MANAGEMENT STRATEGY EVALUATION (MSE) 101

Indigenous Information Package

PROTECT + ENHANCE + RESTORE

NOVEMBER 26, 2020

MANAGEMENT STRATEGY EVALUATION (MSE) 101 : INDIGENOUS INFORMATION PACKAGE
Island Marine Aquatic Working Group

ISLAND MARINE AQUATIC WORKING GROUP

Management Strategy Evaluation (MSE) 101 : Indigenous Information Package

Table of Contents

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OVERVIEW

What is a Management Strategy Evaluation?

Management Strategy Evaluation (MSE) is a name for a specific type of decision-making process used to determine preferred management approaches/procedures for a specific fishery. The management procedures are weighed against pre-determined Objectives, which are defined by Policy, First Nations, Stakeholders and Non-Government Agencies. Currently, the management of Pacific Herring in British Columbia is transitioning to this style of management.

Basically, "MSE" is a fancy name for a more inclusive, transparent way of managing a fishery.

It involves simulation testing (aka. computer modelling) of how various **Management Procedures** MAY perform relative to identified **Management Objectives**.

KEY: It's not about forecasting and models alone, it's about involving and incorporating the needs and wants of Indigneous communites, stakeholders, user groups and conservation objectives into the management of herring.

Figure 1. An overview of the MSE Process Source: http://www.cmar.csiro.au/research/mse/

Approach and Components of the MSE

MSEs can take several years to complete and often are iterative processes, in which the whole process is continuously re-vistied every few years to see if it is still working and if new management procedures or objectives need to be added/explored or revised. For this reason, DFO is completing "Cycles" or phases.

Management Strategy Evaluation Approach (a "cycle"):

1. Develop **measurable objectives**
2. Identify **management procedures**
3. Test drive **management procedures** in computer simulation using operating models
4. Evaluate management outcomes in meeting the **measurable objectives**
5. Communicate results and apply preferred **management procedures** consistently
6. Learn, repeat, revise – make system better, not worse

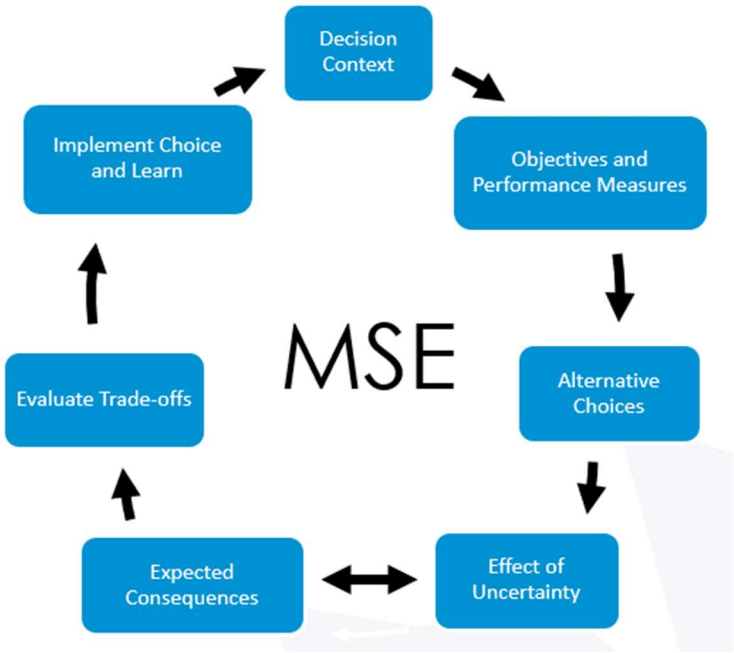

Figure 2. Overview of a "Cycle" in the MSE Approach, created by DFO Herring Team

There are a number of components to the MSE process. Of particular importance to the MSE process is the identification of **OBJECTIVES. See Appendix 2 – 4 for guidance on developing Objectives and specific examples.**

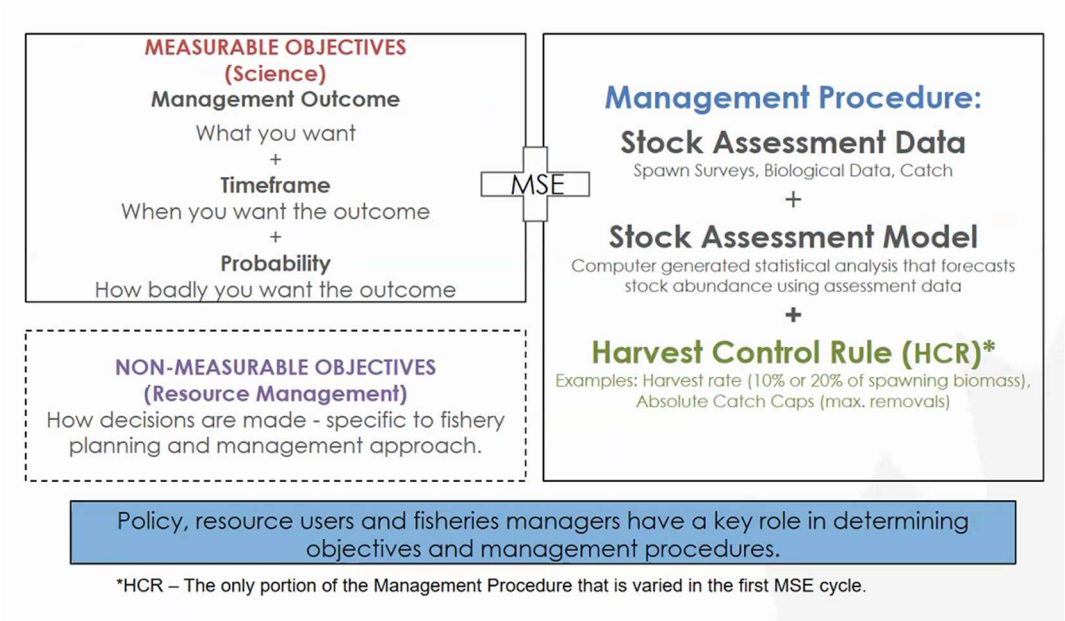

Figure 3. An Overview of the Compoinents of the MSE Process

OBJECTIVES

By developing objectives, Indigenous communities have the opportunity to state the kind management objectives they want to see for the herring fisheries in their territories.

> First Nations, policy, stakeholders, resource users and fisheries managers have a **key role** in determining **objectives**.

Objectives start with an overall **Goal.**

For example a goal could be: ***Protect Indigneous rights based (Aboriginal and Treat rights and priority access) fisheries.***

The overall goal is then used to develop objectives.

There are two different "types" of objectives:

1. **Measurable Objectives – these are objectives that can be measured quantitatively using science**
    a. **Example of a Measurable objective:** By 2018, regular commercial fisheries can only occur in a management area if the forecast and in-season return is greater than 15,000 tonnes for that management area 90% of the time.

