

Red-rim Melania (*Melanoides tuberculata*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2023

Revised, August 2023, July 2024

Web Version, 7/25/2024

Organism Type: Mollusk

Overall Risk Assessment Category: High



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1 Native Range and Status in the United States

Native Range

From Daniel et al. (2019):

“Native range included the subtropical and tropical portions of Africa (with exception of most of coastal western Africa) and southern Asia (Brown 1994).”

From Albrecht et al. (2018):

“Bangladesh; Benin; Brunei Darussalam; Burundi; China; Congo; Congo, The Democratic Republic of the; Egypt; Eritrea; Eswatini; Ethiopia; Gabon; India; Kenya; Lao People's Democratic Republic; Libya; Malawi; Malaysia; Mauritania; Mozambique; Namibia; Niger; South Africa; South Sudan; Sri Lanka; Sudan; Tanzania, United Republic of; Thailand; Timor-Leste; Uganda; Viet Nam; Yemen (South Yemen, Socotra, North Yemen); Zimbabwe”

From Okumura and Rocha (2020):

“*M. tuberculata* is native to North and East Africa, Southeast Asia, China and some Indo-Pacific islands, with wide distribution on these areas (Madsen & Frandsen, 1989)”

Status in the United States

From Daniel et al. (2019):

“Established in multiple waterbodies in Arizona, California, Colorado, Florida, Hawaii, Idaho, Louisiana, Montana, Nevada, Oregon, Puerto Rico, South Carolina, Texas, Utah and Wyoming. Populations in North Carolina, Virgin Islands and South Dakota are unknown.”

USGS (2024) reports an occurrence in Cottonwood Creek, Lincoln County, Washington, in February 2024, with the comment “In the creek. Tons of them. Just put a few in a tank until confined identity.” The status of this introduction is unknown.

Simpson et al. (2022) classify *M. tuberculata* in the United States as having a “self-sustaining population outside of captivity or cultivation [...]”

From Fofonoff et al. (2018):

“*Melanoides tuberculata* was first reported in California in 1972, from a ditch in Riverside County, California. In 1988, it was collected in the Sacramento-San Joaquin Delta.”

“*Melanoides tuberculata* was first collected on the East Coast of Florida (FL) in Lake Osceola on the University of Miami campus in 1966 (Clench 1970), and by 1973 it was found in brackish water in the Pompano Canal, Fort Lauderdale (Russo 1974, cited by Roessler 1977). By 1975, this snail was abundant in mangrove areas of the Matheson Hammock-Snapper Creek area of Coral Gables, FL adjacent to Biscayne Bay. [...] The Red-Rim *Melania* reached the upper St. Johns River, FL by 1975 (USGS Nonindigenous Aquatic Species Program 2003; Florida Museum of Natural History 2013; Lee 2013). It was present in the Indian River Lagoon drainage, in the St. Lucie River and Sebastian Creek drainages (Harbor Branch Oceanographic Institution Collections).”

“*Melanoides tuberculata* was first found on the Gulf Coast of Florida in 1969 in the Hillsborough River in Hillsborough State Park (Clench 1970). This snail is now abundant in the tidal tributaries of Tampa Bay (Baker et al. 2004). In 1975, it was found to be abundant [sic] in

several brackish (2.5-3.0 PSU) canals flowing into Lake Pontchartrain, in New Orleans, Louisiana (Dundee and Paine 1977).”

“*Melanoides tuberculata* was reported from the Hawaiian Islands at least as early as 1915 (Academy of Natural Sciences of Philadelphia 2013), but it may have been a prehistoric introduction to the islands.”

From CABI (2023):

“*M. tuberculata* individuals are now for sale on the Internet due to the fact that they are often considered a beneficial addition to most aquariums.”

Live *Melanoides tuberculata* can be found for sale extensively in the United States. For example, from Aquatic Arts (2023):

“Malaysian Trumpet AKA Red-Rimmed Melania Snail (*Melanoides tuberculata*) Bredby, Aquatic Arts \$7.99”

Regulations

The following U.S. States prohibit or regulate transportation, purchase, possession, sale, stocking, or cultivation of *Melanoides tuberculata*: Arkansas (AGFC 2022), North Carolina (NCDEQ 2022), South Dakota (SDGFP 2022), Utah (UDWR 2020), and Wisconsin (WDNR 2022).

Means of Introductions within the United States

From Daniel et al. (2019):

“Imported by the aquarium industry as early as the 1930s. Some of the early known populations most likely began from local aquarium hobbyists' releases.”

Remarks

This ERSS was previously published in March 2018, under the name *Melanoides tuberculatus*. Revisions were done to incorporate new information and to bring the document in line with current standards.

From Albrecht et al. (2018):

“The species name is sometimes spelled *Melanoides tuberculatus* (see Madhyastha 2012), but this is incorrect because *Melanoides* Olivier, 1804 was clearly intended to be feminine as it was combined with the feminine specific epithet *fasciolata* in the original description.”

From Harding et al. (2019):

“Our results also agree with other genetic studies showing *M. tuberculata* is polyphyletic and in need of taxonomic revision (Facon et al. 2003; Van Bocxlaer et al. 2015).”

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From Neubauer (2017):

“Animalia (Kingdom) > Mollusca (Phylum) > Gastropoda (Class) > Caenogastropoda (Subclass) [unassigned] > Caenogastropoda (Order) > Cerithioidea (Superfamily) > Thiaridae (Family) > Thiarinae (Subfamily) > *Melanoides* (Genus) > *Melanoides tuberculata* (Species)”

According to Neubauer (2017), *Melanoides tuberculata* is the valid scientific name for this species.

Database and literature searches for this ERSS were conducted using the valid scientific name *Melanoides tuberculata* and the synonym *Melanoides tuberculatus*.

Size, Weight, and Age Range

From CABI (2023):

“*M. tuberculata* can reach up to a mean adult size of 20-40 mm depending on the morphs considered and environmental conditions (Pointier, 1989), but Murray (1975) reported individuals 70-80 mm in shell length in Texas.”

From Fofonoff et al. (2018):

“Adult snails [...] live for about 2 years (Livshits and Fishelson 1983; Rader et al. 2003; Work and Mills 2013; Bolaji et al. 2011).”

Environment

From Fofonoff et al. (2018):

“*Melanoides tuberculata* is a predominantly freshwater snail, found in springs, streams, lakes swamps, etc. (Pointier et al. 1993[a]; Thompson 2004). It occasionally invades brackish and marine habitats, especially mangrove swamps (Roessler et al. 1977; Wingard et al. 2007; Barroso and Matthews-Cascon 2009).”

