

Table iv.1. Color scheme for the Ecological Features of the ecosystem summary sheet and the corresponding criteria for assignment to each category for the status and trends. Contributing elements time series should be standardized to zero mean and unit standard deviation relative to an appropriate reference period.

	Ecological Features	
	Status	Trend
Green	The state over the last 5 years is consistent with conditions observed/estimated during high productivity/high resilience periods. (mean > 0.5 SD)	The trend over the last 5 years indicates consistent improving of the state/condition. (trend > 1 SD/5 y or >20% increase in state)
Yellow	The state over the last 5 years is consistent with conditions observed/estimated during average productivity/average resilience periods.	The trend over the last 5 years does not indicate any consistent change of the state/condition.
Red	The state over the last 5 years is consistent with conditions observed/estimated during low productivity/low resilience periods. (mean < -0.5 SD)	The trend over the last 5 years indicates consistent deterioration of the state/condition. (trend < -1 SD/5 y or >-20% decline in state)
Grey	Unknown - insufficient data to assess or assessment pending.	Unknown - insufficient data to assess or assessment pending.

Table iv.2. Color scheme for the Management Measures of the ecosystem summary sheet and the corresponding criteria for assignment to each category for the status and trends.

	Management Measures	
	Status	Trend
Green	Good. Current management measures are delivering the desired results.	Good. Management measures over the last 5 years are improving conditions; moving towards/maintaining the desired results.
Yellow	Uncertain. Current management measures appear to have limited ability to deliver the desired results.	Uncertain. Management measures over the last 5 years are not improving conditions; no clear movement towards achieving the desired results.
Red	Poor. Current management measures appear insufficient to deliver the expected results or no management measure is in place.	Poor. Management measures over the last 5 years are not effective or no management measure is in place; conditions are moving away/deteriorating from the desired results.
Grey	Unknown - insufficient data to assess or assessment pending.	Unknown - insufficient data to assess or assessment pending.

Grand Bank (3LNO) Ecosystem Summary Sheet

The Grand Bank (3LNO) EPU is currently experiencing low productivity conditions, with total EPU biomass well below pre-collapse levels (pre-1990s). Current reduced productivity appears associated with bottom-up processes. Ongoing warming trends together with increases in warm water species suggest that this ecosystem may be starting to undergo important structural changes. VME protection in this EPU has improved between 2019 and 2021, but only two VME types out of seven are well protected. Overall catch levels are consistent with current ecosystem productivity and the avoidance of high risk of ecosystem overfishing.

