FISHES OF UTAH LAKE

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ABSTRACT.— There has been a drastic change in fish populations inhabiting Utah Lake during the last 100 years. When the pioneers first entered Utah Valley they found a well-established cutthroat trout population in Utah Lake and in the tributaries flowing into the lake. After intensive agricultural and industrial development this salmonid disappeared, and carp, white bass, and black bullhead are the common species today. The known history of the Utah Lake fisheries is summarized. Through proper management it is possible to establish a sport fishery of the common fish species currently in the Lake, including walleye, channel catfish, and largemouth bass. The ichthyofauna of Utah Lake may be an underrated natural resource. Today, no native sport fishery exists in Utah Lake, although sportsmen are harvesting introduced species. Utah Lake has a dynamic fishery that must be continually monitored and managed if it is remain productive.

The ichthyofauna of Utah Lake has experienced drastic changes since the white man entered Utah Valley to colonize the agricultural lands. This lake, which once had a wealth of trout, suckers, and minnows, now contains carp, white bass, and black bullheads. Proper management of the sport fish and commercially important fish is of primary concern to district fishery biologists.

Utah Lake is a warm, shallow, eutrophic body of water in Utah County, Utah, which may be the most underrated natural resource for fishes in the state. The fishes currently in Utah Lake could be an important source of needed protein for human consumption in the near future.

The native fishes once associated with the lake are the cutthroat trout, mountain whitefish, Utah chub, leatherside chub, least chub, longnose dace, Utah sucker, webug sucker, June sucker, mountain sucker, mottled sculpin (Bonneville), and Utah Lake sculpin (Tables 1,3). Included are 4 families, 9 genera, 12 species, and 2 subspecies. There has been a drastic change in the ichthyofauna since man settled Utah valley.

Accounts of the early history of Utah indicate that Utah Lake was a productive,

TABLE 1. Utah Lake fish species in order of decreasing abundance as shown by gill net catches in 1958 and 1970.

Order	1958	1970
1	Carp	White bass
2	Utah chub	Black bullhead
3	Channel catfish	Carp
4	Perch	Walleye
5	Utah sucker	Channel catfish
6	Black bullhead	Utah sucker
7	Walleye	
8	White bass	

TABLE 2. Pesticides and mercury in fish taken from Utah Lake in ppm (wet muscle tissue measure) (Smith 1973).

	Mean	Range
Mercury		
Carp and bullhead	0.152	0.030–0.470
White bass[1]	0.050	
Dieldrin		
Carp	0.012	0.000–0.023
Bullhead	0.007	0.004–0.010
White bass[1]	0.011	
p,p'-DDT		
Carp	0.011	0.000–0.036
Bullhead	0.012	0.003–0.020
White bass[1]	0.021	
p,p'DDE		
Carp	0.020	0.000–0.056
Bullhead	0.007	0.000–0.013
White bass[1]	0.056	
PCB's		
Carp	0.115	0.000–0.200
Bullhead	0.100	0.100–0.100
White bass[1]	0.180	

[1]Analysis by WARF Research Institute, Madison, Wisconsin in November 1970.

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beautiful lake teeming with native cutthroat trout weighing 15 to 16 pounds. Since the Mormon settlers entered Utah Valley in the early 1850s there has been a steady decline in the quality of fisheries. The once abundant native cutthroat trout is now extinct and the large number of suckers that once existed are on the decline. Introduced species are now the most common fish in the lake (Tables 1 and 4). The major causes of the decline of the fisheries in Utah Lake include extensive commercial fisheries, water manipulation, agricultural practices, and pollution. Diversion and blocking of the feeder streams to Utah Lake reduced access to spawning areas used by the cutthroat trout and the suckers. Fluctuations in the water level, and water quality, poor agricultural practices, and increased sewage effluent reduced the water quality for the feeder streams and in Utah Lake. The introduction of exotic fish species caused extensive competition with the native fish stock. Carp became one of the most abundant fish, and their activities contribute greatly to the high turbidity of the lake water. The carp are, however, utilized to some extent by a lo-

TABLE 3. Current status of native fishes of Utah Lake.

Fish	Status 1977	Comments
Salmonidae		
Salmo clarki (Bonneville cutthroat trout)	Lake form extinct, river form hybridized	Common to west side Wasatch Mountains. Probably two races: a large lake dweller and a river dweller. Grew to 18 pounds in the lake.
Prosopium williamsoni (Mountain whitefish)	Rare in lower Provo River	Probably entered river deltas in the lake. Was common in early commercial fishery; called mountain herring.
Cyprinidae		
Gila atraria (Utah chub)	Very rare	Common in lake until early 1960s. Probably eliminated by introduced walleyes and white bass.
Iotichthys phlegethontis (Least chub)	Extinct	Few still found in Kamas Valley-Provo River and other areas in Utah. Habitat loss in lake.
Gila copei (Leatherside chub)	Extinct	Some in Kamas Valley-Provo River and other areas in Utah.
Rhinichthyes cataractae (Longnose dace)	Rare	Few in Current Creek south tributary, Utah Lake. Common in other streams in Utah.
Catostomidae		
Catostomus ardens (Utah sucker)	Rare-common	Once very common in Utah Lake and inlet streams. Filled rivers with spawners in spring.
Catostomus fecundus (Webug sucker)	Rare	May be hybrid between June and Utah sucker. Widely distributed in lake.
Chasmistes liorus (June sucker)	Rare-extinct	Once very abundant, now near extinction. Probable plankton feeder; terminal mouth.
Catostomus playtrhynchus (Mountain sucker)	Few, status unknown	Inlet streams of Utah Lake, never ventured far into lake.
Cottidae		
Cottus bairdi semiscaber (Bonneville mottled sculpin)	Many	Provo River and other inlet streams.
Cottus echinatus (Utah Lake sculpin)	Rare, none collected since 1930s	Small spring inlet streams originating in Utah Valley. Common in Bonneville sediments where fish fossils found.

TABLE 4. Fish introductions in Utah Lake and its tributaries, 1880–1974.

