Bonytail Chub Foods and Feeding Habits, Cibola High Levee Pond, lower Colorado River, Arizona and California, 2003-2004

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Introduction

This report presents one aspect of ongoing studies of native bonytail *Gila elegans* and razorback sucker *Xyrauchen texanus* in the Cibola High Levee Pond (HLP). The Cibola HLP is a small (ca. 5 acre) remnant of the lower Colorado River channel located between the river and inland (high) levees on the U.S. Fish and Wildlife Service's Cibola National Wildlife Refuge in La Paz County, Arizona and Imperial County, California. The pond was reclaimed to eliminate non-native fishes and first stocked with native species in 1993, and since then the site has served roles in both management and research (see LaBarbara and Minckley 1999, Marsh 2000, Mueller et al. 2003).

The purposes of this investigation were to (1) document foods utilized by bonytail, (2) examine food utilization as a function of fish size, and (3) investigate temporal aspect of feeding habitats and food utilization by bonytail inhabiting the Cibola HLP. These goals were to be accomplished by acquiring non-lethal stomach samples from evening and nighttime collections of bonytail representing relatively larger and relatively smaller fish across two years.

Methods

Sample Collection. A combined sample of 72 bonytail was acquired from trammel net collections made on 7 May 2003 and 4-5 May 2004. Nets were placed to sample two different feeding times, evening (samples collected from 1800 to 2400 hrs) and night (samples collected from 0100 to 0545 hrs). A distinct size class was sampled each year -- nominal TL for 2003 was >375 mm (n=28) and for 2004 was <375 mm (n=44). Fish were held in a floating live car for a brief time after capture, then measured (total length [TL], nearest mm) and weighted (nearest 2 gm). Stomach and intestinal (GI) contents were removed by flushing GI material through the vent by using a special apparatus inserted into the esophagus (Wasowicz and Valdez 1994) that was an effective method to avoid fish sacrifice. The apparatus consisted of a one-way, rubber squeeze bulb and tygon tubing of varying sizes (6.5, 8.0, 9.5, and 11.0 mm outside diameter), with tubing size matched appropriately to fish gape size. GI tracts were flushed with clear water from the sample site through a sieve, and into a sample container. Fish with empty tracts were noted. Samples were fixed in 10% formalin and later rinsed in fresh water and transferred to 70% ethanol for examination in the laboratory.

Gut Content Examination. Gastrointestinal samples were individually washed through a 500 micron-mesh sieve and solids wet-weighed to the nearest 0.001 g. The contents of each sample was visually examined with the aid of a binocular dissecting scope, and the percent of the total quantity was estimated for each of the following six categories: amorphic organic matter (AOM), inorganic matter, plant, fish, invertebrate, or other. When possible, individual prey items were identified to family-level. Samples were then placed in 70% ethanol for storage.

Results

Bonytail examined from 2003 (n=28) ranged in total length from 376 to 510 mm with a mean of 447, and ranged in weight from 305 to 1136 g with a mean of 565, while fish from 2004 (n=44) were smaller; 271 to 509 mm long with mean of 325 and weight 129 to 710 g with a mean of 222 g (see Fig. 1). Weight-length relationships represented a continuum from smaller to larger fish, and there was more variation among larger individuals (Figs. 1 and 2).

Of 72 fish sampled in both years, 13 GI tracts (18%) were to be empty. The frequency of empty tracts was more than four times higher for evening (33%) than for night (7%) samples (Fig. 3), but the gross composition of GI contents was similar between the two feeding times (Fig. 4).

AOM consisted predominantly of nondescript, brownish material or “grutch.” This might have included stomach lining, mucous, or ingested materials in advanced stages of digestion (beyond identification). Inorganic material consisted of pebbles, rocks, grains of sand, and insect larval cases that were composed of sand grains and pebbles (e.g., trichopterans including hydroptilidae). Plant matter consisted of various aquatic macrophytes including *Najas* sp., *Potamogeton* sp., and *Chara* sp. Fish matter consisted of any fish part or whole including scales, bones, and flesh. Invertebrate matter consisted of a variety of groups including microcrustaceans (copepods, ostracods, and *Daphnia*), crayfish, corbiculidae, tapeworms, dipteran larvae and adults, notonectidae, and odonate nymphs and adults. Asian tapeworm *Bothriocephalus acheilognathi* was positively identified in one specimen and tapeworm proglotids, presumably Asian tapeworm, were found in 8 of 72 (11%) samples representing all available sizes of bonytail. Other matter included both identifiable (bull frog *Rana catesbiana*) and unidentifiable vertebrate remains.