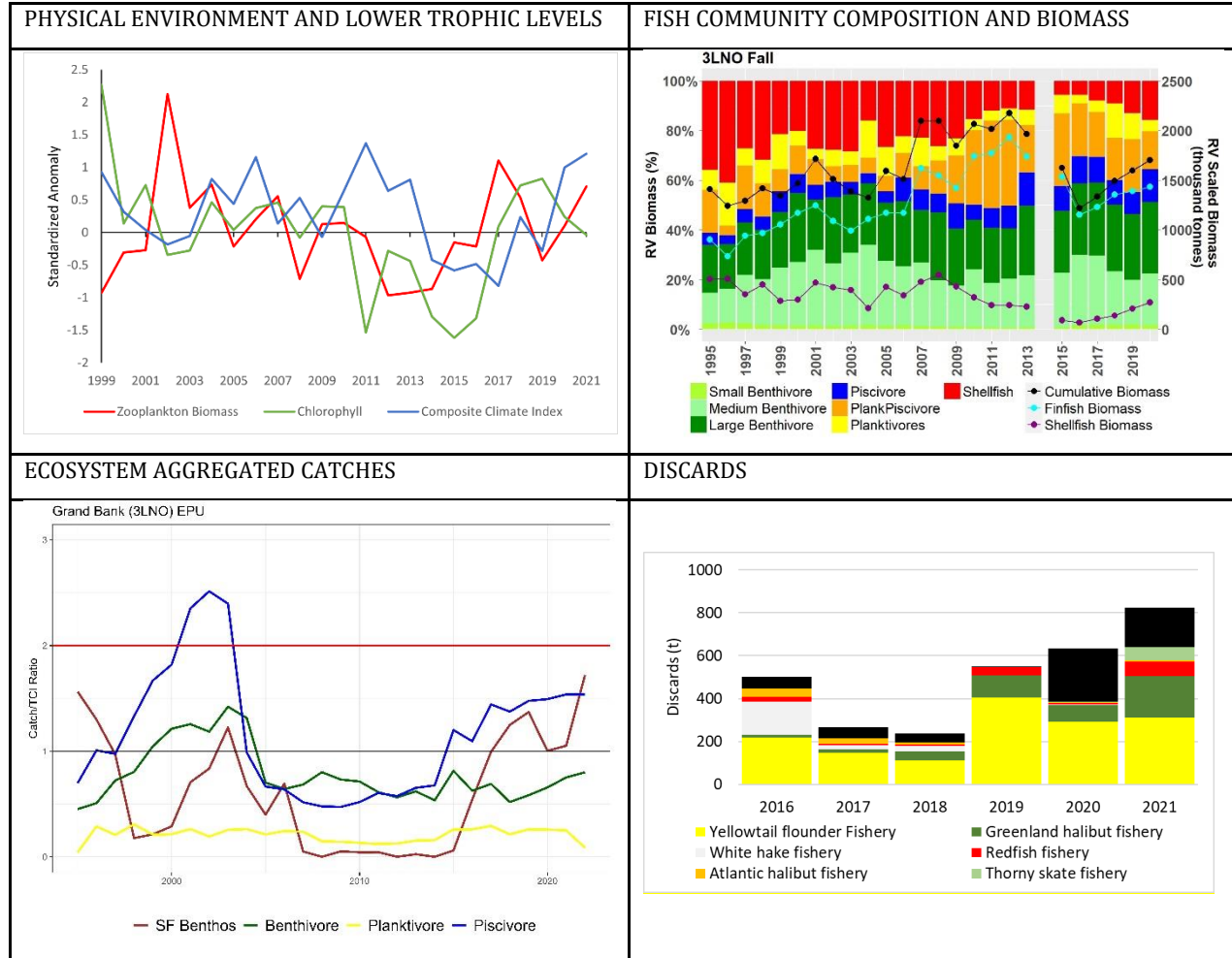
ECOLOGICAL FEATURES					
Convention Principle					Comment
A	Ecosystem status and trends (long-term sustainability)		Status (S)	Trend (T)	Summary of multiple trends/state
	1	Physical Environment			Ocean climate index above normal conditions in 2020-2021, with 2021 being the second highest value since 1999. Clear increasing trend over the last 5 years, from below normal conditions to above normal.
	2	Primary Productivity			Chlorophyll at normal level in 2021, recovered from a prolonged below normal state in 2013-2017. Indices are dominated by cyclic changes with no clear trend.
	3	Secondary Productivity			Zooplankton biomass above normal in 2021, recovered from below normal levels in 2011-2014. Indices are dominated by cyclic changes with no clear trend.
	4	Fish productivity			Total EPU biomass in 2020 from Canadian surveys increased from the lows in 2015-2016, but remains well below pre-collapse levels (pre-1990s). However, Spanish surveys indicate likely declines after 2020. Average weight of individuals by functional group in the survey has declined since the late 2000s and remains below normal for many functional groups.
	5	Community composition			Shellfish has increased in dominance in 2015-2020 after clear declines in previous years, but piscivores have yet to regain their pre-collapse dominance. There is an increase in warm water species like silver hake and Atlantic halibut.
B	Ecosystem productivity level and functioning		S	T	Summary of multiple trends/state
	1	Current Fisheries Production Potential			Total biomass density declined from ~40-50% to ~30% of the estimated pre-collapse (pre-1990s) level between 2014-2016. Some indications of improvement in 2019-2020, but lack of surveys prevents evaluating the progression of these changes.
	2	Status of key forage components			Reduced levels of capelin and shrimp, and near average levels of sand lance.
	3	Signals of food web disruption			Diet variable, declining trend in stomach content weights, with below normal levels since 2013.

