



Early Detection of Invasive Plant Species Monitoring Plan

Standard Operating Procedure #8: Conducting Corridor Surveys

Version 1.0 (14 June 2017)

Change History

New Version	Revision Date	Author	Changes Made	Justification
1.0	6/14/2017	A. Ainsworth, J. Gross	Developed.	Significant changes to draft ED narrative document.

Only changes in this specific SOP will be logged here. Version numbers will be incremented by a whole number (e.g., Version 1.3 to Version 2.0) when a change is made that significantly affects requirements or procedures. Version numbers will be incremented by decimals (e.g., Version 1.6 to Version 1.7) when there are minor modifications that do not affect requirements or procedures for publication in the series.

Purpose

This SOP describes how to collect field data to detect incipient invasive plant species within Pacific Island Network (PACN) parks as part of the Early Detection of Invasive Species Monitoring Plan (Ainsworth et al. 2017). Data are collected along disturbance corridors that may serve as dispersal and establishment pathways for invasive plant species within a park. These data provide an opportunity for early detection and control of potentially problematic invasive species before they can become fully established. Early detection and rapid response are among the most cost effective invasive plant species management strategies.

A master equipment list can be found in SOP #1 “Before the Field Season.” The master equipment list will be updated as needed if this SOP is revised. Guidance on creating and updating species lists is in SOP #5 “Creating Target Species Lists.” Instructions on using Global Positioning System (GPS) units or using a tablet for data collection are detailed in SOP #7A “Using Global Positioning System (GPS) Units” or SOP #7B “Using ArcCollector.”

Procedures

A selected set of roads, trails, fence lines, structures, and other areas disturbed by humans are surveyed each monitoring cycle to determine the presence, distribution, and abundance of incipient invasive plants along these disturbance and dispersal corridors. The primary focus is on detecting non-native species that are in the early stages of becoming established within a park or section of a park. Crews are to record all plant species that are unknown, *not* documented on species checklists for the study area [e.g. NPSpecies checklist (<https://irma.nps.gov/NPSpecies/>) or more detailed ecoregion checklists], or specifically cited on a target species list (See SOP #5 “Creating Target Species Lists”) or any species featured on early detection identification cards (Ainsworth et al. 2017: Appendix E), which in most cases are not already documented on park species lists.

Crews will record data for early detection surveys using one of two approaches. The first approach involves the use of physical field data forms, a GPS unit, and a handheld camera. The second approach uses a mobile device such as a tablet computer to integrate the devices and field forms into one process. The mobile device runs ArcCollector which provides an interface to collect waypoints, enter species attribute data, and take and link photographs. The mobile approach is still being field tested but may be an option for future surveys depending on ease of use, reliability, and technical support. In general, the ED plan and SOPs have been written with the field data form approach in mind, but can easily be adapted to the mobile device approach in the future.

Field Work

Selection of corridors to be surveyed is described in SOP #6 “Selecting Survey Locations.” These sites include linear features (e.g., roads, trails, fence lines) and nonlinear features (e.g., quarry areas, around buildings, parking lots). Surveys of linear features are conducted by walking along the pathway or corridor, while nonlinear features will require a survey of the perimeter along with an appropriate systematic sampling of the core area. Corridor surveys extend as far as visibility allows on either side of the corridor.

Before the start of a survey, the crewmembers will have discussed a general plan outlining which corridors they intend to survey. Hardcopy or digital maps are useful to mark planned routes and the completed corridors. Two crew members are best for surveying linear corridors as this allows each member to survey one side of the corridor. Pilot studies indicated that travel time when conducting road surveys can be greatly decreased by utilizing two teams of two and a vehicle. The road is still surveyed by foot, but each team alternates moving the vehicle past the other team. This method keeps team members connected and provides added flexibility and mobility to the survey. Furthermore, it eliminates the need to walk long distances back to the vehicle at the end of the day.

One field data form (see example and blank form below) is used throughout the early detection survey and mimics a journal in which additional entries and pages are added until the early detection survey is completed for the park. Each entry on the data form is associated with a waypoint and may be recorded to document the section of corridor traversed (path waypoints), a species of interest (species waypoints), or some other phenomenon (miscellaneous waypoints). Waypoints are not renamed within the GPS unit and instead are recorded directly onto the field data form using the default waypoint number provided (001, 002, etc.). Each waypoint will have associated observed data (attributes) recorded with it on the field form which will be entered manually into a database and linked with the waypoint when back at the office. The Park (location), Date, and GPS unit, along with the Waypoint number will be used to uniquely identify each waypoint.

