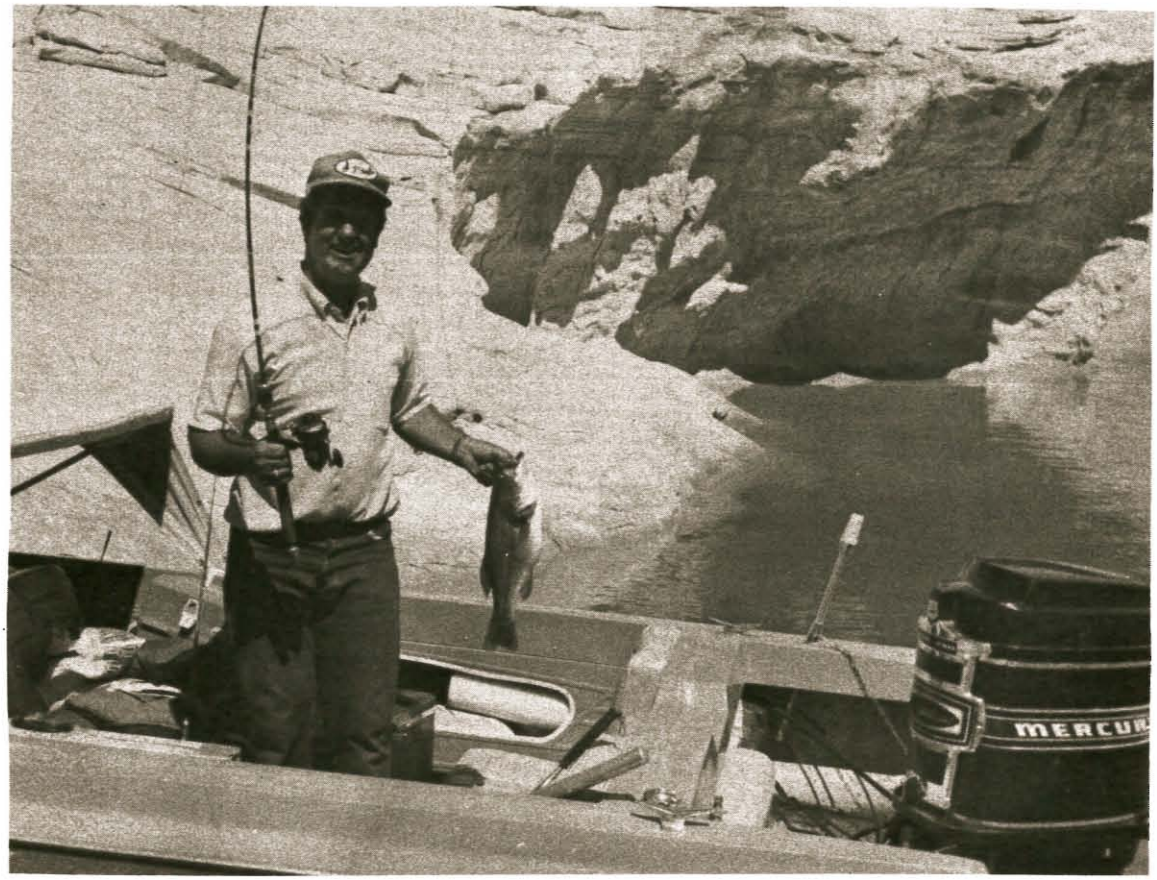
LAKE POWELL
POST-IMPOUNDMENT INVESTIGATIONS

ANNUAL PERFORMANCE REPORT
1975



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STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES
John E. Phelps, *Director*

LAKE POWELL

POST-IMPOUNDMENT INVESTIGATIONS

Annual Performance Report

1975

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Publication Number 76-21

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ANNUAL PERFORMANCE REPORT

State U T A H

Project No. F-28-R-4 Name Colorado River Drainage Reservoirs and Tailwaters Fisheries Management, Investigations and Surveys.

Period Covered: February 1, 1975 to December 31, 1975

Job Number: I Title: Threadfin Shad Study

Objective: To (1) develop, through mid-water trawling and other associated sampling devices, an adequate system for sampling threadfin shad in Lake Powell, (2) to utilize the developed system in determining some threadfin shad population dynamics (population level indices and seasonal characteristics), (3) to evaluate changes in threadfin shad population levels resulting from introduction of striped bass (Morone Saxatilis); (4) to collect other pertinent information relating to threadfin shad in Lake Powell (areas of interest may include age and growth, spawning, fecundity, sexual maturity, food preferences, etc.).

Accomplishments: Trawling capability of the Steel Clipper was nearly completed. All major equipment (hydraulic winches, pumps, and controls) were installed and made operational. Delays in shipment of the trawl precluded field trial of the entire mechanism and any collection of data on threadfin shad. All minor equipment necessary for connecting the trawl to the winch system was obtained or ordered. Field trial and data collection will begin during the next project segment.

Job Number: II Title: Measurement of Fishery Harvest, Pressure, and Success

Objective: To determine the magnitude and nature of fishing harvest, pressure, and success through creel census.

Accomplishments: Project personnel conducted creel census 4-8 days per month at the three major access areas (Wahweap, Bullfrog Bay, and Hall's Crossing) from March through September. Pressure during other months was light and did not justify effort involved in a programmed regular creel census.

An estimated 126,619 angler days were exerted from January through September 1975 (Table 1). The largest portion of fishing pressure occurred at Wahweap (49.5 percent). Anglers at Bullfrog Bay and Hall's Crossing made up 30.1 and 15.8 percent of the pressure, respectively. Angling pressure peaked in May (35,829 angler days) and dropped off to a low in August (6,420 angler days). Length of the average angling day was approximately 4-5 hours during spring months (Table 2). Length of the angler day decreased during the summer months to about 3 hours. Number of boats engaged in fishing also changed as the season progressed (Table 3). During March and April, fishing made up the better part of all boating activities. However, during summer months, warm water sports predominated (i.e. swimming, water skiing, etc.). The number of boats engaged in fishing dropped to a low of 11.4 percent in August.

Table 1. Total estimated fishing pressure in angler days by access area, January through September 1975 (percent of total pressure is given in parentheses). Fishing pressure was estimated using fishermen per boat factors applied to National Park Service boat counts.

Month		Wahweap	Bullfrog	Hall's	Hite	Total
January	(1.3)	756	482	390	38	1,666
February	(3.5)	2,237	1,350	708	95	4,390
March	(11.2)	7,446	3,520	2,664	554	14,184
April	(22.0)	12,126	9,111	4,578	2,059	27,874
May	(28.3)	18,162	10,735	5,253	1,679	35,829
June	(15.9)	10,468	6,035	2,920	691	20,114
July	(6.2)	4,200	2,187	1,293	197	7,877
August	(5.1)	3,517	1,696	1,021	186	6,420
September	(6.5)	3,744	2,967	1,198	356	8,265
Total	(100)	62,656 (49.5)	38,083 (30.1)	20,025 (15.8)	5,855 (4.6)	126,619

Table 2. Length of mean angler day (hours), February to September, 1975.

	Wahweap	Bullfrog	Hall's	Mean
February	6.50	No Sample	No Sample	6.50
March	4.34	4.90	4.11	4.48
April	4.59	4.54	3.11	4.52
May	6.17	4.58	4.43	5.39
June	3.93	3.13	4.29	3.80
July	3.45	2.69	2.38	2.98
August	3.19	4.53	4.42	3.77
September	3.96	No Sample	No Sample	3.96
Mean	4.79	4.12	4.13	4.51

Table 3. Number of boats engaged in fishing and nonfishing activities from creel census sample (mean number of fishermen per boat in parentheses).

	Fishing	Nonfishing	Percent Fishing	Total
March	295 (3.4)	127	69.9	422
April	411 (2.8)	83	78.4	524
May	748 (3.2)	960	43.8	1708
June	457 (2.7)	1232	27.1	1689
July	134 (2.6)	687	16.3	821
August	103 (2.7)	797	11.4	900
September	62 (2.4)	249	19.9	311

In all, 2136 interviews representing 6312 anglers were conducted during the 1975 creel census. Interviewed fishermen creeled 14,942 fish and fished 27,375 hours for a catch rate of 0.55 fish per hour (Table 4). Bass (0.26 per hour) and crappie (0.24 per hour) were caught at nearly the same rate (Table 5). Bluegill and channel catfish were taken at a rate of 0.02 fish per hour, while rainbow trout and other species were creeled at rates less than 0.01 per hour.

