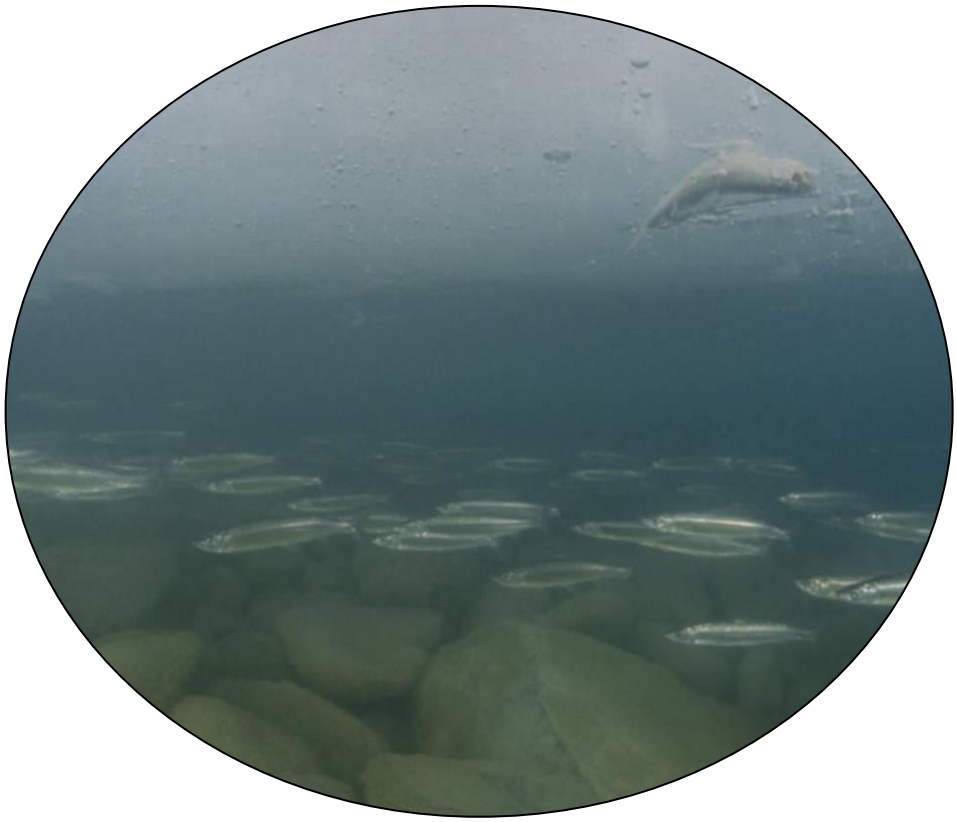
Bear Lake

Fisheries Management Plan

2015



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INTRODUCTION

This document is the first revision of the original Bear Lake Fisheries Management Plan that was finalized in 2009. The original document indicated the plan would undergo a review in five years. The updated document summarizes the development of an interstate fisheries management program for Bear Lake, Utah-Idaho. The primary purpose for preparing the updated interstate plan was to document the success and/or failures of the accomplishments recommended in the original plan. This plan also shares the management priorities held by the Utah Division of Wildlife Resources (UDWR) and Idaho Department of and Game (IDF&G). Those priorities revolve around two central management objectives: 1) to conserve native species and 2) enhance sport fishing opportunities. The plan was originally prepared and has been updated by state fishery biologists from both states and includes input from public meetings held in Garden City, Utah and Montpelier, Idaho. Management proposals in this plan were also presented to the Utah Northern Regional Advisory Council, the Utah Wildlife Board, the Commission for Idaho Department of Fish and Game, the range-wide Bonneville Cutthroat Trout team, and the Utah Blue Ribbon Fisheries Council.

This document contains five distinct sections. The first section provides a general overview of Bear Lake and its fish community. The second section is a summary of past fishery management practices. The third section describes ongoing fish monitoring programs and research studies used in the development of management guidelines. The fourth section outlines goals and objectives for recreational fishing and conservation goals for endemic and native fish populations. The last section is a record of public involvement.

Over the past six decades, a tremendous amount of fisheries and ecological research has been completed to better understand the unique properties of Bear Lake's aquatic resources. One of the seminal contributors of that work was Dr. William F. Sigler. A quote from his 1962 publication "BEAR LAKE AND ITS FUTURE" is an excellent preface to this management plan:

> *"Even in such a wide-ranging and eternally changing field as biology, a few statements about certain aspects can be made with a minimum likelihood of their being refuted. In this class are the*

following: No two lakes are identical. Any given lake is simultaneously many things to many people. A lake is never static. The influence of a lake reaches far beyond it shores."

OVERVIEW OF BEAR LAKE

Bear Lake is a 70,000 acre system located in northern Utah and southeast Idaho. The Utah-Idaho border roughly bisects the 20-mile long lake in half and is between 5-8 miles wide. It has a maximum elevation of 5,924 ft above sea level. The maximum depth, when at full pool, is 208 feet and average depth is 85 feet. Most of the lake bed is covered in fine marl sediment. Primary and secondary production are both thought to be limited by precipitation of calcium carbonate, which strips phosphorous from the water column Birdsey (1985). The precipitate also gives the lake its famous turquoise iridescence.

St. Charles, Swan, Big Spring, and Fish Haven creeks are the primary natural tributaries to the lake. In addition to the natural tributaries, the Bear River is diverted into Bear Lake. In 1911, a canal was constructed to divert the Bear River at Stewart Dam into Bear Lake. The water delivery system stores spring runoff water in Mud Lake which gravity flows into the northeast corner of Bear Lake. Rocky Mountain Power operates, through a legal decree (Kimball Decree), the top 21 feet of the lake as irrigation storage. The stored water is pumped out of the lake during summer irrigation and delivered back to the Bear River through the outlet canal.

Bear Lake's fish community supports four endemic species: Bonneville Whitefish *Prosopium spilonotus*, Bear Lake Whitefish *Prosopium abyssicola*, Bonneville Cisco *Prosopium gemmifer*, and Bear Lake Sculpin *Cottus extensus*. In addition to the four endemic species, Bear Lake provides habitat for one of two remaining native adfluvial stocks of Bonneville Cutthroat Trout (*Oncorhynchus clarki utah*). A complete species list for Bear Lake and its tributaries are shown in Table 1.

Table 1. Species list for Bear Lake and its tributaries.

Common Name	Scientific Name	Origin
Bear Lake Sculpin	*Cottus extensus*	Endemic
Bonneville Whitefish	*Prosopium spilonotus*	Endemic
Bear Lake Whitefish	*Prosopium abyssicola*	Endemic
Bonneville Cisco	*Prosopium gemmifer*	Endemic
Bonneville Cutthroat Trout	*Oncorhynchus clarki utah*	Native
Redside Shiner	*Richardsonius balteatus*	Native
Speckled Dace	*Rhinichthys osculus*	Native
Utah Sucker	*Catostomus ardens*	Native
Utah Chub	*Gila atraria*	Native
Green Sunfish	*Lepomis cyanellus*	Exotic
Rainbow Trout	*Oncorhynchus mykiss*	Exotic
Brown Trout	*Salmo trutta trutta*	Exotic
Brook Trout	*Salvelinus fontinalis*	Exotic
Lake Trout	*Salvelinus namaycush*	Exotic
Black Bullhead	*Ameiurus melas*	Exotic
Yellow Perch	*Perca flavescens*	Exotic
Common Carp	*Cyprinus carpio carpio*	Exotic

