Uses of cocoons of *Eupackardia calleta* and *Rothschildia cincta* (Lepidoptera: Saturniidae) by Yaqui Indians in Arizona and Mexico

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Abstract: Cocoons of the two saturniid moths *Eupackardia calleta* and *Rothschildia cincta* have been used for centuries by American Indians to make ankle rattles, worn during ceremonial dances. Although both species occur in western Mexico and southern Arizona, finding their cocoons north of the Mexico/U.S.A. border has been difficult in the past several decades, due primarily to habitat loss and sparser moth populations. Overcollecting of cocoons of *R. cincta* by humans probably also keeps the moth populations low. Traditional uses are compared to and contrasted with newer innovations. New information on larval hostplants, field collecting, and population structure of the two moths is given.

Usos de los capullos de *Eupackardia calleta* y *Rothschildia cincta* (Lepidoptera: Saturniidae) por Indios Yaqui en Arizona y México

Resumen: Los capullos de los satúrnidos *Eupackardia calleta* y *Rothschildia cincta* han sido usados durante siglos por los indios americanos para hacer matracas de tobillo, llevadas durante danzas ceremoniales. Aunque ambas especies existen en el oeste de México y el sur de Arizona, el hallazgo de sus capullos al norte de la frontera entre México y Estados Unidos ha resultado difícil durante las últimas décadas, debido principalmente a la pérdida de hábitats y a la existencia de poblaciones cada vez menos densas. Una recolección excesiva de capullos de *R. cincta* por parte de humanos mantiene también probablemente las poblaciones de esta especie a un nivel bajo. Los usos tradicionales se comparan y contrastan con innovaciones más nuevas. Se da información nueva sobre las plantas alimenticias de las larvas, recolección en el campo, y estructura poblacional de las dos especies.

Der Gebrauch von Kokons von *Eupackardia calleta* und *Rothschildia cincta* (Lepidoptera: Saturniidae) durch Yaqui-Indianer in Arizona und Mexiko

Zusammenfassung: Kokons der beiden Saturniidenarten *Eupackardia calleta* und *Rothschildia cincta* werden seit Jahrhunderten von Indianern benutzt, um Rasselschnüre für Beine und Knöchel herzustellen, die bei zeremoniellen Tänzen benutzt werden. Obwohl die beiden Arten im westlichen Mexiko und dem südlichen Arizona vorkommen, sind die Kokons nördlich der US-Grenze in den letzten Jahrzehnten kaum noch zu finden gewesen. Dies wurde in erster Linie durch Habitatzerstörung und geringe Populationsdichten der Arten verursacht. Auch die Ausnutzung der Arten durch das gezielte Einsammeln der Kokons hält die Populationsdichte niedrig. Der traditionelle Gebrauch wird mit neueren Nutzungsformen verglichen. Darüber hinaus werden neue Informationen über Raupenfutterpflanzen, das Auffinden im Freiland und die Populationsstrukturen der beiden Arten berichtet.

Introduction

Two large saturniid moths that inhabit the Sonoran Desert, which straddles northwestern Mexico and the southwestern United States, produce cocoons that have been used to make ceremonial dance rattles by several tribes of Indians for centuries. The two are the calleta silkmoth (*Eupackardia calleta* (Westwood, [1854])) (Fig. 1) and the cincta silkmoth (*Rothschildia cincta* (Tepper, 1883)) (Fig. 2), both in the tribe Attacini, also containing the better-known *Attacus*, *Samia*, and *Hyalophora*. The genus *Eupackardia* is currently considered to contain only a single species, but ranges from Baja California to southern Texas down to Guatemala. The genus *Rothschildia* contains more than 25 species and ranges from extreme southern Texas and Arizona down to northern Argentina, inhabiting various biomes including deserts, grasslands, thornbrush, and rainforests (Lemaire 1978). Most of what is known about these two moths is found in the writings of Collins & Weast (1961) and Ferguson (1972), plus a particularly detailed and valuable compilation by Weast (1989). Fine color illustrations showing the beautiful moths of most species of the genus *Rothschildia* were given by Draudt (1929: pls. 101–103, 134) and D'Abrera (1998).