Family, accepted common name	Date, number introduced	location	Fate
Clupeidae			
American shad	1887 (2,000,000 fry),	Utah Lake	1889; 1¾ lb shad.
	1888 (2,000,000 fry)	Utah Lake	For sale—soon died out.
Salmonidae			
Silver salmon	1927 (325,000 fry)	Utah Lake	Died out.
Rainbow trout	1894, 1900	Provo River	Probably sustained in Provo River
Brown trout	Prior 1900, planted regularly by 1910.	Provo River, most inlet streams	Became self-sustaining in Provo River.
Lake trout	1894 (100,000 fry),	Unknown	1905 evaluation, no favorable results
	1900 (250,000 fry)	Spring Creek	
	1900 (50,000 fry)	Provo River near Heber, Utah	
Brook trout	1894 (500 12" long)		1905, doing well in Provo River; subsequently died out.
	1895 (1,000 adults)		
	1903–to present—occasional stocking	Most inlet streams	Mostly put and take; some reproductions.
		Up high in inlet streams and lakes	
Lake whitefish	1895 (2,000,000 fry)	Utah Lake	No populations established.
	1919 (2,000,000 fry)	Utah Lake	
	1921 (100,000 fry)	Utah Lake	
Grayling	1899 (30,000 fry)	Inlet streams, Utah Lake	No populations established.
Anguilidae			
American eel	1872	Pond on Jordan River	1874, 1½ lb take near mouth of Provo River.
	1887 (80 up to 18")	Jordan River	1894, few taken up to 30" from Utah Lake; never became established.
Cyprinidae			
Gold fish	1881 (130 adults)	Ponds near Jordan River	Few taken by commercial fishermen each year.
	(47 adults), occasional small releases through 1974	Utah Lake	
Carp	1882 (200 young)	Ponds near Jordan River	Successful; population rapidly expanded until very abundant in Utah Lake and lower inlet streams.
	1883 (?)		
	1886–1903 several thousand	Jordan River	
		Utah Lake	
Golden shiner	1969 (100,000 to 200,000)	Various locations around Utah Lake	May have become established.
Fathead minnow	1969 (100,000 to 200,000)	Various locations around Utah Lake.	Occasional in littoral zone.
Bullhead minnow	1969 (?)	Various locations	Occasional in small inlet streams.

Table 4 continued.

Family, accepted common name	Date, number introduced	location	Fate
Ictaluridae			
Channel catfish	1888	Utah Lake	Has become common in Utah Lake. Reduced in recent years.
	1911	Utah Lake	
	1919	Utah Lake	
	1920	Utah Lake	
Black bullhead	1871	Jordan River	1900, became common in Utah Lake fishery. Very abundant, 1974.
	1873	Jordan River	
	1893 (100 6-15")		
Percidae			
Yellow perch	1890	Utah Lake	1894, present in commercial catches
	1891 (636)	Utah Lake	
	1923	Utah Lake	
	1931	Utah Lake	
	1932	Utah Lake	1934, drought killed many. Occasional catch, 1974.
Walleye	1952 (600,000)	Utah Lake	
	1954 (300,000)	Utah Lake	First spawning runs. Provo River, 1955 or 1956
	1956 (900,000)	Utah Lake	
	1968–1973 (19,907,594)	Lower Provo River Benjamin slough	
Centarchidae			
Smallmouth bass	1912 (160)	Spring Creek	Not established.
	1914 (600)	Spring Lake	Fishery for short time then died out.
Largemouth bass	1890 (mixed sizes)	Utah Lake	1893, bass season opened.
	1891 (1,700 fry)	Utah Lake	1895, 2000 spawners taken for planting elsewhere.
	1894 (100 adults)	Utah Lake	
	1902–1913	Powell slough used as natural hatchery	1902, population down.
	1912 (5,000,000 fry hatched in Powell slough)		1901, commercial seining outlawed; became common along shore.
Green sunfish	1890 (mixed)		Established in stream inlets.
	1930–1949	Various inlet streams and Jordan River	
Bluegill	1890 (mixed)	Various inlet streams and Jordan River	Occasional along shore.
Black crappie	1890	Utah Lake	Unknown but rarely if at all taken.
	1895 (85 adults)		
	1931, 1932, 1933—several thousand young	Mouth of Provo River	1934, drought killed most.
Serranidae			
White bass	1956 (209 mixed)	Utah Lake	Very abundant.

cal commercial fisherman and could become a source of human food in the future. White bass, another introduced species, is also very abundant in the lake. Table 5 lists the current species in Utah Lake and their relative abundance. (The text contains a description of each of the common species currently in Utah Lake.)

TABLE 5. Checklist of the fish species currently found in and near Utah Lake, Utah County, Utah, with information concerning their relative abundance.

Species	Abundance in 1977
Brown trout (*Salmo trutta*)	rare (inlet streams)
Cutthroat trout (*Salmo clarki*)	rare (extinct in Utah Lake)
Rainbow trout (*Salmo gairdneri*	rare (inlet streams)
Carp (*Cyprinius carpio*)	very common
Utah chub (*Gila atraria*)	very rare
Fathead minnow (*Pimephales promelas*)	rare
Golden shiner (*Notemigonus cryspleucas*)	rare
Redside shiner (*Richardsonius balteatus*)	rare
Utah sucker (*Catostomus ardens*)	common-rare
June sucker (*Chasmistes liorus*)	rare-extinct
Webug sucker (*Catostomus fecundus*)	rare
Mountain sucker (*Catostomus platyrhnchus*)	very rare
Channel catfish (*Ictalurus punctatus*)	common
Black bullhead (*Ictalurus melas*)	very common
Mosquitofish (*Gambusia affinis*)	common
White bass (*Morone chrysops*)	very common
Largemouth bass (*Micropterus salmoides*)	common
Green sunfish (*Lepomis cyanellus*)	common
Bluegill (*Lepomis macrochirus*)	common
Yellow perch (*Perca flavescens*)	rare
Walleye (*Stizostedion vitreum*)	common
Mottled sculpin (*Cottus bairdi*)	rare

To date 25 species of fish have been introduced into Utah Lake (Popov 1949). Thirteen of these introductions were successful and 11 failed (Table 4). The carp, white bass, black bullhead, channel catfish, and walleye have been the most successful. The status of the golden shiner and the fathead minnow is unknown, but it is hoped that these two minnow species will provide a forage fish for the larger piscivorous fish such as the walleye and largemouth bass.

Today, no native sport fishery exists in Utah Lake. The fish species utilized by the sportsmen are all introduced. The most widely fished-for species are the channel catfish, black bullhead, walleye, and white bass.

The walleye fishery appears to be stabilized with annual stockings of sac-fry to supplement the natural spawn. There is substantial fishing pressure for this species, particularly in the early spring during their spawning period. The number of walleye collected in nets and caught by fishermen increased in 1970 over that in 1958, a fact that shows the beginning of an established walleye fishery in the lake.

A brief annotated history of the fisheries of Uah Lake prior to 1849 on to 1974 is found in Table 7.

Origin of Native Fish Species

The native fishes of Utah Lake are most nearly related to those of the Columbia River Drainage. The Columbia River element probably reached Utah Lake by means of a river connection established during the late Pliocene-Pliestocene, when the continued uplift of the Sierra Nevada, glaciation, and vulcanism interacted to change the direction of Great Basin river outflow from a Mississippi-Atlantic Ocean connection to a Columbia River-Pacific Ocean connection (Hubbs and Miller 1948). Demographic evidence of this relationship is found in the similar genera of the families in Pliocene-Pliestocene times and recently (see Table 6).

The reasons why some families and genera that were in Lake Bonneville are not now represented in Utah Lake or even in Utah, are not known. However, if Lake Bonneville dried up between 8000 and 5000 BC, leaving only springs and streams (Bissell 1968), then the more lake-dependent species could have been eliminated.