HISTORY OF THE FISHERY

Fish Stocking

The first records of fish stocking in Bear Lake occurred in the 1890s. The first two species introduced were American Shad *Alosa sapidissima* and Lake Whitefish *Coregonus clupeaformis* captured from the Great Lakes. During the following century, numerous other species were introduced to Bear Lake including: Chinook Salmon *Oncorhynchus tshawytscha*, Atlantic Salmon *Salmo salar*, Kokanee Salmon *Oncorhynchus nerka*, Largemouth Bass *Micropterus salmoides*, Rainbow Trout *Oncorhynchus mykiss*, Brook Trout *Salvelinus fontinalis*, Lake Trout *Salvelinus namaycush*, Yellowstone Cutthroat Trout *Oncorhynchus clarkii bouvieri*, Bonneville Cutthroat Trout *Oncorhynchus clarkii utah*, and Mysis Shrimp *Mysis spp.* (Figure 1). Many of the introductions were limited to one or two stocking events that failed to establish reproducing populations. The variety of species introduced was greatest prior to the 1950s. After that, the focus was placed on four species: Yellowstone Cutthroat Trout, Bonneville Cutthroat Trout, Rainbow Trout, and Lake Trout.

During the 1950s through the early 1980s, large numbers of Rainbow Trout were stocked in Bear Lake and its tributaries. Unlike most other species introduced to the lake, the hatchery stocked Rainbow Trout established naturally reproducing populations. A naturally produced Rainbow Trout population currently thrives in St. Charles Creek. Unfortunately, the wild Rainbow Trout hybridized with the native Bear Lake Bonneville Cutthroat Trout. Concerns over hybridization eventually led to the termination of Rainbow Trout stocking in the 1980s. Because a naturally reproducing population continues to thrive, eliminating the stocking program has not reduced the hybridization problem, however during the last segment of this management plan both UDWR and IDF&G have conducted rotenone treatments to remove Rainbow Trout and Rainbow Trout x Bear Lake Bonneville Cutthroat Trout hybrids on Swan Creek and Fish Haven Creek, respectively, and reintroduced genetically pure Bear Lake Bonneville Cutthroat Trout into both of these streams.

Lake Trout have been stocked into Bear Lake in various numbers since 1911 (Chamber 1913; Popov and Low 1950). Lake Trout stocking peaked in the 1970's and 1980's. Shortly thereafter, questions regarding potential impacts to native species prompted both UDWR and IDF&G to evaluate the Lake Trout stocking program. No stocking of Lake Trout took place from 1990-1994. Results of predation studies completed by Utah State

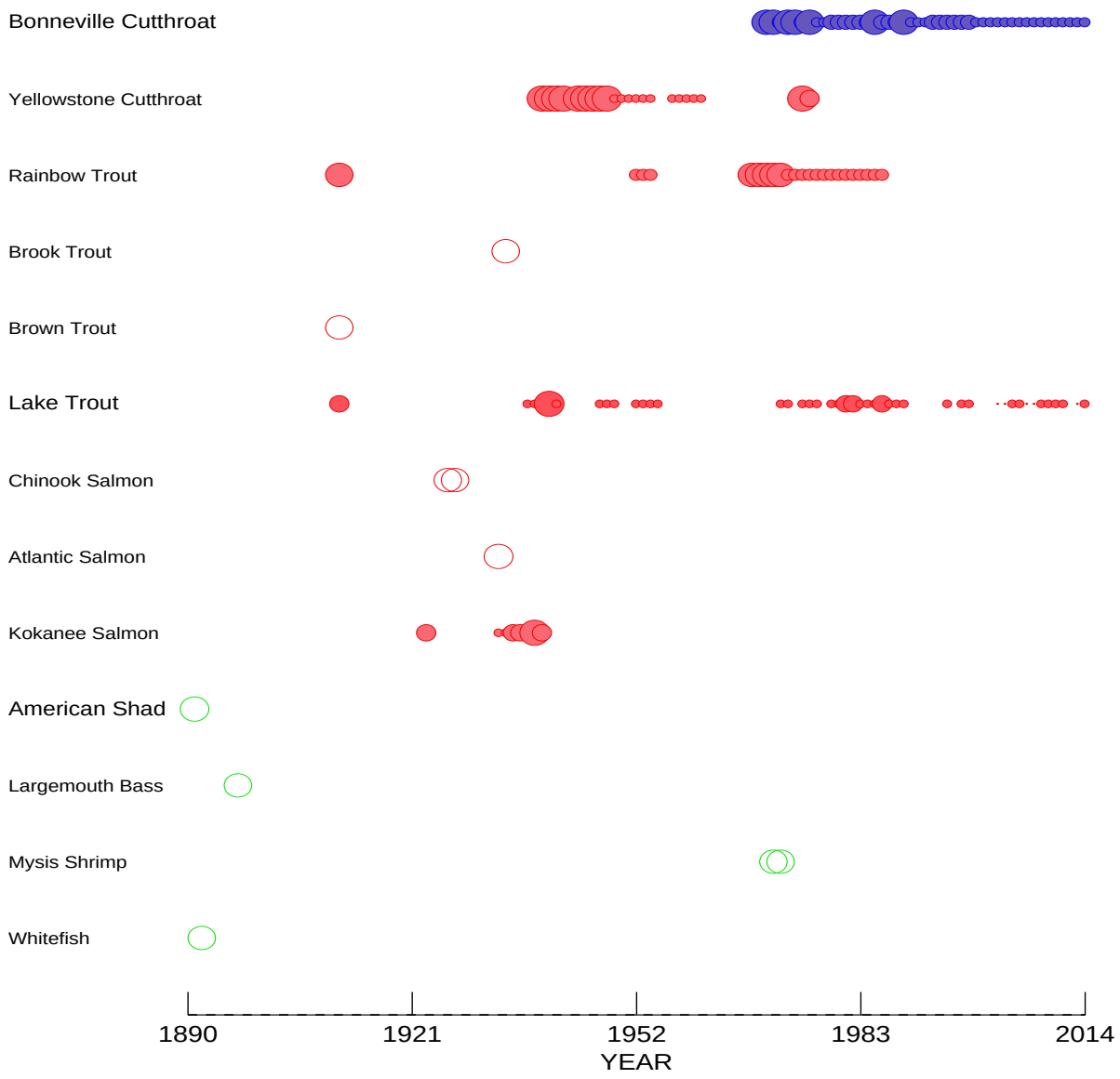

Figure 1. Fish stocking history for Bear Lake. The size of circle indicates the relative number of fish released. The largest circles represent a release of about 1 million fish. Open circles denote stocking events for a species of less than three attempts.

University (USU) showed that Bear Lake's endemic fish community responded more to changes in primary and secondary production than changes in predator densities (Wurtsbaugh et al. 1998). In 1995, the agencies agreed to again stock Lake Trout. A conservative Lake Trout stocking program was initiated with a goal of stocking 50,000 Lake Trout every third year. This stocking regime took place from 1995-2000. In 2002, a sterile Lake Trout stocking program was initiated. Stocking sterile Lake Trout increases management control and reduces the potential for establishing a natural reproducing population. Because of variation in early survival of sterile Lake Trout, the stocking goal was changed to 17,000 fish per year instead of 50,000 fish triennially. This allowed for some survival variability between years, yet maintained the same amount of approximately 50,000 fish over a three-year period.

