Project: Airborne Optical Detection of Invasive Species at Yellowstone Lake

Brief Description: Montana State University requests $1.5 million to develop and deploy airborne optical sensors for detecting and mapping invasive lake trout at Yellowstone Lake in Yellowstone National Park.

Executive Summary:
The Yellowstone ecosystem is being seriously threatened by invasive lake trout that eat the prized native cutthroat trout, thereby eliminating the principal protein source for Grizzly bears, Pelicans, Otters, and other vital species in Yellowstone National Park. The National Park Service is conducting an aggressive program to locate and eradicate invasive species from Yellowstone Lake. To enhance these efforts, Montana State University (MSU) researchers recently demonstrated the ability of airborne laser radar (lidar) to locate pockets of invasive lake trout in Yellowstone Lake. This proposed project is to develop and deploy compact optical sensor systems on small aircraft to respond to a time-critical need for advanced detection and mapping of invasive fish species in Yellowstone Lake.

Project Description:
In 1994, invasive lake trout were discovered in Yellowstone Lake in Yellowstone National Park. It is presently unknown how non-native Lake Trout came to occupy the waters of Yellowstone Lake, but it is clear that if unchecked these predatory fish will obliterate the prized native cutthroat trout population, resulting in cascading negative effects in the Greater Yellowstone ecosystem. Already, lake trout have dramatically reduced the cutthroat trout population in recent years. Lake trout reside at much greater depth than cutthroat trout and do not spawn in streams and rivers, whereas cutthroat trout live in relatively shallow water and spawn in adjoining rivers and streams. Therefore, lake trout cannot replace cutthroat trout as the primary protein source for species such as bears, pelicans, otters, etc.

Aggressive gill-netting and other capture mechanisms by Yellowstone National Park (YNP) fisheries biologists has slowed the growth of the lake trout population, but there is a great need for new techniques for locating lake trout spawning locations to enable rapid and effective eradication. Recently, MSU researchers conducted a small-scale research effort to determine if *airborne laser sensors* (light detection and ranging, or “lidar”) could be *used to locate spawning lake trout*. A map generated from this experiment recently led YNP biologists to a previously unknown pocket of invasive lake trout in the remote southeast corner of Yellowstone Lake. YNP biologists have asked MSU to conduct further measurements in a combined effort to save the native cutthroat trout. In response, MSU is submitting this request for funding to build advanced optical sensors, deploy them in airborne measurements at Yellowstone Lake, and work in collaboration with fisheries biologists and ecologists to locate and eradicate invasive lake trout from Yellowstone Lake.

Congressional Action Needed: Funding of $1.5 million in FY10 is requested.

Importance to Montana and the Nation: This project will help save the Yellowstone cutthroat trout, a valuable natural resource with tremendous financial impact on the Montana economy through tourism and recreation. The entire nation will benefit directly from this application of advanced optical remote sensing technology to protect the ecosystem in the nation’s first national park. This project also will strengthen and diversify the rapidly growing synergy between MSU and the Montana optics industry. Growth in this field has been especially strong in the Bozeman area because of collaborations with and technology transfer from MSU. This effort will increase collaboration between MSU and several Bozeman optics companies, such as Quantel USA (formerly Big Sky Laser Technologies), Resonon, Inc., and FLIR. This work also will strengthen the ability of MSU to train the highly educated work force needed for these industries. The project also will directly benefit a newly formed Bozeman optics company, NWB Sensors, created to commercialize MSU-patented technology in compact infrared imaging systems that will be used as part of this project.

Contacts at Montana State University:

Thomas J. McCoy	Vice President for Research	406-994-2891	
Lee H. Spangler	Associate Vice President for Research	406-994-4399	spangler@montana.edu

Airborne Optical Detection of Invasive Species at Yellowstone Lake – Talking Points

- This project addresses a time-critical need in the Greater Yellowstone Ecosystem.
- This is an ideal contribution to MSU's goal to expand its role as the *University of the Yellowstone.*
- The MSU optical remote sensing group has achieved world-wide recognition for developing novel optical sensing technology for application to wide-ranging scientific problems.
- Before coming to MSU, the principal investigator previously worked with the NOAA group who pioneered the airborne fish lidar technique.
- The project will benefit from an existing working relationship between the principal investigator and Yellowstone Park fisheries biologists.
- The feasibility of the work proposed here has already been demonstrated in a recent experiment in which we demonstrated the feasibility of airborne laser radar (lidar) to locate previously unknown pockets of invasive lake trout in Yellowstone Lake.
- YNP fisheries biologists have requested additional airborne lidar capabilities and measurements.
- The project benefits from previous and future collaboration with the NOAA group who pioneered the airborne fish lidar technique.
- This project will flight-qualify a much smaller and more efficient lidar system developed at MSU and provide unique sensing and mapping tools for use in future applications on behalf of Montana natural resources.
- The optical sensors used in this project will include compact infrared and hyperspectral imaging systems and lasers developed by local Montana companies.
- The compact infrared imagers to be deployed as part of this project will be commercialized through an MSU patent that is being licensed by a newly formed Bozeman optics company, NWB Sensors.
- This project is likely to lead to novel airborne laser technology that will be licensed to a Montana industry for commercialization.
- These efforts will help create a sustainable suite of instruments at MSU that can be used for a wide range of airborne sensing applications of interest to Montana and the Fish and Wildlife Service.
- The preliminary Yellowstone fish lidar experiment resulted in improved lidar designs that need to be built to make these more advanced sensors available in smaller aircraft.
- The MSU team includes several world leaders in the development of novel lasers and sensors.
- The MSU team has experience deploying compact hyperspectral imagers made by Resonon, Inc. (Bozeman, MT company) on unattended aerial vehicles (UAVs) and small aircraft.
- The MSU principal investigator is working with Resonon, Inc. and FLIR (Bozeman companies) to develop novel calibration schemes for airborne hyperspectral and infrared imagers.
- This project will employ hyperspectral imagers made by Resonon, Inc. (Bozeman, MT) and ultra-compact thermal infrared imagers made by FLIR Systems, Inc. (CA and Bozeman, MT);
- The MSU faculty members working on this proposed effort have been involved with numerous small companies in Montana, including Resonon, Inc., FLIR Systems, Inc., Big Sky Laser Technologies, AdvR, ILX Lightwave, S & K Electronics, Bridger Photonics, etc., and have a notably dedicated and successful record of technology transfer.