Data Set Citation

When using this data, please cite the data package

General Information

Title:	**Field Estimates of Attraction of Ceratitis capitata to Trimedlure and Bactrocera dorsalis to Methyl Eugenol in Varying Environments**
Identifier:	manoukis.14.9

Abstract: Measuring and modeling the attractiveness of semiochemical-baited traps is of significant importance to detection, delimitation and control of invasive pests. Here we describe the results of field mark-release-recapture experiments with Ceratitis capitata (Wiedemann) and Bactrocera dorsalis (Hendel) to estimate the relationship between distance from a trap baited with trimedlure and methyl eugenol, respectively, and probability of capture for a receptive male insect. Experiments were conducted using a grid of traps with a central release point at two sites on Hawaii Island, a Macadamia orchard on the East side of the island and a lava field on the West side. We found that for B. dorsalis and methyl eugenol there is a 65% probability of capture at about 36 m from a single trap regardless of habitat. For C. capitata, we found a 65% probability of capture at a distance of about 14 m from a single trap in the orchard and 7 m in the lava field. We also present results on the spatial and temporal pattern of recaptures. The attraction data are analyzed via a hyperbolic secant-based capture probability model.

Keywords:

- Mark-Release-Recapture
- tephritid
- attraction range
- pheromone

Data Table, Image, and Other Data Details:

Metadata download	Ecological Metadata Language (EML) File

Data Table:

Name:	**weather_means.csv**
Description:	average weather during release-recapture weeks

Physical Structure Description:

Object Name:	weather_means.csv	
Size:	684 byte	
Text Format:	Number of Header Lines:	1
	Record Delimiter:	#x0A
	Attribute Orientation:	column
	Simple Delimited:	Field Delimeter: ,

Number Of Records:	6

Online Distribution Info:

ecogrid://knb/manoukis.13.1

Attribute(s) Info:

Name	Column Label	Definition	Type of Value	Measurement Type	Measurement Domain	Missing Value Code	Accuracy Report	Accuracy Assessment	Coverage	Method
Start_date	Release-recapture start date	The date when measurements started for the week	text	dateTime						
End_date	Release-recapture stop date	date when measurements stopped		dateTime						
location	site	Site where data were collected		nominal	**Domain Info**					
minT	min temp	minimum temperature		interval	**Unit** celsius **Precision** 0.1 **Type** real					
maxT	maximum temp	maximum temperature		interval	**Unit** celsius **Precision** 0.1 **Type** real					
meanT	average temp	average temperature		interval	**Unit** celsius **Precision** 0.1 **Type** real					
minH	minimum RH	minimum relative humidity (air)		interval	**Unit** RelativeHumidity **Type** real					
maxH	maximum RH	maximum relative humidity (air)		interval	**Unit** RelativeHumidity **Type** real					
meanH	mean RH	mean relative humidity (air)		interval	**Unit** RelativeHumidity **Type** real					
Meanwind	mean wind	mean wind speed		interval	**Unit** metersPerSecond **Type** real					

Data Table:

Name:	**all_weather_data.csv**
Description:	all weather data, 5 min interval

Physical Structure Description:

Object Name:	all_weather_data.csv
Size:	1216522 byte
Text Format:	

Number of Header Lines:	1
Record Delimiter:	#x0A
Attribute Orientation:	column
Simple Delimited:	

Field Delimeter:	,

Number Of Records:	13558

Online Distribution Info:

Attribute(s) Info:

Name	Column Label	Definition	Type of Value	Measurement Type	Measurement Domain		Missing Value Code	Accuracy Report	Accuracy Assessment	Coverage	Method
DATE-TIME	date and time	Date and time		dateTime							
DT	day and time, excel	Excel format day and time		dateTime							
MG	wind mag direction	Direction wind is coming from, magnetic; relative to N, clockwise		ratio	**Unit** degree **Precision** 1 **Type** whole						
TR	wind mag direction	Direction wind is coming from, magnetic; relative to N, clockwise		ratio	**Unit** degree **Precision** 1 **Type** whole						
WS	Wind speed	Wind speed, m/s		ratio	**Unit** metersPerSecond **Precision** .1 **Type** real						
CW	cross wind speed	cross wind speed, m/s		ratio	**Unit** metersPerSecond **Precision** .1 **Type** real						
HW	head wind	Head wind speed, m/s		ratio	**Unit** metersPerSecond **Precision** .1 **Type** real						
TP	air temp	Air temperature		interval	**Unit** fahrenheit **Precision** 0.1 **Type** real						
WC	wind chill	Wind Chill		interval	**Unit** fahrenheit **Type** real						
RH	Relative Hum	Relative Humidity		ratio	**Unit** RelativeHumidity **Type** real						
HI	heat index	Heat Index		interval	**Unit** fahrenheit **Type** real						
DP	dew point	Dew Point		interval	**Unit** fahrenheit **Type** real						
WB	wet bulb	Wet bulb temperature		interval	**Unit** fahrenheit **Type** real						
BP	Barometric Pressure	Barometric Pressure - inches Hg		ratio	**Unit** atmosphere **Type** real						
AL	altitude	altitude (est)		interval	**Unit** foot **Type** whole						
DA	density altitude	density altitude (est)		ratio	**Unit** foot **Type** whole						

