NTS GIS Network- Meeting Minutes

Tuesday, September 18, 2018 , 1:00 pm Mountain Time (12pm PT, 2pm CT, 3pm ET)

MEETING AGENDA

1. **Welcome & Introductions** (Ryan Cooper/Peter Bonsall/Kerry Shakarjian)

   Meeting Attendees:

   1. Peter Bonsall (Moderator) – National Park Service, GIS Specialist, WASO
   2. Ryan Cooper (Note Taker) – National Park Service, Geographer, Lewis and Clark NHT
   3. Adam Calkins (Presenter) – US Forest Service, Archaeologist
   4. Dale Hamilton (Presenter) – Northwest Nazarene University, Assistant Professor of Computer Science
   5. Candace Bogart – US Forest Service Region 3, GIS Coordinator
   6. Larry Short – Santa Fe Trails Association
   7. Mike Elliot – National Park Service, Cultural Resource Specialist, NTIR
   8. Jennifer Frederick – Bureau of Land Management
   9. Lisa Gilbert
   10. Sueanne Cmehil-Warn – US Forest Service
   11. Stafford Hazelett - Portland, Oregon, member of Oregon-California Trails Association
   12. Mike Chodornek
   13. Sandra Broncheau-McFarland – US Forest Service Nez Perce Nee Me Poo NHT
   14. Dave Vincent – US Geological Survey
   15. Gita Urban-Mathieux – US Geological Survey/NGP
   16. Laura White - R3 US Forest Service Administrator for AZNST
   17. Charlynne Smith - North Carolina State University, Research Associate
   18. Brenda Yankoviak – US Forest Service, CDNST Administrator
   19. David Fothergill – US Forest Service Region 1, Landscape Architect, Pacific Northwest NST
   20. Justin DeMaio – Bureau of Land Management
   21. Joe Bergstrom – US Forest Service
   22. Victoria Smith-Campbell – Bureau of Land Management
   23. Reese Hirth – National Park Service, Geographer, Midwest
   24. Matt Colwin – National Park Service, GIS Specialist, Midwest

2. **Announcements & Information from Audience**
   a. 2018 National Trails Conference, Vancouver, WA - Oct 22-25, 2018.
   b. REI celebrates 50 years of National Scenic Trails with merchandise and interactive map: https://www.rei.com/blog/national-scenic-trails?cm_mmc=sm_fb-_-impact_agenda-_-national_scenic_trails-_-blog

3. **Discussion Topic**

   Presenters: Adam Calkins, U.S. Forest Service and Dr. Dale Hamilton, Northwest Nazarene University

   Applications of Unmanned Aircraft Systems (UAS), Photogrammetrics, and Machine Learning to Record Archaeological Sites and Historic Trails

   Archaeologists have two goals, to record known sites and locate new ones. In 2018, the Boise National Forest began thinking outside the box to accomplish these objectives. We signed an agreement with Northwest Nazarene University (NNU) to begin using Unmanned Aircraft Systems (UAS or drones) to record and find archaeological sites. Over the summer of 2018, we recorded over 2,000 acres of National Forest Land with a UAS. While most of the work was done on historic mining sites, we also recorded small sections of historic railroad grade. Sections of the Oregon Trail were recorded in 2017. In addition to recording sites, undergraduate students at NNU have developed Machine Learning algorithms to locate archaeological artifacts and features. One of these algorithms can locate historic metal fragments (cans, stoves, sheet metal, etc.), and another can locate linear features, such as roads and trails. The techniques of UAS data collection and Machine Learning algorithms, being developed by NNU and the Boise National Forest, will help federal agencies and private organizations locate, record, and manage archaeological sites and historic trails. Our presentation focuses on the genesis of this partnership, methods for data collection, and the results.

