Protocol

Questions

What are the effects on herbivorous arthropod populations, specifically butterflies, in the absence of birds?

a. Is there an increased abundance of butterflies on Guam, which has no insectivorous forest birds, compared to Saipan and Rota, which do have insectivorous forest birds?

b. Are rates of herbivorous arthropod predation higher on Saipan and Rota than on Guam?

Hypothesis

Birds exert top-down control of herbivorous arthropods.

Prediction

If birds exert top-down control of herbivorous arthropods, then a higher abundance of butterflies will occur on Guam than on Saipan and Rota. In addition, predation rates on Lepidoptera will be lower on Guam than on Saipan and Rota.

Butterfly Survey

Materials

1. Field notebook
2. Pencil
3. Flagging tape
4. GPS
5. At least 2 people

Protocol

1. Find possible limestone forest sites
   1. There should be 3 native forest limestone sites. (insert description)
   2. There should be 3 disturbed limestone sites. (insert description)
2. Using a GPS device, measure a 300 m distance.
   1. The 300m distance should be on a trail that is fairly straight. Slight curves are acceptable; however, avoid trails that are in loops or circles, as this can cause butterfly counts to be redundant.
3. Mark off the 300m mark with flagging tape
   1. With a partner walk the length of the trail in one direction. One partner will watch and search for butterflies 5 meters to each side, front and above. Note\*: Pace should be fairly slow, 2min. 30 sec. per 100m
   2. The other partner will keep a tally in a field notebook of all butterflies spotted, and species of the butterflies spotted.

Notes Regarding Survey Conditions

* 1. Weather should be uniform throughout all surveys. Temperature should be between 55 and 102 degrees. In the event of sudden rain during a butterfly survey, the surveyors should wait until rain has ceased and then restart the survey.
  2. Surveys should be taken between 10am and 3pm.
  3. Wind speeds should not be excessive. On the Beaufort scale, wind should not exceed 5. In the event that winds are too strong, the survey should be rescheduled for a more suitable time.

Clay Caterpillar Experiment

Materials

1. Non-hardening, non-toxic - green clay
2. Rubber Cement
3. Flagging Tape
4. GPS
5. Field notebook
6. Plastic Containers
7. Cloth
8. Wax paper

Protocol

1. Make clay caterpillars
   1. Roll 150 clay caterpillars for each site. They should be smooth and 30 mm long and 3 mm wide: roughly modeled after the *Eurema Blanda* caterpillar found in the Micronesian Butterfly Guide.
   2. Place the clay caterpillars in a plastic container.
2. There should be two randomly chosen 300m trails for the clay caterpillar experiment on each island, one native limestone forest and one disturbed limestone forest.
3. On each trail distribute 150 clay caterpillars.
   1. Starting at the 0 meter mark, every 2 meters on each side of the trail, tie flagging around the base of a tree. If there is no tree at the 2 meter mark, use closest tree. Trees are picked based on 2 meter spacing.
   2. place a caterpillar on each flagged tree, alternating placement of caterpillars between both sides of trail
   3. Alternate placement of caterpillar between stem and leaf. So the first two caterpillars will be placed on stems (and they will be on opposite sides of the trail), and the next two caterpillars will be place on leaves. Follow this pattern throughout
   4. The stem or leaf should be at a height above 1 meter but no higher than 2 meters. The caterpillar is fully exposed to the canopy..
   5. Continue this process for the duration of the 300m trail.
4. Adding caterpillars
   1. Using the cloth, wipe off any stems or leaves that may be wet due to rain.
   2. Inspect caterpillar for any new markings acquired during transit to field. Smooth out caterpillar if possible, or replace caterpillar entirely.
   3. Apply rubber cement to substrate.
   4. Apply caterpillar to stem or leaf.
   5. Ensure that no markings have been added to the clay caterpillar during handling.
5. Record in field notebook the site name of the trail and the time and date the caterpillars were
6. Leave the clay caterpillars out for 48 hours.
7. Collect caterpillars
   1. Go back to trail 48 hours later
   2. Look for caterpillars. At each caterpillar, record in the field notebook the tally of caterpillars that have suspected predation (markings or pinches), no predation at all (smooth), as well as the number of caterpillars that are missing or found on ground
   3. Collect caterpillars that have suspected predation for further analysis . Place caterpillars in individual plastic Ziploc bags and place in large Tupperware for protection
8. Analysis
   1. General linear mixed effects model

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|  | Island | Site | Type of Forest | Important Notes | Concerns |
| 1 | Guam | Anao | Native |  |  |
| 2 | Guam | S. Blas | Native |  |  |
| 3 | Guam | Guam Community College Trail | Native | Trail is much curvier than others |  |
| 4 | Guam | Two Lovers Point | Disturbed | Large presence of African Tulips |  |
| 5 | Guam | Pagat | Disturbed | Need to visit |  |
| 6 | Guam | Ritidian | Native | Need to visit |  |
| 7 | Guam | Forest behind UOG | Native | Need to visit |  |
| 8 | Guam | Racetrack | Native | Need to visit |  |
| 9 | Guam | Anao Disturbed, on road to S.Blas | Disturbed |  |  |
| 10 | Saipan | Forbidden Island | Native |  |  |
| 11 | Saipan | Marpi | Native |  |  |
| 12 | Saipan | LADT – trail | Native |  |  |
| 13 | Saipan | LADTS – road | Disturbed |  |  |
| 14 | Saipan | Naftan | Disturbed |  |  |
| 15 | Saipan | Grotto bike trail | Disturbed |  |  |
| 16 | Saipan | Bird Island Conservation Area Trail (Toyota Key Trail) | Disturbed |  |  |
| 17 | Rota | Palii | Native |  |  |
| 18 | Rota | Gravel Pit (Coconut Crab hunter trail at base of cliff | Native |  |  |
| 19 | Rota | Isa | Native |  |  |
| 20 | Rota | Bird Sanctuary | Native | Mixed vegetation |  |
|  | Rota | Entrance road to David Calvo farm near Bird Sanctuary | Disturbed | Good amount of tangantangan |  |
| 21 | Rota | Tweksberry Park | Distrubed |  | Less than 300m |
| 22 | Rota | Wedding Cake island Trail | Disturbed | Tangantangan | Open canopy; Less than 300m |