

Salinas River Lagoon Fish Distribution

Spring 2025 Tidewater Goby Surveys

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Executive Summary

Tidewater goby surveys have been ongoing since 2018, generally occurring in both the spring and fall of most years. The fall of 2024 was the first survey that did not result in physical captures of the species, although concurrent environmental DNA (eDNA) sampling indicated continued presence in the lagoon during that time. A recent tidewater goby distribution survey was conducted in the Salinas River Lagoon May 27–28, 2025, shortly after a prolonged period of connectivity to the marine environment (the lagoon was breached from February 15 through May 12, 2025). Surveys this spring once again confirmed the presence of the species in the lagoon.

Tidewater goby were found at various sampled locations from the Highway 1 bridge to the sandbar, albeit in low numbers, which ranged from 0 to 10 individuals per seine haul. Captured tidewater gobies measured from 14 mm to 41 mm in total length, corresponding to estimated individual ages ranging from 48 to 271 days (hatched between August 29, 2024, and April 9, 2025). Larval gobies smaller than 14 mm are too small to sample using the standard mesh size recommended for goby surveys, but could have been present.

These findings are encouraging, suggesting that tidewater goby, which typically struggle to persist in habitats that remain connected to the ocean for prolonged periods of time, were able to successfully survive, grow, and reproduce in the lagoon despite several such periods in recent years. The Salinas River Lagoon was connected to the marine environment from January 3 until September 21, 2023, from January 4 until mid-July 2024, and again in 2025, for a three-month period immediately preceding this survey.

Overall, the fish community in the lagoon was dominated by other species with a broad salinity tolerance, and included Pacific staghorn sculpin, bay pipefish, arrow goby, yellowfin goby, speckled sanddab, starry flounder, inland silverside, juvenile carp, threespine stickleback, and mosquitofish.

Salinity concentrations were relatively high throughout the lagoon, ranging from 8.2 parts per thousand (ppt) to 17.02 ppt. Surface temperatures and dissolved oxygen were favorable and well within the range of fish species expected in the lagoon, ranging from 17.2 to 21.5 °C, and 8.16 to 11.42 mg/l, respectively.

In summary, it is encouraging that tidewater goby could once again be physically sampled, despite failure to do so during the preceding sampling event in October 2024. Recent, broad-scale environmental DNA sampling in nearby and adjacent watersheds suggests that tidewater goby occupy areas in hydrologically connected slough complexes (Moro Cojo, Bennett, Watsonville, and Elkhorn sloughs), providing potential source populations for recolonization in the event of localized extirpation. However, the frequency of migration between isolated populations is likely rare, highlighting the importance of suitable refuge habitat within the Salinas River lagoon itself. Such habitat may be found in the upstream reaches of the lagoon, where tidal influence during breaches is muted and salinity remains low. Opportunity to sample by hand-held beach seine is limited in this area, and boat-based sampling by small otter trawl should be explored to improve our understanding of the overall distribution of tidewater goby within the Salinas River Lagoon.

Background

The tidewater goby (*Eucyclogobius newberryi*) is a small fish, typically less than 2 inches (50 mm) in length, and only found in brackish water lagoons, estuaries, and marshes along the California coast. While short-lived, the species is highly resilient to environmental changes, as its natural habitat is subject to rapidly changing conditions, such as temperature, salinity, and water levels.

Adult tidewater gobies have a broad tolerance for environmental changes to cope with such dramatic fluctuations. While these fish typically inhabit brackish waters with salinities less than 12 parts per thousand (ppt), they have been documented in the wild at salinities greater than that of seawater (up to 42 ppt; Swift et al. 1989). However, juvenile gobies appear less resilient to such breaching events and suffer high rates of mortality when exposed to increases in salinity (Hellmair & Kinziger 2014).

