

State of California
Department of Fish and Wildlife

Memorandum

Date: December 21, 2021

To: Stephanie Fong
Acting Regional Manager
Bay Delta Region

From: James White
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Subject: 2021 Fall Midwater Trawl Annual fish abundance and distribution summary

The California Department of Fish and Wildlife (CDFW) has conducted the Fall Midwater Trawl Survey (FMWT) to index the fall abundance of pelagic fishes annually since 1967 (except 1974 and 1979). FMWT equipment and methods have remained consistent since the survey's inception, allowing the indices to be compared across time. These relative abundance indices are not intended to approximate population sizes. However, we expect that our indices reflect general patterns in population change (Polansky et al. 2019).

Presently, the FMWT conducts 4 monthly surveys from September through December and calculates a monthly abundance index for each survey. The annual abundance index, for each pelagic species, is the sum of the monthly survey indices. Sampling regions range from San Pablo Bay upstream to Stockton on the San Joaquin River, to near Hood on the Sacramento River, and into Cache Slough and through the Sacramento River Deep Water Ship Channel (SRDWSC). During each monthly survey, one 12-minute oblique midwater trawl tow is conducted at each of 100 index stations used for index calculation and at an additional 22 non-index stations that provide enhanced distribution information (Fig. 1). Monthly and annual abundance indices are calculated using catch data from index stations grouped into 14 regions. Monthly abundance indices are calculated by averaging catch per tow for index stations in each region, multiplying each regional average by its respective weighting factor (i.e., a scalar based on water volume) for each region, and summing those products for all 14 regions. All fish are identified and counted at each station.

Station 721 was not sampled in 2021 due to aquatic vegetation. This station in Cache Slough has been increasingly difficult to sample the past few years due to increasing amounts of an invasive aquatic plant, Brazilian waterweed (*Egeria densa*), fouling sampling gear. Thus, the decision was made this year to sample instead further downstream in Cache Slough by 2 kilometers which is deeper (average ~20 feet) with less vegetation. This new station is labeled 722 and is at the same location as Summer Towntnet (STN) 722 and Spring Kodiak Trawl (SKT) 716.

The 2021 sampling season began September 1 and was completed on December 16. In September, October, November, and December, 121, 122, 122, and 122 fish tows were conducted as well as 32 zooplankton tows, respectively. Here we report catch from index and non-index stations, species distributions by region, and annual abundance indices for seven pelagic fish species; Delta Smelt (native), Striped Bass (introduced), Longfin Smelt

(native), American Shad (introduced), Threadfin Shad (introduced), Splittail (native), and Wakasagi (introduced). A map of species distribution by station is also publicly available online: ([FMWT Species Distribution Map](#)).

