

CHAPTER 5

Fish Survey

The goal of the Hamilton Wetlands Restoration Project is to create a diverse array of wetland and wildlife habitats to benefit a number of special status species, migratory and other resident species that occur in the San Francisco Bay-Delta. The former Hamilton Army Airfield was breached on April 25, 2014, re-connecting San Pablo Bay tides to 648 acres of tidal and seasonal wetlands, transitional ecotone and upland habitats. Once part of an extensive network of tidal wetlands along the western margin of San Pablo Bay, the Hamilton site is one of the few remaining tidal wetlands, restored or natural, within the region. As such, ongoing monitoring is paramount to understand how wildlife responds during the course of the sites evolution, and will surely inform future restoration efforts within the region.

The purpose of conducting annual fish monitoring is to document the species richness, abundance, and distribution within the Hamilton restoration site. Documenting annual changes in the fish community throughout the course of the site's evolution over time serves as an important variable in evaluating the overall health of the site, and will help inform future restoration efforts in the region. On May 14 & 15, 2018 Environmental Science Associates (ESA) conducted the fourth year of fish sampling throughout the Hamilton restoration site. This report documents those findings.

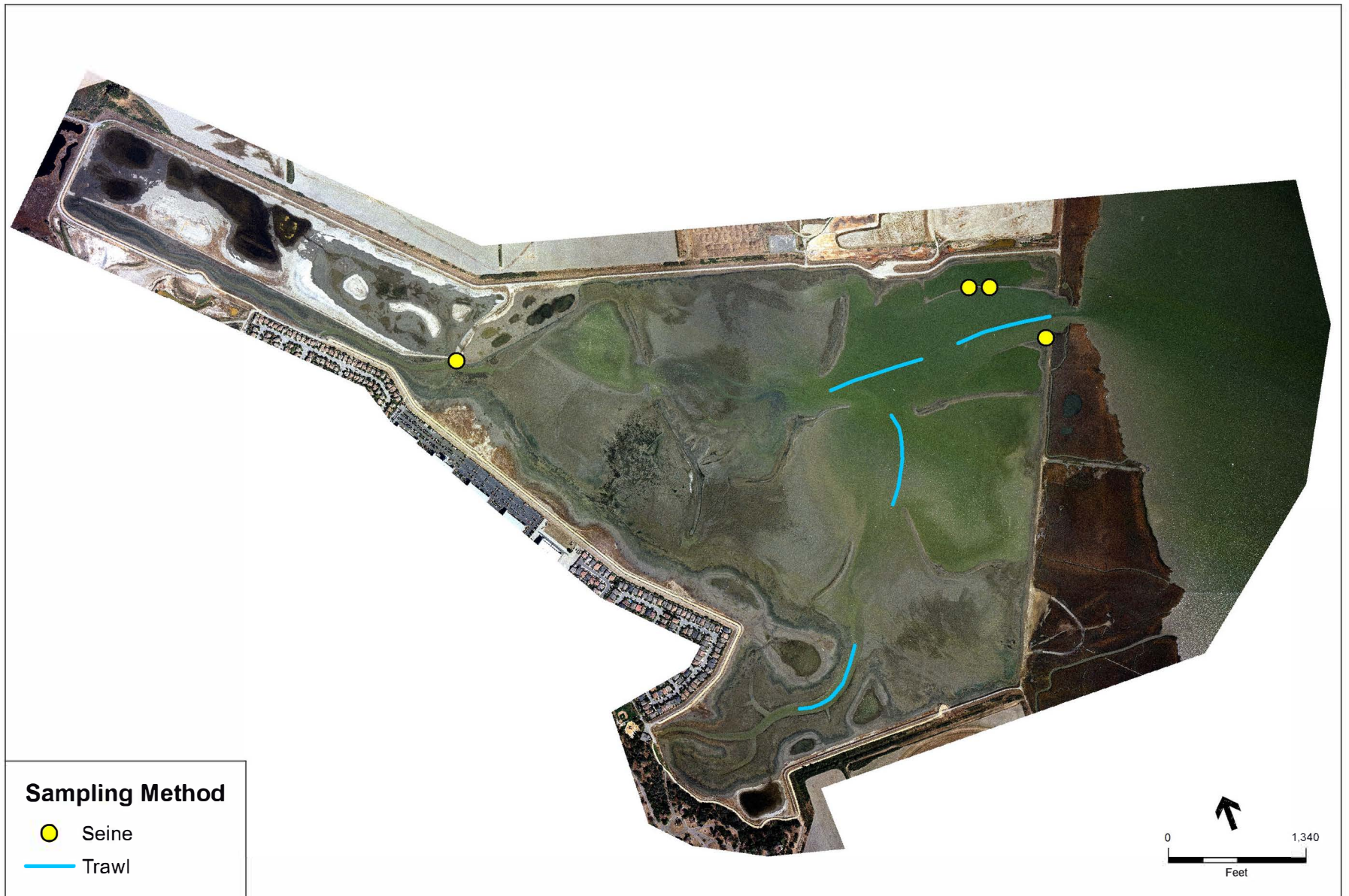
5.1 Materials and Methods

5.1.1 Fish Sampling Methods

The fish sampling methodology for the year 3 (2018) survey was consistent with that of Years 0 through 2 (2015-2017), in that it consisted of the same modes of sampling and reoccupied the same locations within the site. The timing of the survey was also relatively similar (late April to early May).