This idea is supported by the fact that all native species of Utah Lake fish (1880 AD) had both lake and river spawning forms and depended heavily upon river-produced young for recruitment. In addition, *Prosopium spilonotus*, a lake species, was common in Lake Bonneville but is now restricted to Bear Lake (Stokes et al. 1964).

TABLE 6. Comparison of fish faunas (families, genera) of Lake Idaho, Lake Bonneville, and Utah Lake.

Lake Idaho (Late Pliocene)	Lake Bonneville (Late Pliestocene)	Utah Lake drainage 1880 A.D.)
Salmonidae	Salmonidae	Salmonidae
Salmo	*Salmo*	*Salmo*
Prosopium	*Prosopium* (2 spp)	*Prosopium*
Cyprinidae	Cyprinidae	Cyprinidae
Ptychocheilus	*Gila*	*Gila* (2 spp)
Arcocheilus		*Iotichthys*
Diastichus (2 spp)	*Rhinichthyes*	
Mylocyprinus		
Mylopharodon (2 spp)		
Sigmopharyngodon		
Catostomidae	Catostomidae	Catostomidae
Catostomus (5 spp)	*Catostomus*	*Catostomus* (2 spp)
Chasmistes		*Chasmistes*
Deltistes (2 spp)		
Ictaluridae		
Ictaluris		
Centrarchidae		
Archoplites		
Cottidae	Cottidae	Cottidae
Cottus	*Cottus* (2 spp)	*Cottus* (2 spp)

Fisheries, American Indian Period

Although written records are few, there is evidence that fish from Utah Lake and its tributaries were utilized by various American Indian cultures that inhabited Utah Valley and adjoining areas. In 1776, Fathers Dominquez and Velez de Escalante described Utah Lake as teeming with several kinds of edible fish. That the natives dried the fish for later consumption is evidenced by the supply of dried fish the Spanish took with them when they left Utah Valley (Auerbach 1943).

Early trappers and explorers found similar utilization of the fisheries (Bagley 1964, Fremont 1845, Stansbury 1852), and they caught many of their fish during the spawning season in late spring and early summer by wading into a riffle and manually throwing them on to the bank (Pratt 1849). Remains found in archeological "digs" around Utah Lake have found fish use from 800 to 1300 AD by the Sevier-Fremont culture (Green 1961, Wheeler 1968). Early Mormon settlers were also exposed to the Utah Lake fishery by the native Americans whom they replaced in Utah Valley.

Founding of the Commercial Fishery—1880

The first Mormon pioneers stopped at Fort Bridger, Wyoming, where William Clayton recorded a discussion between Jim Bridger and Brigham Young (Clayton 1921). Bridger felt that the region around Utah Lake was the best country in the vicinity of the great Salt Lake, because there were timber near the streams and an abundance of fish in the streams, south from Utah Lake.

The summer arrival of the Mormons (24 July 1847) into the Salt Lake Valley, the impending winter, the need to build shelter and prepare ground for crops, and the knowledge of those waiting to come left little time to explore. However, in December 1847, Parley P. Pratt and party traveled to Utah Lake with a boat and fish net. They sailed the western side of the lake and caught a few mountain trout and other fish (Pratt 1888). Carter (1969) felt that their lack of success was because the trout went to deeper waters in the winter. However, Pratt's party fished the west side of Utah Lake, which was never known for its trout populations.

TABLE 7. Brief annotated history of the fisheries of Utah Lake, 1849–1974.

Date*	Activity	Possible causes
Prior to 1849	American Indians caught and used fish from Utah Lake for at least 500 years (Auerbach 1943, Fremont 1845, Green 1961).	
1849	Spawning fish (trout, suckers, and mullet) in lower Provo River, dried or salted in barrels. Beginning of commercial fishery in Provo River and Utah Lake (Green 1961, Huntington 1847).	Provided sustenance to Provo settlers who had to clear ground.
1850–1852	Spawning fish in rivers and streams still caught. Nets and traps more common, advent of boats and lake year-round fishing. Fishermen from Provo and other settlements. Lower Provo River Fishery predominates (Huff 1847).	Settlement of American Fork, Lehi, Pleasant Grove, Springville, Spanish Fork (Palmyra), Payson, and Alpine—all consumed fish (Gardner, 1913, Hons 1950, Johnson 1900, Carter 1969).
1850–1860*	Rapid increase in commercial fishing with year-round harvest; long seines introduced. Selling of fish common in Utah Valley and Salt Lake Valley. Permanent fish traps allowed along millrace in lake fishing streams. Gradual decline in American Indian fishing. Higher prices obtained in winter than summer. State, county, and local governments begins some regulation of fishing. Provo City regulated the Provo River, while Utah County regulated the fisheries of Utah Lake and other streams (Spanish Fork, Jordan River, Payson Creek, and Provo Bay streams) (Bean 1852, Utah Legislative Assembly 1855, Carter 1969).	Mormon population grew from 6,000 in 1849 to 40,000 in 1860 (Arrington 1966). Drought and grasshopper plague, 1855–56 (Jarvis 1962, Madsen 1910). Severe winter weather and Indian depredations reduced cattle. Coming of Johnston's Army, 1857–58, added burden on resources as Salt Lake Valley settlers fled south (Arrington 1966).
1856	Peter Madsen begins long-term fishery at the mouth of Provo River and south (Carter 1969).	
1860–1870	Decline in number of commercial fishing groups; consolidation of fishing areas. Peter Madsen picks up other areas for expanded fishery (J. Procd. Provo City Council 1866, 1872).	
	Some decline in fishery noted. Manufacture of fish oil for leather and machinery began (Burton 1860, Carter 1959).	All inlet streams of Utah Lake appropriated for irrigation by 1874. Loss of recruitment as age 0 fish turned out on the land (Israelson 1938).
1860–1974*	Spawning fish, their eggs, and young destroyed by fluctuating water levels of inflow streams into Utah Lake; reduced fish populations (Winger 1972).	Regulation of inflow streams primarily for irrigation.
1862	Territorial legislature took over regulation of Jordan River Fishery and outlawed fish traps (Utah Legislative Assembly 1866).	Overfishing during spawning season.
	Peddlers or middle men developed, buying the fishermen's catch and then selling them in Utah and Salt Lake Counties (Carter 1959).	
	Set line fishery with many hooks becomes popular for trouting. Gill netting was practiced but declared illegal by the Utah County Court (J. Procd. Utah County Court 1857, 1894).	

Table 7 continued.