2. **Non-measurable Objectives (aka *Operational* Objectives) – these are objectives that cannot be measured.** Instead they fall within fishery management.
    a. **Example of a Non-Measurable objective:** By 2020, no Food & Bait herring fisheries until [the local Indigneous community) have been consulted and accommodated each year 100% of the time.

Both are important. It is also important to develop a series of **Objectives.**

Examples of Objectives are provided in Appendix 2.

Management Procedures

Management procedures calculate the catch limit. They include anything that humans can control. They cannot include anything that nature controls.

An example of a management procedure is the Harvest Control Rule. The Harvest Control Rule is set at a specific level of harvest to meet objectives.

Real Life Fishery Examples of MSE process

The MSE process has been implemented in a number of fisheries around the world, including:

- Pacific Halibut
- Sablefish
- South African Hake
- New Zealand Rock Lobster

BENEFITS OF MANAGEMENT STRATEGY EVALUATION

What are the benefits of an MSE for Indigneous Communites?

MSE allows Indigneous communities to actively participate and state the kind of **Management Objectives** they want to see for the herring in their territory. Through Objectives established in the MSE Process, First Nations are given a stronger voice in how the fishery is managed. Through "objective setting" and the MSE process there is a systematic way to incorporate traditional knowledge, Indigneous perspectives, and specific local needs and directives for herring, within the broader herring management context.

For example, Nations on the West Coast of Vancouver Island have indicated (through Traditional Ecological Knowledge) that herring spawn used to be much deeper (12 layers) and that they would like to see the herring spawn this thick again. This was then turned into an Objective and incorporated into the Management process.

What are the overall, general benefits of an MSE

- Increased transparency in decision making
- Indigenous communities, stakeholders, user groups, and managers have have input into the management.
- Helps to identify management plans that are more precautionary and more robust to natural variation in the environment and to uncertainty and error in science.
- Through the MSE Process, DFO has learned that they need to manage stocks differently, with different Harvest rates, management procedures, etc. As heard by DFO science, some things that have been learned through the MSE process to date include:
    - **Stock specific needs are coming out through the simulations**
    - Assessment model can OVER estimate spawning biomass = quotas set higher than intended
    - Continued use of the "old" Management Procedures could = over-harvest
    - Being aware of this allows science to make recommendations for catch caps that prevent overharvesting.
    - Changes to harvest rates (HR) (reductions) and catch caps reduce the impact of assessment errors and help keep stocks away from critical levels.
    - Generic harvest control rule of 20% does not fit all stocks

FREQUENTLY ASKED QUESTIONS

How is MSE different from the usual DFO Fisheries Management process?

The MSE process is different from the usual or "status quo" way that DFo managed the fishery in the past:

- More transparent decision making
    - Results are presented by Science and show which management actions/decisions will meet each objective and which won't. This allows First Nations to see how their objectives are met and ranked by fisheries managers and decision makers.
- Involves more upfront input from First Nations, stakeholders and the public and more technical analysis.
- Before MSE, the Department managed all herring stocks to the same "generic" Harvest Control Rule of 20%.
    - MSE simulations have shown that some stocks will decline at this harvest rate, while others may not. So, it has forced the Department to change the way it was managing.

MSE "does not seek to proscribe an optimal strategy or decision. Instead it seeks to provide the decision maker with the information on which to base a rational decision, given their own objectives, preferences, and attitudes to risk."

-Source: http://www.cmar.csiro.au/research/mse/

How do Indigneous Communities actually contribute to the process?

There are a number of ways that Indigneous communities can contribute to the process. To date, Indigneous communities and groups have been involved in different ways.

For example, on the West Coast of Vancouver Island, the Nuu-chah-nulth Tribal Council (NTC) has been involved with the MSE process since 2015. NTC created a Herring Technical Working group (involving both DFO and Indiengous participants) to begin developing objectives. Once the working group developed preliminary objectives, they were reviewed and approved by the Council of Hawiiah.

Other Indigneous groups have participated in workshops. Others have chosen to engage bilaterally with DFO to develop Objectives.

Timelines/Schedules

Because it is so time consuming to complete a full cycle of the MSE simulations every year for all of the Major stock areas, DFO is working in Cycles. Cycles will be completed every two years.

Cycle 1 of the MSE Process was completed in 2019.

Cycle 2 of the MSE process will begin in summer 2020.

- Cycle 2 will involve incorporating and simulating objectives for the westcoast Vancouver Island and Strait of Georgia.

What are the limitations or uncertainties of the MSE?

Although there are a number of benefits and improvments from the old way of managing herring, there are limitations to the MSE process (listed below). But there are uncertainties and limitations to any Fishery Management system.

- No way to rank objectives
- New process, learning as we go
- Models are not perfect
- Unclear on repercussions if management decides to go against objectives
- Ultimately, decisions still rest with the Minister BUT, at least there is a roadmap and clear objectives and Legislation in place that the Minister must justify his/her decision against. This means it is much more transparent than it has been in the past.
- The MSE approach is only as good as the underlying models and assumptions it is based on

Herring Management Areas

Below is a list of the current DFO Herring Management Areas. There are 5 MAJOR stock areas and two MINOR stock areas. Maps are provided in Appendix 2.

Five Major Stock Areas:

- Haida Gwaii
- Prince Rupert District
- Central Coast
- West Coast Vancouver Island (WCVI)
- Strait of Georgia

Two Minor stock areas:

