

NORTH PACIFIC RESEARCH BOARD PROJECT FINAL REPORT

Habitat Mapping Technology Workshop for Alaska

NPRB Project 615

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Abstract:

The Marine Habitat Mapping Technology Workshop for Alaska was convened in Anchorage on April 2-4, 2007, to examine the technologies that would be effective for benthic marine habitat mapping in the Alaska region. It was intended to increase understanding of benthic habitat mapping and to help guide evaluation and selection of technologies for future habitat mapping projects. The agenda was designed around two days of synthesis presentations by twenty-three invited speakers, poster presentations by attendees, and a half-day discussion in three breakout groups. The first day focused on the concept of marine habitat mapping and technologies available for remote sensing over large areas, mainly acoustic mapping of the seafloor. On the second day, presentations and discussion shifted to technologies available for visual scale observations and sampling, as well as analysis of visual data and habitat classification. The final talks presented case histories from three large habitat studies (Oregon, Ireland, Australia) that provide contrasting approaches. Breakout groups on the third day discussed (1) Selection of appropriate technologies to facilitate multidisciplinary approaches: Integrating biology and geology; (2) Techniques and tools specific to environmental settings; and (3) What can we learn from Ireland-Australia-California. A peer-reviewed monograph from the workshop contains chapters developed from the speakers' presentations, a full workshop report, and an index. This monograph has been published on CD by Alaska Sea Grant, and the contents are also available online.

Key Words:

workshop, benthic habitat, seafloor habitat, habitat association, geology, mapping, sonar, video, classification, fishery

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Study Chronology:

- Initial award period: September 1, 2006 to August 31, 2008.
- November 2006: Workshop information web page created on the Alaska Sea Grant web site.
<http://seagrants.uaf.edu/conferences/2007/benthic/index.html>
- December 2006 – February 2007: Workshop information flyer distributed by mail, email, and at conferences.
- January 2007: Semiannual Progress Report submitted for the period Sept 2006 – Jan 2007.
- April 2-4, 2007: Habitat Mapping Technology Workshop for Alaska held at the Sheraton Anchorage Hotel. Abstracts were posted on the web site in advance of the workshop.
- July 2007: Semiannual Progress Report submitted for the period Jan 2007 – June 2007.
- January 2008: Semiannual Progress Report submitted for the period July 2007 – Dec 2007.
- May 2008: Co-PI Brian Allee retired from the University of Alaska Fairbanks.
- September 2008: No-cost extension to December 31, 2008 approved by NPRB.
- October 2008: The publication *Habitat Mapping Technology for Alaska*, edited by J.R. Reynolds and H.G. Greene, was distributed on CD and posted online. This peer-reviewed publication contained 16 papers by workshop speakers, plus the Workshop Report and an index.
- November 2008: Semiannual Progress Report submitted for the period Jan 2008 – June 2008.
- June 2009: Final Report submitted for the period Sept 2006 - Dec 2008.

Introduction:

In the marine science community, there is now broad recognition that a comprehensive ecosystem approach is necessary for effective management of marine resources. Habitat considerations are an essential part of this approach. Federal legal mandates for designation of Essential Fish Habitat and Habitats of Particular Concern drive marine resource management in this direction; however, regulatory measures adopted to minimize impact of human activities, without the information of whether or where vulnerable habitat is at risk, may be ineffective or unnecessarily restrictive. Thus marine scientists and managers face a growing need to define and delineate ecosystems and to recognize the linkages between different aspects of the marine environment. An important step in defining essential fish habitat and potential mitigative measures is to understand the relationship between habitat characteristics, fish distribution, and fishing effort and other human activities [e.g., Barnes and Thomas, 2005].

The workshop and publication described in this report focused on the range of technologies for subtidal benthic habitat mapping in Alaska. While marine habitat also includes the water column and the tidal zone, the technologies and strategies for mapping those habitats are different from those used in benthic habitat mapping. Thus the water column/pelagic habitat and the tidal zone were not covered in this workshop. The topics were also restricted to proven technologies that are available and ready for use, and did not cover technologies still in development or testing stage. Finally, in order to maintain focus on the technologies, the oral presentations deliberately did not cover results of existing habitat mapping programs in Alaska, except where the latter provided relevant illustration of the strengths, weaknesses, and capabilities of the technologies. Workshop participants were encouraged to use the poster session for presentation of specific habitat mapping projects, technologies under development, capabilities of specific vehicles or systems available for charter, concerns and advocacy, and any other subject related to marine habitat mapping.

