

HABITAT AND POPULATIONS OF THE VALLEY ELDERBERRY LONGHORN BEETLE ALONG THE SACRAMENTO RIVER¹

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Abstract: Prior to 1985, the valley elderberry longhorn beetle, a threatened species protected under the federal Endangered Species Act, was known only from northern California riparian areas along the American River and Putah Creek in the Sacramento Valley, and along several rivers in the northern San Joaquin Valley. During 1985-1987, our study extended the known range of the beetle northward along the Sacramento River to Red Bluff by searching riparian areas for elderberry shrubs, the required habitat for beetle larvae; by searching shrubs for beetle emergence holes; and by searching for adult beetles during their brief spring emergence period. The survey results showed that the beetle is distributed widely along the river but is rare.

The valley elderberry longhorn beetle (*Democerus californicus dimorphus* Fisher [Coleoptera: Cerambycidae]), herein abbreviated VELB, is federally designated as a threatened species under the Endangered Species Act. VELB is endemic to riparian areas in the Sacramento and San Joaquin Valleys of California, where its larvae inhabit elderberry (*Sambucus* sp.) shrubs. Because of the severe reduction in the Central Valley's natural riparian vegetation over the last 150 years, the beetle's habitat has become scarce and discontinuous.

This paper describes a study to determine (a) locations of active colonies of the VELB along the Sacramento River from the City of Sacramento upstream to Red Bluff, and (b) the distribution of potential and actual VELB habitat within the same reach. Potential VELB habitat was defined by the presence of elderberry shrubs within areas of riparian vegetation. Actual VELB habitat was defined by the presence of VELB emergence holes in elderberry shrubs. Active colonies were defined by detection of adult VELB during their spring emergence period in April and May.

The Valley Elderberry Longhorn Beetle

Two subspecies of elderberry longhorn beetles, (*D. c. dimorphus* and *D. c. californicus*), occur in California. The California elderberry longhorn beetle (*D. c. californicus*) occupies valleys of the coastal ranges of Califor-

nia, from Los Angeles northward to Mendocino County. The two subspecies occupy distinct geographic ranges (Linsley and Chemsak 1972).

VELB (i.e., *D. c. dimorphus*) are moderate-sized, brightly colored, sexually dimorphic beetles with female body lengths of 18-25 mm and male body lengths of 13-21 mm (Linsley and Chemsak 1972). Their antennae are long, extending more than half their body lengths. Males exhibit one of two different color patterns. In some, the elytra (i.e., the first pair of hardened wings that protect the flight wings) resemble those of the coastal subspecies (*D. c. californicus*), whose elytra are dark metallic green with bright reddish orange borders (U.S. Fish and Wildlife Service 1984). In other VELB males, the solid green pattern is reduced to four oblong spots on the elytra. Intergrades between the two divergent color patterns also exist. In general, both male and female VELB are smaller than *D. c. californicus*.

Little is known about the life history of VELB; it is assumed, however, to follow a sequence of events similar to that of several related species of *Democerus* beetles (U.S. Fish and Wildlife Service 1984). Females may lay as many as 200 eggs during their short life span. Eggs are laid on foliage or leaf petioles at the outer tips of branches of living elderberry plants and in bark crevices of larger stems and trunks. Presumably, the eggs hatch 2-3 days after they are laid. Larvae bore through the pith of stems and possibly through the roots of elderberry shrubs. When larvae are ready to pupate, they work their way through the pith, open an emergence hole through the bark, and then return to the pith for pupation. Adults exit through the emergence holes, approximately 0.5 cm in diameter, and then can be found on elderberry foliage, flowers, or stems, or on associated plants (U.S. Fish and Wildlife Service 1984).

VELB was first described by Fisher in 1921 from specimens collected in Sacramento (U.S. Fish and Wildlife Service 1984). By 1984, VELB was known from only three Central Valley drainages: Merced River, Putah Creek, and the American River. Since designation of the VELB as threatened in 1980, a number of field surveys (in addition to those reported here) have produced new records of VELB through observations of adult beetles or their emergence holes. These new locations include many sites on the American River floodplain; the

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Cosumnes River floodplain; sites along several creeks near Roseville, California, west of Folsom Lake; and sites along the Mokelumne, Calaveras, San Joaquin, Middle, Tuolumne, and Merced Rivers in the San Joaquin Valley (Jones & Stokes Associates, Inc. 1987).