- Area 2W
- Area 27

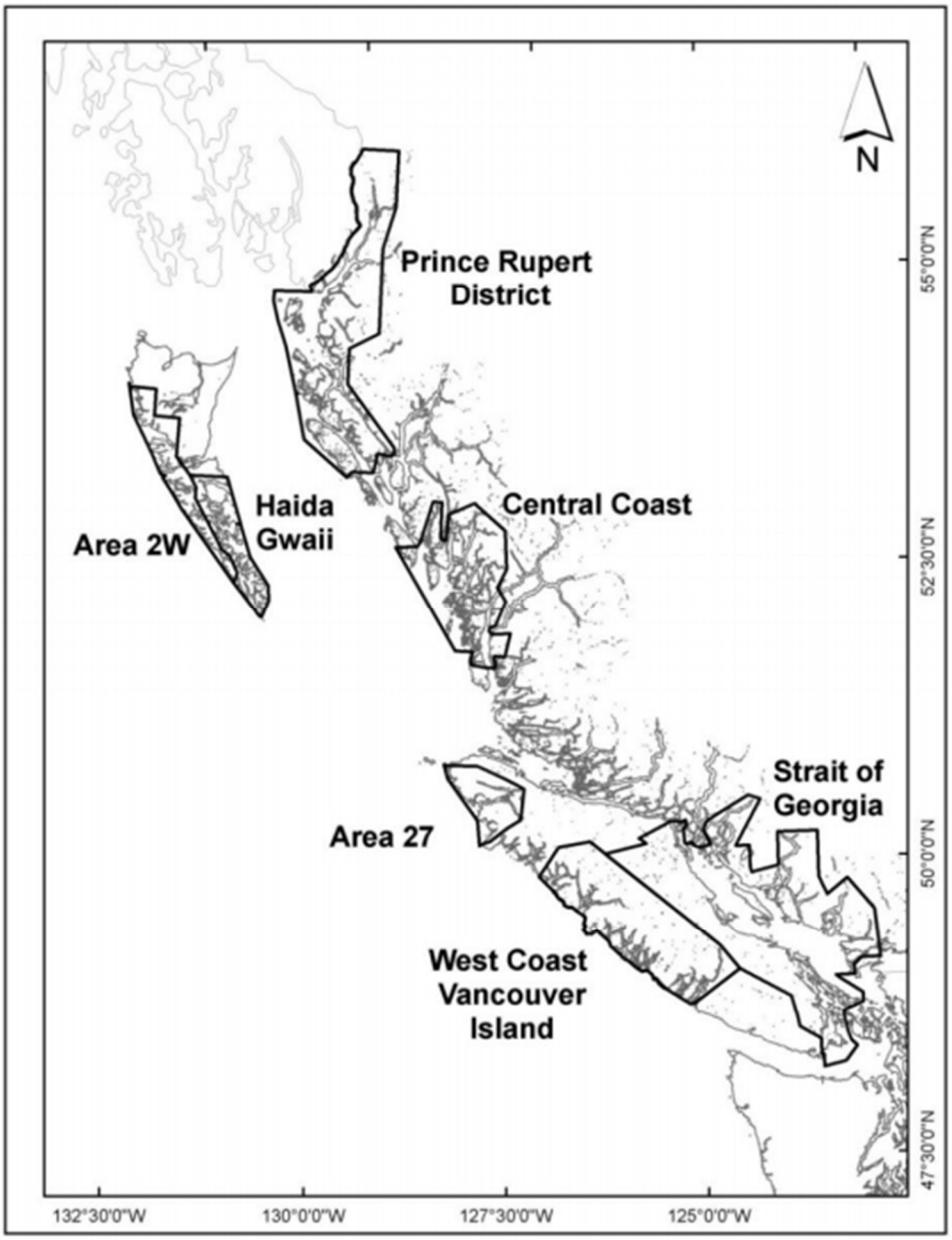

Figure 4. Map of the 5 **Major** and 2 **Minor** Pacific Herring stock assessment regions and fishing areas (Source: DFO Integrated Fisheries Management Plan http://www.pac.dfo-mpo.gc.ca/fm-gp/mplans/herring-hareng-ifmp-pgip-sm-eng.pdf)

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INTERNET RESOURCES

Management Strategy Evaluation for Fisheries

https://www.pewtrusts.org/en/research-and-analysis/fact-sheets/2016/11/management-strategy-evaluation-for-fisheries

Management Strategy Evaluation Development by the International Pacific Halibut Commission- Youtube video

https://youtu.be/1xOS2BTbquA

Glossary of Terms

Catch Cap	A model free way to cap the catch every year. So even if the model forecasts that there is enough biomass to remove over 2,000, the catch Cap prevents that from happening.
Constant mortality	Natural mortality will remain constant. Whatever the current natural mortality rate, is exactly what it will continue to be in the future.
Density Dependent Mortality (DDM)	Natural mortality is affected by the density of the herring population. When there are less herring, natural mortality increases. In this natural mortality scenario, the assumption is that there will be a very high mortality at a low spawning stock biomass.
Density Independent Mortality (DIM)	Natural mortality is not related to the density of the population. In this natural mortality scenario, the assumption is that natural mortality will follow the average trend seen in the last 10 years.
Harvest Control Rule	operational component of a harvest strategy (Management procedure). Essentially pre-agreed guidelines that determine how much fishing can take place, based on indicators of stock status. It is a decision making tool that is related to a Harvest rate
Harvest Rate (HR)	The rate at which a fish stock is harvested.
Limit Reference Point (LRP)	an undesirable state of a stock or fishery. Considered “serious harm”
Lower Control Point	The point where the biomass allows for a fishery
Management Procedure (MP)	procedure taken to calculate a catch limit.
Management Strategy Evaluation (MSE)	for a specific type of decision-making process to determine preferred management approaches/procedures to manage pacific herring in British Columbia.
Measurable objective	these are objectives that can be measured quantitatively using science
Non-measureable objective	These are also called "Operational objectives". These are objectives that cannot be measured. Instead they fall within fishery management rather than science.
Objective	Objectives are specific "wants" for the fishery. There are two types of objectives, measurable and non-measurable.
Operational Control Point (OCP)	Points where management can take actions
Projected SB_{2020}/SB_0	This is the projected spawning stock biomass for 2020 relative to the unfished biomass (or the Limit Reference Point).
SB_0	Unfished biomass
Spawning Biomass	The total weight of the fish in a stock that are old enough to spawn; the biomass of all fish beyond the age or size class in which 50% of the individuals are mature. For Pacific herring, age 2 is the average age at maturity.
Upper Control Point	The point where fisheries need to be ramped down to avoid the stock falling below the fishery reference point.
Upper Stock Reference Point	target stock status for ensuring an adequate buffer for avoiding serious harm to productivity

