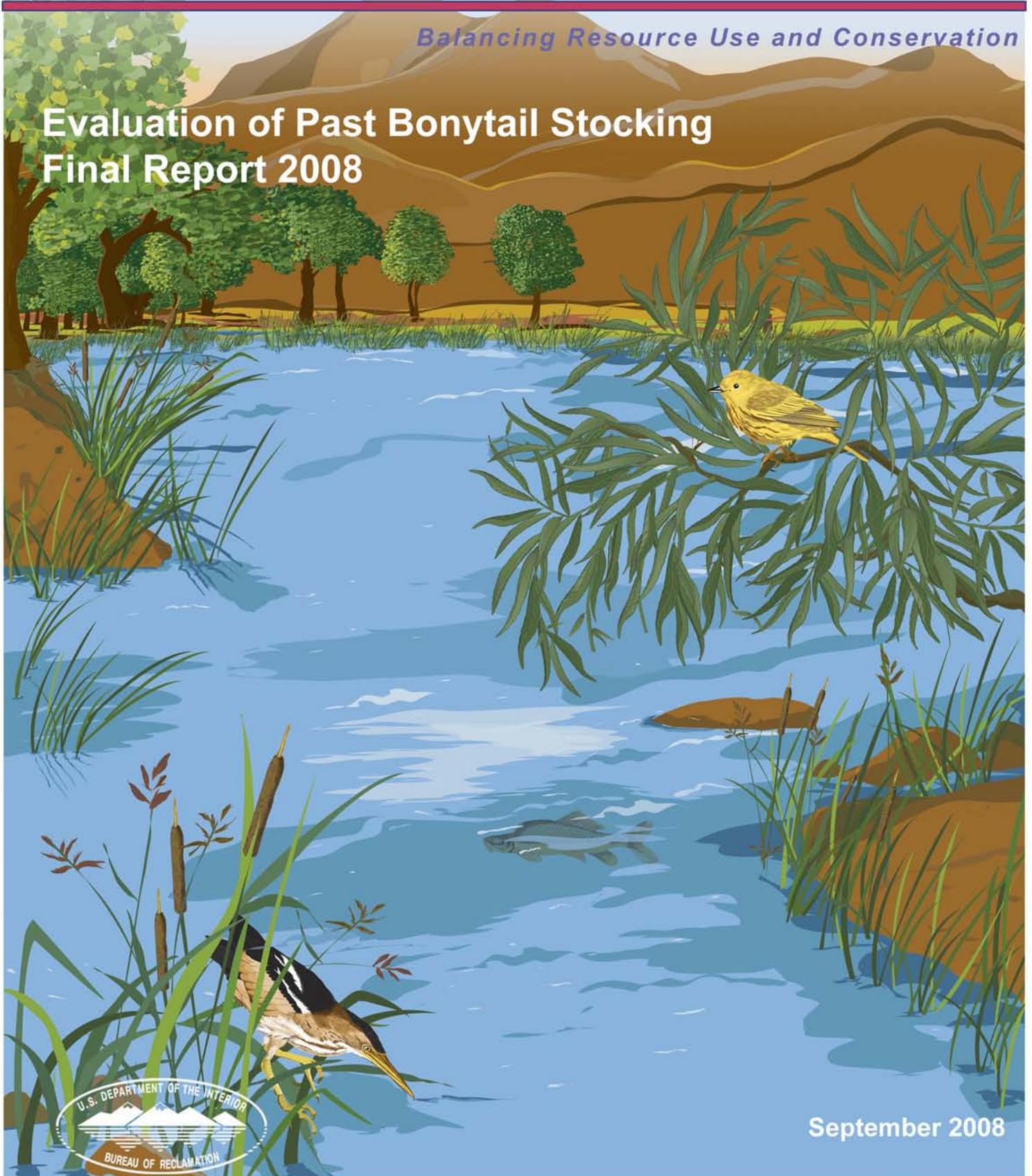




Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Evaluation of Past Bonytail Stocking Final Report 2008



September 2008

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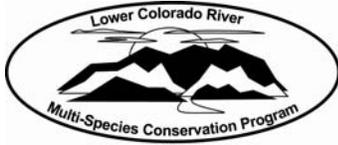
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Lower Colorado River Multi-Species Conservation Program

Evaluation of Past Bonytail Stocking Final Report 2008

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In fulfillment of Agreement No. 07-FG-300001 between Arizona State University and Bureau of Reclamation, Boulder City, Nevada

Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
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September 2008

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DISCLAIMER: The authors exercised reasonable care to ensure that the information presented in this report is correct and accurate; however, we cannot assume responsibility for omissions or inadvertent errors, and the user assumes all risks of use.

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SUMMARY

This report represents part of Work Task C16 of the Multi-Species Conservation Plan for the lower Colorado River. It presents the findings of a comprehensive review of stockings of hatchery-reared, endangered bonytail, *Gila elegans*, into the Colorado River basin. We attempted to identify parameters including physical and chemical characteristics of stocking waters that determine relative success of bonytail stockings, and interpret these results to develop recommendations for specific areas of research and management to pursue to enhance existing programs. Our ultimate goal was to help identify and develop strategies that may increase long-term, post-stocking survival of bonytail in the lower Colorado River basin.

Results of the bonytail stocking compilation led to development of a suite of key recommendations for research and management, which are summarized below for the lower Colorado River basin. Implementation of these recommendations is expected to lead directly to opportunities to increase post-stocking bonytail survival. Some recommendations are generally applicable, while the suitability of others should be evaluated individually by each responsible entity.

1. Further research should be conducted to characterize physiological stress responses to handling at rearing facilities, stress at stocking (e.g., sub-sample fish at stocking site), and delayed, post-stocking responses (e.g., fish captured 7, 14, and 21 d post-stocking).
2. Further research should be performed to determine the effects at stocking of water temperature changes and handling on bonytail of various sizes.
3. Transport and stocking waters should be within the fewest degrees possible of rearing waters, and bonytail should be tempered accordingly at stocking sites.
4. Stocking should occur only in December, January, February, and perhaps as late as March, depending on local conditions.
5. No fish should be stocked that is shorter than 200 mm total length.
6. Weight and year class data should always be included with current stocking data.

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7. Minimum of stocking age should be Age 2, and fish at Age 3+ should be stocked if facility space allows. Fish that reach target size (length) by Age 1 or 2 should be held over in backwaters or off-channel habitats until Age 3+.
8. Bonytail should be stocked at Age 3+ when possible to reduce gender selection.
9. Year classes should remain separate unless fish are PIT-tagged prior to mixing.
10. In Lake Mohave (Reach 2), either reduce the number of fish stocked into the “River” and “Arizona Bay” areas of Lake Mohave, or do not stock these areas. All or most fish should be stocked into the “Basin” and “Lower Lake” areas.
11. In Lake Havasu (Reach 3), either reduce the number of fish stocked into the “Lake Havasu” area, or do not stock this area. All or most fish should be stocked into the “River” and some into “Lower Lake” areas of Lake Havasu.
12. In the lower Colorado River below Parker Dam (Reaches 4 and 5), stock fish at least into both A-7 and C-7 backwaters.
13. PIT-tag all bonytail stocked into the lower Colorado River basin.
14. Continue adult monitoring programs.
15. Water quality measurements should occur at all bonytail stocking and capture locations.
16. Reallocate the number of bonytail stocked into Lake Mohave (Reach 2) for stocking into Lake Havasu (Reach 3) and possibly the lower Colorado River below Parker Dam (Reaches 4 and 5).
17. Continue to create and manage off-channel habitats for bonytail.

INTRODUCTION

Bonytail, *Gila elegans*, is one of the “big river” fishes of the Colorado River basin that was considered common less than half a century ago, numbering in the hundreds of thousands and distributed throughout six western states including parts of Wyoming, Colorado, and Utah, states considered as the “upper basin,” and Nevada, Arizona, and California, states considered as the “lower basin,” plus Baja California Norte and Sonora, Mexico (Figure 1). Water development, and introduction and establishment of non-native species resulted in widespread extirpation and declines in distribution and abundance of this and other native species beginning early in the 20th century, which culminated in its listing as endangered (U.S. Fish & Wildlife Service [FWS] 1980). Wild bonytail populations that remain today are so small that reliable abundance estimates cannot be determined and the species is considered functionally extinct. Bonytail now occur in the Colorado River basin only as scattered repatriates and extremely rare wild individuals in the lower basin’s Lakes Mohave and Havasu, and as captive populations in isolated backwaters and constructed facilities.

In an effort to preclude extinction, bonytail propagation began more than 25-years ago when wild bonytail were collected from Lake Mohave and hatchery personnel at FWS Willow Beach National Fish Hatchery (WBNFH), Willow Beach, AZ, successfully induced five female and male pairs to spawn (Hamman 1982; Minckley et al. 1989). A portion of the F₁ progeny from this historical spawn remain alive today (2008) at FWS Dexter National Fish Hatchery & Technology Center (DNFH & TC), Dexter, NM; the wild adults all have perished. Some of the original progeny and their own offspring are part of a captive breeding program where genetically known paired fish are manually spawned (FWS 2005). More “wild” bonytail were captured in Lake Mohave since the 1980’s, approximately 50 fish, and transported to the facilities mentioned, but they did not survive for use in the program (Minckley et al. 1989; FWS 2005; Pacey and Marsh 2007), or genetic analysis found that at least 25 of these fish had origins from hatchery stock (FWS 2005). No contributions to the bonytail breeding program have been made from the upper basin because of the scarcity of fish in that region (Czapla 1999).

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Young bonytail are produced manually as reported above or naturally (i.e., volunteer spawn from brood stock adults held in ponds), and young from both production methods are distributed based on annual stocking commitments, which vary by Colorado River basin. In the upper basin, the State of Colorado is committed to the annual production of 24,000 fish, 200+ mm average total length (avg TL), and the State of Utah is committed to annual production of 16,280 fish, 200+ mm avg TL for stocking into their respective portions of the Colorado River and its connectives (Czapla 2002; Appendix 1). However, because of overlapping and inconsistent efforts, an addendum to these original plans was adopted and under a revised protocol for the next six years, the State of Colorado is committed to producing 5,330 fish 200+ mm avg TL while the State of Utah is committed to producing 10,660 fish 200+ mm avg TL (Nesler et al. 2003; Appendix 2).

For the lower basin, the FWS committed in their 1996 Biological Opinion to produce 25,000, 250-300 mm avg TL bonytail for stocking into Lake Mohave and 6,000 fish for stocking into Lake Havasu (Devine 1995; Appendix 3). In addition, the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) has production goals of 620,000, 300 mm avg TL bonytail stocked over the next 50 years. Target numbers are: Lake Mohave (Reach 2; 5,000 fish/yr for 40 years), from Davis Dam to Parker Dam (Reach 3; 4,000 fish/yr for 50 years, and between Parker and Imperial dams (Reaches 4 and 5; 8,000 fish/yr for five consecutive years and 4,000 fish/yr for 45 years; Burke 2006, Appendix 4). In 1993, the U.S. Bureau of Land Management, Lake Havasu Fisheries Improvement Project embarked on a ten-year bonytail stocking commitment of 30,000, 250+ mm avg TL fish, which it accomplished by its culmination date in 2003 (Minckley and Thorson 2007).

It has been reliably determined that post-stocking survival of some hatchery-reared native Colorado River fishes is strongly correlated with size at release, with survivorship increasing dramatically within a relatively narrow interval of fish length (e.g., Marsh et al. 2003). Bonytail have been propagated and reared under hatchery conditions for

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several decades and it has been noted that a wide-size variation within a cohort of fish persists through time. This is important because the largest individuals have the highest expectation of survival after release into the wild. Reasons for the phenomenon of variable growth are unknown and could include genetics, seasonal effects, diet, density, temperature, or other conditions of the rearing environment. Regardless, development of methods to reduce growth variations and to rear fish uniformly to substantial size (12-inches [300-mm], or larger) has potential to increase both hatchery efficiency and post-stocking survival (Pacey and Marsh 2007).

Captures of stocked fish are few and long-term survival has been nil. Most early stockings were of small fish that apparently were lost to predation, but long-term survival has been disappointing even for larger fish stocked in recent years. There have been few adaptive adjustments to the programs to incorporate new information or attempts to increase survival of stocked fish. It was the focus of this study to compile bonytail-stocking data for open waters of the Colorado River basin and to assess post-stocking success, with emphasis on the lower basin. We also attempted to identify specific areas for follow-up research and management investigation, and make management recommendations.

METHODS

Compilation of bonytail stockings

A literature review of bonytail rearing practices was recently completed (Pacey and Marsh 2007) and during this process, we accumulated references specifically detailing bonytail stockings throughout open waters of the Colorado River basin (Appendix 5). For upper basin data, collaboration was established with the Colorado River Fishery Project (FWS, Grand Junction, CO), who reviewed stocking data findings from the literature and edited them as necessary. Stocking data from the lower basin was gathered from the Native Fish Work Group's (NFWG) lower Colorado River database, which includes bonytail stocked without tags, PIT- (passive integrated transponder),

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wire tags and other tag types, from Lake Mohave to the lower Colorado River below Parker Dam. We contacted various agencies and made several site visits to acquire accurate information of stocking events where there were uncertainties or data were equivocal.

We addressed several areas of problematic stocking data. Generally, mm avg TL were associated with each stocking event; however, in some instances only a range of TLs was available. In these cases, mm avg TL was estimated as the mid-point of the range (e.g., “120-155 mm avg TL” would be presented here at 137 mm avg TL) and noted. Occasionally, only very general stocking location information was provided (e.g., Lake Mohave), and we made every effort to acquire more specific information. Similarly, we attempted to determine the correct numbers of fish stocked when different totals for the same stocking events were from two or more sources.

Stocking locations were reported in approximate river miles (RM) and we converted all to river kilometers (RK). According to the 2003 integrated stocking plan for Utah and Colorado (Nesler et al. 2003; T. Francis 2007 pers. comm.), there are five bonytail stocking areas for the upper basin. These are defined as the “lower Green” (120-249 RM [193-401 RK]), “middle Green” (249-302 RM [401-489 RK]), and “Dinosaur National Monument” (302-370 RM [489-595 RK]) for the Green River, and “Colorado River” (110.5 RM [178 RK]) and “Colorado River between Palisade and Loma” (154-185 RM [248-298 RK]) for the mainstem Colorado River (Figure 1).

The LCR MSCP divided the lower basin into five reaches, and we further subdivided two of these reaches into general bonytail stocking areas for reporting purposes. There currently is no bonytail stocking into Reach 1, which comprises the Colorado River downstream from Glen Canyon Dam to Hoover Dam and includes Grand Canyon and Lake Mead. Lake Mohave (Reach 2) has four sub-areas – “River” (south from Hoover Dam (63 RM [101 RK]) to 37 RM [60 RK]); “Arizona Bay” (below 37 RM [60 RK] to 23 RM [37 RK]); “Basin” (below 23 RM [37 RK] to 12 RM [19 RK]); and “Lower Lake” (below 12 RM [19 RK] to Davis Dam [0 RM, RK]) (Figure 2). For Lake Havasu (Reach

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3), there were three sub-areas – “River” (south from Davis Dam (82 RM [132 RK]) to 28 RM [45 RK]); “Lake Havasu” (from 28 RM [45 RK] to 19 RM [31 RK]); and “Lower Lake” (less than 19 RM [31 RK] to Parker Dam [0 RM, RK]) (Figure 3). The lower Colorado River below Parker Dam (Reaches 4 and 5), extends from that structure at 192 RM [309 RK] downstream to the Southerly International Boundary (Figure 4).

Physical and chemical characteristics of stocking waters

We reviewed and gathered water quality data from 1981 to present (2007) from the U.S. Geological Survey (USGS) “Water Data for the Nation” website, www.waterdata.usgs.gov/nwis. Water sampling stations were selected based on proximity to bonytail stocking areas, and are as follows:

- Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34", longitude 109°14'05" (NAD27), datum of gage: 4,758.00 FASL (NGVD29), drainage area: 29,660.00 SM, and contributing drainage area: 25,400.0 SM]
- Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10", longitude 110°09'02" (NAD27), gage datum: 4,040.18 FASL (NGVD29), drainage area: 44,850 SM]
- Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06", longitude 108°31'28" (NAD27), gage datum: 5,600 FASL (NGVD29), and drainage area: 7,660 SM]
- Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00", longitude 108°27'00" (NAD27), gage datum: 4,628.12 FASL (NGVD29), drainage area: 7,928 SM and contributing drainage area: 7,928 SM]

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- Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38", longitude 109°17'34" (NAD27), gage datum: 4,090.00 FASL (NGVD29), drainage area: 24,100 SM]
- Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30", longitude 114°34'17" (NAD27), gage datum: 490 feet above sea level (FASL; NGVD29), drainage area: 173,300 square miles (SM), and contributing drainage area: 169,300 SM]
- Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44", longitude 114°08'22" (NAD27), gage datum: 300.54 FASL (NGVD29), drainage area: 182,700 SM, and contributing drainage area: 178,700 SM]

USGS had many parameters available; however, we focused on water temperature (°C), discharge (instantaneous, cubic feet per second, CFS), turbidity (nephelometric turbidity units [NTU]), specific conductance (microsiemens per centimeter at 25 °C [pS/cm] and measured in the field), (milligrams per liter [mg/L]), pH (unfiltered water in field), and suspended sediment concentration (mg/L). Data were downloaded for each parameter by water sampling location, generally from 1996 to present (2007) for upper basin and 1981 to present (2007) for lower basin.

Bonytail post-stocking assessment

We found upper basin stocking events and post-stocking data described in Chart and Cranney (1993), Meismer and Trammell (1999), Cavalli and Hudson (2000), Hudson and Jackson (2001), Badame and Hudson (2003), Bestgen et al. (2006), McAda (2006), and Francis (2008). We gathered additional post-stocking data from electronic communications among parties.

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In the lower basin, we identified post-stocking data by reviewing capture data in the NFWG database and literature found in Pacey and Marsh (2007) as well as in electronic communications among parties. PIT-tagged captures were associated with their stocking event when possible and noted where appropriate. Time at large (TAL) between stocking and capture was calculated by subtracting most recent capture date by stocking date for days at large (DAL) and then dividing this number by 30 days for months at large (MAL). We reported capture areas in the same general stocking areas as described above.

RESULTS AND DISCUSSION

Bonytail stocking summary

The most recent bonytail stocking documents for the Colorado River basin are included in the appendices as previously mentioned. It was not our intent to compare what we found in the stocking data to these documents although we mention items from the current programs when appropriate.

The following stocking totals are approximate and as accurate as possible. We made every attempt to locate stocking data including contacting agencies, hatcheries and data managers. However, there were stocking events that we could not confirm reported in Appendix 6.

Colorado River Basin

More than 1.3-million bonytail have been stocked into the Colorado River basin ($N=1,318,205$), comprised of 177K PIT-tagged, 463K wire-tagged, and 675K untagged fish; 3,052 fish were stocked with an unknown tag type (Table 1). Not included in this total are 148K fish that we were unable to confirm if they were stocked into open water

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or into lakeside backwaters (see Appendix 6 for additional information), and an estimated 115K escaped bonytail larvae (Christopherson et al. 2004).

There were four rivers in the upper basin that received bonytail – Green, Yampa, mainstem Colorado and Gunnison Rivers (Table 1). As of 2007, nearly more than 900K fish were stocked ($N=937,019$), comprising 119K PIT-tagged, 334K wire-tagged, and 481K untagged fish. Green River received most of the stocked fish for the upper basin ($N=738,347$; 79% of total upper river stockings) as 67K PIT-tagged, 190K wire-tagged and 481K untagged fish. Yampa River received 30K wire-tagged fish, which was 3% of total upper river stockings. The mainstem Colorado River received 169K fish (18% of total upper river stockings) as 52K PIT-tagged and 114K wire-tagged fish. Two PIT-tagged fish were stocked into the Gunnison River.

More than 89% of total fish stocked were < 200 mm avg TL ($N=839,134$) when they were stocked into the upper basin (Table 2); however, 478K were untagged larvae stocked as part of an experimental study (Modde and Haines 2005) (Tables 2A and 2B). To date (2007), more than 67K fish were stocked that were near or longer than the current stocking target size of 200 mm avg TL; 31K fish had no mm avg TLs available (Table 2). Of PIT-tagged fish, more than 56% were ≥ 200 mm avg TL ($N=66,585$); 16,619 PIT-tagged fish had no avg TLs available (Table 2A). All of the wire- and untagged fish were smaller than 200 mm avg TL ($N=803,146$) with the exception of 115 adult research study fish ≥ 350 mm avg TL and 3,000 excess bonytail stocked with fin-clips in 2007; 8,514 wire-tagged fish had no associated avg TLs and 3,052 fish were stocked with an unknown tag type (Tables 2A and 2B).

Bonytail stockings into the waters of the lower basin included Lakes Mohave (Reach 2), and Havasu (Reach 3), and the lower Colorado River below Parker Dam (Reaches 4 and 5) (Table 1). To date (2007), agencies stocked 381,186 fish as 57K PIT-tagged, 129K wire-tagged, and 194K untagged fish; it was unconfirmed which area received 902 PIT-tagged fish (either Lakes Mohave or Havasu). Lake Mohave received more total bonytail than Lake Havasu ($N=220,057$ and $N=153,802$, respectively), but it has

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received 10K fewer PIT-tagged fish ($N=22,875$ and $N=32,864$, respectively) and substantially fewer wire-tagged fish ($N=29,215$ and $94,438$, respectively). Both reservoirs received untagged fish, Lake Mohave with 167K and Lake Havasu with 26K. The lower Colorado River area below Parker Dam (Reaches 4 and 5) received 6,425 bonytail stocked total to date (2007).

To date (2007), more than 39K fish have been stocked that were near or longer than the current stocking plan target of ≥ 300 mm avg TL; 15K fish had no avg TLs available (Table 2). More than 23% of PIT-tagged fish were ≥ 300 mm avg TL ($N=12,921$); 880 PIT-tagged fish had no avg TLs available (Tables 2A and 2B). However, this was less than half of the number of wire-tagged fish stocked at this same size ($N=26,312$). All of the untagged fish stocked into the lower basin were smaller than 200 mm avg TL ($N=179,985$), contributing to the 64% of total fish stocked < 200 mm avg TL ($N=280,094$); 14K untagged fish had no avg TLs available.

Upper Colorado River Basin¹

Green River, UT-CO – DNFH & TC produced all bonytail stocked into the Green River, primarily through manual production with the exception of a few fish ($N=86$) stocked from the original paired wild fish spawning at WBNFH, for a grand total of over 738K fish stocked (Tables 3-5, and Appendix 7). Manual production derived from paired matings is a requirement of the Utah and Colorado stocking plans (Nesler et al. 2003, Appendix 2). All of the wire-tagged fish ($N=189,950$) were reared at Wahweap State Fish

¹ Recently it was reported that 13,168 PIT-tagged bonytail were stocked between 1996 and 1999 in the upper basin (Francis 2008); however, our research suggested 13,230 fish (Table 3 and 5). Similarly, Francis (2008) reported 86,246 PIT-tagged fish stocked between 2002 and 2006, and we found 89,568 fish. Part of this latter discrepancy could be related to the 3,052 fish with unknown tags that we could not confirm (Table 1), and both discrepancies likely are related to data preening during general database management.

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Hatchery (SFH, Utah Division of Wildlife Resources), Big Water, UT while PIT-tagged fish ($N=67,311$) were reared there and at J. W. Mumma Native Aquatic Species Restoration Facility, Alamosa, CO (NASRF, Colorado Division of Wildlife).

Of PIT-tagged fish, a majority of PIT-tagged fish ($N=42,221$; 63% of total stocked) were stocked into the “Dinosaur National Monument” area, while 25,068 fish (37% of total stocked) were stocked in the “lower Green” area; there were nine fish we could not determine a more accurate stocking location for than “Green River”. There were 13 fish stocked into the “middle Green” area (Table 3). All wire-tagged fish were stocked into the “lower Green” area ($N=143,428$) with the exception of 46,522 fish whose exact stocking location was unavailable (Table 4). Untagged fish were stocked into the “middle Green” and “Dinosaur National Monument” areas ($N=447,500$ and 33,500, respectively; Table 5).

Bonytail have been fairly consistently stocked into the Green River since 1998 with the exception of two stockings in 1988 and 1989 of research fish (Tables 3-5). The first batch was PIT-tagged, but thereafter most of the fish stocked were wire-tagged until the program was revised in 2002-2003 (Nesler et al., 2003). After that time all fish put into the system were PIT-tagged and generally greater than 200 mm avg TL (Hudson and Jackson 2001; Nesler et al. 2003). More than 50K fish have since been stocked at or above this size, which is almost 75% of total PIT-tagged fish; 2,587 PIT-tagged fish had no associated avg TLs available (Table 3). All of the wire-tagged ($N=190K$) and untagged fish ($N=481K$) were shorter than 200 mm avg TL with the exception of 86 untagged fish that were longer than 400 mm avg TL and part of a telemetry study (Tables 4 and 5). The untagged fish were bonytail stocked as part of two studies in 2003 and 2004, and one study included approximately 478K untagged larvae (7 mm avg TL) stocked into various floodplains and refuges near the “middle Green” area (265 RM [427 RK] to 307 RM [494 RK]; Modde and Haines 2005). In 1988 and 1989, a telemetry study included large adult bonytail (> 400 mm avg TL) released into the Green River with a variety of tags (radio tag, Carlin and/or floy tags). These were released at several locations on the Green River, all in the “middle Green” area, above of Desolation

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Canyon (approximately 200 RM [322 RK] to the upper end of Island Park (334 RM [538 RK]); Chart and Cranney 1993).

More than 93% of PIT-tagged fish have been stocked during autumn (generally September, October and November; $N=62,628$), whereas the majority of wire-tagged fish have been stocked in April ($N=76,509$); more than 61K wire-tagged fish were stocked in months unavailable (32%; Tables 3 and 4). The majority of fish stocked with no tags were larvae, and these were stocked shortly after their production in May (Table 5).

Yampa River, CO – Approximately 30K, shorter than 200 mm avg TL wire-tagged bonytail, produced by manual spawning at DNFH & TC and reared at Wahweap SFH, have been stocked into the Yampa River, April, May and July, 2000-2001 (Appendix 8).

Mainstem Colorado River, UT-CO– DNFH & TC produced all bonytail stocked into the mainstem Colorado River, primarily through manual production, for a total number of 168,670 fish stocked in the mainstem Colorado River (Tables 6 and 7, and Appendix 9); included in this total were 3,052 fish stocked with an unknown tag type and not reported in Tables 6 and 7. Wahweap SFH, NASRF and Trinidad State Junior College reared both wire- and PIT-tagged fish, with more than 81% of all bonytail reared at Wahweap SFH ($N=136,801$). Almost all stockings ($N=120,003$; 71% of total stocked) were at known stocking locations; specific stocking locations were unavailable for the remainder of the fish stocked in Colorado River watershed ($N=48,667$). Both wire- and PIT-tagged fish have been stocked into the mainstem Colorado River fairly consistently since 1996, with a majority of all fish stocked < 200 mm avg TL ($N=126,883$; 75% of total stocked); 12% of fish stocked had no associated avg TLs available ($N=19,814$). Only 11% of total fish stocked were \geq 200 mm avg TL ($N=18,971$).

Most PIT-tagged fish were stocked in the autumn ($N=39,037$; 75% of total PIT-tagged fish stocked), while most wire-tagged fish were stocked in spring (generally March, April, and May; $N=61,534$; 54% of total wire-tagged fish stocked); both tag types had

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fish with unknown stocking months ($N=34,837$) (Tables 6 and 7). No records were found of fish stocked into the mainstem Colorado River without any type of tag.

Gunnison River, CO – Two PIT-tagged fish with no available mm avg TL, produced by unknown spawning methods at DNFH & TC and reared at NASRF, were stocked into the Gunnison River in September 2003 (Appendix 10).

Lower Colorado River Basin

Lake Mohave (Reach 2), AZ-NV² – Wild bonytail from Lake Mohave were spawned at WBNFH by Roger Hamman in 1981 and they were the first source of hatchery-produced, F_1 bonytail repatriated into Lake Mohave later that year ($N=54,837$) (Hamman 1982). Thereafter, bonytail were produced only at DNFH & TC (by an unknown process, either by manual or natural spawning; $N=165,223$), for a grand total of more than 220K tagged fish stocked into Lake Mohave (Tables 8-10, and Appendix 11). Fish have been stocked in the lake most years since 1981, with stocking of PIT-tagged fish beginning in 1993 and continuing to 2006 (Table 8). Wire-tagged fish were generally not stocked into Lake Mohave with the exception of a batch of fish in 1994 (Table 9), but changes in stocking plans in 2005 with the LCR MSCP (Burke 2006, Appendix 4) have now allowed for wire-tagged fish stocked in batches containing PIT-tagged fish. For the first decade of bonytail stockings (1981-1991), almost 168K fish were stocked with no wire or PIT tags – 41,517 fish had oxytetracycline tags and 1,162 fish were fin-clipped; the remaining fish were unmarked ($N=125,288$; Table 10 and Appendix 11).

² Recently it was reported that 180,129 bonytail of all tag types and untagged were stocked between 1981 and 2002 in Lake Mohave (Reach 2; Minckley and Thorson 2007), however our research found 192,450 fish (Tables 7, 8 and 8A). The discrepancy is likely related to additional data found during our study as well as data preening during general database management.

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In the Colorado River below Hoover Dam and above Davis Dam, bonytail are reared either in lakeside backwaters or at off-site facilities; all fish from lakeside backwaters are PIT-tagged (Table 8). Most of the lakeside backwaters are in the “Basin” area with the exception of Yuma Cove (24.5 RM [39.4 RK]), AZ which is in the “Arizona Bay” area, and Davis Cove (0.5 RM [0.8 RK]), AZ which is in the “Lower Lake” area. Few PIT-tagged bonytail stocked have been reared in lakeside backwaters ($N=590$; 3% of total stockings) as compared to the number of fish reared at off-site facilities ($N=22,285$) because lakeside backwaters are not a specific rearing location for bonytail as they are for rearing razorback sucker (*Xyrauchen texanus*). Generally, fish reared at lakeside backwaters are stocked directly out of those backwaters into Lake Mohave at the same general locations (Table 11).

Off-site facilities are located in five states – Arizona (WBNFH and Achii Hanyo Fish Hatchery (FH, FWS), Arizona-California (Cibola NWR), California (Niland Warmwater FH, California Department of Fish and Game; no longer in service), Nevada (Boulder City [BC] golf course ponds and wetlands park, Bureau of Reclamation), New Mexico (DNFH & TC) and Texas (Uvalde NFH, FWS); all wire-tagged fish stocked into Lake Mohave were from off-site facilities ($N=29,215$). Both wire- and PIT-tagged fish come from BC golf course ponds, DNFH & TC, Uvalde NFH, and WBNFH, only wire-tagged fish come from Achii Hanyo FH and only PIT-tagged fish come from BC Wetlands Park and Cibola NWR HLP. DNFH & TC and WBNFH also stocked fish with only oxytetracycline tags, fin clips, or no tags. Fish reared at off-site facilities are stocked into a variety of locations around Lake Mohave (Table 11).

Bonytail have been stocked throughout Lake Mohave (Reach 2), from Davis Cove in the “Lower Lake” area at 0.5 RM (0.8 RK) to 60 RM (97 RK) above Davis Dam, which is only seven RM (11 RK) below Hoover Dam. Stockings occurred on both Arizona and Nevada sides of the lake, and in different habitat types such as along coves and near the mid-channel of the reservoir. Most of the stockings with known locations (excluding fish stocked into “Lake Mohave”) occurred in the general “Arizona Bay” area of the lake

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($N=50,266$; 46% of total stockings). However, when tag types are separated, most PIT-tagged fish were stocked into the “River” area ($N=11,402$, 50% of PIT-tagged fish stocked) while both wire- and untagged fish were stocked mainly into the “Arizona Bay” area ($N=12,210$ and $34,740$, respectively). There were 1,200 PIT-tagged and 110K untagged fish stocked with unavailable stocking locations (51% of total stockings).

All months of the year have seen bonytail stockings into Lake Mohave over the years. However, hatchery facilities suggested that stocking personnel postpone stocking until cooler months of the year (November and December) to lower handling stress and potentially increase survival (Pacey and Marsh 2007). In years prior to wire- and PIT tagging (1981-1991), 74% of fish were stocked in October ($N=124,814$).

To date (2007), more than 167K bonytail were stocked ≤ 249 mm avg TL which was 76% of total number of fish stocked; approximately 20K have been stocked with avg TLs of 300+ mm (9% of number of fish stocked). More than 14K fish stocked had no avg TL available.

Lake Havasu (Reach 3), AZ-NV-CA – All fish stocked into Lake Havasu were produced at DNFH & TC by either manual or natural spawning, for a total of 127,302 fish stocked into Lake Havasu (Tables 12-13, and Appendix 12). Similar to Lake Mohave, fish are reared in both lakeside backwaters and off-site locations, although less than 1% of PIT-tagged fish have been reared in lakeside backwaters ($N=207$) as compared to those PIT-tagged fish reared in off-site locations ($N=32,657$); all wire-tagged fish were reared in off-site facilities ($N=94,438$). Unlike Lake Mohave, lakeside backwaters on Lake Havasu were targeted for rearing bonytail, but it proved challenging (Minckley and Thorson 2007). Arizona off-site rearing locations include Achii Hanyo FH, Bubbling Ponds SFH (Arizona Game and Fish, AZGFD), Emerald Canyon Golf Course ponds, Parker (FWS), Office Cove tanks, Bill Williams NWR (FWS), Palm Lake and “Hassayampa Preserve” in Hassayampa River Preserve (Arizona Nature Conservatory), and WBNFH. Other sites include DNFH & TC, Cibola NWR HLP, and Uvalde NFH. Only Achii Hanyo FH and DNFH & TC stocked fish with both wire and PIT tags, all of

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the other off-site locations PIT tag their fish with the exception of Uvalde NFH, which only wire-tags fish.

Ninety-three percent of PIT-tagged and 43% of wire-tagged fish were stocked into the “Lower Lake” (0-11.5 RM [0-0.8 RK]) area ($N=30,722$ and $41,066$, respectively). Few PIT-tagged fish were stocked above 15.8 RM (25 RK) while few wire-tagged fish were stocked about 11.5 RM (19 RK) with the exception of 5,172 fish stocked about 43.5 RM (70 RK) in the “River” area.

Bonytail have been consistently stocked into Lake Havasu since 1992 and during all months, although the majority of all stockings occurred during autumn ($N=107,349$; 49%). Only 7% of the wire-tagged fish were 300+ mm avg TL at stocking ($N=6,580$) whereas 17% of PIT-tagged fish were 300+ mm avg TL at stocking ($N=5,627$). Most fish stocked were < 200 ($N=87,875$; 40% of total stocked).

Some PIT-tagged bonytail stocking data were located for which we were unable to ascertain into which reservoir these fish were stocked, and therefore these are not included in total for either lakes Mohave or Havasu (Appendix 10).