Data Table:

Name:	**dist_capt_averages.csv**
Description:	per trap average recapture and distances

Physical Structure Description:

Object Name:	dist_capt_averages.csv
Size:	18498 byte

Text Format:		
	Number of Header Lines:	1
	Record Delimiter:	#x0A
	Attribute Orientation:	column
	Simple Delimited:	Field Delimeter: ,

Number Of Records:	384

Online Distribution Info:

ecogrid://knb/manoukis.16.1

Attribute(s) Info:

Name	Column Label	Definition	Type of Value	Measurement Type	Measurement Domain	Missing Value Code	Accuracy Report	Accuracy Assessment	Coverage	Method
Grid	grid spacing	inter-trap distance		nominal	**Domain Info**					
Spp	species	Tephritid species released		nominal	**Domain Info**					
Env	site	site where release occurred		nominal	**Domain Info**					
Row	trap row	trap row (A-H)		nominal	**Domain Info**					
Col	trap column	trap column (0-7)		nominal	**Domain Info**					
Mean_released	mean number released	average across releases of the number of males released		ratio	**Unit** dimensionless **Type** whole					
Mean_Activ	Mean activation proportion	average across releases of the proportion males activated/attracted		ratio	**Unit** dimensionless **Type** real					
Dist	distance	distance from release point to trap		ratio	**Unit** meter **Type** whole					
Mean	mean number recaptured	average across releases of the number of males recaptured		ratio	**Unit** dimensionless **Type** real					

Data Table:

Name:	**all_recapture_data.csv**
Description:	all recapture data

Physical Structure Description:

Object Name:	all_recapture_data.csv
Size:	20895 byte

Text Format:		
	Number of Header Lines:	1
	Record Delimiter:	#x0A
	Attribute Orientation:	column
	Simple Delimited:	
		Field Delimeter: ,

Number Of Records:	768

Online Distribution Info:

ecogrid://knb/manoukis.17.1

Attribute(s) Info:

Name	Column Label	Definition	Type of Value	Measurement Type	Measurement Domain	Missing Value Code	Accuracy Report	Accuracy Assessment	Coverage	Method
trap	trap ID	trap row and column		nominal	**Def** trap row and col no					
row	trap row	trap row		nominal	**Def** trap row (A-H)					
col	trap col	trap column		nominal	**Def** trap column no (0-7)					
Recapture_date	Date of recapture	Date of recapture for trap		dateTime						
Release_date	Date of release	Date of release for given trap		dateTime						
number	number of flies	number of marked males reacptured		ratio	**Unit** dimensionless **Type** natural					

Data Table:

Name:	**coords_grids.csv**
Description:	trap locations

Physical Structure Description:

Object Name:	coords_grids.csv
Size:	6948 byte

Text Format:		
	Number of Header Lines:	1
	Record Delimiter:	#x0A
	Attribute Orientation:	column
	Simple Delimited:	
		Field Delimeter: ,

Number Of Records:	195

Online Distribution Info:

ecogrid://knb/manoukis.18.1

Attribute(s) Info:

Name	Column Label	Definition	Type of Value	Measurement Type	Measurement Domain	Missing Value Code	Accuracy Report	Accuracy Assessment	Coverage	Method
Latitude	latitude	Latitude (DMS-Degrees, Minutes, Seconds)		nominal	**Def** Latitude (DMS-Degrees, Minutes, Seconds)					
Longitude	longitude	Longitude (DMS-Degrees, Minutes, Seconds)		nominal	**Def** Longitude (DMS-Degrees, Minutes, Seconds)					
Name	trap name	trap name		nominal	**Def** trap label (Row, Col)					
Description	location/grid	location and grid type		nominal	**Domain Info**					

Other Entity:

Name:	**Manoukis et al 2015 manuscript**
Data Object Type:	Other
Description:	Final paper describing methods and results; note useful information in Table 1

