

# 2019 Winnebago System Lake Sturgeon Spearing Season

## *Post-Season Synopsis*

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### **Introduction and Methods:**

The Winnebago System is home to one of the nation's largest lake sturgeon populations while also hosting the largest recreational harvest for the species. The Winnebago system is one of only two lake sturgeon populations in North America that support a winter spear fishery, with Black Lake, Michigan being the other. The practice of harvesting sturgeon through a hole cut in the ice was first practiced by Native Americans as a method to provide needed protein during harsh winters. Settlers later adopted this method, along with other techniques, to harvest lake sturgeon. Declining sturgeon stocks resulted in the first sturgeon harvest regulations in the early 1900s and a harvest ban from 1915-1931. However, a winter spear fishery on the Winnebago System re-opened in 1932 as part of an economic relief bill during the Great Depression. There has been an annual season since.

Regulations associated with sturgeon spearing seasons have changed through time, but the premise of using a spear to harvest a sturgeon through the ice has remained constant. Currently, there are two separate spear fishing opportunities for lake sturgeon on the Winnebago System. One fishery occurs on Lake Winnebago, while the other takes place on the Upriver Lakes (Butte des Morts, Winneconne, and Poygan). The average success rate between the two fisheries is quite different, with spearers being much more successful on the Upriver Lakes (average success rate = 62%) relative to Lake Winnebago (average success rate = 9%). The biggest factor affecting success rates between the fisheries is the difference in water depth. The Upriver Lakes are much shallower than Lake Winnebago, meaning that water clarity doesn't impact the fishery as much. Gravid fish ready to spawn that upcoming spring also tend to overwinter in the Upriver Lakes and these lakes serve as juvenile rearing habitat for lake sturgeon. Therefore, a higher density of fish likely reside within the Upriver Lakes at that time of the year. The difference in success rates substantially impact the regulations for each fishery. For example, effort is not restricted for the fishery on Lake Winnebago. Each spearer is limited to the purchase of a single spearing license, which permits them to harvest one fish per season. In comparison, effort is restricted to 500 permits per season on the Upriver Lakes. Spearers interested in fishing the Upriver Lakes apply for a permit or purchase a preference point prior to an August 1<sup>st</sup> deadline. Permits are then issued through a drawing where priority is granted to applicants with the most points. All applicants not awarded a permit are issued a preference point for use in future drawings. Spearers must purchase a spearing license



for Lake Winnebago (\$20 for residents, \$65 for non-residents) prior to an October 31<sup>st</sup> deadline. There is not a deadline for purchasing licenses on the Upriver Lakes, as effort is already restricted through the drawing. Both fisheries begin on the 2<sup>nd</sup> Saturday of February and are open daily for a maximum of 16 days, or until any of the pre-set harvest caps for juvenile females (<55”), adult females (>55”), or males are reached. Spearers can fish from 7AM-1PM each day the fishery is open and must register their fish at a WDNR operated registration station prior to 2PM the same day the fish was harvested. Harvest numbers are tallied by the WDNR at the end of each spearing day. The fishery is immediately closed if 100% of any of the sex-specific harvest caps have been reached. Spearers have one more day if the harvest has exceeded 90% of any of the sex-specific harvest caps for that fishery.

Overharvest is the biggest threat to the long-term sustainability of sturgeon populations. Therefore, it is critical to proactively manage fisheries and ensure that harvest is maintained at or below sustainable levels. The lake sturgeon spear fishery on the Winnebago System is one of the most heavily regulated fisheries in North America. Implementation of various regulations, including a reduction in the length of spearing days and implementation of a lottery fishery on the Upriver Lakes, have all benefitted the sturgeon resource. However, implementation of the harvest cap system in 1999 has been the most influential. The goal of the harvest cap system is to maintain harvest at or below 5% of the adult population. Abundance estimates derived from annual mark recapture data are used to set juvenile female, adult female, and male harvest caps for each spearing season. This harvest management strategy provides recreational harvest opportunities without threatening the long-term sustainability of the sturgeon resource.



DNR staff register a fish at Stockbridge Harbor while a crowd gathers to see the registration process.

The annual sturgeon spear fishery not only provides an opportunity for anglers to harvest lake sturgeon, but it also provides WDNR staff with a unique opportunity to collect biological data from harvested fish. Data collected during the registration process are critical to managing the fishery and recapture data collected from harvested fish are used to estimate abundance. Each fish is measured to the nearest 0.1” (total length to the longest point of the caudal fin), weighed to the nearest 0.1 pound, checked for internal (PIT: passive integrated transponder) and external (Monel: metal tags on the dorsal fin) tags, and assessed for sex and reproductive stage. All PIT tagged fish are referenced against a database to determine whether they are stocked fish of known-age or wild recruits. The stocked fish consist of 15 unique year classes that have been stocked in the upper Fox River as part of a restoration effort to increase the abundance of migrant adult lake sturgeon in the upper Fox River. There

have been various life stages of fish stocked through these efforts, but fish have primarily been stocked out as either fall fingerlings (average 9.7”) or yearlings (average 17.8”). Most stocked fish were marked with PIT tags prior to stocking, which will allow managers to quantify natural recruitment rates while also evaluating movement and survival of stocked fish.

In addition to the length, weight, sex and tagging data collected from each harvested fish, stomach samples are collected from roughly 65 fish harvested from Lake Winnebago and 35 from the Upriver Lakes during each season for diet analysis. Additional sampling may occur based on management needs and ongoing research projects, but these sampling strategies often change from year to year. For the 2019 season, otolith and dorsal spines were collected from all known-age (stocked) fish for an age validation study, and otolith and pectoral fin ray samples were collected from roughly 100 fish for a microchemistry research project.