The term benthic habitat mapping refers to characterization of the seafloor substrate and biology, including species-habitat associations. Benthic habitat mapping delineates regions that are potential habitat for species that depend on the benthic environment in some way. These maps directly address issues of habitat distribution. Properly constructed, they may be used to infer population size and density of individual species or species assemblages, and as a tool for evaluating the health of benthic ecosystems.

The primary difficulty lies in reconciling (1) the need to define and characterize marine habitats over the large areas covered by ecosystems or populations, i.e., large enough to be useful for management or

predictive modeling purposes, with (2) the capabilities and cost of the technologies available to accomplish this at high enough resolution. Techniques and technologies for benthic habitat mapping and characterization have been under development in the U.S. and elsewhere over the past 20-30 years, and have been used in the U.S. West Coast and Alaska regions since the early 1990s [e.g., Reynolds et al., 2001].

To address the need for habitat maps that cover significant areas of the seafloor in an efficient way, the general approach developed by the scientific community is to combine acoustic mapping of the seafloor with groundtruthing and biological surveys by visual observations. In essence, a geological interpretation of the acoustic mapping data is used to extrapolate the visual observations across a much wider area of the seafloor. Based on this combination of data, the wider area is then divided, or classified, into different types of habitats. The acoustic mapping itself, as well as the visual observations, can be done as a series of nested surveys at different resolutions. The extent to which the extrapolation is valid depends on the complexity of the area, resolution of the data, use of representative groundtruth observations, successful geological interpretation, and identification of the significant species-habitat associations. For analysis of these associations and their relationship to fisheries and oceanographic conditions, the habitat data may be merged in a GIS database with commercial and survey fishery data and oceanographic data.

For benthic species, the characteristics of the seafloor substrate are a crucial factor in determining species distribution and population densities [e.g., Nasby-Lucas et al., 2002]. On a local scale, and in the absence of human-induced disturbances, depth and substrate are usually the primary variables. Other factors, such as water mass characteristics, currents, and nutrient supply, vary on a larger scale and thus exert less control on local variability of benthic habitat. But even at a regional scale, where spatial and temporal variation in these factors is more important, the depth and substrate may still dominate and may be related to the presence of local currents, nutrient supply, etc. Thus, a map of benthic habitat starts with a map of seafloor depth and substrate characteristics.

The biological aspect of benthic habitat mapping involves identification of the species that are present, species-habitat associations, and population densities if possible. Because of the need for species identification, the biological surveys have been limited to visual surveys and sampling. Experimentation with new techniques has so far not produced a revolution in this aspect of habitat mapping. For example, experiments with laser line scan mapping, which produces data intermediate in scale between that of acoustic mapping and visual observations, were somewhat successful but revealed drawbacks that have not been overcome to date [e.g., Amend et al., 2008]. A newly developed technique with comparable

resolution is the Dual-frequency Identification SONar (DIDSON), a so-called acoustic camera [Rose, 2005]. In general, however, rather than pushing the limits of data resolution, recent efforts have focused on improving underwater camera systems of various kinds and the platforms on which they are mounted [e.g., Somerton and Glendhill, 2005].

Objectives:

Our objectives were to conduct a workshop on the topic of marine habitat mapping technologies, emphasizing (a) available tools and techniques, with their potential applications and costs; (b) methodologies for classifying seafloor habitats; (c) a synthesis approach, to aid those who are not experts in the field; (d) a focus on needs specifically in the three large marine ecosystems around Alaska, i.e., Gulf of Alaska, Bering Sea/Aleutian Islands, and Arctic; and (e) a workshop format that includes and educates a wide range of interested groups such as local community leaders, commercial fishing organizations, and NGOs. The workshop format was intended to serve both the wider community and the managers/researchers who need specific technical knowledge about marine habitat mapping. A major outcome was to be a peer-reviewed publication, a synthesis volume from the workshop that could serve as a reference for planning marine habitat mapping activities in Alaska and the Northeast Pacific. This proposal was a direct response to the NPRB 2006 Request for Proposals, section 2.c.ii, “Marine habitat mapping technology workshop.”

