Lake Powell Fisheries Investigations

1981 (Segment 10) Annual Report

for Colorado River Drainage and Tailwaters
Dingell-Johnson Project F-28-R

Publication Number 82-6

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LAKE POWELL FISHERIES INVESTIGATIONS

Annual Performance Report

January 1981 - December 1981

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UTAH STATE DIVISION OF WILDLIFE RESOURCES

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ABSTRACT

Fisheries research with predator and prey species of Lake Powell was summarized for sample year 1981. Threadfin shad, the dominant forage fish, rebounded from the five-year low in young-of-the-year production noted in 1980. The key to increased threadfin production was the extension of the spawning season into the summer months. Sport angling pressure continued its steady yearly increase, while angling catch rates declined slightly from the previous year. Black crappie and largemouth bass were creeled most often but walleye and striped bass both reached record harvest levels. Gill netting to demonstrate game fish population trends showed increasing walleye numbers, while numbers of largemouth bass decreased. Electrofishing surveys indicated poor production of largemouth bass and black crappie young-of-the-year in 1981, a year of low spring runoff and stable, rather than rising, water levels during the spawning season. Natural reproduction of striped bass was detected, not only in the Colorado River but also within the reservoir near Glen Canyon Dam. Relative abundance of young-of-the-year striped bass was the highest yet reported in Lake Powell, and higher for fish spawned within the reservoir than for fish apparently spawned in the Colorado River. Natural reproduction was detected in the San Juan Arm for the first time, and attributed to in-reservoir spawning.

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THREADFIN SHAD STUDY

JOB I

Methods

Threadfin shad (*Dorosoma petenense*) spawning was monitored with meter net collections. Monthly meter net samples were taken in side canyons or the backs of bays near each trawling location. The standard meter net tow was 2 minutes in length with the net towed just under the surface. Four tows were made at each station. Secchi disc readings and surface water temperatures were recorded at each sample site.

Monthly mid-water trawl collections were taken from June through September in Wahweap, Bullfrog, Good Hope and the San Juan (Figure 1). Sampling methods used were reported in Gustaveson et al. 1980. Depending on total length, shad were divided into one of three life history stages; larvae (< 25 mm), juveniles (26-50 mm), and adults (>50 mm).

Adult shad were collected with a boom shocker at the Rincon, Bullfrog Bay and Good Hope Bay (Figure 1). A complete description of the shocker and methods are given in Job III.

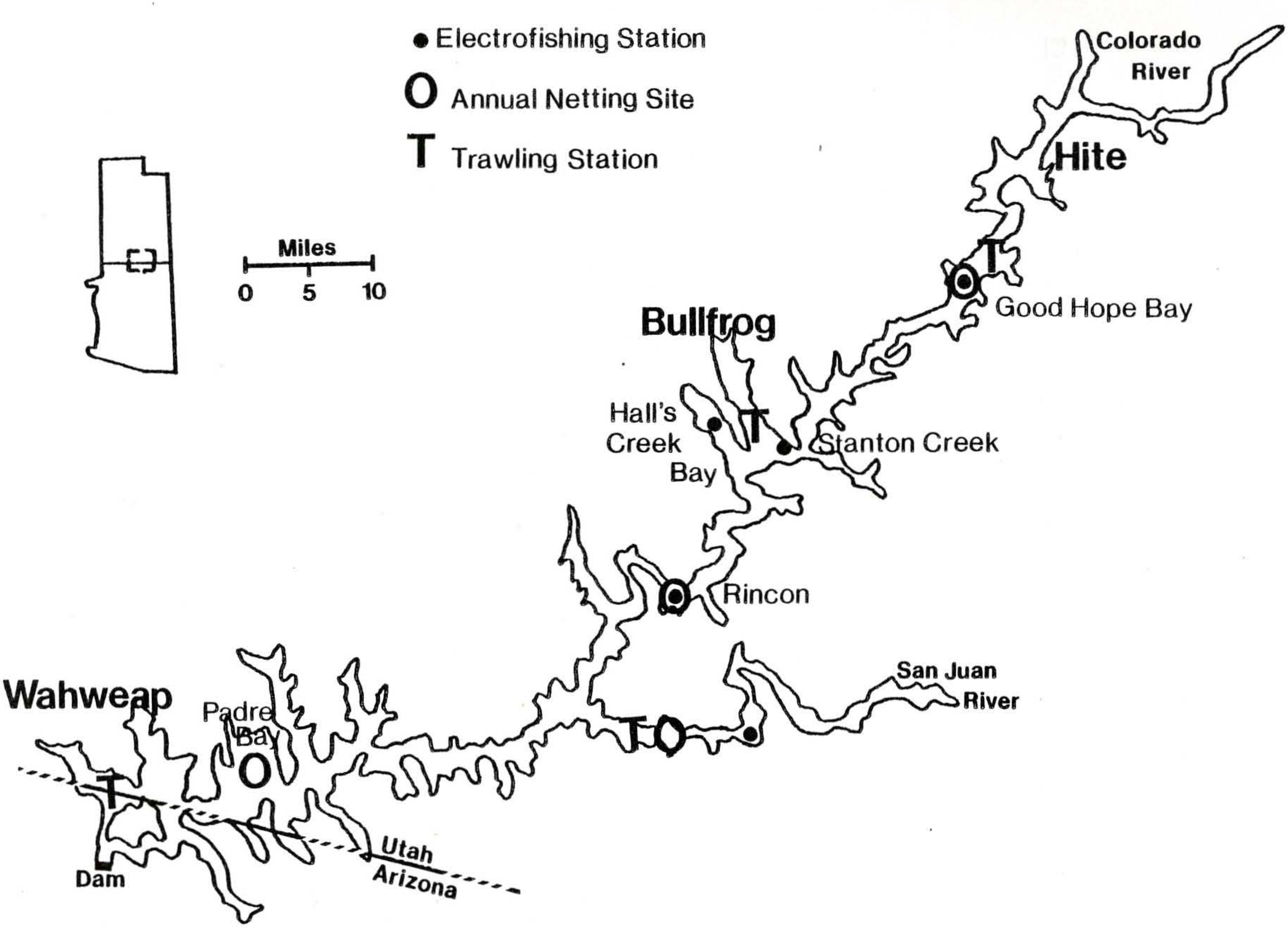


Figure 1. Map of Lake Powell showing trawling locations, annual netting sites and electrofishing stations.

Results and Discussion

Threadfin shad were spawning lake-wide by the third week of May and spawning continued until mid-August. This was the first year since 1978 that spawning continued after early July.

Meter netting began in late May and continued until no larval shad were collected at a particular sample site. The highest numbers of larval shad were collected where secchi disc readings were less than 1.0 m. Conversely, larval shad were seldom collected when water clarity exceeded 3 m. Average total length of larval shad collected was approximately 10 mm. Spawning apparently occurred in turbid water since shad less than 10 mm exhibit poor swimming ability and would not be expected to move far from the hatching site.

Larval shad were collected at Wahweap and Bullfrog Bays until mid-August 1981 (Figures 2-3). However, no larval shad were collected at Good Hope Bay after July 1981 (Figure 4). Desha and Cha canyons on the San Juan Arm were sampled during May and June 1981 but no larval shad were collected. Water clarity exceeded 3 m during meter net sampling in these canyons.

Four stations were trawled monthly from June through September 1981. Trawling at Wahweap and Bullfrog indicated y-o-y shad production increased dramatically from 1980 levels (Figures 5 and 7).

The y-o-y shad populations peaked earlier at Good Hope Bay and the San Juan (Figures 6 and 8) than they did at Wahweap and Bullfrog Bays (Figures 5 and 7).

In July electrofishing equipment was used in an attempt to assess adult shad numbers. Shoreline transects were sampled at the Rincon,

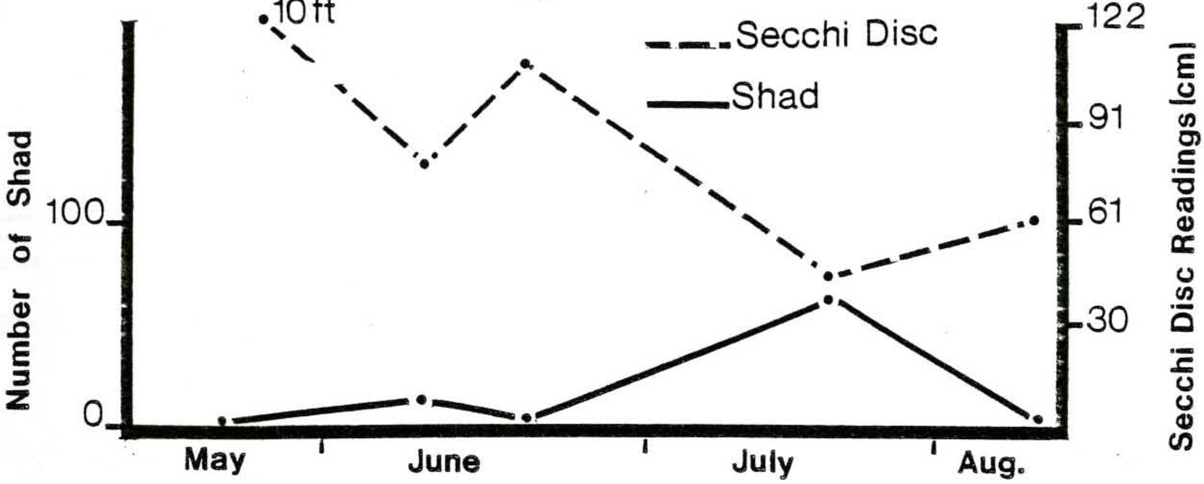


Figure 2. Secchi disc readings and mean number of young-of-the-year shad collected in meter net tows in Wahweap Bay, Lake Powell, May-August 1981.

