I. Converges with M. on the Kalaupapa Coast to Make a B.L.T.

Two plant monitoring protocols combine with a vegetation mapping inventory to create a more robust understanding of the resources.

Bacon is delicious on its own. But when you add tomato to the bacon, the salty smokiness mixes with the tangy sweet acid of the fruit to make something even better. Add toast, lettuce, and mayo, and you've just created a taste sensation which is undoubtedly more scrumptious than its individual parts.

The Inventory & Monitoring program (I&M) monitors natural "vital signs" like the Focal Terrestrial Plant Community (FTPC) and Established Invasive Plant Species (EIPS). Though these projects are each designed to serve a specific purpose, they can be used in tandem to achieve an even better understanding of the plant communities. Sprinkle on top a snapshot of another aspect of park resources like the recent vegetation mapping inventory, and you end up with a bona fide synergy of science. The B.L.T. Effect, if you will.

The detail achieved by bringing together different components of plant community composition can be extremely valuable to resource managers, and help with evaluating the health or status of natural resources of concern. In the future, I&M plans to supplement these protocols with other vital signs such as Early Detection of Invasive Plant Species and Focal Plant Species monitoring.

A vegetation monitoring plot in the coastal strand of Kalaupapa National Historical Park

Focal Terrestrial Plant Community Monitoring

To conduct this monitoring protocol, crews travel to the backcountry areas of Pacific Island Network (PACN) national parks to survey the vegetation of focal plant communities. These include wet forests, subalpine shrublands, coastal communities, limestone forests, and a mangrove forest. Specific areas within these communities, or "sampling frames", were determined by park staff based on vegetation, geography and other factors. More importantly, sampling frames were assigned to areas that are still considered to be relatively intact ecologically.

Monitoring FTPC consists of determining all native and non-native species present in a 20x50m (forests and subalpine shrublands) or 10x20m (coastal) plot. Crews also take readings on the substrate and understory cover, then count and take measurements on seedlings, shrubs, and trees. Depending on access, vegetation diversity and density, this process can be fairly quick or take multiple days for a single plot. Monitoring is repeated every five years at each park to provide long-term plant community data, and eventually trends.

Some areas (above and background) of the coastal strand plant community are dominated by native plants like 'akoko (*Euphorbia degeneri*), 'ilima (*Sida falax*), hinahina (*Heliotropium anomalum var. argenteum*), 'ākulikuli (*Sesuvium portulacastrum*), and naupaka (*Scaevola taccada*). Invasive plants, like Bermuda grass (*Cynodon dactylon*) are scattered throughout the coast, and threaten to displace native species like mau'u (*Fimbristylis cymosa*; photo to the right).

Established Invasive Plant Species Monitoring

EIPS monitoring is conducted within the same sampling frames as FTPC – areas that are considered to be relatively intact. To monitor this vital sign, crews walk transects and estimate the types and amounts of all non-native species found in contiguous plots along the way. While the length of transects vary depending on where we are, each transect is 5m wide. Plots along the transects are either 10x5m or 20x5m, depending on the situation.

Following the same schedule as FTPC monitoring, EIPS transects are repeated every five years for each PACN park.

Vegetation Mapping Inventory

In 2008, I&M crews, contractors, and cooperators started working together to produce detailed vegetation classification maps for each PACN park. This process begins with crews painstakingly documenting all vegetation within (a lot of randomly generated) 400m² circles. Contractors then combine these data with satellite imagery to produce draft maps of plant associations scattered across the parks. Afterward, crews conduct accuracy assessments before final maps and reports are produced (see The Whole Ground Truth).

Vegetation maps are a great tool for resource management in their own right. These inventories provide a snapshot of the vegetation across the parks. They can help managers identify areas of concern.

Bringing it all Together with Thematic Maps... A Better Sandwich

The meat of the story is in the thematic maps that are created from a combination of plant monitoring and vegetation inventory data. These maps are made to display specific themes or data of interest. A theme that targets non-native plant species, for example, can help provide insight to the "health" of areas within the parks.

We combine data from FTPC monitoring plots, EIPS transects, and vegetation mapping plots to create thematic maps (e.g. map below) for targeting non-native species cover in the rocky and sandy sampling frames of the Kalaupapa Coast. These maps will be published with the Kalaupapa Coastal Strand EIPS monitoring report (available soon) and focus on species of concern to the park, especially those that have the ability to displace native vegetation. By bringing together FTPC, EIPS, and vegetation inventory data we can provide resource managers with a more detailed picture of how these potentially damaging non-native species are spreading in relatively intact plant communities. The result is stronger than the sum of its parts... not unlike a good B.L.T.

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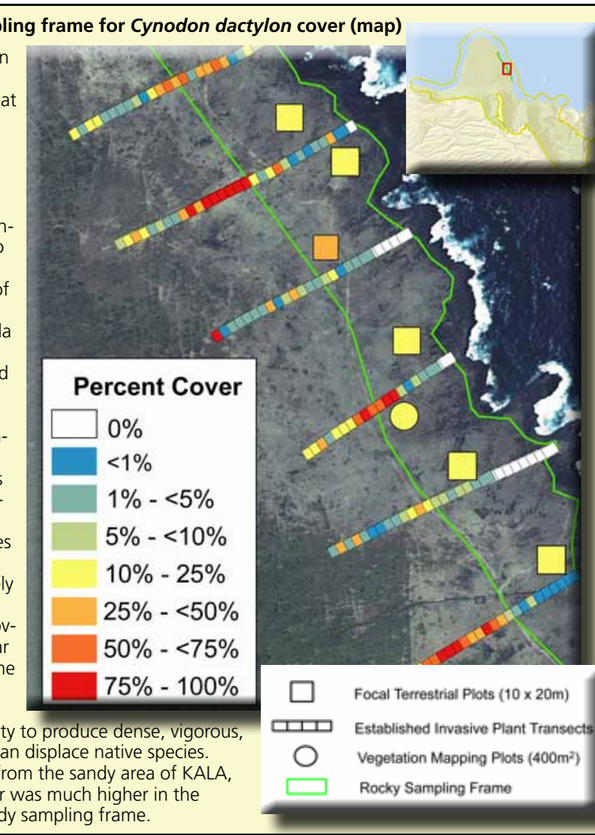
Rocky sampling frame for *Cynodon dactylon* cover (map)

If you've ever visited or seen pictures of the Kalauapa NHP (KALA), you'll recall that the southeastern coast is covered in native and non-native grasses and herbs. Bermuda grass (*Cynodon dactylon*) was the most frequent and abundant non-native species, according to the EIPS monitoring data. This map shows a section of the rocky sampling frame, where we mapped Bermuda grass cover for 15 FTPC plots, 16 EIPS transects, and two vegetation mapping plots. Unlike other PACN parks, EIPS monitoring transects extended beyond the sampling frame boundaries into a "buffer" area to better monitor encroaching non-native species. Analyses from EIPS data show that Bermuda grass was relatively widespread in the rocky area. The frequency and cover of this species was similar between the sampling frame and buffer area. Bermuda grass may be a species of concern because of its ability to produce dense, vigorous, low-growing strands that can displace native species. These results are different from the sandy area of KALA, where Bermuda grass cover was much higher in the buffer area than in the sandy sampling frame.