E	State of biological diversity		S	T	Summary of multiple trends/state
	1	Status of VMEs	Yellow	Grey	Area and biomass of VMEs are considered to be at similar levels since the start of their assessments. Differences in estimates in the 2016-2021 period are due to improvements in the evaluation methods and availability of data.
	2	Status of non-commercial species	Yellow	Green	Based on 22 non-commercial species selected from the multispecies surveys, 60% of the species are above 20% of their historical maximum, an increase from around 50% in 2016.
MANAGEMENT MEASURES					
Convention Principle					Comment
C/D	Apply Precautionary Principle		S	T	Summary of metrics on level of management action
	1	Aggregate catches and risk of ecosystem overfishing (2TCI ecosystem reference point)	Yellow	Green	All catches are below 2TCI. Piscivore and Suspension Feeding Benthos catches are above 1TCI. Piscivore catches have been increasing since 2015.
	2	Multispecies and/or environmental interactions	Red	Red	No explicit consideration of species interactions and/or environmental drivers.
	3	Production potential of single species	Yellow	Yellow	Only 66% of NAFO managed stocks (8 out of 12) are in condition of supporting fisheries. Some stocks have declining trends or status unknown due to lack of recent survey information and/or absence of reference points.
D/E	Minimize harmful impacts of fishing on ecosystems		S	T	Summary of metrics on level of management action
	1	Level of protection of VMEs	Yellow	Green	All VMEs with some level of protection, but only two out of seven with good level of protection. Protection has improved between 2019 and 2022. Fishing with bottom contacting gears does not intrude in closed areas.
	2	Level of protection of exploited species	Yellow	Green	Ecosystem reference point to inform on ecosystem overfishing (2TCI) has been adopted. LRPs or HCRs are available for 80% of managed stocks. No multispecies assessments are in place.
D/F	Assess significance of incidental mortality in fishing operations		S	T	Summary of metrics on level of management action
	1	Discard level across fisheries	Yellow	Red	Total discards for the NRA show a significant increase in 2018-2021. While the greatest tonnage occurs in the yellowtail flounder fishery, most fisheries show increasing trends in discards. In terms of percentage of total catch from a fishery, the reported discards relative to total catch in 2016-2021 was less than 5% for the main fisheries (redfish, yellowtail flounder, Greenland halibut, thorny skate). However, Atlantic halibut and white hake fisheries had high discard levels (15-50%) in 2016-2018.

	2	Incidental catch of depleted and/or protected species, or other species of conservation interest			<p>By-catch of American plaice in the yellowtail fishery is a concern for the rebuilding of this stock.</p> <p>Wolffish are species at risk in Canada. Incidental catch of wolffishes in 3LNO fisheries in 2016-2021 in the NRA was low (less than 1% of survey biomass), oscillating without trend around a value of 33 t per year.</p> <p>Incidental catch of Greenland sharks in the NRA during the same period oscillated without trend around a value of 60 t per year. Special protection measures for this species are in place.</p>
OTHER CONSIDERATIONS (outside mandate of NAFO Convention)					
Human Activities other than fisheries			S	T	Comment
	1	Oil and gas activities			As of 2022, there are four offshore production fields on the Grand Bank and exploration activities along the Flemish Pass, eastern shelf break, and oceanic areas off the eastern shelf break. The total area for 3KLMNO of licenses ¹ has increased 16.3-fold from 2014 to 2021. There have been 12 reported incidents between 2015 and 2022, with a major oil spill in 2018, and one in 2019 that extended into the NRA. A proposed development project in the Flemish Pass overlaps with fishing grounds. It is expected, based on current exploration leases and development projections, that oil and gas exploration activities will continue to increase in the NRA.
	2	Pollution			The most recent information (up to 2017) indicates that there is low occurrence and density of litter in 3L and fisheries are the primary source from both NAFO-managed and non-NAFO managed fisheries. Data for more recent years has been collected in the EU surveys but has yet to be analyzed. Standardized protocols for litter data collection have been implemented in the EU surveys.
Fisheries not managed by NAFO			S	T	Comment
		Non-NAFO fisheries (coastal states and other RFMOs)			<p>Among the fisheries managed by Canada in this EPU, 70% are currently supporting fisheries, and 46% have Limit Reference Points. Lack of recent survey information represents a challenge for stock-assessments.</p> <p>Swordfish and tuna fisheries operate in this EPU under ICCAT jurisdiction.</p>
		Level of protection of VMEs (coastal states and other RFMOs)			Only coral and sponge VMEs are considered for protection under Canadian regulations. Among the VMEs present and covered by these regulations most have some level of protection, and one is unprotected.