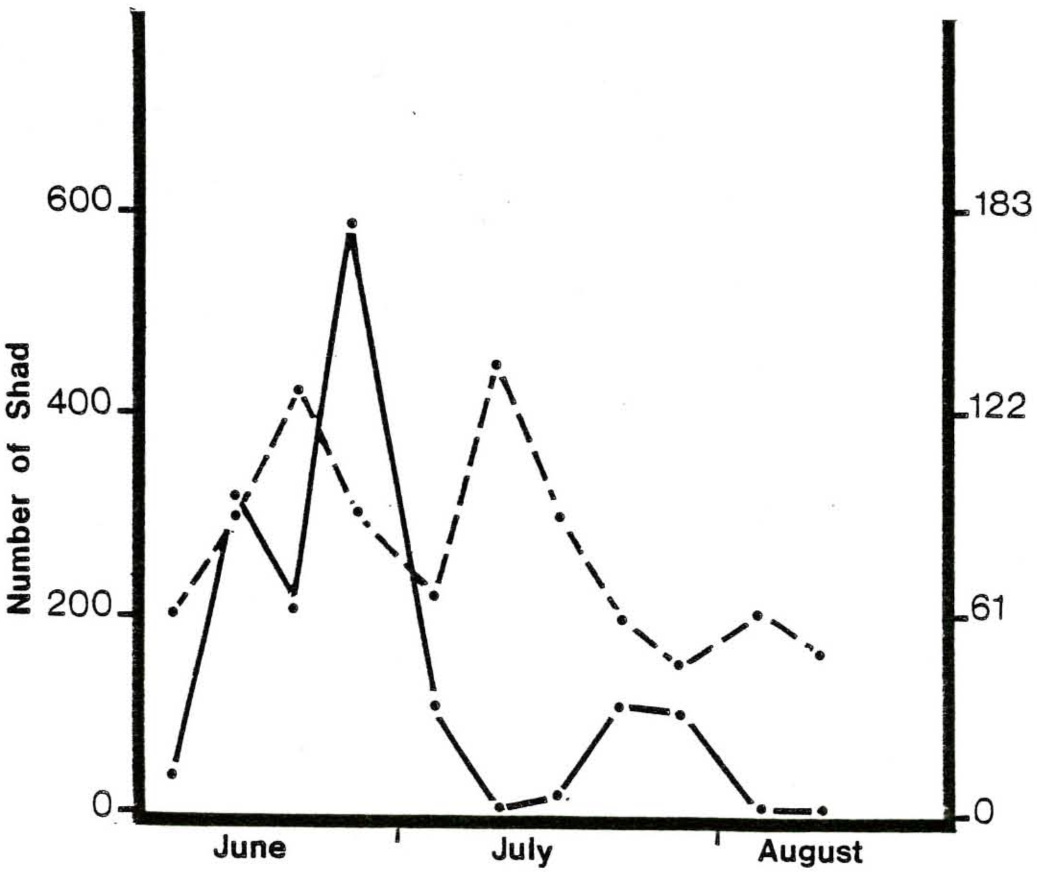


Figure 3. Secchi disc readings and mean number of young-of-the-year shad collected in meter net tows in Bullfrog Bay, Lake Powell, May-August 1981.

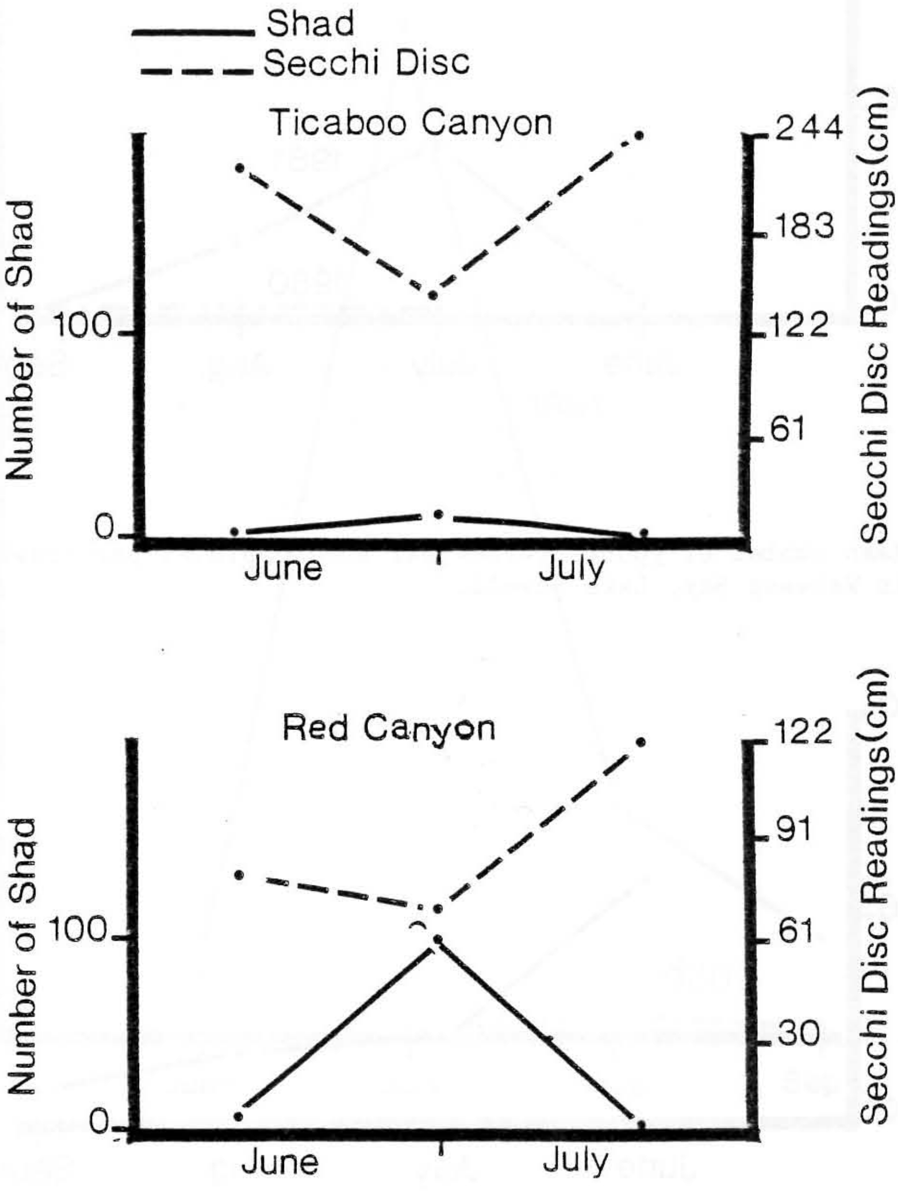


Figure 4. Secchi disc readings and mean number of young-of-the-year shad collected in meter net tows in Ticaboo and Red Canyons, Good Hope Bay, Lake Powell, June-August 1981.

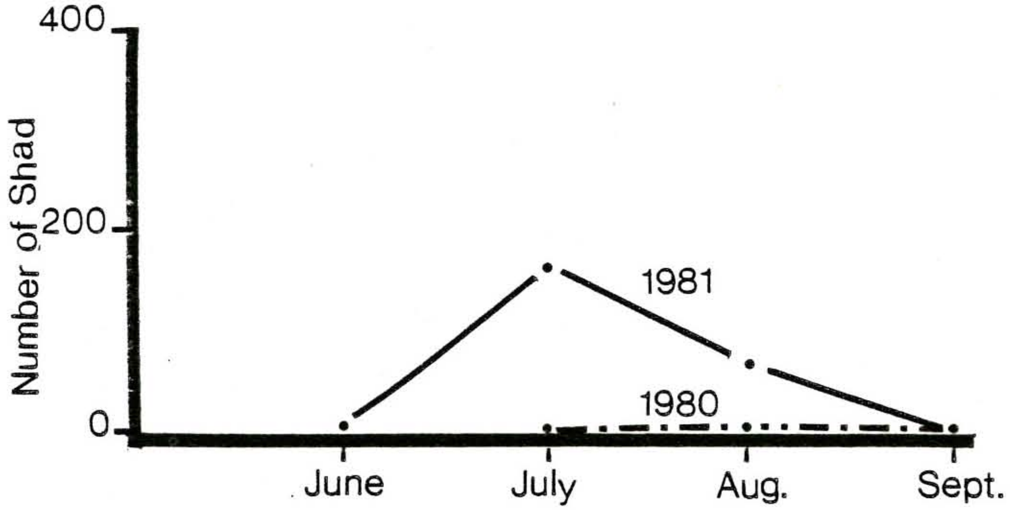


Figure 5. Mean number of young-of-the-year shad captured per trawl haul in Wahweap Bay, Lake Powell.

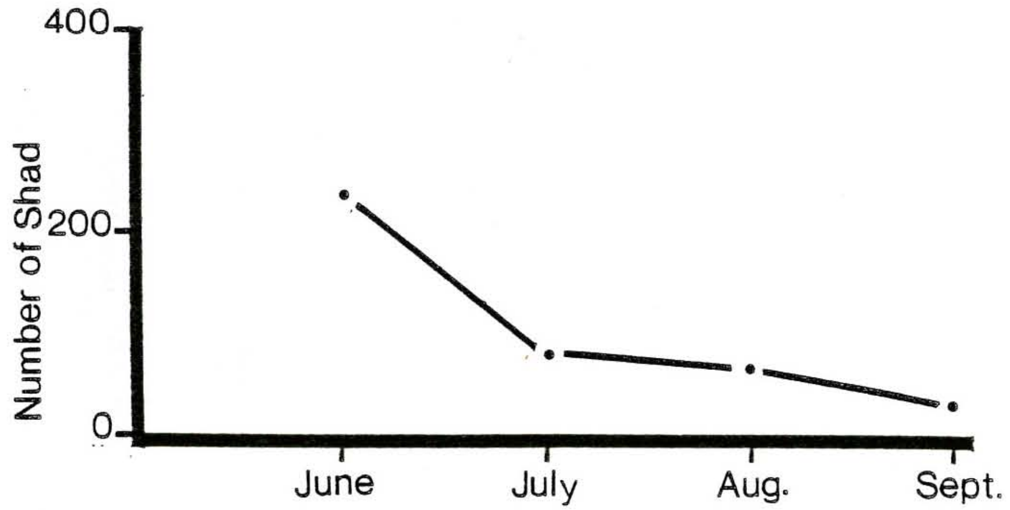


Figure 6. Mean number of young-of-the-year shad captured per trawl haul in the San Juan Arm, Lake Powell, 1981.

