Flower visitation among Hawaiian *Scaevola* (Goodeniaceae)

Michelle D. Elmore[1, 2] and Donald R. Drake[1]

[1]Botany Department, University of Hawai'i at Mānoa
[2] PCSU - Army Natural Resources

Pollination: transfer of pollen to a receptive stigma; may or may not result in fertilization

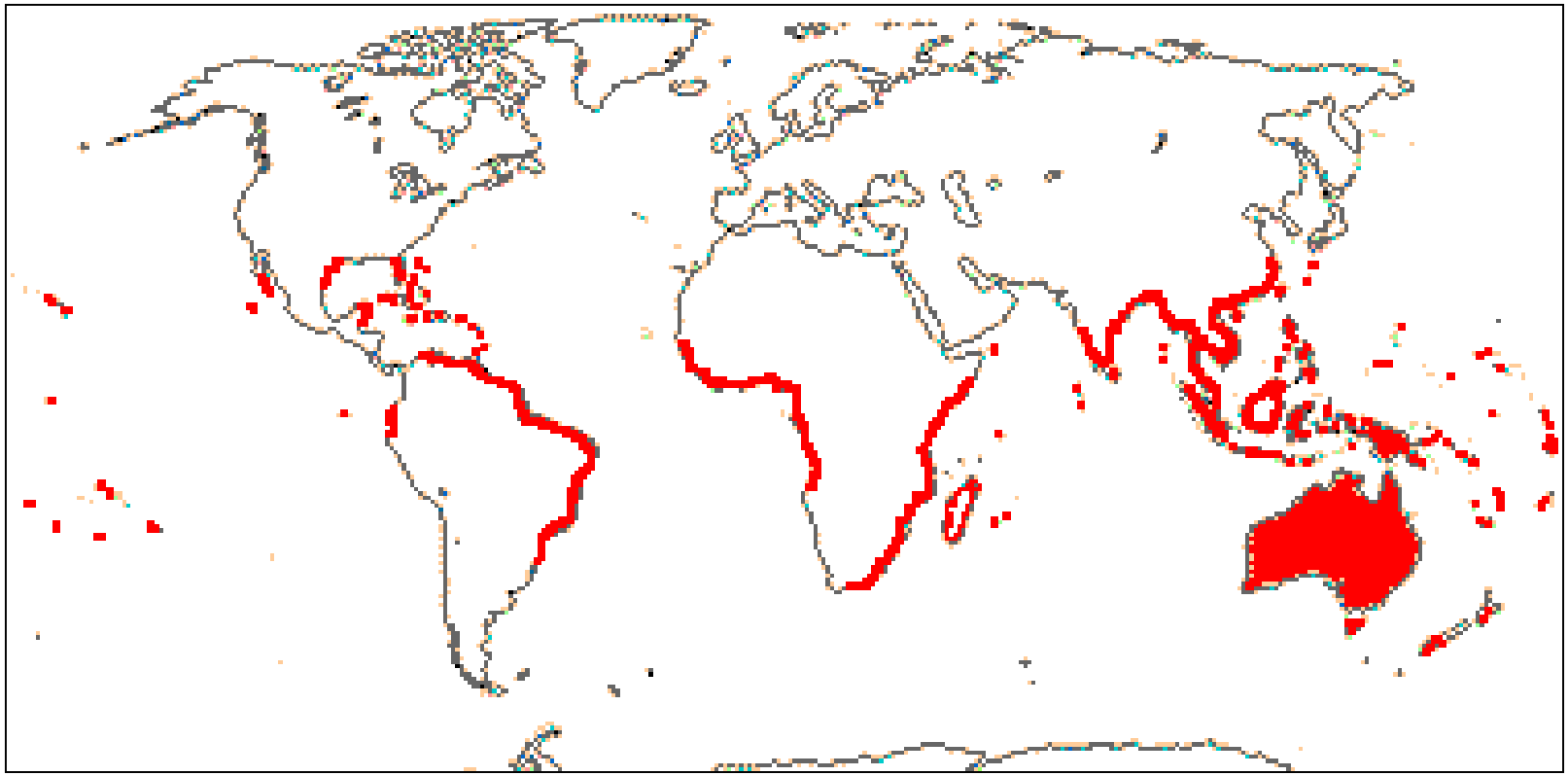
Fertilization: union of sperm and egg

Flower visitation: may or may not result in pollination, but most frequent visitors are often most important for plant reproduction

