

Palamedes Swallowtail, Laurel Swallowtail, *Papilio palamedes* (Drury 1773) (Insecta: Lepidoptera: Papilionidae)¹

Donald W. Hall²

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Introduction

The Palamedes swallowtail is a large, dark swallowtail butterfly marked with yellow spots and bands. It is particularly common in and near swampy woods.

Nomenclature

Linnaeus grouped some swallowtails and other butterflies under the genus name *Papilio* and used the names of heroes of the Trojan War as specific epithets (Tyler 1975). *Papilio* is the Latin word for butterfly. Palamedes is a character of Greek mythology (Opler and Krizek 1984).

There is disagreement on the generic classification of the swallowtails (Hancock 1983; Miller 1987). Some authors (e.g., Tyler et al. 1994; Minno et al. 2005) follow the system that elevates the subgenus *Pterourus* to generic status as proposed by Hancock (1983). The subgenus name *Pterourus* is from the Greek roots “ptero” for wing and “ura” for tail (Borror 1960). However, Miller (1987) argued that there

is insufficient evidence to support elevation of the *Papilio* subgenera to genera. Because the name *Papilio* is still so widely used in many sources available to the public, it will be used here instead of *Pterourus* for practical reasons.

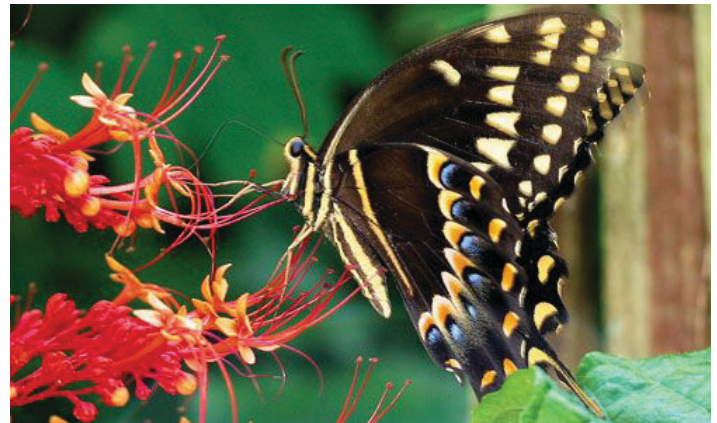


Figure 1. Palamedes swallowtail, *Papilio palamedes* (Drury) sipping nectar from a pagoda flower, *Clerodendrum paniculatum* L.
Credits: Donald W. Hall, UF/IFAS

Synonymy

Tyler et al. (1994), Heppner (2003) and Pelham (2008) listed the following synonyms:

Papilio chalcas (Fabricius 1775)

Papilio flavomaculatus (Goeze 1779)

1. This document is EENY-060, one of a series of the Entomology and Nematology Department, UF/IFAS Extension. Original publication date August 1998. Revised August 2010, August 2013, August 2016, January 2018, February 2021, and February 2024. Visit the EDIS website at <https://edis.ifas.ufl.edu> for the currently supported version of this publication. This document is also available on the Featured Creatures website at <http://entnemdept.ifas.ufl.edu/creatures/>.

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Scudder (1889) used the genus name *Euphœades* (Hübner) and listed *Papilio palamedes* as a synonym. In addition to the synonyms listed above, Scudder also listed the following synonyms:

Euphœades chalcas Hübner

Princeps heroicas chalcas Hübner

Distribution

The Palamedes swallowtail is found in the coastal plains of the southeastern states from southeast Virginia to Louisiana and Texas and all of mainland Florida (Figure 2). Strays have been found outside the year-round range as far west as Nebraska and as far north as New York (Butterflies and Moths of North America 2017). The Palamedes swallowtail is rare in the Florida Keys, and records from the Keys are considered to be of strays from the mainland (Minno and Emmel 1993).

