

# THE TRACKER



YERC'S NEWSLETTER

"Intelligence is the ability to adapt to change."

STEPHEN HAWKING

## IN THIS ISSUE:

**YELLOWSTONENET: PREVENTATIVE ECOSYSTEM HEALTH CARE**

**EPIIC: THE FUTURE OF ECOLOGICAL DATA DISTRIBUTION**

**RIVERNET: FROM DIAGNOSTIC MONITORING TO ECOLOGICAL FORECASTING**

**LANDNET: COLLABORATION FOR SUSTAINABLE RANCHING**

**WILDNET: AN INCREASING AMOUNT OF WILDLIFE IN NORTHERN YELLOWSTONE?**

**NOTES FROM THE FIELD**





## YELLOWSTONENET: PREVENTATIVE ECOSYSTEM HEALTH CARE

**YERC's flagship program, YellowstoneNET, brings people, data, and technology together to solve Yellowstone's most pressing ecological problems**

2020 was a year we'll never forget. We were all very concerned about health issues, what to believe in or not, and what might lay ahead. The Yellowstone Ecological Research Center (YERC) is similarly concerned about those in our Greater Yellowstone Ecosystem and its water, wildlife, and working landscapes—all the natural amenities we rely upon for our own health and well-being. And that's why we have just launched our YellowstoneNET program as a way for everyone to engage as concerned citizens, conservation stewards, and the scientists we are. YellowstoneNET is a network of people involved in community

science that can access incredible amounts of information on ecosystems using an internet platform called EPIIC (Ecosystem Prognosis, Impacts, and Information Cooperative)—an Internet of Nature's Things [\[more info here\]](#). It also delivers datastreams, diagnostics, planning tools, and forecasts from our three programs (RiverNET, LandNET, and WildNET) and data from many other sources including academia, agencies, and corporations.

YERC is one of many organizations that seeks to protect the Greater Yellowstone Ecosystem. However, we are different, very different. We

are taking several unique approaches to not just protect Yellowstone but sustain a healthy ecosystem for future generations of all species using Yellowstone as an open lab for the world. We now seek to put our science to work and YellowstoneNET is a novel way to do just that.

First, while seeking to understand how ecosystems work through traditional research, YellowstoneNET also ingests the essential diagnostics from long-term monitoring projects in Yellowstone. Like the results of a panel of serum parameters from your doctor, these diagnostics form the basis for a preven-

## YELLOWSTONENET

tative health care plan that leads to sustained health. They are also used for what scientists call predictive modeling—projections and forecasts so we can not only maintain a resilient ‘well-normal state’ for our ecosystems but also make informed decisions for restoration and recovery as needed. Such forecasts (prognostics from diagnostics) are similar to how weather forecasting services offer 36-hour and weekly forecasts as well as access to historical trends. What actions would we take if we knew that the Madison river is going to warm 5 degrees in the coming week, if bison will likely be leaving Yellowstone Park tomorrow [[learn about our bison migration work](#)], or if grizzly bears will be seeking new food sources at riskier lower elevations [[learn about our research on grizzlies diets](#)]?

Second, YellowstoneNET provides valuable information in an independent, non-advocacy, non-partisan, and transparent manner

which is badly needed during an epidemic of misinformation, polarization, and distrust. Whether an advocacy organization, agency, business, academic institution, or landowner, we all need access to the same data so we can make informed decisions, prevent problems, and forge successful conservation strategies. YellowstoneNET also uses protocols that are standardized, transparent, repeatable, and defensible. These attributes along with a community of individuals and organizations working together to bear witness to the collection of data will improve trust in the application of those data to solve problems.

