Use Authorization

In presenting this dissertation in partial fulfillment of the requirements for an advanced degree at Idaho State University, I agree that the Library shall make it freely available for inspection. I further state that permission to download and/or print my dissertation for scholarly purposes may be granted by the Dean of the Graduate School, Dean of my academic division, or by the University Librarian. It is understood that any copying or publication of this dissertation for financial gain shall not be allowed without my written permission.

Signature _____

Date _____

THE TROPHIC ECOLOGY OF A DESERT RIVER FISH ASSEMBLAGE: INFLUENCE OF SEASON AND HYDROLOGIC VARIABILITY

by

Kathrine E. Behn

A thesis

submitted in partial fulfillment

of the requirements for the degree of

Master of Science in the Department of Biological Sciences

Idaho State University

May 2017

Copyright 2017

Kathrine E Behn

To the Graduate Faculty:

The members of the committee appointed to examine the thesis of Kathrine E. Behn find it satisfactory and recommend that it be accepted.

_____

Dr. Colden V. Baxter,

Major Advisor

_____

Dr. Ken A. Aho,

Committee Member

_____

Dr. Theodore A. Kennedy,

Committee Member

_____

Dr. David M. Pearson,

Graduate Faculty Representative

Idaho State
UNIVERSITY

Office for Research - Research Outreach & Compliance
921 S. 8th Avenue, Stop 8046 • Pocatello, Idaho 83209-8046

September 2, 2012

Colden Baxter, Ph.D.
Biological Sciences
Box 8007
Pocatello, ID 83209

RE: Your application dated regarding study number 702: Estimating the trophic basis of fish production in the Little Colorado River with comparison to mainstem Colorado River

Dear Dr. Baxter:

Your request for approval of the new protocol listed above was reviewed by the Idaho State University IACUC. This is to confirm that your protocol was approved. Your protocol number is 702.

You are free to proceed with your study as described in your protocol effective immediately.
The study is subject to renewal on or before 9/2/2015, unless closed before that date.

Please note that any changes to the protocol as approved must be immediately reported and approved. Contact me (208-282-2179; fax 208-282-4529; email: anmlcare@isu.edu) if you have any questions or require further information.

Sincerely,

Tom Bailey
IACUC Coordinator

Phone: (208) 282-1336 • Fax: (208) 282-4723 • isu.edu/research
ISU is an Equal Opportunity Employer

ACKNOWLEDGEMENTS

First and foremost, I thank my advisor Dr. Colden Baxter for seeing me through this project all the way from the logistics of flood crossings to NMDS graphs and poor grammar. Few students are given the gift of so much trust or the keen support to embark on a master's project involving so much complexity and risk. Thank you. I would also like to thank Dr. Ken Aho who generously and enthusiastically mentored me along the rocky path of learning statistics and graphing in R, and Dr. Dave Pearson kindly agreed to serve as my GFR at the last minute.

I am indebted to many colleagues at the USGS Grand Canyon Monitoring and Research Center who provided critical support for my project. Dr. Theodore "Ted" Kennedy contributed to the initial brainstorming, negotiated helicopter rides, generally greased the wheels, and financed lab processing. Adam Copp gave logistical assistance and invaluable camaraderie in the field. Josh Smith also contributed considerable time and effort to sampling and logistics. Nick Voichick, and the "sed-heads" carried samples and supplies to and from Boulders camp. Charles Yackulic, Josh Korman, Jeff Muehlbauer, Carol Fritzinger, Seth Felder, and Dave Foster all assisted with field logistics. Maria Dzul allowed the use of extra fish samples from the USGS LCR efforts. I thank Dr. Mike Yard for introducing so many of us to the joys and perils of Grand Canyon field work and for his professional friendship. Thanks to Brian Dierker for many, many boat rides and snacks. I am grateful to The U.S. Fish and Wildlife Service and Arizona Game and Fish, especially Randy Van Haverbeke, Dr. Dennis Stone and Aaron Bunch for allowing me to use their camp and tag along on sampling trips.

I thank the members past and present of the ISU Stream Ecology Center for their help and friendship. Matt Schenk, Ryan Blackadar, Hannah Harris, and Martin Ventura gamely joined my sampling trips and negotiated the difficult trail to my sampling site. Alex Bell, Maedeh Mozneb, Maria Pacioretty, Nate Tillotson, and especially Martin Ventura bravely spent many, many hours picking though the gut samples.

I am grateful to Drs. Robert O. Hall (University of Wyoming), Wyatt Cross (Montana State University), Emma Rosi-Marshall (The Cary Institute of Ecosystem Studies), and Colden Baxter and Ted Kennedy (again), for their mentoring and support during my employment on the Colorado River Food Base project. I never would have attempted, nor been even half as successful with this project without the lessons learned from Food Base.

I thank Stan Lindstedt for allowing me to be invited on what was my first of many of his Grand Canyon backpacking trips (this year will be 10 for us!). I'd never have pulled this off without those practiced skills. I'll admit, the first trip was a steep and painful learning curve --but subsequently filled with so much unbridled fun and fantastical wonder. I would like to thank the professors of my undergraduate education at Northern Arizona University. Specifically, Drs. Russell Balda, Dean Blinn, W. Linn Montgomery, and Peggy Pollack. These fine educators generously gave me so much of their knowledge and more importantly time and contributed greatly to my success. I am grateful to my parents who have always supported my scholastic endeavors without question. Finally, the biggest thank you goes to my husband Jason Pilarski, who has been my constant companion on this crazy ride, and who carried half my stuff down to the LCR. You are my endless inspiration, and I can't wait for our next adventure.

TABLE OF CONTENTS

LIST OF FIGURES vi
LIST OF TABLES viii
ABSTRACT ix
INTRODUCTION 1
METHODS 5
Study site and sample collection 5
Gut contents 7
Analyses 11
RESULTS 17
Temperature & hydrologic conditions 17
Catch of fishes 18
Frequency of empty guts 20
Diet composition & food webs 20
NMDS analysis of patterns within species and seasons 23
Gut Fullness 29
DISCUSSION 30
BIBLIOGRAPHY 39
APPENDIX 1 71

LIST OF FIGURES

Figure 1: The Little Colorado River at base flow with associated clear-water conditions in April, 2012; as seen from approximately 3.7 rkm from the confluence with the mainstem Colorado River. Photo by Kathrine E. Behn..... 54

Figure 2: The Little Colorado River in flood in July, 2012, as seen from "Boulders Camp", 1.9 rkm from the confluence with the mainstem Colorado River. Photo by Colden V. Baxter. 54

Figure 3: The discharge and temperature of the Little Colorado River over the duration of our sampling. Data were collected by the U.S. Geological Survey at gauging station 09402300 (U.S. Geological Survey). Discharge data were converted from source's units (English) to metric. Temperature data from March through mid-April, 2014 were missing. 55

Figure 4: Seasonal food webs illustrating the average proportion of food resources in guts of Little Colorado River fishes (calculated by dry weight) during (A) July, 2012, (B) September 2012, (C) January, 2013, (D) March 2013, and (E) June 2014. 57

Figure 5: Non-metric multidimensional scaling (NMDS) analysis plots of Little Colorado River fish diets by species within season (A) July, 2012, (B) September, 2012, (C) January, 2013, (D) March, 2013, and (E) June, 2014. Datapoints are coded and grouped by species. Ellipses illustrate the 95% confidence interval of the bivariate mean of a given species calculated on standard error of the mean..... 59

Figure 6: Non-metric multidimensional scaling (NMDS) analysis plots of Little Colorado River fish diets by season within species: (A) bluehead sucker, (B) flannelmouth sucker, (C) humpback chub, and (D) speckled dace. Datapoints are coded and grouped by season. Ellipses illustrate the 95% confidence interval of the bivariate mean of a given season calculated on standard error of the mean. 60

Figure 7: Average proportions of dietary items by dry weight for (A) bluehead sucker, (B) flannelmouth sucker, (C) humpback chub, and (D) speckled dace in the Little Colorado River. Items within bars gradate from terrestrial origin at the top of the stack to ambiguous origin in the mid-section to aquatic near the bottom..... 61

Figure 8: Boxplots of seasonal measures of gut fullness across seasons for the four native fishes in the Little Colorado River: (A) bluehead sucker, (B) flannelmouth sucker, (C)

humpback chub, and (D) speckled dace. Weight of gut contents were normalized by size of the individual fish and multiplied by assimilation efficiencies to yield adjusted mass of gut contents per mass of fish. Boxes are bounded by the upper and lower 25% quartiles, and the dark band represents the median. Outliers are marked with open circles and whiskers span from the sample minimum to maximum (excluding outliers)..... 62

LIST OF TABLES

Table 1: Diet items observed in fish guts collected in the Little Colorado River from July, 2011 to June 2013. Listed are descriptions of diet items, corresponding names of groupings, assimilation efficiency multipliers, and assumed origins. Lumped group name abbreviations are: BAIHR = benthic aquatic invertebrates, high resistance to floods; BAILR = benthic aquatic invertebrates, low resistance to floods; PAILR = pelagic aquatic invertebrates, low resistance to floods 63

Table 2: Influential diet items that separated or grouped Little Colorado River fish species among seasons as revealed by non-metric multidimensional scaling. Items with coefficients of determination (r^2) values over 0.16 are shown, in increasing order, by month. Also included are the vector endpoints of the various diet items in diet space with color gradations indicating increasing (orange) or decreasing (blue) values. 66

Table 3: Influential diet items that separated or grouped seasonal patterns among diets of Little Colorado River fishes as revealed by non-metric multidimensional scaling. Items with coefficients of determination (r^2) values over 0.16 are shown, in increasing order, by species. Also included are the vector endpoints of the various diet items in diet space with color gradations indicating increasing (orange) or decreasing (blue) values. 67

Table 4: The degrees of freedom, *F* statistics, and *P* values for pairwise permutational multiple analysis of variance for species comparisons within months. *P* values are corrected with Holm's method for pairwise comparisons. Fish abbreviations are as follows: BHS, bluehead sucker; FMS, flannelmouth sucker; HBC, age 1 year+ humpback chub; HBC YOY, young-of-the-year humpback chub; SPD speckled dace. 68

Table 5: The degrees of freedom, *F* statistics, and *P* values for pairwise permutational multiple analysis of variance for month comparisons within species. *P* values are corrected with Holm's method for pairwise comparisons. Fish abbreviations are as follows: BHS, bluehead sucker; FMS, flannelmouth sucker; HBC (all months except June), age 1 year+ humpback chub; HBC 1+ (June), age 1 year+ humpback chub; HBC YOY (June), young-of-the-year-humpback chub; SPD, speckled dace. 69

ABSTRACT

Food webs are valuable tools for investigating and depicting the trophic relationships within interacting communities of organisms; however, like any other analysis these descriptions are dependent upon accurate data which encompass the full spectrum of consumption of food resources. Weak linkages and diversity within diets are thought to be stabilizing features of food webs that can account for resilience under environmentally variable conditions, although these features are often overlooked owing to a focus on the more obvious strong linkages. The free-flowing desert rivers of the American Southwest are naturally dynamic ecosystems containing fish assemblages adapted to withstand large fluctuation of flow, temperature and sediment loads. Along with unique morphological features, it is thought that plasticity in feeding behavior enables native Southwestern fishes to withstand the highly variable feeding conditions that are associated with swings in seasonal and hydrologic variability. Over the course of 2 years, we investigated the feeding ecology of the fish assemblage of the Little Colorado River, Arizona. We collected fish diet samples in July, September, January, March and June which included the following hydrologic-seasonal combinations: turbid summer, turbid fall, clear-water winter, turbid winter, and clear-water summer. Here we give a detailed description of the array and proportional contributions of food resources to fishes' diets. We present the findings in the form of fish-centered, 2-trophic-level food web modules (or sub-webs), inclusive of all potentially digestible food items, as well as non-metric multidimensional scaling analyses of diets and seasonal comparisons of gut fullness. Despite being only small subsamples of the greater ecosystem food web, our illustrations show high diversity of dietary items in terms of both absolute numbers and

consumer-to-resource ratios, within a fish assemblage that is apparently resistant to extreme but recurrent variability. All native fishes consumed a mix of terrestrial and aquatic resources, though the water column-feeding humpback chub had the largest percentage of terrestrially derived food items and appeared to capitalize on food resources made available by a summer flash flood. We propose that an opportunist/generalist feeding habit that takes advantage of both in-stream and terrestrial food resources as they are available, resulting in a food web of many weak linkages, has allowed native fishes to persist in this highly variable environment.

INTRODUCTION

Studies of food webs have been central to the science of ecology for nearly a century (Elton 1927), but their capacity to extrapolate broad generalizations may be inadvertently constrained by approaches that oversimplify the complexity of feeding relationships (Polis 1991; Martinez 1991; Gellner and McCann 2016). A focus on strong interactions, traditionally presumed to be the most important (Power et al. 1996), ignores weak linkages that may be critical to community function (Polis 1991; McCann 2012). The increasing use of integrative assimilation measurements, such as stable isotope analyses, can be time efficient and potentially more economical than traditional dietary analysis techniques, but these approaches are also susceptible to pitfalls in sample collection limitations or erroneous interpretations (Martínez Del Rio et al. 2009; Boecklen et al. 2011). For example, analyses of stable isotopes often provide relatively coarse measures of the elemental sources that support consumer tissues, but which highlight only major dietary components and obscure minor foodweb linkages as well as any periods of food limitation (Phillips et al. 2014). Mirroring the problems of oversimplification in analysis is the fact that many food webs exist in a degraded form, thus obfuscating inferences (Vitousek et al. 1997; Hobbs et al. 2006). Human-driven alterations of community structure and habitat homogenization may confound our understanding of natural trophic interactions (Chapin III et al. 2000; Hooper et al. 2005). Thus, understanding the complexity of feeding relationships in relatively intact systems may provide critical perspective for understanding diversity and stability of trophic interactions.

Prior to anthropogenic alterations, desert rivers of the Southwestern U.S. were subject to large swings in hydrology both intra- and inter-annually as part of their natural flow regime. Recorded discharge for the Colorado River at Lees Ferry (now gauge no. 09380000) from 1921 to the start of construction of Glen Canyon Dam in 1956 ranges from a low of less than 25 m^3s^{-1} in December, 1924 to a high of approximately 4,800 m^3s^{-1} in June, 1921 (Topping, Schmidt, and Vierra 2003; U.S. Geological Survey) with floods occurring from mid-April through early November. The long seasonal duration and extremity of flooding in Southwestern streams and rivers is driven by the fact that high flows can be a result of spring snowmelt, summer monsoonal events and tropical Pacific weather disturbances in the fall. Historically, these stochastic and sometimes localized events resulted in a patchwork landscape of aquatic habitats of different successional stages throughout river basins (Deacon and Minckley 1974; Meffe and Minckley 1987; W. L. Minckley and Marsh 2009; Larned et al. 2010). This dynamism set the stage for riverine food webs and the feeding ecology of the unique assemblage of fishes endemic to the Colorado River basin, which had presumably adapted to the feast and famine extremes of resource availability.

Southwestern native fishes, with the exception of a few top piscivorous predators such as the Colorado pikeminnow (*Ptychocheilus lucius*), have frequently been described as opportunistic generalists that evolved to feed on a variety of plants and animals in response to this environmental instability (Deacon and Minckley 1974; Smith 1981; Olden, Poff, and Bestgen 2006). However published studies of detailed diet analyses that incorporate the range of seasonal and hydrologic conditions that desert river fishes may encounter are few in number (e.g. Schreiber and Minckley 1981; Pilger, Gido, and Propst

2010) or limited in scope to a focal species (e.g. humpback chub, *Gila cypha*; Kaeding and Zimmerman 1983; Childs, Clarkson, and Robinson 1998; Valdez and Hoffnagle 1999). An added problem is that conclusions regarding trophic ecology of these fishes are likely influenced by the highly-altered flow regimes under which the most detailed studies have been conducted (e.g. Cross et al. 2013; Seegert et al. 2014). Such novel conditions may not be favorable to long-term survival of native species, and may provide a simplified perspective on food webs from environments that have experienced biophysical homogenization.

Desert river fishes and their feeding ecology have been studied for decades in the Colorado River in Grand Canyon due, in part, to the endangered listing of one of its resident fishes, the humpback chub, and a need to inform the adaptive management of Glen Canyon Dam operations. The dam has reduced annual flow variation, restricted variation in water temperature and eliminated the downstream passage of sediment and most organic material (Wright et al. 2005). Native fish populations in Grand Canyon likely suffer from common conservation challenges such as habitat modification and homogenization, as well as invasive species (Gloss and Coggins 2005). However, questions remain regarding the more unique ways in which flow regulation and physical manipulation affect the ecological integrity of this ecosystem. Other critically important factors that may contribute to native fish decline include the loss of functional traits within the invertebrate community and mismatches between seasonal production and the disturbances of hydropeaking (Cross et al. 2010; Cross et al. 2013; Hall Jr. et al. 2015; Kennedy et al. 2016). Fishes' migrations into tributaries and some species' long life spans have been hypothesized to mediate impacts of the dam on native fishes, although

continued problems with recruitment may eventually overtake natural resistance of these long-lived animals (Stefferud, Gido, and Propst 2011). Tributaries in the Grand Canyon remain largely unregulated, and those with the greatest range of flow variability are mostly free of exotic species; however, it is unclear what role beyond that of critical spawning habitat the tributaries play and to what degree the tributaries are being relied upon to bolster long-term survival. Observations of inter-annual and spatial variability in growth rates of juvenile fish in tributaries (Dzul et al. 2014; Spurgeon et al. 2015), as well as correlations between tributary hydrology and increased recruitment (Van Haverbeke et al. 2013), emphasize the need to identify factors leading to tributaries' influence on fish populations in the Colorado River.

Here we present a multi-season investigation of the diets of fishes in the Little Colorado River (LCR), a large tributary of the mainstem Colorado River in Grand Canyon. The LCR is largely unaffected by flow modification and subject to natural seasonal and stochastic swings in hydrology and turbidity. Invasion by non-native species has occurred, but thus far they have failed to dominate or even constitute a large proportion of the biomass (Stone et al. 2007; Van Haverbeke et al. 2013). The LCR also has the singular distinction of containing the full assemblage, including all life stages, of native fishes remaining in the Grand Canyon reach of the Colorado River. We compared food resource use within and across species and broadly hypothesized that within this free-flowing desert river: 1) native fishes consume a high diversity of diet items and have a correspondingly large number of weak linkages with food resources, and 2) high seasonal variation within diet composition and gut fullness occurs and is driven by hydrologic disturbance and seasonal phenology.

METHODS

Study site and sample collection

The LCR in Northern Arizona drains 68,635 km^2 of the mountains, forests, and deserts of the Colorado Plateau. The watershed is ephemeral throughout its length with perennial streams in the mountainous headwaters and near its terminus at the mainstem Colorado River in Grand Canyon where a unique and large (Q~6 m^3s^{-1}) karstic spring empties into the river channel (Blue Spring) approximately 21 rkm from the confluence. There are two small impoundments near the headwaters (River Reservoir and Lyman Lake), however the ephemeral nature of the midsection is not due to anthropogenic flow restrictions but the result of the arid climate and desert landscape. At baseflow, the lower perennial section of the river is renowned for the milky turquoise appearance of its calcium-rich water (Figure 1). Storm runoff and snowmelt from higher in the watershed flow through highland deserts (e.g., the Painted Desert), which are prone to erosion and subsequently contribute large amounts of sediment to the LCR and the mainstem Colorado River (Andrews 1991; Topping, Rubin, and Vierra 2000; Figure 2). The water chemistry of the LCR is markedly different from that of the mainstem Colorado River, particularly when the LCR is at baseflow and the characteristics of Blue Spring's water dominate the discharge. Chief amongst these differences, salinity and conductivity levels in the LCR are an order of magnitude greater, 3,500—6,000 µS cm^{-1} compared to 400—1,100 µS cm^{-1} in the mainstem (Kaeding and Zimmerman 1983). Additionally, due to the effect of Glen Canyon Dam (a hypolimnetic release structure) on the mainstem river and the groundwater influence on the LCR, the LCR is warmer than the mainstem throughout the year. Not only is this currently the case, but pre-dam temperatures of the mainstem

river only overtook those of the springs-dominated LCR for a few months in late summer (Kaeding and Zimmerman 1983; Voichick and Wright 2007).

We repeatedly sampled a 1.5 km reach starting at a point 1.9 km upstream from the confluence of the LCR and mainstem Colorado River. Though this reach contains all of the physical habitats found throughout the entirety of the perennially flowing lower segment (shallow pool, deep pool, riffle, travertine cascade), observations of spatial variability in humpback chub growth rates suggest it may not represent the full range of feeding conditions available to fish (Dzul et al. 2014). We expected, however, that seasonal and/or hydrologically driven differences in fishes' feeding ecology would exceed those associated with spatial variation and thus focused our efforts on repeated sampling of a location with the logistical advantages of access and having long-term monitoring data. Our goal for seasonal sampling was to capture the four seasons and two turbidity conditions that occur under a spring snowmelt, summer rainy season climate: summer/clear, fall/turbid, winter/clear, spring/turbid. As we began the summer/clear sampling in July 2012, we were struck by the first flood of the monsoonal season (Figure 2), which added an additional pairing of season and hydrology; summer/turbid. After missing the clear-water window of summer sampling again in 2013, we were forced to delay the collection of this potentially highly productive and energetically influential period until the summer of 2014.

Sampling of all species of fish was done with the approval of ISU's Internal Animal Care and Use Committee, as well as permitted by the U.S. Fish and Wildlife Service and Arizona Game and Fish Department. We captured fish using methods approved by the U.S. Fish and Wildlife Service for sampling waters containing high

numbers of endangered humpback chub, in this instance hoopnets, seine hauls and targeted dip-net sweeps (Van Haverbeke et al. 2013). Another common sampling method, electrofishing, has reduced efficacy in the LCR due to the high conductivity of the water (Meador, Cuffney, and Gurtz 1993).

We relied on hoopnets (0.5–0.6 m in diameter, 1.0 m in length, 6-mm mesh, with a single 0.1-m throat; Memphis Net and Twine, Inc.) as a primary method of capture for large fishes following the methods of Van Haverbeke et al. (2013). We scent-baited nets by loading common dry cat food into bait tubes fashioned out of PVC pipe and clipping them to the interior of the net. Fish could detect the presence of the bait through ¼ inch holes in the wall of the pipe, but could not access it. We checked nets at approximately 2 hour intervals in order to balance the time that fish would be trapped and likely not feeding (but still digesting), and the need to minimize our presence in the area. We used seine hauls (1/8" mesh, Memphis Net and Twine, Inc.) to capture small-bodied fishes that we expected would not be captured in high numbers with hoopnets (e.g. speckled dace, *Rhinichthys osculus*, and juvenile suckers). We performed seine hauls over sandy, low-angled shorelines, cobbled substrates, in-between travertine cascades, and in backwaters. Once captured, we transported fish directly to our processing area in buckets of aerated water.

Gut contents

We utilized two methods for sampling the gut contents of fishes, dependent on species. For endangered humpback chub, we used a non-lethal gastric lavage method (the Baker-Fraser method; Stone 2004), which has been approved for use in chub over 100 mm long in the LCR by the U.S. Fish and Wildlife Service. This approach is

distinguished by flushing from the vent to the mouth and unavoidably introduced some methodological variation into comparisons among species (because humpback chub samples consisted of the contents of the entire gut tract). However it has been demonstrated to maximize effectiveness while minimizing risk based on humpback chub gut morphology (Stone 2004).

For the lavage, we used a manual pump-style pesticide/herbicide sprayer that was modified with a pipette tip on the end of the delivery tube. The sprayer contained river water sieved to 60 µm to reduce contamination from drifting particulates. We anesthetized chub by placing them individually in a bath of river water containing a small amount of tricaine methanesulfonate (aka MS-222). Chub were observed and monitored to gauge their reaction to the drug. We removed fish from anesthesia and proceeded with lavage when tail movements became slow and weak. Although we did not conduct a structured comparison of MS-222 vs. clove oil, after just a few initial attempts testing both compounds as anesthesia, the MS-222 treatment resulted in the fish being easier to handle and led to a faster procedure and thus increased overall success. If a fish did not respond to attempts to lavage it and water appeared to be running through the gut tract, we passed it onto the recovery bath with no sample collected and recorded it as empty. As we conducted the lavage procedure, we collected an individual's gut contents in a plastic tray. We then concentrated the material by passing it through a 60 µm sieve and preserved it in 70% ethanol. We received an additional sampling of humpback chub from U.S. Geological Survey colleagues working in the LCR that consisted of a small number of less than 100 mm fish (young-of-the-year, YOY) collected as accidental mortalities. These small chub were collected during June and July of 2014. All species other than

chub were sampled lethally. For small fish (up to approximately 100 mm total length), we preserved the entire body but made a small cut to the abdomen to increase preservative penetration to the abdominal cavity. For large fish (> 100mm) we removed the entire gastrointestinal tract in the field and preserved it in ethanol.

In the laboratory, we sorted the gut contents into categories using 10—40X magnification microscopes. Humpback chub samples went directly to microscopic analysis while other species' gut contents first had to be removed from the dissected gut. For species that have a "true" stomach, and for juvenile suckers, we removed the portion of the gut anterior to the first u-bend. For medium and large suckers, we dissected out the anterior 20% of the gut by length. This subsampling of the length of the gut was performed to avoid overemphasizing those diet items that were resistant to digestion. We separated diet items into groups of similar origin (terrestrial or aquatic) and, for invertebrates, identified them to taxonomic Family when feasible. We also noted the presence of parasitic Asian tapeworm (*Bothriocephalus acheilognathi;* Clarkson, Robinson, and Hoffnagle 1997; see Appendix 1). At this point, we transferred the categorized diet items into individually pre-weighed (± 0.1µg) aluminum tins and dried them at 60°C for at least 12 hours, after which we re-weighed the tins with contents and subtracted the weight of the tin to determine the dry weight of the diet material.

