Southeast Asian Toad (*Duttaphrynus melanostictus*)

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, January 2021
Revised, January 2021
Web Version, 10/4/2021

Organism Type: Amphibian
Overall Risk Assessment Category: High

Photo: Dupont B. Licensed under Creative Commons Attribution-Share Alike 2.0 Generic. Available: https://www.flickr.com/photos/berniedup/8681194072/. (January 2021).

1 Native Range and Status in the United States

Native Range

From Fuller (2012):

"Widely distributed in South Asia. Asian common toads occur from northern Pakistan through Nepal, Bangladesh, India including the Andaman and Nicobar Islands, Sri Lanka, Myanmar, Thailand, Laos, Vietnam, Cambodia and southern China, Taiwan, Hong Kong and Macau to

Malaysia, Singapore, and the Indonesian islands of Sumatra, Java, Borneo, Anambas and Natuna Islands."

Status in the United States

From EDDMapS (2020):

"One *D. melanostictus* was intercepted by USDA from inside a shipping container of Money Trees (*Pachira aquatica*). This cargo originated from a port at Zhanjiang, Guangdong, China, on 25 July2010; however, the location of the tree farm is not known. This *D. melanostictus* was subsequently transferred to Zoo Miami before being deposited in the FLMNH. This is the first known voucher for this species in Florida."

This species is in trade in the United States (e.g., Backwater Reptiles 2018).

Means of Introductions in the United States

From Fuller (2012):

"Hitchhiker in cargo (Krysko et al., 2011)."

Remarks

This ERSS was previously published in January 2018. Revisions were completed to incorporate new information and conform to updated standards.

From CABI (2019):

"Phylogenetic and population genetic analyses by Wogan et al. (2016) indicate three distinct evolutionary lineages corresponding to the Asian mainland, coastal Myanmar and the Sundaic islands (Indonesia) which suggests that *D. melanostictus* actually consists of multiple species, each having narrower geographical ranges and ecological niches than is currently recognized.

Some reports of the much more extensively studied relative *Rhinella marina* in South East Asia have been misdentifications of *D. melanostictus* as confirmed by Trainor (2009) for East Timor."

From Othman et al. (2020):

"In agreement with our hypotheses, the Quaternary glaciations were the main events that shaped the distribution of *Duttaphrynus melanostictus* in the Eastern Indomalayan realm. Vicariance and dispersal between Upper Pliocene to Lower Pleistocene were the consequences of glaciations and climatic transitions, resulting in the isolation of clade I on insular refugia in Southeast Asia, such as the Southern Sundaic and Wallacea (Mid-Pleistocene Revolution MPR; 1.85 to 1.0 Ma). Following the MPR, clades II and III diverged from each other around 0.84 Ma, following a restriction in gene flow and causing clade II to become isolated in stable habitats along coastal Myanmar, Southern Thailand and Peninsular Malaysia (Late MPR; 0.57 Ma). Meanwhile, populations from clade III dispersed over large areas and reached the Chinese mainland and islands such as Hainan and Taiwan (Upper Pleistocene; 0.06 Ma). Subsequent to natural

dispersion, human-mediated dispersal resulted in population movements such as the secondary invasion of Taiwan (Holocene; 0.02 Ma) and the invasion of the Southern Sundaic and Wallacea (Upper Pleistocene; 0.04 Ma). While anthropogenic factors played a minor role in the population structure of *D. melanostictus*, they played an important role on recent invasion."

From van Dijk et al. (2004):

"This form is probably a complex of more than one species. *Duttaphrynus tienhoensis* was synonymized with *D. melanostictus* by Dubois and Ohler (1999)."

Information searches were conducted using the valid name *Duttaphrynus melanostictus*. In cases where information was found incidentally under a synonym it has been noted.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2021):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Tetrapoda
Class Amphibia
Order Anura
Family Bufonidae
Genus *Duttaphrynus*
Species *Duttaphrynus melanostictus* (Schneider, 1799)

"Taxonomic Status:
Current Standing: valid"

ITIS (2021) lists the following synonyms of *Duttaphrynus melanostictus: Bufo melanostictus, Bufo chlorogaster, Rana dubia, Bufo bengalensis, Bufo flaviventris, Rana melanosticta, Bufo carinatus, Bufo dubius, Bufo isos, Bufo gymnauchen, Docidophryrne isos, Docidophryne spinipes,Phrynoidis melanostictus, Bufo longecristatus, Bufo tienhoensis, Docidphyrne melanostictus, Bufo camortensis, Ansonia kamblei, Bufo melanostictus melanostictus,* and *Bufo melanostictus hazarensis.*

Size, Weight, and Age Range

From AmphibiaWeb (2016):

"It is the largest toad in Pakistan, female exceeds 150 mm in snout-vent length."

“Total length of tadpole 26-27 mm, tail 19-20 mm.”

From Gelb (2013):

“Snout-vent length of males ranges from 57 to 83 mm and females range between 65 and 85 mm.”

“Asian common toads live an average of 4 years in the wild and up to 10 years in captivity. ("Pest Risk Assessment: Asian spined toad (*Bufo melanostictus*)" [The State of Queensland], 2010; Khan, 2000; Mercy, 1999; Saidapur and Girish, 2001)”

Environment

From van Dijk et al. (2004):

“Terrestrial, Freshwater (=Inland waters)”

“It is mainly a species of disturbed lowland habitats, from upper beaches and riverbanks to human-dominated agricultural and urban areas. It is uncommon in closed forests. It breeds in still and slow-flowing rivers and temporary and permanent ponds and pools. Adults are terrestrial and may be found under ground cover (eg. rocks, leaf-litter, logs), and are also associated with human habitations. The larvae are found in still and slow-moving waterbodies.”

From Gelb (2013):

“Asian common toads […] are found throughout, […] habitats up to 2000 meters above sea level.”

From van Dijk et al. (2004):

“It has been recorded from sea level up to 1,800m asl.”

From Tingley et al. (2018):

“*Duttaphrynus melanostictus* […] its western range limit is tightly aligned with the transition between deciduous forests and arid desert and thorn scrub landscapes. In addition, the Himalayas presumeably represent a dispersal barrier at the northern range limit.”

From Trainor (2009):

“[…] has wide ecological tolerance (surviving in temperatures of about 13-40 degrees Celcisus).”

Climate

From Tingley et al. (2018):

"*Duttaphrynus melanostictus* primarily occurs throughout temperate and tropical forests in its native range, […]"

From Gelb (2013):

"Asian common toads […] are found throughout, subtropical, and tropical habitats […]"

Distribution Outside the United States

Native

From Fuller (2012):

"Widely distributed in South Asia. Asian common toads occur from northern Pakistan through Nepal, Bangladesh, India including the Andaman and Nicobar Islands, Sri Lanka, Myanmar, Thailand, Laos, Vietnam, Cambodia and southern China, Taiwan, Hong Kong and Macau to Malaysia, Singapore, and the Indonesian islands of Sumatra, Java, Borneo, Anambas and Natuna Islands."

Introduced

From van Dijk et al. (2004):

"Extant & Introduced [:] Indonesia (Sulawesi, Maluku, Papua, Bali); Papua New Guinea"

From Fuller (2012):

"They were introduced to the islands of Bali, Sulawesi, Ambon and Manokwari, and the northeastern portion of the Vogelkop Peninsula in New Guinea (Krysko et al., 2011; EOL, 2012)."