Tribes of American Indians who still use moth cocoons for ankle rattles include the Tarahumara in Chihuahua, the Mayo and the Seri in Sinaloa and Sonora, the Pima and the Tóhono O'odham in Arizona and Sonora (Peigler 1994), and the Yaqui, the tribe which is the focus of this report. Parezo (1991: 53) depicted a Pima rattle in color, and two of the historical hand rattles made by tribes in California using cocoons of *Hyalophora euryalus* (Boisduval, 1855) were shown in color in the same book (1991: 146–147). The Athapascan tribes in the same areas, such as the Apache (including the Navajo) neither make nor use cocoon rattles. The Yaqui live in several communities in Arizona including Pascua in Tucson and Guadalupe near Phoenix. Although separated from the other Yaqui in their ancestral land of Sonora a century ago, the two groups maintain cultural ties (Spicer 1980, Kolaz 1985). Yaquis in Arizona speak English and most of them speak Spanish. The indigenous Yaqui language is declining in usage in Arizona, but many of the elders there still speak it. Most of the ones in Mexico speak Spanish, but some speak only Yaqui. The second author of this paper is a Yaqui Indian who is a pascola dancer and actively studies and teaches the cultural history and traditions of his Tribe.

Ankle rattles for ceremonial dances

The rattles are called "tenabares", or "tenevoim" in the Yaqui language, and these words are often used to refer to them when speaking Spanish and English. They are made in pairs, and worn around the ankles or lower legs. Two main kinds exist, used for different dances. The first (Fig. 10) is a shorter one with fewer cocoons that wraps around the ankle three times, and is used by deer dancers (venado dance). The second type (Figs. 11, 13) is much longer, with 200 or more cocoons, and covers much of the leg between the knee and ankle when worn. This latter type is used by pascola dancers. These dances are particularly performed in public ceremonies during the week leading up to Easter Sunday, but are also seen at less public events such as weddings and funerals. The dances date back several centuries, referred to by Pérez de Ribas (1968), who traveled in Mexico from about 1604 till 1643, and in the Yaqui River area from 1617 to 1619. We believe that cocoon rattles were made and used in northwestern Mexico long before the Spaniards arrived.

There are different styles of tenabares, depending on the tribe and the maker. Those made by the Tarahumara are sewn onto long, thin strips of cloth, with spaces between single cocoons. Those of the Mayo, Pima, and Yaqui tribes are sewn with cordage or yarn, and the cocoons are arranged in pairs. The pair represents male and female, to signify reproduction or renewal. Within the cocoons are placed odd and even numbers of materials, such as gravel. For example, a pair may contain 1 and 2 stones, or 2 and 3, or 3 and 4, etc., this oddness and evenness imparting the gender to the cocoons. One elder who was a pascola dancer told Maldonado that this pairing ensures perpetuation of the moth.

Traditionally, the Yaqui tenabares have bright red tassles called "flowers," which symbolize Divine Grace in the Christian aspect of the regalia and ceremony. Some artisans make their rattles flashy, and it is important during their construction to bear in mind comfort, using a soft yarn or cloth. Otherwise, hours of dancing with tough cordage will result in abrasive injuries to the lower leg, which in fact, are quite common no matter the materials used in the construction. The Yaqui rattles are usually painted white, to protect and preserve them, and to keep them looking new. Any kind of white paint can be used, but Maldonado dips each cocoon into an oil-base paint which must be allowed to dry before making the tenabares. Rattles are repainted yearly, traditionally during the Renewal Time, an Indian season corresponding to Lent in the Roman Catholic Church. Most Yaquis today are Roman Catholics, both in Arizona and Mexico. The other Indian tribes do not use red tassles nor white paint on their dance rattles.

In the early 1960s in Arizona, only one Yaqui pascola dancer was known to collect his own cocoons to make his rattles. No Indian people try to find cocoons anymore in Arizona, because they are virtually impossible to locate in the field. The scarcity of cocoons was already pointed out by Griffith (1972), who wrote of "the apparent unavailability in the north of such naturally occuring objects as cocoons for leg rattles." Consequently, in recent decades, all rattles used in Arizona were brought in from Mexico as finished products. Maldonado bought a pair in 2001 in Navajoa, Sinaloa (Mayo territory), for US$ 300. He then obtained another pair in 2002 for US$ 150. The scarcity of cocoons has led to general increases in market value. The problem is exacerbated by the fact that Indian and non-Indian collectors of hand-made artifacts also purchase such items. For example, Peigler himself bought four pairs from Arizona merchants by mailorder in 1993 and 1994 (see Peigler 1994).

The Yaqui do not distinguish between cocoons of *E. calleta* and *R. cincta* when seeking materials to make ankle rattles. Historical rattles in the Arizona State Museum (Tucson) contain cocoons of both species, usually one or the other, but occasionally individual rattles contain both. However, the majority of cocoons in traditional tenabares are of *R. cincta;* those made with cocoons of *E. calleta* are less common. Cocoon rattles from Mexico and Arizona are much less common in museum collections in Europe than in the United States. Therefore, Peigler donated representative samples of these rattles to the Senckenberg-Museum in Frankfurt am Main in January 2005, including the one shown in Figure 10.

