

NOTES ON THE *PAPILIO MACHAON* COMPLEX IN ARIZONA

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The *Papilio machaon* complex is unusually well represented within the territory which comprises the State of Arizona. There has been considerable discussion as to the relationships and validity of some of the species, subspecies, and forms, which is understandable, since their ranges overlap in many places. The purpose of this paper is to help clear up some of these perplexing questions by a simple setting forth of the facts gathered from eight years of year-around collecting within the State.

My first acquaintance with this complex group in Arizona was at Yuma in the southwestern corner of the State. At Yuma *P. rudkini* Comstock is the most abundant *Papilio*, with form "clarki" running a close second. The form "comstocki" is not nearly as abundant as the other two forms. Within the town of Yuma the larvæ of *P. rudkini* fed on the introduced Queen Anne's Lace (*Daucus carota* L.), which grows in the flower gardens about town. Unfortunately no larvæ were found on native plants, but the finding of larvæ on an introduced Umbelliferæ indicates it may also feed on native plants of this family. However, *P. rudkini* larvæ have been found feeding on *Thamnosma montana* Torr. & Frem. (Rutaceæ) in the Ivanpah Mts. of southeastern California and in the Grand Canyon. This plant also grows in the Yuma area and is probably the native food plant about Yuma.

The range of *P. rudkini* is quite extensive. It is found along the Mexican border at Yuma and Sonoita and throughout the desert regions as far east as Phoenix and Wickenburg. To the north it skirts the higher plateau and mountain country, but extends into Utah and Nevada, running up the canyon of the Colorado River as far as the Grand Canyon National Park, also up the Verde River valley as far as Cottonwood.

The best places to look for *P. rudkini* are the desert dry washes and canyons of the desert mountains. The flight period is very irregular as is that of most desert butterflies; captures have been made from January through November. The deciding factor as to when it may be found seems to be rainfall. In one locality it may be absent for many months, while only ten or twenty miles away it may be in full flight, for rain in the desert is usually extremely local and unpredictable.

Much more needs to be learned about the relationship of *P. rudkini* to *P. polyxenes*, with which it comes in contact in the eastern part of its range.

*Papilio polyxenes* Fabricius is the second member of the group to be collected. Several specimens were picked up in the foothills of the Santa Catalina Mts. near Tucson, Arizona, and a number of larvæ were collected in a vegetable garden at St. David, Cochise Co., Arizona. These larvæ were feeding on Carrot leaves and in appearance were typical *P. polyxenes* larvæ.

*P. polyxenes* seems to be confined mostly to the southeastern part of the State. However, several specimens from the central part of Arizona appear to be *P. polyxenes*. One of these, a female, was collected on Mingus Mt., Yavapai Co., and two more females were reared from larvæ collected on Parsley (*Petroselinum crispum* Mill.) near Cottonwood. *P. polyxenes* seems to be even more variable in Arizona than in most of its range. Females vary from a very dark form with few, if any, of the yellow spots present to specimens similar to the one figured by BARNES and MCDUNNOUGH (*Contrib. Nat. Hist. Lepid. No. America*, vol. 3: plate IV, fig. 1). It is doubtful that such specimens should be placed under the name *P. americanus* Kollar, for such specimens come from ova of typical females from which most of the adults are normal *P. polyxenes*. There have been reports of *P. polyxenes* from the Grand Canyon National Park, but careful examination of the specimens in the Work Shop collection at the Park revealed these specimens to belong to other species. So far, all records which have been checked place the range of *P. polyxenes* as the southeastern quarter of Arizona.

*Papilio bairdii* Edwards is the third member of the *P. machaon* complex found in the State. In the past it has been confused with form "clarki" of *P. rudkini* and with Arizona specimens of *P. polyxenes*. In eight years of collecting in the State *P. bairdii* proved to be a very scarce insect most years. About the only place where it may be found year after year is the Grand Canyon area, where it flies with *P. rudkini* and form "clarki" and "comstocki," and a large race of *P. indra*. This race of *P. indra* is very similar in appearance to females of *P. bairdii*. Consequently there has been considerable misidentification of specimens from the Grand Canyon area. Actually, *P. bairdii* is a very distinctive *Papilio* and need not be confused with either *P. polyxenes* or *P. rudkini* and can readily be separated from the *P. indra* race by the abdominal markings. EDWARDS' figures in his fine work are good representations of *P. bairdii* and are characteristic of Arizona specimens. His description is excellent and his characterization and statement of its variation are all true. It is given to great variation, and a single colony has yielded dark, light, intermediate, and all combinations of coloring and pattern from very dark melanic specimens, in which the postmedian band of yellow spots is all but obsolete, to form "hollandi" and specimens which cannot be separated from *P. brucei*. The one outstanding character which all the *P. bairdii* specimens examined possess is the large definitely yellow marginal and postmedian spots on the underside. Of course in melanic specimens the postmedian spots are reduced or obsolete. There is always a slight tinge of fulvous or orange in the postmedian yellow spots between the second and third median veins and the third median and first cubital veins on the under surface. From this minimum of two fulvous-tinged post-median spots, the amount of fulvous tinge may extend to all the post-median and marginal spots of the secondaries. However, in the most fulvous specimens fulvous remains just a tinge, and yellow remains the dominant color of the spots. Only one of the hundred or more specimens examined shows a barely perceptible fulvous tinge in the post-median spots of the primaries. There are a number of other characters that could be mentioned, each of which may

or may not be present in a particular specimen. The markings of the abdomen vary without regard to the other characters. Very dark specimens may have heavily yellow-washed abdomens with black claspers, or light "hollandi" specimens may have dark abdomens; sometimes the abdomen is dark and the claspers completely yellow. The various characters seem to vary in color without relation to one another. In spite of all this variability *P. bairdii* can be separated readily from *P. rudkini* and *P. polyxenes* when one becomes familiar with its peculiarities. Female *P. bairdii* are usually very dark, with only a faint trace of the post-medial series of yellow spots. On the underside the characters are the same as for the male, with all light markings reduced and in some specimens an increase in the fulvous coloring.