“In Biscayne Bay, Florida *M. tuberculata* occurred at 0-33 PSU [practical salinity units] and tolerated salinities up to 45 PSU, although reproduction ceased at ~18 PSU (Wingard et al. 2007). In estuaries on Oahu, Hawaii and Ceara, Brazil, the snail occurred from freshwater to 34 and 30 PSU, respectively (Englund et al. 2000; Barroso and Matthews-Cascon 2009). However, another population, in Lagos Lagoon, Nigeria, did not tolerate salinities over 25 PSU (Bolaji et

al. 2011). This snail, though aquatic, is quite tolerant of desiccation – individuals survived 80-140 hours of air exposure at 25°C and 20% humidity (Weir and Salice 2012). Given the genetic diversity reported in this species (Samadi et al. 1999; Facon et al. 2008), it is likely that local populations will vary in environmental tolerances.”

From NatureServe (2023):

“This species is rarely found in temporary water bodies but may resist a broad spectrum of environmental conditions (Pointier et al., 2005).”

From Fofonoff et al. (2018):

“Snails from the San Marco River, Texas tolerated temperatures of 17 to 32.5°C with little mortality, but a temperature of 13°C killed all the snails within 12 days (Mitchell and Brandt 2005). Many scattered populations in the western US, Europe, and New Zealand are confined to warm springs or thermal effluents (Duggan 2002; Rader et al. 2003; Oscoz et al. 2009).”

From Daniel et al. (2019):

“Research has been conducted to determine the snails lethal water temperature, about 50° Celsius (120° Fahrenheit), for the disinfection [of] fishing gear and research equipment which may inadvertently spread snails to uninfested waters (A. Mitchell, personal communication).”

Climate

From Fofonoff et al. (2018):

“*Melanoides tuberculata* is a snail of warm-temperate to tropical distribution.”

Distribution Outside the United States

Native

From Daniel et al. (2019):

“Native range included the subtropical and tropical portions of Africa (with exception of most of coastal western Africa) and southern Asia (Brown 1994).”

From Albrecht et al. (2018):

“Bangladesh; Benin; Brunei Darussalam; Burundi; China; Congo; Congo, The Democratic Republic of the; Egypt; Eritrea; Eswatini; Ethiopia; Gabon; India; Kenya; Lao People's Democratic Republic; Libya; Malawi; Malaysia; Mauritania; Mozambique; Namibia; Niger; South Africa; South Sudan; Sri Lanka; Sudan; Tanzania, United Republic of; Thailand; Timor-Leste; Uganda; Viet Nam; Yemen (South Yemen, Socotra, North Yemen); Zimbabwe”

From Okumura and Rocha (2020):

“*M. tuberculata* is native to North and East Africa, Southeast Asia, China and some Indo-Pacific islands, with wide distribution on these areas (Madsen & Frandsen, 1989)”

Introduced

From Albrecht et al. (2018):

“Algeria; Australia; Bahrain; Bolivia, Plurinational States of; Brazil; Comoros; Cuba; Dominica; Ecuador (Ecuador (mainland)); Fiji; French Guiana; French Polynesia; Germany; Guadeloupe; Guyana; Honduras; Japan; Kuwait; Malta; Martinique; Mauritius (Mauritius (main island)); Mayotte; Montserrat; Nepal; Netherlands; New Caledonia; New Zealand; Panama; Papua New Guinea; Paraguay; [...] Réunion; Saint Lucia; Samoa; Seychelles (Seychelles (main island group)); Slovakia; Spain (Spain (mainland)); Suriname; Tonga; Trinidad and Tobago; [...] Uruguay; Venezuela, Bolivarian Republic of; Wallis and Futuna”

“In addition to the tropical-subtropical countries and regions listed, it also occurs in many Palaearctic countries indoors (aquariums, hothouses, garden shops) or outdoors in warm waters, either artificial ones such as cooling water ponds, e.g., of nuclear power plants or natural ones, such as a thermal spring outflow in Slovakia (Májský 2000). On Madagascar it occurs over the whole island and is common in e.g., rice fields. The origin of the species in Madagascar (native or introduced) is uncertain. It also has been introduced in most islands in the Indian Ocean, including the Comoros, Mauritius, Mayotte, Réunion and the Seychelles.”

From Yanai et al. (2017):

“One species (*Melanoides tuberculata*) could not be definitely categorized as native or non-indigenous [to Israel] since it is widely distributed in aquatic habitats in Israel (Milstein et al. 2012) but is also found in many other countries (IUCN 2016) that export ornamental water plants globally, including to Israel.”

From Willan and Kessner (2021):

“[...] it has been accidentally introduced in [...] northern Australia where it is now recorded from northern Western Australia, the Northern Territory, throughout Queensland, and northern New South Wales.”

From Breure et al. (2022):

“[...] in South America also known from [Ecuador’s] neighbouring countries Brazil, Colombia, and Peru (Simone, 2006; Ramírez et al., 2003; Linares & Vera, 2012).”

From Duggan and Knox (2022):

“Recently invaded areas include [...] a geothermally heated stream in temperate Serbia in 2011 (Milenkovic and Gligorijevic 2012).”

“In New Zealand, *M. tuberculata* is known [...] from one non-indigenous population surviving in a geothermally heated stream (Duggan 2002; Duggan et al. 2007).”

Means of Introduction Outside the United States

From CABI (2023):

“*M. tuberculata* recently invaded the whole inter-tropical belt mainly as a result of the trade in aquarium plants. Further invasions are therefore likely, especially of ‘improved’ morphs, in relation to the increase of trade in aquarium fishes and plants. *M. tuberculata* individuals are now for sale on the Internet due to the fact that they are often considered a beneficial addition to most aquariums, cleaning up leftover food and eating algae.”

“Besides accidental introductions, it has to be noticed that *M. tuberculata* was subsequently used in 1970s and 1980s for bio control programmes in several islands of the Caribbean area (such as St Lucia, Martinique and Guadeloupe) as a competitor of *Biomphalaria* spp., the intermediate snail hosts of schistosomiasis (Prentice, 1983; Pointier et al., 1989; Pointier and Guyard, 1992; Pointier and Jourdan, 2000).”

From Fofonoff et al. (2018):

“*Melanoides tuberculata* has been widely introduced in tropical America and the Caribbean, both as an aquarium release and as biocontrol for native snails hosting disease-causing trematodes. It was introduced [...] to Martinique in 1985 (Pointier et al. 2005), Dominica by 1975 (Reeves et al. 2008), Guadeloupe in 1979 (Pointier et al. 1993[a]) [...]. It was present and used to make ornaments in Veracruz, Mexico (Abbott 1973) and is now established in at least 12 Mexican states (Conteras-Arquieta 1998). *Melanoides tuberculatus* was collected in Panama by 1971, and in 1972, was collected from the bottom of the Miraflores Locks of the Panama Canal (USNM 734154, U.S. National Museum of Natural History 2013).”

