The GRYNdow

Winter 2019/2020 Newsletter

National Park Service
U.S. Department of the Interior

Greater Yellowstone Inventory & Monitoring Network

Bighorn Canyon National Recreation Area/NPS

The GRYNdow is a window into GRYN science in Greater Yellowstone Ecosystem parks.

Inside This Issue

Envisioning the Future of I&M

This year marks two decades of NPS inventory and monitoring science and the opportunity for the I&M Division to reflect on accomplishments and opportunities in the future. Why do this now? Since 2000, I&M networks across the country have completed inventories, refined monitoring protocols, collected and analyzed mountains of data, and reported to parks. It is the first time that all networks are at the same place with all protocols completed and implemented. As I&M transitions from development to continuous information sharing, it's time to pause and consider what works and what can be improved. Importantly, to maximize the influence and utility of the information generated, we are thinking big, developing an audacious goal with the intent to still provide the best scientific information and to expand and increase the relevancy of our science to parks and beyond.

We will not be changing who we are or what we do, but making sure we are working together and headed in the same direction so we can be resilient to inevitable change. We are working with all the I&M staff, including scientists, biotechs, admin folks, communicators, and network, regional, and national program managers to ensure that this effort is inclusive. We are strengthening our core (our people), ensuring relevance to parks, and making the most of our information to make our program sustainable in the long term. As this process develops, we will include others from across NPS and especially the parks.

How are we doing this? It takes time and energy. We are following a visioning process based on scientific studies (what you should expect from a science division!) of successful organizational change. Many organizations and businesses have successfully navigated complex change using this methodology (Collins and Poris 2000, Harvard Business Review). Around 120 I&M staff from across the country participated in one of four Jam Sessions (e.g., workshops) where participants listened, shared, created new and deepened existing relationships, and connected with our mission to develop a new vision for a stronger and even more successful I&M in the future.

Our vision exercise was collaborative; we described a vivid description of what we want I&M to look like, feel like, and represent in 2040. Specifically, we highlighted themes, including high caliber science, partnerships, collaboration, inclusion, communication, and amplifying who we are and what we do to improve and expand park stewardship, that will lead us to our big, hairy, audacious goal (BHAG). This is our "moon shot." To explore I&M in 2040, we developed Vivid Descriptions that connect I&M to society and the world to create a force of good. These are aligned with the NPS Mission, NPS Core Values, I&M's Purpose and Mission, and the core goals established when I&M began. We are currently synthesizing and distilling results from our JAM sessions that will be coalesced when we come back together as one group for a larger I&M-wide workshop. We will then layout the road map for implementation.

Two decades ago, the function and role of I&M networks was a radical idea. A bold vision and plan followed by hard work and excellent science made I&M an indispensable resource for science-based management in parks. Help us imagine what we can accomplish in another 20 years with a new audacious goal and even bolder vision!

Yellowstone Science Special Edition on Vital Signs

The latest issue of Yellowstone Science magazine, *Vital Signs: Monitoring Yellowstone's Ecosystem Health*, was released on 18 September 2019. This issue takes a careful look at the value of ecosystem monitoring in Yellowstone National Park. Included are a collection of articles that together emphasize the need for a formal, forward-looking and comprehensive 'vital signs' monitoring program for Yellowstone National Park and the Greater Yellowstone Ecosystem.

In this issue, contributing authors describe why tracking nature's vital signs is as important as tracking our own human vital signs for assessing and managing health. In this era of rising temperatures, droughts, extreme weather events, and declining global biodiversity, rapid and appropriate management response is necessary to maintain natural, functioning ecosystems. While existing monitoring programs have proven their value to management, a more comprehensive regional program is also needed that crosses disciplines and boundaries as threats to wild and working landscapes accelerate. Collaborative vital signs monitoring will also be essential to exploring and describing how modern stressors like exurban development, novel diseases, and invasive species interact with climatic change to influence the health of Yellowstone's ecosystems.

