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PICES-ICES WG53/WGSPF meeting (May 2026)

Activity 11: Small Pelagic Fish in 2050 (Synthesis of WG53/WGSPG 10 activities)

Activity leaders: Myron Peck, Chris Rooper, Shin-ichi Ito

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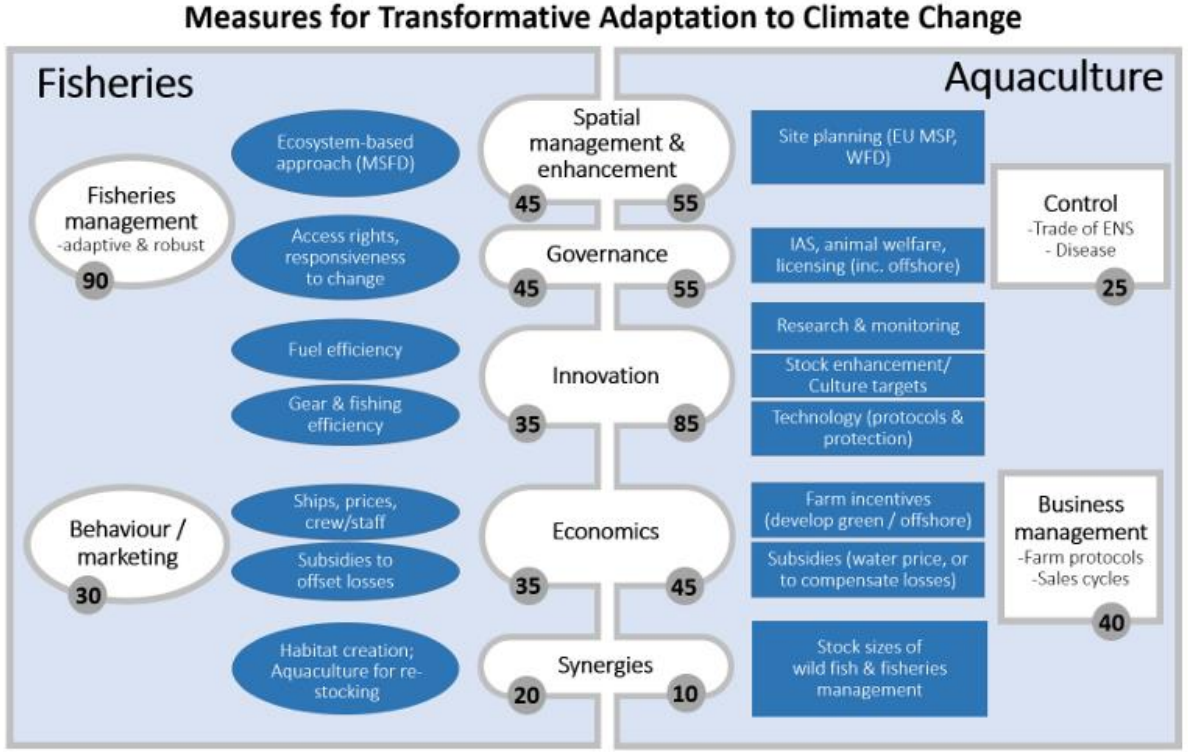
Activity progress: meetings

- 3 activity leaders meet at the SPF - 2026 at La Paz.
- Chris Rooper and WG53/WGSPF members convened W3 “Addressing Knowledge Gaps and Future-proofing Monitoring of Small Pelagic Communities Using Novel Methods and Technologies” and all 3 activity leaders attended.
- 3 activity leaders confirmed that the priority of activity 11 is synthesize the activities of WGSPF/WG53 (a possible example is bow-tie analyses in CERES).



Peck et al. (2020) Climate Change and European Fisheries and Aquaculture: ‘CERES' Project Synthesis Report.

