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FIRST RECORDS OF *ZAPRIONUS INDIANUS* (DIPTERA: DROSOPHILIDAE), A PEST SPECIES ON COMMERCIAL FRUITS FROM PANAMA AND THE UNITED STATES OF AMERICA

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Zaprionus indianus Gupta 1970 (Diptera: Drosophilidae) is native to Africa, the Middle East, and southern Eurasia (Chassagnard & Kraaijeveld 1991; Bächli 1999-2005). It was first found in the Americas in 1999, when it was reported from São Paulo, Brazil (Vilela 1999). Since then, it has spread rapidly through Brazil (Santos et al. 2003; Tidon et al. 2003; Leão & Tidon 2004; da Silva et al. 2005) and Uruguay (Goní et al. 2001, 2002) and has been predicted to reach the USA in the near future (David et al. 2006). Here we report the first records of *Z. indianus* from Panama and the USA.

On 6 and 7 Oct 2003, DH collected several individuals of *Z. indianus* on Isla Contadora, Panama. KH reared several individuals of *Zaprionus* (Steck 2005) from fruits of longan, *Dimocarpus longan* Lour., and Barbados cherry, *Malpighia emarginata* Sessé & Moc. ex DC., collected on 26 Jul 2005 in St. Lucie Co., Florida. Dr. C. Ribeiro Vilela confirmed the identification as *Z. indianus*. From Sep 2005 to Feb 2006, KH reared additional flies from various hosts in Broward, Indian River, Martin, Okeechobee, DeSoto, Highlands, and Osceola counties; additional collections were made in Collier County, and a single fly was detected in a tephritid fruit-fly trap in Palm Beach Co. On 13 Oct 2005, LMA collected a single female from Tom Brown Park, Tallahassee, Leon County, which is the first occurrence for north Florida. On 15 Oct 2005, KvdL, DH, and colleagues collected about a dozen individuals along Forest Road 305 in the Apalachicola National Forest. In each case, flies were netted off banana baits. KvdL identified these specimens as *Z. indianus* using published keys (Chassagnard 1988; Chassagnard & Tsacas 1993) and by direct comparison with alcohol-preserved material from a laboratory stock of *Z. indianus* provided by Dr. Jean David. *Zaprionus indianus* is yellowish overall and has an even number of distinctive silvery-white stripes on the top of the head and the thorax and a series of 4 to 6 distinct composite spines on the anterior femora. These spines are not located on small tubercles, and each has a second short branch at its base, functioning as a rest for the tibia of the folded leg. The narrow (relative to those of other species) black bands bordering the silvery thoracic stripes do not widen on the scutellum, and the scutellum is without a white tip (see van der Linde 2006 for more details). This combination of characters is sufficient to distinguish *Z. indianus* from all other known species of the genus.

Zaprionus indianus is a generalist that breeds on fallen fruit and fruit on the tree. In Africa, it is known to infest fruits of 74 species in 31 plant families (Lachaise & Tsacas 1983). A similar pattern of host use is apparent in Brazil (Vilela 1999; Vilela et al. 2001; Santos et al. 2003; Leão & Tidon 2004). It has been reared from the following hosts in Florida: *Annona glabra* (pond apple), *Psidium guajava* (guava), *Psidium cattleianum* (strawberry guava), *Arabotrys hexapetalus* (climbing ilang-ilang), *Malpighia emarginata* (Barbados cherry, acerola), *Eugenia uniflora* (Surinam cherry), *Dimocarpus longan* (longan), *Anacardium occidentale* (cashew), *Punica granatum* (pomegranate), *Phoenix* sp. (a palm), × *Citrofortunella microcarpa* (calamondin), *Citrus sinensis* (sweet orange), *Citrus aurantium* (sour orange), *Citrus* × *paradis* (grapefruit), *Fortunella* sp. (kumquat), and *Eriobotrya japonica* (Thunb.) Lindl. (Loquat). Of these Florida hosts, only *A. glabra* is native. The occurrence of the species in the Apalachicola National Forest far from commercial orchards suggests that it utilizes other native fruits in north Florida.

