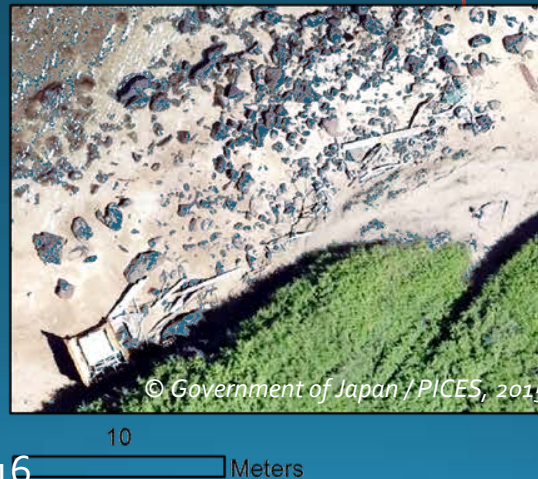


Mapping marine debris on Hawaiian shorelines using ultra-high resolution aerial ortho-imagery



Kirsten Moy - DAR/DLNR

Miguel Castrence - Resource Mapping Hawai'i

Workshop on Mission Concept for Marine Debris Sensing Jan 19 – 21, 2016

Project background

Japanese Tsunami Marine Debris (JTMD)

- March 2011 Earthquake and Tsunami swept ~ 5 million tons into sea
 - Est. 70% sank immediately; 1.5 M tons remaining dispersed across Pacific



Project background

Japanese Tsunami Marine Debris (JTMD)

- March 2011 Earthquake and Tsunami swept ~ 5 million tons into sea
 - Est. 70% sank immediately; 1.5 M tons remaining dispersed across Pacific
- Sept. 2012 First confirmed JTMD item 4' square blue plastic fishing container: JTMD-01



Project background

Japanese Tsunami Marine Debris (JTMD)

- There are now
30 confirmed
JTMD on HI's list



Project background

Japanese Tsunami Marine Debris (JTMD)

AQUATIC INVASIVE SPECIES (AIS)

- Aquatic Invasive Species (AIS) arrive in the Hawaiian Islands on marine debris: “*Rafting*”



Project background

Japanese Tsunami Marine Debris (JTMD)

AQUATIC INVASIVE SPECIES (AIS)

- Aquatic Invasive Species (AIS) arrive in the Hawaiian Islands on marine debris: “*Rafting*”
- Of ~1.5 million tons of debris from the 2011 Japanese Tsunami, much remained in coastal waters or were already in the water and accumulated marine growth native to Japan. *These rafts transport alien communities to Hawaiian waters where they may become established*



Project background

Japanese Tsunami Marine Debris (JTMD)

AQUATIC INVASIVE SPECIES (AIS)

- Aquatic Invasive Species (AIS) arrive in the Hawaiian Islands on marine debris: “Rafting”
- Of ~1.5 million tons of debris from the 2011 Japanese Tsunami, much remained in coastal waters or were already in the water and accumulated marine growth native to Japan. *These rafts transport alien communities to Hawaiian waters where they may become established*
- 77 Confirmed cases of AIS on debris items
 - 42 Mussels
 - 15 Barnacles
 - 11 Algae
 - 4 Crustaceans
 - +69 Suspected cases

Established
Lepas barnacles
bryozoans collected shells Gooseneck cariosus limpets
chitons possible macroalgae foam Benthic Goosenecks Hawaii
Anemone Mytilus Samples Pelagic crab Serpulidae limu
bivalves hydroid mussel sent Algal barnacles Jellyella
One pink Polysiphonia Oceanic goose-neck
barnacle slime sp Small native red inverts observed crustaceans
senticulosa tufts Hinksia growth boring Taxonomy
crabs other sludge dead blue fuzz
Ulva Diatoms neck green
oyster marine found galloprovincialis
borers Boring Sherwood non-native large Semibalanus
alga Rosa Goose shipworms opercular cases
check alien Specimen Blidingia Plagusia Possibly
fouling compressa Feldmannia reported white
cyanobacterium directly oysters biofouling
bryozoan inspection Dictosphaera Carlton
algae common Megabalanus alga Rivularia



