



**DRAFT2 Fishery and Water Quality Monitoring of Pajaro River Estuary, 2025**  
(Sampling for Tidewater Goby under USFWS Endangered Species Recovery Permit TE-793645-5)



**Upper Pajaro Estuary, looking upstream at sampling site, adjacent to the model airport.  
2 October 2025 (D.W. Alley)**

**Purpose of Sampling**

The Pajaro Storm Drain Maintenance District is required to conduct annual fish sampling in the Pajaro Lagoon/Estuary as a permit condition for emergency lagoon breaching to avoid flooding. Fish sampling documents the presence/absence, distribution and abundance of Steelhead (*Oncorhynchus mykiss*), Tidewater Goby (*Eucyclogobius newberryi*), and other fish and wildlife. 2025 was the 14<sup>th</sup> year of annual sampling, which began in 2012.

## **Summary of 2025 Results**

No Steelhead and one Tidewater Goby were captured from sampling in the lower Pajaro River Estuary along the beach berm or at sites upstream adjacent to the model airplane airport, Thurwachter Bridge, the boat launch and under the Highway 1 Bridge (4 miles upstream of Watsonville Slough). In other sampling efforts in Santa Cruz County by our group, one Tidewater Goby was captured in nearby Soquel Lagoon and 14 in Aptos Lagoon in 2025. They had been detected in all 3 locations in 2022 (Alley 2023a; Alley 2023b; Alley 2024a; 2024b). The sandbar was open to the Monterey Bay at the mouth of the River at high tide only. During the timing of our sampling of Pajaro Estuary in 2025, there was no tidal fluctuation because the beach berm at the mouth was sufficiently high to prevent tidal influx. However, the lower estuary was highly saline. The catch was dominated by Jack Smelt (*Atherinopsis californiensis*) and Top Smelt (*Atherinops affinis*) (**Tables 1-4**). Other captured species, in order of declining numbers, included nonnative Mosquitofish (*Gambusia spp.*; mostly in the uppermost estuary lagoon), Pacific Herring (*Clupea pallasii*), Shiner Surfperch (*Cymatogaster aggregata*), Kelp Pipefish (*Syngnathus californiensis*), California Halibut (*Paralichthys californicus*), Staghorn Sculpin (*Leptocottus armatus*), Arrow Goby (*Clevelandia ios*), Thornback Guitarfish (*Platyrrhinoidis triseriata*: new species), Longjaw Mudsucker (*Gillichthys mirabilis*), Plainfin Midshipman (*Porichthys notatus*), Starry Flounder (*Platichthys stellatus*), other Sculpin (*Cottus spp.*; too small to identify to species), Bat Ray (*Myliobatis californica*), Diamond Turbot, (*Pleuronichthys guttulatus*) and another new one- Black-and-Yellow Rockfish, (*Sebastes chrysomelas*; I.D. by Robert Lea, Ichthyologist). Though once common in the Pajaro River system and Lagoon in the 1960's and historically, native Hitch (*Lavinia exilicauda*) has not been detected since 2014 (**Lea, pers. comm.; Snyder 1913**).

The estuary was highly saline throughout the water column except at the upper boat launch and Highway 1 sites. The lower estuary was moderately warm in the morning, with ample morning oxygen levels. Water temperature and oxygen levels were tolerable for Steelhead. But conditions were too saline to sustain Steelhead, if they had been present previously. The upper estuary was warmer than the lower estuary, and with oxygen adequate in the upper 0.75 to 1.0 m of the water column, though severely stratified to nearly anaerobic at the model airport and Thurwachter Bridge below. More oxygen was present near the bottom at the upper boat launch and Highway 1 sites in the afternoon. The upper estuary would have been too warm for Steelhead in early October, and was likely even warmer earlier in the summer.

Tidewater Gobies could have inhabited the lower estuary along the beach berm and the upper estuary from the boat launch upstream in 2025, as water quality measurements confirmed that oxygen was available throughout the water column. But high salinity measured at the bottom would be problematic for successful Tidewater Goby spawning. With the limited overwintering refuge between the levees during the previous wet winters having high stormflows (WY2023 and WY2024) and one stormflow approaching bankfull stormflows in 2025, the surviving Tidewater Goby population may have been small in spring 2025 when nesting began. Their near absence in

our sampling (one captured along the beach berm) was consistent with likely low survival over the winter.

