CATCH EFFICIENCY COMPARISONS OF FOUR COMMERCIAL GILLNET MESH SIZES IN THE TAKING OF SOCKEYE AND CHUM SALMON IN DISTRICTS 111 AND 115, SOUTHEAST ALASKA

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Regional Information Report[1] No. 1J94-13

Alaska Department of Fish and Game
Commercial Fisheries Management and Development Division
Juneau, Alaska

April 1994

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INTRODUCTION

This report describes the preliminary results of a gillnet mesh size study evaluating the fishing efficiency (CPUE) of four mesh sizes in the taking of sockeye and chum salmon during the summer season in two adjacent fishing districts in Southeast Alaska. Gillnets comprised of 5 1/4", 5 3/4", 6" and 6 1/4" mesh were fished in Districts 111 and 115 during five consecutive weeks in July and August. Due to a lack of gear availability, the study was conducted over a 2-year period; District 111 was conducted in 1991, while District 115 was completed in 1992 (Figure 1).

Hatchery summer chum salmon enhancement has increased in recent years in Districts 111 and 115. Additional fishing time is often required to harvest these summer chum salmon returns, above that which would normally be allowed during the traditional sockeye salmon fishery. In order to increase chum salmon catches while reducing sockeye interceptions the department implemented a minimum mesh size which is larger than the optimal sockeye mesh size. By fishing a larger mesh size, more fishing time could be allowed to catch chum salmon, without further increasing the sockeye salmon catch.

Over time, two different minimum mesh sizes have been adopted into regulation for District 111 and 115. The department may implement a minimum mesh of 6" in District 111, and 6 1/4" in District 115, during periods established by emergency order for the protection of sockeye salmon during the chum salmon season. During the 1990 Board of Fisheries meeting several proposals were submitted to change the minimum mesh size of each district to be more consistent with the other. Since evidence was not available to support either as the "right" mesh size, the Board of Fisheries directed the department to conduct a gear study to compare several mesh sizes to determine which mesh size would be most efficient at catching chum salmon while letting most sockeye to pass through.

METHODS

The study was conducted in two separate gillnet fishing districts in Southeast Alaska. Gillnet Districts 111 (Taku/Snettisham) and 115 (Lynn Canal) were selected because each district encompassed chum salmon hatcheries or chum salmon remote release sites. Both districts had increasing summer chum salmon harvests during stable or declining sockeye returns. The Douglas Island Pink and Chum (DIPAC) hatchery, the state hatchery in Port Snettisham, and the Northern Southeast Regional Aquaculture Association (NSERAA) were the primary summer chum salmon stock enhancers, with release sites located in lower Lynn Canal, Stephen's Passage, and Gastineau Channel.

The study in District 111 was conducted in 1991, while the study in District 115 was completed in 1992. Fishing was conducted in both years for a five consecutive weeks; fishing occurred in District 111 from

July 5 to August 2, and in District 115 from July 9 to August 7. In each district, one gillnet boat was chartered to fish a 24-hour period the same day each week for the 5-week period.

Each vessel fished a 200-fathom net comprised of four, 50-fathom panels of different mesh size gillnets. The net was hung at a ratio of 2.2 fathoms of gillnet web for every 1 fathom of cork line (fishing industry standard). Mesh color and thread size matched that which was currently used in each area as suggested by local Uroko net distributors.

The panels included the following gillnet mesh sizes:

1. Uroko multistrand, 5 1/4"
2. Uroko multistrand, 5 3/4"
3. Uroko multistrand, 6"
4. Uroko multistrand, 6 1/4"

Panels were separated by 5-fathom spaces to avoid panels leading fish to adjacent panels. Panels were ordered randomly at the beginning of each fishing period. The order was fished for the first 12 hours, after which the two inside panels were switched with the two outside panels. When setting the net from the vessel, the ends of the net were alternately fished next to the beach. By alternating the position of the panels within the net, and alternating the ends of the net in relationship to the beach, each panel was exposed to the same geographical fishing conditions.

Species, sex, length and girth were recorded for each fish caught by panel (mesh size) for each set. In addition, the method by which each fish was caught in the web was recorded in order to evaluate the drop-out rate for each mesh type. Method of entanglement was classified as:

1. Drop-outs
2. Those fish caught only by portions of their mouth or maxillary
3. Those fish which are impaled past their gills or gill plates
4. Those fish which are impaled past the head

In order to standardize catches to catch per hour fished, the time when the net was set was recorded, as well as the time each panel started to come into the boat, and the time each panel was completely on board. Fishing time was defined as that period from when the first float left the vessel to when the last float was reeled back on to the boat, and it was calculated as:

$$T = (tin1 - tout) + 0.5(tin2 - tin1)$$

where,

T = fishing time in hours

tout = time first float of net leaves the boat;

tin1 = time panel starts coming in to boat; and

tin2 = time panel is totally on the boat

RESULTS

Sockeye and chum salmon were the predominant species caught in both District 111 and District 115 during the study. In District 111, a total of 1,844 chum, 905 sockeye, 162 pink, 86 coho and 9 king salmon were caught (Table 1). District 115 had a total catch of 800 chum, 586 sockeye, 505 pink, 1 coho, and 1 king salmon (Table 2). Fishing occurred in District 111 on July 5-6, July 11-12, July 18-19, July 25-26 and August 1-2, 1991. District 115 fishing dates were July 9-10, July 16-17, July 24-25, July 30-31 and August 5-7, 1992.

In general, the total catch and proportion of each species within the catch differed between weeks. In District 111 the sockeye salmon catch peaked on July 18-19 (3rd week) with a weekly catch of 288, while chum salmon peaked on July 11-12 (2nd week) with a total catch of 789. The peak sockeye catch in District 115 of 252 fish occurred on July 9-10, and the peak weekly chum catch of 322 fish occurred on July 16-17. Due to the design of the study (i.e., time of year, mesh size selected, etc.), pink, coho, and king salmon were considered as species incidental to the purpose of this study and catch efficiencies were not developed for them.

Catch Efficiencies: (CPUE)

The study showed that although there were differences between fishing weeks and mesh size efficiency in catching sockeye and chum salmon (Figures 2-6 and 8-12), overall there were general trends in gear efficiency of the four mesh sizes studied (Figures 1 and 7). CPUE was defined as the total catch divided by the total effort for a given time period. As mesh size increased, sockeye salmon catches decreased. Chum salmon catch efficiencies by mesh size were less clear, with the three larger mesh sizes exhibiting very similar CPUEs, though in District 115, the 6 1/4" mesh exhibited the lowest catch rate for chum salmon.

Sockeye Salmon

In District 111, the 6" mesh caught the fewest sockeye over the study period (2.6 fish/hour), but it was not significantly ($\alpha = .05$) different than the 6 1/4" mesh (3.0 fish/hour). Although both the 6" and 6 1/4" mesh caught the same number of females, the 6 1/4" mesh caught more males, resulting in a higher overall CPUE, although the results are not significantly different. The 5 1/4" mesh was significantly more effective in catching sockeye salmon than the 5 3/4", 6", and 6 1/4" mesh sizes, and the 5 3/4" was significantly more effective than the 6" or 6 1/4" mesh.

In District 115, the 6 1/4" mesh caught the fewest sockeye over the study period (2.2 fish/hour), but it was not significantly different than the 6.0" mesh (2.3 fish/hour). The 6 1/4" mesh caught significantly fewer female sockeye than the 6" mesh (0.9 and 1.1 fish/hour, respectively). The 6 1/4" mesh, as in District 111, was significantly less efficient in catching sockeye than the 5 1/4", 5 3/4" and 6" gillnet mesh sizes.

Chum Salmon

In District 111, the 5 1/4" mesh caught significantly fewer chum salmon than the 5 3/4", 6", and 6 1/4", but the CPUEs for the larger mesh sizes were not significantly different from each other. Chum salmon CPUEs for the 5 3/4", 6" and 6 1/4" were 7.9, 7.5, and 8.0 fish, respectively. The 5 3/4" mesh caught the most female chums, while the 6 1/4" mesh caught more males, although the differences were not significant.

In District 115, the 6" mesh caught the most chum, with the CPUE for 6" mesh significantly higher than for the 6 1/4" mesh (4.1 and 3.1 fish, respectively). The 5 3/4" mesh caught the most female chums, while the 6" mesh caught the most males, but differences were not significant. Chum salmon CPUEs for the 5 1/4" and 5 3/4" mesh sizes were 3.4 and 3.7 fish, respectively.

CPUE for sockeye and chum salmon for each fishing week and total season are found in Figures 1-6 (District 111) and Figures 7-12 (District 115).

Incidental Species

Although CPUE values were not calculated for incidental species, total catch by species by mesh size is available (Tables 1 & 2). In District 111, the 5 1/4" mesh caught the most pink salmon (93 fish); 6 1/4" caught the most king salmon (4), and coho salmon were caught equally by all four mesh sizes (19-23

fish). In District 115, the 5 1/4" mesh also caught the most pink salmon (244), 5 3/4" mesh caught the only king salmon, and coho salmon were caught equally by the 5 3/4" and 6" mesh (1 each).

Catch Proportions

Of particular importance to this study was the proportion of chum (with respect to the catch of chum and sockeye salmon), caught by a given mesh size, since we need to know which mesh size maximizes the proportion of chum in a total catch of chum and sockeye salmon. Across all weeks, in Districts 111 and 115, there were only a few times when the proportion of chum was greatest for 6 1/4" mesh. It was usually greatest for the 6" mesh in District 111 (Figures 14-18), and the 5 3/4" or 6" mesh in District 115 (Figures 20-24) . Although the chum catch proportion for 6" mesh was never statistically significantly different from the proportion for 6 1/4", the overall evidence points to a mesh size less than 6 1/4" as being more efficient in both districts.

DISCUSSION

The objective of this study was to determine a mesh size which would be efficient at harvesting chums but at the same time, be least effective at harvesting sockeye salmon. In both District 111 and 115, the 6" mesh produced the highest proportion of chum to sockeye salmon in the catch, although not significantly different than the 5 3/4" and 6 1/4" mesh (Figures 13 and 19). Therefore, 6" mesh would be the logical mesh size to implement during a period when the department desired to target summer chum salmon and have minimal impacts on sockeye salmon stocks. However, due to the fact that the 6 1/4" mesh catches more males than females (of both species), it may be a slightly more effective mesh size to use when trying to further increase escapement of females.

Results of this study were specific to the size (length and/or girth) distribution encountered in each district. Lynn Canal results in 1992 pointed to an even smaller optimum mesh size than in Taku study, possibly because there were larger chum in the Taku return areas in 1991 (Figure 25). If the size distribution changes in the future, we can use the results of this study to predict the optimal mesh size for our objective.

Analysis of length/girth relationships to mesh size and selectivity will be discussed in a future technical report.

TABLE 1. DISTRICT 111 CATCH BY SPECIES BY WEEK BY MESH SIZE

TAKU MESH SIZE STUDY PRELIMINARY DATA

WEEK 1--14 SETS

	PINK (6-1/4")	ORANGE (6")	GREEN (5-3/4")	BLUE (5-1/4")	TOTAL CATCH BY SPECIES
CHUM	106	112	93	46	357
SOCKEYE	49	42	47	61	199
PINK	0	1	2	2	5
KING	0	1	0	0	1
COHO	0	0	0	0	0

WEEK 2--12 SETS

	PINK (6-1/4")	ORANGE (6")	GREEN (5-3/4")	BLUE (5-1/4")	
CHUM	225	204	214	146	789
SOCKEYE	19	13	49	34	115
PINK	2	1	10	18	31
KING	3	1	1	0	5
COHO	0	1	0	0	1

WEEK 3--11 SETS

	PINK (6-1/4")	ORANGE (6")	GREEN (5-3/4")	BLUE (5-1/4")	
CHUM	117	108	113	92	430
SOCKEYE	76	48	60	104	288
PINK	13	7	18	50	88
KING	1	0	0	1	2
COHO	4	4	7	5	20

WEEK 4--15 SETS

	PINK (6-1/4")	ORANGE (6")	GREEN (5-3/4")	BLUE (5-1/4")	
CHUM	35	35	52	26	148
SOCKEYE	26	44	45	50	165
PINK	1	4	6	12	23
KING	0	0	0	1	1
COHO	11	6	5	3	25

WEEK 5--11 SETS

	PINK (6-1/4")	ORANGE (6")	GREEN (5-3/4")	BLUE (5-1/4")	
CHUM	27	26	30	37	120
SOCKEYE	21	19	31	67	138
PINK	1	1	2	11	15
KING	0	0	0	0	0
COHO	7	11	11	11	40

TOTALS FOR WEEKS 1-5 (63 SETS)

CHUM	510	485	502	347	1844
SOCKEYE	191	166	232	316	905
PINK	17	14	38	93	162
KING	4	2	1	2	9
COHO	22	22	23	19	86

GRAND TOTAL	3006

TABLE 2. DISTRICT 115 CATCH BY SPECIES BY WEEK BY MESH SIZE

LYNN CANAL MESH SIZE STUDY PRELIMINARY DATA

	PINK (6-1/4")	ORANGE (6")	GREEN (5-3/4")	BLUE (5-1/4")	TOTAL CATCH BY SPECIES
WEEK 1–8 SETS					
CHUM	28	35	47	32	142
SOCKEYE	56	58	61	77	252
PINK	20	26	59	107	212
KING	0	0	0	0	0
COHO	0	0	1	0	1
WEEK 2–10 SETS					
CHUM	75	98	71	78	322
SOCKEYE	14	9	11	8	42
PINK	10	18	24	50	102
KING	0	0	0	0	0
COHO	0	0	0	0	0
WEEK 3–9 SETS					
CHUM	4	8	17	4	33
SOCKEYE	15	11	11	28	65
PINK	4	16	26	38	84
KING	0	0	0	0	0
COHO	0	0	0	0	0
WEEK 4–13 SETS					
CHUM	42	63	52	63	220
SOCKEYE	5	12	8	9	34
PINK	13	21	19	41	94
KING	0	0	1	0	1
COHO	0	0	0	0	0
WEEK 5–16 SETS					
CHUM	22	29	24	8	83
SOCKEYE	32	42	67	52	193
PINK	0	3	2	8	13
KING	0	0	0	0	0
COHO	0	1	0	0	1
TOTALS FOR WEEKS 1-5 (56 SETS)					
CHUM	171	233	211	185	800
SOCKEYE	122	132	158	174	586
PINK	47	84	130	244	505
KING	0	0	1	0	1
COHO	0	1	1	0	2
				GRAND TOTAL	1894

