Wenck Associates, Inc.
1800 Pioneer Creek Ctr.
P.O. Box 249
Maple Plain, MN 55359-0249

(763) 479-4200
Fax (763) 479-4242
E-mail: wenckmp@wenck.com

TECHNICAL MEMORANDUM

TO: John R. Thene, P.E., Project Manager
Joe Bischoff
Wenck Associates, Inc.

FROM: Jeff Madejczyk

DATE: February 22, 2007

SUBJECT: Comfort Lake Forest Lake Watershed District (CLFLWD)
Review of Aquatic Plant Survey of Lakes in the CLFLWD

As requested, a review of the results of the CLFLWD 2006 Lake Aquatic Plant Survey was conducted. The aquatic plant survey was conducted by the Washington Conservation District (WCD) and the results were presented in the CLFLWD 2006 Water Monitoring Report prepared by the WCD. Seven district lakes were surveyed in 2006 including Bone Lake, Shields Lake, Big Comfort Lake, Little Comfort Lake, Moody Lake, Halfbreed Lake and Forest Lake. The Forest Lake survey was separated out into the three major basins of first basin (west), second basin (center) and third basin (east). Each lake was sampled in both the Spring (June) and Fall (September). Each lake or basin was sampled by transects. The transects began at a point off-shore where no aquatic vegetation was visible and the transect ran from that point back towards shore. Species presence/absence and well as notes on relative abundance were recorded for each transect. The results were summarized into percentages of emergent, floating, submergent and exotic species present in each lake for the spring and fall surveys. The plant community of each lake was also given a diversity rating of low (1-4 species), moderate (5-8 species) or high (9+ species) for both the spring and fall surveys. An important note is that the exotic species curly leaf pondweed (*Potamogeton crispus)* was found in all of the lakes sampled during the spring survey. A summary of the significant survey findings for each lake is presented.

Bone Lake

The aquatic plant community of Bone Lake contained a large percentage of exotic species with either curlyleaf pondweed or Eurasian watermilfoil found at 83% and 100% of the spring and fall survey transects respectively. Bone Lake was the only lake surveyed where Eurasian watermilfoil was observed. The plant community of Bone Lake was classified as moderately diverse. There were no emergent plants observed at any transects in Bone Lake during either the spring or fall survey.

Moody lake

The most telling finding from the Moody Lake aquatic plant survey is that the exotic species curlyleaf pondweed and reedy canary grass were found during both the spring and fall surveys. Curly leaf pondweed is not normally sampled during fall surveys because dieback of the species normally

begins in late spring to early summer. Dieback of curlyleaf pondweed was observed during the spring survey (conducted in late June) but viable curlyleaf buds (turions) were observed during the fall survey. The overall diversity of aquatic plant community was classified as low. The only other submergent species observed other than curlyleaf pondweed was common waterweed, which was often growing in dense stands. The overall low diversity of submerged species and their presence in dense stands is considered to be an indicator of excessive nutrients and degraded water quality and clarity. There were no emergent species observed during the spring survey but emergent vegetation was observed at 100% of the transects in the fall.

Little Comfort Lake

The exotic species curlyleaf pondweed was found during both the spring and fall surveys on Little Comfort Lake. Predictably curlyleaf pondweed was much more prevalent in the spring survey, prior to dieback occurring, when it was found at 100 percent of the sites compared to only eight percent of the sites during the fall survey. The overall diversity of the Little Comfort Lake plant community was classified as moderate in during the spring survey and as low during the fall survey. Coontail was found in dense stands during both the spring and fall surveys. Coontail is a considered a tolerant submergent species and being present in dense stands, as it was during the Little Comfort Lake survey, is normally an indicator of excessive nutrients and degraded water quality and clarity.

Sylvan/Halfbreed Lake

Overall the aquatic plant community of Sylvan/Halfbreed Lake was the healthiest of any of the lakes sampled during the 2006 CLFLWD aquatic plant surveys. Sylvan/Halfbreed Lake had the highest plant community diversity and least amount of invasive species compared to the other lakes surveyed. A healthy mix of emergent, floating and submergent species were observed at a majority of the sample transects. Curlyleaf pondweed was observed during the spring survey but only at 4 of the 11 (36%) of the sample transects. Several aquatic species that are considered indicators of high ecological quality were found at Sylvan/Halfbreed Lake including chara, wild celery and northern watermilfoil. Aquatic macrophyte growth was observed at depths out to approximately 25 feet, which is an indicator of the high water clarity in the lake.

Shields Lake

The overall diversity of the aquatic plant community was very low with typically only three species observed at each transect. The invasive species curlyleaf pondweed was found at 100 percent of the survey transects during the spring survey. Viable curlyleaf buds (turions) were observed during the fall survey at one third of transects. In addition to the large amount of curlyleaf pondweed dieback, the other submergent species were observed were dead or decaying during the fall survey. This likely indicates that the poor water quality and clarity in late summer and early fall is negatively impacting the aquatic plant community of Shields Lake.

Big Comfort Lake

The exotic species curlyleaf pondweed was observed in Big Comfort Lake during both the spring and fall surveys. A dense stand of curlyleaf pondweed was observed at the inlet from Little Comfort Lake, which indicates that the species is possibly being flushed into Big Comfort Lake from Little

Comfort Lake. However, the results from the other transects indicate that curlyleaf pondweed is likely also being carried into the lake by boats and boat trailers. The overall diversity of the Big Comfort Lake plant community was classified as moderate, with species of emergent, floating and submergent plants being observed during both the spring and fall surveys.

Forest Lake – First (West) Basin

The overall diversity of the First Basin of Forest Lake was classified as moderate. Curly leaf pond weed was present during the spring survey at approximately two thirds of the sample transects. The City of Forest Lake has initiated a regular plant harvesting operation aimed at controlling the density of curlyleaf pondweed and as such accurate plant densities were difficult to ascertain at certain transects. Curlyleaf pondweed was observed at less than ten percent of the transects during the fall survey, which is likely due to a combination of the species dieback and the harvesting operation by the City of Forest Lake. Emergent, floating and submergent species were observed during both the spring and fall surveys. The native aquatic macrophytes seem to be successfully coexisting with the exotic species in many areas, despite the occurrence of the exotic in relatively dense stands at certain locations.

Forest Lake – Second (Mid) Basin

The overall diversity of the Second Basin of Forest Lake was classified as high. Curly leaf pondweed was present during the spring survey at approximately 80 percent of the sample transects. The City of Forest Lake has initiated a regular plant harvesting operation aimed at controlling the density of curlyleaf pondweed and as such accurate plant densities were difficult to ascertain at certain transects. Curlyleaf pondweed was observed at less than ten percent of the transects during the fall survey, which is likely due to a combination of the species dieback and the harvesting operation by the City of Forest Lake. Emergent, floating and submergent species were observed during both the spring and fall surveys. The native aquatic macrophytes seem to be successfully coexisting with the exotic species in many areas, despite the occurrence of the exotic in relatively dense stands at certain locations. Several species that are considered of high ecological value were sampled in Second Basin of Forest Lake including wild celery, chara and large leaf pondweed.

Forest Lake – Third (East) Basin

The overall diversity of the Third Basin of Forest Lake was classified as high. Curly leaf pondweed was present during the spring survey at approximately two thirds of the sample transects. The City of Forest Lake has initiated a regular plant harvesting operation aimed at controlling the density of curlyleaf pondweed and as such accurate plant densities were difficult to ascertain at certain transects. Curlyleaf pond weed was not observed during the fall survey, which is likely due to a combination of the species dieback and the harvesting operation by the City of Forest Lake. Emergent, floating and submergent species were observed during both the spring and fall surveys. The native aquatic macrophytes seem to be successfully coexisting with the exotic species in many areas, despite the occurrence of the exotic in relatively dense stands at certain locations. Several species that are considered of high ecological value were sampled in Third Basin of Forest Lake including wild celery, chara and large leaf pondweed.

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TECHNICAL MEMORANDUM

TO: John Thene, P.E.

FROM: Jeff Madejczyk
Joe Bischoff

DATE: July 23, 2007

SUBJECT: Ecological Data Review for CLFLWD Lakes

Attachments: Summary Graphs and Tables

Data Review Methodology

The ecological data for the CLFLWD lakes was reviewed in an attempt to understand the ecological communities of each lake. The intent of the review was to determine important ecological factors that may be influencing lake water quality and could assist in the refinement of lake response modeling efforts.

Ecological data was obtained from two sources, the Minnesota Department of Natural Resources (DNR) and the Washington Conservation District. Fish community data was obtained from lake management and fish survey reports from the lake files maintained in the DNR central office. Plant community data was obtained from DNR surveys in the central office lake files as well as from the WCD 2006 report to the CLFLWD. Zooplankton data was obtained from the WCD 2006 report to the CLFLWD.

Historical fish community data from all surveys for each lake was summarized in terms of species abundance and biomass and displayed graphically for review. DNR lake fish surveys are conducted using two sampling methods; gill nets and trap nets. These sampling methods do have some sampling bias, including focusing on game management species (i.e., northern pike and walleye), under representing small minnow and darter species presence/abundance and under representing management species such as largemouth bass. Fish community data was also summarized by trophic groups for each lake. Species within a trophic group serve the same ecological process in the lake (i.e., panfish species feed on zooplankton and invertebrates; may serve as prey for predators). Analyzing all the species as a group is often a more accurate summary of the fish community.

The trophic group summary included the following species in each group:

- Forage Species: Golden Shiner, White Sucker, Yellow Perch
- Panfish: Black Crappie, Bluegill, Green Sunfish, Pumpkinseed Sunfish, White Crappie
- Top Predator: Bowfin, Largemouth Bass, Northern Pike, Rockbass, Walleye
- Rough Fish: Black Bullheads, Brown Bullheads, Common Carp, Yellow Bullhead

Trophic group abundance and biomass data was summarized and graphed in the same manner as the species data for each fish survey for each lake. Fish community data has not been collected by the DNR for Birch or School Lakes.

Plant community data for the CLFLWD lakes has been collected by the DNR and WCD. The data was collected using a similar transect method by each agency. The DNR surveys included a relative abundance rating for the lake each observed species, while the WCD method included presence/absence of each species along a sample transect. The DNR relative abundance rating includes the following categories: abundant; common; occasional; rare; and present. In order to compare the WCD survey data and display all surveys graphically, percent occurrence value was assigned to each DNR category in the following manner:

Abundant	= 80%
Common	= 50%
Occasional	= 25%
Rare	= 10%
Present	= 5%
Not Observed	= 0%

The WCD presence/absence data for each lake was summarized as the percent of transects where the species was observed and one of the above relative abundance ratings was assigned so that data across all surveys could be displayed graphically and compared. Plant community data was not collected by the DNR or WCD for Birch or School Lakes.

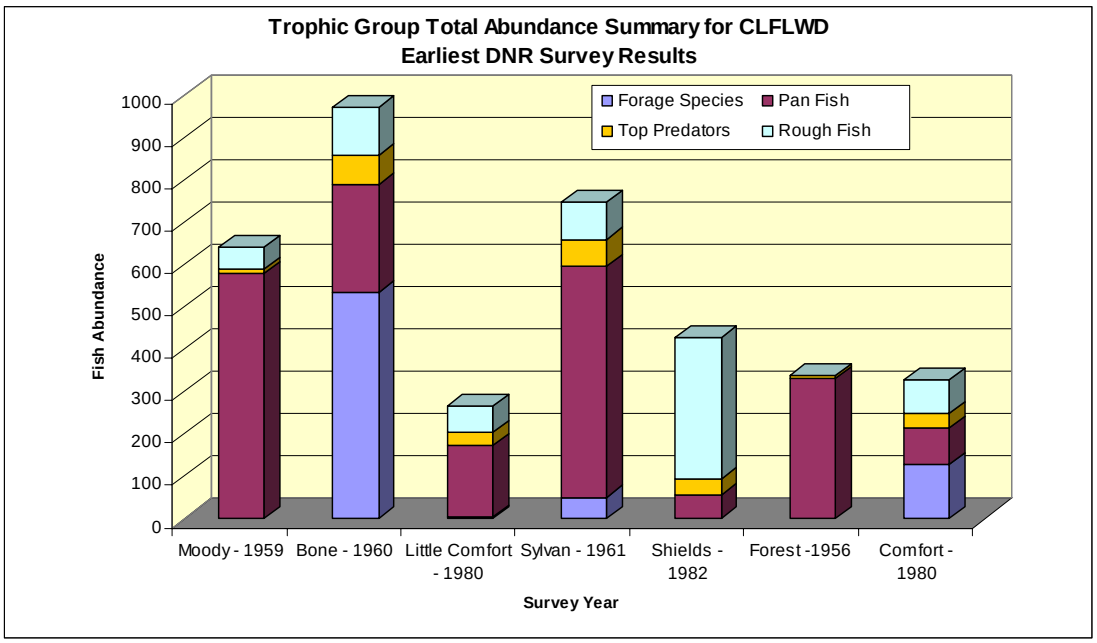
Zooplankton data was collected by WCD in 2006 for the following lakes: Bone Lake, Shields Lake and all three basins of Forest Lake. Zooplankton data was not collected in any of the other CLFLWD lakes.

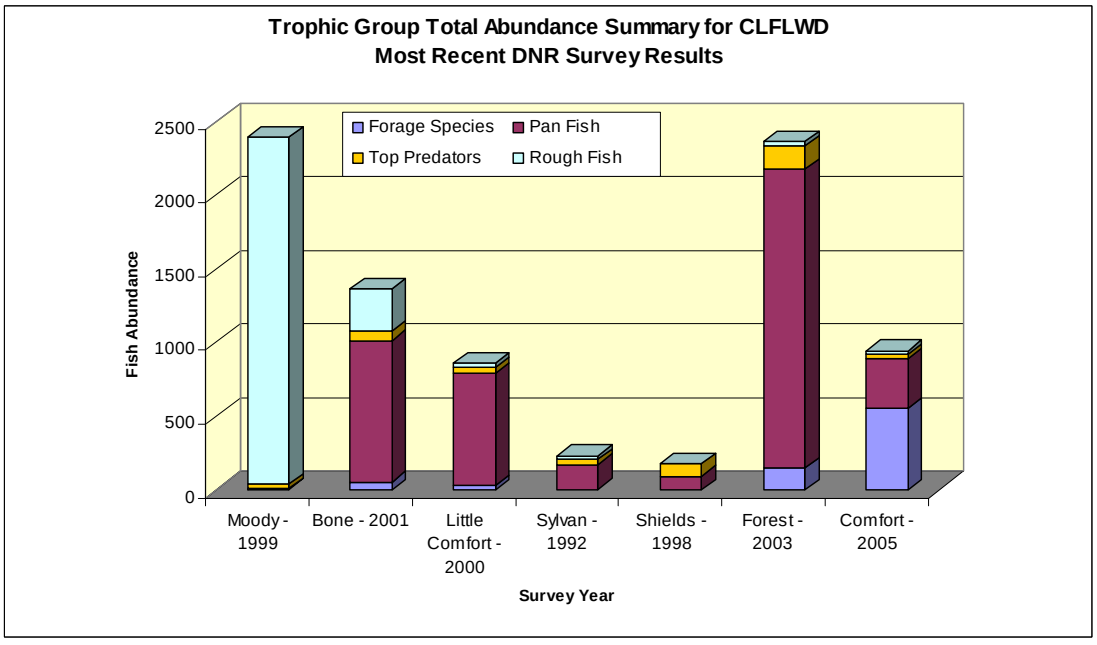
Fisheries Trends in the Watershed

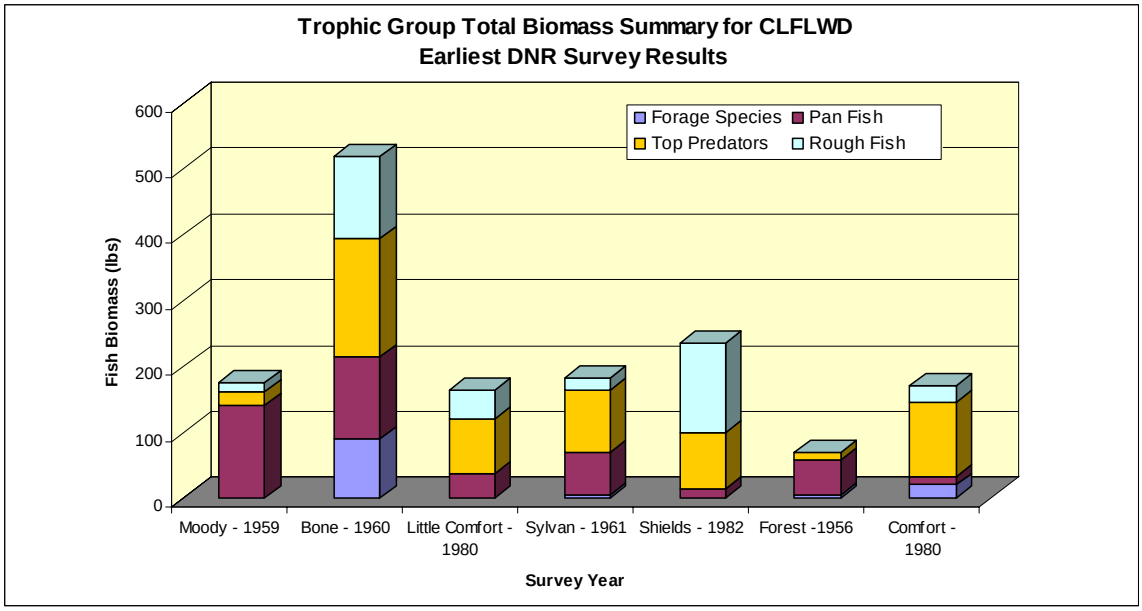
An analysis of the fisheries surveys across all lakes in the CLFLWD was conducted by comparing the trophic community data from the earliest and most recent surveys for each lake. Review of the abundance data reveals that in general panfish are the most abundant group of fish in the watershed. Panfish were the most abundant group during

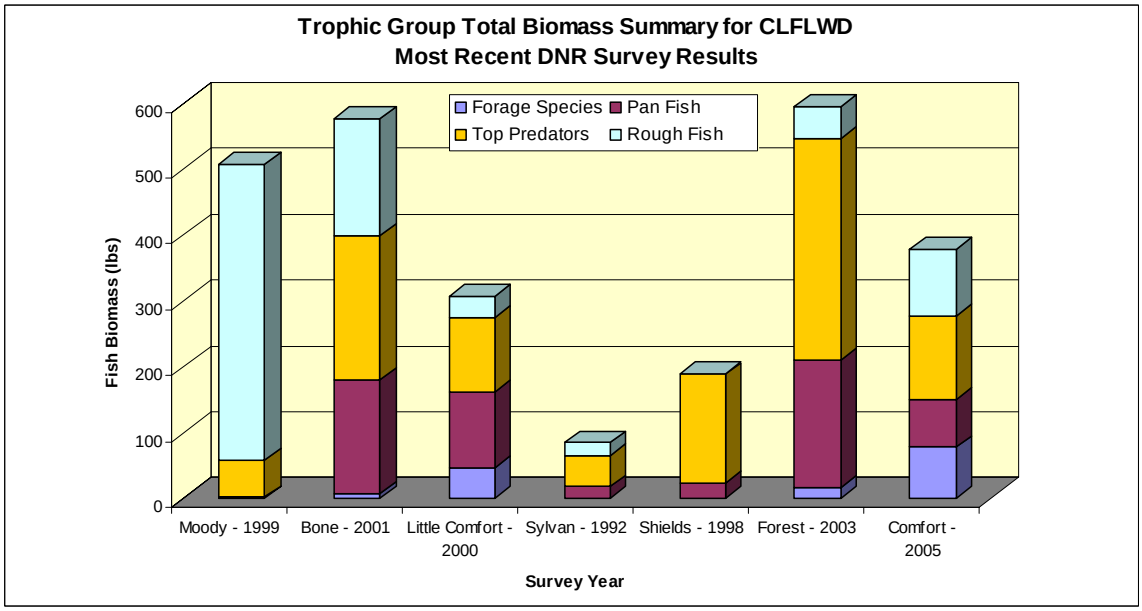
the earliest and most recent fish surveys in most of the lakes. The most interesting change in fish abundance across the watershed is the decrease in panfish and increase in rough fish abundance in Moody Lake.

