

Shimofuri Goby (*Tridentiger bifasciatus*)

Ecological Risk Screening Summary

U.S. Fish and Wildlife Service, February 2011

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1 Native Range and Status in the United States

Native Range

From Nico et al. (2018):

“Fresh and brackish water. Asia, including Japan, Korea, China, Taiwan, and the former Soviet Union (Akihito and Sakamoto 1989).”

From Froese and Pauly (2018):

“Northwest Pacific: Japan, China [Wu et al. 1999] and South Korea [Kim et al. 2005].”

From Eschmeyer et al. (2018):

“China, Korea, Japan and Russia”

Status in the United States

From Howard and Booth (2016):

“Shimofuri gobies were first discovered in the Suisun Marsh, part of the upper San Francisco Estuary [California]. Gobies then spread to the Sacramento-San Joaquin Delta (Delta) (Matern 2001). Shimofuri gobies have spread from the Delta more than 500 km through aqueducts of the California State Water Project (CSWP), over the Transverse Ranges, and into coastal drainages of southern California (Matern and Fleming 1995). Shimofuri gobies have invaded reservoirs associated with the East and West Branches of the CSWP in Southern California [...] These include Pyramid Lake (Swift et al. 1993), Castaic Lake (D. Black, California Department of Fish and Wildlife (CDFW), personal communication), Silverwood Lake, Lake Matthews, and Skinner Reservoir (Q. Granfors, CDFW, personal communication). Shimofuri gobies are likely also present in Lake Perris and Diamond Valley Lake because of connection to the CSWP, but have not been detected as of June 2016 (Q. Granfors, CDFW, personal communication). Gobies were collected in Lower Otay Reservoir in San Diego in June, 2016 (D. Black, CDFW, personal communication). Shimofuri gobies were first discovered in the Santa Clara River watershed in 1990 at Pyramid Lake and were later found downstream of Pyramid Dam in middle Piru Creek in 1992 (Swift et al. 1993). Swift [et al.] (1993) described these fish as chameleon gobies (*Tridentiger trigonocephalus*), but later identified them as Shimofuri gobies (C. Swift, Natural History Museum of Los Angeles, personal communication).”

Means of Introductions in the United States

From Nico et al. (2018):

“Probably introduced via ballast water circa 1985 (Matern and Fleming 1995).”

Remarks

From Nico et al. (2018):

“Akihito and Sakamoto (1989) resurrected this species after over 50 years of synonymy with *T. trigonocephalus*. They provided details on distinguishing characteristics, and also provided color photographs for both species. Distinguishing characteristics were also summarized by Matern and Fleming (1995). According to Matern and Fleming (1995), some published reports of *T. trigonocephalus* in California (e.g., Raquel 1988; Meng et al. 1994) actually refer to *T. bifasciatus*.”

Eschmeyer et al. (2018) lists *Tridentiger bucco* as now being a synonym for *Tridentiger bifasciatus*.

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2018):

“Kingdom Animalia

Subkingdom Bilateria
Infrakingdom Deuterostomia
Phylum Chordata
Subphylum Vertebrata
Infraphylum Gnathostomata
Superclass Actinopterygii
Class Teleostei
Superorder Acanthopterygii
Order Perciformes
Suborder Gobioidae
Family Gobiidae
Genus *Tridentiger*
Species *Tridentiger bifasciatus* Steindachner, 1881 – shimofuri goby”

From Eschmeyer et al. (2018):

“**Current status:** Valid as *Tridentiger bifasciatus* Steindachner 1881. Gobiidae: Gobionellinae.”

Size, Weight, and Age Range

From Froese and Pauly (2018):

“Max length : 12.0 cm TL male/unsexed; [Baensch and Riehl 1997]”

Environment

From Froese and Pauly (2018):

“Marine; freshwater; brackish; demersal; amphidromous [McDowall 1997].”

