University of Nevada

Reno

Contributions to the Life History of the Lahontan Tui Chub, *Gila bicolor obesa* (Girard), in Walker Lake, Nevada

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by

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Abstract

Walker Lake, a moderately eutrophic, alkaline-saline Lake currently supports three fish species, one of which is the Lahontan cutthroat trout (*Salmo clarki henshawi*), which feeds primarily on a cyprinid, the Lahontan tui chub (*Gila bicolor obesa*). During 1976 and 1977 this minnow was studied to define it's life history interactions within the lake.

Tui chub were by far the dominant fish caught in gillnets during the study. Hypolimnetic oxygen depletions were found to restrict tui chub to epilimnetic regions of the lake from mid-June through November. The fish were found to spawn in littoral areas over a rocky and algal substrate beginning in late May or early June and extending through late July or early August when water temperatures approached 15.5°C (60°F).

Chub eggs were incubated in the laboratory and the developmental embryological stages monitored and described. From fertilization to hatch-out, eggs required 74, 98, and 137 hours at 24.4, 21.1, and 18.8°C respectively.

At the end of the first four years of growth tui chub fork lengths were 11.6, 17.6, 21.8, and 24.2 cm respectively, and increments of growth were 11.6, 6.0, 4.2, and 2.4 cm respectively. The majority of tui chub probably die of old age near 5 or 6 years, and maximum longevity appeared to be 7 years.

The average coefficient of condition for 184 tui chub was 1.51, but fluctuated seasonally. The regression equation for the length-weight relationship was log weight = -1.73+2.93 (log fork length).

Zooplankton was the most important component in the diet of tui chub followed by filamentous algae, tendipedidae larvae, bottom substrate, *Hyalella azteca*, and tui chub.

on his work at Upper Klamath Lake, Oregon, found that it took an almost complete lack of dissolved oxygen to prevent blue and tui chub from occupying all sections of the lake. He found these species in areas where dissolved oxygen was as low as 0.1 mg/l and a scum of decaying algae existed. Capture of tui chubs under similar dissolved oxygen conditions is reported by Kimsey (1954) from Eagle Lake, California.

Overcrowding of tui chub during periods of low dissolved oxygen appeared to be taking place at Walker Lake. Intraspecific competition may be a factor in food availability when these large schools of chub were forced to surface regions, which may in turn affect the zooplankton populations; the zooplankton population does not exhibit any decreasing trends in total numbers during the period of suspected crowding (Koch et. al., unpublished data).

Spawning

Tui chub from Walker Lake became sexually mature during the spring of their third year, with the exception of a few males that were observed to be mature at the end of the second year. This age is consistent with what Kimsey (1954) found in Eagle Lake, California, however, Kucera (1976) found some Pyramid Lake female chub mature at two years of age and the majority of males mature at two years.

Male and female tui chub are easily identified to their sex during the spawning season. The most obvious change

occurs in the males who become covered with small nuptial tubercles. The females undergo a slight enlargement of the anal region and exhibit a marked protrusion of the genital papilla. In both sexes the fins take on a slight reddish coloration.

At maturity the ovaries are visible as two equal parts arranged longitudinally in the body cavity ventral to the kidney. Early in development, the ovary is a light yellow mass with individual eggs nearly undistinguishable. In a ripe or nearly ripe condition the eggs change from the firm, opaque, color to a soft transparent straw color. When a female is in this ripe condition she is easily detected by her heavy body form.

Available literature is consistent in stating that tui chub are inshore spawners. In Eagle Lake, California, mature tui chub were found to migrate from the deeper southern end of the lake to the shallower northern end during the spawning season (Kimsey, 1954). LaRivers (1962) also made the observation that tui chub congregate in shallow shoreline areas to spawn. Gill net catches at Pyramid Lake reveal that almost 97 percent of the adult tui chub were inshore in July (Sigler and Assoc., 1977).

In 1917 Snyder made the following observation of tui chub at Pyramid Lake:

> "On May 16 the writer began observations on the western side of Pyramid Lake at The Willows (Sutcliff). The weather was then cold and squally, the lake rough and forbidding. Relatively

> few fishes were seen, although large schools of suckers were spawning and a few minnows (chub) might be observed here and there among the suckers and in the algae, while an occasional trout was caught by the Indians. On May 20 the weather suddenly settled and became warm. As the sun went down, its last rays from over the mountains fell on the surface of the lake, which was as calm and placid as a great mirror. About 2 o'clock on the following morning there was heard a vigorous lapping of the water, which in the quiet air appeared entirely without cause until it was found to accompany the leaping of vast numbers of fishes. Far out and up and down the shores the surface of the water fairly boiled. Spring had come, and with it, in the dim light of the early morning, myriads of fishes from the depths of the lake. Daylight revealed them everywhere, along the shore, among the boulders, and in the algae, hovering in enormous schools over the bars and moving about in the clear water of the sheltered bays. From this time the suckers rapidly disappeared, while the large trout approached the shore in their eagerness to feed on the luckless minnows. Most of these fish were not ready to spawn and no ripe individuals were seen until May 24, after which date spawning soon began."

