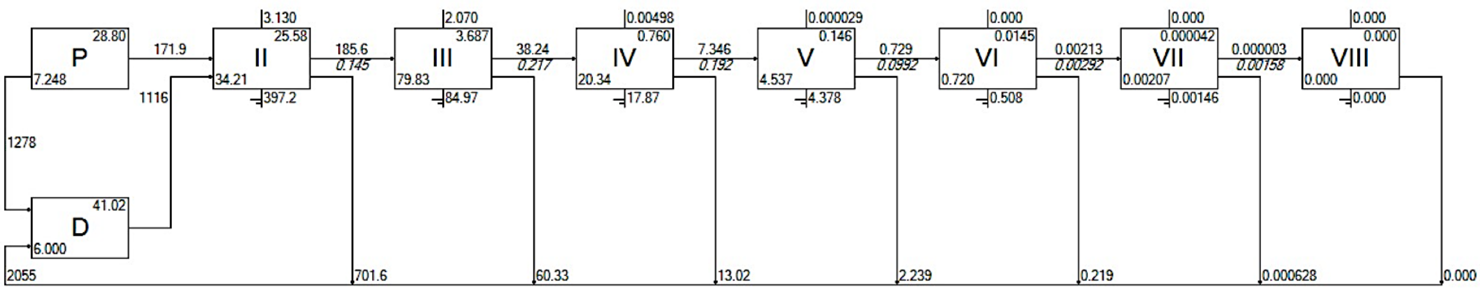
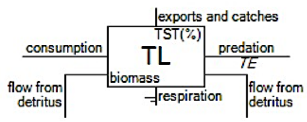
Version 1.5

Development of a Mass Balance Foodweb Model for Utah Lake

Proof- of- Concept





DRAFT USING PRELIMINARY DATA

To
Wasatch Front Water Quality Council
Salt Lake City, UT

By
David C. Richards, Ph.D.

OreoHelix Ecological, Vineyard UT 84059
Phone: 406.580.7816
Email: oreohelix@icloud.com

August 8, 2022

SUMMARY

Utah Lake continues to be a highly abused ecosystem ever since Americans of European decent settled along its shores over 150 years ago. The lake has lost its ecological integrity and is in poor health by most qualitative and bioassessment based standards. Its resilience to future perturbation and resistance to improvement (restoration) appears to be compromised.

There is much concern as to the future of Utah Lake and what can be done to improve its condition (i.e., health, integrity), including the reduction of algal blooms and restoration of its native biota. However, there has been little to no effort expended to examine or understand the importance of the lake's food web and how top-down, trophic cascades effect and respond to current conditions or how biomanipulation may help restore its ecosystem health despite decades of research documenting their importance worldwide. Restoring the lake cannot proceed without this understanding. Consequently, a representative food web model was urgently needed.

This report presents the first ever proof-of-concept, trophic- level, mass- balanced foodweb model of Utah Lake that will allow researchers and managers to understand and better manage this important ecosystem. The model chosen and developed was the widely used and freely available EcoPath with EcoSim (EwE) model.

Biomasses, diets, and production/biomass ratios of eighty- one taxonomic groups were modeled as inputs including taxa from phytoplankton, zooplankton, benthic invertebrates, fishes, benthic algae, and detritus based on lengthy synthesis of extremely limited data augmented with literature values. Carp removal program fisheries 'catch', and chironomid export estimates were also modeled.

The EwE model produced dozens of ecosystem metrics and indices, most of which supported the premise that Utah Lake ecosystem is impaired and dominated by only a handful of taxa including invasive Common Carp, other invasive fishes, and pollution tolerant chironomids, and that the lake energy sources are co-dominated by water column primary production and strongly respiring detritus mostly in the form of detrital snow. Model results also showed that the lake has low robustness (e.g., resistance), is well below optimal trophic functioning, and is in an 'immature' early succession stage primarily because of chronic wave action that consistently disturb unconsolidated sediments and reset the food web thus preventing maturation of the system.

The carp reduction program had both negative and positive mixed level trophic impacts on several groups. These results support continued and increased carp reduction efforts.

EwE clearly demonstrated that increased monitoring and research are essential to best manage the lake. Additional model inputs, forcing functions, scenarios, and incorporation with models being developed by others are required to ensure that the EwE model is the most useful tool for scientifically managing Utah Lake and is the go-to model. This proof-of-concept draft Utah Lake

EwE model is available to all interested researchers and managers. Collaboration, refinement, and utilization by others is strongly encouraged.

Table of Contents

List of Figures

List of Tables

Appendices

Introduction

Utah Lake, a remnant of Pluvial Lake Bonneville, is a large, shallow, turbid, eutrophic, slightly saline, and highly regulated lake managed as a reservoir. Its ecosystem has been severely degraded since first settlement by Americans of European descent over 150 years ago (Richards 2022).

Primary production in Utah Lake has been almost completely dominated by water column phytoplankton (algae) for >> 50 years indicating an unbalanced poorly functioning ecosystem. In a healthy state, the lake should have relatively equal contributions from water column and benthic primary production given its shallow nature (Scheffer 1998, Scheffer and Jeppesen 1998). Algal blooms, including potentially toxic cyanobacteria blooms, occur regularly during summer months. Submerged and emergent aquatic macrophytes (plants) were once abundant throughout much of the littoral zones of the lake but are now near absent. Mollusk (mussels, clams, and snails) diversity and abundance peak in the Utah Lake-Jordan River drainage and the surrounding areas in the depauperate western USA (Richards 2017, Richards 2014). Unfortunately, and almost entirely due to human activities, Utah Lake's keystone native mollusk assemblage has been near annihilated. The native mussel, *Anodonta californiensis/nutalliana* is extinct in the lake even though the lake was home to more of this ecosystem engineer than any other water body in Utah in the recent past (Richards 2014). Fingernail clams, primarily *Sphaerium* sp. are near extirpated in Utah Lake and may now be below viable population levels and extinction prone (Richards personal observations). Invasive Asian clam (*Corbicula* sp.) is now the most abundant bivalve. Of the eleven native snail taxa that historically occurred in the lake, only two tolerant taxa, *Physella* sp. and *Stagnicola* sp. remain (Holcomb et al. 2020, Richards unpublished data). The lake's once diverse benthic assemblage is now mostly dominated by only two or three pollution tolerant chironomid (midge) and oligochaete (segmented worm) taxa (Richards 2022). Utah Lake once supported 13 species of native fish, ten of which have been extirpated or extinct. The lake currently only supports three of its native species including the threatened June Sucker (*Chasmistes liorus*), Utah Sucker (*Catastomus ardens*), and Utah Chub (*Gila artraria*) that account for less than 2% relative abundance (see Appendix 2). Twelve non-native and highly invasive species now account for 98% relative abundance, including the dominance by Common Carp (*Cyprinus carpio).* By most standards the lake has lost its ecological integrity and is in poor health. Utah Lake's resilience to future perturbation and its resistance to improvement (restoration) appears to be compromised (Richards 2022).

Justification

There is much concern as to the future of Utah Lake and what can be done to improve its condition (i.e., health, integrity), including the reduction of algal blooms. However, the focus of concern has been almost exclusively on nutrient reduction (bottom-up) and to a lesser extent invasive carp control. There has been little to no effort expended to examine or understand the importance of the lake's food web and how top-down, trophic cascades directly and indirectly effect and respond to current conditions or how biomanipulation may help restore its ecosystem. Restoring Utah Lake to reduce algal blooms and improve its fisheries and ecosystem function cannot proceed without this understanding. Hence, a representative food web model was urgently needed

Presented here is the first trophic- level, mass- balanced foodweb model of Utah Lake. This model along with subsequent iterations and improvements will allow researchers and managers to understand and better manage this important ecosystem by,

1) quantifying the composition and structure of the trophic groups that comprise the lake,
2) evaluating the negative and positive trophic impacts, and
3) understanding emergent properties such as the maturity and the degree of growth of the system, etc.

A food web reference point is now established for Utah Lake for comparisons with future scenarios that can be used to guide management strategies. Ongoing sensitivity and uncertainty analyses will help determine data gaps in future iterations. Describing the food web structure and trophic interactions among the lakes' biological groups will vastly improve our current knowledge on the role of key ecosystem processes and development of decision support tools necessary for effective management[1] (Crowder and Norse, 2008; Murawski et al., 2010, Lira et al. 2018).

Methods

EcoPath with EcoSim (EwE) Food Web Models

Food web models are widely used to investigate complex interactions at the ecosystem level by providing simplified representations based on trophic structure (Fath et al. 2019; Safi et al. 2019). One of the most popular approaches to determine aquatic food web dynamics is the temporal dynamic modeling approach used in EcoPath with EcoSim (EwE) (Christensen & Walters 2004; Heymans et al. 2016), which has been shown to provide valuable forecasts of future scenarios (e.g., Serpetti et al. 2017; Corrales et al. 2018, Horn et al. 2021).

EcoPath with EcoSim, EwE was originally intended "to lead to policy exploration for ecosystem-based fisheries management" (Christensen, Walters, and Pauly 2005). The EwE modelling approach (Christensen and Walters 2004) is based on modelling energy flow and provides several well documented flow-based indicators (Dame and Christian, 2008, Long et al., 2015, Heymans et al. 2016) and has been applied to hundreds of ecosystems around the world (Colléter et al., 2015, Coll 2015), with over 500 unique models documented in EcoBase so far (see website at http://sirs.agrocampus-ouest.fr/EcoBase/). Although EwE has been predominantly used to investigate the impacts of fishing (Pauly 2000), more recent studies have investigated the impacts of environmental changes (Bentley et al., 2017, Serpetti et al., 2017, Colléter et al. 2015, Heymans et al. 2014, Heymans et al. 2016, Zhang et al., 2019), invasive species (Corrales et al., 2017, Yin et al 2022), pollutants (Tierney et al., 2018, Walters and Christensen, 2018), hypoxia (Mutsert et al. 2016), ecosystem effects of macrophyte recovery (Horn et al. 2021), modeling decline in ecosystem structure and maturity (Nuttal et al. 2011), environmental impact assessment (Fretzer 2016), effects of excessive nutrient loads (Kao et al. 2014), and even

[1] The working hypothesis that prompted the creation of this model(s) is that the Utah Lake ecosystem is highly stressed, has low resilience, and is resistant to change, including improvement in its degraded alternative stable state primarily due to an altered food web. This food web model will provide evidence for or against this hypothesis.

ecosystem impacts of microplastics (Boyer et al. 2022). In addition to its application to mostly marine modelling, EwE has been used for large lake food web modelling including extensively throughout the Great Lakes, USA (Cox and Kitchell 2004, Kitchell et al. 2000, Blukacz-Richards and Koops 2012, Hossain et al. 2012, Stewart and Sprules 2011, Langseth et al. 2012, Langseth 2012, Kao and Rutherford 2014).

EwE builds on a static, mass-balanced snapshot of the system "EcoPath", that can be developed to a time-dynamic model "EcoSim" and then used for simulations (Christensen et al., 2009). EwE is a free ecological/ecosystem modeling software suite. EwE has three main components:

- EcoPath – a static, mass-balanced snapshot of the system.
- EcoSim – a time dynamic simulation module for policy exploration; and
- Ecospace – a spatial and temporal dynamic module (https://EcoPath.org).

Derivations of EcoPath and EcoSim are detailed in Christensen and Pauly (1992) and Walters et al. (1997, 2000); software and documentation are available at http://www.EcoPath.org/. EwE version 6.6.7 was used for this proof-of-concept Utah Lake foodweb model.

Two master equations must be satisfied to correctly parameterize the EcoPath model. The first equation describes the production of each functional group as a set of *n* linear equations for *n* groups:

$$\left(\frac{P_i}{B_i}\right)\cdot B_i \cdot EE_i - \sum_{j=1}^{n} B_j \cdot \left(\frac{Q_j}{B_j}\right) \cdot DC_{ji} - Y_i - E_i - BA_i = 0$$

where (P_i/B_i) is the production to biomass ratio for group *i* (which is equal to the coefficient of total mortality Z under steady-state conditions (Allen 1971), *EEi* is the ecotrophic efficiency (the proportion of production used in the system), B_i and B_j are the biomasses of the prey and predators respectively, (Q_j/B_j) is the consumption to biomass ratio, DC_{ji} is the fraction of prey *i* in predator *j*'s diet, Y_i is catch rate for the fishery for group *i*, E_i is the net migration rate, and B_{ai} is the biomass accumulation for group *i*. The EcoPath model assumes conservation of mass over a year.

Energy balance within each group is ensured with the second master equation:

Consumption = production + respiration + unassimilated energy

where production can be described as:

Production = predation mortality + catches + net migration + biomass accumulation + other mortality

Production can be described by the following equation:

$$P_i = \sum_{l} Q_j \cdot DC_{ji} + (F_i + NM_i + BA_i + MO_i) \cdot B_i$$

where P_i is the production of prey group *i*, Q_j is the consumption of predator *j*, DC_{ji} is the diet composition contribution of *i* to *j*'s diet, F_i is the instantaneous rate of fishing mortality, NM_i is the net migration rate of prey group *i*, BA_i is the biomass accumulation rate for *i*, $M0_i$ is the other mortality rate for *i* (non-predation, non-fishery), and B_i is the biomass of *i*.

Data Used

Phytoplankton, zooplankton, and benthic invertebrate biomass and diets were derived from Richards and Miller (2017, 2019 b, 2019c, 2019d), Richards (2018, 2019 a, b, c, 2021a, 2022), and Wasatch Front Water Quality Council and Utah Division of Water Quality databases. Fish biomass and diets were derived from Landom and Walsworth (2021), Walsworth, Landom, and Gaeta (2020), Walsworth and Landom (2021), Walsworth, Wallace, and Landom (2022), University of Utah unpublished diet estimates, and Utah Division of Wildlife Resources net survey data. Fish taxa biomass other than carp biomass estimates were derived from reported carp biomass estimates (Walsworth and Landom 2021), relative abundances, and length/weight relations reported in Appendix 1 and Appendix 2. Fish data were cross referenced using FishBase (https://www.fishbase.se/home.htm). Fish taxa were separated into several ontogenetic groups based on University of Utah unpublished diet study size classes (Appendix 1 and Table 1). Mean length and biomass of small size fish taxonomic classes were estimated using 5 mm as minimum size and medium -1 mm reported sizes (Appendix 1). Zooplankton and benthic invertebrate ontogenetic groups were not used in this proof-of-concept model but can be in future models.

Production to biomass ratio (P/B) estimates were made from literature values. Most of the phytoplankton, zooplankton, and benthic invertebrate P/B values were estimated on the high end of reported values because Utah Lake is highly eutrophic and productive (Table 3). For example, phytoplankton P/B = 200 used in this proof-of-concept model was consistent with Mutsert et al. (2015) where P/B = 182 in nutrient rich waters of the Gulf of Mexico that had high primary production (Turner et al. 2006). Benthic invertebrate P/B was modeled between 100 and 150 based on (Richards unpublished data and personal observation) and freshwater benthic invertebrate authorities Benke et al. (1984) and Hauer and Benke (1991) who documented that chironomid P/B > 100 is common (Richards 2021b).

Several diet estimates had to be adjusted incrementally to balance the model because EcoPath is a mass balance model, and all diet proportions must add to 1.00. Utah Lake mean annual temperature = 16.7 ^{O}C (Richards 2022) was used to help generate and verify several benthic invertebrate production values using Brey (2001), associated computational spreadsheets, empirical models, and the Brey (2021) model.

Model Parameters

Utah Lake ecosystem was not separated into subregions such as Provo Bay or Goshen Bay for this model but can be in future scenarios. The model was based on yearly averages using data from 1995 to 2021, although seasonal averages can be modeled in future iterations when adequate data are compiled, and the need arises. The currency unit used was wet weight (tons/km^2). Other currency units can be modeled in future scenarios including, joules (J/m^2), calories (kcal/m^2), carbon (g/m^2), nitrogen (mg N/m^2), phosphorus (mg P/m^2) or other types of currency after transformations are made. The model was developed as a mostly quasi-closed system, i.e., little or no migration but can be modeled as an open system (e.g., transfer of mass and energy in and out of the system) in future iterations.

Taxonomic groups list

Table 1 contains the taxonomic (functional) groups used in the model. This table will be updated shortly.

Table 1. Taxonomic groups used in model including taxon functional group used and representative dominant taxa

a. Phytoplankton

Taxon Functional Group Used	Dominant taxa in Utah Lake[1]
Bacillariophyta	*Melosira granulata* var. angustissima, *Fragilaria crotonensis*, *Nitzschia acicularis*, *Stephanodiscus niagarae*, centric diatoms, pennate diatoms
Chlorophyta	*Chlamydomonas* spp., *Oocystis* sp., *Kirchneriella* spp., *Pediastrum* duplex, *Pediastrum* spp., *Monoraphidium arcuatum*, *Acutidesmus pectinatus*, *Willea rectangularis*, *Ankistrodesmus falcatus*, *Closteriopsis longissima* var. tropica, *Scenedesmus* quadricauda, Lagerheimia spp.
Cryptophyta	*Cryptomonas* sp.
Cyanophyta	*Dolichospermum crassum*, *Aphanizomenon flosaquae, Planktothrix agardhii, Phormidium* sp.
Dinophyta	*Ceratium hirudinella*
Euglenophyta	*Euglena* spp., *Phacus* spp., *Lepocinclis* spp., *Trachellomonas* spp.

[1] from Richards 2018, 2021 and Rushforth Phycology unpublished data.

b. Benthic algae

Taxon Functional Group Used	Dominant taxa in Utah Lake
Benthic Algae	NA

c. Macrophytes and Epiphytes

Taxon Functional Group Used	Dominant taxa in Utah Lake[1]
Macrophytes	*Bolboschoenus maritimus, Typha latifolia, Ceratophyllum demersum, Rumex crispus, Lemna minor, Schenoplectus acutus, Phragmites australis, Stuckenia* sp., others
Epiphytes	NA

[1] from Landom and Walsworth 2021, Richards et al. 2022

d. Zooplankton

Taxon Functional Group Used	Dominant taxa in Utah Lake[1]
Asplanchnidae	*Asplanchna* sp.
Bosminidae	*Bosmina longirostris, Bosmina liederi, Bosmina* sp.
Brachionidae	*Brachionus calyciflorus, B.plicatilis, B. quadridentatus, B. variabilis, B. sp. Almenara, Keratella* sp.
Canthocamptidae	*Attheyella* sp., *Cletocamptus sp.*
Ceriodaphnia	*Ceriodaphnia cf. acanthine, C. dubia, C. quadrangula*
Chydoridae	*Chydorus brevilabrus, C. sphaericus, Kurzia media, Leberis c.f. davidi, Leydigia leydigi, L. lousi, Pleuroxus aduncus, P. denticulatus, P. striatus*

Cyclopidae	*Acanthocyclops americanus, A. robustus, Eucyclops agilis, Microcyclops rubellus*
Daphnia	*Daphnia ambigua, D. exilis D. galeata, D. magna, D. mendotae, D. pulex, D. retrocurva, Scapholeberis mucronate, S. vetulus, S. mixtus, S. c.f. punctatus*
Diaptomidae	*Leptodiaptomus sicilis*
Ilyocryptidae	*Ilyocryptus* sp.
Laophontidae	NA
Leptodoridae	*Leptodora kindtii*
Macrothricidae	*Macrothrix* sp.
Moinidae	*Moina cf. micrura, M. macrocopa*
Sididae	*Diaphanosoma cf. Heberti , D. brachyurum*

[1]from Richards 2019a, b,c see Marshall update or contact River Continuum Concepts for most recent updates

e. Benthic macroinvertebrates (see Richards et al reports)[1]

Taxon Functional Group Used	**Dominant taxa in Utah Lake**
Acari	Lebertia sp.
Amphipoda	*Hyalella* sp.
Chironominae	
Coleoptera	Oreodytes sp., other Dytscidae
Corbicula sp. (bivalves)	*Corbicula* sp.
Corixidae	*Corisella decolor, C. tarsalis*
Decopoda	
Glossiphoniidae	Hirudinea, *Helobdella stagnalis*
Isopoda	
Lymnaeidae	Stagnicola sp.
Physidae	*Physa* sp.
Odonata	
Oligochaetes	
Ostracod	*Ostracoda* sp.
Tanypodinae	*Tanypus neopunctipenis*

[1] Other taxa to be updated

f. Fishes[1]

		Size classes (mm)	
Common Name	**Scientific Name**	**Min**	**Max**
Black Bullhead 1	*Ameiurus melas*	5	36
Black Bullhead 2	*Ameiurus melas*	37	197
Black Bullhead 3	*Ameiurus melas*	207	360
Black Crappie 1	*Pomoxis nigromaculatus*	5	40
Black Crappie 2	*Pomoxis nigromaculatus*	41	156
Black Crappie 3	*Pomoxis nigromaculatus*	160	288

Bluegill 1	*Lepomis macrochirus*	5	26
Bluegill 2	*Lepomis macrochirus*	27	137
Bluegill 3	*Lepomis macrochirus*	141	228
Green Sunfish 1	*Lepomis cyanellus*	5	131
Green Sunfish 2	*Lepomis cyanellus*	132	195
Green Sunfish 3	*Lepomis cyanellus*	223	499
Channel Catfish 1	*Ictalurus punctatus*	503	746
Channel Catfish 2	*Ictalurus punctatus*	5	76
Channel Catfish 3	*Ictalurus punctatus*	77	104
Channel Catfish 4	*Ictalurus punctatus*	110	145
Common Carp 1	*Cyprinus carpio*	5	21
Common Carp 2	*Cyprinus carpio*	22	294
Common Carp 3	*Cyprinus carpio*	300	725
Fathead Minnow 1	*Pimephales promelas*	5	46
Fathead Minnow 2	*Pimephales promelas*	47	48
Fathead Minnow 3	*Pimephales promelas*	51	63
June Sucker 1	*Chasmistes liorus*	5	313
June Sucker2	*Chasmistes liorus*	314	391
June Sucker 3	*Chasmistes liorus*	401	576
Northern Pike 1	*Esox lucius*	5	81
NorthernPike 2	*Esox lucius*	82	299
Northern Pike 3	*Esox lucius*	302	594
Northern Pike 4	*Esox lucius*	608	892
Walleye 1	*Sander vitreus*	5	80
Walley 2	*Sander vitreus*	81	145
Walleye 3	*Sander vitreus*	255	420
Walley 4	*Sander vitreus*	460	721
White Bass 1	*Morone chrysops*	5	34
White Bass 2	*Morone chrysops*	35	128
White Bass 3	*Morone chrysops*	133	298
White Bass 4	*Morone chrysops*	303	412
Yellow Perch 1	*Perca flavescens*	5	47
Yellow Perch 2	*Perca flavescens*	48	145
Yellow Perch 3	*Perca flavescens*	160	251

[1] Landom and Walsworth 2021, Walsworth et al. 2020, 2022, USU unpublished data, UDWR net data.

Fleets

There is only one semi-commercial fishing fleet in Utah Lake, the carp removal project. Estimates of tons km^{-2} year^{-1} of carp removal vary and were tentatively modeled at 3 t km^{-2} year^{-1}

based on Walsworth, Wallace, and Landom (2022)[2]. Recreational sports fisheries occur on Utah Lake but no estimates of 'take' (i.e., creel census data) were available and therefore, not modelled.

Exports

The only estimate of exports used in the model was for the two Chironomidae taxa, Chironominae and Tanypodinae as adults leaving the system. It was assumed that about half of the adult population biomass of these two taxa did not return to lake. This was based on several assumptions, 1) males were half the adult population biomass and did not return as did females to deposit eggs, 2) wind events forced a portion of the population away from the lake, 3) an unknown proportion of the adult population was lost to predation (e.g., spiders, birds, dragonflies, etc.), and 4) artificial urban lights attracted adults away from the lake and that portion of the population did not return. Subsequently net migration was estimated at 1.70 t km^2 y^{-1} for Chironominae and 0.52 t km^2 y^{-1} for Tanypodinae. Certainly, some plankton, drifting invertebrates, and fishes leave the system via the Jordan River. However, there were no data available for estimation of these exports.

Results

All biomass, diet, and production values used in this proof-of-concept model are best estimates based on limited empirical data and are subject to change as estimates are further refined. Subsequently, result values presented here can be considered reasonably accurate but imprecise estimates and considered most useful as relative (qualitative) values.

Diets

Original diet estimates were adjusted slightly and incrementally to balance model. The following table, Table 2 is the first-round diet estimates. In addition to the taxa diets in the following table, two frog species, Boreal Chorus Frog (*Pseudacris maculata)* (native) and American Bullfrog (*Lithobates catesbeianus)* (invasive) occur in Utah Lake but there was no available biomass data consequently, they were not used in the model. However, one American Bullfrog was found in Northern Pike 3 diet.

[2] There appears to be some discrepancies in carp removal estimates that will be updated pending further documentation.

Table 2. Mass balance adjusted diet matrix.

	Prey \ predator	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	**Bacillariophyta**	0.540	0.390	0.540	0.540	0.540	0.540	0.340	0.240	0.340	0.540	0.540	0.540	0.490	0.340	0.340	0.000	0.000
2	**Chlorophyta**	0.350	0.440	0.350	0.350	0.350	0.350	0.400	0.350	0.400	0.350	0.350	0.350	0.350	0.400	0.400	0.000	0.000
3	**Cryptophyta**	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.000	0.000
4	**Cyanophyta**	0.040	0.100	0.040	0.040	0.040	0.040	0.190	0.300	0.190	0.040	0.040	0.040	0.050	0.150	0.150	0.000	0.000
5	**Dinophyta**	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.000	0.000
6	**Euglenophyta**	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.050	0.010	0.010	0.010	0.010	0.050	0.050	0.050	0.000	0.000
7	**Benthic Algae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	**Macrophytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	**Epiphytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	**Asplanchnidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	**Bosminidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	**Brachionidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	**Canthocamptidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	**Ceriodaphnia**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	**Chydoridae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	**Cyclopidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	**Daphnia**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	**Diaptomidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	**Ilyocryptidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	**Laophontidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	**Leptodoridae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	**Macrothricidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	**Moinidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	**Sididae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

25	**Acari**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	**Amphipoda**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000
27	**Chironominae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.000
28	**Coleoptera**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000
29	**Corbicula sp.**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000
30	**Corixidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	**Decopoda**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	**Glossiphoniidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	**Isopoda**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000
34	**Lymnaeidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000
35	**Physa sp.**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000
36	**Odonata**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	**Oligochaetes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	**Ostracod**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	**Tanypodinae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.000
40	**BlackBullhead1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
41	**BlackBullhead2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	**BlackBullhead3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	**BlackCrappie1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	**BlackCrappie2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	**BlackCrappie3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	**Bluegill1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	**Bluegill2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	**Bluegill 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	**GreenSunfish1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	**GreenSunfish 2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	**GreenSunfish 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	**ChannelCatfish1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	**ChannelCatfish2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	**ChannelCatfish3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

55	**Channel Catfish 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	**CommonCarp1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
57	**CommonCarp2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	**CommonCarp3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	**Fathead Minnow1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
60	**FatheadMinnow2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
61	**FatheadMinnow 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	**June Sucker 1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	**JuneSucker2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	**JuneSucker 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	**NorthernPike1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	**NorthernPike2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	**NorthernPike3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	**Northern Pike 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	**Walleye1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	**Walley2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
71	**Walleye3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	**Walley 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	**WhiteBass1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
74	**WhiteBass2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	**WhiteBass3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	**White Bass 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
77	**YellowPerch1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
78	**YellowPerch2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
79	**YellowPerch3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	**DetritusSnow**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.500
81	**Detritus**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.500

	Prey \ predator	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**

1	**Bacillariophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	**Chlorophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	**Cryptophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	**Cyanophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	**Dinophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	**Euglenophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	**Benthic Algae**	0.000	0.000	0.000	0.100	0.100	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	**Macrophytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	**Epiphytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.400	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	**Asplanchinida**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.042	0.000	0.000	0.042	0.000
11	**Bosminidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.002	0.000	0.032	0.001
12	**Brachionidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.013	0.000
13	**Canthocamptidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.010	0.000
14	**Ceriodaphnia**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.128	0.003	0.000	0.128	0.003
15	**Chydoridae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.006	0.000
16	**Cyclopidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.415	0.004	0.000	0.415	0.008
17	**Daphnia**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.000	0.000	0.000	0.134	0.002	0.000	0.134	0.005
18	**Diaptomidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.004	0.000	0.150	0.001
19	**Ilyocryptidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.000	0.000	0.029	0.000
20	**Laophontidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.000
21	**Leptodoridae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.001	0.000	0.003	0.000
22	**Macrothricidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.000
23	**Moinidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.013	0.000
24	**Sididae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.006	0.000	0.019	0.000
25	**Acari**	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	**Amphipoda**	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.009	0.001	0.000	0.034
27	**Chironominae**	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.739	0.004	0.000	0.347
28	**Coleoptera**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.097
29	**Corbicula sp.**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	**Corixidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.300

31	**Decopoda**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	**Glossiphoniidae**	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	**Isopoda**	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	**Lymnaeidae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	**Physa sp.**	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	**Odonata**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.097
37	**Oligochaetes**	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	**Ostracod**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	**Tanypodinae**	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.230	0.001	0.000	0.107
40	**BlackBullhead1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000
41	**BlackBullhead2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	**BlackBullhead3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	**BlackCrappie1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000
44	**BlackCrappie2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.107	0.000	0.000
45	**BlackCrappie3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	**Bluegill1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
47	**Bluegill2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.048	0.000	0.000
48	**Bluegill 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	**GreenSunfish1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000
50	**GreenSunfish 2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000
51	**GreenSunfish 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	**ChannelCatfish1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.000	0.000
53	**ChannelCatfish2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.073	0.000	0.000
54	**ChannelCatfish3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	**Channel Catfish 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	**CommonCarp1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000
57	**CommonCarp2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.182	0.000	0.000
58	**CommonCarp3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	**Fathead Minnow1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000
60	**FatheadMinnow2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.000	0.000

61	**FatheadMinnow 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000
62	**June Sucker 1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	**JuneSucker2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	**JuneSucker 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	**NorthernPike1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	**NorthernPike2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	**NorthernPike3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	**Northern Pike 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	**Walleye1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.066	0.000	0.000
70	**Walley2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
71	**Walleye3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	**Walley 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	**WhiteBass1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.037	0.000	0.000
74	**WhiteBass2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.000	0.000
75	**WhiteBass3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	**White Bass 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
77	**YellowPerch1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
78	**YellowPerch2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000
79	**YellowPerch3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	**DetritusSnow**	0.900	0.190	0.400	0.600	0.600	0.500	0.500	0.900	0.300	0.100	0.500	0.400	0.900	0.000	0.000	0.000	0.000	0.000
81	**Detritus**	0.100	0.000	0.600	0.300	0.300	0.500	0.500	0.000	0.300	0.000	0.500	0.600	0.100	0.000	0.000	0.000	0.000	0.000

	Prey \ predator	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
1	**Bacillariophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	**Chlorophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	**Cryptophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	**Cyanophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	**Dinophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	**Euglenophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	**Benthic Algae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

8	**Macrophytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000
9	**Epiphytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	**Asplanchinida**	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.042	0.000	0.000	0.042	0.000	0.000	0.042	0.541
11	**Bosminidae**	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.001	0.000	0.032	0.004	0.001	0.032	0.000
12	**Brachionidae**	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.013	0.000	0.000	0.013	0.167
13	**Canthocamptidae**	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.010	0.000	0.000	0.010	0.000
14	**Ceriodaphnia**	0.128	0.005	0.000	0.000	0.000	0.000	0.000	0.128	0.000	0.000	0.128	0.004	0.002	0.128	0.100
15	**Chydoridae**	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.006	0.000	0.000	0.006	0.000
16	**Cyclopidae**	0.415	0.011	0.000	0.000	0.001	0.001	0.000	0.200	0.002	0.000	0.415	0.032	0.002	0.415	0.100
17	**Daphnia**	0.134	0.005	0.005	0.000	0.000	0.001	0.000	0.134	0.000	0.000	0.134	0.004	0.006	0.134	0.093
18	**Diaptomidae**	0.150	0.002	0.002	0.000	0.000	0.000	0.000	0.150	0.000	0.000	0.150	0.000	0.001	0.150	0.000
19	**Ilyocryptidae**	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.000	0.000	0.029	0.000	0.000	0.029	0.000
20	**Laophontidae**	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.000	0.000	0.003	0.000
21	**Leptodoridae**	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.000	0.000	0.003	0.000
22	**Macrothricidae**	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.003	0.000	0.000	0.003	0.000
23	**Moinidae**	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.013	0.000	0.000	0.013	0.000
24	**Sididae**	0.019	0.001	0.000	0.000	0.001	0.000	0.000	0.019	0.000	0.000	0.019	0.000	0.000	0.019	0.000
25	**Acari**	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	**Amphipoda**	0.000	0.292	0.283	0.002	0.103	0.044	0.000	0.215	0.209	0.000	0.000	0.000	0.000	0.000	0.000
27	**Chironominae**	0.000	0.445	0.439	0.671	0.673	0.698	0.001	0.000	0.104	0.002	0.000	0.420	0.385	0.000	0.000
28	**Coleoptera**	0.000	0.000	0.000	0.001	0.000	0.008	0.000	0.000	0.000	0.165	0.000	0.002	0.002	0.000	0.000
29	**Corbicula sp.**	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	**Corixidae**	0.000	0.000	0.000	0.002	0.000	0.010	0.000	0.000	0.000	0.165	0.000	0.002	0.013	0.000	0.000
31	**Decopoda**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.000	0.000	0.000
32	**Glossiphoniidae**	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	**Isopoda**	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	**Lymnaeidae**	0.000	0.000	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.009	0.000	0.000
35	**Physa sp.**	0.000	0.000	0.006	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.009	0.000	0.000
36	**Odonata**	0.000	0.000	0.021	0.001	0.013	0.000	0.000	0.000	0.284	0.333	0.000	0.000	0.000	0.000	0.000
37	**Oligochaetes**	0.000	0.000	0.001	0.110	0.000	0.023	0.000	0.000	0.000	0.000	0.000	0.000	0.057	0.000	0.000

38	**Ostracod**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	**Tanypodinae**	0.000	0.237	0.236	0.207	0.208	0.216	0.000	0.000	0.001	0.001	0.000	0.223	0.202	0.000	0.000
40	**BlackBullhead1**	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000
41	**BlackBullhead2**	0.000	0.000	0.000	0.000	0.000	0.000	0.028	0.000	0.050	0.000	0.000	0.000	0.000	0.000	0.000
42	**BlackBullhead3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	**BlackCrappie1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
44	**BlackCrappie2**	0.000	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	**BlackCrappie3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	**Bluegill1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
47	**Bluegill2**	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	**Bluegill 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	**GreenSunfish1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50	**GreenSunfish 2**	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	**GreenSunfish 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	**ChannelCatfish1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	**ChannelCatfish2**	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
54	**ChannelCatfish3**	0.000	0.000	0.000	0.000	0.000	0.000	0.049	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	**Channel Catfish 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	**CommonCarp1**	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.100	0.000	0.000	0.000	0.000	0.000	0.000
57	**CommonCarp2**	0.000	0.000	0.000	0.000	0.000	0.000	0.336	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	**CommonCarp3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	**Fathead Minnow1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.100	0.167	0.000	0.000	0.000	0.000	0.000
60	**FatheadMinnow2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.167	0.000	0.000	0.000	0.000	0.000
61	**FatheadMinnow 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	**June Sucker 1**	0.000	0.000	0.000	0.000	0.000	0.000	0.421	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
63	**JuneSucker2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	**JuneSucker 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	**NorthernPike1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	**NorthernPike2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	**NorthernPike3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

68	**Northern Pike 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	**Walleye1**	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	**Walley2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
71	**Walleye3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	**Walley 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	**WhiteBass1**	0.000	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
74	**WhiteBass2**	0.000	0.000	0.000	0.000	0.000	0.000	0.101	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	**WhiteBass3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	**White Bass 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
77	**YellowPerch1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
78	**YellowPerch2**	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
79	**YellowPerch3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	**Detritus Snow**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.150	0.000	0.000
81	**Detritus**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.150	0.000	0.000

	Prey \ predator	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**	**76**	**77**	**78**	**79**
1	**Bacillariophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	**Chlorophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	**Cryptophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	**Cyanophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	**Dinophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	**Euglenophyta**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	**Benthic Algae**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	**Macrophytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	**Epiphytes**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	**Asplanchinida**	0.237	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.042	0.000	0.000	0.000	0.042	0.000	0.000
11	**Bosminidae**	0.000	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.032	0.000	0.000
12	**Brachionidae**	0.073	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.013	0.000	0.000
13	**Canthocamptidae**	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.010	0.000	0.000
14	**Ceriodaphnia**	0.306	0.128	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.128	0.000	0.000	0.000	0.128	0.000	0.000

15	**Chydoridae**	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.000	0.000	0.000	0.006	0.000	0.000
16	**Cyclopidae**	0.033	0.415	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.415	0.003	0.000	0.000	0.415	0.013	0.000
17	**Daphnia**	0.339	0.134	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.134	0.001	0.000	0.000	0.134	0.002	0.000
18	**Diaptomidae**	0.012	0.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.150	0.000	0.000	0.000	0.150	0.002	0.000
19	**Ilyocryptidae**	0.000	0.029	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.029	0.000	0.000	0.000	0.029	0.000	0.000
20	**Laophontidae**	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.003	0.000	0.000
21	**Leptodoridae**	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.003	0.002	0.000
22	**Macrothricidae**	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.003	0.000	0.000
23	**Moinidae**	0.000	0.013	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.000	0.000	0.013	0.000	0.000
24	**Sididae**	0.000	0.019	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.019	0.000	0.000
25	**Acari**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	**Amphipoda**	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.001
27	**Chironominae**	0.000	0.000	0.756	0.738	0.671	0.000	0.000	0.000	0.671	0.001	0.000	0.000	0.000	0.050	0.007	0.002	0.000	0.565	0.004
28	**Coleoptera**	0.000	0.000	0.000	0.004	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.047	0.000
29	**Corbicula sp.**	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.050	0.000	0.000	0.000	0.000	0.000
30	**Corixidae**	0.000	0.000	0.000	0.022	0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.050	0.002	0.000	0.000	0.047	0.000
31	**Decopoda**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.040	0.000	0.000	0.000	0.000	0.000
32	**Glossiphoniidae**	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	**Isopoda**	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	**Lymnaeidae**	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	**Physa sp.**	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	**Odonata**	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.150	0.003
37	**Oligochaetes**	0.000	0.000	0.000	0.000	0.110	0.000	0.000	0.000	0.110	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	**Ostracod**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	**Tanypodinae**	0.000	0.000	0.233	0.228	0.207	0.000	0.000	0.000	0.207	0.000	0.000	0.000	0.000	0.012	0.002	0.001	0.000	0.174	0.001
40	**BlackBullhead1**	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.109	0.002	0.002	0.000	0.041	0.000	0.002	0.000	0.000	0.012
41	**BlackBullhead2**	0.000	0.000	0.000	0.000	0.000	0.000	0.020	0.015	0.000	0.052	0.146	0.058	0.000	0.000	0.220	0.000	0.000	0.000	0.000
42	**BlackBullhead3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	**BlackCrappie1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.050	0.001	0.000	0.000	0.010	0.005	0.002	0.000	0.000	0.008
44	**BlackCrappie2**	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000	0.016	0.004	0.000	0.000	0.002	0.024	0.000	0.000	0.097

45	**BlackCrappie3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	**Bluegill1**	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.009	0.000	0.000	0.000	0.019	0.003	0.001	0.000	0.000	0.006
47	**Bluegill2**	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.004	0.000	0.137	0.024	0.012	0.000	0.000	0.006	0.000	0.000	0.000	0.000
48	**Bluegill 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	**GreenSunfish1**	0.000	0.000	0.000	0.000	0.000	0.034	0.008	0.000	0.000	0.014	0.001	0.001	0.000	0.010	0.011	0.003	0.000	0.000	0.019
50	**GreenSunfish 2**	0.000	0.000	0.000	0.000	0.000	0.092	0.049	0.003	0.000	0.000	0.016	0.008	0.000	0.000	0.004	0.000	0.000	0.000	0.000
51	**GreenSunfish 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	**ChannelCatfish1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	**ChannelCatfish2**	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.021	0.004	0.003	0.000	0.095	0.015	0.005	0.000	0.000	0.028
54	**ChannelCatfish3**	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.026	0.000	0.000	0.050	0.081	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	**Channel Catfish 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	**CommonCarp1**	0.000	0.000	0.000	0.000	0.000	0.101	0.001	0.000	0.000	0.003	0.001	0.001	0.000	0.011	0.002	0.001	0.000	0.000	0.007
57	**CommonCarp2**	0.000	0.000	0.000	0.000	0.000	0.034	0.163	0.018	0.000	0.000	0.044	0.136	0.000	0.000	0.042	0.083	0.000	0.000	0.583
58	**CommonCarp3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	**Fathead Minnow1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.001	0.000	0.000	0.005
60	**FatheadMinnow2**	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.005	0.002	0.000	0.000	0.020	0.005	0.004	0.000	0.000	0.021
61	**FatheadMinnow 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	**June Sucker 1**	0.000	0.000	0.000	0.000	0.000	0.045	0.013	0.018	0.000	0.000	0.000	0.000	0.000	0.054	0.000	0.000	0.000	0.000	0.000
63	**JuneSucker2**	0.000	0.000	0.000	0.000	0.000	0.004	0.114	0.141	0.000	0.000	0.125	0.138	0.000	0.000	0.300	0.300	0.000	0.000	0.000
64	**JuneSucker 3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	**NorthernPike1**	0.000	0.000	0.000	0.000	0.000	0.569	0.109	0.086	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	**NorthernPike2**	0.000	0.000	0.000	0.000	0.000	0.103	0.062	0.476	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	**NorthernPike3**	0.000	0.000	0.000	0.000	0.000	0.000	0.143	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	**Northern Pike 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	**Walleye1**	0.000	0.000	0.000	0.000	0.000	0.000	0.019	0.000	0.000	0.000	0.075	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010
70	**Walley2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.001	0.000	0.000	0.034	0.071	0.002	0.000	0.000	0.000
71	**Walleye3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	**Walley 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	**WhiteBass1**	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.023	0.000	0.125	0.046	0.060	0.000	0.446	0.164	0.430	0.000	0.000	0.193
74	**WhiteBass2**	0.000	0.000	0.000	0.000	0.000	0.010	0.076	0.183	0.000	0.466	0.427	0.469	0.000	0.000	0.110	0.137	0.000	0.000	0.000

75	**WhiteBass3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	**White Bass 4**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
77	**YellowPerch1**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000	0.001	0.002	0.000	0.000	0.000	0.000
78	**YellowPerch2**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.015	0.024	0.000	0.000	0.021	0.000	0.000	0.000	0.000
79	**YellowPerch3**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
80	**DetritusSnow**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
81	**Detritus**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Biomass, Production, Consumption, and Ecotrophic Efficiency

Table 3 provides EcoPath's basic estimates of Utah Lake foodweb including estimated biomass (ton km^{-2}), production/biomass ($year^{-1}$) and production/consumption($year^{-1}$) that were slightly and incrementally adjusted to balance the model. Consumption/biomass($year^{-1}$) and ecotrophic efficiency (EE) were estimated by the EcoPath model.

Table 3. Basic estimates of Utah Lake foodweb. Habitat area = 1.00. Biomass (t/km2), Production/biomass (/year) and Production/consumption(/year) were estimated by author to mass balance model. Consumption/biomass(/year) and Ecotrophic efficiency were estimated by EcoPath model.

Taxon	Trophic level	Biomass (t/km²)	Production/biomass (/year)	Consumption biomass (/year)	Ecotrophic Efficiency EE	Production/consumption (/year)
Bacillariophyta	1.00	0.37	200.00		0.90	
Chlorophyta	1.00	0.40	200.00		0.77	
Cryptophyta	1.00	0.50	200.00		0.08	
Cyanophyta	1.00	1.49	200.00		0.07	
Dinophyta	1.00	3.70	200.00		0.00	
Euglenophyta	1.00	0.69	200.00		0.02	
Benthic Algae	1.00	0.05	200.00		0.35	
Macrophytes	1.00	0.01	200.00		0.43	
Epiphytes	1.00	0.05	200.00		0.40	
Asplanchnidae	2.00	0.05	100.00	200.00	0.68	0.50
Bosminidae	2.00	0.05	100.00	200.00	0.32	0.50
Brachionidae	2.00	0.05	100.00	200.00	0.21	0.50
Canthocamptidae	2.00	0.01	100.00	200.00	0.44	0.50
Ceriodaphnia	2.00	0.08	100.00	200.00	0.83	0.50
Chydoridae	2.00	0.02	100.00	200.00	0.15	0.50
Cyclopidae	2.00	0.20	100.00	200.00	0.94	0.50
Daphnia	2.00	0.10	100.00	200.00	0.82	0.50
Diaptomidae	2.00	0.08	100.00	200.00	0.89	0.50
Ilyocryptidae	2.00	0.05	100.00	200.00	0.27	0.50
Laophontidae	2.00	0.01	100.00	200.00	0.15	0.50

Leptodoridae	2.00	0.01	100.00	200.00	0.23	0.50
Macrothricidae	2.00	0.05	100.00	200.00	0.03	0.50
Moinidae	2.00	0.01	100.00	200.00	0.59	0.50
Sididae	2.00	0.05	100.00	200.00	0.20	0.50
Acari	2.98	0.00	150.00	300.00	0.95	0.50
Amphipoda	2.00	0.08	150.00	300.00	0.73	0.50
Chironominae	2.00	3.37	100.00	200.00	0.21	0.50
Coleoptera	2.82	0.05	100.00	200.00	0.49	0.50
Corbicula sp.	2.00	0.05	100.00	200.00	0.14	0.50
Corixidae	2.00	0.05	150.00	300.00	0.67	0.50
Decopoda	2.00	0.05	100.00	200.00	0.14	0.50
Glossiphoniidae	2.00	0.05	100.00	200.00	0.20	0.50
Isopoda	2.00	0.05	100.00	200.00	0.41	0.50
Lymnaeidae	2.00	0.05	100.00	200.00	0.19	0.50
Physa sp.	2.00	0.05	100.00	200.00	0.39	0.50
Odonata	2.99	0.05	100.00	200.00	0.37	0.50
Oligochaetes	2.00	0.55	100.00	200.00	0.13	0.50
Ostracod	2.00	0.01	100.00	200.00	0.21	0.50
Tanypodinae	2.00	1.04	100.00	200.00	0.32	0.50
BlackBullhead1	3.00	0.20	20.00	40.00	0.68	0.50
BlackBullhead2	3.00	1.00	5.00	12.50	0.66	0.40
BlackBullhead3	4.25	6.49	0.10	1.00	0.00	0.10
BlackCrappie1	3.00	0.06	10.00	20.00	0.90	0.50
BlackCrappie2	3.18	0.28	5.00	12.50	0.60	0.40
BlackCrappie3	4.30	4.69	0.10	1.00	0.00	0.10
Bluegill1	3.00	0.07	10.00	20.00	0.53	0.50
Bluegill2	3.00	0.50	5.00	12.50	0.80	0.40
Bluegill 3	3.02	5.06	0.10	1.00	0.00	0.10

GreenSunfish1	3.00	0.05	20.00	40.00	0.44	0.50
GreenSunfish 2	3.01	0.25	5.00	12.50	0.28	0.40
GreenSunfish 3	3.01	0.50	0.10	1.00	0.00	0.10
ChannelCtfish1	4.01	0.10	15.00	30.00	0.87	0.50
ChannelCtfish2	3.00	3.00	1.00	2.50	0.69	0.40
ChannelCtfish3	3.63	3.00	0.10	1.00	0.84	0.10
ChnnelCatfish 4	3.80	0.00	0.01	0.20	0.00	0.05
CommonCarp1	3.00	0.10	10.00	20.00	0.53	0.50
CommonCarp2	2.70	5.50	1.00	2.50	0.70	0.40
CommonCarp3	2.69	85.00	0.10	1.00	0.00	0.10
FatheadMnnw1	3.00	0.05	10.00	20.00	0.80	0.50
FatheadMnnw2	3.00	0.20	5.00	12.50	0.61	0.40
FatheadMnnw3	3.00	0.50	0.10	1.00	0.70	0.10
June Sucker 1	3.00	0.15	15.00	30.00	0.89	0.50
JuneSucker2	3.00	0.75	5.00	12.50	0.95	0.40
JuneSucker 3	3.00	0.61	0.10	1.00	0.00	0.10
NorthernPike1	3.00	0.00	10.00	20.00	0.29	0.50
NorthernPike2	4.11	0.00	1.00	2.50	0.36	0.40
NorthernPike3	4.28	0.00	0.01	0.05	0.72	0.20
Northern Pike 4	4.69	0.00	0.01	0.20	0.00	0.05
Walleye1	3.00	0.07	10.00	20.00	0.90	0.50
Walley2	4.40	0.50	5.00	12.50	0.88	0.40
Walleye3	4.38	0.21	1.00	10.00	0.00	0.10
Walley 4	4.41	0.01	0.10	2.00	0.00	0.05
WhiteBass1	3.00	1.00	10.00	16.67	0.98	0.60
WhiteBass2	3.83	1.35	5.00	10.00	0.96	0.50
WhiteBass3	4.17	11.00	0.10	1.00	0.00	0.10
White Bass 4	4.09	0.01	0.05	1.00	0.00	0.05

YellowPerch1	3.00	0.20	10.00	20.00	0.02	0.50
YellowPerch2	3.19	0.40	3.00	7.50	0.36	0.40
YellowPerch3	3.84	0.46	0.10	1.00	0.00	0.10
Detritus Snow	1.00	5.00	80.00			
Detritus	1.00	1.00			0.10	

Net migrations, flow to detritus, net efficiency, Omnivory Index

Table 4 provides three key indices, flow to detritus (tons km^2 year^{-1}), net efficiency, and omnivory index from the EcoPath model. These metrics are described in more detail further on in this report.

Table 4. Flow to detritus, net efficiency, and omnivory index.

Taxon	Net Migration (t/km^2/year)	Flow To Detritus (t/km^2/year)	Net efficiency	Omnivory index
Bacillariophyta		7.656		0.000
Chlorophyta		18.440		0.000
Cryptophyta		90.820		0.000
Cyanophyta		275.836		0.000
Dinophyta		737.564		0.000
Euglenophyta		133.684		0.000
Benthic Algae		6.500		0.000
Macrophytes		1.150		0.000
Epiphytes		6.000		0.000
Asplanchinida		3.583	0.625	0.000
Bosminidae		5.381	0.625	0.000
Brachionidae		5.955	0.625	0.000
Canthocamptidae		0.956	0.625	0.000
Ceriodaphnia		4.554	0.625	0.000
Chydoridae		2.491	0.625	0.000
Cyclopidae		9.211	0.625	0.000
Daphnia		5.834	0.625	0.000
Diaptomidae		4.044	0.625	0.000
Ilyocryptidae		5.668	0.625	0.000
Laophontidae		1.252	0.625	0.000
Leptodoridae		0.935	0.625	0.000
Macrothricidae		6.852	0.625	0.000
Moinidae		0.808	0.625	0.000
Sididae		6.013	0.625	0.000
Acari		0.102	0.625	0.167
Amphipoda		7.570	0.625	0.000
Chironominae	1.685	398	0.625	0.000
Coleoptera		4.566	0.625	0.167
Corbicula sp.		6.277	0.625	0.000
Corixidae		5.444	0.625	0.000
Decopoda		6.310	0.625	0.000
Glossiphoniidae		5.993	0.625	0.000

Isopoda		4.950	0.625	0.000
Lymnaeidae		6.055	0.625	0.000
Physa sp.		5.055	0.625	0.000
Odonata		5.168	0.625	0.177
Oligochaetes		69.755	0.625	0.000
Ostracod		0.597	0.625	0.000
Tanypodinae	0.52	112.3	0.625	0.000
BlackBullhead1		2.896	0.625	0.000
BlackBullhead2		4.219	0.500	0.000
BlackBullhead3		1.947	0.125	0.241
BlackCrappie1		0.300	0.625	0.000
BlackCrappie2		1.282	0.500	0.130
BlackCrappie3		1.407	0.125	0.404
Bluegill1		0.635	0.625	0.000
Bluegill2		1.746	0.500	0.001
Bluegill 3		1.518	0.125	0.022
GreenSunfish1		0.957	0.625	0.001
GreenSunfish 2		1.529	0.500	0.013
GreenSunfish 3		0.150	0.125	0.005
ChannelCatfish1		0.802	0.625	0.120
ChannelCatfish2		2.419	0.500	0.000
ChannelCatfish3		0.649	0.125	0.230
Channel Catfish 4		0.001	0.063	0.13
CommonCarp1		0.874	0.625	0.000
CommonCarp2		4.400	0.500	0.212
CommonCarp3		25.500	0.125	0.216
Fathead Minnow1		0.302	0.625	0.000
FatheadMinnow2		0.886	0.500	0.000
FatheadMinnow 3		0.115	0.125	0.000
June Sucker 1		1.158	0.625	0.000
JuneSucker2		2.999	0.571	0.000
JuneSucker 3		0.184	0.125	0.003
NorthernPike1		0.006	0.625	0.001
NorthernPike2		0.001	0.500	0.127
NorthernPike3		0.001	0.250	0.30
Northern Pike 4		0.001	0.063	0.24
Walleye1		0.493	0.714	0.001
Walley2		1.851	0.533	0.181
Walleye3		0.618	0.125	0.177

Walley 4		0.005	0.063	0.205
WhiteBass1		3.571	0.750	0.000
WhiteBass2		5.685	0.833	0.248
WhiteBass3		3.300	0.125	0.202
White Bass 4		0.003	0.063	0.101
YellowPerch1		2.758	0.625	0.000
YellowPerch2		1.367	0.500	0.144
YellowPerch3		0.137	0.125	0.035
Detrital Snow		0.000	0.000	0.000
Detritus		0.000	0.000	0.353

Pedigree analysis

EcoPath, pedigree routine analysis was used to confirm the validity of the input data or the overall quality of the data. Input parameters were categorized with codes based on their reliability (Pauly et al., 2000), such as 'same ecosystem high precision',' same ecosystem low precision', 'guesstimate', 'derived from empirical relationships' or 'derived from other EcoPath models' (Christensen et al., 2008, 2005). Each option selected for different parameters of a specific functional group was taken into consideration for the calculation of pedigree index P, and its scale varied between 0 and 1.

The overall pedigree index P calculation is based on the individual index value:

$$P = \sum_{i=1}^{n} \sum_{j=i} \frac{I_{ij}}{n}$$

Bhavan et al. (2021) stated that in general, P ranged from 0.13 to 0.74 (Colléter et al. 2013, Lira et al. 2018) with a mean P = 0.44 based on fifty EwE models (Morissette (2007). For this proof-of-concept foodweb model for Utah Lake, P = 0.24 showing that the overall data quality was considered relatively low and improvements in data quality are needed.

A measure of fit t* was also used, as the pedigree index P is a function of the number of groups present in the system.

$$t* = P \cdot \sqrt{N-2} \, / \, \sqrt{1-P^2}$$

Where, *N* is the number of living groups in the given model (Christensen et al., 2005).

In this proof-of-concept model t* = 2.20, suggesting that the model was low to moderately robust (Yin et al. 2022, Christensen and Walters 2005, Bhavan et al. 2021).

Respiration

The respiration of any living group (i) can be expressed as,

$$Re\ sp_i = (1 - GS_i) \cdot Q_i - (1 - TM_i) \cdot P_i$$

where *Re* sp_i is the respiration of group i, GS_i *is* the fraction of *i*'s consumption that is not assimilated, Qi is the consumption of i, and TM_i is the proportion of the production that can be attributed to primary production. Table 5 provides several respiration related results for each taxonomic group including respiration, assimilation, respiration/assimilation, production/respirations, and respiration/biomass.

Table 5. Respiration related metric results.

