Ala Kahakai National Historic Trail (ALKA)

Vegetation Classification and Mapping Work Plan

Anticipated Start Date: FY08 - Anticipated End Date: Unknown

Anticipated Project Cost: $45,333

Proposed Tasks, Costs and Labor

Task	Proposed Dates	Organization	Amount	Days	Costs	ODC's	Discussion
Planning Meeting	N/A	NPS, PACN, ALKA, NatureServe, Contractors	-	-	$ -	$ -	Meeting could be combined with HAVO's
Preliminary Assoc. List	N/A	Unknown	-	-	-	-	Use other parks data to create
Field Data Collection	N/A	NPS/Contractor	45 Plots	9	$9,360	$6,913	1 field crew
Classification and Support	N/A	NatureServe	-	-	$ -	$ -	Unknown at this time
Mapping and Support	N/A	Contractor	2180 Acres	10	$7,500	$1,500	Mapping will use existing imagery and will only occur on areas outside of HAVO, PUHE, PUHO, & KAHO
Accuracy Assessment	N/A	NPS/Contractor	0	0	$ -	$ -	The entire trail will be surveyed.
Final Deliverables	N/A	NPS/Contractor	N/A	20	$10,000	$2,500	Includes expenses for report production
Contingency 20%	All	All	-	-	$5,375	$2,185	
Totals	-	-	-	**51**	**$32,235**	**$13,098**	**$45,333**

Introduction

ALKA is an unique National Park Service unit since it encompasses most of western and southern portions of the big island of Hawaii and crosses through private, state, and federal lands, with 17% of the trail occurring in HAVO, PUHE, PUHO, and KAHO (50% private and 33% other). Established in 2000 for the preservation, protection and interpretation of traditional Native Hawaiian culture and natural resources, ALKA is a 175-mile trail corridor full of cultural and historical significance. It traverses through hundreds of ancient Hawaiian settlement sites and through 200 ahupua'a, or traditional sea to mountain land divisions. Cultural resources along the trail include several important heiau (temples), royal centers, kahua (house site foundations), loko'ia (fishponds), ko'a (fishing shrines), ki'i pohaku (petroglyphs), holua (stone slide), and wahi pana (sacred places). Natural resources include anchialine ponds, pali (precipices), nearshore reefs, estuarine ecosystems, coastal vegetation, migratory birds, native sea turtle habitat, and several threatened and endangered endemic species of plants and animals. The park is actively reaching out to private land-owners, public and not-for-profit organizations, state land managers, and communities for their support and help in managing the trail.

Since ALKA is a new linear park it presents some unique challenges related to vegetation mapping. First ALKA is a recent addition to the NPS and as such can not be funded by the national program at this time. The lack of a clear funding source combined with the high amount of private lands puts ALKA as probably the last park unit to be classified and mapped. It is proposed that once the other parks on Hawaii have been completed these data will be used to create a product for the sections ALKA in HAVO, PUHE, PUHO, and KAHO. The remaining portions will then be addressed in a stepwise fashion, factoring into account access, logistics, and availability of existing imagery. No formal accuracy assessment is planned and only minimal plot data in new types will be collected.

Photo: A Portion of ALKA at KAHO.

TASK 1.0 Planning Sessions and Meetings

For cost savings and logistic issues the preliminary planning and scoping for this project will likely be completed in conjunction with HAVO, PUHE, PUHO, and/or KAHO. This meeting will be for the portions of ALKA that are contained in these parks. For the remaining sections, close communication, follow-up meetings and conference calls with ALKA staff will be needed for field work coordination and logistical support. The initial planning meeting will be used to brief AKLA staff on the status of these projects and to discuss the project design, imagery, mapping, plant distribution and ecology, and project review. Prior to the meeting several decisions need to be made regarding the mapping, timeline and the involvement of other interested agencies and neighbors. For the purposes of this planning document several assumptions were made for this task. These include:

Assumptions:

- Sufficient pre-planning will occur to establish the approach and milestones for the field data collection, classification, mapping, and digital database production;
- The sampling approach will be discussed and finalized at the planning meeting;
- The final project boundary will be discussed and finalized at the planning meeting;
- Follow-up meetings and communications will be needed to determine when additional sections of the trails can be assessed and sampled.