Ed- Note that at these critical temperatures, males may be sexually viable, but females are not. See next page.

This author first observed spawning activity on June 8 and May 20 in 1976 and 1977 respectively at Walker Lake. The surface water temperature on June 8 was 16.5°C (62°F) and on May 20 was 13.5°C (56°F). Kimsey (1954) found spawning to first occur in Eagle Lake near a temperature of 15.5°C (60°F).

Spawning observations revealed large schools of chub within 1-2 m of the shoreline at a depth of from .25-1 m. The dorsal and caudal fins of the fish broke the surface of the water on many instances. Substrate type varied from small pebbles to large rocks with small amounts of algae attached to their surface in many cases. Actual spawning

was not observed, but an examination of a spawning site revealed a number of chub eggs between the rocks and attached to algae.

On June 8 of 1976 eight tui chub were caught by rod and reel from one of these spawning schools, of which six were male and two were female. All of the males were running ripe with milt, but neither of the females were yet at a stage to extrude their eggs. Subsequent observations revealed nearly the same results. During the embryological field work of the study, ripe female tui chub were very difficult to obtain in late July and early August 1976, although almost 100 percent of the males would continue to extrude their sperm with only slight pressure on the abdomen. From a total of 174 females collected from an inshore gill net set only 3 individuals (1.7 percent) were in a running ripe condition on August 4. Several other net sets produced approximately the same results in attempting to locate viable eggs for incubation in early August.

Sex ratios were obtained from a sample of 852 fish. The ratio of males to females is 1:1.16 which does not deviate substantially from an assumed 1:1 ratio. Pyramid Lake female tui chub were found to survive to an older age than males (Kucera, 1977), which may explain the sex ratio favoring females in Walker Lake. However, this ratio fluctuates dramatically during the spawning season. Gill netting from June through July, 1976 at inshore locations

revealed males entering spawning areas earlier than females (Figure 10). On June 15 males comprised 85.1 percent, but decreased to 54.3 percent by July 19. Kucera (1976) found that out of a total of 262 fish that were sexed from an inshore gill net set in Anderson Bay at Pyramid Lake in June, 86 percent were males.

Spawning activity ranged from late May and early June to the middle of August in 1976 on Walker Lake. The peak in spawning activity probably occurred in mid-July when the sex ratio again approached normality (Figure 10). Tui chub in Pyramid Lake were also found at the peak of their spawning activity in July of 1976 (Kucera, 1976).

It appears as though males are the first to become sexually active in the spring and last to become sexually inactive at the termination of the spawning season. Reproductive behavior such as this would seem to insure many spawning males for each spawning female and in turn a greater chance of fertilization of the eggs. Being a broadcast-type spawner, and not giving any care to the eggs after spawning, the tui chub population would undoubtedly benefit from such behavior.

