

BIO/POC Topic Session (S2)

Mechanisms of physical-biological coupling forcing biological “hotspots”

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Background

This session will examine the physical and oceanographic factors that correspond to ecological or economic “hotspots” in the North Pacific and North Atlantic and their marginal seas. For the Pacific, this session will focus on the Kuroshio/Oyashio extensions and ecotone, the intersection of the Sea of Okhotsk and the western North Pacific (Kurul Islands region), and the Western Bering Sea. For the Atlantic, this session will focus on the North Sea, the intersection of the Gulf Stream and Labrador Current, in addition to tidally driven systems such as the Gulf of Maine and Gulf of St. Lawrence. “Hotspots” can broadly be defined as areas encompassing high species diversity, high abundance of individuals, especially of important indicator species, or areas of high economic value. Interdisciplinary contributions on physical-biological coupling and resulting seasonal or year-round “hotspots” in primary to tertiary productivity are invited. This includes data on physics, phyto- and zooplankton, forage fish, and upper trophic level predators (*e.g.*, fish, seabirds, mammals, humans). We are particularly interested in simultaneous multi-species multi-use hotspots (*i.e.*, sites of ecological importance that overlap highly with sites of economic value) and potential changes in hotspots under future climate change scenarios. Modeling and empirical studies are encouraged. We will solicit a special publication in the primary literature pending subscription to the session.

Summary of presentations

Session 2 at PICES 2011 had a total of 14 talks and with no fewer than 40 attendees in the audience. Some talks focused on the physical oceanography at known marine hotspots (4 papers), while others considered seabirds (4), fish (3), and marine mammal (3) hotspots, multispecies hotspots, and also overlaps between hotspots and human impacts. A common theme was the issue of scale underlying identification or formation of hotspots, from those formed by ocean currents spanning 5000 km² to tidally driven hotspots in the wakes of headlands at the scale of 100 km². Scale differences highlight a range in biophysical factors affecting hotspot formation and persistence.

We discussed interest in assembling a special journal issue stemming from the theme session and at least half of the presenters were prepared to contribute a paper to a special issue. Our impression was that by reaching out to the broader community there will be sufficient interest for a full volume. Further interest and potential journals will be considered during the coming months. The audience felt that by focusing on mechanisms of hotspot formation in addition to other questions noted below, this volume would be sufficiently distinguished from the 2006 Deep-Sea Research II volume stemming from a 2004 PICES hotspot session. From the discussion session, we identified which questions about hotspots were most important to answer as a focus of the theme issue and came up with the following:

- 1) How do the two broad classes of hotspots differ, specifically what are the mechanisms of hotspot formation for both 1) aggregative and 2) bottom-up forced hotspots. How do the mechanisms allow the hotspot to persist or re-occur predictably?
- 2) How do we prioritize hotspots, *e.g.* does a certain percentage of the population have to visit a hotspot for it to be a hotspot, or are hotspots that support high biodiversity and strong ecological interactions the most important hotspots?
- 3) How might species interactions affect the use of hotspots by certain species?
- 4) What hotspots are at greatest risk? Which hotspots have greatest threat from human uses (*e.g.* fisheries, shipping lanes). For persistent or predictable hotspots, how persistent are they over decadal or multi-decadal time scales, *e.g.* which hotspots are likely to change under broad scale forcing such as regime shifts or climate change?

List of papers

Oral presentations

Sei-Ichi Saitoh, Robinson M. Mugo, Mukti Zainuddin and Fumihito Takahashi (Invited)

Potential fishing zones as “hotspots” of skipjack tuna (*Katsuwonus pelamis*) and albacore (*Thunnus alalunga*) in the western North Pacific

Shin-ichi Ito, Yugo Shimizu, Shigeho Kakehi, Taku Wagawa, Masatoshi Satoh, Daisuke Ambe, Takeshi Okunishi and Kazuyuki Uehara

A quasi-steady warm water jet and an ecological hotspots in the western North Pacific

David G. Foley

Constructing oceanographic data sets and delivery systems to meet the needs of biologists

Robert Survan, Kathy Kuletz, Martin Renner, Patrick Ressler, Shannon Fitzgerald, Kiyooki Ozaki, Fumio Sato, Tomohiro Deguchi and Elizabeth Labunski (Invited)

Mechanisms affecting seabird-prey associations over submarine canyons in the northwestern Bering Sea

Igor M. Belkin (Invited)

Satellite oceanography of fronts as biological hotspots

Robinson M. Mugo, Sei-Ichi Saitoh, Fumihito Takahashi, Akira Nihira and Tadaaki Kuroyama

When, where and why skipjack tuna, red flying squid and pacific saury potential fishing zones are likely to overlap in the western North Pacific: A proof of concept

Takashi Yamamoto, Akinori Takahashi, Nariko Oka, Takahiro Iida, Nobuhiro Katsumata, Katsufumi Sato and Philip N. Trathan

Foraging areas of streaked shearwaters in relation to seasonal changes in the marine environment of the Northwestern Pacific

Jürgen Alheit (Invited)

Climate variability impact on North Sea ecosystem

Elliott L. Hazen, Scott A. Shaffer, Michelle A. Kappes, Ryan R. Rykaczewski, David G. Foley, Steven J. Bograd and Daniel P. Costa

Oceanographic habitat segregation among postbreeding Hawaiian albatrosses and potential changes from 2001-2100

Mary-Anne Lea, Jeremy T. Sterling, Nicholas A. Bond, Sharon Melin, Rolf Ream and Tom Gelatt

Habitat use of Alaskan northern fur seal pups in the western North Pacific Ocean

Kaoru Hattori, Takeomi Isono and Orio Yamamura

Wintering aggregations of Steller sea lions in Ishikari-Bay, Sea of Japan

Haruka Nishikawa, Ichiro Yasuda, Sachihiko Itoh, Yoshikazu Sasai and Hideharu Sasaki

Impacts of climatic regime shift on Japanese sardine stock collapse

Konstantin Rogachev

Satellite and direct observations of circulations features associated with bowhead feeding hotspots in the Sea of Okhotsk

Poster Presentations

Tomoko Harada, Kentaro Kazama, Tomohiro Deguchi, Hajime Suzuki and Yutaka Watanuki

Foraging behavior of subtropical black-footed albatross *Phoebastria nigripes* and the marine environment around Bonin Islands

Igor M. Belkin and S. Kalei Shotwell

Propagation of SST anomalies along the North Pacific