Nectar robbing hole in *Scaevola glabra*

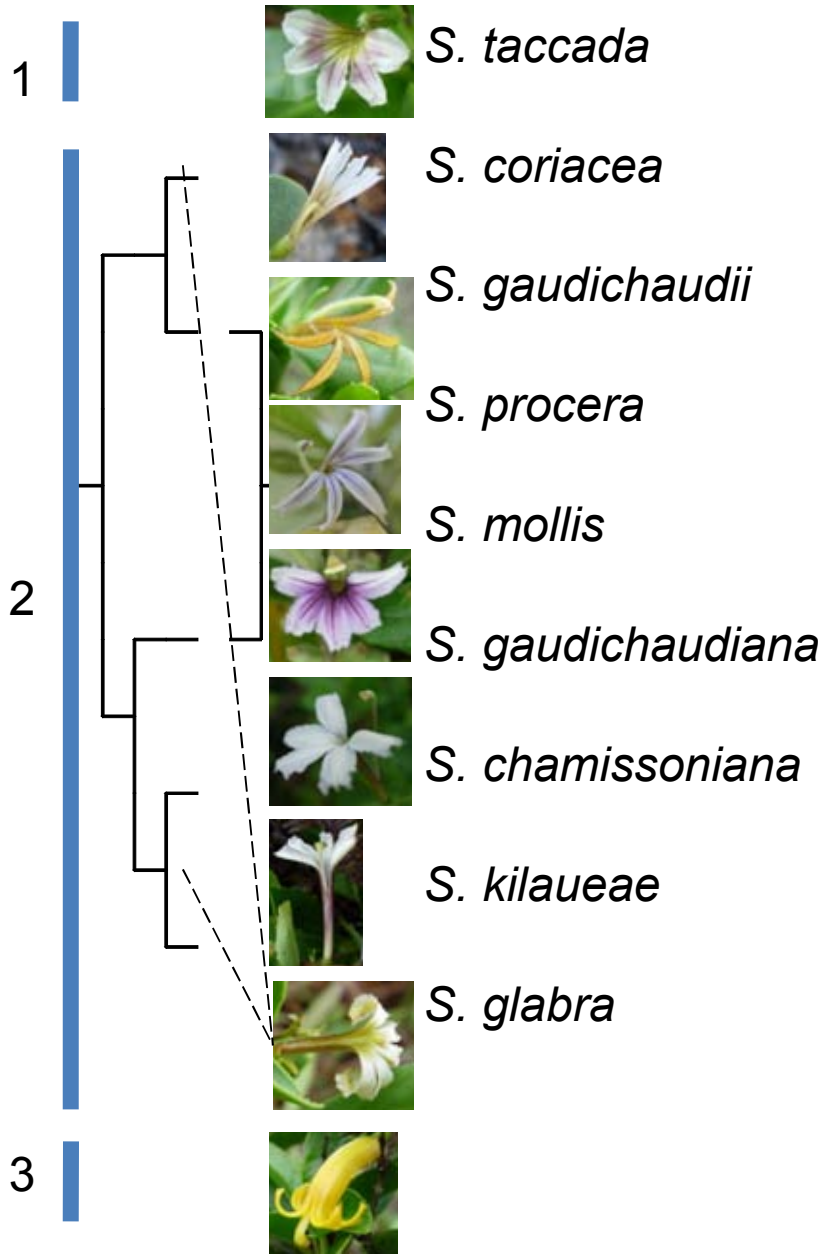
Goodeniaceae

-12 genera
-ca. 400 species
-protandrous
-insect pollinated



Scaevola in Hawai'i

- 10 species (one extinct)
- 3 separate lineages
- Diversity of habitats and elevation
- Variation in flower shape, color, size, scent
- Flower visitation by insects and birds



Howarth and Baum, 2005

Research questions

What are the visitors?

