Interagency Ecological Program San Francisco Estuary 20 mm

Survey (20 mm) **(FISH)** Metadata

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# Study Management

**IEP Study Name:** 20-mm Survey

## Program element: 033

**Agency:** Department of Fish and Wildlife, Bay Delta Region (R3) **Office Location:**

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# Study Overview

**Purpose/Objective:** The 20mm Survey monitors post-larval **(Should this say larval...? which is it post-larval or larval)** and juvenile Delta Smelt distribution and relative abundance throughout their historical spring range in the Sacramento-San Joaquin Delta and San Francisco Estuary (Bay-Delta Estuary). The data is also used to help estimate larval and juvenile Delta Smelt and Longfin Smelt entrainment at the State Water Project (SWP) and Central Valley Project (CVP). This document contains metadata for **only the fish data** of the 20 mm survey.

**Data collected:** Surface water temperature (°C), surface and bottom electro-conductivity (EC, *µ*S/cm, normalized at 25 °C), Secchi depth (cm), water volume (m3), tidal stage, and identification, counts, and lengths (mm, fork lengths or total length for species without a forked tail) of fishes to the lowest possible taxon.

**Geographic range of work:** The 20mm Survey currently samples 47 stations every other week from March to July. These stations are distributed 1 station in east San Pablo Bay, 6 in the Napa River, 16 in Suisun Bay/Confluence region, 12 in the Sacramento River/Cache Slough/Deep Water Ship Channel region, and 12 in the South and Central Delta. During high outflow years, 5 additional stations are sampled in San Pablo Bay to provide greater spatial coverage of potential Delta Smelt habitat.

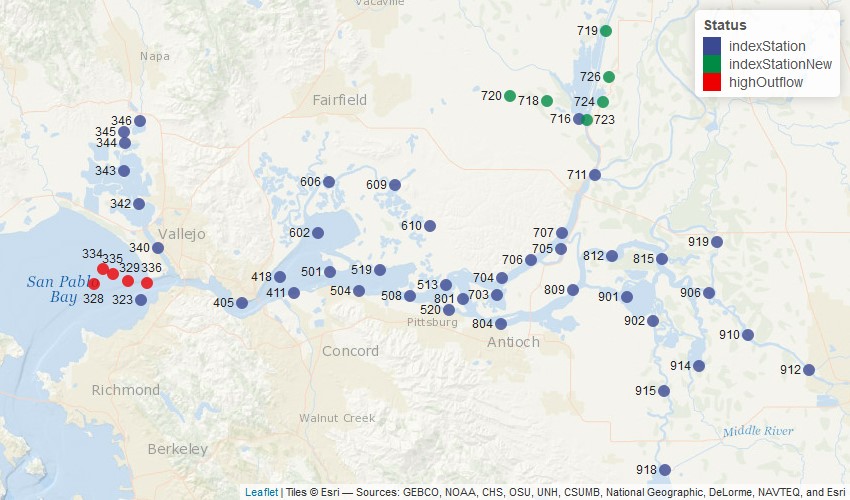


Figure 1: The geographic range of work of the 20mm Survey. Each point represents the location of a sampling station, totalling to 52 stations of primary interest. Stations are colored according to their relationship to the 20mm Index calculation, where blue represents stations that have been included since the advent of the calculation, green since 2022, and red represents high outflow stations that are not included.

**Number of sites:** 47 stations that are sampled yearly. During high outflow years, 5 additional stations are sampled. See the metadata section for additional details of each station.

**Data range:** 1995-04-24 to 2021-07-16 (YYYY-mm-dd)

**Sampling frequency**: Sampling begins in March/April and is conducted *every other week*. Sampling ends in July or Agust **(What are these specific ending conditions?)**. Standard sampling surveys are numbered 0-9, while supplemental sampling surveys are identified as *≥* 10.