From Moore (2015):

"In March 2014, the Asian toad *Duttaphrynus melanostictus* was reported from Madagascar's second largest city and main port Toamasina, […] We found the toad to be widespread to the south and west of city center and estimate its minimum range to include an area of at least 108 km2. Social surveys indicate that the toad may have already been present for some years and potentially introduced prior to 2010, with the site of its introduction likely south of Toamasina near National Route 2 and the Ambatovy Plant."

From Kaiser et al. (2014):

"The species was apparently first noticed in the Oecusse District during the staging of Korean peacekeepers, and it has achieved residency throughout the lowlands of that district."

"According to a short survey in September 2009 (Trainor 2009), toads are now found in most districts of Timor-Leste. The species appears to be on a relentless march across the country and its distribution now nearly extends to Lautém District (Trainor 2009). Tadpoles or hatchlings of this species have been encountered near human settlements on the southern coast of Viqueque District, and in buffalo wallows along the main coast road in the north […]. It appears likely that the toads will colonize the entire island in the near future."

From Soorae et al. (2020):

"We report the first record of the Asian common toad *Duttaphrynus melanostictus* (Schneider, 1799) in Abu Dhabi emirate, United Arab Emirates and the Arabian Peninsula. A total of six individuals were collected in 2016 from habitat within and immediately surrounding the Al Wathba Wetland Reserve (AWWR), a wetland near Abu Dhabi city. […]. Outside of Asia *D. melanostictus* has established populations in the Maldives (Kraus 2009) and recently in Madagascar (Kolby et al. 2014; Moore et al. 2015). Individual stowaways are being increasingly recorded in countries such as South Africa, Australia and New Zealand (Kraus 2009; Measey et al. 2017) […] Suspected to have arrived around 2010, a 2014 survey found it to have established around Madagascar's main port Toamasina with a surrounding range thought to be to be at least 108 km2 (Moore et al. 2015), a follow up survey carried out by Licata et al. (2019) documented a fivefold expansion in the area occupied by this invader [*D. melanostictus*]."

"In total six *Duttaphrynus melanostictus* (4 adults and 2 sub-adults, […]) were identified and removed from along the northern part of the wetland reserve between March and October 2016. These toads were located within or just immediately outside the boundary fence […]"

From Reilly et al. (2017):

"Recent survey work has now documented the first report of Asian common toads on the islands [Wallacea] immediately west (Sumbawa) and south (Sumba) of the islands comprising the Komodo Dragon's range:"

Means of Introduction Outside the United States

From Kaiser et al. (2011):

"The common Asian toad […] was introduced into Timor-Leste fairly recently, probably during the staging of the international peacekeeping force in the transition period from Indonesian occupation to independence (1999–2002). During this time, migration of a considerable number of people between West Timor and Timor-Leste also took place, which may have sped up the inadvertent spread of toads (see Trainor 2009 for a more detailed account of the species' presumed origin)."

From Price-Rees et al. (2012):

*"*For example, the black-spined toad (*Duttaphrynus melanostictus*) is spreading rapidly through Indonesia, and several specimens have been intercepted at Australian ports (Australian Quarantine and Inspection Service 2010)."

From The State of Victoria (2021):

"An increasing number are being intercepted at Australian airports and sea ports from flights and ships arriving from Asia, where the toad is widespread. They are usually found in shipping containers, machinery and personal effects such as bags and shoes."

From Gelb (2013):

"The ways in which these toads have been introduced is not fully known in most areas, although in some areas it is assumed that Asian common toads first occurred on these islands [Bali, Papua New Guinea, Sulawesi, Andaman and Nicobar] when they were fist settled. In other cases, such as in Papua New Guinea, it is rumored that the Department of Health released these toads as means to control mosquito populations."

From Tingley et al. (2018):

"All intercepted toads were found hitchhiking in shipments of commodities that were not associated with the import of live animals into Australia, confirming that toads were unintentionally transported. *Duttaphrynus melanosticus* is also not a common pet species in Australia, ruling out intentional or unintentional releases of pets. There are no additional known pathways of introduction for *D. melanosticus* into Australia."

From Soorae et al. (2020):

"Individual stowaways are being increasingly recorded in countries such as South Africa, Australia and New Zealand (Kraus 2009; Measey et al. 2017) arriving via air and shipping pathways (Tingley et al. 2018). […]. The most likely introduction pathway is from accidental stowaways in containers and transport of plant products."

Short Description

From AmphibiaWeb (2016):

"Head with distinct rostral, preorbital, supraorbital, postorbital and a short orbito-tympanic, cranial crests; no temporal ridge; interorbital space much broader than upper eyelid; tympanum very distinct, at least two third the diameter of the eye; first finger generally but not always extends beyond second; double subarticular tubercles only under third finger. Toes with single subarticular tubercle; parotid elipticle, with dark brown scattered branching concretions; skin heavily tuberculated on flanks, tubercles usually tipped with dark brown spines; a lateral dorsal staggered row of 8-9 enlarged tubercles; cranial crests, lips, digit tips, metacarpal and metatarsal tubercles are cornified with dark brown, which tend to peal off in preserved specimens; head is almost smooth."

"Color: Dorsum uniform gray of various shades, brown or reddish with dark spots, ventrum uniform dirty white, speckled with light brown on chin and throat."

“The throat of breeding male is light orange or yellow. It develops cornified pads on inner side of first and second fingers.”

“Tadpole: The tadpoles are uniform dark, inhabits side pools along hilly torrents, schools of them swarm along the marginal waters of ponds and puddles feeding on any type of algal material. The body is typically bufonid, globular with weak tail, dorsal fin is broad while ventral is narrow. The oral disc is typically bufonid, with 2(2)/3 labial tooth row formula, the oral papillae are lateral. The beak is finely serrated and sharp (Khan, 1991).”

Biology

From AmphibiaWeb (2016):

“Nocturnal, appears soon after sunset; during day hides under stones, logs, piles of vegetation, holes and crevices among stones and in ground. Once a suitable place is selected, it is permanently shared with several toads.”

“The toad is [sic] lethargic timid animal. It moves about with deliberate hops from place to place in search of insects on which it feeds. In tropical southeast Asia it is most common amphibian, comes out after sunset in large numbers and frequents mostly the human habitations, where it congregate under street lamps to feed on photophilic insects (Church, 1960).”

“In temperate environs of western Himalayas, the breeding is initiated by the monsoon rains, from July to August. Males, gather in shallow side-pools along torrents and ponds. The call in low melodious "curr, curr, curr" repeated several times ending in a whistling note. The calling males become quite aggressive, tugging and jumping over each other, males for exceed female in numbers. It breeds in every available space containing some water from first showers of monsoon rains in the southern India (McCann, 1938). Males are much smaller than females. However, in tropical southeast Asia, the toad is known to breed throughout the year (Church, 1960).”

“Calling males occasionally jump over each other and try to secure a nuptial hold on each other, however, kicks and zestful wriggling dislodge them from each other and soon they resume calling. The females lurch round, as soon one comes close, a male jumps over it and quickly tightens it nuptial clasp, the other suitors are shaken off as the nuptial pair moves to a quitter [sic] place away from the site.”

“The eggs are laid in a double jelly string, generally in deep quieter water, where the egg-string is entangled in the vegetation or female moves round the submerged vegetation to wound the egg string round it. An egg is enclosed in a double gelatinous capsule (Khan, 1982).”