Are non-native species potentially competing with or replacing native visitors?

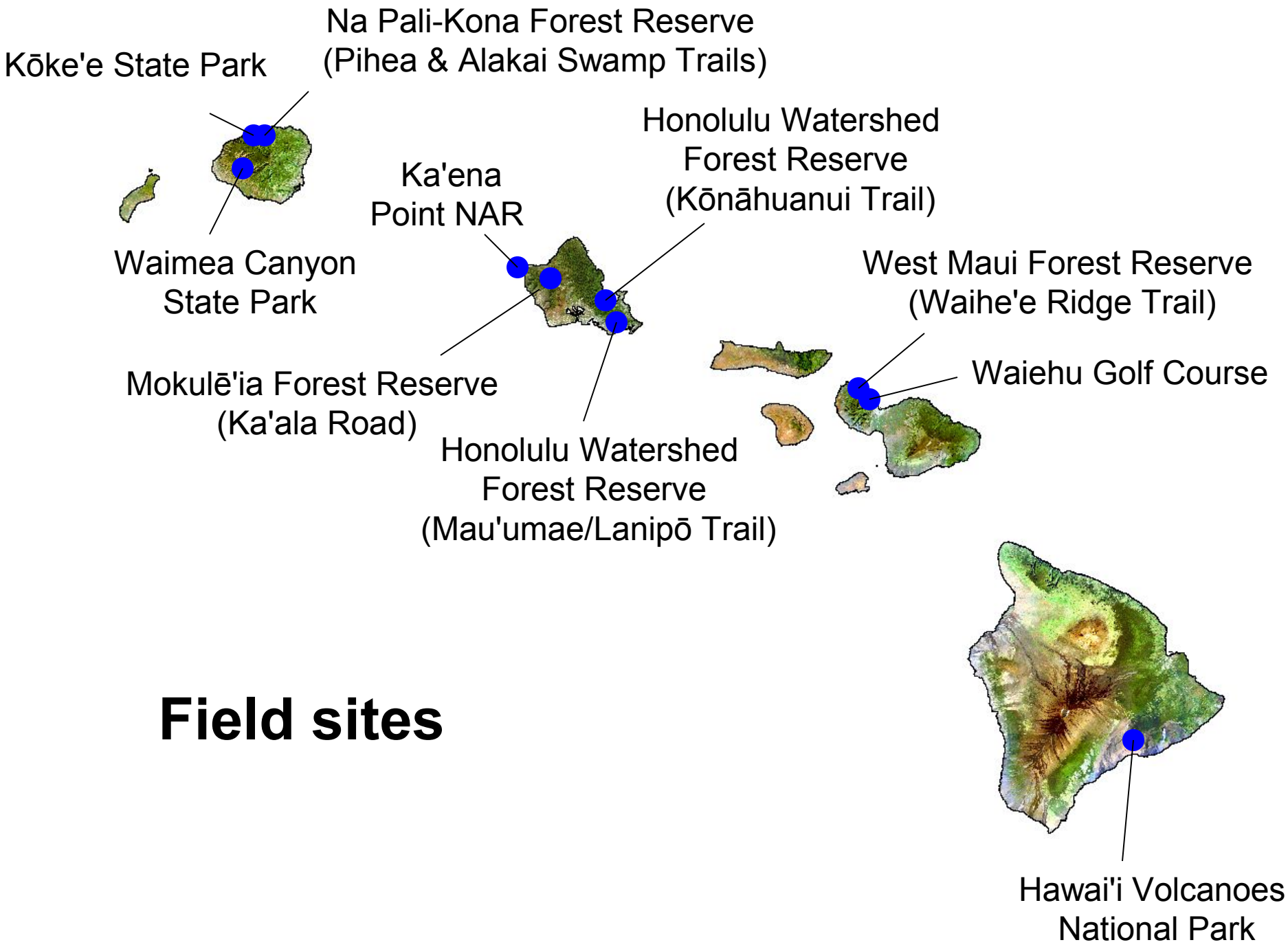
Are native and alien species visiting flowers in a manner that may result in pollination?

