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Ecosystems and Oceans Science / Sciences des écosystèmes et des océans

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LAKE WHITEFISH (*COREGONUS CLUPEAFORMIS*) STOCK ASSESSMENT FOR GREAT SLAVE LAKE, 2022

CONTEXT

Fisheries and Oceans Canada (DFO) Fisheries Management requested that the Lake Whitefish (*Coregonus clupeaformis*) stocks of Great Slave Lake (GSL) be reviewed to assess trends in harvest, catch effort, and biological indicators, incorporate these data into population models to estimate time-series for stock status, calculate the population abundance/biomass and sustainable harvest levels, and evaluate candidate reference points (Limit Reference Point and Upper Stock Reference) and associated uncertainties consistent with DFO's Precautionary Approach Framework (DFO 2009, 2013, 2021, 2023a).

This Fisheries Science Advisory Report is from the regional peer review meeting of May 22–24, 2024 on Stock Assessment for Lake Whitefish (*Coregonus clupeaformis*) and Lake Trout (*Salvelinus namaychus*) in Great Slave Lake, Northwest Territories, 2022. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

SCIENCE ADVICE

Status

- The Lake Whitefish stock biomass in the Main-Basin (MB) of GSL, including Fisheries Management Areas (FMAs) IW, IE, II, III, IV and V, is currently considered above the proposed limit reference point (LRP = 7,222 tonnes [t]) and above the upper stock reference (USR = 14,444 t), placing it in the Healthy Zone with a 1% likelihood of being in the Cautious Zone.
- FMA IW stock biomass is currently above the proposed LRP = 1,465 t and above the USR = 2,930 t, placing it in the Healthy Zone with a 1% likelihood of being in the Cautious Zone.
- FMA IE stock biomass is currently above the proposed LRP = 1,397 t and above the USR = 2,795 t, placing it in the Healthy Zone with a 1% likelihood of being in the Cautious Zone.
- FMA II stock biomass is currently above the proposed LRP = 1,445 t and above the USR = 2,910 t, placing it in the Healthy Zone with a 1% likelihood of being in the Cautious Zone.
- FMA III stock biomass is currently above the proposed LRP = 207 t and above the USR = 413 t, placing it in the Healthy Zone with a 1% likelihood of being in the Cautious Zone.
- FMA IV stock biomass is currently above the proposed LRP = 932 t and above the USR = 1,864 t, placing it in the Healthy Zone with a 1% likelihood of being in the Cautious Zone.
- FMA V stock biomass is currently above the proposed LRP = 1,426 t and above the USR = 2,852 t, placing it in the Healthy Zone with a 1% likelihood of being in the Cautious Zone.
- FMA VI has been closed to commercial fishing since 1974 and was not assessed.

Trends

- Mean Catch-per-Unit Effort (CPUE) was slightly higher in the fishery-independent survey (FIS) data (2011-2019 and 2022), compared to those from fishery-dependent surveys (FDS) in 1973–1974, 1977–1989 and 1996, especially in FMAs III, IV and V.
- CPUE for Lake Whitefish was high in 2022, likely due to decreased fishing effort and harvest since 2008, exacerbated by historic low commercial fishing efforts since 2020.
- Mean weight and length have not changed significantly in the FIS (2011–2019 and 2022). The mean age was stable in FMA IW and increasing in FMA IE; both areas had ages older than their respective mean ages from 1973 to 2022.
- The biological trends of increasing both CPUE and mean age were likely due to decreased fishing effort and harvest between 2008 and 2022.
- There was a steady increase in biomass between 1998 and 2022 in the Main Basin;
- The relative annual contribution of Lake Whitefish to the total commercial harvest decreased from 79% in 2012 to 43% in 2022.

Ecosystem and Climate Change Considerations

- GSL experiences significant seasonal and annual fluctuations in water levels, discharge, and biological productivity, which are closely associated with climate change (e.g., variable precipitation, increased temperature-driven evaporation) and water regulation for electricity generation.
- The Slave River is responsible for > 77% of the water inflow into GSL. Since 1972, winter runoff inputs have gradually increased, while summer inflows have significantly decreased, likely due to climate change. Changes in inflow affect the availability of overwintering, summer feeding, and fall spawning habitats as well as biological productivity in the lake.
- Significantly rising temperatures, reduced ice-covered period, and condensed spring melt may diminish the quantity and quality of overwintering and nursery habitats, especially for early life history stages, which can directly affect egg survival and growth of the recruiting juvenile fish.
- Current and anticipated changes in the environmental variables may impact the biological characteristics, quantity and quality of habitats as well as cascading effects in the trophic connections of adult Lake Whitefish (DFO 2015, Zhu et al. 2016).
- Due to the nature of their life history, river-spawning populations are expected to be the first impacted by changes to ice-cover formation and break-up timing, as well as misaligned spawning and hatch/emergence timing.
- There has been an observed shift toward smaller phytoplankton species with climate change. This may affect the dominant zooplankton species within the lake, causing a cascading effect that extends to higher trophic levels, including fish.

Stock Advice

- Although Lake Whitefish stock and exploitation statuses within all FMAs are currently in the Healthy Zone, Total Allowable Harvest (TAH) combined with Lake Trout exceeds Lake Whitefish MSY for FMAs IE, IV, V and MB.

- Lake Whitefish in GSL would benefit from being managed under a separate commercial TAH rather than as combined with Lake Trout. This is due to the differences in demographic characteristics, life histories, habitat characteristics, resilience to exploitation, and vulnerability to environmental changes. Moreover, both species currently hold different positions in the Precautionary Approach Framework.
- FMA-specific TAH should be based on the combination of B_{MSY} and F_{MSY} estimates of the respective FMA, current stock biomass, and according to the DFO Precautionary Approach Framework (DFO 2009). This fishery would benefit from the future development of Harvest Control Rules (HCRs).
- Biological Reference Points (BRPs) obtained from this process should be a starting point for the current stock status. In consideration of Lake Whitefish biology (e.g., age at maturity = 5 years) and the Government of Northwest Territories Revitalization Strategy, GSL Lake Whitefish stocks should be fully assessed at least every 5 years. Annual update assessments should also be conducted to monitor for any precipitous shifts of sensitive indicators, which could trigger an earlier full assessment, in respective FMAs.

BASIS FOR ASSESSMENT

Assessment Details

Year Assessment Approach was Approved

Approved in Multi-Species Stock Assessment Framework for GSL, March 14–15, 2023 (Zhu et al. In prep.[1]).

Assessment Type

Full Assessment

Most Recent Assessment Date

1. Last Full Assessment: January 26–27, 2011 (DFO 2015) and April 25–26, 2013 (DFO 2023b).
2. Last Interim-Year Update: May 22–24, 2024

Stock Assessment Approach

1. Broad category: Data-moderate (JABBA), a typical state-space Bayesian surplus production model (BSM).
2. Specific category: Index-based (including fishery-dependent and fishery-independent indices) and Surplus Production.

