

Northwest Atlantic Fisheries Organization



**Report of the NAFO Joint Fisheries Commission–Scientific Council  
Working Group on Ecosystem Approach Framework to Fisheries Management (WG-  
EAFFM)**

10-12 August 2016  
Halifax, Nova Scotia, Canada

NAFO  
Dartmouth, Nova Scotia, Canada  
2016

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1. Opening.....	3
2. Appointment of Rapporteur .....	3
3. Adoption of Agenda .....	3
4. SC response to FC requests for advice: .....	3
a) examination of work developed by the Scientific Council on SAIs in support of the reassessment of NAFO bottom fishing activities, including VME areas outside the NAFO footprint and the refinement of VME kernel density analysis polygon boundaries (FC request 4); .....	3
b) consider widening the scope of the NAFO coral and sponge identification guides (FC request 5); ...	4
c) consider risk assessment of scientific trawl surveys impact on VME in closed areas and the effect of excluding surveys from these areas on stock assessments (FC request 6);.....	4
d) develop a work plan to address potential impact of activities other than fishing on VMEs, in particular VME closed areas (FC request 11);.....	4
e) identify areas of significant concentrations of non-coral and sponge VME indicator species using all available information (FC request 15).....	5
5. Discussion of ongoing matters: .....	5
a) Consideration of Candidate Closed Areas 13 and 14.....	5
b) Significant concentrations of VME indicator species on the Tail of the Bank.....	6
6. Further development and application of the Ecosystems Approach to Fisheries (EAF) Roadmap, including further consideration of any issues raised at the June SC meeting .....	6
7. Recommendations to forward to FC and SC.....	7
8. Other Matters .....	7
9. Adoption of the report .....	8
10. Adjournment .....	8
Annex 1. List of Participants .....	9
Annex 2. Agenda.....	11
Annex 3. SC Advice on SAIs in support of the Reassessment of NAFO Bottom Fisheries Activities..	12
Annex 4. Maps of Candidate Areas 13 and 14 referred to in Recommendation 5.....	27
Annex 5. Progress on the NAFO Roadmap towards an Ecosystem Approach to Fisheries .....	29

## **Report of the NAFO Joint Fisheries Commission–Scientific Council Working Group on Ecosystem Approach Framework to Fisheries Management (WG- EAFFM)**

10-12 August 2016  
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### **1. Opening**

The meeting was called to order at 10:00 hrs on 10 August 2016 by co-Chairs, Robert Day (Canada) and Andrew Kenny (EU). Representatives from Canada, the European Union (EU), Iceland, Japan, Norway, the Russian Federation, and the USA were in attendance. The Scientific Council was represented by the SC Chair. Observers were present from the Ecology Action Centre, the Secretariat of the Convention on Biological Diversity (CBD) and Dalhousie University - Environment Information: Use & Influence Research Initiative (EIUI) (Annex 1).

### **2. Appointment of Rapporteur**

The Senior Fisheries Commission (FC) and Scientific Council (SC) Coordinators, Ricardo Federizon and Tom Blasdale were appointed as co-Rapporteurs.

### **3. Adoption of Agenda**

With the addition of one item “the meeting report of the FC Working Group on Bycatch, Discards and Selectivity (WG-BDS) held 9 August 2016”, the agenda was adopted (Annex 2).

### **4. SC response to FC requests for advice:**

#### **a) examination of work developed by the Scientific Council on SAIs in support of the reassessment of NAFO bottom fishing activities, including VME areas outside the NAFO footprint and the refinement of VME kernel density analysis polygon boundaries (FC request 4);**

The co-Chair (AK) presented the advice of the Scientific Council meeting of June 2016, which was based on an assessment performed by WG-ESA in November 2015. The presentation is included as Annex 3 of this report and the full assessment is included as Annex VI of the June 2016 Scientific Council report (SCS Doc. 16/14 Rev.). The working group (WG) welcomed the thorough work of SC and WG-ESA and the clarity with which such a complex piece of work was presented to the meeting. It was recognised that this work is well ahead of anything being done in RFMOs elsewhere, with only a few coastal States having developed comparable assessment methods.

It was considered that a number of areas of the advice needed further clarification. In particular, the WG considered that the use of colour coding to represent ‘low’, ‘moderate’ and ‘high’ risk categories was less informative than simply having a table with quantitative numbers (percentages), particularly as the thresholds used to determine which category of risk applied were not explicit as they were assigned using expert judgment. Similarly, the weighting given to the various factors (especially resilience/sensitivity) in determining overall risk as ‘high’ or ‘low’ was not explicit. Clearer objective ranking processes and options for objective weighting criteria for the overall assessment of risk were recommended for future assessments.

As specified in the FC request, exposure to risk and impact to Vulnerable Marine Ecosystems (VMEs) was calculated on the basis of both area and biomass. Participants generally agreed that biomass would give a more meaningful assessment, but that estimates of VME habitat area at risk and impact are useful in a management context. The possibility of combining both figures as an average was considered.

For future assessments, the WG agreed that it would be desirable to assess the overlap of NAFO fisheries with VME to evaluate fishery specific impacts in addition to the cumulative impacts and to assess all six FAO criteria (Article 18 of the *FAO International Guidelines for the Management of Deep-Sea Fisheries in the High*

*Seas*), including the three FAO functional SAI criteria which could not be quantified in the current assessment (recovery potential, ecosystem function alteration, and impact relative to habitat use duration of VME indicator species). Further work will be required to allow non-sponge and coral VMEs (for example bryozoan and sea squirts) to be assessed in future.

It was further suggested that the analysis could be repeated to examine the effect of inclusion of candidate areas 13 and 14 (sea pen VMEs). However, this was not agreed by all WG members. Some members noted no updated advice on the candidate areas had been provided and that there were concerns with the assessment method for SAI (e.g., in relation to calculation of fishing effort), including the uncertainties raised in page 29 of the SC June 2016 Report and the fact that growing evidence pointed at the need for further analysis of the potential resilience of sea pens by the research project NEREIDA, during 2016-2017.

Specific recommendations of the working group in relation to this agenda item are given in **WG-EAFFM recommendation #1** below.

**b) consider widening the scope of the NAFO coral and sponge identification guides (FC request 5);**

The SC response to this request was presented by the SC Chair. Although the NAFO VME Guide continues to be focused on corals, sponges, and other benthic taxa, there are existing guides and catalogues that can be useful for identifying other species, like some skates and sharks. SC has identified some of this relevant material, and recommends it be provided to NAFO observers in a usable format. It was further clarified that skates and sharks, while not considered as components of VMEs, are frequently associated with seamounts and can be vulnerable species in their own right. For this reason, NAFO protects seamounts as VME indicator elements.

Specific recommendations of the working group in relation to this agenda item are given in **WG-EAFFM recommendation #2** below.

**c) consider risk assessment of scientific trawl surveys impact on VME in closed areas and the effect of excluding surveys from these areas on stock assessments (FC request 6);**

The SC Chair presented the work of SC on the impacts of removing the closed areas from the survey design for relevant stock surveys. A partial analysis was conducted to evaluate the impact of removing the closed areas on the indices of biomass derived from the EU survey in Div. 3M. The results show minimal impact on estimates of survey biomass and trends for all the assessed species with the exception of roughhead grenadier and Greenland halibut. For these species the difference in the biomass indices (with and without the hauls in the closed areas) is more noticeable, but the trends were similar to the original index. Further investigation is required for abundance indices by length or age used in the assessments. If the closed areas are removed from the survey design, some of the strata may not be properly sampled.

Several working group participants commented on the partial nature of this study and inquired whether there was a plan to complete the study and to reach a final conclusion about excluding surveys from closed areas. It was agreed that this could be done, but that it would entail a considerable amount of work which would have to be considered in the context of other SC priorities.

Specific recommendations of the working group in relation to this agenda item are given in **WG-EAFFM recommendation #3** below.

**d) develop a work plan to address potential impact of activities other than fishing on VMEs, in particular VME closed areas (FC request 11);**

The SC Chair presented the advice from the June 2016 SC meeting. WG-ESA conducted a thorough review of activities with the potential to impact VMEs in the NRA; however, Scientific Council considered that developing the requested work-plan is beyond its capacity and purview. WG-EAFFM noted the progress that has been made by the Secretariat in forging links with other relevant organizations with management authority within the NRA (IMO, the International Seabed Authority, CBD) and in exploring mechanisms to improve the exchange of information. It was agreed that it would be beneficial for the Secretariat to maintain this dialogue. It was pointed out that Contracting Parties participate in many of these and other fora and can

be expected to have access to information on their activities. Contracting Parties and FC should therefore consider appropriate means to facilitate active monitoring of assessments, planning processes and actions taken in order to identify and, if needed, respond on issues concerning NRA fisheries, fisheries resources, and biodiversity (see WG-EAFFM recommendation #4 below).

The CBD Secretariat gave an overview of an ongoing process to bring together RFMOs and Regional Seas Organisations to facilitate a more cross-sectoral approach and integration of information. The WG agreed that it would be beneficial for NAFO to monitor this work and engage as appropriate (subject to resource availability) and for any outcomes to be communicated at the next meeting of this WG.

Specific recommendations of the working group in relation to this agenda item are given in **WG-EAFFM recommendation #4** below

**e) identify areas of significant concentrations of non-coral and sponge VME indicator species using all available information (FC request 15).**

The co-Chair (AK) presented the SC advice. In situ photographic surveys conducted by Fisheries and Oceans Canada on the Tail of Grand Bank during June 2015 did not result in the identification of significant concentrations of either erect bryozoans or large sea squirts. These results indicate that the patch size of the non-coral and sponge VME indicator species is less than 1 square km. These VME indicator species require hard substrate to attach to the sea bed and it is likely that areas with high catches are also in areas with more extensive hard bottom types. SC considered that the resolution of the kernel density polygons to define VME does not sufficiently represent the patchy nature of these taxa and therefore more detailed information about the distribution and type of surficial geology and sediments of the area would help to better define the habitats where these species occur in significant concentrations. SC recommends that the location of the significant catches, rather than the full kernel density polygon areas, be used to identify significant concentrations of these VME indicator species.

The WG discussed whether it would be feasible to manage VMEs on such a small geographical scale (possibly ~1km scale) and agreed that this would need further consideration. The co-Chair of WG-ESA showed fishing effort maps which indicate that fishing vessels avoid the areas where bryozoan turfs occur. This would be consistent with the presence of small patches of hard substrate.

**5. Discussion of ongoing matters:**

**a) Consideration of Candidate Closed Areas 13 and 14**

Some discussion relating to this agenda item was included under item 4a, where it was noted that the sea pens VME type was assessed as being at high risk in the risk assessment of SAI conducted by SC. The WG agreed that FC should consider what management response would be appropriate taking into consideration that, although having different characteristics (less sensitive (and more resilient)) than sponges and large gorgonians, this habitat is still considered to be a VME under the FAO guidelines. The management response might, but would not necessarily, include closure of the areas formerly identified as candidate closed areas 13 and 14 (see Annex 4). It was also emphasized that the NAFO footprint is managed according to the ecosystem approach to ensure sustainable fisheries. It is understood that some VMEs will be impacted in sustaining viable fisheries in the NAFO footprint, but this has to be managed and limited so as not to cause significant adverse impacts, while allowing responsible fisheries to continue.

One Contracting Party suggested that many of the current assessment results (index of sensitivity, fishing stability, extent of VME fragmentation, apparent spatial association with the red fish fishery) can be explained if the sea pen communities are more resilient to fishing pressure than formerly assumed.

It was noted by some Contracting Parties, however, that the research efforts on sea pen recovery rates and the significance of sea pens to redfish production has been limited and that these issues have to be studied further and documented. These Contracting Parties expressed the need to apply a precautionary approach and to take some protective action in the meantime, including as a time-limited measure while research is undertaken.

Some Contracting Parties expressed concern about drilling for oil and gas having taken place in NAFO sea pen closed area 10 (Northwest Flemish Cap) during the first half of 2016.

Specific recommendations of the working group in relation to this agenda item are given in **WG-EAFFM recommendation #5** below.

**b) Significant concentrations of VME indicator species on the Tail of the Bank**

This agenda item was substantially covered in the discussion of agenda item 4e) work to identify areas of significant concentrations of non-coral and sponge VME indicator species using all available information (FC request 15). The possibility of small scale closures was mentioned and could be considered in future SAI work, but it was recognized that small size of these VME patches (less than 1km<sup>2</sup>) would be challenging to manage. Furthermore, it was highlighted that because these patches occur in rocky outcrops, trawls avoid them anyway in order not to damage or entangle the gear.

**6. Further development and application of the Ecosystems Approach to Fisheries (EAF) Roadmap, including further consideration of any issues raised at the June SC meeting**

The co-Chair of WG-ESA Mariano Koen-Alonso reported on progress made in SC on the development of the EAF roadmap (Annex 5).

An updated version of the Ecosystem Production Potential (EPP) model has been developed including improved description of the microbial loop, explicit benthic-pelagic coupling, splitting the benthic production into suspension and deposit feeding components and allowing for fishing on meso-zooplankton. This has made very little difference to the productivity of the exploited trophic levels, suggesting that the production potential is well captured by the model. This has been used to calculate Fisheries Production Potential (FPP) for three ecosystem production units, the Newfoundland Shelf, the Grand Banks and the Flemish Cap.

Details of the EAF Roadmap progress are documented in the November 2015 meeting report of the WG-ESA (SCS Doc. 15/19) and the SC report from June 2016 (SCS Doc. 16/14 Rev.).

The WG welcomed this work but several members commented that it would be helpful to develop a less technically complex way of presenting the information for managers; for instance, a red-yellow-green system as currently used in single stock advice. It was agreed to recommend that SC and FC discuss how the concept of FPP-based TCC at the ecosystem production unit scale could inform the management of NAFO stocks and provide feedback and further direction.

