Western Riverside County
Multiple Species Habitat Conservation Plan (MSHCP)
Biological Monitoring Program

Delhi Sands Flower-loving Fly
(*Rhaphiomidas terminatus abdominalis*) Survey Report 2007

13 March 2008

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NOTE TO READER:

This report is an account of survey activities undertaken by the Biological Monitoring Program for the Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). The MSHCP was permitted in June 2004. The Biological Monitoring Program monitors the distribution and status of the 146 covered species within the Conservation Area to provide information to Permittees, land managers, the public and the Wildlife Agencies (i.e., the California Department of Fish and Game and the U.S. Fish and Wildlife Service). Monitoring Program activities are guided by the MSHCP species objectives for each covered species, the information needs identified in MSHCP Section 5.3 or elsewhere in the document, and the information needs of the Permittees.

While we have made every effort to accurately represent our data and results, it should be recognized that our database is still under development. Any reader wishing to make further use of the information or data provided in this report should contact the Monitoring Program to ensure that they have access to the best available or most current data.

The primary preparer of this report was the Project Lead, Andy Boyce. If there are any questions about the information provided in this report, please contact the Monitoring Program Administrator. If you have questions about the MSHCP, please contact the Executive Director of the Western Riverside County Regional Conservation Authority (RCA). For further information on the MSHCP and the RCA, go to www.wrc-rca.org.

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INTRODUCTION

The Delhi sands flower-loving fly (*Rhaphiomidas terminatus abdominalis*; "DSF") is federally listed as endangered and is restricted to 3 Core Areas within the MSHCP Conservation Area. Species Objective 2 for DSF states that "within the MSHCP Conservation Area, Reserve Managers shall document successful reproduction at all 3 Core Areas ... once a year for the first five years after permit issuance and then as determined to be appropriate…" (Dudek & Associates 2003). Documentation of successful reproduction is defined as "the presence/absence of pupae cases or newly emerged (teneral) individuals".

In 2007, the Monitoring Program continued testing a protocol developed in 2005 to detect DSF at the only Core Area where DSF habitat has been conserved as of the beginning of the 2007 field season (i.e., Teledyne in the Jurupa Hills). The primary goal of the survey was to develop a protocol that can be used at all 3 Core Areas to evaluate whether the DSF species-specific objectives have been met. Because the natural history of DSF is not satisfactorily understood, and because the federal Recovery Plan for DSF requires additional data such as population densities and trends (U.S. Fish and Wildlife Service 1997) several additional survey goals were added by the Biological Monitoring Program.

Survey Goals:

A) Document successful DSF reproduction at Core Areas.

B) Test and refine surveying protocol developed in 2005 for teneral and adult DSF within the Conservation Area.

C) Gather additional data to measure adult DSF detectability during flight season and estimate the density and population size of adult DSF within Core Areas.

D) Provide data regarding DSF resource selection and important distribution covariates.

METHODS

Protocol Development

The protocol used for surveys in 2007 was the same as the protocol implemented in 2005 and 2006, which was modified from the U.S. Fish and Wildlife Service's (USFWS) *Interim General Survey Guidelines for the Delhi Sands Flower-loving Fly dated July 1997* (Appendix A). We altered the original USFWS protocol to specifically address the above survey goals, rather than focusing on the USFWS's goal of providing a credible method for determining DSF presence-absence at a given site. The main adjustments involved using line-distance sampling to estimate DSF detection probability, density, and population size, and placing less emphasis on mapping habitats on-site.

Personnel and Training

All field observers studied pinned specimens of co-occurring winged invertebrate species, a DSF-specific training manual prepared by the Biological Monitoring Program, and relevant invertebrate field guides. Emphasis was placed on the ability to recognize DSF in the field using physical morphology and behavior and on the ability to identify all co-occurring winged insects to family. Observers were also trained to identify plant species important to DSF and how to differentiate between adult and teneral individuals. All field observers passed the USFWS DSF practical exam before participating in field surveys. Surveyors conducting DSF surveys in 2007 included:

- Adam Malisch, Lead Biologist, (Regional Conservation Authority)
- Andy Boyce, Project Lead, (Regional Conservation Authority)
- Amanda Breon, (Regional Conservation Authority)
- Amy Rowland, (Regional Conservation Authority)
- Angela Hyder, (Regional Conservation Authority)
- Ariana Maloner, (Regional Conservation Authority)
- Dan Williams, (Regional Conservation Authority)
- Espie Sandoval, (Regional Conservation Authority)
- Laura Weisel, (Regional Conservation Authority)
- Lynn Miller, (Regional Conservation Authority)
- Matt Talluto, (Regional Conservation Authority)
- Rosina Gallego, (Regional Conservation Authority)
- Joseph Moglia, (California Department of Fish and Game)
- Karin Cleary-Rose, Interim Monitoring Program Administrator (USFWS)

Study Site Selection

The Monitoring Program was only able to survey 1 of 3 Core Areas designated by the MSHCP (Teledyne/Jurupa Hills) in 2007. Survey transects may be established in the other Core Areas when all or portions of them are conserved.