For the purposes of this work plan the project boundary for ALKA assumes a 100 foot (30 meter) environs on either side of the trail corridor, minus the areas of the trail that fall in the jurisdiction of HAVO, PUHE, PUHO and KAHO and any open ocean areas. This results in a project area of approximately 2180 acres (**Figure 2**). The actual vegetation mapping area will likely be smaller due to the large amount of non-vegetated lands including transportation corridors, agricultural lands and urban areas falling within the project area. If the environs area changes as a result of planning meeting discussions, the estimated level of effort for some tasks in this plan may change.

Task Deliverables: A summary of the planning meeting minutes along with copies of the presentations will be distributed.

TASK 2.0 Preliminary Plant Alliance/Association and Species Lists

A preliminary list of plant associations and alliances including the known ecological systems for ALKA will be solicited from NatureServe. The preliminary list will be based on the final classifications for HAVO, PUHE, PUHO, and/or KAHO in addition to a review of any other applicable existing data known to occur on the big island of Hawaii. The initial list will also include an estimate on the likeliness that the type occurs in and around the trail. A review of this list will be conducted by ALKA and PACN staff with additions added to the list and types removed that are known not to occur in the area.

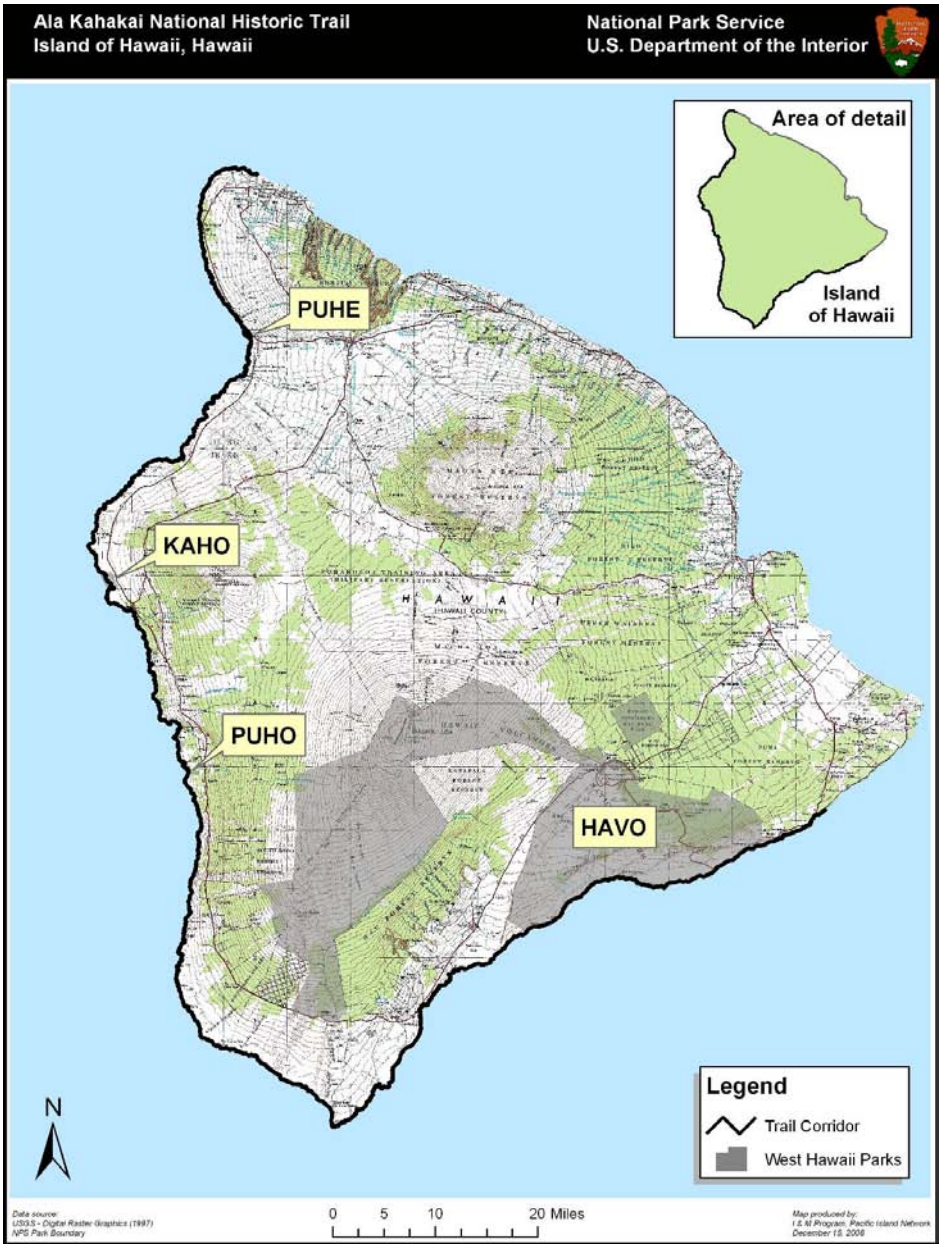

Figure 2. Approximate Project Boundary for the ALKA Vegetation Mapping Project.

Assumption:

- Sufficient vegetation data occurs for this area that a preliminary list of associations can be created.

Task Deliverables: A preliminary list of plant associations and alliances for ALKA will be prepared by either NatureServe or NPS staff and will be presented to PACN prior to planning and field work.

TASK 3.0 Field Data Collection

Since ALKA is a linear park the traditional sampling scheme needs to be modified to take into account access, logistics and the constrained sampling area. First, all ALKA lands inside HAVO, PUHE, PUHO, and KAHO will be sampled as part of these projects. Second, the remaining areas will be prioritized based on those segments that cross through lands containing native and non-native vegetation (especially TNC, state or publicly held lands). Finally, once draft maps have been completed for the prioritized segments, field crews will walk the vegetated portions noting any changes to the map and sample any new vegetation communities encountered. No formal stratification or sampling scheme will be done and it's anticipated that all areas of the trail will eventually be visited by the field crews.