Study Area

The study area encompassed the floodplain of the Sacramento River, from its confluence with the American River at River Mile (RM) 60 in the City of Sacramento to Red Bluff Diversion Dam at RM 243. Within this 183-mile-long reach, the study focused on areas occupied by native riparian vegetation, which comprises a mosaic of riparian scrub on levees and other regularly disturbed areas, young-growth cotton wood-willow forest on lower terraces, and mature mixed-riparian forest on higher terraces. Many intervening sites have been cleared for agriculture or installation of levee protection. Other papers presented in these proceedings, such as by McCarten (1988), describe riparian vegetation along the Sacramento River in greater detail.

Methods

Riparian vegetation within the study area was delineated on aerial photographic map plates in the Sacramento River Aerial Atlas of the U.S. Army Corps of Engineers (U.S. Army Corps of Engineers 1984). At least 30 percent of the riparian vegetation area was selected randomly and visited during the winter surveys. Individual survey polygons were selected so that the probability of selection was proportional to the size of the polygon of delineated riparian vegetation (Husch and others 1972). Polygons of riparian vegetation varied widely in size from less than 1 hectare to more than 50 hectares. Use of the proportional probability selection procedure ensured that large-area polygons would not be under-represented in the survey.

Each selected riparian polygon was searched thoroughly on the ground to determine the presence or absence of elderberry shrubs. If present, elderberry shrubs were in turn thoroughly searched for VELB emergence holes by inspecting the shrub stems carefully. Holes were presumed to have been produced by VELB emergence if they were of the appropriate shape and size (i.e., about 0.6 cm diameter and uniformly cylindrical). No other Cerambycid borers are known to occupy elderberry shrubs in Central Valley riparian areas. Stem searches were often quite difficult because of dense understories of poison-oak and blackberries. Any elderberries found to have VELB emergence holes were characterized on field data sheets.

Spring surveys for adult VELB were conducted in stands of elderberries with emergence holes previously detected during the winter surveys. A three- or four-person crew walked slowly through the elderberry stands, searching the leaves, flowers, and stems of each shrub, sometimes using binoculars. Spring surveys were conducted during the late April to late May period when adult beetles emerge from their larval galleries. Where adult beetles were collected, data were taken on characteristics of the VELB specimens, the substrates on which they were found, weather conditions, elderberry phenology, and vegetation structure. All collected VELB specimens were deposited in the University of California, Berkeley, Essig Museum.

Results

Elderberries as Potential Habitat

The winter surveys over 3 study years (i.e., 1985, 1986, and 1987) covered a total of 1,943 hectares in 66 polygons of riparian vegetation (Table 1). Average sizes of surveyed polygons varied among three sections of the study area. In the Sacramento-Colusa reach, 25 polygons averaged about 15 hectares per polygon; in the Colusa-Chico Landing reach, 23 polygons averaged 30 hectares per polygon; and in the Chico Landing-Red Bluff reach, 18 polygons averaged 50 hectares per polygon. This pattern reflects the fact that riparian vegetation below Colusa is confined to narrow strips within tightly constraining levees. From Colusa to Chico Landing, setback levees encompass large areas of riparian vegetation, and above Chico Landing, the absence of levees is associated with the largest stands of riparian vegetation.

Sixty-three of the 66 polygons surveyed throughout the study contained stands of elderberry shrubs (Table 1). Two of the three polygons without elderberries were located in the Sacramento-Colusa reach, possibly reflecting higher intensities of maintenance on narrow berms within the levees below Colusa.

VELB Emergence Holes

VELB emergence holes were found in 42 (64 percent) of the 66 polygons covered by the winter surveys (Table 1). Percentages of polygons with detected emergence holes increased from 28 percent below Colusa to 94 percent above Chico Landing. Evidently, habitat use by VELB has been wide-spread throughout the upstream portions of the study area.

Table 1 - Aggregate survey results for 3 study years.