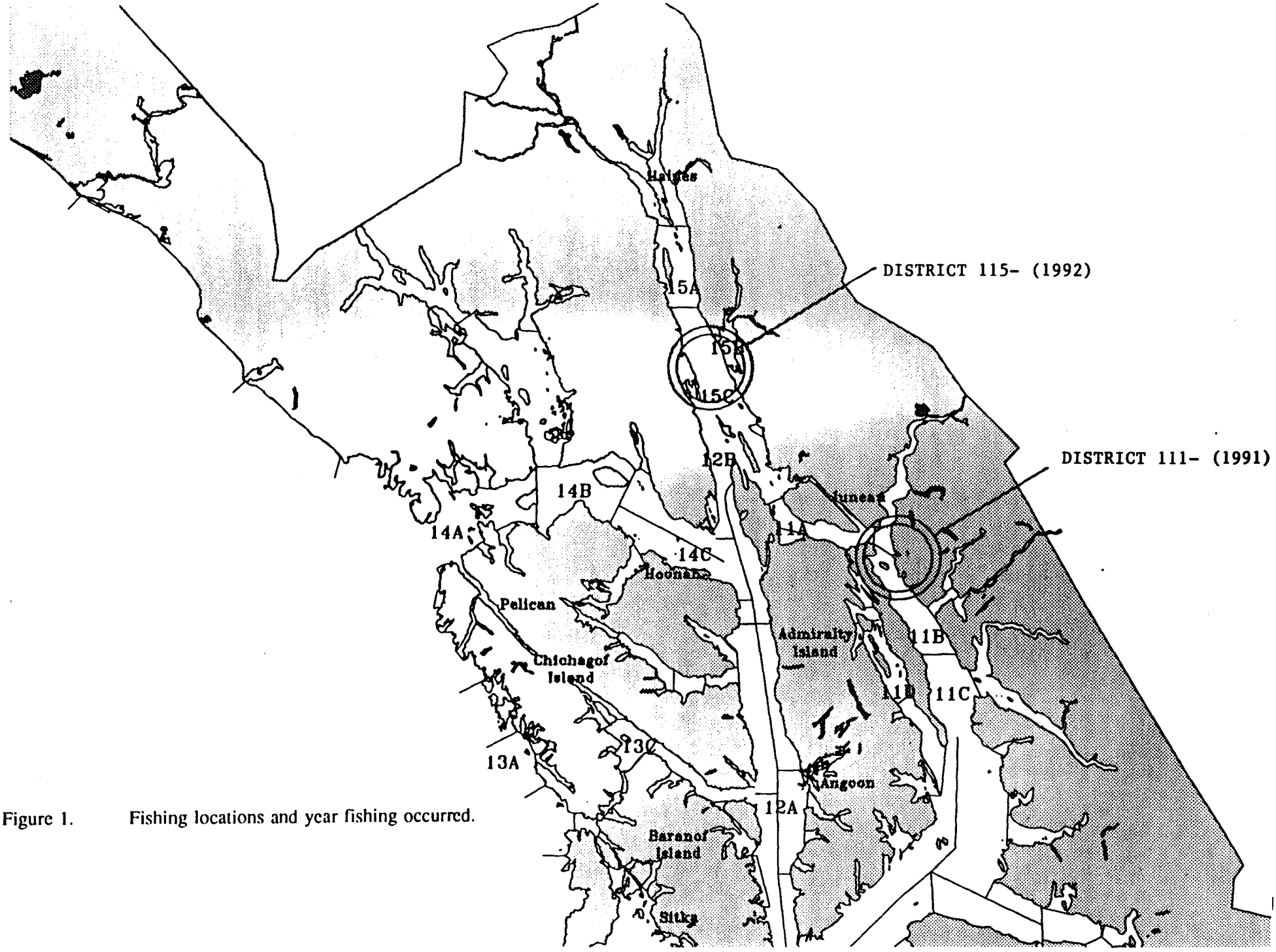

Figure 1. Fishing locations and year fishing occurred.

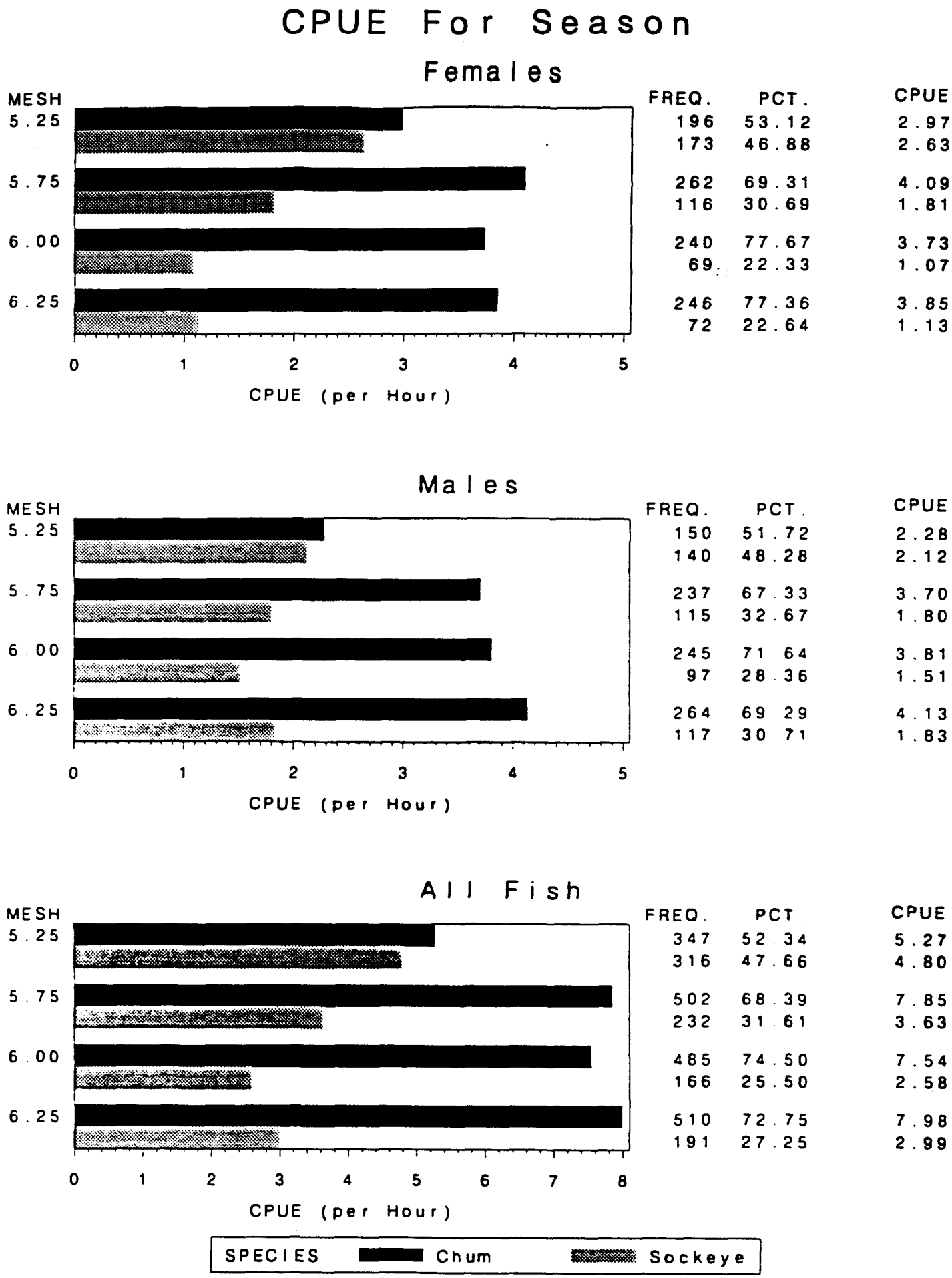

Figure 2. District 111 CPUE by mesh size by species-all weeks.

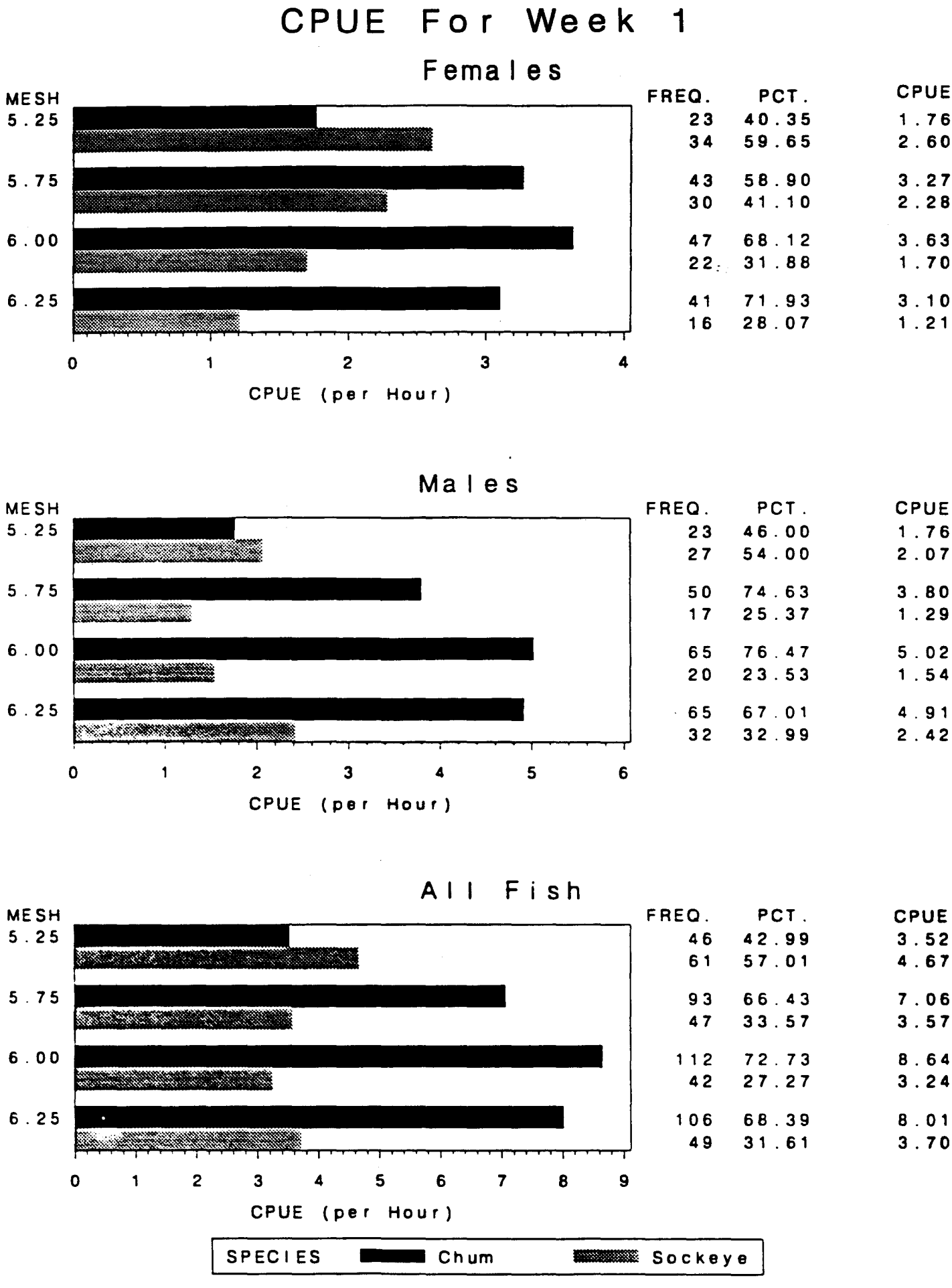

Figure 3. District 111 CPUE by mesh size by species-Week 1.

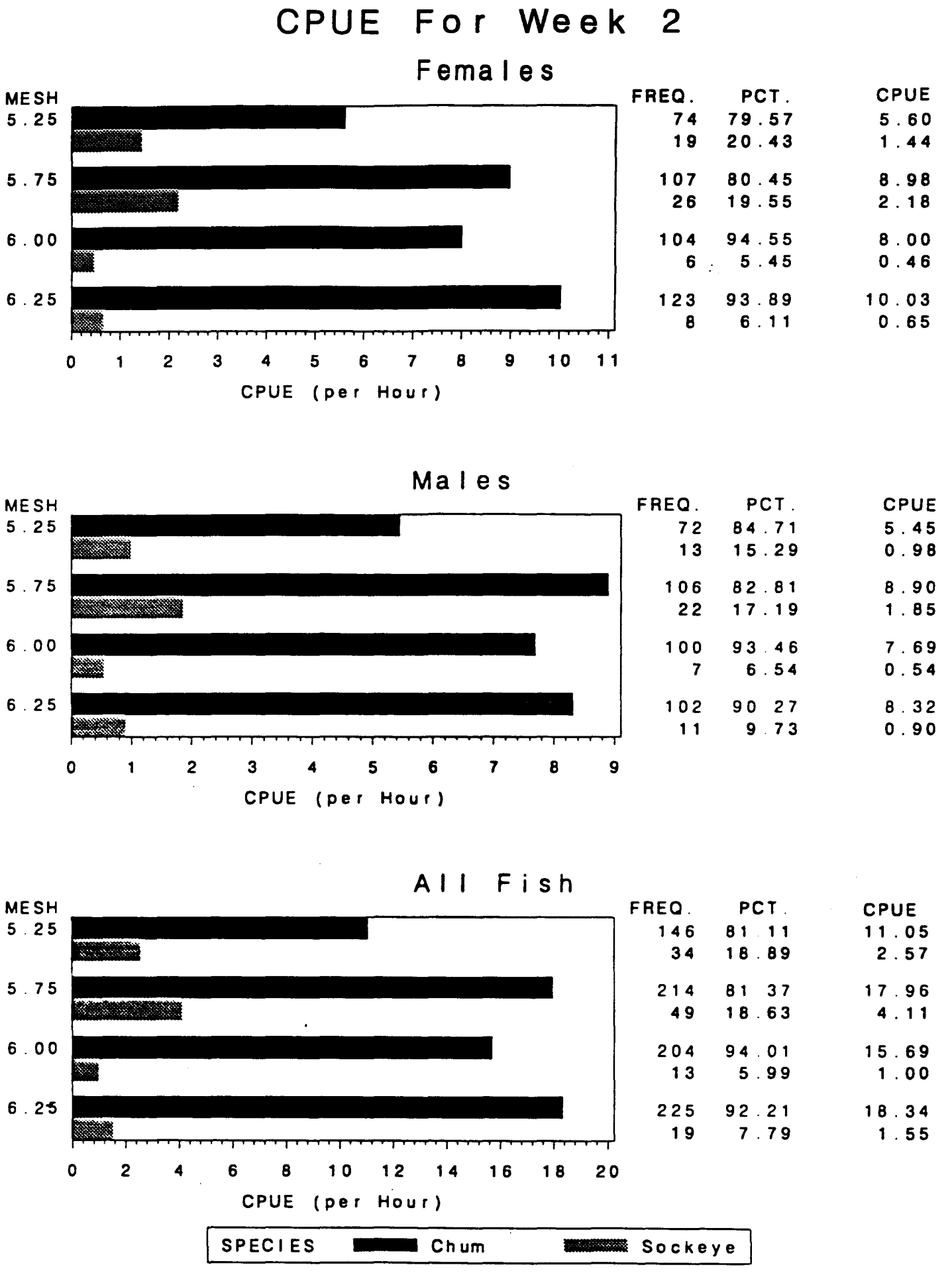

Figure 4. District 111 CPUE by mesh size by species-Week 2.