Date*	Activity	Possible causes
1863	Jens Michelson begins long-term fishery, mouth of Spanish Fork River (Carter 1959).	Serves south Utah County and market for fish oil.
1870	The fishing decline was noticed and a special committee was appointed in 1870 at the general conference of the LDS Church to develop fish culture (Popov 1949).	Return water from irrigated fields and cities warmer and higher in salt and silt load.
1870–1974	Change of inflowing waters quality; from cold, clear snowmelt to turbid warmer, more nutrient-rich waters (White et al. 1969).	Diversion of surface waters into irrigation, urban, and industrial use, then returned.
1872	Yarrow and Cope visited and felt the trout fishery had declined by about ⅓. Several court cases on mesh size of siene and unlicensed fishermen. Fish traps must have free passage when not in use. The lake cutthroat esteemed above all other fish for flavor. Beginning of sports fishing in greater numbers (Cope and Yarn 1875).	First dam built across Jordan River, beginning of lake level manipulations. Beginning of riverbed manipulations. Beaver dams destroyed, channelization, stream bank denuding becomes severe (*Salt Lake Tribune* 31 July 1932). More leisure time, larger population of younger people.
1875	Continued decline in catch, still a ready market. Utah Lake trout shipped to western (California) and eastern (Denver and Chicago) markets by railroad (J. Procd. Utah County Court 1894).	Higher prices in out-of-state markets. Completion of Central Utah Railroad branch.
1876	Territorial legislature bans seining and poisons or explosives, and requires a fish passageway in all dams. Setlines reduced to 3 hooks per line (Utah Legislative Assembly 1876).	Concern over decrease territorywide on fish, particularly Utah Lake trout.
1878	First Utah County fish and game commissioner appointed (Utah Archives #25, 1940:279–80).	
1880	Entrances of all irrigation canals should be screened (Utah Legislative Assembly 1880).	General knowledge that irrigation practices were destroying many fish.
1880	Visit by David Starr Jordan, who described Utah Lake as universe's greatest sucker pond (Jordan and Gilbert 1881, *Salt Lake Tribune* 1923).	Changing fish population, suckers gaining ascendency.
1882	Lawful to fish with seine 200 yds long by 12 ft wide, mesh 2 inch center and 1½ inch in wings (Utah Legislative Assembly 1882).	Complaint by Madsen and others.
1884	Mesh size reduced 1½ in for 50 ft center. Compromise point for Utah Lake level reached (Utah Legislative Assembly 1884).	Result of years of haggling between Salt Lake and Utah Counties over lake level.
1886	Screen law for irrigation ditches repealed because a nuisance to clean screens. Carp introduced into Utah Lake (Utah Legislative Assembly 1886).	Farmers win their view in territorial legislature.
1888	Season established from 1 October to 1 June to legally seine or hook and line fish for trout. Set line fishing prohibited. However, it continued through 1930s on commercial scale. Still (1974) practiced by some sports fishermen (Utah Legislative Assembly 1888).	Concern over sharp decline in catch of trout. Was best way to catch large trout, bass, and catfish without sorting course fish.

Table 7 continued.

Date*	Activity	Possible causes
1890	Territorial game warden appointed. Large mouth bass introduced into Utah Lake (Utah Legislative Assembly 1890).	No one enforced laws before.
1890–1894	Black bullheads, channel catfish introduced into Utah Lake (Popov 1949).	Desire to improve fishing in Utah Lake.
1893	C. F. Decker and Co. begins buying Utah Lake fish from Madsens. Sell from ice wagons to Salt Lake City markets (Scott 1951).	Economic demand, public desire shifts from dried and salted to fresh fish.
1894*	Carp and large mouth bass common in seine hauls. People accept them and they become a regular part of commercial fishery. Still many suckers and chubs (Popov 1949).	Introduced species become acclimated and rapidly expand in numbers.
1894	Most trout shipped out of territory. Suit brought in Utah County court to halt practice (Utah County Court Journal 1894:186).	Higher prices, desire for cash or out-of-territory credit.
1895	Large mouth bass become very common in Utah Lake; catch is 5:1, bass to trout, while suckers, chubs, and other common fish (carp?) are caught 18:1 to bass and trout (*Deseret Evening News* Jan. 16, 1895).	Decline of trout, large numbers of forage fish to feed bass.
1897	Only carp, chubs, mullets, and suckers can legally be taken by seine; however trout and large mouth bass can still be taken by hook and line then sold through 1904. Game wardens must accompany seiners. Legal net not to exceed 200 yds (Scott 1951).	Cutthroat population very reduced. Increased hook and line fishery for bass and trout.
1897	Mills, factories, power plants, and manufacturing concerns required to install fish screens in intake canals (Utah Legislative Assembly 1897:94–95).	Reduce unnecessary destruction of fish (was not enforced strongly).
1897	Unlawful to seine within half mile of inflowing river into Utah Lake. Unlawful seines destroyed. Game warden had to go on every seining trip (Utah Legislative Assembly 1897).	Realization by public at large of need to recruit young fish each year to maintain fishery.
1897–1905	Approximately $133,496 wholesale fish sold from Utah Lake (estimate may be very low) (Carter 1969).	Much unreported fishing occurred.
1899	Legal to ship certain fish out of Utah, including carp, chubs, suckers, black bullhead. D. S. Jordan again visits Utah Lake, finds fishery decline (Utah Legislative Assembly 1899).	Market among eastern U.S. cities.
1899–1904	Around 500,000 lbs of fish from Utah Lake shipped out of state (Chambers 1910).	To get needed out-of-state capital.
1900–1903	Channel catfish and black bullheads introduced into Utah Lake (Popov 1949).	Attempt to get more diversified fishery.
1900–1914	Increased catch of common fish, reaching 3,500,000 lbs live weight per year. Because many fish were between 3–5 lbs, 90 percent human consumption brought premium prices in eastern U.S. cities (Chambers 1910, Chambers 1913, Carter 1969).	Beef high in cost. European and Asian immigrants prized carp.

Table 7 continued.