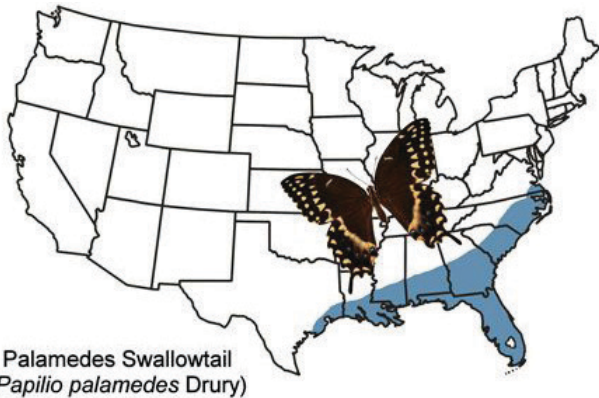


Figure 2. Palamedes swallowtail, *Papilio palamedes* (Drury), United States year-round distribution.
Credits: Donald W. Hall, UF/IFAS

Description

Adults

The wingspread is 11.2–13.2 cm (4.4–5.2 in) (Opler and Malikul 1998). The sexes are similar in appearance. The upper surface of the wings is brownish-black with yellow markings. The front wing has a double row of yellow spots on the distal one third and a row of small, yellow spots on the margin. The upper side of the hind wing has a marginal row of yellow spots and an uninterrupted sub-marginal yellow band (Figure 3). The tails may have a yellow stripe down the middle. The abdomen has broad yellow longitudinal stripes.

Male black swallowtails, *Papilio polyxenes* Fabricius, are similar, but smaller, the hindwing sub-marginal yellow band is interrupted by black wing veins, and the abdomen has longitudinal rows of yellow spots instead of stripes.

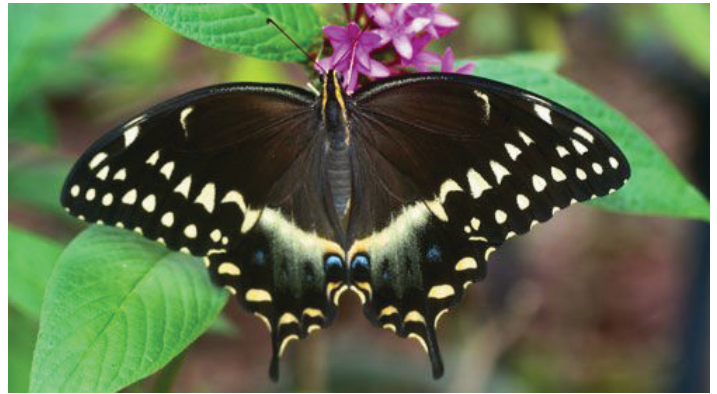


Figure 3. Palamedes swallowtail, *Papilio palamedes* (Drury) posed on Egyptian starcluster, *Pentas lanceolata* (Forssk.) Deflers.
Credits: Donald W. Hall, UF/IFAS

The underside of the hind wing has a distinctive basal yellow line that runs parallel to the body (Figure 4).



Figure 4. Palamedes swallowtail, *Papilio palamedes* (Drury), posed on Egyptian starcluster, *Pentas lanceolata* (Forssk.) Deflers. Note characteristic hind wing basal yellow line (arrow).
Credits: Donald W. Hall, UF/IFAS

Eggs

Eggs are pale greenish-white (Figure 5).



Figure 5. Palamedes swallowtail, *Papilio palamedes* (Drury), egg.
Credits: Donald W. Hall, UF/IFAS

Larvae

Full-grown larvae (5th instars) are approximately six centimeters (2.4 inches) in length (Minno et al. 2005). They are green with a pale yellow lateral line edged beneath with a fine black line. The underside of the larva is pinkish-brown. Abdominal segments have a transverse band of six blue dots with each dot ringed by a fine black line (much thinner than those on larvae of the spicebush swallowtail, *Papilio troilus* Linnaeus). One dot on each side is beneath the lateral line. There is a pair of large tan false eyespots lined with black on the rear of the thorax. The eyespots have a large black center and a white “false reflection” above. Larvae also have a smaller pair of tan spots at the front of the abdomen.



Figure 6. Palamedes swallowtail, *Papilio palamedes* (Drury), full-grown (5th instar) larva.

Credits: Donald W. Hall, UF/IFAS

Young larvae (instars 1–3) are tan to brown with a white middle (Figures 7 and 8). Second through fourth instars also have a pair of false eyespots on the thorax. The early instars (1–3) are similar in appearance to young larvae of the spicebush swallowtail except abdominal segments 8 and 9 (including the scoli [Figure 8]) are completely white. The mid-dorsal area of segment 8 and all of segment 9 is brown on young *Papilio troilus*. Also, the scoli of *Papilio troilus* on these segments are brown instead of white.



Figure 7. Palamedes swallowtail, *Papilio palamedes* (Drury), 1st instar and base of partially eaten egg shell (arrow).