The winter spear fishery on the Winnebago System also provides a unique opportunity to collect fecundity data from harvested fish. The term fecundity refers to the ability to produce an abundance of offspring or new growth. In fisheries management, fecundity is quantified as the number of eggs that a female carry. Lake sturgeon are known to have high fecundity, but collection of fecundity data is rare as the fish needs to be sacrificed or harvested for the ovaries to be removed for sampling. Fecundity data collected during the sturgeon harvest assessment could be applied to population models for the Winnebago System population as well as other sturgeon populations throughout North America. Bruch et al. (2006) was one of the first studies to report fecundity data for a wild lake sturgeon population. However, the publication was based off a relatively small sample size of fish and recommended additional collection of fecundity data from larger lake sturgeon. WDNR staff greatly expanded on this data set through sampling that was conducted during the 2006-2016 spear seasons. Fecundity data from fish larger than 130 pounds and less than 40 pounds are still sparse. Therefore, WDNR staff looked to collect data from any gravid (F4) lake sturgeon meeting these criteria.

The primary objective of the lake sturgeon harvest assessment on the Winnebago System is to manage harvest, but there are many facets of that core objective. More specifically, our assessment objectives for the 2019 season were to: 1) obtain sex-specific estimates of sturgeon abundance and exploitation, 2) monitor size structure and condition of the harvestable sturgeon population, 3) monitor sturgeon foraging habits, 4) monitor effort, spearer success rate and demographics of the spearing community, 5) evaluate sturgeon age and growth, 6) collect pectoral fin rays and otoliths from harvested lake sturgeon in support of an otolith microchemistry project, 7) add to the fecundity data set, and 8) promote the sturgeon resource and sturgeon management program through outreach at WDNR operated registration stations.

## **Results and Discussion:**

The 2018 abundance estimates for the Winnebago System lake sturgeon population are 24,100 adult males and 18,400 adult females. Abundance estimates were used to guide establishment of the system-wide safe harvest caps for the 2019 sturgeon spearing season. Harvest caps were set at 430 juvenile females (<55”), 950 adult females (>55”), and 1,200 males. The Upriver Lakes fishery was allocated 10% (95 fish) of the adult female harvest

cap and 20% of the juvenile female (86 fish) and male (240 fish) harvest caps, while the remaining number of fish within the harvest caps were allocated to the Lake Winnebago fishery. The 2019 season marked the 4<sup>th</sup> straight season that the adult female cap was set at 950 adult females.

There were 12,897 sturgeon spearing licenses purchased for the 2019 sturgeon spearing season (Lake Winnebago = 12,411; Upriver lakes = 486). The 2004 season was the first year that a Lake Winnebago sturgeon spearing license was not offered with the purchase of a Wisconsin Patron's License, thus 2004-present provide the best comparison of license sales. During that time period, license sales for the Lake Winnebago fishery steadily increased between 2004-2016 (Figure 1). However, license sales have been consistent in recent years with around 12,400 licenses purchased per season. The limited entry fishery on the Upriver Lakes was implemented in 2007 and the number of applicants has steadily increased to a record 8,113 for the 2019 season (Figure 2). Applicants with 8 or more preference points were awarded a spearing permit in 2019, while 431 of 542 applicants with 7 preference points were drawn for Upriver Lakes spearing permits (Table 1).

Water clarity is the best predictor of sturgeon spearing success for the Lake Winnebago sturgeon spear fishery. Clarity for the 2019 season was extremely variable with greater than 13' of visibility throughout the northern third of Lake Winnebago and much poorer visibility (7-9') in the central and southern portions. The average water clarity was 9.5', which is below the 12' threshold that typically is required for harvest to reach the caps. The relatively poor water clarity on Lake Winnebago resulted in a 16-day season, marking the 4<sup>th</sup> consecutive full-length season and the 7<sup>th</sup> over the past 9 years. There were 479 sturgeon harvested from Lake Winnebago (3.9% success rate), which ranks as the 52<sup>nd</sup> highest harvest dating back to 1941 (79 seasons).

The Upriver Lakes are collectively much shallower than Lake Winnebago and, therefore, water clarity does not have the same impact on spearing success. The 2019 spearing season on the Upriver Lakes lasted 10 days, tying the 2011 season as the 2<sup>nd</sup> longest fishery since the lottery format was implemented. The 307 fish (63.2% success rate) registered during the season was slightly higher than the average harvest of 298 fish per season since 2007.



Matt Leitner registered his 126.2 pound, 79.2 inch lake sturgeon at Stockbridge Harbor during the 2019 sturgeon spearing season.

The northern portion of Lake Winnebago experienced the highest harvest with 57.8% of the fish being harvested in areas 1 and 2 (Table 2). The number of fish registered at each station indicated similar trends as Stockbridge Harbor and Waverly Beach paced the way with 144 and 100 fish respectively (Table 3). Harvest from the Upriver Lakes fishery was driven by Lake Poygan as 93.2% of the fish registered came from this waterbody. The registration station at Critter's paced the way with 148 fish registered, followed by Indian Point and Boom Bay with 112 and 47 fish respectively (Table 3).



The average length and weight of fish harvested from lake Winnebago were 57.7" and 47.3 pounds. In comparison, the averages for the Upriver Lakes fishery were 56.3" and 43.1 pounds. Males between 50-59.9" were most commonly represented in the harvest, while females 60-69.9" were most frequently observed (Figure 3).

The biggest storyline coming out of the 2019 spearing season was a large fish registered at Wendt's on opening day. The 171.0 pound, 85.5" female lake sturgeon registered by Jonathan Eiden (right photo inset) was the largest fish registered during the 2019 season on the Winnebago System, but the lore of this fish goes beyond being the largest fish of the season. In fact, this fish was quite famous within the local sturgeon community as she was previously handled by WDNR staff twice. The first capture was below the Shawano Paper Mill Dam in 2004 when the fish was measured at 84". She was recaptured below the Shawano Paper Mill Dam in 2012, but this time she was measured at 87.5" making this the longest fish ever handled by WDNR staff during spring spawning stock assessments conducted on the Winnebago System. Lake sturgeon captured during spring assessments are not weighed, but the pre-spawn weight of the fish was estimated to be upwards of 240 pounds. This fish became the poster child for the potential record-breaking caliber fish within the population and she was even named "Stella" by some spearers.