Review of the biomass data for lakes across the watershed reveals that in general the top predators make up the largest portion of biomass, from both the earliest and most recent surveys for each lake. With the exception of Moody Lake, both rough fish and panfish biomass have remained relatively stable within each lake, when comparing the earliest and most recent fish surveys.






Trophic Group Total Biomass Summary for CLFLWD
Earliest DNR Survey Results
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Biomass (lbs)
0
100
200
300
400
500
600
Moody - 1959
Bone - 1960
Little Comfort - 1980
Sylvan - 1961
Shields - 1982
Forest -1956
Comfort - 1980
Survey Year


Trophic Group Total Biomass Summary for CLFLWD
Most Recent DNR Survey Results
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Biomass (lbs)
0
100
200
300
400
500
600
Moody - 1999
Bone - 2001
Little Comfort - 2000
Sylvan - 1992
Shields - 1998
Forest - 2003
Comfort - 2005
Survey Year

INDIVIDUAL LAKE SUMMARIES

Graphs and tables summarizing the ecological data reviewed for each lake are attached to this memorandum. The following sections describe the findings of this review.

Moody Lake Ecological Summary

The ecological summary for Moody Lake followed the methods described at the beginning of this memo. There were no significant changes or deviations for the above described methodology. Overall the state of the fish and aquatic plant communities would be classified as poor, dominated by tolerant, undesirable or exotic species. The specific summary points for the ecological communities of Moody Lake are presented below.

Fish Community

Northern pike are the primary management species, with bluegill black crappie and largemouth bass as secondary management species. Supplemental stocking is not conducted.
Panfish populations have been declining since initial survey in 1959. Bluegill and pumpkinseed abundance decreased dramatically from 1989 to 1999, while black crappies were not collected.
Rough fish, consisting mainly of bullheads, were collected at very high numbers in most recent survey and have been increasing since initial survey in 1959.
Winterkill has not been documented but the presence of winterkill species (black bullhead and golden shiner) in conjunction with dramatic decrease in panfish populations indicates the lake may have suffered some degree of past winterkill.
Op predator biomass has been relatively consistent over last tow surveys. Northern pike are the main top predator present, with walleye and largemouth bass captured sporadically.

Plant Community

The overall macrophyte community diversity is low, with very few desirable species present. Very few submergent or floating leaf species have been observed across surveys.
Submergent plants have extended out to approximately eight feet in the 1989 DNR survey and decreased slightly to approximately six to seven feet in most recent surveys.
Exotic species curly leaf pondweed and reed canary grass were found in both spring and fall 2006 surveys. Curly leaf pond weed is not normally collected in fall surveys, which indicates high abundance in lake.
Common cattails are the dominant emergent species and are abundant around the lake. Floating leaf species are poorly represented, with white water lily and floating leaf pondweed abundance decreasing between 1989 and 2006 surveys.
Canada waterweed was common to abundant throughout the lake in both DNR and WCD surveys. Dense stands of Canada waterweed can be indicative of increased nutrients and offer little suitable fish habitat.

Zooplankton

No zooplankton data is available.

Bone Lake Ecological Summary

The ecological summary for Bone Lake followed the methods described at the beginning of this memo. There were no significant changes or deviations for the above described methodology. Overall the state of the fish and plant communities of Bone Lake would be considered moderately healthy, with a mix of desirable management species along with the presence of some less desirable exotic or tolerant species. The specific summary points for the ecological communities of Bone Lake are presented below.

Fish Community

Primary management species is walleye, with largemouth bass and bluegill as secondary management species. Lake management includes supplemental stocking.
Panfish populations have fluctuated over time but have always been relatively abundant. Panfish biomass increased dramatically in the 2001, rebounding from an all time low in the 1996 survey.
Rough fish abundance and biomass has fluctuated over time in similar manner to the panfish population over time. The carp collected in the surveys are large adult fish, averaging close to 8 pounds in the most recent survey.
Top predator biomass and abundance remained relatively over majority of surveys, with a significant increase in biomass in the 2001 survey. The stocked walleye experience good growth and the average size fish is large.
Rough fish removal of carp and bullheads has been conducted by the DNR in the 1960's and 1980's. Commercial fishing for rough fish has taken place, targeting the large bullheads and carp in the lake.
DNR lake management plan from 1998 indicates that future fish community management efforts could include chemical rehabilitation of the lake and the addition of an aeration system.

Plant Community

Overall macrophyte diversity in the lake is moderate, with submergent and floating leaf species present.
Submergent plants extended out to approximately six feet in the 2006 WCD survey.
Exotic species were prevalent in the 2006 survey, with both curly leaf pondweed and Eurasian water milfoil found.
In addition to abundance of exotic species, coontail is also abundant in the lake. When present in dense stands this species can be an indicator of increased nutrients and provides poor fish habitat when growing in dense stands.
Emergent species were not documented in 2006 survey but some cattails do exist along lake
White water lily is the dominant floating leaf species, with spatterdock also present.
Some desirable high quality submergent species are present in the lake, including chara, sago pondweed and wild celery, although these species were observed rarely to occasionally in 2006 survey.

Zooplankton

Little Comfort Lake Ecological Summary

The ecological summary for Little Comfort Lake followed the methods described at the beginning of this memo. There were no significant changes or deviations for the above described methodology. Overall the state of the fish and plant communities of Little Comfort Lake would be considered moderate to poor, with some desirable management species present, but an increase in some less desirable exotic or tolerant species in recent years. The specific summary points for the ecological communities of Little Comfort Lake are presented below.

Fish Community

The primary management species for the lake is northern pike, with blue gill crappies and largemouth bass as secondary management species. Supplemental stocking is not conducted.
Panfish species dominate the fish population and are present in above average numbers and average size for the lake class.
Rough fish are present in the lake, including bullheads and carp. Overall rough fish population has remained relatively stable, with total rough fish biomass less than panfish or top predator groups over the last four surveys from 1980 to 2000.
Top predators comprise a significant portion of the fish biomass in each survey. Overall abundance of top predators is average for lake class but individual fish are above average in size.
Lake experienced a winterkill in 1985/86 but has not experienced a winter kill since that time.

Plant Community

Overall diversity of plant community is low; the number of submergent and floating leaf species has been consistent across surveys.
Submergent plants extended out to depths of approximately 10 feet in DNR 1990 survey, but decreased to approximately six to eight feet in the proceeding surveys.
Curly leaf pondweed has been abundant in the lake since at least 1990 based on DNR and WCD surveys. It was observed growing in dense stands in most recent spring survey.
Common cattails are the dominant emergent species; yellow water lily is the dominant floating leaf species.
Coontail is the other submergent species that dominates the macrophyte community, growing in dense stands. Dense stands of coontail provides relatively poor fish habitat.

Zooplankton

No zooplankton data is available.

Sylvan Lake Ecological Summary

The ecological summary for Sylvan Lake followed the methods described at the beginning of this memo. There were no significant changes or deviations for the above described methodology. Overall the state of the fish and plant communities of Sylvan Lake would be considered good, with high overall community diversity, the dominance of desirable management species and low occurrence of tolerant or exotic species. The specific summary points for the ecological communities of Sylvan Lake are presented below.

Fish Community

Northern Pike and bluegill are the primary management species, with black crappie and largemouth bass as secondary management species. Supplemental stocking is not conducted.
Panfish including bluegill, pumpkinseed sunfish and black crappies are abundant in the lake. Individuals are average size for this lake class, but make up a small portion of the total biomass collected.
Bullheads are present in the lake, but overall rough fish abundance has remained relatively stable over the last five fish surveys from 1961 to 1992. Carp were not collected in DNR surveys.
Top predators comprise the largest portion of the fish biomass in each of the lake surveys. The northern pike are below average in size for this lake class. Largemouth bass are known to be abundant in the lake even tough they are collected infrequently in the surveys.

Plant Community

Lake has the highest overall macrophyte community diversity community of the target lakes in the District. A high number of submergent and floating leaf species have been present in each macrophyte survey.
Many desirable species indicative of good water quality are present (including chara, wild celery, and northern water milfoil) and have been present in the lake since initial survey.
Submergent plants have extended out to as deep as 18 feet in each of the macrophyte surveys conducted.
Curly leaf pondweed was not found in 1992 DNR survey but is now present in the lake based on 2006 survey. Desirable native species still dominate the macrophyte community and have not been overtaken by exotics.
Emergent species were surveyed in low abundance in both DNR and WCD surveys, mainly consisting of cattails, bulrush and sedges. White and yellow water lilies are the main floating leaf species.
An increase in the abundance and density of stands of coontail and Canada waterweed may be indicative of declining water quality. These species can reach nuisance levels in the presences of excess nutrients and when in dense stands offer little in terms of fish habitat.

Zooplankton

No zooplankton data is available.

Shields Lake Ecological Summary

The ecological summary for Shields Lake followed the methods described at the beginning of this memo. There were no significant changes or deviations for the above described methodology. Overall the state of the fish and plant communities of Shields Lake would be considered poor, with low overall community diversity, the low occurrence of desirable management species and the dominance of less desirable tolerant or exotic species. The specific summary points for the ecological communities of Shields Lake are presented below.

Fish Community

Primary management species for the lake is largemouth bass, with walleyes as the secondary management species. Limited supplemental stocking has occurred.
Chemical reclamation of lake was conducted in 1994 to remove rough fish.
Panfish abundance and total biomass is relatively low within the lake. Panfish biomass has increased since chemical reclamation of the lake.
Rough fish abundance and biomass have decreased dramatically since chemical reclamation. Currently rough fish abundance and biomass in the lake is low.
Top predator abundance and biomass has increased since chemical reclamation, with top predators comprising the majority of the fish biomass in the most recent survey.
The lake has been aerated since 1995 to prevent winter fish kills. High abundance of black bullheads and low presence of other species in 1987 survey indicates winterkill may have occurred that past winter.

Plant Community

Overall diversity of macrophyte community is low, with very few submergent and floating leaf species present.
Submergent plants have extended out to approximately nine feet in the 1998 DNR survey and decreased to approximately six feet in most recent surveys.
Curly leaf pondweed was found in the lake in both DNR and WCD survey. Overall abundance of curly lead pondweed increased significantly between 1998 and 2006 spring surveys
With the exception of duckweed, floating leaf macrophyte species are not found in the lake. Past efforts by the DNR to plant white water lily and whitestem pondweed have failed.
Common cattails are the main emergent macrophyte species present around the lake, exhibiting similar abundance in both the 1998 and 2006 surveys.
Coontail was found to be abundant in the spring surveys in both 1998 and 2006. When present in dense stands this species can be an indicator of increased nutrients and provides poor fish habitat when growing in dense stands.

Zooplankton

Forest Lake Ecological Summary

The ecological summary for Forest Lake followed the methods described at the beginning of this memo. One important note when reviewing the graphs and summary data for Forest Lake is that the fisheries data graphs do not contain gill net data for the surveys from 1956 trough 1998. This data was not found when reviewing the lake management file in the DNR office. The surveys years from 1956 through 1998 contain trap net data only. Trap nets are effective at sampling pan fish species but compared to gill nets are less effective at sampling target management species such as northern pike and walleye. The fish survey data for 2003 contains but gill and trap net survey data.

Overall the state of the fish and plant communities of Forest Lake would be considered moderate to good, with good overall community diversity, a moderately high occurrence of desirable management species and the presence of only some tolerant or exotic species. The specific summary points for the ecological communities of Shields Lake are presented below.

Fish Community

Primary management species are walleye and muskellunge, with largemouth bass and bluegill as secondary management species. Lake management includes supplemental stocking.
Panfish abundance and biomass has been average for this lake class. At times panfish have been abundant but populations of bluegill and black crappie are mainly dominated by smaller individuals
Rough fish abundance and biomass has been relatively low across all DNR surveys. Carp were not collected until 1969 survey; current carp numbers remain low in lake.
Top predator biomass and abundance has been high across all surveys. Top predator population is supplemented through stocking of walleyes and muskellunge. Walleyes have experienced above average growth rates.
Rough fish removal of carp and bullheads was conducted by the DNR in the 1940's and 1950'.
DNR lake management plan.

Plant Community

Overall macrophyte diversity in the lake is high, with a variety of submergent and floating leaf species present.
Submergent plants have been observed at depths from approximately 10 to 13 feet in both DNR and WCD surveys.
Exotic species curly leaf pondweed has been present in all surveys but abundance increased in 2006 WCD survey. Overall curly leaf pondweed is not the dominant species and has not over taken the desirable native species.
Emergent species are not abundant around the lake, likely due to the amount of residential development along the lake shoreline. Cattails and bulrush are the main emergent species documented in each of the surveys.
Yellow water lily is the most abundant floating leaf species and has been documented occasionally to commonly across all surveys. White water lily is also present to a lesser extent.
A variety of desirable high quality submergent species are common to abundant in the lake, including chara, largeleaf pondweed, sago pondweed and wild celery. Sago pondweed and largeleaf pond weed provide excellent feeding and refuge habitat for fish.

Zooplankton

Comfort Lake Ecological Summary

The ecological summary for Comfort Lake followed the methods described at the beginning of this memo. There were no significant changes or deviations for the above described methodology. Overall the state of the fish and plant communities of Comfort Lake would be considered moderately healthy, with moderate overall community diversity, the occurrence of some desirable management species and some less desirable tolerant or exotic species. The specific summary points for the ecological communities of Comfort Lake are presented below.

Fish Community

Primary management species are northern pike and walleye, with bluegills and largemouth bass as secondary management species. Lake management includes supplemental walleye stocking.
Panfish are abundant in the lake but small individuals dominate population. Panfish biomass has remained relatively low over time.
Rough fish biomass has remained fairly constant from 1980 to present. Recent increase in rough fish biomass is due to growth of older carp, not an increase in population size. Overall, numbers of rough fish in the lake are low.
Several top predator species occur in the lake and make up the largest portion of the total fish biomass collected in each survey From 1980 to present. Top predators have experienced average to above average growth in the lake but total population is limited by access to spawning habitat and the forage fish population size (i.e. perch).
Carp and bullheads were removed by the DNR from the late 1940's to early 1960's. Based on DNR lake management plan, the present rough fish populations could be managed through commercial fishing.