From Nico et al. (2018):

“Shimofuri gobies can tolerate a wide range of temperature and salinity values. They exhibit thermal tolerances greater than those of most native fishes in the San Francisco Estuary, and exhibit salinity tolerances well-suited to salinities found throughout most of the San Francisco Estuary (Matern 1999, 2001).”

Climate/Range

From Froese and Pauly (2018):

“Temperate; 10°C - 25°C [Baensch and Riehl 1997; assumed to represent recommended aquarium water temperatures]”

Distribution Outside the United States

Native

From Nico et al. (2018):

“Fresh and brackish water. Asia, including Japan, Korea, China, Taiwan, and the former Soviet Union (Akihito and Sakamoto 1989).”

From Froese and Pauly (2018):

“Northwest Pacific: Japan, China [Wu et al. 1999] and South Korea [Kim et al. 2005].”

From Eschmeyer et al. (2018):

“China, Korea, Japan and Russia”

Introduced

From Qin et al. (2019):

“The East Route of South-to-North Water Transfer Project of China (ESNT) uses the Grand Canal as the main pathway for water conveyance from the Yangtze River upstream to northern China and links five major lakes that serve as water storages along the route. The ESNT was completed in 2013. [...] We observed invasions of two estuarine gobiids, *Taenioides cirratus* (Blyth, 1860) and *Tridentiger bifasciatus* (Steindachner, 1881), into the linked lakes. [...] *Tridentiger bifasciatus* was first observed in Luoma and Nansi lakes in 2015 and in Dongping Lake in 2016.”

“We observed adults with well-developed gonads and new recruitment of young-of-the-year juveniles of this species in Nansi Lake since 2016, suggesting successful establishment of the population.”

Means of Introduction Outside the United States

From Qin et al. (2019):

“Invasion of *T. bifasciatus* was associated with operation of the ESNT [East Route of South-to-North Water Transfer Project of China].”

“Dispersal of drifting larvae has been reported as the primary way that this species expands its distribution (Matern and Fleming 1995).”

Short Description

From Nico et al. (2018):

“Species of *Tridentiger* can be distinguished from all North American native gobies by the presence of tricuspid (three-lobed) teeth in the outer row of the jaw. This species can be separated from *T. trigonocephalus* primarily by coloration patterns (white spots on lower portion

of head, orange/red margin and no conspicuous stripes on 2nd dorsal and anal fins in *T. bifasciatus*; no white spots on lower portion of head, white margin and conspicuous [sic] stripes on 2nd dorsal and anal fins in *T. trigonocephalus*), and from *T. barbatus* by the presence of barbels on the head on the latter species.”

Biology

From Nico et al. (2018):

“The shimofuri goby is primarily [sic] feeds on benthic invertebrates, including ostracods, copepods, isopods, amphipods, oligochaetes, polychaetes, and mysids (Matern 1999; Matern and Brown 2005). Other introduced species, including the hydroid *Cordylophora caspia* and cirri of the barnacle *Balanus improvisus*, comprise a large portion of the diet of *T. bifasciatus* (Matern and Brown 2005).”

“Spawning in the shimofuri goby generally occurs from March to September in oligohaline (up to 19 ppt.) to fresh water (Matern 1999; Wang 2011). Males build and guard nests inside of cavities with hard interior surfaces, such as oyster shells, crevices, logs, or cans/bottles (Matern 1999; Wang 2011). Reproduction occurs multiple times throughout the season (Matern 1999). Maturity is reached in 1 year, with a maximum longevity of 2 years (Matern 1999).”

From Froese and Pauly (2018):

“Euryhaline [Pietsch et al. 2000]”

Human Uses

No information available.

Diseases

No information available. No OIE-reportable diseases (OIE 2019) have been documented in this species.

Threat to Humans

From Froese and Pauly (2018):

“Harmless”

3 Impacts of Introductions

From Nico et al. (2018):

“The shimofuri goby may compete with the federally endangered tidewater goby *Eucyclogobius newberryi* if the two come in contact. The two species are very similar in habitat and dietary preferences (Matern and Fleming 1995). One potential scenario that would cause the two species to become sympatric is introduction of the shimofuri goby into Lake Cachuma in southern

California via the California Aqueduct, and then into the Santa Ynez River (Matern and Fleming 1995).”

