Chameleon Goby (*Tridentiger trigonocephalus*)
Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, December 2023
Revised, January 2024
Web Version, 5/19/2026

Organism Type: Fish
Overall Risk Assessment Category: Uncertain



Photo: U.S. Geological Survey. Public Domain. Available: https://commons.wikimedia.org/wiki/File:T.trigonocephalus.jpg (December 2023).

1 Native Range and Status in the United States

Native Range

From Maddern (2014):

"*T. trigonocephalus* is native to Russia (eastern Siberia), Japan, Taiwan, China (including Hong Kong) and the Korea Republic (Ni and Kwok, 1999; Froese and Pauly, 2014; NIMPIS, 2014)."

From Froese and Pauly (2023):

"Western Pacific: South and East China, Yellow Sea and the Sea of Japan, Pacific coasts of Japan and the Philippines. Chromi Inlet in the Amur Estuary, Novgorodskaya Cove in the Bay of Pos'ete, and into the mouths and lower reaches of rivers runnning into Peter the Great Bay and into Amur Bay in Russia (Reshetnikov et al. 1997)."

Additionally, Fricke et al. (2023) report *T. trigonocephalus* as native to northern Vietnam.

Status in the United States

From Nico et al. (2023):

"Established in California. Recently, chameleon goby populations in San Francisco Bay have plummeted, possibly because of predation by yellowfin gobies (Meng et al. 1994)."

From Maddern (2014):

"Nonindigenous populations of *T. trigonocephalus* were first observed in California, USA, in 1960. The species was first recorded in Los Angeles Harbor (Haaker, 1979; Eschmeyer et al., 1983; Matern and Fleming, 1995) and, two years later, in the Redwood City docks, in the southern portion of San Francisco Bay (Matern and Fleming, 1995). *T. trigonocephalus* also occurs in Lake Merritt in Oakland, which is connected to San Francisco Bay (Courtenay et al., 1986). Its presence was noted in San Diego Bay in 1995 and 1998 (Pondella and Chinn, 2005)."

From Fofonoff et al. (2018):

"Between 1978 and 1992 specimens were collected along the coast of southern California from Ventura to Laguna (USGS Nonindigenous Aquatic Species Program 2014), and a few have been found in San Diego Bay (Pondella and Chin 2005). […] This fish appears to be established in San Diego Bay, but is rare (Williams et al 2016). It has been collected in the brackish Napa River at a salinity of 16 PSU (2001, California Academy of Sciences 2009)."

No records of *T. trigonocephalus* in live trade in the United States were found.

Regulations

Tridentiger trigonocephalus is regulated at the family level (Gobiidae) in Hawaii (HDOA 2019) and New Mexico (NMDGF 2023). Please refer back to state agency regulatory documents for details on the regulations, including restrictions on activities involving this species. While effort was made to find all applicable regulations, this list may not be comprehensive. Notably, it does not include regulations that do not explicitly name this species or its genus or family, for example, when omitted from a list of authorized species with blanket regulation for all unnamed species.

Means of Introductions within the United States

From Nico et al. (2023):

"The initial introduction may have been as fertilized eggs on introduced Japanese oysters (Courtenay et al. 1984, 1986, 1991) or from ballast water (Eschmeyer et al. 1983)."

From Maddern (2014):

"*T. trigonocephalus* can also be translocated and accidentally released due to fisheries/aquaculture-related activities (NIMPIS, 2014)."

Remarks

This ERSS was previously published in October 2012. Revisions were completed to incorporate new information and conform to updated standards.

From Nico et al. (2023):

"Some reports in the literature referring to *T. trigonocephalus* collections made in freshwater in California (i.e., Raquel 1988; Meng et al. 1994) should actually refer to *T. bifasciatus* (Matern and Fleming 1995). […] *Tridentiger trigonocephalus* is more common in marine environments than is *T. bifasciatus*; it is rarely found in salinities less than 22 ppt. (Matern and Fleming 1995; Fleming, personal communication)."

From Boltachev and Karpova (2014):

"The information about the records of chameleon goby near the coast of Turkey (Shiganova and Öztürk, 2010) is not true because the authors cited the publication by Boltachev (2009), where the species was not mentioned at all."

According to Larson (2021), other common names for this species include Japanese Goby, Striped Tripletooth Goby, and Trident Goby. These alternative common names were used to search for information for this report.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2023):

Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Gobioidei
Family Gobiidae
Genus *Tridentiger*
Species *Tridentiger trigonocephalus* (Gill, 1859)

According to Fricke et al. (2023), *Tridentiger trigonocephalus* (Gill 1859) is the current valid name for this species.

The following synonyms of *Tridentiger trigonocephalus* from Fricke et al. (2023) were used to search for information for this report: *Amblygobius shatinensis, Gobius fasciapectoralis*, *Triaenophorichthys taeniatus, Triaenophorus trigonocephalus*, *Tridentiger genimaculatus, Tridentiger marmoratus,* and *Trifissus ioturus*.

Size, Weight, and Age Range

From Nico et al. (2023):

"Size: 11 cm."

"Chameleon gobies reach maturity in 1 year, with a maximum life span of 3 years (Dotu 1958)."

From Maddern (2014):

"Adults may grow up to 120 mm."

Environment

From Fofonoff et al. (2018):

"It is rare at salinities below 22 PSU (Fuller et al. 1999), but has been collected at 16 PSU (California Academy of Sciences 2009)."

According to Larson (2021), the depth range for *Tridentiger trigonocephalus* is 0–14 meters.

Maddern (2014) states that the salinity tolerance for this species is 3.1–35ppt but optimum range is 22–35ppt, water pH is 7.5 to 9.5, and water temperature tolerance is 5–34.8°C with optimal range being 18–26°C.

Climate

From Froese and Pauly (2023):

"Temperate; […] 53°N - 32°N, 114°E - 146°E"

From Fofonoff et al. (2018):

"*Tridentiger trigonocephalus* (Chameleon Goby) ranges from cold-temperate to tropical climates in coastal marine waters (Froese and Pauly 2018)."

Distribution Outside the United States

Native

From Maddern (2014):

"*T. trigonocephalus* is native to Russia (eastern Siberia), Japan, Taiwan, China (including Hong Kong) and the Korea Republic (Ni and Kwok, 1999; Froese and Pauly, 2014; NIMPIS, 2014)."

From Froese and Pauly (2023):

"Western Pacific: South and East China, Yellow Sea and the Sea of Japan, Pacific coasts of Japan and the Philippines. Chromi Inlet in the Amur Estuary, Novgorodskaya Cove in the Bay of Pos'ete, and into the mouths and lower reaches of rivers running [sic] into Peter the Great Bay and into Amur Bay in Russia (Reshetnikov et al. 1997)."

Additionally, Fricke et al. (2023) report *T. trigonocephalus* as native to northern Vietnam.

Introduced

From Maddern (2014):

"*T. trigonocephalus* has also been introduced to Israel (Goren et al., 2009) and Ukraine (Boltachev and Karpova, 2010)."

