Yuma Cove backwater population analysis

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Introduction

This summary analysis for Yuma Cove backwater is auto-generated and results stated within should be considered preliminary. These results are based on an analysis of stocking, capture, and PIT scanning records starting on 2013-01-01 and ending on 2024-08-02. Several approaches are used to assess the overall status of the population in the backwater. Known survival analysis provides a detailed fish by fish accounting of the fish that are known to be alive in the backwater based on PIT scanning. In backwaters with nearly continuous PIT scanning, these known survivor numbers should be no less than 95% of the actual PIT tagged population, as all fish are provided at a minimum 120 days of PIT scanning regardless of tagging date. Backwater sampling events are used to evaluate recruitment, size class distribution, and proportion of tagged to untagged fish in the backwater. The tagged to untagged proportion is used in conjunction with the known survival analysis to provide point estimates of the adult population size. The biomass of the most recent sampling event is estimated based on capture records and a length-weight relationship established from all backwater capture data. Any reduction of biomass through harvest or mortality is assessed through PIT scanning conducted after the most recent autumn harvest.

Known Survival

Known survival analysis uses PIT scanning data to track the number of PIT tagged fish alive in the backwater on any given date. For a fish to be included in the total, it must have been tagged and release prior to the date (x-axis), and it must have been scanned at least once 120 days after it's release date. This avoids including fish that were scanned within a few days of tagging, but died before contributing significantly to the population. For example, a fish tagged and released on January 1, 2019 will be included in the known population total for every day after January 1, 2019 as long as it was scanned once after May 1, 2019. If it was never scanned again after May 5, 2019, then it will be a part of the known population from January 1, 2019 through May 5, 2019, and removed from the population for all subsequent dates.

The initial stocking into Yuma Cove backwater on 2013-02-11 consisted of 100 females and 100 males, but only 104 (80 females and 24 males) survived to 120 days post-stocking based on PIT scanning data (Figure 1). The stair step pattern of known survivors from the initial stocking is indicative of a dramatic decline in survivor numbers over summer months for both sexes. Based on PIT scanning after the most recent spawning season (2023), the remaining known survivors from the initial stocking include 12 females and 2 males. This represents a mean annual survival of 83.3% over 11 years.
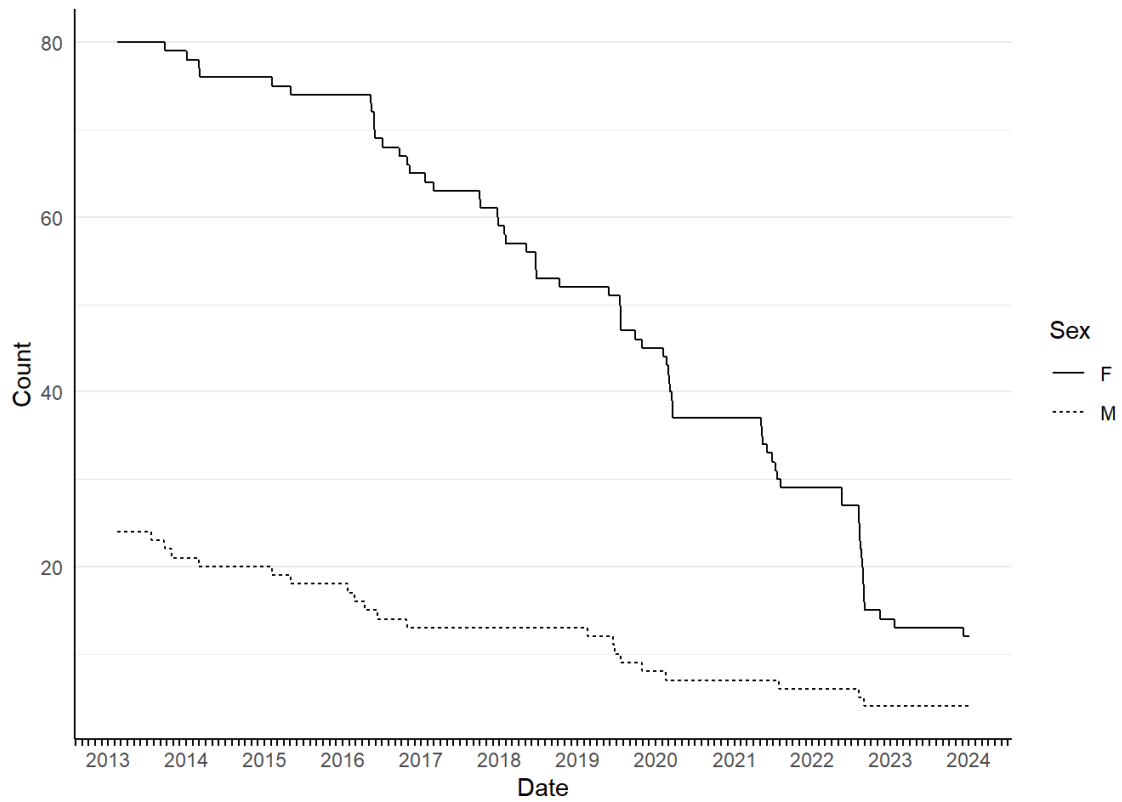
Figure 1: Initial stocking known survivors over time by sex.

