**NASA DEVELOP National Program**

**Summer 2016 Project Proposal**

**NASA Goddard Space Flight Center**

**Puerto Rico Agriculture**

Utilizing Earth Observations to Map the Spread of the Red Palm Mite in Puerto Rico

**Project Overview**

***Objective:*** This project aims to establish a method of tracking Red Palm Mite population distributions using Earth observations in Puerto Rico.

***Community Concern:*** The Red Palm Mite (*Raoiella indica* Hirst) is an invasive pest impacting ornamental and fruit-producing palm crops throughout Central and South America. The species feeds via the stomatal aperture of several palm host plants and is currently spreading throughout the Caribbean. Impacts include decreases in agricultural productivity and increase in pest management. Detection and tracking of their spread will enable strategic planning of mitigation and countermeasure programs. Remote sensing will also provide efficient means of mapping populations.

***National Application Area Addressed:*** Agriculture

***Study Location:*** Puerto Rico

***Study Period:*** October 2000 to June 2030

***Advisors:*** Dr. Ronald Ochoa, USDA-ARS, Dr. Michael Cosh, USDA-ARS

***Source of Project Idea:*** The project idea came from entomologists researching at the Beltsville Agricultural Research Center (BARC) at the USDA. Dr. Ronald Ochoa at BARC sought new methods to monitor the spread of *Raoiella indica* Hirst in response to the fact that the Red Palm Mite is the biggest mite blight occurring in the western hemisphere.

**Partner Overview**

***Partner Organizations:***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization** | **POC (Name, Position/Title)** | **Partner Type** | **Boundary Org?** |
| University of Puerto Rico | Dr. Jose Carlos Rodrigues, Researcher | End-User | Yes |
| USDA-Agricultural Research Service | Dr. Ron Ochoa, Research Entomologist (Acarology); Dr. Michael Cosh, Research Hydrologist; Dr. Gary Miller, Research Entomologist | Collaborator | No |

***End-User Overview***

***End-User’s Current Decision Making Process:***

The current decision making process employed by researchers at the University of Puerto Rico and the USDA Animal and Plant Health Inspection Service (APHIS) in Puerto Rico involve sending field teams to investigate potential Red Palm Mite infestations. Targeted sampling based on known palm extent is costly and fails to depict the breadth of the outbreak at a landscape scale. Current means of Red Palm Mite mitigation are widespread application of pesticides which are both time consuming and costly, and may have negative impact on the environment.

***End-User’s NASA Earth Observations Capacity:***

Researchers at Puerto Rico and the USDA do not have substantial experience with NASA data or its management in monitoring the Red Palm Mite in Puerto Rico.

***Collaborator & Boundary Organization Overview***

***Collaborator Support:***

Dr. Ronald Ochoa (BARC) is a mite specialist with more than 30 years working on systematics, ecology, and biology of plant feeding mites. Michael Cosh (BARC) is a hydrologist with 13 years of experience with remote sensing expertise for vegetation monitoring. Dr. Gary Miller (BARC) is an entomologist, with 35 years of experience on insects of economic importance. Their leveraged science advising and weekly meetings with the team throughout the term will ensure success.

***Boundary Organization Dissemination:***

Dr. Jose Rodrigues at the University of Puerto Rico is the PI for Red Palm Mite research and mitigation efforts for the island, and through his work with the USDA-APHIS, disseminates information through a network in the Cooperative Agricultural Pest Survey program.

***Project Communication & Transition Overview***

***In-Term Communication Plan:***

Drs. Ochoa, Miller and Cosh will have regular meetings with the DEVELOP team locally in Maryland and via email and teleconferences. These meetings will occur on a bi-weekly basis throughout the term.

***Transition Approach:***

After development of the methodology and tools, deliverables will be transferred to Dr. Jose Carlos Rodrigues via email who will maintain communication with boundary organizations for eventual implementation operationally.

**Earth Observations Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 5, TM** | Spectral vegetation indices | Vegetation indices will be used to determine the spread and severity of Red Palm Mite infestation.  |
| **Landsat 7, ETM+** | Spectral vegetation indices | Vegetation indices will be used to determine the spread and severity of Red Palm Mite infestation.  |
| **Landsat 8, OLI** | Spectral vegetation indices | Vegetation indices will be used to determine the spread and severity of Red Palm Mite infestation. |
| **Resourcesat-1, LISS-4, and LISS-3**  | Spectral vegetation indices | Vegetation indices will be used to determine the spread and severity of Red Palm Mite infestation. |
| **Sentinel-2, MSI** | Spectral vegetation indices | Vegetation indices will be used to determine the spread and severity of Red Palm Mite infestation. |