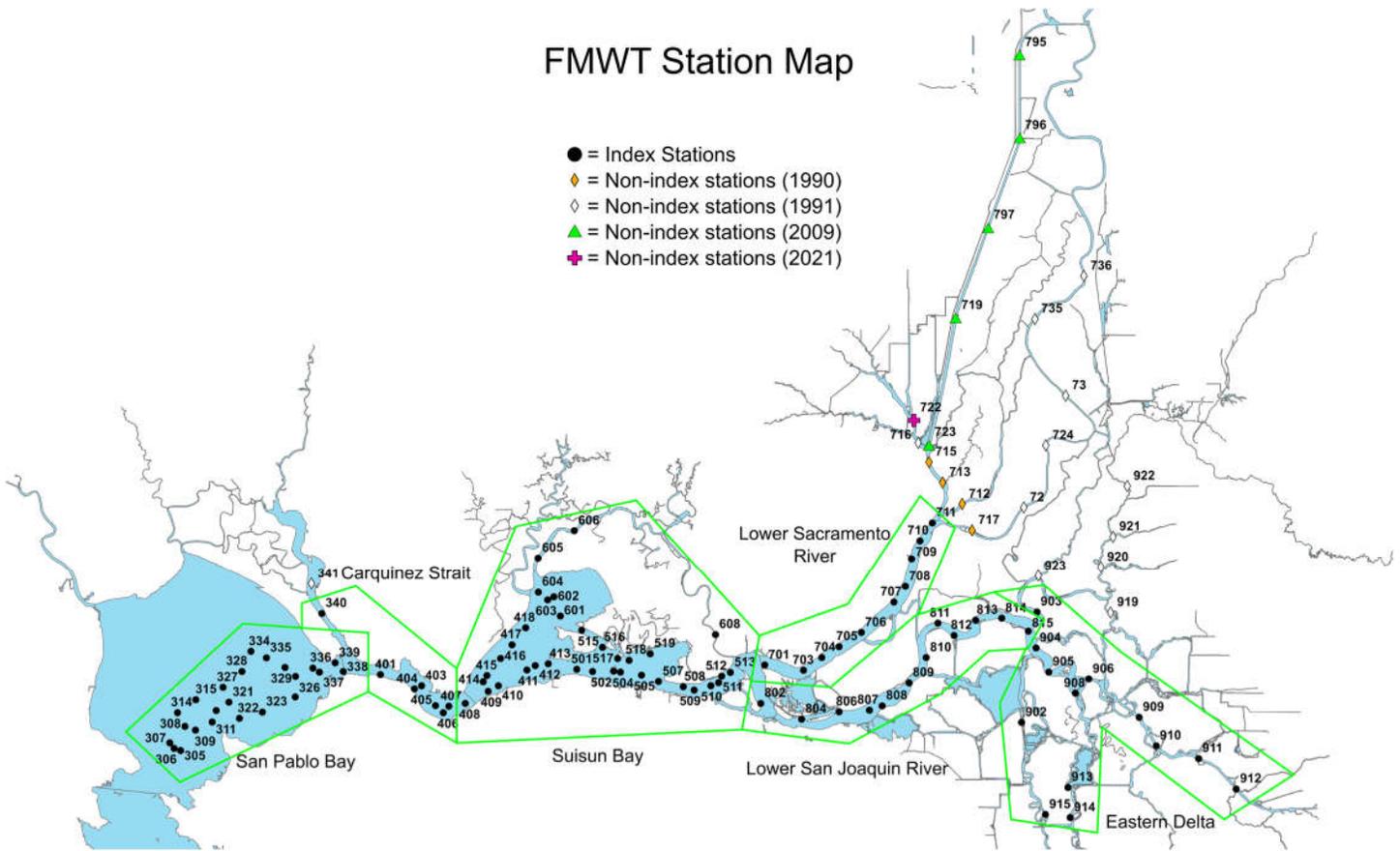


Figure 1. Map of CDFW Fall Midwater Trawl Survey monthly sampling sites among index and non-index stations in the upper San Francisco Estuary, California, USA. Polygons represent regional groupings of index stations.

Delta Smelt (*Hypomesus transpacificus*)

The 2021 abundance index was 0 and was tied with 2018 through 2020 for the lowest in FMWT history (Fig. 2). This is a continuation of a pattern of low indices that occurred in recent years. No Delta Smelt were collected from any stations during our survey months of September- December. An absence of Delta Smelt catch in the FMWT is consistent among other surveys in the estuary. The Enhanced Delta Smelt Monitoring (EDSM) survey of the U.S. Fish and Wildlife Service (USFWS) caught 8 Delta Smelt (6 marked individuals, 2 wild individuals) among 65 sampling days (between 9/1 and 12/17) comprised of 784 tows (U.S. Fish and Wildlife Service 2021 Dec 17). EDSM catch occurred on December 16 and 17, 2021. Delta Smelt numbers are very low and below the effective detection threshold by most sampling methods.

