

Sharing Tails[®]: Teaching Children about Native Arizona Fish
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Final Report
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Grant Summary Description

Develop and implement an educational outreach program, hereby known as Sharing Tails®, directed toward early-age public elementary school children in Arizona that informs them about (1) the values of native fish to the State's natural heritage, (2) the problem of endangerment of native fishes, and (3) some of the issues of environmental conservation.

Purpose and Objective

The purpose of Sharing Tails® was to educate Arizona's children about our native fishes through site visits at public elementary schools using grade-level appropriate educational activities and materials. This project was performed over the course of three years and our target goal was to contact 30,000 students. Our objective was to create excitement about native Arizona fishes in children who potentially would become the future protectors and advocates for these unique animals. Our project coincided with Reclamation's desire to convey to the public the value of native aquatic species and the problems that non-native species create for conservation and recovery of native species and their habitats.

Overall Assessment

Sharing Tails® was a successful program that fulfilled a need for a proactive, free statewide program that taught children about native Arizona fish. During the course of the program, from January 1, 2009 through May 30, 2011, we provided our program to 33,285 students (111% of our total target goal of 30,000 students) during 378 school visits. These visits included calls at the same facility more than once in an academic year for multiple grade-levels programs. When we selected for unique school districts and schools, we visited totals of 71 districts and 182 schools (respectively, 43 and 22% of total public elementary school districts and schools in Arizona with kindergarten programs). In years Two and Three we exceeded our target goal of 10,000 students per year by 23% and 51%, respectively, and we exceeded our yearly % target number of students' goal by 20% and 9% for kindergarten and first grade, respectively. Evaluation of teacher-assisted student questionnaires reflected the overall effectiveness and success of our program. Teacher feedback on the program was positive and constructive, and suggestions were appreciated and many were incorporated where possible.

Introduction

Residents new to Arizona are surprised to learn that we have fish unique to our state. Locals may know at least some or all of a common name or two, but few Arizonans know a majority (78%) of our state's 36 native fish species are federally listed or candidates for listing as endangered or threatened or they are Wildlife of Special Concern in Arizona. One species, the Santa Cruz (Monkey Spring) pupfish, *Cyprinodon arcuatus*, is extinct. Several other species are extirpated, which means they are no longer found in Arizona, but persist elsewhere. We also believe that most Arizonans are generally unaware of the primary direct cause of this environmental catastrophe and the most significant deterrent to successful conservation of this fauna, which is predation by non-native, aquatic piscivorous fish that prey on all life stages of native Arizona fish (Pacey and Marsh 1998). We decided to attempt to remedy this situation by creating a public outreach educational program specifically to teach about native Arizona fish. We believe that public educational outreach information provided by private organizations and state and federal agencies for native fish consciousness in Arizona has been lacking, uninteresting, and intermittent at best. We attempted to locate and report on as many on-going public educational outreach programs about native Arizona fish as possible by searching the internet (via Google and other website search engines) and then following up with specific programs if there were questions. We present this information below, initially gathered in 2008 and updated in 2011 for this report. Any omissions are regrettable and unintended.

We found few private organizations specifically addressing native fish education in Arizona. Cabela's retail outlet in Glendale held native Arizona fish on-site and posted information (Wong 2006), but these fish have since died or otherwise been removed and replaced with non-native fishes (pers. obs.). In the mid-nineties, the Phoenix Zoo had native Arizona fish on-site with posted information as well as formal outreach programs with endangered species information (Phoenix Zoo 2006). Later inspection of their recently renovated desert pupfish (*Cyprinodon macularius*) pond exhibit showed few fish persisted after infiltration by non-native frogs and the main lake may or may not have a few remaining razorback sucker (*Xyrauchen texanus*) and bonytail (*Gila elegans*). The Sonoran Sea Aquarium™ had planned for formal, invited and fee-based environmental outreach programs in southern Arizona schools and at area public events (Marty 2007; Sonoran Sea Aquarium 2007), but this facility never materialized and its program information no longer exists online. In 2010, Arizona Sea Life Aquarium opened in the City of Tempe, however this facility does not currently house any native Arizona fish (R. Sipes, pers.comm.). Nina Mason Pulliam Rio Salado Audubon Center in the City of Phoenix received Gila topminnow (*Poeciliopsis occidentalis*) and desert pupfish from Arizona Game and Fish Department (AZGFD) and they offer free, school groups science-based field trips accommodating up to 60 students per field trip.

We used the Arizona Association for Environmental Education (AAEE) website, <http://arizonaee.org/>, and their “EE directory” and “Detailed Resource Search” to search by county for environmental outreach programs. We used the search term “fish,” but it returned no county programs. We returned to this website in 2011 and found this search process is no longer available. The Desert Outdoor Center at Lake Pleasant, which is a part of the Maricopa County Parks & Recreation program, continues to offer Cast-Away Kids, a requestable science program for K-12 that emphasizes fishing knowledge and skills, and promotes awareness, appreciation and support for Arizona’s recreational fishing opportunities. The program makes mention of Arizona’s native and non-native fish species (Maricopa County 2006). The Arizona Department of Education (ADE) approves this fee-based, 45-50 minute program. In 2011, we could not locate any new county programs when using Google, each county name and the search terms, “native fish” and “environmental outreach.”