For invertebrate, fish, and plant matter, composition varied by fish size (TL): plant matter decreased while invertebrate matter increased with increased fish size (Figs. 5 and 6). Fish parts were observed in 8% of GI samples (6 of 72), and were restricted to fish longer than 425 mm.

GI sample weights showed little linear relationship to fish body weight or total length (Figs. 7 and 8). Mean stomach sample wet weight was 1.544 g, the nonzero range was 0.061 to 13.970 g, and standard deviation was 2.667. Fish length and weight ranges are provided in Fig. 1.

Discussion

Telemetry studies at Cibola High Levee Pond indicate that adult bonytail are active during nighttime and spend the daylight hours dormant and hidden under cover amongst large boulders. This is consistent with the volume and composition of stomach contents and proportion of empty guts, which indicated the most intense feeding occurred at night.

Asian tapeworm was reported in humpback chub *Gila cypha* from the Little Colorado River in Grand Canyon (Clarkson et al. 1997), but this represents the first record of Asian tapeworm in bonytail from “wild” habitat on the lower Colorado River, and may signal future occurrences of this pest in other species and in other places. It is unknown if the tapeworm was introduced accidentally with hatchery stocks of bonytail or razorback sucker, or with other species that were stocked illegally by unknown persons. Researchers, managers and other should be aware of its potential presence and provide interested parties with incident reports as they occur.

The few available data from other studies indicate that bonytail feed on benthic and drifting aquatic invertebrates and terrestrial insects under natural stream conditions (Kirsch 1889). A composite sample of sub-adult bonytail and roundtail (*Gila robusta*) chubs from Green River, Utah, ate mostly chironomid dipteran larvae and mayfly (ephemeroptera) nymphs when small, shifting to floating items (e.g., terrestrial insects) as they grew (Vanicek and Kramer 1969). Adult bonytail in Green River fed mostly on terrestrial insects, presumably taken from the surface, but there was no evidence of piscivory. In contrast, bonytail in Lake Mohave were found to prey on small (64 mm TL), newly stocked rainbow trout (Wagner 1955). Jonez and Sumner (1954) found plankton, insects, algae, and organic debris in bonytail from Lake Mead, and a few specimens from lakes Mohave and Havasu contained zooplankton (Minckley 1973). Our results contribute substantial new detail to our understanding of bonytail feeding ecology, but add little new qualitative information about their food utilization.

There were several factors that introduce an unknown level of uncertainly into our study. First, on more than one occasion, nets were run in stages such that early catch was held in a live car for a period of time before being re-assimilated with the later catch. This allowed an unequal time for digestion or evacuation of GI contents within sub-samples of fish. Potential effects of this protocol on food consumption results are unknown. Next, there were no control samples that could be used to evaluate the effectiveness of the siphoning method vs. surgical extraction of GI contents. However, studies by others (Bio/West 1994, Wasowicz and Valdez 1994) suggest that siphoning was nearly 100% effective with roundtail chub *Gila robusta* and was assumed similarly effective with humpback chub *Gila cypha.* Bonytail is morphologically similar to these congeners and we are unaware of any reason stomach pumping would be differentially effective among the three species. Finally, an expected linear relationship between fish weight and GI sample size was not observed. Implications of this result are not clear, but it may have been due in part to variation among samples in time elapsed between capture and processing.