The assessment of Lake Whitefish stocks in GSL was conducted using quantitative stock assessment models to estimate key population dynamics indicators, including biomass (B), fishing mortality (F), Maximum Sustainable Yield (MSY), biomass at MSY (B_{MSY}), and fishing mortality at MSY (F_{MSY}). These model parameters were applied to generate a set of BRPs, such as LRP, set at 40% of B_{MSY}, and USR, set at 80% of B_{MSY}, which were compliant with the DFO

[1] Zhu, X., Malley, B.K., Alsip, L.E., and Connolly, T.J. In prep. Identifying good practices for the development of fisheries assessment and management framework for Lake Whitefish in Great Slave Lake, Northwest Territories, Canada. DFO Can. Sci. Advis. Sec. Res. Doc.

Precautionary Approach Framework (DFO 2009, 2021, 2023a). The removal rate (RR), based on F_{MSY}, was calculated to evaluate whether current harvest levels are within sustainable limits.

Stock Structure Assumption

Recent research combining genomic analysis, otolith shape studies, and ecological data revealed that Lake Whitefish in GSL are composed of multiple, distinct population units. Preliminary otolith shape analysis has elucidated the presence of at least three putative ecotypes, while a genomic study has uncovered the existence of at least eight genetically distinct populations. These results support significant intraspecific diversity in Lake Whitefish populations that could reflect diverging habitat use and biological traits across the lake. This assessment assumes that several distinct or mixed stocks support the fishery within the MB. While more than one stock may contribute to catches in a given FMA, most harvest within each FMA likely comes from a single dominant stock.

Reference Points

A target reference point (TRP) is a benchmark for the ideal condition of a fish stock, representing a biomass or fishing level that balances biological sustainability with economic, social, and ecological goals through effective fisheries management. Produced by the stock assessment models, a TRP outlines the optimal fishing rate (F_{MSY}) that supports healthy stock levels (B_{MSY}) to meet the management target, MSY. The DFO's PA Policy guidance (DFO 2009, 2021, 2023a) provides practical criteria for applying the TRP to estimate the default values of LRP, USR, and RR. All the estimated TRP and BRPs for Lake Whitefish in GSL are summarized in Table 1 and 2.

Table 1. Lake Whitefish target reference point (TRP) parameters include the maximum sustainable yield (MSY, t), biomass (B_{MSY}, t) and fishing mortality rate (F_{MSY}, per year) at MSY. The TRP parameters are reported as medians with 95% credible intervals of lower (LCI) and upper (UCI) values by Fisheries Management Area (FMA) and for the entire Main Basin (MB) in Great Slave Lake.

FMA	MSY			B_{MSY}			F_{MSY}		
	Median	LCI	UCI	Median	LCI	UCI	Median	LCI	UCI
IW	331	170	1,726	3,662	1,683	19,331	0.0910	0.0510	0.1650
IE	269	126	1,473	3,494	1,474	18,798	0.0780	0.0460	0.1320
II	499	174	2,589	3,637	1,245	18,359	0.1390	0.0770	0.2510
III	73	33	269	516	188	1,631	0.1470	0.0750	0.2890
IV	337	192	1,578	2,330	1,190	9,980	0.1470	0.0710	0.3020
V	265	88	1,789	3,565	1,192	26,906	0.0730	0.0420	0.1280
MB	1,412	886	4,036	18,054	10,581	51,752	0.0780	0.0450	0.1350

Table 2. Biological reference points (BRPs) include limit reference point (LRP, t), upper stock reference (USR, t), removal rate at LRP (RR_{LRP}) and USR (RR_{USR}) for Lake Whitefish in GSL. The TRP parameter MSY (Table 1) was compared with the current total allowable harvest (TAH, t) by Fisheries Management Area (FMA) and for the entire Main Basin (MB) in Great Slave Lake, as a percentage of Maximum Sustainable Yield (%MSY).

FMA	LRP	USR	RR_{LRP}	RR_{USR}	TAH	%MSY
IW	1,465	2,930	0.0364	0.0728	227	68.64
IE	1,397	2,795	0.0312	0.0624	318	118.09
II	1,455	2,910	0.0556	0.1112	318	63.75
III	207	413	0.0588	0.1176	46	63.10
IV	932	1,864	0.0588	0.1176	409	121.42
V	1,426	2,852	0.0292	0.0584	364	137.26
MB	7,222	14,444	0.0312	0.0624	1,682	119.11

Data

Harvest Data (1945–2022): The fish plants have provided commercial harvest records as round weights. Harvest data was reported in the entire MB between 1945 and 1972. Since 1973, DFO has implemented FMA regulations to track the variations in the biological characteristics, commercial harvest, and enforcement of conservation and protection actions.

Biological Data (1973–2022): Since 1973, biological information, including age, growth, mortality, and relative abundance (a proxy of CPUE), has been routinely collected through the implementation of several fishery-dependent survey (FDS) programs (DFO 2015). Since 2011, a fishery-independent gillnet-based study (FIGS) program has been carried out to monitor the relative abundance and biomass of multispecies in different FMAs of GSL (DFO 2023b, Zhu et al. 2024).

ASSESSMENT

The population biomass dynamics of Lake Whitefish were quantitatively assessed by the FMA and basin to demonstrate the significant spatiotemporal differentiation in the commercial harvest, biomass, fishing mortality, and stock and exploitation status in GSL (Figure 1–7).

Biomass

Lake Whitefish biomass in GSL varies across FMAs and basins, but the stocks remain healthy. In the Western Basin (FMAs IW and IE), biomass has steadily increased since 2008 due to reduced fishing pressure, and by 2022, both areas were well above the USR, firmly within the Healthy Zone. Trends in the Central Basin (FMAs II and III) are more varied. FMA II has remained stable near its sustainable level (B_{MSY}), while FMA III is recovering more slowly following past overfishing, though improvement has been evident since 2006. In the Northern Basin (FMAs IV and V), biomass has remained stable or increased since 1998. FMA IV holds some of the highest biomass levels in the lake, while FMA V, though lower, remains above the USR. For the Main Basin, biomass in 2022 was estimated at 18,054 t, placing the stock solidly in the Healthy Zone.