As for state organizations, the Arizona Game and Fish Department (AZGFD) created Focus: Wild Arizona which is a free environmental education program primarily for teachers and home schoolers, http://www.azgfd.gov/i_e/ee/environmental_education.shtml, and it is useful for all school grade levels, but it contains only one reference to native Arizona fish information (Monster Fire, Native Fish) (AZGFD 2006). AZGFD also developed an activity coloring/information page series (Wild Kids), some focusing on endangered and non-native animals, and native Arizona fish (AZGFD 2006). The agency offers this series on their website along with other native Arizona fish fact sheets and copies of news articles (S. Voiland, pers. comm.), as well as photos and videos (AZGFD 2006). AZGFD also offers on-site classroom presentations for K-12, but none are centered directly on native Arizona fish and many of these as well as lesson plans are limited to fourth grade and higher (AZGFD 2006, AZGFD 2011). AZGFD also supports Adobe Mountain Wildlife Center, Phoenix, which provides site visits with live, rehabilitated wildlife to fourth grade and higher (Arizona Wildlife Center 2011). No native Arizona fish are part of their program. In Superior, the Boyce Thompson Arboretum State Park has Gila topminnow and desert pupfish on-site and posted information (Arizona Board of Regents 2003). These same fish species are located at several of the State’s public schools including schools in Tucson (ADE 2007b), Tempe and Peoria, all part of the Gila Topminnow and Desert Pupfish Recovery Plans and Safe Harbor Agreement (Sowka 2000).

We found no formal environmental outreach programs at Arizona State University, University of Arizona (UA) or Northern Arizona University (NAU). Arizona Cooperative Fish and Wildlife Research Unit, of Arizona Cooperative Extension, is the public outreach branch of UA’s School of Natural Resources, College of Agriculture and Life Sciences, and it serves as a “statewide network of knowledgeable faculty and staff that provides lifelong educational programs for all Arizonans” (School of Renewable Natural Resources 2001). Their focus is to improve human lives by sharing research-based information, which

includes information about natural resources, fisheries and wildlife; however, they do not currently have any formal native Arizona fish educational programs (S. Bonar and W. Matter, pers. comm.). NAU's Merriam-Powell Center for Environmental Research is that institution's public education and outreach facility; however, they have no formal native Arizona fish programs (S. Sommer, pers. comm.). Also at NAU, at their Science and Mathematics Learning Center, they participate in the Full Option Science System (FOSS), which is a research-based science curriculum for grades K–8 developed at the Lawrence Hall of Science, University of California at Berkeley ("What is FOSS?" 2007). One of the programs available to area schools is titled "Goldfish and Guppies," which presents native Arizona fish along with other fish information (Northern Arizona University 2001).

We used the AAEE website mentioned above and found the following federal programs: Bureau of Land Management (BLM), Arizona State Office (no programs found on website); Cabeza Prieta National Wildlife Refuge (NWR), U.S. Fish & Wildlife Service (FWS; no programs found on website); Imperial NWR, FWS (no programs found on website, however they have native Arizona fish on-site and posted material; H. Cyprian, pers. comm.); San Bernardino/Leslie Canyon NWR, FWS (no programs found on website, however they have native Arizona fish on-site and printed material; C. Lohrengel, pers. comm.); Cibola NWR, FWS (no programs found on website; native Arizona fish and posted information are located in visitor center; B. Seese, pers. comm.). At the Carl Hayden Visitor Center, Glen Canyon Dam National Recreation Area, there is an endangered fish aquarium and posted material (National Park Service 2006), and at U.S. Geological Survey's Grand Canyon Monitoring and Research Center in Flagstaff there is posted information, but no formal native Arizona fish public outreach (M. Andersen, pers. comm.). BLM created a Junior Ranger booklet, which presents activities about the Gila Box Riparian National Conservation Area (GBRNCA), near Safford and are most appropriate for children between the ages of 8-12 years old (H. Blasius, pers. comm.). The booklets are available at the GBRNCA and upon request.

Federal employees will visit schools and provide program information upon request. The FWS and National Park Service (NPS) work with Page High School whereby students grow native Arizona fish at a local golf course for release into waterways that route into Lake Powell (UA 2007). FWS and its Arizona Ecological Services Office teamed-up with Thunderbird High School in Phoenix to introduce city public high school students to the Endangered Species Act and Arizona's threatened, endangered, and sensitive species, which included native Arizona fish (FWS 2007). The Grand Canyon Field Institute [Grand Canyon Association (GCA) in partnership and sponsored by the NPS] provide a Travelin' Trunk program, which includes one lesson on Colorado River ecology and does mention native Arizona fish although the program is directed at fourth through eighth grade. This program costs \$20 for trunk shipment. For undisclosed fees, the GCA will provide information for any visiting grade level although it is unclear if they discuss native Arizona fish. FWS's Arizona Fish and Wildlife Conservation Office in

Pinetop offers several programs, "Biologist in Training," "Roundtail in the Classroom" and "Native Fish Bingo" and coloring sheets (J. Johnson, pers. comm.).

Overall we found that native fish education in Arizona is generally passive (e.g., fish on-site with or without posted signage), fee-based, or web-oriented only with links or downloadable materials in PDF format. We found several programs have fallen by the wayside since 2008 and only a few programs are available without a fee that may meet Arizona Department of Education - Standards Based Teaching and Learning for Science (e.g., AZGFD classroom programs), but whether schools are aware of these programs or if these programs advertise themselves to schools is unknown. Other programs also limit their outreach to their immediate geographic areas.