Not all individuals that we sampled for gut contents contained measurable material, and at other times, materials were almost negligible. In instances where there was no externally derived material that was discernable from gut tissue, an individual was classified as empty and dropped from further compositional analyses. In instances where gut contents were so small as to be of questionable value in characterizing the diet and

more likely merely residual materials of digestion (mostly amorphous detritus and terrestrial vegetation), additional criteria were used to classify a fish as "functionally empty." Large-bodied fishes were labeled functionally empty if gut contents weighed less than 1 µg dry mass in total. Small-bodied fishes were labeled functionally empty if gut contents were less than 0.5 µg dry mass and contained no identifiable invertebrate matter. The reasoning behind this was that some very small individuals were observed whose guts contained, for instance, a single chironomid larvae (weight = 0.2 µg) that took up the entire volume of the stomach. In this scenario, a total dry mass less than 0.5 µg, despite being very small, constituted a valuable data point for characterization of diet.

After processing the gut contents with a dissection scope, most samples had large proportions (up to 100%) of fine materials that were questionable in nature and insufficiently described at 10—40X magnification. Possible constituents ranged from high quality items such as diatoms and microscopic algae to indigestible items such as sand. Given the high proportion and frequency of the fine materials and the large range of potential quality, we proceeded with further analysis at higher magnification.

We first accounted for the weight of the organic portion of the fine material by estimating the ash-free dry mass. We quantitatively subsampled the fine material, dried it in the same manner as the identifiable components with the exception of using pre-ashed tins, combusted the samples at 500°C for 4 hours, and weighed the remaining inorganic material. We calculated the organic fraction by subtracting the initial dry weight from the final ash weight (minus the weight of the tin) and extrapolated to the whole of the sample using the subsample to total volume ratio. We omitted the inorganic sediment weight from the calculations of dietary components and all subsequent analyses.

We then used 400X microscopic visual analysis to characterize the organic portion of the fine materials following the procedure of Seegert et al. (2014), who demonstrated that area and weight-based estimates of fine-fraction gut contents of small-bodied fishes in the Colorado River in Grand Canyon were comparable. A cursory assessment revealed relatively few identifiable resources (diatoms and other unicellular algae, plant material, amorphous detritus, and very rarely, invertebrate parts), so we proceeded to subsample the remaining samples. We randomly chose a maximum of 10 individuals from each season/species combination for this analysis and proceeded to make slide mounts for these samples. We visually scanned the filter field with 4 centrally located transects (2 horizontally oriented, 2 vertically oriented). We disregarded sand particles and categorized and estimated the proportional area of the organic materials to the nearest 5%. We then applied these proportional estimates to the extrapolated weight of the organic fine fraction component that we collected via the aforementioned combustion procedure. For those samples that we precluded from individual microscope analysis, the averages of the season/species combination of those that were analyzed were applied to the weight of the fine fraction.

Analyses

To address our first overarching hypothesis, that LCR fish diets would contain a high diversity of diet items and that trophic linkages would be skewed towards many weak links, we quantified seasonal diet proportions and food web pathways to fishes. We used the asbio package (Aho 2016) in R (R Core Team 2014) to calculate bootstrapped means (10,000 permutations) and bias-corrected and accelerated 95% confidence intervals for the different proportions of diet items. We chose the bias corrected and

accelerated method of calculating confidence intervals due to its capacity to incorporate skew in the proportion data and its lower bounding at zero. We then used the software program Pajek (Batagelj and Mrvar 1996) to create seasonal food web diagrams of fish species connected to their food resource organisms by weighted lines representing the bootstrapped average diet proportions. To compare seasonal food webs quantitatively, we calculated food web connectedness metrics that included the number of taxa, number of linkages, the average number of links per consumer species, the total number of weak linkages (using thresholds of both 1% and 5% of the average fish species' diet; cf. Winemiller 1990), and we identified the species with the highest number of linkages.

To address our second set of overarching hypotheses, that we would find high seasonal variation within diet composition and gut fullness and that it would be driven by hydrologic disturbance and seasonal phenology, we conducted non-metric multidimensional scaling analyses (NMDS), examined seasonal trends in groups of dietary items, and compared variation in measures of fullness within and among species. After initially assessing the diversity and composition of seasonal consumption using food webs, we then grouped diet items into larger, descriptive categories preceding NMDS analysis (Table 1). We used a functional traits based approach to lump aquatic and terrestrial invertebrates into groups of similar origin and or means of delivery to the water column based on hydrologic resistance according to knowledge of natural history and morphology (cf. Townsend, Scarsbrook, and Dolédec 1997). This approach allowed us to focus on how hydrology and seasonality affected food resources throughout the year as well as by species of fish and associated feeding mode. We created 18 functional categories, three of which contained most species of aquatic invertebrates: benthic

aquatic invertebrates with low resistance to floods (i.e. those taxa without grasping hooks or claws), benthic aquatic invertebrates with high resistance to floods (i.e. those that burrow or attach to the benthos), and pelagic aquatic invertebrates with low resistance to floods (i.e. typically water surface or water column residents). We expected that benthic aquatic invertebrates with high resistance to floods would be consumed most consistently through time and across the array of native fishes. We expected that pelagic aquatic invertebrates with low resistance to flooding would be consumed most sporadically through the year, and in the highest numbers following long periods without floods. We also expected that benthic aquatic invertebrates with low resistance to floods should be consumed more sporadically than benthic aquatic invertebrates with high resistance to floods but at higher rates than pelagic invertebrates. A notable exception to this three-category system of aquatic invertebrates was chironomid midges, which we treated as its own group. This decision was based on the difficulty of identifying chironomids beyond family and the fact that they occupy a very large range of microhabitats spanning the range of vulnerability to floods (Ferrington Jr., Berg, and Coffman 2008), from vulnerable biofilms (e.g. *Eukiefferiella spp.*) to less susceptible depositional sediments (e.g. *Chironomus spp.*). Terrestrial invertebrates were lumped into general terrestrial invertebrates, riparian invertebrates (those usually associated specifically with riparian vegetation) and winged terrestrial invertebrates. We expected that, as a whole, terrestrial invertebrates would show up in fish diets most frequently during flooding events when they are entrained by rising waters. Riparian invertebrates were expected to be consumed in higher amounts in the summer and fall when deciduous plants are in leaf (Baxter, Fausch, and Saunders 2005; Rundio and Lindley 2012). Winged terrestrial invertebrates

should be the least likely to be swept up by flooding but may show increased summer seasonality correlating to vegetation cycles and temperature.

In the second suite of analyses we focused solely on the four native fishes that dominated the assemblage: bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), humpback chub (*Gila cypha*; adult and juvenile for July 2014), and speckled dace. Our catch of nonnative species was extremely low and often restricted to one or two seasons per species which limited quantitative comparisons. Moreover, our intent was not to assess food limitation or competition between species or natives vs. nonnatives per se, but to evaluate the general trophic ecology of fishes in an un-impounded tributary, and thus we required a robust sampling of a species over time.

We used the vegan package (Oksanen et al. 2013) in R (R Core Team 2014) to conduct the NMDS procedures. We performed ordination analyses on individual fish's dietary proportions and also plotted the results by month, evaluating overlap among species, and plotted by species to evaluate overlap among seasons. We kept our data in the form of raw proportions of the diet (i.e., untransformed), specified Bray-Curtis distance measures, standardized our results with 2-D solutions, and depicted groups within plots using ellipses representing 95% confidence intervals for the true bivariate centroid based on standard errors of the mean. After having already established the degree of diversity in LCR fishes' diets using the food webs, for the purposes of the NMDS analysis, we removed functionally grouped diet items that never constituted at least 5% of a species' average diet. This step diminished the effects of very rare diet items and allowed us to focus on drivers of groupings or similarities between species or months (McCune and Grace 2002). In doing so, we omitted fish eggs and macrophytes.

Fish tissue was also omitted as a diet item in the NMDS analysis because fish consumption was quite rare in our dataset and averaged proportions were low, excluding the gut contents of an individual speckled dace in January. We also omitted amorphous detritus from our NMDS analysis to avoid the possible methodological bias towards larger proportions of amorphous detritus in humpback chub due to whole gut lavage technique that we used for this species (vs. only the anterior 20% of the gut for other species). Unlike the suckers and dace, we separated out YOY humpback chub in the seasonally separated analyses. The size distribution of the catch of suckers and dace within a given season typically did not allow for a robust analysis of separate life stages, and while we could not conduct across-season comparisons for YOY humpback chub, we judged that any additional analysis for this species life stage would contribute to the limited knowledge base. To further refine the results of the NMDS analyses, we also conducted pairwise permutational MANOVA's (M. J. Anderson 2001) on the lumped diet data grouped by species within sampling seasons and grouped by season within species to statistically identify multivariate similarities and differences between groups (species and seasons respectively). The adonis function in the vegan package is a permutation modified MANOVA algorithm suitable for non-normally distributed data such as dietary proportions, and, unlike the ellipses which we used to visually illustrate the central location of species or seasons, does not restrict community results to a 2-D summary of a distance matrix. We specified the Bray-Curtis method of differentiation, performed 10,000 permutations, and adjusted *P* values for multiple comparisons using Holm's method (Holm 1979). As a final step in our NMDS analyses we conducted vector fit analysis to further inform the comparisons among groups resulting from the

MANOVA. For each analysis, we viewed the correlation coefficients of the distribution of points along the vectors representing the 14 dietary groups. We judged those vectors with the highest correlation coefficients as being primary drivers of groupings or of separations of species and or months if data points overlapped or grouped separately along vectors, respectively.

Lastly, to explore gut fullness among seasons, we estimated gut fullness corrected for food quality, which allowed us to investigate seasonal variation in the context of food resources to consumers (following Ahlgren 1990). We first multiplied the weights of the different food categories for a given individual fish by literature-derived estimates of assimilation efficiency ("AE" multipliers, Table 1). Easily digestible food items such as aquatic invertebrates with little tissue defense were multiplied by high values, whereas more indigestible tissues such as dry terrestrial plant material were multiplied by small values. Assimilation efficiencies were 0.1 for *Cladophora* and other macroalgae (Leibfried 1988) and 0.5 for diatoms (Huryn 1996). Zooplankton efficiencies were 0.6 (Ahlgren 1990). All other aquatic invertebrate assimilation efficiencies ranged from 0.7 to 0.9 (Atmar and Stewart 1972; Eiriksdottir 1974; Elliot 1976). We assigned invertebrate exuviae a nominal value of 0.1. Fish and fish eggs efficiencies were 1 (Elliott and Hurley 2000). Snail tissue was also 1 apart from intact Physid snails which we assigned a value of 0.5 to account for the indigestible shell portion. Terrestrial vegetation and bryophytes were 0.2 (Fowler 1982). We estimated terrestrial seeds (0.4) at the high end of a range for plant material from Wiley and Wike (1986), Terrestrial invertebrates and pupating aquatic invertebrates were 0.7 (Warren and Davis 1967) with the exception of the grub-like Dolichipodidae fly larvae (0.9) and terrestrial beetle larvae,

often Elateridae (0.8). The assimilation efficiency for amorphous detritus was 0.2 (Ahlgren 1990). Based on these new AE-corrected weights, we then re-calculated individual fishes' total gut contents. We also normalized totals by the weight of the individual fish to account for differences in species size and gut morphology. We illustrated the distribution and medians of these data using box and whisker diagrams.

RESULTS

Temperature & hydrologic conditions

The discharge of the LCR and associated water clarity varied dramatically among our sampling trips. Additionally, we captured the full range of annual temperature variation, from a low of approximately 12°C to a high of approximately 26°C (Figure 3). On our first day of sampling in July of 2012, our sampling crew was caught up in the first large spate of the summer monsoon season (Figure 2 and Figure 3). The river was already turbid from small-scale, localized runoff when we began collections and daily high water temperatures had fallen from approximately 26.5°C to 22.5°C, although the river's discharge had not yet diverged from baseflow. Shortly after we began collecting fish, the discharge rose suddenly by 10X to a measured peak of 69.7 m^3s^{-1}.

In September of 2012, near the end of the monsoonal season, the river had been turbid or actively flooding since the July spate. Contributed sediments had yet to clear out and water clarity had been low throughout the duration from July to September. Water temperatures during this period were still seasonally warm (19—23°C; Figure 3) and near their annual high for the year.

In January of 2013, the river was running clear at baseflow (~ 6 m^3s^{-1}). The last significant flood of the 2012 monsoon season had occurred in mid-September and the river had returned to baseflow by October 1. There had yet to be any winter storms warm enough or large enough to result in above average discharge. Temperatures were at or near the lowest recorded during baseflow for that winter (11—13°C; Figure 3); winter storms carrying cold runoff later drove water temperature down to below 6°C. Catch numbers in January were low, and our field crew had to sample late into the night to bolster sample sizes for even the most numerous fish species (in this case, humpback chub). The LCR resumed a pattern of low-grade flooding in late January such that by the March collection trip, it had been moderately above baseflow for the duration between sampling trips, apart from less than 1 week in early March 2013. During the March sampling period the river was under the influence of a small freshet which brought discharge up to 44.7 m^3s^{-1} and drove water temperature down to 10—14°C (Figure 3).

Winter storms and snowpack runoff were sparse over the winter of 2013—2014. A large storm in late November produced a 55—85 m^3s^{-1} flood. The only other significant runoff event of the winter of 2013—2014 occurred as snowpack melt in early to mid-March, which resulted in a right-tailed hydrograph peak with a maximum Q of 42.5 m^3s^{-1} (Figure 3). Baseflow resumed by April 1 of that year and continued through the sampling effort in June. By the sampling in June, water temperatures were nearing their high for the year (18—25°C; Figure 3).

Catch of fishes

We caught the following 12 fish species over the course of the 5 sampling trips: native bluehead sucker (BHS), flannelmouth sucker (FMS), humpback chub (HBC), and

speckled dace (SPD), as well as nonnative black bullhead (*Ameiurus melas*, BBH), brown trout (*Salmo trutta*, BRT), common carp (*Cyprinus carpio*, CAR), channel catfish (*Ictalurus punctatus*, CCF), fathead minnow (*Pimephales promelas*, FHM), plains killifish (*Fundulus zebrinus*, PKF), rainbow trout (*Oncorhynchus mykiss*, RBT), and redside shiner (*Richardsonius balteatus*, RSH) (see Appendix 1).

The catch of native fishes (79%—99.7%) greatly outnumbered nonnatives (Appendix 1). High numbers of plains killifish in July 2012 during the summer flood event increased the percentage of non-natives for that trip, but we observed relatively few on subsequent trips. Brown trout and rainbow trout were each represented by a single individual. The brown trout had an empty gut. The gut contents of the rainbow trout are reported (Appendix 1), although this fish was excluded from further dietary analysis. We quantified the composition of the diets of nonnative species (Appendix 1), and included them in our food web illustrations and analyses (Figure 4). However, due to the dominance of natives in our catch and the low sample size of non-natives throughout our seasonal sampling, we restricted further quantitative comparisons to native species only. Of the total 497 specimens collected for dietary analysis, 476 individuals were processed. The collection of plains killifish from the September 2012 (13 fish) was lost in a lab accident and eight individuals of various species and seasons were considered too disintegrated to process for contents.

Among the repeatedly caught native species (bluehead sucker, flannelmouth sucker, humpback chub, and speckled dace), we observed some trends in catch of fish with different gear types and associated habitats. Humpback chub older than one year were most frequently caught in hoopnets (mean = 88%, Appendix 1) which were most

commonly placed in pools and deeper runs. On the other end of the spectrum, speckled dace were caught primarily using seines (mean = 78%, Appendix 1) which were pulled through riffles, shallow runs and shallow pools interspacing travertine cascades. Bluehead suckers were slightly more likely to be caught and sampled with seines (mean = 63%, Appendix 1), whereas flannelmouth suckers were equally likely to be caught and sampled in seines or hoopnets (mean = 47% hoopnets, 53% seine; Appendix 1). The small number of young-of-the-year humpback chub that were sampled and found with food items were caught in hoopnets 60% of the time and by seines 40% of the time (Appendix 1).

Frequency of empty guts

Among the fish that we sampled, the frequency of those with empty guts varied with season and species (Appendix 1). Across the sampling trips, we observed the highest overall frequency of empty guts in January 2013 when 27% of sampled fish had empty guts, however the highest percentage within a species occurred in June when 58% of bluehead suckers caught were devoid of food.

Diet composition & food webs

We observed 84 total digestible food items in the gut contents of LCR fishes (Table 1, Appendix 1). We characterized 53 of these diet items as being aquatic in origin, 28 as being terrestrial, and the remaining 3 as ambiguous in origin (Table 1). In addition to these digestible materials, we encountered travertine, mineralized *Chara* (a green alga encrusted in calcium carbonate deposits), fine sediment, small stones, cases of caddisfly larvae, crushed snail shells, bone, as well as unidentifiable items (organic, but likely inedible; Appendix 1). These items were excluded from further analysis due to

their indigestibility. Travertine can be incidentally consumed in addition to high quality food items in instances where it is part of a diatom/travertine matrix (C. O. Minckley and Deacon 1975), however 400X microscopic analysis revealed few if any diatoms, leading us to conclude it had little to no nutritional value. Mineralized *Chara* was restricted mainly to the guts of humpback chub collected in January, and though the vegetative tissue may have had some very minor caloric value, the exceptional density compared to other diet items, and consequently its potential to distort results of weight-based analyses, led us to omit it. We also observed small filaments that appeared to be plastic in many samples, but we did not record these as we could not be certain that they did not appear as a by–product of the equipment used in fishing and containment efforts (e.g. nets, buckets, etc.).

The diets of humpback chub were far more diverse overall than those of the other native fishes, with a total of 73 distinct food items encountered in chub gut content samples (Figure 4, Appendix 1). Following chub, in order, were flannelmouth suckers (41 total diet items), speckled dace (36 diet items) and bluehead sucker (34 diet items). We recorded fish tissue in the diets of all native fishes (Appendix 1), but were unable to identify prey species and therefore these linkages were omitted from the food webs. Fish sampled during the scouring flood of July contained the highest diversity of food resources (70 items, Figure 4A), and, not surprisingly, the food web for this season had the highest number of links per fish species of any recorded throughout our study (59, humpback chub). Correspondingly, measures of connectedness were low (0.054) in this season indicating a shift towards many weak links between fishes and their prey. On the opposite end of the spectrum, in the clear-water period of January, we found the lowest

number of dietary items in fish guts, half that of July (30, Figure 4C). Web connectedness was correspondingly high (0.123), indicating a stronger weight on average of links between consumers and prey. January was the only month in which humpback chub did not consume the highest diversity of diet items, a distinction that belonged to flannelmouth sucker (21 items, Figure 4C), though chub were a close second with 20 diet items. Food webs for September, March and June fell between these two endpoints and had similar maximum linkages of any species (37—42, humpback chub in all cases, Figure 4B,D,E), similar number of prey items (48—47), and roughly similar connectedness (0.08—0.09). The higher connectedness in June was the result of low diversity in bluehead sucker diets during that period.

Throughout the duration of our study, most food web linkages represented low percentages of the total proportion of a species diet (i.e. most linkages were weak links). In July, the month with the highest diversity of prey items, the proportion of links that represented 1% or less of a species average diet was 65%. Extending the threshold to a maximum of 5% encompassed 84% of the linkages in the July food web (Figure 4A). The number of weak links was smallest in January, nevertheless over 50% of links represented 1% or less of the average diet, and 70% represented at most 5% of the average diet (Figure 4C). Results from September, March and June spanned these values (Figure 4B,D,E).

Occurrence of terrestrial items in food webs peaked in July corresponding with monsoonal floods (31% of food items, Figure 4A), and was lowest in clear-water January, amounting to just over half that of July (17%, Figure 4A). However, the frequency of terrestrial food items in food web pathways to fishes was not strongly

associated with turbidity. For instance, the food web for September (turbid) contained 25% terrestrially derived food items (Figure 4B), while March and June food webs, during flooding and clear-water respectively, both contained 30% terrestrial items (Figure 4D,E).

NMDS analysis of patterns within species and seasons

NMDS and permutational MANOVA analysis of fish gut contents collected in July (Figure 5A, Table 2) revealed that, during this period, diets of speckled dace and both species of suckers overlapped with one another whereas humpback chub was distinct from this group (speckled dace vs. bluehead sucker $P = 1$, speckled dace vs. flannelmouth sucker, $P = 0.7$, bluehead sucker vs. flannelmouth sucker $P = 1$, all other species combinations $P < 0.01$; Table 4). Multiple dietary components drove this division (Table 2). The top two drivers of this pattern were insect parts, which were more common in chub than other species (14% of chub diets vs. < 5% average for suckers and dace) and benthic aquatic invertebrates with low resistance to floods, which were consumed to a higher degree by the suckers and dace than chub (11%—19% for suckers and dace, 3% for suckers). In addition to these differences humpback chub ate 2X the combined amounts of two terrestrially derived items (terrestrial vegetation and terrestrial invertebrates, 32% combined) than the other species (suckers and dace average = 17%), while suckers and dace consumed 2X the combined aquatic resources of benthic aquatic invertebrates with high resistance to floods, chironomids, diatoms, and pelagic invertebrates (combined average of 24% vs. 10% for chub).

In September (Figure 5B, Table 2), diet composition of suckers and dace overlapped again (speckled dace vs. bluehead sucker, $P = 0.3$, speckled dace vs.

flannelmouth sucker, $P = 0.1$, bluehead sucker vs. flannelmouth sucker, $P = 0.4$, Table 4), whereas chub differed from the suckers and dace group (humpback chub vs. all species combinations, $P < 0.01$, Table 4). Food items associated with this division were terrestrial vegetation, benthic aquatic invertebrates with low resistance, and insect parts, although terrestrial vegetation was by far the most important driver. The terrestrial vegetation that we observed in humpback chub gut contents in September constituted the single highest average (60%) of any food item from any species-time combination and 2—3X more than that of suckers and dace (23% for both bluehead suckers and dace, 33% for flannelmouth suckers). Following terrestrial vegetation, benthic aquatic invertebrates with low resistance to flooding also drove the separation between the suckers and dace group and humpback chub (9.6% average in diets of suckers and dace, 1.1% average in humpback chub). Invertebrate parts separated suckers from humpback chub, however in this instance it grouped humpback chub and speckled dace. Diets of humpback chub and speckled dace consisted of 10% and 11% invertebrate parts respectively, while diets of flannelmouth suckers had less than half of that at 5.4% and diets of bluehead suckers consisted of less than 1% invertebrate parts.

In January (Figure 5C, Table 2), the only difference that we detected among diets of the fish assemblage occurred between humpback chub and the two species of suckers ($P < 0.01$, Table 4). This difference was driven by consumption of chironomids, benthic aquatic invertebrates with high resistance to flooding, and terrestrial vegetation. Suckers consumed large proportions of chironomids (40% for bluehead suckers, 51% for flannelmouth suckers) but low percentages of benthic aquatic invertebrates with high resistance to flooding (both under 10%), while chub ate larger proportions of terrestrial

vegetation (30%) and benthic aquatic invertebrates with high resistance to flooding (22%). Our sample size of speckled dace was low in this period (n=4) but their diets did not appear distinct from any of the other species.

In March (Figure 5D, Table 2), after an extended period of turbid conditions, the diets of all species were distinct from both one another ($P < 0.05$ for all species combinations, Table 4). A caveat is that the sample size for flannelmouth suckers was low during this period (n=3). Driving these differences were consumption of terrestrial vegetation, benthic aquatic invertebrates with high resistance, and chironomids. Similar to September, in March humpback chub consumed large proportions (58%) of terrestrial vegetation which was the 2nd highest proportion for any species-food item time combination observed during the study. Terrestrial vegetation in diets of humpback chub was found at nearly twice that in diets of bluehead suckers (33%) and nearly 3X that of flannelmouth sucker (14%) and speckled dace (10%). Speckled dace in this month consumed the highest proportion of benthic aquatic invertebrates with high resistance (53%), which set their diets apart from the other species. Finally, in this period, chironomids constituted only relatively low proportions of speckled dace (7%) and flannelmouth sucker (9%) diets, but we found higher levels in bluehead suckers (21%) and only traces in humpback chub (<1%).

Diets of fishes in June (Figure 5E, Table 2) showed the highest degree of separation among species with all species-pair combinations statistically distinct from one another (all $P < 0.01$, Table 4), except that of flannelmouth suckers and speckled dace ($P = 0.20$, Table 4). Important drivers of these differences were consumption of *Cladophora*, chironomids, and diatoms. In June, adult humpback chub consumed large

amounts of *Cladophora* (37%), a pattern not observed in any other species. Flannelmouth suckers, speckled dace, and bluehead suckers grouped together based on their consumption of high proportions of chironomids (flannelmouth sucker = 25%, speckled dace = 17%, bluehead sucker = 18%). However, bluehead suckers consumed large quantities of diatoms (mean = 31%), which, like the consumption of *Cladophora* by humpback chub, distinguished their diets from those of other species and split them from the observed groupings.

Ordination and permutational MANOVA analysis of bluehead sucker diets revealed a large degree of variation among individuals within seasons which contributed to their dietary overlap among most seasons (Figure 6A, Table 3). The only pairwise seasonal differences for this species occurred between June and July ($P = 0.02$, Table 5), and between June and March ($P < 0.01$, Table 5). Bluehead sucker consumption of chironomids, which ranged from 6—40% was the most important driver of these differences amongst seasons. Following the importance of chironomids was variation in bluehead sucker consumption of diatoms and terrestrial vegetation, which ranged from 0—30% and 10—33% respectively. For bluehead suckers, the highest degree of dietary overlap among seasons occurred between July and September ($P = 0.31$, Table 5) when percentages of diatoms were low (< 10% during both samplings), and chironomid and terrestrial consumption were similarly moderate to high (chironomid range 12—6%, terrestrial vegetation range 21—23%).