“In South America, *M. tuberculata* was first reported from Venezuela in 1972 (Pointier et al. 1999), from Brazil in 1967 in Sao Paulo (Vaz et al. 1986, cited by Barroso and Matthews-Cascon 2009), and Argentina in 1999 (Peso et al. 2011). [...] Introductions are still occurring in the Eastern Hemisphere around the edges of its native range, including Spain (Oscos et al. 2009), Malta (Cilia et al. 2013) and New Zealand (Duggan 2002).”

From Albrecht et al. (2018):

“During the 20th century it was introduced, e.g. via rice cultivation, to many other regions [...].”

Short Description

From CABI (2023):

“*M. tuberculata* has a turreted shell with rounded body whorls that are ornamented with spiral grooves and sometimes axial undulating ribs well marked on the middle and upper whorls. The shells are pale to dark brown with numerous reddish brown flames and spots. However,

characteristics of the shell (general shape, background colour, ornaments and sculptures) can vary according to the morphs considered (Facon et al., 2003). The spire is usually twice the length of the aperture or more (Morrison, 1954). The aperture is oval-shaped and the operculum is paucispiral, with the nucleus near the base (Morrison, 1954; Thompson, 1984). The head is tongue-like and constricted on its ventral side to give rise to the foot. The tentacles arise from just above this constricted area and are long and slender.”

Biology

From Fofonoff et al. (2018):

“This snail has separate sexes, but reproduces primarily by parthenogenetic reproduction (without fertilization), with only occasional sexual reproduction, resulting in populations that are largely clonal (Samadi et al. 1999; Facon et al. 2008). Males were 20-33% of the populations in Israeli streams (Livshits and Fishelson 1983), but in other populations, males are rare or absent. Reproduction is ovoviviparous, with eggs being incubated in the female's brood pouch in the last (largest) whorl of the shell, and hatching out as small snails, 1.0 - 4.5 mm in length, with 3-6 shell whorls. The time of brooding and the size of the newborn snails decreased as the number of snails in aquaria increased. Annual fecundity is estimated at 365 embryos per year (Keller et al. 2007). The snails reach maturity at about 10-16 mm shell length, in about 3-7 months. [...] However, populations, even on small islands, such as Martinique, may vary considerably in life history patterns, as a result of multiple introductions, and occasional hybridization of mostly clonal lineages (Samadi et al. 1999; Facon et al. 2008).”

“*Melanoides tuberculata* grazes on microalgae and detritus, but does not feed on the leaves of larger plants (Miranda et al. 2012). It is eaten by crabs, fishes, and birds, as indicated by a diversity of parasites which use it as an intermediate host.”

From CABI (2023):

“Studies in Martinique and Guadeloupe Islands (Pointier et al., 1989, 1993[b]) allowed investigating life patterns of *M. tuberculata* under natural conditions. It showed that this snail has a demographic strategy characterized by a slow growth and a long life span (up to three years in some habitats). They revealed also that maximum reproduction took place during the rainy season between June and November (Pointier et al., 1993[b]), but reproduction did not completely stop during the dry season. [...] This species is active mostly at night, hiding beneath decaying plants and stones or burying themselves in the mud during the day (Livshits and Fishelson, 1983).”

From Daniel et al. (2019):

“Subpopulations may reach extremely high densities of 200-300 ind/m² in Lake Chad (Lévêque 1967) and up to 10,000 ind/m² (Pererea and Walls 1996) in sandy or gravelly sediments where the snails do not only live upon the surface but also in the top-layer (endobenthic).”

“The species feeds on microalgae and detritus (dead plants and animals).”

Human Uses

From Fofonoff et al. (2018):

“In some parts of the world, *M. tuberculata* has been introduced as a biocontrol agent to control native snails (*Biomphalaria* spp.) hosting trematodes causing schistosomiasis in humans. In Martinique, deliberate introductions of this snail (starting in 1973) resulted in the local extinction of [trematode-carrying] *B. glabrata* and great reductions of *B. straminea* (Pointier 2001). Similar introduction programs have been successful in St. Lucia (Prentice 1983, cited by Pointier et al. 1994), Guadeloupe (Pointier et al. 1993[a]), Venezuela (Pointier et al. 1994), and Minas Gerais, Brazil (Guimarães et al. 2001).”

“Ornamental: *Melanoides tuberculata* is a popular aquarium snail, often sold under the name 'Malaysian Trumpet Snail'.”

From Daniel et al. (2019):

“It is well known that this species is eaten by molluscivorous fish, such as some cichlid species and carp, but its use as a commercially interesting food source in fish farming requires confirmation. It is sometimes used in ethnic ornaments.”

Live *Melanoides tuberculata* can be found for sale extensively in the United States. For example, from Aquatic Arts (2023):

“Malaysian Trumpet AKA Red-Rimmed Melania Snail (*Melanoides tuberculata*) Bredby, Aquatic Arts \$7.99”

Diseases

***Melanoides tuberculata* has been documented as a carrier of white spot syndrome virus, a disease listed by the World Organisation for Animal Health (2023).**

From Bandeira et al. (2018):

“The present findings reveal that wild specimens of [...] *Melanoides tuberculatus* in the Paraíba River (Brazil) have white spot syndrome virus and these animals therefore play an important role in the maintenance of this agent in local shrimp production activities, acting as vectors and/or reservoirs of the virus in nature.”

From Derrai (2008):

“*M. tuberculata* is an intermediate host of a number of trematode parasites such as: *Paragonimus kellicotti* [Proctor and Gregory 1974; Madariaga et al. 2007]; the Chinese liver fluke *Clonorchis sinensis*, and the Oriental lung fluke *Paragonimus westermani* [Vaz et al. 1986; Guimarães et al. 2001]; the rat lung-worm *Angiostrongylus cantonensis* [Crook et al. 1968; Ibrahim 2007]; *Loxogenoides bicolor*, *Transversotrema laruei*, and *Stictodora tridactyla* [Ukong et al. 2007]; *Gastrodiscus aegyptiacus* [Mukaratirwa et al. 2004]; Oriental eye-fluke *Philophthalmus gralli* [Ismail and Arif 1993; Díaz et al. 2002; Mukaratirwa et al. 2005]; *P. distomatosa* [Radev et al.