“The swarms of recently metamorphosed toadlets from synchronised pairings leave water, many fall prey to several kind of predators, while several are crushed under feet and passing traffic.”

From van Dijk et al. (2004):

“It is mainly a species of disturbed lowland habitats, from upper beaches and riverbanks to human-dominated agricultural and urban areas. It is uncommon in closed forests. It breeds in still and slow-flowing rivers and temporary and permanent ponds and pools. Adults are terrestrial and may be found under ground cover (eg. rocks, leaf-litter, logs), and are also associated with human habitations. The larvae are found in still and slow-moving waterbodies.”

From Gelb (2013):

“Asian common toads are generalists when it comes to choosing a habitat, but they prefer lowland areas such as lowland disturbed forests, forest margins, riparian areas, dense evergreen forests, gardens, and human dominated agricultural and urban areas. (Khan 2000, Mercy 1999, The State of Queensland 2010) ("Pest Risk Assessment: Asian spined toad (*Bufo melanostictus* [*Duttaphrynus melanostictus*])", 2010; Khan, 2000)”

“Asian common toads have typical anuran development which is indirect with an aquatic tadpole stage. Eggs become larva within 24 and 28 hours. Saidapur and Girish (2001) showed that Asian common toad tadpoles reared with sibling groups grow at a higher rate and develop faster compared to larvae reared in mixed groups. Because females produce so many eggs, intraspecific competition among tadpoles is likely intense in the ephemeral pools in which this species breeds. Therefore, Saidapur and Girish (2001) suggested that the rapid growth and development of tadpoles in the presence of siblings helps increase reproductive success. A study done by Mogali et al (2011) illustrates that tadpoles of Asian common toads will emerge at different times and sizes with the presents of predators. When predators are present tadpoles will decrease in body mass up to 46% and metamorphosis will also occur earlier (Mogali et al 2011, The State of Queensland 2010, Saidapur and Girish 2001). ("Pest Risk Assessment: Asian spined toad (*Bufo melanostictus*)", 2010; Mogali, et al., 2011; Saidapur and Girish, 2001)”

“Breeding is water dependent. In areas with a clear wet and dry season breeding will typically happen at the beginning of the wet season. In areas with no lack of moisture breeding will persist year round. The lunar cycle dictates ovulation, which occurs just before or after a full moon. The ovaries can make up 30% of the total body weight at this time. The female will lay a long string of black eggs, which are externally fertilized by the male. Eggs are enclosed in a thick mucus membrane and deposited on submerged vegetation. Eggs are usually laid in a temporary pond or vernal pool. Huang et al (1997) suggested male Asian common toads have a continuous spermatogenic cycle; in other words, sperm cells are produced year round. Thus, mating for males is not seasonally dependent in areas that are continuously moist. Although in more temperate regions with a clear wet and dry season, Asian common toads have been shown to favor specific seasons, a study done in Taiwan showed that there was a larger concentration of spermatophores in the male toad during a specific time of the year (Kahn [sic] 2000, Mercy 1999, The State of Queensland 2010, Saidapur and Girish 2001). ("Pest Risk Assessment: Asian spined toad (*Bufo melanostictus*)", 2010; Khan, 2000; Mercy, 1999; Saidapur and Girish, 2001)”

“There is no parental care in Asian common toads (Kahn 2000, Mercy 1999, The State of Queensland 2010, Saidapur and Girish 2001) ("Pest Risk Assessment: Asian spined toad (*Bufo melanostictus*)", 2010; Khan, 2000; Mercy, 1999; Saidapur and Girish, 2001)”

“Asian common toads are insectivorous although these toads are also known to be an opportunist and will feed on a variety of arthropods and even mollusks. An analysis of the stomach contents of multiple specimens of Asian common toads yielded arthropod orders such as earwigs, grasshoppers, crickets, weta, and locusts, true bugs, moths and butterflies, beetles, typical bugs, sawflies, wasps, bees and ants, termites, cockroaches, and mantids, true flies, centipedes, and millipedes. Though these toads are opportunistic feeders the insects that showed the greatest abundance in the stomach were sawflies, wasps, bees and ants, beetles and termites. This toad is feeds on insects that are known pests to human such mosquitoes and various crop pests (Mercy 1999, The State of Queensland 2010). ("Pest Risk Assessment: Asian spined toad (*Bufo melanostictus*)", 2010; Mercy, 1999)”

Human Uses

From van Dijk et al. (2004):

“It is sometimes found in the international pet trade but at levels that do not currently constitute a major threat. It is eaten locally in northern Thailand.”

This species is found for sale from Backwater Reptiles (2018) for $14.99 per individual. Backwater Reptiles (2018) is located in Rocklin, California.

Diseases

No OIE-reportable diseases (OIE 2021) were found to be associated with *D. melanostictus*.

According to Poelen et al. (2014), *Duttaphrynus melanostictus* is a host for the following parasites: *Oswaldocruzi melanosticti, Oswaldocruzia hoeppli, Cosmocercoides pulchra, Nematotaenia dollfusi, Pseudoacanthocephalus nguyenthileae, Diplodiscus sinicus, Distomum sociale, Meteterakis govindi, Diplodiscus japonicas, Cosmocerca japonica, Mesocoelium sociale, Rhabdias* sp.*, Mesocelium, Pseudocryptotropa* sp.*, Lecithodendriidae, Oxyuroidea*, roundworms (*Nematoda*), *Cosmocercoides pulchra,* and *Oochoristica anomala*.

From Nakano and Sung (2014):

“In Hong Kong, only the Asian common toad, *Duttaphrynus melanostictus* (Schneider, 1799), has been reported as a host species for *T.* [*Tritetrabdella*] *taiwana* (Yuen and Nakano, 2012).”

From McAllister et al. (2010):

“*Aplectana macintoshii* (Stewart, 1914) Travassos, 1931 […] Other reported hosts: Amphibia: […] Asian black-spotted toad, *Duttaphrynus melanostictus* (=*Bufo melanostictus*, Stewart, 1914; […]”

From Junker et al. (2015):

"The heterakid genus *Meteterakis* Karve, 1930 was originally erected to accommodate *M. govindi* Karve, 1930, a parasite described from a bufonid toad *Duttaphrynus melanostictus* (Schneider) (syn. *Bufo melanostictus* Schneider) (Bufonidae) in Burma (Karve, 1930)."

"*M*[*eteterakis*]. *bufonis* (Biswas & Chakravarty, 1963) Baker, 1984 (syn. *Heterakis bufonis* Biswas & Chakravarty, 1963) from *D. melanostictus* in India"

"*M. aurangabadensis* Deshmukh & Choudhari, 1980 (spicules 620–720 lm long) from *D. melanostictus* in India (Deshmukh & Choudhari, 1980);"

"*M. karvei* Naidu & Thakare, 1981 (spicules 660–840 lm long) from *D. melanostictus* in India (Naidu & Thakare, 1981);"

"*M. singaporensis* (Sandosham, 1954) Inglis, 1958 (syn. *Africana singaporensis* Sandosham, 1954) (spicules 740–960 lm long) from *D. melanostictus* in Singapore (Sandosham, 1954);"

"*M. gambhiri* Zhang & Zhang, 2011 (spicules 220–270 lm long) from *D. melanostictus* in Manipur, India,"

From Labisko et al. (2015):

"Similarly, and despite no currently recorded infection or capacity as a host for Bd [*Batrachochytrium dendrobatidis*, chytrid fungus] (www.bd-maps.net/surveillance/s_species.asp; accessed 21 September 2014), the recent discovery of Asian Common Toads (*Duttaphrynus melanostictus*) on the east coast of Madagascar, having likely arrived in shipping containers from Asia (Kolby 2014a), highlights a further risk to Seychelles endemic fauna as a potential disease vector."