In 1973, the UDWR began the Bear Lake Bonneville Cutthroat Trout Enhancement Project with two main objectives: 1) determine if the native Bear Lake Bonneville Cutthroat Trout still existed in pure morphologically distinct form, and 2) if the native Bear Lake Cutthroat Trout existed, develop methodologies to enhance the population. Because of the extensive stocking of non-native Cutthroat Trout and Rainbow Trout, the native strain of Bear Lake Bonneville Cutthroat Trout was feared to be extirpated (McConnell et al. 1957). Initial morphological comparison completed by the UDWR determined that the native Bear Lake Bonneville Cutthroat Trout was indeed morphologically distinct and existed in both the lake and at least two tributaries. Bear Lake Bonneville Cutthroat Trout enhancement efforts then focused on developing a hatchery supplementation program. The program included developing a broodstock and collecting spawn from wild populations ascending Swan Creek (UT) and St. Charles Creek (ID). In 1973, the UDWR also constructed Mantua hatchery which was dedicated to holding broodstock and rearing fish for supplementation. During the past four decades, over 30 million Bear Lake Bonneville Cutthroat Trout have been produced and released in Bear Lake. Changes in the hatchery program have been made, but the program continues to support a popular sport fishery and provide a safety net for Bear Lake's native Bear Lake Bonneville Cutthroat Trout. Nielson (1994) provides a detailed review of the Bear Lake Bonneville Cutthroat Trout enhancement program.

Annual stocking of Bear Lake Bonneville Cutthroat Trout during the past decade has varied between 140,000 and 230,000 fish. This is a reduction in stocking when compared to the previous decade where 170,000 to more than 300,000 thousand fish were annually

stocked. Fish are stocked in the spring at a target size of 7 inches. That stocking strategy was developed over many years of performance evaluations completed by UDWR (Nielson 1994). Both states have agreed that Bear Lake should not be used as a source of eggs for transfer to other fisheries.

Creel Surveys

In general, Bear Lake is a very specialized fishery with highly variable catch rates that depend largely on season, target species, and the experience level of individual anglers. Angling pressure is concentrated in the fall-winter months and is associated with spawning activity of Lake Trout, Bonneville Whitefish, and Bonneville Cisco. The dip-net fishery for Bonneville Cisco is perhaps one of the more unique fishing opportunities provided in either state. The dip-net fishery is so unique that creel survey work is generally separated from standard lake surveys, and tens of thousands of Bonneville Cisco can be harvested during the peak spawning period.

The first comprehensive creel surveys were completed in the early 1950s. McConnell et. al. (1957) reported that total angler visits ranged between 9,000 and 12,000. Catch rates ranged from 0.18 to 0.33 fish per hour. Return to creel on Rainbow Trout during the study was less than 5% (McConnel et al. 1957). In the following decades, angling pressure on Bear Lake changed from primarily shore-line angling to fishing from boats. The change resulted in increased angling effort.

Beginning in 1976, creel surveys were completed every two to three years. Some of the surveys were 12-months and others were 6-month surveys. Beginning in 2005 the UDWR and IDF&G agreed to conduct 12 month-long creel surveys once every five years. A summary of selected 12-month creel surveys are shown in Table 2. In general, total angling effort has varied between about 30,000 to 60,000 angler hours (UDWR; annual progress reports). Pressure has been greatest in years when Bear Lake freezes, which provides foot access to the best fishing areas in the lake (Tolentino and Nielson 2003). Catch rates on the lake ranged from about 0.31 and 0.88 fish per hour.

Table 2. Representative 12-month creel surveys from Bear Lake. Rainbow Trout stocking was discontinued in the 1980's, which explains the NA values for the 1999-2010 surveys.

Year	Pressure (hrs)	Catch Rate (fish/hr)	Catch/Harvest			
			Cutthroat Trout	**Lake Trout**	**Rainbow Trout**	**Whitefish**
1953*	51,000	0.33	1,000	500	4,000	7,500
1979*	80,000	0.31	6,900	1,900	4,400	11,400
1984*	116,000	0.31	14,400	1,600	2,800	16,100
1999	53,000	0.88	8,900/3,400	4,100/3,100	NA	3,000/2,200
2002	66,645	0.56	10,000/4,100	3,800/2,200	NA	14,400/8,300
2005	30,000	0.43	2,200/800	5,000/2,300	NA	1,200/1,000
2010	29,708	0.34	5,100/1,700	1,000/400	NA	1,600/1,100

*Harvest only reported in 1953, 1979, and 1984.

MONITORING PROGRAMS AND PREDATION RESEARCH

Bear Lake Sculpin and Bonneville Cisco monitoring programs were developed in the late 1980s. Initial sampling protocols were established by researchers at Utah State University. Once the methods were refined, the monitoring programs have been maintained by UDWR from 1995-present. The monitoring programs are critical management tools necessary to ensure that predator stocking densities are consistent with endemic and native fish conservation goals. Whitefish populations are monitored using standard gill-net surveys. The trend data are included in the species specific goals and objectives section of this document.

In addition to developing standard monitoring programs, Utah State University researchers evaluated predator-prey relationships in Bear Lake. The studies have been instrumental in setting current stocking levels for Lake Trout and Bear Lake Bonneville Cutthroat Trout. One of the first efforts was reported by Ruzycki et al. (1994). Major conclusions from that report indicate that current Lake Trout and Bear Lake Bonneville Cutthroat Trout stocking levels were not jeopardizing endemic prey species. In 1998, a final report on limnology and predator studies was completed by Utah State University (Wurtsbaugh et al. 1998). The primary conclusion from that work stated: *"Results of the limnological analyses, forage fish population surveys, and piscivore population dynamics that have been investigated during the past eight years indicated that the trophic dynamics of the Bear Lake food web was strongly dominated by bottom-up processes. Top-down consumer effects of predators regulating prey populations were not apparent."* In addition to those findings, evidence of potential competition between Lake Trout and Bear Lake Bonneville Cutthroat Trout was hypothesized (Ruzycki and Wurtsbaugh 1995). In a peer reviewed publication, scientists agreed with earlier findings that Bear Lake's fish community is driven by bottom-up controls, but warned of a potential decoupling of predator-prey relationships during extended periods of drought that could reduce endemic fish production (Ruzycki et al. 2001). Additional information on predator-prey relationships in Bear Lake can be found in Albrecht et al. (2004), Mazur and Beauchamp (1999), Orme et al. (1998), and Ruzycki et al. (1994).

MANAGEMENT GOALS

This section of the plan outlines management goals, objectives, strategies, and evaluation methods for the Bear Lake Bonneville Cutthroat Trout, introduced sport fish, and the four endemic species.

Bear Lake Bonneville Cutthroat Trout

Management Goals

- Maintain a viable population of adfluvial Bear Lake Bonneville Cutthroat Trout.
- Maintain a Bear Lake Bonneville Cutthroat Trout sport fishery
- Manage as a “Trophy Water” (UDWR Management Guidelines 2014 and IDF&G Management Strategy)

Management Objectives

- Maintain a Bear Lake Bonneville Cutthroat Trout angler catch rate 0.01-0.2 fish/hour
- Maintain the average size of Bear Lake Bonneville Cutthroat Trout in the creel at 17 inches total length or greater and strive to provide an opportunity to catch “memorable” sized fish.
- Achieve an adult spawning population of 500 (250 females) adfluvial Bear Lake Bonneville Cutthroat Trout for St. Charles Creek.
- Achieve an adult spawning population of 300 (150 females) adfluvial Bear Lake Bonneville Cutthroat Trout for Fish Haven Creek.
- Determine the amount of Bear Lake Bonneville Cutthroat Trout natural recruitment from the major Bear Lake tributaries: Swan Creek, Fish Haven Creek, and St. Charles Creek; and does the contribution vary with lake level and stream flow. Note: this objective would be best accomplished through a university study and is noted in the section entitled: Additional Evaluation Studies for all Species.