Table 4. Fish harvested per hour by month and access area, March to September, 1975.

Month	Wahweap	Bullfrog	Hall's	Mean
March	0.40	0.29	0.23	0.35
April	0.56	0.61	0.39	0.57
May	0.65	0.61	0.81	0.67
June	0.45	0.56	0.65	0.53
July	0.47	0.57	0.58	0.52
August	0.15	0.20	0.33	0.22
September	0.15	No Sample	No Sample	0.15
Mean	0.53	0.51	0.66	0.55

Table 5. Fish harvested per hour by species and access area.

Species	Wahweap	Bullfrog	Hall's	Mean
Black crappie	0.21	0.27	0.33	0.24
Largemouth bass	0.29	0.19	0.27	0.26
Bluegill	0.02	0.02	0.04	0.02
Channel catfish	0.01	0.03	0.03	0.02
Rainbow trout	*t	t	t	t
Others	t	t	t	t
All Species	0.53	0.51	0.66	0.55

*t = less than 0.01 fish per hour

On a monthly basis, bass fishing was best in July (Table 6). Catch rates for bass remained high from March through July (0.25 - 0.35 fish per hour), but dropped off sharply in August and September (less than 0.10 fish per hour). Crappie fishing was best in April and May (about 0.30 fish per hour), but was poor during the remainder of the year (less than 0.14 fish per hour). Bluegill and channel catfish were taken in limited numbers, but July and August were best for both species.

Bass were the predominant species harvested from the reservoir (48.4 percent, Table 8) with crappie a close second (44.1 percent). Crappie comprised a larger portion of the total creel at Bullfrog (52.1 percent) and Hall's Crossing (48.7 percent), than at Wahweap (39.8 percent). Bass made up 54.7 percent of the catch at Wahweap where most fishing pressure occurred (49.5 percent, Table 1).

Table 6. Fish harvested per hour by species and month, March through September, 1975.

Month	Hours Fished	Black Crappie	Largemouth Bass	Bluegill	Channel Catfish	Rainbow Trout	Other Species	Total
March	4181	0.09	0.25	*t	t	t	-0-	0.35
April	5180	0.30	0.25	0.02	t	t	-0-	0.58
May	10761	0.37	0.27	0.03	0.01	t	t	0.67
June	4517	0.14	0.32	0.03	0.04	t	t	0.53
July	1012	0.05	0.35	0.04	0.08	-0-	t	0.52
August	1004	0.02	0.10	0.04	0.06	t	t	0.22
September	619	0.01	0.09	0.02	0.03	-0-	t	0.15
Total	27274	0.24	0.28	0.02	0.02	t	t	0.55

*t = less than 0.01 fish per hour.

Table 7. Percent species composition of fish harvested by access area.

Species	Wahweap	Bullfrog	Hall's	Total
Black crappie	39.8	52.1	48.7	44.1
Largemouth bass	54.7	37.7	40.7	48.4
Bluegill	3.3	4.6	5.8	4.1
Channel catfish	1.8	5.4	4.7	3.1
Rainbow trout	0.3	t	t	t
Other species	t	t	t	t

*t = less than 0.1 percent

Lures were the favored fishing gear (Table 8). Of all parties interviewed, 53.0 percent used lures exclusively, 24.8 percent used live bait, and 20.2 percent tried a combination of the two. Lures were the preferred gear each month except August and September when live bait predominated. Percent of fish creeled by different methods (Table 9) followed nearly the same ratio as the gear use figures. Most fish caught were taken by lures (54.3 percent), followed by a combination of bait and lures (22.9 percent), and live bait (21.2 percent). Certain species were caught more readily on specific types of gear (Table 9 and 10). Crappie were caught at a rate of 0.37 fish per hour on lures (77.3 percent of all crappie harvested) and only 0.04 fish per hour on live bait. Total numbers of bass caught were split about equally between live bait (34.2 percent) and lures (37.7 percent), but catch rates were higher with live bait (0.36 fish per hour) compared to lures (0.20 fish per hour).

Table 8. Type of terminal gear used by fishermen by percentage.

Month	Live Bait	Other Bait	Lures	Bait and Lures
February	50.0	0.0	50.0	0.0
March	27.5	1.0	46.4	25.1
April	28.6	0.7	49.1	21.5
May	14.8	1.8	63.3	20.0
June	28.4	1.6	54.2	15.8
July	38.9	6.1	42.0	13.0
August	40.0	7.4	28.4	24.2
September	42.1	3.5	24.6	29.8
Total	24.8	2.0	53.0	20.2

Table 9. Percentage of fish harvested using different types of terminal fishing gear, February through September, 1975.

Species	Live Bait	Other bait	Lures	Bait and lures
Black crappie	4.0	1.1	77.3	17.6
Largemouth bass	34.2	1.0	37.7	27.1
Bluegill	27.7	9.2	35.7	27.5
Channel catfish	58.5	5.4	10.9	25.3
Rainbow trout	21.9	12.5	53.1	12.4
Other species	0.0	5.9	82.4	11.8
Combined	21.2	1.5	54.3	27.9

Table 10. Catch rate of various species with different terminal gear, February through September, 1975.

Species	Live bait	Other bait	Lures	Bait and Lures
Black crappie	0.04	0.24	0.37	0.18
Largemouth bass	0.36	0.23	0.20	0.30
Bluegill	0.02	0.19	0.02	0.03
Channel catfish	0.04	0.08	t	0.02
Rainbow trout	t	0.01	t	t
Others	0.00	t	t	t

*t = indicates rate less than 0.01

Although most of Lake Powell is within the state of Utah, the majority of anglers were from other states (Table 11). Anglers at Wahweap were mainly from Arizona (85.3 percent). At Bullfrog, Utah residents comprised 43.3 percent of the total, while anglers from Colorado numbered 47.6 percent. Hall's Crossing was used mainly by Colorado anglers (33.8 percent), with approximately equal use by Utah (25.9 percent) and New Mexico anglers (19.1 percent).

Table 11. Residence of anglers by percentage, determined for each access area.

State	Wahweap[1]	Bullfrog[2]	Hall's
Utah	4.9	43.3	25.9
Arizona	85.3	1.2	8.2
California	5.2	3.9	7.5
Colorado	1.1	47.6	33.8
New Mexico	1.9	0.4	19.1
Other states	1.6	3.7	5.5

1 Wahweap totals include interviews taken from February through September, 1975.

2 Bullfrog and Hall's totals include interviews taken from March through August, 1975.

A creel census computer program was completed and tested. The program was used to partially analyze 1975 creel census data. Computer analysis will also allow comparisons to be made of all creel data collected since 1970. Data has been coded and needs only to be punched and run. A report describing trends in fishing harvest, pressure, and success since impoundment will be written and published separately.

Job Number: III Title: Index to Annual Fish Population Trends

Objective: To use gill netting and electro-fishing as indices of game fish population trends.

Accomplishments: Standardized sampling was conducted during March at four stations on Lake Powell (Padre Bay, Cha Canyon, Rincon, and Red Canyon). Ten experimental diving gill nets with varying mesh panels (1, 1½, 2, and 3 inch bar mesh) were fished for three consecutive days at each station. Nets were set perpendicular to the shoreline over similar rock and rubble habitat. Annual netting has been conducted since 1971. Although ten nets fished for three days per station each year was the preferred schedule, net loss and poor weather conditions reduced the sample size in some years.

A total of 961 fish (8.0 per net) were taken in 1975 (Table 12). The highest catch rate occurred in 1972 (10.1 fish per net). The lowest catch rate per net (4.0) occurred in 1971 when 49 net sets in Padre Bay and Red Canyon yielded 196 fish. Sixteen species were captured during the five years of sampling (Table 13). Largemouth bass, walleye, carp, crappie, and channel catfish were the dominant species taken. Bluegill and green sunfish were important in the catch during some years.