You might be questioning the discrepancy between the length and weight estimates of this fish between capture in 2012 and harvest in 2019. The difference in length is attributable to a couple of factors. First, our measuring boards only go up to 84", meaning there was potential error when assigning the length of the last couple of inches in both handling events. Additionally, it can be difficult to obtain accurate length measurements from fish captured in spring as they are thrashing around and not always completely relaxed. Obtaining accurate length estimates from fish harvested during the spear fishery can also be difficult if the fish is frozen and stiff. For these reasons, the difference of 2" is well within reason. The difference in weight is directly related to availability of different prey sources. Gizzard shad are a fatty food source that exhibit boom or bust year classes and experience large die offs during Wisconsin winters. Lake sturgeon in the Winnebago

System opportunistically feed on these dead or dying shad and fish condition (plumpness) can be strongly impacted by year class strength of gizzard shad. The capture of this fish in 2012 followed strong gizzard shad hatches in 2009 and 2010, whereas shad hatches in 2017 and 2018 were very weak (Figure 4). This fish could have easily weighed an additional 60-70 pounds had there been stronger year classes of gizzard shad in recent years.

***"Heavy Hitters Club"***

**STURGEON**

***Largest on Lake Winnebago System***

**1941 to Present**

(170 lbs & over)

|      | Weight | Length | Year |
|------|--------|--------|------|
| 1st  | 212.2  | 84.2   | 2010 |
| 2nd  | 188    | 79.5   | 2004 |
| 3rd  | 185    | 80.2   | 2011 |
| 4th  | 180    | 79     | 1953 |
| 5th  | 179.8  | 79.6   | 2012 |
| 6th  | 179.0  | 80.0   | 2013 |
| 7th  | 175.3  | 78.5   | 2012 |
| 8th  | 172.7  | 76.9   | 2011 |
| 9th  | 172    | 78     | 2008 |
| 10th | 171.3  | 83.0   | 2010 |
| 11th | 171.3  | 75.6   | 2011 |

**2016**

Regardless of current fish condition, the fish harvested by Jonathan Eiden on opening day was impressive. The fish missed out on the list of top 11 heaviest fish (10 and 11 are same weight; left photo inset) by only 0.3 pounds. The fish was longer than all fish present on the list but fell short by just a few ounces. Most of the heaviest fish on record were harvested during the 2010-2013 seasons. Fish harvested during these seasons were in extremely good condition resulting from strong gizzard shad hatches in 2009, 2010, and 2012 (Figure 4). Numerous fish have been harvested during recent seasons that are long enough to carry the necessary weight to join this list, but the last addition came during the 2013 season. I expect the record books to experience a large shake up the next time we see multiple strong year classes of gizzard shad in a short time span, similar to what occurred between 2009-2012.

Stomach samples were collected from 87 fish harvested during the 2019 sturgeon spearing season (Lake Winnebago = 58; Upriver lakes = 29). The proportion of empty diets was higher for

fish harvested from the Upriver Lakes (27.6%) relative to Lake Winnebago (6.9%: Figure 6). Chironomid larvae (redworms) represented the most commonly observed prey item and were observed in 77.6% of the stomachs sampled from Lake Winnebago and 69.0% of the stomachs sampled from the Upriver Lakes (Figure 6). No gizzard shad were observed during sampling. This was only the 2<sup>nd</sup> time in 8 years of sampling on Lake Winnebago and 7 years of sampling on the Upriver Lakes that no shad were observed in sturgeon diets. Isopods were present in 19.0% of the stomachs collected from Lake Winnebago and 3.4% of samples collected from the Upriver Lakes (Figure 6). In general, isopods were observed in stomachs collected from fish harvested from areas 1, 3, 5 and 6 on Lake Winnebago. Sturgeon are normally feeding on isopods over rock/reef habitats, so it's not surprising to observe isopods in stomachs of sturgeon harvested from these lake areas that contain the most rock/reef habitat. Live zebra mussels were not observed in any of the stomachs collected from sturgeon harvested from either fishery. We did observe a few dead zebra

mussel shells in several stomachs that contained isopods, but these shells were dead and believed to have been inadvertently ingested as fish were feeding on isopods.

The WDNR conducts forage analyses each year to evaluate trends within the forage base, particularly for gizzard shad and Chironomid larvae. Relative abundance of Chironomid larvae is assessed by collecting dredge samples at 32 sites from Lake Winnebago and 48 sites from the Upriver Lakes during the early part of August. This standardized assessment commenced in 2013 on Lake Winnebago and 2017 on the Upriver Lakes. The 2018 assessment on Lake Winnebago yielded high catch rates relative to years past indicating an increase in relative abundance of Chironomid Larvae (Figure 7). It's premature to make conclusions about Chironomid density on the Upriver Lakes given that 2018 was only the 2<sup>nd</sup> year of sampling. Relative abundance and hatch strength of gizzard shad is assessed through an annual bottom trawl assessment that samples 46 standardized waypoints during each month from August through October. Few gizzard shad were observed during the 2018 trawl assessment, indicating a weak year class of shad available to sturgeon during the 2019 spear fishery. Based on these results, WDNR staff predicted that lake sturgeon would be most heavily feeding on Chironomid larvae during the 2019 spearing season, which was confirmed by the diet analysis.

Fish condition, or plumpness, is a metric that is used to compare overall health of fish within the population through time. Condition often fluctuates from year to year depending on availability of key forage items. For lake sturgeon within the Winnebago System, the two staple forage items are Chironomid larvae and gizzard shad, but shad abundance has the greatest impact on fish condition. Some spearers have expressed concerns about the overall condition of lake sturgeon harvested during the 2018 and 2019 seasons. Abundance of Chironomid larvae and gizzard shad were low during the 2018 spearing season, which led to fish being in relatively poor condition relative to other years (Figure 5). However, a strong cohort of Chironomid larvae contributed to increases in fish condition for the 2019 season, particularly for Lake Winnebago. In fact, the condition value of 0.99 for fish harvested from Lake Winnebago was essentially average. Chironomid abundance is typically lower in the Upriver Lakes, making condition of fish harvested from that fishery more dependent on gizzard shad abundance. Thus, the condition value of 0.94 for fish harvested from the Upriver Lakes was lower. As I



Kraig Kelliher (left) and Doug Endlich (right) with their two fish that they speared on the last day of the 2019 season. Kraig's fish was 111.7 pounds, 74.0" and Doug's fish was 68.3 pounds and 67.7" (Paul Muche Photo).



mentioned previously, fish harvested during the 2010-2013 spearing seasons were in extremely good condition, which strongly contributed to the record books being virtually rewritten in a short period of time. Some folks look at the length-weight relationship of fish harvested in recent seasons and believe that the population has been undernourished because they aren't as heavy as they were during that time period. What we need to keep in mind is that fish condition observed during the 2010-2013 seasons was the anomaly and that what we are observing in recent seasons is more likely a representation of normal condition.

