2021 Field Season Summary: Adult Sturgeon Population Study

California Department of Fish and Wildlife

Region 3: Bay-Delta

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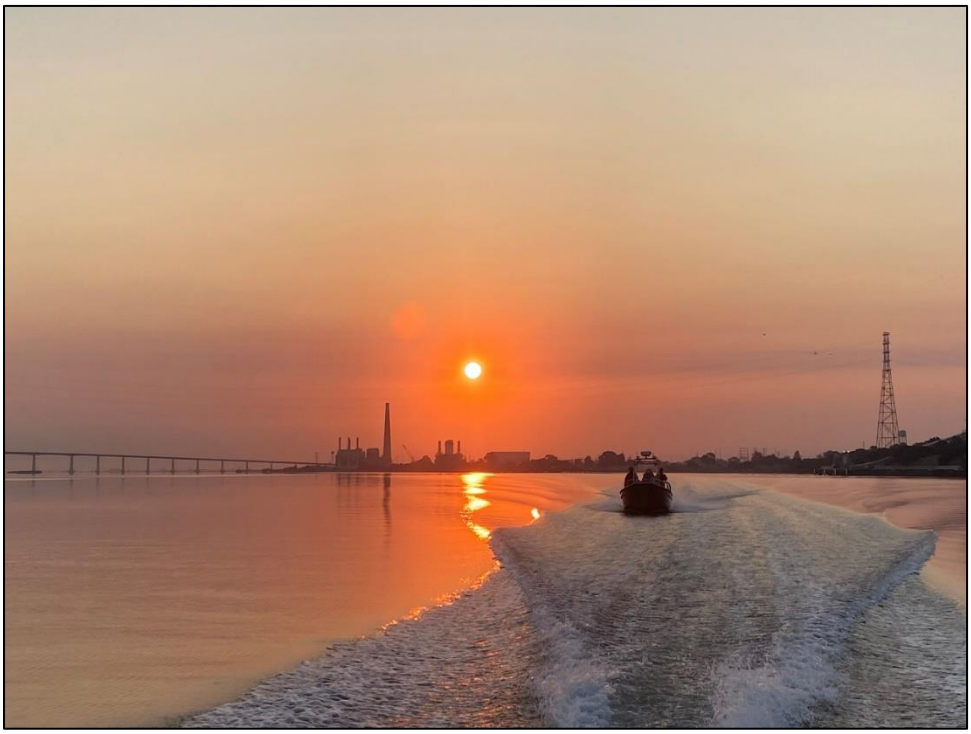

Introduction

The San Francisco Estuary (SFE), representing the tidal waters of the Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, and San Francisco Bay, contains two native sturgeon species, White Sturgeon (*Acipenser transmontanus*) and Green Sturgeon (*Acipenser medirostris)*. White Sturgeon (*Acipenser transmontanus*) are a long-lived and semi-anadromous species which spend most of their lives in the estuary and rivers upstream of the SFE. Green Sturgeon are also long lived; however, they are fully anadromous and spend a considerable portion of their lives in the Pacific Ocean (Lindley et al. 2008). Sturgeon (primarily white) briefly supported a commercial fishery in the SFE around 1900, but reduced abundance and a reduction in average size prompted the closure of the fishery in 1917 (Skinner 1962). After several decades of closure, a recreational fishery for sturgeon (white and green) was re-opened in 1954 (Kohlhorst et al. 1991). The White Sturgeon recreational fishery remains open; however, the Green Sturgeon fishery was closed in 2007 when the southern distinct population segment (sDPS) of Green Sturgeon (those found in the SFE) was listed as threatened under the Federal Endangered Species Act.

White Sturgeon in the SFE support an important recreational fishery. As such, CDFW has an interest in maintaining quality angling opportunities while sustainably managing harvest. The recreational fishery currently operates with a daily harvest limit of one White Sturgeon, 101.6-152.4cm fork length, and a maximum of three annually under a tag-report card system[1]. In addition to recreational harvest, White Sturgeon also experience mortality through predation, ship-strikes, and juvenile entrainment at the State Water Project and Central Valley Project export facilities in the southern Delta as well as at smaller diversions within the Delta.

CDFW first conducted a mark-recapture study of White Sturgeon in 1954 to monitor and manage the population dynamics of White and Green Sturgeon under the then new recreational fishery. Semi-regular sampling as the Adult Sturgeon Population Study then began in 1984, with annual sampling in the years since 2005 (except 2018). The study now operates as a part of the Interagency Ecological Program (IEP), a multi-agency monitoring enterprise tasked with studying the effects of water exports and impoundments on the ecology of the SFE. Under this monitoring framework, the Adult Sturgeon Population Study addresses compliance with water rights decisions D-1485 and D-1641, as it helps inform abundance trends and recruitment success of the White and Green Sturgeon populations relative to freshwater outflow and exports.

This report summarizes the 2021 field season for the Adult Sturgeon Population Study (IEP work plan element 005). Field sampling was conducted from August 3rd to October 27th, 2021, in Suisun Bay, California.

For summaries of previous field seasons, please see the Sturgeon Study Bibliography[2].

[1] CDFW Sturgeon Report Card Overview

[2] CDFW Sturgeon Study Bibliography

Methods

The CDFW Adult Sturgeon Population Study employs trammel nets to capture and tag adult White Sturgeon for the purpose of estimating the population size of legal-sized (101.6-152.4cm) fish. The survey operates in the fall (August through October) to minimize bycatch of listed salmonids. The tags used are small circular disk-tags with monetary reward values posted for anglers to encourage reporting. Tag recaptures and angler tag returns are used to generate absolute abundance estimates.

Vessels

Figure 1. Kvichak aluminum center console research vessel.

Sampling was conducted using two Kvichak 24' aluminum center console skiffs (Figure 1), berthed at New Bridge Marina (Antioch, CA). The skiffs are powered by 225hp Honda outboard motors and feature setback consoles for increased foredeck space. Nets were manually deployed over the bow and manually retrieved over the starboard gunnel by two crew members.

