Interim Report of the Steering Committee for a Basin-Wide Marine Growth Study

In 2023 (SAG(23)02), the SAG identified and reviewed 'research priorities' for mortality of salmon at sea and in 2024 (ICR(24)03) the Board ranked "basin-wide patterns of marine growth and survival of Atlantic salmon" as its top research priority and agreed that the Board should focus any of its own new research on this topic. A proposal outlining a potential marine scale growth study (ICRIS(25)02) was developed and in 2025 (ICR(25)11), the Board formed a Steering Committee to:

a) co-ordinate scale sample digitisation through specific points of contact who would be responsible for digitisation; and

b) work inter-sessionally to identify and outline potential routes to funding the next phase of the project, including discussions with the NGOs, the IPRIs and the NASCO Secretariat.

The Board requested (ICR(25)11) that the Steering Committee prepare:

- an interim report with ballpark costings in February 2026, based on their work so far. This report may include identification of potential funding sources and an indication of how much money would be required to allow those Parties not currently able to participate to join the project; and
- a further progress report in advance of the 2026 Annual Meeting of the Board to inform discussions at that meeting.

This report represents the Steering Committee's interim report outlining progress to date in addressing the objectives, which were addressed through monthly meetings and inter-meeting work conducted by individual Steering Committee Members.

Steering Committee Members (Parties):

- Hlynur Bardson (Iceland)
- Cindy Breau (Canada)
- Shelley Denny (Indigenous Peoples' representatives and institutions)
- Peder Fiske (Norway)
- Nora Hanson (United Kingdom)
- Michael Millane (European Union)
- Timothy Sheehan (United States)
- Ken Whelan (Non-Governmental Organizations)

Co-ordination of sample digitation

After its formation (circa August 2025), the Steering Committee began meeting monthly and also established points of contact (PoCs) for each stock unit. PoCs are intended to be the primary point of contact for each stock unit and the stock units were defined based on the ICES WGNAS designations within the Life Cycle Model used to conduct stock assessments within the North Atlantic study area (see ICRIS(25)02 for further information). Additional PoCs were also identified for salmon producing countries within the North Atlantic that are not included

within ICES WGNAS Life Cycle Model and therefore don't have official ICES WGNAS stock unit designations, but had expressed an interest in the study through tangential communications. An inventory of all stock units (ICES defined and non-ICES defined) considered is provided in Annex I.

In October 2025, PoCs and all Steering Committee members were invited to a webinar detailing the proposed sample requirements and a detailed description of the automated tool for growth layer extraction from scale images (Appendix II). During this meeting, it was made clear that jurisdictions with existing *in-kind* support to image scale archives should do so. Further, all PoCs were also strongly encouraged to verify that any potential scale images considered for use within the project conformed to the necessary requirements for processing via the automated tool.

The Steering Committee subsequently conducted an informal survey with all PoCs to:

- gauge interest in participating in the study;
- to assess if efforts have been initiated to compile the scale image datasets;
    - if yes, to assess if the scale images been verified as of adequate quality;
    - if not, to assess what hurdles are preventing work from being initiated;
- to assess if the Board could help alleviate any hurdles; and
- to assemble a quick inventory of what each PoCs intends to provide.

To date (February 2026), responses have been received from 15 PoCs (representing 11 ICES defined and 4 non-ICES defined stock units). Responses have not been received from 2 PoCs (representing 1 ICES defined and 1 non-ICES defined stock units). The Russian Federation responded that they would not be able to participate in the study as their available scale archive did not meet those outlined within the original study proposal (ICRIS(25)02). A summary of the responses follows:

- Gauge interest in participating in the study;
    - *All 15 respondents are interested in participating in the study*
- To assess if efforts have been initiated to compile the scale image datasets;
    - *6 have initiated compiling scale image datasets*
    - *2 are inventorying their scale archive*
    - *7 have not*
- If yes, have the scales been verified as of adequate quality;
    - *6 have initiated efforts to verify if their scale images are of adequate quality*
- If not, to assess what hurdles are preventing work from being initiated;
    - *Identified hurdles are lack of funding/resources and competing priorities*
- To assess if the Board could help alleviate any hurdles; and
    - *Lack of funding was identified as the primary hurdle*
- To assemble a quick inventory of what each PoCs intends to provide
    - *For all participating stock units, the following is expected to be delivered*
        - *1 dataset per stock unit (consisting of scales from one river or multiple rivers combined) at a minimum*

- *~50-100 scales per sea age (1SW and 2SW) per year*
- *Generally 1970/80/90's through to the present*

Resource related

The SC was also asked to advise on resources that may be available to support this project. This information can be delineated into 3 general categories:

- Resource requirements;
- Current resource availability; and
- Potential future funding sources

Resource requirements

Some progress has been made with estimating ballpark costing to support the implementation and completion of the basin-wide marine growth study. Although a detailed budget sheet covering the financial needs of all aspects of the project has not been developed, some general information has been compiled and can be used as a general gauge.

Many jurisdictions have initiated efforts to collate their scale archives. Resources to support these efforts had been through in-kind support and have been supported through existing base resources or newly acquired resources Here is a summary of the origin of resources expended to date to support the collation of scale image datasets:

- Canada
  - DFO has provided $100,000 CAN funding to support the scale imaging work
- France
  - Scale imaging was previously financed by other related projects
- Iceland
  - Existing resources were reprioritized to support the scale imaging work
- Ireland
  - Existing resources will be reprioritized to support the scale imaging work
- Norway
  - Scale imaging was previously financed by other related projects, but existing resources will be used to collate additional scale image archives and to collate additional images from the wild salmon.
- Scotland
  - Scale imaging was previously financed by existing resources and further efforts to develop the scale image dataset are reliant on continued resource commitment.
- USA
  - Existing resources were reprioritized to support the scale imaging work

Equipment cost

For jurisdictions that haven't initiated the collation of their scale image dataset, there could be a need for specialized equipment. A wide variety of options are available and a simple costing breakdown of the lower end versus higher end equipment options is provided below:

	min	**max**
Microscope	£2,997.24	£22,479.30
Camera	£749.31	£5,994.48
attachment	£149.86	£149.86
software	£0.00	£749.31
TOTALS	**£3,896.41**	**£29,372.95**

Scientific Officer/Technician/Contractor

Some jurisdictions have indicated that they would need to hire a new Scientific Officer / Technician / Contractor (i.e. technician) to collate the scale image datasets from their scale archive. It is exceedingly difficult to estimate a cost of what it will take given jurisdictional variability. However, a range of estimates is available. Some jurisdictions estimated that it would take between £75-100K to hire a full time technician for a year to complete the work. However, it is noted that Canada has hired 5 part-time students to conduct the work to accumulate the scale image datasets for each of their 5 provinces for £55K in total. This further highlights the difficulty in estimating this cost across jurisdictions.