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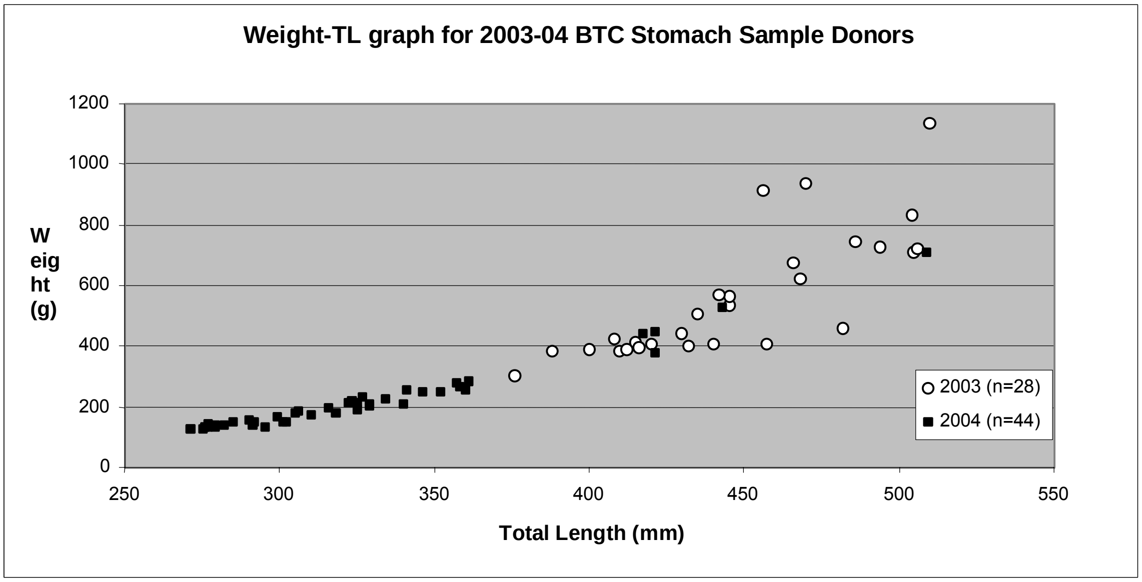

Fig. 1. Weight vs. length raw data plot for bonytail chub sampled for stomach contents, Cibola High Levee Pond, AZ-CA, 2003-2004. Data for fish with empty stomachs are included.

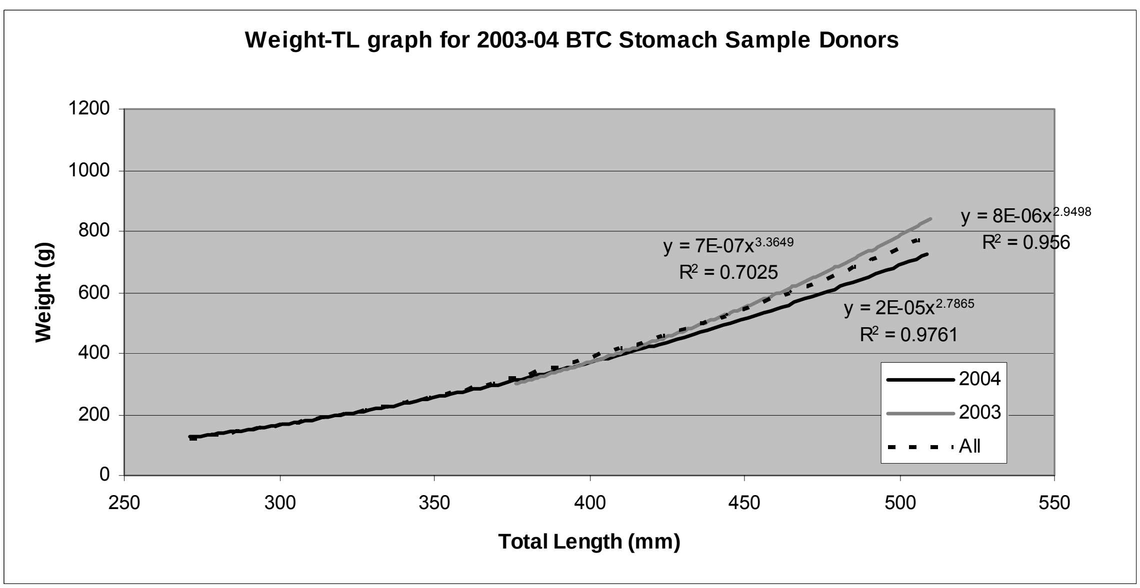

Fig. 2. Weight vs. length relationships for bonytail chub sampled for stomach contents, Cibola High Levee Pond, AZ-CA, 2003-2004. Data for fish with empty stomachs are included.