Date*	Activity	Possible causes
1900–1952	Gradual filling and dredging of mouth of Provo River eliminates varied habitats, reducing fish population (Loy 1972).	Construction of more permanent docking and recreational facilities, and obtaining more farm land.
1901	Legal to catch and sell fish from Utah Lake by hook and line (Sharp 1897).	
1903	Unlawful to catch trout commercially by any means (Utah Legislative Assembly 1903).	Population decline continued.
1905	Five Utah fish-selling businesses do $105,000 wholesale and $90,000 retail business within state of Utah. At least 10 percent (probably much more) came from Utah Lake (Carter 1969).	Good market for fish continues.
1905–1930	Sport fishery for large mouth bass becomes important (Carter 1969).	Development of resorts, rail connections around Utah Lake.
1907	Required commercial seining license cost varied from year to year ($1 to $25), usually $10. Royalty to state on fish seined, 15¢ to 25¢ per 100 lbs of live fish (Utah Legislative Assembly 1907).	Help regulate fishing on Utah Lake.
1909	Unlawful to commercially take large mouth bass; commercial fishing concentrates on more abundant common fishes (Utah Legislative Assembly 1909).	Slight decline in bass population; upsurge in sport or table fishing.
1909–1974	Input of Colorado basin water via Strawberry Reservoir-Spanish Fork River into Utah Lake drainage and possible introduction of fish species, e.g., speckled dace now in Utah Lake drainage (current creek) (White et al. 1969).	Desire of farmers in Spanish Fork area for more irrigation water, Strawberry Reservoir constructed.
1910	Beginning of extensive illegal seasonal set line fishery in Provo Bay and other parts of lake for channel catfish and bullhead catfish. Up to 100 participants (Carter 1969).	Ready market for dressed catfish, added to family income.
1910–1920	Perch, green sunfish, and bluegill introduced into Utah Lake (Popov 1949).	Desire for more fish species for sportsman.
1910–1974	Turbidity and silt load of Spanish Fork River increases to 11–12-month duration and eliminates much of the fishery at mouth of river (Loy 1972).	Silt from Diamond Fork's unstable water shed, dredging of stream bottom, return flow from agriculture.
1914, 1915, 1930s	Fish were siened by Utah State Fish and Game Department personnel and given to the needy (Siddoway 1918).	National and state economic depressions.
1914–1930	Carp and suckers caught to make chicken food. Live boxes used extensively. From early 1920s to early 1930s, fish for chicken food was greatest use of fish (Carter 1969).	Good chicken egg production.
1915	Shipping fish by railroad live to eastern U.S. was not continued as freight rates became too high (Carter 1969).	Market was there but transportation costs too high.
1917	Utah state government hires more seiners to catch fish from the Lake, sold from 2¢ to 5¢/lb (Siddoway 1918).	Conservation of other meat to supply WWI efforts.

Table 7 continued.

Date*	Activity	Possible causes
1917–1920	Extensive use for human consumption; some canned.	WWI price of meat was high, short of supply.
1923	Average weight of rough fish caught below 3 lbs—market outside Utah then reduced orders (Carter 1969).	Overfishing of older year classes.
1928–1950	A small percentage of rough fish used in feeding hatchery rainbow trout. Phased out with development of all dry pellet ration (Carter 1969).	Development of extensive rainbow hatchery program by state of Utah to stock waters for sport
1929–1935	Human consumption of rough fish increases sharply. Sold in Utah and Salt Lake Valleys. Each week 3,000 lbs shipped on ice by railroad to California for human consumption (Carter 1969).	Nationwide (1929–1939) depression—Utah Lake fish very inexpensive compared to beef.
1930–1974	Input of Weber River water via Provo River into Utah Lake, and possible introduction of new genetic material, e.g., mountain whitefish population of lower Provo River shows highly variable serum electrophoretic patterns, but those of lower Weber River are very constant (Hanson 1970).	Lack of sufficient water in Provo River to meet all the irrigational demands.
1930–1974*	Destruction of spawning suckers and carp by clubs, pitchforks, etc., in the name of sport(?). Few of the fish are utilized, and elimination of spawners has further reduced the sucker populations of the lake (Liddiard 1968, White 1973).	Lack of understanding of their detrimental effect on fish population.
1932	Catch of 54,000 lbs live weight/week by fishermen sold for 1¢ to 7¢ per lb (Carter 1969).	
1932–1935	Many fish died from overcrowding and suffocation in the summer, and freezing and thawing in the winter (Hatton 1939, Liddiard 1968).	Drought reduced size of Utah Lake, irrigation demands on inflowing streams dried them up.
1932–1935	Large mouth bass population sharply declines—sport fishermen complain to state agencies.	Drought reduced bass population and reduced much of littoral habitat along with increased farming and filling of marsh habitat along eastern shore.
1932–1974	*Tamarix pentandra*, a woody plant introduced; becomes a dominant species of littoral zone. Seining for fish became more difficult and net repairs more frequent (White et al. 1969).	Water level variance greater due to lake manipulation as a reservoir; reduced or eliminated many species in littoral zone.
1933	Sharp decline in use of fish for chicken food (Carter 1969).	Development of pellets and dry mash. Though more expensive, supply more constant and less work.
1933	Development of market among mink ranchers (Carter 1969).	Mink ranching in Murray, Coalville, and Echo, Utah, becomes big business.
1934–1936	Dredging of channels in Provo Bay during drought to increase flow into Utah Lake for Salt Lake Valley irrigation (White 1964).	Claim of Utah Lake as a reservoir.
1935	Fish numbers so depleted some commercial fishermen forced out of business.	

Table 7 continued.

Date*	Activity	Possible causes
1936–1939	Well-meaning groups destroy heron gull and cormorant young and nests to reduce predation on reduced fish populations (Featherstone 1961).	Desire to save fisheries.
1936–1939	Rains return and the loose organic soils of upper Provo Bay washed into spring and lake areas of lower Provo Bay, filling area (e.g., Crystal Lake becomes known as Mud Bay) (Harrison 1962).	Suspended soil followed dredged channels.
1950	Introduction of walleye, which developed a small self-sustaining population increasingly popular with anglers, especially during early spring upriver spawning runs (Arnold 1960).	Provide better sport fishing in Utah Lake.
1952–1974	Accelerated dredging and channelization of lower Provo River. Most deep, large hole areas with protective willow and cottonwood cover are removed. Resident fish populations reduced to very low levels, forage (minnows) fishes almost entirely eliminated, only spawning and foraging fish now commonly found in River (White 1973).	U.S. Army Corps of Engineers flood control. Individual land owners, irrigation companies desire to control water drainage. Urbanization of stream bank.
1956	Introduction of white bass; by 1967 it had become one of most numerous fishes in Utah Lake. It is readily caught by anglers in the spring. It grows only slightly after second year of life (Vincent 1967).	Desire to provide more sport fisheries.
1969	Introduction of fathead minnow and golden shiner. Fatheads are now (1974) found in mouths of inflow streams. Golden shiners have not done well (White 1969).	To provide forage fish for the game fishes.
1974	Most native populations eliminated; a few suckers remain.	Result of irrigation, overharvest, habitat destruction.
1974	Commercial fishing on a limited scale during the winter. Carp, suckers, and black bullhead are legally taken. Little human consumption, sold to animal food processors.	Little demand for common fish.
1974	Sport fishing heavy during early spring for walleye and white bass. Spring and fall fishing for black bullheads common. Occasional channel catfish, large mouth bass taken. Localized fisheries for green sunfish and bluegills during the late spring.	Closeness of Utah Lake to Wasatch Front population centers; more leisure time and higher cost of recreation.

*Asterisk indicates approximate date.

Brigham Young was interested in obtaining fish from Utah Lake to help feed the expanding settlements in the Salt Lake Valley. In January 1849, he sent an exploring party to Utah Lake to seek out fishing places (*LDS Journal History of the Church*, 6 January 1849). Then in March 1849, the General Authorities of the LDS Church voted to send a colony to Utah Valley for the explicit purposes of farming (raise a few beavers, fish, and teach the Indians how to farm and read) (*LDS Journal History of the Church*, 10 March 1849).