"In Australia, *T. trigonocephalus* was first discovered in Sydney harbour in 1971. It was subsequently found in the Swan River, Perth, in 1976, and in Melbourne harbour/Port Phillip Bay in 1977. The species has also been recorded from Port Kembla, New South Wales and, more recently, it has been found in South Australia (Hammer, 2006)."

From NIMPIS (2026):

"Australian distribution: Established"

From Fofonoff et al. (2018):

"In 2006, a single specimen of *T. trigonocephalus* was collected in Sevastopol Bay, Ukraine, on the Black Sea (Boltachev et al. 2007). That same year, 2006, one specimen was collected in the Mediterranean Sea (Goren et al. 2009). In 2008, 17 individuals with eggs and nests were found in Sevastopol Bay, indicating an established population (Boltachev and Karpova 2010)."

No information was found to confirm the establishment status of *T. trigonocephalus* in Israel.

Means of Introduction Outside the United States

From Maddern (2014):

"Ballast water from international bulk-cargo vessels containing eggs/fish, and/or translocation amongst fouling organisms on vessel hulls, are considered the most likely introduction vectors."

“It is likely that it was accidentally introduced to Australia via ship ballast water, and it has since been introduced several times by ships from Japan or Taiwan (Hoese, 1973; Pollard and Hutchings, 1990; Bray, 2011).”

“*T. trigonocephalus* can also be translocated and accidentally released due to fisheries/aquaculture-related activities (NIMPIS, 2014).”

From Boltachev and Karpova (2014):

“The most probable vector of the species introduction [to Sevastopol Bay, Black Sea] is the introduction as a result of sorting or quality control, because at the beginning of the 1980s several dozen chameleon gobies were brought from Posyet Bay (Far East) as decorative fishes for the Sevastopol Aquarium, but because of the absence of spectacular coloration, the fish were released alive into Sevastopol Bay and probably were the base for the formation of a local independent population.”

Short Description

From Maddern (2014):

“*T. trigonocephalus* is a small grey-brown goby, with two characteristic black stripes: one running from just above the eye to the tail fin and the second from the snout, through the eye, and along the upper portion of the pectoral to tail fin. The species can mask the black stripes by changing colour to a motley grey-brown, and the stripes are usually absent in larger fish above 9 cm. The head is covered in white speckles. There are two dorsal fins which have brown horizontal stripes and scattered white spots. The anal fin has a grey to orange stripe along the middle and the caudal fin is often covered with wavy brown vertical bars and scattered white spots.”

“The head is depressed and much broader than it is deep, with a broad interorbital space and a large mouth. The mouth is oblique, large, rear end of jaws below middle of eyes in young, below posterior quarter of eyes in adults. One pore by each nostril, two pores between front of eyes, median pore between rear end of eyes, pore behind upper quarter of each eye and pore behind middle of each eye; pore above rear end of preopercles, short detached tube, with pore at each end above each operculum and three preopercular pores on each side; gilt openings restricted to pectoral fin bases; tongue tip rounded. Two dorsal fins: first dorsal fin low with rounded margin, originating above and just behind ventral fin insertions; second dorsal fin origin just behind first dorsal fin; anal fin origin below and just behind second dorsal fin origin; caudal fin margin rounded. Pectoral fins with tips of upper two rays free from membrane, margin of fin rounded. Pelvic fins fused to form cup-shaped disc, originating below and just behind pectoral fin insertions.”

“Meristic features: dorsal fin VI, I, 12-13; anal fin I 10-11; caudal fin 17; pectoral fin 18-22; pelvic fin I, 5. Top of head scaled to behind eyes, 19-21 transverse rows of scales before first dorsal fin origin, rest of head without scales; body scales ctenoid, except on belly, in 45-55

vertical rows; pectoral fin bases and area before ventral fins scaled. There are 56 scales along the lateral line."

From Nico et al. (2023):

"This goby gets its name from its ability to rapidly change colors from a striped to a barred pattern (Eschmeyer et al. 1983)."

From Froese and Pauly (2023):

"Dorsal spines (total): 7; Dorsal soft rays (total): 12-14; Anal spines: 1; Anal soft rays: 10 - 11."

Biology

From Froese and Pauly (2023):

"Found in oyster shells and crevices among barnacles and other fouling organisms (Eschmeyer et al. 1983). Oviparous (Breder and Rosen 1966)."

From Nico et al. (2023):

"Chameleon gobies are benthic omnivores, similar to other goby species in California, primarily consuming amphipods, polychaete worms, and hydrozoans (Kwak et al. 2004)."

"Spawning of chameleon gobies in California generally occurs from May through September (Haaker 1979; Wang 2011). Males construct and guard nests in hard substrates such as clam/oyster shells or crevices in jetties, and opportunistically in discarded cans and bottles (Haaker 1979; Wang 2011)."

From GISD (2023):

"Chameleon goby […] lives in shallow water on (or near) the bottom, under rocks, in burrows, or in crevices (NIMPIS 2006). This bottom dweller may find a home in seagrass meadows (Kwak [et al. 2004])."

"[…] Eggs take nine to 10 days to hatch. Females are able to spawn up to 10 times within a breeding season, which is from March through to November in the USA (FishBase 2006). In Japan, temperatures during the breeding season are between 18°C to 26°C."

"The Chameleon goby mostly takes its prey from within the sediment and may consume large numbers of polychaetes, feeding mainly at night (Kwak [et al. 2004]). Stomach contents have also been found to include crab larvae and caprellid amphipods (Kwak [et al. 2004])."

From Inui et al. (2010):

"The spawning sites of […] *T. trigonocephalus* [in the Ikisan River estuary, Kyushu, Japan] were found to be near the river mouth […]"

"[…] *T. trigonocephalus* spawned downstream, and the nest abundance of each of these species was positively correlated with the density of bivalve shells […]"

From Maddern (2014):

"Natural dispersal of *T. trigonocephalus* is most likely to occur during the planktonic larval stage. Adults are benthic and sedentary, and are therefore less likely to travel large distances unaided. Water currents/tidal regimes may assist the dispersal of larvae and adults."

Human Uses

From Larson (2021):

"It was listed as a component of the marine ornamental trade (Rhyne et al. 2015), but no further information is available."

Diseases

No information was found associating *Tridentiger trigonocephalus* with any diseases listed by the World Organisation for Animal Health (2023).

Poelen et al. (2014) list *Micracanthorhynchina dakusuiensis* as a parasite of *Tridentiger trigonocephalus.*

Threat to Humans

From Froese and Pauly (2023):

"Harmless"

3 Impacts of Introductions

From Nico et al. (2023):

"The impacts of this species are currently unknown, as no studies have been done to determine how it has affected ecosystems in the invaded range. The absence of data does not equate to lack of effects. It does, however, mean that research is required to evaluate effects before conclusions can be made."