In Yellowstone National Park, scientists have been championing the monitoring of physical vital signs (e.g., river flows) and biological vital signs (e.g., whitebark pine) for decades. In the Vital Signs Issue several principal themes emerge: 1) the need for increasing the number of vital signs that are formally monitored, 2) the importance of expanding monitoring programs beyond park boundaries and across the Greater Yellowstone Ecosystem, and 3) the value of regular communication of trends in vital sign conditions to decision makers and the public. Andrew Ray, the Greater Yellowstone Network aquatic ecologist, is the guest editor on this issue of Yellowstone Science.

Read this special edition of Yellowstone Science at https://www.nps.gov/articles/series.htm?id=8A1106D1-CBC3-15BF-85C5DD6B6D66D4EF.

Climate Smart Conservation

Last April, Andrew Ray, David Thoma, and David Lawrence (Climate Change Response Program) worked with Yosemite National Park's Vegetation and Ecological Restoration (VER) branch to offer a two day workshop for staff at Yosemite National Park called Planning for a Changing Climate – Putting Principles into Practice.

Approximately 40 people, from multiple Yosemite divisions, neighboring parks, and the Sierra Nevada Inventory and Monitoring Network presented and participated in this workshop. The workshop included multiple case studies from the region and offered participants an opportunity to discuss the real-world resource challenges at Yosemite National Park. Andy, David, and Dave have continued the conversation with Yosemite's VER staff and will be working to co-develop a case study of this experience that can be shared with other parks.

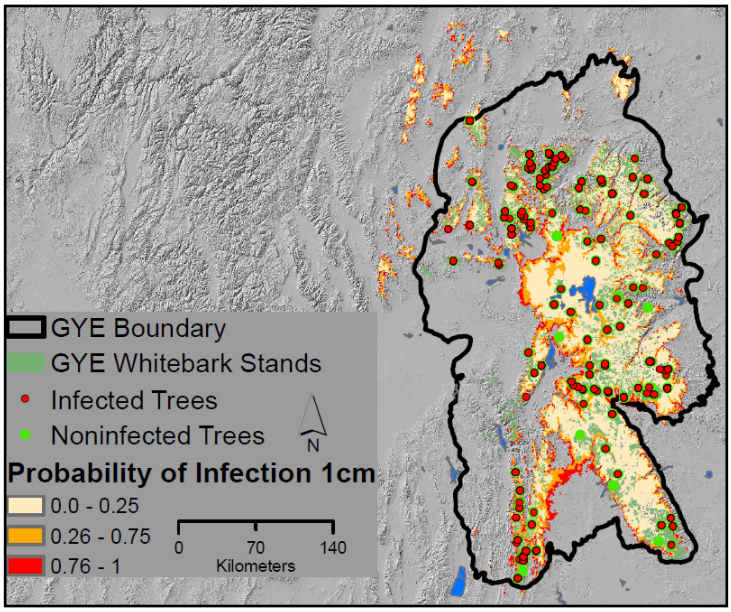
Tunnel View in Yosemite National Park, made famous by Ansel Adams, allows you to see El Capitan and Half Dome. In January, it was blanketed with fresh snow. Snow, glaciers, and river flows were among the topics discussed at the "Planning for a Changing Climate in Yosemite National Park " meeting on April 10 and 11, 2019. NPS photo

Mapping the Probability of White Pine Blister Rust

Mountain pine beetle and white pine blister rust have been killing whitebark pine trees in the Greater Yellowstone Ecosystem for many years, but the beetle outbreak between 2004 and 2012 targeted and killed most of the large, older trees. As a result blister rust may now be the greater threat to the remaining trees.

