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THE TRACKER

YERC'S NEWSLETTER

"Intelligence is the ability to adapt to change."
STEPHEN HAWKING

YELLOWSTONE ECOLOGICAL RESEARCH CENTER

IN THIS ISSUE:

LOOKING BACK ON 2021 - PROGRAM HIGHLIGHTS

This past year has been a whirlwind of growth for YERC amidst pressing challenges facing the land, water, and wildlife of the Greater Yellowstone Ecosystem. Now (more than ever) we're called to come together around science to drive meaningful conservation success.

Read on to learn more about our highlights from 2021 - including program specific highlights from our community science cooperatives.

IN 2021 YERC...

Welcomed Tory Dille as YERC's new Development and Communications Manager.

Had a record year of fundraising (including the Give-A-Hoot campaign thanks to the Park County Community Foundation). We're so grateful for our engaged donor community!

Received grant awards from the Cinnabar Foundation, AMB West Philanthropies, MiTACS, and Patagonia.

Provided mentorship opportunities for 8 projects including that included 27 undergraduate students at MSU (interns, work-study students, and senior theses).

Received match funding from Montana Conservation Corps for a full-time RiverNET Field Coordinator.

LandNET and WildNET

Strengthened our LandNET partnership with Western Sustainability Exchange through the soft release of the Land Health Dashboard with several cooperating large ranches in Montana.

Kick-started WildNET! We created 3 working groups and joined 2 national NGO groups to create strategies and emergent technologies to address carnivore coexistence strategies given the wolf and grizzly bear crisis in the GYE.

Conducted riparian songbird surveys in YNP and in Paradise Valley.

RiverNET

Provided water quantity and quality data in near real-time from May thru October for the Upper Yellowstone Watershed on the RiverNET Application for the fourth year in a row.

Released the RiverNET Data Platform Application and received media coverage surrounding our efforts while continuing to work with landowners in Paradise Valley.

Expanded the RiverNET program to the Madison River Watershed and the Upper Snake River Watershed including fundraising events and establishment of critical partnerships.

Conducted macroinvertebrate surveys on select tributaries of the Yellowstone and Madison Rivers as a new diagnostic for RiverNET.

Completed the (feature recognition) cell phone app for automatic macroinvertebrate identification.

Developed a total water budget for the Upper Yellowstone Watershed and conducted initial forecasts of climate change impacts.

Created a working group for riparian vegetation monitoring and mapping of structural characteristic of the Yellowstone River.

We truly couldn't do this without our incredible community of donors and partners. Thank you for your continued support - we look forward to growing with you.

With gratitude,
The team at YERC

Want to support us? Visit
www.yellowstoneresearch.org/donateyerc

(Cover & Above: Canva)

The mission of the Yellowstone Ecological Research Center is to empower individuals and communities with data-driven science and technology to activate land, water, and wildlife stewardship across the Greater Yellowstone Ecosystem and beyond.

In 1993, YERC designed and executed the gold-standard foundational research that measured the impact of the wolf reintroduction on Yellowstone. In pursuit of these studies at the dawn of the internet, YERC adapted new uses of data and technology - in both the lab and the field - to model what was learned. To this day, YERC canid research is referenced far and wide and YERC experts join in on national conversations.

YERC has continuously modernized these techniques to broaden our research to include watershed, landscape and wildlife modeling with visualization, and so pioneered the data fusion approaches that resulted in internet applications such as EAGLES, COASTER and ClimateScape. These novel web-based peer-reviewed prediction and visualization tools were useful to thousands of researchers, landowners and policy managers alike.

YERC's storied success is rooted in land steward collaborations. We work with private landowners and conservation professionals towards a collaborative common interest - atoms and animals don't recognize borders, and stakeholders in their ecosystems have different needs. We have learned from our neighbors and educated thousands of students, MS and PhDs across 100 projects in the application of these principles. Many YERC graduates are now themselves research leaders.

