Transformative Detection of *Hypericum canariense*: Building a drone-based image library to catalyze invasive species control in coastal California

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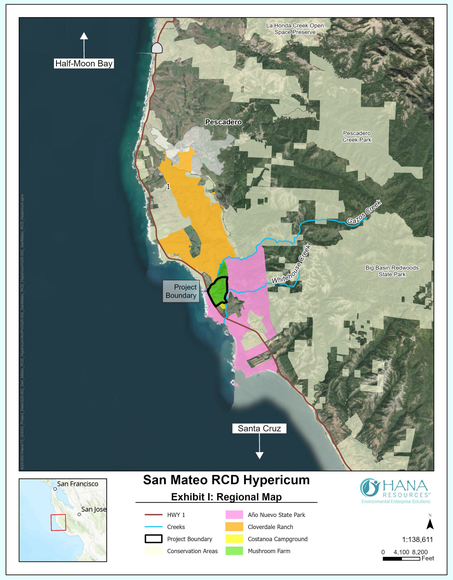
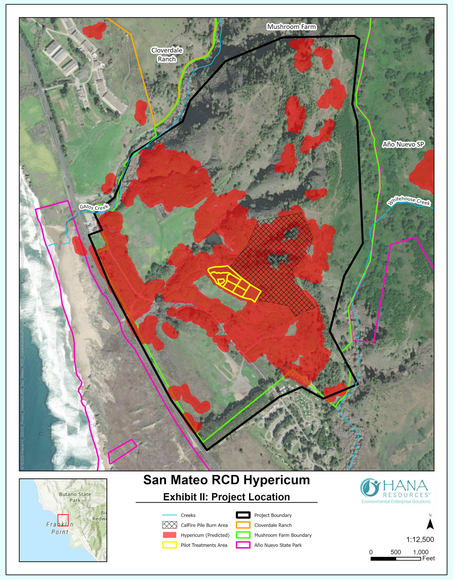
Overview & Applications

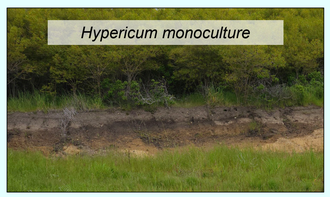
The Coastal Prairie and Working Lands Restoration Project will restore 753 acres of coastal prairie, sage scrub, and oak woodland habitat on The Mushroom Farm in Pescadero, San Mateo County, CA, through the targeted removal of Canary Island St. John's Wort (*Hypericum canariense*). This invasive species forms dense, woody stands that crowd out native plants, elevate wildfire risk, and degrade habitat for over 15 special-status species, including the San Francisco garter snake and California red-legged frog. Led by the San Mateo Resource Conservation District in partnership with HANA Resources, Natures Image, and the San Jose Conservation Corps, the project will enable natural regeneration of native vegetation, strengthen regional habitat connectivity, and advance landscape-scale climate resilience goals. A central innovation is the development of a Hypericum recognition library using drone imagery and proprietary species recognition software. This tool will prioritize treatment by distinguishing satellite patches from dense core infestations, support biomass removal and retreatment planning, and reduce the need for labor-intensive ground surveys. By directly informing restoration of prairie, oak woodland, and sage scrub habitats, the library strengthens outcomes for native plant recovery and the species that depend on these ecosystems. Training developed with Cal-IPC and SJCC will further prepare Corpsmembers, crew leaders, and supervisors to understand the site's history, Hypericum's impacts, the species at risk, and their vital role in the success of the project. Together, these innovations restore biodiversity, build local workforce capacity, and create a scalable model for coastal resilience.





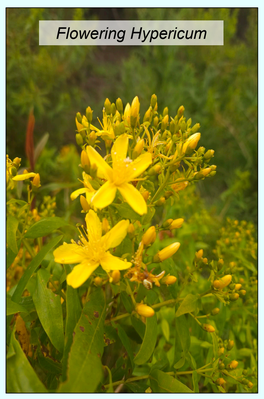
Study Area

The 753-acre Mushroom Farm, located in Pescadero, San Mateo County, CA, sits between Año Nuevo State Park and Midpeninsula Regional Open Space District's Cloverdale Ranch. Over 200 acres are dominated by Hypericum, placing nearby protected lands and the Gazos Creek watershed at risk. The site's rugged terrain makes ground surveys challenging and costly, making UAV imagery a critical tool for efficient mapping, monitoring, and restoration planning.


Hypericum monoculture


Treatment area


10-15 ft Hypericum stands


Flowering Hypericum

Library Development

The Hypericum image library integrates UAV flights, high-resolution orthomosaics, and machine learning to create a scalable tool for invasive plant detection and monitoring. By building a robust dataset of Hypericum stands and testing models across diverse conditions, the library enables precise mapping that supports treatment prioritization, restoration planning, and cost-effective monitoring. Standardized workflows ensure results are reliable and transferable to other land managers, providing a model that can be applied to invasive species management across California.


HANA staff piloting Wingtra takeoff

UAV Flight

Licensed drone pilots conduct flights over the project area using a high-resolution camera mounted on a UAV. Multiple flight paths are completed at 400 ft altitude to capture overlapping imagery of the survey site. This overlapping coverage ensures the ability to stitch images into seamless maps and provides consistent resolution across rugged terrain.