2000]; *Haplorchis pumilio* [Díaz et al. 2002]; *Haplorchis* sp. [Dzikowski et al. 2003]; *Centrocestus formosanus* [Pointier 1999; Díaz et al. 2002; Levy 2004]; and *Centrocestus* sp. [Dzikowski et al. 2003; Ben-Ami and Heller 2005]”

From Mitchell et al. (2007):

“The snail transmits several trematodes directly to fish and indirectly to humans and birds (Abbott 1952; Dundee and Paine 1977; Nollen and Murray 1978; Mitchell et al. 2000). Some of these include the human liver fluke *Clonorchis sinensis*, the oriental lung fluke of humans *Paragonimus westermani*, the oriental eye fluke of birds *Philophthalmus gralli*, and the gill trematode of fishes *Centrocestus formosanus*. The gill trematode encysts in the gills of many fish species and has caused serious losses among commercially raised tropical fishes (e.g., cichlids, tetras, and tropical cyprinids) in Florida (Blazer and Gratzek 1985; Mitchell et al. 2005; data of W. K. Vogelbein and R. M. Overstreet presented at the International Association for Aquatic Animal Medicine Annual Conference, 1988).”

According to Poelen (2014), the following species have been reported as parasites of *Melanoides tuberculatus*: *Cercaria chackai*; *Cercaria cerasus*; *Philophthalmus*; *Transverso tremapatialense*; *Cercaria sagitta*; *Centrocestus formosanus*.

From Daniel et al. (2019):

“Red-rim melania is an intermediate host of *Paragonimus westermani*, (Oriental lung fluke), Metagonimus trematode, *Clonorchis sinensis* (Chinese liver fluke), *Opisthorchis sinensis*, *Philophthalmus* sp., and *Haplorchis* sp.”

Threat to Humans

From CABI (2023):

“Besides its positive consequences concerning schistosomiasis, *M. tuberculata* may play the role of intermediate host for several trematode parasites of medical or veterinary importance (Murray, 1971; Jacobson, 1975; Dundee and Paine, 1977).”

From Daniel et al. (2019):

“Other parasites have also been found associated with this snail which can infect humans (Mitchell et al. 2007).”

3 Impacts of Introductions

From Fofonoff et al. (2018):

“Competition: *Melanoides tuberculata* has a proven history of replacing some native snail species in tropical and subtropical environments, an ability that has been exploited in biocontrol programs to control snails which are hosts for schistosomiasis (Pointier et al. 1994; Guimarães et al. 2001; Pointier 2001). This competitive ability is a concern, when this snail invades water

bodies which contain rare native species. So far, impacts on native marine snails in Biscayne Bay [Florida] are limited, in part because this snail is concentrated in sites near the mouths of canals and other disturbed sites (Wingard et al. 2007). The central Texas springs invaded by *M. tuberculata* are habitat for a number of endemic and highly localized snail species, including *Elimia comalensis*, *Tryonia circumstriata*, *Pseudotryonia adamantia*, *Assiminea pecos*, and *Physella* spp. However, in some springs, high densities of native snails coexist with *M. tuberculata* (Karatayev et al. 2009; Ladd and Rogowski 2012). The exact mechanisms by which *M. tuberculata* displace other snail species has not been studied in detail; however, behavioral interference, food competition, and egg predation are possibilities (Ladd and Rogowski 2012)."

"Predation: Predation on egg masses is one possible means by which *M. tuberculata* displaces native snails. However, in experiments using eggs of *Physella* spp. from a Texas spring, predation rates were quite low (Ladd and Rogowski 2012). This snail did eat the egg masses of an endangered central Texas fish, *Etheostoma fonticola* (Fountain Darter), but at rates lower than those of most other native and introduced snails (Phillips et al. 2010)."

"Habitat Change: A novel effect of a freshwater snail invasion was observed in Tobago, where large shells of *M. tuberculata* and *Tarebia granifera* (Quilted Melania) were washed down streams into coastal waters during storms, providing a new empty-shell resource for hermit crabs (*Clibanarius tricolor* and *C. vittatus*) and drastically changing the patterns of shell use (van Oosterhout et al. 2013)."

"Parasite-Predator Vector: *Melanoides tuberculata* is a host to 37+ parasites in its native range and has been a vector for at least 3 trematodes (*Centrocestus formosanus*; *Haplorchis pumilio*; *Philophthalmus gralli*) which have been introduced to the Western Hemisphere, and the US, including central Texas. These parasites develop in snails, then fishes, with birds and mammals as their final hosts (Karatayev et al. 2009; Alves-Pinto et al. 2011). No harmful parasites were found in a survey of *M. tuberculata* in Biscayne Bay, Florida. However, the 3 introduced Asian trematodes, *C. formosanus* and *P. gralli* are found in *M. tuberculata* in central Texas springs and streams. *Centrocestus formosanus* infects the gills of fishes and can cause extensive fish mortality. This trematode is a threat to several local endemic fishes, including the endangered Fountain Darter (Karatayev et al. 2009; Ladd and Rogowski 2012)."

From CABI (2023):

"*M. tuberculata* has no negative impact on aquatic macrophytes (Madsen, 1992) although it has been reported to displace several gastropods where introduced (Murray, 1971; Jacobson, 1975; Pointier, 1999). Roessler et al. (1977) reported competition for trophic resources with *Neritina virginea* in Florida. *M. tuberculata* was also shown to outcompete *Biomphalaria glabrata* and *B. straminea* in Martinique and Guadeloupe Islands (especially in stable aquatic habitats) (Pointier and McCullough, 1989), and *B. havanensis* and *Pachychilus largillierti* in Honduras (Clarke, 1987)."

From Daniel et al. (2019):

“The introduction of this species in the Caribbean has affected the native hermit crab shell-use and behavior (van Oosterhout et al. 2013).”

The following U.S. States prohibit or regulate transportation, purchase, possession, sale, stocking, or cultivation of *Melanoides tuberculata*: Arkansas (AGFC 2022), North Carolina (NCDEQ 2022), South Dakota (SDGFP 2022), Utah (UDWR 2020), and Wisconsin (WDNR 2022).

4 History of Invasiveness

The History of Invasiveness for *Melanoides tuberculata* is classified as High. *Melanoides tuberculata* has established numerous populations outside its native range. There is clear, convincing, and reliable evidence of its ability to cause population declines in native snails. The species is also a host for multiple parasites that can infect humans and other native animals.

