M.L. 2019 Project Abstract For the Period Ending June 30, 2022

PROJECT TITLE: Unlocking the Science of Minnesota's Moose Decline PROJECT MANAGER: Nicole Mattson AFFILIATION: Minnesota Zoo MAILING ADDRESS: 13000 Zoo Blvd CITY/STATE/ZIP: Apple Valley, MN 55124 PHONE: (952) 431-9540 E-MAIL: nicole.mattson@state.mn.us WEBSITE: www.mnzoo.org FUNDING SOURCE: Environment and Natural Resources Trust Fund LEGAL CITATION: M.L. 2019, First Special Session, Chp. 4, Art. 2, Subd. 03p as extended by M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 18

APPROPRIATION AMOUNT: \$199,000.00 AMOUNT SPENT: \$198,489.97 AMOUNT REMAINING: \$510.03

Sound bite of Project Outcomes and Results

The Minnesota Zoo gathered moose researchers to share their key scientific research findings about Minnesota's moose decline. The research findings were used to develop interactive interpretive features for the Zoo's moose habitat, an educational website, and an engaging online game that highlights the survival challenges influencing Minnesota's moose population.

Overall Project Outcome and Results

The moose is an iconic Northwoods animal that has had an important presence in Minnesota and at the Minnesota Zoo. However, moose in Minnesota have experienced periods of dramatic population decline over the last 30 years. They have nearly disappeared from northwestern Minnesota. Since 2004, moose numbers have decreased by roughly 50% in the northeastern part of our state. Significant public resources have been invested in scientific research to understand Minnesota's moose decline. Many Minnesotans are keenly aware of the moose decline and want to know more about its causes and what can be done to help.

With ENRTF support, the Minnesota Zoo collaborated with researchers from across the state to identify key scientific research findings about Minnesota's moose decline and population dynamics. This project used those key research findings to develop interactive interpretive displays at the Minnesota Zoo's moose habitat. A new, accessible, educational website was created to make the research findings available for broad virtual access. The website features basic moose natural history, information about moose research in Minnesota, and a custom, interactive game. The game encourages a user to experiment with habitat features to create a simulated environment where moose thrive. While the player attempts to manage for a healthy moose population over the course of a year, random, unexpected events occur. Players learn about some of the challenges wildlife managers (and moose) face in Minnesota.

The physical interpretive elements and online resources created from this project focus on complicated research findings in an engaging, accessible, and easily understandable fashion. These deliverables will be maintained by the Minnesota Zoo and will benefit learners of all ages for years to come.

Project Results Use and Dissemination

Through meetings, presentations and seminars, hundreds of Minnesota Zoo staff and volunteers have learned about Minnesota's moose decline and this ENRTF project. Thousands of guests have interacted with the interpretive elements created for the Zoo's moose exhibit. Thousands of people have also engaged with the virtual components resulting from this project.

Virtual components of this project include:

- <u>Mission Moose website</u>
- <u>Aerial Moose Survey video</u>
- Moose Research video

These online resources have been featured in professional newsletters, publications, listservs, websites and on social media platforms. The Dakota County Tribune also wrote an <u>article</u> about the Mission Moose website and game.



Environment and Natural Resources Trust Fund (ENRTF) M.L. 2019 ENRTF Work Plan Final Report (Main Document)

Today's Date: August 12, 2022 Final Report Date of Work Plan Approval: June 5, 2019 Project Completion Date: June 30, 2022

PROJECT TITLE: Unlocking the Science of Minnesota's Moose Decline

Project Manager: Nicole Mattson Organization: Minnesota Zoo College/Department/Division: Mailing Address: 13000 Zoo Blvd. City/State/Zip Code: Apple Valley, MN 55124 Telephone Number: (952) 431-9540 Email Address: nicole.mattson@state.mn.us Web Address: www.mnzoo.org

Location: Statewide

Total Project Budget: \$199,000

Amount Spent: \$198,489.97

Balance: \$510.03

Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03p as extended by M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 18

Appropriation Language: \$199,000 the first year is from the trust fund to the Minnesota Zoological Garden to develop educational displays, interactive exhibits, and engaging online programs that summarize and share scientific findings about moose decline in Minnesota. This appropriation is available until June 30, 2021, by which time the project must be completed and final products delivered.

M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 18. ENVIRONMENT AND NATURAL RESOURCES TRUST FUND; EXTENSIONS. [to June 30, 2022]

I. PROJECT STATEMENT:

The moose is an iconic Northwoods mammal that has had an important presence in Minnesota and at the Minnesota Zoo. However, moose in Minnesota have experienced dramatic population declines in the last 25 years. They have nearly disappeared from northwestern Minnesota. Moose numbers have declined by almost 60% over the past decade in the northeastern corner of our state. Minnesotans are keenly aware of the moose decline and want to know more about its causes and what can be done to help.

Significant public resources have been invested in scientific research to understand Minnesota's moose decline. The Zoo will develop state of the art interpretive displays and interactive materials to make these complex research findings accessible to all Minnesotans—to those who visit the Zoo's popular moose exhibit and to those who visit the Zoo's website. With an annual attendance of 1.3 million visitors, extensive experience in educational interpretation, and over 2.7 million website hits per year, the Minnesota Zoo is in a unique position to disseminate moose research findings in an understandable fashion.

To accomplish this goal, the Zoo will:

- Work with Minnesota DNR and other scientists to develop key messages that reflect the major research findings and management strategies pertaining to Minnesota's moose decline.
- Create and build interpretive graphic displays, interactive components and touchable artifacts to be located at the site of the Zoo's existing moose exhibit.
- Develop and implement a website that explains moose research findings using plain language and providing online access to the information found onsite at the Zoo. The website will include an innovative and interactive moose management game, engaging moose research videos and annual updates on Minnesota's moose population.

II. OVERALL PROJECT STATUS UPDATES:

First Update January 31, 2020

With support from the Environmental and Natural Resource Trust Fund, the Minnesota Zoo has been able to collaborate with top moose researchers from across several agencies and disciplines in Minnesota including the Minnesota Department of Natural Resources, National Park Service, University of Minnesota—Twin Cities and Duluth campuses, and Grand Portage and Fond du Lac Bands of Lake Superior Chippewa. Based on key moose research findings, three major themes have been identified for the new interpretive signage and interactive features at the Minnesota Zoo's moose exhibit: (1) the uniqueness of Minnesota's moose research, population dynamics, and cultural importance to Minnesotans, (2) moose scientific research methods, and (3) the complexities and challenges of moose population management in Minnesota. We remain on track to refine and further develop interpretive elements at the Zoo's moose exhibit and to make these engaging learning tools accessible to a broader online audience.

Second Update July 31, 2020

The COVID-19 pandemic has had cascading impacts on all work areas of the Minnesota Zoo, including this project as noted in the below Amendment Request. Interpretive themes have been further refined to account for the challenges of our current reality and resulting changes proposed in the below Amendment Request. In order to include the three themes identified in Activity 1, some of the interpretive content will need to move to an online-only format and will no longer be included onsite at the Zoo's existing moose exhibit. Although activity timelines and completion dates have been revised, this project will still be completed by June 30, 2021 barring any unforeseen additional delays related to COVID-19.

Amendment Request as of July 31, 2020

Due to the COVID-19 pandemic, the Minnesota Zoo no longer has the resources to construct a new moose viewing structure. New onsite signage and interactive elements will be installed at the two existing viewing

areas of the moose exhibit. The remaining content and interactive features will be available online-only. As some of the educational content will shift to an online-only platform, better software, improved animation and professional videos will be incorporated into Activity 3. Given the increased reliance on online interpretive elements, the decision was made to hire a professional videographer to create compelling photo and video stories of moose research, rather than leave video production and editing work to web and software developers.

Lastly, the Zoo's graphic designer no longer has the capacity to design the onsite signage for this project and instead will move to a consulting role on all graphic design aspects of this project. A freelance graphic designer will be hired to design the onsite interpretive signage.