Lower Colorado River below Parker Dam (Reaches 4 and 5), AZ-CA – Three bonytail stockings totaling 6,425 fish occurred in the lower Colorado River below Parker Dam from fish produced by manual or natural spawning at DNFH & TC (Appendix 10). All fish were reared at Achii Hanyo FH and stocked in December, one stocking in 2006 and two in 2007. The fish stocked in 2006 were released at 120 RM (193 KM) of A-7 backwater, upper area, AZ, and their avg mm TL was 313. They were a mix of 600 fish both PIT- and wire- tagged, and 3,407 wire-tagged only. The two stockings in 2007 were at 120 RM (193 KM) as well and at 188 RM (303 RK), River Island State Park, AZ. The mm avg TL of fish at both stockings was 320 and fish were of 2005-year class. The fish stocked into River Island State Park were wire-tagged only ($N=1,208$), while the fish stocked at A-7 backwater had a combination of both PIT and wire tags ($N=150$), and wire tags only ($N=1,060$).

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Physical and chemical characteristics of stocking waters

The following are monthly averages for selected parameters from U.S. Geological Survey water sampling data that coincided with stocking months; not all months were represented each year, unless otherwise noted. Water quality data were not available for all stocking months, and not all water sampling areas had water quality data.

Discussion regarding physical and chemical characteristics of the Gunnison River is omitted as no repatriate stockings occurred there; however, for reference, its data are presented in Tables 14-20 and Appendices 13-19.

Water temperature (Table 14 and Appendix 13)

In the “middle Green” area (Green River near Jensen), water temperature ranged from 2 to 23 °C, and in the “lower Green” area (Green River at Green River), water temperature ranged from 1 to 24 °C. In the Yampa River (near Deerlodge Park and the only un-impounded stream among those for which we acquired data), it ranged from 0 to 24 °C and in the mainstem Colorado River (Colorado River near Cisco), water temperature ranged from 1 to 23 °C. Below Davis Dam, water temperature in the Colorado River ranged from 11 to 19 °C, while below Parker Dam, it ranged from 12 to 26 °C. Optimum temperature for all life stages of bonytail have not been determined; however, Vanicek and Kramer (1969) found wild spawning adults in 18 °C and Marsh (1985) found percent hatch and survival for bonytail eggs and larvae were highest at 15 and 20 °C. Hamman (1982) found under hatchery conditions, bonytail adults spawned and eggs hatched best at 20 to 21 °C.

Discharge (Table 15 and Appendix 14)

Discharge in the “middle Green” area ranged from 1,585 to 12,414 CFS and in the “lower Green” area it ranged from 2,305 to 11,893 CFS. In the Yampa River, it ranged from 142 to 8,343 CFS, and in the mainstem Colorado River, it ranged from 2,725 to

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15,256 CFS. Below Davis Dam, discharge in the Colorado River ranged from 14,130 to 26,657 CFS, while below Parker Dam, it ranged from 7,165 to 18,475 CFS. Most hatchery fish do not live under flow or flow-through conditions (Pacey and Marsh 2007).

Turbidity (Table 16 and Appendix 15)

No turbidity data were available for the “middle Green” area, Yampa River or Colorado River below Parker Dam. Turbidity ranged from 12 to 1,117 NTU in the “lower Green” area. In the mainstem Colorado River, it ranged from three to 700 NTU. Below Davis Dam, turbidity in the Colorado River ranged from one to two NTU. Only Wahweap SFH reported turbidity in their ponds, 4.83 NTU (Pacey and Marsh 2007).

Specific conductance (Table 17 and Appendix 16)

Specific conductance in the “middle Green” area ranged from 332 to 791 pS/cm while in the “lower Green” area it ranged from 444 to 875 pS/cm. In the Yampa River, it ranged from 195 to 727 pS/cm, and in the mainstem Colorado River, it ranged from 536 to 2,034 pS/cm. Below Davis Dam, specific conductance in the Colorado River ranged from 966 to 1,023 pS/cm, while below Parker Dam, it ranged from 958 to 1,070 pS/cm. WBNFH reported total dissolved solids at 820 mg/L, DNFH & TC reported conductivity ranging from 3,950-4900 (no units provided) and total dissolved solids from 3,938-4,564 mg/L, and Wahweap SFH reported specific conductance at 1,568 μ mhos (Pacey and Marsh 2007).

Dissolved oxygen (Table 18 and Appendix 17)

Dissolved oxygen (DO) in the “middle Green” area ranged from 8.2 to 11.2 mg/L, and in the “lower Green” area it ranged from 6.8 to 12.3 mg/L. In the Yampa River, it ranged from 7.1 to 11.8 mg/L, and in the mainstem Colorado River, it ranged from 7.0 to 12.3 mg/L. Below Davis Dam, DO in the Colorado River ranged from 7.9 to 11.3 mg/L, while

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below Parker Dam, it ranged from 7.7 to 10.3 mg/L. Dissolved oxygen ranged from three to 15 mg/L at rearing facilities (Pacey and Marsh 2007).

pH (Table 19 and Appendix 18)

In the “middle Green” area, pH ranged from 8.0 to 8.5, and in the “lower Green” area, it ranged from 8.1 to 8.4. In the Yampa River, pH ranged from 8.1 to 8.6, and in the mainstem Colorado River, it ranged from 8.1 to 8.4. Below Davis Dam, pH in the Colorado River ranged from 7.8 to 8.1, while below Parker Dam, it ranged from 8.0 to 8.2. The pH at rearing facilities ranged from 7.5 to nine (Pacey and Marsh 2007).

Suspended sediments (Table 20 and Appendix 19)

In the “middle Green” area, suspended sediments ranged from 80 to 825 mg/L, and in the “lower Green” area, it ranged from 94 to 1,796 mg/L. In the Yampa River, suspended sediments ranged from 12 to 1,169 mg/L, and in the mainstem Colorado River, it ranged from 56 to 960 mg/L. Below Parker Dam, suspended sediments concentrations in the Colorado River ranged from two to six mg/L. Wahweap SFH reported < 4.0 mg/L total suspended solids (Pacey and Marsh 2007).

Bonytail post-stocking assessment

Upper Colorado River Basin

Most of the upper Colorado River capture data (and stocking events) were reported in Chart and Cranney (1993), Meisner and Trammell (1999), Cavalli and Hudson (2000), Hudson and Jackson (2001), Badame and Hudson (2003), Bestgen et al. (2006) and McAda (2006). Francis (2008) reported that between 1996 and 2006, 286 PIT-tagged bonytail have been captured collectively in the Green River ($N=181$) and mainstem Colorado River ($N=105$) areas, and 619 untagged, wire-tagged or PIT-tagged fish with no paired release data were captured in the upper basin – 905 bonytail total for the

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upper basin to date (2006). These captures represent less than one one-tenth of one percent of the total number stocked. More recently, 17 bonytail were captured in the “lower Green” area (as of July 2007), two of which were untagged and longer than 400 mm TL at capture, with one a reproductive male (P. Badame, 2007, Utah Division of Wildlife Resources, unpublished data).

Lower Colorado River Basin

In the lower basin, there have been 458 bonytail captures to date by adult monitoring efforts of the NFWG (2007) (Pacey unpublished data). These captures represent approximately one-tenth of one percent of the total number of fish stocked. For thorough analysis, we divided captures into two groups: paired-capture data (i.e., fish with stocking data paired with capture data) and unpaired-capture data (i.e., fish with no stocking data to pair with capture data).

Paired-Capture Data

To date (2007), we collected 38 PIT-tagged bonytail with paired release and capture data in the lower basin; however, we excluded three fish from further analysis due to unknown release location, same-trip capture and fewer than four to five DALs, (Appendix 20). The breakdown by area for the 35 captures was six fish from Lake Mohave, 24 fish from Lake Havasu, and five fish in the lower Colorado River below Parker Dam (Table 21).

The current LCR MSCP plan (Burke 2006; Appendix 4) recommends stocking fish at 300+ mm avg TL and that is consistent with the size of fish captured (Appendix 20). For example, none of the total fish captured were smaller than 200 mm TL at stocking, 37% were 200-299 mm TL ($N=13$) and 63% were 300+ mm TL ($N=22$). By reservoir area, Lake Mohave captures had two fish 200-249 mm TL, two fish 250-299 and two fish 300+ mm TL. For Lake Havasu, nine fish were 250-299 mm TL and 15 fish were 300+ mm TL. In the lower Colorado River below Parker Dam, all five fish were 300+ TL.

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TAL for fish ranged from slightly more than one month to three years (Table 21). Lake Mohave fish ranged from 107 DAL (approximately four MAL) to 936 DAL (approximately 31 MAL) or almost three years. Lake Havasu fish ranged from 61 DAL (approximately two MAL) to 1,185 DAL (approximately 40 MAL or three YAL), and fish captured in the lower Colorado River below Parker Dam ranged from 33 DAL (approximately one MAL) to 118 DAL (approximately four months).

Only twenty fish from both lakes Mohave and Havasu had year class information (Appendix 20). For Lake Mohave fish, two fish were three years old at stocking and one was five to six years old at stocking. All of the Lake Havasu fish were five to six years old at stocking. Since there has only been three stockings into the lower Colorado River below Parker Dam since 2006 and those fish were a mix of 2004+ year class, at least some of these fish were two plus years old at the time of stocking.

Of the total paired fish, only 12% ($N=3$) were reared in lakeside backwaters while the remaining 88% ($N=32$) were reared in off-site facilities (Appendix 20). The two contributing lakeside backwaters were North Nine Mile Cove (16 RM [26 RK]), NV and Yuma Cove (25 RM [39 RK]), AZ, while there were five off-site facilities including Achii Hanyo FH, Bubbling Ponds SFH, Cibola NWR HLP, DNFH & TC and WBNFH, who alone contributed 49% of the total paired fish.

More than 83% of fish ($N=5$) were captured in the “Basin” area of Lake Mohave while no fish were captured in the “River” area (Table 21). For all of the “Basin” area captures, RM ranged from 16 (26 RK) to 20 RM (32 RK), whereas the total range of the “Basin” area is 12-23 RM (19-37 RK). However, the single fish that moved from the “Lower Lake” to “Basin” was found at 23 RM (37 RK), more than three RM (almost five RK) farther north. Fish stocked in the “Lower Lake” area ($N=2$) either stayed in the same area ($N=1$) or moved into the “Basin” ($N=1$) area. One fish did not seem to travel, while other fish traveled from one RM (two RK) to 18 RM (26 RK) from their stocking

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locations, and more fish traveled north from their stocking sites ($N=3$) than south ($N=2$) although one fish did not move in any discernable direction (Table 22).

The most bonytail with paired-capture data were in Lake Havasu ($N=24$), and more than 46% of these were captured in the “Lower Lake” and “River” areas ($N=11$ both areas), while 4% were captured in “Lake Havasu” area ($N=2$; Table 21). Although the “Lower Lake” area RM range is 0-19 RM (31 RK), all fish were found within 0.3-0.5 RM (0.5-0.8 RK) whereas the “River” area RM range is from 28 RM (45 RK) to Davis Dam (approximately 82 RM [132 RK]) and fish were only captured between 30-43 RM (48-70 RK) (Table 22).

All fish stocked into the “Lower Lake” area of Lake Havasu stayed in that same area ($N=11$; Table 21). Fish stocked into “Lake Havasu” area either stayed in the same area ($N=1$) or traveled into the “Lower Lake” area ($N=1$), while fish stocked into the “River” area either stayed in that area ($N=9$) or moved into the “Lake Havasu” area ($N=2$).

TAL for Lake Havasu fish ranged from 61 DAL (approximately two MAL) to 1,185 DAL (approximately 40 MAL), or more than three years (Table 21). Fish in Lake Havasu traveled from 0.2 RM (0.3 RK) to 15 RM (25 RK) from their stocking locations (Table 22). Half (50%) of the 24 fish traveled less than one mile from their stocking sites ($N=11$), and these fish had the same TAL range as mentioned for all of Lake Havasu fish. More fish traveled north from their stocking location than south ($N=14$ and 4, respectively) although six fish did not move in any apparent direction (Table 22).

For both Lakes Mohave and Havasu, monthly average water quality from below Davis Dam was reviewed for the stocking months with captures (January, July, August, October, November and December; in Table 23 and Appendix 20). Water temperature ranged from 12 to 19 °C, discharge ranged from 15,922 to 26,657 CFS, turbidity ranged around one NTU, specific conductance ranged from 969 to 1,023 pS/cm, DO from 8.0 to 11.3 mg/L, pH from 7.6 to 8.1, and suspended sediment concentration from one to 2 mg/L. For Lake Havasu, more than 67% of fish captured ($N=16$) were stocked in November

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with the following monthly average parameters: 16 °C water temperature, 19,864 CFS, 2 NTU, 992 pS/cm, 9.1 mg/L DO, 7.9 pH and 1 mg/L suspended sediment concentration.

Bonytail repatriates are new to the lower Colorado River below Parker Dam, but there already have been five captures to date with paired data and approximately one month TAL (Table 21). Only one of the three captured fish moved, which was 5.5 RM (8.6 RK) south from its stocking location (Table 22). For fish stocked below Parker Dam in December 2006 and 2007 (Appendix 10), average monthly water quality parameters were: water temperature at 12 °C, discharge at 7,458 CFS, specific conductance at 1,006 pS/cm, 9.3 mg/L DO, 8.2 pH and suspended sediment at 3 mg/L (Table 23).

With our paired data, we tested whether there was a significant difference between the parametric avg TL at stocking (i.e., significant size bias in the sample of stocking TLs, which is a size-selective mortality factor) and a “sample” of stockings TLs (i.e., a sample is fish later captured) for different groupings of populations (Table 24). A significant difference would mean that there was a significant size bias in the sample of stocking TLs (i.e., a size-selective mortality factor). For data, we used 57,374 PIT-tagged bonytail stocking records, excluding 909 fish with missing TL, that were in the NFWG tagging database to date (2007). For each reservoir-stocking site (i.e., lakeside backwater and off-site facility), avg TL and standard deviation (SD) were considered parametric values representing the population of stocked fish for that reservoir-stocking site combination. We considered captures within a reservoir-stocking site a random sample within each reservoir-stocking site population. Therefore, avg TL of captured fish at stocking within each reservoir-stocking site was compared to the parametric value using the parametric SD and a one-tailed z-score test given the sample size of each comparison as the total number of fish captured per reservoir-stocking site.

For Lake Havasu, 32,611 fish were stocked into this reservoir from off-site facilities with an avg TL (population mean TL, pTL) of 280 mm and SD (population SD, pSD) of 30.34 mm. Twenty-five of these fish have been captured with an average stocking TL (sample

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mean TL, sTL) of 312 mm. A sample distribution of size (n) from a population would have a standard deviation (sSD) of:

$$sSD = pSD/\text{sqrt}(n) = 30.34/\text{sqrt}(25) = 30.34/5 = 6.07$$

Therefore the distance between sTL and pTL in sSD units is equal to

$$(sTL - pTL)/sSD = (312 - 280)/6.07 = \sim 5.27$$

This is the z-score in a normally distributed variable and the one tailed p-value (i.e., the probability of getting a more extreme value) is equal to one minus the cumulative distribution function at the given z-score (effectively zero in this case).

For Lake Mohave, when we grouped lakeside backwaters and off-site facilities, there was a significant difference between the "random" sample stocking TL (i.e., fish that are captured) and the population stocking TL for off-site facilities, but when we grouped the fish as only the reservoir, there was no difference (Table 24 and Figure 5). This meant that there was a size-selective component in survival in Lake Mohave for off-site facility reared fish, but not for lakeside backwater-reared fish. However, our sample size was very small, and the p-value was close to 0.05 for off-site fish. For Lake Havasu and the lower Colorado River below Parker Dam, we only have captures from off-site facilities so it is difficult to know if size-selective mortality is more severe for off-site reared fish; however, there is definitely a size-selective component in survival for both areas.

Unpaired-Capture Data

To date (2007), 420 bonytail were captured in the lower basin (excluding 38 fish with paired data as discussed above), with the fewest occurring in Lake Mohave ($N=127$) as compared to Lake Havasu ($N=152$) and the lower Colorado River below Parker Dam ($N=141$) combined (Tables 25-27). In Lake Mohave, the majority of fish were captured in the "Basin" area ($N=64$; 50% of fish captured in Lake Mohave) followed by the "Lower

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Lake” area ($N=33$; 26%), “Arizona Bay” area ($N=2$; 2%) and “River” area ($N=1$; < 1%); 21% ($N=27$) did not have an available capture location. In the “Basin” area, fish capture locations ranged from 16-23 RM (26-37 RK) and in the “Lower Lake” area these locations ranged from 3.6-4 RM (5.8-7 RK).

Bonytail have been captured most years in Lake Mohave since 1983 (Table 25), and most were captured in May, generally the month of the Lake Mohave bonytail “roundup” when members of the NFWG and volunteers perform adult monitoring, mainly in hopes of collecting wild broodstock (Minckley and Thorson 2007). Most of these fish were marked in the NFWG database as “wild” fish ($N=120$; 94% of total captures in Lake Mohave); however, they may have been untagged repatriates as suggested about other “wild” fish in a report by the FWS (2005).

In Lake Havasu, most captures were in the “River” area ($N=143$; 94% of total captures in Lake Havasu), followed by the “Lower Lake” and “Lake Havasu” areas ($N=7$ and 1; 5 and < 1%, respectively; Table 26). All of the “River” area fish were found near 43 RM (69 RK), while the “Lower Lake” fish RM ranged from 0-8.5 RM (13.7 RK). Fish have been captured in Lake Havasu since 1999, although Minckley and Thorson (2007) reported captures as early as 1996. More than 93% of fish were captured in December, even though the Lake Havasu “roundup” generally occurs in February. Unlike Lake Mohave, most of the fish captured in Lake Havasu were repatriates ($N=146$; 96% of total captures); however, these all were either fin-clipped or wire-tagged.

More than 140 fish were captured in the lower Colorado River below Parker Dam (Table 27). The majority were captured in a backwater area on the Arizona side of the river ($N=126$; 89% of total captures in the lower Colorado River below Parker Dam), and all were repatriates. Most of these captures occurred within a very short period of time (days) after a stocking event. While there were no stocking months data available for these captures, we reviewed monthly average water quality data from below Parker Dam for capture months January, February, April, November and December (Table 23 and 27). During these months, water temperature ranged from 12 to 26 °C; discharge ranged

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from 7,458 to 18,475 CFS; specific conductance ranged from 950 to 1,070 pS/cm; DO ranged from 7.7 to 10.3 mg/L; pH ranged from 8.0 to 8.2; and suspended sediments concentration ranged from 2 to 5 mg/L.

RESEARCH AND MANAGEMENT RECOMMENDATIONS

Bonytail live and thrive at a variety of water temperatures under hatchery conditions, from temperatures associated with skim ice at Wahweap SFH to scorching summers with temperatures as high as 32 °C at Trinidad State Junior College, Trinidad, CO (Pacey and Marsh 2007). However, handling of fish does not occur during these stressful extremes, which is acceptable because too much handling reduces bonytail growth (Paukert et al. 2005). A recent laboratory study suggested that 150-300 mm avg TL hatchery-reared bonytail held in trammel nets for two hours and then processed (i.e., measured, weighed, tagged and tissue sampled) had substantially higher survival when fish were held at 15 °C than at 20 °C and 25 °C (T. Hunt, AZGFD, 2008, unpublished data). This handling combination is similar to the stresses associated with stocking – harvest at a rearing facility, processing as described above (generally without tissue sampling), followed by water temperature changes during transport from rearing facilities to stocking waters.

We suggest further research studies to better characterize physiological stress responses to handling at rearing facilities as well as stress at stocking (e.g., sub-sample fish at stocking site) and post-stocking (e.g., fish captured 7, 14, and 21 d post-stocking). It may be determined that facilities should hold fish on station for a period of time so fish recover from handling, as currently is done at Wahweap SFH (Pacey and Marsh 2007). We also suggest further studies of the effects of water temperature changes and handling on bonytail at various lengths, weights, and ages at stocking. Finally, we suggest transport water should be within the fewest °C possible of stocking water, and bonytail should always be tempered accordingly.

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Because water temperature may significantly affect bonytail survival, water temperature (and possibly other physical and chemical parameters as noted by the monthly summaries above) at stocking areas should be routinely monitored, daily or weekly, prior to stocking. Similarly, we suggest temperature studies of any potential stocking sites to determine their suitability, and no fish should be stocked into unsuitable or sites of unknown water quality. Based on min/max water temperatures found in this report (Table 28), we suggest bonytail stockings should occur only in December, January, and February, and perhaps only as late as March, depending on local conditions. For the best possible survival, it may be that fish should not be stocked during other months. Hatcheries should plan accordingly

Pacey and Marsh (2007) suggested stocking month should coincide with spawning time (late spring) when fish would exhibit their dimorphic sexual characteristics and gender could be accurately determined because adult-sized fish are the target stocking size. In light of further evidence, it may be that this suggestion could be altered such that fish would only be stocked during winter months, as suggested above, at which time a subsample of fish could be sacrificed to accurately determine sex by internal morphological examination.

We recommend that no bonytail smaller than 200 mm TL should be stocked. Only a single fish shorter than this size has been returned in the PIT-tag capture data to this date (2008; Pacey, unpublished data). In the upper basin, on separate occasions researchers found smallmouth bass preying upon stocked bonytail, in one case a 330 mm TL smallmouth bass attempted to consume an approximately 225 mm TL bonytail (Bestgen et al. 2006). Bestgen et al. (2006) also determined at their current stocking target size of 200+ mm avg TL hatchery-reared bonytail was a size susceptible to predation and infections. Further, survival rates were low in general several weeks post-stocking; there was only one report of a fish captured < 200 mm TL (Valdez et al. 2003).

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In the lower basin, fish greater than 250 mm avg TL appear to be an acceptable target size, but 300 mm avg TL or greater may result in significantly higher survival because 63% of paired-capture fish were approximately this size ($N=22$ out of 35; Appendix 13). DNFH & TC and WBNFH both reported that once fish reach approximately 300 mm TL, it is difficult for fish to manifest better growth under current hatchery conditions, and especially-so without a specific bonytail diet for maximum growth (Pacey and Marsh 2007). In addition to the current target size in TL, it may be that fish need more weight at the time of stocking for improved survival. For research purposes, we suggest weight data collection along with length at the time of stocking -- only 6% of the total number of PIT-tagged fish released in the lower basin ($N=57,241$) were weighed (Pacey, unpublished data). In Table 29, we present unpublished data from the NFWG for TL and weight (g) of PIT-tagged bonytail at release and capture in lakes Mohave and Havasu, and in the Colorado River below Parker Dam (Pacey, unpublished data). A possible trend exhibited in this data may be that fish should be at least 120 g at the target length of 300 mm TL.

Some bonytail reach target length within one to two years after production, but others take substantially longer because there are significant growth variations within year classes (Pacey and Marsh 2007). In the past with a target of 200 mm avg TL, this variation in year class allowed some very young fish to be stocked as they reached target length quickly, whereas the “shorts” (runts) were held over, sometimes for several years, to reach target length. Based on the year class information of paired captures (Appendix 11 and 12), it may be that the captured fish were “shorts” because they were generally two to three years old at stocking, and that age is a factor in survival.

We recommend a minimum stocking age of Age 2 fish, and stocking at Age 3+ if facility space allows. If fish reach target size by Age 1 or 2, we suggest these fish be held over in backwaters or off-channel habitats as suggested in Minckley et al. (2003) until Age 3+. DNFH & TC suggested that the largest fish at Ages 0-2 in a year class were generally female, and it was cautioned that the larger target size at stocking might

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result in stocking mostly female bonytail (Pacey and Marsh 2007). Again, we suggest stocking Age 3+ bonytail when possible to reduce gender selection.

To improve data analysis, we suggest year class data be included with stocking data. Only 41% of the total number of PIT-tagged fish released in the lower basin ($N=57,241$) had year class information (Pacey, unpublished data). This would also allow us to know the exact age when combined with TAL as some fish were almost six years old at the time of capture. We also recommend that bonytail year classes remain separate on station or in other locations unless fish are PIT-tagged prior to their mixing.

In Lake Mohave, we suggest no stocking, or substantially reducing the number of fish stocked, into the “River” and “Arizona Bay” areas of Lake Mohave; only three fish have been captured in these areas to date (2007) (Tables 21 and 25). All or most fish should be stocked into the “Basin” and “Lower Lake” areas.

In Lake Havasu, we suggest no stocking, or substantially reducing the number of fish stocked, into the “Lake Havasu” area; only four fish to date (2007) have been captured in this area (Tables 21 and 25). Instead we suggest all or most fish should be stocked into the “River” or “Lower Lake” areas of Lake Havasu, where to date (2007), 171 fish have been captured.

In the lower Colorado River below Parker Dam, we suggest stocking fish into at least both A-7 and C-7 backwaters (Tables 21 and 25). A study of physical and chemical characteristics of stocking waters in all of these general areas may provide details on why bonytail apparently prefer some areas to others.

We suggest all bonytail stocked into the lower basin be PIT-tagged to improve data analysis. While there was useful information from the 35-paired captures, more information could have been available from the other 385 fish captured. This additional information would assist in determining an annual bonytail population estimate by

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stocking area similar to the annual razorback sucker population estimate generated for Lake Mohave.

To improve post-stocking assessments, we suggest experimenting with various capture methods including angling at dusk as suggested as a growth monitoring method (Pacey and Marsh 2007). However, under hatchery conditions, bonytail feed from dusk to dawn, and stopped feeding in some cooler climates from October to March, and angling during these daytime hours of these months may be fruitless as the fish may be substantially inactive and generally not available for capture. We suggest continued adult monitoring programs and water quality assessment at bonytail capture locations.

We recommend considering reallocating bonytail stockings as described in the current LCR MSCP plan (Burke 2006) such that more emphasis would be placed upon Lake Havasu and the lower Colorado River below Parker Dam. We understand that paired capture data are few, but when the numbers of captures/stocking area are compared, Lake Havasu may be the more successful survival location. It is too soon to know if bonytail stocking into the lower Colorado River below Parker Dam will be successful.

We strongly encourage the continued creation, development, and management of off-channel habitats for bonytail (Minckley et al. 2003). With the exception of one fish, bonytail < 200 mm avg TL do not survive in the lower basin. Non-native predation or other factors are clearly precluding bonytail larval and juvenile survival and recruitment in the wild. Moreover, all life stages survive and thrive under a variety of controlled, predator-free settings (Pacey and Marsh 2007).

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TABLES

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 1. Summary of bonytail stockings by basin, stocking area and tag type into the Colorado River basin, 1981-2007.

Basin	Stocking Area ^a	N Fish				Total
		PIT Tag	Wire Tag	No Tag	Unknown Tag Type	
Upper	Green River	67,311	189,950	481,086		738,347
	Yampa River		30,000			30,000
	Mainstem Colorado River	51,879	113,739		3,052	168,670
	Gunnison River	2				2
Total		119,192	333,689	481,086	3,052	937,019
Lower	Mohave	22,875	29,215	167,967		220,057 ^b
	Havasu	32,864	94,438	26,500 ^c		153,802 ^d
	Lower river below Parker Dam ^e	750	5,675			6,425
	Either Lake Mohave or Havasu	902				902
Total		57,391	129,328	194,467	0	381,186 ^f
Grand Total		176,583	463,017	675,553	3,052	1,318,205 ^f

^aSee Figure 1 and report text specific stocking areas. Stocking areas for the lower basin -

"Mohave" is Lake Mohave (Reach 2) and "Havasu" is Lake Havasu (Reach 3).

^bDoes not include 104,923 unconfirmed fish (see Appendix 6).

^cFish stocked into Bill Williams NWR in 1994 (see Appendix 12).

^dDoes not include 43,567 unconfirmed fish (see Appendix 6).

^eAll PIT-tagged fish in lower river below Parker Dam are also wire-tagged, but their numbers are not included in the wire tags total.

^fDoes not include 148,490 unconfirmed fish (see Appendix 6).

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Table 2. Summary of bonytail stockings by basin, stocking area, and average total length

(TL) in mm by current stocking plans (2007) into the Colorado River basin, 1981-2007.

Basin	Stocking Area ^a	N Fish				Total
		Avg TL (mm)				
		< 200	200+	No TLs		
Upper	Green River	682,301	47,729	8,317		738,347
	Yampa River	30,000				30,000
	Mainstem Colorado River	126,833	18,971	22,866		168,670
	Gunnison River			2		2
Total		839,134	66,700	31,185		937,019
Basin	Stocking Area ^a	N Fish				Total
		Avg TL (mm)				
		< 200	200-299	300+	No TLs	
Lower	Mohave	165,696	19,278	20,601	14,482	220,057 ^b
	Havasu	114,375	27,219	12,207	1	153,802 ^c
	Lower river below Parker Dam ^d			6,425		6,425
	Either Lake Mohave or Havasu	23			879	902
Total		280,094	46,497	39,233	15,362	381,186 ^e

^aSee Figure 1 and report text specific stocking areas. Stocking areas for the lower basin -

"Mohave" is Lake Mohave (Reach 2) and "Havasu" is Lake Havasu (Reach 3).

^bDoes not include 104,923 unconfirmed fish (see Appendix 6).

^cDoes not include 43,567 unconfirmed fish (see Appendix 6).

^dAll PIT-tagged fish in lower river below Parker Dam are also wire-tagged, but their numbers are not included in the wire tags total.

^eDoes not include 148,490 unconfirmed fish (see Appendix 6).

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Table 2A. Summary of bonytail stockings by basin, stocking area, tag type and average total length (TL) in mm by current stocking plan (2007) into the Colorado River basin, 1981-2007.

Basin	Stocking Area ^a	N Fish												Total			
		Avg TL (mm)															
		PIT Tag				Wire Tag				No Tag							
		< 200	200+	No TLs	Total	< 200	200+	No TLs	Total	< 200	200+	No TLs	Total				
Upper	Green River	14,365	47,629	5,317	67,311	189,936	14		189,950	478,000	86	3,000	481,086	738,347			
	Yampa River					30,000			30,000				0	30,000			
	Mainstem Colorado River	21,623	18,956	11,300	51,879	105,210	15	8,514	113,739			3,052 ^b	3,052	168,670			
	Gunnison River			2	2				0				0	2			
Total		35,988	66,585	16,619	119,192	325,146	29	8,514	333,689	478,000	86	6,052	484,138	937,019			
Basin	Stocking Area ^a	N Fish												Total			
		Avg TL (mm)															
		PIT Tag				Wire Tag				No Tag							
		< 200	200-299	300+	No TLs	Total	< 200	200-299	300+	No TLs	Total	< 200	200-299		300+	No TLs	Total
Lower	Mohave	1	16,330	6,544		22,875	12,210	2,948	14,057		29,215	153,485			14,482	167,967	220,057 ^c
	Havasu	17	27,219	5,627	1	32,864	87,858		6,580		94,438	26,500 ^d				26,500 ^d	153,802 ^e
	Lower river below Parker Dam ^f			750		750			5,675		5,675					0	6,425
	Either Lake Mohave or Havasu	23			879	902					0					0	902
Total		41	43,549	12,921	880	57,391	100,068	2,948	26,312	0	129,328	179,985	0	0	14,482	194,467	381,186 ^g

^aSee Figure 1 and report text specific stocking areas. Stocking areas for the lower basin - "Mohave" is Lake Mohave (Reach 2) and "Havasu" is Lake Havasu (Reach 3).

^bCould not confirm is PIT or wire tags, but had tags. Included here for reporting purposes.

^cDoes not include 104,923 unconfirmed fish (see Appendix 6).

^dFish stocked into Bill Williams NWR in 1994 (see Appendix 12).

^eDoes not include 43,567 unconfirmed fish (see Appendix 6).

^fAll PIT-tagged fish in lower river below Parker Dam are also wire-tagged, but their numbers are not included in the wire tags total.

^gDoes not include 148,490 unconfirmed fish (see Appendix 6).

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Table 2B. Summary of bonytail stockings by basin, stocking area, average total length (TL) in mm and tag type into the Colorado River basin, 1981-2007.

Basin	Stocking Area ^a	N/ Fish											
		Avg TL (mm)											
		< 200				200-249				250-299			
		PIT Tag	Wire Tag	No Tag	Total	PIT Tag	Wire Tag	No Tag	Total	PIT Tag	Wire Tag	No Tag	Total
Upper	Green River	14,365	189,936	478,000	682,301	29,690			29,690	17,939			17,939
	Yampa River		30,000		30,000				0				0
	Mainstem Colorado River	21,623	105,210		126,833	9,417			9,417	9,410			9,410
	Gunnison River				0				0				0
	Total	35,988	325,146	478,000	839,134	39,107	0	0	39,107	27,349	0	0	27,349
Lower	Mohave	1	12,210	153,485	165,696	1,517	2		1,519	14,813	2,946		17,759
	Havasu	17	87,858	26,500	114,375	791			791	26,428			26,428
	Lower river below Parker Dam ^b				0				0				0
	Either Lake Mohave or Havasu	23			23				0				0
	Total	41	100,068	179,985	280,094	2,308	2	0	2,310	41,241	2,946	0	44,187
	Grand Total	36,029	425,214	657,985	1,119,228	41,415	2	0	41,417	68,590	2,946	0	71,536
		300-349				> 350				No TLs			
Upper	Green River				0		14	86	100	5,317		3,000	8,317
	Yampa River				0				0				0
	Mainstem Colorado River	129			129		15		15	11,300	8,514	3,052 ^b	22,866
	Gunnison River				0				0	2			2
	Total	129	0	0	129	0	29	86	115	16,619	8,514	6,052	31,185
Lower	Mohave	6,505	14,057		20,562	39			39			14,482	14,482
	Havasu	5,540	6,580		12,120	87			87	1			1
	Lower river below Parker Dam ^c	750	5,675		6,425				0				0
	Either Lake Mohave or Havasu				0				0	879			879
	Total	12,795	26,312	0	39,107	126	0	0	126	880	0	14,482	15,362
	Grand Total	12,924	26,312	0	39,236	126	29	86	241	17,499	8,514	20,534	46,547

^aSee Figure 1 and report text specific stocking areas. Stocking areas for the lower basin - "Mohave" is Lake Mohave (Reach 2) and "Havasu" is Lake Havasu (Reach 3).

^bCould not confirm is PIT or wire tags, but had tags. Included here for reporting purposes.

^cAll PIT-tagged fish in lower river below Parker Dam are also wire-tagged, but their numbers are not included in wire tags total.

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 3. Summary of PIT-tagged bonytail stockings into the Green River, UT-CO, 1998-2007. River miles and kilometers are approximate.