Following our Envision Yellowstone Summit in 2017, YERC deepened our investment to measure and predict local ecosystems through local data fusion, data-driven collaborative decision making, and community education. We call this Precision Ecology, and we build it on our principles of **Science, Technology** and **Place**. We pursue it through our three field programs, our fusion platform EPIIC, and now our proposed Field Center at the northern gateway of Yellowstone National Park.

The challenges facing our lands, water, and wildlife call for data-driven models and strategies to understand and address the changes we're seeing in our wild backyards. Join us in the mission to arm the Greater Yellowstone Ecosystem for the future, and enhance and demonstrate our Precision Ecology standards for the benefit of all.

Land Acknowledgement: *YERC's programs take place in the Greater Yellowstone Ecosystem on the land of the 30+ tribal nations and communities with current and ancestral connections to the Greater Yellowstone Ecosystem.*

Bison move across the Greater Yellowstone Ecosystem in early winter. *Photo: Canva*

WILDLIFE COEXISTENCE, CONNECTIVITY, CORRIDORS AND STRONGHOLDS: THE "BISON IN THE LIVING ROOM"

AN ESSAY ON YERC'S WILDNET PROGRAM BY YERC'S CHIEF SCIENTIST

As the scientific discipline of ecology grows, new slogans, terms, and subdisciplines are necessarily created to further promote and protect life on earth (biodiversity). For example, the creation of conservation biology over 30 years ago promoted population genetics, a very important aspect that had previously been underemphasized; similarly in the realm of landscape ecology - 'spatial mapping' of ecological phenomena on the empirical landscape - turned out to be a landmark step in putting theory into practice. Even today, we see Artificial Intelligence (AI) assisting wildlife conservation by further developing and upgrading what ecological statisticians have been doing with neural networks for decades. Collectively, we are devising new approaches and techniques to work towards protecting our wildlife populations - especially those species in peril. This species level focus is key to the health of ecosystems, the basic subdivision of life on Earth.

At the confluence of landscape ecology and conservation biology, a variety of related terms arose - connectivity, corridors, crossings, greenways, etc. - that are collectively referred to as wildlife connectivity or corridor ecology. An excellent treatise on this subdiscipline is Corridor Ecology: Linking Landscapes for Biodiversity Conservation and Climate Adaptation written by colleagues Jodi Hilty et al. They look at how important landscape features, often linear, can be managed and arranged to allow wildlife to move to and from quality habitat. This is critically important for the recovery of a wildlife population that has substantially declined because human activities have caused massive reduction and fragmentation of their native habitats. Individuals become isolated from natural movement patterns that access vital resources to survive and reproduce. This conflict brought on the question of how to best design and manage the landscape - both public lands and private working lands - to maintain and restore viable populations that are resilient to impacts from human activities and climate change. This is not easy in a human dominated landscape delineated with political and jurisdictional boundaries that are largely unknown to wildlife.

Before light is shed on the bison standing in the living room, it's important to take a step back and look at the basics, because no matter how we use the many approaches that each promote a 'conservation fix', we must understand the root cause of population decline. With this knowledge in hand, then and only then, can we proceed with a successful conservation solution. Wildlife biologists often identify the characteristics of a variable-sized habitat patch that are conducive to, or reward, wildlife species that exploit the resources within for their survival and reproduction. Evolution selects for wildlife behaviors that favor these stronghold habitats where they experience nutritional and demographic rewards. However, the risks in these strongholds are often ignored or misunderstood rendering the analysis,

The species population concept in ecology is of fundamental importance. Life on Earth or biodiversity can be organized into three basic levels: genes, species, and ecosystems. The famous biologist EO Wilson places priority on the species level that integrates both genes and ecosystems. Species carry genetic information, add structure and function to ecosystems, are easier to understand and study, and provide the main and practical means for humans to manage and restore genetic diversity and ecosystem health - both vital to resilience in a changing world.

and subsequent understanding, deficient. When such diagnostics models are broadcast in the scientific and popular literature, there is a strong probability that decision-making made on these deficient models will be biased and lead to mismanagement.