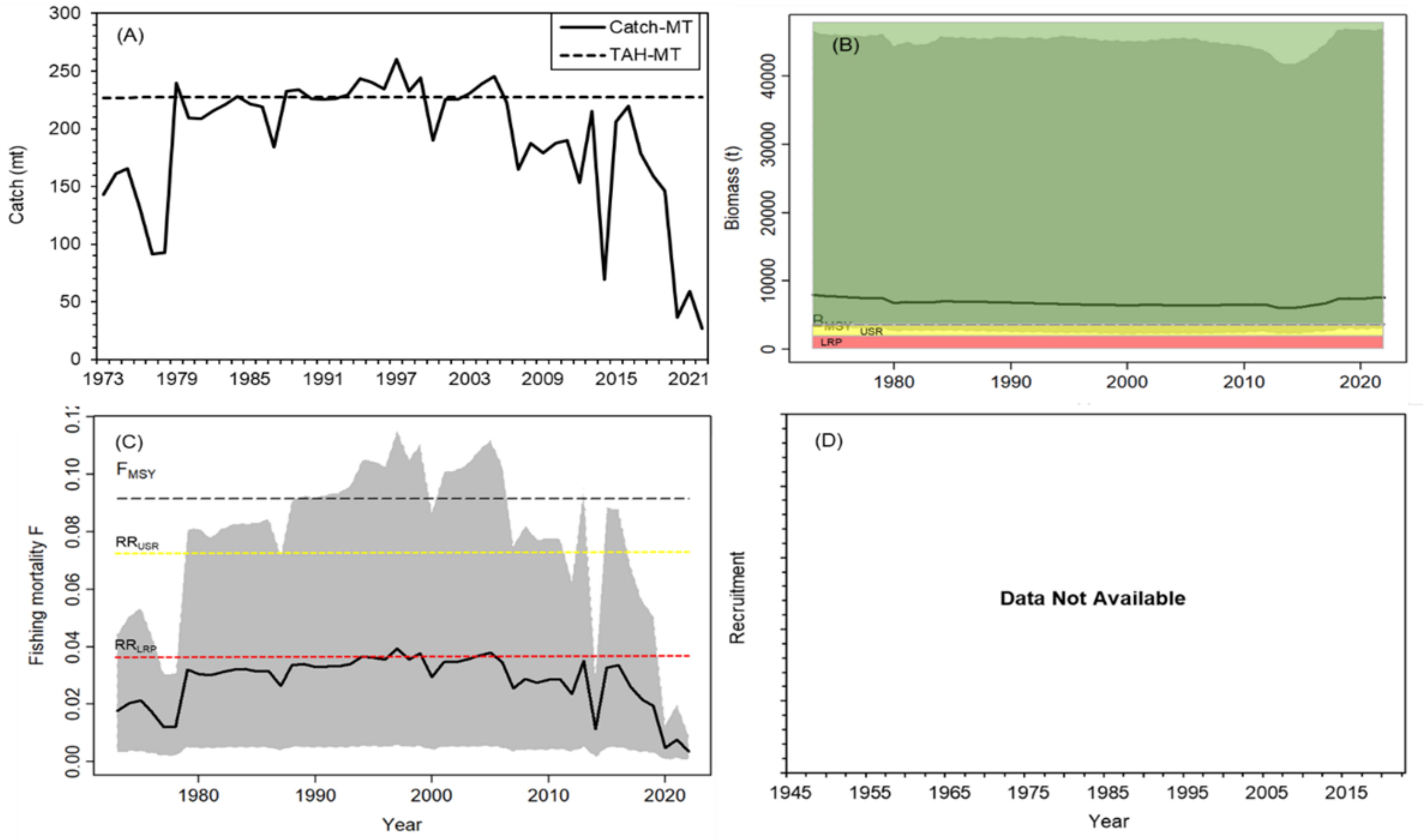

Figure 1. Lake Whitefish stock assessment of A) catch and total allowable harvest (TAH, mt), B) Stock Biomass (t) showing the Upper Stock Reference (USR, yellow), Limit Reference Point (LRP, red), and Biomass at Maximum Sustainable Yield (B_{MSY}, green), C) fishing mortality at MSY (F_{MSY}, black dash line), Removal Rates at LRP ($RR_{LRP,}$ yellow dash line), and USR ($RR_{USR,}$ red dash line), and D) recruitment for the species in Fisheries Management Area IW (Western Basin).

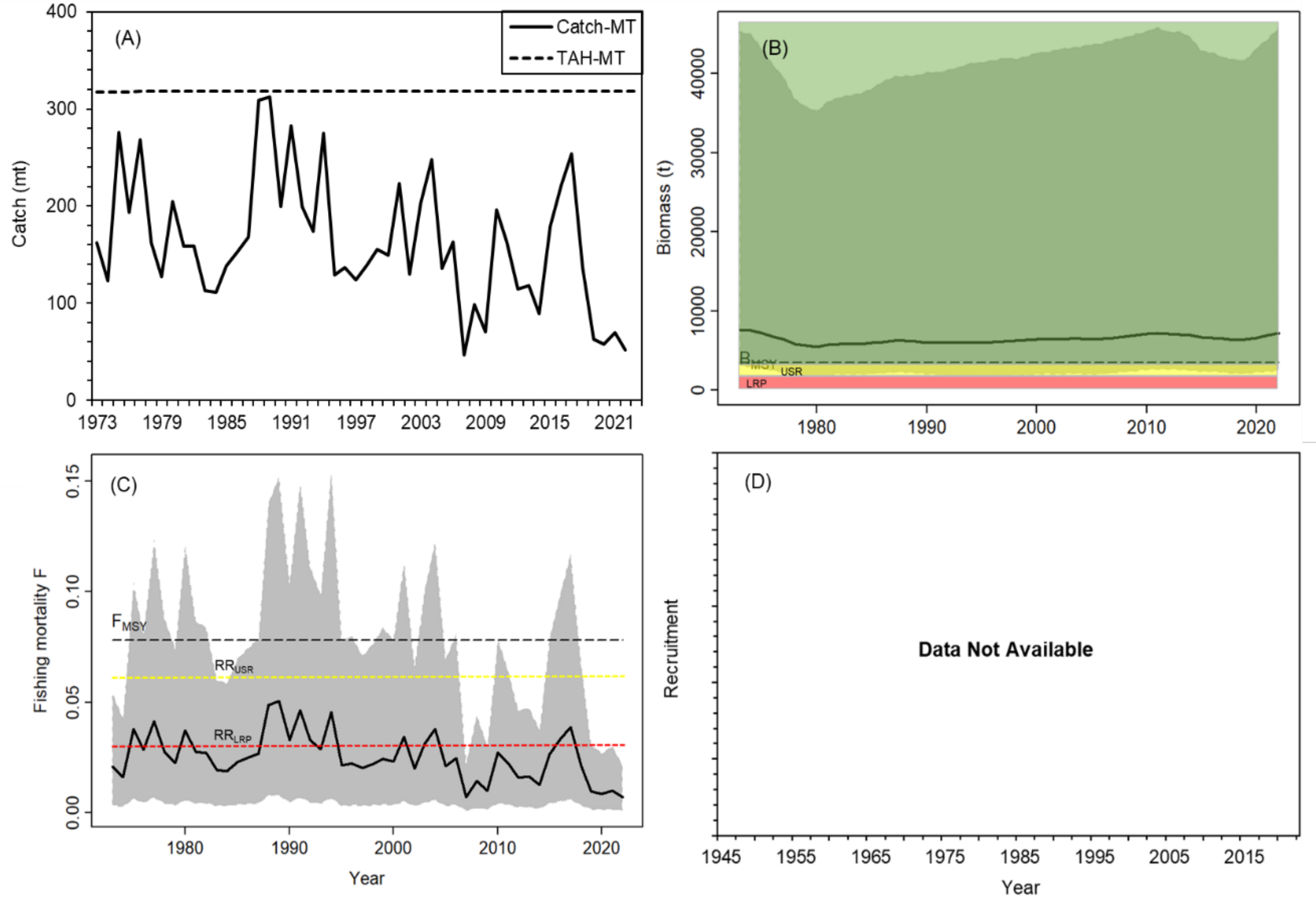

Figure 2. Lake Whitefish stock assessment of A) Catch and total allowable harvest (TAH, mt), B) Stock Biomass (t) showing the Upper Stock Reference (USR, yellow), Limit Reference Point (LRP, red), and Biomass at Maximum Sustainable Yield (B_{MSY}, green), C) fishing mortality at MSY (F_{MSY}, black dash line), Removal Rates at LRP (RR_{LRP}, yellow dash line), and USR (RR_{USR}, red dash line), and D) recruitment for the species in Fisheries Management Area IE (Western Basin).