### **2025 Estuary Conditions**

During fish sampling in early October 2025, an estuary without fluctuating depth and current was present due to a partially closed sandbar that was open only at high tide. The drought years of 2015, 2021 and 2022 were the latest previous years having a closed sandbar. The estuary was highly saline throughout the water column (24-25 ppt) in 2025 except at the upper boat launch and Highway 1 sites where it was less than 19 ppt down to 0.5 meters and moderately saline below that. The lower estuary was moderately warm in the 20-21 °C range in the morning, with ample morning oxygen levels between 5.4 and 8.5 mg/L near the bottom and higher above. Water temperature and oxygen levels were tolerable water temperature for Steelhead. But conditions were too saline to sustain Steelhead, if they had been present previously. The upper estuary was warmer and generally between 23 and 27 °C in the afternoon, and with oxygen adequate in the upper 0.75 to 1.0 m of the water column, though severely stratified to nearly anaerobic at the model airport and Thurwachter Bridge below 1.25 m from the surface down to 2.5 m. More oxygen was present near the bottom at the upper boat launch and Highway 1 sites in the afternoon. The upper estuary would have been too warm for Steelhead in early October, and was likely warmer on some days earlier in the summer. Secchi depth was to the bottom (2 meters at our deepest measured site near Thurwachter Bridge).

### **Methods**

Pajaro Estuary (partially open sandbar at high tide only) was sampled on October 1 – 3, 2025. The tide was lower than the height of the sandberm at the River mouth during the timing of our daily sampling, and there was no tidal fluctuation. Sampling locations in the lower estuary were similar to past years, they being spread out south along the beach berm from the mouth of Watsonville Slough at the north end (**Figure 1**). The upper estuary was sampled at the previous years' locations adjacent to the model airport (1.8 miles upstream of Watsonville Slough), at Thurwachter Bridge (2.1 miles upstream of Watsonville Slough) and behind the City of Watsonville wastewater treatment plant at the boat launch (2.9 miles upstream of Watsonville Slough). An additional sampling site was added at the Highway 1 Bridge (4 miles upstream of Watsonville Slough).

On 1 October, the lower estuary along the beach was sampled for Steelhead with the 106-foot bag seine (8 successful seine hauls). On 2 October, the upper estuary was sampled with the 106-foot bag seine (3/8-inch mesh) at the model airport and Thurwachter Bridge sites, and water quality data were collected. Three seine hauls were made at the model airport, with 3 more at Thurwachter Bridge. Water quality was measured from a boat at the perceived thalweg (deepest portion) at these two sites (water temperature (°C), salinity (parts per thousand), conductivity (umho = micro-siemens = 1 millionth of a siemens) and oxygen (mg/L = parts per million) measured through the water column at 0.25 meter intervals). Secchi depths were measured at the two sites.

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalis, chlorides, sulfides and carbonate compounds and not just sodium chloride. Secchi depth is the depth in the water column at which the black and white secchi disc first becomes visible as it is raised through the water column.

On 3 October, Tidewater Gobies were sampled for, using a 30-foot seine with 1/8-inch mesh. Five seine hauls were made in the lower estuary along the beach berm. Four seine hauls were made in the upper estuary (model airport, Thurwachter Bridge, boat launch and Highway 1). Water quality was measured at 5 stations. Water quality measurements at three lower estuary stations were made nearshore by wading in at seining locations. Water quality measurements at the boat launch and Highway 1 were made nearshore by wading out into the channel. Water quality measurements taken on 2 and 3 October were sufficient to determine general water quality conditions during the fish sampling period in early fall.