Transect Placement

Transects were placed in the same locations as they were in 2005 and 2006. Delhi series soils were previously identified and mapped at the Teledyne site (see U.S. Fish and Wildlife Service 1997). We installed 32 parallel transects within the mapped polygon of appropriate soils on-site (Figure 1). Transects were approximately 15 m apart, 50 to 200 m long, and oriented in a N/NE direction. Transect orientation was randomly selected prior to installation. Transects were installed by driving wooden stakes approximately every 30 to 40 m and flagging several shrubs or grasses between stakes so that surveyors could easily navigate directly along the transect and accurately measure the perpendicular distance between any point on the transect and any DSF observation. All transect lengths sum to just over 5 km.

Survey Methods

We conducted visual encounter surveys using line-distance sampling (Buckland et al. 2001, 2004) along transects during appropriate weather conditions, with surveyors walking approximately 0.5 miles per hour. Although, as discussed below, appropriate weather conditions for DSF surveys are not comprehensively known, we conducted surveys in late summer, in the middle of the day, and not during precipitation events. Rarely, thick vegetation (*e.g.*, *Prunus ilicifolia* or *Rhus trilobata*) prohibited surveyors from walking directly on-transect. In these situations, the impenetrable section of the transect was marked with flagging, the surveyor walked around this section, and the impenetrable section of the transect was excluded from the survey. Approximately 66 m of transect length (1.3% of the total) was excluded in 2007.

As dictated by the USFWS protocol, we conducted surveys between 1000 hrs and 1400 hrs to provide some standardization of environmental conditions. We divided the site into 3 sections and walked all sections concurrently, with 1 observer in each section. The coordinates of all DSF observed during the survey were recorded with a GPS unit. DSF incidentally detected between surveys were also recorded but were not included in detectability or density analyses.

Data collected at the start of each survey included: date, observer, time, general weather description, temperature in shade at 1 m above ground, average wind speed, and cloud cover (Appendix B). Surveyors recorded the families of co-occurring winged insect species encountered as the survey progressed. Time, general weather description, temperature in shade at 1 m above ground, average wind speed, and cloud cover were also recorded 1 hour after the survey began, and hourly until the survey was complete. The same data were collected once more at the end of a survey. Data collected when DSF were encountered included: the measured perpendicular distance from the original sighting location to the transect, the coordinates of the original sighting, time, sex, activity, whether or not the individual was teneral, and any other relevant notes. We conducted DSF surveys in 2007 between 10 July and 17 August. Because DSF observations began to decrease in late July and we wanted to maximize our sample size, we decided to increase sampling intensity by conducting 2 consecutive surveys of each section beginning 27 July 2007. The 2007 survey protocol is described more completely in the *Western Riverside County MSHCP Biological Monitoring Program Protocol for Delhi Sands Flower-loving Fly Surveys, dated July 2006* (Appendix A).

We sampled the vegetation on fifty-two 100 m^2 plots at the Teledyne site in 2007 to compare areas with DSF observations, areas with no DSF observations, and areas where we observed DSF individuals perched in 2007. In order to determine where to place plots for vegetation sampling, we created a GIS map of all DSF observation points from the past 2 years with 20 m diameter buffers around each point, forming a "DSF observation polygon". We then placed a virtual grid of 100 m^2 plots over the Teledyne survey area and 13 plots were randomly chosen from both inside and outside the DSF observation polygon for a total of 26 sample plots. An additional twenty-six 100 m^2 plots were centered over points where DSF were observed perched during surveys in 2007. Points where DSF were observed flying during surveys were not surveyed for vegetation because we believe it is less likely that DSF were actively selecting the resources directly at locations where they were observed flying.