Appendix 1: Maps of Herring Management Areas

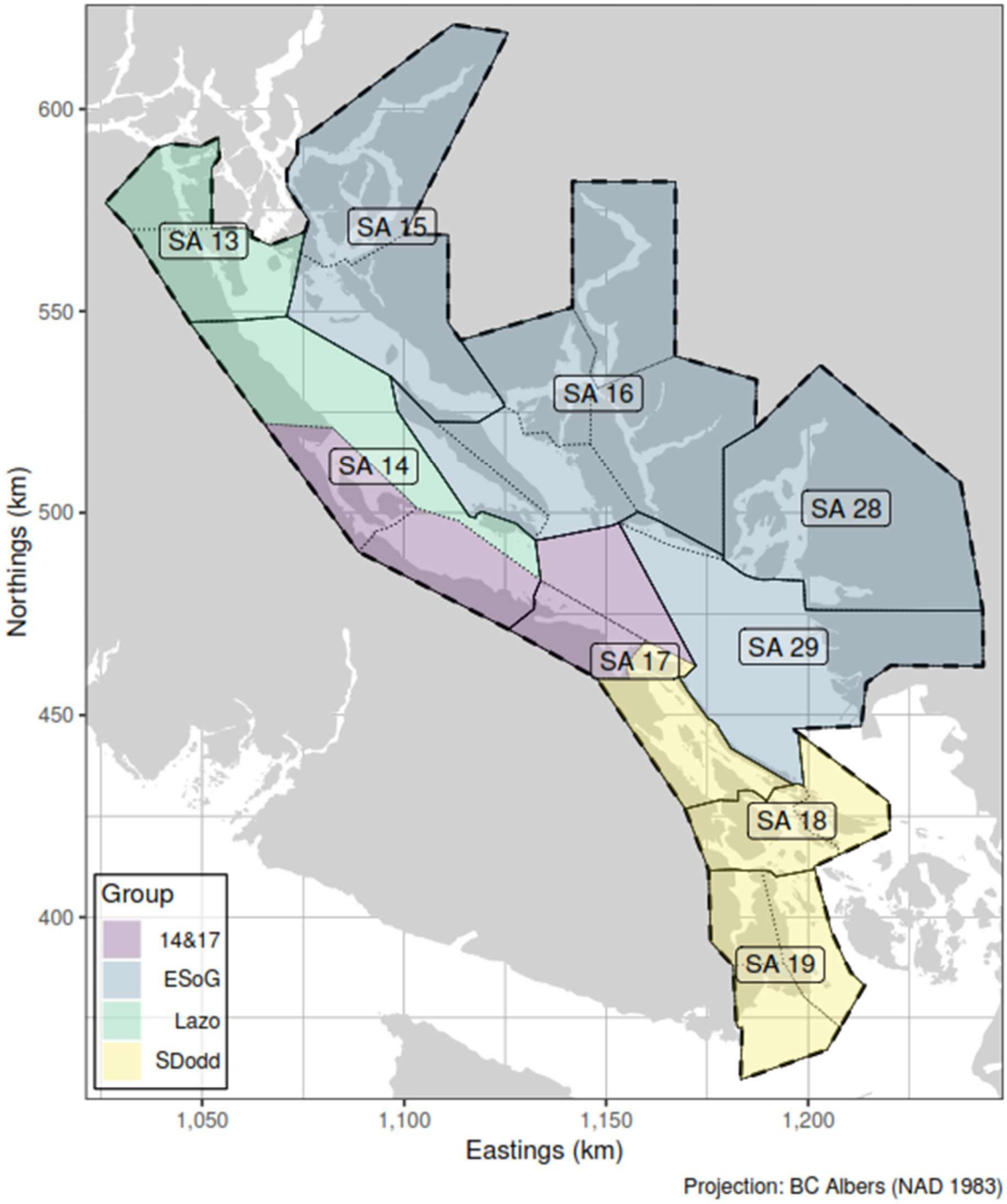

Figure 5. Boundaires for the Strait of Georgia **Major** stock assessment region. Figure 2. Boundaries for the Strait of Georgia major stock assessment region (SAR;thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines). Units: kilometres (km). Legend: `14&17' is Statistical Areas 14 and 17 (excluding Section 173); `ESoG' is eastern Strait of Georgia; `Lazo' is above Cape Lazo; and `SDodd' is South of Dodd Narrows. Source: DFO Pacific Herring preliminary data summary for Strati of Georgia, 2019. Available at: https://www.dropbox.com/s/hz4l2pfaknmhzgz/Final%202019%20Data%20Summaries.zip?dl=0

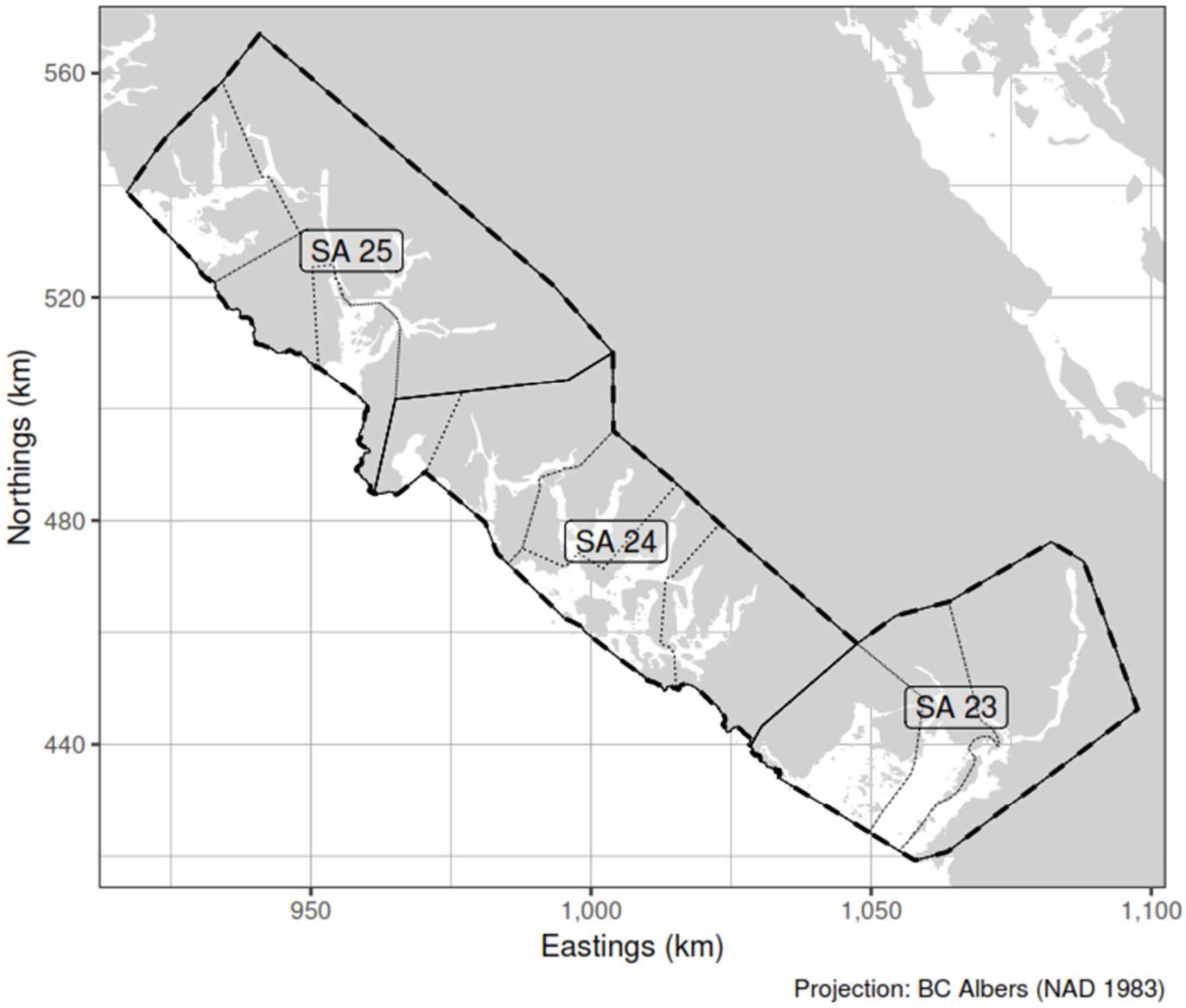

Figure 6. Boundaires for the West Coast of Vancouver Island Major stock assessment region region (SAR; thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines).