In years past, sampling has been conducted using larger vessels, namely the New Alosa, a 42' aluminum fishing vessel. The New Alosa was taken out of service for power replacement during 2020 and 2021 sampling seasons.

Crew

Typical crew consisted of six people: one mate/boat operator on each vessel, one environmental scientist, one scientific aid, and two technical staff. The environmental scientist and scientific aid were primarily responsible for tagging, collecting/recording data, and ensuring fish health, while technical staff were primarily tasked with retrieving and removing fish from nets. Due to the small crew sizes, science staff frequently assisted with net/fish retrieval. Mates (Figure 2) primarily operated vessels, directed technical staff, and selected sampling sites for maximum catch.

Trammel Net

The trammel nets used are custom in-house constructed nets comprised of four 25-fathom (45.7 m) long by 2-fathom (3.7 m) deep panels (Figure 2). Each 25-fathom panel consists of a gillnet sandwiched between two panels of trammel net. The gillnet is an Alaska salmon-style webbing made up of multi-strand monofilament twist. Stretched diagonal dimensions of the gillnet mesh varied by 25-fathom panel and included two 8" panels, one 7" panel, and one 6" panel. The trammel portion of the net was made up of three multi-strand twisted nylon braids with a spacing of 12" top and 13" bottom for the 6" panel, 14" top and 15" bottom for the 7" panel, and 16" top and 17" bottom for the 8" panels.

Prior to 2007, eight panels were linked end to end, forming a 200-fathom trammel net. However, nets were reduced to four panels (100 fathoms) in 2007 to reduce the potential for marine mammal interactions. Due to the use of two smaller vessels (Kvichaks) versus a single large vessel during the 2020 and 2021 sampling seasons, the amount of net was reduced to two linked panels (50 fathoms) per boat to reduce the weight of the trammel net for manual retrieval. One linked trammel net had an 8" panel and a 7" panel while the other had an 8" panel and a 6" panel.

Figure 2. CDFW Mates, Ken Flowers (left) and Ramiro Soto (right), removing a large White Sturgeon from trammel net.

Site Selection

Over the lifetime of the survey, sampling has occurred in Suisun Bay, San Pablo Bay, and opportunistically in the lower portions of the San Joaquin River. Areas sampled were chosen based on staff expertise to maximize White Sturgeon catch and due to logistical constraints of vessel status, distance from port, etc. No sampling was conducted in San Pablo Bay during the 2021 field season.

The net was set in locations selected to avoid known snags and unfavorable currents by the senior boat operator. The net was deployed cross current with the vessels downwind and on average, it took approximately three minutes to set during the 2021 sampling season. The deployed net was continuously monitored to detect snags, tangles, marine mammal interactions, and to avoid conflicts with other vessels and hazards such as channel markers (Figure 3). The net was set as many times as possible (usually 4-6) each field day.

Figure 3. Deployed trammel net in Suisun Bay, California.

Sturgeon

Each sturgeon brought on board was immediately removed from the net and carefully placed in a plastic tub filled with water from the netting location. Fish up to approximately

140cm could be handled by a single crew member, while larger and heavier sturgeon required two or more crew to lift (Figures 2,4). Scientific staff measured all sturgeon for fork-length and began measuring girth at the midpoint between the pectoral and pelvic fins midway through the sampling season in response to the observation of skinny/emaciated fish.

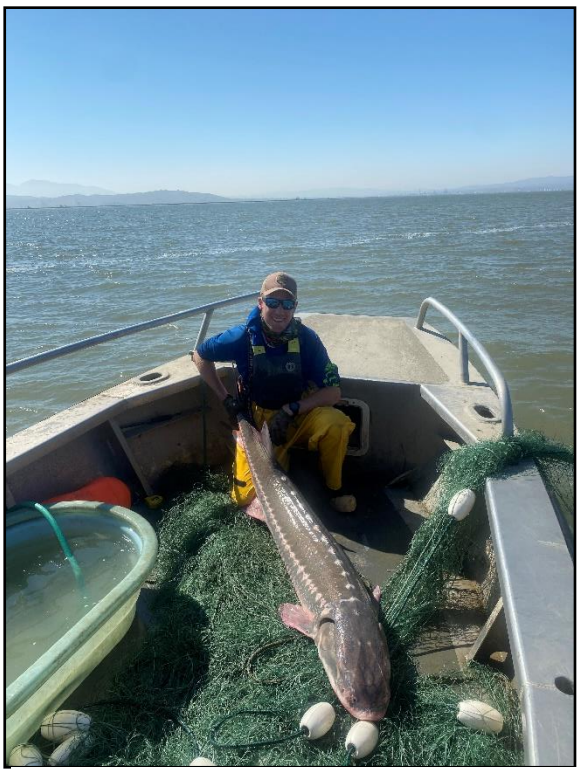

Figure 4. CDFW Environmental Scientist Dylan Stompe with an oversized sturgeon.

Each sturgeon (white and green) was visually checked for existing external tags, evidence of a shed or clipped tag, and was scanned with a handheld PIT tag reader for existing PIT tags. Initially, White Sturgeon 95-168cm were tagged with reward disk tags ($50, $100, and $150) in the flesh just below the base of the dorsal fin, midway between the anterior and posterior ends of the fin (Figure 5). The size range selected for tagging was changed to 95-150cm on 8/24/2021 to account for slightly undersized fish growing into the slot limit and nearly oversized fish growing out of the slot limit during the following sampling year. Tag recaptures from previous seasons were recorded and fish were retagged if deemed necessary. Prior to release, fish were fully recovered, and the condition of each fish (good, fair, poor) was assessed and recorded. White Sturgeon which were in especially poor condition as evidenced by external injuries or weak opercular movement were not tagged and were released after fully recovering.

In addition to disk tags, when possible, sturgeon were tagged with passive integrated transponder (PIT) tags to measure movement and disk tag shedding rates. We experienced considerable issues with handheld PIT tag readers during the 2021 sampling season, resulting in 25 White Sturgeon and one Green Sturgeon not receiving PIT tags. 12mm full-duplex tags were used initially but were changed to 23mm half-duplex tags on 8/26/2021 due to limited stock of 12mm tags.