Taxon	Respiration (t/km²/year)	Assimilation (t/km²/year)	Respiration / assimilation	Production / respiration	Respiration / biomass (/year)
Bacillariophyta	0.00				
Chlorophyta	0.00				
Cryptophyta	0.00				
Cyanophyta	0.00				
Dinophyta	0.00				
Euglenophyta	0.00				
Benthic Algae	0.00				
Macrophytes	0.00				
Epiphytes	0.00				
Asplanchinida	3.00	8.00	0.38	1.67	60.00
Bosminidae	3.00	8.00	0.38	1.67	60.00
Brachionidae	3.00	8.00	0.38	1.67	60.00
Canthocamptidae	0.60	1.60	0.38	1.67	60.00
Ceriodaphnia	4.80	12.80	0.38	1.67	60.00
Chydoridae	1.20	3.20	0.38	1.67	60.00
Cyclopidae	12.00	32.00	0.38	1.67	60.00
Daphnia	6.00	16.00	0.38	1.67	60.00
Diaptomidae	4.80	12.80	0.38	1.67	60.00
Ilyocryptidae	3.00	8.00	0.38	1.67	60.00
Laophontidae	0.60	1.60	0.38	1.67	60.00
Leptodoridae	0.48	1.28	0.38	1.67	60.00
Macrothricidae	3.00	8.00	0.38	1.67	60.00
Moinidae	0.60	1.60	0.38	1.67	60.00
Sididae	3.00	8.00	0.38	1.67	60.00
Acari	0.14	0.36	0.38	1.67	90.00
Amphipoda	6.75	18.00	0.38	1.67	90.00
Chironominae	202.20	539.20	0.38	1.67	60.00
Coleoptera	3.00	8.00	0.38	1.67	60.00
Corbicula sp.	3.00	8.00	0.38	1.67	60.00

Corixidae	4.50	12.00	0.38	1.67	90.00
Decopoda	3.00	8.00	0.38	1.67	60.00
Glossiphoniidae	3.00	8.00	0.38	1.67	60.00
Isopoda	3.00	8.00	0.38	1.67	60.00
Lymnaeidae	3.00	8.00	0.38	1.67	60.00
Physa sp.	3.00	8.00	0.38	1.67	60.00
Odonata	3.00	8.00	0.38	1.67	60.00
Oligochaetes	33.00	88.00	0.38	1.67	60.00
Ostracod	0.30	0.80	0.38	1.67	60.00
Tanypodinae	62.40	166.40	0.38	1.67	60.00
BlackBullhead1	2.40	6.40	0.38	1.67	12.00
BlackBullhead2	5.00	10.00	0.50	1.00	5.00
BlackBullhead3	4.54	5.19	0.87	0.14	0.70
BlackCrappie1	0.36	0.96	0.38	1.67	6.00
BlackCrappie2	1.42	2.84	0.50	1.00	5.00
BlackCrappie3	3.28	3.75	0.88	0.14	0.70
Bluegill1	0.44	1.17	0.38	1.67	6.00
Bluegill2	2.50	5.00	0.50	1.00	5.00
Bluegill 3	3.54	4.05	0.87	0.14	0.70
GreenSunfish1	0.60	1.60	0.38	1.67	12.00
GreenSunfish 2	1.25	2.50	0.50	1.00	5.00
GreenSunfish 3	0.35	0.40	0.88	0.14	0.70
ChannelCatfish1	0.90	2.40	0.38	1.67	9.00
ChannelCatfish2	3.00	6.00	0.50	1.00	1.00
ChannelCatfish3	2.10	2.40	0.87	0.14	0.70
Channel Catfish 4	0.00	0.00	0.94	0.07	0.15
CommonCarp1	0.60	1.60	0.38	1.67	6.00
CommonCarp2	5.50	11.00	0.50	1.00	1.00
CommonCarp3	59.50	68.00	0.88	0.14	0.70
Fathead Minnow1	0.30	0.80	0.38	1.67	6.00
FatheadMinnow2	1.00	2.00	0.50	1.00	5.00
FatheadMinnow 3	0.35	0.40	0.88	0.14	0.70
June Sucker 1	1.35	3.60	0.38	1.67	9.00
JuneSucker2	2.81	6.56	0.43	1.33	3.75
JuneSucker 3	0.43	0.49	0.88	0.14	0.70
NorthernPike1	0.00	0.01	0.38	1.67	6.00
NorthernPike2	0.00	0.00	0.50	1.00	1.00
NorthernPike3	0.00	0.00	0.75	0.33	0.03
Northern Pike 4	0.00	0.00	0.94	0.07	0.15

Walleye1	0.28	0.98	0.29	2.50	4.00
Walley2	2.19	4.69	0.47	1.14	4.38
Walleye3	1.44	1.65	0.87	0.14	7.00
Walley 4	0.02	0.02	0.94	0.07	1.50
WhiteBass1	3.33	13.33	0.25	3.00	3.33
WhiteBass2	1.35	8.10	0.17	5.00	1.00
WhiteBass3	7.70	8.80	0.87	0.14	0.70
White Bass 4	0.01	0.01	0.94	0.07	0.75
YellowPerch1	1.20	3.20	0.38	1.67	6.00
YellowPerch2	1.20	2.40	0.50	1.00	3.00
YellowPerch3	0.32	0.37	0.88	0.14	0.70
DetritusSnow	0.00				
Detritus	0.00				

Foodweb Flow Diagrams

The following examples of foodweb trophic level flow diagrams illustrate who is eating whom in Utah Lake and relative trophic link strengths. Flow diagrams are much easier to visualize and manipulate within the EwE program.

Biomass based

The following figures are examples of biomass based trophic level flow diagrams.

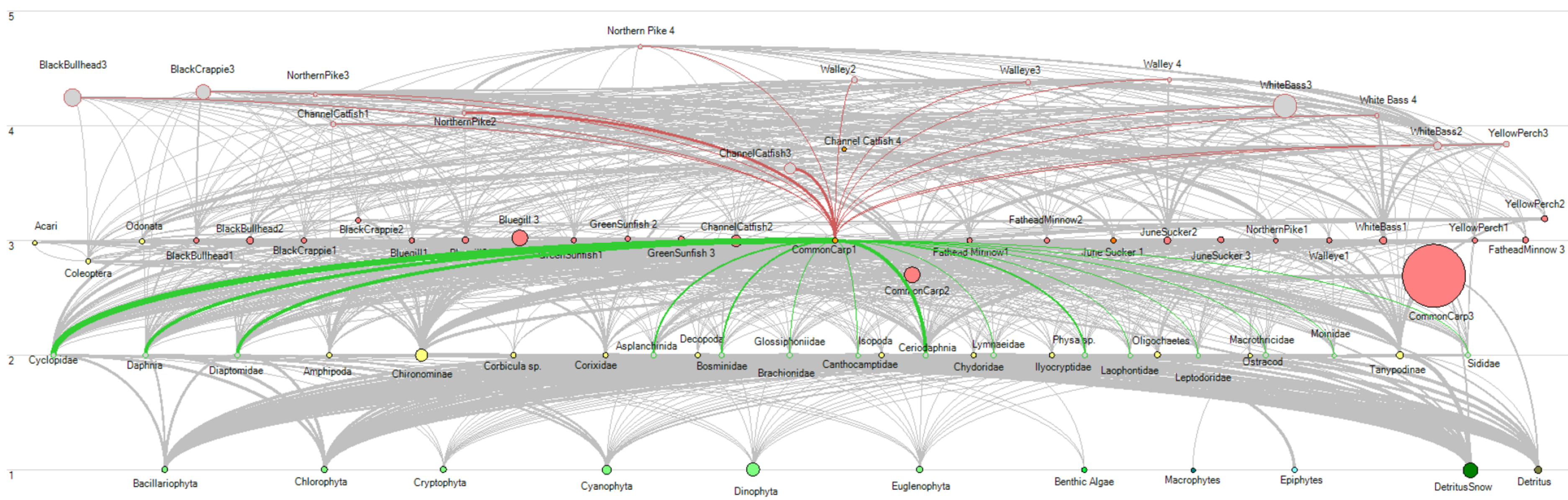


Figure 1. Small Common Carp 1 diets (green connections) and predators (orange/red connections).

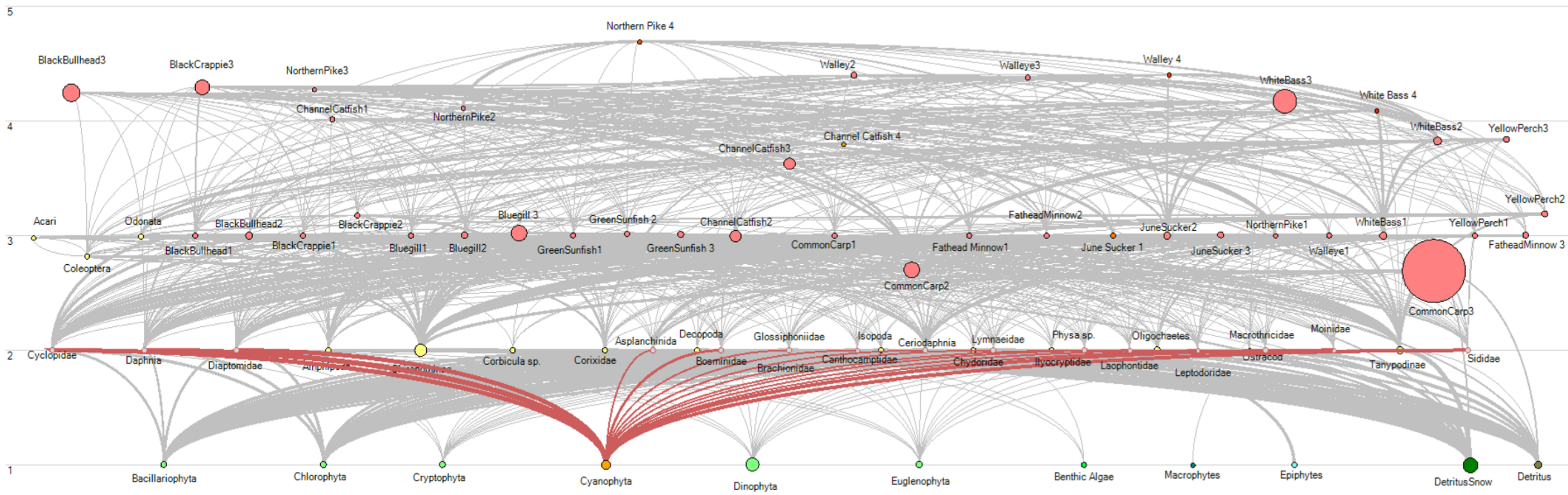


Figure 2. Cyanophyta predators (orange/red connections).

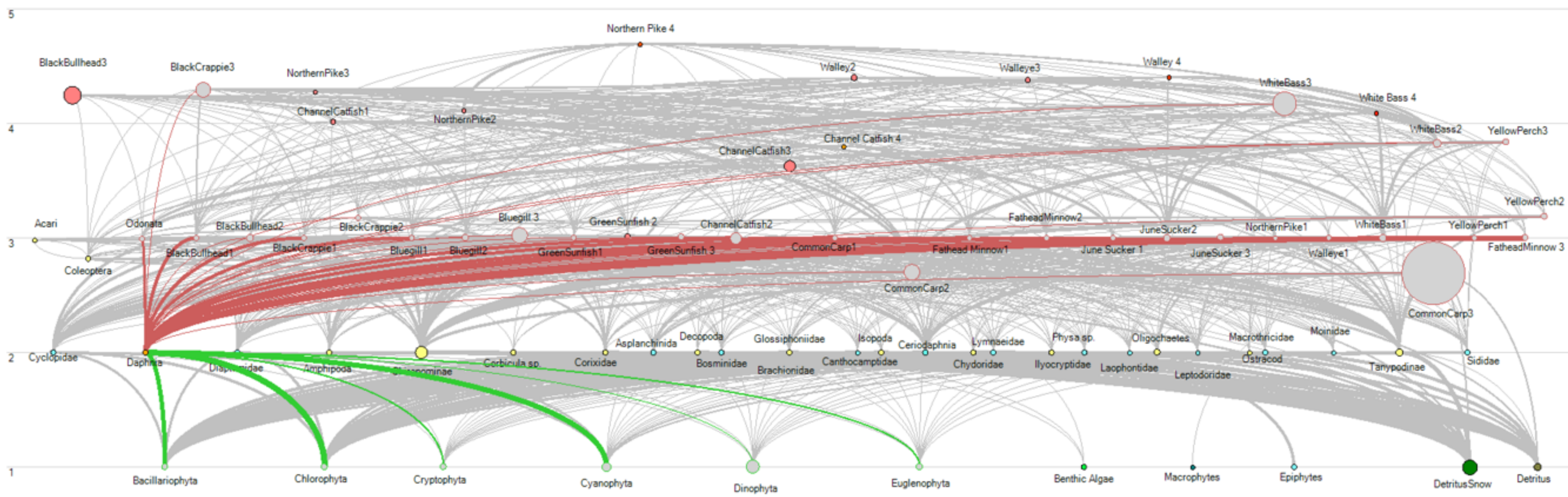


Figure 3. Daphnia sp. diets (green connections) and predators (orange/red connections).

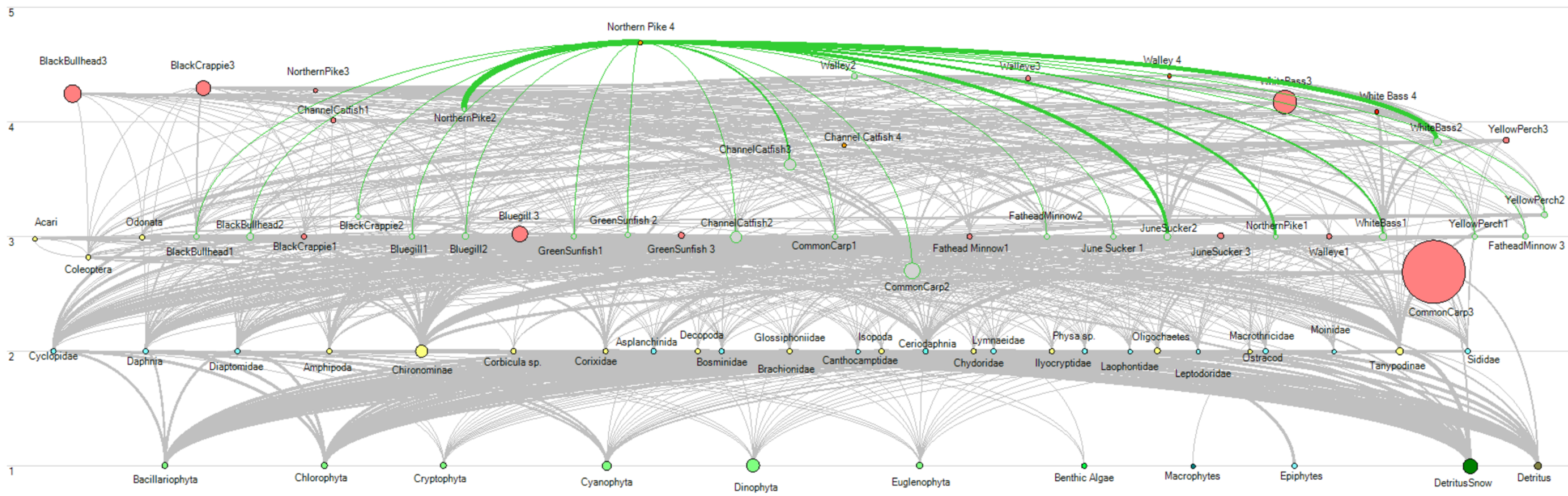


Figure 4. Large Northern Pike 4 diets (green connections) and predators (orange/red connections).

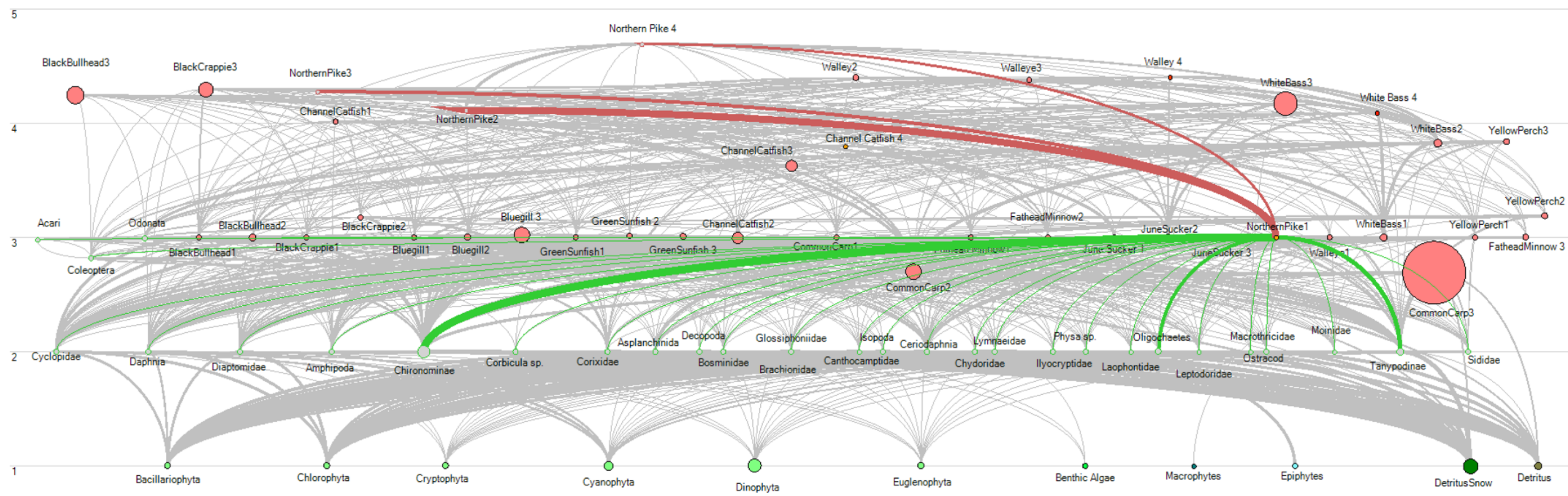


Figure 5. Small Norther Pike 1 diets (green connections) and predators (orange/red connections).

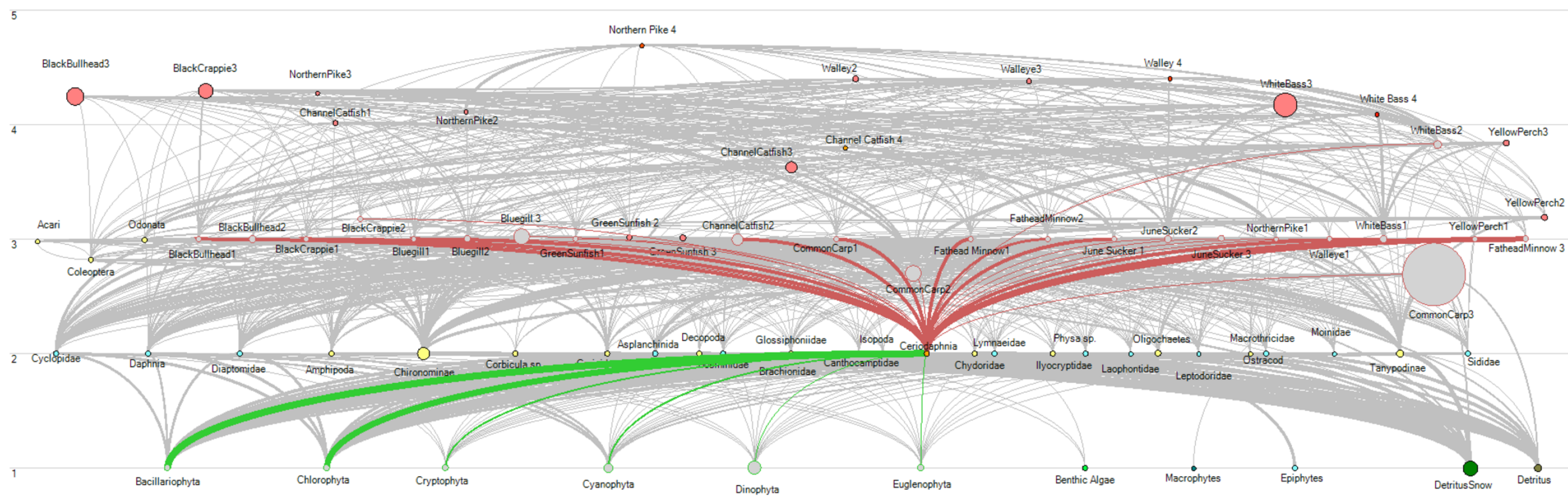


Figure 6. Ceriodaphnia diets (green connections) and predators (orange/red connections).

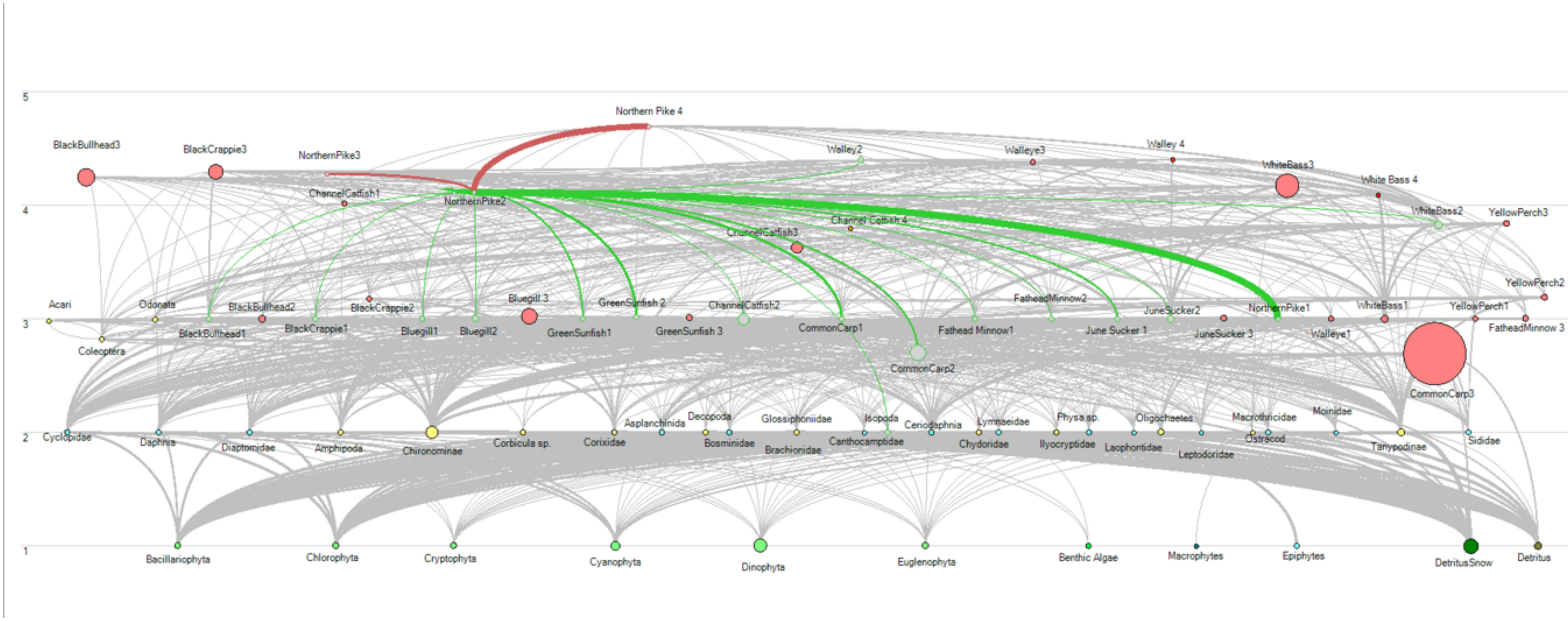


Figure 7. Medium sized Northern Pike 2 diets (green connections) and predators (orange/red connections).

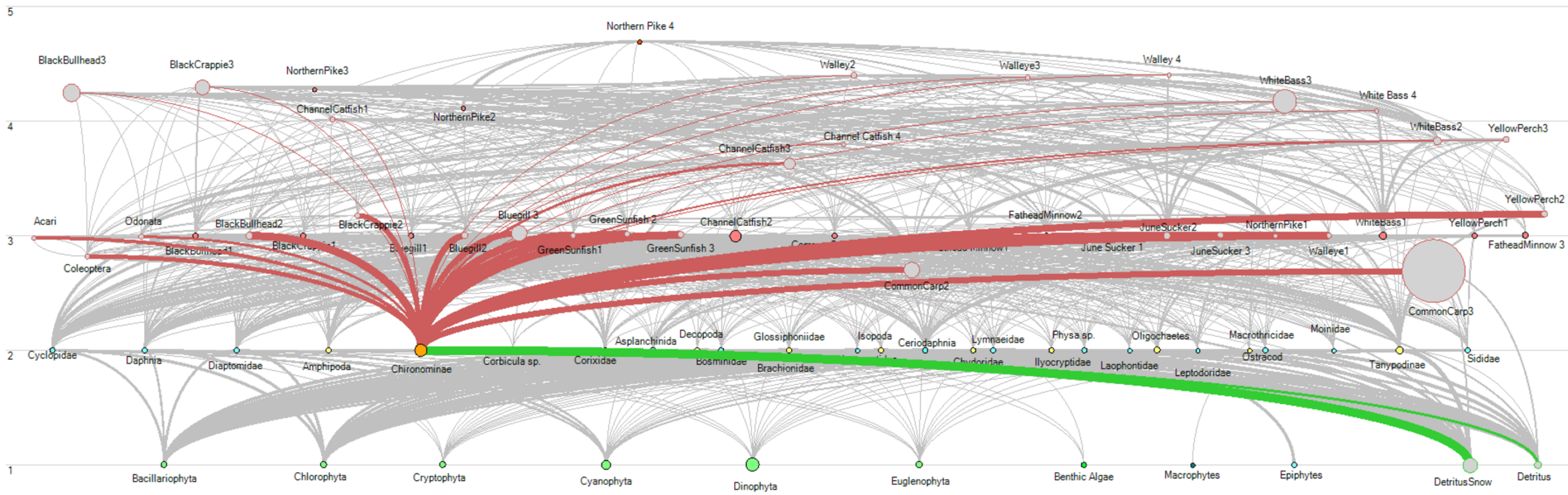


Figure 8. Chironominae diets (green connections) and predators (orange/red connections).

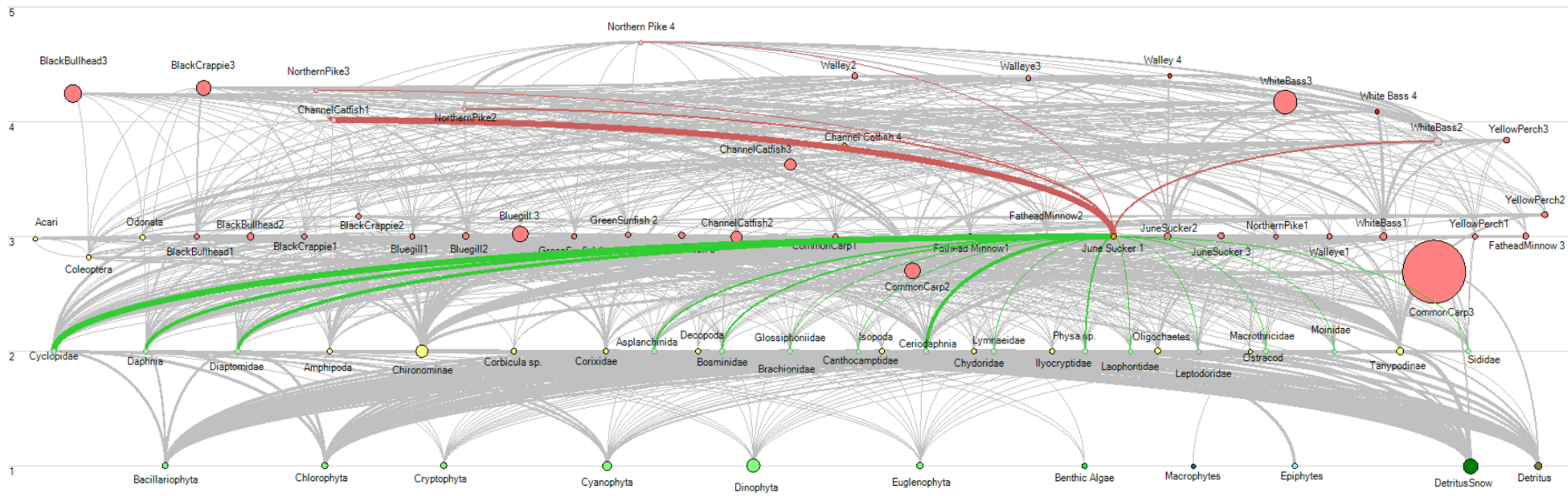


Figure 9. Small June Sucker 1 diets (green connections) and predators (orange/red connections).

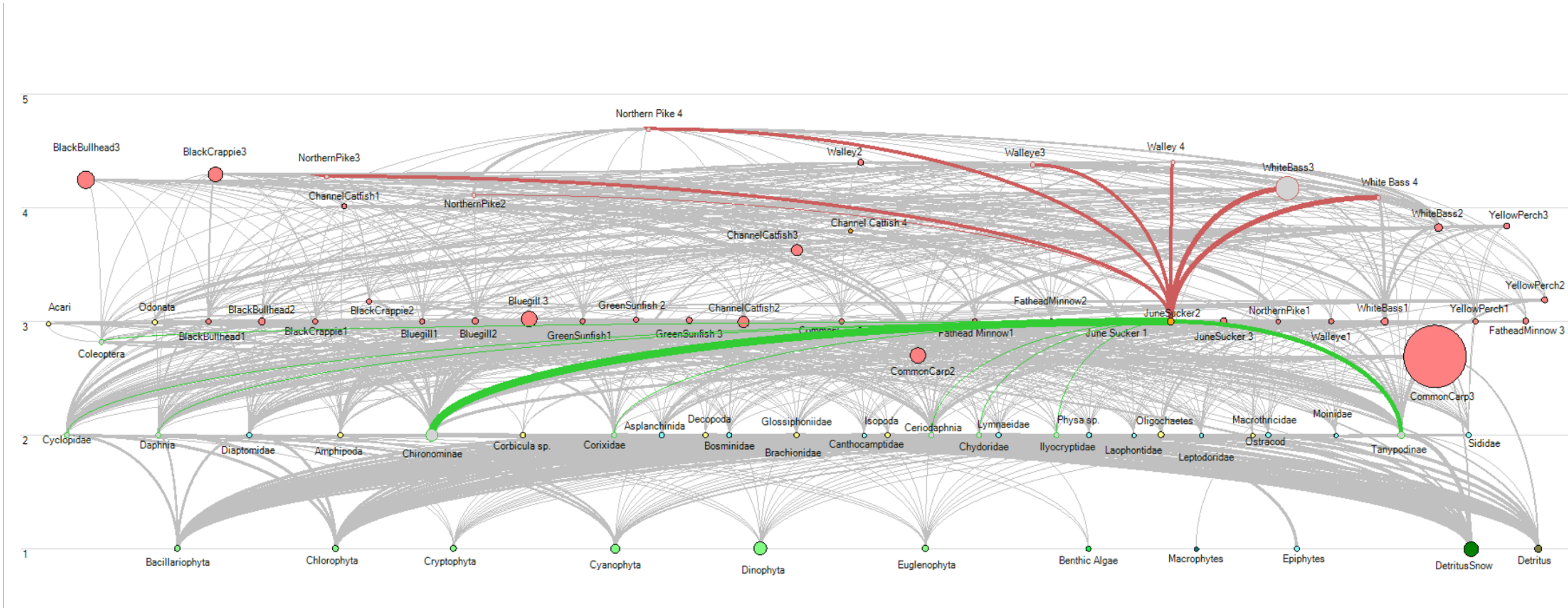


Figure 10. Medium sized June Sucker 2 diets (green connections) and predators (orange/red connections).

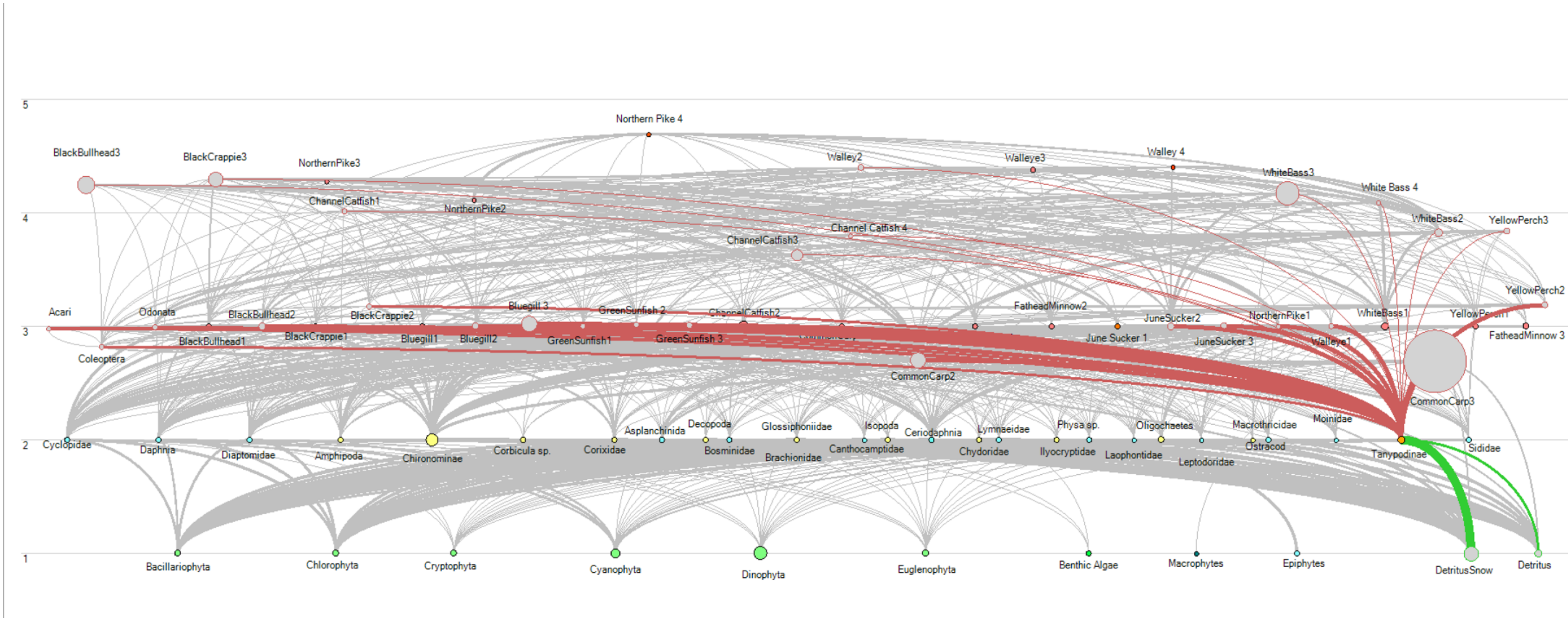


Figure 11. Tanypodinae diets (green connections) and predators (orange/red connections).

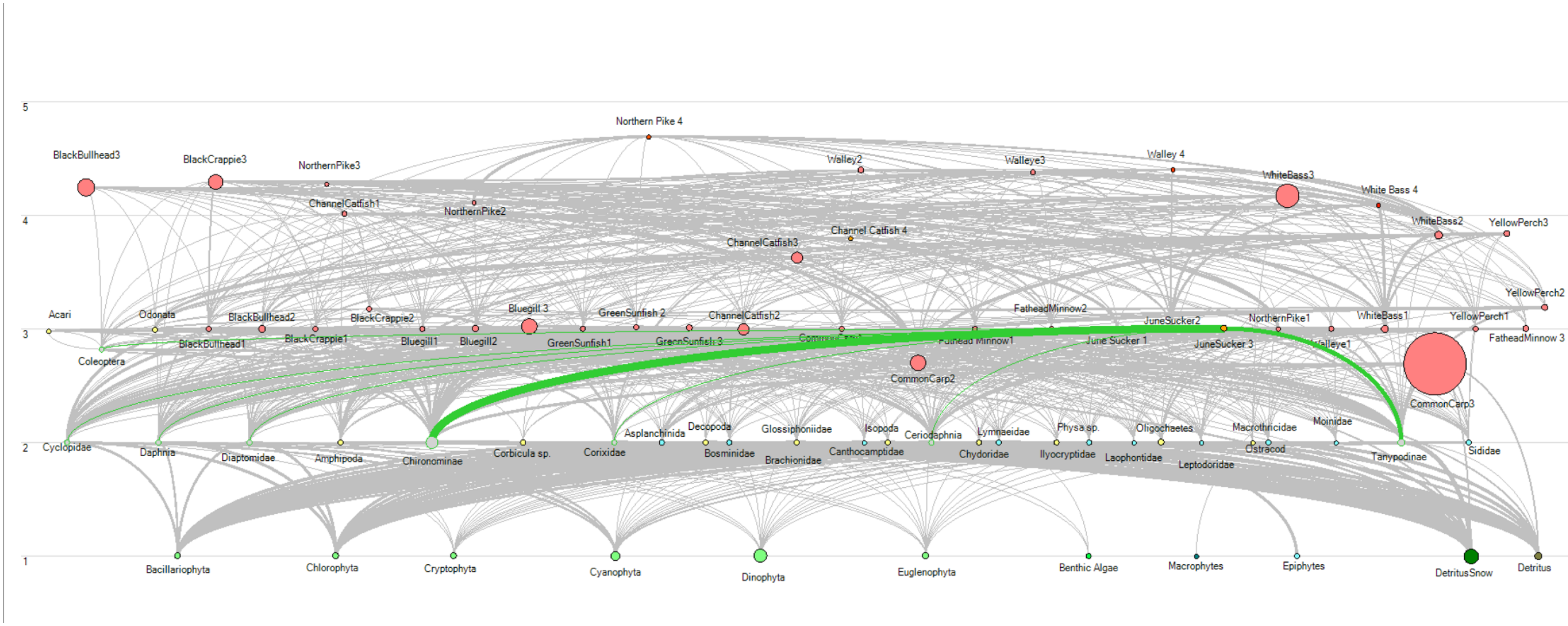


Figure 12. Large June Sucker 3 diets (green connections) and predators (orange/red connections).

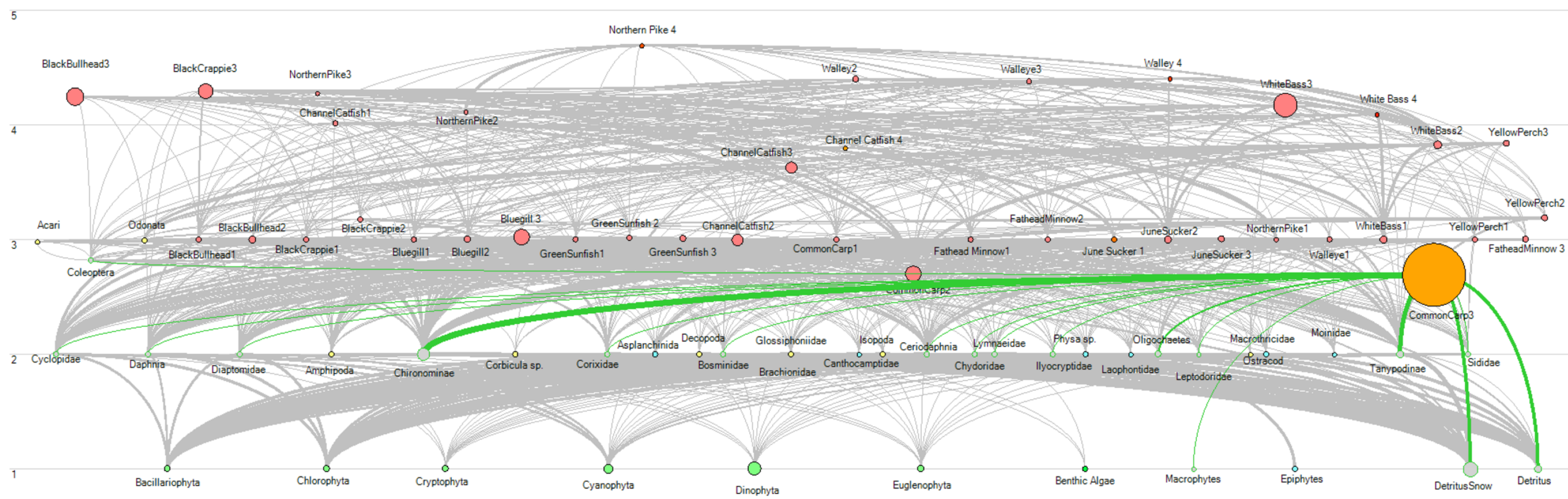


Figure 13. Large Common Carp 3 diets (green connections) and predators (orange/red connections).

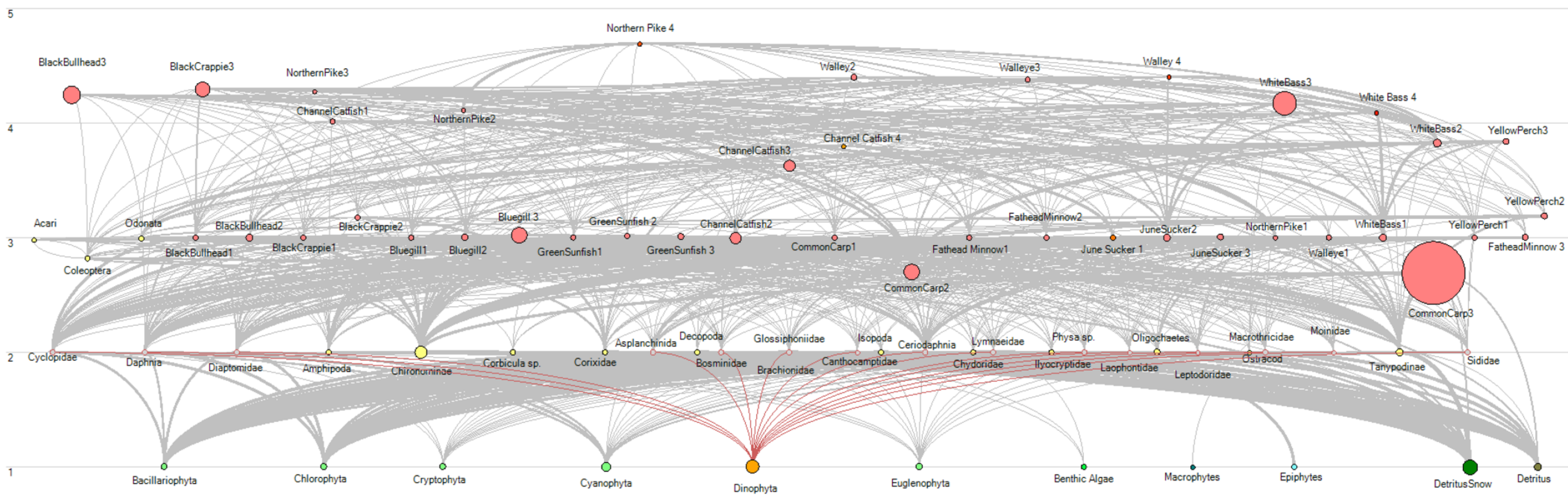


Figure 14. Dinophyta predators (orange/red connections).

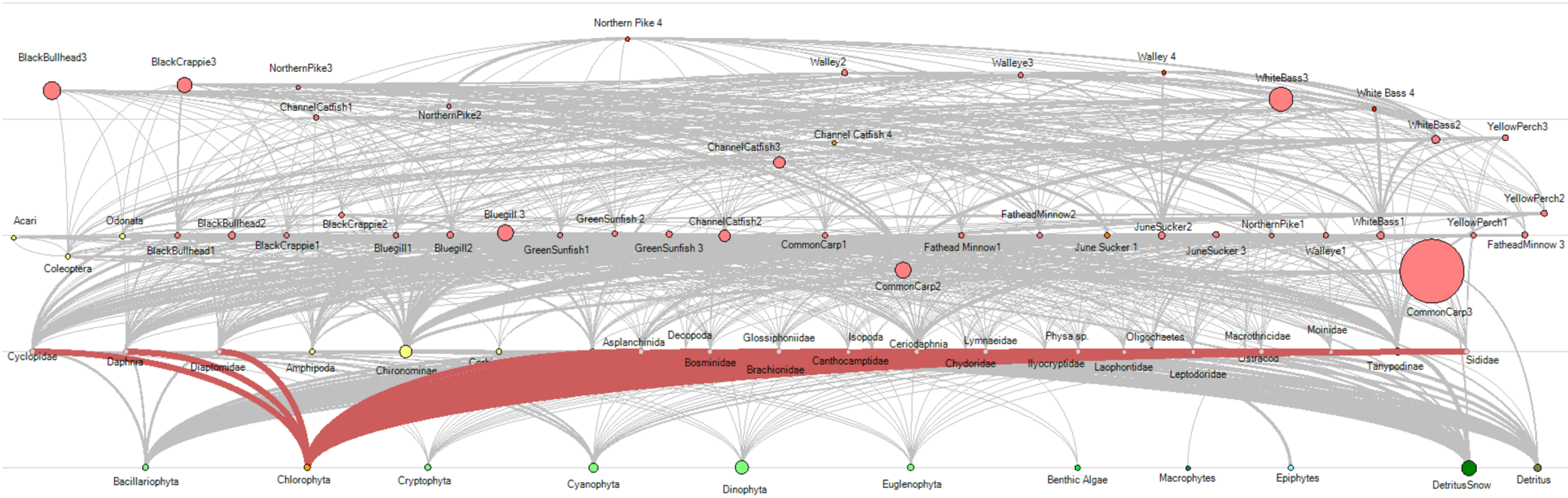


Figure 15. Chlorophyta predators (orange/red connections).

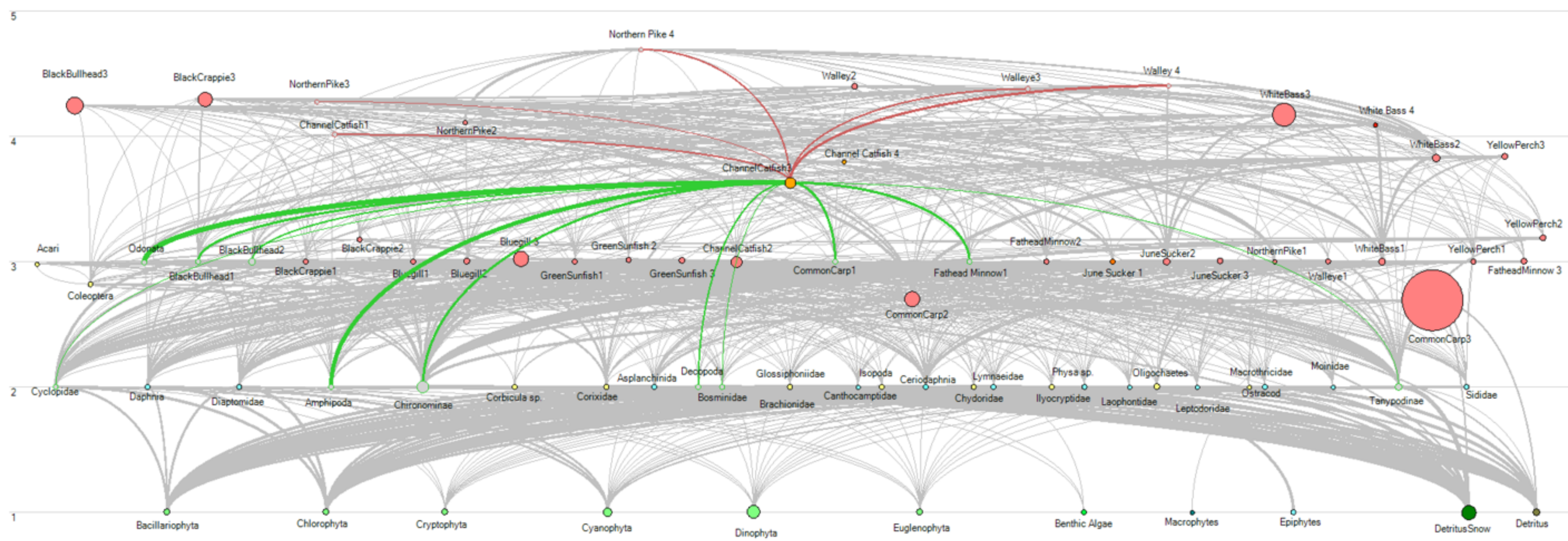


Figure 16. Small Channel Catfish 1 diets (green connections) and predators (orange/red connections).

Production based

The following are examples of production-based flow diagrams.

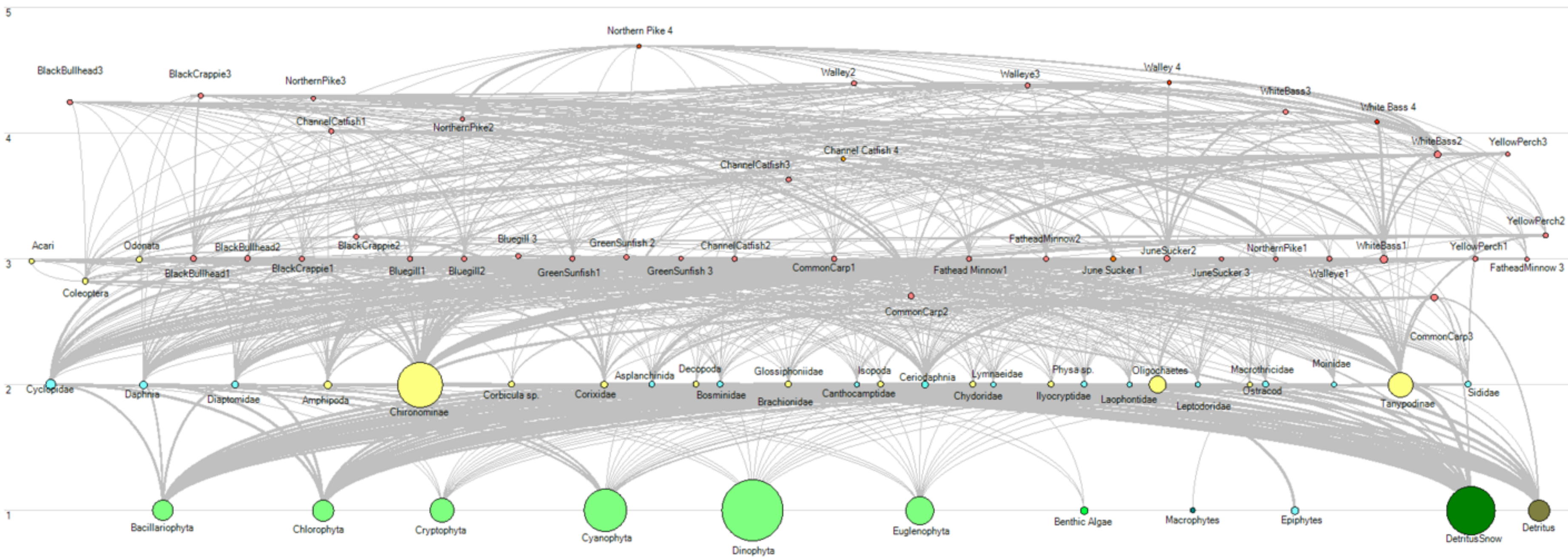


Figure 17. Production based trophic level flow diagram for all groups. Size of circles equates to relative level of production.

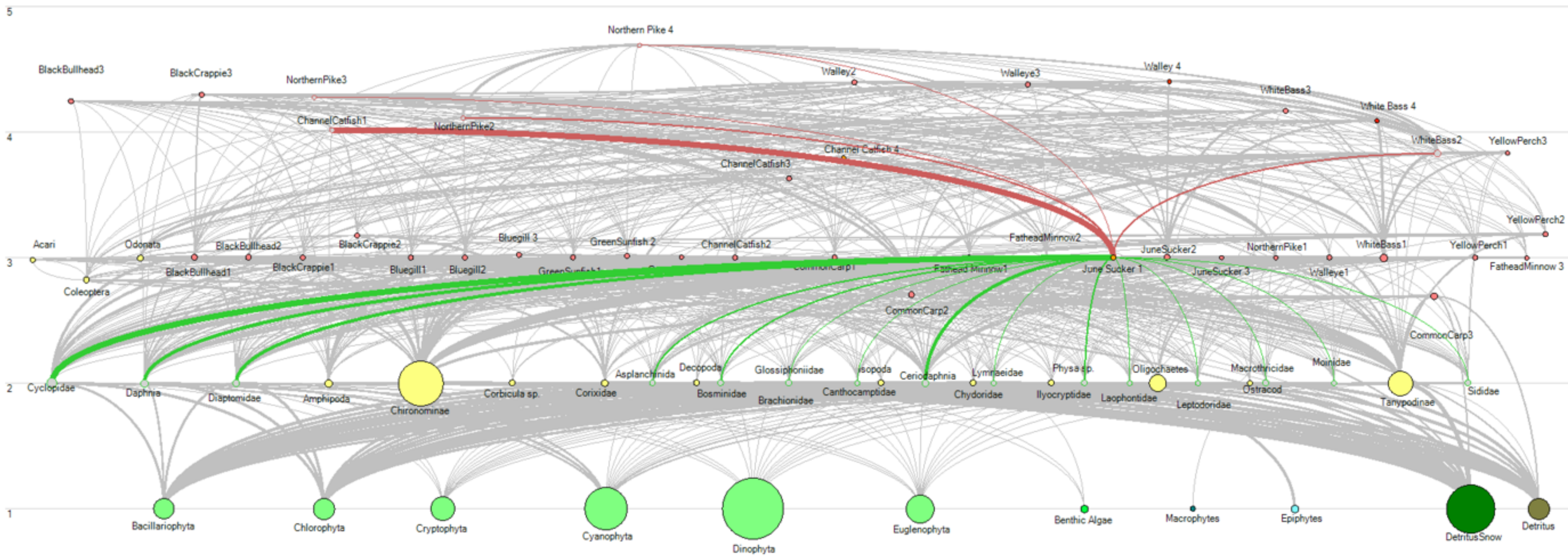


Figure 18. Production based trophic level flow diagram for small June Sucker. Size of circles equates to relative level of production.

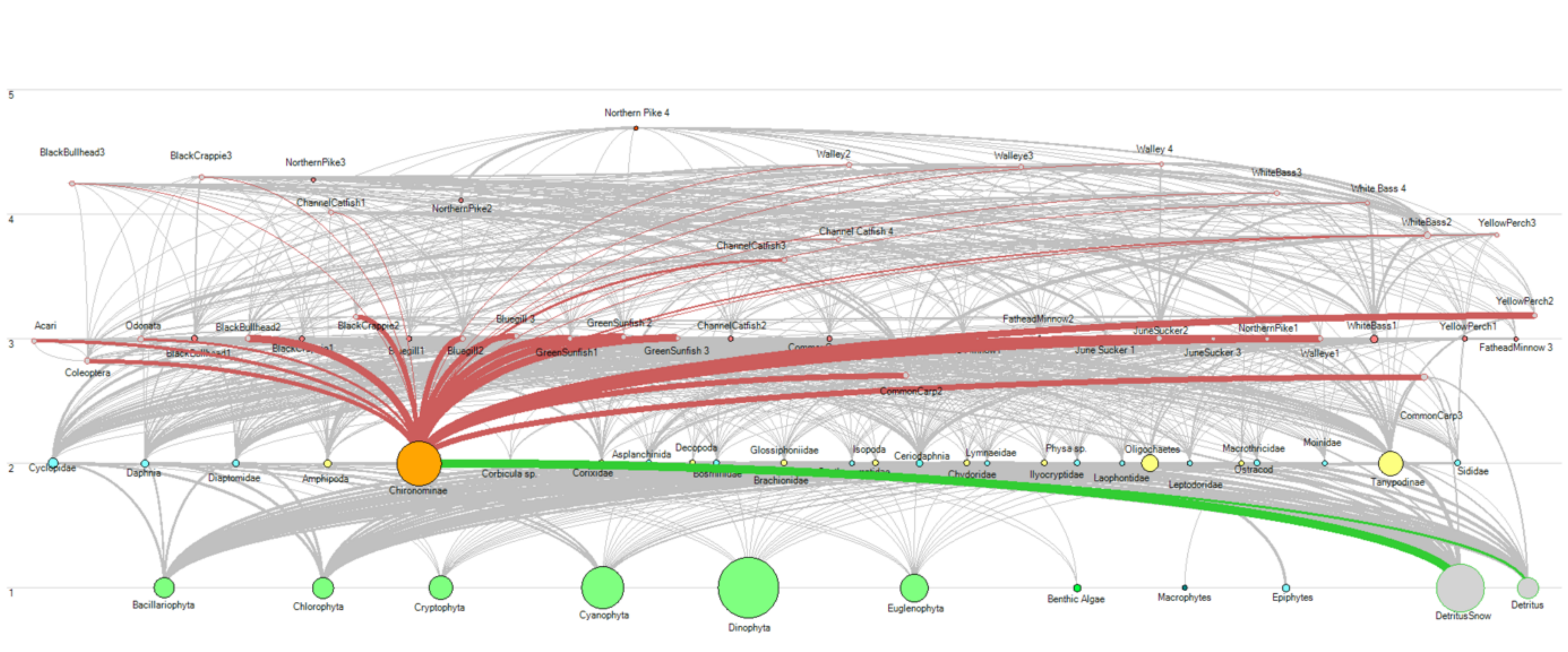


Figure 19. Production based trophic level flow diagram for Chironominae. Size of circles equates to relative level of production.

