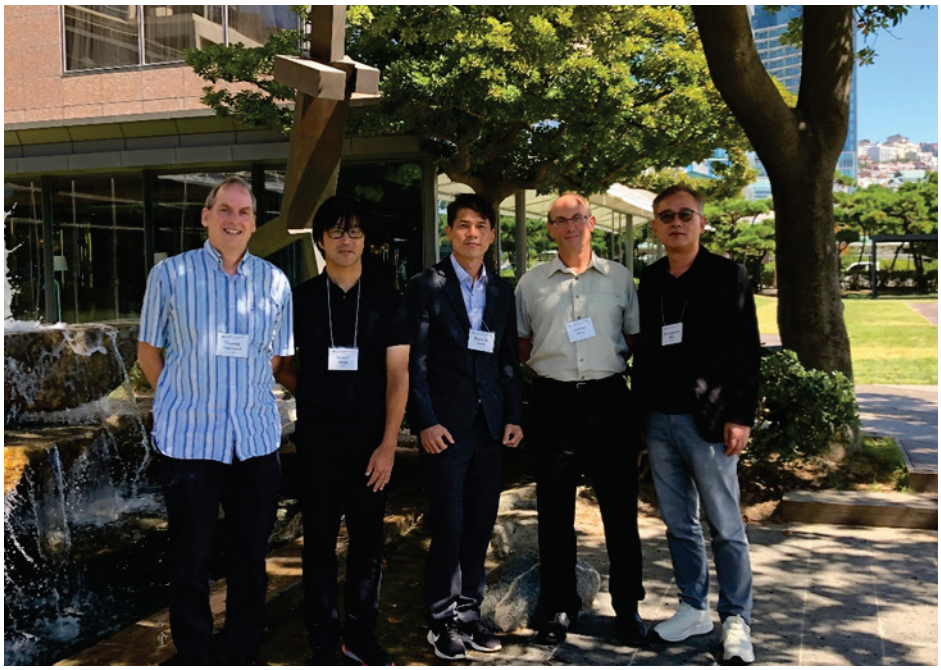
2022 Report of the Advisory Panel on *Marine Non-indigenous Species*

Following two years of difficult COVID-19 restrictions, the Advisory Panel on *Marine Non-indigenous Species* (AP-NIS) met for the sixth time, in-person at PICES-2022 in Busan, Korea, but due to the ongoing global pandemic not all members were able to travel. Dr. Therriault (Canada), the Chair of this PICES expert group, circulated a draft agenda to members in August 2022 and based on comments and feedback, the draft agenda (*AP-NIS Endnote 2*) was finalized. It was immediately clear how excited and energized AP-NIS members and business meeting participants (*AP-NIS Endnote 1*) were to be able to meet in-person once again. The AP-NIS meeting convened on Saturday September 24, 2022, starting at 9:00 h. This was the day following a wonderful tour of the Korea Institute of Ocean Science and Technology (KIOST) facility at Geoje Island on Friday September 23, 2022 where participants were introduced to a multitude of research and monitoring projects highly relevant to PICES MEQ (*e.g.*, micro-/macro-plastics, oil spill response) and AP-NIS (*e.g.*, NIS land-based test facility for ballast water management). Following an amazing lunch with old colleagues and new collaborators at a local restaurant, we had a "mini-workshop" on topics highly relevant for AP-NIS, including eDNA applications to NIS and biofouling research, interactions that simply were not possible in a virtual world.



AP-NIS participants in sunny Busan during PICES-2022. Left to right: Thomas Therriault, Satoshi Nagai, Seung Ho Back, Andrew Ross, Kyongsoon Shin.

AGENDA ITEMS 1 AND 2
Welcome, introductions, opening remarks, new members

Dr. Therriault called the meeting to order and acknowledged that although some AP-NIS members were able to safely travel to Busan, the ongoing COVID-19 pandemic still prevented others from attending PICES-2022 in-person. However, even those unable to attend this year were very optimistic that they would be able to fully participate in-person at PICES-2023 in Seattle, USA. Following introductions, members/observers adopted the draft agenda (*AP-NIS Endnote 2*). Since the last (virtual) meeting at PICES-2021 there were some membership changes: Dr. Satoshi Nagai replaced Dr. Satoshi Watanabe (Japan) while Drs. Joseph Krieger and Carolyn Tepolt replaced Dr. Jeanette Davis (USA). Although the

