

BULLFROG PREDATION ON A JUVENILE COHO SALMON IN HUMBOLDT COUNTY, CALIFORNIA

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The American Bullfrog (*Lithobates catesbeianus*, formerly *Rana catesbeiana*; hereafter Bullfrog) is the largest ranid frog in North America, and is native to the eastern part of the continent east of the Rocky Mountains (Stebbins 2003). Bullfrogs were first introduced to California in 1896 (Jennings and Hayes 1985) and have since become a widespread aquatic invasive species throughout much of western United States and southwestern Canada. Bullfrogs are voracious, opportunistic predators and competitors where they have been introduced or spread (see review in Casper and Hendricks 2005). For example, Bullfrogs have been implicated in the decline of several native western ranid frogs through predation and competition (Moyle 1973; Kupferburg 1997; Rosen and Schwalbe 2002; Pearl and others 2004). Here we report an observation of an adult Bullfrog consuming a juvenile Coho Salmon (*Onchorynchus kisutch*) in a small coastal California stream.

On 3 May 2009 at 09:30, we captured an adult female Bullfrog (150 mm snout-urostyle length, 324 g, 55 mm mouth gape) in a trap used to capture migrating salmonid smolts in Freshwater Creek, a tributary to Humboldt Bay, Humboldt County, California (UTM: Zone 10, 0408628 E, 4515351 N, NAD 83; 1.5 m elevation). We scanned the Bullfrog with a passive integrated transponder (PIT) reader to determine if it contained any PIT tags from previously marked juvenile salmonids. After we determined the Bullfrog contained a PIT tag, we euthanized it and conducted a stomach dissection. The only prey item found was a Coho Salmon smolt (116 mm FL, 16.5g), swallowed head first (Fig. 1). This Coho Salmon was previously captured, PIT tagged, and released (at the trapping facility) on 29 April 2009. The

relatively fresh condition of the fish suggested that it was captured by the Bullfrog in the trap, which had been set 19 h earlier. Three post-metamorphosed Bullfrogs and 2 Bullfrog tadpoles were captured at this salmonid trapping facility in 2008 and 2009. None of the post-metamorphosed individuals contained vertebrate prey items in their stomachs.

Fishes, including members from the Cyprinidae and Ictaluridae families, have often been described as prey of Bullfrogs (Cohen and Howard 1958; Korschgen and Baskett 1963; Corse and Metter 1980; Clarkson and deVos 1986; Wang and others 2008), yet this is the 1st observation of predation on a juvenile salmonid. Prey species consumed by alien invasive species are an important but often overlooked consideration for managers, especially when threatened or endangered species are identified as prey (Sanderson and others 2009). Marked population declines of Coho Salmon in all freshwater habitats in California have led to both federal and state listings under the Federal (ESA) and California (CESA) Endangered Species Acts (Federal Register 1997, CDFG 2002).

Potential niche overlap and behavioral interactions between juvenile Coho Salmon and the Bullfrog have not been studied, but both species have been documented using similar seasonal habitats. For example, off-channel ponds, protected side channels, and other seasonally-flooded areas proximal to a main channel are important for juvenile Coho Salmon production (Pollock and others 2004; Roni and others 2006; Rosenfeld and others 2008). Studies have also shown similar habitat use by all life stages of Bullfrogs in some river drainages (Moyle 1973; Fuller 2008). Local ecological requirements could limit interactions among Bullfrogs and juvenile Coho Salmon. For example, Bullfrogs prefer warm water and are noted to be inactive in water temperatures below 15°C (Harding

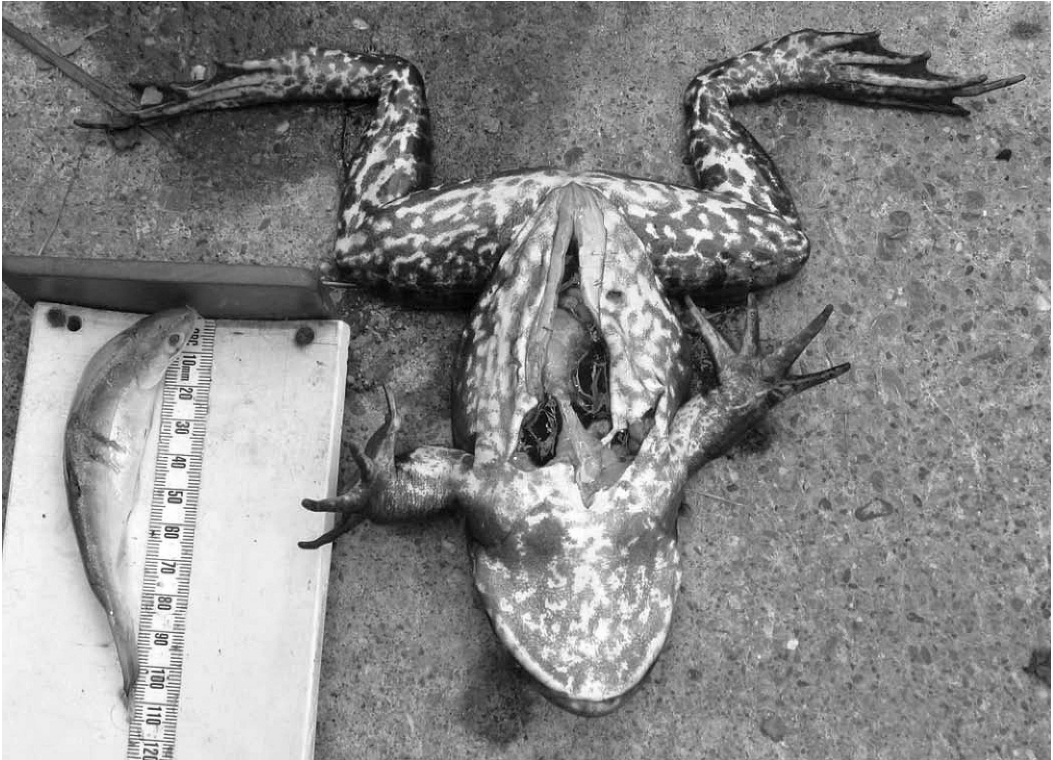


FIGURE 1. Dissected Bullfrog and a Coho Salmon smolt (left) found in the frog's stomach at Freshwater Creek, Humboldt County, California. Note 2 apparent vertical bite marks on the smolt's side.

1997), whereas juvenile Coho Salmon are adapted to cold water and require temperatures below 18°C (Welsh and others 2001). Notwithstanding these preferences, during the spring of 2008 and 2009, our 5 observations of active Bullfrogs in Freshwater Creek occurred when stream temperatures were low (15 March to 15 May, mean annual water temperature: 8.9°C ± 0.15 [s]; range: 5.0°C to 12.0°C), well below upper critical limits for juvenile Coho Salmon.

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