

Bsal Task Force

2017 Annual Report

January 2018



salamander
fungus
.org

Background

Batrachochytrium salamandrivorans (*Bsal*) is an emerging fungal pathogen that infects amphibian skin. It was discovered in 2013 in Europe, following the discovery of ongoing mortality of Fire Salamanders (Martel et al. 2013). It appears to be expanding in distribution (Spitzen-van der Sluijs et al. 2016). A 2014 experiment (Martel et al. 2014) revealed susceptibility of salamanders from around the world to the pathogen, including some North American species. At a 2015 workshop in Colorado, researchers and managers discussed approaches to learn more about *Bsal* and the related emerging infectious disease caused by it and to forestall potential biodiversity losses in the Americas where it was not known to occur (Grant et al. 2016).

The *Bsal* Task Force was initiated in June 2015 (Figure A, below). Seven interactive Working Groups (Figure B) were formed: 1) Surveillance/Monitoring, 2) Diagnostics, 3) Data Management, 4) Response, 5) Outreach/Communication, 6) Research and 7) Decision Support.

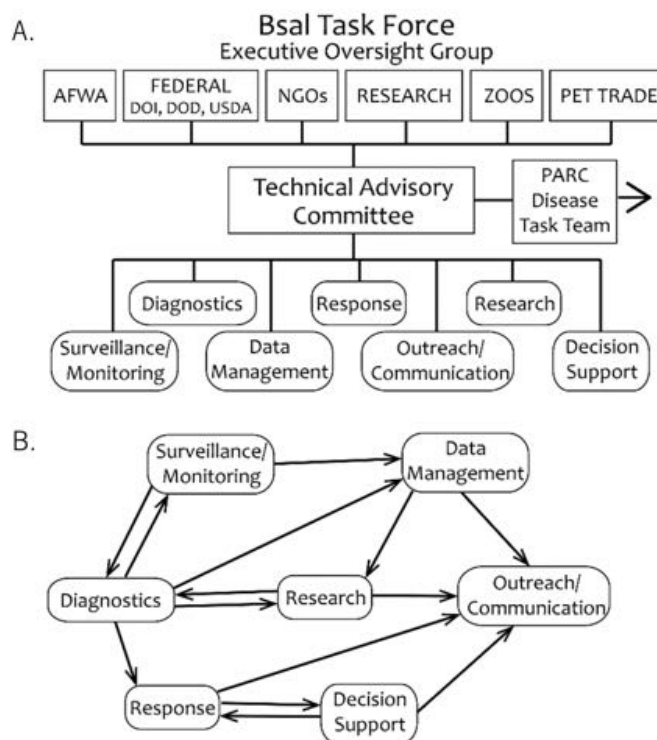


Figure A (top), Structure of the *Bsal* Task Force. Figure B, Interactive Working Groups within the task force.

Working Group leads serve on the Technical Advisory Committee, which also includes representatives from concerned partner groups such as the Pet Industry Joint Advisory Council (PIJAC), Amphibian Survival Alliance, and US federal agencies. An Executive Oversight Group was envisioned for consultation. Related tasks have been taken up by the Disease Task Team founded by Partners in Amphibian and Reptile Conservation (PARC), and an independent working group in Canada, the Canadian Herpetological Health Working Group. National amphibian disease contacts in Mexico have been identified.

Actions to forestall *Bsal* transmission have been undertaken by three key partners. In 2015, the PIJAC instituted a moratorium on Asian salamander imports. In early 2016, the US Fish and Wildlife Service implemented an Interim Rule of the Lacey Act, naming 201 salamanders as injurious. They used an evidence-based approach prohibiting importation of any salamander genus whose members were shown to be carriers or to be lethally affected by *Bsal* in published papers. In the summer of 2017, Canada implemented import restrictions on all salamanders (Customs Notice 17-17; <http://www.cbsa-asfc.gc.ca/publications/cn-ad/cn17-17-eng.html>). This report compiles activities conducted by the *Bsal* Task Force and their partners from September 2016 to August 2017.

Key Accomplishments in 2016-2017

- The **US Department of Interior Strategic Sciences Group** conducted a two-day workshop to assess the immediate consequences of and responses to the hypothetical discovery of a *Bsal*-related die-off event in the United States. This exercise provided a detailed glimpse of the array of decisions that managers would be faced with in response to *Bsal* discovery, including actions to respond to a die-off episode. This information is being used to help enhance preparation and highlights the need to evaluate objectives and management options in advance of *Bsal* discovery.
- The **Partners in Amphibian and Reptile Conservation (PARC) Disease Task Team** has established a herpetofauna disease reporting system to help make sure that observations of disease-related mortality episodes are communicated to authorities who can determine if further investigation is needed. Among other things, this system helps increase the odds of discovering *Bsal* early in the invasion process.
- Data management is key to research and surveillance. A data sharing portal has been established but is in need of funding to sustain.
- Several surveillance programs have independently reported initial findings of *Bsal* testing in the wild and captivity in North America: to date, *Bsal* has not been reported in North America. *Bsal*-related literature and information is posted at: salamanderfungus.org and amphibiandisease.org
- The **Government of Canada** implemented an importation restriction on all salamander (Caudata) species. The restriction was enacted through an amendment to the Wild Animal and Plant Trade Regulations (WAPTR) in May 2017. It prohibits salamander importation into the country unless authorized by a permit issued by Environment and Climate Change Canada (ECCC). It is a temporary (1-yr) measure put into force while ECCC officials develop a longer-term regulatory approach based upon risk assessment and consult with stakeholders.