COVID pandemic has made travel difficult, it was noted that the Chinese representatives have had limited participation on this PICES expert group since its inception. Thus, it was agreed that Dr. Therriault would make a request *via* MEQ and Science Board that the Chinese Governing Council delegates consider adding Dr. Aibin Zahn (Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing) as an additional member of AP-NIS, given his expertise on various NIS topics, including eDNA and other molecular tools that have been the basis of current work within AP-NIS. AP-NIS also had extensive discussions about how Early Career Ocean Professionals (ECOPs) might contribute to this PICES expert group. It was noted that securing travel authorizations and funding are likely major impediments for ECOP participation in general and that this would be true for AP-NIS as well. It was suggested that hybrid meetings may allow ECOPs to participate in business meetings virtually, especially in years where AP-NIS might not be holding a topic session or workshop (which has been a method used at past meetings to bring ECOPs to the meeting venue by giving them multiple roles), but that this type of engagement does not always provide the full experience of being an active member of a PICES expert group (see also Agenda Item 4). Ultimately the naming of members to PICES expert groups rests with Governing Council members and AP-NIS will continue to identify possible ECOP opportunities as they arise for future meetings, topic sessions, and workshops.

AGENDA ITEMS 3 AND 4
Review AP-NIS ToR, and AP-NIS meetings/logistics

The discussion on ECOP involvement led directly to a discussion about how AP-NIS can be most effective at conducting its business, especially the challenges and benefits of in-person, hybrid, and virtual meeting options that have dominated the past two and a half years (Agenda Item 4) and this discussion was guided by the AP-NIS TOR which can be found on the PICES website at https://meetings.pices.int/members/advisory-panels/AP-NIS (Agenda Item 3). Many factors were considered in our discussion, including (but not limited to): cost, CO_2 emissions, approvals, number of participants, *etc*. No AP-NIS member was in favour of moving to a virtual meeting only format. Despite having to conduct business this way during the height of the pandemic, AP-NIS members felt we were only barely able to keep things progressing and that a number of key activities had stalled. There was overwhelming support for in-person meetings as it allows extensive discussions and interactions that extend into coffee breaks and group dinners where the social exchanges facilitate more personal interactions that, in turn, enhance scientific collaborations. Finally, the discussion circled back to engagement of ECOPs, and members felt strongly that a hybrid option that would allow ECOPs (or others with competing commitments) to be able to attend the business meeting may provide the flexibility to ensure maximum attendance, especially in years where AP-NIS is not planning on hosting a topic session or workshop. There were several logistical issues raised and discussed around hybrid options, including the potential to have a second meeting chair to deal with the computer interface and management of online participants. Recognizing this agenda item was to be discussed in Busan, some additional input was provided in advance from members unable to attend, and their views aligned with discussions in the room. Ultimately AP-NIS decided to continue to pursue in-person meetings held in conjunction with the PICES Annual Meeting and to explore options of possible inter-sessional meetings if/when a majority of AP-NIS members might be attending a conference or workshop. Thus, Dr. Therriault will ask MEQ and Science Board for a 1-day business meeting at PICES-2023 in Seattle, USA.

AGENDA ITEM 5
Update on PICES collaborations with NOWPAP

PICES has a long history of collaborations with NOWPAP, especially on topics related to MEQ, including non-indigenous species (NIS) and harmful algal blooms (HABs). Thus, Dr. Therriault took

the opportunity to invite NOWPAP-CEARAC member Dr. Yoshida to present to AP-NIS at the meeting, but at the last minute he was unable to travel to Busan. However, he was able to provide a quick update to Dr. Therriault who shared this information at the meeting. Due to ongoing international challenges, all NOWPAP activities are paused. There remains a strong interest and commitment to advance topics of mutual interest between NOWPAP and PICES, such as eDNA tools when activities resume.