# Field Sampling Methods

**Net:** The 20mm Survey samples for both fish and zooplankton across multiple tows per site. A 20-mm net targets larval and juvenile fish and is a conical plankton net that is 5.5 meters (m) in length, has a mouth area of 1.51 m2, and features a 1600 *µ*m (1/16 in.) knotless nylon Delta mesh (35 lb. test). Fish are collected into a removable 2.2 L screened (474 *µ*m stainless steel wire bolting cloth) cod-end jar attached to the deepest part of the net. Zooplankton are sampled concurrently with the fish net using a Clarke-Bumpus (CB) net attached to the top of the 20-mm net frame. The CB net is 78 cm in length, has a mouth area of 0.010101 m2, and features a 160 *µ*m knotless nylon mesh. Similar to fish, zooplankton are collected into a removal **XXXX** L screened cod-end jar attached to the deepest part of the CB net. **(I could remove this information about the CB since this is fish only metadata?)** General Oceananics flowmeters are mounted in the mouth of the 20-mm and CB nets to estimate the volume (m3) of water sampled by each net. After each tow, the entire sample is transferred into a labeled holding jar containing 10% formalin neutralized with sodium borate. Rose Bengal dye is added to each jar to aid in separating animals from detritus for identification under a microscope in the laboratory.

**NEEDED? Was this the same for the 20 mm like the SLS?**: The mesh size was altered prior to the 2014 season to 500 *µ*m NitexR, when the original mesh size was no longer available and new nets were purchased (see 2014 changes below). These new nets were incorporated as old nets became unusable. The net is mounted on a fixed metal tube frame with skids and is connected to the frame by a canvas mouth. At the end of each tow, net contents are washed into a cod-end jar attached to the deepest part of the net.

**Tow:** Up to three replicate 10 minute stepped oblique tow with the boat moving at 1 m/s **(AGAINST THE CURRENT?)** to keep the CB net completely submerged is conducted at each sampling location. Specifically, fish are sampled across all tows, while zooplankton are typically sampled only once during the first tow. The amount of cable released is dependent on the water depth at the sampling location. A gradual oblique tow is achieved following the tow schedule specific to the amount of cable released and the duration of the tow. Although most tows are 10 minutes in length, tow time can be reduced during periods of heavy samples. If the net is clogged during algal blooms, jellyfish blooms, or heavy debris events and the cod end jar is overfilling with materials, the tow time can be reduced to 5 or 2.5 minutes and follow an alternate tow schedule and recording the duration on the datasheet. If materials are still overflowing from the cod-end jar in a 2.5 minute tow, the tow or entire station is dropped. Re-tows do occur if a sample is compromised, the flow meter of the fish net reads less than 10000 or greater than 30000 in a 10 minute tow, or the flow meter of the CB net reads less than 5000 or greater than 25000 in a 10 minute tow. All abnormal events are to be recorded in the “comments” section of the datasheet.

**Flowmeter calibration:** General Oceananics flowmeters are used to estimate the volume of water sampled by each net. This calculation relies on a calibration factor specific to the flowmeter model that equates the rotor constant with the number of counts. Prior to 2015, the calibration factor each every flow meter was calibrated at UC Davis before the start of the season. Beginning in 2015, the calibration flume at UC Davis became inoperable, and the meters were sent to General Oceanics for refurbishing before each field season to justify using the factory calibration factor. Since 2019, meters are inspected at the end of every field season and are replaced with new units if refurbshing is required–this ensures that the factory calibration factor can continue to be used to estimate tow volume.

**Environmental and water quality data:** Immediately prior to each tow, bottom and surface water samples are indepedently collected. The bottom water sample is taken using a Van Dorn into a bucket, while the surface water sample is taken directly using a separate bucket. From these water samples: 1) surface water temperature (°C) and surface and bottom EC (*µ*S/cm, normalized at 25 °C) are recorded using a calibrated (before each season) and rinsed YSI Model 30; and 2) surface turbidity (NTU) is recorded using a calibrated (before each season) HACH 2100p turbidity meter (sample vials are cleaned with a Kimwipe before each sample). Secchi depth (m) is measured using Secchi discs mounted to rigid meter sticks to a maximum depth of two meters; values are measured by the same person off the side of the boat in the shade without sunglasses on for the entire day to maximize consistency. Water bottom depth (ft) is recorded using a depth finder on the boat. Tide data is recorded as the visually observed tidal stage by the crew during the tow as high slack, ebb, low slack, or flood.

**Catch data:** At the end of every tow, the net is washed down so that all visible vegetation, fish, sand, and debris are collected into the cod-end jar. Large debris and fish (*≥* 50 mm) can be removed if positively identified. When salmonids are caught, fork lengths are measured, presence of the adipose fin noted, and the fish are immediately released gently and alive. All other larval and juvenile fish are kept in distinctively labeled sampling jars and preserved in 10% buffered (sodium borate) and dyed (rose bengal) formalin for later processing in the laboratory.