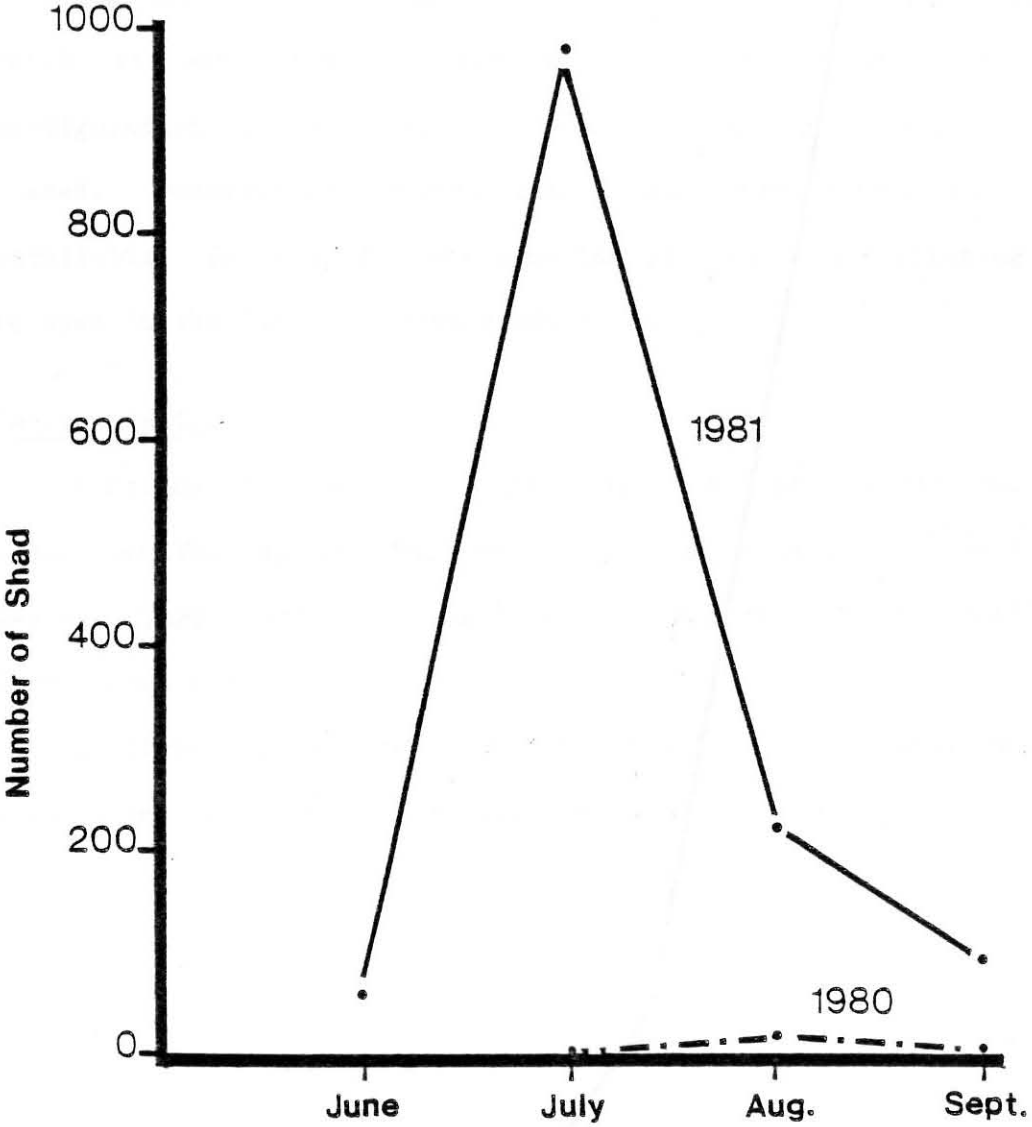


Figure 7. Mean number of young-of-the-year shad captured per trawl haul in Bullfrog Bay, Lake Powell.

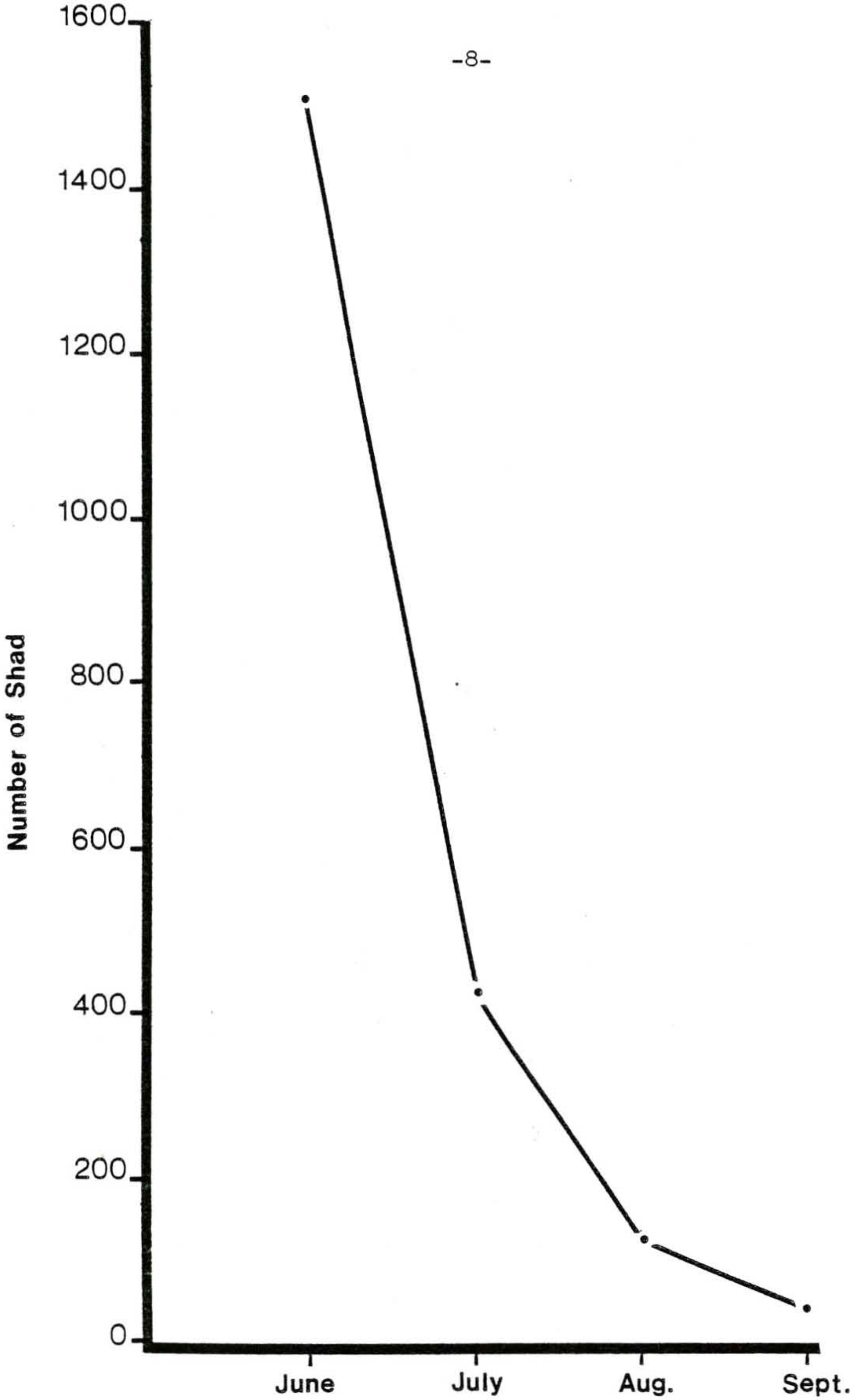


Figure 8. Mean number of young-of-the-year shad captured per trawl haul in Good Hope Bay, Lake Powell, 1981.

Bullfrog and Good Hope Bays. Although adult shad were collected, the catch at each transect was affected by weather and shoreline configuration so that catch information was highly variable and probably biased. Comparisons between lake areas were therefore, considered unreliable. Because of these sampling problems electrofishing will not be used in the future to sample adult shad.

Recommendations

Continue meter netting monthly at Good Hope and the San Juan and weekly at Wahweap and Bullfrog to determine length of shad spawning season. Begin netting approximately mid-May and continue until no more larval shad are collected.

Continue monthly trawl sampling at Wahweap, San Juan, Bullfrog and Good Hope to determine annual trends in threadfin shad abundance.

MEASUREMENT OF FISHERY HARVEST, PRESSURE AND SUCCESS

JOB II

Methods

A scheduled creel census was conducted from April through September at the four major access areas on the lake - Wahweap, Hall's Crossing, Bullfrog and Hite - in 1981. Anglers were interviewed as they returned to launching ramps. Catch rates (fish/angler hour) were estimated from data reported by anglers for their previous day of fishing, as well as for the census day. Estimates of angling pressure were based on recreational use data collected by National Park Service personnel at access points.

Results and Discussion

A total of 3,828 boating parties was checked by creel clerks during the six month census period. Of these, 1,322 (35%) reported angling activity. Anglers spent an average of 4.0 hours fishing per day. The mean number of anglers per fishing boat was 2.5.