The following quotation describes **potential** impacts of introduction from *Tridentiger trigonocephalus*.

From Maddern (2014):

"Potential impacts of introductions include competition for resources (food and habitat) with native species, although they have not been documented."

“Empirical research clearly outlining impacts of *T. trigonocephalus* on invaded ecosystems is lacking, and specific impact mechanisms have not been researched. However, resource competition for food and habitat with native species are likely to occur. As *T. trigonocephalus* is carnivorous, as are many gobiids, there is the potential for it to compete for food resources with indigenous gobiids. Furthermore, because the species has specific habitat requirements (i.e. use of hard substrates), it is likely to compete with indigenous species with similar habitat requirements (NIMPIS, 2014).”

“Introduced populations of *T. trigonocephalus* in Australia and the USA have persisted, although not thrived (Lockett and Gomon, 2001). In Australia, the species has not expanded its distribution from rocky/hard substrates or anthropogenically-modified habitats in ports and harbours and, in the Swan River estuary, it is rare (Gill and Potter, 1993). Thus, potential impacts on ecosystems are likely to be less than those observed for highly successful introduced gobiids with large ranges, such as e.g. *Acentrogobius pflaumii* (Lockett and Gomon, 2001; Maddern and Morrison, 2008).”

Tridentiger trigonocephalus is regulated in Hawaii (HDOA 2019) and New Mexico (NMDGF 2023). See section 1.

4 History of Invasiveness

The History of Invasiveness for *Tridentiger trigonocephalus* is classified as Data Deficient. There are records of nonnative introductions into the United States, Australia, and Ukraine that have resulted in established populations. However, there is no clear, convincing, and reliable information on impacts of introductions.

5 Global Distribution



Figure 1. Reported global distribution of *Tridentiger trigonocephalus*. Map from GBIF Secretariat (2023). Observations are reported from United States (California), Australia, China, Taiwan, Japan, the Republic of Korea, Vietnam and Georgia. The occurrence in Georgia was not used to select source points for climate matching because this location was not confirmed as an established population.

No georeferenced occurrences were available for parts of the native range of *T. trigonocephalus* in the Philippines or eastern Russia.

Additional points in Ukraine were included in the climate matching analysis based on information provided by Slynko et al. (2020).

6 Distribution Within the United States

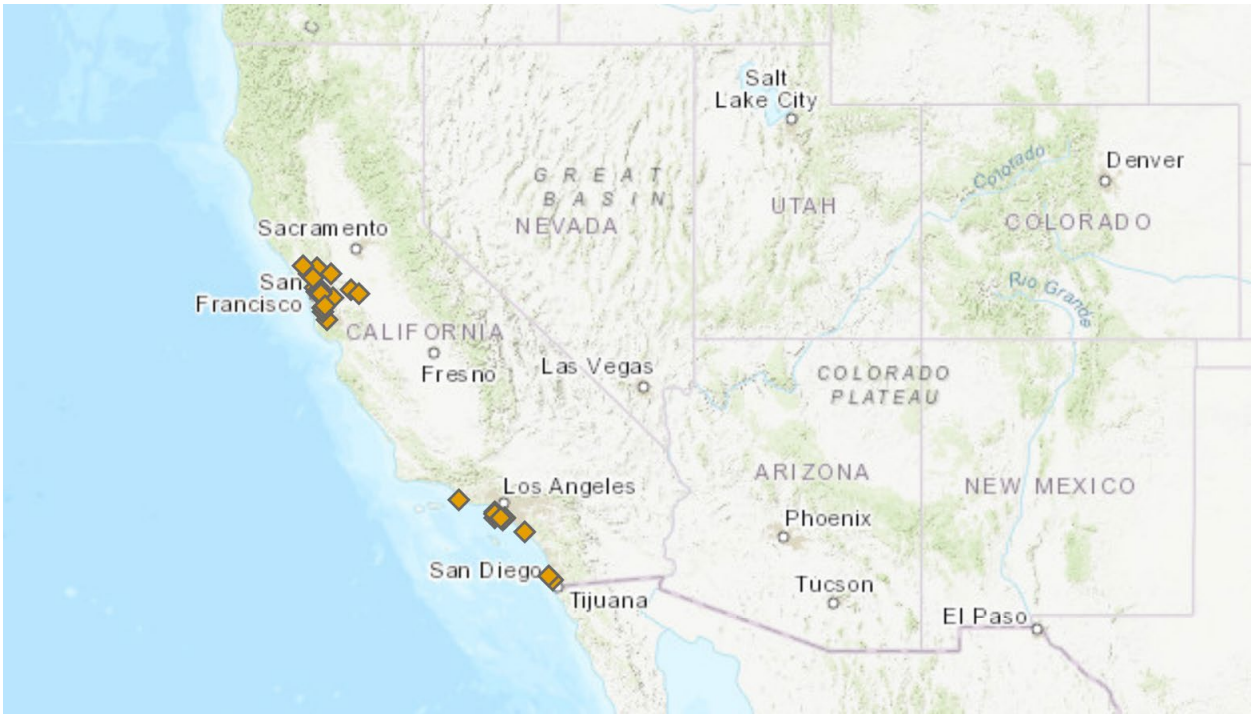

Figure 2. Reported distribution of *Tridentiger trigonocephalus* in the United States. Map from Nico et al. (2023). Observations are reported from California and represent established populations.

7 Climate Matching

Summary of Climate Matching Analysis

Note: The following climate match does not account for salinity tolerance. Species establishment will require both a suitable climate and the availability of aquatic habitat with appropriate salinity (see Environment, above). The climate match for *Tridentiger trigonocephalus* to the contiguous United States was highest in central and southern California where this species is currently established. Other areas of high match included peninsular Florida and the Southern Atlantic Coast. Areas of low climate match were found in coastal Washington and Oregon, along the Cascade and Sierra Nevada ranges, and in the Rocky Mountains. The rest, and vast majority, of the contiguous United States had a medium climate match. The overall Climate 6 score (Sanders et al. 2023; 16 climate variables; Euclidean distance) for the contiguous United States was 0.629, 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 *Tridentiger trigonocephalus* (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.