What structurally looks like high-value habitat can be riddled with risks such as disturbance, predation, overharvest, disease, and structures such as fencing and roads. So if we include all known risks and rewards, we can then identify real strongholds by using the ultimate performance and management metric: demography, that is, are they safe for survival and reproduction? Are they drawn to a particular stronghold or do they pass through or quickly leave. Then, we have to determine if there is a sufficient amount of that habitat or carrying capacity for the population in question. For these reasons, YERC's WildNET program is focused on the quantification of strongholds with regard to not only it's carrying capacity or habitat value -measured by the probability of selecting that stronghold - but it's contribution to a species cumulative demographic success or fitness as it attempts to survive and reproduce across all the habitats included in its home range. Our past research terms this approach a 'RRSC', (pronounced 'risk') population model and stands for Risk-Reward Spatial Capacity population model. This approach is described in a 2012 book chapter and marries spatially-explicit habitat selection models with population models over time. Finally, if there is not a sufficient amount of stronghold habitat for a particular species, then conservation action needs to be taken to allow wildlife species to access additional amounts by linking or connecting strongholds with safe passage (corridors).

We will very likely make mistakes in population management decisions, conservation programs, and restoration programs if we don't stay focused on identifying the root cause(s) of mortality - the risks as well as the rewards of strongholds - as well as where and when they occur and the degree they interact.

And even if mistakes are made we can learn and then adjust (adaptive management) if we commit to long-term monitoring that can also provide for cutting-edge science that gets at cause and consequence. For example, some causes of mortality interact and substitute for another, for example, a predator may prey on an ungulate - a fawn in the summer or an older bull elk in late winter - that are nutritionally compromised and likely to die anyway. Yet others are tragically more additive to other forms of mortality, for example, harvesting a healthy pregnant cow elk, or excluding it from valuable winter range forage. We're flying blind without this basic knowledge of the risks and rewards at critical life history stages - that often occur during the winter - of each species, especially today when the impacts of climate and human activities are interacting in unpredictable ways that are rendering traditional management and decision-making systems ineffective.

A habitat stronghold is a more recent concept defined as a spatial unit where populations are strong, diverse, and the habitat has a high intrinsic potential to support a particular species, or suite of species. It became popular with conservation efforts aimed at restoring species in peril, like salmon or tigers. Although implicit, YERC's WildNET program specifically adds a demographic component to this definition: where a species can survive to reproduce. This adds a vitally important measurement of success or performance metric needed to evaluate, learn from, and adjust the conservation decision-making process in a timely manner at a time of rapid change - from both climate and human impacts.

I submit that the bison - our elephant - in the living room is our willingness to ignore the basic empirical facts that a very large majority of catastrophic declines in species populations (and extinctions) worldwide, and in the GYE, are attributable to two major root causes: (1) overharvest or killing, and (2) major loss of natural, evolved habitat. It's not rocket science. Again, new terms, slogans and subdisciplines can add to our understanding of the root causes and consequences, but if we don't first identify and quantify the casualties of population fluctuations which are tightly linked to available habitat, then whatever conservation decision we make will likely be ineffective in recovering and or sustaining a healthy population. This benchmark of success is needed to mitigate the causes of loss head-on by identifying where and when mortality occurs.

This often ignored aspect of coexistence is its most important.

This benchmark for success suggests a closely related concept when evaluating different choices and options when attempting to restore or recover. It's also akin to running a successful business: set your performance metrics (measures of success). For wildlife, it's rather simple: survive in order to successfully reproduce (fitness). This demands that we quantify strongholds. For example, why construct a 5 million dollar overpass if it doesn't at least increase overall annual survival and reproductive success of the target population, let alone reduce wildlife-vehicle collisions? Why create landowner incentives to decrease depredations using lethal means when they are not economically and/or socially justified? Or when non-lethal means (often referred to as coexistence strategies) are more cost effective and don't cause a decrease in population levels which takes away value from other valued land-use activities on adjacent lands (wildlife viewing and hunter harvest)? Finally, how are we evaluating the various alternative choices?