Angling pressure and recreational boat use continued to increase on Lake Powell during 1981 (Figure 9). The index of angling pressure was 90,039 boat days, an increase of 15% over 1980. The index of total recreational boat use (including nonfishing boats) was 290,689 boat

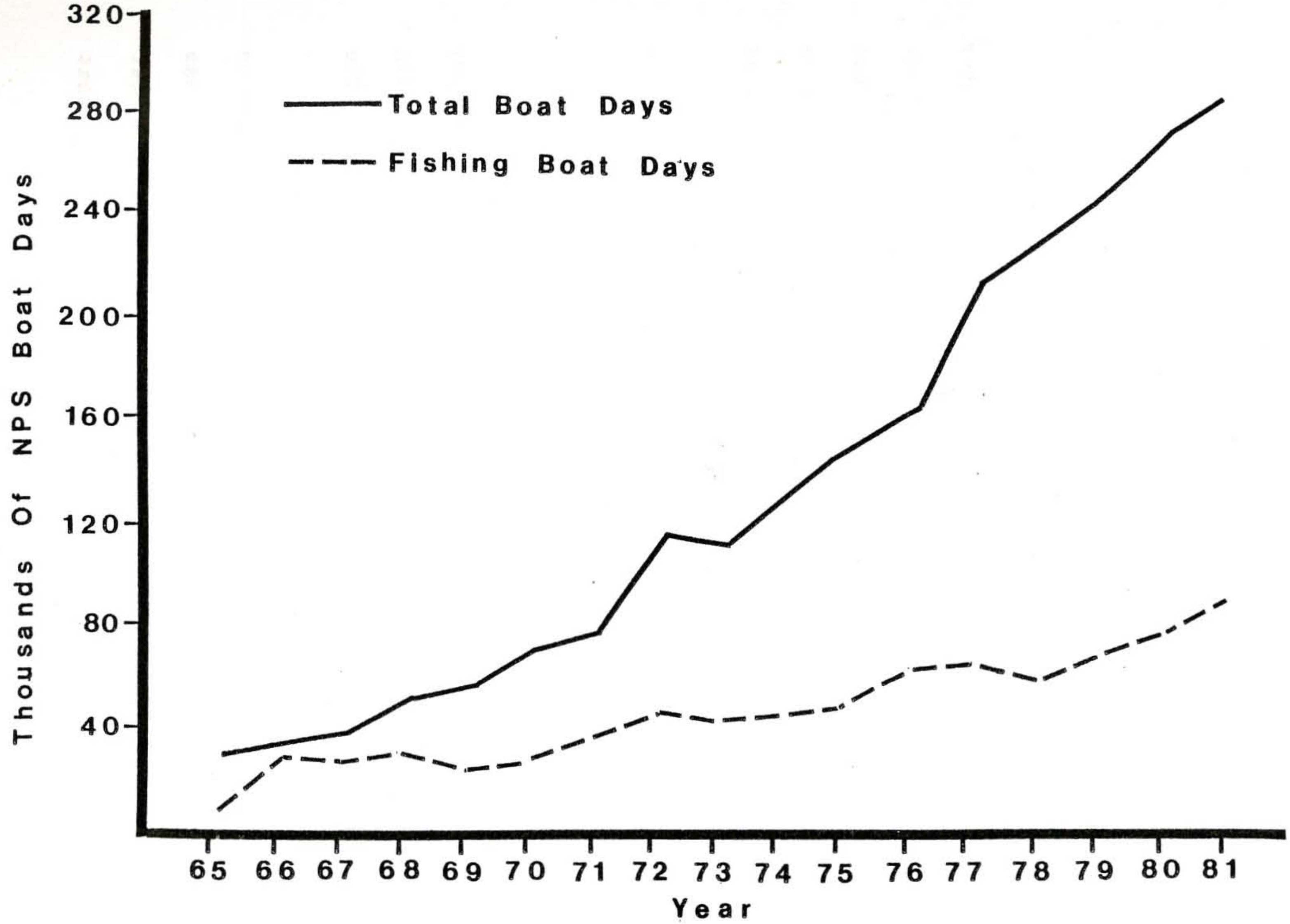


Figure 9. Indices of total recreational boat use and angling pressure, 1965-1981, Lake Powell.

days, compared to 274,745 boat days in 1980. As in 1980, the Bullfrog access area accounted for the highest angler use (40%) of the four major access points. The trend of increasing use at Lake Powell continued, despite the rising cost of fuel.

Most angling pressure during the spring (April-June) was directed at largemouth bass (Micropterus salmoides) and black crappie (Pomoxis nigromaculatus) (Table 1). During the summer and early fall (July-September), striped bass (Morone saxatilis) and indiscriminant angling gained in importance (Table 2).

Catch rates (fish/angler hour) for largemouth bass, black crappie and all species totaled was down slightly from 1980 (Figure 10). The best fishing for largemouth bass and black crappie in 1981 was in the upper reservoir (Hite), while walleye (Stizostedion vitreum) and striped bass fishing was better on the lower end of the reservoir (Wahweap), as indicated in Table 3.

Angler success for walleye continued to increase throughout the reservoir. The overall catch rate (0.030 fish/angler hour) represents a two fold increase over 1980. Walleye contribute to the sport fishery largely over a three month period (May-July) (Tables 4 and 5). As black crappie and largemough bass fishing began to decline, walleye catchability increased, extending the length of the sport fishing season.

The sport fishery harvest of striped bass also increased in 1981. The overall catch rate for the six census months was 0.021 fish per angler hour (Table 3). Striped bass anglers were most successful in late summer (August-September) when the fish were caught trolling or

Table 1. Species sought (%) by anglers, Lake Powell, April-June 1981.

Species	Wahweap	Bullfrog	Hall's	Hite	Total
Any	20.1	30.7	8.7	22.3	20.1
Largemouth bass	52.9	35.5	44.9	43.4	46.4
Black crappie	9.3	22.3	33.6	31.1	20.4
Striped bass	10.8	5.9	7.8	0.0	7.5
Walleye	4.7	2.8	4.0	0.4	3.6
Channel catfish	1.5	1.7	0.9	2.8	1.6
Rainbow trout	0.6	1.0	0.0	0.0	0.5

Table 2. Species sought (%) by anglers, Lake Powell, July-September 1981.

Species	Wahweap	Bullfrog	Hall's	Hite	Total
Any	38.7	43.0	37.5	37.8	39.2
Largemouth bass	17.9	39.5	38.6	50.0	28.8
Black crappie	0.3	2.6	2.3	8.1	2.0
Striped bass	39.9	7.9	10.2	2.7	25.2
Walleye	1.5	5.3	8.0	0.0	2.9
Channel catfish	1.8	1.8	2.3	1.4	1.8
Rainbow trout	0.0	0.0	1.1	0.0	0.2

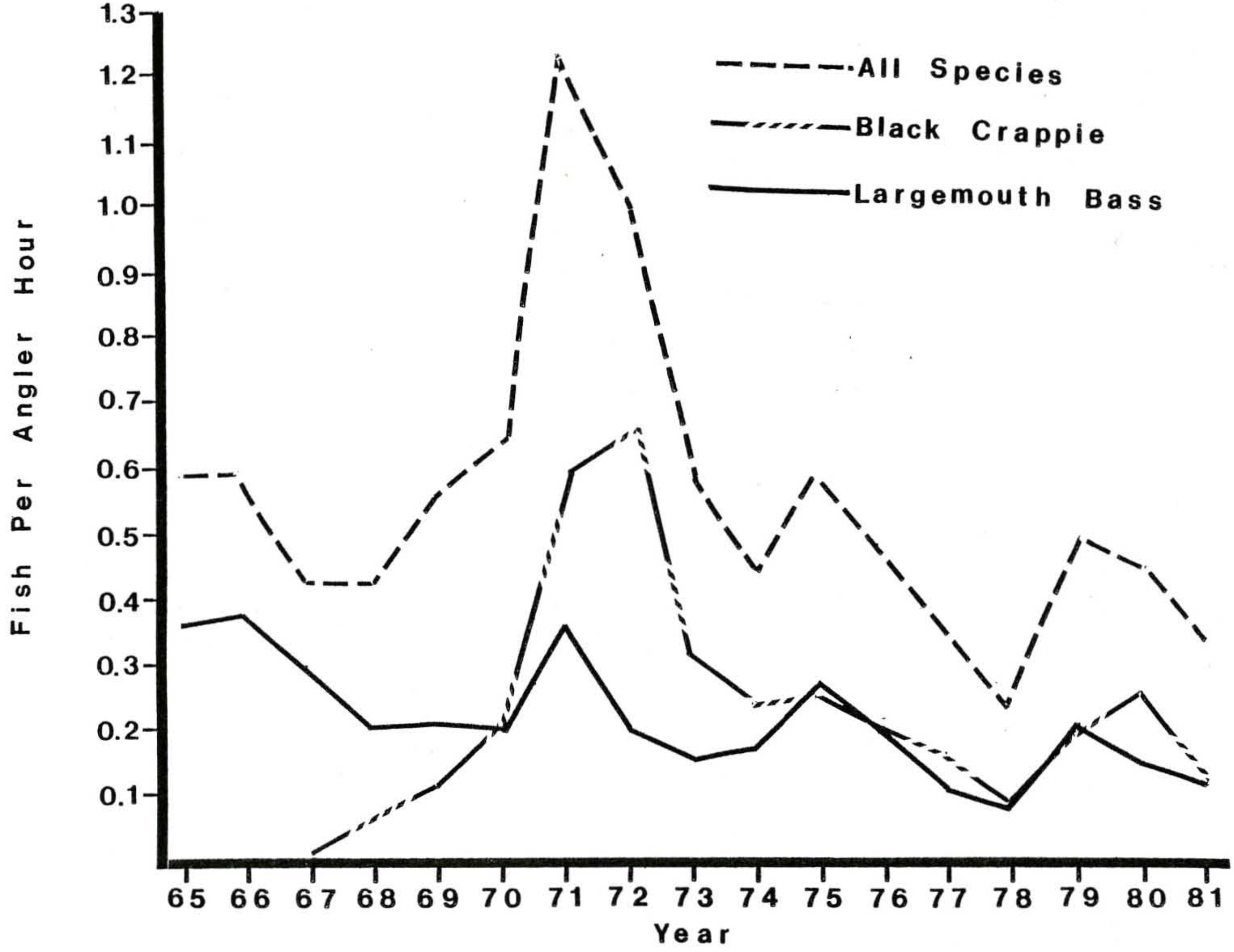


Figure 10. Catch rates (fish/angler hour) for largemouth bass, black crappie and all species during the months of April-June 1965-81, Lake Powell.

Table 3. Sport fishery catch rates (fish/angler hour) by species and access area, Lake Powell, April-September 1981.

Species	Wahweap	Bullfrog	Hall's	Hite	Mean[a]
Largemouth bass	0.109	0.120	0.124	0.210	0.127
Black crappie	0.086	0.084	0.083	0.227	0.103
Walleye	0.044	0.024	0.017	0.004	0.030
Striped bass	0.034	0.009	0.007	0.005	0.021
Channel catfish	0.028	0.032	0.030	0.035	0.030
Bluegill	0.014	0.016	0.049	0.043	0.025
Rainbow trout	t[b]	t	0.000	0.000	t
Other species	0.000	0.004	0.003	0.002	0.001
All species	0.315	0.289	0.313	0.526	0.337

[a]Mean = total fish divided by total angler hours.