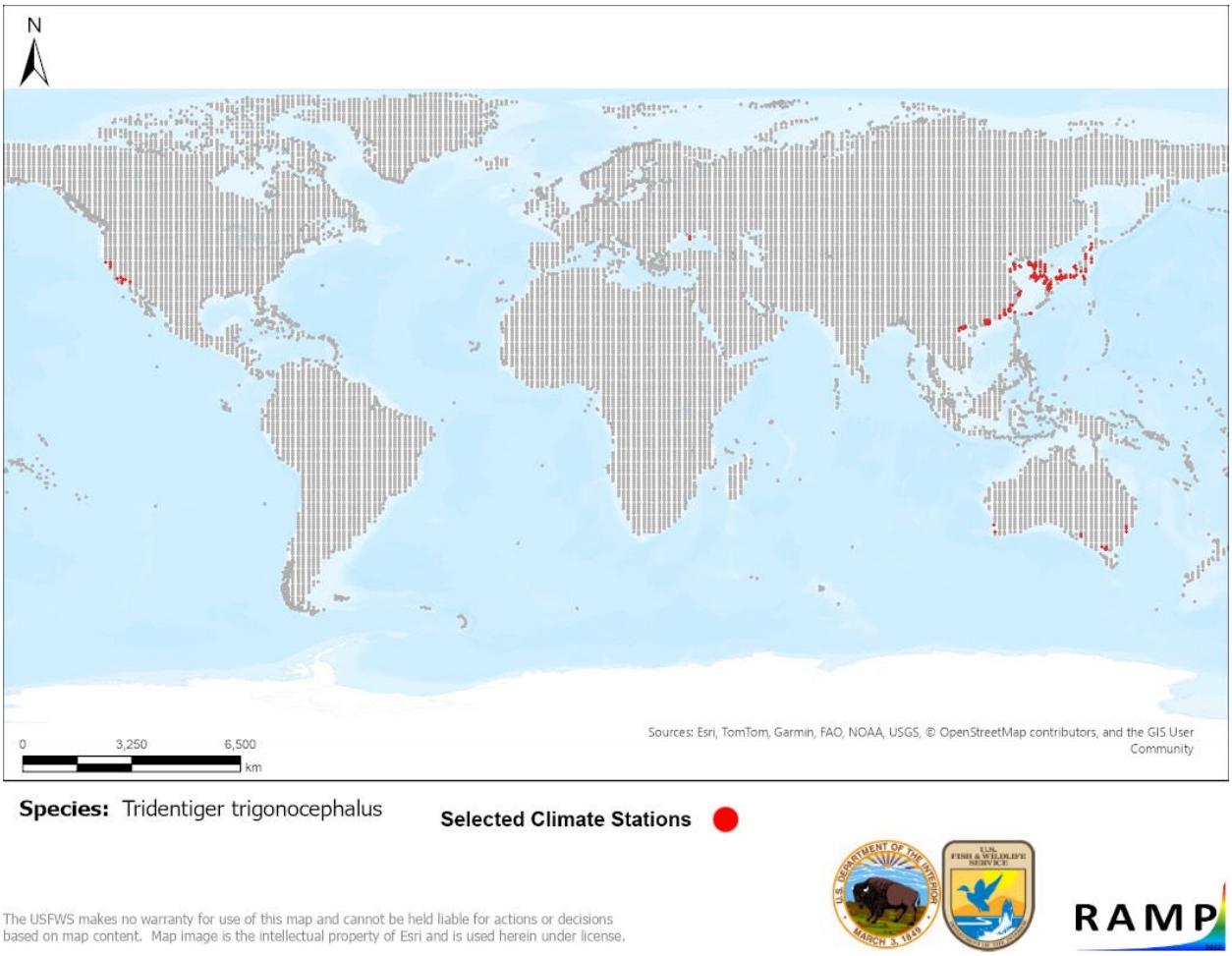

Figure 3. RAMP (Sanders et al. 2023) source map showing weather stations in selected as source locations (red; Australia, China, Japan, North Korea, South Korea, Taiwan, Ukraine, United States, and Vietnam) and non-source locations (gray) for *Tridentiger trigonocephalus* climate matching. Source locations from GBIF Secretariat (2023) and Slynko et al. (2020). Selected source locations are within 100 km of one or more species occurrences, and do not necessarily represent the locations of occurrences themselves.

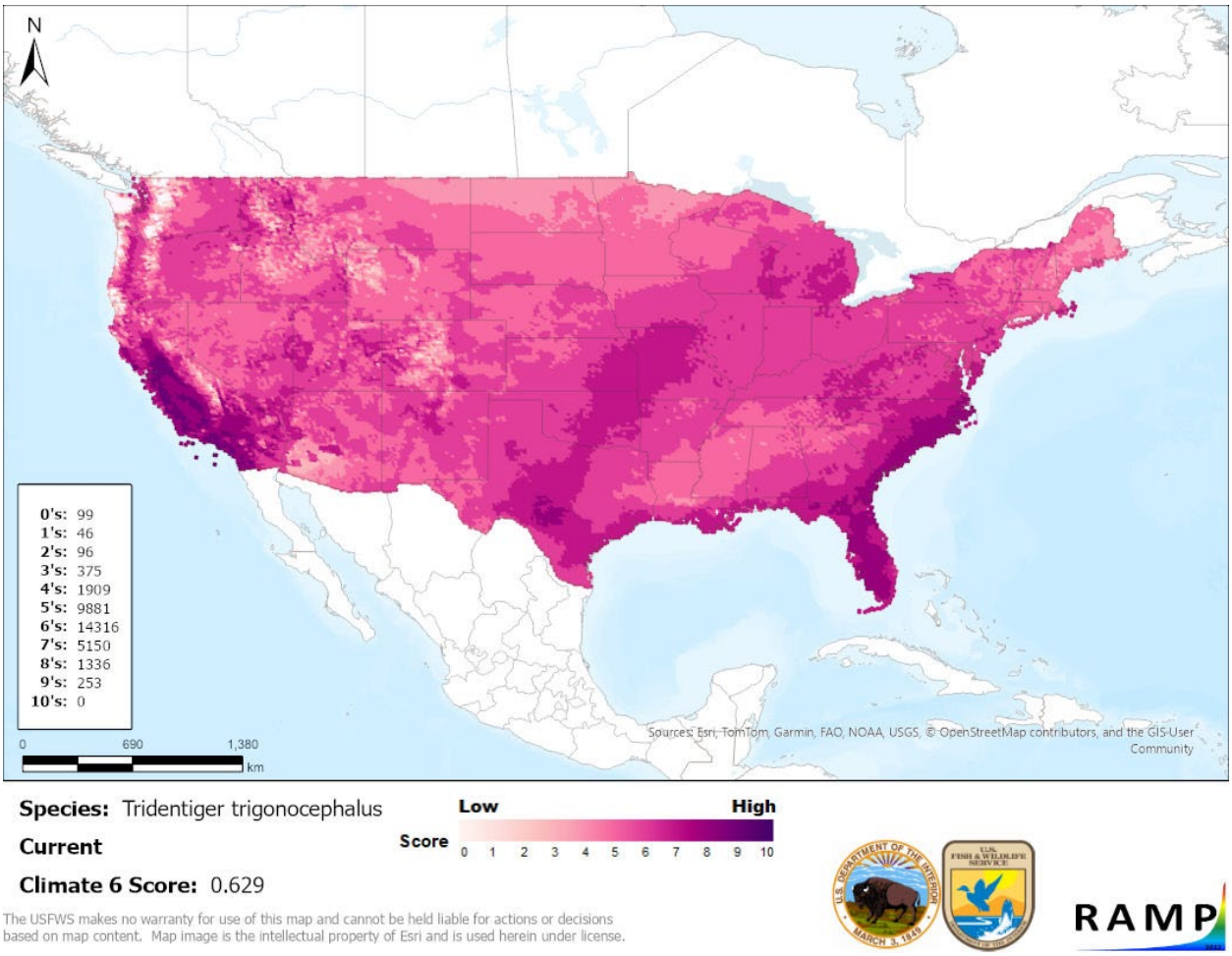

Figure 4. Map of RAMP (Sanders et al. 2023) climate matches for *Tridentiger trigonocephalus* in the contiguous United States based on source locations reported by GBIF Secretariat (2023) and Slynko et al. (2020). Counts of climate match scores are tabulated on the left. 0/Pale Pink = Lowest match, 10/Dark Purple = Highest match.