AGENDA ITEMS 6–9

NIS information sharing, changing distributions and pathways, policy, regulation and management, best practices

Information sharing is a central theme within AP-NIS (see Agenda Items 6–9). TOR 1 states the AP will continue to share information on NIS in the North Pacific *via* an updated NIS database. At the first AP-NIS meeting at PICES-2017 in Vladivostok, discussions started on the most appropriate database to exchange such information and at PICES-2018 in Yokohama, members agreed that the ICES-sponsored database AquaNIS would be preferred, in part due to the long history of collaboration on marine science issues between PICES and ICES, including on NIS. However, collecting such information has been challenging, in part due to COVID-19 restrictions and membership changes. At the PICES-2021 business meeting, Dr. Therriault invited Dr. Sergej Olenin, the AquaNIS database manager, to provide AP-NIS members an overview of this database which is capable of housing species records and introduction events from around the world, including the North Pacific, and members identified key contacts that would compile data to be deposited in AquaNIS from Canada, Japan, and Korea (as USA was not represented last year). Although members still face COVID-induced challenges, members agreed to continue to populate country records that will be uploaded in advance of PICES-2023. Further, AP-NIS identified the need to share information beyond NIS occurrences and discussed possible methods for doing so. It was agreed that Dr. Therriault will talk to the PICES Secretariat about hosting an AP-NIS website page that will allow members to post and exchange things like primary publications or links to key products (technical reports, manuals, *etc.*).

The meeting then turned to the individual country reports as part of our information exchange. Given the membership changes with new roles and responsibilities for some, AP-NIS had an in-depth discussion about how best to communicate the findings/results that are most important for member countries. This led to the development of a new reporting template for AP-NIS (*AP-NIS Endnote 3*) that easily captures the most critical bits of information related to AP-NIS' TOR. One of the most important things to understand is the extent of new NIS invasions, and this year *Schizoporella errata* was recorded for the first time in the Korean waters of Jeju Island. In addition, the European Green Crab (*Carcinus maenas*) continues to spread along the west coast of North America with new sightings (southeast Alaska during the summer of 2022).

AGENDA ITEM 10

Potential workshops/topic sessions/training courses

Another key activity of AP-NIS is to host topic sessions and workshops (TOR 4), including with other organizations (TOR 5). At past PICES Annual Meetings AP-NIS has hosted a virtual session on eDNA (PICES-2020) with the planned extended version of this session in-person during PICES-2022. These topic sessions were designed to complement planned workshops on eDNA with NOWPAP and ICES, both of which have been delayed due to the COVID pandemic.

AP-NIS discussed the continued value in collaborating with NOWPAP and ICES to ensure these activities are productive and well attended. The AP further discussed options for a continued presence

at PICES Annual Meetings and so Drs. Therriault (Canada) and Tepolt (USA) drafted a topic session proposal entitled "*The complex reality of managing Non-indigenous Species (NIS) in the North Pacific*" (*AP-NIS Endnote 4*) based on their experiences working with scientists, managers, First Nations/Tribes, and local stakeholders currently dealing with the Green Crab invasion on the west coast of North America, especially within the Salish Sea that was submitted via the online portal. All AP-NIS members supported this topic session and endorsed the idea to seek MEQ support.

AGENDA ITEM 11
AP-NIS special project

AP-NIS has discussed various potential projects over the past five years but eDNA issues in the context of early detection or monitoring for NIS is a topic that has received considerable discussion and support for topic sessions and workshops. Thus, AP-NIS discussed the possibility of having a special project on this topic. More specifically, AP-NIS members are aware of several projects developing or using eDNA tools such as the eDNA manual that has been developed by the eDNA Society of Japan and the Fisheries and Oceans Canada Canadian Science Advisory Secretariat Research Documents on eDNA applications. However, how best to implement these remains a challenge. Thus, AP-NIS discussed the role it could play in reviewing these existing documents in order to identify a standardized approach that could be applied among PICES member countries. The intent would be to develop this as plain language guidance to ensure broad uptake by those applying these tools (avoiding the technical jargon that can create confusion among non-experts). AP-NIS members agreed to identify such documents within their countries that can be discussed at PICES-2023.

There was additional discussion about other areas where AP-NIS could make broader scientific contributions. For example, PICES could develop advice on NIS issues *via* a perspectives piece similar to what ICES periodically produces for its member states. This could be something timely like the effectiveness of coatings *vs* in-water cleaning, or ways to reduce the risk of NIS introductions *via* shipping. Building on past capacity building exercises conducted by WG 21 (Non-indigenous Aquatic Species), AP-NIS also felt it possible to develop a project to develop and deploy cost-effective NIS monitoring tools that could be used beyond the PICES domain, as surveillance for NIS early detection should be based on an understanding of possible threats. Such a project could be funded *via* capacity development or education and outreach initiatives and could involve countries active in biosecurity such as New Zealand and Australia.

