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Ipomoea carnea Jacq. (Convolvulaceae) in Costa Rica

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IPOMOEA CARNEA JACQ. (CONVOLVULACEAE) IN COSTA RICA*

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ABSTRACT

This is the first report of *Ipomoea carnea* (Convolvulaceae) from lowland Costa Rica. These populations are unusual for the species in flower color, flowering season and pollinator. Other aspects of the biology of the species in Guanacaste, especially pollination, flower robbing and extrafloral nectary visitors, are discussed.

This is a first report of *Ipomoea carnea* Jacq. from Guanacaste Province, Costa Rica. This paper also establishes a pollinator for *I. carnea* and describes some of its basic biology.

Ipomoea carnea Jacq. (Convolvulaceae) is a woody morning glory which climbs by twining but is capable of growing unsupported to over two meters.

Ipomoea carnea has been shown to be a synonym of *I. fistulosa* Mart. ex Choisy (Austin, in press) and *I. crassicaulis* (Benth.) Robins. (O'Donell, 1952). *I. carnea* is scarcely known from Costa Rica under any of these names, although the plant ranges from Mexico to Argentina and Peru (Matuda, 1963; O'Donell, 1952; MacBride, 1959). All the reports from Costa Rica are from high elevations: two from the region of San Ramón at 800–900 meters in 1926 and 1928, one north of Santa Ana at 940 meters at about the same time and another cultivated in San José in the 1930's (Standley, 1937). However, *Ipomoea carnea* is locally abundant in areas of Guanacaste Province (voucher specimens are deposited in the Herbario Nacional de Costa Rica). A large population grows in seasonally flooded pastures near Hacienda Palo Verde and the plant is abundant on rocky slopes above the beach at Playas del Coco, Playa Panama, Playa Hermosa and on the road approaching Playa Tamarindo, all on the northern coast of the Nicoya Peninsula. It probably ranges south along the coast into Puntarenas.

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Plants in the Guanacaste populations were determined as *I. carnea* by D. F. Austin, Florida Atlantic University. Irene Baker and I found them to have the standard chromosome number reported for the species, n = 15 (Darlington and Wylie, 1956). Nevertheless these plants are unusual in that they flower only during the dry season (November to April) rather than continuously, as is usual for the species (Austin, 1973, in litt.). Furthermore they have the lightest colored flowers known for the species (Austin, 1974, in litt.), being white with a purple throat; generally *I. carnea* flowers have pink to purple corollas.

I. carnea flowers are open for only one day, opening about 5:30 am and closing by 2:00 pm. Anthers have dehisced when the flower opens. Nectar levels are low until about 9:00 am when the level rises to two microliters.

TABLE 1. ***Ipomoea carnea*** **Floral Nectar Production.**

(Bagged Flowers)

Time	No. of Flowers	Average Nectar Production (microliters)
7:00 am	23	0.34
8:00 am	22	0.49
9:00 am	45	2.05
10:00 am	48	2.00
11:00 am	21	2.70
12 noon	40	2.90

At Palo Verde the flowers are pollinated by *Melitoma euglossoides* L. & S., and *Ancyloscelis wheeleri* (Cock.), (Anthophoridae). The Anthophoridae are Neotropical bees restricted in their pollen collecting to plants of the genus *Ipomoea* (Mitchener, 1954). A list of other flower visitors and some comments are given in Table 2. The two anthophorids are by far the most abundant visitors at Palo Verde. They characteristically enter the flower, take nectar, turn around within the corolla and harvest pollen. By 11:00 am, 85% of the flowers have had the pollen taken. The anthophorids remain active although individual flower visits are much shortened since only nectar is available in most cases.

