

Report of the Joint PICES/ICES Working Group on *Impacts of Warming on Growth Rates and Fisheries Yields*

The Joint ICES/PICES Working Group on *Impacts of Warming on Growth Rates and Fisheries Yields* (WG 45/WGGRAFY) was approved by PICES in August 2020, and the inaugural Working Group meeting was held virtually from September 7–10, 2020. Because this meeting was the first time the group would officially meet, the goals of the meeting were to introduce WG 45 members to each other, ensure a common understanding of the WG 45 Terms of Reference (ToRs), allow sub-groups to discuss the individual ToRs in order to develop a workplan and identify publication goals, and develop an action plan for the next 6-month period. The meeting was led by WG 45 Co-Chairs: Dr. Paul Spencer (PICES/USA), Prof. Shin-ichi Ito (PICES/Japan), Dr. Tara Marshall (ICES/UK), Dr. Alan Baudron (ICES/UK), and Dr. John Morrongellio (Australia/guest).

Due to the wide range of time zones for participants, the WG meeting was spread across 4 days with 2 hours of meeting time per day. Prior to the meeting, the WG Co-Chairs produced a series of pre-recorded presentations that introduced the ToRs and aspects of the research questions, methodology, and potentially available data associated with the project.

The meeting was largely focused around the first 4 ToRs for the project, which are:

- ToR 1: Assess the capacity of statistical models to incorporate temperature-dependency of growth, and compare their predictions of growth variation across specific warming scenarios and locations.
- ToR 2: Analyse long-term growth patterns across multiple large marine ecosystems that are experiencing different trends in temperature, including the direct comparison of empirical length at age data for specific species across their range, and the application of a common modelling approach.
- ToR 3: Assess the impacts of warming on past yield per recruit of commercial fisheries, and forecast trends in future yield under plausible warming scenarios.
- ToR 4: Identify options for expanding scientific community access to global length-at-age data that are routinely collected by fisheries agencies worldwide.

Day 1: September 7, 2020

The agenda items for this include a brief kick-off presentation by the Co-Chairs, and introductions of the meeting participants to each other (3 minutes per person), and opportunities to ask questions pertaining to the meeting activities in the remainder of the week.

Day 2: September 8, 2020

The goal of Day 2 of the WG meeting was to build our common scientific understanding of the WG 45 ToRs. The activities for this day consisted of 10 minutes presentations pertaining to the first 4 ToRs:

ToR/Theme	Speaker	Affiliation
1 Growth models	Tim Miller	NOAA Fisheries (US)
	Christine Stawitz	NOAA Fisheries (US)
2 Analysis of growth patterns	Asta Audzijonyte	Nature Research Centre (Lithuania)
	Max Lindmark	Swedish University of Agricultural Sciences (Sweden)
3 Impact on yield	William Cheung	University of British Columbia (Canada)
	Malin Pinsky	Rutgers, the State University of New Jersey (US)
	Yongjun Tian	Ocean University of China (China)
4 Datasets	Paul Spencer	NOAA Fisheries (US)
	John Pinnegar	Cefas (UK)
	Shin-ichi Ito	University of Tokyo (Japan)

Day 3: September 9, 2020

The goal of Day 3 of the workshop was to develop “Implementation Plans” (IPs) for achieving each of the ToRs listed above, identify ToR leaders, and discuss publication goals. This was accomplished by having the meeting participants separate into breakout groups to engage in smaller group discussions for each of the ToRs. Draft “strawman” Implementation Plans (SIPs) were developed prior to the meeting and used as a starting point. Specifically, the following topics were discussed in the breakout sessions:

- ToR 1: Hypotheses of how temperature may affect size at age; the types of appropriate statistical models; confounding factors and processes; types of outputs; and ecosystems and datasets that can serve as case studies.
- ToR 2: How the temperature-size rule may affect temporal trends in size at age or maximum size, and the ability to attribute these trends to changes in water temperature; other factors beyond temperature that contribute to variability in size at age; subsetting fish stocks to reflect available data (*i.e.*, deep water stocks may be minimally affected by sea surface temperature).
- ToR 3: Best approaches for assessing the impacts of temperature-induced changes in growth on fishery yields; development of a generalized model applied to many systems, or bespoke models tailored to specific systems; and accounting for confounding factors.
- ToR4: Potential data sources not already the current metadata table; data formatting; working arrangements for data sharing; data governance.

Day 4: September 4, 2020

The goal of Day 4 of the WG meeting was to meet in plenary to review and discuss the draft SIPs for each ToR, agree on IPs for each ToR over the next 6 months, identify ToR leaders and identify individual responsibilities to the IPs.