Analyst

Phase 2 requires the hiring of a multi-year analyst position who would be responsible for the extraction, analysis and manuscript development of growth increment data from collated scale image datasets. There are many unknowns which makes it difficult to provide an estimated cost for this position given as it hasn't been determined where this analyst would operate out of, in addition to jurisdictional variability. However, it is envisioned that this analyst position might be equivalent to a post doc position. Rough ballpark estimates of what this position could cost are estimated to range from £75-125K per year.

Current resource availability

The SC notes that the IASRB currently holds resources that are allocated, or could be allocated, to support Phase 2 of the proposed marine growth study (i.e. hiring of an analyst to extract the growth data, conduct the analysis and write the scientific papers). A summary of the existing resources is provided below:

- During the IASRB June 2025 Annual meeting (CNL(25)08), The Board member for the U.S. indicated that the U.S. *may* consider re-allocating its **£40,150** voluntary contribution, currently ring-fenced for the SALSEATrack or ROAM projects, to the scale project.
- Circa September 2025, the U.S. provided a voluntary contribution of 60K USD (~**£45K**) to "partially fund the hiring of a temporary analyst to support the basin-wide marine growth study led by the Board"

Potential future funding sources

Additional monies are required to complete the basin-wide marine growth study. Additional money could fall under two categories:

1. Money to support jurisdictions currently not collating scale image datasets, due to lack of funding, and
2. Money to fund the hiring of a multi-year temporary analysis to oversee and conduct Phase 2 of the project.

The SC has not compiled an inventory of the resources needed to support jurisdictions to collate their scale image datasets. This decision was made due to a few reasons:

- Numerous jurisdictions are currently working to collate their scale image datasets. This work is being supported via in-kind contributions.
- It would be extremely challenging to develop a costing analysis to conduct this work across all the different jurisdictions given jurisdictional variability in infrastructure to support this work, compensation, schemes, employment options, etc.
- The original proposal for this outline stated that Phase 1 (i.e. scale image dataset collation) should be supported through in-kind contributions and Phase 2 should be supported by resources provided by or obtained by the Parties.

The SC has investigated some potential funding sources/options to support Phase 2 of the study. These options are outlined below:

- Norway indicated that it may consider making a voluntary contribution to the IASRB to support the hiring of a temporary analyst to support the basin-wide marine growth study led by the Board;
- The EU indicated that it may consider making a voluntary contribution to the IASRB to support the hiring of a temporary analyst to support the basin-wide marine growth study led by the Board;
- Members of the SC have been in communications with researchers involved in a large project consortium who are contributing to a EU Horizon Europe funding proposal. The project name is DiadPath and one aspect of one of the proposed work packages will include funding request for a multi-year pre-doctoral position who would contribute to the extraction, analysis and manuscript development development of the growth increment data from collated scale image datasets (i.e. Phase 2). The project proposal is due to be submitted in spring 2026 and a funding decision is expected by fall 2026.
    - There is no guarantee that this proposal will be awarded. However, the project consortium has an excellent track record and has been successful in the Horizon funding calls. Members of the SC have had preliminary discussions with the leaders of the relevant work package on a number of important topics that would need to be considered if the funding were awarded (e.g., role of the SC in the project moving forward, data availability standards, potential to supplement analyst funding with existing Board resources)

Annex 1

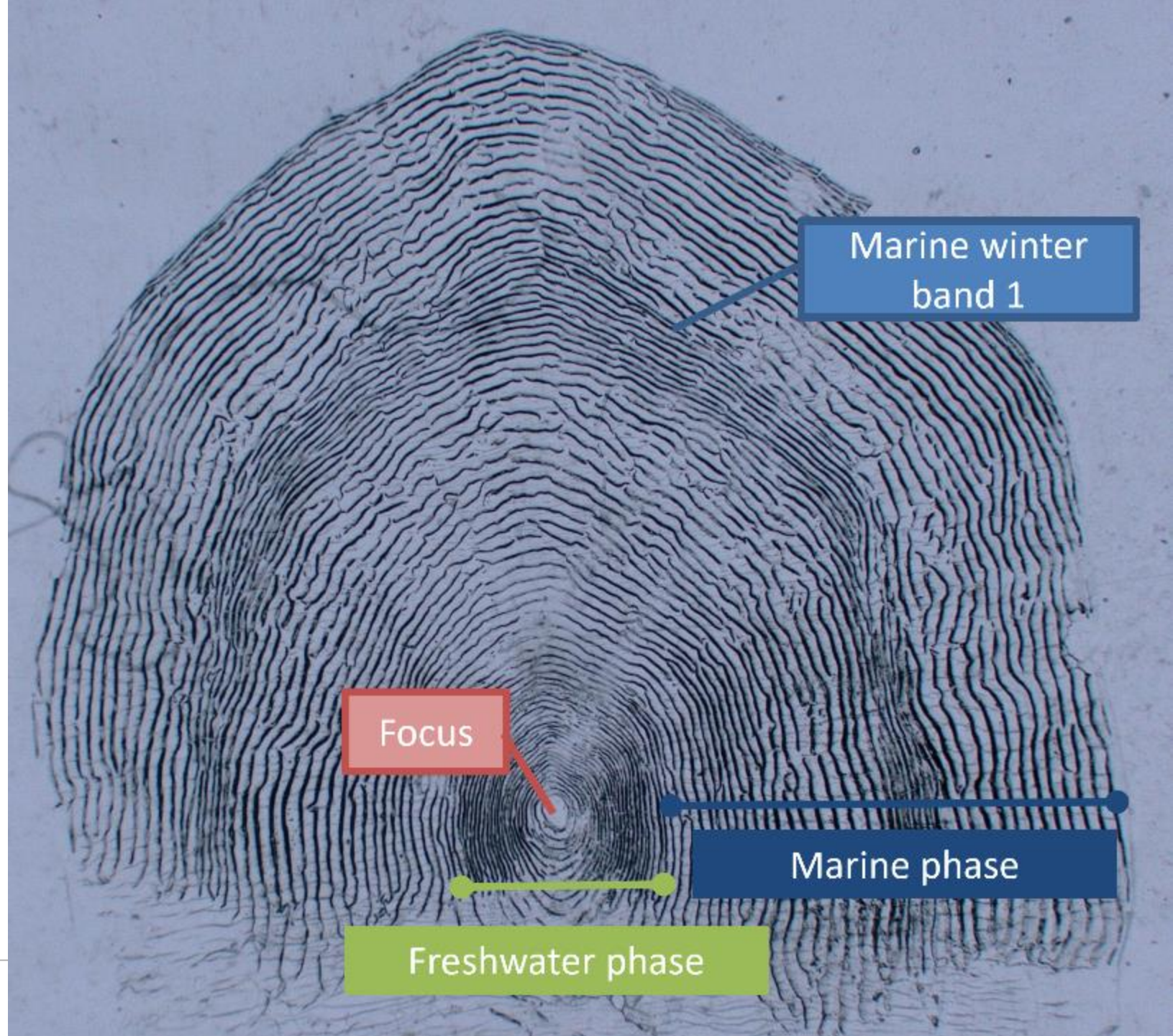
Inventory of all stock units (ICES defined and non-ICES defined) considered for participation in the Board's basin-wide marine growth study