Threat to Humans

From The State of Victoria (2021):

"The Asian black-spined toad has a poison gland much like the Cane toad. The toads skin secretions contain several bioactive compounds with lethal, hypotensive, hypertensive, neurotoxic, cardiotoxic, haemolytic and sleep inducing factors, potentially causing severe impacts for native species which may prey on the toad.

The milky toxin has a pungent odour and may cause itching in the nose and eyes when handled by humans. It does not pose a direct threat to human safety unless directly consumed. The consumption of Asian black-spined toad skin or eggs can cause serious illness or even death."

From Moore et al. (2015):

"Because *D. melanostictus* is poisonous, these concerns also extend to human health risks. *D. melanostictus* is implicated as the cause of poisoning in humans through consumption in Laos

and has also been documented as the cause of death and cardiac arrest in children who have consumed toad tissue [Keomany et al. 2007]. This health risk is elevated in the case of Madagascar, as its extensive rural populations to some extent rely on hunting and gathering for their sources of protein, their diet can include Anurans, and many people are unaware of the poisonous nature of the Asian toad."

From Trainor (2009):

"Frogs are widely eaten by villagers in Timor-Leste, and at least one child has been killed, and many others have become sick after eating toads. The toad is a public health issues because local villagers lack knowledge about the toad's toxicity. It is also a nuisance because toads can enter wells, drown and rot, potentially polluting important water sources."

3 Impacts of Introductions

From Trainor (2009):

"Frogs are widely eaten by villagers in Timor-Leste, and at least one child has been killed, and many others have become sick after eating toads. The toad is a public health issues because local villagers lack knowledge about the toad's toxicity. It is also a nuisance because toads can enter wells, drown and rot, potentially polluting important water sources."

"During 2007 a toad [*Duttaphrynus melanostictus*] was newly reported for Timor-Leste. There were immediate reports of local villagers eating the toad and either dying or becoming sick. The death of a 6 year old boy in Ermera, confirmed by a Cuban doctor and police following autopsy, is the only known death caused by toads in Timor-Leste (*Tempo Semanal*, 1 December 208)."

"Recently hatched chickens (chicks) do die after ingesting toad toxin typically from road-killed toads. […] Villagers indicated that toads ate the young shoots of maize, an important staple crop, but we were unable to confirm this information."

"Some villagers indicated that buffalo and cattle had been killed after eating toads, but we were unable to verify this information."

"Some native wildlife is killed when attempting to eat toads (while others, may be immune to the toxins, especially those evolving in Asia where toads occur naturally), and the toads prey on a wide range on [sic] terrestrial invertebrates, which may threaten with extinction some endemic or otherwise ecologically valuable invertebrate species."

From Kaiser et al. (2014):

"A greater threat, however, emanates from the introduced *Duttaphrynus melanostictus* (see Trainor 2009). This species is capable of occupying niches in which other species (both frogs and smaller reptiles) exist, is a formidable predator of small frogs and small reptiles (e.g., geckos, skinks), and it can become a nuisance and an object of pursuit in human habitations, to the extent that frogs may be considered equally offensive as toads merely by having a similar appearance."

From Gelb (2013):

"These toads are understood to be reproducing rapidly in these areas; there is a possibility that Asian common toads are displacing a smaller species of toads such as crested toads. Asian common toads are suspected to cause intense ecological damage. On the islands where Asian common toads have become naturalized it is competing heavily for similar resources of native anurans. These toads are also known to feed on the eggs, larva and juveniles of other native amphibians, which further exasperates the added competition. This competition may in the future resemble the ecological crisis of cane toads in Australia (Church 1960, Lever 2003, The State of Queensland 2010). (Church, 1960; Lever, 2003)"

From Reilly et al. (2017):

"With large mammalian predators absent from most of the Wallacean islands, the apex predators are varanid lizards and large snakes, both of which we have observed either dead or incapacitated in the field with *D. melanostictus* in their mouth or stomach (S. Reilly pers. obs.). Varanid lizards that are naturally sympatric with toads have evolved to cope with the potent toad toxins, while varanid lizards that are not naturally sympatric are highly susceptible to the toxins (Ujvari et al., 2013). The iconic Komodo dragon (*Varanus komodoensis*), which has a restricted geographic range and small population sizes, is extremely susceptible to toad toxin (Ujvari, Mun, Conigrave, Ciofi, & Madsen, 2014)."

The following information pertains to *potential* impacts from introduction of *Duttaphrynus melanostictus*.

From Labisko et al. (2015):

"Similarly, and despite no currently recorded infection or capacity as a host for Bd [*Batrachochytrium dendrobatidis*, chytrid fungus] (www.bd-maps.net/surveillance/s_species.asp; accessed 21 September 2014), the recent discovery of Asian Common Toads (*Duttaphrynus melanostictus*) on the east coast of Madagascar, having likely arrived in shipping containers from Asia (Kolby 2014a), highlights a further risk to Seychelles endemic fauna as a potential disease vector."

From Piludu et al. (2015):

"Another cause of concern is the spread of the invasive Asian common toad *Duttaphrynus melanostictus* that was recorded for the first time in Toamasina in March 2014 (Kolby, 2014b). A species distribution model performed by Pearson (2015), showed a high probability of occurrence in the distribution of [*Mantella*] *aurantiaca*, which suggest an increased risk of disease transmission and food-web disruption."

From Gelb (2013):

"These toads have few natural predators; although they have been known to be preyed upon by snakes and birds. The possible introduction of these toads could be detrimental to a new ecosystem."

From Licata et al. (2019):

"The ongoing spread of the Asian toad is likely to pose major threats to the Malagasy native ecosystems. The most feared effect related to this biological invasion is the poisoning of native predators (Brown et al. 2016, Marshall et al. 2018). The Asian toads can release a cardiotoxic toxin that can be fatal to predators if ingested (Chen and Kovaríková 1967; Marshall et al. 2018), and the vast majority of native potential predators seems to be non-resistant to bufotoxins (Marshall et al. 2018). Other potential negative effects include the transmission of pathogens to native amphibian species, and the competition for breeding sites and feeding resources (Mahapatra et al. 2017), given its explosive breeding behaviour (Fan et al. 2013) and the sizeable clutches of up to ten thousand eggs (own unpublished data)."

From Trainor (2009):

"Populations of native vertebrates which feed on toads that are not immune from the toxin have apparently crashed since the arrival of the toad. This includes *Varanus* monitors (*Varanus timorensis* and presumably *Varanus salvator*), and reportedly Green Pit Viper *Trimesurus insularis*."

"Possibly some frog species have been locally extirpated."