Leaders for each of the ToRs were identified, and deadlines for the next 6 months were identified for 3 of the 4 ToRs. (For ToR 3, it was decided not to set a 6-month deadline during the meeting due to the dependence of outputs from the other ToRs.)

Progress after the September 2020 WG 45 meeting

Prof. Shin-ichi Ito presented an update on WG 45 to the PICES/ICES Section (Initiative) on *Climate Change Effects on Marine Ecosystems* (S-CCME/SICCME) and FIS meetings at PICES-2020 in September 2020. The final Implementation Plans have been developed from the initial “strawman” IPs for the first 4 ToRs. Most of the ToR subgroups have held, or will soon hold, meetings to discuss progress on meeting the goals identified in the IPs, indicated by the following dates:

ToR 1: November 20, 2020, January 12 2021, February 26, 2021

ToR 2: February 24, 2021

ToR 3: January 20, 2021

Additionally, an abstract entitled “*Incorporating temporal changes in fish growth into stock assessments using state-space models*” was submitted to the 2021 ICES Annual Science Conference (Theme Session G, Beyond recruitment correlations: accounting for environmental change in single-species advice), scheduled for September 6–9, 2021 in Copenhagen, Denmark.

*WG 45 Endnote 1***WG 45 participation list****Members**

Shin-ichi Ito (Japan, PICES Co-Chair)
 Paul Spencer (USA, PICES Co-Chair)
 Tara Marshall (UK, ICES Co-Chair)
 Alan Baudron (UK, ICES Co-Chair)
 John Morrongellio (Australia, Co-Chair)
 Sean Anderson (Canada, PICES)
 Yue Jin (China, PICES)
 Shuyang Ma (China, PICES)
 Yongjun Tian (China, PICES)
 Takeshi Tomiyama (Japan, PICES)
 Sukgeun Jung (Korea, PICES)
 Asta Audzijonyte (Australia, ICES)
 Rodrigo Wiff (Chile, ICES)
 Ralf van Hal (Netherlands, ICES)
 Daniel Howell (Norway, ICES)
 Edda Johannessen (Norway, ICES)
 Natalia Yaragina (Russia, ICES)
 Max Lindmark (Sweden, ICES)
 Richard Nash (UK, ICES)
 Bryony Townhill (UK, ICES)
 John Pinnegar (UK, ICES)
 Robert Allman (USA, ICES)
 Malin Pinsky (USA, ICES)
 Cody Szuwalski (USA, ICES)

PICES/ICES members unable to attend

Kunihiro Fujiwara (Japan, PICES)
 Tom Helser (USA, PICES)
 Jochen Depestele (Belgium, ICES)
 Rick Rideout (Canada, ICES)
 Einar Hjorleifsson (Iceland, ICES)
 Myron Peck (Netherlands, ICES)
 Johanna Fall (Norway, ICES)
 Alfonso Perez Rodriguez (Norway, ICES)
 Valerio Bartolino (Sweden, ICES)

Observers

Robert Allman (USA)
 Joanna Bernhardt (Canada)
 William Cheung (Canada)
 Tim Essington (USA)
 Emily Fobert (Australia, ICES)
 Malin Karlsson (Sweden, ICES)
 Tim Miller (USA)
 Mark Payne (Denmark, ICES)
 Christine Stawitz (USA)
 Sarah Willington (Australia, ICES)
 Henry Wooton (Australia, ICES)

Observers unable to attend

Anatoly Filin (Russia)
 Yury Kovalev (Russia)
 Melissa Haltuch (USA)
 Alan Haynie (USA)

WG 45 Endnote 2

Meeting agenda

Because this meeting occurred over 4 days and included “synchronous” (*i.e.*, done during the meeting time) and “asynchronous” (*i.e.*, done outside of the meeting time) activities, we used the meeting map shown below.

Meeting Map for WGGRAFY online meeting (September 2020)

Day	Start time (UTC)	Duration (hours)	Sequential asynchronous and synchronous activities												
			Pre-meeting asynchronous	Review key materials on Sharepoint; communicate questions	MATERIALS AVAILABLE BY 24/8/20										
1	12:00	1.5		Web-meeting	Introductions and Ice breaker										
		0.5			Homework asynchronous	Collect info from attendees									
2	19:00	2			Web-meeting	Presentations relevant to TORs									
					Homework asynchronous	Brainstorm and reflect on TORs	Review any missed material, consider how can contribute to TORs								
3	12:00	0.25								Web-meeting	Goals for sub-group discussions				
		1.75									Sub-groups	Discuss strawman implementation plans for TORs			
												Homework asynchronous	Review missed material, consolidate action plans for each TOR		
4	19:00	2											Web-meeting	Deadlines implementation plan to guide future activities	
			Post-meeting asynchronous												Implementation Plan

Day 1 Online-meeting September 7 12:00-13:30 UTC (real-time)

Aim: Introduction to WGGRAFY and ice-breaker

- Kick-off presentation by co-chairs to enthuse WG members
- Introduction of participants to each other (3 minutes each person)
- Schedule of meetings and activities during the lifetime of WG
- Expectations of WG members
- Week ahead

Day 1 homework (on your own time)

Complete surveys about data available from participants institute, review data sources (Data availability table) file, collect background information about interests and expertise of participants as well as affiliations, review presentations on Sharepoint.