Credits: Donald W. Hall, UF/IFAS

Fourth instars are similar in pattern to second and third instars, but the scoli on the ninth abdominal segment are reduced to small bumps (Figure 9).

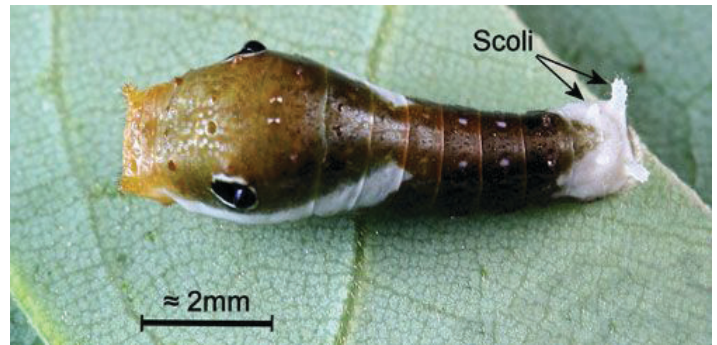


Figure 8. Palamedes swallowtail, *Papilio palamedes* (Drury), early instar larva (2nd or 3rd). Note white terminal segments and scoli.

Credits: Donald W. Hall, UF/IFAS



Figure 9. Palamedes swallowtail, *Papilio palamedes* (Drury), late fourth instar larva.

Credits: Donald W. Hall, UF/IFAS

Pupae

Pupae may be green or brown and have two short horns (Figure 10).

Scudder (1889) gave detailed descriptions of all stages including all five larval instars.



Figure 10. Palamedes swallowtail, *Papilio palamedes* (Drury), green and brown pupae.

Credits: Donald W. Hall, UF/IFAS

Life Cycle

There are two flights in Virginia (Opler and Krizek 1984; Scott 1986) and at least three flights in Florida (Minno et al. 2005). Males patrol wooded areas in search of females.

During courtship, the female flies 1–2 feet above the ground, and the male flies 1–2 feet above her (Glassberg et al. 2000). Oviposition occurs near mid-day (Opler and Krizek 1984). Eggs are laid singly on the underside of new foliage of the host plants (see below) (Scriber 1996). Before pupation, full-grown larvae cease feeding and turn to a yellow color. These “prepupae” typically wander off the host plants to pupate (Minno et al. 2005). The “prepupae” retain the yellow color during the pupation process (Figure 11). Pupae are the overwintering stage (Cech and Tudor 1995; Minno and Minno 1999).



Figure 11. Palamedes swallowtail, *Papilio palamedes* (Drury), prepupa. Credits: Donald W. Hall, UF/IFAS

Within the last 24 hours before adult emergence, the preadult gradually becomes visible through the transparent pupal cuticle (Figure 12).



Figure 12. Palamedes swallowtail, *Papilio palamedes* (Drury), preadult. Credits: Donald W. Hall, UF/IFAS

Host Plants

Red bay, *Persea borbonia* var. *borbonia* (L.), and swamp bay, *Persea palustris* (Raf.) Sarg. (Lauraceae) are the primary host plants (Scriber and Margraf 2005). These species may be differentiated by the following characteristics:

1. Hairs on the stems and leaves of *Persea borbonia* are closely appressed while those of *Persea palustris* are crinkly—giving the leaves and stems a fuzzy feel (Figure 13).