Largemouth bass dominated the catch each year (56.1 percent of the total sample, Table 14). Bass comprised as much as 63.4 percent of the fish taken in 1974 and made up greater than 50.0 percent of the sample every year except 1971 when they totaled 41.3 percent of the catch. Catch rates for largemouth bass ranged from 1.65 per net in 1971 to 5.82 per net in 1972. Walleye were second in abundance, making up 26.8 percent of the total in the 1975 sample (Table 14). Walleye catch rate per net has varied from a low of 0.29 in 1971 to a high of 2.15 in 1975.

Table 12. Number of gill nets set and number of fish taken by standardized annual sampling, 1971-1975 (F/N = number of fish per net.).

	1971			1972			1973			1974			1975		
Station	No. Nets	No. Fish	F/N	No. Nets	No. Fish	F/N	No. Nets	No. Fish	F/N	No. Nets	No. Fish	F/N	No. Nets	No. Fish	F/N
Padre Bay	18	54	3.0	22	281	12.7	30	128	4.3	30	211	7.0	30	200	6.7
Red Canyon	31	142	4.6	24	191	8.0	30	105	3.5	30	154	5.1	30	248	8.3
Cha Canyon	-	-	-	24	230	9.6	30	165	5.5	30	212	7.1	30	276	9.2
Rincon	-	-	-	24	252	10.5	30	139	4.6	30	182	6.1	30	237	7.9
Total	49	196	4.0	94	954	10.1	120	539	4.5	120	759	6.3	120	961	8.0

Table 13. List of fish collected during spring gill netting on Lake Powell, 1971-1975.

Common name	Scientific name
Threadfin shad	*Dorosoma petenense*
Rainbow trout	*Salmo gairdneri*
Brown trout	*Salmo trutta*
Carp	*Cyprinus carpio*
Boneytail chub	*Gila cypha*
Colorado squawfish	*Ptychocheilus lucius*
White sucker	*Catostomus commersoni*
Flannelmouth sucker	*Catostomus latipinnis*
Humpback sucker	*Xyrauchen texanus*
Black bullhead	*Ictalurus melas*
Yellow bullhead	*Ictalurus natalis*
Channel catfish	*Ictalurus punctatus*
Green sunfish	*Lepomis cyanellus*
Bluegill	*Lepomis macrochirus*
Largemouth bass	*Micropterus salmoides*
Black crappie	*Pomoxis nigromaculatus*
Walleye	*Stizostedion vitreum vitreum*

Table 14. Catch rate and percent of total catch for selected species collected during spring gill netting on Lake Powell, 1971-1975.

Species	1971		1972		1973		1974		1975	
	Catch rate	Percent of catch	Catch rate	Percent of catch	Catch rate	Percent of catch	Catch rate	Percent of catch	Catch rate	Percent of catch
Largemouth bass	1.65	41.3	5.82	57.4	2.71	62.3	4.01	63.4	4.49	56.1
Walleye	0.29	7.1	1.12	11.0	0.41	9.4	1.09	17.3	2.15	26.8
Black crappie	0.12	3.1	0.67	6.6	0.27	6.1	0.27	4.2	0.36	4.5
Bluegill	0.12	3.1	0.52	5.1	0.06	1.3	0.05	0.8	0.04	0.5
Green sunfish	0.10	2.5	0.16	1.6	0.09	2.1	0.13	2.0	0.06	0.7
Channel catfish	0.12	3.1	0.43	4.2	0.20	4.6	0.14	2.3	0.25	3.1
Carp	1.14	28.6	0.79	7.8	0.32	7.3	0.34	5.4	0.36	4.4
Flannelmouth sucker	0.18	4.6	0.28	2.7	0.11	2.5	0.17	2.6	0.08	0.9
All species	4.04		10.12		4.17		6.33		8.01	

Yearly ratios of mean number of bass and walleye caught per net tested among sampling stations was not statistically independent by Chi square analysis ($\alpha = .05$). Nonindependence indicated that gill nets captured bass and walleye in the same relative porportions at each individual station every year. When numbers were up or down at any one netting site, the catch rate changed porportionally at the other stations.

Nonindependence indicated that data among sampling stations could be combined and averaged for individual years. Linear regression calculations were made to compare data among years (Figure 1). Regression analysis of bass catch rate to year sampled was used to determine if bass populations were increasing or decreasing. The regression line ($Y = 3.391 + 0.142X$) had a positive slope ($b = 0.142$), but the slope was not significantly different from $b = 0$ (t test $\alpha .05$). Data was, thus, insufficient to confirm an increasing or decreasing trend in bass numbers, but suggested fluctuations around a constant level. Linear regression of walleye catch rate over the five year study ($Y = -0.298 + 0.428X$) showed a positive slope ($b = 0.428$) significantly different from $b = 0$ ($t = 73.79, \alpha = 0.001$). Numbers of walleye as measured by gill nets, thus, significantly increased at the four sample sites since 1971. Other species were captured in too few numbers to be treated in the above manner.

An electro-fishing boat was tested on Lake Powell in the fall of 1975. The boat, a 26 by 8 foot pontoon boat, was rigged with an electro-fishing system designed by Mr. Joseph Coffelt, Coffelt Electronics Co., Inc. The system utilized DC current and a VVP unit which produced a pulsed current over four electrodes. The system worked well and the VVP unit was ordered for purchase. Electro-fishing will be incorporated into a regular sampling program pending arrival and installation of all necessary equipment.

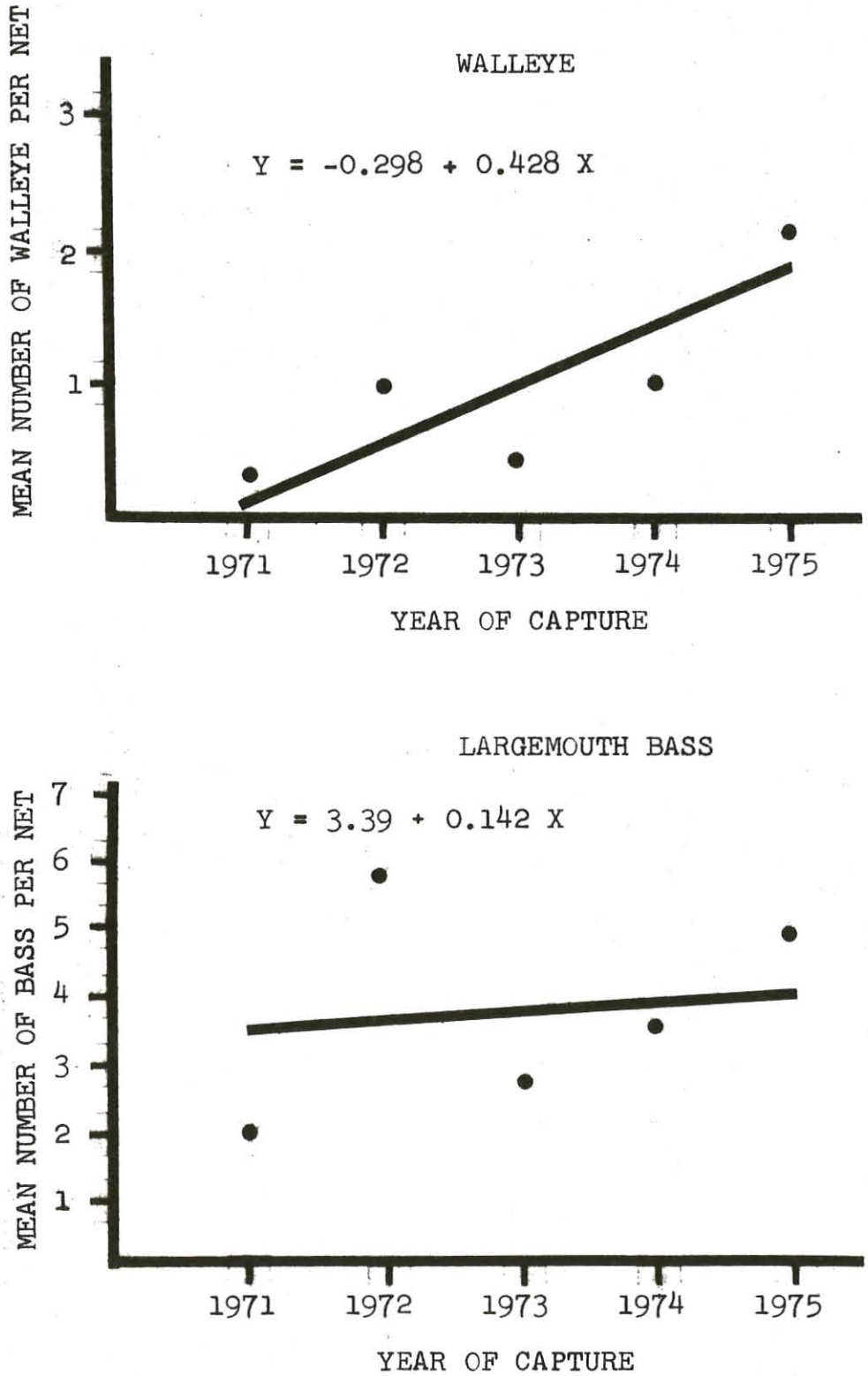

Figure 1. Average number of walleye and largemouth bass captured per gill net in relation to year of capture, Lake Powell.