Methods:

A range of available mapping systems, survey tools, sampling tools, and classification schemes, as well as experimental systems under development, confronts anyone trying to design a new habitat mapping program. The workshop and publication described in this report focused on proven technologies that would be effective for subtidal benthic habitat mapping in the Alaska region. Characteristics and needs of the three large marine ecosystems around Alaska, i.e., Gulf of Alaska, Bering Sea/Aleutian Islands, and Arctic, were considered. The workshop and publication were designed with a synthesis approach in which experts in the various aspects of marine habitat mapping would identify the key issues, evaluate available technologies and techniques, and present the results in a form that can be used to educate managers and other interested parties. The publication would also serve as a reference for matching needs with tools for specific marine habitat mapping programs.

Workshop outcomes were intended to benefit numerous groups: fishery and marine resource managers; the scientific community that conducts marine habitat mapping; representatives of state government and

coastal communities; commercial fishing organizations; non-governmental organizations (NGOs); and companies that conduct marine mapping and imaging surveys.

A Steering Committee was convened to design the workshop agenda, select invited speakers, and identify and encourage potential attendees and poster presentations.

A text-style workshop announcement and call for posters was distributed electronically to the mailing list of Alaska Sea Grant and to a supplementary list compiled specifically for the workshop. Members of the Steering Committee distributed the announcement within their respective organizations. Announcements were also distributed electronically through the Alaska Chapter of the American Fisheries Society and through ArcticInfo. Advertisement deliberately focused on an Alaskan audience, with a few exceptions, in order to maintain the focus of the workshop.

A printed workshop flyer was distributed to the Steering Committee, the NPRB office, Marine Advisory Program offices around the state, and attendees at the Alaska Marine Science Symposium. The electronic version of this flyer was also widely disseminated by email, and appeared to be a popular form of advertisement. (See Publications below.)

The dates of the workshop, April 2-4, 2007, were selected in consultation with the staff of the North Pacific Research Board and were chosen to avoid scheduling conflicts with other meetings, events, and field programs (though ultimately the workshop did overlap with a meeting of the North Pacific Fishery Management Council in Anchorage). Facilities were originally reserved at the Captain Cook Hotel in June 2006; however, in mid-January 2007 the Captain Cook Hotel determined that their meeting space had been double-booked and they declined to honor the reservation. Alternate arrangements were made with the Sheraton Anchorage Hotel.

Online registration for the workshop opened in mid-January, 2007 with an advance registration fee of \$150. Because all speakers were invited by the Steering Committee, workshop attendees were encouraged to contribute to the formal poster sessions. Poster submissions were reviewed for appropriateness, and all were accepted. Poster abstracts were accepted online through February 16, at which point the Program and Abstracts booklet went to the printer.

Results:

The Habitat Mapping Technology Workshop for Alaska was held on April 2-4, 2007 at the Sheraton Anchorage Hotel. A total of 88 participants attended, with 59 from Alaska, 20 from elsewhere in the U.S.,

seven from Canada, and one each from Australia and Ireland. Five of the international attendees were invited speakers. Due to an unexpected schedule conflict with a meeting of the North Pacific Fisheries Management Council (also in Anchorage), several people who had expressed interest in the workshop were unable to attend, and others split their time between the two meetings. During registration, 49 people expressed interest in participating in one of the breakout groups on the third day, and approximately that number of people did participate.

