



# Variability in Use of *Dasiphora fruticosa* (L.) Rydb. as a Nectar Plant by Butterflies: Latitudinal Differences in the Rocky Mountains

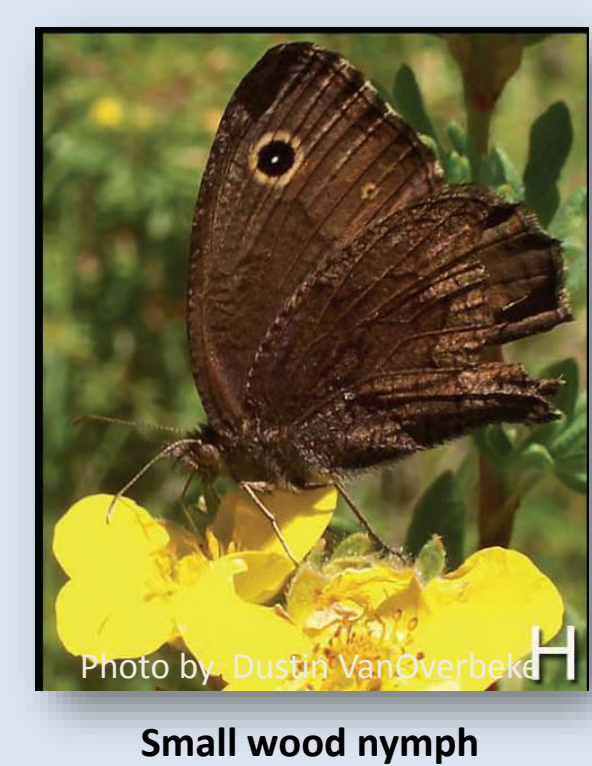
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## Introduction

Wild *Dasiphora fruticosa* (L.) Rydb. [Syn. *Potentilla fruticosa*] (family Rosaceae), is a flowering woody shrub distributed across the northern hemisphere in cooler temperate and subarctic regions. In North America, it often grows at high altitudes in meadows and mixed conifer forest openings in the Rocky Mountains (Elkington & Woodell 1963, Vanoverbeke et al., 2007, Tuell et al., 2008, Denisow et al., 2013). Given the greater frequency of mild, dry winters, and increased severity of summer drought and fires in the mountain west, our lab investigated whether a shrub, such as *D. fruticosa*, plays a critical role as a nectar resource for pollinators, especially butterflies, when other more ephemeral floral resources are unavailable due to dry conditions (Dunne et al., 2003, Aldridge et al., 2011, Iler et al., 2013). In 2004, our lab verified that *D. fruticosa* was an important nectar resource for adult butterflies in the southern Rockies (Jemez Mountains, New Mexico) yet little is known if this is true for more northern latitudes. Therefore, this study specifically set out to investigate:

1. Which insect Orders visited and nectared on *D. fruticosa* in a more northern latitude, e.g., the Sawtooth National Recreation Area, ID and how often did they visit?
2. How do our observations on butterflies compare with those previously collected from the more southern latitude of the Jemez Mountains, NM?



- a. What is the availability of blooming *D. fruticosa* compared with other flowering forbs as an insect floral resource?
- b. How often did butterflies visit flowers and spend nectaring on *D. fruticosa* and other blooming forbs?