An environmental education program should provide learners with positive information about the value of the natural environment (Neill 2006), and our goal was the same for our native Arizona fish program. We also had a specific, receptive audience in mind – Arizona's public elementary schools' kindergarteners. Kindergarteners are an amazing group of four-to-six year olds who are inherently curious about their environment (Duschl et al. 2007; Harlan and Rivkin 2004; Ward 1983), and who are always ready with countless "why" questions (Swift and Rather 1964). They routinely use cause and effect to understand their world (Dushel et al. 2007), enjoy learning science (Howe 2002), and are open to new ideas that will be long lasting in their emotional development (Rivas and Owens 1999). The Phoenix Zoo does not teach kindergarteners about endangered species because they found it is not "an effective program for this age group" (Phoenix Zoo 2006), but we believe otherwise, as do others (Bryant and Hungerford 1977, Rivas and Owens 1999, Norhagen 2010). We believed that Sharing Tails® would be a unique, successful program that would fulfill a desperate need for a proactive, free statewide program to teach children about native Arizona fish, and three years of program implementation proved us right.

Methods

We designed a state-wide, proactive, and free program that would primarily reach out to kindergarteners in Arizona's public elementary schools over the course of three years. As Year One students matriculated to first and second grades, we visited a percentage of these students each year in order to assess our program effectiveness and retention over time (Table 1). During years Two and Three we continued to visit new kindergarteners and first graders. For site visits, Year One included school days from January 1, 2009 through December 2009, Year Two included school days from August 1, 2009 through May 31, 2010, and Year Three included school days from August 1, 2010 through May 31, 2011. School days overlapped for years One and Two, so schools visited twice in Year One were not counted twice in Year One; rather the second visit counted towards Year Two.

We gathered district and school data from ADE's website, <http://www.ade.az.gov/edd/>, input it into a Microsoft Office® Access database, then found there were 164 districts/governing boards and 832 elementary schools with kindergarten programs (Table 2) with more than 85,000 children enrolled in the state (October FY 2007; ADE 2007a). We could not visit this many schools and students in a single year's time so we proposed to randomly select schools. Our grant limited us to visiting schools only in the Phoenix metropolitan area during Year One so we determined which districts and schools were in this area and generally in proximity to our offices (i.e., travel time not more than one hour one way) and which schools were not, deemed "metro" and "outer" schools, respectively. We determined 38 districts in the area and randomly selected 200 elementary schools with kindergarten programs (Table 2). Within this group of randomly ordered schools, we included schools into the Sharing Tails® program until we met our target number of 10,000 students for Year One, which was approximately 50 schools from 28 districts throughout spring and fall semesters of 2009; ten districts were targeted and not randomly chosen.

Once we completed our selection process, we planned to gain school access by first contacting district offices. Our initial contact began November 2008 when we mailed our program information to district superintendents. Three districts immediately declined our program, which accounted for 12 schools and approximately 1,071 students, so we added in four more randomly chosen districts and included five of their schools which accounted for 553 students. Ten schools from four districts we did not randomly select asked to receive our program ($N=880$ students), which included one preschool class. Many districts did not respond to our program information, while others forwarded the information directly to either all schools in their districts or to the randomly chosen schools. We found through follow-up telephone calls to superintendent offices that many districts have Curriculum Specialists, Directors of Curriculum, or similar specialists to whom we were redirected via telephone, email, or postal mail. Many of these professionals did not respond to our program information, while others asked to review our materials, which we provided. Some of these professionals followed-up with us, others did not. Next we proceeded directly to individual school principals either via telephone, email or postal mail. One immediately declined our program while another accepted our materials, but declined a presentation. Many of these professionals did not respond and we proceeded directly to kindergarten team leaders either via telephone, email or postal mail. Two accepted our materials, but declined our site visit.

With the challenges reported above regarding contacting districts and principals as well as not receiving enough interest from randomly chosen schools only, we opted to contact kindergarten team leaders directly during the latter six months of Year One (now school year 2009-2010) and open up scheduling Sharing Tails® to all public elementary districts and their schools in the Phoenix metropolitan area. In July 2009, we contacted team leaders from school year 2008-2009 ($N=40$ schools, students would count towards Year Two's target goals) via mailed letter and email for the first opportunity to schedule our

program. At the same time, we contacted first grade team leaders at these same schools via mailed letter to solicit interest for our program. We mailed letters in late August 2009 to the remaining schools' kindergarten team leaders in the Phoenix metropolitan area ($N=339$ schools) and followed-up via email ($N=191$) or fax ($N=69$) with any school that did not respond to our letters. We were unable to reach five schools via either email or fax and we did not pursue any other contact method. In December 2009, we mailed our letter with Sharing Tails® flier to the kindergarten team leaders at the remaining public schools throughout Arizona ($N=388$ schools in 126 districts). Sixteen letters were returned due to insufficient addresses and those addresses were corrected for future mailings. In August 2010 (for Year Three), we sent postcards to grade-level team leaders at all public schools around Arizona (approximately 700 postcards; schools who previously scheduled Sharing Tails® were contacted directly via email). Less than 10 post cards were returned for insufficient addresses. We corrected addresses then sent new postcards out again. We had several returned emails with insufficient addresses. We researched alternative team leader contacts at the schools and emailed them accordingly.

We initially thought to obtain security clearances as necessary or required by Federal, State and local governments. In Year One, three school districts required security background checks, which included fingerprints. We did not follow up at the district level as the schools from two of these districts allowed us on campus without renewing our security clearance. All schools independently required we sign in as visitors or volunteers at school offices and wear badges. In Year Two, we no longer attempted any *a priori* security background checks, instead we complied with schools that independently required we sign in as visitors or volunteers at school offices and wear badges. This was the same for Year Three. We also wanted faculty, staff, students and volunteers to recognize us from year to year so we developed a simple uniform of a long-sleeved blue knit shirt embroidered with the Sharing Tails® logo ("Sharing Tails®: Teaching Children about Native Arizona Fish"), Marsh & Associates, LLC name and outline of a razorback sucker, khaki-colored outdoor field pants and hiking boots. We maintained this uniform for years Two and Three. For first and second grade presentations we also wore a white lab coat.