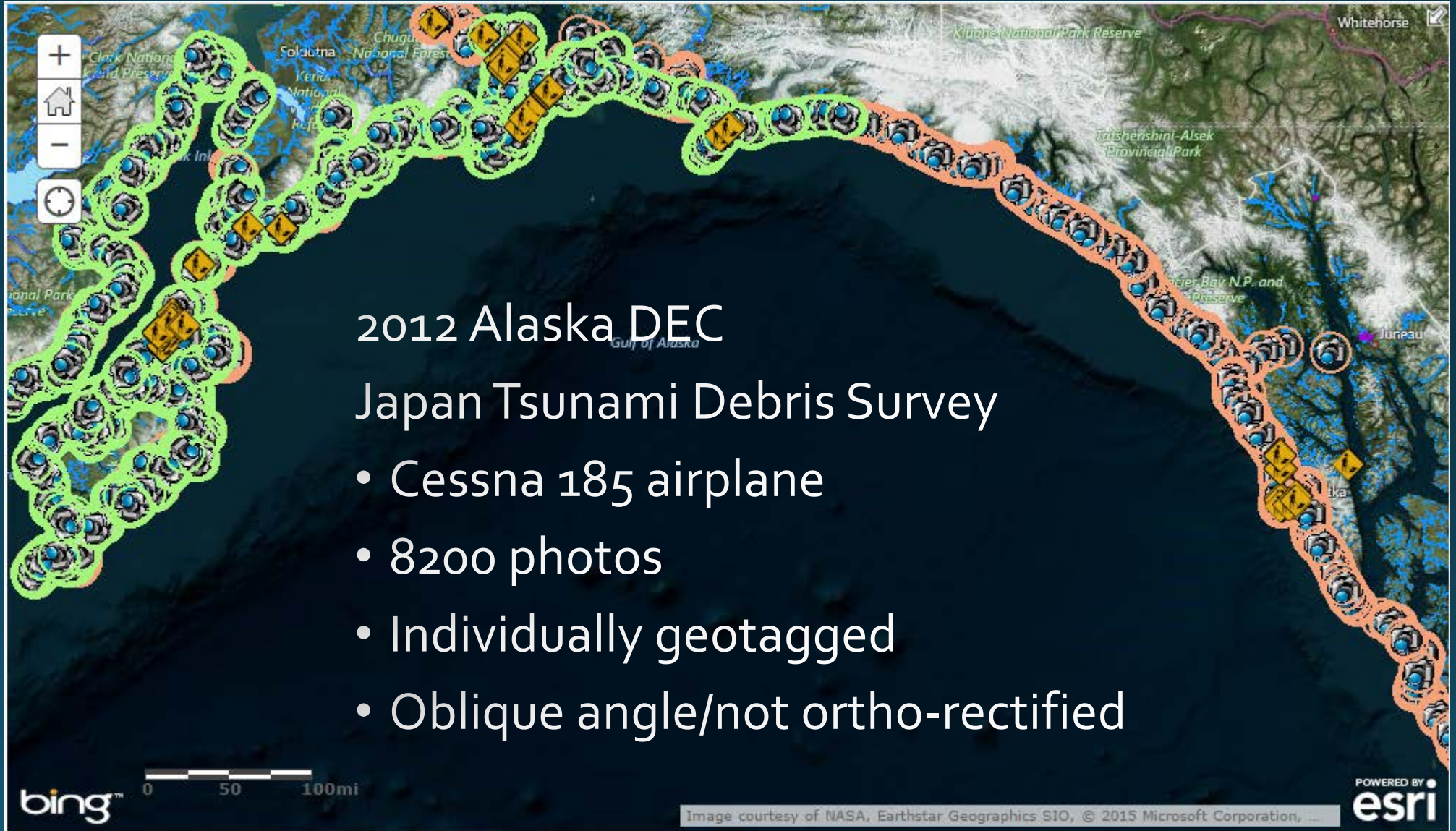
Improving upon previous efforts

2008 MHI – DFG survey

- Hughes 500 helicopter
- In-air observations
- Focus on DFG



Improving upon previous efforts



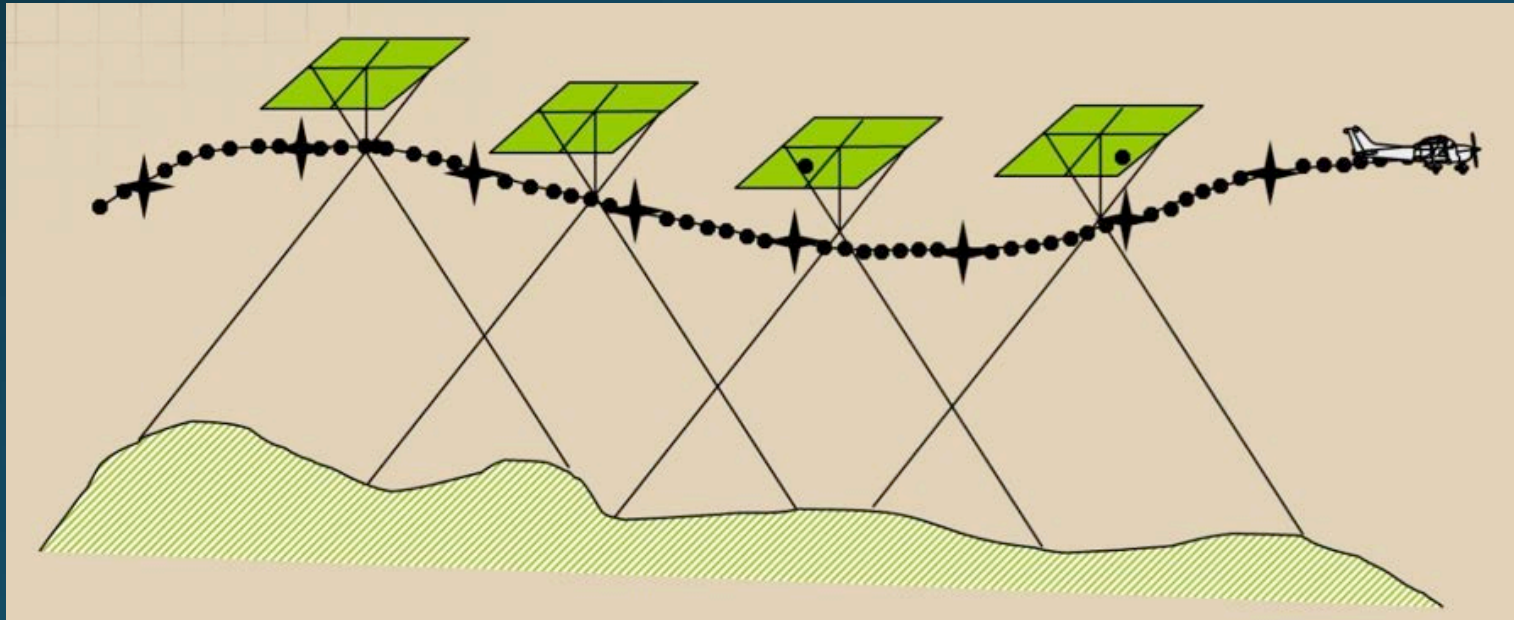
Ortho-imagery

- High resolution GIS data combining the visual detail of aerial photos with the spatial accuracy and reliability of a map
- Cessna 206 with belly port, gyro-stabilized gimbal, 3-camera array & computer for navigation / data collection



Challenges

- Image overlap
- Weather conditions
- Terrain
- Coastline complexity
- Airspace restrictions