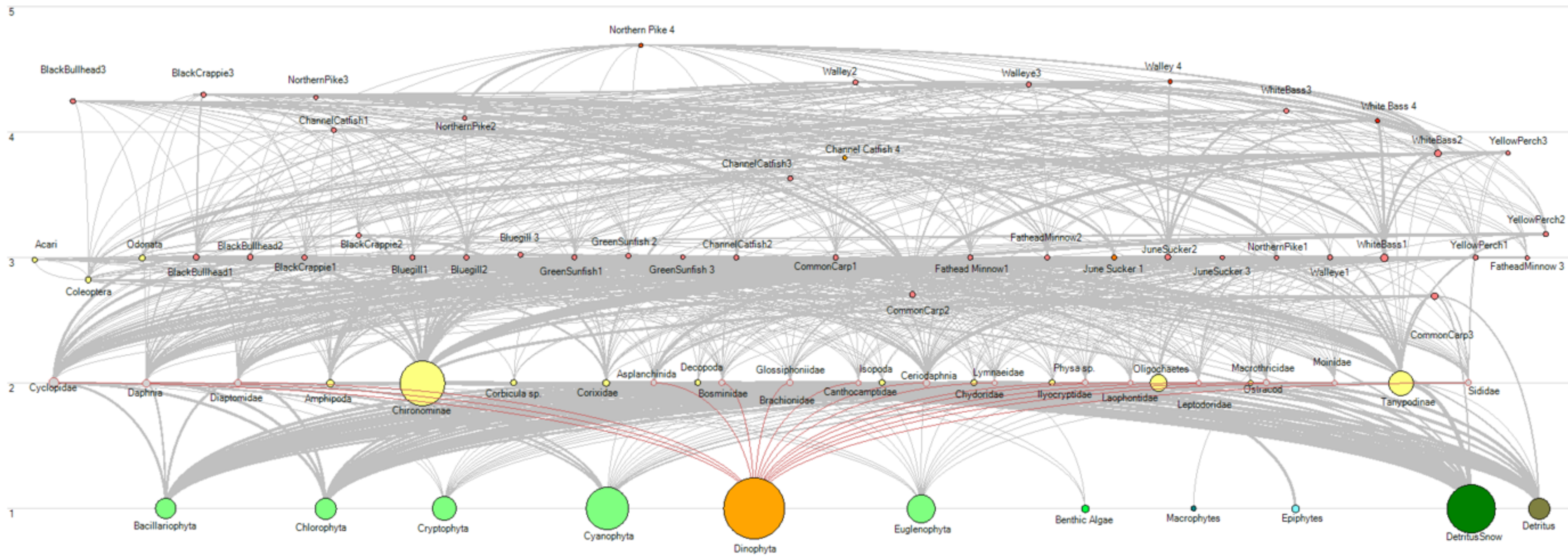


Figure 20. Production based trophic level flow diagram for Dinophyta. Size of circles equates to relative level of production.

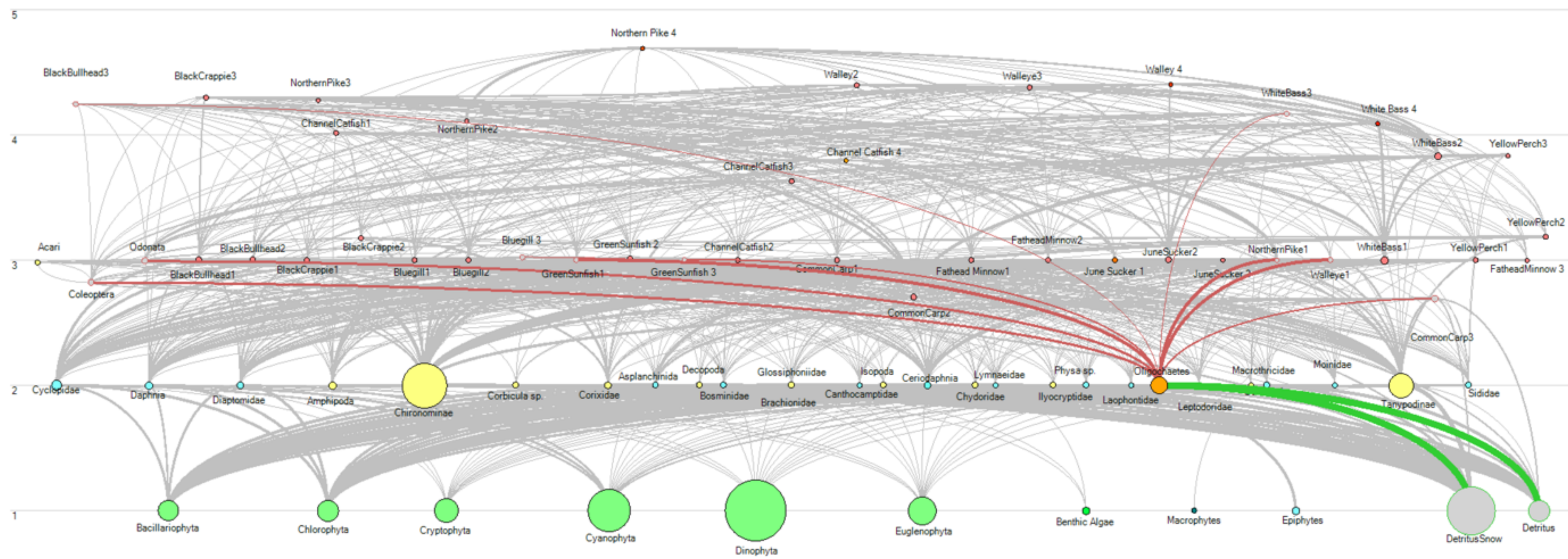


Figure 21. Production based trophic level flow diagram for Oligochaetes. Size of circles equates to relative level of production.

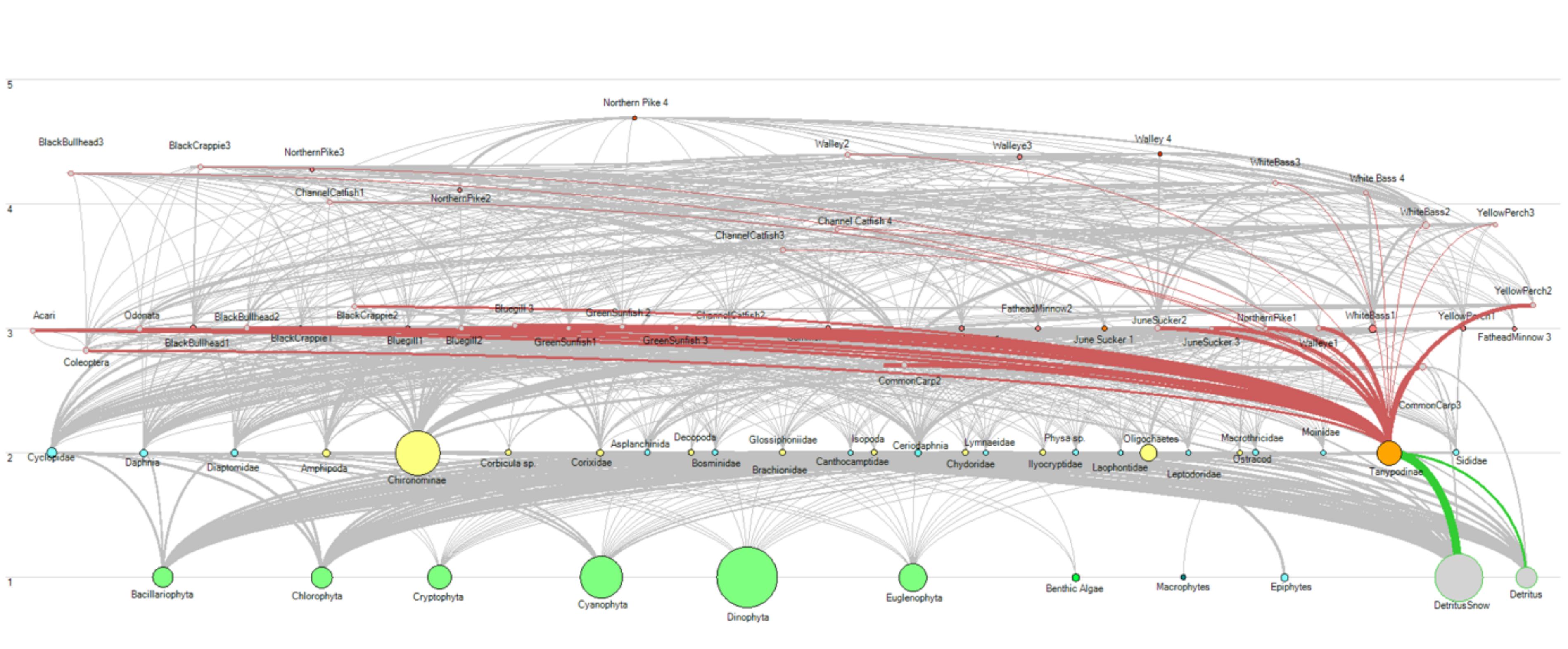


Figure 22. Production based trophic level flow diagram for Tanypodinae. Size of circles equates to relative level of production.

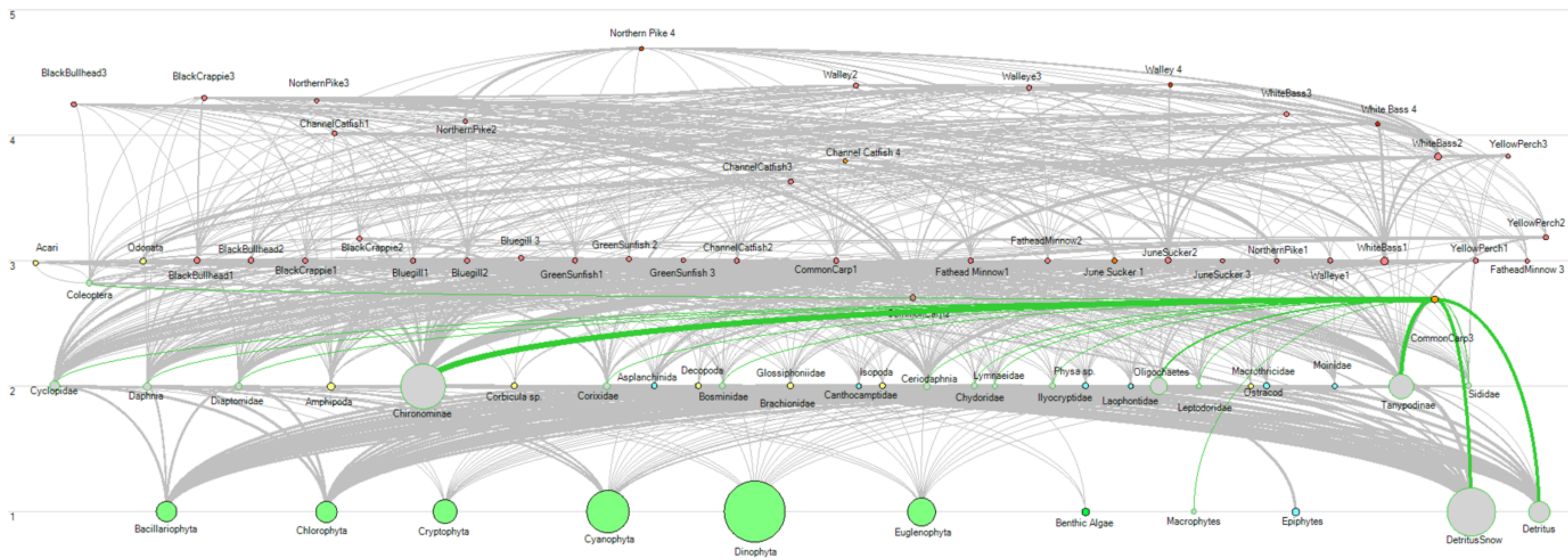


Figure 23. Production based trophic level flow diagram for large Common Carp (3). Size of circles equates to relative level of production.

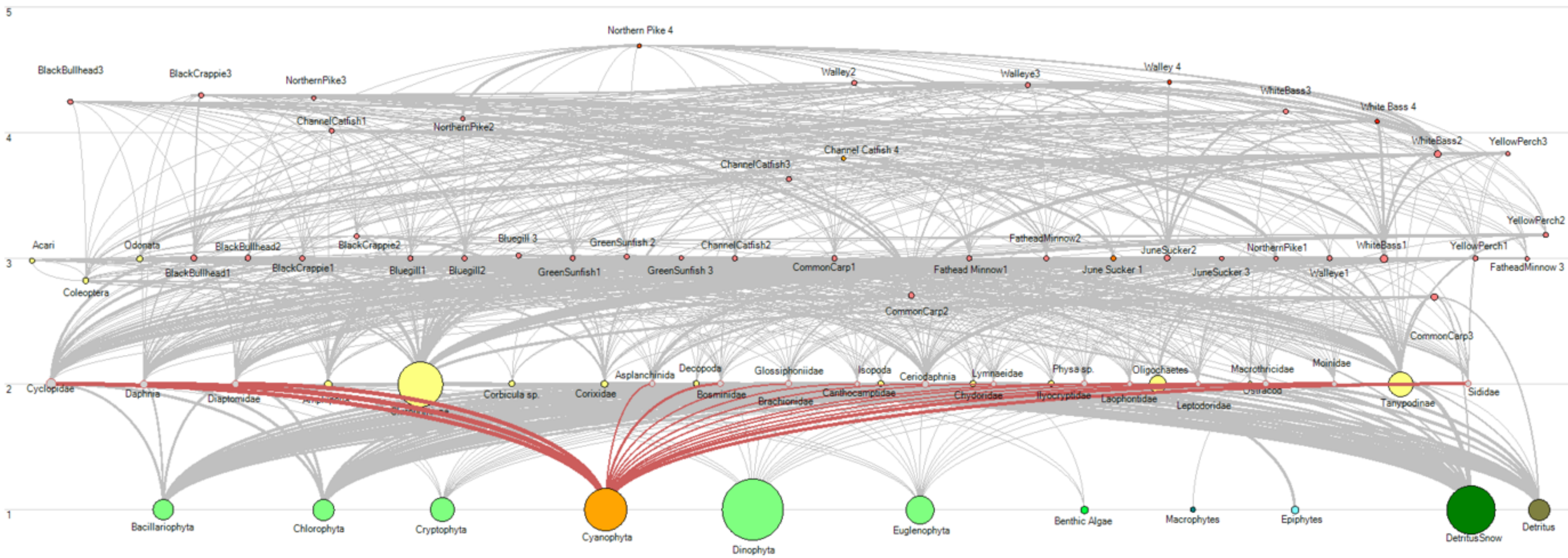


Figure 24. Production based trophic level flow diagram for Cyanophyta. Size of circles equates to relative level of production.

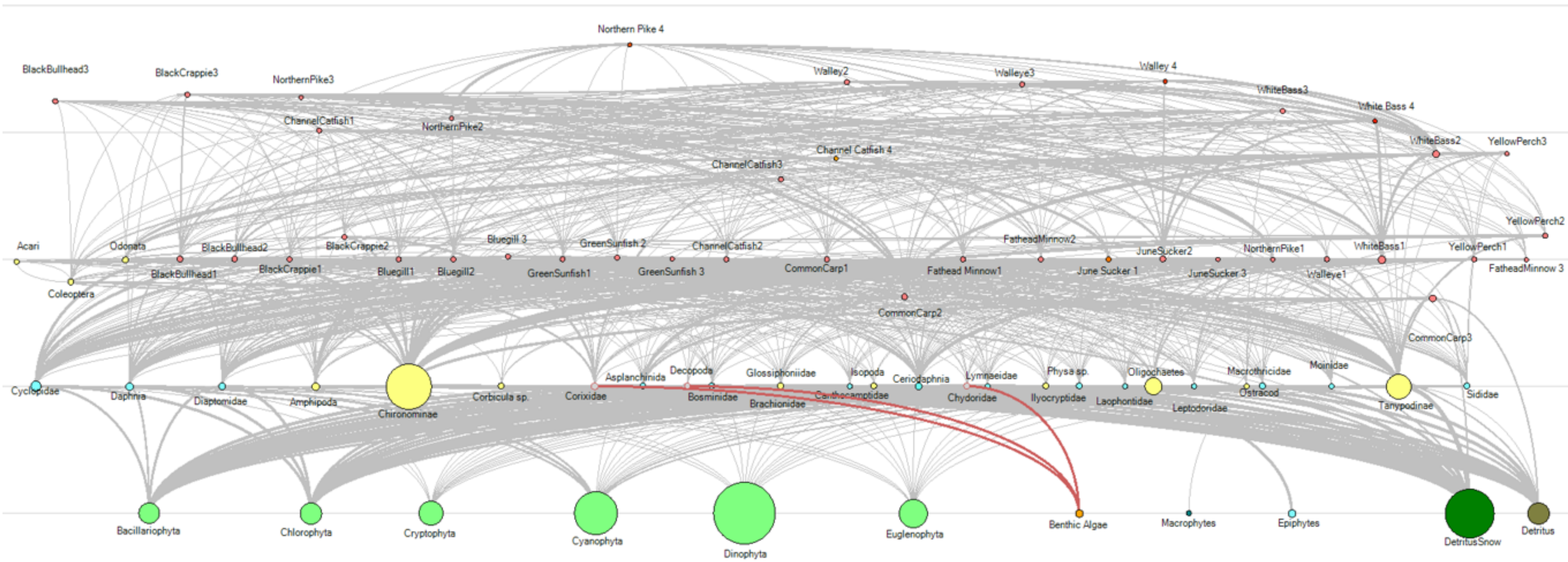


Figure 25. Production based trophic level flow diagram for benthic algae. Size of circles equates to relative level of production.

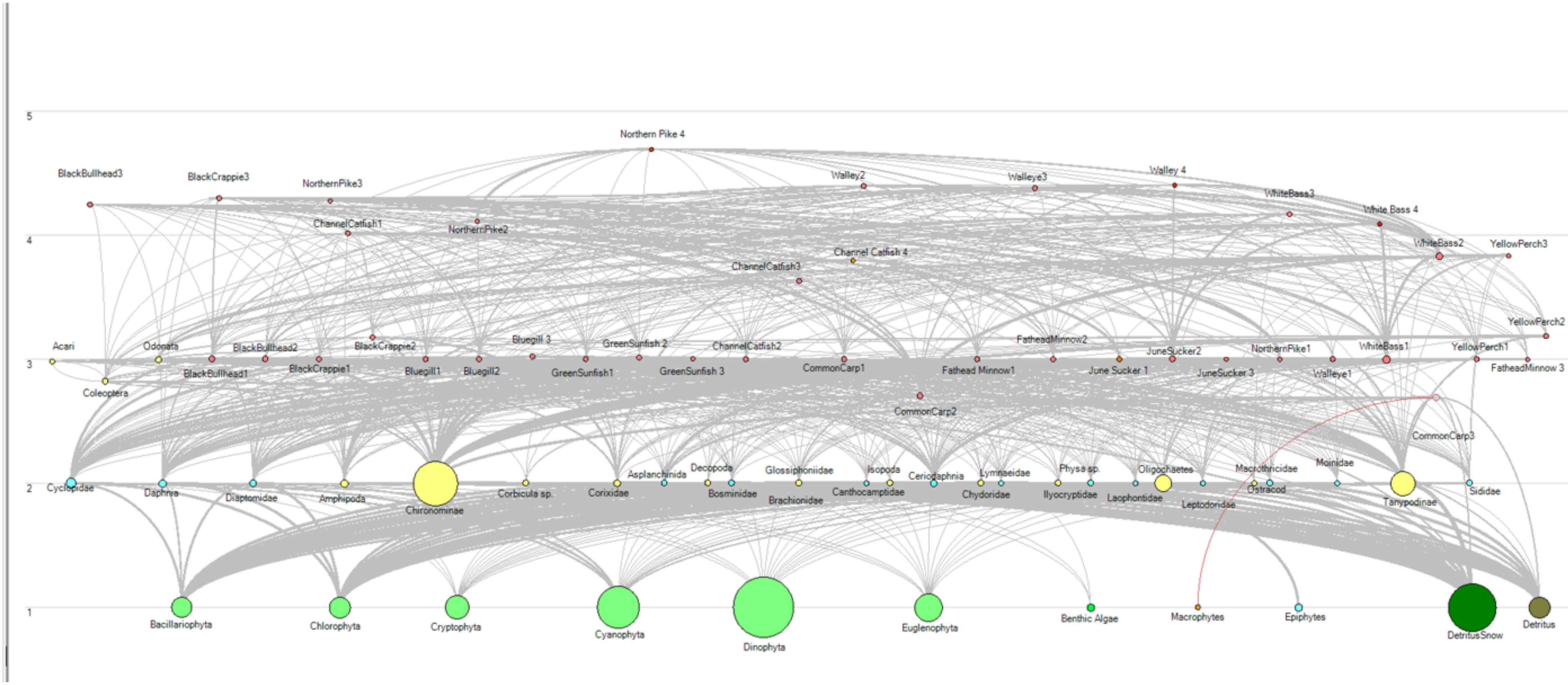


Figure 26. Production based trophic level flow diagram for macrophytes. Size of circles equates to relative level of production.

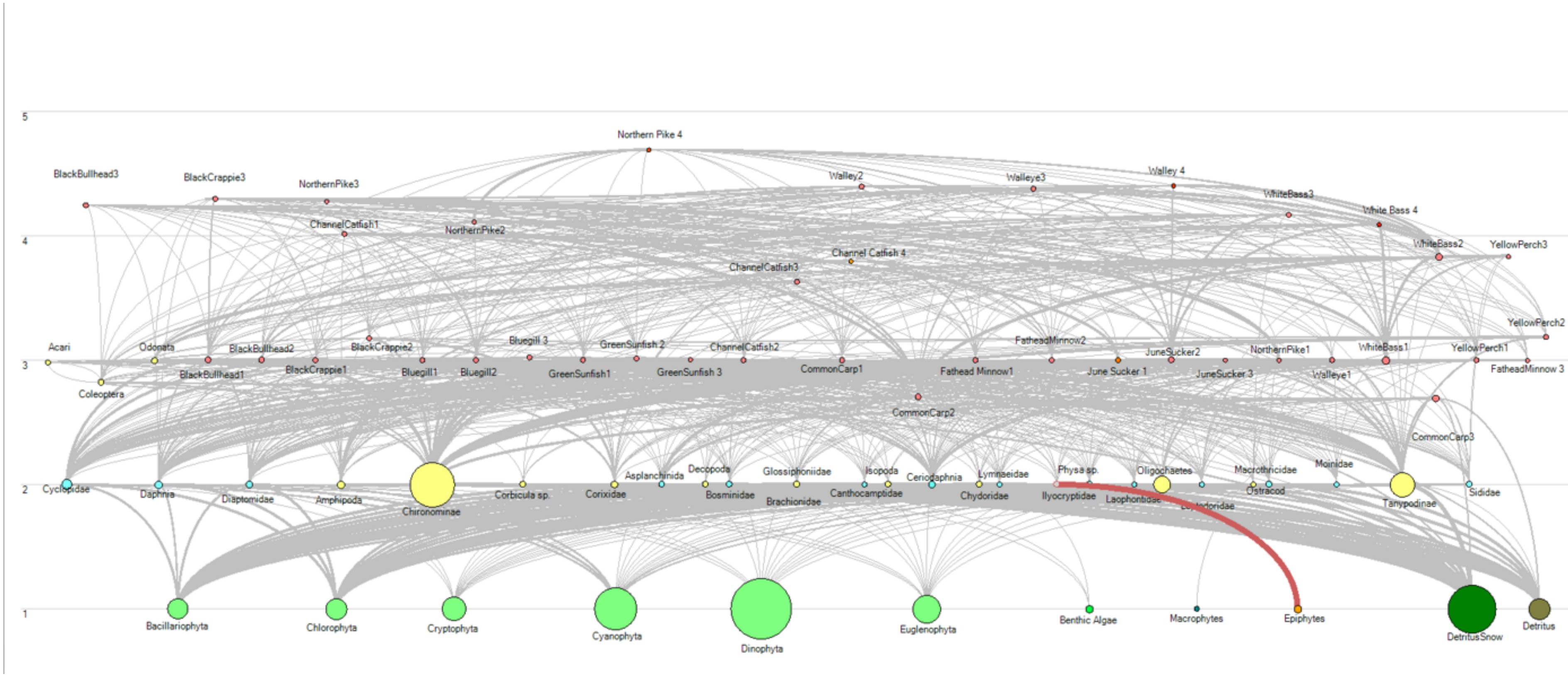


Figure 27. Production based trophic level flow diagram for epiphytes. Size of circles equates to relative level of production.

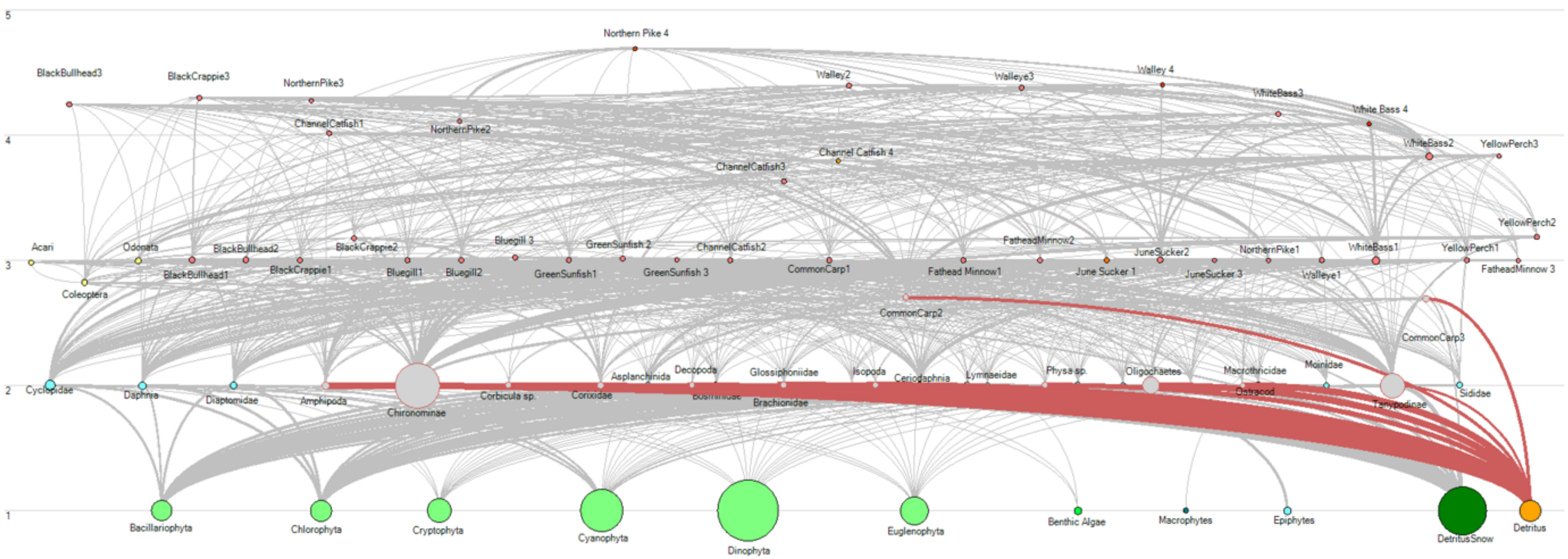


Figure 28. Production based trophic level flow diagram for detritus. Size of circles equates to relative level of production.

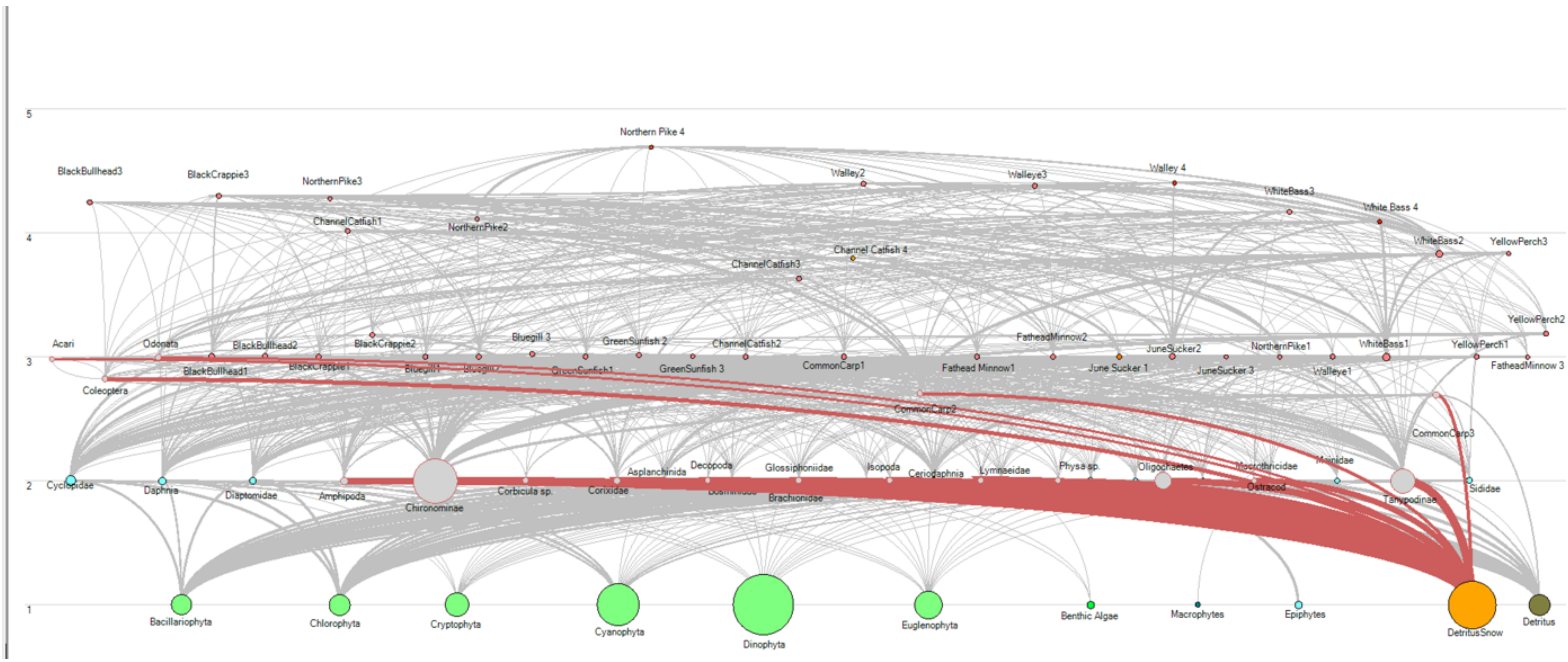


Figure 29. Production based trophic level flow diagram for detrital snow. Size of circles equates to relative level of production.

Prey Overlap

Table 6 shows proportion prey overlap. There was high overlap in prey for most taxa.

Table 6. Proportion Prey Overlap.

a. Asplanchnidae to Sididae

	Group name	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
10	Asplanchnidae	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
11	Bosminidae	0.956	1.000	0.956	0.956	0.956	0.956	0.982	0.886	0.982	0.956	0.956	0.956	0.970	0.988	0.988
12	Brachionidae	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
13	Canthocamptidae	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
14	Ceriodaphnia	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
15	Chydoridae	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
16	Cyclopidae	0.911	0.982	0.911	0.911	0.911	0.911	1.000	0.956	1.000	0.911	0.911	0.911	0.933	0.995	0.995
17	Daphnia	0.770	0.886	0.770	0.770	0.770	0.770	0.956	1.000	0.956	0.770	0.770	0.770	0.806	0.939	0.939
18	Diaptomidae	0.911	0.982	0.911	0.911	0.911	0.911	1.000	0.956	1.000	0.911	0.911	0.911	0.933	0.995	0.995
19	Ilyocryptidae	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
20	Laophontidae	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
21	Leptodoridae	1.000	0.956	1.000	1.000	1.000	1.000	0.911	0.770	0.911	1.000	1.000	1.000	0.995	0.922	0.922
22	Macrothricidae	0.995	0.970	0.995	0.995	0.995	0.995	0.933	0.806	0.933	0.995	0.995	0.995	1.000	0.948	0.948
23	Moinidae	0.922	0.988	0.922	0.922	0.922	0.922	0.995	0.939	0.995	0.922	0.922	0.922	0.948	1.000	1.000
24	Sididae	0.922	0.988	0.922	0.922	0.922	0.922	0.995	0.939	0.995	0.922	0.922	0.922	0.948	1.000	1.000

b. Acari to Tanypodinae

	Taxon	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
25	Acari	1.000	0.163	0.193	0.748	0.126	0.209	0.209	0.163	0.163	0.193	0.132	0.604	0.000	0.000	0.000
26	Amphipoda	0.163	1.000	0.758	0.299	0.980	0.938	0.938	1.000	1.000	0.682	0.714	0.162	0.000	0.000	0.000
27	Chironominae	0.193	0.758	1.000	0.358	0.627	0.891	0.891	0.758	0.758	0.988	0.517	0.192	0.000	0.000	0.000

28	Coleoptera	0.748	0.299	0.358	1.000	0.232	0.382	0.382	0.299	0.299	0.358	0.239	0.626	0.000	0.000	0.000
29	Corbicula sp.	0.126	0.980	0.627	0.232	1.000	0.857	0.857	0.980	0.980	0.537	0.698	0.126	0.000	0.000	0.000
30	Corixidae	0.209	0.938	0.891	0.382	0.857	1.000	1.000	0.938	0.938	0.859	0.675	0.208	0.000	0.000	0.000
31	Decopoda	0.209	0.938	0.891	0.382	0.857	1.000	1.000	0.938	0.938	0.859	0.675	0.208	0.000	0.000	0.000
32	Glossiphoniidae	0.163	1.000	0.758	0.299	0.980	0.938	0.938	1.000	1.000	0.682	0.714	0.162	0.000	0.000	0.000
33	Isopoda	0.163	1.000	0.758	0.299	0.980	0.938	0.938	1.000	1.000	0.682	0.714	0.162	0.000	0.000	0.000
34	Lymnaeidae	0.193	0.682	0.988	0.358	0.537	0.859	0.859	0.682	0.682	1.000	0.466	0.192	0.000	0.000	0.000
35	Physa sp.	0.132	0.714	0.517	0.239	0.698	0.675	0.675	0.714	0.714	0.466	1.000	0.131	0.000	0.000	0.000
36	Odonata	0.604	0.162	0.192	0.626	0.126	0.208	0.208	0.162	0.162	0.192	0.131	1.000	0.000	0.000	0.000
37	Oligochaetes	0.163	1.000	0.758	0.299	0.980	0.938	0.938	1.000	1.000	0.682	0.714	0.162	1.000	0.980	0.758
38	Ostracod	0.126	0.980	0.627	0.232	1.000	0.857	0.857	0.980	0.980	0.537	0.698	0.126	0.980	1.000	0.627
39	Tanypodinae	0.193	0.758	1.000	0.358	0.627	0.891	0.891	0.758	0.758	0.988	0.517	0.192	0.758	0.627	1.000
40	BlackBullhead1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
41	BlackBullhead2	0.410	0.000	0.000	0.467	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.274	0.000	0.000	0.000
42	BlackBullhead3	0.008	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000
43	BlackCrappie1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
44	BlackCrappie2	0.455	0.000	0.000	0.441	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.663	0.000	0.000	0.000
45	BlackCrappie3	0.016	0.000	0.000	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.000	0.000	0.000
46	Bluegill1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
47	Bluegill2	0.578	0.000	0.000	0.596	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.429	0.000	0.000	0.000
48	Bluegill 3	0.588	0.000	0.000	0.603	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.432	0.000	0.000	0.000
49	GreenSunfish1	0.427	0.000	0.000	0.519	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.000
50	GreenSunfish 2	0.458	0.000	0.000	0.515	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.315	0.000	0.000	0.000
51	GreenSunfish 3	0.437	0.000	0.000	0.499	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.309	0.000	0.000	0.000
52	ChannelCatfish1	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	> 0.001	0.000	0.000	0.000
53	ChannelCatfish2	0.164	0.000	0.000	0.152	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.244	0.000	0.000	0.000
54	ChannelCatfish3	0.257	0.000	0.000	0.273	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.219	0.000	0.000	0.000
55	Channel Catfish 4	0.101	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.296	0.000	0.000	0.000
56	CommonCarp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
57	CommonCarp2	0.581	0.388	0.274	0.662	0.378	0.368	0.368	0.388	0.388	0.247	0.294	0.412	0.388	0.378	0.274

58	CommonCarp3	0.596	0.407	0.284	0.708	0.396	0.387	0.387	0.407	0.407	0.255	0.312	0.467	0.407	0.396	0.284
59	Fathead Minnow1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
60	FatheadMinnow2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000
61	FatheadMinnow 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.140	0.000	0.000	0.000
62	June Sucker 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
63	JuneSucker2	0.401	0.000	0.000	0.458	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.268	0.000	0.000	0.000
64	JuneSucker 3	0.408	0.000	0.000	0.465	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.285	0.000	0.000	0.000
65	NorthernPike1	0.427	0.000	0.000	0.519	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.000
66	NorthernPike2	> 0.001	0.000	0.000	> 0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	> 0.001	0.000	0.000	0.000
67	NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	Walleye1	0.427	0.000	0.000	0.519	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.000
70	Walley2	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	> 0.001	0.000	0.000	0.000
71	Walleye3	> 0.001	0.000	0.000	> 0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	> 0.001	0.000	0.000	0.000
72	Walley 4	> 0.001	0.000	0.000	> 0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	> 0.001	0.000	0.000	0.000
73	WhiteBass1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
74	WhiteBass2	0.114	0.000	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000
75	WhiteBass3	0.010	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000
76	White Bass 4	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000
77	YellowPerch1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000
78	YellowPerch2	0.470	0.000	0.000	0.509	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.357	0.000	0.000	0.000
79	YellowPerch3	0.004	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000

C1. Black Bullhead to Yellow Perch

	Taxon	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41
41	BlackBullhead2	0.410	0.000	0.000	0.467	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.274	0.000	0.000	0.000	0.007	1.000
42	BlackBullhead3	0.008	0.000	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.000	0.000	0.000	0.009
43	BlackCrappie1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	1.000	0.007
44	BlackCrappie2	0.455	0.000	0.000	0.441	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.663	0.000	0.000	0.000	0.019	0.669
45	BlackCrappie3	0.016	0.000	0.000	0.016	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.017	0.000	0.000	0.000	0.000	0.016

46	Bluegill1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	1.000	0.007
47	Bluegill2	0.578	0.000	0.000	0.596	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.429	0.000	0.000	0.000	0.022	0.822
48	Bluegill 3	0.588	0.000	0.000	0.603	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.432	0.000	0.000	0.000	0.004	0.822
49	GreenSunfish1	0.427	0.000	0.000	0.519	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.000	0.000	0.984
50	GreenSunfish 2	0.458	0.000	0.000	0.515	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.315	0.000	0.000	0.000	0.001	0.987
51	GreenSunfish 3	0.437	0.000	0.000	0.499	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.309	0.000	0.000	0.000	0.001	0.997
52	ChannelCatfish1	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.002
53	ChannelCatfish2	0.164	0.000	0.000	0.152	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.244	0.000	0.000	0.000	0.757	0.011
54	ChannelCatfish3	0.257	0.000	0.000	0.273	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.219	0.000	0.000	0.000	0.004	0.205
55	Channel Catfish 4	0.101	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.296	0.000	0.000	0.000	0.000	0.005
56	CommonCarp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	1.000	0.007
57	CommonCarp2	0.581	0.388	0.274	0.662	0.378	0.368	0.368	0.388	0.388	0.247	0.294	0.412	0.388	0.378	0.274	0.057	0.831
58	CommonCarp3	0.596	0.407	0.284	0.708	0.396	0.387	0.387	0.407	0.407	0.255	0.312	0.467	0.407	0.396	0.284	0.010	0.791
59	Fathead Minnow1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	1.000	0.007
60	FatheadMinnow2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.032	0.000	0.000	0.000	0.314	0.002
61	FatheadMinnow 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.140	0.000	0.000	0.000	0.440	0.004
62	June Sucker 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	1.000	0.007
63	JuneSucker2	0.401	0.000	0.000	0.458	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.268	0.000	0.000	0.000	0.004	1.000
64	JuneSucker 3	0.408	0.000	0.000	0.465	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.285	0.000	0.000	0.000	0.004	0.999
65	NorthernPike1	0.427	0.000	0.000	0.519	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.000	0.000	0.984
66	NorthernPike2	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000
67	NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	Walleye1	0.427	0.000	0.000	0.519	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.320	0.000	0.000	0.000	0.000	0.984
70	Walley2	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.002
71	Walleye3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	WhiteBass1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	1.000	0.007
74	WhiteBass2	0.114	0.000	0.000	0.062	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.125	0.000	0.000	0.000	0.006	0.096
75	WhiteBass3	0.010	0.000	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.015

76	White Bass 4	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.004
77	YellowPerch1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.061	0.000	0.000	0.000	1.000	0.007
78	YellowPerch2	0.470	0.000	0.000	0.509	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.357	0.000	0.000	0.000	0.019	0.938
79	YellowPerch3	0.004	0.000	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.007

C2.

		42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
41	BlackBullhead2	0.009	0.007	0.669	0.016	0.007	0.822	0.822	0.984	0.987	0.997	0.002	0.011	0.205	0.005	0.007	0.831
42	BlackBullhead3	1.000	0.000	0.010	0.526	0.000	0.010	0.010	0.010	0.010	0.010	0.352	0.001	0.077	0.022	0.000	0.010
43	BlackCrappie1	0.000	1.000	0.019	0.000	1.000	0.022	0.004	0.000	0.001	0.001	0.000	0.757	0.004	0.000	1.000	0.057
44	BlackCrappie2	0.010	0.019	1.000	0.023	0.019	0.652	0.663	0.685	0.696	0.696	0.002	0.052	0.343	0.427	0.019	0.664
45	BlackCrappie3	0.526	0.000	0.023	1.000	0.000	0.021	0.022	0.016	0.018	0.017	0.336	0.008	0.099	0.047	0.000	0.017
46	Bluegill1	0.000	1.000	0.019	0.000	1.000	0.022	0.004	0.000	0.001	0.001	0.000	0.757	0.004	0.000	1.000	0.057
47	Bluegill2	0.010	0.022	0.652	0.021	0.022	1.000	0.999	0.824	0.895	0.855	0.002	0.274	0.422	0.004	0.022	0.785
48	Bluegill 3	0.010	0.004	0.663	0.022	0.004	0.999	1.000	0.825	0.895	0.855	0.002	0.260	0.445	0.030	0.004	0.789
49	GreenSunfish1	0.010	0.000	0.685	0.016	0.000	0.824	0.825	1.000	0.978	0.990	0.002	0.002	0.209	0.007	0.000	0.844
50	GreenSunfish 2	0.010	0.001	0.696	0.018	0.001	0.895	0.895	0.978	1.000	0.995	0.002	0.068	0.282	0.017	0.001	0.845
51	GreenSunfish 3	0.010	0.001	0.696	0.017	0.001	0.855	0.855	0.990	0.995	1.000	0.002	0.028	0.232	0.013	0.001	0.845
52	ChannelCatfish1	0.352	0.000	0.002	0.336	0.000	0.002	0.002	0.002	0.002	0.002	1.000	0.000	0.008	0.000	0.000	0.002
53	ChannelCatfish2	0.001	0.757	0.052	0.008	0.757	0.274	0.260	0.002	0.068	0.028	0.000	1.000	0.286	0.000	0.757	0.036
54	ChannelCatfish3	0.077	0.004	0.343	0.099	0.004	0.422	0.445	0.209	0.282	0.232	0.008	0.286	1.000	0.569	0.004	0.198
55	Channel Catfish 4	0.022	0.000	0.427	0.047	0.000	0.004	0.030	0.007	0.017	0.013	0.000	0.000	0.569	1.000	0.000	0.007
56	CommonCarp1	0.000	1.000	0.019	0.000	1.000	0.022	0.004	0.000	0.001	0.001	0.000	0.757	0.004	0.000	1.000	0.057
57	CommonCarp2	0.010	0.057	0.664	0.017	0.057	0.785	0.789	0.844	0.845	0.845	0.002	0.036	0.198	0.007	0.057	1.000
58	CommonCarp3	0.010	0.010	0.664	0.017	0.010	0.759	0.765	0.825	0.808	0.811	0.002	0.009	0.197	0.015	0.010	0.988
59	Fathead Minnow1	0.000	1.000	0.019	0.000	1.000	0.022	0.004	0.000	0.001	0.001	0.000	0.757	0.004	0.000	1.000	0.057
60	FatheadMinnow2	0.000	0.314	0.005	0.000	0.314	0.006	0.002	0.000	0.000	0.000	0.000	0.282	0.001	0.000	0.314	0.013
61	FatheadMinnow 3	0.000	0.440	0.011	0.000	0.440	0.012	0.006	0.000	0.000	0.001	0.000	0.496	0.000	0.000	0.440	0.013
62	June Sucker 1	0.000	1.000	0.019	0.000	1.000	0.022	0.004	0.000	0.001	0.001	0.000	0.757	0.004	0.000	1.000	0.057
63	JuneSucker2	0.009	0.004	0.662	0.015	0.004	0.811	0.811	0.982	0.984	0.995	0.002	0.004	0.198	0.005	0.004	0.824

64	JuneSucker 3	0.009	0.004	0.685	0.016	0.004	0.816	0.816	0.984	0.986	0.996	0.002	0.003	0.200	0.015	0.004	0.831
65	NorthernPike1	0.010	0.000	0.685	0.016	0.000	0.824	0.825	1.000	0.978	0.990	0.002	0.002	0.209	0.007	0.000	0.844
66	NorthernPike2	0.045	0.000	0.000	0.037	0.000	0.000	0.000	0.000	0.000	0.000	0.097	0.000	0.039	0.001	0.000	0.000
67	NorthernPike3	0.390	0.000	0.000	0.508	0.000	0.000	0.000	0.000	0.000	0.000	0.338	0.000	0.008	0.000	0.000	0.000
68	Northern Pike 4	0.112	0.000	0.000	0.126	0.000	0.000	0.000	0.000	0.000	0.000	0.115	0.000	0.004	0.000	0.000	0.000
69	Walleye1	0.010	0.000	0.685	0.016	0.000	0.824	0.825	1.000	0.978	0.990	0.002	0.002	0.209	0.007	0.000	0.844
70	Walley2	0.363	0.000	0.002	0.499	0.000	0.002	0.002	0.002	0.002	0.002	0.181	0.000	0.063	0.003	0.000	0.002
71	Walleye3	0.350	0.000	0.000	0.348	0.000	0.000	0.000	0.000	0.000	0.000	0.248	0.000	0.038	0.002	0.000	0.000
72	Walley 4	0.387	0.000	0.000	0.417	0.000	0.000	0.000	0.000	0.000	0.000	0.346	0.000	0.015	0.000	0.000	0.000
73	WhiteBass1	0.000	1.000	0.019	0.000	1.000	0.022	0.004	0.000	0.001	0.001	0.000	0.757	0.004	0.000	1.000	0.057
74	WhiteBass2	0.163	0.006	0.165	0.427	0.006	0.090	0.090	0.099	0.099	0.101	0.111	0.005	0.064	0.091	0.006	0.096
75	WhiteBass3	0.177	0.000	0.017	0.365	0.000	0.015	0.015	0.016	0.016	0.016	0.139	0.001	0.070	0.009	0.000	0.016
76	White Bass 4	0.228	0.000	0.004	0.424	0.000	0.004	0.004	0.004	0.004	0.004	0.159	0.000	0.005	0.006	0.000	0.004
77	YellowPerch1	0.000	1.000	0.019	0.000	1.000	0.022	0.004	0.000	0.001	0.001	0.000	0.757	0.004	0.000	1.000	0.057
78	YellowPerch2	0.011	0.019	0.802	0.021	0.019	0.818	0.829	0.942	0.947	0.948	0.002	0.012	0.371	0.223	0.019	0.854
79	YellowPerch3	0.504	0.000	0.006	0.510	0.000	0.007	0.007	0.007	0.008	0.007	0.577	0.001	0.014	0.017	0.000	0.007

C3.

		58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
41	BlackBullhead2	0.791	0.007	0.002	0.004	0.007	1.000	0.999	0.984	0.000	0.000	0.000	0.984	0.002	0.000	0.000	0.007	0.096	0.015	0.004	0.007	0.938	0.007
42	BlackBullhead3	0.010	0.000	0.000	0.000	0.000	0.009	0.009	0.010	0.045	0.390	0.112	0.010	0.363	0.350	0.387	0.000	0.163	0.177	0.228	0.000	0.011	0.504
43	BlackCrappie1	0.010	1.000	0.314	0.440	1.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.006	0.000	0.000	1.000	0.019	0.000
44	BlackCrappie2	0.664	0.019	0.005	0.011	0.019	0.662	0.685	0.685	0.000	0.000	0.000	0.685	0.002	0.000	0.000	0.019	0.165	0.017	0.004	0.019	0.802	0.006
45	BlackCrappie3	0.017	0.000	0.000	0.000	0.000	0.015	0.016	0.016	0.037	0.508	0.126	0.016	0.499	0.348	0.417	0.000	0.427	0.365	0.424	0.000	0.021	0.510
46	Bluegill1	0.010	1.000	0.314	0.440	1.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.006	0.000	0.000	1.000	0.019	0.000
47	Bluegill2	0.759	0.022	0.006	0.012	0.022	0.811	0.816	0.824	0.000	0.000	0.000	0.824	0.002	0.000	0.000	0.022	0.090	0.015	0.004	0.022	0.818	0.007
48	Bluegill 3	0.765	0.004	0.002	0.006	0.004	0.811	0.816	0.825	0.000	0.000	0.000	0.825	0.002	0.000	0.000	0.004	0.090	0.015	0.004	0.004	0.829	0.007
49	GreenSunfish1	0.825	0.000	0.000	0.000	0.000	0.982	0.984	1.000	0.000	0.000	0.000	1.000	0.002	0.000	0.000	0.000	0.099	0.016	0.004	0.000	0.942	0.007
50	GreenSunfish 2	0.808	0.001	0.000	0.000	0.001	0.984	0.986	0.978	0.000	0.000	0.000	0.978	0.002	0.000	0.000	0.001	0.099	0.016	0.004	0.001	0.947	0.008
51	GreenSunfish 3	0.811	0.001	0.000	0.001	0.001	0.995	0.996	0.990	0.000	0.000	0.000	0.990	0.002	0.000	0.000	0.001	0.101	0.016	0.004	0.001	0.948	0.007

52	ChannelCatfish1	0.002	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.097	0.338	0.115	0.002	0.181	0.248	0.346	0.000	0.111	0.139	0.159	0.000	0.002	0.577
53	ChannelCatfish2	0.009	0.757	0.282	0.496	0.757	0.004	0.003	0.002	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.757	0.005	0.001	0.000	0.757	0.012	0.001
54	ChannelCatfish3	0.197	0.004	0.001	0.000	0.004	0.198	0.200	0.209	0.039	0.008	0.004	0.209	0.063	0.038	0.015	0.004	0.064	0.070	0.005	0.004	0.371	0.014
55	Channel Catfish 4	0.015	0.000	0.000	0.000	0.000	0.005	0.015	0.007	0.001	0.000	0.000	0.007	0.003	0.002	0.000	0.000	0.091	0.009	0.006	0.000	0.223	0.017
56	CommonCarp1	0.010	1.000	0.314	0.440	1.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.006	0.000	0.000	1.000	0.019	0.000
57	CommonCarp2	0.988	0.057	0.013	0.013	0.057	0.824	0.831	0.844	0.000	0.000	0.000	0.844	0.002	0.000	0.000	0.057	0.096	0.016	0.004	0.057	0.854	0.007
58	CommonCarp3	1.000	0.010	0.003	0.011	0.010	0.783	0.791	0.825	0.000	0.000	0.000	0.825	0.002	0.000	0.000	0.010	0.097	0.016	0.003	0.010	0.825	0.006
59	Fathead Minnow1	0.010	1.000	0.314	0.440	1.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.006	0.000	0.000	1.000	0.019	0.000
60	FatheadMinnow2	0.003	0.314	1.000	0.663	0.314	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.314	0.002	0.000	0.000	0.314	0.004	0.000
61	FatheadMinnow 3	0.011	0.440	0.663	1.000	0.440	0.006	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.440	0.003	0.000	0.000	0.440	0.003	0.000
62	June Sucker 1	0.010	1.000	0.314	0.440	1.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.006	0.000	0.000	1.000	0.019	0.000
63	JuneSucker2	0.783	0.004	0.002	0.006	0.004	1.000	0.999	0.982	0.000	0.000	0.000	0.982	0.002	0.000	0.000	0.004	0.096	0.015	0.004	0.004	0.933	0.007
64	JuneSucker 3	0.791	0.004	0.002	0.005	0.004	0.999	1.000	0.984	0.000	0.000	0.000	0.984	0.002	0.000	0.000	0.004	0.100	0.015	0.004	0.004	0.940	0.007
65	NorthernPike1	0.825	0.000	0.000	0.000	0.000	0.982	0.984	1.000	0.000	0.000	0.000	1.000	0.002	0.000	0.000	0.000	0.099	0.016	0.004	0.000	0.942	0.007
66	NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.334	0.315	0.000	0.018	0.026	0.034	0.000	0.014	0.018	0.017	0.000	0.000	0.058
67	NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.334	1.000	0.375	0.000	0.313	0.387	0.446	0.000	0.512	0.560	0.676	0.000	0.000	0.522
68	Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.315	0.375	1.000	0.000	0.321	0.388	0.400	0.000	0.045	0.298	0.268	0.000	0.000	0.045
69	Walleye1	0.825	0.000	0.000	0.000	0.000	0.982	0.984	1.000	0.000	0.000	0.000	1.000	0.002	0.000	0.000	0.000	0.099	0.016	0.004	0.000	0.942	0.007
70	Walley2	0.002	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.018	0.313	0.321	0.002	1.000	0.860	0.854	0.000	0.255	0.376	0.414	0.000	0.002	0.082
71	Walleye3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.387	0.388	0.000	0.860	1.000	0.950	0.000	0.092	0.606	0.450	0.000	0.000	0.120
72	Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.034	0.446	0.400	0.000	0.854	0.950	1.000	0.000	0.109	0.534	0.499	0.000	0.000	0.277
73	WhiteBass1	0.010	1.000	0.314	0.440	1.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.006	0.000	0.000	1.000	0.019	0.000
74	WhiteBass2	0.097	0.006	0.002	0.003	0.006	0.096	0.100	0.099	0.014	0.512	0.045	0.099	0.255	0.092	0.109	0.006	1.000	0.379	0.730	0.006	0.116	0.294
75	WhiteBass3	0.016	0.000	0.000	0.000	0.000	0.015	0.015	0.016	0.018	0.560	0.298	0.016	0.376	0.606	0.534	0.000	0.379	1.000	0.738	0.000	0.017	0.200
76	White Bass 4	0.003	0.000	0.000	0.000	0.000	0.004	0.004	0.004	0.017	0.676	0.268	0.004	0.414	0.450	0.499	0.000	0.730	0.738	1.000	0.000	0.005	0.388
77	YellowPerch1	0.010	1.000	0.314	0.440	1.000	0.004	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.006	0.000	0.000	1.000	0.019	0.000
78	YellowPerch2	0.825	0.019	0.004	0.003	0.019	0.933	0.940	0.942	0.000	0.000	0.000	0.942	0.002	0.000	0.000	0.019	0.116	0.017	0.005	0.019	1.000	0.008
79	YellowPerch3	0.006	0.000	0.000	0.000	0.000	0.007	0.007	0.007	0.058	0.522	0.045	0.007	0.082	0.120	0.277	0.000	0.294	0.200	0.388	0.000	0.008	1.000

Predator Overlap

Table 7 shows proportion predator overlap.