Job Number: IV Title: Striped Bass Culture

Objective: To evaluate variables affecting survival and growth of pond cultured striped bass and to develop techniques for rearing of larval striped bass to fingerling size.

Accomplishments: Three shipments of striped bass fry were received and stocked in culture ponds in late May, 1975 (Table 15). Two shipments were from California and one from North Carolina. Culture ponds were fertilized with alfalfa hay at the rate of 650 lbs per surface acre prior to receiving fry. Stocking different rates of striped bass was evaluated by varying the rate among ponds (ponds received 20, 35, or 50 thousand fry per acre-ft). Fry were held in seran tempering baskets until six days of age and then released into the culture ponds. Survival of fry in tempering baskets was poor in ponds #1, #2, and #6 and excellent in ponds #3, #4, and #5. High mortality was attributed to fungus infections, sudden exposure of fry to intense light, adverse wind and wave action, and plankton blooms dominated by organisms too large to serve as food.

Table 15. Stocking rates of striped bass larvae in rearing ponds, 1975.

Pond	Source	Fish per acre-ft	Total fry	Date Received	Age Received (days)	Age Released (days)	Survival in Tempering Basket
1*							
a	Cal.	50,000	53,000	5-20-75	4	not released	poor
b	N. Carolina	50,000	53,000	5-22-75	2	not released	poor
c	Cal.	50,000	53,000	5-28-75	5	6	poor
2	Cal.	50,000	53,000	5-20-75	4	6	poor
3	Cal.	20,000	142,000	5-20-75	4	6	excellent
4	N. Carolina	20,000	123,000	5-22-75	2	6	excellent
5	N. Carolina	35,000	720,000	5-22-75	2	6	excellent
6	Cal.	35,000	750,000	5-28-75	5	6	poor

* Three attempts were made at tempering fry in pond #1 before surviving fry were released into the pond.

Fingerlings were harvested July 15-20th, at an age of 57-62 days. A total of 100,678 fingerlings were produced for a mean survival of 5.5 percent (Table 16). Ponds #1, #2, and #6 failed to produce any fish. Ponds #3, #4, and #5 produced considerable numbers of fingerlings. Pond #3 was particularly successful, producing 67,955 fish with an overall survival of 47.9 percent.

Results obtained from different stocking rates of striped bass fry during 1974-1975 are given in Table 17. Data was difficult to interpret because of lack of control over numerous variables influencing survival besides stocking rates. The best information was probably obtained from pond #1 in 1974 and pond #3 in 1975. Excellent fingerling production was obtained in both ponds, and survival was probably least influenced by uncontrolled variables. Pond #1 was stocked at the lower rate (83,333 per acre) and had a high percent survival (58.8 percent) and total production (44,080 fingerling per acre). An increased stocking rate in pond #3 (142,000 per acre) may have increased fingerling production (67,955 per acre) and also resulted in reduced survival (47.9 percent). In either case, actual stocking rates probably did not deviate far from an optimum level. Field observation would suggest that production capacity of pond #3 was at a maximum. Even if supplemental food had been provided, space for additional fish was limited. Crowding was obvious with the smaller fish in pond #3 apparently restricted to shallow, less desirable areas of the pond by harassment from larger fish. Although data available on stocking rates is still limited, 140,000 fry per acre (20,000 per acre-ft in pond #3) was believed to be a satisfactory figure. Further refinement of stocking rates may not be immediately necessary, especially in view of the difficulty and error in estimating actual numbers of fry.

Table 16. Striped bass harvest from experimental rearing ponds, 1975.

Pond #	Total # Fry Released	# Fry Per Acre	Total Weight fingerling produced (Kg)	Mean # fingerling per Kg	Total # fingerling produced	Length (mm)	Percent Survival
1	53,000	132,500	-	-	-	-	0.0
2	53,000	132,500	-	-	-	-	0.0
3	142,000	142,000	141.0	482	67,955	55	47.9
4	123,000	111,818	13.6	375	5,114	61	4.2
5	720,000	232,258	85.7	322	27,609	60	3.8
6	750,000	184,615	-	-	-	-	0.0
Total	1,841,000	-	240.4	418	100,678	56	5.5

Table 17. Results from successful culture ponds receiving different stocking rates of striped bass fry, 1974-75.

Year	Pond	Number fry stocked per Acre	Number fry stocked per Ac-Ft	Fingerling production % survival	Fingerling production per Acre
1975	5	232,258	35,000	3.8	8,906
1974	6	171,000	28,461	7.8	9,184
1974	4	150,000	27,117	9.0	13,682
1975	3	142,000	20,000	47.9	67,955
1974	3	125,000	18,512	6.4	8,385
1975	4	111,818	20,000	4.2	4,649
1974	1	83,333	28,571	58.8	44,080

During 1974 and 1975 volume was used as a standard unit in determining fertilization and stocking rates. Values were expressed in terms of acre-ft. Experimentation in 1975 required that plankton production be held relatively constant among ponds. Pond #1-4 were fertilized at a constant rate (650 lbs per acre-ft) in hopes of achieving this. Ponds #5 and #6 were fertilized at a lower rate because of a lack of fertilizer. Results are shown in Figure 2. Plankton production was not held constant. No relationship was apparent between fertilization in terms of acre-ft and plankton production. However, when comparisons were made between the amount of fertilizer applied per surface acre and plankton production, a relationship was evident. Ponds that received greater amounts of fertilizer per surface acre, generally had higher mean standing crops of zooplankton. Plankton crops were even more predictable when water seepage from each pond was considered (Figure 2). Ponds with moderate fertilization per surface acre had relatively high standing crops of zooplankton if the rate of water loss was low. It was evident that productivity, in this case, was more closely associated with surface area than total water volume.