“Shimofuri gobies likely compete with native species for *Corophium* amphipods, which are seasonally abundant in winter and comprise a major prey item of tule perch (*Hysteroecarpus traski*), Sacramento sucker (*Catostomus occidentalis*), prickly sculpin (*Cottus asper*), staghorn sculpin (*Leptocottus armatus*), and starry flounder (*Platichthys stellatus*) (Feyrer et al. 2003).”

From Howard and Booth (2016):

“The invasion of alien gobies, including the Shimofuri goby, may negatively affect the native tidewater goby. Tidewater gobies are present in the Santa Clara River estuary, but the population appears to be in decline. Shimofuri gobies, which have established populations in the San Francisco Bay region (Moyle 2002), compete with and prey upon smaller tidewater gobies (R. Swenson, Environmental Science Associates (ESA), personal communication). Initial experiments indicated that Shimofuri gobies aggressively intimidate, outcompete, and prey upon tidewater gobies in the laboratory (R. Swenson, ESA, personal communication). Tidewater goby and Shimofuri goby diets overlap, including benthic macroinvertebrates like oligochaetes, polychaetes, ostracods, copepods, and isopods (Swenson and McCray 1996), and may result in direct competition for food resources. To date, the possible effects of interactions in the wild between exotic goby species and tidewater gobies are largely conjectural (U.S. Fish and Wildlife Service 2005), and effects may be less than those observed in the laboratory because Shimofuri gobies prefer hard substrates, whereas tidewater gobies prefer sandy substrates. Further monitoring in the Santa Clara estuary may provide insight into real world interactions between these goby species and potential consequences for tidewater gobies in the future.”

From Matern and Brown (2005):

“Shimofuri gobies fed substantially on two novel alien resources, barnacle cirri and hydroids.”

4 Global Distribution



Figure 1. Known global distribution of *Tridentiger bifasciatus*, reported from eastern Asia (China, South Korea, Japan, Russia) and the western United States. Map from GBIF Secretariat (2019). No georeferenced occurrences were available for the species range in Taiwan.