[b]t = less than 0.001 fish/angler hour.

Table 4. Species composition (%) of the total recorded creel for anglers interviewed at Wahweap, April-September 1981.

Species	Apr	May	Jun	Jul	Aug	Sep
Largemouth bass	31.1	41.2	32.5	31.2	17.4	37.3
Black crappie	59.2	17.3	9.8	1.8	0.0	2.9
Walleye	3.2	22.4	34.0	13.8	2.9	2.0
Striped bass	1.7	4.3	12.8	20.2	53.6	30.4
Channel catfish	2.3	7.8	9.1	26.6	20.3	22.5
Bluegill	2.1	6.6	1.1	6.4	5.8	4.9
Rainbow trout	0.2	0.1	0.0	0.0	0.0	0.0
Other	0.3	0.3	0.8	0.0	0.0	0.0

Table 5. Species composition (%) of the total recorded creel for anglers interviewed at Bullfrog, Hall's Crossing and Hite, April-September 1981.

Species	Apr	May	Jun	Jul	Aug	Sep
Largemouth bass	25.7	45.5	37.4	61.1	37.3	67.2
Black crappie	70.4	22.2	13.2	1.7	6.8	13.8
Walleye	0.5	1.2	16.9	18.4	3.0	1.6
Striped bass	0.0	1.6	4.1	4.3	4.6	3.5
Channel catfish	1.1	11.0	20.9	9.4	9.5	11.3
Bluegill	1.9	16.4	6.6	5.1	38.8	2.6
Rainbow trout	0.0	0.1	0.0	0.0	0.0	0.0
Other	0.4	2.0	0.9	0.0	0.0	0.0

casting to surface feeding schools. Although striped bass were caught reservoir-wide, catch rates were higher in the Wahweap area. Higher success on the lower end of the reservoir was due to a larger number of anglers pursuing striped bass there (Tables 1 and 2) and a larger population of striped bass. The harvest of striped bass should continue to increase in the future as the population expands and anglers become more knowledgeable of striped bass habits.

Recommendations

Creel census should be conducted from April through October 1982. Methods should be consistent with those used in 1981. Special effort should be made to obtain scales, and total length and weight from all striped bass creeled. These data will provide information on the contribution of naturally reproduced fish to the creel. In addition, a sample of total length measurements will be taken from creeled largemouth bass and black crappie to determine at what size and age they become acceptable to the angler.

INDEX TO ANNUAL FISH POPULATION TRENDS

JOB III

Annual Netting

Methods

Methods employed for the standardized Lake Powell gill netting in the spring are described in Gustaveson et al. 1980. As usual, four stations were sampled in 1981 during the first two weeks in March, employing 30 net days per station.

A sample of walleye and largemouth bass was used to quantify fish condition according to the visceral fat index (VFI) used by the Utah Division of Wildlife Resources.

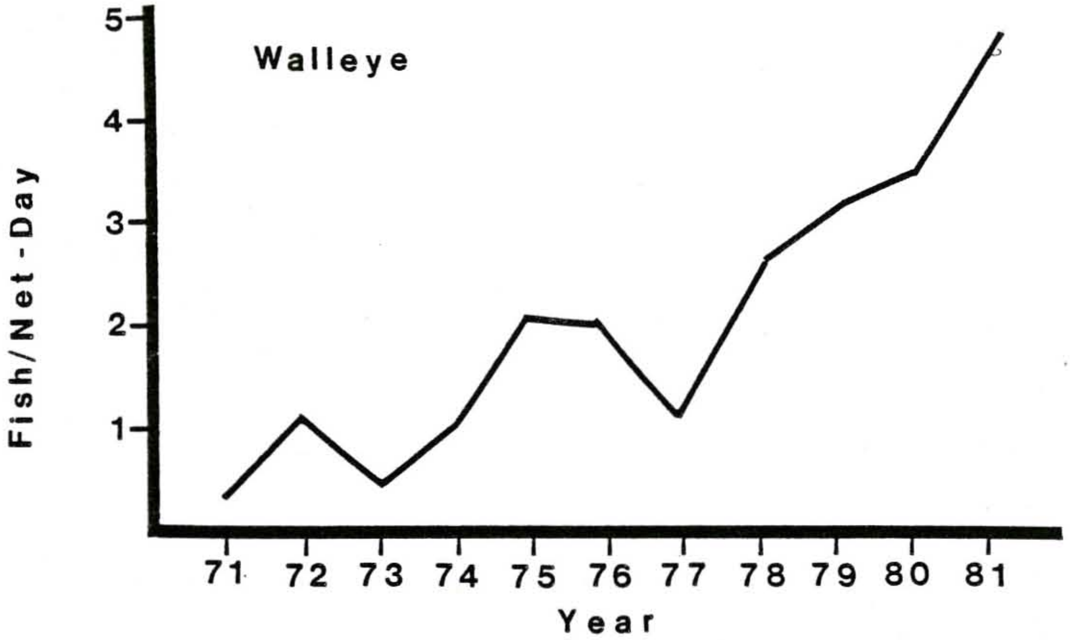
Results and Discussion

A total of 920 fish was collected in 119 net days during the annual spring netting. The highest catch rates (11 fish/net day) were recorded at Good Hope Bay and Rincon, followed by Padre Bay and the San Juan (Table 6). The majority (83%) of the catch consisted of walleye (65%) and largemouth bass (18%). Walleye continued to show an increasing trend, while the catch rate of largemouth bass continued to decline (Figure 11). The mean catch rate of walleye increased by more than one

Table 6. Catch rate (fish/net day) during annual gill netting, Lake Powell, March 1981.

Species	Padre Bay	San Juan	Rincon	Good Hope Bay	Total[a]	% of Catch
Largemouth bass	0.14	0.57	2.30	2.60	1.41	18.3
Walleye	5.34	1.07	6.90	6.67	4.99	64.6
Black crappie	0.00	0.47	0.00	0.17	0.16	2.1
Bluegill	0.00	0.03	0.07	0.10	0.05	0.7
Green sunfish	0.03	0.10	0.07	0.07	0.07	0.9
Channel catfish	0.10	0.10	0.43	0.03	0.17	2.2
Carp	1.03	0.27	0.67	0.23	0.55	7.1
Flannelmouth sucker	0.07	0.00	0.03	0.07	0.04	0.5
Rainbow trout	0.00	0.00	0.03	0.00	0.01	0.1
Brown trout	0.00	0.00	0.03	0.00	0.01	0.1
Striped bass	0.00	0.00	0.20	0.77	0.24	3.2
Yellow bullhead	0.00	0.03	0.03	0.07	0.03	0.4
Total	6.72	2.63	10.77	10.77	7.73	---

[a]Total number of fish divided by total net days.



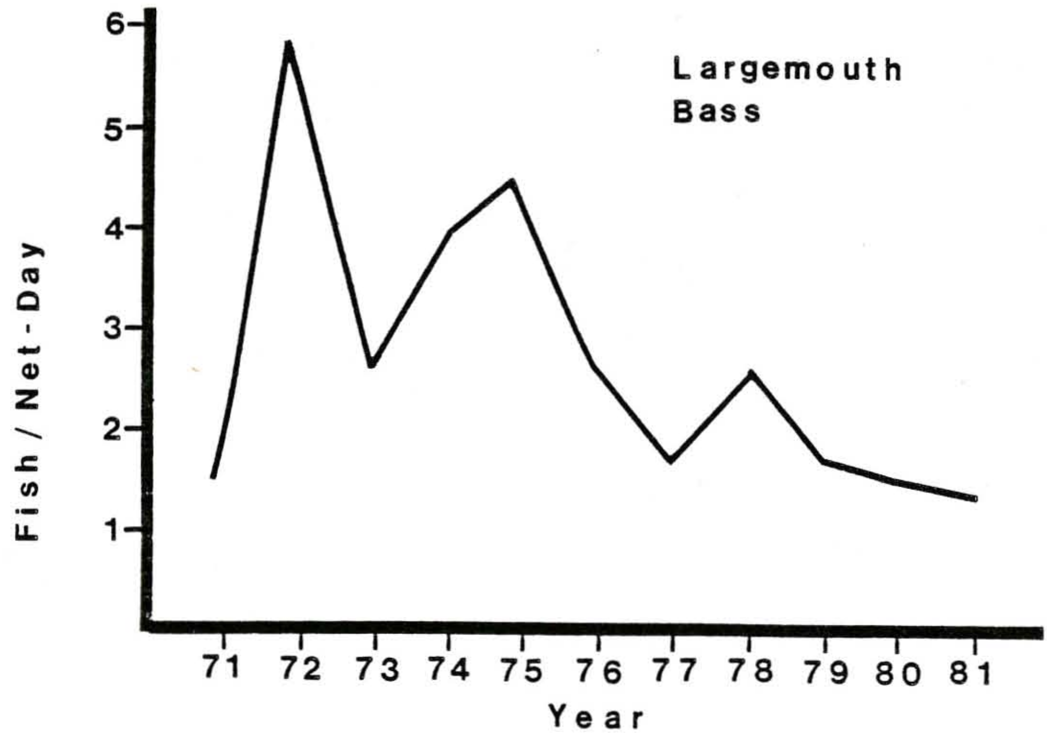


Figure 11. Catch rates (fish/net day) for walleye and largemouth bass from annual netting, 1971-81, Lake Powell.

fish per net day from that of 1980. The overall catch rate for largemouth bass was the lowest recorded since the annual netting program was initiated. Striped bass accounted for over 3% of the catch, which was the highest incidence yet recorded for this species. Other species collected were only occasionally caught and showed no changes from past collections.

Walleye collected at all stations were in excellent condition, with the only exception being those caught in Padre Bay, which showed slightly lower VFI values (Table 7). This may be due to the lower forage base (threadfin shad) observed at the lower end of the lake (see Job I). Largemouth bass were in generally good condition and showed no major differences between lake areas (Table 8).