# Lab analysis, fish ID and QC

In the lab, before the next survey if possible, fish are identified from each sample under a microscope by trained lab staff. First, fish are separated from debris and other organisms during a process named “sorting”. Then, the entire sample undergo a quality control (QC) check to ensure that fish were not missed during sorting. Finally, fish undergo ID and count by an identifier, which can be followed by a QC from a larval fish ID specialist to confirm all species identifications and counts. This ID QC process is dependent on the experience of the identifier doing the first ID. Fish identifiers will begin with all their identifications QC’ed and transition to having fewer and fewer samples QC’ed with experience, until the identifier is considered themselves a larval fish ID specialist. Samples are randomly selected to undergo this QC process. Across all samples (QC required or not), all CESA and ESA fishes and any questionable fish IDs must undergo a second ID. All fish are identified to species or the lowest possible taxon. Since the inception of the survey, *there have not been instances* **(IS THIS STILL CORRECT FOR THE 20 MM?** when of a species has been identified to a lower taxon or identified under a different name. Only the first 50 randomly selected individuals of each species from each tow are measured for lengths to the nearest millimeter, and the rest of the sample is simply enumerated. However, all Longfin Smelt and Delta Smelt are measured for lengths regardless of catch size **WILL THIS STILL BE TRUE? I remember there was talk about perhaps not doing this for LFS as you can catch thousands at some stations**.

# Calculating catch per unit effort (CPUE)

## Fish

The total number of fish per volume water sampled (standardized to 10000 *m*3) across all replicate tows is calculated using the following equations:

*Vt* = *A ∗ K ∗ Dt*

*Where:*

*Vt* = volume of water (*m*3) filtered through the net per tow *t*

*A* = mouth opening of the net (1.51 *m*2)

*K* = calibration factor of the flow meter, 0.026873027 since 2015

*Dt* = difference in flow meter counts from start to finish of tow *t*

*nt* = *Ft/Vt ∗* 10000*m*3

*Where:*

*nt* = number of fish per 10000 *m*3

*Ft* = fish caught per tow *t*

*Vt* = volume of water filtered through the net *m*3 per tow *t*

P*nt*

*Nt* =

*rt*

*Where:*

*Nt* = number of fish per 10000 *m*3 per tow *t*

*Ft* = fish caught per tow *t*

*Vt* = volume of water filtered through the net *m*3 per tow *t*

## Zooplankton

From 2004-current, the number of each zooplankton taxon per cubic meter sampled by the Clark-Bumpus net is calculated using the following equations:

*Vt* = *A ∗ K ∗ Dt*

*Where:*

*Vt* = volume of water (*m*3) filtered through the net per tow *t*

*A* = mouth opening of the net (0.010101 *m*2)

*K* = calibration factor of the flow meter, 0.026873027 since 2015 *Dt* = difference in flow meter counts from start to finish of tow *t*

P *CcX*

## *Z* = *V*

*N*

*where:*

*Z* = the number of zooplankton per *m*3

*C* = the number of zooplankton taxon counted per cell *c*

*X* = the sample volume (sample diluation)

*V* = the volume of water filtered by the net *m*3

*N* = number of cells completed

From 1995-2003, the number of zooplankton per *m*3 was calculated as:

*CX*

### Z = V

*S*

*where:*

*Z* = the number of zooplankton per *m*3

*C* = the number of zooplankton taxon counted per cell *c*

*X* = the sample volume (sample diluation)

*V* = the volume of water filtered by the net *m*3

*S* = the number of Sedgewick-Rafter cells counted

**???????????????? Shouldnt this older formula also have** P**?**

# Data management

All field data are entered into a digital Access database using eletronic forms between survey events during the season. Immediately after entry, data undergoes two rounds of ‘line-by-line’ checks, wherein all data fields are checked against the original datasheets for fidelity. At the end of the survey field season once all the fish samples have been processed in the laboratory and data entry is complete, all data is ‘finalized’ to be as accurate as possible for public use. The first step in this finalization process is to conduct two additional line-by-lines. Next, a project lead will run a series of coded queries to analyze the underlying data distributions to detect potential outliers in the environmental data. Not all data is changed if it is flagged as an outlier (generally beyond 2 standard deviations of the mean). In most cases, outliers are real data.