### **Results – Fish Capture**

Sampling of the lower estuary along the beachfront with the larger bag seine yielded 15 native fish species (**Table 1**). Smelt were again the most abundant species, with those being identified as Jack Smelt and Top Smelt. Many young-of-the-year smelt were very small and escaped through the seine mesh. Other captured species, in order of declining numbers, included Pacific Herring, Shiner Perch, Kelp Pipefish, California Halibut, Staghorn Sculpin, Arrow Goby, Thornback Guitarfish, Threespine Sticklebacks (mostly in the upper lagoon), Starry Flounder, Plainfin Midshipman, Bat Ray, Diamond Turbot and Black-and-yellow Rockfish. Sampling results with the large seine in the upper estuary near the model airplane airport and Thurwachter Bridge yielded Smelt, Staghorn Sculpin and Shiner Perch (**Table 2**). Using the large seine, no Steelhead were detected in the upper or lower estuary.



Our sampling with the fine-meshed seine for Tidewater Goby in the lower estuary yielded 9 native species, in declining numbers those being Kelp Pipefish, Smelt (Jack and Top), Arrow Goby, Staghorn Sculpin, California Halibut, Threespine Stickleback, other sculpin (too small to positively identify) and Tidewater Goby (**Table 3**). Arrow Gobies were captured at 4 of 5 sites along the beach berm. The one Tidewater Goby was captured along the northern beach berm at the site nearest Watsonville Slough. All 5 beach berm sites were north of the estuary outlet. In 2022 when the sandbar was closed, Tidewater Gobies were captured with the fine-meshed seine in small numbers at all 5 sites in the lower lagoon.

In the upper estuary, sampling results with the fine-meshed seine at the 4 sites yielded no Tidewater Gobies (**Tables 3 and 4**). Species captured included 6 native species in declining numbers, those being Threespine Stickleback, Arrow Goby, Smelt (Jack and Top), Longjaw Mudsucker and Kelp Pipefish. Nonnative Mosquitofish were captured at the uppermost Highway 1 site where it dominated the catch, followed by Threespine Stickleback.

Figure 1. Pajaro Lagoon Fish and Water Quality Sampling Sites



**Legend**

-  Sampling site - tidewater goby
-  Sampling site - tidewater goby and steelhead

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**Table 1. Fish capture\* results from sampling lower Pajaro Estuary with the 106-foot bag seine (3/8-inch mesh), 1 October 2025.**

Date	Location	Seine Haul #	Steel head	Tide-water Goby	Arrow Goby	Pacific Herring	Smelt (jack and top)*	Stag horn Sculpin	Calif. Halibut	Shiner Surf Perch	Starry Flounder	Three spine Stickle back	Thorn back Guitar fish	Kelp Pipe fish	Plain fin Mid ship man	Black-and-Yellow Rock fish	Diamond Tur bot	Bat Ray
1 Oct 2025	South of Watsonville Slough	1			3		415	4	2					17			1	
	South of #1	2				125	20		3	8				2				
	South of #2	3			1	45	24	1		1		4		11				
	South of #3	4				33	22	2	4	16	1			2				
	South of #4	5				2	72	1	3	5		1	3		1	1		
	South of #5	6			1	1	139		16	3	3				2			
	South of #6	7				10	288	1	1	3								
	South of #7	8			1	4	111	1	3				3	2				1
<b>Total</b>		<b>8</b>	<b>0</b>	<b>0</b>	<b>6</b>	<b>220</b>	<b>1091</b>	<b>10</b>	<b>32</b>	<b>36</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>34</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>

\*150+ Yellowshore crabs, 50+ purple crabs, 12+ European green crabs, 7 Dungeness crabs.

\*\*Some YOY smelt escaped through the seine due to their small size.