Production Facility	N fish	% of Total ^a
Dexter National Fish Hatchery	67,311	-
Type of Production		
Unknown if manual or natural spawning	3,447	5
Manual broodstock spawning, unknown if F1s or from breeding matrix	63,864	95
Rearing Location		
Mumma Aquatic Species Restoration Facility, CO	27,153	40
Wahweap State Fish Hatchery, UT	40,158	60
Stocking Location ^b		
371 RM (597.1 RK), UT	8,600	20
344.8 RM (554.9 RK), Green River at Echo Park, UT	1,592	4
344 RM (553.6 RK), Green River at Echo Park, UT	16,961	40
327 RM (526.3 RK), Rainbow Park Boat Ramp, Dinosaur National Monument, CO	12,972	31
319.3 RM (513.9 RK), UT	2,096	5
Dinosaur National Monument Total	42,221	(63)
301 RM (484.4 RK), Near Jensen, UT	13	100
Middle Green Total	13	(<1)
120.0 RM (193.1 RK), Green River State Park, UT	12,943	52
119 RM (191.5 RK), Green River State Park, UT	12,125	48
Lower Green Total	25,068	(37)
Green River, UT	9	(<1)
Stocking Year		
2007	10,813	16
2006	6,717	10
2005	7,119	11
2004	13,096	19
2003	5,982	9
2002	20,708	31
2000	9	< 1
1998	2,867	4
Stocking Month		
June	2,578	4
July or August	9	< 1
September	6,666	10
October	33,936	50
November	22,026	33
Unknown	2,096	3
Avg TL (mm) at Stocking		
< 200	14,365	21
200-249	32,420	48
250-299	17,939	27
No TLs given in data	2,587	4

^aValues in parenthesis are % total of total number stocked when grouping is used within a category.

^bAccording to the 2003 integrated stocking plan for Utah and Colorado (Nesler et al. 2003; T. Francis 2007 pers. comm.), there are three bonytail stocking areas for the Green River, defined as the "lower Green," "middle Green," and "Dinosaur National Monument." See Figure 1 and report text for specific stocking areas.

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Table 4. Summary of wire-tagged bonytail stockings into the Green River, UT-CO, 1999-2002. River miles and kilometers are approximate.

Production Facility	N fish	% of Total ^a
Dexter National Fish Hatchery	189,950	100
Type of Production		
Unknown if manual or natural spawning	14	< 1
Manual broodstock spawning, unknown if F1s or from breeding matrix	189,936	99
Rearing Location		
Wahweap State Fish Hatchery, UT	189,950	100
Stocking Location ^b		
120.1 RM (193.2 RK), Green River State Park, UT	10,000	7
120.0 RM (193.1 RK), Green River State Park, UT	129,428	90
119 RM (191.5 RK), Green River State Park, UT	4,000	3
Lower Green Total	143,428	(75)
Green River, UT	46,522	(25)
Stocking Year		
2002	18,700	10
2001	93,044	49
2000	68,206	36
1999	10,000	5
Stocking Month		
March	14	< 1
April	76,509	40
October	52,205	27
Unknown	61,222	32
AVG TL (mm) at Stocking		
< 200	189,950	100

^aValues in parenthesis are % total of total number stocked when grouping is used within a category.

^bAccording to the 2003 integrated stocking plan for Utah and Colorado (Nesler et al. 2003; T. Francis 2007 pers.

comm.), there are three bonytail stocking areas for the Green River, defined as the "lower Green," "middle Green," and "Dinosaur National Monument." See Figure 1 and report text for specific stocking areas.

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Table 5. Summary of other bonytail stockings without PIT- or wire tags into the Green River, UT, 1988-2007. River miles and kilometers are approximate.

Production Facility	N fish	% of Total ^a
Dexter National Fish Hatchery	481,000	> 99
Willow Beach National Fish Hatchery	86	< 1
Total	481,086	-
Type of Production		
Manual broodstock spawning, unknown if F1s or from breeding matrix	481,000	> 99
Wild fish, manually spawned at hatchery	86	< 1
Rearing Location		
Dexter National Fish Hatchery, NM	478,086	> 99
Wahweap State Fish Hatchery, UT	3,000	< 1
Stocking Location ^b		
307 RM (494 RK), Thunder Ranch wetland, UT	33,500	-
Dinosaur National Monument Total	33,500	7
291 RM (468 RK), Bureau of Land Management managed floodplains Bonanza Bridge, UT	3,480	< 1
267 RM (429 RK), Bureau of Land Management managed floodplains Above Brennan, UT	3,120	< 1
265 RM (near 427 RK), Johnson Bottom floodplain in Ouray National Wildlife Refuge, UT	177,650	37
265 RM (near 427 RK), Leota Bottom cell-10 in Ouray National Wildlife Refuge, UT	158,850	33
265 RM (near 427 RK), Old Charley Wash in Ouray National Wildlife Refuge, UT	104,400	22
Middle Green Total	447,500	93
Green River, UT	86	< 1
Stocking Year		
2007	3,000	< 1
2004	264,500	55
2003	213,500	44
1989	47	< 1
1988	39	< 1
Stocking Month		
March	10	< 1
May	478,016	99
June	22	< 1
July	28	< 1
October	10	< 1
November	3,000	< 1
AVG TL (mm) at Stocking		
7	478,000	99
> 400	86	< 1
No TLs given in data	3,000	< 1

^aValues in parenthesis are % total of total number stocked when grouping is used within a category.

^bAccording to the 2003 integrated stocking plan for Utah and Colorado (Nesler et al. 2003; T. Francis 2007 pers. comm.), there are three bonytail stocking areas for the Green River, defined as the "lower Green," "middle Green," and "Dinosaur National Monument." See Figure 1 and report text for specific stocking areas.

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Table 6. Summary of PIT-tagged bonytail stockings into the mainstem Colorado River, UT-CO, 1996-2007. River miles and kilometers are approximate.

Production Facility	<i>N</i> fish	% of Total
Dexter National Fish Hatchery	51,879	100
Type of Production		
Manual broodstock spawning, unknown if F1s or from breeding matrix	49,770	96
Unknown if manual or natural spawning	2,109	4
Rearing Location		
Mumma Aquatic Species Restoration Facility, CO	17,403	34
Wahweap State Fish Hatchery, UT	31,576	61
Mumma Native Aquatic Species Restoration Facility and Trinidad State Junior College, CO	2,900	6
Stocking Location		
154-185 RM (248-298 RK), Colorado River, from Palisade to Loma, CO	2,548	5
165 and 171 RM (265 and 275 RK), Colorado River, CO	2,900	6
111 RM (178.6 RK), Cisco boat ramp, UT	23,883	46
94.3 RM (151.7 RK), UT	8,383	16
96.2 RM (154.8 RK), UT	1,980	4
Colorado River watershed, CO	12,185	23
Stocking Year		
2007	5,570	11
2006	9,430	18
2005	6,023	12
2004	8,219	16
2003	4,174	8
2002	8,100	16
1998	6,215	12
1997	2,168	4
1996	1,980	4
Stocking Month		
March	119	< 1
April	3,701	7
May	2,587	5
June	2,566	5
September	11,183	22
October	18,817	36
November	9,037	17
Unknown	3,869	7
AVG TL (mm) at Stocking		
< 200	21,623	42
200-249	9,417	18
250-299	9,410	18
300-349	129	< 1
No TLs given in data	11,300	22

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Table 7. Summary of wire-tagged bonytail stockings into the mainstem Colorado River, UT-CO 1999-2004.

River miles and kilometers are approximate.

Production Facility	<i>N</i> fish	% of Total
Dexter National Fish Hatchery	113,739	100
Type of Production		
Manual broodstock spawning, unknown if F1s or from breeding matrix	113,724	99
Unknown if manual or natural spawning	15	< 1
Rearing Location		
Mumma Aquatic Species Restoration Facility, CO	8,514	7
Wahweap State Fish Hatchery, UT	105,225	93
Stocking Location		
111 RM (178.6 RK), Cisco boat ramp, UT	3,000	3
110.0 RM (177.0 RK), UT	27,968	25
94.6 RM (152.2 RK), Dewey Bridge, UT	10,015	9
94.3 RM (151.7 RK), UT	36,274	32
Colorado River watershed, CO	36,482	32
Stocking Year		
2004	8,514	7
2003	3,000	3
2001	55,936	49
2000	36,274	32
1999	10,015	9
Stocking Month		
March	15	< 1
April	53,005	47
May	8,514	7
October	21,237	19
Unknown	30,968	27
AVG TL (mm) at Stocking		
< 200	105,210	93
≥ 350	15	
No TLs given in data	8,514	7

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Table 8. Summary of PIT-tagged bonytail stockings into Lake Mohave (Reach 2), AZ-NV, 1993-2006. River miles and kilometers are approximate.

Production Facility	N fish	% of Total ^a
Dexter National Fish Hatchery ^b	22,875	100
Type of Production		
Natural broodstock spawning in holding ponds	14	< 1
Unknown if manual or natural spawning ^b	22,861	99
Rearing Location		
Arizona Juvenile	31	5
Dandy Cove	22	4
Davis Cove	78	13
Nevada Egg	75	13
Nine Mile Coves ^b	210	36
North Chemehueve Cove	2	< 1
Yuma Cove ^b	172	29
Lakeside Backwaters Total ^b	590	(3)
Boulder City Golf Course Ponds, NV	134	1
Boulder City Wetlands Park, NV	79	< 1
Cibola NWR High Levee Pond, AZ-CA	3	< 1
Dexter National Fish Hatchery, NM	1,789	8
Ulvade National Fish Hatchery, TX	354	2
Willow Beach National Fish Hatchery, AZ ^b	19,926	89
Off-site Facilities Total ^b	22,285	(97)
Stocking Location ^c		
60 RM (97 RK), AZ	314	3
56 RM (90 RK), AZ	15	< 1
52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	2,927	26
52.6 RM (84.7 RK), Willow Beach National Fish Hatchery (below), AZ	4	< 1
52.5 RM (84.5 RK), Willow Beach boat ramp, AZ	754	7
48 RM (77.3 RK), Monkey Hole, NV	1	< 1
47.7 RM (77 RK), Big Horn Cove, AZ	1,740	15
44 RM (71 RK), AZ	1,317	12
43 RM (69 RK), AZ-NV	98	1
42 RM (68 RK), AZ	627	5
41.51 RM (66.8 RK), Russian Cove, AZ	967	8
41.5 RM (67 RK), AZ	373	3
41.1 RM (66.1 RK), Elizabeth J. Cove, NV	756	7
41 RM (66 RK), AZ	404	4
39.75 RM (64 RK), Nelson's Landing, NV	5	< 1
39.5 RM (64 RK), AZ	650	6
39.5 RM (63.6 RK), Placer Cove, NV	82	1
38 RM (61 RK), AZ	368	3
River Total	11,402	(50)
37 RM (60 RK), NV	417	13
36 RM (58 RK), NV	387	12
35.5 RM (57 RK), AZ	96	3
34 RM (55 RK), AZ	527	16
33.6 RM (54.1 RK), Eagle Cove (north of), AZ	738	22
30 RM (48 RK), AZ	974	29
24.7 RM (39.7 RK), Gold Cove, AZ	1	< 1
24.5 RM (39.4 RK), Yuma Cove, AZ ^b	176	5
Arizona Bay Total ^b	3,316	(14)
22.75 RM (36.6 RK), Cottonwood Cove, NV ^b	974	53
20.5 RM (33 RK), Carp Cove, AZ	496	27
19.25 RM (31 RK), Six Mile Coves (north of), NV	25	1
16.35 RM (26.3 RK), North Nine Mile Cove, NV ^b	210	11
15.91 RM (25.6 RK), Nevada Egg, NV	75	4
15.9 RM (25.6 RK), Dandy Cove, NV	22	1
15.4 RM (24.8 RK), Arizona Juvenile, AZ	41	2
12.1 RM (19.5 RK), Chemehuevi Cove, NV	2	< 1
Basin Total ^b	1,845	(8)
8 RM (12.9 RK), Desert Cove, AZ	416	8
5.25 RM (8.5 RK), Princess Cove, AZ ^b	3,832	75
1.5 RM (2.4 RK), Katherine's Landing, AZ	786	15
0.5 RM (0.8 RK), Davis Cove, AZ	78	2
Lower Lake Total ^b	5,112	(22)
Lake Mohave	1,200	(5)

^aValues in parenthesis are % total of total number stocked when grouping is used within a category.

^bAt least one bonytail was captured in this category.

^cSee Figure 1 and report text for specific stocking areas.

Stocking Year	N fish	% of Total
2006	1,611	7
2005 ^b	1,360	6
2004 ^b	7,133	31
2003	500	2
2002	5,707	25
2001	6	< 1
2000	1,044	5
1999	3,006	13
1998	596	3
1997 ^b	660	3
1996	812	4
1995	426	2
1993	14	< 1
Stocking Month		
January	1,277	6
February	126	1
March	431	2
April	273	1
May	1,922	8
June	796	3
July	1,735	8
August	2,081	9
September	679	3
October ^b	864	4
November ^b	5,782	25
December ^b	6,909	30
AVG TL (mm) at Stocking		
< 200	1	< 1
200-249	1,517	7
250-299 ^b	14,813	65
300-349 ^b	6,505	28
≥ 350	39	< 1

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Table 9. Summary of wire-tagged bonytail stockings into Lake Mohave (Reach 2), AZ-NV 1994-2007. River miles and kilometers are approximate.

Production Facility	<i>N</i> fish	% of Total ^a
Dexter National Fish Hatchery	29,215	100
Type of Production		
Unknown if manual or natural spawning	29,215	100
Rearing Location		
Achii Hanyo Fish Hatchery, AZ	5,584	19
Boulder City Golf Course Ponds, NV	2	< 1
Dexter National Fish Hatchery, NM	12,210	42
Ulvade National Fish Hatchery, TX	766	3
Willow Beach National Fish Hatchery, AZ	10,653	36
Stocking Location ^b		
52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	10,934	-
River Total	10,934	(37)
24.5 RM (39.4 RK), Yuma Cove, AZ	12,210	-
Arizona Bay Total	12,210	(42)
22.75 RM (36.6 RK), Cottonwood Cove, NV	2	-
Basin Total	2	< 1
5.25 RM (8.5 RK), Princess Cove, AZ	5,303	87
1.5 RM (2.4 RK), Katherine's Landing, AZ	766	13
Lower Lake Total	6,069	(21)
Stocking Year		
2007	2,946	10
2006	8,473	29
2005	5,584	19
1998	2	< 1
1994	12,210	42
Stocking Month		
March	2	< 1
November	16,807	58
December	12,406	42
AVG TL (mm) at Stocking		
< 200	12,210	42
200-249	2	< 1
250-299	2,946	10
300-349	14,057	48

^aValues in parenthesis are % total of total number stocked when grouping is used within a category.

^bSee Figure 1 and report text for specific stocking areas.

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 10. Summary of other bonytail stockings without PIT- or wire tags into Lake Mohave (Reach 2), AZ-NV, 1981-1991.

River miles and kilometers are approximate.

Production Facility	N fish	% of Total ^a
Dexter National Fish Hatchery	113,130	67
Willow Beach National Fish Hatchery	54,837	33
Total	167,967	-
Type of Production		
Natural broodstock spawning in holding ponds	113,130	67
Wild fish, manually spawned at hatchery	54,837	33
Rearing Location		
Dexter National Fish Hatchery, NM	166,805	99
Niland Warmwater Fish Hatchery, CA	1,162	1
Stocking Location ^b		
22.75 RM (36.6 RK) Cottonwood Cove, NV	21,901	39
20 RM (32 RK) Cottonwood Basin East, AZ	34,740	61
Arizona Bay Total	34,740	(34)
1.5 RM (2.4 RK), Katherine's Landing, AZ	1,162	-
Lower Lake Total	1,162	(< 1)
Lake Mohave	110,164	(65)
Stocking Year		
1991	9,283	6
1990	44,678	27
1989	12,540	7
1988	20,040	12
1987	13,971	8
1985	12,618	8
1982	13,320	8
1981	41,517	28
Stocking Month		
February	1,162	1
July	13,320	8
October	124,814	74
November	28,671	17
AVG TL (mm) at Stocking		
< 200	153,485	91
No TLs given in data	14,482	9

^aValues in parenthesis are % total of total number stocked when grouping is used within a category.

^bSee Figure 1 and report text for specific stocking areas.

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Table 11. Summary of bonytail stockings by rearing and stocking locations into Lake Mohave (Reach 2), AZ-NV, 1981-2007.

River miles and kilometers are approximate.

Location		/V fish
Rearing	Stocking	
Achii Hanyo Fish Hatchery	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	281
	5.25 RM (8.5 RK), Princess Cove, AZ	5,303
Achii Hanyo Fish Hatchery Total		5,584
Arizona Juvenile	15.4 RM (24.8 RK), Arizona Juvenile, AZ	31
Boulder City Golf Course Ponds	39.5 RM (63.6 RK), Placer Cove, NV	60
	24.5 RM (39.4 RK), Yuma Cove, AZ	4
	22.75 RM (36.6 RK), Cottonwood Cove, NV	65
	Lake Mohave	7
Boulder City Golf Course Ponds Total		136
Boulder City Wetlands Park	39.75 RM (64 RK), Nelson's Landing, NV	5
	39.5 RM (63.6 RK), Placer Cove, NV	21
	22.75 RM (36.6 RK), Cottonwood Cove, NV	10
	19.25 RM (31 RK), Six Mile Coves (north of), NV	25
	0.5 RM (0.8 RK), Davis Cove, AZ	1
	Lake Mohave	17
Boulder City Wetlands Park Total		79
Chemehuevi Cove	12.1 RM (19.5 RK), Chemehuevi Cove, NV	2
Cibola NWR High Levee Pond	0.5 RM (0.8 RK), Davis Cove, AZ	3
Dandy Cove	15.9 RM (25.6 RK), Dandy Cove, NV	22
Davis Cove	15.4 RM (24.8 RK), Arizona Juvenile, AZ	4
	0.5 RM (0.8 RK), Davis Cove, AZ	74
Davis Cove Total		78
Dexter National Fish Hatchery	24.5 RM (39.4 RK), Yuma Cove, AZ	12,210
	22.75 RM (36.6 RK), Cottonwood Cove, NV	21,901
	20 RM (32 RK), Cottonwood Basin East, AZ	34,740
	5.25 RM (8.5 RK), Princess Cove, AZ	1,357
	1.5 RM (2.4 RK), Katherine's Landing, AZ	432
	Lake Mohave	110,164
Dexter National Fish Hatchery Total		180,804
Nevada Egg	15.91 RM (25.6 RK), Nevada Egg, NV	75
Niland Warmwater Fish Hatchery	1.5 RM (2.4 RK), Katherine's Landing, AZ	1,162
Nine Mile Coves	16.35 RM (26.3 RK), North Nine Mile Cove, NV	210
Ulvade National Fish Hatchery	1.5 RM (2.4 RK), Katherine's Landing, AZ	1,120
Unknown	20.5 RM (33 RK), Carp Cove, AZ	496

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Table 11 con't. Summary of bonytail stockings by rearing and stocking locations into Lake Mohave (Reach 2), AZ-NV, 1981-2007.

River miles and kilometers are approximate.

Location		N fish
Rearing	Stocking	
Willow Beach National Fish Hatchery	60 RM (97 RK), AZ	314
	56 RM (90 RK), AZ	15
	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	13,580
	52.6 RM (84.7 RK), Willow Beach National Fish Hatchery (below), AZ	4
	52.5 RM (84.5 RK), Willow Beach boat ramp, AZ	754
	5.25 RM (8.5 RK), Princess Cove, AZ	2,475
	48 RM (77.3 RK), Monkey Hole, NV	1
	47.7 RM (77 RK), Big Horn Cove, AZ	1,740
	44 RM (71 RK), AZ	1,317
	43 RM (69 RK), AZ-NV	98
	42 RM (68 RK), AZ	627
	41.51 RM (66.8 RK), Russian Cove, AZ	967
	41.5 RM (67 RK), AZ	373
	41.1 RM (66.1 RK), Elizabeth J. Cove, NV	756
	41 RM (66 RK), AZ	404
	39.5 RM (64 RK), AZ	650
	39.5 RM (63.6 RK), Placer Cove, NV	1
	38 RM (61 RK), AZ	368
	37 RM (60 RK), NV	417
	36 RM (58 RK), NV	387
	35.5 RM (57 RK), AZ	96
	34 RM (55 RK), AZ	527
	33.6 RM (54.1 RK), Eagle Cove (north of), AZ	738
	30 RM (48 RK), AZ	974
	24.7 RM (39.7 RK), Gold Cove, AZ	1
	22.75 RM (36.6 RK), Cottonwood Cove, NV	901
	15.4 RM (24.8 RK), Arizona Juvenile, AZ	6
	8 RM (12.9 RK), Desert Cove, AZ	416
	Lake Mohave	1,176
	Willow Beach National Fish Hatchery Total	
Yuma Cove	24.5 RM (39.4 RK), Yuma Cove, AZ	172
Grand Total		220,057

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Table 12. Summary of PIT-tagged bonytail stockings into Lake Havasu (Reach 3), AZ-NV-CA, 1992-2007. River miles and kilometers are approximate.

Production Facility	N fish	% of Total ^b
Dexter National Fish Hatchery ^a	32,864	100
Type of Production		
Unknown if manual or natural spawning ^a	32,864	100
Rearing Location		
Bulkhead Cove	4	2
Helicopter Cove	2	1
Office Cove	198	96
Pittsburgh Point Cove	3	1
Lakeside Backwaters Total	207	(1)
Achii Hanyo Fish Hatchery, AZ ^a	12,435	38
Bubbling Ponds State Fish Hatchery, AZ ^a	1,905	6
Cibola NWR High Levee Pond, AZ-CA ^a	228	1
Dexter National Fish Hatchery, NM	4,695	14
Emerald Canyon Golf Course Ponds, AZ	636	2
Hassayampa Preserve, AZ	17	< 1
Office Cove tanks, AZ	2	< 1
Palm Lake, AZ	65	< 1
Willow Beach National Fish Hatchery, AZ ^a	12,674	39
Off-site Facilities Total ^a	32,657	(99)
Stocking Location ^c		
42 RM (67.6 RK), Topock Marsh, AZ ^a	1,182	-
River Total ^a	1,182	(4)
22.5 RM (36 RK), Campbell Cove, AZ	1	20
19 RM (30.6 RK), Pittsburgh Point Cove, AZ	4	80
Lake Havasu Total	5	(< 1)
18.5 RM (29.8 RK), Palms Marina, AZ	12	< 1
15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ ^a	15,023	49
0.5 RM (0.8 RK), Bulkhead Cove, AZ	43	< 1
0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ ^a	7,502	24
0.1 RM (0.16 RK), Takeoff Point, AZ	704	2
0 RM, Office Cove, AZ ^a	7,438	24
Lower Lake Total ^a	30,722	(93)
Lake Havasu ^a	955	(3)

Stocking Year	N fish	% of Total
2007	38	< 1
2006 ^a	300	1
2005	12	< 1
2004 ^a	9,827	30
2003 ^a	8,669	26
2002 ^a	9,409	29
2001	710	2
2000 ^a	1,548	5
1999 ^a	1,093	3
1998	810	2
1997	125	< 1
1996 ^a	144	< 1
1995 ^a	95	< 1
1994	66	< 1
1993	1	< 1
1992	17	< 1
Stocking Month		
January ^a	325	1
February	116	< 1
March	1,932	6
April	589	2
May	724	2
June	726	2
July ^a	1,920	6
August ^a	3,639	11
September	28	< 1
October	4,701	14
November ^a	12,365	38
December ^a	5,799	18
AVG TL (mm) at Stocking		
< 200	17	< 1
200-249 ^a	791	2
250-299 ^a	26,428	80
300-349 ^a	5,540	17
≥ 350	87	< 1
No TLs given in data	1	< 1

^aAt least one bonytail was captured in this category.

^bValues in parenthesis are % total of total number stocked when grouping is used within a category.

^cSee Figure 1 and report text for specific stocking areas.

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 13. Summary of wire-tagged bonytail stockings into Lake Havasu (Reach 3), AZ-NV-CA, 1994-2007. River miles and kilometers are approximate.

Production Facility	<i>N</i> fish	% of Total ^a
Dexter National Fish Hatchery	94,438	100
Type of Production		
Unknown if manual or natural spawning	94,438	100
Rearing Location		
Achii Hanyo Fish Hatchery, AZ	1,408	1
Dexter National Fish Hatchery, NM	90,633	96
Ulvalde National Fish Hatchery, TX	2,397	3
Stocking Location ^b		
74.2 RM (119.4 RK), Laughlin Lagoon, NV	1,264	24
43.5 RM (70 RK), Park Moabi, CA	3,908	76
River Total	5,172	(5)
11.5 RM (19 RK), No Entry Cove, AZ	39,658	97
0 RM, Office Cove, AZ	1,408	3
Lower Lake Total	41,066	(43)
Lake Havasu	48,200	(51)
Stocking Year		
2007	2,775	3
2006	3,805	4
1994	87,858	93
Stocking Month		
January	1,511	2
March	1,264	1
October	87,858	93
November	2,397	3
December	1,408	1
AVG TL (mm) at Stocking		
< 200	87,858	93
300-349	6,580	7

^aValues in parenthesis are % total of total number stocked when grouping is used within a category.

^bSee Figure 1 and report text for specific stocking areas.

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 14. Monthly average water temperature measured in degrees Celsius (°C) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River basin, 1981-2007. See Appendix 14 for water sampling data.

Month	Water Sampling Location						
	Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
	Near Jensen ^a	Green River ^a	Deerlodge Park ^a	Near Grand Junction ^a	Near Cisco, UT ^a	Below Davis Dam, AZ-NV ^b	Below Parker Dam, AZ-NV ^a
Jan	3	1	0	3	1	12	12
Feb	-	3	2	5	3	11	13
Mar	6	8	3	7	10	12	17
Apr	10	13	10	11	11	15	19
May	14	16	13	14	15	16	22
Jun	17	20	18	18	19	17	24
Jul	23	24	23	21	23	18	26
Aug	20	24	24	20	22	19	26
Sep	15	18	17	18	17	19	-
Oct	11	12	10	11	14	19	20
Nov	4	5	4	6	5	16	16
Dec	2	1	0	2	2	14	12

^aData years, 1996-2007.

^bData years, 1981-1987.

U.S. Geological Survey (USGS) water sampling locations:

Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34", longitude 109°14'05" (NAD27)]

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10", longitude 110°09'02" (NAD27)]

Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06", longitude 108°31'28" (NAD27)]

Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00", longitude 108°27'00" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38", longitude 109°17'34" (NAD27)]

Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30", longitude 114°34'17" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44", longitude 114°08'22" (NAD27)]

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 15. Monthly average discharge (instantaneous) measured in cubic feet per second (CFS) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River basin, 1981-2007. See Appendix 15 for water sampling data.

Month	Water Sampling Location						
	Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
	Near Jensen ^a	Green River ^a	Deerlodge Park ^a	Near Grand Junction ^a	Near Cisco, UT ^a	Below Davis Dam, AZ-NV ^b	Below Parker Dam, AZ-NV ^c
Jan	2,300	2,305	539	1,635	2,725	19,165	9,325
Feb	-	3,272	685	1,515	3,602	20,048	12,048
Mar	2,872	4,530	1,486	1,838	4,512	14,130	18,200
Apr	5,385	7,636	3,595	2,889	8,416	21,571	15,386
May	12,414	11,893	8,343	5,050	15,256	25,300	18,475
Jun	9,639	11,149	6,224	3,106	11,891	22,367	16,097
Jul	3,053	3,417	729	1,955	4,635	25,403	17,300
Aug	1,585	2,466	290	1,647	3,783	26,657	12,561
Sep	1,850	3,292	142	1,999	5,090	23,887	-
Oct	2,441	2,886	405	2,212	4,785	19,864	9,080
Nov	2,730	3,226	555	1,899	4,072	17,660	7,165
Dec	2,040	3,370	448	1,433	3,734	15,922	7,458

^aData years, 1996-2007.

^bData years, 1981-1987.

^cData years, 1996-2006.

U.S. Geological Survey (USGS) water sampling locations:

Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34", longitude 109°14'05" (NAD27)]

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10", longitude 110°09'02" (NAD27)]

Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06", longitude 108°31'28" (NAD27)]

Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00", longitude 108°27'00" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38", longitude 109°17'34" (NAD27)]

Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30", longitude 114°34'17" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44", longitude 114°08'22" (NAD27)]

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 16. Monthly average turbidity measured in unfiltered water and in nephelometric turbidity units (NTU) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River basin, 1981-2004. See Appendix 16 for water sampling data.

Month	Water Sampling Location			
	Green River, UT	Gunnison River, CO	Colorado River	
	Green River ^a	Near Grand Junction ^b	Near Cisco, UT ^c	Below Parker Dam, AZ-NV ^d
Jan	-	4	-	1
Feb	23	11	28	1
Mar	420	26	92	2
Apr	128	74	220	1
May	205	117	122	1
Jun	84	24	63	1
Jul	115	36	47	-
Aug	110	41	207	1
Sep	1,117	22	298	-
Oct	42	14	700	2
Nov	86	7	25	2
Dec	12	3	3	1

^aData years, 1996-2000.

^bData years, 1988-1995.

^cData years, 1996-2000.

^dData years, 1996-2004.

U.S. Geological Survey (USGS) water sampling locations:

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10", longitude 110°09'02" (NAD27)]

Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00", longitude 108°27'00" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38", longitude 109°17'34" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44", longitude 114°08'22" (NAD27)]

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 17. Monthly average specific conductivity measured in unfiltered water in microsiemens per centimeter at 25°C (µS/cm) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River basin, 1981-2007. See Appendix 17 for water sampling data.

Month	Water Sampling Location						
	Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
	Near Jensen ^a	Green River ^a	Deerlodge Park ^a	Near Grand Junction ^a	Near Cisco, UT ^a	Below Davis Dam, AZ-NV ^b	Below Parker Dam, AZ-NV ^b
Jan	702	875	625	802	1,275	1,023	959
Feb	-	852	727	830	1,130	1,010	1,009
Mar	676	817	699	751	1,007	1,010	1,003
Apr	567	653	481	598	646	994	1,009
May	332	444	197	511	536	984	958
Jun	345	454	195	698	2,034	974	968
Jul	518	649	455	858	963	969	1,070
Aug	656	757	601	1,020	1,082	970	978
Sep	791	819	671	993	1,062	966	-
Oct	633	759	555	971	1,160	992	980
Nov	623	842	545	890	1,183	992	972
Dec	770	805	601	940	1,128	992	1,006

^aData years, 1996-2007.

^bData years, 1981-1987.

U.S. Geological Survey (USGS) water sampling locations:

Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34", longitude 109°14'05" (NAD27)]

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10", longitude 110°09'02" (NAD27)]

Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06", longitude 108°31'28" (NAD27)]

Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00", longitude 108°27'00" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38", longitude 109°17'34" (NAD27)]

Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30", longitude 114°34'17" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44", longitude 114°08'22" (NAD27)]

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Table 18. Monthly average dissolved oxygen measured in unfiltered water in milligrams per liter (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River basin, 1984-2007. See Appendix 18 for water sampling data.

Month	Water Sampling Location						
	Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
	Near Jensen ^a	Green River ^b	Deerlodge Park ^c	Near Grand Junction ^c	Near Cisco, UT ^b	Below Davis Dam, AZ-NV ^d	Below Parker Dam, AZ-NV ^c
Jan	-	-	11.8	11.7	-	11.3	10.3
Feb	-	11.8	11.5	10.7	10.6	10.7	10.2
Mar	11.2	10.1	11.3	10.4	9.5	10.3	9.4
Apr	9.4	9.0	9.6	8.9	9.2	9.8	9.4
May	9.2	8.2	8.8	8.4	8.3	9.5	9.1
Jun	9.1	7.3	8.2	8.0	8.1	9.0	8.1
Jul	8.2	6.8	7.1	7.5	7.0	8.7	10.0
Aug	8.9	7.0	7.5	7.9	7.0	8.0	7.7
Sep	8.6	7.8	8.1	7.9	7.9	7.9	-
Oct	9.2	9.5	9.5	9.1	8.8	8.7	9.2
Nov	-	10.6	10.7	11.8	10.9	9.1	8.7
Dec	-	12.3	11.4	12.2	12.3	9.9	9.3

^aData years, 1997-2003.

^bData years, 1996-2000.

^cData years, 1996-2007.

^dData years, 1984-1987.

U.S. Geological Survey (USGS) water sampling locations:

Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34, longitude 109°14'05" (NAD27)]

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10, longitude 110°09'02" (NAD27)]

Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06, longitude 108°31'28" (NAD27)]

Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00, longitude 108°27'00" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38, longitude 109°17'34" (NAD27)]

Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30, longitude 114°34'17" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44, longitude 114°08'22" (NAD27)]

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 19. Monthly pH average of unfiltered water measured in the field at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River basin, 1981-2007. See Appendix 19 for water sampling data.

Month	Water Sampling Location						
	Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
	Near Jensen ^a	Green River ^a	Deerlodge Park ^a	Near Grand Junction ^a	Near Cisco, UT ^a	Below Davis Dam, AZ-NV ^b	Below Parker Dam, AZ-NV ^a
Jan	8.0	8.3	8.1	8.4	8.4	8.1	8.2
Feb	-	8.4	8.6	8.4	8.2	7.9	8.2
Mar	8.5	8.2	8.4	8.4	8.3	8.0	8.2
Apr	8.4	8.3	8.3	8.2	8.1	8.0	8.1
May	8.1	8.1	8.2	8.1	8.1	7.9	8.2
Jun	8.2	8.3	8.2	8.2	8.2	7.8	8.1
Jul	8.4	8.4	8.5	8.3	8.3	7.9	8.0
Aug	8.4	8.4	8.5	8.3	8.2	7.6	8.0
Sep	8.1	8.4	8.5	8.3	8.3	7.8	-
Oct	8.4	8.4	8.4	8.4	8.3	8.0	8.2
Nov	8.3	8.3	8.5	8.7	8.3	7.9	8.2
Dec	8.3	8.3	8.4	8.4	8.3	8.1	8.2

^aData years, 1996-2007.

^bData years, 1981-1987.

U.S. Geological Survey (USGS) water sampling locations:

Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34, longitude 109°14'05" (NAD27)]

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10, longitude 110°09'02" (NAD27)]

Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06, longitude 108°31'28" (NAD27)]

Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00, longitude 108°27'00" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38, longitude 109°17'34" (NAD27)]

Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30, longitude 114°34'17" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44, longitude 114°08'22" (NAD27)]

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Table 20. Monthly average of suspended sediments concentration in milligram per liter (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River basin, 1981-2005. See Appendix 20 for water sampling data.

Month	Water Sampling Location				
	Green River, UT		Yampa River, CO	Colorado River	
	Near Jensen ^a	Green River ^b	Deerlodge Park ^c	Near Cisco, UT ^d	Below Parker Dam, AZ-NV ^e
Jan	-	104	-	-	3
Feb	-	292	-	71	2
Mar	825	846	843	348	6
Apr	450	1,195	465	876	3
May	701	1,380	870	960	3
Jun	287	650	437	251	3
Jul	80	1,129	471	524	5
Aug	-	893	175	734	5
Sep	-	1,796	12	607	5
Oct	41	428	18	942	4
Nov	-	192	1,169	96	5
Dec	-	94	7	56	3

^aData years, 1996-2005.

^bData years, 1981-2000.

^cData years, 1996-2002.

^dData years, 1988-2000.

^eData years, 1982-1991.