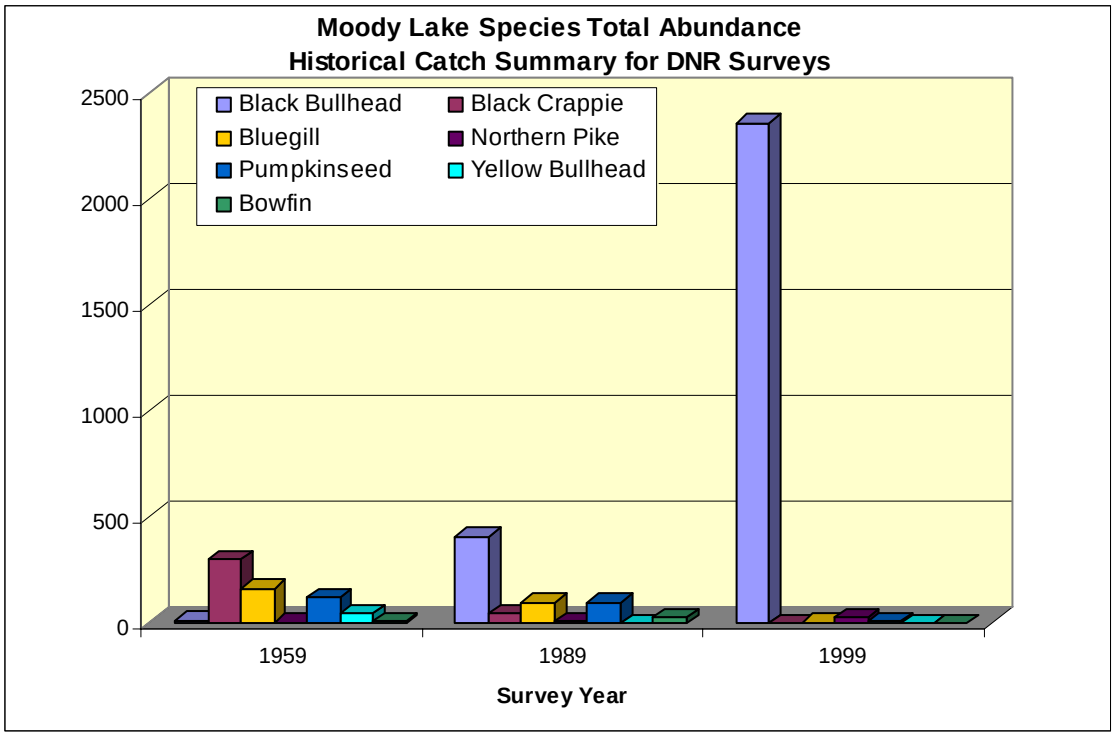
Plant Community

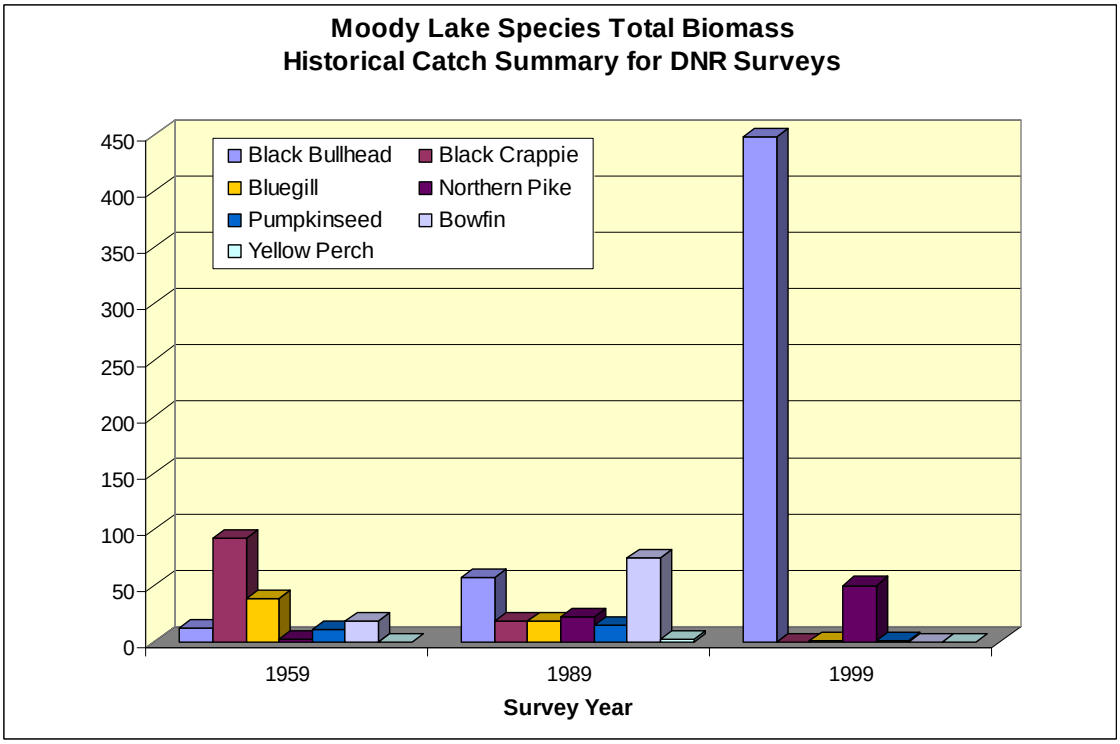
Overall plant community is moderately diverse, number of floating leaf and submergent species has remain relatively stable across all surveys.
Submergent plants extend out to depths of approximately 10 feet in DNR 1990 survey, but decreased to approximately seven feet in the proceeding surveys.
Exotic species curly leaf pondweed was not found in 1990 but is now abundant in the lake based on Spring 2006 survey. Appears to be entering lake from Little Comfort Lake culvert and also boat trailers.
Submergent species indicative of a healthy plant community are present in the lake including sago pondweed and northern water milfoil but overall abundance of these species is low.
Common cattails are the dominant emergent species; yellow water lily is the dominant floating leaf species.
Some submergent species desirable for fish habitat, such as sago pondweed and large leaf pondweed, are present.

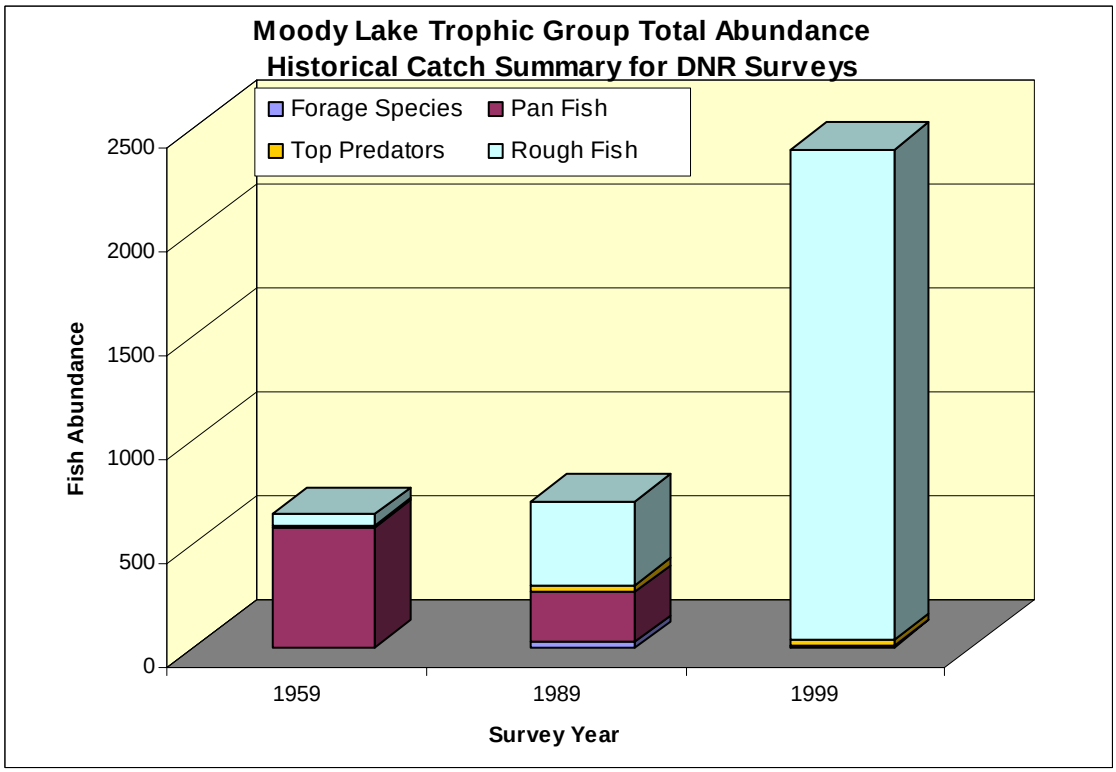
Zooplankton

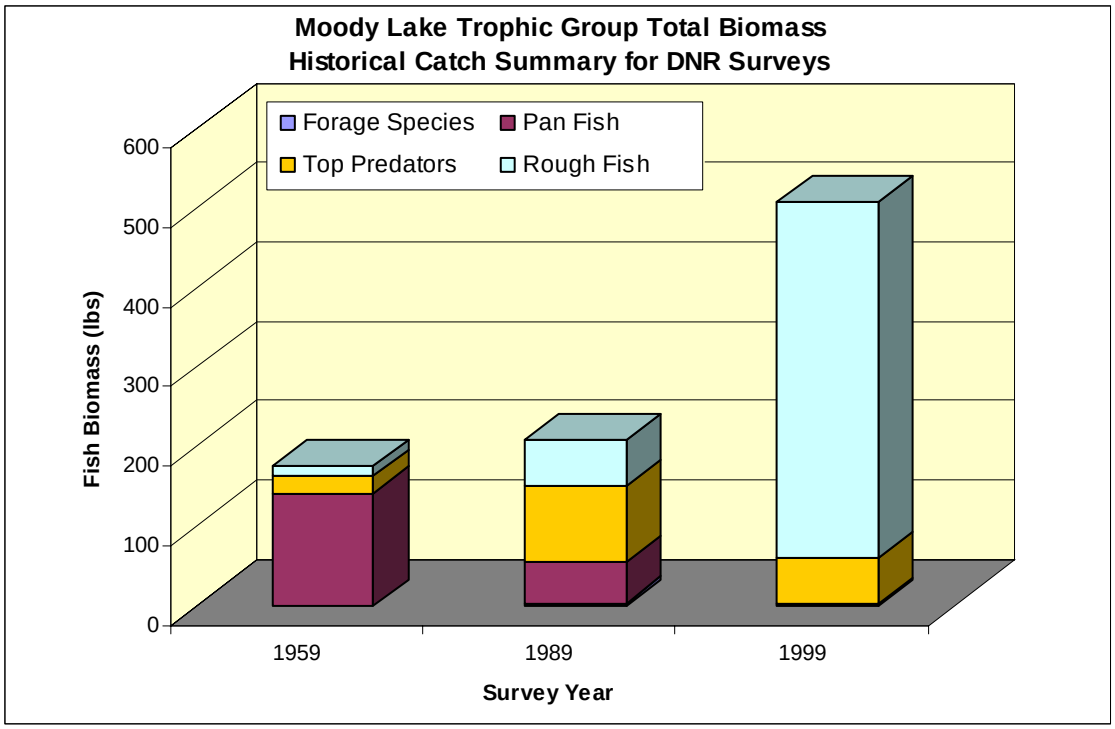
No zooplankton data is available.

Moody Lake


Moody Lake Species Total Abundance
Historical Catch Summary for DNR Surveys
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Pumpkinseed
Yellow Bullhead
Bowfin
2500
2000
1500
1000
500
0
1959
1989
1999
Survey Year


Moody Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Pumpkinseed
Bowfin
Yellow Perch
450
400
350
300
250
200
150
100
50
0
1959
1989
1999
Survey Year


Moody Lake Trophic Group Total Abundance
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
2500
2000
1500
1000
500
0
Fish Abundance
1959
1989
1999
Survey Year

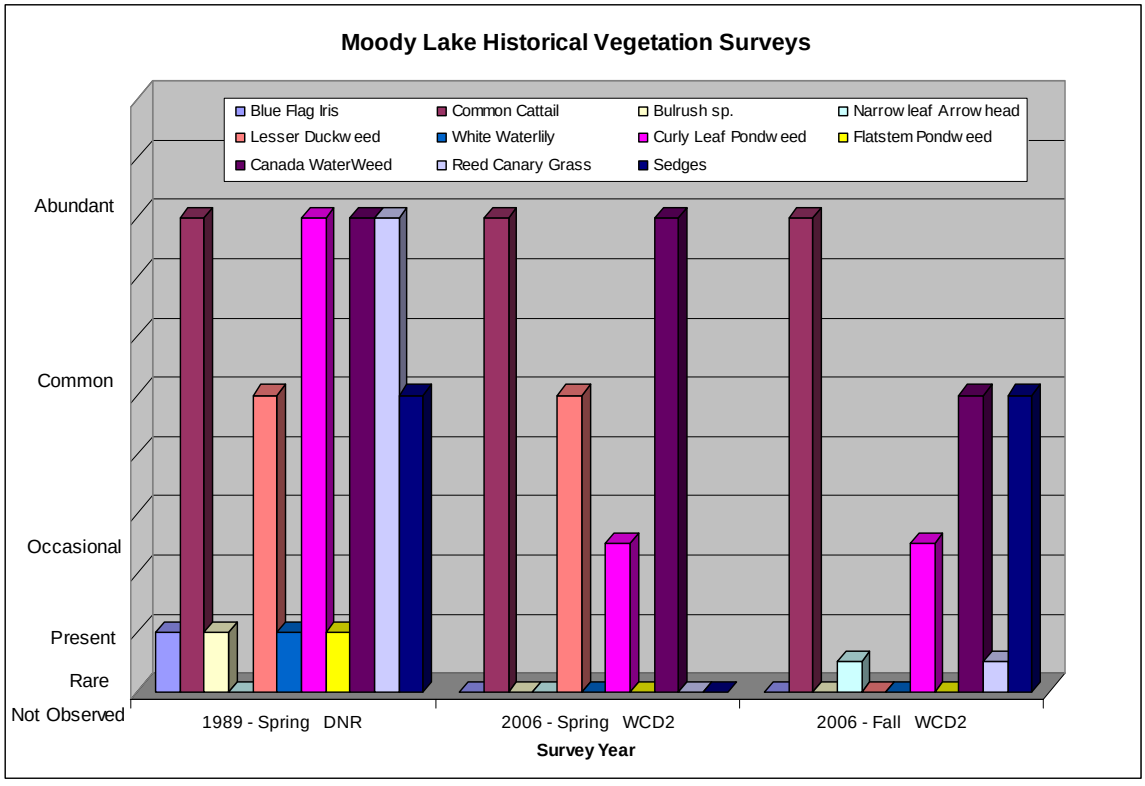

Moody Lake Trophic Group Total Biomass
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
600
500
400
300
200
100
0
Fish Biomass (lbs)
1959
1989
1999
Survey Year

Species	Plant Type	1989 - Spring DNR	2006 - Spring WCD[2]	2006 - Fall WCD[2]
Blue Flag Iris	Emergent	Rare	Not Observed	Not Observed
Common Cattail	Emergent	Abundant	Abundant	Abundant
Bulrush sp.	Emergent	Rare	Not Observed	Not Observed
Narrowleaf Arrowhead	Emergent	Not Observed	Not Observed	Present
Narrowleaf Cattail	Emergent	Rare	Not Observed	Not Observed
Needlerush	Emergent	Rare	Not Observed	Not Observed
Reed Canary Grass	Emergent	Abundant	Not Observed	Present
Sedges	Emergent	Common	Not Observed	Common
Water Plantain	Emergent	Present	Not Observed	Not Observed
Lesser Duckweed	Floating Leaf	Common	Common	Not Observed
Floating Leaf Pondweed	Floating Leaf	Common	Not Observed	Not Observed
White Waterlily	Floating Leaf	Rare	Not Observed	Not Observed
Canada WaterWeed	Submergent	Abundant	Abundant	Common
Curly Leaf Pondweed	Submergent	Abundant	Occasional	Occasional
Flatstem Pondweed	Submergent	Rare	Not Observed	Not Observed
Floating Leaf Burreed	Submergent	Occasional	Not Observed	Not Observed

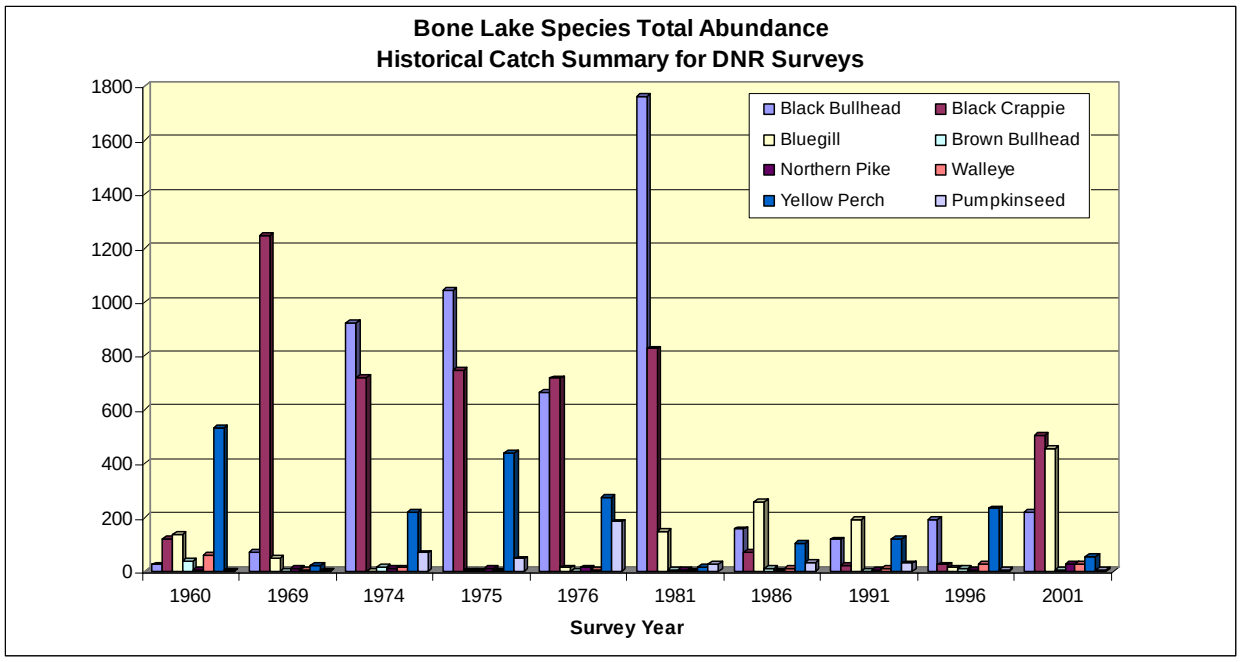
**: Plants were classified as either Abundant, Common, Occasional, Rare, or Present in DNR Survey.