Stock complex	NASCO Party	County	Stock Unit
ICES defined stock units			
NAC	Canada	Canada	Labrador
NAC	Canada	Canada	Newfoundland
NAC	Canada	Canada	Quebec
NAC	Canada	Canada	Gulf of St Lawrence
NAC	Canada	Canada	Scotia-Fundy
NAC	USA	USA	USA
N NEAC	Iceland	Iceland	Northeast
S NEAC	Iceland	Iceland	Southwest
N NEAC	EU	Norway & Finland	River Tana/Teno
N NEAC	EU	Sweden	Sweden
S NEAC	EU	France	France
S NEAC	EU	Ireland	Ireland
S NEAC	EU	Ireland & UK - NI	River Foyle
N NEAC	Norway	Norway	Southeast
N NEAC	Norway	Norway	Southwest
N NEAC	Norway	Norway	Mid
N NEAC	Norway	Norway	North
N NEAC	Russian Federation	Russian Federation	Archangelsk
N NEAC	Russian Federation	Russian Federation	Kola / White Sea
N NEAC	Russian Federation	Russian Federation	Kola / Barents Sea
N NEAC	Russian Federation	Russian Federation	Pechora River
S NEAC	UK	UK - England	UK - E&W
S NEAC	UK	UK - Wales	UK - E&W

S NEAC	UK	UK - NI	DAERA areas
S NEAC	UK	UK - Scotland	East
S NEAC	UK	UK - Scotland	West
non-ICES defined stock units			
S NEAC	EU	Portugal	
S NEAC	EU	Spain (Cantabria)	
S NEAC	EU	Spain (Galicia)	
S NEAC	EU	Germany	
N NEAC	EU	Denmark	

North Atlantic salmon marine growth study

October 2025



Agenda

- Overview of project
- Scale measuring tool
- Sample and scale image requirements
- Resource required
- Q & A

Bit of background

- SAG identified “research priorities” for mortality of salmon at sea (Nov 2023)
- No 1 = “studying basin-wide patterns of marine growth and survival of Atlantic salmon” (Feb 2024)
- IASRB agreed to focus on this top priority, asking the SAG to outline a marine growth study proposal (Feb 2024)
- N Hanson, T Sheehan and C Breau scope out potential study, reporting to SAG (Jan 2025)
- IASRB decision to move forward with jurisdictions who can (June 2025)
- Steering Committee formed to a) start sample collation process and b) explore funding opportunities. Reporting to IASRB in Feb 2026

IASRB = International Atlantic salmon research Board; SAG = Science Advisory Group to the Board

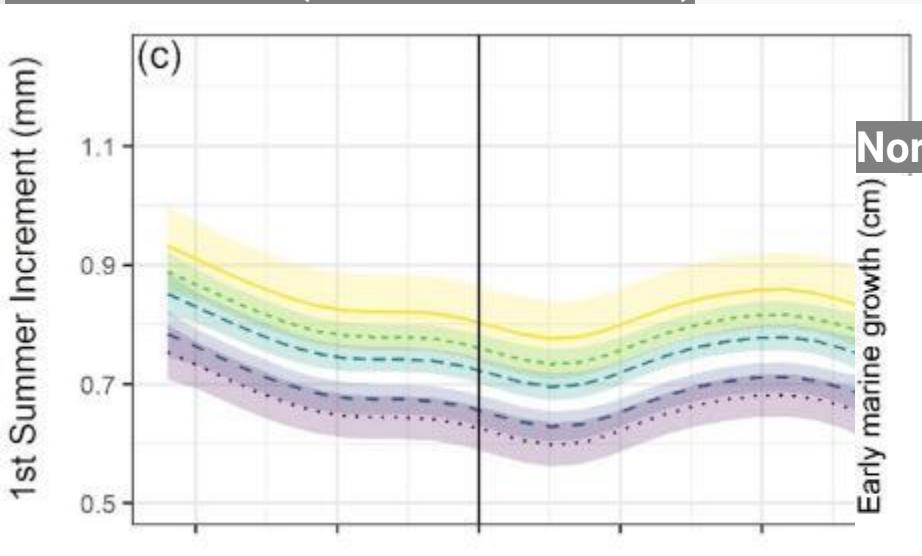
Steering Committee

- Tim Sheehan (USA)
- Cindy Breau (Canada)
- Mick Millane (EU)
- Hlynur Bardarson (Iceland)
- Peder Fiske (Norway)
- Nora Hanson (UK)
- Ken Whelan (NGO)

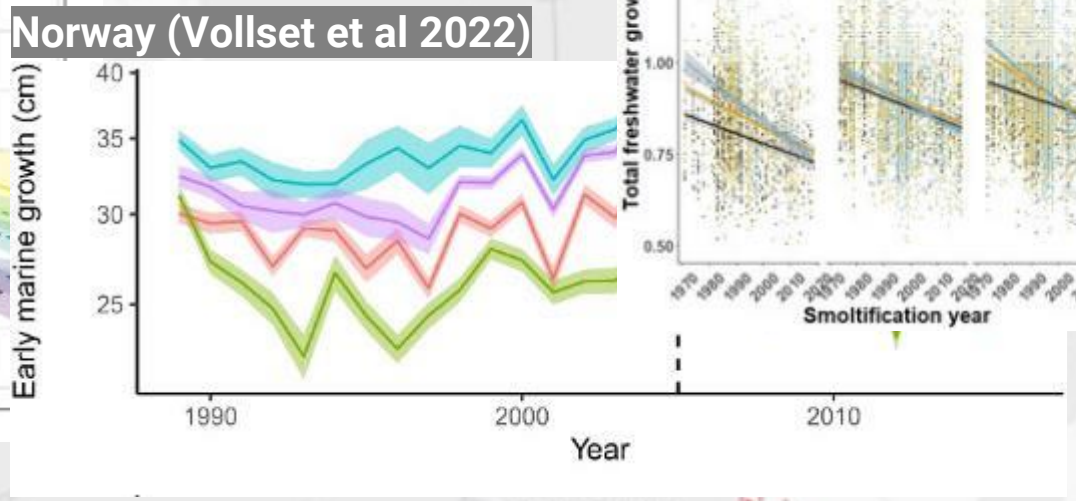
Why this, why now?