In the past five years, Maldonado tried unsuccessfully to locate cocoons of *R. cincta* in southern Arizona. The following information was given to him by other Yaquis. He was sent to the town of Globe, told to look on willows along the Gila River in the Estrella Mountains, told to look on willows along the Salt River through Phoenix, and told to look on South Mountain near Guadalupe, all of which he tried without finding any cocoons. He also heard that cocoons could be found in Ajo, but did not go there. Another locality about 8 kilometers south of the Saguaro National Monument was suggested, and he spent a full day there searching on limberbush and ocotillo without success. Pascola dancers who were elders from other tribes suggested St. Johns, a community south of Guadalupe on the Pima Reservation.

An elder in Río Yaqui (Sonora) once told Maldonado that when a viable cocoon was found, he would remove the pupa and dig a small hole in the soil with his finger at that site and bury it, so that it would survive. Although this procedure may have been widely practiced and believed among Indian collectors of cocoons, it would certainly result in the death of the pupa. It is possible that this was only done by that one elder and perhaps a few others with whom he collected. However, if the practice was more widespread, we suppose that it may account for why cocoons have traditionally been cut so low, wasting up to 50% of the upper portion (compare Figs. 3 and 11), before making rattles. Cutting the

cocoon higher would result in an opening too small to remove the pupa undamaged. This leads us to make the noteworthy point that the new dance rattles that Maldonado made using cocoons of *E. calleta* contain much more of the original cocoons; compare the older and newer models in our Figure 11.

In July 2004 Peigler sent about 350 empty cocoons of *Eupackardia calleta* to Maldonado, who used most of them to make a large new pair of tenabares (one shown on the right in Fig. 11). The cocoons were a mixture of wild-collected and captive-reared ones, all from near the Coastal Bend of Texas, primarily from the towns of Beeville, George West, Three Rivers, and Goliad. On 7–8 October 2004 Maldonado visited the University of the Incarnate Word and presented lectures to students, wearing his regalia and demonstrating the pascola dance. Therefore, it is worth noting that the first public debut of those new rattles made with Texan cocoons was in southern Texas. He also wore hand-carved pascola masks and used a sonasum (see Figs. 12–13), all made by him. On 9–10 October, Maldonado and his wife and sister accompanied Peigler on day trips to Corpus Christi, Beeville, and other towns, and the four collected another 531 cocoons of *E. calleta*, of which only 43 were viable. Cocoons usually persist on the hostplants for more than two years after the moths emerge (Fig. 6). Additional field observations in Texas will be presented in a later subsection.

For centuries American Indians have traveled great distances to obtain the natural objects required by their material culture. Maldonado's pilgrimage from Arizona to Texas is one further example. Maldonado already has enough cocoons to make two more sets of pascola dance rattles, and is engaged in rearing larvae of both *E. calleta* (Texas stock) and *R. cincta* (Baja California Sur stock) in his garden in Arizona, with hopes of having a perpetual source of cocoons. Cocoons of the Central American *Rothschildia lebeau* (Guérin-Méneville, 1868) are indistinguishable from those of *R. cincta*, and the livestock is usually easier to obtain and to rear, so this species also has potential for Maldonado.

The Texas populations of *R. lebeau* are usually referred to as *R. forbesi* Benjamin, 1934. Some authors have treated the name *forbesi* as a synonym or subspecies of *R. lebeau,* but we remain uncertain about this status.

Medicinal necklaces and the sonasum

An historical necklace with six cocoons of *Eupackardia calleta* dating back to the nineteenth century was illustrated and described by Peigler (1994), but its origin was unknown. He also showed a necklace with two cocoons of *Rothschildia cincta* that he bought from a Tarahumara woman in Chihuahua in 1992, and speculated that it may have been considered to have medicinal value. Maldonado has only seen one such necklace with *R. cincta* cocoons in Arizona, decades ago, worn by a pascola dancer. Instead of cocoons, most "medicine bags" have a small leather bag worn as a pendant on a necklace. The contents of the cocoons are private and personal, but the purpose is always to protect from the spells of witches. They are not rattles, but instead contain a fetish believed to have power. Examples include tobacco, herb medicine, seeds, or sea salt. The cocoons probably simply serve as containers, but it is possible that they have some significance to the person who makes or wears the necklace. Ferguson (1972: 231) referred to a cocoon of *E. calleta* that had been used as a rattle by a medicine man in Arizona, but did not specify whether it was on a handle or necklace. If the latter, it belonged to this category of medicinal containers.