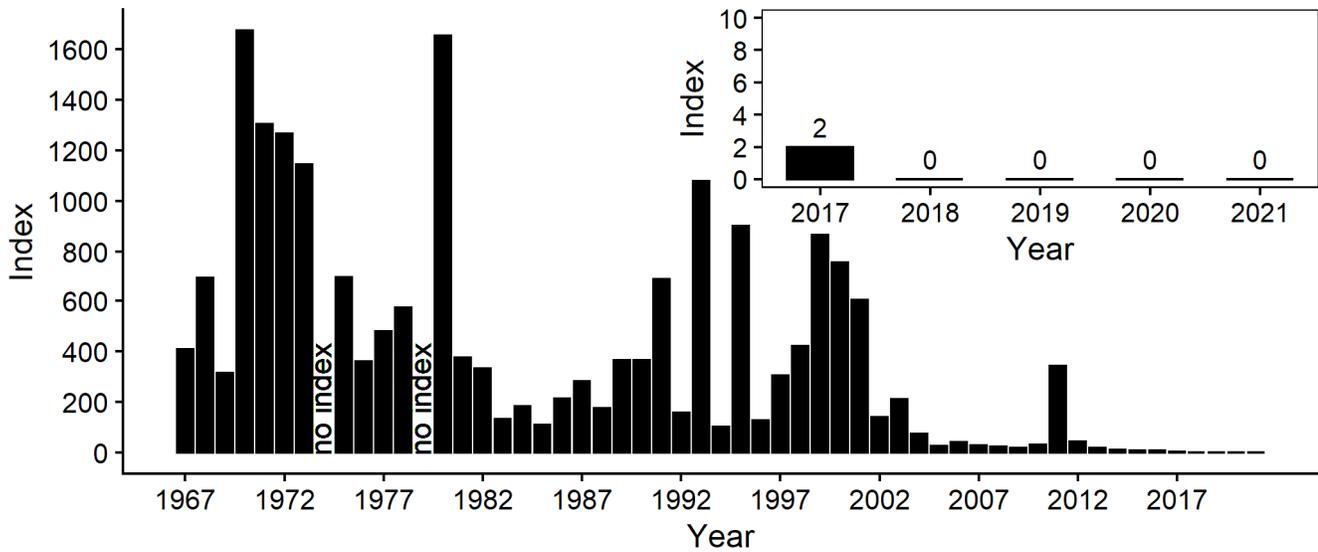


Figure 2. FMWT Delta Smelt annual abundance indices (all ages), 1967-2021. Inset graph shows detailed view of previous 5 years.

Age-0 Striped Bass (*Morone saxatilis*)

The 2021 abundance index was 56, representing a 7% increase from last year's index (Fig. 3).

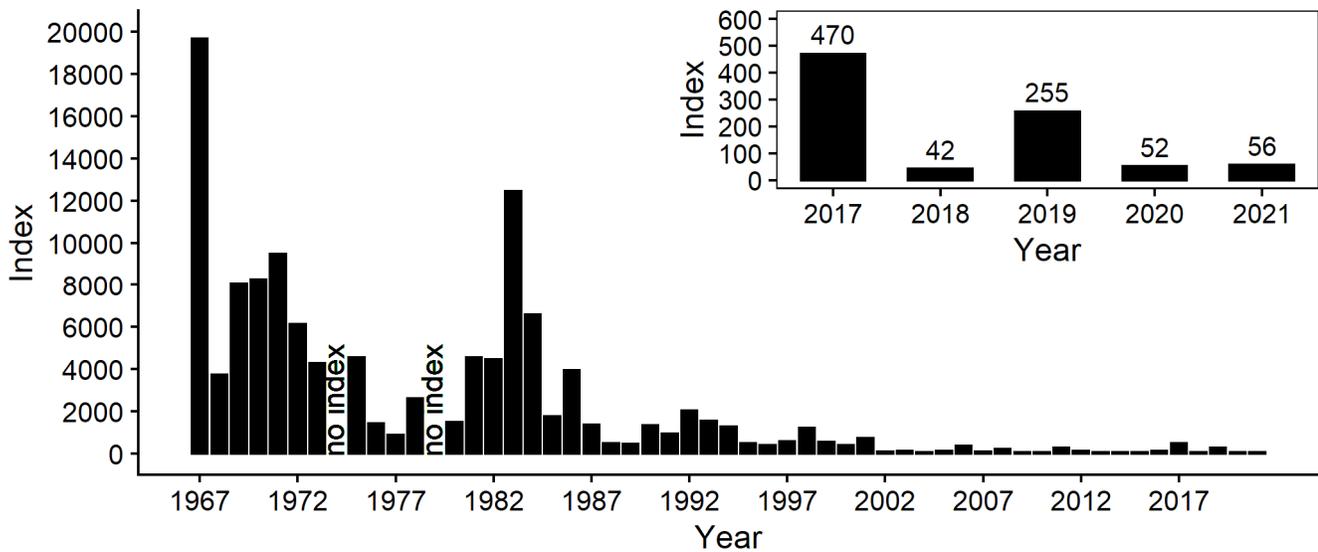


Figure 3. FMWT Age-0 Striped Bass annual abundance indices, 1967-2021. Inset graph shows detailed view of previous 5 years.