Ultimately, vegetation along ALKA will be sampled using two approaches. These include verification work and formal plot data. Verification work will be used to guide and improve the mapping. Vegetation plot data will be collected for newly encountered plant communities to help complete the classification. Verification work will be a rapid form of data collection, where only the dominant plants (i.e. plant communities) are noted on the field maps or registered with GPS coordinates. Vegetation plot data will be more rigorous and include precise location, provisional association name, physical environment information, topographic data, physiognomic data, species lists, height classes, foliar cover values, diameter at breast height measurements for trees over 10 centimeters in diameter, and environmental notes and observations by researchers. Vegetation plots are necessary to prepare the classification and as such they are subjectively placed in vegetation types that are representative of an area, relatively homogenous, and larger than the 0.5 hectare (ha) minimum mapping unit (MMU). Ecotones are avoided to the extent possible.

Unique vegetation patches less than the project MMU may also be sampled using vegetation plots. These are often termed "park specials" because of their value for overall management prescriptions, but fall below the project MMU. Resource management staff will be given the chance at the planning meeting to discuss these options. Some common park special types include: small patches of invasive and exotic plants, small wetlands, or rare/endangered plants.

This work plan assumes that approximately 15 new associations will be found along ALKA. This would indicate that approximately 45 plots need to be collected to fully document the diversity. It is anticipated that work will be conducted by one field crew consisting of either experienced NPS staff or contracted field botanists. Plot data collection is estimated to take 9 days using a 2-person crew. New plots will be collected using the standard plot form (either paper or digital) created by PACN in conjunction with the national program (**Appendix 6**).