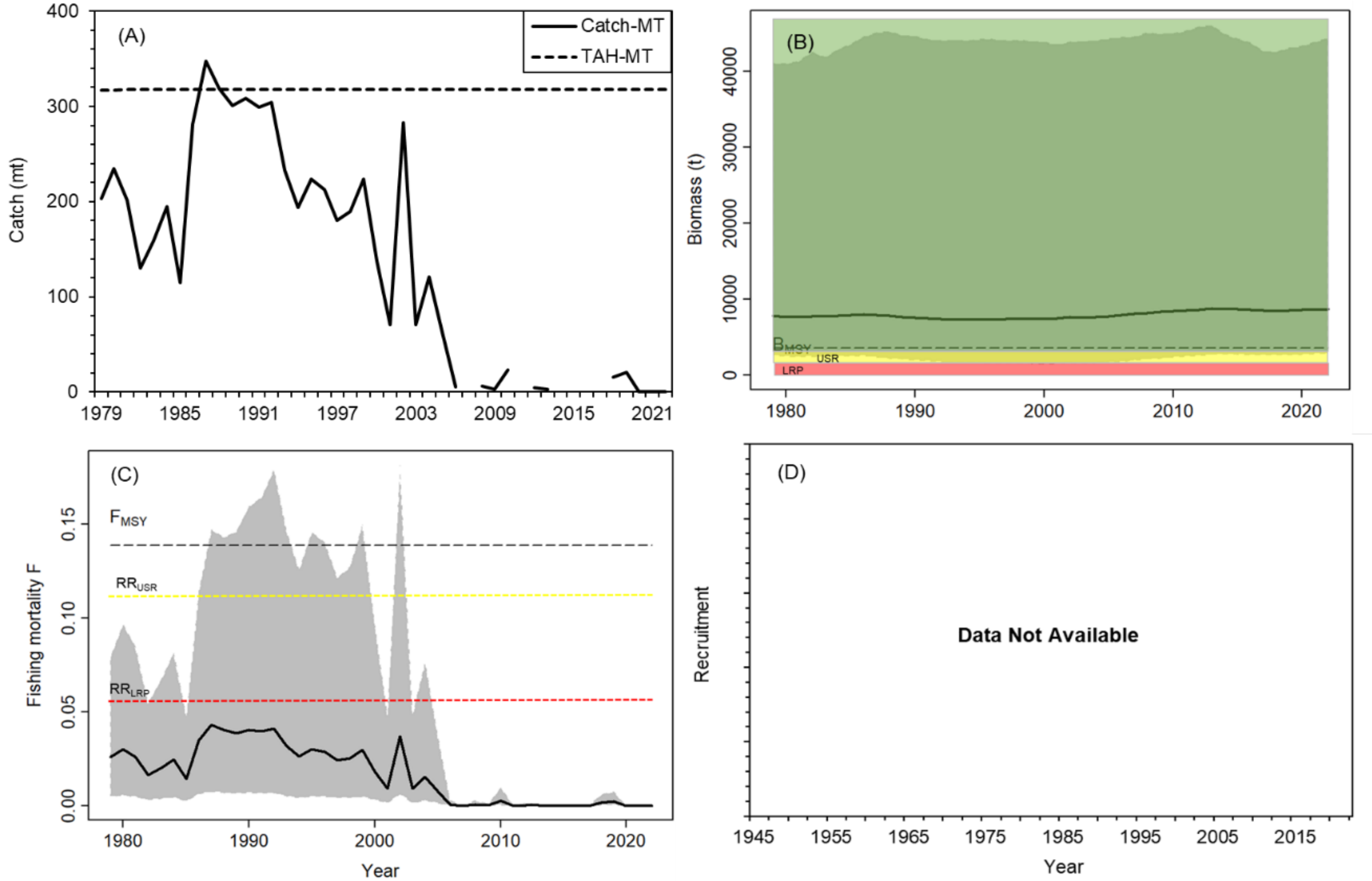

Figure 3. Lake Whitefish stock assessment of A) Catch and total allowable harvest (TAH, mt), B) Stock Biomass (t) showing the Upper Stock Reference (USR, yellow), Limit Reference Point (LRP, red), and Biomass at Maximum Sustainable Yield (B_{MSY}, green), C) fishing mortality at MSY (F_{MSY}, black dash line), Removal Rates at LRP (RR_{LRP}, yellow dash line), and USR (RR_{USR}, red dash line), and D) recruitment for the species in Fisheries Management Area II (Central Basin).