AGENDA ITEM 12
Global NIS activities of interest

Not discussed.

AGENDA ITEM 13
Update on FUTURE

As the FUTURE SSC liaison with AP-NIS, Dr. Therriault provided a brief update highlighting alignment with the UN Decade for Ocean Science and linkages to AP-NIS, as NIS are a global threat to healthy and productive marine ecosystems. Since Science Board requested information from expert groups in advance of PICES-2022, Dr. Therriault reviewed the expert group report with AP-NIS members and all were in agreement with its content.

AGENDA ITEM 14
Funding requests to MEQ

None.

AGENDA ITEM 15
Other business

None.

AGENDA ITEM 16
Adjourn

Dr. Therriault thanked meeting participants and concluded this in-person meeting of PICES AP-NIS.

AP-NIS Endnote 1

AP-NIS participation list

Members

Thomas Therriault (Canada, Chair)
Satoshi Nagai (Japan)
Kyoungsoon Shin (Korea)

Observers

Seung Ho Back (Korea)
Andrew Ross (Canada, MEQ Vice-Chair)

Members unable to attend

China: Lijun Wang, Li Zheng
Japan: Hiroshi Kawai
Korea: Keun-Hyung Choi, Jongwoo Park
USA: Joseph Krieger, Carolyn Tepolt

AP-NIS Endnote 2

AP-NIS meeting agenda

Saturday, September 24, 2022

1. Welcome, introductions, opening remarks
2. Welcome new member(s) of AP-NIS and brief introduction of research area/interests
   a. Discuss possible new members
   b. Discuss possible engagement of ECOPs
3. Review AP-NIS ToR
4. Discuss AP-NIS meetings/logistics
   a. PICES is encouraging more online meetings
   b. ICES meetings rotate among member countries with meetings not linked to ASC
   c. Some PICES ExGs meet annually but not at the PICES Annual Meeting
   d. Possibility of some hybrid options?
   e. Others?
5. Update on PICES collaborations with NOWPAP (Takafumi)

   a. Update on eDNA training workshops within NOWPAP and potential for new activities
6. Information sharing on NIS within PICES and beyond (ToR 1)
   a. **Action Item** from PICES-2018: Members to have some records for review and upload to AquaNIS
   b. **Action Item** from PICES-2021: Canada, Japan, and South Korea agree to upload records to AquaNIS
   c. Discuss any challenges related to record gathering/reporting for AquaNIS
   d. Discuss current situation for each member country and develop revised timeline for submissions to AquaNIS (ongoing)
7. Changing NIS distributions and pathways (ToR 3)
   a. **Action Item** from PICES-2018: Members to report:
      i. New introductions of marine NIS
      ii. Spread of existing/known marine NIS
      iii. Vectors and pathways updates
8. Policy, Regulation and Management of NIS in the North Pacific (ToR 2)
   a. **Action Item** from PICES-2018: Members to report:
      i. Recent efforts related to eDNA but could be others
   b. Updates from IMO activities
      i. Ballast water
      ii. Biofouling Correspondence Group
      iii. Others?
9. Discussion on Best Practices (ToR 2) (**Action Item** from PICES-2018 was to focus on Monitoring but can discuss other topics if of interest)
   a. For Monitoring/Early Detection (Current Focus)
      i. Current efforts in each member country (e.g., traditional surveys, eDNA, *etc*.)
      ii. Topic Session S6 on Thurs Sept 29, 2002 that builds on Virtual Topic Session at PICES-2020 (VS3) on eDNA approaches to detecting NIS
      iii. Discuss possible systematic monitoring among PICES member countries and key partners (*e.g*., NOWPAP, ICES) such as settlement plates for biofouling
10. Potential for hosting workshops/topic sessions/training courses/*etc*.
   a. Continued interest from NOWPAP and ICES. Consider invited speakers, financial support, etc. Will get an update from NOWPAP under Agenda Item 4 and from ICES here.
   b. Potential to host topic session and/or workshop at 11th ICMB now planned for May 2023 (Baltimore, USA)
   c. Potential capacity building activities (WG-21 did some of this)
   d. Potential to collaborate with other groups (i.e., ICES/NOWPAP/*etc*.)
      i. Recent efforts related to eDNA but could be others
11. Discussion of a Special Project to be undertaken by AP-NIS (time permitting)
   a. Possible focus on biofouling issue in the North Pacific.
   b. Possible species or vector of common interest
12. Update on Global NIS activities of interest to AP-NIS
   a. World Ocean Assessment 3 has started with expected Chapter on NIS
   b. IPBES Global Assessment (currently seeking peer input)
   c. Others?
13. Update on PICES FUTURE Program, including UN Decade for Ocean Science
14. Finalize info/funding requests for MEQ
15. Other business
16. Adjourn