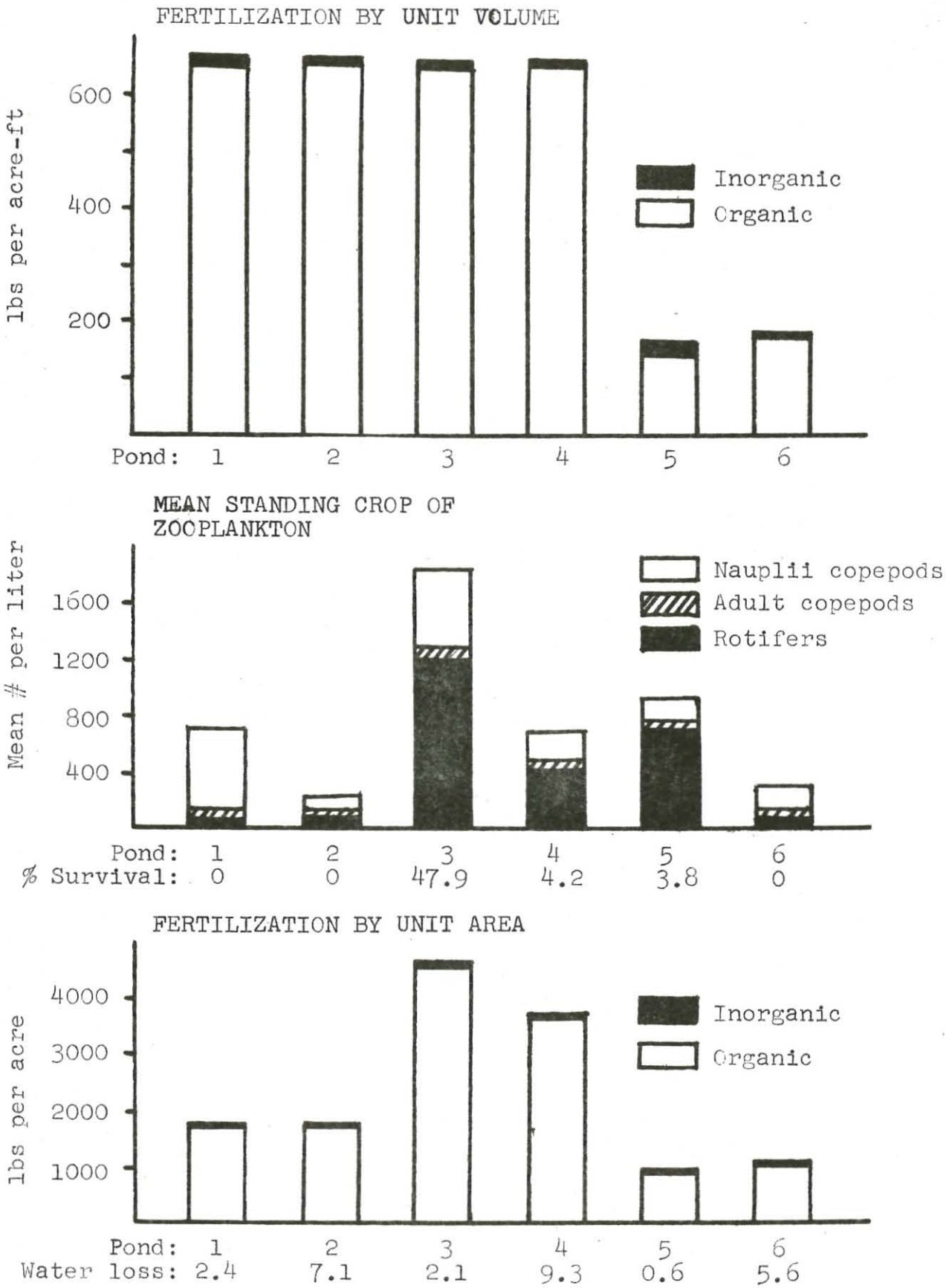

Figure 2. **Comparison of zooplankton crops and fertilization schedules, 1975. Water loss expressed as percent of total pond volume per day.**

Best fingerling production during 1975 occurred in the pond with the highest fertilization rate (pond #3, Figure 2). Although ponds #1-4 received an initial 650 lbs of alfalfa hay per acre-ft, pond #3 received the greatest amount in terms of surface acres (4,600 lbs). Field observations, as well as quantative plankton analysis, indicated that pond #3 had a distinctly richer plankton bloom than any other pond. It is recommended that initial fertilization rates near 4,600 lbs per surface acre of alfalfa hay be further evaluated.

High survival in pond #3 during 1975 provided an opportunity to periodically sample fish during the culture period and determine food habits. A dip net or small seine was used to collect 10-20 striped bass at weekly intervals. In general, food habits changed from smaller to larger items as striped bass increased in length (Figure 3). Rotifers, the smallest organisms available, were found in stomachs during the first two weeks after fry introduction, but were later avoided. Rotifers were never used to a great extent, but may have been important at the time fry started to feed, before any stomachs were collected. Nauplii copepods, the next larger organism, were also utilized by fry during the first month, but were unimportant after striped bass obtained about 30 mm total length. Utilization of adult copepods started when fry were about 12 days old and gradually increased in importance until they made up 100 percent of the diet. Although size of adult copepods was not measured, it was evident that striped bass selected larger individuals as the culture period progressed. During mid-June, zooplankton numbers began to decline (Figure 4) and striped bass converted to feeding on benthic chironomids (Figure 3). After supplementary fertilization, zooplankton numbers again increased, and striped bass reverted back to utilizing adult copepods. Benthic organisms apparently acted as a food reserve when plankton became limited.

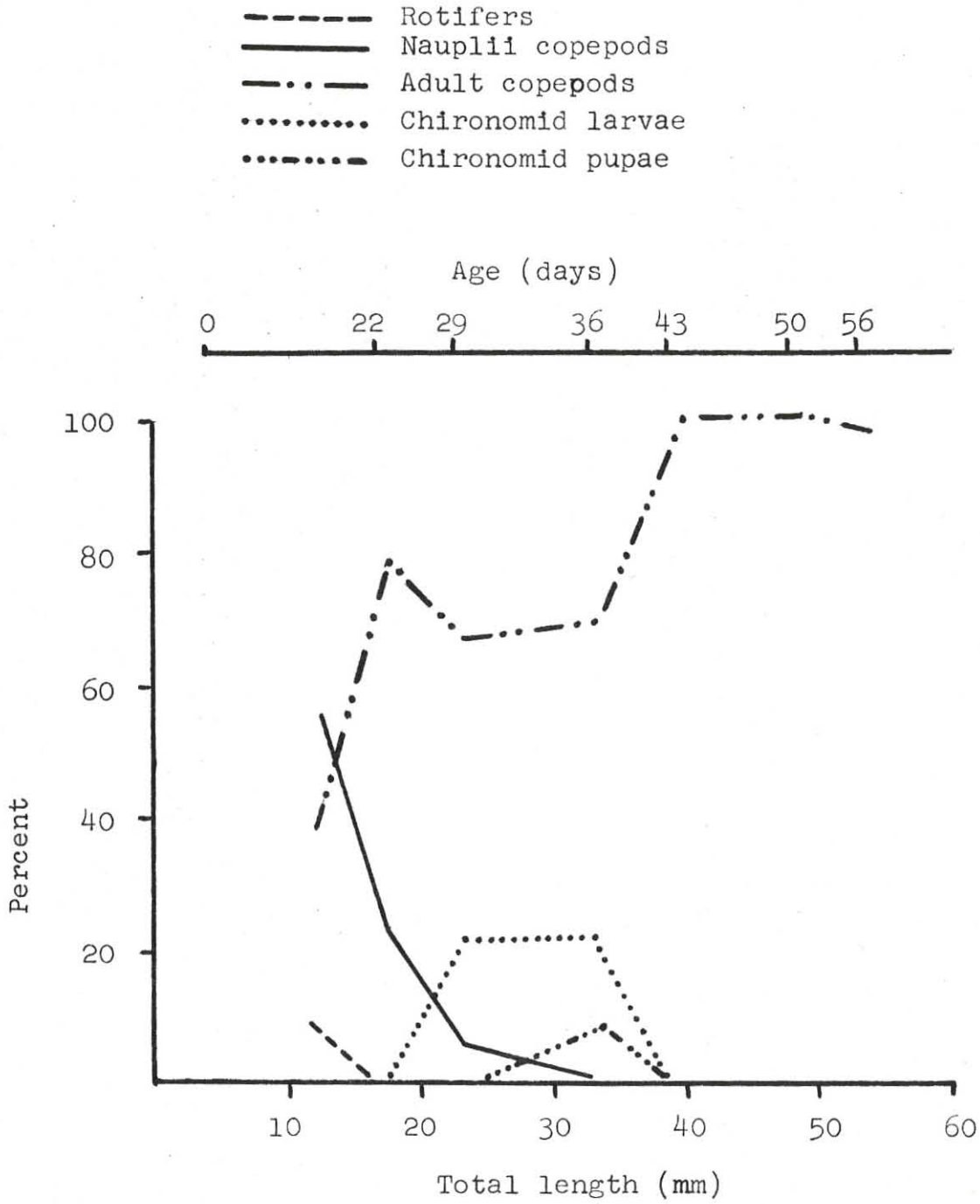

Figure 3. Striped bass food habits compared to growth in length, pond #3, 1975. Values expressed as percent by number.