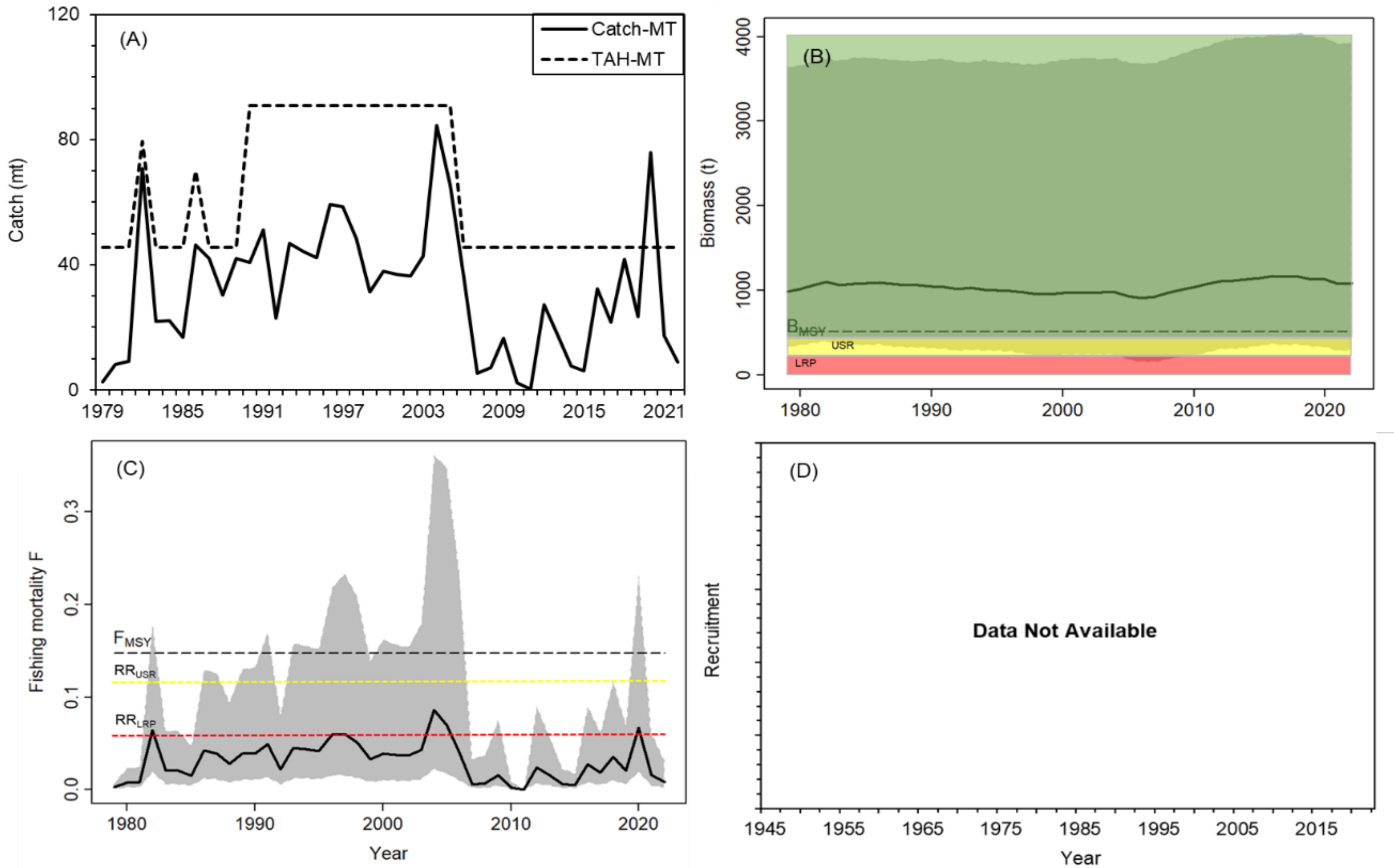

Figure 4. Lake Whitefish stock assessment of A) Catch and total allowable harvest (TAH, mt), B) Stock Biomass (t) showing the Upper Stock Reference (USR, yellow), Limit Reference Point (LRP, red), and Biomass at Maximum Sustainable Yield (B_{MSY}, green), C) fishing mortality at MSY (F_{MSY}, black dash line), and Removal Rates at LRP (RR_{LRP}, yellow dash line), and USR (RR_{USR}, red dash line), and D) recruitment for the species in Fisheries Management Area III (Central Basin).

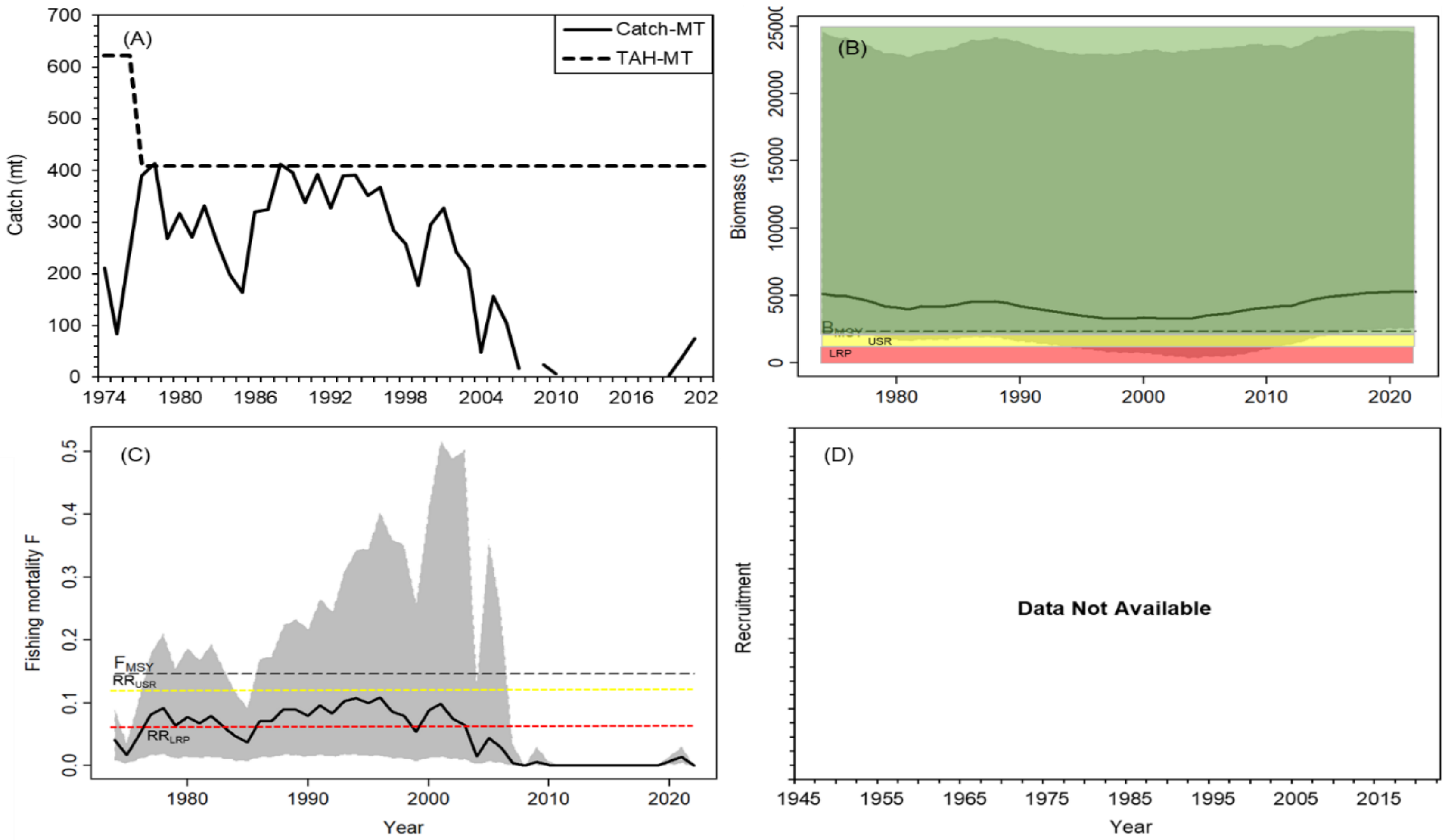

Figure 5. Lake Whitefish stock assessment of A) Catch and total allowable harvest (TAH, mt), B) Stock Biomass (t) showing the Upper Stock Reference (USR, yellow), Limit Reference Point (LRP, red), and Biomass at Maximum Sustainable Yield (B_{MSY}, green), C) fishing mortality at MSY (F_{MSY}, black dash line), Removal Rates at LRP (RR_{LRP}, yellow dash line), and USR (RR_{USR}, red dash line), and D) recruitment for the species in Fisheries Management Area IV (Northern Basin).