- can **large-scale drivers** of salmon growth and survival be identified, and to what extent does growth in salmon vary in synchrony among larger regions?
- can the **critical periods** that might affect survival be identified? Growth in scales can be partitioned into seasonal timeframes so it may be possible to identify, for example, whether spring, mid-summer, autumn or winter is most critical
- **Ultimately**: aide targeted management; improve forecasting
- Automated tools becoming more tractable

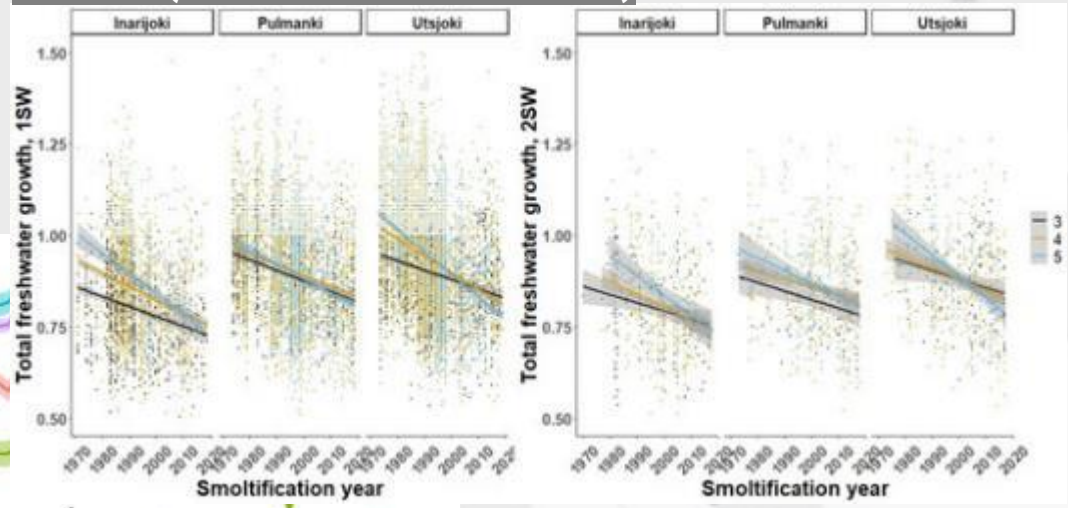
North America (Tillotson et al 2021)



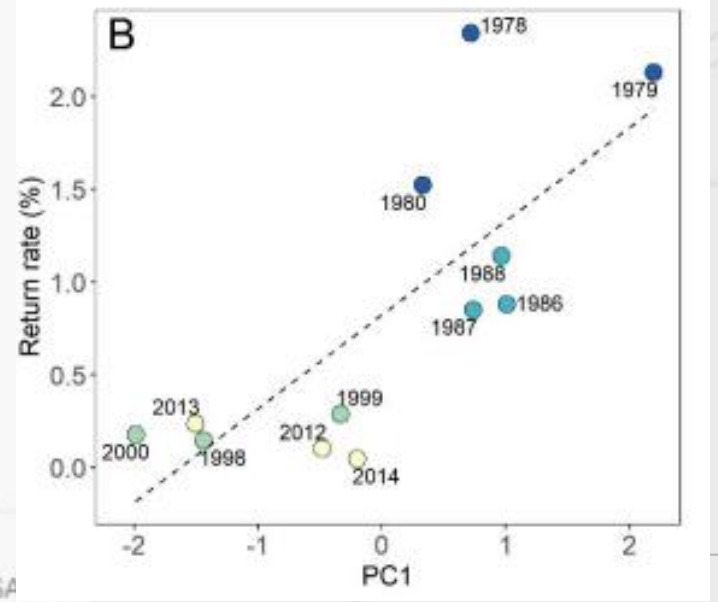
Norway (Vollset et al 2022)



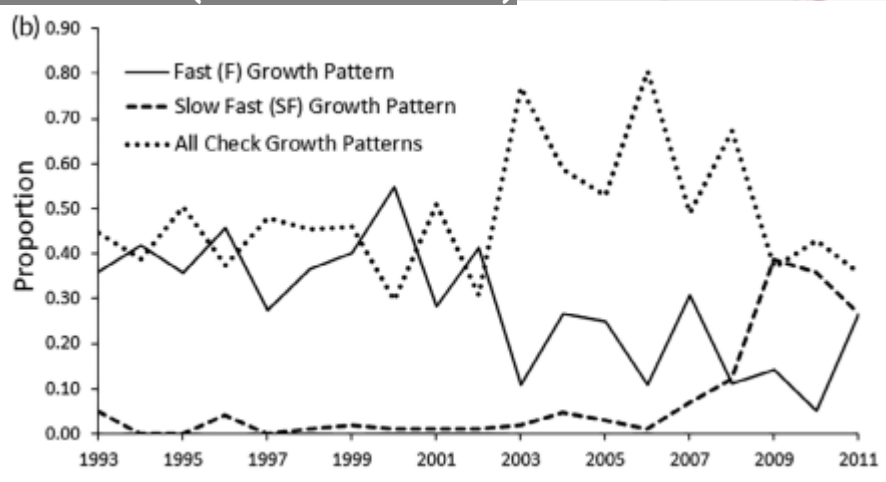
Finland (Alioravainen et al 2023)



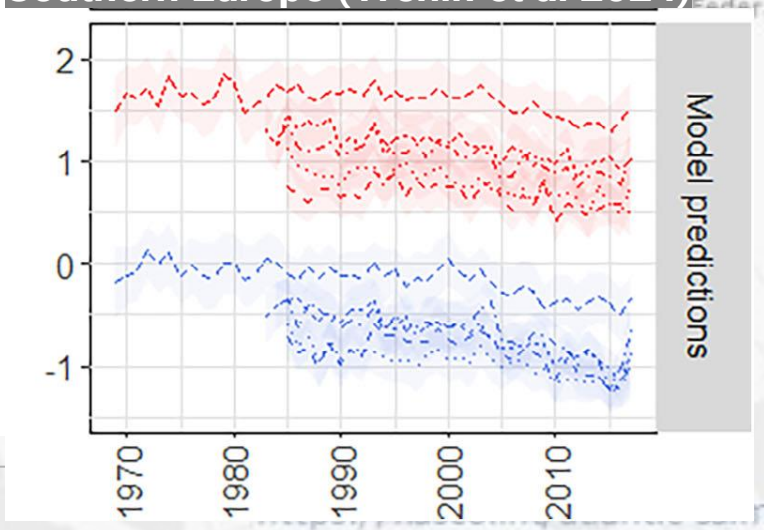
Penobscot (Barajas et al 2021)



North Esk (Todd et al 2021)