To accommodate these revisions in project scope, we are requesting funds be shifted from the Supplies budget to Professional/Technical/Service Contracts, Other Budget Items and Personnel as follows:

- Professional/Technical/Service Contracts would be increased by \$6,900 to a revised budget of \$104,400.
- Other Budget Items would be increased by \$750 to a revised budget of \$2,950.
- Personnel would be increased by \$350 to a revised budget of \$77,650.
- Supplies would be reduced by \$8,000 to a revised budget of \$14,000.

We are requesting these changes because of shifting challenges due to COVID-19. The interpretive program developer will need additional time to revise and accomplish Activities 2 and 3 to accommodate for the lack of a new moose viewing structure. To account for these additional costs, we propose to use funds that were designated for supplies and interpretive elements that would have been housed inside of the moose viewing structure.

Amendment Approved by LCCMR 9/29/2020

Third Update February 1, 2021

COVID-19-related disruptions have caused additional delays to this project. There have been significant, unanticipated obligations for the Project Manager from May 2020 through January 2021 as the Minnesota Zoo worked through two drive-through experiences, two re-openings in a socially-distanced format and an additional Zoo closure. In October 2020, the Minnesota Zoo indicated to LCCMR staff that a one-year extension on this project would be desired. While we await news of Legislative and Governor approval of the blanket extension requests for projects expiring in June 2021, we are proceeding on an extremely condensed timeline to complete as much of this project as possible. We are aiming for a June 30, 2021 project completion date. Condensed timelines for Activities 2 and 3 can be found in the corresponding Activity Updates below.

Project extended to June 30, 2022 by LCCMR 6/30/21 as a result of M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 18, legislative extension criteria being met.

Fourth Update August 31, 2021

Substantial progress has been made on this project, especially on Activities 2 and 3. Great strides have been made in the dissemination of project outcomes as well. The approval of the one-year blanket extension for projects originally expiring in June 2021 has allowed us to pivot our approach on some aspects of Activities 2 and 3. Revised completion dates reflecting the one-year project extension for Activities 2 and 3 deliverables can be found in the corresponding Activity Updates. Although COVID-19-related complications have continued to hamper this project, the changes detailed in the below Amendment Request will provide a path to full completion by June 30, 2022.

Amendment Request as of August 31, 2021

Due to unanticipated cost increases in construction materials since the start of the COVID-19 pandemic and the need to follow best practices in creating accessible video content, the Minnesota Zoo is requesting a budget

amendment on remaining project funds. This budget correction would not increase the overall project cost but would allow us to shift unspent funds.

As part of Activity 2 in March 2021, the Minnesota Zoo posted a request for proposals (RFP) seeking bids for railing reinforcement/repair work, signage fabrication and custom bracket fabrication for new interpretive elements at the moose exhibit. Despite wide promotion and posting this RFP for three weeks, we did not receive any bids for this work. We believe this was because the cost of construction materials doubled since this aspect of the project budget was created.

With approval from LCCMR staff in April 2021, we solicited competitive bids from vendors to accomplish these three tasks individually, rather than as one combined Professional/Technical/Services Contract. Given the looming June 30, 2021 completion deadline, LCCMR staff advised the Minnesota Zoo to proceed with this change to the project budget and follow-up with an Amendment Request once the updated cost breakdown for these tasks was determined. In order to complete the railing work necessary for the installation of new interpretive signage and interactive tactile elements, the Zoo utilized internal funds to supplement this project budget. Additionally, Zoo staff will install the new interpretive graphics and associated brackets, rather than seeking an installation vendor.

During the process of developing online content with accessibility for users with limited vision in Activity 3, we identified the need to add audio describing to forthcoming videos. This cost has been included in the amended budget as a line item in Other Budget Items.

To accommodate the above revisions, we are requesting funds be shifted from the Supplies Budget and Professional/Technical/Services Contracts to Other Budget Items as follows:

- Professional/Technical/Service Contracts would be decreased by \$9,758 to a revised budget of \$94,642.
- Supplies would be reduced by \$1,537 to a revised budget of \$12,463.
- Other Budget Items would be increased by \$11,295 to a revised budget of \$14,245.

The overall Personnel Budget is unchanged; however, we propose to apply Personnel funds remaining beyond June 30, 2021 to the Interpretive Program Developer/Project Manager salary for September 2021 – February 2021. The bulk of the unfinished work on the project will take place during this timeframe.

Amendment Approved by LCCMR 11/08/2021

Fifth Update February 28, 2022

Despite cascading COVID-19-related disruptions at nearly every step of this project, steady progress has been made towards completion of this ENRTF project. Primary concept development is complete for the new moose interpretive artifact cart that is included in Activity 2. New moose interpretive signage and brackets, created as part of Activity 2, have arrived at the Zoo and will be installed once the snow melts. Concepts have been determined for videos that will be added to the Moose Mission website (www.moosemissionmn.org) as part of Activity 3. Additional content has also been gathered and created for the Moose Mission website.

Of particular interest, the accessible online components of the project, created in Activity 3, were launched publicly in fall 2021. These resources have been widely-shared and well-received. Specifics can be found in the Dissemination Update below.

Only a handful of outstanding items remain to be completed by June 2022:

- installation of new moose signage and brackets at the Zoo's moose habitat
- fabrication of a custom moose artifact crate or cart
- purchase of supplemental interpretive moose artifacts for the crate or cart

- video production for the Moose Mission website
- audio describing for accessibility of videos on the Moose Mission website

Final Report Summary August 12, 2022

The moose is an iconic Northwoods animal that has had an important presence in Minnesota and at the Minnesota Zoo. However, moose in Minnesota have experienced periods of dramatic population decline over the last 30 years. They have nearly disappeared from northwestern Minnesota. Since 2004, moose numbers have decreased by roughly 50% in the northeastern part of our state. Significant public resources have been invested in scientific research to understand Minnesota's moose decline. Many Minnesotans are keenly aware of the moose decline and want to know more about its causes and what can be done to help.

With ENRTF support, the Minnesota Zoo collaborated with researchers from across the state to identify key scientific research findings about Minnesota's moose decline and population dynamics. This project used those key research findings to develop interactive interpretive displays at the Minnesota Zoo's moose habitat. A new, accessible, educational website was created to make the research findings available for broad virtual access. The website features basic moose natural history, information about moose research in Minnesota, and a custom, interactive game. The game encourages a user to experiment with habitat features to create a simulated environment where moose thrive. While the player attempts to manage for a healthy moose population over the course of a year, random, unexpected events occur. Players learn about some of the challenges wildlife managers (and moose) face in Minnesota.

The physical interpretive elements and online resources created from this project focus on complicated research findings in an engaging, accessible and easily understandable fashion. These deliverables will be maintained by the Minnesota Zoo and will benefit learners of all ages for years to come.

III. PROJECT ACTIVITIES AND OUTCOMES:

Activity 1: Collaborate with moose biologists to interpret existing research

Description: The Minnesota Zoo will convene DNR and other scientists from across the state to review and summarize key findings from the existing scientific literature on various topics related to Minnesota's moose decline. Topics likely to be addressed include: moose population estimates over time, habitat use and needs, predation, heat stress, parasites and other health issues. Messaging about current management tactics and conservation challenges will be also identified. The Zoo will then refine the information to make it more accessible and understandable for a general public audience, including both children and adults.

Activity 1 ENRTF BUDGET: \$10,000

Outcome	Completion Date
1. Key messages regarding moose research results and moose management will be	December 31, 2019
identified for use in Activities 2 & 3	

First Update on Activity 1 January 31, 2020

On August 20-21, 2019, the Minnesota Zoo hosted moose researchers from across the State to summarize their key scientific research findings. Participants included Glenn DelGiudice (Minnesota Department of Natural Resources), Michelle Carstensen (Minnesota Department of Natural Resources), Steve Windels (National Park Service), Ron Moen (University of Minnesota – Duluth), Tiffany Wolf (University of Minnesota – Twin Cities), Arno Wuenschmann (University of Minnesota – Twin Cities) and Joseph Bump (University of Minnesota – Twin Cities). Seth Moore (Grand Portage Band of Lake Superior Chippewa) participated remotely via an online meeting platform, and James Forester (University of Minnesota – Twin Cities) remotely shared his key scientific research findings with workshop participants. Since he was not available for the Zoo workshop or remote

participation, Mike Schrage (Fond du Lac Band of Lake Superior Chippewa) separately shared his research findings with the project team.