Task Force Organization

The *Bsal* Task Force is an ad hoc group of scientists, managers, and citizens who are helping to understand and forestall the threat of *Bsal* in North America. Although a central focus is to coordinate strategic planning and efforts in the USA, there is participation from both Canada and Mexico, and also with European and Australian scientists.

Organizational Progress

Working Groups were initially formed in June 2015. Since then, they have met via conference calls on a regular basis to outline new tasks and discuss progress on existing efforts. Group membership is open and inclusive, but was initially founded with persons involved with disease research, natural resource management in state and federal agencies, environmental or conservation groups, non-governmental organizations, and the pet industry. Each group has one to three leads, who help to coordinate personnel, manage the workload, and report to the Technical Advisory Committee.

The Technical Advisory Committee (TAC) is populated by the Working Group leads and representatives from selected partner groups including federal agencies, the IUCN Amphibian Survival Alliance (ASA), and the Pet Industry Joint Advisory Council (PIJAC). The TAC meets by conference call monthly, with a focus on new items and round-robin reporting by participants. New items have included tasks to be assigned or delegated to others, opportunities for products and grant proposals, and communication-outreach and networking needs. Monthly meeting notes are routed to TAC members, then to their working group members, to ensure communication. A lead for the TAC is determined by the TAC and is rotated each year. The incoming and outgoing leads serve as co-leads. Decisions of the TAC are made by consensus.

An Executive Oversight Group (EOG) was originally envisioned to be created as a mechanism to inform managers or leaders of new *Bsal* information or emerging *Bsal* topics at higher organizational levels, potentially including US Department staff, the Association of Fish and Wildlife Agencies (AFWA), and PIJAC. The initiation of the *Bsal* Task Force EOG was proposed to national leaders at the North American Wildlife and Natural Resources Conference in March 2016. Discussion there expanded the need for such an oversight body not just for *Bsal*, but for other non-agricultural wildlife diseases with analogous task forces such as White-nose Syndrome in bats, as well as wildlife diseases without formalized task forces such as Sea-star Wasting Disease. An EOG for non-agricultural wildlife diseases is the topic of continued discussion. This topic segues to that of a recognized gap in US laws for wildlife health. Whereas the US Animal Health Protection Act (7 USC 109) covers agricultural wildlife health, there is no companion legislation for non-agricultural wildlife. This topic is an example of what the EOG could address.

Working Group Reports

Research Working Group

Leads:

Reid Harris (Amphibian Survival Alliance), Matthew Gray (University of Tennessee)

Participants:

Molly Bletz, Cherie Briggs, Alessandro Catenazzi, Joseph Cussac, Maria Forzan, Evan Grant, Brandon LaBumbard, Karen Lips, Ana Longo, An Martel, Debra Miller, Oz Ossiboff, Gabriela Parra, Josh Parrott, Frank Pasmans, Angie Peace, Kenzie Pereira, Johan Piovio-Scott, John Romansic, Jamie Voyles, Vance Vredenburg, Doug Woodhams, Sarah Woodley.

Key Points:

- Extramural Funding Secured for *Bsal* Research
 - Secured
 - BAND Foundation = \$195,000 (4 universities)
 - David H. Smith Conservation Fellowship = \$148,000
 - North Carolina Wildlife Resources Commission = \$99,750
 - Tennessee Wildlife Resources Agency = \$24,000
 - Amphibian Survival Alliance = \$8000
 - Liquid Spark = \$2,675
 - Herpetologists' League = \$1,000
 - In Review
 - NSF CAREER = \$830,000
 - Mohamed bin Zayed Species Conservation Fund = \$25,000
 - Not funded
 - Morris Animal Foundation = \$141,491 (3)
 - Southeast At-Risk Species (SEARS) Initiative = \$58,255
- Completed Susceptibility Trials on 28 Species
- Completed Trials on the Interaction of *Bsal* and *Bd*
- Completed Trials on *Bsal* Inactivation by the Mucosome and Specific AMPs
- Developed Preliminary *Bsal* Epidemiology Models for *Notophthalmus viridescens*
- Organized Two Professional Development Workshops
 - Annual Meeting of the Southeast Partners in Amphibian and Reptile Conservation
 - Annual Meeting of the Northeast Partners in Amphibian and Reptile Conservation
- Delivered 9 Research Presentations
 - International Conference of the Wildlife Disease Association (1, Mexico)
 - Eight World Congress of Herpetology (1, China)
 - Annual Meeting of the Northeast Partners in Amphibian and Reptile Conservation (6, USA)

- Annual Meeting of the Tennessee Chapter of The Wildlife Society (1, USA)
- Delivered 7 Outreach Presentations
 - University of Tennessee-Knoxville (2)
 - University of Massachusetts-Boston (2)
 - Association of Fish and Wildlife Agencies (2)
 - Carnegie's Powdermill Nature Reserve (1)
- Created Website and Video on SOP for *Bsal* Susceptibility Trials
 - <https://ag.tennessee.edu/fwf/Bsal/project/Pages/Methodology.aspx>
- Peer-refereed Publications
 - Published:
 - Grant et al. (2017): *Frontiers in Ecology and the Environment* 15:214-221
 - Gray et al. (2017): *Herpetological Review* 48:334-351
 - In Review:
 - Woodhams et al. (in review): Prodigiosin, Violacein, and Volatile Organic Compounds Produced by Widespread Cutaneous Bacteria of Amphibians Can Inhibit Two *Batrachochytrium* Fungal Pathogens. *Microbial Ecology*.
- Participated in 4 Interviews
 - *Science* (2)
 - *Scientific American* (1)
 - GEOLino (1)



Bolitoglossa cf. amazonica from southern Peru.
(Photo: Alex Shepack)

Data Management Working Group

Summary:

The new **Chytrid Data Management Web Portal** is fully operational, and has been undergoing a series of improvements over the last year. A suite of graphics is now available to visualize data, for example by taxon or location. A focus now is to upload *Bsal* project data to the portal, transfer historical *Bd* data from *Bd*-maps.net, and update the portal with both *Bsal* and *Bd* reports from the literature.