Table 7. Proportion Predator Overlap.

	Taxon	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	Bacillariophyta	1.000	0.958	0.968	0.726	0.968	0.647	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	Chlorophyta	0.958	1.000	0.998	0.873	0.998	0.717	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	Cryptophyta	0.968	0.998	1.000	0.864	1.000	0.738	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	Cyanophyta	0.726	0.873	0.864	1.000	0.864	0.781	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	Dinophyta	0.968	0.998	1.000	0.864	1.000	0.738	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	Euglenophyta	0.647	0.717	0.738	0.781	0.738	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	Benthic Algae	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	Macrophytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.063	0.000	0.000	0.039	0.046	0.018	0.112	0.026	0.000	0.000
9	Epiphytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	Asplanchinida	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.537	1.000	0.545	0.615	0.542	0.559	0.564	0.544	0.545	0.545
11	Bosminidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.063	0.000	0.537	1.000	0.533	0.989	0.991	0.997	0.979	0.944	0.994	0.989	0.989
12	Brachionidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.533	1.000	0.540	0.611	0.538	0.555	0.560	0.539	0.540	0.540
13	Canthocamptidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.545	0.989	0.540	1.000	0.986	0.997	0.981	0.922	0.999	1.000	1.000
14	Ceriodaphnia	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.039	0.000	0.615	0.991	0.611	0.986	1.000	0.991	0.976	0.951	0.990	0.986	0.986
15	Chydoridae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.542	0.997	0.538	0.997	0.991	1.000	0.982	0.938	0.999	0.997	0.997
16	Cyclopidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.018	0.000	0.559	0.979	0.555	0.981	0.976	0.982	1.000	0.916	0.981	0.981	0.981
17	Daphnia	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.112	0.000	0.564	0.944	0.560	0.922	0.951	0.938	0.916	1.000	0.932	0.922	0.922
18	Diaptomidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.026	0.000	0.544	0.994	0.539	0.999	0.990	0.999	0.981	0.932	1.000	0.999	0.999
19	Ilyocryptidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.545	0.989	0.540	1.000	0.986	0.997	0.981	0.922	0.999	1.000	1.000
20	Laophontidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.545	0.989	0.540	1.000	0.986	0.997	0.981	0.922	0.999	1.000	1.000
21	Leptodoridae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.080	0.000	0.510	0.964	0.505	0.942	0.958	0.954	0.934	0.926	0.954	0.942	0.942
22	Macrothricidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.545	0.989	0.540	1.000	0.986	0.997	0.981	0.922	0.999	1.000	1.000
23	Moinidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.545	0.989	0.540	1.000	0.986	0.997	0.981	0.922	0.999	1.000	1.000

24	Sididae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.000	0.531	0.983	0.526	0.978	0.977	0.980	0.963	0.923	0.983	0.978	0.978
25	Acari	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.160	0.000	0.000	0.000
26	Amphipoda	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.095	0.179	0.094	0.176	0.183	0.176	0.095	0.259	0.180	0.176	0.176
27	Chironominae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.729	0.000	0.000	0.101	0.000	0.000	0.061	0.062	0.034	0.169	0.036	0.000	0.000
28	Coleoptera	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.115	0.000	0.000	0.014	0.000	0.000	0.010	0.009	0.008	0.225	0.006	0.000	0.000
29	Corbicula sp.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.004	0.005	0.001	0.000	0.000
30	Corixidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.337	0.000	0.000	0.037	0.000	0.000	0.025	0.026	0.013	0.266	0.015	0.000	0.000
31	Decopoda	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.002	0.000	0.004	0.005	0.001	0.000	0.000
32	Glossiphoniidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	Isopoda	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.157	0.000	0.000	0.000
34	Lymnaeidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.984	0.000	0.000	0.073	0.000	0.000	0.045	0.053	0.023	0.126	0.028	0.000	0.000
35	Physa sp.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.577	0.000	0.000	0.053	0.000	0.000	0.032	0.038	0.017	0.093	0.020	0.000	0.000
36	Odonata	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.001	0.000	0.004	0.003	0.001	0.000	0.000
37	Oligochaetes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.900	0.000	0.000	0.074	0.000	0.000	0.047	0.054	0.021	0.180	0.030	0.000	0.000
38	Ostracod	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.177	0.000	0.000	0.000
39	Tanypodinae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.805	0.000	0.000	0.099	0.000	0.000	0.059	0.064	0.034	0.174	0.035	0.000	0.000
40	BlackBullhead1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.002	0.003	0.001	0.000	0.000
41	BlackBullhead2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
42	BlackBullhead3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	BlackCrappie1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.002	0.001	0.000	0.000
44	BlackCrappie2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
45	BlackCrappie3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	Bluegill1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.005	0.001	0.000	0.000
47	Bluegill2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
48	Bluegill 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	GreenSunfish1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.003	0.004	0.001	0.000	0.000
50	GreenSunfish 2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
51	GreenSunfish 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	ChannelCatfish1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
53	ChannelCatfish2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.005	0.001	0.000	0.000

54	ChannelCatfish3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
55	Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	CommonCarp1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.001	0.000	0.003	0.003	0.001	0.000	0.000
57	CommonCarp2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
58	CommonCarp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	Fathead Minnow1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
60	FatheadMinnow2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.005	0.001	0.000	0.000
61	FatheadMinnow 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
62	June Sucker 1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.003	0.001	0.000	0.000
63	JuneSucker2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
64	JuneSucker 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	Walleye1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
70	Walley2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.002	0.001	0.000	0.000
71	Walleye3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	WhiteBass1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.004	0.006	0.001	0.000	0.000
74	WhiteBass2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
75	WhiteBass3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
77	YellowPerch1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.003	0.001	0.000	0.000
78	YellowPerch2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
79	YellowPerch3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Taxon	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	Bacillariophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	Chlorophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	Cryptophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	Cyanophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	Dinophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	Euglenophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	Benthic Algae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	Macrophytes	0.080	0.000	0.000	0.015	0.000	0.000	0.729	0.115	0.000	0.337	0.000	0.000	0.000	0.984	0.577	0.000	0.900	0.000	0.805	0.000
9	Epiphytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	Asplanchinida	0.510	0.545	0.545	0.531	0.000	0.095	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	Bosminidae	0.964	0.989	0.989	0.983	0.000	0.179	0.101	0.014	0.000	0.037	0.001	0.000	0.000	0.073	0.053	0.003	0.074	0.000	0.099	0.001
12	Brachionidae	0.505	0.540	0.540	0.526	0.000	0.094	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	Canthocamptidae	0.942	1.000	1.000	0.978	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	Ceriodaphnia	0.958	0.986	0.986	0.977	0.000	0.183	0.061	0.010	0.001	0.025	0.002	0.000	0.000	0.045	0.032	0.001	0.047	0.000	0.059	0.001
15	Chydoridae	0.954	0.997	0.997	0.980	0.000	0.176	0.062	0.009	0.000	0.026	0.000	0.000	0.000	0.053	0.038	0.000	0.054	0.000	0.064	0.000
16	Cyclopidae	0.934	0.981	0.981	0.963	0.000	0.095	0.034	0.008	0.004	0.013	0.004	0.000	0.000	0.023	0.017	0.004	0.021	0.000	0.034	0.002
17	Daphnia	0.926	0.922	0.922	0.923	0.160	0.259	0.169	0.225	0.005	0.266	0.005	0.000	0.157	0.126	0.093	0.003	0.180	0.177	0.174	0.003
18	Diaptomidae	0.954	0.999	0.999	0.983	0.000	0.180	0.036	0.006	0.001	0.015	0.001	0.000	0.000	0.028	0.020	0.001	0.030	0.000	0.035	0.001
19	Ilyocryptidae	0.942	1.000	1.000	0.978	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	Laophontidae	0.942	1.000	1.000	0.978	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	Leptodoridae	1.000	0.942	0.942	0.982	0.000	0.179	0.171	0.074	0.067	0.079	0.071	0.000	0.000	0.089	0.065	0.031	0.097	0.000	0.145	0.042
22	Macrothricidae	0.942	1.000	1.000	0.978	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	Moinidae	0.942	1.000	1.000	0.978	0.000	0.176	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	Sididae	0.982	0.978	0.978	1.000	0.001	0.190	0.070	0.003	0.000	0.008	0.000	0.000	0.000	0.017	0.012	0.000	0.017	0.000	0.051	0.000
25	Acari	0.000	0.000	0.000	0.001	1.000	0.423	0.063	0.538	0.000	0.525	0.000	0.652	0.997	0.002	0.549	0.006	0.279	0.659	0.084	0.000
26	Amphipoda	0.179	0.176	0.176	0.190	0.423	1.000	0.113	0.244	0.003	0.244	0.043	0.212	0.377	0.012	0.220	0.210	0.105	0.216	0.114	0.051
27	Chironominae	0.171	0.000	0.000	0.070	0.063	0.113	1.000	0.178	0.016	0.425	0.018	0.045	0.057	0.802	0.602	0.048	0.848	0.023	0.985	0.011
28	Coleoptera	0.074	0.000	0.000	0.003	0.538	0.244	0.178	1.000	0.452	0.914	0.464	0.000	0.535	0.127	0.087	0.138	0.277	0.657	0.194	0.235

29	Corbicula sp.	0.067	0.000	0.000	0.000	0.000	0.003	0.016	0.452	1.000	0.219	0.952	0.000	0.002	0.004	0.002	0.000	0.000	0.000	0.008	0.349
30	Corixidae	0.079	0.000	0.000	0.008	0.525	0.244	0.425	0.914	0.219	1.000	0.226	0.000	0.521	0.364	0.252	0.160	0.525	0.638	0.452	0.117
31	Decopoda	0.071	0.000	0.000	0.000	0.000	0.043	0.018	0.464	0.952	0.226	1.000	0.000	0.000	0.000	0.000	0.207	0.000	0.000	0.008	0.421
32	Glossiphoniidae	0.000	0.000	0.000	0.000	0.652	0.212	0.045	0.000	0.000	0.000	0.000	1.000	0.662	0.000	0.717	0.000	0.186	0.000	0.047	0.000
33	Isopoda	0.000	0.000	0.000	0.000	0.997	0.377	0.057	0.535	0.002	0.521	0.000	0.662	1.000	0.002	0.550	0.000	0.279	0.668	0.077	0.000
34	Lymnaeidae	0.089	0.000	0.000	0.017	0.002	0.012	0.802	0.127	0.004	0.364	0.000	0.000	0.002	1.000	0.609	0.003	0.934	0.000	0.876	0.000
35	Physa sp.	0.065	0.000	0.000	0.012	0.549	0.220	0.602	0.087	0.002	0.252	0.000	0.717	0.550	0.609	1.000	0.002	0.753	0.000	0.640	0.000
36	Odonata	0.031	0.000	0.000	0.000	0.006	0.210	0.048	0.138	0.000	0.160	0.207	0.000	0.000	0.003	0.002	1.000	0.000	0.000	0.028	0.206
37	Oligochaetes	0.097	0.000	0.000	0.017	0.279	0.105	0.848	0.277	0.000	0.525	0.000	0.186	0.279	0.934	0.753	0.000	1.000	0.188	0.911	0.000
38	Ostracod	0.000	0.000	0.000	0.000	0.659	0.216	0.023	0.657	0.000	0.638	0.000	0.000	0.668	0.000	0.000	0.000	0.188	1.000	0.048	0.003
39	Tanypodinae	0.145	0.000	0.000	0.051	0.084	0.114	0.985	0.194	0.008	0.452	0.008	0.047	0.077	0.876	0.640	0.028	0.911	0.048	1.000	0.005
40	BlackBullhead1	0.042	0.000	0.000	0.000	0.000	0.051	0.011	0.235	0.349	0.117	0.421	0.000	0.000	0.000	0.000	0.206	0.000	0.003	0.005	1.000
41	BlackBullhead2	0.000	0.000	0.000	0.000	0.000	0.011	0.003	0.003	0.000	0.009	0.016	0.000	0.000	0.000	0.000	0.057	0.000	0.010	0.001	0.079
42	BlackBullhead3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	BlackCrappie1	0.033	0.000	0.000	0.000	0.000	0.001	0.008	0.205	0.366	0.101	0.369	0.000	0.000	0.000	0.000	0.001	0.000	0.002	0.004	0.683
44	BlackCrappie2	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.002	0.000	0.007	0.000	0.453
45	BlackCrappie3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	Bluegill1	0.077	0.000	0.000	0.000	0.000	0.003	0.018	0.490	0.926	0.240	0.921	0.000	0.000	0.000	0.000	0.003	0.000	0.002	0.009	0.535
47	Bluegill2	0.000	0.000	0.000	0.000	0.000	0.005	0.001	0.003	0.000	0.005	0.000	0.000	0.000	0.000	0.000	0.014	0.000	0.002	0.001	0.781
48	Bluegill 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	GreenSunfish1	0.059	0.000	0.000	0.000	0.000	0.005	0.014	0.336	0.513	0.171	0.534	0.000	0.000	0.000	0.000	0.013	0.000	0.005	0.007	0.685
50	GreenSunfish 2	0.000	0.000	0.000	0.000	0.000	0.003	0.001	0.005	0.000	0.004	0.000	0.000	0.000	0.001	0.000	0.007	0.000	0.008	0.001	0.540
51	GreenSunfish 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	ChannelCatfish1	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.003	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.006	0.000	0.397
53	ChannelCatfish2	0.077	0.000	0.000	0.000	0.000	0.003	0.017	0.478	0.872	0.234	0.874	0.000	0.000	0.000	0.000	0.001	0.000	0.003	0.009	0.602
54	ChannelCatfish3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003
55	Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	CommonCarp1	0.037	0.000	0.000	0.000	0.000	0.156	0.016	0.229	0.410	0.113	0.645	0.000	0.000	0.000	0.000	0.733	0.000	0.001	0.004	0.448
57	CommonCarp2	0.000	0.000	0.000	0.000	0.000	0.005	0.002	0.005	0.000	0.006	0.000	0.000	0.000	0.000	0.000	0.013	0.000	0.006	0.001	0.522
58	CommonCarp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

59	Fathead Minnow1	0.005	0.000	0.000	0.000	0.000	0.157	0.009	0.031	0.061	0.016	0.323	0.000	0.000	0.000	0.000	0.781	0.000	0.001	0.001	0.324
60	FatheadMinnow2	0.075	0.000	0.000	0.000	0.000	0.006	0.017	0.439	0.708	0.218	0.729	0.000	0.000	0.000	0.000	0.012	0.000	0.003	0.008	0.745
61	FatheadMinnow 3	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.006	0.000	0.439
62	June Sucker 1	0.039	0.000	0.000	0.000	0.000	0.001	0.009	0.251	0.484	0.122	0.479	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.200
63	JuneSucker2	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.003	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.008	0.000	0.011	0.001	0.001
64	JuneSucker 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	Walleye1	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.004	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.006	0.000	0.444
70	Walley2	0.031	0.000	0.000	0.000	0.000	0.007	0.009	0.190	0.318	0.101	0.324	0.000	0.000	0.000	0.000	0.022	0.000	0.006	0.005	0.458
71	Walleye3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	WhiteBass1	0.079	0.000	0.000	0.000	0.000	0.004	0.018	0.489	0.884	0.241	0.888	0.000	0.000	0.000	0.000	0.005	0.000	0.003	0.009	0.517
74	WhiteBass2	0.000	0.000	0.000	0.000	0.000	0.002	0.001	0.003	0.000	0.004	0.000	0.000	0.000	0.000	0.000	0.007	0.000	0.004	0.001	0.629
75	WhiteBass3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
77	YellowPerch1	0.033	0.000	0.000	0.000	0.000	0.005	0.009	0.198	0.312	0.105	0.322	0.000	0.000	0.000	0.000	0.015	0.000	0.009	0.005	0.412
78	YellowPerch2	0.000	0.000	0.000	0.000	0.000	0.004	0.002	0.005	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.016	0.000	0.010	0.002	0.263
79	YellowPerch3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Taxon	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
1	Bacillariophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	Chlorophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	Cryptophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	Cyanophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	Dinophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	Euglenophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	Benthic Algae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

8	Macrophytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	Epiphytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	Asplanchinida	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	Bosminidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.002	0.000
12	Brachionidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	Canthocamptidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	Ceriodaphnia	0.000	0.000	0.001	0.000	0.000	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.002	0.000	0.000	0.001	0.000	0.000	0.000	0.002
15	Chydoridae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	Cyclopidae	0.000	0.000	0.002	0.000	0.000	0.004	0.000	0.000	0.003	0.000	0.000	0.000	0.004	0.000	0.000	0.003	0.000	0.000	0.001	0.004
17	Daphnia	0.000	0.000	0.002	0.000	0.000	0.005	0.000	0.000	0.004	0.000	0.000	0.000	0.005	0.000	0.000	0.003	0.000	0.000	0.000	0.005
18	Diaptomidae	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.001
19	Ilyocryptidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	Laophontidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	Leptodoridae	0.000	0.000	0.033	0.000	0.000	0.077	0.000	0.000	0.059	0.000	0.000	0.000	0.077	0.000	0.000	0.037	0.000	0.000	0.005	0.075
22	Macrothricidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	Moinidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	Sididae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	Acari	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	Amphipoda	0.011	0.000	0.001	0.001	0.000	0.003	0.005	0.000	0.005	0.003	0.000	0.001	0.003	0.000	0.000	0.156	0.005	0.000	0.157	0.006
27	Chironominae	0.003	0.000	0.008	0.001	0.000	0.018	0.001	0.000	0.014	0.001	0.000	0.001	0.017	0.000	0.000	0.016	0.002	0.000	0.009	0.017
28	Coleoptera	0.003	0.000	0.205	0.004	0.000	0.490	0.003	0.000	0.336	0.005	0.000	0.003	0.478	0.000	0.000	0.229	0.005	0.000	0.031	0.439
29	Corbicula sp.	0.000	0.000	0.366	0.000	0.000	0.926	0.000	0.000	0.513	0.000	0.000	0.000	0.872	0.000	0.000	0.410	0.000	0.000	0.061	0.708
30	Corixidae	0.009	0.000	0.101	0.001	0.000	0.240	0.005	0.000	0.171	0.004	0.000	0.001	0.234	0.000	0.000	0.113	0.006	0.000	0.016	0.218
31	Decopoda	0.016	0.000	0.369	0.000	0.000	0.921	0.000	0.000	0.534	0.000	0.000	0.000	0.874	0.000	0.000	0.645	0.000	0.000	0.323	0.729
32	Glossiphoniidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	Isopoda	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	Lymnaeidae	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	Physa sp.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	Odonata	0.057	0.000	0.001	0.002	0.000	0.003	0.014	0.000	0.013	0.007	0.000	0.001	0.001	0.000	0.000	0.733	0.013	0.000	0.781	0.012
37	Oligochaetes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

38	Ostracod	0.010	0.000	0.002	0.007	0.000	0.002	0.002	0.000	0.005	0.008	0.000	0.006	0.003	0.000	0.000	0.001	0.006	0.000	0.001	0.003
39	Tanypodinae	0.001	0.000	0.004	0.000	0.000	0.009	0.001	0.000	0.007	0.001	0.000	0.000	0.009	0.000	0.000	0.004	0.001	0.000	0.001	0.008
40	BlackBullhead1	0.079	0.000	0.683	0.453	0.000	0.535	0.781	0.000	0.685	0.540	0.000	0.397	0.602	0.003	0.000	0.448	0.522	0.000	0.324	0.745
41	BlackBullhead2	1.000	0.000	0.260	0.041	0.000	0.159	0.157	0.000	0.552	0.222	0.000	0.000	0.133	0.098	0.000	0.127	0.247	0.000	0.093	0.183
42	BlackBullhead3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	BlackCrappie1	0.260	0.000	1.000	0.100	0.000	0.589	0.705	0.000	0.689	0.124	0.000	0.089	0.502	0.005	0.000	0.229	0.099	0.000	0.044	0.453
44	BlackCrappie2	0.041	0.000	0.100	1.000	0.000	0.026	0.273	0.000	0.102	0.936	0.000	0.977	0.340	0.060	0.000	0.035	0.602	0.000	0.100	0.313
45	BlackCrappie3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	Bluegill1	0.159	0.000	0.589	0.026	0.000	1.000	0.212	0.000	0.745	0.060	0.000	0.018	0.935	0.004	0.000	0.447	0.077	0.000	0.076	0.843
47	Bluegill2	0.157	0.000	0.705	0.273	0.000	0.212	1.000	0.000	0.554	0.382	0.000	0.232	0.170	0.049	0.000	0.078	0.471	0.000	0.098	0.413
48	Bluegill 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	GreenSunfish1	0.552	0.000	0.689	0.102	0.000	0.745	0.554	0.000	1.000	0.247	0.000	0.067	0.688	0.011	0.000	0.342	0.349	0.000	0.095	0.818
50	GreenSunfish 2	0.222	0.000	0.124	0.936	0.000	0.060	0.382	0.000	0.247	1.000	0.000	0.861	0.353	0.143	0.000	0.054	0.753	0.000	0.117	0.414
51	GreenSunfish 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	ChannelCatfish1	0.000	0.000	0.089	0.977	0.000	0.018	0.232	0.000	0.067	0.861	0.000	1.000	0.318	0.000	0.000	0.028	0.499	0.000	0.093	0.268
53	ChannelCatfish2	0.133	0.000	0.502	0.340	0.000	0.935	0.170	0.000	0.688	0.353	0.000	0.318	1.000	0.005	0.000	0.432	0.242	0.000	0.094	0.884
54	ChannelCatfish3	0.098	0.000	0.005	0.060	0.000	0.004	0.049	0.000	0.011	0.143	0.000	0.000	0.005	1.000	0.000	0.019	0.441	0.000	0.002	0.006
55	Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	CommonCarp1	0.127	0.000	0.229	0.035	0.000	0.447	0.078	0.000	0.342	0.054	0.000	0.028	0.432	0.019	0.000	1.000	0.070	0.000	0.903	0.405
57	CommonCarp2	0.247	0.000	0.099	0.602	0.000	0.077	0.471	0.000	0.349	0.753	0.000	0.499	0.242	0.441	0.000	0.070	1.000	0.000	0.111	0.444
58	CommonCarp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	Fathead Minnow1	0.093	0.000	0.044	0.100	0.000	0.076	0.098	0.000	0.095	0.117	0.000	0.093	0.094	0.002	0.000	0.903	0.111	0.000	1.000	0.129
60	FatheadMinnow2	0.183	0.000	0.453	0.313	0.000	0.843	0.413	0.000	0.818	0.414	0.000	0.268	0.884	0.006	0.000	0.405	0.444	0.000	0.129	1.000
61	FatheadMinnow 3	0.020	0.000	0.094	0.992	0.000	0.019	0.257	0.000	0.075	0.932	0.000	0.968	0.333	0.148	0.000	0.032	0.594	0.000	0.095	0.292
62	June Sucker 1	0.029	0.000	0.198	0.035	0.000	0.485	0.026	0.000	0.294	0.060	0.000	0.000	0.463	0.709	0.000	0.237	0.434	0.000	0.031	0.393
63	JuneSucker2	0.966	0.000	0.136	0.038	0.000	0.128	0.056	0.000	0.458	0.205	0.000	0.000	0.117	0.043	0.000	0.064	0.208	0.000	0.032	0.160
64	JuneSucker 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
66	NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
67	NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

68	Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	Walleye1	0.044	0.000	0.092	0.946	0.000	0.019	0.262	0.000	0.078	0.937	0.000	0.892	0.324	0.265	0.000	0.032	0.611	0.000	0.091	0.292
70	Walley2	0.576	0.000	0.260	0.040	0.000	0.476	0.495	0.000	0.789	0.253	0.000	0.000	0.403	0.001	0.000	0.234	0.465	0.000	0.120	0.702
71	Walleye3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	WhiteBass1	0.294	0.000	0.527	0.051	0.000	0.981	0.183	0.000	0.808	0.117	0.000	0.034	0.934	0.014	0.000	0.448	0.144	0.000	0.084	0.880
74	WhiteBass2	0.467	0.000	0.831	0.202	0.000	0.234	0.815	0.000	0.625	0.321	0.000	0.158	0.189	0.212	0.000	0.079	0.339	0.000	0.050	0.266
75	WhiteBass3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
77	YellowPerch1	0.795	0.000	0.307	0.226	0.000	0.479	0.322	0.000	0.833	0.436	0.000	0.169	0.503	0.077	0.000	0.239	0.505	0.000	0.100	0.659
78	YellowPerch2	0.876	0.000	0.157	0.288	0.000	0.149	0.332	0.000	0.618	0.508	0.000	0.226	0.199	0.099	0.000	0.087	0.554	0.000	0.091	0.387
79	YellowPerch3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	Taxon	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
1	Bacillariophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	Chlorophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	Cryptophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	Cyanophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	Dinophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	Euglenophyta	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	Benthic Algae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	Macrophytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	Epiphytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	Asplanchinida	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	Bosminidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	Brachionidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	Canthocamptidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	Ceriodaphnia	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.002	0.000	0.000	0.000	0.001	0.000	0.000
15	Chydoridae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	Cyclopidae	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.004	0.000	0.000	0.000	0.002	0.000	0.000

17	Daphnia	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.006	0.000	0.000	0.000	0.003	0.000	0.000
18	Diaptomidae	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000
19	Ilyocryptidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	Laophontidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	Leptodoridae	0.000	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.031	0.000	0.000	0.079	0.000	0.000	0.000	0.033	0.000	0.000
22	Macrothricidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	Moinidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	Sididae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	Acari	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	Amphipoda	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001	0.007	0.000	0.000	0.004	0.002	0.000	0.000	0.005	0.004	0.000
27	Chironominae	0.001	0.009	0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.009	0.000	0.000	0.018	0.001	0.000	0.000	0.009	0.002	0.000
28	Coleoptera	0.004	0.251	0.003	0.000	0.000	0.000	0.000	0.000	0.004	0.190	0.000	0.000	0.489	0.003	0.000	0.000	0.198	0.005	0.000
29	Corbicula sp.	0.000	0.484	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.318	0.000	0.000	0.884	0.000	0.000	0.000	0.312	0.000	0.000
30	Corixidae	0.001	0.122	0.008	0.000	0.000	0.000	0.000	0.000	0.001	0.101	0.000	0.000	0.241	0.004	0.000	0.000	0.105	0.011	0.000
31	Decopoda	0.000	0.479	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.324	0.000	0.000	0.888	0.000	0.000	0.000	0.322	0.000	0.000
32	Glossiphoniidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	Isopoda	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	Lymnaeidae	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	Physa sp.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	Odonata	0.001	0.000	0.008	0.000	0.000	0.000	0.000	0.000	0.001	0.022	0.000	0.000	0.005	0.007	0.000	0.000	0.015	0.016	0.000
37	Oligochaetes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	Ostracod	0.006	0.000	0.011	0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.000	0.000	0.003	0.004	0.000	0.000	0.009	0.010	0.000
39	Tanypodinae	0.000	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.009	0.001	0.000	0.000	0.005	0.002	0.000
40	BlackBullhead1	0.439	0.200	0.001	0.000	0.000	0.000	0.000	0.000	0.444	0.458	0.000	0.000	0.517	0.629	0.000	0.000	0.412	0.263	0.000
41	BlackBullhead2	0.020	0.029	0.966	0.000	0.000	0.000	0.000	0.000	0.044	0.576	0.000	0.000	0.294	0.467	0.000	0.000	0.795	0.876	0.000
42	BlackBullhead3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
43	BlackCrappie1	0.094	0.198	0.136	0.000	0.000	0.000	0.000	0.000	0.092	0.260	0.000	0.000	0.527	0.831	0.000	0.000	0.307	0.157	0.000
44	BlackCrappie2	0.992	0.035	0.038	0.000	0.000	0.000	0.000	0.000	0.946	0.040	0.000	0.000	0.051	0.202	0.000	0.000	0.226	0.288	0.000
45	BlackCrappie3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
46	Bluegill1	0.019	0.485	0.128	0.000	0.000	0.000	0.000	0.000	0.019	0.476	0.000	0.000	0.981	0.234	0.000	0.000	0.479	0.149	0.000

47	Bluegill2	0.257	0.026	0.056	0.000	0.000	0.000	0.000	0.000	0.262	0.495	0.000	0.000	0.183	0.815	0.000	0.000	0.322	0.332	0.000
48	Bluegill 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
49	GreenSunfish1	0.075	0.294	0.458	0.000	0.000	0.000	0.000	0.000	0.078	0.789	0.000	0.000	0.808	0.625	0.000	0.000	0.833	0.618	0.000
50	GreenSunfish 2	0.932	0.060	0.205	0.000	0.001	0.001	0.000	0.000	0.937	0.253	0.000	0.000	0.117	0.321	0.000	0.000	0.436	0.508	0.000
51	GreenSunfish 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
52	ChannelCatfish1	0.968	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.892	0.000	0.000	0.000	0.034	0.158	0.000	0.000	0.169	0.226	0.000
53	ChannelCatfish2	0.333	0.463	0.117	0.000	0.000	0.000	0.000	0.000	0.324	0.403	0.000	0.000	0.934	0.189	0.000	0.000	0.503	0.199	0.000
54	ChannelCatfish3	0.148	0.709	0.043	0.000	0.000	0.000	0.000	0.000	0.265	0.001	0.000	0.000	0.014	0.212	0.000	0.000	0.077	0.099	0.000
55	Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
56	CommonCarp1	0.032	0.237	0.064	0.000	0.001	0.001	0.000	0.000	0.032	0.234	0.000	0.000	0.448	0.079	0.000	0.000	0.239	0.087	0.000
57	CommonCarp2	0.594	0.434	0.208	0.000	0.000	0.000	0.000	0.000	0.611	0.465	0.000	0.000	0.144	0.339	0.000	0.000	0.505	0.554	0.000
58	CommonCarp3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
59	Fathead Minnow1	0.095	0.031	0.032	0.000	0.000	0.000	0.000	0.000	0.091	0.120	0.000	0.000	0.084	0.050	0.000	0.000	0.100	0.091	0.000
60	FatheadMinnow2	0.292	0.393	0.160	0.000	0.000	0.000	0.000	0.000	0.292	0.702	0.000	0.000	0.880	0.266	0.000	0.000	0.659	0.387	0.000
61	FatheadMinnow 3	1.000	0.071	0.011	0.000	0.000	0.000	0.000	0.000	0.972	0.000	0.000	0.000	0.039	0.211	0.000	0.000	0.199	0.259	0.000
62	June Sucker 1	0.071	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.075	0.173	0.000	0.000	0.474	0.073	0.000	0.000	0.195	0.033	0.000
63	JuneSucker2	0.011	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.026	0.540	0.000	0.000	0.267	0.322	0.000	0.000	0.729	0.827	0.000
64	JuneSucker 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
65	NorthernPike1	0.000	0.000	0.000	0.000	1.000	0.915	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	NorthernPike2	0.000	0.000	0.000	0.000	0.915	1.000	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
67	NorthernPike3	0.000	0.000	0.000	0.000	0.004	0.011	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
68	Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
69	Walleye1	0.972	0.075	0.026	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.041	0.261	0.000	0.000	0.218	0.278	0.000
70	Walley2	0.000	0.173	0.540	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.583	0.350	0.000	0.000	0.860	0.781	0.000
71	Walleye3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
72	Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
73	WhiteBass1	0.039	0.474	0.267	0.000	0.000	0.000	0.000	0.000	0.041	0.583	0.000	0.000	1.000	0.228	0.000	0.000	0.617	0.302	0.000
74	WhiteBass2	0.211	0.073	0.322	0.000	0.000	0.000	0.000	0.000	0.261	0.350	0.000	0.000	0.228	1.000	0.000	0.000	0.440	0.448	0.000
75	WhiteBass3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
76	White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

77	YellowPerch1	0.199	0.195	0.729	0.000	0.000	0.000	0.000	0.000	0.218	0.860	0.000	0.000	0.617	0.440	0.000	0.000	1.000	0.921	0.000
78	YellowPerch2	0.259	0.033	0.827	0.000	0.000	0.000	0.000	0.000	0.278	0.781	0.000	0.000	0.302	0.448	0.000	0.000	0.921	1.000	0.000
79	YellowPerch3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Niche Overlap

Niche Overlaps are presented in Table 8. Most niche overlaps were zooplankton taxa due to poor resolution of their diets used in the model. Other strong overlaps were mostly the detritivores and early life stages of fishes (Table 8).

Table 8. Taxa niche overlap. Correlation cutoff = 0.50 was used for this table. Other correlation cutoffs can be easily evaluated.

Niche overlap

Asplanchinida: Bosminidae	Asplanchinida: Brachionidae	Asplanchinida: Canthocamptidae	Asplanchinida: Ceriodaphnia
Asplanchinida: Chydoridae	Asplanchinida: Cyclopidae	Asplanchinida: Daphnia	Asplanchinida: Diaptomidae
Asplanchinida: Ilyocryptidae	Asplanchinida: Laophontidae	Asplanchinida: Leptodoridae	Asplanchinida: Macrothricidae
Asplanchinida: Moinidae	Asplanchinida: Sididae	Bosminidae: Brachionidae	Bosminidae: Canthocamptidae
Bosminidae: Ceriodaphnia	Bosminidae: Chydoridae	Bosminidae: Cyclopidae	Bosminidae: Daphnia
Bosminidae: Diaptomidae	Bosminidae: Ilyocryptidae	Bosminidae: Laophontidae	Bosminidae: Leptodoridae
Bosminidae: Macrothricidae	Bosminidae: Moinidae	Bosminidae: Sididae	Brachionidae: Canthocamptidae
Brachionidae: Ceriodaphnia	Brachionidae: Chydoridae	Brachionidae: Cyclopidae	Brachionidae: Daphnia
Brachionidae: Diaptomidae	Brachionidae: Ilyocryptidae	Brachionidae: Laophontidae	Brachionidae: Leptodoridae
Brachionidae: Macrothricidae	Brachionidae: Moinidae	Brachionidae: Sididae	Canthocamptidae: Ceriodaphnia
Canthocamptidae: Chydoridae	Canthocamptidae: Cyclopidae	Canthocamptidae: Daphnia	Canthocamptidae: Diaptomidae
Canthocamptidae: Ilyocryptidae	Canthocamptidae: Laophontidae	Canthocamptidae: Leptodoridae	Canthocamptidae: Macrothricidae
Canthocamptidae: Moinidae	Canthocamptidae: Sididae	Ceriodaphnia: Chydoridae	Ceriodaphnia: Cyclopidae
Ceriodaphnia: Daphnia	Ceriodaphnia: Diaptomidae	Ceriodaphnia: Ilyocryptidae	Ceriodaphnia: Laophontidae
Ceriodaphnia: Leptodoridae	Ceriodaphnia: Macrothricidae	Ceriodaphnia: Moinidae	Ceriodaphnia: Sididae
Chydoridae: Cyclopidae	Chydoridae: Daphnia	Chydoridae: Diaptomidae	Chydoridae: Ilyocryptidae
Chydoridae: Laophontidae	Chydoridae: Leptodoridae	Chydoridae: Macrothricidae	Chydoridae: Moinidae
Chydoridae: Sididae	Cyclopidae: Daphnia	Cyclopidae: Diaptomidae	Cyclopidae: Ilyocryptidae
Cyclopidae: Laophontidae	Cyclopidae: Leptodoridae	Cyclopidae: Macrothricidae	Cyclopidae: Moinidae
Cyclopidae: Sididae	Daphnia: Diaptomidae	Daphnia: Ilyocryptidae	Daphnia: Laophontidae
Daphnia: Leptodoridae	Daphnia: Macrothricidae	Daphnia: Moinidae	Daphnia: Sididae
Diaptomidae: Ilyocryptidae	Diaptomidae: Laophontidae	Diaptomidae: Leptodoridae	Diaptomidae: Macrothricidae
Diaptomidae: Moinidae	Diaptomidae: Sididae	Ilyocryptidae: Laophontidae	Ilyocryptidae: Leptodoridae
Ilyocryptidae: Macrothricidae	Ilyocryptidae: Moinidae	Ilyocryptidae: Sididae	Laophontidae: Leptodoridae
Laophontidae: Macrothricidae	Laophontidae: Moinidae	Laophontidae: Sididae	Leptodoridae: Macrothricidae
Leptodoridae: Moinidae	Leptodoridae: Sididae	Macrothricidae: Moinidae	Macrothricidae: Sididae
Moinidae: Sididae	Acari: Coleoptera	Chironominae: Lymnaeidae	Chironominae: Physa sp.
Chironominae: Oligochaetes	Chironominae: Tanypodinae	Corbicula sp.: Decopoda	Corixidae: Isopoda
Corixidae: Oligochaetes	Corixidae: Ostracod	Glossiphoniidae: Isopoda	Glossiphoniidae: Physa sp.
Isopoda: Physa sp.	Isopoda: Ostracod	Lymnaeidae: Oligochaetes	Lymnaeidae: Tanypodinae
Physa sp.: Oligochaetes	Physa sp.: Tanypodinae	Oligochaetes: Tanypodinae	BlackBullhead1: BlackCrappie1
BlackBullhead1: Bluegill1	BlackBullhead1: ChannelCatfish2	BlackBullhead1: WhiteBass1	BlackBullhead2: GreenSunfish1
BlackBullhead2: JuneSucker2	BlackBullhead2: YellowPerch2	BlackCrappie1: Bluegill1	BlackCrappie1: ChannelCatfish2
BlackCrappie1: WhiteBass1	BlackCrappie2: GreenSunfish 2	BlackCrappie2: CommonCarp2	BlackCrappie2: Walleye1
Bluegill1: ChannelCatfish2	Bluegill1: WhiteBass1	Bluegill2: GreenSunfish1	GreenSunfish1: YellowPerch2
GreenSunfish 2: CommonCarp2	GreenSunfish 2: Walleye1	GreenSunfish 2: YellowPerch2	ChannelCatfish2: WhiteBass1
ChannelCatfish2: YellowPerch1	CommonCarp1: Fathead Minnow1	CommonCarp2: Walleye1	CommonCarp2: YellowPerch2
JuneSucker2: YellowPerch2	WhiteBass1: YellowPerch1		

Several important ecosystem statistics are presented in Table 9 and explained in more detail in subsequent sections.

Table 9. Ecosystem Statistics

Parameter	Value	Units
Sum of all consumption	1,520	T km-^{2} year^{-1}
Sum of all exports	949	T km-^{2} year^{-1}
Sum of all respiratory flows	504	T km-^{2} year^{-1}
Sum of all flows into detritus	2,060	T km-^{2} year^{-1}
Total system throughput	5,035	T km-^{2} year^{-1}
Sum of all production	2,556	T km-^{2} year^{-1}
Calculated total net primary production	1,449	T km-^{2} year^{-1}
Total primary production/total respiration	2.87	
Net system production	944	T km-^{2} year^{-1}
Total primary production/total biomass	9.86	
Total biomass/total throughput	0.029	T km-^{2} year^{-1}
Total biomass (excluding detritus)	146	T km-^{2}
Connectance Index	0.13	
System Omnivory Index	0.05	
EcoPath pedigree	0.25	
Measure of fit, t*	0.97	
Shannon diversity index	1.95	

Transfer efficiencies

The entire lake system was aggregated in the form of discrete trophic levels in the model. Transfer efficiencies (expressed in %) of two consecutive trophic levels were estimated as the ratio between the sum of exports from a given trophic level (including the flow that was transferred from one trophic level to the next) and throughput at the trophic level (Ulanowicz 1995). The highest transfer efficiencies were from Producer trophic levels II, III, and IV and the lowest was from Producer trophic level VI (Table 10).

Table 10. Trophic Level Transfer Efficiencies (%)

Source \ Trophic level	II	III	IV	V	VI	VII
Producer	30.49	37.15	28.56	11.32	0.02	
Detritus	12.02	15.64	9.61	5.65	1.97	0.17
All flows	14.49	21.72	19.22	9.92	0.29	0.16

The estimated proportion of total flow originating from detritus in Utah Lake was 0.66. This demonstrated not only a water column primary production-based ecosystem but inefficient transfer within the water column to a detritus-based driven food web. Estimated transfer efficiencies (calculated as geometric mean for TL II-IV) from primary producers = 31.86%, from detritus = 12.18%, and total =18.22%.

See Matthias et al. 2021 for interpretation of TTEs

See Bhavan et al. 2021 for interpretations of other output metrics: total system throughput, mean trophic level, gross efficiency, primary production, total primary production or total biomass, total biomass or total throughput, system omnivory index, connectance index, Finn’s cycling index, system transfer efficiency, ascendency, system overheads, robustness and ecoexergy.

Keystoneness

Obviously, abundant high biomass taxonomic (functional) groups are more likely to have large ecosystem impacts. However, keystone species can have structuring roles in ecosystems even when in low abundance. Libralato et al. (2006) introduced the keystoneness (KS) index which scales ε with biomass, “penalizing” a taxa with high abundance. The KS index attributes high values to taxa that have large impacts but at low biomass (Nuttall et al. 2011).

Christensen and Walters (2005) describe the EcoPath Keystoneness index in more detail:

> “Keystones are defined as relatively low biomass species with a structuring role in their food webs. Thus, identifying keystone species in a given ecosystem may be formulated as: (1) estimating the impact on the different elements of an ecosystem resulting from a small change to the biomass of the species to be evaluated for its ‘keystoneness’; and (2) deciding on the keystoneness of a given species as a function of both the impact estimated in (1) and its own biomass. Experimental quantification of interaction strength, necessarily focus on few species, and they require a priori assumptions on the importance of the interactions, which can bias the identification of keystone species. Moreover, empirical measurements, although very important, are expensive and time consuming and, owing to the spatio-temporal heterogeneity of habitats, physical conditions, and densities of organisms, published results tend to be case-specific and context-dependent. Although models can only represent but a caricature of the complexity of the real world, the modelling approach can be helpful since it allows overcoming some of the difficulties mentioned. Here we present an approach for estimating the keystoneness of the functional groups (species or group of species) of food web models. Network mixed trophic impact analysis, based on Leontief’s economic input-output analysis, allows us to express the relative change of biomasses in the food web that would result from an infinitesimal increase of the biomass of the observed group, thus identifying its total impact. The analysis of the mixed trophic impacts presented here was applied to a suite of mass-balance models, and the results allow us to rank functional groups by their keystoneness. Overall, we concluded that the straightforward methodology proposed here and the broad use of EcoPath with EcoSim (where mixed trophic impact analysis is implemented) together give a solid empirical basis for identification of keystone functional groups (Libralato *et al.*, 2006).”

The following figure (Figure 30) illustrates the Keystoneness (relative total impact) for each taxonomic group modeled.

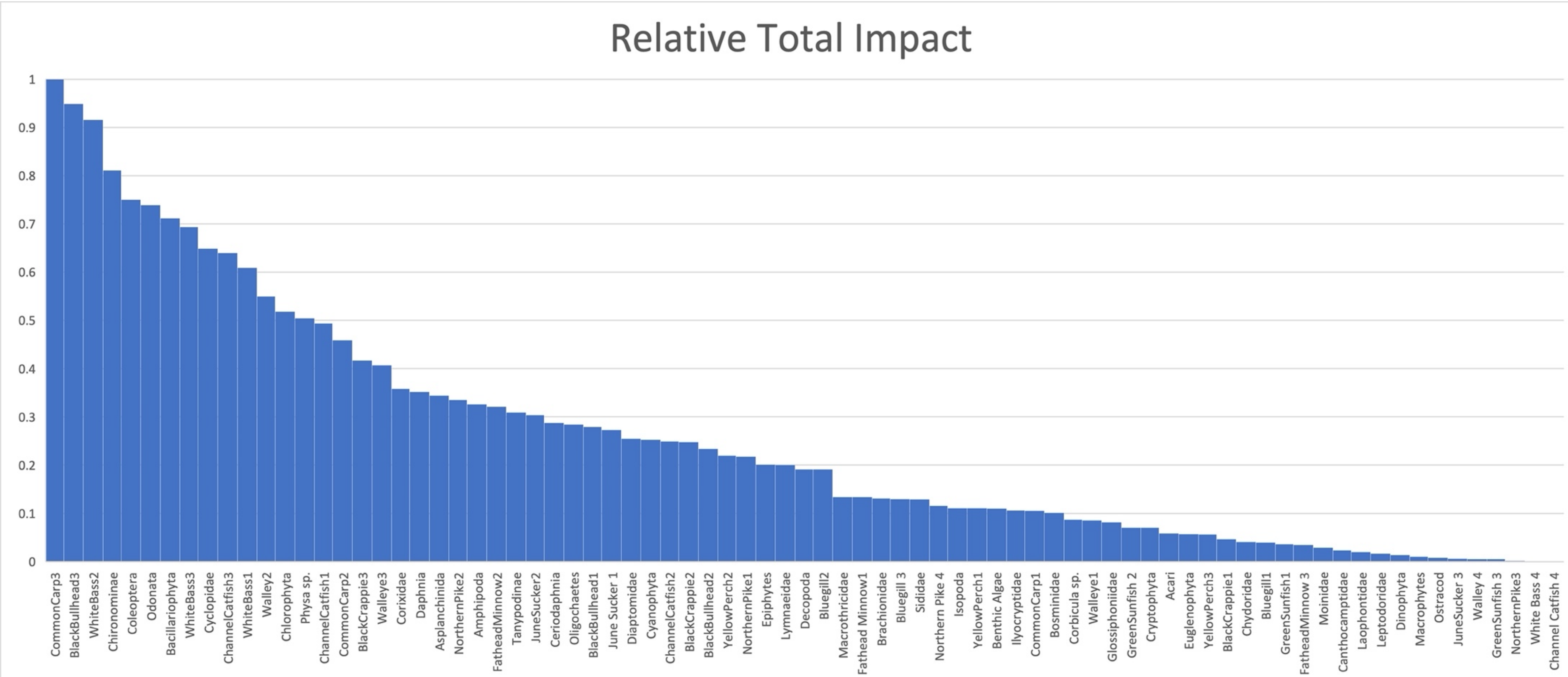


Figure 30. Relative total impact (Keystoneness) of individual taxa.

Large sized Common Carp had the most impact (keystoneness) as did large sized catfish (Black Bullhead, Channel Catfish), medium-large sized White Bass, Bacillariophyta, and Chironominae which also had the highest biomasses and production (Figure 30, Table 3) documenting their major ecosystem impacts in Utah Lake. Several groups had low biomass but high keystoneness including Coleoptera, Odonata, and Physa sp., etc. (Figure 30).

Trophic Structure

Mixed trophic impact

Mixed trophic impact (MTI) has been incorporated into EcoPath analysis based on the direct and indirect approach routine by Ulanowicz and Puccia (1990). It is an "n × n" matrix of prey and predator. This routine is referred to as an aid to notify the possible impact of direct and indirect interactions (including competition) in a balanced state (Christensen et al., 2008). Mixed trophic impacts are presented in Figure 31

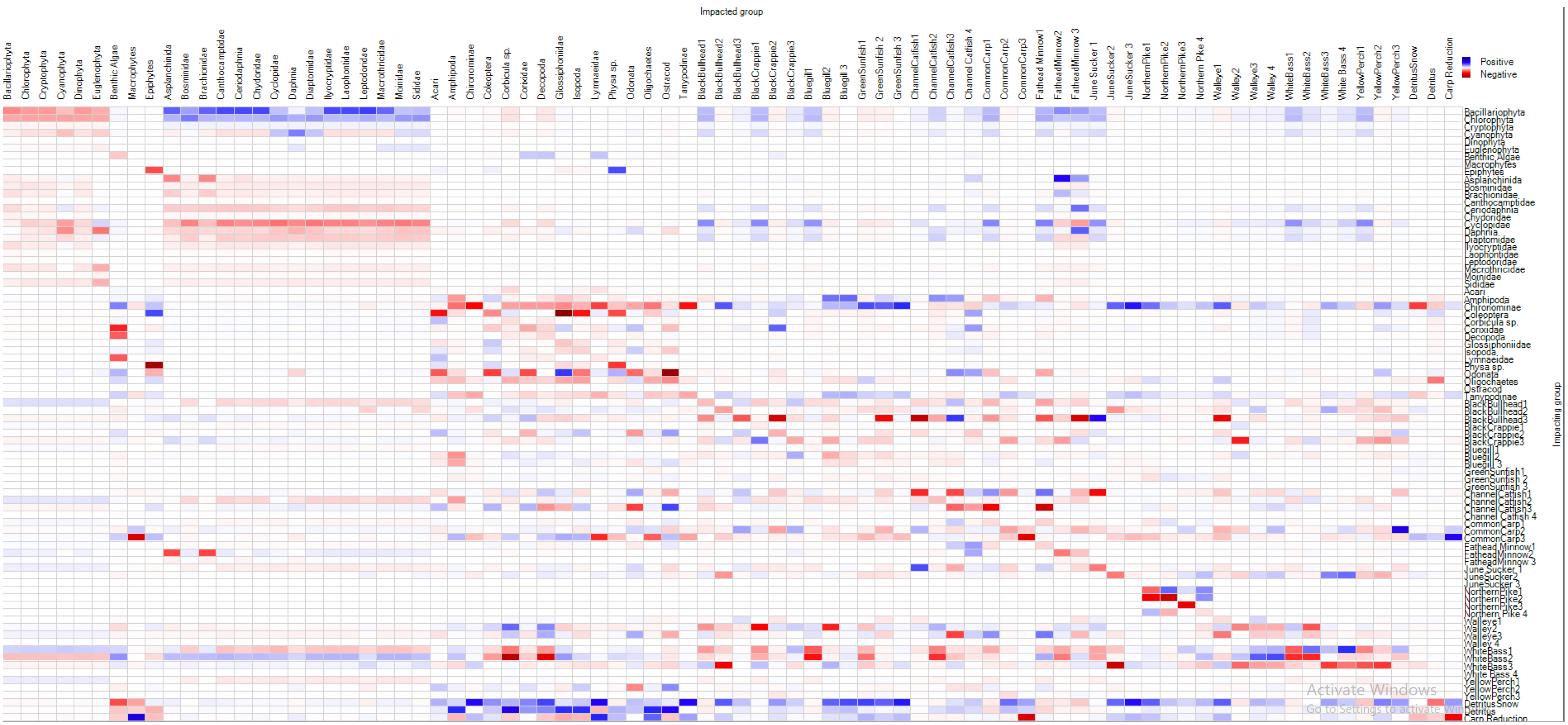


Figure 31. Mixed trophic level impacts for each taxonomic group and carp fleet.

Mixed trophic impact values for each taxon are in Appendix 4.

Trophic flow in trophic levels

Estimated trophic level flows and biomasses from primary producers (Table 11) and from detritus (Table 12).

Table 11. Estimated flows and biomasses from primary producers

Trophic level \ Flow	Import	Consumption by predators	Export	Flow to detritus	Respiration	Throughput
VIII		0.000	0.000	0.000	0.000	0.000
VII		> 0.001	0.000	> 0.001	> 0.001	> 0.001
VI		0.0001	0.000	0.188	0.439	0.627
V		0.627	0.000	1.692	3.222	5.540
IV		5.540	0.0002	7.005	6.856	19.40
III		19.40	0.07	17.08	15.86	52.41
II		52.41	0.025	67.59	51.92	171.9
I	0.00	171.9	0.000	1278	0.000	1450
Sum	0.00	249.9	0.095	1371	78.30	1700

Table 12. Estimated flows and biomasses from detritus

Trophic level \ Flow	Import	Consumption by predators	Export	Flow to detritus	Respiration	Throughput
VIII		0.000	0.000	0.000	0.000	0.000
VII		> 0.001	0.000	0.001	0.001	0.002
VI		0.002	0.000	0.0305	0.07	0.102
V		0.102	> 0.001	0.547	1.156	1.806
IV		1.806	0.004	6.012	11.02	18.84
III		18.84	2.001	43.25	69.11	133.2
II		133.2	3.105	634.0	345.3	1116

I	5.000	1116	944.5	0.000	0.000	2065
Sum	5.000	1270	949.6	683.8	426.6	3335

Estimated biomasses by trophic levels are presented in Table 13.

Table 13. Estimated biomass by trophic level

Trophic level	Living (t/km²)	Detritus (t/km²)	Total (t/km²)	Non-hidden
VII	0.002		0.002	0.004
VI	0.72		0.72	0.81
V	4.53		4.53	5.64
IV	20.34		20.34	29.74
III	79.83		79.83	137.7
II	34.21		34.21	65.14
I	7.24	6	13.25	13.25

Lindeman spine

The Lindeman spine (Lindeman 1942) (Figure 32) shows the general functional structure of the system based on the aggregation of the Utah Lake trophic groups into eighty-one trophic levels and describes the flow transfer between the trophic levels.

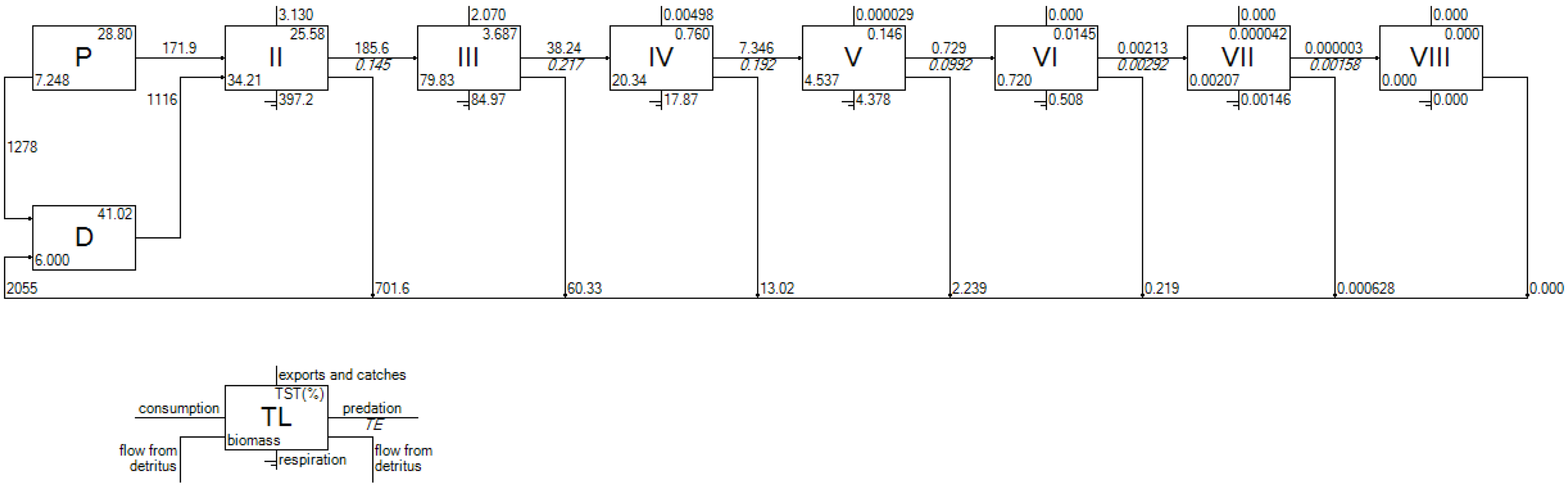


Figure 32. Lindeman spine representation of Utah Lake. Trophic flows are transferred from primary producers (P) and detritus (D) to the trophic levels I to V, where TST (%): Total System Throughput and TE: transfer efficiency. Flows are represented in t/km^2/year and biomass in t/km^2.