Following research summaries and associated questions, the group brainstormed and discussed the following:

- What is happening with other moose populations around the world regarding scientific research, population management and population dynamics? Are there other areas with similarities to Minnesota with regard to research, management and population dynamics?
- What information about moose or moose research would you want to share with the general public? Why?
- What can we tell people to do to help moose in Minnesota?
- What's next in moose research? What do we still need to learn? What research projects are underway or forthcoming? How can this information be used in moose management?
- What can we say about climate change with scientific certainty? What are the future implications for Minnesota's moose population?

The main takeaway messages from the workshop included:

- Minnesota's moose population is unique in that we have a complex ecological system with good habitat, multiple predators, deer, and a range of pathogens. Other places around the world look to the long-term research that has been done here.
- Moose often face multiple challenges to their survival simultaneously, which adds to the complexity of understanding the causes of Minnesota's moose decline and effectively responding to it.
 - Generalized over the entire State, the majority (65%) of documented moose mortality is due to health-related factors (parasites, bacterial infections, calving, undetermined health issues) and a lesser amount (30%) of documented moose mortality is predator-related. Wolves alone do not appear to be driving moose decline and data suggest parasites may be a significant contributing factor.
 - For example, in 45% of documented cases of wolves preying on moose, those moose were predisposed by other health issues.
- Typical population dynamics and mortality factors for moose vary geographically (e.g., northwestern Minnesota vs. northeastern Minnesota vs. Voyageurs National Park):
 - The northwestern Minnesota moose population has a low pregnancy rate, high calf survival rate, and a low adult survival rate. The population peaked with ~4,000 moose in 1980, but today contains less than 100 moose.
 - The northeastern Minnesota moose population has a normal/high pregnancy rate, low calf survival rate, and a low adult survival rate. The population peaked with >8,000 moose in 2006, but today has 3,250 – 5,580 moose.
 - The Voyageurs National Park moose population has a low pregnancy rate, high calf survival rate, and a high adult survival rate. There is no timber harvest within the Park. This moose population has a low density and has remained relatively stable over the last 10 years (with about 40-50 moose). Over the last 30 years, moose have shifted northwest within Voyageurs National Park.
- Moose alter behavior relative to weather, landscape, predators and pathogens.
- The relationship between deer, moose and wolves is complicated and deeply intertwined. From a management perspective, any focus on one of the three species may impact the other two species. Strong public opinion in favor of any of those three species, further complicates moose management.

In fall 2019, all moose researchers had opportunities to review and clarify meeting notes and summaries to ensure accuracy. Minnesota Zoo staff have begun to use information generated in Activity 1 to guide concept development for interpretive elements in the Zoo's moose viewing structure. As further research findings

become clear over the next year, additional information may be added to these key research findings (for example, Minnesota DNR researchers are analyzing results of a temperature study on moose).

Second Update on Activity 1 July 31, 2020

The completion of the scientific workshop and the subsequent identification of key messages associated with moose research and management, the primary focus of this activity, were outlined in the previous Activity 1 Progress Update. However, in March 2020, the Minnesota Department of Natural Resources published results of the State's annual aerial moose survey. Those results show the continued short-term trend for the moose population in northeastern Minnesota remaining relatively stable and calf survival remaining low. This information will be included in interpretive elements that highlight changes to Minnesota's moose population over time. To date, Minnesota DNR researchers have not analyzed results of their temperature study on moose referenced above in the First Update for Activity 1. As interpretive elements for this project are finalized, moose researchers that collaborated on Activity 1 will have opportunities to share any additional research findings.

Third Update on Activity 1 February 1, 2021

The completion of the scientific workshop and the subsequent identification of key messages associated with moose research and management, the primary focus of this activity, were outlined in the previous Activity 1 Progress Updates. Due to the COVID-19 pandemic, researchers with the Minnesota Department of Natural Resources (DNR) have not analyzed results of their temperature study on moose referenced above in the First Update for Activity 1. To date, additional research findings have not been identified for inclusion in this project. The Minnesota DNR will publish results of the State's aerial moose survey this spring. Those results will be incorporated into the virtual components of this project and onsite signage at the Minnesota Zoo.

Fourth Update on Activity 1 July 30, 2021

The completion of the scientific workshop and the subsequent identification of key messages associated with moose research and management, the primary focus of this activity, were outlined in previous Activity 1 Progress Updates. Due to the COVID-19 pandemic, researchers with the Minnesota Department of Natural Resources (DNR) have not analyzed results of their temperature study on moose referenced above in the First Update for Activity 1. To date, additional research findings have not been identified for inclusion in this project. Due to COVID-19 concerns, the Minnesota Department of Natural Resources and tribal partners were unable to conduct the State's aerial moose survey this past winter. Planning is underway to resume the survey this coming winter. When results of the survey are published in the spring of 2022, they will be incorporated into the virtual components of this project and onsite signage at the Minnesota Zoo.

Fifth Update on Activity 1 February 28, 2022

The completion of the scientific workshop and the subsequent identification of key messages associated with moose research and management, the primary focus of this activity, were outlined in the previous Activity 1 Progress Updates. Due to continuing capacity challenges, researchers with the Minnesota Department of Natural Resources (DNR) have not analyzed results of their temperature study on moose referenced above in the First Update for Activity 1. To date, additional research findings have not been identified for inclusion in this project. After a COVID-19-related hiatus in 2021, the Minnesota DNR will publish results of the State's annual aerial moose survey this spring. Those results will be incorporated into the virtual components of this project and onsite signage at the Minnesota Zoo this spring.

Final Report Summary August 12, 2022

In August 2019, the Minnesota Zoo hosted moose researchers from across the State to summarize their key scientific research findings. Participants included Glenn DelGiudice (Minnesota Department of Natural Resources), Michelle Carstensen (Minnesota Department of Natural Resources), Steve Windels (National Park Service), Ron Moen (University of Minnesota – Duluth), Tiffany Wolf (University of Minnesota – Twin Cities), Arno Wuenschmann (University of Minnesota – Twin Cities), Joseph Bump (University of Minnesota – Twin Cities), Seth Moore (Grand Portage Band of Lake Superior Chippewa), and James Forester (University of

Minnesota – Twin Cities). Since he was not available for the Zoo workshop or remote participation, Mike Schrage (Fond du Lac Band of Lake Superior Chippewa) separately shared his research findings with the project team.

Following research summaries and associated questions, the group brainstormed and discussed the following:

- What is happening with other moose populations around the world regarding scientific research, population management and population dynamics? Are there other areas with similarities to Minnesota with regards to research, management and population dynamics?
- What information about moose or moose research would you want to share with the general public? Why?
- What can we tell people to do to help moose in Minnesota?
- What's next in moose research? What do we still need to learn? What research projects are underway or forthcoming? How can this information be used in moose management?
- What can we say about climate change with scientific certainty? What are the future implications for Minnesota's moose population?

The main takeaway messages from the moose workshop included:

- Minnesota's moose population is unique in that we have a complex ecological system with good habitat, multiple predators, deer, and a range of pathogens. Other places around the world look to the long-term research that has been done here.
- Moose often face multiple challenges to their survival simultaneously, which adds to the complexity of understanding the causes of Minnesota's moose decline and effectively responding to it.
 - Generalized over the entire State, the majority (65%) of documented moose mortality is due to health-related factors (parasites, bacterial infections, calving, undetermined health issues) and a lesser amount (30%) of documented moose mortality is predator-related. Wolves alone do not appear to be driving moose decline and data suggest parasites may be a significant contributing factor.
 - For example, in 45% of documented cases of wolves preying on moose, those moose were predisposed by other health issues.
- Typical population dynamics and mortality factors for moose vary geographically (e.g., northwestern Minnesota vs. northeastern Minnesota vs. Voyageurs National Park):
 - The northwestern Minnesota moose population has a low pregnancy rate, high calf survival rate, and a low adult survival rate. The population peaked with ~4,000 moose in 1980, but today contains less than 100 moose.
 - The northeastern Minnesota moose population has a normal/high pregnancy rate, low calf survival rate, and a low adult survival rate. The population peaked with >8,000 moose in 2006, but today has 3,250 – 5,580 moose.
 - The Voyageurs National Park moose population has a low pregnancy rate, high calf survival rate, and a high adult survival rate. There is no timber harvest within the Park. This moose population has a low density and has remained relatively stable over the last 10 years (with about 30-50 moose). Over the last 30 years, moose have shifted northwest within Voyageurs National Park.
- Moose alter behavior relative to weather, landscape, predators and pathogens.
- The relationship between deer, moose and wolves is complicated and deeply intertwined. From a management perspective, any focus on one of the three species may impact the other two species. Strong public opinion in favor of any of those three species, further complicates moose management.