Management Strategies

1. Stock 170,000 Bear Lake Bonneville Cutthroat Trout annually, unless natural recruitment is determined to be sufficient to maintain lake populations at which time, a reduction in stocking quota would be considered. Stock Bear Lake Bonneville Cutthroat Trout at an average size of 7 inches (or greater) during early May. Stock Bear Lake Bonneville Cutthroat Trout on the Utah and Idaho sides of Bear Lake where accessible by stocking trucks.

   Rationale: The proposed stocking rate is 2.42 Bear Lake Bonneville Cutthroat Trout per acre at lake elevation 5923.65 feet (70,000 acres). This number is comparable to what was stocked into Bear Lake during the 2000-2007 timeframe during which the angler catch rate for Bear Lake Bonneville Cutthroat Trout decreased from 0.42 fish/hr to 0.07 fish/hr. However, recent (2012-2014) gill-netting and Swan Creek fish trap data (Tolentino 2014) have demonstrated what appears to be increased natural recruitment of Bear Lake Bonneville Cutthroat Trout to the Bear Lake fishery since 2012 (Figure 2). This increase is likely linked to a barrier removal project completed on Fish Haven Creek in 2010. Since then, Bear Lake Bonneville Cutthroat Trout have been observed spawning in Fish Haven Creek annually. In the past, low natural recruitment was due in part from dewatering of some spawning tributaries during or right after the spawning period. In addition, during drought years (2005-2010) some tributaries never reached the lake due to low flows and shallow sand flats at the point where they would typically enter Bear Lake when water levels are at or near full pool. Major efforts in screening irrigation diversions on tributary streams, monitoring of flow in irrigation diversions, and removing fish passage barriers, especially during the last 10 years, have resulted in increased or more consistent in-stream flows and habitat availability. These actions have likely increased natural recruitment to the Bear Lake Bonneville Cutthroat Trout population in Bear Lake.

   Prior to 2000, the UDWR was stocking a minimum 270,000 Bear Lake Bonneville Cutthroat Trout annually and the resulting 1999 and 2002 creel survey revealed that angler catch rate was at levels which would have met the objectives of this plan (Neilson and Tolentino 2000, Tolentino and Nielson 2003) and the average size of fish harvested was approximately 16.75-17.75 inches for the 1999 and 2002 creel surveys, respectively (Tolentino 2007). With the increased natural recruitment

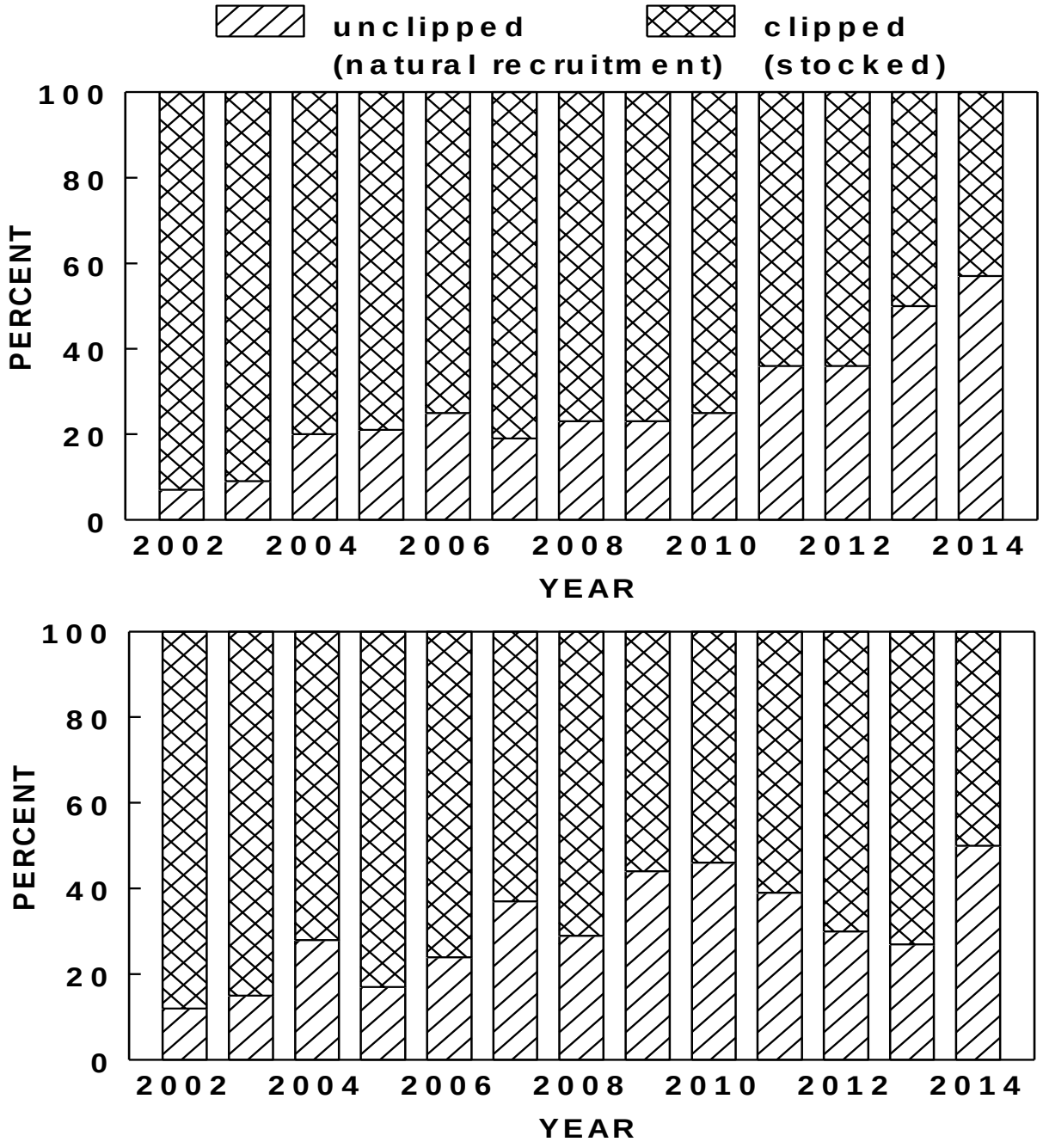

Figure 2. Percentage of adipose fin clipped (stocked) and unclipped (naturally recruited) Bonneville Cutthroat Trout sampled from Bear Lake 2002-2014, taken from standardized gill-net sampling (top) and from the Swan Creek Cutthroat Trout trap (bottom).

we believe stocking at the current level will also be able to maintain the Bear Lake Bonneville Cutthroat Trout fishery at levels to meet the objectives of this plan.

To maximize survival, Bear Lake Bonneville Cutthroat Trout are stocked at seven inches or greater during the time of year when zooplankton abundance begins to increase. The peak zooplankton abundance in Bear Lake occurs between March and September (Wurtsbaugh and Hawkins 1990). Yule (1992) inferred that stocking larger trout reduces the length of time the stocked fish are vulnerable to predation. Recruitment of Bear Lake Bonneville Cutthroat Trout from Bear Lake tributaries has typically made up less than 10% of the standing stock of Bear Lake Bonneville Cutthroat Trout in Bear Lake (Nielson and Birdsey 1991, Nielson and Tolentino 1998, 2000).

