

ABSTRACT

Western juniper (*Juniperus occidentalis*) has been expanding its range and increasing in density for over a hundred years in the western United States, where it is native, due to factors such as fire suppression, grazing and even climate change. Extensive efforts have been made to remove western juniper and restore the shrublands being replaced. Seed-feeding insects can greatly reduce the seed crop in any given plant species, so knowledge of the insects that prey upon western juniper seeds and the proportion of seeds eaten could give some insight into the number of viable seeds that are available for dispersal. We have been collecting juniper berries for dissection or rearing twice a year, once in the spring and once in the fall, from 2009-2012 at two field sites in northeastern California. Collections have yielded over 30 different species of arthropods. Relationships between some inhabitants are uncertain, but comprise phytophages, predators, parasitoids, hyperparasitoids, and inquilines. Of particular interest to this study are the seed-destroying arthropods collected, which include species of Coleoptera, Lepidoptera, Hymenoptera, and Trombidiformes. We have found that 6.2% of juniper seeds are eaten or damaged by insects at our sites. This is highly variable among trees, with some trees having almost no viable seeds and other trees escaping insect damage.

INTRODUCTION

The initial research goal was to only identify seed feeding insects that impact the seed crop by reducing the number of seeds available for dispersal and, thus, seedling recruitment. We have discovered a diverse array of arthropods that are too interesting to ignore. Since Marcovitch (1915) described the insects of *J. virginiana* berries, there has not been a description of insects inhabiting juniper cones in North America, and there have not been any publications describing the insects of *J. occidentalis* in particular. With the active management of western juniper occurring throughout its range, it is important to understand the biodiversity associated with these trees.

METHODS

Two field sites in northeastern California: Madeline and Shinn Peak (Figure 1).



Figure 1. Map showing the two juniper berry collection sites.

- ❖ Collection sites were located in the southern portion of *J. occidentalis*' known distribution.
- ❖ Berries were collected once in the fall and once in the spring.
- ❖ In the fall, 20 trees were sampled at both sites and in the spring 10 trees were sampled.
- ❖ For each collection, several hundred berries were collected (unless few were available) from all sides of each tagged tree and placed in a Ziploc bag.
- ❖ Berries were returned to the lab and stored temporarily in the freezer.
- ❖ One hundred berries were haphazardly selected from each bag and the remaining berries were placed in a petri dish to rear adults.
- ❖ These 100 berries were then measured, weighed, and dissected. Skin and husk ("fruit") color, as well as the presence of any holes in the skin or seed coat, along with evidence of frass in the seed or husk was also recorded.
- ❖ The number of seeds per cone was noted and seeds were carefully cut open.
- ❖ When immatures or adults were found, location (fruit or seed), condition, color and a short description was recorded. Presence and condition of exuvia, eggs, and other potentially relevant is also recorded.
- ❖ Berries have also been collected from trees adjacent to study plots and placed in light boxes to rear additional adults.