Kolaz (1985: 40) wrote, "When the pascola is dancing to the music of the flute and drum, he holds and shakes an instrument called a 'sonasum', a hand-carved instrument with two rows of metal discs that produces a clanging sound. During the dance, the pascola holds this instrument in his right hand and hits it against the palm of his left hand in various rhythms." Another name for this musical instrument is "sistrum" (Griffith 1972). Maldonado has carved numerous masks and sonasums, using wood from the roots or trunk of cottonwood (*Populus fremontii* S. Wats., Salicaceae). In 2001 he carved two in the image of a caterpillar plus cocoon (Fig. 12). As with virtually all indigenous art, they are somewhat stylized, but they do have four pairs of prolegs along the middle of the segmented body, and the gaudy colors are rather reminiscent of the mature living larvae of *E. calleta* and *R. cincta*. The moth-shaped metal discs within were cut by him from sheet brass.

Biology and field observations of *Rothschildia cincta* and *R. lebeau*

Rothschildia cincta was shown in color by Draudt (1929: pl. 101), misidentified under the name *R. jorulla* (Westwood, [1854]). It varies in its ground color, as pointed out by D'Abrera (1998: 96). We do not agree with other authors that the taxon found farther south in western and southern Mexico named *guerreronis* by Draudt (1929) is a subspecies of *cincta*, but consider it to be a full, valid species. The two ♂ specimens shown by Lemaire (1978: pl. 9) appear to represent two distinct species, and our same opinion applies to the two ♂♂ shown in color by Draudt (1929: pls. 101, 134). However, we do not propose here a formal taxonomic change in the status of the name *guerreronis*, but leave this question to be resolved by future workers.

There has also been confusion and disagreement regarding the identification and label data on some of the specimens shown on Ferguson's (1972) plate 17. Peigler has collected cocoons of *Rothschildia* in the Lower Rio Grande Valley of Texas (Cameron and Hidalgo counties) several winters, and believes that only one species in the genus occurs in that area. Of course, Ferguson's figures 3 and 6 are *R. cincta* (which he misidentified as *R.*

Fig. 1: *Eupackardia calleta,* ♀ from Goliad, Texas, from wild cocoon collected by Robert A. Miranda and Joel T. Burke in February 2004. **Fig. 2:** *Rothschildia cincta,* ♀ from Valle Perdito, Baja California Sur, emerged 13 November 2004, reared ex-ovo by R. Peigler on *Prunus serotina*. **Fig. 3:** Cocoons of *R. cincta* from San Carlos, Sonora. **Fig. 4:** Mature larva of *E. calleta* from Goliad, shown on esperanza (*Tecoma stans*). **Fig. 5:** Mature larva of *R. cincta* from San Isidro, Baja California Sur. **Fig. 6:** Cocoons of *E. calleta* and *R. lebeau* sometimes girdle twigs, evidence that they are strong and may persist on the hostplants for two or more years. The stems are cenizo and Arizona ash (*Fraxinus velutina*). **Fig. 7:** Cenizo (*Leucophyllum frutescens*) flowering in Texas. **Fig. 8:** Ocotillo (*Fouquieria splendens*) in Carlsbad National Park, New Mexico (with the Guadalupe Mountains in Texas visible in the distance). **Fig. 9:** Close-up view of ocotillo. — Photos by R. Peigler.

Fig. 10: Yaqui cocoon rattle for deer dance, showing red tassles. **Fig. 11:** Tenabares for pascola dance, old rattle (left) from Río Yaqui, Sonora, with cocoons of *R. cincta,* and new rattle (right) made in Arizona in 2004 from cocoons of *E. calleta* from Texas. **Fig. 12:** Sonasum in form of caterpillar plus cocoon, carved by Merced MALDONADO. — Photos by R. PEIGLER. — **Fig. 13:** Merced MALDONADO demonstrating pascola dance, wearing tenabares that he made from cocoons of *E. calleta*. — Photo by Sigrun MALDONADO.

jorulla) from Arizona, but the others (figs. 2, 4, 5, 7–9) all fall within the normal variation of *R. lebeau* (= *forbesi*) and we think that they all bear correct locality labels. Hoffmann (1942) discussed the taxonomic questions of the Mexican representatives of the genus in some detail, including the phenotypic variation of *lebeau* and *forbesi*, and the status of *guerreronis*.

