

Yuma Cove backwater population analysis

B.R. Kesner

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 2024-01-05. 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 females and males. This represents a mean annual survival of 0% over 11 years.

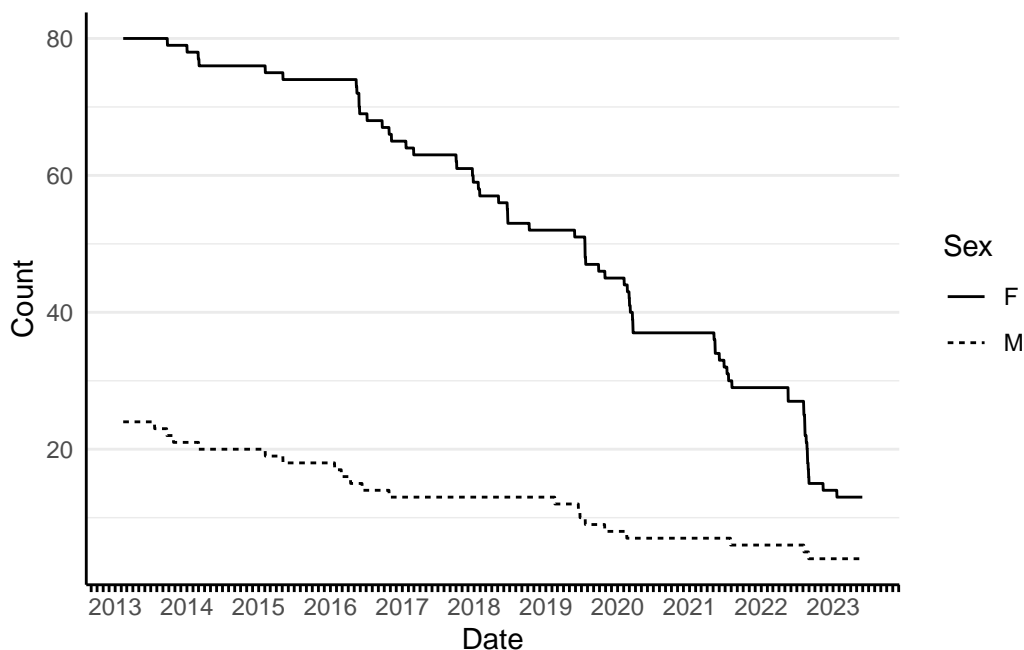


Figure 1: Initial stocking known survivors over time by sex.

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).

The most recent count (PIT scanning after March of 2024) of known survivors in Yuma Cove backwater is 0 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)
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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 <350, 2 \geq 350 and <500, 3 \geq 500 mm TL.

Table 2: Capture summary by size class.

Year	Month	Size class		
		1	2	3
2013	November	48	33	56
2014	January	3	4	6
2014	May	0	15	59
2015	May	0	152	14
2016	May	0	83	17
2016	October	113	23	4
2017	May	3	14	2
2017	October	40	56	35
2018	October	484	24	14
2019	November	10	45	34
2020	November	230	66	46
2021	October	245	30	35
2022	November	284	17	27
2023	November	266	7	13

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+.

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Year	Month	Recaptured		Proportion
		Y	N	
2013	November	79	10	0.888
2014	January	9	1	0.900
2014	May	74	0	1.000
2015	May	42	124	0.253
2016	May	44	56	0.440
2016	October	14	13	0.519
2017	May	9	7	0.562
2017	October	36	55	0.396
2018	October	23	15	0.605
2019	November	37	42	0.468
2020	November	56	56	0.500
2021	October	40	25	0.615
2022	November	25	19	0.568
2023	November	13	7	0.650

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).

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.