Fecundity was estimated for one fish harvested during the 2019 season. The fish was 53.5" and weighed 37.3 pounds. This weight is on the smaller side for a mature female lake sturgeon, so the ovaries were collected to expand our data set. The ovary weight from this fish was 7.3 pounds, meaning that 19.6% of the fish's body weight was attributable to ovary weight. Based on the data collected, this fish was estimated to be carrying 173,400 eggs.

There were 15 known-age fish harvested during the 2019 sturgeon spearing season with 10 coming from Lake Winnebago and 5 from the Upriver Lakes. These known-age fish comprised 2.1% of the total harvest from Lake Winnebago and 1.6% of the harvest from the Upriver Lakes. Known-age fish ranged in size from 37.3-57.1" and were 14-18 years of age. Specifically, 6 fish were from the 2001 year class (age 18), 2 were from the 2002 year class (age 17), 6 were from the 2003 year class (age 16), and 1 was from the 2005 year class (age 14). There have been 15 year classes of lake sturgeon stocked in the upper Fox River since 2001. As indicated by harvest data, several of the earlier year classes have recruited to the 36" minimum length limit. The contribution of these stocked fish to the harvest will increase through time as more year classes grow into harvestable sizes.

The Wisconsin DNR and the University of Wisconsin Stevens Point have collaborated on multiple lake sturgeon research projects in recent years. Aging structures (otoliths and fin rays) were collected from the known-age fish that were harvested as part of an ongoing age validation study to evaluate the accuracy of age estimates derived from otoliths and pectoral fin rays. Fish accumulate growth information in their calcified structures (fins, otoliths, etc.), and these structures can be cross sectioned and viewed under a microscope to estimate age, similar to counting the number of rings on a tree stump to estimate the age of the tree. Given that the stocked fish are of a known age, we can evaluate the accuracy of our aging methods by comparing age estimates derived from the calcified structure to the actual, known age of the fish. Previous research has demonstrated that age estimates derived from pectoral fin rays are relatively accurate for lake sturgeon up to age 14, but underestimate the age of older fish. The oldest stocked fish within the Winnebago System are now 18 years of age, so relatively young by the lake sturgeon standards. Collection of additional aging data from these known-age fish in future spearing seasons will be invaluable to evaluating the use of calcified structures to estimate fish age.

Pectoral fin rays and otoliths were also removed from roughly 100 fish as part of a microchemistry research project. Similar to how fish accumulate growth information in their calcified structures, basic water chemistry information is also accumulated. If the elemental signatures within different spawning tributaries are unique, then we may be able to analyze the concentration of various elements within the core of the fish's otolith or pectoral fin ray to assign that fish back to a specific tributary that they were hatched in. This research has various management implications, but the greatest utility would be in



guiding future habitat development projects. Specifically, to protect important spawning sites and identify sites for future habitat work within the system. This project is in the early stages of development, but hopefully will provide some important insights into fish recruitment.

I'm often asked how I would summarize a sturgeon spearing season and whether the season was a success. This is often a loaded question, as there are a lot of facets to a sturgeon spearing season and it really depends on how you define success. To me, most sturgeon spearing seasons are a success before they even get started. It doesn't come down to how many fish are harvested or how long the season lasted, rather success comes from the opportunity. The opportunity to get together with family members and close friends to renew the unique traditions of another sturgeon spearing season and reminisce about memories made during past seasons. After all, that's what the season is about for so many people, it's the group camaraderie. The success rates are low, particularly for Lake Winnebago, even during a shortened season where the harvest caps are reached. So, it's the social aspects of the sport that really make it special and keep people participating year after year. Additionally, sturgeon spearing is such a unique harvest opportunity. There is only one other place in North America where you can legally obtain a license to spear a lake sturgeon. Therefore, just the opportunity to participate makes each season a success for many who spear.

The 2019 sturgeon spearing season was also a success as 786 spearers filled their tag and registered a fish at one of the WDNR registration stations. To my knowledge, this is the largest recreational harvest of lake sturgeon in the world, despite not reaching the harvest caps. Further, many spearers were able to harvest their first fish during the 2019 sturgeon spearing season. I can't highlight them all within this report, but Josh Reitz and Lauren Schumacher are two of the "first timers" (photo inset below). Congratulations to Josh and Lauren on their first fish and congratulations to all other spearers that filled their tag during the 2019 spearing season!



Wrapping things up, I would call the 2019 spearing season a success. As highlighted within this report, the WDNR was able to collect a tremendous amount of data from harvested fish. The data collected will allow us to effectively manage the population and fishery moving forward. On the social side, it's inherently obvious that a strong fish stock is required to support any fishery, but it's the unique tradition of sturgeon spearing that makes this sport so special and defines success for myself and many spearers. The 2019 season provided an opportunity for people to once again participate in this unique fishery and continue their group traditions. I'm confident that there were countless memories made during the season that will be reminisced upon during future seasons. Thank you to everyone for making the 2019 spearing season a safe and successful season!