In spring 2022, the Minnesota Department of Natural Resources published results of the state's annual aerial moose survey. The number of moose in northeastern Minnesota is now estimated to be 3,440 - 6,780. While there was a slight increase in the number of moose since the previous survey in 2020, the population estimate remains statistically unchanged.

Activity 2: Develop and fabricate interpretive displays at the Zoo's moose exhibit

Description: For most major topic areas identified in Activity 1, the Zoo will create onsite interpretive signage and displays for the Zoo's moose exhibit. Displays will include customized, interactive components that allow visitors to learn about Minnesota's unique moose population, moose health challenges and associated research. Touchable artifacts will also be created that encourage Zoo visitors to explore moose natural history and research.

Activity 2 ENRTF BUDGET: \$90,969.97

Outcome	Completion Date
1. Concept development for interpretive displays and components completed.	October 31, 2019
2. Schematic designs for interpretive displays and components completed.	February 28, 2022
3. Final designs for interpretive displays and components completed.	March 31, 2022
4. Production and installation of interpretive displays and components completed.	June 27, 2022

First Update on Activity 2 January 31, 2020

The interpretive concepts for the moose exhibit were determined in fall 2019. While further refining is still needed, three main interpretive themes have been identified for the moose exhibit:

- Uniquely Minnesota / the Story of Minnesota Moose: Interpretive elements will feature moose in the history and culture of our State, the nature of long-term moose research in Minnesota, and general moose natural history. Graphics will highlight "What's Normal for Moose?" with regards to mortality factors, behavior, life span, and pregnancy and survival rates, along with geographic variations across Minnesota.
- You be the Moose Researcher: Interpretive elements will highlight moose research methods and some
 of the planning, coordination, dedication and rigor involved in studying moose. Imagery or graphics will
 depict how hunter harvested moose have contributed to research in Minnesota. Interactive and tactile
 elements will combine real or mock scenarios, actual research images, and simulated equipment to
 allow guests to "determine" the causes of particular moose deaths.
- You be the Moose Manager: Interpretive features will focus on the array of complex factors influencing moose survival in Minnesota and how difficult it is to manage Minnesota's moose population. Videos and an interactive simulation game will allow guests to take on the virtual role of a Minnesota moose manager. Additional details about this element can be found below in the Activity 3 update.

Second Update on Activity 2 July 31, 2020

As referenced above in the Amendment Request, the Minnesota Zoo no longer has the resources to construct a new moose viewing structure to house interpretive elements at the moose exhibit due to the COVID-19 pandemic. As such, in April and May 2020, we were compelled to revise the interpretive elements for Activity 2 to account for the elimination of this feature. New onsite signage and interactive elements will instead be installed at the two existing viewing areas of the moose exhibit. The railings at the existing moose viewing areas will need to be repaired and restored so they can support brackets for new graphics and a large, interactive tactile feature. The large, interactive tactile graphic will replace the hands-on mock microscope that would have been housed in the moose viewing structure.

While the three main interpretive themes remain unchanged, how each of those themes will be incorporated had to be re-considered due to COVID-19. Onsite interpretation will focus on the "Uniquely Minnesota/the Story of Minnesota Moose" theme and parts of "You be the Moose Researcher" theme. Specific concepts on onsite signage will include:

- The unique nature of Minnesota's moose population dynamics, long-term research and the cultural importance of moose in Minnesota
- Moose mortality and health challenges in Minnesota
- Trends in Minnesota's moose population over time
- General moose natural history

Online elements will include the education content onsite at the Zoo, plus all other key themes identified in Activity 1. As noted in the Second Progress Update for Activity 3 below, some of the education content will now only be shared in an online format.

Third Update on Activity 2 February 1, 2021

As referenced above in the Overall Project Update, this Activity has experienced additional delays due to the COVID-19 pandemic. The remaining time to complete Activity 2 is extremely limited. Completion of this Activity by June 30, 2021 will depend on contractor availability and fabrication lead times for signage, brackets and railing reinforcement. Schematic design likely will not be complete until early May 2021. Final design will be complete in mid-late May 2021. We are aiming for a late June installation of new interpretive displays at the Zoo's moose exhibit.

A freelance graphic designer was selected to work on new interpretive signage in January 2021. Work is in progress to write content and obtain photographs for signage. Due to COVID-19, there have been challenges in gathering photographs for signs, as some of the collaborating moose researchers currently do not have access to their work areas. Graphic design work is expected to take place in March.

A professional/technical Request for Proposals will be issued in February 2021, with the goal of awarding a contract in late March or early April. As soon as this contract is in place, bracket design, railing repair, and sign fabrication can begin. The lead time to produce permanent signage with the Zoo's durability needs and quality standards is usually 8-12 weeks. Railing repair work and bracket fabrication will occur concurrently but will also take several weeks to complete. The Project Manager will remain in contact with LCCMR staff if the requested one-year project extension is not approved and we find we are unable to complete all parts of this Activity before June 30, 2021.

Planning is underway to identify artifacts that would be safe to use at the moose exhibit in light of COVID-19. Due to COVID-19, most interpretive touch features onsite at the Minnesota Zoo are presently removed or covered to discourage guest touching. We are researching options that can be easily cleaned and stored when not in use.

Fourth Update on Activity 2 August 31, 2021

As outlined in the above Amendment Request, the Minnesota Zoo did not receive any proposals for the combined railing repair work, signage fabrication, and bracket fabrication in spring 2021. However, once those three tasks were separated, we were able to obtain competitive bids and move those pieces of Activity 2 forward individually.

The cost for railing repair/reinforcement at the two moose viewing areas was higher than the cost of railing replacement. The Minnesota Zoo used internal funding to cover the additional unanticipated costs associated with this work. To improve the overall appearance of this area of the Northern Trail, compliment the new interpretive elements and extend the longevity of the replacement railings, the Minnesota Zoo also decided to replace the curbing which anchors the railings. New railings and curbs were fabricated and installed in June 2021.

Graphic design of the new moose signs was completed in April 2021. Due to supply chain issues, fabrication of the interpretive signs and interactive tactile element was delayed. Signage fabrication was completed in August

2021. Bracket fabrication for the new signs and tactile interactive has also experienced delays due to availability of materials. The vendor fabricating brackets expects materials to arrive within the next few weeks. While we await arrival of the new brackets, temporary interpretive signage has been placed at the two moose viewing areas.

Photos of the new railings, curbs and temporary interpretive signage at the Minnesota Zoo's two moose viewing areas are shown below.





Images of graphic art for some of the new moose interpretive signs are shown below.

Alces alces Moose

At nine or ten feet in height, moose are the largest member of the deer family. Unlike their deer relatives, moose most often live alone.

What They Eat:

Moose feed for about eight hours a day in summer, gobbling 30 to 40 pounds of new shoots and leaves from shrubs, trees and water plants. In winter, when leaves aren't available, moose nibble on twigs.

What They Do:

Most active at dawn and dusk, moose search for food when temperatures are comfortable. They spend a great deal of their day chewing. With antlers up to six feet across, adult males compete for females and fight off predators such as wolves.

How They're Doing:

Moose are generally doing fine across much of their range. However, in Minnesota they have declined, likely due to a combination of factors including disease, parasites and low calf survival. Climate change may also play a role in our state's population decrease.



Where They Live: Northern forests, hogs and other wetlands provide good food and cover for moose. Thick coars and long legs help moose survive cold, snowy winters.