When all tagged fish are included in the known population analysis, increases to the number of known survivors are possible due to the tagging and survival of naturally recruited fish or fish from supplemental stocking (Figure 2 and Figure 3). Most fish captured, tagged, and released were given juvenile or unknown sex designations. The proportion of fish with unknown sex therefore increased over time, whereas juvenile fish rarely survived long enough to be added to the known survivors count (Figure 2).
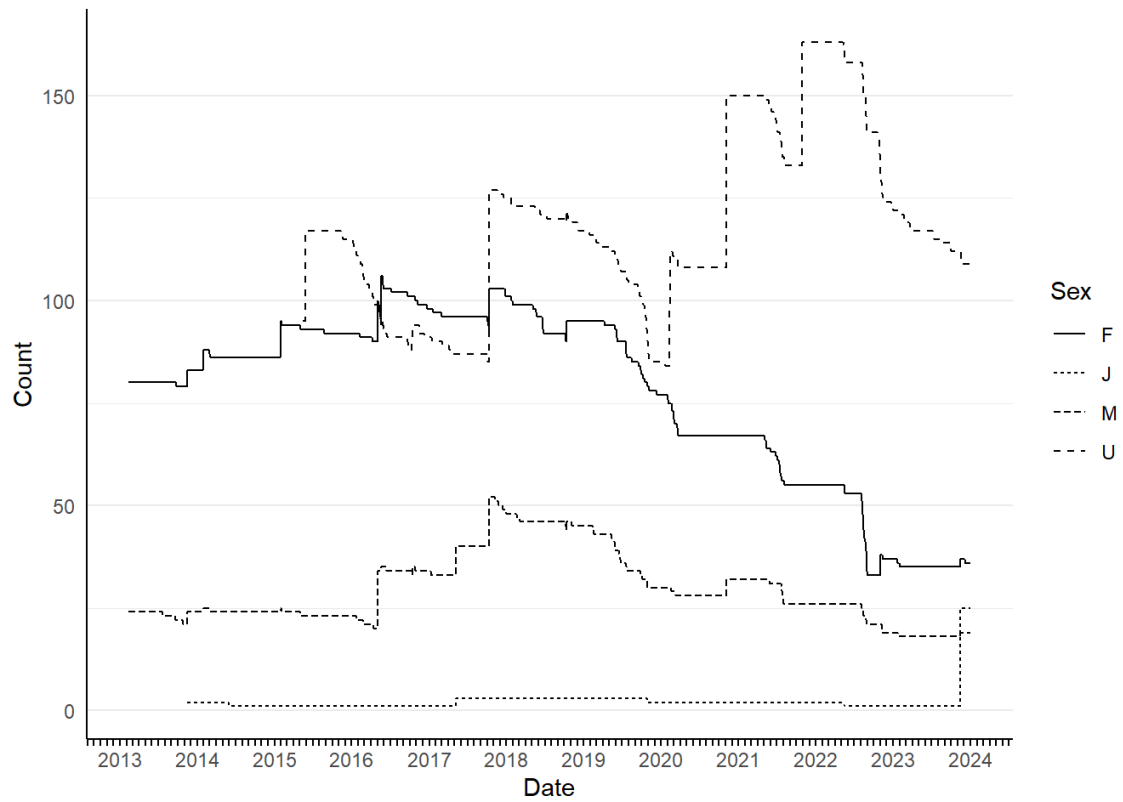
Figure 2: Known survivors over time by sex.
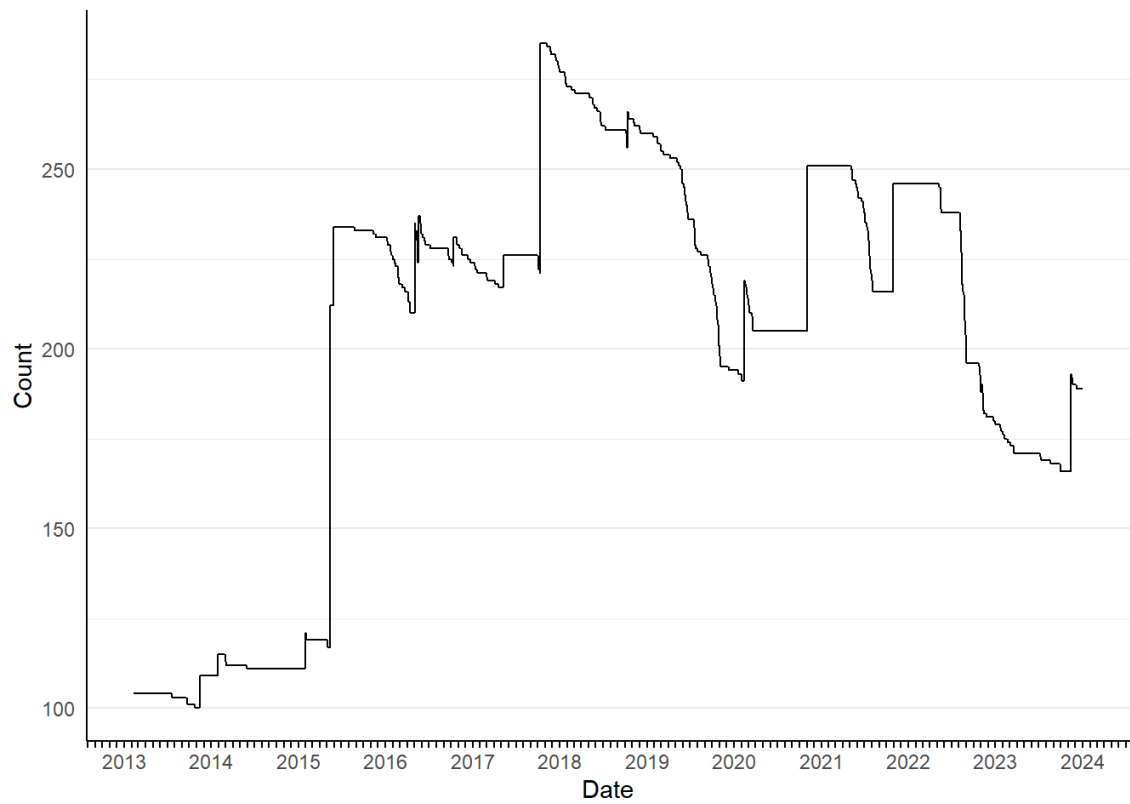