U.S. Geological Survey (USGS) water sampling locations:

Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34", longitude 109°14'05" (NAD27)]

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10", longitude 110°09'02" (NAD27)]

Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06", longitude 108°31'28" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38", longitude 109°17'34" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44", longitude 114°08'22" (NAD27)]

Final – Evaluation of bonytail stockings in the Colorado River Basin

Table 21. Summary stocking and captured location, and time-at-large for paired PIT-tagged bonytail data from the lower Colorado River Basin, 1996-2007.

Reservoir	Stocking location	Capture location	Stocking Area	Capture Area	DAL	MAL	N Fish
Mohave ^b	5.25 RM (8.45 RK), Princess Cove, AZ	23 RM (37 RK), Bass Cove, NV	Lower Lake	Basin	113	4	1
	22.75 RM (36.61 RK), Cottonwood Cove, NV	16.78 RM (27.00 RK), Valhalla Cove to Half-way Wash (north of), NV	Basin	Basin	107	4	1
	16.25 RM (26.15 RK), Nine Mile Coves, NV	20 RM (32 RK), Cottonwood Cove East, AZ	Basin	Basin	203	7	1
	5.25 RM (8.45 RK), Princess Cove, AZ	3.3 RM (5.3 RK), Forked Coves, AZ	Lower Lake	Lower Lake	152	5	1
	16.25 RM (26.15 RK), Nine Mile Coves, NV	17.5 RM (28.2 RK), Half-way Wash, NV	Basin	Basin	936	31	1
	16.25 RM (26.15 RK), Nine Mile Coves, NV	16.25 RM (26.15 RK), Nine Mile Coves, NV	Basin	Basin	140	5	1
Mohave total					6		
Havasu ^c	15.8 RM (25.4 RK), BLM Partner's Point Work Camp, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lake Havasu	Lower Lake	69	2	1
	42 RM (68 RK), Topock Marsh, AZ	27.5 RM (44.3 RK), Clear Bay Cove, CA	River	Lake Havasu	105	4	1
	42 RM (68 RK), Topock Marsh, AZ	30 RM (48 RK) Cove, AZ	River	Lake Havasu	84	3	1
	15.8 RM (25.4 RK), BLM Partner's Point Work Camp, AZ	27.5 RM (44.3 RK), Clear Bay Cove, CA	Lake Havasu	Lake Havasu	77	3	1
	42 RM (68 RK), Topock Marsh, AZ	37.3 RM (63.0 RK), Pulpit Rock Cove, AZ	River	River	64	2	1
	42 RM (68 RK), Topock Marsh, AZ	43.5 RM (70.0 RK), Park Moabi, CA	River	River	63	2	1
	42 RM (68 RK), Topock Marsh, AZ	43.5 RM (70.0 RK), Park Moabi, CA	River	River	66	2	2
	42 RM (68 RK), Topock Marsh, AZ	43.25 RM (69.60 RK), Park Moabi Lagoon, CA	River	River	85	3	2
	42 RM (68 RK), Topock Marsh, AZ	43.25 RM (69.60 RK), Park Moabi Lagoon, CA	River	River	98	3	1
	42 RM (68 RK), Topock Marsh, AZ	43.25 RM (69.60 RK), Park Moabi Lagoon, CA	River	River	101	3	1
	42 RM (68 RK), Topock Marsh, AZ	43.25 RM (69.60 RK), Park Moabi Lagoon, CA	River	River	121	4	1
	0 RM, Office Cove, AZ	0.5 RM (0.8 RK), Bill Williams River Delta, AZ	Lower Lake	Lower Lake	61	2	1
	0 RM, Office Cove, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	77	3	1
	0 RM, Office Cove, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	109	4	1
	0 RM, Office Cove, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	621	21	1
	0 RM, Office Cove, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	208	7	1
	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	1,185	40	1
	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	224	7	3
	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	546	18	1
	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	0.3 RM (0.5 RK), Bill Williams River NWR, AZ	Lower Lake	Lower Lake	98	3	1
Havasu total					24		
Lower	A-7 backwater upper	C-7 backwater	-	-	33	1	-
	A-7 backwater upper	C-7 backwater	-	-	33	1	-
	A-7 backwater upper	A-7 backwater upper	-	-	35	1	-
	A-7 backwater upper	A-7 backwater upper	-	-	36	1	-
	A-7 backwater upper	A-7 backwater upper	-	-	118	4	-
Lower total					5		
Grand total					35		

^aStocking areas - "Mohave" is Lake Mohave (Reach 2), "Havasu" is Lake Havasu (Reach 3) and "Lower" is the lower Colorado River (Reach 4 and 5). See Figure 1 and report text for specific stocking areas.

^bOne fish omitted as it was a same day capture.

^cOne fish omitted as its stocking location was unknown and one fish was 6 DAL.

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Table 22. Change in distance and direction from stocking to capture location for paired PIT-tagged bonytail data from the lower Colorado River Basin, 1996-2007.

Reservoir	Change in Distance	DAL	MAL	N Fish
Mohave	17.75 RM (27.57 RK)	113	4	1
	5.97 RM (9.61 RK)	107	4	1
	3.75 RM (6.04 RK)	203	7	1
	1.95 RM (3.14 RK)	152	5	1
	1.25 RM (2.01 RK)	936	31	1
	No change	140	5	1
Mohave total				6
Havasu	15.5 RM (24.94 RK)	69	2	1
	14.5 RM (23.34 RK)	105	4	1
	12 RM (19 RK)	84	3	1
	11.7 RM (18.8 RK)	77	3	1
	4.7 RM (7.6 RK)	64	2	1
	1.5 RM (2.4 RK)	63	2	1
		66	2	2
	1.25 RM (2.01 RK)	85	3	2
		98	3	1
		101	3	1
	0.5 RM (0.8 RK)	121	4	1
		61	2	1
	0.3 RM (0.5 RK)	77	3	1
		109	4	1
		208	7	1
		621	21	1
	No change	98	3	1
		224	7	3
		546	18	1
1,185		40	1	
Havasu total				24
Lower	5.5 RM (8.6 RK)	33	1	2
	No change	35	1	1
		36	1	1
		118	4	1
Lower total				5
Grand total				35

*Stocking areas - "Mohave" is Lake Mohave (Reach 2), "Havasu" is Lake Havasu (Reach 3) and "Lower" is the lower Colorado River (Reach 4 and 5). See Figure 1 and report text for specific stocking areas.

Reservoir	Change in Direction	DAL	MAL	N Fish	
Mohave	No change	140	5	1	
	No change total				1
	North	113	4	1	
		203	7	1	
		936	31	1	
	North total				3
South	107	4	1		
	152	5	1		
South total				2	
Mohave total				6	
Havasu	No change	98	3	1	
		224	7	3	
		546	18	1	
		1,185	40	1	
	No change total				6
	North	61	2	1	
		63	2	1	
		66	2	2	
		77	3	2	
		85	3	2	
		98	3	1	
		101	3	1	
		109	4	1	
		121	4	1	
		208	7	1	
		621	21	1	
	North total				14
	South	64	2	1	
		69	2	1	
84		3	1		
105		4	1		
South total				4	
Havasu total				24	
Lower	No change	35	1	1	
		36	1	1	
		118	4	1	
	No change total				3
	South	33	1	2	
South total				2	
Lower total				5	
Grand total				35	

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Table 23. Summary of monthly averages of various water quality parameters for U.S. Geological Survey water sampling locations around the Colorado River basin near bonytail stocking areas, 1981-2007. See Tables 14-20 for specific data years per water sampling location.

Month	Parameter ^a	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV ^b
Jan	Water temp	3	1	0	3	1	12	12
	Discharge	2,300	2,305	539	1,635	2,725	19,165	9,325
	Turbidity				4		1	
	Specific conductivity	702	875	625	802	1,275	1,023	959
	Dissolved oxygen			11.8	11.7		11.3	10.3
	pH	8.0	8.3	8.1	8.4	8.4	8.1	8.2
	Suspended solids		104				1	3
Feb	Water temp		3	2	5	3	11	13
	Discharge		3,272	685	1,515	3,602	20,048	12,048
	Turbidity		23		11	28	1	
	Specific conductivity		852	727	830	1,130	1,010	1,009
	Dissolved oxygen		11.8	11.5	10.7	10.6	10.7	10.1
	pH		8.4	8.6	8.4	8.2	7.9	8.2
	Suspended solids		292			71	1	2
Mar	Water temp	6	8	3	7	10	12	17
	Discharge	2,872	4,530	1,486	1,838	4,512	14,130	18,200
	Turbidity		420		26	92	2	
	Specific conductivity	676	817	699	751	1,007	1,010	1,003
	Dissolved oxygen	11.2	10.1	11.3	10.5	9.5	10.3	9.4
	pH	8.5	8.2	8.4	8.4	8.3	8.0	8.2
	Suspended solids	825	846	843		348		5
Apr	Water temp	10	13	10	11	11	15	19
	Discharge	5,385	7,636	3,595	2,889	8,416	21,571	15,386
	Turbidity		128		74	220	1	
	Specific conductivity	567	653	481	598	646	994	1,009
	Dissolved oxygen	9.4	8.9	9.6	8.9	9.2	9.8	9.4
	pH	8.3	8.3	8.3	8.2	8.1	8.0	8.1
	Suspended solids	450	1,194	465		876	1	3
May	Water temp	14	16	13	14	15	16	22
	Discharge	12,414	11,893	8,343	5,050	15,256	25,300	18,475
	Turbidity		205		117	121	1	
	Specific conductivity	332	444	197	511	536	984	958
	Dissolved oxygen	9.2	8.2	8.8	8.4	8.3	9.5	9.1
	pH	8.1	8.1	8.2	8.1	8.1	7.9	8.2
	Suspended solids	701	1,380	870		960		3
Jun	Water temp	17	20	18	18	18	17	24
	Discharge	9,639	11,149	6,224	3,106	11,891	22,367	16,097
	Turbidity		84		24	63	1	
	Specific conductivity	345	454	195	698	2,034	974	968
	Dissolved oxygen	9.1	7.3	8.2	8.0	8.1	8.9	8.1
	pH	8.2	8.3	8.2	8.2	8.2	7.8	8.1
	Suspended solids	287	650	437		251		3
Jul	Water temp	23	24	23	21	23	18	26
	Discharge	3,053	3,417	729	1,955	4,635	25,403	17,300
	Turbidity		115		36	47		
	Specific conductivity	518	649	455	858	963	969	1,070
	Dissolved oxygen	8.2	6.7	7.1	7.5	7.0	8.7	10.0
	pH	8.4	8.4	8.5	8.3	8.3	7.9	8.0
	Suspended solids	80	1,129	471		524		5

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Table 23 con't. Summary of monthly averages of various water quality parameters for U.S. Geological Survey water sampling locations around the Colorado River basin near bonytail stocking areas, 1981-2007. See Tables 14-20 for specific data years per water sampling location.

Month	Parameter ^a	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV ^b
Aug	Water temp	20	24	24	20	22	19	26
	Discharge	1,585	2,466	290	1,647	3,783	26,657	12,561
	Turbidity		110		40	207	1	
	Specific conductivity	656	757	601	1,020	1,082	970	978
	Dissolved oxygen	8.9	7.0	7.5	7.9	7.0	8.0	7.7
	pH	8.4	8.4	8.5	8.3	8.2	7.6	8.0
	Suspended solids		893	175		734		5
Sep	Water temp	15	18	17	18	17	19	
	Discharge	1,850	3,292	142	1,999	5,090	23,887	
	Turbidity		1,117		22	298		
	Specific conductivity	791	819	671	993	1,062	966	
	Dissolved oxygen	8.6	7.8	8.1	7.9	7.9	7.9	
	pH	8.1	8.4	8.5	8.3	8.3	7.8	
	Suspended solids		1,796	12		607		5
Oct	Water temp	11	12	10	11	14	19	20
	Discharge	2,240	3,120	387	2,313	4,785	19,864	9,080
	Turbidity		42		14	700	2	
	Specific conductivity	633	759	555	971	1,160	992	980
	Dissolved oxygen	9.1	9.5	9.5	9.1	8.8	8.7	9.2
	pH	8.4	8.4	8.4	8.4	8.3	7.9	8.2
	Suspended solids	41	428	18		941		4
Nov	Water temp	4	5	4	6	5	16	16
	Discharge	2,441	2,886	405	2,212	4,785	19,864	9,080
	Turbidity		85		7	25	2	
	Specific conductivity	623	842	545	890	1,183	992	972
	Dissolved oxygen		10.6	10.7	11.8	10.9	9.1	8.7
	pH	8.3	8.3	8.5	8.7	8.3	7.9	8.2
	Suspended solids		191	1,169		96	1	5
Dec	Water temp	2	1	0	2	2	14	12
	Discharge	2,040	3,370	448	1,433	3,734	15,922	7,458
	Turbidity		12		3	3	1	
	Specific conductivity	770	805	601	940	1,127	992	1,006
	Dissolved oxygen		12.3	11.4	12.2	12.3	9.9	9.3
	pH	8.3	8.3	8.4	8.4	8.3	8.1	8.2
	Suspended solids		94	7		56	2	3

^aParameter description:

Water temperature, in Celsius (°C)

Discharge, instantaneous, in cubic feet per second (CFS)

Turbidity, unfiltered, in nephelometric turbidity units (NTU)

Specific conductance, unfiltered, field, in microsiemens per centimeter at 25 °C (pS/cm)

Dissolved oxygen, unfiltered, in milligrams per liter (mg/L)

pH, unfiltered, in field

Suspended sediment concentration (mg/L)

^bAll water quality parameters from 1996-2007, with the exception of suspended sediment concentration (mg/L) which began in 1982.

U.S. Geological Survey (USGS) water sampling locations:

Green River near Jensen, UT [USGS map 09261000, Uintah County, UT, latitude 40°24'34", longitude 109°14'05" (NAD27)]

Green River at Green River, UT [USGS map 09315000, Emery County, UT, latitude 38°59'10", longitude 110°09'02" (NAD27)]

Yampa River at Deerlodge Park, CO [USGS map 09260050, Moffat County, CO, latitude 40°27'06", longitude 108°31'28" (NAD27)]

Gunnison River near Grand Junction, CO [USGS map 09152500, Mesa County, CO, latitude 38°59'00", longitude 108°27'00" (NAD27)]

Colorado River near Cisco, UT [USGS map 09180500, Grand County, UT, latitude 38°48'38", longitude 109°17'34" (NAD27)]

Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30", longitude 114°34'17" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44", longitude 114°08'22" (NAD27)]

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Table 24. Comparisons of bonytail population size as a function of rearing site for stocking areas, Lakes Mohave and Havasu, and the lower Colorado River below Parker Dam. Data are from PIT-tagged bonytail, their TLs in mm at release and capture.

Factor		Population release data			"Sample" data		Statistical results		
Reservoir & Rearing Site		Population size	pTL	pSD	N	sTL	sSD	z score	one tailed p-values
Lake Mohave	Lakeside backwater	592	276	42.72	3	269	24.66	-0.271	0.6066666
	Off-site	22,303	281	34.57	3	318	19.96	1.865	0.0310806
	Unknown	1	243	-	0	-	-	-	-
Lake Havasu	Lakeside backwater	208	267	20.62	0	-	-	-	-
	Off-site	32,611	280	30.34	25	312	6.07	5.324	0.0000001
Lower Colorado River below Parker Dam	Off-site	750	315	31.34	4	345	15.67	1.943	0.0259854
Reservoir		33,569			29				
Lake Mohave		22,896	281	34.82	6	294	14.21	0.905	0.1827124
Lake Havasu		32,819	280	30.31	25	312	6.06	5.344	0.0000000
Lower Colorado River below Parker Dam		750	315	31.34	4	345	15.67	1.943	0.0259854
Rearing Site		33,569			29				
	Lakeside backwater	800	274	38.42	3	269	22.18	-0.193	0.5765025
	Off-site	55,664	281	32.36	32	317	5.72	6.304	0.0000000
		56,464			35				
		56,465	281	32.47	35	313	5.49	5.846	0.0000000

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Table 25. Summary of bonytail captured in Lake Mohave (Reach 2), AZ-NV, 1983-2007. Paired PIT-tagged bonytail data are not included.

Capture Location ^a	N Fish	% Total ^b
52.85 RM (85.05 RK), Willow Beach NFH (above), AZ-NV	1	-
River total	1	(< 1)
24.5 RM (39.4 RK), Yuma Cove, AZ	2	-
Arizona Bay total	2	(2)
22.75 RM (36.61 RK), Cottonwood Cove, NV	12	19
21.3 RM (34.3 RK), Cottonwood and Carp Coves, AZ-NV	8	13
21.15 RM (34.0 RK), Cottonwood Cove Landing, Resort and Marina (north point), NV	8	13
20.5 RM (32.9 RK), Carp Cove, AZ	1	2
20.28 RM (32.64 RK), Mesquite and Tequila Cove, NV	1	2
20 RM (32 RK), Cottonwood Cove East, AZ	24	38
19.75 RM (31.78 RK) Bill Gayes Cove, NV	5	8
16.25 RM (26.15 RK), Nine Mile Cove, NV	2	3
15.91 RM (25.60 RK), Nevada Egg, NV	1	2
15.9 RM (25.6 RK), Dandy Cove, NV	2	3
Basin total	64	(50)
4.15 RM (6.68 RK), Gasoline Alley Cove, AZ	3	9
3.91 RM (6.29 RK), Yoke Cove (point off of), AZ	2	6
3.9 RM (6.28 RK), Yoke Cove, AZ	2	6
3.8 RM (6.1 RK), Arrowhead Cove (north of), AZ	1	3
3.7 RM (6.0 RK), Arrowhead Cove, AZ	24	73
3.6 RM (5.8 RK), Arrowhead Cove (south of), AZ	1	3
Lower Lake total	33	(26)
Lake Mohave	27	(21)
Total	127	-
Capture Month		
Mar	9	7
Apr	9	7
May	80	63
Jun	20	16
Jul	1	1
Aug	4	3
Nov	4	3
Total	127	-
Capture Year		
2007	1	1
2006	2	2
2002	1	1
2000	1	1
1999	5	4
1998	3	2
1997	26	20
1996	7	6
1995	15	12
1994	6	5
1993	15	12
1992	3	2
1991	4	3
1990	14	11
1989	9	7
1988	10	8
1986	3	2
1985	1	1
1983	1	1
Total	127	-

History	N Fish Capture		Total	% Total
	First	Second		
Unknown	7	-	7	6
Wild ^c	117	3	120	94
Total	124	3	127	-

^aSee Figure 1 and report text for specific stocking areas.

^bValues in parenthesis are % total of total number stocked when grouping is used within a category.

^cFish noted as "wild" in NFWG database, but may have been untagged repatriates.

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Table 26. Summary of bonytail captured in Lake Havasu (Reach 3), AZ-NV-CA, 1999-2007. Paired PIT-tagged bonytail data are not included.

Capture Location ^a	N Fish	% Total ^b
43.5 RM (70.0 RK), Park Moabi, CA	142	99
43.25 RM (69.60 RK), Park Moabi Lagoon, AZ	1	1
River total	143	(94)
20.5 RM (33.0 RK), Site Six and Crazy Horse Campground, AZ	1	-
Lake Havasu total	1	(< 1)
8.5 RM (13.7 RK), Standard Wash Cove, AZ	1	14
0.6 RM (1.0 RK), Bill Williams River Bridge, downstream about 200 m, AZ	1	14
0.3 RM (0.5 RK), Bill Williams River NWR, AZ	4	57
0 RM, Office Cove, AZ	1	14
Lower Lake total	7	100 (5)
Lake Havasu	1	(< 1)
Grand Total	152	-
Capture Month		
Feb	5	3
Mar	1	1
Apr	1	< 1
Jul	1	1
Oct	2	1
Dec	142	93
Grand Total	152	-
Capture Year		
2007	3	2
2006	143	94
2005	1	< 1
2004	2	1
2002	1	< 1
2000	1	< 1
1999	1	< 1
Grand Total	152	-

History	N Fish Capture		Total	% Total
	First	Second		
Repatriate	139	7	146	96
Unknown	4	1	5	3
Wild ^c	1	-	1	1
Total	144	8	152	-

^aSee Figure 1 and report text for specific stocking areas.

^bValues in parenthesis are % total of total number stocked when grouping is used within a category.

^cFish noted as "wild" in NFWG database, but may have been untagged repatriates.

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Table 27. Summary of bonytail captured in the lower Colorado River below Parker Dam (Reach 4 and 5), AZ-CA, 2007. Paired PIT-tagged bonytail data are not included.

Capture Location	<i>N</i> Fish	% Total
120 RM (193 KM), A-7 backwater, upper, AZ	125	89
119 RM (192 KM), A-7 backwater, lower, AZ	1	< 1
114.5 RM (184.3 RK), C-7 backwater, CA	14	10
88.5 RM (142.4 RK) Palo Verde, main channel	1	< 1
Total	141	-
Capture Month		
Jan	19	13
Feb	7	5
Apr	6	4
Nov	1	< 1
Dec	108	77
Total	141	-

^aAll fish captured were repatriates.

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Table 28. Summary of monthly averages of min/max °C water temperatures for two U.S. Geological Survey water sampling locations near bonytail stocking areas in the lower Colorado River Basin, 1981-2007. See Table 14 for specific data years.

Month	Water Temperature (°C)		
		Below Davis Dam	Below Parker Dam
Jan	Min	10	10.4
	Max	15	13.2
Feb	Min	10	11.5
	Max	12.5	13.5
Mar	Min	10	16
	Max	13.5	17.5
Apr	Min	14	17.5
	Max	16	19.6
May	Min	12.5	20.7
	Max	18	22.5
Jun	Min	15	22.5
	Max	18	25.8
Jul	Min	17	26
	Max	20.5	26
Aug	Min	18	24.2
	Max	22	27
Sep	Min	16	-
	Max	20	-
Oct	Min	18	19.5
	Max	19	19.5
Nov	Min	14.5	13.3
	Max	17	19.9
Dec	Min	12.5	10.5
	Max	14	13

U.S. Geological Survey (USGS) water sampling locations:

Colorado River below Davis Dam, AZ-NV [USGS map 9423000, Clark County, NV, latitude 35°11'30, longitude 114°34'17" (NAD27)]

Colorado River below Parker Dam, AZ-CA [USGS map 09427520, San Bernardino County, CA, latitude 34°17'44, longitude 114°08'22" (NAD27)]

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Table 29. Comparison of weight in g (min/max range) to average total length (TL) in mm at release and capture of repatriated bonytail in the lower Colorado River basin. Fish captured in Lakes Mohave (Reach 2) and Havasu (Reach 3), and the lower Colorado River below Parker Dam (Reaches 4 and 5).

Avg TL (mm)	Weight (g)						N fish with no weights	
	Release			Capture				
	Min	Max	N fish	Min	Max	N fish		
<200	26	66	21				1	
200-249	18	256	1,255	77	77	2	1	
250-299	63	260	1,978	93	190	18	4	
300-349	125	554	208	120	373	82	27	
350+	190	1,083	123	310	1,230	77	51	
Total			3,585				179	84

FIGURES

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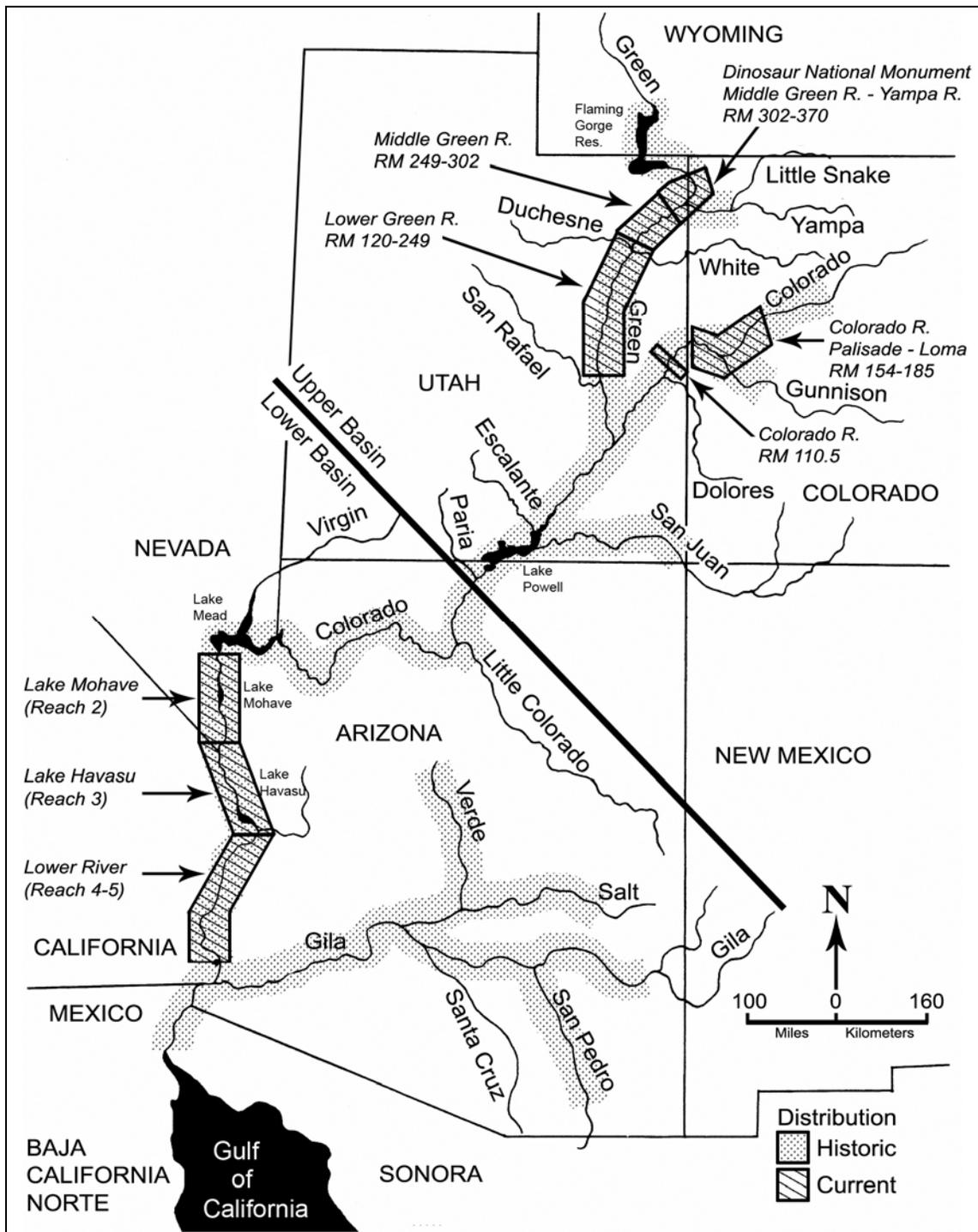


Figure 1. Historic (adapted from FWS 1990) and current (adapted from Nessler et al. 2003 and Burke 2006) distribution areas for bonytail in the Colorado River basin. Current distribution areas are general bonytail stocking areas. The bonytail stocking areas for the upper basin are defined as the “lower Green” (120-249 RM (193-401 RK)), “middle Green” (249-302 RM (401-489 RK)), and “Dinosaur National Monument” (302-370 RM (489-595 RK)) for the Green River, and “Colorado River” (110.5 RM (178 RK)) and “Colorado River between Palisade and Loma” (154-185 RM (248-298 RK)) for the mainstem Colorado River (Nessler et al. 2003; T. Francis 2007 pers. comm.). See Figures 2-4 this report for RM and RK for lower basin bonytail stocking areas.

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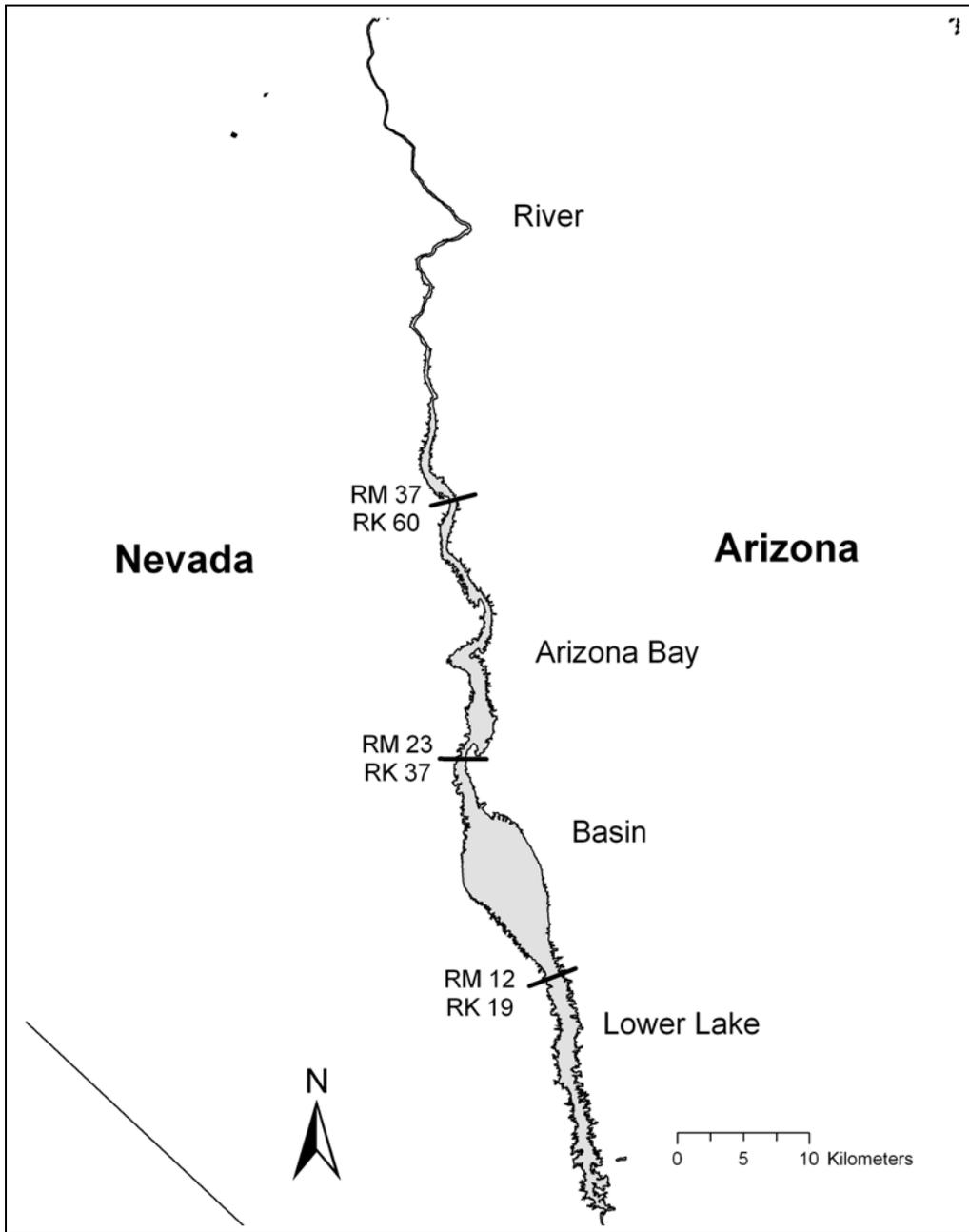


Figure. 2. Bonytail stocking areas in the Lake Mohave (Reach 2) portion of the lower Colorado River, AZ-NV, divided into sub-areas from north to south for reporting purposes. Sub-areas are "River," "Arizona Bay," "Basin" and "Lower Lake." Lake Mohave is impounded to the north by Hoover Dam located at 63 RM (101 RK) and to the south by Davis Dam located at 0 RM (0 RK).

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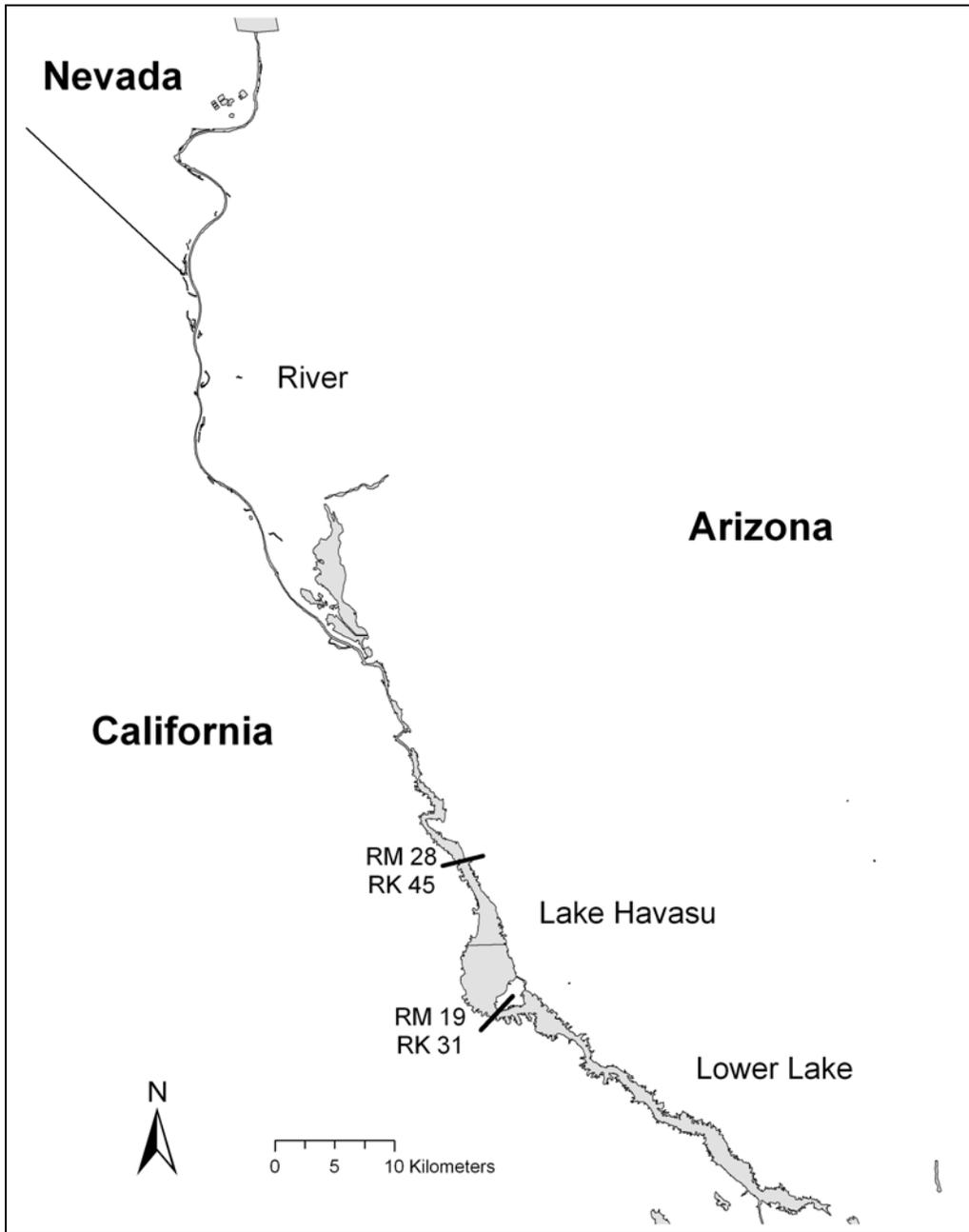


Figure 3. Bonytail stocking areas in the Lake Havasu (Reach 3) portion of the lower Colorado River, AZ-CA-NV, divided into sub-areas from north to south for reporting purposes. Sub-areas are "River," "Lake Havasu" and "Lower Lake." Lake Havasu is impounded to the north by Davis Dam located at 82 RM (132 RK) and to the south by Parker Dam at 0 RM (0 RK).