Tidewater gobies can breed multiple times within their short (up to about one year) lifespan (Goldberg 1977; Swift et al. 1989). When conditions are favorable, tidewater gobies can reproduce quickly and become plentiful. Because migration between populations is rare, substantial genetic differences have developed among tidewater goby populations. As a species, tidewater goby persist as a metapopulation, wherein subpopulations in isolated habitats may experience periodic localized extinctions and recolonization (during comparatively brief periods of connectivity). Extinction and recolonization rates are higher in the southern portion of the species' range (Lafferty et al. 1999a, 1999b), whereas subpopulations are more stable along California's North Coast (Kinziger et al. 2016).

Until their discovery during routine fish monitoring surveys in the Salinas River Lagoon in 2013, tidewater goby were last documented there in 1951 and presumably extirpated due to levee construction and channelization (USFWS 2013). Observations beginning in 2013 likely represented a natural recolonization event from nearby Bennett Slough or Moro Cojo Slough. In 2014, tidewater goby were the second most abundant species sampled in the lagoon (only three species were detected; HES 2015). Routine fish monitoring surveys were not conducted by MCWRA or its contractors from 2015–2017, but since 2018, periodic surveys (generally in spring and fall) have monitored the persistence and distribution of tidewater goby in the Salinas River Lagoon, with particular focus on the impacts of environmental conditions (e.g. changes in water quality, marine connectivity) and facilitated breaching events (permitted as an emergency flood prevention measure).

These monitoring efforts have revealed that tidewater goby experience notable fluctuations in abundance and distribution, as inferred from presence or absence at various sampling locations in the lower lagoon. The Old Salinas River (OSR) is of particular interest to the colonization and persistence of the species in the Salinas River Lagoon; serving as a potential migration corridor for a range of fish species, the persistent and unidirectional current of water from the lagoon to the Moss Landing during typical operation of the slide gate is not considered a favorable habitat characteristic for gobies; however, when the lagoon is breached, water is not deliberately discharged through the OSR, thus creating potential refuge habitat for gobies, sheltered from strong currents and tidal fluctuations.

While recent eDNA surveys of the broader hydrologic area from the Pajaro River estuary to Moro Cojo, Watsonville, Bennett, and Elkhorn sloughs (conducted in spring and fall of 2024) indicate that multiple areas support tidewater goby populations and these may serve as sources for recolonization in the event of localized extirpations, many questions regarding the status and ecology of tidewater goby in the area remain unanswered (including the extent of the species' distribution in the lagoon upstream of Highway 1, which is difficult to sample due to poor access and deep water). Additional details on past tidewater goby surveys can be found in a comprehensive summary report, prepared on behalf of MCWRA (FISHBIO 2022).

This report provides an overview of survey results from May 2025.

Methods

Tidewater goby collection surveys in the Salinas River Lagoon utilize a 10 x 4 ft. beach seine ($\frac{1}{8}$ inch mesh) to sample numerous locations throughout the lagoon, distributed from near the sandbar/breach location to the Highway 1 Bridge, as well as in the Old Salinas River (OSR) directly behind the slidegate. Targeted sampling for tidewater goby is conducted following protocols developed by the United States Fish and Wildlife Service (USFWS 2005; Appendix F). After each seine haul, all captured fish are transferred from the seine to an aerated, temporary holding bucket, identified to species level, enumerated, and measured. Following identification and measurement, all sampled fish, including tidewater goby, are released at the site of capture.

Measurements of tidewater gobies are used to evaluate the reproductive period of the species in the Salinas River Lagoon. As growth in fishes is generally continuous and indefinite, differences in size – or range in individual sizes encountered in a population at a particular point in time – can be used as an approximation of the temporal extent of their reproductive period, particularly in small, short-lived species such as tidewater goby (Hellmair & Kinziger 2014).

Additional details on sampling methods and locations, as well as a comprehensive overview of past occupancy patterns of tidewater goby in the Salinas River Lagoon can be found in FISHBIO (2022).

