

Dice Snake (*Natrix tessellata*) Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, March 2022

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Organism Type: Reptile

Overall Risk Assessment Category: High



Photo: Andrei Daniel Mihalca. Licensed under Creative Commons Attribution-Share Alike 3.0 Unported. Available: https://commons.wikimedia.org/wiki/File:Natrix_tessellata_capturing_a_Gobius_fish_-_20060710.jpg. (January 2022).

1 Native Range and Status in the United States

Native Range

From Mebert et al. (2021):

“In Europe this species ranges from southern Switzerland and Germany (where it occurs both as isolated subpopulations considered to be relicts and as introduced populations - Speybroeck et al. 2016) eastwards into northern Austria, mainland Italy, Slovenia, the Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Ukraine and southern Russia, and southwards into Croatia (where both historical reports and recent sightings also exist from the offshore islands of Kirk and Cres but "have been debated"- Speybroeck et al. 2016), Bosnia-Herzegovina, Serbia and Montenegro, Macedonia, Albania and Greece (including the islands of Lesbos, Crete, Rhodes, Serifos and Samos, although it is otherwise absent from most Mediterranean islands). In northern Russia and Ukraine, it occurs as isolated relict subpopulations in warmer, hilly areas (Kotenko et al. 2011). A recent discovery has confirmed its occurrence on Cyprus (Göçmen and Merbert 2011).”

“Outside Europe the snake ranges from Turkey into Syria, Lebanon, Israel, Jordan and northern Egypt (the Nile Delta and lower Nile Valley), and eastwards through the Caucasus (Russia, Georgia, Armenia and Azerbaijan), Iran and Iraq, and Central Asia (Turkmenistan, Kazakhstan, Tajikistan, Uzbekistan, Krgyzstan and Afghanistan) to northwest China and northern Pakistan. It is apparently absent from the Arabian Peninsula, and with no confirmed records from the far north of Saudi Arabia bordering its Jordanian range (Egan 2007, Branch et al. 2008). A record from Yemen, based on a single juvenile specimen, is considered uncertain (Egan 2007), and may represent an erroneous locality (Branch et al. 2008, Merbert 2011). It was until recently known only from a historical report in Pakistan, but was recently rediscovered in this country (Masroor and Mebert 2012). Both known Pakistani localities lie within valleys in the western Karakorum range and it has been suggested that the snake may be confined to these refugia, which lie at the southeastern limit of its global range (Mebert et al. 2013).”

Status in the United States

A single individual was observed in a warehouse in Virginia in 1982 (Somma 2018).

From Somma (2018):

“Not established in the U.S.”

Natrix tessellata is in trade in the United States and can be found for sale in aquarium and pet stores.

From Underground Reptiles (2022):

“Dice Snake [*Natrix tessellata*]

From: \$39.99”

Means of Introductions in the United States

From Somma (2018):

“This single specimen was a waif introduced by overseas freight shipments (Mitchell, 1994).”

Remarks

No additional remarks.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2022):

“Current Standing: valid”

Kingdom Animalia

Subkingdom Bilateria

Infrakingdom Deuterostomia

Phylum Chordata

Subphylum Vertebrata

Infraphylum Gnathostomata

Superclass Tetrapoda

Class Reptilia

Order Squamata

Suborder Serpentes

Infraorder Alethinophidia

Family Colubridae

Subfamily Natricinae

Genus *Natrix*

Species *Natrix tessellata* (Laurenti, 1768)

Size, Weight, and Age Range

From Somma (2018):

“The length of this species is 610-1,371 mm (24-54 in) (Steward, 1971).”

Environment

From Somma (2018):

“The tessellated water snake is an aquatic snake (except when basking on land) [...]. They can be found in or near almost any aquatic habitat (Arnold and Burton, 1978; Street, 1979; Leviton et al., 1992; Arnold and Ovenden, 2002). Tessellated water snakes may bask in branches above water (Trutnau, 1986).”