Leads:

Michelle Koo (UC Berkeley and AmphibiaWeb), Deanna Olson (US Forest Service, Pacific Northwest Research Station)

Participants:

Philip Kahn (website developer, UC Berkeley); Vance Vredenburg (AmphibiaWeb steering committee, San Francisco State University); David Wake (AmphibiaWeb director, UC Berkeley).

Key Points:

- Since Spring 2016 when we launched the beta version of the new AmphibiaWeb disease management portal (<https://amphibiandisease.org>), we have continued developing and improving user interfaces for both the contributor and the scientific community. Improvements include: faster searches; better tips to help the user navigate the search interface; decluttering the home page (e.g., collapsing advanced search options, allowing user to close informational boxes); added downloadable data and table options; added ability to add KMLs (geographic data format) as project bounding boxes; and many changes to the database. For example, learning from past experiences with the *Bd*-maps.net site, we have added a customized recommended citation for each project page, which incorporates the project title, project PI, project DOI and the current date of access; these are located at the top of each project page.
- In Spring 2017, we launched a new feature of the website called the Data Dashboard (<https://amphibiandisease.org/dashboard.php>), which graphs snapshot views of all the available, aggregated public data. Charts and graphs are generated dynamically with the current public data in a cache. Several of the data visualizations are downloadable as PNGs (Portable Network Graphics format). Each species has its own data page with charts dynamically generated from data and links to AmphibiaWeb species pages, the species range map, and the project that is contributing the data.
- Registered users have steadily grown as have sample submissions. Public and private projects are distinguished, with only public data viewable by others. Total projects-- 35 projects (7 public). Total samples-- 6,720 (5,984 public). Total species sampled-- 256 species from 20 countries
- In the next year, we are facing two data tasks that will require coordination from the leads and the programming personnel. One of the data tasks will be integration of the legacy *Bd*-maps data stored in flat spreadsheets. Koo and Olson will work with Kathryn Ronnenberg (US Forest Service), who has been maintaining these data in spreadsheets, and Philip Kahn (portal developer) who will adjust the current portal schema to accommodate these datasets. In previous reports we outlined the

technical challenges to integrating these data and the longer we wait the more we will have to work with, so we are keen to accomplish this critical task. The other data task is uploading the USGS *Bsal* monitoring data from the 15 regional areas where swabs were taken.

- Another challenge is future funding for ongoing development and maintenance. Currently the US Forest Service and AmphibiaWeb (Berkeley Natural History Museums, UC Berkeley) are cost-sharing the disease portal, but both entities are facing future funding shortfalls or at least uncertainties. We have and need to continue discussing how to pursue grant opportunities for new and improved functionalities.
- Preliminary discussions have been conducted about the utility of this web portal for data management additional diseases. We anticipate this discussion to continue over the next year, as the portal capacity for *Bsal* and *Bd* becomes more fully realized.

Outcomes:

- Presentations and demonstrations:
 - Michelle S. Koo et al. at the Society of Northwestern Vertebrate Biology and NW Partners in Amphibian and Reptile Conservation (PARC) annual meeting Feb 28th- Mar 3rd, Arcata, CA; Abstract published: *Northwestern Naturalist* 98(2):162
 - Lightning talk by Michelle S. Koo et al. at the Joint Meeting of Ichthyologist and Herpetologists Annual Meeting, Austin, TX. July 14, 2017
- With the Surveillance Working Group, we created 15 projects representing the regional areas where monitoring for *Bsal* was conducted. Specifically we worked with Donn Holmes (USGS) and Hardin Waddle (lead Surveillance WG and USGS) to represent the ARMI monitoring goal of testing 10,000 samples last year for *Bsal*. We will start uploading these data samples for public access this coming year.
- Collaboration with Federico Castro Monzon from the Leibniz Institute of Freshwater Ecology and Inland Fisheries, Free University, Berlin, Germany was initiated for facilitating an update of *Bd*-maps data from recent literature, for transfer to amphibiandisease.org.

Interactions with Other Groups:

The Data Management Working Group works closely with the Surveillance Working Group, the Communications and Outreach Working Group, and the PARC Disease Task Team.