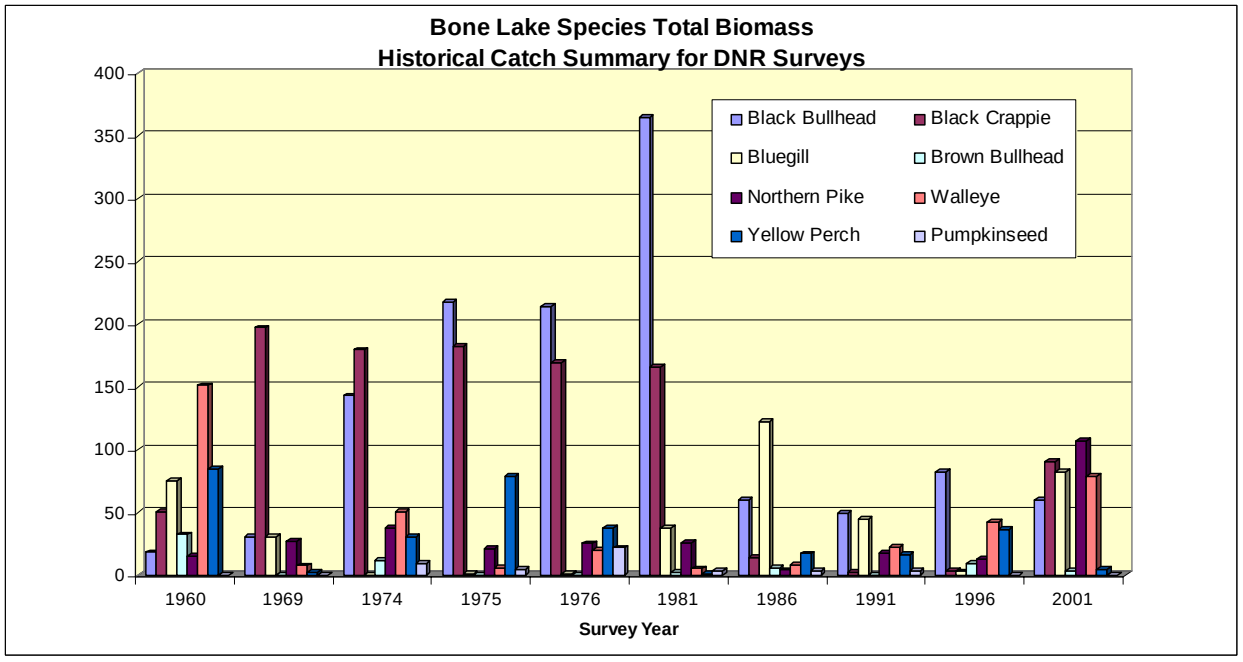
The following numerical values were assigned to each category for display purposes.

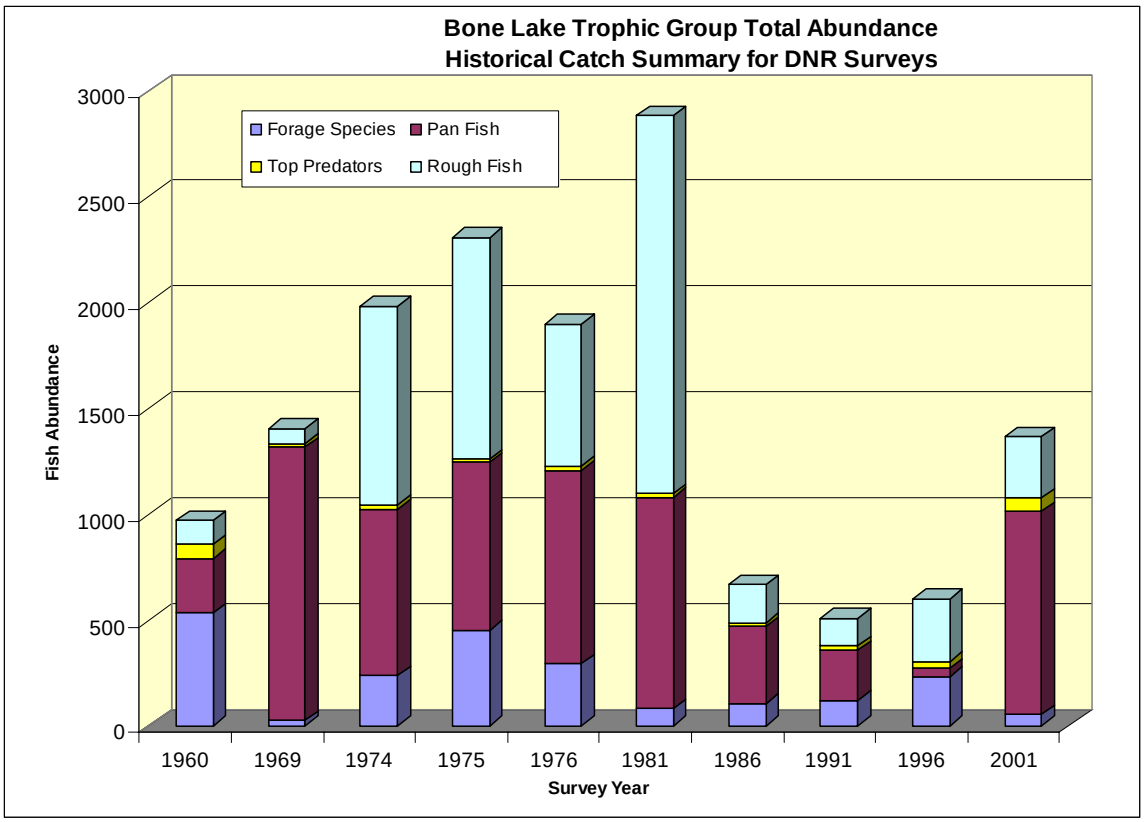
Abundant = 80% , Common = 50%, Occasional = 25%, Rare = 10%, Present = 5%

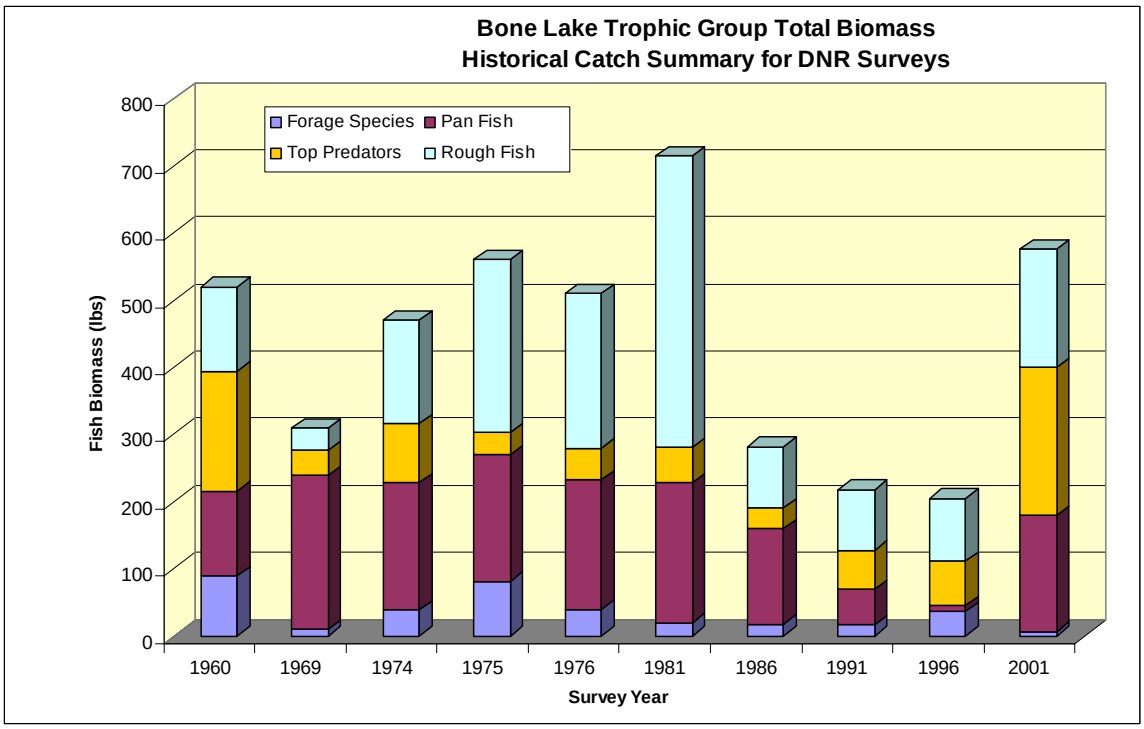


Bone Lake


Bone Lake Species Total Abundance
Historical Catch Summary for DNR Surveys
1800
1600
1400
1200
1000
800
600
400
200
0
Black Bullhead
Black Crappie
Bluegill
Brown Bullhead
Northern Pike
Walleye
Yellow Perch
Pumpkinseed
1960
1969
1974
1975
1976
1981
1986
1991
1996
2001
Survey Year


Bone Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
400
350
300
250
200
150
100
50
0
Black Bullhead
Black Crappie
Bluegill
Brown Bullhead
Northern Pike
Walleye
Yellow Perch
Pumpkinseed
1960
1969
1974
1975
1976
1981
1986
1991
1996
2001
Survey Year

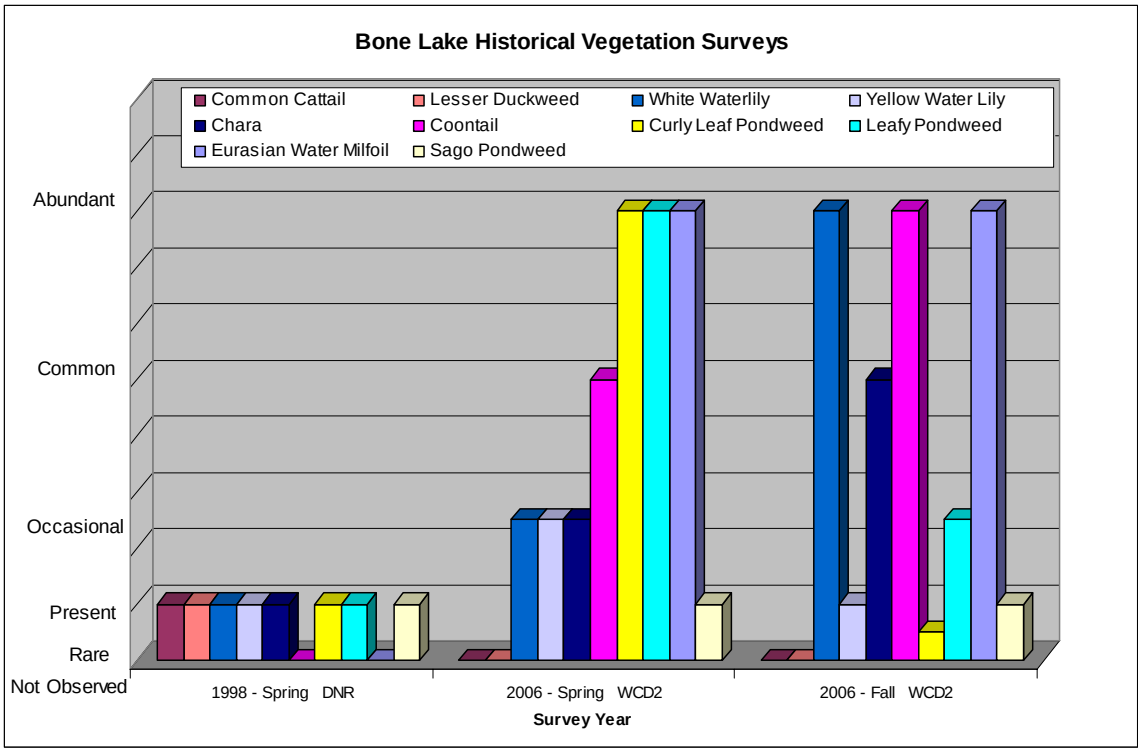

Bone Lake Trophic Group Total Abundance
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Abundance
3000
2500
2000
1500
1000
500
0
1960
1969
1974
1975
1976
1981
1986
1991
1996
2001
Survey Year


Bone Lake Trophic Group Total Biomass
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Biomass (lbs)
800
700
600
500
400
300
200
100
0
1960
1969
1974
1975
1976
1981
1986
1991
1996
2001
Survey Year

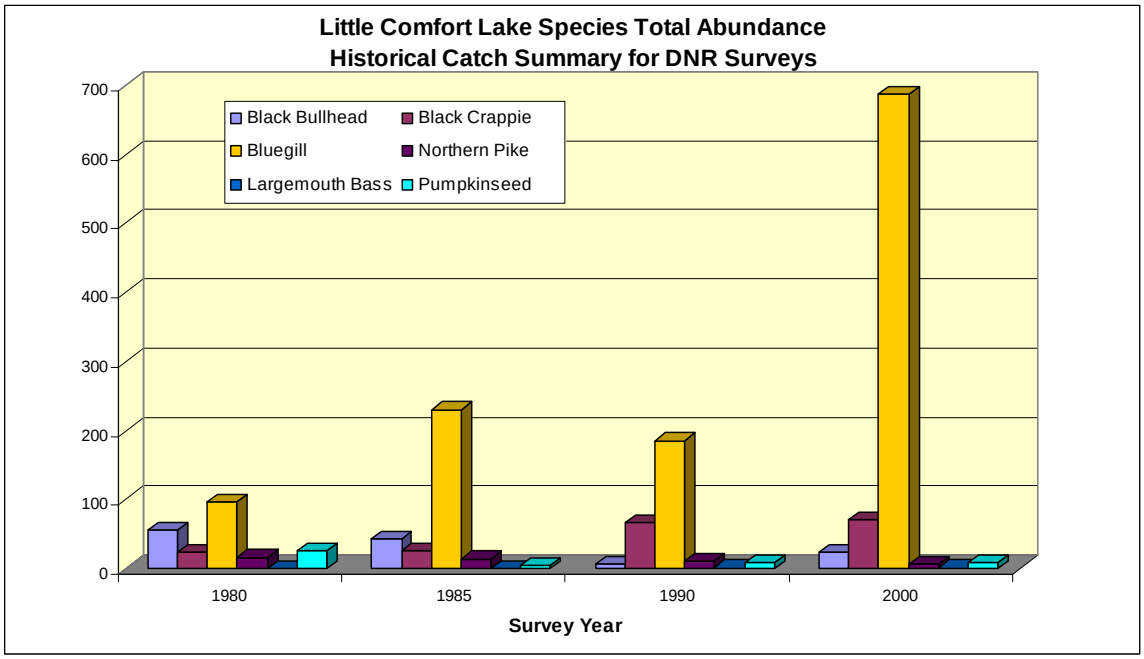
Species	Plant Type	1990 - Spring DNR	2006 - Spring WCD[2]	2006 - Fall WCD[2]
Arrowhead	Emergent	Rare	Not Observed	Not Observed
Common Cattail	Emergent	Rare	Not Observed	Not Observed
Lesser Duckweed	Floating Leaf	Rare	Not Observed	Not Observed
White Waterlily	Floating Leaf	Rare	Occasional	Abundant
Yellow Water Lily	Floating Leaf	Rare	Occasional	Rare
Bushy Pondweed	Submergent	Rare	Not Observed	Not Observed
Canada WaterWeed	Submergent	Rare	Common	Rare
Chara	Submergent	Rare	Occasional	Common
Coontail	Submergent	Not Observed	Common	Abundant
Curly Leaf Pondweed	Submergent	Rare	Abundant	Present
Eurasian Water Milfoil	Submergent	Not Observed	Abundant	Abundant
Flatstem Pondweed	Submergent	Not Observed	Present	Not Observed
Leafy Pondweed	Submergent	Rare	Abundant	Occasional
Northern Water Milfoil	Submergent	Rare	Not Observed	Not Observed
Sago Pondweed	Submergent	Rare	Rare	Rare
Wild Celery	Submergent	Not Observed	Not Observed	Present

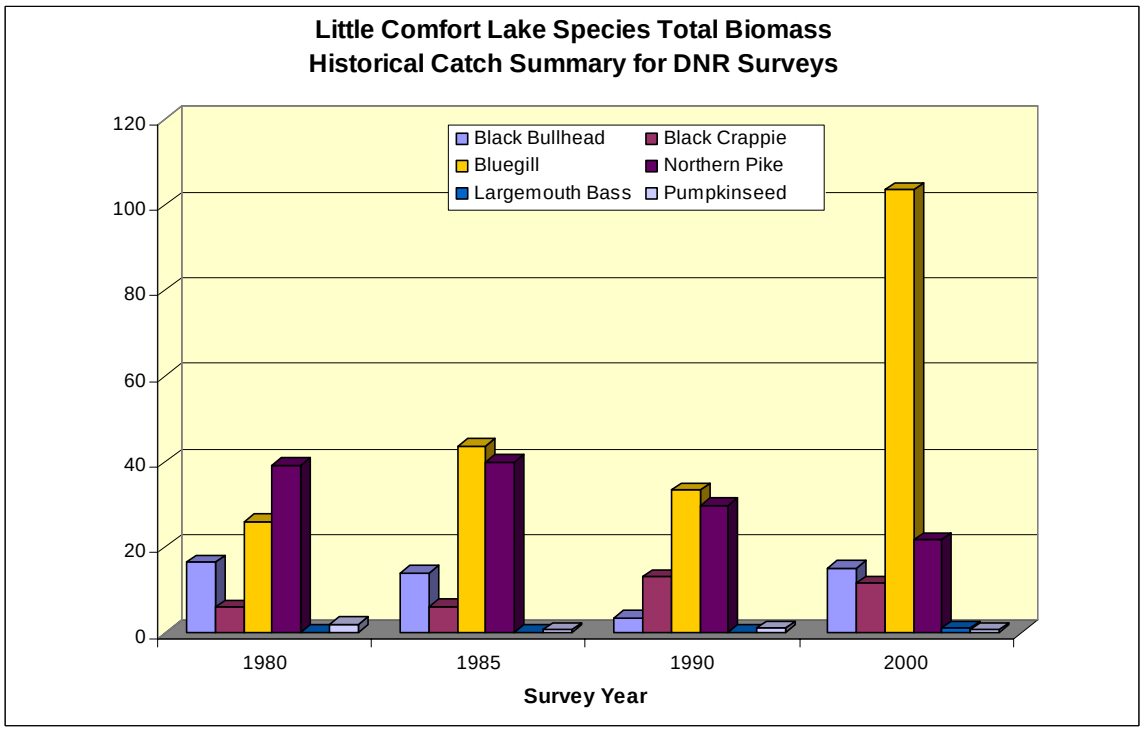
**: Plants were classified as either Abundant, Common, Occasional, Rare, or Present in DNR Survey.