Striped Bass were collected every month during September-December. 49 age-0 Striped Bass were collected at index stations and 2 from non-index stations. Monthly catch was highest in November, with catch highest in Lower Sacramento River among months (Table 1).

Table 1: Age-0 Striped Bass catch among regions during the 2021 Fall Midwater Trawl survey sampling at index and non-index stations. *SRDWSC = Sacramento River Deepwater Shipping Channel.

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
September	Index	Lower Sacramento River	1
October	Index	Lower Sacramento River	8
November	Index	Eastern Delta	1
November	Index	Lower Sacramento River	9
November	Index	Lower San Joaquin River	15
November	Index	Suisun Bay	11
December	Index	Lower Sacramento River	3
December	Index	Lower San Joaquin River	1
December	Non-Index	Napa River	1
December	Non-Index	SRDWSC	1
Total			51

Longfin Smelt (*Spirinchus thaleichthys*)

The 2021 abundance index was 323, representing a 91% increase from last year’s index (Fig. 4).

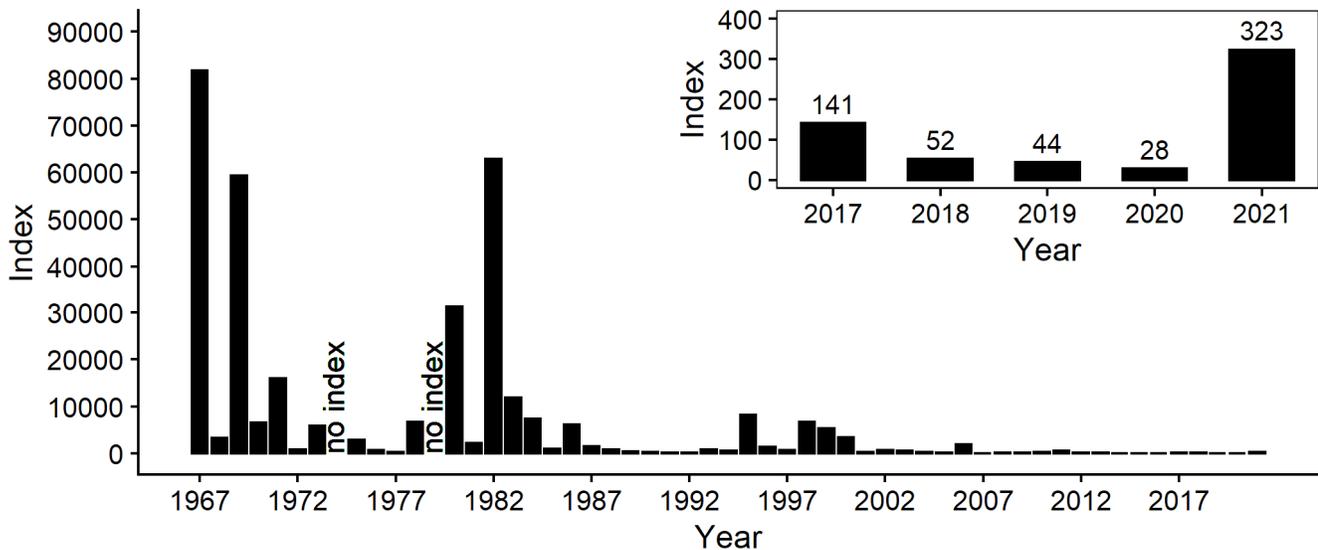


Figure 4. FMWT Longfin Smelt annual abundance indices, 1967-2021. Inset graph shows detailed view of previous 5 years.