***Ancillary Datasets:***

USDA National Agricultural Statistical Service – National Land Cover Database – Stands of known palm trees will aid the analysis of the spread and severity of the Red Palm Mite infestation

USDA Farm Service Agency – National Agriculture Imagery Program – Vegetation indices will be used to determine the spread and severity of Red Palm Mite infestation

**Decision Support Tool & End-Product Overview**

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Product** | **Partner Use** | **Datasets & Analyses** | **Software Release Category** |
| Red Palm Mite Hazard Coverage Maps | Tracking *Raoiella indica* Hirst spread will become more efficient using remotely sensed data, helping with mitigation and remediation of impacted areas. | Landsat 5, 7, 8, Resourcesat-1, and Sentinel-2 data will be used to identify mite affected areas.  | 1 |

***End-User Benefit:***

The main benefit of the project is to understand the distribution of mite populations. Understanding areas affected by the mite, and distribution of palms, will establish more effective programs of management, prevention, and control of this pest. Population dispersal and seasonal behavior also could be identified for subsequent regulation programs. Local, state, federal, and university departments of agriculture, entomology or plant protection could use the information for understanding and management of this invasive species.

**Project Timeline & Previous Related Work**

***Project Timeline:*** 1 Term: 2015 Summer

***Related DEVELOP Work:***

Fall 2015 (Fort Collins) – Colorado Agriculture: Mapping Forest Species Composition at the Colorado State Forest State Park Using Landsat 8 with Integrative Spatial Modeling

Fall 2013 (MSFC) – Cumberland Ecological Forecasting: Using NASA Earth Observations to Model Representative Species Dispersion in the Cumberland Plateau to Aide in Conservation Efforts

Spring 2014 (MSFC) – Cumberland Ecological Forecasting: Using NASA Earth Observations to Model Representative Species Dispersion in the Cumberland Plateau to Aide in Conservation Efforts

Fall 2013 (Fort Collins) – Rocky Mountains Ecological Forecasting: Mapping Lodgepole Pine Mortality in the Central Rocky Mountains Using NASA Earth Observing System and Boosted Regression Tree Models

Spring 2014 (UGA) – Smoky Mountains Ecological Forecasting: Utilizing NASA Earth Observations to Monitor Long Term Hemlock Decline Caused by Invasive Hemlock Woolly Adelgid in Great Smoky Mountains National Park

Fall 2014 (SSC) - U.S. Disasters and Ecological Forecasting: Assessing the Potential to Use VIIRS 375m Data for Detecting Forest Disturbances

**Project Needs/Requests**

***Participants Requested:*** 3

***Software & Scripting:***

ArcGIS – Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat 5 TM, 7 ETM+, 8 OLI; Resourcesat-1 LISS-4, LISS-3; and NAIP imagery.

ENVI – Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat 5 TM, 7 ETM+, 8 OLI; Resourcesat-1 LISS-4, LISS-3; and NAIP imagery.

Google Earth Engine – Data acquisition, Raster Manipulation/Analysis, Image Enhancement & Map Creation of Landsat 5 TM, 7 ETM+, 8 OLI; Resourcesat-1 LISS-4, LISS-3; and NAIP imagery.

**Notes & References:**

***References:***

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Beard, J.J., Ochoa, R., Bauchan, G.R., Trice, M.D., Redford, A.J., Walters, T.W. and Mitter, C. (2012) Flat Mites of the World. Identification Technology Program, CPHST, PPQ, APHIS, USDA; Fort Collins, CO. [Rev. 2015] <http://idtools.org/id/mites/flatmites/>

Ochoa, R., J.J. Beard, G. Bauchan, E.C. Kane, A.P. G. Dowling and E.F. Erbe. 2011. Herbivore exploits chink in armor of host. American Entomol. 57(1): 26-29.

Beard, J.J. R. Ochoa, G. Bauchan, W.C. Welbourn, C. Pooley, and A.P.G. Dowling. 2012. External mouthpart morphology in the Tenuipalpidae (Tetranychoidea): *Raoiella* a case study. Exp. Appl. Acarol. 57(3-4): 227-255.

Dowling, A.P.G., R. Ochoa, J.J. Beard, W.C. Welbourn and E.A. Ueckermann. 2012. Phylogenetic investigation of the genus *Raoiella* (Prostigmata: Tenuipalpidae): diversity, distribution, and world invasions. Exp. Appl. Acarol. 57(3-4): 257-269.

Kane, E. C., R. Ochoa, G. Mathurin, E. F. Erbe and J.J. Beard. 2012. *Raoiella indica* Hirst (Acari: Tenuipalpidae): An exploding mite pest in the neotropics. Exp. Appl. Acarol. 57(3-4): 215-225.