Physical Structure Description:

Object Name:	2015ManoukisField.pdf	
Size:	664164 byte	
Externally Defined Format:	Format Name:	application/pdf

Online Distribution Info:

ecogrid://knb/manoukis.19.1

Involved Parties

Data Set Creators

Individual:	**Dr. Nicholas Manoukis**
Organization:	**USDA-ARS-PBARC**
Position:	Research Biologist
Address:	64 Nowelo St., Hilo, HI 96720 USA
Email Address:	nicholas.manoukis@ars.usda.gov

Data Set Contacts

Individual:	**Dr. Nicholas Manoukis**
Organization:	**USDA-ARS-PBARC**
Position:	Research Biologist

Address:	64 Nowelo St.,
	Hilo, HI 96720 USA
Email Address:	nicholas.manoukis@ars.usda.gov

Data Set Characteristics

Geographic Region:

Geographic Description:	Hawaii Island, Hawaii, USA	
Bounding Coordinates:	West:	-156.375 degrees
	East:	-154.625 degrees
	North:	20.375 degrees
	South:	18.625 degrees

Time Period:

Begin:	2013-07-08
End:	2014-01-17

Taxonomic Range:

Classification:	Rank Name:	Genus		
	Rank Value:	Bactrocera		
	Classification:	Rank Name:	Species
		Rank Value:	Bactrocera dorsalis
		Common Name:	Oriental fruit fly
Classification:	Rank Name:	Genus		
	Rank Value:	Ceratitis		
	Classification:	Rank Name:	Species
		Rank Value:	Ceratitis capitata

Sampling, Processing and Quality Control Methods

Step by Step Procedures

Step 1:

Description:

Site selection

Experiments were conducted in the Island Princess macadamia orchard in Keaau, East Hawaii Island (hereafter "IP"; N19 36.725, W155 05.084) and in the Puuwaawaa area of West Hawaii near Ohiki Bay (hereafter "PWW"; N19 52.376, W155 54.730), between July 2013 and January 2014. These two sites represent extremely different ecological contexts, with contrasting temperature and rainfall patterns. The plant communities in the two locations also differ significantly. The IP site is shaded by tall macadamia trees (Macadamia spp.) and Norfolk Island pine (Araucaria heterophylla Franco), and at the edge of the site there are host fruit orchards including papaya (Carica papaya L.) and guava (Psidium spp.). In PWW the

ground is covered with Pahoehoe lava with very little vegetation in evidence, though there were a small number of Kiawe shurbs (Prosopis pallida Kunth).The exposed lava surface was subject to higher levels of wind compared with IP.

Step 2:

Description:

Insect sourcing

Ceratitis capitata and B. dorsalis were obtained from the research colony at the Daniel K. Inouye United States Pacific Basin Agricultural Research Center (DKI-PBARC) in Hilo Hawaii. The B. dorsalis colony was derived from wild flies collected in Puna, Hawaii Island in 1984, while the C. capitata colony was originally derived from wild flies collected on Oahu Island about 1978. Both colonies have since been maintained in the laboratory on artificial diet in large (0.6m w x 1.18m h x 1.32m d) mixed cages at a density of about 50,000 per cage and were periodically refreshed with wild flies from Hawaii Island to maintain genetic diversity. Adult male flies were 12-14 days old at the time of release.

Step 3:

Description:

Grid Preparation

One week prior to the first release for a given combination of experimental parameters, Jackson traps baited with lure and containing sticky panels were set up in a regular grid at the study site. Lures used followed the guidelines used for detection networks in California (Gilbert et al. 2010): For C. capitata, 2 ml of trimedlure was applied to a wick, which in turn was hung from a basket-type holder within the Jackson trap. For B. dorsalis, 6 ml methyl eugenol with 1% Dimethyl 1,2-dibromo-2,2-dichloroethylphosphate ("dibrom") was soaked into a wick, which was then placed in the trap using a basket-type holder and a coarse screen to keep the flies from contacting the wick.

All trapping grids were 8 x 8, with an inter-trap distance s. In IP for each species we conducted three separate releases or 'tests' (replicates) for each of two values of s: 75 m and 150 m. In PWW, due to the difficulty of moving over the lava terrain and placing posts for hanging traps we used s = 100 m only and the number of tests was limited to two.

Step 4:

Description:

Mark-release-recapture

Flies for release were marked using fluorescent powder (Day-Glo Color Co., Cleveland OH, USA) following standard methodology at the pupal stage (Steiner 1965). A different color was used for each cohort being released for a set of replicates. A set of replicates per experimental treatment was defined as releases in the same habitat with the same value of s (grid size).