Figure 5. Reward disk-tag in a White Sturgeon.

Environmental/Site Data

Environmental data were collected at the beginning of each net set by

one of the scientific staff. Water quality metrics were measured using an ocean-type (solid white) Secchi disk for turbidity (cm) and a YSI Pro2030 to measure water temperature (C), specific conductivity (µS/cm), salinity (ppt), percent dissolved oxygen, and total dissolved oxygen (mg/L). In addition, the time of the start and end of the net set and retrieval, latitude and longitude of the start of the net set, the number of pinnipeds in the vicinity of the net and raiding the net, any vessel interactions, and wind conditions based on the Beaufort scale were recorded. Periodically, an ultrasonic acoustic receiver (VR100 receiver and VH165 omnidirectional hydrophone, VEMCO, Nova Scotia, Canada) was deployed to determine if any sturgeon carrying long-term telemetry tags were in the vicinity.

Figure 6. CDFW Environmental Scientist Dylan Stompe with a Striped Bass captured in trammel net.

Bycatch

Bycatch (Figure 6) was identified to species, measured (fork length), and released as quickly as possible. In addition, the physiological condition (bright, off, dark) and whether an adipose fin was present was recorded for most Chinook Salmon. We noted all marine mammals (Pacific Harbor Seals and California Sea Lions) observed within 50 meters of the net and instances of a marine mammal observed raiding the net (i.e. removing or attempting to remove fish from net).

Analysis

Daily catch per unit effort (CPUE) of White Sturgeon was calculated as a metric of relative abundance. Effort was quantified as the number of fathoms fished, divided by 100, times the number of hours fished. CPUE was then calculated as the number of White Sturgeon captured per day, divided by the sum of effort (eq. 1). The number of hours fished was calculated by subtracting the amount of time between the end of the net set and the end of the net retrieval. Daily CPUEs were plotted for each calculatable year since the survey's inception. 1954 and 1967 were excluded from CPUE analysis because the duration of net sets was not recorded for these years. We chose to represent CPUE by day and not by individual net set as has been reported in the past, since changes to the fishing duration and length of net deployed has changed over time. Net-set CPUE is more sensitive to changes in effort and is likely to report artificially lower values due to higher frequencies of zero catch in shorter net-sets.

$$Daily\ CPUE = \frac{\sum White\ Sturgeon\ Catch}{\sum(\frac{fathoms\ fished}{100} * hours\ fished)}$$

(Eq. 1)

Length frequencies of captured White Sturgeon were calculated for the 2016 through 2021 sampling seasons. Lengths were then binned into 5cm length categories and compared to recent sampling years. The median fork lengths of both Green and White Sturgeon as well as estimates of ages based on Von Bertalanffy growth equations (Kohlhorst et al. 1980, Brennan 1988, Ulaski and Quist 2021) were also calculated and age frequencies of White Sturgeon captured during 2021 were plotted. In addition, summaries of the length metrics for the three most common bycatch species (Chinook Salmon, California Halibut, Striped Bass) were generated.

Finally, a conceptual model of the factors which may influence the number of White Sturgeon encountered in the Adult Sturgeon Population Study was generated to describe the potentially confounded relationship between the relative abundance calculated from CPUE analysis and the true population size of SFE White Sturgeon. The conceptual model does not capture all possibly influential variables or relationships; however, it will be further expanded in future reports and/or manuscripts. Likewise, it is beyond the scope of this report to model these relationships, but we will address this in future work.

Results

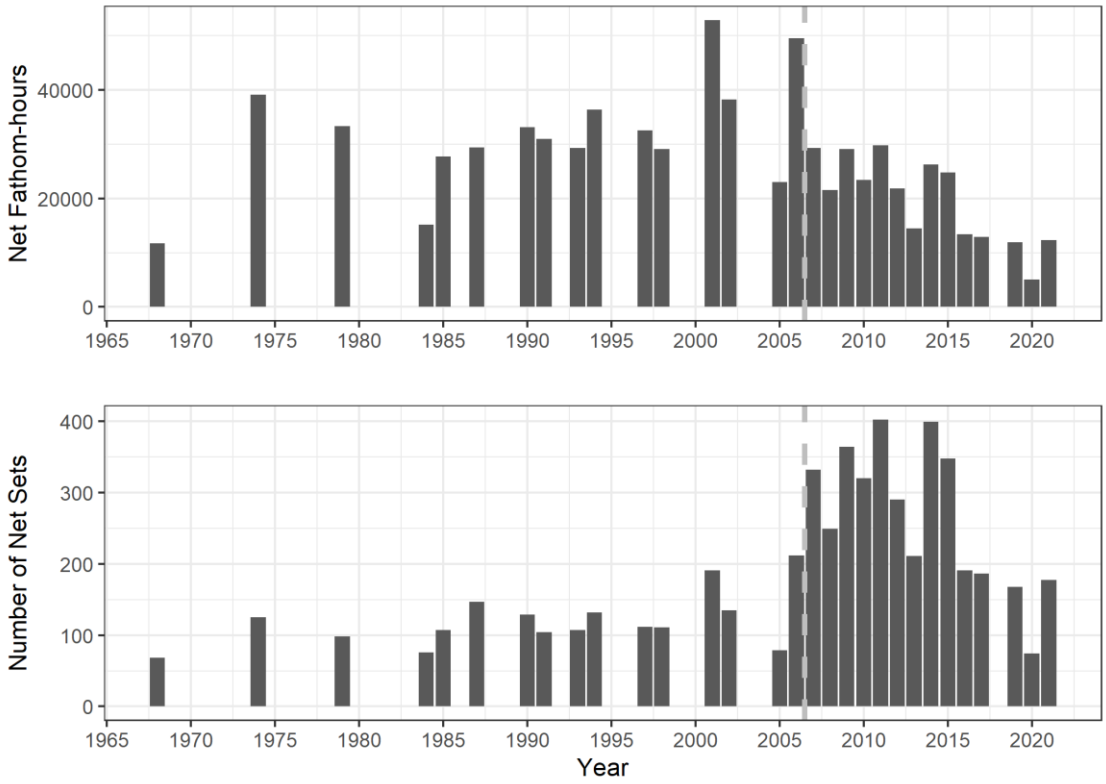

Figure 7. Top: annual total effort as net fathom-hour in years since 1968. Bottom: total number of net sets per sampling season. Vertical grey lines denote change in trammel net size from 200 to 100 fathoms to minimize contact with pinnipeds. Years without bars indicate no sampling.