River Mile	Collection Date	Time of Day	Weather	Temp.	Specimen Characteristics			Substrate Characteristics			
					Sex	Activity During Observation	Height During Observation (c)	Stem Diameter (m)	Total Height (m)	Exposure of Shrub	Overstory
84.3 west	5/3/85	1200	Clear, gentle breeze	77 °F	Male	walking, flying	2.1	7.6	6.0	Sun	Open
84.3 west	5/3/85	1226	Clear, gentle breeze	77 °F	Male	walking	1.5	5.1	2.0	Sun	Open
126.5 west	5/3/85	1558	Clear, no wind	75 °F	Female	Resting	0.9	2.5	1.2	Part shade	Open
235 West	5/5/85	1105	Clear, no wind	78 °F	Male	Flying, resting	2.1	5.1	4.6	Sun	Open
138.7 West	4/29/87	1100	20% clouds, no wind	70 °F	Female	Resting	2.1	10.2	3.0	Shade	Mixed riparian
138.7 West	4/29/87	1130	20% clouds, no wind	75 °F	Male	Resting	1.8	1.9	3.0	Shade	Mixed riparian
169.5 West	4/29/87	1540	50% clouds, slight breeze	80 °F	Male	Resting	3.0	14.0	6.0	Sun	Open
177.7 East	5/7/87	1045	20% clouds, no wind	85 °F	Female	Resting	2.4	10.2	6.0	Sun	Open
179.4 East	5/8/87	1022	20% clouds, no wind	80 °F	Male	walking	1.2	10.2	4.6	Sun	Open
179.4 East	5/8/87	1350	30% clouds, no wind	90 °F	Female	Resting	0.08	11.4	4.6	Sun	Open

Stem Diameter at VELB Emergence Holes

Stem diameters at 49 current-year emergence holes detected in May 1987 are shown by size classes in Figure 1. Current-year holes were positively identified by the presence of fresh wood and frass (i.e., wood shavings usually mixed with excrement produced by the boring insect). No holes were detected on stems less than 2.5 cm in diameter, whereas the largest stem with a hole was 20 cm in diameter. Sixty-six percent of the holes were observed in stems less than 7.0 cm in diameter, and 34 percent were observed in stems greater than this size.

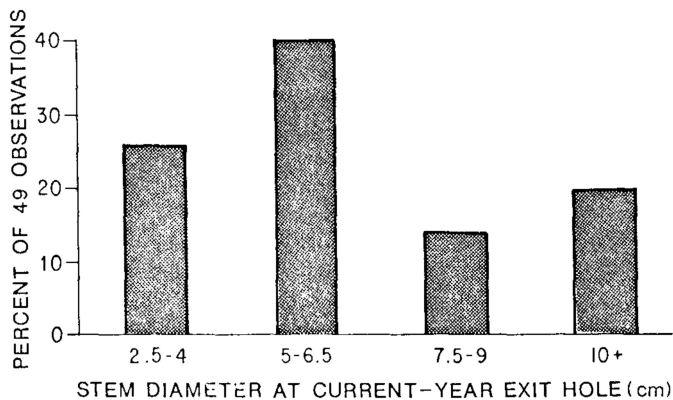


Figure 1- Frequency distribution of stem diameters at current-year holes detected in May 1987.

Stem Height at VELB Emergence Holes

Stem heights were estimated at 627 VELB emergence holes observed during 1986 and 1987 surveys. Nearly 70 percent of the observed emergence holes were at heights at or below 1.2 m on elderberry stems (Figure 2). Approximately 10 percent were detected at heights above 1.8 m.

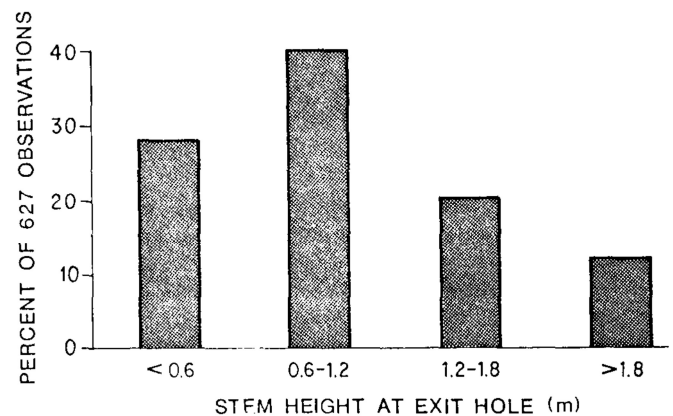


Figure 2- Frequency distribution of stem heights at VELB exit holes detected in 1986 and 1987.

Table 2 – Descriptions of collections of adult VELB specimens.