The known localities of *R. cincta* were published by Lemaire (1978) and especially Weast (1989), which can be summarized as follows: Kitt Peak and Brown Canyon, Baboquivari Mountains, south-central Pima County, Arizona; Organ Pipe Cactus National Monument, western Pima County, Arizona; and the Mexican states of Baja California Sur, Sonora, Sinaloa, and Nayarit. It probably ranges east into Chihuahua, because we have seen tenabares made by the Tarahumara composed of cocoons of this species. The insect has been found in the 1970s and 1980s in specific places in Arizona including Kitt Peak Road and Peña Blanca Canyon, the latter in Santa Cruz County. The overall distribution appears to coincide with the Pacific slopes of the Sierra Madre Occidental, and within the Sonoran Desert biome. Weast pointed out that there are two different climatic zones in Arizona where the moth occurs, noting that the localities in the Baboquivaris experience cooler winters with periodic freezing, whereas the Organ Pipe Cactus region has milder winters. Christopher Conlan (personal communication) has never observed *R. cincta* farther north in the Baja Peninsula than the town of Mulegé, and has collected adults at lights or cocoons in Juncalito and Agua Verde. The distribution of the moth coincides with subdivisions of the Sonoran Desert (Turner & Brown 1982: 189) in Sonora, Arizona, and Baja California Sur, where it particularly agrees with the extension of that desert to the Northeast into the Baboquivari Mountains, and along the facing coasts of Sonora and Baja California Sur. Along the eastern coastal ranges of Baja California Sur is a biogeographical province called the Extended Cape Region Province by Brown et al. (1992: 10–15, fig. 7), characterized by a Neotropical biota. All known localities for *R. cincta* on the peninsula appear to fall within this province of the Sonoran Desert. Conlan reports that he finds cocoons from the beaches up into the foothills.

As far as we know, the primary hostplant of *R. cincta* in both Arizona and Mexico is the limberbush (*Jatropha cardiophylla* (Torr.) Muell. Arg., Euphorbiaceae), also called sangre-de-Cristo and sangre-de-drago (Kearney & Peebles 1942: 532). Conlan (personal communication) told us that cocoons were usually found singly (one per bush), but were often on about 20–25% of the limberbush shrubs he checked in Baja California Sur, and that larvae frequently stray from the true hostplant to nearby plants on which to spin their cocoons. Anecdotal reports, plus our knowledge of foods used by other species of *Rothschildia,* leave no doubt that willows (*Salix*) are also fed upon by larvae of *R. cincta* in riparian zones.

Enicospilus lebophagus Gauld, 1988 (Ichneumonidae: Ophioninae) is a large orange wasp that parasitizes the larvae of several species of *Rothschildia,* and then makes its cocoon within that of the host. Conlan sent a female of *E. lebophagus* to Peigler that emerged 28 August 1997 from a cocoon of *R. cincta* that he collected 9 km south of Mulegé in December 1996. This represents an extension of the known range of this parasitoid and provides a definitive host record of *R. cincta*. A previous report of the parasitoid by Peigler (1996), based on a cocoon from the Mexican state of Jalisco and considered to possibly represent *R. cincta*, more likely refers to *guerreronis*. A ♂ of *E. lebophagus* emerged 26 September 2004 from a cocoon of *Rothschildia lebeau* collected on *Salix humboldtiana* Willd. in San Benito, Cameron County, Texas, in December 2003 by Michael P. Johns and Peigler. That ♂ plus the ♀ from Mulegé were deposited in the insect collection of the University of Georgia (Athens, Georgia).

In Arizona, the moths of *Rothschildia cincta* are probably on the wing from December till February in the Organ Pipe Cactus National Monument region, but flights coincide with rains in July and August farther east in the Baboquivaris (Weast 1989). Conlan told us that *R. cincta* can emerge anytime between July and November in Baja California Sur, and that cocoons may delay for up to two years waiting for significant rainfall before emerging, and such rains also induce foliation of the hostplants. He has had cocoons remain viable in captivity for four years. According to independent reports from D. Robacker and C. Conlan (personal communication), ♀♀ of *R. cincta* arrive at lights in Baja California Sur about two hours after dark, usually before midnight.

We had the opportunity to rear *R. cincta* from eggs sent by David Robacker who collected ♀♀ at light 15 August 2004 at San Isidro (southeast of La Paz) and 16 August 2004 at Valle Perdito (south of La Paz), both localities in Baja California Sur. Larvae (Fig. 5) grew well and matured on wild black cherry (*Prunus serotina* L., Rosaceae), forming their cocoons in early October. A pair of these emerged in early November 2004 in Arizona, and two ♀♀ from the same brood emerged indoors in San Antonio on 13 and 26 November 2004, and the two latter cocoons had never been wetted. The long flight period in nature coupled with this proof that all pupae do not enter diapause, indicates that there can be more than one generation per year, usually within the second half of the calendar year.