Recommendations

Continue the annual netting program for fish population trend data during the month of March. Also, continue to monitor fish condition at the time of annual netting through the use of the visceral fat index.

Table 7. Percent of total sample occurring in each category of the visceral fat index[a] for walleye collected by gill netting during March 1981, Lake Powell.

Location	Visceral Fat Index Category 0	1	2	3	4	
Good Hope Bay	0	0	10	29	61	(n = 31)
Rincon	2	0	5	20	73	(n = 40)
San Juan	0	0	10	39	51	(n = 31)
Padre Bay	0	42	30	28	0	(n = 43)

[a]Internal body fat present:

0 - None.

1 - Little, less than 50% of each caecum is covered.

2 - Approximately 50% of the caecum is covered.

3 - More than 50% of each caecum is covered.

4 - Pyloric caeca are completely covered with fat.

Table 8. Percent of total sample occurring in each category of the visceral fat index for largemouth bass collected by gill netting during March 1981, Lake Powell.

Location	Visceral Fat Index Category 0	1	2	3	4	
Good Hope Bay	0	3	23	67	7	(n = 30)
Rincon	2	15	35	48	0	(n = 40)
San Juan Arm	0	12	71	17	0	(n = 17)

Electrofishing

Methods

Electrofishing procedures were similar to those described by Gustaveson et al. 1980, with the exception of a new electroshocking unit. The Coffelt Model RF-10 was replaced with a Coffelt Model VVP-15 d.c. pulsator. The output to the positive array was 12-15 a. and 220-240 v. d.c., with a pulse rate of 80 per second. Sampling stations were altered somewhat from previous years to conform more closely with the spring gill-netting sites. The transects at Knowles Canyon and North Wash were replaced by transects at Good Hope Bay and the San Juan Arm (Figure 12). Five stations were sampled for two nights each. The index of abundance for the species collected at each location was mean catch rate (fish/hour of electrofishing) for two nights of sampling.

Results and Discussion

A total of 2,273 fish was collected during 9 nights of electrofishing at five shoreline stations. Mean catch rates for all species were highest at Hall's Creek Bay and Stanton Creek, followed by Rincon, San Juan and Good Hope Bay (Table 9). Bluegill (*Lepomis macrochirus*) and green sunfish (*Lepomis cyanellus*) accounted for over 83% of the total catch. Catch rates for y-o-y largemouth bass and black crappie were the lowest recorded since 1978, suggesting a weak 1981 year class for both species (Figure 12). Poor recruitment was probably due to low spring runoff and a declining water level, which limited nursery areas and escape cover. Strong year classes of largemouth bass and

Table 9. Mean catch rate (fish/hour) of fish collected by electrofishing, Lake Powell, 28 August - 6 September 1981.

Species	Good Hope Bay	Hall's Creek Bay	Stanton Creek	Rincon	San Juan	% of Total Catch
Young-of-the-year largemouth bass	12	21	57	9	7	6.3
Age I and older largemouth bass	1	8	13	5	7	1.9
Young-of-the-year black crappie	0	4	2	1	0	0.3
Young-of-the-year striped bass	71	4	7	1	1	5.4
Channel catfish	9	7	14	7	7	2.6
Green sunfish	57	183	138	151	157	39.3
Bluegill	47	268	251	144	89	43.9
Red shiner	3	1	0	0	0	0.2
Yellow bullhead	0	0	0	1	0	a
All species[b]	199	496	483	317	269	--

[a]Less than 0.1%.

[b]Total fish divided by total hours of electrofishing.

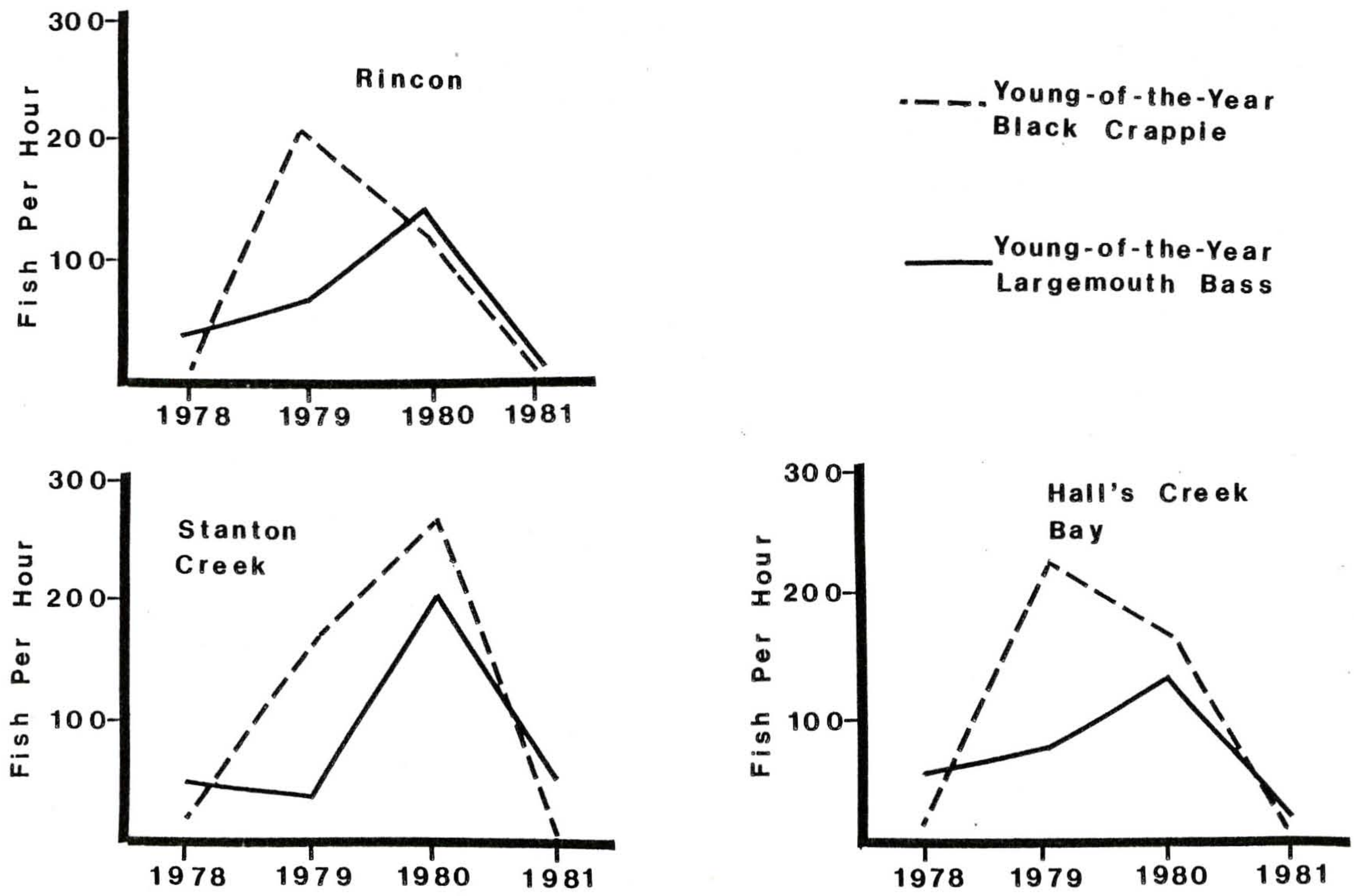


Figure 12. Mean number of young-of-the-year largemouth bass and black crappie collected/hour of electrofishing during August-September, 1978-81, Lake Powell.

black crappie in 1979 and 1980 should dampen the effect that low 1981 production might have on the future sport fishery harvest. Another noticeable change from past years was the presence of y-o-y striped bass at every location. Striped bass made up 5.4% of the total catch and were the most frequently occurring fish at the Good Hope Bay station (Table 9). Electrofishing data indicate a strong 1981 striped bass year class (see Job IV).

As in the past, large schools of adult threadfin shad were encountered at all stations, but were not quantitatively sampled.

Recommendations

Continue annual electrofishing during August - September 1982. Maintain 1981 sampling stations, which coincide with the spring annual netting sites.

MONITORING OF STRIPED BASS POPULATION DEVELOPMENT

JOB IV

Methods

Biological data were obtained from striped bass taken in gill nets, by angling, electrofishing, seining and during regular creel census interviews. Spawning fish were sampled with 6.4 cm and 7.6 cm square mesh bottom set gill nets that were 61 m long and 1.8 m deep. Nets were generally set overnight and checked after 14 hours.

Stage of maturity of female striped bass was determined during spring sampling by microscopic examination of ova. Maturity stages I-IV (I - immature, II - mature, III - ripe, IV - overripe) were assigned, based on the extent of oil globule development (adapted from Kapke 1978).

Young-of-the-year were collected by standardized trawl sampling (Job I), timed electrofishing (Job III), seining with 9.1 m seines of 0.64 cm square mesh, and with experimental gill nets. Seining activities were limited to shallow sandy beach areas where water clarity was less than 60 cm. Seining areas were further limited due to the steep, rocky nature of the shoreline and the high water clarity of Lake Powell. Seine avoidance by striped bass appeared to be greatest when clarity was high.

A complement of five large mesh and five small mesh experimental gill nets, fished for two consecutive sets totaling 40 hours (two nights and one day) at each of four stations, constituted the standardized fall gill netting. Nets were set in similar habitat at each station; off long, gradually sloping, rock and rubble points of land. Small mesh experimental gill nets were 27.4 m long by 1.8 m deep, with three 9.1 m panels of 1.3, 1.9, and 2.5 cm square mesh. Large mesh experimental gill nets were 30.5 m long by 1.8 m deep, with four panels of 2.5, 3.8, 5.1, and 7.6 cm square mesh.