Days 1 and 2 of the workshop were designed as a mini-short course on benthic habitat mapping. The first two presentations introduced the need for the workshop and the concept of marine habitat mapping. The topic then moved to technologies available for remote sensing, mainly methods for acoustic mapping of the seafloor. The speakers were hydrographers and geologists. During Day 2, the morning speakers focused on the technology available for *in situ* scale observations and sampling. These talks covered remotely operated vehicles (ROVs), the manned submersible *Delta*, the autonomous underwater vehicle (AUV) SeaBED, and towed camera/video sleds. The speakers for this section were marine biologists. Three mid-day talks addressed different aspects of data analysis and habitat classification. The final talks in the workshop presented case histories from three major habitat studies: two decades of habitat research and mapping on Heceta Bank, Oregon; the Irish National Seabed Survey; and Australia's representative marine protected area program.

The speaker schedule for Days 1 and 2 was intended to allow for extensive discussion. Speakers were asked to plan on 30-minute talks, and 10 minutes were scheduled for questions and discussion. This worked very well on Day 1. Late changes to the agenda for Day 2 reduced discussion time somewhat.

Sixteen posters submitted by participants were displayed in a large room next to the meeting room. The formal poster session with refreshments was held at 5:30-8:00 pm on Day 1, immediately following the afternoon talks. Posters were displayed through the entire workshop, and the poster space was also used for coffee breaks to encourage people to view and discuss them.

At the end of Day 2, participants were invited to suggest discussion topics for breakout groups on the following morning. The breakout topics selected by the Steering Committee were: (1) Selection of appropriate technologies to facilitate multidisciplinary approaches: Integrating biology and geology; (2) Techniques and tools specific to environmental settings; and (3) What can we learn from Ireland-Australia-California. Moderators from each group presented the results at a plenary session at the end of the morning. Followup contributions were also received from several participants after the workshop.

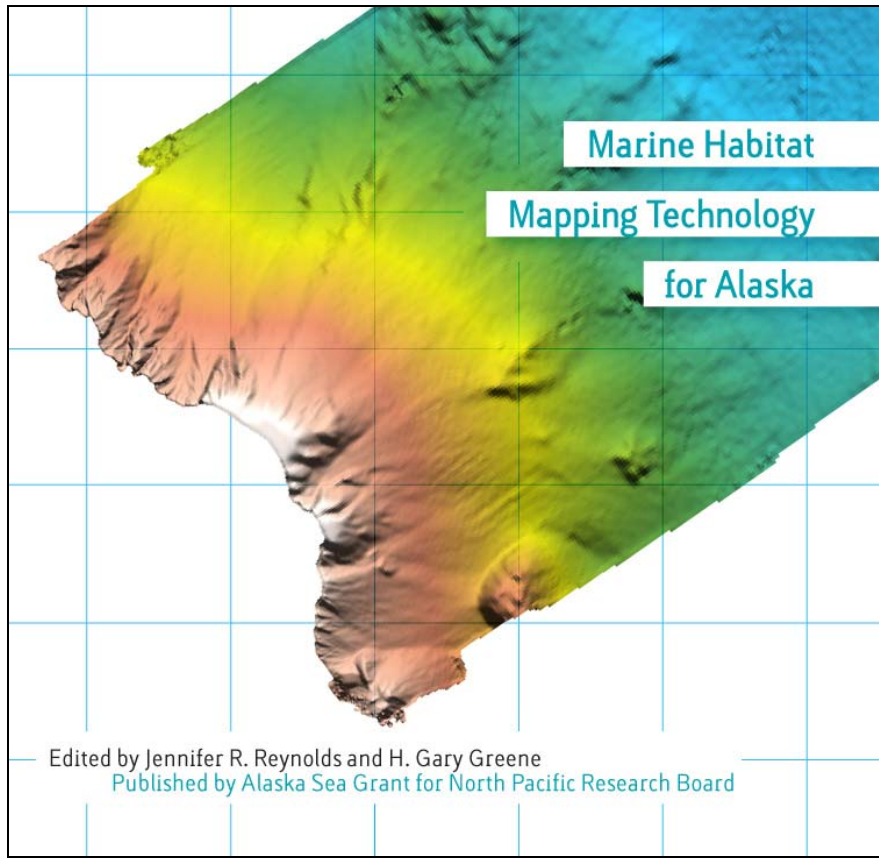
A workshop evaluation survey was distributed to participants during the afternoon break of Day 2. Surveys were returned by the end of Day 3. A list of all workshop participants, with affiliations and contact information, was distributed electronically to the participants on April 18.