Response Working Group

Lead:

Priya Nanjappa, Association of Fish and Wildlife Agencies (AFWA)

Participants:

Michael Adams (USGS ARMI); Jenn Ballard (USFWS); Jeremy Coleman (USFWS, White-nose Syndrome National Coordinator); Evan Grant (USGS ARMI); Matt Gray (Univ of Tennessee – Knoxville); Camille Harris (USGS, Wildlife Disease Coordinator); Blake Hossack (USGS ARMI), Jonathan Kolby (James Cook University); Robert Lovich (Dept of Defense/Navy); Joe Mendelson (Zoo Atlanta); Jenny Powers (NPS); Dede Olson (USFS); Mary Kay Watry (NPS)

Summary statement:

The Response Working Group intends to serve as a resource for issues related to eradication, containment, or other management response should *Bsal* be detected in North America. The group is actively finalizing a *Bsal* Rapid Response Plan template, intended for customization by management unit or captive salamander facility, which provides guidance for suggested actions upon a salamander mortality event or confirmed *Bsal* detection. The plan will be made available via www.salamanderfungus.org once completed.

Key Points:

- The response team continues to refine a Rapid Response Plan (RRP) template document to help agencies and institutions customize it for their own capacities and resources.
- Guiding questions and explanatory notes have been added to facilitate customization.
- A 2017 update to a 2010 manual regarding protocols for sampling both live and morbid or dead animals for diagnostic testing is being incorporated into the document, which has proved to be a time-consuming task.
- The RRP will be a living document, where guidance will continue to be refined as new treatment, mitigation, or management opportunities become available. It will also incorporate any lessons learned when or if actual *Bsal* detection scenarios occur that demonstrate new or improved approaches to be integrated into the plan.

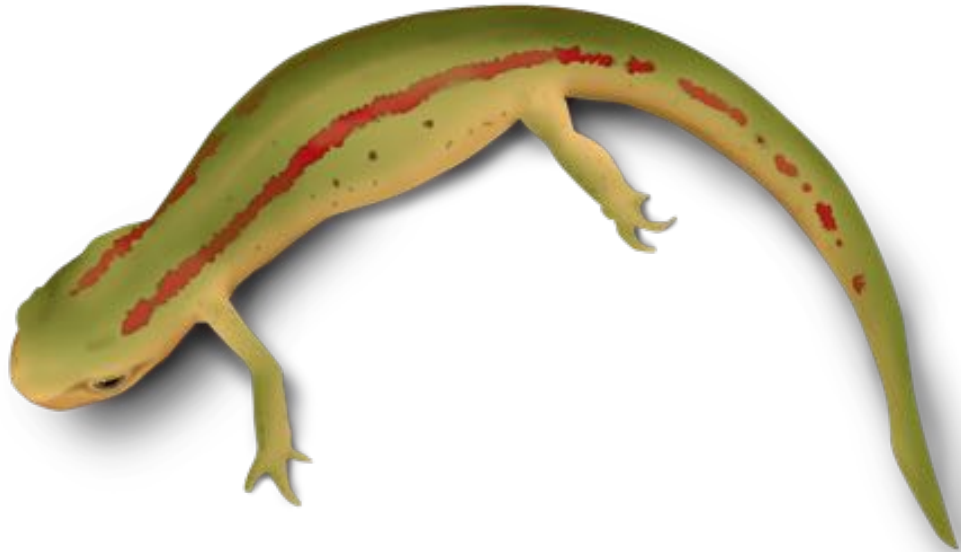
Outcomes:

- Although the RRP is specific to *Bsal*, the guidance within is applicable to other instances of amphibian diseases, and could potentially serve as a model for responses to other fish or wildlife diseases.
- Once released, the Response Working Group, in collaboration with AFWA, will distribute the plan broadly and write letters to appropriate agency officials and institutional leadership to facilitate its use, as well as to facilitate their preparedness and implementation in the event of a *Bsal* detection.
- In addition, the Response Working Group will serve as a go-to group when real world situations require expert input or consultation.

- The RRP will also help serve as a guiding document for the *Bsal* Strategic Plan, currently in development.

Interactions with other groups:

The Diagnostics Working Group leadership continues to assist in refining the details of the RRP with respect to obtaining and confirming a *Bsal* detection. The Response Working Group will work with the Decision Support Working Group to develop workshops or other opportunities to assist agencies and other stakeholders in determining how best to customize the RRP for their purposes, available capacities, and resources. We are in contact with the Research and Surveillance Working Groups as well, so that we can stay on top of the latest findings that can inform or improve the RRP, and so that we can assist when response actions are needed.



Notophthalmus perstriatus from the southeastern United States.
(Illustration: Mark Mandica)

Diagnosics Working Group

Summary:

The *Bsal* Diagnosics Working Group has worked from Summer 2015 – Summer 2017 to coordinate the activities of diagnostic laboratories around the country for *Bsal* testing. The group is composed of private and public laboratories, each with a vested interest in the consistency and accuracy of *Bsal* testing nationwide. The group addressed the majority of the needs in the first year and are currently maintaining a group to primarily address any needs and concerns of the diagnostic community. Their accomplishments are described below.

Lead:

Jake Kerby (Univ. South Dakota)

Participants:

Allan Pessier (Washington State University), Heather Fenton (Govt of the NW Territories, Canada), LeAnn White (USGS – National Wildlife Health Center), Jeff Lorch (USGS – National Wildlife Health Center), Dan Grear (USGS – National Wildlife Health Center), Deb Iwanowicz (USGS – National Fish Health Research Laboratory), Deb Miller (Univ. of Tennessee), James Lewis (ASA), Maria Forzan (Cornell University College of Veterinary Medicine), An Martel (Gent University), Frank Pasmans – Gent University), Julie Ellis (Northeast Wildlife Disease Cooperative), John Wood (Pisces Molecular), Steven Lloyd (Zoologix), Matt Allender (Univ. of Illinois), Robert Ossiboff (Univ. of Florida), Tom Waltzek (Univ. of Florida), Michael Garner (Northwest ZooPath), Alessandro Catenazzi (Southern Illinois University), Laura Sprague (USFWS Idaho Fish Health Lab), Teresa Lewis (USFWS Midwest Fish Health Center), Carly Muletz Wolz (Smithsonian Institution – Center for Conservation Genomics)

