

GEOGRAPHICAL DISTRIBUTION OF HOSTPLANT CHOICE
IN *EUPHYDRYAS EDITHA* (NYMPHALIDAE)

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An investigation of populations of *Euphydryas editha* Boisduval reveals a disjunct distribution of foodplant choice (Fig. 1). *Euphydryas editha* may oviposit on plants of at least five genera: *Collinsia*, *Castilleja*, *Pedicularis*, *Orthocarpus* (Scrophulariaceae), and *Plantago* (Plantaginaceae). With rare exceptions, only a single plant species is selected in each population, even though plants that are selected elsewhere may be abundant. This parallels observations of Downey & Fuller (1961) on *Plebejus icarioides* Boisduval. We have visited as many *Euphydryas* populations as possible, identifying primary hostplants of 50 by observing oviposition or by locating eggs or webs of prediapause larvae. Post-diapause larvae may move onto secondary foodplants and may even prefer these to primary hosts (Table 1). Oviposition preference in the laboratory is not necessarily the same as that in the field, and cannot always be used as positive evidence for placing a population in a particular foodplant category.

Our present knowledge of the distribution of hostplant choice (mostly in California) is summarised in Fig. 1. Though it is difficult to separate cause and effect, there are strong correlations between plant species chosen and a) timing of flight season, and b) type of community inhabited. Early-flying, coastal populations are *Plantago*-feeding, with some oviposition on *Orthocarpus* (EW, WS) and fewer on *Collinsia* (CS). Low altitude, late-flying populations in the chaparral belt of the Inner Coast Ranges are all on serpentine soils and utilise *Pedicularis densiflora* Benth. ex Hook. (plant identifications follow Munz & Keck, 1959). Very close to a number of *Pedicularis*-feeding populations, but on a scree at 6900 feet in elevation in Mendocino County there is a single population (HM) feeding on a small and rather scarce annual, *Collinsia greenei* Gray. At similar elevations of the Sierra Nevada and in the San Bernardino Mountains we have records of small *Collinsia* species being utilised: *C. childii* Parry ex Gray at CP, *C. callosa* Parish at WK, and *C. parviflora* Dougl. ex Lindl. on both the east (SN) and the west (SL) slopes of the Sierra. It seems likely (S. O. Mattoon, pers. comm.) that

TABLE I. Primary and secondary foodplants of some *E. editha* populations.

Population	Oviposition plants in order of importance	Secondary prediapause foodplants	Postdiapause foodplants in order of importance
JR	<i>P. erecta</i>	<i>O. densiflorus</i>	<i>P. erecta</i> <i>O. densiflorus</i>
EW	<i>O. densiflorus</i> <i>P. erecta</i>		<i>O. densiflorus</i> <i>P. erecta</i>
LO	<i>P. insularis</i> <i>P. hookeriana</i>		<i>P. insularis</i> <i>P. hookeriana</i> *
DP	<i>P. densiflora</i> <i>C. bartsiaefolia</i>		<i>P. densiflora</i> <i>C. foliolosa</i> <i>C. affinis</i> <i>C. bartsiaefolia</i>
CP	<i>C. childii</i>		<i>C. childii</i>
WK	<i>C. callosa</i>		<i>C. callosa</i>
SN	<i>C. parviflora</i> <i>P. lanceolata</i>		<i>C. parviflora</i> <i>P. lanceolata</i>
SL	<i>C. parviflora</i>		<i>C. parviflora</i> <i>P. semibarbata</i>
GH	<i>P. semibarbata</i>		<i>P. semibarbata</i>
MC	<i>C. tinctoria</i>		<i>C. tinctoria</i> <i>C. sparsiflora</i> <i>Lonicera interrupta</i> <i>Plectritis ciliosa</i> *
IF	<i>C. tinctoria</i>		<i>C. tinctoria</i>
GL	<i>C. nana</i>		<i>P. heterodoxus</i> <i>C. nana</i>
TM	<i>C. nana</i>		<i>C. nana</i>

* Order of importance may vary from year to year.

populations of this type occur widely in Lassen and Shasta counties. In the southwestern Sierra these *Collinsia*-feeding populations are interspersed with colonies in the same general habitat (coniferous forest clearings; sandy, granitic soil) in which *Pedicularis semibarbata* Gray is utilised (GH, BM). Both *P. semibarbata* and *C. parviflora* are common and well distributed, but *E. editha* populations seem to be few and widely scattered at these altitudes. Thus, as with *P. densiflora* in the Inner Coast Ranges, the distribution of *E. editha* is not limited by the distribution of its larval foodplants.

At lower altitudes (1000–4000 ft.) in the western Sierra is a N–S belt of *E. editha* populations which are hostplant specific for *Collinsia*

tinctoria Hartw. ex Benth., rejecting even other *Collinsia* species where these are present (*C. sparsiflora* F. & M. at MC, and *C. sp.* at IF).

Finally, at high altitudes (8000–11,500 ft.) along the crest of the Sierra we have found oviposition on *Castilleja nana* Eastw. to be the rule. At one of these populations (EP) we found another case of rejection of a congeneric plant, *Castilleja breweri* Fern. At EP, *C. breweri* is as abundant as *C. nana* and grows intermingled with it, but is not used for oviposition.