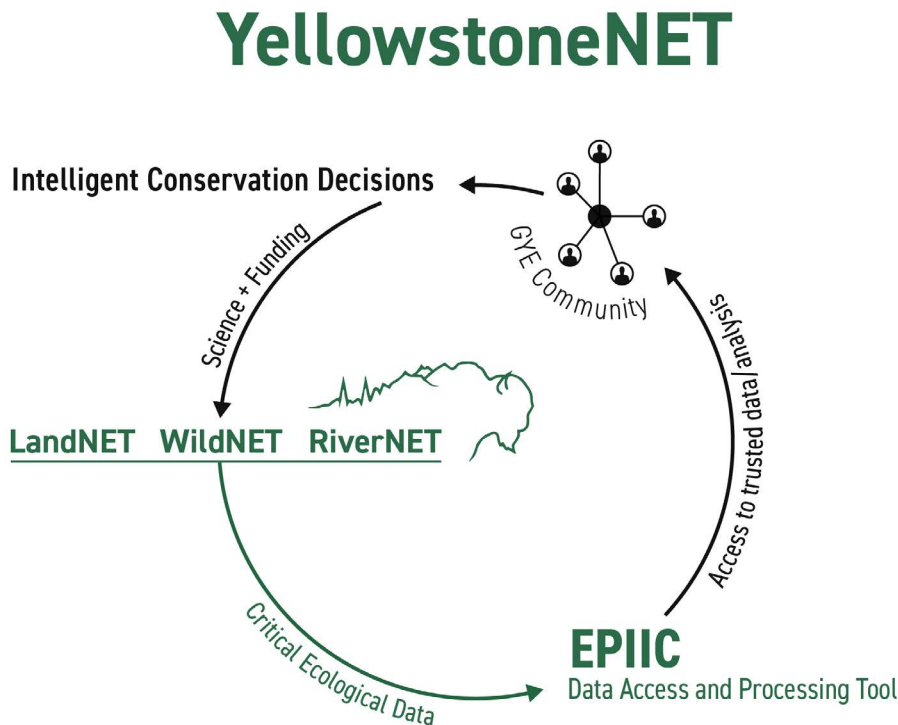
Third, due to the unprecedented and unpredictable changes in climate, politics, and human land-use activities we need this trusted information—health diagnostics and prognosis—in a timely manner. We provide fast turnaround of our datastreams so that we can simultaneously adapt to change

while building trust by working together in our community science approach. They say the “truth is out there” and YellowstoneNET, a People’s Science, can be the gateway to understanding and discovery in the Yellowstone ecosystem.

## USING OUR DIAGNOSTIC ANALYSIS, WE ARE CREATING A PREVENTATIVE HEALTH CARE PLAN FOR OUR HOME ECOSYSTEMS, WATERSHEDS, AND LANDSCAPES.

Since the organization’s inception in 1993, YERC has been conducting long-term research and monitoring projects to provide the public with unbiased scientific information on the ecological health and integrity of the Greater Yellowstone Ecosystem. We are free from the time constraints placed on many research projects by the duration of short-term degree programs. Rather we focus on the scale of ecosystems where 10,000 year old rivers flow and 40 year-old grizzlies have untold stories. Furthermore, while YERC strives to be a useful member of the scientific community, the “end users” of our programs are primarily members of the broader communities within the GYE. From farmers to fishermen, businesses to biologists, and politicians to poets, YERC’s programs focus on providing data to anyone who cares about this famous landscape and our home ecosystem. We all want healthy trout and elk populations, migrating birds, clean water, fresh air, healthy soils, and the ability for our plant communities to bounce-back after a fire, flood, or disease outbreak.

During the Envision Yellowstone summit in 2017, private industry thought leaders from across the continent helped YERC transform its data-producing projects into three distinct programs: RiverNET, WildNET, and LandNET.



*The YellowstoneNET flywheel: people, data, and technology sustaining our iconic ecosystem.*

## YELLOWSTONENET

Yet, the impact of these programs is limited unless we find a better way to engage the community and deliver critical ecological information where needed. YellowstoneNET is that engagement and delivery platform. All stakeholders can access and interact with datastreams from natural living systems (biodiversity), which is both a missing and powerful component of the effort to sustain a healthy GYE.

YellowstoneNET will accomplish five goals: (1) involve all stakeholders in community science where individuals, especially landowners, collect data through citizen science initiatives using sensors, (2) aggregate unbiased ecological data from RiverNET, WildNET, LandNET, and other publicly available sources, (3) provide transparent, open-access to that data via a cloud based platform, EPIIC, (4) supply a vast array of tools for intelligent decision-making and preventive health care of our landscapes, and (5) deliver, “what if scenarios” and short-term forecasts for problem-solving and planning for what’s ahead.

As a scientific organization, YERC recognizes that policy, practices, and management affecting the natural resources of ecological systems should be based on trusted empirical measurements. However, the events of 2020 exposed the reality that data alone holds little influence without trust. At its core YellowstoneNET is an effort to engage the community with ecological data in a way that builds trust. Community- and citizen-science initiatives, a central feature of YellowstoneNET, transcend the agendas of industry and advocacy groups, both real and perceived. Stakeholders learn to trust the data in EPIIC because they helped collect it. YERC’s positioning as a conduit of unbiased information bolsters the work of stakeholders to become involved shareholders in Yellowstone’s health. Regional advocacy organizations need factual input for their campaigns. Policy-makers need factual information to make decisions. Businesses both small and large that rely upon ecosystem amenities such as plant production and quality recreation need sustained income from stable, resilient landscapes.