Specific recommendations of the working group in relation to this agenda item are given in **WG-EAFFM recommendation #6** below.

## 7. Recommendations to forward to FC and SC

WG-EAFFM recommends:

**In relation to the reassessment of NAFO bottom fisheries (agenda item 4a)**

1. To support the next re-assessment in 2020, that SC;
  - a) assess the overlap of NAFO fisheries with VME to evaluate fishery specific impacts in addition to the cumulative impacts;
  - b) consider clearer objective ranking processes and options for objective weighting criteria for the overall assessment of risk;
  - c) maintain efforts to assess all of the six FAO criteria (Article 18 Article 18 of the FAO International Guidelines for the Management of Deep-Sea Fisheries in the High Seas) including the three FAO functional SAI criteria which could not be evaluated in the current assessment (recovery potential, ecosystem function alteration, and impact relative to habitat use duration of VME indicator species).
  - d) continue work on non-sponge and coral VMEs (for example bryozoan and sea squirts) to prepare for the next assessment.

**In relation to widening the scope of the NAFO coral and sponge guide (item 4b)**

2. In addition to the VME guide, that SC further develop and compile identification guides for fishes (e.g. sharks and skates) that could be provided to observers.

**In relation to risk assessment of scientific trawl surveys impact on VMEs (item 4c)**

3. In consideration of other SC priorities, that SC maintain efforts to conclude the assessment of the impact of survey hauls on VMEs in closed areas and the effect of excluding surveys from these areas on stock assessments.

**In relation to potential impact of non-fishing activities (item 4d)**

4. That NAFO Secretariat maintains dialogue with relevant organizations and explore mechanisms to improve the exchange of information. The FC and Contracting Parties may consider other means to facilitate active monitoring of assessments, planning processes and actions taken in other fora in order to identify and, if needed, respond on issues concerning NRA fisheries, fisheries resources, and biodiversity.

**In relation to ongoing matters (agenda item 5)**

5. Taking note of the recent SAI assessment from the SC, that FC consider management response, if appropriate, including the possible closure of the areas previously identified as sea pen candidate areas 13 and 14 (Eastern Flemish Cap) if proposals are made at the annual meeting (see Annex 4).

**In relation to Ecosystem Approach to Fisheries (EAF) (agenda item 6)**

6. FC/SC give consideration (possibly through their informal dialogue) to how Fisheries Production Potential (FPP) limits could inform management of NAFO stocks and provide feedback and further direction.

## 8. Other Matters

The acting chair of the FC ad hoc Working Group on Bycatch, Discards and Selectivity (WG-BDS) gave a brief presentation of the outcomes of the meeting which took place on 9 August 2016. The report of this meeting was not yet finalized but will be available as FC Doc. 16/05. The WG noted that some aspects of bycatch, discards and selectivity could be incorporated into the of the WG-EAFFM workplan as identified by the Ecosystem Roadmap which notes bycatch as an area of focus.

### **9. Adoption of the report**

It was agreed that the text of the recommendations to Fisheries Commission and Scientific Council agreed in plenary was considered final. A first draft of the remainder of the report would be written up by the Secretariat and circulated firstly to the Chair and then to Contracting Parties in the days following the meeting.

### **10. Adjournment**

The meeting was adjourned at 12:00 hrs on 12 August 2016. The Chairs thanked participants for their positive approach and engagement in the meeting, thanked the Secretariat for their support and hospitality, and wished participants a safe journey home.



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## **Annex 2. Agenda**

1. Opening
2. Appointment of Rapporteur
3. Adoption of Agenda
4. SC response to FC requests for advice:
  - a) examination of work developed by the Scientific Council on SAIs in support of the reassessment of NAFO bottom fishing activities, including VME areas outside the NAFO footprint and the refinement of VME kernel density analysis polygon boundaries (FC request 4);
  - b) consider widening the scope of the NAFO coral and sponge identification guides (FC request 5);
  - c) consider risk assessment of scientific trawl surveys impact on VME in closed areas and the effect of excluding surveys from these areas on stock assessments (FC request 6);
  - d) develop a work plan to address potential impact of activities other than fishing on VMEs, in particular VME closed areas (FC request 11); and
  - e) identify areas of significant concentrations of non-coral and sponge VME indicator species using all available information (FC request 15).
5. Discussion of ongoing matters:
  - a) Consideration of Candidate Closed Areas 13 and 14
  - b) Significant concentrations of VME indicator species on the Tail of the Bank
6. Further development and application of the Ecosystems Approach to Fisheries (EAF) Roadmap, including further consideration of any issues raised at the June SC meeting
7. Recommendations to forward to FC and SC
8. Other Matters
9. Adoption of Report
10. Adjournment

### Annex 3. SC Advice on SAIs in support of the Reassessment of NAFO Bottom Fisheries Activities

#### FC Request 4: Reassessment of Bottom Fisheries

Fisheries Commission requests the Scientific Council to continue to develop work on **Significant Adverse Impacts** in support of the reassessment of NAFO bottom fishing activities required in 2016, specifically an assessment of the risk associated with bottom fishing activities on known and predicted VME species and elements in the NRA.

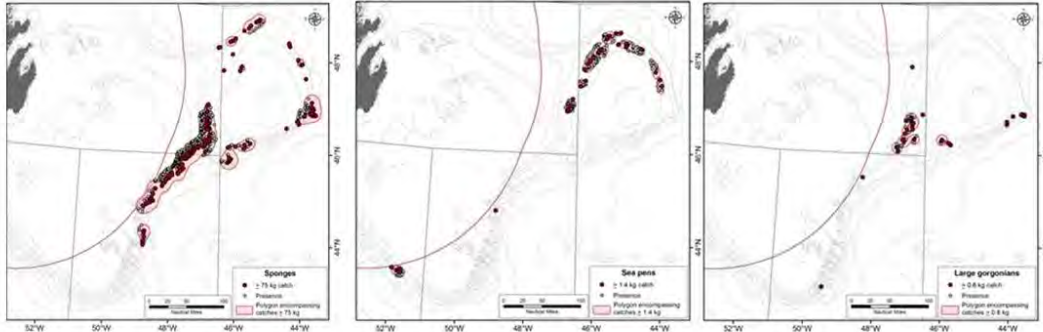
FC further requests that:

- a) that Scientific Council should take into account the protection afforded to VME areas outside the NAFO fisheries footprint in the calculation of the VME area and biomass at risk of bottom fishing impact;
- b) that Scientific Council refine VME kernel density analysis polygon boundaries, taking into account current understanding of distribution patterns in relation to environmental variables.

WGEAFFM August 2016

No.	Fisheries Assessment Tasks (Article V, 2011 NCEM)	WGESA Report
1	Type(s) of fishing conducted or contemplated, including vessels and gear types, fishing areas, target and potential bycatch species, fishing effort levels and duration of fishing (harvesting plan)	Section 4.2.4 (description of fisheries)
2	Existing baseline information on the ecosystems, habitats and communities in the fishing area, against which future changes can be compared	Sections 4.2.2 (introduction), 4.2.3 (description of VMEs), 4.2.4 (description of fisheries)
3	Identification, description and mapping of VMEs known or likely to occur in the fishing area	Section 4.2.3 (description of VMEs)
4	Identification, description and evaluation of the occurrence, scale and duration of likely impacts, including cumulative impacts of activities covered by the assessment on VMEs	Section 4.2.5 (assessment of SAI)
5	Consideration of VME elements known to occur in the fishing area	Section 4.2.3 (description of VMEs)
6	Data and methods used to identify, describe and assess the impacts of the activity, the identification of gaps in knowledge, and an evaluation of uncertainties in the information presented in the assessment	Section 4.2.5 (assessment of SAI)
7	Risk assessment of likely impacts by the fishing operations to determine which impacts on VMEs are likely to be significant adverse impacts	Section 4.2.5 (assessment of SAI)
8	The proposed mitigation and management measures to be used to prevent significant adverse impacts on VMEs, and the measures to be used to monitor effects of the fishing operations	(Joint FC/SC Working Group on the Ecosystem Approach Framework to Fisheries Management)

## Description of VMEs



The primary tool used to quantitatively determine VME extent is kernel density analysis (KDA; Kenchington et al., 2014)

Three VME types assessed for SAI:

- Sponge
- Sea pen
- Large Gorgonian

## Refining the VME boundary

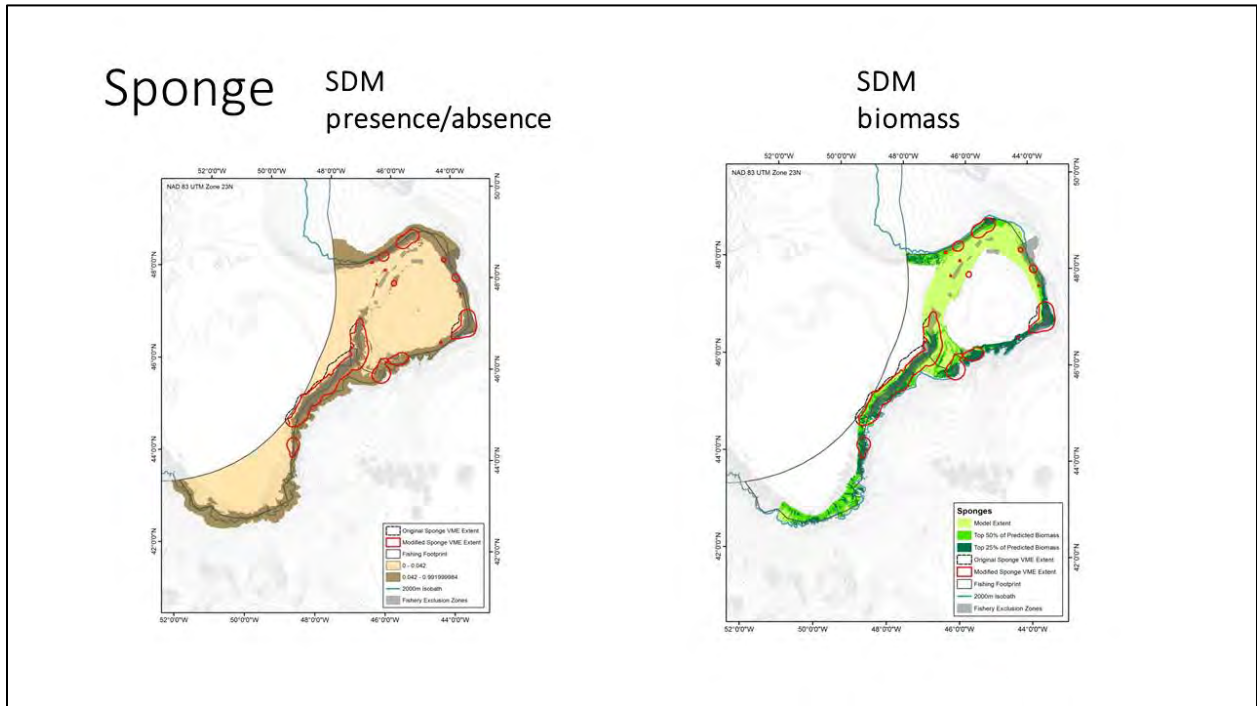
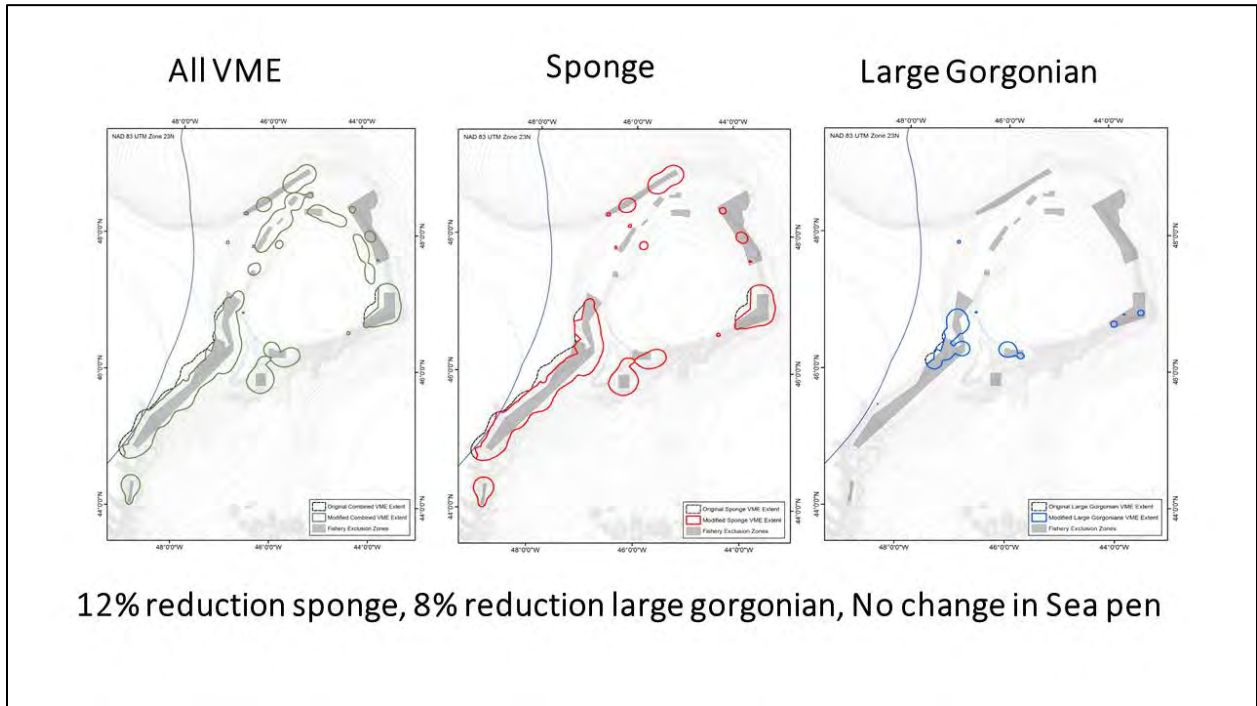
Develop SDMs incorporating habitat data

- i. using presence/absence model of VME significant concentrations (DFO)
- ii. using VME biomass from areas not fished (Cefas)

Overlay with KDE VME polygons and redefine boundary where both models agree absence.