Environmental education is not taught as a stand-alone subject in Arizona schools, rather ADE determines scientific academic standards for students, which are then used by individual districts or governing boards to create curricula to meet those standards (K. Bravo, pers. comm.). ADE does not endorse or approve specific courses of study, but instead individual districts or governing boards generally have a committee that reviews instructional programs, which include special programs such as Sharing Tails®. With Arizona's Science Standards per grade level in hand (ADE 2007c; appendices 1-3), we created our program to meet several aspects of these standards using native Arizona fish:

Kindergarten

Strand 1: Concept 1 (PO2), Concept 2 (PO1), Concept 3 (PO1), Concept 4 (PO1)

Strand 2: Concept 1 (PO1)

Strand 3: Concept 2 (PO1)

Strand 4: Concept 1 (PO1, PO2), Concept 3 (PO1, PO2)

1st grade

Strand 1: All Concepts (all POs)

Strand 2: Concept 1 (PO1)

Strand 3: Concept 2 (PO2)

Strand 4: Concept 1-3 (all POs)

2nd grade

Strand 1: All Concepts (all POs)

Strand 2: Concept 1 (PO2), Concept 2 (PO1)

Strand 3: Concept 2 (PO3)

Strand 4: Concept 1 (all POs), Concept 2 (PO3)

We also ensured that our program continued to follow the Excellence in Environmental Education – Guidelines for Learning (Pre K-12) and specifically Strand 2.2 and the living environment, letter C – explain basic ways in which organisms are related to their environments and to other organisms, as outlined by North American Association for Environmental Education (North American Association for Environmental Education 2007). Care was given not to overburden our students, particularly kindergartners, with too many facts or too much depressing information (Harlan and Rivkin 2004). Instead, we focused on our main goal to promote native Arizona fish consciousness.

Our program was delivered through site visits using multi-media presentations with interactive play and hands-on activities, the way that children learn in their worlds (Howe 2002, Miller et al. 2009) although play in schools is becoming increasingly rare (Brown and Vaughn 2009). Neuman (1980) found that discovery play in simulated environments (e.g., creating an underwater environment in a classroom) led kindergartners to retain more factual and conceptual information longer. We created an underwater environment to simulate fresh water habitat around Arizona, which created an artificial, out-of-school setting that will emphasize a strong positive attitude and lasting values towards our natural aquatic environment (Howe and Disinger 1988), by using a Chauvet B550 Bubble King Effect bubble machine. With bubbles floating around most of the students, we would venture “underwater” at the beginning of each presentation with students using their “Fish Sticks” (described later in this report) or their arms to simulate swimming. We often spoke of how cold or fast the “water” moved as we safely landed on the

“bottom” of the river, stream or fish tank (depending on which grade-level presentation). To operate the multi-media presentations, we used a Dell Inspiron 1525 laptop computer with Windows® Vista to power two Microsoft PowerPoint® presentations, which ran simultaneously with the assistance of OfficeOne Animations 2.3, each through a NEC VT700 projector onto a six foot wide portable projector screen (appendices 4-9). Our presentations included photos, video, animations and cartoons. During the presentations, we interacted with students by asking questions related to the presentation then we would answer our own questions with what information we wanted to convey. We used life-sized fish models and replicas of fish body parts for demonstration. At the end of each presentation, we “surfaced,” then after question time, students accessed hands-on activities.

We determined target areas regarding native Arizona fish to direct our educational program. We chose six of the 36 native Arizona fish for Year One’s kindergarteners: desert pupfish, bonytail, razorback sucker, loach minnow (*Tiaroga cobitis*), Apache trout (*Oncorhynchus apache*) and Colorado squawfish or pikeminnow (*Ptychocheilus lucius*). We presented each fish species at least three times with photos and models and explained their value to our state. Some fish were used for counting, diagrammatic purposes and shown in video. At each site presentation and in an effort to meet several aspects of ADE’s Kindergarten Science Standards as reported above, we discussed fish habitat of Arizona fish including fresh water and moving vs. non-moving bodies of water, needs of living vs. non-living things, what is a scientist and how, what and where we do our work with fish in Arizona, which includes video and photos, and basic fish biology information. At the end of each presentation, we discussed why no live fish were part of the program, the endangered/protected status of the fishes presented, and we asked students to participate in their conservation by not releasing any of their pet fish into the wild. We also entertained questions if time and teachers allowed. The hands-on activity for kindergarteners was for each student to be measured or measure themselves against free-standing, life-sized Colorado pikeminnow models.

