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The Distribution of the Frog *Eleutherodactylus johnstonei* (Amphibia: Eleutherodactylidae) in Trinidad, West Indies

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ABSTRACT

Eleutherodactylus johnstonei is an invasive anuran of Trinidad, West Indies. Monitoring the spread has shown that its local range is the north-west of Trinidad. *E. johnstonei* is increasing in population size and is increasing its local range by expanding into disturbed habitats. No immediate ecological threat has been identified. Previous studies on high amplitude callers suggest that *E. johnstonei* has the potential to become a pest in urban residential areas due to its loud mating calls. It is likely that *E. johnstonei* has become a permanent part of Trinidad's biodiversity and its calls would become common in many more suitable disturbed areas in Trinidad.

Key words: *Eleutherodactylus, johnstonei,* invasive species, distribution, anuran, audio monitoring.

INTRODUCTION

Eleutherodactylus johnstonei is an invasive anuran first reported in Trinidad by Kenny (1979) as *E. martinicensis.* It is a small, dull coloured frog, brown to gray dorsally with a creamy under surface (Savage 2002). Adult males are 17-25 mm long and adult females 17-35 mm (Savage 2002).

Males call from sunset to after midnight producing a short, high-pitched two note call. A short 2000 Hz note followed by a longer 3500 Hz note makes up the call (Watkins *et al.* 1970). Males call from ground level to 3 m above the ground (Murphy 1997). In Trinidad, calling males were heard mostly in disturbed habitats often in hedges and potted plants around residences and business places.

E. johnstonei feeds mostly on ants, but also on leafhoppers, spiders, termites and springtails (Savage 2002; Murphy 1997). It is most likely eaten by many predators including other anurans. *E. johnstonei* is a leaf litter and cavity breeding frog. It is not dependent on standing water for any part of its life cycle including metamorphosis (Bourne 1997). Calling and reproduction occurs throughout the year however, reproduction is highest during the wettest months of the year. Studies in Guyana showed that males sired 3.3 clutches/year while females produced 4.3 clutches/year (Bourne 1997). Egg clutches contain on average 14 eggs; hatched froglets have a snout-to-vent length of 3.5 mm and reach sexual maturity in about a year (Bourne 1997).

E. johnstonei's current range is the Lesser Antilles and is considered to be an invasion species of Bermuda, Jamaica, Trinidad, Venezuela, Curaçao, Guyana, Anguilla, Dominica and Panama City (Schwartz and Henderson 1991; Kaiser 1992; Kaiser and Hardy 1994). Its ability to colonise and use a great variety of habitats is based on *E. johnstonei's* broad physiological tolerance to dehydration and high temperatures and its non dependence on standing water (Pough *et al.* 1977; Stewart and Martin 1980; Stewart 1977).

The last published range of *E. johnstonei* in Trinidad includes a report from Kaiser (1997) of two populations existing outside the Port of Spain harbour. Murphy (1997) described the distribution in Trinidad as the Port of Spain dock area in the vicinity of the Port of Spain Holiday Inn (now Crowne Plaza). Since then the range of *E. johnstonei* has expanded greatly. Monitoring *E. johnstonei's* spread in Trinidad is continuing and this study updates the known distribution of *E. johnstonei* in Trinidad up to February 2011.

METHOD

Male *E. johnstonei* have distinctive mating calls and usually calls from just after sunset to early hours of the morning. This distinctive call alllows one to monitor for their presence. Accordingly, monitoring was done from just after sunset until midnight along the roadways of Trinidad. Monitoring was done from 2000 until 2002 (Manickchan 2003). More recently the monitoring period spanned two cycles of wet and dry seasons from October 2009 to February 2011. A total of 100 nights of monitoring was achieved within this period, 25 per season, per year.

Most monitoring was done during Sunday to Thursday nights. Friday and Saturday nights were largely avoided as the human sound factor sometimes made acoustic monitoring difficult. To monitor, the vehicle was stopped at intervals for a two-minute period and presence/absence data was collected for that point (small area within audio range of calling individuals, diameter about 50 m). Usually over 100 points could be monitored per night. Over 2000 points were monitored. Many northern areas from Chaguaramas to Toco, western areas Curepe to Icacos, southern and central areas and eastern areas from Manzanilla to Guayaguayare were monitored. Areas monitored were chosen to cover as much of Trinidad as possible. Points were chosen to reflect a range of levels and types of disturbance and habitat types. A few off-road sites were also monitored. Within a chosen area, of around 5 km^2, 5 -10 points were randomly chosen and monitored. If *E. johnstonei* was found to be present in the area, more intensive monitoring was achieved by monitoring every 50 m. This allowed entire population sizes to be estimated. Beyond the monitoring days, several amateur herpetologists and all field assistants (over 10 people) were trained to identify *E. johnstonei's* calls and noted its presence wherever found. These areas were checked or rechecked. All anecdotal presence data from other herpetologists were also checked. Records of recent Trinidadian anuran surveys, mostly Environmental Impact Assessments, were also examined.