Because we are interested in the resource selection patterns of DSF, we estimated the percent cover of trees, shrubs, grasses/forbs, invasive grasses, DSF indicator plants (U.S. Fish and Wildlife Service 1997), litter, bare ground, rock, loose sand, stabilized sand, and dead standing vegetation (Appendix C). We identified all plants to species and estimated each species' percent cover of the plot. If on-site identifications were not possible, we collected the minimum amount of plant material necessary for later identification. Finally, we recorded additional notes regarding disturbances on-site or further relevant information not collected during the standard vegetation sampling procedure. The vegetation sampling protocol we used is described more completely in the *Delhi Sands Flower-Loving Fly Vegetation Protocol, 2006* (Appendix D).

In 2006, 3 permanent photo stations were distributed across the Teledyne site to visually monitor the spread of short-pod mustard (*Hirshfeldia incana*) and non-native grasses across the dune system because they appear to be stabilizing the soil. Encroaching invasive plants are a likely threat to DSF because data from previous years indicated that DSF were most abundant in areas that contain a high percentage of native vegetation (low levels of introduced plants) and more than 60 percent open sand substrate (U.S. Fish and Wildlife Service 1997, also see *Delhi Sands Flower-loving fly Survey Report 2006*).

In 2007 we revisited these photo stations and took digital photos in the 4 cardinal directions. Although each photo station was originally marked with a labeled wooden stake and we had location coordinates for each station, unauthorized stake removal unfortunately prevented us from relocating the exact points from 2006, and the ability to compare photos year-to-year is questionable.

Data Analysis

We entered raw data into an Excel spreadsheet and manipulated those data for entry into program DISTANCE (Thomas et al. 2006) in order to estimate detection probability, density, and population size. We analyzed data collected in 2007 as a complete group, after truncating records, and after combination with 2006 data. After analyzing all 2007 data as a complete group, we excluded all data collected after we began surveying each section twice daily (27 July) because we believed that reductions in observations may have reflected dying individuals which violates a primary assumption of distance sampling (i.e., that the sampled population is closed to birth, death, immigration, and emigration during the sampling period). We also tried combining 2006 and 2007 data in order to increase sample size, although we recognized that this violates the above assumption as DSF is an annual species. This analysis was more an experiment to look at the possible benefit of an increased sample size than a valid attempt to estimate density or population size.

To analyze vegetation sampling data we used an unpaired Student's t-Test to test for differences in mean percent cover of vegetation and ground cover estimates from areas with no DSF observations to areas with DSF observations, and areas where we observed DSF individuals perched in 2007.

RESULTS

We surveyed DSF transects at the Teledyne site on 29 separate days in 2007, beginning 10 July, and ending 17 August. We observed 47 adult DSF during field surveys in 2007 and an additional 4 DSF during training or transect installation, for a total of 51 DSF observations (Figure 1). Evidence of successful reproduction (i.e., teneral individuals) was confirmed in 2007, as a small number of individuals did appear relatively young or newly emerged. Additionally, we discovered a DSF pupae case (exuviae) during training exercises, further corroborating successful reproduction at Teledyne in 2007.

The distance analyses failed to provide realistic estimates of detection probability, density, or population size regardless of whether data collected in 2007 were analyzed as a complete group, after truncating records, or after combination with 2006 data. The most strongly supported model using all 2007 data produced a density estimate of 0.418 individuals/ha (95% CI: 0.332 – 0.526 individuals/ha), with an estimated population size of 3 individuals (95% CI: 2 - 3 individuals) and a detection probability estimate of 0.54 (95% CI: 0.43 – 0.68). Estimates using truncated (n = 27 observations) or combined data (n = 55) were similar.

Vegetation sampling data from Teledyne in 2007 showed significant differences ($p < 0.05$) in mean percent cover of stabilized sand and *Hirshfeldia incana* between areas inside the DSF observation polygon and areas outside this polygon. The mean percent cover of stabilized sand (2.8%) and *Hirshfeldia incana* (3.5%) were significantly less in detection areas than in non-detection areas (8.0% and 11.6% for stabilized sand and *Hirshfeldia incana*, respectively). Mean percent cover of bare ground was significantly greater in areas where we observed DSF individuals perched in 2007 (44.5%) than in non-detection areas (27.8%).

DISCUSSION

In the third year of DSF monitoring, we observed more DSF during surveys than the previous 2 years, confirmed breeding at the 1 Core Area were conservation has occurred (Teledyne), and collected DSF observation covariates along with resource selection data including vegetation sampling at 52 different points within the Teledyne site.