Figure 3: Known survivors over time.

The most recent count (PIT scanning after March of 2024) of known survivors in Yuma Cove backwater is 178 fish (Table 1). The survivors tagging history is a combination of stocking and tagging events conducted in the backwater since the original stocking in 2013. Mean TL is the mean total length recorded of all known survivors at tagging.

Table 1:
Current known survivors tagging history.

Event	Year	Month	TL (mm)	M	F	U	J
Stocking	2013	February	393	2	0	0	0
Stocking	2013	February	439	0	12	0	0
Stocking	2014	January	360	0	2	0	0
Stocking	2015	January	435	0	1	0	0
Stocking	2020	February	362	0	0	13	0
Capture	2015	May	429	0	0	34	0
Capture	2016	May	480	0	0	1	0
Capture	2016	May	433	3	0	0	0
Capture	2016	May	450	0	7	0	0
Capture	2016	October	475	0	0	1	0
Capture	2016	October	443	1	0	0	0
Capture	2017	May	472	5	0	0	0
Capture	2017	May	272	0	0	0	1
Capture	2017	October	363	0	0	16	0
Capture	2017	October	415	2	0	0	0
Capture	2017	October	517	0	2	0	0
Capture	2018	October	159	0	0	1	0
Capture	2018	October	525	0	2	0	0
Capture	2020	November	480	0	0	21	0
Capture	2020	November	488	2	0	0	0
Capture	2021	October	488	0	0	17	0
Capture	2022	November	545	0	5	0	0
Capture	2023	November	470	1	0	0	0
Capture	2023	November	217	0	0	0	24
Capture	2023	November	516	0	2	0	0

Backwater Sampling Events

Sampling events in Yuma Cove backwater have resulted in the capture and tagging of 2657 fish (Table 2). Most fish captured were small and did not survive long enough to contribute to the overall spawning population. To separate the small fish unlikely to contribute to the adult spawning population from the larger subadult to adult fish, all captured fish were broken down into three size classes based on the TL at capture; 1 <250, 2 >=250 and <350, 3 >=350 mm TL.

Table 2:
Capture summary by size class.

Year	Month	Size class 2	3	1
2013	November	48	89	0
2014	January	3	10	0
2014	May	0	74	0
2015	May	0	166	0
2016	May	0	100	0
2016	October	112	27	1
2017	May	3	16	0
2017	October	40	91	0
2018	October	1	38	483
2019	November	10	79	0
2020	November	56	112	174
2021	October	144	65	101
2022	November	2	44	282
2023	November	56	20	210

Size Class 3 fish were assumed to all be adults, whereas size class 2 fish were assumed to be a mix of subadult and adult fish at the time of capture. Both size classes together made up the entirety of the potential spawning population. Although some size class 2 fish were immature at capture, they had a similar survival profile to size class 3, and were likely to mature a year or two following their tagging and release. The proportion of potential spawning fish (size class 2+) that were recaptures (captured with a tag) were assumed to represent the proportion of the total potential spawning population that was PIT tagged within the backwater (Table 3).

Table 3:
Recapture status for size class 2+.

Year	Month	Recaptured Y	N	Proportion
2013	November	79	58	0.577
2014	January	12	1	0.923

Year	Month	Recaptured Y	N	Proportion
2014	May	74	0	1.000
2015	May	42	124	0.253
2016	May	44	56	0.440
2016	October	14	125	0.101
2017	May	9	10	0.474
2017	October	36	95	0.275
2018	October	23	16	0.590
2019	November	37	52	0.416
2020	November	56	112	0.333
2021	October	40	169	0.191
2022	November	26	20	0.565
2023	November	13	63	0.171