So take bison for example! We know from history that humans nearly killed them off to extinction if it were not for a small group of concerned conservationists that worked together to allow the remaining few in the protected area known as Yellowstone National Park. With a population reduction of over 99.9% we catastrophically disrupted the North American continent by functional extinction of the major grazing herbivore in terms of biomass, but also a key process known as migration . This is a recurring seasonal pattern whereby a species impact forage - is distributed over space and time and greatly lessens the impact to plant communities. These migrations undoubtedly evolved over thousands of years - along with other factors like predation, competition, fire, and climate - to establish a dynamic steady-state condition that shaped the great plains and grasslands of North America.

Bison, like other large mammal species - ungulates and carnivores - that barely survived human impacts in the 19th and 20th centuries, are capable of moving many miles during a short period and are beginning to repopulate their former historic range. In doing so, they are now facing the second major human impact - habitat loss. As they attempt to 'learn' new migratory routes, they seek modern analogs to their historic grasslands and face continued mortality risks, primarily on their low elevation winter range. This brings up a whole host of questions with regard to root cause and consequence. For example, as we attempt to restore migratory and dispersing large mammal species, how do we know which ones to focus on? Are the identified routes today artifacts of past culturally evolved routes or are they recent? Are they ephemeral and disappear in a few years due to natural impacts like changing forage production patterns or any one of numerous human impacts? Does a study that lasts a few years tell us what habitat and movement corridors are most important to protect in the long-run when so many factors - that vary seasonally and annually - affect their movements? Even if we learn about the annually variable routes as well as traditionally used movement corridors, how can we identify and prioritize the most important stronghold habitats to connect in space and time so that we provide wildlife species sufficient habitat to survive and then reproduce but also decrease conflicts with humans (vehicle strikes, depredation on livestock and crops)?

Take today's famous stronghold - safe haven habitat - for many large mammals, called the northern ungulate winter range of Yellowstone National Park, includes, and is expanding further into, Paradise Valley. This is where species like ungulates - elk, pronghorn, mule deer, and bison - attempt to migrate from protected summer range down to their historic lower elevation winter range, primarily in Paradise Valley. These species, along with dispersing carnivores, seek habitat strongholds to survive the energetic bottleneck called winter. With the required nutrition comes significant risk to gain the reward of forage and prey. During this winter period all the mature females of these large mammals are pregnant which adds to the population risk which can come with great consequences.

While talking with quantitative ecologist and wildlife demographer Dr. Kenneth Wilson of the Fish, Wildlife and Conservation department at Colorado State University (and YERC board member), he mentioned the similarity of wildlife moving to and from lower elevations as "navigating the streets of a major city where a migrating ungulate or dispersing carnivore attempts to safely move forward during a risky 'green light' and only stop at a 'red light' or supposed safe stronghold". Similarly, and even more morbose, is the "red light, green light game" during the first episode of a popular TV series called Squid Game. It provided a stark example of the problems an individual faces when leaving their more-or-less protected home in Yellowstone National Park. Individuals are seeking to avoid a 'debt', that for wildlife, is a lack of nutrition during winter. In that show, the slightest misstep or confusing rule ended in death and few made it to the finish line. Similarly, wildlife often face a juggernaut of additional human risks - a spatially confusing maze of choices that are difficult to perceive and respond to. These mortality risks are often in addition to natural mortality factors they face during the winter energetic bottleneck where they need to gain enough food to survive, especially for pregnant females.

Clearly, a new approach is needed for wildlife population ecology and management. One that is evidence-based, focused on causality, and has management and conservation decisions that adjust to annual performance metrics (e.g., 60% survival). Thus, in our WildNET program, we are focused on population models, full of real empirical field data, that are capable of quantifying all landscape factors - both risks and rewards that include different impact

Coexistence is a sustained state in which humans and wildlife can co-adapt to living in shared landscapes, where human impacts on wildlife are governed in a way that ensures long-term wildlife population resiliency or fitness, social legitimacy, and tolerable levels of risk.