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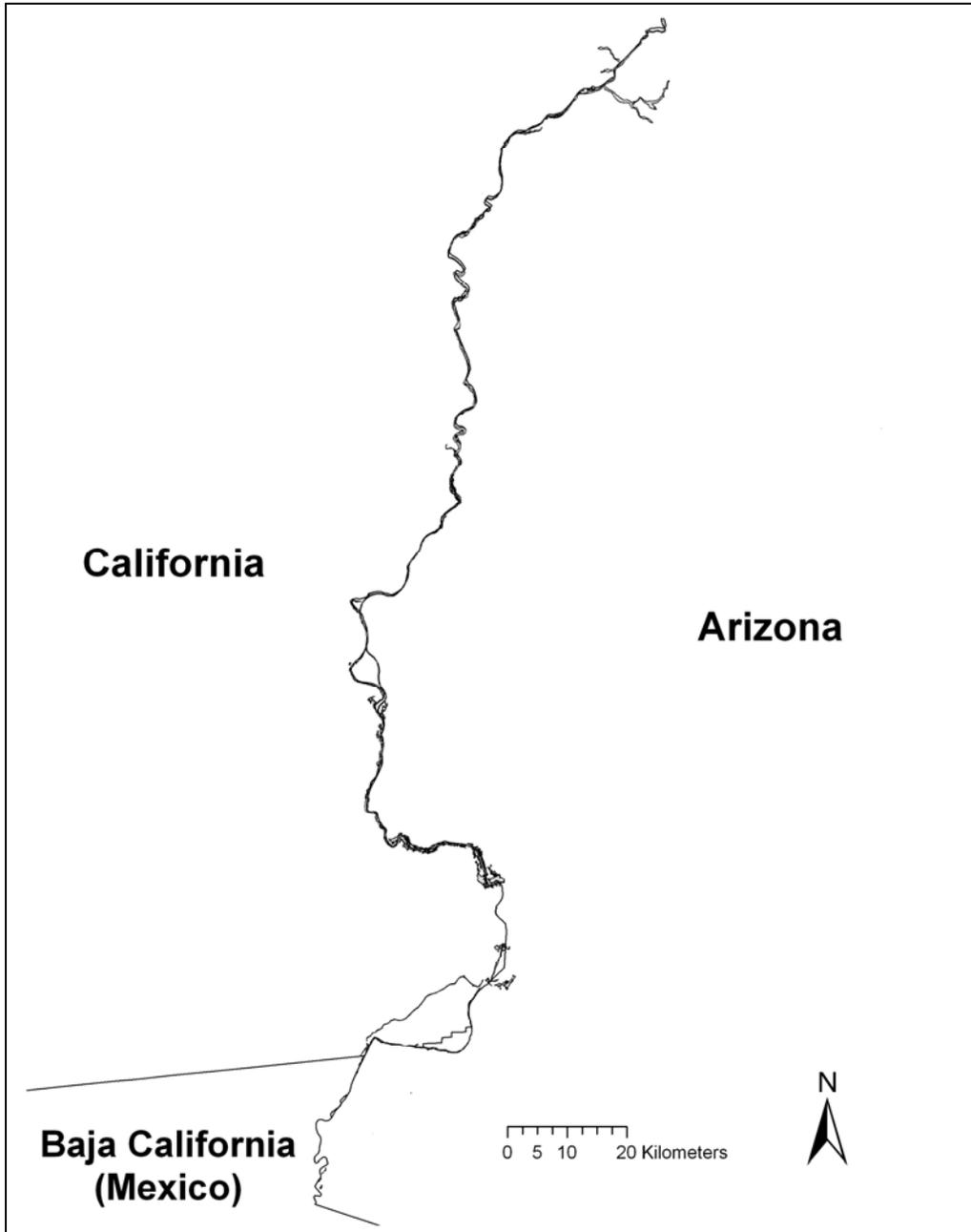


Figure. 4. Bonytail stocking areas in the portion of the lower Colorado River downstream from Parker Dam (Reaches 4 and 5), AZ-CA. The lower Colorado River is impounded to the north by Parker Dam at 192 RM (309 RK) and ends to the south at the Southerly International Boundary at 0 RM (0 RK).

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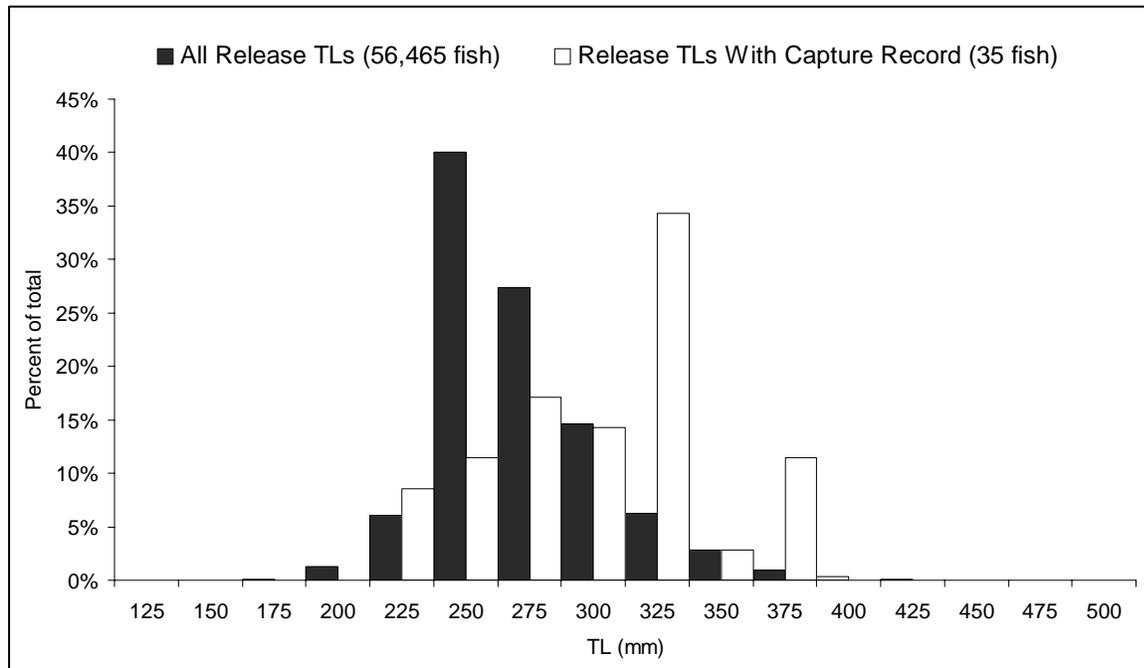


Figure 5. Comparison of total length (TL) at release for bonytail stocked (black bars) for those later captured (white bars) in the lower Colorado River basin, 1993-2007.

APPENDICES

Appendix 1

Upper Colorado River basin bonytail stocking commitment, 2002.

Under separate cover.

Appendix 2

Upper Colorado River basin bonytail stocking commitment, addendum, 2003.

Under separate cover.

Appendix 3

Lower Colorado River basin bonytail stocking commitment, FWS 1997.

Under separate cover.

Appendix 4

Lower Colorado River basin bonytail stocking commitment, LCR MSCP 2006.
Under separate cover.

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Appendix 5. Annotated bibliography of citations of bonytail stocking data, in alphabetical order by author and year. LitID (literature identification) is a unique number assigned to each source of literature for tracking purposes in comprehensive bonytail rearing literature review (Pacey and Marsh 2007).

- Badame, P.V. and J.M. Hudson. 2003. Reintroduction and monitoring of hatchery-reared bonytail in the Colorado and Green Rivers, 1996-2001. Utah Division of Wildlife Resources, Salt Lake City. 54 pages. LitID 1428
- Bradwisch, Q. 2003. Wahweap operation and maintenance, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 3 pages. LitID 1902
- Bradwisch, Q. 2004. Wahweap operation and maintenance, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 3 pages. LitID 1895
- Bradwisch, Q. 2005. Wahweap operation and maintenance, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 3 pages. LitID 1888
- Bradwisch, Q. 2006. Wahweap operation and maintenance, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 3 pages. LitID 1974
- Bradwisch, Q. 2007. Wahweap operation and maintenance, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 3 pages. LitID 1984
- Chart, T. 1989. Radio telemetry monitoring of stocked *Gila elegans* in the Green River, Utah. Annual report. Utah Division of Wildlife Resources. 40 pages + appendix LitID 1863
- Chart, T.E. and S.J. Cranney. 1993. An evaluation of hatchery-reared bonytail chub (*Gila elegans*) released in the Green River, Utah, 1988-1989. Publication number 93-12. Utah Division of Wildlife Resources, Salt Lake City. 72 pages. LitID 57
- Gustaveson, W. and Q. Bradwisch. 2000. Wahweap operation and maintenance, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 3 pages. LitID 1913
- Gustaveson, W. and Q. Bradwisch. 2002. Operation and maintenance of Wahweap State Fish Hatchery, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 4 pages. LitID 1905
- Gustaveson, W. and Q. Bradwisch. 2001. Wahweap operation and maintenance, Utah. Annual report. Utah Division of Wildlife Resources, Page, Arizona. 3 pages. LitID 1935

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- Hamman, R. 1988. *Gila elegans* stocking records and numbers, DNFH. U.S. Fish & Wildlife Service, Dexter NFH, New Mexico. LitID 793
- Jensen, B.L. 1989. Annual report, fiscal year 1989. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery, New Mexico. 19 pages. LitID 93
- Jensen, B.L. 1990. Annual report, fiscal year 1990. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery, New Mexico. 14 pages. LitID 94
- Jensen, B.L. 1991. Annual report, fiscal year 1991. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery, New Mexico. 18 pages. LitID 95
- Jensen, B.L. 1981. Annual report, fiscal year 1981. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery, New Mexico. 8 pages. LitID 83
- Jensen, B.L. 1985. Annual narrative report, calendar year 1985. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery, New Mexico. 11 pages. LitID 88
- Jensen, B.L. 1987. Annual narrative report, calendar year 1987. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery, New Mexico. 27 pages. LitID 84
- Jensen, B.L. 1988. Annual report, fiscal year 1988. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery, New Mexico. 19 pages. LitID 92
- Jensen, B.L. 1992. Annual report, fiscal year 1992. U.S. Fish & Wildlife Service, Dexter, New Mexico. 16 pages. LitID 1881
- Jensen, B.L. 1994. Annual report, fiscal year 1994. U.S. Fish & Wildlife Service, Dexter, New Mexico. LitID 1880
- Marsh, P.C. 1992. Fish sampling at ASU Karsten Golf Course, autumn 1992. Arizona State University, Tempe. 1 page. LitID 1941
- Marsh, P.C. 1997. *Gila elegans* stocking records for Lake Mohave, AZ-NV. Arizona State University, Tempe. 2 pages. LitID 1869
- McAda, C. 2006. Bonytail stocking numbers 1996-2005. Utah Division of Wildlife Resources. 2 pages. LitID 1940
- McAda, C. 2006. Overview of the Upper River Colorado River Recovery Program Propagation program with a preliminary assessment of survival of stocked fish in the rivers of the Upper Colorado River Basin. Draft. U.S. Fish and Wildlife Service, Grand Junction, Colorado. 10 + tables. LitID 1980
- Meismer, S. and M. Trammell. 1999. Bonytail reintroduction. Annual report. U.S. Fish & Wildlife Service, Moab, Utah. 9 pages. LitID 1916

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- Minckley, C.O. 1994. Memorandum: bonytail stocking, October 18, 1994. U.S. Fish & Wildlife Service, Arizona Fishery Resources Office, Parker, Arizona. 1 page. LitID 243
- Minckley, C.O. 1994. Memorandum: bonytail stocking, October 31, 1994. U.S. Fish & Wildlife Service, Arizona Fishery Resources Office, Parker, Arizona. 2 page. LitID 1929
- Minckley, C.O. 1994. Memorandum: stocking of bonytail chubs into Lake Mohave, November 27, 1994. U.S. Fish & Wildlife Service, Arizona Fishery Resources Office, Parker, Arizona. 1 page. LitID 1930
- Modde, T. and G.B. Haines. 2005. Survival and growth of stocked razorback sucker and bonytail in multiple floodplain wetlands of the middle Green River under reset conditions. Final report. U.S. Fish & Wildlife Service, Colorado River Fish Project, Vernal, Utah. 66 pages. LitID 1661
- Modde, T.H. and L.L. Meyer 1992. Evaluation of pre-introduction stress on the survival of bonytail chub stocked in the Green River. Utah State University, Cooperative Fish and Research Unit. 13 pages. LitID 647
- Native Fish Work Group. No date. Miscellaneous reports and data from Native Fish Work Group meetings. Arizona State University, Tempe. (did not try to find original sources). LitID 1971
- Pacey, C.A. 2006. Lower Colorado River Native Fish Work Group PIT tagging database - various output tables. Arizona State University, Tempe. Access database. LitID 1936
- Schnoor, K.D. and J. Logan. 2003. Native aquatic species restoration facility operation and maintenance. Annual report. Colorado Division of Wildlife, Alamosa. 4 pages. LitID 1901
- Schnoor, K.D. and J. Logan. 2004. Operation and maintenance of J.W. Mumma Native Aquatic Species Restoration Facility, Colorado. Annual report. Colorado Division of Wildlife, Alamosa. 4 pages. LitID 1894
- Schnoor, K.D. and J. Logan. 2005. NASRF operation and maintenance, Colorado. Annual report. Colorado Division of Wildlife, Alamosa. 4 pages. LitID 1887
- Schnoor, K.D. and J. Logan. 2006. J.W. Mumma NASRF Operation and Maintenance - Colorado. Colorado Division of Wildlife, Alamosa. 4 pages. LitID 1975

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- Schnoor, K.D. and J. Marrinan. 2007. J.W. Mumma NASRF Operation and Maintenance - Colorado. Colorado Division of Wildlife, Alamosa. 4 pages. LitID 1984
- U.S. Fish & Wildlife Service. 1995. Annual report, fiscal year 1995. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery & Technology Center, New Mexico. 13 pages. LitID 1920
- U.S. Fish & Wildlife Service. 2002. Annual report, fiscal year 2001. U.S. Fish & Wildlife Service, Dexter, New Mexico. 59 pages + appendices. LitID 1848
- U.S. Fish & Wildlife Service. 2003. Annual report, fiscal year 2001. U.S. Fish & Wildlife Service, Dexter, New Mexico. 26 pages + appendices. LitID 1849
- U.S. Fish & Wildlife Service. 2004. Annual report, fiscal year 2003. U.S. Fish & Wildlife Service, Dexter, New Mexico. 70 pages + appendices. LitID 420
- U.S. Fish and Wildlife Service. 2005. Bonytail (*Gila elegans*) genetics management and captive propagation plan. U.S. Fish and Wildlife Service, Dexter National Fish Hatchery and Technology Center, New Mexico. 69 pages. LitID 1847
- U.S. Fish & Wildlife Service. 2006. Egg and fish production summary 1995-2000, Dexter National Fish Hatchery & Technology Center. U.S. Fish & Wildlife Service, Dexter National Fish Hatchery & Technology Center, New Mexico. 5 pages LitID 1926
- U.S. Fish & Wildlife Service. 2006. Dexter National Fish Hatchery & Technology Center monthly accomplishment report, May 2006. U.S. Fish and Wildlife, Dexter National Fish Hatchery & Technology Center, Dexter, NM. 5 pages. LitID 1977
- U.S. Fish & Wildlife Service. 2006. Dexter National Fish Hatchery & Technology Center monthly accomplishment report, November 2006. U.S. Fish and Wildlife, Dexter National Fish Hatchery & Technology Center, Dexter, NM. 4 pages. LitID 1973
- U.S. Fish & Wildlife Service. 2007. Dexter National Fish Hatchery & Technology Center monthly accomplishment report, February 2007. U.S. Fish and Wildlife, Dexter National Fish Hatchery & Technology Center, Dexter, NM. 4 pages. LitID 1976
- U.S. Fish & Wildlife Service. 2007. Dexter National Fish Hatchery & Technology Center monthly accomplishment report, January 2007. U.S. Fish and Wildlife, Dexter National Fish Hatchery & Technology Center, Dexter, NM. 5 pages. LitID 1981

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Unknown. No date. Miscellaneous bonytail stockings from Dexter National Fish Hatchery & Technology Center, table. 1 page. LitID 1982.

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Codes for Appendices 6-13.

Type of Production	
Manual broodstock spawning, unknown if F1s or from breeding matrix	1
Unknown if manual or natural spawning	2
Wild fish, manually spawned at hatchery	3
Natural broodstock spawning in holding ponds	4
Production and Rearing Location	
Achii Hanyo Fish Hatchery	1
Arizona Juvenile	2
Boulder City Golf Course Ponds	3
Boulder City Wetlands Park	4
Bubbling Ponds Fish Hatchery	5
Bulkhead Cove	6
Carp Cove	7
Cibola NWR High Levee Pond	8
Dandy Cove	9
Davis Cove	10
Dexter National Fish Hatchery	11
Emerald Canyon Golf Course Ponds	12
Hassayampa Preserve	13
Helicopter Cove	14
Mumma Native Aquatic Species Restoration Facility	15
Nevada Egg	16
Niland Warmwater Fish Hatchery	17
Nine Mile Coves	18
North Chemehueve Cove	19
Office Cove backwater	20
Office Cove tanks	21
Palm Lake	22
Pittsburgh Point Cove	23
Uvalde National Fish Hatchery	24
Wahweap SFH	25
Willow Beach National Fish Hatchery	26
Yuma Cove	27
Mumma Native Aquatic Species Restoration Facility and Trinidad State Junior College	28
Rearing Type	
Lakeside backwater	1
Off-site facility	2

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Appendix 6. Unconfirmed bonytail stockings into the lower Colorado River basin. Unknown if stocked into open water or lakeside backwaters.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Basin	Stocking Area	Stocking Location	Avg TL (mm)	Total N fish	LITID ^a
11	2	11	Unknown	May	1983	Lower	Lake Mohave (Reach 2)	Lake Mohave	-	28,710	1847
11	2	11	Unknown	October	1989	Lower	Lake Mohave (Reach 2)	Lake Mohave	-	27,170	1847
11	2	11	Unknown	Unknown	1988-1989	Lower	Lake Mohave (Reach 2)	Lake Mohave	102	15,540	1982
11	2	11	Unknown	Unknown	1995-1996	Lower	Lake Mohave (Reach 2)	Lake Mohave	308	131	1982
11	2	11	Unknown	Unknown	1996-1997	Lower	Lake Mohave (Reach 2)	Lake Mohave	279	784	1982
11	2	11	Unknown	Unknown	1999	Lower	Lake Mohave (Reach 2)	Lake Mohave	250	15,557	1982
11	2	11	Unknown	Unknown	2000	Lower	Lake Mohave (Reach 2)	Lake Mohave	250	7,379	1982
11	2	11	Unknown	Unknown	2002	Lower	Lake Mohave (Reach 2)	Lake Mohave	250	1,273	1982
11	2	11	Unknown	October	2000	Lower	Lake Mohave (Reach 2)	Lake Mohave	254	8,379	1847, 1849
11	2	11	Unknown	October	1993	Lower	Lake Havasu (Reach 3)	Lake Havasu	-	14,992	1847
11	2	11	Unknown	November	1995	Lower	Lake Havasu (Reach 3)	Lake Havasu	-	1,000	1847
11	4	11	1993	October	1994	Lower	Lake Havasu (Reach 3)	Bill Williams National Wildlife Preserve, 0.3 RM (0.48 RK), AZ ^b	91	25,575	243, 1880
11	2	11	Unknown	Unknown	Unknown	Lower	Lake Havasu (Reach 3)	Lake Havasu	-	2,000	1848

^aSee Appendix 5 citations associated with each LITID (literature identification), which is a unique number assigned to each source of stocking data and used for tracking purposes in comprehensive bonytail rearing literature review (Pacey and Marsh 2007).

^bLITID1880 stated 17,992 fish, LITID 243 stated 25,575 fish; unsure if these were stocking into backwater cove... into the Office Cove adjacent to the ...Bill Williams River NWR.; nose-tagged.

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Codes for Appendix 7, bonytail chub stockings into the Green River, UT-CO, 1988-2007.

Comment Code	Comments
a	Fish used in telemetry experiment; five extra fish stocked possibly from this harvest
b	Fish used in telemetry experiment
c	Fish used in telemetry experiment, LITID 647 states another 22 fish came from Dexter were also transported up but no Dexter record (all but 3 eventually died)
d	Corrected as per UCRRIP database: LITID 1428 reported 3,000 fish stocked
e	Number fish harvested from Wahweap for stocking into field: LITID 1916 gave stocking location
f	Could not definitively determine actual cohort of origin due to CWT and non-lethal sampling
g	Number fish harvested from Wahweap for stocking into field: related data LITID 1913
h	related data LITID 1913
i	Fish sent to fair untagged, but may have been tagged when released into river, Bradwisch (pers. comm)
j	LITID 1980 reported fish stocked out in 10/2002 and 4999 fish stocked and stocked at RM 344
k	Fish tagged in September and stocked in Oct: stocking location from LITID 1901: LITID 1980 reported 8599 fish stocked, LITID 1904 reported 8464, corrected as per UCRRIP database staff
l	LITID 1901 reported 4962 fish stocked; LITID 1940 reported 5,000, corrected as per UCRRIP database staff
m	Number fish stocked from LITID 1940
n	Corrected as per UCRRIP database staff, LITID 1940 reported 1198 fish, but used mean in this table
o	LITID 1940 for number of fish stocked, LITID 1902 reported 3501 fish
p	LITID 1887 reported 2988; LITID 1940 stated stocked 2580; corrected as per UCRRIP database
q	UCRRIP corrected as per database, LITID 1940 reported 3494, but used mean from cite
r	3349 fish stocked as per LITID 1940
s	3094 fish stocked as per LITID 1940
t	LITID 1940 stated 546 fish stocked
u	Average of TL range 80-100 mm
v	Average of TL range 120-155 mm
w	Average of TL range 175-250
x	Average of TL range 175-360
y	No TLs given in data
z	Difficult to determine exact stocking locations on Green River, although all above of Desolation Canyon (approx 200 RM (322 RK) to the upper end of Island Park (334 RM (538 RK))
aa	2,399 fish 2004 year class and 331 fish 2006 year class

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Appendix 7. Bonytail stockings into the Green River, UT-CO, 1988-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total N fish	N PIT Tag	N Wire Tag	Other Tag Type	Comment Code	LITID ^a	
26	3	11	1981	March	1988	Green River, UT	406	10	0	0	Carlin and radio tag	a, z	57, 92, 1863	
26	3	11	1981	May	1988	Green River, UT	434	4	0	0	Carlin and radio tag	a, z	57, 92, 1863	
26	3	11	1981	June	1988	Green River, UT	426	10	0	0	Carlin and radio tag	a, z	57, 92, 1863	
26	3	11	1981	July	1988	Green River, UT	420	15	0	0	Carlin and radio tag	b, z	57, 92, 1863	
26	3	11	1981	May	1989	Green River, UT	415	12	0	0	Radio tag, Carlin or floy tag	b, z	57, 93	
26	3	11	1981	June	1989	Green River, UT	404	12	0	0	Radio tag, Carlin or floy tag	c, z	57, 93, 647	
26	3	11	1981	July	1989	Green River, UT	409	13	0	0	Radio tag, Carlin or floy tag	b, z	57, 93	
26	3	11	1981	October	1989	Green River, UT	414	10	0	0	Radio tag, Carlin or floy tag	b, z	57, 93, 94	
11	1	25	1997	October	1998	120 RM (193.1 RK), Green River State Park, UT	124	2,867	0	0		d	1428, 1972	
11	1	25	1998	April	1999	120.1 RM (193.2 RK), Green River State Park, UT	93	10,000	0	10,000		e	1428, 1916	
11	2	25	1996	March	2000	120.0 RM (193.1 RK), Green River State Park, UT	411	14	0	14	Radio	f	1428	
11	1	25	1998	April	2000	120 RM (193.1 RK), Green River State Park, UT	187	9,962	0	9,962		g	1428, 1913	
11	1	25	1999	April	2000	120 RM (193.1 RK), Green River State Park, UT	94	10,025	0	10,025			1428, 1913	
11	1	25	2000	October	2000	120 RM (193.1 RK), Green River State Park, UT	97	48,205	0	48,205		h	1428, 1913	
11	1	25	1999 or 2000	July or August	2000	Green River, UT	-	9	9	0		l, y	1913	
11	1	25	1999	April	2001	120 RM (193.1 RK), Green River State Park, UT	134	5,000	0	5,000		j	1428, 1980	
11	1	25	2000	April	2001	120 RM (193.1 RK), Green River State Park, UT	82	41,522	0	41,522			1428	
11	1	25	1999, 2000 or 2001	Unknown	2001	Green River, UT	90	46,522	0	46,522		u	1935	
11	1	25	2000	October	2002	119 RM (191.5 RK), Green River State Park, UT	137	4,999	4,999	0		m, v	1905, 1940	
11	1	25	2000	October	2002	119 RM (191.5 RK), Green River State Park, UT	137	4,000	0	4,000		v	1905	
11	1	25	2000	Unknown	2002	120 RM (193.1 RK), Green River State Park, UT	137	14,700	0	14,700		v	1905	
11	1	25	2000	September	2002	301 RM (484.4 RK), Near Jensen, UT	137	13	13	0		v	1905, 1940	
11	1	25	2000	Unknown	2002	319.3 RM (513.9 RK), UT	142	2,096	2,096	0		n	1905, 1940	
11	1	15	2000	October	2002	344 RM (553.6 RK), Green River at Echo Park, UT	209	5,000	5,000	0		l	1901, 1940	
11	1	15	2000	October	2002	371 RM (597.1 RK), UT	223	8,600	8,600	0		k	1901, 1940	
11	1	25	2001	October	2003	119 RM (191.5 RK), Green River State Park, UT	142	893	893	0				1940
11	1	11	2000	May	2003	267 RM (429 RK), Bureau of Land Management managed floodplains Above Brennan, UT	7	120	0	0				1661
11	1	11	2000	May	2003	291 RM (468 RK), Bureau of Land Management managed floodplains Bonanza Bridge, UT	7	3,480	0	0				1661
11	1	25	2001	October	2003	327 RM (526.3 RK), Rainbow Park Boat Ramp, Dinosaur National Monument, UT	141	3,497	3,497	0		o		1902, 1940
11	1	15	2001 and 2002	October	2003	344.8 RM (554.9 RK), Green River at Echo Park, UT	210	1,592	1,592	0				1940
11	1	11	2003	May	2003	Johnson Bottom floodplain (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250 RM)), UT	7	81,500	0	0				1661
11	1	11	2000	May	2003	Johnson Bottom floodplain (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250 RM)), UT	7	2,400	0	0				1661
11	1	11	2000	May	2003	Leola Bottom cell-10 (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250RM)), UT	7	3,600	0	0				1661
11	1	11	2003	May	2003	Leola Bottom cell-10 (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250RM)), UT	7	75,000	0	0				1661
11	1	11	2003	May	2003	Old Charley Wash (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250 RM)), UT	7	45,000	0	0				1661
11	1	11	2000	May	2003	Old Charley Wash (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250 RM)), UT	7	2,400	0	0				1661
11	1	25	2001, 2002 or 2003	November	2004	119 RM (191.5 RK), Green River State Park, UT	213	3,094	3,094	0		s, w		1895, 1940
11	1	25	2001, 2002 or 2003	October	2004	327 RM (526.3 RK), Rainbow Park Boat Ramp, Dinosaur National Monument, UT	213	3,349	3,349	0		r, w		1895, 1940
11	1	15	2002	September	2004	344 RM (553.6 RK), Green River at Echo Park, UT	234	2,988	2,988	0		p		1887, 1940
11	1	15	2001 and 2003	September	2004	344 RM (553.6 RK), Green River at Echo Park, UT	224	3,665	3,665	0		q		1940
11	1	11	2004	May	2004	Johnson Bottom floodplain (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250 RM)), UT	7	93,750	0	0		-		1661
11	1	11	2004	May	2004	Leola Bottom cell-10 (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250RM)), UT	7	80,250	0	0		-		1661
11	1	11	2004	May	2004	Old Charley Wash (near 427 RK (265 RM)) in Ouray NWR (427-403 RK (265-250 RM)), UT	7	57,000	0	0		-		1661
11	1	11	2004	May	2004	Thunder Ranch wetland (494 RK (307 RM)), UT	7	33,500	0	0		-		1661
11	1	25	2002	October	2005	119 RM (191.5 RK), Green River State Park, UT	267	3,139	3,139	0		x		1888, 1940
11	1	25	2002	November	2005	120 RM (193.1 RK), Green River State Park, UT	204	1,402	1,402	0		-		1940
11	1	15	2003	June	2005	344 RM (553.6 RK), Green River at Echo Park, UT	-	2,578	2,578	0		y		1940
11	1	25	2004	November	2006	120 RM (193.1 RK), Green River State Park, UT	267	3,270	3,270	0		x		1940, 1974
11	2	25	Unknown	November	2006	327 RM (526.3 RK), Rainbow Park Boat Ramp, Dinosaur National Monument, UT	267	3,447	3,447	0		x		1940, 1974
11	1	25	2005	November	2007	327 RM (526.3 RK), Rainbow Park Boat Ramp, Dinosaur National Monument, UT	267	2,679	2,679	0		x		1983
11	1	25	2005	November	2007	120 RM (193.1 RK), Green River State Park, UT	267	5,404	5,404	0		x		1983
11	1	25	Unknown	November	2007	267 RM (429 RK), Bureau of Land Management managed floodplains Above Brennan, UT	-	3,000	0	0	3,000 ^b	-		1983
11	1	15	2004 and 2006	September	2007	344 RM (553.6 RK), Green River at Echo Park, UT	226	2,730	2,730	0		aa		1984

^aSee Appendix 5 citations associated with each LITID (literature identification), which is a unique number assigned to each source of stocking data and used for tracking purposes in comprehensive bonytail rearing literature review (Pacey and Marsh 2007).

^bFin-clipped, excess bonytail of mixed year classes.

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Appendix 8. Bonytail stockings into the Yampa River, UT-CO, 2000-2001. Data presented in order by stocking year and month.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total /N fish	/N PIT Tag	/N Wire Tag	LITID ^a
11	1	25	1999	July	2000	Yampa River, CO	114	10,000	0	10,000	1428
11	1	25	2000	April	2001	Yampa River, CO	82	7,000	0	7,000	1428
11	1	25	2000	May	2001	Yampa River, CO	82	13,000	0	13,000	1428

^aSee Appendix 5 citations associated with each LitID (literature identification), which is a unique number assigned to each

source of stocking data and used for tracking purposes in comprehensive bonytail rearing literature review (Pacey and Marsh 2007).

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Codes for Appendix 9, bonytail chub stockings into the mainstem Colorado River, UT-CO, 1988-2007.

Comment Code	Comments
a	LITID 1940 reported 2000 fish stocked; corrected as per UCRRIIP database staff
b	LITID 1428 reported 2165 fish stocked; corrected as per UCRRIIP database staff
c	LITID 1980 reported 119 fish stocked; LITID 1428 reported 10 (PIT and radio, 337.3 mm TL) and 104 (PIT only, 316.2 mm TL) total stocked; LITID 1940 reported 113 mm TL mean, corrected as per UCRRIIP database staff
d	LITID 1980 reported 2816 fish stocked; corrected as per UCRRIIP database staff
e	This group is added to 1,048 fish group for a total of 2,484 fish stocked LITID 1980; UCRRIIP had total from this group at 3204 fish
f	Number fish harvested from Wahweap for stocking into field; this group is added to 1,436 fish group for a total of 2,484 fish stocked LITID 1980; UCRRIIP had total from this group at 3204 fish
g	UCRRIIP had total from this group at 3204 fish
h	Could not definitively determine actual cohort of origin due to CWT and non-lethal sampling; LIID 1972 reported 10 fish and stocked March 1998
i	Number fish harvested from Wahweap for stocking into field; LIID 1916 gave stocking location; LITID 1971 reported 5K to Yampa and 5K to Middle Green, for 10K total, but LIID 1428 reported 10K all to Yampa
j	Average of TL range 80-100 mm
k	LITID 1980 reported fish stocked in Oct 2002, at RM 110 in CO; corrected as per UCRRIIP; Average of TL range 120-155 mm
l	LitID 1940 for number of fish stocked, LITID 1902 reported 3303 fish
m	Average of TL range 130-200 mm
n	The remaining 2001 year class (1809 fish) died from Ich; UCRRIIP suggested CWT as no PIT tags were reported; no TLs given in data
o	UCRRIIP reported only 1187 PIT tagged, suggested other 5946 were CWT; no TLs given in data
p	UCRRIIP reported only 1400 PIT tagged, suggested other 1815 were CWT; no TLs given in data
q	3084 fish stocked as per LITID 1940; Average of TL range 175-250 mm
r	No TLs given in data; unable to confirm if fish PIT or wire tagged
s	No TLs given in data
t	Average of TL range 175-360 mm
u	Number fish stocked from LitID 1940; LitID 1887 stated stocked 2567
v	337 fish 2003 year class and reared at Mumma, 300 fish 2004 year class reared at Mumma, and 2,263 2004 year class reared at Trinidad State Junior College; mm avg TL is avg to two avg (228 and 225)

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Appendix 9. Bonytail stockings into the mainstem Colorado River, UT-CO, 1996-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total N fish	N PIT Tag	N Wire Tag	Other Tag Type	Comment Code	LITID ^a
11	2	25	1996	October	1996	96.2 RM (154.8 RK), UT	130	1,980	1,980	0	-	a	1428, 1940
11	1	25	1997	October	1997	94.3 RM (151.7 RK), UT	130	2,158	2,158	0	-	b	1428, 1940
11	2	25	1996	October	1997	94.3 RM (151.7 RK), UT	330	10	10	0	Radio	-	1428
11	2	25	1996	March	1998	94.3 RM (151.7 RK), UT	318	119	119	0	Radio	c	1428, 1940, 1980
11	1	25	1997	April	1998	94.3 RM (151.7 RK), UT	112	2,816	2,816	0	-	d	1428, 1940, 1980
11	1	25	1997	October	1998	94.3 RM (151.7 RK), UT	124	1,436	1,436	0	-	e	1428, 1980
11	1	25	1998	October	1998	94.3 RM (151.7 RK), UT	120	1,048	1,048	0	-	f	1428, 1980
11	1	25	1997	October	1998	94.3 RM (151.7 RK), UT	124	796	796	0	-	g	1428
11	2	25	1996	March	1999	94.6 RM (152.2 RK), Dewey Bridge, UT	390	15	0	15	Radio	h	1428, 1916, 1940, 1972
11	1	25	1998	April	1999	94.6 RM (152.2 RK), Dewey Bridge, UT	93	10,000	0	10,000	-	i	1428, 1916
11	1	25	1999	April	2000	94.3 RM (151.7 RK), UT	79	15,037	0	15,037	-	-	1428, 1913
11	1	25	2000	October	2000	94.3 RM (151.7 RK), UT	97	2,237	0	2,237	-	-	1428, 1913
11	1	25	1999	October	2000	94.3 RM (151.7 RK), UT	169	19,000	0	19,000	-	-	1428, 1913
11	1	25	1999	April	2001	110.0 RM (177.0 RK), UT	134	7,061	0	7,061	-	-	1428
11	1	25	2000	April	2001	110.0 RM (177.0 RK), UT	82	20,907	0	20,907	-	-	1428
11	1	25	1999, 2000 or 2001	Unknown	2001	Colorado River watershed, CO	90	27,968	0	27,968	-	j	1935
11	1	25	2000	October	2002	111 RM (178.6 RK), Cisco boat ramp, UT	137	8,100	8,100	0	-	k	1905, 1940, 1980
11	1	25	2001	October	2003	111 RM (178.6 RK), Cisco boat ramp, UT	141	3,289	3,289	0	-	l	1902, 1940
11	1	25	2000, 2001 or 2002	Unknown	2003	111 RM (178.6 RK), Cisco boat ramp, UT	165	3,000	0	3,000	-	m	1902
11	1	25	2001, 2002 or 2003	November	2004	111 RM (178.6 RK), Cisco boat ramp, UT	213	3,084	3,084	0	-	q	1895, 1940
11	1	25	2002	September	2005	111 RM (178.6 RK), Cisco boat ramp, UT	267	3,457	3,457	0	-	t	1888, 1940
11	1	25	2004	November	2006	111 RM (178.6 RK), Cisco boat ramp, UT	267	3,283	3,283	0	-	t	1940, 1974, 1976
11	1	15	2001	April	2003	Colorado River watershed, CO	216	885	885	0	-	-	1901, 1940
11	1	15	2001	May	2004	Colorado River watershed, CO	-	753	0	753	-	n	1894
11	1	15	2002	May	2004	Colorado River watershed, CO	-	7,133	1,187	5,946	-	o	1894
11	1	15	2001	May	2004	Colorado River watershed, CO	-	3,215	1,400	1,815	-	p	1894
11	1	15	2002	September	2004	Colorado River, from Palisade to Loma, CO	229	2,548	2,548	0	-	u	1887, 1940
11	1	15	2003	Unknown	2004	Colorado River watershed, CO	-	3,052	0	0	-	r	1894
11	1	15	2003	June	2005	Colorado River watershed, CO	-	2,566	2,566	0	-	s	1940
11	1	15	2004	September	2006	Colorado River watershed, CO	-	2,278	2,278	0	-	s	1940
11	1	15	2004	Unknown	2006	Colorado River watershed, CO	-	3,152	3,152	0	-	s	1975
11	1	15	2003	Unknown	2006	Colorado River watershed, CO	-	717	717	0	-	s	1975
11	1	15	2005	November	2007	111 RM (178.6 RK), Cisco boat ramp, UT	267	2,670	2,670	0	-	t	1983
11	1	28	2003 and 2004	September	2007	165 and 171 RM (265 and 275 RK), Colorado River, CO	227	2,900	2,900	0	-	v	1984

^aSee Appendix 5 citations associated with each LITID (literature identification), which is a unique number assigned to each source of stocking data and used for tracking review (Pacey and Marsh 2007).