Flannelmouth suckers diets showed some clustering around the summer months of June and July ($P = 0.06$, Table 5) and June and January ($P = 0.05$, Table 5), whereas marked differences occurred between most other month combinations (all $P < 0.05$, Table

5, Figure 6B). March was statistically similar to July, September, and January, but inference regarding flannelmouth sucker in this month (*n*=3) is weak owing to low sample size. Differences among months were driven by variation in proportions of chironomids, terrestrial vegetation, and terrestrial seeds (Table 3). Overlap between diets of flannelmouth sucker in July and June was likely a result of very similar proportions of chironomids which were 20% and 25%, respectively. Differences between September and the January/June grouping can be attributed to alternating high amounts of aquatically and terrestrially derived food resources. Chironomids ranged from less than 4% in September to over 50% in January and over 25% in June. The pattern of terrestrial vegetation was opposite, 33% in September, 6% in January, and 9% in June. Terrestrial seeds followed a pattern similar to terrestrial vegetation (September = 6%, January = not present, and June < 1%), but constituted large proportions of the diet in March (22%). The number of flannelmouth suckers collected in March were few in number (*n*=3), and their diets were highly variable, resulting in overlap with July, September and January.

Humpback chub diets differed amongst all sampling periods and between juvenile and adults (all $P = 0.002$, Table 5), except after prolonged flooding (i.e., September and March; $P = 0.08$, Table 5). The food resources that drove much of these differences were terrestrial vegetation and *Cladophora.* The category of benthic aquatic invertebrates with high resistance to floods was the third most important group (Table 3). Similar to flannelmouth suckers, humpback chub's consumption of terrestrial vegetation co-varied with turbidity and flooding and alternated with other aquatic food resources. Consumption in September and March was dominated by terrestrial vegetation (59% and 58% respectively; Figure 7C) whereas the lowest average proportion of terrestrial

vegetation that we observed in chub guts was in June (14%). Diets of chub in June aged 1 year+ contained large proportions of *Cladophora* (37%) which was rarely, if ever, documented in other seasons. The proportion of benthic invertebrates with a high resistance to flooding ranged from a high of 22% in January to a low of less than 4% in September after prolonged flooding. In diets of chub in January, this functional grouping consisted primarily of caddisfly (Hydropsychidae) larvae and mayfly (Baetidae) nymphs (Appendix 1).

NMDS and permutational MANOVA analysis of dace revealed some clustering of summer months (July and June; Figure 7D, $P = 0.15$, Table 5). A slight degree of overlap between January and July was observed, as well as between January and March. However, the low sample size in January (n=4) likely limits this inference. All other month combinations lacked significant overlap (all $P \leq 0.02$, Table 5). Food items most important to driving differences and similarities in dace diets were benthic aquatic invertebrates of both high and low resistance, and terrestrial vegetation (Table 3). Benthic aquatic invertebrates with high resistance to floods were eaten most frequently by dace in January and March (53% and 46%, respectively, see Figure 7D for all grouped dietary averaged for speckled dace) and least frequently in July, September and June, 9%, 11% and 11% respectively. Consumption of benthic aquatic invertebrates with low resistance to floods was similarly moderate in July, and September (11% and 10%), but double that in June (22%). Terrestrial vegetation in dace diets generally corresponded with turbidity and ranged from a high of 23% in September to a low of only 6% in June.

Gut Fullness

Despite differences in sampling techniques, humpback chub exhibited lower measures of gut fullness (corrected for assimilation efficiency of food resources) compared to the other species. Humpback chub's highest seasonal median was ~ 3X lower than bluehead sucker highest seasonal median (Figure 8). This pattern also held for raw values of fullness. Speckled dace had the highest measures of fullness, three individuals had over 10 µg AE-corrected dried gut contents per body mass (g) of fish, and the annualized median for dace (0.8 µg g^{-1}) was double that of flannelmouth suckers (0.4 µg g^{-1}) and 4X that of bluehead suckers (0.2 µg g^{-1}; Figure 7).

Humpback chub exhibited the highest degree of seasonality or hydrologically influenced variability in gut fullness (Figure 8C), though bluehead suckers were a close second. In July during the monsoonal flood, the median fullness of chub guts (0.5 µg g^{-1}) was more than twice that observed for chub in any other season. The 2nd highest gut fullness for humpback chub was found in June (median = 0.1 µg g^{-1}; Figure 8C). Similarly, bluehead suckers also had their highest levels of fullness during the July flood (median = 1.6 µg g^{-1}) compared to all other sampling periods, although the 2nd highest was found in January (median= 0.3 µg g^{-1}; Figure 8A). Flannelmouth suckers exhibited the highest measures of fullness in June (0.7 µg g^{-1}; Figure 8B), whereas measures of median fullness in July and January were similar (0.3 µg g^{-1} and 0.4 µg g^{-1}, respectively). Flannelmouth suckers had much lower fullness in September (median = 0.1 µg g^{-1}) and March (median = 0.001 µg g^{-1}) after 10 weeks of chronic flooding in September and nearly 8 weeks of turbid conditions in March.

DISCUSSION

Our study of the trophic ecology of fishes in the LCR revealed very high diversity in the diets of all native species and correspondingly low proportional linkage strength for most individual food items. Such diversity and weak linkages between consumers and resources may contribute to community stability in the face of stochastic environmental disturbance or fluctuations in resource availability (Ives and Carpenter 2007; O'Gorman and Emmerson 2009; Gellner and McCann 2016). Seasonal food webs for the LCR had up to 137 linkages, with varying assemblages of up to 6 fishes, each feeding on up to 81 prey items. These observations appear distinct compared to most of other similarly sized temperate rivers and streams in the American West. For example, studies in the states of Colorado (Allan 1981) and Washington (Bellmore et al. 2013), which focused on salmonid-dominated assemblages, described less than half the diversity of diet items despite using similar taxonomic resolution. Our findings are more consistent with those from the most detailed study of seasonal diet variability of a desert fish assemblage (Schreiber and Minckley 1981) as well as those reported from the Neotropics (but see Polis 1991 for a discussion of the technical pitfalls of comparing food webs). Winemiller's (1990) study of seasonality in food webs of tropical streams and floodplain habitats described heavily linked food webs, up to 1,243 links, consisting of up to 54 fish species. Winemiller (1990) observed that the food web at the site with the lowest diversity of ichthyofauna in his study (11 species, which is closer to that of the LCR) had 334 linkages, with only 41% of those being above a threshold of 1% of the proportional diet, in other words, 59% weak linkages. We found that fish-centered food webs of the LCR had similar levels (54—66%) of weak links.

Our study encompassed a wide gradient of seasonal and hydrologic conditions and supports the characterization of Southwestern desert fishes as opportunistic generalists adapted to landscapes that are both seasonally and stochastically variable (Schreiber and Minckley 1981; W. L. Minckley and Meffe 1987). High hydrologic variability has been shown to correspond to a generalist pattern of feeding ecology amongst fishes (Poff and Allan 1995; Blanchette et al. 2014) and may be a key abiotic factor mediating the trophic ecology and resultant food web structure of fish assemblages (Winemiller and Rose 1992; Winemiller 1996; Mims and Olden 2013), particularly those of desert rivers and streams (Olden, Poff, and Bestgen 2006). All four native fishes we examined exhibited high levels of generalist feeding throughout the sampling period with both a large amount of overlap in frequently occurring food items between seasons and among species. We also found evidence of fishes utilizing seasonal resource pulses. Piscivory, whether from hunting or scavenging, was rare, but was observed at least once in all native species, including suckers.

Contrary to our own perceptions of the July 2012 monsoonal flood as a powerful disturbance, it did not appear to be detrimental to the feeding behavior of the native fishes. In fact, it appeared to instead deliver a pulse of food resources for some species, which is consistent with the idea that native fishes are typically resilient, if not resistant to the flooding disturbances of their habitats (Meffe and Minckley 1987; Pearsons, Li, and Lamberti 1992; Matthews, Harvey, and Power 1994). Previous work in the Grand Canyon area has detailed the ability of individual humpback chubs and flannelmouth suckers to maintain position during an artificial flood with a discharge of 1,274 m^3s^{-1} (McIvor and Thieme 1999; Valdez and Hoffnagle 1999). Seasonal, flood-facilitated,

allochthonous contributions to fish diets are well-known phenomena in other aquatic systems, particularly tropical lowland rivers (Goulding 1980; Junk, Bayley, and Sparks 1989). In those contexts, studies have detailed the effect of floods expanding the available foraging habitat for fishes to adjacent floodplains and flooded forests, whereas our observations in the desert canyon of the LCR point to the entrainment and scouring of allochthonous materials and subsequent availability of these resources to fishes. We found that all native species were actively feeding during the flood event that we sampled, despite the potential for physical damage as well as extremely turbid conditions (summed concentrations of sand, silt and clay = 54.650 mg L^{-1} at stream gauge no. 09402300; U.S. Geological Survey). Humpback chub collected during this flood had more than double the gut fullness of those from any of the other periods sampled. This phenomenon was most pronounced in humpback chub, but was also observed in bluehead sucker. Flannelmouth sucker and speckled dace, while not having distinctively high levels of fullness, appeared to be feeding at rate that was similar to other time periods. Valdez and Hoffnagle (1999) also observed humpback chub actively feeding during a controlled flood in the mainstem Colorado River near the confluence with the LCR . In general, however, our observations are the first to document how fishes native to desert rivers may not only persist in the face of dramatic floods, but thrive on a pulse of food resources delivered with some precipitation events.

The large percentage of allochthonous detritus we observed in the diets of native fishes throughout the year was most striking after periods of extended low to moderate flooding (i.e. September and March). This phenomenon has not been well documented amongst southwest desert river fishes. Deacon and Minckley (1974) claimed that the

absence of terrestrial detritus is characteristic of the feeding ecology of desert fishes, though it has also been suggested that this conclusion might be due to an assumption of low inputs of allochthonous materials into desert streams during baseflow, coupled with difficulty in accessing and sampling flooding events during which allochthonous materials are transported into and down rivers (Naiman 1981). Recent work utilizing stable isotope techniques has indicated that terrestrial inputs can be important contributions to food webs in some arid streams and rivers, and that this integration may be mediated by seasonal and hydrologic variability (Zeug and Winemiller 2008; Blanchette et al. 2014). Diets of LCR fishes in January of 2012 and June of 2013, collected while the river was clear, included large proportions of autochthonous materials; aquatic invertebrates for flannelmouth sucker in January, and filamentous algae for both humpback chub and bluehead suckers in June. These results are what would typically be expected from descriptions of desert rivers as autochthonous-dominated systems (Minshall 1978; Fisher et al. 1982; Bunn, Davies, and Winning 2003). However, our overall results indicate seasonally and/or hydrologically mediated linkages exist between southwest desert fishes and terrestrial production, a trend common to both plants and animals in arid ecosystems (Brown and Ernest 2002; Chesson et al. 2004; Schwinning and Sala 2004).

Evidence from our investigation of the LCR not only bears out the characterization of desert fishes as generalists in a broad sense, but emphasizes their plasticity in diet in response seasonal change, although we did observe some variation in trophic niches among species, some of which was consistent with prior reports and some that represented departures. In particular, based on our observations of their diets and the

habitats in which they were captured, we speculate that in the LCR adult humpback chub are primarily a water column feeder uniquely adapted to feeding in high velocity, turbid rivers. We caught humpback chub overwhelmingly using hoopnets (88% of fish sampled) as opposed to seines. One caveat to our comparison between humpback chub diets and those of other studies or of other species within our own study was the unavoidable sampling of the entire gut tract as opposed to only the less digested anterior gut or stomach. This may bias our results high for less digestible dietary items such as recalcitrant terrestrial vegetation or insect parts (e.g. legs, pieces of carapace). However, our findings of high seasonal variation in these less digestible materials in chub guts as well as extremely high diversity in chub diets overall suggest that our study was largely robust to this problem. Overall, our results closely mirror previous studies (Valdez and Hoffnagle 1999; Cross et al. 2013), with humpback chub consuming large proportions of terrestrially derived diet items when turbidity was high (>80% of diet in July and March) and large proportions of filamentous algae in the clear water summer period (>45% in June). Additionally, we found that during January clear-water conditions when suckers and dace were consuming large proportions of high-quality aquatic invertebrates (mean = 61% for the 3 species) and their consumption of terrestrial resources was low (mean = 9% for the three species), humpback chub continued to eat terrestrial vegetation (16%) and incorporated large proportions of travertine encrusted *Chara* into their diets, although aquatic invertebrate consumption was also higher (39%) than in other months. This further emphasizes adult humpback chub's reliance on drift as a key delivery mode for food resources. Juvenile humpback chub diets from June and July, 2014 diverged from both adult humpback chub and the other native species present during that sampling

period based on their greater consumption of terrestrial invertebrates and lack of consumption of *Cladophora*. Three possible explanations for this pattern include an ontogenetic shift in feeding behavior (e.g. a switch from near surface foraging to picking from the current), an ontogenetic shift in habitat accessibility and use (e.g. going from shallow to deep water), or a combination of both.

Observations of the diets of other native fishes also presented both agreements and departures from published descriptions. We found that bluehead suckers consumed the largest percentage of diatoms as part of their annual diet (peak in June 2013), which is consistent with their reputation as herbivorous, benthic scrapers (Sigler and Miller 1963). However, we also found that bluehead suckers consumed large proportions (up to 40% average in January) of chironomid larvae. In fact, chironomids and other aquatic invertebrates such as copepods were eaten in sizeable proportions throughout the year but were consumed in highest proportions during winter and early spring. Similarly, flannelmouth suckers also consumed strikingly large proportions of aquatic invertebrates (up to 73% average in January) and little algal biomass (< 10% on average throughout) although they did consume large amounts of terrestrial vegetation (up to 39% on average in September). A previous, unpublished report by Carothers and Minckley (1981) described flannelmouth suckers switching from consuming terrestrial origin vegetative detritus while inhabiting the tributaries of the Colorado River in Grand Canyon to consuming *Cladophora* while located in the mainstem river. In spite of their reputation as herbivores/detritivores (e.g. Olden, Poff, and Bestgen 2006) it is likely that an analysis of the trophic basis of production of both species of suckers in the LCR would reveal invertebrates as bioenergetically very important seasonally, if not annually, as was

recently described by Cross et al. (2013) for these species in the mainstem Colorado River in Grand Canyon. Previous descriptions of the diets of speckled dace are understandably variable given their ubiquitous occurrence throughout rivers, streams and springs of the Western U.S. (Moyle 2002). Our observations support a characterization of speckled dace as primarily insectivorous, interstitial foragers with minor dependence on detritus and algae, which agrees with some accounts of this species in Southwestern rivers and streams (Schreiber and Minckley 1981; Angradi, Spaulding, and Koch 1991) and corresponds with our higher catch rate of fish sampled using seines as opposed to hoopnets for this species (78% of catch vs. 22%). Speckled dace in the LCR had the highest percentages of baetid mayfly nymphs in their diets of any species (47% in March) and consistently consumed high levels of aquatic invertebrates in general. Generally, baetid mayflies prefer hard-bottomed flowing habitats (Day 1956; Rabeni and Minshall 1977), which are present in the LCR as gravel runs and riffles. At baseflow, much of the shallow riffle habitat of the LCR is only accessible to small-bodied fishes such as speckled dace, fathead minnow and juveniles of the other species, and it is likely that speckled dace can monopolize these areas particularly during times of the year when juveniles of larger species have outgrown them.

Non-native fishes comprised a very small percentage of our catch, to the point where small sample sizes precluded rigorous comparisons with diets of native species and seasonal descriptions were not possible, but a few observations warrant discussion. The most numerous non-native species we captured, plains killifish, we encountered in July and September during and at the end of the seasonal monsoonal flow pulse. The high occurrence of empty stomachs among these fish may imply that they were in the process

of being flushed out from origins further upstream, as has been suggested to be a repeated phenomenon in the LCR by Stone et al. (2007). Our small catch of red-side shiners in July had guts that were similarly empty. In contrast, gut contents of fathead minnows, which were also relatively rare, were roughly similar to native fishes and contained invertebrates, terrestrial vegetation, detritus and algae. Channel catfish have long been suspected of preying on juvenile native fishes in the LCR, but are difficult to capture in the LCR using hoopnets or seines (Van Haverbeke et al. 2013) and therefore the degree of predation by catfish remains difficult to assess. Our catch of catfish was limited to juveniles who were almost wholly insectivorous (Appendix 1). Overall, our dietary analysis of small-bodied, non-native fishes points to some overlap with native fishes in food resource use, as was recently described in nearshore habitats along the mainstem Colorado River in Grand Canyon (Seegert et al. 2014). The inconsistency and low numbers that we observed suggests that other factors might be more important in limiting native fishes in the LCR.

In conclusion, the high degree of generalist and opportunistic feeding that we observed among fishes in the LCR corresponded with many weak food web linkages and a native fish assemblage that appeared resistant to high hydrologic variability. This description contrasts with that of recent work in the adjacent mainstem Colorado River which described a novel (albeit productive) food web dominated by nonnative species and a fish assemblage that was vulnerable to hydrologic disturbance and strongly linked to two aquatic invertebrate taxa (i.e., chironomid midges and simuliid blackflies; Cross et al. 2013). While direct comparisons should be treated cautiously due to the possibility of discrepancies in methods, foodweb metrics from these two studies reveal marked

differences. The lowest number of food items used by fishes that we observed was 30 in January, whereas a compilation of 5 seasonal sample periods revealed only 16 total food items used by fishes in the reach of the mainstem close to the confluence with the LCR. Average food web linkages in the LCR were at least 17.3 food items per fish (also in January) but only 9.6 in the mainstem study, and finally the proportion of weak links was over 50% (and up to 66%) throughout our sampling in the unregulated tributary but only 20% in the adjacent regulated mainstem.

Our study did not assess the possibility of food limitation, but does suggest that the incorporation of a mixture of a large variety of aquatic and terrestrial resources may buffer fish populations against seasonal and stochastic hydrologic disturbance. For fish that move between the mainstem river and the LCR, these distinctive habitats could serve as complementary resources, e.g., food resources may be high in one and less so in the other, recalling conditions of a pre-dam patchwork landscape. Alternatively, the homogeneity of the much larger mainstem river and associated instability of the food web (Cross et al. 2011; Cross et al. 2013)could result in a situation exacerbating poor conditions in both areas (e.g. low food resources in the LCR and widespread, low resources in the mainstem river). Additional analysis of the record of hydrologic conditions coupled with population trends may provide understanding of past pattern and inform future adaptive management of fish populations and food webs in the Grand Canyon area.

BIBLIOGRAPHY

Ahlgren, Molly O. 1990. "Nutritional Significance of Facultative Detritivory to the Juvenile White Sucker (Catostomus commetsoni)." *Canadian Journal of Fisheries and Aquatic Sciences* 47 (1): 49–54. doi:10.1139/f90-005.

Aho, K. 2016. "Package 'Asbio.'" *R Package Ver. 2.0*. https://cran.r-project.org/package=asbio.

Allan, J.D. 1981. "Determinants of Diet of Brook Trout (*Salvelinus fontinalis*) in a Mountain Stream." *Canadian Journal of Fisheries and Aquatic Sciences* 38: 184–92. doi:10.1139/f81-024.

Anderson, A.M., and L.C. Ferrington Jr. 2013. "Resistance and Resilience of Winter-Emerging Chironomidae (Diptera) to a Flood Event: Implications for Minnesota Trout Streams." *Hydrobiologia* 707 (1): 59–71. doi:10.1007/s10750-012-1406-4.

Anderson, M.J. 2001. "A New Method for Non-Parametric Multivariate Analysis of Variance." *Austral Ecology* 26 (2001): 32–46. doi:10.1111/j.1442-9993.2001.01070.pp.x.

Andrews, E.D. 1991. "Sediment Transport in the Colorado River Basin." In *Colorado River Ecology and Dam Management. Proceedings of a Symposium Held May 24-25, 1990, Santa Fe, New Mexico*, 54–74. Washington, D.C.: The National Academies Press. doi:10.17226/1832.

Angradi, T.R., J.S. Spaulding, and E.D. Koch. 1991. "Diel Food Utilization by the Virgin River Spinedace, *Lepidomeda mollispinis mollispinis* and Speckled Dace, *Rhinichthys osculus*, in Beaver Dam Wash, Utah." *Southwestern Naturalist* 36 (2):

158–70. doi:10.1894/0038-4909-54.2.i.

Atmar, G.L., and K.W. Stewart. 1972. "Food, Feeding Selectivity, and Ecological Efficiencies of *Fundulus notatus (Cyprinodontidae)*." *American Midland Naturalist* 88: 76–89.

Batagelj, V., and A. Mrvar. 1996. "Pajek." http://mrvar.fdv.uni-lj.si/pajek.

Baxter, C.V., K.D. Fausch, and W.C. Saunders. 2005. "Tangled Webs: Reciprocal Flows of Invertebrate Prey Link Streams and Riparian Zones." *Freshwater Biology* 50 (2): 201–20. doi:10.1111/j.1365-2427.2004.01328.x.

Bellmore, J.R., C.V. Baxter, K. Martens, and P.J. Connolly. 2013. "The Floodplain Food Web Mosaic: A Study of Its Importance to Salmon and Steelhead with Implications for Their Recovery." *Ecological Applications* 23 (1): 189–207.

Blanchette, M.L., A.M. Davis, T.D. Jardine, and R.G. Pearson. 2014. "Omnivory and Opportunism Characterize Food Webs in a Large Dry-Tropics River System." *Freshwater Science* 33 (1): 142–58. doi:10.1086/674632.

Boecklen, W.J., C.T. Yarnes, B.A. Cook, and A.C. James. 2011. "On the Use of Stable Isotopes in Trophic Ecology." *Annual Review of Ecology, Evolution, and Systematics* 42 (1): 411–40. doi:10.1146/annurev-ecolsys-102209-144726.

Brown, J.H., and S.K.M. Ernest. 2002. "Rain and Rodents: Complex Dynamics of Desert Consumers." *BioScience* 52 (11): 979–87.

Bunn, S.E., P.M. Davies, and M. Winning. 2003. "Sources of Organic Carbon Supporting the Food Web of an Arid Zone Floodplain River." *Freshwater Biology* 48 (4): 619–

35. doi:10.1046/j.1365-2427.2003.01031.x.

Carothers, S.W., and C.O. Minckley. 1981. "A Survey of the Fishes, Aquatic Invertebrates and Aquatic Plants of the Colorado River and Selected Tributaries from Lees Ferry to Separation Rapids. Final Report, U.S. Bureau of Reclamation Contract 7-07-30-X0026." Boulder City, Nevada. http://www.nativefishlab.net/library/textpdf/17435.pdf.

Chapin III, F.S., E.S. Zavaleta, V.T. Eviner, R.L. Naylor, P.M. Vitousek, H.L. Reynolds, D.U. Hooper, et al. 2000. "Consequences of Changing Biodiversity." *Nature* 405 (6783): 234–42. doi:10.1038/35012241.

Chesson, P., R.L.E. Gebauer, S. Schwinning, N. Huntly, K. Wiegand, M.S.K. Ernest, A. Sher, A. Novoplansky, and J.F. Weltzin. 2004. "Resource Pulses, Species Interactions, and Diversity Maintenance in Arid and Semi-Arid Environments." *Oecologia* 141 (2): 236–53. doi:10.1007/s00442-004-1551-1.

Childs, M.R., R.W. Clarkson, and A.T. Robinson. 1998. "Resource Use by Larval and Early Juvenile Native Fishes in the Little Colorado River, Grand Canyon, Arizona." *Transactions of the American Fisheries Society* 127 (4): 620–29. doi:10.1577/1548-8659(1998)127.

Clarkson, R.W., A.T. Robinson, and T.L. Hoffnagle. 1997. "Asian Tapeworm *(Bothriocephalus acheilognathi)* in Native Fishes from the Little Colorado River, Grand Canyon, Arizona." *Great Basin Naturalist* 57 (1): 66–69. http://scholarsarchive.byu.edu/gbn/vol57/iss1/8.

Cross, W.F., C.V. Baxter, K.C. Donner, E.J. Rosi-Marshall, T.A. Kennedy, R.O. Hall Jr.,

H.A. Wellard Kelly, and R.S. Rogers. 2011. “Ecosystem Ecology Meets Adaptive Management: Food Web Response to a Controlled Flood on the Colorado River, Glen Canyon.” *Ecological Applications* 21 (6): 2016–33. doi:10.1890/10-1719.1.

Cross, W.F., C.V. Baxter, E.J. Rosi-Marshall, R.O. Hall Jr., T.A. Kennedy, K.C. Donner, H.A.W. Kelly, S.E.Z. Seegert, K.E. Behn, and M.D. Yard. 2013. “Food-Web Dynamics in a Large River Discontinuum.” *Ecological Monographs* 83 (3): 311–37. doi:10.1890/12-1727.1.

Cross, W.F., E.J. Rosi-Marshall, K.E. Behn, T.A. Kennedy, R.O. Hall Jr., A.E. Fuller, and C.V. Baxter. 2010. “Invasion and Production of New Zealand Mud Snails in the Colorado River, Glen Canyon.” *Biological Invasions* 12 (9): 3033–43. doi:10.1007/s10530-010-9694-y.

Day, W.C. 1956. “Ephemeroptera.” In *Aquatic Insects of California: With Keys to North American Genera and California Species*, edited by R.L. Usinger, 79–105. University of California Press.

Deacon, J.E., and W.L. Minckley. 1974. “Desert Fishes.” In *Desert Biology: Special Topics on the Physical and Biological Aspects of Arid Regions, Volume II*, edited by G.W. Brown Jr., 385–488. New York, NY: Academic Press.

Dzul, M.C., C.B. Yackulic, D.M. Stone, and D.R. Van Haverbeke. 2014. “Survival, Growth, and Movement of Subadult Humpback Chub, *Gila cypha*, in the Little Colorado River, Arizona.” *River Research and Applications* 32 (3): 373–82. doi:10.1002/rra.2864.

Eiriksdottir, G. 1974. “Feeding and Assimilation by the White Sucker, *Catostomus*

commersoni." Master's Thesis. Cornell University.

Elliot, J.M. 1976. "Energy Losses in the Waste Products of Brown Trout (*Salmo trutta l.*)." *The Journal of Animal Ecology* 45: 561–80.