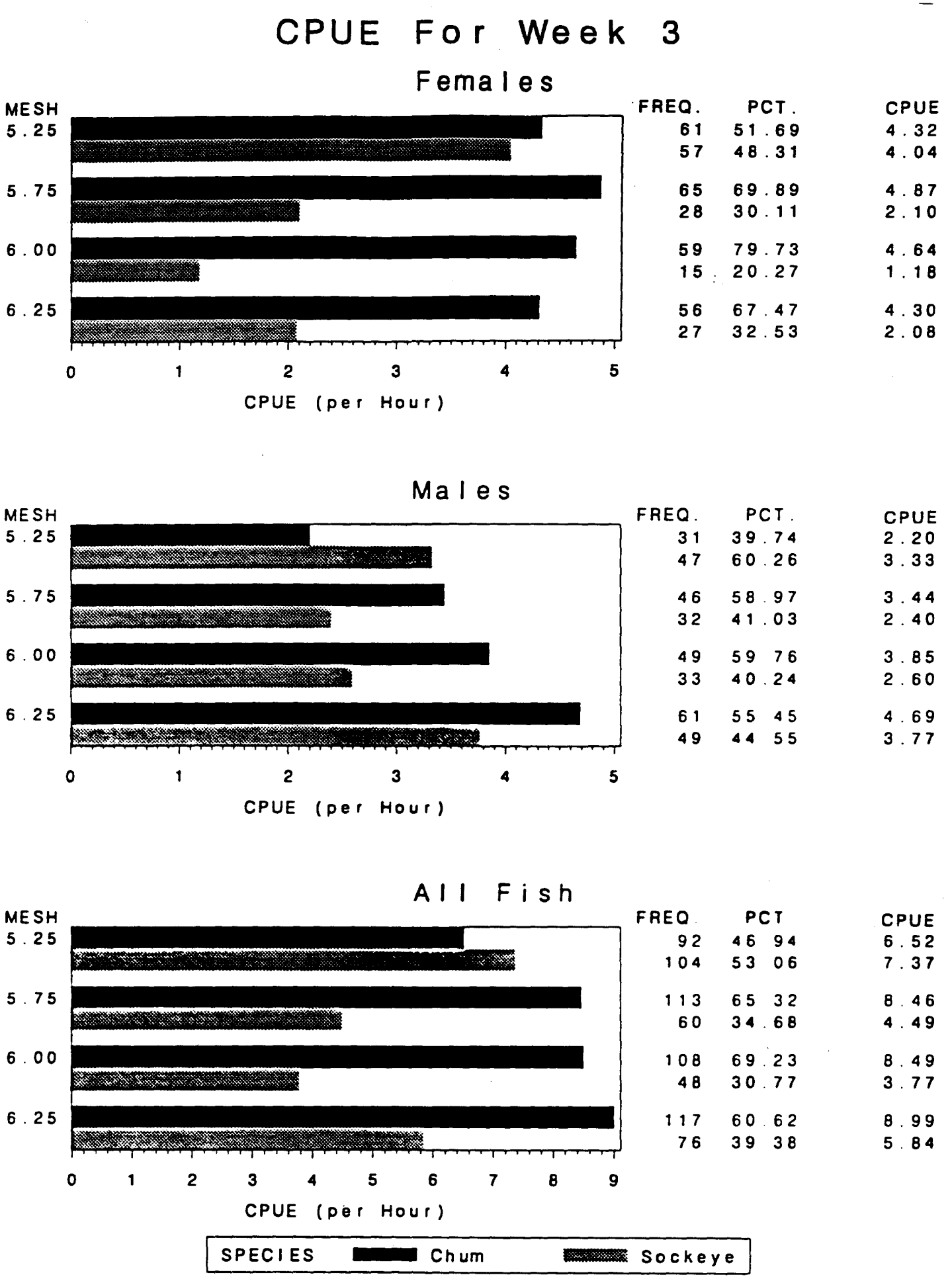

Figure 5. District 111 CPUE by mesh size by species-Week 3.

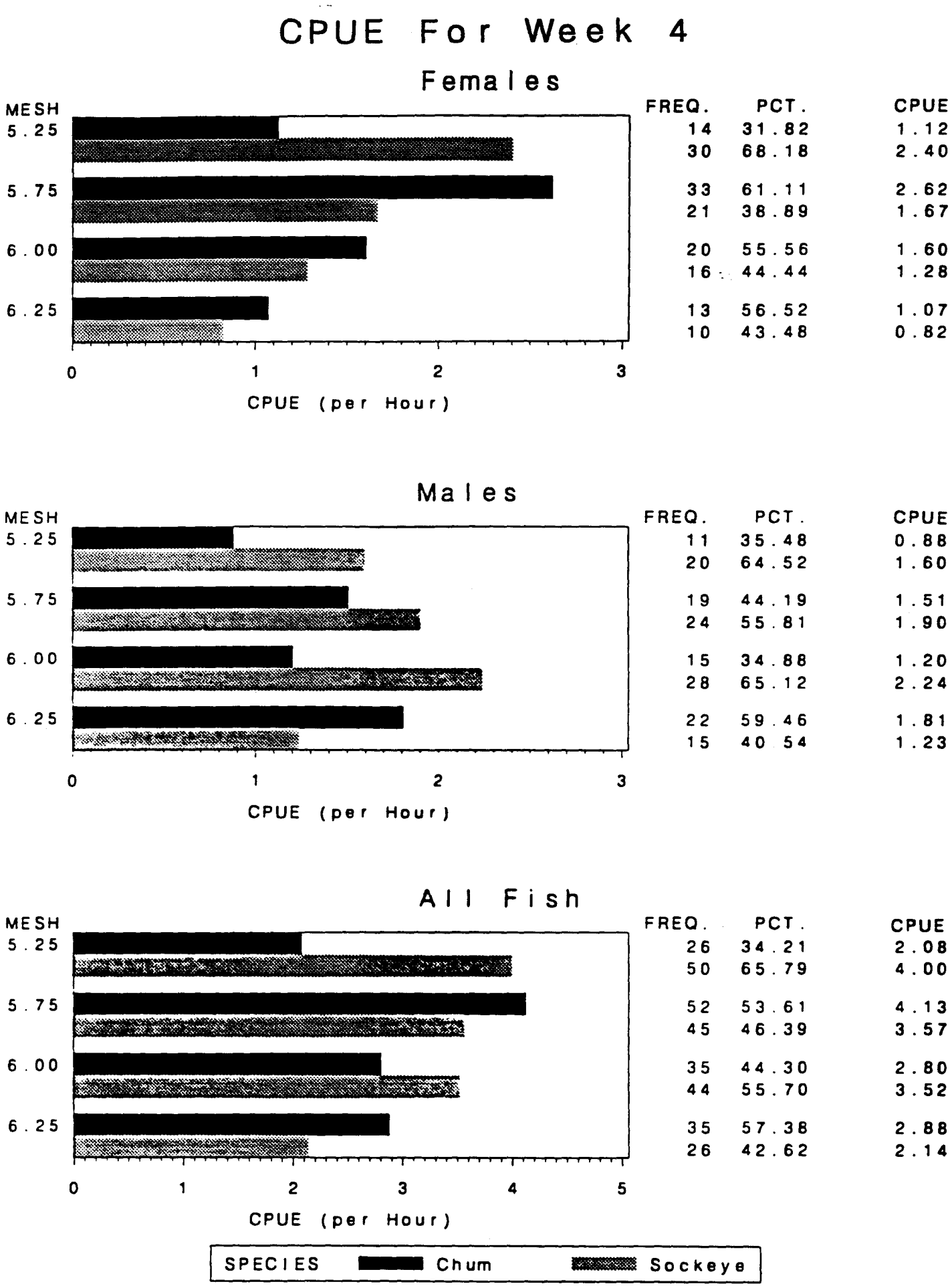

Figure 6. District 111 CPUE by mesh size by species-Week 4.

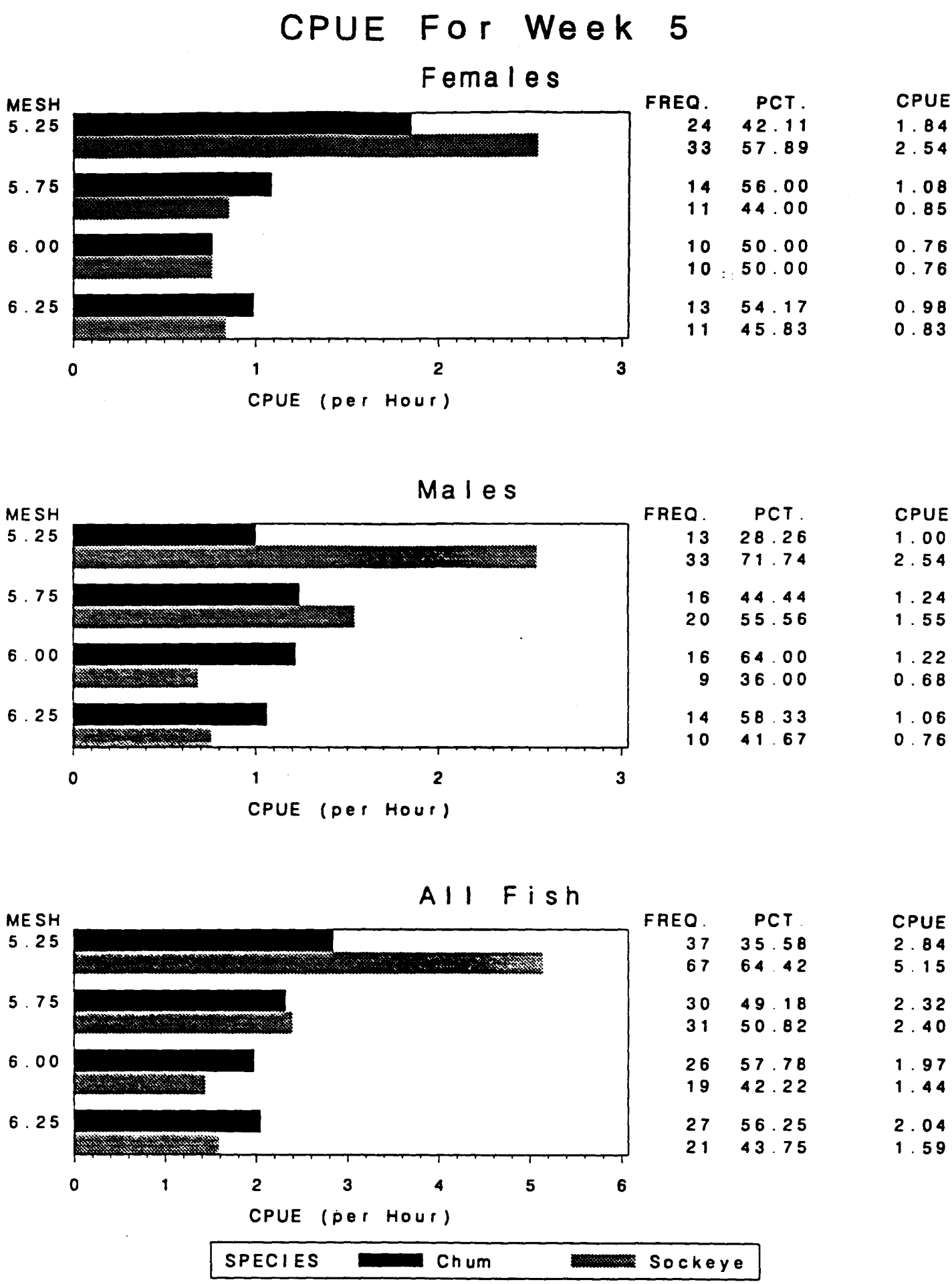

Figure 7. District 111 CPUE by mesh size by species-Week 5.