Methods

Timed observations:

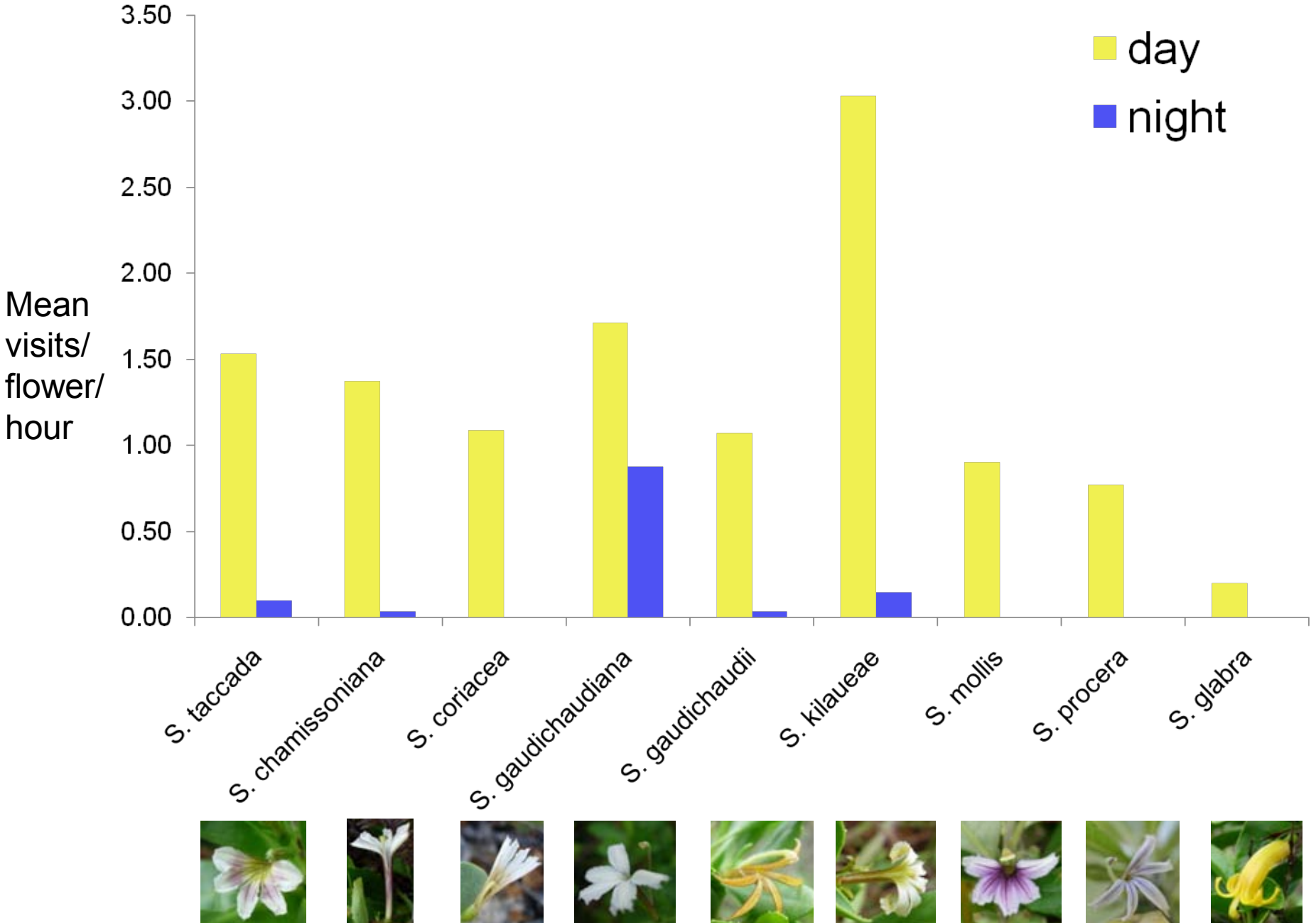
- -approx. 20 hrs/species
- -day and night observations
- -visitor behavior:
  - time at flower
  - resource used
  - contact with pollen or stigr
  - nectar robbing