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Codes for Appendix 10, miscellaneous bonytail chub stockings the Colorado River basin, 2000-2007.

Comment Code	Comments
a	UCRRIP added data; no lengths given in data
b	No lengths taken
c	Reported 444 fish; no lengths given in data

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Appendix 10. Miscellaneous bonytail stockings into the Colorado River basin, 2000-2007. River miles and kilometers are approximate. See Appendix 20 for capture code information.

Basin	Area	Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total N fish	N PIT Tag	N Wire Tag	Comment Code	N Fish Captured	Capture Code	LITID ^a
Upper	Gunnison River, CO	11	2	15	Unknown	September	2003	57.1 RM (91.9 RK), Gunnison River, CO	-	2	2	0	a	0	-	1941
Lower	Either Lake Mohave or Havasu (Reach 2 or 3)	11	2	26	Unknown	January	2001	Either Lake Havasu or Lake Mohave	102	23	23	0	-	0	-	1936
Lower	Either Lake Mohave or Havasu (Reach 2 or 3)	11	2	26	Unknown	January	2001	Either Lake Havasu or Lake Mohave	-	66	66	0	b	0	-	1936
Lower	Either Lake Mohave or Havasu (Reach 2 or 3)	11	2	26	Unknown	January	2001	Either Lake Havasu or Lake Mohave	-	24	24	0	b	0	-	1936
Lower	Either Lake Mohave or Havasu (Reach 2 or 3)	11	2	26	Unknown	June	2001	Either Lake Havasu or Lake Mohave	-	347	347	0	b	0	-	1936
Lower	Either Lake Mohave or Havasu (Reach 2 or 3)	11	2	26	2001	March	2003	Either Lake Havasu or Lake Mohave	-	442	442	0	c	0	-	1936
Lower	Lower Colorado River (Reach 4 and 5) ^b	11	2	1	2004 + others	December	2006	120 RM (193 KM), A-7 backwater, upper, AZ	313	4,007	600	3,407	-	5	1	1936
Lower	Lower Colorado River (Reach 4 and 5) ^b	11	2	1	2005	December	2007	188 RM (303 RK), River Island State Park, AZ	320	1,208	0	1,208	-	0	-	1936
Lower	Lower Colorado River (Reach 4 and 5) ^b	11	2	1	2005	December	2007	120 RM (193 KM), A-7 backwater, upper, AZ	320	1,210	150	1,060	-	0	-	1936

^aSee Appendix 5 citations associated with each LIID (literature identification), which is a unique number assigned to each source of stocking data and used for tracking purposes in comprehensive bonytail rearing literature review

(Pacey and Marsh 2007).

^bAll PIT-tagged fish in lower river below Parker Dam are also wire-tagged, but their numbers are not included in the wire tags total.

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Codes for Appendix 11, bonytail stockings into Lake Mohave (Reach 2), AZ-NV, 1981-2007.

Comment Code	Comments
a	LITID 83 stated 43,000 stocked (26,871 in Oct and 14,700 in Nov); oxytetracycline tags
b	Originally had rearing location as WBNFH; no lengths taken
c	LITID 1869 reported of two batches of fish 9,135 and 3,483, totaling 12,618
d	LITID 1971 reported AZGFD reported 12,264 fish at 76 mm; LITID 84, 793 and 92 reported 13,971 to Lake Mohave
e	4,600 fish of total harvested (26,140) died after harvest, died due to gas bubble disease caused by nitrogen supersaturation
f	No lengths taken; fin-clipped
g	LITID 1971 stated 43,516 stocked into Lake Mohave on 10/22/1990
i	Part of LitID 1936 and report of two stockings, 3,501 and 2,596 fish for total 6,097
j	Nose-tagged

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 11. Bonytail stockings into Lake Mohave (Reach 2), AZ-NV, 1981-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate. See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total /# fish	/# PIT Tag	/# Wire Tag	Comment Code	/# Fish Captured	Capture Code	LITID ^a
11	2	11	1981	October	1981	Lake Mohave	102	26,817	0	0	a	0	-	83, 793, 1971
11	2	11	1981	November	1981	20 RM (32 RK), Cottonwood Basin East, AZ	102	14,700	0	0	a	0	-	83, 793, 1971
26	3	11	1981	July	1982	Lake Mohave	-	13,320	0	0	b	0	-	793, 1971
11	2	11	1985	October	1985	22.75 RM (36.6 RK), Cottonwood Cove, NV	101	12,618	0	0	c	0	-	88, 793, 1869, 1971
11	2	11	1987	November	1987	Lake Mohave	165	1,707	0	0	d	0	-	84, 94, 793, 1971
11	2	11	1987	November	1987	Lake Mohave	140	12,264	0	0	d	0	-	84, 94, 793, 1971
11	2	11	1988	October	1988	20 RM (32 RK), Cottonwood Basin East, AZ	127	20,040	0	0	e	0	-	92, 93, 1869, 1971
11	2	11	1988	October	1989	Lake Mohave	102	12,540	0	0	-	0	-	94, 1971
11	4	17	1987	February	1990	1.5 RM (2.4 RK), Katherine's Landing, AZ	-	1,162	0	0	f	0	-	84, 1869, 1971
11	2	11	1989	October	1990	Lake Mohave	102	2,576	0	0	-	0	-	95, 1971
11	2	11	1989	October	1990	Lake Mohave	89	40,940	0	0	g	0	-	95, 1971
11	2	11	1991	October	1991	22.75 RM (36.6 RK), Cottonwood Cove, NV	102	9,283	0	0	-	0	-	1881, 1971
11	2	10	1992	January	1993	0.5 RM (0.8 RK), Davis Cove, AZ	259	1	1	0	-	0	-	1936
11	2	10	1992	October	1993	0.5 RM (0.8 RK), Davis Cove, AZ	228	7	7	0	-	0	-	1936
11	4	10	1992	December	1993	0.5 RM (0.8 RK), Davis Cove, AZ	245	5	5	0	-	0	-	1936
11	2	10	1992	December	1993	0.5 RM (0.8 RK), Davis Cove, AZ	227	1	1	0	-	0	-	1936
11	2	11	1994	November	1994	24.5 RM (39.4 RK), Yuma Cove, AZ	101	12,210	0	12,210	j	0	-	1926, 1930, 1971
11	2	2	Unknown	October	1995	15.4 RM (24.8 RK), Arizona Juvenile, AZ	236	5	5	0	-	0	-	1936
11	2	2	Unknown	October	1995	15.4 RM (24.8 RK), Arizona Juvenile, AZ	241	17	17	0	-	0	-	1936
11	2	18	Unknown	October	1995	16.35 RM (26.3 RK), North Nine Mile Cove, NV	259	9	9	0	-	0	-	1936
11	2	18	Unknown	October	1995	16.35 RM (26.3 RK), North Nine Mile Cove, NV	258	201	201	0	-	3	3	1936
11	2	16	Unknown	October	1995	15.91 RM (25.6 RK), Nevada Egg, NV	262	64	64	0	-	0	-	1936
11	4	2	Unknown	November	1995	15.4 RM (24.8 RK), Arizona Juvenile, AZ	262	3	3	0	-	0	-	1936
11	2	2	Unknown	November	1995	15.4 RM (24.8 RK), Arizona Juvenile, AZ	250	1	1	0	-	0	-	1936
11	2	27	Unknown	November	1995	24.5 RM (39.4 RK), Yuma Cove, AZ	321	3	3	0	-	0	-	1936
11	2	16	Unknown	November	1995	15.91 RM (25.6 RK), Nevada Egg, NV	258	11	11	0	-	0	-	1936
11	2	2	Unknown	November	1995	15.4 RM (24.8 RK), Arizona Juvenile, AZ	226	2	2	0	-	0	-	1936
11	2	27	Unknown	November	1995	24.5 RM (39.4 RK), Yuma Cove, AZ	316	106	106	0	-	0	-	1936
11	2	27	Unknown	November	1995	24.5 RM (39.4 RK), Yuma Cove, AZ	328	4	4	0	-	0	-	1936
11	4	26	Unknown	February	1996	15.4 RM (24.8 RK), Arizona Juvenile, AZ	385	1	1	0	-	0	-	1936
11	4	26	Unknown	February	1996	15.4 RM (24.8 RK), Arizona Juvenile, AZ	378	5	5	0	-	0	-	1936
26	3	2	Unknown	May	1996	15.4 RM (24.8 RK), Arizona Juvenile, AZ	395	3	3	0	-	0	-	1936
11	2	26	Unknown	May	1996	24.7 RM (39.7 RK), Gold Cove, AZ	355	1	1	0	-	0	-	1936
11	2	27	Unknown	October	1996	24.5 RM (39.4 RK), Yuma Cove, AZ	235	1	1	0	-	0	-	1936
11	2	9	Unknown	October	1996	15.9 RM (25.6 RK), Dandy Cove, NV	210	22	22	0	-	0	-	1936
11	2	19	Unknown	October	1996	12.1 RM (19.5 RK), Chemehuevi Cove, NV	291	1	1	0	-	0	-	1936
11	4	27	Unknown	November	1996	24.5 RM (39.4 RK), Yuma Cove, AZ	338	1	1	0	-	0	-	1936
11	2	27	Unknown	November	1996	24.5 RM (39.4 RK), Yuma Cove, AZ	363	10	10	0	-	0	-	1936
11	2	26	Unknown	November	1996	Lake Mohave	277	761	761	0	-	0	-	1936
11	2	27	Unknown	November	1996	24.5 RM (39.4 RK), Yuma Cove, AZ	330	2	2	0	-	0	-	1936
11	2	27	Unknown	November	1996	24.5 RM (39.4 RK), Yuma Cove, AZ	320	1	1	0	-	0	-	1936
11	2	27	Unknown	November	1996	24.5 RM (39.4 RK), Yuma Cove, AZ	345	3	3	0	-	0	-	1936
26	3	26	Unknown	April	1997	Lake Mohave	388	3	3	0	-	0	-	1936
11	2	3	Unknown	May	1997	39.5 RM (63.6 RK), Placer Cove, NV	289	4	4	0	-	0	-	1936
11	2	3	Unknown	July	1997	22.75 RM (36.6 RK), Cottonwood Cove, NV	250	1	1	0	-	0	-	1936
11	2	27	Unknown	August	1997	24.5 RM (39.4 RK), Yuma Cove, AZ	255	1	1	0	-	0	-	1936
11	2	3	Unknown	August	1997	39.5 RM (63.6 RK), Placer Cove, NV	253	2	2	0	-	0	-	1936
11	2	26	1994	September	1997	42 RM (68 RK), AZ	261	570	570	0	-	0	-	1880, 1936
11	2	4	Unknown	September	1997	39.5 RM (63.6 RK), Placer Cove, NV	270	1	1	0	-	0	-	1936
11	2	3	Unknown	September	1997	39.5 RM (63.6 RK), Placer Cove, NV	240	1	1	0	-	0	-	1936
11	2	26	Unknown	September	1997	48 RM (77.3 RK), Monkey Hole, NV	250	1	1	0	-	0	-	1936
11	2	27	Unknown	September	1997	24.5 RM (39.4 RK), Yuma Cove, AZ	335	1	1	0	-	0	-	1936

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Appendix 11 cont'. Bonytail stockings into Lake Mohave (Reach 2), AZ-NV, 1981-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate. See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total /# fish	/# PIT Tag	/# Wire Tag	Comment Code	/# Fish Captured	Capture Code	LITID ^a
11	1	3	Unknown	October	1997	22.75 RM (36.6 RK), Cottonwood Cove, NV	245	32	32	0	-	0	-	1936
11	2	3	Unknown	October	1997	22.75 RM (36.6 RK), Cottonwood Cove, NV	285	1	1	0	-	0	-	1936
11	2	27	Unknown	October	1997	24.5 RM (39.4 RK), Yuma Cove, AZ	316	30	30	0	-	0	-	1936
11	2	4	Unknown	October	1997	39.5 RM (63.6 RK), Placer Cove, NV	300	1	1	0	-	0	-	1936
11	2	19	Unknown	October	1997	12.1 RM (19.5 RK), Chemehuevi Cove, NV	310	1	1	0	-	0	-	1936
11	2	3	Unknown	November	1997	Lake Mohave	249	4	4	0	-	0	-	1936
11	2	27	Unknown	November	1997	24.5 RM (39.4 RK), Yuma Cove, AZ	297	4	4	0	-	1	4	1936
11	2	4	Unknown	November	1997	Lake Mohave	263	2	2	0	-	0	-	1936
11	2	3	Unknown	January	1998	22.75 RM (36.6 RK), Cottonwood Cove, NV	229	4	4	0	-	0	-	1936
11	2	4	Unknown	January	1998	39.5 RM (63.6 RK), Placer Cove, NV	330	1	1	0	-	0	-	1936
11	2	26	Unknown	February	1998	22.75 RM (36.6 RK), Cottonwood Cove, NV	266	37	37	0	-	0	-	1936
11	2	26	Unknown	February	1998	22.75 RM (36.6 RK), Cottonwood Cove, NV	251	52	52	0	-	0	-	1936
11	2	4	Unknown	March	1998	22.75 RM (36.6 RK), Cottonwood Cove, NV	240	1	1	0	-	0	-	1936
11	2	26	Unknown	March	1998	41.1 RM (66.1 RK), Elizabeth J. Cove, NV	227	256	256	0	-	0	-	1936
11	2	3	Unknown	March	1998	22.75 RM (36.6 RK), Cottonwood Cove, NV	247	7	5	2	-	0	-	1936
11	2	26	Unknown	April	1998	42 RM (68 RK), AZ	248	8	8	0	-	0	-	1936
11	2	26	Unknown	April	1998	42 RM (68 RK), AZ	219	42	42	0	-	0	-	1936
11	2	26	Unknown	April	1998	44 RM (71 RK), AZ	214	23	23	0	-	0	-	1936
11	2	26	Unknown	May	1998	42 RM (68 RK), AZ	208	7	7	0	-	0	-	1936
11	2	3	Unknown	June	1998	39.5 RM (63.6 RK), Placer Cove, NV	232	9	9	0	-	0	-	1936
11	2	26	Unknown	July	1998	Lake Mohave	214	14	14	0	-	0	-	1936
11	2	26	Unknown	July	1998	39.5 RM (63.6 RK), Placer Cove, NV	275	1	1	0	-	0	-	1936
11	2	3	Unknown	September	1998	22.75 RM (36.6 RK), Cottonwood Cove, NV	310	2	2	0	-	0	-	1936
11	2	26	Unknown	October	1998	Lake Mohave	250	18	18	0	-	0	-	1936
11	2	27	Unknown	October	1998	24.5 RM (39.4 RK), Yuma Cove, AZ	190	1	1	0	-	0	-	1936
11	2	3	Unknown	November	1998	39.5 RM (63.6 RK), Placer Cove, NV	267	4	4	0	-	0	-	1936
11	2	26	Unknown	November	1998	Lake Mohave	287	73	73	0	-	0	-	1936
11	2	3	Unknown	November	1998	22.75 RM (36.6 RK), Cottonwood Cove, NV	275	18	18	0	-	0	-	1936
11	2	26	Unknown	December	1998	Lake Mohave	213	18	18	0	-	0	-	1936
11	2	27	Unknown	December	1998	24.5 RM (39.4 RK), Yuma Cove, AZ	315	1	1	0	-	0	-	1936
11	2	27	Unknown	December	1998	24.5 RM (39.4 RK), Yuma Cove, AZ	305	1	1	0	-	0	-	1936
11	2	3	Unknown	January	1999	39.5 RM (63.6 RK), Placer Cove, NV	263	3	3	0	-	0	-	1936
11	2	3	Unknown	February	1999	39.5 RM (63.6 RK), Placer Cove, NV	291	27	27	0	-	0	-	1936
11	1	26	Unknown	March	1999	60 RM (97 RK), AZ	229	57	57	0	-	0	-	1936
11	2	3	Unknown	March	1999	39.5 RM (63.6 RK), Placer Cove, NV	297	6	6	0	-	0	-	1936
11	2	3	Unknown	March	1999	39.5 RM (63.6 RK), Placer Cove, NV	297	3	3	0	-	0	-	1936
11	2	26	Unknown	April	1999	Lake Mohave	237	197	197	0	-	0	-	1936
11	2	26	Unknown	May	1999	30 RM (48 RK), AZ	254	494	494	0	-	0	-	1936
11	2	26	Unknown	May	1999	30 RM (48 RK), AZ	251	480	480	0	-	0	-	1936
11	2	26	Unknown	May	1999	8 RM (12.9 RK), Desert Cove, AZ	248	416	416	0	-	0	-	1936
11	2	26	Unknown	May	1999	Carp Cove, 20.5 RM (33 RK), AZ	250	496	496	0	-	0	-	1936
11	2	27	Unknown	May	1999	24.5 RM (39.4 RK), Yuma Cove, AZ	245	1	1	0	-	0	-	1936
11	4	26	Unknown	June	1999	Lake Mohave	245	91	91	0	-	0	-	1936
11	2	26	Unknown	June	1999	60 RM (97 RK), AZ	234	257	257	0	-	0	-	1936
11	2	3	Unknown	June	1999	Lake Mohave	258	3	3	0	-	0	-	1936
11	2	4	Unknown	June	1999	39.5 RM (63.6 RK), Placer Cove, NV	307	3	3	0	-	0	-	1936
11	2	26	Unknown	June	1999	56 RM (90 RK), AZ	305	15	15	0	-	0	-	1936
11	2	3	Unknown	June	1999	39.5 RM (63.6 RK), Placer Cove, NV	250	1	1	0	-	0	-	1936
11	2	4	Unknown	August	1999	22.75 RM (36.6 RK), Cottonwood Cove, NV	245	1	1	0	-	0	-	1936
11	2	27	Unknown	August	1999	24.5 RM (39.4 RK), Yuma Cove, AZ	320	1	1	0	-	0	-	1936

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Appendix 11 cont'. Bonytail stockings into Lake Mohave (Reach 2), AZ-NV, 1981-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate. See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total /# fish	/# PIT Tag	/# Wire Tag	Comment Code	/# Fish Captured	Capture Code	LITID ⁹
11	2	3	Unknown	August	1999	22.75 RM (36.6 RK), Cottonwood Cove, NV	250	1	1	0	-	0	-	1936
11	2	4	Unknown	September	1999	22.75 RM (36.6 RK), Cottonwood Cove, NV	233	3	3	0	-	0	-	1936
11	2	3	Unknown	September	1999	24.5 RM (39.4 RK), Yuma Cove, AZ	330	1	1	0	-	0	-	1936
11	2	3	Unknown	September	1999	24.5 RM (39.4 RK), Yuma Cove, AZ	330	2	2	0	-	0	-	1936
11	2	10	Unknown	October	1999	0.5 RM (0.8 RK), Davis Cove, AZ	247	9	9	0	-	0	-	1936
11	2	3	Unknown	October	1999	24.5 RM (39.4 RK), Yuma Cove, AZ	305	1	1	0	-	0	-	1936
11	2	10	Unknown	November	1999	0.5 RM (0.8 RK), Davis Cove, AZ	261	28	28	0	-	0	-	1936
11	2	10	Unknown	November	1999	0.5 RM (0.8 RK), Davis Cove, AZ	251	13	13	0	-	0	-	1936
11	2	26	Unknown	November	1999	38 RM (61 RK), AZ	265	368	368	0	-	0	-	1936
11	2	4	Unknown	December	1999	19.25 RM (31 RK), Six Mile Coves (north of), NV	337	25	25	0	-	0	-	1936
11	2	4	Unknown	December	1999	Lake Mohave	338	3	3	0	-	0	-	1936
11	4	4	Unknown	January	2000	22.75 RM (36.6 RK), Cottonwood Cove, NV	400	1	1	0	-	0	-	1936
11	2	4	Unknown	January	2000	22.75 RM (36.6 RK), Cottonwood Cove, NV	285	2	2	0	-	0	-	1936
11	2	26	Unknown	March	2000	43 RM (69 RK), AZ-NV	267	98	98	0	-	0	-	1936
11	2	4	Unknown	May	2000	Lake Mohave	283	12	12	0	-	0	-	1936
11	2	4	Unknown	May	2000	39.5 RM (63.6 RK), Placer Cove, NV	264	6	6	0	-	0	-	1936
11	2	4	Unknown	May	2000	22.75 RM (36.6 RK), Cottonwood Cove, NV	300	1	1	0	-	0	-	1936
11	2	26	1998	June	2000	37 RM (60 RK), NV	259	417	417	0	-	0	-	1936
11	2	26	Unknown	July	2000	36 RM (58 RK), NV	268	387	387	0	-	0	-	1936
11	2	4	Unknown	July	2000	39.5 RM (63.6 RK), Placer Cove, NV	292	9	9	0	-	0	-	1936
11	2	10	Unknown	July	2000	0.5 RM (0.8 RK), Davis Cove, AZ	360	1	1	0	-	0	-	1936
11	2	10	Unknown	July	2000	0.5 RM (0.8 RK), Davis Cove, AZ	360	1	1	0	-	0	-	1936
11	4	10	Unknown	August	2000	15.4 RM (24.8 RK), Arizona Juvenile, AZ	365	1	1	0	-	0	-	1936
11	2	10	Unknown	August	2000	15.4 RM (24.8 RK), Arizona Juvenile, AZ	340	3	3	0	-	0	-	1936
11	2	26	Unknown	September	2000	35.5 RM (57 RK), AZ	296	96	96	0	-	0	-	1936
11	2	26	Unknown	September	2000	Lake Mohave	230	1	1	0	-	0	-	1936
11	2	10	Unknown	October	2000	0.5 RM (0.8 RK), Davis Cove, AZ	360	8	8	0	-	0	-	1936
11	4	4	Unknown	March	2001	39.75 RM (64 RK), Nelson's Landing, NV	341	5	5	0	-	0	-	1936
11	4	4	Unknown	May	2001	0.5 RM (0.8 RK), Davis Cove, AZ	350	1	1	0	-	0	-	1936
11	4	26	Unknown	January	2002	33.6 RM (54.1 RK), Eagle Cove (north of), AZ	263	71	71	0	-	0	-	1936
11	2	26	Unknown	January	2002	33.6 RM (54.1 RK), Eagle Cove (north of), AZ	261	459	459	0	-	0	-	1936
11	2	26	Unknown	January	2002	34 RM (55 RK), AZ	267	527	527	0	-	0	-	1936
11	2	26	Unknown	January	2002	33.6 RM (54.1 RK), Eagle Cove (north of), AZ	260	208	208	0	-	0	-	1936
11	2	26	Unknown	August	2002	41.5 RM (67 RK), AZ	297	373	373	0	-	0	-	1936
11	2	26	Unknown	August	2002	44 RM (71 RK), AZ	274	112	112	0	-	0	-	1936
11	2	26	Unknown	August	2002	41 RM (66 RK), AZ	265	404	404	0	-	0	-	1936
11	2	26	Unknown	August	2002	44 RM (71 RK), AZ	269	824	824	0	-	0	-	1936
11	2	26	Unknown	August	2002	44 RM (71 RK), AZ	265	358	358	0	-	0	-	1936
11	2	26	Unknown	November	2002	39.5 RM (64 RK), AZ	268	329	329	0	-	0	-	1936
11	2	26	Unknown	November	2002	39.5 RM (64 RK), AZ	265	321	321	0	-	0	-	1936
11	2	26	Unknown	November	2002	41.51 RM (66.8 RK), Russian Cove, AZ	267	404	404	0	-	0	-	1936
11	2	26	Unknown	November	2002	41.51 RM (66.8 RK), Russian Cove, AZ	268	563	563	0	-	0	-	1936
11	2	26	Unknown	December	2002	52.5 RM (84.5 RK), Willow Beach boat ramp, AZ	266	459	459	0	-	0	-	1936
11	2	26	Unknown	December	2002	52.5 RM (84.5 RK), Willow Beach boat ramp, AZ	267	295	295	0	-	0	-	1936
11	2	26	Unknown	July	2003	41.1 RM (66.1 RK), Elizabeth J. Cove, NV	257	500	500	0	-	0	-	1936
11	2	26	2002	November	2004	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	310	1,032	1,032	0	-	0	-	1936
11	2	26	1999 and 2000	December	2004	5.25 RM (8.5 RK), Princess Cove, AZ	288	437	437	0	i	0	-	1936
11	2	26	2002	December	2004	47.7 RM (77 RK), Big Horn Cove, AZ	291	652	652	0	i	0	-	1936
11	2	26	1999 and 2000	December	2004	47.7 RM (77 RK), Big Horn Cove, AZ	298	1,088	1,088	0	i	0	-	1936
11	2	26	2002	December	2004	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	309	1,074	1,074	0	i	0	-	1936

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Appendix 11 con't. Bonytail stockings into Lake Mohave (Reach 2), AZ-NV, 1981-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate. See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total /# fish	/# PIT Tag	/# Wire Tag	Comment Code	/# Fish Captured	Capture Code	LITID ^a
11	2	26	1999 and 2000	December	2004	22.75 RM (36.6 RK), Cottonwood Cove, NV	297	812	812	0	i	1	5	1936
11	2	26	2002	December	2004	5.25 RM (8.5 RK), Princess Cove, AZ	310	2,038	2,038	0	i	2	6	1936
11	4	8	Unknown	October	2005	0.5 RM (0.8 RK), Davis Cove, AZ	362	3	3	0	-	0	-	1936
11	2	11	2001	November	2005	5.25 RM (8.5 RK), Princess Cove, AZ	306	1,357	1,357	0	-	0	-	1936
11	2	1	2002 and 2003	December	2005	5.25 RM (8.5 RK), Princess Cove, AZ	300	4,178	0	4,178	-	0	-	1936
11	2	1	2002 and 2003	December	2005	5.25 RM (8.5 RK), Princess Cove, AZ	319	1,125	0	1,125	-	0	-	1936
11	2	1	2002 and 2003	December	2005	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	300	281	0	281	-	0	-	1936
11	2	26	2004	February	2006	52.6 RM (84.7 RK), Willow Beach National Fish Hatchery (below), AZ	292	4	4	0	-	0	-	1936
11	2	26	2004	July	2006	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	295	821	821	0	-	0	-	1936
11	2	11	2000 and 2001	October	2006	1.5 RM (2.4 RK), Katherine's Landing, AZ	305	432	432	0	-	0	-	1936
11	2	26	Unknown	November	2006	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	320	3,831	0	3,831	-	0	-	1936
11	2	24	2000 and 2001	November	2006	1.5 RM (2.4 RK), Katherine's Landing, AZ	303	354	354	0	-	0	-	1936, 1973
11	2	24	2005	November	2006	1.5 RM (2.4 RK), Katherine's Landing, AZ	300	766	0	766	-	0	-	1936, 1973
11	2	26	Unknown	December	2006	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	320	3,876	0	3,876	-	0	-	1936
11	2	26	2005	December	2007	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	253	1,636	0	1,636	-	0	-	1936
11	2	26	2005	December	2007	52.75 RM (84.9 RK), Willow Beach National Fish Hatchery, AZ	253	1,310	0	1,310	-	0	-	1936

^aSee Appendix 5 citations associated with each LITID (literature identification), which is a unique number assigned to each source of stocking data and used for tracking purposes in comprehensive bonytail rearing literature review

(Pacey and Marsh 2007).

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Codes for Appendix 12, bonytail stockings into Lake Havasu (Reach 3), AZ-NV-CA, 1992-2007.

Comment Code	Comments
a	Part of handling stress experiment at Achii Hanyo
b	Stocking slip reported 1708
c	LITID 1971 reported 5092 stocked total
c	LITID 1971 reported 5092 stocked total
d	LITID 1971 reported 1183 total stocked
e	LITID 1971 reported 1656
f	LITID 1971 reported 248 stocked
g	LITID 1971 reported 2000 total stocked
h	LITID 1971 reported 2180 stocked total
i	LITID 1971 reported 2452 stocked
j	LITID 1971 reported 640 stocked
k	LITID 1971 reported 2100 total for three stockings for Nov 2002
l	LITID 1971 reported 2100 total for three stockings for Nov 2002; no lengths given in data
m	Fish sent from WBNFH to BP, then back to WBNFH. BR tallied fish as from WBNFH.
n	LITID 1971 reported 300 stocked
o	LITID 1971 reported 780 stocked
p	LITID 1971 reported 877 stocked
q	LITID 1971 reported 1025 stocked
r	LITID 1971 reported 293 stocked
s	LITID 1971 reported 1781 total (two stockings, 800 and 981)
t	LitID 1920 suggested 47,959 to WBNFH; LitID 1929 only has one stocking slip for 96,159 fish
u	LITID reported 37152; nose-tagged
v	LITID 1936, REARING ID 239; no day given only month and year
x	Stocked with no tags

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Appendix 12. Bonytail stockings into Lake Havasu (Reach 3), AZ-NV-CA, 1992-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate.

See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total /# fish	/# PIT Tag	/# Wire Tag	Comment Code	/# Fish Captured	Capture Code	LITID ¹
11	2	13	Unknown	July	1992	Lake Havasu	167	17	17	0	v	0	-	1936
11	2	11	Unknown	October	1993	0 RM, Office Cove, AZ	322	1	1	0	-	0	-	1936
11	2	22	Unknown	February	1994	0 RM, Office Cove, AZ	370	38	38	0	-	0	-	1095, 1936
11	2	22	Unknown	February	1994	0 RM, Office Cove, AZ	391	2	2	0	-	0	-	1936
11	2	22	Unknown	April	1994	0 RM, Office Cove, AZ	389	24	24	0	-	0	-	1936
11	2	22	Unknown	April	1994	0 RM, Office Cove, AZ	357	1	1	0	-	0	-	1936
11	2	12	Unknown	July	1994	0.1 RM (0.16 RK), Takeoff Point, AZ	267	1	1	0	-	0	-	1936
11	2	11	1994	October	1994	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	89	26,500	0	0	x	0	-	1880, 1920
11	2	11	1994	October	1994	11.5 RM (19 RK), No Entry Cove, AZ	79	39,658	0	39,658	u	0	-	1880, 1920, 1929
11	2	11	1994	October	1994	Lake Havasu	76	48,200	0	48,200	t	0	-	1880, 1920, 1929
11	2	8	Unknown	February	1995	0 RM, Office Cove, AZ	264	7	7	0	-	0	-	1936
11	2	8	Unknown	July	1995	0 RM, Office Cove, AZ	278	5	5	0	-	0	-	1936
11	2	8	Unknown	September	1995	0 RM, Office Cove, AZ	272	5	5	0	-	0	-	1936
11	2	8	Unknown	October	1995	0 RM, Office Cove, AZ	272	13	13	0	-	0	-	1936
11	2	8	Unknown	December	1995	0 RM, Office Cove, AZ	301	14	14	0	-	1	7	1936
11	2	12	Unknown	August	1995	0.1 RM (0.16 RK), Takeoff Point, AZ	288	1	1	0	-	0	-	1936
11	2	12	Unknown	August	1995	0.1 RM (0.16 RK), Takeoff Point, AZ	283	5	5	0	-	0	-	1936
11	2	12	Unknown	September	1995	0.1 RM (0.16 RK), Takeoff Point, AZ	270	3	3	0	-	0	-	1936
11	2	12	Unknown	September	1995	0.1 RM (0.16 RK), Takeoff Point, AZ	269	1	1	0	-	0	-	1936
11	2	8	Unknown	May	1995	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	295	5	5	0	-	0	-	1936
11	2	8	Unknown	June	1995	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	262	1	1	0	-	0	-	1936
11	2	8	Unknown	October	1995	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	251	1	1	0	-	0	-	1936
11	2	12	Unknown	July	1995	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	316	1	1	0	-	0	-	1936
11	2	12	Unknown	July	1995	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	274	2	2	0	-	0	-	1936
11	2	12	Unknown	October	1995	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	270	27	27	0	-	0	-	1936
11	2	12	Unknown	December	1995	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	255	1	1	0	-	0	-	1936
11	2	6	Unknown	October	1995	0.5 RM (0.8 RK), Bulkhead Cove, AZ	301	1	1	0	-	0	-	1936
11	2	6	Unknown	October	1995	0.5 RM (0.8 RK), Bulkhead Cove, AZ	302	1	1	0	-	0	-	1936
11	2	12	Unknown	November	1995	19 RM (30.6 RK), Pittsburgh Point Cove, AZ	271	1	1	0	-	0	-	1936
11	2	8	Unknown	April	1996	0 RM, Office Cove, AZ	440	1	1	0	-	0	-	1936
11	2	12	Unknown	July	1996	0 RM, Office Cove, AZ	265	2	2	0	-	0	-	1936
11	2	20	Unknown	June	1996	0 RM, Office Cove, AZ	260	2	2	0	-	0	-	1936
11	2	20	Unknown	June	1996	0 RM, Office Cove, AZ	267	1	1	0	-	0	-	1936
11	2	20	Unknown	August	1996	0 RM, Office Cove, AZ	250	1	1	0	-	0	-	1936
11	2	8	Unknown	March	1996	0.1 RM (0.16 RK), Takeoff Point, AZ	286	11	11	0	-	0	-	1936
11	2	8	Unknown	September	1996	0.1 RM (0.16 RK), Takeoff Point, AZ	303	11	11	0	-	0	-	1936
11	2	8	Unknown	September	1996	0.1 RM (0.16 RK), Takeoff Point, AZ	277	4	4	0	-	0	-	1936
11	2	8	Unknown	November	1996	0.1 RM (0.16 RK), Takeoff Point, AZ	302	42	42	0	-	0	-	1936
11	2	8	Unknown	January	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	286	13	13	0	-	1	8	1936
11	2	8	Unknown	February	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	268	12	12	0	-	0	-	1936
11	2	8	Unknown	March	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	256	1	1	0	-	0	-	1936
11	2	8	Unknown	November	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	304	1	1	0	-	0	-	1936
11	2	12	Unknown	September	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	330	1	1	0	-	0	-	1936
11	2	12	Unknown	September	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	261	3	3	0	-	0	-	1936
11	2	12	Unknown	October	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	266	22	22	0	-	0	-	1936
11	2	14	Unknown	February	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	285	1	1	0	-	0	-	1936
11	2	14	Unknown	April	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	248	1	1	0	-	0	-	1936
11	2	20	Unknown	February	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	256	2	2	0	-	0	-	1936

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Appendix 12 con't. Bonytail stockings into Lake Havasu (Reach 3), AZ-NV-CA, 1992-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate.