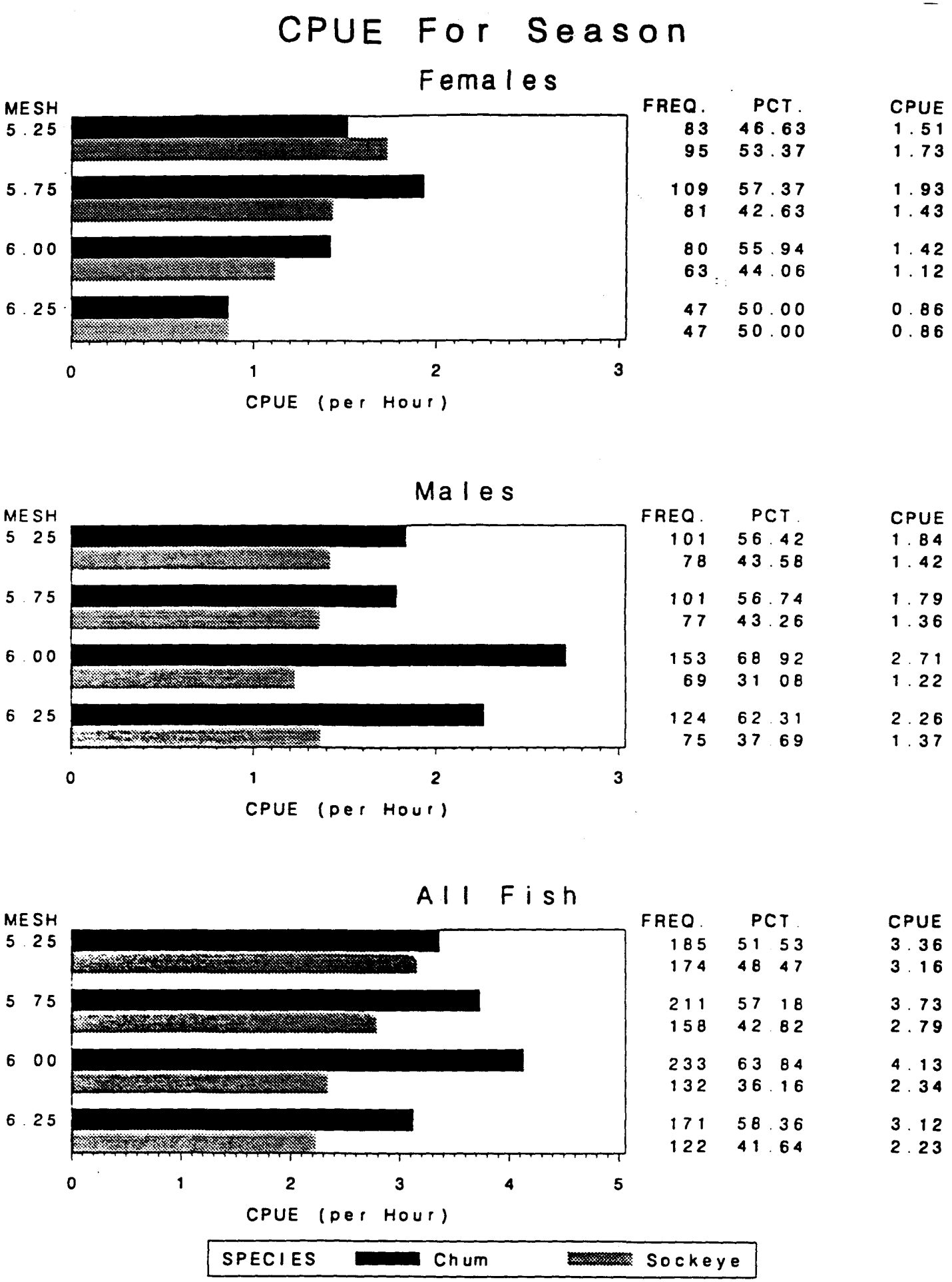

Figure 8. District 115 CPUE by mesh size by species-all weeks.

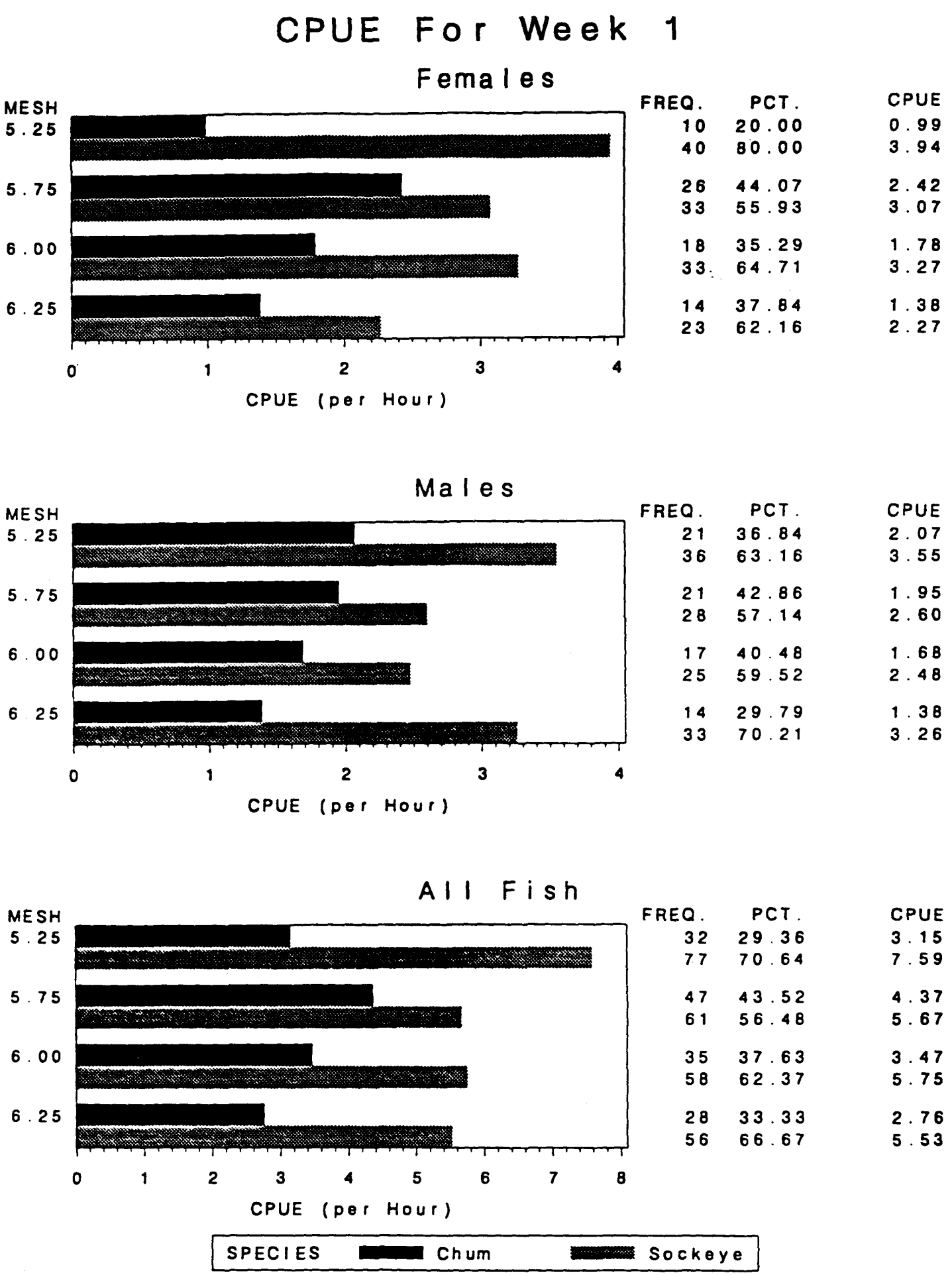

Figure 9. District 115 CPUE by mesh size by species-Week 1.

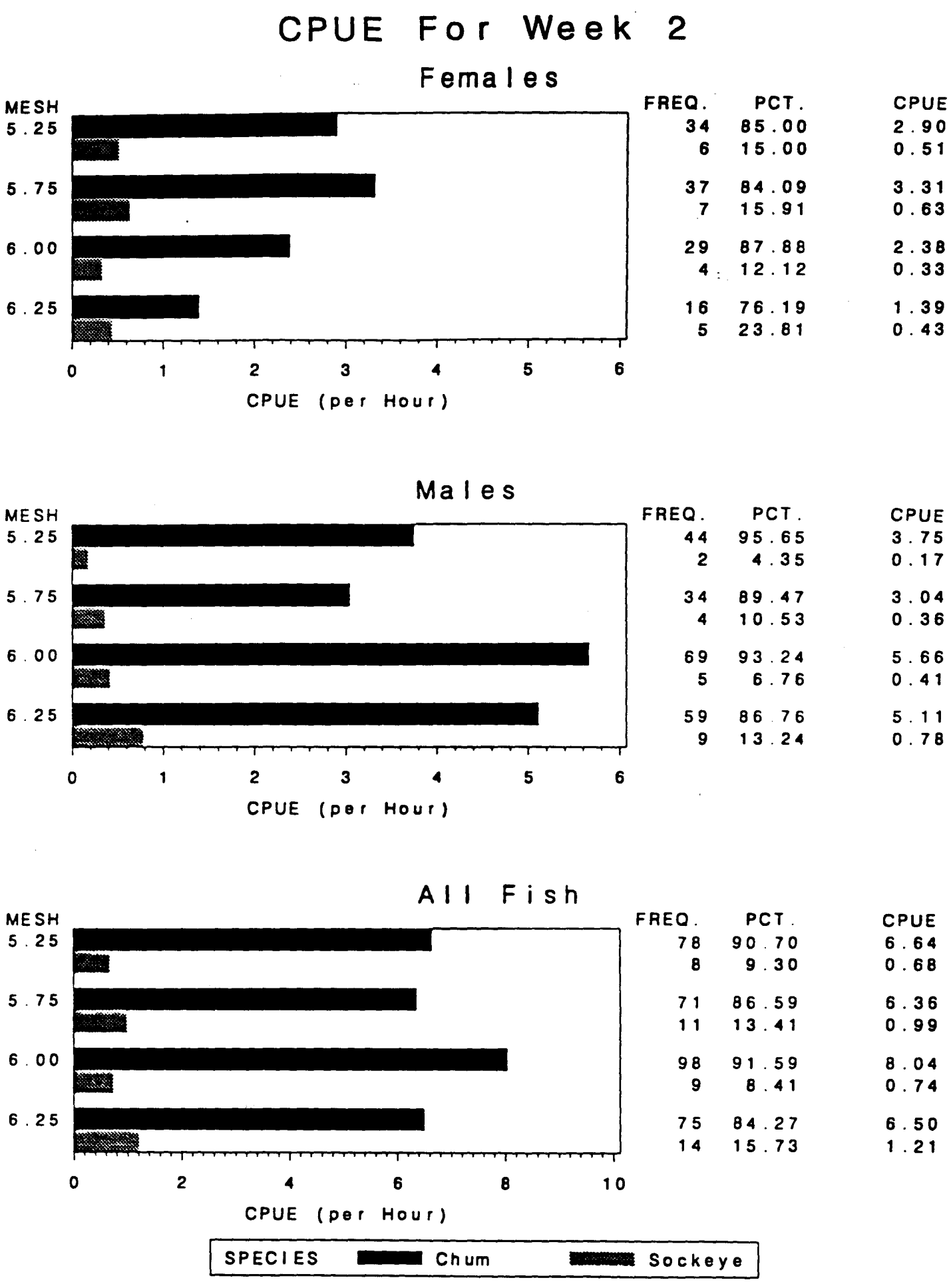

Figure 10. District 115 CPUE by mesh size by species-Week 2.

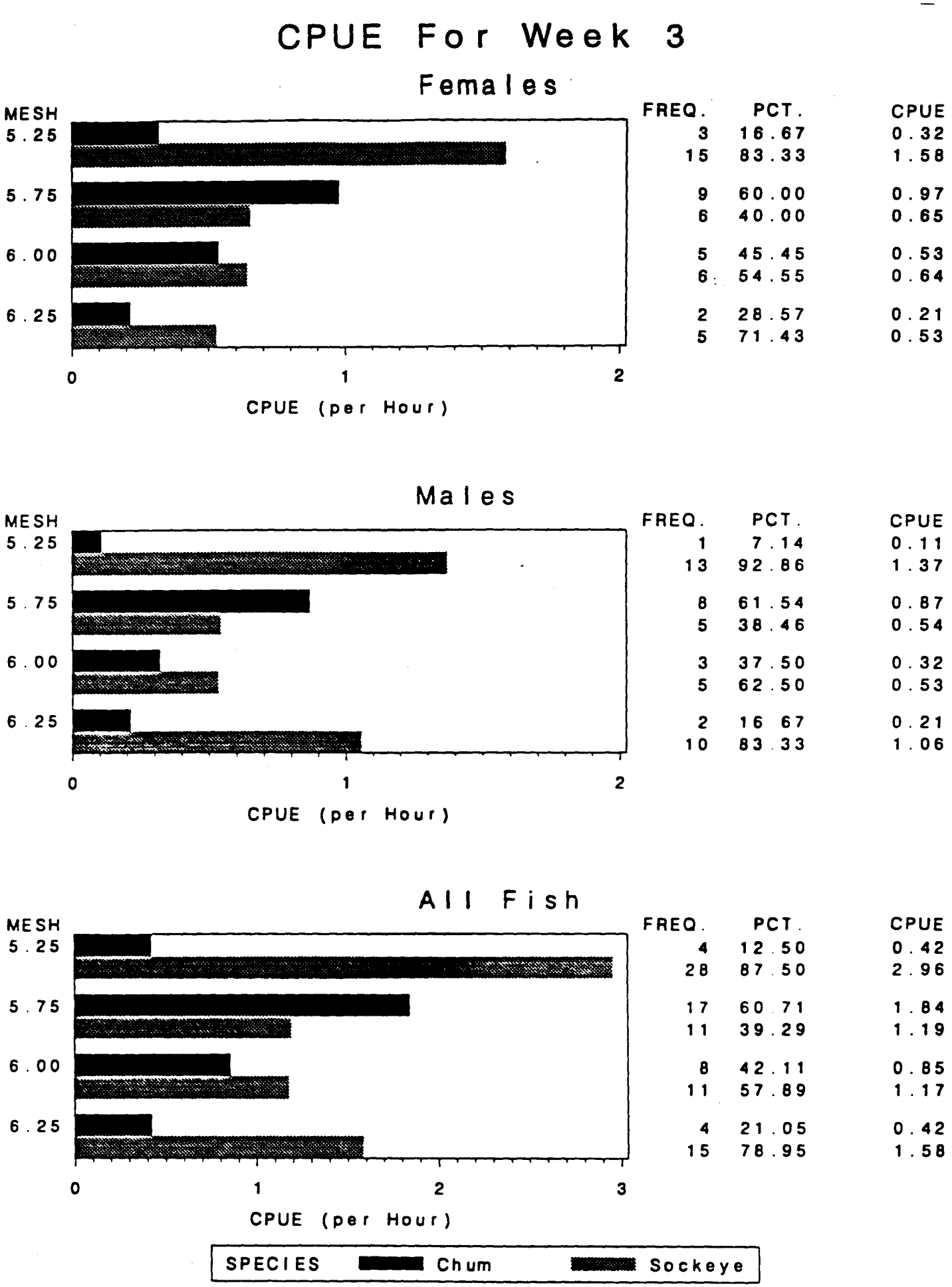

Figure 11. District 115 CPUE by mesh size by species-Week 3.