Funding for moose signage was provided by the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).



Uniquely Minnesota

Minnesota's moose population is unique. No place else in the world has the same complex mix of habitat, predators, parasites and disease. The research surrounding our state's moose population is also one-of-a-kind. In fact, many natural resource agencies and biologists look to the studies that have been done in Minnesota.

Current Range

Northwoods Icon

You may have visited Moose Lake State Park. Perhaps you're familiar with the annual Moose Madness Festival in Grand Marais. Maybe you remember the former Minnesota Moose professional hockey team. Moose are a centerpiece in Minnesota's "up north" identity.





Tradition

The importance of moose to the people of Minnesota pre-dates European settlement. Native people have used moose meat for food, furs for warmth, bones for tools and other body parts for ceremonies. As long as people have lived here, moose have been a significant part of our state's culture. The remaining piece of Activity 2 that is incomplete is the procurement of display and touchable artifacts, including storage. As the Minnesota Zoo re-imagines operations amid the persisting uncertainties with the COVID-19 pandemic and recovery, we have determined that a custom mobile cart or semi-mobile crate is the best storage solution for display and touchable moose artifacts. Several moose researchers that collaborated as part of Activity 1 have donated moose artifacts and spare or retired research equipment to the Minnesota Zoo to be used as teaching artifacts. The anticipated Completion Dates have been revised above to account for this final part of Activity 2.

Fifth Update on Activity 2 February 28, 2022

Due to supply chain delays, the fabrication of brackets for the new interpretive signs at Minnesota Zoo's moose habitat took several months longer than anticipated. The brackets finally arrived at the Zoo in February 2022. Once the snow melts and Zoo staff can access curbs for installation, the new moose signage will be installed in the spring.

Preliminary concept development is complete for the custom mobile cart or semi-mobile crate for touchable moose artifacts. The interpretive artifact cart or crate will be located at the Minnesota Zoo's moose exhibit during the summer months and will be housed indoors in the Zoo's Minnesota Lodge for use during the rest of the year. All touchable artifacts have been identified for purchase. Purchased artifacts will supplement retired research equipment that has been donated by moose researchers who collaborated on Activity 1. The Minnesota Zoo will issue a request for proposals to have the custom cart or crate fabricated this spring. Activity 2 is on track for completion in June 2022.

Final Report Summary August 12, 2022

With the support of ENRTF, the Minnesota Zoo has created engaging interpretive signage and interactive elements at the Zoo's moose habitat. The updated interpretive features incorporate key scientific research findings about moose and moose decline in Minnesota, as shared by moose scientists in Activity 1. Photos of select moose signage are shown below.

Interpretive signs at the Minnesota Zoo's moose habitat

Between fall 2020 and spring 2022, the Minnesota Zoo created new, interpretive signs and mounting brackets for the public viewing areas at the Zoo's moose habitat. Attractive, durable, permanent signage was installed in April 2022. Signage information is presented so that is understandable and interesting for a broad, general audience.

Specific topics highlighted on new interpretive signage include:

- The unique nature of Minnesota's moose population dynamics, long-term research and the cultural importance of moose in Minnesota
- Moose mortality and health challenges in Minnesota
- Trends in Minnesota's moose population over time
- General moose natural history







Above: An interactive flip graphic was included as part of the new interpretive signage. It appears to be engaging for Zoo guests both young and young-atheart.

Below: The Minnesota Moose Decline sign includes a modular panel that will be updated annually by the Minnesota Zoo for years to come. This panel was updated for 2022 in July 2022.



Interpretive props for engaging guests at the Minnesota Zoo

Through a competitive bidding process in spring 2022, the Minnesota Zoo hired a fabricator to design and build a durable, custom cart or crate for engaging guests with interpretive props and artifacts at the Zoo's moose habitat. The Zoo sought a product that provided the mobility of a cart, the sturdiness of a crate, a stationary surface to engage guests, and a secure storage area for valuable props and artifacts. The result is a cart and crate combined! The custom cart/crate can be moved via wheels or locked into place through a unique crank system that lowers the cart/crate over the wheels. The cart/crate includes lockable storage with padded shelves for moose props and artifacts.

Some props and artifacts for use in the interpretive cart/crate (such as retired radio telemetry equipment, moose gps collars and internal transmitters) were donated by moose researchers who collaborated on Activity 1. Additional props and artifacts were purchased in spring 2022. However, due to supply chain delays, one item has remained on backorder for several months. Thus, \$168.79 remains unspent for Activity 2. As soon as the backordered item becomes available, Zoo funds will be used to complete the purchase.

During the winter months, the cart/crate will be utilized and stored in the Minnesota Zoo's indoor areas. During the summer months, the cart/crate will be used at the outdoor viewing areas of the Zoo's moose habitat and for educational programs.



Left: View of the front of the custom interpretive cart/crate. The cart/crate includes a prominent ENRTF acknowledgement sign.

Activity 3: Develop interactive, web-integrated, moose research technology components

Description: The Zoo will use technology to expand access to and understanding of moose research and research methodologies. This includes development of customized, interactive programs that will allow users to become virtual moose managers, experimenting with real or simulated moose data to gain an understanding of the complex factors affecting moose survival in Minnesota. These programs will be beta tested with various groups to ensure usability and desired learning outcomes. The technology interactives will be available online through the Zoo's website. The Zoo's website will also be expanded to include additional information about moose research, including professional videos that highlight moose research.

Activity 3 ENRTF BUDGET: \$97,520

Outcome	Completion Date
1. Concept development for interactive online components completed.	November 13, 2020
2. Schematic designs for interactive technology components completed. Concepts for videos finalized.	January 31, 2022

3. Basic moose research content developed for Zoo's website. Video production in	March 31, 2022		
progress.			
4. Beta testing of interactive online components completed. Video editing and audio describing in progress.	May 6, 2022		
5. Final designs for interactive online components completed. Video production and audio describing complete.	June 17, 2022		
6. Integration of moose research content, videos and online interactives with Zoo's website.	June 27, 2022		

First Update on Activity 3 January 31, 2020

With input from internal Zoo staff, moose researchers, and several educational software developers, a preliminary concept for the moose technology interactive was created. The early concept is a kiosk that offers (1) videos of moose behavior and research, (2) annual updates on Minnesota's moose population, and (3) a learning game where the user becomes a virtual moose manager. The learning game will be developed for 5th-8th grade students as the primary audience. In the learning simulation game, the player "manages" the moose population by adjusting factors that influence moose survival (e.g. habitat quality, number of wolves, levels of moose parasites, weather, etc.). As a player progresses to more advanced levels, survival factors and unpredictable events that may impact the moose population are simultaneously incorporated (e.g. an outbreak of winter ticks, higher than normal levels of bear predation on moose calves, a colder and snowier than normal winter, etc.). Players will quickly understand how difficult it is to "manage" moose in Minnesota and will begin to grasp some of the complex factors influencing Minnesota's wild moose population. In February 2020, an RFP will be issued to seek a professional/technical contractor to develop software and design, fabricate and install this interactive technology station at the Minnesota Zoo's moose exhibit.

Second Update on Activity 3 July 31, 2020

In February 2020, the Minnesota Zoo issued a Request for Proposals (RFP) seeking a vendor for software development and design, fabrication and installation of a moose technology station inside of the anticipated moose viewing structure. Proposals were due March 10 and were scored in late March. Due to the COVID-19 pandemic, the Zoo closed to the public on March 14. By early April, with no clear path to re-opening the Minnesota Zoo and ongoing uncertainties, we elected to cancel the RFP.

Although the new viewing structure will not be constructed, new onsite signage and interactive elements will be installed at the two existing viewing areas of the moose exhibit. The remaining interpretive content and interactive features will be available online-only as there will no longer be a viewing structure to house the interactive kiosk at the moose exhibit. As such, better software, improved animations and additional elements such as professional videos and an engaging moose autopsy feature will be incorporated into Activity 3. The software for the virtual moose manager game will no longer need to be designed for the quick hold time that would have been required for a kiosk housed at the Zoo. Instead, online users can spend more time using and learning from the game. The addition of professional-quality videos, improved animation and a moose autopsy feature will enhance the education concepts and further engage online users, giving them a view into the research methods, planning, coordination, dedication and rigor involved in studying moose. These changes will improve the virtual learning experience, which has become essential in the time of COVID-19.

