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Increased Abundance and the Food Consumption of Northern Squawfish (*Ptychocheilus oregonensis*) at River Kilometer 75 in the Columbia River

Abstract

An increase of northern squawfish (*Ptychocheilus oregonensis*) has occurred in the lower Columbia River at Jones Beach, River Kilometer 75, near Woodson, Oregon. A total of 71 squawfish was captured in beach seines from 1966 to 1972 (6650 sets), whereas the average annual catch from 1977 to 1983 was 859 (7602 sets). A sudden increase in squawfish was noted in May 1980 following the eruption of Mount St. Helens. Stomach analysis of squawfish in 1983 indicated that 95 percent contained food, primarily crustaceans, insects, and fish. Juvenile salmon (*Oncorhynchus* spp.) were collected in the same waters, but were not found in the stomachs of any of the northern squawfish examined.

Introduction

For several years the National Marine Fisheries Service has studied the migrational characteristics and survival of juvenile salmonids entering the Columbia River estuary (Dawley *et al.* 1986). The primary sampling site was Jones Beach near Woodson, Oregon, River Kilometer (RKm) 75. Because northern squawfish (*Ptychocheilus oregonensis*) are known predators of juvenile salmon (*Oncorhynchus* spp.) (Ricker 1941, Jeppson and Platts 1959, Thompson 1959, Thompson and Tufts 1967, Steigenberger and Larkin 1974, Uremovich *et al.* 1980, Bentley and Dawley 1981), the numbers of squawfish captured were also monitored.

Northern squawfish captured in beach seines have increased dramatically since 1966 (Table 1). The increasing population of squawfish in the river has a potentially deleterious effect on the survival of juvenile salmonids. This report documents squawfish abundance in beach seine catches at RKm 75 from 1966 to 1972 and from 1977 to 1983. The diets of squawfish captured during July-September 1983 are also discussed.

Methods

A 95 m long beach seine was used that extended out from the Oregon shore to a depth of about 6 m at the outer end of the sweep (Sims and Johnsen 1974). Sampling effort in 1966 and 1967 was limited to 138 and 283 sets, respectively, but during 1968-1972 and 1977-1983 averaged 1237 sets each year (Table 1). Seining generally began at sunrise and continued for seven hours.

A sample of 196 squawfish captured between 20 July and 8 September 1983 were measured to the nearest 0.1 cm (fork length) and immediately immersed in a lethal concentration of ethyl p-aminobenzoate. Because of rapid digestion, as reported by Steigenberger and Larkin (1974), stomach contents were examined within 90 minutes of capture. Food items were separated into four categories: fish, insects, crustaceans, and molluscs. Food categories were evaluated using percent frequency of occurrence, *i.e.*, the portion of the total number of stomachs containing a particular food category. Because our primary concern was salmonids in the diet, the only stomach contents that were precisely identified were fish.

Results and Discussion

The abundance of squawfish at Jones Beach changed dramatically between the two sampling periods. From 1966 through 1972 only 71 squawfish were captured (Table 1). When sampling resumed in 1977, squawfish catches increased substantially; annual catches averaged 401 from 1977 through 1979.

In 1980, the squawfish catch increased to 762, with a sudden increase following the 18 May eruption of Mount St. Helens; 84 percent of the squawfish captured during May were post-eruption and were obtained from 27 percent of the fishing sets. The increased catch continued through July. Beach seine catches of sculpin (*Cottus* spp.), peamouth (*Mylocheilus caurinus*), and sucker (*Catostomus* spp.) also showed dramatic increases following the eruption of Mount St.

TABLE 1. Beach seine catches of northern squawfish in the Columbia River at Jones Beach (RKm 75), 1966-1972 and 1977-1983.

Year	Total Sets[a/]	Catch per 100 sets						Total Catch
		April	May	June	July	Aug.	Sept.	
1966	138	-[b/]	0.0	0.0	0.0	0.0	0.0	0
1967	283	-	0.0	0.0	0.0	0.0	0.0	0
1968	1,076	0.0	0.0	0.0	0.4	1.0	1.1	4
1969	1,649	0.0	0.4	0.0	0.7	1.7	0.7	10
1970	1,572	0.0	0.5	0.0	0.3	1.1	-	5
1971	999	0.0	0.6	0.8	0.4	0.8	-	6
1972	924	0.0	0.0	0.0	11.4	11.2	-	46
1977	1,400	0.0	0.0	7.8	28.5	101.8	67.9	514
1978	1,171	1.7	0.8	11.7	41.6	57.2	21.1	233
1979	1,211	0.5	4.1	13.9	58.4	94.0	106.2	457
1980	1,136	1.2	19.4/275.0[c/]	47.0	84.4	101.0	78.4	762
1981	1,161	0.5	72.3	252.6	223.9	192.9	159.3	1,754
1982	1,277	4.0	88.5	99.7	204.8	146.9	225.0	1,414
1983	1,266	1.5	69.0	94.8	91.8[d/]	84.2[d/]	58.3[d/]	877

a/ Low catch rates and inconsistent sampling effort between years precluded use of data for the period October-March.
b/ "-" = No effort
c/ Catch before eruption/catch after eruption—139 sets before eruption and 52 sets after the eruption.
d/ About one-half of the fish captured were used for gut content analysis.