See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total # fish	# PIT Tag	# Wire Tag	Comment Code	# Fish Captured	Capture Code	LITID ³
11	2	20	Unknown	March	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	273	1	1	0	-	0	-	1936
11	2	20	Unknown	March	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	268	6	6	0	-	0	-	1936
11	2	20	Unknown	June	1996	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	258	1	1	0	-	0	-	1936
11	2	23	Unknown	April	1996	19 RM (30.6 RK), Pittsburgh Point Cove, AZ	260	3	3	0	-	0	-	1936
11	2	12	Unknown	August	1996	22.5 RM (36 RK), Campbell Cove, AZ	291	1	1	0	-	0	-	1936
11	2	12	Unknown	October	1997	0.1 RM (0.16 RK), Takeoff Point, AZ	303	8	8	0	-	0	-	1936
11	2	12	Unknown	October	1997	0.1 RM (0.16 RK), Takeoff Point, AZ	323	24	24	0	-	0	-	1936
11	2	20	Unknown	October	1997	0.1 RM (0.16 RK), Takeoff Point, AZ	269	54	54	0	-	0	-	1936
11	2	20	Unknown	July	1997	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	260	10	10	0	-	0	-	1936
11	2	8	Unknown	April	1997	0.5 RM (0.8 RK), Bulkhead Cove, AZ	267	19	19	0	-	0	-	1936
11	2	8	Unknown	April	1997	0.5 RM (0.8 RK), Bulkhead Cove, AZ	242	1	1	0	-	0	-	1936
11	2	20	Unknown	May	1997	0.5 RM (0.8 RK), Bulkhead Cove, AZ	252	4	4	0	-	0	-	1936
11	2	20	Unknown	May	1997	0.5 RM (0.8 RK), Bulkhead Cove, AZ	258	2	2	0	-	0	-	1936
11	2	20	Unknown	October	1997	0.5 RM (0.8 RK), Bulkhead Cove, AZ	256	3	3	0	-	0	-	1936
11	2	1	Unknown	November	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	269	62	62	0	-	0	-	1936
11	2	1	Unknown	November	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	263	46	46	0	-	0	-	1936
11	2	1	Unknown	November	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	264	272	272	0	-	0	-	1936
11	2	8	Unknown	February	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	295	19	19	0	-	0	-	1936
11	2	8	Unknown	March	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	336	3	3	0	-	0	-	1936
11	2	8	Unknown	December	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	317	38	38	0	-	0	-	1936
11	2	12	Unknown	October	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	292	305	305	0	-	0	-	1936
11	2	20	Unknown	June	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	306	1	1	0	-	0	-	1936
11	2	20	Unknown	June	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	278	12	12	0	-	0	-	1936
11	2	20	Unknown	October	1998	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	265	43	43	0	-	0	-	1936
11	2	6	Unknown	November	1998	0.5 RM (0.8 RK), Bulkhead Cove, AZ	281	1	1	0	-	0	-	1936
11	2	6	Unknown	November	1998	0.5 RM (0.8 RK), Bulkhead Cove, AZ	305	1	1	0	-	0	-	1936
11	2	20	Unknown	February	1998	0.5 RM (0.8 RK), Bulkhead Cove, AZ	251	1	1	0	-	0	-	1936
11	2	20	Unknown	February	1998	0.5 RM (0.8 RK), Bulkhead Cove, AZ	280	1	1	0	-	0	-	1936
11	2	20	Unknown	February	1998	0.5 RM (0.8 RK), Bulkhead Cove, AZ	263	5	5	0	-	0	-	1936
11	2	20	Unknown	January	1999	0 RM, Office Cove, AZ	260	1	1	0	-	0	-	1936
11	2	1	Unknown	April	1999	0.1 RM (0.16 RK), Takeoff Point, AZ	223	539	539	0	-	0	-	1936
11	2	1	Unknown	January	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	255	70	70	0	-	0	-	1936
11	2	12	Unknown	January	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	297	216	216	0	-	0	-	1936
11	2	20	Unknown	January	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	282	4	4	0	-	0	-	1936
11	2	20	Unknown	January	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	275	10	10	0	-	0	-	1936
11	2	20	Unknown	January	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	273	6	6	0	-	0	-	1936
11	2	20	Unknown	January	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	288	1	1	0	-	0	-	1936
11	2	20	Unknown	February	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	259	4	4	0	-	0	-	1936
11	2	20	Unknown	February	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	286	4	4	0	-	0	-	1936
11	2	20	Unknown	February	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	257	1	1	0	-	0	-	1936
11	2	20	Unknown	February	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	285	2	2	0	-	0	-	1936
11	2	20	Unknown	March	1999	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	241	10	10	0	-	0	-	1936
11	2	20	Unknown	February	1999	0.5 RM (0.8 RK), Bulkhead Cove, AZ	239	3	3	0	-	0	-	1936
11	2	1	Unknown	August	1999	Lake Havasu	245	199	199	0	-	1	9	1936
11	2	1	Unknown	August	1999	Lake Havasu	252	23	23	0	-	0	-	1936
11	2	1	Unknown	November	2000	0 RM, Office Cove, AZ	259	1,548	1,548	0	-	2	10	1936
11	2	20	Unknown	February	2001	0 RM, Office Cove, AZ	268	2	2	0	-	0	-	1936
11	2	26	Unknown	June	2001	Lake Havasu	255	708	708	0	-	0	-	1936

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 12 con't. Bonytail stockings into Lake Havasu (Reach 3), AZ-NV-CA, 1992-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate.

See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total /# fish	/# PIT Tag	/# Wire Tag	Comment Code	/# Fish Captured	Capture Code	LITID ³
11	2	21	Unknown	August	2002	0 RM, Office Cove, AZ	255	2	2	0	-	0	-	1936
11	2	26	Unknown	August	2002	0 RM, Office Cove, AZ	266	783	783	0	o	1	13	1971
11	2	1	Unknown	July	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	267	1,160	1,160	0	s	2	11	1971
11	2	1	Unknown	July	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	263	722	722	0	s	1	12	1971
11	2	1	Unknown	August	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	261	212	212	0	r	1	14	1971
11	2	1	Unknown	August	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	267	1,379	1,379	0	q	0	-	1971
11	2	1	Unknown	August	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	263	680	680	0	p	0	-	1971
11	2	5	2000	November	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	276	935	935	0	m	1	16	1936
11	2	5	2000	November	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	284	483	483	0	m	1	15	1936
11	2	5	2000	November	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	281	487	487	0	m	0	-	1936
11	2	26	Unknown	August	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	266	32	32	0	-	0	-	1936
11	2	26	Unknown	November	2002	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	269	100	100	0	-	0	-	1936
11	2	11	Unknown	November	2002	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	-	1	1	0	l	0	-	420, 1971
11	2	11	Unknown	November	2002	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	271	1,114	1,114	0	k	0	-	420, 1971
11	2	11	Unknown	November	2002	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	271	998	998	0	k	0	-	420, 1971
11	2	26	Unknown	August	2002	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	252	3	3	0	-	0	-	1936
11	2	26	Unknown	August	2002	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	268	310	310	0	n	0	-	1971
11	2	1	Unknown	August	2002	Lake Havasu	269	8	8	0	-	0	-	1936
11	2	1	Unknown	December	2003	0 RM, Office Cove, AZ	281	1,601	1,601	0	g	1	17	1971
11	2	1	Unknown	December	2003	0 RM, Office Cove, AZ	287	280	280	0	-	0	-	1936
11	2	1	Unknown	December	2003	0 RM, Office Cove, AZ	292	1,100	1,100	0	h	0	-	1971
11	2	1	Unknown	December	2003	0 RM, Office Cove, AZ	286	497	497	0	g	0	-	1971
11	2	12	Unknown	January	2003	0 RM, Office Cove, AZ	297	1	1	0	-	0	-	1936
11	2	12	Unknown	January	2003	0 RM, Office Cove, AZ	336	3	3	0	-	0	-	1936
11	2	26	Unknown	December	2003	0 RM, Office Cove, AZ	258	243	243	0	f	0	-	1971
11	2	11	Unknown	December	2003	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	255	25	25	0	-	0	-	1936
11	2	1	Unknown	December	2003	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	282	1,201	1,201	0	h	0	-	1971
11	2	1	Unknown	December	2003	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	290	499	499	0	-	0	-	1936
11	2	11	Unknown	October	2003	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	286	2,544	2,544	0	i	0	-	1971
11	2	26	Unknown	May	2003	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	266	24	24	0	-	0	-	1936
11	2	26	Unknown	May	2003	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	262	651	651	0	j	0	-	1971
11	2	26	Unknown	March	2004	0 RM, Office Cove, AZ	265	859	859	0	-	0	-	1936
11	2	26	Unknown	March	2004	0 RM, Office Cove, AZ	267	101	101	0	-	0	-	1936
11	2	12	Unknown	March	2004	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	390	7	7	0	-	0	-	1936
11	2	26	Unknown	March	2004	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	275	587	587	0	-	0	-	1936
11	2	26	Unknown	March	2004	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	288	346	346	0	-	0	-	1936
11	2	26	2000	October	2004	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	289	1,654	1,654	0	e	0	-	1971
11	2	26	1999 and 2000	November	2004	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	305	5,090	5,090	0	c	1	18	1971
11	2	26	2002	November	2004	15.8 RM (25 RK), BLM Partner's Point Work Camp, AZ	350	1	1	0	c	0	-	1971
11	2	26	1999 and 2000	November	2004	42 RM (67.6 RK), Topock Marsh, AZ	291	1,182	1,182	0	d	11	19	1971
11	2	11	Unknown	February	2005	18.5 RM (29.7 RK), Palms Marina, AZ	456	12	12	0	-	0	-	1936
11	2	1	2004 + others	December	2006	0 RM, Office Cove, AZ	311	1,707	299	1,408	b	1	2	1940, 1971
11	2	8	Unknown	December	2006	0 RM, Office Cove, AZ	430	1	1	0	-	0	-	1936
11	2	24	2005	November	2006	43.5 RM (70 RK), Park Moabi, CA	300	2,397	0	2,397	-	0	-	1936
11	2	1	2004 and 2005	May	2007	0.3 RM (0.48 RK), Bill Williams National Wildlife Preserve, AZ	242	38	38	0	a	0	-	1940
11	2	11	2005	January	2007	43.5 RM (70 RK), Park Moabi, CA	305	1,511	0	1,511	-	0	-	1936, 1981
11	2	11	2002, 2003 and 2004	March	2007	74.2 RM (119.4 RK), Laughlin Lagoon, NV	315	1,264	0	1,264	-	0	-	1936

Final – Evaluation of bonytail stockings in the Colorado River Basin

⁹Appendix 12 cont1. Bonytail stockings into Lake Havasu (Reach 3), AZ-NV-CA, 1992-2007. Data presented in order by stocking year and month. River miles and kilometers are approximate.

See Appendix 20 for capture code information.

Production Location	Type of Production	Rearing Location	Year Class	Stocking Month	Stocking Year	Stocking Location	Avg TL (mm)	Total N fish	N PIT Tag	N Wire Tag	Comment Code	N Fish Captured	Capture Code	LITID ³
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³See Appendix 5 citations associated with each LITID (literature identification), which is a unique number assigned to each source of stocking data and used for tracking purposes in comprehensive bonytail rearing literature review (Pacey and Marsh 2007).

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 13. Water temperature measurements (°C) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1981	Jan						10.0	
	Feb						11.0	
	Mar						10.0	
	Apr						14.0	
	May						12.5	
	Jun						18.0	
	Jul						20.5	
	Aug						19.0	
	Sep						18.0	
	Oct						19.0	
	Nov						17.0	
	Dec						14.0	
1982	Jan						14.0	
	Feb						10.0	
	Mar						11.0	
	Apr						14.0	
	May						16.0	
	Jun						16.5	
	Jul						17.0	
	Aug						21.0	
	Sep						19.0	
	Oct						19.0	
	Nov						17.0	
	Dec						14.0	
1983	Jan						10.0	
	Feb						10.5	
	Mar						12.5	
	Apr						14.0	
	May						15.0	
	Jun						15.0	
	Jul						18.5	
	Aug						22.0	
	Sep						20.0	
	Oct						18.0	
	Nov						15.0	
	Dec						13.0	
1984	Jan						12.0	
	Feb						12.5	
	Mar						13.0	
	Apr						15.0	
	May						17.0	
	Jun						17.5	
	Jul						19.0	
	Aug						18.0	
	Sep						18.0	
	Oct						18.0	
	Nov						14.5	
	Dec						12.5	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 13 con't. Water temperature measurements (°C) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado Basin River, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1985	Jan						15.0	
	Feb						12.0	
	Mar						13.5	
	Apr						15.0	
	May						16.0	
	Jun						17.0	
	Jul						17.0	
	Aug						18.0	
	Sep						16.0	
1986	Apr						16.0	
	May						16.5	
	Jun						18.0	
	Jul						18.0	
	Aug						19.5	
	Sep						20.0	
	Oct						19.0	
	Nov						16.0	
Dec						14.0		
1987	Jan						13.0	
	Feb						12.0	
	Mar						12.0	
	Apr						16.0	
	May						18.0	
	Jun						17.0	
	Jul						18.0	
	Aug						18.0	
	Sep						19.0	
1996	Jan				1.0			11.5
	Feb				5.5			
	Mar		7.3		5.5	8.5		16.0
	Apr	10.0	12.0		9.2	10.0		19.0
	May	12.7			12.8	14.0		
	Jun	16.5	19.2		17.5	18.0		24.0
	Jul	21.0	25.0		18.8	23.0		
	Aug	22.3	23.0		20.2	22.0		26.5
	Sep		16.0		16.6	15.0		
	Oct	13.0		9.7	13.6			
	Nov		7.0	0.5	7.2	5.0		16.0
	Dec	2.0			0.0			12.5
1997	Jan	3.0			2.5			
	Feb		1.0		2.7	5.0		12.5
	Mar	4.5	6.5	7.4	6.9	8.0		
	Apr	12.0	13.0	6.0	9.2	11.0		19.5
	May		16.8	10.0	11.8	14.0		
	Jun		20.8	16.4	14.5	15.8		23.0
	Jul		22.8		17.0	20.8		
	Aug	19.0	22.0	20.6	17.0	22.0		25.0
	Sep		17.0		18.6	16.0		
	Oct	10.5			11.5			19.5
	Nov	6.0	3.0	0.4	7.7	4.5		
	Dec			-0.1	3.0			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 13 con't. Water temperature measurements (°C) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado Basin River, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1998	Jan			0.4	2.6			11.0
	Feb		4.0	-0.1	2.9	5.5		13.5
	Mar		8.5	3.7	4.4	12.0		
	Apr	8.0	14.0	9.1	9.7	9.5		18.5
	May	10.7	15.5	11.8	11.3	12.0		
	Jun	15.9	17.3	14.0	14.1	18.0		22.5
	Jul	23.0	26.0	21.6	19.9	25.0		
	Aug		23.5		19.5	23.5		25.0
	Sep		17.0	21.1	19.0	17.5		
	Oct	10.0	12.0	11.3	11.3	11.0		
	Nov		6.0	2.1	6.8	5.0		
	Dec		3.0			1.0		10.5
1999	Jan				4.2			11.0
	Feb			0.9				
	Mar	7.5	10.0	3.9	7.5	12.0		
	Apr		12.5		10.0	12.0		17.5
	May	13.4	13.0	11.8		16.0		21.0
	Jun	14.8		14.8	18.5	18.5		23.0
	Jul	23.0	23.0		21.2	22.0		
	Aug	21.5	23.5	23.8		22.5		25.0
	Sep		17.5		16.7	17.0		
	Oct		9.5	10.9	13.3			
	Nov		4.0	5.4	8.1	7.5		
	Dec		0.0			2.0		
2000	Jan			0.0	4.8			12.0
	Feb			5.0				
	Mar	6.5	5.5	6.1	5.8	11.0		
	Apr	10.1	13.5	8.1	11.4	13.0		19.6
	May	15.8	18.5	12.4	12.9	16.5		
	Jun	15.4	22.0	17.0	17.3	20.0		25.8
	Jul	20.3	24.5	24.9	19.7	22.5		
	Aug	8.5	23.0	25.0	21.7	22.0		25.5
	Sep	17.0	18.5	18.0		18.0		
	Oct		11.0	15.8	11.2	16.0		
	Nov		3.0		4.5	0.5		13.3
	Dec			0.0	2.1			
2001	Jan		0.0			0.0		
	Feb		1.0		3.7	3.0		
	Mar	6.7	11.0	0.5	6.0	11.0		17.5
	Apr	10.0	14.5	12.8	13.1	11.0		
	May	14.5	18.5	13.8	11.8	15.0		
	Jun	18.9	22.5	18.5	21.6	22.0		24.0
	Jul	21.5	22.5	19.8	20.3	23.0		
	Aug	22.5		25.3	16.9			24.9
	Sep			16.5				
	Oct			8.5	8.0			
	Nov		9.0			4.5		19.9
	Dec				1.5			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 13 con't. Water temperature measurements (°C) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado Basin River, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2002	Jan					1.0		10.4
	Feb					0.5		
	Mar		8.5		8.5	10.0		
	Apr	9.9		9.0	14.5			
	May	13.0	17.0	16.5	20.5	16.5		20.7
	Jun	15.9	23.0	20.9	22.5	22.0		
	Jul	23.3	25.0	27.0		24.0		
	Aug	20.3		25.1	20.0	18.5		24.2
	Sep	16.8	18.0	13.2	15.0			
	Oct	12.4		6.0	10.5			
	Nov			1.9				15.5
	Dec				3.5			
2003	Jan							13.2
	Feb				7.0			
	Mar	4.4	8.0	0.2	11.5	8.0		
	Apr	10.4		11.3	14.5	12.0		
	May	14.1	13.5	9.7	12.4	17.0		22.5
	Jun				17.7			
	Jul	25.5	23.5	26.3	22.3	22.0		
	Aug	22.9	25.0	23.0	21.5	22.0		27.0
	Sep			20.0				
	Oct			12.4	11.9			
	Nov		6.0			4.5		
	Dec			0.0	1.7			13.0
2004	Feb		4.5			6.6		11.5
	Mar			2.5	11.0	10.0		
	Apr		15.0	12.2	8.3			
	May		15.0	12.1	10.8	16.0		22.0
	Jun		18.0		20.3	19.5		
	Jul		22.3	22.6	23.7			
	Aug		23.0	24.5	20.1	22.0		26.0
	Sep		17.7			19.0		
	Oct		14.7	3.8				
	Nov	5.0	8.5		8.5	8.0		
	Dec		1.1		0.0	2.0		13.0
	2005	Jan		2.0	0.2	4.1		
Feb			3.8	1.8	6.8			
Mar		5.0	8.8			6.0		
Apr		12.0	9.1		11.9	10.5		19.5
May		14.4	14.0		12.7	15.0		
Jun		19.4	16.5	13.5	16.2			
Jul		23.5	23.0	21.5	20.9	22.0		26.0
Aug		20.0		24.5		21.0		26.5
Sep			19.0	15.8	15.7			
Oct		12.6		10.7	10.7			
Nov		3.3		8.4		4.0		
Dec			0.0					

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 13 con't. Water temperature measurements (°C) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado Basin River, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2006	Jan	2.2			3.9			
	Feb			0.8		2.0		12.5
	Mar	7.4	3.5		7.0			
	Apr			11.5				18.5
	May	13.0	15.5	14.7	17.3	13.0		
	Jun	23.2		23.7		18.5		25.5
	Jul		27.0	26.7		25.0		
	Aug	21.9		22.0	19.0	22.5		26.5
	Sep	12.3						
	Nov			9.6	1.7			17.6
	Dec			0.0		2.0		
	2007	Jan			0.0			
Feb						4.0		
Mar			5.5		7.4			
Apr				7.7	9.8	11.6		18.5
May			20.0	12.3	15.7	17.5		
Jun			19.5	20.5		17.4		
Jul			19.0	21.0	22.2	22.0		
Aug			26.0			21.0		
Sep				16.6	21.1			
Oct		10.4	12.5					
Nov		2.2	3.0	7.0		6.0		
Dec					2.8			

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Appendix 14. Discharge (instantaneous) measurements (CFS) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1981	Jan						15,300	
	Feb						5,190	
	Mar						2,090	
	Apr						18,900	
	May						19,300	
	Jun						18,700	
	Jul						8,520	
	Aug						25,200	
	Sep						19,200	
	Oct						4,560	
	Nov						10,100	
	Dec						2,240	
1982	Jan						4,590	
	Feb						14,100	
	Mar						14,800	
	Apr						20,300	
	May						23,400	
	Jun						9,070	
	Jul						18,800	
	Aug						19,700	
	Sep						9,310	
	Oct						8,260	
	Nov						5,100	
	Dec						4,670	
1983	Jan						19,200	
	Feb						18,700	
	Mar						4,790	
	Apr						19,200	
	May						20,100	
	Jun						25,200	
	Jul						44,800	
	Aug						43,600	
	Sep						42,800	
	Oct						40,300	
	Nov						25,700	
	Dec						25,100	
1984	Jan						31,200	
	Feb						30,400	
	Mar						28,600	
	Apr						30,500	
	May						30,300	
	Jun						35,000	
	Jul						34,700	
	Aug						30,600	
	Sep						30,000	
	Oct						26,500	
	Nov						27,200	
	Dec						27,100	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 14 con't. Discharge (instantaneous) measurements (CFS) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1985	Jan						24,800	
	Feb						27,600	
	Mar						23,300	
	Apr						23,900	
	May						27,200	
	Jun						27,500	
	Jul						28,300	
	Aug						28,200	
	Sep						27,300	
1986	Apr						24,600	
	May						33,900	
	Jun						28,000	
	Jul						28,600	
	Aug						24,600	
	Sep						24,000	
	Oct						19,700	
	Nov						20,200	
1987	Jan						19,900	
	Feb						24,300	
	Mar						11,200	
	Apr						13,600	
	May						22,900	
	Jun						13,100	
	Jul						14,100	
	Aug						14,700	
	Sep						14,600	
1996	Jan				1,670			8,960
	Feb				2,020			
	Mar		5,025		2,710	5,150		18,000
	Apr	7,630	8,430		2,910	12,800		17,800
	May	17,033			4,895	25,700		
	Jun	11,090	15,100		2,680	15,700		18,600
	Jul	5,105	3,100		2,965	5,280		
	Aug	1,775	2,200		1,320	3,090		9,280
	Sep		2,700		1,930	4,650		
	Oct	1,920		282	2,910			
	Nov		4,050	633	2,070	4,680		8,840
	Dec	2,040			2,005			4,340

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 14 con't. Discharge (instantaneous) measurements (CFS) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1997	Jan	2,560			2,310			
	Feb		4,950		2,510	4,800		15,000
	Mar	3,570	9,000	2,320	5,620	8,990		
	Apr	5,440	12,400	2,400	6,205	14,300		14,700
	May		25,600	12,500	9,885	26,500		
	Jun		27,800	17,600	9,240	35,275		14,100
	Jul		6,955		4,633	8,250		
	Aug	2,910	4,200	876	3,225	5,630		17,800
	Sep		8,930		2,790	7,810		
	Oct	4,450			3,220			9,080
	Nov	4,360	6,340	630	2,850	5,440		
	Dec			534	2,670			
1998	Jan			713	2,385			18,200
	Feb		4,920	780	2,130	4,570		18,400
	Mar		6,390	3,518	1,735	6,960		
	Apr	8,320	14,300	4,055	2,660	7,660		11,400
	May	14,375	16,200	11,150	8,243	22,650		
	Jun	11,618	19,250	8,828	4,417	10,700		18,600
	Jul	5,500	6,090	3,441	2,030	4,470		
	Aug		4,120		1,450	4,030		17,700
	Sep		4,080	210	1,710	4,240		
	Oct	3,070	4,780	580	1,840	6,390		
	Nov		5,020	669	1,800	4,610		
	Dec		4,780			3,770		18,200
1999	Jan				1,350			4,730
	Feb			760				
	Mar	5,520	6,770	1,850	1,110	4,380		
	Apr		7,100		1,849	6,010		18,400
	May	14,975	14,000	10,363		17,500		18,600
	Jun	17,367		9,710	3,190	17,500		19,300
	Jul	3,180	8,800		2,430	6,620		
	Aug	2,490	3,830	572		6,210		11,700
	Sep		3,880		3,170	7,170		
	Oct		3,460	376	4,790			
	Nov		3,750	425	1,880	5,920		
	Dec		3,870			3,835		
2000	Jan			483	1,520			9,270
	Feb			641				
	Mar	2,400	3,780	719	1,513	3,970		
	Apr	4,910	6,410	2,610	3,430	8,080		16,400
	May	8,910	9,450	7,780	4,280	10,200		
	Jun	16,000	3,690	6,730	2,390	5,950		18,000
	Jul	1,955	1,890	464	1,510	3,930		
	Aug	1,340	1,720	38	1,890	3,760		9,800
	Sep		1,930	216		3,760		
	Oct		2,170	398	1,800	3,180		
	Nov		2,050		1,430	3,110		4,690
	Dec			456	1,400			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 14 con't. Discharge (instantaneous) measurements (CFS) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2001	Jan		1,770			2,830		
	Feb		2,030		1,060	2,590		
	Mar	2,525	4,500	886	1,240	2,790		18,400
	Apr	3,385	5,380	2,440	2,060	4,190		
	May		13,600	6,710	3,480	9,830		
	Jun	3,620	2,630	2,530	1,300	4,260		19,600
	Jul		1,400	343	1,260	2,680		
	Aug	976		235	2,140			10,700
	Sep			105				
	Oct			219	1,650			
	Nov		1,710			3,210		10,200
	Dec				1,200			
2002	Jan					2,620		9,060
	Feb					2,500		
	Mar		2,160		1,115	2,610		
	Apr	2,663		1,520	687			
	May	6,000	3,660	2,060	946	1,910		18,800
	Jun	4,955	1,950	335	828	1,940		
	Jul	918	709	25		1,620		
	Aug	812		37	818	1,760		18,300
	Sep		980	51	1,010			
	Oct	1,030		209	1,070			
	Nov			278				4,930
	Dec				715			
2003	Jan							5,730
	Feb				607			
	Mar	1,360	1,970	346	669	1,960		
	Apr	5,260		6,130	1,150	2,370		
	May	14,300	7,210	9,600	4,570	17,500		22,100
	Jun				1,840			
	Jul	1,330	2,660	217	1,010	3,620		
	Aug	1,060	1,050	89	1,040	2,800		10,200
	Sep			80				
	Oct			161	1,070			
	Nov		1,820			2,840		
	Dec			373	771			2,260
2004	Feb		1,770			706		4,690
	Mar			762	1,460	4,570		
	Apr		4,000	3,000	1,510			
	May		11,100	6,860	2,830	10,000		14,400
	Jun		5,640		1,010	4,700		
	Jul		2,047	554	997			
	Aug		1,205	167	1,010	2,400		5,290
	Sep		1,595			2,910		
	Oct		2,070	897				
	Nov	1,610	2,700		1,090	3,570		
	Dec		2,350		926	2,730		5,030

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 14 con't. Discharge (instantaneous) measurements (CFS) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2005	Jan		2,840	669	1,210			
	Feb		2,690		1,570			
	Mar	1,890	3,320			3,740		
	Apr	5,470	3,070		6,683	14,000		15,000
	May	14,696	9,820		9,416	22,400		
	Jun	10,045	19,000	7,020	4,163			
	Jul	3,380	3,450		1,440	6,810		17,300
	Aug	1,820		385		3,540		14,000
	Sep		2,240	136	1,593			
	Oct	1,737		519	1,560			
	Nov	2,220		519		3,500		
	Dec		2,480					
2006	Jan	2,040			998			
	Feb			558		3,060		10,100
	Mar	2,840	3,650		1,210			
	Apr			7,210				14,000
	May	9,020	15,200	8,700	3,390	10,800		
	Jun	2,420		1,380		12,900		4,480
	Jul		1,850	452		4,000		
	Aug	1,080		214	1,930	3,930		13,400
	Sep	1,850						
	Nov			638	2,170			
	Dec			429		4,600		
	2007	Jan			289			
Feb						4,090		
Mar			3,270					
Apr				2,990	2,630	6,330		
May			4,980	7,710	3,612	8,080		
Jun			5,280	1,880		9,980		
Jul			2,050	332	1,270	3,700		
Aug			1,400			4,460		
Sep				193	1,790			
Oct			1,950					
Nov			1,590	647		3,840		
Dec					1,780			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 15. Turbidity measurements in unfiltered water (NTU) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2004. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location			
		Green River, UT	Gunnison River, CO	Colorado River	
		Green River	Near Grand Junction	Near Cisco, UT	Below Parker Dam, AZ-NV
1988	Feb		6.8		
	Mar				
	Apr		13		
	May				
	Jun		14		
	Jul				
	Aug		39		
	Sep		50		
	Oct				
	Nov		7.6		
	Dec				
	1989	Feb		9.8	
Apr			130		
Jun			41		
Jul			30		
Aug			36		
Oct					
Nov			9		
1990	Jan				
	Feb		8.5		
	Mar		28		
	May		130		
	Jun				
	Jul				
	Aug		21.5		
	Oct		14		
	Dec				
1991	Mar		24		
	Apr		68		
	May		68		
	Jul		51		
	Sep		1.2		
	Oct				
	Nov		10		
	Dec				

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 15 con't. Turbidity measurements in unfiltered water (NTU) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2004. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location			
		Green River, UT	Gunnison River, CO	Colorado River	
		Green River	Near Grand Junction	Near Cisco, UT	Below Parker Dam, AZ-NV
1992	Jan				
	Feb		5.5		
	Mar				
	Apr		85		
	May				
	Jun		17		
	Jul				
	Aug		32		
	Sep				
	Oct				
	Nov				
	Dec		3		
1993	Feb		37		
	Apr				
	May		200		
	Jun				
	Jul		26		
	Aug		56		
	Sep		14		
	Oct				
	Nov		2.2		
	Dec				
	Jan				
	1994	Jan			
Feb			1.1		
Mar					
Apr					
May			38		
Jun					
Jul					
Aug			59		
Sep					
Oct					
Nov					
Dec					

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 15 con't. Turbidity measurements in unfiltered water (NTU) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2004. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location			
		Green River, UT	Gunnison River, CO	Colorado River	
		Green River	Near Grand Junction	Near Cisco, UT	Below Parker Dam, AZ-NV
1995	Jan		3.6		
	Feb				
	Mar				
	Apr				
	May		150		
	Jun				
	Jul				
	Aug				
	Oct				
	Nov				
	Dec				
	1996	Jan			
Feb					
Mar		105		46	0.5
Apr		99		99	0.5
May				90	
Jun		103		29.5	0.5
Jul		160		29	
Aug		9.6		19	0.7
Sep		110		72	
Oct					
Nov		230		62	1.5
Dec					1.8
1997	Jan				
	Feb	23		28	1.2
	Mar	1400		190	
	Apr	150		160	0.48
	May	185		120	
	Jun	107.5		58	1
	Jul	27		25	
	Aug	310		22	1.2
	Sep	4900		93	
	Oct				1.6
	Nov				
	Dec				

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 15 con't. Turbidity measurements in unfiltered water (NTU) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2004. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location			
		Green River, UT	Gunnison River, CO	Colorado River	
		Green River	Near Grand Junction	Near Cisco, UT	Below Parker Dam, AZ-NV
1998	Jan				1.5
	Feb				1.3
	Mar				
	Apr				1
	May				
	Jun				1.5
	Jul				
	Aug	32		18	1.1
	Sep	22			
	Oct	64		700	
	Nov	19		9.8	
	Dec	1.5		4.4	0.96
1999	Jan				0.27
	Feb				
	Mar	150		32	
	Apr	64		470	0.29
	May	200		230	0.17
	Jun			140	0.44
	Jul	158		80	
	Aug	170		910	1.6
	Sep	480		980	
	Oct	20			
	Nov	7.5		2.5	
	Dec	22		2.5	
2000	Jan				0.81
	Feb				
	Mar	24		100	
	Apr	200		150	0.5
	May	230		46	
	Jun	41		25	0.84
	Jul			54	
	Aug	30		67	1.3
	Sep	74		45	
	Oct				
	Nov				1.7
	Dec				