These queries simply alert the project lead of potential erroneous data, and care is taken to edit only data that truly needs to be edited, e.g., data that was entered incorrectly or caused by equipment failures. All resulting data edits are documented in a separate log file.

# The provided data tables

The “20mmStations.csv”, “FishLength.csv”, “FishSample.csv”, “Gear.csv”, “GearCodesLkp.csv”, “MeterCorrection.csv”, “Station.csv”, “Survey.csv”, and “Tow.csv” are available “relational tables” from the 20mm Access database. These tables are exported directly from Access in R and the only manipulations were to include relevant columns, fix unicode encoding errors, and fix float-point errors; all underlying data collected in the field and entered into the database remained as-is. The “TMM.csv” file is the integrated dataset that combines these relational tables together. Users should be aware of the units of the recorded values between the relational and integrated tables, as they may differ (documented in the metadata section of the EDI publication page). All steps are coded in R and the relevant codes are provided with the EDI publication and/or housed on [trinhxuann/CDFW-IEP-Surveys Github page.](https://github.com/trinhxuann/CDFW-IEP-Surveys)

## Zero filling

Zero filling is the process of assigning a count value of 0 for instances of no fish catch during a tow. “No fish catch” can be defined as two levels: 1) across all fish species (a tow that catches no fishes at all), or 2) specific to a singular species (a tow that catches no individuals of a particular species but does for other species). Instances of no fish catch of *any* fish species in a tow (level 1) *are not* recorded in the relational “FishSample.csv” table, but the environmental data associated with that tow *is* recorded in the relational “Tow.csv” table. The joined “TMM.csv” table flagged these instances in the Length\_NA\_flag column and filled in the corresponding catch count value (Count) as 0. Zero-filling was not implemented for instances of no fish catch of a particular species in a tow (level 2) in the integrated “TMM.csv” file; however, code for this step is provided in the “TTMMIntegrateEDI.R” script for users who are interested.

## Count data

The count data provided is the adjusted length frequency of each recorded length per species per tow:

*Fm,l*  *Fa,l* = *Tc Tm*

*Where:*

*Fa,l* = adjusted frequency of each recorded length *l*

*Tc* = total catch

*Fm,l* = measured frequency of each recorded length *l*

*Tm* = total number of fish measured

# Project history

The table below is a timeline of critical changes to the survey methods since its inception. The years listed below are water years, which begins three months before the new calendar year on October 1.

Table 1: History of substantial changes to the 20mm Survey since its inception. Rows are highlighted per unique water year.

|  |  |
| --- | --- |
| Year | Changes |
| 1995 | NA |
| 1996 | Napa River Stations (341, 342, 343, 344, 345, 346, & 347) added to sampling program. |
| 1997 | Napa River stations (341 & 347) and Big Break station (802) discontinued from sampling program. |
| 1998 | Zooplankton taxa stages (Eurytermora copepodid& Pseudodiaptomus copepodid) added to database. |
| 1999 | Number of fish measured reduced from 300 to 100 (all delta smelt are measured regardless of catch size). |
| 2000 | NA |
| 2001 | Number of fish measured reduced from 100 to 50 (all delta smelt are measured regardless of catch size). |
| 2002 | Napa River stations 347, 348, & 349 added to sampling program when higher outflow conditions persist in Napa River. |
| 2003 | Zooplankton taxon Pseudodiaptomus spp. speciated to include  Pseudodiaptomuseuryhalinus, Pseudodiaptomus forbesi, and Pseudodiaptomusmarinus. |
| 2004 | Zooplankton processing changed from identifying the first 200 organisms to 6% of the sub-sample. |
| 2005 | Zooplankton processing continued to process 6% of the sub-sample, but would not exceed 20 slides from a sample. |
| 2006 | Zooplankton processing will continue to process 6% of the sub-sample, but will process a minimum of 5 cells and a maximum of 20 cells from a sample. Zooplankton taxa stages (Acartia copepodid, Acartiella copepodid, and Tortanus copepodid) added to database.  Cumaceans and Chironomid larvae were dropped from the list of organisms to be identified. |
| 2007 | NA |
| 2008 | Cache Slough complex stations (718, 720, 726, 724, 723, 719) added to regular sampling program. |
| 2009 | Supplemental sampling in Sacramento Deepwater Channel stations (794, 795, 796, 797, 798, 799) occurred over surveys 7 and 8. |
| 2010 | Implementation of the use of a Hach Model # 2100P Turbidimeter as Standard Operating Procedure to record turbidity in NTU’s. Recorded Latitude and Longitude on datasheets, but not entered into database. |
| 2011 | Begin recording latitude and longitude coordinates of each sampling station in the field, and this data was entered into the database |
| 2012 | NA |
| 2013 | NA |