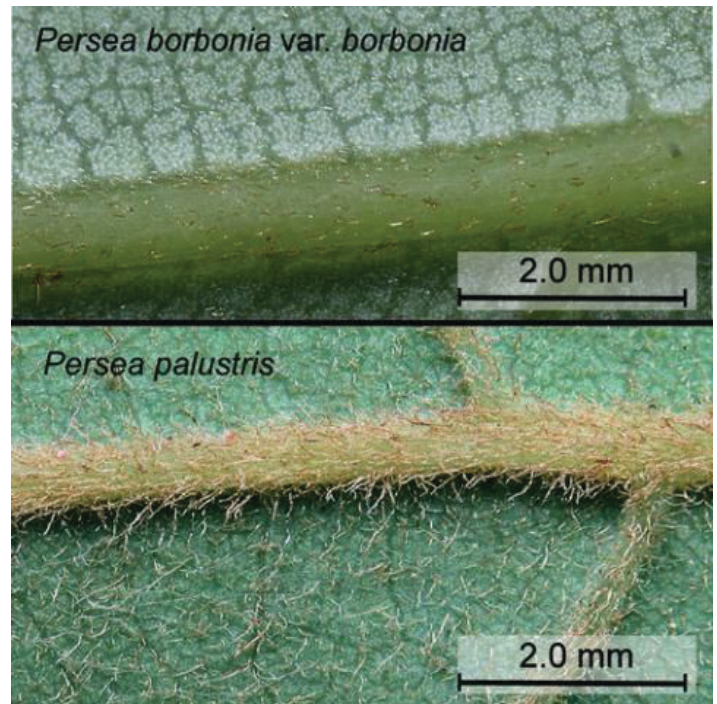


Figure 13. Leaf hairs of red bay, *Persea borbonia* var. *borbonia* (L.), and swamp bay, *Persea palustris* (Raf.) Sarg. Credits: Donald W. Hall, UF/IFAS

2. Peduncles (stalks of flowers, inflorescences or fruits) of *Persea borbonia* are equal to or shorter than the subtending (below and close to) leaf petioles while those of *Persea palustris* are longer than the subtending petioles (Flora of North America undated) (Figure 14).

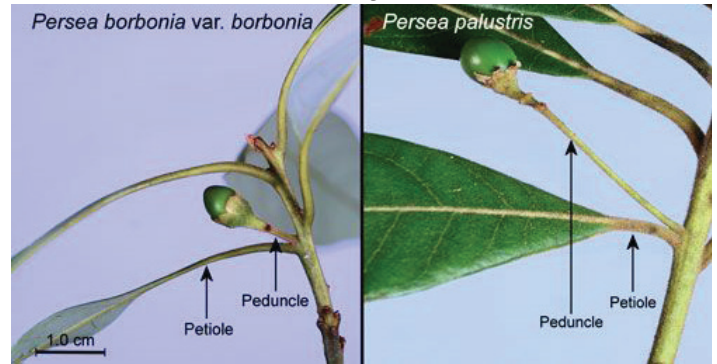


Figure 14. Peduncles and subtending petioles of red bay, *Persea borbonia* var. *borbonia* (L.), and swamp bay, *Persea palustris* (Raf.) Sarg. Credits: Donald W. Hall, UF/IFAS

Although *Papilio palamedes* larvae are capable of developing normally on silk bay (*Persea borbonia* var. *humilis* [Nash] L.E. Kopp), a plant of scrub habitats, they have not been reported on it—possibly a result of habit preference or oviposition preference of females (Scriber and Margraf 2005).

All of our native species of Lauraceae are now threatened by laurel wilt disease. Laurel wilt is caused by *Raffaelea lauricola* T.C. Harr., Fraedrich and Aghayeva, a fungal symbiont of the red bay ambrosia beetle, *Xyleborus glabratus* Eichhoff.

The red bay ambrosia beetle was first detected near Savannah, Georgia in 2002 (Fraedrich et al. 2008; Mayfield 2007) and is believed to have been introduced from Southeast Asia in the wood of shipping crates (Mayfield 2008).

Laurel wilt infection results in blockage of the xylem and fairly rapid death of red bays (Figure 15). It is estimated that laurel wilt has killed over 300 million red bay trees (Hughes et al. 2017).



Figure 15. Red bays, *Persea borbonia* var. *borbonia* (L.), killed by laurel wilt.

Credits: Donald W. Hall, UF/IFAS (Shell Mound, Cedar Key, FL)

There is currently regrowth from the stumps of infected red bay trees, and Palamedes swallowtails are thriving on this new growth (Chupp and Battaglia 2014). However, Riggins et al. (2019) reported that there were significantly fewer Palamedes swallowtails in laurel wilt-infected stands of red bay. Selection of resistant red bays for reforestation is the most promising approach to management of laurel wilt (Hulcr and Stelinski 2017). There is evidence for existence of some resistant trees (Hughes 2013), and research is being conducted to identify resistant individuals (Hughes et al. 2015).

The exotic (and invasive) camphortree, *Cinnamomum camphora* (L.) J. Presl., has shown some degree of resistance to laurel wilt. Chupp and Battaglia (2014) looked at possible host-shifting by Palamedes swallowtails from red bay to camphortree. Palamedes larvae will feed and develop on camphortree foliage. Unfortunately, females will not normally oviposit on it.