From Mebert et al. (2021):

“It occurs from sea level up to 2,800 m asl.”

Climate

No information found on climate for *Natrix tessellata*.

Distribution Outside the United States

Native

From Mebert et al. (2021):

“In Europe this species ranges from southern Switzerland and Germany (where it occurs both as isolated subpopulations considered to be relicts and as introduced populations - Speybroeck et al. 2016) eastwards into northern Austria, mainland Italy, Slovenia, the Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Ukraine and southern Russia, and southwards into Croatia (where both historical reports and recent sightings also exist from the offshore islands of Kirk and Cres but "have been debated"- Speybroeck et al. 2016), Bosnia-Herzegovina, Serbia and Montenegro, Macedonia, Albania and Greece (including the islands of Lesbos, Crete, Rhodes, Serifos and Samos, although it is otherwise absent from most Mediterranean islands). In northern Russia and Ukraine, it occurs as isolated relict subpopulations in warmer, hilly areas (Kotenko et al. 2011). A recent discovery has confirmed its occurrence on Cyprus (Göçmen and Merbert 2011).

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Introduced

From Dubey et al. (2015):

“The piscivorous dice snake (*Natrix tessellata*) has been introduced to Geneva Lake, western Switzerland [...]”

“The dice snake (*Natrix tessellata*), a piscivorous colubrid from southern and eastern Europe, was introduced in 1925 and between 1950 and 1960 in northern riparian areas of Lake Geneva (Morton 1925, Metzger et al. 2011) [...]”

From Somma (2018):

“The only currently established, nonindigenous, European populations are north of the Alps in Switzerland (Arnold and Ovenden, 2002).”

Means of Introduction Outside the United States

From Mazza et al. (2011a):

“[...] voluntarily introduced [...]”

Short Description

From Somma (2018):

“The tessellated watersnake [*Natrix tessellata*] has strongly keeled dorsal scales, numbering 19 midbody rows, and a divided anal scale (Steward, 1971; Street, 1979; Leviton et al., 1992). The head may appear narrow and elongate (Arnold and Burton, 1978). Dorsal coloration varies from brown, gray-green, to olive, sometimes with a reddish tinge, with four or more longitudinal rows of dark brown or black squares or blotches; the blotches may unite across the dorsum to form crossbars (Arnold and Burton, 1978; Street, 1979; Trutnau, 1986; Arnold and Ovenden, 2002). The neck often has a distinct black chevron (Steward, 1971; Street, 1979; Arnold and Ovenden, 2002). Some individuals can have no markings or be completely black (Steward, 1971; Arnold and Burton, 1978; Street, 1979; Arnold and Ovenden, 2002). *Natrix tessellata* has 160-197 ventral scales, and 48-86 subcaudal scales (Leviton et al., 1992).”

Biology

From Mebert et al. (2021):

“This is a largely aquatic species associated with rivers, coasts, streams, lakes, ponds and the surrounding terrestrial habitat, including those in agricultural and other disturbed areas. It may be the most aquatic snake in Europe, with a preference for larger waterbodies than the related viperine snake (*Natrix maura*), and records exist of animals foraging along the shoreline at Trieste on the Black Sea coast (Speybroeck et al. 2016). It is active both diurnally and nocturnally, and can be almost fully nocturnal in southern parts of the range during the hottest months (Speybroeck et al. 2016). It occurs in some coastal areas along the Mediterranean, Black and Caspian Seas. It appears emerges from hibernation from the middle of March to the beginning of April through most of its range. The activity period typically lasting from March to October (Speybroeck et al. 2016). The species lays a clutch of between 5 and 37 eggs, with juveniles emerging in August or September (Speybroeck et al. 2016).”

From Mebert (2011a):

“The dice snake (*Natrix tessellata*) is known for its close association to water. Monitoring studies mostly located this species within 10 m of the water line (refs. in Gruschwitz et al. 1999). Concerning larger [*sic*] distances, Werner (1938) stated, that *N. tessellata* leaves the water only for hibernation, oviposition or for utilizing particularly suitable spots for thermoregulation.”

