JUNIPERUS (CUPRESSACEAE) SPECIATION AND THE RANGES AND EVOLUTION OF TWO *CALLOPHRYS* (LYCAENIDAE)

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It seems popularly assumed that the allopatric distributions of *Callophrys* (*Mitoura*) *siva* Edwards and *C.* (*M.*) *gryneus* Huebner are determined by the ranges of the several "species" of *Juniperus* which are the larval food-plants. Klots (1951) reports *C.* (*M.*) *gryneus* as feeding on *Juniperus virginiana* L. while Brown (1957, and in correspondence) reports *C.* (*M.*) *siva* utilizing several western junipers like *J. scopulorum* Sarg., *J. utahensis* Engelm., and *J. occidentalis* Hock. There is no other discussion in the literature known to this author which indicates opposing evidence to this popular assumption. Remington & Pease (1955) seem to sense the confusion within *Juniperus* taxonomy and report *C.* (*M.*) *gryneus* as feeding simply on "*Juniperus* sp." They also establish the usability of Swamp White Cedar [*Chamaecyparis thyoides* (L.)] for *C.* (*M.*) *gryneus*.

Until recently there has been no definitive work on the speciation of *Juniperus* in the areas of the United States including the distributions of *C.* (*M.*) *siva* and *C.* (*M.*) *gryneus*. Van Haverbeke (1968) has produced a detailed computer analysis of morphological and lipid characters (the latter analyzed by infrared spectroscopy) of *Juniperus* spp. in which he develops indices of hybridization between *J. scopulorum* and *J. virginiana* in the Missouri River Basin. The important problem is whether the bihybrid swarm of *Juniperus* he describes is best characterized as two species or simply variation within one clinal situation obscured through years of evolution. In his conclusions, through the analysis of statistical distributions, he presents several evaluations which strongly support the presence of two species (*J. scopulorum* and *J. virginiana*). Although no extreme parental types were discovered east or west in his study areas, he favors the conclusion that *J. virginiana* and *J. scopulorum* possess integrity enough to warrant his interpretation of data as percentage of each of these species' *germ plasm* in each study area. The data and conclusions within his study are important in making comments on factors determining the distribution of the two species of *Callophrys* considered in this paper.

In recent years *C.* (*M.*) *siva* has been reported on the Great Plains in a number of populations. Johnson (1972) reports *C.* (*M.*) *siva* in eight Nebraska counties, a few east of the 100th meridian. John S. Nordin (in