Path Waypoints

Corridor path waypoints are collected at the start and end of surveys and, if necessary, after intersections to document the path traveled and elapsed time during the survey. One corridor may contain multiple paths if a corridor is not surveyed continuously. A path association will be recognized by a start point and an end point of the same number. Each path will contain only one start waypoint (Path Start 1) and one end waypoint (Path End 1), but may contain multiple intersection points (example: Path Int. 1.1, Path Int. 1.2) If a survey is stopped for an extended period of time (e.g. lunch break, end of work day, etc.) then the stopping point along the corridor will be marked with a path end point and the number that matches the previous path start. A new path start point will be created at the same location when the survey resumes. Intersection points are not necessary at every corridor intersection, as the crew will have outlined the planned route on a map before starting the survey. Intersection points are available if the crew deviates from the planned route, discovers a new corridor that needs survey, or needs more detailed documentation of the path traversed for whatever reason. Recording of path waypoints provides a record of the corridor traversed and provides a reliable method for calculating efforts (i.e. time elapsed between associated start and end points). Turning on track logs for GPS devices is encouraged as it provides a secondary source of documenting corridors traversed. If a track log can be recorded reliably on the GPS unit, it may be used in place of intersection points but should not replace the collection of path start and path end waypoints which are needed to calculate survey effort. Instructions on creating track logs are detailed in SOP #7A “Using Global Positioning System (GPS) Units” and SOP #7B “Using ArcCollector.”

The first waypoint of a survey will be a “path start” waypoint. In the notes section of this waypoint the surveyor should describe how the crewmembers traveled to this start point from the office or camp (vehicle, helicopter, hiking, or a combination), the route taken to get there (if not obvious), and define the cardinal direction that the crewmembers will travel along the corridor while conducting the survey. Correspondingly, the last waypoint of a survey will be the “path end” waypoint and it also should explain in the notes section how the crewmembers will return to the office or camp in addition to any problems, issues, or comments that came up during the survey.

Species Waypoints

A GPS waypoint is created and recorded on the field data form (see field form below) for incipient plant detections including 1) unknown species, 2) any plant that is not documented on the park’s master plant species list (NPSpecies) or park section list (if available) or 3) plants specifically targeted by the park or by I&M outreach products (target lists). All incipient plant detections (both known and unknown species) will include the associated attributes of age, reproductive status, and abundance (Table 1). These attributes will be recorded on the field data form. The age and reproductive status of the plant is important to many invasive species control programs in evaluating a timeline for treatment and understanding population trends. Crews will record whether or not the plant is fruiting/flowering along with a note if the plant is a juvenile or adult. Abundance data also help resource management develop appropriate control strategies. Depending on the habit of the plant, abundance may be recorded by either the number of individuals (<10, 11-50, >50), or by an area estimate of the plant cover (<1m², 1-5m², >5m²) and whether the population is contiguous or scattered. If a species has continuous cover of more than 5 m (e.g., grasses where individuals are difficult to identify), only the center point is recorded. Alternatively, if the population is scattered with large gaps between individuals or patches, multiple waypoints may be needed. Surveyors should consider what method will best document the population and allow NRM to easily locate the population in the future. If only dead individuals are present along a corridor, they will be reported as “dead and present” by adding “-Dead” after the species name. Notes regarding any conditions that

may explain why the species is dead (e.g., drought, seasonality, or treatment) will be taken. Litter material along a corridor is not recorded as species presence. If the recorded point is located >5 m away from the incipient plant (e.g. plant can be seen from a distance but is far from corridor or unsafe to reach), then the estimated distance and direction will be noted from the point. Photographs can be used with every waypoint type (path, species, and misc.) to help convey information. Even if the species is known a photo may aid resource management in their rapid response (e.g., invasive is difficult to see because it is hidden under canopy of another plant or high up in the tree canopy). Or, a photo may help convey abundance and distribution of population.

Table 1. Species Observation Waypoint Attributes.