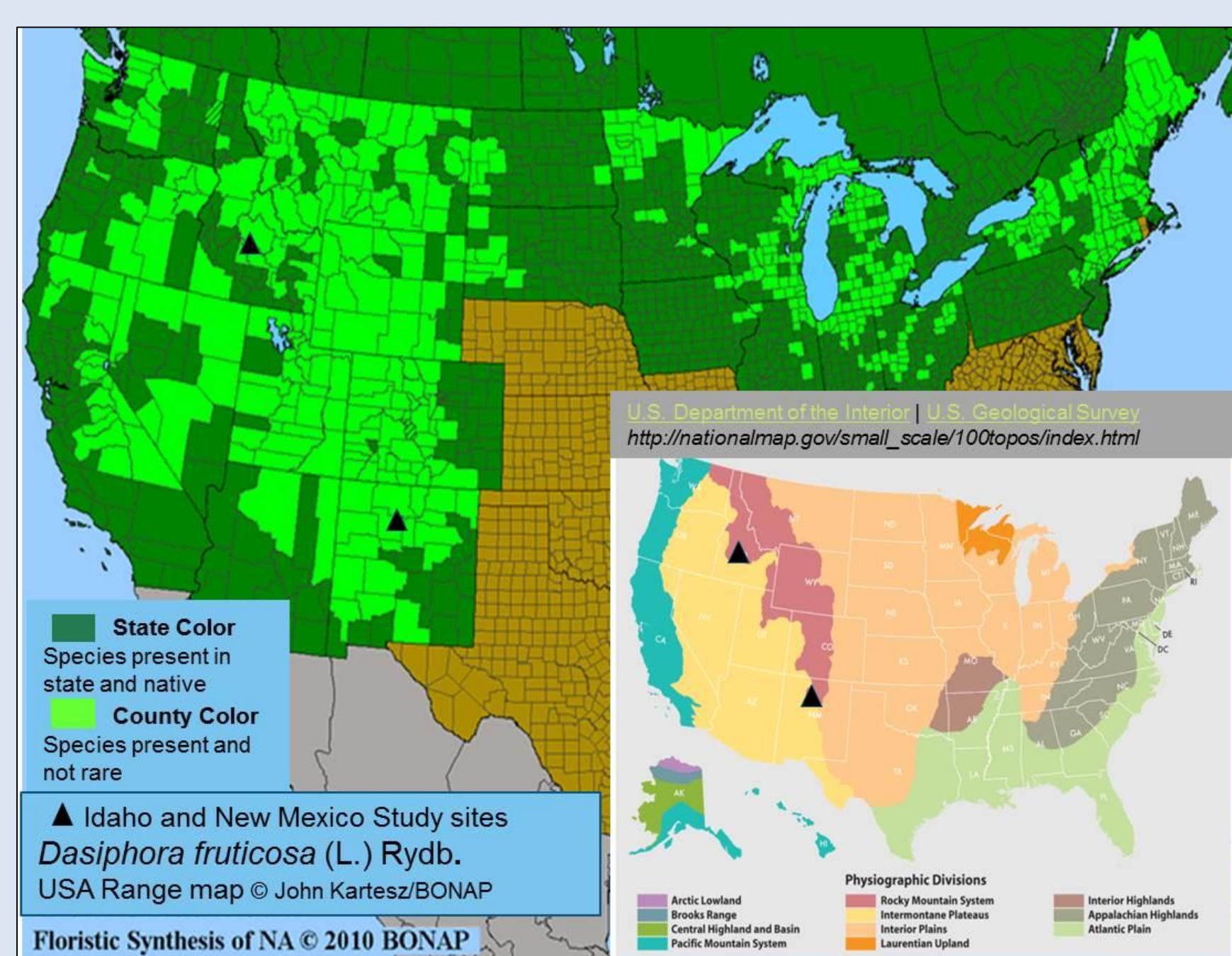


Fig. 1. Distribution map of *Dasiphora fruticosa* across the continental United States. Dark green shows that the plant is native and present in the state as a whole while light green depicts that the plant is present and common in certain counties. The smaller map represents the physiographic divisions within the U.S. and the black triangles are the Idaho and New Mexico study sites.

## Methods

- We conducted our research during the summer of 2014 in the Boulder Mountains of the Sawtooth National Forest/Sawtooth National Recreation Area, Ketchum, Idaho. We worked in three designated areas, Caribou (6490' elevation), Spruce Creek (6795') and Kings Creek (7096'), along an elevation gradient up the Wood River Valley. Each site was chosen for its abundance of *D. fruticosa* in an open meadow in close proximity to a stream with easy accessibility for sampling.
- Vegetation sampling (*D. fruticosa* size, flower counts, forb availability etc) was conducted along 25-m transects (n=5, 4 & 3) spread across each area, respectively.
- Insect visitation observations (10 min./shrub) were conducted on *D. fruticosa* at close range (2m) along each transect/site and foraging observations were conducted randomly while walking across each area. Nectar plant visitation rates were summarized and proportions of total observation time were calculated for each butterfly behavior and. Sample sizes and statistical analyses are given on all resulting tables and graphs.