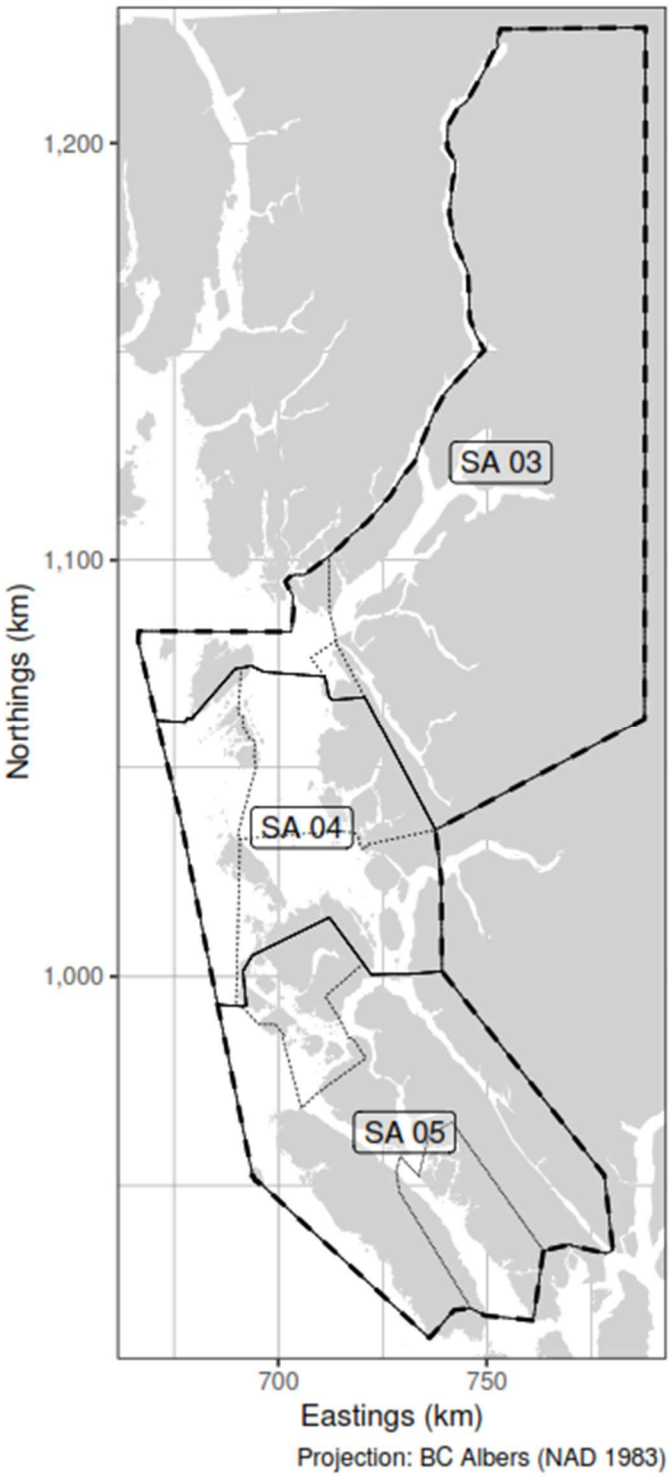

Figure 7 Boundaries for the Prince Rupert District **Major** stock assessment region (SAR; thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines).

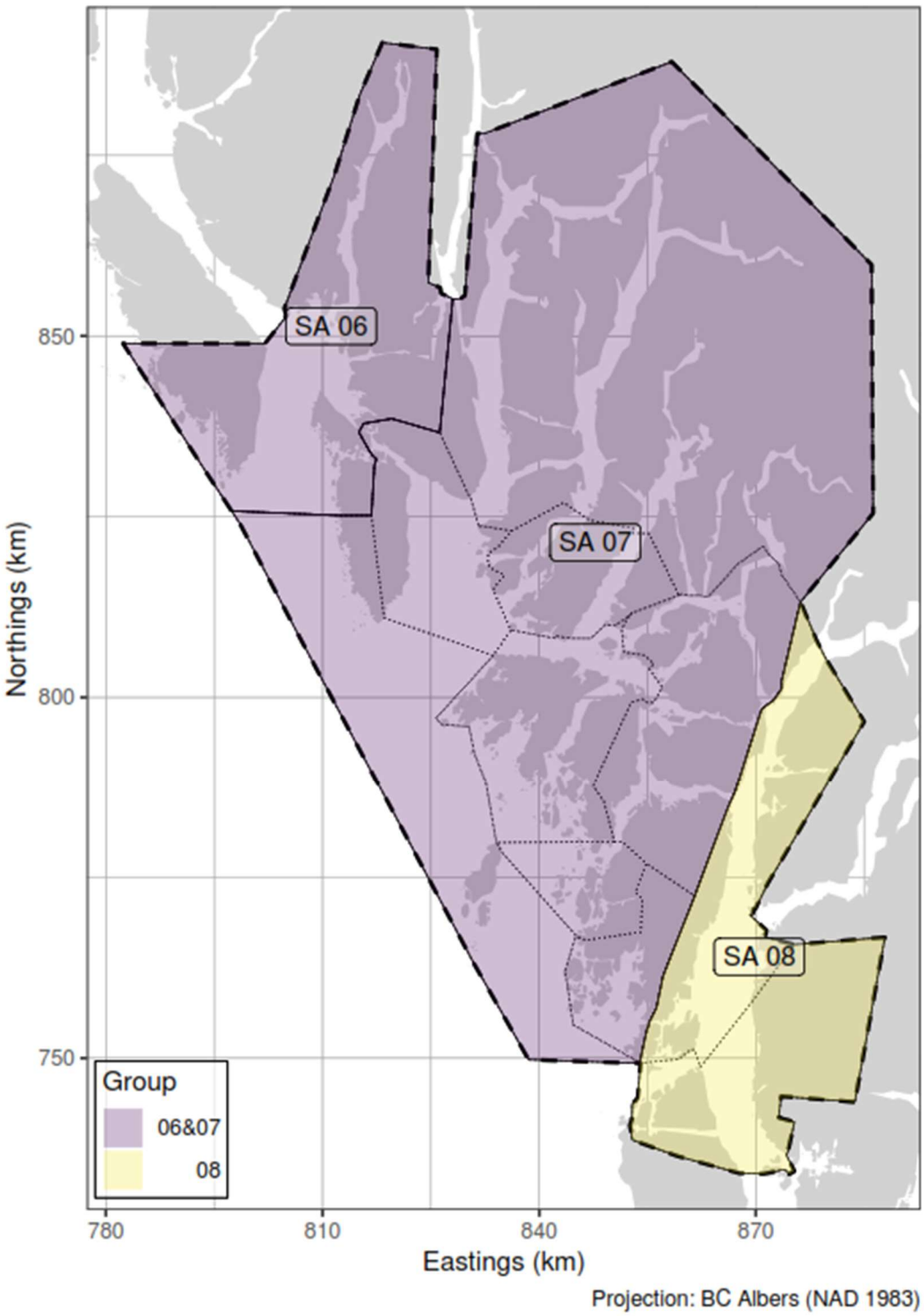

Figure 8 Boundaries for the Central Coast **Major** stock assessment retion (SAR; thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines).Legend: `06&07' is Statistical Areas 06 and 07; and `08' is Statistical Area 08.