4 History of Invasiveness

The spread of *Duttaphrynus melanostictus* is well documented with nonnative populations becoming established across Southeast Asia and Africa, including the islands of Indonesia, Papua New Guinea, Bali, Sulawesi, Ambon, Manokwari, Timor-Leste, and Madagascar. This species is becoming increasing intercepted as stowaways in shipping containers in countries such as South Africa, Australia, New Zealand, and more recently United Arab Emirates and the Arabian Peninsula; however no established populations have been recorded at this time in those countries. Information is available from reliable, credible sources regarding negative impacts from the introduction and establishment of *D. melanostictus*. There have been reported illness from people eating the toad, with at least one death in Timor-Leste. Also reported are impacts to livestock and wildlife from consumption of the toad toxin. Many sources also list potential impacts such as out competing native species and preying on native species. The history of invasiveness is classified as High, primarily due to the documented negative impact to human populations in invaded areas.

5 Global Distribution

Figure 1. Known global distribution of *Duttaphyrnus melanostictus*. Map from GBIF Secretariat (2021). The location in Florida is a result of one specimen that hitchhiked in shipping materials and not an established population. The point in Korea is similarly from a single individual, reported as a possible escaped pet. These locations were not used as source points in the climate match analysis.

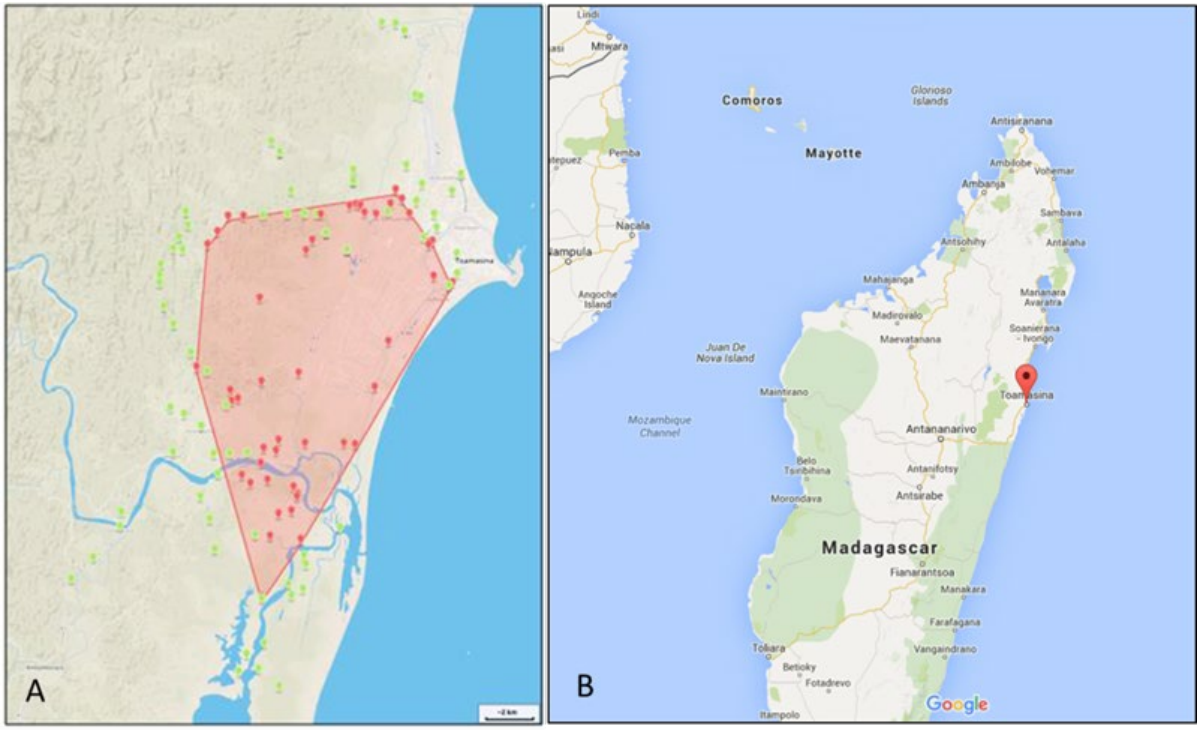

Figure 2. Map A, from Moore et al. (2015), survey results for *D. melanostictus* around the city of Toamasina, Madagascar. Red locations were positive for the species, green were negative. Map B shows the location of Toamasina within Madagascar (Google Maps 2016). Licata et al. (2019) reported a fivefold range expansion and an estimated 2.5-3.5 km/year expansion rate of *D. melanostictus*.

6 Distribution Within the United States

Duttaphrynus melanostictus has not been reported in the wild in the United States.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Duttaphrynus melanostictus* was generally low in the northern half of the contiguous United States. High match was found in the Southwest along the United States and Mexico border, as well as in peninsular Florida. Medium match was found along the southern Atlantic Coast, in States bordering the Gulf of Mexico, and in southern central States. The overall Climate 6 score (Sanders et al. 2018; 16 climate variables; Euclidean distance) for the contiguous United States was 0.076, medium (scores between 0.005 and 0.103, exclusive, are classified as medium). The following States had high individual Climate 6 scores: Arizona, Florida, New Mexico, and Texas. States that had medium individual Climate 6 scores included: California, Georgia, Oklahoma, and South Carolina. All remaining States had low individual Climate 6 scores.

