Ash Meadows Wildlife Refuge

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Ash Meadows National Wildlife Refuge (Ash Meadows) is a rare desert oasis (Fraser and Martinez 2002) with more than 50 perennial seeps and springs. It is located approximately 128 kilometers northwest of Las Vegas, Nevada. Ash Meadows was established in 1984 to conserve threatened and endangered species, and their habitats. The Refuge contains the largest concentration of endemic species, in the United States and second greatest concentration in North America. Perhaps because of the large number of endemic species, the Nature Conservancy further distinguishes Ash Meadows as "One of the most important natural areas on the North American continent."

So what is else is special about Ash Meadows? From its stark desert mountains to its crystal blue waters and green oases, Ash Meadows is a land of contrast. After all, how many wildlife refuges do you know that are on the same tour circuit as a mine and a brothel? Believe it or not, brothels actually promoted themselves alongside Ash Meadows in Nevada magazine and these brothels are still our neighbors.

Beyond the brothels, the Refuge is unique in that it provides designated critical habitat for seven threatened and endangered plant species, one threatened aquatic insect, and four endangered fishes – all of which are endemic to the Ash Meadows area. Including migratory birds, there are a total of 14 threatened and endangered species that utilize Ash Meadows. The Refuge also provides habitat for around

Fig. 1.
The outflow of Fairbanks Springs, which is part of the Ash Meadows Refuge in Nevada. Restoration efforts are underway at the spring. This picture highlights the contrast between its life-giving waters and the desolate desert landscape that surrounds it.

Fig. 2.
Construction crews work to turn Carson Slough into a hotbed of desert development in the 1960s. The destrcution of the springs habitat allowed for the rampant spread of non-native species. These actions combined to extirpate many native species throughout the Refuge area.

100 species of plants and animals that are considered sensitive, or are state protected or priority species. In saving Ash Meadows, a whole suite of unique species and habitats were saved. The protection of Ash Meadows was accomplished by the early Desert Fishes Council members who, much like NANFA members, saw the value in our remarkable native fishes.

One of the largest remaining oases in the Mojave Desert, the 50-some seeps and springs within Ash Meadows produce almost 11,000 gallons of water per minute. This unique environment – the combination of a watered island in a sea of desert – and the large number of endemic and relict species led, in 1986, to Ash Meadows being one of the first four wetlands in the United States to be designated a "Wetland of International Importance" by the Ramsar Convention. This in itself is remarkable, but what is truly amazing about this Refuge is that it exists at all, especially considering the past utilization of Ash Meadows's resources.

Among the many impacts to the area, perhaps the most pervasive is the alteration of hydrologic processes. The Carson Slough, the major artery of the Refuge and the receiving end of a 385-square mile hydrologic basin, was drained and mined for peat in the early 1960s. The wetland was leveled, tilled and converted to farm fields, and the numerous springs feeding into the Slough were diverted into irrigation ditches (Fig. 2). Also, at least one of the springs in Ash Meadows, Jackrabbit, was pumped completely dry, extirpating the Ash Meadows Amargosa Pupfish (*Cyprinodon nevadensis mionectes*) (Fig. 3) and the Ash Meadows Speckled Dace (*Rhinichthys osculus nevadensis*) (Fig. 4). populations in that system.

Another major issue that impacts restoration and nearly every project on the Refuge is the presence of invasive species. Since 2007, the Refuge has documented 64 non-native and pest plants, 13 of which are priority weed species. One of the many impacts of exotic vegetation is its effect on the fire regime, and in turn, potential impacts to our endangered fishes.

Eleven species of non-native fishes and invertebrates have been documented on the Refuge since 2008. Most of these invasive fishes were introduced prior to Refuge establishment, but others such as

