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Notes

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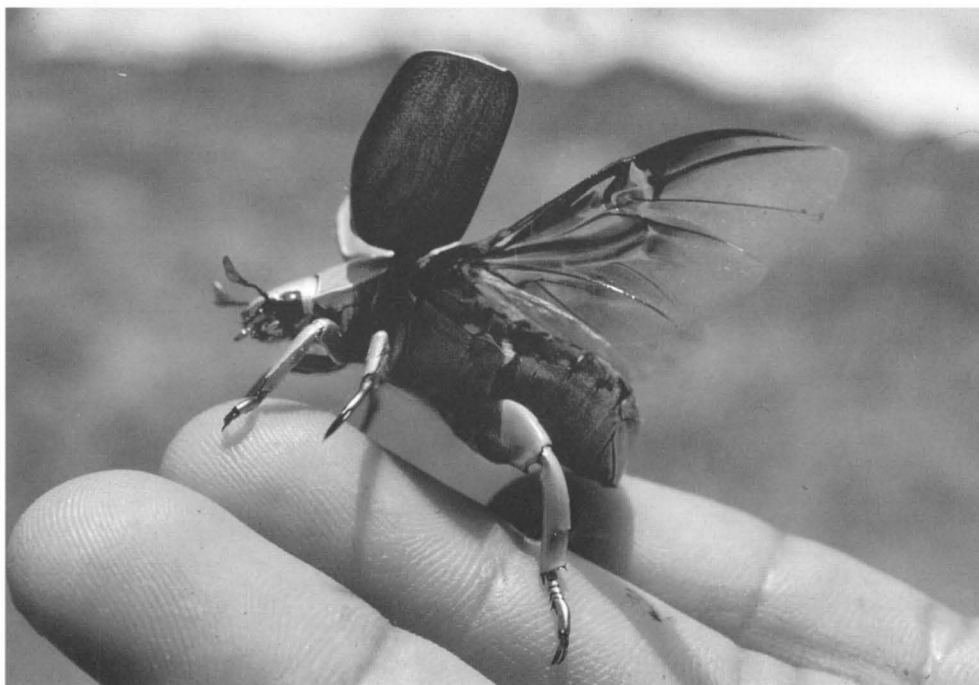
Jewel Scarabs

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Jewel Scarabs are a group of about 100 species of some of the most spectacular insects that you'll ever see! Most are various shades of iridescent green, but others are spectacular, metallic "jewels" of silver, gold, red, pink, purple, or blue. They are beetles of the family Scarabaeidae, in the subfamily Rutelinae. This subfamily is known by the common name "Shining Leaf Chafers" because many are shiny, colorful beetles that feed on leaves as adults. As a specialist in Jewel

Scarabs of the genus *Chrysina*, I naturally consider these to be among the finest and most fascinating of insects, but maybe I'm a bit biased!

Jewel Scarabs are found only in the New World, mainly in the mountains of Mexico and Central America. Four species, including the very fancy *Chrysina gloriosa* which has silver and green striped wing covers (elytra), occur in the mountains of western Texas, New Mexico and Arizona. Only a couple species



This individual of *Chrysina karschi* was used in mark-release-recapture studies at 5,000 feet elevation in Cusuco National Park in western Honduras. Photo by Ronald Cave.

are known from the Andes Mountains of northwestern South America. Many species are found in the incredibly beautiful and diverse cloud forests of Central America. It's a real treat to study Jewel Scarabs (or anything else) that live in these cloud forests because of the endless variety of strange, wonderful, and very colorful animals and plants that surround you.