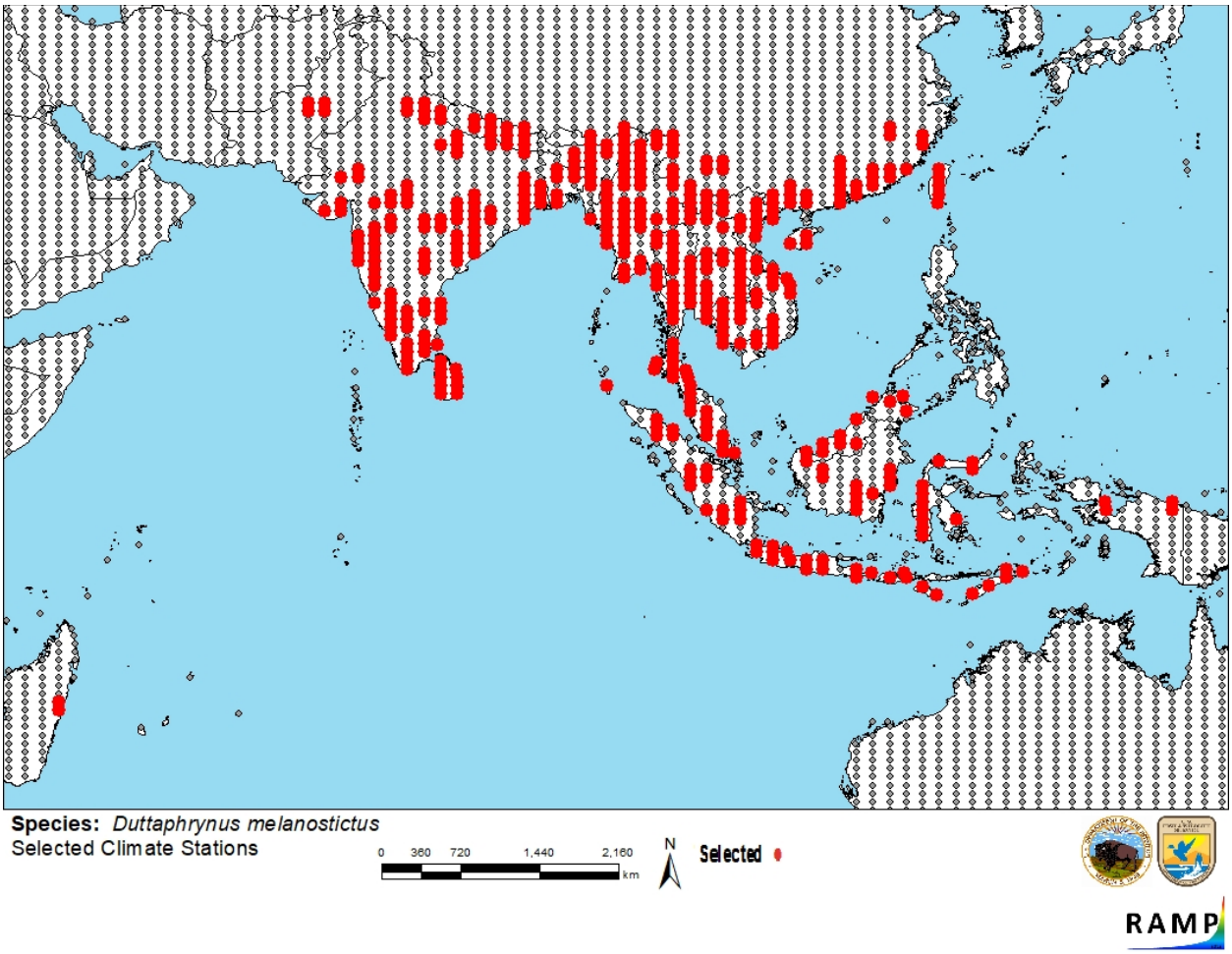

Figure 4. RAMP (Sanders et al. 2018) source map showing weather stations in Madagascar, Pakistan, and Southeast Asia selected as source locations (red; Madagascar, Pakistan, India, Sri Lanka, Nepal, China, Taiwan, Thailand, Myanmar, Vietnam, Laos, Cambodia, Indonesia, and Papua New Guinea) and non-source locations (gray) for *Duttaphrynus melanostictus* climate matching. Source locations from Moore et al. (2015), Licata et al. (2019), and GBIF Secretariat (2020). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

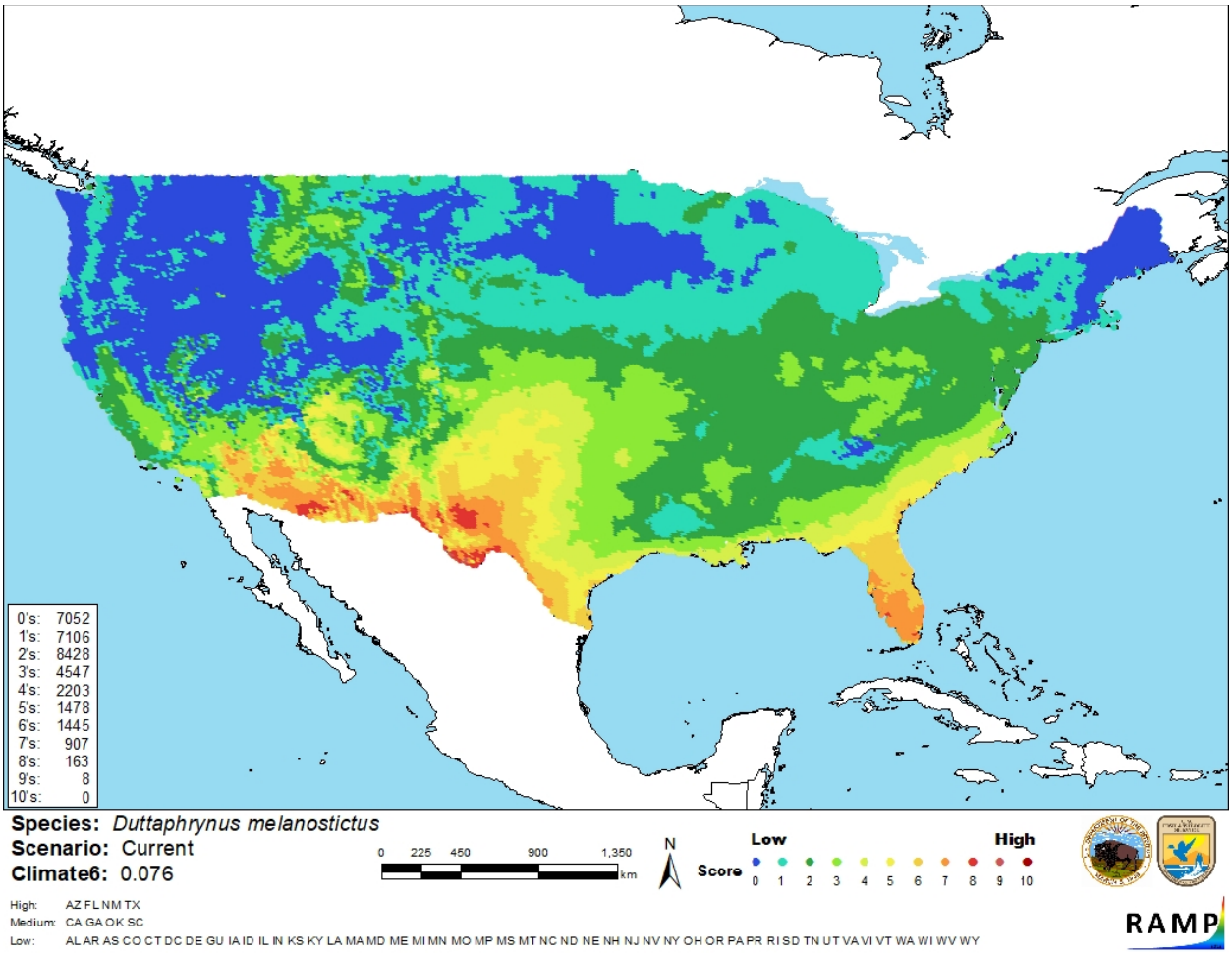

Figure 5. Map of RAMP (Sanders et al. 2014) climate matches for *Duttaphrynus melanostictus* in the contiguous United States based on source locations reported by Moore et al. (2015), Licata et al. (2019), and GBIF Secretariat (2020). Counts of climate match scores are tabulated on the left. 0 = Lowest match, 10 = Highest match.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: (Count of target points with climate scores 6-10)/ (Count of all target points)	Overall Climate Match Category
0.000≤X≤0.005	Low
0.005<X<0.103	Medium
≥0.103	High

8 Certainty of Assessment

The certainty of assessment is classified as Medium. Information on the biology and ecology of this species is widely available. Records of introduction and established populations were found. Information regarding negative impacts came mainly from research reports, books, and scientific

websites. The lack of impact information from a peer-reviewed journal prevents the classification of the certainty of assessment a High.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Duttaphrynus melanostictus, Southeast Asian toad, is a poisonous toad native to Southeast Asia (northern Pakistan, Nepal, Bangladesh, India (including the Andaman and Nicobar Islands), Sri Lanka, southern China (including Taiwan, Hong Kong and Macau), Myanmar, Lao People's Democratic Republic, Vietnam, Thailand, Cambodia, Malaysia, Singapore, and Indonesia (Sumatra, Java, Borneo, Anambas and Natuna Islands). The history of invasiveness for *Duttaphrynus melanostictus* is classified as High. There have been multiple introductions that resulted in established populations. *D. melanostictus* has most often been translocated by being a stowaway in international shipping (air and sea). There have been reports of illness due to human consumption of this toad in invaded areas, including at least one death. There are also reports of livestock and wildlife deaths due to consumption of the toad toxin. This species is suspected to compete with native toads and is potentially a carrier for chytrid fungus, an OIE reportable disease. This species is available in the pet trade in the United States. The overall climate match for the contiguous United States is Medium, with the highest areas of match being found in the Southwest and Florida. The certainty of assessment is Medium, due to available impact information but the lack of information from a peer-reviewed source. The overall risk assessment category for *Duttaphrynus melanostictus* is High.