Lepidopterists speculate as to why *R. cincta* is so difficult to find in Arizona most years. Pupae of this species tolerate freezing temperatures (Weast 1989), although we believe that colder climate is indeed a factor limiting its northernmost distribution. Maldonado has observed a lot of habitat destruction or at least alteration in southeastern Arizona in recent decades. In the 1960s, there were massive sprayings of DDT to combat cotton pests. Large tracts of land previously covered by mesquite (*Prosopis* spp., Leguminosae) forests have been converted

to agriculture and residential housing developments. However, we propose that Arizona populations of *R. cincta* have probably been drastically reduced or even exterminated by humans collecting the cocoons, an idea first suggested to Peigler several years ago by Michael Collins (personal communication). Pima and Tóhono O'odham people have possibly been doing this in Arizona for centuries, and Yaquis and lepidopterists have also frequently sought cocoons in that region all during the twentieth century. Peigler & Naumann (2003: 85, 91, 96, 110) found five independent reports in the entomological literature suggesting or documenting that lepidopterists had overcollected cocoons of *Samia* in Japan, Spain, Austria, France, and the United States. Humans are efficient and persistent collectors of such conspicuous cocoons.

The main foods of *R. lebeau* in southern Texas and northeastern Mexico are *Citrus* (Rutaceae), several species of willow including the very tall *Salix humboldtiana* (Correll & Johnston 1979: 451), uña de gato or lime prickly-ash (*Zanthoxylum fagara* (L.) Sarg., Rutaceae) and Arizona ash (*Fraxinus velutina* Torrey, Oleaceae), the latter also called desert ash or fresno. Populations of this moth north of the Rio Grande/Río Bravo fluctuate greatly, depending on severe freezes (which may not occur for several consecutive winters) and the abundance of *Enicospilus lebophagus*. Two full days of searching by Michael Johns and Peigler in December 2003 resulted in only two empty cocoons and two parasitized ones. Cocoons containing this same parasitoid were also collected in January 2004 by R. D. Weast and M. M. Collins at Laguna Atascosa National Wildlife Refuge, Cameron County, Texas, on lime prickly-ash. In some previous winters, Peigler found that more than 100 viable cocoons could easily be collected during a single afternoon. The almost complete conversion of original thornbrush to agriculture and buildings in the Lower Rio Grande Valley has not exterminated this moth, because willows grow commonly along drainage canals, and citrus and Arizona ash are planted commonly in yards.

Biology and field observations of *Eupackardia calleta*

In southern Arizona, the main hostplants known to be used by *Eupackardia calleta* are the Mexican jumping bean or yerba-de-fleche (*Sapium biloculare* (S. Wats.) Pax, Euphorbiaceae) and the ocotillo (*Fouquieria splendens* Engelm., Fouquieriaceae) (Figs. 8–9), also called slimwood or coach-whip, this latter first published by Ferguson (1972), but since verified by other lepidopterists doing field work in that region. Cocoons on ocotillo are generally found at the base of the plant, only a few centimeters above ground level, and the peduncle is attached by a flattened end (J. B. Duncan, personal communication), somewhat like the attachment of a nest of paperwasps (*Polistes* spp., Vespidae).

In Baja California Norte, Chris Conlan (personal communication) found a third-instar larva on boojum or cirio (*Fouquieria columnaris* Kellogg, Fouquieriaceae) south of Cataviña in November 2003, and a cocoon on a boojum tree north of Cataviña in February 2004, which yielded a ♀ moth in September 2004. Conlan says that cocoons of *E. calleta* are not common on the peninsula, and are usually found on larger boojum trees, attached near ground level up to more than one meter high. Kirby Wolfe (personal communication) also found eggs and larvae of *E. calleta* on boojum trees in Baja California. In Mexico City in July 1976, Peigler found cocoons on California pepper trees (*Schinus molle* L., Anacardiaceae). In Val Verde County (Highway 90 at Pecos River), western Texas, Peigler found a young larva on escobilla or Gregg ash (*Fraxinus greggii* Gray) in October 1993, and Maldonado observed that larvae from southeastern Texas that he reared in Arizona in 2004 fed and grew very well on Gregg ash. In southeastern Texas, larvae and cocoons are also sometimes found on various other Oleaceae, such as *Forestieria angustifolia* Torrey and privet (*Ligustrum* L.). The plant named esperanza that Weast (1989) reported to be a food in southern Texas is surely *Tecoma stans* (L.) Juss. (Bignoniaceae), a native yellow-flowered ornamental, usually called esperanza in Texas (Correll & Johnston 1979: 1444). Larvae from Goliad, Texas, freely accepted this plant in captivity in San Antonio in November 2004 (see Fig. 4). In Arizona, Maldonado offered foliage of limberbush to larvae from Texas, and it was also accepted.