The formal workshop report includes a description of the workshop design, summaries of each speaker's presentation and audience discussion; the breakout group reports; comments and additional issues raised in plenary session; and a day rate table (cost to lease vehicles and systems in Alaska) [Reynolds et al., 2008; see Publications below].

Following the workshop, preparation began for a peer-reviewed monograph that would present the outcome of the workshop. Producing this monograph involved efforts from 2 editors, 38 authors and co-authors, 46 peer reviewers, and the staff of Alaska Sea Grant. The speakers were asked to contribute papers based on their presentations at the workshop and feedback from the workshop. The first submission was received in June 2007, with the others arriving during the fall and winter. The review process was handled by PI Jennifer Reynolds with assistance from Co-PI Gary Greene. Manuscript reviews were solicited from experts in the various fields; the reviews were anonymous by default, though some reviewers chose to sign theirs. Reviews for the manuscript on which Reynolds was a co-author (Greene et al., 2008) were handled by Alaska Sea Grant's publication manager, Sue Keller.

The monograph was designed and formatted in-house at Alaska Sea Grant by Sue Keller and Jen Gunderson, with assistance from other ASG staff. Proofreading and copy editing were handled by Sue Keller and Jennifer Reynolds. A full index was created by a commercial indexing service. Printing of the actual CDs and CD sleeves was done commercially, and they were distributed by Alaska Sea Grant staff.

The publication was ready for distribution in October, 2008. A total of 400 CDs were printed, of which 200 were mailed to workshop attendees as well as others who expressed interest during workshop preparation; 50 were given to NPRB; and 100 have been requested by other individuals as of March, 2009. The publication has been promoted on the web site of the Alaska Sea Grant Bookstore at <http://seagrant.uaf.edu/bookstore/pubs/AK-SG-08-03.html>. It has been listed in the Alaska Sea Grant paper publications catalog, and promoted at trade fairs, sales events, and science symposia as well as by listservs, newsletters, press release, and other publicity.



Discussion:

There are several indications of the success of this workshop. One is the survey distributed at the workshop. We received 27 responses, which is a 41% response rate when NPRB staff and the Steering Committee are excluded (they were not expected to complete the survey). The response to the multiple choice questions may be summarized quantitatively:

	Just right	Long	Short
The 2.5-day workshop was	22	0	4
Time for viewing posters was	20	1	5
Social time for meeting with colleagues was	16	0	10
	Just right	High	Low
The number of oral presentations was	19	5	2
	Yes	Sort of	No
Did the program content meet your expectations?	16	10	0
Were you a presenter at the workshop? (speaker or poster)	10	--	16

The survey also invited comments on four topics: the workshop's strengths (25 responses), the workshop's weaknesses (19 responses), general comments (19 responses), and suggested topics for future workshops (10 responses). The comments varied widely. Dominant themes in "workshop strengths" were excellent, expert speakers; the diversity and mix of topics; and the international case studies. Themes in "workshop weaknesses" included problems with the meeting room (visibility of the screen, lighting, temperature, not enough microphones); some talks were a little too long for the material covered; some participants struggled to follow the technical discussions; several wished there had been more time for discussion after presentations (remarking that the group discussions were useful); and several wrote requests to link benthic habitat with oceanography. Most of the "general comments" were compliments, with a few logistical suggestions such as providing a list of recommended restaurants or asking people to use the microphones. Three people said that they had been "a little lost" in the mapping technology on Day 1, and would have preferred either a pre-workshop primer or more overview and less depth in the presentations. Approximately half of the "suggested topics for future workshops" had to do with moving toward ecosystem understanding, either by integrating benthic habitat maps with oceanography (and fisheries oceanography) or by developing ways to use the habitat maps as an element in ecosystem assessments. Overall, the responses to the workshop were strongly positive.