RESULTS

E. johnstonei's distribution is currently limited to the north-west portion of the island. Figure 1 shows the currently known distribution of *Eleutherodactylus johnstonei* in Trinidad.

The areas shown in Fig. 1, from west to east, are Chaguaramas, Carenage, Goodwood Park, Westmoorings, Four Roads junction, Morne Coco Road, Sierra Leone, St. Lucien, Water Wheel, Cocorite, Maraval, St. James, Woodbrook, Port of Spain, Barataria, San Juan, El Socorro, Aranguez, St. Joseph, Curepe, St. Augustine, Macoya, Maloney and La Horquetta.

The largest populations of *E. johnstonei* were found at Diego Martin, Woodbrook, San Juan and El Socorro (over 2000 calling individuals per area). The most westerly located presence sites, Chaguaramas, Carenage and Goodwood Park, and the most easterly located presence sites, St. Joseph, Curepe, St. Augustine, Macoya, Maloney and La Horquetta, have relatively small populations of less than 50 calling individuals (often less than 10).

DISCUSSION

The presence of *E. johnstonei* was first noted in Trinidad by Kenny (1979) and the frog has now become established in a few locations of Trinidad. In 1992, two small populations of *E. johnstonei* 200 m apart were observed in Port of Spain (Kaiser 1997). By the end of 2002, the population was in the thousands and extended