However, the primary hostplant in southern Texas is the cenizo (*Leucophyllum frutescens* (Berl.) I. M. Johnst., Scrophulariaceae) (Fig. 7). This ornamental shrub is widely planted in urban and suburban landscapes, also called Texas ranger in Texas, and purple sage in Arizona, where it is not native but commonly planted. Cenizo means "old one" in Spanish, in allusion to the gray color of the leaves. Although the plant is evergreen and the gray cocoons of *E. calleta* are similarly colored, when cocoons are present, they are usually easy to locate. There is a horticultural variety of cenizo with lime-green instead of gray leaves, but based on cocoon finds, we concluded that ♀ moths have no preference when ovipositing. Bushes of cenizo are loose and open when left alone, but become compact and dense when pruned, making cocoons harder to find.

♂♂ of *Eupackardia calleta* are day fliers and are believed to mimic the toxic pipevine swallowtails (*Battus philenor* (L.), Papilionidae), which we observed to be very common in coastal Texas. The possibility that adults of *E. calleta* might retain the toxicity of their larvae (see below) calls for further study, opening the question of whether this mimicry is Müllerian or Batesian. ♀♀ are night fliers and are attracted to light. There are two main flights in Texas, with moths emerging in March and April and again in October and November. Many pupae remain viable in their cocoons for a year or longer, and emergences can

be triggered by rains following dry periods. Caterpillars can evidently survive freezing temperatures, because Peigler found one mature and two half-grown larvae in Beeville in late December of 1998. In larvae from Texas, the blue scoli are set upon extensions of the body that can range from dark yellow to dark orange, but never as carmine red as on those from Arizona. These patches on mature larvae from Baja California are copper-colored (C. Conlan, personal communication).

Although there are rare reports of this moth being found as far north as Houston and San Antonio (Gregory Muise, personal communication), the northern range of where populations regularly exist in Texas is approximately around Victoria and Cuero. Farther west its distribution is less documented, but it does occur in Val Verde County and the Big Bend National Park in western Texas. Extensive natural stands of cenizo are present between Brackettville and Del Rio, so its original range in southeastern and western Texas may not be disjunct.

We observed a few fields of wild-growing cenizo a few kilometers south of Beeville, but larger stands, covering thousands of hectares, can been seen south of the town of George West and around the town of Alice. We have not found cocoons in these areas (although we did not not search very much, mainly because of fencing), and we expected them to be very difficult to find, as in the proverbial "needle in a haystack." We believe that these fields of cenizo certainly support large reservoir populations of *E. calleta*, and that ♀♀ commonly fly from these into distant towns and oviposit on cultivated shrubs of cenizo. The lower density of cenizo in fact increases the likelihood of ♀♀ ovipositing on them. In towns such as Beeville, George West, Goliad, and Three Rivers, cocoons are often found on more than half of the shrubs that are checked. In larger towns like Beeville and especially Corpus Christi, self-perpetuating urban populations can persist for several generations, with additional propagules arriving from the natural stands of cenizo to the south, probably almost every year. These hypotheses are supported by the fact that we found almost no cocoons in Alice, a town that is surrounded by the natural populations of cenizo, and thus the cenizos in yards and parks in Alice are not isolated enough to invite oviposition by ♀♀ that have flown out of the nearby fields. On the contrary, a ♀ flying into Beeville or Goliad, would probably be very inclined to oviposit onto the first cenizo encountered after many kilometers of searching.

In George West, we collected several cocoons on a large shrub of cenizo in a yard on a street with many adjacent houses. The cenizo was growing between, and in direct contact with, two larger and taller bushes of arborvitae (*Thuja orientalis* L., Cupressaceae). Many more cocoons were found by us deep within those two plants, making it clear that the larvae of *E. calleta* preferred arborvitae over cenizo as their spinning sites. Elsewhere, we also found two cocoons attached to chain-link fences alongside cenizo shrubs.