Although we were able to obtain a density estimate with our distance-sampling model, we do not believe that this estimate accurately reflects the true number of DSF at the Teledyne site. This conclusion is based on the distribution of observations on the site (Figure 1), implying that either there are more individuals present than accounted for in the model, or individual DSF cover large territories in relatively short time periods. Furthermore, the continued presence of DSF at the site over multiple years suggests that the population is either increasing, stable and of viable size, or decreasing slowly. None of these scenarios supports the empirical result of a true population size of 3. Given the limited distribution of the remaining DSF habitat and the urban matrix in which it is imbedded, it is also unlikely that the density estimate is correct and the Teledyne population persists due to immigration from an occupied area outside of the Teledyne site.

While we were able to substantially increase our observation sample size in 2007 compared with previous years (47 observations in 2007, 8 in 2006, 6 in 2005) 47 observations remains relatively few, and due to the lack of basic life history information we are unsure whether primary assumptions of distance sampling are being met. Distance sampling assumes that p(0) (probability of detection at distance = 0) = 1, and we are not confident that this is the case with DSF surveys. Some Monitoring Program observers have reported nearly missing DSF individuals directly on the transect line, and it seems feasible that a DSF individual, if perched on vegetation or a dark substrate, could be missed if it failed to flush when an observer passed. If DSF spend some proportion of their time perched in a way that makes them less than perfectly detectable at distance = 0, then our density estimates would be biased low. A second assumption of distance sampling is that the sampled population is closed during the sampling period. Given the little existing knowledge of DSF life history, it is possible that there is more than 1 adult emergence and death cycle during the DSF survey period.

The 66 m of transect that were excluded from sampling may also partially account for the low-density estimate produced by distance sampling. Because large shrubs were excluded from sampling, any DSF using these shrubs would be excluded from the population, resulting in a biased density estimate. Due to the difficulty of conducting a visual line transect survey through large shrubs, an alternate method will have to be employed to determine if DSF are indeed using these shrubs.

Distance sampling may not be an effective form of estimating DSF detection probability, density, or population size at the Teledyne site. Additional ecological and life history information such as microhabitat resource use, lifespan as an adult, and typical adult emergence patterns could help us to understand the availability of DSF to be observed during a survey, design more appropriate sampling schemes, and direct data analysis. However, even if appropriate sample sizes for detectability or density analyses are not possible with the existing monitoring scheme, the visual encounter surveys along pre-established transects help standardize the survey method through the season and among observers, and ensures that the surveyed sites are thoroughly covered. This sampling design coupled with vegetation sampling of areas where flies are observed perching versus areas where flies are not observed perching yield the best information we can hope for about the species' use of the site.

Contrary to 2006 results, percent cover of loose sand did not emerge as a statistically correlated variable with detection of DSF. The apparent negative correlation of DSF observations with stabilized sand and *Hirschfeldia incana* corroborates previous assertions that stabilization of existing Delhi-series soils and expansion of non-native plant distributions may adversely impact DSF at the Teledyne site. Whether by cause or by reaction, non-native mustards and grasses seem to be occupying the stabilizing soils. The sand flow at this location has been cut off by developments and there is concern that without incoming wind-blown sand the dunes onsite may continue to stabilize and become increasingly inhospitable to DSF.