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 15 con't. Turbidity measurements in unfiltered water (NTU) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2004. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location			
		Green River, UT	Gunnison River, CO	Colorado River	
		Green River	Near Grand Junction	Near Cisco, UT	Below Parker Dam, AZ-NV
2001	Jan				
	Feb				
	Mar				2.5
	Apr				
	May				
	Jun				2.3
	Jul				
	Aug				0.88
	Sep				
	Oct				
	Nov				0.9
	Dec				
2002	Jan				1.2
	Feb				
	Mar				
	Apr				
	May				0.33
	Jun				
	Jul				
	Aug				1.7
	Sep				
	Oct				
	Nov				2.1
	Dec				
2003	Jan				0.8
	Feb				
	Mar				
	Apr				
	May				1.1
	Jun				
	Jul				
	Aug				1.2
	Sep				
	Oct				
	Nov				
	Dec				0.79

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 15 con't. Turbidity measurements in unfiltered water (NTU) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2004. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location			
		Green River, UT	Gunnison River, CO	Colorado River	
		Green River	Near Grand Junction	Near Cisco, UT	Below Parker Dam, AZ-NV
2004	Jan				
	Feb				0.97
	Mar				
	Apr				
	May				0.69
	Jun				
	Jul				
	Aug				
	Sep				
	Oct				
	Nov				
	Dec				

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 16. Specific conductance in unfiltered water (pS/cm) measurements at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1981	Jan						1,240	
	Feb						1,110	
	Mar						1,100	
	Apr						1,100	
	May						1,090	
	Jun						1,080	
	Jul						1,080	
	Aug						1,090	
	Sep						1,080	
	Oct						1,070	
	Nov						1,080	
	Dec						1,090	
1982	Jan						1,100	
	Feb						1,090	
	Mar						1,090	
	Apr						1,090	
	May						1,080	
	Jun						1,070	
	Jul						1,060	
	Aug						1,080	
	Sep						1,090	
	Oct						1,090	
	Nov						1,090	
	Dec						1,120	
1983	Jan						1,120	
	Feb						1,090	
	Mar						1,100	
	Apr						1,110	
	May						1,100	
	Jun						1,100	
	Jul						1,100	
	Aug						1,100	
	Sep						1,100	
	Oct						1,040	
	Nov						1,000	
	Dec						1,000	
1984	Jan						900	
	Feb						1,000	
	Mar						990	
	Apr						1,000	
	May						990	
	Jun						980	
	Jul						960	
	Aug						950	
	Sep						950	
	Oct						920	
	Nov						940	
	Dec						920	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 16 con't. Specific conductance in unfiltered water (pS/cm) measurements at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1985	Jan						940	
	Feb						930	
	Mar						920	
	Apr						930	
	May						920	
	Jun						900	
	Jul						900	
	Aug						880	
	Sep						880	
1986	Apr						880	
	May						850	
	Jun						840	
	Jul						840	
	Aug						840	
	Sep						840	
	Oct						840	
	Nov						850	
Dec						830		
1987	Jan						840	
	Feb						840	
	Mar						860	
	Apr						850	
	May						855	
	Jun						850	
	Jul						845	
	Aug						850	
	Sep						820	
1996	Jan				806			1,100
	Feb				755			
	Mar		830		553	955		1,090
	Apr	740	640		601	510		1,080
	May	320			511	330		
	Jun		432		627	520		1,080
	Jul	400	670		603	880		
	Aug	670	800		1,016	1,270		1,060
	Sep		930		1,020	1,160		
	Oct	680		590	1,120			
	Nov		850	595	794	1,130		1,050
	Dec	770			692			1,050

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 16 con't. Specific conductance in unfiltered water (pS/cm) measurements at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1997	Jan	730			572			
	Feb		800		540	930		1,030
	Mar	710	740	643	386	670		
	Apr	700	600	674	383	500		1,010
	May		385	231	330	365		
	Jun		373	193	412	343		1,000
	Jul		520		496	705		
	Aug	550	700	423	880	850		990
	Sep		720		888	940		
	Oct	590			652			980
	Nov	650		635	633			
	Dec			684	585			
1998	Jan			626	540			964
	Feb			853	612			927
	Mar			795	645			
	Apr	560		686	613			925
	May	331		262	335			
	Jun	345		210	494			930
	Jul	320		285	841			
	Aug		660		1,040	1,090		920
	Sep		760	644	1,040			
	Oct	620	780	635	948	1,130		
	Nov		750	573	1,010	1,120		
	Dec		730			1,190		922
1999	Jan				896			920
	Feb			684				
	Mar	656	740	686	852	960		
	Apr		720		742	930		925
	May	411	540	233		455		915
	Jun	393		164	600	420		913
	Jul	540	568		914	860		
	Aug	620	750	412		950		906
	Sep		780		721	880		
	Oct		780	624	484			
	Nov		800	662	831	920		
	Dec		770			1,050		
2000	Jan			849	888			910
	Feb			850				
	Mar	678	780	845	747	1,040		
	Apr	511	550	550	439	590		904
	May	312	435		477	560		
	Jun	285	500	126	632	750		900
	Jul	565	740	445	873	1,020		
	Aug	650	760	751	866	1,090		890
	Sep	640	800	646		1,070		
	Oct		800	459	995	1,190		
	Nov		820		1,110	1,300		900
	Dec			594	904			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 16 con't. Specific conductance in unfiltered water (pS/cm) measurements at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2001	Jan		860			1,280		
	Feb		870			866	1,260	
	Mar	703	820	691	958	1,200		915
	Apr	672	590	418	540	680		
	May	345	350	158	479	520		
	Jun	365	570	234	949	850		871
	Jul	590	760	474	1,040	1,190		
	Aug	710		700	1,400			910
	Sep			727				
	Oct			658	1,020			
	Nov		890			1,270		898
	Dec				965			
2002	Jan					1,270		909
	Feb					1,200		
	Mar		910		810	1,110		
	Apr	571		640	925			
	May	305	530	244	1,090	1,120		926
	Jun	341	510	233	915	1,160		
	Jul	679	800	862		1,390		
	Aug	715		985	1,130	1,660		929
	Sep	994	980	880	1,250			
	Oct	685		586	1,200			
	Nov			619				933
	Dec				1,260			
2003	Jan							953
	Feb				1,180			
	Mar	688	940	619	1,050	1,490		
	Apr	432		350	642	840		
	May	360	540	193	488	420		970
	Jun				724			
	Jul	597	500	440	883	890		
	Aug	708	800	684	981	1,200		988
	Sep			639				
	Oct			596	1,200			
	Nov		810			1,400		
	Dec			619	1,300			993
2004	Feb		850			1,170		1,000
	Mar			617	688	700		
	Apr		630	316	734			
	May		335	131	526	510		1,020
	Jun		400		1,090	790		
	Jul		586	346	974			
	Aug		837	523	1,070	1,300		1,020
	Sep		795			1,260		
	Oct		646	380				
	Nov	550	833		1,180	1,200		
Dec		841		1,060	1,280		1,060	

Final – Evaluation of bonytail stockings in the Colorado River Basin

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Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2005	Jan		890	495	860			
	Feb		888		685			
	Mar	680	838			940		
	Apr	351	842		484	430		1,050
	May	319	470		326	390		
	Jun	250	420	193	533			
	Jul	450	690		973	730		1,070
	Aug	654		405		1,130		1,080
	Sep		790	639	1,110			
	Oct	695		469	1,120			
	Nov	633		453		1,250		
	Dec		880					
2006	Jan	674			1,050			
	Feb			521		1,190		1,080
	Mar	620	740		834			
	Apr			278				1,100
	May	284	355	161	512	490		
	Jun	440		206		12,900		1,080
	Jul		650	386		1,010		
	Aug	630		526	794	1		1,060
	Sep	740						
	Nov			463	671			1,080
	Dec			506		990		
	2007	Jan			530			
Feb						1,070		
Mar			830		743			
Apr				422	480	690		1,080
May			500	156	550	740		
Jun			430	193		570		
Jul			650	399	981	950		
Aug			750			1,360		
Sep				525	923			
Oct		530	790					
Nov		658	980	362		1,060		
Dec					752			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 17. Dissolved oxygen in unfiltered water (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1984-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1984	Jan						13.6	
	Feb						10.2	
	Mar						9.8	
	Apr						9	
	May						9.1	
	Jun						8.2	
	Jul						8.8	
	Aug						7.9	
	Sep						7.8	
	Oct						8.4	
	Nov						9.1	
	Dec						9.9	
1985	Jan						10.6	
	Feb						10.5	
	Mar						10.3	
	Apr						10.1	
	May						9.8	
	Jun						9.4	
	Jul						9	
	Aug						8.1	
	Sep						7.7	
1986	Apr						9.9	
	May						9.6	
	Jun						8.7	
	Jul						8.4	
	Aug						8.4	
	Sep						8.1	
	Oct						8.9	
	Nov						9	
Dec						9.9		
1987	Jan						9.8	
	Feb						11.3	
	Mar						10.8	
	Apr						10.3	
	May						9.5	
	Jun						9.6	
	Jul						8.4	
	Aug						7.7	
	Sep						7.8	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 17 con't. Dissolved oxygen in unfiltered water (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1984-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1996	Jan				11.3			10.6
	Feb				10.3			
	Mar		9.7		10.5	9.3		9.9
	Apr		9.1		9.6	9.6		8.8
	May				8.5	8.3		
	Jun		7.1		8.1	7.8		8.2
	Jul		6.5		8	6.8		
	Aug		7.3		9.4	6.9		7.6
	Sep		8		7.5	8.2		
	Oct				8.6			
	Nov		10.1	12.7	12.2	10.5		9.3
	Dec				13.2			10.3
1997	Jan				12.5			
	Feb		11.8		12.4	10.6		10.7
	Mar		10.1	10.5	10.2	10		
	Apr		8.9		8.2	9.4		9.6
	May		8		8.7	8.7		
	Jun		7.5	9.6	8.4	8.1		8.5
	Jul		6.9		7.8	6.9		
	Aug		6.6	9.2	7.7	6.9		8.2
	Sep		7		8.1	7.5		
	Oct	9			8.7			9.2
	Nov			11.5	12			
	Dec				11.8			
1998	Jan				11.1			10.9
	Feb				11.5			10.3
	Mar			11.2	10.7			
	Apr			10.6	9.4			9.9
	May				8.7			
	Jun			8.8	8.1			8.3
	Jul				7.2			
	Aug		7.2		8	7.3		7.9
	Sep		8.1	7.1	7.5			
	Oct		9.2	9	8.6	8.8		
	Nov		10.7		12.3	12.3		
	Dec		11.3			13.3		10.8
1999	Jan				10			10.9
	Mar	11.3	9.7	11.5	10.3	9.6		
	Apr		9.2		10.7	9		9.9
	May	9.4	8.9			8.1		8.9
	Jun	9.1		8.5	8	7.9		8.7
	Jul	7.6	6.9		7.4	7.3		
	Aug	8.7	6.9	7.2		7		8.4
	Sep		7.9		8.2	8.1		
	Oct		9.8	9.6	8.9			
	Nov		11		11	9.8		
Dec		13.3			11.2			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 17 con't. Dissolved oxygen in unfiltered water (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1984-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location							
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River			
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV	
2000	Jan				10.4			11.2	
	Mar	10.3	10.8	10.9	10.6	9.1			
	Apr	8.7	8.6		8.3	8.8		8.7	
	May		7.7		8	8.1			
	Jun		7.2	7.6	7.8	8.6		7.8	
	Jul		6.7		7.9	7			
	Aug		6.8	7.2	7.8	6.9		8.3	
	Sep		8			7.8			
	Oct				9.6				
	Nov							10.2	
	Dec			11.6	11.6				
	2001	Feb				10.1			
Mar				12.4	11.7			8.9	
Apr					7.7				
May				8.6	8.6				
Jun					7.5			7.3	
Jul					6.9				
Aug				7.2	6.7			6.9	
Oct				9.9	10.5				
Nov								7.3	
Dec					11.9				
2002		Jan							10.4
		Mar				9			
	Apr	10.3		9.5	8.6				
	May	9.4		8.1	7			8.7	
	Jun				8.2				
	Jul	8.6		7					
	Aug	8.7		6.4	8.5			7.2	
	Sep	8.6		8.6	7.6				
	Oct	9.3		10.1	9.4				
	Nov							8.2	
	Dec				11.1				
	2003	Jan							8
Feb					10.2				
Mar		12.1		11.5	9.5				
Apr		9.3			8.2				
May		8.7		9.2	7.8			9.2	
Jun					7.7				
Jul		8.5			6.2				
Aug		9.3		8	7.5			7.1	
Oct					8.6				
Dec				11.4	11.5			7.1	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 17 con't. Dissolved oxygen in unfiltered water (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1984-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location							
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River			
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV	
2004	Feb				9.5			9.3	
	Mar				8				
	Apr			9.1	9.6				
	May			8.8	10.2			9.7	
	Jun				8				
	Jul			7.3	7				
	Aug				7.4			5.9	
	Oct			9.2					
	Nov				11.2				
	Dec				13.7			9.1	
	2005	Jan			12	13.1			
		Feb				10.8			
Apr					9.4			8.7	
May					8.3				
Jun					8.5				
Jul					8.5			10	
Aug								8.9	
Sep				8.7	7.9				
Oct				9.4	9.3				
Nov				9.9					
2006		Jan				13.4			
	Feb			11.5				10.3	
	Mar				12.8				
	Apr							9.5	
	May			9.4	8.2				
	Jun			7.7				7.8	
	Jul			6.6					
	Aug			7.6	7.8			8	
	Nov			9.3	11.9			8.6	
	Dec			11.3					
	2007	Jan			11.5				
Feb									
Mar					11.6				
Apr				9.2	8.7			10.3	
May				8.7					
Jun				7					
Jul				7.4	8.4				
Aug									
Sep				7.8	8.2				
Oct									
Nov				9.9					
Dec					12.6				

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 18. pH of unfiltered water measured in field at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1981	Jan						8.0	
	Feb						7.9	
	Mar						7.9	
	Apr						7.8	
	May						7.9	
	Jun						8.0	
	Jul						7.5	
	Aug						7.5	
	Sep						7.7	
	Oct						7.7	
	Nov						7.8	
	Dec						7.9	
1982	Jan						7.8	
	Feb						7.9	
	Mar						7.8	
	Apr						7.9	
	May						7.8	
	Jun						7.8	
	Jul						7.9	
	Aug						7.7	
	Sep						7.6	
	Oct						7.8	
	Nov						7.8	
	Dec						7.8	
1983	Jan						7.9	
	Feb						8.0	
	Mar						7.9	
	Apr						8.0	
	May						7.8	
	Nov						7.8	
	Dec						8.3	
1984	Jan						8.4	
	Feb						7.5	
	Mar						8.2	
	Apr						8.7	
	May						7.9	
	Jun						7.7	
	Jul						8.1	
	Aug						6.9	
	Sep						8.2	
	Oct						8.3	
	Nov						8.1	
	Dec						8.3	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 18 con't. pH of unfiltered water measured in field at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1985	Jan						8.2	
	Feb						8.2	
	Mar						8.1	
	Apr						8.1	
	May						7.9	
	Jun						7.7	
	Jul						8.2	
	Aug						7.8	
	Sep						7.9	
1986	Apr						7.7	
	May						7.9	
	Jun						7.8	
	Jul						7.8	
	Aug						8.0	
	Sep						7.8	
	Oct						8.0	
	Nov						7.8	
Dec						8.0		
1987	Jan						8.1	
	Feb						7.9	
	Mar						7.9	
	Apr						8.0	
	May						8.0	
	Jun						7.9	
	Jul						7.8	
	Aug						7.8	
	Sep						7.5	
1996	Jan				8.1			8.0
	Feb				8.3			
	Mar		8.3		8.1	8.2		8.2
	Apr	8.4	8.3		8.0	8.1		8.2
	May	8.1			8.3	8.0		
	Jun		8.3		8.2	8.0		8.1
	Jul	8.4	8.4		8.5	8.5		
	Aug	8.5	8.5		8.4	8.3		7.9
	Sep		8.5		8.2	8.3		
	Oct	8.5			8.3			
	Nov		8.5	8.3	8.6	8.4		8.3
	Dec	8.3			8.2			8.2

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 18 con't. pH of unfiltered water measured in field at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
1997	Jan	8.3			8.4			
	Feb		8.5		8.4	8.5		8.3
	Mar	8.5	8.3	8.1	8.1	8.3		
	Apr	8.4	8.3		8.3	8.3		8.2
	May		8.2		8.1	8.2		
	Jun		8.3	8.1	8.1	8.2		8.3
	Jul		8.5		8.3	8.5		
	Aug	8.4	8.5	8.5	8.3	8.5		8.1
	Sep		8.3		8.4	8.4		
	Oct	8.5			8.7			8.2
	Nov	8.5		8.4	8.9			
	Dec				8.6			
1998	Jan			8.1	8.5			8.3
	Feb			8.4	8.4			8.3
	Mar			8.2	8.5			
	Apr	8.4		8.4	8.3			8.1
	May	8.1		8.3	8.2			
	Jun			8.0	8.3			8.2
	Jul	8.3		8.5	8.3			
	Aug		8.6		8.4	8.4		8.1
	Sep		8.5	8.4	8.4			
	Oct	8.1	8.4	8.4	8.5	8.2		
	Nov		8.3		8.4	8.4		
	Dec		8.3			8.4		8.2
1999	Jan				8.3			8.2
	Mar	8.3	8.4	8.4	8.3	8.4		
	Apr		8.5		8.1	8.1		8.2
	May	8.3	8.2			8.0		8.2
	Jun	8.3		8.2	8.2	8.0		8.1
	Jul	8.5	8.3		8.3	8.4		
	Aug	8.7	8.4	8.5		8.3		8.1
	Sep		8.4		8.5	8.2		
	Oct		8.4	8.6	8.2			
	Nov		8.4		8.7	8.3		
Dec		8.3			8.4			
2000	Jan				8.1			8.3
	Mar	8.6	7.3	8.6	8.2	8.2		
	Apr	8.5	8.2		8.1	8.1		8.0
	May		8.0		8.1	8.0		
	Jun		8.4	8.0	8.3	8.3		8.0
	Jul	8.6	8.5		8.2	8.4		
	Aug	8.5	8.4	8.4	8.4	8.2		8.0
	Sep	8.4	8.5			8.3		
	Oct		8.3		8.4	8.3		
	Nov		8.3			8.4		8.1
	Dec			8.5	8.7			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 18 con't. pH of unfiltered water measured in field at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2001	Jan		8.4			8.4		
	Feb		8.3		8.5	8.3		
	Mar	8.8	8.2	8.5	8.5	8.3		8.2
	Apr	8.5	8.3		8.2	8.1		
	May	8.2	8.2	8.1	8.2	8.3		
	Jun		8.4		8.3	8.4		8.2
	Jul	8.5	8.4		8.0	8.4		
	Aug	8.6		8.5	8.0			8.1
	Oct			8.6	8.4			
	Nov		8.2			8.3		8.2
	Dec				8.5			
	2002	Jan					8.4	
Feb						8.4		
Mar			8.4		8.4	8.3		
Apr		8.4		8.3	8.6			
May		8.3	8.4	8.3	8.2	8.1		8.1
Jun			8.3		8.3	8.3		
Jul		8.3	8.4	8.4		8.3		
Aug		8.4		8.5	8.4	7.6		8.1
Sep		8.3	8.2	8.4	8.4			
Oct		8.5		8.5	8.2			
Nov								8.3
Dec					8.3			
2003	Jan							8.3
	Feb				8.3			
	Mar	8.4	8.2	8.5	8.4	8.1		
	Apr	8.1			8.1	8.2		
	May	8.0	7.9	8.0	7.8	8.1		8.2
	Jun				8.1			
	Jul	8.3	8.4		8.1	8.3		
	Aug	8.1	8.3	8.5	8.0	7.7		8.0
	Oct				8.4			
	Nov		8.3			8.2		
	Dec			8.4	8.3			8.1
	2004	Feb		8.3		8.5		
Mar					8.1	8.2		
Apr			8.2	8.2	8.3			
May				8.1	8.1	8.1		8.2
Jun			8.2		8.3	8.3		
Jul			8.4	8.4	8.6			
Aug			8.4		8.4	8.3		8.0
Sep						8.3		
Oct				7.7				
Nov		8.0	8.2		8.6	8.3		
Dec					8.5	8.3		8.3

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 18 con't. pH of unfiltered water measured in field at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2007. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location						
		Green River, UT		Yampa River, CO	Gunnison River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Grand Junction	Near Cisco, UT	Below Davis Dam, AZ-NV	Below Parker Dam, AZ-NV
2005	Jan		8.2	8.1	8.6			
	Feb				8.6			
	Mar	8.4	8.5			8.4		
	Apr	8.1			8.1	8.0		8.1
	May	7.3	8.2		7.9	8.3		
	Jun		8.2	8.1	8.2			
	Jul		8.4		8.6	8.3		8.0
	Aug	8.2				8.3		7.8
	Sep		8.3	8.7	8.4			
	Oct	8.1		8.6	8.4			
	Nov	8.1		8.6		8.4		
	Dec		8.2					
2006	Jan	7.7			8.7			
	Feb			8.7		8.3		7.9
	Mar	8.2	8.5		8.7			
	Apr			8.2				8.1
	May	8.1	8.0	8.5	8.3	8.2		
	Jun	8.1		8.3		8.1		8.1
	Jul		8.5	8.6		8.0		
	Aug	8.3		8.6	8.7	8.4		8.0
	Sep	7.7						
	Nov			8.5	8.9			8.2
	Dec			8.4		8.3		
	2007	Jan			8.1			
Feb						7.7		
Mar			8.0		8.7			
Apr				8.4	8.3			8.2
May			8.2	8.2		7.9		
Jun			8.1	8.4		8.0		
Jul			8.5	8.5	8.4	8.1		
Aug			8.4			7.9		
Sep				8.6	8.0			
Oct		8.5	8.4					
Nov		8.4	8.3	8.5		8.4		
Dec					8.3			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
1981	Jan		17			
	Feb		60			
	Mar		127			
	Apr		434			
	May		2,355			
	Jun		104			
	Jul		262			
	Aug		369			
	Sep		522			
	Oct		1,520			
	Nov					
	Dec					
1982	Jan					
	Feb		780			
	Mar					
	Apr		1,760			
	May		2,020			
	Jun		932			
	Jul					
	Aug		4,100			
	Sep					
	Oct					6
	Nov					6
	Dec					4
1983	Jan		190			3
	Feb		429			3
	Mar		549			6
	Apr		2,340			6
	May		2,070			4
	Jun		1,050			4
	Jul		1,270			6
	Aug		540			8
	Sep		466			6
	Oct		223			
	Nov		76			
	Dec		86			

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
1984	Jan					
	Feb					
	Mar		1,880			
	Apr		3,770			
	May		2,180			
	Jun		1,230			
	Jul		880			
	Aug		1,250			
	Sep		1,120			
	Oct		388			
	Nov		166			4
	Dec					3
1985	Jan					5
	Feb					3
	Mar		1,770			
	Apr		3,210			2
	May		1,300			4
	Jun					3
	Jul		9,460			2
	Aug					1
	Sep		274			3
	Oct					2
	Nov		98			5
	Dec					2
1986	Jan					2
	Feb		358			3
	Mar		738			3
	Apr		839			
	May		1,311			2
	Jun		542			8
	Jul		624			8
	Aug		318			6
	Sep		1,240			
	Oct					4
	Nov					
	Dec					4

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
1987	Feb		200			3
	Mar		1,390			
	Apr		1,660			2
	May		1,194			
	Jun		107			2
	Jul		716			
	Aug		1,034			
	Oct					3
	Nov		131			
	Dec					2
1988	Feb					2
	Mar		607		91	
	Apr					1
	May				415	
	Jun				349	2
	Jul				90	
	Aug					2
	Sep					
	Oct					4
	Nov		90		112	5
	Dec					2
	1989	Jan				
Feb						1
Mar			1,530		316	2
Apr			233		677	2
May			300			2
Jun			179		117	2
Jul			59		118	3
Aug						3
Sep						3
Oct						4
Nov			146		42	8
Dec						6

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
1990	Jan					4
	Feb					2
	Mar		382		45	11
	Apr		433		405	2
	May		234		208	2
	Jun		406		138	2
	Jul		244		3,640	4
	Aug					11
	Sep					7
	Oct					5
	Nov		126		98	4
	Dec					3
1991	Jan					2
	Feb					2
	Mar		261		127	
	Apr		266		642	
	May		1,000		1,400	
	Jun		345		319	
	Jul		442		156	
	Aug					
	Sep					
	Oct					
	Nov		534		287	
	Dec					
1992	Jan					
	Feb					
	Mar		645		188	
	Apr		796		2,960	
	May		2,390		2,190	
	Jun					
	Jul					
	Aug					
	Sep					
	Oct					
	Nov					
	Dec					

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
1993	Jan					
	Feb					
	Mar					
	Apr					
	May					
	Jun		1,400		562	
	Jul					
	Aug					
	Sep					
	Oct					
	Nov					
	Dec				54	
1994	Jan					
	Feb					
	Mar		357		135	
	Apr		522		383	
	May		1,540		1,020	
	Jun		46		129	
	Jul					
	Aug					
	Sep					
	Oct					
	Nov		105		100	
	Dec					
1995	Feb					
	Mar		275		905	
	Apr					
	May					
	Jun		754		303	
	Jul					
	Aug					
	Sep		184		77	
	Oct		57		43	
	Nov		161		23	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
1996	Jan					
	Mar		328		110	
	Apr	545	527		599	
	May	748			383	
	Jun	233	817		228	
	Jul	170	330		90	
	Aug				39	
	Sep		212		191	
	Oct					
	Nov		532	2,300	127	
	Dec					
	1997	Jan				
Feb			114		69	
Mar			3,540	2,310	618	
Apr			1,130		852	
May			1,355	635	690	
Jun			1,049	536	388	
Jul			300		189	
Aug			547	175	81	
Sep			12,750		447	
Oct						
Nov			142	38	46	
Dec						
1998	Jan					
	Feb		106		72	
	Mar		378	151	674	
	Apr		1,590		251	
	May	720	932	1,123	1,453	
	Jun	408	1,343	623	138	
	Jul		159	296	95	
	Aug		96		85	
	Sep			12	162	
	Oct		287		1,840	
	Nov		300		80	
	Dec		46		56	

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
1999	Jan					
	Feb					
	Mar	409	408	878	90	
	Apr		224		1,360	
	May	654	1,230	942	1,630	
	Jun	408		416	262	
	Jul		937		217	
	Aug		596		3,310	
	Sep		1,010		2,640	
	Oct		93	18		
	Nov		74		45	
	Dec		150		58	
2000	Jan					
	Feb					
	Mar		63	34	882	
	Apr	503	578	465	635	
	May	654	668	782	207	
	Jun	531	97		82	
	Jul	55	128	1,100	123	
	Aug		78		154	
	Sep		187		124	
	Oct					
	Nov					
	Dec			7		
2001	Jan					
	Feb					
	Mar	1,240				
	Apr	125				
	May					
	Jun	65		174		
	Jul					
	Aug					
	Sep					
	Oct					
	Nov					

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location					
		Green River, UT		Yampa River, CO	Colorado River		
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV	
2002	Jan						
	Feb						
	Mar						
	Apr	488					
	May	444					
	Jun	199					
	Jul	14		18			
	Aug						
	Sep						
	Oct						
	Nov						
2003	Jan						
	Mar						
	Apr						
	May						
	Jul						
	Aug						
	Sep						
	Oct						
	Nov						
	Dec						
	2004	Feb					
		Mar					
Apr							
May							
Jun							
Jul							
Aug							
Sep							
Oct							
Nov							
Dec							

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 19 con't. Suspended sediment concentration (mg/L) at U.S. Geological Survey water sampling locations near bonytail stocking areas in the Colorado River Basin, 1981-2005. Values are either a single measurement or a monthly average.

Year	Month	Water Sampling Location				
		Green River, UT		Yampa River, CO	Colorado River	
		Near Jensen	Green River	Deerlodge Park	Near Cisco, UT	Below Parker Dam, AZ-NV
2005	Jan					
	Feb					
	Mar					
	Apr	588				
	May	987				
	Jun	165				
	Jul					
	Aug					
	Sep					
	Oct	41				
	Nov					
	Dec					

Final – Evaluation of bonytail stockings in the Colorado River Basin

Appendix 20. Paired release and capture PIT tag data of repatriated bonytail in the lower Colorado River, 1996-2007. See Appendices 10-12 for capture code information.

Capture Code	Stocking Area ^a	Rearing Location	Rearing Type	Year Class	Sex	Stocking Date	Capture Date	DAL	MAL	YAL	Stocking Location	Capture Location	Release TL (mm)	Capture TL (mm)	Capture Zone ^b	Release Zone ^b
1	Lower	1	2	2004+others	U	13-Dec-06	15-Jan-07	33	1	-	A-7 backwater upper	C-7 backwater	345	335	-	-
-	Lower	1	2	2004+others	U	13-Dec-06	15-Jan-07	33	1	-	A-7 backwater upper	C-7 backwater	350	342	-	-
-	Lower	1	2	2004+others	U	13-Dec-06	17-Jan-07	35	1	-	A-7 backwater upper	A-7 backwater upper	345	342	-	-
-	Lower	1	2	2004+others	U	13-Dec-06	18-Jan-07	36	1	-	A-7 backwater upper	A-7 backwater upper	340	335	-	-
-	Lower	1	2	2004+others	U	13-Dec-06	10-Apr-07	118	4	-	A-7 backwater upper	A-7 backwater upper	350	348	-	-
2	Havasu	11	2	-	M	14-Dec-06	21-Feb-07	69	2	-	BLM Partner's Point Work Camp	Bill Williams River NWR	375	310	-	-
9	Havasu	11	2	-	M	25-Aug-99	22-Feb-00	181	6	-	Lake Havasu	Bill Williams River NWR	225	238	-	-
10	Havasu	11	2	-	F	02-Nov-00	19-Feb-01	109	4	-	Office Cove	Bill Williams River NWR	284	285	-	-
-	Havasu	11	2	-	J	02-Nov-00	16-Jul-02	621	21	2	Office Cove	Bill Williams River NWR	290	260	-	-
11	Havasu	11	2	-	U	15-Jul-02	24-Feb-03	224	7	-	Bill Williams River NWR	Bill Williams River NWR	283	310	-	-
-	Havasu	11	2	-	U	15-Jul-02	24-Feb-03	224	7	-	Bill Williams River NWR	Bill Williams River NWR	260	285	-	-
12	Havasu	11	2	-	U	16-Jul-02	25-Feb-03	224	7	-	Bill Williams River NWR	Bill Williams River NWR	270	282	-	-
14	Havasu	11	2	-	U	27-Aug-02	24-Feb-04	546	18	1	Bill Williams River NWR	Bill Williams River NWR	255	375	-	-
17	Havasu	11	2	-	U	09-Dec-03	24-Feb-04	77	3	-	Office Cove	Bill Williams River NWR	265	270	-	-
7	Havasu	8	2	-	U	01-Dec-95	31-Jan-96	61	2	-	Office Cove	Bill Williams River Delta	286	287	-	-
8	Havasu	8	2	-	U	25-Jan-96	31-Jan-96	6	0	-	Bill Williams River NWR	Bill Williams River Delta	336	334	-	-
15	Havasu	5	2	-	U	18-Nov-02	15-Feb-06	1,185	40	3	Bill Williams River NWR	Bill Williams River NWR	335	505	-	-
3	Mohave	18	1	-	U	25-Oct-95	18-May-98	936	31	3	Nine Mile Coves	Half-way Wash	322	420	Basin	Basin
-	Mohave	18	1	-	J	25-Oct-95	13-Mar-96	140	5	-	Nine Mile Coves	Nine Mile Coves	244	245	Basin	Basin
-	Mohave	18	1	-	J	25-Oct-95	15-May-96	203	7	-	Nine Mile Coves	Cottonwood Cove East	242	283	Basin	Basin
5	Mohave	26	2	1999/2000 WBNFH	J	01-Dec-04	18-Mar-05	107	4	-	Cottonwood Cove	Valhalla Cove to Half-way Wash (north of)	290	295	Basin	Basin
6	Mohave	26	2	2002 WBNFH	J	16-Dec-04	08-Apr-05	113	4	-	Princess Cove	Bass Cove	380	375	Basin	Lower Lake
-	Mohave	26	2	2002 WBNFH	M	16-Dec-04	17-May-05	152	5	-	Princess Cove	Forked Coves	285	290	Lower Lake	Lower Lake
13	Havasu	26	2	-	U	01-Aug-02	25-Feb-03	208	7	-	Office Cove	Forked Coves	315	-	-	-
16	Havasu	26	2	-	U	20-Nov-02	26-Feb-03	98	3	-	Bill Williams River NWR	Forked Coves	275	276	-	-
18	Havasu	26	2	1999/2000 WBNFH	J	18-Nov-04	03-Feb-05	77	3	-	BLM Partner's Point Work Camp	Forked Coves	380	383	-	-
19	Havasu	26	2	1999/2000 WBNFH	U	23-Nov-04	15-Feb-05	84	3	-	Topock Marsh	Forked Coves	340	325	-	-
-	Havasu	26	2	1999/2000 WBNFH	J	23-Nov-04	28-Jan-05	66	2	-	Topock Marsh	Forked Coves	340	342	-	-
-	Havasu	26	2	1999/2000 WBNFH	J	23-Nov-04	28-Jan-05	66	2	-	Topock Marsh	Forked Coves	325	327	-	-
-	Havasu	26	2	1999/2000 WBNFH	J	23-Nov-04	25-Jan-05	63	2	-	Topock Marsh	Forked Coves	320	322	-	-
-	Havasu	26	2	1999/2000 WBNFH	U	23-Nov-04	16-Feb-05	85	3	-	Topock Marsh	Forked Coves	330	330	-	-
-	Havasu	26	2	1999/2000 WBNFH	U	23-Nov-04	16-Feb-05	85	3	-	Topock Marsh	Forked Coves	310	310	-	-
-	Havasu	26	2	1999/2000 WBNFH	U	23-Nov-04	04-Mar-05	101	3	-	Topock Marsh	Forked Coves	380	382	-	-
-	Havasu	26	2	1999/2000 WBNFH	U	23-Nov-04	08-Mar-05	105	4	-	Topock Marsh	Forked Coves	320	320	-	-
-	Havasu	26	2	1999/2000 WBNFH	U	23-Nov-04	24-Mar-05	121	4	-	Topock Marsh	Forked Coves	330	329	-	-
-	Havasu	26	2	1999/2000 WBNFH	J	23-Nov-04	26-Jan-05	64	2	-	Topock Marsh	Forked Coves	345	345	-	-
-	Havasu	26	2	1999/2000 WBNFH	U	23-Nov-04	01-Mar-05	98	3	-	Topock Marsh	Forked Coves	325	330	-	-
-	Mohave	27	1	-	U	25-Nov-97	25-Nov-97	0	-	-	Yuma Cove	Forked Coves	330	335	Arizona Bay	Arizona Bay

^aStocking areas - "Lower" is the lower Colorado River (Reach 45), "Havasu" is Lake Havasu (Reach 3) and "Mohave" is Lake Mohave (Reach 2).