The habitat complexity within Hamilton is such that, in order to comprehensively sample all available habitats, multiple sampling methods are required. A 40 ft. beach seine was used to sample the nearshore areas within the main and tertiary tidal channels. Since seining is a depth-limited method, an otter trawl was used to survey the in-channel habitat within the main, secondary and tertiary channels. The net head line dimensions of the otter trawl are 12 ft. wide by 3 ft. high. Sampling locations are shown in **Figure 17**.

All fishes captured were identified to the species, measured (total length in mm), and returned to the channel in which they were caught. The sampling results represent a snapshot of the species abundance and distribution at a given point in time, as such they are not assumed to capture all species that may be present within the site.



5.1.2 Site Conditions

Fish sampling was conducted spring 2018 (May 14 and 15) and timed to coincide with tidal elevations appropriate for ensuring sufficient depth for both sampling and navigation. Tidal elevations for the sampling dates are reported in **Table 5-1**.

TABLE 5-1
PREDICTED TIDE HEIGHT DURING SAMPLING PERIODS

Date	Tide Height (ft MLLW) and Time (PT)
May 14, 2018	High Tide: 6.29 (00:20)
	Low Tide: -0.34 (07:29)
	High Tide: 4.98 (13:30)
	Low Tide: 1.35 (19:46)
May 15, 2018	High Tide: 6.54 (00:55)
	Low Tide: -0.75 (08:10)
	High Tide: 5.08 (14:24)
	Low Tide: 1.63 (19:59)

Petaluma River Entrance, San Pablo Bay California, Sta.ID 9415252

5.2 Fish Sampling Results

5.2.1 Species Composition

This sampling effort resulted in the capture and identification of 697 individual fish representing 13 families and 18 species (**Table 5-2**)