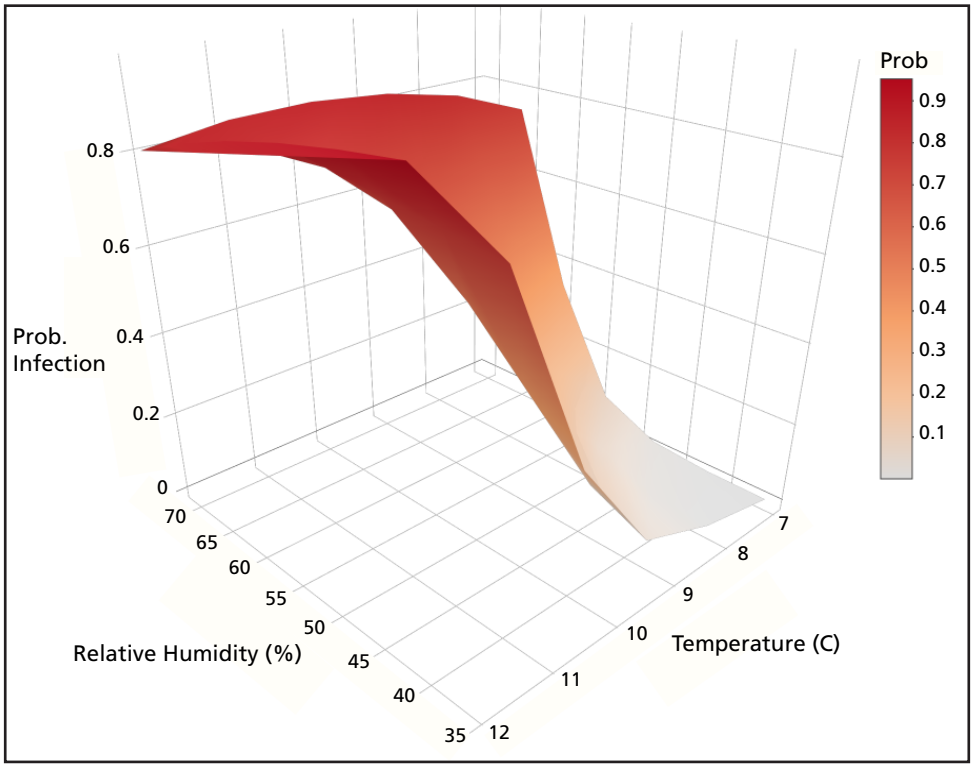
Blister rust is a harmful fungal disease in whitebark pine in the Western U.S. and Canada. It was introduced to the U.S. in the early 1900s and is now found throughout the Greater Yellowstone Ecosystem, but the intensity of infection is not the same everywhere. *Why is that?* In a recent publication in *Forests*, Greater Yellowstone Network and U.S. Geological Survey scientists show that the probability of blister rust infection is related to temperature and humidity. They arrived at this conclusion by observing 5,000 trees over 16 years and linking the climate conditions at every tree to the likelihood of infection.

Blister rust infection in whitebark pine. NPS photo



Map of blister rust infection probability created by applying the developed climate model to the Greater Yellowstone Ecosystem landscape.

Specifically, they found the probability of infection was greatest when August and September average temperatures were between 9°C and 11°C and relative humidity was between 60% and 70%. The relatively tight range of temperature and humidity conditions where blister rust occurs in the Greater Yellowstone Ecosystem is linked to the survival requirements of the infection agent called a basidiospore. These airborne spores released from a gooseberry or currant bush are a "Goldilocks" disease. That is, they can only survive the journey to a whitebark pine when the weather is just right: not too hot, not too cold, and not too dry. The model of blister rust infection probability related to temperature and humidity was used to map the likelihood of death in seedling whitebark pine. This map can be used by managers to help determine reestablishment planting sites.