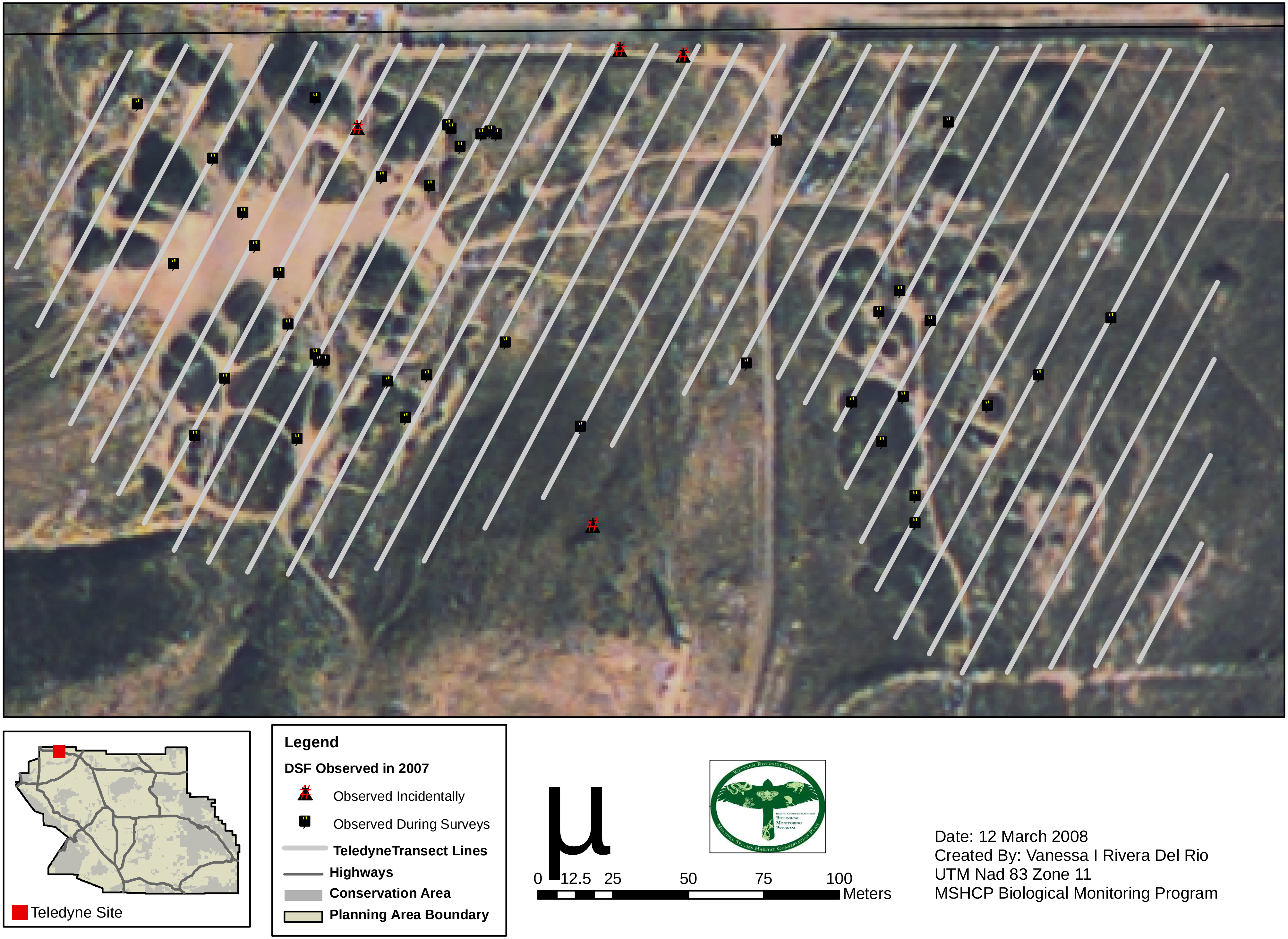
Recommendations for Future Surveys

We will continue to use our existing survey methods (visual encounter surveys along established transects with vegetation sampling) to document DSF reproduction at Teledyne, as required by the species objective, at least for the next 2 years. The established photo stations will help document the extent of non-native weedy species on the site. Management actions to address the spread of weeds and the stabilization of the dunes should be considered. When conservation is accomplished within the other 2 Core Areas, we will focus on documenting reproduction in those Cores.

If in the future, an accurate DSF population estimate is desired, a new or adjusted survey protocol allowing for the rarity and potentially low detectability of DSF should be considered. Although the sample size from 2007 was much larger than it has been during previous years, the low encounter rate (number of observations/transect meter) resulted in an unrealistically low density estimate. Conducting 2 complete surveys per day during the peak DSF season may help further increase the encounter rate, but more intensive monitoring efforts may be needed to provide the necessary information to evaluate the detection probability, density, and population size of this species. For example, attaching transmitters to newly emerged individual DSF would allow us track to lifespan and daily microhabitat use, enabling us to better avoid violating the assumptions of distance sampling and to apply modifiers to results during data analyses if the availability for observation of DSF during surveys is less than 100% (Buckland et al. 2001). An alternative to attaching transmitters to individual DSF could be to have observers follow DSF individuals and record data about their location and activities, although this method would not provide information regarding lifespan. Individually marking DSF with unique identification tags for a mark/recapture analysis may also be feasible given the apparent small population size but this approach would be time consuming and would require capturing and handling a potentially delicate federally-listed endangered species.

Use of transmitters and individually marking flies are beyond the scope of what is needed to meet current species objectives, and while these activities would yield important life history information about the fly, management actions to control weeds and or address the stabilization of the dune system would probably be more beneficial to the species and the MSHCP management needs. If transmitters or a mark-recapture program are pursued, they should be pursued with funding from outside the MSHCP.