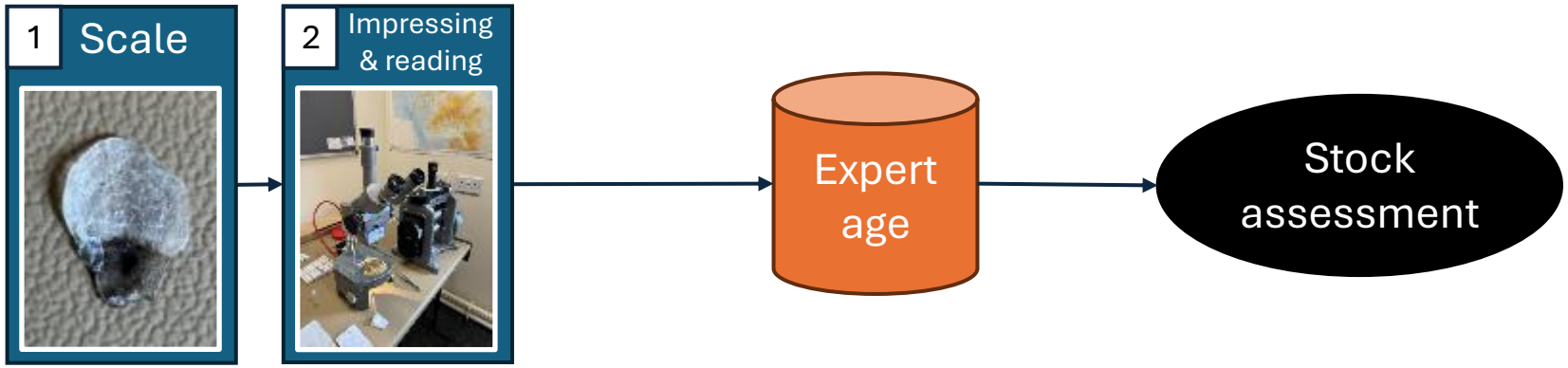


Southern Europe (Trehin et al 2024)



Scale circulus detection

- Object detection tool developed in 2024
- Publicly available to download and use: [ffl-salmon-at-sea / sscd — Bitbucket]
- Deep Leaning (CNN) pipeline
- Returns granular information on circuli spacing
- Trained on ~58k marked ‘objects’