2014 NA

|  |  |
| --- | --- |
| 2015 | Review of project documents indicated a discrepancy between documented 20-mm net dimensions and actual 20-mm net dimensions. In 1995 staff worked with Lodi Tent and Awning to accommodate for shrinkage of the canvas-collar mouth of the nets. The problem was resolved by increasing the circumference of the mouth from 455 cm to 493 cm. It appears that all subsequent 20-mm net purchases incorporated this change; however, these changes were not incorporated into documentation of net dimensions. The updated net dimensions are now available in the protocol. |
| 2015 | A total of 6 additional tows were performed during surveys 6-9 at stations 706, 707, and 719 as part of a pilot study on Delta Smelt genetics at UC Davis. Samples were preserved in 95% EtOH and sent to Mandi Finger, with Bernie May’s lab. Stations sampled each survey was based on the likelihood of Delta Smelt occurrence, as indicated by results of prior surveys. |
| 2015 | The vendor that historically supplied the net mesh to construct 20-mm nets went out of business. A new vendor was found, Christensen Net Works. New nets were constructed and used in 2015. |
| 2015 | Factory k value (0.026873027) used in the ‘MeterCorrections‘ table. Flowmeters were not calibrated at UC Davis due to machinery malfunction. The facility is awaiting repairs. |

2016 Like 2015, no flowmeter calibration occurred in 2016. The factory value was used for all meters, and 9 meters were sent for refurbishing prior to the survey season.

|  |  |
| --- | --- |
| 2017 | Continued using factory k value for ‘MeterCorrections.‘ Malfuctioning and inaccurate flowmeters were sent to General Oceanics for refurbishing prior to field season. |

2018 Continued using factory k value for ‘MeterCorrections.‘ Malfuctioning and inaccurate flowmeters were sent to General Oceanics for refurbishing prior to field season.

|  |  |
| --- | --- |
| 2019 | Continued using factory k value for MeterCorrections. Flowmeters were sent to General Oceanics for refurbishing prior to field season or replaced with new meters if readings are inaccurate (assessed at the end of a season). Factory K values will continue to be used until we can test the flowmeters independently. |

2020 Surveys 2 and 3 only sampled the high priority stations in the south and central Delta due to concerns related to the COVID-19 pandemic.

# Station metadata

Station theoretical latitudes and longitudes and start and end dates are provided in Table 2. A visualization of the number of surveys per water year (which encapsulates a field season) is also provided in Figure 2.

Table 2: List of stations sampled by 20mm since its inception. "StartDate" indicates the date when sampling first began for a station; "EndDate" indicates the date when sampling last ended at a station, and "Ongoing" represents stations that are still actively sampled by the survey. The high outflow stations are ongoing stations, however, end dates are provided due to the intermittency of these stations.

|  |  |  |  |
| --- | --- | --- | --- |
| Station | StartDate | EndDate | Status |
| 323 | 1995-04-28 | Ongoing | indexStation |
| 340 | 1995-04-28 | Ongoing | indexStation |
| 342 | 1996-04-29 | Ongoing | indexStation |
| 343 | 1996-04-29 | Ongoing | indexStation |
| 344 | 1996-04-29 | Ongoing | indexStation |
| 345 | 1996-04-29 | Ongoing | indexStation |
| 346 | 1996-04-29 | Ongoing | indexStation |
| 405 | 1995-04-27 | Ongoing | indexStation |
| 411 | 1995-04-28 | Ongoing | indexStation |
| 418 | 1995-04-27 | Ongoing | indexStation |
| 501 | 1995-04-28 | Ongoing | indexStation |
| 504 | 1995-04-28 | Ongoing | indexStation |
| 508 | 1995-04-28 | Ongoing | indexStation |