Female *Hylaeus connectens* harvesting pollen from *S. chamissoniana*


Na Pali-Kona Forest Reserve
(Pihea & Alakai Swamp Trails)
Kōke'e State Park
Honolulu Watershed
Forest Reserve
(Kōnāhuanui Trail)
Ka'ena
Point NAR
Waimea Canyon
State Park
West Maui Forest Reserve
(Waihe'e Ridge Trail)
Waiehu Golf Course
Mokulē'ia Forest Reserve
(Ka'ala Road)
Honolulu Watershed
Forest Reserve
(Mau'umae/Lanipō Trail)
Hawai'i Volcanoes
National Park

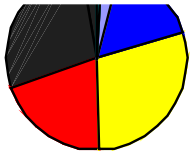
Field sites

Visitation rates during the day and night

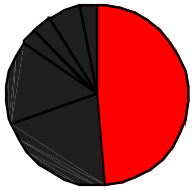


Frequency of visitation by each visitor taxon

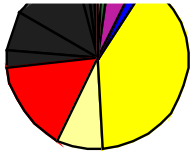
S. chamissoniana (n=115)



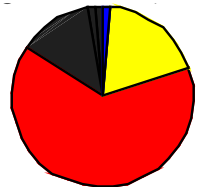
S. coriacea (n=67)



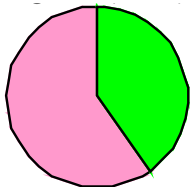
S. gaudichaudiana (n=98)



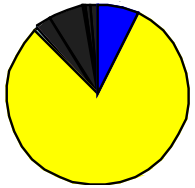
S. gaudichaudii (n=76)



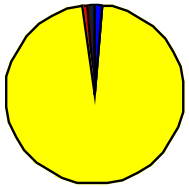
S. glabra (n=20)



S. kilaueae (n=243)

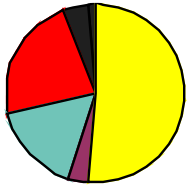


S. mollis (n=83)



S. procera (n=63)

S. taccada (n=171)



- Hemignathus kauiensis
- Himatione sanguinea
- Magumma parva
- Zosterops japonicus
- Blattaria
- Beetle 1
- Beetle 2
- Elateridae
- Psychotidae
- Syrphidae
- Apis mellifera
- Bee spp.
- Bethylidae
- Ceratina arizonensis
- Ceratina smaragdula
- Formicidae
- Hylaeus connectens
- Hylaeus spp.
- Hylaeus spp.
- Megachile
- Nesodynerus?
- Vespula pensylvanica
- Wasp 1
- Wasp 2
- Xylocopa sonorina
- Microlepidoptera
- Conocephalus saltator
- Grasshopper 1
- Thysanoptera
- Larva 1
- Unknown 1
- Unknown 2
- Unknown 3
- Unknown 4
- Unknown 5
- Unknown 6