Yellowstone is one of our planet’s iconic ecosystems, and has long been a laboratory for influential ecological research projects and global conservation efforts. With your support we have completed the architectural design phase of YellowstoneNET and are now in the construction phase with code-writing, realtime data downloads, data sharing tools, predictive models, analysis and summary capabilities, and user-specific mobile applications. We thank the many supporters and collaborators for pioneering this very unique program and hope you all can support this effort in the year just ahead. We hope what we learn from YellowstoneNET can spread the benefits of trusted unbiased data, open access, and community involvement to ecosystems around the world.

**Robert Crabtree**  
YERC Founder and Chief Scientist



[Join YellowstoneNET today.](#)



*Courtesy of Bob Landis, Landis Trailwood Films*

# EPIIC: THE FUTURE OF ECOLOGICAL DATA DISTRIBUTION

Find out how we are partnering with cutting-edge organizations to make ecological data accessible to all

*Photo: Boiling River. Owen Robbins, YERC Intern*

YERC is excited to have formed a coalition with Microsoft, Topcoder, Amphora, and Montana State University's Computer Sciences Department to innovate ways to curate, present, and deliver essential ecological data via an internet platform called the Ecosystem Prognosis, Impacts, and Information Cooperative, or EPIIC. Each coalition member provides complementary skills, technology and expertise to jointly build the first Internet of Things for Nature (IoT - Nature). It is befitting to build the world's first IoT for Nature in the region surrounding the Greater Yellowstone Ecosystem which includes the world's first national park and our nation's first forest reserve. YERC's Chief Scientist, Dr. Robert (Bob) Crabtree hired Roby Roberts in 2018 as YERC's new Chief Technology Officer to lead the coalition's effort. Roberts, an experienced data scientist, who was formerly at Oracle, helped pioneer the construction of cloud computing systems.

Linked to the central hub of this newly formed coalition organizations are agencies, academic institutions, and concerned citizens that provide key ecological data to fuel EPIIC. The community science approach builds trust in

the data so that it becomes useful information to aid natural resource decision-making. EPIIC also fuels what we call community science where concerned individuals from all stakeholders work together and bear witness to the collection, storage, processing, and dissemination of key diagnostics of ecosystem health. EPIIC will provide easy and transparent access to anyone who shares concern for the changing impacts in the GYE region that can either degrade, sustain, or recover ecosystem health. People combined with technology—both tried and true conservation measures and the latest technologies—will help remove barriers to allow informed decision-making and conservation success in the GYE.

Easy access and effective presentation of sensor data and its analysis results will help sustain our natural resources and ecosystems by making time-sensitive, informed decisions in today's changing world. Sensors are human, citizen scientists armed with cell phone apps, or electronic, including the thousands of devices that monitor wildlife, water, and our ever-changing terrestrial landscapes from the ground, drones, planes, and satell-

ites. By collaborating with organizations that have broad expertise and reach, YERC plans to enhance data distribution to all stakeholders while developing a community science cooperative model aimed at increasing the trust and use of valuable ecological data. These innovations act as early warning indicators (diagnostics) that continually monitor ecosystem health and integrity.

## THE COMMUNITY SCIENCE APPROACH BUILDS TRUST IN ECOLOGICAL DATA

Critical to developing trust in the current 'age of misinformation' is open and transparent access to highly-valuable information. Furthermore, our multi-party coalition designed EPIIC to allow individuals and stakeholder groups to contribute data

When all parties are involved in, and bear witness to, the collection, analysis and dissemination of data, it becomes trusted information—something we desperately need today. EPIIC is further designed to disseminate



*Mammoth Hot Springs. Owen Robbins, YERC Intern*

long-term research and monitoring results to quantify the human and climate impacts to our rivers, vegetation, soil, and wildlife. This diagnostic analysis leads to prognoses for ecosystem health which is directly related to human health because we rely upon a supply of natural resources to survive.

YERC's partners allow EPIIC to function at a larger scale than would be typically possible for a small science-based nonprofit organization. Topcoder, a recognized leader in crowdsourcing with an impressive list of clients, from NASA, to Harvard Medical School, to Eli Lilly and Company, is critical to this effort. Consistency in providing high quality deliverables to clients and access to great projects for developers enabled Topcoder to cultivate a community of 1.5+ million members from around the world. Topcoder is donating their services for the project, and we are inspired by the volunteers from around the world who have stepped up to contribute skills to sustain one of our planet's iconic ecosystems.