**Table 2. Fish capture\* results from sampling upper Pajaro Estuary with the 106-foot bag seine (3/8-inch mesh), 2 October 2025.**

Date	Location	Seine Haul	Steel-head	Tide-water Goby	Arrow Goby	Northern Anchovy	Smelt	Staghorn Sculpin	Three-spine Stickle-back	Starry Flounder	Shiner Surfperch
2 Oct 2025	Model Airport	1-3					2331	3			3
	Thurwachter Bridge	4-6					66	1	1		
<b>Total</b>			<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2397</b>	<b>4</b>	<b>1</b>	<b>0</b>	<b>3</b>

**Table 3. Fish capture\* results from sampling the periphery of lower and upper Pajaro Estuary with the 30-foot seine (1/8-inch mesh), 3 October 2025.**

Date	Location	Seine Haul	Steel-head	Tide-water Goby	Arrow Goby	Three spine Stickle back	Kelp Pipe fish	Longjaw Mud sucker	Smelt	Mosquito fish	Stag-horn Sculpin	Calif. Halibut	Other Sculpin
3 Oct 2025	Approx. 100 m south of Pajaro Dunes	1		1	1	7	2		4		3	4	
	South of #1	2			3	1	16		1		6	4	2
	South of #2	3			10	7	6		7		2	1	
	South of #3	4			4	1	2				7	6	
	South of #4	5					2		8			2	
	Model Airport- 0.3 miles down from Thurwachter Bridge	6				1	1	5	2				
	Thurwachter Bridge- 2.1 miles upstream from Watsonville Slough	7							3				
	Boat Launch- 0.8 miles upstream of Thurwachter Br.	8											
	Highway 1 Bridge- 1.0 mile upstream of boat launch	9			9	300+				1000+			
<b>Total</b>		<b>8</b>	<b>0</b>	<b>1</b>	<b>27</b>	<b>317+</b>	<b>29</b>	<b>5</b>	<b>25</b>	<b>1</b>	<b>18</b>	<b>17</b>	<b>2</b>

**Table 4. Annual Number of Tidewater Gobies Captured in Pajaro Estuary/ Lagoon in Fall.**

Year	# of Tidewater Gobies	# of Seine Hauls at Approximately Similar Locations with 30-foot Seine (1/8-inch mesh)
2012	111	8
2013	436	8
2014	414	8
2015	42	8
2016	29	8
2017	0 (1 with 3/8-inch mesh seine adjacent model airplane airport)	8
2018	0	8
2019	0	8
2020	11	8
2021	0	8
2022	7	8
2023	0	8
2024	0	8
2025	1	9 (One site added at Highway 1)



**Black-and-Yellow Rockfish      1 October 2025 (I.M. Laursen)**



**Plainfin Midshipman 1 October 2024 (I.M. Laursen)**



**Jack Smelt 1 October 2024 (I.M. Laursen)**



**Longjaw Mudsucker      1 October 2024   (I.M. Laursen)**



**Kelp Pipefish              3 October 2023   (I.M. Laursen)**



**Thornback Guitarfish      1 October 2025 (C. Steiner)**



**Bat Ray      4 October 2022 (D.W. Alley)**



**Native Hitch (*Lavinia exilicauda*) once common in Pajaro Lagoon in the 1960's, now rarely observed.  
7 October 2014 (D.W. Alley)**

### **Water Quality**

In 2025 at the time of sampling in late morning and early afternoon on October 2 and October 3, the estuary was highly saline throughout the water column (24-25 ppt) except at the upper boat launch and Highway 1 sites where it was less than 19 ppt down to 0.5 meters and increasingly saline below that. Estuary conditions in 2025 were adequate for saltwater-tolerant fish life but too salty for Steelhead. Salinity-related stress to freshwater acclimatized Steelhead would occur when conductivity levels reach 12,000 to 15,000 micro-mhos, associated with sudden increases in salinity to 10–12 ppt (**J. Cech, fish physiologist, personal communication**). However, Steelhead acclimatized to estuary conditions with fluctuating salinity and stratification can survive where salinity increases with depth as long as near surface, salinity is low and water temperature is cool enough. In the lower estuary, salinity was beyond the tolerance of Steelhead in October. The upper estuary was inhospitable to Steelhead except near the surface at the boat launch and Highway 1, with too high salinity for Steelhead measured throughout the water column at Thurwachter Bridge and the model airport.

The lower estuary was moderately warm in the 20-21 °C in the morning, with ample morning oxygen levels between 5.4 and 8.5 mg/L near the bottom and higher above. Water temperature and oxygen levels were tolerable for Steelhead. But conditions were too saline to sustain Steelhead in the lower estuary. Tidewater Gobies could tolerate these water quality conditions.