Habitat strongholds are particularly critical during the winter months, when resources are scarce. Photo: Canva

scenarios including land-use, hunting, climate, habitat, forage, prey, and predators. We build these models in a way that end-users can predict the consequences of many different What-if-Scenarios - natural and human-caused impacts - on wildlife populations. We evaluate them by addressing how those impacts promote survival or add to mortality, for example, how a particular stronghold affects demography, the ultimate performance metric of a stronghold whether connected or not. Remember, population ecology in a nutshell goes like this: you must compete to eat and not get eaten in order to survive and then reproduce. That's a simplification, but it underscores what real coexistence strategies are about and how the many risks and rewards that species face during their life history stages culminate in passing on their genes or not. So let's take a razor sharp focus on how the causal factors (both human and non-human) affect species decline.

From my young adult years as an avid hunter, angler, and fur-trapper, to my adult career as a conservation ecologist involved in large mammal research and monitoring, I have always advocated for a common sense, evidence-based approach to science that aids in sustained decision-making. In evaluating different alternative choices, I use three yardstick measures, called *the three "E's"*. First is **Ecology**. What does an objective, independent assessment using the best available science say about the issue or impact? Then **Economics.** What is a full-cost accounting, including unpriced values, of the proposed action and its impact cost to humans, wildlife, and the ecosystem they inhabitat? Finally, what are the **Ethical** considerations of the impact given alternative choices, including no-action? This is where the ecological and the social sciences - and their open, repeatable, predictive, and transparent methods - can identify the best option(s) that sustains healthy wildlife populations while hopefully providing economic incentives that work for people. This is the basis of a sound coexistence program that is also embedded in our WildNET program, where all stakeholder groups - academia, agencies, NGOs, businesses/corporations, and the general public, especially landowners - work together to collect trusted data that can then be used for sustained decision-making according to the three **E** yardstick measures and their performance metrics, so that the options can be adjusted as needed to adapt to change (climate, market trends, land-use).

We seek the truth - from common sense and science - that's out there in nature. We avoid the politics of mis- and disinformation campaigns, all too-common among and within and between stakeholder groups. Afterall, empirical evidence is the key to finding the truth as well as gaining the trust of landowners, whether it's ecological, judicial, or forensic. Such scientific information that adds reliable knowledge can come from landowners, biologists, managers, and businesses - not just from academia. So let's look directly at the bison standing in the living room waiting to move forward and start with the root causes of population fluctuations. What is the consequence of the impact (called a crime in judicial systems)?

How can we remedy and prescribe - called restorative justice? In the environmental, ecological, and social sciences, we similarly look at the consequential impacts of the human perpetrator which is what we attempt to do with county, state, and federal statutes like NEPA on species populations and attempt to mitigate and adapt. That's why we're excited to apply our WildNET principles and approaches to restoring species populations so we can all coexist sustainably in our home ecosystems across generations.

Dr. Bob Crabtree
YERC Founder and Chief Scientist

Help us launch this critical program by donating to WildNET and supporting science-based coexistence strategies for wildlife—we can't do this without you!

COLLABORATION SPOTLIGHT: MSU STUDENT CAPSTONE AND YERC INTERN PROJECTS

YERC has mentored hundreds of students at both the undergraduate and graduate levels over the past few decades. This year we continued and expanded our collaboration with Montana State University (MSU) by supporting a record 23 student internships - mostly talented seniors. They represent several departments including Computer Science, Mechanical Engineering, Electrical Engineering, and Earth Sciences. YERC staff works closely with MSU faculty to co-advise these students in their design proposal, execution of work, and final deliverables - most of which further develop our internet platform called EPIIC. For example, we have 5 senior Capstone projects working on projects for YERC. Most importantly, it provides young adults the chance to do 'hands-on' projects to solve real-world problems while gaining invaluable experience to build their resumes and launch their careers.

One team of computer science students is working on a mobile app to improve the timeliness and accuracy of ecological data collected in the field. Types of data collected will include photos of wildlife, aquatic insects, and vegetative ground cover as well as data for water quality samples or soil moisture. These datasets stream in real-time from the field to the EPIIC platform!

A second team is working on the integration of imagery from drones, airplanes, and satellites into Artificial Intelligence (AI) driven mapping products and simulation models that produce end-user defined products and tools to plan for, and adapt to, optimal water allocation, drought adaptation, land-use planning, wildlife management, and response to flood and wildfire risk.