Assessment Elements

- **History of Invasiveness (Sec. 4): High**
- **Overall Climate Match Category (Sec. 7): Medium**
- **Certainty of Assessment (Sec. 8): Medium**
- **Remarks, Important additional information:** Species is poisonous, can cause serious illness or death if ingested. Potential carrier of the chytrid fungus.
- **Overall Risk Assessment Category: High**

10 Literature Cited

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 11.

AmphibiaWeb. 2016. *Duttaphrynus melanostictus*. AmphibiaWeb. Berkeley: University of California. Available: http://amphibiaweb.org/cgi/amphib_query?where-genus=Duttaphrynus&where-species=melanostictus (January 2021).

Backwater Reptiles. 2018. Asian Spiny Toad for sale. Available: https://www.backwaterreptiles.com/toads/asian-spiny-toad-for-sale.html (January 2021).

BISON. 2021. Biodiversity Information Serving Our Nation. U.S. Geological Survey. Available: https://bison.usgs.gov (January 2021).

[CABI] CABI International. 2019. *Duttaphrynus melanostictus* (Asian common toad). CABI Invasive Species Compendium. Wallingford, UK: CAB International. Available: http://www.cabi.org/isc/datasheet/121979 (January 2021).

EDDMapS. 2020. Early Detection and Distribution Mapping System. Tifton: University of Georgia, Center for Invasive Species and Ecosystem Health. Available: https://www.eddmaps.org/distribution/point.cfm?id=2462874 (January 2021).

Fuller P. 2012. *Duttaphrynus melanostictus*. Gainesville, Florida: U.S. Geological Survey, Nonindigenous Aquatic Species Database. Available: http://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=2867 (January 2021).

GBIF Secretariat. 2021. GBIF backbone taxonomy: *Duttaphrynus melanostictus* (Schneider, 1799). Copenhagen: Global Biodiversity Information Facility. Available: http://www.gbif.org/species/2422538 (January 2021).

Gelb J. 2013. *Duttaphrynus melanostictus*. Animal Diversity Web. Available: http://animaldiversity.org/accounts/Duttaphrynus_melanostictus/ (January 2021).

Google Maps. 2016. Toamasina, Madagascar. Available: https://www.google.com/maps/place/Toamasina,+Madagascar/@-18.7985337,46.5589661,6.18z/data=!4m5!3m4!1s0x21f5004877b03b39:0xdd4a6822e32e1e71!8m2!3d-18.1442811!4d49.3957836 (January 2021).

[ITIS] Integrated Taxonomic Information System. 2021. *Duttaphrynus melanostictus* (Schneider, 1799). Reston, Virginia: Integrated Taxonomic Information System. Available: http://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=773557 (January 2021).

Junker K, Mariaux J, Measey GJ, Mutafchiev Y. 2015. *Meteterakis saotomensis* n. sp. (Nematoda: Heterakidae) from *Schistometopum thomense* (Bocage) (Gymnophiona: Dermophiidae) on São Tomé Island. System Parasitology 92:131–139.

Kaiser H, O'Shea M, Kaiser C. 2014. Amphibians of Timor-Leste: a small fauna under pressure. Pages 361–370 in Heatwole H, Das I, editors. Conservation Biology of Amphibians of Asia. Borneo: Natural History Publications.

Kaiser H, Soares ZA, O'Shea M. 2011. New beginnings – a first report on frog research in Timor-Leste. FrogLog 99:44–45.

Labisko J, Maddock ST, Taylor ML, Chong-Seng L, Gower DJ, Wynne FJ, Wombwell E, Morel C, French GCA, Bunbury N, Bradfield KS. 2015. Chytrid fungus (*Batrachochytrium dendrobatidis*) undetected in the two orders of Seyschelles amphibians. Herpetological Review 46:41–45.

Licata F, Ficetola GF, Freeman K, Mahasoa RH, Ravololonarivo, Fidy JFSN, Koto-Jean AB, Nahavitatsara ER, Andreone F, Crottini A. 2019. Abundance, distribution and spread of the invasive Asian toad *Duttaphrynus melanostictus* in eastern Madagascar. Biological Invasions 21:1615–1626.

McAllister CT, Bursey CR, Freed PS. 2010. *Aplectana macintoshii* (Nematoda: Cosmocercidae) from two species of anurans (Bufonidae, Pyxicephalidae) from the Republic of Namibia, southwest Africa. Comparative Parasitology 77:100–104.

Moore M, Fidy JFSN, Edmonds D. 2015. The new toad in town: distribution of the Asian toad, *Duttaphrynus melanostictus*, in the Toamasina area of eastern Madagascar. Tropical Conservation Science 8(2):440–455.

Nakano T, Sung Y-H. 2014. A new host record of *Tritetrabdella taiwana* (Hirudinida: Arhynchobdellida: Haemadipsidae) from the Asian painted frog *Kaloula pulchra* (Anura: Mycrohylidae), in Hong Kong, China, with a taxonomic note on *T. taiwana*. Comparative Parasitology 81:125–129.

[OIE] World Organisation for Animal Health. 2021. Animal diseases. Available: https://www.oie.int/en/what-we-do/animal-health-and-welfare/animal-diseases/ (September 2021).

Othman SN, Chen Y-H, Chuang M-F, Andersen D, Jang Y, Borzee A. 2020. Impact of the Mid-Pleistocene revolution and anthropogenic factors on the dispersion of Asian black-spined toads (*Duttaphyrnus melanostictus*). Animals 10(7):1157–1181.

Piludu, N, Dubos N, Rasafimanahaka JH, Razafindraibe P, Randrianantoandro JC, Jenkins RKB. 2015. Distribution, threats and conservation of a critically endangered amphibian (*Mantella aurantiaca*) in eastern Madagascar. Herpetology Notes 8:119–123.

Poelen JH, Simons JD, Mungall CJ. 2014. Global Biotic Interactions: an open infrastructure to share and analyze species-interaction datasets. Ecological Informatics 24:148–159.

Price-Rees SJ, Brown GP, Shine R. 2012. Interacting impacts of invasive plants and invasive toads on native lizards. The American Naturalist 179(3):413–422.

Reilly SB, Wogan GOU, Stubbs AL, Arida E, Iskandar DT, McGuire JA. 2017. Toxic toad invasion of Wallacea: a biodiversity hotspot characterized by extraordinary endemism. Global Change Biology 23:5029–5031.

Sanders S, Castiglione C, Hoff M. 2018. Risk Assessment Mapping Program: RAMP. Version 3.1. U.S. Fish and Wildlife Service.

Soorae PS, Frankham GJ, Mohamed AA. 2020. The first record of the Asian common toad *Duttaphrynus melanostictus* Schneider, 1799 in Abu Dhabi, United Arab Emirates. BioInvasions Records 9(2):434–443.

The State of Victoria. 2021. Asian black-spined toad. Australia: Agriculture Victoria. Available: https://agriculture.vic.gov.au/biosecurity/pest-animals/priority-pest-animals/asian-blackspined-toad (September 2021).