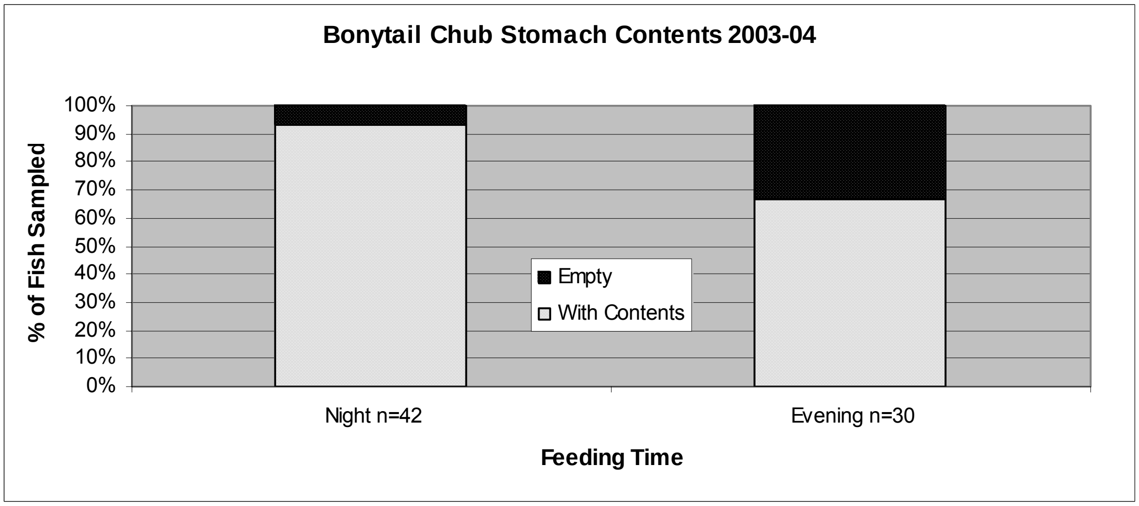

Fig. 3. Bonytail chub stomach contents following daytime and night feeding, Cibola High Levee Pond, AZ-CA, 2003-2004.

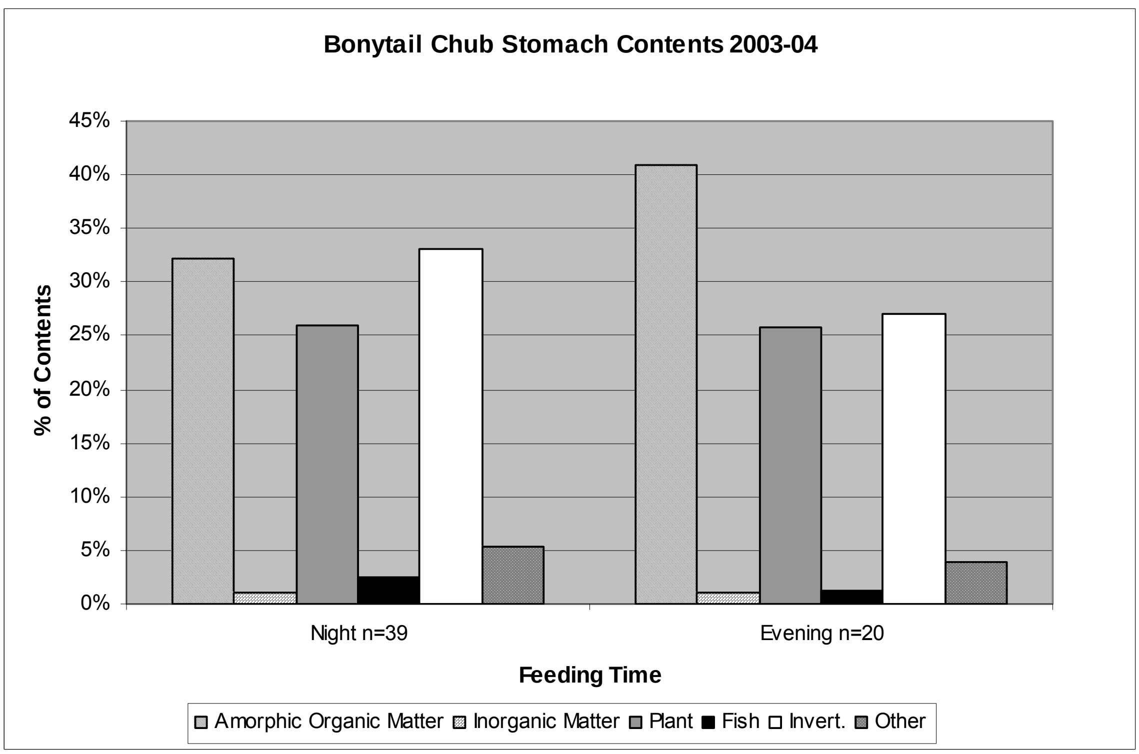

Fig. 4. Bonytail chub stomach contents by feeding time, Cibola High Levee Pond, AZ-CA, 2003-2004. Fish with empty stomachs are excluded.