On the morning of a first release fresh sticky panels were introduced to the 64 Jackson traps in the grid. Weather conditions were recorded using a Kestrel 4500 portable weather station with weather vane attachment (Nielsen-Kellerman, Boothwyn PA) mounted on a tripod in the center of the grid logging environmental variables every 5 minutes. Around 08:00 about 2000 marked male flies were released at the center of the grid by opening three 25-cm cubical cages each containing about 700 males. At the same time the lure response bioassay was initiated at DKI-PBARC for experiments in IP and at the field site for those in PWW. Following completion of the bioassay the release cages were closed and collected (around 11:00) and the remaining males were counted.

Recapture consisted of removing the sticky card insert from each Jackson trap in the grid during the morning and replacing it with a fresh insert. Inserts were transported to DKI-PBARC in Hilo in brown paper sandwich bags and preserved at 0oC for later processing. Processing consisted of crushing the heads of all captured flies on filter paper, adding a drop of acetone and checking for fluorescent powder under UV light. Since we used different colors for each replicate we were able to determine which release each recaptured fruit fly had come from.

For an experimental week, replicate releases for a given fruit fly/habitat/grid size combination were conducted on Monday, Wednesday and Friday. Recaptures (trap servicing) were conducted Tuesday through Saturday and again on the following Monday. On days when both a recapture and release were scheduled (Wednesday and Friday) we serviced the traps prior

	to release.
Step 5:	
Description:	**Lure response bioassay**

The proportion of flies that were responsive to the lures being used was tested at the time of each release using a subsample of the flies released. We conducted the bioassays at DKI-PBARC for releases conducted at IP and at the release site for experiments at PWW.

For B. dorsalis the bioassay was conducted using a Y-tube glass olfactometer (5.5cm diameter, 25cm arm length and base length). One arm of the tube contained odor from 5 micro-L of methyl eugenol on a wick and the other arm contained no lure. Air flow was 150 ml/min of carbon-filtered air per arm using a compressed air tank. About 20 males were introduced to the bottom of the tube after a five minute equilibration period, and the number of individuals in each were recorded every minute for 15 minutes. We found that the flies reached a final distribution after about 10 minutes. This procedure was repeated with a fresh set of 20 males with the lure on the other arm. The number in each arm at the 15th minute was considered the result in each of the two trials, and these were averaged for the final result. From the number in each arm, we calculated the proportion activation (number in both arms/number introduced) and the proportion responders (number in lure arm/number in both arms); these are sometimes termed proportion responsive and proportion selective, respectively (Bertschy et al. 1997).

For C. capitata and trimedlure, Y-tube bioassays were ineffective because the insect arrests upon encountering the odor (Hendrichs et al. 1989), probably due to its association with lekking site localization (Shelly et al. 1993). This differs from the response to methyl eugenol, which is ingested since it acts as a pheromone precursor for B. dorsalis (Shelly and Nishida 2004). Therefore, we used a carrousel olfactometer assay in a 1 m3 enclosure. Two standard Jackson traps were placed in the rotating carousel at 2 rpm; one contained a 2g trimedlure plug and the other was left empty as a control. Forty male C. capitata from the batch being released were introduced to the enclosure at release time and the final number in each Jackson trap was counted after about four hours. We treated the total number caught in both traps divided by the number introduced to the assay as analogous to the proportion activation in the Y-tube B. dorsalis bioassay, and the number in the lure-baited trap divided by the total in the traps as the proportion responders. Therefore we were able to obtain comparable measures of activation and responsiveness for both species. |
| Instrument(s): | Y-tube olfactometer and caroussel olfactometer |

Data Set Usage Rights

Access Control:		
Auth System:	knb	
Order:	allowFirst	
Allow:	[read]	public

Additional Metadata

```
additionalMetadata
        |___element 'metadata'
        |       |___element 'unitList'
        |       |       |___element 'unit'
        |       |       |       \___attribute 'id' = 'RelativeHumidity'
        |       |       |       \___attribute 'multiplierToSI' = ' '
        |       |       |       \___attribute 'name' = 'RelativeHumidity'
        |       |       |       \___attribute 'parentSI' = 'pascal'
        |       |       |       \___attribute 'unitType' = 'pressure'
        |       |       |       |___element 'description'
        |       |       |       |       |___text 'Ratio of the partial pressure of water vapor to the equilibrium vapor p
        |       |       |       |___text '\n '
        |       |       |___text '\n '
        |       |___text '\n '
        |___text '\n '
```