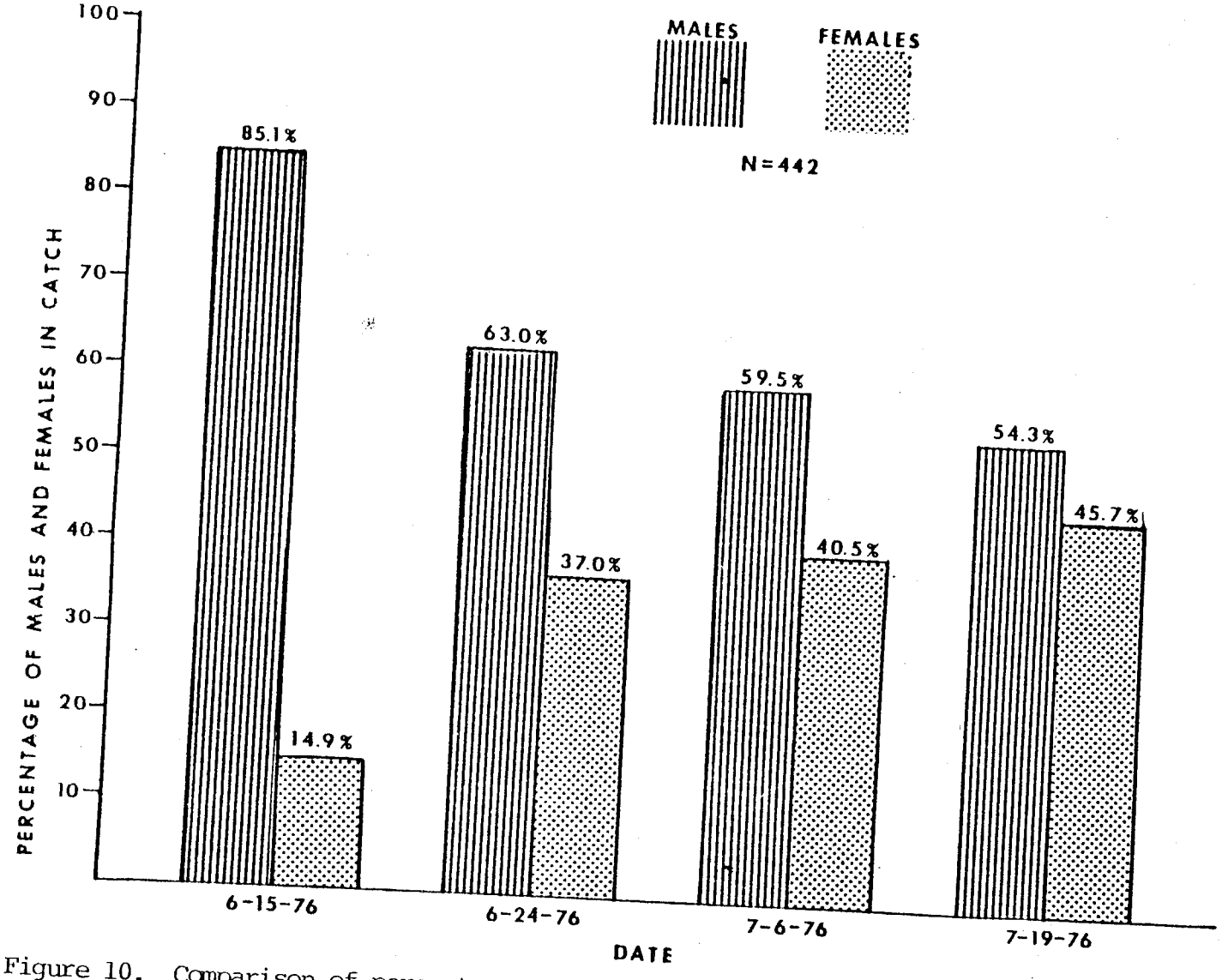

Figure 10. Comparison of percentage male to female tui chub caught in bottom set gill nets in 5 m to 7 m of water between June 15, and July 19, 1976 Walker Lake, Nevada.

Embryology

Observations on the embryological development and early larval stages of the tui chub were conducted from mid-July to early August, 1976 on Walker Lake. The rate of development was found to be very dependent upon water temperatures. Table 8 shows the results of the effects of temperature on the incubation period of tui chub eggs. This data is graphically illustrated in Figure 11.

Table 8. Results of incubating tui chub eggs during July and August 1976, Walker Lake, Nevada.

Dates of Incubation	Hours from Fertilization to Hatch-out	Temperature Range (°C)	Temperature Mean (°C)
7-24-76 to 7-27-76	74	23.5-26.5	24.4
7-30-76 to 8-3-76	98.5	20.0-23.5	21.1
8-2-76 to 8-7-76	137	18.0-21.5	18.8

Results show that at an average incubation temperature of 24.4°C the eggs took 74 hours to hatch out. This compares to incubation temperatures of 21.1 and 18.8°C with a hatch-out time of 98.5 and 137 hours, respectively. Harry (1951) incubated tui chub eggs from Eagle Lake, California at 7.2°C for the first 100 hours and then allowed temperatures to vary from 1.1 to 28.9°C. At this variable temperature regime the eggs hatched out on the twelfth day of incubation. Kimsey (1954) also incubated Eagle Lake tui chub eggs which were collected