Birds

Roaches

Beetles

Flies

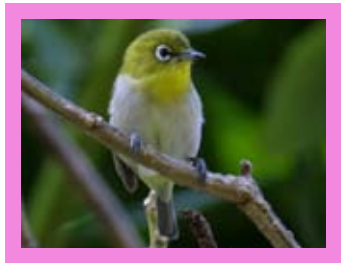
Ants, Bees & Wasps

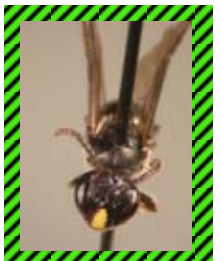
Small moths

Grasshoppers

Thrips

Unknown

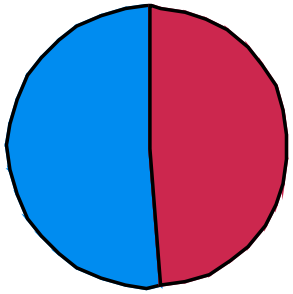




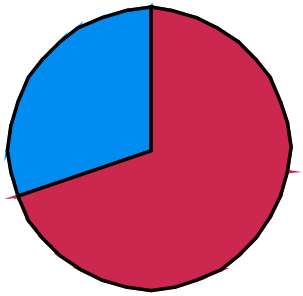
Frequency of visits by native vs. alien species

S. chamissoniana (n=115)

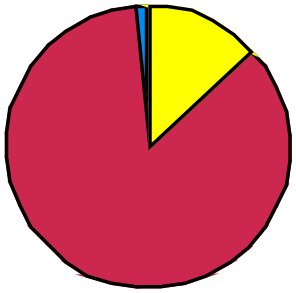
S. coriacea (n=67)



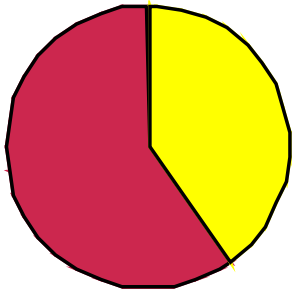
S. gaudichaudiana (n=98)



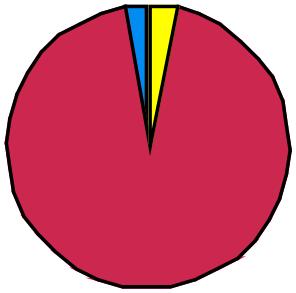
S. gaudichaudii (n=76)



S. glabra (n=20)

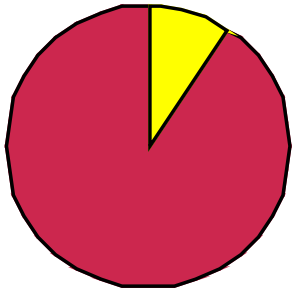


S. kilaueae (n=243)

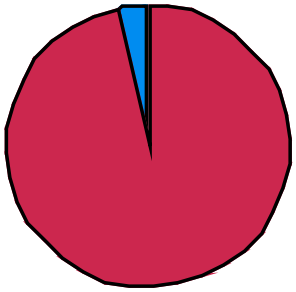


S. mollis (n=83)

S. procera (n=63)



S. taccada (n=171)



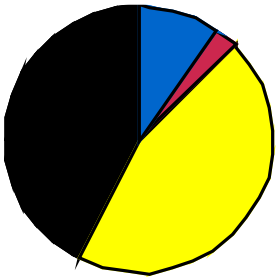
Native
-*Hylaeus* spp.
-Kaua'i 'Amakihi
-'Anianiau
-'Apapane

Non-native

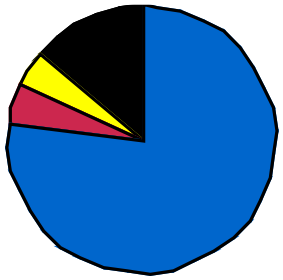
Unknown

Resource use frequency among all visitors

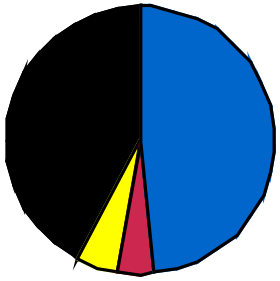
S. chamissoniana (n=103)



