

Identifying and Managing Insect Prey for the Hawaiian Hoary Bat

Robert Peck

Hawaii Cooperative Studies Unit
University of Hawaii at Hilo
USGS Pacific Island Ecosystems
Research Station



Questions and considerations

- Can habitats be characterized in terms of insect prey availability?
- How does insect prey change in space and time?
- What are methods to sample insect prey?
- What do diet samples tell us?

Host plant associations: koa

Scotorythra rara



Scotorythra paludicola



Cydia walsinghamii



Thyrocopa argentea



Amorbia emigratella



Opogona omoscopa



- Specialist herbivores
 - *Scotorythra paludicola*
 - *Cydia* (seeds, twigs)
- Generalist herbivores
 - *Scotorythra rara*
 - *Amorbia*
- Scavengers (generalists)
 - *Opogona*
 - *Thyrocopa*
 - *Hyposmocoma*



Koa



Plants important for caterpillars!

Host plant associations: pasture grasses

Agrotis ipsilon



Athetis thoracica *Mythimna unipunctata*



- Mostly non-native grasses and weeds
- Mostly non-native insects



Omiodes localis



Pasture grasses and weeds

Hosts associations: Livestock



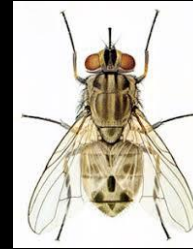
Scarab beetles
(71 species)



Hydrophilid beetles



Stable fly



Horn fly



House fly



Cattle



Dung beetle



Goats and sheep

Other habitat types

- Aquatic habitats
 - Streams
 - Standing water
 - Some Diptera, Trichoptera (caddisfly)
- Urban areas
 - Termites from buildings
 - Moths attracted to bright lights