The upper estuary was warmer than the lower estuary and generally between 23 and 27 °C in the early afternoon in early October. The daily maximum water temperature is typically warmer later

in the afternoon on clear days. This indicated that the upper estuary was too warm for Steelhead even in early October, and water temperature was likely even warmer earlier in the summer. These warm water conditions would be tolerated by Tidewater Gobies.

Oxygen levels in the upper estuary at the model airport and Thurwachter Bridge were adequate for Steelhead by late morning in the upper 0.75 to 1.0 m of the water column, though severely stratified to nearly anaerobic conditions below 1.25 m from the surface down to 2.5 m. Oxygen levels were adequate for Steelhead further upstream at the boat launch and Highway 1 sites later in the afternoon, though oxygen concentration was stratified with nearly anaerobic conditions at the bottom. These oxygen conditions would be tolerable for Tidewater Gobies along shallow margins.

**Table 5. Water quality measurements in the upper Pajaro estuary during fish sampling for Steelhead, 2 October 2025.**

		2-Oct-2025							
		Model Airport (mid-channel) Air temp. 18.5 °C			1144 hr	Thurwachter Bridge (mid-channel) Air temp. 19.1 °C			1403 hr
Depth	Temp	Salin	Oxygen	Cond	Temp	Salin	Oxygen	Cond	
(m)	( C )	(ppt)	(mg/l)	micro- mos	( C )	(ppt)	(mg/l)	micro- mos	
<b>0</b>	22.3	14.6	9.61	23103	24.0	20.5	9.09	32151	
<b>0.25</b>	23.0	18.8	7.29	29139	24.1	21.0	7.35	32856	
<b>0.5</b>	23.2	22.5	4.68	34612	24.1	21.9	6.49	34321	
<b>0.75</b>	23.3	23.2	4.85	35569	24.4	22.9	7.63	35904	
<b>1.0</b>	23.4	24.3	2.69	37112	24.4	23.0	8.02	35951	
<b>1.25</b>	23.4	24.8	0.91	37819	23.9	24.2	6.65	37322	
<b>1.50</b>	24.0	25.6	0.16	39227	24.6	26.4	0.17	40929	
<b>1.75</b>	23.9	29.5	0.10	43542	24.2	29.4	0.08	44638	
<b>1.87b</b>					24.2	29.5	0.07	44861	
<b>2.00</b>	23.7	30.3	0.09	45419					
<b>2.25</b>	23.5	30.5	0.08	45597					
<b>2.50b</b>	23.4	30.6	0.07	45571					

\* “b” indicates the estuary bottom where measurements were taken through the water column.

**Table 6. Water quality measurements in the lower Pajaro estuary (Seine Hauls 1, 3 and 5 nearshore along beach) and 2 upper estuary sites during fish sampling for Tidewater Goby, 3 October 2025.**

3-Oct-2025								
	Seine Haul 1 (l. estuary) air temp 20.4 °C			1017hr	Seine Haul 3 (lower estuary)			1116hr
Depth	Temp	Salin	Oxygen	Cond	Temp	Salin	Oxygen	Cond
(m)	( C)	(ppt)	(mg/l)	micro-mhos	( C)	(ppt)	(mg/l)	Micro-mhos
<b>0</b>	20.9	24.4	8.86	35341	20.9	24.2	9.10	34450
<b>0.25</b>	20.9	24.3	7.33	35158	20.7	24.5	7.03	35324
<b>0.5</b>	20.8	24.3	7.13	35096	20.7	24.5	6.23	35329
<b>0.75</b>	20.6	24.3	6.75	35024	20.7	24.6	5.39	35467
<b>1.0b</b>	20.7	24.3	6.14	35074	20.7	24.7	4.04	35559
	Seine Haul 5 (lower estuary) air temp 18.7 °C			1203 hr	Seine Haul 8- Boat Launch Launch (upper estuary nearshore) air temp 23.3 °C (Adjacent to Wastewater Plant)			1424 hr
Depth	Temp	Salin	Oxygen	Cond	Temp	Salin	Oxygen	Cond
(m)	( C)	(ppt)	(mg/l)	micro-mhos	( C)	(ppt)	(mg/l)	micro-mhos
<b>0</b>	21.0	25.0	9.73	36220	24.5	12.9	14.07	21254
<b>0.25</b>	21.0	25.1	8.47	36247	25.3	13.2	14.39	22028
<b>0.5</b>	20.9	25.1	8.64	36221	23.2	17.8	14.41	29644
<b>0.75</b>	20.9	25.1	8.52	36216	26.0	22.1	9.31	35865
<b>1.00b</b>	20.9	25.1	8.59	36230	25.6	24.7	6.62	39334