Results

Tidewater goby were found at various sampled locations from the Highway 1 bridge to the sandbar, albeit in low numbers, which ranged from 0 to 10 per seine haul (19 in total). Locations where tidewater gobies were documented during 2024 (two sampling events) and in May 2025 are summarized in Figure 1 (see Appendix 1 for a graphic summary of tidewater goby occupancy in the lower lagoon). Tidewater goby distribution can be patchy, as exemplified by the capture of more than half of gobies (n=10) sampled during this event in one single location (adjacent to the breach site/sandbar). Captured tidewater gobies measured from 14 mm to 41 mm in total length, corresponding to estimated individual ages ranging from 48 to 271 days and hatch dates between August 29, 2024, and April 9, 2025, respectively. Most individuals sampled during this event hatched in early spring, only one older (larger) fish was estimated to have hatched late during the preceding summer. During the previous sampling event (Fall 2024), tidewater goby were not physically detected (captured) for the first time since the inception of periodic goby monitoring,

albeit the species was detected during an eDNA survey conducted at the same time. This suggests that tidewater goby were relatively rare at that time, thus few individuals of that age/size class are expected to still be alive by the following spring. However, capture of smaller individuals during May 2025 is a clear indication of successful reproduction.

These findings are encouraging, suggesting that tidewater goby, which typically struggle to persist in habitats that remain connected to the ocean for prolonged periods of time, were able to successfully survive, grow, and reproduce in the lagoon despite several such periods in recent years. The Salinas River Lagoon was connected to the marine environment from January 3 until September 21, 2023, from January 4 until mid-July 2024, and again in 2025, for a three-month period immediately preceding this survey.