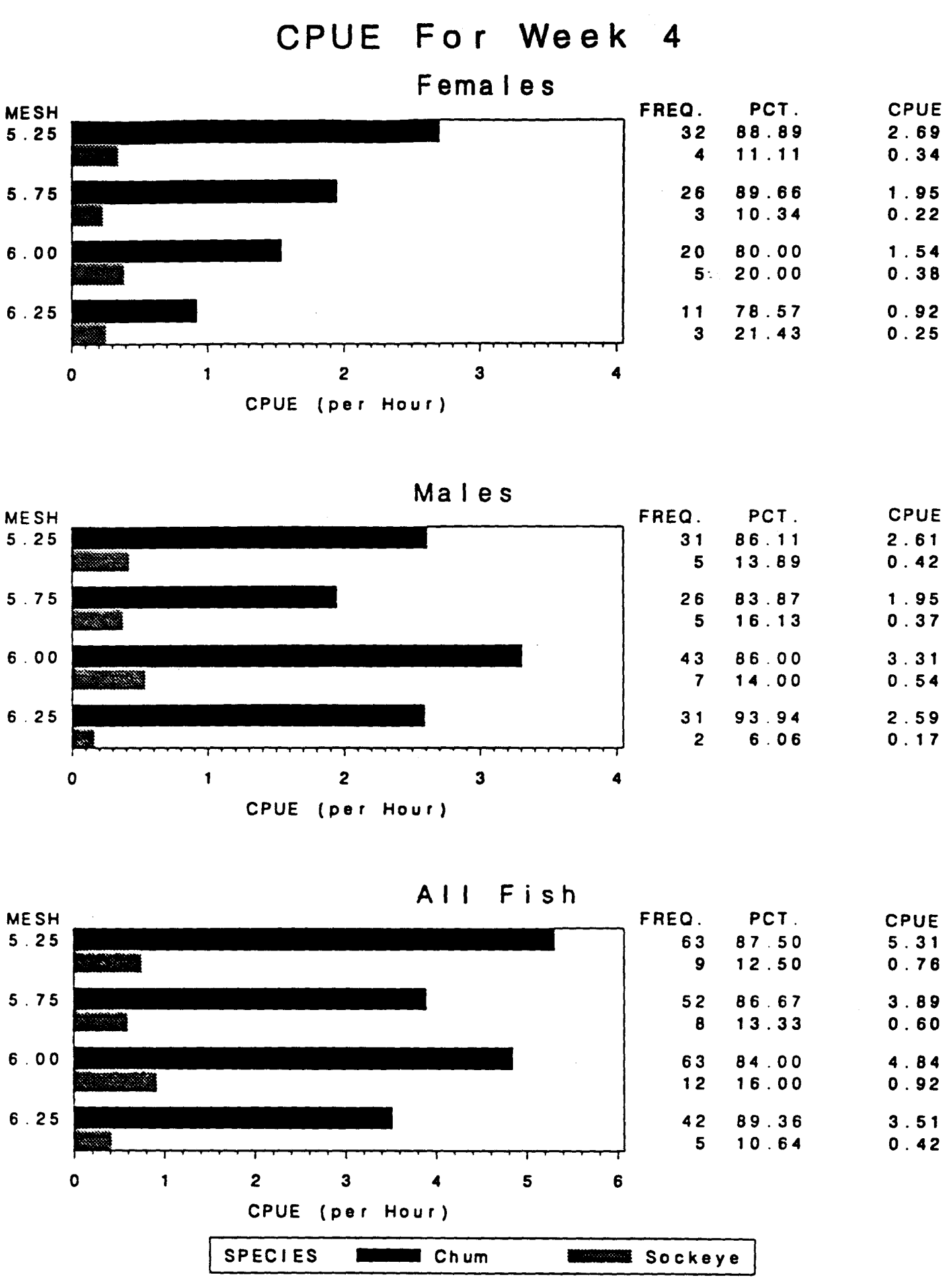

Figure 12. District 115 CPUE by mesh size by species-Week 4.

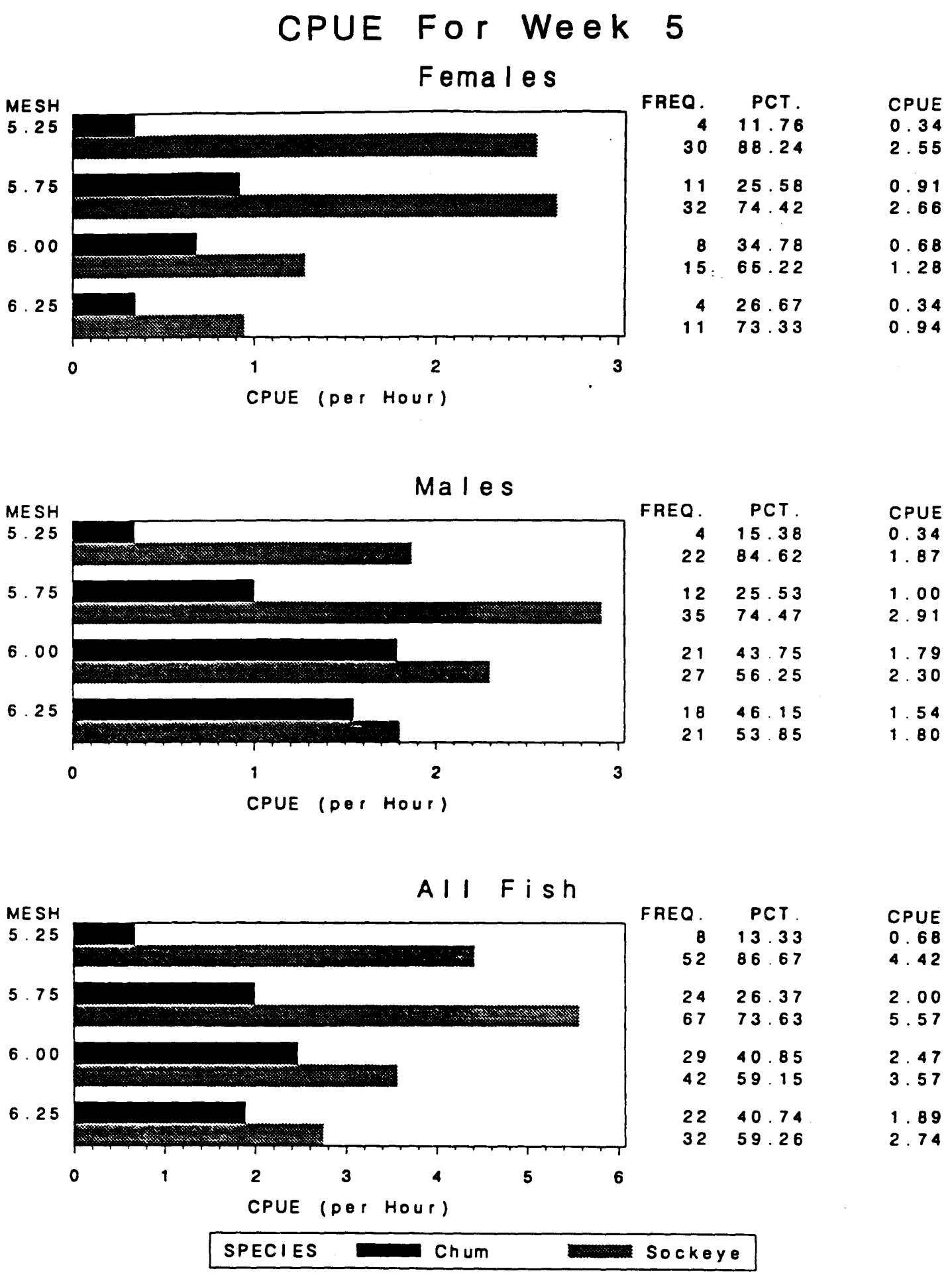

Figure 13. District 115 CPUE by mesh size by species-Week 5.

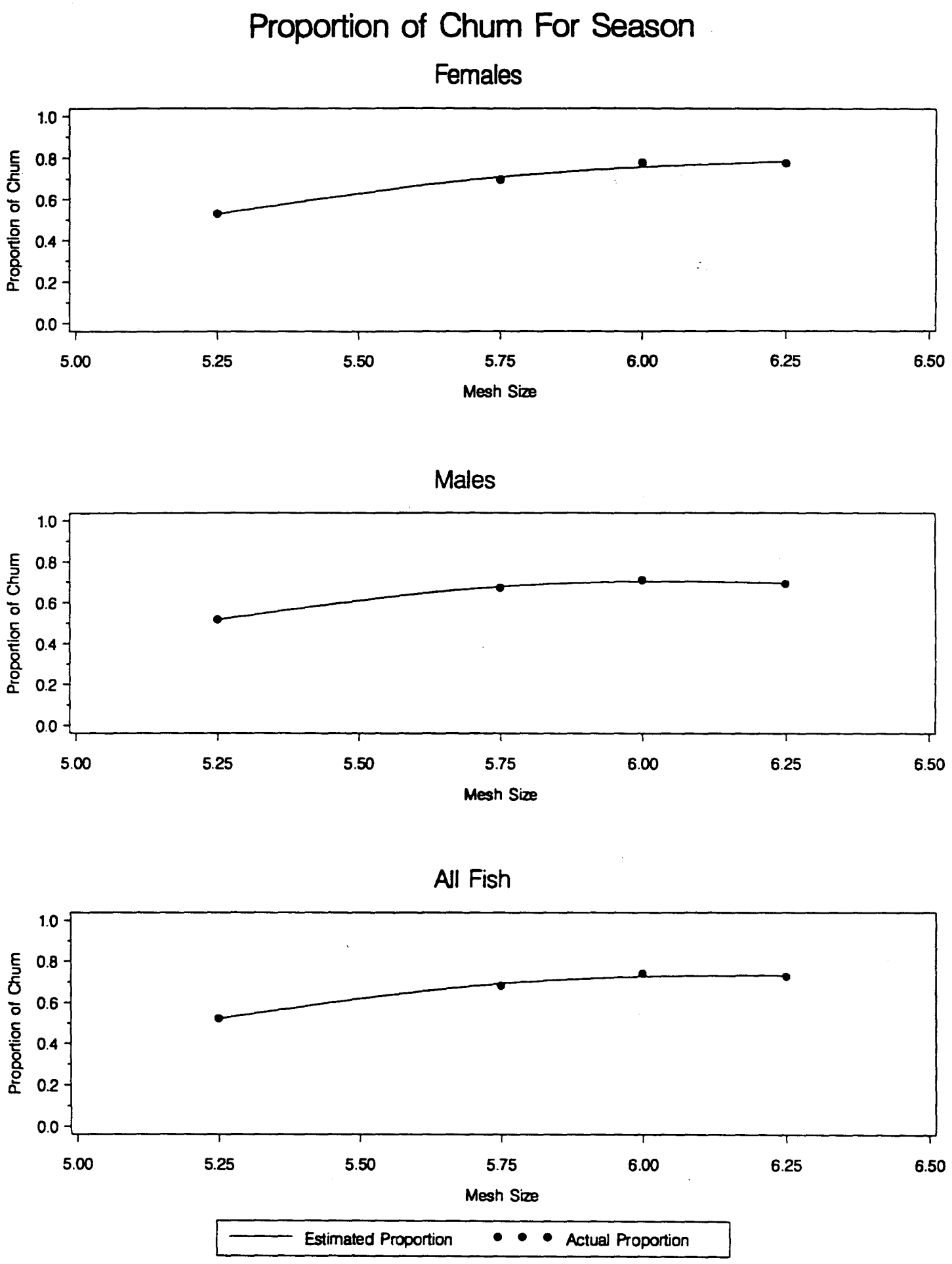

Figure 14. District 111. Proportion of chums to total chum/sockeye salmon catch by mesh size-all weeks.

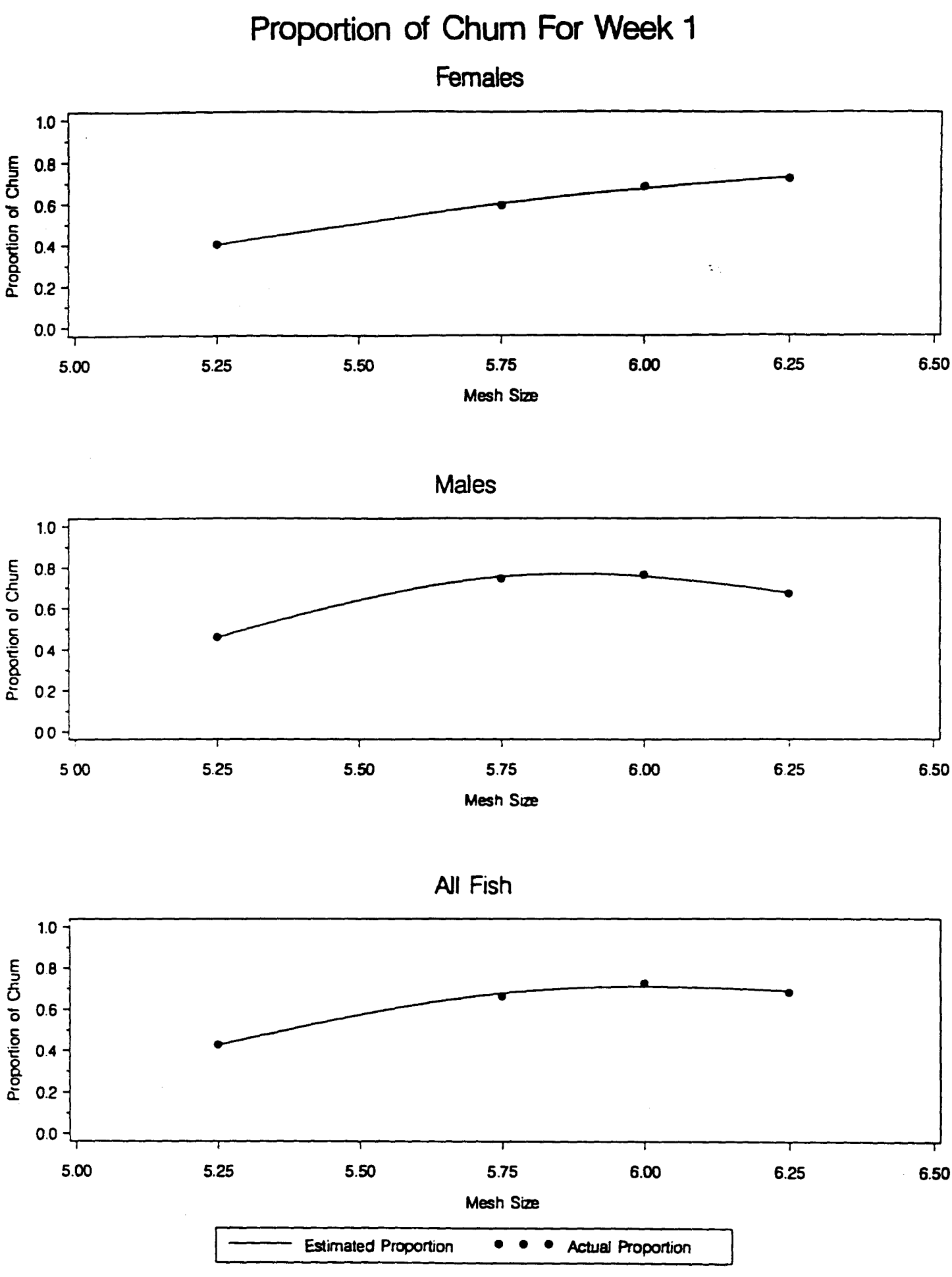

Figure 15. District 111. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 1.