Species of other Lauraceae genera (e.g., *Sassafras albidum* [Nutt.] Nees, and *Lindera benzoin* [L.]) have been listed as occasional hosts in some of the older literature (e.g., Harris 1972; Klots 1951; Scott 1986; Tyler 1975). Larvae will feed on these and other species of Lauraceae in captivity (Brooks 1962), but adults are reluctant to lay eggs on them even when caged with the plants (Brooks 1962; Lederhouse et al. 1992). It is possible that some of the records on other

Lauraceae species may have been due to mistaken identification of spicebush swallowtail (*Papilio troilus* L.) larvae as Palamedes swallowtail larvae. The distribution of *Papilio palamedes* closely coincides to the distribution of its *Persea* hosts (Cech and Tudor 2005; Chupp and Battaglia 2014; Lederhouse et al. 1992).

Sweet bay, *Magnolia virginiana* L. (Magnoliaceae), is also listed as a host in most of the older butterfly books (e.g., Holland 1949; Harris 1972; Klots 1951; Opler and Krizek 1984; Tyler et al. 1994, Plate 93 caption), but females will not oviposit on it (Brooks 1962), and larvae refused to eat it in laboratory studies (Brooks 1962; Scriber et al. 2000). In fact, chemicals extracted from *Magnolia virginiana* are toxic to first instar Palamedes swallowtail larvae (Nitao et al. 1992). Erroneous listings of *Magnolia virginiana* as a host date back to a watercolor painting by John Abbot of the Palamedes swallowtail life cycle on “*Magnolia glauca*” (now *Magnolia virginiana*) (Figure 16) mentioned by Scudder (1889 [p. 1850]) (see Calhoun 2007). Calhoun (2017) gives a fascinating discussion of the history of this host plant error.

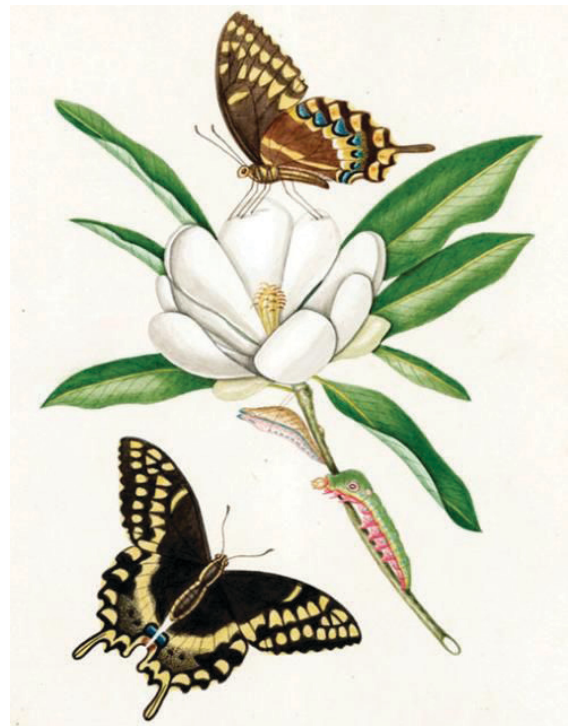


Figure 16. Watercolor painting by John Abbot (about 1816–1818) of life stages of *Papilio palamedes* (Drury) incorrectly on *Magnolia virginiana* L.

Credits: Digital image provided by John Calhoun; original painting at the Alexander Turnbull Library, Wellington, New Zealand

Magnolia virginiana and *Persea* bays (particularly *Persea borbonia*) are commonly mistaken for each other, and this may have resulted in some of the erroneous host records for *Papilio palamedes*. *Persea* species can often be recognized

by the characteristic leaf galls of the **red bay psyllid**, *Trioza magnoliae* (Ashmead) (Figure 17), which are usually present. There are no reliable records of *Trioza magnoliae* from *Magnolia virginiana*. Therefore, it is obvious from the specific epithet “*magnoliae*” that Ashmead confused *Persea borbonia* and *Magnolia virginiana*.



Figure 17. Red bay, *Persea borbonia* var. *borbonia* (L.), with galls of the red bay psyllid, *Trioza magnoliae* (Ashmead). Inset: *Persea borbonia* flower.

Credits: Donald W. Hall, UF/IFAS

The leaves of sweet bay (*Magnolia virginiana*) and red bay *Persea borbonia* are similar in appearance with dark-green, glossy upper surfaces and glaucous undersides, and they sometimes grow side-by-side in moist areas. They can be differentiated with certainty by the stipular scar that completely surrounds the twig in (*Magnolia virginiana*) but is lacking in *Persea* species (Figure 18).