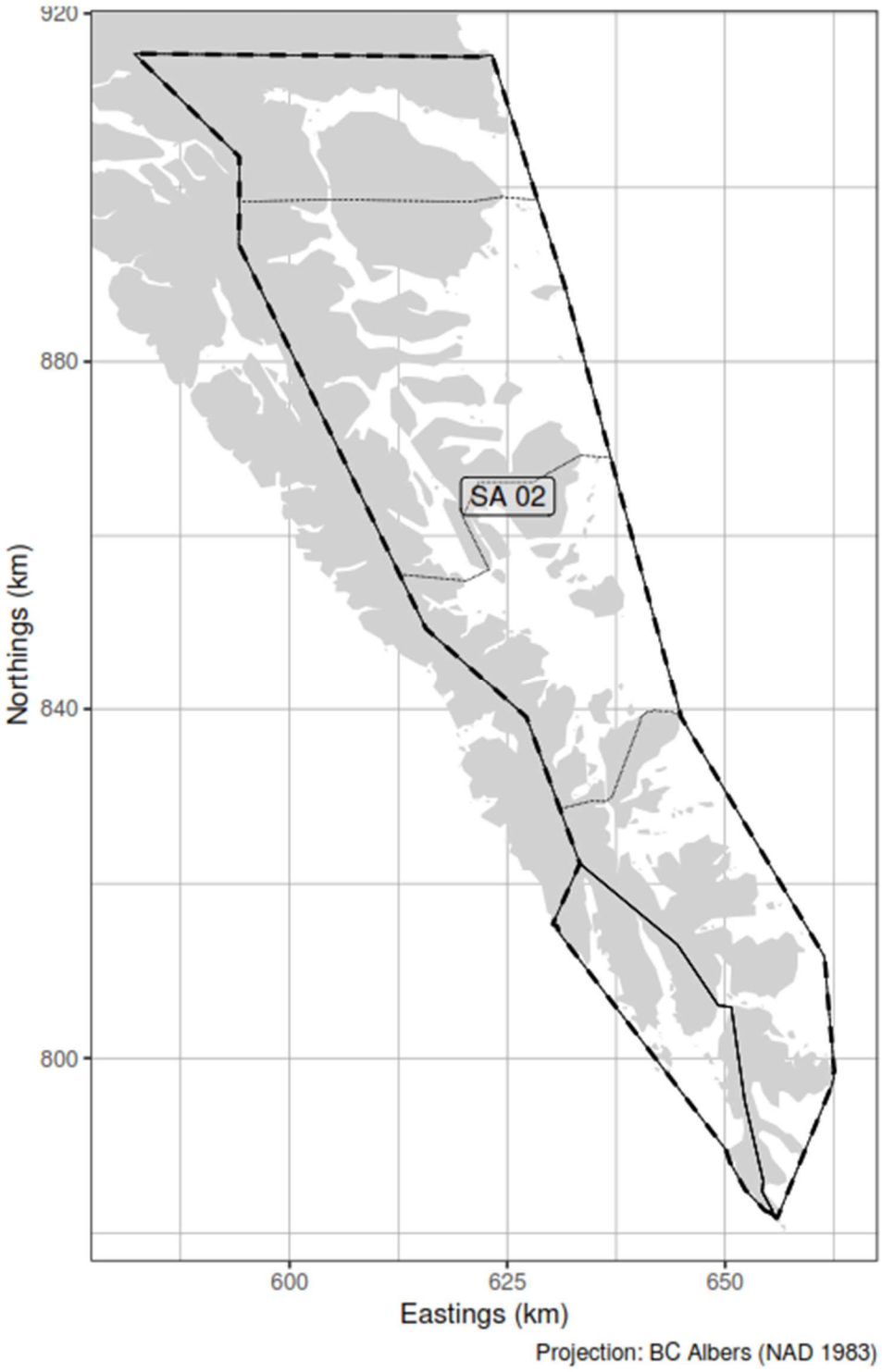

Figure 9 Boundaries for the Haida Gwaii **Major** stock assessment region.

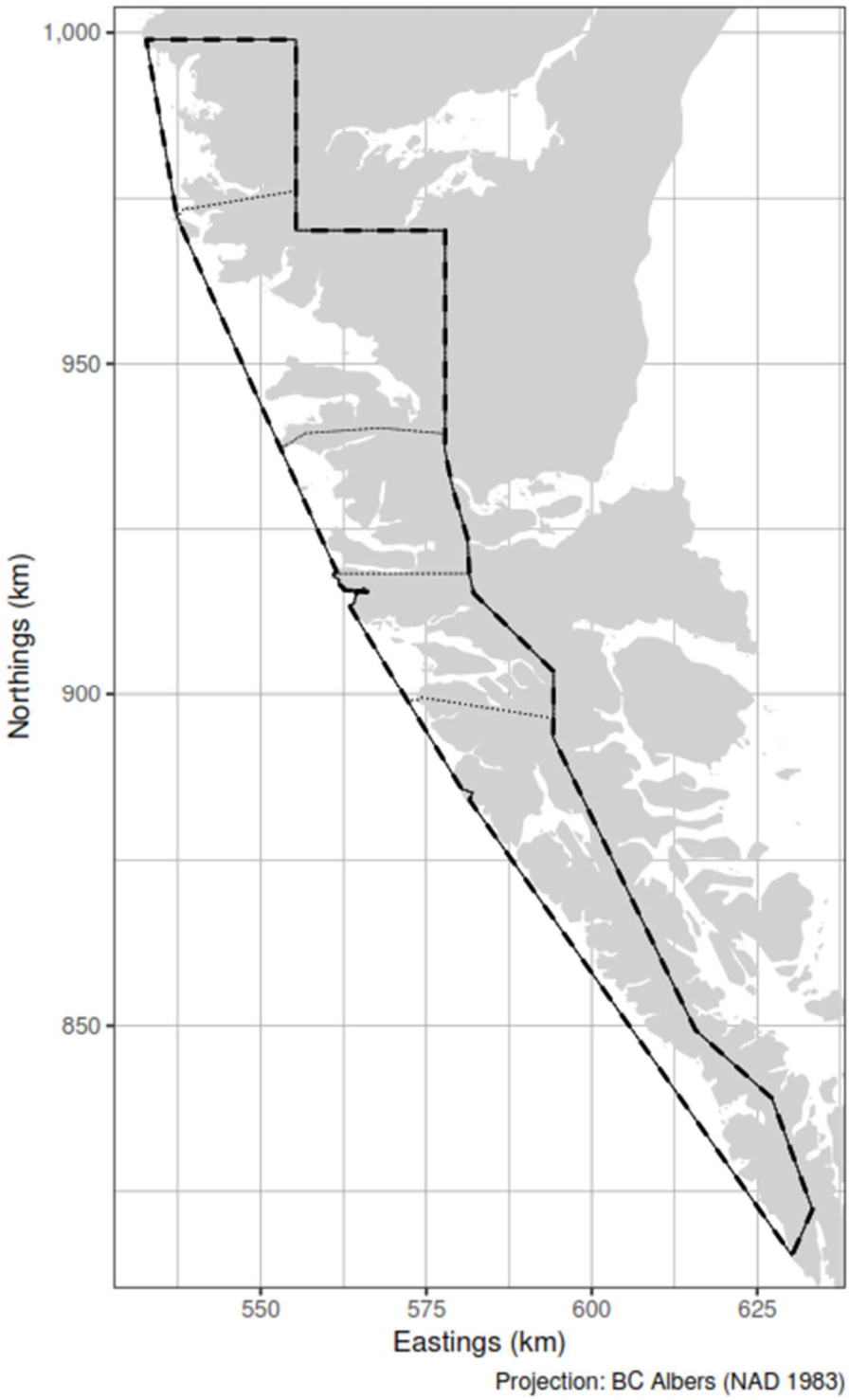

Figure 10. Boundaries for the Area 2 West (Area 2W) **Minor** stock assessment region.