For Year Two’s kindergarten, we proceeded with what we reported above for Year One. For first graders, we chose four of the 36 native Arizona fish: Gila topminnow, humpback chub (*Gila cypha*), flannelmouth sucker (*Catostomus latipinnis*) and Yaqui catfish (*Ictalurus pricei*); we repeated/reinforced information about desert pupfish and razorback sucker. Similar to our kindergarten program, we presented each fish multiple times with photos and models and explained their value to our state, and some fish were used for addition (basic arithmetic), diagrammatic purposes and in video. We reviewed fish habitat of Arizona fish including fresh water and moving vs. non-moving bodies of water and needs of living vs. non-living things. In an effort to meet several aspects of ADE’s First Grade Science Standards as reported above, we presented similarities and differences between and among native Arizona fish, mildly identified stages of human life, presented similarities and differences between razorback sucker and Gila topminnow life cycles, and compared habitats of our fish around Arizona. At the end of each presentation, we discussed

why no live fish were part of the program, the endangered/protected status of the fishes presented, and we asked students to participate in their conservation by not releasing any of their pet fish into the wild. We also entertained questions if time and teachers allowed. The hands-on activities for first graders included touching plastic, closed jars of life-sized models of razorback sucker eggs and larvae, and viewing each with large plastic magnifying glasses, as well as life-sized models of razorback sucker juveniles and adults, and a free-standing, small (six foot) hoop net complete with suspended plush non-native fish. For the life cycle materials, we placed placards nearby with phase names and photos, and for the hoop net, we hung a labeled sign inside. We also wore a white lab coat over our uniform during our site visits so that we could “show and tell” students what a fish scientist may wear sometimes and possibly create scientist awareness in these younger students (Chambers 1983).

We continued to use the educational program and materials created and detailed for kindergarten and first grade as reported above for Year Three. For this year’s second graders, we re-presented all ten native Arizona fish taught in kindergarten and first grade: desert pupfish, loach minnow, Apache trout, bonytail, razorback sucker, Colorado squawfish or pikeminnow, Gila topminnow, humpback chub, flannelmouth sucker and Yaqui catfish. Similar to our other programs, we presented each fish multiple times with photos and models and explained their value to our state and some we used for diagrammatic purposes and in video. We reviewed fish habitat of native Arizona fish including fresh water and moving vs. non-moving bodies of water. In an effort to meet several aspects of the ADE’s Second Grade Science Standards as reported above, we presented why native Arizona fish were endangered, similarities and differences between and among native Arizona and non-native fish, mildly identified stages of human life cycle in order to present similarities and differences between native and non-native life cycles, compared and contrasted body parts of native Arizona and non-native fish and presented a conservation habitat-sharing solution to the co-existence of native Arizona and non-native fish in a manner not to promote one-sided, biased information (Schmidt 1996) that may incite non-native fish enthusiasts. At the end of each presentation, we discussed why no live fish were part of the program, the endangered/protected status of the fishes were presented and we asked students to participate in their conservation by not releasing any of their pet fish into the wild. We also entertained questions if time and teachers allowed. The hands-on activities for second graders included touching plastic, closed jars of marking tags [anchor, radio and passive integrated transponder (PIT)] with placards nearby with tag type, photo and information, and performing fish scientist work on non-native, 125 kHz PIT-tagged plush fish: weighing fish on kitchen scale, measuring fish on fish measuring board and scanning fish with 125 kHz hand-held scanner. We also wore a white lab coat over our uniform during our site visits so that we could increase scientist awareness in these students as some are now aware of what a scientist may look like (Chambers 1983).

We created many of our materials with Adobe® Photoshop® Elements 6, including adapted digital drawings of native Arizona fish artwork by Randy Babb. Teachers received some of these materials prior to our visit via mail and they included coloring sheets, craft projects, databooks, word searches (dependent upon grade level, appendices 10-12), program letter with program and activity instructions, teacher-assisted questionnaire for students, teacher survey, native Arizona fish coloring guide, native Arizona fish location guide and reading suggestions (appendices 13-15), self-addressed, stamped envelope and a black and white full copy of Minckley and Rinne's 1991 report, "Native fishes of arid lands: a dwindling resource of the desert Southwest." After each site visit, teachers received writing booklets, math puzzles, life cycle worksheets (dependent upon grade level, appendices 16-18) and native Arizona fish replicas (desert pupfish, loach minnow, Apache trout, bonytail, razorback sucker and Colorado pikeminnow, Appendix 19). These six inch replicas were produced especially for the Sharing Tails® program by Safari, Ltd., Miami Gardens, FL and Hong Kong China, through a creative and collaborative process with Marsh & Associates LLC. We distributed replicas with descriptive hang tags (i.e., tags attached to replicas, Appendix 20) in reusable, recycled material bags with the Sharing Tails® image logo imprint (Appendix 21).

To assess the effectiveness of our program, we provided teachers with teacher-assisted questionnaires for students in the pre-visit materials as reported above (appendices 13-15). At each grade level, we requested teachers ask students five questions before and after our presentation, tallying student responses each time. We provided teachers with stamped, self-addressed envelopes to return the questionnaires along with their personal feedback to our offices. Once in receipt of questionnaires, we totaled the number of responses to each question by before and after, then reviewed if the number of responses increased or decreased in the proper direction. For each "before" question per grade level where the responses went in the proper direction, we scored it as "yes" to our program's effectiveness. We scored it as a "no" to our program's effectiveness if both before and after responses went in the improper direction. We scored it as a "maybe" to our program's effectiveness if either before or after responses went in both the proper and improper directions. Questionnaires with incomplete responses were not included in analysis.

Results

Between January 1, 2009 and May 31, 2011, we provided our program to 33,285 students (111% of our target goal of 30,000 students) at 378 school visits (Table 3). These school calls included visiting the same facility more than once in a school year for multiple grade-levels programs. When we selected for unique school districts and schools by removing multiple grade level programs at same schools, we ultimately visited 71 districts (43%) and 182 schools (22%; Table 2). As Sharing Tails® continued from

year to year, the unique number of schools visited in the metro area increased while the number in the outer area remained relatively unchanged, but both areas represented a range of 12-18% of the total number of schools in each area by year overall (Table 2). Alternately, the unique number of districts visited in the metro area remained steady while the number in the outer area increased. The metro area's unique school districts visited represented a range of 63-68% of the total number of schools in each area by year overall, while the outer area's unique school districts visited represented a range of 26-33% of the total number of schools in each area by year overall.