It was evident from data collected in 1974 and 1975 that fingerling production was related to the success of initially introducing striped bass fry (Table 18). Successful ponds, (ponds producing substantial numbers of fingerlings) always resulted when survival in tempering baskets was rated good-excellent. Invariably, pond production was poor if fry did not do well in the baskets. Survival of fry for the first 24-48 hours after stocking was probably the most important factor in determining overall fingerling production in 1974 and 1975. Restocking tempering baskets in which fry do not do well with new fry would be the best way of insuring that all ponds receive successful fry introductions. This could be done in the future, if multiple shipments of fry can be arranged.

Table 18. Comparison between striped bass fry survival in tempering baskets and fingerling production, 1974-75.

Survival in tempering basket	Number ponds	Successful ponds	Percent survival to fingerling
poor - fair	5	0	0.0
good - excellent	7	7	9.3

Zooplankton abundance in culture ponds in 1975 showed a possible relationship to fry survival and fingerling production. Plankton populations were monitored every fourth day from the time ponds were filled to the time of harvest. Occurrence of zooplankton in pond #3 which had the highest percent survival and greatest production is represented in Figure 4. At the time of fry introduction, the plankton community was dominated by small organisms. Larger organisms developed later and in the same sequence that occurred in the diet. In contrast, the plankton development in pond #1 was considerably different (Figure 5). Fry were introduced shortly after the plankton bloom had reached its peak. Greater numbers of large adult organisms were present and three attempts at introducing fry were unsuccessful. Timing of plankton blooms with fry introductions was possibly of major importance. Stocking fry at a time well before zooplankton numbers peaked, not only assured numerous quantities of small organisms that were potential food and minimum numbers of large organisms that might compete for food, space, and possibly be predaceous, but also allowed more complete utilization of the entire plankton bloom.

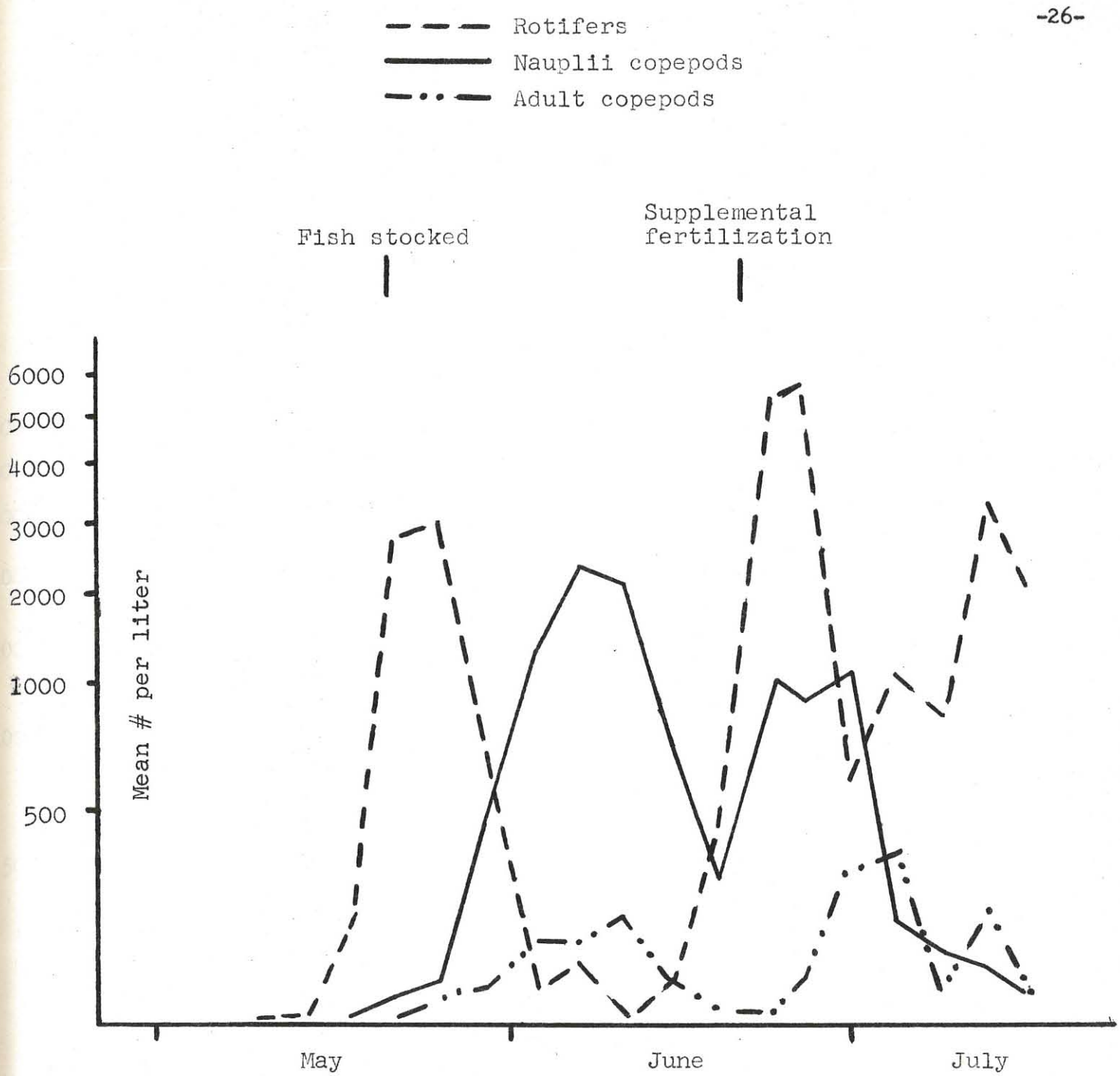

Figure 4. Changes in abundance of predominant zooplankton found in pond #3, 1975.