A total of 124 Longfin Smelt were collected at index stations and 0 from non-index stations. Fish were distributed San Pablo Bay through the confluence of the Sacramento and San Joaquin rivers. Monthly catch was highest in November, with catch highest in San Pablo Bay most months (Table 2). Higher catch is usually expected in December as Longfin Smelt adults return to the estuary from the ocean to spawn as water temperatures drop in the late fall or winter.

Table 2: Longfin Smelt catch among regions during the 2021 Fall Midwater Trawl survey sampling at index and non-index stations.

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
September	Index	Suisun Bay	1
October	Index	Lower Sacramento River	2
October	Index	San Pablo Bay	2
October	Index	Suisun Bay	2
November	Index	Carquinez Strait	21
November	Index	San Pablo Bay	31
November	Index	Suisun Bay	9
December	Index	Carquinez Strait	2
December	Index	Lower Sacramento River	2
December	Index	Lower San Joaquin River	1
December	Index	San Pablo Bay	27
December	Index	Suisun Bay	24
Total			124

Threadfin Shad (*Dorosoma petenense*)

The 2021 abundance index was 221, representing a 65% decrease from last year's index (Fig. 5).

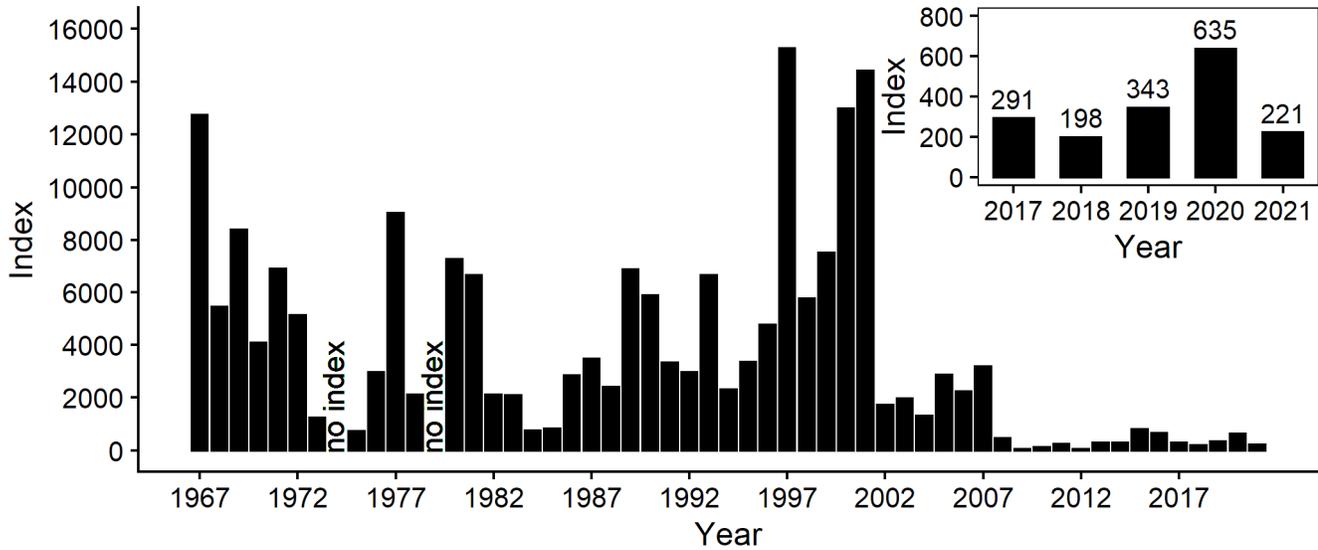


Figure 5. FMWT Threadfin Shad annual abundance indices, 1967-2021. Inset graph shows detailed view of previous 5 years.

A total of 190 Threadfin Shad were collected at index stations and 613 from non-index stations. The greatest monthly catch was in December, with catch highest in SRDWSC most months (Table 3).

Table 3: Threadfin Shad catch among regions during the 2021 Fall Midwater Trawl survey sampling at index and non-index stations. *SRDWSC = Sacramento River Deepwater Shipping Channel.