*Ryan Koenigs*

Ryan Koenigs  
Winnebago System Sturgeon Biologist

Table 1. Number of applicants at each preference point level for the 2019 sturgeon spear fishery. Some of the applicants with >8 points were not selected in the drawing as they had applied in a group with a group member having fewer preference points.

| <b>Upriver Lakes Sturgeon Spearing Drawing Results (2019 Season)</b> |                     |                  |                                |
|--|---------------------|------------------|--------------------------------|
| <b># of Preference Points</b>  | <b># Applicants</b> | <b># Winners</b> | <b># Purchased Pref. Point</b> |
| 11   | 1                   | 0                |                                |
| 10   | 2                   | 2                | 3                              |
| 9  | 11                  | 10               | 8                              |
| 8  | 68                  | 57               | 24                             |
| 7  | 542                 | 431              | 101                            |
| 6  | 701                 | 0                | 234                            |
| 5  | 621                 | 0                | 323                            |
| 4  | 527                 | 0                | 453                            |
| 3  | 510                 | 0                | 569                            |
| 2  | 594                 | 0                | 756                            |
| 1  | 820                 | 0                | 1245                           |
| Total  | 4397                | 500              | 3716                           |

Table 2. Number of juvenile female, adult female, male, and total lake sturgeon harvested from individual areas of Lake Winnebago. The number of fish harvested from each Upriver Lake is also represented.

| <b>Area Totals</b>  |         |           |      |        |
|---------------------|---------|-----------|------|--------|
|                     | Juv Fem | Adult Fem | Male | Totals |
| L. Winnebago Area 1 | 14      | 47        | 44   | 105    |
| L. Winnebago Area 2 | 27      | 76        | 69   | 172    |
| L. Winnebago Area 3 | 3       | 34        | 27   | 64     |
| L. Winnebago Area 4 | 6       | 13        | 21   | 40     |
| L. Winnebago Area 5 | 4       | 7         | 8    | 19     |
| L. Winnebago Area 6 | 12      | 29        | 38   | 79     |
| L. Winnebago        | 66      | 206       | 207  | 479    |
| L. Butte des Morts  | 1       | 0         | 6    | 7      |
| L. Poygan           | 42      | 85        | 159  | 286    |
| L. Winneconne       | 1       | 4         | 9    | 14     |
| Upriver Lakes       | 44      | 89        | 174  | 307    |
| Totals              | 110     | 295       | 381  | 786    |

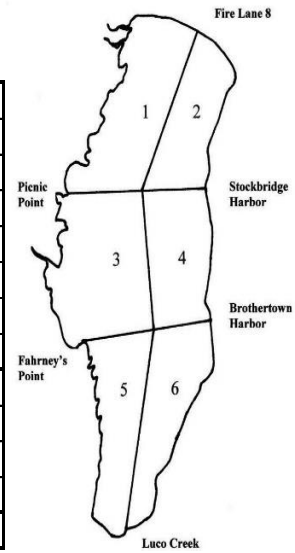


Table 3. Number of juvenile female, adult female, male, and total lake sturgeon registered at DNR registration stations during the 2019 spearing season on the Winnebago System.

| <b>Station Totals</b>   |         |           |      |        |
|-------------------------|---------|-----------|------|--------|
|                         | Juv Fem | Adult Fem | Male | Totals |
| Waverly                 | 10      | 50        | 40   | 100    |
| Stockbridge             | 26      | 57        | 61   | 144    |
| Quinney                 | 3       | 5         | 11   | 19     |
| Jim & Lindas/Cal Harbor | 11      | 29        | 36   | 76     |
| Wendts                  | 4       | 28        | 19   | 51     |
| Jerry                   | 2       | 15        | 8    | 25     |
| Paynes                  | 10      | 22        | 32   | 64     |
| Critters                | 16      | 43        | 89   | 148    |
| Indian Point            | 20      | 34        | 58   | 112    |
| Boom Bay                | 8       | 12        | 27   | 47     |



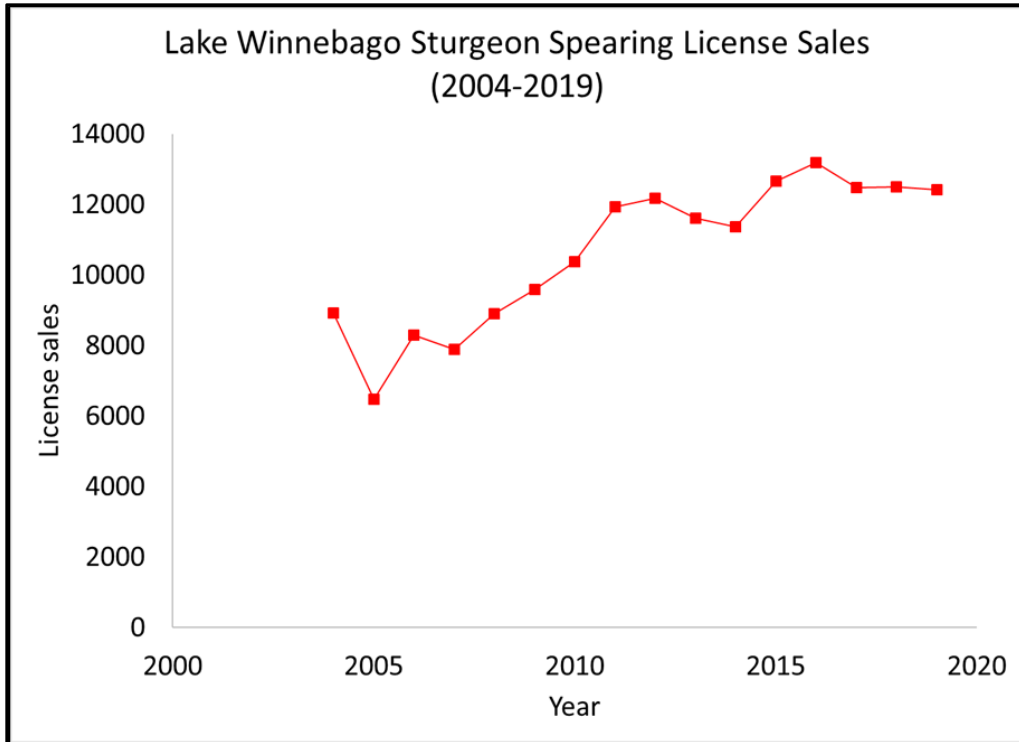


Figure 1. The number of sturgeon spearing licenses sold for the 2004-2019 sturgeon spearing season that were held on Lake Winnebago. Data collected prior to 2004 are not included as sturgeon spearing licenses were included in the Patron's License.