Attribute	Values
Age	Adult; Juvenile
Reproductive Status	
Flowering or Fruiting	Yes; No
Abundance	
Individuals	1-10; 11-50; >50
Cover	<1m ² ; 1-5 m ² ; >5m ²
Distribution	Contiguous; Scattered

Unknown Species

If the incipient plant species is known, then the species name is recorded. If the incipient plant species is unknown, additional steps are required. The surveyors first must determine if the unknown species has been recorded already during the current survey. If it has not yet been recorded, the following steps are taken:

1. Assign a number to the unknown species using a sequential numbering system (e.g. “Unknown 1”, “Unknown 2”, etc.) and enter this name in place of the species name.
2. Assign a short alias to help remember the plant (e.g. “Fuzzy Yellow Aster,” “Road Euphorbia,” “Hairy Ligule Grass”) and record this alias in the notes section.
3. Note the life form (i.e. Fern, Graminoid, Herb, Shrub, Tree, or Vine) of the unknown species.
4. In the notes section, write down any characteristics and measurements of the plant that might not be noticeable or measurable in a photo (e.g. length of stem, petiole, peduncle, pedicel, leaf size, etc.).
5. Take at least 3 detailed photos of the plant that display the unique characteristics.

All subsequent detections of the same unknown species will receive the same unknown species number (e.g. “Unknown 1”) in place of the species name and the same alias in the notes section. Surveyors can look back at the field data form to determine what number had been assigned to the same unknown previously. Subsequent detections of the same unknown species do not require additional notes or photos, unless a new plant characteristic (e.g. flower, fruit) is observed.

Voucher specimens of unknown species or new park records may be collected as described in SOP #9 “Collecting and Vouchering.” Typically, the entire plant is collected unless the population is small (<20 individuals) and there is a chance the plant might be native, in which case only the parts of the plant required for keying are collected (e.g., a flower and stem without roots). If a voucher specimen

is collected for the species waypoint, this detail will be noted on the field data form and the specimen itself will be labeled with the unknown number, alias, life form, and collector's name.

Rare Native Species Waypoints

Rare native species of interest to NRM can be recorded during early detection surveys using the same approach as an incipient plant detection as described above.

Miscellaneous Waypoints

During early detection surveys, field crews may encounter other items of interest to I&M, NRM, or other park staff. These occurrences can be documented using a miscellaneous waypoint. Some examples of miscellaneous waypoints might include fence sections that need repair, signs of vandalism, or safety hazards.

Office Work

After returning from the field, crews will need to prioritize tasks including reviewing unknown plants and properly preserving plant samples, downloading and managing digital data, scanning and storing field data forms, and keying out unknown plants for species identification.

Reviewing unknown plant species

Crews will utilize plant keys and appropriate literature to identify unknown species from the field. Samples should be identified as soon as possible because important characteristics may be obscured as the plant dries out. If a substantial number of unknowns exist, it may benefit the crew to create a "Unknown Species Log" as outlined in Appendix E of the Established Invasive Plant Species Monitoring Plan. Plants that are unidentifiable by survey staff are shown to additional local staff or other local plant experts for identification. Any samples needing further taxonomic clarification are forwarded to Bishop Museum in Honolulu for identification. Taxonomy for all species follows Wagner et al. (1999), with taxonomic changes and new island records kept current using a major 2012 update and revision (Wagner et al. 2012), and continuously updated master checklists for the state maintained by Bishop Museum and the Smithsonian Institution.

Digital Data

Photos will need to be downloaded from cameras and properly organized when field crews return to the office after surveys. See SOP #13 "Managing Photographic Images."

All raw spatial data (waypoints and track logs) recorded in the field are downloaded according to SOP#7A "Using GPS Units." A relational database (Ainsworth et al. 2017; Appendix C) will be used to 1) Enter waypoint attributes recorded on field data forms, 2) Link waypoints with attributes and associated photos, and 3) update taxonomic information and classify records (see below) associated with species waypoints. As unknown plants become identified, periodic updates to the working relational database will need to be made to ensure the most up-to-date information is stored in one place.

After a species waypoint has received positive identification to the species level, it is assigned to categories 0-8 outlined as follows:

- (0) *Not a new record and not a target species* – Species that, after positive identification, was already known in the area being surveyed and is not considered a target species or known threat (i.e. after identification, the species did not fit any other category listed below).