TABLE 5-2
FISH SPECIES PRESENT IN THE PROJECT SITE – 2018

Common Name	Scientific Name	Families
Native Species		
Northern anchovy	<i>Engraulis mordax</i>	<i>Engraulidae</i>
Pacific herring	<i>Clupea pallasii</i>	<i>Clupeidae</i>
Pacific staghorn sculpin	<i>Leptocottus armatus</i>	<i>Cottidae</i>
Three-spined stickleback	<i>Gasterosteus aculeatus</i>	<i>Gasterosteidae</i>
Topsmelt	<i>Atherinops affinis</i>	<i>Atherinopsidae</i>
California halibut	<i>Paralichthys californicus</i>	<i>Paralichthyidae</i>
Bay pipefish	<i>Syngnathus leptorhynchus</i>	<i>Syngnathidae</i>
Diamond turbot	<i>Hypsopsetta guttulata</i>	<i>Pleuronectidae</i>
Leopard shark	<i>Triakis semifasciata</i>	<i>Triakidae</i>
Shiner surfperch	<i>Cymatogaster aggregata</i>	<i>Embiotocidae</i>
Speckled sanddab	<i>Citharichthys stigmatæus</i>	<i>Paralichthyidae</i>
Starry flounder	<i>Platichthys stellatus</i>	<i>Pleuronectidae</i>
Non-Native Species		
Chameleon goby*	<i>Tridentiger trionocephalus</i>	<i>Gobiidae</i>
Yellowfin goby	<i>Acanthogobius flavimanus</i>	<i>Gobiidae</i>
Rainwater killifish	<i>Lucania parva</i>	<i>Fundulidae</i>
Shokihaze goby	<i>Tridentiger barbatus</i>	<i>Gobiidae</i>
Shimofuri goby	<i>Tridentiger bifasciatus</i>	<i>Gobiidae</i>
Striped bass	<i>Morone saxatilis</i>	<i>Moronidae</i>

* Chameleon goby and shimofuri goby are known to hybridize in the San Francisco Bay-Delta, it is unclear to what extent the chameleon gobies observed were of hybrid stock.

5.2.2 Main Tidal Channel

Over the course of the two-day sampling event, eight (8) seine hauls and four (4) otter trawls were conducted within the main tidal channel (**Figure 18**). Each trawl was towed for approximately 10 minutes beginning at the time the gear was fully deployed (on the bottom) at a speed of approximately 1-1.5 knots.

Seventeen (17) fish species were captured in the main channel during the survey, with the assemblage being comprised of mostly native species (12 native species, 5 non-native species, 491 captured fish) (**Table 5-3**). Juvenile yellowfin goby and staghorn sculpin were the most abundant species captured in the main tidal channel, both nearshore and in-channel, comprising over 54% of the total catch, combined. The benthic assemblage was dominated by the two aforementioned species, as well as chameleon goby which constituted another 17% of the main tidal channel catch. Multiple native flatfish were captured within the main tidal channel including: starry flounder (6% of total catch), California halibut (3%), speckled sanddab (<1%), and diamond turbot (<1%). Seven (7) pelagic species were recorded in the main tidal channel, the most common being juvenile topsmelt (15%). All other pelagic species were encountered in much lower numbers and include northern anchovy (2%), Pacific herring (2%), leopard shark (<1%) threespine stickleback (<1%), and striped bass (<1%).

5.2.3 Secondary and Tertiary Tidal Channels

The trawl was deployed within both the secondary and tertiary channels, but because of access difficulties the seine was deployed only in portions of the tertiary channel network and not at all in the secondary channels. Each trawl followed the same methodology as the main channel, with the tow lasting approximately 10 minutes at 1-1.5 knots. This effort was similar to past sampling years.

The secondary and tertiary channels showed similar species abundance patterns as observed in the main channel, albeit with slightly less diversity (10 total species) and less overall abundance (206 individuals). Northern anchovy (23% of total catch) and topsmelt (13%) were the most frequently encountered pelagic species only a small number of threespine stickleback, rainwater killifish, and Pacific herring were also recorded. Yellowfin goby were the most abundant benthic species encountered (28%), however staghorn sculpin (18%) and chameleon goby (8%) were also observed in high numbers. All species recorded in the secondary and tertiary channels were also present in the main channel, with the exception of rainwater killifish.