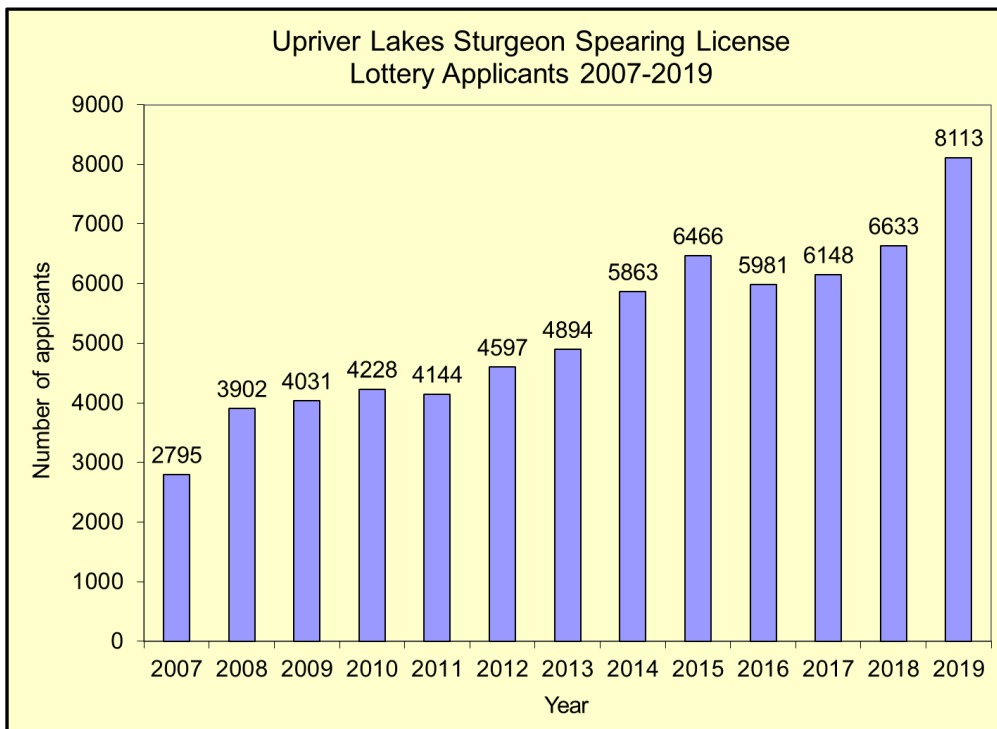


Figure 2. Number of applicants for the Upriver Lakes limited entry fishery. The current drawing format was implemented in 2007 and 500 permits are awarded per season.

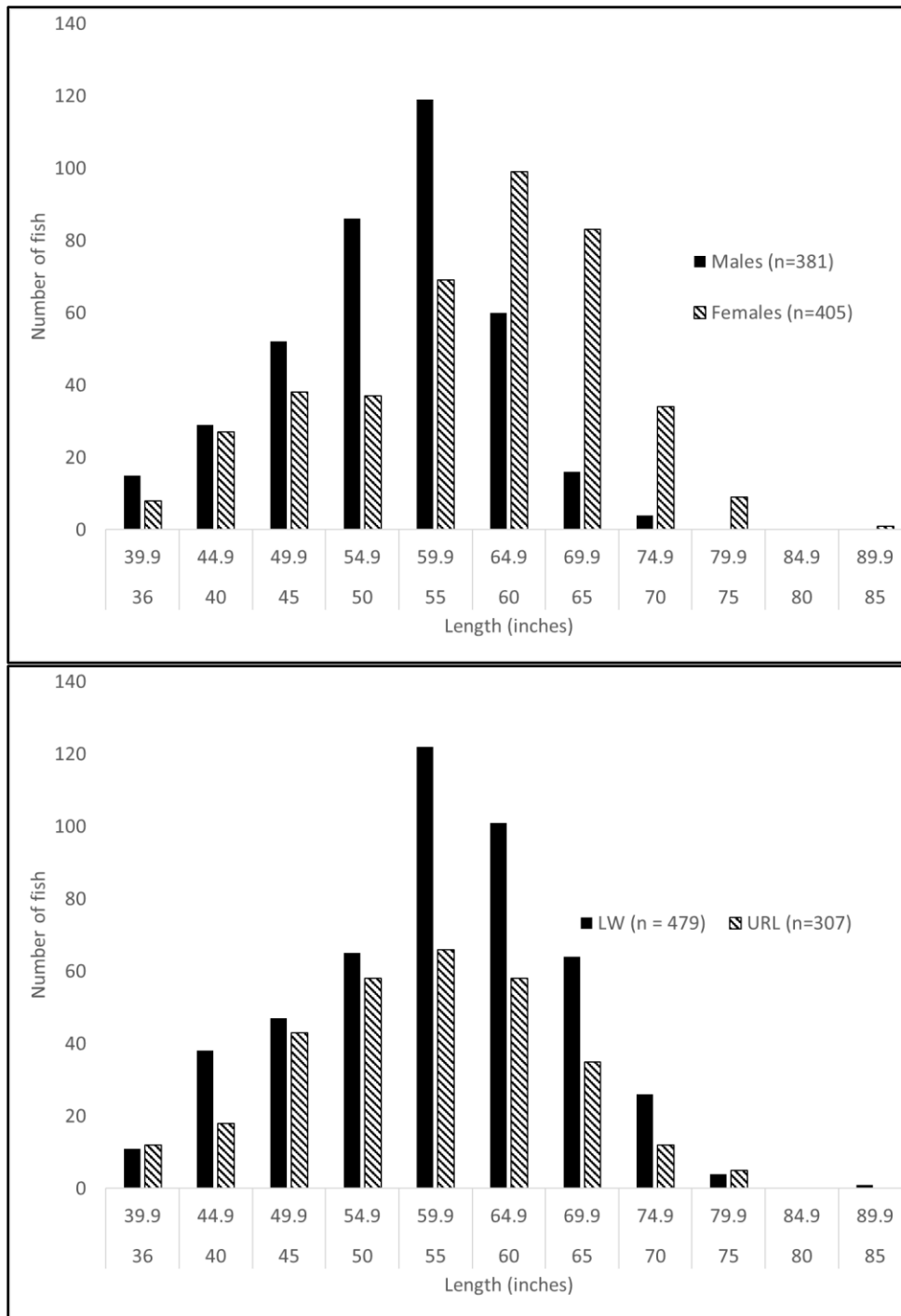


Figure 3. Top: Length distribution of male (black bars) and female (hashed bars) lake sturgeon harvested from the Winnebago System during the 2019 spearing season. Bottom: Length distribution of lake sturgeon harvested from the Lake Winnebago (black bars) and Upriver Lakes (hashed bars) during the 2019 spearing seasons.