Total System Throughput (TST%), Trophic Level (TL) Exports (t km^2 y^{-1}) (including export from detritus to TL II), detrital exports, and respiration rates all decreased from detritus to primary producers through the other seven trophic levels (Figure 32). Detrital exports were greatest from primary producers (P) due to inefficient grazing from zooplankton (TL II) (Richards 2022). The highest transfer efficiency (TE) was estimated at TL III = 0.22, followed by TL II and TL IV at 0.15 and 0.19, respectively. The lowest TE was TL VII at < 0.01 and exports and catches were mostly from TL II to TL III and III to TL IV (Figure 32).

Whole System Properties

Total system throughput (TST)

Total system throughput (TST) is the sum of all the flows in the system (Finn, 1976). Kay et al. (1989) also defined TST as the sum of all internal and external inputs to system components or the sum of all outputs (endogenous flows, exports and respiration) of all the compartments and represented the size of the entire system in terms of flow.

$$TST = \sum_{ij} Tij$$

Where, Tij is the flow from compartment i to compartment j.

Estimated total system throughput for Utah Lake was 5,040 t km^2 $year^{-1}$ indicative of a eutrophic system and similar to but greater than values reported from lagoons and coral reef systems in the Yucatan Peninsula, Mexico (Vega-Cendejas and Arreguín-Sánchez 2001, Abascal-Monroy et al. 2016, Arias-González et al. 2004).

System omnivory index (SOI)

The system omnivory index is the average omnivory index of all consumers weighted by the logarithm of each consumer's food intake. Logarithms were used as weighting factors because typically, intake rates are approximately log normally distributed within the system.

SOI is a measure of how feeding interactions are distributed between trophic levels. (see the discussion of the omnivory index for a further description of the component omnivory indices). The idea of system omnivory index was inspired by drawbacks of the connectance index (Pauly et al., 1993b). The connectance index is strongly dependent on how the groups of the system are defined. As this is quite arbitrary in aquatic systems, where interactions of nearly all groups are possible at some development stage, connectance would be close to 1 in most systems described. Moreover, a prey has the same 'score' in the connectance index whether it contributes 1, 10 or 100% of its predators' diet. Both of these drawbacks are overcome by the system omnivory index. The use of the latter index is recommended to characterize the extent to which a system displays web-like features. (Christensen, Walters, and Pauly 2005).

The omnivory index in the EwE model was calculated as the variance of the trophic levels of a consumer's prey (Pauly et al., 1993).

$$OIi = \sum_{j=i} n \ (TLj - (TLi - 1))2 \ \cdot DCji$$

Where TLj is the TL of prey "j", TLi is the TL of predator "i" and DCij is the proportion of prey "j" constituting the diet of predator "i". The system omnivory index (SOI) is the average group omnivory index weighted by the logarithm of the total food consumption (Heymans, 2003). The SOI measures the distribution pattern of feeding interactions between trophic levels (Vasconcellos et al., 1997). A high value of the omnivory index indicates that the consumer feeds more from different trophic levels.

Estimated System Omnivore Index (SOI) for Utah Lake was 0.05, which is on the low end established by Libralato (2008). This indicates an unstable environment for the few trophic groups considered omnivores, which means that the lake ecosystem had few connections between its trophic groups (omnivores). This suggests that Utah Lake is vulnerable to impacts on omnivorous groups and the plasticity to obtain resources by other means could be affected (Bondavalli and Bodini 2014). The loss of trophic groups can also occur because the impact can spread throughout the system in the form of a trophic cascade (Cardona 2006; Heath et al. 2014), which I hypothesized to be true.

Connectance Index (CI)

The connectance index (CI) is the ratio between the number of actual connections between the functional groups in the ecosystem and the number of possible links in the system (Ulanowicz, 1986, Gilbert 2009). In mature systems, a high CI value indicates a food web with large number of trophic links (Lira et al. 2018).

In EcoPath, the connectance index (*CI*) is the ratio of the number of actual links to the number of possible links. Feeding on detritus (by detritivores) is included in the count, but the opposite links (i.e., detritus 'feeding' on other groups) are disregarded.

The number of possible links in an EcoPath model can be estimated as $(N-1)^2$, where N is the number of living groups. It has been observed that the actual number of links in a food web is roughly proportional to the number of groups in the system (Nee, 1990). Thus

$$CI = N/(N-1)2 \approx 1/(N-1)$$

which defines a hyperbolic relationship. Odum (1971) expected food chain structure to change from linear to weblike as systems mature. Hence, the connectance index can be expected to be correlated with ecosystem maturity.

The value of the connectance index is, at least in aquatic systems, largely determined by the level of taxonomic detail used to represent prey groups, and this preclude meaningful intersystem comparisons. Christensen, Walters, and Pauly (2005) suggested that the SOI as an alternative (see System omnivory index (SOI).

CI for Utah Lake was 0.13. This value is lower than values reported elsewhere (Swain et al. 2022, Chi-Espínola and Vega-Cendjas 2022) and supports the SOI result suggesting an unstable environment (see System omnivory index (SOI)).

Holistic Ecosystem Indicators: Ascendancy, Overhead, and Capacity

Holistic system indicators such as Ascendency, Overhead, and Development Capacity are useful indicators (Kay et al., 1989) but are not always included in trophic studies (Baird and Ulanowicz, 1993; Arreguín-Sánchez et al. 2002, 2004; Vidal and Pauly 2005; Lira et al. 2018). Ulanowicz (1989) mentions that in the absence of disturbances an ecosystem evolves, and this is observed with an increase in Ascendency, i.e., ecosystem growth (Christensen 1995).

System stability refers to the resilient capacity of an ecosystem (Ulanowicz, 2000, 1986; Ulanowicz and Puccia, 1990), “which describes network indices such ascendancy, overhead, redundancy and relative ascendancy as measures of the ecosystem’s growth, development and system reserve. A system with high ascendency is more developed and diversified and contains efficient pathways of energy flow in an unperturbed condition (Ulanowicz, 1986). However, the relative ascendancy indicates the relative position and organization of the system and shows a negative correlation with system maturity and system robustness” (Christensen and Pauly, 1993). A full explanation of these indices can be found in Odum (1969), Mejer and Jorgensen (1979), Ulanowicz (1986), Herendeen (1989) and Christensen (1995).

Ascendency

Ascendency is the measure of the average mutual information in a system. It is a product of total throughput (TST) and average mutual information (AMI) of a system (Ulanowicz and Puccia, 1990):

$$A = T\ (TST)*I\ (AMI)$$

Ascendency is symmetrical and will have the same value whether calculated from input or output (Christensen et al., 2008).

Utah Lake ascendency and % ascendency, overhead, %overhead, capacity and % capacity results are in Table 14. Interpretation of these Utah Lake values is not straightforward at this time and needs to be compared with values from the literature.

Table 14. Estimated Total Ascendency, % Ascendency, Overhead, % Overhead, Capacity, and % Capacity for Utah Lake using EcoPath model.

Source	Ascendency (flowbits)	Ascendency (%)	Overhead (flowbits)	Overhead (%)	Capacity (flowbits)	Capacity (%)
Import	6.447	0.0257	43.43	0.173	49.88	0.199
Internal flow	29114	116.2	-10347	-41.30	18767	74.90
Export	4194	16.74	-1461	-5.833	2733	10.91
Respiration	905.3	3.613	2600	10.38	3505	13.99
Total	34220	136.6	-9166	-36.58	25054	100.00

Ascendency, overhead, capacity, information, and throughput by taxon results are in Appendix 3.

Development capacity, C

Development capacity (C) is the upper limit of ascendency, i.e., the utmost potency of a system to reach higher development (Ulanowicz et al., 2009).

$$C = -\sum_{ij} Tijlog\left(\frac{Tij}{TST}\right)$$

Capacity is also the product of TST and the diversity of individual flow (Heymans, 2003; Ulanowicz and Puccia, 1990).

Total C and Total % C for Utah Lake are in Table 14.

Overhead and redundancy

Overhead, *O* also known as the "system reserve" to counter the external perturbation (Ulanowicz, 1986), is complementary to ascendancy. It describes the parallel (unrecognize) path of energy in a system (Feng et al., 2018). Unlike ascendency, overhead is asymmetrical, i.e., the values from input and output are different (Christensen et al., 2008). Among the four components of overhead (i.e., export, import, internal flow and respiration), overhead in internal flow or redundancy is a sensible attribute to measure the system stability by indicating the number of parallel ways for energy flow between two components (Christensen et al., 2005; Heymans et al., 2007):

$$O = C\text{-}A$$

Overhead and the redundancy are measures of the resilient capacity of any system; a high overhead bearing system is more resilient and has more reserve strength (Odum, 2014). Functional redundancy is the major aspect of the resilient capacity and is considered the integral part to maintain robustness so that a system can overcome any stress factor to maintain its function (Mumby et al., 2014).

Estimated Overhead and % Overhead had negative values (Table 14) that need to be reexamined but likely suggesting that this preliminary Utah Lake foodweb model input data needs to be further refined.

Finn's cycling index

Finn's cyclic index (FCI) is the fraction of the total system throughput utilized within the system (Finn, 1976). A highly stressed system possesses a low FCI value (Odum, 1985).

$$FCI = \frac{TST}{TSTc}$$

Here, TST represents the total system throughput and the amount of TST recycled in a system. Finn (1980) defined Finn's path length as "the average number of groups that an inflow or outflow passes through", and it is calculated as

$$Path\ Length = \frac{Total\ system\ throughput}{\sum Export + \sum Respiration}$$

Finn’s cycling index (FCI) indicates the utilization of system productivity and maturity (Finn, 1976). FCI can vary from zero (no cycling) to one (complete cycling) (Finn 1983). A high FCI shows higher utilization of matter in the system (Abdul and Adekoya, 2016; Monaco and Ulanowicz, 1997; Ulanowicz, 1986; Vasconcellos et al., 1997). According to Christensen and Pauly (1993), a high FCI indicates system maturity, but very high values denote system stress, while low FCI values represent vulnerable ecosystems.

FCI for Utah Lake was modeled at 2.71% and Finn’s mean path length = 3.46 suggesting the lake is susceptible to disturbances and the lake likely does poorly at utilization of matter within the system (Swain et al 2022).

Table 15. Cycles and Pathways Lengths

Parameter	Value	Unit
Throughput cycled (excluding detritus)	0.54	t/km²/year
Predatory cycling index	0.059	% Throughput without detritus
Throughput cycled (including detritus)	136.2	t/km²/year
Finn's cycling index	2.71	% Total throughput
Finn's mean path length	3.46	none
Finn's straight-through path length		without detritus
Finn's straight-through path length	3.37	with detritus

System robustness

Ecological network indices such as ascendency, overhead and capacity are links for the system organization and collectively measure the system robustness. System robustness stands for the sustainability of the system based on the survival of the most robust unit (taxon) (Ulanowicz et al., 2009).

Robustness (R) can be calculated by

$$R = -\alpha log(\alpha)$$

Here, α = (relative Ascendancy) = A/C. It can be a value between 0 and 1. Utah Lake total ecosystem α = 1.37 and R = 0.18 (Table 16) indicating an immature (chronic early succession) system, with low resilience, and below optimal trophic functioning based on Mukherjee et al. (2019) ‘window of vitality’ (Bhavan et al. 2020).

Table 16. Relative ascendency (α) and robustness, R for Utah Lake foodweb.

Source	Ascendency (flowbits)	Capacity (flowbits)	Relative Ascendency α	Robustness, R
Import	6.447	49.88	0.13	-0.11
Internal flow	29114	18767	1.55	0.30
Export	4194	2733	1.53	0.29
Respiration	905.3	3505	0.26	-0.15

Total	34220	25054	1.37	0.18

Ecoexergy

Ecoexergy is the amount of inherent workable energy of the system when it maintains equilibrium within its living environment. The concept has been suggested by Jørgensen (2005, 2007). When a system is at maximum distance from thermodynamic equilibrium, it possesses the highest value of exergy (Jørgensen 2007). Therefore, ecoexergy measures the distance from thermodynamic equilibrium (Jørgensen 2005)[3]. Higher group organisms possess more exergy value than the simpler organisms, and in a complex system, the exergy level is high. Living systems have a particular high exergy mostly due to their high information content (Jørgensen 2005). The theory is that biological systems including ecosystem should evolve in a way that they optimize their thermodynamic efficiency (Nielsen et al. 2020). Exergy can be considered one of the major functional parameters of the ecosystem, as it reflects the components' energy level to maintain the normal functioning of any system (Zhang et al., 2010).

$$Ex = \sum_{i=1}^{n} \beta i C i$$

Here, βi is the weighing factor of the ith component of a system, and Ci is the corresponding concentration of this component. I = 1 is for detritus, and the β values of different organisms are reported by Jørgensen (2007).

Exergy values for Utah Lake were not calculated in this model but will be calculated in future iterations.

[3] Ecoexergy is often explained as a translation of Darwinian survival of the fittest. The fittest ecosystem is the one able to use and store fluxes of energy and materials in the most efficient manner i.e., it has the highest ecoexergy (Nielsen et al. 2020).

Carp Removal Program

Carp removal was estimated at 3 t km^{-2} yr^{-1} which was about 3.33% removal per year. Consequently, fishing mortality rate was estimated to be 9% y^{-1} for medium sized carp, and 3% y^{-1} for large carp. Carp removal subsequently was a minor component of the food web based on overall carp production (Figure 33) and biomass (Figure 34), however mixed trophic level impacts suggested that the carp removal program had substantial negative and positive effects on the food web (Table 17).

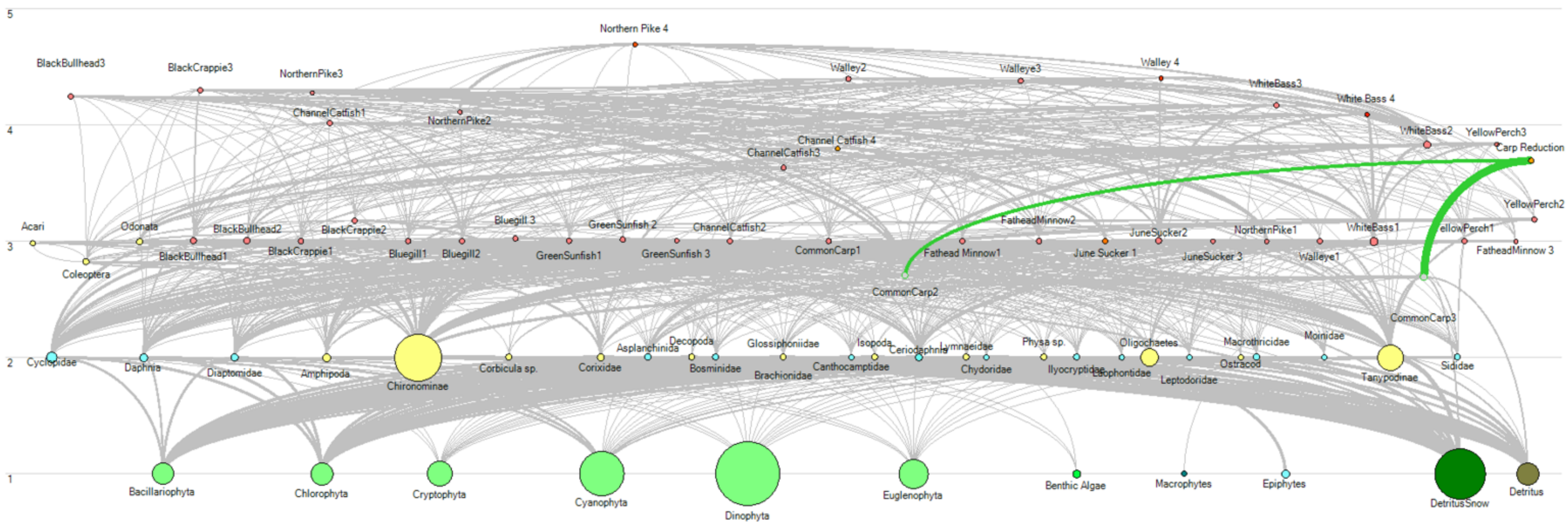


Figure 33, Carp reduction component of foodweb based on production estimates.

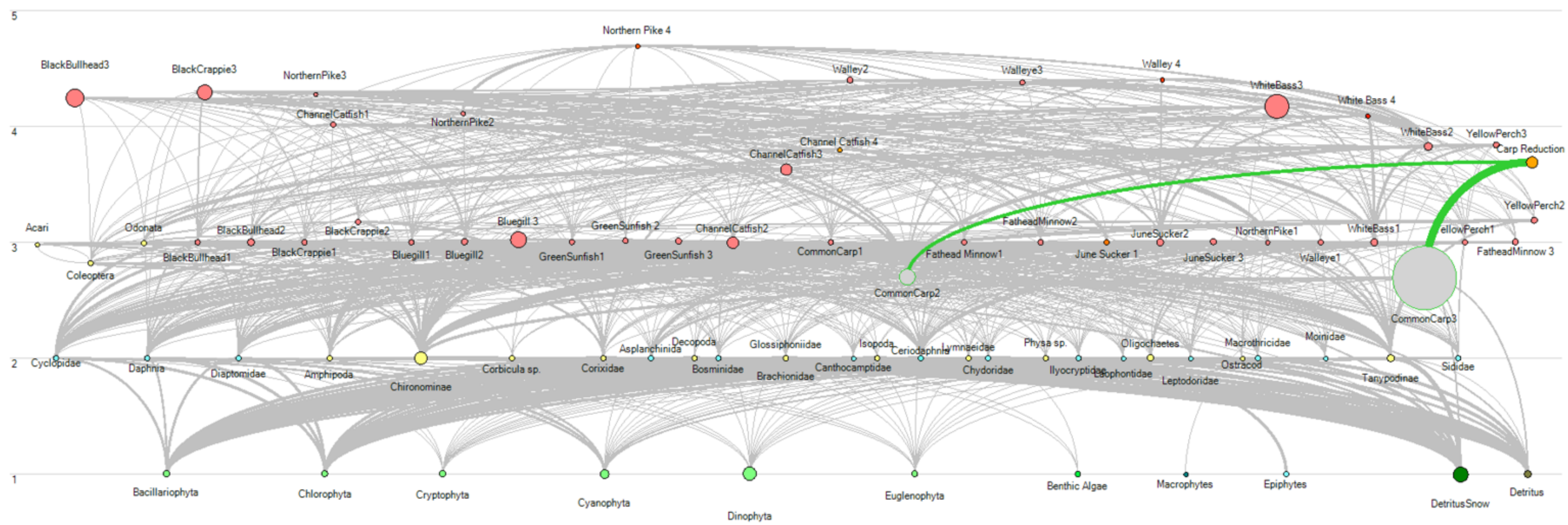


Figure 34. Carp reduction component of foodweb based on biomass estimates

The Carp removal program had negative mixed trophic level impacts on several taxa, the removal program itself, and detrital snow and detritus. These groups, and others, decreased in biomass when carp were removed (Table 17a). Contrarily, the Carp removal had positive impacts on other groups including macrophytes, lymnaeid snails, oligochaetes, chironomids, several fish ontogenetic groups, including June Sucker (Table 17b).

Table 17. Mixed trophic level Impacts of Carp removal program (fleet).

a. Negative impacts

Common Carp 3	-0.51
Carp Reduction	-0.43
Glossiphoniidae	-0.13
Amphipoda	-0.11
Isopoda	-0.11
Detrital Snow	-0.10
Epiphytes	-0.10
Ostracod	-0.09
Decopoda	-0.08
Corbicula sp.	-0.08
Benthic Algae	-0.07
Detritus	-0.07

b. Positive Impacts

Macrophytes	0.51
Lymnaeidae	0.33
Oligochaetes	0.24
Tanypodinae	0.15
GreenSunfish1	0.12
Walleye1	0.11
June Sucker 3	0.11
Green Sunfish 3	0.10
Chironominae	0.10
Physa sp.	0.10
NorthernPike1	0.09
BlackBullhead2	0.08
Green Sunfish 2	0.07
JuneSucker2	0.07
YellowPerch2	0.06
Bluegill 3	0.05

Discussion

Results from this proof-of-concept EcoPath foodweb model, although not precise, strongly support our understanding of the Utah Lake ecosystem: a longtime-chronically-abused lake with a foodweb almost completely dominated by Common Carp and chironomids that is water column primary production centric and has large amounts of detrital snow supporting detritivorous benthos. The biomass of carp far exceeded all other taxa. Estimated total biomass of carp in the lake was almost 60% of the total biomass of all other organisms combined.

Many of the generated results and indices/metrics in the EcoPath model also pointed towards a dysfunctional ecosystem as suggested by Richards and Miller (2019d) and Richards (2022). Dominance and 'keystoneness' by a handful of species predominantly invasive fishes including by far Common Carp, but also Channel Catfish, Black Bullhead, White Bass but also native midges (chironomids primarily *Chironomus* sp. and *Tanypus* sp.) strongly indicate a grossly out of balance and poorly functioning food web/ecosystem as did several other metrics including system robustness, omnivory index, etc. However, the EcoPath model was based on very limited input data with low Pedigree. An increase in research and monitoring is urgently needed, as is frequent updating model inputs. Also, fish diets were based on only one sample event. Diet analyses need to be updated regularly. Stable isotope analyses are an important addition for long-term general diet assessment.

The model did not fully describe taxon specific ontogenetic temporal diet shifts and life histories of most taxa. For example, Black Bullheads spawn later in the season than White Bass subsequently, diets, predators, and niches of early life stages of these two invasive species likely don't overlap to the extent the model would indicate. This is likely true of the other fish taxa in Utah Lake. The biomass of primary producer taxa also peaks at different times within a year, as do zooplankton, therefore, zooplankton diets, predators, and niches don't always overlap as shown in this preliminary model (Richards 2019b, c, Richards 2021). Zooplankton diets were not directly measured and were only based on literature estimates. This needs to be rectified in future iterations.

An important component of the food web that was not modeled was the microbial loop and associated nanoplankton due to lack of data. It is widely recognized that a large portion of primary production flows through the water column pool of dissolved organic matter (DOM), either after excretion by phytoplankton or by lysis of ungrazed cells. This component of primary production is not directly available to zooplankton grazers. It is mainly used by bacteria and auto/ heterotrophic nanoflagellates (Mackinson and Daskalov 2007). Bacteria and nanoflagellates can utilize anywhere from 5 to 50% of primary production in some aquatic systems (van Es and Meyer-Reil 1982, Mackinson and Daskalov 2007) that is then converted into bacteria and nanoflagellate biomass which then becomes available to zooplankton grazers via the 'microbial loop' (Azam et al. 1983) (Figure 35). Cole et al. (1989) reported that heterotrophic bacterial production can be twice as large as the production of zooplankton production and planktonic bacterial production can range from 20%–30% of total planktonic primary production (Mackinson and Daskalov 2007). Kirman (2000) classified microflora (bacteria and nanoflagellates) as those organisms smaller than phytoplankton (microplankton = 20 to 200 μm, nano = 2 to 20 μm, picoplankton = 0.2 to 2 μm)

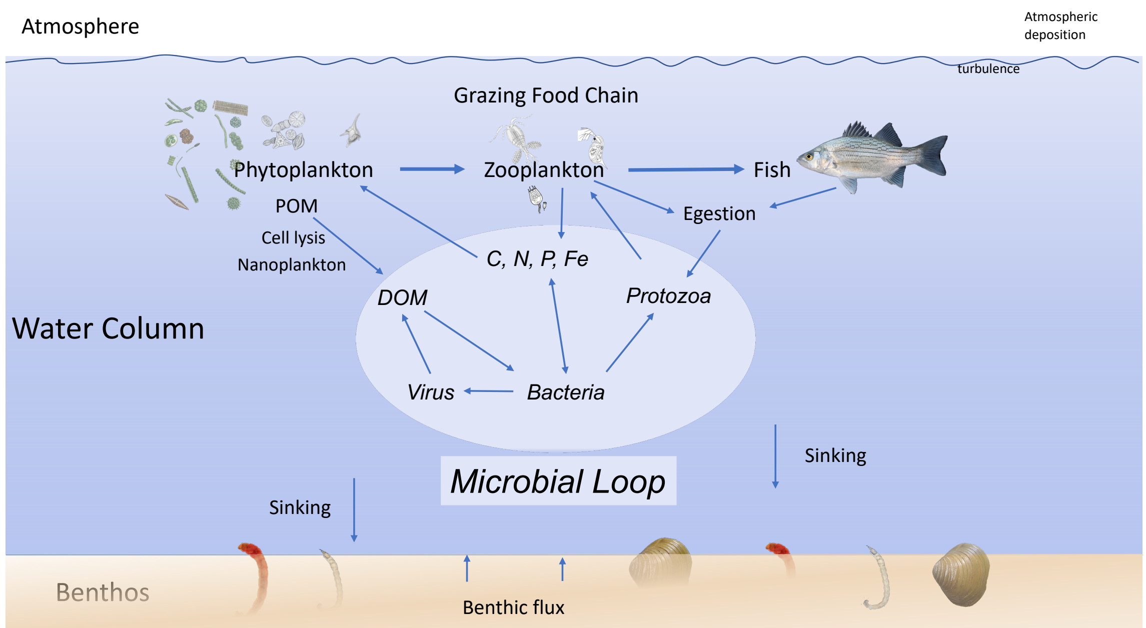


Figure 35. Simplified version of the microbial loop in Utah Lake. Modified from Azam (1998). The importance of the microbial loop in Utah Lake's food web is likely vastly underestimated and which will be incorporated into ongoing food web models.

The microbial loop (Figure 35) is expected to be a significant if not dominant contributor to the lake's food web given the eutrophic condition and the dominance of water column food web components of Utah Lake (Legendre and Rassoulzadegan 1995, De Laender et al. 2010). For example, Matthias et al. (2021) using EcoPath models showed the importance of the microbial loop in Lake Superior and that the microbial loop in Lake Superior was highly efficient (TTE > 0.20). Matthias et al. (2021) also found that the inclusion of the microbial loop in EcoPath models resulted in vastly different trophic structures than models that did not include microbial loops and that the microbial loop is critically ecologically important and highly responsive to water column dynamics. Utah Lake water column dynamics are also of utmost importance to its food web as demonstrated in this proof-of-concept model.

Although the microbial loop was not modeled in this proof-of-concept model, it will be modeled in future iterations initially as part of the detritus component and then depending on relevant literature findings or preferably empirical data collected from the lake, incorporated into separate groups similar to phytoplankton divisions and zooplankton families used in the initial model similar to Munawar et al. (2009).

The importance of modelling top-down controls of nutrients on algal blooms cannot be overstated. Although nutrients are essential for algae growth, nutrients typically explain substantially less than half the variability of algal blooms in lakes. Carpenter and Kitchell (1993) stated that algal concentrations (Chlorophyll a) can differ among lakes by an order of magnitude or more at any given level of nutrient loading or concentration. In their studies, this relationship had an $R^2 = 0.40$. Similarly, Utah Division of Water Quality reported that the relation between Chlorophyll a and P in Utah Lake had an $R^2 = 0.38$ (Figure 36).

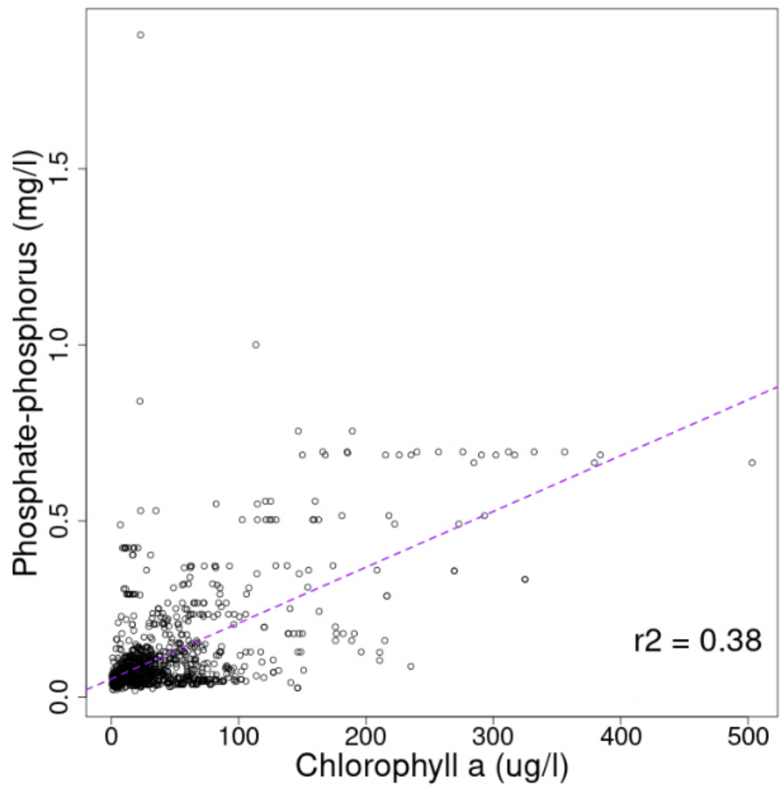


Figure 36. Relationship between Chlorophyll a (µg L^{-1}) and phosphorus (mg L^{-1}) in Utah Lake (data from Utah Division of Water Quality).

Obviously, something other than nutrient concentrations must be affecting algal growth. The answer appears to lie within foodweb interactions. Carpenter and Kitchell (1993) found that just one simple component of the food web, *zooplankton mean length* (an indicator of size-selective predation and the intensity of grazing) explained 45% of the variability in summer mean chlorophyll *a* in their study lakes, more than did nutrient levels.

There are thousands of ecological interactions other than those described by *zooplankton mean length* that affect chlorophyll *a* (e.g., algal blooms) in lakes. These other factors dwell in the realm of trophic cascades or top-down controls. Scientific understanding of trophic cascades and top-down controls in food webs is not new. This concept has been well established in the ecological literature for almost a century (Elton 1927, Lindeman 1942, Paine 1980, others) and even since Darwin's (1859) view that plants and animals 'are bound together by a web of complex relations' (Carpenter and Kitchell 1993). In general, "*the trophic cascade hypothesis states that nutrient input sets the potential productivity of lakes and that deviations from the potential are due to food web effects*" (Carpenter et al., 1985, Carpenter and Kitchell 1993), i.e., trophic cascades/top-down control.

Results from mixed trophic level impacts in this EcoPath foodweb model showed that for the most part the only taxa groups that negatively affected algal taxa were other algal taxa and to a lesser extent zooplankton taxa (Figure 31). In addition, much of the water column phytoplankton based primary production fell as detrital snow increasing the importance of detritus in the foodweb, which also happens to be a major food resource for carp. This further illustrates a poorly functioning ecosystem where the zooplankton assemblage has been degraded to a level where it cannot top-down control algae.

Ecosystem robustness and exergy are important indices for determining the health and sustainability issues of ecosystems (Swain et al 2022) and this EcoPath model was able to some extent describe Utah Lake's ecosystem functioning, system hierarchy, and system maturity (Christensen and Pauly, 1993). In addition, the internal indices e.g., ecotrophic efficiency (EE), trophic level (TL) and transfer efficiency (TE) can be useful for comparative analyses of temporal changes in functional groups within the lake and for understanding the future functioning of its ecosystem, or lack thereof (Heymans et al., 2004). As an example, the EcoPath model suggested that Utah Lake's ecosystem did not follow Lindeman's (1942) 10% law where an increase in TL should result in a decrease in TE. There was an increase in TE from TL II to TL III from 0.15 to 0.22 using the EcoPath model for Utah Lake. This suggests major trophic level transfer problems within the lake ecosystem.

The EcoPath model is considered a proof-of concept model because food web data for Utah Lake are woefully inadequate. Consequently, this model helps identify data gaps that are needed to be filled so as to guide future monitoring and research.

Results of the EcoPath proof-of-concept model presented in this report are just a small portion of the potential of EwE. EcoPath models can be compared using different scenarios and EcoSim models can then be used as a time dynamic simulation module for management exploration. Ecospace can then be used as a spatial and temporal dynamic module once input data are refined. EwE can be integrated with other ecosystem models including the WASP models that are in development. Forcing functions can also be added to all EwE modules including possibly microbial loop forcing functions.

Use of currency other than biomass (t km^2 y^{-1}) can be used in future iterations and then run in EcoSim to evaluate different scenarios. One important currency would be phosphorus, P. Utah Lake is highly eutrophic with very high levels of P within the system (Richards 2022b). It is important to trace P through the foodweb to help determine best management of nutrients. For example, Richards (2022) estimated that there was approximately 2150 tons of P stored in Utah Lake living organisms, of that about 1350 tons of P were stored in Common Carp biomass. The carp removal program was estimated to remove about 30 to 50 tons of P annually (Richards 2022).

Also, it is anticipated that WASP models that Utah Division of Water Quality are developing for Utah Lake will provide a suite of P concentrations that will result in precise estimates of changes in phytoplankton division biomasses, particularly cyanobacteria, and more importantly levels of toxins. These P and resultant predicted phytoplankton biomass scenarios can then be incorporated into EwE to determine how the foodweb influences WASP model predictions and to better refine both WASP and EwE models.

Conclusion

This proof-of concept- mass balance EcoPath model of Utah Lake food web is a critical first step for a more complete understanding of how best to manage the lake including algal blooms and the lake's fisheries. Without this component, Utah Lake cannot be adequately managed. Further refinement of input data is crucial and reflects the poor state of knowledge of Utah Lake's fisheries and other components of its foodweb. The EcoPath model performed very well describing, quantifying, and verifying aspects of the lake's ecosystem that until now have not been examined even given the impreciseness of the model, The ultimate goal is the restoration of Utah Lake including a well-balanced foodweb and fully functioning ecosystem consisting of native flora and fauna. The EcoPath model results presented in this report along with additional EwE models being developed are a critical first step and the foundation for success of this goal.

Recommendations

This proof-of-concept EcoPath foodweb model for Utah Lake provided the necessary first step for understanding and managing the lake. Results from the model highlighted major data and management gaps. Subsequently, the following are recommended:

- Constantly refine all input data based on empirical data and literature values when no empirical data are available.

- Vastly increase sampling effort of members of food web including plankton, benthic algae, benthic invertebrates, macrophytes, detritus, and fishes.

- Funding needs to be made available for a dedicated research and monitoring program and research station on Utah Lake. Fisheries studies are sorely lacking, as is food web monitoring. This is due to severe under funding and apparent lack of concern for research and monitoring or the importance of this unique ecosystem. Most other large lakes in the U.S have dedicated and well-funded research programs including Flathead Lake, Lake Tahoe, all of the Great Lakes, Pyramid Lake, etc.

- Given the vast scientific literature on the top-down effects of higher trophic levels on lower trophic levels and their complex interactions, including top-down effects on algal blooms; development and implementation of foodweb models such as this proof-of-concept model need to have equal or more funding and professional effort than bottom-up models such as nutrient centric models (e.g., WASP models). These models can then be combined to describe conditions and best manage Utah Lake.

- Run multiple scenarios once input data are refined and specific management goals are defined.

- Separate phytoplankton, benthic algae, and zooplankton into higher resolution taxonomic groups. Further refine diets. Run models.

- Incorporate the microbial loop in future EwE models.

- Add functional traits to each taxon and separate into functional groups where appropriate. Functional trait analyses are now considered more relevant to understanding ecosystem function than are taxonomically based groups (Richards 2021a) and have been used in recently published EwE models (Endrédi et al. 2021).

- Carp harvest values need further verification.

- Use different types of currency in EwE models. Phosphorus is a likely candidate currency.

- Coordinate modelling efforts between agencies and researchers sharing EwE model. The primary goal of developing this EcoPath model was to share with other groups.

Acknowledgements

Grateful acknowledgment to Utah State University fisheries researchers including Kevin Landom, Utah Division of Natural Resource fisheries biologists, Wasatch Front Water Quality Council members Dr. Theron Miller, Leland Myers, Frank Fluckiger, and Council technicians for input and support. WFWQC for funding. Mr. Brett Marshall, River Continuum Concepts, and Rushforth Phycology for valuable foodweb insights.

Literature Cited

Abascal-Monroy IM, Zetina-Rejón MJ, Escobar-Toledo F, López-Ibarra GA, Sosa-López A, Tripp-Valdez A (2016) Functional and structural food web comparison of terminos Lagoon, Mexico in three periods (1980, 1998, 2011). Estuar Coast 39(4):1282–1293.https:// doi. org/ 10. 1007/ s12237- 015- 0054-0.

Abdul, W.O., Adekoya, E.O., 2016. Preliminary EcoPath model of a tropical coastal estuarine ecosystem around bight of Benin, Nigeria. Environ. Biol. Fishes 99, 909–923.

Allen KR (1971) Relation between production and biomass. J Fish Res 28(10):1573–1581. https:// doi. org/ 10. 1139/ f71- 236

Allen, J. I. and L. Polimene. 2011. Linking physiology to ecology: towards a new generation of plankton models. J. Plankton Res. , 33, 989–997.

Angermeier, P. L., and J. R. Karr. 1994. Biological integrity versus biological diversity as policy directives: Protecting biotic resources. BioScience 44:690-697.

Arias-González JE (1998) Trophic models of protected and unprotected coral reef ecosystems in the south of the Mexican Caribbean. J Fish Biol 53:236–255. https:// doi. org/ 10. 1111/j. 1095-8649. 1998.tb010 30.x

Arreguín-Sánchez F, Arcos E, Chávez EA (2002) Flows of biomass and structure in an exploited benthic ecosystem in the Gulf of California. Mexico Ecol Modell 156(2–3):167–183.

Arreguín-Sánchez F, Zetina-Rejón M, Manickchand-Heileman S, Ramírez-Rodríguez M, Vidal L (2004) Simulated response to harvesting strategies in an exploited ecosystem in the southwestern Gulf of Mexico. Ecol Model 172(2–4):421–432

Azam, F. 1988. Microbial control of oceanic carbon flux: the plot thickens. Science. Vol. 280: 694-696.

Baird D, Ulanowicz RE (1993) Comparative study on the trophic structure, cycling and ecosystem properties of four tidal estuaries. Mar Ecol Prog Ser 99(3):221–237

Bentley, J.W., Serpetti, N., Fox, C.J., Reid, D., Heymans, J.J., 2018. Modelling the food web in the Irish Sea in the context of a depleted commercial fish community. Part 1: EcoPath Technical Report., Scottish Association for Marine Science. https://doi.org/10.6084/m9.figshare.6323120.v1.

Bhavan et al. 2021. Ecosystem modelling to understand the trophic dynamics and ecosystem health of a small tropical Indian estuary. Ecological Informatics. 66: 101429.

Blukacz-Richards, E.A., Koops, M.A., 2012. An integrated approach to identifying ecosystem recovery targets: application to the Bay of Quinte. Aquat. Ecosyst. Health Manag. 15, 464–472.

Bondavalli C, Bodini A (2014) How interaction strength affects the role of functional and redundant connections in food webs. Ecol Complex 20:97–106. https:// doi. org/ 10. 1016/j. ecocom. 2014. 09.004

Boyer, J., K. Rubalcava, S. Booth, and H. Townsend. 2022. Proof-of-concept model for exploring the impacts of microplastics accumulation in the Maryland coastal bays ecosystem. Ecological Modelling. 464 109849.

Brey, T. 2001. Population dynamics in benthic invertebrates. A virtual handbook. Version 01.2. http://www.thomas-brey.de/science/virtualhandbook.

Brey, T. 2012. A multi-parameter artificial neural network model to estimate macrobenthic invertebrate productivity and production. Limnology and Oceanography Methods. 1: 92-101. https://doi.org/10.4319/lom.2012.10.581.

Calow, P. 1987. Towards a definition of functional ecology. Funct. Ecol. , 1, 57–61.

Cameron, C.J., Cameron, I.F. and Paterson, C.G. 1979. Contribution of organic shell matters to biomass estimates of Unionid bivalves. Canadian Journal of Zoology, 57(8):1666-1669.

Cao, Y, Hawkins, CP. 2019. Weighting effective number of species measures by abundance weakens detection of diversity responses. J Appl Ecol. 2019; 00: 110.https://doi.org/10.1111/1365-2664.13345

Carpenter et al. 1985. Cascading trophic interactions and lake productivity. BioScience, 35: 634-639.

Carpenter, S.R. and J.F. Kitchell. 1993. The trophic cascade in lakes. Cambridge Studies in Ecology.

Christensen, V., Pauly, D., 1993. Trophic models of aquatic ecosystems. WorldFish. 26,1–390.

Christensen, V., Walters, C., Pauly, D., Forrest, R.E., 2008. EcoPath with EcoSim version 6 User 848 Guide. Fisheries Centre, University of British Columbia, Vancouver November 2, 235.

Christensen, V., Walters, C.J., Pauly, D., 2005. EcoPath with EcoSim: a user's guide. Fish.Centre, Univ. Br. Columbia, Vancouver, p. 154.

Christensen, V., Walters, C.J., Pauly, D., Forrest, R., 2008. EcoPath with EcoSim Version 6.User Guide. Lenfest Ocean Futur. Proj, p. 235.

Christensen,V. and C.J. Walters. 2004. EcoPath with EcoSim: methods, capabilities and limitations. Ecol. Model., 172 (2004), pp. 109-139.

Cole, J.J., Finlay, S., and Pace, M.L., 1989. Bacterial production in fresh and saltwater ecosystems: a cross system overview. Mar. Ecol. Prog. Ser., 43: 1-10.

Coll, M., Akoglu, E., Arreguín-Sánchez, F. et al. Modelling dynamic ecosystems: venturing beyond boundaries with the EcoPath approach. Rev Fish Biol Fisheries 25, 413–424 (2015). https://doi.org/10.1007/s11160-015-9386-x

Colléter, M., Valls, A., Guitton, J., Morissette, L., Arreguín-S´anchez, F., 2013. EcoBase: A Repository Solution to Gather and Communicate Information from EwE Models. Fisheries Centre of the University of British Columbia, Vancouver, Canada.

Colléter, M., Valls, A., Guitton, J., Gascuel, D., Pauly, D., Christensen, V., 2015. Global overview of the applications of the EcoPath with EcoSim modeling approach using the EcoBase models repository. Ecological Modelling 302, 42–53. https://doi.org/10.1016/j.ecolmodel.2015.01.025

Cardona L (2006) Trophic cascades uncoupled in a coastal marsh ecosystem. Biol Invasions 8(4):835–842.

Corrales X, Coll M, Ofir E, Piroddi C, Goren M, Edelist D, Heymans JJ, Steenbeek J, Christensen V, Gal G (2017) Hindcasting the dynamics of an Eastern Mediterranean marine ecosystem under the impacts of multiple stressors. Marine Ecology Progress Series 580:17–36

Cox, S.P., Kitchell, J.F., 2004. Lake Superior ecosystem, 1929−1998: simulating alternative hypotheses for recruitment failure of lake herring (Coregonus artedi). Bull. Mar. Sci. 74, 671–683.

Crowder, L., Norse, E., 2008. Essential ecological insights for marine ecosystem-based management and marine spatial planning 32, 772–778. doi:10.1016/j.marpol.2008.03.012

Dame, J.K., Christian, R.R., 2008. Evaluation of ecological network analysis: Validation of output. Ecol. Modell. 210, 327–338. doi:10.1016/j.ecolmodel.2007.08.004

Darwin, C. 1859. The Origin of Species. The Modern Library, New York.

De Laender, F., D. Van Oevelen, K. Soetaert, and J. J. Middelburg. 2010. Carbon transfer in herbivore- and microbial loop-dominated pelagic food webs in the southern Barents Sea during spring and summer. Mar. Ecol. Prog. Ser. 398: 93- 108. doi: 10.3354/meps08335.

De Mutsert K, Steenbeek J, Lewis K et al (2016) Exploring effects of hypoxia on fish and fisheries in the northern Gulf of Mexico using a dynamic spatially explicit ecosystem model. Ecol Model 331:142–150. https:// doi. org/ 10. 1016/j. ecolm odel. 2015. 10. 013

Elton, C.S. 1927. Animal Ecology. Sidgwick and Jackson, Ltd., London.

Endrédi, A., Patonai, K., Podani, J., Libralato, S. and F. Jordán. 2021. Who is where in marine food webs? A Trait-Based Analysis of Network Positions. Front. Mar. Sci. 8:636042. doi: 10.3389/fmars.2021.636042

Feng, J., Tian, X.-L., Dong, S.-L., He, R.-P., Zhang, K., Zhang, D.-X., Li, L., Zhang, Q.-Q., Zhang, T., 2018. Comparative analysis of the energy fluxes and trophic structure of polyculture ecosystems of Portunus trituberculatus based on EcoPath model. Aquaculture 496, 185–196.

Finn, J.T., 1976. Measures of ecosystem structure and function derived from analysis of flows. J. Theor. Biol. 56, 363–380.

Fretzer, S. 2016. Using the EcoPath approach for environmental impact assessment—A case study analysis. Ecological Modelling. 331: 160-172.

Frey, D. 1975. Biological integrity of water: An historical perspective. Pp. 127-139 in The Integrity of Water, R. K. Ballentine and L. J. Guarraia, eds. Washington, D.C.: Environmental Protection Agency.

Gilbert AJ (2009) Connectance indicates the robustness of food webs when subjected to species loss. Ecol Indic 9(1):72–80.

Halpern, B. S., Silliman, B. R., Olden, J. D., Bruno, J. P., and Bertness, M. D. (2007). Incorporating positive interactions in aquatic restoration and conservation. Front. Ecol. Environ. 5, 153–160. doi: 10.1890/1540-9295(2007)5[153:IPIIAR]2. 0.CO;2.

Heath MR, Cook RM, Cameron AI, Morris DJ, Speirs DC (2014). Cascading ecological effects of eliminating fishery discards. Nat.Commun 5:1–8. https:// doi. org/ 10. 1038/ ncomm s4893.

Heymans, J.J., 2003. Ecosystem Models of Newfoundland and Southeastern Labrador: Additional Information and Analyses for "Back to the Future".

Heymans, J.J., Coll, M., Link, J.S., Mackinson, S., Steenbeek, J., Walters, C., Christensen, V., 2016. Best practice in EcoPath with EcoSim food-web models for ecosystem-based management. Ecological Modelling 331, 173–184. https://doi.org/10.1016/j.ecolmodel.2015.12.007

Heymans, J.J., Gu´enette, S., Christensen, V., 2007. Evaluating network analysis indicators of ecosystem status in the Gulf of Alaska. Ecosystems 10, 488–502.

Heymans, J.J., Shannon, L.J., Jarre, A., 2004. Changes in the northern Benguela ecosystem over three decades: 1970s, 1980s, and 1990s. Ecol. Model. 172, 175–195.

Heymans et al 2018

Heymans JJ, Coll M, Link JS, Mackinson S, Steenbeek J, Christensen V. 2016. Best practice in EcoPath with EcoSim food-web models for ecosystem based management. Ecological Modelling 331:173–184

Hill et al 2007

Holcomb, J. et al. and D.C. Richards. 2019. Analysis of Relict Shell Snails of Goshen Bay on Utah Lake. Progress Report to Wasatch Front Water Quality Council, Salt Lake City, UT.

Horn et al. 2021. Food web models reveal potential ecosystem effects of seagrass recovery in the northern Wadden Sea. Restoration Ecology. 1-13.

Hossain, M., Arhonditsis, G.B., Koops, M.A., Minns, C.K., 2012. Towards the development of an ecosystem model for the Hamilton Harbour, Ontario, Canada. J. Great Lakes Res. 38, 628–642

Jørgensen, S.E. 2005. Chapter 15 - Maximization of Ecoexergy in Ecosystems. Editor(s): Stanislaw Sieniutycz, Henrik Farkas. Variational and Extremum Principles in Macroscopic Systems, Elsevier. 675-692,

Jørgensen, S.E., 2007. Description of aquatic ecosystem's development by eco-exergy and exergy destruction. Ecol. Model. 204, 22–28.

Kao, Yu-Chun, S. Adlerstein, and E. Rutherford. 2014. The relative impacts of nutrient loads and invasive species on a Great Lakes food web: An EcoPath with EcoSim analysis. Journal of Great Lakes Research. 40. 10.1016/j.jglr.2014.01.010.

Karr, J. R. 1993. Defining and assessing ecological integrity: Beyond water quality. Environmental Toxicology and Chemistry, 12: 1521-1531. doi:10.1002/etc.5620120902

Karr, J. R., and D. R. Dudley. 1981. Ecological perspective on water quality goals. Environmental Management 5:55-68.

Karr, J. R., and E. W. Chu. 1997. Biological Monitoring and Assessment: Using Multimetric Indexes Effectively. EPA 235-R97-001. University of Washington, Seattle.

Karr, J. R., K. D. Fausch, P. L. Angermeier, P. R. Yant, and I. J. Schlosser. 1986. Assessing Biological Integrity in Running Waters: A Method and its Rationale. Special Publication No. 5. Champaign, Ill.: Natural History Survey.

Kennedy, M.C., O'Hagan, A., 2001. Bayesian calibration of computer models. Journal of the Royal Statistical Society: Series B (Statistical Methodology) 63, 425–464.

Kirman (2000)

Kitchell, J.F., Cox, S.P., Harvey, C.J., Johnson, T.B., Mason, D.M., Schoen, K.K., Aydin, K., Bronte, C., Ebener, M., Hansen, M., Hoff, M., Schram, S., Schreiner, D., Walters, C.J., 2000. Sustainability of the Lake Superior fish community: interactions in a food web context. Ecosystems 3, 545–560.

Landom, K.L. 2010. Introduced Sport Fish and Fish Conservation in a Novel Food Web: Evidence of Predatory Impact. M.S. Thesis. Utah State University, Logan, UT.

Landom, K and T. E. Walsworth. 2021. Utah Lake ecosystem monitoring to support June sucker conservation efforts

Langseth, B.J., 2012. An Assessment of Harvest Policies for a Multi-Species Fishery in Lake Huron Using a Food-web Model. (Doctoral dissertation) Michigan State University, East Lansing, Michigan.

Langseth, B.J., Rogers, M., Zhang, H.Y., 2012. Modeling species invasions in EcoPath with EcoSim: an evaluation using Laurentian Great Lakes models. Ecol. Model. 247, 251–261.

Legendre L, Rassoulzadegan F (1995) Plankton and nutrientdynamics in marine waters. Ophelia 41:153–172

Libralato S (2008) System Omnivory Index. In: Jørgensen SE, Fath BD (eds) Ecological indicators. Academic Press, Oxford, pp 3472–3477

Libralato S, Christensen V, Pauly D (2006) A method for identifying keystone species in food web models. Ecol Model 195:153–171. https:// doi. org/ 10. 1016/j. ecolm odel. 2005. 11. 029

Lindeman, R.L., 1942. The trophic-dynamic aspect of ecology. Ecology 23, 399–417.

Liu, H., Yang, J. and Gan, J. 2010. Trace element accumulation in bivalve mussels Anodonta woodiana from Taihu Lake. China Archives of Environmental Contamination and Toxicology, 59(4), pp. 593–601.

Lira A, Angelini R, Le Loch F, Ménard F, Lacerda C, Frédou T et al. 2018. Trophic flow structure of a neotropical estuary in northeastern Brazil and the comparison of ecosystem model indicators of estuaries. J Mar Syst 182:31–45

Long, R.D., Charles, A., Stephenson, R.L., 2015. Key principles of marine ecosystem-based management. Marine Policy 57, 53–60.

Mackinson, S. and Daskalov, G., 2007. An ecosystem model of the North Sea to support an ecosystem approach to fisheries management: description and parameterization. Sci. Ser. Tech Rep., Cefas Lowestoft, 142: 196pp.

Malathi, S. and S.Thippeswamy. 2013. The proximate and mineral compostions of freshwater mussel Parreysia corrugate (Mullar, 1774) from Tunga River in the Western Ghats, India. Global Journal of Biology, Agriculture, and Health Sciences. Vol 2(3): 165-170.

Mann, K.H. 1964. The pattern of energy flow in the fish and invertebrate fauna of the River Thames. Verhandlungen - Internationale Vereinigung fuer Theoretische und Angewandte Limnologie, 15, pp. 485-495.

Matthias, B.G. et al. 2021. Trophic transfer efficiency in the Lake Superior food web: Assessing the impacts of non-native species. Journal of Great Lakes Research. 47: 1146-1158.

Monaco, M.E., Ulanowicz, R.E., 1997. Comparative ecosystem trophic structure of three US mid-Atlantic estuaries. Mar. Ecol. Prog. Ser. 161, 239–254.

Morissette, L., 2007. Complexity, Cost and Quality of Ecosystem Models and their Impact on Resilience: A Comparative Analysis, with Emphasis on Marine Mammals and the Gulf of St. Lawrence. Doctoral dissertation. University of British Columbia.

Mukherjee, J., Karan, S., Chakrabarty, M., Banerjee, A., Rakshit, N., Ray, S., 2019a. An approach towards quantification of ecosystem trophic status and health through ecological network analysis applied in Hooghly-Matla estuarine system, India. Ecol. Indic. 100, 55–68.

Mumby, P.J., Wolff, N.H., Bozec, Y., Chollett, I., Halloran, P., 2014. Operationalizing the resilience of coral reefs in an era of climate change. Conserv. Lett. 7, 176–187.

Munawar, M., Munawar, I.F., Fitzpatrick, M., Niblock, H., Lorimer, J., 2009. The base of the food web at the top of the Great Lakes: structure and function of the microbial food web of Lake Superior. In: Munawar, M., Munawar, I.F. (Eds.), State of Lake Superior, Ecovision World Monograph Series. Michigan State University Press, East Lansing, MI, pp. 208–318.

Murawski, S.A., Steele, J.H., Taylor, P., Fogarty, M.J., Sissenwine, M.P., Ford, M., Suchman, C., 2010. Why compare marine ecosystems? ICES J. Mar. Sci. 67, 1. doi:10.1093/icesjms/fsp221

Mutsert, de, K. et al. 2015. Exploring effects of hypoxia on fish and fisheries in the northern Gulf of Mexico using a dynamic spatially explicit ecosystem model. Ecological Modelling.

Negus, C.L. 1966. A quantitative study of growth and production of Unionid mussels in the river Thames at Reading. Journal of Animal Ecology, 35(3), 513-532.

Newell, R.I.E. and Ott, J.A. 2013. Macrobenthic communities and eutrophication. In Ecosystems at the Land-Sea Margin: Drainage Basin to Coastal Sea (eds T.C. Malone, A. Malej, L.W. Harding, N. Smodlaka and R.E. Turner). doi:10.1029/CE055p0265.

Newell. R.I.E, Fisher TR, Holyoke RR, Cornwell JC. 2005, Influence of eastern oysters on nitrogen and phosphorus regeneration in Chesapeake Bay, USA. In: Dame R, Olenin S (eds) The comparative roles of suspension feeders in ecosystems. NATO Science Series: IV Earth and Environmental Sciences, Vol 47. Springer, Netherlands, p 93–120.

Nielsen, Søren & Müller, Felix & Marques, João & Bastianoni, Simone & Jørgensen, S.E. 2020. Thermodynamics in Ecology. Entropy. 22. 820. 10.3390/e22080820.

Nuttall, M.A., A. Jordaan, R.M. Cerrato, and M.g. Frisk. 2011. Identifying 120 years of decline in ecosystem structure and maturity of Great South Bay, New York using the EcoPath modelling approach. Ecological Modelling. 222: 3335-3345.

Odum, E.P., 1985. Trends expected in stressed ecosystems. Bioscience 35, 419–422.

Odum, E.P., 2014. The strategy of ecosystem development. In: The Ecological Design and Planning Reader. Springer, pp. 203–216.

Odum, E.P., Barrett, G.W., 1971. Fundamentals of ecology. Saunders, Philadelphia.

Ostroumov, S.A. 2005. Suspension-feeders as factors influencing water quality in aquatic ecosystems. Pages 147–164 in R. Dame and S. Olenin, editors, The comparative roles of suspension feeders in ecosystems. NATO Science Series: IV Earth and Environmental Sciences Volume 47. Springer, Netherlands.