Fig. 2. Photo of our study plant *Dasiphora fruticosa* in the Sawtooth National Recreation Area, Idaho.



Fig. 3. Data collection sites in the Sawtooth National Recreation Area, Ketchum Idaho and Jemez Mountains, New Mexico. TOP: Jemez Mountains; MIDDLE LEFT: Kings Creek; MIDDLE RIGHT: Caribou; BOTTOM: Spruce Creek



Fig. 4. Aaron Irber and Dr. Kleintjes Neff collecting vegetation data at the Spruce Creek site.

## Acknowledgments

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## Results and Conclusions

1. Which insect Orders visited and nectared on *D. fruticosa* in a more northern latitude, e.g., the Sawtooth National Recreation Area, ID and how often did they visit?

**INSECT VISITORS:** Lepidoptera visit *D. fruticosa* flowers significantly less often than Diptera, Hymenoptera and Coleoptera. Denisow et al., (2013) had similar results for ornamental *D. fruticosa* in Europe. No butterflies were observed visiting *D. fruticosa* flowers in King Creek. When totals were compared among sites, mean number (rank) of insect visitors on *D. fruticosa* observed per 10 min. of observation time was significantly greater at Caribou than for Spruce (Kruskal-Wallis Stat. 19.00, p<0.05, Dunns Multiple Comparison test). *D. fruticosa* height, width and flower counts/m<sup>2</sup> were ns among sites.