513 1995-04-26 Ongoing indexStation

|  |  |  |  |
| --- | --- | --- | --- |
| 519 | 1995-04-28 | Ongoing | indexStation |
| 520 | 1995-04-27 | Ongoing | indexStation |
| 602 | 1995-04-27 | Ongoing | indexStation |
| 606 | 1995-04-27 | Ongoing | indexStation |
| 609 | 1995-04-27 | Ongoing | indexStation |
| 610 | 1995-04-27 | Ongoing | indexStation |
| 703 | 1995-04-26 | Ongoing | indexStation |
| 704 | 1995-04-26 | Ongoing | indexStation |
| 705 | 1995-04-25 | Ongoing | indexStation |
| 706 | 1995-04-26 | Ongoing | indexStation |
| 707 | 1995-04-25 | Ongoing | indexStation |
| 711 | 1995-04-25 | Ongoing | indexStation |
| 716 | 1995-04-25 | Ongoing | indexStation |
| 718 | 2008-03-17 | Ongoing | indexStationNew |
| 719 | 2008-03-17 | Ongoing | indexStationNew |
| 720 | 2008-03-17 | Ongoing | indexStationNew |
| 723 | 2008-03-17 | Ongoing | indexStationNew |
| 724 | 2008-03-17 | Ongoing | indexStationNew |
| 726 | 2008-03-17 | Ongoing | indexStationNew |
| 801 | 1995-04-26 | Ongoing | indexStation |
| 804 | 1995-04-26 | Ongoing | indexStation |
| 809 | 1995-04-24 | Ongoing | indexStation |
| 812 | 1995-04-25 | Ongoing | indexStation |
| 815 | 1995-04-25 | Ongoing | indexStation |
| 901 | 1995-04-24 | Ongoing | indexStation |
| 902 | 1995-04-24 | Ongoing | indexStation |
| 906 | 1995-04-25 | Ongoing | indexStation |
| 910 | 1995-04-24 | Ongoing | indexStation |
| 912 | 1995-04-24 | Ongoing | indexStation |
| 914 | 1995-04-24 | Ongoing | indexStation |
| 915 | 1995-04-24 | Ongoing | indexStation |
| 918 | 1995-04-24 | Ongoing | indexStation |
| 919 | 1995-04-25 | Ongoing | indexStation |
| 330 | 1995-05-26 | 1995-05-26 | NA |
| 341 | 1996-04-29 | 1996-05-13 | NA |
| 802 | 1995-04-26 | 1996-06-11 | NA |
| 997 | 1999-06-28 | 1999-06-28 | NA |
| 998 | 1999-06-28 | 1999-06-28 | NA |
| 999 | 1999-06-28 | 1999-06-28 | NA |
| 348 | 2001-03-24 | 2001-06-04 | NA |
| 349 | 2001-03-24 | 2001-06-04 | NA |
| 347 | 1996-07-26 | 2002-04-19 | NA |
| 798 | 2009-06-01 | 2009-06-01 | NA |
| 799 | 2009-06-01 | 2009-06-01 | NA |
| 794 | 2009-06-15 | 2009-06-15 | NA |
| 795 | 2009-06-15 | 2009-06-15 | NA |
| 796 | 2009-06-15 | 2009-06-15 | NA |
| 797 | 2009-06-15 | 2009-06-15 | NA |
| 328 | 1995-07-07 | 2019-05-09 | highOutflow |

329 1995-08-04 2019-05-09 highOutflow

|  |  |  |
| --- | --- | --- |
| 334 1995-08-04 | 2019-05-09 | highOutflow |
| 335 1995-08-04 | 2019-05-09 | highOutflow |
| 336 1995-07-07 | 2019-05-09 | highOutflow |

