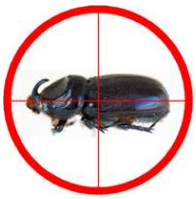
Research in Support of the Guam Coconut Rhinoceros Beetle Eradication Project



Field Cage Experiment
New Lure vs Depleted Lure

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We performed a semifield experiment in which coconut rhinoceros beetles were allowed to fly freely in two large field cage (20' x 20' x 10'). In one cage, we placed a single baffled bucket trap baited with a new Oryctalure®and in the other cage we placed an identical trap baited with a depleted lure. The experiment was replicated once. Traps caught between 62% to 78% of flying beetles. Difference in trap-catch between traps baited with new lures and depleted lures were not significant. Estimated pheromone release rate is 17.0 mg per day for the new lure and 0.4 mg per day for the depleted lure.

It is possible that the Oryctalure release rate is too high and that beetles are becoming arrested or repelled as they approach traps baited with fresh lures. Guam trapping records show that, on average, more than twice the number of beetles was caught in depleted traps than in traps with new lures and this is statistically very highly significant.

1 Introduction

Mass trapping was ineffective in protecting mature coconut palms on Guam. In Guam's Tumon Bay area severe defoliation has been experienced within high density trapping

C:/Documents and Settings/Administrator/My Documents/CRB Field Cage/depleted

Figure 1: Large, custum-designed field cages (20' x 20' x 10') used for semifield experiments with the coonut rhinoceros beetle.

areas in the hotel landscaping environment. In the current experiment, we measured trap efficacy for beetles flying within large field cages and compared trap-catch in a trap with fresh lure, and one baited with a depleted lure.

2 Methods

2.1 Beetles

For each experiment, we field collected adult coconut rhinoceros beetles, *Oryctes rhinoceros*. These were housed in two plastic tubs half filled with peat moss, 30 beetles in each tub. The beetles were fed bananas two days prio to the start of each experiment. In experiment 1, beetles were fed a second time, during the experiment, on May 17. Beetles were kept in an air conditioned room when not being used in flight tests.

2.2 Field Cages

Experiments were performed in two custom-designed large field cages (20' x 20' x 10') erected at the University of Guam's Agricultural Experiment Station in Yigo (Fig. 1).

2.3 Traps and Lures

We used standard traps and lures (Oryctalure®, ChemTica, Costa Rica) used by the Guam Coconut Coconut Rhinoceros Beetle Eradication Project (Fig. 2). Each lure consists of a liquid rhino beetle aggregation pheromone contained in a clear plastic membrane. The pheromone is colored red which makes it easy to determine how much liquid is left in the lure. Traps are baffled bucket traps made locally. Baffles are made out of Coroplast®and the buckets are standard seven gallon paint buckets. A lure is hung in a hole cut at the center of the baffle. In one cage, we placed a single baffled bucket trap baited with a new Oryctalure®and in the other cage we placed an identical trap baited with a depleted lure. No liquid was evident in the depleted lure. We estimated the release rate of pheromones from lures used in the second experiment by wieghing the lures at 900h on June 7, hanging both lures in the shade under a canopy, and reweighing the lures at 1300h on June 17.

2.4 Flight Tests

Flight tests were only run during evenings in which the average wind speed was less than 5 mph, as measured by a weather station only 300' from the field cages, and when the probability of rain during the test period was low. At about 30 minutes prior to sunset, a plastic tub containing 30 beetles was put in each cage and the lid was removed. Beetles cannot crawl out of tubs, but they can fly out. Each cage contained a trap hung at about 6 feet above the ground and One cage contained a trap baited with a new lure and the other contained a trap baited with a depleted lure.

After making a decision to run a flight test, at about 30 minutes prior to sunset, a tub containing 30 beetles was placed in each cage and the lid was removed. Location of the trap and the tub were adjusted so that the trap was directly upwind with respect to the tub.

At about three hours after sunset, beetles were collected, counted and returned to their tubs. Beetles which had been trapped and those found elsewhere with the cage were tallied.

3 Results

Beetles became active and started emerging from the peat moss in the tubs at sunset. They began to fly at about 15 minutes after sunset and flight activity lasted for about one hour. Direct observations confirmed that beetles were unable to crawl out of the tubs.