Figure 1. Delhi Sands Flower-loving Fly Observations and Transect Lines in 2007.



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Appendix A: Western Riverside County MSHCP Biological Monitoring Program Protocol for Delhi Sands Flower-loving Fly Surveys

July 2006

This protocol was modified from the U.S. Fish and Wildlife Service's (USFWS) Interim General Survey Guidelines for the Delhi Sands Flower-loving Fly (*Rhaphiomidas terminatus abdominalis*, DSF) dated December 1996. Protocol adjustments were made to specifically address the survey goals below, rather than focusing on the USFWS's goal of providing a credible method for determining DSF presence-absence at a given site. The main adjustments include using a line-distance sampling methodology to estimate DSF density and detectability and less emphasis on mapping habitats on-site.

GOALS:

A) Document successful reproduction of DSF within Core Areas, as measured by the presence/absence of newly emerged (teneral) individuals.

B) Gather data regarding DSF density, detectability, resource selection, and important distribution covariates including co-occurring insect Families within Core Areas.

To achieve the above goals, visual encounter surveys along pre-established transects will be conducted annually in Core Areas accessible to the Monitoring Program. Data resulting from these surveys will be used to verify reproduction within Core Areas and analyzed to provide insight into the ecology of DSF as described in Goal B. Although they are to be recorded if detected, focused surveys for pupae cases (exuviae) will not be conducted using this protocol.

TIMING:

Surveys for adult DSF will be conducted annually for approximately twelve weeks during the flight season, generally from July through September. The beginning and end of the survey season will be established by biologists from the Monitoring Program. Annual surveys at a given location will not begin until adult DSF have been observed at that location in the year of the survey.

SURVEY LOCATIONS:

Surveys will be conducted annually in Core Areas accessible to the Monitoring Program. Accessible lands will be identified by the Lead Field Coordinator prior to surveys.

In 2006, we will survey only the Jurupa Hills Core Area, as the Core Areas in the northwestern corner of the Plan Area (Mira Loma), and in the Agua Mansa Industrial Center area are currently inaccessible to the Monitoring Program.

METHODS:

I. Transect Setup

Survey transects will be established in suitable habitat within accessible Core Areas. Suitable habitat was previously defined by the presence of Delhi series soils described by a GIS shapefile. Pilot surveys in 2005 indicated that 32 parallel transects spaced approximately 15m apart, and ranging from approximately 50 to 200m long provided adequate coverage of the suitable habitat within the Jurupa Hills Core Area (see Delhi Sands Flower-loving Fly (*Rhaphiomidas terminatus abdominalis*) Survey Report 2005). Transects will be marked with wooden stakes approximately every 30 – 40m and flagging on shrubs or grasses between stakes so that surveyors can easily navigate between stakes and accurately measure the perpendicular distance between any point on the transect and any DSF observation.

During transect establishment, impenetrable vegetation stands (*e.g.*, *Prunus ilicifolia* or *Rhus trilobata*) that prohibit surveyors from walking directly on-transect will be marked with flagging on both sides of the stand. Surveyors will walk around these sections, and the impenetrable section of the transect will be excluded from the transect and subsequent analysis.

II. Surveying for Adult Delhi Sands Flower-loving Fly

Before surveys begin, surveyors must demonstrate the ability to identify DSF and co-occurring insect Families by passing the USFWS Delhi Sands flower-loving fly practical exam, and locating and identifying insects in the field with the Lead Field Coordinator. Refer to the Field Training Manual for instructions.

After the survey season begins, each transect will be surveyed once per weekday for a minimum of twelve weeks during the flight season, or until the Lead Field Coordinator has determined that a sufficient amount of data has been collected. Surveys will be conducted on established transects between 10:00 and 14:00. Weather conditions should be clear skies and winds less than five mph. If wind speeds are sustained at greater than five mph, surveyors will delay beginning the survey until they decrease or cancel the survey if winds do not decrease. Infrequent gusts over five mph are acceptable. Surveys should not be conducted under extremely cloudy, overcast, or rainy conditions since DSF has not been observed under these conditions (U.S. Fish and Wildlife Service 1997).