We doubt that the urban populations are denser because of reduced predation and parasitism. Compared to other large saturniids, *Eupackardia calleta* appears to be free of parasitoids in the larval stage, and we have never reared any wasps or flies from the cocoons. Birds and rodents also probably avoid the gaudy larvae because of their aposematic coloration (Fig. 4) and toxic secretions. Deml & Dettner (1993) found that glands in larvae of *E. calleta* secrete phenylacetaldehyde, benzonitrile, epinephrine (= adrenalin), trehalose, glycerol, acetylcholine, and other active compounds. They further demonstrated that this strong-smelling chemical defense repels ants (Formicidae). Protection from ants is important to caterpillars living in desert and thornbrush areas, especially if they sometimes move from one hostplant to another across the ground. However, we did not observe such secretions or odors from larvae of *Rothschildia cincta*, which also sometimes stray from their hostplants to spin their cocoons.

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David Robacker supplied eggs of *R. cincta* at our request. Kirti Mathura, a horticulturist at the Desert Botanical Garden (Phoenix, Arizona) provided plants and expertise to Maldonado. Unpublished information and specimens were also provided by Michael M. Collins, Christopher A. Conlan, J. Bruce Duncan, Gregory D. Muise, Robert D. Weast, and Kirby L. Wolfe. For assistance in collecting in the field we thank Sigrun Sæmundsdottir Maldonado and Frances Hosten, and Peigler's students Joel T. Burke, Patrick J. Greener, Michael P. Johns, and Robert A. Miranda.

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Hessenfauna

14. Nachtrag zum Wiederfund von *Peribatodes ilicaria* (Geyer, [1833]) (Lepidoptera, Geometridae) in Hessen

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Auf meine Mitteilung über einen hessischen Fund von *Peribatodes ilicaria* (Geyer, [1833]) (Lepidoptera: Geometridae) im Heft **25** (1/2) (Radtke 2004) dieser Zeitschrift bekam ich von Christian Finke, Bad Wünnenberg, weitere Informationen zum Vorkommen dieser Art im Diemeltal. Demnach wurde *P. ilicaria* in letzter Zeit zunächst 1988 von Dudler im hessischen Diemeltal (Landkreis Kassel) gefunden (Dudler et al. 1994). [Diese Veröffentlichung wird auch der Einstufung von *P. ilicaria* für Hessen im Verzeichnis der Schmetterlinge Deutschlands von Gaedike & Heinicke (1999) zugrundeliegen. Da Dudler et al. dort aber nicht als Gewährsleute für hessische Makrolepidoptera genannt sind, hatte ich diese Quelle nicht berücksichtigt.]

Im Laufe weiterer Untersuchungen des Diemeltales durch die Autoren der erwähnten Veröffentlichung (Dudler et al. 1994) seit Mitte der neunziger Jahre des 20. Jahrhunderts wurde die Art an mittlerweile 6 Fundorten nachgewiesen. Von diesen befindet sich nur einer auf der nordrhein-westfälischen Seite, hingegen 5 auf hessischer, vier im Landkreis Kassel und einer im Landkreis Waldeck-Frankenberg. Auch der von mir 2004 zitierte Fundort Sielen (Schumacher 2001) liegt auf der hessischen Seite des Diemeltales. [Ich hatte übersehen, daß das Arbeitsgebiet der Arbeitsgemeinschaft Rheinisch-Westfälischer Lepidopterologen die Landesgrenzen NRWs überschreitet.] Diese Fundorte fügen sich insgesamt gut in die offenbar inselartige Verbreitung der Art im Diemelraum ein. Aufgrund der Stetigkeit der Beobachtungen (seit über 130 Jahren, siehe Speyer 1872 in meiner Notiz von 2004!) und der Anzahl der Fundorte ist diese Population sicherlich als überregional bemerkenswert zu bezeichnen.

Finke empfiehlt, auf Goméz de Aizpúrua (1997) und dessen Erfahrungen in Spanien hinweisend, die Raupen dieser Art auch an Kiefern (und nicht nur an „verschiedenen Laubhölzern“) zu suchen, da diese an allen ihm bekannten Fundorten von *P. ilicaria* anzutreffen sind. Auch am Fundort Hoher Steiger bilden Kiefern einen wichtigen Aspekt der Flora. (Goméz de Aizpúrua 1997 listet die folgenden Raupenfutterpflanzen für *P. ilicaria,* den er noch als *P. manuelaria* benennt, auf: *Quercus ilex* [Fagaceae], *Malus communis* [Rosaceae], *Juniperus oxycedrus* [Cupressaceae], *Cedrus* sp. und *Pinus sylvestris* [Pinaceae].)

Für die von C. Finke mitgeteilten Informationen zu *P. ilicaria* möchte ich mich ganz herzlich bedanken.

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