As part of our WildNET program, mechanical engineering students are coming up with creative ways to use drones to protect livestock from predators. These are non-lethal methods of deterring predators using auditory, visual and olfactory elements to help protect ranchers from economic loss. Using a drone to deploy deterrents covers more acreage, more quickly without putting a range rider at risk. These tools are all aimed at providing pathways to coexistence with critical wildlife species.

Another project is building a prototype Smart FishNET or Smart-NET. This device can be strapped-on to a fish landing net and automatically detect if a fish has a unique fish tag (RFID pit tag), measure water temperature, record fish size, and upload the data to the angler's cell phone and then to EPIIC.

And another multi-disciplinary engineering project, with seven students from 4 departments, is building a large mammal marking system that detects movement and speed and safely paint-ball marks the 'rear quarters' of a large mammal. This empowers the very popular and growing 'camera trap' user community to derive estimates of population size, movements, and survival, as well as identify problem or diseased individuals.

YERC is using a data-driven approach to help write the next chapter of human-wildlife coexistence in the Greater Yellowstone Ecosystem. Pictured below are students in YERC's Large Mammal Taggging Group.

Finally we have several directed study students and YERC interns working to develop GIS and remote sensing data products. This coordinated project aims to fill two needed gaps identified as a priority by managers, biologists, landowners, and decision-makers: (1) a freely available habitat map of cover types that is updated every to track change, and (2) the user-friendly ability to visualize all map and image products in a sophisticated, internet-based visualization platform. One offshoot of this project was the production of a 3D map of riparian vegetation structure and composition at a spatial resolution of 2 centimeters!

And for the first time in three semesters, we were able to enjoy a brain-storming session over pizza and beer! We spread out the seven project teams in a covid-responsible manner and gathered in a relaxed setting so students could get acquainted, share ideas, troubleshoot problems they are facing with their projects, and in the process, gain collaborative work skills.

We are so grateful to have the opportunity to mentor the next generation of conservation-minded professionals!

Melissa Todd

Business Manager

Melissa Todd has been the office manager at YERC for 9 years and also advises MSU students that work on both office, lab, and field projects. These students are busy taking classes and gaining valuable real-world work experience to complement their career goals post-graduation. Melissa handles our partnership between MSU internships and Senior capstone projects.

PROGRAM SPOTLIGHT: LANDNET

YERC's partnership with Western Sustainability Exchange (WSE) is a critical component of our growing LandNET program. Roby Roberts, YERC CTO, has been working with WSE staff on an application to support conservation-minded ranching.

The Land Health Dashboard is a tool to store and visualize data for on-ranch planning and forecasting that enables a rancher to organize grazing and ecological data in one place; it is currently being developed and refined with the WSE and YERC team prior to an official release.

Examples of data that rancher can collect:

- track herd movement
- record soil sampling data including organic matter and soil carbon
- observe wildlife changes, e.g. bird counts

With the data in one place, the rancher can:

- forecast the grazing days per season
- evaluate pasture health using imagery or low-cost drones
- monitor trends over time so that the rancher can observe and adapt the management of their resources.

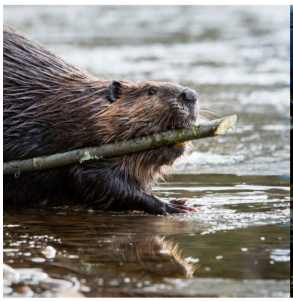
Photo: Canva

The Upper Yellowstone River flows through Paradise Valley. *Photo: Canva*

PROGRAM SPOTLIGHT: RIVERNET DIAGNOSTICS

The community spoke and we listened! We're exicted to annouce **Phase II of our diagnostic monitoring program for Yellowstone Headwaters RiverNET.**

Our focus is on the tributaries - where the impacts occur and restoration is most effective. Our approach is complementary to agency efforts and we are now providing the key diagnostics on how impacts have or have not affected the watershed to keep it healthy for trout, other wildlife, and our human communities.