From Mebert (2011b):

“[...] due to their semi-aquatic habits dice snake rarely consume terrestrial prey, such as reptiles or mammals (see some refs. in Gruschwitz et al. 1999, Mebert 2011).”

From Dubey et al. (2015):

“Our study revealed that the invasive dice snake eats the recently introduced freshwater blenny in Lake Geneva (Raymond et al. 2010). Thus, this snake is able to switch very quickly to a new prey item, suggesting that it is opportunistic regarding diet.”

From Tuniyev et al. (2011):

“The majority of publications report that *Natrix tessellata* is characterized by diurnal activity (see refs. in Gruschwitz et al. 1999). Some publications presumed that this species aestivates in crevices and holes during hot and dry summer periods (e. g. Hecht 1930, Lenz & Gruschwitz 1993, Mebert 2007). However, nocturnal activity, as we have already reported from these snakes (Tunijev 2001), is a potentially overlooked behavior alternative to diurnal behavior during the hot summer season.”

“We conclude that nocturnal activity in *N. tessellata* is rather widespread, as we have observed them to be active at night up to 12 pm.”

From Somma (2018):

“Female tessellated watersnakes lay their flexible-shelled eggs on land in a moist sheltered environment such as loose soil beneath objects, rotting vegetation, anthropogenic refuse, and crevices of stone walls (Steward, 1971; Street, 1979; Arnold and Ovenden, 2002).”

Human Uses

From Mebert et al. (2021):

“In Egypt, Syria and Iraq this species is collected in large numbers for the international pet trade (S. Baha El Din pers. comm., K. Mebert pers. comm. 2013, Mebert 2011 and refs therein).”

From Shehab et al. (2011):

“These snakes [*Natrix tessellata*] are sold for about 2 US\$ a piece as “aquarium” animals. They are sent to Turkey and Europe by buses and other land transport as indicated by customs officers on the borders.”

From Somma (2018):

“In Europe, *N. tessellata* are commonly kept by snake hobbyists (Trutnau, 1986; Mattison, 1987, 1992; Arnold, 1995).”

Diseases

No records of OIE-reportable diseases (OIE 2022) were found for *Natrix tessellata*.

According to Poelen et al. (2014) *Natrix tessellata* can be the host to the following parasites: *Telorchis assula*, *Serpentirhabdias fuscovenosa*, *Eustrongylides excisus*, *Ophiotaenia europaea*, and *Hexametra quadricornis*.

In addition to the diseases and parasites listed above, WoRMS (2022) lists the following as parasites of *Natrix tessellata*: *Alaria alata*, *Codonocephalus* sp., *Strigea strigis*, and *Telorchis ercolanii*.

Threat to Humans

No information found on threats to humans from *Natrix tessellata*.

3 Impacts of Introductions

From Dubey et al. (2015):

“Local, dramatic declines in the viperine snake population might be associated with the appearance of the dice snake through dietary overlap between these 2 species, which mainly feed on bullhead (*Cottus gobio*). In response to this decline, a control program for dice snake was implemented in 2007 to reduce numbers of this introduced snake.”

“Since 1999, declines of the large viperine snake [*Natrix maura*] population have been documented and these declines might be associated with the presence of the dice snake (Metzger et al. 2009, 2011; Mazza et al. 2011[b]). Indeed, the trophic niche overlap between the 2 species is very significant (75–95%; Metzger et al. 2009, Mazza et al. 2011[b]), with the majority of prey eaten by both species being the European bullhead (*Cottus gobio*).”

“Body condition of viperine snakes also responded positively to removal of dice snakes, which suggests that the control program benefits this endangered species.”

From Mazza et al. (2011a):

“Later, a study summarizing observations from 1996 to 2006, clearly showed a major reduction of the viperine snake population and a simultaneous increase of the dice snake numbers (URSENBACHER et al. 2006).”