Results and Discussion

Striped bass spawning was studied intensively in the Colorado River. For the second consecutive year, a team from the Utah Cooperative Fishery Research Unit, and personnel from the Utah Division of Wildlife Resources collected data in the Gypsum Canyon area for the duration of the spawning season. The study findings, reported by Persons et al. (1981), showed that average gill net catch rate of striped bass was 1.5 times greater in 1981 than in 1980. Stocking records indicated the potential broodstock (age 4+ fish) was 1.7 times greater in 1981. Spawning began earlier in 1981 due to lower runoff and milder weather which resulted in suitable spawning temperatures (16° C) at an earlier data. A spent female was captured when sampling began on 26 May 1981. Spent females did not appear until 11 June 1980, when water temperatures first reached 16° C. The exact spawning location was undetermined but probably was near Gypsum Canyon, based on the following data from the Gypsum area: the ratio of male to female striped bass captured (2.3:1); the capture of males before females; and the collection of spent fish and striped bass eggs in that area. Striped bass were not captured in collection gear set upstream from the steep, narrow gorge known as Cataract Canyon which contains 23 major rapids in the 19.3 km of canyon between Spanish Bottoms and Gypsum Canyon. It is assumed that striped bass do not ascend the Colorado River above Cataract and that spawning occurs somewhere within the canyon (Persons et al. 1981).

Unlike 1980, striped bass were not collected in the San Juan River in 1981. Lower lake levels and very low runoff created a barrier that reduced the chances of striped bass spawning in the river. A sand bar extended across the river at the site of last year's mixing zone. A narrow channel was located at one side of the sand bar, but it persisted only 200 m before giving way to a uniform sand bottom 1.5 cm deep from bank to bank. Mature striped bass were concentrated in Piute Farms Bay, downstream from the barrier, apparently for spawning purposes. Two days of sampling produced 40 striped bass with a 1:1 sex ratio. Although mature males were running ripe, mature females varied from maturity stage I-II. No ripe or spent females were collected, even though the early May surface water temperatures were 21° C in the river and 23° C in the bay.

The recurring aggregation of prespawning striped bass again appeared at Glen Canyon Dam from March through April 1981. Periodic sampling indicated that males began to ripen in mid-April. By the end of April all of the mature males were running ripe. The prespawning aggregation left the staging area at the dam during the first week of

May, presumably to spawn. A small number of moribund and dead adult striped bass were reported in Wahweap Bay and Warm Creek Bay beginning on 12 May 1981. The mortality was assumed to be directly related to spawning stress and appeared to correspond with the onset of spawning throughout the reservoir and in the Colorado River.

On 14 May 1981 a school of spawning striped bass was collected in a gill net set in Warm Creek Bay. Eight fish in various stages of maturity were captured. One ripe female, (stage III), six ripe males and a spent female were taken. Surface water temperature fluctuated between 15.7° and 19.4° C on this date. The fish were caught near shore. The substrate was a steep, rock and rubble slope common to most of the shoreline at Lake Powell. Evidence of spawning within the lower reservoir was also detected in 1979 but assumed to be unsuccessful (Gustaveson et al. 1980).

The success of spawning in the lower reservoir was further investigated with exploratory mid-water trawl sampling (Job I). Forty-one days after the capture of spawning fish, two larval striped bass (18-22 mm) were collected in Warm Creek Bay. The collection was significant because these fish were over 290 km from the Colorado River. By the traditional definition of spawning habitat, the river was the only area where successful spawning should be expected.

The y-o-y striped bass in the lower reservoir, however, could not be explained by recruitment from the tributaries. Bureau of Reclamation studies of the overflow density current, using total dissolved solids (TDS) as an indicator, showed that the overflow created by the weak 1981 spring flood influenced the reservoir from the Colorado River inflow to a point 190 river km above the dam (Pers. Comm, D. Merritt 1981, U.S. Bureau of Reclamation, Denver, CO). The current was then intruded by summer interflow currents and assimilated with the existing lake water (Figure 13). Eggs and larvae spawned in the Colorado River would not be expected to be transported by the overflow current any closer than 190 reservoir km from the dam. The y-o-y found in the lower reservoir were therefore concluded to be the result of in-reservoir spawning. In-reservoir spawning has not been documented in other waters.

Seine sampling was initiated to determine the extent of in-reservoir and river spawning success. Striped bass y-o-y were captured throughout the length of the reservoir (Figure 14). The highest average catch per seine haul was obtained at Wahweap from fish spawned within the reservoir. The next highest catch rate was at Hite, presumably from fish spawned in the Colorado River.

Annual electrofishing sampling for assessment of y-o-y game fish production showed high numbers of striped bass in Good Hope Bay (Job III, Table 9). These fish were presumably the progeny of river spawning striped bass. Striped bass y-o-y were collected at every station sampled in the mid and upper reservoir. The y-o-y collected at the San Juan station were the first naturally reproduced striped bass collected in the San Juan Arm of Lake Powell. These fish were apparently the result of in-reservoir spawning, in view of the spawning barrier guarding the entrance to the San Juan River this year.

A fall gill net survey was conducted in October 1981 to assess the magnitude of the 1981 striped bass year class. The highest catch rate was at the Wahweap station, which indicated that in-reservoir spawning

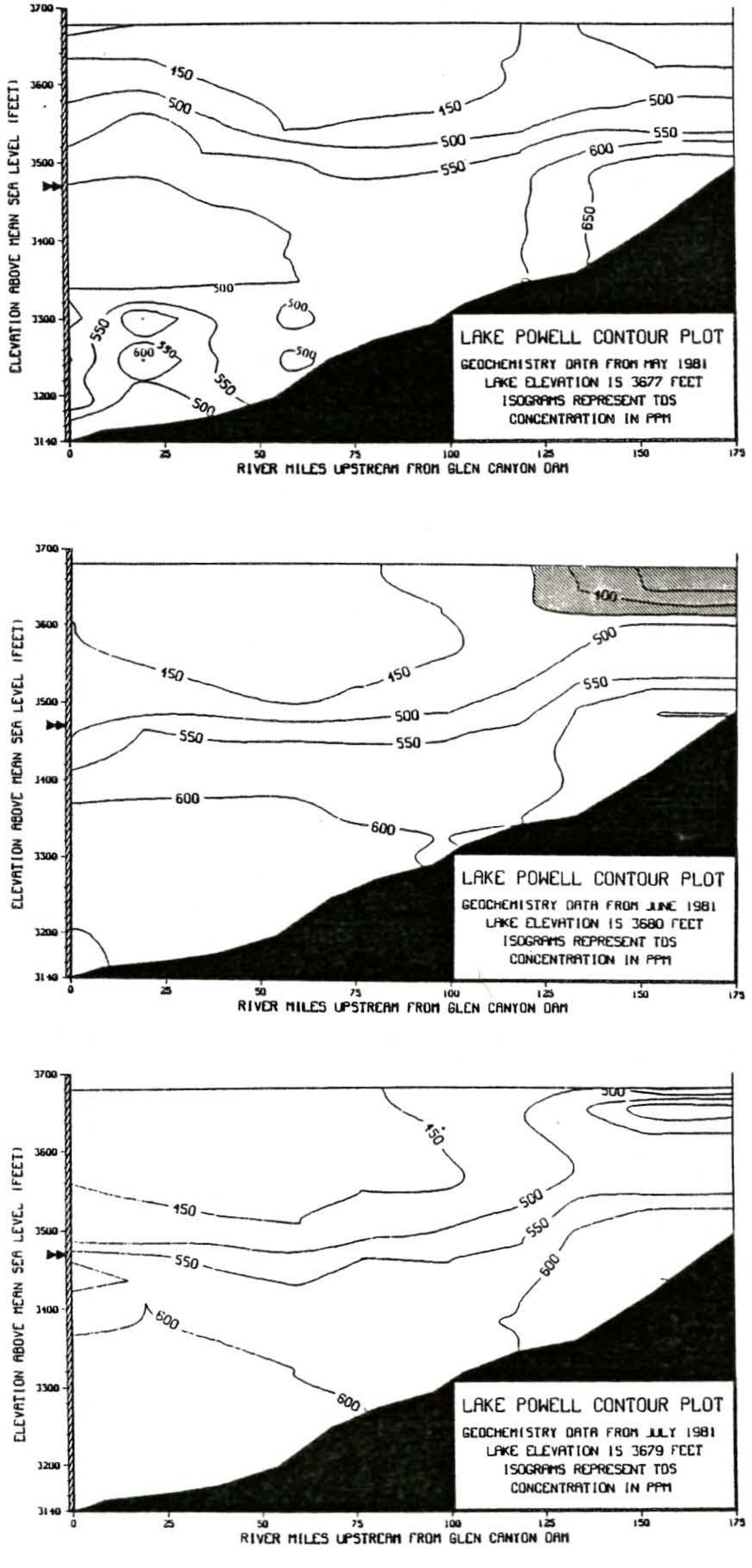


Figure 13. Inflow density current overflow (<450 TDS isogram) from the Colorado River, May, June and July, 1981.

Location	Y-O-Y caught/ seine haul
1. Wahweap	7.0
2. Warm Creek	1.17
3. Navajo Canyon	1.75
4. The Rincon	4.5
5. Bullfrog Bay	0.25
6. Hite	5.5
7. Imperial to Gypsum Canyons	0