Spawning Adult Population Size

The total spawning population (tagged and untagged) was estimated from the recapture proportion (of size class 2+ fish) for all years when there is a autumn or early winter (after September) capture event. The known survivors (Figure 4) for each year as of December 1st was divided by the autumn recapture proportion for the same year. The recaptures and total captures used to calculate recapture proportion were adjusted for fish that avoid detection or that were harvested during the capture event by removing fish captured but never scanned after the capture event. Population estimates were calculated for all years with an autumn sample of more than 10 total captures after adjustment. The 95% confidence intervals were derived from the binomial distribution based on the autumn capture values (trials = total captures, successes = recaptures).
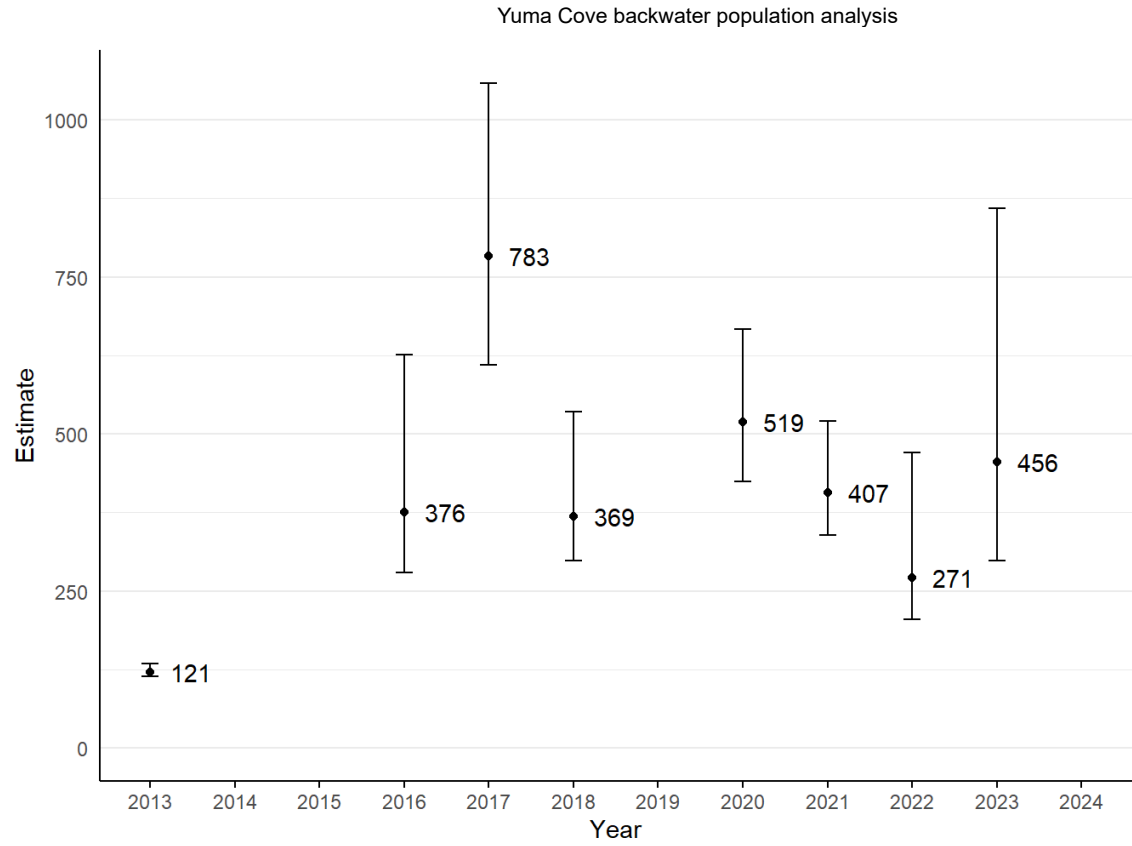
Figure 4: Adult population estimates based on recapture proportion and known survivors.