“One important factor differentiating the two species’ [*N. maura* and *N. tessellata*] habitat is the orientation of the shores. It seems that the dice snake prefers southern orientation. We suggest that this species is comparatively more thermophilic and, hence, occupies habitat segments with a more direct solar radiation. [...] However, the viperine snake [*N. maura*], which approaches its northern limit in Switzerland, obviously inhabits also these more thermophilic habitat [*sic*], if the alien species [*N. tessellata*] would not be present, thus indicating a possible effect of competitive exclusion or displacement.”

From Metzger et al. (2009):

“Introduction in the 1920s (Morton, 1925) and subsequent decades (J. Garzoni, pers. comm.) of the Dice snake (*Natrix tessellata*), [...] to the riparian land of Lake Geneva was pointed out as the probable reason for the strong decline of the native Viperine snake (average decline of the estimated population size of the Viperine snake, *Natrix maura*, since 1996: -4.4% per year, Ursenbacher et al., submitted [no date]; see also Kooler and Ursenbacher, 1999; Monney, 2004; Ursenbacher and Monney, 2007, 2008).”

4 History of Invasiveness

Natrix tessellata was introduced to Lake Geneva, Switzerland and has now become established. Since then, the population of native *Natrix maura* (viperine snake) has dramatically declined. Various authors have put forth that the decline in *N. maura* is due to the simultaneous increase in *N. tessellata* and a few correlative mechanisms have been demonstrated. *N. tessellata* has been documented in trade but there was no information found regarding the duration or volume of this trade. The History of Invasiveness is classified as High due to the impacts on the native *N. maura*.

5 Global Distribution

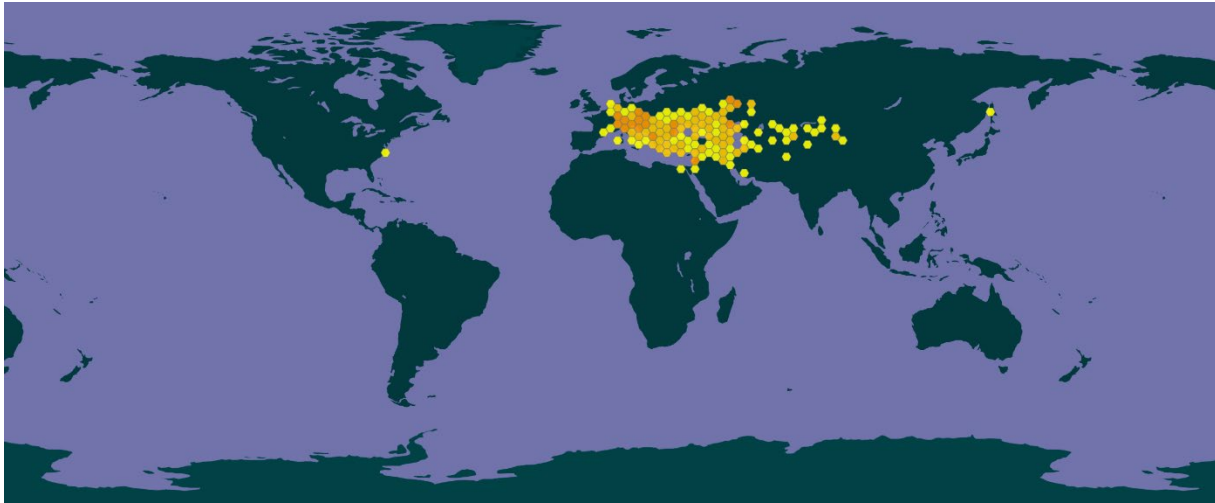


Figure 1. Map of global distribution of *Natrix tessellata*. Map from GBIF Secretariat (2022). Source points within the United States and Russia were not used in climate match as no evidence of establishment could be found for these areas.