5 Distribution Within the United States

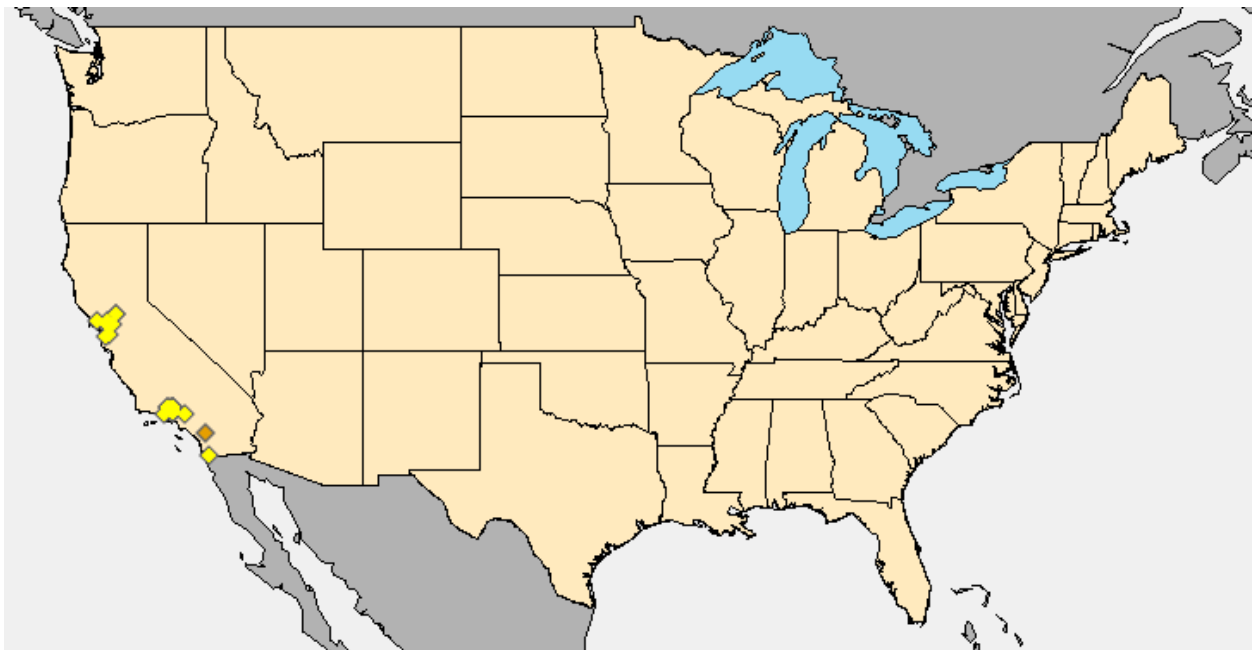


Figure 2. Distribution of *Tridentiger bifasciatus* in the United States. Map from Nico et al. (2018). The yellow diamonds represent established populations, while orange diamonds represent introductions that are not considered established. Only established populations were included in the climate matching analysis.

6 Climate Matching

Summary of Climate Matching Analysis

The climate match (Sanders et al. 2018; 16 climate variables; Euclidean Distance) for *Tridentiger bifasciatus* with the contiguous United States is high overall, represented by a Climate 6 score of 0.230. (Scores of 0.103 or greater are classified as high.) High matches were found in California, where the species is currently established, as well as in northwestern Minnesota, coastal North Carolina, and parts of the Columbia River basin and northern California. Most of the contiguous United States had a medium match. Low matches were found in parts of the Rocky Mountains, much of the Great Basin, both east and west of the Cascade Range in the Pacific Northwest, the South-Central United States including southern Texas and parts of the Lower Mississippi River basin, southern Arizona, southeastern Florida, and coastal New England.