8 Certainty of Assessment

The Certainty of Assessment for *Tridentiger trigonocephalus* is classified as Low. Information is available on the biology and ecology of this species. There are some misidentifications of *T. tridentiger* leading to variation in its reported distribution across sources. Although there are confirmed established populations of *Tridentiger trigonocephalus* outside of its native range, there is no evidence of impacts or lack of impacts of introduction reported in peer-reviewed literature. Additionally, the higher-salinity aquatic environments this species inhabits are rare across much of the contiguous United States, leading to increased uncertainty in where the species may be able to establish.

9 Risk Assessment

Summary of Risk to the Contiguous United States

Tridentiger trigonocephalus, the Chameleon Goby, is a fish that is native to marine and estuarine areas of eastern Asia including the Yellow Sea, East China Sea, and Sea of Japan.
T. trigonocephalus has established populations outside its native range, including in California, Australia, and Ukraine. Populations were likely introduced as eggs or larvae in the ballast water of ships or through the trade of oysters contaminated with *T. trigonocephalus* eggs.
T. trigonocephalus is regulated in Hawaii and New Mexico as part of the Gobiidae family. The History of Invasiveness for *Tridentiger trigonocephalus* is classified as Data Deficient due to the absence of evidence of impacts or lack of impact of introductions. The climate matching analysis for the contiguous United States indicates establishment concern for this species. Locations with the highest climate match include areas of southern California (where it is currently established), parts of the Florida Peninsula and up the Atlantic coast as well as parts of the Pacific Northwest. *Tridentiger trigonocephalus* prefers marine or brackish waters with salinities of at least 22 ppt, which limits establishment potential in much of the interior of the United States. The Certainty of Assessment for this ERSS is classified as Low due to the lack of information on impacts of introduction and the salinity requirements of this species. The Overall Risk Assessment Category for *Tridentiger trigonocephalus* in the contiguous United States is Uncertain.

Assessment Elements

- **History of Invasiveness (see Section 4): Data Deficient**
- **Establishment Concern (see Section 7): Yes**
- **Certainty of Assessment (see Section 8): Low**
- **Remarks, Important additional information: Some reports in the literature referring to *T. trigonocephalus* collections should actually refer to *T. bifasciatus*. *T. trigonocephalus* is more common in marine environments and is rarely found in salinities less than 22 ppt.**
- **Overall Risk Assessment Category: Uncertain**

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.

Boltachev AR, Karpova EP. 2014. Faunistic revision of alien fish species in the Black Sea. Russian Journal of Biological Invasions 5:225–241.

Fofonoff PW, Ruiz GM, Steves B, Simkanin C, Carlton JT. 2018. *Tridentiger trigonocephalus*. National Exotic Marine and Estuarine Species Information System. Edgewater, Maryland: Smithsonian Environmental Research Center. Available: https://invasions.si.edu/nemesis/calnemo/species_summary/171912 (May 2026).

Fricke R, Eschmeyer WN, van der Laan R, editors. 2023. Eschmeyer's catalog of fishes: genera, species, references. California Academy of Science. Available: http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp (December 2023).

Froese R, Pauly D, editors. 2023. *Tridentiger trigonocephalus*. FishBase. Available: https://fishbase.mnhn.fr/summary/SpeciesSummary.php?ID=3899&AT=chameleon+goby (December 2023).

GBIF Secretariat. 2023. GBIF backbone taxonomy: *Tridentiger trigonocephalus* (Gill, 1859). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/2376462 (December 2023).

[GISD] Global Invasive Species Database. 2023. Species profile: *Tridentiger trigonocephalus.* Gland, Switzerland: Invasive Species Specialist Group. Available: https://www.iucngisd.org/gisd/speciesname/Tridentiger+trigonocephalus (December 2023).

[HDOA] Hawaii Department of Agriculture. 2019. Non-domestic animal import rules. Hawaii Administrative Rules Chapter 4-71.

Inui R, Onikura N, Kawagishi M. 2010. Selection of spawning habitat by several gobiid fishes in the subtidal zone of a small temperate estuary. Fisheries Science 76:83–91.

[ITIS] Integrated Taxonomic Information System. 2023. *Tridentiger trigonocephalus* (Gill, 1859). Reston, Virginia: Integrated Taxonomic Information System. Available: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=171912&print_version=PRT&source=to_print#null (December 2023).

Larson H. 2021. *Tridentiger trigonocephalus*. The IUCN Red List of Threatened Species. Available: https://www.iucnredlist.org/species/166989/1160489 (December 2023).

Maddern M. 2014. *Tridentiger trigonocephalus* (chameleon goby). In CABI Compendium. Wallingford, United Kingdom: CAB International. Available: https://www.cabidigitallibrary.org/doi/10.1079/cabicompendium.15017603 (December 2023).

Nico L, Fuller P, Neilson M. 2023. *Tridentiger trigonocephalus* (Gill, 1859). Nonindigenous Aquatic Species Database. Gainesville, Florida: U.S. Geological Survey. Available: https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=717 (December 2023).

[NIMPIS] National Introduced Marine Pest Information System. 2026. Species – *Tridentiger trigonocephalus*. Canberra, Australia: Department of Agriculture, Water and the Environment. Available: https://nimpis.marinepests.gov.au/species/species/47 (May 2026).

[NMDGF] New Mexico Department of Game and Fish. 2023. Director's species importation list. Santa Fe: New Mexico Department of Game and Fish. Available: https://www.wildlife.state.nm.us/download/enforcement/importation/information/Importation-Info-Directors-Species-Importation-List-1-3-2023.pdf (October 2023).

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.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

Slynko YV, Slynko EE, Abliazov ER, Skvortsova EG, Filinskaya OV. 2020. Molecular-genetic identification of chameleon goby *Tridentiger trigonocephalus* (Gill, 1859) in the Black Sea. Ecologica Montenegrina 32:46–52.

[USFWS] U.S. Fish and Wildlife Service. 2024. Standard operating procedure: how to prepare an "Ecological Risk Screening Summary." Version 3. Available: https://www.fws.gov/media/standard-operating-procedures-how-prepare-ecological-risk-screening-summary-2024 (May 2026).