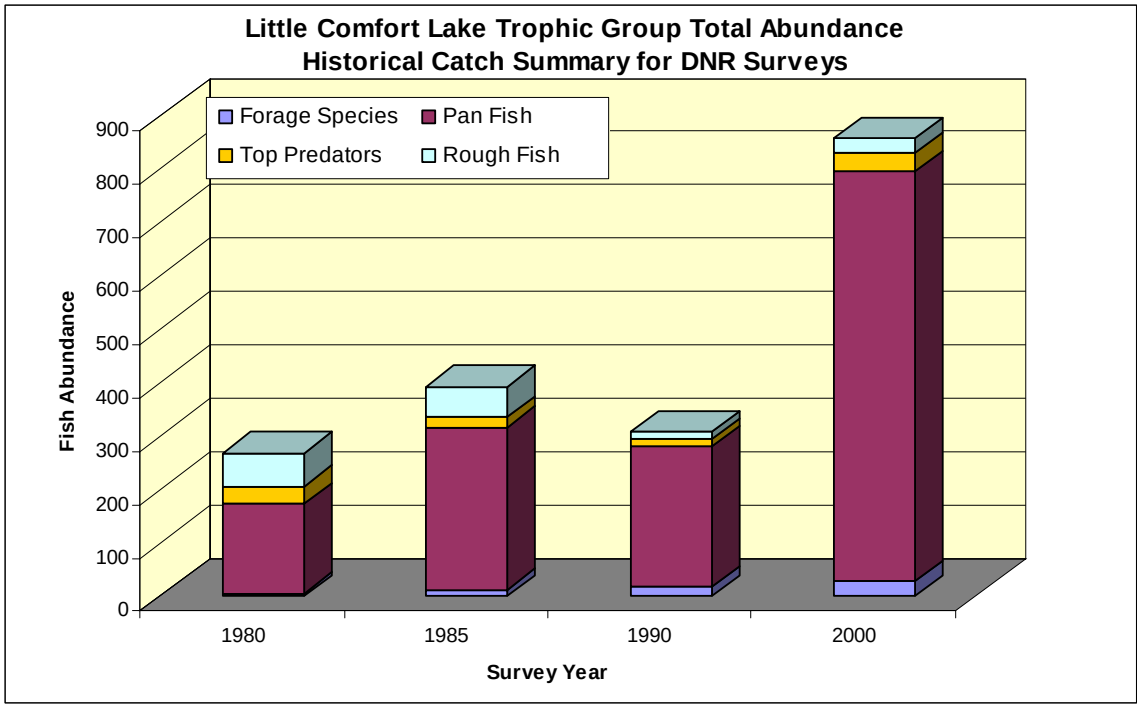
The following numerical values were assigned to each category for display purposes.
Abundant = 80% , Common = 50%, Occasional = 25%, Rare = 10%, Present = 5%

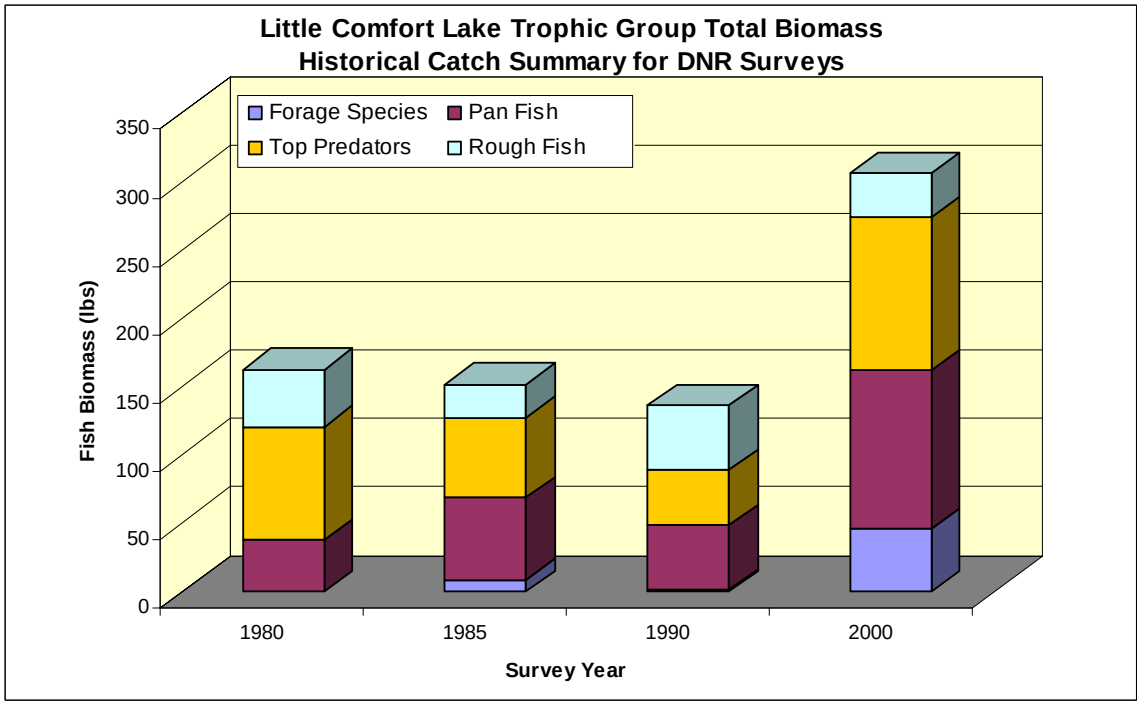


Little Comfort


Little Comfort Lake Species Total Abundance
Historical Catch Summary for DNR Surveys
700
600
500
400
300
200
100
0
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Largemouth Bass
Pumpkinseed
1980
1985
1990
2000
Survey Year


Little Comfort Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
120
100
80
60
40
20
0
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Largemouth Bass
Pumpkinseed
1980
1985
1990
2000
Survey Year


Little Comfort Lake Trophic Group Total Abundance
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
900
800
700
600
500
400
300
200
100
0
Fish Abundance
1980
1985
1990
2000
Survey Year


Little Comfort Lake Trophic Group Total Biomass
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
350
300
250
200
150
100
50
0
Fish Biomass (lbs)
1980
1985
1990
2000
Survey Year

Species	Plant Type	1990 - Spring DNR	2000 -Fall DNR	2006 - Spring WCD[2]	2006 - Fall WCD[2]
Blue Flag Iris	Emergent	Occasional	Rare	Present	Not Observed
Common Cattail	Emergent	Abundant	Common	Common	Common
Hardstem Bulrush	Emergent	Occasional	Rare	Not Observed	Not Observed
Narrowleaf Arrowhead	Emergent	Occasional	Rare	Not Observed	Not Observed
Narrowleaf Cattail	Emergent	Common	Common	Not Observed	Not Observed
Needlerush	Emergent	Not Observed	Rare	Not Observed	Not Observed
Reed Canary Grass	Emergent	Not Observed	Common	Not Observed	Not Observed
Sedges	Emergent	Common	Common	Not Observed	Not Observed
Skullcap sp.	Emergent	Not Observed	Rare	Not Observed	Not Observed
Smartweed	Emergent	Not Observed	Rare	Not Observed	Not Observed
Watermeal	Emergent	Not Observed	Common	Not Observed	Not Observed
Lesser Duckweed	Floating Leaf	Common	Common	Common	Present
White Waterlily	Floating Leaf	Common	Common	Common	Abundant
Yellow Waterlily	Floating Leaf	Common	Rare	Rare	Rare
Coontail	Sumergent	Abundant	Abundant	Abundant	Abundant
Curly Leaf Pondweed	Sumergent	Abundant	Not Observed	Abundant	Present
Flatstem Pondweed	Sumergent	Common	Rare	Occasional	Present
Narrowleaf Pondweed	Sumergent	Occasional	Present	Present	Present
Northern Water Milfoil	Sumergent	Present	Not Observed	Present	Not Observed

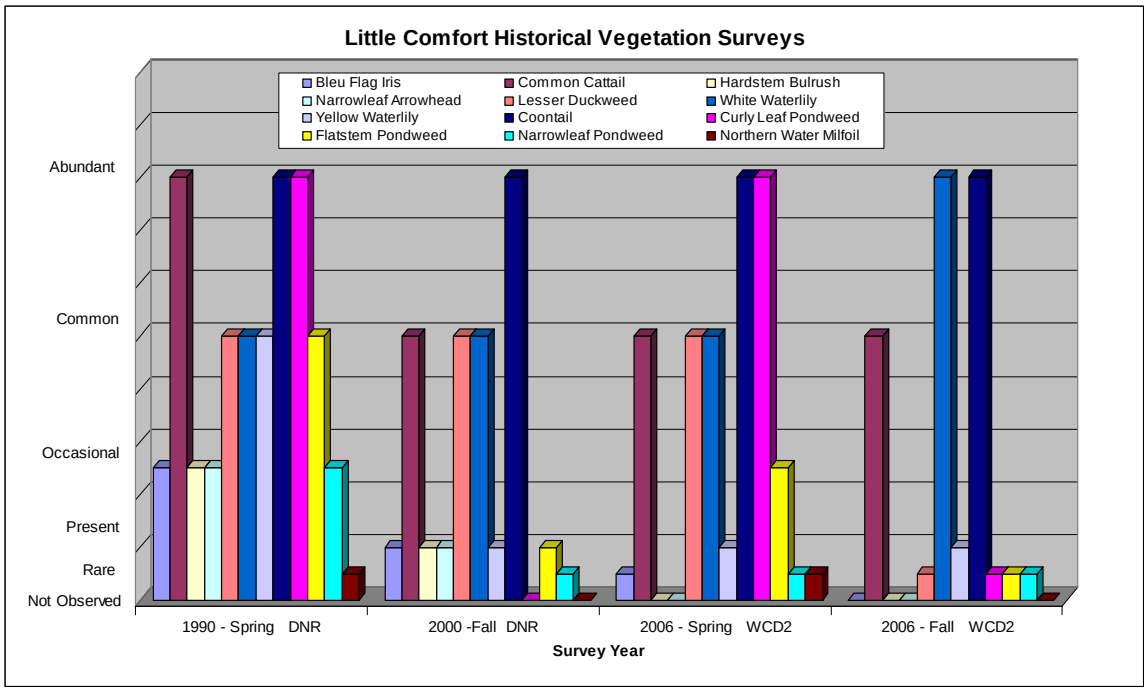
1: Survey condcuted by Minnesota Department of Natural Resources Fisheries Bereau

2: Survey conducted by Washington Conservation District

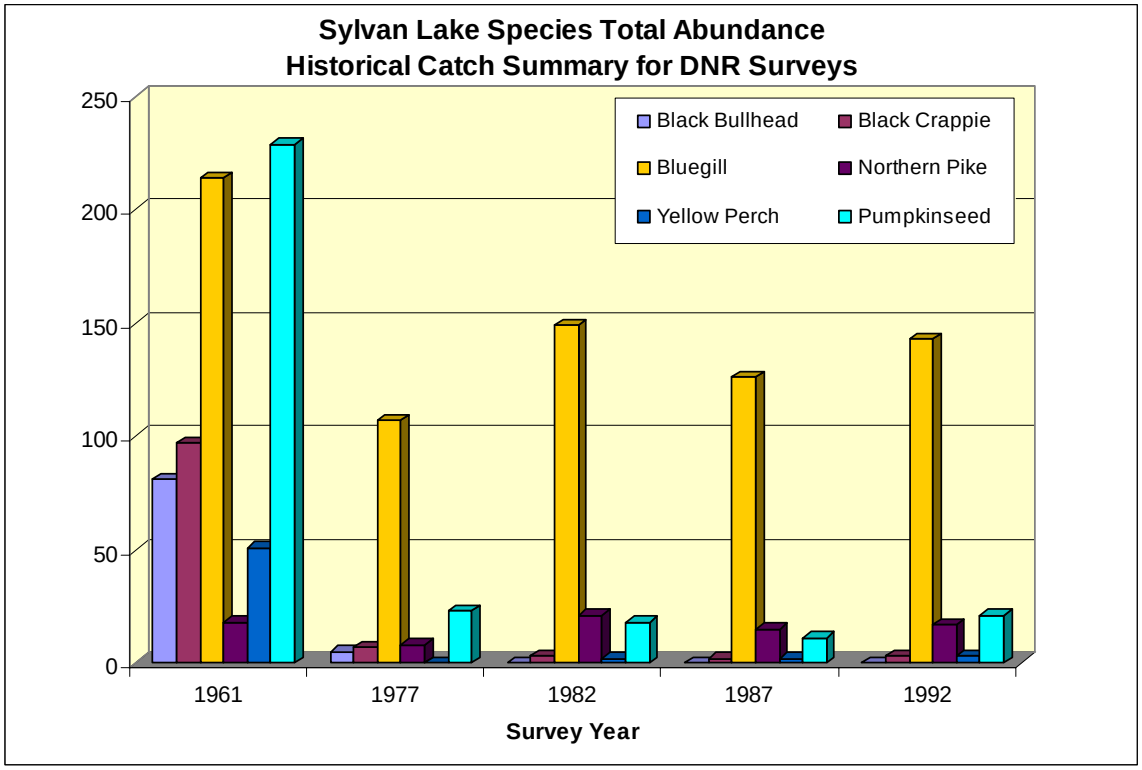
3 : Plants were classified as either Abundant, Common, Occasional, Rare, or Present in DNR Survey.

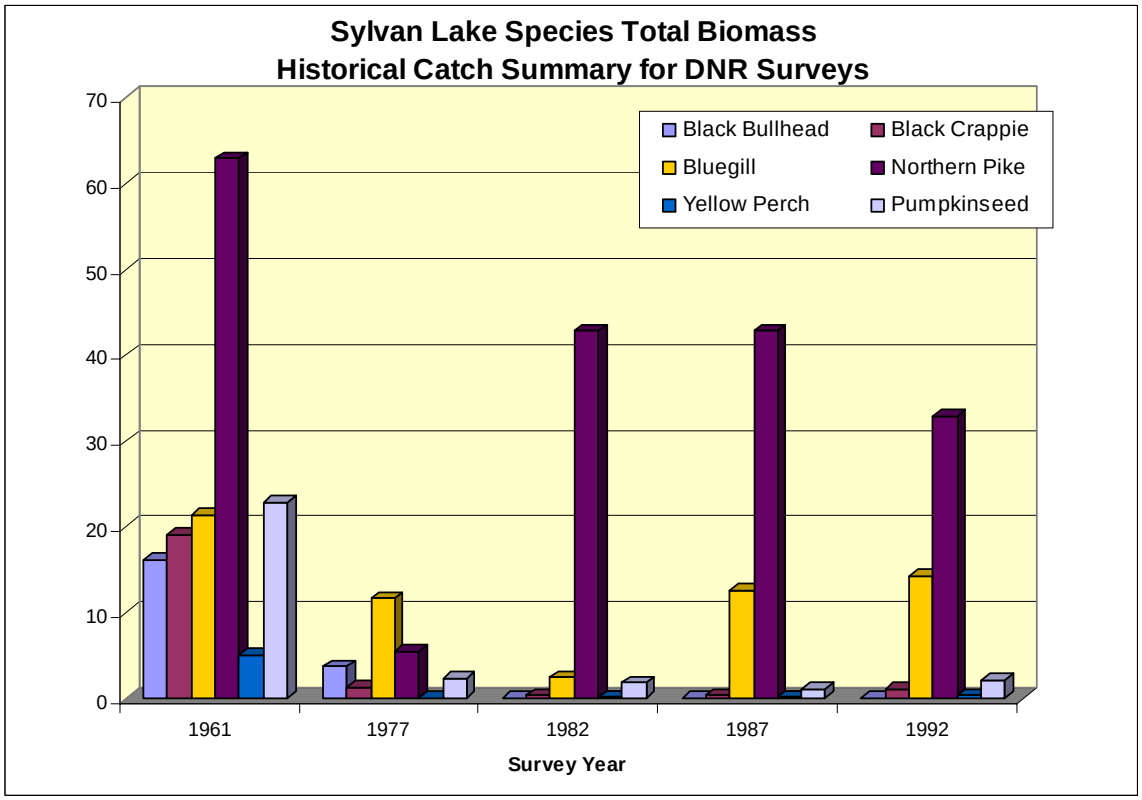
The following numerical values were assigned to each category for display purposes:

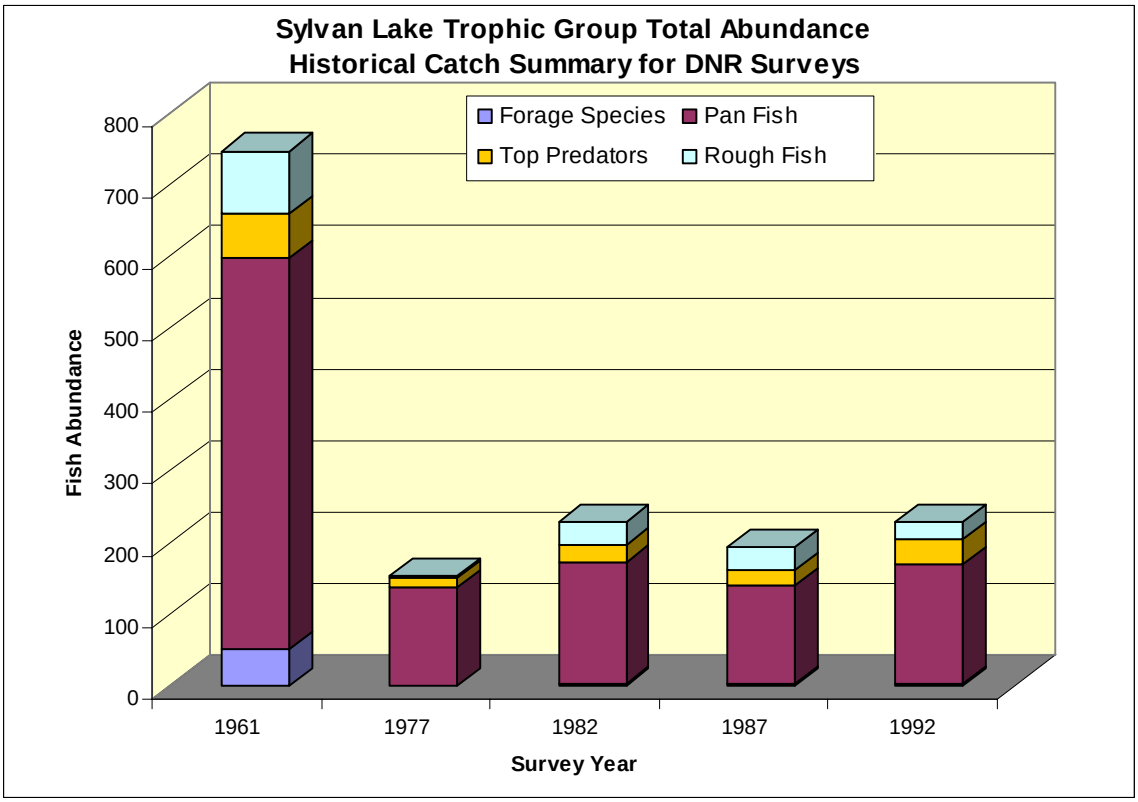
Abundant = 80% , Common = 50%, Occasional = 25%, Rare = 10%, Present = 5%, Not Observed = 0