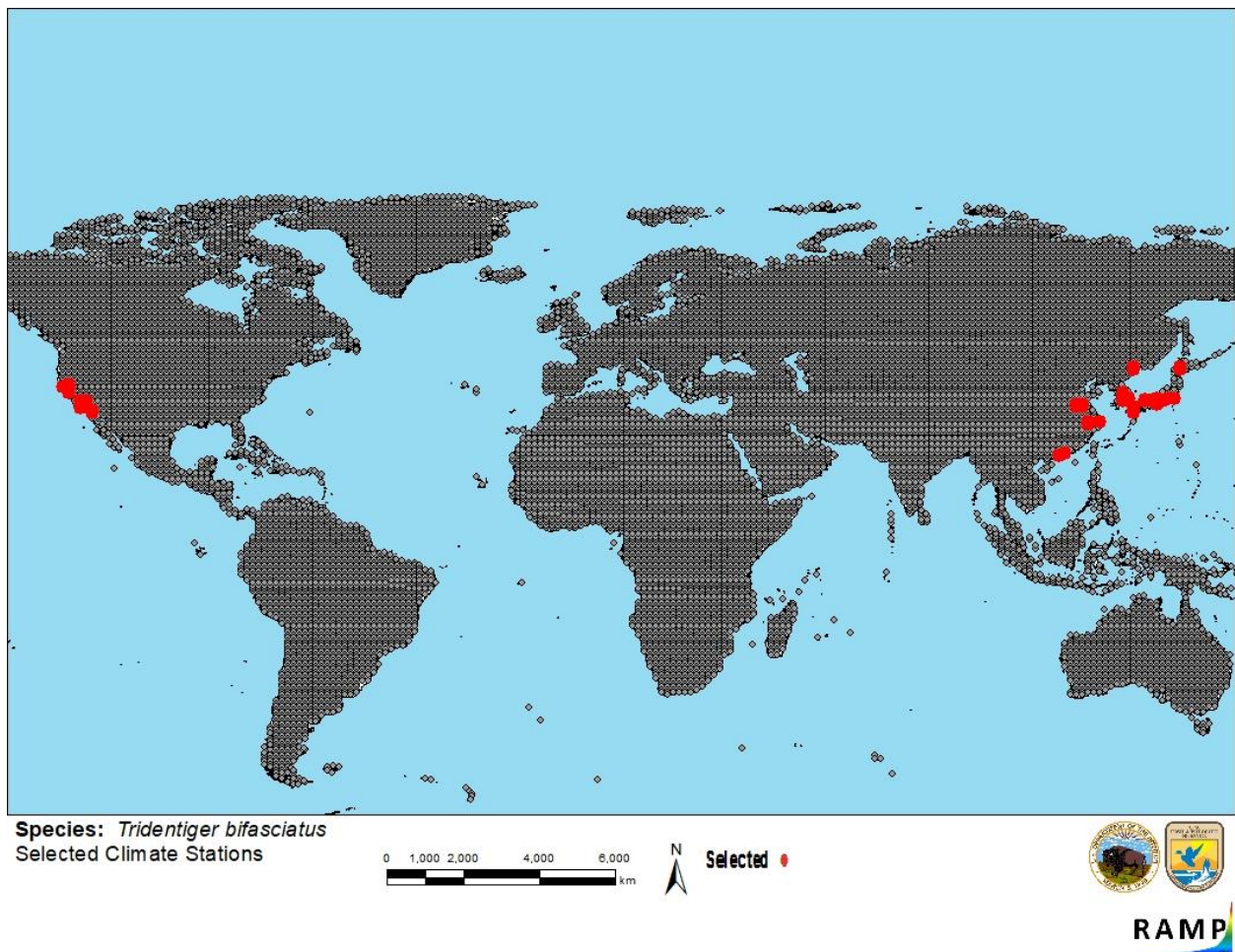


Figure 3. RAMP (Sanders et al. 2018) source map showing weather stations in the United States and eastern Asia selected as source locations (red; United States, China, Russia, South Korea, Japan) and non-source locations (gray) for *Tridentiger bifasciatus* climate matching. Source locations from GBIF Secretariat (2018). Additional locations in inland China from Qin et al. (2019).