5 Global Distribution

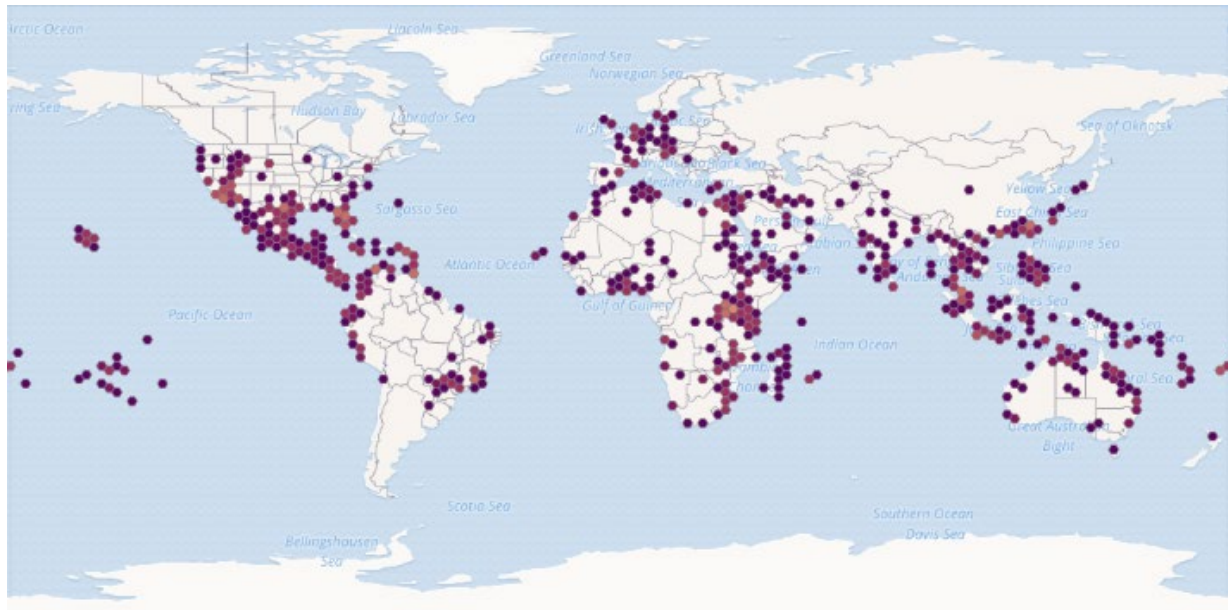


Figure 1. Reported global distribution of *Melanoides tuberculata*. Map from GBIF Secretariat (2023). Observations are reported from North America, northern South America, Africa, southern and southeastern Asia, and Oceania. Many temperate established populations were not included in selecting source locations for the climate matching analysis because these populations occurred in warm springs or artificially heated waters that do not reflect the prevailing climate, such as those populations in Colorado, Idaho, Montana, South Dakota, Utah, and Wyoming, USA; New Zealand; and Serbia (Rader et al. 2003; Duggan and Knox 2022; USGS 2024). Additionally, no information was found to confirm established populations of *M. tuberculata* in the United Kingdom, France, Belgium, the Netherlands, Germany, Switzerland, Italy, Austria, Czechia, Hungary, Sweden, Ukraine, Chile, Afghanistan, southern areas of Australia, Guam, Bermuda, or the U.S. States of North Carolina, South Carolina, New Jersey, Ohio, and Minnesota; occurrences in these locations were excluded from the selection of source points for climate matching. Exclusions from the climate matching analysis were also made for a country centroid in China and an occurrence with coordinate errors in northern India.

6 Distribution Within the United States



Figure 2. Reported distribution of *Melanoides tuberculata* in the United States. Map from USGS (2024). Established populations are shown in yellow and other occurrences are shown in orange. Only established populations were used to select source locations for the climate matching analysis. Established populations in Colorado, Idaho, Montana, South Dakota, and Wyoming were further excluded from the climate matching analysis because these populations occurred in warm springs or artificially heated waters that do not reflect the prevailing climate.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Melanoides tuberculata* in the contiguous United States was high along the Southern Atlantic and Gulf Coasts, throughout Texas into southern Oklahoma and southern and eastern New Mexico, throughout Arizona and much of California, southern Nevada, and on the Columbia Plateau in eastern Washington and Oregon. With the exception of the Columbia Plateau, *M. tuberculata* is already established in each of these areas. There were additional medium-high matches in the Great Basin, on the Colorado Plateau, and across the remainder of the Southern Plains. The climate match was medium in the southern Midwest, Great Lakes, and Mid-Atlantic regions, transitioning to low match in the Northeast and Northern Plains. Additional areas of low match occurred in the inland Southeast, along the Cascade Mountains, and in scattered areas of the Rocky Mountains. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.659, indicating that Yes, there is establishment concern for this species. The Climate 6 score is calculated as: (count of target points with scores ≥ 6)/(count of all target points). Establishment concern is warranted for Climate 6 scores greater than or equal to 0.002 based on an analysis of the

establishment success of 356 nonnative aquatic species introduced to the United States (USFWS 2024).

Projected climate matches in the contiguous United States under future climate scenarios are available for *Melanoides tuberculata* (see Appendix). These projected climate matches are provided as additional context for the reader; future climate scenarios are not factored into the Overall Risk Assessment Category.