In addition to continued water quality and quantity monitoring, RiverNET Phase II for the Yellowstone Headwaters will expand our monitoring program to include:

- aquatic insects
- riparian songbirds
- trout population surveys
- algae monitoring
- riverine mammal biodiversity surveys
- streambank characterization
- riparian vegetation structure and composition.

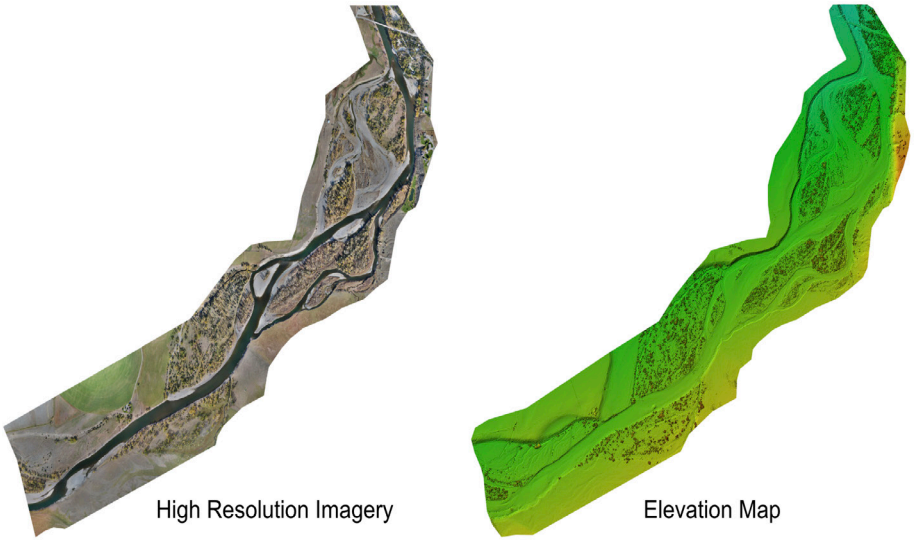
INSIGHTS FROM RIPARIAN MAPPING

Mapping with drone photogrammetry provides a cost-effective method to accurately produce a high-resolution imagery of streambank condition, riverine floodplain habitat, riparian vegetation structure, and composition of riparian corridors. By collecting baseline conditions and performing flights on an annual or bi-annual interval, the data has potential to be used as the basis for a long-term monitoring program of riparian corridor conditions.

This fall, YERC interns performed flights for two sections of the Yellowstone River in Paradise Valley near Pine Creek Bridge and Emigrant Bridge. For these test cases, drone imagery was used to create a high-resolution image and digital elevation model (DEM). With further analysis and processing, this data can be used to gauge the effectiveness of vegetation/ habitat restoration and connectivity, resilient ranching practices, and an ecosystem service (biodiversity) credit program via verification (some ground truth will be needed). When co-registered with lidar data and the many other GIS layers, these valuable data layers can lay the groundwork for sustainable land-use practices, vegetation restoration programs, land-use planning, determining wildlife migration corridors and connectivity, and smart growth practices.

Aleck Gantick and Ryley Enich, YERC Staff

Mallards Rest to Pine Creek Bridge



High resolution (2 cm) imagery from our drone provides a wealth of information about riparian health and streambank conditions. For example, the image on the left can be used to classify vegetation and streambank condition into many useful categories. The image on the right is a three-dimensional map that includes the elevation of the ground as well as the height of individual plants.

GET INVOLVED IN THE STEWARDSHIP OF THE GREATER YELLOWSTONE ECOSYSTEM!

Visit www.yellowstoneresearch.org to:

Subscribe to our quarterly newsletter

Purchase a high quality 27x40 map of the Greater Yellowstone Ecosystem

Access our open source data-sharing platform, EPIIC

Come and volunteer with us!
We need *your* help collecting data and working with our programs! Help out on our WildNET, LandNET, or RiverNET programs by visiting the *collaborate* page on our website.

Become a sponsor of one of our hard working team members!
Sponsor an intern or Sponsor a Field Tech

Fund a wildlife camera!
Fund your first camera on our website

Adopt a river!
Join the Adopt-A-River program on our website