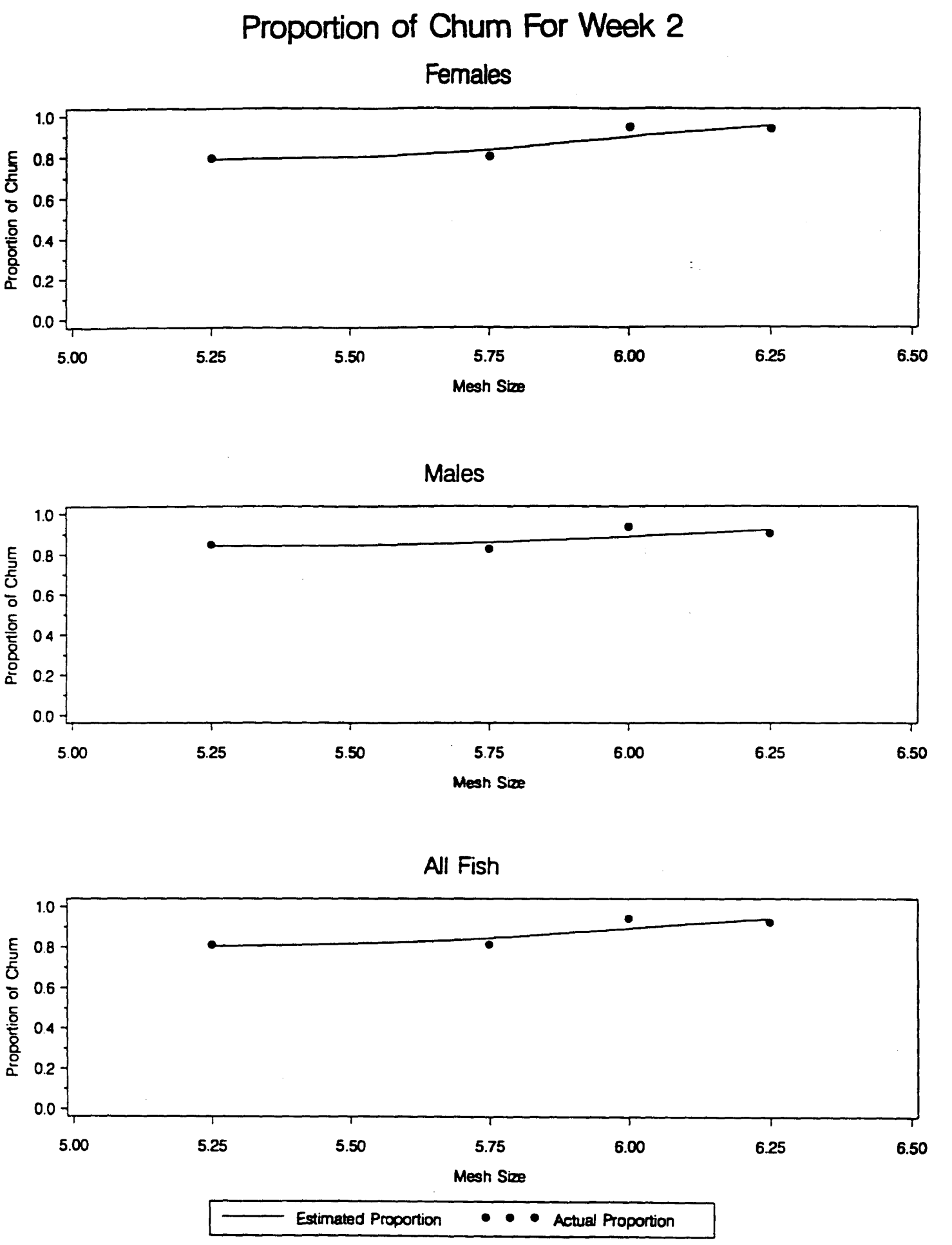

Figure 16. District 111. Proportion of shums to total chums/sockeye salmon catch by mesh size-Week 2.

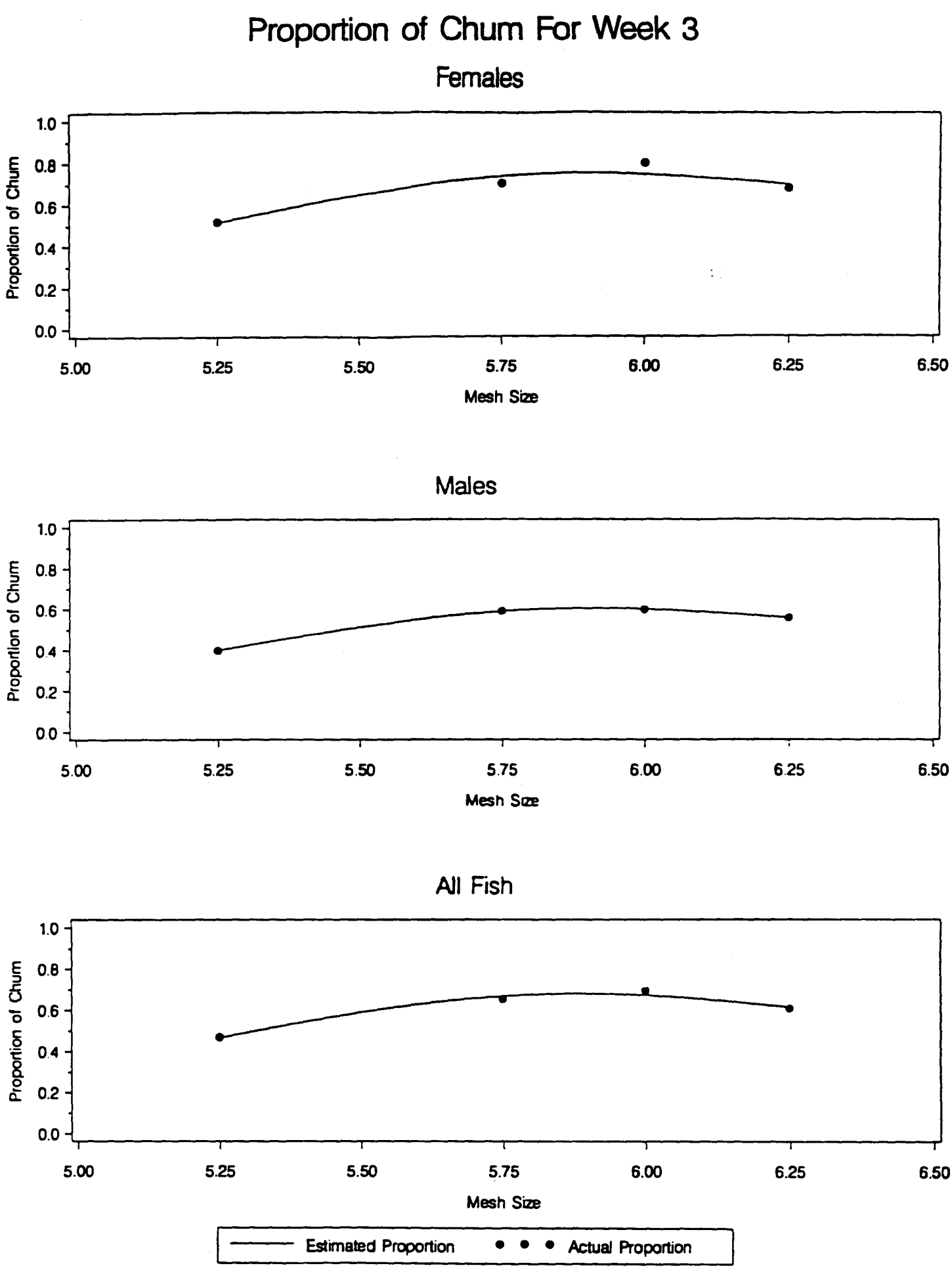

Figure 17. District 111. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 3.

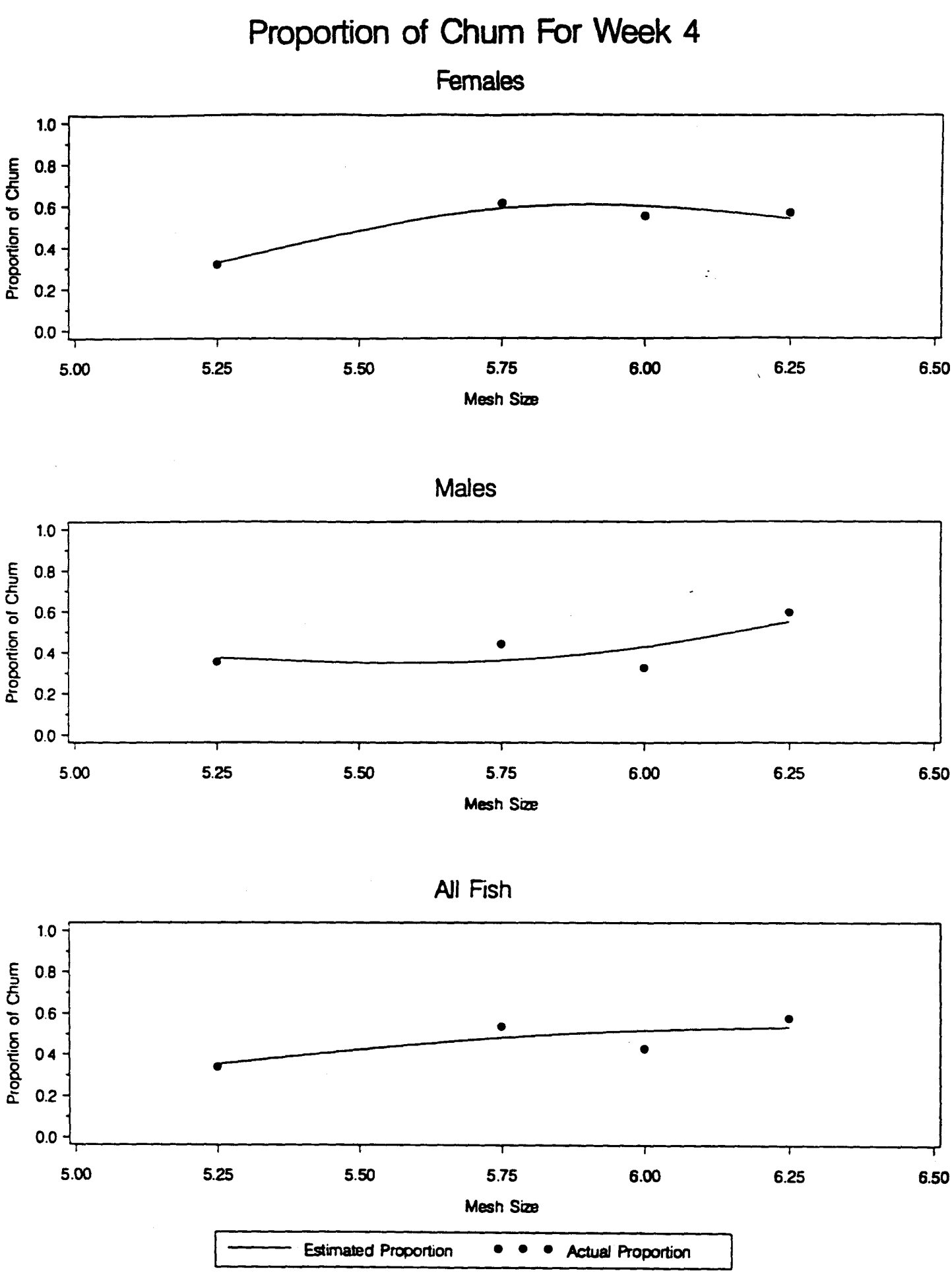

Figure 18. District 111. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 4.

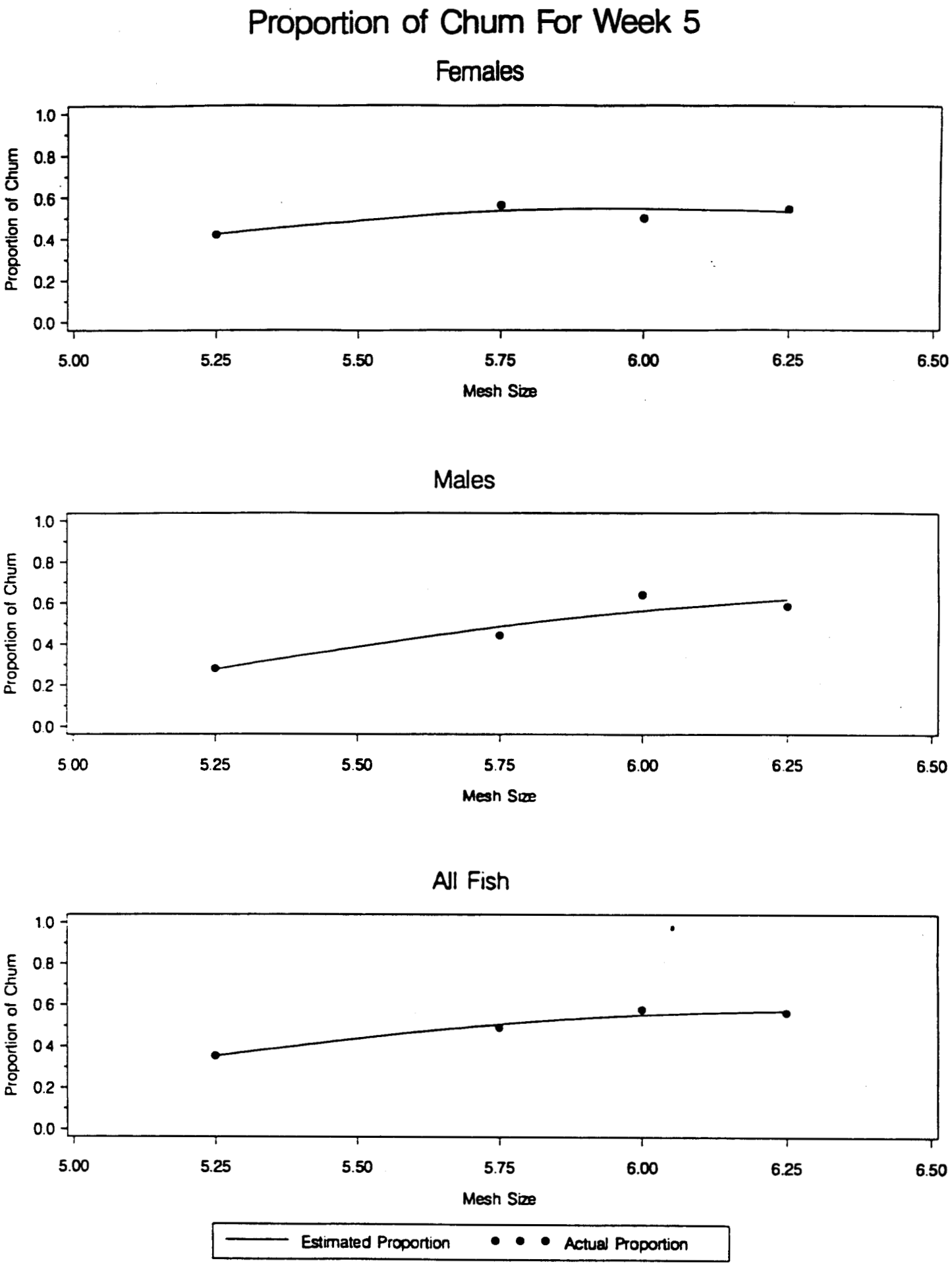

Figure 19. District 111. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 5.