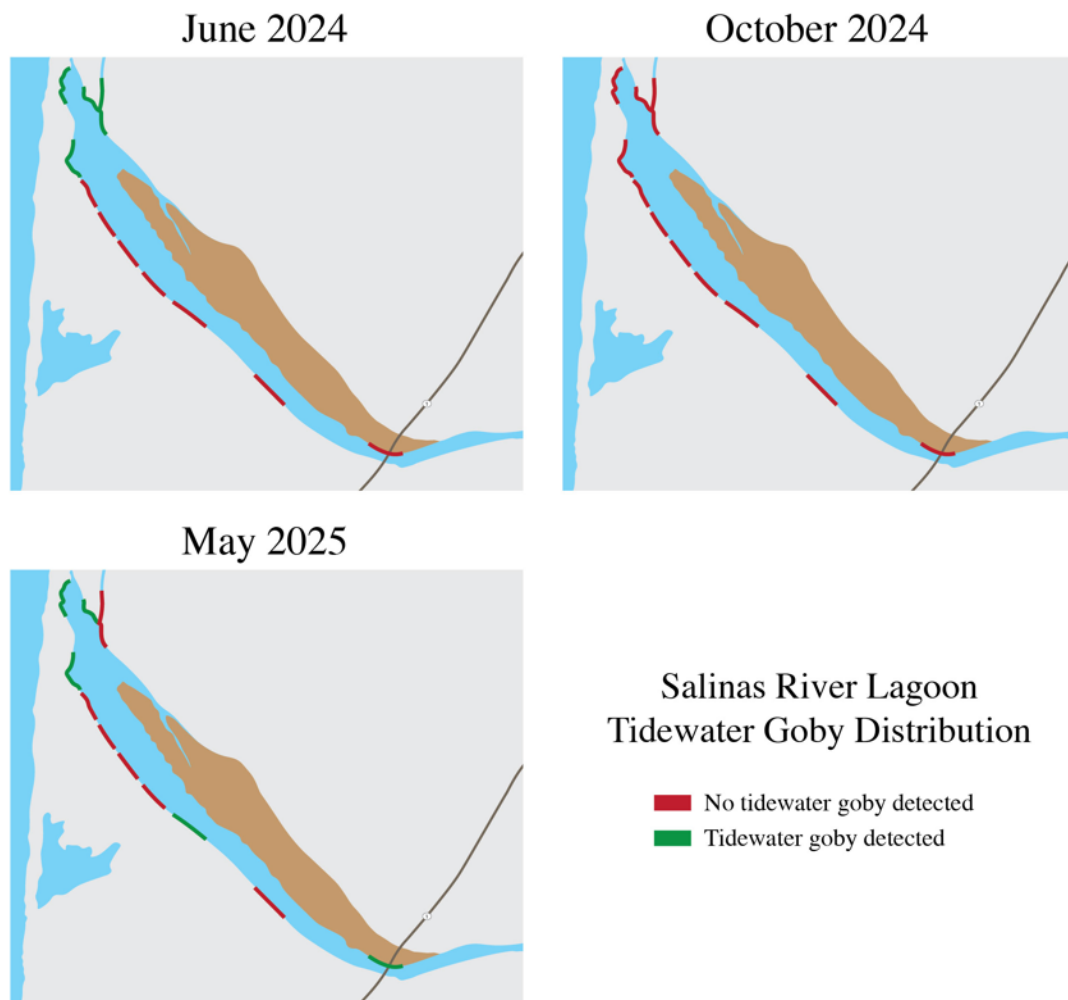


Figure 1. Summary of recent detection records of tidewater goby in the Salinas River Lagoon in 2024 (Spring and Fall) and 2025 (Spring), illustrating presence (green) and absence (red). Note: Methods and effort are not standardized.

Overall, the fish community was dominated by euryhaline species (with a broad salinity tolerance) and marine species, clearly a result of recent connectivity to the ocean. As in past surveys, Pacific staghorn sculpin (*Leptocottus armatus*) was the most abundant species sampled (n=169) and was found at all but one of the sampled locations. Notable observations from this survey effort include detections of bay pipefish (*Syngnathus leptorhynchus*), which is the first time this species was captured during this effort (Figure 3). Surveys also revealed high numbers of both arrow goby (*Clevelandia ios*, n=31), a predominantly marine species closely related to tidewater goby, and yellowfin goby (*Acanthogobius flavimanus*, n=162), including many juveniles (Figure 4). Additional species included speckled sanddab (*Citharichthys stigmaeus*, n=8), starry flounder (*Platichthys stellatus*, n=7), inland silverside (*Menidia beryllina*, n=10), juvenile carp (*Cyprinus carpio*, n=2), threespine stickleback (*Gasterosteus aculeatus*, n=1), and mosquitofish (*Gambusia affinis*, n=1).

Salinity concentrations (measured with a YSI ProSolo Digital Water Quality Meter) were relatively high throughout the lagoon, ranging from 8.2 ppt (at the Highway 1 bridge) to 17.02 ppt (at the northern end of the sandbar, near the general breach location; Table 1). Typically, salinity at the Highway 1 bridge has remained below 5 ppt during past surveys (often much lower), with a marked increase towards the sandbar, but generally not exceeding 10–12 ppt. Surface temperatures and dissolved oxygen were favorable and well within the range of fish species expected in the lagoon, ranging from 17.2 to 21.5 °C, and 8.16 to 11.42 mg/l, respectively. No widgeongrass (*Ruppia sp.*), generally considered an indicator of favorable tidewater goby habitat, was documented at any of the sampled locations.