2. Consider reducing Bear Lake Bonneville Cutthroat Trout stocking rates if it is determined that naturally recruited Cutthroat Trout are sustaining the desired angler catch rates in both the 2015 and 2020 angler creel surveys.
3. Work with private landowners and irrigation companies to stabilize stream flows in Fish Haven Creek during the irrigation season.
4. Pursue methods to increase the adult spawning population in Swan, St. Charles and/or Fish Haven creeks, if necessary.
5. Be involved as much as possible in tributary water management meetings that may impact natural recruitment of Bear Lake Bonneville Cutthroat Trout.
6. If the average size of harvested Bear Lake Bonneville Cutthroat Trout drops below 17 inches, reevaluate stocking rates of both Bear Lake Bonneville Cutthroat Trout and Lake Trout.
7. Consider methods to reduce non-native species in St. Charles Creek

Monitoring and Evaluation

1. Set gillnets annually in the spring, summer and fall in order to monitor Bear Lake Bonneville Cutthroat Trout, Lake Trout and Whitefish populations by season and depth. Spring netting is used to monitor over-winter survival of Bear Lake Bonneville Cutthroat Trout and to determine trends in populations of endemic fish. In addition, the spring netting allows for diet analyses prior to plankton blooms and prior to stocking of Bear Lake Bonneville Cutthroat Trout. Summer netting is used to examine the diets of fish during lake stratification when plankton and benthic invertebrates are concentrated at the intersection of the thermocline with the bottom; it also allows for monitoring post stock survival of Bear Lake Bonneville Cutthroat Trout. Fall netting is used to examine the condition of Bear Lake Bonneville Cutthroat Trout, Lake Trout, and Whitefish going into the winter. It also allows for determining distribution of fish based on depths and location. The UDWR will undertake an examination of the data during this plan segment, possibly in conjunction with a university study, to determine if the current sampling strategy needs to be adjusted.
2. Conduct comprehensive 12 month angler creel surveys on Bear Lake at five year intervals (latest creel survey is being conducted during 2015).
3. Conduct spot creel surveys on years without comprehensive creel surveys to evaluate size objectives and catch rates as needed.

Lake Trout

Management Goals:

- Provide Bear Lake anglers with the opportunity to pursue Lake Trout.
- Manage as a “Special Opportunity Water” (UDWR Management Guidelines 2014 and IDF&G Management Strategy) which means the water is managed for specific purpose that includes providing a unique species such as Lake Trout.

Management Objectives:

- There is no quantitative management goal for Lake Trout. Lake Trout are stocked primarily to provide another potential trophy component to the fishery. Over a decade of research completed by Utah State University, indicated that past Lake Trout and

Bear Lake Bonneville Cutthroat Trout stocking programs did not appear to be significantly impacting the endemic fish population in Bear Lake (Wurtsbaugh et al. 1998).

Management Strategies:

1. Maintain the Lake Trout population by stocking 17,000 sterile Lake Trout annually. Stock Lake Trout at the largest size available (with a goal of 8 inches) during early-mid November after fall gill-net sampling is completed.

   Rationale: The proposed stocking rate is equal to the annual stocking of approximately 17,000 fish that occurred from 2008-2013 and the 50,000 Lake Trout that were stocked every three years from 1995-2001. Lake Trout provide angling diversity, are very popular with anglers, and have been stocked into Bear Lake since 1911. Even when fertile fish were stocked, very little if any natural recruitment has occurred (Bioenergetics modeling simulations performed by Albrecht et al. (2004) shows that continuing the stocking of Lake Trout at 17,000 fish/year combined with endemic fish monitoring programs will likely ensure sustainability of the Bear Lake food web while simultaneously promoting a diverse and desirable fishery.

Monitoring and Evaluation

1. Monitor Lake Trout abundance in Bear Lake through seasonal (spring, summer, fall) gill-net surveys.
2. Monitor Lake Trout diet. Seasonal diet information will be analyzed from Lake Trout collected in gill nets. If shifts in prey selection by Lake Trout are observed, repeat the bioenergetic modeling completed in the 1990s (Ruzycki and Wurtsbaugh 1999).
3. Conduct comprehensive angler creel surveys on Bear Lake at five year intervals (latest comprehensive creel survey is being conducted during 2015).

Bonneville Whitefish

Management Goals:

- Preserve, protect, and maintain the Bonneville Whitefish population in Bear Lake
- Maintain a sport fishery for Bonneville Whitefish
- Manage as a “Special Opportunity Water” (UDWR Management Guidelines 2014 and IDF&G Management Strategy) which means the water is managed for specific purpose that includes providing a unique species such as Bonneville Whitefish.

Management Objectives:

- Maintain healthy, self-sustaining populations of Bonneville Whitefish
- Due to the natural cyclic nature of Whitefish populations we recognize that having standard creel objectives may be unattainable. It is important to note that Bonneville Whitefish have comprised up to 25% of the creel catch in past years when Bear Lake was ice covered.

Management Strategies:

1. Consider increasing spawning habitat by introducing rock substrate. Tolentino and Albrecht (2007) documented that rock was the primary substrate used by spawning Bonneville Whitefish. Most of the available rock substrate in Bear Lake occurs in the top 20 feet of the water column, which is subject to dewatering related to irrigation withdrawals. Bonneville Whitefish are long-lived (20+ years; Ward 2001 and Thompson 2003) which enabled them to thrive in Bear Lake through previous droughts. However, climate change has been identified as increasing the frequency and severity of drought cycles (www.nrdc.org/globalWarming/fcons.asp), and this may sustain lower water levels for longer periods of time. Thus, adding rocky littoral habitat may be an important addition to help conserve the Bonneville Whitefish as well as other endemics in Bear Lake. Introducing rock along shorelines at elevations of 5914 (UP&L datum) and lower may improve Whitefish spawning success during prolonged drought cycles. Moon (2007) showed that: 1) the artificial rock reefs placed in Bear Lake by the UDWR in 2005 were used in high numbers by both Bonneville Whitefish and Bonneville Cisco indicating that it provided additional habitat for both of these

endemic fish during their spawning seasons; and 2) the artificial rock reefs provided additional foraging habitat for Bonneville Whitefish. Despite concerns of exotic Lake Trout affinity for artificial rock reef spawning, Moon (2007) demonstrated that Lake Trout, did not use the of artificial rock reefs in Bear Lake. Although rocky habitat additions may work in some instances, it simply may not be feasible to add enough rock to positively influence the overall population of Bonneville Whitefish.

Monitoring and Evaluation

1. Set gill nets annually in the spring, summer and fall in order to monitor Bonneville Whitefish populations by season and depth.
2. Conduct comprehensive angler creel surveys on Bear Lake at five year intervals (latest comprehensive creel survey is being conducted during 2015).
3. Whitefish less than 250mm TL should continue to be sub-sampled from gill nets so the percent composition of the total gill-net catch by Bonneville and Bear Lake Whitefish can be computed in order to track individual population trends over time and throughout the seasons.

Bear Lake Whitefish

Management Goals:

- Preserve, protect, and maintain the Bear Lake Whitefish population in Bear Lake.

Management Objectives:

- Maintain healthy, self-sustaining populations of Bear Lake Whitefish.
- Because Bear Lake Whitefish are relatively small, are found mainly at depths greater than 35 meters, they are typically not pursued or harvested by anglers.

Monitoring and Evaluation

1. Set gill nets annually in the spring, summer and fall in order to monitor Bear Lake Whitefish populations by season and depth.
2. Whitefish less than 250mm TL should continue to be sub-sampled from gill nets so the percent composition of the total gill-net catch by Bonneville and Bear Lake Whitefish

can be computed in order to tract individual population trends over time and throughout the season.