Effectively reduce and not increase the VME polygon area





## Description of fisheries

Cod, redfish,  
Northern shrimp  
and Greenland  
halibut,

Accounting for  
84% of total  
index of biomass  
every year

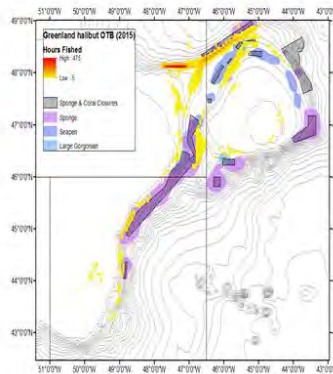
Fishery	Target Species	Main Area of Operation	Gear
Greenland Halibut Fishery	Greenland halibut	NAFO Divs 3LMNO	Bottom otter trawl
3M Redfish Fishery	Redfish	NAFO Div. 3M	Bottom otter trawl
3M Shrimp Fishery (under moratorium)	Shrimp	NAFO Div. 3M	Bottom otter trawl
3M Trawl Cod Fishery	Atlantic Cod	NAFO Div. 3M	Bottom otter trawl and paired bottom trawls
3M Longline Cod Fishery	Atlantic Cod	NAFO Div. 3M	Longline
Skate Fishery	Skate	NAFO Divs 3NO	Bottom otter trawl
Yellowtail flounder Fishery	Yellowtail flounder	NAFO Div. 3N	Bottom otter trawl
Witch flounder Fishery (re-opened in 2015)	Witch flounder	NAFO Divs 3NO (expected area)	Bottom otter trawl
3LNO Redfish Fishery	Redfish	NAFO Divs 3LNO	Bottom otter trawl
3LNO Shrimp Fishery (under no directed fishery in 2015)	Shrimp	NAFO Div. 3L	Bottom otter trawl
White Hake Fishery	White hake	NAFO Divs 3NO	Bottom otter trawl
Squid Fishery (no directed fishing since 1999)	Shortfin squid	NAFO Subareas 3+4	Bottom and midwater otter trawl

A total of 12  
operational  
fisheries

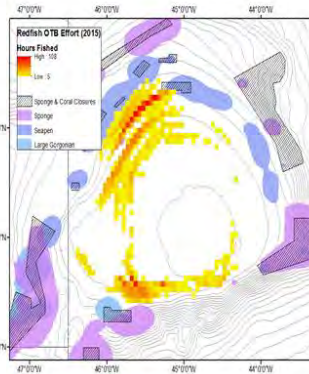
Gear, depth,  
vessel power,  
length, catch  
composition.

Maps 2012 - 2015

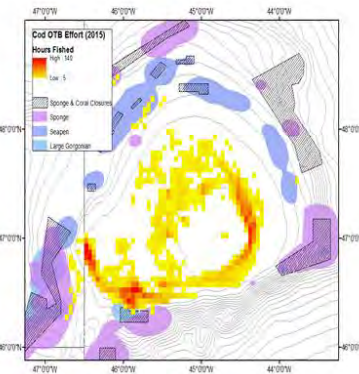
3LMNO Greenland halibut



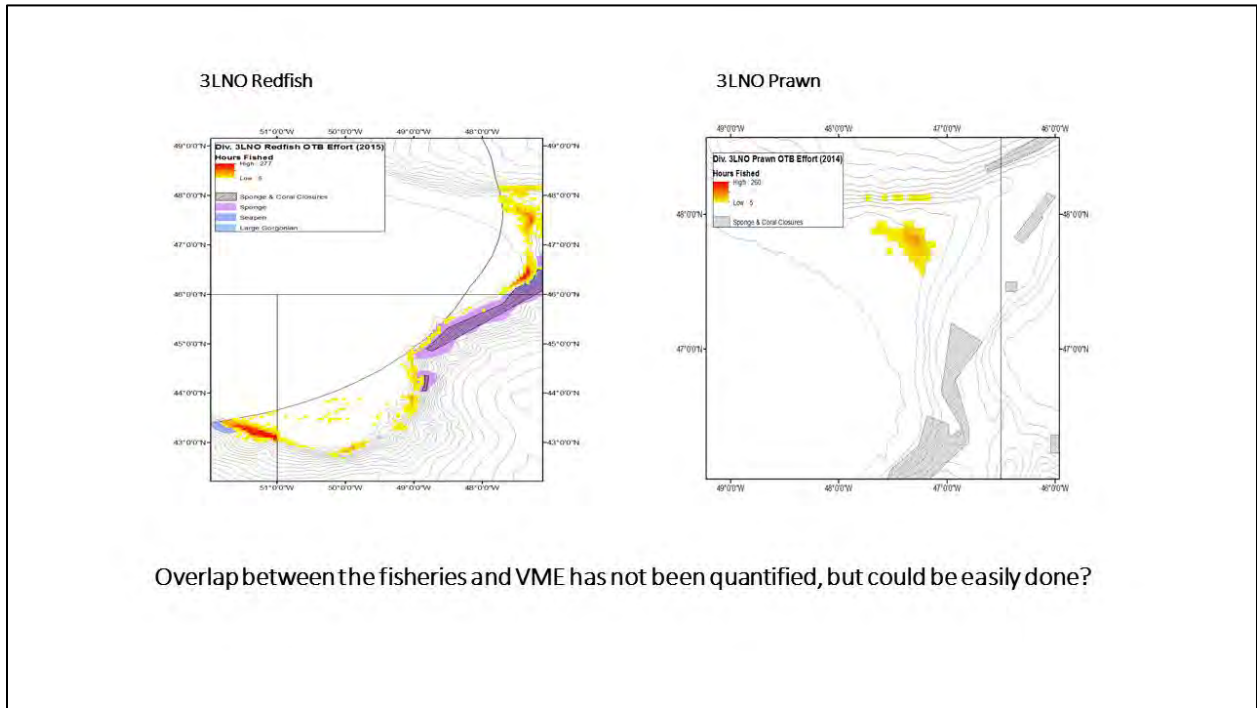
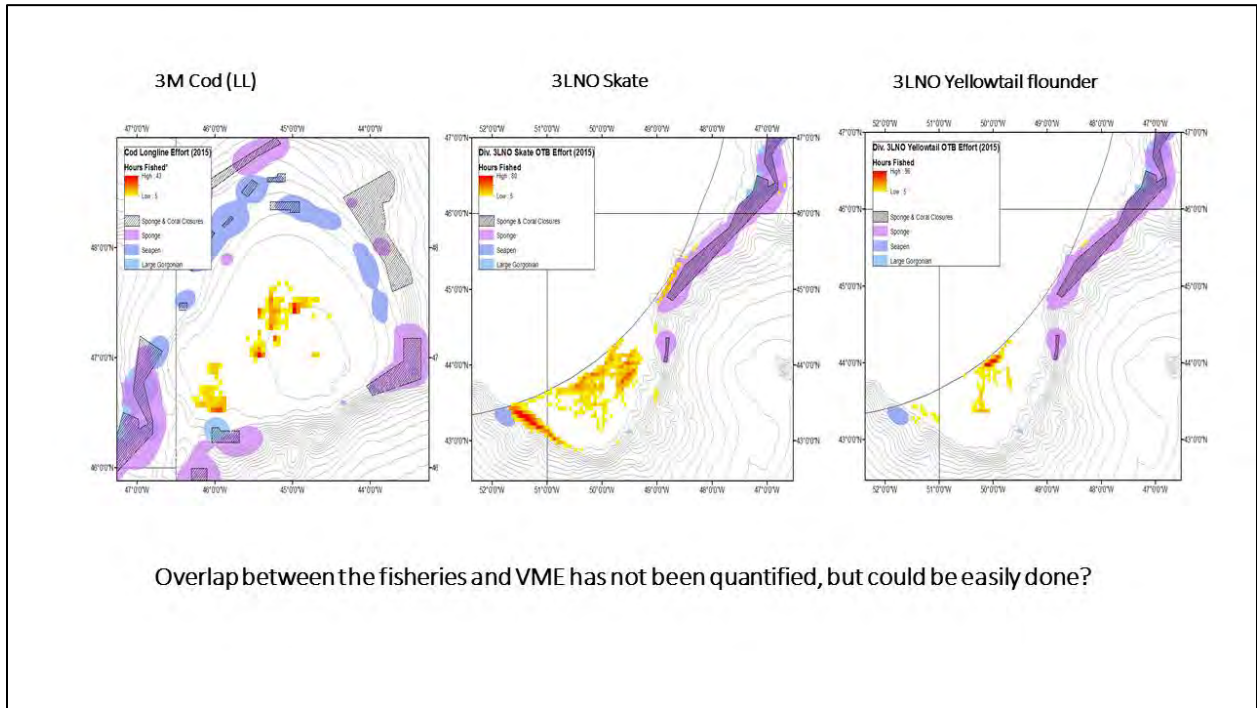
3M Redfish



3M Cod



Overlap between the fisheries and VME has not been quantified, but could be easily done?





## Assessment of SAI: FAO Criteria

- i. the intensity or severity of the impact at the specific site being affected;
- ii. the spatial extent of the impact relative to the availability of the habitat type affected
- iii. the sensitivity/vulnerability of the ecosystem to the impact;
- iv. the ability of an ecosystem to recover from harm, and the rate of such recovery;
- v. the extent to which ecosystem functions may be altered by the impact; and
- vi. the timing and duration of the impact relative to the period in which a species needs the habitat during one or more of its life history stages

Food and Agriculture Organization of the United Nations, International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (Rome: FAO, 2009).

## NAFO Approach

1. Define and quantify; i) VME at risk of impact and, ii) VME impacted
2. Define assessment specific SAI criteria (based upon FAO criteria and NAFO data)
3. Apply criteria and make an overall assessment of SAI

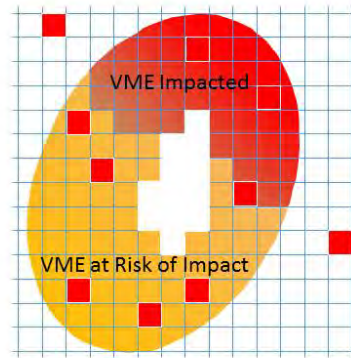
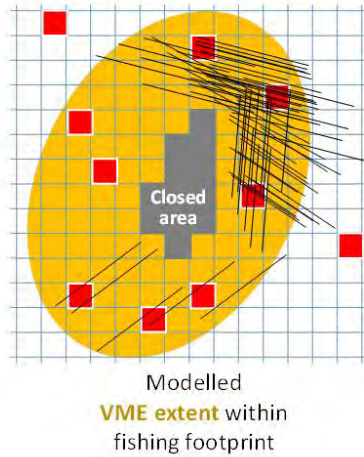
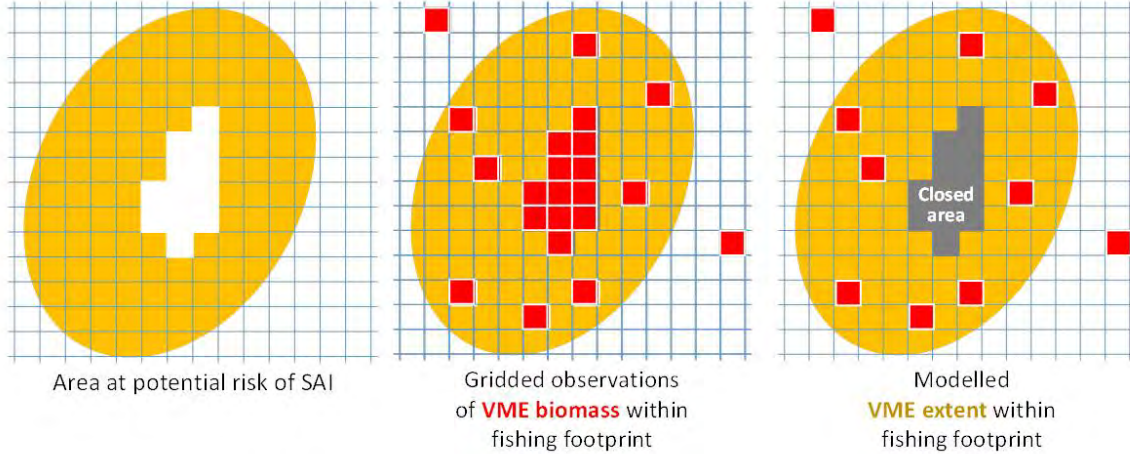
## Defining VME Risk/Impact categories

- (i) VME at **low risk** of impact
  - a. VME Fishery closures (inside the footprint)
  - b. VME out-side the fishing footprint
  - c. VME Fishery closures (outside the footprint)
- (ii) VME at **high risk** of impact
  - a. VME inside the footprint not previously fished outside any fishery closure
- (iii) VME **impacted**
  - a. VME inside the footprint that has been fished