Key Points:

- The diagnostics working group has maintained a list of the testing modalities available for a variety of amphibian diseases at the member laboratories and placed this on the salamanderfungus.org website to help encourage and inform those who might want to conduct disease testing.
- New technologies for diagnostics have been discussed, but the preference is to maintain Taqman based qPCR and histology as best methods for definitive diagnosis of chytridiomycosis.
- Members of the group contributed to a study to examine the consistency of testing among different laboratories. Results are to be published in a peer reviewed journal.

Diagnosics Outcomes or Impacts:

- The group has maintained a list of the testing modalities available for a variety of amphibian diseases at the member laboratories and compared the PCR protocols being used for *Bsal*.
- We have maintained a list of the labs available for *Bsal* testing and made that publicly available.
- The group worked with other working groups to create proper wording for a template to send to state agencies regarding diagnostics and determination of the presence of *Bsal* or *Bsal* caused chytridiomycosis within their state. Enforcement and permitting

personnel are needed to help the laboratories understand their requirements under the new Lacey Act listing and to assist them with permit application questions.

- Members of the group contributed to a voluntary ring-test to compare *Bsal* testing results between laboratories and techniques, and laboratories teamed up to improve testing where needed. A manuscript for this work is being completed. A second round of testing that will include DNA extraction from both filtered water (to replicate eDNA sampling) and cotton swabs (to replicate samples collected from live or death animals) is scheduled to occur in early 2018.



Bolitoglossa cf. amazonica from southern Peru.
(Photo: Alex Shepack)

Decision Support Working Group

Summary:

The Decision Support Working Group provides facilitation, relevant models and analyses to support management decisions regarding *Bsal*.

Lead:

Evan Grant (USGS)

Participants:

Robin Russell (USGS), Katie Richgels (USGS), Riley Bernard (USGS/Penn State University), Rachel Katz (USFWS)

Key Points:

This group initiated the development of a model to assess the effectiveness of importation bans of salamanders as a management strategy for *Bsal*, given the deep uncertainty in the processes leading to introduction of *Bsal* to wild and susceptible populations. The group continued to work on this objective into 2017. In addition, some members of the group engaged in an effort to consolidate historical ARMI data to estimate the population level effects of Bd on amphibians. Though not directly related to *Bsal*, this effort was the first step toward developing a population-level amphibian model that incorporated disease effects and that could be used for decision making purposes. Two accepted manuscripts have resulted from our discussions:

- Grant, E.H., E. Muths, M. Adams, R. Katz, S. Canessa, J. Ballard*, L. Berger, C. Briggs, J. Coleman, M. Gray, C. Harris, R. Harris, B. Hossack, K. Huyvaert, Jo. Kolby, K. Lips, R. Lovich, H. McCallum, J. Mendelson, P. Nanjappa, D. Olson, J. Powers, K. Richgels, R.E. Russell, B.Schmidt, A. Spitzen-van der Sluijs, M. K. Watry, D. C. Woodhams, C. L.White. 2016. Developing a proactive response to the introduction of a fungal pathogen, *Batrachochytrium* salamandrivorans to US salamander populations. *Frontiers in Ecology and Evolution* 15:214-221.
- Russell R.E., R.A. Katz, K.D.L. Richgels, D.P. Walsh, E. H. Grant. 2017. A Framework for Modeling Emerging Diseases to Inform Management. *Emerging Infectious Diseases*. 23:1-6.

One manuscript in preparation

- A manuscript investigating the expected effectiveness of an importation ban on salamanders is in preparation.

In addition, we submitted a proposal to the USGS Powell Center to support model development:

- Investigating the population-level effects of disease on amphibian populations; proposal was not successful

Presentations related to decision analyses:

- Russell, R.E. Estimating effects for uncooperative critters. 2016. University of Minnesota Conservation seminar. (invited).

Progress:

We are making efforts to extend the scope of the work to address emerging fungal diseases in general including white-nose syndrome (this is partially to attract greater funding sources and increase the level of interest in the project). The aim is to learn from WNS how to best prepare for proactive and preventative management for *Bsal* as well as for future wildlife diseases.

A set of questions was sent to Federal and State land managers, with the goal of helping to get a better sense of the management issues and information needs to develop a response to the salamander chytrid fungus (*Bsal*), and to better understand the context in which these decisions take place. This survey of manager issues is ongoing with a focus on state and federal natural resource management agencies, and will be summarized and compared against issues facing managers in making conservation decisions for bats under threat of WNS. Although preventing the arrival of a pathogen is most effective for controlling an emerging infectious disease, prevention is not failsafe. Additionally, resource managers often consider multiple social, economic, and ecological objectives, and are challenged with confronting difficult trade-offs for any given disease management strategy (i.e., an optimal action for managing a wildlife disease may result in declines in recreational or economic values).