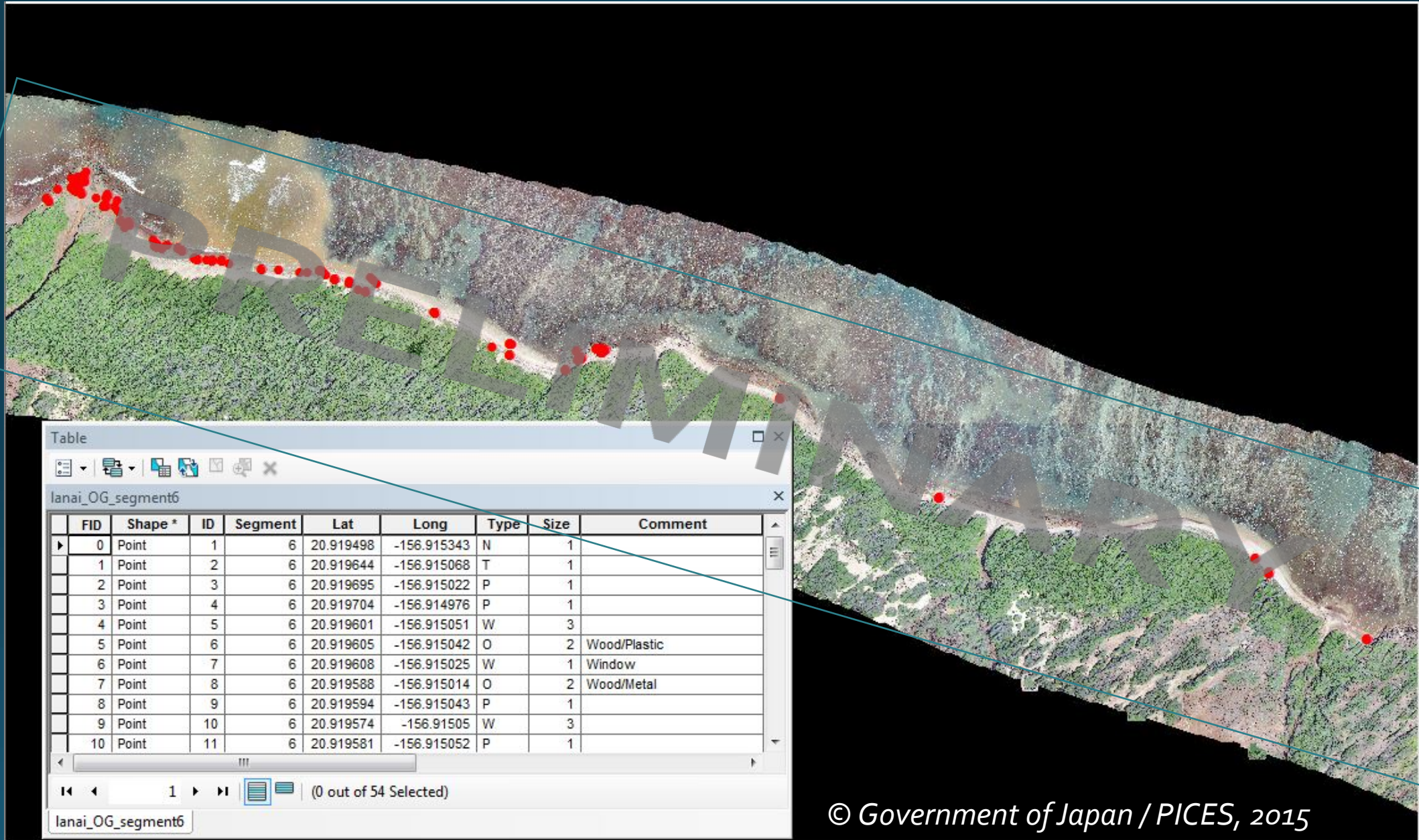


Project overview

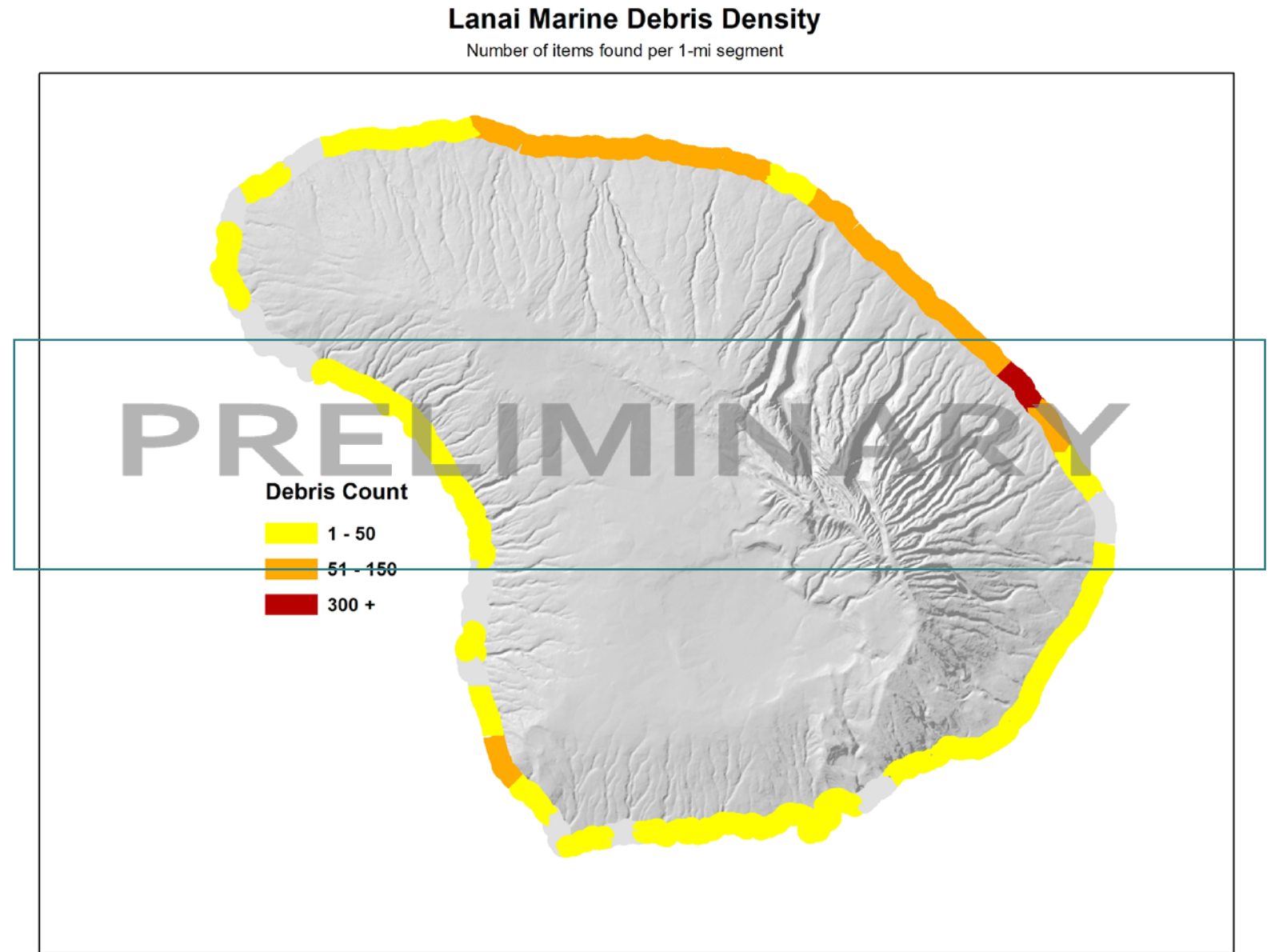
1. Aerial surveys
 - Coastlines of the main 8 islands of the state of Hawai'i
 - August – November 2015
2. Image processing
 - Spatial resolution: 2cm
 - Swath: 200-300 m
3. GIS analysis
 - Debris locations, type, size
 - Final results in spring 2016