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Activity progress: discussion

- OceanObs'29 Whitepaper
  - Do we propose a section to OceanObs'29?
  - https://www.oceanobs29.net/
  - Qingdao China
- UN Decade for Ocean Science
  - Do we need to connect to UNDOS?
  - FishSCORE?
  - The Fisheries Strategies for Changing Oceans and Resilient Ecosystems

https://gmri.org/projects/fisheries-strategies-for-changing-oceans-and-resilient-ecosystems-by-2030-fishscore2030/

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General points for WG meeting

- List of ideas “for how your activity can contribute to the Small Pelagics in 2050 Synthesis” from each activities will be listed here.
  - Activity 3: anticipate change in life history traits (LFT) under climate change + projection
  - Activity 6: will there be targeted fisheries for mesopelagic species?
  - Activity 7: W3 SPF surveys 2050
  - Activity 9: EBFM scenario developments?
  - Activity 10: set SPF in the broader employment and labor landscape
  - **Activity 10:** Evaluate need for increased cooperatieve strategies, for transboundary SPF stocks (environment changes)
  - **Activity 10:** Consideer future scenarios with and without potential collaboration

We are waiting for inputs from each activity.

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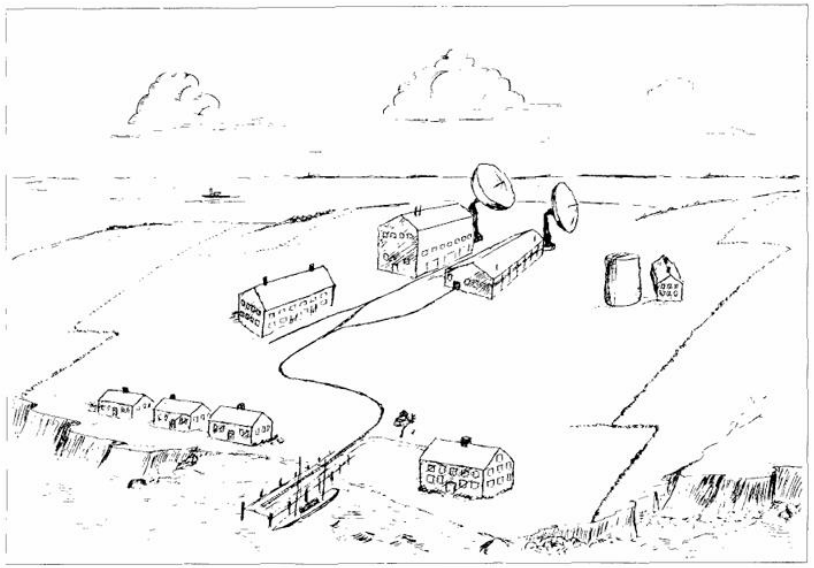
Activity progress: results

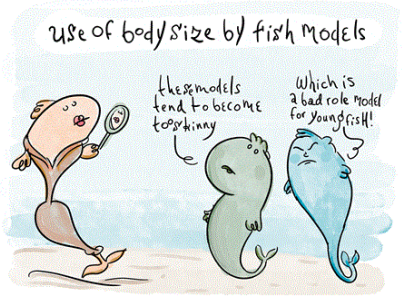
Activity 11 must wait for outputs from each activity one more year. Before it,

- A potential publication: Science fiction “SPF science in 2050 and beyond”

Package of dreams for science regarding SPF which are expected to be realized in 2050 and beyond.



Stommel (1989) The Slocum mission. Oceanography, 2, 22-25.



Link et al. (2019) A graphic novel from the 4th International Symposium on the Effects of Climate Change on the World’s Oceans. ICES J. Mar. Sci.

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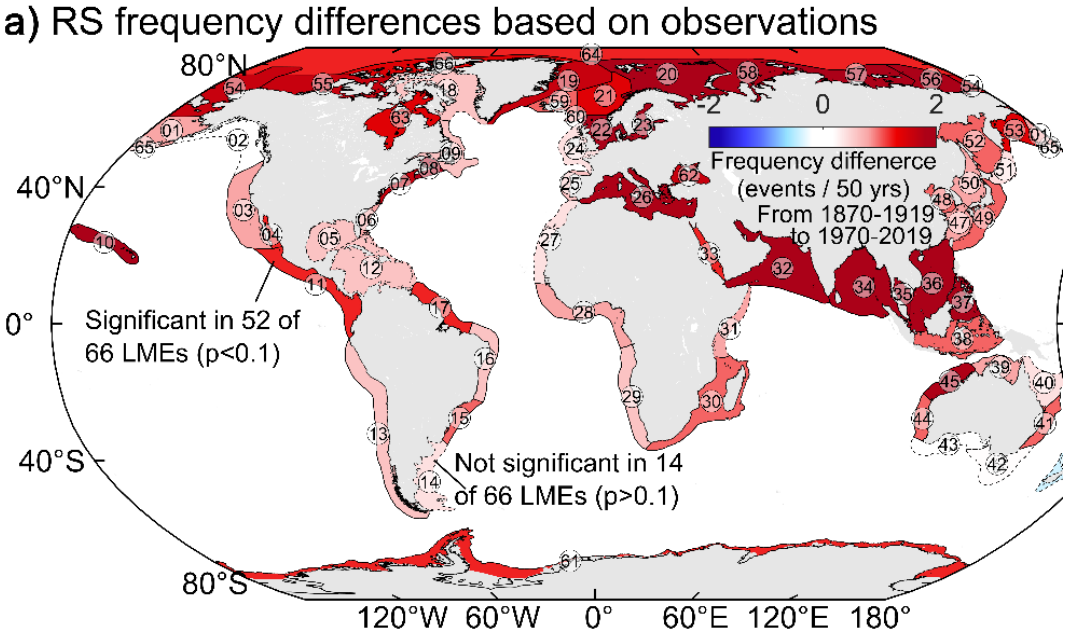
SF 2050 (SPF)