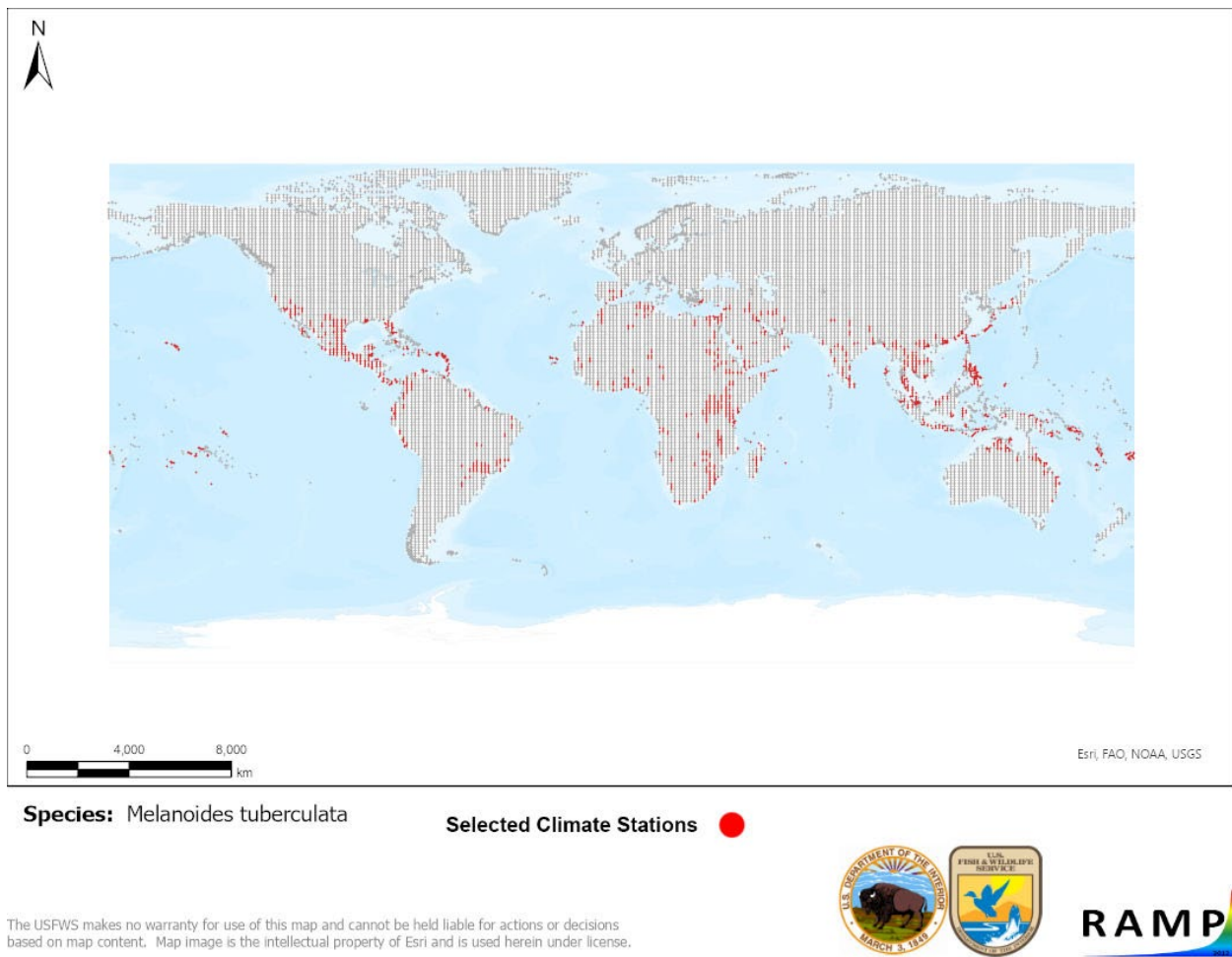


Figure 3. RAMP (Sanders et al. 2023) source map showing global weather stations selected as source locations (red; United States, Mexico, throughout Central America and the Caribbean, Colombia, Venezuela, Ecuador, Peru, Suriname, French Guiana, Brazil, Paraguay, Spain, throughout Africa, Turkey, the Arabian Peninsula, Israel, Syria, Iraq, Iran, India, China, Japan, throughout Southeast Asia, Papua New Guinea, Australia, islands throughout the southern Pacific Ocean) and non-source locations (gray) for *Melanoides tuberculata* climate matching. Source locations from GBIF Secretariat (2023). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