TABLE 5-3
FISHES CAPTURED IN THE MAIN, SECONDARY AND TERTIARY CHANNELS

Species	Main Tidal Channel				Secondary Tidal Channels				Tertiary Tidal Channels			
	Count	Total Length (mm)			Count	Total Length (mm)			Count	Total Length (mm)		
		Mean	Min	Max		Mean	Min	Max		Mean	Min	Max
Seine												
California halibut	1	31	31	31								
Chameleon goby	32	50	30	75					12	53	40	65
Diamond turbot	1	87	87	87								
Leopard shark	1	184	184	184								
Northern anchovy	3	35	30	39					22	36	30	45
Shimofuri goby	4	64	51	71								
Speckled sanddab	1	50	50	50								
Staghorn sculpin	96	48	26	95	No Seine in Secondary Channels				18	44	20	80
Starry flounder	9	41	20	63					1	30	30	30
Three-spined stickleback	3	30	30	30					4	29	25	30
Topsmelt	72	30	20	38					22	95	30	140
Yellowfin goby	9	36	20	78					31	42	25	60
Pacific herring									1	160	160	160
Rainwater killifish									3	40	35	45
Trawl												
Bay pipefish	1	180	180	180								
California halibut	2	224	107	340	1	108	108	108				
Chameleon goby	51	57	38	85	2	42	38	45	2	54	45	63
Leopard shark	1	190	190	190								
Northern anchovy	7	42	38	45	16	32	28	40	9	35	30	40
Pacific herring	8	54	25	142	1	56	56	56	4	33	30	35
Shimofuri goby	2	63	55	70								
Shiner surfperch	1	137	137	137								
Shokihaze goby	6	55	45	70								
Staghorn sculpin	20	48	20	70	9	35	20	61	10	45	35	60
Starry flounder	20	70	20	205	6	33	25	41	1	20	20	20
Striped bass	1	325	325	325								
Yellowfin goby	139	40	10	75	26	28	20	41				
Topsmelt					3	30	30	30	2	30	20	40

**TABLE 5-4
COMPARISON BETWEEN SURVEY YEARS**

Species	2015	2016	2017	2018
Marine				
Bat ray	3	4	0	0
Bay pipefish	3	1	0	1
Northern anchovy	2439	981	854	57
California halibut	11	10	30	4
California tonguefish	20	3	0	0
Diamond turbot	1	7	0	1
Speckled sanddab	0	0	0	1
Starry flounder	0	0	0	37
Leopard shark	12	0	0	2
Shiner surfperch	4	1	0	1
Walleye surfperch	1	0	0	0
Topsmelt	142	290	4	99
Pacific herring	0	2	1	14
Estuarine				
Chameleon goby	15	101	24	99
Pacific staghorn sculpin	45	7	63	153
Prickly sculpin	10	0	0	0
Rainwater killifish	1	3	3	3
Shimofuri goby	7	0	0	6
Shokihaze goby	119	22	65	6
Yellowfin goby	1	0	755	205
Longjaw mudsucker	0	4	0	0
Anadromous				
American shad	6	0	0	0
Chinook salmon	0	0	1	0
Striped bass	2	3	2	1
Freshwater (Brackish)				
Three-spined stickleback	1	11	39	7
Species Origin (overall subtotal)				
<i>Native</i>	13	12	7	12
<i>Non-Native</i>	7	4	4	6
Total	2843	1450	1841	697

5.3 Invertebrate Sampling

No targeted invertebrate sampling was conducted as part of the survey effort, however, as with previous survey years, multiple species and age classes were observed throughout the site. Multiple shrimp species (*Crangon* spp.) and age classes were observed throughout the site; however larval individuals were extremely abundant within all of the tidal channels. The high abundance of larval shrimp is important for the rearing larval and juvenile fish, and suggests a large amount of production at lower trophic levels. The combination of consistently high numbers of juvenile shrimp and domination of the fish assemblage by juveniles suggest that Hamilton is serving as an important rearing site for multiple species.

Unlike previous years, large numbers of jellyfish were observed throughout the site, regardless of survey method or location. The majority of the jellyfish were approximately 1-inch in bell diameter, however a few larger individuals of approximately 4-inch bell diameter were also encountered. All jellyfish were moon jellies (*Aurelia aurita*), a widely distributed jellyfish, common along the California coastline. It is not uncommon for large incursions of moon jellyfish to occur within the San Francisco Bay-Delta and, while infrequent, a similar influx was documented in 2010.¹