- Many change but under managements
- Geographical & phenological shift:
  - new emerging species
  - hybridization
  - new ecosystem structure
- Size change
  - Shrink in some & enlargement in others
- Intensified regime shifts
  - Larger fluctuation?
- Intensified eddies & fronts
- Increased exposure to anthropogenic materials due to elevated respiration
  - Mercury, microplastics, PFAS, etc.



Xing et al. (2026, Nature Comm.)
https://doi.org/10.1038/s41467-026-70986-z

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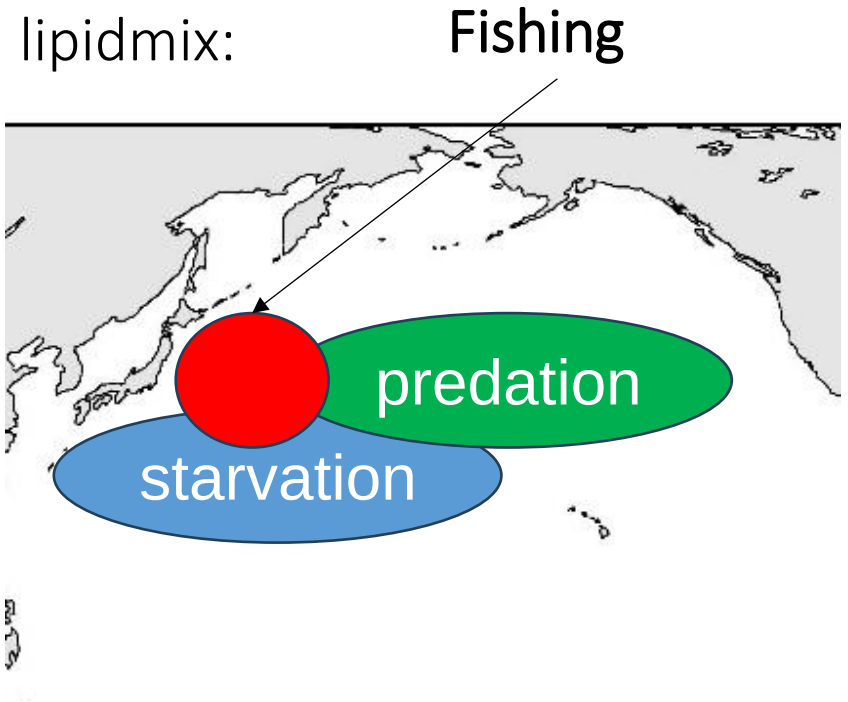
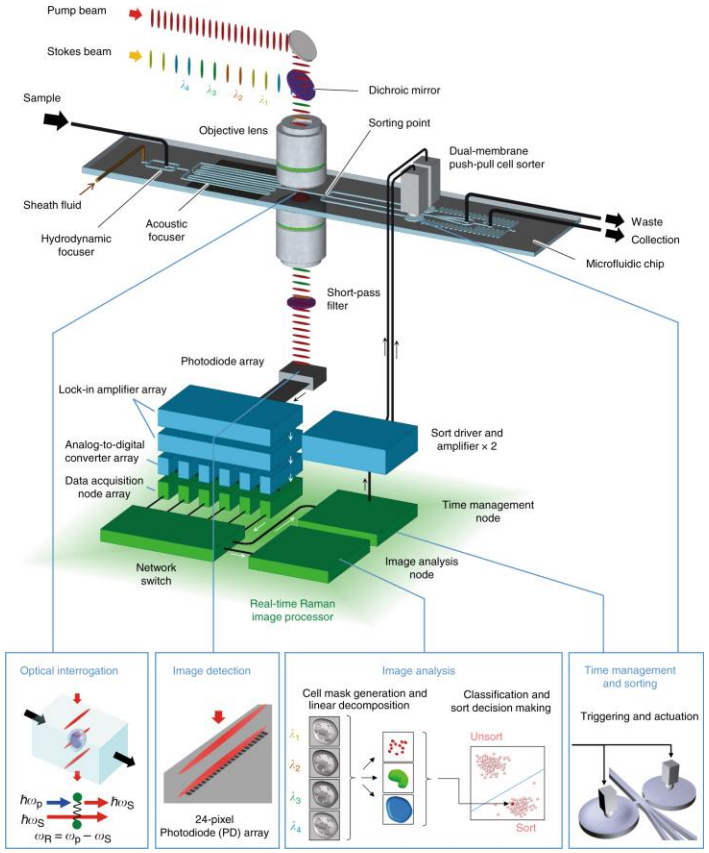
SF 2050 (analyses)