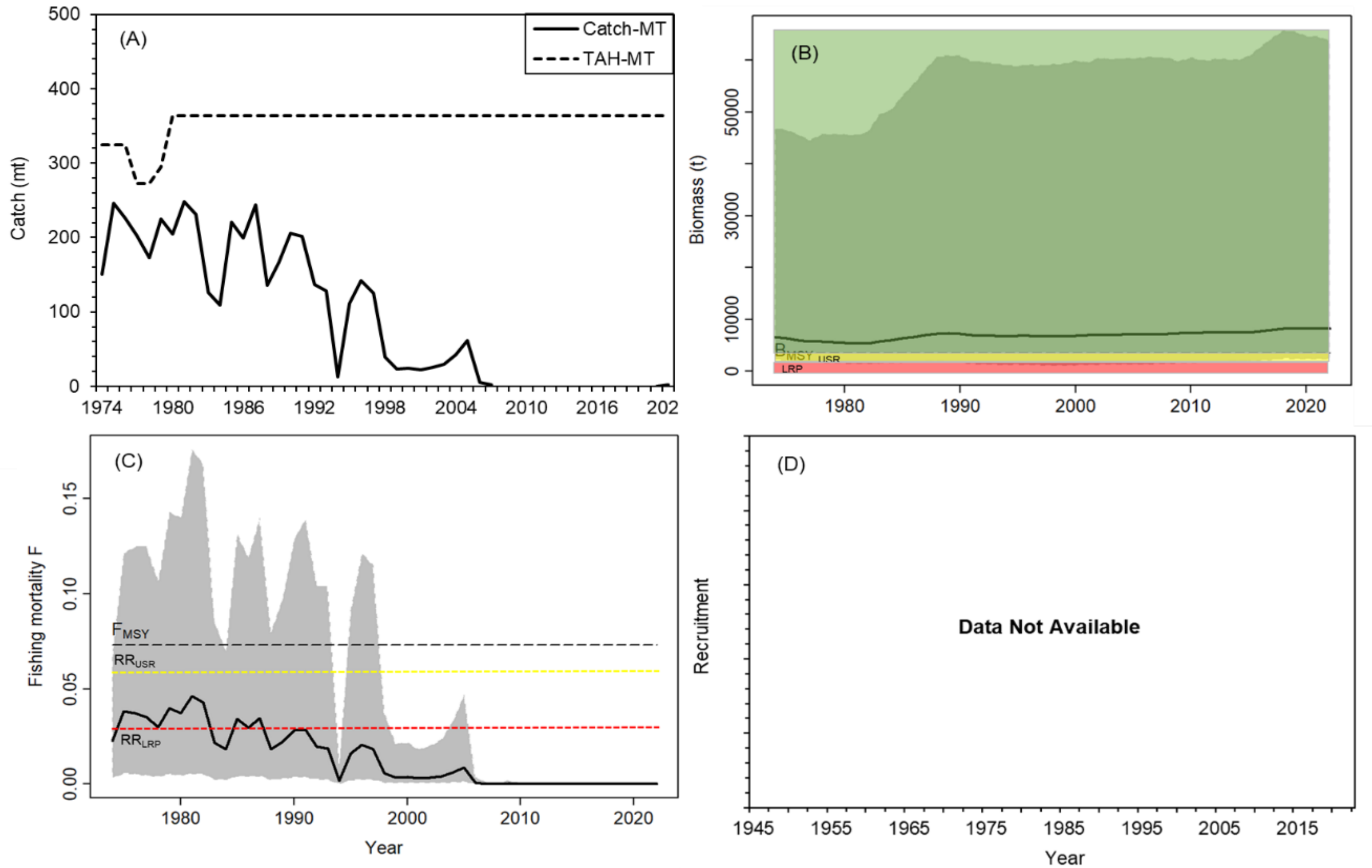

Figure 6. Lake Whitefish stock assessment of A) Catch and total allowable harvest (TAH, mt), B) Stock Biomass (t) showing the Upper Stock Reference (USR, yellow), Limit Reference Point (LRP, red), and Biomass at Maximum Sustainable Yield (B_{MSY}, green), C) fishing mortality at MSY (F_{MSY}, black dash line), Removal Rates at LRP (RR_{LRP}, yellow dash line), and USR (RR_{USR}, red dash line), and D) recruitment for the species in Fisheries Management Area V (Northern Basin).