\* “b” indicates the estuary bottom where measurements were taken through the water column.

**Table 6 (cont'd). Water quality measurements in the lower Pajaro estuary (Seine Hauls 1, 3 and 5 nearshore along beach) and 2 upper estuary sites during fish sampling for Tidewater Goby, 3 October 2025.**

		3-Oct-2025					
Seine Haul 9– Highway 1 (upper estuary) air temp 21.2°C		1527 hr					
Depth	Temp	Salin	Oxygen	Cond			
(m)	( C)	(ppt)	(mg/l)	micro-mhos			
0	22.7	9.2	10.02	15.58			
0.25	23.0	9.5	9.59	15561			
0.5	26.5	17.2	6.76	28891			
0.75	27.2	22.6	4.58	37185			
0.87b	27.0	24.3	0.29	39884			

\* “b” indicates the estuary bottom where measurements were taken through the water column.

After 15 years of water quality monitoring and Steelhead/Tidewater Goby sampling of Santa Rosa Creek Lagoon near Cambria, CA (Alley 2008), and 30+ years of the same at Soquel Creek Lagoon in Capitola, CA (Alley 2026a), the following recommendations were made to insure Steelhead habitation in Central Coast lagoons. They would be difficult to attain in Pajaro Lagoon/Estuary due to the absence of/ or extremely limited summer stream inflow.

- *The 7-day rolling average water temperature within 0.25 m of the bottom should be 19°C or less.*
- *Maintain the daily maximum water temperature below 25°C (77°F).*
- *If the maximum daily water temperature should reach 26.5°C (79.5°F), it should be considered the lethal limit for Steelhead.*
- *Water temperature at dawn near the bottom for at least one monitoring station should be 16.5°C (61.7°F) or less on sunny days **without** morning fog or overcast **and** 18.5°C (65.3°F) or less on days **with** morning fog or overcast.*
- *Maintain the daily dissolved oxygen concentration near the bottom at 5 milligrams/liter or greater, though it does not become critically low and potentially lethal until it is less than 2 mg/l throughout the water column for several hours, with the daily minimum occurring near dawn or soon after.*

Coastal lagoons/estuaries are very food-rich environments where Steelhead growth rates are very high, despite warmer water temperatures. A study completed by **Farrel et al. (2015)** indicated that the thermal range over which a Tuolumne River *O. mykiss* population could maintain 95% of peak aerobic capacity was 17.8°C to 24.6°C. Furthermore, up to a temperature of 23°C, all individual fish could maintain a factorial aerobic scope (FAS) value >2.0 (FAS = Maximum metabolic rate (MMR) / Routine metabolic rate (RMR)), one that is predicted to provide sufficient aerobic capacity for the fish to properly digest a meal.

Tidewater Gobies can physiologically tolerate the warmest, most saline, and lowest oxygen conditions that may be found in lagoon/estuary conditions, so long as some oxygen is present on the bottom. However, they typically build their nests in sand on the bottom under freshwater or low salinity conditions and minimal tidal fluctuation and current. Therefore, to reproduce they need freshwater conditions, or nearly so, and oxygen along the bottom away from tidal fluctuations. This condition may only exist at the upper end of a lagoon/estuary where freshwater inflow occurs. If the sandbar closes and a freshwater lagoon develops from sufficient freshwater inflow in the summer, spawning conditions may be extensive. Artificial summer and fall sandbar breaching unassociated with stormflow, especially after freshwater conversion of the lagoon, would negatively impact Tidewater Gobies because the lagoon would become saline from Bay inflow until the sandbar closed again and without sufficient inflow to reconvert it to freshwater. Tidewater Gobies are poor swimmers and require overwintering backwater habitat that is protected from river current to avoid being flushed out of the wet-season estuary by stormflow.

