatened vertebrate taxon (IUCN Red List of Threatened Species). *Batrachochytrium salamandrivorans* is closely related to the amphibian pathogen *Batrachochytrium dendrobatidis* (*Bd*) which is known to affect more than 200 amphibian species, is linked to spread through the global pet trade, has caused extinctions, and continues to be a

leading cause of amphibian mortality events worldwide. Thus, the potential impact of *Bsal* on salamander biodiversity is a serious concern. Early detection of *Bsal* would allow for the rapid institution of management actions to prevent and control the spread of the fungus should it be detected in North America.

Recent Publications of Interest

Richgels KLD, Russell RE, Adams MJ, White CL, Grant EHC. 2016, Spatial variation in risk and consequence of *Batrachochytrium salamandrivorans* introduction in the USA. *R. Soc. Open Sci.* 3: 150616. http://dx.doi.org/10.1098/rsos.150616

> This study describes the development of a *Bsal* risk assessment based upon fungal ecology, spatial data on imports and pet trade establishments, and salamander species diversity. The Pacific coast, southern Appalachian Mountains, and mid-Atlantic regions are predicted to have the highest relative risk from *Bsal* exposure. Ongoing priorities include import restrictions and surveillance of high-risk areas. USGS distributed a press release about this publication.

Grant EHC, Muths E, Katz RA, Canessa S, Adam MJ, Ballard JR, Berger L, Briggs CJ, Coleman J, Gray MJ, Harris MC, Harris RN, Hossack B, Huyvaert KP, Kolby JE, Lips KR, Lovich RE, McCallum HI, Mendelson JR III, Nanjappa P, Olson DH, Powers JG, Richgels KLD, Russell RE, Schmidt BR, Spitzen-van der Sluijs A, Watry MK, Woodhams DC, White CL. 2016, Salamander chytrid fungus (*Batrachochytrium salamandrivorans*) in the United States—Developing research, monitoring, and management strategies: U.S. Geological Survey Open-File Report 2015-1233, 16 p. http://dx.doi.org/10.3133/ofr20151233

> This publication describes key findings, top research priorities, and outcomes of the first international workshop to identify crucial *Bsal* research and monitoring needs. The workshop was led by the USGS ARMI and included individuals from wildlife conservation organizations, resource management agencies, and academic institutions from the U.S. and Europe. The workshop facilitated development of the *Bsal* Task Force and a *Bsal* Strategic Action Plan.

Yap TA, Koo MS, Ambrose RF, Wake DB, Vredenburg VT. 2015, Averting a North American biodiversity crisis: A newly described pathogen poses a major threat to salamanders via trade. *Science*, 349(6247), 481-482. doi: 10.1126/science.aab1052. UCLA: 926087. http://escholarship.org/uc/item/3bn651f5

> This study analyzed the threat of *Bsal* to North America, the risk of the amphibian trade, and the need for mitigation and response to *Bsal* invasion. Three zones of high risk were identified including the southeastern U.S., western U.S., and the highlands of central Mexico. The five most active ports of salamander importation include Los Angeles, CA, Tampa, FL, New York, NY, Atlanta, GA, and San Francisco, CA. Future studies were recommended to analyze transmission, susceptibility, and other influential variables.

For questions regarding *Bsal* surveillance, please contact Dr. Daniel Grear, 608-270-2478, or Dr. Natalie Nguyen, 608-270-2400 x2394.

Disease Investigation Services:
To request diagnostic services or report wildlife mortality, please contact the NWHC at **608-270-2480** or by email at NWHC-epi@usgs.gov, and a field epidemiologist will be available to discuss the case. To report wildlife mortality events in Hawaii or Pacific Island territories, please contact the Honolulu Field Station at 808-792-9520 or email Thierry Work at thierrywork@usgs.gov. Further information can be found at http://www.nwhc.usgs.gov/services/.

Wildlife Mortality Reporting and Diagnostic Services Request Worksheet

If you have any questions or concerns regarding the scientific and technical services we provide, please do not hesitate to contact NWHC Director Jonathan Sleeman at 608-270-2401, jsleeman@usgs.gov.

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