Analysis



Analysis

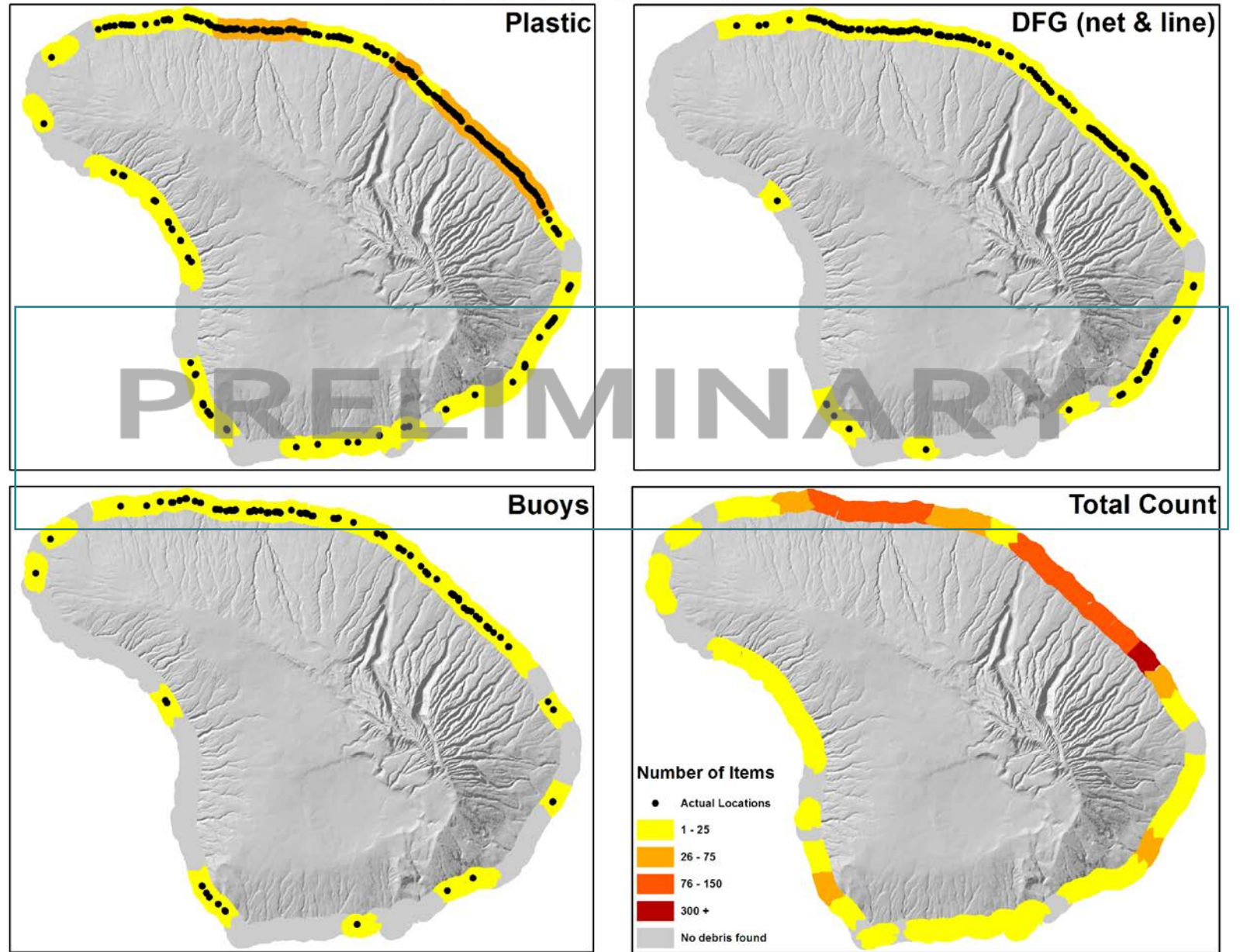


Produced based on information collected using funding provided by the Ministry of the Environment of Japan through the North Pacific Marine Science Organization. Aerial surveys conducted by Resource Mapping on September 9, 2015. GIS analysis performed by the University of Hawaii, Social Science Research Institute, Hawaii Coral Reef Initiative, funded by Hawaii Department of Land and Natural Resources through use of Japanese Gift Funds.