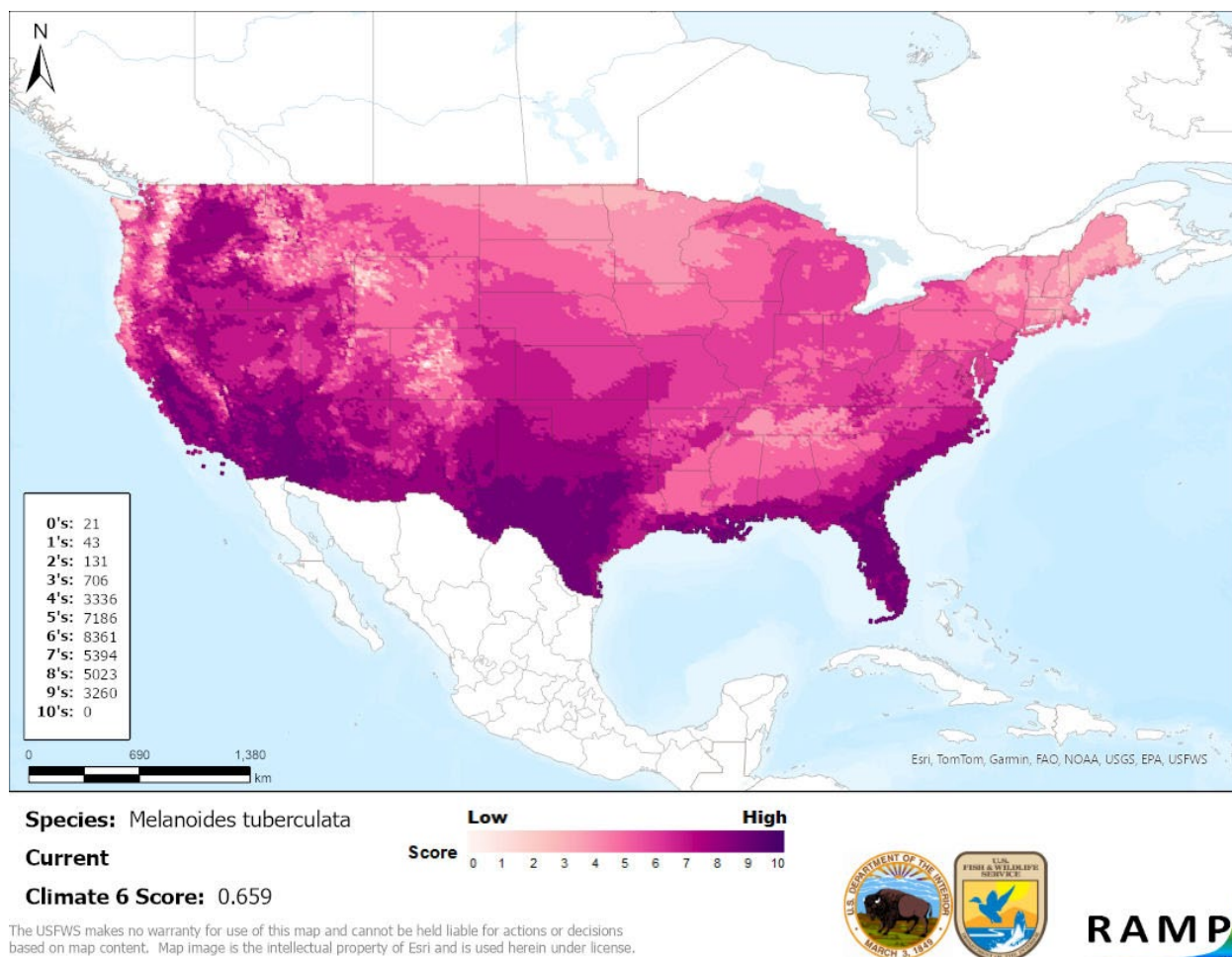


Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Melanoides tuberculata* in the contiguous United States based on source locations reported by GBIF Secretariat (2023). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Melanoides tuberculata* is classified as High. Abundant, clear, and convincing information is available about *Melanoides tuberculata*'s distribution and negative impacts of introduction from peer-reviewed scientific literature. The exclusion of some occurrences from the climate matching analysis due to their location within warm springs did not reduce the result of the climate matching analysis below the level where establishment concern is warranted.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Melanoides tuberculata, red-rimmed melania, is a mollusk that is native to much of Africa and southern Asia. The species has become established in North and South America, Europe, and Oceania, primarily through the aquarium trade and intentional introduction as biocontrol for the native snail hosts of trematodes that can cause schistosomiasis. In the United States, *M. tuberculata* is established along the Gulf Coast from Florida to Texas, in California, and in warm springs in the Interior West. Transport, possession, sale, stocking, or cultivation of *M. tuberculata* is regulated by at least five U.S. States. *M. tuberculata* has been responsible for declines in native snail populations in multiple locations in the Caribbean and Central America. The species is also a host for numerous parasites of significance to humans and other animals, including an endangered fish species. The History of Invasiveness for *M. tuberculata* is classified as High due to its successful establishment outside its native range and the clear, convincing, and reliable documentation of negative impacts of introduction. The climate matching analysis for the contiguous United States indicates establishment concern for this species. Areas with the highest climate match are in the coastal Southeast, Southwest, and California. The Certainty of Assessment for this ERSS is classified as High due to the availability of abundant, clear, and convincing information about *M. tuberculata*'s distribution and negative impacts of introduction from peer-reviewed, scientific literature. The Overall Risk Assessment Category for *M. tuberculata* in the contiguous United States is High.

Assessment Elements

- **History of Invasiveness (see section 4): High**
- **Establishment Concern (see section 7): Yes**
- **Certainty of Assessment (see section 8): High**
- **Remarks, Important additional information: *Melanoides tuberculata* has been documented as a carrier of white spot syndrome virus, a disease listed by the World Organisation for Animal Health.**
- **Overall Risk Assessment Category: High**

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Appendix

Summary of Future Climate Matching Analysis

Future climate projections represent two Shared Socioeconomic Pathways (SSP) developed by the Intergovernmental Panel on Climate Change (IPCC 2021): SSP5, in which emissions triple by the end of the century; and SSP3, in which emissions double by the end of the century. Future climate matches were based on source locations reported by GBIF Secretariat (2023).

Under the future climate scenarios (figure A1), on average, high climate match for *Melanoides tuberculata* was projected to occur in California, the Great Basin, Gulf Coast, Southern Atlantic Coast, Southern Florida, Southern Plains, and Southwest regions of the contiguous United States. These areas of high match were similar to those seen under current climate. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.675 (model: MPI-ESM1-2-HR, SSP5, 2085) to a high of 0.866 (model: MRI-ESM2-0, SSP5, 2085). All future scenario Climate 6 scores were above the Establishment Concern threshold, indicating that Yes, there is establishment concern for this species under future scenarios. The Climate 6 score for the current climate match (0.659, figure 4) falls below the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2085, the most extreme climate change scenario. Under the SSP5, 2085 scenario, areas within the Northern Plains saw a large increase in the climate match relative to current conditions; under other scenarios, there was a moderate increase in climate match in this region. Additionally, scattered areas within the Appalachian Range, Colorado Plateau, Great Lakes, Northeast, Northern Pacific Coast, and Western Mountains saw a moderate increase in the climate match relative to current conditions. Primarily at the 2085 time step, areas within the Appalachian Range, California, Gulf Coast, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, and Southwest saw a moderate decrease in the climate match relative to current conditions. No large decreases were observed regardless of time step and climate scenarios, although very small areas of large or moderate change may be visible on the maps (figure A3). Overall, more of the contiguous United States showed positive change in climate match under future climate scenarios than showed negative change.

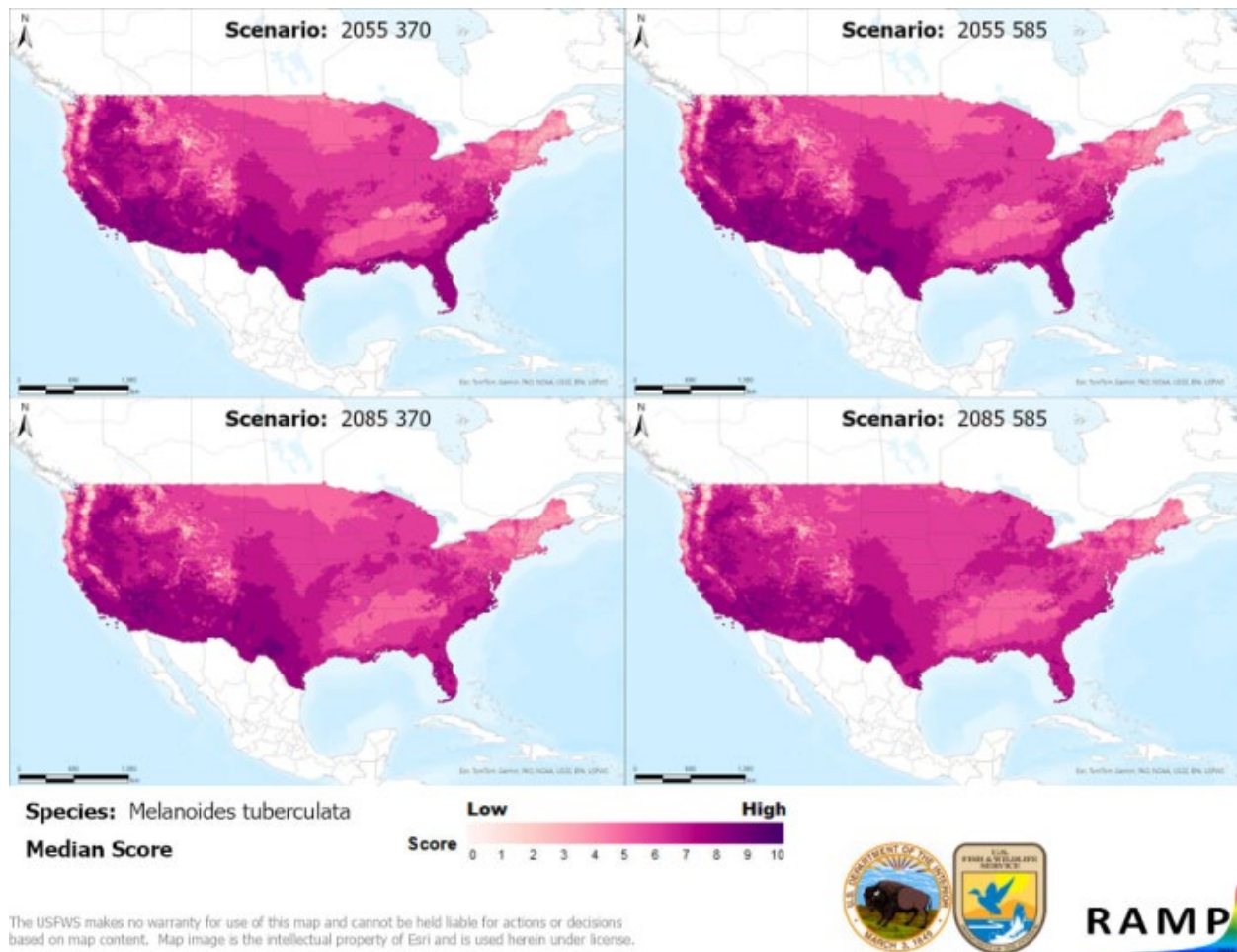


Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Melanoides tuberculata* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