Sampling effort for the 2021 season was focused primarily in Suisun Bay due in part to the challenges with operating small vessels during high wind conditions, which is common during the late summer months. Over the course of the sampling season, we successfully conducted 177 net-sets during 38 calendar days and caught a total of 382 White Sturgeon and 6 Green Sturgeon. The number of net sets during 2021 was greater than most years prior to 2006, however, due to the shortened net length (100 fathoms) and reduced fishing time the number of net fathom-hours fished was lower than most previous years (Figure 7).

Trammel nets were set an average of 4.7 times per day, with a mean fishing time per net-set of 42.2 ± 7.4 (s.d.) minutes. The average daily CPUE for White Sturgeon ranged from 0 to 6.97 fish per 100 fathom-hour, and 0 to 4.55 fish per 100 fathom-hour for fish within the current slot limit (101.6-152.4 cm FL). Average daily CPUE during 2021 was 2.90 ± 1.64 (s.d.) White Sturgeon per 100 fathom-hour and 1.79 ± 1.05 (s.d.) slot-sized White Sturgeon per 100 fathom-hour. Median daily CPUE was similar or slightly higher than most previous years, except for the exceptionally high catch years of 1968, 1984 and 1985 and increased catch years of 1997 and 1998 (Figure 8). Only one the 38 survey

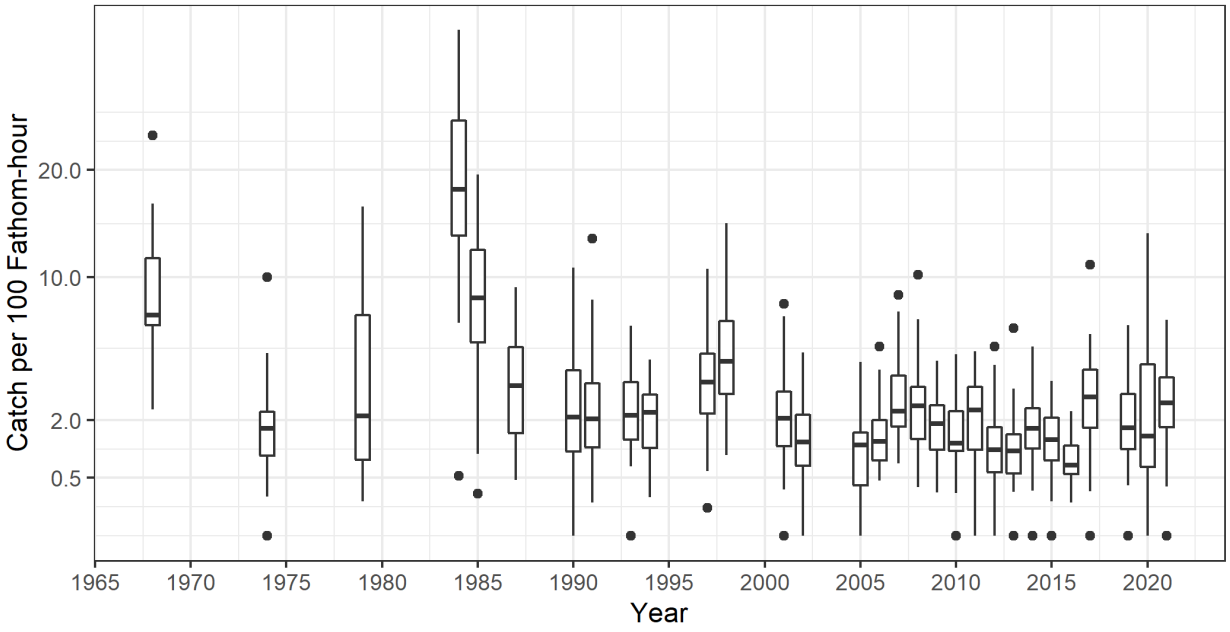

Figure 8. Box plot of daily CPUE (catch per 100 net fathom-hour, calculated per day) of all White Sturgeon captured during CDFW Adult Sturgeon Population Study tagging operations. Horizontal bar within box denotes median value, top of box the 75th percentile, bottom of box the 25th percentile, outliers by points above and below whiskers, and whiskers extend to 1.5 times the interquartile range. Note y-axis is on a square root scale.

days produced zero sturgeon (Figure 9) and the average monthly CPUE in 2021 for all sizes of White Sturgeon were similar among months.

Of the 382 White Sturgeon which were captured during the 2021 sampling season, 284 received reward disk tags and 349 received PIT tags. 236 of the disk-tagged fish were within the current slot limit, 43 were just short of the slot limit (95-101.5cm), four were oversized (>152.4cm), and one was unmeasured. The four oversized disk-tagged fish were tagged during the beginning of the sampling season prior to reducing the maximum tagging size from 168cm to 150cm. No Green Sturgeon received disk tags; however, five out of six captured Green Sturgeon were PIT tagged.

Table 1. White Sturgeon recaptured during the 2021 Adult Sturgeon Population Study.