Nate Brouger, a manager on Topcoder's Service Innovation team, also voiced his enthusiasm for this global collaboration: "What excites me about this project is seeing Topcoder community members from all over the world contributing their talents and time because they see the profound impact that a platform like EPIIC can have by enabling users to diagnose, predict, prevent, or mitigate the effects of ecosystem problems with data-driven insights". With the help of the Topcoder community, the YellowstoneNET initiative will have the ability to influence policy decisions, inform corporate actions, and involve the community in decisions made for the health of our ecosystem.

In early 2020, YERC added partner Amphora Data for crucial components of the technical infrastructure behind EPIIC, specifically a data platform designed from the start for data sharing. Amphora ingests and stores data on an integration platform for real-time data processing and third-party collaboration in a

scalable and secure cloud environment—all designed for collaboration partnerships of a broad end-user community. This company, co-founded by Australian entrepreneurs Rian Finnegan and Issac Donnelly, aims at improving data collaboration and amplification across research, agriculture, and ecology.

The Amphora data-sharing platform will host EPIIC data storage, curation, and retrieval for the many applications and predictive models being built to now to test and further develop EPIIC. We are now streaming recently collected field and sensor data in from our 2019 and 2020 field campaigns. According to Finnegan, Amphora's software specialist, "One of the reasons we founded Amphora is that we wanted to find ways to tackle these big land-use issues (biodiversity loss, climate change, topsoil erosion etc), but neither of us are farmers nor ecologists. We realised that we could play a part by building tools that can be used by others, and in turn enhance their collaborative capability. That's the beauty

of collaboration—each person brings their own unique experience and perspective, and together you can build something that none could achieve on their own”. This platform enables users to register on the Amphora website, granting access to view and download published EPIIC data. Collaboration between YERC and Amphora enables EPIIC to achieve its primary goal of distributing key ecological data to the hands of policy-makers, YERC stakeholders, outdoor enthusiasts, agencies, and landowners—all laden with the responsibility of decision-making in a preventative, timely manner that sustains the biodiversity we rely upon.

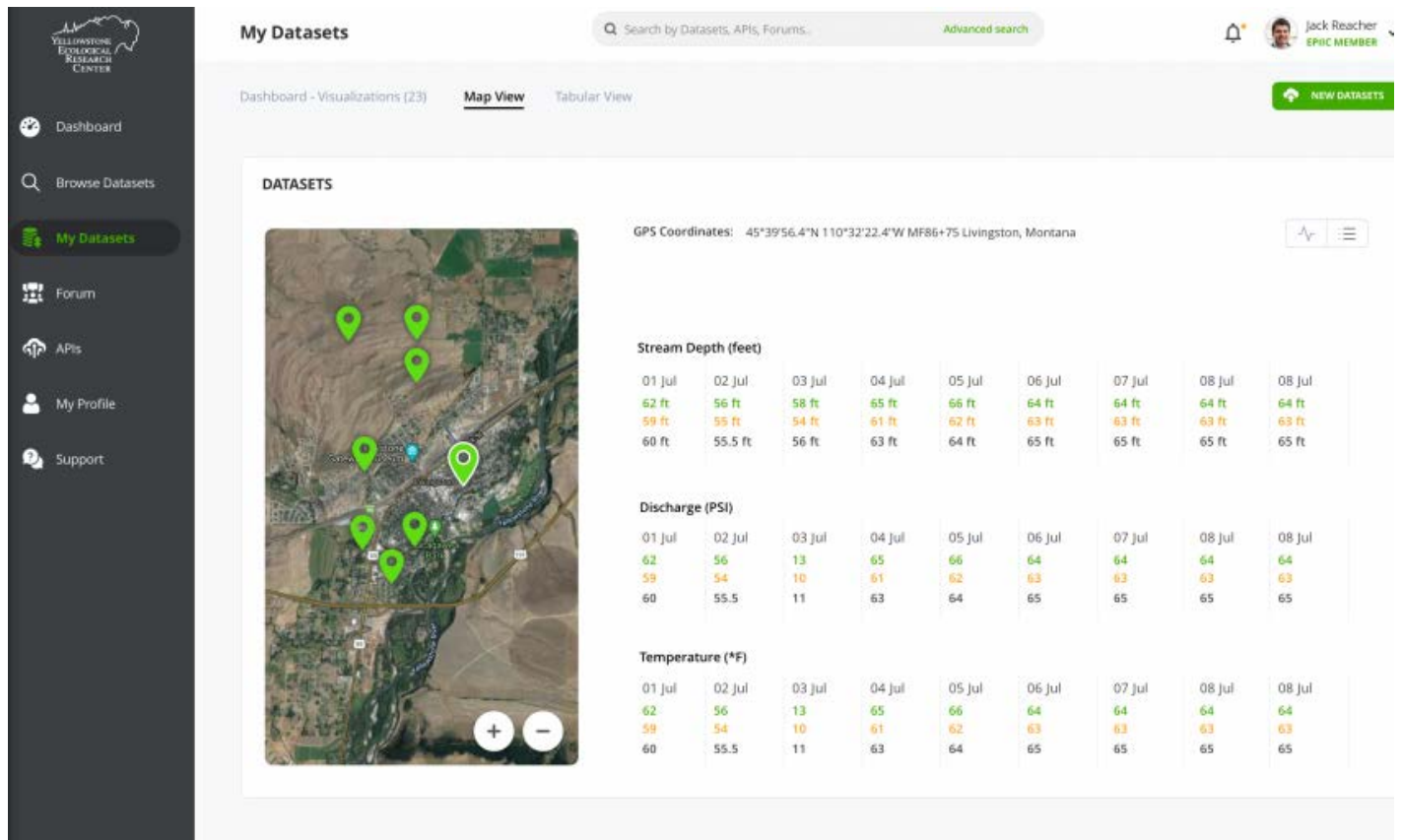
Central to YERC’s YellowstoneNET initiative is sponsoring three MSU computer science senior capstone projects, with five talented students working with our private industry partners to create the EPIIC ‘engine’ of YellowstoneNET. According to John Paxton, Department Chair of Computer Sciences at MSU, “YERC is providing wonderful capstone projects for five MSU computer science majors. The projects provide these students with the opportunity to work on an important interdisciplinary problem while improving their data science skills.”