A second means of evaluating the success and effectiveness of the workshop is the response to publication of the monograph. During the last stages of the peer review process, authors told editor Jennifer Reynolds that this summary of mapping technology was the first of its kind worldwide, and was serving as a resource for the experts even before it was published. Responses to our ordering questionnaire include Nancy Bird, Prince William Sound Oil Spill Recovery Institute, who said, "This publication will greatly benefit our vast array of researchers and oceanographers." Uses include "library collection for a fisheries research lab," and "natural resource research ideas." Furthermore, as noted above, approximately 100 copies of the CD have been mailed to people or organizations who were not on the workshop mailing list and contacted Alaska Sea Grant with requests after the CD was released. (File downloads from the Alaska Sea Grant and NPRB web sites have not been tallied.) One might conclude that the monograph is useful to its intended audience, and that its audience is growing.

As part of the original plan for the workshop, a decision had been made to publish the monograph on CD. The original reason for this decision was budgetary; however, the electronic format had three other significant advantages. First, there were no limits on manuscript length or the number of color plates and figures. Second, the maps, graphics, and photos could be published in very detailed and high resolution

format. If they had been distributed in printed form, they would have required many large color pages, at great expense. With the electronic format on CD, readers could display these figures on a computer screen, changing the resolution at will, and could print out the size most useful to them. (This advantage is not available to those who use files downloaded from one of the web sites, as the files posted online have been down-sampled to page size resolution for smaller file size, easier download, and easier email transmission.) Third, commercial production of CDs was much faster than commercial printing of a hard-cover book, enabling more rapid distribution to the audience.

One of the goals for this publication is wide distribution and easy access. We note that obtaining doi (Digital Object Identifier) numbers for the individual chapters makes them easier to find through online searches; this should facilitate wider distribution. The authors have also been encouraged to make their chapters available through their own institutions' web sites. Likewise, the index is intended to encourage use of the monograph as a reference volume, although we recognize that many people will not download the index from the Alaska Sea Grant or NPRB web sites. Nevertheless, it is included on all CDs and is easily accessible online.

Conclusions:

A variety of technologies are available and applicable to benthic habitat mapping in the Alaska region. These technologies may be divided into two general categories: remote sensing, for broad-scale mapping of the seabed; and visual scale, for finer scale characterization, groundtruthing interpretations, identification of the species that are present, and species-habitat associations. The Habitat Mapping Technology Workshop for Alaska discussed the capabilities and limitations of these technologies, as well as techniques for their application to habitat mapping. The workshop also addressed the issue of habitat mapping in a large region, and included three case studies that provide contrasting approaches. A peer-reviewed monograph was published by Alaska Sea Grant, containing papers developed from the speakers' presentations, a full workshop report, and an index. This publication may serve as a reference, and a source of information to help guide choices and project design for future habitat mapping in Alaskan waters.

Publications:

1) Publication overview:

Workshop flyer: This document has been posted on the Alaska Sea Grant workshop web page as “Marine Habitat Mapping Technology conference flyer” and on the NPRB Project 615 web page as “Workshop Factsheet.”

Program and Abstracts: Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, 46 pp.

This document has been posted on the NPRB Project 615 web page as “Abstracts + Program.”

Workshop report, published as a chapter in the monograph:

Reynolds, J.R., H.G. Greene, J. Kurland, D. Woodby, and B. Allee. 2008. Workshop Report: Marine Habitat Mapping Technology Workshop for Alaska. In J.R. Reynolds and H.G. Greene (eds.), *Marine Habitat Mapping Technology for Alaska*. Alaska Sea Grant College Program, University of Alaska Fairbanks (Fairbanks, Alaska), pp. 237-265. doi:10.4027.mhmta.2008.17

Peer-reviewed monograph:

Reynolds, J.R. and H.G. Greene (eds.). 2008. *Marine Habitat Mapping Technology for Alaska*. Alaska Sea Grant College Program, University of Alaska Fairbanks (Fairbanks, Alaska), 282 pp.
Alaska Sea Grant publication AK-SG-08-03

NPRB publication #190. Individual chapters also have their own NPRB publication numbers.

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doi:10.4027/mhmta.2008.00 Individual chapters also have their own doi numbers.