Date Tagged	FL When Tagged	Date Recaptured	FL When Recaptured
09/04/2019	108cm	10/05/2021	114cm
10/16/2019	113cm	10/13/2021	117cm
09/18/2019	105cm	10/14/2021	113cm
08/17/2021	127cm	10/18/2021	128cm

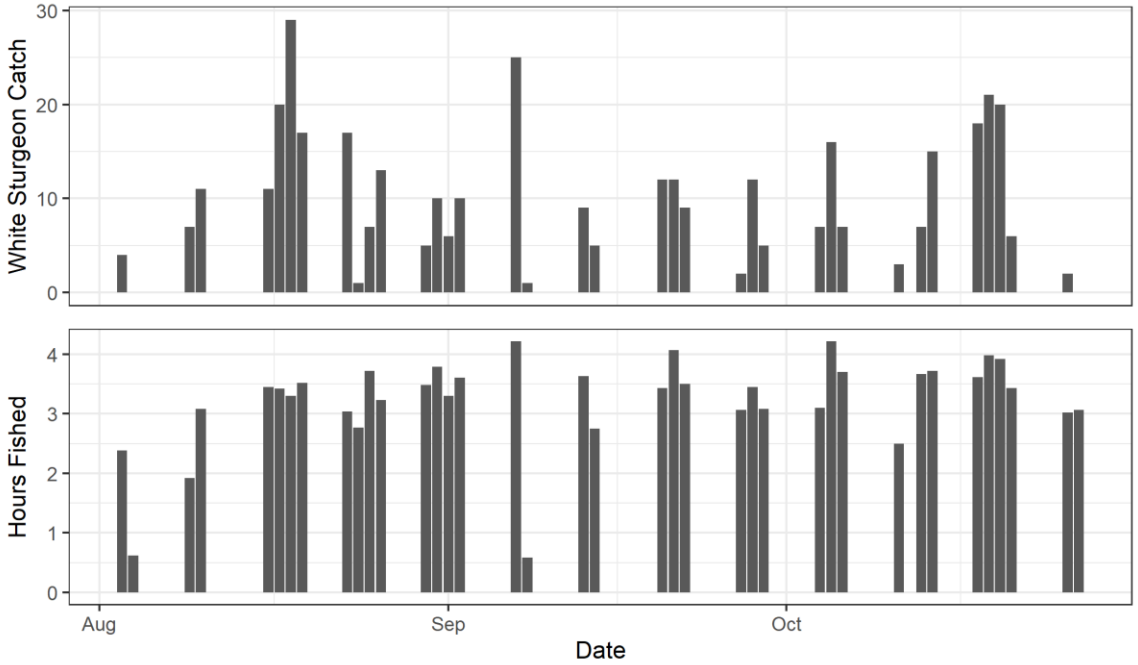

Figure 9. Number of White Sturgeon caught (top) and hours fished (bottom) during the 2021 sampling season.

Three White Sturgeon were recaptured from previous years tagging efforts and a single White Sturgeon was recaptured from tagging earlier in the season (Table 1). All recaptures were slot-sized fish and the three recaptures from previous tagging seasons were all tagged in 2019. Growth rates ranged from 2cm/year to 4cm/year.

The largest White Sturgeon captured during 2021 was 220cm (~7ft 3in) and the median size was 111cm (~3ft 8in). Two, and potentially three, strong year classes were observed from 2021 length frequency data (Figure 10, 11), likely representing strong recruitment events in 2006, 2011, and 2017 (K. Hieb, CDFW Bay Study, unpublished data). The median White Sturgeon length during 2021 was greater than 2016-2019 and slightly less than was observed during the 2020 season (Figure 10). The slight reduction in median length may be partially driven by the small sample size during 2020.

Table 2. Capture date, fork length, estimated age, and estimated spawn year of Green Sturgeon captured during 2021 sampling. Ages calculated using Von Bertalanffy growth equation from Ulaski and Quist (2021).

Capture Date	Fork Length (cm)	Estimated Age	Estimated Spawn Year
8/10/2021	90	6	2015
8/10/2021	121	11	2010
8/18/2021	129	13	2008
10/18/2021	77	4	2017
10/19/2021	71	4	2017
10/20/2021	73	4	2017

The captured Green Sturgeon were in general smaller, with a maximum size of 129cm (~4ft) and a median size of 77cm (~2ft 6in). Four year-classes were represented based on a Von Bertalanffy growth equation for sDPS Green Sturgeon (Ulaski and Quist 2021; Table 2). Half (n=3) of the Green Sturgeon captured during the 2021 field season are likely to have been spawned during 2017, an extremely wet year.

Bycatch during the 2021 sampling season was dominated by Chinook Salmon (*Oncorhynchus tshawytscha*) with a catch count of 73, followed by California Halibut (*Paralichthys californicus*) at 10 and Striped Bass (*Morone saxatilis*) at 9 (Table 3). 26%