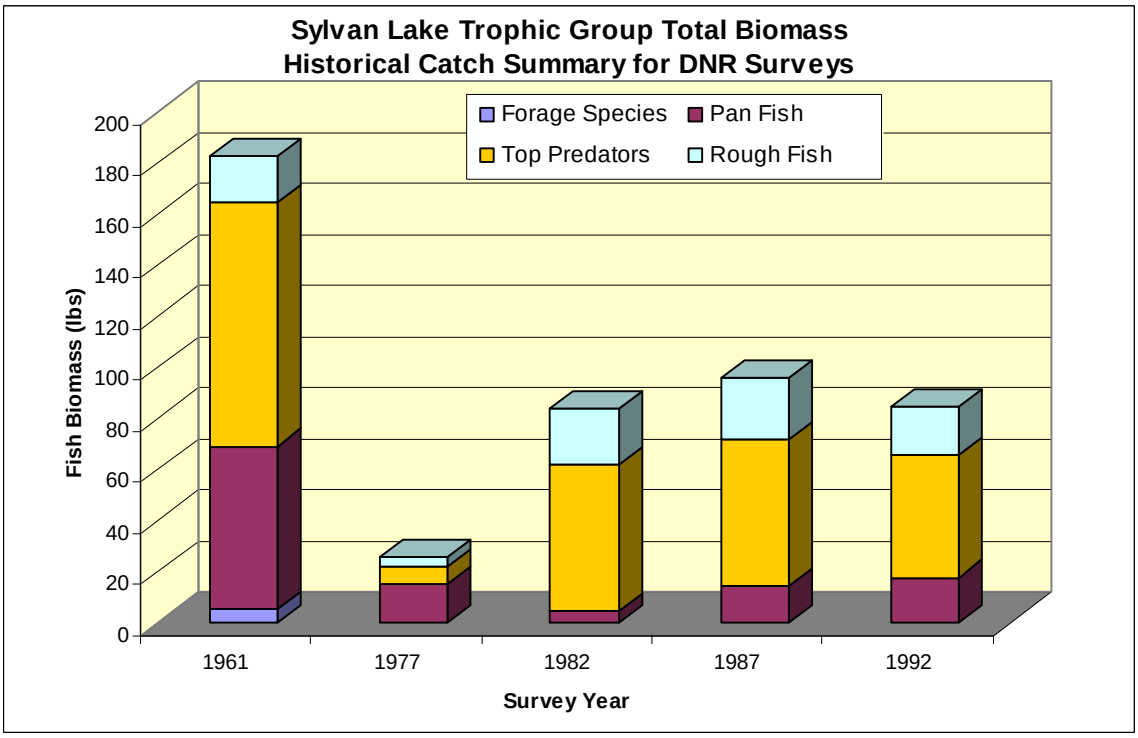


Sylvan Lake


Sylvan Lake Species Total Abundance
Historical Catch Summary for DNR Surveys
250
200
150
100
50
0
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Yellow Perch
Pumpkinseed
1961
1977
1982
1987
1992
Survey Year

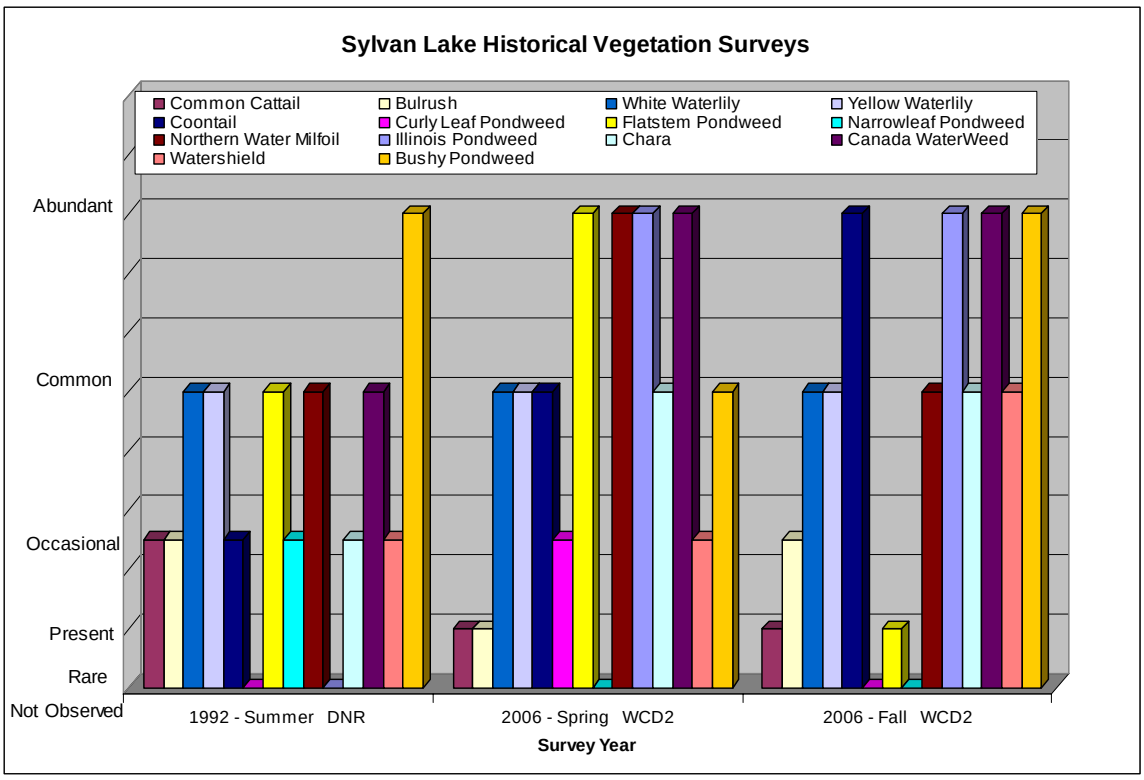

Sylvan Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
70
60
50
40
30
20
10
0
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Yellow Perch
Pumpkinseed
1961
1977
1982
1987
1992
Survey Year


Sylvan Lake Trophic Group Total Abundance
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Abundance
800
700
600
500
400
300
200
100
0
1961
1977
1982
1987
1992
Survey Year

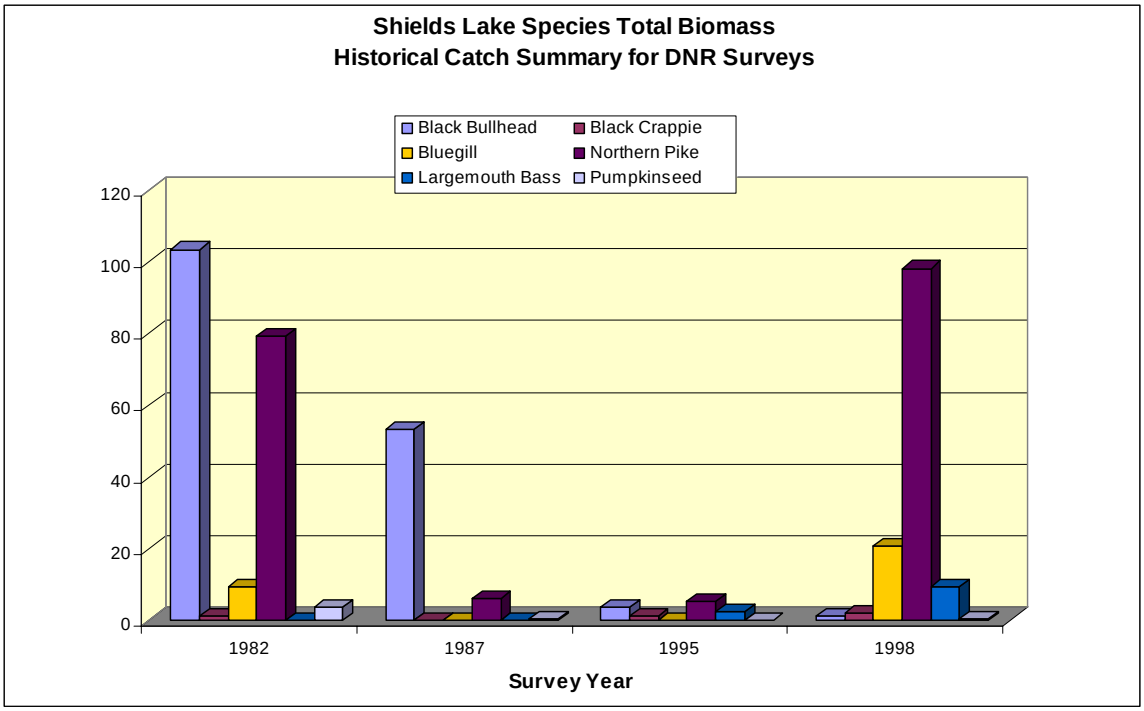

Sylvan Lake Trophic Group Total Biomass
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Biomass (lbs)
200
180
160
140
120
100
80
60
40
20
0
1961
1977
1982
1987
1992
Survey Year

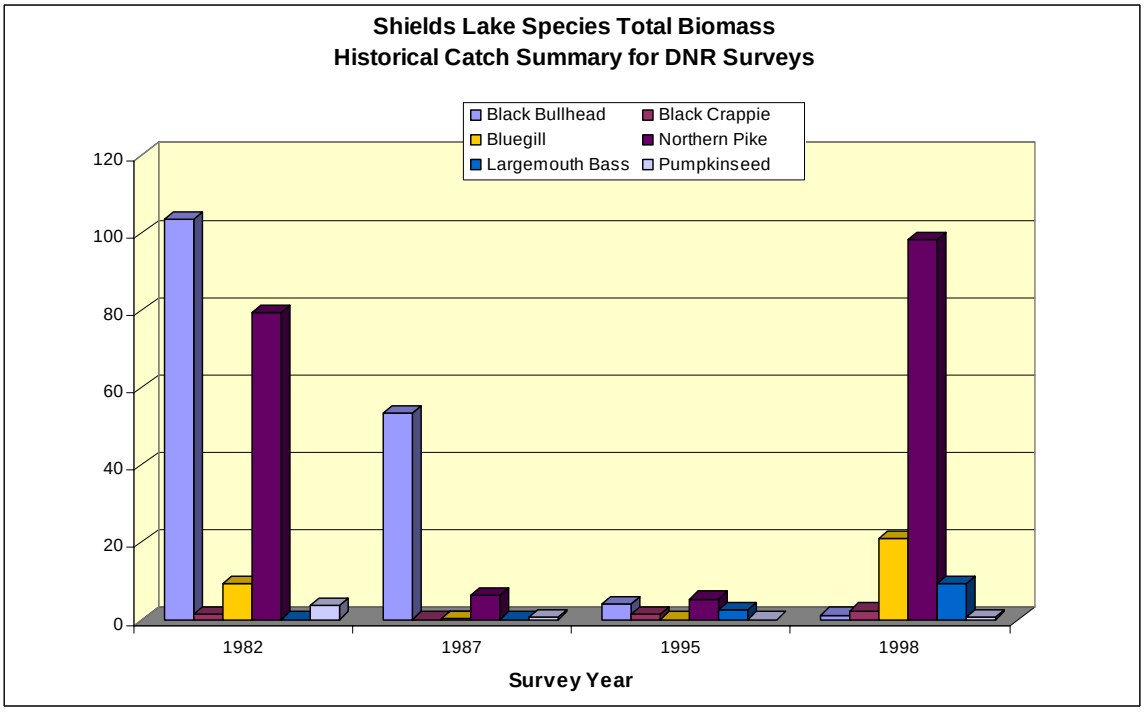
Species	Plant Type	1992 - Summer DNR	2006 - Spring WCD[2]	2006 - Fall WCD[2]
Blue Flag Iris	Emergent	Rare	Not Observed	Not Observed
Common Cattail	Emergent	Occasional	Rare	Rare
Bulrush	Emergent	Occasional	Rare	Occasional
Narrowleaf Arrowhead	Emergent	Not Observed	Present	Present
Reed Canary Grass	Emergent	Not Observed	Not Observed	Present
Sedges	Emergent	Occasional	Present	Occasional
Spikerush	Emergent	Rare	Present	Present
Smartweed	Emergent	Common	Not Observed	Occasional
Swamp Milkweed	Emergent	Common	Not Observed	Not Observed
Wild Celery	Emergent	Not Observed	Occasional	Occasional
Wild Rice	Emergent	Occasional	Not Observed	Not Observed
Floatingleaf pondweed	Floating Leaf	Occasional	Present	Not Observed
White Waterlily	Floating Leaf	Common	Common	Common
Yellow Waterlily	Floating Leaf	Common	Common	Common
Bushy Pondweed	Submergent	Abundant	Common	Abundant
Bladderwort	Submergent	Not Observed	Rare	Occasional
Canada WaterWeed	Submergent	Common	Abundant	Abundant
Chara	Submergent	Occasional	Common	Common
Coontail	Submergent	Occasional	Common	Abundant
Curly Leaf Pondweed	Submergent	Not Observed	Occasional	Not Observed
Flatstem Pondweed	Submergent	Common	Abundant	Rare
Illinois Pondweed	Submergent	Not Observed	Abundant	Abundant
Largeleaf Pndweed	Submergent	Common	Common	Not Observed
Leafy Pondweed	Submergent	Not Observed	Occasional	Rare
Narrowleaf Pondweed	Submergent	Occasional	Not Observed	Not Observed
Northern Water Milfoil	Submergent	Common	Abundant	Common
Sago Pondweed	Submergent	Occasional	Present	Present
Watershield	Submergent	Occasional	Occasional	Common

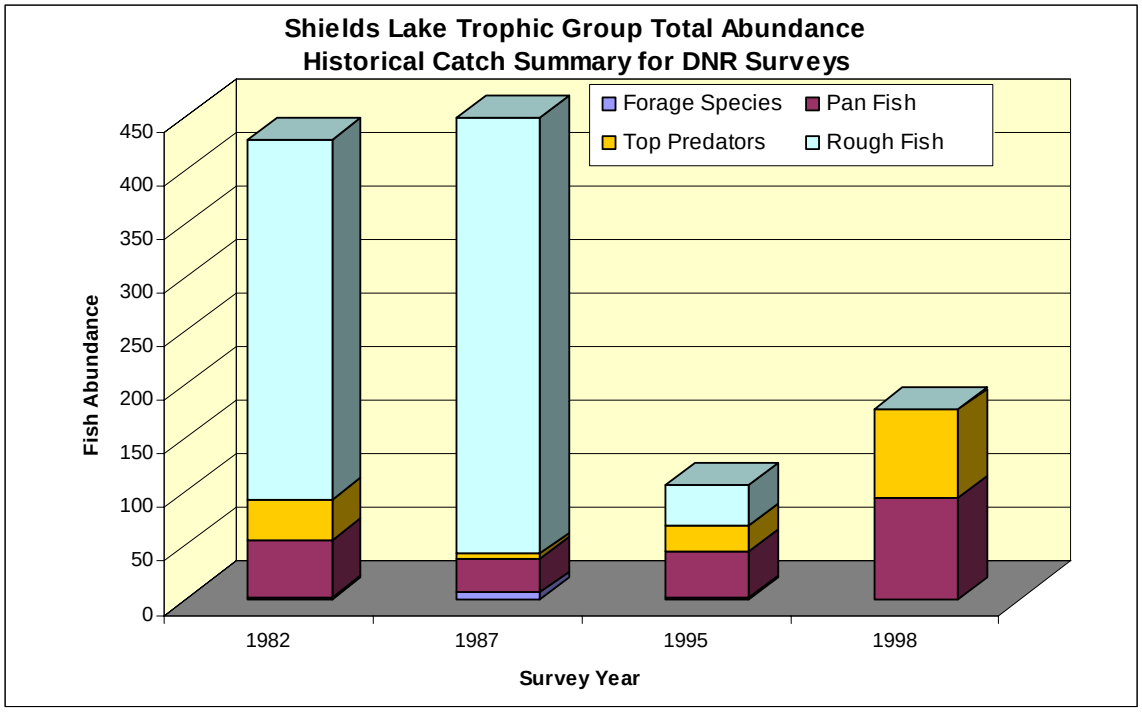
**: Plants were classified as either Abundant, Common, Occasional, Rare, or Present in DNR Survey. The following numerical values were assigned to each category for display purposes.
Abundant = 80% , Common = 50%, Occasional = 25%, Rare = 10%, Present = 5%

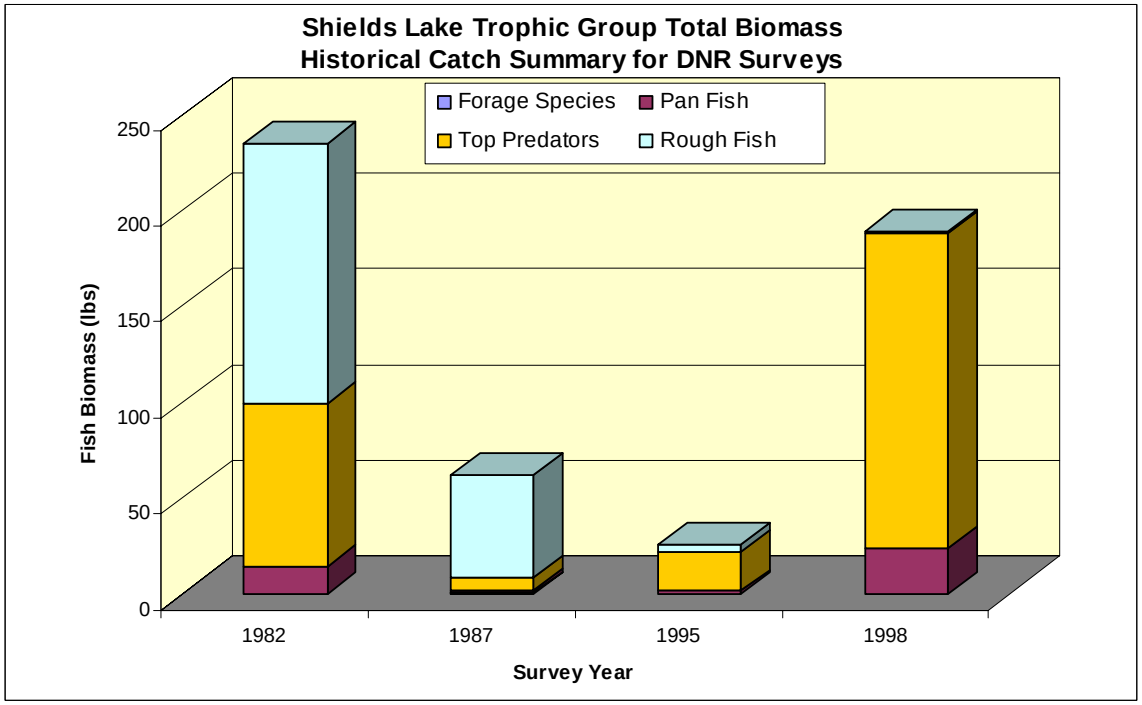


Shields Lake


Shields Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Largemouth Bass
Pumpkinseed
120
100
80
60
40
20
0
1982
1987
1995
1998
Survey Year