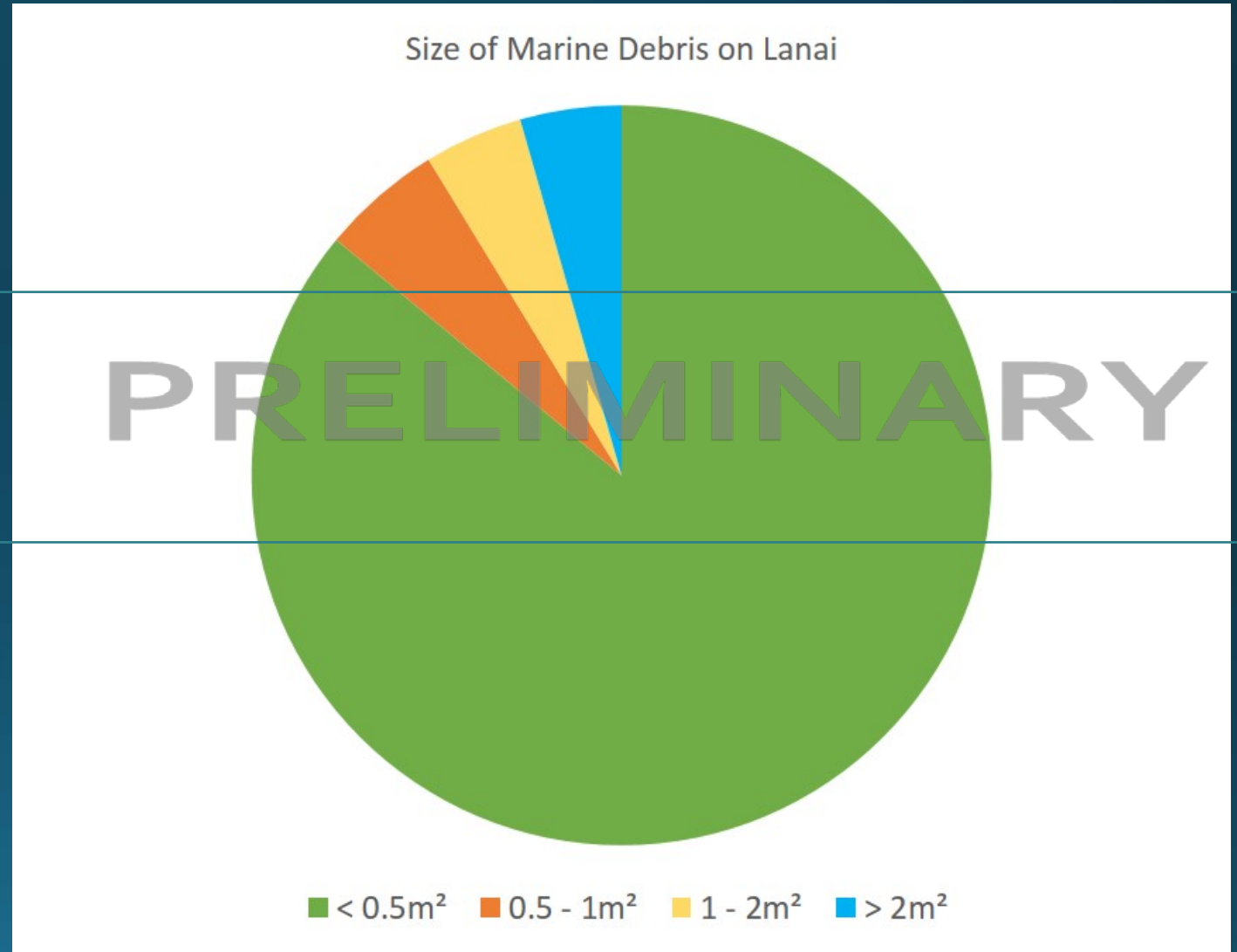
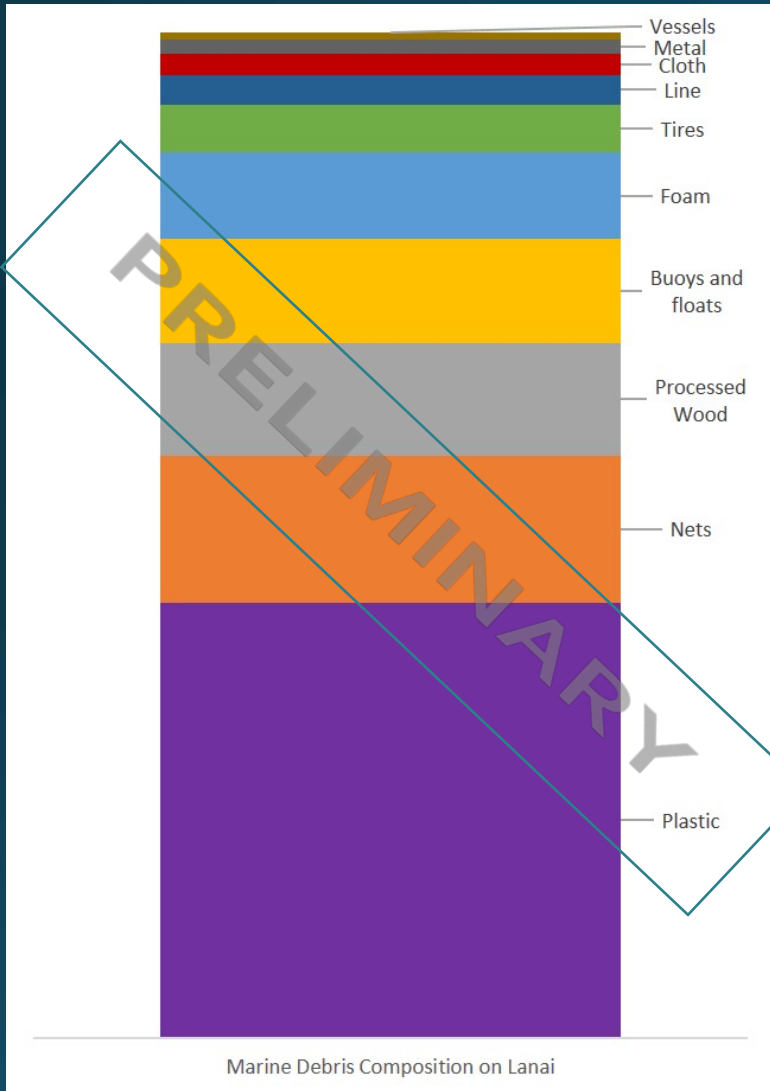
Analysis