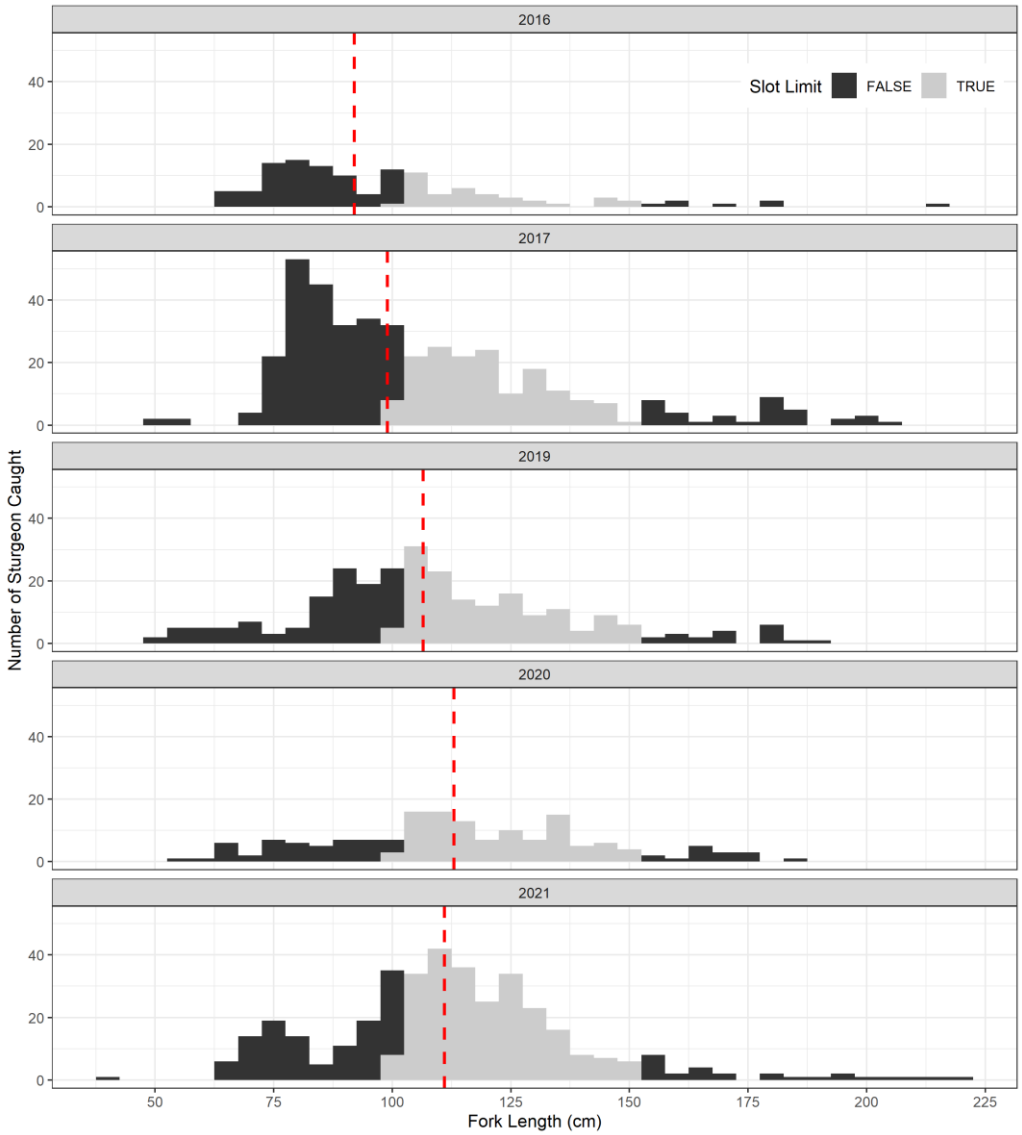

Figure 10. White Sturgeon length frequency distribution for years 2016–2017 & 2019-2021. Lengths are binned by 5cm, shading represents whether a sturgeon was in the slot limit for legal harvest (101.6-152.4cm) and red dashed vertical line represents annual median lengths. Light grey shaded boxes are slot-sized sturgeon and dark grey shaded boxes are over or undersized sturgeon.

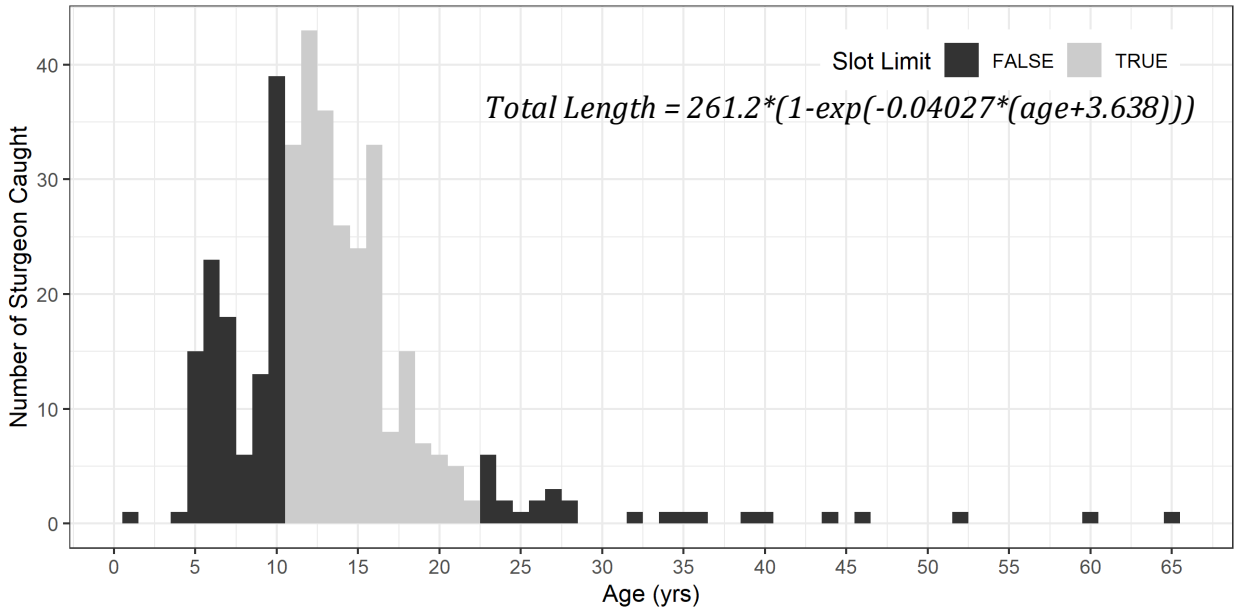

Figure 11. Age frequency of White Sturgeon captured during 2021 sampling. Light grey bars represent White Sturgeon within the current slot limit (101.6-152.4cm FL) and dark grey bars are fish above or below slot limit size. Ages calculated using Von Bertalanffy growth equation from Kohlhorst et al. (1980).

(19/73) of the Chinook Salmon captured were missing their adipose fin. Given that 25% of fall-run Chinook Salmon are adipose fin-clipped in California hatcheries, it is likely that all the Chinook Salmon we captured were of hatchery origin. Chinook Salmon ranged in size from 62-107cm fork length, averaging 82 ± 8.7cm (s.d.; Table 3). These fish were all mature adults and given the location of sampling (Suisun Bay) and presence of dark fish late into the sampling season, may have been lost on their upstream migration. The other two most prevalent bycatch species, California Halibut and Striped Bass, ranged in size from 39-76cm and 69-109cm fork length, respectively (Table 4).

Pinnipeds (Harbor Seals and California Sea Lions) did not present major challenges to sampling in 2021 despite 10 interactions with Harbor Seals and 15 interactions with California Sea Lions. Harbor Seals were observed raiding the net on two occasions and California Sea Lions on one occasion. No sturgeon were observed being removed from the net, however, one sturgeon was captured with a recent injury which may have been due to a pinniped bite.

Table 3. Numbers of other species (bycatch) caught during the 2021 sturgeon tagging season.