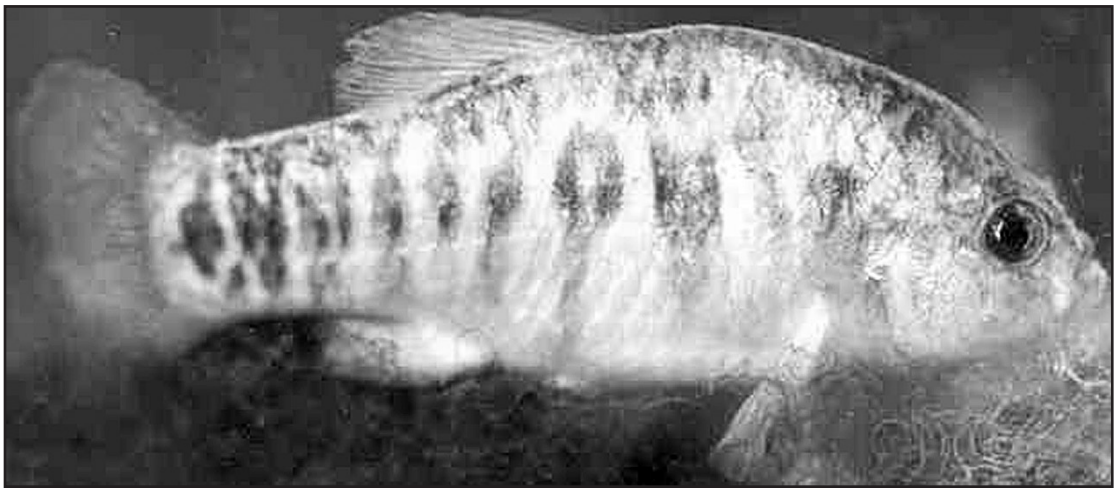

Fig. 3.
The Ash Meadows Amargosa Pupfish: another subspecies endemic to Ash Meadows.

Convict Cichlid (*Archocentrus nigrofasciatus*) have been introduced more recently as abandoned aquarium pets. Non-native fishes and invertebrates negatively impact the aquatic ecosystem; some compete with pupfish and dace for limited resources, and others like Largemouth Bass (*Micropterus salmoides*), actually consume endangered fishes.

Unfortunately, the Ash Meadows Killifish (*Empetrichthys merriami*) and two other species (one springsnail and one vole), all endemic, were extinct by the time the Refuge was established. Although establishment of Ash Meadows stopped the outright destruction of habitat and the loss of already documented endemic species, it did not guarantee the survival of endemic species. With no funding for restoration or recovery, it would be another 13 years after the Refuge was established before the first serious effort to return one of the degraded springbrooks to a semblance of its pre-disturbance condition occurred.

Fighting Back!

As recently as the 1970s, there had been springs numbering in the teens at the base of the Point of Rocks ridgeline, but they were dug up to create large ponds, where the private land owner at the time proposed to develop the Calvada Lakes housing development. In 1997, Kings Pool and approximately one-half mile of stream channel

Fig. 4.
The Ash Meadows Speckled Dace, an endemic subspcecies that inhabits the Refuge.

Fig 5.
The restored Fairbanks Springs: an oases that serves as critical habitat for Refuge wildlife.
The grayscale image does not do justice to its verdant character.

were restored, followed in 2000 with the restoration of the Point of Rocks (Fig. 5). Prior to the restoration of Kings Pool, endangered pupfish were in the minority; non-native Largemouth Bass, Sailfin Molly (*Poecilia latipinna*), Western Mosquitofish (*Gambusia affinis*), and Red Swamp Crayfish (*Procambarus clarkii*) far outnumbered native fish. Restoration of Kings Pool was accomplished by eradicating Largemouth Bass and filling in the unnatural ponds, the latter of which increased the water temperature favoring the native pupfish. Following restoration, pupfish regained dominance in the system and are the most abundant. These restoration projects were incredibly successful; however, it was realized the Refuge needed an overall plan for conducting and prioritizing successful restoration projects in the Refuge.

In 2005, a Geomorphic and Biological Assessment was completed to set priorities and guide restoration activities in the Refuge. Since that Assessment was completed, the Refuge has acquired LIDAR data as a means to obtain detailed elevation data that can be used to determine the existing gradient throughout the Refuge. One of the advantages of LIDAR is that it is capable of mapping bare earth in vegetated areas. Barriers to the natural hydrology dating from the agricultural period such as berms, levees, and ditches – which many not be obvious because of vegetation overgrowth – become evident under LIDAR scrutiny. The Assessment also identified studies that would be needed to determine what might be impacted during major restoration activities and provided guidelines to evaluate restoration success. Everything from using palynology to determine "historic" vegetation to baseline inventories such as a refuge-wide archeological

survey, were completed. Also, microbial studies are in progress to help management understand the communities in our springs, not only as the base of the food chain, but for what it can tell us about water quality and spring connectivity. All of these studies and many more are being used to inform management and guide current and future restoration projects.

Armed with new technology and the information provided by the Assessment, the Refuge continues to work on restoration projects of varying scales to recover species and habitats. From the 1997 restoration of Kings Pool management learned that it was possible to restore habitats which favor native fish species over non-native ones. Similar to that restoration, the Refuge continues to eradicate non-native aquatic species before restoring hydrology, using as many integrated pest management tools as possible. Since 2008, the Refuge has successfully eradicated 11 isolated populations of non-native aquatic fishes and invertebrates, which has allowed hydrologic restoration to move forward.