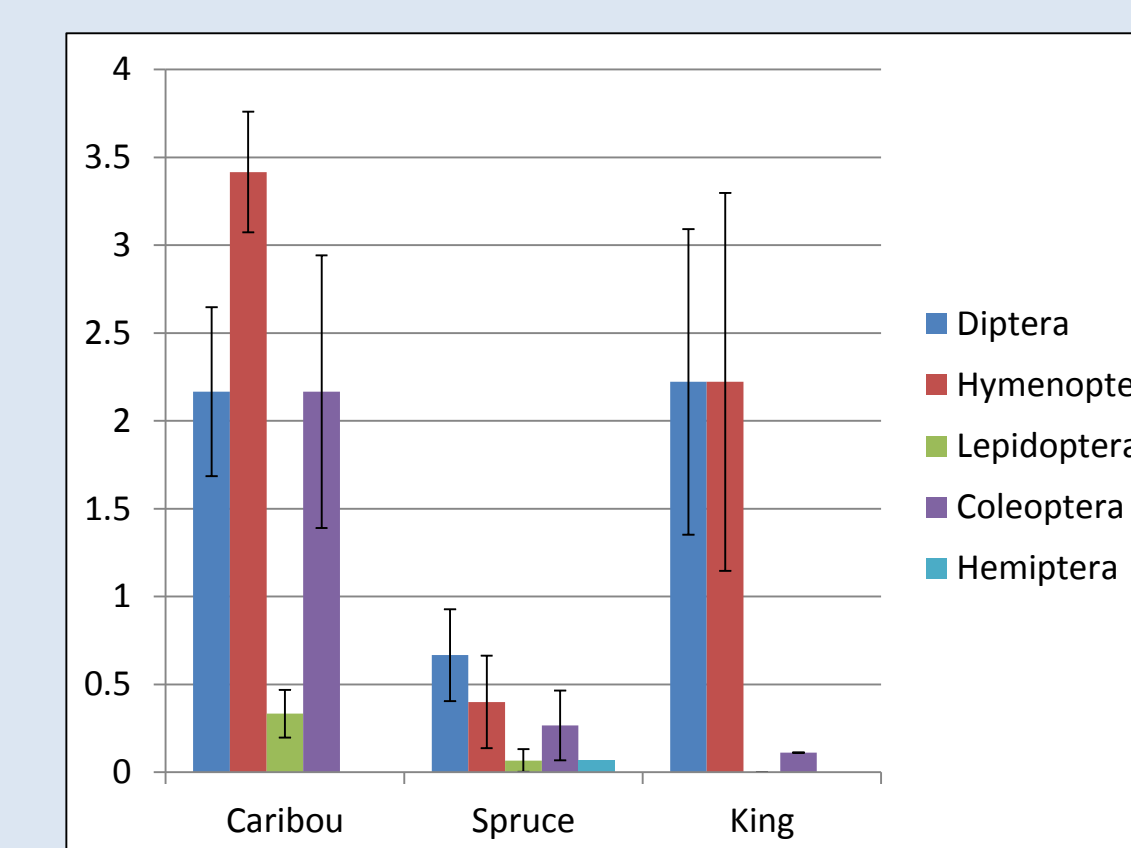


Fig. 5. Mean (+/- SE) number of insect visitors by Order per 10 minutes of observation time among three study areas (Spruce n=15 plants (2.5 hrs); Caribou n=12 plants (2 hrs); King n=9 (1.5 hrs))



Fig. 6. Representative insects from Orders that visited *D. fruticosa*. TOP LEFT: Lepidoptera; TOP RIGHT: Coleoptera; BOTTOM LEFT and MIDDLE: Diptera; BOTTOM RIGHT: Hymenoptera.

- 2a. What was the availability of blooming *D. fruticosa* compared with other non-woody flowering plants (forbs) for insects in the northern (ID) vs southern (NM) Rocky Mountain study areas?

Table 1. Floral resource availability in Idaho study areas

Floral resource availability on Idaho sample sites	Proportion (%) of quadrats a species was present and blooming	
	Spruce (n=25)	Caribou (n=20)
<i>Penstemon procerus</i>	--	75
<i>D. fruticosa</i>	84	80
<i>Potentilla gracilis</i>	92	100
<i>Achillea millefolium</i>	68	35
<i>Geranium viscosissimum</i>	--	75
<i>Rumex</i> spp.	28	--
<i>Bistorta bistoroides</i>	24	--
All others (6 species)	≤12	≤10

Results of  $\chi^2$  on total number of observed number quadrats occupied by each species (n=6 categories) present for Spruce ( $\chi^2=2.28$ , df=5, p<0.05) [Others included: *Calichortus eurycaurus*, *Eriogonum heracleoides*, *Symphitrichum foliaceum*, unknowns] and for Caribou ( $\chi^2=17.72$ , df=5, p<0.05) [Others included: *Solidago* spp., *Agastache urticifolia*, *Rumex* spp., *Cirsium* spp., *Hackelia* spp., unknowns.]

Table 2. Floral resource availability in New Mexico study areas combined

Floral resource availability on New Mexico sample sites	Proportion (%) of quadrats a species was present and blooming (mean of 3 sites for each of two sampling periods)	
	Period 1 (n=18)	Period 2 (n=18)
<i>D. fruticosa</i>	46	63
<i>Potentilla pulcherrima</i>	33	5
<i>P. hippiana</i>	15	9
<i>Achillea lanulosa</i>	46	48
<i>Galium</i> spp.	35	11
<i>Erigeron</i> spp.	0	18
All others (9 species)	<10	<10

Others included: *Allium* spp., *Campanula rotundifolia*, *Erigeron* spp., *Geranium richardsonii*, *Helianthus hoopesii*, *Helianthella quinquevervis*, *Manarda menthifolia*, *Pseudocymopterus montanus*, *Tragopogon dubius* or no blooming forb present.

Table 3. Proportion of total nectaring time and total visits butterflies were observed on blooming plant species that served as available floral resources

Nectar Plant Species	Proportion of total nectaring time spent on plant species	Proportion of total visits to plant species
<i>Dasiphora fruticosa</i>	0.564	0.448
<i>Potentilla gracilis</i>	0.337	0.306
<i>Agastache urticifolia</i>	0.005	0.020
<i>Eriogonum heracleoides</i>	0.040	0.082
<i>Achillea millefolium</i>	0.050	0.061
<i>Symphitrichum foliaceum</i>	0.090	0.041
Other	0.022	0.041
New Mexico (n=54 visiting butterflies) (total # of plants visited = 71)		
<i>Dasiphora fruticosa</i>	0.542	0.478
<i>Potentilla pulcherrima</i>	0.017	0.042
<i>P. hippiana</i>	0.008	0.014
<i>Helianthella quinquevervis</i>	0.077	0.070
<i>Helianthus hoopesii</i>	0.199	0.112
<i>Cirsium undulata</i>	0.008	0.014
<i>Achillea lanulosa</i>	0.012	0.140
<i>Galium</i> spp.	0.013	0.014
<i>Erigeron</i> spp.	0.104	0.085
<i>Allium</i> spp.	0.024	0.028