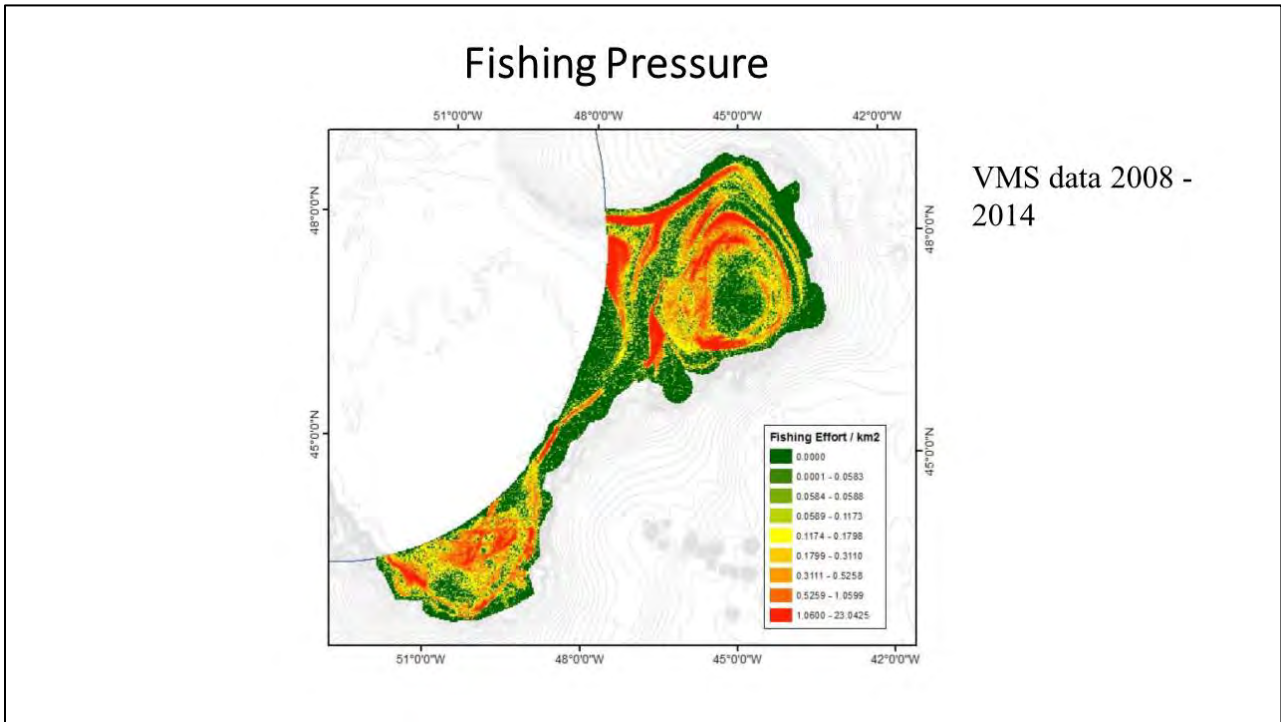
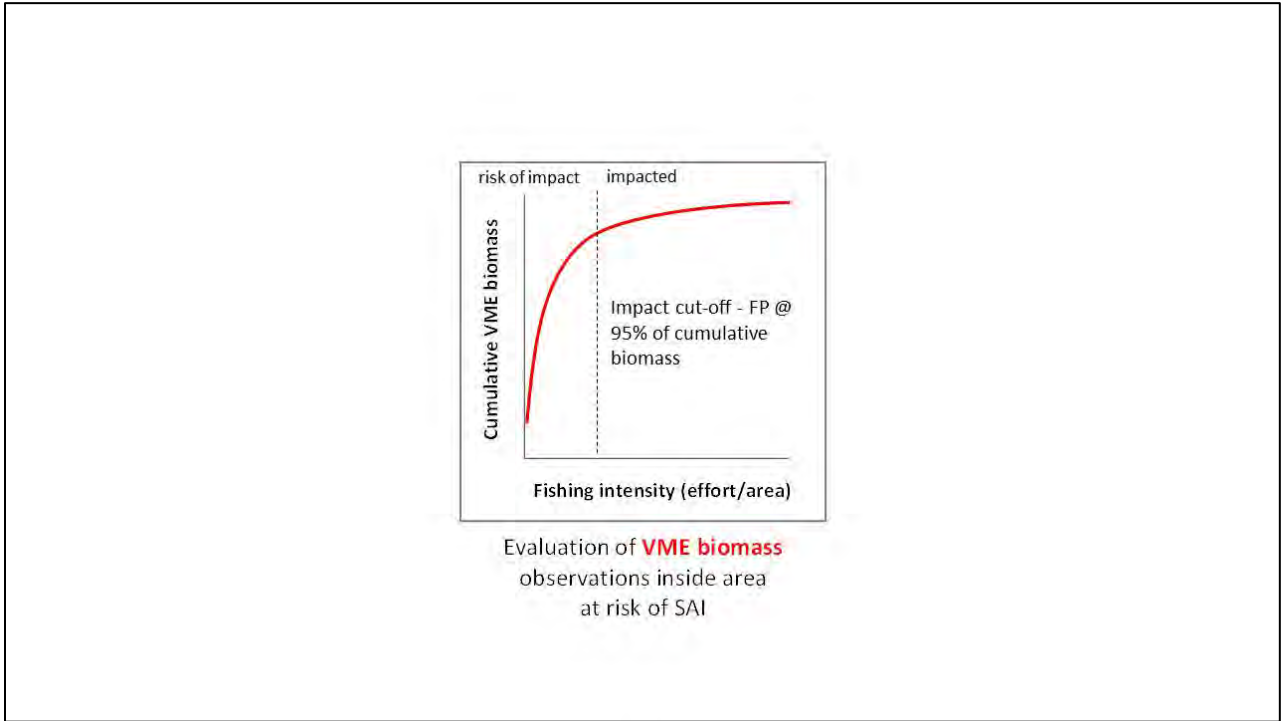
## Impact Assessment Approach :

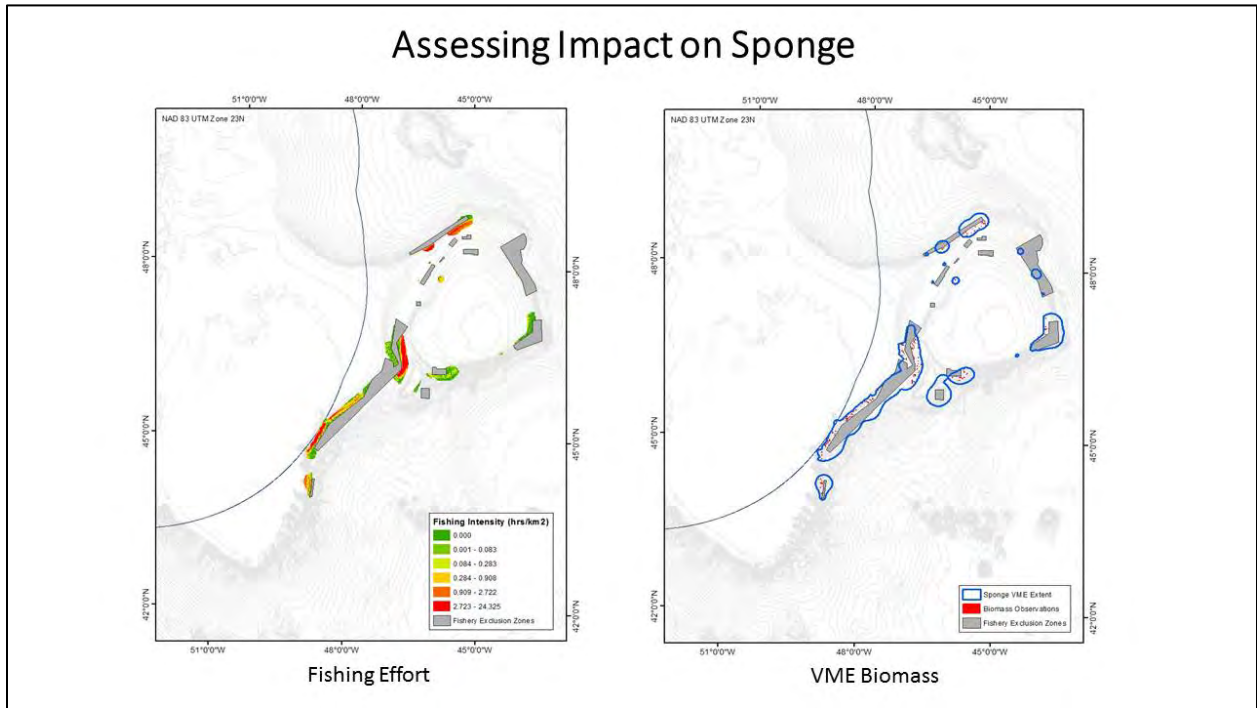
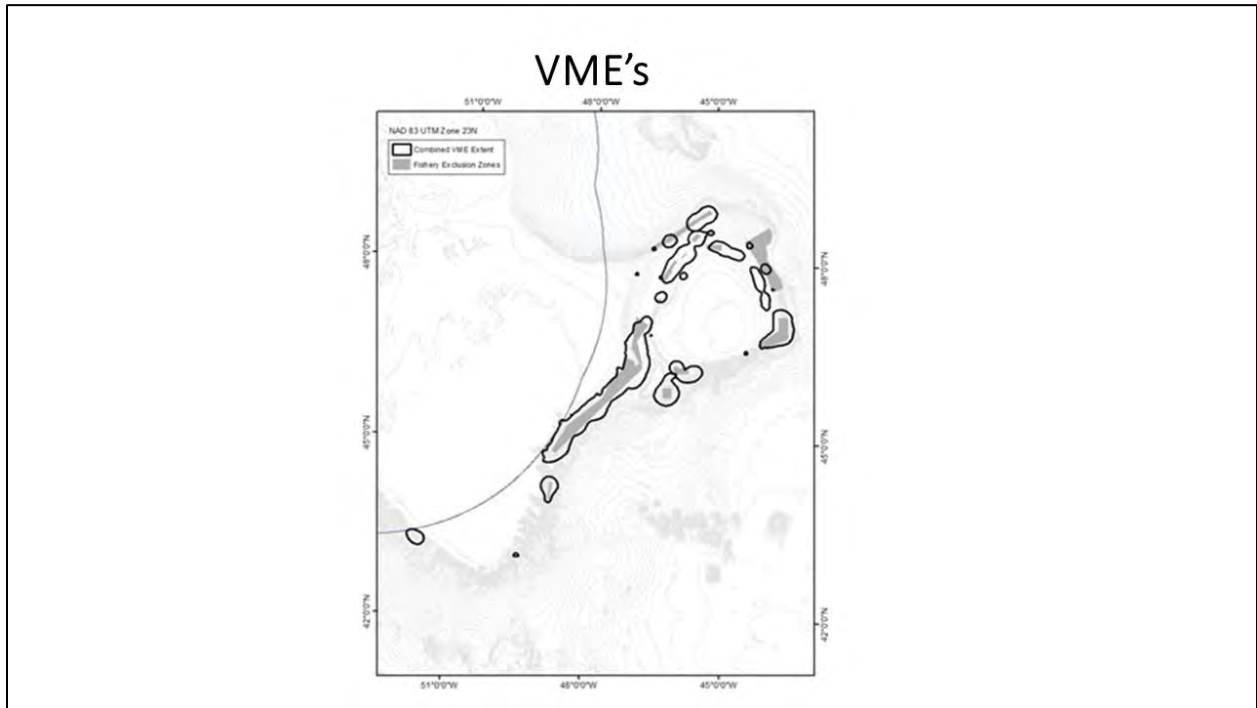
1. Analyse VMS data to generate a fishing activity/intensity layer (2008 – 2014)
2. Create biomass layers of VME species at the same spatial resolution (2000 – 2015)
3. Assess interaction/overlap between fishing activity and biomass layers.
  - Identify areas of impact and areas at risk of impact

