2021 Report of Working Group 48 on *Towards Best Practices Using Imaging Systems for Monitoring Plankton*

The Working Group on *Towards Best Practices Using Imaging Systems for Monitoring Plankton* (WG 48) was established in 2021 under the chairmanship of Dr. Hongsheng Bi (USA). After its initial meeting in March 2021, WG 48 met in June, and September 7 during PICES-2021 (hosted by the People's Republic of China) to discuss the working plans and progress toward the terms of references (ToR).

AGENDA ITEMS 1 AND 2
Welcome, opening remarks, and membership

- Dr. Bi called the meeting to order and following introductions, members (*WG 48 Endnote 1*) adopted the draft agenda (*WG 48 Endnotes 2 and 3*).
- Contact information for the Working Group was completed. Following the WG discussions, we invited Drs. Lindsay Dhugal from JAMSTEC and Kazutaka Takahashi from the University of Tokyo to increase the representation of west side of North Pacific countries. Dr. Bi will present the request for members from Japan to BIO.

AGENDA ITEM 3
Working plans and progress towards terms of reference

- Applications of imaging systems for monitoring plankton: advantages and limitations of imaging systems for plankton monitoring (ToR 1), comparison of different imaging systems (ToR 2), and different platforms for the deployment of imaging systems (ToR 3).
- We have completed a preliminary draft on the utilization of imaging systems for monitoring plankton (ToR 1–3). Examples of applications of different imaging systems for monitoring around the North Pacific have been identified, including Imaging FlowCytobot (IFCB), the Scripps Plankton Camera, Video Plankton Recorder (VPR) and PlanktonScope.
- Comparison of different image processing algorithms (ToR4) and build common libraries and testing datasets (ToR 5).
- An outline has been developed for comparing different plankton image processing algorithms (ToR 4–5). We will continue to finalize the outline and develop a draft in next few months.
- Build a network of scientists deploying imaging systems to monitor plankton within PICES member countries (ToR 6).
- Promote international collaborations among plankton monitoring programs through international organizations such as PICES and ICES (ToR 7).
- Dr. Pitor Margoński was appointed as an ex officio WG member from ICES to strengthen connections with ICES.
- Submit a report summarizing results (ToR 8)
- Developing the manuscript on imaging systems is underway, written tasks have been assigned and writing is ongoing.   We also discussed the outline for a manuscript on plankton image processing.

AGENDA ITEM 4
Meeting proposals

- We proposed a theme session for the 2022 Ocean Science Meeting in Hawaii, and the session was accepted. However, the proposed session is likely to be combined with another session due to a relatively low number of submissions (*WG 48 Endnote 4*).

- WG 48 also proposed a topic session for PICES-2022, and the session proposal was accepted (*WG 48 Endnote 5*).

WG 48 Endnote 1

WG 48 participation list

Members	Country	June attendance	September 7 attendance
Hongsheng Bi (Co-Chair)	USA	☑	☑
Xuemin Cheng	USA	☑	☑
David Kimmel	USA	☑	☑
Julie Keister	USA	☑	☑
Robert Campbell	USA	☒	☒
Mark Benfield	USA	☑	☑
Alexis Fischer	USA	☑	☒
Akash Sastri (BIO)	Canada	☑	☒
Paul Covert	Canada	☒	☑
Haiyong Zheng	China	☑	☑
Haifeng Gu	China	☑	☒
Satoshi Kitjima	Japan	☑	☑
Park Wongyu	Korea	☒	☒
Pitor Margoński	ICES *ex officio* member	☑	☑

WG 48 Endnote 2

WG 48 March 9 meeting agenda

20:00 – 2100 EST, Tuesday, March 9, 2022

1. Opening remarks (Bi)
2. Updates on membership
3. Working plan to ToRs (All)
   - Discuss comparison different imaging systems.
   - Discuss examples of plankton monitoring program using imaging systems.
4. Final comments (Co-Chair)
5. Adjourn

WG 48 Endnote 3

WG 48 September 8 meeting agenda

20:00 – 2100 EST, Wednesday, September 8, 2022

1. Opening remarks (Bi)
2. Updates on membership
3. Progress
   - A draft outline for image processing
4. Meetings and meeting proposal
5. Adjourn

WG 48 Endnote 4

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Proposal for a Scientific Session on
"*Towards best practices for using imaging systems for plankton monitoring*"
at the Ocean Sciences Meeting 2022

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Co-convenors: Hongsheng Bi (USA), David Kimmel (USA), Julie Keister (USA), Haiyong Zheng (China), Xuemin Cheng (China)

Plankton are the base of marine food webs, and so are essential for sustaining fisheries, seabirds, and marine mammals. Plankton are also ideal indicators of changes in hydro-climatic forces and ecosystem status because they are typically short-lived and respond quickly to environmental changes. Traditional plankton monitoring programs often involve field sampling and sample processing techniques that are high cost, time consuming, and labor intensive. These limitations restrict the potential to use planktonic communities as indicators of environmental change. However, recent developments in plankton imaging systems and machine algorithms provide a unique opportunity to move plankton monitoring programs from net-based techniques to either fully imaging-based or a hybrid of net-based and imaging-based plankton monitoring approaches.

There is little doubt that imaging systems are useful and powerful tools in plankton monitoring, because of significant progress in the development of imaging systems and deployment platforms including profiling floats, autonomous surface vehicles, and underwater autonomous vehicles. However, it is important to understand the strength and limitations of the imaging systems that are currently available for plankton monitoring, and a need to develop broadly applicable taxonomic identification algorithms, in order to continue to make significant advances in the field. We propose a special session during the 2022 Ocean Science conference to summarize the strengths, limitations, and recent progress of imaging systems and deployment platforms. Our session seeks contributions that highlight the utilization of different imaging techniques, automated plankton recognition and enumerating procedures, and sampling protocols that are routinely applicable to monitor plankton using imaging systems. Our goal is to share state-of-the-art science that serves to facilitate the deployment of imaging systems for plankton monitoring worldwide.

WG 48 Endnote 5

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Proposal for a Topic Session on
"*Application and best practice of imaging technologies for plankton and ecosystem monitoring*"
at PICES-2022

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Co-convenors: Hongsheng Bi (China), David Kimmel (USA), Julie Keister (USA), Akash Sastri (Canada)

Traditional plankton monitoring programs often involve field sampling and sample processing techniques that are high cost, time consuming, and labor intensive. These limitations restrict the potential to use planktonic communities as indicators of environmental change. However, recent developments in plankton imaging systems and machine algorithms provide a unique opportunity to move plankton monitoring programs from net-based techniques to either fully imaging-based or a hybrid of net-based and imaging-based plankton monitoring approaches. It is important to understand the strength and limitations of imaging systems and a need to develop broadly applicable taxonomic identification algorithms. This session focuses on plankton imaging systems and image processing methods. Our session seeks contributions that provide examples of imaging systems that are applied to plankton monitoring and discuss how captured images are processed using automated recognition and enumeration methods. Our goal is to share state-of-the-art science that serves to facilitate the deployment and use of imaging systems for plankton monitoring worldwide.