AP-NIS Endnote 3

Reporting template for AP-NIS

TOR 1

Continue to share information on marine non-indigenous species (NIS) in the North Pacific via an updated NIS database.

- Describe progress in collecting NIS information for AquaNIS (*e.g*., Number of records uploaded, *etc*.).
- We want to ensure we collect information on any NEW NIS invasions in PICES member countries and the spread of existing NIS in PICES member countries.

TOR 2

Exchange information on updated regulations/policy, best practices for monitoring, early detection, rapid response, and control/containment options.

- We want to capture any changes to policy or regulations.
- We want to understand the types of NIS monitoring in each PICES member country (target species, locations, *etc*.). This is more about the "how" monitoring being done rather than the "finding – TOR 1".
- We want to understand if there have been any rapid responses to new detections or status of ongoing control/management efforts.
- This TOR is about exchanging information on lessons learned – what worked well and what didn't.

TOR 3

Develop a better understanding of changing distributions of NIS and invasion pathways and vectors in the context of global climate change including expected changes in water temperature, salinity, oxygen, and pCO_2.

- Develop a better understanding of changing distributions of NIS and invasion pathways and vectors in the context of global climate change including expected changes in water temperature, salinity, oxygen, and pCO_2.
- This TOR is more about research and/or risk assessment. Include any new findings for species or vectors/pathways. Also, include and advice for managers.
- Ask PICES for website to share primary papers or technical reports.

TOR 4

Plan workshops/sessions/symposia related to NIS topics. (For example, a joint PICES/ICES Theme Session on "The increasing importance of biofouling for marine invasions: an ecosystem altering mechanism" was held at the 2014 ICES Annual Science Conference.).

- AP-NIS will think about possible workshops or sessions at relevant meetings annually.

TOR 5

Work with other international, intergovernmental organizations (e.g., IMO, ICES, NOWPAP and WESTPAC) and/or countries to accomplish these terms of reference, especially those related to data/information exchange.

- If applicable, describe any collaborations on NIS with external groups or organizations

Other

- If applicable, describe any other activities on NIS not captured in TOR to 5 above.

AP-NIS Endnote 4

Proposal for a Topic Session on
"*The complex reality of managing Non-indigenous Species (NIS) in the North Pacific*"
at PICES-2023

Co-conveners: Thomas Therriault (Canada); Carolyn Tepolt (USA)

Sponsorship: Coastal Restoration Society, Washington Crab Team, ICES (TBC)

Duration: 1 day

Non-indigenous species (NIS) can cause ecological and economic damage to coastal marine ecosystems and are a threat to biodiversity, ecosystem services, and the livelihood of coastal communities around the North Pacific. The spread of marine NIS has increased in the last decade due to globalization and other related human activities and climate change. This has sparked an increased awareness about the threats NIS pose and the need for better management and policy to mitigate their impacts, especially in already stressed coastal environments. Once such example is the spread of European Green Crab (*Carcinus maenas*) along the west coast of North America where management efforts have recently ramped up. Further, it was quickly realized that management needed to be coordinated and inclusive, especially over large spatial scales. Similarly, despite considerable species-specific knowledge, many scientific gaps were identified (from monitoring and early detection to control and eradication) and successful management interventions were only possible *via* collaborative networks including agencies, Indigenous groups, and a variety of stakeholders. This topic session will explore the complexities of managing NIS from different perspectives and will not be limited to only Green Crab. The goal is to share experiences around successes and challenges of managing marine NIS, especially those that span different spatial scales or jurisdictions, and how these challenges were resolved or not. This will allow generalizations that will be helpful for PICES member countries managing marine NIS.