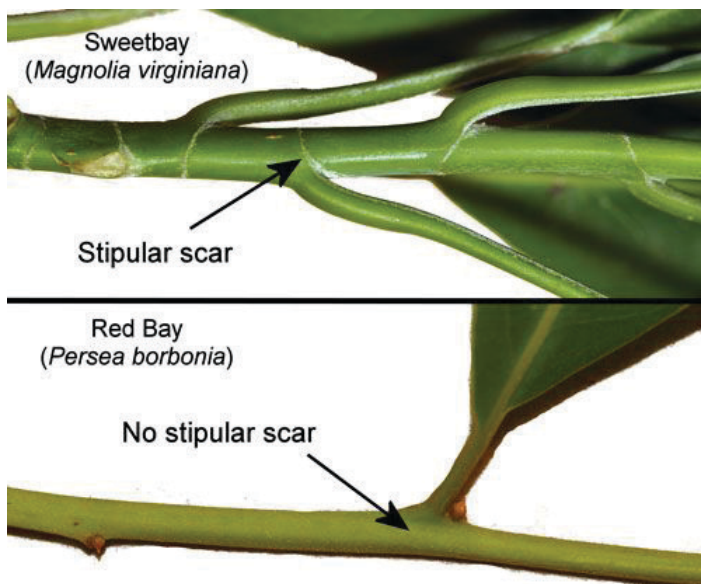


Figure 18. Stems of red bay, *Persea borbonia* var. *borbonia* (L.), and sweet bay, *Magnolia virginiana* L. showing stipular scars of *Magnolia virginiana*.

Credits: Donald W. Hall, UF/IFAS

Also, the flowers and fruits are quite different. The flowers of *Persea borbonia* are small (about 5 mm in diameter) and greenish-white (Figure 17 [inset]), and the fruits are berry-like drupes (about 1 cm in diameter) (Figure 14). The flowers of *Magnolia virginiana* are much larger (about 6 cm in diameter) and yellowish-white in color, and the fruits are cone-like and open to release red seeds that hang by threads (Figure 19). Detailed descriptions and drawings of both species are given by Zomlefer (1994).

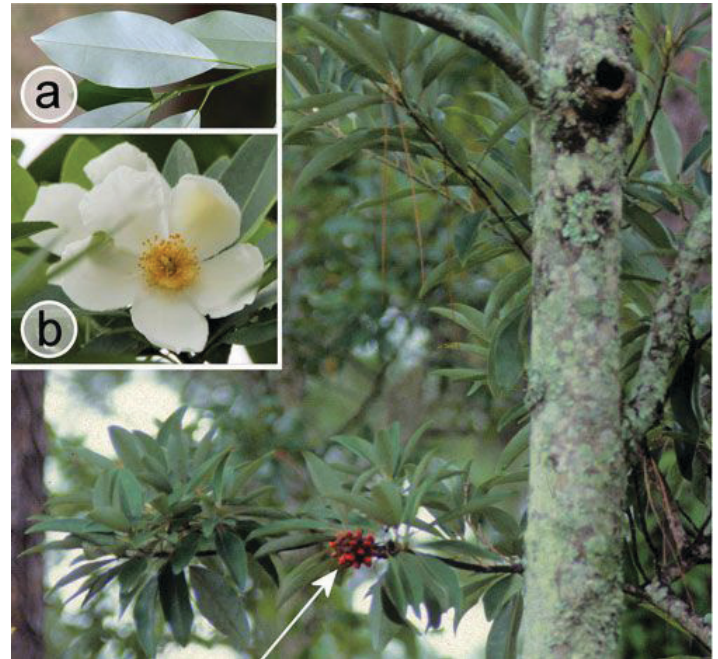


Figure 19. Sweet bay, *Magnolia virginiana* L. Arrow: fruit with seeds. Insets: a) foliage b) flower. *Magnolia virginiana* was erroneously reported as a larval host for the Palamedes swallowtail, *Papilio palamedes* (Drury).

Credits: Donald W. Hall, UF/IFAS

Some of the erroneous host records of Palamedes swallowtail larvae on *Magnolia virginiana* may result from confusion with the similar larvae of the closely-related tiger swallowtail (*Papilio glaucus* L.) which commonly uses *Magnolia virginiana* as a host.