S. coriacea (n=65)

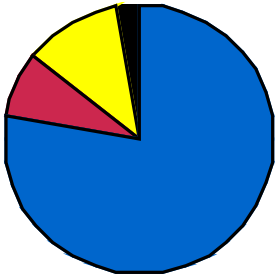


S. gaudichaudiana (n=95)

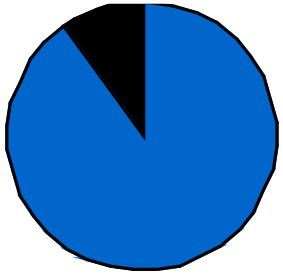


Nectar
Nectar and pollen
Pollen
Unknown

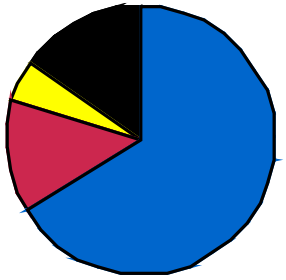
S. gaudichaudii (n=76)



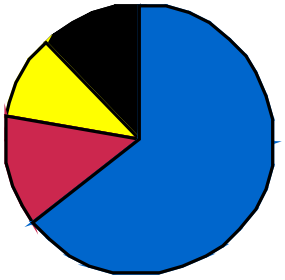
S. glabra (n=20)



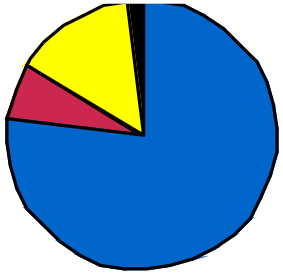
S. kilaueae (n=242)



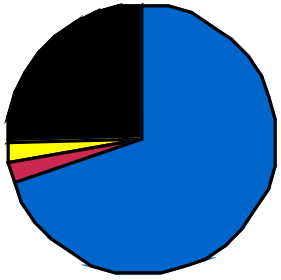
S. mollis (n=81)



S. procera (n=63)

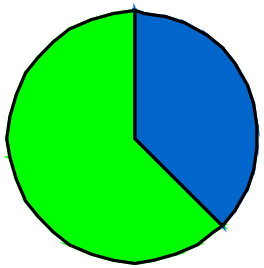


S. taccada (n=170)



Frequency of visitation conducive to pollination among all visitors

S. chamissoniana (n=104)



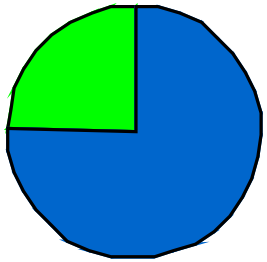
S. coriacea (n=22)

S. gaudichaudiana (n=95)

No contact

Contact

S. gaudichaudii (n=65)

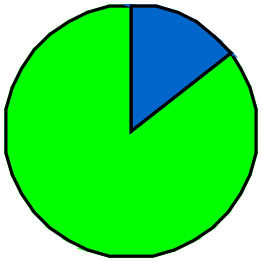


S. glabra (n=17)

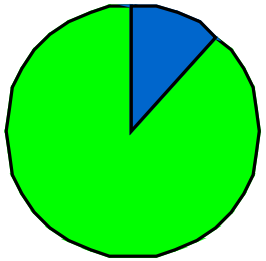
S. kilaueae (n=168)

S. mollis (n=73)

S. procera (n=51)



S. taccada (n=120)



Conservation implications

Pollination limitations may occur due to:

- infrequent visitation (*S. glabra*)
- infrequent contact with pollen/stigma (*S. gaudichaudiana* and *S. gaudichaudii*),

Only 2 spp. had relatively frequent visitation conducive to pollination (*S. kilaueae* and *S. taccada*)

Frequent visitation may not be necessary due to low number of ovules

Alien spp. may be disrupting plant-native pollinator interactions

Alien spp. may be important pollinators

Future research

-Observations at multiple populations, multiple islands, across several field seasons

- Efficacy of flower visitors

- Effects of non-native visitors on native species

- Breeding and mating systems

Conclusion

- Alien species most common visitors (esp. honey bees, ants, Japanese White-Eyes)
  - Most visitation during the day
  - Diversity of visitors variable
  - Some native visitors: *Hylaeus* spp., Kaua'i 'Amakihi, 'Anianiau, 'Apapane

- At least ½ the visits are conducive to pollination for all but 2 spp.