On 12 March 1849, the first settlers entered Utah Valley under the leadership of John S. Higbee, who had accompanied Parley P. Pratt on the first fishing expedition (Jensen 1924). They settled on the south side of the

river and began laying out their fields and building a fort. By May, the Indians were involved in their annual fishing activities on the Provo River as the spawning fish were moving into the river. The settlers soon joined in catching them by hand. When Parley P. Pratt visited the colony in the last week of June 1849 and saw thousands of fish being caught by Indians and whites, he estimated that 5000 barrels of fish could be secured annually from the fishery (Pratt 1849). The early pioneer diaries of Utah Valley mention the fine fish from Provo River and Utah Lake (Colton 1946).

It would seem that the Indian and early pioneer fishery was of mixed species, with the cutthroat trout bringing the highest prices. A brief annotated history is given in Table 7.

Transition from Commercial Fishery to Sport Fishery

The transition from a commercial fishery to a sport fishery was the result of several related factors. The exploitation by commercial fishermen plus the destruction of the spawning grounds and habitat led to the complete destruction of the most desirable food fish in Utah Lake, the Utah cutthroat trout (*Salmo clarki*).

It became obvious by the late 1800s that some action would have to be taken to prevent the complete destruction of desirable fish in Utah Lake. The state legislature in 1897 passed a law making it illegal to take any fish by seine except carp (*Cyprinus carpio*), Utah chub (*Gila atraria*), and suckers (*Catostomus sp.*) (Carter 1969). In 1899, black bullheads (*Ictalurus melas*) and channel catfish (*Ictalurus punctatus*) were added to the list of fish that could be siened. They were dropped from the list in 1929. The 1897 law also required all mills, factories, power plants, and manufacturing concerns to screen their canals to attempt to prevent the destruction of trout. It also prohibited seining within one-half mile of the mouth of any stream during the spawning period. This law and others following it were not strictly enforced until the early 1920s and 1930s, when the commercial harvest of game fish had pretty nearly come to an end. During the early period of exploitation nearly 100 percent of the fish harvested from Utah Lake was used for human consumption (Carter 1969). As agriculture and transportation improved, the state gradually developed a more stable economy and it was no longer necessary to rely on fish as a source of food to supplement the diet of early settlers; however, by this time the cold water fishery had disappeared and was replaced by warm water species.

Biology of Utah Lake Fishes

Very meager information is available concerning population densities, production, life histories, and food habits of the fish species found in Utah Lake. Some of the fish listed in Table 5, such as the trout species, may be migrants from the streams and rivers that enter the lake.

A controversy exists regarding the species of sucker present in the lake. Hatton (1939) described three species of sucker (June sucker, Webug sucker, and Utah sucker) from Utah Lake. Collections by BYU researchers have shown at least the Utah sucker and the June sucker still exist in the Lake. Hatton (1939) also collected the mountain sucker, but no subsequent records of this species have been found. The June sucker is endemic to Utah Lake and its current status should be determined; if it is present, it should be protected and a thorough ecological study should be conducted to gain as much information about this species as possible.

The littoral zones of Utah Lake are used as reproducing and rearing areas for most of the fish in Utah Lake (White and Dabb 1970). Seining of the shallow shore areas indicated that young-of-the-year fish were abundant in these areas (Table 8). The most dominant fish

TABLE 8. Seining of shallow littoral areas of Utah Lake, Utah County, Utah, by the Utah Division of Natural Resources around 1970.

Species	Percent of total catch
White bass	70
Carp	16
Black bullhead	8
Bluegill	.6
Channel catfish	.6
Golden shiner	.6
Yellow shiner	.6
Largemouth	.6
Walleye	.6
Fathead minnow	.6

was white bass, and carp and black bullhead were quite abundant. Bluegill, channel catfish, golden shiner, yellow perch, largemouth bass, walleye, and the fathead minnow were common.

The Lincoln Bench area, with its rubble-gravel substrate, had the highest species diversity. All areas with the rubble substrate were used by the fish for reproduction and rearing areas. Bird Island was a primary site for channel catfish reproduction. Mud Lake was also utilized by channel catfish, as well as white bass, for spawning and rearing. The rocky littoral zone along the eastern shore of Goshen Bay is an important fish spawning and nursery area.

DESCRIPTIONS OF FISH CAUGHT FOR SPORT

Channel Catfish

Age and Growth: Channel catfish were introduced into Utah Lake in 1911 and have been stocked on numerous occasions since.

Lawler (1960) calculated the following lengths at ages one through 12 years based on the body length (total length)-spine radius relationship: 64, 146, 197, 256, 320, 365, 402, 457, 474, 487, and 489 mm. The length-weight relationship is expresed by the equation Log W = -4.814 + 3.025 LogL. The actual spawning season has not been definitely determined, but possibly extends from late June until September. As a result, the first year growth of channel catsifh is very slow (Lawler 1960). Carlander (1969) reported that channel catfish in turbid waters (similar to Utah Lake) over 500 acres grew at approximately the following average lengths for the years one through 11: 84, 163, 224, 277, 340, 381, 450, 472, 518, 531, and 577 mm. Fish in reservoirs reported by Carlander were growing faster and attained a greater length than channel catfish in Utah Lake.

Reproduction: Lawler (1960) found that no channel catfish had reached sexual maturity until four years of age. The percentage of fish that had reached sexual maturity from age four on was as follows: IV—9 percent, V—59 percent, VI—94 percent, VII—99 percent and VIII—100 percent. Carlander (1969) reported that Katy (1959) found in a summary of literature that channel catfish typically mature between the ages of four and six years.

In Utah Lake the majority of spawning apparently takes place in the waters surrounding Bird Island, off Lincoln Beach, and adjacent to the Knolls (Lawler 1960). These areas are honeycombed with rock outcrops and ledges. It was reported by Stewart (1968) that fairly large numbers of channel catfish moved into Mud Bay during June, July, and August and had moved out by October 16. He captured gravid females from 12 June to 27 July.

Diet: The dominant food item found in the stomachs of channel catfish in Utah Lake was fish (Lawler 1960). Fish occurred in 29 percent of the stomachs examined and comprised 84 percent of the food volume. Insects were found in 29 percent of the stomachs and crustaceans in 4 percent. Utah chub, yellow perch (*Perca flavescens*), and black bullheads were the dominant fish found in channel catfish stomachs. Smaller catfish fed heavily on Diptera larvae. Brown (1968) examined several species of fish taken by seine in January 1968 and found that chironomid larvae were the dominant food items in all species, including channel catfish. Channel catfish examined by Dabb and Thompson (1975) ranged from 35 to 372 mm, with one fish 613 mm long. Fish taken in both the littoral and pelagic areas of the lakes were depending heavily on chironomids for food. The one large fish examined contained the remains of three carp. The forage food base for larger channel catfish has been reduced since Lawler's work; Utah chub and yellow perch are now very rare in the lake.