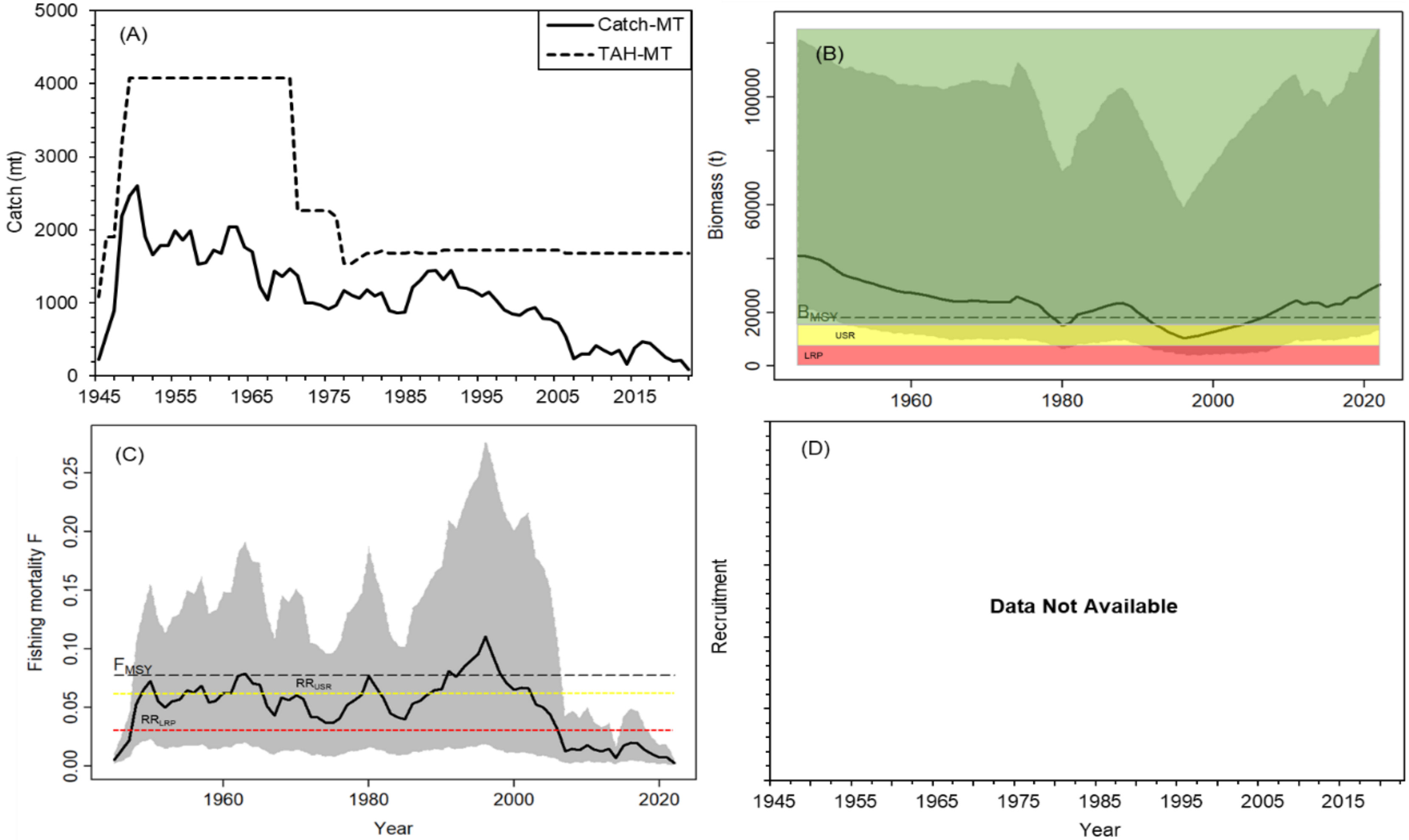

Figure 7. Lake Whitefish stock assessment of A) Catch and total allowable harvest (TAH, mt), B) Stock Biomass (t) showing the Upper Stock Reference (USR, yellow), Limit Reference Point (LRP, red), and Biomass at Maximum Sustainable Yield (B_{MSY}, green), C) fishing mortality at MSY (F_{MSY}, black dash line), Removal Rates at LRP (RR_{LRP}, yellow dash line), and USR (RR_{USR}, red dash line), and D) recruitment for the species in the Main Basin (Fisheries Management Areas IW, IE, II, III, IV and V) in Great Slave Lake.

Fishing Mortality

Fishing pressure on Lake Whitefish varies across Great Slave Lake FMAs but remains within sustainable limits. In the Western Basin (FMAs IW and IE), fishing mortality has stayed below the sustainable fishing mortality threshold (F_{MSY}) since 2008. In the Central Basin, trends are mixed. FMA II experienced a decline in fishing pressure after 2005, supporting stock recovery, while FMA III had brief periods of overfishing in 2005 and 2020. Recent fishing levels in FMA III are now below F_{MSY}, indicating progress toward sustainability. In the Northern Basin (FMAs IV and V), fishing mortality has remained very low since 2005, supporting stable or improving stock conditions. Overall, fishing mortality across the Main Basin remains well below the F_{MSY} benchmark, indicating that current harvest levels are sustainable.

Spawning stock biomass

Lake Whitefish recruitment in GSL has been generally stable, with encouraging signs of recovery in recent years. In the Western Basin (FMAs IW and IE), recruitment has remained steady or increased since 2012, likely driven by reduced fishing pressure and improved spawning conditions (Figure 8). In the Central Basin, trends are more mixed. FMA II has shown gradual improvement, while FMA III continues to show variability, reflecting its sensitivity to past overfishing and changing environmental conditions. Recruitment in the Northern Basin (FMAs IV and V) remains strong, particularly in FMA IV, which consistently supports some of the highest biomass levels in the lake. Across the Main Basin, recruitment has been on an upward trend since 2005, supported by the fact that lower fishing effort can lead to maintaining stronger year-class survival.

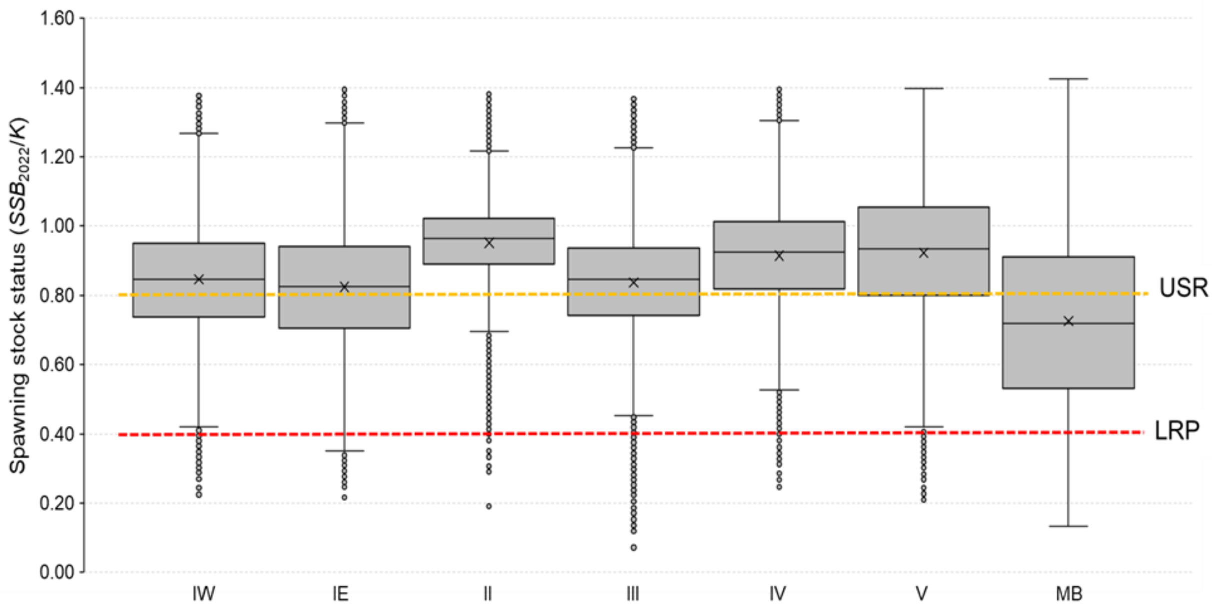

Figure 8. Comparison of current statuses of proxy spawning stock status (SSB_{2022}/K) with limit reference points (LRPs, red) and upper stock references (USRs, yellow) for Lake Whitefish by Fisheries Management Areas (x-axis) and the entire Main Basin of Great Slave Lake in 2022, derived from 25,000 Monte Carlo samples in the Pella-Tomlinson Bayesian state-space surplus production model.

Harvest

Harvest trends for Lake Whitefish in GSL have undergone significant changes over the decades. Commercial harvest peaked at 2,604 t in 1950 but has declined substantially since 2000, reaching a historic low of 90 t in 2022. The Western Basin (FMAs IW and IE) continues to support most Lake Whitefish harvest due to its proximity to fish processing facilities, with current harvest levels remaining below MSY and TAH. In the Central Basin, harvest has been minimal since 2006, particularly in FMA III, where fishing activity is low. The Northern Basin (FMAs IV and V) has experienced negligible harvests for over a decade, contributing to the fish biomass stability and recovery in these areas. Historically, Lake Whitefish has been the dominant species in GSL commercial fisheries.

Length and Age

Lake Whitefish in GSL show some spatiotemporal variation in average size and age across different FMAs, though overall trends have remained relatively stable over time (Zhu et al. 2016). Generally, fish in the Western Basin (FMAs IW and IE) tend to be younger and slightly smaller than those in more northern areas. For example, fish in FMA IW averaged around 12 years of age with a mean fork length of 439 mm, while in FMA IE, fish were slightly older at 15 years and somewhat smaller in size.

Moving toward the Central and Northern Basins, fish tend to be older, with average ages between 17 and 19 years and fork lengths generally ranging from 423 to 428 mm. FMA IV, in particular, had the oldest average age observed. These patterns suggest that fish in less-harvested areas may live longer, potentially due to lower fishing pressure.