1
Scale
2
Impressing & reading
Expert age
Stock assessment

1 Scale

2 Impressing & reading

Expert age

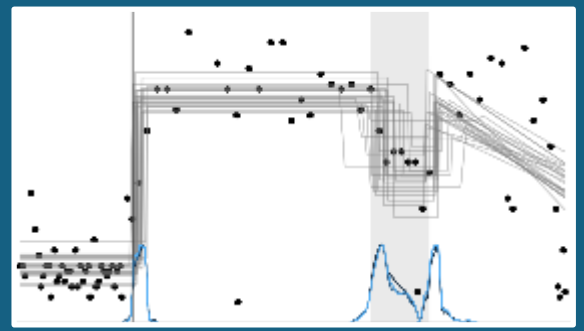
Stock assessment

3 Imaging

4 Image

5 Automatic circuli detection

6 Automatic feature detection



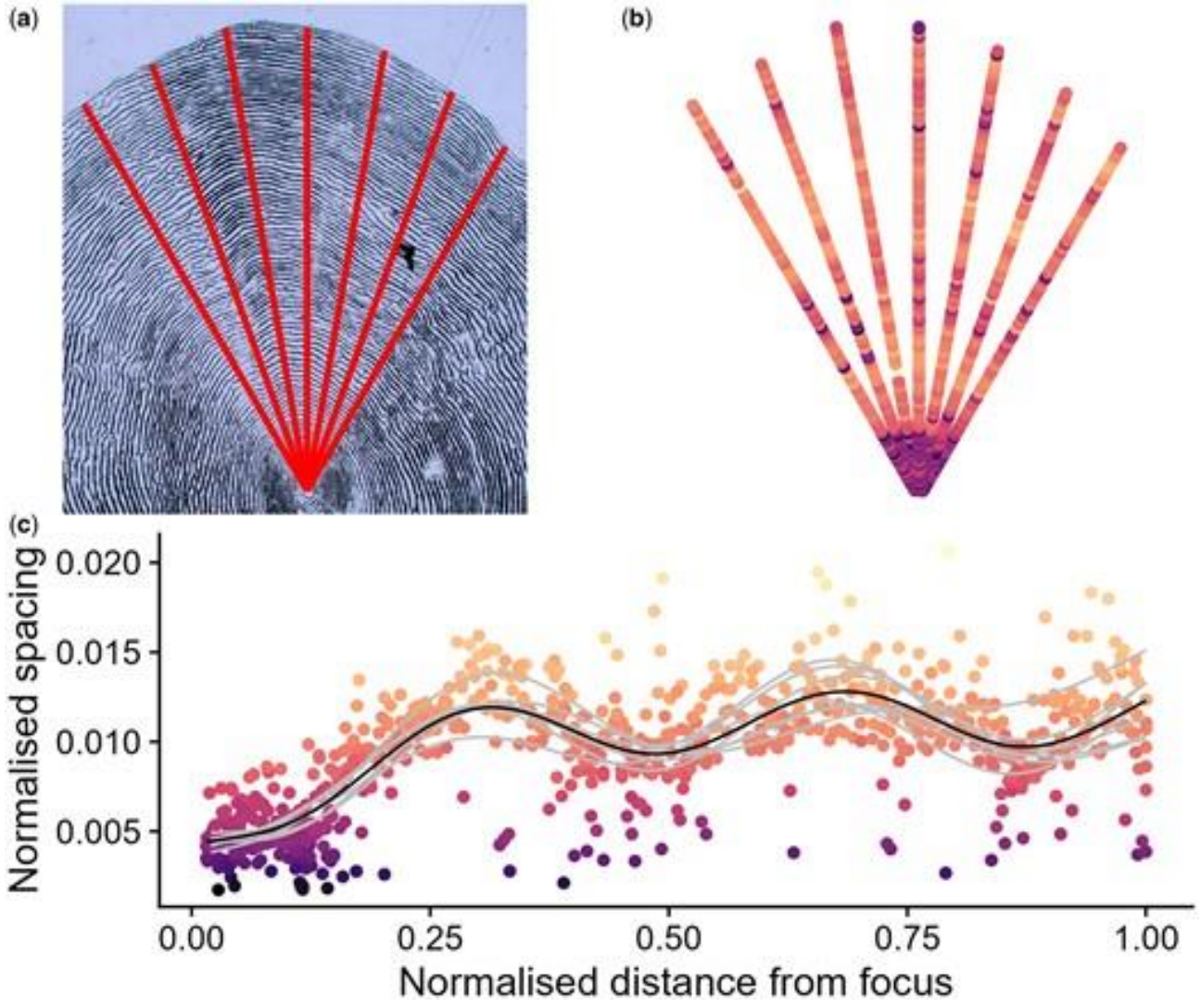
5 Automatic circuli detection

Model 1: Focus detection

Model 2: Circuli detection

Scale circulus detection

- Multiple transects
- Consistent information retrieval
- High throughput



Sample requirements

- Spatial scale
- Temporal scale
- Sample sizes
- Ages
- Representativeness

At least one population time series from each stock unit

20-30 years, covering 1990s and 2000s

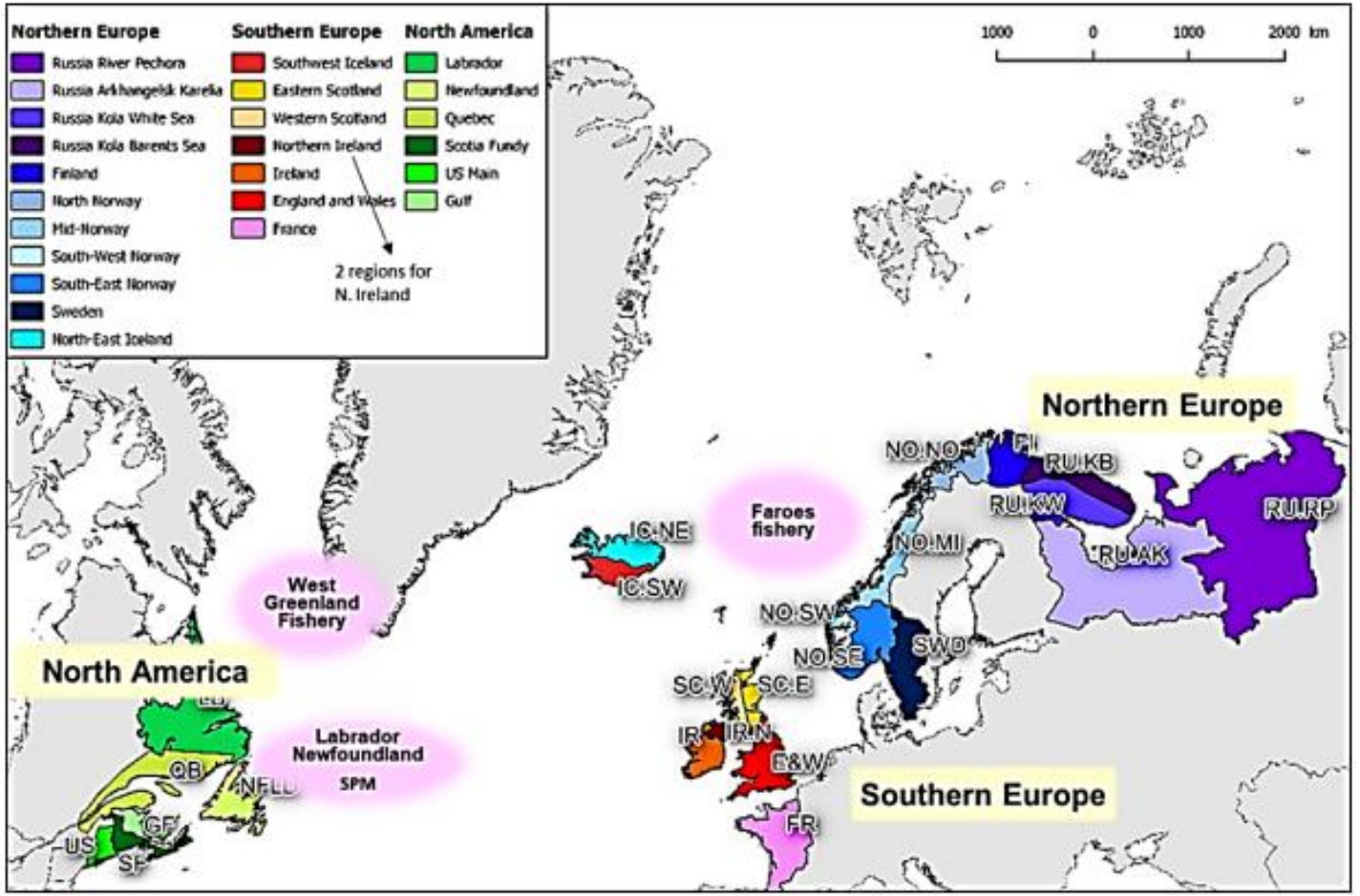
Aim of ca 75 samples per sea age per year for each stock unit (across all available populations)