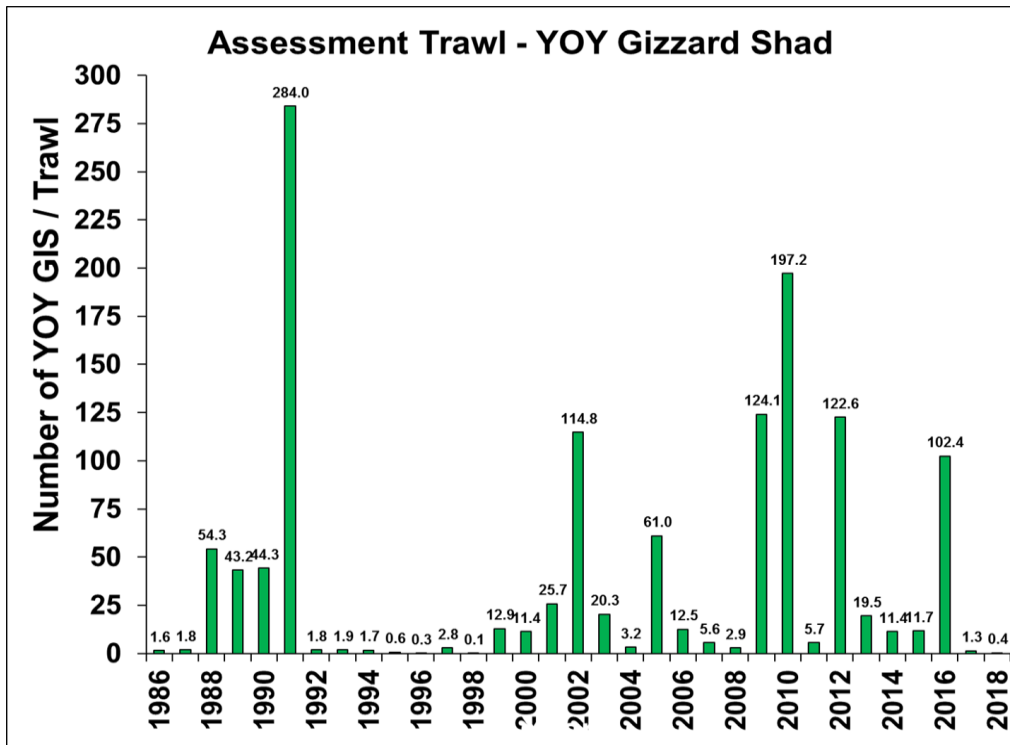


Figure 4. Year class strength of gizzard shad observed during fall (August-October) bottom assessments conducted on Lake Winnebago (1986-2018). Gizzard shad experience large winter die-offs. Therefore, year classes of gizzard shad observed during trawling are available to sturgeon during the following spearing season.

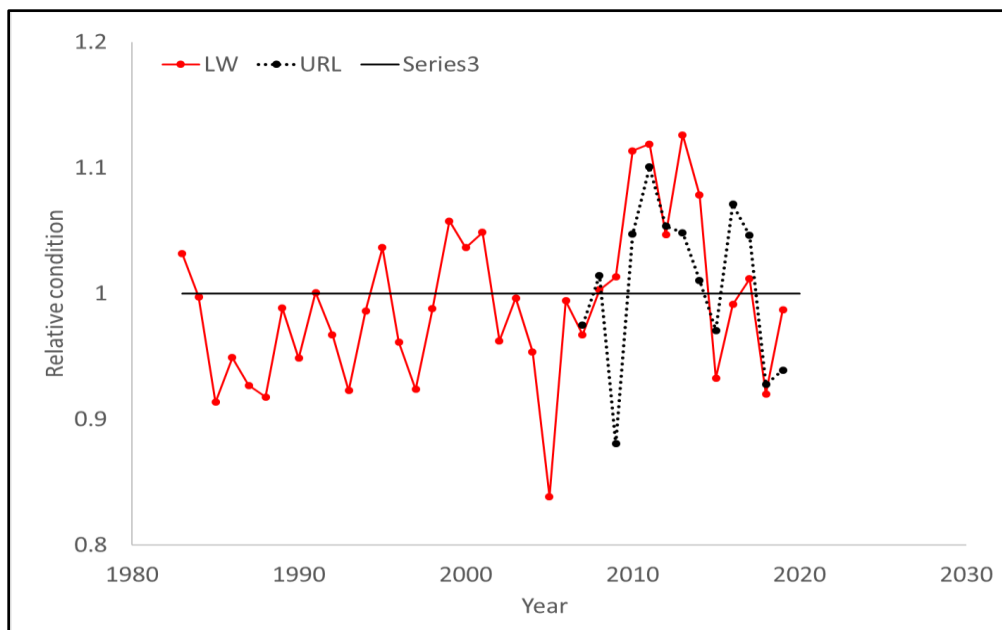


Figure 5. Relative condition (plumpness) of lake sturgeon harvested during the 1983-2019 spearing seasons on Lake Winnebago (solid red line) and the 2007-2019 seasons on the Upriver Lakes (dashed black line). A value of 1 is considered average weight.