Elliott, J.M., and M.A. Hurley. 2000. "Daily Energy Intake and Growth of Piscivorous Brown Trout, (*Salmo trutta*)." *Freshwater Biology* 44 (2): 237–45.

Elton, C. 1927. *Animal Ecology*. edited by J.S. Huxley. London, UK: Sidgwick & Jackson Ltd.

Ferrington Jr., L.C., M.B. Berg, and W.P. Coffman. 2008. "Chironomidae." In *An Introduction to the Aquatic Insects of North America, Fourth Edition*, edited by R.W. Merritt, K.W. Cummins, and M.B. Berg, 847–990. Dubuque, IA: Kendall/Hunt Publishing Company.

Fisher, S.G., L.J. Gray, N.B. Grimm, and D.E. Busch. 1982. "Temporal Succession in a Desert Stream Ecosystem Following Flash Flooding." *Ecological Monographs* 52 (1): 93–110. doi:10.2307/2937346.

Fowler, M.C. 1982. "Experiments on Food Conversion Ratios and Growth Rates of Grass Carp (*Ctenopharyngodon idella val.*) in England." In *Proceedings of the Second International Symposium on Herbivorous Fish, Novi Sad, Yugoslavia.*, 107–10. Wageningen, The Netherlands: European Weed Research Society.

Gellner, G., and K.S. McCann. 2016. "Consistent Role of Weak and Strong Interactions in High- and Low-Diversity Trophic Food Webs." *Nature Communications* 7: 11180. doi:doi:10.1038/ncomms11180.

Gloss, S.P., and L.G. Coggins. 2005. “Fishes of Grand Canyon.” In *The State of the Colorado River Ecosystem in Grand Canyon: A Report of the Grand Canyon Monitoring and Research Center 1991-2004, U.S. Geological Survey Circular 1282*, edited by S.P. Gloss, J.E. Lovich, and T.S. Melis, 33–56. Reston, VA: U.S. Geological Survey.

Goulding, M. 1980. *The Fishes and the Forest: Explorations in Amazonian Natural History*. Berkeley and Los Angeles, CA: The University of California Press.

Hall Jr., R.O., C.B. Yackulic, T.A. Kennedy, M.D. Yard, E.J. Rosi-Marshall, N. Voichick, and K.E. Behn. 2015. “Turbidity, Light, Temperature, and Hydropeaking Control Primary Productivity in the Colorado River, Grand Canyon.” *Limnology and Oceanography* 60 (2): 512–26. doi:10.1002/lno.10031.

Haverbeke, D.R. Van, D.M. Stone, L.G Coggins Jr., and M.J. Pillow. 2013. “Long-Term Monitoring of an Endangered Desert Fish and Factors Influencing Population Dynamics.” *Journal of Fish and Wildlife Management* 4 (1): 163–77. doi:10.3996/082012-JFWM-071.

Hobbs, R.J., S. Arico, J. Aronson, J.S. Baron, P. Bridgewater, V.A. Cramer, P.R. Epstein, et al. 2006. “Novel Ecosystems: Theoretical and Management Aspects of the New Ecological World Order.” *Global Ecology and Biogeography* 15 (1): 1–7. doi:10.1111/j.1466-822X.2006.00212.x.

Holm, S. 1979. “A Simple Sequentially Rejective Multiple Test Procedure.” *Scandinavian Journal of Statistics* 6 (2): 65–70. doi:10.2307/4615733.

Hooper, D.U., F.S. Chapin, J.J. Ewel, A. Hector, P. Inchausti, S. Lavorel, J.H. Lawton, et

al. 2005. “Effects of Biodiversity on Ecosystem Functioning: A Consensus of Current Knowledge.” *Ecological Monographs* 75 (1): 3–35. doi:10.1890/04-0922.

Huryn, A.D. 1996. “An Appraisal of the Allen Paradox in a New Zealand Trout Stream.” *Limnology and Oceanography* 41 (2): 243–52. doi:10.4319/lo.1996.41.2.0243.

Ives, A.R., and S.R. Carpenter. 2007. “Stability and Diversity of Ecosystems.” *Science* 317 (5834): 58–62. doi:10.1126/science.1133258.

Junk, W.J., P.B. Bayley, and R.E. Sparks. 1989. “The Flood Pulse Concept in River-Floodplain Systems.” In *Proceedings of the International Large River Symposium (LARS)*, edited by D.P. Dodge, 110–27. Canadian special publication of fisheries and aquatic sciences 106. doi:10.1371/journal.pone.0028909.

Kaeding, L.R., and M.A. Zimmerman. 1983. “Life History and Ecology of the Humpback Chub in the Little Colorado and Colorado Rivers of the Grand Canyon.” *Transactions of the American Fisheries Society* 112 (5): 577–94.

Kennedy, T.A., J.D. Muehlbauer, C.B. Yackulic, D.A. Lytle, S.W. Miller, K.L. Dibble, E.W. Kortenhoeven, A.N. Metcalfe, and C.V. Baxter. 2016. “Flow Management for Hydropower Extirpates Aquatic Insects, Undermining River Food Webs.” *BioScience* 66 (7): 561–75. doi:10.1093/biosci/biw059.

Larned, S.T., T. Datry, D.B. Arscott, and K. Tockner. 2010. “Emerging Concepts in Temporary-River Ecology.” *Freshwater Biology* 55 (4): 717–38. doi:10.1111/j.1365-2427.2009.02322.x.

Leibfried, W.C. 1988. “The Utilization of Cladophora glomerata and Epiphytic Diatoms

as a Food Resource by Rainbow Trout in the Colorado River below Glen Canyon Dam, Arizona." Doctoral dissertation. Northern Arizona University.

Lytle, D.A. 2000. "Biotic and Abiotic Effects of Flash Flooding in a Montane Desert Stream." *Archiv Für Hydrobiologie* 150 (1): 85–100.

Martinez, N.D. 1991. "Artifacts or Attributes? Effects of Resolution on the Little Rock Lake Food Web." *Ecological Monographs* 61 (4): 367–92. doi:10.2307/2937047.

Martínez Del Rio, C., N. Wolf, S.A. Carleton, and L.Z. Gannes. 2009. "Isotopic Ecology Ten Years after a Call for More Laboratory Experiments." *Biological Reviews* 84 (1): 91–111. doi:10.1111/j.1469-185X.2008.00064.x.

Matthews, W.J., B.C. Harvey, and M.E. Power. 1994. "Spatial and Temporal Patterns in the Fish Assemblages of Individual Pools in a Midwestern Stream (U.S.A.)." *Environmental Biology of Fishes* 39 (4): 381–97. doi:10.1007/BF00004807.

McCann, K.S. 2012. *Food Webs*. Princeton, NJ: Princeton University Press.

McCune, B., and J.B. Grace. 2002. *Analysis of Ecological Communities*. Gleneden Beach. OR. USA.: MjM Software Design.

McIvor, C.C., and M.L. Thieme. 1999. "Flannelmouth Suckers: Movement in the Glen Canyon Reach and Spawning in the Paria River." In *The Controlled Flood in Grand Canyon*, edited by R.H. Webb, J.C. Schmidt, G.R. Marzolf, and R.A. Valdez, 289–95. Washington, D.C.: American Geophysical Union Geophysical Monograph Series 110.

Meador, M.R., T.F. Cuffney, and M.E. Gurtz. 1993. "Methods for Sampling Fish

Communities as Part of the National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 93-104." https://water.usgs.gov/nawqa/protocols/OFR-93-104/fishp1.html.

Meffe, G.K., and W.L. Minckley. 1987. "Persistence and Stability of Fish and Invertebrate Assemblages in a Repeatedly Disturbed Sonoran Desert Stream." *American Midland Naturalist* 117 (1): 177–91. doi:doi:10.2307/2425718.

Mims, M.C., and J.D. Olden. 2013. "Fish Assemblages Respond to Altered Flow Regimes via Ecological Filtering of Life History Strategies." *Freshwater Biology* 58 (1): 50–62. doi:10.1111/fwb.12037.

Minckley, C.O., and J.E. Deacon. 1975. "Foods of the Devil's Hole Pupfish, *Cyprinodon diabolis (Cyprinodontidae)*." *The Southwestern Naturalist* 20 (1): 105–11. doi:10.2307/3670016.

Minckley, W.L., and P.C. Marsh. 2009. *Inland Fishes of the Greater Southwest: Chronicle of a Vanishing Biota*. Tucson, AZ: The University of Arizona Press.

Minckley, W.L., and G.K. Meffe. 1987. "Differential Selection by Flooding in Stream-Fish Communities of the Arid American Southwest." In *Community and Evolutionary Ecology of North American Stream Fishes*, edited by W.J. Matthews and D.C. Heins, 93–104. Norman, OK: University of Oklahoma Press.

Minshall, G.W. 1978. "Autotrophy in Stream Ecosystems." *BioScience* 28 (12): 767–71. doi:10.2307/1307250.

Moyle, P.B. 2002. *Inland Fishes of California: Revised and Expanded*. Berkeley and Los

Angeles, California: University of California Press.

Naiman, R.J. 1981. “An Ecosystem Overview: Desert Fishes and Their Habitats.” In *Fishes in North American Deserts*, edited by R.J. Naiman and D.L. Soltz, 493–531. New York, NY: John Wiley & Sons, Inc.

O’Gorman, E.J., and M.C. Emmerson. 2009. “Perturbations to Trophic Interactions and the Stability of Complex Food Webs.” *Proceedings of the National Academy of Sciences of the United States of America* 106 (32): 13393–98. doi:10.1073/pnas.0903682106.

Oksanen, J., F.G. Blanchet, R. Kindt, P. Legendre, P.R. Minchin, R.B. O’Hara, G.L. Simpson, P. Solymos, M.H.H. Stevens, and H. Wagner. 2013. “Package ‘vegan.’” *R Package Ver. 2.0–8*, 254. doi:10.4135/9781412971874.n145.

Olden, J.D., L.N. Poff, and K.R. Bestgen. 2006. “Life-History Strategies Predict Fish Invasions and Extirpations in the Colorado River Basin.” *Ecological Monographs* 76 (1): 25–40. doi:10.1890/05-0330.

Pearsons, T.N., H.W. Li, and G.A. Lamberti. 1992. “Influence of Habitat Complexity on Resistance to Flooding and Resilience of Stream Fish Assemblages.” *Transactions of the American Fisheries Society* 121 (4): 427–36.

Phillips, D.L., R. Inger, S. Bearhop, A.L. Jackson, J.W. Moore, A.C. Parnell, B.X. Semmens, and E.J. Ward. 2014. “Best Practices for Use of Stable Isotope Mixing Models in Food-Web Studies.” *Canadian Journal of Zoology* 92 (10): 823–35. doi:10.1139/cjz-2014-0127.

Pilger, T.J., K.B. Gido, and D.L. Propst. 2010. "Diet and Trophic Niche Overlap of Native and Nonnative Fishes in the Gila River, USA: Implications for Native Fish Conservation." *Ecology of Freshwater Fish* 19 (2): 300–321. doi:10.1111/j.1600-0633.2010.00415.x.

Poff, N.L., and J.D. Allan. 1995. "Functional Organization of Stream Fish Assemblages in Relation to Hydrological Variability." *Ecology* 76 (2): 606–27. doi:10.2307/1941217.

Polis, G.A. 1991. "Complex Trophic Interactions in Deserts: An Empirical Critique of Food-Web Theory." *The American Naturalist* 138 (1): 123–55. http://www.jstor.org/stable/2462536.

Power, M.E., D. Tilman, J.A. Estes, B.A. Menge, W.J. Bond, L.S. Mills, G. Daily, J.C. Castilla, J. Lubchenco, and R.T. Paine. 1996. "Challenges in the Quest for Keystones." *BioScience* 46 (8): 609–20. doi:10.2307/1312990.

Rabeni, C.F., and G.W. Minshall. 1977. "Factors Affecting Microdistribution of Stream Benthic Insects." *Oikos* 29 (1): 33–43. doi:10.2307/3543290.

R Core Team. 2014. "R Core Team (2014). R: A Language and Environment for Statistical Computing." *R Foundation for Statistical Computing, Vienna, Austria. URL http://www.R-Project.org/.*

Robinson, C.T. 2012. "Long-Term Changes in Community Assembly, Resistance, and Resilience Following Experimental Floods." *Ecological Applications* 22 (7): 1949–61. doi:10.1890/11-1042.1.

Rundio, D.E, and S.T. Lindley. 2012. "Reciprocal Fluxes of Stream and Riparian Invertebrates in a Coastal California Basin with Mediterranean Climate." *Ecological Research* 27 (3): 539–50. doi:10.1007/s11284-011-0920-6.

Schreiber, D.C., and W.L. Minckley. 1981. "Feeding Interrelations of Native Fishes in a Sonoran Desert Stream." *Great Basin Naturalist* 41 (4): 409–26. http://www.jstor.org/stable/41711841.

Schwinning, S., and O.E. Sala. 2004. "Hierarchy of Responses to Resource Pulses in Arid and Semi-Arid Ecosystems." *Oecologia* 141 (2): 211–20. doi:10.1007/s00442-004-1520-8.

Seegert, S.E.Z., E.J. Rosi-Marshall, C.V. Baxter, T.A. Kennedy, R.O. Hall Jr., and W.F. Cross. 2014. "High Diet Overlap between Native Small-Bodied Fishes and Nonnative Fathead Minnow in the Colorado River, Grand Canyon, Arizona." *Transactions of the American Fisheries Society* 143 (4): 1072–83. doi:10.1080/00028487.2014.901250.

Sigler, W.F., and R.R. Miller. 1963. *Fishes of Utah*. Salt Lake City, UT: Utah State Department of Fish and Game.

Smith, M.L. 1981. "Late Cenozoic Fishes in the Warm Deserts of North America: A Reinterpretation of Desert Adaptations." In *Fishes in North American Deserts*, edited by R.J. Naiman and D.L. Soltz, 11–38. New York, NY: John Wiley & Sons, Inc.

Spurgeon, J.J., C.P. Paukert, B.D. Healy, M. Trammell, D. Speas, and E. Omana-Smith. 2015. "Translocation of Humpback Chub into Tributary Streams of the Colorado

River: Implications for Conservation of Large-River Fishes." *Transactions of the American Fisheries Society* 144 (3): 502–14. doi:10.1080/00028487.2015.1007165.

Stefferud, J.A., K.B. Gido, and D.L. Propst. 2011. "Spatially Variable Response of Native Fish Assemblages to Discharge, Predators and Habitat Characteristics in an Arid-Land River." *Freshwater Biology* 56 (7): 1403–16. doi:10.1111/j.1365-2427.2011.02577.x.

Stone, D.M. 2004. "Differential Detection of Ingested Items Evacuated from Genus *Gila* Cyprinids by Two Nonlethal Alimentary Tract Lavage Techniques." *Journal of Freshwater Ecology* 19 (4): 559–565. doi:10.1080/02705060.2004.9664735.

Stone, D.M., D.R. Van Haverbeke, D.L. Ward, and T.A. Hunt. 2007. "Dispersal of Nonnative Fishes and Parasites in the Intermittent Little Colorado River, Arizona." *The Southwestern Naturalist* 52 (1): 130–37. doi:10.1894/0038-4909(2007)52[130:DONFAP]2.0.CO;2.

Topping, D.J., D.M. Rubin, and L.E. Vierra Jr. 2000. "Colorado River Sediment Transport: 1. Natural Sediment Supply Limitation and the Influence of Glen Canyon Dam." *Water Resources Research* 36 (2): 515–42. doi:10.1029/1999WR900285.

Topping, D.J., J.C. Schmidt, and L.E. Vierra Jr. 2003. "Computation and Analysis of the Instantaneous-Discharge Record for the Colorado River at Lees Ferry, Arizona: May 8, 1921, through September 30, 2000." *U.S. Geological Survey Professional Paper 1677*, 118 p. http://pubs.usgs.gov/pp/pp1677/pdf/pp1677.pdf.

Townsend, C.R., M.R. Scarsbrook, and S. Dolédec. 1997. "Quantifying Disturbance in Streams: Alternative Measures of Disturbance in Relation to Macroinvertebrate

Species Traits and Species Richness." *Journal of the North American Benthological Society* 16 (3): 531–44. doi:10.2307/1468142.

U.S. Geological Survey. n.d. "Water Quality Samples for the Nation, USGS 09380000 Colorado River at Lees Ferry, Accessed March 4, 2017 at URL http://waterdata.usgs.gov/nwis/qwdata/?site_no=09380000."

———. n.d. "Water Quality Samples for the Nation, USGS 09402300 Little Colorado River above Mouth near Desert View, Accessed March 4, 2017 at URL http://waterdata.usgs.gov/nwis/qwdata/?site_no=09402300."

Valdez, R.A., and T.L. Hoffnagle. 1999. "Movement, Habitat Use, and Diet of Adult Humpback Chub." In *The Controlled Flood in Grand Canyon*, edited by R.H. Webb, J.C. Schmidt, G.R. Marzolf, and R.A. Valdez, 297–307. Washington, D.C.: American Geophysical Union, Geophysical Monograph 110.

Vitousek, P.M., H.A. Mooney, J. Lubchenco, and J.M. Melillo. 1997. "Human Domination of Earth's Ecosystems." *Science* 277 (5325): 494–99. doi:10.1126/science.277.5325.494.

Voichick, N., and S.A. Wright. 2007. "Water-Temperature Data for the Colorado River and Tributaries between Glen Canyon Dam and Spencer Canyon, Northern Arizona, 1988-2005." *U.S. Geological Survey Data Series 251*, 24 p. https://pubs.usgs.gov/ds/2007/251/ds-251.pdf.

Warren, C.E., and G.E. Davis. 1967. "Laboratory Studies on the Feeding, Bioenergetics, and Growth of Fish, Special Report 230." Pacific Cooperative Water Pollution and Fisheries Research Laboratories, Oregon State University, Corvallis, Oregon.

Wiley, M.J., and L.D. Wike. 1986. “Energy Balances of Diploid, Triploid, and Hybrid Grass Carp.” *Transactions of the American Fisheries Society* 115 (6): 853–63.

Winemiller, K.O. 1990. “Spatial and Temporal Variation in Tropical Fish Trophic Networks.” *Ecological Monographs* 60 (3): 331–67. doi:10.2307/1943061.

———. 1996. “Factors Driving Temporal and Spatial Variation in Aquatic Floodplain Food Webs.” In *Food Webs: Integration of Patterns and Dynamics*, edited by G.A. Polis and K.O. Winemiller, 298–312. New York, NY: Chapman & Hall.

Winemiller, K.O., and K.A. Rose. 1992. “Patterns of Life-History Diversification in North American Fishes: Implications for Population Regulation.” *Canadian Journal of Fisheries and Aquatic Sciences* 49 (10): 2196–2218. doi:10.1139/f92-242.

Wright, S.A., T.A. Melis, D.J. Topping, and D.M. Rubin. 2005. “Influence of Glen Canyon Dam Operations on Downstream Sand Resources of the Colorado River in Grand Canyon.” In *The State of the Colorado River Ecosystem in Grand Canyon: U.S. Geological Survey Circular 1282*, edited by S.P. Gloss, J.E. Lovich, and T.S. Melis, 17–31. Reston, VA: U.S. Geological Survey. http://pubs.usgs.gov/circ/1282/c1282.pdf.

Zeug, S.C., and K.O. Winemiller. 2008. “Relationships between Hydrology, Spatial Heterogeneity, and Fish Recruitment Dynamics in a Temperate Floodplain River.” *River Research and Applications* 24 (1): 90–102. doi:10.1002/rra.1061.

Figure 1: The Little Colorado River at base flow with associated clear-water conditions in April, 2012; as seen from approximately 3.7 rkm from the confluence with the mainstem Colorado River. Photo by Kathrine E. Behn.

Figure 2: The Little Colorado River in flood in July, 2012, as seen from "Boulders Camp", 1.9 rkm from the confluence with the mainstem Colorado River. Photo by Colden V. Baxter.

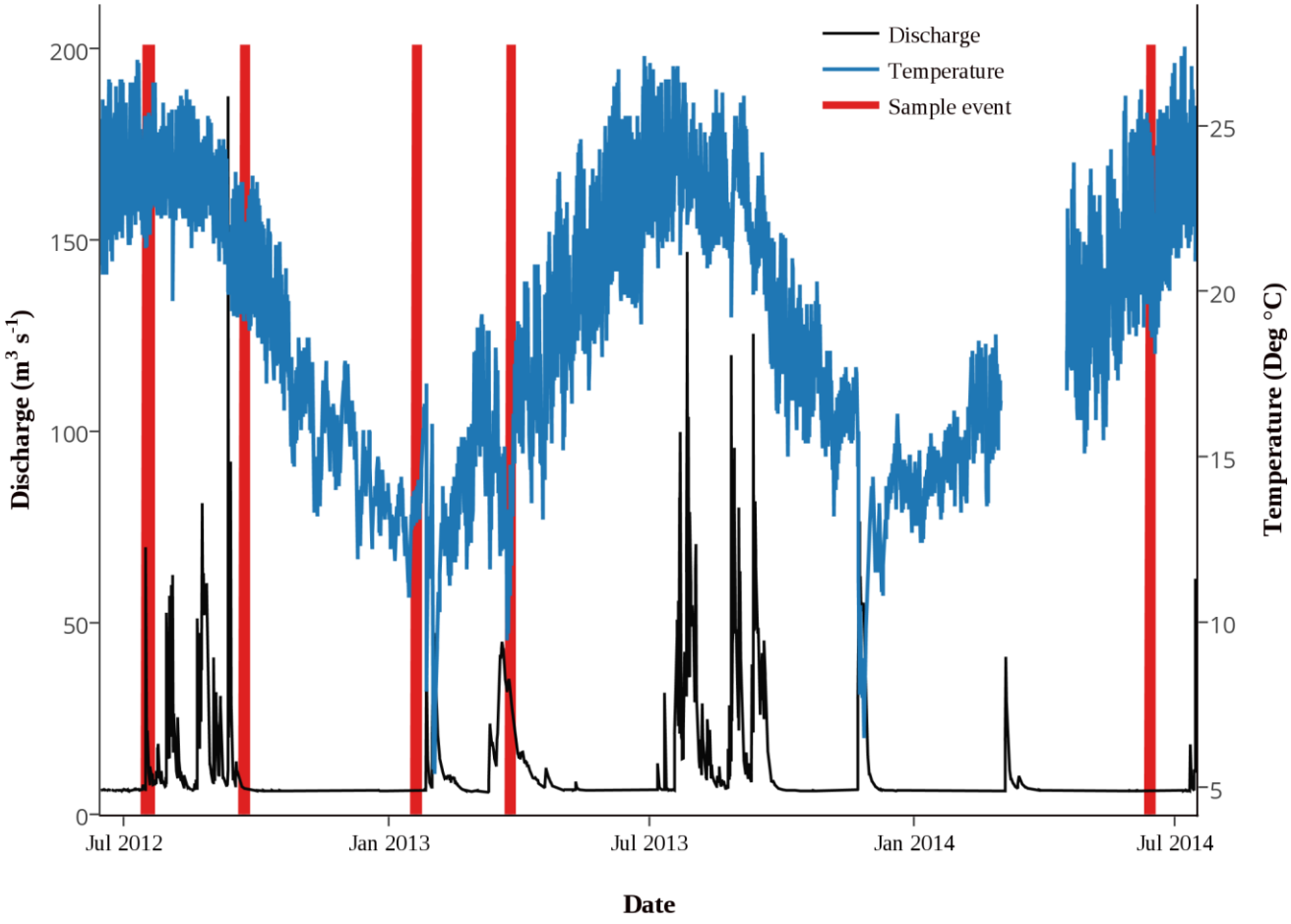
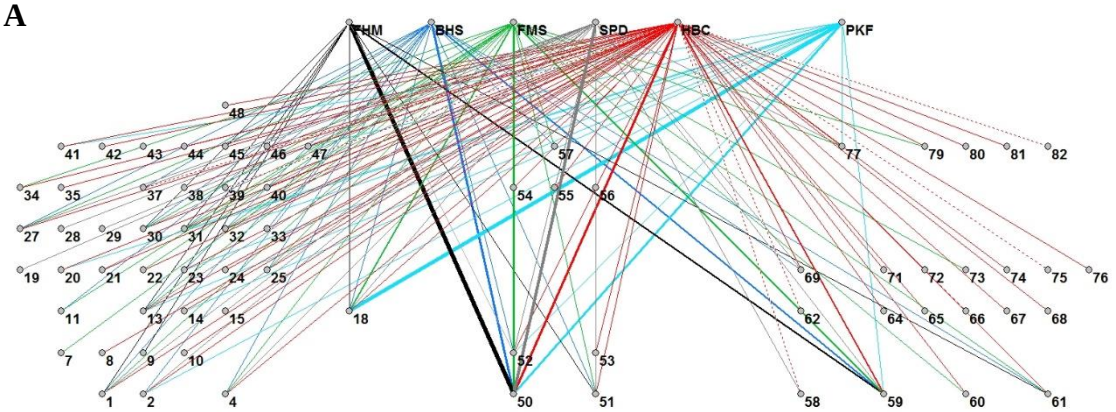


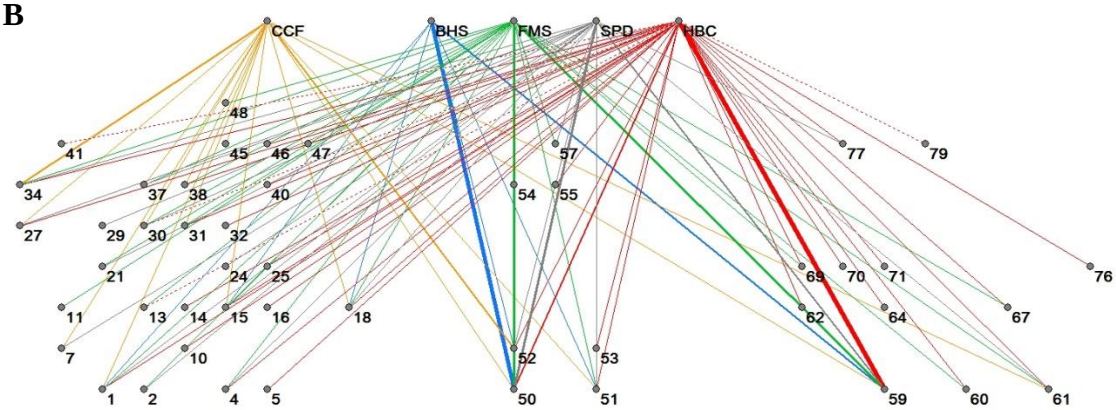
Figure 3: The discharge and temperature of the Little Colorado River over the duration of our sampling. Data were collected by the U.S. Geological Survey at gauging station 09402300 (U.S. Geological Survey). Discharge data were converted from source's units (English) to metric. Temperature data from March through mid-April, 2014 were missing.