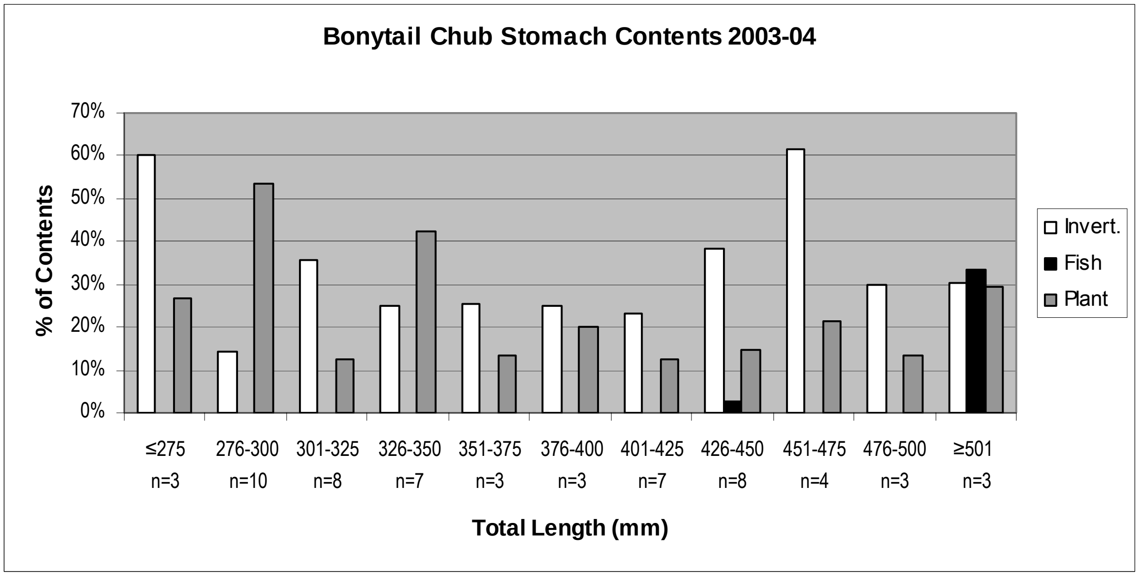

Fig. 5. Bonytail chub stomach contents by 25 mm size class, Cibola High Levee Pond, AZ-CA, 2003-2004. Fish with empty stomachs are excluded.

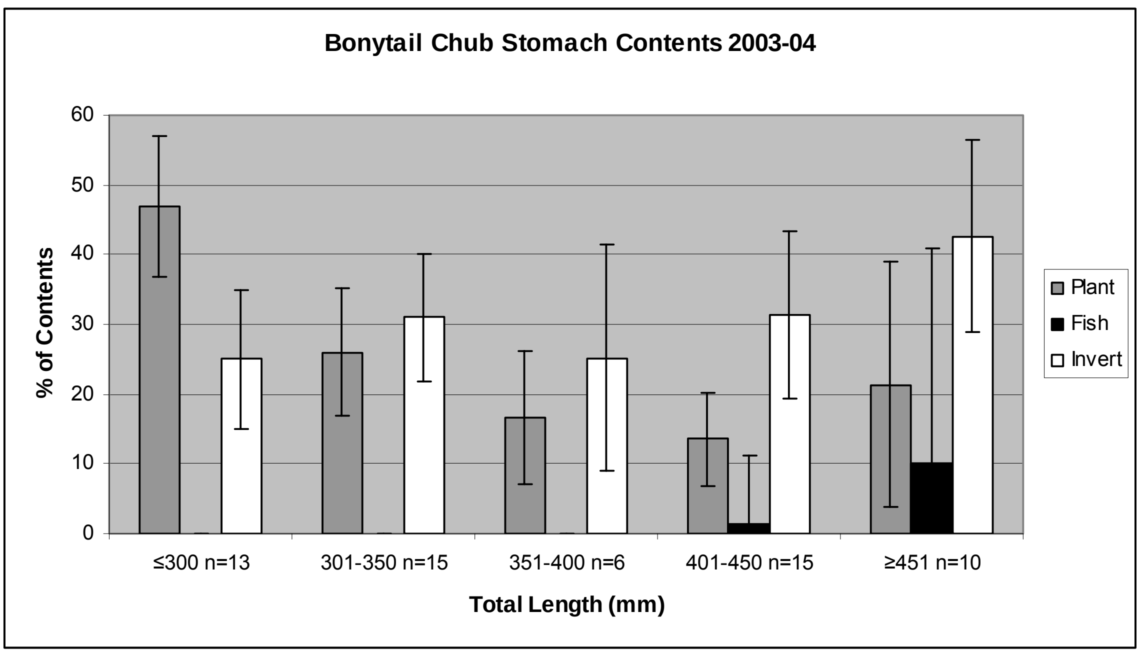

Fig. 6. Bonytail chub stomach contents by 50 mm size class, Cibola High Levee Pond, AZ-CA, 2003-2004. Fish with empty stomachs are excluded.