Although the geographical range of *E. editha* extends from British Columbia to Baja California and eastwards to Colorado, Wyoming, and Alberta, we have little information on foodplant choice outside of California. In eastern Nevada we found two populations approximately three miles apart. In one of these, at 8000 ft. in a Pinon-juniper community, *Pedicularis centranthera* is the foodplant, while in the other, at 11,000 ft., oviposition is on *Castilleja lapidicola*. In the McDonald Forest, near Corvallis, Oregon, we found postdiapause larvae feeding on the common weed, *Plantago lanceolata* L., in clearings of coniferous forest. We have been informed (D. V. McCorkle, pers. comm.) that this Eurasian import is also utilised for oviposition.

We suspect that, even for California, the pattern of foodplant choice we describe here is incomplete. We have been unable to locate eggs or larvae of *E. editha* at a number of California populations where adults are well known, notably Parkfield Summit (Fresno-Monterey county line), Gold Lake (Sierra County), Bishop Creek (Inyo County), and Mather (Tuolumne County). Furthermore, several museum records of *E. editha*, such as those from eastern San Diego County, seem not to fit into any of the categories we have described.

These data indicate that conclusions about foodplant relationships of an entire species of herbivorous insect should be made with caution when they are based on study of one or a few populations. Furthermore, since other aspects of the ecology of the insect, such as population dynamics, may be influenced by its choice of foodplant (White, 1973), these types of investigation also should ideally proceed on a population basis until a general pattern emerges. The lack (or complexity) of pattern in our data (Fig. 1) emphasizes the importance of evolution at the population level in the strategy of *E. editha*. Such evolution has allowed rapid exploitation of new food resources, such as the imported *Plantago lanceolata* and *Plantago insularis* Eastw. (Bassett & Baum, 1969) as they have become available. This exploitive ability stems from the high reproductive potential of *E. editha* (Labine, 1968) and the low frequency of oviposition on alternative foodplants coupled with the ability to utilise these plants in response to selection. The hypothesis

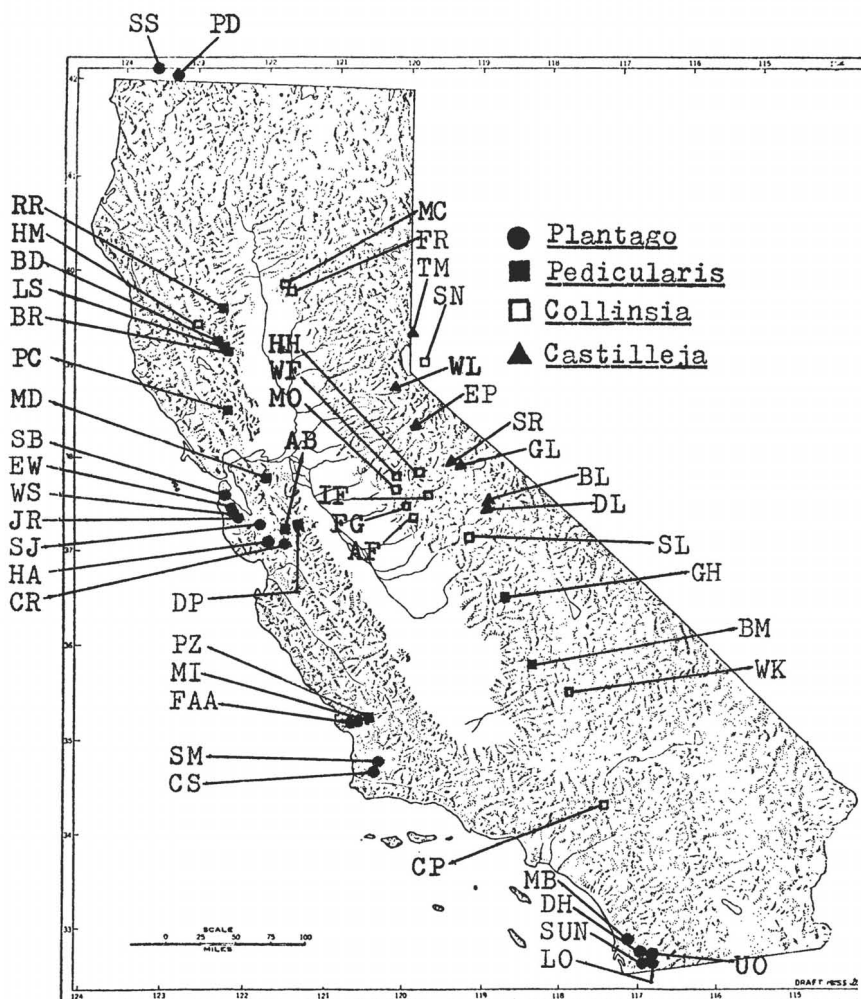


Fig. 1. *Euphydryas editha* populations designated by their code initials. The symbols superimposed on this map of California represent the location and the larval foodplant of each population.

that the range of plants acceptable to a migrant female *E. editha* broadens with increasing oviposition motivation as she searches (Singer, 1971) would, if true, explain how a population can be founded on a foodplant which would not have been utilised in the parent population even if present.

Since there is no simple correlation between primary hostplant used by an *E. editha* population and the subspecies to which the population

would be assigned, we propose to discuss the relationships between ecology and taxonomy of the insect in a separate paper.

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THE BIOLOGY OF *PAPILIO INDRA NEVADENSIS* (PAPILIONIDAE) IN NEVADA

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In the late 1960's, a new race of *Papilio indra* Reakirt was discovered in at least two isolated mountain ranges of the Great Basin state of Nevada. Described by Emmel & Emmel (1971), *Papilio indra nevadensis* is differentiated in the adult stage from all other known