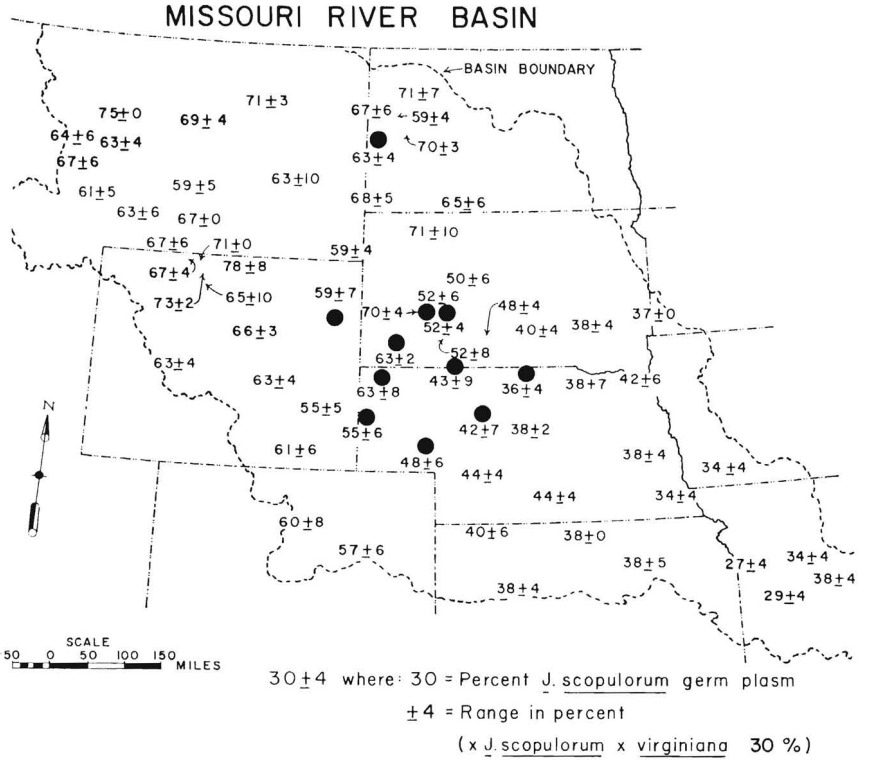

Fig. 1. Locations of known *Callophrys* (*Mitoura*) *siva* populations on the Great Plains superimposed above the plus-or-minus sign of a Van Haverbeke computation. Note that one population (70 ± 4%) is located by an arrow and that the single Wyoming population corresponds to no Van Haverbeke computation. In the figure a computation such as 30 ± 4 means 30% plus or minus 4% *J. scopulorum* "germ plasm."

Counties in which *C.* (*M.*) *siva* populations occur, with the general Van Haverbeke percentage given to facilitate more rapid association, are listed below. Two counties named together indicate juniper areas running across county boundaries; county locations of particular areas mentioned in the text are noted.

North Dakota: Billings County (63%); **South Dakota**: Pennington County (Black Hills area) (70%), Meade County (52%), Custer County (63%); **Wyoming**: Weston County (none); **Nebraska**: Dawes County (63%), Cherry County (43%), Brown and Rock Counties (Long Pine Recreation Area) (36%), Banner and Scotts Bluff Counties (55%), Thomas County (Nebraska National Forest at Halsey) (42%), Keith County (48%).

correspondence) reports the species at several locations in western and central South Dakota, and he and F. Martin Brown (in correspondence) report specimens from North Dakota. All of these populations occur (except for the Black Hills of South Dakota) in scattered escarpments or in areas of *Juniperus* on bluffs and buttes on the plains. The geographical locations of these populations can be seen in Fig. 1.

Fig. 1 superimposes the location of known populations of *C.* (*M.*) *siva* upon Van Haverbeke's figure of computer percentages of hybridization based on the sum of all his analyses of characters. The dots representing populations of *C.* (*M.*) *siva* are located directly above the plus-or-minus sign of the corresponding Van Haverbeke computation except where located by an arrow (see explanation of figure).

A great amount of variation in the type of juniper being utilized by *C.* (*M.*) *siva* is apparent, varying from 70 ± 4% *J. scopulorum* in the Black Hills of South Dakota to 36 ± 4% *J. scopulorum* in the Long Pine area of north-central Nebraska. Though this information is interesting, it gains its greatest import when compared to hybrid indices for *Juniperus* populations occurring into the range of *C.* (*M.*) *gryneus*. These indices are given elsewhere in Van Haverbeke's paper. Indices for *Juniperus* spp. in northeast and central Missouri, within the range of *C.* (*M.*) *gryneus* (the species is also reported in Nebraska by Klots, 1951, but was not validated by Johnson, 1972) range up to 38 ± 4% *J. scopulorum*, and in areas of the eastern United States upwards to 39% *J. scopulorum*. The latter, however, requires caution due to the small amount of sampling in extreme eastern areas.

In the intervening area between the allopatric ranges of *C.* (*M.*) *siva* and *C.* (*M.*) *gryneus* there is considerable overlapping in the identity of the type of *Juniperus* available for food-plant use. The question emerges whether there is a threshold at which *C.* (*M.*) *siva* and *C.* (*M.*) *gryneus* segregate in their use of food-plants. Such segregation could be in reaction to morphological characters or chemistry. If segregation exists there must be some type of selection of juniper in the areas where the integrities of juniper used by the two species overlap. Such a selection might not be made by the female imago but might simply be due to larval mortality, or sterility of resulting adults, when ova are laid on unacceptable plants. However, it is equally possible that there may be no segregation due to food-plant type between these two butterfly species and that some other factor is keeping them allopatric in distribution. This indicates the possibility that the two species may eventually become sympatric.