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
September	Index	Lower Sacramento River	8
September	Index	Lower San Joaquin River	1
September	Non-Index	SRDWSC	8
October	Index	Lower Sacramento River	5
October	Index	Lower San Joaquin River	17
October	Index	Suisun Bay	2
October	Non-Index	SRDWSC	100
November	Index	Lower Sacramento River	7
November	Index	Lower San Joaquin River	51
November	Index	Suisun Bay	16
November	Non-Index	SRDWSC	241
December	Index	Lower Sacramento River	55
December	Index	Lower San Joaquin River	22

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
December	Index	Suisun Bay	6
December	Non-Index	Cache Slough	2
December	Non-Index	SRDWSC	261
December	Non-Index	Upper Sacramento River	1
Total			803

American Shad (*Alosa sapidissima*)

The 2021 abundance index was 398, representing a 64% decrease from last year's index (Fig. 6). Abundance indices have fluctuated substantially during the period 2017-2021, ranging from a low of 398 to a high of 3086.

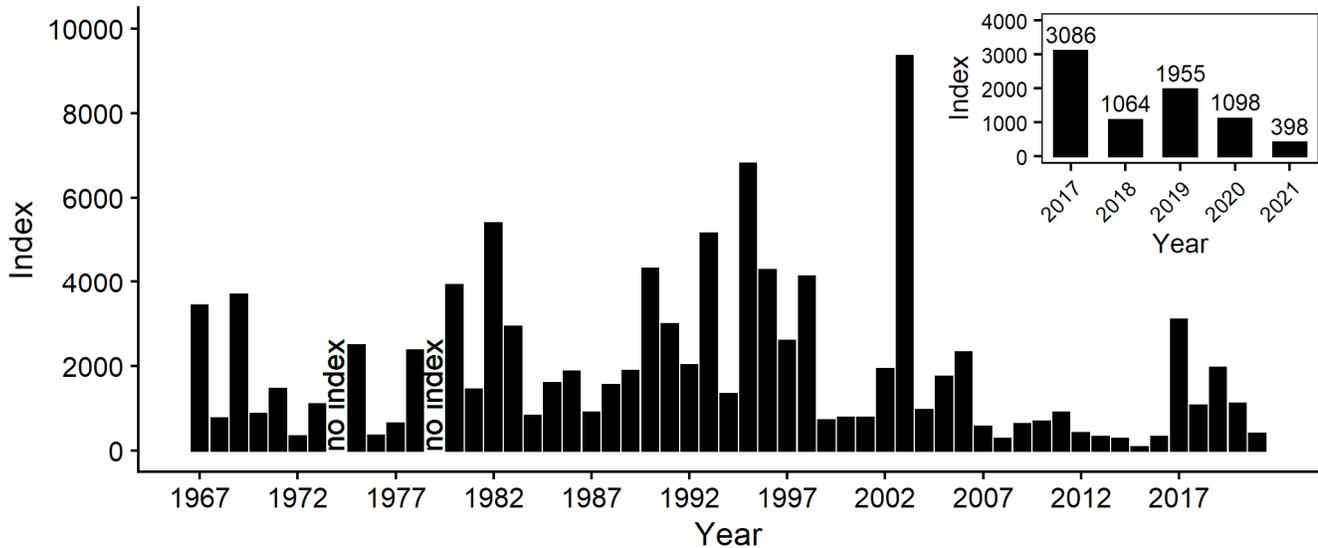


Figure 6. FMWT American Shad annual abundance indices, 1967-2021. Inset graph shows detailed view of previous 5 years.

A total of 241 American Shad were collected at index stations and 107 from non-index stations. American Shad were collected mostly from SRDWSC with the greatest monthly catch in October (Table 4).

Table 4: American Shad catch among regions during the 2021 Fall Midwater Trawl survey sampling at index and non-index stations. *SRDWSC = Sacramento River Deepwater Shipping Channel.

