MONARCH JOINT VENTURE

Remote Sensing Program:
Machine Learning for Monarchs

The Monarch Joint Venture (MJV) and its technology partner Simple Business Automation (SBA) are creating a precision conservation strategy that expands habitat research and evaluation tools for the monarch conservation community. This new remote sensing program uses machine learning and computer vision to identify and count important habitat resources using standard cameras mounted on drones (unmanned aerial systems, UASs). Images captured by UASs are processed to recognize and count individual resources, such as milkweed stems, and provide estimates of its density and distribution across the landscapes surveyed. Data are stored in a secure online interface that offers options for data access and sharing and viewing aggregated data at different scales and timeframes.

Conservation Benefits

- **Increases the scale and efficiency of habitat monitoring without displacing the need for in-field research.** *For example, milkweed density in a 2.5-acre field may be estimated in 15 minutes using remote sensing and 1-4 hours using the field-based Integrated Monarch Monitoring Program (IMMP). Note that IMMP can assess certain metrics (e.g., monarch reproduction) that remote sensing cannot.*
- **Expands capability to fill information gaps quickly to inform conservation decisions.**
- **Improves repeatability for detecting change.**
- **Provides opportunities for future expansion of the technology** *(e.g., additional algorithms)*

Current Accomplishments and Accuracy

Common milkweed served as the pilot species for the program. The MJV and its partners collected aerial imagery of Midwest grasslands, manually annotated common milkweed in the images, and worked with machine learning developers to build, test, and refine the algorithm. A ground-truthing protocol facilitated model improvements and performance evaluation. Currently, this program can identify at least 80% of the common milkweed stems in an image (i.e., recall), each stem with a 93% accuracy (i.e., precision). Optimizing both metrics can achieve 84% recall with 89% precision. A software application (both mobile and web form) is in development to automate flight planning and data processing, storage, and reporting. Individual and organizational subscriptions will be available for this tool, and additional algorithms will be systematically developed and deployed.

80% recall

93% precision

Next Steps

In 2023, specific projects will evaluate the effectiveness of this new technology on a larger scale on private and public lands across the Midwest. These projects offer the opportunity to test the common milkweed algorithm in different landscapes and in a variety of contexts (e.g., intermixed with similar-looking species). Project partners are collaborating on a peer-reviewed publication to describe the technology's development and capabilities. Additionally, data can be used to further advance this technology's capabilities:

- Estimating blooming plant/nectar resource cover
- Mapping and management planning for invasive species
- Detecting nests or other wildlife using thermal sensors
- Identifying and quantifying additional plant species
- Developing compatibility with additional UAS platforms
- Developing Standard Operating Procedures for using existing algorithms and developing new ones

How To Engage

Contribute to the program and set yourself up for its use! Scan the QR code below to learn more and express your interest in any of the following:

- Share what UAS equipment and platforms you use and how you use them
- Test existing software using your drone
- Collect and share aerial imagery of grasslands
- Conduct field surveys
- Sign up for technology announcements and developments
- Invest in the development of this technology

Currently, the program is being developed for two UAS platforms, and will be expanded. These include:

- **DJI Phantom 4 Pro V2.0**
- **Parrot Anafi USA GOV**

2233 University Ave. W, Suite 426
Saint Paul, MN 55114

(260) 209-4273
www.monarchjointventure.org

MONARCH JOINT VENTURE