Characterizing foraging habitat: Amaulu



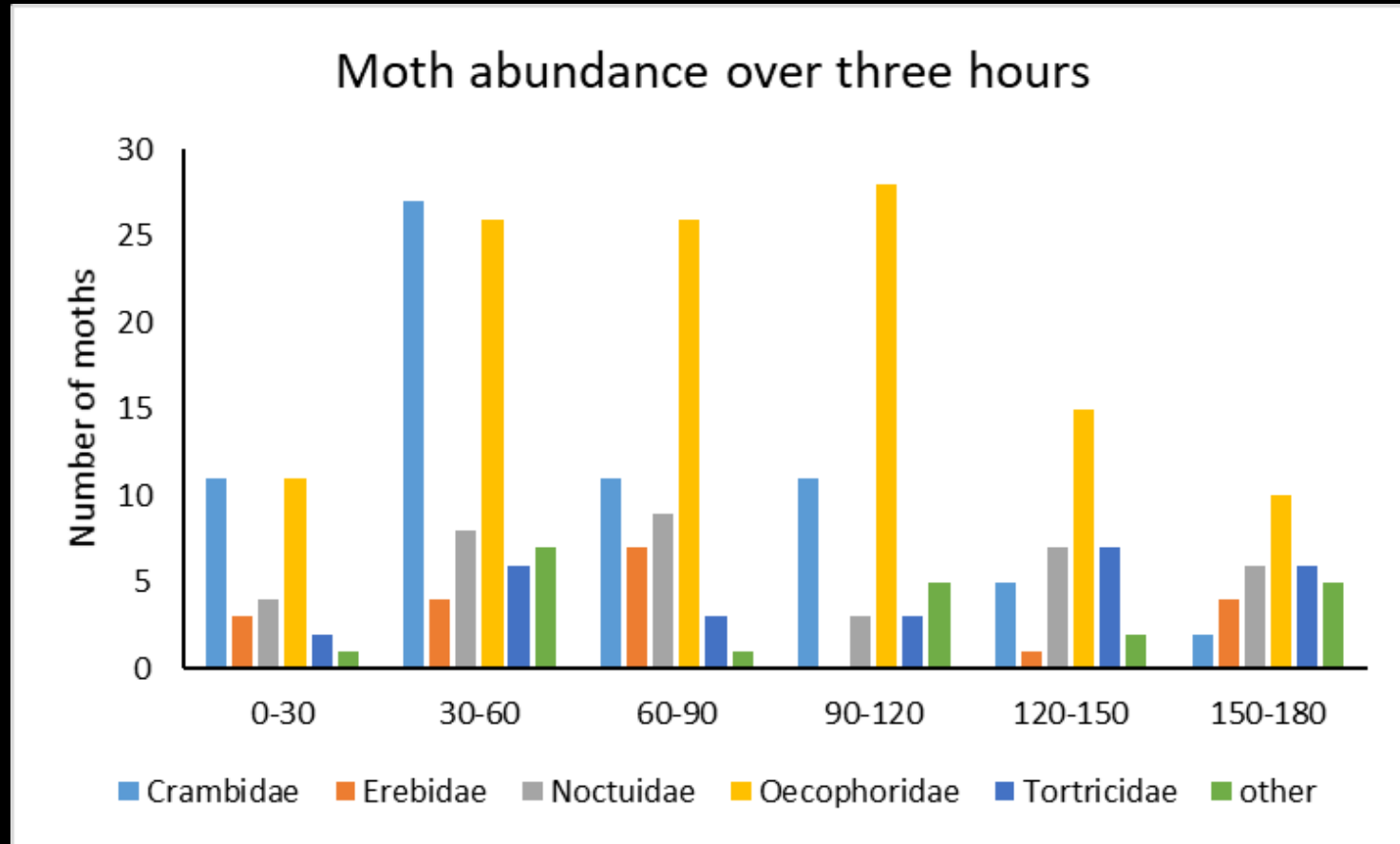
Characterizing foraging habitat: Amaulu



■ Crambidae ■ Erebidae ■ Gelechioidea ■ Geometridae ■ Noctuidae
■ Oecophoridae ■ Pyralidae ■ Tortricidae ■ unknown

30 Sept and 1 Oct 2019
N=14 moth species

Moth activity during evening



- Sampled insects at 30 min intervals for three hours
- Concurrent with mist netting for bats
- Record weather conditions (temp, wind, rain)

Prey size

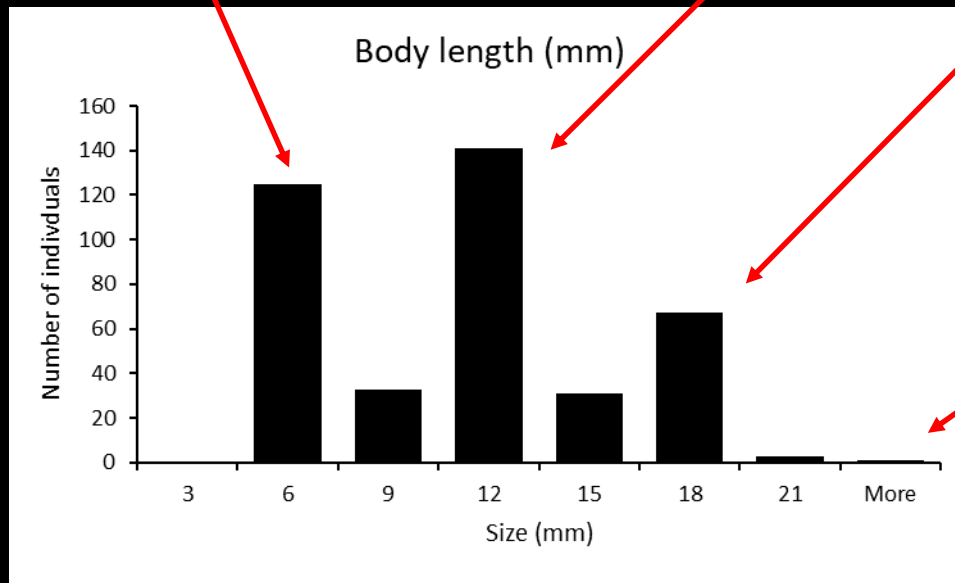
Omiodes localis (11.5)



Stoeberhinus testaceus (5.9)



Agrotis ipsilon (15.9)