5.4 Discussion

The 2018 sampling season saw a significant reduction in the total number of fish captured. This reduction in abundance occurred most significantly with northern anchovy and yellowfin goby. During the 2017 sampling season large numbers of juvenile and larval anchovy and yellowfin goby were encountered throughout the site, regardless of sampling method. While still abundant relative to other species found within the site, both anchovy and yellowfin goby numbers declined significantly between 2017 and 2018. It is unclear whether the decline in abundance is a result of typical year-to-year fluctuations in population abundance, or a result of changes in hydrologic conditions within the site. Alternatively, the geomorphological evolution of site from primarily open mudflat to a more sinuous, channelized environment could be contributing to this reduction in abundance. The 2018 survey season also occurred later in the calendar year than the previous survey events and may also be a factor in this decline. Regardless of the proximate cause, this significant decline in abundance over the course of one year should not be viewed as a larger assemblage-level population trend. Given that the majority of the decline occurred within the larval/juvenile age class, it is likely this decline is part of standard year-to-year fluctuations in fecundity. However, continued monitoring is required to determine if this decrease is part of larger trend.

The relative abundance of pelagic species was generally the same as previous years, with yellowfin goby, staghorn sculpin, chameleon goby, topsmelt, and northern anchovy dominating the assemblage. However, as mentioned previously, significant declines in juvenile northern anchovy and yellowfin goby were observed compared to previous years. The benthic assemblage continued to be dominated by non-native goby species but showed a dramatic increase in the number of native staghorn sculpin within the site. There was an increase in native fish species

¹ NBC Bay Area. 2018. *Countless Jellyfish Wash Ashore at Pacifica Beach in San Francisco*. Published May 29, 2018. Available at: <https://www.nbcbayarea.com/news/local/Countless-Jellyfish-Wash-Ashore-at-Pacifica-Beach-in-San-Francisco-483994971.html>

relative to the 2017 survey, more consistent with first two survey years. A single leopard shark was recorded within the site for the first time since the 2015 survey season.

Consistent with the preceding two survey years, the fish collected during this sampling event represent a diversity of trophic levels, life stages, and life history requirements. Larval and juvenile fish were primarily represented by staghorn sculpin and yellowfin goby. Both seine and trawl were utilized throughout the site in order to comprehensively sample both nearshore and in-channel habitat, however, nearshore conditions made seining in secondary channels impossible. Trawling and seining captured both benthic and pelagic species, with yellowfin goby being the dominant species encountered by each method. Consistent with the 2017 survey, trawls and seine hauls yielded similar levels of abundance and showed a similar composition of species. Additionally, there seemed to be a fairly even distribution of fish life-stage regardless of the method used, with large numbers juvenile fish captured by both methods. However, as with previous years, the largest fish sampled were captured by trawl.

Monitoring over the past four years (2015 to 2018) has documented a diverse assemblage of species throughout the tidal wetland restoration site. While the number and abundance of individual species has fluctuated annually, utilization of all portions of the project site by multiple species and life stages has consistently been documented. When compared to the nearby Sonoma Baylands tidal wetland, the Hamilton site shows a greater abundance in native species and fewer invasive species. **Table 5-5** provides a comparative summary of the three years of monitoring at the Hamilton site and decade of surveys at the Sonoma Baylands.

**TABLE 5-5
COMPARISON BETWEEN SITES**

Species	Hamilton Wetlands 2015 - 2018	Sonoma Baylands 1999 - 2014
Native Species		
Northern anchovy	X	X
Pacific herring	X	X
Topsmelt	X	X
Bay pipefish	X	X
Three-spined stickleback	X	X
Staghorn sculpin	X	X
Prickly sculpin	X	X
Longjaw mudsucker	X	X
Diamond turbot	X	X
Starry flounder	X	X
Shiner surfperch	X	
Walleye surfperch	X	
Bat ray	X	
Leopard shark	X	
California halibut	X	
California tonguefish	X	
Chinook salmon	X	
Speckled sanddab	X	
Longfin smelt		X
Sacramento splittail		X
English sole		X
Arrow goby		X
Introduced Species		
Striped bass	X	X
American shad	X	X
Rainwater killifish	X	X
Shokihaze goby	X	X
Shimofuri goby	X	X
Chameleon goby	X	X
Yellowfin goby	X	X
Inland silverside		X
Brown bullhead		X