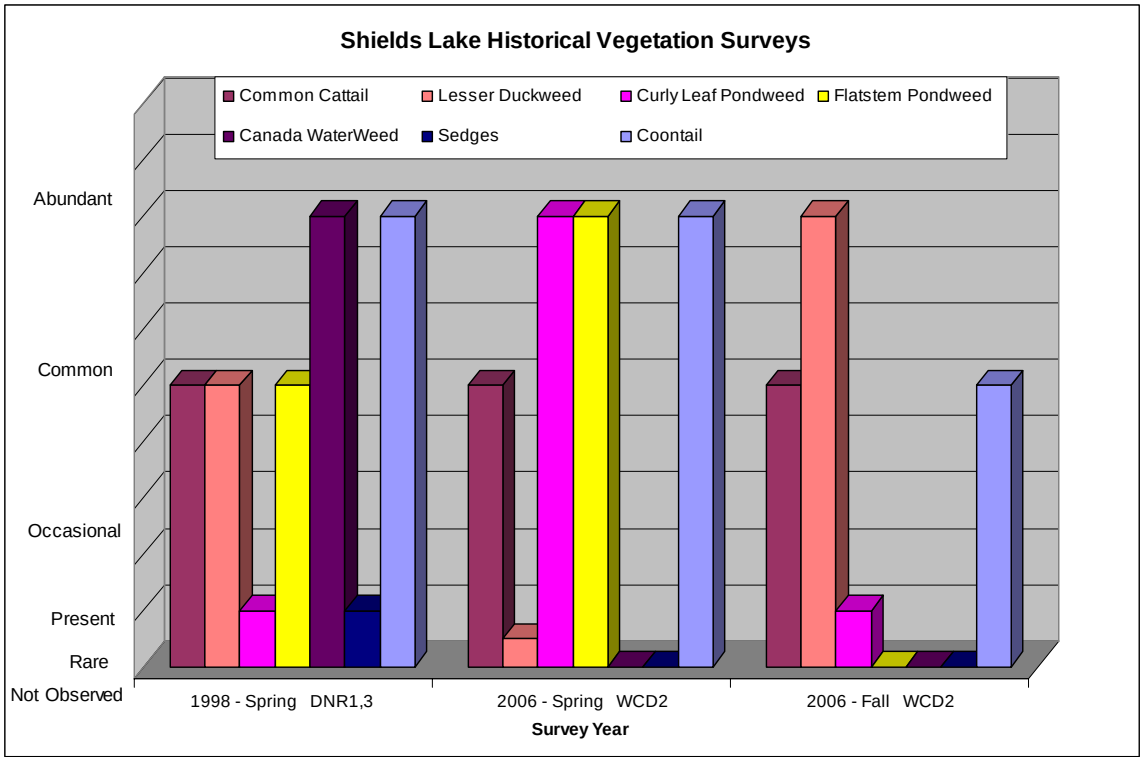

Shields Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
Black Bullhead
Black Crappie
Bluegill
Northern Pike
Largemouth Bass
Pumpkinseed
120
100
80
60
40
20
0
1982
1987
1995
1998
Survey Year


Shields Lake Trophic Group Total Abundance
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Abundance
0
50
100
150
200
250
300
350
400
450
1982
1987
1995
1998
Survey Year

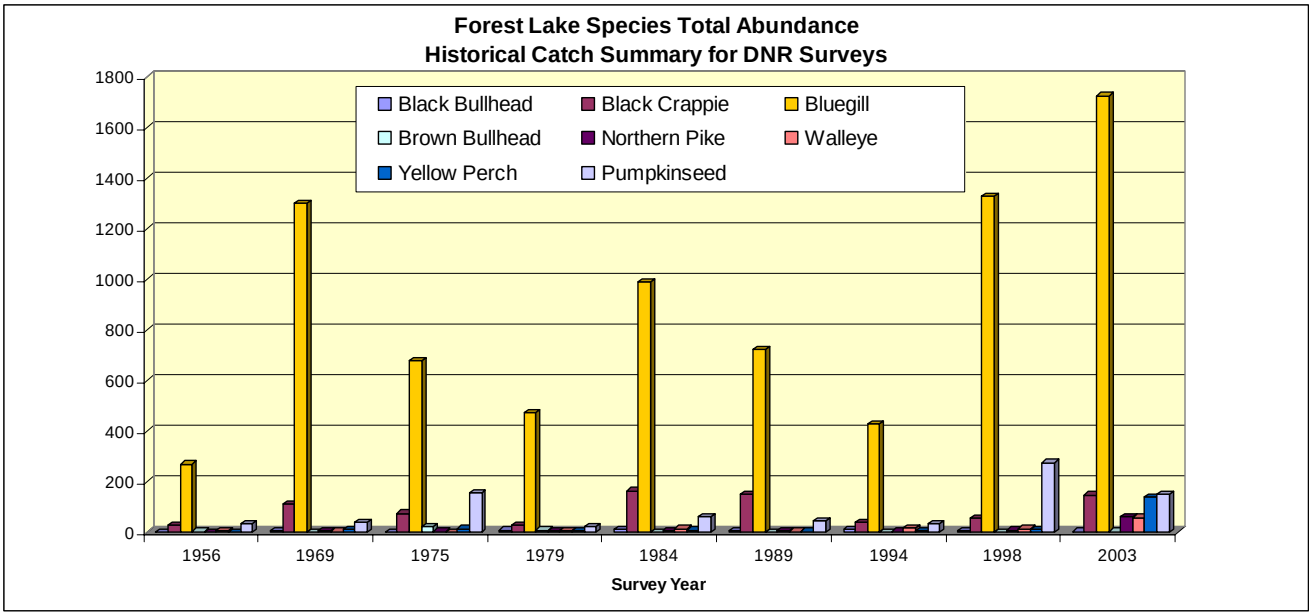

Shields Lake Trophic Group Total Biomass
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Biomass (lbs)
0
50
100
150
200
250
1982
1987
1995
1998
Survey Year

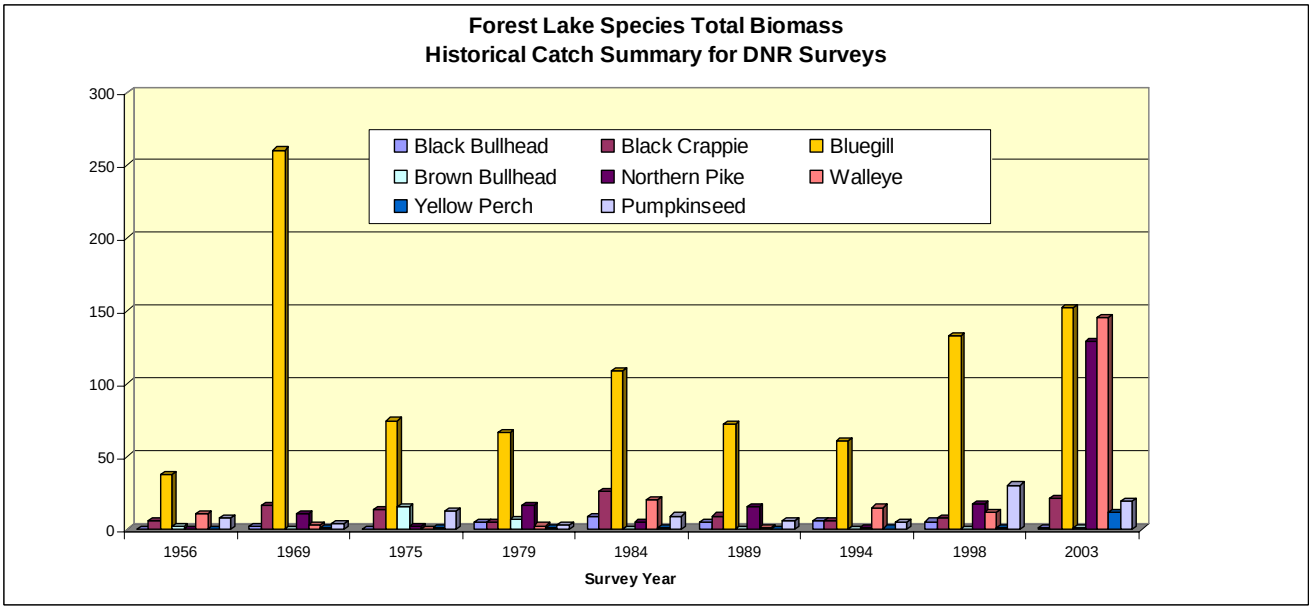
Species	Plant Type	1998 - Spring DNR[1,3]	2006 - Spring WCD[2]	2006 - Fall WCD[2]
Common Cattail	Emergent	Common	Common	Common
Sedges	Emergent	Rare	Not Observed	Not Observed
Smartweed	Emergent	Rare	Not Observed	Not Observed
Watermeal	Emergent	Common	Not Observed	Not Observed
Lesser Duckweed	Floating Leaf	Common	Present	Abundant
Canada WaterWeed	Submergent	Abundant	Not Observed	Not Observed
Curly Leaf Pondweed	Submergent	Rare	Abundant	Rare
Coontail	Submergent	Abundant	Abundant	Common
Flatstem Pondweed	Submergent	Common	Abundant	Not Observed

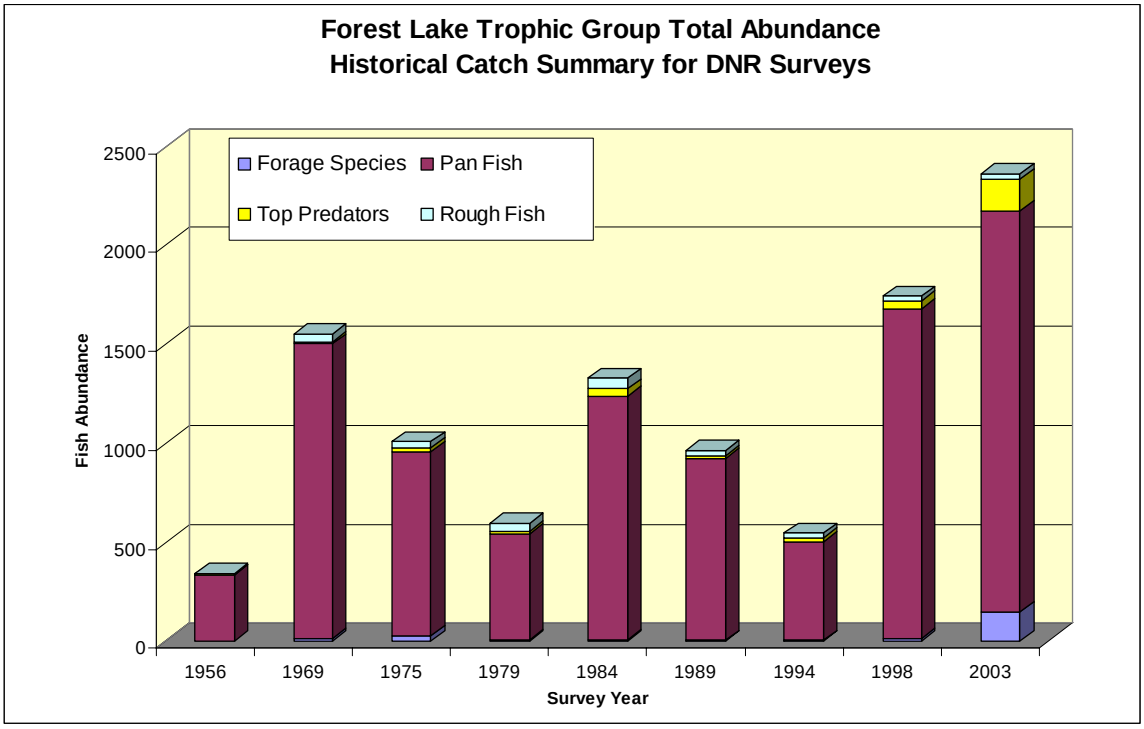
1: Survey condcuted by Minnesota Department of Natural Resources Fisheries Bureau
2: Survey conducted by Washington Conservation District
3 : Plants were classified as either Abundant, Common, Occasional, Rare, or Present in DNR Survey. The following numerical values were assigned to each category for display purposes.
Abundant = 80% , Common = 50%, Occasional = 25%, Rare = 10%, Present = 5%

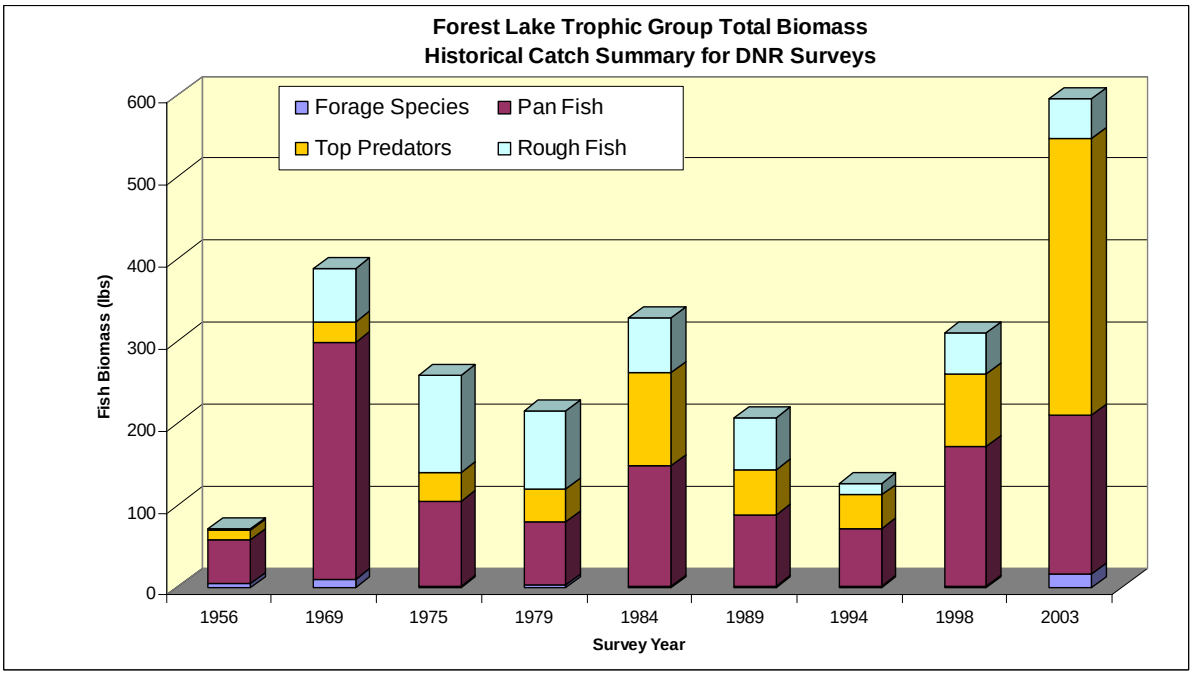


Forest Lake


Forest Lake Species Total Abundance
Historical Catch Summary for DNR Surveys
1800
1600
1400
1200
1000
800
600
400
200
0
Black Bullhead
Black Crappie
Bluegill
Brown Bullhead
Northern Pike
Walleye
Yellow Perch
Pumpkinseed
1956
1969
1975
1979
1984
1989
1994
1998
2003
Survey Year