*P. bairdii* occurs in a cycle of some kind, for it may be scarce or absent for a number of years, and then it suddenly becomes abundant. 1952 was a year of great abundance in central Arizona, particularly in the Mingus Mts. — Oak Creek Canyon area. The flight began in late spring (April and May), and the second generation was on the wing in late June. From late June until October and even the first part of November there followed a continuation of emergence. From July onward the ova, young larvæ, mature larvæ, chrysalids, and imagines could all be collected the same day. The last larvæ were collected in late October on Mingus Mt. Larvæ were also found in Oak Creek Canyon and at Fry Canyon near Flagstaff.

In early August, after numerous *P. bairdii* larvæ had been collected, a female of *P. polyxenes* came wandering through the garden and oviposited on the Parsley. This gave an excellent opportunity to rear the larvæ of the two species together and make careful comparisons. Below are the results:

Ova: those of *P. bairdii* are considerably larger than those of *P. polyxenes*, enough larger to enable easy identification with the naked eye; the color and shape are about the same.

First instar: *P. bairdii* are larger, with a greater amount of mid-dorsal light coloring.

Second instar: the proportionate difference in the size remains, but *P. bairdii* have a greater amount of whitish yellow dorsally.

Third instar: *P. bairdii* are one-third larger than *P. polyxenes*; the latter are still quite dark, with lighter mid-dorsal area; *P. bairdii* have the characteristic markings of the mature larva — yellowish green, striped with black on each segment, and with a series of orange spots on black bands.

Fourth instar: *P. polyxenes* are still dark, with a lighter mid-dorsal area; *P. bairdii* are larger and with definitely bright yellow-green color; not much change in markings.

Fifth instar: *P. bairdii* are varying shades of bright green, with narrow black bands and orange-yellow spots on the black bands and considerable black between segments. There are some *P. polyxenes* larvæ that remained very dark and predominantly black in color, while all *P. bairdii* larvæ were about the same bright green.

Pupæ: *P. bairdii* and *P. polyxenes* pupæ are quite different and may be distinguished readily. *P. bairdii* pupæ are considerably larger and thicker in shape, also less angular. The projection on the thorax is much smaller in *P. bairdii*, as are also the bifid head projections. These smaller projections, together with the stoutness of *P. bairdii* pupæ make them rather easy to separate from those of *P. polyxenes*. After emergence of the adults, it was interesting to note that the smaller *P. polyxenes* pupæ yielded considerably larger specimens for their size than did those of *P. bairdii*.

*P. bairdii* form "hollandi" Edwards: three specimens taken during the peak of the 1952 season have the wider band of post-median yellow spots which characterizes form "hollandi." These specimens are not true "hollandi" as pictured in HOLLAND'S *Butterfly Book* (pl. XL, fig. 3), in that they do not have the two yellow spots in the cell of the forewing. One specimen has a faint trace of these spots. One has one spot only, and the other has no trace of either of the spots. They also differ from HOLLAND'S figure in having yellow-spotted abdomens rather than the yellow sides of HOLLAND'S figure.

The same year that *P. bairdii* became so abundant four specimens of *P. bairdii brucei* were taken. These specimens were flying with the *P. bairdii* but are typical *P. brucei*. *P. brucei* has been much confused with *P. zelicaon*, but true *P. brucei* is very similar to *P. bairdii oregonia* Edwards, particularly on the underside of the primaries. However, it has heavier black markings on the underside of the secondaries. One character which seems to be constant and can be used to separate *P. brucei* and *P. zelicaon* is the color of the ventral surface of the abdomen. In all *P. brucei* specimens examined from California, Oregon, Arizona, and western Nebraska the ventral surface is predominantly yellow. In *P. zelicaon* from California, Oregon, Washington, Arizona, Utah, and Colorado the ventral surface is black. At present, this character seems to be the best to separate the two quite similar butterflies.

*P. zelicaon* Lucas has been taken along the northern border of Arizona, particularly on the Kaibab Plateau and eastward. These Kaibab specimens are true *P. zelicaon* and not *P. brucei* as they have been called by some. There seems, however, to be no reason why typical *P. brucei* should not be found flying with *P. zelicaon*, since *P. bairdii* flies in the area. Careful identification should be made of all *P. brucei* or *P. zelicaon* taken in northern Arizona.

*Papilio indra* Reakirt so far has been taken in Arizona only in the Grand Canyon and Kaibab Plateau area, where it flies with *P. bairdii*, *P. rudkini*, and *P. zelicaon*. The distinctive Arizona race of this species is being described and named in a separate paper.

The exact standing and relationships of the various species to one another in the area of the State of Arizona is not fully understood, for not all of the facts have been learned. At present it appears that *Papilio zelicaon* is a separate species; *Papilio bairdii*, with its "hollandi" and *brucei* forms is another species complex. The true relationship of *P. bairdii* and *P. brucei* is not certain, for *P. bairdii* is sexually dimorphic and *brucei* is not. This is also true of *P. rudkini* and its form (?) "clarki." It may be that these are separate but interbreeding species, instead of races or forms of one species. *Papilio polyxenes* is another species complex with an indefinite or little-understood relationship to the *Papilio rudkini* complex. For the present it would probably be best to retain them as separate species. *Papilio indra* is a very fine species complex and at present appears to be one of the most distinct. The observations and experiments in crossing the various strains should shed much valuable information on the relations of these insects to one another.