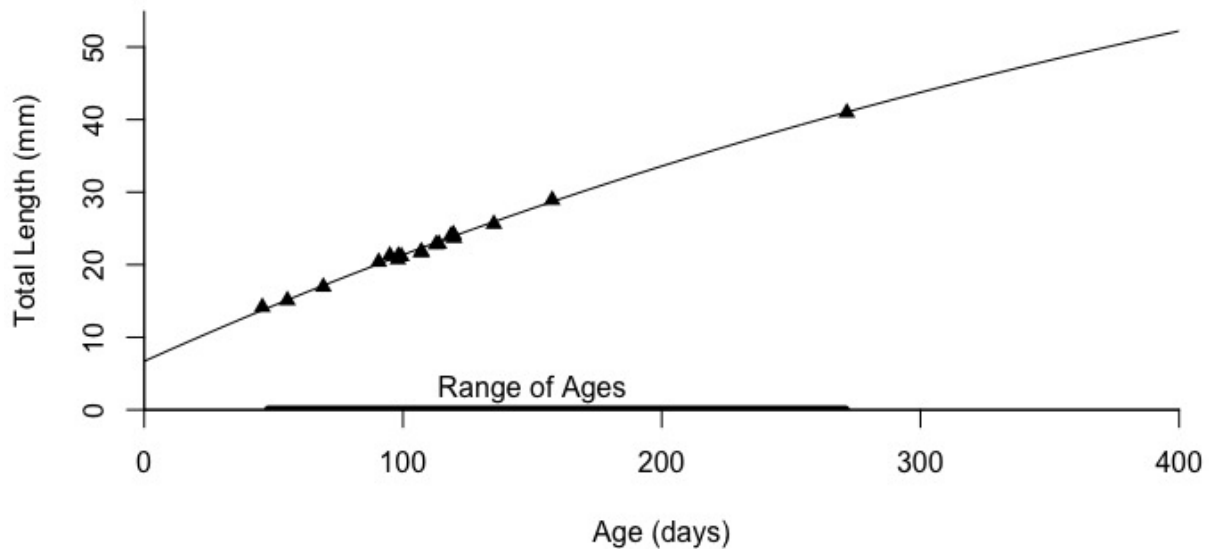


Figure 2. Total lengths (in millimeters [mm]) of tidewater goby (n=19) captured during surveys conducted on May 27–28, 2025, and their estimated age, based on Von Bertalanffy growth parameters (Hellmair & Kinziger 2014).



Figure 3. Bay pipefish captured in the Salinas River Lagoon while beach seining for tidewater goby on May 27, 2025 (near the slidegate).



Figure 4. Juvenile yellowfin goby captured in the Salinas River Lagoon while beach seining for tidewater goby on May 27, 2025.

Table 1. Summary of sampling locations, environmental parameters, and catch in the Salinas River Lagoon, May 27–28, 2025.

Area	Coordinates	Temp. (°C)	Salinity (ppt)	TWG Catch	Other species (n)	<i>Ruppia</i> Presence
OSR	36.75004, -121.8011	20.8	14.97	0	Pacific staghorn sculpin (3)	Absent
Outside OSR	36.74983, -121.80148	21.5	15.62	1	Pacific starry flounder (6), bay pipefish (2)	Absent
Sandbar (North)	36.75133, -121.80264	20.1	17.02	10	Pacific staghorn sculpin (8), yellowfin goby (6)	Absent
Highway 1	36.73203, -121.78302	20.5	8.20	2	Pacific staghorn sculpin (12), speckled sanddab (2), starry flounder (2), yellowfin goby (2), carp (1), three-spined stickleback	Absent
Sandbar (Center)	36.74855, -121.80326	17.2	13.28	4	Pacific staghorn sculpin (31), yellowfin goby (31), speckled sanddab (5), starry flounder (4), top smelt (1)	Absent
Sandbar (South)	36.74713, -121.80335	18.2	12.5	0	Arrow goby (3), yellowfin goby (24), Pacific staghorn sculpin (2), unidentified (1)	Absent
Southwest Corner	36.74641, -121.80293	19.1	14.91	0	Arrow goby (6), Pacific staghorn sculpin (1), yellowfin goby (1)	Absent
NWR Shoreline 1	36.74434, -121.80143	19.1	15.11	0	Arrow goby (4), Pacific staghorn sculpin (1)	Absent
NWR Shoreline 2	36.74391, -121.80119	19.4	15.2	0	Arrow goby (1), Pacific staghorn sculpin (1), top smelt (1)	Absent
NWR Shoreline 3	36.74341, -121.80073	19.8	12.97	0	Arrow goby (1), Pacific staghorn sculpin (1), speckled sanddab (1), top smelt (1)	Absent
NWR Shoreline 4	36.74167, -121.79911	20.1	12.92	2	Arrow goby (7), Pacific staghorn sculpin (1), yellowfin goby (1)	Absent
NWR Shoreline 5	36.73953, -121.79629	19.8	10.05	0	Inland silver side (10), carp (1), mosquito fish (1)	Absent
NWR Shoreline 6	36.73903, -121.79545	19.9	10.06	0	Arrow goby (9), Pacific staghorn sculpin (1), starry flounder (1), yellowfin goby (1)	Absent