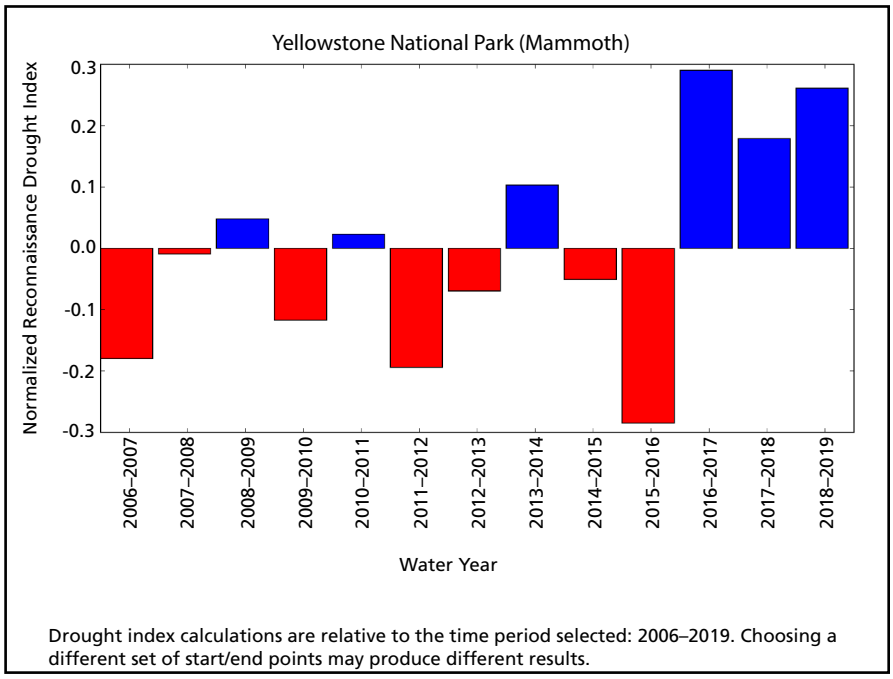
The climate model of blister rust infection probability created by identifying the climate conditions where blister rust occurred or did not occur in whitebark pine trees over 16 years of monitoring in the Greater Yellowstone Ecosystem.

For More Information:

Thoma, D. P., E. K. Shanahan, and K. M. Irvine. 2019. Climatic correlates of white pine blister rust infection in whitebark pine in the Greater Yellowstone Ecosystem. Forests 10(8):666

Wetland and Amphibian Monitoring

We have monitored amphibians and wetlands annually in Yellowstone and Grand Teton national parks since 2006; 2019 marked the 14th year of surveys. In 2019, crews visited 332 wetland sites from 31 catchments (24 in Yellowstone National Park and 7 in Grand Teton National Park). When standing water was present, sites were surveyed by two independent surveyors. The 2019 Normalized Reconnaissance Drought Index (Mammoth Weather Station data are shown here) was 2nd highest (wettest) in the 14-year time series and represented the 3rd year in a row with a positive drought index (wetter conditions).



Drought Index data from Mammoth weather station in Yellowstone National Park.

The 2019 amphibian season was notably challenging. We received above average levels of snowfall in February (200% to 400% above average), which contributed to a lingering snowpack in 2019 relative to previous years. Not surprisingly, wetlands were larger than we had seen in recent years and surveys took longer to complete. How that extra moisture affected amphibian breeding will be revealed after a careful review of the data. **What we do know is that** two of the 31 surveyed catchments in 2019 contained all four species of amphibians; no observations of amphibian breeding were recorded in the Death Canyon catchment in Grand Teton National Park. Boreal chorus frogs and Columbia spotted frogs were the most commonly detected amphibian species in 2019 and breeding occurrence for each species was observed in 26 of the 31 surveyed catchments. Breeding evidence for western tiger salamanders and western toads were less common and detected in 16 and 4 catchments, respectively.

Amphibian field crew during a training session with Idaho State Professor of herpetology, Chuck Peterson (far left). NPS photo

In 2019, we published several papers summarizing our wetland and amphibian monitoring work in peer-reviewed scientific journals and other popular outlets (see Gould et al. 2019 and Ray et al. 2019a, b on page 8).

This year, our staff partnered with Yellowstone Forever and Idaho State University to coordinate and teach a 3-day field course (Discovering Wetlands) in Yellowstone's Northern Range. The course included fieldwork and laboratory activities and participants stayed at the Buffalo Ranch in Yellowstone's Lamar Valley.

We also worked with two Climate Adaptation Fellows/PhD students from Utah State University (Lainie Brice and Guen Grosklos) on wetland and amphibian projects, and we are working with Dr. Chuck Peterson at Idaho State University to continue use of iNaturalist for making amphibian and reptile observations outside of monitoring catchments. These and the Greater Yellowstone Network annual monitoring observations will be included in a revision of the amphibian field guide for Yellowstone and Grand Teton national parks, originally published in 1995.