6 Distribution Within the United States

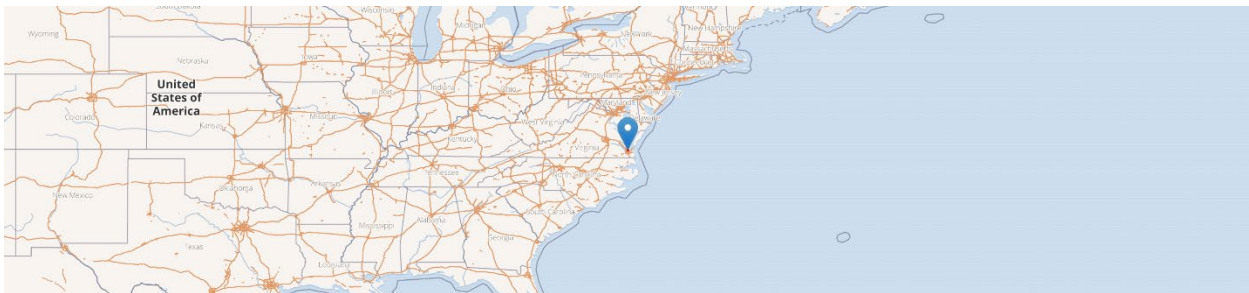


Figure 2. Map of *Natrix tessellata* observation in the United States. Map from GBIF Secretariat (2022). This location was not used as a source point in the climate match; the introduction did not result in an established population.

7 Climate Matching

Summary of Climate Matching Analysis

The climate match for *Natrix tessellata* was generally high for the majority of the contiguous United States. Small areas of low match were found along the Pacific Coast from the Olympic Peninsula to northern California. There were also areas of low match in the Cascade and Sierra Nevada Mountain ranges. Southwestern Arizona had a medium match and there was a larger area of medium match in the southeast from eastern Texas to North Carolina. The overall Climate 6 score (Sanders et al. 2021; 16 climate variables; Euclidean distance) for the contiguous United States was 0.925, High (Scores of 0.103 and greater are classified as High). All States had

a High individual Climate 6 score except for Florida, which had a Medium individual Climate 6 score.