Lanai Debris Density by Item Type

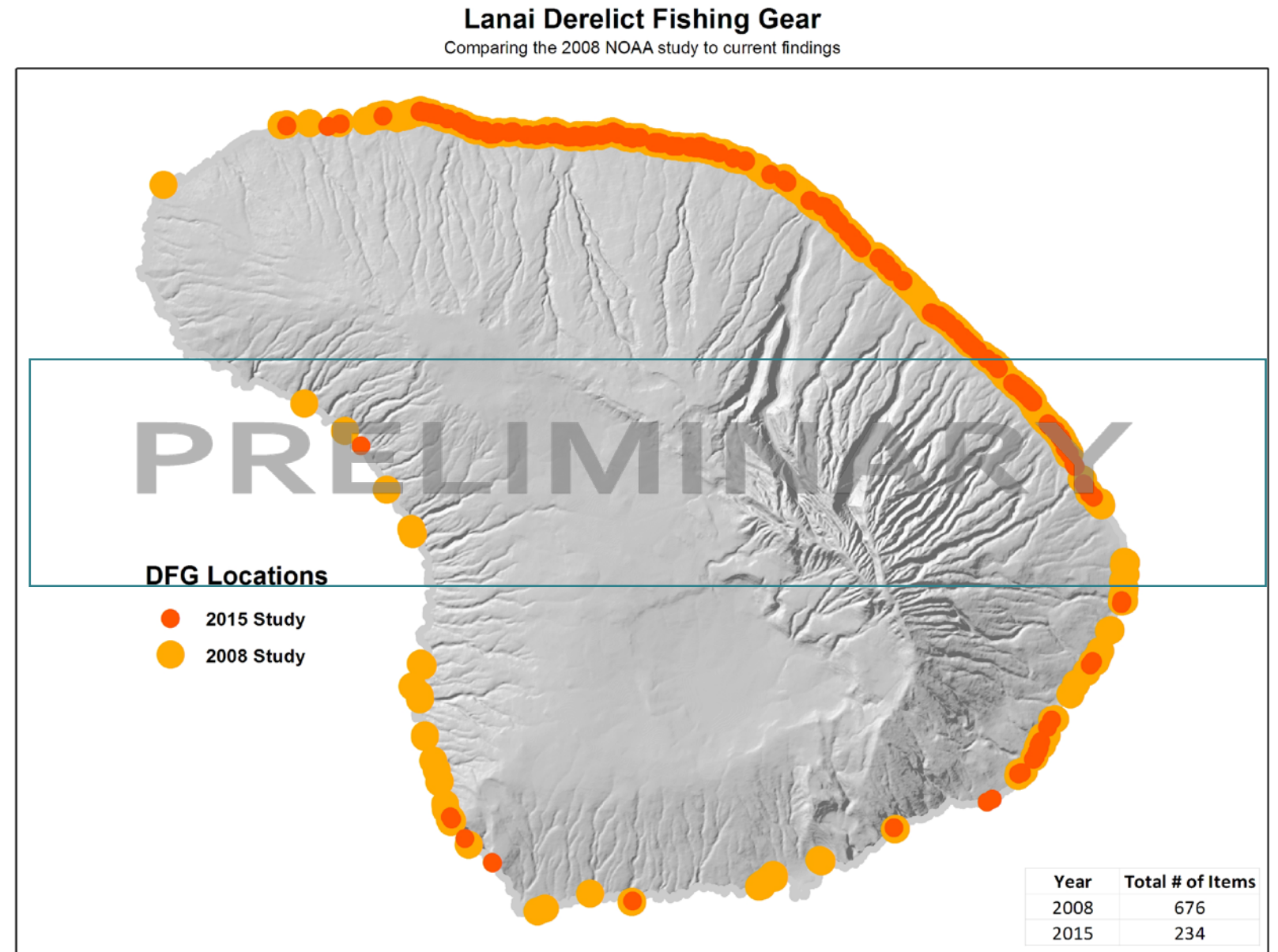
Number of items per segment for three main debris types



Analysis



Analysis



Produced based on information collected using funding provided by the Ministry of the Environment of Japan through the North Pacific Marine Science Organization. Aerial surveys conducted by Resource Mapping on September 9, 2015. GIS analysis performed by the University of Hawaii, Social Science Research Institute, Hawaii Coral Reef Initiative, funded by Hawaii Department of Land and Natural Resources through use of Japanese Gift Funds.

Validation/ground-truthing

2015 aerial imagery
(Resource Mapping Hawaii)



© Government of Japan / PICES, 2015

2013 Google Earth



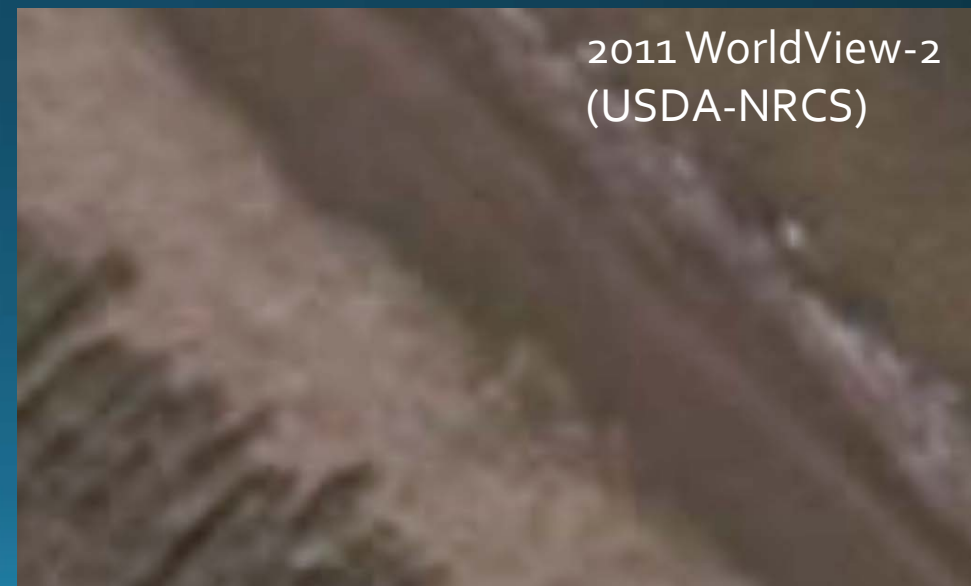
2011 WorldView-2
(USDA-NRCS)