- 2b. How did butterfly floral visitation rates and nectaring time spent on *D. fruticosa* and other blooming forbs compare between the two state study areas as well as among sites in Idaho?

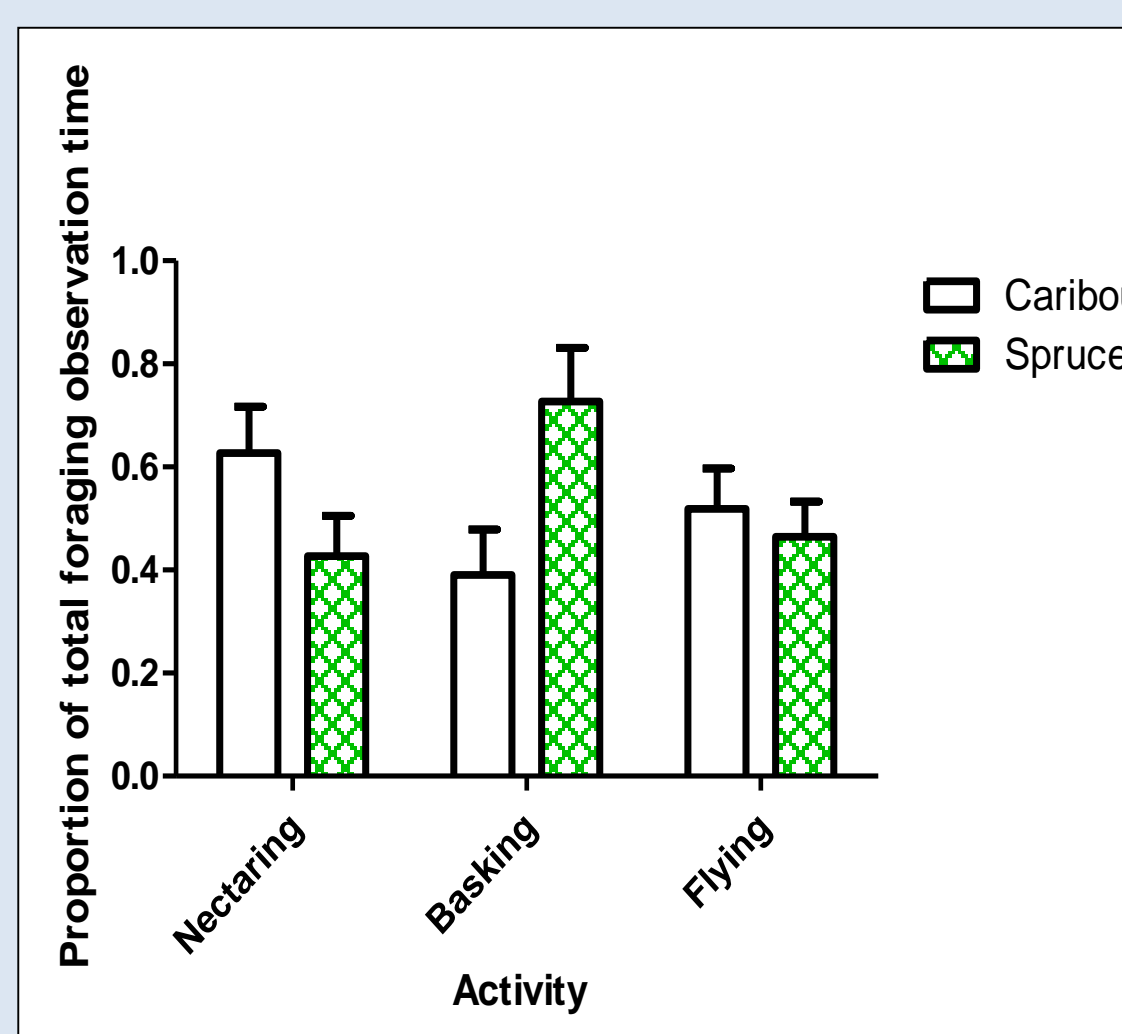


Fig. 7. Comparison of the mean proportion of observation time butterflies spent nectaring, basking and flying in two of the Sawtooth NRA, Idaho study sites. Two Way ANOVA, p<0.05, df=2, F=4.96 for interaction between sites and activity, each alone ns. Butterflies spent significantly more time basking at Spruce Creek. (Due to low numbers, King Ck. and chasing category dropped. Proportions arcsine transformed)