Third Update on Activity 3 February 1, 2021

Activity 3 has experienced additional unpredictable delays due to the COVID-19 pandemic. The remaining time to complete this Activity is extremely limited. In February 2021, the Minnesota Zoo will issue a professional/technical Request for Proposals seeking a vendor for moose website design and development of an online educational, simulation game. The rough concepts for the online interactive elements have been determined and will be fleshed out further once a contractor is selected. Proposals from prospective bidders are due in mid-March and we expect to select a vendor shortly thereafter.

By late April 2021, schematic design for the online interpretive components will be complete. Video content will need to be determined and footage will need to be gathered by late April as well. Due to COVID-19, there have been delays in gathering footage and photographs for video use, as some of the collaborating moose researchers currently do not have access to their work areas.

In early May, remaining content will be determined for the moose website and video production will be in progress. Beta testing and final development of all online features will happen in June 2021. The goal is to integrate the new website and online elements with the Zoo's website in late June. The Project Manager will remain in contact with LCCMR staff if the requested one-year project extension is not approved and we find we are unable to complete all parts of this Activity before June 30, 2021.

Fourth Update on Activity 3 August 31, 2021

Exciting progress has been made on Activity 3. In February 2021, the Minnesota Zoo issued a request for proposals seeking a vendor for design of a moose website and development of an online, educational moose game. There was much interest in this project and seven project proposals were received in March 2021. Work with the selected contractor began in late March and proceeded rapidly through concept development, schematic design, creation of custom artistic illustrations, website and game build, several rounds of user testing, accessibility testing, and final design. The website and game had a soft launch in June 2021. Final design and punch list items were recently completed.

The website can be found at: <u>www.moosemissionmn.org</u>. It is a simple site aimed at 5th-8th grade students yet is still appealing to audiences of any age. The accessible website features basic moose natural history, information about moose research in Minnesota, and an interactive game. The game encourages a user to experiment with habitat features to create a healthy environment where moose thrive. While the player attempts to manage for a healthy moose population over the course of a year, random, unexpected events occur. Players learn about and experience some of the challenges wildlife managers face in Minnesota. The elements and events in the game are based on findings from Minnesota moose researchers and concepts developed in Activity 1.

Select screenshots of the moose website are shown below.



MOOSE MINNESOTA ZOO

NODSE HIGHLIGHTS

WHAT MAKES A **MINNESOTA MOOSE?**



MOOSE ARE NORTHWOODS ICONS

You may have visited Moose Lake State Park. Perhaps you're familiar with the annual Moose Madness Festival in Grand Marais, Minnesota. Maybe you remember the former Minnesota Moose professional hockey team. Moose are a centerplece in Minnesota's "up north" identity. But the importance of moose in Minnesota predates European settlement. Native people have used moose meet for food, furs for warmth. bones for tools, and other body parts for ceremonies. As long as people have lived here, moose have been a significant part of our state's culture.



THEY HAVE A HUGE APPETITE

Moose are the largest member of the deer family, with an appetite to match their size! Most active at dawn and dusk, moose search for food when temperatures are comfortable. They'll feed for about eight hours a day in summer; gobbling 30 - 40 pounds of new shoots and leaves from shrubs, trees and water plants. In winter, when leaves aren't available, moose nibble on twigs. Just like cows, moose have four-chambered stomachs, so they spend a great deal of time chewing and re-chewing their food.



THEY'RE PERFECTLY ADAPTED **TO FRIGID WINTERS** Moose live only in cold, snowy regions across the top of the world-making northern Minnesota a

2020 MINNESOTA MODSE REPORT

HOW HAS MINNESOTA'S MOOSE **POPULATION DECLINED?**

This graph shows the moose population trends in Minnesota over the last 25 This gets sheet the mease population tends in Minesca eer the list 25 was. Lengterm mease sounds are indexed for understandle (by earls oper efferences that would be missed in a single-per survey. The northwestern Minesch mease population is estimated to be 100 individual—a number co small that measehes there dopper doing parity surveys. The northeadem population has declined by reguly 64% since 2008, but the population has since abalized in the durity area.

READ THE REPORT 🔿

REGIONAL MOOSE POPULATION 1995-2020



2020. Due to COVID-19, the annual survey was not constant of in 2021.

HOW DO RESEARCHERS STUDY MOOSE?

THE SCIENCE OF MODSE

MOOSE MORTALITY



After the near disappearance of northwestern Min esota's moose population, biologists were quick to respond to the decline in northeastern Minnesota. Scientists from across the state, including those at Table to set before the most the data why he population defined. Some enging cause and the Minesot 22 are verside to find at why he population defined. Some enging causes are annihing whiter nutrition, paraller, mease desht, and responses to impersive. Motility or desht, duties have helped reveal to headb challenges mease face. Minesota's beyong reasesht would not have bespecie whole digitilant funding and be terminely of a decided group of the decided of the termination of a solution of the solution biologists.

COUNTING POPULATIONS



Wildlife biologists rely on yearly surveys to get an understanding of how many moose live in an area. Using a low-fying helicopter, scientists fly over certain areas and count hew many model hey can see. These surveys are done in winter when there aren't leaves to block views and it's easiest to see big animals against a backlong of white snew. With enough of these aerial surveys, biologists can estimate how many moose live in the entire state.

nice place to be in winter

The remaining piece of Activity 3 that is incomplete is the creation of videos for integration into the moose website. The videos will highlight Minnesota moose research. Some of the existing video content has already been gathered from moose researchers who collaborated on Activity 1. Once a professional videographer is contacted for this work, video concepts will be finalized and remaining content will be filmed. In accordance with best digital accessibility practices, audio described versions of the videos will be created for viewers with limited vision. Placeholder photos currently occupy the areas where videos will be placed on the moose website, so the live website does not appear incomplete. The Outcomes and anticipated Completion Dates have been revised above to account for this final part of Activity 3.

Fifth Update on Activity 3 February 28, 2022

Activity 3 is nearing completion. Early fall 2021 was dedicated to incorporating additional content into the new Moose Mission website (<u>www.moosemissionmn.org</u>), completing punch list items, troubleshooting minor usability issues with the website and game, and refining online content accessibility. As indicated in the Dissemination Update below, the moose website and game have been broadly shared.

The remaining piece of Activity 3 that is in-progress is the creation of two videos for integration into the Moose Mission website. Concepts for the videos have been determined: one video will feature footage from the annual aerial moose survey conducted in Minnesota in the winters of 2020 and 2022, and the other video will feature footage and images of Minnesota moose research. Moose researchers that collaborated in Activity 1 recently provided additional footage and photographs to be used in the production of these videos. A professional videographer will be hired in March. Video production and editing will take place in April, May and June. Audio describing will be added to the videos in June before they are incorporated into the moose website. Activity 3 will be complete in June 2022.

Final Report Summary August 12, 2022

With the support of ENRTF, the Minnesota Zoo developed and launched an exciting new moose website in June 2021 called Mission Moose. The website can be found at: <u>www.moosemissionmn.org</u>. It is a simple site aimed at 5th- 8th grade students yet is still appealing to audiences of any age. The accessible website features basic moose natural history, information about moose research in Minnesota, and an interactive learning game. The game encourages a user to experiment with habitat features to create a healthy environment where moose thrive. While the player attempts to manage for a healthy moose population over the course of a year, random, unexpected events occur. Players learn about and experience some of the challenges wildlife managers face in Minnesota. The elements and events in the game are based on findings from Minnesota moose researchers and concepts developed in Activity 1. To date, the moose game has been played over 3,670 times. On average, players spend over five minutes playing and learning.