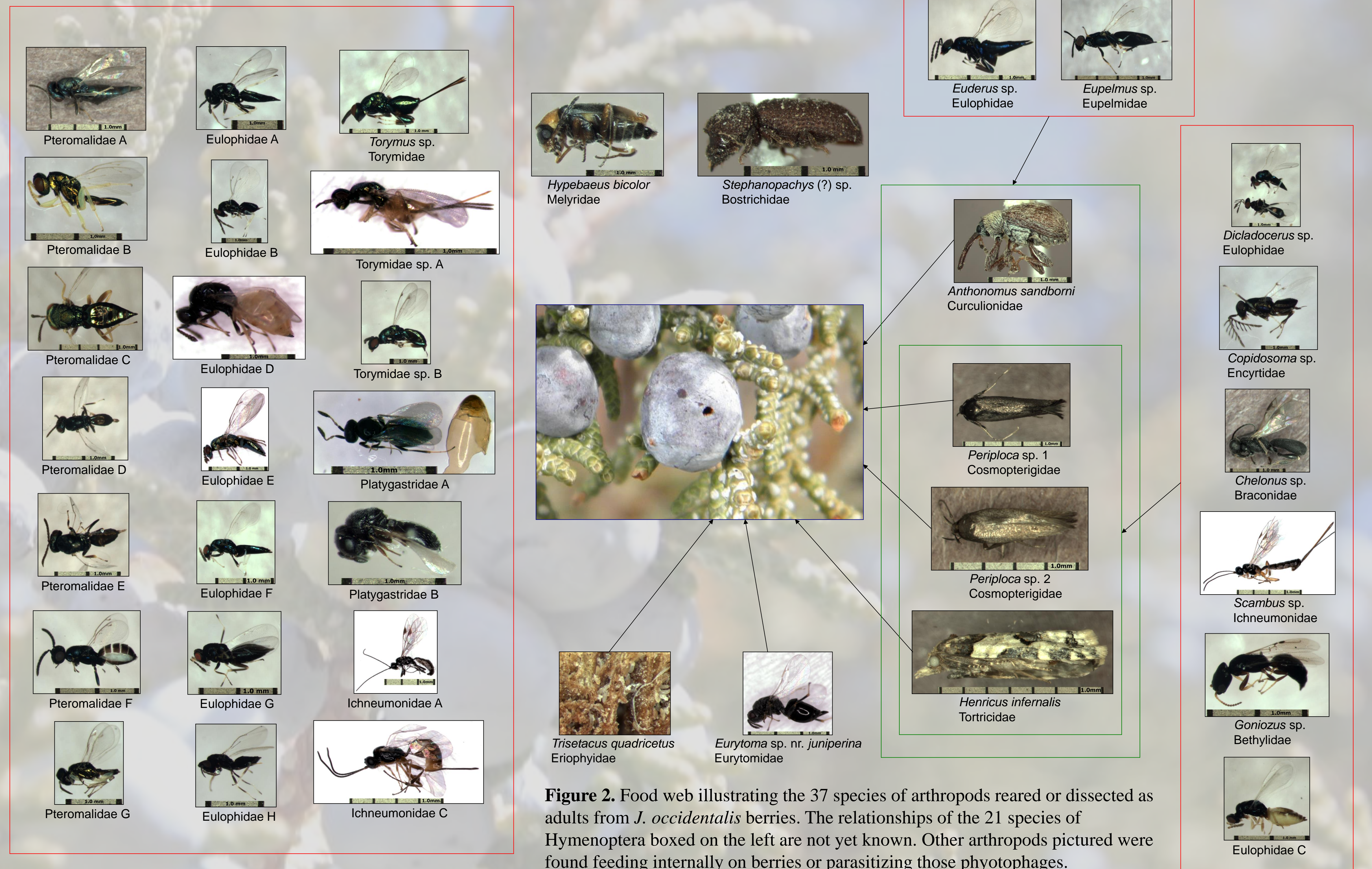


Figure 2. Food web illustrating the 37 species of arthropods reared or dissected as adults from *J. occidentalis* berries. The relationships of the 21 species of Hymenoptera boxed on the left are not yet known. Other arthropods pictured were found feeding internally on berries or parasitizing those phytophages.

RESULTS

- ❖ 37 species of arthropods were reared or dissected from spring and fall collected berries at two locations in northeastern California (Figure 2).
- ❖ Particular habits of numerous collected species are not yet known. Six species of phytophagous arthropod adults were found in our sampling.
- ❖ Of the 36 species of berry-inhabiting insects encountered at our sites, 19 are represented by 5 or fewer adults of the 420+ reared out or dissected from berries.
- ❖ Nearly half of the 420+ adults belong to 3 groups – *Periploca* spp., *Eurytoma* sp. nr. *juniperina*, and Pteromalidae A.
- ❖ Out of 15,014 dissected berries, 990 contained mite damaged seeds. This was highly variable between trees, with one tree having mite attacked seeds in 72 out of 100 berries, while many others had no mites in the 100 berries selected.

CONCLUSIONS

Juniperus occidentalis harbors a diverse and complex community of arthropods in cones. Some of these insects can drastically reduce a seed crop within a given year, leaving almost no seeds available for dispersal, while others seem to only consume the husk. Densities of these seed feeding or husk feeding arthropods can vary greatly from tree to tree. Parasitoids and hyperparasitoids are associated with both seed and husk feeders. DNA analysis matching unidentified larvae dissected from berries to identified adults should aid in revealing detailed life histories of these arthropods and allow us to better understand which part each of these characters play in this juniper berry microcosm.

ACKNOWLEDGMENTS

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