- eDNA:
  - identify individuals (e.g. Japanese sardine JS202501000049)
  - Idenfity age by epigenetics (eDNA cell-sorter)
- eRNA, exosome + transcriptome, proteome, metaborome, lipidmix:
  - Life history & health & stress
    =>stress map, mortality map, energy intake map
- close-kin mark-recapture method
  - Biomass, family tree
  - **super mother fish,** super couple (marriage party)
- Genomics
  - Micro-population
- SPF teleconnection analyses
  - Impacts on ecosystem by teleconnection caused by SPF



SF 2050 (observation)

- Observation ship with AI robots:
  - Water sampling robot (8 hours working, no watch)
  - AI camera
  - AI sorter
  - Anti-rolling wearable device (no sea-sick)
  - Remote class (everybody can be like Jacques-Yves Cousteau)
- More environment coupled observation:
  - Microstructure, submesoscales, fronts, eddies, typhoon, super El Nino, etc.
  - Carbon budget, chemical components, etc.
  - Virus, bacteria (health)
- International cruises + soler&wind&bioenergy
  - Transboundary observation



Nitta et al. (2020) "Raman image-activated cell sorting", Nature Communications 11, 3452

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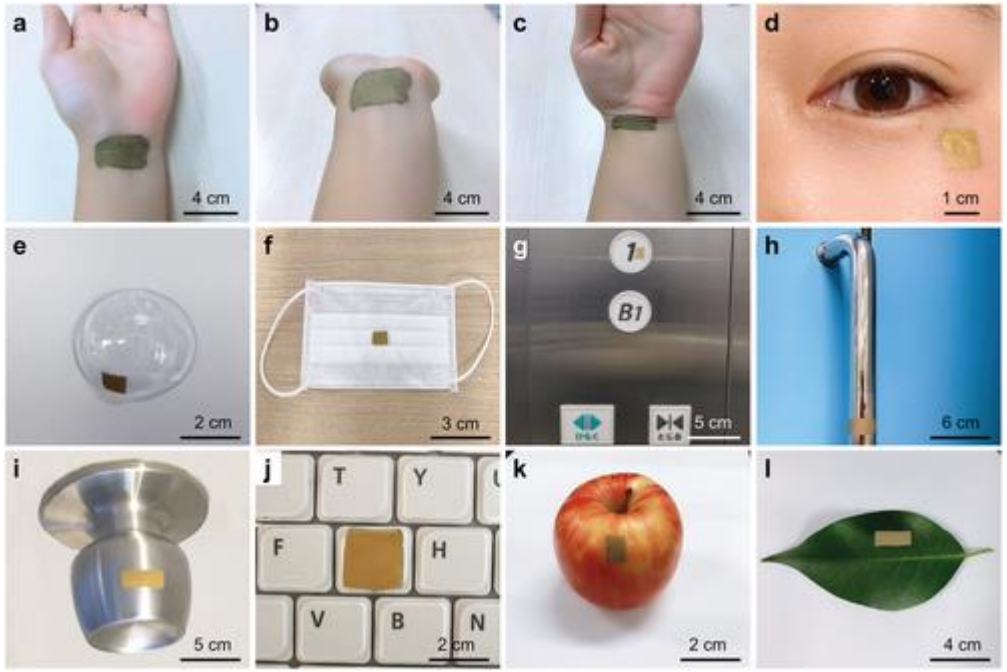
SF 2050 (remote sensing)