Estimating Biomass

Total length (TL) and mass (g) have been recorded for 1988 fish in Yuma Cove backwater (Figure 5). The parameters of a length-weight relationship were estimated using maximum likelihood based on these records and was used to estimate mass for fish when TL was recorded but mass was not. One potential consequence of overcrowding in a backwater and subsequent resource limitation is that the length-weight relationship might change over time. However, this was not the in Yuma Cove backwater as the length-weight relationship was consistent regardless of year (Figure 5); most recent measurements in black.
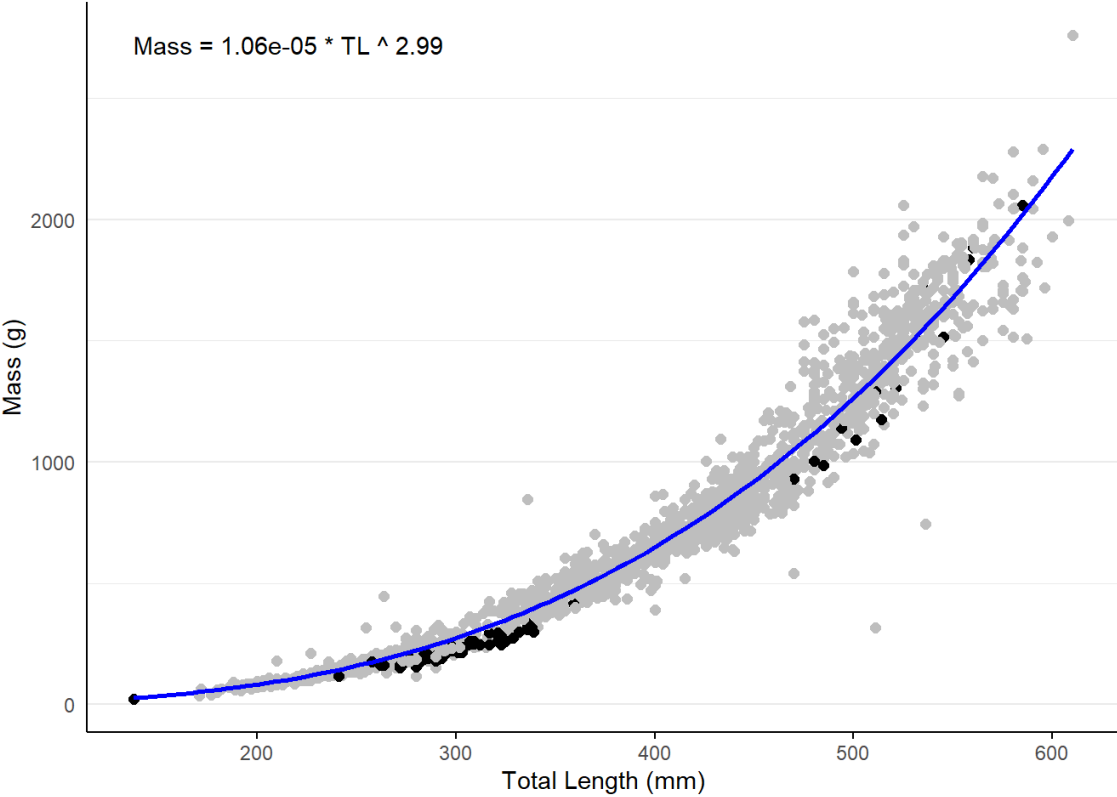
Figure 5: Length-weight relationship based on all capture and release records.

Total biomass of the most recent autumn sampling event 2023 was calculated in kilograms (kg) from individual mass as measured when available or mass estimates based on the length-weight relationship (Table 4). Harvest and mortality reduced the available biomass post-sampling, and so the available biomass from surveyed fish was calculated based on recent PIT scanning (contacted at least once in the current year).

Table 4:
Biomass estimate from recent autumn sample and surviving biomass from that sample based on PIT scanning.

SizeClass	Mean TL (mm)	Biomass (kg)	Count	Alive	Alive Biomass (kg)
1	116	3.568	210	13	0.225
2	299	12.580	56	9	2.330
3	512	27.108	20	15	21.093

This biomass estimate isn't the total population biomass. The known population in the backwater is 178 fish, and the estimated total population is 456. 72% of the known population has been at large for more than 3 years, (129 out of 178 fish, Table 1). It is likely that most if not all of those fish are Size Class 3 adults.