Image Processing

Captured aerial photos are stitched together into a georeferenced orthomosaic. Vegetation index profiles are generated, enabling detailed mapping without the need for field transects. Post-processing also reduces distortions from topography, lighting, and shading, ensuring high accuracy for later analysis.

Species Annotation / Library Development

The orthomosaic is imported into deep learning plant recognition software. Using a species library (e.g., *Hypericum canariense*), polygons are classified and shapefiles generated to delineate species presence. The growing dataset trains the AI model to recognize Hypericum in diverse conditions, building the foundation for scalable invasive species detection.

Validation

Results are checked for accuracy against known data and corrected for errors such as mosaic misalignments and shadow effects. Neural network models are refined until error values asymptotically approach zero, ensuring reliable detection. Ground-truthing with field surveys confirms accuracy and improves model performance across multiple landscapes.

Post-Treatment Mapping

Validated shapefiles are analyzed in GIS to calculate acreage of target species. Maps highlight treated versus untreated areas, providing a baseline for monitoring effectiveness of management actions. This step directly supports adaptive management by showing where retreatments are needed and tracking native vegetation recovery over time.

Project Innovation

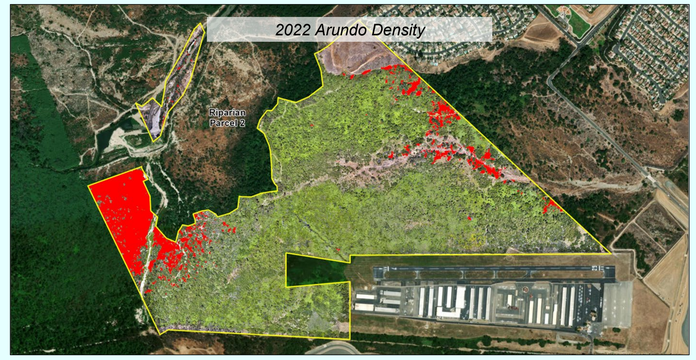
- **Will be first drone-based Hypericum image library in California**, creating a scalable tool for invasive species management.
- **Integrates UAV ortho imagery, species annotation, and machine learning** to accurately detect Hypericum across rugged terrain.
- **Replicable workflow**: protocols and models can be adapted to other invasive species and landscapes, reducing the need for costly ground surveys.
- **Scalable design**: library already adapted for *Arundo donax* and suitable for future regional and statewide applications.
- **Cost effective and precise**: increases detection accuracy, isolates satellite infestations vs dense cores, and guides strategic treatment to maximize ecological benefits.
- **Climate and community benefits**: supports restoration of native habitats, wildfire risk reduction, and provides a transferable tool for land managers across California.

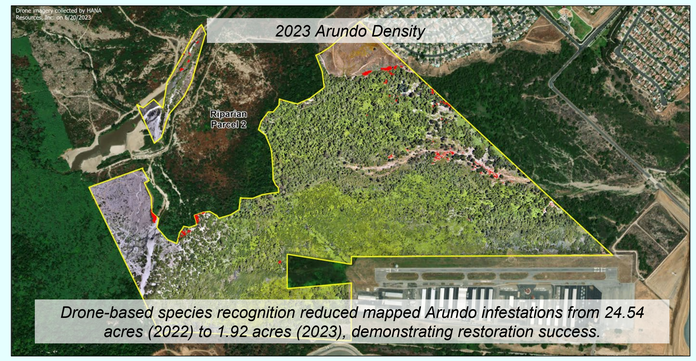
This pioneering library not only transforms how Hypericum infestations are detected and managed, but also establishes a scalable model that reduces costs, improves accuracy, and accelerates restoration outcomes across California's most challenging landscapes.

Proof of Concept

A drone-based image library has already been successfully developed for *Arundo donax* (giant reed) demonstrating the feasibility of combining UAV ortho imagery, species annotation, and machine learning for invasive plant detection. Pilot UAV surveys confirmed reliable species recognition access across rugged terrain, with protocols designed for scalability.

From 2022-2023, mapped Arundo infestations decreased from 24.54 acres to 1.92 acres, providing a measurable example of restoration success. These same methods will be applied to Hypericum to guide biomass removal, prioritize retreatments, and support large-scale habitat restoration.

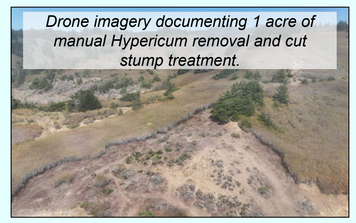




Drone-based species recognition reduced mapped Arundo infestations from 24.54 acres (2022) to 1.92 acres (2023), demonstrating restoration success.

Projected Post-Treatment Results

Biomass removal of Hypericum, combined with targeted seeding, is expected to accelerate the recovery of native coastal prairie species. Early results from a 1-acre pilot on The Mushroom Farm have demonstrated strong native recruitment, with 24 species returning within just six months of treatment. Anticipated post-treatment recovery includes native grasses and forbs such as purple needlegrass (*Stipa pulchra*), soaproot (*Chlorogalum pomeridianum*), and blue wildrye (*Elymus glaucus*). These species stabilize soils, improve carbon storage, and provide essential habitat for special-status wildlife.


Drone imagery documenting 1 acre of manual Hypericum removal and cut stump treatment.


Native species recruitment following Hypericum removal on a 1-acre coastal prairie restoration site post-treatment.

Acknowledgments and Funding

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