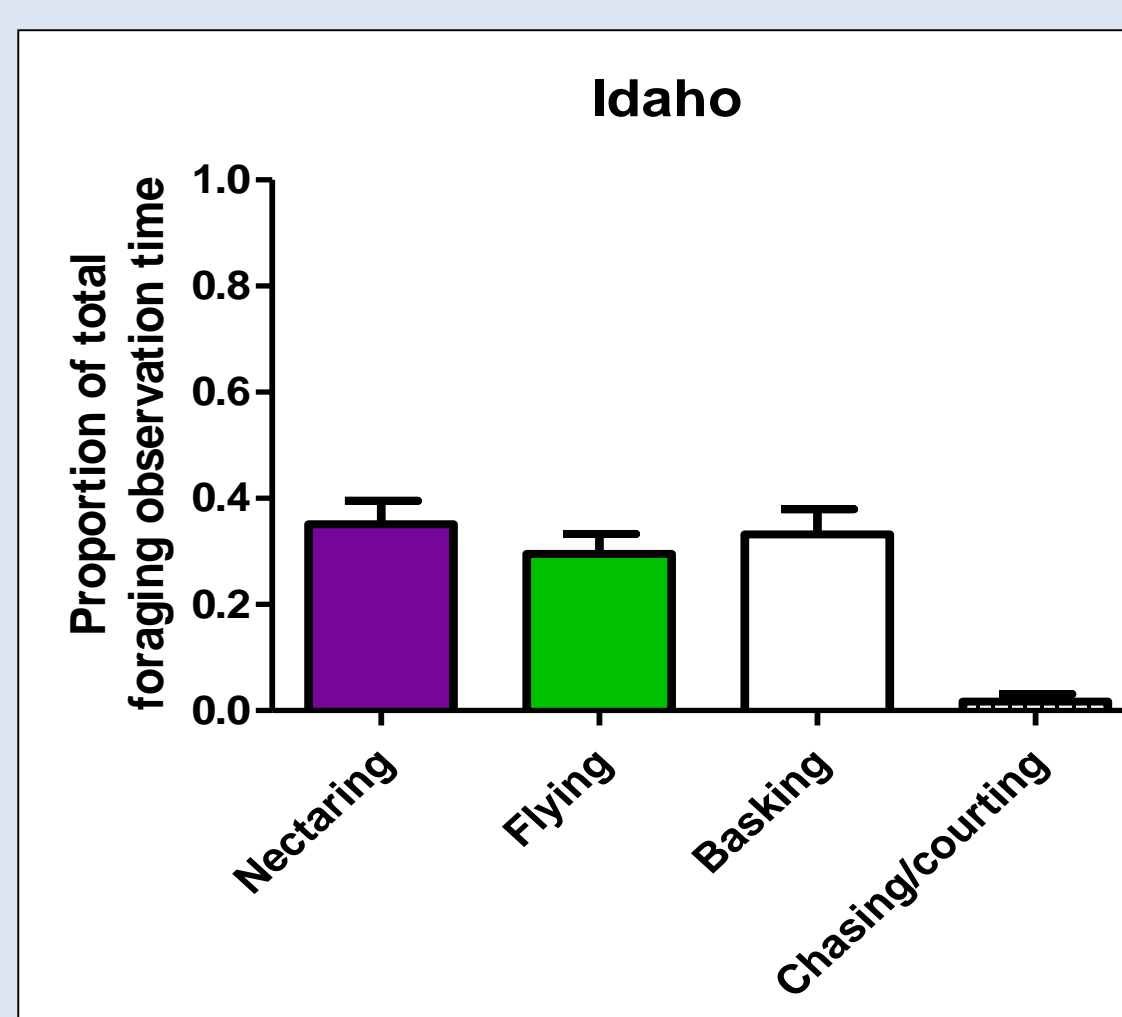