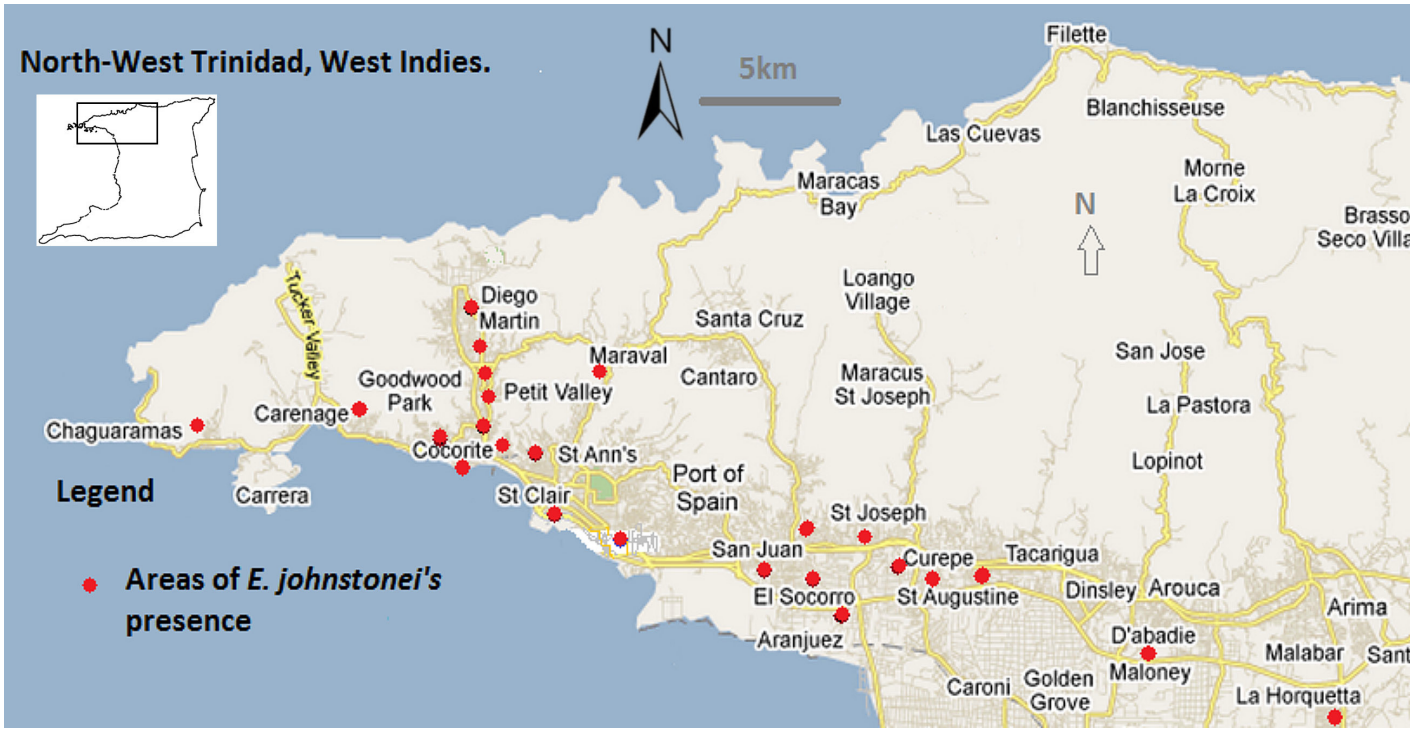

Fig. 1. Currently known distribution of *Eleutherodactylus johnstonei* in Trinidad, West Indies.

from Goodwood Park to Curepe (Manickchan 2003). Currently the population extends from Chaguaramas to La Horquetta. All areas of *E. johnstonei's* distribution in Trinidad were in highly disturbed areas.

The distribution of *E. johnstonei* in Trinidad has followed a pattern seen in several other countries such as Panama City, Dominica, Venezuela and Guyana. *E. johnstonei* was introduced in Panama City by 1987 and by 1997 was common in gardens of residential areas (Kaiser 1997); in Dominica *E. johnstonei* was introduced by 1979 and by 1997 no undisturbed habitat had been colonized (Kaiser 1997); in Venezuela *E. johnstonei* has been present since the 1960's and 20 years later (Gorzula S. 1989; La Marca 1992) no natural habitats in Venezuela were colonised by the frog. In Guyana, voucher specimens of *E. johnstonei* were collected since 1919 (Kaiser 1997), but by 2002 populations of *E. johnstonei* remained confined to the urban areas although agricultural land and anthropogenic disturbed forest were close by (Kaiser *et al.* 2002).

Although *E. johnstonei* has successfully colonised many countries, its range expansion is largely limited to areas of habitat disturbance caused mainly by human expansion (Kaiser 1997). Competition and predation factors probably account for its rare occurrence in less disturbed areas. It is transported to new countries along with importation products (Kaiser 1997).

An invasive species can degrade an ecosystem in many ways such as by hosting diseases, altering natural processes, altering community structures, disrupting food webs and reducing biodiversity. Invasive organisms also reduce the habitat area available to local endemics and can cause population fragmentation. Documented negative impacts of invasive anurans include poisoning of native species, vectoring of parasites and diseases, water contamination and genetic contamination via hybridisation. Kaiser (1997) considers management of *E. johnstonei* to include prevention of further or repeat introductions, close monitoring of ranges and preservation of native habitat to ensure survival of local endemics.

The most commonly occurring calling sites of *E. johnstonei* in Trinidad are low elevation, well manicured urban residences with many plants. It is likely that *E. johnstonei* will continue to spread only into disturbed areas of Trinidad. Studies in Jamaica (Schwartz and Henderson 1991) and Venezuela (Hardy and Harris 1979), show that *E. johnstonei* is able to out-compete local endemics only in highly disturbed areas. As this niche is not the major habitat of any local endemics, *E. johnstonei* is unlikely to negatively affect any local endemics more than reducing the size of their available habitat. Besides habitat usage and competition factors, no other negative ecological impacts have been reported or observed for *E. johnstonei.*

An invading species will be considered a pest if it negatively affects the economy or aesthetics of an area. The main pest consideration for *E. johnstonei* is its loud continuous calls. At calling sites with very large numbers of callers, the sound is very loud and can be viewed as a disturbance. Some local residents complain about the sound but many seem so acclimatized as not to notice it (Manickchan, pers. comm.). Reports from Bermuda state that some visitors claim that *E. johnstonei* calls disturb their sleep while others learn to love the sound (Forbes 1992). An invasive anuran, *Eleutherodactylus coqui* was declared a pest in 2006 in Hawaii for several reasons including its loud mating calls (Kraus 2007). Studies show that this anuran's call has negatively affected the economy by negatively affecting tourism and property prices (Beard and Pitt 2005). Eradication of *E. coqui* in Hawaii has not been attempted due to its large population size and control and management of local populations has proven to be very difficult (Kraus 2007). No similar studies have been found for *E. johnstonei.*

The worldwide trend of increased habitat disturbance and documented *E. johnstonei* population growth patterns suggest that locally *E. johnstonei's* population will continue to expand into suitable disturbed habitats. Macro climate modelling studies also suggest that the rate of *E. johnstonei's* population growth would increase in the future (Rodder 2009). It is likely that *E. johnstonei* has become a permanent part of Trinidad's biodiversity and its calls will become common in many disturbed areas of Trinidad.

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