World Organisation for Animal Health. 2023. Animal diseases. Paris: World Organisation for Animal Health. Available: https://www.woah.org/en/what-we-do/animal-health-and-welfare/animal-diseases/ (December 2023).

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.

Boltachev AR. 2009. Specifying species belonging of barracuda of group *Sphyraena obtusata* (Pisces: Sphyraenidae) found in the Black Sea. Journal of Ichthyology 49:128–131.

Boltachev AR, Karpova EP. 2010. Naturalization of the Pacific chameleon goby *Tridentiger trigonocephalus* (Perciformes, Gobiidae) in the Black Sea (Crimea, Sevastopol Gulf). Journal of Ichthyology 50(2):188–196.

Boltachev AR, Vasil'eva ED, Danilyuk ON. 2007. The first finding of the striped tripletooth goby *Tridentiger trigonocephalus* (Perciformes, Gobiidae) in the Black Sea (the estuary of the Chernaya River, Sevastopol Bay). Journal of Ichthyology 47:847–850.

Bray DJ. 2011. Trident goby, *Tridentiger trigonocephalus* (Gill 1860). Fishes of Australia. Available: http://www.fishesofaustralia.net.au/home/species/165 (December 2023).

Breder CM, Rosen DE. 1966. Modes of reproduction in fishes. Neptune City, New Jersey: T.F.H. Publications.

California Academy of Sciences. 2009. [Source material did not provide full citation for this reference.]

Courtenay WR Jr, Hensley DA, Taylor JN, McCann JA. 1984. Distribution of exotic fishes in the continental United States. Pages 41–77 in Courtenay WR Jr, Stauffer JR Jr, editors. Distribution, biology and management of exotic fishes. Baltimore, Maryland: Johns Hopkins University Press.

Courtenay WR Jr, Hensley DA, Taylor JN, McCann JA. 1986. Distribution of exotic fishes in North America. Pages 675–698 in Hocutt CH, Wiley EO, editors. The zoogeography of North American freshwater fishes. New York: John Wiley and Sons.

Courtenay WR Jr, Jennings DP, Williams JD. 1991. Appendix 2: exotic fishes. Pages 97–107 in Robins CR, Bailey RM, Bond CE, Brooker JR, Lachner EA, Lea RN, Scott WB. Common and scientific names of fishes from the United States and Canada, 5th edition. Bethesda, Maryland: American Fisheries Society. American Fisheries Society Special Publication 20.

Dotu Y. 1958. The bionomics and life history of two gobioid fishes, *Tridentiger undicervicus tomiyama* and *Tridentiger trigonocephalus* (Gill) in the innermost part of Ariake Sound. Scientific Bulletin of the Faculty of Agriculture, Kyushu University 16:343–358.

Eschmeyer WN, Herald ES, Hamann H. 1983. A field guide to Pacific Coast fishes of North America. Peterson Field Guide Series. Boston, Maryland: Houghton Mifflin.

Fishbase. 2006. *Tridentiger trigonocephalus* (Gill, 1859). FishBase. Available: http://filaman.ifmgeomar.de/Summary/speciesSummary.php?ID=3899&genusname=Tridentiger&speciesname=trigonocephalus (December 2006).

Froese R, Pauly D, editors. 2018. FishBase. [Source did not provide full citation for this reference.]

Fuller PL, Nico L, Williams JD. 1999. Nonindigenous fishes introduced into inland waters of the United States. Bethesda, Maryland: American Fisheries Society.

Gill HS, Potter IC. 1993. Spatial segregation amongst goby species within an Australian estuary, with a comparison of the diets and salinity tolerance of the two most abundant species. Marine Biology 117:515–526.

Goren M, Gayer K, Lazarus N. 2009. First record of the Far East chameleon goby *Tridentiger trigonocephalus* (Gill, 1859) in the Mediterranean Sea. Aquatic Invasions 4:413–415.

Haaker P. 1979. Two asiatic gobiid fishes, *Tridentiger trigonocephalus* and *Acanothogobius flavimans*, in southern California. Bulletin of the Southern California Academy of Science 78:56–61.

Hammer MP. 2006. Range extensions for four estuarine gobies (Pisces: Gobiidae) in southern Australia: historically overlooked native taxa or recent arrivals?. Transactions of the Royal Society of South Australia 131(2):187–196.

Hoese DF. 1973. The introduction of the gobiid fishes *Acanthogobius flavimanus* and *Tridentiger trigonocephalus* into Australia. Koolewong 233–235.

Kwak SN, Huh SH, Klumpp DW. 2004. Partitioning of food resources among *Sillago japonica*, *Ditremma temmincki*, *Tridentiger trigonocephalus*, *Hippocampus japonicus*, and *Petroscirtes breviceps* in an eelgrass, *Zostera marina*, bed. Environmental Biology of Fishes 71:353–364.

Lockett MM, Gomon MF. 2001. Ship mediated fish invasions in Australia: two new introductions and a consideration of two previous invasions. Biological Invasions 3:187–192.

Maddern MG, Morrison S. 2008. Introduction of the streaked goby *Acentrogobius pflaumii* (Bleeker 1853) (Pisces: Gobiidae) into southwestern Australia. Australian Zoologist 35:96–99.

Matern SA, Fleming KJ. 1995. Invasion of a third Asian goby species, *Tridentiger bifasciatus*, into California. California Fish and Game 81(2):71–76.

Meng L, Moyle PB, Herbold B. 1994. Changes in abundance and distribution of native and introduced fishes of Suisun Marsh. Transactions of the American Fisheries Society 123:498–507.

Ni I, Kwok K.1999. Marine fish fauna in Hong Kong waters. Zoological Studies 38(2):130–152.

[NIMPIS] Australia: National Introduced Marine Pest Information System. 2006. *Tridentiger trigonocephalus* (chameleon goby). Available: http://www.marine.csiro.au/crimp/nimpis/Default.htm (December 2006).

[NIMPIS] Australia: National Introduced Marine Pest Information System. 2014. *Tridentiger trigonocephalus* (chameleon goby). Available: http://data.daff.gov.au/marinepests/index.cfm?fa=main.spDetailsDB&sp=6000016505#generalInfo

Pollard DA, Hutchings PA. 1990. A review of exotic marine organisms introduced to the Australian region. I. Fishes. Asian Fisheries Science 3:205–221.

Pondella DJ, Chinn ZJK. 2005. Records of chameleon goby, *Tridentiger trigonocephalus*, in San Diego Bay, California. California Fish and Game 91:57–59.

Raquel PF. 1988. Record of the chameleon goby, *Tridentiger trigonocephalus*, from the Sacramento-San Joaquin Delta. California Fish and Game 74:60–61.

Reshetnikov YS, Bogutskaya NG, Vasil'eva ED, Dorofeeva EA, Naseka AM, Popova OA, Savvaitova KA, Sideleva VG, Sokolov LI. 1997. An annotated check-list of the freshwater fishes of Russia. Journal of Ichthyology 37:687–736.