**Impact Assessment Approach:**

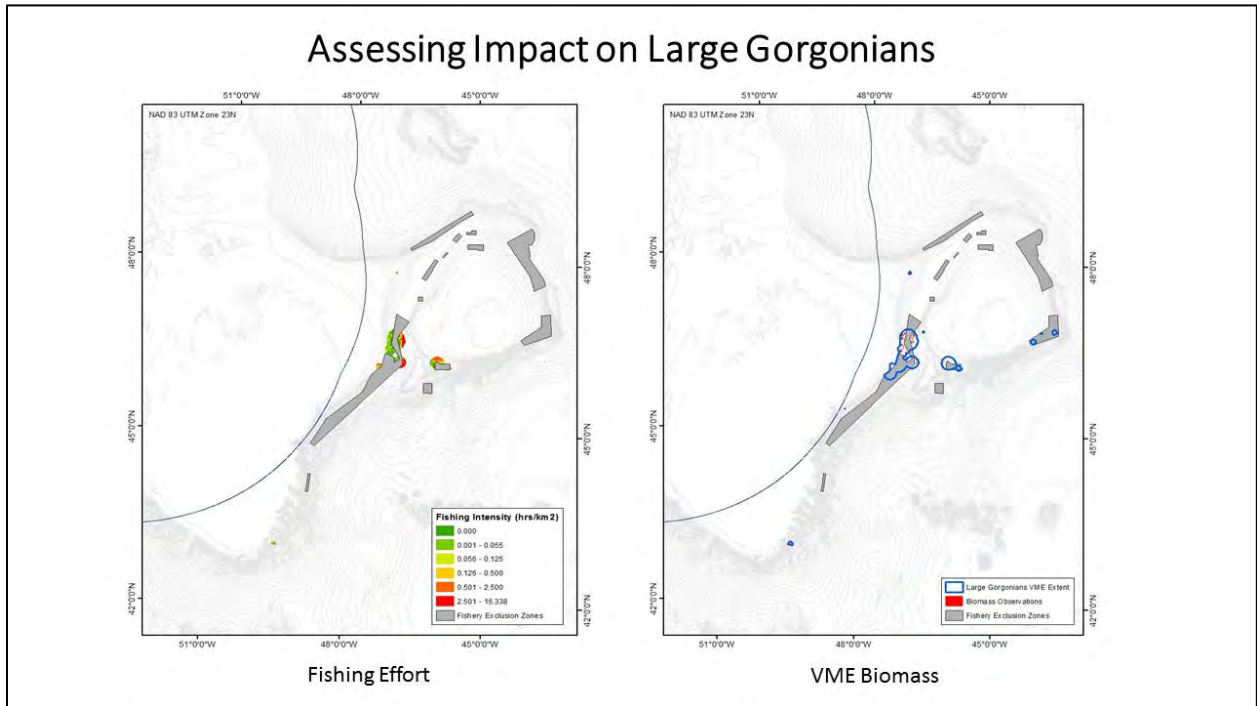
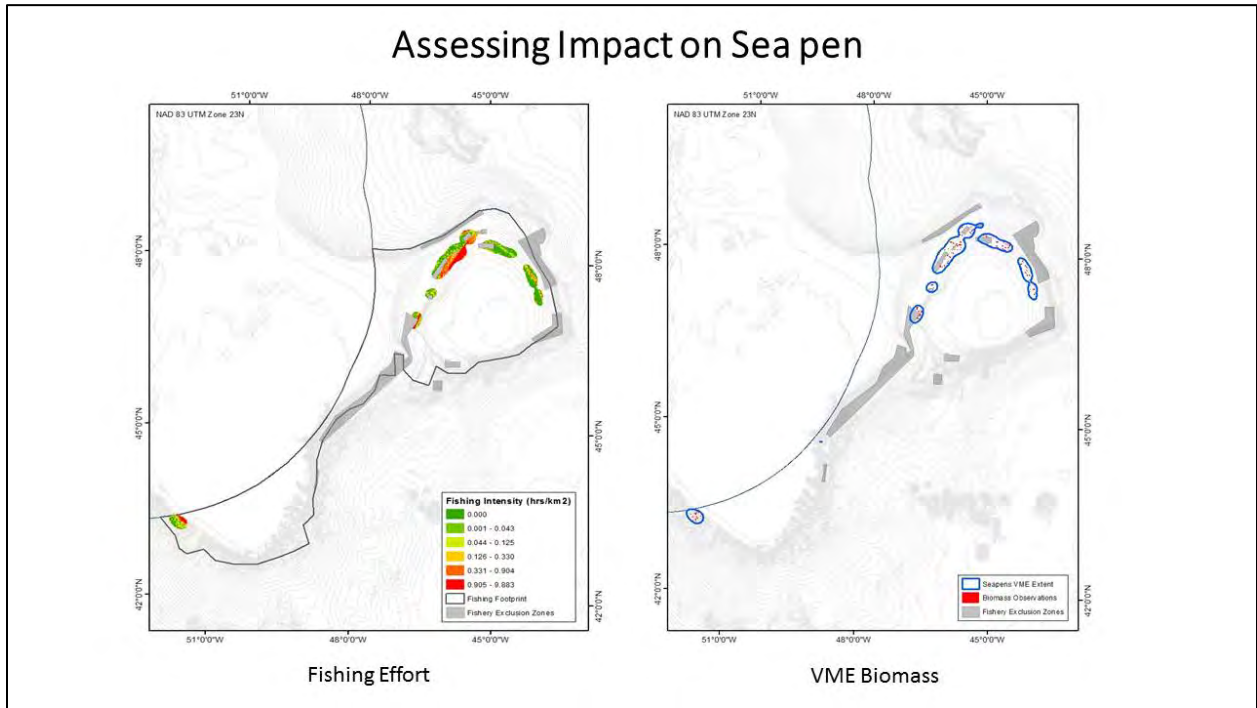


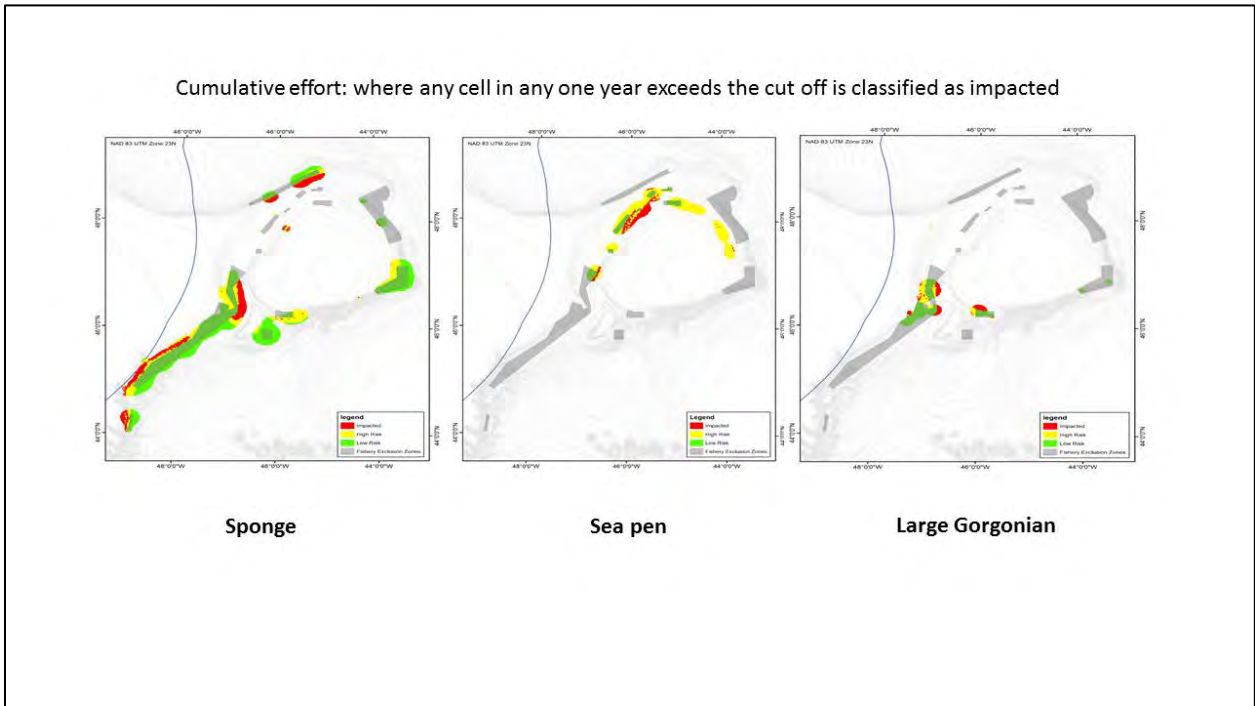
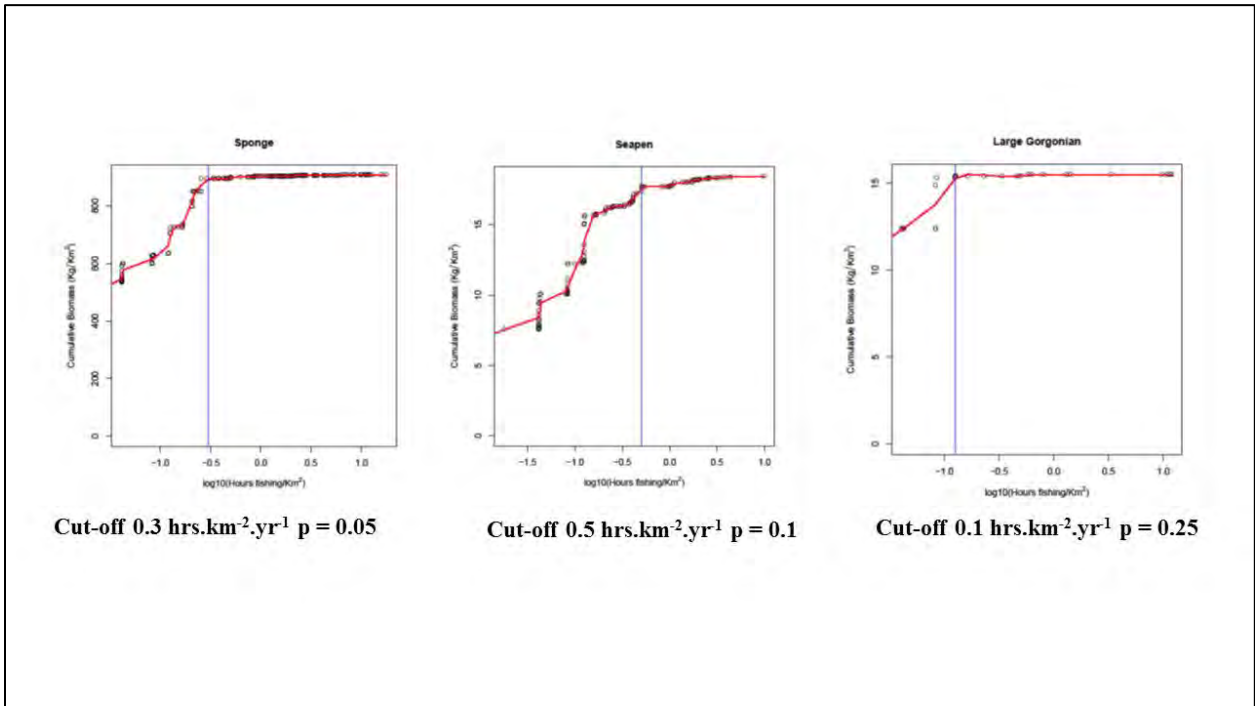
- Areas of low fishing intensity and high VME biomass = **Risk of Impact**
- Areas of high fishing intensity and low VME biomass = **Impacted**











VME risk/impact categories - Area (km<sup>2</sup>)

	Sponges		Sea pens		Large gorgonians	
	km <sup>2</sup>	(%)	km <sup>2</sup>	(%)	km <sup>2</sup>	(%)
VME at Low risk	12,874	(65)	1,094	(16)	1,980	(56)
Closure inside footprint	4,227	(21)	1,094	(16)	1,485	(42)
Closure outside footprint	3,679	(19)			495	(14)
Outside fishing footprint	4,888	(25)				
VME Impacted	4,259	(21)	2,662	(38)	1,091	(31)
VME at High risk	2,771	(14)	3,226	(46)	434	(12)
Total area of VME	19,824	(100)	6,983	(100)	3,505	(100)

## VME risk/impact categories - Biomass (kg)

	Sponges		Sea pens		Large gorgonians	
	kg	(%)	kg	(%)	kg	(%)
VME at Low risk	113,157	(73)	20	(19)	132	(63)
Closure inside footprint	49,541	(32)	20	(19)	115	(55)
Closure outside footprint	45,806	(30)			17	(8)
Outside fishing footprint	17,810	(11)				
VME Impacted	25,621	(17)	45	(42)	48	(23)
VME at High risk	16,149	(10)	41	(39)	28	(14)
Total biomass of VME	15,4926	(100)	106	(100)	208	(100)



### Definitions of criteria used to assess SAI in the current study

SAI criteria	Definition
Area/Biomass at low risk	This refers to the proportion of the area or biomass of VME which is currently at low risk either because it falls within a fishery closure area and/or is in an area outside of the fishing footprint
Area/Biomass impacted	Proportion of the area or biomass of VME which has been exposed to a level of fishing effort above the defined cut-off point within any one year
Area/Biomass at high risk	Proportion of the area or biomass of VME which falls below the defined cut-off point of fishing effort within any one year.
Number of overlapping VMEs	Proportion of area overlapping with other VMEs
Fishing effort/biomass cut-off value (Index of VME sensitivity)	The impact cut-off values for each of the VMEs are used as a proxy of sensitivity (a high cut-off value indicates a low sensitivity)
Index of fishing stability	Number of cells consistently fished above the impact cut-off value over time as a proportion of the total cells impacted
Index of Risk of VME fragmentation	Proportion of discrete VME without protection

### Quantitative evaluation of SAI criteria

SAI criteria	Sponge		Sea pen		Large gorgonian	
	Area	Biomass	Area	Biomass	Area	Biomass
Low risk	65%	73%	16%	19%	56%	63%
High risk	14%	10%	46%	39%	12%	14%
Impacted	21%	17%	38%	42%	31%	23%
VMEs overlapping	11%		2%		74%	
Index of Sensitivity	0.3		0.5		0.1	
Fragmentation	1%		26%		2%	
Fishing area stability	32%		14%		21%	
Overall risk of SAI	Low		High		Low	

## SC Conclusion

SC completed the assessment of the risk of Significant Adverse Impacts (SAIs) from bottom fishing activities on VMEs in the NRA. The results indicated that both large gorgonians and sponges VME have a low overall risk of SAI, while sea pen VMEs were assessed as having a high overall risk of SAI.

SAI criteria	Sponge		Sea pen		Large gorgonian	
	Area	Biomass	Area	Biomass	Area	Biomass
Low risk	Low	Low	High	Mod	Mod	Low
High risk	Low	Low	High	High	Low	Low
Impacted	Mod	Mod	High	High	High	Mod
VMEs overlapping	Mod		High		Low	
Index of Sensitivity	High		Mod		High	
Fragmentation	Low		High		Low	
Fishing area stability	Low		High		Low	
<b>Overall risk of SAI</b>	<b>Low</b>		<b>High</b>		<b>Low</b>	

## Improvements

- Assess the overlap of fisheries with VME to assess fishery specific impacts as proportion of area – (WGEAFFM 2016)
- Consider options for objective weighting criteria for the overall assessment (WGESA 2016)
- Conduct studies to support assessment of functional SAI criteria, e.g. resilience (recovery potential), links with fisheries etc.

Report has not considered what if any options are needed for management response.....