Chorus frog in Thorofare Catchment in the far southeast corner of Yellowstone National Park. NPS photo

Water Resources Monitoring

Greater Yellowstone Network has been monitoring water quality for more than a decade in Bighorn River National Recreation Area (NRA), Yellowstone National Park (NP) and Grand Teton NP; 2019 marked the 14th year of sampling for several rivers (e.g., Snake River) in the network. In 2019, all sampling started in April. Our crews collected water from three river locations and measured flows at three spring locations in Bighorn Canyon NRA. They also measured water quality at two river locations in Grand Teton NP and four river locations in Yellowstone NP.

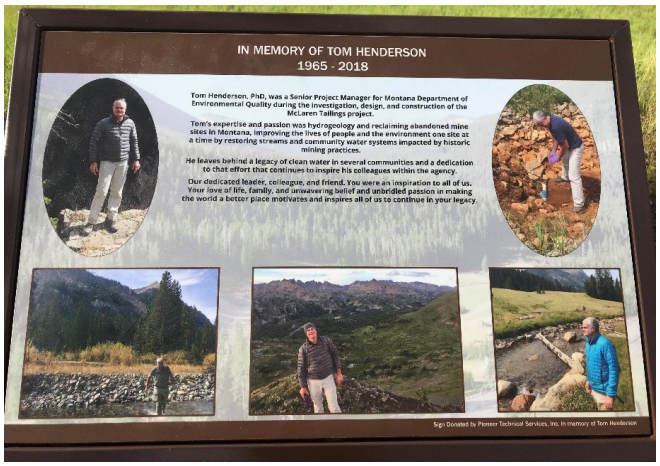
Despite the existence of **well above average** levels of snowfall in February 2019, river flows in Grand Teton NP and Yellowstone NP were unremarkable. In the Yellowstone River at Corwin Springs, peak flows were 18,400 cubic feet per second (cfs) and ranked 33rd highest in the 96-year record. In the upper Snake River at Flagg Ranch, peak flow was 5,490 cfs and ranked 26th highest out of a 36-year record. The amounts of dissolved and suspended nutrients and solids of each focal river was likely unique in 2019 relative to years with below (e.g., 2016) or above (e.g., 2011) average river and stream flows. Our multi-year time series is well poised to explore these variations in river water quality across all parks. In 2019, we began a partnership with USGS scientists from the Utah and Wyoming-Montana Water Science Centers to examine long-term trends in water quality from a single monitoring location. This work focused specifically on integrating the analysis of flows and dissolved solids patterns to explore how seasonal sampling could affect the results.

In Bighorn Canyon NRA, a new automated flow monitoring system was deployed in Layout Creek this year with the help of Megan Doughty, a recent hydrology graduate from Colorado School of Mines and Water Resources Guest Scientist through the Geoscientist-in-the-Parks program. With Megan's help, we piloted the use of water level loggers for monitoring spring and stream flow at multiple locations in the park. The system captured a large, scouring flow event on July 24/25 that eroded the channel below Ewing Snell Ranch and damaged a wild horse exclusion fence. The rain event that contributed to that flow event was likely a local microburst. We don't have an accurate estimate of rain that fell in Layout Creek drainage, but the Hillsboro, Montana weather station about one mile away recorded 0.1 inches on July 24 and 0.15 inches on July 22. Continuous monitoring of select locations in Bighorn Canyon will allow us to track and quantify changes in flow associated with large rain events in this ephemeral stream.

Megan Doughty (Geoscientist-in-the-Parks guest scientist) measures discharge in Layout Creek.