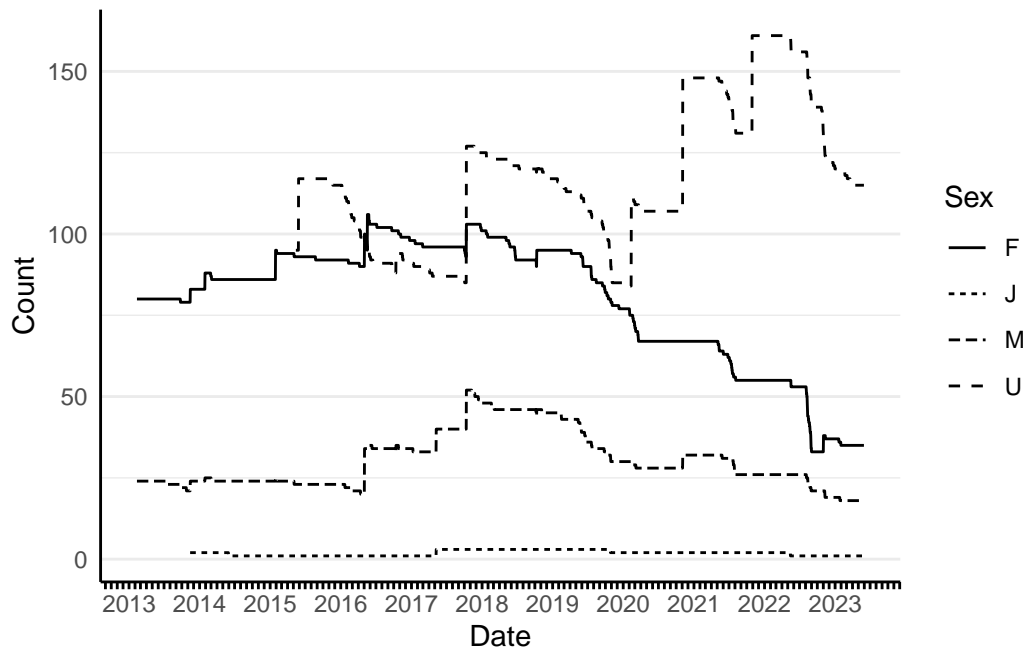


Figure 2: Known survivors over time by sex.

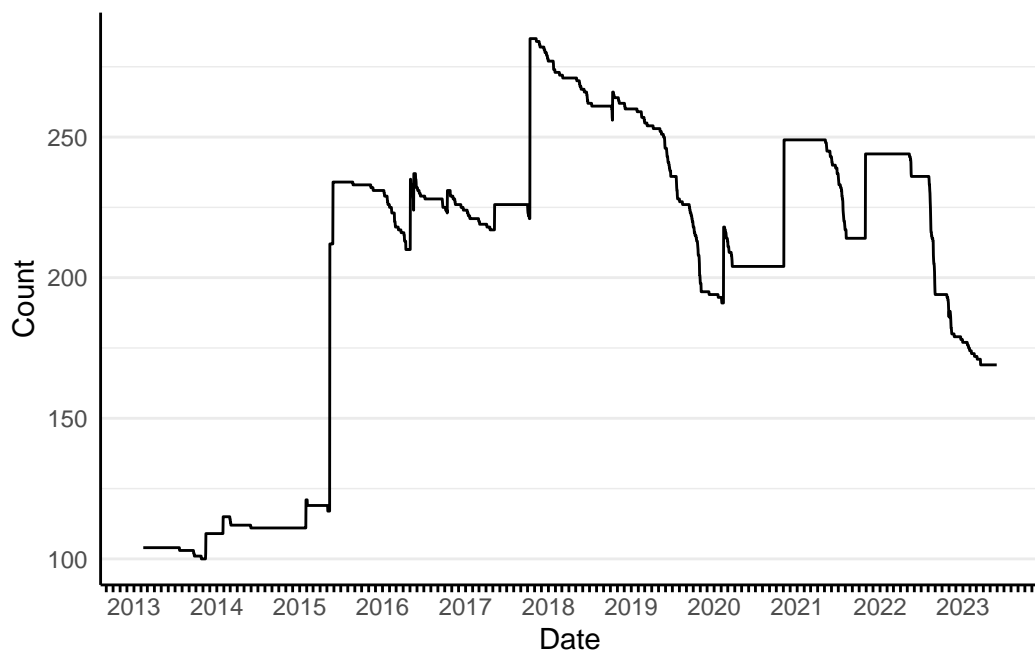


Figure 3: Known survivors over time.