In years Two and Three we exceeded our program's target goal of 10,000 students per year by 23% and 51%, respectively, while in Year one, we only met 59% of our yearly target (Table 1). Our program exceeded the % total target goal by grade level for both kindergarten and first grade, by 20% and 9%, respectively; however, we only met 34% of our second grade target (Table 3). A majority of our school visits were in the Phoenix metropolitan area (248 schools, 66% of schools visited) accounting for 73% of students ($N=24,216$) receiving our program (Table 3).

Of 1,467 teachers who participated in our program, we received 584 questionnaires (40%) of which only 67% ($N=393$) were available for evaluation due to incomplete responses (i.e., only before questions answered, only after questions answered, any blank questions; Table 4a). We generally received more questionnaires from kindergarten teachers than any other grade, but once we eliminated incomplete questionnaires, the percent of questionnaires used for reporting between grade levels was relatively the same (range 54-81%). The difference between the number of student responses before and after our presentation was less than 10% (range 0 to 8%), which meant that we basically had an even number of responses before and after (Table 4b). By reviewing the number of responses increased or decreased in the proper direction by question, we found that we were probably effective on most questions most years (Table 4c.) For kindergarten, we were ineffective in years One and Two on Question 3 (do fish have noses?), for first grade in years Two and Three we were ineffective on Question 4 (do baby fish look like their parents?), and for second grade we were ineffective for Question 5 (should we protect Arizona's native fish from disappearing forever?). Our results were very unofficial and definitely could have been affected by some abnormalities as some questionnaires looked like the tally marks were placed in the incorrect spaces, that some teachers may have filled in the questionnaires without administering them to students, and the difference in the total number of students before and after could be related to student absenteeism.

Year One site visits were limited to the Phoenix metro area and they began January 2009 (2008-2009 school year) and continued through the 2009-2010 school year until December 31, 2009. We visited 5,863 students (59% of our target goal of 10,000 kindergarteners) at 59 schools (Table 3) in 24 districts

(Table 2). Three schools received materials in the mail, but did not participate with site visits. Five schools asked for two separate presentations for their kindergarten classes. One school initiated contact with us, but did not follow-up to schedule a site visit. Approximately 260 teachers participated in our program and 109 (42%) remitted the teacher-assisted student questionnaire, however only 59 questionnaires (54%) were complete (Table 4a). The difference between the number of students participating in the questionnaire before and after was negligible (range 1-3%; Table 4b). We were effective in our teaching with all questions with the exception of Question 3 (do fish have noses?; Table 4c). Teacher feedback was positive and constructive (Appendix 22). Constructive comments included such remarks as lengthening or shortening the presentation, increasing instructor movement during presentation, increasing child participation, increasing use of “Fish Sticks” for identifying fish parts, using a “sh” sound and pattern with vocalizations between instructor and children, splitting group size into smaller groups and giving multiple presentations per school, and include tactile items. All of these suggestions were appreciated and many were incorporated where possible. Two kindergarten teams who received our first-year presentation opted out of receiving further information and scheduling our program again, although their teacher surveys from Year One were positive.

Site visits in Year Two began with the 2009-2010 school start in August 2009. This year we traveled throughout Arizona and our program reached 128 unique schools (79 metro and 49 outer schools) and 12,269 students total (Tables 1 and 2). The total number of students visited was 23% greater than our target number of students. This year we visited 10,730 kindergarteners (43% greater than target) and 1,539 first graders (39% less than target; Table 3). Nineteen schools asked for multiple presentations for their grade-level classes for a total of 192 total presentations for Year Two. Thirteen schools initiated contact with us, but did not follow-up to schedule a site visit, one school canceled after receiving materials and twelve schools were turned down as we did not have any available dates. One school chose to have combination class presentations (e.g., kindergarten and first grade at a kindergarten presentation). Approximately 484 kindergarten and 67 first grade teachers (551 teachers total) participated in our program and 233 (42%) remitted the teacher-assisted student questionnaire with 162 questionnaires (69%) actually completed (Tables 4a and 4d). The difference between the number of students participating in the questionnaire before and after was negligible (range 0-6%; Table 4b). We were effective in our teaching with all questions with the exception of Question 3 (do fish have noses?) in kindergarten and Question 4 (do baby fish look like their parents?) in first grade (Table 4c). Teacher feedback on the program in Year Two was positive and constructive (Appendices 22 and 23). Constructive comments included such remarks as lengthening or shortening the presentation, increase description of habitat terms (e.g., pond, pool and lake), increase size of coloring guides, splitting group size into smaller groups and giving multiple presentations per school, and including music. All of these suggestions were appreciated and incorporated wherever possible.