¹ License types: Exploration, Significant Discovery and Production





Selected indicators to illustrate the 3LNO EPU status. Upper left-hand panel shows anomalies of the 3LNO subset of the NL Climate Index, chlorophyll-a, and zooplankton biomass index. Upper-right panel shows the relative composition of the fish community by functional groups from Canadian 3LNO fall survey. Lower left-hand panel shows the nominal total catch by functional guilds scaled relative to the corresponding Total Catch Index (TCI: black line; 2TCI: red line). The lower-right panel shows the tonnage of discards (total weight of all species) in each fishery from NAFO haul-by-haul catch reports and therefore include catches in the NRA only.

ECOLOGICAL FEATURES

Ecosystem Status and Trends

The last 5 years have been characterized by improved levels of nutrients and phytoplankton indices, as well as total zooplankton biomass with respect to earlier years. Small-sized copepods have significantly increased in abundance but the larger, lipid-rich taxa that are preferred prey of forage fish have been below normal in 2013-2020. After 2013-2014, total fish biomass declined and lost the gains built-up since the mid-1990s. After the lows around 2016-2017 the biomass of both finfish and shellfish showed signs of improvement by 2020. However, the declines observed in the Spanish survey after 2020 suggest that these improvements may have not continued. The piscivore functional group has not regained its pre-collapse dominance, with its proportion in biomass in the community remaining steady since 2015. Ongoing warming trends together with increases in warm water species like silver hake and Atlantic halibut suggest that this ecosystem may be starting to undergo structural changes.

Ecosystem productivity level and functioning

The Grand Bank continues experiencing low productivity conditions. After the regime shift in the late 1980s and early 1990s, this ecosystem never regained its pre-collapse biomass level. Improved conditions between

the mid-2000s and early 2010s allowed a build-up of total biomass up to ~40-50% of the pre-collapse level. This productivity was associated to good environmental conditions for groundfish, and modest increases in forage species, principally capelin. Since 2013, reduced levels of capelin and shrimp, and near average levels of sandlance, have been observed; the biomass of these forage species are not showing a clear trend. A reduction in total biomass density to ~30% of pre-collapse levels occurred after 2013-2014. Some indications of improvement were observed in 2019-2020, but without a clear trend. More recent information is limited due to lack of Canadian surveys, with Spanish surveys indicating declines after 2020. Although variable, diet composition of key predators suggests reduced contributions of forage species, and average stomach content weights of cod and Greenland halibut have shown declines, suggesting poor foraging conditions.

State of biological diversity

Biological diversity is a multi-faceted concept. Out of its many dimensions, assessment of its state is being limited to Vulnerable Marine Ecosystems (VMEs) and the number of non-commercial fish species considered depleted until more comprehensive approaches can be developed. Although identification and delineation of VMEs is being done, it is difficult to assess their status given the absence of a defined baseline and the unquantified impacts from historical fishing activities. In this context, area and biomass of VMEs are considered to be at similar levels since the start of their assessments in 2016. Differences in estimates in the 2016-2021 period are due to improvements in the evaluation methods and data. Based on 22 non-commercial fish species selected from the multispecies surveys, 60% of the species are above 20% of their historical maximum. This has increased from around 50% in 2016.