A



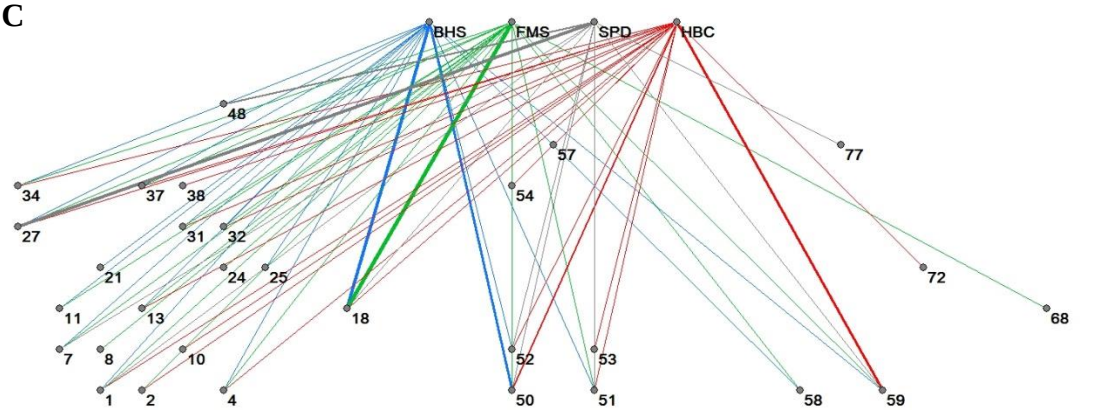
T = 75; L = 151; C = 0.054; MaxL = 59 (HBC); 1% L = 65%; 5% L = 84%

B



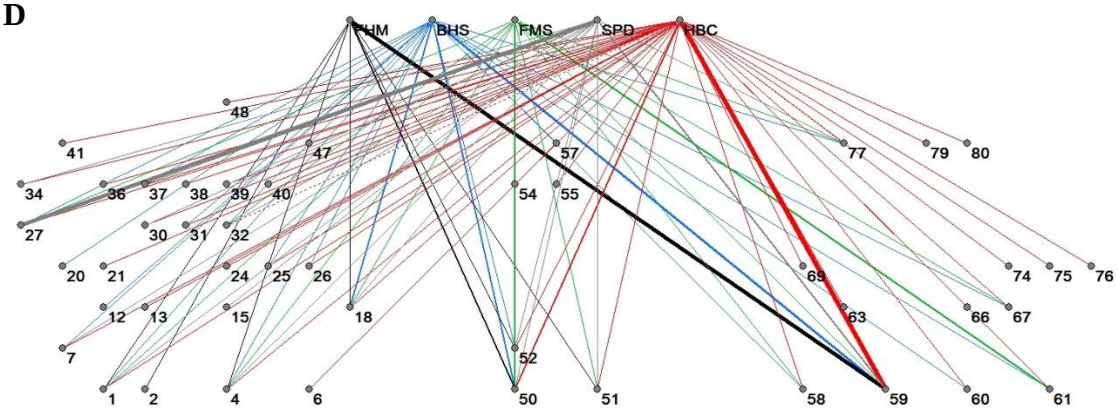
T = 53; L = 106; C = 0.077; MaxL = 37 (HBC); 1% L = 57%; 5% L = 76%

C



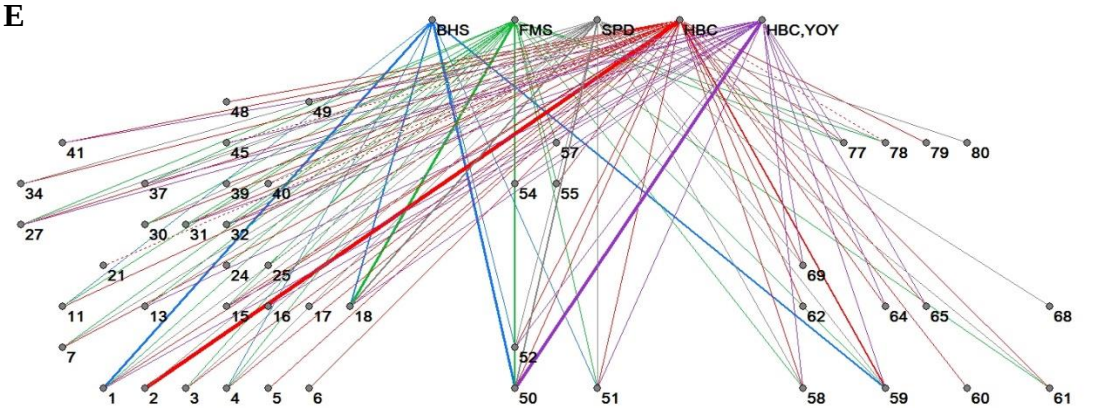
T = 34; L = 69; C = 0.123; MaxL = 21 (FMS); 1% L = 54%; 5% L = 70%

D



T = 52; L = 101; C = 0.076; MaxL = 42 (HBC), 1% L = 60%; 5% L = 78%

E



T = 52; L=119; C=0.090; MaxL = 39 (HBC); 1% L = 57%; 5% L = 76%

Aquatic origin Terrestrial origin

Figure 4: Seasonal food webs illustrating the average proportion of food resources in guts of Little Colorado River fishes (calculated by dry weight) during (A) July, 2012, (B) September 2012, (C) January, 2013, (D) March 2013, and (E) June 2014.

Prey items are roughly arranged by trophic level (vertically) and by origin (aquatic items on the left, ambiguous items in the middle, terrestrial on the right). Linkages between fish and prey are described with the following metrics: T = total number of taxa present (including fishes); L = total number of links between all consumers and prey; C = connectedness L/(T*(T-1)/2); MaxL = the maximum number of prey items consumed by a fish species; 1% L = the percentage of linkages representing 1% or less of a species' diet; 5% L = the percentage of linkages representing 5% or less of a species' diet. Dotted lines indicate proportions less than 0.00%. Fish abbreviations are as follows: CCF, channel catfish; FHM, fathead minnow; BHS, bluehead sucker; FMS, flannelmouth sucker; SPD, speckled dace; HBC, humpback chub; HBC, YOY, young-of-year

humpback chub; PKF, plains killifish. Diet item numbers correspond to: 1, diatoms; 2, Cladophoraceae; 3, Rhodophyta; 4, algal detritus; 5, *Chara*; 6, Bryophyta; 7, Nematoda; 8, Annelida; 9, Naididae; 10, Oligochaeta; 11, Copepoda; 12, Daphniidae; 13, Ostracoda; 14, Physidae; 15, Simuliidae larvae; 16, Simuliidae pupae; 17, Chironomidae exuviae; 18, Chironomidae larvae; 19, Chaoboridae larvae; 20, Psychodidae larvae; 21, Tipulidae larvae; 22, Stratiomyidae larvae; 23, Ephydridae larvae; 24, unidentified diptera larvae; 25, unidentified diptera pupae, 26, Plecoptera nymph; 27, Baetidae nymph; 28, Ephemerellidae nymph; 29, Ameletidae nymph; 30, unidentified Ephemeroptera nymph; 31, Ceratopogonidae larvae; 32, Hydroptilidae larvae; 33, Lepidostomatidae larvae; 34, Hydropsychidae larvae; 35, Rhyacophilidae larvae; 36, Polycentropodidae larvae; 37, Empididae larvae; 38, Zygoptera nymph; 39, unidentified Odonata nymph; 40, Anisoptera nymph; 41, Corixidae; 42, Corydalidae larvae; 43, Sialidae larvae; 44, Haliplidae; 45, unidentified aquatic Coleoptera larvae; 46, Dytiscidae adult; 47, Tabanidae larvae; 48, fish; 49, fish eggs; 50, amorphous detritus; 51, vegetative detritus; 52, invertebrate parts; 53, snail body tissue; 54, unidentified terrestrial Coleoptera larvae; 55, unidentified terrestrial Coleoptera adult; 56, Therevidae larvae; 57, mite; 58, Chironomidae adult; 59, unidentified terrestrial vegetation; 60, Tamarisk bracts; 61, terrestrial seeds; 62, aphid; 63, thrip; 64, *Diorhabda* larvae; 65, *Diorhabda* adult; 66, termite; 67, Curculionoidae adult; 68, Cicadellidae adult; 69, ants; 70, flying ants; 71, Orthoptera adult; 72, Elateridae larvae; 73, Dolichopodidae larvae; 74, Lepidoptera larvae; 75, Lepidoptera adult; 76, Scarabaeidae adult; 77, unidentified winged insect; 78, Simuliidae adult; 79, Hemiptera; 80, spider; 81, pseudoscorpion; 82, Solpugidae;

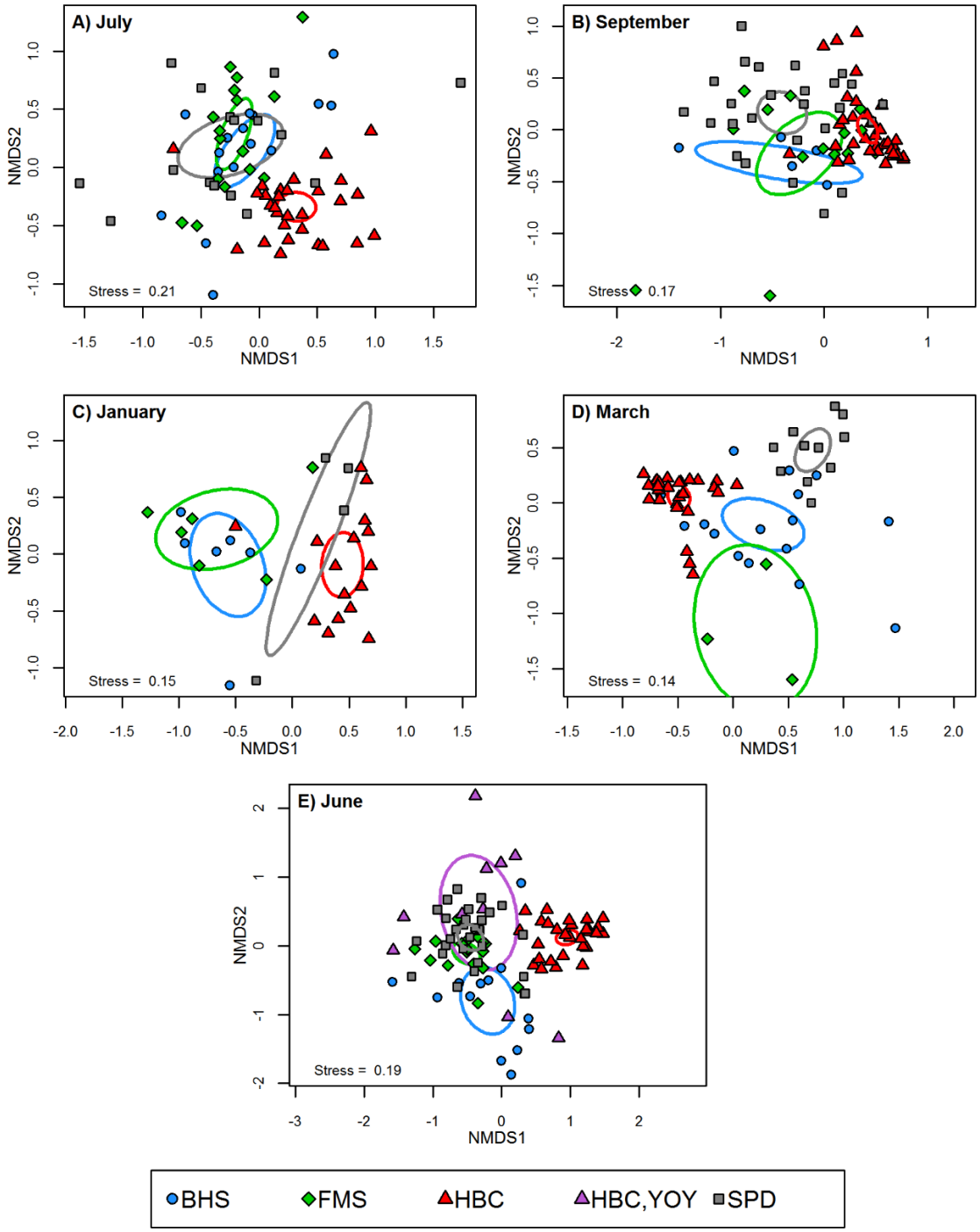


Figure 5: Non-metric multidimensional scaling (NMDS) analysis plots of Little Colorado River fish diets by species within season (A) July, 2012, (B) September, 2012, (C) January, 2013, (D) March, 2013, and (E) June, 2014. Datapoints are coded and grouped by species: BHS, bluehead sucker; FMS, flannelmouth sucker; HBC, adult humpback chub; HBC YOY, young-of-the-year humpback chub; SPD, speckled dace. Ellipses illustrate the 95% confidence interval of the bivariate mean of a given species calculated on standard error of the mean.

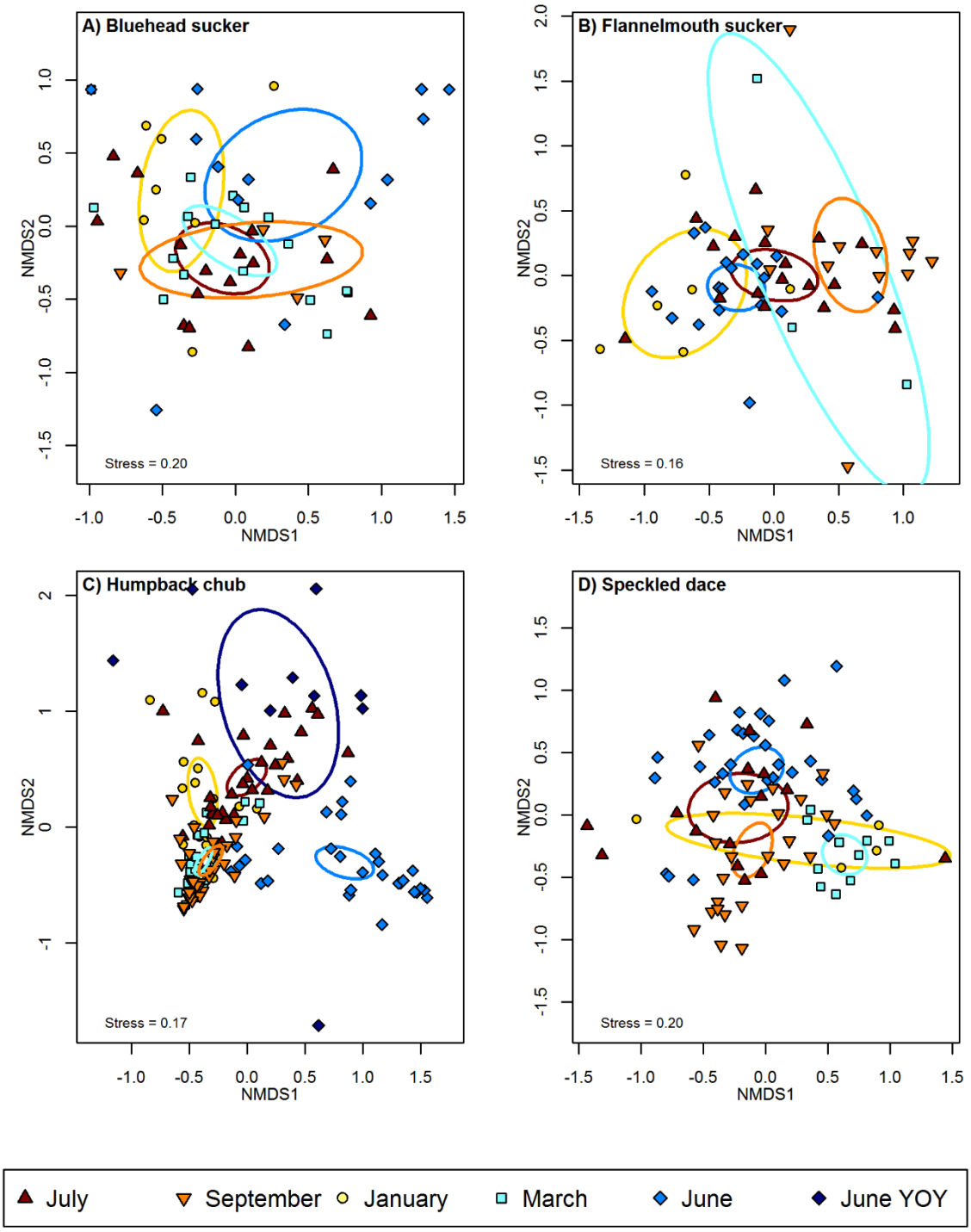


Figure 6: Non-metric multidimensional scaling (NMDS) analysis plots of Little Colorado River fish diets by season within species: (A) bluehead sucker, (B) flannelmouth sucker, (C) humpback chub, and (D) speckled dace. Datapoints are coded and grouped by season. Ellipses illustrate the 95% confidence interval of the bivariate mean of a given season calculated on standard error of the mean.

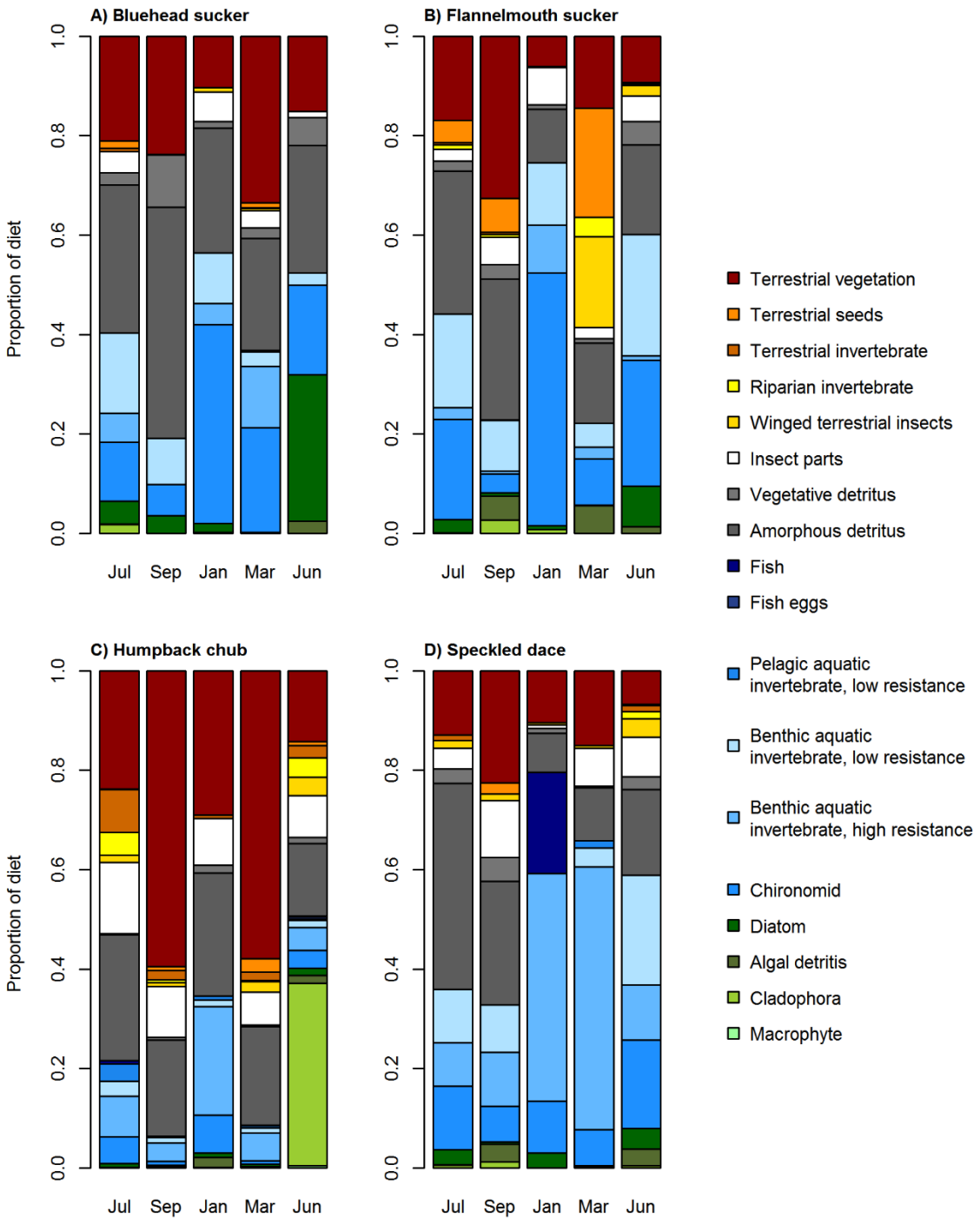


Figure 7: Average proportions of dietary items by dry weight for (A) bluehead sucker, (B) flannelmouth sucker, (C) humpback chub, and (D) speckled dace in the Little Colorado River. Items within bars gradate from terrestrial origin at the top of the stack to ambiguous origin in the mid-section to aquatic near the bottom.

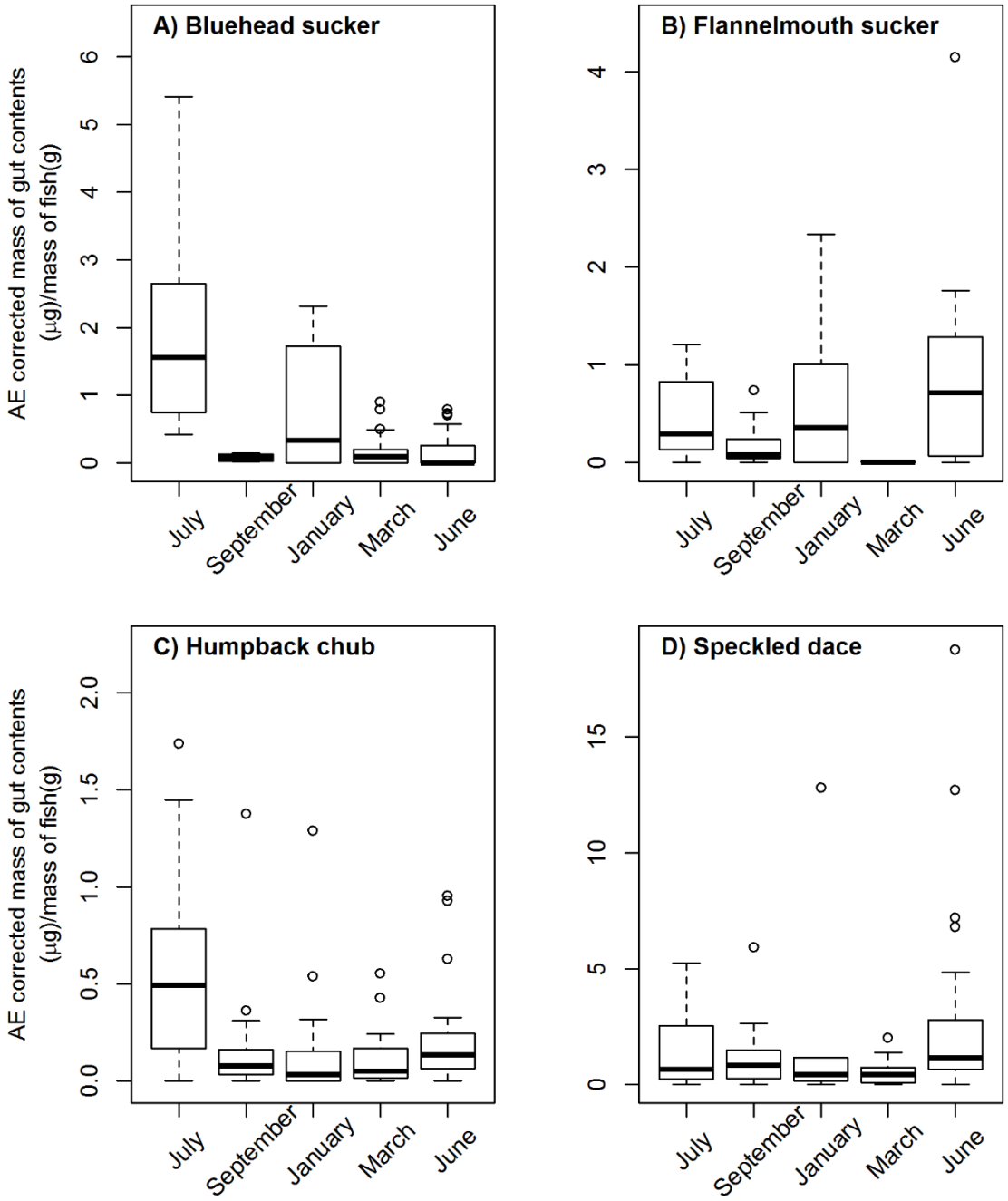


Figure 8: Boxplots of seasonal measures of gut fullness across seasons for the four native fishes in the Little Colorado River: (A) bluehead sucker, (B) flannelmouth sucker, (C) humpback chub, and (D) speckled dace. Weight of gut contents were normalized by size of the individual fish and multiplied by assimilation efficiencies to yield adjusted mass of gut contents per mass of fish. Boxes are bounded by the upper and lower 25% quartiles, and the dark band represents the median. Outliers are marked with open circles and whiskers span from the sample minimum to maximum (excluding outliers).