Harvest: The channel catfish population has apparently declined considerably since 1960, when Lawler reported his work. In 1958 and 1959, respectively, a fisherman catch rate of 0.40 and 0.45 fish per hour was reported. Arnold (1958, 1959) reported a gill net catch rate of 0.47 and 0.25 fish per hour for the two years 1958 and 1959. White and Dabb (1970) duplicated Arnold's gill net work and caught 0.03 channel catfish per hour. Fishermen in 1970 were taking channel catfish at the rate of 0.05 fish per hour (Utah State Division of Wildlife Resources 1970).

Black Bullhead

Age and Growth: Black bullheads were introduced into Utah Lake in 1871 (Popov and Low 1950). Their population has fluctuated through the years and is presently one of the largest in the lake. Bullheads in the lake exhibit an explosive growth rate in the first two years of life and attain a maximum size by the end of their second year. After age two they grow very little (0.5 to 1.7 percent mean annual increment) (Thompson and Dabb 1974). Calculated total lengths based on aging by spine section were 131, 292, 292, and 295 mm for the ages one through four (Thompson and Dabb 1974). This growth compares favorably with bullhead growth in Iowa and Oklahoma waters (Carlander 1968).

Reproduction: No research has been done on bullheads in Utah Lake to determine age at maturity or time of spawning. However, spawning activity has been observed typically during the month of July. Sigler and Miller (1963) state that spawning typically occurs when water temperature warms to between 65 and 75 F.

Diet: Brown (1968) reported that chironomids were the dominant food item in bullheads taken near Lincoln Beach in January 1968. A total of 211 black bullheads were collected from May to October 1974 and their stomach contents examined (Dabb and Thompson 1975). They exhibit the most diversified diet of any game fish in the lake, utilizing 11 different food items. Both juveniles and adults fed prominantly on chironomids. They secondarily utilized copepods in May and June and changed to *Leptodora kindtii* during July, August, and October. Kutkuhn (1955, 1958) reported that, along with insects and zooplankton, fish and frogs were an important part of the bullhead diet in Iowa lakes. No fish were found in the stomachs of bullheads in Utah Lake.

Movements: Movement of black bullheads was studied using radio telemetry in 1973 (Thompson and Dabb 1974). They appear to occupy a rather restricted though large area of the lake for some time and then move to another. Movement is generally associated with wind and wave action. One bullhead was tracked under the ice in January and February for 336 hours. It moved a distance of only 900 feet and occupied an area of approximately 4 acres (Thompson and Dabb 1974). Another bullhead tracked for 485 hours in April and May moved 13,900 feet and occupied an area of 63 acres. A third bullhead tracked for 244 hours moved a distance of 59,800 feet and occupied an area of 1550 acres. Movement was generally restricted to a particular bay and was generally fairly close to shore. Bullheads were constantly moving.

Harvest: Black bullheads were the fish most commonly caught by fishermen in Utah Lake. The catch rate during the summer months of 1970 averaged 1.5 fish per hour and ranged from 0.40 to 2.60 fish per hour (Utah Division of Wildlife Resources 1970). The average bullhead catch rate in 1958 and 1959 was 0.38 fish per hour and ranged from 0.13 to 1.04 fish per hour (Arnold 1958). The gill net catch rate in 1958 and 1959 was 0.12 fish per hour compared to 0.74 fish per hour in 1970 (White and Dabb 1970). The bullhead population was probably larger, based on these data in 1970, than it was in the late 1950s.

Large Mouth Bass

The large mouth bass (*Micropterus salmoides*) population boomed following its introduction in 1890 and was very important to the commercial fishermen. Commercial harvest of largemouth bass increased to approximately 65,000 pounds by 1900 and then steadily declined (Carter 1969). During the winter of 1924–25 tons of large mouth bass washed ashore as a result of oxygen depletion. During the winters of 1959–60 there were many reports of dead large mouth bass. At the present time their population is very small, with only an occasional fish being taken by fishermen and biologists. During the summer of 1970, only four large mouth bass were checked by creel clerks. No research has been done on this valuable sport fish to determine the reason for its failure to succeed, and research is needed to determine if success with this species could be achieved.

Walleye

Age-Growth: Walleye were first introduced into Utah Lake in 1952 and were subsequently introduced in 1954, 1955, and

1956. Arnold (1960) reported that walleye grew to the following average sizes for ages one through six: 169, 290, 330, 374, 389, and 399 mm for males; and 172, 298, 347, 395, 440, and 465 mm for females. The length-weight relationship is expressed by the equation Log W = -4.79031 + 3.02554 Log L. Cleary (1948) reported the following lengths at the end of years one through six: 124, 230, 308, 364, 409, and 454 mm for walleye in Clear Lake, Iowa. Walleye grew faster in Utah Lake for the first four years and were then surpassed by the Clear Lake fish.

Reproduction: Walleye in Utah Lake begin spawning at two years of age for males and three years of age for females. However, a majority of the spawners are from three to five years old. Walleye typically begin spawning by about mid-March and continue until mid-April. Sakamoto and White (1974) obtained six males and nine females from the Division of Wildlife Resources and undertook a fecundity study. Males examined ranged in age from five to eight years and females from seven to ten years. Fecundity of fish they examined increased with fish length. Calculated fecundity of fish 400 mm long was 12,500 eggs per female. Walleye 700 mm long had a calculated fecundity of 257,800 eggs. The range in fecundity of fish examined was 46,524 to 227,138 eggs per female.

During recent years the Utah Division of Wildlife Resources has attempted to increase the walleye population in Utah Lake because of its growing popularity with fishermen. Walleye running the Provo River were captured and spawned artificially, the eggs were hatched at one of the state hatcheries, and the fry were returned to the lake. The division collected 11.0, 21.9, 21.0, 31.6, and 14.9 million eggs during each of the years 1972 through 1976. The Springville State Fish Hatchery, where most of the eggs have been incubated, has been successful in hatching approximately 50 percent of these eggs.

Diet: Arnold (1960) reported the four species of forage fish comprised 63.5 percent of all identified food found in walleye stomachs. These were redsided shiner, yellow perch, Utah chub, and carp. Most of the stomachs that Arnold examined came from fish that were from 400 to 500 mm long. Brown (1968) found chironomids to be the dominant food item in walleye taken in January 1968 near Lincoln Beach. Dabb and Thompson (1975) examined walleye stomachs of fish ranging in size from 123 to 474 mm. Smaller fish (range 234 to 360 mm) were dependent on chironomids, copepods, and liptodorans. Their diet studies did not include fish taken during the months of June and July. Walleye taken from August through October (size range 157 to 474 mm) contained 100 percent fish, consisting of carp, white bass, and channel catfish. Redsided shiner, Utah chub, and yellow perch are now rarely found in the lake. This lack of forage fish is undoubtedly having an adverse effect on the growth of walleye.