Finally, we celebrated the Delisting of Soda Butte Creek in December 2018. This was the first time in Montana's history that a river was delisted following the reclamation of an abandoned mine. We partnered with MT DEQ scientist, Tom Henderson, to design a study plan and collect the information necessary for the delisting determination. Our colleague Tom died unexpectedly in October 2018 and prior to the delisting. To honor Tom and commemorate the delisting, our network partnered with Yellowstone NP, MT DEQ, MT FWP, USFS, WY DEQ, and the Beartooth Alliance to celebrate with Tom's family and residents of Cooke City and Silvergate, Montana, in July 2019.

During the celebration in honor of Dr. Tom Henderson, Yellowstone's superintendent, Cam Sholly, presented Tom's family (shown with Andrew Ray of GRYN) with an official NPS Soda Butte Creek sign and recognized the impact of Tom's work to Yellowstone National Park.



Tom championed the cleanup and helped initiate monitoring activities on Soda Butte Creek. Combined, these efforts ultimately led to the removal of the stream from the impaired waters list. Pioneer Technical Services and other partners installed a plaque at the McLaren project site near Cooke City, Montana and unveiled it as part of the celebration in July 2019.

Other Updates

Uplands monitoring at Bighorn Canyon NRA. NPS photo

Whitebark pine monitoring at Custer-Gallatin National Forest in 2019. NPS photo

Whitebark pine cones in 2019 at Basin Creek in Custer-Gallatin National Forest. NPS photo

Data Management

We recently moved the network's master Wetlands and Amphibian Monitoring Database for Grand Teton and Yellowstone national parks from a local Microsoft Access solution to the NPS ArcGIS Online Organization. Using this DOI/NPS-approved cloud-based service provides a stable platform for reliably hosting the master database and makes it easy to collaborate with partners for data collection, entry and review. This new data management approach also facilitates development of web maps, story maps, and web applications for reviewing, reporting, and sharing data. Our staff are currently using the system internally, and we hope to provide external services to parks and the public within the next couple of years.

Upland Vegetation

Upland vegetation monitoring continued in 2019 in three of the dominant upland vegetation community types found in Bighorn Canyon National Recreation Area (NRA): juniper woodland communities, juniper-mountain mahogany communities, and sagebrush-steppe and grassland communities. Efforts to investigate recent mountain mahogany die-off in the Park resumed with the development of a study plan and collection of photo images on active tent caterpillar infestations and mortality.

We continue to assist Grand Teton National Park with upland vegetation monitoring, to mentor students and interns, and to collaborate with resource managers and other cooperators on natural resource issues in Bighorn Canyon NRA. As part of this collaborative effort, we keep our online data visualizer, VegViz, current and publicly-accessible. You can explore vegetation community trends in several national parks at the VegViz website: www.vegviz.org.

Whitebark Pine

In 2019, we visited 44 transects assigned to Panel 4 stands and an additional two permanent transects and 40 rapid assessment transects on Bureau of Land Management Wyoming lands. This year marked the completion of our fourth full panel revisit rotation. As such, we will be generating the fourth step-trend analysis this coming winter including updated estimates on the proportion of whitebark pine trees infected with blister rust and overall mortality in the Greater Yellowstone Ecosystem.

As we launch into our 17th year of monitoring the health of whitebark pine in the Greater Yellowstone Ecosystem, we continue to augment and support whitebark pine protection and restoration efforts by resource managers from multiple agencies and to expand upon our scientific engagement with other inventory and monitoring networks. To this end, we are leading a multi-network investigation to determine the best indicators of historical and future dispersal of blister rust and other drivers of whitebark pine mortality using a landscape approach. This information can be used to bolster ongoing management practices extending cross-boundary collaboration.

In 2020, we will survey Panel 1 stands consisting of 45 transects, including 2 transects on Bureau of Land Management lands, to be revisited from June through September. In keeping with our tradition of mentoring emerging scientists, we will host several Montana State University student-interns and two high school students.

Internship Announcement

The NPS *Future Park Leaders of Emerging Change* internship program is supporting an intern to work with Greater Yellowstone Network and the Yellowstone National Park Climate Program to develop a Climate Smart Conservation strategy for aquatic resources in the Greater Yellowstone Ecosystem. This 12-week, paid internship provides exemplary students (advanced undergraduate or graduate) a pathway to apply their skills and ideas to park-based challenges and solutions.