Helens. The eruption caused above-average river flows and water temperatures and extreme turbidity in the Columbia River downstream from its confluence with the Cowlitz River (RKm 109). We believe that resident squawfish in the Cowlitz and Columbia Rivers were forced downstream by adverse water quality conditions, resulting in the increased catches.

The peak squawfish catch at Jones Beach occurred in 1981 (1754) and declined in 1982 (1414) and 1983 (877).

Juvenile salmonids were not found in any of the 196 squawfish stomachs examined. However, 14.3 percent of the squawfish examined contained other fishes (Table 2). In the stomachs containing fish, threespine stickleback (*Gasterosteus aculeatus*) were observed in 75 percent, juvenile American shad (*Alosa sapidissima*) in 14 percent, and suckers (*Catostomus* spp.) in 4 percent.

About 95 percent of the stomachs examined contained food items. The most common items were crustaceans (86.2 percent occurrence); insects and molluscs were observed less often (36.2 and 11.7 percent occurrence, respectively). Thompson (1959) and Buchanan *et al.* (1981) observed that squawfish rarely consumed items from more than a single food category; however, 43 percent of the stomachs we examined contained more than one food category.

TABLE 2. Major stomach contents of 196 northern squawfish captured in the Columbia River at Jones Beach (RKm 75), 20 July-8 September 1983.

Food category	No. of stomachs with a certain food item	Frequency of occurrence (%)
Fish (any species)	28	14.3
Stickleback	21	10.7
American shad	4	2.0
Sucker	1	0.5
Unidentified	4	2.0
Crustaceans	169	86.2
Insects	71	36.2
Molluscs	23	11.7

The mean fork length (ML) of squawfish examined was 16.3 cm, with a range of 6.7-45.0 cm (Figure 1). Thompson (1959) found that squawfish of this size were primarily immature specimens, and the diet of immature fish is different than the diet of adults due to their size. Uremovich *et al.* (1980), in a literature review, stated that northern squawfish longer than 15.1 cm fork

length fed occasionally on fish, and those exceeding 30.4 cm fed primarily on fish. At Jones Beach, squawfish longer than 15.1 cm accounted for 65 percent of squawfish examined, and 82 percent of those had fed on fish. Two percent of the squawfish were longer than 30.4 cm, and none contained fish.

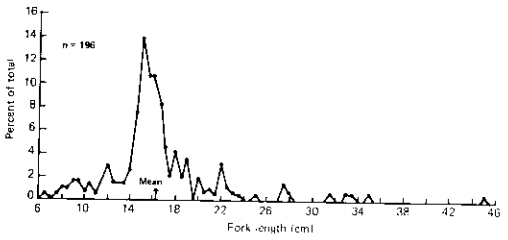

Figure 1. Length frequency of northern squawfish captured in the Columbia River at Jones Beach (RKm 75), 20 July to 8 September 1983.

Squawfish have been described as opportunistic feeders, concentrating on more abundant food sources or those easiest to capture (Thompson 1959, Olney 1975, Buchanan *et al.* 1981). Uremovich *et al.* (1980) sampling in the forebay of Bonneville Dam on the Columbia River, and Bentley and Dawley (1981), sampling in the tailrace of Lower Granite Dam on the Snake River, observed salmonids in 21 percent of the squawfish captured. Thompson (1959) and Thompson and Tufts (1967) reported squawfish predation on juvenile salmon only following releases from a nearby hatchery (2-51 percent occurrence and 1-32 percent occurrence, respectively). Buchanan *et al.* (1981) suggested that previous studies of squawfish predation in flowing rivers were misleading due to the proximity of sampling sites to hatchery release sites or hydroelectric dams where salmon are more vulnerable to predation. During the peak migration period of juvenile salmonids in the free-flowing portion of the lower Willamette River, Buchanan *et al.* (1981) found that only 2 percent of the 1127 squawfish examined had eaten salmonids.

Consistent with Buchanan *et al.* (1981), none of the squawfish we examined contained salmonids even though 8723 subyearling chinook salmon (ML = 8.9 cm, range = 5.0-15.0 cm) were captured coincidentally. We believe that a portion of this salmon population was available to those squawfish larger than 15.1 cm, yet was not consumed. About 6700 juvenile shad (ML = 4.9 cm, range = 3.0-21.0 cm) were also captured but were observed in only 2 percent of the squawfish stomachs. Similar numbers of stickleback (10794) were seined but not measured during this time. They were the most frequently eaten fish species (11 percent occurrence). The varying consumption rates by squawfish for these three fish species may reflect the relative difficulty of capture.

Increased abundance of squawfish at the upstream entrance to the Columbia River estuary has serious implications for salmon managers. Predation by squawfish may be increasing in this area where millions of juvenile salmonids are released each year. In addition, squawfish have been shown to occupy a similar niche and compete with juvenile salmonids for food and space (Jeppson and Platts 1959, Heun 1983).

At Jones Beach, the majority of squawfish captured were juveniles and thus unlikely piscivores; their diet consisted of small crustaceans and insects. The larger adults, which are known piscivores, may also be increasing in other areas of the estuary.

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