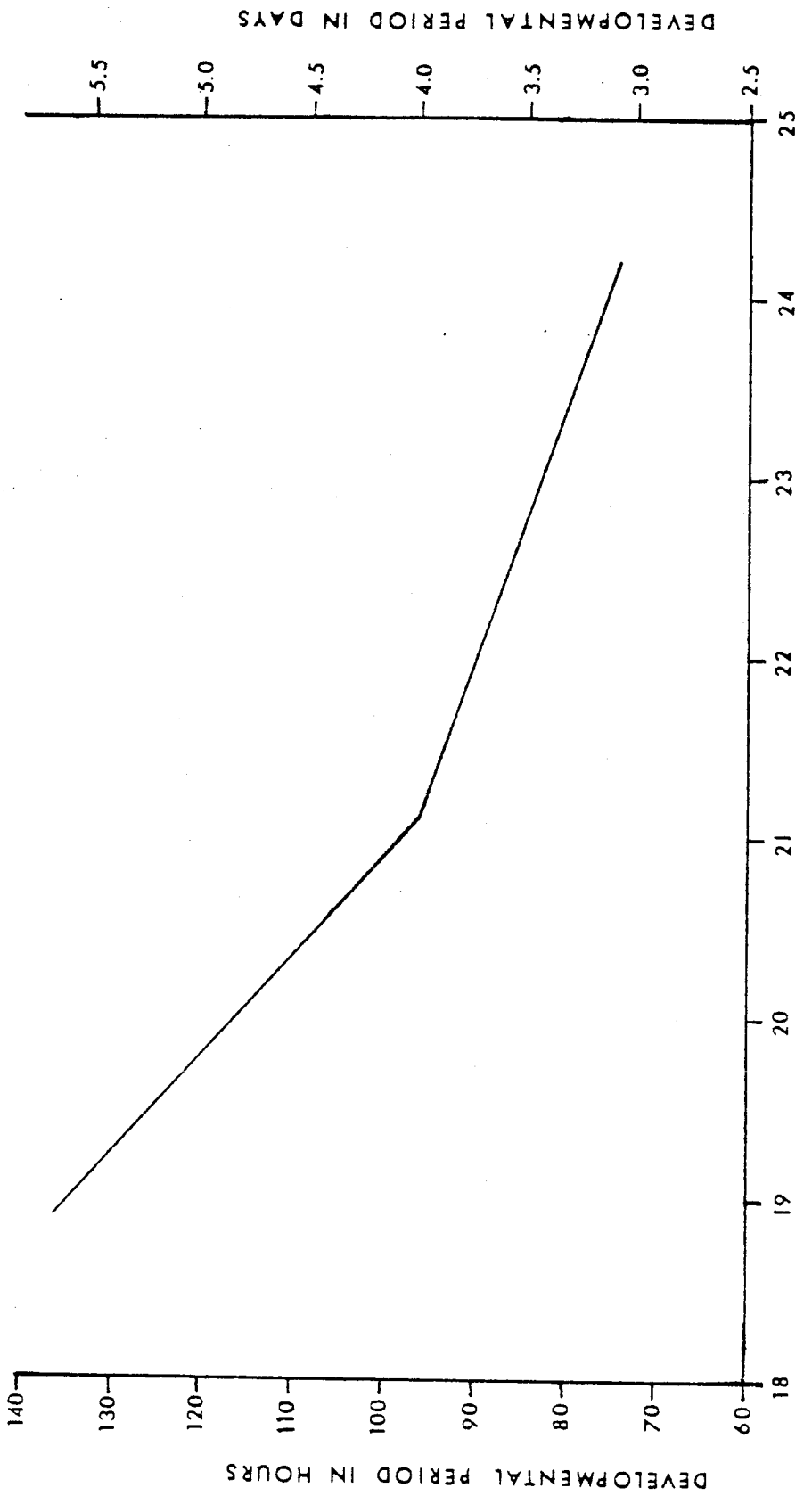

Figure 11. Developmental period for tui chub eggs for three average water temperatures, July and August, 1976 Walker Lake, Nevada.

July 25, 1948. He left them in a quart jar where the air temperature varied from 4.4 to 32.2°C and found the fry actively feeding in nine days. In East Lake, Oregon Bird (1975) hatched out tui chub eggs in 192 and 142 hours at 14.6 and 21.9°C, respectively. He concluded that highly fluctuating incubation temperatures caused eggs to take much longer to hatch out compared to when temperatures were stabilized.

The ability of tui chub eggs to withstand such a high variation in water temperatures is a valuable survival trait for the species. The eggs are laid in water that is shallow enough to warm up during periods of high solar radiation and cool down at night. The short duration of the egg stage is also a highly beneficial adaptation as environmental conditions have a shorter period of time to cause mortality at this critical stage of development.

Lahontan tui chub eggs flow freely from females when they are in a condition to accept fertilization. It was found that when eggs were forcibly extruded fertilization would not occur. Freshly stripped eggs are approximately 1-1.5 mm in diameter, yellowish, opaque, and very adhesive. They are demersal and their specific gravity is considerably more than that of Walker Lake water as the eggs quickly sink to the bottom. After fertilization the perivitelline space becomes separated from the zygote

and swelling occurs giving the egg as a whole an outer diameter of 1.5 - 1.8 mm. At this stage the eggs were water hardened for roughly 1/2 hour, then placed in hatching jars and development allowed to proceed normally. Table 9 shows the general stages of development through time which occurred during incubation.