Discussion

The tidewater goby population in the Salinas River Lagoon continues to persist despite several periods of prolonged connectivity to the ocean in recent years, and a three-month period immediately preceding this survey. This is a strong indication that the lagoon provides sufficiently suitable and diverse habitats where tidewater goby can find suitable refuge to persist through repeated and prolonged periods of less-than-ideal conditions.

However, the pathways for recolonization (in the event of localized extirpation) and the connectivity (migration) between nearby populations remain poorly understood. A recent investigation using eDNA (FISHBIO 2025) revealed the presence of tidewater goby at multiple locations throughout nearby estuaries and slough complexes, suggesting a relatively resilient metapopulation in the Watsonville-, Moro Cojo-, Bennett-, and Elkhorn Slough complex. It is

thought that the Old Salinas River is an important migratory corridor into the Salinas River Lagoon for several species, including tidewater goby. As the slidegate is closed when the lagoon is breached, the OSR may also serve as an important refuge habitat for tidewater goby during periods of environmental stochasticity in the lagoon, such as during breaching events that result in tidal impacts to the lagoon over extended periods of time. Similarly, suitable, stable refuge habitat may be found in the upstream reaches of the lagoon, where tidal influence during breaches is muted and salinity remains low. Opportunity to sample by hand-held beach seine is limited in this area, and boat-based sampling by small otter trawl should be explored to improve our understanding of the overall distribution of tidewater goby within the Salinas River Lagoon.

During the May survey, arrow gobies and yellowfin gobies were found in unusually large numbers. Both species have been documented in the lagoon in recent years, but in much lower numbers (e.g. a single arrow goby over two surveys in 2023). All captured yellowfin gobies (n=162) were juveniles (smaller than 35 mm in length), and past sampling events have only documented adult individuals of this species.

Most tidewater goby were also small (juveniles) with the exception of a single larger individual (41 mm), likely a post-spawn female (see cover photo). Future surveys will provide additional insight regarding the relative abundance of the three goby species. Arrow gobies can be abundant in the Salinas River Lagoon at times, particularly while the sandbar is breached and for some time thereafter (B. Spies, pers. comm.). However, the species rarely co-occurs with tidewater gobies for extended periods of time. Interactions between tidewater goby and yellowfin goby are poorly understood, but it is likely that the species compete directly for resources, and that the much larger (mature) yellowfin goby may prey upon tidewater goby.

In summary, while prolonged time periods of lagoon closure likely benefit the tidewater goby population in the Salinas River Lagoon by providing stable environmental conditions, the population has persisted through extended periods of marine connectivity over the past two years. However, novel stressors related to the increased abundance of non-native species with similar life histories may affect the tidewater goby in the future.

Future monitoring is expected to provide additional insights regarding population resilience of tidewater goby, abundance trends of competing species, and the prevalence of widgeongrass, which is associated with preferred habitats of tidewater goby but has been largely absent from the lagoon in recent years.

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Appendix 1. Summary of tidewater goby occupancy in the Salinas River Lagoon, 2013 - 2023.