Adult Behavior

Adults (predominantly males) sip moisture from mud (Opler and Krizek 1984)—probably for sodium (Arms et al. 1974). Adults of both sexes sip nectar from flowers. Coastal sweet pepperbush (*Clethra alnifolia* L.), pickerelweed (*Pontederia cordata* L.), and thistles (*Cirsium* spp.) are reported to be particularly attractive as nectar sources (Opler and Krizek 1984; Tyler 1975). Palamedes swallowtails are considered the primary pollinators of sandhill thistle (*Cirsium repandum* Michaux) (Theis and Raguso 2005) and orange-fringed orchid (*Platanthera ciliaris* (L.) Lindl.) (Chupp et al. 2015).

Many plants are valuable as nectar sources for *Palamedes* swallowtails. Minno and Minno (1999) have extensive lists of both native and exotic nectar plants for butterflies. Most states have native plant societies that are valuable sources of information on native plants and many also hold native plant sales.

Natural Enemies

Predators

Scriber et al (1998) reported the following spiders as predators of *Palamedes* swallowtail adults: *Argiope* spp., *Trichonephila clavipes* (L.), and an unidentified species of crab spider. Adult *Palamedes* are also palatable to birds (Brower 1958). It is probable that both larvae and adults are eaten by a variety of vertebrate and insect predators.

Parasitoids

There are at least two hymenopterous parasitoids of *Papilio palamedes*:

- *Pteromalus vanessae* Howard (Krombein et al. 1979)
- *Trogus pennator* (Fabricius) (Wahl and Sime 2006)

Defenses

Concealment and Camouflage

Early instar caterpillars do not cut and fold leaves to make a shelter as does *Papilio troilus* (Minno et al. 2005; Scudder 1889), but older larvae may spin silk mats on leaves that cause the leaves to curl upward—partially concealing the larvae (Scott 1986) (Figure 20).

The yellow coloration of prepupae (Figure 9) blends with leaf litter and probably makes them less visible to predators while they are wandering to find pupation sites.

Mimicry

Early instar larvae resemble bird or lizard droppings (Figure 21).

Last instar larvae with their swollen thoraxes and false eyes are probably green snake or tree frog mimics (Lederhouse 1990) (Figure 22).

While females of the other black-colored swallowtails (*Papilio troilus* [L.], *Papilio polyxenes* Fabricius, and the black morph females of *Papilio glaucus* [L.]) are believed to be Batesian (edible) mimics of the (distasteful or poisonous) pipevine swallowtail, *Battus philenor* (L.) (Brower 1958; Brower and Brower 1968; Poulton 1909), the *Palamedes* swallowtail does not appear to be mimetic (Brower 1958).



Figure 20. *Palamedes* swallowtail, *Papilio palamedes* (Drury), 5th instar larva on curled leaf.

Credits: Donald W. Hall, UF/IFAS



Figure 21. *Palamedes* swallowtail, *Papilio palamedes* (Drury), early instar larva (arrow) digitally pasted into photo with bird or lizard (probably lizard) droppings.

Credits: Donald W. Hall, UF/IFAS



Figure 22. *Palamedes* swallowtail, *Papilio palamedes* (Drury), 5th instar larva (left) and squirrel tree frog, *Hyla squirella* Bosc (right).

Credits: a) Donald W. Hall, UF/IFAS; b) William Barichivich, US Geological Survey

Osmeteria

All North American swallowtail larvae have eversible (capable of being everted or turned inside out) horn-like organs behind the head known as osmeteria. The osmeteria

of Palamedes swallowtail larvae are bright yellow-orange in all larval instars. When threatened, larvae rear up, extrude the osmeterium, and attempt to smear the potential predator with a chemical repellent (Figure 23). The osmeterial secretion of fifth instars is composed primarily of isobutyric and 2-methylbutyric acids (Eisner et al. 1970; Eisner et al. 2005). Osmeterial secretions of earlier instars are probably composed primarily of terpenes (Ômura et al. 2006).



Figure 23. Palamedes swallowtail, *Papilio palamedes* (Drury), middle instar larva with osmeterium extruded.

Credits: Donald W. Hall, UF/IFAS

Acknowledgements

The author would like to acknowledge Howard Frank and Marc Minno for reviewing this article and offering helpful suggestions. The author also expresses appreciation to John Calhoun for providing the digital image of John Abbot's watercolor (Figure 15) and William Barichivich for permission to use his photograph of the squirrel tree frog (Figure 20).

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