MSU computer science students are taking

on key components to build EPIIC. One project uses cloud-based services to design, create and execute important processing on data streams such as water temperature, discharge, and nutrients. According to YERC’s Roby Roberts, these processes efficiently apply statistical methods of identifying trends and outliers in ecological data, as well as providing an early warning alert system for freshwater resource issues. Real-time processing of near real-time river and stream data is even more valuable in conjunction with other data sources, such as wildlife crossing monitors, wildlife cameras, soil moisture sensors, meteorological instruments, well depth measurements, and snow characteristics, which will also be included in EPIIC.

Another project incorporates readily available datasets including those from NASA satellites (e.g., 30m Landsat, 500m MODIS imagery) with data from private drones. Rapid drone deployment (learn more in the “Notes from the Field” below) provides incredible opportunities to inform land-use practices due to the near real-time availability of these datasets on the EPIIC platform. Publicly available satellite imagery is often years old, whereas near real-time drone data represents current conditions, encouraging preventative action and adaptive decision-making. With the help of trained machine learning classifiers, this program has the ability to create accurate maps of current conditions such as land cover, soil, vegetation, and water. In addition, informed classifiers will analyze trends, and short term forecasts. With the help of MSU, YERC is creating a process which can be applied to a variety of datasets including daily snow cover and temperature. This process will also enable YERC to gather more accurate water, wetland, and riparian area measurements in order to better understand water quantity and quality in the Upper Yellowstone River





A screenshot showing RiverNET data displayed in a prototype of EPIIC's user interface

watershed. The quantity and quality of water is determined by establishing seasonal baselines, charting annual trends, and identifying changing conditions, all of which could be more accurately measured using the near real-time data offered by satellite imagery and private drones.

Cloud-based software is being developed that quickly and concisely classifies aquatic insects from standardized riverbed samples. These samples are collected from the Yellowstone River, and its tributaries. This program will serve as a new source of data for YERC's existing RiverNET database which focuses on monitoring water quality and quantity. Roby Roberts explains that this program aims at developing an image detection algorithm, integrating the models into a mobile application, and pushing the data

from the app into the RiverNET database in the cloud.

These essential cloud computing resources have been granted to YERC by Microsoft's AI for Earth program. Microsoft's AI for Earth program expands the benefits of cutting edge software beyond the business realm by putting "Microsoft cloud and AI tools in the hands of those working to solve global environmental challenges". This program's main objective is preserving earth's ecosystems by creating a Planetary Computer which will have the capabilities to build an interconnected network of environmental data and tools. As part of Microsoft's AI for Earth program [link here], YERC has been granted access to critical tools on Microsoft cloud computing system called Azure. It excels at building and managing cloud-based appli-

cations and services for our planet and its vulnerable ecosystems and represents a leap forward in efficiently including biological data in decision making about rivers, landscapes, and wildlife.

Thanks to the unique contributions of all five coalition partners, EPIIC provides an unbiased, independent starting point to forge successful, 'intelligent' conservation efforts, make informed policy decisions, improve agricultural practices, or better understand the 'well-normal state' of a large ecosystem in which we recreate.