- Future research needed
  - What are most important pollinators?
  - How are non-native flower visitors impacting native visitors?

Mahalo!

Assistance: Cliff Morden, Sheila Conant, Pat Aldrich, Frank Howarth, Hui o Laka/C.C.C. Camp, Carl Martin, Wendy McDowell, Sheldon Plentovich, Katherine Postelli, Heather Sahli, Aaron Shiels, Andy Taylor, Tommy Thompson, Alex Wegmann and Alvin Yoshinaga

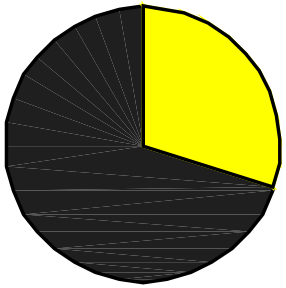
Funding: Ecology, Evolution and Conservation Biology (NSF DGE02-32016); Charles H. Lamoureux Fellowship; Hawaii Audubon Society

Permits: DLNR-Div State Parks (Alvin Kyono); DLNR-DOFAW (Vickie Caraway, John Cumming, Charmian Dang, Betsy Gagne, Earl Pawn, Wayne Souza); HAVO (Rhonda Loh)

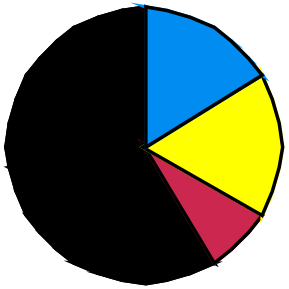
Frequency of visits to male vs. female phase flowers by primary visitor in which indusium was contacted

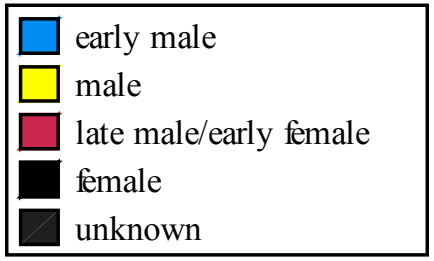
S chamissoniana (Honey bees, n=36)

S. coriacea (Ants, n=10)

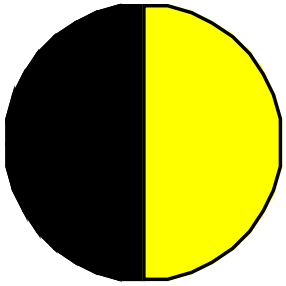


S. gaudichaudiana (Honey bees, n=12)

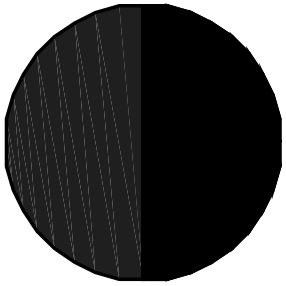




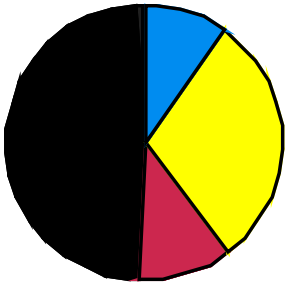
S. gaudichaudii (Hylaeus, n=8)



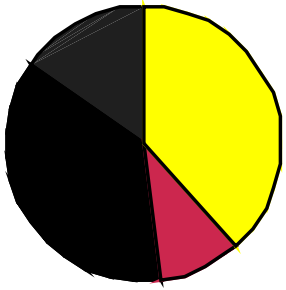
S. glabra (Japanese White-Eye, n=8)



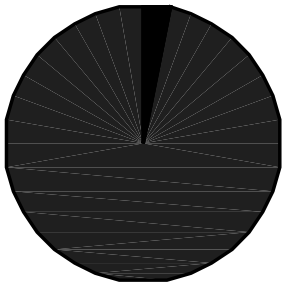
S. kilaueae (Honey bees, n=93)



S. mollis (Honey bees, n=52)



S. procera (Japanese White-Eye, n=30)



S. taccada (Honey bees, n=70)