This species has been recorded as a pest on oranges, peaches, and figs in Brazil (Santos et al. 2003) and might therefore become a pest in the USA. A pest alert has been issued by the Division of Plant Industry, Florida Department of Agriculture & Consumer Services (Steck 2005). The species will be difficult to control because its breeding substrates are not limited to cultivated fruits (Santos et al. 2003; Steck 2005) and because of its ability to lay eggs on fruits that are still on the plant (Raga et al. 2003; Tidon et al. 2003; Steck 2005). In Florida, we reared *Z. indianus* from ripe *M. emarginata*, *P. granatum*, *E. japonica*, and *D.*

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longan fruits that were collected directly from the tree. In most host species, fruit damage is necessary to allow *Z. indianus* access to fruit on the tree. An important exception is figs, where the eggs are laid at the ostiole, which gives easy and direct access to the soft contents of the fruits (Vilela et al. 2001; Raga et al. 2003). Infested figs are unsuitable for human consumption. As a result, fig production has been reduced by 40-50% in some areas (Stein et al. 2003) and exports by up to 80% (Stein et al. 2003). Closing the ostiole with adhesive (producer) tags, gel, or Bordeaux mixture reduced the infestation with *Z. indianus* dramatically (Raga & de Souza Filho 2003).

Zaprionus indianus spreads rapidly in newly colonized areas (Goní et al. 2001, 2002; Santos et al. 2003; Stein et al. 2003; Tidon et al. 2003; Leão & Tidon 2004; da Silva et al. 2005; Ferreira & Tidon 2005; David et al. 2006). Large population sizes are seen the second year of its presence in an area (Goní et al. 2002; Santos et al. 2003; Tidon et al. 2003; da Silva et al. 2005; Ferreira & Tidon 2005). The percentage of flies from rearing samples ranged from <10% in Leon County, to 10-20% in Indian River Co. to about 50% in Okeechobee Co. to >50% in Broward, St. Lucie, and Martin counties, suggesting a relatively recent invasion. The species prefers savanna-like habitats and is less abundant in closed-canopy forests (Tsacas et al. 1981; Tidon et al. 2003). It becomes very abundant in urban habitats (Vilela 1999; Santos et al. 2003; Ferreira & Tidon 2005). We expect that *Z. indianus* will invade all suitable habitats in the southern USA.

Catching a species in the act of arriving offers a rare opportunity to study the dynamics of such an invasion in progress. We are confident that these are recent introductions for both countries, as we did not find this species in previous collections in the same areas. KvdL collected drosophilid flies along the Panama Canal in Jun-Jul 1998 and Apr 2002 using oviposition traps baited with banana, and Allen H. Hurlbert (University of New Mexico, personal communication) did not find this species in extensive collections made on Barro Colorado Island (Smithsonian Tropical Research Institute) between Oct 2002 and Nov 2003, at Pipeline Road in Dec 2002, and at Galeta Research Station in May 2003. JSB and DH have made irregular collections of drosophilid flies across the southeastern U.S. since 2000 and in far south Florida as recently as Mar 2003. KH made at least five collections of fruit in Indian River, Martin, and St. Lucie counties during 2004 and reared only *Drosophila* spp. In particular, samples reared from guava in Indian River Co. in Jan 2004 and Okeechobee Co. in Apr 2005 and from Barbados cherry in St. Lucie Co. in Nov 2004 yielded only *Drosophila melanogaster*, whereas in Sep-Oct 2005, those same sites and fruits also yielded *Z. indianus*. JSB made weekly collections on fruit and vegetable compost in Tallahassee from Aug 2000 to Jul 2005 and less frequently at other Tallahassee locations, including Tom Brown Park. We also performed extensive mark-release-recapture experiments with *Drosophila* at the Apalachicola National Forest site in 2000, 2003, and May 2005. The distinctive appearance of *Z. indianus* makes it unlikely that experienced observers would fail to recognize it in a sample. A large number of collections have been made in countries north of Brazil since 1999 (Bächli 1999-2005) without detection of any *Z. indianus*.

Individuals of this species collected in Tallahassee will be deposited at the American Museum of Natural History. Other Florida specimens are deposited in the Florida State Collection of Arthropods in Gainesville.

Summary

Zaprionus indianus has continued its range expansion in the Western Hemisphere. We report here the first observations from Panama (2003) and Florida, USA (2005). We are confident that the invasions were discovered in progress in both places. This species is a generalist that uses both cultivated and native fruits as breeding substrates. It has been reported as a pest species on figs in Brazil but generally breeds only on fallen fruits or on damaged fruits still on the tree.

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