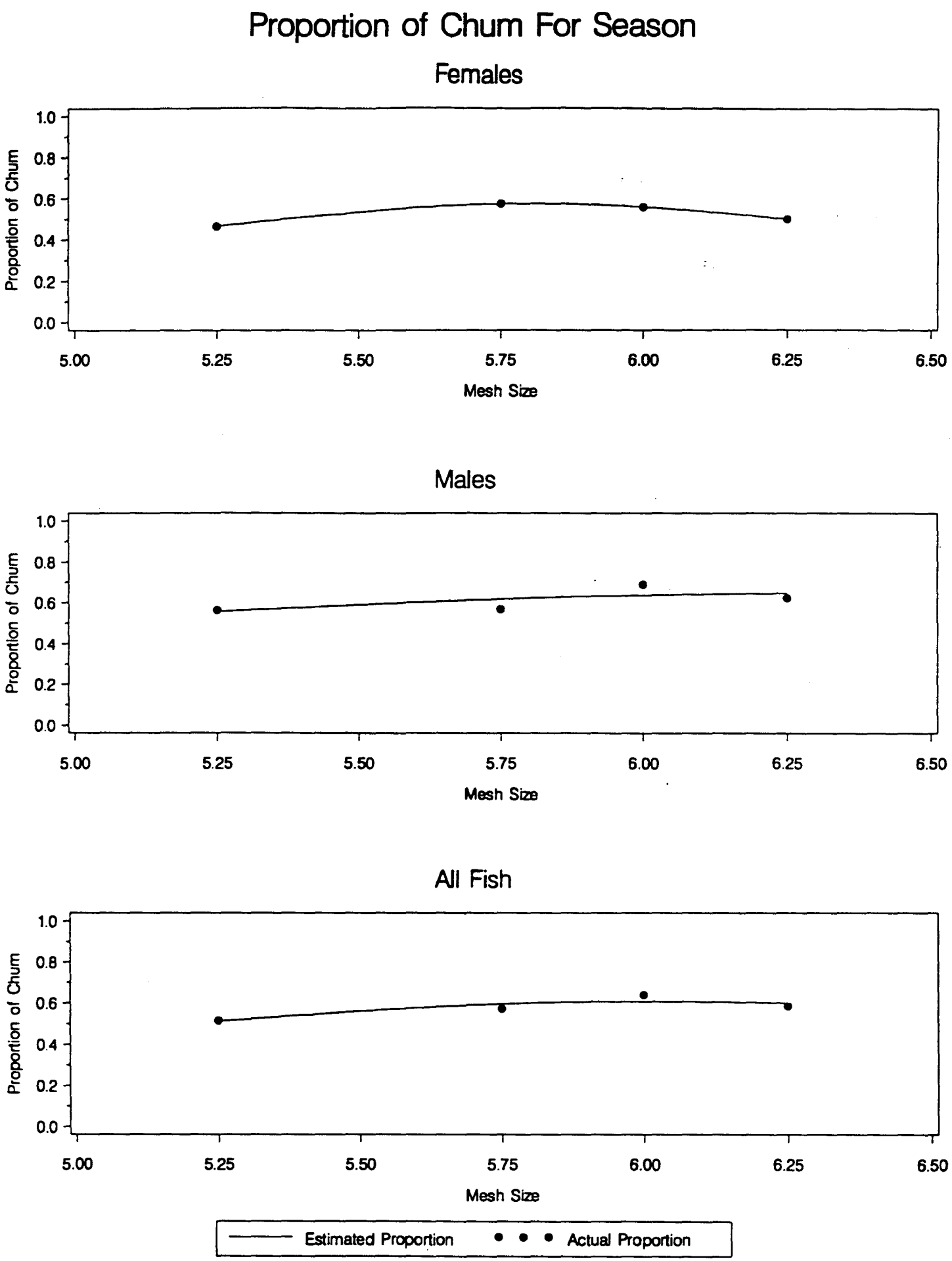

Figure 20. District 115. Proportion of chums to total chum/sockeye salmon catch by mesh size-all weeks.

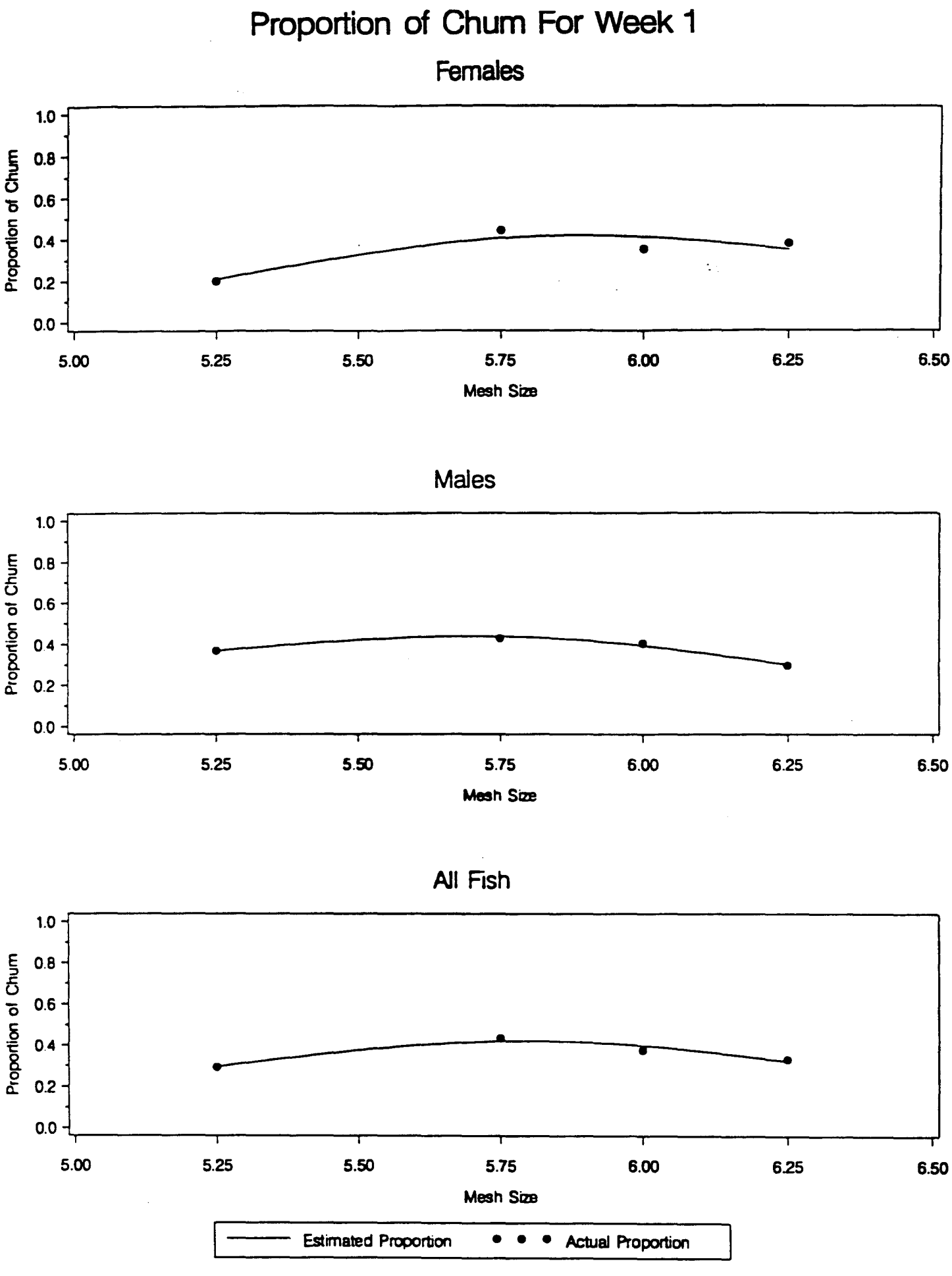

Figure 21. District 115. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 1.

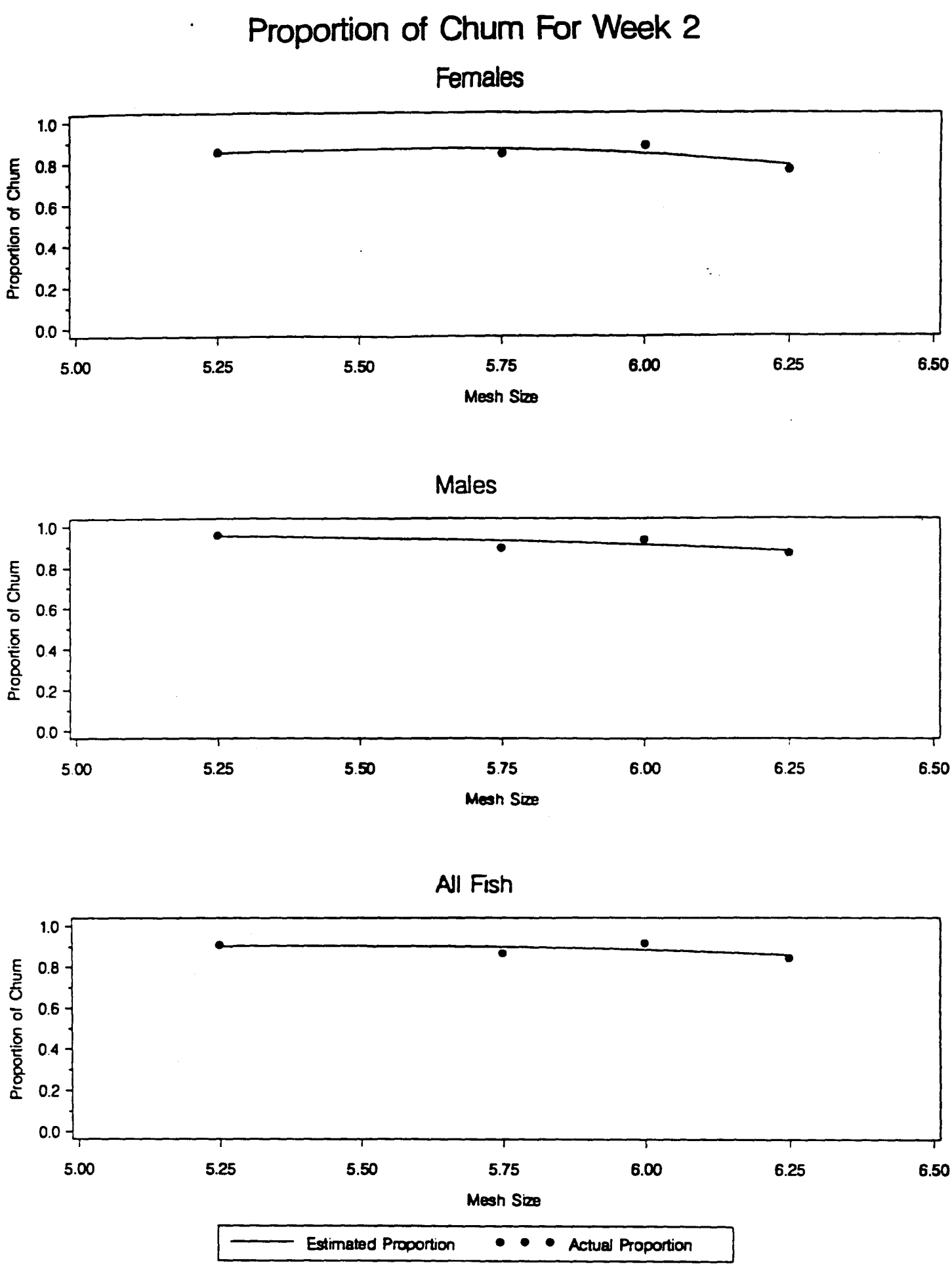

Figure 22. District 115. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 2.