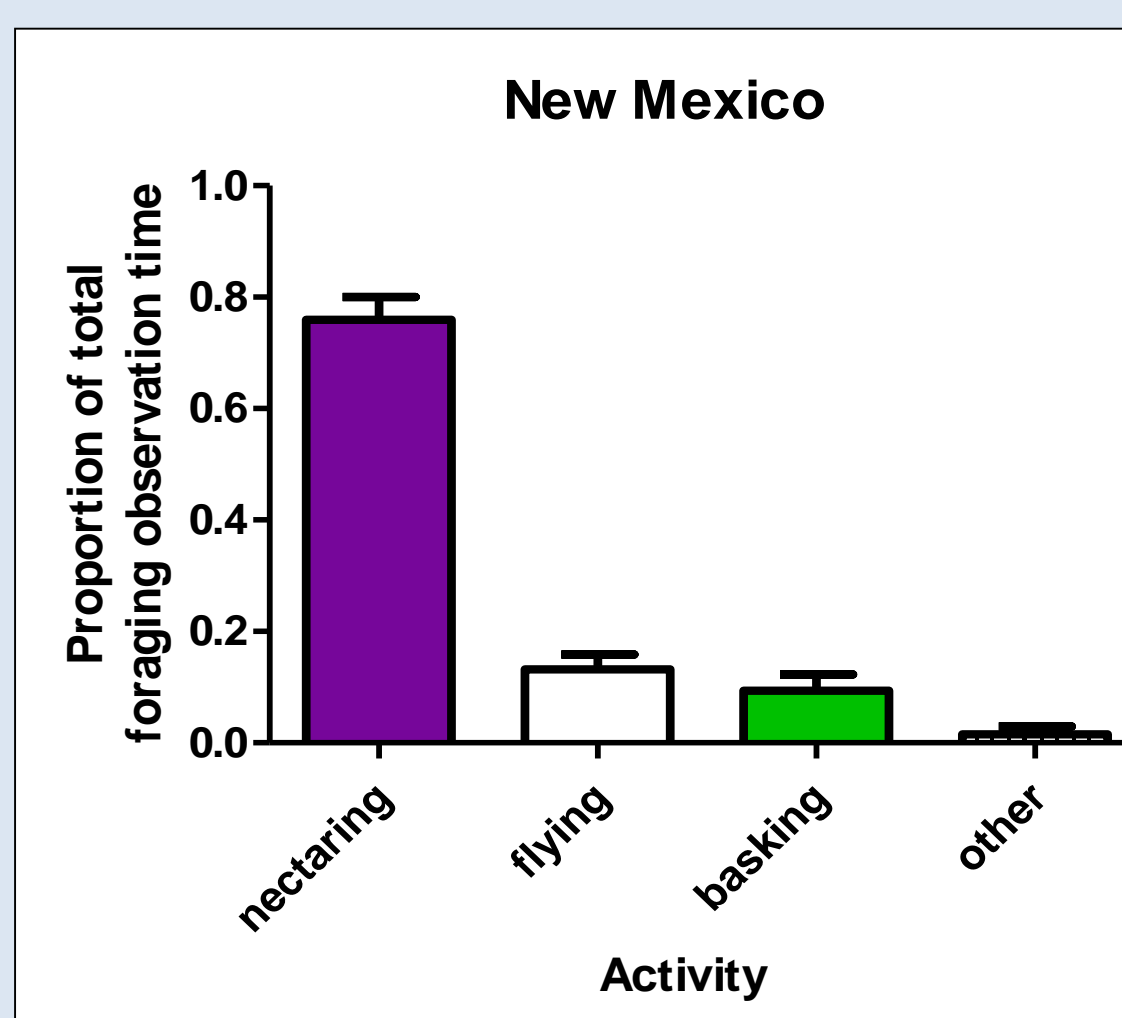