Number of surveys per station per water year

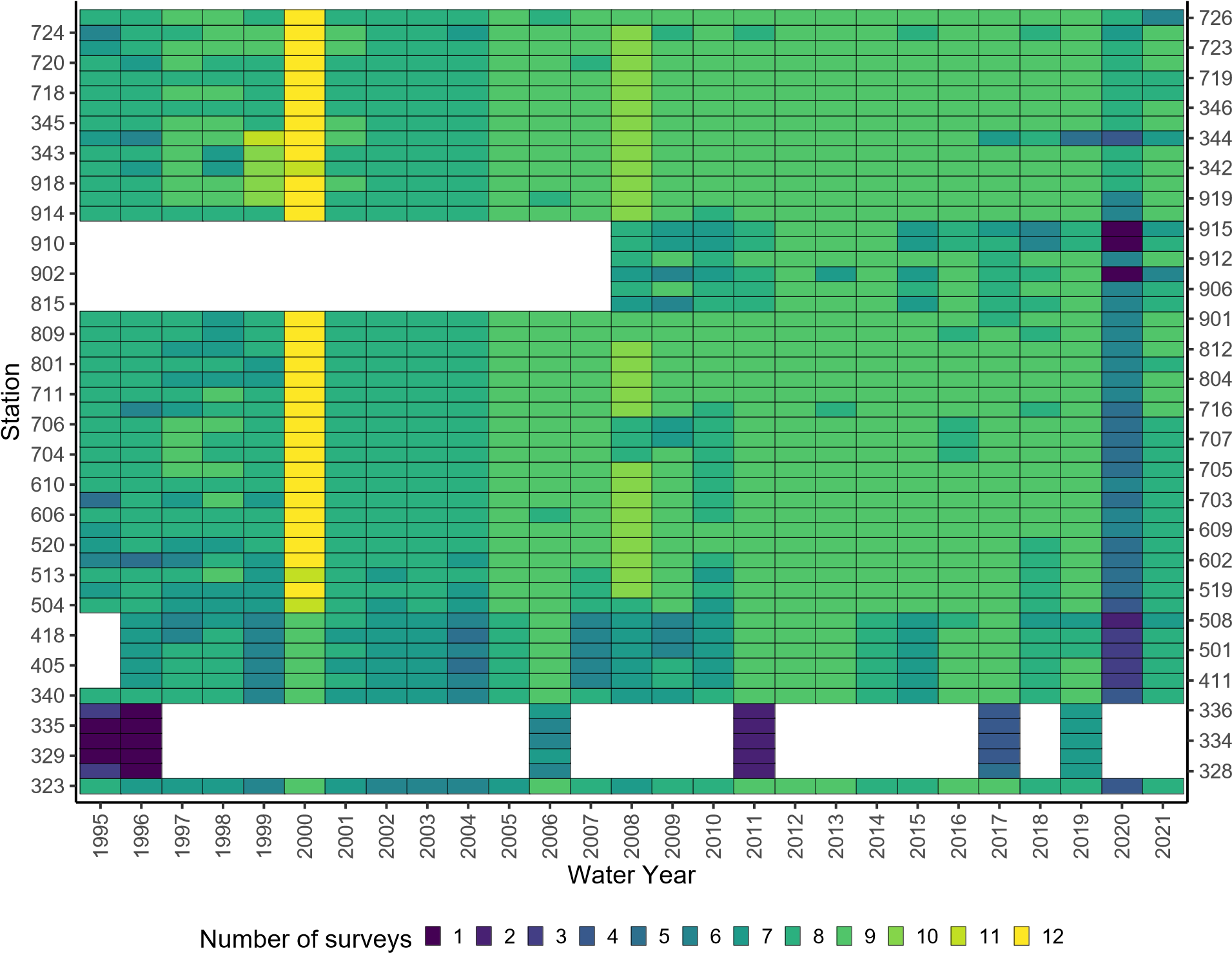


Figure 2: The number of times a station was surveyed per water year is shown in various colors, following documentation present in Table 1. No color indicates that a station was not sampled for that water year.