Currently, the Refuge is working on two restoration projects of differing scales and complexities. Our largest undertaking to date is taking place in the Upper Carson Slough management unit and includes the restoration of Fairbanks and Soda springs. Before restoration began, all the water from these two springs was in agricultural-era irrigation ditches. Restoration activities began in 2008, when a non-native Convict Ccichlid population first discovered by the Desert Springs Action Committee in 2005, was successfully eradicated from Fairbanks Spring (Fig. 5). In 2010, after more than a year of planning and design evaluation, hydrologic restoration of Fairbanks and Soda springs began. Phase I included the restoration of Soda Spring and the upper two miles of Fairbanks outflow channel and was completed in April 2010 (Fig. 1). Following completion of Phase 1, speckled dace were repatriated into Fairbanks outflow (dace were last documented in Fairbanks Spring in the 1950s). Recent monitoring suggests their population has more than doubled in the last eight months since they were repatriated, which is a positive sign. Phase II of the restoration includes the lower two miles of Fairbanks, Rogers, and Longstreet outflows as they flow into Peterson Reservoir and is nearly complete. Despite recent floods in December 2010 with estimated surface flows of 1,500 CFS, the restored outflow channels only had limited damage.

The second restoration project currently in progress on the Refuge is located in a different management unit known as the Warm Springs Complex (WSC); which is the only location where the endangered Warm Springs Pupfish (Cyprinodon nevadensis pectoralis) occurs. The WSC contains six low-discharge warm spring systems with individual flows ranging from 1.13 x 10-4 to 1.98 x 10-4 cubic meters per second and spring-source water temperatures ranging from 28^{O} to 33.5^{O} C year round. Among these six springs are North and South Indian springs.

The Warm Springs pupfish population at South Indian Spring was extirpated in 2005 (possibly due to the presence of invasive species) and the North Indian Spring population was estimated to be less than 100 individual fish. Additionally, once present endemic invertebrates such as the Warm Springs Naucorid (Ambrysus relictus) also were extirpated. Restoration began in 2009 at North and South Indian springs with the attempted eradication of Western Mosquitofish and Red Swamp Crayfish by means of desiccation. Prior to restoration activities, Warm Springs Pupfish were salvaged from the site. Recent monitoring has indicated that both Western Mosquitofish and Red Swamp Crayfish have been eradicated from both North and South Indian springs. Restoration will continue in 2011 with the construction of new outflow channels in hopes of improving habitat for Warm Springs Pupfish and the endemic aquatic invertebrates. After construction activities are complete, the salvaged Warm Springs Pupfish will be returned and endemic aquatic invertebrates will be reintroduced.

What lies ahead?

The Refuge has been fortunate in having access to Southern Nevada Public Lands Management Act (SNPLMA) funding in the last few years to tackle the restoration projects previously mentioned. However, SNPLMA funding has pretty much dried up with the economic downturn. The unfortunate part of decreased funding is that it comes at a time when new potential threats to Devils Hole and Ash Meadows arise: multiple proposals for solar-thermal projects in the Amargosa Valley that may increase water drawdown and inappropriate development on the outskirts of the Refuge such as a

Fig 6.
The beauty of Point of Rock Springs is a hallmark of successfully completed restoration projects at Ash Meadows. The location is now more hospitable for all forms of biota, including those pesky bipedal apes.

proposed utility corridor running next to our south and west boundary, which would cut through the Carson Slough in the Ash Meadows Area of Critical Environmental Concern (ACEC) that surrounds the Refuge. Of course, the threats of continuing drought and climate change also threaten the recovery of the Ash Meadows ecosystem.

Healthy, functional wetlands are crucial if they are to survive climate change. Ash Meadows is a mighty small place in the grander scale of things, but many believe it is worth the efforts to protect it in light of these threats because of the potential to recover such a unique ecosystem. Because Ash Meadows is one of the most biologically diverse areas in the country, there is much to gain with conservation of this area and much to lose if we don't.

The restoration of springs and wetlands in Ash Meadows will continue to move forward, but with no long-term funding, will rely more on volunteers and a recently formed Friends group. Nevertheless, Refuge employees continue to develop educational programs, improve interpretation opportunities along new and old boardwalks, and hold volunteer events which help maintain restoration projects.

In October 2010, NANFA members volunteered 185 hours removing invasive Cattail (Typha domingensis) from Crystal Spring outflow, where a recent Green Sunfish (Lepomis cyanellus) invasion has decimated the pupfish population. Since the removal of invasive cattail, Refuge staff has been able to effectively set hoop nets to remove sunfish. Monitoring of the system is ongoing, but is possible and effective only because of volunteer events such as these.

If you would like additional information, would like to join the Desert National Wildlife Refuge Complex friends group, or would like to volunteer at Ash Meadows, please call 775-372-5435 or visit http://www.fws.gov/desertcomplex/ashmeadows/.