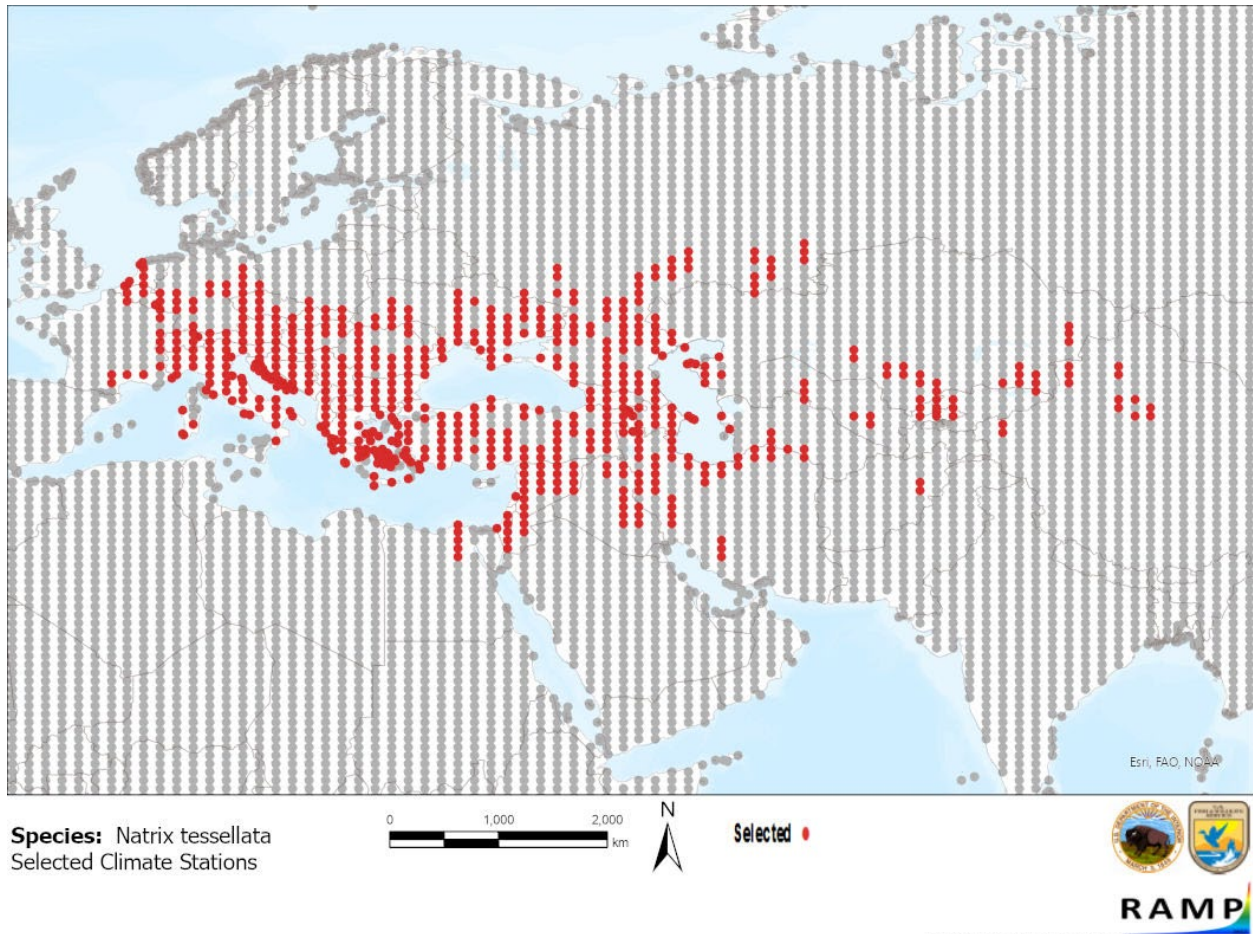


Figure 3. Map of RAMP (Sanders et al. 2021) showing weather stations in Europe and Asia selected as source locations (red; Europe, Asia, Middle East, Africa) and non-source locations (gray) for *Natrix tessellata* climate matching. Source locations from GBIF Secretariat (2022). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