Species	Scientific Name	Count
Chinook Salmon	*Oncorhynchus tshawytscha*	73
California Halibut	*Paralichthys californicus*	10
Striped Bass	*Morone saxatilis*	9
American Shad	*Alosa sapidissima*	1
Bat Ray	*Myliobatis californica*	1
Starry Flounder	*Platichthys stellatus*	1

Table 4. Summary of length measurements for bycatch species caught during the 2021 sturgeon tagging season. N = number measured, Min = minimum, Max = maximum, Avg = average, Med = median, SD = standard deviation.

Species	N	Min	Max	Avg	Med	SD
Chinook Salmon	69	62	107	82	83	8.7
California Halibut	10	39	76	57	55	10.6
Striped Bass	6	69	109	89	88	13.6

Finally, it should be noted that two dead White Sturgeon were observed floating in the channel near Pittsburg, California. These fish were severed in half (Figure 12), possibly due to a ship-strike or California Sea Lion predation. These observations were incidental during normal transiting from Antioch to Suisun Bay. Location, observational data (including pictures), and fin ray material from one individual were collected to document the carcasses.

Figure 12. White Sturgeon carcass recovered near Pittsburg, California.

Discussion

Despite considerable logistical challenges, including a positive case of COVID-19 and the absence of our primary research vessel, the New Alosa, 2021 adult White Sturgeon sampling was largely successful. We disk-tagged a total of 284 White Sturgeon – the second greatest number tagged since 2012 despite more restrictive tagging criteria. In addition, we greatly expanded the amount of data we collect on water quality metrics and on each individual sturgeon.

Daily catch per unit effort of White Sturgeon during the 2021 season was similar to what has been seen for most previous years, aside from the exceptionally high catches in 1984 and 1985. This indicates that the population remains at a somewhat stable level, however, due to the long lifespan and late maturity of White Sturgeon it is likely that this stability could be disrupted given sudden changes in mortality rates (ship-strikes, predation, fishery) or given long periods of unsuccessful recruitment. Given this, the observation of adult sturgeon carcasses from ship-strike or predation mortality is concerning.

The low level of within-season recaptures may also be a point of concern. The movements of White Sturgeon immediately following tagging are unstudied, so it is unclear if infrequent within-season recaptures are the result of low capture probability within Suisun Bay or if White Sturgeon behavior is possibly affected by the act of tagging. We will be addressing this uncertainty in future field seasons by tagging some individuals with acoustic tags.

The newly collected environmental and morphometric data will allow for modeling of the effects of potentially influential variables on sturgeon catch moving forward. This will further clarify the relationship between trammel net catch and White Sturgeon abundance in the SFE (Appendix Figure 1). In a future manuscript, we will use these relationships to model abundance estimates and create spatiotemporally stratified annual indices of relative abundance, as is done for key species in other SFE surveys[3].

Other modifications to the Adult Sturgeon Population Study moving forward will include revised protocols to reflect new data collection procedures, revised datasheets, and revision to the sturgeon tagging database to make it easily accessible to the public and other stakeholders. In addition, we have begun piloting an angler-guide data collection program to collect additional morphometric data on White Sturgeon and to increase our engagement with the fishing community.

[3] See CDFW Example Fish Species Indices

Acknowledgements

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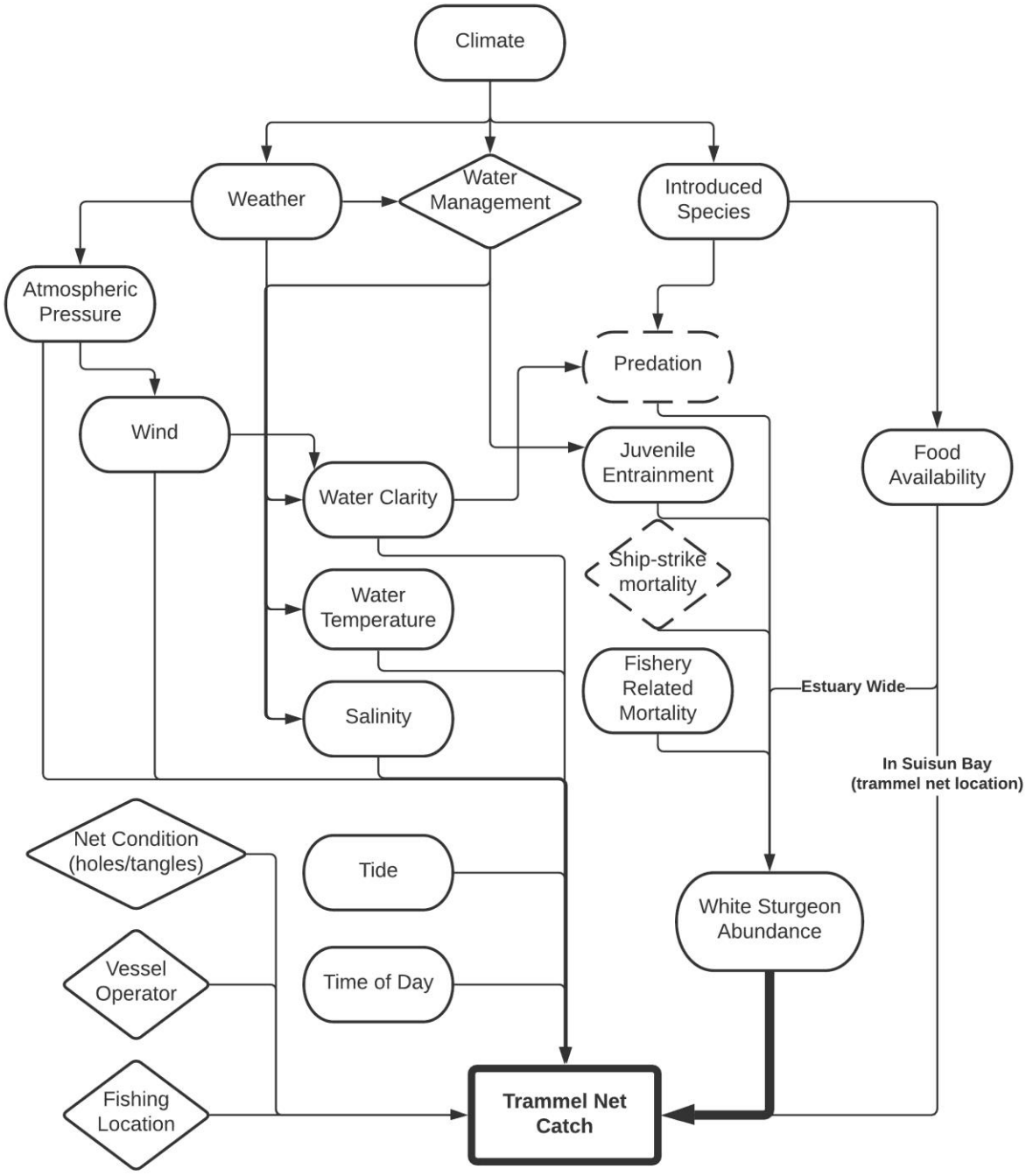
Appendix