Adult Jewel Scarabs emerge from their pupal cells below ground during the rainy season; for most species this is from May to September, varying from one region



Cloud forest habitat in La Muralla National Park in central Honduras. This is where we discovered *Chrysina cavei*. *Chrysina quetzalcoatl* also lives here, but it is uncommon because there are very few pine trees in this kind of habitat. Photo by Dave Hawks.

to another. They are active mostly at night, and they fly to their host trees where they feed on leaves and find mates. These beetles live up to about three months, although longevity probably varies among species. After mating, female Jewel Scarabs deposit eggs singly in or near rotting wood just beneath ground level, often in stumps or dead roots. The larvae (grubs) hatch within a few weeks and feed on rotten wood for several months to over a year depending on the species and food quality. Many of the nutrients used in larval development are derived from the bacteria and fungi responsible for the decomposition of the wood. The grubs pupate in an earthen cell and metamorphose into adults within a month or two, but they do not emerge until rains or other environmental cues provide the required stimuli.

The host trees of the adults of many species of Jewel Scarabs are known, and most of the species that occur in Mexico and the southwestern United States feed on oak trees. Less is known about host trees of the Central American species, but some of these also feed on oak leaves. At least one species, the flashy, silver-colored *Chrysina strasseni* from Guatemala and Honduras, feeds on the leaves of *Inga*, a tree in the pea family. A few species feed on pine needles, and *Chrysina gloriosa*, from southeastern Arizona, New Mexico, and western Texas, feeds on juniper. *Chrysina woodi*, a strikingly bright

green species with metallic blue tarsi ("feet"), feeds on walnut and oak leaves in the mountains of west Texas and southeastern New Mexico. There is one species of Jewel Scarab, *Chrysina orizabae*, that does not feed as an adult beetle. This species is found at high elevations, above 7,000 feet, on the slopes of the volcanoes of central Mexico. It is the only species, to my knowledge, that is active as an adult almost exclusively before the rainy season begins. Since it doesn't feed, *C. orizabae* has no need to synchronize its emergence with the availability of new growth on a host tree that begins with the onset of the rainy season. Morphological features of this species that correspond to its non-feeding habit, as well as its cold, high elevation environment, are its atrophied digestive tract, high level of body fat, and overly abundant, long, dense hairs that cover much of its body. Additionally, *C. orizabae* males have greatly enlarged antennal plates which contain the chemoreceptive pits that detect female pheromones (sex attractants). Since they presumably live for a much shorter time than other species of Jewel Scarabs, males of *C. orizabae* must find the females more quickly, and their more highly developed antennae assist in this goal. In fact, since they do not feed as adults, reproducing is pretty much all they do!

Except for interesting life history and ecological characteristics, such as in the case of *C. orizabae*, clearly the most striking feature of Jewel Scarabs is their coloration. The brilliant colors that we observe in these beetles are structural colors. In other words, the colors are produced by the reflection of light at different wavelengths that results from the layers of urea crystals found in the cuticle. In fact, when these layers are destroyed by chemical or other means, we discover that Jewel Scarabs look like just plain ol' brown June Bugs! Well, sort of. The Scarabs we commonly call May Beetles and June Beetles are related to *Chrysina* but are in different subfamilies. Other familiar examples of structural coloration include the bright colors of parrots, the iridescent red, purple or blue neck feathers



Chrysina karschi hides during the day among sweet gum leaves in western Honduras. Its green elytra and purplish legs enhance its camouflage. Photo by Dave Hawks.



Ronald Cave at one of our mercury vapor lamps which attracts Jewel Scarabs and an endless variety of other nocturnal insects. Photo by Dave Hawks.

(gorgette) of male hummingbirds, the amazing colors of many tropical fish, and the brilliant metallic blue of tropical Morpho butterflies.

In the case of Jewel Scarabs, most, if not all, of their bright colors serve to provide camouflage (crypsis) among the foliage where they feed and mate. Numerous observations, and the fact that most mating in Jewel Scarabs occurs at night, indicate that coloration is not involved in courtship or mate selection in these beetles. About three-fourths of the species are green, and so the idea of crypsis is easy to imagine. In fact, I have observed the adults of several species resting during the day among foliage where they blended in perfectly and were very difficult to see. Even the green and silver striping in *Chrysina gloriosa* blends beautifully with the irregular arrangement of green scales of juniper foliage. In fact, *C. gloriosa* appears to employ two strategies for hiding from potential predators (or beetle collectors): green represents crypsis, and the irregular silver stripes serve to break up the outline of the beetle. This is called "disruptive coloration." The species with pinkish or reddish coloration may hide among foliage better than one might think because the young leaves and stems of many trees are pinkish or reddish. Two widely distributed pine feeding species, *C. adalaida* and *C. quetzalcoatli*, are striped with green and dark reddish-brown, and these beetles are very well camouflaged among the clusters of pine needles where they feed.