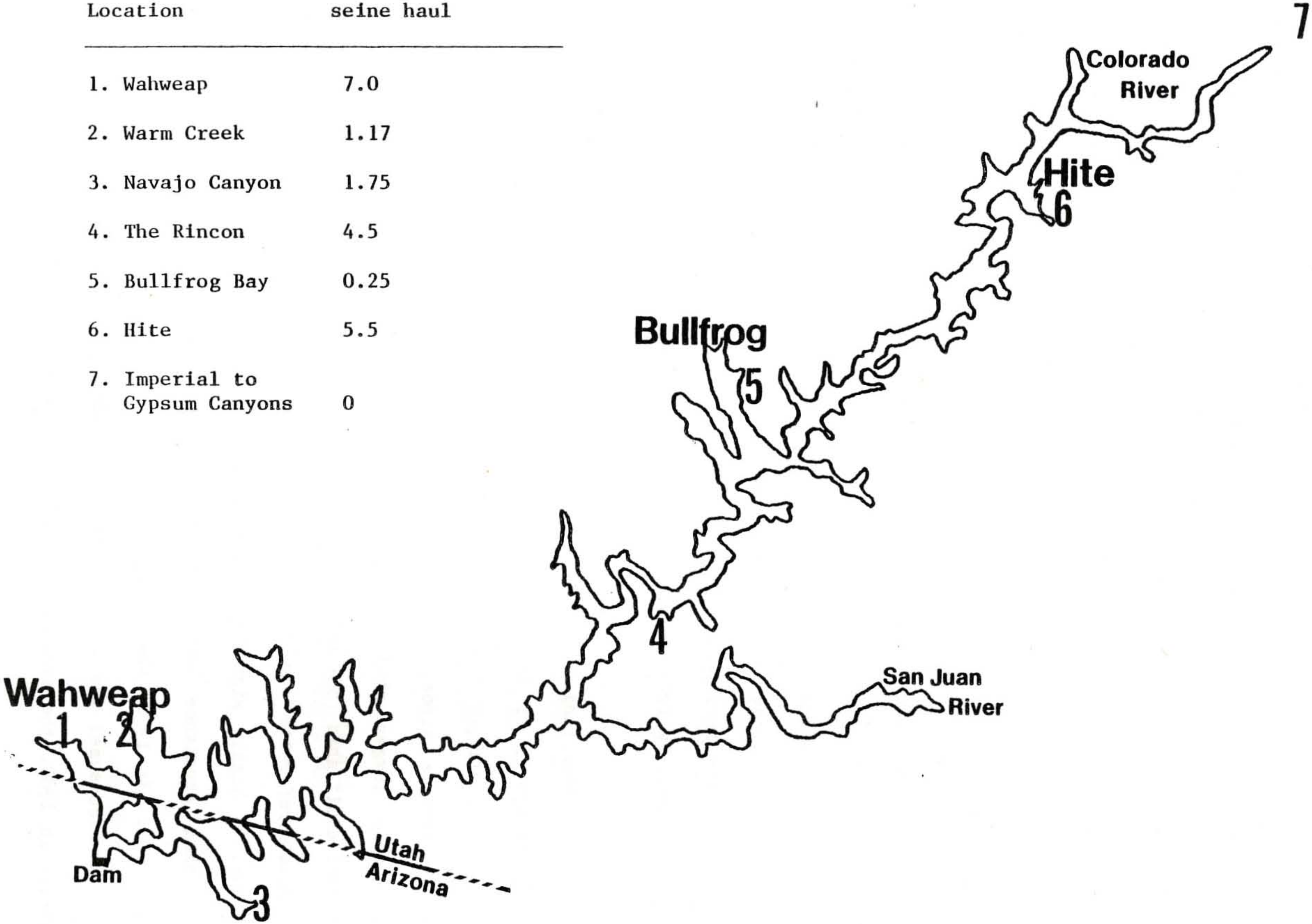


Figure 14. Results of exploratory seining for age 0 striped bass in Lake Powell, July 1981. Numbers on the map correspond to location numbers in the upper left hand corner.

may be more significant than recruitment from tributary spawning (Table 10). The second highest catch rate was in Good Hope Bay on the opposite end of the reservoir. Striped bass y-o-y were captured at the mid-lake stations, Rincon and San Juan, but in lower numbers than at the stations on the extreme ends of the reservoir. A comparison of standardized netting catch rates showed y-o-y striped bass produced in 1981 to be a strong year class. Numbers were similar to production in Santee-Cooper reservoir, the oldest and one of the best inland striped bass fisheries in North America. Relative abundance of y-o-y striped bass generally exceeds that produced from stocking striped bass at the rate of 10-15 fish per acre (Table 10). The y-o-y grew at rates similar to those reported last year (Gustaveson et al. 1981), with average TL of fish caught ranging from 199.78 mm at Wahweap to 289.86 mm at Good Hope Bay.

Striped bass food habits data suggests a trend toward an increase in the average TL of threadfin shad consumed with an increase in the average TL of striped bass (Figure 15). From a sample of 370 striped bass of various sizes, larger striped bass preferentially consumed increasingly larger shad. Striped bass in excess of 400 mm (TL) preferred adult shad (50+ mm).

Size preference was not a limiting factor on the size of shad consumed. A highly significant negative correlation was shown between y-o-y shad abundance and size of shad consumed by striped bass (Figure 16). In 1978, when y-o-y shad were most abundant, the average TL of shad consumed was 45 mm (juvenile). When young shad were least abundant in 1980, the average size of shad consumed was 70 mm (adult).

Table 10. Comparison of young-of-the-year striped bass caught using standardized gill-net techniques, Lake Powell, 1981.

State	Lake	C/U[a]	Stocking rate/acre
UT/AZ	Lake Powell (present study)		Natural reproduction
	Good Hope Bay	4.11	
	Rincon	0.58	
	San Juan (Neskahi Cyn)	0.31	
	Wahweap	6.53	
	Lake average	2.88	
UT/AZ	Lake Powell (1980)		Natural reproduction
	Good Hope Bay	1.26	
	San Juan (Neskahi Cyn)	0.00	
SC	Santee Cooper	3.19	Natural reproduction
VA	Kerr	0.30	Natural reproduction
VA	Claytor	0.10	10.01
VA	Smith Mountain	0.24	15.34
TX	Spence	4.29	10.10
TX	Granbury	0.90	10.00
TX	Mayse	1.90	10.00
TX	Whitney	1.70	10.00

[a]C/U= striped bass/1,000 sq ft of gill net/12 hr, standard method, AFS Striped Bass Committee, after McCloskey 1980.

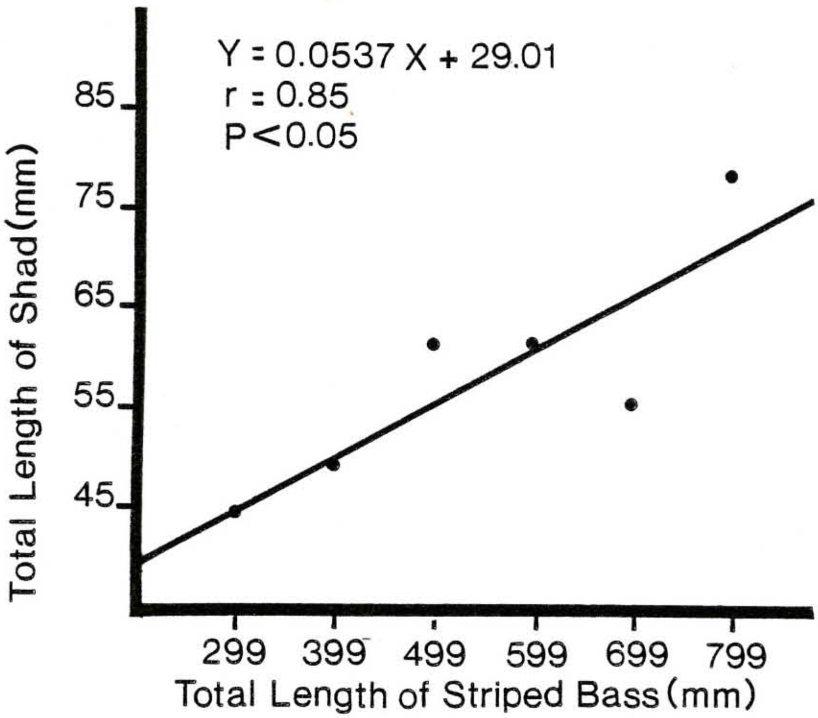


Figure 15. Linear correlation between total length of striped bass and mean total length of threadfin shad consumed, Lake Powell, 1975-1981.

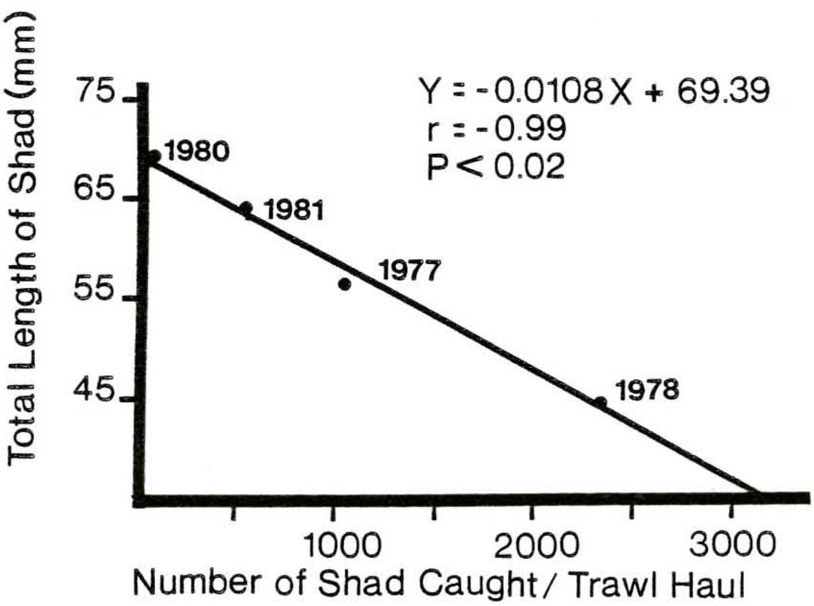


Figure 16. Mean total length of threadfin shad found in striped bass stomachs related to peak numbers of young-of-the-year threadfin shad collected in mid-water trawl collections, Lake Powell.

To some extent, this negative relationship may reflect the increased average size of striped bass in recent years. Relative abundance of shad, however, appears to be more important in determining size of shad consumed than does size selectivity of foraging striped bass. Striped bass will consume any size shad available but if a size range of shad is available, larger fish will apparently select larger shad.

Recommendations

Study the various Lake Powell spawning populations of striped bass with emphasis on determining trends in broodfish abundance by spawning area. Broodfish not sacrificed should be tagged to determine long range movement and migration within the reservoir.

Investigate the mechanism that allows in-reservoir spawning in Lake Powell. Attempt to locate spawning fish and determine if their eggs are suspending in the water column or settling on the substrate prior to hatching.

Determine the presence and distribution of y-o-y striped bass with trawl, seine and electrofishing equipment. Continue to base year class magnitude and trends on results of standardized fall gill-net sampling.

Continue to collect food habits, and age and growth data, especially from larger fish (age 6+). Data will be used to predict the nature of the striped bass fishery that can be expected in the coming years at Lake Powell, particularly the potential of the fishery to produce large striped bass (>5 kg) considering the present forage base composition.

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