Challenges:

Challenges include engaging managers when risk is low (*Bsal* has not been detected in the US). Some managers report that they have many issues on their lands, and don't have the ability or the time to consider problems before they exist. This effectively limits the ability to identify and implement proactive management – representing a major challenge for developing management strategies for *Bsal* and other emerging infectious diseases. Specific and measurable amphibian management objectives are not common among natural resource agencies and we are working with several agencies to set objectives for amphibians in communities vulnerable to *Bsal*. In addition, there have been not treatment options identified for *Bsal* (and limited options for other fungal diseases of wildlife), which limits the alternatives available to managers.

Outcomes:

- 1) The Decision Support group has received completed questionnaires of management issues from managers in NPS, FS and FWS, and have begun to characterize the scope of the decision problems faced by these agencies. Workshops with a set of managers with 'common' decision problems will be organized and work will begin in the next year to begin to frame these decisions, beginning with the first draft of the conceptual model developed during the June 2015 Powell Center workshop.
- 2) The group has been working with the US FWS to frame emerging disease problems for local management and treatment decisions for white-nose syndrome in US bats, in addition to *Bsal* and amphibian population management decisions. The intention is to use insights from this disease to inform *Bsal* decision problems, and vice versa.

Interactions with Other Working Groups:

Ongoing work includes collaboration with the USFWS to frame emerging disease problems for WNS local management and treatment decisions, with the intention to use insights to inform *Bsal* decision problems. Multiple ARMI PIs were engaged in the collation of historical data on amphibian disease presence and population dynamics.

Surveillance and Monitoring Working Group

Summary:

The surveillance working group has conducted quarterly calls during 2017. Our primary focus has been fostering communication within our group to ensure that there is a timely sharing of information on where sampling for *Bsal* is taking place. Although there is no formal direction of surveillance effort, there is informal coordination within the group. A main focus of the group continues to be working with the data management group to provide up-to-date information on where *Bsal* sampling has occurred.

New discussions have centered on developing a surveillance strategy document and a response plan for a *Bsal* detection in North America. The surveillance strategy would potentially address the design of a sampling scheme, but also cover other issues such as surveillance of captive salamander populations and those being transported through the pet trade. The surveillance working group continues to be open to new members, and we continue to seek information on other researchers engaging in *Bsal* sampling.

Lead:

Hardin Waddle (USGS)

Participants:

Caleb Hickman (Eastern Band of Cherokee Indians), Chris Petersen (US Navy), Craig Stephen (Canadian Wildlife Health Cooperative), Daniel Grear (USGS), Evan Grant (USGS), Jonathan Kolby (James Cook Univ.), Laura Sprague (USFWS), Matt Gray (Univ. of Tennessee), Michael Adams (USGS), Michelle Koo (Univ. of California), Natalie Nguyen (USGS), Purnima Govindarajulu (BC Ministry of Environment), Rachel Vallender (Candaian Wildlife Service), Samuel Iverson (Canadian Wildlife Service), Vance Vredenburg (San Francisco State Univ.)

Key Points:

- The USGS surveillance monitoring for *Bsal* is ongoing but ramping down to a much lower level of effort.
- Other groups and individuals are surveying regionally (Appalachians, Pacific Northwest).
- We are working to get surveillance data in the public domain to attempt to encourage effort to be spread to more areas.
- We are discussing a document that would outline an approach to surveillance in the vicinity of an area with a positive detection of *Bsal*.

Interactions with other groups:

Members of the Decision Support, Diagnostics, and Database groups participate in the Surveillance group calls.

Communications and Outreach Working Group

Summary:

The *Bsal* Communications & Outreach working group manages *Bsal*-related communication and products for outreach, especially relative to providing informational materials for a myriad of interested groups and people with concern for salamander health and well-being.

Leads:

Mark Mandica (Amphibian Foundation), Jillian Farkas (University of South Dakota), Alex Shepack (Southern Illinois University)

Participants:

Tiffany Yap, Natalie Nguyen, Megan Serr

Key Points:

- Website: Continued maintenance and posting to *salamanderfungus.org*. Updates are posted when new journal articles, popular press items, or other relevant *Bsal* items become available.
- Social Media: We continue to maintain and utilize Twitter (@salamanderfungi) and Facebook (www.facebook.com/salamanderfungus/). As of Aug. 23 we have 454 followers on Twitter and 237 on Facebook. Twitter followers have increased by more than 200 since last year, while the Facebook page has only received 11 more. We attribute lack to visibility and fewer posts in the past year.
- Publications: Several members of the task force authored a review article discussing *Bsal* and current Task Force activities. The article, titled "*Batrachochytrium dendrobatidis* and the risk of a second pandemic" has been accepted for publication in *EcoHealth*.

Challenges:

Maintaining active membership has been a challenge. The intermittent nature of the tasks of this working group make it hard to keep members involved. Additionally, increased communication is necessary between Task Force participants and the communication group so that media releases can be prepared in advance prior to the release of publications.

Outcomes:

- We had several unique twitter posts that reached large audiences including the *Bsal* Podcast videos from the annual Southeast PARC meeting (8,650 impressions with 95 engagements with the post) and the Vietnam *Bsal* paper (1,297 impressions with 15 engagements with the post).
- On our facebook page, all our posts in 2017 reached at least 250 people, and had at least 30 engagements.
- There were nearly 4,000 page views (users viewed a unique page at least once) on the salamanderfungus.org website between August 2016-2017. The majority of the users viewing the salamanderfungus.org website within the same time period are from the United States (64.4%), followed by Canada (8.4%), then China (4.3%).
- As we continue to post updates, articles, and information, we are increasing our chance of engaging with individuals, groups, and organizations to make them aware of what is occurring with *Bsal*. This gives us the opportunity to share what work the *Bsal* Task Force has accomplished, and what work is currently occurring.