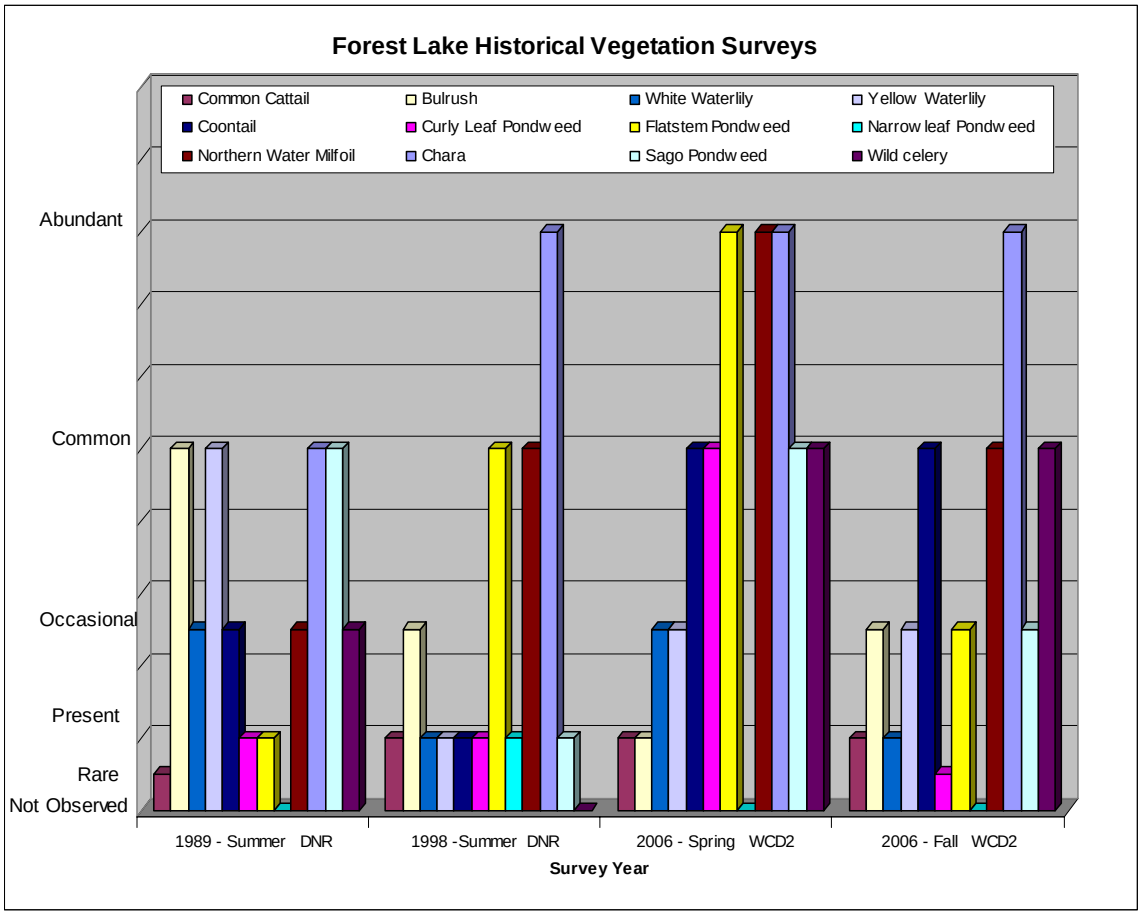

Forest Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
300
250
200
150
100
50
0
Black Bullhead
Black Crappie
Bluegill
Brown Bullhead
Northern Pike
Walleye
Yellow Perch
Pumpkinseed
1956
1969
1975
1979
1984
1989
1994
1998
2003
Survey Year


Forest Lake Trophic Group Total Abundance
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Abundance
2500
2000
1500
1000
500
0
1956
1969
1975
1979
1984
1989
1994
1998
2003
Survey Year

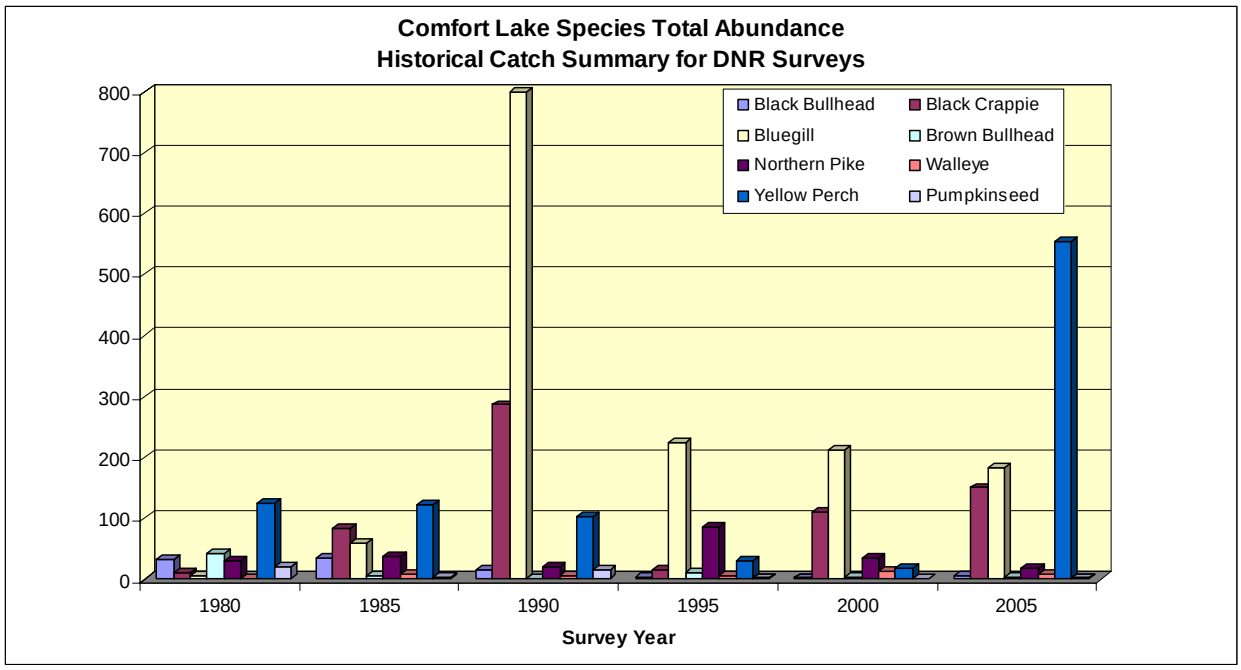

Forest Lake Trophic Group Total Biomass
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Biomass (lbs)
600
500
400
300
200
100
0
1956
1969
1975
1979
1984
1989
1994
1998
2003
Survey Year

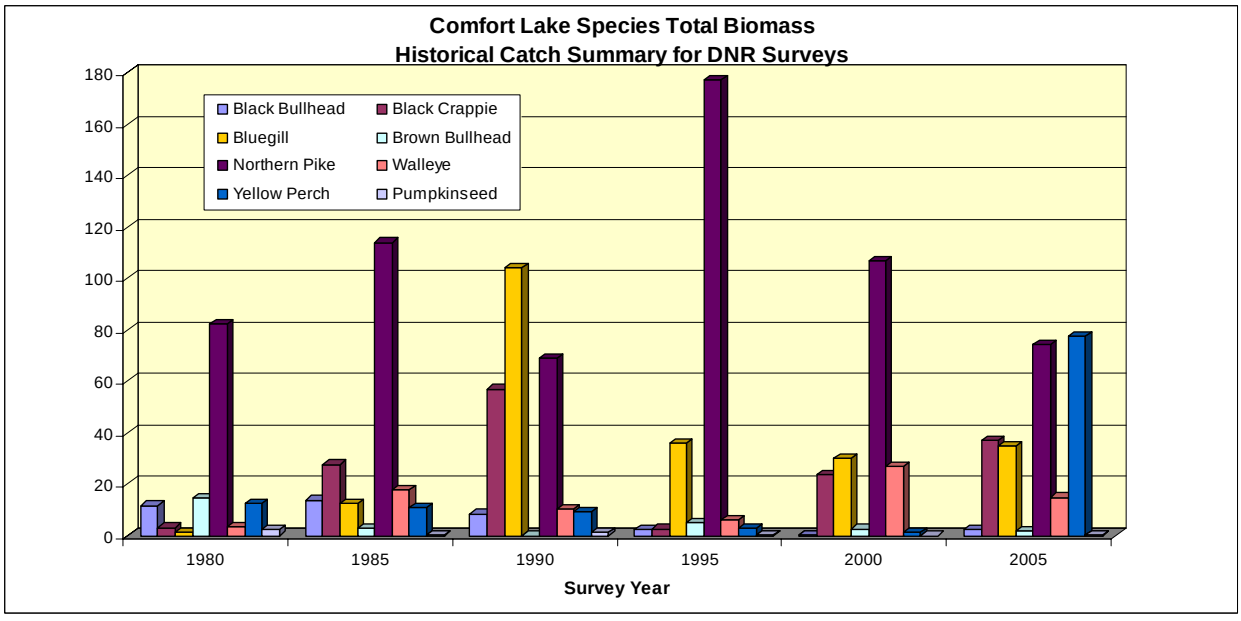
Species	Plant Type	1989 - Summer DNR	1998 -Summer DNR	2006 - Spring WCD[2]	2006 - Fall WCD[2]
Common Cattail	Emergent	Present	Rare	Rare	Rare
Bulrush sp.	Emergent	Common	Occasional	Rare	Occasional
Arrowhead	Emergent	Rare	Not Observed	Not Observed	Not Observed
Narrowleaf Cattail	Emergent	Occasional	Rare	Not Observed	Not Observed
Purple Loosestrife	Emergent	Present	Not Observed	Not Observed	Not Observed
Swamp Milkweed	Emergent	Not Observed	Rare	Not Observed	Not Observed
Duckweed	Floating Leaf	Not Observed	Rare	Not Observed	Not Observed
White Waterlily	Floating Leaf	Occasional	Rare	Occasional	Rare
Yellow Waterlily	Floating Leaf	Common	Rare	Occasional	Occasional
Bladderwort	Submergent	Not Observed	Rare	Occasional	Not Observed
Bushy Pondweed	Submergent	Occasional	Common	Common	Common
Canada WaterWeed	Submergent	Not Observed	Rare	Occasional	Present
Chara	Submergent	Common	Abundant	Abundant	Abundant
Claspingleaf Pondweed	Submergent	Occasional	Not Observed	Common	Common
Coontail	Submergent	Occasional	Rare	Common	Common
Curly Leaf Pondweed	Submergent	Rare	Rare	Common	Present
Flatstem Pondweed	Submergent	Rare	Common	Abundant	Common
Illinois Pondweed	Submergent	Rare	Rare	Rare	Occasional
Largeleaf Pndweed	Submergent	Not Observed	Rare	Occasional	Occasional
Leafy Pondweed	Submergent	Not Observed	Not Observed	Abundant	Not Observed
Narrowleaf Pondweed	Submergent	Not Observed	Rare	Not Observed	Not Observed
Northern Water Milfoil	Submergent	Occasional	Common	Abundant	Common
Sago Pondweed	Submergent	Common	Rare	Common	Occasional
Whitestem pondweed	Submergent	Not Observed	Not Observed	Rare	Occasional
Wild celery	Submergent	Occasional	Not Observed	Common	Common

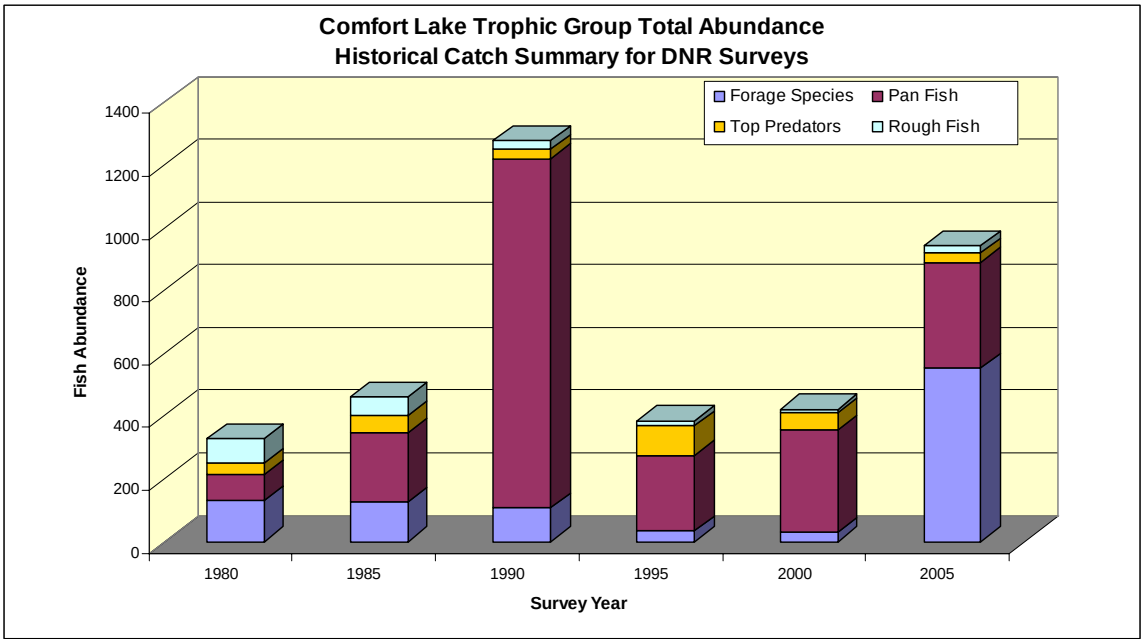
**: Plants were classified as either Abundant, Common, Occasional, Rare, or Present in DNR Survey.
The following numerical values were assigned to each category for display purposes.
Abundant = 80% , Common = 50%, Occasional = 25%, Rare = 10%, Present = 5%

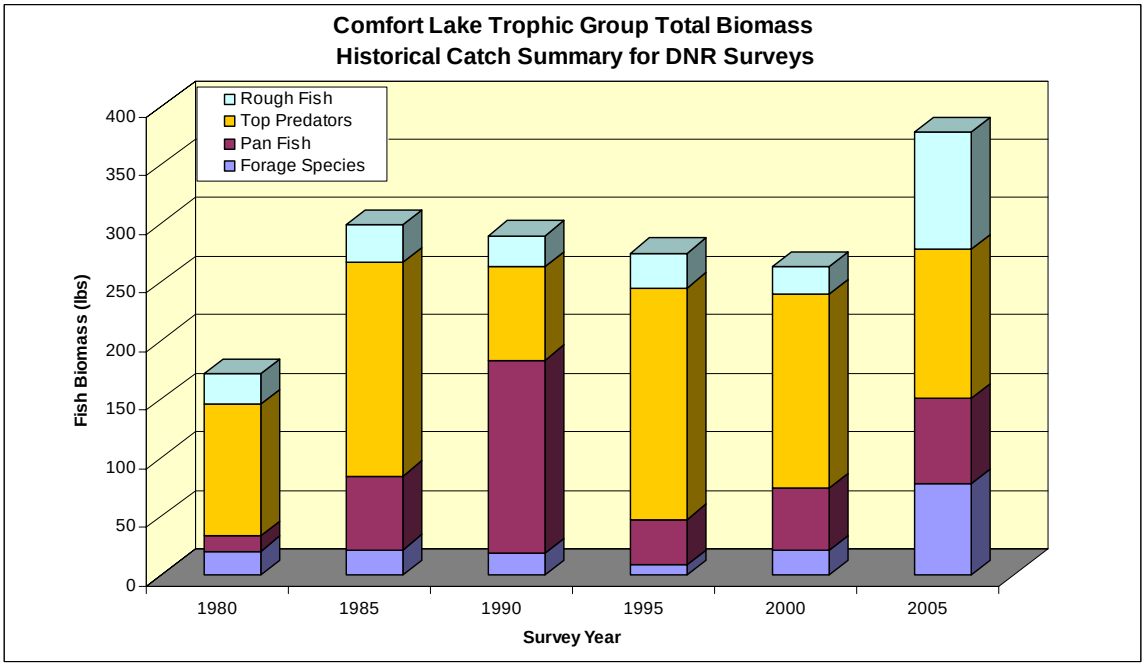


Comfort Lake


Comfort Lake Species Total Abundance
Historical Catch Summary for DNR Surveys
800
700
600
500
400
300
200
100
0
1980
1985
1990
1995
2000
2005
Survey Year
Black Bullhead
Black Crappie
Bluegill
Brown Bullhead
Northern Pike
Walleye
Yellow Perch
Pumpkinseed


Comfort Lake Species Total Biomass
Historical Catch Summary for DNR Surveys
180
160
140
120
100
80
60
40
20
0
1980
1985
1990
1995
2000
2005
Survey Year
Black Bullhead
Black Crappie
Bluegill
Brown Bullhead
Northern Pike
Walleye
Yellow Perch
Pumpkinseed


Comfort Lake Trophic Group Total Abundance
Historical Catch Summary for DNR Surveys
Forage Species
Pan Fish
Top Predators
Rough Fish
Fish Abundance
0
200
400
600
800
1000
1200
1400
1980
1985
1990
1995
2000
2005
Survey Year


Comfort Lake Trophic Group Total Biomass
Historical Catch Summary for DNR Surveys
Rough Fish
Top Predators
Pan Fish
Forage Species
Fish Biomass (lbs)
0
50
100
150
200
250
300
350
400
1980
1985
1990
1995
2000
2005
Survey Year

Species	Plant Type	1990 - Spring DNR	2000 -Fall DNR	2006 - Spring WCD[2]	2006 - Fall WCD[2]
Blue Flag Iris	Emergent	Common	Present	Not Observed	Not Observed
Blue Joint	Emergent	Abundant	Not Observed	Not Observed	Not Observed
Common Cattail	Emergent	Common	Rare	Common	Common
Bulrush sp.	Emergent	Not Observed	Present	Present	Rare
Horsetail	Emergent	Rare	Not Observed	Not Observed	Not Observed
Narrowleaf Arrowhead	Emergent	Not Observed	Present	Not Observed	Not Observed
Narrowleaf Cattail	Emergent	Not Observed	Occasional	Not Observed	Not Observed
Needlerush	Emergent	Present	Not Observed	Not Observed	Not Observed
Reed Canary Grass	Emergent	Present	Common	Not Observed	Not Observed
Sedges	Emergent	Not Observed	Rare	Not Observed	Not Observed
Skullcap sp.	Emergent	Occasional	Present	Not Observed	Not Observed
Smartweed	Emergent	Not Observed	Present	Not Observed	Not Observed
Swamp Milkweed	Emergent	Not Observed	Rare	Not Observed	Not Observed
Watermeal	Emergent	Not Observed	Not Observed	Not Observed	Not Observed
Lesser Duckweed	Floating Leaf	Occasional	Present	Not Observed	Not Observed
White Waterlily	Floating Leaf	Common	Rare	Common	Common
Spatterdock	Floating Leaf	Abundant	Common	Abundant	Abundant
Canada WaterWeed	Submergent	Occasional	Present	Not Observed	Not Observed
Coontail	Submergent	Abundant	Present	Occasional	Rare
Curly Leaf Pondweed	Submergent	Not Observed	Present	Abundant	Rare
Flatstem Pondweed	Submergent	Not Observed	Present	Present	Present
Illinois Pondweed	Submergent	Not Observed	Not Observed	Present	Present
Largeleaf Pndweed	Submergent	Common	Present	Rare	Not Observed
Leafy Pondweed	Submergent	Not Observed	Not Observed	Occasional	Not Observed
Narrowleaf Pondweed	Submergent	Not Observed	Present	Not Observed	Not Observed
Northern Water Milfoil	Submergent	Occasional	Present	Common	Rare
Sago Pondweed	Submergent	Not Observed	Occasional	Abundant	Present

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