Paine, R.T. 1980. Food Webs: Linkage, interaction strength and community infrastructure. Journal of Animal Ecology. 49(3): 666-685.

Pauly, D., Christensen, V., Walters, C., 2000. EcoPath, EcoSim, and Ecospace as tools for evaluating ecosystem impact of fisheries. ICES journal of Marine Science 57, 697–706.

Pauly, D., Palomaresa, M.L.D., Christensen, P.I.V., 1993. Improved construction, parametrization and interpretation of steady-state ecosystem models

Richards, D.C. 2014. Freshwater mollusk survey, Jordan River, UT. Part 1: Unionid mussels and non-pulmonate snails. Final Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Consulting, Vineyard, UT.

Richards, D. C. 2017. Native Unionoida Surveys, Distribution, and Metapopulation Dynamics in the Jordan River-Utah Lake Drainage, UT. Report to Wasatch Front Water Quality Council. Salt Lake City, UT. OreoHelix Consulting, Vineyard, UT. Version 1.5 May, 26, 2017. Available at:http://wfwqc.org/wp-content/uploads/2017/04/Native-Unionoida-Surveys-and-Metapopulation-Dynamics-in-the-Jordan-River-Utah-Lake-drainage-UT-Version-1.5-compressed.pdf. With supporting documentation at: http://wfwqc.org/wp-content/uploads/2017/10/Appendix-8-Native-Mussels-Spreadsheet-FINAL-read-only.xlsx.

Richards, D. C. 2018. Relationships between Phytoplankton Richness and Diversity, Zooplankton Abundance, and cyanoHAB Dominance in Utah Lake, 2016. Draft Technical Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Consulting. 67pp.

Richards, D.C. 2019a. Spatial and Temporal Variability in Zooplankton Assemblages in Utah Lake 2015 to 2019. Progress Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Consulting, Vineyard, UT.

Richards, D.C. 2019b. Zooplankton assemblages in highly regulated Utah Lake: 2015-2018. Progress Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Consulting, Vineyard, UT.

Richards, D.C. 2019c. Spatial and Temporal Variability of Zooplankton Body Lengths in Utah Lake. Technical Memo to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Consulting, Vineyard, UT.

Richards, D.C. 2021a. Seasonal patterns of phytoplankton assemblage densities and functional traits in Utah Lake: A foodweb model prerequisite. Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Ecological, Vineyard, UT.

Richards, D.C. 2021b. Preliminary estimates of somatic secondary production and production-biomass ratios of chironomid larvae in a Farmington Bay wetland. Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Ecological, Vineyard, UT.

Richards, D.C. 2022a. The health and integrity of Utah Lake 2022: A brief ecological evaluation. Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Ecological, Vineyard, UT.

Richards, D.C. 2022b. Utah Lake Phosphorus Cycle: Biota As Temporary Storage Sinks Technical Memo to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Ecological, Vineyard, UT.

Richards, D. C. and T. Miller. 2017. A preliminary analysis of Utah Lake's unique foodweb with a focus on the role of nutrients, phytoplankton, zooplankton, and benthic invertebrates on HABs. Utah Lake Research 2016. Progress Report. Wasatch Front Water Quality Council, Salt Lake City, UT.

Richards, D. C. and T. Miller. 2019a. Apparent extinction of native mussels in Lower Mill Creek and Mid-Jordan River, Utah. Western North American Naturalist. 79(1): 72-84.

Richards, D. C. and T. Miller. 2019b. Utah Lake Research 2017-2018: Progress Report: Continued analysis of Utah Lake's unique foodweb with a focus on the role of nutrients, phytoplankton, zooplankton, and benthic invertebrates on cyanoHABs. Chapter 1: Phytoplankton Assemblages. Submitted to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Consulting, Vineyard, UT.

Richards, D.C. and T. Miller. 2019c. A Provisional Multi-Metric Index of Biological Integrity (MIBI) to Assess Water Quality in Utah Lake centered on Regulatory Directives. Draft Technical Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Ecological, Vineyard, UT.

Richards, D.C. and T. Miller. 2019d. Factors Effecting the Ecological Health and Integrity of Utah Lake with a Focus on the Relationships between Water Column Regulators, Benthic Ecosystem Engineers, and CyanoHABs. Progress Report to Wasatch Front Water Quality Council. Salt Lake City, UT.

Serpetti N, Baudron AR, Burrows M, Payne BL, Helaouët P, Fernandes PG, Heymans J (2017) Impact of ocean warming on sustainable fisheries management informs the ecosystem approach to fisheries. Scientific Reports 7:1–15

Sorokin, I.I., O. Giovanardi, F. Pranovi, and P.I. Sorokin. 1999. Need for restricting bivalve culture in the southern basin of the Lagoon of Venice. Hydrobiologia 400 (0): 141-148.

Steenbeek J, Buszowski J, Christensen V, Akoglu E, Aydin K, Ellis N, Felinto D, Guitton J, Lucey S, Kearney K, Mack- inson S, Pan M, Platts M, Walters C. 2018. EcoPath with

EcoSim as a model-building toolbox: source code capabilities, extensions, and variations. Ecol Model

Steenbeek, J., Coll, M., Gurney, L., Melin, F., Hoepffner, N., Buszowski, J., Christensen,V., 2013. Bridging the gap between ecosystem modeling tools and geographicinformation systems: driving a food web model with external spatial–temporaldata. Ecol. Model. 263, 139–151.

Stewart, T.J., Sprules, W.G., 2011. Carbon-based balanced trophic structure and flows in the offshore Lake Ontario food web before (1987−1991) and after (2001−2005) invasion-induced ecosystem change. Ecol. Model. 222, 692–708.

Swain, P.R., P.K. Parida, P. Panikkar, B.K. Behera, S.K. Nag, B. K. Das. 2022. Impact assessment of an invasive macrophyte community on ecosystem properties: A Mass Balance Approach for Chilika lagoon, India. Ecological Informatics. 69(101592). https://doi.org/10.1016/j.ecoinf.2022.101592.

Tierney, K.M., Heymans, J.J., Muir, G.K.P., Cook, G.T., Buszowski, J., Steenbeek, J., Walters, W.J., Christensen, V., MacKinnon, G., Howe, J.A., 2018. Modelling marine trophic transfer of radiocarbon (14C) from a nuclear facility. Environmental Modelling and Software 102,138–154.

Turner, R.E., Rabalais, N.N., Justic, D., 2006. Predicting summer hypoxia in the northern Gulf of Mexico: riverine N, P, and Si loading. Mar. Pollut. Bull. 52, 139–148,http://dx.doi.org/10.1016/j.marpolbul.2005.08.012.

Ulanowicz, R.E., 1986. A phenomenological perspective of ecological development. In: Aquatic Toxicology and Environmental Fate: Ninth Volume. ASTM International.

Ulanowicz, R.E., 1995. Utricularia's secret: the advantage of positive feedback in oligotrophic environments. Ecol. Model. 79, 49–57.

Ulanowicz, R.E., 2000. II. 7.1 ascendancy: a measure of ecosystem performance. In:Handb. Ecosyst. Theor. Manag, p. 303.

Ulanowicz, R.E., 2012. Growth and Development: Ecosystems Phenomenology. Springer Science & Business Media.

Ulanowicz, R.E., Abarca-Arenas, L.G., 1997. An informational synthesis of ecosystem structure and function. Ecol. Model. 95, 1–10.

Ulanowicz, R.E., Goerner, S.J., Lietaer, B., Gomez, R., 2009. Quantifying sustainability: resilience, efficiency, and the return of information theory. Ecol. Complex. 6, 27–36.

Ulanowicz, R.E., Puccia, C.J., 1990. Mixed trophic impacts in ecosystems. Coenoses 7–16.

Ulanowicz, R.E., Norden, J.S., 1990. Symmetrical overhead in flow networks. Int. J. Syst.Sci. 21, 429–437.

Ullah, M.H., Rashed-Un-Nabi, M., Al-Mamun, M.A., 2012. Trophic model of the coastal ecosystem of the bay of Bengal using mass balance EcoPath model. Ecol. Model. 225, 82–94.

Uusitalo, L., Lehikoinen, A., Helle, I., Myrberg, K., 2015. An overview of methods to evaluate uncertainty of deterministic models in decision support. Environ. Model. Softw. 63, 24–31. https://doi.org/10.1016/j.envsoft.2014.09.017.

Uusitalo, L. et al 2022. Integrating diverse model results into decision support for good environmental status and blue growth. Science Total Environment. 806: 150450.

Van Es and L. Meyer-Reil (1982) Biomass and metabolic activity of heterotrophic marine bacteria. Advances in Microbial Ecology 6: 111–170.

Vasconcellos, M., Mackinson, S., Sloman, K., Pauly, D., 1997. The stability of trophic mass-balance models of marine ecosystems: a comparative analysis. Ecol. Model.100, 125–134.

Vega-Cendejas ME, Arreguín-Sanchez F (2001) Energy fluxes in a mangrove ecosystem from a coastal lagoon in Yucatan Peninsula. Mexico Ecol Modell 137(2–3):119–133

Vidal L, Pauly D (2005) Integration of subsystems models as a tool toward describing feeding interactions and fisheries impacts in a large marine ecosystem, the Gulf of Mexico. Ocean Coast Manag 47:709–725

Walsworth, T.E., Landom, K. and Gaeta, J.W., 2020. Compensatory recruitment, dynamic habitat, and selective gear present challenges to large-scale invasive species control. Ecosphere, 11(6): p.e03158

Walsworth, T.E., & Landom, K. 2021. Common carp population response to ongoing control efforts in Utah Lake. Annual report submitted to the June Sucker Recovery Implementation Program. Utah State University. 28 pp.

Walsworth, T.E., E. Wallace, and K. Landom. 2022. Common carp population response to ongoing control efforts in Utah Lake. Annual report submitted to the June Sucker Recovery Implementation Program Project I.21.03 Carp population modeling. Department of Watershed Sciences, The Ecology Center, Utah State University Logan, UT 84322

Walters, W.J. and V.Christensen. 2018. Ecotracer: analyzing concentration of contaminants and radioisotopes in an aquatic spatial-dynamic food web model. Journal of Environmental Radioactivity. 181:115-127.

Wetzel, R. G. 2001. Limnology: lake and river ecosystems. Third Edition. Academic Press. San Diego, CA. ISBN13-978-0-12-744760-5

Yin et al. 2022. Modeling ecosystem impacts of the invasive Japanese smelt Hypomesus nipponensis in Lake Erhai, southwestern China. Ecological Informatics. 67: 1 – 13.

Zhang, J., Gurkan, Z., Jørgensen, S.E., 2010. Application of eco-exergy for assessment of ecosystem health and development of structurally dynamic models. Ecol. Model. 221, 693–702.

Appendices

Appendix 1. Length-weight ratios of fish taxa used in food web model.

		Length range (mm)			
Common Name	Size Class	Min	Max	Mean	Weight (g)
Black Bullhead 1	small	5	36	21	1.68
Black Bullhead 2	med	37	197	117	54.76
Black Bullhead 3	large	207	360	284	321.49
Black Crappie 1	small	5	40	23	1.52
Black Crappie 2	med	41	156	99	29.11
Black Crappie 3	large	160	288	224	150.53
Bluegill 1	small	5	26	16	1.20
Bluegill 2	med	27	137	82	33.62
Bluegill 3	large	141	228	185	170.20
Channel Catfish 1	small	5	131	68	23.12
Channel Catfish 2	med	132	195	164	133.66
Channel Catfish 3	large	223	499	361	651.61
Channel Catfish 4	very large	503	746	625	1950.00
Green Sunfish 1	small	5	76	41	8.20
Green Sunfish 2	med	77	104	91	40.95
Green Sunfish 3	large	110	145	128	81.28
Common Carp 1	small	5	21	13	1.18
Common carp 2	med	22	294	158	174.75
Common Carp 3	large	300	725	513	1838.59
Fathead Minnow 1	small	5	46	26	1.30
Fathead Minnow 2	med	47	48	48	4.51
Fathead Minnow 3	large	51	63	57	6.50
June Sucker 1	small	5	313	159	176.97
June Sucker 2	med	314	391	353	869.79
June Sucker 3	large	401	576	489	1670.43
Northern Pike 1	small	5	81	43	11.09
Northern Pike 2	med	82	299	191	217.74
Northern Pike 3	large	302	594	448	1204.22
Northern Pike 4	very large	608	892	750	3375.00
Walleye 1	small	5	80	43	10.84
Walleye 2	med	81	145	113	76.61
Walleye 3	large	255	420	338	683.44

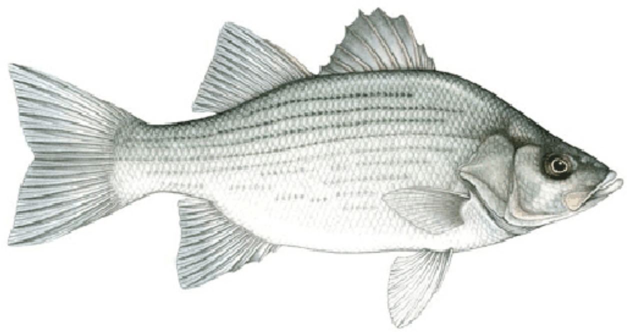
Walleye 4	very large	460	721	591	2092.14
White Bass 1	small	5	34	20	1.14
White Bass 2	med	35	128	82	19.93
White Bass 3	large	133	298	216	139.32
White Bass 4	very large	303	412	358	383.42
Yellow Perch 1	small	5	47	26	1.35
Yellow Perch 2	med	48	145	97	18.62
Yellow Perch 3	large	160	251	206	84.46

June sucker biomass modeled as carp, Northern Pike biomass modeled as Walleye, Fathead Minnow modeled as Yellow Perch, because there were not enough data to do individually, 5 mm was arbitrary minimum length for all early life stages of fish taxa

Appendix 2. Utah Lake Fish Assemblage Life History: Prerequisite for Food Web Models

Utah Lake Fish Assemblage Life History

Prerequisite for Food Web Models



DRAFT
To
Wasatch Front Water Quality Council
Salt Lake City, UT
By
David C. Richards, Ph.D.

OreoHelix Ecological, Vineyard UT 84059
Phone: 406.580.7816
Email: oreohelix@icloud.com

April 4, 2022

Version 1.1

Introduction

Understanding fish assemblage dynamics in Utah Lake is critical for the scientific management of the lake. Without this understanding and applied management guided by food web models that incorporate assemblage dynamics, the lake will continue its downward trend of decreased health and loss of resilience to future perturbations.

Methods

I consulted with DNR fisheries managers and USU fisheries biologists to obtain the most comprehensive fisheries data available for Utah Lake. Data were from several netting programs including commercial seining, trap nets, juvenile traps, and trawls collected from 1998 through 2021. The goal of synthesizing data is to estimate annual average biomass per unit area (ton km^{-2}) of each fish species, however data are not readily transformed to this metric. Additional analyses will be required. In addition, an important goal is to estimate diets of each fish species. Most fish species other than carp and suckers in Utah Lake undergo ontogenetic diet shifts as they grow typically from eating zooplankton to benthic invertebrates and then other fishes. I used the available trap data to estimate size-year classes for each species as well as length-weight relationships, body condition indices, and relative abundances. This is the first round of analyses and will be refined prior to incorporating into our Utah Lake food web models.

Results

Note: ***these are only first round estimates. More detailed analyses are required before using in food web models or evaluating fish assemblage dynamics in detail.***

Relative abundances

Five introduced fish taxa including White Bass, Common Carp, Black Bullhead, Bluegill, and Black Crappie now comprise 94% relative abundance in Utah Lake (Figure 37,Table 18 **Error! Reference source not found.**). The other nine fish species occurring in the lake make up only 6% of total relative abundance (Table 18, Figure 38). Only three native species remain in Utah Lake, suckers (June Sucker and Utah Sucker) and Utah Chub at 0.11% relative abundance. 98.8% of fish abundance in the lake is invasive species. A balanced fishery is needed to restore ecosystem functioning within the food web and to help control algal blooms.

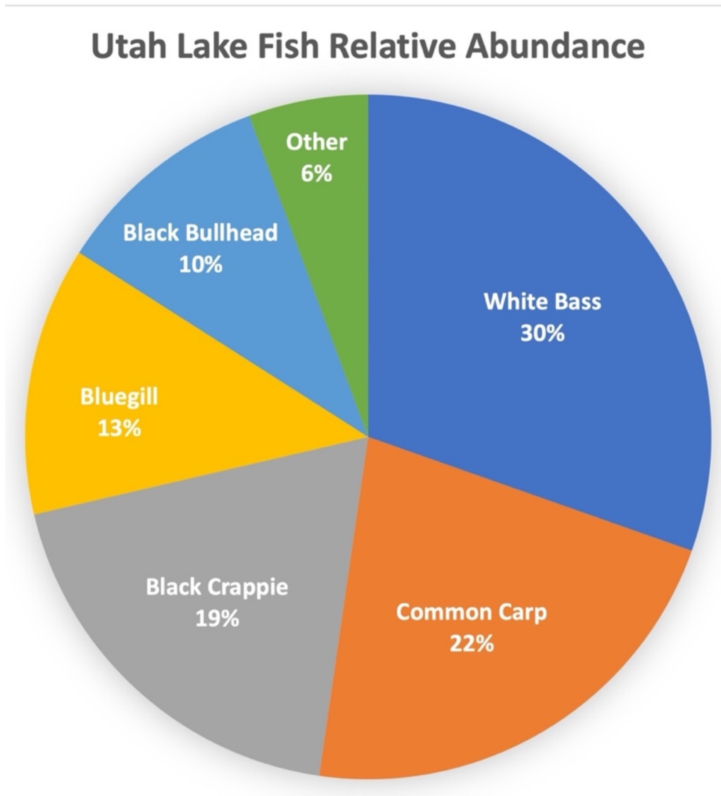


Figure 37. Relative abundances of fishes in Utah Lake as of 2021.

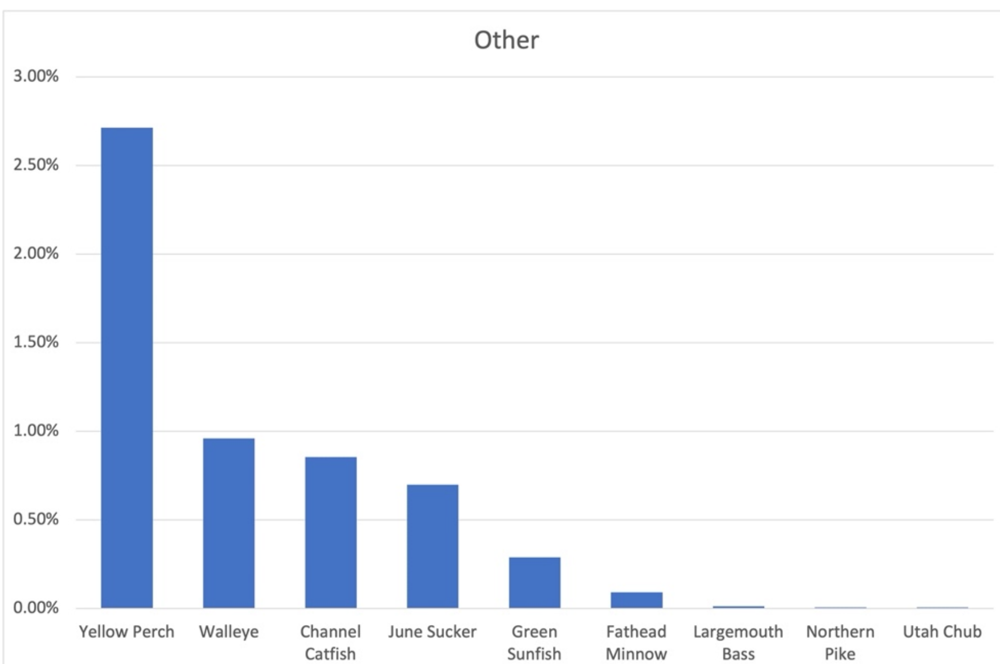


Figure 38. "Other" category of relative abundances of fishes in Utah Lake. See Figure 37.

Table 18. Relative abundance of fish species in Utah Lake.

Species	Count	% Relative Abundance

White Bass	12361	30.39%
Common Carp	8901	21.89%
Black Crappie	7758	19.08%
Bluegill	5160	12.69%
Black Bullhead	4196	10.32%
Yellow Perch	1103	2.71%
Walleye	390	0.96%
Channel Catfish	347	0.85%
June Sucker	284	0.70%
Green Sunfish	117	0.29%
Fathead Minnow	37	0.09%
Largemouth Bass	5	0.01%
Northern Pike	3	0.01%
Utah Chub	3	0.01%
Brown Trout	2	0.00%
Pumpkinseed	1	0.00%
Total	40668	

Length-Weight Relationships

The following are length-weight relationships for major fish species in Utah Lake. Residuals can be used to determine factors as to why some individuals are in better condition than others, but this is not a primary goal of the food web models.

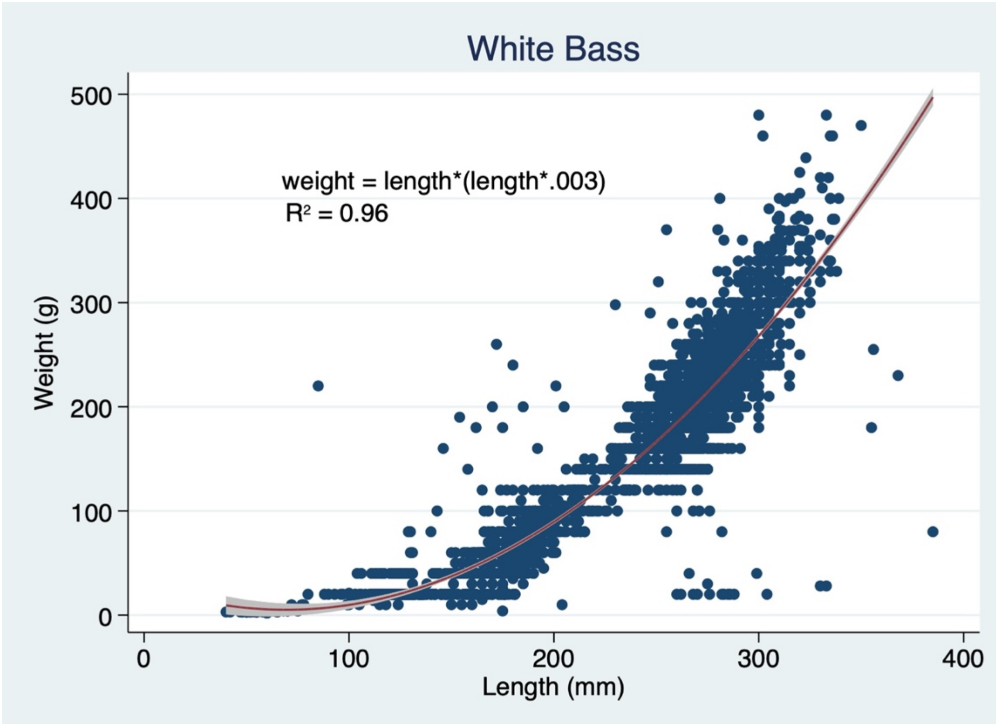


Figure 39. White Bass Length-weight relation. N = 3786

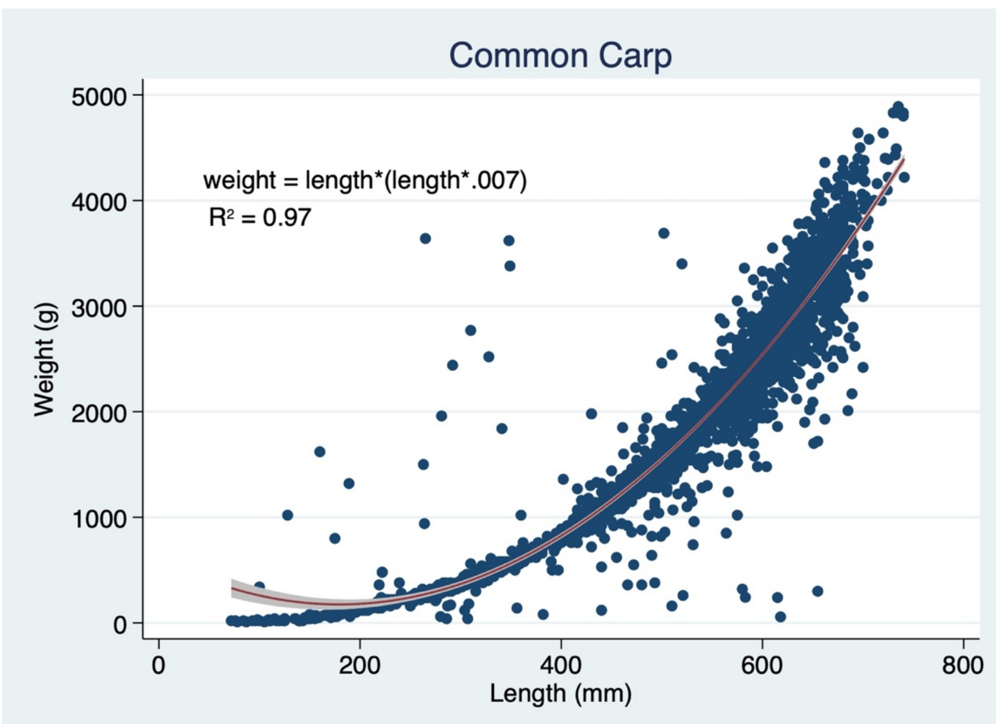


Figure 40. Common CARP LENGTH-weight relation N = 2269

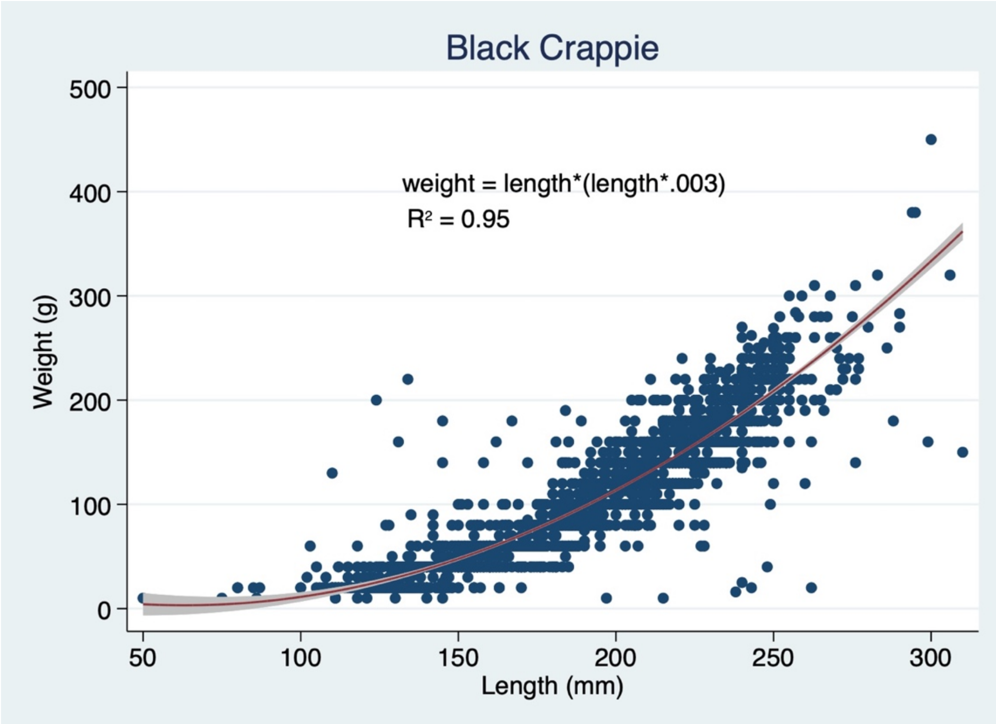


Figure 41. Black Crappie Length-weight relation N = 2534

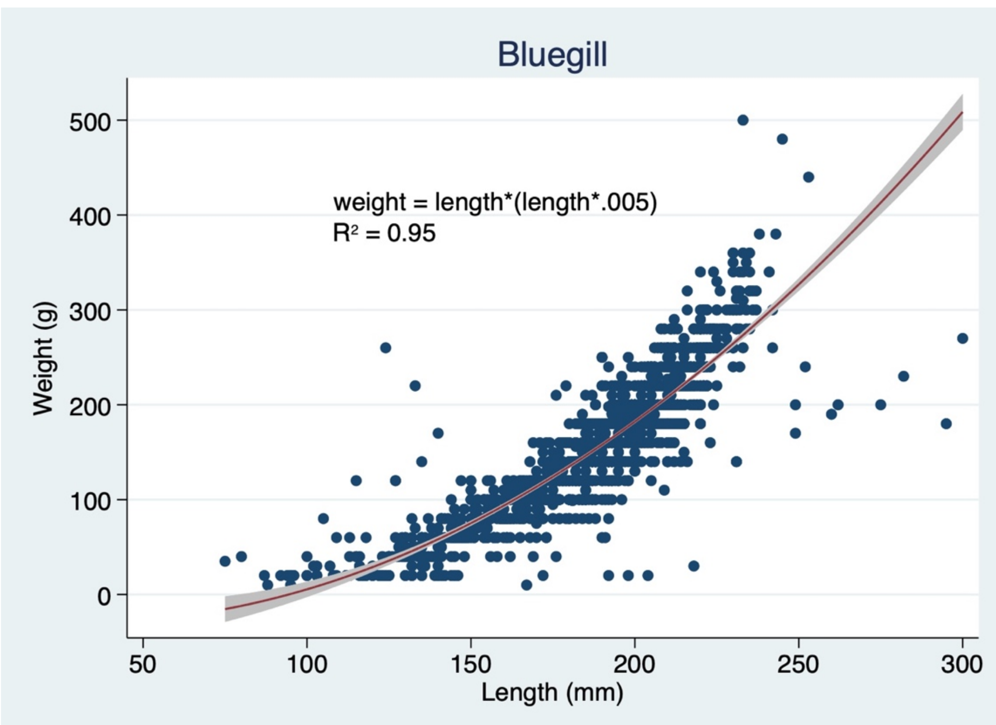


Figure 42. Bluegill Length-weight relation N = 1806

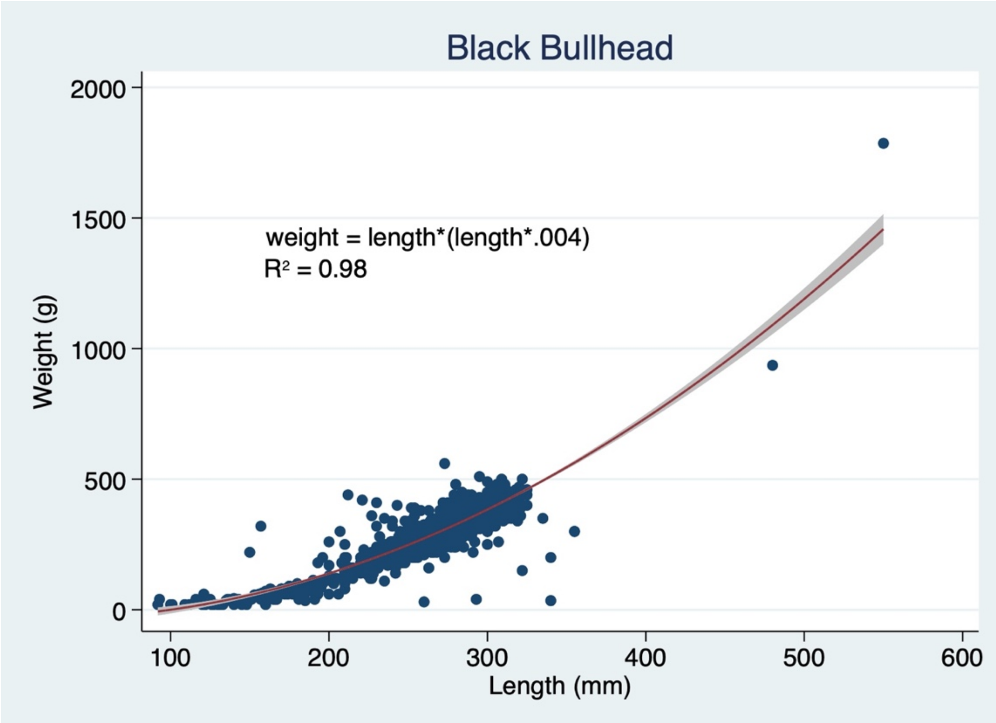


Figure 43. Black Bullhead Length-weight relation. N = 1701

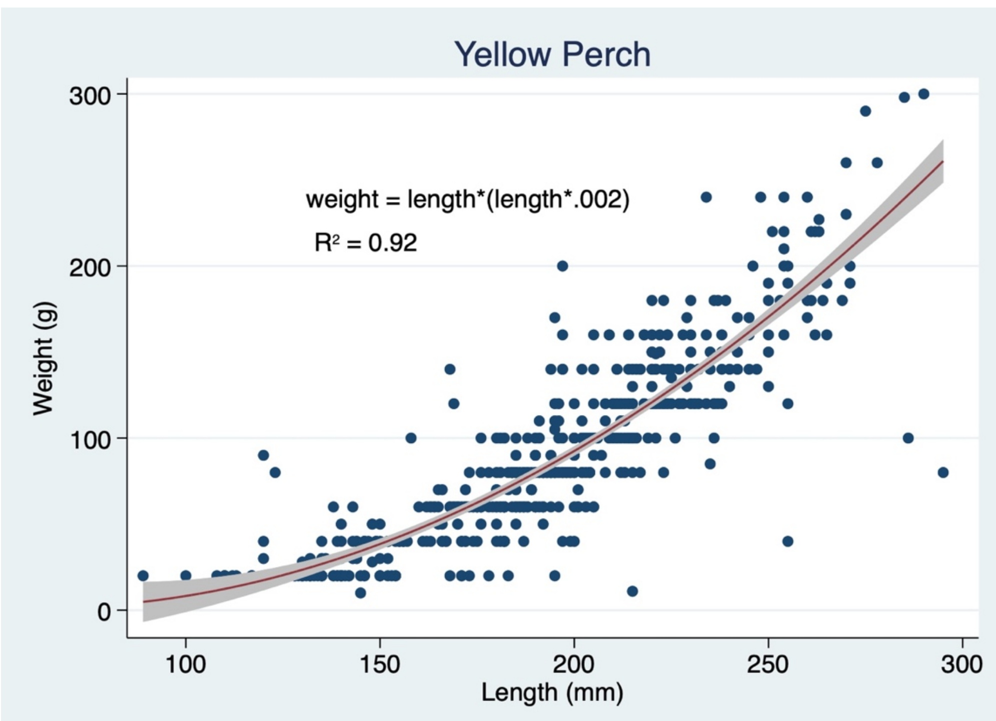


Figure 44. Yellow Perch Length-weight relation. N = 534

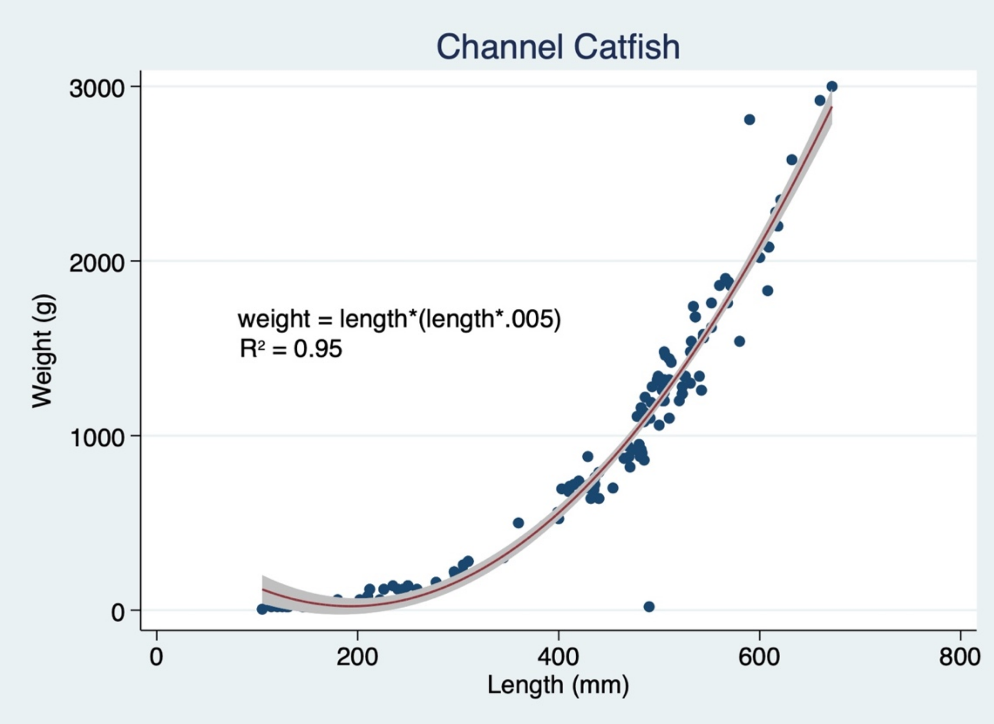


Figure 45. Channel Catfish Length-weight relation. N = 143

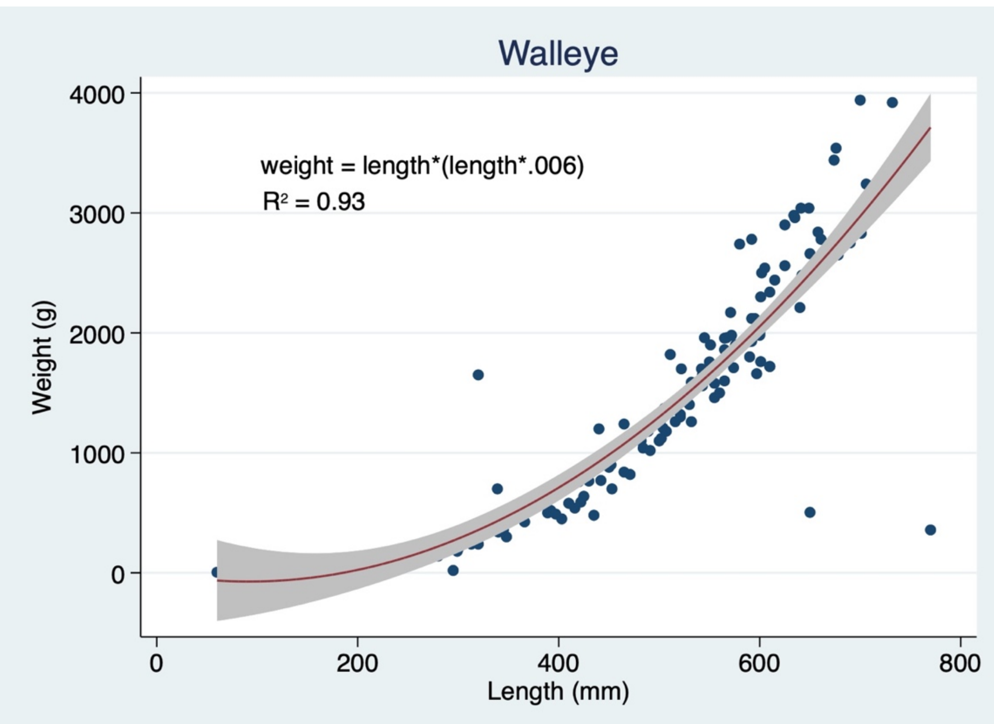


Figure 46. Walleye Length-weight RELATION. N = 145

Age-Size Stanzas

Age-size stanza estimates are necessary for food web model to account for ontogenetic diet shifts. However, in this first round analysis, 0+ age/size fish are severely underestimated. Very little data was available for this age/size group and will have to be estimated from literature values of size at reproduction, number of eggs produced at each age group and egg survivability to 0+ fish. Only August and September data were used to allow for 0+ fish to become catchable in nets. Also, the larger the fish the larger the prey that can be consumed, larger older fish can eat a more varied diet of other fishes. These factors need to be addressed before working food web models can be developed.

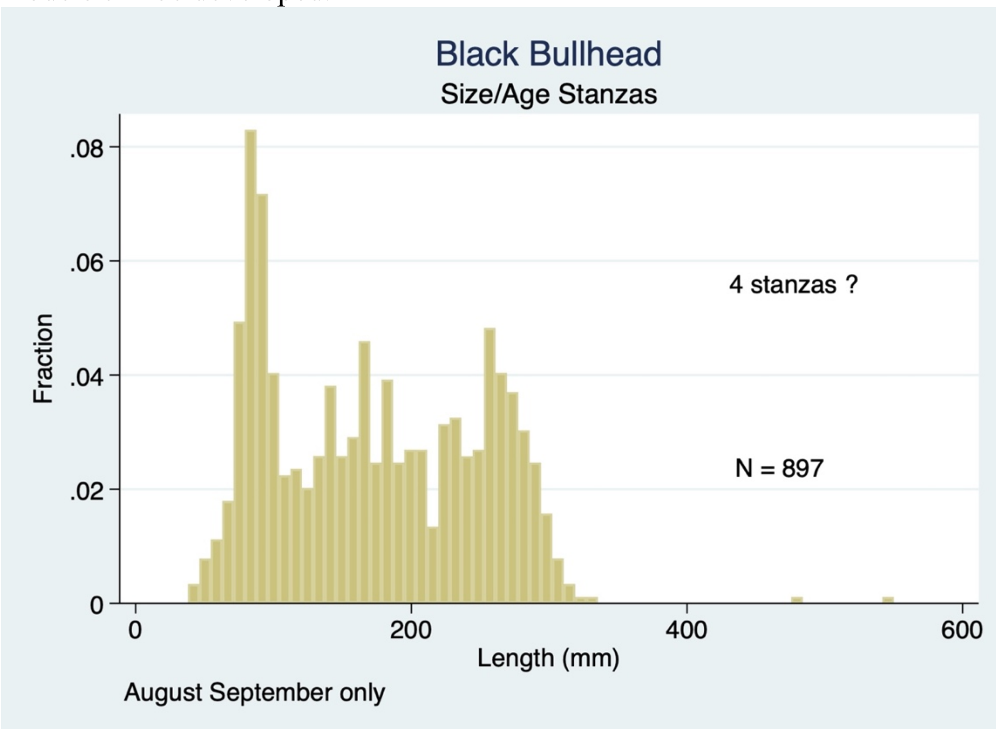


Figure 47.

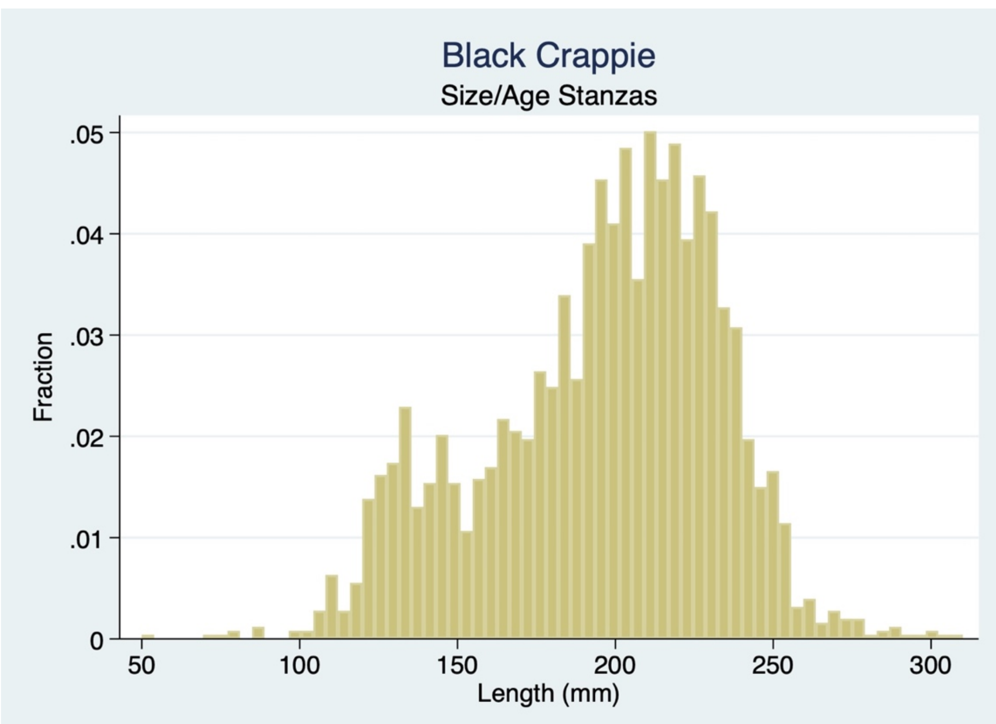


Figure 48.

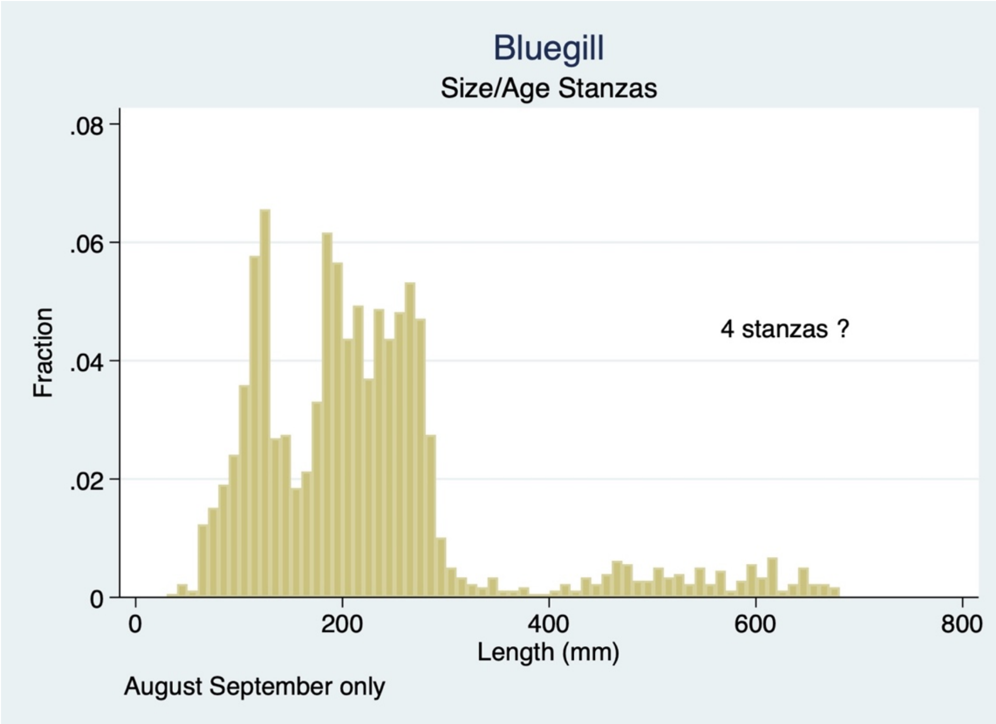


Figure 49.

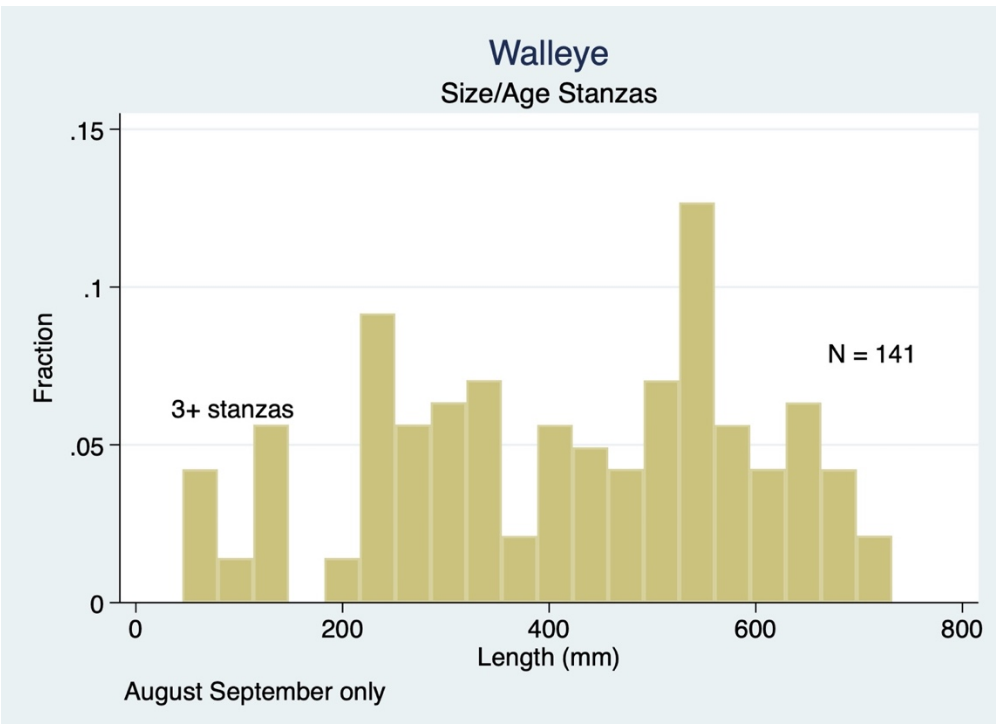


Figure 50.

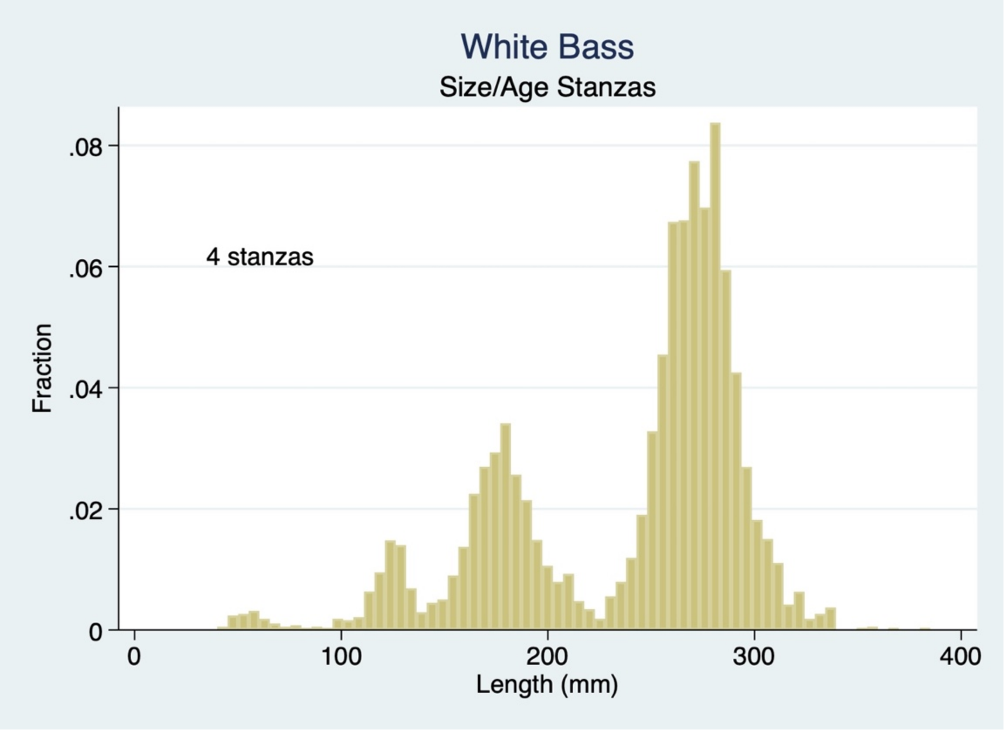


Figure 51.

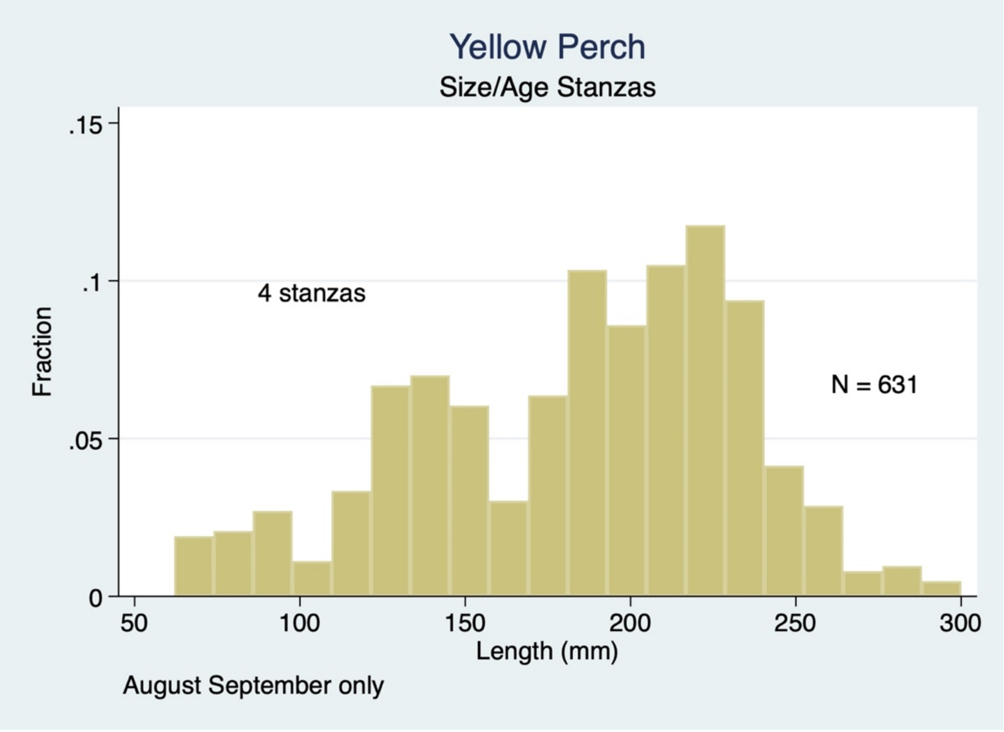


Figure 52.

Other species are not so easy to determine size/age stanzas from available data.

Ontogenetic diet shifts, "Who is Eating Whom?"

A critical component of the food web models is to determine "who eats whom'", i.e., fish diets. No data was available from Utah Lake fish diets; therefore, a literature review was conducted to begin estimating diets based on ontogenetic diet shifts. Start of ontogenetic diet shift estimates is in Table 2.

Table 19. Estimated Size (length in MM) ontogenetic diet shifts of fish species in Utah Lake

Common Name	Scientific Name	Zooplankton	Benthic Invertebrates	Fish	Citation
Black Bullhead[1]	*Ameiurus melas*			180-240	7
Black Crappie	*Pomoxis nigromaculatus*		16	140-180	6, 7
Bluegill	*Lepomis macrochirus*	10-25	>25		18,
Channel Catfish	*Ictalurus punctatus*			100	6
Common Carp	*Cyprinus carpio*				
Largemouth Bass	*Micropterus salmoides*			50 - 100	7, 8
Walleye	*Sander vitreus*			35-80	9, 10
White Bass	*Morone chrysops*			50 - 150	11, 12, 13, 14
Yellow Perch	*Perca flavescens*	20	30 – 60	80-170	1, 2, 3, 4 ,5, 7, 16, 17

[1]Yellow Bullhead was used as surrogate for Black Bullhead

Ontogenetic diet shifts citations

1.Graeb, et al. 2006. Ontogenetic Changes in Prey Preference and Foraging Ability of Yellow Perch: Insights Based on Relative Energetic Return of Prey. Transactions of the American Fisheries Society 135:1493–1498.

2.Pycha, R. L., and L. L. Smith, Jr. 1955. Early life history of the yellow perch, *Perca flavescens* (Mitchill) in the Red Lakes, Minnesota. Transactions of the American Fisheries Society 84:249–260.

3.Ney, J. J., and L. L. Smith, Jr. 1975. First-year growth of the yellow perch, Perca flavescens in the Red Lakes, Minnesota. Transactions of the American Fisheries Society 104:717–725.