MANAGEMENT MEASURES

Precautionary Principles

The NAFO Roadmap addresses sustainability of fishing at three nested levels of ecosystem organization: ecosystem, multispecies and stock levels. At the present time, only considerations at the ecosystem and stock levels are in place. All catches are below the 2TCI ecosystem reference point, indicating that catch levels are consistent with current ecosystem productivity and the prevention of ecosystem overfishing. However, piscivore and suspension feeding benthos catches are above TCI. Piscivore catches have been increasing since 2015. Only 65% of the NAFO managed stocks in the Grand Bank are in conditions of supporting fishing, and some stocks have declining trends or status unknown due to lack of recent survey information. Impacts of either species interactions or environmental drivers are not currently being considered in the provision of stock advice or management.

Minimize harmful impacts of fishing on ecosystems

Minimization of harmful impacts of fishing on benthic communities has been focused on the protection of VMEs. Many coral and sponge VMEs in the Grand Bank are currently protected with dedicated closures, but the 30 coral closure provides no effective protection for the identified VMEs in that area. Closures protect 95% of sponge VME, 38% of sea pen VME, and 87% of large gorgonian coral VME biomass in 3LNO, however only 23% of black coral VME biomass is currently protected by closures for other taxa. Only 2% or less of small gorgonian corals, sea squirts and erect bryozoans VME biomass are protected.

At the ecosystem level, Total Catch Indices (TCI) for functional guilds in this EPU have been developed and an ecosystem reference point (2TCI) has been adopted to inform on the risk of ecosystem overfishing. At the stock level, 80% of managed stocks have LRPs or HCRs, although some LRPs are based solely on survey indices. At this time, there are no multispecies assessments to inform on trade-offs among fisheries.

Assess significance of incidental mortality in fishing operations

Total aggregated discards have shown significant increases in 2018-2021, peaking at ~800 t in 2021. Total discards were highest in the yellowtail flounder fishery, but have been increasing in other fisheries too. As a fraction of total catches, the reported discards in 2016-2021 were less than 5% for the main fisheries (redfish, yellowtail flounder, Greenland halibut, thorny skate). However, Atlantic halibut and white hake fisheries had high discard levels (15-50%) in 2016-2018.

Generally, the incidental catch of wolffish in 3LNO fisheries in 2016-2021 was low (less than 1% of survey biomass), oscillating without trend around 33 t per year. Incidental catches of Greenland sharks oscillated

around 60 t per year for the same period. Special protection measures for Greenland shark were adopted in 2022.

OTHER CONSIDERATIONS

Human activities other than fishing

As of 2022, there are four offshore production fields on the Grand Bank and intense exploration activities along the eastern shelf break, oceanic areas off the shelf break, and Flemish Pass. The total area for 3KLMNO of licenses² has increased 16.3-fold from 2014 to 2021. There have been 12 reported environmental incidents on the Grand Bank between 2015 and 2022, with a major oil spill in 2018, and one in 2019 that extended into the NRA. A proposed development project in the Flemish Pass overlaps with fishing grounds. It is expected, based on current exploration leases and development projections, that oil and gas exploration activities will continue to increase in the EPU, including the NRA.

The most recent information (up to 2017) indicates that there is low occurrence and density of litter in 3L and fisheries are the primary source from both NAFO-managed and non-NAFO managed fisheries. Data for more recent years has been collected in the EU surveys but has yet to be analyzed. Standardized protocols for litter data collection have been implemented in the EU surveys.

Fisheries not managed by NAFO

Among the fisheries managed by Canada in this EPU, 70% are currently supporting commercial fisheries, and 46% of those have LRPs. Lack of recent survey information represents a challenge for stock-assessments. Swordfish and tuna fisheries operate in this EPU under ICCAT jurisdiction.

Only coral and sponge VMEs are considered for protection under Canadian regulations (classified as Significant Benthic Areas - SiBAs). Among the VMEs present and covered by these regulations most have some level of protection (large and small gorgonians, and sea pens), and one is unprotected (sponges).

References

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² License types: Exploration, Significant Discovery and Production