In spring 2022, two short professional videos were created for integration into the moose website. One video highlights the annual aerial survey that is conducted each winter to estimate the size of the moose population in northeastern Minnesota. The second video provides an overview of the moose population decline in Minnesota and the recaps some of the key scientific research findings associated with the decline. For the second video, the Project Manager and a videographer travelled to northern Minnesota to interview four research scientists who participated in Activity 1. The team was fortunate enough to also obtain footage of a moose field necropsy while in northern Minnesota. The two videos have been linked to the new moose website from the Minnesota Zoo's YouTube page. These videos can be viewed at:

Aerial Survey video: <u>https://www.youtube.com/watch?v=XgFDhYo3RA4</u> Moose Research video: https://www.youtube.com/watch?v=fPIMOngQf1s

Due to unforeseen circumstances, the audio describing for the moose videos has not been completed. The audio describer who was scheduled to complete the audio description scripting and recording notified the Project Manager of unexpected family conflicts in mid-June 2022. This did not allow enough time to seek another audio describer and complete the work before the project's June 30th end date. As such, \$300 budgeted for audio

describing remains unspent. The Project Manager has since gathered a list of potential audio describers. Accessibility of the videos for people with limited vision is important to the Minnesota Zoo. This audio describing work will be completed with separate Zoo funds in fall 2022. The audio described versions of each video will be integrated onto the moose website when complete.

IV. DISSEMINATION:

Description: Updates on activities will be shared with collaborators via regular written communication. A summary document of key moose research findings will be generated in Activity 1. Those findings will primarily be shared with the general public via interpretive messaging at the new moose exhibit and through the Minnesota Zoo's website. Additionally, information will be disseminated through the Zoo's education department during programs and through the Zoo's marketing department leading up to the exhibit opening in 2021. Lastly, information obtained in Activity 1 will be shared with Zoo staff and volunteers so they can disseminate to the general public in preparation for the exhibit opening in 2021.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgement Guidelines.

First Update January 31, 2020

In fall 2019, the Minnesota Zoo shared detailed workshop notes with all of the moose researchers in order to ensure accuracy. Meeting summary notes were finalized in December 2019.

In December 2019, a summary of the meeting notes was included in a monthly newsletter for Minnesota Zoo staff. In the coming year, additional information will be shared with Zoo interpretive volunteers.

Preliminary concepts for the interactive technology component were shared with moose researchers in January 2020. As the interactive software development progresses, moose researchers will have additional opportunities to review this interpretive element.

Second Update July 31, 2020

Much of the past six months has been spent revising and amending the direction of this project due to COVID-19. In July 2020, key research findings were shared with Education staff at the Minnesota Zoo via a virtual staff meeting. In the coming weeks, details on the amended project components will be shared with the moose researchers that collaborated on Activity 1.

Third Update February 1, 2021

The Minnesota Zoo has either been closed to the public or operating with a very limited in-person capacity over the last six months. There have not been opportunities to share results of this project with staff, volunteers or students as was initially planned. As new interpretive elements are created, developed and installed over the next few months, they will be shared with staff. Online elements will be shared with educators, students and the general public as they become available. When we are able to safely allow interpretive volunteers back onsite at the Zoo, the new interpretive features stemming from this project will be shared during volunteer training.

Fourth Update August 31, 2021

The moose website and game have been shared with select staff at the Minnesota Zoo during the soft launch period. The website and game will be shared more broadly with Zoo staff and volunteers during a public release. A marketing and communications plan for the public release of the moose website and game is being developed for October 2021. Communication about the public launch will be included in various Minnesota Zoo newsletters, on the Minnesota Zoo home page, through social media, in teacher newsletters, and through the Association of Zoos and Aquariums Education Listserv.

In July 2021, the Interpretive Program Developer/Project Manager was invited to present about this ENRTF project at Minnesota's Moose Research and Management meeting. The two-day meeting included 50-75 researchers and natural resource managers that work with moose, or whose work impacts moose. Meeting participants were given an overview of the project and a progress update on completion. The moose website and game were shared with meeting participants. After a demonstration of the game, several positive comments were received about how it creatively gives players a glimpse into real-world challenges of Minnesota moose management.

Fifth Update February 28, 2022

The Moose Mission website and game have been shared widely since public launch in October 2021. These accessible online resources have been featured in the following newsletters, publications, listservs, web sites and social media platforms over the past five months:

- Websites: Minnesota Zoo homepage, Get STEM and ZOOMS teacher Basecamp site
- Newsletters: Minnesota Zoo member newsletters and Minnesota Zoo teacher newsletter
- Listservs: AZA (Association of Zoos and Aquariums), AZA Region 5, ASTC (Association of Science and Technology Centers) and NSTA (National Science Teachers Association)
- Facebook postings by: Minnesota Zoo, Minnesota Zoo for Educators, and International Wolf Center

In early November 2021, the Interpretive Program Developer/Project Manager was interviewed by the Dakota County Tribune. The newspaper article about the Moose Mission website, game and this ENRTF project can be found <u>here</u>.

The Mission Moose website and game were briefly shared during Zoo-wide staff meetings in November 2021. As a more in-depth follow-up to those meetings in December 2021, the Interpretive Program Developer/Project Manager and Dr. Glenn DelGiudice (Moose and Deer Project Leader for the Minnesota Department of Natural Resources) presented a joint conservation seminar for Minnesota Zoo staff and volunteers. Dr. DelGiudice presented about Minnesota's moose population trends and the Zoo's Interpretive Program Developer gave an overview of this ENRTF project, highlighting how this scientific information was incorporated into the Mission Moose website, game and other project deliverables.

To date, the Moose Mission website has had over 2,000 visits, with an average stay time of five minutes. Thirtyfive percent of visits have come from outside of Minnesota. The Moose Mission website and game have been well-received, especially by educators and other science organizations. In fact, a number of other zoos and environmental education institutions have reached out to the Minnesota Zoo for more information about the creation of these custom online resources.

Final Report Summary August 12, 2022

This project and its outcomes have been shared widely.

Through All-Staff meetings, department presentations and conservation seminars, hundreds of Minnesota Zoo staff and volunteers have learned about Minnesota's moose decline and this ENRTF project. Volunteers and staff who will use the interpretive cart/crate and associated props and artifacts will receive formal training and additional background information in the coming months.

In July 2021, the Project Manager presented about this ENRTF project at Minnesota's Moose Research and Management meeting. The two-day meeting included 50-75 researchers and natural resource managers that work with moose, or whose work impacts moose. Meeting participants were given an overview of the project and the Moose Mission website and game were shared. After a demonstration of the game, several positive comments were received about how it creatively gives players a glimpse into real-world challenges of Minnesota moose management.

The Moose Mission website and game were publicly launched in October 2021. These accessible online resources have been featured in the following newspapers, newsletters, publications, listservs, websites and social media platforms:

- Websites: Minnesota Zoo homepage, Get STEM and ZOOMS teacher Basecamp site
- Newsletters: Minnesota Zoo member newsletters and Minnesota Zoo teacher newsletter
- Listservs: AZA (Association of Zoos and Aquariums), AZA Region 5, ASTC (Association of Science and Technology Centers) and NSTA (National Science Teachers Association)
- Facebook postings by: Minnesota Zoo, Minnesota Zoo for Educators, and International Wolf Center
- Newspaper: Dakota County Tribune article. <u>Here</u> is a link to the article.

The Moose Mission website and game have been well-received, especially by educators and other science organizations. One of the researchers who collaborated on Activity 1, Dr. Seth Moore (Director of Biology and Environment for the Fond du Lac Band of Lake Superior Chippewa) shared the Moose Mission game with local middle and high school students this past school year. A number of other zoos and environmental education institutions have reached out to the Minnesota Zoo for more information about the creation of these engaging, custom online resources.

To date, the Moose Mission website has had roughly 4,420 visits, with an average stay time of five minutes. Thirty percent of visits have come from outside of Minnesota. The game has been played over 3,670 times, with an average play time of over five minutes.

V. ADDITIONAL BUDGET INFORMATION:

A. Personnel and Capital Expenditures

Explanation of Capital Expenditures Greater Than \$5,000:

We anticipate that there will be three capital expenditures (executed via professional/technical/service contracts) that will exceed \$5,000, as part of this project:

- fabrication of permanent educational graphics with an expected lifespan of 10 years, including a large, interactive tactile graphic. This includes repairing and restoring existing exhibit railings, and fabricating and installing brackets, signs and a large tactile feature.
- software contract to develop, produce, and install interactive technology components with webintegration with an expected lifespan of 5-10 years
- videography contract for editing footage, photos and audio to be incorporated into online learning software, including captioning for accessibility

These expenditures are essential to successfully achieve this project's goal of disseminating moose research findings in an accessible manner to the general public. We project that the capital expenditures associated with this project will extend beyond the 3-year duration of this grant, enabling us to continue to educate the public about Minnesota's moose decline for at least 10 years.