4.Wu, L., and D. A. Culver. 1992. Ontogenetic diet shift in Lake Erie age-0 yellow perch (Perca flavescens): a size-related response to zooplankton density. Canadian Journal of Fisheries and Aquatic Sciences 49:1932–1937

5.Fisher, S. J., and D. W. Willis. 1997. Early life history of yellow perch in two South Dakota glacial lakes. Journal of Freshwater Ecology 12:421–429.

6.Becker, G.C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison, Wis.

7. Keast, A. 1985a. The piscivore feeding guild of the fishes in small freshwater ecosystems. Environ. Biol. Fishes, 12: 119-129.

8. Olson, M.H. 1996. Ontogenetic niche shifts in largemouth bass: variability and consequences for first-year growth. Ecology, 77: 179-190.

9. Mathias, J.A., and Li, S. 1982. Feeding habits of walleye larvae and juveniles: comparative laboratory and field studies. Trans. Am. Fish. Soc. 111: 722-735.

10. Smith, L.L., Jr., and Pycha, R.L. 1960. First-year growth of the walleye, Stizostedion vitreum (Mitchell), and associated factors in the Red Lakes, Minnesota. Limnol. Oceanogr. 5: 281-290.

11. Matthews, W.J., Gelwick, F.P., and Hoover, J.J. 1992. Food and habitat use by juveniles of species of Micropterus and Morone in a southwestern reservoir. Trans. Am. Fish. Soc. 121: 54-66

12. Ruelle, R. 1971. Factors influencing growth of white bass in Lewis and Clark Lake. In Reservoir fisheries and limnology. Edited by G.E. Hall. Am. Fish. Soc. Spec. Publ. No. 8.

13. Priegel, G.R. 1970. Food of white bass, Roccus chrysops, in Lake Winnebago, Wisconsin. Trans. Am. Fish. Soc. 99: 440-443.

14. Ewers, L.A., and Bosel, M.W. 1935. The food of some Buckeye Lakes fishes. Trans. Am. Fish. Soc. 65: 57-68

16. Keast, A. 1977. Diet overlap and feeding relationships between the year classes in the yellow perch (Perca flavescens). Environ. Biol. Fishes, 2: 53-70.
17. Johnson, F.H. 1977. Responses of walleye (Stizostedion vitreum vitreum) and yellow perch (Perca flavescens) populations to the removal of white sucker (Catostomus commersoni) from a Minnesota lake, 1966. J. Fish. Res. Board Can. 34: 1633-1642.
18.Showalter, A.M. et al. 2016. Ontogenetic diet shifts produce trade-offs in elemental imbalance in bluegill sunfish. Freshwqter Biology. doi:10.1111/fwb.12751.

Reproduction and Life Cycle

Literature based. Values are dependent on age, size, or water temperatures. Values are not precise for Utah Lake populations; however no data exists for Utah Lake.

Common Name	**Scientific Name**	**Number of eggs (mean; range or max)**	**Breeding temp (^{0}C)**	**Egg to larvae (days)**	**Larval to independence (days)**	**Citation**
Black Bullhead	*Ameiurus melas*	2610; 1238-4755	22 - 22	5 - 10	12 - 17	3, 4, 5, 6, 7, 8, 9
Black Crappie	*Pomoxis nigromaculatus*	40,000; 188,000	14 - 20	2 - 3	2 - 4	1, 2,
Bluegill	*Lepomis macrochirus*	18,000; 3,800 – 80,000	21 - 32	3	3	10, 11
Channel Catfish	*Ictalurus punctatus*	3,000 – 50,000	>20	4 - 10	4 - 28	12
Common Carp	*Cyprinus carpio*	300,000; 1,000,000	18 - 24	4		13
Largemouth Bass	*Micropterus salmoides*	4,000; 3,000 – 45,000	>15	1 - 5	7 - 10	14
Walleye	*Sander vitreus*					
White Bass	*Morone chrysops*	500,000	14 - 20	2		15
Yellow Perch	*Perca flavescens*	23,000	7 - 11	8 - 10		16
June Sucker	*Chasmistes liorus*					
Utah Sucker	*Catostomus ardens*					

Reproduction and Life Cycle Citations

1.AnimalDiversityWeb.https://animaldiversity.org/accounts/Pomoxis_nigromaculatus/.2.FishBase.http://www.fishbase.us/summary/SpeciesSummary.php?ID=3388&AT=Black+Crappie.3. Animal Diversity Web. https://animaldiversity.org/accounts/Ameiurus_melas/.4. Wallace, C. 1967. Observation on the reproductive behavior of the black bullhead (*Ictalurus melas*) Copeia 1967(4):852-853. 5. Dennison, S.G. and R.V. Bulkley. 1972. Reproductive potential of the black bullhead, *Ictalurus melas*, in Clear Lake, Iowa. Transactions of the American Fisheries Society 1972(3):483-487. 6.http://txstate.fishesoftexas.org/ameiurus%20melas.htm. 7.Copp, G.H. et al. 2016. A review of growth and life-history traits of native and non-native European populations of black bullhead Ameiurus melas. Rev Fish Biol Fisheries (2016) 26:441–469. DOI 10.1007/s11160-016-9436-z. 8. Novomeska, A. and V. Kovac. 2009. Life-history traits of non-native black bullhead Ameiurus melas with comments on its invasive potential. J. Appl. Ichthyol. 25 (2009), 79–84. 9. 10. Animal Diversity Web. http://txstate.fishesoftexas.org/lepomis%20macrochirus.htm. 11. Animal Diversity Web. https://animaldiversity.org/accounts/Lepomis_macrochirus/. 12. Animal Diversity Web. https://animaldiversity.org/accounts/Ictalurus_punctatus/. 13. 14. Animal Diversity Web. https://animaldiversity.org/accounts/Micropterus_salmoides/. 15. Animal Diversity Web. https://animaldiversity.org/accounts/Morone_chrysops/. 16. Animal Diversity Web. https://animaldiversity.org/accounts/Perca_flavescens/#reproduction.

Weight Length Ratio over time

Some length-weight ratios were developed by year to visualize any trends. They are in the following graphs.

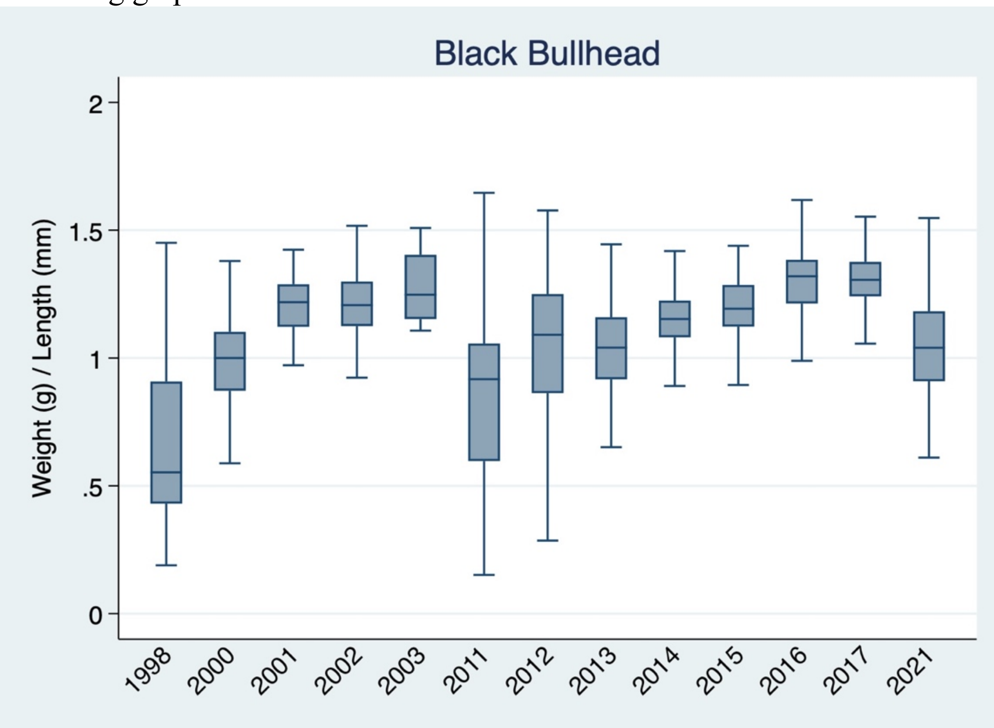


Figure 53.

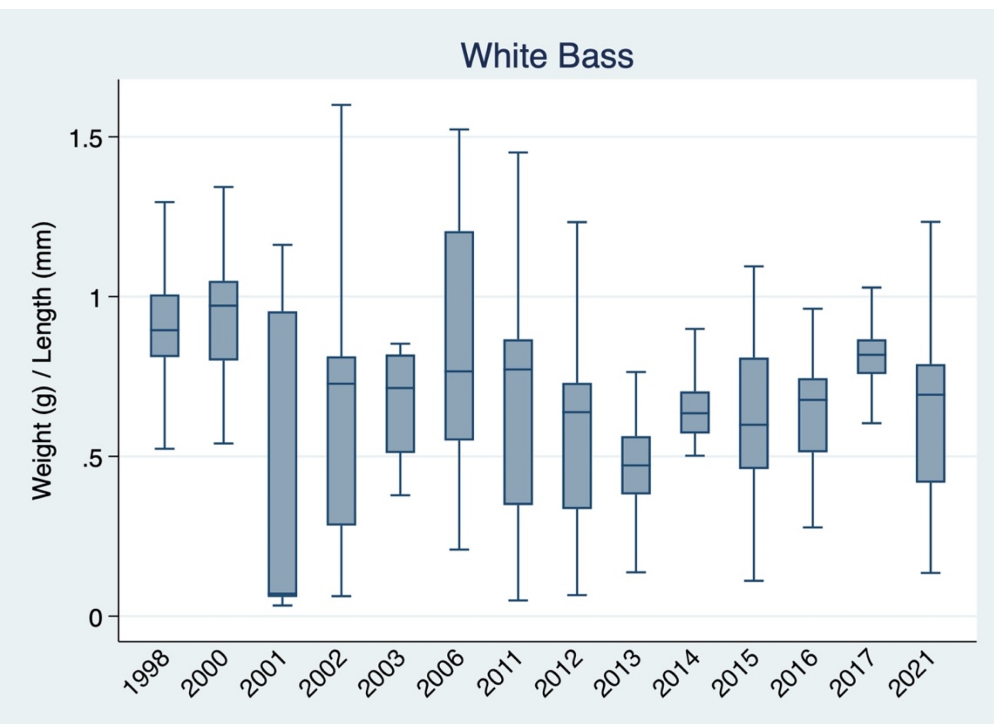


Figure 54.

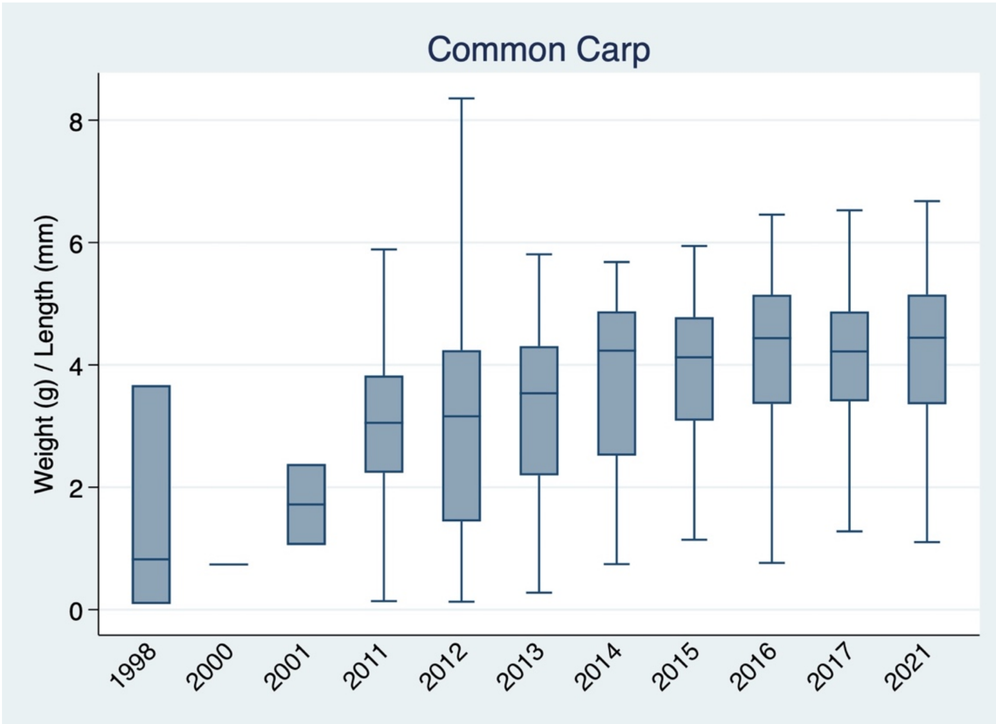


Figure 55.

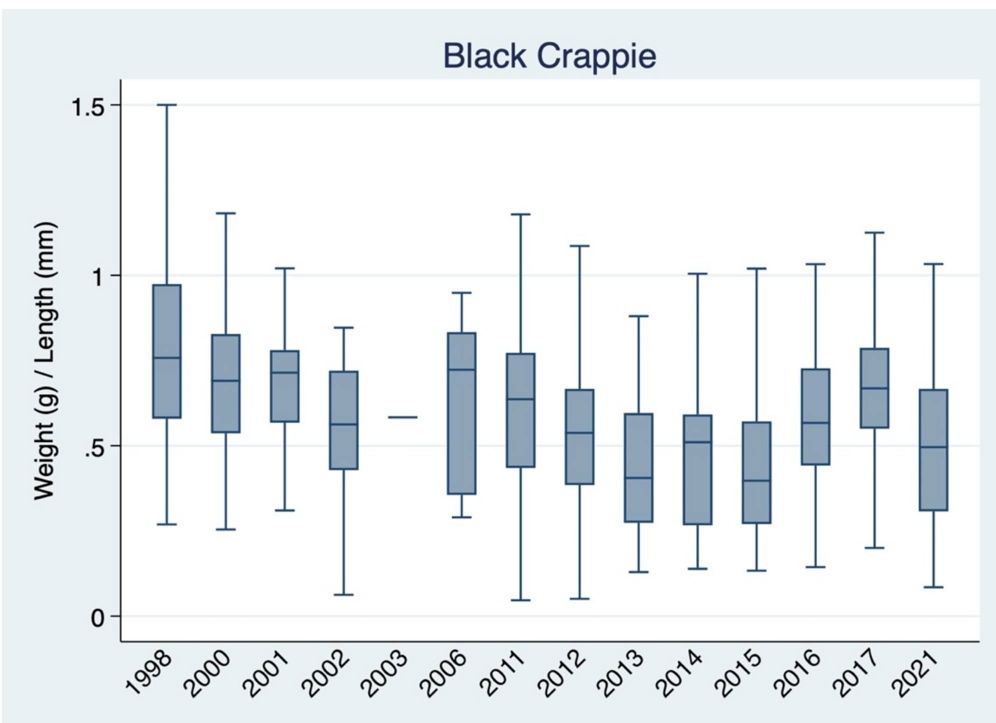


Figure 56.

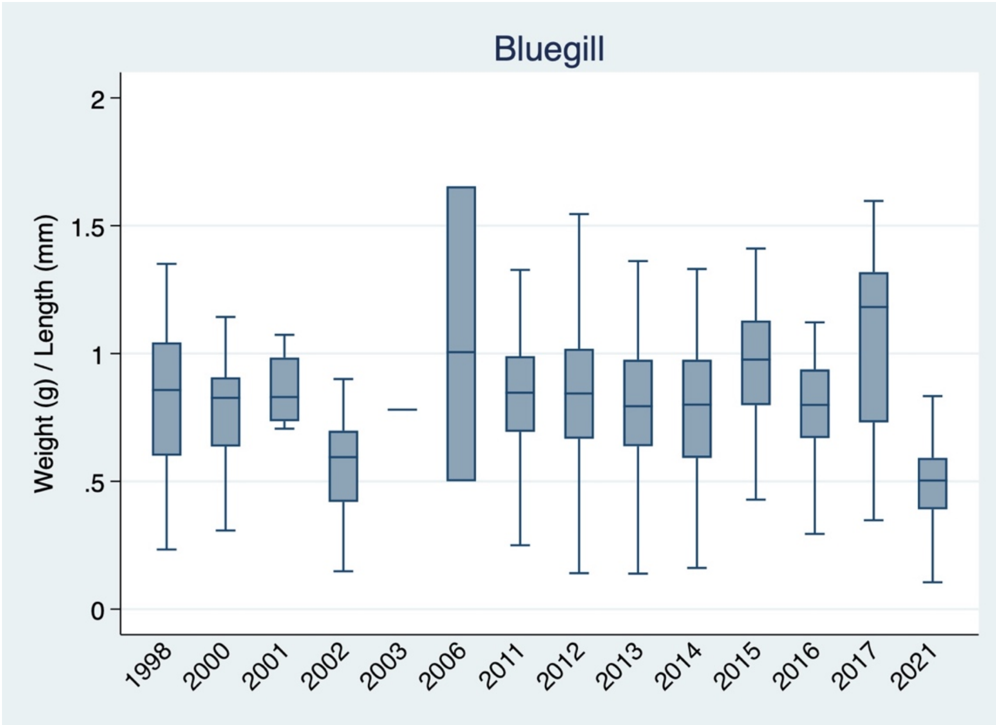


Figure 57.

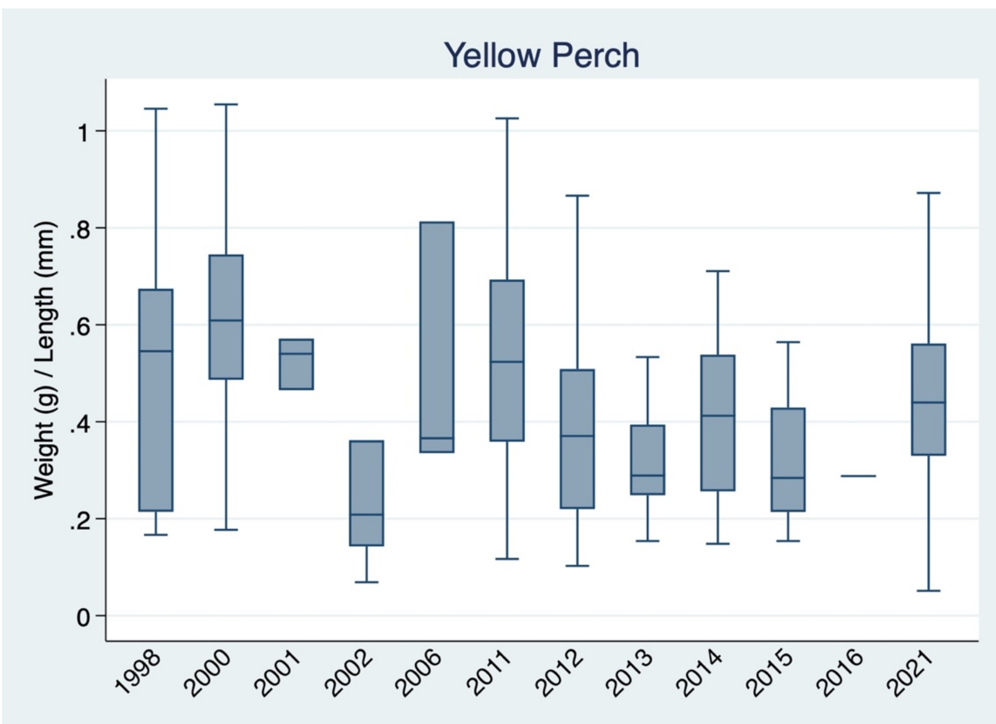


Figure 58.

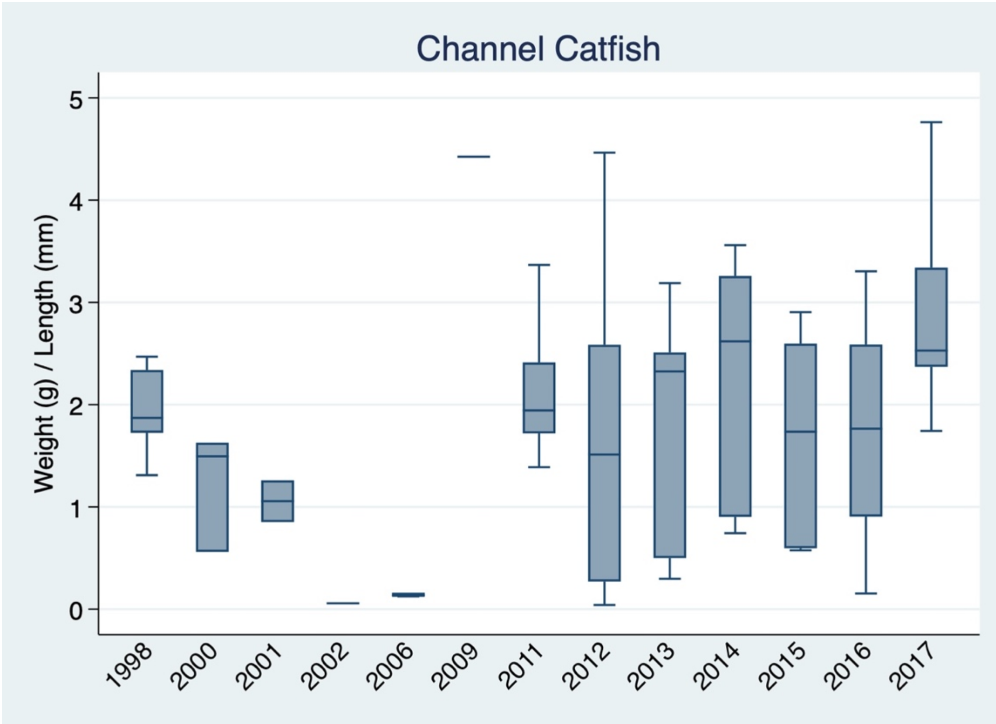


Figure 59.

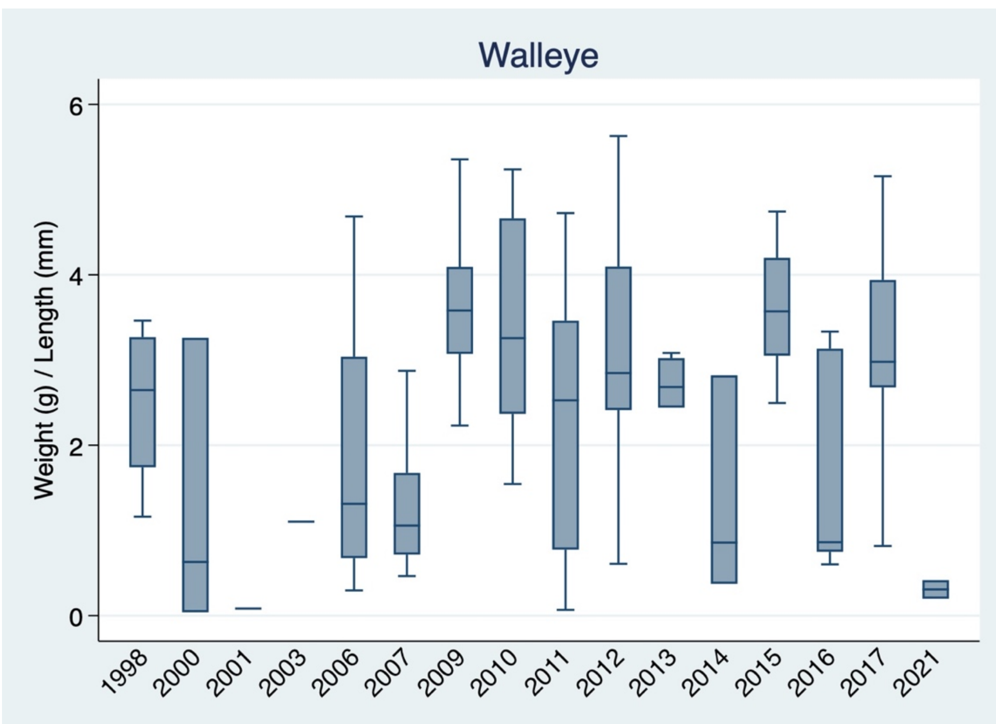


Figure 60.

Literature Cited

Richards, D.C. 2022. Plankton biomass, diets, production-biomass ratios, and ecotrophic efficiency estimates for Utah Lake foodweb model development: Is it raining algae on the benthos in the summer? Report to Wasatch Front Water Quality Council, Salt Lake City. OreoHelix Ecological, Vineyard, UT.

Richards, D.C. et al. 2019. Factors Effecting the Ecological Health and Integrity of Utah Lake with a Focus on the Relationships between Water Column Regulators, Benthic Ecosystem Engineers, and CyanoHABs. Progress Report 2020. Version 2.3. Report to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Ecological, Vineyard, UT.

Richards, D. C. and T. Miller. 2019. Utah Lake Research 2017-2018: Progress Report: Continued analysis of Utah Lake's unique foodweb with a focus on the role of nutrients, phytoplankton, zooplankton, and benthic invertebrates on cyanoHABs. Chapter 1: Phytoplankton Assemblages. Submitted to Wasatch Front Water Quality Council, Salt Lake City, UT. OreoHelix Consulting, Vineyard, UT.

Appendices

The following are statistical results for figures and analysis presented in this draft report.

White Bass regression

```
. regress weight c.totallength#c.totallength in 23202/26988, noconstant

      Source |       SS           df       MS      Number of obs   =     3,787
-------------+----------------------------------   F(1, 3786)      =  89495.91
       Model |   126953715         1   126953715   Prob > F        =    0.0000
    Residual |  5370600.39     3,786   1418.5421   R-squared       =    0.9594
-------------+----------------------------------   Adj R-squared   =    0.9594
       Total |   132324315     3,787  34941.7256   Root MSE        =    37.664

-----------------------------------------------------------------------------------------------
                       weight |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------------------+----------------------------------------------------------------
c.totallength#c.totallength |   .0028011   9.36e-06   299.16   0.000     .0027827    .0028195
-----------------------------------------------------------------------------------------------
```

Common Carp regression

```
. regress weight c.totallength#c.totallength in 14829/17098, noconstant

      Source |       SS           df       MS      Number of obs   =     2,270
-------------+----------------------------------   F(1, 2269)      =  70923.22
       Model |  1.1030e+10         1  1.1030e+10   Prob > F        =    0.0000
    Residual |   352889349     2,269  155526.377   R-squared       =    0.9690
-------------+----------------------------------   Adj R-squared   =    0.9690
       Total |  1.1383e+10     2,270  5014678.71   Root MSE        =    394.37

-----------------------------------------------------------------------------------------------
                       weight |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
------------------------------+----------------------------------------------------------------
c.totallength#c.totallength |   .0070666   .0000265   266.31   0.000     .0070146    .0071187
-----------------------------------------------------------------------------------------------
```

Black Crappie regression

```
. regress weight c.totallength#c.totallength in 3823/6357, noconstant

      Source |       SS           df       MS      Number of obs   =     2,535
-------------+----------------------------------   F(1, 2534)      =  48504.00
       Model |  40700796.8         1  40700796.8   Prob > F        =    0.0000
    Residual |  2126336.17     2,534  839.122403   R-squared       =    0.9504
-------------+----------------------------------   Adj R-squared   =    0.9503
       Total |    42827133     2,535  16894.3325   Root MSE        =    28.968

------------------------------------------------------------------------------------------
                     weight |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------------+-------------------------------------------------------------
c.totallength#c.totallength |   .0030097   .0000137   220.24   0.000     .0029829    .0030365
------------------------------------------------------------------------------------------
```

Black Bullhead

```
. regress weight c.totallength#c.totallength in 1/1702, noconstant

      Source |       SS           df       MS      Number of obs   =     1,700
-------------+----------------------------------   F(1, 1699)      =  75164.69
       Model |   166319289         1   166319289   Prob > F        =    0.0000
    Residual |  3759431.15     1,699   2212.7317   R-squared       =    0.9779
-------------+----------------------------------   Adj R-squared   =    0.9779
       Total |   170078720     1,700  100046.306   Root MSE        =     47.04

------------------------------------------------------------------------------------------
                     weight |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------------+-------------------------------------------------------------
c.totallength#c.totallength |   .0041616   .0000152   274.16   0.000     .0041319    .0041914
------------------------------------------------------------------------------------------
```

Yellow Perch regression

```
. regress weight c.totallength#c.totallength in 32311/32845, noconstant

      Source |       SS           df       MS      Number of obs   =       535
-------------+----------------------------------   F(1, 534)       =   6239.75
       Model |  5270082.82         1  5270082.82   Prob > F        =    0.0000
    Residual |  451015.183       534  844.597721   R-squared       =    0.9212
-------------+----------------------------------   Adj R-squared   =    0.9210
       Total |     5721098       535  10693.6411   Root MSE        =    29.062

---------------------------------------------------------------------------------------------
                     weight |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------------+----------------------------------------------------------------
c.totallength#c.totallength |   .0024438   .0000309    78.99   0.000      .002383    .0025046
---------------------------------------------------------------------------------------------
```

Walleye regression

```
. regress weight c.totallength#c.totallength in 22811/22956, noconstant

      Source |       SS           df       MS      Number of obs   =       146
-------------+----------------------------------   F(1, 145)       =   1930.12
       Model |   395214711         1   395214711   Prob > F        =    0.0000
    Residual |    29690387       145  204761.289   R-squared       =    0.9301
-------------+----------------------------------   Adj R-squared   =    0.9296
       Total |   424905098       146  2910308.89   Root MSE        =    452.51

---------------------------------------------------------------------------------------------
                     weight |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------------+----------------------------------------------------------------
c.totallength#c.totallength |   .0056283   .0001281    43.93   0.000     .0053751    .0058815
---------------------------------------------------------------------------------------------
```

Channel Catfish

```
. regress weight c.totallength#c.totallength in 14484/14627, noconstant

      Source |       SS           df       MS      Number of obs   =       144
-------------+----------------------------------   F(1, 143)       =   2960.81
       Model |   181732818         1   181732818   Prob > F        =    0.0000
    Residual |  8777249.84       143  61379.3695   R-squared       =    0.9539
-------------+----------------------------------   Adj R-squared   =    0.9536
       Total |   190510068       144  1322986.58   Root MSE        =    247.75

---------------------------------------------------------------------------------------------
                     weight |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------------+----------------------------------------------------------------
c.totallength#c.totallength |   .0050661   .0000931    54.41   0.000     .0048821    .0052502
---------------------------------------------------------------------------------------------
```

```
. ttest kpre == kpost, unpaired

Two-sample t test with equal variances
------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
    kpre |     538    1.175197    .0181882    .4218723    1.139468    1.210926
   kpost |   3,248    1.054693    .0056763    .3235001    1.043563    1.065822
---------+--------------------------------------------------------------------
combined |   3,786    1.071817    .0055543    .3417577    1.060927    1.082706
---------+--------------------------------------------------------------------
    diff |            .1205044    .0157888                 .089549    .1514598
------------------------------------------------------------------------------
    diff = mean(kpre) - mean(kpost)                               t =   7.6323
Ho: diff = 0                                     degrees of freedom =     3784

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

```
. ttest wlpre == wlpost, unpaired

Two-sample t test with equal variances
```

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
wlpre	538	.7858175	.0144316	.3347383	.7574682	.8141668
wlpost	3,249	.6047751	.0043964	.250594	.5961551	.613395
combined	3,787	.6304949	.0044134	.2715927	.621842	.6391477
diff		.1810424	.012296		.156935	.2051498

```
    diff = mean(wlpre) - mean(wlpost)                             t =  14.7237
Ho: diff = 0                                     degrees of freedom =     3785