As in Year Two, site visits in Year Three began with the 2010-2011 with school starting in August 2010. This year we again traveled throughout Arizona and our program reached 128 unique schools (80 metro and 48 outer schools) and 15,153 students total (Tables 1 and 2). The total number of students visited was 51% greater than our target number of students. This year we visited 10,380 kindergarteners (108% greater than target), 3,925 first graders (57% greater than target) and 818 second graders (66% less than target; Table 3). Thirty-seven team leaders asked for multiple presentations per their grade-level for a total of 236 total presentations for Year Three. Sixteen schools initiated contact with us, but did not follow-up to schedule site visits and one school was turned down as we did not have any available dates. Fourteen schools invited either pre-kindergarten or Special Education classes to presentations, or chose to have combination class presentations such as reported above. Approximately 458 kindergarten, 163 first grade, and 35 second grade teachers participated in our program (656 teachers total) and remitted 242 (37%) teacher-assisted student questionnaire with 172 questionnaires (71%) completed (Tables 4a and 4d). The difference between the number of students participating in the questionnaire before and after was negligible (range 0-8%; Table 4b). We were effective for all questions except Question 5 (should we protect Arizona's native fish from disappearing forever?; Table 4c). For second graders we were not as much ineffective on this question as most (103 out of 105 students, 98%) responded that we should protect Arizona's native fish from disappearing forever prior to our visit. Teacher feedback on the program in Year Three was positive and constructive (Appendices 22-24). Constructive comments included such remarks as splitting group size into smaller groups, providing more "hands-on time" at the end of presentations, and presenting more fish video. All of these suggestions were appreciated and incorporated wherever possible.

We strove for flexibility and in years Two and Three we allowed for some exceptions (e.g., providing our presentation to first and second graders who did not benefit from our kindergarten program) due to requests of the team leaders and their class sizes and locations around Arizona. This accounted for the high number of second graders in outer areas receiving our program in Year Three (Table 1). It was expected that as our program continued we would see an increase in the number of schools in the outer areas participating (Table 3).

Also as part of our program, we created a native Arizona fish counting book appropriate for kindergarten through second grade and self-published it www.blurb.com. The book can be located at permalink, <http://www.blurb.com/bookstore/detail/2102603> and purchased at the publisher's current 2011 prices of \$27.43, \$41.18 and \$42.43 for bound softcover, hardcover with dustjacket or hardcover with ImageWrap, respectively. We sent a weblink to the book to the teachers via email who participated in Sharing Tails®

as well as an email announcement to the lower Colorado River list server. Both of these communications generated positive responses.

We also received substantial positive feedback when we presented our program at the most recent Colorado River Aquatic Biologists meeting in Laughlin, NV (January 2011, http://www.lcrmscp.gov/CRAB/presentations/2011/teach_child_az_fish.pdf), and we will be presenting it again in September at the American Fisheries Society meeting in Seattle, WA at a special environmental education symposium. Because of the uniqueness of our program, we were selected to give a full 15 minute oral presentation while many others were relegated to either short oral (four minute) and/or poster presentations. We also have a manuscript draft in progress for submission to the Journal of Environmental Education.

Based on our annual and grade level numbers of students as well as teacher and student feedback, we believe from our results that Sharing Tails® is a unique and successful program that fulfilled a desperate need for a proactive, free statewide program to teach children about native Arizona fish. Brewer (2002) suggested there are at least five elements to a successful outreach program, and here we evaluate how, and how well, Sharing Tails fulfilled each element. First, with a successful program, *participants need to experience the wonder of science in addition to factual information*. We made every attempt to excite the students about native fish, from blowing bubbles, creating “Fish Sticks”, pretending to go underwater, presenting large and coloring photos and cartoons, animating information delivery and representing with life-sized fish models and fish replicas. Based on the interaction with students at the site visits from year to year and teachers’ comments, we believe we met this element splendidly. Second, *collaboration with teachers is critical because they support their students throughout the outreach or research partnership program and provide valuable assistance in preparing students for the program*. We definitely worked with teachers, from making our program as available as possible, everyday of the week at anytime, including making allowances for AM and PM kindergarten, multiple presentations per class per site visit and presentation sites. We provided materials or changed materials as we could per teacher suggestions (e.g., fish coloring guides). Third, *scientists need guidance on how to make the experience successful for the participants and themselves*. We successfully completed this element by providing and receiving teacher comment surveys. And based in part to working directly with teachers, we also incorporated into our program many aspects to provide for students’ varying learning abilities. For each grade level, our program was well-timed and short (30-45 min) with constant instructor movement and voice inflection. We encouraged audience participation, group work with pre-visit materials, and provided hands-on activities that mimicked real fish science work. We also encouraged critical thinking in students by asking teachers to give the teacher-assisted questionnaire to students prior to our presentation. Then during our presentation we would review the exact same material in hopes students would retain it for the post-visit

questionnaire time. Fourth, *training of participants is vital to the success of outreach and partnership programs*. This element relates to data collection, which as a whole was not part of our program. The only data collected were for our use only and were in the form of the teacher-assisted student questionnaire. We received 40% of questionnaires from participating teachers; however, 67% were used for reporting (Table 4a). This may or may not have been a decent return rate, we do not know. And finally, *successful programs incorporate some form of program assessment*. We were successful with this final element as every teacher that participated ($N=1,467$) received a survey form and a stamped, self-addressed envelope.

Any minor issues encountered during the Sharing Tails® program were successfully confronted and resolved in a timely manor. No major issues were encountered as the program progressed smoothly towards its timely, successful completion and fulfillment of all stated goals and requirements. There were no failures of the program. Year One targets were less than expected (Table 1); however, we spent half this year creating the program and it was a new program, possibly making teachers somewhat wary. We also did considerable contacting and re-contacting in Year Two either via email, phone, fax or mail, which led to the exceptional numbers of kindergarteners and first graders (Table 3). Our program seems to lag a year behind such that we did not meet our target number of kindergarteners in Year One, but we did in Year Two. Similarly for first graders, we did not meet our target in Year Two, but we did in Year Three. It is expected, had Sharing Tails received continued funding, we would have potentially met our second grade target in Year Four.