That these bees* pollinate *I. carnea* is apparent from the large *Ipomoea* pollen loads on bees captured in midmorning. Furthermore, capsule development was greatly

* Specimens determined by H. V. Daly, U. California, Berkeley and W. E. Laberge, Ill. Nat. Hist. Survey, Urbana, Ill.

increased in flowers that were visited by anthophorids. Of 181 flowers, chosen at random, 162 yellowed and dropped off within three days of flowering. Only 19 (10.4%) developed into fruit. However, 16 of 37 (43.2%) flowers which I observed to be visited by a bee were still green after three days. The difference between the frequency of seed set in random flowers and in anthophorid–visited flowers is highly significant: $x^2 = 23.9$, $P \ll 0.005$ and establishes effective pollination by the anthophorids.

Table 2. *Ipomoea carnea* **Flower Visitors**

Insect	Comments
Anthophoridae	89 observations, 15 captured, more heard or glimpsed; small bee
Melitoma euglossoides	
Ancyloscelis wheeleri	
Xylocopine bees	Fairly common in November, absent in January; small bee
Ceratina sp.	1 observation; large bee
Xylocopa gualanensis Cockerell	
Euglossine bee	1 observation; too large to enter corolla fully
Coleoptera	
Nemognatha coeruleipennis	2 observations; small beetle

This is the first report of pollination of *I. carnea* by anthophorid bees. Austin (1974, in litt.) reports that they are pollinated by bees of the genus *Bombus* and by the wasp *Campsomeris* in Florida, by bees of the genus *Peponapis* and *Melissodes bimaculata nulla* in Yucatan. Van der Pijl (1954), describes pollination of flowers of an introduced population of *I. carnea* in Malaya by the bees *Xylocopa confusa, X. caerulea* and, occasionally, *Lithurgus* sp.

In Guanacaste only bees are attracted to the flowers, while wasps, flies and beetles are common on the plant but only go to the extrafloral nectaries. There are five extrafloral nectaries on each pedicel and two on each petiole. The anthophorids were never attracted to the extrafloral nectaries. This was true of the other, rarer flower visitors as well. Individuals of *Xylocopa frontalis* (Oliver) were regularly attracted to the flowers but were prevented, by size, to enter the corolla. It would generally climb over the edge of the corolla surface, walk down the corolla on the outside and rob the flower of nectar by biting a hole close to the base of the petals. By the end of each day, 50–70% of the flowers were thus robbed. However, robbing was significantly decreased if there were other insects on the pedicellar extrafloral nectaries (Keeler, in prep.). It is interesting to note that these interactions form around *I. carnea* in the Old World Tropics as well. Niewenhuis

von Uexküll (1907) and van der Pijl (1954), both observing introduced *I. carnea* in Malaya, reported similar the robbing of nectar by *Xylocopa latipes* also too large to enter the corolla. Both workers discussed whether extrafloral nectary visitors were effective in discouraging flower robbing: Niewenhuis decided they were not, van de Pijl decided they were.

The array of insects attracted to the extrafloral nectaries is indicated in general terms in Table 3. Apparently a list of extrafloral nectary visitors to a tropical plant has not been published previously. These insects play a role in the defense of the plant, discouraging flower robbers and herbivores (Keeler, in preparation). Extrafloral nectar is produced night and day, in the wet season by the petiolar extrafloral nectaries and in the dry season by the pedicellar extrafloral nectaries. The reliability and abundance (about 4 microliters/branch/day) of this nectar, undoubtedly makes it an important resource for nectar–feeding insects.

Table 3. ***Ipomoea carnea*** **Extrafloral Nectary Visitors**

(Percents average May to January figures)

ANTS		OTHER INSECTS	
Solenopsis – several species	10%	Vespidae – many species	
Camponotus – many species	50%	Diptera – many species	
Crematogaster – 1 species		Lampyridae – 4 species	
Odontomachus – 1 species		Elateridae – 2 species	
Ectatoma – 1 species		Coccinellidae – 2-3 species	
Pseudomyrmex – 4 species		Chrysomelidae – 4 species	
	10%	Cerambycidae – 2 species	
8–10 other ant genera	10%	Tenebrionidae – 2 species	
		Lycidae – 1 species	
		Lygaeidae – 1 species	
all ants	80%	altogether	20%

The leaves are attacked by a number of lepidopteran larvae (caterpillars), microlepidopteran larvae (leaf miners) and several weevils (Curculionidae). There is strikingly little damage to the foliage due to grazing. In a heavily grazed field at Palo Verde, over a six month period, I only once saw leaves that appeared to have been cropped by cattle. O'Donell (1952) and MacBride (1959) report that the leaves are believed to be poisonous to cattle and are acrid to human taste. The sap was determined to contain phenolics and alkaloids by p-nitranaline (Smith, 1969) and Dragendorff's (Stahl, 1969) tests, respectively. Very likely these are responsible for the cattle's distaste for the leaves.