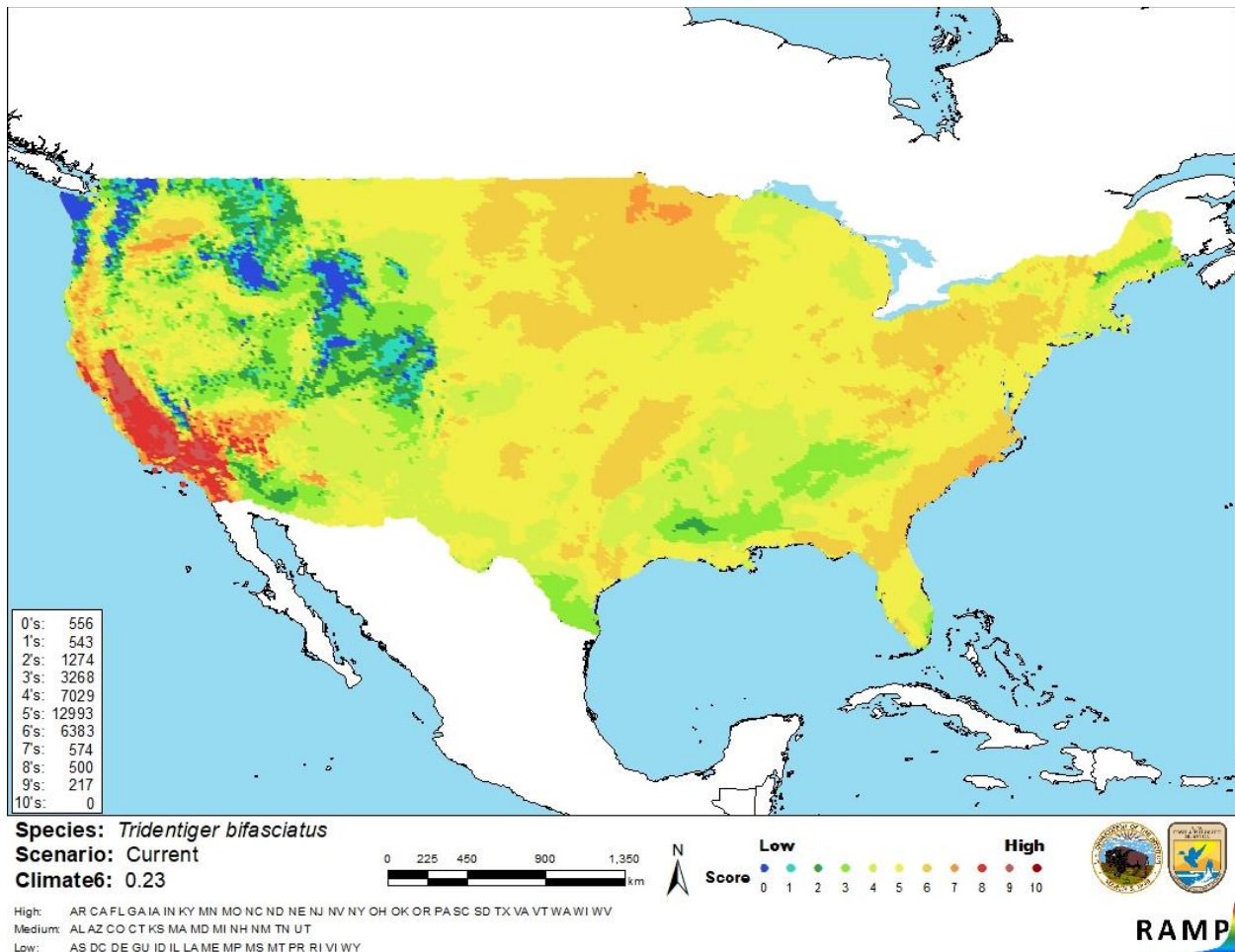


Figure 4. Map of RAMP (Sanders et al. 2018) climate matches for *Tridentiger bifasciatus* in the contiguous United States based on source locations reported by GBIF Secretariat (2018). Additional locations in inland China from Qin et al. (2019). 0=Lowest match, 10=Highest match.

The “High”, “Medium”, and “Low” climate match categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 \leq X < 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

Information on the biology, distribution, and impacts from introduction exists for *Tridentiger bifasciatus*, although not in great quantity. More research is needed on impacts of introduction to determine their significance because current information is largely conjectural. Certainty of assessment for *T. bifasciatus* is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Tridentiger bifasciatus, Shimofuri Goby, is a fish species native to China, Taiwan, South Korea, Japan and Russia. First introduced in 1985 via a ship's ballast hull, the species is now firmly established and abundant in the vicinity of San Francisco, California. It has spread throughout the State via the California State Water Project, reaching several lakes in southern California. The species is also established outside its native range in China. In California, scientists speculate it could negatively affect the federally endangered tidewater goby *Eucyclogobius newberryi* if the two come in contact given their shared habitat and dietary preferences. The major proposed mechanism of impact on native species is competition for food resources. History of invasiveness is classified as "none documented" because *T. bifasciatus* is established beyond its native range, but there is not yet any clear and convincing evidence of purported negative impacts. Climate match with the contiguous United States was high. Certainty of assessment is low due to equivocal information on impacts. Until more definitive studies are available on the impacts of *T. bifasciatus*, the overall risk assessment for the species is uncertain.

Assessment Elements

- **History of Invasiveness (Sec. 3): None Documented**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Low**
- **Remarks/Important additional information:** Some published reports of *T. trigonocephalus* in California actually refer to *T. bifasciatus*.
- **Overall Risk Assessment Category: Uncertain**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

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.

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