Reach	Winter Surveys						Spring Surveys			
	Area Surveyed (ha)	Polygons Surveyed	Polygons with:				Area Surveyed (ha)	Polygons Surveyed	Polygons with Adult VELB	
			Elderberries No.	Percent	VELB Exit Holes No.	Percent			No.	Percent
Sacramento- Colusa (RM 60-145)	383	25	23	92	7	28	40	4	3	75
Colusa Chico Landing (RM 145-195)	688	23	22	96	18	78	523	16	3	19
Chico Landing- Red Bluff (RM 195-243)	875	18	18	100	17	94	274	13	1	8
TOTAL	1,946	66	63	95	42	64	837	33	7	21

Characteristics of Elderberry Clumps with VELB Exit Holes

A total of 367 elderberry clumps (i.e., groups of stems apparently arising from the same root stock) with VELB emergence holes were observed during the three winter surveys. Elderberry clumps with holes were found in young-growth riparian stands of young cottonwoods and willows on low-terrace areas of the Sacramento River floodplain (15 percent of 360 clumps); riparian stands of mature and senescent cottonwoods, generally on low-terrace areas, often with woody vines of wild grape (35 percent); mature riparian stands of mixed tree species including cottonwood, boxelder, walnut, or valley oak, often with woody vines of wild grape, on high-terrace areas (35 percent); and both high- and low-terrace areas with no overstory (14 percent of clumps).

Adult VELB Collections

Ten VELB adults were collected at seven different locations on five different dates in spring 1985 and spring 1987 (Table 2). The adult beetles were collected in seven of the 33 polygons surveyed during spring (Table 1). Three of the four polygons below Colusa provided VELB collections, indicating the importance of narrow riparian strips with elderberries as active VELB habitat.

Adult VELB were collected in 3 of the 16 polygons surveyed during spring between Colusa and Chico Landing. Nine of these 16 polygons were surveyed during late

spring 1986, when no VELB were found anywhere in the study area, possibly due to effects of the February 1986 flooding along the Sacramento River, unusual weather conditions, and patterns of elderberry phenology during spring 1986. Above Chico Landing, adult VELB were collected in only 1 of the 13 polygons (Table 1). The low collection rate here also reflected the regionwide lack of collections in 1986.

More details on study results can be found in the report by Jones & Stokes Associates (1987).

Discussion

VELB Rarity

During this study, approximately 70 person-days of field time were spent searching habitat containing VELB emergence holes. This effort resulted in collections of only 10 adult VELB, showing that VELB is a rare insect. Our low rate of collection may have been influenced by two other factors in addition to the species' rarity. Visual searches for VELB adults are difficult within suitable habitat because elderberry shrubs are tall and because VELB adults are generally more active in higher portions of shrubs (e.g., 5 of 10 adults were

collected at heights of 2 m or more). Many shrubs are inaccessible because of dense understories or overhanging vines of wild grape, blackberry, and poison-oak. In addition, VELB adults are not greatly mobile, they do not concentrate on elderberry flowers, and they do not often fly about, even in hot weather.

VELB Distribution on Sacramento River Floodplain

VELB emergence holes were detected in elderberries in most riparian stands surveyed, indicating that VELB are widespread, although rare, in suitable riparian habitat along the Sacramento River. The relatively small proportion of current-year emergence holes suggests that the population is limited at any one site by factors other than habitat availability.

Within the Sacramento River floodplain, VELB does not appear to be restricted to particular kinds of riparian vegetation or floodplain topography. VELB emergence holes were found in nearly all situations, ranging from isolated elderberry clumps in savannalike areas to continuous stands beneath tall overstories, areas with or without extensive woody understory vegetation, and on both low- and high-terrace floodplains.

VELB requires established elderberry plants of mature size and age. No emergence holes were found on stems less than 2.5 cm in diameter, consistent with the presumed 2-year period that VELB larvae are thought to inhabit elderberry shrubs. Stems of less than 2.5 cm in diameter may be inhabited by VELB larvae but grow greatly in diameter within the 2-year period. Annual cutting, burning, or herbicide treatment of elderberry shrubs would preclude VELB occupancy.

Role of Birds

If birds forage after VELB larvae, they may be an important factor regulating VELB populations. Bird holes were found at nearly every site where VELB emergence holes were found. A key need for monitoring VELB populations is to determine the role of birds in creating holes in elderberry stems, in enlarging or reworking VELB emergence holes, and in preying on VELB larvae. Easily distinguished bird holes were at least as common as VELB holes at many sites and were far more abundant than VELB holes at some sites. We dissected several elderberry stems with bird holes and found evidence of tunneling by insect larvae, presumably VELB, in the pith.

In searching for evidence of VELB, we recorded only clearly identifiable Cerambycid emergence holes and rejected holes that appeared to be created or enlarged by birds. If birds commonly enlarge holes originally bored by emerging VELB, they would obscure them as VELB

emergence holes. Thus, the VELB population along the Sacramento River may be larger than is currently indicated by frequencies of emergence holes.