In both experiments, the trap in each cage caught about 75% of those which flew (Table 1, Table 2). The trap baited with the deplete lure caught as many flying insects as the trap baited with a new lure(Table 3, Table 4).

Estimated pheromone release rate is 17.02 mg per day for the new lure and 0.39 mg per day for the depleted lure.

Figure 2: Standard veined-baffle bucket trap used by the Guam Coconut Rhinoceros Eradication Project. Note Oryctalure®hung at the senter of the baffle.

Table 1: Experiment 1 data summary.

	Date	Cage	Beetles	Lure	Flyers	Trapped
1	05/15/12	N	C2	Dep	9	8
2	05/15/12	S	C1	New	5	4
3	05/16/12	S	C2	New	5	4
4	05/18/12	N	C2	Dep	2	2
5	05/18/12	S	C1	New	8	6
6	05/19/12	N	C1	Dep	4	3
7	05/19/12	S	C2	New	5	4
8	05/25/12	N	C2	New	4	3
9	05/25/12	S	C1	New	1	1
10	05/26/12	N	C1	New	4	2
11	05/26/12	S	C2	Dep	2	0
12	05/27/12	N	C2	New	1	1
13	05/27/12	S	C1	Dep	4	2
14	05/28/12	N	C1	New	0	0
15	05/28/12	S	C2	Dep	2	0
16	05/29/12	N	C2	New	1	0
17	05/29/12	S	C1	Dep	1	0

Table 2: Experiment 2 data summary.

	Date	Cage	Beetles	Lure	Flyers	Trapped
1	06/04/12	N	G2	New	16	12
2	06/04/12	S	G1	Dep	13	11
3	06/05/12	N	G1	New	4	3
4	06/05/12	S	G2	Dep	5	3

Table 3: Experiment 1 results. Difference in proportions of flying beetles trapped by a new lure and a depleted lure are not significant (t-test, $p = 0.5445$).

	Lure	Flyers	Trapped	Proportion trapped
1	Dep	24	15	0.62
2	New	34	25	0.74

Table 4: Experiment 2 results. Difference in proportions of flying beetles trapped by a new lure and a depleted lure are not significant (t-test, p = 1).

	Lure	Flyers	Trapped	Proportion trapped
1	Dep	18	14	0.78
2	New	20	15	0.75

4 Discussion

After discovering that a trap baited with a depleted lure catches an equivalent number of beetles as a trap baited with a new lure, I checked trapping records from operational traps. Trappers hang a new lure in each trap whenever they observe that all the liquid has evaporated from the previously applied Oryctalure controled release dispenser. Thus we can calculate the trap-catch from traps with depleted lures by selecting records from the `trap_visits` table where `lure_replaced` is true:

```
# Finds number of beetles caught in traps baited with
# depleted lures (lure_replaced = 'Y') in comparison to those baited
# with undepleted lures (lure_replaced = 'N').
# Trap routes operated by Mary, Grimm, and Wenninger were excluded
# because these records were entered manually and lure replacement
# was often not recorded.
#########################################################################
require(RODBC)

## Loading required package:  RODBC

conn = odbcConnect("oryctes")
sql = paste(
   "SELECT",
   "  lure_replaced,",
   "  (male_count+female_count+unsexed_count) AS trap_catch",
   "FROM trap_visit",
   "WHERE",
   "  lure_replaced NOT LIKE ''",
   "  AND (person_id NOT LIKE '%Mary%')",
   "  AND (person_id NOT LIKE '%Grimm%')",
   "  AND (person_id NOT LIKE '%Wenninger%')")
dat=sqlQuery(conn, sql)
odbcClose(conn)
t.test(trap_catch~lure_replaced, data=dat)

##
##  Welch Two Sample t-test
##
## data:  trap_catch by lure_replaced
## t = -14.62, df = 24884, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1446 -0.1104
## sample estimates:
```

```
## mean in group N mean in group Y
##         0.09212         0.21959
##
```

As you can see, on average, more than twice the number of beetles was caught in depleted traps than in traps with new lures and this is statistically very highly significant. It is possible that the Oryctalure release rate is too high and that beetles are becoming arrested or repelled as they approach traps baited with fresh lures. Miller et al. 2005, working on dose-dependent pheromone responses of mountain pine beetle found that Lidgren trap catches decreased by about one order of magnitude when the pheromone release rate was increased above an optimum of about 0.5 mg per day.