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Table 1. Percent target number of students and number of students expected to participate in Sharing Tails® by grade level during the three years of the program. Included are the actual numbers of students visited, percent of target number of students, and the number of unique schools (i.e., no schools with multiple grade level presentations included in number although we could have visited the same school in the following years) by Sharing Tails® year.

Sharing Tails year	% Target <i>N</i> students (target <i>N</i> students)			Total target <i>N</i> students	<i>N</i> students visited (% target <i>N</i> students)	Unique <i>N</i> schools visited
	K	1st	2nd			
One	100 (10,000)	-		10,000	5,863 (59)	59
Two	75 (7,500)	25 (2,500)	-	10,000	12,269 (123)	128
Three	50 (5,000)	25 (2,500)	25 (2,500)	10,000	15,153 (151)	128
Total	22,500	5,000	2,500	30,000	33,285 (111)	182

Table 2. Number of public elementary school districts and their schools with kindergarten programs located in the metro and outer areas of Arizona. Included are the numbers of unique districts and schools (i.e., no schools with multiple grade level presentations included in number although we could have visited the same school in the following years) by Sharing Tails® year.

Location	<i>N</i> Districts	<i>N</i> Schools	Sharing Tails year	Unique <i>N</i> districts visited (% <i>N</i> districts)	Unique <i>N</i> schools visited (% <i>N</i> schools)
Metro	38	443	One	24 (63)	59 (13)
			Two	26 (68)	79 (18)
			Three	24 (63)	80 (18)
			Total	30 (79)	120 (27)
Outer	126	389	Two	33 (26)	49 (13)
			Three	36 (29)	48 (12)
			Total	41 (33)	63 (16)
Total	164	832		71 (43)	182 (22)

Table 3. Summary of number of schools and students visited in the metro and outer areas by grade level and Sharing Tails® year. Included is the percent target number of students based on total number of students visited. These school visits included visiting the same school more than once in a school year for multiple grade-levels programs.

Grade	Sharing Tails year	N schools visted (% total)			N students visited (% total)		
		Metro	Outer	Total	Metro	Outer	Total (% target N Students)
K	One	59 (100)	0	59	5,863 (100)	0	5,863 (59)
	Two	74 (60)	49 (40)	123	7,153 (67)	3,577 (33)	10,730 (143)
	Three	76 (63)	45 (37)	121	7,253 (70)	3,127 (30)	10380 (208)
	Total	209 (69)	94 (31)	303	20,369 (75)	6,704 (25)	26,973 (120)
1	Two	14 (93)	1 (7)	15	1,489 (97)	50 (3)	1,539 (61)
	Three	23 (49)	24 (51)	47	2,271 (58)	1,654 (42)	3925 (157)
	Total	37 (60)	25 (40)	62	3,760 (69)	3,193 (31)	5,464 (109)
	Three	2 (15)	11 (85)	13	187 (22)	661 (78)	848 (34)
	Grand total	248 (66)	130 (34)	378	24,216 (73)	9,069 (27)	33,285 (111)

Table 4a. Number of teachers who participated in Sharing Tails®, the number of teacher-assisted student questionnaires they returned and how many were used for reporting by grade level and Sharing Tails® year. Included are the percent total questionnaires returned and the percent of questionnaires returned and used for reporting.

Grade	Sharing Tails year	N Teachers	Questionnaires returned (% of total returned)	Questionnaires used for reporting (% of questionnaires returned and used for reporting)
K	One	260	109 (42)	59 (54)
	Two	484	216 (45)	150 (69)
	Three	458	192 (42)	132 (69)
	Total	1,202	517 (43)	341 (66)
1	Two	67	17 (25)	12 (71)
	Three	163	43 (26)	35 (81)
	Total	230	60 (26)	47 (78)
2	Three	35	7 (20)	5 (71)
Grand total		1,467	584 (40)	393 (67)

Table 4c. Summary by grade level and Sharing Tails® year as to the effectiveness of our program by reviewing the student responses as presented in Table 4b to five questions in teacher-assisted student questionnaire. We reviewed each “before” question per grade level and where the responses went in the proper direction we then scored it as “yes” to our program’s effectiveness. We scored it as a “no” to our program’s effectiveness if both before and after responses went in the improper direction. Questionnaires with incomplete responses were not included in analysis. Questions are listed in Table 4b and appendices 13-15

Grade	Sharing Tails year	Was Sharing Tail effective?				
		Q1	Q2	Q3	Q4	Q5
K	One	Yes	Yes	No	Yes	Yes
	Two	Yes	Yes	No	Yes	Yes
	Three	Yes	Yes	Yes	Yes	Yes
1	Two	Yes	Yes	Yes	No	Yes
	Three	Yes	Yes	Yes	No	Yes
2	Three	Yes	Yes	Yes	Yes	No

Table 4d. Summary of teachers who participated in Sharing Tails®, the number of teacher-assisted student questionnaires they returned and how many were used for reporting by Sharing Tails® year. Included are the percent total questionnaires returned and the percent of questionnaires returned and used for reporting.

Sharing Tails year	N Teachers	Questionnaires returned (% of total returned)	Questionnaires used for reporting (% of questionnaires returned and used for reporting)
One	260	109 (42)	59 (54)
Two	551	233 (42)	162 (69)
Three	656	242 (37)	172 (71)
Total	1,467	584	393