CDs of this monograph with full-resolution figures are available through Alaska Sea Grant’s bookstore (no charge) <http://seagrants.uaf.edu/bookstore/pubs/AK-SG-08-03.html>. The CD also contains a low resolution pdf of the publication for the convenience of searching. An online version of the contents with all figures downsampled to page-size print resolution may be downloaded from the North Pacific Research Board web site and from Alaska Sea Grant’s online bookstore.

2) Full reference-style list of workshop abstracts:

Amend, M., J. Lomnický, K. Smith, B. McConnaughey, C. Yeung, G. McGillicuddy, and Y. Rzhánov. 2007. Adding ecological context to EFH models using ground truthing technologies. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 31.

- Barrie, J.V. 2007. Surficial geology: The third dimension in habitat mapping. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 16.
- Blakeslee, M. 2007. Towed ROV transects with vehicle-mounted scanning sonar provide up to 100-meter swath width for detection and real-time video truthing of crabs, sea stars, and other epibenthos. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 32.
- Byerly, M. 2007. Use of a shallow-water ROV in the Northern Gulf of Alaska. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 19.
- Byerly, M. and M. Spahn. 2007. Habitat-based groundfish assessment using a shallow-water ROV in the Northern Gulf of Alaska. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 33.
- Caress, D.W., H. Thomas, D. Conlin, D. Thompson, D. Clague, C.K. Paull, J. Paduan, R. Keaten, W.J. Kirkwood, R. McEwen, and R. Henthorn. 2007. High-resolution multibeam, side-scan, and sub-bottom surveys of seamounts, submarine canyons, deep-sea fan channels, and gas seeps using the MBARI AUV *D. Allan B.* Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 13.
- Cochrane, G., P. Dartnell, J. Harney, and L. Etherington. 2007. Video supervised numerical classification of acoustic data from Glacier Bay, Alaska. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 26.
- Cook, S., B. Bornhold, J. Harper, and K. Kopeck. 2007. Habitat mapping of the Sydney, B.C., waterfront using acoustic and video imaging techniques. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 34.
- DaSilva Lage, J. B. Richards, and D. Lockhart. 2007. Mapping in Alaska for fisheries habitat and nautical charting. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 35.
- Galloway, J.L. 2007. Systematic seafloor habitat mapping of the British Columbia Coast. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 17.
- Greene, H.G. 2007. Marine benthic habitat classification: What's best for Alaska? Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 25.

- Grehan, A.J. and C. Brown. 2007. Do large scale multibeam survey programmes improve our knowledge of seafloor habitats? The example of the Irish National Seabed Survey (INSS). Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, pp. 28-29.
- Harper, S., S. Jewett, and B. Konar. 2007. Scientific diving methods for ground truthing marine habitat maps. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 36.
- Hare, R. 2007. Small-boat surveys in shallow water. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 15.
- Harris, P.T., A. Heap, T. Whiteway, and A. Post. 2007. Application of geoscience information to marine environmental management at the scale of continental margins: Australia's representative marine protected area program. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 30.
- Hou, T., L. Huff, and R.A. McConnaughey. 2007. Toward quantitative approach: Evaluating impact of bottom trawls by enhancing high-resolution side scan sonar data process. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 37.
- Kurland, J., D. Woodby and D. Witherell. 2007. Marine habitat mapping: What is it and why do managers need it? Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 7.
- Lockhart, C. 2007. Bathymetric LIDAR surveys for marine habitat: What can be expected from an airbourne bathymetric LIDAR survey? Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 11.
- Lockhart, D. 2007. Multibeam surveys for marine habitat: What can be expected from a multibeam survey? Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 10.
- Mayer, L. and L. Fonseca. 2007. Multibeam echo sounding as a tool for fisheries habitat studies. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, pp. 8-9.
- McConnaughey, B., C. Yeung, S. Syrjala, and K. Smith. 2007a. Mapping environmental variables to produce essential fish habitat models. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 38.