Tidewater Gobies could inhabit the lower estuary in 2025, as water quality measurements confirmed that oxygen was available throughout the water column. They could likely inhabit much of the upper estuary along the shallow margins where oxygen was present. But high salinity measured at the bottom would be problematic for successful Tidewater Goby spawning. With the limited overwintering refuge between the levees during the previous 2025 winter having one stormflow approaching bankfull flow, the surviving Tidewater Goby population may have been small in spring 2025 when nesting began. Their near absence in our sampling was consistent with likely low survival over the winter. A bankfull event is a stormflow that occurs with approximately a 1.5 to 2-year frequency, without respect to how high the water surface reaches on the streambank. A bankfull event can be much less than a flow that will fill the streambanks of a river or cause flooding. The bankfull event is channel forming, however, and causes the streambed to move. According to the hydrologist, Luna Leopold, the dominant discharge or channel forming flow is theorized to be approximately the 2-year flow in most rivers (**Leopold et al. 2000; Dover Edition**) and typically ranges from about the 1.3- to the 2.5-year event (**Rosgen 1996**). The 2-year flow for the Pajaro River just downstream of Soap Lake is approximately 2,450 cubic feet per second (cfs) and is 3,200 cfs downstream of the USGS gage at Chittenden. It is 3,500 cfs downstream of Salsipuedes Creek (work done in 2002 by Schaaf & Wheeler Consulting Civil Engineers regarding the Pajaro River Watershed Study). Streamflow data for USGS gage 11159500 at Watsonville (downstream of Salsipuedes Creek) indicates there were six stormflows above 3,500 cfs in WY2023, two of which exceeded 10,000 cfs. There were two stormflows approaching 3,500 in WY2024 (2,830 and 2,440 cfs). One stormflow approached 3,500 cfs in February of WY2025 (2960 cfs).

Tidewater Gobies were present in low densities during our sampling of Soquel and Aptos Lagoons in 2025 with two bankfull events in WY2025 (**Alley 2026a; 2026b**).

### **Conclusions**

No Steelhead and one Tidewater Goby were detected in the Pajaro Estuary in fall 2025, as was the case for Steelhead in the previous 13 years of annual monitoring. At the time of fish sampling, the sandbar was open at high tide only (no depth fluctuation except at high tide), creating a highly saline estuary except reduced salinity near the surface at our uppermost Highway 1 monitoring site, 4 miles upstream of Watsonville Slough. The lower estuary had ample oxygen and water temperature within the Steelhead thermal tolerance range and could have supported freshwater acclimated Steelhead, except it was too saline for Steelhead. The upper estuary was too warm for Steelhead and too saline for freshwater acclimated Steelhead except near the surface at Highway 1. Water temperature was likely even warmer earlier in the summer when air temperature was more elevated. For comparison, July and August are typically the warmest months in Soquel Lagoon (**Alley 2026a**), as well as in other smaller lagoons in San Luis Obispo County, such as San Simeon and Santa Rosa Creek Lagoons (**Alley 2003; 2004**). Water temperature declines by October in these other lagoons. These comparisons are weak because these are smaller lagoons which have sandbars that close every summer, and the sandbar

at the Pajaro rivermouth often does not. However, it is reasonable to assume that with longer day lengths and warmer air temperature earlier in the summer, water temperatures will be cooler near the surface in early October in the Pajaro Estuary than earlier in the summer, even without a closed sandbar.

Water quality was adequate for survival of Tidewater Gobies in 2025. But spawning conditions were likely very marginal only in the uppermost estuary and absent in the lower estuary due to high salinity at the bottom. With the leveed channel in Pajaro Estuary, protected backwaters with tules are limited for providing overwintering cover during the one stormflow event that occurred during the previous winter.

## LITERATURE CITED AND PERSONAL COMMUNICATIONS

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