**Annex 4. Maps of Candidate Areas 13 and 14 referred to in Recommendation 5**

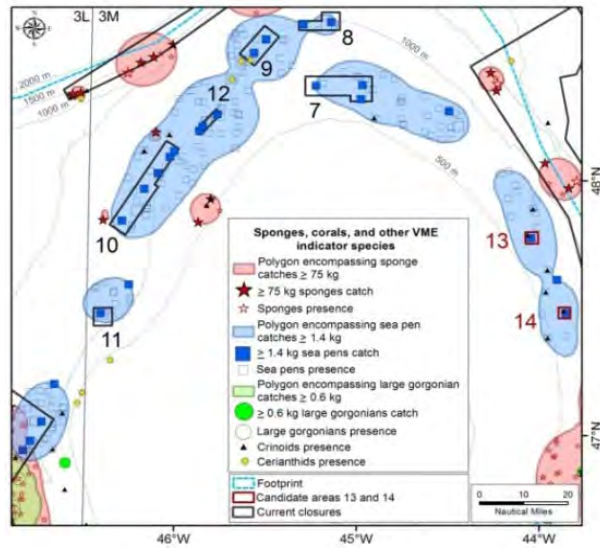


Figure 1. Closed Areas 7 – 12 and Candidate Areas 13 and 14.

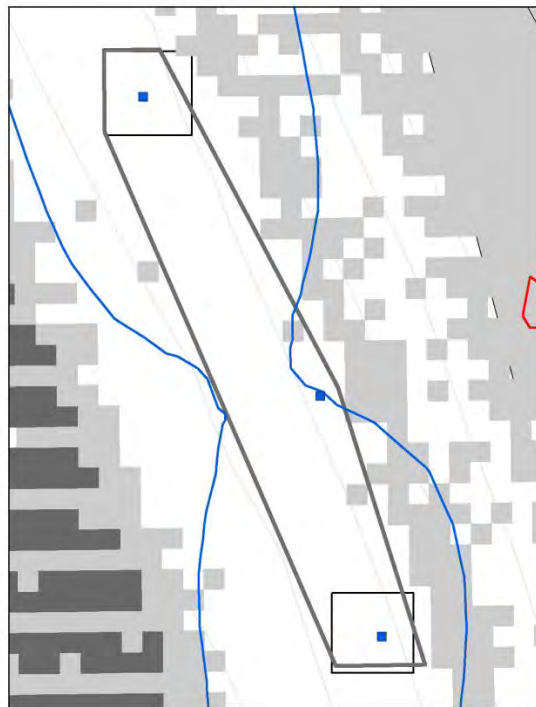


Figure 2. Candidate Areas 13 and 14 from 2003-2013 VMS data.



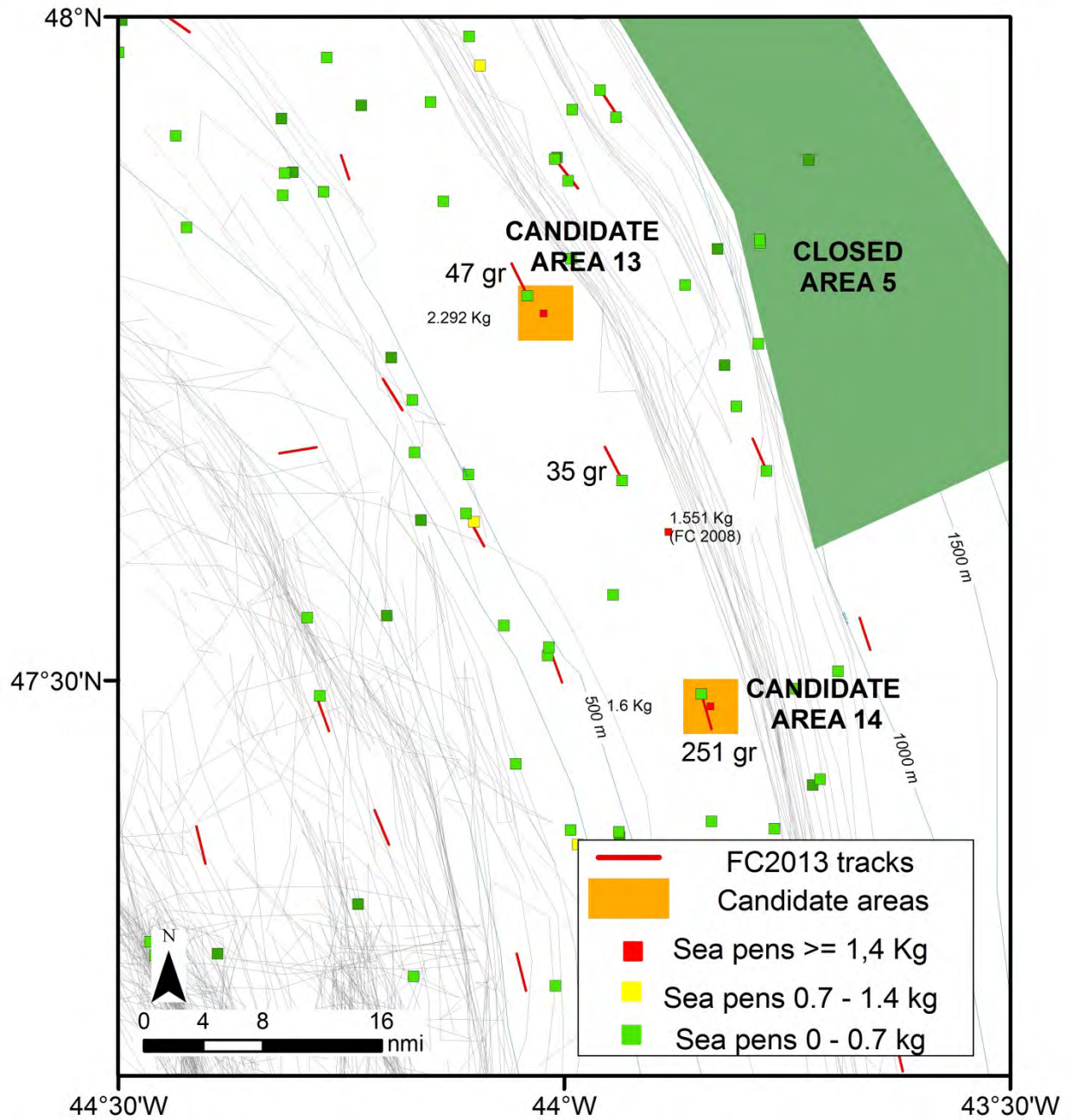


Figure 3. Candidate Areas 13 and 14.

## **Annex 5. Progress on the NAFO Roadmap towards an Ecosystem Approach to Fisheries**

NAFO FC-SC WG-EAFFM Meeting  
10-12 August 2016, Halifax, NS

1

# Progress on the NAFO Roadmap towards an Ecosystem Approach to Fisheries (EAF)

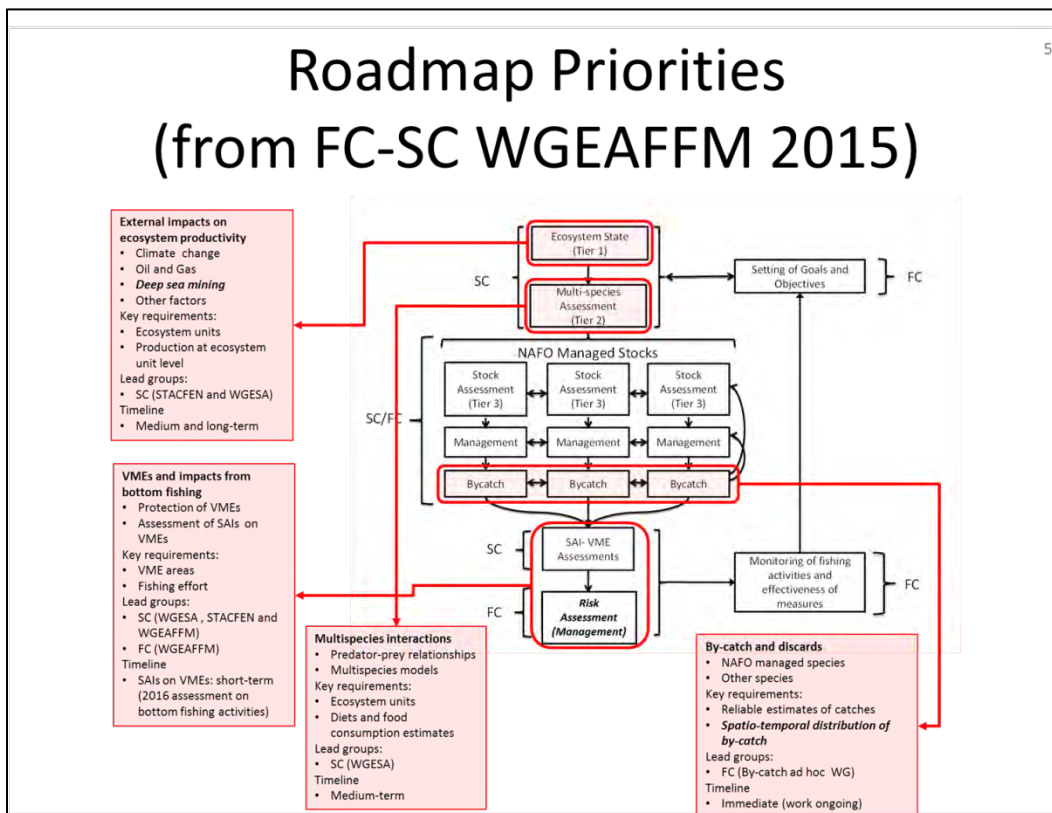
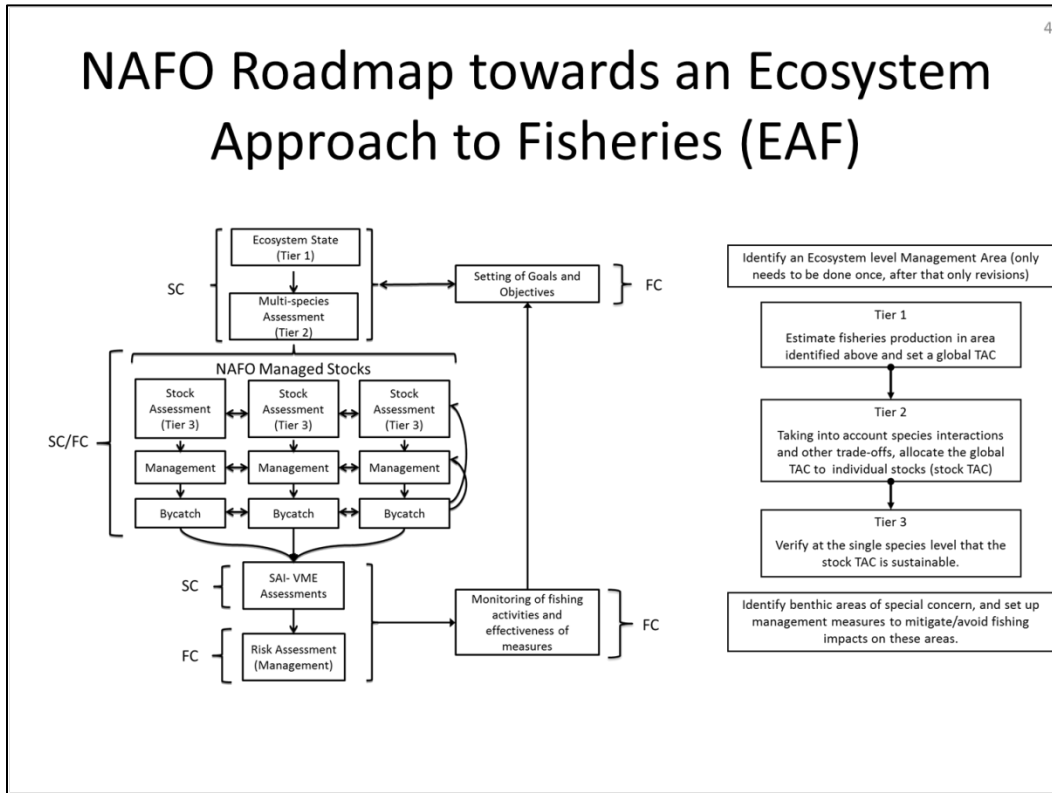
Mariano Koen-Alonso