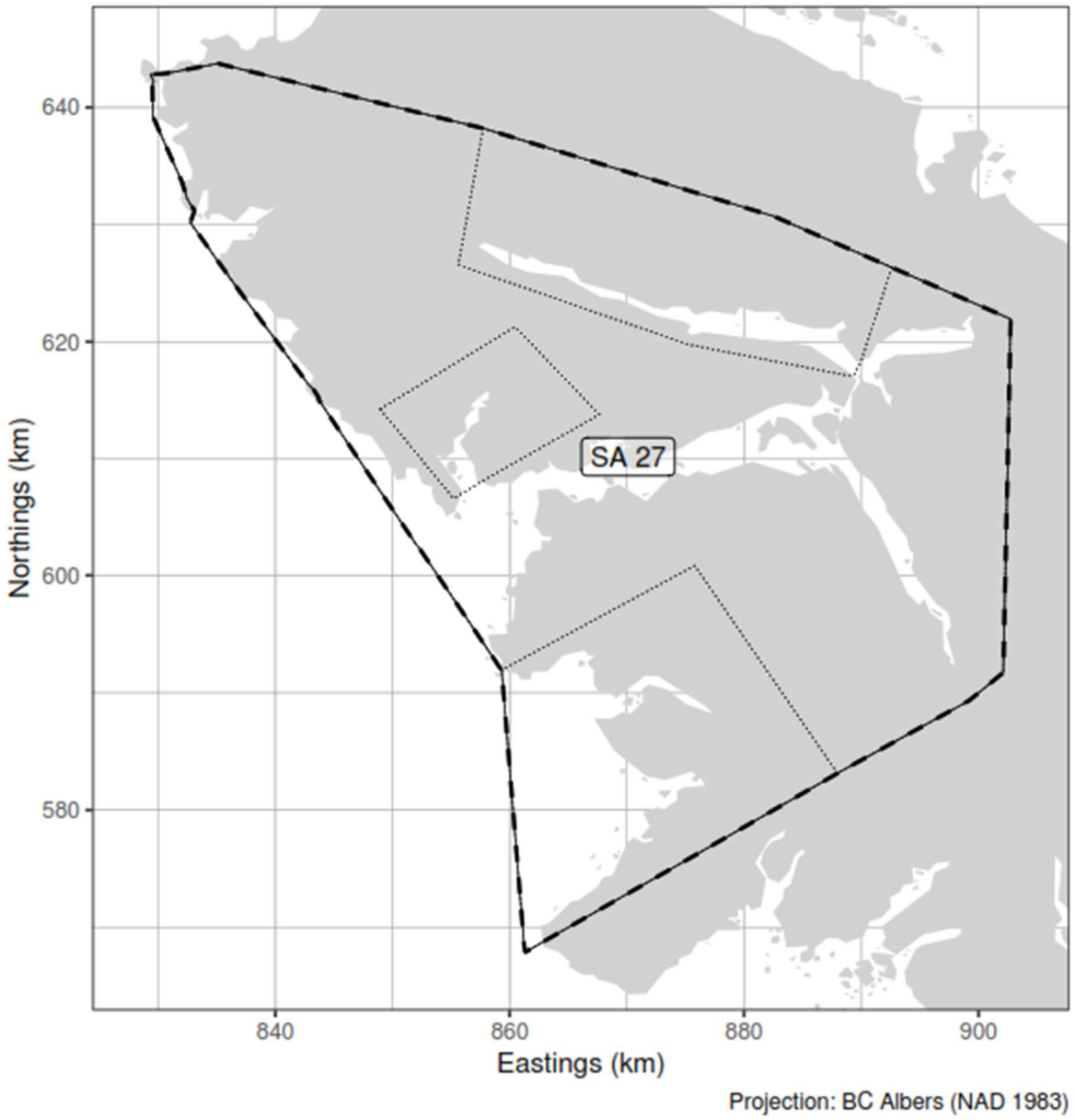

Figure 11. Boundaries for the Area 27 **Minor** stock assessment region.

Appendix 2: Examples of Objectives

MSE OBJECTIVES developed by the Nuu-chah-nulth Nations for WCVI Pacific Herring

(Res Doc.) Table B.1. Nuu-chah-nulth (NCN) Nations objectives. Objectives are organized into four categories: governance, economic, ecological, and socio-cultural. Each category has one or more goals, and each goal has one or more specific objective, categorized as either measurable or operational.

Categories	Goals	Objectives	Measurable	Operational
Governance	1) Have smaller scale management areas for the WCVI Area. (Geographic scale of management)	1.1) Three independent stock areas by 2018 for the WCVI area 100% of the time. The herring stock areas are based on DFO statistical areas – 23, 24 and 25.		x
		1.2) By 2018, Area 26 is managed as an independent minor stock area, 100% of the time.		x
		1.3) By 2018, TACs are developed and managed independently in Management Areas 23-25, 100% of the time.		x
		1.4) By 2018, in-season assessment information will be used to adjust TACs, fisheries and fishing plans as appropriate 100% of the time.		x
	2) Protect Nuu-chah-nulth's rights based (Aboriginal and Treaty rights and priority access) fisheries	2.1) By 2017, no WCVI Food & Bait herring fisheries until Nuu-chah-nulth have been consulted and accommodated each year 100% of the time.		x
		2.2) Only rights based herring fisheries in that part of Area 26 referred to as the Maa-nulth Domestic Fishing Area, 100% of the time.		x
		2.3) By 2018, regular commercial fisheries can only occur in a management area if the forecast and in-season return is greater than 15,000 tonnes for that management area 90% of the time.	x	x