Bonneville Cisco

Management Goals:

- Preserve, protect, and maintain the Bonneville Cisco population in Bear Lake.
- Maintain a sport fishery for Bonneville Cisco.
- Manage as a "Special Opportunity Water" (UDWR Management Guidelines 2014 and IDF&G Management Strategy) which means the water is managed for specific purpose that includes providing a unique species such as Bonneville Cisco.

Management Objectives:

- Maintain the lake-wide Bonneville Cisco population above 2.5 million (Figure 3).
- Bonneville Cisco are caught by anglers using hand held dip nets or by snagging during their January spawning season and are used either for bait or consumed. Maintain current regulations that allow for harvest of Bonneville Cisco.

Management Strategies:

1. If Bonneville Cisco abundance estimates begin to decline in a precipitous, annual manner, and the biologists anticipate, using the best available data, future population estimates to fall below the minimum population goal of 2.5 million Bonneville Cisco, IDF&G and UDWR will discontinue Lake Trout stocking. Reductions in Bear Lake Bonneville Cutthroat Trout stocking will also be considered. Once the Bonneville Cisco population stabilizes for two or more consecutive years and recovers to at least 2.5 million fish, Lake Trout and Bear Lake Bonneville Cutthroat Trout stocking programs can be reinstated. **Rationale:** Although USU's research suggested that Bonneville Cisco numbers were not significantly impacted by Lake Trout or Bear Lake Bonneville Cutthroat Trout predation, those studies were completed during a time when Bonneville Cisco abundance was high. If Bonneville Cisco abundance drops below previous recorded lower levels (1.6 million), predation may become a more significant controlling factor and reducing predator densities may be warranted. However, with stocking sterile Lake Trout at conservative rates (Albrecht et. al. 2004)

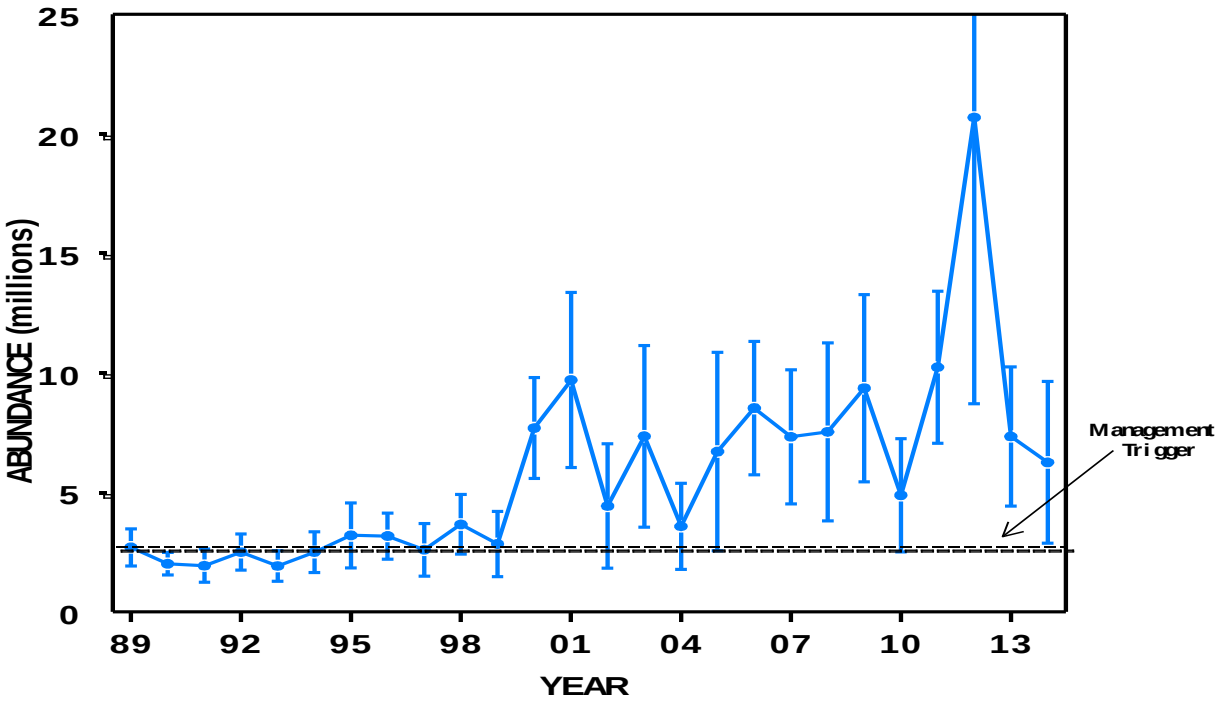

Figure 3. Hydroacoustic estimates of Bonneville Cisco abundance in Bear Lake from 1989 through 2014. The horizontal line represents the management trigger for reducing hatchery stocking of predators.

as compared to the stocking rate in the 1980's, it is likely the predation will continue to be minimal.

2. Consider increasing spawning habitat by introducing rock substrate. Bonneville Cisco prefer to spawn over rocky shoreline areas, (McConnell et. al. 1957, Sigler 1963, Luecke and Bouwes 1992) however, they have been documented spawning over many other areas of the lake in deeper water with differing bottom substrates which included shells, Chara sp. beds, artificial rock reefs, and marl (Moon 2007, UDWR unpublished data). Egg survival over these deep water habitats have not yet been documented. Thus, adding rocky littoral habitat may be an important addition to help conserve the Bonneville Cisco as well as other endemics in Bear Lake. Moon (2007) showed that: 1) the artificial rock reefs placed in Bear Lake by the UDWR in 2005 were used in high numbers by both Bonneville Whitefish and Bonneville Cisco indicating that it provided additional habitat for both of these endemic fish during their spawning seasons; and 2) the artificial rock reefs provided additional foraging habitat for

Bonneville Whitefish. Despite concerns of exotic Lake Trout affinity for artificial rock reef spawning, Moon (2007) demonstrated that Lake Trout, did not use the artificial rock reefs in Bear Lake. Although rocky habitat additions may work in some instances, it simply may not be feasible to add enough rock to positively influence the overall population of Bonneville Cisco.

3. Work with water management entities to maintain water levels in Bear Lake that will provide adequate spawning habitat to maintain Bonneville Cisco populations above 2.5 million.
4. If the Bonneville Cisco population drops below 2.5 million, the agencies will consider reducing or perhaps eliminating the harvest of Bonneville Cisco by sport fishing and dip netting.

Monitoring and Evaluation

1. Conduct annual hydroacoustic surveys on Bear Lake to estimate the population numbers of Bonneville Cisco. Utilize hydroacoustic data as well as spawning season sizes, sex ratios, and length-weight relationships to evaluate population size structure. The data provides the opportunity to track Bonneville Cisco trends over time and project the strength of future year classes.
2. Conduct comprehensive angler creel surveys on Bear Lake at five year intervals.
3. Conduct spot creel surveys on years without comprehensive creel surveys to evaluate size of harvested fish and catch/harvest rates as needed.
4. Continue monitoring endemic and exotic species' use of artificial rock piles. If use of the artificial structure appears to benefit endemics and not exotic species, consider placement of rock similar to the preferred spawning rock substrate along low water shoreline areas.

Bear Lake Sculpin

Management Goals:

- Preserve, protect, and maintain the endemic Bear Lake Sculpin population in Bear Lake.