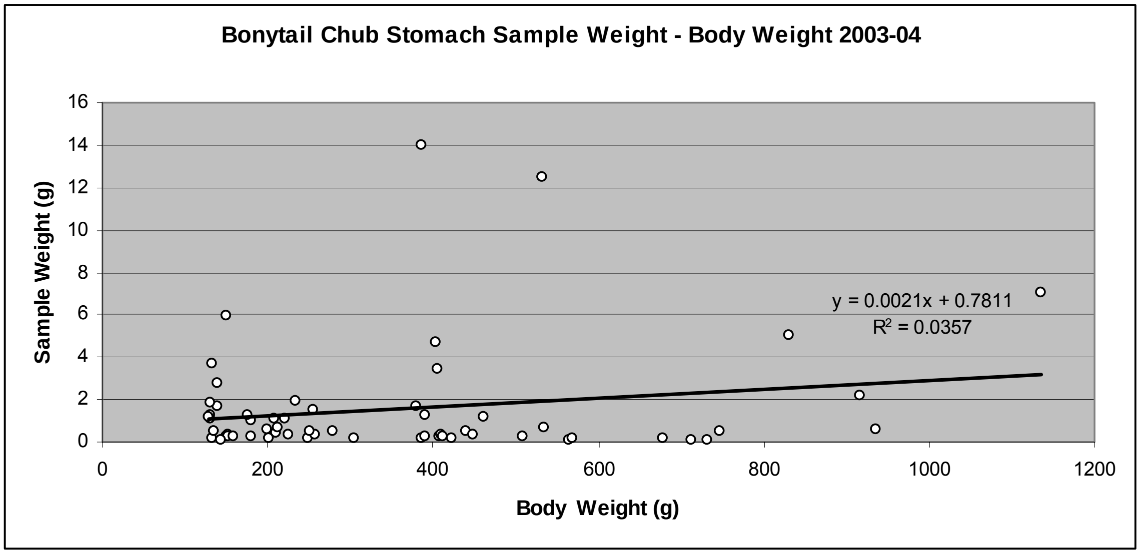

Fig. 7. Bonytail stomach contents weight to fish body weight relationship, Cibola High Levee Pond, AZ-CA, 2003-2004.

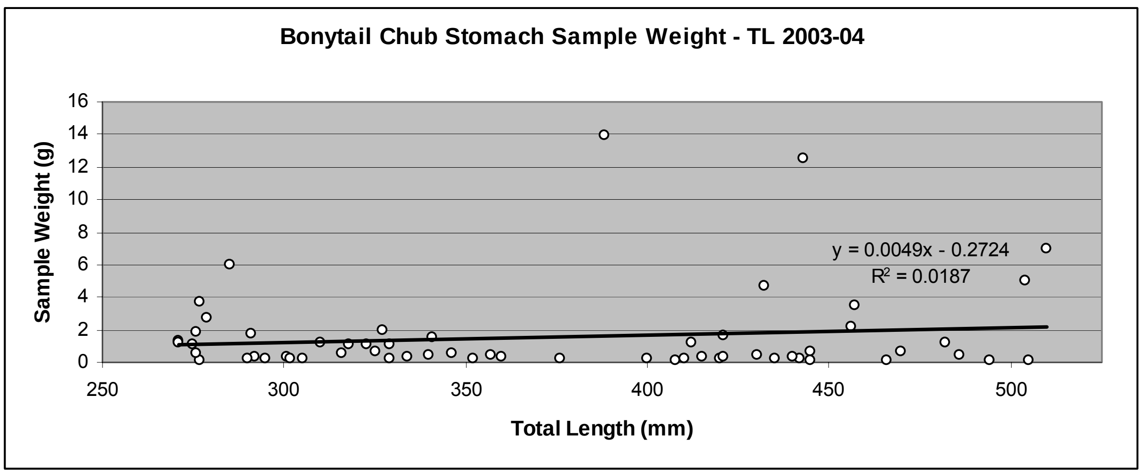

Fig. 8. Bonytail stomach contents weight to fish total length relationship, Cibola High Levee Pond, AZ-CA, 2003-2004.