Notes:

- US Forest Service – Challenge Cost Share Agreement signed in 2018
- Purpose to record historic archaeological landscapes including mining sites, railroad grades, historic trails
- Northwest Nazarene University tasked with developing models to locate artifacts and features
- Commercial FAA rules – must have pilot, registered with FAA, UAS must remain in sight, must not fly higher than 120 meters (400 feet)
- Non-commercial FAA rules – Do not need a Part 107 exemption
- Equipment used:
    - DJI Phantom 4 with 12 megapixel camera, 15 minutes of flight time per battery
    - DJI Inspire with 12 megapixel camera, 10-12 minutes of flight time per battery but faster speed, CIR camera
- Recommendations for purchasing UAS equipment – start small and inexpensive, good UAS at big box stores, get lots of practice
- Develop flight plan – have pilot and Lead Visual Observer (LVO)
- LVO directs commands between remote visual observers and pilot
- Visual observers spread out all across project area all the way to designated location
- Visual observers and LVO communicate back and forth – key concept (good communication)
- Definitions:
    - Orthomosaic – georeferenced 2D model stitched from aerial images of landscape
    - 3D model – accurate representation of landscape on all 3 axis
    - Machine Learning – automates analytic model building
- Users collect training images, which include objects we want Artificial Intelligence (AI) to find
- Users identify known objects/training objects
- AI builds model that allows it to identify objects
- Run AI on drone orthomosaics
- Machine learning is not native to archaeology alone – flexible, versatile
- Building model – supervised classification: learn by example, support vector machine, decision tree, convolutional neural network
- Record Historic Trails – UAS acquire high resolution images, help with Trail recognition
- Images allow birds eye view of things you can't see on ground
- Can also help identify a trail corridor
- Things to look for:
    - Changes in vegetation (more or less vegetation; linear)
    - White or brown lines (absence of vegetation)
    - Changes in shadows (swales or depressions)
- Oregon Trail –as part of the project, recorded 3 miles of trail; 1 mile had burned, 2 miles unburned
- Northwest Nazarene University developed algorithm to locate linear features
- Image classification results
- Safety, speed – able to record 200 acres an hour, birds eye view
- 2018 – Historic mining, historic railroad
- Each pixel represents 5 cm on the ground; 600,000 pixels in example image, single pixel on Google Earth
- Mine tailings classifier – temporal distribution of site types
- Road detection classification
- Can scatter – algorithm more effective than human eye; outperformed humans
- Pilots can fly drone lower for higher spatial resolution
- Best practices – 120 meters high for landscapes; 40-50 meters for sites
- Know previous flight area prior to flying adjacent area
- DEMS are not substantially more accurate with use of GPS ground station
- Future plans – summer 2019; finish algorithms in winter
- 24 hours between flying drone and examining data; want to record 4,000 acres
- Multispectral imagery record structures
- Questions? – contact acalkins@fs.fed.us or dhamilton@nnu.edu
- Discussion – Can you fly a drone over private lands without permission? Varies by state. In Idaho you have to have landowner permission; official agreements in place for Forest Service/federal lands.
- Unable to fly UAS over NPS lands or wildlife refuges
- One helpful way to persuade private landowners to give permission is to ask if there is anything they would like photos of on their property and give them photos.
- Dale thankful for this project giving students real world problems to work on.

4. **Future Meeting Dates & Topics**
    a. **Oct 16, 2018** – Lisa Johnson, Protected Areas of the United States, PADUS 2.0 Update
    b. **Nov 20, 2018** – Peder Nelson, GLOBE Observer and the NASA Earth to Sky initiative for the National Trails System
    c. **Dec 18, 2018** – No call this month, enjoy the holidays!

We always welcome suggestions for additional topics for discussion or presentations. Please contact Ryan Cooper, Peter Bonsall, and/or Derek Nelson with your suggestions!

NTS GIS Email Address: ntsgis@nps.gov
NTS GIS Network Email List: ntsgis@webmail.itc.nps.gov
NTS GIS Network Website: http://pnts.org/new/national-trails-system-gis-network/

NTS GIS Network Mission:
We established the NTS GIS Network as a way to connect the diverse array of National Trails System staff and partners who use GIS systems and products in their work. One of our goals is to facilitate the sharing of information and tools that h elp us do our jobs more efficiently and innovatively. Because the national trails system is managed as a collaboration of agencies and partner organizations, the NTS GIS Network is open to anyone.