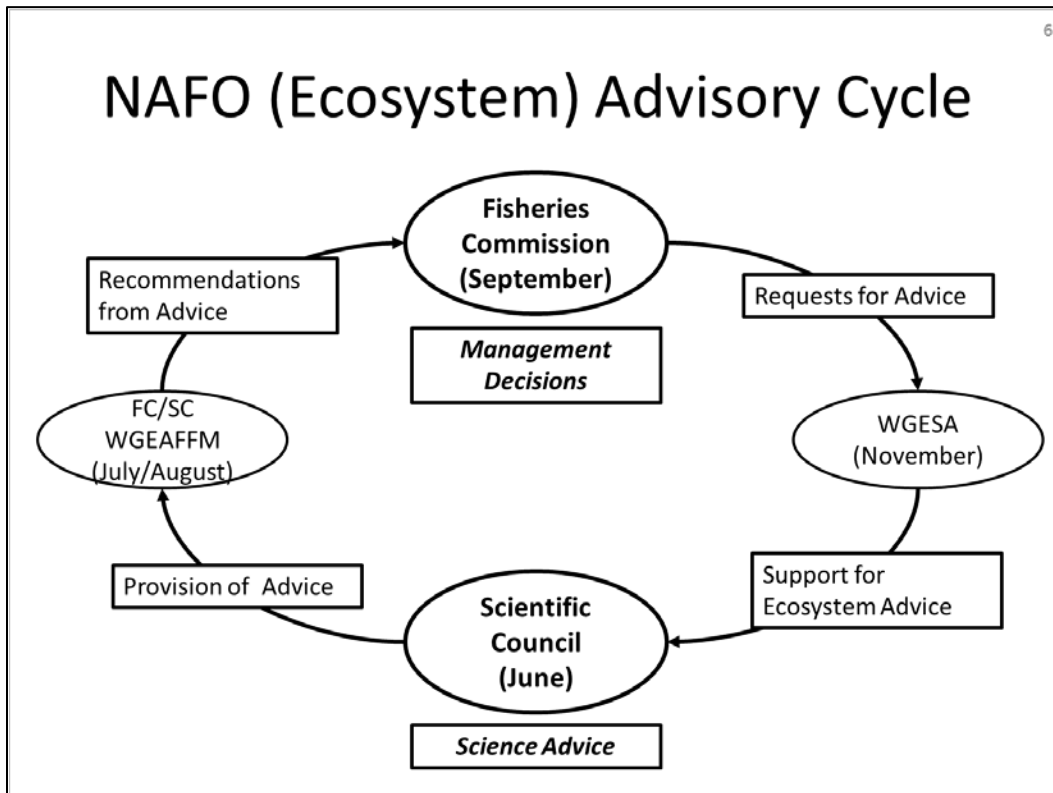
2

## Quick Outline

- Introduction
- Roadmap progress
  - EPP models, FPP, and Guidelines for Total Catch Ceilings
  - Selected highlights from SC WGESA worth keeping in mind (1 slide each)
    - Multispecies model for Flemish Cap
    - Expansion of silver hake into the Grand Bank
    - Slow-down of groundfish rebuilding in Newfoundland Shelf
- Other considerations

Ecosystem Approach to Fisheries in NAFO – **INTRODUCTION** (slide 3)





NAFO Roadmap towards and Ecosystem Approach to Fisheries (EAF) - **PROGRESS ON ROADMAP** (slide 7)

8

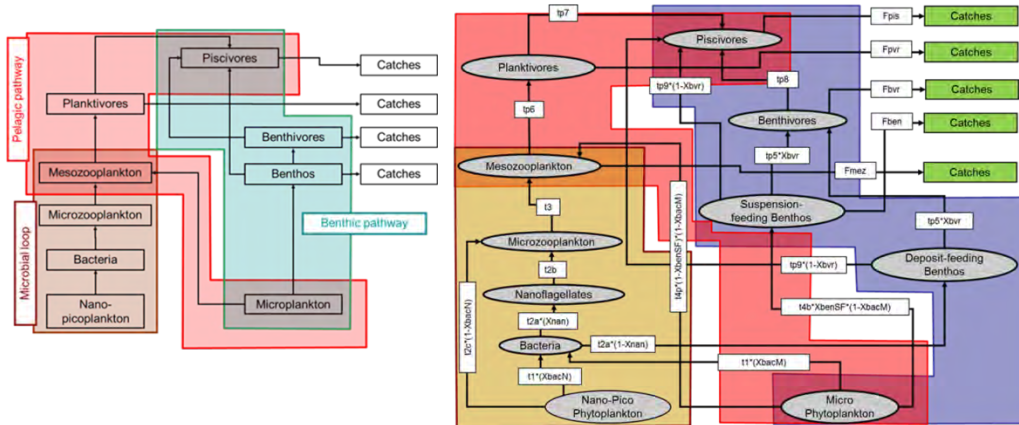
## Pilot EAF exercises

- SC is pursuing EAF pilot exercises for the Newfoundland Shelf (2J3K), Grand Bank (3LNO), and Flemish Cap (3M) Ecosystem Production Units (EPUs).
- Initial guidelines for Total Catch Ceilings for these EPUs were presented at FC/SC WGEAFFM in 2015.

# Ecosystem Production Potential Models

EPP-v1: Original

EPP-v2: Updated version



9

## EPP-v2:

### what's new and what does it mean

#### What's new

- Improved description of the microbial loop
- Explicit benthic-pelagic coupling
- Split of benthos production into suspension-feeding & deposit-feeding benthos
- Allows for the possibility of fishing on meso-zooplankton

#### What does it mean

- Very little difference in productivity for most exploitable nodes.
- Important increase in overall benthos productivity.
- Differences have only minor impacts for pilot EAF exercises.
- This suggests that production potential of upper trophic levels appears reasonably captured.

10



11

## Fisheries Production Potential: new runs

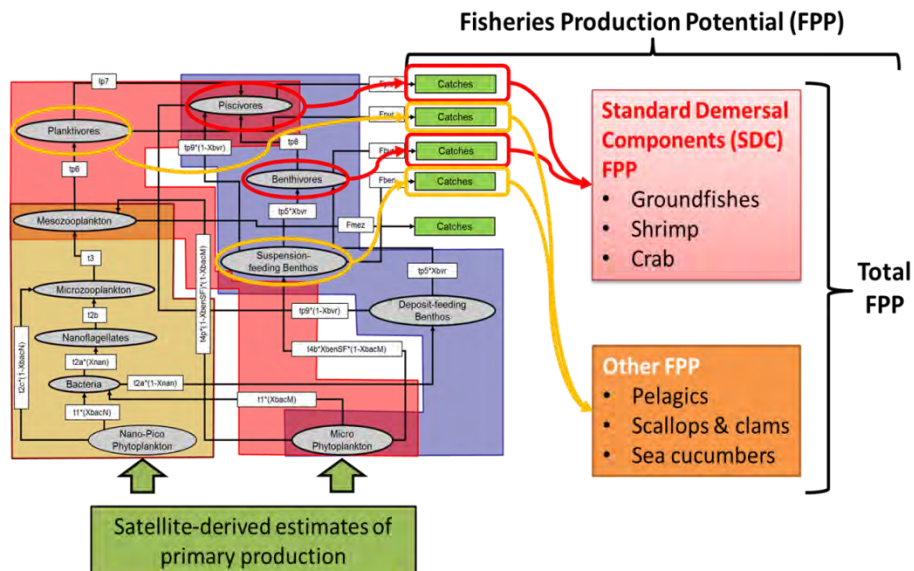
- Maximum sustainable exploitation rate was defined as the median of all the microplankton/total production values for large marine ecosystems around the world (Rosenberg et al. 2014):

$$F=20\%$$

- Other assumptions similar as before:
  - Only 50% of pelagic production is from spp of potential “commercial” value.
  - Only 10% of suspension feeding benthos is from spp of potential “commercial” value.

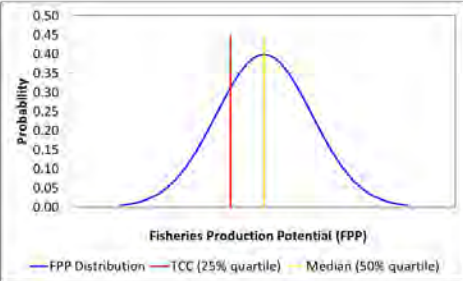
12

## FPP calculation



13

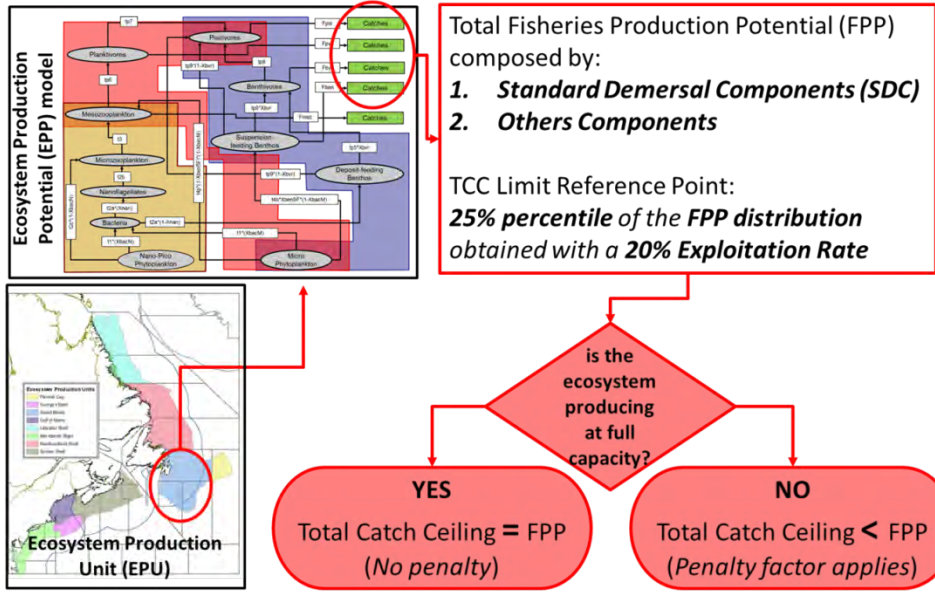
## Fisheries Production Potential as a Limit Reference Point



- Estimates of FPP should be considered as Limit Reference Points (LRPs).
- Therefore, catches should have a low probability of exceeding FPP.
- Although the exact value of “low probability” is not defined in the NAFO PA framework, it is exemplified using a 20% value.
- Following this rationale, the 25% percentile of the distribution of FPP can be used to define a Total Catch Ceiling (TCC). This would ensure that total catches would have a low probability of exceeding the ecosystem sustainability level.
- The median of the distribution can provide an indication of situations where total catches have clearly exceeded sustainability levels.

14

## Calculation of Total Catch Ceilings



**Total Fisheries Production Potential (FPP) composed by:**

1. **Standard Demersal Components (SDC)**
2. **Others Components**

**TCC Limit Reference Point:**  
**25% percentile of the FPP distribution obtained with a 20% Exploitation Rate**

is the ecosystem producing at full capacity?

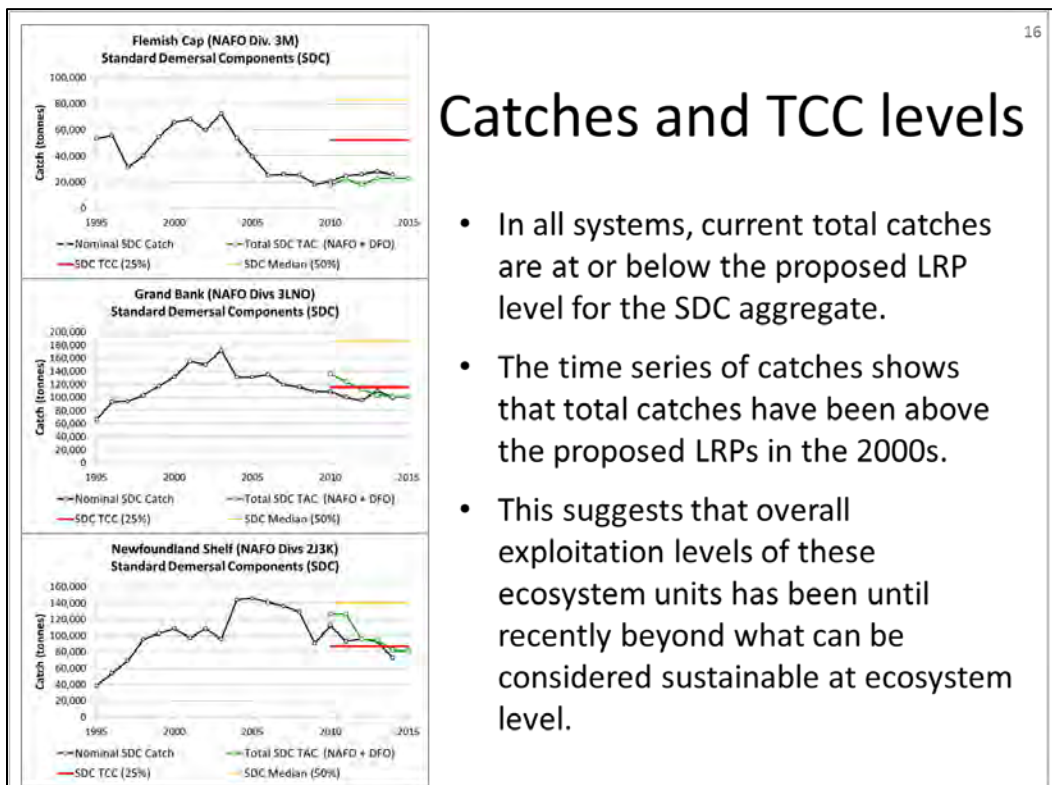
**YES**  
Total Catch Ceiling = FPP  
(No penalty)