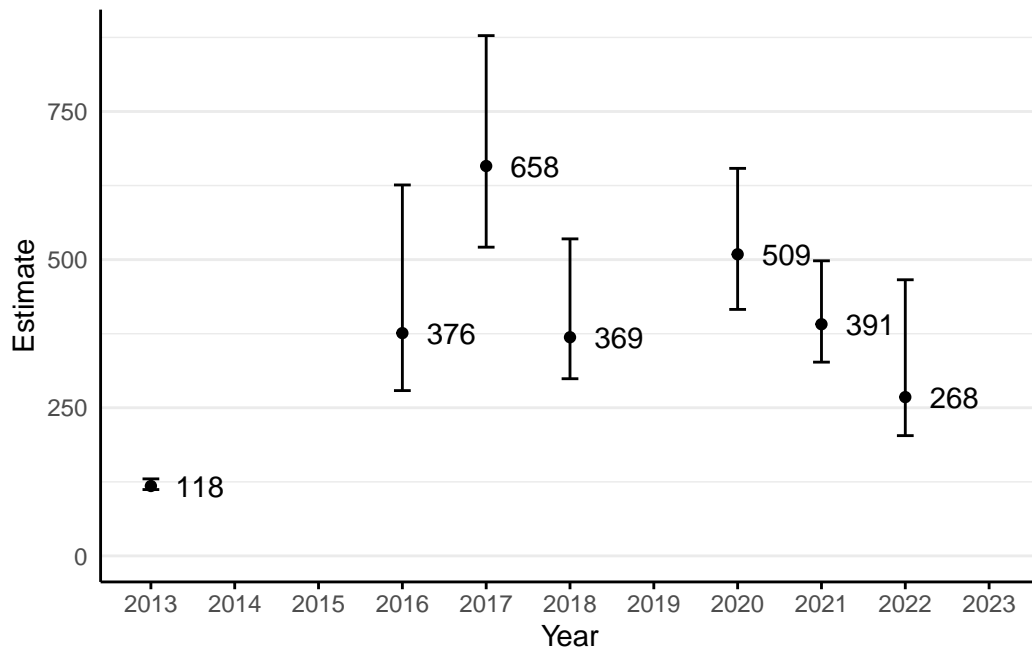


Figure 4: Adult population estimates based on recapture proportion and known survivors.

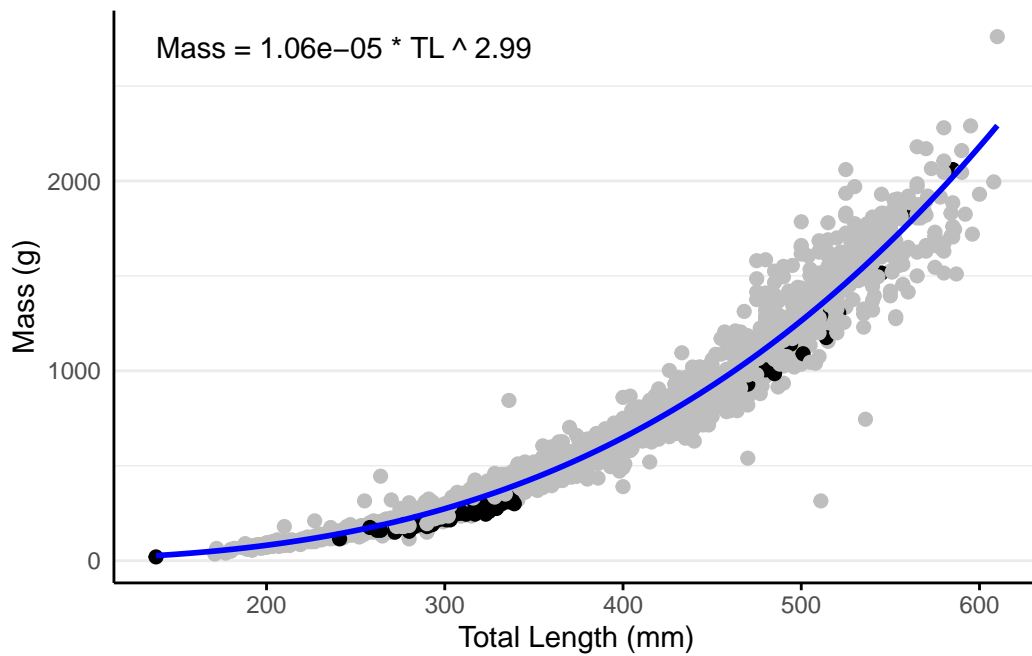


Figure 5: Length-weight relationship based on all capture and release records.

Total biomass of the most recent autumn sampling event 2022 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	154	16.148	266	0	0
2	467	6.798	7	0	0
3	536	20.310	13	0	0

This biomass estimate isn't the total population biomass. The known population in the back-water is 0 fish, and the estimated total population is 268. NA% of the known population has been at large for more than 3 years, (0 out of 0 fish, Table 1). It is likely that most if not all of those fish are Size Class 3 adults.