Rhyne AL, Tlusty MF, Holmberg RJ, Szczebak JT. 2015. Marine aquarium biodiversity and trade flow. Available: https://www.aquariumtradedata.org/ (December 2023).

Shiganova T, Öztürk B. 2010. Trend on increasing Mediterranean species arrival into the Black Sea. Pages 75–91 in Briand F, editor. CIESM workshop monographs 39: climate forcing and its impacts on the Black Sea marine biota. Monaco: CIESM.

USGS Nonindigenous Aquatic Species Program. 2003–2025. Nonindigenous Aquatic Species Database. Available: https://nas.er.usgs.gov/.

Wang. 2011. [Source material did not provide full citation for this reference.]

Williams et al. 2016. [Source material did not provide full citation for this reference.]

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) and Slynko et al. (2020).

Under all the future climate scenarios for the contiguous United States (figure A1), high climate match for *Tridentiger trigonocephalus* was projected to occur in California. Areas of high climate match were also projected within the Appalachian Mountains, Great Lakes, Southern Atlantic Coast, Southern Florida, and the Western Mountains regions under some future climate scenarios. The areas of high match were fewer and smaller under the SSP5, 2085 scenario than under other scenarios. The Climate 6 scores for the individual future scenario models (figure A2) ranged from a low of 0.287 (model: UKESM1-0-LL, SSP5, 2085) to a high of 0.654 (model: MRI-ESM2-0, SSP3, 2055). 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 (0.629, figure 4) falls within the range of scores for future projections. The time step and climate scenario with the most change relative to current conditions was SSP5, 2055, the most extreme climate change scenario. Under one or more time step and climate scenarios, areas within the Colorado Plateau, Great Lakes, Northeast, Northern Plains, Southwest, and Western Mountains saw a moderate increase in the climate match relative to current conditions. The climate match in the Southwest peaked at the 2055 time step whereas other areas were projected to reach their highest climate match at the 2085 time step. No large increases were observed regardless of time step and climate scenarios. Under one or more time step and climate scenarios, areas within California and the Gulf Coast saw a large decrease in the climate match relative to current conditions. Additionally, areas within the Appalachian Range, Colorado Plateau, Great Basin, Mid-Atlantic, Northern Pacific Coast, Southeast, Southern Atlantic Coast, Southern Florida, Southern Plains, Southwest, and Western Mountains saw a moderate decrease in the climate match relative to current conditions. Decreases in climate match were most pronounced under scenario SSP5, 2085. Additional very small areas of large or moderate change may be visible on the maps (figure A3).

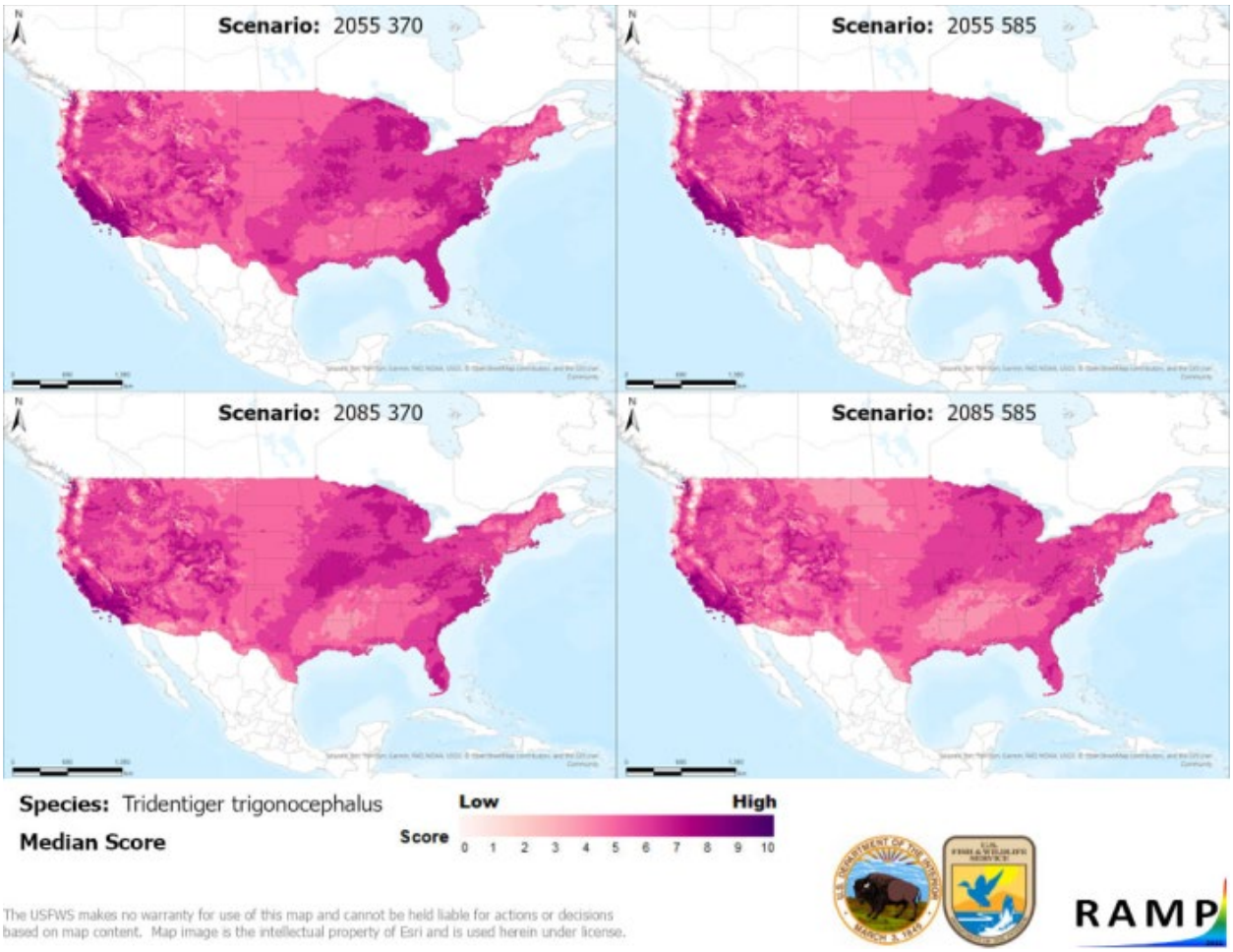

Figure A1. Maps of median RAMP (Sanders et al. 2023) climate matches projected under potential future climate conditions using five global climate models for *Tridentiger trigonocephalus* in the contiguous United States. Climate matching is based on source locations reported by GBIF Secretariat (2023) and Slynko et al. (2020). 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.