Subsequent to any sampling, ALKA will prioritize sampling sections and secure all of the necessary permits and permissions. PACN and NPS staff will work closely with all of the associated land managers to ensure that sensitive and dangerous sites are avoided and all field work is done in accordance with local customs.

A minimum of two ground photographs for each vegetation plot will be taken. Photos would be digital, logged in a summary table, and labeled. Fire fuel and related issues will be discussed at the planning meeting. If it is deemed necessary for ALKA, additional data forms will be used to capture basic fuel loading information (**Appendix 6**). If fire is not a concern only the first pages of the field form will be used. Vegetation plot data will be collected in accordance with the methods established during the planning meeting. The following table (**Table 4**) identifies potential plot size based on the vegetation type being sampled.

Table 4. Vegetation Plot Size by Class

CLASS	AREA	DIMENSIONS
Forest or Woodland	1000 m^2	20m x 50m; 10m x 100m; or circular
Shrubland	400 m^2	10m x 40m; 20m x 20m; or circular
Herbaceous	100 m^2	10m x 10m or circular

Source: TNC and ESRI 1994a

Upon completion of field sampling all of the plot data will be entered or transferred to PACN's standard plot database. The database will be created by PACN based on similar databases from other networks such as TNC Plots database used by the NVMP. The individual plant species nomenclature will follow the Integrated Taxonomic Information System (ITIS) as the standard. ITIS has broad acceptance in the taxonomic literature and by professionals working with the taxa of interest. ITIS conforms to the International Code of Botanical Nomenclature, contains botanical codes that allow for the ranks, variety, subvariety, forma, and subforma and will be evaluated using the national PLANTS Database (http://plants.usda.gov/home_page.html) (USDA, NRCS 2001). Upon entry the database will be checked for completeness and accuracy by PACN staff.

In summary, the ALKA field work will be an on-going process that builds off the classification and field data collected at the other NPS parks on the big island. Based on that work, ground verification and sampling work will continue in a systematic approach as new segments are opened and public access is granted.

Assumptions:

- Existing data will be minimally useful for this project;
- Approximately 45 vegetation plots (at a rate of 5/day) would be sampled to complete an accurate classification;
- All of the trail will be verified by experienced field crews at some point using a combination of observation points, descriptions of the dominant vegetation and field notes made on the draft vegetation maps;

- Issues of access due to topography and/or private land-owners may reduce the number of plots in some plant communities;
- NPS staff or a contractor will be responsible for entering the field data into the PACN database, this time will be covered under the project management budget.

Task Deliverables: 45 plots, multiple observation points, UTM waypoints, descriptions of the dominant vegetation and field notes verifying the associations along ALKA will be delivered to PACN. Data will be delivered in either paper or digital form.

TASK 4.0 Vegetation Classification, Alliance/Association Descriptions and Field Key

Following vegetation plot data collection and data entry NatureServe (Western Region Office) staff will analyze the data and classify it into the National Vegetation Classification System (NVCS) (Grossman et al. 1998). The NVCS as developed by The Nature Conservancy and currently maintained by NatureServe represents a national system containing 7 levels with the finest being the plant association. Associations are separated from the next highest category, alliance, through the use of total floristic composition and are named by the most dominant and/or indicator species. For the name or title given to an association or alliance, a single dominant species may be used (*Pinus ponderosa* Woodland). If two species of the same stratum are used they are separated by a dash (*Chrysothamnus viscidiflorus – Ericameria parryi* Shrubland). If two species occur in different strata, then a slash is used to separate them (*Picea pungens / Betula occidentalis* Woodland). Parentheses are used when the diagnostic species are not consistent in the association or alliance (i.e. *Bromus inermis* – (*Pascopyrum smithii*) Semi-natural Herbaceous Vegetation). Currently the NVCS is under revision and NatureServe is proposing to add new levels to the hierarchy. Upon approval by the Federal Geographic Data Committee (FGDC) these new standards will applied to the ALKA data and all of the PACN parks.