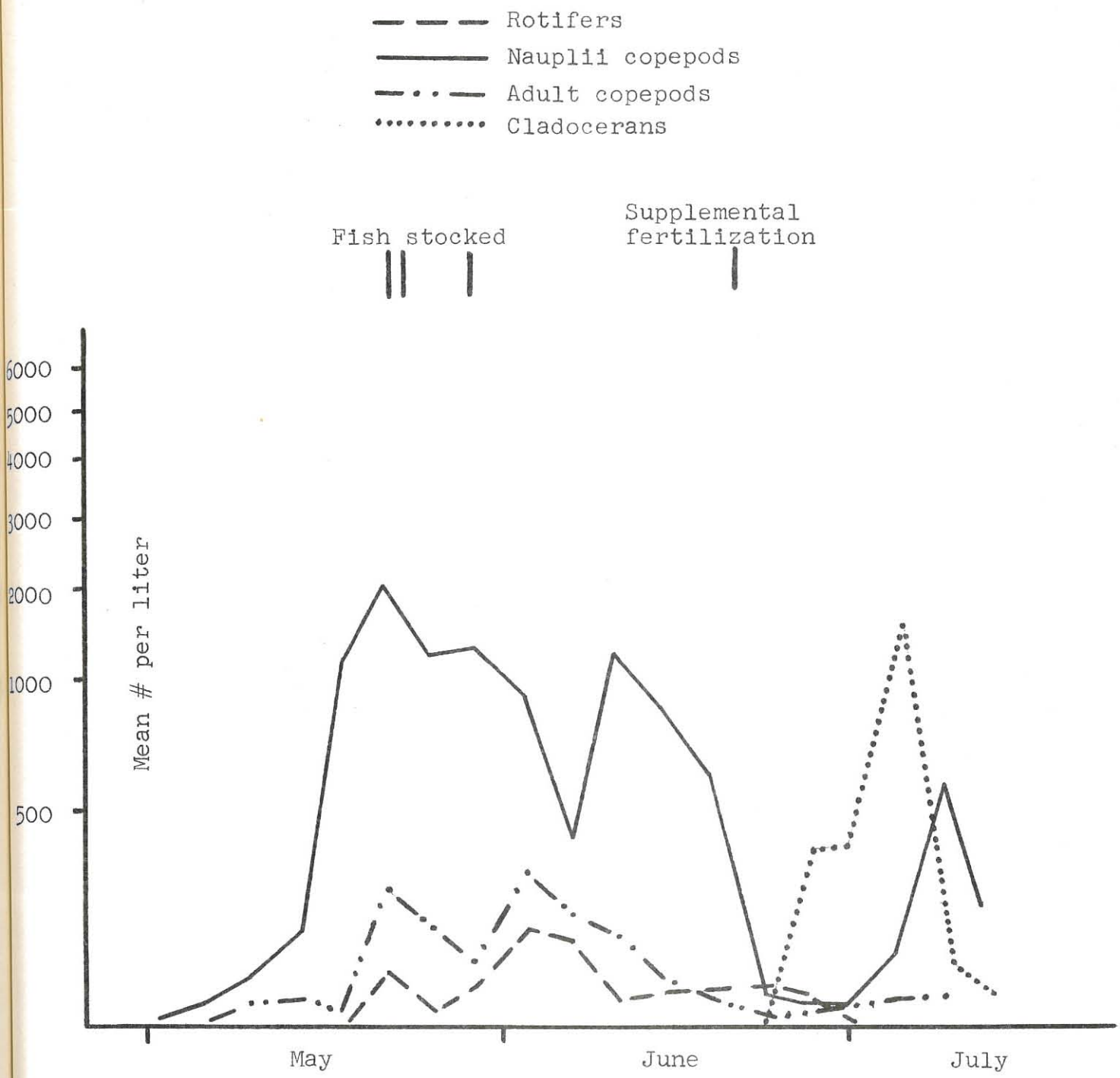

Figure 5. Changes in abundance of predominant zooplankton found in pond #1, 1975.

Pond #6, which was unsuccessful, also had a plankton bloom dominated by large organisms when fry were stocked. All successful ponds had plankton blooms consisting mainly of small organisms at the time of fry introduction. Pond #2 apparently had a desirable plankton population when fry were stocked, but samples of the fry indicated that nearly 100 percent were infected with fungus. Results were not conclusive, but possible relationships between fry survival and quality of zooplankton deserves future attention.

A number of precautions might also help improve survival of fry during the initial stages of introduction. Best results were obtained when fry shipments arrived in the evening and were stocked at night. This minimized sudden exposure of sensitive fry to bright light. Extremes in temperature, wind, and wave action were also avoided at night, allowing more favorable conditions for adjustment. Construction of windbreaks and covers for seran baskets might also reduce detrimental effects of intense light and wave action. Utilization of more baskets could enhance fry survival by reducing density of fry in any one basket.

Fingerling production for 1974 and 1975 was also compared to source of fry and age when shipped (Table 19 and 20). Fry received from California had the most widely variable results. Out of five attempts, California fry were only successful in two ponds. The two successful ponds, however, were exceptionally productive. East coast shipments were successful in five out of seven attempts, but generally less productive. A similar trend was evident for age when shipped. California fry were shipped when 3-5 days old, while east coast fry were shipped at 2 days of age. With only limited data on source of fry and age when shipped, no positive conclusions could be drawn.

Table 19. Fingerling production comparing three different sources of striped bass fry, 1974-1975.

Source	# Ponds* stocked	# Successful ponds (%)	Fingerling production in successful ponds	
			% Survival	Mean # per Acre
California	5	2 (40.0)	49.8	61,133
North Carolina	2	2 (100.0)	3.9	7,791
Virginia	4	2 (50.0)	7.9	11,160

*one successful pond, not included above, was stocked with a mixed source from North Carolina and Virginia.

Table 20. Fingerling production comparing striped bass fry shipped at different ages, 1974-1975.

Age at receipt (days)	# Ponds stocked	# Successful ponds (%)	Fingerling production in successful ponds	
			% Survival	Mean # per acre
2	7	5 (71.4)	5.3	9,017
3-4	4	2 (50.0)	49.8	61,133
5	1	0 (0)	-	-

Job Number: V Title: Evaluation of Striped Bass Introduction

Objective: To evaluate the success of the striped bass introduction into Lake Powell, both biologically and as a sport fishery.

Accomplishments: An estimated total of 94,878 fingerling striped bass were stocked in Lake Powell during July 15-20th, 1975. All introductions were made at boat ramps in Wahweap Bay. During the first 2 days of stocking, fingerlings were released at the government boat ramp. Four 100 ft experimental gill nets (each with four panels of 1, 1½, 2 and 3 inch mesh) were fished at the release site to evaluate the extent of predation on the newly released striped bass. The number of predator fish caught in the nets was low and only four stomachs were found to contain striped bass (Table 21). Soon after release, striped bass fingerlings oriented themselves, formed schools, and moved away from the boat ramp. It was apparent that increasing numbers of predator fish were being attracted to the ramp area as stocking progressed. Sunfish were particularly abundant and thought to be attracted by the large number of aquatic insects present in the transported water from the culture ponds. To reduce attraction and possible predation on striped bass, other boat ramps in the area were also utilized.

Table 21. Stomach contents of predaceous fish captured near the government docks during stocking of striped bass fingerlings, July 16 and 17, 1975.

Species	# stomachs examined	Stomachs containing striped bass		# Striped bass per stomach	
		number	percent	mean	range
Largemouth Bass	10	3	33.3	1.0	0-7
Green Sunfish	2	1	50.0	1.0	0-2
Black Crappie	2	0	0.0	0.0	-
Channel Catfish	4	0	0.0	0.0	-

Growth of striped bass in Lake Powell was rapid (Figure 6). Fish stocked in July, 1974 averaged 282 mm (11.1 in) total length and weighed 303 g (0.67 lb) by December. Little growth occurred during winter and spring, but resumed again in June. Scale analysis showed distinct annulus formation in early June. By the end of their second summer, striped bass averaged 410 mm (16.4 in) total length and had a mean weight of 831 g (1.82 lb). Growth of striped bass stocked in 1975 was rapid from July through September (Figure 6). Fish captured from October through December were not as large as the previous year, but the difference might have been caused by sampling bias from the use of smaller mesh gill nets.

Food habits of striped bass during their first summer in Lake Powell are described in Figure 7. Dipteran larvae and pupae (Heleidae and Chironomidae) dominated the diet shortly after stocking. Threadfin shad began to enter the diet when striped bass reached about 90 mm (3.5 in) total length. By the time striped bass were 130 mm (5.1 in) long, fish made up the entire diet (72 percent threadfin shad and 28 percent unidentified). Threadfin shad continued to dominate the diet of striped bass during their second year of life (Table 22). Crayfish were the only other identifiable food item found.