Validation/ground-truthing



Validation/ground-truthing



Validation/ground-truthing



2016 site visit
(Anne Rosinski-HCRI)

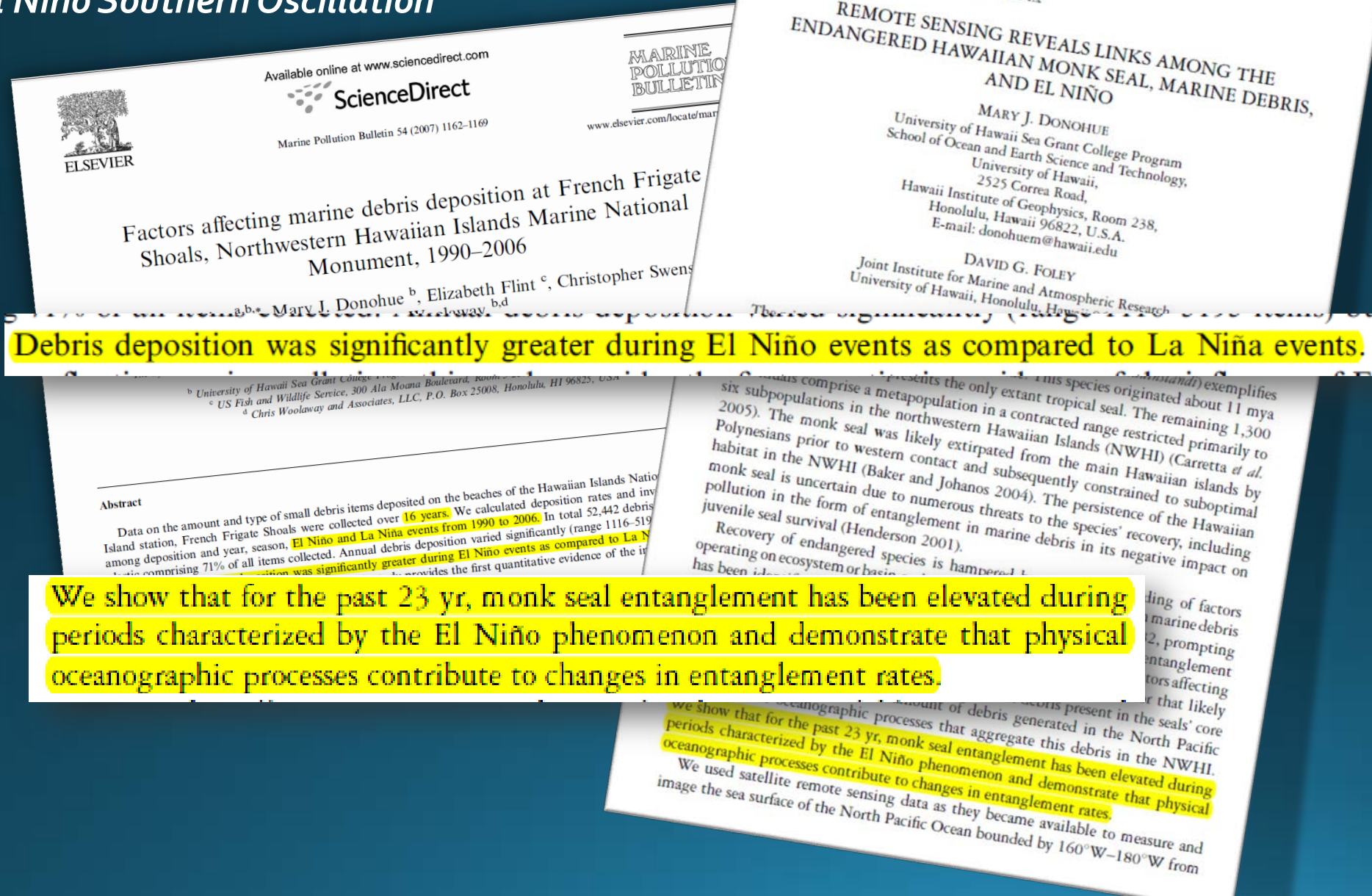


Informing Removal Efforts

- “Hotspots” to direct managerial focus and NGO effort
- Large item removal needs and accessibility
- Coordinating with Partners

Future direction

El Niño Southern Oscillation



Available online at www.sciencedirect.com



ScienceDirect
Marine Pollution Bulletin 54 (2007) 1162–1169

MARINE
POLLUTION
BULLETIN

www.elsevier.com/locate/marpolbul

Factors affecting marine debris deposition at French Frigate Shoals, Northwestern Hawaiian Islands Marine National Monument, 1990–2006

Mary J. Donohue^{a,b}, Elizabeth Flint^c, Christopher Swens^d

MARINE MAMMAL SCIENCE, 23(2): 468–473 (April 2007)
© 2007 by the Society for Marine Mammalogy
DOI: 10.1111/j.1748-7692.2007.00114.x

REMOTE SENSING REVEALS LINKS AMONG THE ENDANGERED HAWAIIAN MONK SEAL, MARINE DEBRIS, AND EL NIÑO

MARY J. DONOHUE
University of Hawaii Sea Grant College Program
School of Ocean and Earth Science and Technology,
University of Hawaii,
2525 Correa Road,
Hawaii Institute of Geophysics, Room 238,
Honolulu, Hawaii 96822, U.S.A.
E-mail: donohuem@hawaii.edu

DAVID G. FOLEY
Joint Institute for Marine and Atmospheric Research
University of Hawaii, Honolulu, Hawaii

Debris deposition was significantly greater during El Niño events as compared to La Niña events.