Following entry into the PACN database, the ALKA plot data along with the data for the other parks in the network will be analyzed by NatureServe. Species foliar cover values for each plot will be exported into a spreadsheet format and arranged into a plot by species data matrix. Several of the species recorded in the PACN database, primarily trees and shrubs, may occupy more than one stratum within a particular plot. Such layers provide valuable information regarding the structural diversity of the association and potential successional trends. To incorporate this information into the matrix, the code names for species occurring in more than one layer will be subscripted with a strata code (e.g., T1, T2, S1, S2, S3, etc.). The matrix will be used in exploratory analyses with the objectives of summarizing the compositional and structural characteristics of the communities and assessing possible spatial patterns related to environmental gradients.

Using procedures described by Grossman et al. (1998) and McCune and Mefford (1999), the data matrix would be analyzed as necessary using TWINSPAN, Cluster Analysis, and DECORANA (an ordination technique). The matrix can be edited prior to analysis by first removing all species that had total cover values (summed over all plots) of less than or equal to 1% to keep the influence of minor species at a minimum. Raw foliar cover scores will be used in all data

analysis procedures. The data matrix will then be subjectively evaluated for plots that demonstrated exceptionally low similarity to the remaining plots (outliers). Outlier plots are common in relatively large data sets and occur because of disturbed, heterogeneous, or otherwise unusual sites, or because of gaps in sampling (Gauch 1982). Removing outliers would likely help the efficiency of the analysis and substantially improve the interpretability of the results.

After the initial analyses, the resulting draft vegetation classification efforts will be reviewed by PACN and NPS staff in terms of regional data and existing classification. NPS ecologists will discuss and incorporate suggested revisions, as necessary. Based on the finalized classification, local descriptions for each association will be created for ALKA by NatureServe with input from the field crews. Local descriptions will focus on the park-wide variation including the unique characteristics of the association. Once all of the classifications and local descriptions have been completed for the PACN parks the global descriptions for each association will be modified and up-dated by NatureServe.

Subsequent to the classification, an illustrated, dichotomous field key will be created for ALKA in conjunction with the field keys for HAVO, KAHO, PUHE and PUHO. The field key will walk an average person familiar with the vegetation on the big island through the associations/alliances in a stepwise fashion. During construction members of the field data collection team will be contacted to help provide information for the key and to test it once completed. The preparation of the field key will include annotating each couplet with diagnostic field descriptions and illustrating of the key with representative color slides or digital photos taken in the field.

Assumptions:

- Vegetation plots will likely number around 45 for the ALKA project;
- It is assumed that approximately 15 additional plant associations will be determined for ALKA;
- An ecologist familiar with Hawaii's vegetation will prepare the illustrated plant association field key;
- The field key will contain all of the plant associations found along ALKA including those occurring within HAVO, KAHO, PUHE and PUHO.

Task Deliverables: A comprehensive, classified list of NVCS plant associations and alliances will be created using the plot and observation data for ALKA. Local descriptions for all associations and alliances will be written and contained in the final report and ultimately be used to update the global descriptions. An illustrated field key will be created for the vegetation associations and alliances at ALKA. All classification data will be made available as part of the final report.

TASK 5.0 Mapping

Due to the large linear nature of the trail, ALKA will be mapped differently than the rest of the parks in the network. First, upon completion of the HAVO, PUHO, PUHE, and KAHO vegetation maps, sections of these projects that encompass ALKA will be split out and combined into one GIS layer. The remaining portions will be prioritized based on access and the complexity of the vegetation signatures.