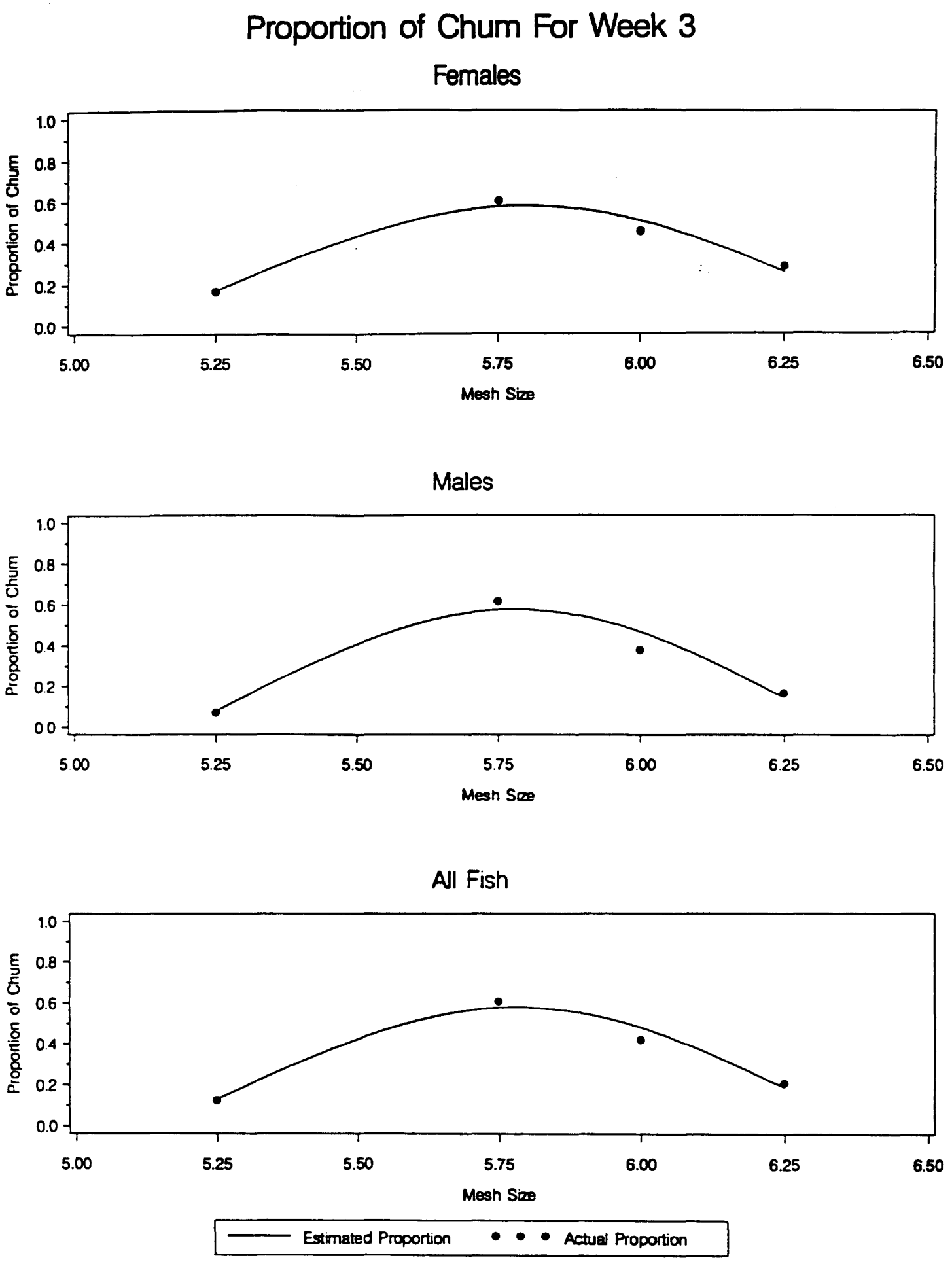

Figure 23. District 115. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 3.

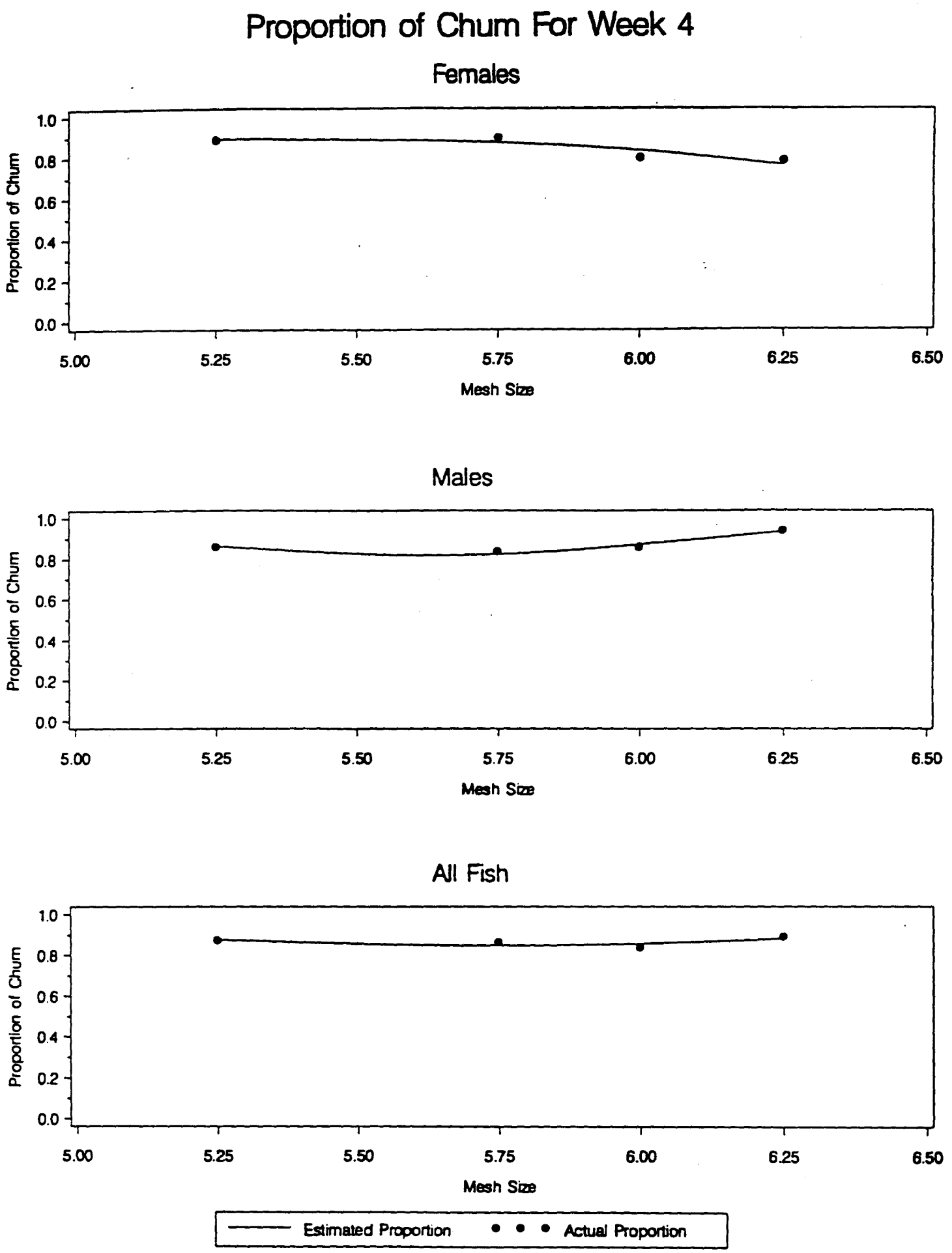

Figure 24. District 115. Proportion of chums to total chum/sockeye salmon catch by mesh size-Week 4.

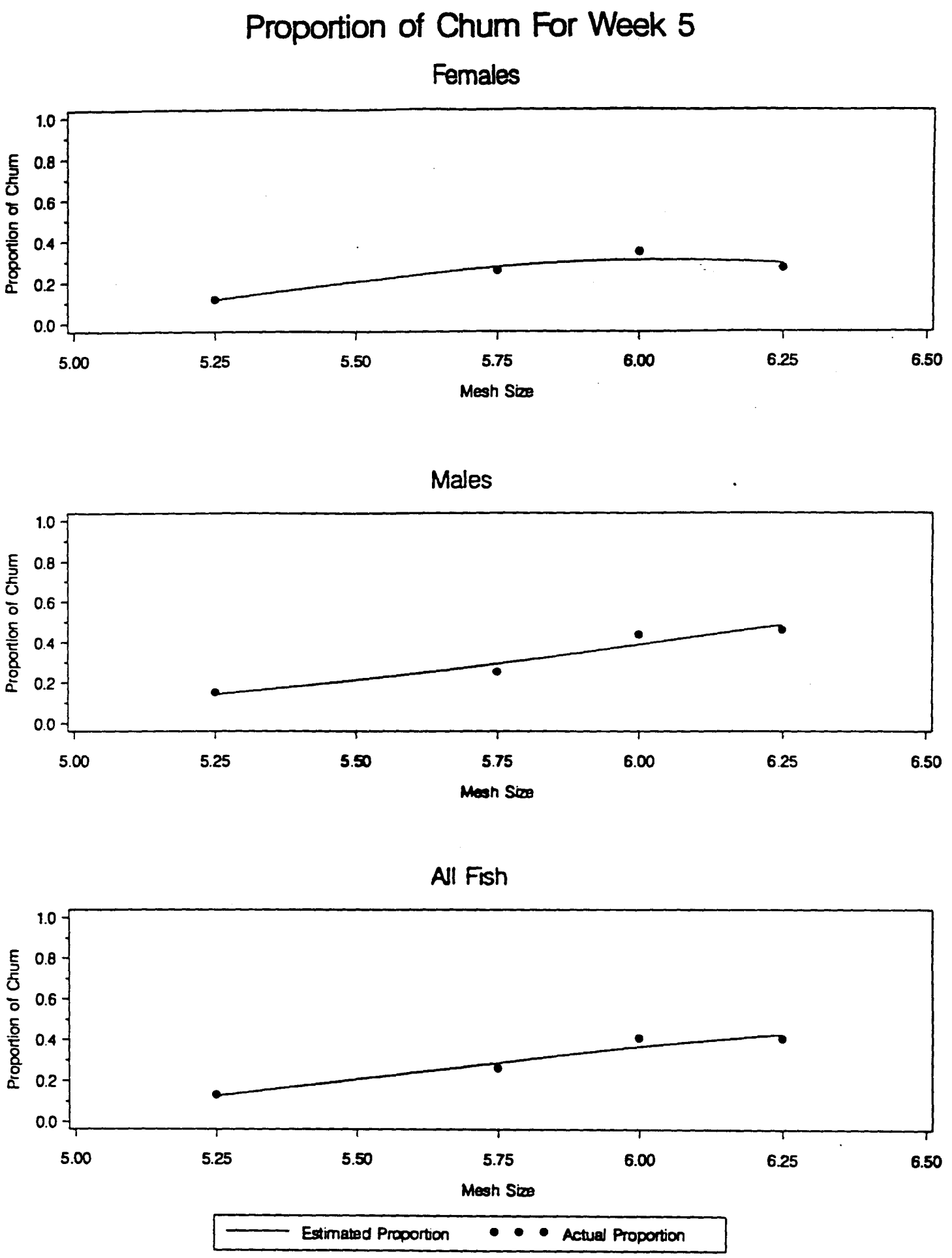

Figure 25. District 115. Proportion of chums to total chum/sockeye catvch by mesh size-Week 5.

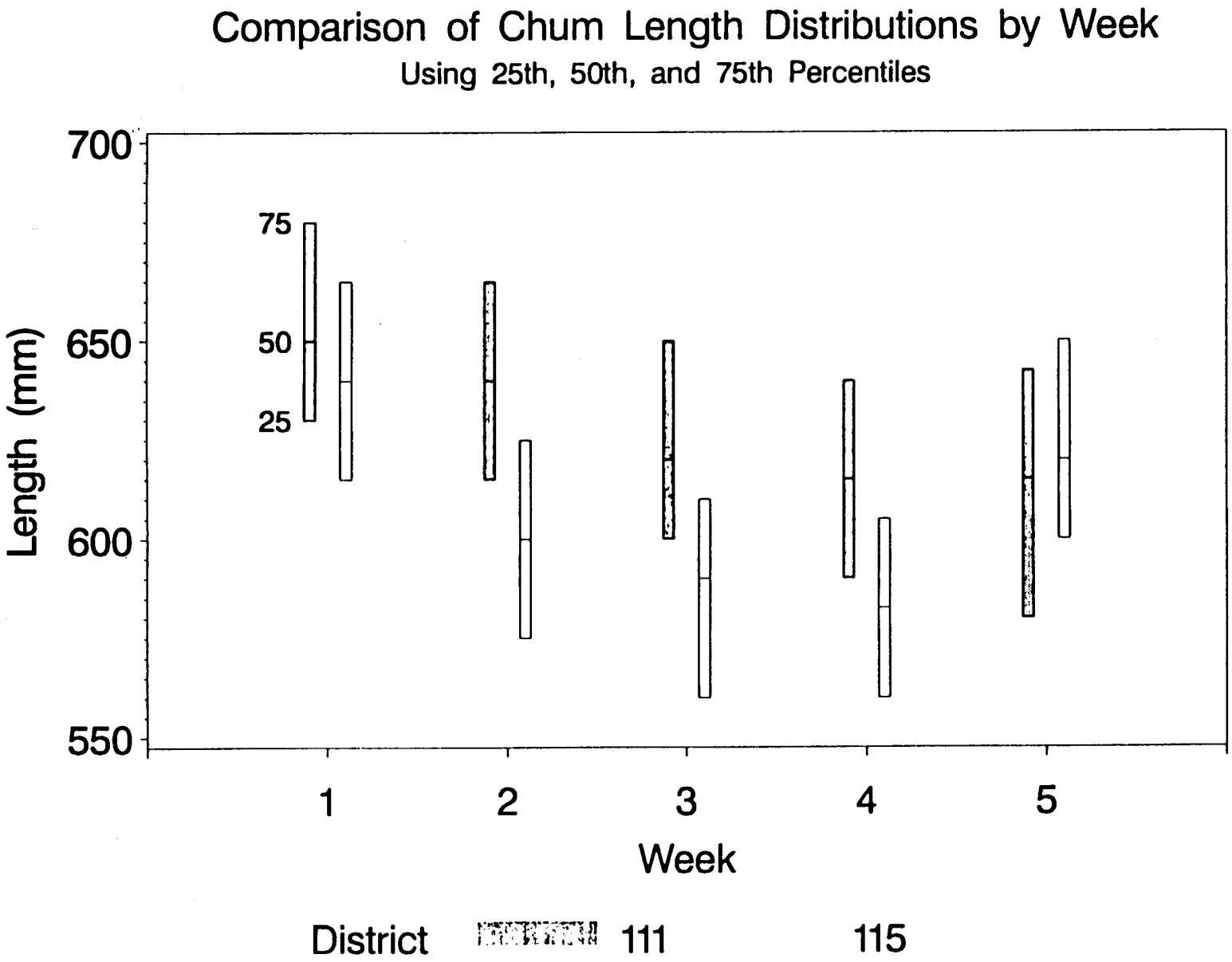

Figure 26. Chum salmon length distribution by Week and District.

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