Sizes and Ages of Elderberries Used by VELB

Nearly 70 percent of current-year exit holes found in May 1987 were in stems 2.5-6.5 cm in diameter at the emergence hole. None were in stems less than 2.5 cm in diameter. Because of the rapid growth rate of young elderberries, stems less than about 6 cm in diameter may have grown from new shoots within the 2-year period of VELB larval occupation.

The best strategy for VELB habitat management is to maintain mixed stands containing all ages and sizes of elderberries. Our data suggest that VELB larvae are able to inhabit a broad range of ages and sizes of elderberries over a minimum size threshold of about 2.5 cm basal stem diameter. Where VELB habitat restoration or enhancement is being considered, a mixture of sizes of elderberries should be established to increase habitat area and quality.

Conclusions

The currently known range of VELB extends through the San Joaquin- Sacramento Valley from the Merced River in Merced County northward to near Red Bluff on the Sacramento River in Tehama County. Our study extended the known range northward by about 120 air miles and 183 river miles, from the City of Sacramento to Red Bluff. Other recent studies have extended the known distribution to at least 6 rivers in the San Joaquin Valley and along the American River through the City of Sacramento.

The currently known range is based on observations of either adult VELB or VELB emergence holes in elderberry shrubs. In our winter surveys along the Sacramento River, 95 percent of all surveyed stands of riparian vegetation contained elderberry shrubs, and VELB emergence holes were detected in 64 percent of the surveyed stands. During our spring surveys in stands with emergence holes, we collected adult VELB in 7 of the 34 stands surveyed.

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PRACTICAL TECHNIQUES FOR VALLEY ELDERBERRY LONGHORN BEETLE MITIGATION¹

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The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) is a live-wood pith-boring beetle of the family Cerambycidae. Elderberry (*Sambucus* spp.) shrubs are the beetle's exclusive host plant. The valley elderberry longhorn beetle (VELB) is classified as a threatened species by the U.S. Fish and Wildlife Service. The VELB is sporadically distributed in the Sacramento and San Joaquin Valleys from Red Bluff to Fresno, California.

This poster presentation describes mitigation measures for VELB habitat loss that has resulted from public and private development at sites along the Sacramento and American Rivers.

Mitigation Techniques and Project Examples

When designing a mitigation program for VELB, it is essential to consider the ecological characteristics of both the VELB and the elderberry host plants, site conditions at both the impact site and the mitigation site if offsite mitigation is used, and the importance of proper timing when dealing with natural systems.

The best way to mitigate project impacts is to build protection of existing elderberry habitat into the project. This is difficult in urban settings where public use and activities reduce the potential for long-term survival and regeneration of elderberry shrubs.

Transplanting Mature Shrubs

Where preservation of habitat in place is not possible, mitigation programs can include habitat enhancement offsite. Transplanting mature elderberries occupied by VELB to a new site is one way to mitigate by offsite habitat enhancement. Unlike offsite mitigation using elderberry seedlings or rooted cuttings, the transplanting of mature plants, if successful, can also translocate VELB larvae within stems to the new site. Successful transplanting of mature elderberry plants when the plants are dormant (approximately November through the first two weeks of February)

Foliage and stems should be pruned to reduce the shoot:root ratio and thus reduce transpirational load until the root system reestablishes. In addition, transplanted shrubs should be irrigated on a schedule that will gradually wean them from artificial moisture supplies. The large-diameter plant material pruned from mature elderberries also should be moved to the transplant site because larvae inhabiting the prunings may emerge as VELB adults during the spring emergence period and lay eggs on the transplanted elderberries.

As mitigation for a large land development project, mature elderberry plants were moved by Jones & Stokes Associates to a parcel deeded to the county as an addition to the American River Parkway. Approximately 80% of the transplanted plants were surviving after the first growing season.

Revegetating with Seedlings or Rooted Cuttings

Elderberry seedlings or rooted cuttings also can be used for offsite habitat enhancement or compensation. An ideal offsite mitigation plan would use young plants in combination with transplanted mature plants.

The easiest way to grow young plants for revegetation is from seed. If seed is not available, cuttings can be taken either in the dormant season as hardwood cuttings or in the spring as softwood cuttings.

Rooted cuttings planted by the California Department of Water Resources in the American River Parkway as mitigation for a floodway vegetation removal program are in their second growing season after planting. The plants were irrigated regularly through the first growing season (every 10 days to 3 weeks). The watering was reduced in the second season, and no watering will occur in following years. The plants had a high survival rate of about 90% after the first growing season, and at the end of the second year well over 50% are still thriving.

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