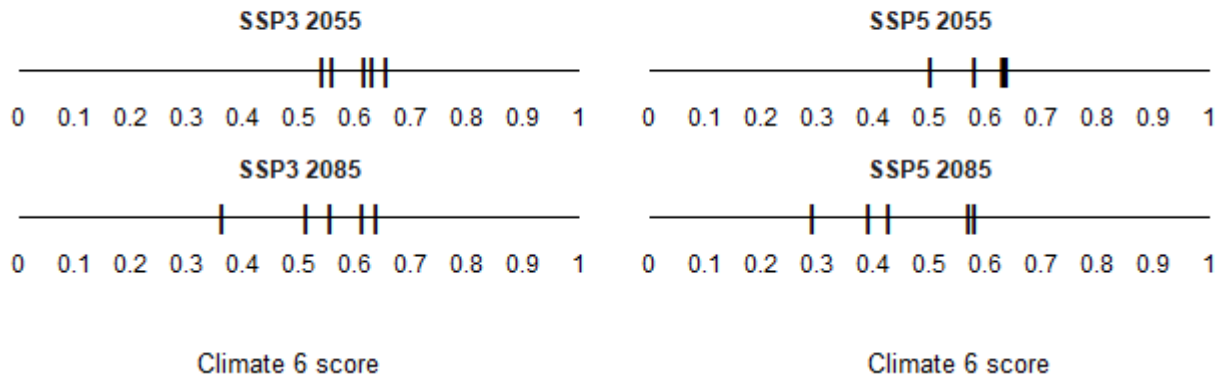

Figure A2. Comparison of projected future Climate 6 scores for *Tridentiger trigonocephalus* in the contiguous United States for each of five global climate models under four combinations of Shared Socioeconomic Pathway (SSP) and time step. SSPs used (from left to right): SSP3, SSP5 (Karger et al. 2017, 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.

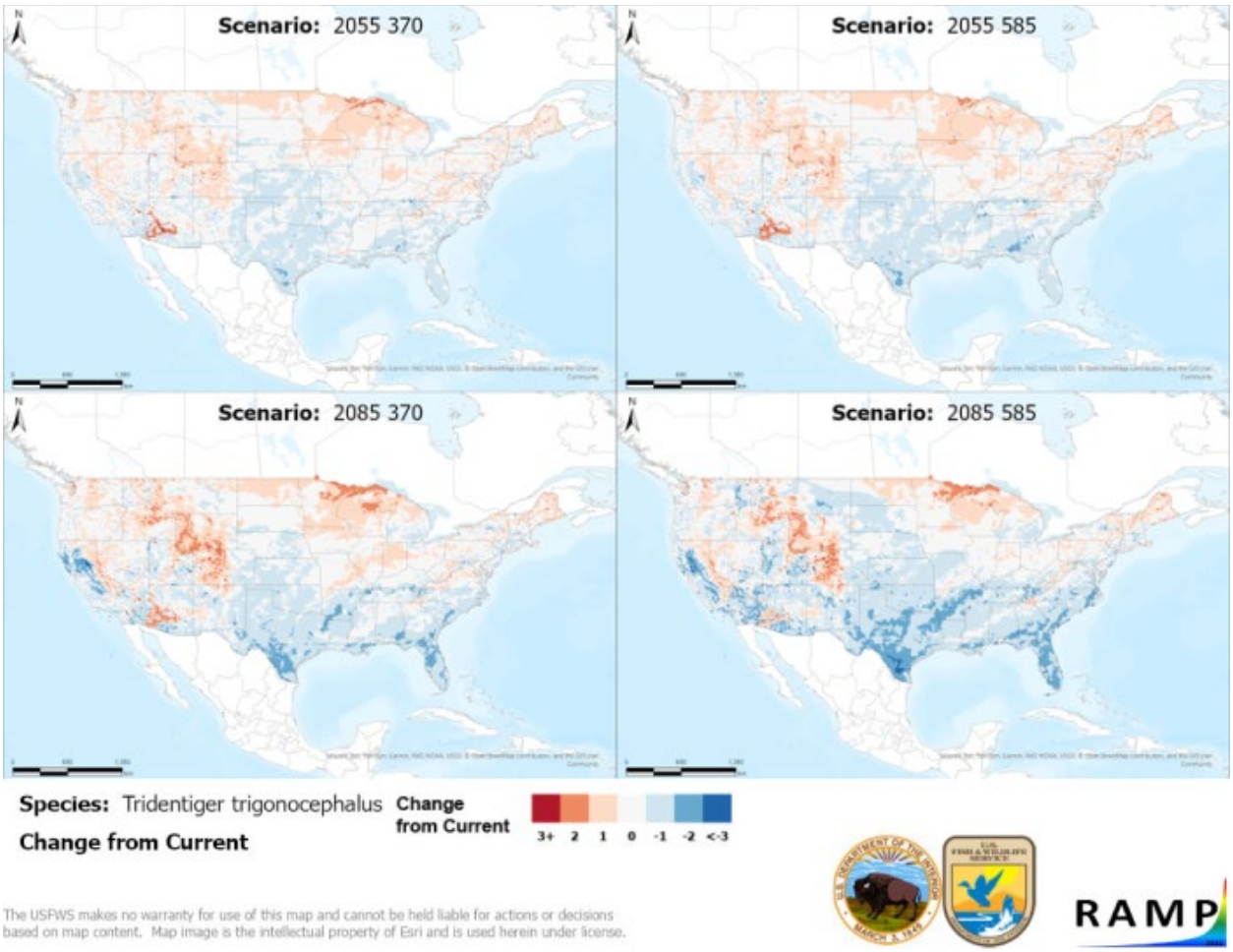

Figure A3. RAMP (Sanders et al. 2023) maps of the contiguous United States showing the difference between the current climate match target point score (figure 4) and the median target point score for future climate scenarios (figure A1) for *Tridentiger trigonocephalus* based on source locations reported by GBIF Secretariat (2023) and Slynko et al. (2020). 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.

Literature Cited

GBIF Secretariat. 2023. GBIF backbone taxonomy: *Tridentiger trigonocephalus* (Gill, 1859). Copenhagen: Global Biodiversity Information Facility. Available: https://www.gbif.org/species/2376462 (December 2023).

[IPCC] Intergovernmental Panel on Climate Change. 2021. Climate change 2021: the physical science basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder HP, Kessler M. 2018. Data from: Climatologies at high resolution for the earth's land surface areas. EnviDat. Available: https://doi.org/10.16904/envidat.228.v2.1.

Karger DN, Conrad O, Böhner J, Kawohl T, Kreft H, Soria-Auza RW, Zimmermann NE, Linder P, Kessler M. 2017. Climatologies at high resolution for the Earth land surface areas. Scientific Data 4:170122.

Sanders S, Castiglione C, Hoff M. 2023. Risk Assessment Mapping Program: RAMP. Version 5.0. U.S. Fish and Wildlife Service.

Slynko YV, Slynko EE, Abliazov ER, Skvortsova EG, Filinskaya OV. 2020. Molecular-genetic identification of chameleon goby *Tridentiger trigonocephalus* (Gill, 1859) in the Black Sea. Ecologica Montenegrina 32:46–52.