Tingley R, Garcia-Diaz P, Arantes CRR, Cassey P. 2018. Integrating transport pressure data and species distribution models to estimate invasion risk for alien stowaways. Ecography 41:635–646.

Trainor CR. 2009. Survey of a population of black-spined toad *Bufo melanostictus* in Timor-Leste: confirming identity, distribution, abundance and impacts of an invasive and toxic toad. Report by Charles Darwin University to AusAID.

van Dijk PP, Iskandar D, Lau MWN, Huiqing G, Baorong G, Kuangyang L, Wenhao C, Zhigang Y, Chan B, Dutta S, Inger R, Manamendra-Arachchi K, Khan MS. 2004. *Duttaphrynus melanostictus*. The IUCN Red List of Threatened Species 2004: e.T54707A86445591. Available: http://www.iucnredlist.org/details/full/54707/0 (January 2021).

11 Literature Cited in Quoted Material

Note: The following references are cited within quoted text within this ERSS, but were not accessed for its preparation. They are included here to provide the reader with more information.

Australian Quarantine and Inspection Service. 2010. Teamwork nabs nasty hitchhikers on the docks. Canberra: Australian Quarantine and Inspection Service. Departmental press release, May 31, 2010.

Brown KA, Farris ZJ, Yesuf G, Gerber BD, Rasambainarivo F, Karpanty S, Kelly MJ, Razafimahaimodison JC, Larney E, Wright PC, Johnson SE. 2016. Modeling co-occurrence between toxic prey and native predators in an incipient invasion. Biodiversity Conservation 25(13):2723–2741.

Chen KK, Kovaríková A. 1967. Pharmacology and toxicology of toad venom. Journal of Pharmaceutical Sciences 56(12):1535–1541.

Church G. 1960. The invasion of Bali by *Bufo melanostictus*. Herpetologica 16:15–21.

Deshmukh PG, Choudhari AC. 1980. *Meteterakis aurangabadensis* n. sp. from toad, *Bufo melanostictus*. Indian Journal of Parasitology 4:37–40.

Dubois A, Ohler A. 1999. Asian and Oriental toads of the *Bufo melanostictus*, *Bufo scaber* and *Bufo stejnegeri* groups (Amphibia, Anura): a list of available and valid names and description of some name bearing types. Journal of South Asian Natural History 4(2):133–180.

EOL. 2012. *Bufo melanostictus*. Encyclopedia of Life. Available: http://eol.org/pages/1039118/details (August 2012).

Fan XL, Lin ZH, Ji X. 2013. Male size does not correlate with fertilization success in two bufonid toads that show size assortative mating. Current Biology 59(6):740–746.

Huang et al. 1997. [Source material did not give full citation for this reference.]

Karve JN. 1930. Some parasitic nematodes of frogs and toads. Annals of Tropical Medicine and Parasitology 24:481–491.

Keomany S, Mayxay M, Souvannasing P, Vilayhong C, Stuart BL, Srour L, Newton PN. 2007. Toad poisoning in Laos. American Journal of Tropical Medicine and Hygiene 77(5):850–853.

Khan M. 2000. *Duttaphrynus melanostictus*. AmphibiaWeb. Available: http://amphibiaweb.org/cgi-bin/ (February 2012).

Khan MS. 1991. Morphoanatomical specialization of the buccopharyngeal region of the anuran larvae and its bearing on the mode of larval feeding. Doctoral dissertation. Lahore, Pakistan: University of the Punjab.

Khan MS. 1982. Collection, preservation and identification of amphibian eggs from the plains of Pakistan. Pakistan Journal of Zoology 14:241–243.

Kolby JE, Kraus F, Rabemananjara F, Rabesihanaka S, Rabibisoa N, Rafanomezantsoa J. 2014. Stop Madagascar's toad invasion now. Nature 509: 563−563.

Kolby JE. 2014[a and b]. Ecology: stop Madagascar's toad invasion now. Nature 509:563–563.

Kraus F. 2009. Alien reptiles and amphibians: a scientific compendium and analysis. Springer Science & Business Media 4:563.

Krysko KL, Burgess JP, Rochford MR, Gillette CR, Cueva D, Enge KM, Somma LA, Stabile JL, Smith DC, Wasilewski JA, Kieckhefer III GN, Granatosky MC, Nielsen SV. 2011. Verified non-indigenous amphibians and reptiles in Florida from 1863 through 2010: Outlining the invasion process and identifying invasion pathways and stages. Zootaxa 3028:1–64.

Lever C. 2003. Naturalized reptiles and amphibians of the world. New York: Oxford University Press.

Mahapatra S, Dutta SK, Sahoo G. 2017. Opportunistic predatory behaviour in *Duttaphrynus melanostictus* (Schneider, 1799) tadpoles. Current Science 112(8):1755–1760.

Marshall BM, Casewell NR, Vences M, Glaw F, Andreone F, Rakotoarison A, Zancolli G, Woog F, Wüster W. 2018. Widespread vulnerability of Malagasy predators to the toxins of an introduced toad. Current Biology 28(11):R654–R655.

McCann. 1938. [Source material did not give full citation for this reference.]

Measey J, Davies SJ, Vimercati G, Rebelo A, Schmidt W, Turner A. 2017. Invasive amphibians in southern Africa: A review of invasion pathways. Bothalia-African Biodiversity & Conservation 47:1–12.

Mercy M. 1999. Studies on some aspects of the biology and ecology of the common Indian toad *Bufo melanostictus* Schneider (Class Amphibia; Order Anura). Mahatma Gandhi University Online Theses Library.

Mogali S, Saidapur S, Shanbhag B. 2011. Levels of predation modulate antipredator defense behavior and metamorphic traits in the toad *Bufo melanostictus*. Journal of Herpetology 45(4):428–431.

Naidu TSV, Thakare VK. 1981. On two new nematodes from fishes and amphibians of Vidarbha Region, Maharashtra State, India. Rivista di Parassitologia 42:415–424.

Pearson RG. 2015. Asian common toads in Madagascar: an urgent effort to inform surveys and eradication efforts. Global Change Biology 21:9.

Saidapur S, Girish S. 2001. Growth and metamorphosis of *Bufo melanostictus* tadpoles: effects of kinship and density. Journal of Herpetology 35(2):249–254.

The State of Queensland. 2010. Pest risk assessment: Asian spined toad (*Bufo melanostictus*). Queensland, Australia: Department of Employment, Economic Development and Innovation. PR10_5469.

Ujvari B, Mun HC, Conigrave AD, Ciofi C, Madsen T. 2014. Invasive toxic prey may imperil the survival of an iconic giant lizard, the Komodo dragon. Pacific Conservation Biology 20:363–365.

Ujvari B, Mun HC, Conigrave AD, Bray A, Osterkamp J, Halling P, Madsen T. 2013. Isolation breeds naivety: Island living robs Australian varanid lizards of toad-toxin immunity via four-base-pair mutation. Evolution 67:289–294.

Wogan GOU, Stuart BL, Iskandar DT, McGuire JA. 2016. Deep genetic structure and ecological divergence in a widespread human commensal toad. Biology Letters 12:20150807.

Yuen Y-L, Nakano T. 2012. *Duttaphrynus melanostictus* (Asian common toad) parasitism. Herpetological Review 43:461–462.