The metallic silver species are unique examples of crypsis that involves mirroring whatever the beetles are resting on. So, when a silver Jewel Scarab is clinging to green leaves, then the beetle looks like just another shiny, wet, green spot among the shiny, wet leaves

(foliage, and everything else, is wet and shiny much of the time during the rainy season in a cloud forest). I have seen silver Jewel Scarabs resting among wet foliage, and they blend in perfectly with their surroundings. The gold species of *Chrysina* are a bit more difficult to explain, and I have never observed a gold beetle on its host tree. Perhaps they also are cryptic in some way that seems less obvious to us, or maybe they are not particularly well camouflaged (but at least do not look like "bird food"). Birds are presumed to be the primary predators of Jewel Scarabs, and, of course, a problem with our interpretation of cryptic coloration in these beetles is that we don't truly know what they look like to birds – just what they look like to us. I am aware of several observations of birds feeding on Jewel Scarabs, such as the exciting example of a pair of Resplendent Quetzals in Honduras harvesting *Chrysina karschi* and feeding them to their young chicks.

Because Jewel Scarabs are primarily active at night, those of us who study and collect them have found that they are most easily obtained with the use of ultraviolet light. As with many other nocturnal insects that are seen around street lights and porch lights, Jewel Scarabs sometimes fly by the dozens or hundreds to fluorescent or mercury vapor lamps placed in their habitats. A colleague, Ronald Cave, and I used mark-release-recapture techniques with over one thousand *Chrysina* individuals of several species in order to learn about their population sizes, the potential for the over-collection of populations, and some other ecological characteristics. We found that the Jewel Scarabs came from a very short distance to arrive at our lamps (not more than about 500 feet), and that in a small area of



A female of *Chrysina cavei* resting on ferns at La Muralla National Park in central Honduras. Females do not have the enlarged hind legs that are present in the males (see color image on poster). Photo by Federico Ocampo.

Honduran cloud forest at a given brief period of time during the season of adult activity, *Chrysina* populations numbered in the hundreds or even thousands of individuals.

Some species of *Chrysina* occur in very limited areas. A few species are known only from a single mountain or only a certain side of a mountain within a fairly narrow elevational range. Understandably, Jewel Scarabs are very popular among insect collectors, and some conservationists have been concerned that collectors could negatively impact some of the more distributionally restricted populations. Ron Cave's and my studies led us to conclude that protection of habitat is the primary concern for Jewel Scarab conservation, and that the potential for overcollecting is very low. Our work on these spectacular beetles is featured in the February 2001 *National Geographic* magazine and can be seen electronically at the University of Nebraska's Division of Entomology website at <http://www-museum.unl.edu/research/entomology/images/images/images/jewelscarabs.htm>.



The grub of *Chrysina pastori*, a greenish-silver species that lives in high elevation cloud forests in western Honduras. Photo by Dave Hawks.

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We are also coordinating our activities with the research being conducted by Team Scarab at the University of Nebraska State Museum. Drs. Ratcliffe and Jameson and their students are engaged in extensive research on scarab beetles, and they are also conducting major collecting expeditions to the New World tropics. I am collaborating with their lab in sequencing numerous DNA samples to help address questions about the relationships of lineages of scarab beetles. Ron is collaborating with Team Scarab in conducting a biotic survey of the rhinoceros beetles and their relatives in Honduras, Nicaragua, and El Salvador. Concomitant with these activities, all of us are establishing authoritatively identified research collections in various Latin American countries as well as training graduate students here and abroad.



The pupa of *Chrysina lecontei*. The adults of this dark green species live in pine forests in the mountains of Arizona, New Mexico, and northern Mexico. Photo by Dave Hawks.



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