Management Objectives:

- Maintain densities at 25 or more age-1 and older Bear Lake Sculpin per trawl (Figure 4). Bear Lake Sculpin abundance varies with lake elevation (Wurtsbaugh et al. 1998). During extended periods of drought, Bear Lake Sculpin densities decline. The declines are related to loss of rocky shoreline habitat important to Bear Lake Sculpin spawning success that becomes unavailable at low lake elevations. Wurtsbaugh et al. (1998) suggested that during drought periods, predation by Lake Trout and Bear Lake Bonneville Cutthroat Trout may further depress Bear Lake Sculpin populations.
- Attempt to estimate the number of Bear Lake Sculpin consumed by fish eating birds during the Bear Lake Sculpin spawning season.

Management Strategies:

1. If Bear Lake Sculpin densities fall below the minimum population density of 25 age-1 and older Bear Lake Sculpin per 20 minute bottom trawl for six consecutive years, IDF&G and UDWR will discontinue Lake Trout stocking. Reductions in Bear Lake Bonneville Cutthroat Trout stocking will also be considered. Once the Bear Lake Sculpin population recovers to yield a catch rate of at least 25 age-1 and older Bear Lake Sculpin per 20 minute bottom trawl, Lake Trout and Bear Lake Bonneville Cutthroat Trout stocking programs can be reinstated. **Rationale:** Although, IDF&G and UDWR biologists believe that water level management may be the most significant controlling factor for Bear Lake Sculpin populations, reducing predator densities is warranted if the Bear Lake Sculpin population declines below 25 Bear Lake Sculpin per 20 minute bottom trawl for six consecutive years. Ruzycki and Wurtsbaugh (2001) indicated that if endemic populations were depressed, Lake Trout could compete with native Bear Lake Bonneville Cutthroat Trout for limited prey resources. Bonneville Whitefish also prey on Bear Lake Sculpin, but reducing their numbers should not be considered until hatchery produced predator populations (Lake Trout and Bear Lake Bonneville Cutthroat Trout) reductions are implemented.

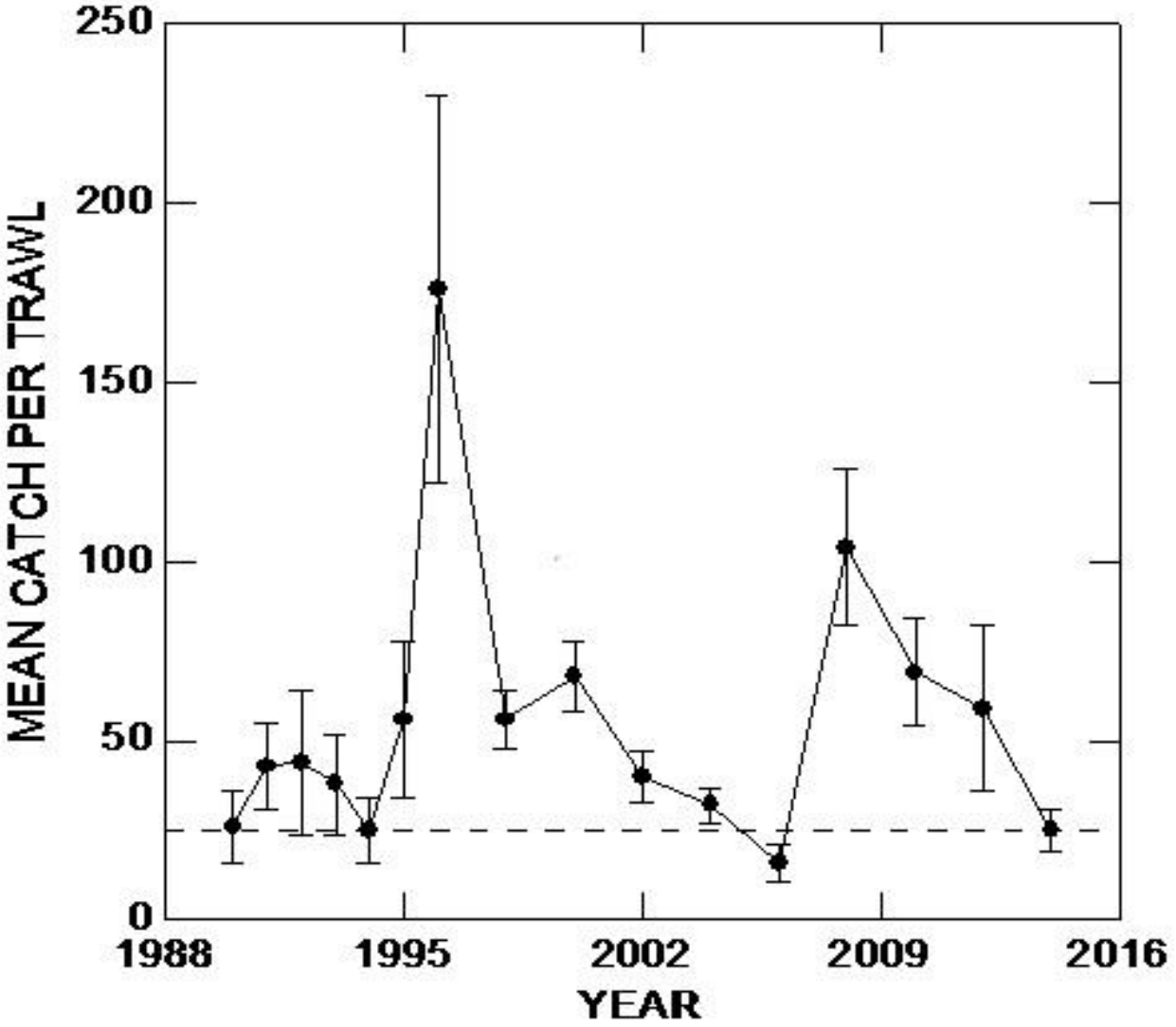

Figure 4. Mean catch per trawl of Bear Lake sculpin > 35 mm total length from Bear Lake between 1990 and 2014*. Densities between 25 and 50 sculpin per trawl extrapolate to a minimum whole lake population estimate between 1 and 2 million fish (Wurtsbaugh et al. 1998). [in 2014 there was a very indeterminate thermocline and could possibly be the reason for the sharp decline in observed sculpin numbers between 2012 and 2014. Therefore, bottom trawling will be conducted in 2015 to determine if this was simply a phenomena of the poor thermocline in 2014 since biologists expected to see an increase in Bear Lake Sculpin due to high lake levels in 2012 and 2013.]

2. In the last 5 years, it appears the number of fish eating birds along the east shoreline of Bear Lake (where the vast majority of the Bear Lake Sculpin spawning habitat is located) has increased several fold (Tolentino, personal observation). Although fish eating birds have always been found at Bear Lake, the increased predation on sculpin during low water years due to extended drought could possibly have a population level affect. Additionally, the reduced lake level concentrates Bear Lake Sculpin on less habitat which obviously makes them easier prey for the birds.
3. Consider increasing spawning habitat by introducing rock substrate. Bear Lake Sculpin spawn in shallow water beneath large cobble and boulders (Ruzycki and Wurtsbaugh 1998). Therefore, similar to Bonneville and Bear Lake Whitefish and Bonneville Cisco populations, irrigation drawdown of Bear Lake can significantly reduce available spawning habitat. Moon (2007) showed that: 1) the artificial rock reefs placed in Bear Lake by the UDWR in 2005 were used in high numbers by both Bonneville Whitefish and Bonneville Cisco indicating that it provided additional habitat for both of these endemic fish during their spawning seasons; and 2) the artificial rock reefs provided additional foraging habitat for Bonneville Whitefish. Despite concerns of exotic Lake Trout affinity for artificial rock reef spawning, Moon (2007) demonstrated that Lake Trout, did not use the of artificial rock reefs in Bear Lake. Although rocky habitat additions may work in some instances, it simply may not be feasible to add enough rock to positively influence the overall population of Bear Lake Sculpin.
4. Work with water management entities to maintain water levels in Bear Lake that will provide adequate spawning habitat to maintain Bear Lake Sculpin populations above a mean of 25 Bear Lake Sculpin per 20 minute bottom trawl.