Fig. 8a. Comparison of the mean proportion of observation time butterflies spent on foraging activities in the New Mexico and Idaho study areas.



a) Idaho 2014 (n=71 obsv.), 12 spp. were observed spending significantly less time courting/chasing than any other activity (Kruskal-Wallis Stat. 59.46, p<0.01). Nectaring time ns. Four spp. accounted for 71% of observations (*Lycaena editha*, *Plebejus icarioides*, *Phyciodes campestris*, *Cercyonis oetus*).

b) New Mexico 2004 (n=57 obsv.), 10 spp. were observed spending significantly more time nectaring than any other activity (Kruskal-Wallis Stat. 147.6, p<0.01). Four spp. accounted for 75% of observations (*Lycaena arata*, *Plebejus icarioides*, *Speyeria hesperis*, *Cercyonis oetus*).

Table 4. Summary of butterfly species observed nectaring on *D. fruticosa* in both Idaho and New Mexico

From total observation time	Idaho	New Mexico
# of total butterfly observations (n) for analysis	71	57
Nectaring only (n)=	44	54
# of butterfly species observed nectaring on <i>Dasiphora fruticosa</i> (& species name)	7	10
<i>Lycaena editha</i>		<i>Colias</i> spp.
<i>Lycaena heteronea</i>		<i>Hemiargus isola</i>
<i>Calliphrys spinetorum</i>		<i>Lycaena arata</i>
<i>Plebejus icarioides</i>		<i>Plebejus icarioides</i>
<i>Plebejus saepialus</i>		<i>Plebejus saepialus</i>
<i>Phyciodes campestris</i>		<i>Leptotes marina</i>
<i>Speyeria hesperis hesperis</i>		<i>Speyeria hesperis hesperis</i>
<i>Cercyonis oetus</i>		<i>Cercyonis oetus</i>
<i>Vanessa cardui</i>		<i>Vanessa cardui</i>
<i>Vanessa annabella</i>		<i>Vanessa annabella</i>

**BUTTERFLY BEHAVIOR:** Butterflies spent significantly more time nectaring than any other foraging activity in NM, whereas in Idaho, time was spent more proportionately among nectaring, basking and flying (Fig. 8ab). In Idaho, among sites, butterflies spent more time nectaring in Caribou and basking in higher elevation Spruce Ck., possibly due to warmer temperatures or more attractive floral resources (Table 1, Fig. 7).

**NECTAR PLANT USE and AVAILABILITY:** Although butterflies were infrequent visitors to *D. fruticosa* compared to other Orders in Idaho (Fig.5), when observed alone, they spent more of the total observed nectaring time (54% in NM & 56% in ID, respectively) on *D. fruticosa* than on any other available blooming species. *D. fruticosa* also received a greater proportion of total butterfly visits (48% in NM & 45% in ID, respectively) (Table 3). This was not surprising given *D. fruticosa* was one of the most available blooming floral resources in both regions during our studies (Tables 1,2). *Potentilla* spp. forbs and *Achillea* spp. were also found to be highly available in our study areas at both latitudes. In Idaho, *P. gracilis* was favorable for visitation and nectaring by butterflies but *Achillea millefolium* was not. In NM, butterflies visited *A. lanulosa* often but did not spend time nectaring on it (Tables 1,2,3).

**IMPORTANCE FOR INSECTS:** Butterflies used *D. fruticosa* as a nectar plant in both of our study regions but more so in the Jemez Mountains, NM than in the Sawtooth NRA, ID. Of interest is that two of the same species of butterflies *Plebejus icarioides* and *Cercyonis oetus*, two nymphalids and two regional coppers *Lycaena arata* and *L. editha*, were found nectaring on *D. fruticosa* more than any other butterfly species. In conclusion, and similar to Denisow et al. (2013), we observed flies, bees, and beetles visiting *D. fruticosa* flowers more than butterflies. However, our presence as human observers may have been a disturbance for butterflies on all sites.