Table 3: Frequency of number of surveys at each station in the

20mm Survey per water year since its inception in 1995

Water Year Station Number of Surveys

1995 323 8

1995 328 3

1995 329 1

1995 334 1

1995 335 1

1995 336 3

1995 340 8

|  |  |  |
| --- | --- | --- |
| 1995 | 405 |  |
| 1995 | 411 | 7 |
| 1995 | 418 | 8 |
| 1995 | 501 | 6 |
| 1995 | 504 | 7 |
| 1995 | 508 | 7 |
| 1995 | 513 | 8 |
| 1995 | 519 | 5 |
| 1995 | 520 | 8 |
| 1995 | 602 | 8 |
| 1995 | 606 | 8 |
| 1995 | 609 | 8 |
| 1995 | 610 | 8 |
| 1995 | 703 | 8 |
| 1995 | 704 | 8 |
| 1995 | 705 | 8 |
| 1995 | 706 | 8 |
| 1995 | 707 | 8 |
| 1995 | 711 | 8 |
| 1995 | 716 | 8 |
| 1995 | 801 | 8 |
| 1995 | 804 | 8 |
| 1995 | 809 | 8 |
| 1995 | 812 | 8 |
| 1995 | 815 | 8 |
| 1995 | 901 | 7 |
| 1995 | 902 | 8 |
| 1995 | 906 | 8 |
| 1995 | 910 | 8 |
| 1995 | 912 | 8 |
| 1995 | 914 | 8 |
| 1995 | 915 | 7 |
| 1995 | 918 | 6 |
| 1995 | 919 | 8 |
| 1996 | 323 | 7 |
| 1996 | 328 | 1 |
| 1996 | 329 | 1 |
| 1996 | 334 | 1 |
| 1996 | 335 | 1 |
| 1996 | 336 | 1 |
| 1996 | 340 | 8 |
| 1996 | 342 | 7 |
| 1996 | 343 | 7 |
| 1996 | 344 | 7 |
| 1996 | 345 | 7 |
| 1996 | 346 | 7 |

|  |  |  |
| --- | --- | --- |
| 1996 | 405 |  |
| 1996 | 411 | 8 |
| 1996 | 418 | 8 |
| 1996 | 501 | 5 |
| 1996 | 504 | 8 |
| 1996 | 508 | 8 |
| 1996 | 513 | 8 |
| 1996 | 519 | 8 |
| 1996 | 520 | 8 |
| 1996 | 602 | 8 |
| 1996 | 606 | 8 |
| 1996 | 609 | 8 |
| 1996 | 610 | 8 |
| 1996 | 703 | 6 |
| 1996 | 704 | 8 |
| 1996 | 705 | 8 |
| 1996 | 706 | 8 |
| 1996 | 707 | 8 |
| 1996 | 711 | 8 |
| 1996 | 716 | 8 |
| 1996 | 801 | 8 |
| 1996 | 804 | 8 |
| 1996 | 809 | 8 |
| 1996 | 812 | 7 |
| 1996 | 815 | 8 |
| 1996 | 901 | 6 |
| 1996 | 902 | 8 |
| 1996 | 906 | 8 |
| 1996 | 910 | 8 |
| 1996 | 912 | 8 |
| 1996 | 914 | 7 |
| 1996 | 915 | 8 |
| 1996 | 918 | 8 |
| 1996 | 919 | 8 |
| 1997 | 323 | 7 |
| 1997 | 340 | 8 |
| 1997 | 342 | 8 |
| 1997 | 343 | 8 |
| 1997 | 344 | 8 |
| 1997 | 345 | 6 |
| 1997 | 346 | 6 |
| 1997 | 405 | 7 |
| 1997 | 411 | 7 |
| 1997 | 418 | 8 |
| 1997 | 501 | 6 |
| 1997 | 504 | 7 |

1997 508

|  |  |  |
| --- | --- | --- |
| 1997 | 513 | 8 |
| 1997 | 519 | 7 |
| 1997 | 520 | 8 |
| 1997 | 602 | 9 |
| 1997 | 606 | 9 |
| 1997 | 609 | 9 |
| 1997 | 610 | 9 |
| 1997 | 703 | 7 |
| 1997 | 704 | 8 |
| 1997 | 705 | 7 |
| 1997 | 706 | 8 |
| 1997 | 707 | 7 |
| 1997 | 711 | 8 |
| 1997 | 716 | 8 |
| 1997 | 801 | 8 |
| 1997 | 804 | 9 |
| 1997 | 809 | 9 |
| 1997 | 812 | 9 |
| 1997 | 815 | 9 |
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| 2017 | 328 | 5 |
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| 2017 | 334 | 4 |
| 2017 | 335 | 4 |
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| 2017 | 343 | 9 |
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| 2017 | 345 | 9 |
| 2017 | 346 | 9 |
| 2017 | 405 | 9 |
| 2017 | 411 | 9 |
| 2017 | 418 | 9 |
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| 2017 | 504 | 9 |
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| 2017 | 513 | 9 |
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| 2017 | 726 | 7 |
| 2017 | 801 | 9 |
| 2017 | 804 | 9 |
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| 2018 | 323 | 8 |
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| 2019 | 323 | 8 |
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| Water Year | Station | Number of Surveys |
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