Appendix Figure 1. Conceptual model of environmental and human-mediated drivers of trammel net catch for the Adult Sturgeon Population Study. Oval boxes represent environmental variables, diamond boxes are human-mediated variables, dotted lines are currently unmeasured variables, and arrows point in direction of influence. Not all possible variables or relationships are captured in this model.

Appendix Table 1. Field Schedule of crew and days sampled during 2021 Adult Sturgeon Population Study, 8/3/2021 – 9/16/2021.

Date	Boat Op. 1	Boat Op. 2	Science Lead	Science Asst.	Tech. Staff 1	Tech. Staff 2
8/3/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Adam C.	Zach L.
8/4/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Adam C.	Trevin L.
8/5/2021	Cancelled					
8/6/2021	No Sampling					
8/7/2021	No Sampling					
8/8/2021	No Sampling					
8/9/2021	Paul M.	Ramiro S.	Adam C.	Jessica C.	Marc B.	Zach L.
8/10/2021	Paul M.	Ramiro S.	Adam C.	Jessica C.	Jim H.	Zach L.
8/11/2021	Cancelled					
8/12/2021	Cancelled					
8/13/2021	No Sampling					
8/14/2021	No Sampling					
8/15/2021	No Sampling					
8/16/2021	Ken F.	Ramiro S.	Adam C.	Jessica C.	Marc B.	Zach L.
8/17/2021	Ken F.	Ramiro S.	Adam C.	Jessica C.	Zach L.	
8/18/2021	Ken F.	Ramiro S.	Adam C.	Jessica C.	Marc B.	Zach L.
8/19/2021	Ken F.	Ramiro S.	Adam C.	Jessica C.	Chris P.	Zach L.
8/20/2021	No Sampling					
8/21/2021	No Sampling					
8/22/2021	No Sampling					
8/23/2021	Paul M.	Dave H.	Dylan S.	Jessica C.	Marc B.	Zach L.
8/24/2021	Paul M.	Dave H.	Dylan S.	Jessica C.	Colby H.	Zach L.
8/25/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Colby H.	Kevin J.
8/26/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Chris P.	Kevin J.
8/27/2021	No Sampling					
8/28/2021	No Sampling					
8/29/2021	No Sampling					
8/30/2021	Ken F.	Dave H.	Dylan S.	Jessica C.	Marc B.	Zach L.
8/31/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Zach L.	Kevin J.
9/1/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Zach L.	Kevin J.
9/2/2021	Ken F.	Ramiro S.	Adam C.		Chris P.	Zach L.
9/3/2021	No Sampling					
9/4/2021	No Sampling					
9/5/2021	No Sampling					
9/6/2021	Holiday					
9/7/2021	Ramiro S.	Spencer L.	Dylan S.	Jessica C.	Colby H.	Zach L.
9/8/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Colby H.	Zach L.
9/9/2021	Cancelled					
9/10/2021	No Sampling					
9/11/2021	No Sampling					
9/12/2021	No Sampling					
9/13/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Zach L.
9/14/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Emily R.	Zach L.
9/15/2021	Cancelled					
9/16/2021	Cancelled					

Appendix Table 2. Field Schedule of crew and days sampled during 2021 Adult Sturgeon Population Study, 9/17/2021 – 10/27/2021.

Date	Boat Op. 1	Boat Op. 2	Science Lead	Science Asst.	Tech. Staff 1	Tech. Staff 2
9/17/2021	No Sampling					
9/18/2021	No Sampling					
9/19/2021	No Sampling					
9/20/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Zach L.
9/21/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Colby H.	Zach L.
9/22/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Zach L.
9/23/2021	Cancelled					
9/24/2021	No Sampling					
9/25/2021	No Sampling					
9/26/2021	No Sampling					
9/27/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Trevin L.
9/28/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Dave H.	Trevin L.
9/29/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Dave H.	Trevin L.
9/30/2021	Cancelled					
10/1/2021	No Sampling					
10/2/2021	No Sampling					
10/3/2021	No Sampling					
10/4/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Colby H.
10/5/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Adam C.	Colby H.
10/6/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Trevin L.
10/7/2021	Cancelled					
10/8/2021	No Sampling					
10/9/2021	No Sampling					
10/10/2021	No Sampling					
10/11/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Trevin L.
10/12/2021	Cancelled					
10/13/2021	Ken F.	Ramiro S.	Adam C.	Jessica C.	Andrew A.	Trevin L.
10/14/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Chris P.	Trevin L.
10/15/2021	No Sampling					
10/16/2021	No Sampling					
10/17/2021	No Sampling					
10/18/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Marc B.	Trevin L.
10/19/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Jasmine W.	Trevin L.
10/20/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Colby H.	Trevin L.
10/21/2021	Ken F.	Ramiro S.	Adam C.	Jessica C.	Chris P.	Trevin L.
10/22/2021	No Sampling					
10/23/2021	No Sampling					
10/24/2021	No Sampling					
10/25/2021	Cancelled					
10/26/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Colby H.	Trevin L.
10/27/2021	Ken F.	Ramiro S.	Dylan S.	Jessica C.	Colby H.	Zach L.