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
```

Appendix 3. Ascendency by taxon.

	Group name	Ascendency (t/km²/year * bits)	Overhead (t/km²/year * bits)	Capacity (t/km²/year * bits)	Information (bits)	Throughput (t/km²/year)
1	Bacillariophyta	307.7	416.1	723.8	0.0611	74.40
2	Chlorophyta	266.1	483.6	749.6	0.0528	80.00
3	Cryptophyta	116.8	513.2	630.0	0.0232	99.00
4	Cyanophyta	358.6	1030	1389	0.0712	298.0
5	Dinophyta	942.3	1126	2068	0.187	739.2
6	Euglenophyta	167.7	577.4	745.2	0.0333	137.0
7	Benthic Algae	24.13	80.42	104.5	0.00479	10.000
8	Macrophytes	4.519	20.04	24.56	0.000898	2.000
9	Epiphytes	33.93	65.54	99.47	0.00674	10.000
10	Asplanchinida	24.38	90.28	114.7	0.00484	10.000
11	Bosminidae	12.74	96.11	108.9	0.00253	10.000
12	Brachionidae	12.41	93.19	105.6	0.00246	10.000
13	Canthocamptidae	3.201	23.59	26.79	0.000636	2.000
14	Ceriodaphnia	38.88	139.6	178.5	0.00772	16.00
15	Chydoridae	4.266	42.72	46.98	0.000847	4.000
16	Cyclopidae	111.7	283.3	395.0	0.0222	40.00
17	Daphnia	44.08	174.3	218.4	0.00875	20.00
18	Diaptomidae	43.29	134.2	177.5	0.00860	16.00
19	Ilyocryptidae	12.54	94.45	107.0	0.00249	10.000
20	Laophontidae	2.162	23.27	25.43	0.000429	2.000
21	Leptodoridae	1.766	19.56	21.32	0.000351	1.600
22	Macrothricidae	9.942	90.05	100.00	0.00197	10.000
23	Moinidae	3.897	23.40	27.29	0.000774	2.000
24	Sididae	11.06	94.53	105.6	0.00220	10.000
25	Acari	1.537	5.482	7.020	0.000305	0.450
26	Amphipoda	51.74	183.2	234.9	0.0103	22.50
27	Chironominae	644.6	2418	3063	0.128	674.0
28	Coleoptera	17.08	93.44	110.5	0.00339	10.000
29	Corbicula sp.	12.01	90.20	102.2	0.00239	10.000
30	Corixidae	30.96	129.6	160.5	0.00615	15.00
31	Decopoda	11.72	90.63	102.3	0.00233	10.000
32	Glossiphoniidae	13.70	89.10	102.8	0.00272	10.000
33	Isopoda	17.66	89.38	107.0	0.00351	10.000

34	Lymnaeidae	10.35	93.02	103.4	0.00205	10.000
35	Physa sp.	14.12	93.16	107.3	0.00280	10.000
36	Odonata	17.80	90.20	108.0	0.00354	10.000
37	Oligochaetes	108.2	640.8	749.1	0.0215	110.0
38	Ostracod	1.365	12.27	13.63	0.000271	1.000
39	Tanypodinae	214.0	1128	1342	0.0425	208.0
40	BlackBullhead1	18.81	74.48	93.29	0.00374	8.000
41	BlackBullhead2	28.61	103.4	132.0	0.00568	12.50
42	BlackBullhead3	11.86	56.16	68.02	0.00236	6.490
43	BlackCrappie1	3.891	13.28	17.17	0.000773	1.200
44	BlackCrappie2	8.321	35.28	43.61	0.00165	3.550
45	BlackCrappie3	8.575	42.79	51.36	0.00170	4.691
46	Bluegill1	2.861	17.15	20.01	0.000568	1.460
47	Bluegill2	16.67	57.22	73.89	0.00331	6.250
48	Bluegill 3	9.252	45.61	54.86	0.00184	5.061
49	GreenSunfish1	3.286	23.35	26.63	0.000653	2.000
50	GreenSunfish 2	4.575	33.64	38.22	0.000909	3.125
51	GreenSunfish 3	0.914	6.176	7.090	0.000182	0.500
52	ChannelCatfish1	11.83	24.97	36.80	0.00235	3.000
53	ChannelCatfish2	16.63	68.81	85.44	0.00330	7.500
54	ChannelCatfish3	6.893	28.92	35.81	0.00137	3.000
55	Channel Catfish 4	0.000400	0.00468	0.00508	0.000000	0.000200
56	CommonCarp1	4.342	22.28	26.62	0.000862	2.000
57	CommonCarp2	31.20	118.5	149.7	0.00620	13.75
58	CommonCarp3	146.4	440.9	587.2	0.0291	85.00
59	Fathead Minnow1	3.438	10.96	14.40	0.000683	1.000
60	FatheadMinnow2	4.943	27.69	32.63	0.000982	2.500
61	FatheadMinnow 3	1.067	6.171	7.238	0.000212	0.500
62	June Sucker 1	16.89	37.53	54.42	0.00335	4.500
63	JuneSucker2	29.18	72.04	101.2	0.00579	9.375
64	JuneSucker 3	1.122	7.400	8.522	0.000223	0.614
65	NorthernPike1	0.0333	0.170	0.204	0.000007	0.0100
66	NorthernPike2	0.00866	0.0476	0.0563	0.000002	0.00250
67	NorthernPike3	0.000239	0.00116	0.00140	0.000000	0.000050
68	Northern Pike 4	0.000400	0.00468	0.00508	0.000000	0.000200
69	Walleye1	5.046	14.35	19.40	0.00100	1.400
70	Walley2	16.71	57.16	73.87	0.00332	6.250
71	Walleye3	3.766	21.24	25.00	0.000748	2.060

72	Walley 4	0.0400	0.335	0.375	0.000008	0.0200
73	WhiteBass1	62.39	115.1	177.5	0.0124	16.67
74	WhiteBass2	42.54	105.5	148.0	0.00845	13.50
75	WhiteBass3	20.11	86.81	106.9	0.00399	11.00
76	White Bass 4	0.0200	0.178	0.198	0.000004	0.01000
77	YellowPerch1	3.995	41.13	45.12	0.000793	4.000
78	YellowPerch2	4.715	32.54	37.25	0.000936	3.000
79	YellowPerch3	0.837	5.715	6.552	0.000166	0.458
80	DetritusSnow	25900	-22133	3768	5.144	0.000014
81	Detritus	4042	130.3	4173	0.803	2060
	Import					5.000
	Total	34220	-9166	25054	6.796	5035
	(%)	136.6	-36.58	100.00		

Appendix 4. Mixed trophic level impacts.

Impacting / Impacted	Bacillariophyta	Chlorophyta	Cryptophyta	Cyanophyta	Dinophyta	Euglenophyta	Benthic Algae	Macrophytes	Epiphytes	Asplanchinida	Bosminidae	Brachionidae	Canthocamptidae	Ceriodaphnia
Bacillariophyta	-0.181	-0.153	-0.157	-0.098	-0.157	-0.124	0.012	-0.003	-0.002	0.245	0.146	0.244	0.280	0.280
Chlorophyta	-0.135	-0.141	-0.139	-0.146	-0.139	-0.135	0.014	-0.003	-0.004	0.116	0.205	0.116	0.107	0.114
Cryptophyta	-0.018	-0.019	-0.019	-0.019	-0.019	-0.019	0.002	0.000	0.000	0.018	0.019	0.018	0.018	0.019
Cyanophyta	-0.024	-0.047	-0.045	-0.098	-0.045	-0.074	0.008	-0.002	-0.003	-0.024	0.010	-0.024	-0.049	-0.043
Dinophyta	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	0.000	0.000	0.000	0.004	0.004	0.004	0.004	0.004
Euglenophyta	-0.007	-0.008	-0.008	-0.013	-0.008	-0.023	0.001	0.000	0.000	-0.001	-0.001	-0.001	-0.001	-0.001
Benthic Algae	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.085	0.000	-0.002	0.001	0.001	0.001	0.001	0.001
Macrophytes	0.000	0.000	0.000	0.000	0.000	0.000	0.001	-0.005	0.001	0.000	0.000	0.000	0.000	0.000
Epiphytes	0.000	0.000	0.000	0.000	0.000	0.000	0.001	-0.001	-0.277	0.000	0.000	0.000	0.000	0.000
Asplanchinida	-0.029	-0.014	-0.017	0.011	-0.017	0.004	0.002	0.000	0.000	-0.185	-0.021	-0.186	-0.025	-0.043
Bosminidae	-0.028	-0.041	-0.031	-0.015	-0.031	0.000	0.000	0.000	0.000	-0.022	-0.034	-0.022	-0.034	-0.032
Brachionidae	-0.048	-0.028	-0.032	0.005	-0.032	-0.005	-0.001	0.000	0.000	-0.076	-0.024	-0.076	-0.028	-0.034
Canthocamptidae	-0.009	-0.004	-0.005	0.003	-0.005	0.001	0.000	0.000	0.000	-0.005	-0.008	-0.005	-0.009	-0.008
Ceriodaphnia	-0.056	-0.020	-0.027	0.035	-0.027	0.018	0.005	-0.002	-0.001	-0.076	-0.072	-0.076	-0.085	-0.085
Chydoridae	-0.021	-0.012	-0.014	0.002	-0.014	-0.002	0.000	0.000	0.000	-0.011	-0.012	-0.011	-0.014	-0.014
Cyclopidae	-0.025	-0.074	-0.060	-0.147	-0.060	0.065	0.016	-0.002	-0.001	-0.097	-0.193	-0.096	-0.194	-0.171
Daphnia	0.003	-0.033	-0.042	-0.179	-0.042	-0.212	0.013	-0.003	-0.009	-0.058	-0.072	-0.058	-0.061	-0.063
Diaptomidae	-0.011	-0.031	-0.025	-0.060	-0.025	0.026	0.006	-0.002	-0.001	-0.029	-0.079	-0.028	-0.080	-0.069
Ilyocryptidae	-0.050	-0.027	-0.031	0.009	-0.031	-0.002	0.000	0.000	0.000	-0.027	-0.033	-0.027	-0.039	-0.037
Laophontidae	-0.011	-0.006	-0.007	0.001	-0.007	-0.001	0.000	0.000	0.000	-0.005	-0.006	-0.005	-0.007	-0.007
Leptodoridae	-0.008	-0.005	-0.005	0.001	-0.005	-0.001	0.000	0.000	0.000	-0.004	-0.005	-0.004	-0.006	-0.006
Macrothricidae	-0.049	-0.033	-0.037	-0.001	-0.037	-0.127	-0.002	0.000	0.001	-0.025	-0.025	-0.025	-0.028	-0.028
Moinidae	-0.003	-0.005	-0.005	-0.005	-0.005	-0.022	0.000	0.000	0.000	-0.004	-0.008	-0.004	-0.008	-0.007
Sididae	-0.024	-0.038	-0.034	-0.038	-0.034	-0.121	-0.001	0.000	0.000	-0.019	-0.028	-0.019	-0.026	-0.025
Acari	0.000	0.000	0.000	0.000	0.000	0.000	0.012	0.000	0.011	0.000	0.000	0.000	0.000	0.000
Amphipoda	0.004	0.004	0.004	0.003	0.004	0.006	0.013	0.006	0.031	0.001	-0.008	0.001	-0.009	-0.008

Chironominae	-0.003	-0.003	-0.003	-0.004	-0.003	-0.004	0.196	-0.039	0.092	0.008	-0.001	0.008	0.007	0.003
Coleoptera	-0.005	-0.005	-0.005	-0.004	-0.005	-0.005	-0.009	-0.001	0.281	0.005	0.005	0.005	0.006	0.005
Corbicula sp.	-0.005	-0.005	-0.005	-0.004	-0.005	-0.005	0.014	0.003	0.002	0.005	0.005	0.005	0.005	0.005
Corixidae	-0.005	-0.004	-0.004	-0.002	-0.004	-0.002	-0.343	-0.003	-0.025	0.006	0.005	0.006	0.006	0.005
Decopoda	-0.004	-0.004	-0.004	-0.004	-0.004	-0.004	-0.251	0.002	0.002	0.004	0.004	0.003	0.005	0.004
Glossiphoniidae	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.002	0.031	0.000	0.001	0.000	0.000	0.000
Isopoda	0.000	0.000	0.000	0.001	0.000	0.001	0.015	0.003	0.020	0.000	0.001	0.000	0.001	0.001
Lymnaeidae	0.000	0.000	0.000	0.000	0.000	0.000	-0.257	-0.003	0.002	0.000	0.000	0.000	0.000	0.000
Physa sp.	0.000	0.000	0.000	0.000	0.000	0.000	0.002	-0.002	-0.691	0.000	0.000	0.000	0.000	0.000
Odonata	-0.001	0.002	0.002	0.012	0.002	0.015	0.111	0.002	-0.119	0.002	0.007	0.002	0.006	0.006
Oligochaetes	0.001	0.001	0.001	0.002	0.001	0.002	0.055	-0.002	0.053	-0.003	0.001	-0.003	-0.001	0.000
Ostracod	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
Tanypodinae	-0.001	0.000	-0.001	0.001	-0.001	0.000	0.070	-0.047	0.038	0.005	-0.002	0.005	0.004	0.001
BlackBullhead1	0.048	0.050	0.049	0.051	0.049	0.047	-0.005	-0.002	0.009	0.001	-0.053	0.001	-0.063	-0.048
BlackBullhead2	0.002	0.003	0.003	0.003	0.003	0.008	-0.030	0.005	-0.010	0.001	-0.007	0.001	0.004	0.001
BlackBullhead3	-0.017	-0.015	-0.015	-0.012	-0.015	-0.015	-0.023	-0.007	0.028	0.045	0.010	0.045	0.011	0.024
BlackCrappie1	0.008	0.008	0.008	0.008	0.008	0.008	-0.002	0.000	0.001	-0.001	-0.008	-0.001	-0.010	-0.008

BlackCrappie2	0.000	0.000	0.000	-0.002	0.000	-0.003	0.046	0.000	-0.012	0.003	-0.002	0.003	-0.002	-0.001
BlackCrappie3	-0.020	-0.018	-0.019	-0.015	-0.019	-0.013	0.022	-0.014	-0.005	0.056	0.013	0.056	0.012	0.014
Bluegill1	0.008	0.009	0.008	0.009	0.008	0.008	0.002	0.000	-0.001	0.000	-0.009	0.000	-0.011	-0.008
Bluegill2	-0.002	-0.002	-0.002	-0.001	-0.002	-0.001	-0.020	-0.001	-0.008	0.007	0.004	0.007	0.004	0.000
Bluegill 3	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.010	0.002	0.007	0.000	0.001	0.000	0.001	0.001
GreenSunfish1	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.004	0.001	-0.004	0.002	0.001	0.002	0.001	0.001
GreenSunfish 2	0.000	0.000	0.000	0.000	0.000	0.000	-0.011	0.001	-0.001	0.001	0.001	0.001	0.000	0.001
GreenSunfish 3	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
ChannelCatfish 1	-0.005	-0.005	-0.005	-0.004	-0.005	-0.002	-0.009	-0.015	-0.011	0.001	0.010	0.001	0.005	0.008
ChannelCatfish 2	0.039	0.037	0.037	0.033	0.037	0.046	0.007	-0.001	-0.007	-0.006	-0.061	-0.006	-0.070	-0.055
ChannelCatfish 3	-0.014	-0.016	-0.016	-0.021	-0.016	-0.021	0.002	-0.002	0.045	-0.001	0.013	-0.001	0.017	0.013
Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CommonCarp1	0.011	0.012	0.012	0.012	0.012	0.011	0.001	0.000	0.004	-0.002	-0.013	-0.001	-0.015	-0.012
CommonCarp2	-0.007	-0.005	-0.006	-0.003	-0.006	-0.007	-0.019	0.081	-0.006	0.022	-0.014	0.022	0.011	0.009
CommonCarp3	0.004	0.005	0.005	0.008	0.005	0.008	0.076	-0.517	0.098	0.000	-0.013	0.000	0.002	-0.009

Fathead Minnow1	0.005	0.005	0.005	0.005	0.005	0.004	0.000	0.000	0.005	-0.001	-0.006	-0.001	-0.007	-0.005
FatheadMinnow 2	0.030	0.017	0.019	-0.003	0.019	0.003	0.002	-0.001	0.000	-0.282	0.028	-0.285	0.031	0.003
FatheadMinnow 3	0.004	0.003	0.003	0.003	0.003	0.004	-0.001	0.000	0.000	-0.022	0.005	-0.023	0.005	-0.017
June Sucker 1	0.024	0.025	0.025	0.027	0.025	0.025	0.002	-0.006	-0.007	0.000	-0.024	0.000	-0.031	-0.023
JuneSucker2	-0.002	-0.002	-0.002	-0.001	-0.002	-0.002	-0.017	0.003	-0.008	0.001	0.005	0.001	0.002	-0.002
JuneSucker 3	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Walleye1	0.000	0.000	0.000	0.000	0.000	0.000	-0.007	0.000	-0.001	0.002	0.000	0.002	-0.001	0.001
Walley2	0.010	0.008	0.008	0.006	0.008	0.008	-0.054	-0.002	0.028	-0.023	-0.009	-0.023	-0.012	-0.009
Walleye3	0.016	0.017	0.017	0.018	0.017	0.018	-0.017	-0.001	-0.009	-0.011	-0.016	-0.011	-0.020	-0.014
Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WhiteBass1	0.067	0.073	0.071	0.079	0.071	0.069	0.063	-0.005	-0.017	0.031	-0.077	0.032	-0.094	-0.069
WhiteBass2	-0.099	-0.097	-0.097	-0.090	-0.097	-0.092	0.169	-0.003	-0.057	0.102	0.097	0.102	0.114	0.097

WhiteBass3	-0.017	-0.017	-0.017	-0.016	-0.017	-0.018	0.031	-0.014	0.015	0.009	0.019	0.009	0.015	0.016
White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YellowPerch1	0.028	0.029	0.028	0.030	0.028	0.027	-0.003	0.001	0.001	-0.005	-0.030	-0.005	-0.035	-0.028
YellowPerch2	0.000	0.000	0.000	-0.003	0.000	-0.004	-0.023	0.001	0.011	0.001	-0.001	0.001	-0.001	-0.001
YellowPerch3	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.002	-0.005	0.001	0.003	0.002	0.003	0.001	0.001
DetritusSnow	-0.010	-0.008	-0.008	-0.004	-0.008	-0.004	-0.280	-0.142	0.023	0.022	-0.001	0.022	0.018	0.009
Detritus	-0.004	-0.004	-0.003	-0.001	-0.003	-0.001	-0.090	-0.069	-0.119	0.010	-0.001	0.010	0.005	0.003
Carp Reduction	-0.003	-0.004	-0.004	-0.008	-0.004	-0.007	-0.074	0.508	-0.097	-0.002	0.015	-0.002	-0.003	0.008

Impacting / Impacted	Chydoridae	Cyclopidae	Daphnia	Diaptomidae	Ilyocryptidae	Laophontidae	Leptodoridae	Macrothricidae	Moinidae	Sididae
Bacillariophyta	0.284	0.096	0.018	0.096	0.280	0.280	0.299	0.233	0.093	0.103
Chlorophyta	0.112	0.158	0.124	0.158	0.107	0.107	0.128	0.107	0.156	0.167
Cryptophyta	0.019	0.018	0.020	0.018	0.018	0.018	0.021	0.018	0.018	0.019
Cyanophyta	-0.046	0.091	0.201	0.091	-0.049	-0.049	-0.038	-0.041	0.050	0.056
Dinophyta	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
Euglenophyta	-0.001	-0.002	0.037	-0.002	-0.001	-0.001	-0.001	0.038	0.037	0.038
Benthic Algae	0.001	0.001	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.001

Macrophytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Epiphytes	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Asplanchinida	-0.025	-0.023	-0.027	-0.018	-0.025	-0.025	-0.024	-0.023	-0.019	-0.018
Bosminidae	-0.034	-0.032	-0.027	-0.032	-0.034	-0.034	-0.033	-0.033	-0.032	-0.032
Brachionidae	-0.028	-0.021	-0.018	-0.019	-0.028	-0.028	-0.030	-0.026	-0.019	-0.020
Canthocamptidae	-0.009	-0.007	-0.005	-0.007	-0.009	-0.009	-0.009	-0.009	-0.007	-0.007
Ceriodaphnia	-0.083	-0.066	-0.051	-0.068	-0.085	-0.085	-0.075	-0.081	-0.070	-0.065
Chydoridae	-0.014	-0.010	-0.007	-0.010	-0.014	-0.014	-0.014	-0.013	-0.010	-0.010
Cyclopidae	-0.188	-0.217	-0.181	-0.210	-0.194	-0.194	-0.164	-0.191	-0.206	-0.190
Daphnia	-0.059	-0.087	-0.119	-0.089	-0.061	-0.061	-0.053	-0.072	-0.092	-0.087
Diaptomidae	-0.077	-0.082	-0.073	-0.086	-0.080	-0.080	-0.068	-0.079	-0.085	-0.078
Ilyocryptidae	-0.039	-0.028	-0.020	-0.029	-0.039	-0.039	-0.039	-0.036	-0.029	-0.029
Laophontidae	-0.007	-0.005	-0.004	-0.005	-0.007	-0.007	-0.007	-0.006	-0.005	-0.005
Leptodoridae	-0.006	-0.004	-0.003	-0.004	-0.006	-0.006	-0.006	-0.005	-0.004	-0.004
Macrothricidae	-0.028	-0.020	-0.021	-0.020	-0.028	-0.028	-0.031	-0.030	-0.025	-0.026
Moinidae	-0.008	-0.008	-0.008	-0.009	-0.008	-0.008	-0.007	-0.009	-0.009	-0.009
Sididae	-0.026	-0.028	-0.033	-0.028	-0.026	-0.026	-0.027	-0.030	-0.032	-0.033
Acari	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Amphipoda	-0.008	0.005	-0.006	-0.010	-0.009	-0.009	-0.005	-0.009	-0.009	-0.009
Chironominae	0.005	0.000	0.013	0.004	0.007	0.007	-0.023	0.007	0.007	-0.016
Coleoptera	0.006	0.004	0.003	0.006	0.006	0.006	0.002	0.006	0.006	0.006
Corbicula sp.	0.005	0.004	0.003	0.005	0.005	0.005	0.003	0.005	0.006	0.005
Corixidae	0.005	0.005	-0.005	0.006	0.006	0.006	0.001	0.006	0.006	0.006
Decopoda	0.005	0.004	0.005	0.005	0.005	0.005	0.003	0.005	0.005	0.004
Glossiphoniidae	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001
Isopoda	0.001	0.001	-0.006	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Lymnaeidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Physa sp.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Odonata	0.006	0.008	-0.066	0.008	0.006	0.006	0.004	0.007	0.009	0.009
Oligochaetes	0.000	-0.001	-0.005	-0.001	-0.001	-0.001	0.002	-0.001	-0.001	0.001
Ostracod	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tanypodinae	0.001	-0.001	-0.003	0.002	0.004	0.004	-0.006	0.004	0.004	-0.004
BlackBullhead1	-0.059	-0.068	-0.030	-0.060	-0.063	-0.063	-0.040	-0.063	-0.063	-0.051
BlackBullhead2	0.005	0.005	0.000	-0.001	0.004	0.004	-0.067	0.004	0.005	-0.062
BlackBullhead3	0.010	0.004	0.019	0.011	0.011	0.011	0.008	0.011	0.011	0.009
BlackCrappie1	-0.009	-0.010	-0.005	-0.009	-0.010	-0.010	-0.006	-0.010	-0.010	-0.008

BlackCrappie2	-0.001	-0.003	0.013	-0.002	-0.002	-0.002	-0.003	-0.002	-0.002	-0.002
BlackCrappie3	0.012	0.020	0.007	0.012	0.012	0.012	0.002	0.012	0.013	0.007
Bluegill1	-0.010	-0.012	-0.006	-0.010	-0.011	-0.011	-0.007	-0.011	-0.011	-0.009
Bluegill2	0.004	0.000	0.000	0.003	0.004	0.004	0.006	0.004	0.004	-0.001
Bluegill 3	0.001	-0.001	0.002	0.000	0.001	0.001	0.002	0.001	0.001	0.002
GreenSunfish1	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.002
GreenSunfish 2	0.000	0.000	0.002	0.000	0.000	0.000	0.001	0.000	0.000	-0.002
GreenSunfish 3	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.000
ChannelCatfish1	0.007	0.011	-0.007	0.005	0.005	0.005	0.004	0.006	0.006	0.005
ChannelCatfish2	-0.065	0.005	-0.043	-0.068	-0.070	-0.070	-0.049	-0.070	-0.070	-0.059
ChannelCatfish3	0.015	0.017	0.036	0.015	0.017	0.017	0.014	0.016	0.015	0.015
Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CommonCarp1	-0.014	-0.016	-0.005	-0.014	-0.015	-0.015	-0.009	-0.015	-0.015	-0.012
CommonCarp2	0.001	-0.007	0.005	0.013	0.011	0.011	0.016	0.011	0.012	0.011
CommonCarp3	-0.011	0.001	-0.027	-0.005	0.002	0.002	-0.014	0.002	0.003	0.005

Fathead Minnow1	-0.006	-0.008	-0.001	-0.007	-0.007	-0.007	-0.004	-0.007	-0.007	-0.006
FatheadMinnow2	0.031	0.015	-0.001	0.026	0.031	0.031	0.030	0.030	0.026	0.025
FatheadMinnow 3	0.005	0.004	-0.015	0.004	0.005	0.005	0.005	0.005	0.005	0.005
June Sucker 1	-0.028	-0.033	-0.021	-0.029	-0.031	-0.031	-0.021	-0.031	-0.031	-0.026
JuneSucker2	0.002	0.003	-0.006	0.003	0.002	0.002	0.019	0.002	0.002	0.015
JuneSucker 3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Walleye1	-0.001	-0.001	0.000	-0.001	-0.001	-0.001	0.000	-0.001	-0.001	0.000
Walley2	-0.011	-0.001	-0.006	-0.010	-0.012	-0.012	0.009	-0.012	-0.012	-0.002
Walleye3	-0.019	-0.017	-0.021	-0.019	-0.020	-0.020	-0.005	-0.020	-0.020	-0.013
Walley 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WhiteBass1	-0.087	-0.110	-0.050	-0.087	-0.094	-0.094	-0.061	-0.094	-0.093	-0.070
WhiteBass2	0.106	0.095	0.065	0.109	0.114	0.114	0.050	0.115	0.116	0.096

WhiteBass3	0.014	0.017	0.008	0.017	0.015	0.015	0.055	0.015	0.015	0.045
White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YellowPerch1	-0.033	-0.038	-0.019	-0.033	-0.035	-0.035	-0.022	-0.035	-0.035	-0.029
YellowPerch2	-0.001	-0.003	0.016	-0.003	-0.001	-0.001	-0.025	-0.001	-0.002	-0.001
YellowPerch3	0.001	0.002	0.000	0.001	0.001	0.001	0.000	0.001	0.001	0.000
DetritusSnow	0.010	0.009	-0.009	0.013	0.018	0.018	-0.023	0.018	0.019	-0.008
Detritus	0.002	0.007	-0.009	0.004	0.005	0.005	-0.001	0.005	0.006	0.004
Carp Reduction	0.011	0.000	0.026	0.003	-0.003	-0.003	0.012	-0.003	-0.004	-0.006

Impacting / Impacted	Acari	Amphipoda	Chironominae	Coleoptera	Corbicula sp.	Corixidae	Decopoda	Glossiphoniidae	Isopoda	Lymnaeidae	Physa sp.	Odonata	Oligochaetes	Ostracod	Tanypodinae
Bacillariophyta	-0.002	-0.009	0.003	-0.009	-0.041	-0.002	-0.036	0.008	0.002	-0.002	0.002	0.003	-0.001	-0.003	0.002
Chlorophyta	-0.004	-0.009	0.004	-0.012	-0.043	-0.005	-0.039	0.011	0.001	-0.002	0.004	0.009	-0.001	-0.009	0.002
Cryptophyta	-0.001	-0.001	0.000	-0.002	-0.006	-0.001	-0.005	0.002	0.000	0.000	0.000	0.001	0.000	-0.001	0.000
Cyanophyta	-0.005	-0.005	0.002	-0.009	-0.020	-0.006	-0.019	0.009	-0.002	-0.001	0.003	0.013	-0.001	-0.012	0.001
Dinophyta	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Euglenophyta	-0.001	-0.001	0.000	-0.001	-0.001	-0.001	-0.001	0.001	0.000	0.000	0.000	0.002	0.000	-0.002	0.000
Benthic Algae	0.007	-0.001	-0.001	-0.008	-0.007	0.082	0.085	0.006	-0.001	0.090	0.002	0.007	-0.002	-0.009	-0.001
Macrophytes	0.000	0.001	-0.001	0.000	0.001	0.000	0.001	0.001	0.001	-0.003	-0.001	0.000	-0.002	0.001	-0.001
Epiphytes	0.017	-0.003	-0.001	0.023	-0.003	-0.001	-0.001	-0.023	-0.012	-0.001	0.277	0.000	-0.004	-0.001	-0.001
Asplanchinida	0.000	0.000	0.001	-0.001	-0.007	0.000	-0.006	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.001

Bosminidae	0.000	-0.001	0.000	0.001	0.000	0.001	0.000	-0.001	0.001	0.000	0.000	-0.002	0.000	0.002	0.000
Brachionidae	0.000	0.001	0.000	0.001	0.002	0.001	0.002	-0.001	0.000	0.000	0.000	-0.001	0.000	0.001	0.000
Canthocamptidae	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ceriodaphnia	0.000	-0.008	0.002	-0.003	-0.019	0.000	-0.016	0.003	0.002	-0.001	0.001	-0.002	0.000	0.002	0.001
Chydoridae	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cyclopidae	0.004	0.006	0.005	-0.006	-0.060	0.001	-0.053	0.004	0.006	-0.003	0.001	-0.011	0.001	0.009	0.003
Daphnia	-0.019	-0.012	0.001	-0.025	-0.013	-0.021	-0.014	0.026	-0.013	0.000	0.009	0.055	-0.005	-0.052	0.000
Diaptomidae	0.001	-0.010	0.002	-0.003	-0.023	0.001	-0.020	0.003	0.003	-0.001	0.001	-0.004	0.000	0.003	0.002
Ilyocryptidae	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.001	0.000
Laophontidae	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Leptodoridae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Macrothricidae	0.001	0.001	0.000	0.002	0.006	0.001	0.005	-0.002	0.000	0.000	-0.001	-0.002	0.000	0.001	0.000
Moinidae	0.000	-0.001	0.000	0.000	-0.002	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Sididae	0.001	0.000	0.000	0.001	0.003	0.001	0.003	-0.001	0.000	0.000	0.000	-0.002	0.000	0.002	0.000
Acari	-0.012	-0.004	0.000	-0.012	-0.058	0.000	0.004	0.013	-0.018	-0.045	-0.011	0.006	0.002	-0.005	-0.001
Amphipoda	0.035	-0.159	-0.013	0.064	-0.020	-0.006	-0.039	-0.078	-0.045	0.002	-0.031	-0.003	-0.018	-0.014	-0.015
Chironominae	-0.020	-0.221	-0.391	-0.013	-0.144	-0.156	-0.155	-0.181	-0.120	-0.295	-0.092	-0.137	-0.213	-0.044	-0.369
Coleoptera	-0.372	-0.050	-0.004	-0.177	0.036	0.000	0.003	-0.781	-0.363	0.029	-0.281	0.013	-0.079	0.028	-0.006
Corbicula sp.	0.097	-0.006	-0.001	-0.012	-0.051	-0.010	-0.031	-0.001	-0.009	-0.002	-0.002	0.000	-0.009	-0.015	-0.001
Corixidae	-0.023	-0.008	-0.006	-0.078	-0.030	-0.133	-0.063	0.070	-0.015	-0.037	0.025	0.094	-0.011	-0.100	-0.006
Decopoda	0.001	-0.003	-0.002	-0.001	-0.031	-0.025	-0.057	-0.006	0.002	-0.027	-0.002	-0.017	-0.003	0.009	-0.002
Glossiphoniidae	-0.039	-0.014	-0.003	0.079	-0.009	-0.005	-0.006	-0.087	-0.045	0.003	-0.031	-0.001	-0.017	-0.008	-0.003
Isopoda	0.034	-0.020	-0.002	0.048	-0.010	-0.033	-0.006	-0.055	-0.068	0.002	-0.020	0.076	-0.022	-0.081	-0.003
Lymnaeidae	0.095	0.000	-0.004	-0.001	-0.004	-0.025	-0.026	0.000	-0.001	-0.037	-0.002	-0.002	-0.002	0.003	-0.005
Physa sp.	0.043	-0.007	-0.002	0.056	-0.006	-0.002	-0.002	-0.058	-0.030	-0.003	-0.309	0.000	-0.011	-0.002	-0.002
Odonata	-0.259	-0.054	0.003	-0.297	0.049	-0.277	-0.002	0.307	-0.213	0.029	0.119	-0.230	-0.052	-0.731	-0.007
Oligochaetes	-0.081	-0.099	-0.031	0.017	-0.123	-0.083	-0.063	-0.133	-0.146	-0.006	-0.053	0.050	-0.129	-0.183	-0.032
Ostracod	-0.003	-0.002	0.000	-0.003	-0.001	-0.003	-0.001	0.002	-0.003	0.000	0.001	0.007	-0.002	-0.009	0.000

Tanypodinae	0.050	-0.093	-0.132	-0.001	-0.031	-0.066	-0.027	-0.047	-0.060	-0.118	-0.038	0.024	-0.086	-0.066	-0.132
BlackBullhead1	0.009	0.012	0.002	0.021	0.014	0.020	-0.010	-0.023	0.002	-0.003	-0.009	-0.028	-0.001	0.026	0.002
BlackBullhead2	-0.010	0.013	-0.049	0.005	0.048	0.018	0.042	0.017	0.005	0.036	0.010	0.029	0.023	-0.009	-0.022
BlackBullhead3	-0.031	0.023	0.014	0.068	0.016	0.103	-0.060	-0.073	-0.043	-0.014	-0.028	0.010	-0.012	-0.016	0.007
BlackCrappie1	0.000	0.003	0.001	0.003	0.008	0.001	0.007	-0.003	-0.002	-0.001	-0.001	0.000	-0.001	0.000	0.001
BlackCrappie2	0.101	0.014	-0.006	-0.038	-0.001	-0.117	0.013	0.036	0.092	0.003	0.012	-0.160	0.026	0.151	0.001
BlackCrappie3	-0.005	0.023	0.004	-0.016	-0.053	-0.020	-0.043	0.015	-0.005	-0.003	0.005	0.025	-0.010	-0.023	0.007
Bluegill1	0.000	0.003	0.000	-0.002	-0.007	-0.001	-0.005	0.002	0.000	0.000	0.001	0.001	0.000	-0.001	0.000
Bluegill2	-0.038	-0.166	-0.011	-0.005	0.041	0.013	0.036	0.016	0.008	0.014	0.008	0.012	0.011	0.000	-0.019
Bluegill 3	-0.031	-0.134	-0.012	0.006	0.009	0.025	0.014	0.003	0.027	-0.016	-0.007	-0.042	0.016	0.049	-0.017
GreenSunfish1	0.002	0.009	-0.008	-0.001	0.001	0.005	0.002	0.005	0.006	0.005	0.004	0.001	-0.022	-0.003	-0.002
GreenSunfish 2	0.002	-0.023	-0.014	0.006	0.006	0.015	0.007	0.000	0.009	0.009	0.001	-0.011	0.009	0.016	-0.005
GreenSunfish 3	0.001	-0.001	-0.002	-0.001	0.001	0.000	0.001	0.003	0.002	0.002	0.001	0.000	0.000	0.001	-0.001
ChannelCatfish1	-0.048	0.013	0.006	-0.032	0.038	-0.034	0.089	0.031	-0.048	-0.005	0.011	0.132	-0.023	-0.127	0.003
ChannelCatfish2	-0.008	-0.152	0.004	-0.017	-0.036	0.003	-0.027	0.019	0.009	-0.001	0.007	0.003	0.004	0.000	0.004
ChannelCatfish3	0.099	-0.036	0.000	0.113	-0.010	0.113	-0.168	-0.115	0.086	-0.007	-0.045	-0.299	0.021	0.286	0.006
Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CommonCarp1	0.010	-0.002	0.000	0.011	-0.003	0.011	-0.018	-0.011	0.009	-0.001	-0.004	-0.030	0.002	0.028	0.001
CommonCarp2	-0.032	0.015	-0.011	-0.003	0.009	0.018	0.019	0.002	-0.033	0.021	0.006	0.068	0.047	-0.069	-0.022
CommonCarp3	-0.016	0.109	-0.100	-0.042	0.078	-0.008	0.080	0.129	0.113	-0.334	-0.098	-0.011	-0.246	0.096	-0.142
Fathead Minnow1	0.010	-0.003	0.000	0.012	0.000	0.012	-0.016	-0.012	0.008	-0.001	-0.005	-0.030	0.002	0.029	0.001
FatheadMinnow2	-0.001	0.003	0.001	-0.001	-0.008	0.000	-0.007	0.001	0.000	0.000	0.000	0.001	0.000	-0.002	0.000
FatheadMinnow 3	0.000	0.001	0.000	0.001	0.001	0.001	0.001	-0.001	0.000	0.000	0.000	-0.001	0.000	0.001	0.000
June Sucker 1	-0.020	0.012	0.002	-0.019	-0.007	-0.018	0.021	0.019	-0.018	-0.001	0.007	0.056	-0.008	-0.054	0.001
JuneSucker2	-0.014	0.012	-0.030	-0.002	0.029	0.005	0.030	0.016	-0.003	0.021	0.008	0.037	0.013	-0.025	-0.013
JuneSucker 3	0.000	0.002	-0.003	0.000	0.001	-0.001	0.001	0.002	0.001	0.002	0.001	0.000	0.002	0.001	-0.001
NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Walleye1	-0.005	0.008	-0.004	0.002	0.010	0.008	0.010	0.000	-0.003	0.003	0.001	0.012	-0.017	-0.013	-0.002
Walley2	0.013	0.033	0.012	0.061	0.233	0.016	0.184	-0.071	-0.034	-0.017	-0.028	-0.014	-0.017	0.003	0.010
Walleye3	-0.046	0.003	0.010	-0.026	0.079	-0.040	0.124	0.023	-0.052	-0.006	0.009	0.127	-0.016	-0.125	0.002
Walley 4	-0.001	0.000	0.000	-0.001	0.001	-0.001	0.002	0.001	-0.001	0.000	0.000	0.002	0.000	-0.002	0.000
WhiteBass1	-0.006	0.046	0.014	-0.053	-0.208	-0.036	-0.161	0.049	0.007	-0.004	0.017	0.030	-0.001	-0.032	0.007
WhiteBass2	-0.003	0.087	0.006	-0.156	-0.615	-0.080	-0.482	0.158	0.057	0.012	0.057	0.045	0.024	-0.037	0.004
WhiteBass3	-0.024	-0.054	0.067	0.001	0.010	-0.034	-0.011	-0.029	-0.043	-0.046	-0.015	0.032	-0.041	-0.061	0.028
White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YellowPerch1	0.001	0.002	-0.001	0.002	0.009	0.001	0.008	-0.002	0.000	0.000	-0.001	-0.001	0.000	0.001	0.000
YellowPerch2	0.083	0.023	-0.011	0.028	-0.009	0.048	0.007	-0.028	0.075	0.000	-0.011	-0.186	0.022	0.178	-0.002
YellowPerch3	-0.003	-0.001	0.001	0.003	0.002	0.005	0.000	-0.003	-0.003	-0.002	-0.001	0.004	-0.004	-0.003	0.001
DetritusSnow	0.121	0.062	0.378	0.173	0.118	0.188	0.286	0.044	0.084	0.411	-0.023	0.095	0.071	0.032	0.386
Detritus	0.034	0.331	0.003	0.080	0.463	0.160	0.185	0.324	0.322	-0.109	0.119	0.085	0.333	0.408	-0.005
Carp Reduction	0.020	-0.111	0.101	0.042	-0.079	0.006	-0.082	-0.129	-0.109	0.332	0.097	0.003	0.241	-0.088	0.145

	BlackBullhead1	BlackBullhead2	BlackBullhead3	BlackCrappie1	BlackCrappie2	BlackCrappie3	Bluegill1	Bluegill2	Bluegill 3	GreenSunfish1	GreenSunfish 2	GreenSunfish 3
Bacillariophyta	0.102	-0.011	0.024	0.104	-0.022	0.033	0.093	-0.022	0.000	-0.025	-0.021	0.003
Chlorophyta	0.115	-0.013	0.025	0.117	-0.023	0.035	0.105	-0.024	0.001	-0.028	-0.022	0.003
Cryptophyta	0.015	-0.002	0.003	0.015	-0.003	0.005	0.014	-0.003	0.000	-0.004	-0.003	0.000
Cyanophyta	0.057	-0.007	0.012	0.058	-0.010	0.016	0.053	-0.011	0.001	-0.013	-0.011	0.001
Dinophyta	0.003	0.000	0.001	0.003	-0.001	0.001	0.003	-0.001	0.000	-0.001	-0.001	0.000
Euglenophyta	0.004	0.000	0.001	0.004	-0.001	0.001	0.003	-0.001	0.000	-0.001	-0.001	0.000
Benthic Algae	-0.001	-0.001	0.002	-0.001	0.022	0.000	-0.003	-0.002	0.000	-0.003	-0.002	0.000
Macrophytes	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001	-0.001
Epiphytes	0.000	-0.001	0.000	0.000	0.001	0.000	0.000	-0.001	0.000	-0.001	-0.001	-0.001

Asplanchinida	0.003	-0.002	0.006	0.006	-0.006	0.011	0.002	-0.005	0.000	-0.004	-0.005	0.001
Bosminidae	0.001	0.001	0.000	0.001	0.000	0.000	0.001	-0.001	-0.001	0.000	-0.001	0.000
Brachionidae	-0.011	0.001	-0.001	-0.010	0.001	0.000	-0.010	0.001	0.000	0.002	0.001	0.000
Canthocamptidae	0.002	0.000	0.000	0.002	0.000	0.000	0.002	-0.001	0.000	0.000	0.000	0.000
Ceriodaphnia	0.047	-0.006	0.012	0.047	-0.010	0.013	0.043	-0.009	-0.002	-0.012	-0.011	0.001
Chydoridae	-0.003	0.000	-0.001	-0.003	0.001	-0.001	-0.003	0.000	0.000	0.001	0.001	0.000
Cyclopidae	0.180	-0.022	0.031	0.181	-0.026	0.051	0.166	-0.027	0.003	-0.038	-0.028	0.005
Daphnia	0.038	-0.007	0.010	0.039	-0.009	0.011	0.036	-0.009	0.002	-0.010	-0.009	0.000
Diaptomidae	0.059	-0.006	0.012	0.058	-0.012	0.014	0.053	-0.014	0.000	-0.014	-0.011	0.001
Ilyocryptidae	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	-0.001	0.000	0.000	0.000	0.000
Laophontidae	-0.002	0.000	0.000	-0.002	0.000	-0.001	-0.001	0.000	0.000	0.000	0.000	0.000
Leptodoridae	-0.001	0.001	0.000	-0.001	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000
Macrothricidae	-0.015	0.002	-0.003	-0.015	0.003	-0.005	-0.014	0.003	0.000	0.004	0.003	0.000
Moinidae	0.004	-0.001	0.001	0.004	-0.001	0.001	0.004	-0.001	0.000	-0.001	-0.001	0.000
Sididae	-0.007	0.006	-0.002	-0.007	0.001	-0.003	-0.006	0.002	-0.001	0.001	0.002	0.000
Acari	0.000	0.000	0.000	0.000	-0.001	0.000	0.001	0.000	0.000	0.001	0.000	0.000
Amphipoda	-0.032	-0.012	0.015	-0.012	0.014	0.030	-0.006	0.218	0.229	-0.020	0.063	0.025
Chironominae	0.006	0.260	0.046	0.014	0.054	0.029	0.012	0.109	0.113	0.278	0.251	0.329
Coleoptera	-0.003	-0.005	0.006	-0.004	0.072	0.000	-0.016	-0.020	-0.019	-0.024	-0.014	-0.001
Corbicula sp.	-0.002	-0.002	-0.001	-0.006	-0.004	0.000	-0.018	-0.005	-0.003	-0.012	-0.002	-0.002
Corixidae	-0.009	-0.007	0.019	-0.004	0.242	0.002	-0.013	-0.010	-0.004	-0.013	-0.017	0.002
Decopoda	-0.005	-0.004	-0.001	-0.004	-0.009	-0.001	-0.013	-0.003	-0.003	-0.010	-0.002	-0.002
Glossiphoniidae	0.000	-0.002	-0.001	0.000	0.005	-0.001	-0.001	-0.005	-0.006	-0.003	-0.003	-0.003
Isopoda	-0.001	-0.002	-0.001	0.000	0.002	-0.001	0.000	-0.007	-0.006	-0.003	-0.002	-0.004
Lymnaeidae	0.000	-0.003	-0.001	0.000	-0.009	0.000	0.001	-0.003	0.002	-0.003	-0.003	-0.004
Physa sp.	0.000	-0.001	0.000	0.000	0.004	0.000	-0.001	-0.003	0.000	-0.003	-0.003	-0.002
Odonata	-0.015	-0.007	-0.005	0.007	-0.035	-0.002	0.012	-0.013	0.001	0.003	0.008	-0.008
Oligochaetes	0.005	-0.021	-0.010	0.001	-0.025	-0.013	0.005	-0.045	-0.048	0.075	-0.027	-0.013

Ostracod	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tanypodinae	-0.003	0.072	0.027	0.004	-0.001	0.031	0.005	0.108	0.120	0.070	0.054	0.088
BlackBullhead1	-0.101	0.000	0.056	-0.077	-0.039	0.083	-0.053	-0.050	0.004	-0.014	-0.036	0.003
BlackBullhead2	0.012	-0.145	-0.011	-0.001	-0.008	-0.015	0.010	-0.021	-0.022	-0.057	-0.054	-0.038
BlackBullhead3	-0.181	0.019	-0.263	-0.019	-0.533	-0.050	0.022	-0.064	0.014	-0.001	-0.399	0.014
BlackCrappie1	-0.017	-0.005	0.001	-0.029	0.000	0.001	-0.008	-0.016	0.001	-0.005	0.001	0.001
BlackCrappie2	-0.013	-0.001	0.073	-0.002	-0.117	-0.004	0.005	-0.006	-0.001	-0.001	-0.046	-0.004
BlackCrappie3	-0.059	0.053	-0.037	0.213	0.012	-0.131	-0.012	-0.131	0.010	-0.067	-0.070	0.005
Bluegill1	-0.012	-0.001	-0.002	-0.014	0.001	0.002	-0.015	-0.002	0.001	-0.004	0.001	0.000
Bluegill2	-0.032	-0.016	0.019	-0.024	-0.024	0.125	0.007	-0.127	-0.056	-0.031	-0.053	-0.019
Bluegill 3	0.006	-0.008	-0.005	0.001	-0.002	-0.007	0.000	-0.045	-0.048	-0.008	-0.021	-0.017
GreenSunfish1	-0.003	-0.010	0.000	-0.003	-0.002	0.013	-0.003	-0.008	-0.001	-0.014	-0.007	-0.006
GreenSunfish 2	-0.004	-0.010	0.021	0.002	-0.019	0.003	0.001	-0.017	-0.014	-0.009	-0.026	-0.011
GreenSunfish 3	0.000	-0.001	0.000	0.000	-0.001	0.000	0.000	-0.001	-0.001	-0.002	-0.001	-0.002
ChannelCatfish1	0.027	0.006	0.088	0.005	-0.085	-0.024	0.030	-0.012	0.010	0.013	-0.069	0.005
ChannelCatfish2	-0.046	-0.004	0.044	-0.050	-0.039	-0.016	-0.060	-0.048	-0.041	-0.013	-0.037	-0.003
ChannelCatfish3	-0.065	-0.034	-0.001	0.017	0.015	-0.013	0.018	-0.005	-0.015	0.006	-0.008	0.002
Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CommonCarp1	-0.020	-0.003	-0.002	-0.012	0.002	-0.002	-0.014	0.001	-0.001	0.000	0.000	0.000
CommonCarp2	-0.031	-0.018	0.143	0.032	-0.144	0.124	0.007	-0.044	-0.004	-0.028	-0.118	-0.011
CommonCarp3	-0.002	-0.074	-0.027	-0.009	-0.026	-0.020	-0.007	-0.039	-0.050	-0.112	-0.058	-0.102
Fathead Minnow1	-0.014	-0.003	0.002	-0.003	0.000	0.003	-0.004	-0.001	-0.001	0.001	-0.002	0.000
FatheadMinnow2	-0.008	0.000	0.007	-0.002	-0.007	0.019	-0.009	-0.004	0.001	-0.005	-0.006	0.001
FatheadMinnow 3	-0.003	0.000	0.003	-0.002	-0.002	-0.001	-0.001	0.000	0.000	0.001	-0.001	0.000
June Sucker 1	-0.020	0.004	0.032	-0.033	-0.033	-0.017	-0.033	-0.001	0.006	0.000	-0.025	0.002
JuneSucker2	0.029	-0.163	-0.009	0.027	-0.006	-0.020	0.007	0.016	-0.012	-0.050	-0.044	-0.023
JuneSucker 3	0.000	-0.002	0.000	0.000	-0.001	0.000	0.000	-0.001	-0.001	-0.002	-0.002	-0.002
NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Walleye1	-0.009	-0.006	0.048	-0.001	-0.038	-0.004	0.005	-0.007	0.000	-0.003	-0.035	-0.003
Walley2	-0.165	-0.076	-0.034	-0.406	0.044	0.074	0.046	-0.345	0.016	-0.090	0.033	0.012
Walleye3	0.038	-0.045	-0.020	0.009	-0.019	-0.002	0.042	-0.011	0.008	0.034	-0.065	0.006
Walley 4	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
WhiteBass1	-0.149	-0.071	-0.002	-0.166	-0.019	0.104	-0.252	-0.034	0.021	-0.108	-0.016	0.012
WhiteBass2	-0.059	-0.023	0.009	-0.125	-0.041	0.021	-0.371	-0.021	0.030	-0.217	-0.017	0.008
WhiteBass3	0.084	-0.423	0.001	0.094	0.006	-0.047	0.012	0.116	0.021	-0.076	-0.028	0.049
White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YellowPerch1	-0.025	0.002	-0.005	-0.025	0.004	-0.006	-0.023	0.005	0.000	0.005	0.004	0.000
YellowPerch2	0.003	-0.014	0.006	0.004	-0.009	0.014	-0.002	-0.001	-0.003	-0.009	-0.015	-0.006
YellowPerch3	0.003	0.002	-0.013	-0.006	-0.037	-0.009	-0.004	0.004	0.000	-0.017	0.011	0.001
DetritusSnow	-0.027	0.254	0.095	0.007	0.161	0.077	-0.009	0.245	0.279	0.291	0.246	0.354
Detritus	-0.024	-0.004	0.031	-0.006	0.046	0.029	-0.018	0.082	0.096	0.024	0.011	0.026
Carp Reduction	0.006	0.076	0.011	0.006	0.043	0.006	0.006	0.044	0.050	0.115	0.072	0.103

Impacting / Impacted	ChannelCatfish1	ChannelCatfish2	ChannelCatfish3	Channel Catfish 4	CommonCarp1	CommonCarp2	CommonCarp3	Fathead Minnow1	FatheadMinnow2	FatheadMinnow 3
Bacillariophyta	0.019	0.071	0.011	0.048	0.107	-0.014	0.003	0.113	0.179	0.149
Chlorophyta	0.024	0.071	0.013	0.036	0.120	-0.014	0.003	0.127	0.085	0.096
Cryptophyta	0.003	0.010	0.002	0.005	0.015	-0.002	0.000	0.016	0.014	0.016
Cyanophyta	0.013	0.033	0.008	0.010	0.058	-0.006	0.002	0.061	-0.010	0.040
Dinophyta	0.001	0.002	0.000	0.001	0.003	0.000	0.000	0.003	0.003	0.003
Euglenophyta	0.001	0.004	0.001	0.001	0.004	-0.001	0.000	0.004	0.001	0.011
Benthic Algae	-0.001	-0.003	0.005	0.014	-0.003	-0.001	0.000	-0.003	-0.002	-0.001
Macrophytes	0.000	0.000	0.000	0.000	0.000	-0.001	0.005	0.000	0.000	0.000

Epiphytes	0.000	-0.001	-0.001	0.004	0.000	0.000	0.001	0.001	0.000	0.000
Asplanchinida	-0.004	0.007	0.001	0.066	0.004	-0.004	0.000	0.005	0.394	0.152
Bosminidae	0.000	0.007	0.000	-0.004	0.001	0.002	0.000	0.001	-0.025	-0.028
Brachionidae	-0.003	-0.006	-0.001	0.016	-0.011	0.000	0.000	-0.012	0.107	0.033
Canthocamptidae	0.000	0.003	0.000	-0.001	0.002	-0.001	0.000	0.003	-0.006	-0.007
Ceriodaphnia	0.008	0.055	0.003	0.010	0.050	-0.007	0.002	0.053	0.011	0.225
Chydoridae	-0.001	-0.001	0.000	-0.002	-0.003	0.000	0.000	-0.003	-0.010	-0.010
Cyclopidae	0.045	0.002	0.016	0.016	0.187	-0.009	0.002	0.197	-0.073	-0.152
Daphnia	0.007	0.052	0.016	0.019	0.034	-0.007	0.003	0.035	0.013	0.248
Diaptomidae	0.011	0.070	0.004	0.000	0.063	-0.012	0.002	0.067	-0.060	-0.058
Ilyocryptidae	0.000	0.006	0.000	-0.005	0.000	-0.001	0.000	0.000	-0.027	-0.027
Laophontidae	0.000	0.000	0.000	-0.001	-0.002	0.000	0.000	-0.002	-0.005	-0.005
Leptodoridae	0.000	0.000	0.000	-0.001	-0.001	0.000	0.000	-0.001	-0.004	-0.004
Macrothricidae	-0.003	-0.009	-0.002	-0.006	-0.016	0.002	0.000	-0.017	-0.020	-0.021
Moinidae	0.001	0.005	0.000	0.000	0.004	-0.001	0.000	0.004	-0.006	-0.007
Sididae	-0.001	0.000	-0.001	-0.005	-0.007	0.000	0.000	-0.007	-0.020	-0.025
Acari	0.000	0.000	0.001	0.000	0.000	0.000	0.000	-0.001	0.001	0.000
Amphipoda	-0.010	0.173	0.150	-0.013	-0.089	-0.019	-0.006	-0.119	-0.010	-0.017
Chironominae	-0.005	-0.047	-0.043	-0.069	0.029	0.072	0.039	0.028	-0.008	-0.040
Coleoptera	-0.003	-0.027	-0.009	0.140	0.001	0.007	0.001	0.009	-0.010	-0.002
Corbicula sp.	-0.001	-0.018	-0.007	-0.004	-0.001	-0.004	-0.003	0.008	-0.009	0.004
Corixidae	-0.015	-0.018	0.021	0.158	-0.016	-0.008	0.003	-0.015	-0.010	-0.014
Decopoda	0.001	-0.012	0.032	-0.014	-0.021	-0.003	-0.002	-0.020	-0.007	0.004
Glossiphoniidae	-0.001	-0.004	-0.003	0.012	0.002	-0.003	-0.002	0.003	0.000	0.001
Isopoda	0.001	-0.004	0.015	0.026	-0.008	-0.003	-0.003	-0.011	0.000	-0.001
Lymnaeidae	0.001	0.001	-0.002	-0.005	0.001	0.001	0.003	0.001	0.001	0.001
Physa sp.	0.000	-0.002	-0.002	0.009	0.001	0.001	0.002	0.001	0.000	0.000
Odonata	0.011	-0.002	0.176	0.140	-0.097	0.002	-0.002	-0.134	0.007	-0.016

Oligochaetes	-0.004	-0.015	-0.007	0.008	0.006	-0.045	0.002	0.006	0.007	0.007
Ostracod	0.000	0.000	0.002	0.001	-0.001	0.000	0.000	-0.001	0.000	0.000
Tanypodinae	0.007	-0.020	-0.033	0.000	0.020	0.093	0.047	0.020	-0.006	-0.024
BlackBullhead1	-0.063	-0.041	0.099	-0.032	-0.109	-0.016	0.002	-0.139	-0.035	-0.068
BlackBullhead2	0.020	0.013	0.006	0.014	0.000	-0.031	-0.005	-0.004	0.007	-0.002
BlackBullhead3	-0.587	-0.137	0.307	-0.024	-0.161	-0.042	0.007	-0.267	-0.069	-0.527
BlackCrappie1	-0.003	-0.003	0.001	-0.001	-0.008	0.000	0.000	-0.009	-0.002	-0.005
BlackCrappie2	-0.055	-0.008	-0.012	-0.079	0.008	-0.014	0.000	0.004	-0.006	-0.051
BlackCrappie3	-0.006	0.016	-0.004	-0.031	-0.011	-0.142	0.014	-0.054	-0.149	0.053
Bluegill1	-0.002	-0.011	-0.002	-0.003	-0.010	0.000	0.000	-0.008	-0.006	-0.004
Bluegill2	-0.015	-0.024	-0.023	0.004	0.017	-0.029	0.001	0.007	-0.015	-0.012
Bluegill 3	0.001	-0.028	-0.034	-0.004	0.019	-0.002	-0.002	0.027	0.002	0.005
GreenSunfish1	-0.001	0.000	0.002	0.000	-0.002	-0.005	-0.001	-0.001	-0.004	0.001
GreenSunfish 2	-0.016	-0.009	-0.004	0.000	0.003	-0.007	-0.001	0.002	-0.002	-0.016
GreenSunfish 3	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000
ChannelCatfish1	-0.332	0.008	-0.285	0.071	0.169	-0.162	0.015	0.219	0.010	-0.112
ChannelCatfish2	-0.047	-0.100	-0.019	-0.011	-0.030	0.003	0.001	-0.019	-0.037	-0.068
ChannelCatfish3	0.034	0.006	-0.240	-0.153	-0.416	-0.004	0.002	-0.554	0.009	0.011
Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CommonCarp1	0.001	-0.010	0.074	-0.018	-0.055	0.000	0.000	-0.068	-0.004	-0.006
CommonCarp2	0.112	-0.018	-0.048	0.021	0.023	-0.139	-0.081	0.015	-0.036	-0.114
CommonCarp3	-0.004	0.022	0.021	-0.014	-0.016	-0.078	-0.483	-0.016	0.007	0.014
Fathead Minnow1	-0.001	-0.004	0.077	0.150	-0.049	-0.001	0.000	-0.064	-0.002	-0.004
FatheadMinnow2	-0.008	-0.012	0.002	0.131	-0.006	-0.004	0.001	-0.006	-0.208	-0.092
FatheadMinnow 3	-0.002	-0.003	0.000	-0.003	-0.002	0.000	0.000	-0.003	-0.018	-0.019
June Sucker 1	0.275	-0.030	-0.128	0.022	0.040	-0.065	0.006	0.068	-0.013	-0.059
JuneSucker2	-0.003	0.005	-0.015	0.014	0.010	-0.024	-0.003	0.012	-0.002	-0.002
JuneSucker 3	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.000	0.000

NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Walleye1	-0.030	-0.005	-0.005	0.005	0.004	-0.007	0.000	0.000	-0.002	-0.044
Walley2	0.032	0.117	0.025	0.013	0.026	-0.009	0.002	-0.021	0.048	0.028
Walleye3	-0.003	0.043	-0.292	0.070	0.173	-0.008	0.001	0.207	0.026	-0.108
Walley 4	0.000	0.000	-0.005	0.001	0.003	0.000	0.000	0.003	0.000	-0.001
WhiteBass1	-0.039	-0.195	-0.046	-0.039	-0.127	-0.028	0.005	-0.071	-0.133	-0.040
WhiteBass2	-0.012	-0.323	-0.089	-0.037	-0.045	0.004	0.003	0.127	-0.205	0.052
WhiteBass3	-0.009	-0.020	0.052	-0.004	-0.026	-0.032	0.014	-0.033	-0.021	0.029
White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YellowPerch1	-0.006	-0.015	-0.003	-0.005	-0.026	0.003	-0.001	-0.027	-0.005	-0.014
YellowPerch2	-0.006	0.003	-0.043	-0.045	0.024	-0.008	-0.001	0.031	-0.004	0.000
YellowPerch3	-0.003	-0.002	0.003	0.000	-0.006	-0.052	0.005	-0.004	-0.008	0.013
DetritusSnow	0.003	-0.015	0.047	0.079	-0.031	0.227	0.142	-0.046	-0.033	-0.083
Detritus	0.004	0.049	0.077	0.055	-0.051	0.094	0.069	-0.062	-0.018	-0.027
Carp Reduction	-0.009	-0.020	-0.015	0.011	0.014	-0.022	-0.508	0.014	-0.002	-0.001

Impacting / Impacted	June Sucker 1	JuneSucker2	JuneSucker 3	NorthernPike1	NorthernPike2	NorthernPike3	Northern Pike 4	Walleye1	Walley2	Walleye3	Walley 4
Bacillariophyta	0.101	-0.013	0.004	-0.002	0.005	0.010	0.012	-0.019	0.019	0.018	0.023
Chlorophyta	0.112	-0.014	0.004	-0.003	0.006	0.012	0.013	-0.021	0.021	0.019	0.025
Cryptophyta	0.015	-0.002	0.001	0.000	0.001	0.001	0.002	-0.003	0.003	0.003	0.003
Cyanophyta	0.055	-0.007	0.002	-0.002	0.003	0.006	0.006	-0.010	0.011	0.009	0.012
Dinophyta	0.003	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.001	0.001	0.001
Euglenophyta	0.004	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.001	0.001	0.001
Benthic Algae	0.000	-0.001	0.001	0.000	-0.001	0.000	0.000	-0.003	0.000	0.002	0.002

Macrophytes	0.000	-0.001	-0.001	-0.001	0.000	0.000	0.000	-0.001	0.000	0.000	0.000
Epiphytes	0.000	-0.001	-0.001	-0.001	0.000	0.000	0.000	-0.001	0.000	0.000	0.000
Asplanchinida	0.007	-0.002	0.000	0.000	0.000	0.000	0.001	-0.004	-0.001	0.003	0.003
Bosminidae	0.001	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Brachionidae	-0.009	0.001	0.000	0.000	-0.001	-0.001	-0.001	0.001	-0.003	-0.001	-0.002
Canthocamptidae	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000
Ceriodaphnia	0.047	-0.004	0.002	-0.001	0.002	0.005	0.006	-0.010	0.009	0.009	0.011
Chydoridae	-0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	-0.001	-0.001
Cyclopidae	0.168	-0.021	0.004	-0.005	0.009	0.019	0.019	-0.027	0.031	0.026	0.035
Daphnia	0.039	-0.002	0.005	-0.001	0.001	0.004	0.005	-0.009	0.007	0.007	0.010
Diaptomidae	0.058	-0.008	0.001	-0.001	0.003	0.005	0.007	-0.010	0.013	0.010	0.012
Ilyocryptidae	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Laophontidae	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Leptodoridae	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Macrothricidae	-0.015	0.002	-0.001	0.000	-0.001	-0.002	-0.002	0.003	-0.003	-0.003	-0.003
Moinidae	0.004	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.001	0.001	0.001
Sididae	-0.007	0.000	-0.001	0.000	0.000	-0.001	-0.001	0.001	-0.001	-0.001	-0.002
Acari	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001
Amphipoda	0.004	-0.011	-0.013	-0.007	-0.005	-0.001	0.000	-0.024	0.016	0.008	0.010
Chironominae	0.017	0.241	0.362	0.221	0.086	0.048	0.095	0.254	-0.035	0.086	0.048
Coleoptera	-0.004	-0.004	-0.001	-0.009	-0.005	-0.002	0.001	-0.021	0.002	0.010	0.013
Corbicula sp.	-0.007	-0.002	-0.002	0.000	-0.001	-0.001	0.004	-0.003	0.005	0.011	0.013
Corixidae	0.004	-0.006	0.013	-0.001	-0.003	-0.002	0.002	-0.020	0.001	0.011	0.012
Decopoda	-0.006	-0.002	-0.002	0.000	-0.002	-0.001	0.004	-0.004	0.004	0.010	0.012
Glossiphoniidae	0.000	-0.002	-0.002	-0.002	-0.001	-0.001	-0.001	-0.002	0.000	0.000	0.000
Isopoda	0.000	-0.002	-0.003	-0.003	-0.001	0.000	-0.001	-0.003	0.000	0.000	0.001
Lymnaeidae	0.000	-0.003	-0.005	-0.003	-0.001	0.000	-0.001	-0.003	0.000	-0.002	-0.001
Physa sp.	0.000	-0.001	-0.002	-0.002	-0.001	0.000	-0.001	-0.003	0.000	0.000	0.000

Odonata	-0.002	0.001	-0.007	0.000	-0.005	0.002	-0.001	-0.002	-0.006	0.000	0.007
Oligochaetes	0.004	-0.019	-0.032	0.051	0.016	-0.001	0.007	0.077	0.003	-0.007	-0.014
Ostracod	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tanypodinae	0.001	0.064	0.099	0.057	0.024	0.018	0.025	0.056	-0.011	0.023	0.019
BlackBullhead1	-0.008	0.010	0.002	0.008	-0.006	-0.007	-0.003	-0.030	0.042	-0.008	-0.004
BlackBullhead2	-0.001	-0.168	-0.041	-0.025	-0.010	-0.009	-0.024	-0.049	-0.005	0.083	0.005
BlackBullhead3	0.392	0.016	0.014	0.025	-0.016	-0.011	0.006	-0.446	-0.014	-0.043	0.005
BlackCrappie1	-0.003	-0.002	0.001	0.001	0.000	-0.001	-0.002	0.002	0.039	-0.005	-0.006
BlackCrappie2	0.038	-0.003	-0.007	0.000	-0.001	-0.002	-0.001	-0.049	-0.002	0.004	-0.005
BlackCrappie3	0.001	0.021	0.004	0.010	-0.007	-0.015	0.007	0.024	-0.356	0.021	0.004
Bluegill1	-0.011	-0.001	0.000	0.001	-0.001	0.000	0.000	0.001	0.005	0.002	0.002
Bluegill2	0.021	-0.010	-0.012	-0.007	-0.004	-0.006	-0.006	-0.022	0.054	-0.001	-0.013
Bluegill 3	-0.001	-0.008	-0.012	-0.008	-0.002	-0.002	-0.004	-0.005	-0.001	-0.005	-0.004
GreenSunfish1	0.001	-0.011	-0.006	-0.020	0.013	0.002	0.003	-0.008	0.005	-0.001	-0.001
GreenSunfish 2	0.010	-0.010	-0.011	-0.046	0.037	0.023	0.015	-0.025	-0.004	0.010	0.004
GreenSunfish 3	0.000	-0.001	-0.002	-0.001	0.000	0.000	-0.001	-0.001	0.000	-0.001	0.000
ChannelCatfish1	-0.404	0.010	0.005	0.005	-0.002	-0.020	-0.023	-0.089	0.007	-0.043	-0.060
ChannelCatfish2	-0.014	-0.003	0.004	0.006	-0.002	-0.006	0.005	-0.026	0.012	0.012	0.016
ChannelCatfish3	-0.005	0.004	0.005	0.024	-0.020	0.009	0.013	-0.006	0.000	0.033	0.060
Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CommonCarp1	-0.014	0.001	0.000	-0.041	0.041	-0.001	0.018	0.000	-0.001	0.004	0.007
CommonCarp2	-0.064	-0.027	-0.013	-0.012	0.005	0.067	0.007	-0.117	-0.069	0.009	0.099
CommonCarp3	-0.006	-0.068	-0.107	-0.089	-0.034	-0.021	-0.035	-0.097	0.014	-0.029	-0.021
Fathead Minnow1	-0.005	0.001	0.000	0.003	-0.002	0.000	0.001	-0.001	-0.004	0.003	0.005
FatheadMinnow2	0.000	-0.002	0.001	0.001	0.000	-0.001	0.001	-0.005	-0.006	0.003	0.003
FatheadMinnow 3	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	-0.002	0.000	0.001	0.000
June Sucker 1	-0.205	0.007	0.001	-0.013	0.014	-0.005	0.017	-0.036	0.003	-0.009	-0.016
JuneSucker2	0.010	-0.205	-0.025	-0.004	-0.019	0.040	0.096	-0.030	-0.066	0.061	0.084

JuneSucker 3	0.000	-0.002	-0.003	-0.002	-0.001	0.000	-0.001	-0.002	0.000	-0.001	0.000
NorthernPike1	0.000	0.000	0.000	-0.237	0.238	0.053	0.179	0.000	0.000	0.000	0.000
NorthernPike2	0.000	0.000	0.000	-0.432	-0.563	-0.011	0.171	0.000	0.000	0.000	0.000
NorthernPike3	0.000	0.000	0.000	0.000	-0.003	-0.461	-0.001	0.000	0.000	0.000	0.000
Northern Pike 4	0.000	0.000	0.000	0.107	-0.120	0.002	-0.048	0.000	0.000	0.000	0.000
Walleye1	0.022	-0.005	-0.003	-0.003	-0.002	0.008	-0.003	-0.052	-0.001	0.065	-0.006
Walley2	0.069	-0.001	0.011	0.000	0.009	-0.001	-0.042	0.059	-0.195	-0.120	-0.125
Walleye3	0.016	-0.036	0.006	-0.004	0.010	-0.009	-0.024	-0.208	-0.006	-0.078	-0.072
Walley 4	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001
WhiteBass1	-0.138	-0.087	0.010	0.023	-0.013	0.080	0.035	-0.011	0.030	0.098	0.121
WhiteBass2	-0.141	-0.016	0.004	0.023	-0.017	-0.012	0.100	-0.059	0.088	0.250	0.279
WhiteBass3	0.034	-0.576	0.055	0.029	0.018	-0.049	-0.083	0.082	-0.232	-0.147	-0.131
White Bass 4	0.000	-0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YellowPerch1	-0.024	0.002	-0.001	0.001	-0.001	-0.003	-0.003	0.004	-0.005	-0.003	-0.004
YellowPerch2	0.003	-0.019	-0.007	-0.004	-0.001	-0.003	-0.003	-0.010	-0.010	0.007	0.015
YellowPerch3	0.003	0.003	0.001	0.001	-0.001	-0.005	-0.001	0.003	0.004	-0.002	-0.007
DetritusSnow	0.005	0.235	0.372	0.250	0.093	0.063	0.110	0.249	-0.036	0.113	0.092
Detritus	-0.009	-0.004	0.005	0.032	0.009	0.011	0.015	0.013	0.000	0.022	0.032
Carp Reduction	0.013	0.071	0.108	0.091	0.033	0.013	0.034	0.110	-0.006	0.028	0.010

Impacting / Impacted	WhiteBass1	WhiteBass2	WhiteBass3	White Bass 4	YellowPerch1	YellowPerch2	YellowPerch3	DetritusSnow	Detritus	Carp Reduction
Bacillariophyta	0.094	0.043	0.017	0.043	0.103	-0.017	0.017	-0.002	0.001	0.000
Chlorophyta	0.107	0.047	0.019	0.048	0.117	-0.017	0.018	-0.002	0.001	0.000
Cryptophyta	0.014	0.006	0.002	0.006	0.015	-0.002	0.002	0.000	0.000	0.000
Cyanophyta	0.053	0.022	0.009	0.024	0.058	-0.007	0.008	-0.001	0.001	0.000
Dinophyta	0.003	0.001	0.000	0.001	0.003	0.000	0.000	0.000	0.000	0.000
Euglenophyta	0.004	0.002	0.001	0.002	0.004	0.000	0.001	0.000	0.000	0.000

Benthic Algae	-0.002	0.005	0.000	0.000	0.000	0.003	0.001	-0.001	-0.002	0.000
Macrophytes	0.000	0.000	0.000	0.000	0.000	-0.001	-0.001	0.001	0.001	0.004
Epiphytes	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000	-0.002	0.001
Asplanchinida	0.002	0.008	0.002	0.002	0.003	-0.005	0.006	0.000	0.000	0.000
Bosminidae	0.001	0.000	0.000	0.000	0.001	-0.001	0.001	0.000	0.000	0.000
Brachionidae	-0.010	-0.003	-0.001	-0.004	-0.011	0.000	0.000	0.000	0.000	0.000
Canthocamptidae	0.002	0.001	0.000	0.001	0.002	0.000	0.000	0.000	0.000	0.000
Ceriodaphnia	0.043	0.020	0.008	0.020	0.048	-0.011	0.006	-0.001	0.001	0.000
Chydoridae	-0.003	-0.001	-0.001	-0.001	-0.003	0.000	-0.001	0.000	0.000	0.000
Cyclopidae	0.168	0.063	0.026	0.074	0.181	-0.022	0.029	-0.003	0.000	0.000
Daphnia	0.036	0.016	0.007	0.017	0.039	-0.002	0.005	0.000	0.002	0.002
Diaptomidae	0.054	0.024	0.009	0.023	0.060	-0.009	0.005	-0.001	0.001	-0.001
Ilyocryptidae	0.000	0.000	0.000	0.000	0.000	0.000	-0.001	0.000	0.000	0.000
Laophontidae	-0.001	-0.001	0.000	-0.001	-0.002	0.000	0.000	0.000	0.000	0.000
Leptodoridae	-0.001	0.000	0.000	0.000	-0.001	0.001	0.000	0.000	0.000	0.000
Macrothricidae	-0.014	-0.006	-0.003	-0.006	-0.015	0.002	-0.002	0.000	0.000	0.000
Moinidae	0.004	0.002	0.001	0.002	0.004	-0.001	0.000	0.000	0.000	0.000
Sididae	-0.006	-0.003	0.000	-0.003	-0.007	0.000	-0.002	0.000	0.000	0.000
Acari	0.001	-0.002	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.000
Amphipoda	-0.006	0.001	-0.003	-0.006	-0.008	-0.015	-0.008	0.003	-0.032	-0.008
Chironominae	-0.006	-0.029	0.137	0.074	-0.066	0.157	0.055	-0.304	-0.081	0.045
Coleoptera	-0.014	0.030	-0.001	-0.001	-0.002	0.036	0.006	0.014	0.059	0.002
Corbicula sp.	-0.016	0.032	-0.001	-0.003	-0.002	-0.002	-0.007	-0.002	-0.024	-0.003
Corixidae	-0.012	0.024	0.000	0.002	-0.004	0.043	0.015	-0.002	-0.013	0.001
Decopoda	-0.011	0.025	-0.001	-0.002	0.000	-0.005	-0.006	-0.004	-0.011	-0.002
Glossiphoniidae	-0.001	0.002	-0.001	-0.001	0.001	0.002	-0.002	-0.001	-0.014	-0.003
Isopoda	0.000	0.000	-0.001	0.000	0.001	0.011	-0.002	-0.001	-0.012	-0.003
Lymnaeidae	0.001	-0.002	-0.002	-0.001	0.001	-0.004	0.000	-0.005	0.004	0.003

Physa sp.	-0.001	0.002	-0.001	0.000	0.000	0.001	0.001	0.001	-0.004	0.002
Odonata	0.011	-0.020	-0.001	0.003	0.002	0.091	0.001	0.004	0.020	-0.001
Oligochaetes	0.006	-0.007	-0.012	-0.008	0.009	-0.007	-0.025	-0.021	-0.209	-0.006
Ostracod	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	-0.002	0.000
Tanypodinae	-0.001	-0.015	0.040	0.025	-0.024	0.043	0.056	-0.081	-0.015	0.055
BlackBullhead1	-0.052	-0.017	-0.008	-0.023	-0.066	-0.021	-0.017	-0.002	-0.001	-0.001
BlackBullhead2	-0.004	-0.030	0.129	-0.059	-0.052	-0.098	-0.020	0.034	0.009	-0.009
BlackBullhead3	0.015	-0.019	-0.001	-0.009	-0.044	-0.068	-0.088	-0.010	-0.002	-0.001
BlackCrappie1	-0.006	-0.010	0.003	-0.003	-0.009	-0.001	0.006	-0.001	-0.001	0.000
BlackCrappie2	0.004	-0.009	-0.002	0.019	-0.004	-0.043	0.077	0.002	-0.007	-0.002
BlackCrappie3	-0.045	0.057	-0.019	-0.018	-0.122	-0.157	-0.094	-0.003	0.002	-0.012
Bluegill1	-0.015	0.007	0.001	-0.005	-0.012	-0.001	0.002	0.000	0.000	0.000
Bluegill2	0.007	-0.030	-0.003	-0.008	-0.016	-0.034	-0.020	0.012	0.010	-0.004
Bluegill 3	0.000	0.003	-0.005	-0.002	0.004	-0.009	-0.002	0.012	0.007	-0.002
GreenSunfish1	-0.004	0.004	0.005	-0.002	-0.004	-0.010	0.015	0.007	0.008	-0.001
GreenSunfish 2	0.001	0.000	-0.002	-0.004	-0.001	-0.012	-0.007	0.010	0.003	-0.002
GreenSunfish 3	0.000	0.000	-0.001	0.000	0.000	-0.001	0.000	0.002	0.001	0.000
ChannelCatfish1	0.027	-0.037	-0.001	-0.005	0.001	0.000	-0.095	-0.004	0.003	-0.014
ChannelCatfish2	-0.057	0.042	0.007	-0.017	-0.042	-0.004	0.010	-0.002	0.006	0.002
ChannelCatfish3	0.018	0.001	-0.005	0.008	0.019	-0.031	-0.004	-0.002	-0.004	0.001
Channel Catfish 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
CommonCarp1	-0.013	0.002	-0.001	-0.005	-0.012	-0.003	0.003	0.000	0.000	0.000
CommonCarp2	-0.005	-0.012	0.014	0.056	-0.040	-0.058	0.485	0.008	-0.012	0.076
CommonCarp3	-0.001	0.008	-0.042	-0.027	0.020	-0.052	-0.051	0.103	0.071	0.418
Fathead Minnow1	-0.005	-0.001	-0.001	-0.001	-0.006	-0.004	0.002	0.000	0.000	0.000
FatheadMinnow2	-0.009	0.009	0.002	-0.001	-0.009	-0.005	0.011	0.000	0.000	0.000
FatheadMinnow 3	-0.001	-0.001	0.000	-0.001	-0.002	0.000	-0.001	0.000	0.000	0.000
June Sucker 1	-0.032	0.009	-0.005	-0.017	-0.031	0.003	-0.049	-0.001	0.001	-0.006

JuneSucker2	-0.016	-0.018	0.189	0.227	-0.077	-0.115	-0.018	0.021	0.006	-0.006
JuneSucker 3	0.000	0.000	-0.001	-0.001	0.001	-0.001	-0.001	0.002	0.001	-0.001
NorthernPike1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
NorthernPike3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Northern Pike 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Walleye1	0.004	-0.008	-0.004	-0.002	-0.005	-0.009	0.002	0.004	0.006	-0.001
Walley2	0.083	-0.261	0.022	0.001	0.020	-0.004	0.013	-0.011	-0.009	0.000
Walleye3	0.032	-0.085	-0.025	-0.009	-0.037	-0.028	0.003	-0.006	-0.002	0.000
Walley 4	0.000	-0.001	0.000	0.000	-0.001	-0.001	0.000	0.000	0.000	0.000
WhiteBass1	-0.248	0.220	0.098	0.322	-0.191	-0.073	0.111	-0.009	0.000	-0.001
WhiteBass2	-0.326	-0.336	0.005	-0.058	-0.055	-0.025	-0.086	-0.002	0.007	0.003
WhiteBass3	-0.068	-0.034	-0.305	-0.209	-0.267	-0.311	-0.031	-0.046	-0.009	0.006
White Bass 4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YellowPerch1	-0.024	-0.010	-0.003	-0.011	-0.026	0.003	-0.004	0.000	0.000	0.000
YellowPerch2	-0.003	0.002	0.010	-0.008	-0.008	-0.041	-0.007	0.005	-0.006	-0.002
YellowPerch3	-0.006	-0.001	-0.002	-0.007	0.003	0.007	-0.035	-0.001	0.001	-0.004
DetritusSnow	-0.028	0.003	0.143	0.083	-0.086	0.195	0.151	0.000	-0.221	0.156
Detritus	-0.018	0.027	0.004	0.004	-0.013	0.010	0.057	-0.034	0.000	0.073
Carp Reduction	0.001	-0.007	0.040	0.021	-0.015	0.059	-0.005	-0.104	-0.070	-0.427