The populations of *C.* (*M.*) *siva* in north-central Nebraska are newly discovered, and therefore their length of establishment is not known. However, the species was never reported in these areas in the early literature on Nebraska Rhopalocera. *C.* (*M.*) *siva* could have reached eastern outposts like the Nebraska National Forest at Halsey and the Long Pine Recreation Area in Nebraska by import of *Juniperus* seedlings planted in those areas by the Forest Service in fairly recent years. This opens the

possibility of germ plasm "pollution" of the *Juniperus* populations by the introduction of western imports.

There are two possibilities emerging from these data: the sympatry of *C. (M.) siva* and *C. (M.) gryneus* and its ramifications, or the segregation of the two (though the types of juniper available for utilization, according to Van Haverbeke's evaluation, seem to overlap). It would be desirable to experiment with the food-plant preferences of *C. (M.) siva* and *C. (M.) gryneus* in the laboratory. It is, however, the purpose of this paper to point out that the new evidence of *Juniperus* hybridization presented by Van Haverbeke has important bearing on lepidopterists' evaluation of the distribution of species of butterflies feeding on that taxon of plants. If *C. (M.) siva* and *C. (M.) gryneus* have evolved into two distinct species through isolation of their gene pools, it seems that some barrier to their sympatry must have been imposed at some time. If *J. scopulorum* and *J. virginiana* once had extreme parental type distribution areas, which are now introgressing spatially east and west, there might be some evidence of a former barrier. Within these two former distribution areas of *Juniperus* parental types might have been the harbors of the populations which evolved what we call *C. (M.) siva* and *C. (M.) gryneus*. Perhaps fluctuations in distributions and barriers in the history of *Juniperus* left the *Callophrys* ranges as "relicts" of former ranges of more typical juniper parental types. If, as Van Haverbeke suggests, *J. virginiana* might be an eastward evolutionary manifestation of *J. scopulorum*, there is a vague possibility that the original gene pool of *C. (M.) gryneus* utilized Swamp White Cedar and later adapted to *Juniperus* spp. as a food-plant.

Certainly the current taxonomic status of *Juniperus* species in the central United States has great import on the considerations of reasons for the respective distributions of *C. (M.) siva* and *C. (M.) gryneus*, and reminds lepidopterists to be more careful in forming generalizations about insect distributions because of their food-plants until more fully aware of the complexities in the plant groups themselves.

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ACCIDENTAL OCCURRENCE OF *AGLAIS URTICAE* (NYMPHALIDAE) IN NOVA SCOTIA

On November 7 1970, John Godfrey of the faculty of Dalhousie University in Halifax, unpacked a crate of books shipped by sea from England. A butterfly flew out of the crate and was captured and brought alive in a plastic box to FWS by George Halverson, a neighbor of Mr. Godfrey's. The specimen, a fresh male of *Aglais urticae* (Linnaeus), could not be killed until the following day, by which time the wings were worn and chipped.

According to Mr. Godfrey the crate was packed and closed in Oxford, England on August 23 1970, and left England by sea in mid-October. The time elapsed between packing and unpacking was 76 days. Mr. Godfrey did not notice a pupal skin in the crate.

The interesting aspect of this occurrence is our knowledge of how the butterfly arrived in Nova Scotia. Had it escaped and then been collected outdoors in Halifax, its presence would have been quite baffling.

We know of no other North American records of this species. The specimen has been deposited in the Lepidoptera collection at the Nova Scotia Museum.

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BUTTERFLIES FEEDING ON A DEAD BOBCAT

On 6 July 1970, Mr. S. K. Dvorak and I captured the following butterflies, all males, imbibing the juices of a dead, decaying, young bobcat along a roadside: *Cercyonis oetus* (Boisduval) (1), *Speyeria zerene conchyliatus* (J. A. Comstock) (3), *Speyeria callippe* near *nevadensis* (Edwards) (1), and *Euphydryas chalcedona* (Doubleday), ssp. (1). The location was ca. 2 road mi. NE of SW entrance to Lava Beds National Monument (road from McCloud), Modoc National Forest, Siskiyou Co., Calif. Instances of butterflies at carrion are given by Payne & King (1969, J. Lepid. Soc. 23: 191–195).

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