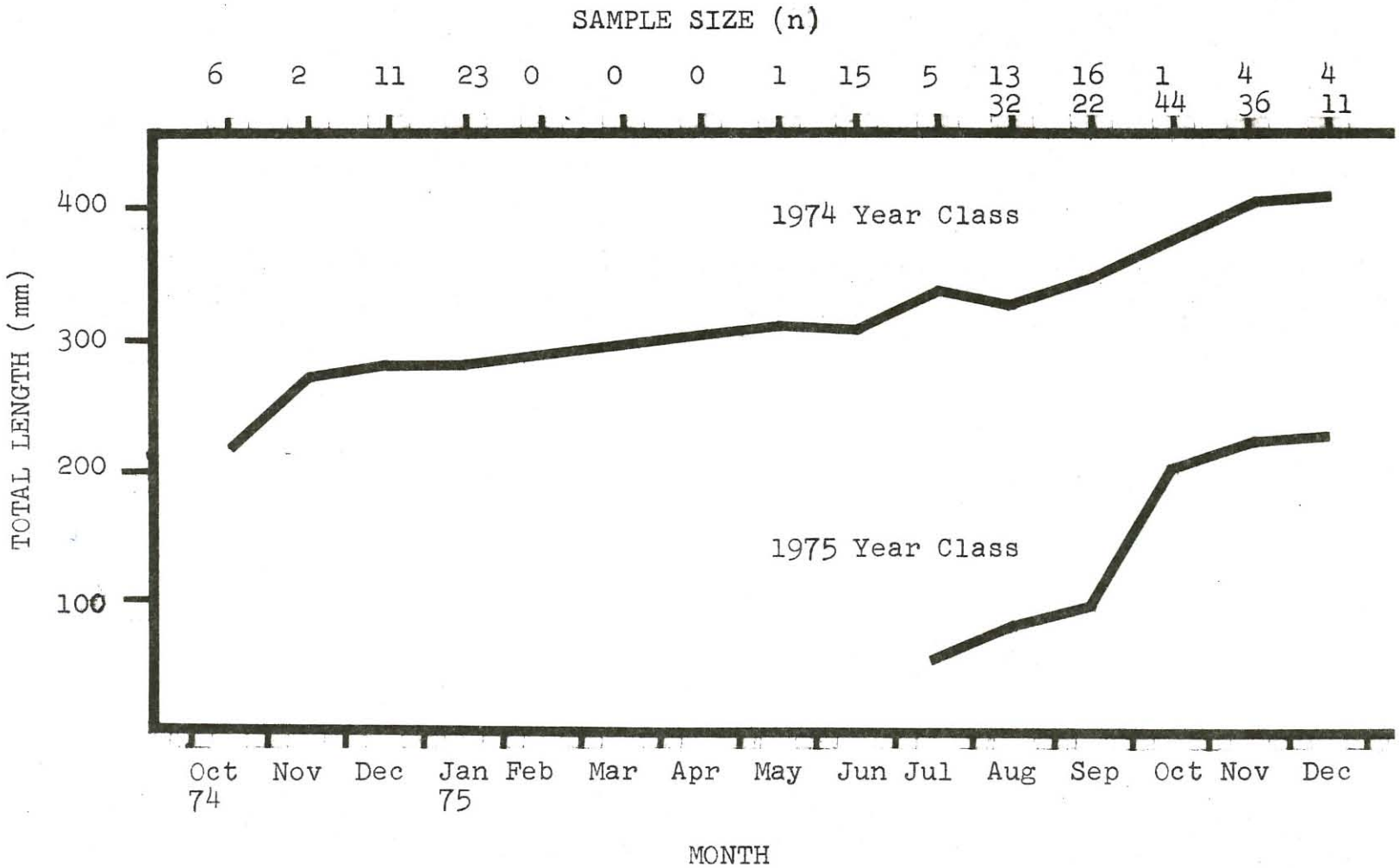

Figure 6. Monthly growth of striped bass at Lake Powell, Utah.

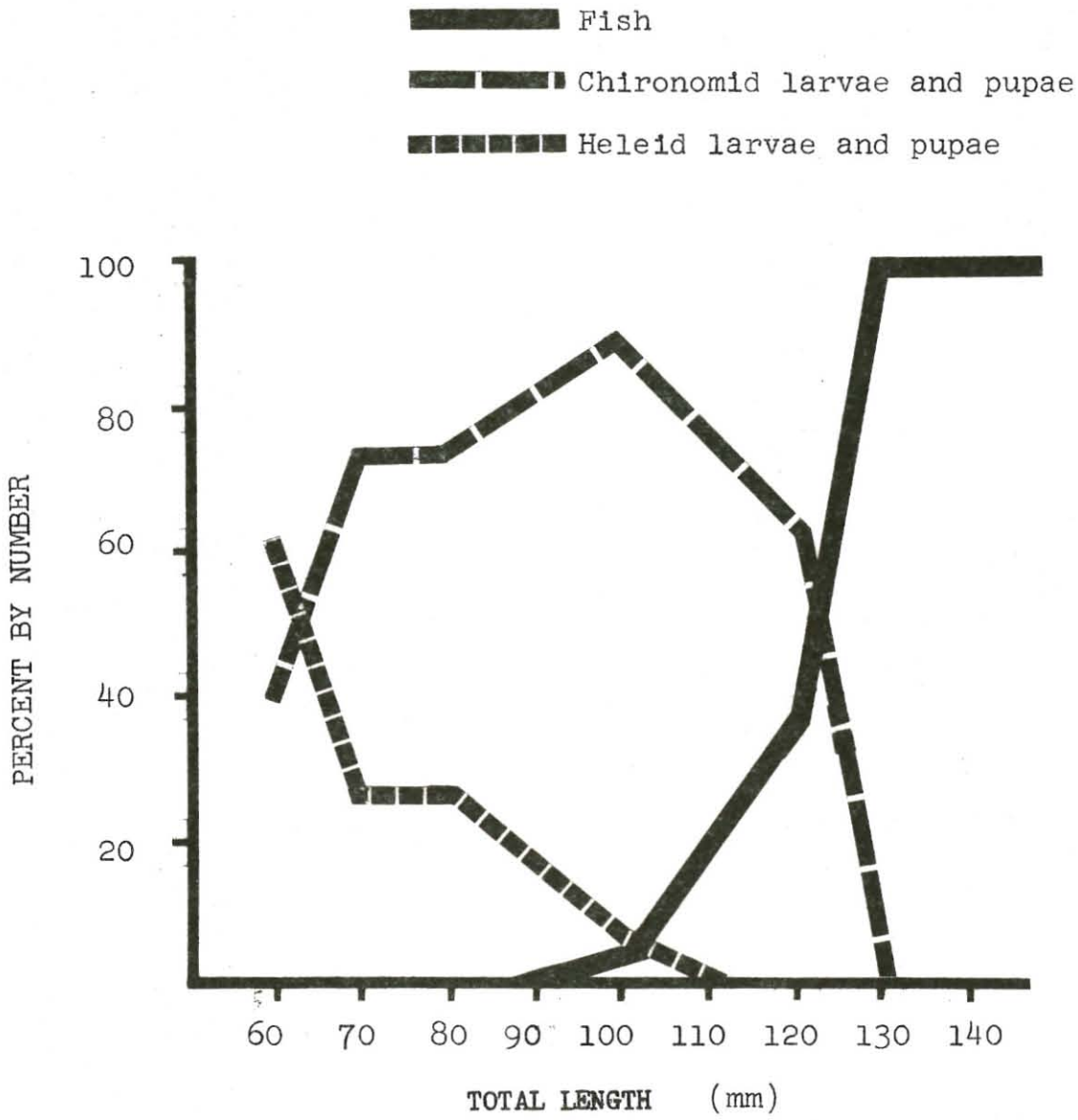

Figure 7. Changes in food habits of Lake Powell, young-of-the-year striped bass with growth.

Table 22. Food habits of striped bass age 1+, Lake Powell, 1975. Values based on total number of stomachs containing food.*

Item	Summer (n=17)			Fall (n=12)			Winter (n=4)		
	% Occ.	% by Vol.	% by No.	% Occ.	% by Vol.	% by No.	% Occ.	% by Vol.	% by No.
Crayfish	6.0	8.0	2.0	-	-	-	-	-	-
Fish	94.0	92.0	98.0	100.0	100.0	100.0	100.0	100.0	100.0
Threadfin Shad	77.0	81.0	90.0	83.0	87.0	83.0	100.0	99.5	93.0
Unidentified	25.0	11.0	8.0	42.0	13.0	17.0	25.0	0.5	7.0

* Note: 15 stomachs of 48 examined were empty.

Returns of striped bass were largely restricted to Wahweap and Warm Creek bays. All fish collected in gill nets were from these locations. With the exception of two fish, all known striped bass taken by anglers were also within 10 miles of the dam. The exceptions occurred in late fall of 1975 when one report was confirmed of a striped bass being caught near Last Chance (25 miles up lake) and another from near Rainbow (45 miles up lake). It is recommended that stocking be expanded in 1976 to upper reservoir areas to better distribute striped bass populations.

A potential mass marking technique was also partially evaluated on 200 striped bass fingerlings (60 mm mean length). Fish were sprayed with orange flourescent pigment at 90-100 lbs pressure with a compressed air gun held at a distance of 18 in. Fish were afterwards placed in a seran basket located in pond #1. Thirteen mortalities (6.5 percent) occurred within 24 hours. The remaining 187 fish were released in the pond. After 18 days the pond was drained and 184 fish were recovered. Average length had increased to 91 mm. All fish were then preserved and a sample checked for mark retention. All fish inspected were marked. This technique showed promise, but more work is needed to determine the longevity of the mark before using the method in a research project. No further work is planned along these lines, unless a distinct need to mark striped bass becomes apparent from project work.