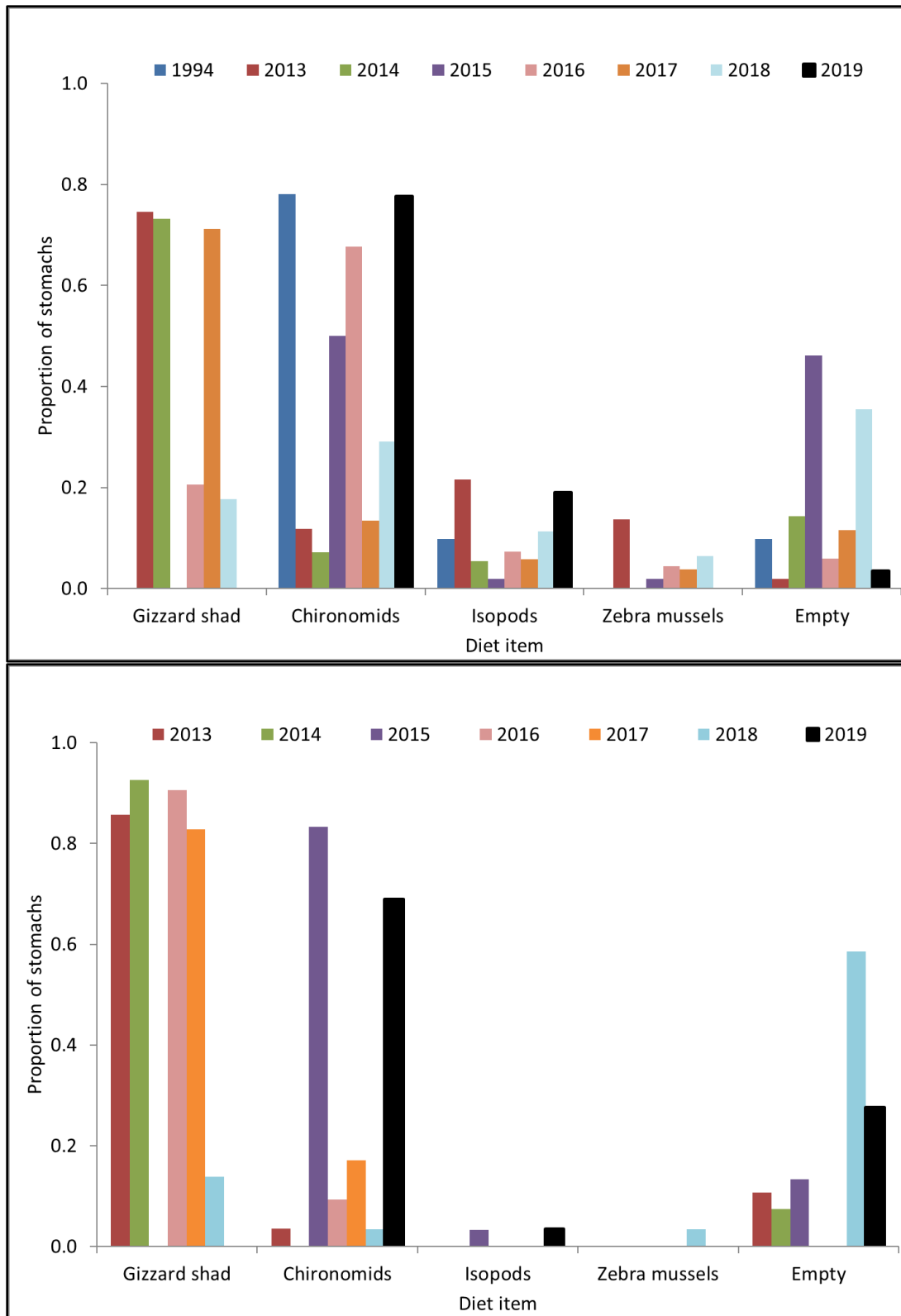


Figure 6. Prevalence of diet items observed in lake sturgeon stomachs removed from fish harvested during the 2013-2019 spear fisheries on Lake Winnebago (top) and the Upriver Lakes (bottom).



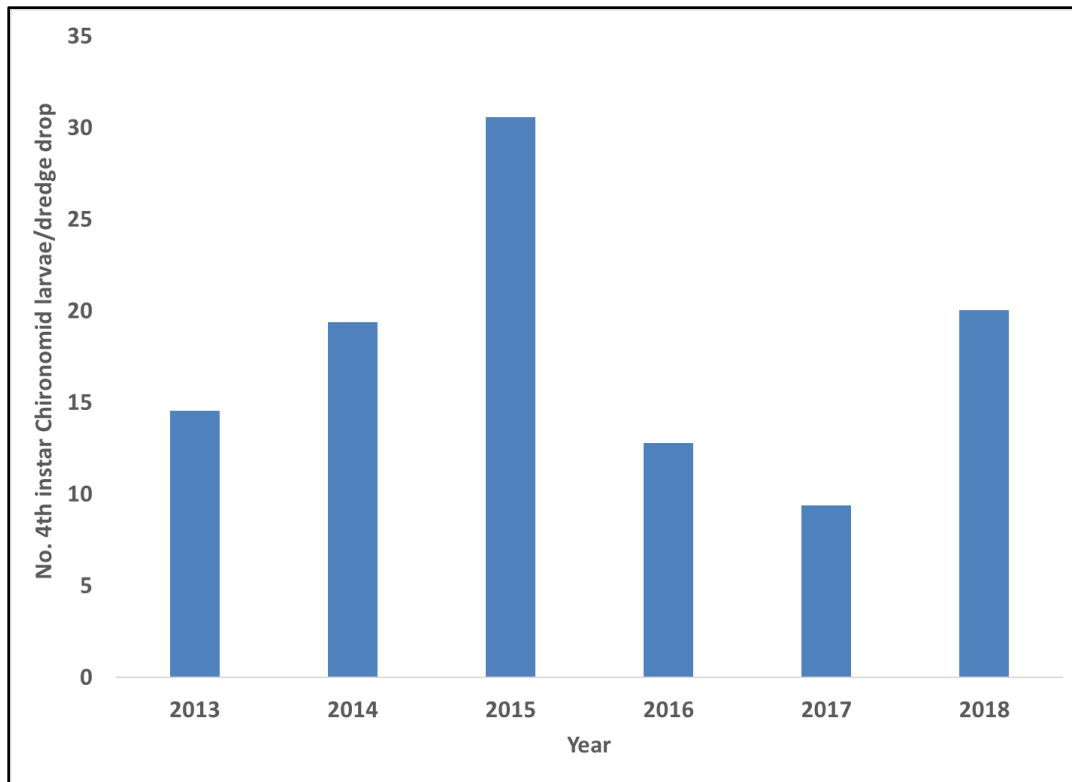


Figure 7. Relative abundance of 4<sup>th</sup> instar Chironomid larvae observed during August Ekman dredge sampling conducted at 33 standardized locations on Lake Winnebago (2013-2018).