

459 eggs, while two and three-year-old females averaged a 42% and 34% increase in mean relative fecundity over one-year-olds, respectively. Since populations are comprised primarily of one year olds, they often comprise 90% of the spawning population (Addley and Hardy, 1993).

Virgin spinedace are typically found in clear, cool, swift streams that have interspersed pools, runs, and riffles (Deacon et al., 1979; Valdez et al., 1991). Upper thermal preferences have been reported as 23.1°C (Deacon et al., 1987). Rinne (1971) found Virgin spinedace most frequently in pools with some type of protection such as undercut banks, boulders or debris; however, variations in habitat preferences have been noted. For example, in Beaver Dam Wash, Virgin spinedace utilize narrow, shallow runs with large amounts of emergent vegetation, while in North Fork of the Virgin River, they most often occupy quiet pools (Rinne, 1971). Virgin spinedace have also been documented to prefer shear zones between high (100 cm/sec) and low (10 cm/sec) velocities containing cover (Deacon et al., 1979; Deacon et al., 1991; Hardy et al., 1989). Nursery habitat preferences, however, remain unclear.

Virgin spinedace are primarily insectivorous, feeding on a wide range of insects and occasionally plant material and organic debris (Angradi et al., 1991; Gregor and Deacon, 1988; Rinne, 1971). Virgin spinedace feed on drifting prey in midwater and at the surface. Usually they maintain equilibrium in the midwater column darting to the surface to capture prey in a manner similar to drift-feeding salmonids (Addley and Hardy, 1993; Rinne, 1971).

#### *Historic Distribution*

The historic distribution of the Virgin spinedace is not well documented. Holden (1977) speculated that historic occurrence was in most of the clearwater tributaries and several mainstem reaches of southwestern Utah, northwestern Arizona, and southeastern Nevada (Figure 1). Museum records from the University of Nevada at Las Vegas, Brigham Young University, University of Michigan Museum of Zoology, and the United States National Museum support Holden (Addley and Hardy, 1993; Cross 1975; Rinne, 1971; Valdez et al., 1991). The earliest survey records indicated this species was common in the Santa Clara River and North Fork of the Virgin River, but probably less common in the Virgin (Tanner (1932, 1936). C.L. Hubbs (unpub. data) collected Virgin spinedace near Bunkerville, Nevada, in 1938, but surveys in 1942 in the same area lacked Virgin spinedace (Cross, 1975). Furthermore, the species was absent from surveys below Littlefield, Arizona between 1942 and 1975 (Cross 1975).