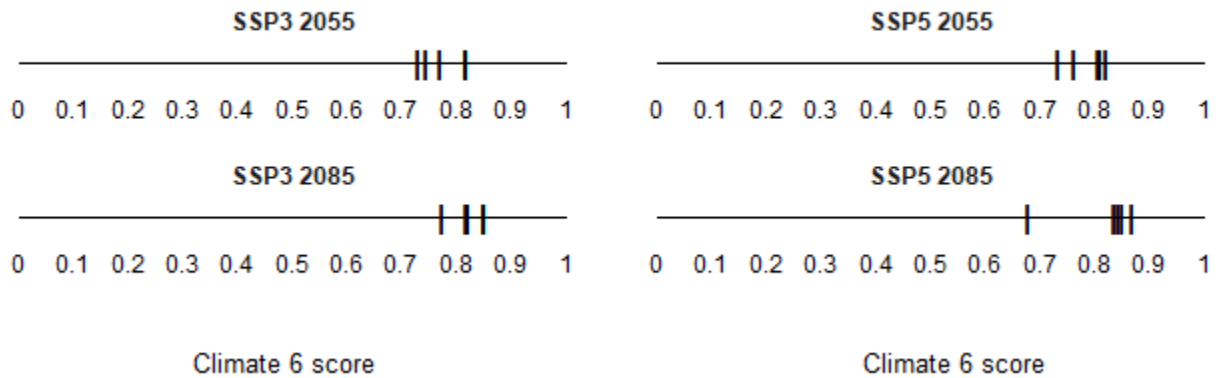


Figure A2. Comparison of projected future Climate 6 scores for *Melanoides tuberculata* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 2018; IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global climate models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0.

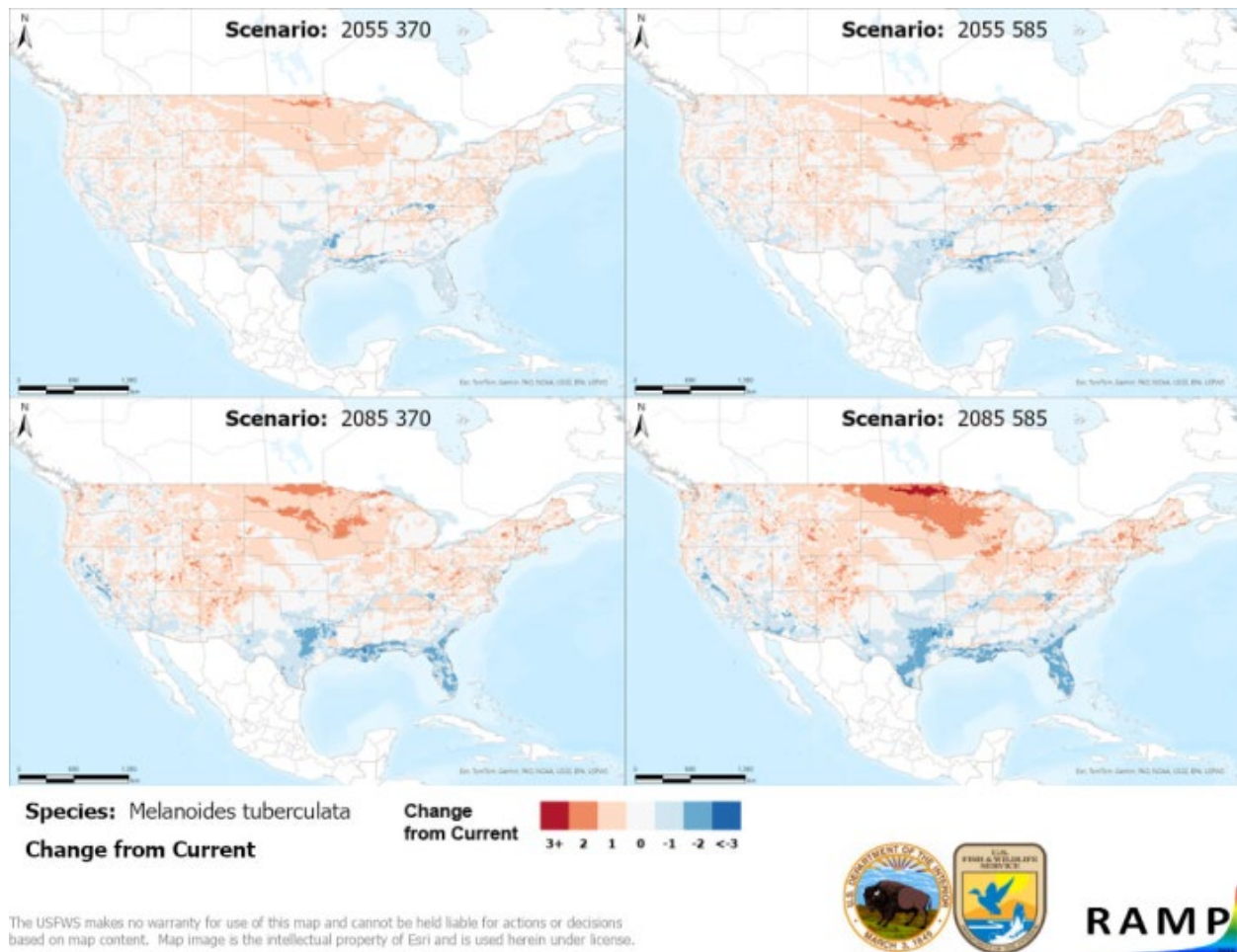


Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Melanoides tuberculata* based on source locations reported by GBIF Secretariat (2023). Shared Socioeconomic Pathways (SSPs) used (from left to right): SSP3, SSP5 (IPCC 2021). Time steps: 2055 (top row) and 2085 (bottom row). Climate source data from CHELSA (Karger et al. 2017, 2018); global models used: GFDL-ESM4, UKESM1-0-LL, MPI-ESM1-2-HR, IPSL-CM6A-LR, and MRI-ESM2-0. Shades of blue indicate a lower target point score under future scenarios than under current conditions. Shades of red indicate a higher target point score under future scenarios than under current conditions. Darker shades indicate greater change.

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