PARC Disease Task Team

Leads:

Matthew J. Gray and Matthew C. Allender

Key Points:

- Published Herpetological Review paper providing guidance on sampling strategies and biosecurity precautions for herpetofaunal pathogens, including *Bsal* (Gray et al. 2017). Appendix 1 compiles information on disinfection procedures. <http://parcplace.org/parcplace/images/stories/pdfs/Grayetal2017.pdf>
- Launched the Herpetological Disease Alert System (HDAS) for North America that allows the public to report observations of possible cases of herpetofaunal disease, including *Bsal* chytridiomycosis. The email submission is: herp_disease_alert@parcplace.org. Members of the PARC DTT forward submissions to herpetological disease experts in the state or province that the case was reported, and provide advice on cases as requested. The HDAS could help facilitate rapid notification and response to a *Bsal* outbreak in North America. Two newsletters were produced announcing the HDAS.
- Provided feedback on video produced by Northeast PARC that illustrates proper disinfecting procedures for pathogens. <http://parcplace.org/resources/herpetofaunal-disease-resources/>
- Drafted decontamination and biosecurity guidelines for individuals that are conducting research in known pathogen-contaminated (high risk) sites and must subsequently sample pathogen-free (low risk) sites due to logistical constraints.
- In partnership with the *Bsal* Research Working Group, the PARC DTT led two workshops on *Bsal* at the Annual Meetings of Southeast and Northeast PARC.
- Members attended an amphibian disease symposium at Arizona State University and provided an update on *Bsal* research findings in the U.S.
- Members attended a US Department of Interior workshop organized by USGS disease experts to develop actions in response to a ‘what-if’ scenario where *Bsal* die-offs were detected in a US National Park, US Forest Service national forest, and on tribal lands.
- Provided feedback to the Canadian Wildlife Health Center on decontamination protocols for fieldwork with reptiles and amphibians, which is posted on their salamander chytridiomycosis website: <http://www.cwhc-rcsf.ca/Bsal.php>
- Worked with the Amphibian Survival Alliance to maintain and update *Bsal* informational website, including significant monthly updates of recent publications: <http://salamanderfungus.org>.
- Submitted tweets by @salamanderfungi for disease-related updates, which appear on <http://salamanderfungus.org>.
- Maintained and updated PARC DTT website, which contains links to *Bsal* resources: <http://parcplace.org/parcplace/resources/disease-task-team.html?id=287:herpetofaunal-disease-resources>

Outcomes:

- HDAS reports have increased over the course of 2017. Amphibian population die-offs in which disease has been detected in affected animals have been identified in the wild in the USA and in captivity in Canada. HDAS facilitated communication between reporting individuals and authorities in the jurisdictions.
- HDAS has facilitated identification of herpetofaunal health contact authorities in all states and provinces in North America.
- Tens of thousands of people received disease information by oral and written products including electronic media.

Strategic Plan contribution:

A member is working with the National Aquatic Nuisance Species Council to address inclusion of amphibian pathogens including *Bsal* to their lists, which has ramifications for US State listings of state-prohibited species. This raises the visibility of *Bsal* for US-wide management by states as an aquatic invasive species (AIS); currently, there is limited aquatic pathogen inclusion on state AIS lists. This proposal relates to both the developing *Bsal* Strategic Action Plan and the larger Wildlife Health Strategic Action Plan.



Ambystoma opacum from eastern North America.
(Illustration: Mark Mandica)

Canadian Herpetological Health Working Group

Summary:

The Canadian Herpetological Health Working Group was formed in 2016 in response to the threat posed by *Bsal* to native salamanders in Canada, as well as reptile and amphibian health and disease issues more generally. The working group is chaired by Environment and Climate Change Canada and is comprised of government, academic, and non-governmental scientists. It reports to the Canadian Wildlife Directors Committee (CWDC), which is a management body comprised of federal, provincial and territorial wildlife directors responsible biodiversity policy and management in Canada.

Lead:

Samuel Iverson (Canadian Wildlife Service, Environment and Climate Change Canada)

Participants:

Joe Crowley (Province of Ontario), Craig Stephen (Canadian Wildlife Health Cooperative), Scott Gillingwater (Upper Thames River Conservation Authority), Yohann Dubois (Province of Quebec), Maria Forzan (Cornell University), Lenny Shirose (Canadian Wildlife Health Cooperative), Bruce Pauli (Environment and Climate Change Canada), Danna Schock (Keyano College), Purnima Govindarajulu (Province of British Columbia), Kristiina Ovaska (IUCN Canada-Amphibian Specialist Group), Cait Nelson (Province of British Columbia).

Key Points and Outcomes:

- The Government of Canada implemented an importation restriction on all Caudata (salamander) species. The restriction was implemented through an amendment to the Wild Animal and Plant Trade Regulations (WAPTR). It prohibits salamander importation unless authorized by a permit issued by Environment and Climate Change Canada and is a temporary (1-yr) measure.
- Environment and Climate Change Canada is currently consulting with stakeholders to transition to a longer-term regulatory approach based upon risk assessment. It is intended that longer-term measures be in place before expiration of the temporary restriction in May 2018.
- Educational outreach materials were developed and distributed to raise awareness about the threat posed by *Bsal* to native salamander populations in Canada. These include a fact sheet tailored to the general public/pet shop owners, a factsheet tailored to the scientific community, and a decontamination protocol for field work with amphibians and reptiles (available: <http://www.cwhc-rscf.ca/bsal.php>). In addition, web materials and a social media campaign were run by Environment and Climate Change Canada during spring-summer 2017.
- Ongoing surveillance is conducted nationally through the Canadian Wildlife Health Cooperative, as well as provincial programs.