**Alexa Jorgenson**  
YERC Marketing Intern



[Help support our EPIIC Coalition](#)





## RIVERNET: FROM DIAGNOSTIC MONITORING TO ECOLOGICAL FORECASTING

We finished our third year of monitoring to provide a prevention and protection plan for the Upper Yellowstone River Watershed. Now a mature and tested community monitoring program, we are pleased to develop a freshwater forecasting system [\[described in more detail here\]](#) similar to weather forecasting. We have also started similar monitoring programs on the Madison, Gallatin, and Snake river systems with local collaborators in each watershed.

We originally chose the Yellowstone River to start RiverNET program because of our

previous research there since the 90s and stakeholder surveys that designated water resources as the ‘most pressing issue’. Another key reason was that few rivers in the world garner the attention and recognition it does. The longest free-flowing, undammed river in the lower 48 winds out of the heart of Yellowstone National Park’s caldera, through the famous Paradise Valley and on to its confluence with the Missouri. From having more miles of blue ribbon trout fishing than any other river in Montana, it’s easy to paint it as the picture of what western rivers should strive to be. The economic vitality and natu-

ral amenities this watershed provides are invaluable. If you want to either maintain or restore health to a river, you must protect its headwaters, hence, the Upper Yellowstone River Watershed in Yellowstone National Park and Paradise Valley.

However, even landmark rivers such as the Yellowstone come under threat from a myriad of sources. From outbreaks of pathogens both in its waters (PKD, whirling disease) and at adjacent headwater habitats (blister rust, bark beetle, Western spruce budworm) to increasing levels of natural and human caused

## RIVERNET

impacts such as fish-killing water temperatures, recreational impacts, invasive species, and increased frequency and severity of wildfires, our freshwater resources are at risk. Even some of the largest tributaries critical for trout spawning, are running dry from irrigation demands and changing precipitation patterns.

When looking to combat, mitigate, or adapt to these impacts, one of the problems for all involved was a lack of timely and accurate data. How can you protect and sustain what you don't understand? Thus, RiverNET focused continuous and standardized data-streams at important locations. We work to turn the data around either instantaneously, or within days so that problems can be identified, and action taken if warranted. This approach, derived from human medicine, samples important diagnostics from 'patients' to develop a preventative health care plan as well as a prognosis, or forecast, for future conditions, guiding decisions that maintain a resilient freshwater ecosystem.

We created RiverNET to provide a baseline for what a healthy Yellowstone watershed should look like, monitor and learn through time as different impacts occur, and develop short-term forecasts to take action in a timely manner. On the ground (at the patient's side) RiverNET conducts basin wide monitoring on the main stem of the Yellowstone river and its many tributaries, for both water quality and quantity diagnostics. The program functions in collaboration with local land owners, the Montana DEQ and DNRC, federal agencies, conservation groups, recreationists, and local businesses to provide quick turnaround data on the watershed that is both trusted and made freely available to the public.

For a river that is central to the identity and economy of a region and the welfare of its ecosystem, it must continuously be fought



*Yellowstone River. Ava Kunze, YERC Intern*

for and protected. To do this, one needs cold, hard numbers to back up effort. The role of RiverNET in providing unbiased data available to all parties interested (and involve the stakeholder parties to bear witness) will allow for these issues to be resolved not with emotion, but with community based science that transform data (diagnostics) into valuable and trusted information to sustain the health of the great rivers that flow out of our famous ecosystem. We thank our many supporters, donors, volunteers, and collaborating partners that made RiverNET the success it is. And we hope to grow new partners to sustain

our monitoring efforts and move to forecasting so that we can make smart decisions in a timely manner that benefits everyone—especially landowners, the key to successful conservation.

**Spencer Link**  
RiverNET Hydrologist



Become a supporter of Rivernet today.  
[Adopt a river for \\$500 here.](#)



## LANDNET: COLLABORATION FOR SUSTAINABLE RANCHING

*YERC, through LandNET, works with ranchers in Paradise Valley to apply drones to ecosystem research and monitoring.*

*Aerial photograph of Mill Creek, Montana  
Joren Nelson, YERC Intern*

We launched our LandNET pilot program in 2020 with the initiation of a long-term monitoring program on Montana's ranchlands and construction of an app tailored to conservation ranchers. LandNET was born from the union of YERC's past research and monitoring programs and the desire to expand the success our RiverNET community model to include floodplains, ranchlands and terrestrial biodiversity as well as an organic collaboration with another local, like-minded Montana not-for-profit, the Western Sustainability Exchange (WSE) [[visit WSE's website](#)] and its resilient ranching program. When we realize that the streams and rivers of our watersheds are the essential circulatory system for our landscapes, it's easy to see how vulnerable producers are to drought. Without sufficient