Focus on 1SW and 2SW, sampling across seasons

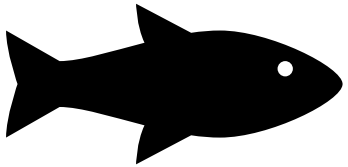
Maiden, ideally wild

Stock unit-specific

- WGNAS estimates of survival and maturation available at this level

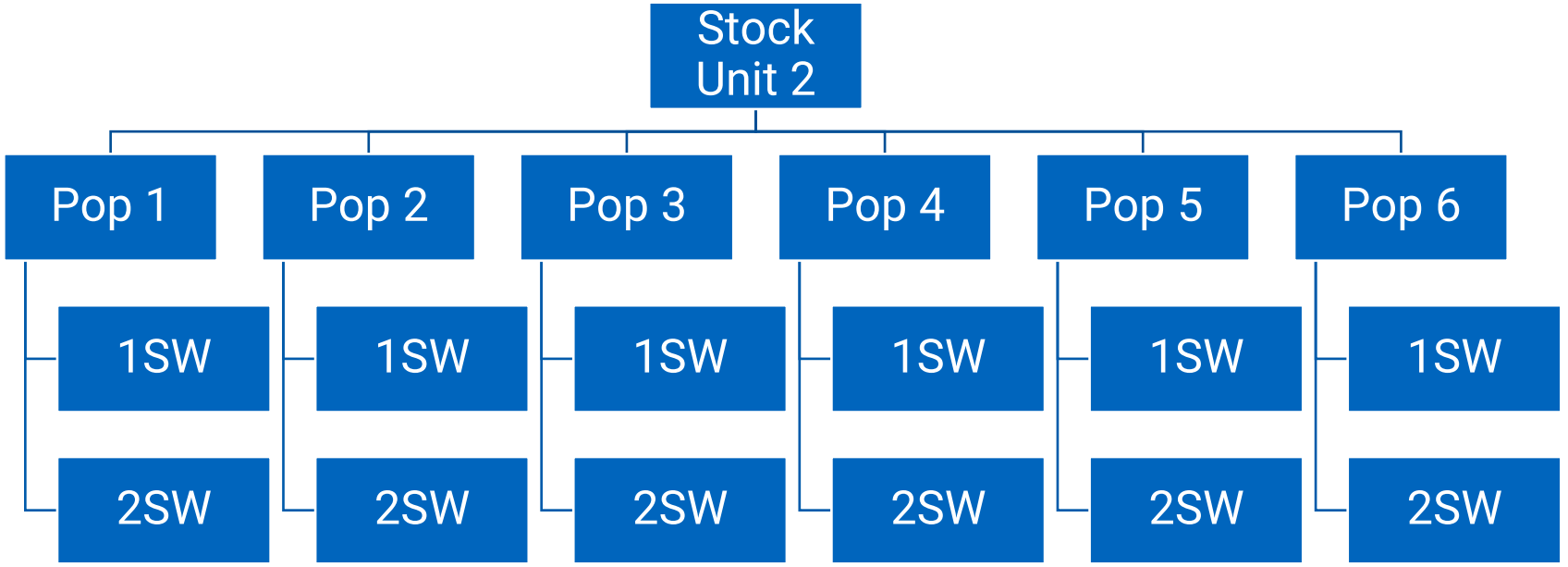


ICES 2024. Benchmark workshop



N ~ 75

N ~ 75


Stock Unit 2
Pop 1
Pop 2
Pop 3
Pop 4
Pop 5
Pop 6
1SW
1SW
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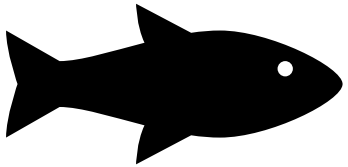
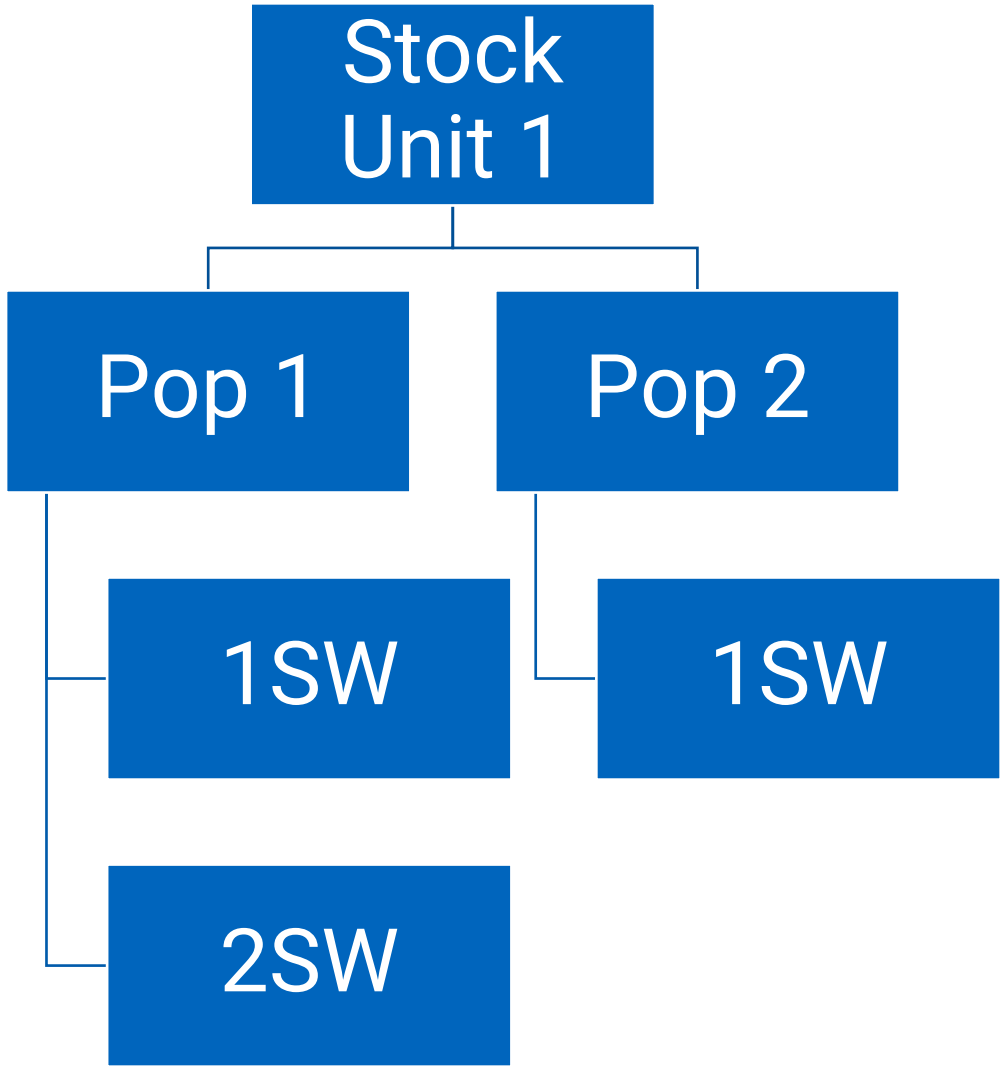




N ~ 75

N ~ 75

Sample requirements

- Trying not to be too proscriptive as many nuances to data collection
- Up to each jurisdiction exactly how to sample to represent the stock

Stock unit level focus

Questions

Image requirements

- This guidance specific to the Hanson et al (2024) tool but similar considerations likely important for other image-processing approaches
- Based on:
  - Experience using tool since 2024
  - Formal evaluation of circuli detection tool
  - Inter-laboratory evaluation (round robin labelling)