The State of Minnesota has a competitive bid process in place for awarding such contracts. The Zoo will abide by the State of Minnesota's guidelines when awarding these three contracts.

Explanation of Use of Classified Staff:

Three staff positions that will be supported by these ENRTF funds are classified. Current personnel have the necessary expertise to successfully and efficiently implement Activities 1, 2, and 3. Without the support of the ENRTF funding, these staff would not have the ability to work on this project. Instead, they would focus on other position responsibilities. Incorporating the existing expertise from across departments at the Zoo will be essential for the completion of this project.

Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: .8 FTE

Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: .8 FTE

VI. PROJECT PARTNERS:

A. Partners outside of project manager's organization receiving ENRTF funding N/A

B. Partners outside of project manager's organization NOT receiving ENRTF funding

All partners who collaborated and advised on Activity 1.

Name	Title	Affiliation
G. DelGuidice	Research Scientist, Moose & Deer Project	Minnesota Department of Natural Resources
	Leader	
R. Moen	Senior Research Associate, Associate	Univ of MN Duluth & Nat Res Research Institute
	Professor	
M. Schrage	Wildlife Biologist	Fond du Lac Band of Lake Superior Chippewa
S. Windels	Wildlife Biologist	National Park Service (Voyageurs National Park)
M. Carstensen	Wildlife Health Program Supervisor	Minnesota Department of Natural Resources
S. Moore	Director of Biology & Environment	Grand Portage Band of Lake Superior Chippewa
T. Wolf	Assistant Professor, Veterinarian	Univ of MN College of Veterinary Medicine
A. Wuenschmann	Professor, Veterinarian	Univ of MN College of Veterinary Medicine
		Veterinary Diagnostic Lab
J. Bump	Associate Professor	Univ of MN Twin Cities
J. Forester	Associate Professor	Univ of MN Twin Cities

VII. LONG-TERM- IMPLEMENTATION AND FUNDING:

The interpretive displays and interactive components at the Zoo's moose exhibit will be viewable yearround by Zoo guests. Interpretive exhibits at the Minnesota Zoo are designed for a 10-20 year lifespan and will be maintained with Zoo funds. The website and interactive technology pieces will also be maintained with Zoo funding for years to come. The Zoo will update content as feasible, when new information is available. This project will help ensure that the public is informed about research focused on moose decline in Minnesota and what Minnesota residents can do to prevent further problems.

VIII. REPORTING REQUIREMENTS:

- Project status update reports will be submitted twice annually for each year of the project: 31 January 2020, 31 July 2020, 1 February 2021, 31 August 2021, and 28 February 2022
- A final report and associated products will be submitted 12 August 2022

IX. SEE ADDITIONAL WORK PLAN COMPONENTS:

- A. Budget Spreadsheet
- **B. Visual Component**

Attachment A: Environment and Natural Resources Trust Fund M.L. 2019 Project Budget - Final Legal Citation: M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 03p Project Manager: Nicole Mattson Project Title: Unlocking the Science of Minnesota's Moose Decline Organization: Minnesota Zoo Project Budget: \$199,000 Project Length and Completion Date: 3 years, June 30, 2022 Today's Date: August 11, 2022



	Budget MENT AND NATURAL RESOURCES TRUST FUND BUDGET Budget 11/8/2021		lget		Dalaura	
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET			Amo	unt Spent	Balance	
BUDGET ITEM			-			
Personnel (Wages and Benefits)	\$	77,650	\$	77,650	\$	
Interpretive Program Developer/Project Manager, \$54,000 (66% salary/34% benefits) 30% FTE each year for 2 years and 11% FTE for July-Sept 2021; additional 10% FTE for Sept 2020-Feb 2021 = + \$4,500						
Wildlife Research Advisor, \$15,000 (74% salary/26% benefits) 5% FTE each year for 2 years						
Graphic Designer, \$4,150 (66% salary/34% benefits) 10% FTE each month for 5 months						
Professional/Technical/Service Contracts						
Freelance graphic design work for onsite signage. Contractor selected in accordance with State of	\$	800	\$	796	\$	
Minnesota purchasing guidelines.						
Photo & video story production for web integration. Contractor selected in accordance with State of Minnesota purchasing guidelines.	\$	6,000	\$	6,000	\$	
Fabrication and installation of new railings along viewing areas of moose habitat which anchor new interpretive signage. Contract awarded through competitive bidding process in accordance with State of Minnesota guidelines.	\$	23,492	\$	23,492	\$	
Software development contract to create interactive technology components with web-integration. Production, beta testing and installation of interactive technology components. See preliminary breakdown below. Contract awarded through competitive bidding process in accordance with State of Minnesota guidelines.	\$	64,350	\$	64,350	\$	
Approx \$64,100 for software development & testing						
Approx \$600 for web domain & host						
Approx \$400 for misc						
Equipment/Tools/Supplies						
Display and touchable artifacts (real or fabricatedtbd), including storage	\$	12,463	\$	12,295	\$	16
Capital Expenditures Over \$5,000						
See Professional/Technical/Service Contracts listed above			\$	-	\$	
Fee Title Acquisition						
Ecoment Acquisition			Ş	-	Ş	
			Ś		Ś	
Professional Services for Acquisition			Ŷ		Ŷ	
			\$		\$	
Printing						
			\$	-	\$	
Travel expenses in Minnesota						
			\$	-	\$	
Other						
Fabrication of permanent educational graphics able to withstand zoo audience for 10-20 years, including large, interactive tactile graphic highlighting moose survival challenges. Awarded through competitive bidding process in accordance with State of Minnesota guidelines.	Ş	3,960	Ş	3,922	Ş	3
Fabrication of brackets for new interpretive signs. Awarded through competitive bidding process in accordance with State of Minnesota guidelines.	\$	7,157	\$	7,157	\$	
Audio describing for video accessibility on new moose website	\$	300			\$	30
Professional stock photos or video footage to be integrated into technology interactives and signage	\$	2,558	\$	2,558	\$	
Two-week RFP postings on State Register for: Exhibitry & Fabrication contract and Software Development contract	\$	270	\$	270	\$	
COLUMN TOTAL	\$	199,000	\$	198,490	\$	51
					. ·	

OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)		Spent		Balance	
Non-State: Minnesota Zoo Foundation catering for two-day moose researcher		\$ 390	\$	390	\$ 0	
workshop at Minnesota Zoo	Secured					
		\$ 81	\$	81	\$ -	
State: Posting technology interactive kiosk RFP on State Register for 1 week	Secured					
State: The Zoo's general operating fund will provide additional support to the		\$ 44,850	\$	44,850	\$-	
project, including utilities and administrative costs (15% of project budget). The						
Zoo's staff carpenters, welders, web developer and audio/visual technician will						
also work on this proposed project (\$15,000). The Zoo's Bio-Programs staff would						
review signage, hands-on interactives and technology components during design,						
development and production phases.	Secured					
State: Replacing curbing along viewing areas of moose exhibit and supplemental		\$ 24,842	\$	24,842	\$-	
funding for increased cost of railing replacement	Secured					
In kind:			\$		\$ -	
PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally					

PAST AND CURRENT ENRTF APPROPRIATIONS	obligated but not yet spent	Spent	Bala	
Current appropriation: N/A		\$-	\$	
Past appropriations: N/A		\$ -	\$	



Minnesota's Moose Decline

Many Minnesotans are aware that moose in Minnesota have undergone periods of alarming population decline since the 1990s. The Minnesota Zoo collaborated with moose researchers to compile scientific findings about the decline. With the support of ENRTF, the Minnesota Zoo created engaging interpretive features at the Zoo's moose habitat and developed an accessible moose website and educational game, making this moose research understandable and available for a broad audience.











