THE EFFECT OF A FLASH FLOOD ON THE SALT CREEK, RIVERSIDE COUNTY, POPULATION OF THE ENDANGERED DESERT PUPFISH, *Cyprinodon macularius*.

by

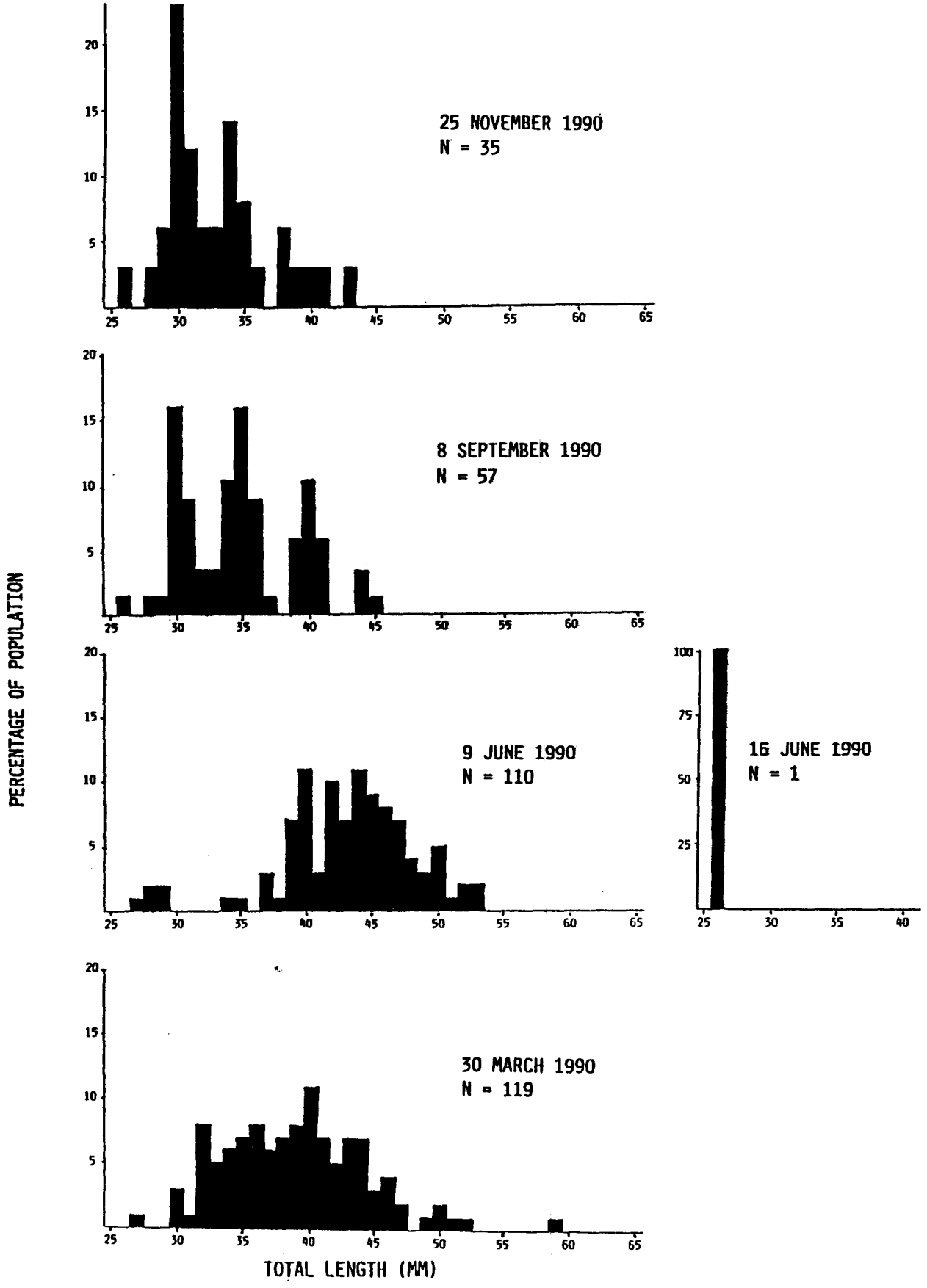
Allan A. Schoenherr
Fullerton College
321 East Chapman Avenue
Fullerton, CA 92634

During the 1990 fiscal year, quarterly visits to Salt Creek, Riverside County, were undertaken for the purpose of trapping and analyzing the populations of Desert Pupfish. In order to analyze population structure and breeding characteristics, length-frequency analysis of fish from each habitat was conducted. Aquatic animals collected in traps along with the pupfish also were recorded.

The most interesting information to arise from this study to date was the consequence of a flash flood on the population. On 9 June 1990, within a few hours of completing a survey, a flash flood occurred. Provisional data on stream flow for 9 June 1990 obtained from the Water Resources Division of the U.S. Geologic Survey office in San Diego indicated that on that day the flow at the mouth of Salt Creek went from a base of 0.9 cubic feet per second (CFS) at 1700 hrs. to 1,080 CFS by 2100 hrs. The flow did not return to normal until 13 June 1990, four days later. I returned to the area on 16 June 1990 to assess the effect of the flood. Only one pupfish was collected and the area had been stripped of submerged aquatic vegetation.