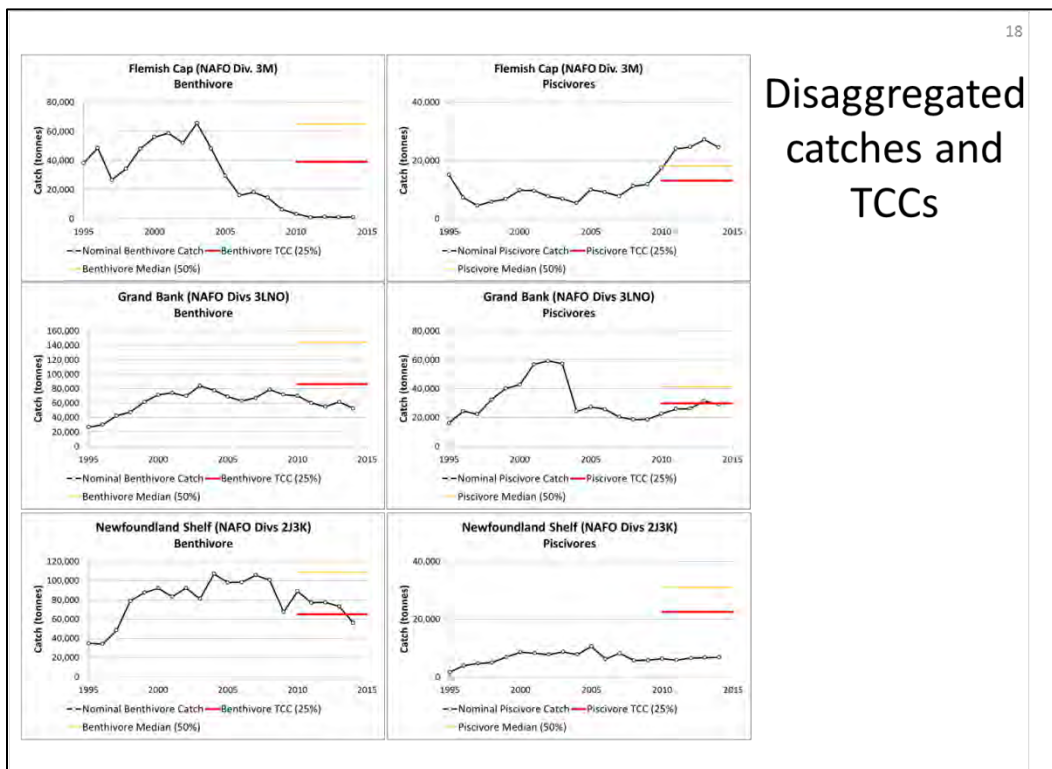
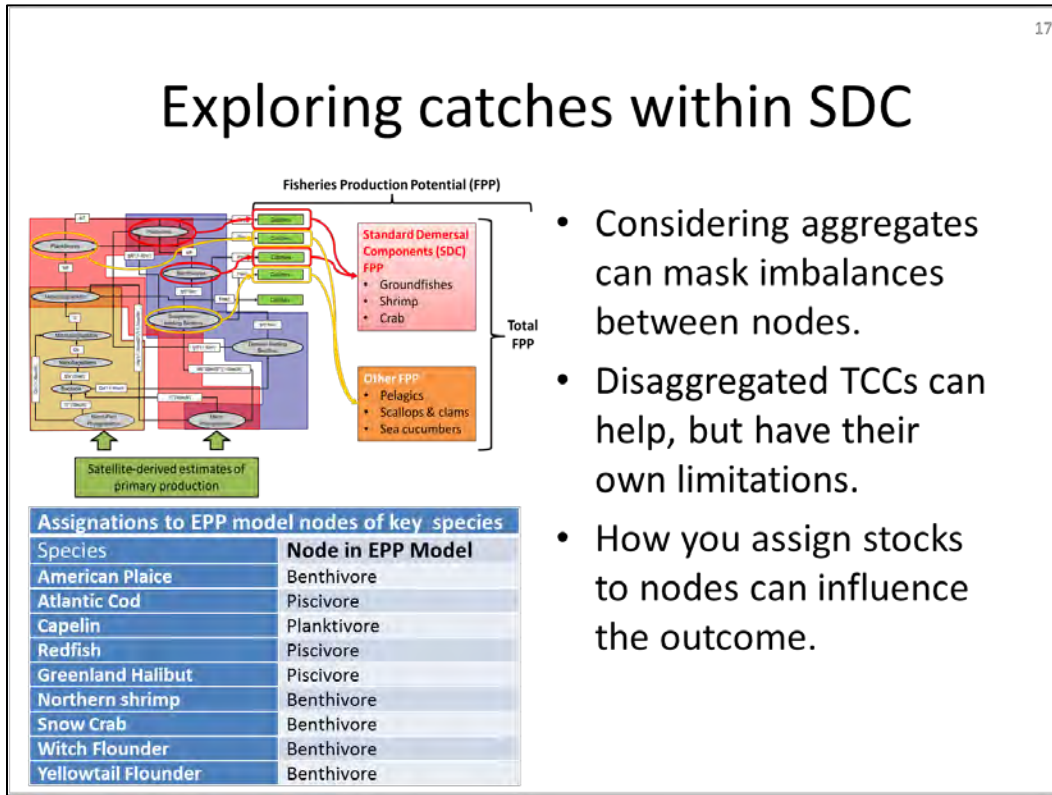
**NO**  
Total Catch Ceiling < FPP  
(Penalty factor applies)

15

## Updated TCC for pilot EAF EPUs

Guidelines for Total Catch Ceilings (TCC)				
	Standard Demersal Components (SDC)		Others	
	Proposed LRP (in tonnes) <small>(25th percentile of FPP distribution)</small>	Median (in tonnes) <small>(50th percentile of FPP distribution)</small>	Proposed LRP (in tonnes) <small>(25th percentile of FPP distribution)</small>	Median (in tonnes) <small>(50th percentile of FPP distribution)</small>
<b>Flemish Cap EPU (3M)</b>	<b>52,000</b>	83,000	<b>75,000</b>	115,000
<b>Grand Bank EPU (3LNO) <i>penalty:50%</i></b>	<b>116,000</b>	186,000	<b>170,000</b>	259,000
<b>Newfoundland Shelf EPU (2J3K) <i>penalty:50%</i></b>	<b>87,000</b>	140,000	<b>130,000</b>	202,000





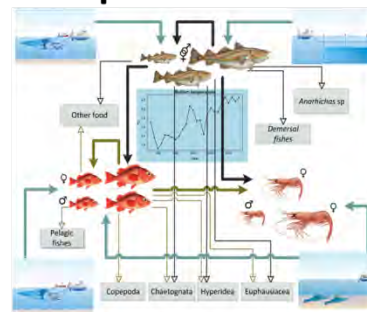
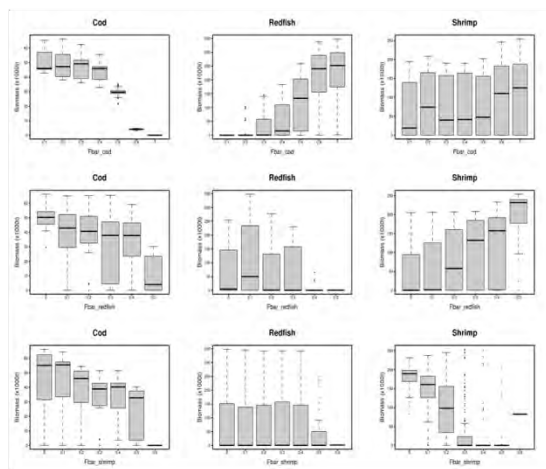


## Conclusions

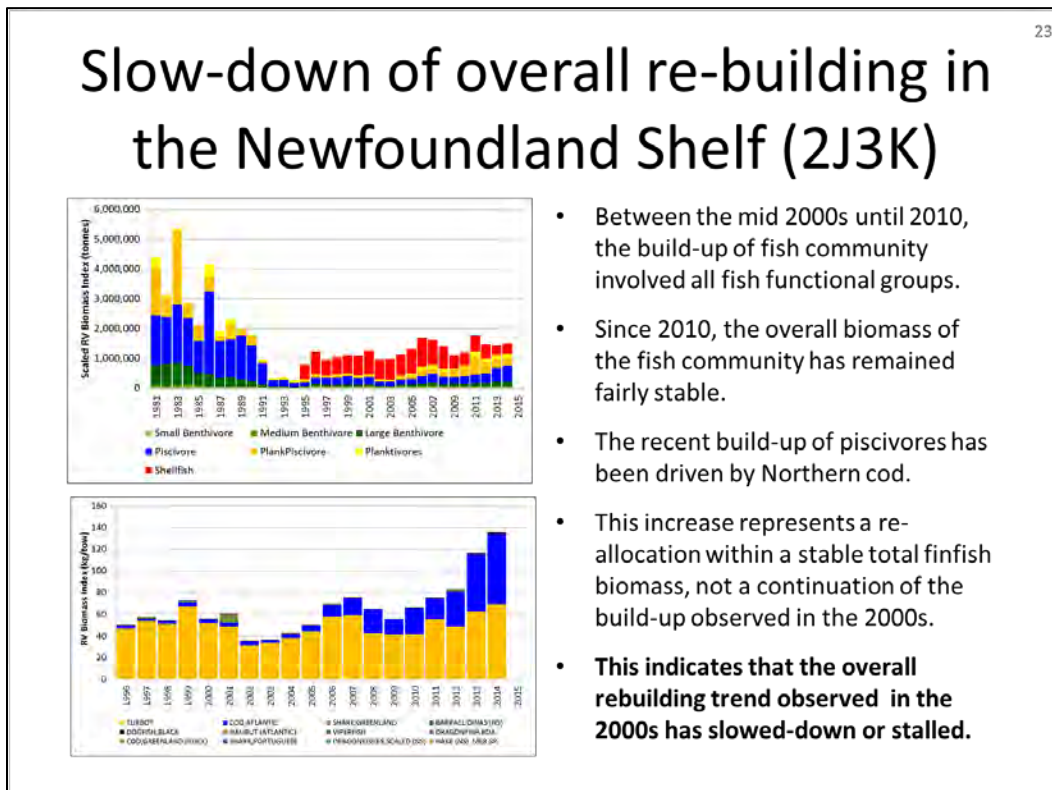
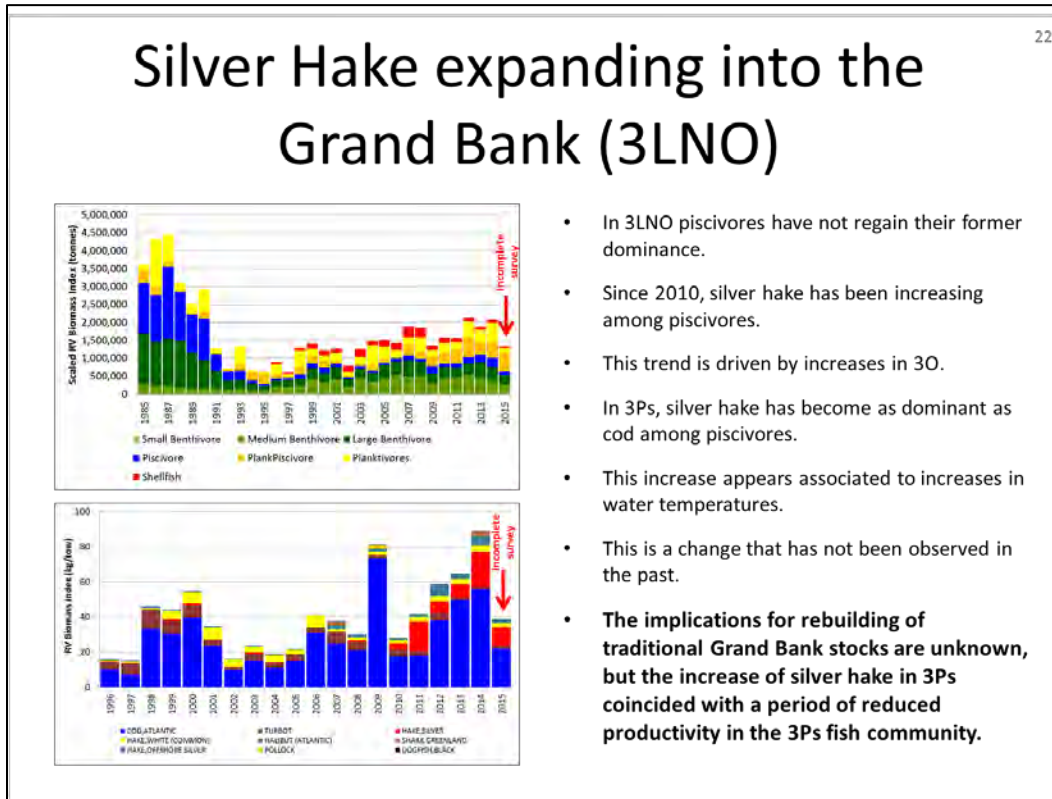
- **2J3K and 3LNO EPUs:** Current catch levels currently within the sustainability envelope, but with little space for growth with perhaps the only exception of piscivores in 2J3K.
- **3M EPU:** Overall catches at the SDC aggregate level appears well within sustainable bounds, but this catch is severely biased towards piscivores. Sustainability at the ecosystem level may be in jeopardy. To prevent impacts on this ecosystem unit, it would be advisable to moderate catches on cod, redfish or both.
- The results for the Flemish Cap indicates that considerations of multispecies interactions are required to properly assess the sustainability of the current catch levels.
- Furthering implementation of Tier 1 of the Roadmap (i.e. TCC implementation) requires that cumulated TACs (and total catches) within these ecosystems units are routinely compiled, presented, and considered as part of the management process.

SC WGESA work – **HIGHLIGHTS WORTH KEEPING IN MIND** (slide 20)

## GadCap: Multispecies model for the Flemish Cap



- GADGET architecture
- Preliminary results capture general dynamic relationships well.
- More work and improvements were done after WGESA and presented at SC. Future work uncertain
- **Key observation:**
  - **Stock productivities of redfish and cod in the Flemish Cap are not independent.**





What is coming – **OTHER CONSIDERATIONS** (slide 24)


25

## What is coming: Things that can affect everyday work

### **Scientific Council**

-  Ecosystem summary sheets (WGESA ToR for 2016)
-  Dwindling capacity in ecosystem research (beware for FC requests)
  - Loosing capacity (WGESA members moving-on, unable to find replacements for outgoing co-chairs, shrinking support by CPs to ecosystem work in NAFO).
  - Increasing turnover membership (hinders multi-year programs).

### **International**

-  UNGA 69/292 (19-Jun-2015).
  - Development of an international legally binding instrument under UNCLOS on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction.
  - Report to UNGA from Preparatory Committee by end 2017.
  - Impact on NAFO unknown.