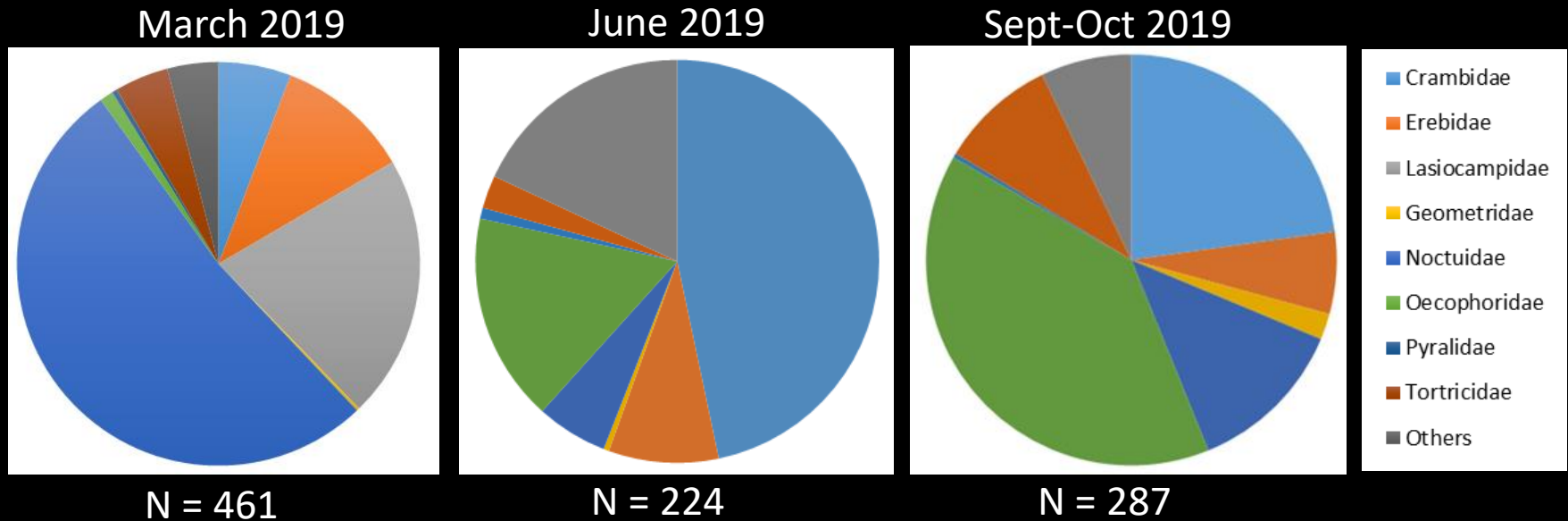


Ascalapha odorata (36.0)



Amauulu, four sites combined, 30 Sept - 1 Oct 2019

Amauulu: seasonal differences in moths



Insects in samples

- Lepidoptera (≥ 31 species)
- Coleoptera (~40 species*)
- Diptera (~21 species*)
- Hemiptera (~22 species*)
- Orthoptera (4 species*)
- Blattodea (2 species*)

Sampling seasons

- March: non-breeding
- June: pupping
- Sept-Oct: breeding

* Sept-Oct samples only

Light trapping

- Bucket trap
 - Collects on its own
 - Timers allow interval to be defined
 - Misses some taxa and individuals
- Hand collecting at sheet
 - Highly effective
 - Easy to define intervals
 - Better associate with guano samples
 - More labor intensive
- Limitations of light trapping
 - Measures relative abundance only
 - Draw from unknown area
 - Trap biases unknown
 - Environment affects activity
 - Temp, wind, rain, moon phase

Bucket trap



Hand collecting at sheet



Malaise trap



- Easy to maintain
- Collects continuously
- Very habitat specific
- Best for ground-flying moths
- Biased against some taxa (beetles)

Hand collecting caterpillars



- Targets caterpillars of specific taxa
- Not practical to survey entire community
- Essential for identifying host-plants

What can bat diet tell us?

Family	Zeales	Zeales	Epps	Epps	Genus	Species	Element or Vegetation
	s	d	s	d			
Blastobasidae	1	0	0	0	Blastobasis		legumes
Carposinidae *†	0	1	0	0	Carposina *†		unknown
Coleophoridae	0	3	0	0	Coleophora		thistle
Cosmopterigidae *†	0	7	0	0	Pyroderces		vegetable waste
Crambidae *†	1	32	3	6	Nomophila	<i>Nomophila noctuella</i>	grasses
						<i>Nomophila sp.</i>	various plants
					Herpetogramma	<i>Herpetogramma licarsisalis</i>	grasses
Erebidae †	2	2	0	0	Hypena		grasses
Gelechiidae *	6	3	0	0	Dichomeris		sourbush (<i>Pluchea</i>)
Geometridae *†	5	15	0	0	Eupithecia *†		predatory, native plants
Gracillariidae	0	0	2	2			Various plants
Hesperiidae	0	1	2	0			Various plants
Lycaenidae *	0	3	0	0			Various plants
Momphidae (Batrachedridae)	0	0	0	1			Various plants
Noctuidae *†	11	46	2	0	Athetis †		grasses
					Feltia †	<i>Feltia subterranea</i> †	various plants
					Peridroma *†	<i>Peridroma saucia</i> †	various plants
					Pseudaletia *†	<i>Pseudaletia unipuncta</i> †	various plants
Oecophoridae *	18	31	3	2			decaying vegetation
Pyralidae *	0	0	2	0			Various plants
Sphingidae †	1	0	0	0			Various plants
Tortricidae *†	2	11	3	0	Cryptophlebia		fruit, seeds
					Crociosema †	<i>Crociosema lantan.</i>	<i>Lantana camara</i>
Xyloryctidae *†	6	12	0	0			decaying vegetation

Summary

- Possible to characterize habitats based on composition of insects collected
 - Important to understand temporal aspects
- Bat foraging habitat can be estimated based on diet
 - Requires knowledge of insect host-plants
- Prey assessment method depends upon objective
 - Important to standardize methods when possible
- Most informative to coincide prey sampling with the collection of bat guano
 - Minimizes spatial and temporal differences

Mahalo!