Survey Equipment:

-Handheld GPS unit	-Clipboard with data sheets and pen
-Thermometer	-Measuring tape
-Anemometer	-Binoculars (if desired)
-Camera	-Insect Identification Aids (if desired)

Data collected at the start of a survey include: date, observer, time, general weather condition, temperature in shade at 1m above ground, average wind speed, and cloud cover category (see Delhi Sands Flower-loving Fly Survey Datasheet). Time, general weather condition, temperature in shade at 1m above ground, average wind speed, and cloud cover are also recorded one hour after the survey begins, two hours after the survey begins, etc. and at the end of the survey.

Surveying consists of walking previously established parallel transects looking for DSF either flying or perched on vegetation. **Move carefully to avoid trampling DSF adults, larvae or otherwise harming the habitat onsite.** Although, as discussed below, DSF are likely to flush out of the way of a moving observer it is imperative to avoid harming individuals because this Endangered Species is so rare. Walk slowly and stop occasionally to look around – surveyors standing still are more likely to see an insect already in flight.

While walking a transect, always remain as close to the centerline of the transect as possible. The statistics used to analyze the data collected assume that close to 100% of the DSF that are directly on-transect are observed. DSF **should** take flight if an observer approaches them and a vigilant observer should notice a DSF take flight in front of them nearly 100% of the time. DSF further off-transect will be observed with a decreasing probability as the distance from an observer on transect to the fly increases and this bias is accounted for in the statistical analysis.

Data collected when a DSF is encountered include: the perpendicular distance from the transect to the **original sighting location** (accurate to the inch, data will be converted to metric measurements later), the coordinates of the original sighting, time, sex, activity, whether or not the individual was teneral, and any other relevant notes. Teneral individuals are "covered with golden pelage and have emerald green eyes and no rigid wing venation" (Kingsley 1996). If recording a DSF as teneral, take a digital photo when possible. Otherwise, take photos if time permits or you want to document the location of the fly. Binoculars are not required for surveying, but can aid in identifying behavior and age class of observed individuals.

When approaching a perched DSF for identification purposes, move slowly and keep the movement of your hands, arms, legs, and body to a minimum. If the fly is first seen in flight, follow from 1 – 2 meters away until it lands, or you have seen enough to confirm that it is a DSF. Do not make sudden movements. If the fly is circling, stand still and wait for it to land – if it perceives your movement, it is less likely to stop. After the individual has been confirmed or disconfirmed as a DSF, and necessary data have been taken, return to the transect departure point, and continue with the survey.

Surveyors should also record the Families of co-occurring winged insect species encountered as the survey progresses. Counts of co-occurring Families are unnecessary. If an insect is observed that you know is **not DSF,** do not spend time attempting to identify the Family if it isn't immediately apparent.Also take waypoints and/or photographs of any other MSHCP Covered Species encountered. Record photographs and waypoints of Covered Species on an Incidental Species Sighting Form if the necessary data can not be stored by naming the marked waypoints appropriately (see Incidental Observation Instructions and Instructions for Taking and Storing Digital Photos).

III. Recording Data

There should be one Delhi Sands Flower-loving Fly datasheet per surveyor for each day of survey activities at each locality surveyed. If there are no observations of DSF on a particular day, that should be noted on the datasheet.

The locations of all adult DSF **incidentally observed** should be recorded with a GPS unit, whether they are observed before, during, or after a survey. DSF observations made during a survey but while walking around an excluded section of a transect are considered incidental and these points are not entered on the survey datasheet. If additional info beyond the date, time, observer, species code, and location coordinates are desired (*e.g.*, substrate, number of individuals, sex, etc.) fill out an Incidental Species Sighting Form. If two or more DSF individuals are observed in the same small area (~10m diameter circle) these can be recorded with the same waypoint, taken near the center of the cluster. Record the number of DSF observed on the Incidental Species Sighting Form. DSF observations made on-transect during a survey do not need to be marked with a GPS, simply record the coordinates on the survey form, as described above. Data will be recorded in the NAD83 datum; all survey areas are in Zone 11S.

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Appendix B: Delhi Sands Flower-loving Fly Survey Sheet

Date ___________ **Dehi Sands Flower-loving Fly** **Teledyne** ____________ Data Entered/Data Proofed

Observers Section

Time	Temp ºC	Avg Wind*	Weather**	Cloud Cover***
Start : _____				
Hour 1: _____				
Hour 2: _____				
Hour 3: _____				
Hour 4: _____				
End : _____				

* mph

** general description

*** 0, 1-20, 21-40, 41-60, 61-80, 81-100

Activities/Behaviors

Perched: indicate substrate

Interspecific Interaction: describe interaction

Intraspecific Interaction: describe interaction

Nectaring: record plant species, or take sample

Oviposition: *describe site, record soil temp!!!*

Cruising

Mating

Age Code

1: fuzz entirely covers dorsal thorax = teneral (note wing margin wear)