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
September	Index	Carquinez Strait	1
September	Index	Lower Sacramento River	5
September	Index	Lower San Joaquin River	1
September	Index	Suisun Bay	12
September	Non-Index	SRDWSC	6
October	Index	Carquinez Strait	5
October	Index	Lower Sacramento River	43
October	Index	Lower San Joaquin River	18
October	Index	San Pablo Bay	3
October	Index	Suisun Bay	10

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
October	Non-Index	SRDWSC	50
November	Index	Carquinez Strait	10
November	Index	Eastern Delta	3
November	Index	Lower Sacramento River	4
November	Index	Lower San Joaquin River	21
November	Index	San Pablo Bay	20
November	Index	Suisun Bay	25
November	Non-Index	SRDWSC	30
December	Index	Carquinez Strait	10
December	Index	Lower Sacramento River	6
December	Index	Lower San Joaquin River	4
December	Index	San Pablo Bay	17
December	Index	Suisun Bay	23
December	Non-Index	Cache Slough	4
December	Non-Index	Napa River	6
December	Non-Index	SRDWSC	11
Total			348

Splittail (*Pogonichthys macrolepidotus*)

The 2021 Splittail abundance index was 0 which shows a continuing trend in recent years of very little to no catch of Splittail in FMWT (Fig. 7). Splittail were collected 3 of the 4 months at non-index stations in the SRDWSC. The Splittail FMWT index tends to be low or zero except in relatively wet years, such as 2011, when age-0 fish tend to be abundant. FMWT operates in water >2 m deep, whereas Splittail, particularly age-0 fish, appear to primarily inhabit water <2 m deep (Sommer et al. 1997; Moyle et al. 2004).

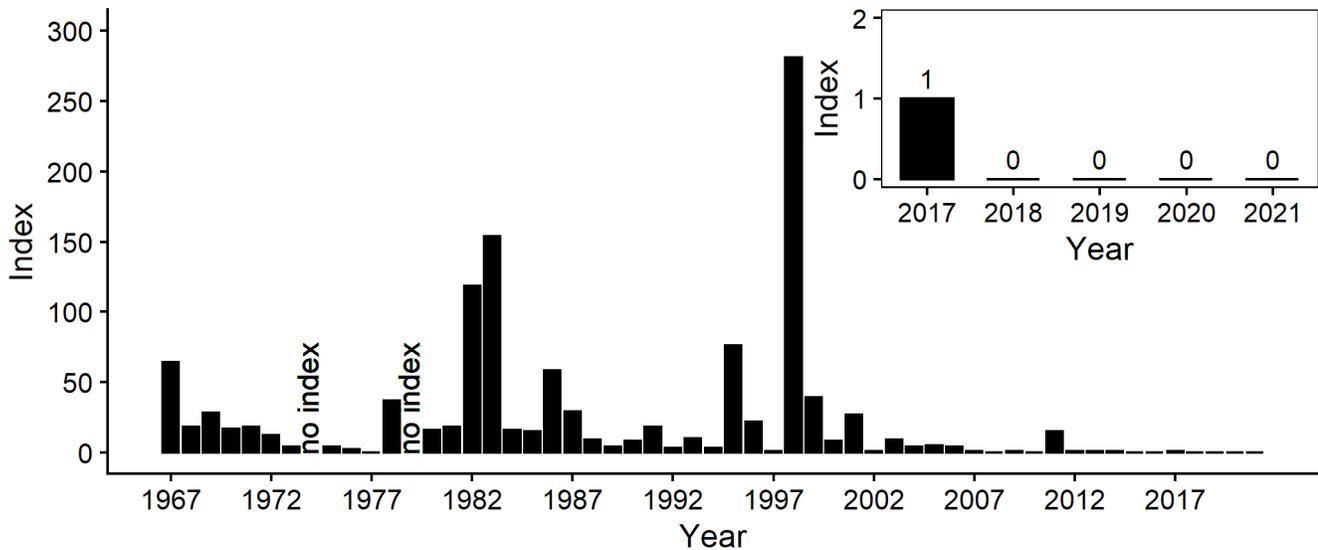


Figure 7. FMWT Splittail annual abundance indices, 1967-2021. Inset graph shows detailed view of previous 5 years.

A total of 0 Splittail were collected at index stations and 4 from non-index stations. Splittail catch was greatest in SRDWSC with the highest monthly catch occurring in December (Table 5).

Table 5: Splittail catch among regions during the 2021 Fall Midwater Trawl survey sampling at index and non-index stations. *SRDWSC = Sacramento River Deepwater Shipping Channel.