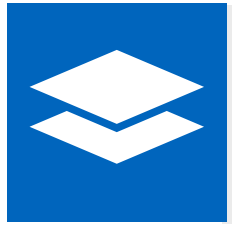
Scale selection

- Intact focus
- No erosion
- Slight damage

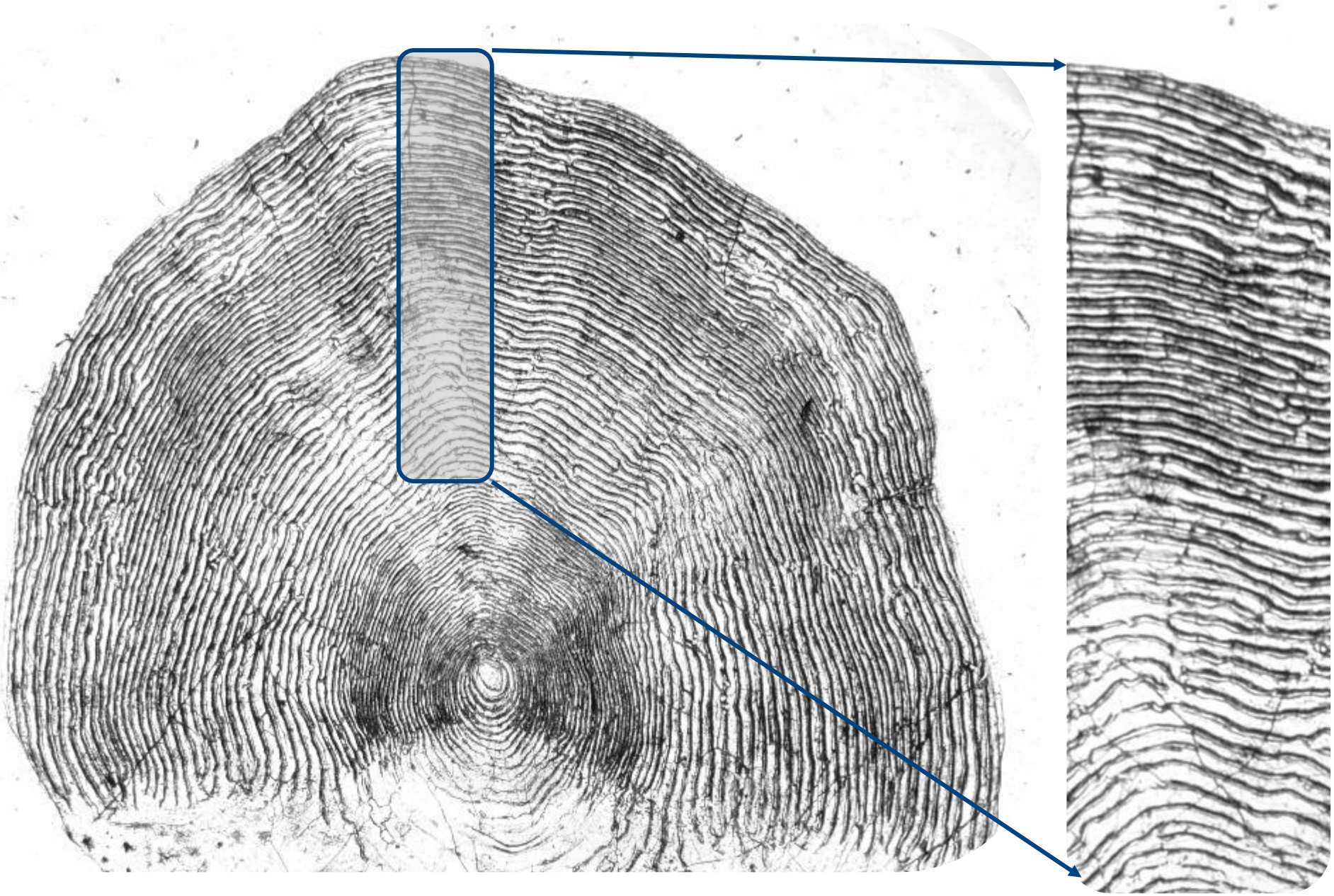
- No focus
- Dirty and damaged

- Intact focus
- Slight erosion
- Some damage

Scale selection = quality is paramount (intact centres, clean, unbroken)



Preparation method

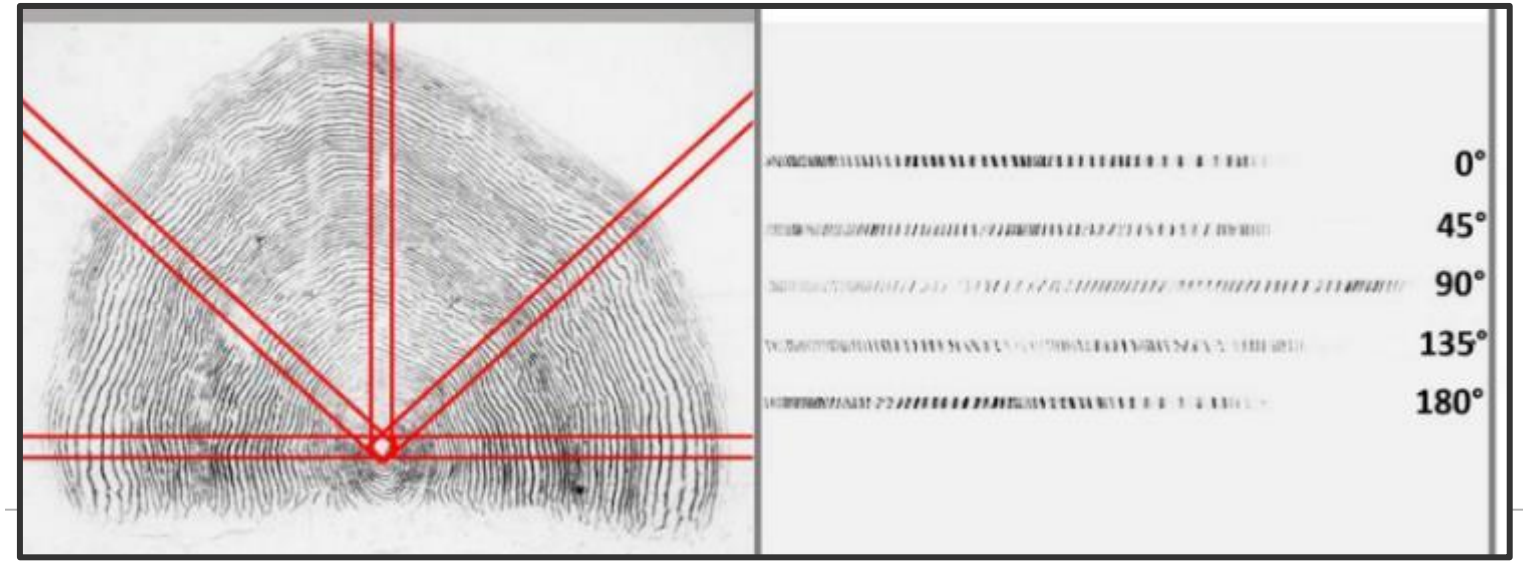


- Double-banding can result in erroneous detections

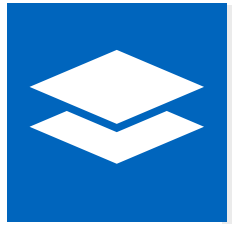
Scale selection = quality is paramount (intact centres, clean, unbroken)

Preparation method = impressions preferred, whole scales if necessary

Image position



Scale selection = quality is paramount (intact centres, clean, unbroken)



Preparation method = impressions preferred, whole scales if necessary

Image position = vertical, whole scale visible, single scale

Resolution

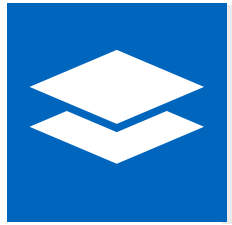
File type	Resolution	File size	Colour
TIFF	3840 x 2748	~ 30MB	RGB

File type	Resolution	File size	Colour
TIFF	2937 x 2602	~ 30MB	RGB

File type	Resolution	File size	Colour
TIFF	1600 x 1200	~ 30MB	RGB

If YOU struggle, so will automated tool

Scale selection = quality is paramount (intact centres, clean, unbroken)



Preparation method = impressions preferred, whole scales if necessary

Image position = vertical, whole scale visible, single scale

Resolution = ca 2500 x 2500 but clear enough for human to detect

File type = .TIFF (preferred), .jpeg

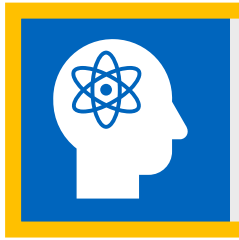
Questions

Resource requirements

- Survey from IASRB to Party members in early 2025 indicated:

Scale preparation

Image capture



Staff time

What now?

- Jurisdictions that can move forward with imaging, do so

Check images with automated tool

- Steering Committee member follows-up to determine participation, barriers to participation with **in-kind support for image collection**
- Actively engage with funding opportunities, especially for Phase II (analysis)
- Steering Committee reports to IASRB (Feb 2026)
- IASRB meets spring 2026 to consider Steering Committee report

Questions