The leaves showed a striking change in shape between the rainy and dry seasons. Rainy season leaves are cordate, as wide or wider than they are long. With the onset of the dry season the new leaves are all distinctly lanceolate, four to five centimeters longer than they are wide. This variation in leaf shape has been a cause of taxonomic confusion and probably represents an adaptation to drought stress. Later in the dry season nearly all the leaves fall.

At Palo Verde, seed set is poor relative to the number of flowers. This is apparently due to a complex self-incompatibility system (Martin, 1968, Keeler, pers, obs.) coupled with the tendency of the pollinating bee to fly to adjacent flowers which are often on the same plant, 10–20% of the flowers develop as fruits. Fruits have a high rate of infestation (at least 18%) by the bruchid *Megacerus alternatus* Bridwell (Specimen determined by C. D. Johnson, Northern Arizona University, voucher specimen in California Insect Survey).

Conclusions

Ipomoea carnea Jacq. is present in lowland Guanacaste Province. Here it is at a much lower elevation than ever reported for Costa Rica. It is furthermore distinct from other known populations for its flower color, seasonality of flowering and pollinator. The species is native to the New World tropics but has been widely cultivated, although I have never seen it in cultivation in Costa Rica. The present distribution of the species presents several interesting problems: is it still growing above 800 meters near San Ramón or Santa Ana? ; does it range very far down the coast? ; how far inland does it get in Guanacaste? ; is it present on the Atlantic coast? If it is found in southern Puntarenas, does it flower longer or non–seasonally there, in accord with the less seasonal climate? If plants of *I. carnea* can be found at 800 meters they should be rather different from the plants in Guanacaste. For example, plants from Guanacaste growing in the greenhouse at the University of California, Berkeley, produced very little extrafloral nectar unless the temperature rose above 27°C. Such temperatures are the rule in lowland Guanacaste but are rather infrequent at 800 meters.

It cannot yet be determined whether *I. carnea* is native to Costa Rica or an escaped species. The same problem applies to many attractive, widely distributed tropical species. If it can be shown that *Ipomoea carnea* is adapted to local conditions in Costa Rica, that is, has formed local races or ecotypes, then it is more likely to be native, or, if it is an escaped plant, to have naturalized a long time ago. There is some evidence that *I. carnea* is well adapted to Guanacaste. The low extrafloral nectar production except at high temperatures certainly would not be adaptive except in lowland areas of Costa Rica. Seasonal flowering is clearly only adaptive in highly seasonal environments such as Guanacaste and not desirable in an ornamental plant. In addition, *I. carnea* leaves in Guanacaste are frequently inhabited by leaf miners, which are usually quite restricted in their host plants (P. A. Opler, 1974). This too suggests a long period of evolution in Guanacaste.

However, more information is needed on the distribution and variation of the plant in Costa Rica before native status can be established.

Studies of the species in other localities are needed to see if the pollinator is the same there. With the wide array of different pollinators which have been reported in different locations, it is impossible to suggest which is the pollinator with which the species evolved and for which the flower morphology is adapted.

Summary

This paper reports *Ipomoea carnea* from Guanacaste Province. These are low elevation populations, unusual in that they flower seasonally, have white flowers and are pollinated by an anthophorid bee. Flower and fruit damage is great, the latter in part due to a common bruchid. Flowers are frequently robbed. The leaves are distasteful. *I. carnea* has abundant extrafloral nectar which attracts a large array of nectar feeding insects. None of the flower visitors are extrafloral nectary visitors or vice versa.

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