Table 1: Diet items observed in fish guts collected in the Little Colorado River from July, 2011 to June 2013. Listed are descriptions of diet items, corresponding names of groupings, assimilation efficiency multipliers, and assumed origins. Lumped group name abbreviations are: BAIHR = benthic aquatic invertebrates, high resistance to floods; BAILR = benthic aquatic invertebrates, low resistance to floods; PAILR = pelagic aquatic invertebrates, low resistance to floods

Description of food item	**Lumped group name**	**Estimate of assimilation efficiency**	**Assumed origin**
Diatoms	Diatom	0.5	Aquatic
Oscillatoria	Other algae	0.1	Aquatic
Red Algae	Other algae	0.1	Aquatic
Unknown Algae	Other algae	0.1	Aquatic
Filamentous Algae	Other algae	0.1	Aquatic
Cladophora	Cladophora	0.1	Aquatic
Chara	Macrophyte	0.1	Aquatic
Bryophyte stem & leaves	Macrophyte	0.2	Aquatic
Nematode	BAIHR	0.9	Aquatic
Annelid	BAIHR	0.9	Aquatic
Naididae	BAIHR	0.9	Aquatic
Oligochaete	BAIHR	0.9	Aquatic
Daphnia	PAILR	0.6	Aquatic
Ostracod	BAILR	0.6	Aquatic
Copepod	BAILR	0.6	Aquatic
Chaoboridae larvae	BAIHR	0.9	Aquatic
Diptera larvae (unknown taxa)	BAILR	0.9	Aquatic
Diptera pupae (unknown taxa)	BAILR	0.7	Aquatic
Ephydridae larvae	BAILR	0.9	Aquatic
Psychodidae larvae	BAILR	0.9	Aquatic
Tabanidae larvae	BAILR	0.9	Aquatic
Physid snail	BAILR	0.5	Aquatic
Snail tissue	BAILR	1	Aquatic
Baetidae nymph	BAIHR	0.9	Aquatic
Ceratopogonidae larvae	BAILR	0.9	Aquatic
Chironomidae larvae	Chironomid	0.9	Aquatic
Chironomidae exuviae	BAILR	0.1	Aquatic
Corixidae	PAILR	0.7	Aquatic
Empididae larvae	BAILR	0.9	Aquatic
Hydropsychidae larvae	BAIHR	0.9	Aquatic
Hydroptilidae larvae	BAILR	0.9	Aquatic
Anisoptera nymph	PAILR	0.8	Aquatic
Odonate (unknown taxa)	PAILR	0.8	Aquatic
Zygoptera nymph	PAILR	0.8	Aquatic
Beetle larvae of aquatic origin (unknown taxa)	BAIHR	0.8	Aquatic
Corydalus nymph	BAIHR	0.7	Aquatic
Sialidae nymph	BAIHR	0.8	Aquatic

Description of food item	Lumped group name	Estimate of assimilation efficiency	Assumed origin
Adult Dytiscid	PAILR	0.7	Aquatic
Haliplidae adult	BAILR	0.7	Aquatic
Ameletidae nymph	BAIHR	0.7	Aquatic
Ephemerellidae nymph	BAIHR	0.9	Aquatic
Ephemeroptera nymph (unknown taxa)	BAIHR	0.9	Aquatic
Lepidostoma larvae	BAIHR	0.9	Aquatic
Polycentropodidae larvae	BAIHR	0.9	Aquatic
Rhyacophila larvae	BAILR	0.9	Aquatic
Plecoptera nymph	BAIHR	0.9	Aquatic
Simuliidae larvae	BAILR	0.9	Aquatic
Simuliidae pupae	BAIHR	0.7	Aquatic
Stratiomyidae larvae	BAIHR	0.9	Aquatic
Tipulidae larvae	BAIHR	0.9	Aquatic
Mite	BAILR	0.7	Aquatic
Fish eggs	Fish eggs	1	Aquatic
Fish	Fish	1	Aquatic
Terrestrial vegetation	Terrestrial vegetation	0.2	Terrestrial
Tamarisk material	Terrestrial vegetation	0.2	Terrestrial
Terrestrial seeds	Terrestrial seeds	0.4	Terrestrial
Dolichipodidae larvae	Terrestrial invertebrate	0.9	Terrestrial
Chironomidae adult	Winged terrestrial	0.7	Terrestrial
Simuliidae adult	Winged terrestrial	0.9	Terrestrial
Therevidae larvae	Terrestrial invertebrate	0.9	Terrestrial
Terrestrial winged insect	Winged terrestrial	0.7	Terrestrial
Thrip	Winged terrestrial	0.7	Terrestrial
Aphid (adult)	Riparian invertebrate	0.7	Terrestrial
Cicadellidae adult	Riparian invertebrate	0.7	Terrestrial
Terrestrial Hemipteran	Riparian invertebrate	0.7	Terrestrial
Orthoptera adult	Terrestrial invertebrate	0.7	Terrestrial
Terrestrial Lepidoptera larvae	Riparian invertebrate	0.7	Terrestrial
Terrestrial Lepidoptera adult	Winged terrestrial	0.7	Terrestrial
Terrestrial Chrysomelidae adult (Tamarisk beetle)	Riparian invertebrate	0.7	Terrestrial
Terrestrial Chrysomelidae larvae (Tamarisk beetle)	Riparian invertebrate	0.7	Terrestrial
Elateridae larvae	Terrestrial invertebrate	0.7	Terrestrial
Scarabaeidae adult	Terrestrial invertebrate	0.7	Terrestrial
Beetle adult of terrestrial origin (unknown taxa)	Terrestrial invertebrate	0.7	Terrestrial
Beetle larvae of terrestrial origin (unknown taxa)	Terrestrial invertebrate	0.8	Terrestrial
Curculionidae	Riparian invertebrate	0.7	Terrestrial
Termite	Terrestrial invertebrate	0.7	Terrestrial
Ants	Terrestrial invertebrate	0.7	Terrestrial
Flying ants	Winged terrestrial	0.7	Terrestrial

Description of food item	Lumped group name	Estimate of assimilation efficiency	Assumed origin
Pseudoscorpion	Terrestrial invertebrate	0.7	Terrestrial
Solpugidae	Terrestrial invertebrate	0.7	Terrestrial
Spider	Terrestrial invertebrate	0.7	Terrestrial
Insect parts of unknown origin	Insect parts	0.7	Unknown
Vegetation of indeterminate origin	Vegetation of unknown origin	0.2	Unknown
Amorphous detritus	Amorphous detritus	0.2	Unknown

Table 2: Influential diet items that separated or grouped Little Colorado River fish species among seasons as revealed by non-metric multidimensional scaling. Items with coefficients of determination (r^2) values over 0.16 are shown, in increasing order, by month. Also included are the vector endpoints of the various diet items in diet space with color gradations indicating increasing (orange) or decreasing (blue) values.

Important diet item within seasons	NMDS Axis 1	NMDS Axis 2	r^2
July			
Pelagic aquatic invertebrates, low resistance	0.8197	-0.5728	0.2148
Diatom	-0.9789	-0.2046	0.2263
Vegetative detritus	-0.9406	0.3396	0.2465
Chironomid	0.0972	0.9953	0.3154
Benthic aquatic invertebrates, high resistance	0.9105	0.4135	0.3292
Terrestrial invertebrates	0.7555	-0.6551	0.3526
Terrestrial vegetation	-0.1722	-0.9851	0.3991
Benthic aquatic invertebrates, low resistance	-0.3887	0.9213	0.4244
Insect parts	0.7571	-0.6533	0.4457
September			
Benthic aquatic invertebrates, high resistance	-0.9763	0.2164	0.1774
Terrestrial seeds	-0.5512	-0.8344	0.2524
Chironomid	-0.8826	0.4701	0.3922
Insect parts	0.1703	0.9854	0.4956
Benthic aquatic invertebrates, low resistance	-0.9277	0.3733	0.5004
Terrestrial vegetation	0.9527	-0.3039	0.8027
January			
Benthic aquatic invertebrates, low resistance	-0.9488	0.3158	0.1848
Vegetative detritus	0.2586	-0.9657	0.1940
Terrestrial vegetation	0.7612	-0.6468	0.5561
Benthic aquatic invertebrate, high resistance	0.5916	0.8062	0.8236
Chironomid	-0.9294	0.3690	0.8703
March			
Terrestrial seeds	-0.0164	-0.9999	0.1786
Riparian invertebrates	0.0851	-0.9964	0.1942
Winged terrestrial	-0.0861	-0.9963	0.2308
Chironomid	0.7058	-0.7084	0.5705
Benthic aquatic invertebrate, high resistance	0.6320	0.7750	0.8438
Terrestrial vegetation	-0.9519	0.3064	0.8776
June			
Terrestrial invertebrates	0.0223	0.9998	0.1611
Terrestrial vegetation	0.7417	-0.6707	0.1790
Winged terrestrials	-0.5098	0.8603	0.1997
Benthic aquatic invertebrates, low resistance	-0.9254	0.3790	0.3563
Diatoms	0.0249	-0.9997	0.4300
Chironomid	-0.9701	-0.2429	0.5390
Cladophora	0.9665	0.2566	0.6555

Table 3: Influential diet items that separated or grouped seasonal patterns among diets of Little Colorado River fishes as revealed by non-metric multidimensional scaling. Items with coefficients of determination (r^2) values over 0.16 are shown, in increasing order, by species. Also included are the vector endpoints of the various diet items in diet space with color gradations indicating increasing (orange) or decreasing (blue) values.

Seasonally important diet items within species	NMDS Axis 1	NMDS Axis 2	r^2
Bluehead sucker			
Insect parts	-0.5626	-0.8268	0.3183
Benthic aquatic invertebrates, low resistance	-0.3847	-0.9231	0.2892
Terrestrial vegetation	0.6971	-0.7170	0.4194
Diatoms	0.8177	0.5756	0.5985
Chironomid	-0.7121	0.7021	0.7243
Flannelmouth sucker			
Other algae	0.2099	-0.9777	0.2204
Benthic aquatic invertebrate, low resistance	-0.9096	0.4156	0.2907
Terrestrial seeds	-0.0156	0.9999	0.4966
Terrestrial vegetation	0.9987	0.0501	0.6749
Chironomid	-0.9081	-0.4187	0.7101
Humpback chub			
Insect parts	0.3401	0.9404	0.1679
Terrestrial invertebrates	0.3567	0.9342	0.2216
Winged terrestrial invertebrates	0.0802	0.9968	0.2404
Chironomid	-0.3762	0.9265	0.2667
Benthic aquatic invertebrates, high resistance	-0.7248	0.6890	0.2723
Cladophora	0.9356	-0.3531	0.7236
Terrestrial vegetation	-0.7248	-0.6889	0.7960
Speckled dace			
Diatom	-0.9658	0.2592	0.1715
Vegetative detritus	-0.7493	-0.6623	0.1879
Chironomid	0.2577	0.9662	0.2328
Terrestrial vegetation	-0.1583	-0.9874	0.5677
Benthic aquatic invertebrates, low resistance	0.0364	0.9993	0.5938
Benthic aquatic invertebrates, high resistance	0.9620	-0.2731	0.7619

Table 4: The degrees of freedom, *F* statistics, and *P* values for pairwise permutational multiple analysis of variance for species comparisons within months. *P* values are corrected with Holm's method for pairwise comparisons. Fish abbreviations are as follows: BHS, bluehead sucker; FMS, flannelmouth sucker; HBC, age 1 year+ humpback chub; HBC YOY, young-of-the-year humpback chub; SPD speckled dace.

Month & species combination		*d.f.*	*F*	*P*
July				
	BHS vs. FMS	1,30	0.5	1.000
	BHS vs. HBC	1,43	9.0	0.001
	BHS vs. SPD	1,30	0.5	1.000
	FMS vs. HBC	1,43	14.4	0.001
	FMS vs. SPD	1,30	1.3	0.741
	HBC vs. SPD	1,43	10.0	0.001
September				
	BHS vs. FMS	1,16	1.0	0.394
	BHS vs. HBC	1,39	9.4	0.001
	BHS vs. SPD	1,28	1.7	0.252
	FMS vs. HBC	1,49	8.1	0.001
	FMS vs. SPD	1,38	2.5	0.095
	HBC vs. SPD	1,61	23.5	0.001
January				
	BHS vs. FMS	1,11	0.5	0.863
	BHS vs. HBC	1,21	8.1	0.002
	BHS vs. SPD	1,9	3.6	0.053
	FMS vs. HBC	1,20	10.8	0.001
	FMS vs. SPD	1,8	4.5	0.050
	HBC vs. SPD	1,18	3.7	0.050
March				
	BHS vs. FMS	1,18	2.7	0.033
	BHS vs. HBC	1,42	16.5	0.001
	BHS vs. SPD	1,26	10.4	0.001
	FMS vs. HBC	1,28	11.2	0.002
	FMS vs. SPD	1,12	7.9	0.004
	HBC vs. SPD	1,36	56.4	0.001
June				
	BHS vs. FMS	1,29	6.7	0.001
	BHS vs. HBC	1,41	10.1	0.001
	BHS vs. HBC YOY	1,21	4.2	0.001
	BHS vs. SPD	1,41	7.7	0.001
	FMS vs. HBC	1,46	41.8	0.001
	FMS vs. HBC YOY	1,26	7.0	0.001
	FMS vs. SPD	1,46	1.5	0.199
	HBC vs. HBC YOY	1,38	14.9	0.001
	HBC vs. SPD	1,58	37.1	0.001
	HBC YOY vs. SPD	1,38	4.2	0.001

Table 5: The degrees of freedom, *F* statistics, and *P* values for pairwise permutational multiple analysis of variance for month comparisons within species. *P* values are corrected with Holm's method for pairwise comparisons. Fish abbreviations are as follows: BHS, bluehead sucker; FMS, flannelmouth sucker; HBC (all months except June), age 1 year+ humpback chub; HBC 1+ (June), age 1 year+ humpback chub; HBC YOY (June), young-of-the-year-humpback chub; SPD, speckled dace.

Species & month combinations	*d.f.*	*F*	*P*
BHS			
July vs. September	1,18	1.2	0.307
July vs. January	1,21	1.9	0.252
July vs. March	1,31	2.9	0.127
July vs. June	1,27	4.0	0.019
September vs. January	1,9	2.8	0.197
September vs. March	1,19	2.3	0.252
September vs. June	1,15	1.8	0.252
January vs. March	1,22	3.4	0.105
January vs. June	1,18	2.6	0.217
March vs. June	1,28	5.3	0.005
FMS			
July vs. September	1,28	4.6	0.019
July vs. January	1,20	4.1	0.047
July vs. March	1,17	2.6	0.075
July vs. June	1,32	3.0	0.063
September vs. January	1,18	7.5	0.004
September vs. March	1,15	2.1	0.075
September vs. June	1,30	11.7	0.001
January vs. March	1,7	3.1	0.055
January vs. June	1,22	3.6	0.047
March vs. June	1,19	4.6	0.019
HBC			
July vs. September	1,64	26.6	0.002
July vs. January	1,43	6.5	0.002
July vs. March	1,54	25.7	0.002
July vs. June 1+	1,57	31.8	0.002
July vs. June YOY	1,37	6.7	0.002
September vs. January	1,51	15.7	0.002
September vs. March	1,62	2.2	0.083
September vs. June 1+	1,65	56.1	0.002
September vs. June YOY	1,45	24.7	0.002
January vs. March	1,41	16.2	0.002
January vs. June 1+	1,44	23.8	0.002
January vs. June YOY	1,24	7.5	0.002
March vs. June 1+	1,55	53.2	0.002
March vs. June YOY	1,35	24.7	0.002
June 1+ vs. June YOY	1,38	14.9	0.002

SPD			
July vs. September	1,40	3.5	0.016
July vs. January	1,18	2.5	0.083
July vs. March	1,25	9.7	0.001
July vs. June	1,44	1.9	0.145
September vs. January	1,28	5.3	0.004
September vs. March	1,35	12.0	0.001
September vs. June	1,54	8.8	0.001
January vs. March	1,13	1.7	0.154
January vs. June	1,32	4.5	0.005
March vs. June	1,39	14.4	0.001

APPENDIX 1

Complete Diet Composition Table

Appendix 1. Seasonal averages and 95% confidence intervals of proportions of diet items in fishes guts by species. Means are bootstrapped estimates based on 10,000 permutations. Confidence intervals are bias corrected and accelerated. Diet items are grouped by origin (aquatic, terrestrial, unknown), the presence of assumed indigestible items are listed at the end of each sampling season. Also listed are catch, number sampled for guts, number of those processed that revealed empty guts, incidence of Asian tapeworm, and equipment used to catch fish whose guts were not empty.

Estimates (bootstrapped means and 95% bias-corrected confidence intervals) of proportions of food items in fishes guts in July, 2012.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Total catch		0	30	2	3	40	21	451	106	116	0	14	43
Total sampled for diet		--	n=16	n=1	n=1	n=14	n=16	n=30	n=0	n=21	--	n=10	n=21
Incidence of empty guts		--	0	0	0	1	0	1	--	7	--	3	4
Incidence of Asian tapeworm*		--	0	0	0	2	0	7	--	0	--	0	0
Equipment used, hoop/seine		--	14/2	1/0	1/0	12/1	15/1	29/0	--	6/8	--	7/0	11/6
Diet Item													
Aquatic origin													
	$\hat{\theta}$	--	0.0449	0.0052	0.0021	0.0044	0.0260	0.0075	--	--	--	--	0.0303
Diatoms	0.025	--	0.0250	--	--	0.0027	0.0157	0.0050	--	--	--	--	0.0195
	0.975	--	0.1011	--	--	0.0056	0.0442	0.0130	--	--	--	--	0.0492
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Oscillatoria	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Red algae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Other algae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0012	--	--	--	0.0017	0.0007	--	--	--	--	0.0012
Unknown filamentous algae	0.025	--	0.0005	--	--	--	0.0009	0.0003	--	--	--	--	0.0004
	0.975	--	0.0025	--	--	--	0.0034	0.0017	--	--	--	--	0.0028

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0184	--	--	--	--	0.0009	--	--	--	--	0.0054
Cladophora	0.025	--	0.0078	--	--	--	--	0.0000	--	--	--	--	0.0000
	0.975	--	0.0629	--	--	--	--	0.0064	--	--	--	--	0.0328
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chara	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Bryophyte	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0038	--	--	--	--	--	--
Nematode	0.025	--	--	--	--	--	0.0005	--	--	--	--	--	--
	0.975	--	--	--	--	--	0.0142	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Annelid	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0008	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	0.0074	--	--	--	--	--	0.0000	--
Naididae	0.025	--	--	--	--	0.0000	--	--	--	--	--	0.0000	--
	0.975	--	--	--	--	0.0451	--	--	--	--	--	0.0000	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0048	--	--	--	--	--
Oligochaete	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0336	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Daphnia	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0209	--	--	0.0037	0.0162	0.0012	--	0.0095	--	0.0007	0.0089
Ostracod	0.025	--	0.0084	--	--	0.0000	0.0067	0.0003	--	0.0000	--	0.0000	0.0033
	0.975	--	0.0709	--	--	0.0263	0.0343	0.0046	--	0.0571	--	0.0041	0.0337

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0834	--	--	--	0.0234	--	--	--	--	--	--
Copepod	0.025	--	0.0368	--	--	--	0.0097	--	--	--	--	--	--
	0.975	--	0.1552	--	--	--	0.0435	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.0019
Chaoboridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0135
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Diptera larvae (unknown taxa)	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0005	--	--	--	--	--
	$\hat{\theta}$	--	0.0035	--	0.1891	--	0.0095	0.0062	--	--	--	--	--
Diptera pupae (unknown taxa)	0.025	--	0.0000	--	--	--	0.0014	0.0034	--	--	--	--	--
	0.975	--	0.0210	--	--	--	0.0422	0.0111	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0013	--	--	--	--	--
Ephydridae larvae	0.025	--	--	--	--	--	--	0.0003	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0038	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0006	--	--	--	--	--
Psychodidae larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0037	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0057	--	--	--	0.0021	--
Tabanidae larvae	0.025	--	--	--	--	--	--	0.0006	--	--	--	0.0000	--
	0.975	--	--	--	--	--	--	0.0254	--	--	--	0.0124	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0003	--	--	--	--	--
Physid snail	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0017	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0002	--	--	--	--	0.0032
Snail Tissue	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	0.0012
	0.975	--	--	--	--	--	--	0.0004	--	--	--	--	0.0078

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0385	--	--	--	0.0021	0.0062	--	--	--	--	0.0081
Baetidae nymph	0.025	--	0.0102	--	--	--	0.0007	0.0036	--	--	--	--	0.0000
	0.975	--	0.1169	--	--	--	0.0057	0.0105	--	--	--	--	0.0490
	$\hat{\theta}$	--	0.0258	--	--	0.0046	0.1316	0.0124	--	0.1076	--	--	0.0592
Ceratopogonidae larvae	0.025	--	0.0042	--	--	0.0000	0.0702	0.0085	--	0.0266	--	--	0.0260
	0.975	--	0.0771	--	--	0.0280	0.2331	0.0184	--	0.3765	--	--	0.1158
	$\hat{\theta}$	--	0.1191	--	--	0.0352	0.2019	0.0540	--	0.4691	--	0.0715	0.1276
Chironomidae larvae	0.025	--	0.0781	--	--	0.0131	0.1344	0.0365	--	0.2621	--	0.0199	0.0694
	0.975	--	0.1882	--	--	0.0796	0.3505	0.0791	--	0.7085	--	0.1445	0.2352
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chironomidae exuviae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0234	--	0.0506	--	--	--
Corixidae	0.025	--	--	--	--	--	--	0.0129	--	0.0000	--	--	--
	0.975	--	--	--	--	--	--	0.0454	--	0.3036	--	--	--
	$\hat{\theta}$	--	0.0110	--	--	--	--	0.0000	--	--	--	--	0.0058
Empididae larvae	0.025	--	0.0000	--	--	--	--	0.0000	--	--	--	--	0.0000
	0.975	--	0.0426	--	--	--	--	0.0002	--	--	--	--	0.0404
	$\hat{\theta}$	--	--	--	--	--	0.0102	0.0178	--	--	--	--	--
Hydropsychidae larvae	0.025	--	--	--	--	--	0.0040	0.0090	--	--	--	--	--
	0.975	--	--	--	--	--	0.0366	0.0399	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0058	0.0010	--	0.0048	--	--	0.0241
Hydroptilidae larvae	0.025	--	--	--	--	--	0.0018	0.0001	--	0.0000	--	--	0.0067
	0.975	--	--	--	--	--	0.0164	0.0034	--	0.0335	--	--	0.0713
	$\hat{\theta}$	--	--	--	--	--	--	0.0051	--	--	--	--	--
Anisoptera nymph	0.025	--	--	--	--	--	--	0.0016	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0128	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	--
Odonate nymph of unknown taxon	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0001	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0006	--	--	--	--	--
Zygoptera nymph	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0027	--	--	--	--	--
	$\hat{\theta}$	--	0.0049	--	--	--	--	0.0004	--	--	--	--	--
Beetle larvae of aquatic origin	0.025	--	0.0000	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	0.0290	--	--	--	--	0.0024	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0160	--	--	--	--	--
Corydalus larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.1113	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0040	--	--	--	--	--	--
Sialidae larvae	0.025	--	--	--	--	--	0.0000	--	--	--	--	--	--
	0.975	--	--	--	--	--	0.0236	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0050	--	--	--	--	--
Adult Dytiscid	0.025	--	--	--	--	--	--	0.0021	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0131	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0002	--	--	--	--	--
Haliplidae adult	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0010	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.0050
Ameletidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0251
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.0029
Ephemerellidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0173

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0086	--	--	0.0075	0.0005	0.0001	--	--	--	--	0.0651
Ephemeroptera nymph	0.025	--	0.0000	--	--	0.0000	0.0000	0.0000	--	--	--	--	0.0020
	0.975	--	0.0432	--	--	0.0451	0.0038	0.0009	--	--	--	--	0.3184
	$\hat{\theta}$	--	0.0052	--	--	--	--	--	--	--	--	--	--
Lepidostomatidae larvae	0.025	--	0.0000	--	--	--	--	--	--	--	--	--	--
	0.975	--	0.0306	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Polycentropodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0012	--	--	--	--	--
Rhyacophila larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0085	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	0.0360	--
Plecoptera nymph	0.025	--	--	--	--	--	--	--	--	--	--	0.0000	--
	0.975	--	--	--	--	--	--	--	--	--	--	0.2143	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.0056
Simuliidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0328
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Simuliidae pupae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0029	0.0194	--	--	--	--	--
Stratiomyidae larvae	0.025	--	--	--	--	--	0.0011	0.0061	--	--	--	--	--
	0.975	--	--	--	--	--	0.0105	0.0573	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0122	--	--	--	0.0027	0.0057
Tipulidae larvae	0.025	--	--	--	--	--	--	0.0038	--	--	--	0.0000	0.0000
	0.975	--	--	--	--	--	--	0.0434	--	--	--	0.0137	0.0281

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0168	--	--	--	0.0017	0.0006	--	--	--	--	--
Mite	0.025	--	0.0074	--	--	--	0.0000	0.0000	--	--	--	--	--
	0.975	--	0.0600	--	--	--	0.0105	0.0034	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0067	--	--	--	--	--
Fish	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0407	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Fish eggs	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial origin													
	$\hat{\theta}$	--	0.2101	0.5071	0.0107	0.2253	0.1694	0.2363	--	0.0710	--	0.0062	0.1288
Terrestrial vegetation	0.025	--	0.1443	--	--	0.1640	0.1238	0.1914	--	0.0000	--	0.0000	0.0795
	0.975	--	0.3870	--	--	0.2998	0.2124	0.2872	--	0.3571	--	0.0371	0.2118
	$\hat{\theta}$	--	--	--	--	--	0.0002	0.0016	--	--	--	--	--
Tamarisk material	0.025	--	--	--	--	--	0.0000	0.0003	--	--	--	--	--
	0.975	--	--	--	--	--	0.0016	0.0057	--	--	--	--	--
	$\hat{\theta}$	--	0.0143	--	--	0.0099	0.0438	0.0008	--	--	--	--	--
Terrestrial seeds	0.025	--	0.0046	--	--	0.0038	0.0148	0.0003	--	--	--	--	--
	0.975	--	0.0407	--	--	0.0347	0.1100	0.0022	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0053	--	--	--	--	--	--
Dolichopodidae larvae	0.025	--	--	--	--	--	0.0000	--	--	--	--	--	--
	0.975	--	--	--	--	--	0.0314	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	0.0050
Chironomidae Adult	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	0.0002	--	--	--	--	0.0308