Harvest: The fisherman harvest of walleye was very light during the late 1950s; practically no fish were taken (Arnold 1960). During recent years (1970–1973) the Division of Wildlife Resources has measured fisherman harvest during the spawning run in March on the Provo River and in the vicinity of the Utah Lake State Boat Park, during which time fisherman hours increased from 6169 in 1970 to 11,198 in 1973. The walleye harvest increased from 1313 in 1970 to 1558 in 1973. The yearly average catch rate for walleye in 1970 was 0.002 fish per hour, excluding the harvest associated with the spawning period. Gill net catch data indicates that the population has changed little since 1958–59. Arnold (1958) took an average of 0.12 and 0.08 fish per hour in gill nets in 1958 and 1959, respectively. White and Dabb (1970) caught 0.08 fish per hour in duplicating Arnold's work. Though no data have been collected, it is apparent that fisherman pressure and success have improved at other locations on the lake, such as the Geneva-Orem boat harbor area, the mouth of the Spanish Fork River, and Lincoln Beach. Walleye harvest remains seasonal and in conjunction with spawning activities, but angler awareness of this prized game fish is increasing.

White Bass

Age-Growth: White bass were introduced to Utah Lake in 1956 when 209 fish were transplated from Colorado (Vincent 1967).

White bass in Utah Lake attained lengths as follows at the end of each year of life: 96, 164, 211, 249, 281, and 291 mm (Trapnell

1969). By comparison, white bass in Oklahoma reach the following lengths at the end of each year: 193, 310, 366, 417, 434, and 452 mm. In an Iowa study white bass grew as follows: 132, 246, 300, 345, 388, and 429 mm (Sigler and Miller 1963). It is apparent that white bass in Utah Lake grow at a slower rate than fish in these two waters. White bass in Utah Lake also show very little growth after their fourth year.

Reproduction: Vincent (1967) reported that mature male white bass began to school up in the spawning areas near Bird Island and Lincoln Beach by mid-April, when the water temperature reached 52 F. Extensive schools of female white bass were never noted, though relatively small numbers of gravid females, compared to numbers of males, were taken throughout the spawning period. Vincent (1967) identified the primary spawning area for white bass to be Lincoln Beach. He also concluded that most actual spawning occurred about mid-June. Vincent did not determine the age of white bass in Utah Lake at the time of sexual maturity, however; typically, white bass mature in their second year of life and a few in their third, but none in their first (Sigler and Miller 1963).

Diets: Young-of-the-year white bass fed primarily on zooplankton, whereas larger fish were dependent on aquatic insects, mainly chironomids (Trapnell 1969). Dabb and Thompson (1975) collected 196 white bass stomachs from May through October 1975. Small white bass (less than 199 mm) fed primarily on copepods in all months but August, when they relied heavily on *Leptodora kindtii*. Larger white bass (greater than 200 mm) fed on copepods in May and June then switched to *L. kindtii* as the primary food during the remaining months. Chironomids were also important to white bass of all sizes. Fish were noticeably absent from the diet of white bass taken in pelagic water. Fish collected in littoral areas of the lake in August were dependent on zooplankton and chironomids; however, a few were feeding on young-of-the-year white bass. These fish typically feed on forage fish after their first year (Webb and Mobb 1967). It appears that the lack of a suitable forage fish in Utah Lake is probably the limiting factor for growth.

Harvest: Very few white bass were taken by boat fishermen on Utah Lake (White and Dabb 1970). During the spring there was an active fishery for them at the mouth of the Provo River. As many as 200 fishermen would often fish under the lights at the boat harbor. Occasionally, catch rates of 10 to 12 fish per hour were attained. The general size of the white bass taken by fishermen was approximately eight to ten inches. The summer catch reported by White and Dabb (1970) was only 0.08 fish per hour, ranging from 0.01 to 1.56 fish per hour.

Forage Instructions: The probable reason for the demise of the sport fish in Utah Lake is that they are predacious on other fish and there are no suitable forage fish in the lake. In 1969 the Utah Division of Wildlife Resources introduced approximately 90,000 fathead minnows (*Piemephales promelas*) and 90,000 golden shiners (*Notemigonus crysoleucas*) into the lake in an attempt to provide this needed forage base. In 1970, golden shiners were occasionally taken in gill nets and both golden shiner and fathead minnows were taken by siening. Golden shiners and fathead minnows were not collected during extensive travel and seine work in 1975. It is assumed that these two species will not succeed as a forage base for the sport fish in Utah Lake.

Population Changes

Arnold (1958), working for the Utah Division of Wildlife Resources, undertook an extensive gill netting program in an attempt to understand relative population abundance. His efforts were duplicated by White and Dabb (1970). Table 1 lists the species taken in gill nets during the two studies in order of decreasing abundance for comparison.

Lowder (1951) reported that the three suckers (*Chasmistes liorus, Catostomus fecundis,* and *Catostomus ardens* were all found in Utah Lake in 1951 and that the decreasing order of relative abundance of fish species in 1951 was carp, sucker, catfish, perch, Utah chub, and largemouth bass. The sucker population was one of the largest in the lake in early history. However, overexploitation, habitat destruction, and the drought of 1932–1935 greatly reduced this

population and it has never returned to its previous size.

The fisherman catch composition in 1958 was channel catfish 60 percent, black bullheads 30 percent, carp 7 percent, and yellow perch 3 percent. The fisherman catch in 1970 consisted of black bullhead 89 percent, channel catfish 3.4 percent, white bass 2.6 percent, carp 2.0 percent, and largemouth bass, yellow perch, and walleye 0.6 percent each. The average catch rate in 1958 was 0.77 fish per hour, and in 1970 the average catch rate was 1.66 fish per hour. The large increase in catch rate was the result of the increase in black bullhead harvest.

During this period the Utah chub has decreased from the second most abundant fish in gill net catches to nothing, and the yellow perch has decreased from fourth most abundant to nothing. The white bass has increased from last to most common species taken in gill nets. The black bullhead has replaced the channel catfish as the dominant fish in the fisherman's creel. Utah Lake has a dynamic fishery that must be continually monitored and managed if it is to remain productive.

Pesticide Levels in Utah Lake Fish

The Food and Drug Administration has set the following acceptable levels for pesticides and mercury: Dieldrin 0.30 ppm, DDT 5.0 ppm, DDE 7.0 ppm, PCB's no level set, and mercury 0.5 ppm (Smith 1973). Carp and black bullhead catfish in Utah Lake were tested in 1973 (Smith 1973). White bass tissue was analyzed for the Bureau of Sport Fisheries and Wildlife by WARF Institute, Incorporated, Madison, Wisconsin, in 1970. Levels of pesticides and mercury in wet muscle tissue are tabulated in Table 2. No fish sampled exceeded any of the levels that have been set.

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