- McConnaughey, B., L. Huff, C. Yeung, and S. Syrjala. 2007b. Using acoustics to characterize sediments for essential fish habitat models. Poster presentation at the Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 39.
- Mikol, R. 2007. Extending the functionality of the consumer-grade GPS for more efficient resource assessment mapping. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 40.
- Noel, J. and S. Lewis. 2007. Alaska bathymetry: down to 50-meter resolution. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 41.
- O'Connell, V., J. Heifetz, C. Brylinsky, H.G. Greene, and K. Shotwell. 2007. A review of habitat-based submersible surveys in the Gulf of Alaska and the role of habitat mapping in fisheries management and research in Alaska. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 21.
- Pacunski, R.E., W.A. Palsson, H.G. Greene, and D. Gunderson. 2007. Conducting visual surveys with a small ROV in shallow water: Lessons learned in San Juan Channel, Washington. Marine Habitat Mapping Technology Workshop for Alaska (Anchorage, Alaska), April 2-4, 2007, Program and Abstracts, p. 18.
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Outreach:

Web page developed: A web page to convey information about the workshop was created on the Alaska Sea Grant web site, under Conferences. <http://seagrant.uaf.edu/conferences/2007/benthic/index.html> All workshop materials referred people to this workshop home page for information and updates. During registration and poster abstract submission, this page had links to online forms for those purposes. The forms were removed when registration closed. The page currently contains a link to an information page in html format; a downloadable version of the workshop flyer with the same information; the agenda; speaker abstracts; a link to the workshop sponsor, i.e., North Pacific Research Board; and a link to the “workshop proceedings,” i.e., the Alaska Sea Grant Bookstore page for the monograph publication <http://seagrant.uaf.edu/bookstore/pubs/AK-SG-08-03.html>.

Workshop Participation: This grant was awarded for the specific purpose of conducting a public workshop and producing a peer-reviewed publication from the workshop. Thus the main activity under this award was an outreach effort. In advertising the workshop and contacting potential participants, the Steering Committee specifically included NGOs, CDQ organizations, commercial fishing organizations, and companies that have conducted mapping/survey operations in Alaska. All of the state’s Marine Advisory Program agents were contacted and provided with workshop fliers and additional background

information, for communication with their communities about the workshop. Even so, NGOs, communities, and commercial fishing interests were only lightly represented at the workshop. Our hope is that the publication will be accessible and useful to these groups.

Factsheets Produced: The workshop flyer was distributed to explain and advertise the workshop. It was distributed in print form and by email. It is a 2-sided color document, 4 inches wide and 10.75 inches high. A PDF version is currently posted on the Alaska Sea Grant workshop web page as “Marine Habitat Mapping Technology conference flyer” and on the NPRB Project 615 web page as “Workshop Factsheet.”

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The staff at Alaska Sea Grant made major contributions to the success of this effort. Meetings Coordinator Sherri Pristash played a crucial role in planning and executing the workshop, Web Coordinator Carol Kaynor created and maintained the workshop web site, and Communications Designer Dave Partee created graphics used at the workshop. Publications Manager Sue Keller oversaw the production, copy editing, proofreading, and distribution of the publication. Publications Coordinator Jen Gunderson designed and laid out its text pages and cover. Adie Callahan, Kathy Kurtenbach, and Dawn Montano also assisted with production and distribution of the CD.

The workshop speakers and poster presenters were essential to the success of the workshop. The speakers further contributed as authors of chapters in the workshop publication. They are listed here in alphabetical order: Vaughn Barrie, Mike Byerly, Dave Caress, Guy Cochrane, Jim Galloway, Gerd Glang, Gary Greene, Anthony Grehan, Rob Hare, Peter Harris, Lloyd Huff, Jon Kurland, Carol Lockhart, Doug Lockhart, Larry Mayer, Tory O’Connell, Bob Pacunski, Clarence Pautzke, Chris Rooper, Brian Tissot, Nick Tolimieri, Doug Woodby, and Mary Yoklavich.

Three graduate students from the University of Alaska Fairbanks, School of Fisheries & Ocean Sciences (Fisheries Division) assisted with logistics of running the workshop and were responsible for recording

the discussions of the breakout groups. These students were Sean Rooney, Jodi Pirtle, and Bill Bechtol. Heidi Herter, Marine Advisory Program agent in Nome, also assisted with workshop logistics.

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