2 : fuzz partially covers body or no fuzz seen

Transect #	Distance	UTM East	UTM North	Time	♀ or ♂	Activity	Age Code	Notes

Appendix C: DFG Rapid Vegetation Assessment

Name(s)	Date:
Site name:	Site ID:
UTMs E 0____ ____ ____ ____ ____ ____	N____ ____ ____ ____ ____ ____ ____

Vegetation		
Dominant layer: Grass/Forb Shrub Tree (circle one)		
	Species	% cover
Trees		
species 1		
species 2		
species 3		
Shrub		
species 1		
species 2		
species 3		
Eriogonum fasciculatum		
Croton californicus		
Forb/Grass		
species 1		
species 2		
species 3		
Heterotheca grandiflora		
Ambrosia acanthicarpa		
Stephanomeria sp.		
Non-native grass		
Mustard		
Total vegetation cover:		

Ground codes		
		% cover
Litter		
Rock		
Bare ground		
Type 1	stabilized sand	
Type 2	loose sand	
Type 3	hardpan	
Type 4	other	

Notes: Disturbance, Site Characteristics, et cetera

Appendix D: Delhi Sands Flower-Loving Fly Vegetation Protocol 2006

The objective of this vegetation protocol is to establish certain vegetation parameters for correlation with trends in Delhi Fly populations. The protocol will provide an additional component to the effort to monitor fly population trends. The data collected will focus on correlating certain aspects of vegetation with fly presence and abundance. We will look at diversity, structure and the presence of certain species as potential correlates to fly population dynamics. We will also monitor the effects of invasive species, and vegetation change on the dynamics of the fly population through time.

This sampling protocol will involve the placement of 100 m^2 vegetation sampling quadrats randomly throughout the fly survey site. This will allow for a characterization of the vegetation of a large area dominated by shrubby and herbaceous vegetation. The preliminary survey entails the random placement of 20 quadrats stratified between areas where flies have been detected and areas where no flies have been detected. To delineate areas of the study sight as such, all fly sightings from the 2005 and 2006 field seasons were mapped and the a 20m buffer was created around each point. Stratification was then based on buffered and non-buffered areas. An additional six vegetation quadrats were chosen non-randomly to be conducted on the total number of sites where flies were observed perched on vegetation. As this study will include some sampling locations centered on points where presence of perching flies has been documented, sampling quadrats will be centered on the points given. This can be facilitated by running two tapes in a diagonal and crossing on another perpendicularly at the midpoint. The length of these diagonals should measure 14.1m, meaning the midpoint should fall at the 7m mark.

Protocol:

1. Enter the name of the surveyor(s) and the date of the survey.
2. Enter the site name (Teledyne)
3. Enter the site ID
4. Enter the UTM's of the point
5. Under the heading, 'vegetation,' choose the dominant vegetation layer
6. Estimate and enter the percent cover of the tree layer. List all species present in this layer and list the percent cover of each
7. Enter the percent cover of the shrub layer and enter the percent cover for *Eriogonum fasciculatum* and *Croton californicus.* These species are thought to be important to the Delhi fly.
8. Next enter the three most dominant shrub species, excluding the two species mentioned in step 7, and their percent cover.

9. Estimate and enter the percent cover for all forb and grass species combined. Next enter the percent cover of the species/groups of concern. These include *Heterotheca grandiflora*, *Ambrosia acanthicarpa*, *Stephanomeria* sp., non-native grasses (taken as a group), and mustards (all species present belonging to the Brassicaceae).

10. Next estimate and record the percent cover of the 3 most dominant species present, not including the species/groups mentioned in step 9.

11. The final field for this section is for the estimate of total vegetation cover.

12. Under the heading Ground codes, enter the percent cover of Litter, Rock, and Bare ground.

13. Finally, enter the percent cover of the 3-4 classes of bare ground. *Stabilized sand* refers to sand whose movement is arrested or whose form is protected from further wind action by growth of vegetation or cementation of sand. *Loose sand* is that on which erosion and deposition are still taking place. *Hardpan* is any bare ground that is substantially compacted. There is an *'Other'* category for any bare ground that does not fit into these three categories. Include next to *'Other'* a description of the soil.

14. In the final section, include any noteworthy remarks about the site, specifically anything relating to the disturbance or deterioration of the site.