- (1) *New State/Territory Record* – Species not previously recorded in the state or territory of the survey.
- (2) *New Island Record* – Species not previously recorded on the island of the survey.
- (3) *New Park Record* – Species not previously recorded in the PACN park where the ED surveys were conducted.
- (4) *New Unit Record* – Species not previously recorded in a specific PACN park unit, but previously recorded elsewhere within that park.
- (5) *New Locality Record* – Species not previously recorded in the specific survey region or ecological zone of the unit being surveyed. This is a more specific geographic delineation than (4).
- (6) *Target species* – Point location for an individual or individuals of non-native species targeted for control and/or eradication by NRM staff at the park being surveyed or a known threat from another source.
- (7) *Unknown species* – Data records with samples that could not be identified to the species level with any available resources. Generally samples of sterile grasses.
- (8) *Rare native species* – Point locations of individuals of rare native species of interest to NRM staff at the park being surveyed.

For some smaller parks (e.g. KAHŌ), categories (4) and (5) are not applicable since those parks are too small to be delineated by units, ecological zones, and/or geographic areas. Category (6) and (8) are only applicable if lists of incipient and/or rare native species of interest are made available to survey staff by local park staff.

ArcMap will be used to create maps of ED surveys completed. Line features that highlight the corridors completed can be created using the “Editor” tools in ArcMap and by snapping to and manually tracing existing road, trail, or other corridor specific GIS data. Path waypoints are used as a guide, tracing from the path start to the path end and following intersection waypoints, track logs, and field maps, as necessary. This newly created “ED surveys completed” layer will be used in reports to visualize corridor surveys and to calculate survey distances.

PACN Park HAVOObservers JG, AA, KKPage 1 of Date(s) 12 JUN 2017Camera # WG-5 #36758GPS Unit Garmin Map64s #1379

Indiv.	Cover
1-10	<1 m ²
11-50	1-5 m ²
>50	>5 m ²

Waypt #	Species* (or Path/Misc)	X (UTME)	Y (UTMN)	Photo #s	Age	Fl/Fr	Abundance	Dist. & Dir. from point
001	Path Start 1	0218166	2117194		Adult Juvenile	Y N	scattered contiguous	
NOTES: Traveled from HAVO office to Kahuku visitor center by vehicle, walked from visitor center to start point at entrance gate. Surveyed walking north along road towards upper glover road.								
002	unknown 1	0218410	2115710	001-006	Adult Juvenile	(Y) N	> 5m ² scattered contiguous	
NOTES: Fuzzy Yellow Aster. Herb. Pubescent pinnatifid leaves, yellow disc and ray florets. Plants ~50 cm tall, Leaves ~ 4 cm long x 1 cm wide, bracts present. Sample taken.								
003	Pinus radiata	0218837	2114426	007-008	Adult Juvenile	Y N	1-10 scattered contiguous	~150m @ 220°
NOTES: Outside of boundary fence. Could not see fruit/flowers from distance.								
004	unknown 2	0263142	2419567	009-010	Adult Juvenile	(Y) N	1-10 scattered contiguous	
NOTES: Purple Axillary Fab. Herb. 70 cm long, pubescent, leaflets 8-12 per leaf, purple flowers axillary solitary or in clusters of 2, pods ~50 cm long, Fabaceae. Sample taken.								
005	unknown 1	0218422	2115691	011-014	Adult Juvenile	Y (N)	< 1m ² scattered contiguous	
NOTES: Fuzzy Yellow Aster								
006	Path Int. 1.1	0218488	2110604		Adult Juvenile	Y N	scattered contiguous	
NOTES: Surveyed road spur traveling west to dead end.								
007	Path End 1	0218488	2110604		Adult Juvenile	Y N	scattered contiguous	
NOTES: Stopped survey at dead end of road 13:15. walked same spur back to main road without surveying.								

* new unknown species: 1) Assign unknown # in place of species, 2) Note alias, 3) Note lifeform, 4) Note characteristics and measurements, 5) At least 3 photos.

Form Revised: 01 JUN 2017

PACN Park _____
 Date(s) _____
 GPS Unit _____

Observers _____
 Camera # _____

Page ____ of ____

Indiv.	Cover
1-10	<1 m ²
11-50	1-5 m ²
>50	>5 m ²

Waypt #	Species* (or Path/Misc)	X (UTME)	Y (UTMN)	Photo #s	Age	Fl/Fr	Abundance	Dist. & Dir. from point
					Adult Juvenile	Y N	scattered contiguous	
NOTES:								
					Adult Juvenile	Y N	scattered contiguous	
NOTES:								
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