In summer of 2020, the intern will compile a database and map of projects, proposed plans, and known issues that will guide a Climate Smart Conservation workshop designed for fisheries biologists, hydrologists, and water quality specialists.

More info: David Thoma (Dave_thoma@nps.gov, 406-994-7725) or Ann Rodman (Ann_rodman@nps.gov, 307-344-2216)

Spotlight on Staff

Kyle Marvinney

Kyle grew up in rural central Maine and received a B. S. in Geology from St. Lawrence University in 2011. After a summer internship monitoring erosion on coastal beaches for the Maine Geological Survey, Kyle moved west to Idaho and then to Bozeman, Montana, to work for the U.S. Forest Service. Kyle spent six summers as a crew member for the Interior West Forest Inventory and Analysis program before making the switch to Greater Yellowstone Network where he is in his second season. Kyle began working on the whitebark pine monitoring and upland vegetation projects, but now also monitors amphibians and water quality. In the winter, Kyle works for Bridger Ski Foundation managing the operation and maintenance of in-town cross country ski trails in Bozeman. In his free time, Kyle likes to ski, bike, and canoe.

Jana Cram

Jana Cram arrived at Greater Yellowstone Network in April 2019 as a field crew leader/aquatic biotech. She has a B.A. in English Literature from Rutgers University and a B.S. in Environmental Science from Valparaiso University. Before moving to Montana, Jana spent seven years at Indiana Dunes NP in Porter, Indiana. She began as a researcher investigating the impact of logjams on fish habitat and river morphology, and became a biotech working in water quality, wetland restoration, and invasive species control. During her last year, she was upland vegetation crew lead for oak savanna and prairie restoration projects along the southern shores of Lake Michigan. Originally from New Jersey, Jana has steadily made her way westward. She enjoys knitting and trail running, which are, fortunately, appropriate hobbies for living in Bozeman, Montana.

Our Ride Through Thick and Thin

Good-bye, our 4-wheel drive co-worker, reliable
as any brand new 2020 souped up SUV, always relieved to see you
waiting at the trailhead, and that you continued to start
season after season even with 158,419 miles on your engine,
we are thankful!

You took us where we needed to go, over hill and dale,
(of course adhering to all NPS and USFS road closures),
through mud bogs, over boulder-strewn two-tracks, patiently shuttling us for hours
through mile after mile of traffic in Yellowstone and Grand Teton national parks,
we are indebted!

Now they say you have to go. The auction block is your fate.
With saggy doors, an air conditioner that delivers a clicking noise instead of cold air,
and what we consider some minor electrical issues, we have been forced to abandon you.
To recount the many adventures we have shared transported on your chassis, brings countless fond memories.
We are eternally grateful!

Farewell our trusty steed……. and we'll miss you!

(An ode to the white expedition by Erin Shanahan, as adapted from Elaine Feinstein's Ode to my Car Poem: International English Language Quarterly, 2015. Vol. 3, No. 1, 34, http://dx.doi.org/10.1080/20519842.2015.1050237)

Recent Publications

Gould, W., A. Ray, L. Bailey, D. Thoma, R. Daley, and K. Legg. 2019. Multistate occupancy modeling improves understanding of amphibian breeding dynamics in the Greater Yellowstone Area. Ecological Applications 29(1):e01825.

Greater Yellowstone Whitebark Pine Monitoring Working Group. 2019. Monitoring whitebark pine in the Greater Yellowstone Ecosystem: 2018 annual report. Natural Resource Data Series NPS/GRYN/NRDS–2019/1225.

Legg, K., and S. Haas. Understanding dynamic ecosystems: the pursuit of the Greater Yellowstone Network. Yellowstone Science 27:14–17.

Lewandowski, M. 2019. Water quality summary for the Lamar River, Yellowstone River, and Madison River in Yellowstone National Park: preliminary analysis of 2016 data. Natural Resource Report. NPS/GRYN/NRR–2019/1873.