- More fishery industry monitoring
- Argo float
  - with acoustics
  - with videos
- Tracing fish robot:
  - Size & shape changiable (Terminator II)
- Gravity anomaly obs. satellite:
  - Sardine run detection
- Wearable sensor + Cheminformatics
  - Monitor health



Liu et al. (2022) "Highly scalable, wearable surface-enhanced Raman spectroscopy", Advanced Optical Materials 10, 2200054 https://doi.org/10.1002/adom.202200054

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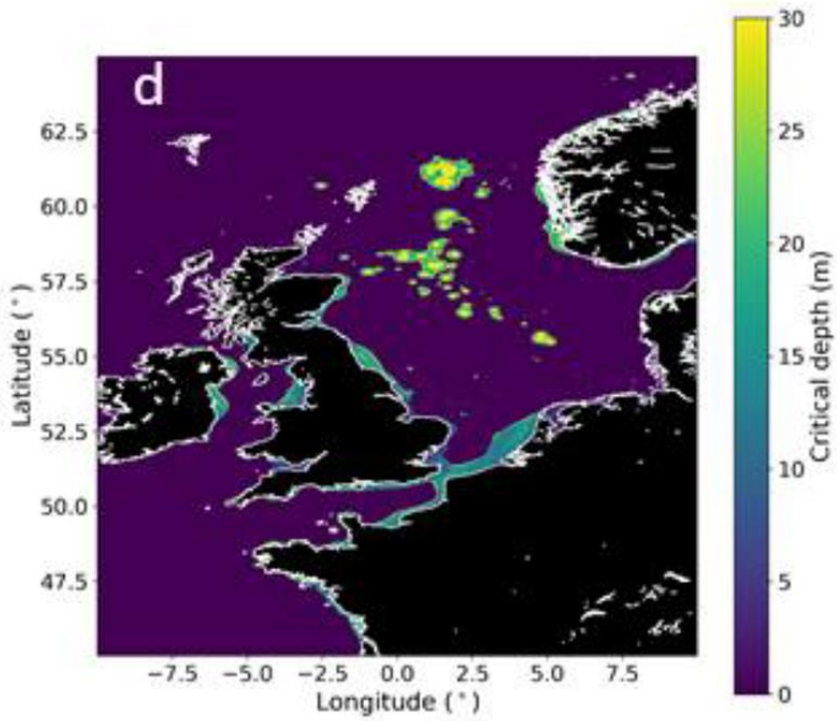
SF 2050 (management)

- Stock assessment => health assessment
  - Co-management, Annual health check
  - MPA for SPF
- Digital twin
  - Fishery pressure assessment
- Phosphorus assessment
  - Because of global phosphorus crisis
- Setnet sorter (avoid bycatch)
- Sorter at gate for seaweed beds
  - Avoid invasion of algae destroy species to protect spawning habitat of SPF
- Noise & light regulation in United Nations Convention on the Law of the Sea
- Ministry of SPF in several counties



Smyth et al. (2021) doi.:10.1525/elementa.2021.00049

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SF 2050 (socioeconomy)

- Increased value as food
  - AI recipe instead of just fly, fly, & fly
- Supply chain also co-design
- Food crisis
  - because of global food crisis, price of SPF will increase
- Phosphorus crisis
  - Because of global phosphorus crisis, price of SPF will increase

SF 2050 (possible outreach)

Followings are examples which attracts general peoples

- “Someday I can't eat sushi”
  - **https://www.euglena.jp/en/sushi/**
- “Weather Forercasts in 2050”
  - https://www.youtube.com/watch?v=NCqVbJwmyuo

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SF 2050: break out discussion

- Discussion style: Think-Pair-Share
  - 2 people (10 minutes)
  - 4 people (10 minutes)
  - 8 people (20 minutes)
- Discussion items:
  - 1st round discussion: Items to be included in SF 2050
  - 2nd round discussion: how to make SF 2050 narrative (storyline)