Evaluation Strategies:

1. Complete bottom trawl surveys every other year. If Bear Lake Sculpin densities decline over a 6-year period (3 sampling periods) annual monitoring will be initiated.

Aquatic invasive species

Management Goals:

- Prevent aquatic invasive species (AIS) introductions utilizing all available methods, means and strategies.

Management Objectives:

- Comply with Utah and Idaho AIS pre-launch inspections/certifications as per current AIS laws.

Management Strategies:

1. Initiate prevention measures to keep AIS from entering the lake, especially Dressenid mussels, Smallmouth Bass, and Walleye.

Evaluation Strategies:

1. Use early summer (close to the day the Bear River inflow is terminated into Bear Lake) gill netting to evaluate the presence/absence of Walleye, Smallmouth Bass, or any other invasive species in Bear Lake.
2. Conduct dressenid mussel attachment surveys and collect water samples for microscopic evaluation and/or DNA assessments using standard methodology.
3. Conduct AIS (especially dressenid mussel and phragmites) outreach with marinas, guides, other non-governmental agencies and other cooperating entities to develop partnerships and increase awareness of AIS threats to the Bear Lake fishery.

Evaluation of Past Plan (2009-2014) Strategies

In the past plan segment (2009-2014) both UDWR and IDF&G studied the objective of "Improve Shore-line Angling Opportunities in Bear Lake". To accomplish this objective approximately 10,000 sterile, Rainbow Trout (approximately 10", 250 mm TL) were stocked off the outside of the Utah State Park marina in 2009 and 2010. An intensive angler creel survey in 2010 was used to assess the return on these stocked fish. The results indicated that the return (catch rate) of these Rainbow Trout in 2010 was about 14%. The goal in the

last plan was at least 30% (catch rate) of these fish, however, that goal was not realized and was likely unattainable. In 2011, the Town of Garden City, UT constructed a 3 acre "community fishery pond" which is located within approximately 500 meters of Bear Lake. During the summer of 2012, UDWR evaluated the return of sterile, Rainbow Trout of similar size, stocked into that pond. The data showed an almost 100% return on the number of fish stocked, with some fish being caught and released several times.

In the future, attempting to create a shoreline fishery for Rainbow Trout in Bear Lake will be discontinued and all stocking of sterile Rainbow Trout will occur in the Garden City Community pond and not in Bear Lake. This will provide a summer fishery in the immediate Bear Lake area for those anglers who do not own a boat.

Additional Evaluation Studies for all Species

Develop needed fisheries research projects for the Bear Lake fishery through increased staffing, universities and/or Cooperative Research Units. Use results of these projects to enhance manager's knowledge and understanding of the fishery so informed management decisions can be made. Examples include but are not limited to:

- Determine the amount of Bear Lake Bonneville Cutthroat Trout natural recruitment from the major Bear Lake tributaries: Swan Creek, Fish Haven Creek, and St. Charles Creek; and determine if the contribution varies with lake level and stream flow.
- Determine the appropriate level of sampling to detect a 15% change in fish population, more specifically, Cutthroat Trout, Lake Trout, Whitefish, Utah Sucker, and Utah Chub.
- Determine how to monitor for Bonneville and Bear Lake Whitefish young-of-year and juvenile year-class survival over spawning and rearing habitat.
- Determine the amount of egg deposition on artificial reefs (constructed in 2005) by endemic species compared to other areas of the lake.
- Pursue research aimed at determining the cost-effectiveness and net-effect of shoreline-placed artificial spawning habitat for Bear Lake Sculpin, Bonneville Cisco, and Bonneville Whitefish.
- Continue to refine stocking strategies to further improve Bear Lake Bonneville Cutthroat Trout post-stock and long-term survival in the lake.

- Monitor pelican predation impacts on spawning Bear Lake Bonneville Cutthroat Trout populations.
- AIS research and prevention.

Date Submitted: June 10, 2015 **Anticipated Plan Review and update**: 2025

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PUBLIC INVOLVEMENT

Public scoping meetings for the original Bear Lake Fish Management Plan (2009) were held in Garden City, Utah and Montpelier, ID. The meetings began with a 30 minute presentation co-presented by Scott Tolentino, of UDWR and David Teuscher, IDF&G. The presentation included: Bear Lake stocking history, overview of the Bear Lake Bonneville Cutthroat Trout enhancement project, review of predator study results, development of native fish monitoring programs, and proposed management goals. Once the presentation was completed, a survey was distributed to meeting participants. The survey was administered to collect public opinions on proposed management strategies for endemic species and plans to enhance sport fishing opportunities. Questionnaire results are shown in Table 3.

In addition to the public meetings, the public meeting presentation was given to attendees at the range-wide Bonneville Cutthroat Trout meeting, the Utah Wildlife Board, the Utah Northern Regional Advisory Council (RAC) and the Utah Blue Ribbon Fisheries Council meeting. No surveys were conducted at these meetings, however, an opportunity was provided to comment on proposed management objectives.

The updated plan (2015) incorporates any new research that was completed during the last plan segment. Some changes were made to the plan, but most were considered minor and therefore, new public meetings were not held. With the improvement of computer-based license tracking and purchasing, both the UDWR and IDF&G can and will conduct an on-line survey regarding any changes of management, opinion surveys, etc. This will allow for better representation of all anglers who fish Bear Lake and not just those that are able to attend a public meeting. This will give biologists a larger and unbiased sample, which should better represent the public's interest regarding Bear Lake fisheries management.

Table 3. Results of public input on proposed management actions for Bear Lake.

Question	Garden City, Utah support	oppose	neutral
Ensure the long-term persistence of endemic fish populations (Bear Lake sculpin, Bear Lake and Bonneville Whitefish, and Bonneville Cisco).	94%	0%	6%
Enhance populations of naturally produced Bonneville Cutthroat Trout.	94%	6%	0%
Provide sport fishing opportunity for Bonneville Cutthroat Trout through a combination of natural production and hatchery supplementation.	100%	0%	0%
Maintain existing sport fishing opportunities for native Whitefish and Bonneville isco.	78%	6%	17%
Continue to provide Lake Trout fishing opportunity by stocking sterile Lake Trout.	78%	6%	17%
Improve shoreline angling success by stocking sterile Rainbow Trout.	83%	6%	11%

Question	Montpelier, Idaho support	oppose	neutral
Ensure the long-term persistence of endemic fish populations (Bear Lake sculpin, Bear Lake and Bonneville Whitefish, and Bonneville cisco).	89%	0%	11%
Enhance populations of naturally produced Bonneville Cutthroat Trout.	100%	0%	0%
Provide sport fishing opportunity for Bonneville Cutthroat Trout through a combination of natural production and hatchery supplementation.	100%	0%	0%
Maintain existing sport fishing opportunities for native Whitefish and Bonneville Cisco.	78%	0%	22%
Continue to provide lake trout fishing opportunity by stocking sterile Lake Trout.	100%	0%	0%
Improve shoreline angling success by stocking sterile Rainbow Trout.	100%	0%	0%

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