Second, recent imagery of the best available quality will be secured and used to map the remaining portions. Delineation and mapping of the vegetation will use the standard photo signature characteristics (tone, texture, color, shape, etc…) and ancillary data (slope, elevation, aspect, etc…). Map classes will strive to maintain a 1:1 ratio of map class to plant association if warranted, however map classes at a minimum will be cross-walked to the plant alliances. The final mapping scheme will be determined at a meeting or conference call between the NPS and contract staff. Typically the map classes in these projects cover three basic considerations, 1) incorporating the NVCS associations/alliances, 2) recognizing the limitations of the imagery (i.e. reliably of seeing the map unit on the image), and 3) meeting the management needs of ALKA. The final mapping product will also include all necessary attribution consisting of the vegetation map classes, general height and density modifiers and links to the NVCS. It is anticipated that approximately 25 plant associations/alliances (15 associations/alliances new to ALKA) and up to 15 land-use/bare ground/geology types will be considered as potential map classes.

Finally as the remaining portions are delineated, field maps will be made for those areas containing vegetation and checked in the field. All resulting changes or modifications to the maps will be incorporated into the final GIS layer. Since access is an issue on private lands, ground-truthing of the entire trail may be spread out over multiple years. Upon completion of the mapping a photo signature key with illustrations will be created and included in the final report.

Assumptions:

- Existing imagery will be of sufficient quality to conduct all digitizing, attribution, and GIS database development;
- Mapping will be conducted at a rate of 1000 acres/day. This rate may require adjustment during the process;
- Level of mapping effort will be calculated based an approximate 2180 acre project area;
- The mapping investigator will produce a photo signature key.
- GIS database building, geo-referencing, attributing, edge matching, and quality checking will occur in conjunction with the mapping;
- Appropriate metadata files will be created as the GIS process proceeds;
- All GIS products will meet or exceed FGDC and USGS/NPS map accuracy standards for 1:12,000-scale maps.

Task Deliverables: A final vegetation digital GIS layer for ALKA will be created to association/alliance level based in part on the other vegetation mapping efforts at HAVO, KAHO, PUHE, and PUHO. Remaining section of ALKA will be mapped from existing imagery and ground checked as necessary. A final illustrated key to the signatures of the map classes will be created. FGDC-standard metadata will be created for the final GIS layer.

TASK 6.0 Accuracy Assessment

At this time, no formal accuracy assessment (AA) of ALKA is planned. This is based on the linear nature of the trail and the ability of the field crews to field-check all portions of the project. Accessibility to the entire trail makes an AA redundant and presents significant additional costs. In terms of spatial accuracy, it will be assumed that the basemap imagery will meet or exceed national map accuracy standards.

Assumptions:

- The entire project area can be verified in the field by experienced field crews;
- The use of ground data will create a map that is of sufficient thematic accuracy.

Task Deliverables: No deliverables are anticipated for this task at ALKA.

TASK 7.0 Final Report and Deliverables

The entire vegetation mapping project for ALKA will be presented in a comprehensive final report with associated deliverables. When applicable, both digital and paper copies of the deliverables will be created using national standards such as the NPS Technical Report format. The final report will include general site and project information, a summation of the methodologies, the results of the classification and mapping work and a detailed discussion. The presentation of results will be aided by illustrations of the park landscape and plant associations and by illustrated keys to map units and plant associations. The report will also contain future recommendations on how to improve the products and suggest any possible add-on projects.

Along with the report other deliverables will include a final paper map layout and digital copies of the data. All digital data will be contained on a CD-Rom or DVD. All report graphics will be included. A draft of all the deliverables will be created and presented to ALKA and PACN staff for review and input prior to finalizing. NPS staff or a contractor will be responsible for editing and standardizing all of the materials supplied by other contractors and agencies into a final comprehensive report.

Assumptions:

- PACN will provide the desired outline of site-specific report topics, if they differ from traditionally written reports and map layouts;
- NPS ecologists will provide the methodology and summation of the field research;
- The mapping contractor will provide methodologies for the mapping effort, GIS production and the digital database production;
- Classification documents including association descriptions, field keys and any methodologies will be provided by NPS or NatureServe;
- NPS or a contractor will be responsible for editing and producing the final report and other deliverables.

Task Deliverables: A final report covering all methods, results and discussions used in the vegetation classification and mapping at ALKA will be created. A final map highlighting the vegetation will be created. All documents will be provided to ALKA and PACN as paper and electronic versions.