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Simuliidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0042	--	--	--	--	--
Therevidae larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0256	--	--	--	--	--
	$\hat{\theta}$	--	--	--	0.5090	--	0.0005	0.0143	--	0.0204	--	--	0.0105
Terrestrial winged insect	0.025	--	--	--	--	--	0.0000	0.0089	--	0.0000	--	--	0.0034
	0.975	--	--	--	--	--	0.0043	0.0249	--	0.1250	--	--	0.0429
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Thrip	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	--
Aphid	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0002	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0007	--	--	--	--	--
Cicadellidae adult	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0040	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0086	0.0006	--	--	--	--	--
Terrestrial Hemipteran	0.025	--	--	--	--	--	0.0000	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	0.0516	0.0035	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0121	--	--	--	--	--
Orthoptera adult	0.025	--	--	--	--	--	--	0.0003	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0715	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0019	--	--	--	--	--
Terrestrial Lepidoptera larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0131	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	--
Lepidoptera adult	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0002	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0125	--	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	0.0042	--	--	--	--	--
adult	0.975	--	--	--	--	--	--	0.0398	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0288	--	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	0.0197	--	--	--	--	--
larvae	0.975	--	--	--	--	--	--	0.0433	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0071	--	--	--	--	--
Elateridae larvae	0.025	--	--	--	--	--	--	0.0013	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0315	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0026	--	--	--	--	--
Scarabaeidae adult	0.025	--	--	--	--	--	--	0.0002	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0143	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0062	--	--	--	--	--
Beetle adult of terrestrial origin	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	0.0426	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0021	--	--	--	--	--
Beetle larvae of terrestrial origin	0.025	--	--	--	--	--	--	0.0002	--	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	0.0097	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0013	--	--	--	--	--
Curculionoidae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0081	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	--
Termite	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0002	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0067	--	--	--	--	0.0555	--	--	--	--	0.0112
Ants	0.025	--	0.0000	--	--	--	--	0.0315	--	--	--	--	0.0000
	0.975	--	0.0408	--	--	--	--	0.1053	--	--	--	--	0.0670
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Flying ants	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Pseudoscorpion	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0006	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	--
Solpugidae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0000	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0004	--	--	--	--	--
Spider	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0012	--	--	--	--	--
Unknown origin													
	$\hat{\theta}$	--	0.0427	--	0.1087	0.1066	0.0228	0.1437	--	0.0233	--	--	0.0411
Insect parts of unknown origin	0.025	--	0.0198	--	--	0.0629	0.0100	0.1131	--	0.0000	--	--	0.0194
	0.975	--	0.0738	--	--	0.1505	0.0525	0.1782	--	0.1398	--	--	0.0755
	$\hat{\theta}$	--	0.0242	0.0778	0.0322	0.0351	0.0201	0.0013	--	--	--	--	0.0297
Vegetative detritus	0.025	--	0.0161	--	--	0.0252	0.0129	0.0009	--	--	--	--	0.0197
	0.975	--	0.0365	--	--	0.0458	0.0352	0.0019	--	--	--	--	0.0417
	$\hat{\theta}$	--	0.2976	0.4099	0.1481	0.5599	0.2884	0.2530	--	0.2855	--	0.8809	0.4140
Amorphous detritus	0.025	--	0.2286	--	--	0.4944	0.2090	0.2039	--	0.1202	--	0.8098	0.3109
	0.975	--	0.3729	--	--	0.6196	0.3984	0.3241	--	0.4945	--	0.9684	0.5429

Appendix 1. Continued.

	BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Indigestible/incalculable items												
Mystery object (Present/Not present)	--	N	N	N	N	--	P	--	N	--	N	N
Hydropsychidae case (Present/Not present)	--	N	N	N	N	N	N	--	N	--	N	N
Hydroptilidae case (Present/Not present)	--	N	N	N	N	P	P	--	P	--	N	N
Fish scales (Present/Not present)	--	N	N	N	N	P	P	--	N	--	N	N
Bone (Present/Not present)	--	N	N	N	N	N	N	--	N	--	N	N
Snail Shell (Present/Not present)	--	N	N	N	N	N	P	--	N	--	N	N

Appendix 1. Continued.

Estimates (bootstrapped means and 95% bias-corrected confidence intervals) of proportions of food items in fishes guts in September, 2012.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Total catch		0	4	0	7	1	15	35	80	13	0	1	36
Total sampled for diet		--	n=4	--	n=7	n=1	n=14	n=41	n=0	n=na	--	n=1	n=28
Incidence of empty guts		--	0	--	1	1	0	4	--	na	--	0	1
Incidence of Asian tapeworm*		--	0	--	0	0	0	8	--	na	--	0	2
Equipment used, hoop/seine		--	0/4	--	6/1	--	1/13	23/14	--	na	--	0/1	0/27
Diet Item													
Aquatic origin													
	$\hat{\theta}$	--	0.0362	--	0.0007	--	0.0061	0.0014	--		--	--	0.0042
Diatoms	0.025	--	0.0132	--	0.0003	--	0.0039	0.0009	--		--	--	0.0028
	0.975	--	0.0684	--	0.0011	--	0.0081	0.0021	--		--	--	0.0069
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Oscillatoria	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Red algae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0465	0.0014	--		--	--	0.0257
Other algae	0.025	--	--	--	--	--	0.0000	0.0000	--		--	--	0.0000
	0.975	--	--	--	--	--	0.2927	0.0085	--		--	--	0.0946
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--		--	--	0.0117
Unknown filamentous algae	0.025	--	--	--	--	--	--	0.0000	--		--	--	0.0055
	0.975	--	--	--	--	--	--	0.0005	--		--	--	0.0328
	$\hat{\theta}$	--	--	--	--	--	0.0270	--	--		--	--	0.0130
Cladophora	0.025	--	--	--	--	--	0.0063	--	--		--	--	0.0034
	0.975	--	--	--	--	--	0.0940	--	--		--	--	0.0399

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0026	--		--	--	--
Chara	0.025	--	--	--	--	--	--	0.0011	--		--	--	--
	0.975	--	--	--	--	--	--	0.0099	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Bryophyte	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	0.0139	--	--	--	--		--	--	0.0173
Nematode	0.025	--	--	--	0.0000	--	--	--	--		--	--	0.0068
	0.975	--	--	--	0.0718	--	--	--	--		--	--	0.0368
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Annelid	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Naididae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0034	--		--	--	--
Oligochaete	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0235	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Daphnia	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0031	0.0000	--		--	--	--
Ostracod	0.025	--	--	--	--	--	0.0000	0.0000	--		--	--	--
	0.975	--	--	--	--	--	0.0219	0.0001	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0330	--	--		--	--	--
Copepod	0.025	--	--	--	--	--	0.0090	--	--		--	--	--
	0.975	--	--	--	--	--	0.1073	--	--		--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Chaoboridae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	0.0080
Diptera larvae (unknown taxa)	0.025	--	--	--	--	--	--	--	--		--	--	0.0000
	0.975	--	--	--	--	--	--	--	--		--	--	0.0477
	$\hat{\theta}$	--	--	--	--	--	0.0037	0.0001	--		--	--	--
Diptera pupae (unknown taxa)	0.025	--	--	--	--	--	0.0000	0.0000	--		--	--	--
	0.975	--	--	--	--	--	0.0258	0.0004	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Ephydridae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Psychodidae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0019	--		--	--	--
Tabanidae larvae	0.025	--	--	--	--	--	--	0.0002	--		--	--	--
	0.975	--	--	--	--	--	--	0.0101	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0002	--		--	--	--
Physid snail	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0016	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--		--	--	--
Snail Tissue	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0005	--		--	--	--
	$\hat{\theta}$	--	--	--	0.0754	--	--	0.0029	--		--	--	0.0033
Baetidae nymph	0.025	--	--	--	0.0365	--	--	0.0007	--		--	--	0.0000
	0.975	--	--	--	0.0995	--	--	0.0079	--		--	--	0.0194

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	0.0733	--	0.0189	0.0059	--		--	--	0.0138
Ceratopogonidae larvae	0.025	--	--	--	0.0488	--	0.0065	0.0006	--		--	--	0.0033
	0.975	--	--	--	0.0969	--	0.0496	0.0187	--		--	--	0.0456
	$\hat{\theta}$	--	0.0623	--	0.0394	--	0.0387	0.0077	--		--	--	0.0744
Chironomidae larvae	0.025	--	0.0298	--	0.0158	--	0.0145	0.0024	--		--	--	0.0497
	0.975	--	0.1271	--	0.0719	--	0.0752	0.0193	--		--	--	0.1056
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Chironomidae exuviae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--		--	--	--
Corixidae	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0003	--		--	--	--
	$\hat{\theta}$	--	--	--	0.0693	--	0.0118	--	--		--	--	0.0261
Empididae larvae	0.025	--	--	--	0.0221	--	0.0031	--	--		--	--	0.0108
	0.975	--	--	--	0.1503	--	0.0289	--	--		--	--	0.0581
	$\hat{\theta}$	--	--	--	0.1913	--	0.0049	0.0311	--		--	--	0.0267
Hydropsychidae larvae	0.025	--	--	--	0.0710	--	0.0002	0.0137	--		--	--	0.0096
	0.975	--	--	--	0.3435	--	0.0281	0.0647	--		--	--	0.0572
	$\hat{\theta}$	--	--	--	--	--	--	0.0002	--		--	--	--
Hydroptilidae larvae	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0009	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0010	--		--	--	--
Anisoptera nymph	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0058	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Odonate nymph of unknown taxon	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	0.0777	--	0.0007	0.0005	--		--	--	--
Zygoptera nymph	0.025	--	--	--	0.0000	--	0.0000	0.0000	--		--	--	--
	0.975	--	--	--	0.3837	--	0.0040	0.0038	--		--	--	--
	$\hat{\theta}$	--	--	--	0.0222	--	--	--	--		--	--	--
Beetle larvae of aquatic origin	0.025	--	--	--	0.0071	--	--	--	--		--	--	--
	0.975	--	--	--	0.0667	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Corydalus larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Sialidae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0005	--		--	--	--
Adult Dytiscid	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0032	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Haliplidae adult	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	0.0109
Ameletidae nymph	0.025	--	--	--	--	--	--	--	--		--	--	0.0044
	0.975	--	--	--	--	--	--	--	--		--	--	0.0392
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Ephemerellidae nymph	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	0.0252	--	0.0004	0.0000	--		--	--	0.0309
Ephemeroptera nymph	0.025	--	--	--	0.0071	--	0.0000	0.0000	--		--	--	0.0124
	0.975	--	--	--	0.0878	--	0.0024	0.0003	--		--	--	0.0724

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Lepidostomatidae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Polycentropodidae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Rhyacophila larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Plecoptera nymph	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	0.0934	--	0.0072	--	0.0278	0.0030	--		--	--	0.0423
Simuliidae larvae	0.025	--	0.0451	--	0.0000	--	0.0106	0.0004	--		--	--	0.0244
	0.975	--	0.1911	--	0.0357	--	0.0539	0.0094	--		--	--	0.0668
	$\hat{\theta}$	--	--	--	--	--	--	0.0002	--		--	--	--
Simuliidae pupae	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0009	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Stratiomyidae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0002	--	--		--	--	0.0058
Tipulidae larvae	0.025	--	--	--	--	--	0.0000	--	--		--	--	0.0000
	0.975	--	--	--	--	--	0.0013	--	--		--	--	0.0341
	$\hat{\theta}$	--	--	--	--	--	0.0033	--	--		--	--	0.0054
Mite	0.025	--	--	--	--	--	0.0000	--	--		--	--	0.0000
	0.975	--	--	--	--	--	0.0196	--	--		--	--	0.0197

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	0.0007	--	--		--	--	--
Fish	0.025	--	--	--	--	--	0.0000	--	--		--	--	--
	0.975	--	--	--	--	--	0.0052	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Fish eggs	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
Terrestrial origin													
	$\hat{\theta}$	--	0.2374	--	0.0807	--	0.3151	0.5777	--		--	0.1070	0.2298
Terrestrial vegetation	0.025	--	0.1093	--	0.0591	--	0.2241	0.5014	--		--	--	0.1870
	0.975	--	0.3460	--	0.1085	--	0.4055	0.6472	--		--	--	0.2822
	$\hat{\theta}$	--	--	--	--	--	0.0104	0.0167	--		--	--	--
Tamarisk material	0.025	--	--	--	--	--	0.0010	0.0019	--		--	--	--
	0.975	--	--	--	--	--	0.0569	0.0915	--		--	--	--
	$\hat{\theta}$	--	--	--	0.0076	--	0.0680	0.0079	--		--	--	0.0137
Terrestrial seeds	0.025	--	--	--	0.0000	--	0.0014	0.0008	--		--	--	0.0029
	0.975	--	--	--	0.0368	--	0.4056	0.0261	--		--	--	0.0426
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Dolichopodidae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Chironomidae Adult	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Simuliidae adult	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--

Appendix 1. Continued.

Diet Item		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Therevidae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0018	--		--	--	0.0146
Terrestrial winged insect	0.025	--	--	--	--	--	--	0.0007	--		--	--	0.0043
	0.975	--	--	--	--	--	--	0.0043	--		--	--	0.0474
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Thrip	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0039	--		--	--	--
Aphid	0.025	--	--	--	--	--	--	0.0008	--		--	--	--
	0.975	--	--	--	--	--	--	0.0116	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Cicadellidae adult	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--		--	--	--
Terrestrial Hemipteran	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0002	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0160	--		--	--	--
Orthoptera adult	0.025	--	--	--	--	--	--	0.0052	--		--	--	--
	0.975	--	--	--	--	--	--	0.0645	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Terrestrial Lepidoptera larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Lepidoptera Adult	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	--	--		--	--	--
adult	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0007	--		--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	0.0001	--		--	--	--
larvae	0.975	--	--	--	--	--	--	0.0033	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Elateridae larvae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0003	--		--	--	--
Scarabaeidae adult	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0017	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0013	--		--	--	--
Beetle adult of terrestrial origin	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	0.0080	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0040	--	--		--	--	--
Beetle larvae of terrestrial origin	0.025	--	--	--	--	--	0.0003	--	--		--	--	--
(unknown taxa)	0.975	--	--	--	--	--	0.0221	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0061	0.0006	--		--	--	--
Curculionoidae	0.025	--	--	--	--	--	0.0000	0.0002	--		--	--	--
	0.975	--	--	--	--	--	0.0307	0.0014	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Termite	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0007	0.0017	--		--	--	--
Ants	0.025	--	--	--	--	--	0.0000	0.0004	--		--	--	--
	0.975	--	--	--	--	--	0.0045	0.0048	--		--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0056	--		--	--	--
Flying ants	0.025	--	--	--	--	--	--	0.0000	--		--	--	--
	0.975	--	--	--	--	--	--	0.0340	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Pseudoscorpion	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Solpugidae	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--		--	--	--
Spider	0.025	--	--	--	--	--	--	--	--		--	--	--
	0.975	--	--	--	--	--	--	--	--		--	--	--
Unknown origin													
	$\hat{\theta}$	--	0.0019	--	0.2263	--	0.0547	0.1018	--		--	0.2139	0.1141
Insect parts of unknown origin	0.025	--	0.0000	--	0.1551	--	0.0269	0.0712	--		--	--	0.0777
	0.975	--	0.0076	--	0.3522	--	0.1001	0.1437	--		--	--	0.1619
	$\hat{\theta}$	--	0.1055	--	0.0019	--	0.0285	0.0057	--		--	--	0.0497
Vegetative detritus	0.025	--	0.0190	--	0.0005	--	0.0199	0.0031	--		--	--	0.0318
	0.975	--	0.3421	--	0.0043	--	0.0374	0.0158	--		--	--	0.0901
	$\hat{\theta}$	--	0.4638	--	0.0889	--	0.2829	0.1936	--		--	0.6791	0.2582
Amorphous detritus	0.025	--	0.3320	--	0.0646	--	0.2073	0.1580	--		--	--	0.2107
	0.975	--	0.6108	--	0.1115	--	0.3570	0.2361	--		--	--	0.3081
Indigestible/incalculable items													
Mystery object (Present/Not present)		--	N	--	N	--	N	N	--		--	--	N
Hydropsychidae case (Present/Not present)		--	N	--	N	--	N	P	--		--	--	N
Hydroptilidae case (Present/Not present)		--	N	--	N	--	N	N	--		--	--	N
Fish scales (Present/Not present)		--	N	--	N	--	N	P	--		--	N	N

Appendix 1. Continued.

	BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item												
Bone (Present/Not present)	--	N	--	N	--	P	N	--		--	N	N
Snail Shell (Present/Not present)	--	N	--	N	--	N	N	--		--	--	N

Appendix 1. Continued.

Estimates (bootstrapped means and 95% bias-corrected confidence intervals) of proportions of food items in fishes guts in January, 2013.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Total catch		0	10	0	0	0	10	24	15	0	1	0	5
Total sampled for diet		--	n=10	--	--	--	n=10	n=22	n=0	--	n=1	--	n=5
Incidence of empty guts		--	3	--	--	--	4	6	--	--	0	--	1
Incidence of Asian tapeworm*		--	0	--	--	--	0	8	--	--	0	--	2
Hoop/seine catch of non-empty guts		--	1/6	--	--	--	1/5	16/0	--	--	0/1	--	1/3
Diet Item													
Aquatic origin													
	$\hat{\theta}$	--	0.0180	--	--	--	0.0079	0.0089	--	--	--	--	0.0301
Diatoms	0.025	--	0.0071	--	--	--	0.0013	0.0057	--	--	--	--	0.0117
	0.975	--	0.0344	--	--	--	0.0279	0.0136	--	--	--	--	0.0638
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Oscillatoria	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Red algae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0176	--	--	--	--	--
Other algae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.1238	--	--	--	--	--
	$\hat{\theta}$	--	0.0022	--	--	--	0.0001	0.0018	--	--	--	--	--
Unknown filamentous algae	0.025	--	0.0007	--	--	--	0.0000	0.0003	--	--	--	--	--
	0.975	--	0.0062	--	--	--	0.0007	0.0072	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0083	0.0018	--	--	0.0124	--	--
Cladophora	0.025	--	--	--	--	--	0.0000	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	0.0497	0.0063	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chara	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Bryophyte	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0136	--	--	--	0.0006	--	--	--	--	--	0.0150
Nematode	0.025	--	0.0014	--	--	--	0.0000	--	--	--	--	--	0.0000
	0.975	--	0.0631	--	--	--	0.0030	--	--	--	--	--	0.0604
	$\hat{\theta}$	--	--	--	--	--	0.0006	--	--	--	0.0186	--	--
Annelid	0.025	--	--	--	--	--	0.0000	--	--	--	--	--	--
	0.975	--	--	--	--	--	0.0035	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Naididae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0214	--	--	--	--	--
Oligochaete	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.1070	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Daphnia	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0119	--	--	--	0.0018	0.0019	--	--	--	--	--
Ostracod	0.025	--	0.0052	--	--	--	0.0000	0.0000	--	--	--	--	--
	0.975	--	0.0338	--	--	--	0.0089	0.0110	--	--	--	--	--
	$\hat{\theta}$	--	0.0222	--	--	--	0.0308	--	--	--	--	--	--
Copepod	0.025	--	0.0054	--	--	--	0.0006	--	--	--	--	--	--
	0.975	--	0.0736	--	--	--	0.1521	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chaoboridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0280	--	--	--	--	--	--
Diptera larvae (unknown taxa)	0.025	--	--	--	--	--	0.0000	--	--	--	--	--	--
	0.975	--	--	--	--	--	0.1389	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0373	--	--	--	0.0495	--	--	--	0.0155	--	--
Diptera pupae (unknown taxa)	0.025	--	0.0083	--	--	--	0.0024	--	--	--	--	--	--
	0.975	--	0.0999	--	--	--	0.1285	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ephydridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Psychodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Tabanidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Physid snail	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0070	--	--	--	--	--
Snail Tissue	0.025	--	--	--	--	--	--	0.0029	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0145	--	--	--	--	--
	$\hat{\theta}$	--	0.0066	--	--	--	0.0065	0.0770	--	--	0.1858	--	0.4437
Baetidae nymph	0.025	--	0.0026	--	--	--	0.0000	0.0369	--	--	--	--	0.1429
	0.975	--	0.0200	--	--	--	0.0325	0.1565	--	--	--	--	0.5986

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0077	--	--	--	0.0125	0.0033	--	--	--	--	--
Ceratopogonidae larvae	0.025	--	0.0036	--	--	--	0.0000	0.0003	--	--	--	--	--
	0.975	--	0.0203	--	--	--	0.0621	0.0105	--	--	--	--	--
	$\hat{\theta}$	--	0.3970	--	--	--	0.5085	0.0763	--	--	0.0681	--	0.1046
Chironomidae larvae	0.025	--	0.1954	--	--	--	0.3133	0.0368	--	--	--	--	0.0561
	0.975	--	0.6314	--	--	--	0.7770	0.1820	--	--	--	--	0.1636
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chironomidae exuviae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Corixidae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0160	--	--	--	0.0012	0.0004	--	--	--	--	--
Empididae larvae	0.025	--	0.0000	--	--	--	0.0000	0.0000	--	--	--	--	--
	0.975	--	0.0402	--	--	--	0.0059	0.0027	--	--	--	--	--
	$\hat{\theta}$	--	0.0135	--	--	--	0.0901	0.1202	--	--	0.3003	--	--
Hydropsychidae larvae	0.025	--	0.0068	--	--	--	0.0000	0.0552	--	--	--	--	--
	0.975	--	0.0405	--	--	--	0.5360	0.2336	--	--	--	--	--
	$\hat{\theta}$	--	0.0071	--	--	--	0.0012	0.0006	--	--	0.0031	--	--
Hydroptilidae larvae	0.025	--	0.0031	--	--	--	0.0000	0.0001	--	--	--	--	--
	0.975	--	0.0215	--	--	--	0.0059	0.0027	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Anisoptera nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	0.2724	--	--
Odonate nymph of unknown taxon	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0074	--	--	--	--	--
Zygoptera nymph	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0438	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Beetle larvae of aquatic origin	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Corydalus larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Sialidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Adult Dytiscid	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Haliplidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ameletidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ephemerellidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ephemeroptera nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Lepidostomatidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Polycentropodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Rhyacophila larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Plecoptera nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Simuliidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Simuliidae pupae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Stratiomyidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0082	--	--	--	--	--	--	--	--	--	--
Tipulidae larvae	0.025	--	0.0000	--	--	--	--	--	--	--	--	--	--
	0.975	--	0.0405	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Mite	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0009	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.2053
Fish	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.8152
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Fish eggs	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial origin													
	$\hat{\theta}$	--	0.1036	--	--	--	0.0608	0.2896	--	--	0.0279	--	0.1058
Terrestrial vegetation	0.025	--	0.0691	--	--	--	0.0185	0.2136	--	--	--	--	0.0363
	0.975	--	0.1452	--	--	--	0.1606	0.3535	--	--	--	--	0.2857
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Tamarisk material	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	0.0402	--	--
Terrestrial seeds	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Dolichopodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0083	--	--	--	0.0006	--	--	--	0.0248	--	--
Chironomidae Adult	0.025	--	0.0000	--	--	--	0.0000	--	--	--	--	--	--
	0.975	--	0.0487	--	--	--	0.0030	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Simuliidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Therevidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.0036
Terrestrial winged insect	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0143
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Thrip	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Aphid	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0017	--	--	--	--	--	--
Cicadellidae adult	0.025	--	--	--	--	--	0.0000	--	--	--	--	--	--
	0.975	--	--	--	--	--	0.0106	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Hemipteran	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Orthoptera adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Lepidoptera larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Lepidoptera Adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	--	--	--	--	--	--
adult	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	--	--	--	--	--	--
larvae	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0060	--	--	--	--	--
Elateridae larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0355	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Scarabaeidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Beetle adult of terrestrial origin	0.025	--	--	--	--	--	--	--	--	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0010	--	--	--	--	--
Beetle larvae of terrestrial origin	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	0.0063	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Curculionoidae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Termite	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ants	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Flying ants	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Pseudoscorpion	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Solpugidae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Spider	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
Unknown origin													
	$\hat{\theta}$	--	0.0604	--	--	--	0.0745	0.0944	--	--	0.0310	--	0.0071
Insect parts of unknown origin	0.025	--	0.0169	--	--	--	0.0247	0.0665	--	--	--	--	0.0000
	0.975	--	0.1574	--	--	--	0.1328	0.1288	--	--	--	--	0.0286
	$\hat{\theta}$	--	0.0129	--	--	--	0.0096	0.0155	--	--	--	--	0.0106
Vegetative detritus	0.025	--	0.0040	--	--	--	0.0009	0.0097	--	--	--	--	0.0018
	0.975	--	0.0307	--	--	--	0.0244	0.0294	--	--	--	--	0.0349
	$\hat{\theta}$	--	0.2512	--	--	--	0.1071	0.2476	--	--	0.0000	--	0.0779
Amorphous detritus	0.025	--	0.1274	--	--	--	0.0064	0.1823	--	--	--	--	0.0106
	0.975	--	0.5584	--	--	--	0.2619	0.3221	--	--	--	--	0.1616
Indigestible/incalculable items													
Mystery object (Present/Not present)		--	N	--	--	--	N	N	--	--	N	--	N
Hydropsychidae case (Present/Not present)		--	N	--	--	--	N	N	--	--	N	--	N
Hydroptilidae case (Present/Not present)		--	N	--	--	--	N	N	--	--	N	--	N
Fish scales (Present/Not present)		--	P	N	--	--	N	N	--	--	P	--	N

Appendix 1. Continued.

	BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item												
Bone (Present/Not present	--	N	N	--	--	N	N	--	--	N	--	N
Snail Shell (Present/Not present)	--	N	--	--	--	N	P	--	--	N	--	N

Appendix 1. Continued.

Estimates (bootstrapped means and 95% bias-corrected confidence intervals) of proportions of food items in fishes guts in March, 2013.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Total catch		0	23	0	0	7	3	71	0	1	0	1	15
Total sampled for diet		--	n=23	--	--	n=7	n=3	n=29	--	n=1	--	n=1	n=15
Incidence of empty guts		--	6	--	--	1	0	2	--	0	--	1	4
Incidence of Asian tapeworm*		--	0	--	--	1	0	3	--	0	--	1	2
Hoop/seine catch of non-empty guts		--	5/12	--	--	0/6	3/0	2/25	--	0/1	--	--	0/11
Diet Item													
Aquatic origin													
	$\hat{\theta}$	--	0.0023	--	--	0.0091	0.0001	0.0042	--	--	--	--	0.0035
Diatoms	0.025	--	0.0011	--	--	0.0027	0.0001	0.0029	--	--	--	--	0.0015
	0.975	--	0.0042	--	--	0.0256	0.0004	0.0069	--	--	--	--	0.0074
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Oscillatoria	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Red algae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0481	0.0001	--	--	--	--	--
Other algae	0.025	--	--	--	--	--	0.0000	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	0.1429	0.0010	--	--	--	--	--
	$\hat{\theta}$	--	0.0003	--	--	0.0163	0.0090	0.0024	--	--	--	--	0.0009
Unknown filamentous algae	0.025	--	0.0001	--	--	0.0005	0.0003	0.0014	--	--	--	--	0.0002
	0.975	--	0.0014	--	--	0.0792	0.0263	0.0056	--	--	--	--	0.0041
	$\hat{\theta}$	--	--	--	--	0.0391	--	--	--	--	--	--	--
Cladophora	0.025	--	--	--	--	0.0000	--	--	--	--	--	--	--
	0.975	--	--	--	--	0.1984	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chara	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0009	--	--	--	--	--
Bryophyte	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0032	--	--	--	--	--
	$\hat{\theta}$	--	0.0002	--	--	--	--	0.0029	--	--	--	--	0.0246
Nematode	0.025	--	0.0000	--	--	--	--	0.0008	--	--	--	--	0.0000
	0.975	--	0.0014	--	--	--	--	0.0101	--	--	--	--	0.1736
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Annelid	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Naididae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Oligochaete	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0032	--	--	--	--	--	--	--	--	--	--
Daphnia	0.025	--	0.0000	--	--	--	--	--	--	--	--	--	--
	0.975	--	0.0196	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0004	--	--	--	--	--
Ostracod	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0026	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Copepod	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chaoboridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0007	--	--	--	--	--
Diptera larvae (unknown taxa)	0.025	--	--	--	--	--	--	0.0002	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0030	--	--	--	--	--
	$\hat{\theta}$	--	0.0060	--	--	--	--	0.0068	--	--	--	--	--
Diptera pupae (unknown taxa)	0.025	--	0.0008	--	--	--	--	0.0024	--	--	--	--	--
	0.975	--	0.0318	--	--	--	--	0.0165	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ephydridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0001	--	--	--	--	--	--	--	--	--	--
Psychodidae larvae	0.025	--	0.0000	--	--	--	--	--	--	--	--	--	--
	0.975	--	0.0007	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0010	--	--	--	--	--
Tabanidae larvae	0.025	--	--	--	--	--	--	0.0002	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0033	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Physid snail	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Snail Tissue	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.1149	--	--	--	0.0236	0.0478	--	--	--	--	0.4799
Baetidae nymph	0.025	--	0.0497	--	--	--	0.0238	0.0272	--	--	--	--	0.3332
	0.975	--	0.2070	--	--	--	0.0714	0.0779	--	--	--	--	0.6197

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	0.0020	--	--	--	--	0.0005	--	--	--	--	--
Ceratopogonidae larvae	0.025	--	0.0000	--	--	--	--	0.0001	--	--	--	--	--
	0.975	--	0.0121	--	--	--	--	0.0017	--	--	--	--	--
	$\hat{\theta}$	--	0.2110	--	--	0.0843	0.0925	0.0068	--	1.0000	--	--	0.0732
Chironomidae larvae	0.025	--	0.1268	--	--	0.0397	0.0220	0.0037	--	--	--	--	0.0433
	0.975	--	0.3716	--	--	0.2164	0.2143	0.0119	--	--	--	--	0.1238
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chironomidae exuviae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0023	--	--	--	--	--
Corixidae	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0132	--	--	--	--	--
	$\hat{\theta}$	--	0.0050	--	--	--	--	0.0010	--	--	--	--	0.0312
Empididae larvae	0.025	--	0.0006	--	--	--	--	0.0001	--	--	--	--	0.0072
	0.975	--	0.0272	--	--	--	--	0.0035	--	--	--	--	0.1082
	$\hat{\theta}$	--	--	--	--	--	--	0.0015	--	--	--	--	0.0075
Hydropsychidae larvae	0.025	--	--	--	--	--	--	0.0004	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	0.0041	--	--	--	--	0.0441
	$\hat{\theta}$	--	0.0157	--	--	--	0.0477	0.0000	--	--	--	--	0.0035
Hydroptilidae larvae	0.025	--	0.0000	--	--	--	0.0000	0.0000	--	--	--	--	0.0000
	0.975	--	0.0952	--	--	--	0.1429	0.0002	--	--	--	--	0.0179
	$\hat{\theta}$	--	--	--	--	--	--	0.0010	--	--	--	--	--
Anisoptera nymph	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0059	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0004	--	--	--	--	0.0155
Odonate nymph of unknown taxon	0.025	--	--	--	--	--	--	0.0002	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	0.0017	--	--	--	--	0.0926

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0006	--	--	--	--	--
Zygoptera nymph	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0039	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Beetle larvae of aquatic origin	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Corydalus larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Sialidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Adult Dytiscid	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Haliplidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ameletidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ephemerellidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0022	--	--	--	--	0.0165
Ephemeroptera nymph	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	0.0163	--	--	--	--	0.1157

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Lepidostomatidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0005	--	--	--	--	--
Polycentropodidae larvae	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0027	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Rhyacophila larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0078	--	--	--	--	0.0004	--	--	--	--	--
Plecoptera nymph	0.025	--	0.0000	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	0.0543	--	--	--	--	0.0026	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.0036
Simuliidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0215
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Simuliidae pupae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Stratiomyidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0013	--	--	--	--	--
Tipulidae larvae	0.025	--	--	--	--	--	--	0.0005	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0028	--	--	--	--	--
	$\hat{\theta}$	--	0.0001	--	--	--	--	--	--	--	--	--	--
Mite	0.025	--	0.0000	--	--	--	--	--	--	--	--	--	--
	0.975	--	0.0007	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0005	--	--	--	--	--
Fish	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0037	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Fish eggs	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial origin													
	$\hat{\theta}$	--	0.3246	--	--	0.4945	0.1445	0.5747	--	--	--	--	0.1508
Terrestrial vegetation	0.025	--	0.2276	--	--	0.3249	0.0497	0.5169	--	--	--	--	0.1092
	0.975	--	0.4565	--	--	0.6191	0.2857	0.6310	--	--	--	--	0.1953
	$\hat{\theta}$	--	0.0104	--	--	--	--	0.0048	--	--	--	--	--
Tamarisk material	0.025	--	0.0000	--	--	--	--	0.0016	--	--	--	--	--
	0.975	--	0.0620	--	--	--	--	0.0107	--	--	--	--	--
	$\hat{\theta}$	--	0.0107	--	--	--	0.2182	0.0268	--	--	--	--	--
Terrestrial seeds	0.025	--	0.0000	--	--	--	0.0000	0.0129	--	--	--	--	--
	0.975	--	0.0643	--	--	--	0.6607	0.0580	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Dolichopodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0044	--	--	--	0.0472	0.0022	--	--	--	--	--
Chironomidae Adult	0.025	--	0.0000	--	--	--	0.0000	0.0002	--	--	--	--	--
	0.975	--	0.0304	--	--	--	0.1429	0.0101	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Simuliidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Therevidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	0.0004	--	--	--	0.1339	0.0172	--	--	--	--	0.0055
Terrestrial winged insect	0.025	--	0.0000	--	--	--	0.0165	0.0098	--	--	--	--	0.0000
	0.975	--	0.0021	--	--	--	0.3559	0.0305	--	--	--	--	0.0331
	$\hat{\theta}$	--	--	--	--	--	--	0.0008	--	--	--	--	--
Thrip	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0059	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Aphid	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Cicadellidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0005	--	--	--	--	--
Terrestrial Hemipteran	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0021	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Orthoptera adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Terrestrial Lepidoptera larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0011	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Lepidoptera Adult	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0007	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	--	--	--	--	--	--
adult	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	--	--	--	--	--	--
larvae	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Elateridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Scarabaeidae adult	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0009	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0064	--	--	--	--	--
Beetle adult of terrestrial origin	0.025	--	--	--	--	--	--	0.0006	--	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	0.0202	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0021	--	--	--	--	--
Beetle larvae of terrestrial origin	0.025	--	--	--	--	--	--	0.0004	--	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	0.0066	--	--	--	--	--
	$\hat{\theta}$	--	0.0006	--	--	--	0.0382	0.0015	--	--	--	--	--
Curculionoidae	0.025	--	0.0000	--	--	--	0.0000	0.0005	--	--	--	--	--
	0.975	--	0.0036	--	--	--	0.1156	0.0036	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Termite	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0008	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0080	--	--	--	--	--
Ants	0.025	--	--	--	--	--	--	0.0035	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0220	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Flying ants	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Pseudoscorpion	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Solpugidae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Spider	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0006	--	--	--	--	--
Unknown origin													
	$\hat{\theta}$	--	0.0353	--	--	0.1482	0.0222	0.0669	--	--	--	--	0.0758
Insect parts of unknown origin	0.025	--	0.0135	--	--	0.0529	0.0000	0.0419	--	--	--	--	0.0304
	0.975	--	0.0706	--	--	0.3111	0.0665	0.1124	--	--	--	--	0.1456
	$\hat{\theta}$	--	0.0203	--	--	0.0250	0.0095	0.0025	--	--	--	--	0.0040
Vegetative detritus	0.025	--	0.0122	--	--	0.0088	0.0007	0.0014	--	--	--	--	0.0010
	0.975	--	0.0302	--	--	0.0491	0.0263	0.0057	--	--	--	--	0.0129
	$\hat{\theta}$	--	0.2260	--	--	0.1834	0.1606	0.1991	--	--	--	--	0.1058
Amorphous detritus	0.025	--	0.1483	--	--	0.0681	0.0120	0.1594	--	--	--	--	0.0441
	0.975	--	0.2994	--	--	0.3315	0.4466	0.2475	--	--	--	--	0.1863
Indigestible/incalculable items													
Mystery object (Present/Not present)		--	N	--	--	N	N	P	--	N	--	--	N
Hydropsychidae case (Present/Not present)		--	N	--	--	N	N	P	--	--	--	--	N
Hydroptilidae case (Present/Not present)		--	P	--	--	N	N	P	--	--	--	--	N
Fish scales (Present/Not present)		--	N	--	--	N	N	P	--	--	--	--	N

Appendix 1. Continued.

	BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item												
Bone (Present/Not present)	--	N	--	--	N	N	N	--	--	--	--	N
Snail Shell (Present/Not present)	--	N	--	--	N	N	P	--	N	--	--	N

Appendix 1. Continued.

Estimates (bootstrapped means and 95% bias-corrected confidence intervals) of proportions of food items in fishes guts in June, 2014.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Total catch		1	31	0	0	0	21	64	146	0	0	0	33
Total sampled for diet		n=1	n=28	n=0	n=0	n=0	n=20	n=31	n=13	n=0	n=0	n-0	n=30
Incidence of empty guts		0	15	--	--	--	2	1	3	--	--	--	0
Incidence of Asian tapeworm*		1	0	--	--	--	0	2	3	--	--	--	2
Hoop/seine catch of non-empty guts		1/0	1/12	--	--	--	7/11	30/0	6/4	--	--	--	8/22
Diet Item													
Aquatic origin													
	$\hat{\theta}$	0.0005	0.2964	--	--	--	0.0816	0.0146	0.0129	--	--	--	0.0417
Diatoms	0.025	--	0.1288	--	--	--	0.0492	0.0099	0.0020	--	--	--	0.0273
	0.975	--	0.5105	--	--	--	0.1570	0.0255	0.0496	--	--	--	0.0644
	$\hat{\theta}$	--	0.0010	--	--	--	--	--	--	--	--	--	--
Oscillatoria	0.025	--	0.0000	--	--	--	--	--	--	--	--	--	--
	0.975	--	0.0063	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0022	0.0023	--	--	--	--	0.0041
Red algae	0.025	--	--	--	--	--	0.0000	0.0000	--	--	--	--	0.0000
	0.975	--	--	--	--	--	0.0134	0.0165	--	--	--	--	0.0244
	$\hat{\theta}$	--	0.0182	--	--	--	0.0055	0.0194	--	--	--	--	0.0159
Other algae	0.025	--	0.0000	--	--	--	0.0000	0.0026	--	--	--	--	0.0021
	0.975	--	0.1086	--	--	--	0.0335	0.1036	--	--	--	--	0.0539
	$\hat{\theta}$	--	0.0058	--	--	--	0.0059	--	--	--	--	--	0.0141
Unknown filamentous algae	0.025	--	0.0012	--	--	--	0.0018	--	--	--	--	--	0.0082
	0.975	--	0.0185	--	--	--	0.0212	--	--	--	--	--	0.0259
	$\hat{\theta}$	--	--	--	--	--	--	0.4894	--	--	--	--	0.0042
Cladophora	0.025	--	--	--	--	--	--	0.3826	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	0.5940	--	--	--	--	0.0295

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0018	--	--	--	--	--
Chara	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0126	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0045	--	--	--	--	--
Bryophyte	0.025	--	--	--	--	--	--	0.0011	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0154	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0025	0.0002	--	--	--	--	0.0017
Nematode	0.025	--	--	--	--	--	0.0000	0.0000	--	--	--	--	0.0000
	0.975	--	--	--	--	--	0.0089	0.0009	--	--	--	--	0.0104
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Annelid	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Naididae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Oligochaete	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Daphnia	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	0.0150	--	--	--	--	0.0794	--	0.0036	--	--	--	0.0021
Ostracod	0.025	--	--	--	--	--	0.0499	--	0.0000	--	--	--	0.0000
	0.975	--	--	--	--	--	0.1162	--	0.0214	--	--	--	0.0149
	$\hat{\theta}$	--	0.0244	--	--	--	0.0682	0.0009	--	--	--	--	--
Copepod	0.025	--	0.0000	--	--	--	0.0384	0.0000	--	--	--	--	--
	0.975	--	0.1452	--	--	--	0.1178	0.0052	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Chaoboridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0081	--	--	--	--	--	--
Diptera larvae (unknown taxa)	0.025	--	--	--	--	--	0.0000	--	--	--	--	--	--
	0.975	--	--	--	--	--	0.0482	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0288	--	--	--	--	--	0.0285
Diptera pupae (unknown taxa)	0.025	--	--	--	--	--	0.0084	--	--	--	--	--	0.0103
	0.975	--	--	--	--	--	0.0973	--	--	--	--	--	0.0665
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ephydridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Psychodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Tabanidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Physid snail	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Snail Tissue	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0035	0.0004	0.0799	--	--	--	0.0059
Baetidae nymph	0.025	--	--	--	--	--	0.0000	0.0000	0.0119	--	--	--	0.0000
	0.975	--	--	--	--	--	0.0212	0.0025	0.3453	--	--	--	0.0215

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	0.0150	--	--	--	--	0.0229	0.0001	0.0035	--	--	--	0.0214
Ceratopogonidae larvae	0.025	--	--	--	--	--	0.0116	0.0000	0.0000	--	--	--	0.0067
	0.975	--	--	--	--	--	0.0478	0.0006	0.0107	--	--	--	0.0530
	$\hat{\theta}$	0.0225	0.1802	--	--	--	0.2520	0.0076	0.1188	--	--	--	0.1779
Chironomidae larvae	0.025	--	0.0797	--	--	--	0.1772	0.0034	0.0393	--	--	--	0.1280
	0.975	--	0.3980	--	--	--	0.3587	0.0158	0.2687	--	--	--	0.2738
	$\hat{\theta}$	--	--	--	--	--	--	0.0003	--	--	--	--	--
Chironomidae exuviae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0019	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0014	0.0040	--	--	--	--
Corixidae	0.025	--	--	--	--	--	--	0.0001	0.0000	--	--	--	--
	0.975	--	--	--	--	--	--	0.0080	0.0239	--	--	--	--
	$\hat{\theta}$	0.0225	--	--	--	--	0.0225	--	0.0092	--	--	--	0.0439
Empididae larvae	0.025	--	--	--	--	--	0.0088	--	0.0040	--	--	--	0.0247
	0.975	--	--	--	--	--	0.0491	--	0.0299	--	--	--	0.0725
	$\hat{\theta}$	0.1423	--	--	--	--	--	0.0323	--	--	--	--	0.1021
Hydropsychidae larvae	0.025	--	--	--	--	--	--	0.0147	--	--	--	--	0.0454
	0.975	--	--	--	--	--	--	0.0682	--	--	--	--	0.1933
	$\hat{\theta}$	--	--	--	--	--	0.0049	0.0026	0.0076	--	--	--	0.0597
Hydroptilidae larvae	0.025	--	--	--	--	--	0.0006	0.0003	0.0018	--	--	--	0.0316
	0.975	--	--	--	--	--	0.0190	0.0165	0.0199	--	--	--	0.1011
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	--
Anisoptera nymph	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0003	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0004	--	--	--	--	--
Odonate nymph of unknown taxon	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0023	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	0.2696	--	--	--	--	--	--	--	--	--	--	--
Zygoptera nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	0.0035	--	--	--	--
Beetle larvae of aquatic origin	0.025	--	--	--	--	--	--	0.0000	0.0000	--	--	--	--
	0.975	--	--	--	--	--	--	0.0001	0.0214	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Corydalus larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Sialidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Adult Dytiscid	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Haliplidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ameletidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Ephemerellidae nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0028	0.0005	--	--	--	--	0.0011
Ephemeroptera nymph	0.025	--	--	--	--	--	0.0000	0.0001	--	--	--	--	0.0000
	0.975	--	--	--	--	--	0.0166	0.0026	--	--	--	--	0.0068

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Lepidostomatidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Polycentropodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Rhyacophila larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Plecoptera nymph	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	0.0374	--	--	--	--	0.0096	0.0015	0.0165	--	--	--	0.0639
Simuliidae larvae	0.025	--	--	--	--	--	0.0011	0.0003	0.0080	--	--	--	0.0395
	0.975	--	--	--	--	--	0.0493	0.0055	0.0504	--	--	--	0.1039
	$\hat{\theta}$	--	--	--	--	--	--	--	0.0017	--	--	--	--
Simuliidae pupae	0.025	--	--	--	--	--	--	--	0.0000	--	--	--	--
	0.975	--	--	--	--	--	--	--	0.0104	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Stratiomyidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0000	--	--	--	--	--
Tipulidae larvae	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0002	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0004	0.0003	--	--	--	--	--
Mite	0.025	--	--	--	--	--	0.0000	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	0.0029	0.0022	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0034	--	--	--	--	--
Fish	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0204	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0056	--	--	--	--	--
Fish eggs	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0340	--	--	--	--	--
Terrestrial origin													
	$\hat{\theta}$	0.2621	0.1514	--	--	--	0.0933	0.1530	0.0104	--	--	--	0.0672
Terrestrial vegetation	0.025	--	0.0772	--	--	--	0.0645	0.1169	0.0030	--	--	--	0.0481
	0.975	--	0.2698	--	--	--	0.1409	0.2067	0.0233	--	--	--	0.0917
	$\hat{\theta}$	--	--	--	--	--	--	0.0344	--	--	--	--	--
Tamarisk material	0.025	--	--	--	--	--	--	0.0180	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0653	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0034	0.0100	--	--	--	--	0.0018
Terrestrial seeds	0.025	--	--	--	--	--	0.0012	0.0042	--	--	--	--	0.0000
	0.975	--	--	--	--	--	0.0135	0.0230	--	--	--	--	0.0106
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Dolichopodidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0143	0.0001	0.0579	--	--	--	0.0031
Chironomidae Adult	0.025	--	--	--	--	--	0.0037	0.0000	0.0080	--	--	--	0.0000
	0.975	--	--	--	--	--	0.0394	0.0003	0.3080	--	--	--	0.0187
	$\hat{\theta}$	--	--	--	--	--	0.0011	0.0000	--	--	--	--	0.0067
Simuliidae adult	0.025	--	--	--	--	--	0.0000	0.0000	--	--	--	--	0.0000
	0.975	--	--	--	--	--	0.0056	0.0000	--	--	--	--	0.0400

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Therevidae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0053	0.0028	0.0802	--	--	--	0.0265
Terrestrial winged insect	0.025	--	--	--	--	--	0.0018	0.0006	0.0112	--	--	--	0.0115
	0.975	--	--	--	--	--	0.0212	0.0091	0.3066	--	--	--	0.0564
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Thrip	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0001	--	--	--	--	--
Aphid	0.025	--	--	--	--	--	--	0.0000	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0010	--	--	--	--	--
	$\hat{\theta}$	0.0150	--	--	--	--	--	--	--	--	--	--	0.0150
Cicadellidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0547
	$\hat{\theta}$	--	--	--	--	--	--	0.0004	--	--	--	--	--
Terrestrial Hemipteran	0.025	--	--	--	--	--	--	0.0001	--	--	--	--	--
	0.975	--	--	--	--	--	--	0.0017	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Orthoptera adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Terrestrial Lepidoptera larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Lepidoptera Adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	0.0382	0.0324	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	0.0185	0.0000	--	--	--	--
adult	0.975	--	--	--	--	--	--	0.0868	0.1929	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0010	0.0080	--	--	--	--
Tamarisk beetle (*Diorhabda sp.*)	0.025	--	--	--	--	--	--	0.0002	0.0000	--	--	--	--
larvae	0.975	--	--	--	--	--	--	0.0029	0.0477	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Elateridae larvae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Scarabaeidae adult	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	0.0022	0.0073	--	--	--	--	--
Beetle adult of terrestrial origin	0.025	--	--	--	--	--	0.0000	0.0008	--	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	0.0156	0.0292	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	0.0063	--	--	--	--
Beetle larvae of terrestrial origin	0.025	--	--	--	--	--	--	--	0.0000	--	--	--	--
(unknown taxa)	0.975	--	--	--	--	--	--	--	0.0377	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Curculionoidae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Termite	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	0.0008	0.0648	--	--	--	0.0044
Ants	0.025	--	--	--	--	--	--	0.0002	0.0162	--	--	--	0.0013
	0.975	--	--	--	--	--	--	0.0030	0.2122	--	--	--	0.0200

Appendix 1. Continued.

		BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item													
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Flying ants	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Pseudoscorpion	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	--
Solpugidae	0.025	--	--	--	--	--	--	--	--	--	--	--	--
	0.975	--	--	--	--	--	--	--	--	--	--	--	--
	$\hat{\theta}$	--	--	--	--	--	--	--	--	--	--	--	0.0085
Spider	0.025	--	--	--	--	--	--	--	--	--	--	--	0.0000
	0.975	--	--	--	--	--	--	--	--	--	--	--	0.0591
Unknown origin				--									
	$\hat{\theta}$	0.1498	0.0124	--	--	--	0.0513	0.0739	0.1139	--	--	--	0.0791
Insect parts of unknown origin	0.025	--	0.0000	--	--	--	0.0298	0.0495	0.0544	--	--	--	0.0552
	0.975	--	0.0743	--	--	--	0.0880	0.1287	0.1975	--	--	--	0.1099
	$\hat{\theta}$	0.0024	0.0564	--	--	--	0.0468	0.0138	0.0099	--	--	--	0.0256
Vegetative detritus	0.025	--	0.0242	--	--	--	0.0286	0.0095	0.0032	--	--	--	0.0176
	0.975	--	0.1324	--	--	--	0.0737	0.0250	0.0243	--	--	--	0.0362
	$\hat{\theta}$	0.0459	0.2561	--	--	--	0.1807	0.0751	0.3567	--	--	--	0.1730
Amorphous detritus	0.025	--	0.1491	--	--	--	0.1365	0.0565	0.1720	--	--	--	0.1284
	0.975	--	0.4153	--	--	--	0.2531	0.1010	0.5863	--	--	--	0.2371
Indigestible/incalculable items													
Mystery object (Present/Not present)		N	N	--	--	--	N	N	N	--	--	--	N
Hydropsychidae case (Present/Not present)		N	N	--	--	--	N	P	N	--	--	--	N
Hydroptilidae case (Present/Not present)		N	N	--	--	--	N	P	N	--	--	--	N
Fish scales (Present/Not present)		N	--	--	--	--	N	P	N	--	--	--	N

Appendix 1. Continued.

	BBH	BHS	CAR	CCF	FHM	FMS	HBC	HBC YOY	PKF	RBT	RSH	SPD
Diet Item												
Bone (Present/Not present)	N	--	--	--	--	P	N	N	--	--	--	N
Snail Shell (Present/Not present)	N	N	--	--	--	N	P	N	--	--	--	N

*We found intestinal parasites, presumably Asian tapeworm (Bothriocephalus acheilognathi, Clarkson, Robinson, and Hoffnagle 1997), in humpback chub, speckled dace, black bullhead, fathead minnow, and redside shiner. In small chub, we observed potentially fatal infestations that completely filled the gut tract in 23% of this group (3 out of 13 individuals).