### **LANDNET WAS BORN FROM THE UNION OF YERC'S PAST RESEARCH AND MONITORING PROGRAMS AND THE DESIRE TO EXPAND THE SUCCESS OUR RIVERNET COMMUNITY MODEL.**

soil moisture, the rich micro-biodiversity in soil (fungi, bacteria, insects) degrades rapidly and severely impacts production of food for people and the forage needed by ungulates, both domestic and wild. Even the decline of forests locally and globally is tied directly to seasonal vegetation moisture stress from unhealthy soils which increases the risk of severe wildfire, as our chief scientist, Bob Crabtree,

is quoted noting in [[this New York Times article](#)]. YERC's holistic mindset confers a unique ability to collaborate with landowners, agencies, and corporations with the goal of collecting meaningful data that is needed to first assess and then maintain and recover our public and private landscapes. Tools that deliver essential diagnostics that are trusted and verifiable must also be useful for individual landowners in their everyday management decisions.

With the help of WSE's long standing history with Montana ranchers, LandNET started a monitoring program focused on the soils, vegetation and biodiversity of participating ranchers in Paradise Valley and central Montana. Landowners will have access to

## LANDNET

their land's soil and vegetation data through the EPIIC internet platform [\[check it out\]](#) and are strongly encouraged to be involved in data collection. YERC started construction of a user-friendly online dashboard linked to EPIIC's dynamic data archives, allowing ranchers to take preventative measures while maintaining or increasing profit margins, thus making them more resilient to disturbances such as drought. LandNET lead biologist, Mikaela Howie, and YERC field technicians Pat Jackson and Richard Rich worked directly with ranchers to set up monitoring transects across various soil and topographic characteristics. This team worked with WSE field techs that together collected soil carbon samples, surface soil moisture data and vegetation cover estimates, taking note of both native and invasive species, such as cheatgrass. Such data are not only valuable to individual landowners, but they also provide a framework on which larger scale

projects can be built that will directly address how ranchland ecosystems are changing over time with climate variability, land-use activities, and population growth.

By including measures of habitat and biodiversity, LandNET contributes to the health of Montana's ranchland ecosystems. LandNET's birding data [\[learn more here\]](#), collected by ornithologists offers a significant puzzle piece to understanding and protecting the health of the whole ecosystem. Birds are 'wild canaries' and provide the best vertebrate indicators of landscape and biodiversity health as they respond rapidly to land-use practices and conservation action. By simply monitoring the diversity of species and numbers over time, both diagnosis and prognosis can tell us whether the landscape is in a sustainable balance (resilient) or degrading—a declining well normal state. We successfully conducted bird surveys at four ranches and along eight

tributaries in Paradise Valley and along traditional sites in Yellowstone National Park. With ongoing support from the community of stakeholders of the LandNET program, bird surveys can be continued in 2021 and beyond, enhancing our understanding of how impacts affect ranchland ecosystems and thereby keeping the whole ecosystem connected and healthy.

Please consider sustaining the valuable work of LandNET to monitor soil carbon, soil moisture, vegetation and bird diversity with a financial donation or by participating as a landowner, volunteer or data user.

**Mikaela Howie**  
LandNET Lead Biologist



[Interested in participating? Email us!](#)



*Mallard's Rest. VC Wald*



*Images right and following page are from wildlife cameras installed and monitored by YERC's WildNET program. Image data is critical to assessing wildlife population dynamics.*

and we simply can't detangle them without information in the form of standardized, trusted monitoring programs. The budgets of agencies that typically conduct these all important monitoring efforts are squeezed and sometimes eliminated. This opens up the opportunity for public-private partnerships, something YERC has specialized in from its inception. As part of our WildNET program we envisioned a future network of camera traps collecting valuable information about changes in species populations that inhabit Paradise Valley. In addition, if we are to develop successful coexistence programs that reduce human-wildlife conflicts, we must gather key data to drive smart decisions and sustainable practices.