Figures 1 and 2 illustrate that two bits of "dogma" about

Figure 1. Length-frequency distribution for Desert Pupfish from Salt Creek during 1990.



floods seemed to be contradicted; that floods wash out small fishes, and that floods tend to wash out non-native species in favor of the native species.

Examination of the histograms for Salt Creek (Figure 1) reveal one of the outcomes or consequences of the flash flood. On 16 June, a week after the flood, only one small pupfish was trapped. In apparent contradiction to what flash floods have done in other desert situations, subsequent sampling revealed that the flood apparently had cleared larger pupfish from the habitat. John (1963, 1964) documented the outwash of small fishes due to flash floods and Harvey (1987) has noted that fish smaller than 10 mm TL are susceptible to downstream displacement. Furthermore, with respect to the Salt Creek Pupfish, *Cyprinodon salinus*, in Death Valley, Williams and Bolster (1989) by measuring dead fish stranded after a flash flood documented that no large fish were apparently washed out and no small fish remained in the area of permanent flow.

Secondly, by 16 June most of the non-native species and nearly all submerged vegetation had been cleared from the habitat. The next two samples, however, revealed a large number of non-native fishes that apparently had washed down from upstream near the Nature Conservancy's facility at Dos Palmas. Flooding is more likely to eradicate non-native fishes, while leaving native forms to prosper in the aftermath (Meffee, 1984; Minckley, 1973; Schoenherr, 1979). I know of no natural situation where a population of pupfish was eliminated by flooding, but the possibility cannot be ignored. Figure 2

Figure 2. Animals trapped in Salt Creek during 1990

NUMBERS OF INDIVIDUALS TRAPPED
(12 traps for 24 hours)

SPECIES	30 MARCH	9 JUNE	16 JUNE	8 SEPT.	24 Nov.
Cyprinodon macularius	119	110	1	57	35
Gambusia affinis	73	152		71	2
Poecilia latipinna		13	1	42	149
Tilapia zillii				7	3
Ictalurus natalis	2				
Procambarus sp.	36	13			
Macrobrachium sp.				1	

clearly shows that pupfish did not return to former numbers, but it also shows that a large number of non-native species had appeared, including three documented "enemies" of pupfish; Mosquitofish (*Gambusia affinis*), Sailfin Mollies (*Poecilia latipinna*), and Zill's Cichlids (*Tilapia zillii*). The latter species has been most seriously implicated in the demise of the Desert Pupfish (Schoenherr, 1981a; 1981b; 1988) and this is the first time that it has been discovered in this part of Salt Creek.

The result if the influx of non-native species will bear watching. It is possible that non-native fishes could be eliminated by low concentrations of dissolved oxygen during hot weather, or that low water temperatures during winter might particularly select against Zill's Cichlid. On 25 November, when the water temperature dropped to 10° C, large adult Zill's Cichlids were nearly moribund. I was able to reach into the water and pick one up in my hand. It was obviously in distress. Hopefully future samples will reveal that non-native fishes are diminishing in number.

The effect of the flood on submerged vegetation may have been devastating to the preferred habitat for the Desert Pupfish at Salt Creek. Prior to the flood the most favorable trapping sites were in association with mats of the filamentous pond weed (*Zannichellia palustris*). The nearly complete washout of that plant doubtless removed cover and spawning substrate from the habitat, the loss of which by itself would have a profound effect on the pupfish. Coupled with the introduction of all the

non-native species, loss of this important component of the habitat compounded the problem. After the flood, the Cyanobacterium (*Lygbya sp.*) became abundant. This photosynthetic organism forms thick mats intermingled with muddy substrate. In many locations this material becomes elevated, forming layers under which the pupfish could retreat. This habitat became a refuge in certain areas, but it is no protection from juvenile cichlids that also seem to seek the same cover.

The apparent similarity in the distribution of pupfish sizes after the flood is puzzling. There is no apparent indication of growth. It is possible that the small number of fish sampled caused a bias in the data. The appearance of small fish in both samples indicated that reproduction was occurring, but it is possible that the fish in the two samples were the offspring of a small number of breeding adults and recruitment had been relatively constant since the flood. Again, future sampling should reveal what becomes of the pupfish in Salt Creek.

Conclusion. The effect of a flash flood on the Salt Creek population showed that large fish were washed out and small fish repopulated thereafter. This observation contradicts previous observations indicating that floods wash out the small fish. It also became apparent that non-native fish were more common after the flood. In this case it appears that the fish were washed down from the upper parts of the Salt Creek drainage where the non-native species are known to occur. The appearance of Zill's Cichlid, *Tilapia zillii*, in pupfish habitat where it has not been reported before could be a serious threat to one of only two

"natural" populations of Desert Pupfish in California. This threat plus the specter of a toxic spill from the proposed "trash train" that would pass upstream within a few hundred meters of its habitat makes the Salt Creek population of Desert Pupfish worthy of constant monitoring.

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