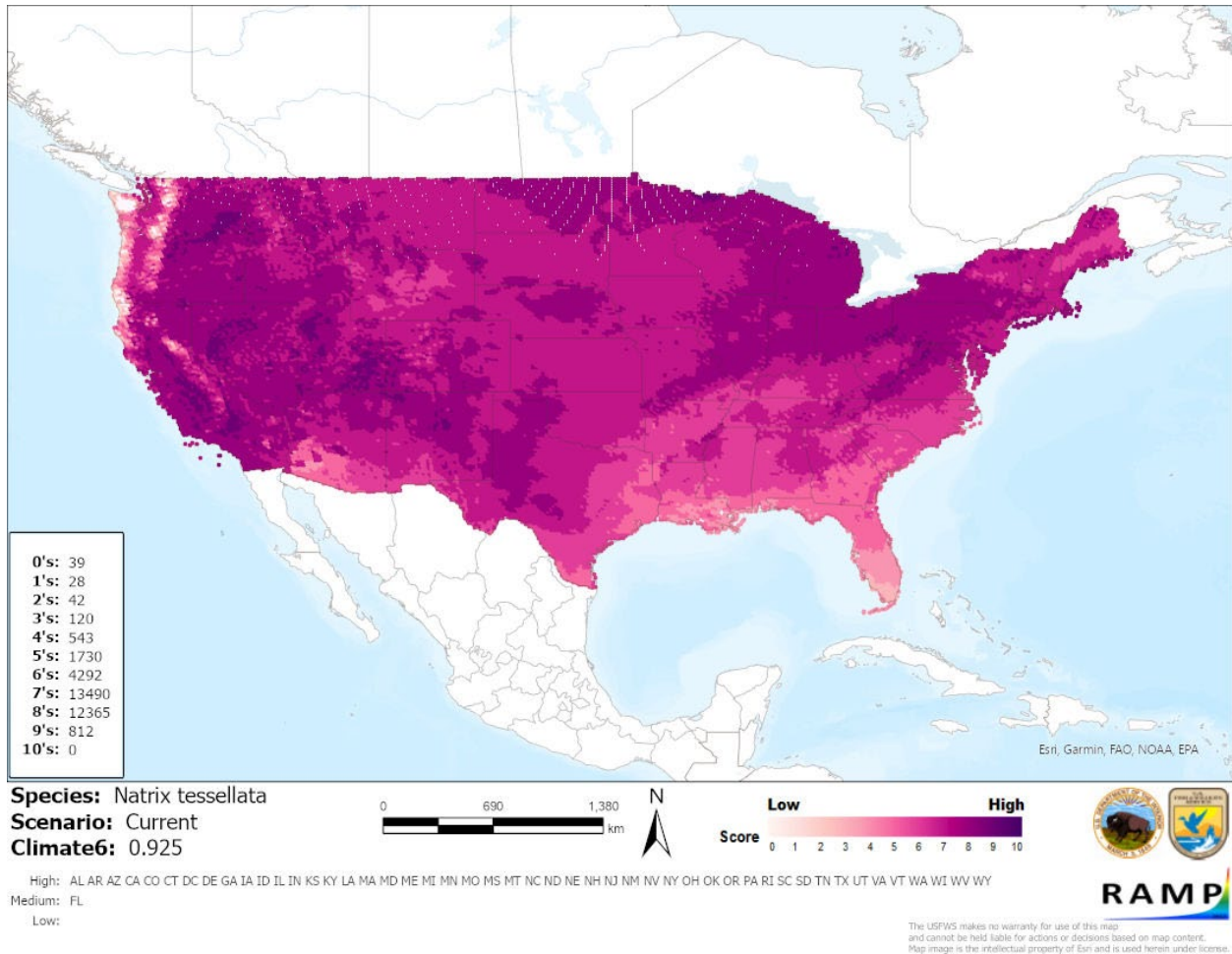


Figure 4. Map of RAMP (Sanders et al. 2021) climate match for *Natrix tessellata* in the contiguous United States based on source locations from GBIF Secretariat (2022). Counts of climate match scores are tabulated on the left. 0/Light Pink = Lowest match, 10/Dark Purple = Highest match.

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
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

8 Certainty of Assessment

The Certainty of Assessment is Medium. There is quality information available about the biology and ecology of *Natrix tessellata*. Records of introduction and establishment were found. Information was available regarding impacts of introduction. Information on impacts was from peer-reviewed sources and provided substantial evidence for mechanisms of impact, although the

authors refrained from definitive statements of cause and effect. The certainty is reduced to medium for that reason.

9 Risk Assessment

Summary of Risk to the Contiguous United States

The dice snake (*Natrix tessellata*) is a largely aquatic snake associated with rivers, coasts, streams, lakes, ponds, and the surrounding terrestrial habitat. It is widely distributed across Europe and ranges into the Middle East and Asia. This species is in trade, although there is limited information about the volume of trade. *N. tessellata* has been introduced and become established along Lake Geneva, Switzerland. The introduction of *N. tessellata* is linked to the reduced abundance and lower body condition of the native *N. maura*. The History of Invasiveness is classified as High. The Overall Climate Match for the contiguous United States was High. The majority of the contiguous United States had high local matches. There were some small areas of low match in the Northwest and areas of medium match in the southwest and southeast. The Certainty of Assessment is Medium due to a lack of definitive statements in the impact information. The Overall Risk Assessment Category is High.

Assessment Elements

- **History of Invasiveness (Sec. 4): High**
- **Overall Climate Match Category (Sec. 7): High**
- **Certainty of Assessment (Sec. 8): Medium**
- **Remarks/Important additional information: No additional remarks**
- **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.

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11 Literature Cited in Quoted Material

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