		2.4) By 2018, no regular commercial herring fisheries except SOK in the Nations preferred rights based herring harvesting areas (as identified by the Nations pre-season) 90% of the time.		x
		2.5) By 2018, all regular commercial herring seine fisheries in Management areas 23-25 must start once the roe yield exceeds 10% , 90% of the time.	x	x
	3) Resources are available for Nuu-chah-nulth to participate significantly in the assessment activities in each Management Area (Participation in management).	3.1) By 2018, herring assessment training is provided to each Nuu-chah-nulth Nation each year, 100% of the time.		x
		3.2) By 2018, Nuu-chah-nulth will be contracted to collect herring spawn information and collect biosamples from each management area 100% of the time.		x
		3.3) By 2018, qualified Nuu-chah-nulth divers will be given preference for participating in the annual herring spawn dive surveys, 100% of the time.		x
Economic	4) Sufficient resources are available for science and management activities (Costs of management and science)	4.1) By 2018, DFO annually budgets sufficient resources to management and science activities for WCVI herring populations 100% of the time.		x
		4.2) By 2018, DFO supports and funds alternative methods to collect herring spawn data such as using dedicated small crews in small boats to collect herring biosamples when and where appropriate 100% of the time.		x
		4.3) By 2018, when abundance is sufficient to support economic fisheries, a portion of the TAC will be used to offset some of the management and science costs, 100% of the time.		x
		4.4) By 2019, an accurate and cost effective method to convert SOK/SOB to whole herring will		x

		be developed and used to assess WCVI SOK/SOB fisheries 100% of the time.		
		4.5) WCVI herring populations are rebuilt to healthy and sustainable levels capable of supporting successful SOB and SOK fisheries in most years *added Aug 2017	x	
Ecological	5) Broad distribution of spawning within Nuu-chah-nulth territories (Distribution of spawn)	5.1) Herring spawn covering at least 70% of pre-1960's spawn coverage areas as per DFO herring spawn area data, by 2025 at least 75% of the time.	x	
	6) Rebuild stock structure and distribution of spawn in the WCVI herring populations (Stock structure).	6.1) By 2020 begin herring transplants in areas 23-26 annually, for a minimum of 20 years.		x
		6.2) By 2018, spawning at new or sites that have not been used for 3 years or more, are not to be exploited by non- rights based fisheries, until spawning occurs in the new areas 3 out 4 years, 100% of time.		x
		6.3) By 2018, 10% of the habitat in the historic spawning areas will be assessed annually, 95% of the time.		x
		6.4) By 2019, 50% of the assessed habitat in the historic spawning areas willed be modified to support spawning herring or receive transplants 95% of the time.		x
		6.5) By 2025, 50% of the transplants and habitat modifications will be assessed for success or failure annually a 100% of the time for 10 years.		x
	7) Assess and manage the impact of marine mammal predation on herring spawn and whole herring in the WCVI area (Stock productivity).	7.1) By 2018, predation on herring and herring spawn by marine mammals must be assessed in each management area (23, 24, 25 and 26) and factored in to each area's assessment and forecast 100% of the time.		x

		7.2) By 2020 a marine mammal predator management plan for Areas 23-26 to protect spawning herring and herring spawn will be developed and used to manage spawning herring, 100% of the time.		x
		7.3) By 2020, predation by marine mammals on spawning herring in Areas 23-26 will be reduced by 50%, 75% of the time.		x
Socio-cultural	8) Enough herring to achieve an average of 12 layers of eggs in a spawn (Local access and Food and traditional use).	8.1) By 2017, the cut-off for each of the management areas 23-25 is 15,000 tonnes, 100% of the time.	x	
		8.2) Minimum of 15,000 tonnes of herring per management area (23-25) by 2025 75% of the time	x	

Appendix 3: List of "Core"Objectives included in the first cycle of MSE

"CORE" Management objectives included in the first MSE cycle for WCVI and SOG (July 2018)

Between 2015 and 2018, DFO engaged in a series of objective-setting workshops with First Nations and the herring fishing industry to formulate biological and yield objectives for the fisheries. The first objective relates to stock conservation by avoiding a threshold to possible serious harm (Kronlund *et al.* 2018); this objective must be met for any MP to merit further consideration (i.e., an imperative conservation objective). The subsequent biomass and yield objectives are each subordinate to the conservation objective, Objective 1. The potential ranking of Objectives 2-6 is not identified here as they may involve trade-offs of management outcomes, e.g., the relative priority of average catch (Objective 6) and stability of catches (Objective 5).

Conservation Objective

1. Avoid the Limit Reference Point (LRP) of $0.3B_0$ (also known as: 30% of the unfished biomass) with high probability over three herring generations (15 years), where "high probability" is defined as 75-95% (DFO 2009).

Biomass Objectives

2. Maintain spawning stock biomass at or above the Upper Stock Reference (USR) with at least 50% probability over three herring generations (15 years). Four candidate USRs include:
    a. $0.4B_0$, 40% of unfished equilibrium spawning biomass,
    b. $0.6B_0$, 60% of unfished equilibrium spawning biomass,
    c. B_{ave}, historical average biomass, and
    d. $B_{ave\text{-}prod}$, average biomass during a productive period (1988 to 2016 for SOG, and 1988 to 1996 for WCVI).
3. Maintain spawning stock biomass at or above a target biomass level of $0.75B_0$ (75% of unfished equilibrium spawning biomass) with at least 75% probability over three herring generations (WCVI only).
4. Maintain spawning stock biomass at or above a target biomass level equivalent to the average biomass from 1990-1999, with at least 75% probability over two herring generations (WCVI only).

Yield Objectives

1. Maintain average annual variability in catch of less than 25% over three herring generations.
2. Maximize the mean average catch over three herring generations.

Source: DFO Herring Team

Appendix 4: Template and Guidance for developing Herring Objectives

Questions to think about when setting Objectives for Herring

1. What are your community's needs for herring?
2. What are some ideas of your community's goals for herring (Science, economic, socio-economic, conservation, governance, ecosystem, etc.)
3. What do you think is a realistic and acceptable timeline to achieve these goals?
4. How has the herring spawn distribution (locations) changed in your area?
5. How would you like to see the herring spawn distribution IMPROVE in your area?
6. What does a healthy herring population look like to you and your community?
7. Do you have any TEK that you would be willing to share involving herring in your area?
8. What is most important to you and your community when it comes to herring?
9. What changes to herring (adults, juveniles and eggs) have you seen over time in your area?
10. Do you know how many layers of eggs used to occur in the spawn in your area?
11. In your opinion, What else should be considered when managing herring?
12. Would you like to see improvement in the science and management in your area?
13. Would you like to participate in the management in your area? How could this be done?

Template for developing herring objectives

Goals	Objectives	Measurable	Operational	Notes/ Key questions
Access	E.g. Maintain access to as many management areas as possibly each year		x	
Manage herring stocks at healthy levels	E.g. Maintain spawning stock biomass at a target biomass level equivalent to the average biomass from xxxx-xxxx, with a 50% probability over x herring generations.	x		What do the reference years mean to the stakeholder? (e.g., successful fisheries, other)

Local area management	E.g., Develop and manage TACs independently for Stat Areas 04 (Big Bay) and 05 (Kitkatla).		x	(1) What community need is met through this objective? (2) Biological basis? (3) What does this look like?
Economics	E.g. Maximize average annual harvest E.g. Minimize inter annual variation in harvest	x		
Monitoring				