^a University of Hawaii Sea Grant College Program
^b US Fish and Wildlife Service, 300 Ala Moana Boulevard, Room 200, Honolulu, HI 96825, USA
^c US Fish and Wildlife Service, 300 Ala Moana Boulevard, Room 200, Honolulu, HI 96825, USA
^d Chris Woolaway and Associates, LLC, P.O. Box 25008, Honolulu, HI 96825, USA

Abstract

Data on the amount and type of small debris items deposited on the beaches of the Hawaiian Islands National Monument, French Frigate Shoals were collected over 16 years. We calculated deposition rates and inventory of debris items deposited on the beaches of the Hawaiian Islands National Monument, French Frigate Shoals among deposition and year, season, El Niño and La Niña events from 1990 to 2006. In total 52,442 debris items were collected. Annual debris deposition varied significantly (range 1116–519 items per beach) among years. El Niño events were associated with significantly greater debris deposition than La Niña events. This study provides the first quantitative evidence of the impact of El Niño events on marine debris deposition.

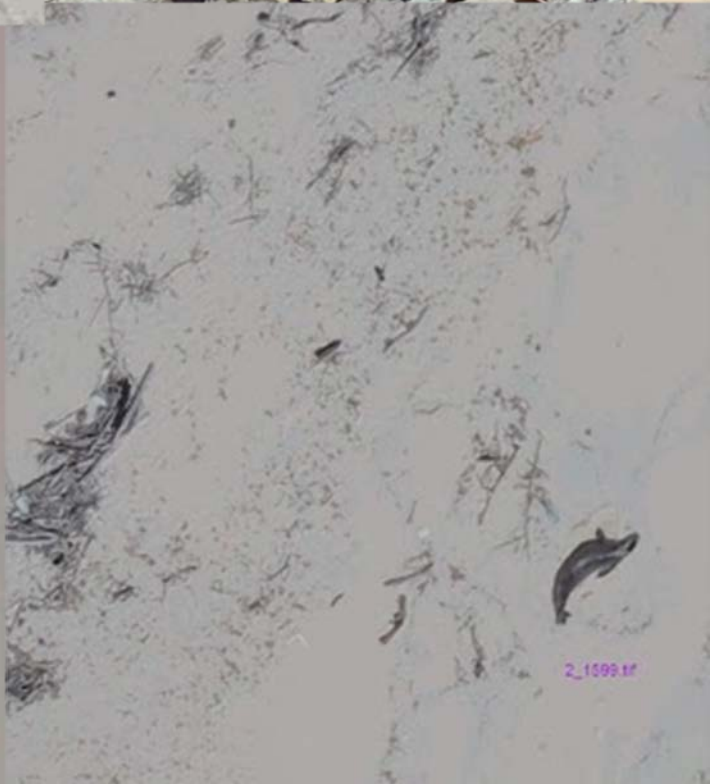
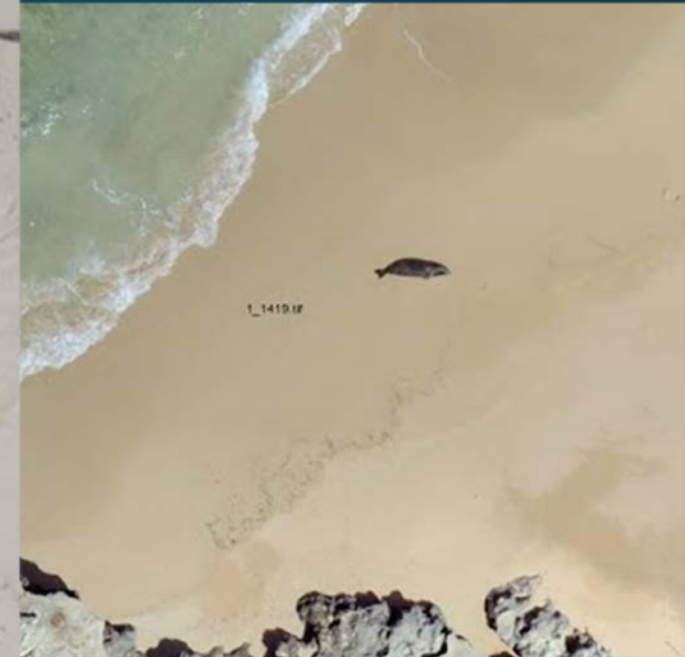
We show that for the past 23 yr, monk seal entanglement has been elevated during periods characterized by the El Niño phenomenon and demonstrate that physical oceanographic processes contribute to changes in entanglement rates.

we show that for the past 23 yr, monk seal entanglement has been elevated during periods characterized by the El Niño phenomenon and demonstrate that physical oceanographic processes contribute to changes in entanglement rates. We used satellite remote sensing data as they became available to measure and image the sea surface of the North Pacific Ocean bounded by 160°W–180°W from

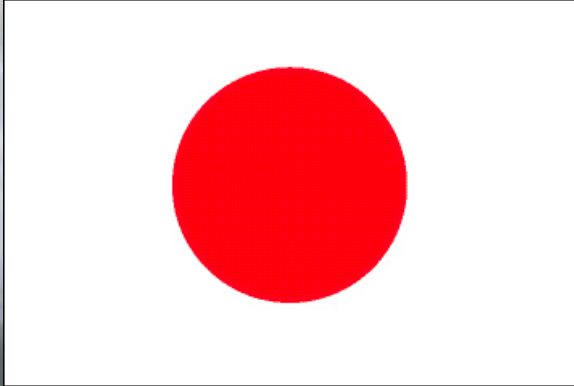
Future directions

Project Expansion

- Long-term monitoring
 - Tracking changes over time
- Automated feature extraction techniques
- Crowdsourcing
 - Citizen science
 - Educational/outreach tool



Mahalo!



PICES



marine debris program



Questions?

Miguel@ReMapHawaii.com

Kmoy@hawaii.edu