Interactions with other groups:

Canadian Herpetological Health Working Group members participate in most *Bsal* Task Force Working Groups.

Updates from Mexico

- Gabriela Parra Olea submitted a proposal to CONACyT to do *Bsal* exposure trials on Mexican salamanders.
- Ana Longo gave a three-day workshop on *Bsal* detection at National Autonomous University of Mexico.
- Gabriela Parra Olea's lab tested 15 species of wild salamander for *Bsal*. All came out negative. Testing continued.

Pet Industry Joint Advisory Council (PIJAC)

PIJAC's mission is to:

- PROMOTE responsible pet ownership and animal welfare
- FOSTER environmental stewardship
- ENSURE the availability of pets

PIJAC members, as pet owners, and as an industry, believe that they have a responsibility to ensure that the animals in their care are treated with kindness and respect, and that pets do not cause environmental or human health problems. PIJAC is a pioneer in developing educational programs for pet owners, the pet industry, related industries, and governmental organizations that address these issues.

PIJAC maintains active Aquatics and Herpetological committees which fund scientific research and conservation projects, and their Zoonosis Committee has entered into a memorandum of understanding (MOU) with the Centers for Disease Control and Prevention (CDC) to share information, educate, and rapidly respond to zoonotic disease outbreaks.

Amphibian Survival Alliance

The Amphibian Survival Alliance (ASA) promotes the conservation of amphibians and their habitats through dynamic partnerships worldwide. The ASA raises awareness of amphibians and their plight, and helps channel vital resources towards the implementation of the global Amphibian Conservation Action Plan (ACAP). The Alliance works directly with two globally-scoped amphibian networks: the IUCN SSC Amphibian Specialist Group (ASG), which provides the science to inform amphibian conservation action and Amphibian Ark, which focuses on amphibian species that cannot currently be safeguarded in their natural environments. Their leadership has continued to benefit the *Bsal* Task Force in the following ways. They created and maintain the salamanderfungus.org website for *Bsal* communication. In addition, they worked closely with the *Bsal* Data Management working group to ensure complementary information was uploaded on this informational website in comparison to the *Bsal* database web portal amphibiandisease.org, knitting the two together seamlessly. The ASA is also working to facilitate the implementation of the ASG's updated ACAP, which highlights research into and control of *Bsal*. Lead Liaison: Reid Harris (ASA and James Madison Univ.). Communication lead: Candace Hansen-Hendrikx (ASA)

Literature Cited

- Grant, E. H. C., E. Muths, R. A. Katz, S. Canessa, M. J. Adams, J. R. Ballard, L. Berger, C. J. Briggs, J. Coleman, M. J. Gray, M. C. Harris, R. N. Harris, B. Hossack, K. P. Huyvaert, J. E. Kolby, K. R. Lips, R. E. Lovich, h. I. McCallum, J. R. I. Mendelson, P. Nanjappa, D. H. Olson, J. G. Powers, K. L. D. Richgels, R. E. Russell, B. R. Schmidt, A. Spitzen-van der Sluijs, M. K. Watry, D. C. Woodhams, and C. L. White. 2016. Salamander chytrid fungus (*Batrachochytrium salamandrivorans*) in the United States: developing research, monitoring, and management strategies. Open-File Report 2015-1233.
- Martel, A., M. Blooi, C. Adriaensen, P. Van Rooij, W. Beukema, M. C. Fisher, R. A. Farrer, B. R. Schmidt, U. Tobler, K. Goka, K. R. Lips, C. Muletz, K. R. Zamudio, J. Bosch, S. Lötters, E. Wombwell, T. W. J. Garner, A. A. Cunningham, A. Spitzen-van der Sluijs, S. Salvidio, R. Ducatelle, K. Nishikawa, T. T. Nguyen, J. E. Kolby, I. Van Bocxlaer, F. Bossuyt, and F. Pasmans. 2014. Recent introduction of a chytrid fungus endangers Western Palearctic salamanders. *Science* **346**:630-631.
- Martel, A., A. Spitzen-van der Sluijs, M. Blooi, W. Bert, R. Ducatelle, M. C. Fisher, A. Woeltjes, W. Bosman, K. Chiers, F. Bossuyt, and F. Pasmans. 2013. *Batrachochytrium salamandrivorans* sp. nov. causes lethal chytridiomycosis in amphibians. *Proceedings of the National Academy of Science* **110**:15325-15329.
- Spitzen-van der Sluijs, A., A. Martel, J. Asselberghs, E. K. Bales, W. Beukema, M. C. Bletz, L. Dalbeck, E. Goverse, A. Kerres, T. Kinet, K. Kirst, A. Laudelout, L. F. Marin da Fonte, A. Nöllert, D. Ohlhoff, J. Sabino-Pinto, B. R. Schmidt, J. Speybroeck, F. Spikmans, S. Steinfartz, M. Veith, M. Vences, N. Wagner, F. Pasmans, and S. Lötters. 2016. Expanding distribution of lethal amphibian fungus *Batrachochytrium salamandrivorans* in Europe. *Emerging Infectious Diseases* **22**:1286-1288.