Despite some year-to-year fluctuations, there is no clear overall trend in length or age within any single FMA. Instead, the data show a consistent mix of younger and older fish across FMAs, with no dominant age class prevailing. This variability indicates a relatively balanced age structure, which is vital for the long-term sustainability of the population.

History of Management

The management of Lake Whitefish fisheries in GSL has evolved to balance commercial fishing with a conservation target. In 1949, a combined TAH of 4,082.9 t for Lake Whitefish and Lake Trout was introduced. However, as Lake Trout populations declined, management efforts focused more specifically on Lake Whitefish. In the 1970s, current FMA boundaries were established, and FMA-specific TAHs were introduced to improve oversight and sustainability.

Since 1972, the Lake Whitefish fishery has been operated under both FMA-specific TAHs and gillnet regulation conditions. By the 1990/91 fishing season, FMAs IW, IE, II, III, and IV TAHs applied exclusively to Lake Whitefish, while FMA V maintained a combined quota for both Lake Whitefish and Lake Trout. The closure of the Simpson Islands fish plant in 1991 due to high transport costs marked a shift in commercial activity within FMA V. Gear regulations have also changed over time. Bottom-set gillnets with 140 mm mesh were initially used, but in 1977, the minimum mesh size was reduced to 133 mm to target younger fish and improve catch efficiency. This was reduced further to 127 mm in some areas in 1997 and expanded to the others by 2000, although most harvesters still use 133 mm mesh-sized gillnets to minimize fish entanglement. Overall, the management history of Lake Whitefish fisheries in GSL reflects a gradual shift toward more adaptive area-specific strategies, including changes to TAH and gear specification, to improve fishing efficiency while supporting long-term conservation goals.

Ecosystem and Climate Change Considerations

Lake Whitefish in GSL are increasingly affected by warming temperatures, reduced water inflow, and shifting ecosystem productivity. Seasonal declines in Slave River discharge due to warming, evaporation, and regulation have reduced nutrient inputs, especially those supporting zooplankton and benthos production, key food sources for Lake Whitefish in summer. As a result, the lake is becoming more nutrient-poor (oligotrophic).

Shorter ice cover and faster spring melt are degrading overwintering habitats, potentially impacting egg survival and juvenile growth. River-spawning populations may be the first to show biological changes, including shifts in maturity schedules, spawning timing, and reproduction potential.

Lake Whitefish rely on low-trophic food sources sensitive to environmental changes. Predators such as Lake Trout, Inconnu, Northern Pike, and other piscivores may also pose a predation risk and increase the vulnerability of Lake Whitefish during its early life stages. These rapid ecosystem shifts have highlighted the need for continued research to better understand the causal impacts of climate and ecosystem changes and guide adaptive management strategies.

SOURCES OF UNCERTAINTY

Several key uncertainties affect the performance of assessment and management for Lake Whitefish in GSL. One major challenge is inconsistent and incomplete data sources, either from FIS or FDS. Variations in fishing effort, gear types, vessel classes, and changes to FMA boundaries make it difficult to track trends and accurately assess stock status over the entire fisheries period.

Biological uncertainties also remain. Past ageing methods using fish scales need to be standardized with current otolith-based methods, and data on the size-at-maturity, spawning frequency, and fecundity are limited. Current mixed-stock assessments do not fully reflect the differences between Lake Whitefish populations or their specific contributions to the fishery.

Environmental changes further add uncertainty. Shifting climate conditions, such as reduced river flow, shorter ice cover season, and warming temperatures, alter habitat availability and quality, especially for spawning and overwintering. These changes also affect Lake Whitefish food sources, such as zooplankton and benthic invertebrate production.

Research Recommendations

Several research efforts are recommended to reduce the key uncertainties affecting Lake Whitefish assessment and management. First, continued data collection is needed to fill gaps in harvest, effort, abundance index, and biological records. This includes expanding monitoring programs, particularly in FMAs with limited spatial coverage, and analyzing logbooks and historical data to build a more complete time series. Standardizing ageing methods is also critical. Aligning historical scale-based data with current otolith-based techniques will improve age and growth estimates across FMAs and decades.

Detailed information on reproduction is essential for enhancing the capacity of quantitative fish population assessment models. Studies on the size-at-maturity, spawning frequency, and fecundity of the species will reduce uncertainties when modelling the fish recruitment and stock productivity. Continued genome research is also a priority. Expanding mixed-stock analysis using genomic methods by collecting new samples across all FMAs and analyzing archived material will help clarify the ecological evolution of the fish population structure and support more tailored management approaches.

Extending ongoing telemetry studies into adjacent river systems is recommended to improve understanding of fish movement and stock distribution. These efforts will help determine how different stocks contribute to the fishery and how they respond to harvest and climate change.

Finally, future quantitative stock assessment models should incorporate ecosystem variables to improve projections under changing environmental conditions. Complementary studies using an ecosystem approach are also needed to understand how regime shifts in supporting biological productivity and multispecies interactions affect the population productivity of Lake Whitefish and trophic connections in the GSL fisheries ecosystem.

LIST OF MEETING PARTICIPANTS

Name	Organization/Affiliation
Joclyn Paulic (Chair)	DFO – Science, Ontario and Prairie Region
Jackie Twilley (rapporteur)	DFO – Science, Ontario and Prairie Region
Jessica Mai (rapporteur)	DFO – Science, Ontario and Prairie Region
Muhammad (Yamin) Janjua	DFO – Science, National Capital Region
Ross Tallman	DFO – Science, Arctic Region
Daniel Enright	DFO – Science, Arctic Region
Chelsey Lumb	DFO – Science, Arctic Region
Brendan Malley	DFO – Science, Arctic Region
Xinhua Zhu	DFO – Science, Arctic Region
Kimberly Howland	DFO – Science, Arctic Region
Kevin Hedges	DFO – Science, Arctic Region
Hailey Chymy	DFO – Science, Arctic Region
Adam van der Lee	DFO – Science, Ontario and Prairie Region
Colin Gallagher	DFO – Science, Arctic Region
Laura Alsip	DFO – Science, Arctic Region
Julie Marentette (FSAR Support)	DFO – Science, National Capital Region
David Boguski	DFO – Fisheries Management, Arctic Region
Alexis Burt	DFO – Fisheries Management, Arctic Region
Michael Kee	DFO – Fisheries Management, Arctic Region
Sarah Lord	DFO – Fisheries Management, Arctic Region
Robert Young	DFO – Retired
Philippe Hénault	Université of Laval – Institut de Biologie Intégrative et des Systèmes (IBIS)
Julie Gibelli	Concordia University
Geoff Klein	Province of Manitoba
Irene Graham	Kátł'odeeche First Nation
Peter Sabourin	Kátł'odeeche First Nation, Commercial Harvester
Mike Low	Dehcho Dene First Nation – Management Program
Paul Vecsei	Tłı̨chǫ Government – Fisheries Biologist
Lloyd Jones	Northwest Territory Métis Nation/Current GSLAC Chair
Pete Cott	Government of Northwest Territories – Environment and Climate Change (GNWT-ECC)

SOURCES OF INFORMATION

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E-Mail: DFO.CACSA-CASCA.MPO@dfo-mpo.gc.ca
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