Day 2 Online web-meeting September 8 20:00-22:00 UTC (real-time)

Aim: Building our common scientific understanding of the WGGRAFY TORs

20:00-20:10 Aims for the day and answering housekeeping questions (WGGRAFY Co-Chairs)

ToR 1 Growth models

20:10 Tim Miller (NOAA Fisheries, US): *Models to evaluate age-specific effects on growth while accounting for covariate measurement error and extraneous factors*

20:20 Christine Stawitz (NOAA Fisheries,US): *Spatiotemporal models of groundfish size-at-age*

ToR 2 Analysis of growth patterns

20:30 Asta Audzijonyte (Nature Research Centre, Lithuania): *Fish body sizes change with temperature but not all species shrink with warming*

20:50 Max Lindmark (Swedish University of Agricultural Sciences): *Long term differentiation in life history traits in an artificially heated brackish lake*

ToR 3 Impact on yield

21:00 William Cheung (University of British Columbia, Canada): *Projecting climate change impacts on body size of fish and implications for potential catches*

21:10 Malin Pinsky (Rutgers the State University of New Jersey, US): *Impacts of historical warming on fisheries production*

21:20 Yongjun Tian (Ocean University of China): *Climate variability patterns and their ecological effects on ecosystems in the northwestern North Pacific*

ToR 4 Datasets

21:30 Paul Spencer (NOAA Fisheries, US): *Size-at-age data in U.S. waters*

21:40 John Pinnegar (CEFAS, UK): TBD

21:50 Shin-ichi Ito (University of Tokyo, Japan): *Status of data mining around Japan*

Day 2 homework (on your own time)

Reflect on TORs, considering individual interests and personal contribution to WGGRAFY activities and prepare for breakout discussions on Day 3. Review information related to the Strawman Implementation Plans for the TOR of personal interest.

Day 3 Online web-meeting September 9 12:00-14:00 UTC (real-time)

Aim: Develop workplans for achieving individual WGGRAFY TORs, identify TOR champions (ideally ICES and PICES), and discuss publication goals if appropriate

12:00-12:15 Discuss aims for the day and answering housekeeping questions. Introduce the Strawman Implementation Plans (SIPs) and indicate how discussion of these will lead to the WGGRAFY workplan which will be discussed on Day 4

12:15-14:00 Breakout group TOR1: Discuss and revise SIP and develop work plan for 6 months including allocation of tasks (Lead: Paul Spencer).

12:15-14:00 Breakout group TOR2: Discuss and revise SIP and develop work plan for 6 months including allocation of tasks (Lead: John Morrongiello)

12:15-14:00 Breakout group TOR3: Discuss and revise SIP and develop work plan for 6 months including allocation of tasks (Lead: Alan Baudron)

12:15-14:00 Breakout group TOR4: Discuss and revise SIP and develop work plan for 6 months including allocation of tasks (Leads: Tara Marshall and Shin-ichi Ito)

Day 3 homework (on your own time)

Reflect on SIP, consider your own individual interests and personal contribution to the SIP and comment on the DRAFT SIP on Sharepoint.

Day 4 Online web-meeting September 10 20:00-22:00 UTC (real-time)

Aim: Plenary session to review and discuss DRAFT SIPs for each TOR, agree on implementation plans (IPs) for each TOR over the next 6 months. Confirm TOR co-champions., identify individual responsibilities to IPs. Discuss the report that needs to be prepared for ICES.

- 20:00 Summary of TOR1 SIP (TOR1 Champions)
- 20:20 Summary of TOR2 SIP (TOR2 Champions)
- 20:40 Summary of TOR3 SIP (TOR3 Champions)
- 21:00 Summary of TOR4 SIP (TOR4 Champions)
- 21:20 Updating Schedule of Activities and Meetings (Co-Chairs)
- 21:30 Reporting to ICES and PICES (Co-Chairs)
- 21:40 Internal communications going forward to keep sub-groups informed of each other's progress, e.g., regular catch-ups with co-champions (Co-chairs)
- 21:50 Feedback about meeting (Co-Chairs)
- 21:55 Closing (Co-Chairs)