Lewandowski, M. A. Ray, K. Mellander, and C. Whaley. 2019. Water quality summary for the Snake River and alpine lakes in Grand Teton National Park and John D. Rockefeller, Jr. Memorial Parkway: preliminary analysis of 2015 data (Revised - 2019). Natural Resource Report. NPS/GRYN/NRR–2019/1932.

Litt, A. R., and A. M. Ray. 2019. Surrogate species: piecing together the whole picture. Yellowstone Science 27:40–43.

Ray, A. D. Patla, and C. Peterson. 2019a. Taking the pulse of wetlands: what are we learning from the amphibian vital sign? Yellowstone Science 27:52–54.

Ray, A. M., A. Sepulveda, K. Irvine, S. Wilmoth, D. Thoma, and D. Patla. 2019b. Wetland drying linked to variations in snowmelt runoff across Grand Teton and Yellowstone national parks. Science of the Total Environment 666:1188–1197.

Ray, A. M., D. P. Thoma, K. L. Legg, D. M. Diamond, and A. J. Hansen. 2019c. Assessing the ecological health of the Greter Yellowstone Ecosystem. Yellowstone Science 27:18–21.

Ray, A., D. Thoma, K. Legg, R. Diehl, A. Sepulveda, M. Tercek, and R. Al-Chokhachy. 2019d. Vital sign monitoring is good medicine for parks. Yellowstone Science 27:4–13.

Shanahan, E. K. 2019. An uncertain future: the persistence of whitebark pine in the Greater Yellowstone Ecosystem. Yellowstone Science 27:67–71.

Shanahan, E., K. M. Irvine, K. Legg, S. Wilmoth, R. Daley, and J. Jackson. 2019. Monitoring five-needle pine on Bureau of Land Management lands in Wyoming: summary report for 2013, 2014, 2016, and 2017. Natural Resource Report. NPS/GRYN/NRR—2019/1931. National Park Service. Fort Collins, Colorado.

Stratton C., A. Hoegh, K. M. Irvine, K. Legg, K. McCloskey, E. Shanahan, M. Tercek, and D. Thoma. 2019. Assessing spatial and temporal patterns in sagebrush steppe vegetation communities, 2012–2018: Grand Teton National Park. Natural Resource Report. NPS/GRYN/NRR—2019/2020.

Thoma, D. P., S. M. Munson, A. W. Rodman, R. Renkin, H. M. Anderson, and S. D. Wacker. 2019a. Patterns of primary production & ecological drought in Yellowstone. Yellowstone Science 27:34–39.

Thoma, D. P., E. K. Shanahan, and K. M. Irvine. 2019b. Climatic correlates of white pine blister rust infection in whitebark pine in the Greater Yellowstone Ecosystem. Forests 10(8):666.

Thoma, D., E. Shanahan, K. Irvine, R. Daley, and K. Legg. 2019c. Relative humidity: key to understanding regional patterns in white pine blister rust prevalence in Greater Yellowstone Ecosystem. Nutcracker Notes: Journal of the Whitebark Pine Ecosystem Foundation 37(2019).

Yellowstone Science. 2019. v27(1). Ray, A., and Others (eds.). Vital signs - monitoring Yellowstone's ecosystem health. April. 96 pp.

Greater Yellowstone Network

2327 University Way, Suite 2
Bozeman, MT 59715

Kristin Legg - Program Manager
(406) 994-7734

Rob Daley - Data Manager
(406) 994-4124

Andrew Ray, PhD - Aquatic Ecologist
(406) 994-7498

Dave Thoma, PhD - Hydrologist
(406) 994-7725

Hydrologic Technician - Vacant

Erin Shanahan - Vegetation Ecologist
(406) 994-7530

Kyle Marvinney - Vegetation Field Crew Lead
(406) 994-7530

Jana Cram - Aquatic Field Crew Lead
(406) 994-7498

Sonya Daw - Writer/Editor

Tani Hubbard - Writer/Editor

GRYNdow Editor: Tani Hubbard (Northern Rockies Conservation Cooperative)