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
October	Non-Index	SRDWSC	1
November	Non-Index	SRDWSC	1
December	Non-Index	SRDWSC	2
Total			4

Wakasagi (*Hypomesus nipponensis*)

Wakasagi were first introduced to northern California reservoirs by California Fish & Game in 1959 to provide forage for rainbow trout and other salmonids. It is believed they were present in the upper San Francisco Estuary as early as 1974, but they were not detected in the estuary until 1990 by other surveys (Moyle 2002). The first detection of Wakasagi by the FMWT survey was in 1995. The 2021 abundance index was 0 because Wakasagi were only caught at non-index stations (Fig. 8).

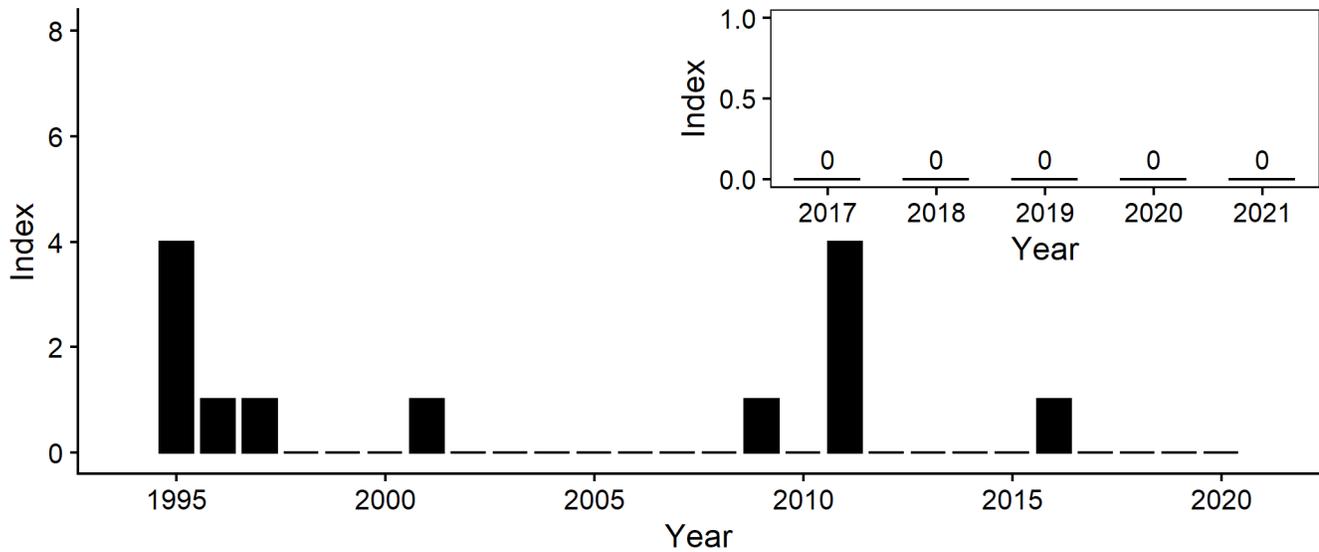


Figure 8. FMWT Wakasagi annual abundance indices, 1995-2021. Inset graph shows detailed view of previous 5 years.

A total of 0 Wakasagi were collected at index stations and 16 from non-index stations. Monthly catch was highest in October and December, with catch being highest in SRDWSC among months (Table 6). Little is known about the life history of the California population of Wakasagi compared to the Japanese populations. Wakasagi in the Estuary have yet to become abundant or widespread, despite broad temperature (2-29°C) and salinity (0-29 ppt) tolerances (Moyle 2002). This species is caught infrequently, catch is generally limited to the north Delta, although catch is higher during wet water years.

Table 6: Wakasagi catch among regions during the 2021 Fall Midwater Trawl survey sampling at index and non-index stations. *SRDWSC = Sacramento River Deepwater Shipping Channel.

<i>Month</i>	<i>Type</i>	<i>Region</i>	<i>Catch</i>
October	Non-Index	SRDWSC	6
November	Non-Index	SRDWSC	4
December	Non-Index	SRDWSC	6
Total			16

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