**THE SIZE AND CHARACTERISTICS OF THESE POPULATIONS OUTSIDE YELLOWSTONE NATIONAL PARK ARE LARGELY UNKNOWN AND THEY OFTEN COME INTO CONFLICT WITH HUMANS.**

## WILDNET: MORE WILDLIFE IN NORTHERN YELLOWSTONE?

Since the reintroduction of wolves in 1995 and 1996, there have been reports of increasing numbers of ungulates (elk, deer, antelope, mountain goats, and bison) and some carnivores (wolves, bears, river otter, fox, and mountain lions) in the northern Yellowstone regions. The size and characteristics of these populations outside Yellowstone National Park are largely unknown and they often come into conflict with humans. Are increa-

ses due to either intrinsic increases in reproduction and survival or shifts in habitats use patterns, and migrations? At the same time, major forces are impacting their distribution and numbers: human growth, land-use practices, fire, and changing climate, especially snowpack. They not affect these populations directly but indirectly through changes in habitat composition and structure. It's a confusing and complex set of factors at play

Given recent advances in technology now available to the private sector, YERC deployed 8 camera traps in Paradise Valley as a pilot study to gather information to design our larger community co-op where private landowners and public land agencies work together to collect and disseminate diagnostics of wildlife population characteristics. We received an initial response from a variety of landowners that use camera traps on their lands and decided to start a pilot project on federal land with permission and support of the US Forest Service. So far the results are encouraging as we analyze data



on ‘captures’ versus ‘effort’ so that we can design our community co-op that measures diagnostics to help identify diseased or problem individuals, obtain important vital rates (mother:offspring ratios), and hopefully estimate population size. YERC is no stranger to camera trap applications. In 1991, YERC’s Chief Scientist, first deployed camera traps to conduct carnivore surveys along with scented hair snag stations and snow-tracking surveys on skis in northern Yellowstone. Of the three methods we determined that snow-track surveys combined with camera traps provided the most efficient means to confirm identification and presence of a species active in the winter. Low and behold, we discovered the presence of fisher (near Cooke City) [[read the article here](#)]. It is believed to be the only naturally surviving population in the lower 48 states after their near complete extirpation and then reintroduction.

**Robert Crabtree**  
YERC Founder and Chief Scientist



[Sponsor a wildlife camera today.](#)

## NOTES FROM THE FIELD

**Drones for Conservation:** Sometimes revelations occur when you least expect it! Last year, YERC scientists were visiting the Anderson Ranch up in Tom Miner basin when Daniel and Malou Anderson spotted a grizzly being escorted away from their cattle by a couple of mustangs. Within a few minutes they launched a drone which flew high above the raucous. It was a bear they’d seen before and we all discussed possible ideas about how drones could be used as a tool to solve important conservation issues such as mapping invasive species, monitoring ice dam formations, identifying key habitats like aspen and willow, and monitoring range condition and production. Thanks to their leadership we approached a nearby conservation-minded rancher, Hunter Terry, who asked what kind of drone he could purchase to similarly use.

*A DJI Inspire 2 in flight.  
Sven Teschke*





*Surveying Ice Formation. Joren Nelson, YERC Intern*

We connected him with YERC intern Joren Nelson, also an MSU student, who is both a fixed-wing pilot and FAA approved drone operator. A drone was purchased along with a high resolution professional quality video camera attached to an image-stabilizing feature called a gimbal. Hunter Terry and his family and friends have programmed it to conduct surveys on their ranch and are willing to loan it to YERC for conservation applications. Thank you Hunter and Caroline Terry and the other cooperating landowners. With continued support, we plan to expand our community co-op concept to additional landowners with drones in Paradise Valley as we test and develop applications that solve problems.

***MSU Student Internships, Work-Study positions, Senior Projects, and Directed Study classes:*** A 'thank you' gathering at Columbo's (pre-pandemic) in Bozeman, Montana. Pictured are some of the 2019-2020 MSU students with majors in statistics, marketing, business management, photography, computer science, ecology and environmental studies. Over the years YERC has provided real-world educational experiences beyond the excellent institutional education provided by Montana State University for several hundred students. With those education experience and practical job experience, students stand out when applying for jobs or further educational opportunities.





# BECOME A MEMBER OF YELLOWSTONENET TODAY!

Upon becoming a member, you'll receive:

A high quality 27x40 map of the Greater Yellowstone Ecosystem

Access to our EPIIC data sharing platform as launched

Our quarterly newsletter and email updates

Sign up today!  
[www.yellowstoneresearch.org](http://www.yellowstoneresearch.org)



# OTHER WAYS TO CONTRIBUTE

**Come and volunteer with us!**

We need *your* help collecting data and keeping us running. Help out on our WildNET, LandNET, or RiverNET programs. [Join our team of volunteers here](#)

**Become a sponsor of one of our hard working teammates!**  
[Sponsor an intern](#) or [Sponsor a Field Tech](#)

**Fund a wildlife camera!**  
[Fund your first camera here](#)

**Adopt a river!**  
[Adopt your river here](#)