Update to Council, October 2005

Aleutian Islands Fishery Ecosystem Plan (AI FEP)

The Council is considering ecosystem-based area-specific management for the Aleutian Islands fisheries. In June 2005, the Council adopted the following purpose and need statement for this action:

> The Council recognizes that an explicit Ecosystem Approach to Fisheries (EAF) is a desirable process for management of the marine fishery resources in the Alaskan EEZ and therefore is a concept that it wishes to continue to pursue and further implement. A primary component of an EAF is the development of ecosystem-based fishery planning documents, and the Council intends to move forward with such development on a pilot basis. The Council recognizes that the Aleutian Islands ecosystem is a unique environment that supports diverse and abundant marine life, and a human presence that is closely tied to the environment and its resources. The Council believes that in light of these features, EAF could be a useful guide for future fishery management decisions in the Aleutian Islands area. Enhancing our current ecosystem approach to fisheries in the Aleutian Islands could allow the Council to better focus on the unique features of and interactions within the Aleutian Islands ecosystem area.

Considering the available options, the Council chose to examine an AI Fishery Ecosystem Plan, including the creation of an AI Ecosystem Plan Team. In part, the Council's decision to move forward with a FEP was motivated by interest at the NOAA Fisheries national level to encourage Councils to begin developing FEPs. Recently, the Administration has distributed its proposal for Magnuson-Stevens Act reauthorization. A description of the pertinent elements of the proposal are attached as Item D-2(1). FEPs would not be required under this proposal, but Councils would be authorized to develop them. Advisory guidelines would be developed by NOAA Fisheries in consultation with the Councils.

The Council requested that staff consider the NMFS-Council working group draft FEP guidelines in developing an FEP, as well as other FEP literature sources. The working group guidelines are compared to other sources in Item D-2(2). Based on these comparisons, a draft structure for an AI FEP is attached as Item D-2(3).

A volume of Fisheries Oceanography dedicated to studies in the Aleutian Islands has just been released. This volume has been referred to at previous meetings, and provides among other things, a discussion of the ecosystem boundaries in the Aleutian Islands archipelago. The abstracts of this volume are attached as Item D-2(4).

Staff also consulted with the groundfish Plan Teams about the advisability of proceeding with an AI FEP. In general, the Plan Teams encouraged the idea of exploring an AI FEP. Regarding the creation of an AI Ecosystem Team, however, the Plan Teams considered that the advice that would be generated by such a team could easily be provided by the existing Plan Teams for groundfish, crab, and scallop.

A concern that has been expressed regarding the development of an AI FEP is that it would set goals and objectives for the Aleutian Islands that would negate the recent revisions to the groundfish FMP policy objectives, and require a new programmatic analysis for all the FMPs. Initial discussions with NOAA GC indicate that at the current time, creating a FEP would not constitute a Federal Action under NEPA, and so would not require NEPA analysis. Instead, any actions that might result from collecting the information in the FEP would be Federal Actions, and these would still be subject to the normal amendment and analytical process. This conclusion may, of course, differ pending changes under Magnuson-Stevens Act reauthorization.

The Ecosystem Committee has not been able to review the AI FEP material prior to this meeting, as requested by the Council. The Committee is scheduled to meet prior to the December meeting, and can provide the Council with recommendations at that time.

Item D-2(1)
October 2005

Ecosystem Changes proposed in the Administration's MSA Reauthorization Bill

From the NOAA Fisheries Fact Sheet:

Proposal: The Administration's Magnuson-Stevens Act (MSA) bill includes provisions to help redirect fishery management policies and procedures away from the traditional emphasis on single target species, and toward a broader ecosystem-based approach:

(1) The bill amends the Act's statement of findings, purposes, and policy by affirming the importance of ecosystems and ecosystem-related objectives.

(2) The term "ecosystem" is defined as "a geographically specified system of living marine resources, the people, the environment, and the processes that control its dynamics."

(3) The bill authorizes the Councils to take ecosystem considerations into account when developing fishery management plans and plan amendments.

(4) The Secretary of Commerce, working with the Councils, is directed to develop advisory guidelines for the Councils on incorporating ecosystem considerations in the fishery management process.

(5) The Councils are authorized, but not mandated, to prepare "fishery ecosystem plans."

Specific language from the Administration Bill

The proposed language relating to fishery ecosystem plans and ecosystem guidelines is as follows. The proposal is to add a new section (e) in Section 303, Contents of Fishery Management Plans:

"(e) Fishery Ecosystems.

"(1) The Secretary shall, in consultation with the Councils, establish advisory guidelines (which shall not have the force and effect of law) for the Councils concerning ecosystem considerations in fishery conservation and management.

"(2) Each Council, or the Secretary as appropriate, may prepare a fishery ecosystem plan in order to assist in implementing an ecosystem approach to managing fisheries within its area of authority.

"(3) Fishery ecosystem plans may contain conservation and management measures applicable to fishery resources throughout the fishery ecosystem, including measures that the Council or the Secretary deems appropriate to–

"(A) avoid or minimize adverse effects of fishing on fish habitat;

"(B) establish marine managed areas in the Exclusive Economic Zone or the high seas; or

"(C) manage fishing capacity.

"(4) If a fishery ecosystem encompasses waters under the authority of more than one Council, or a Council or Councils and the Secretary, for fisheries under Section 302(a)(3), the Councils, or the Council or Councils and the Secretary, as appropriate, may collaborate to jointly prepare a fishery ecosystem plan for that ecosystem."

What does this mean for the Council's AI FEP proposal?

- FEPs are still being encouraged by NOAA Fisheries/Administration
- FEPs do not supercede FMPs (FMPs are still required)

- According to changes proposed under the Administration Bill, a FEP may authorize management measures that apply across fisheries (e.g., the recent closure of much of the AI for EFH mitigation)
    - This is different from the Council's current conception of what its FEP would be (namely a planning and information document rather than one that authorizes management measures)
    - It doesn't necessarily mean that the Council has to include management measures in the FEP; it seems as though a FEP can still be just a planning and information document
- Much depends on how the advisory guidelines are written; however, NOAA Fisheries is supposed to draft the guidelines in consultation with the Councils
    - One of the reasons the Council considered doing an AI FEP was to see how a FEP might or might not be a useful tool for ecosystem-based management – in order to provide input to any guidelines being developed by NOAA Fisheries

Fishery Ecosystem Plan contents – A Comparison

Topic	Suggested Tasks for FEPs		
	Ecosystem Principles Advisory Panel Report, 1999	**Marine Fisheries Advisory Committee Task Force Report, 2003**	**Interim Report of the ad hoc Working Group, May 2005**
Ecosystem Boundary	• Delineate geographic extent of ecosystem	• Describe geographic area of coverage	• Define relevant ecosystem boundaries
Understanding of Ecosystem Area	• Characterize biological, chemical, and physical dynamics of ecosystem • Develop conceptual model of food web • Describe habitat needs of different life history stages for ‘significant food web’ • Assess uncertainty • Consider predator-prey affected by FMP fishing • Consider bycatch in terms of food web/community structure • Assess the ecological, human, and institutional elements of the ecosystem that are outside DOC authority and that most significantly affect fisheries	• Describe current natural resource/ socioeconomic conditions to provide status/ trends • Describe historic ecosystem	• Inventory ecosystem data and information sources, including all relevant federal and non-federal agencies, academic institutions, and others • Assess impacts of fishing and non-fishing activities on non-target species so no gaps in species protection • Define essential fish habitat • Determine effects of variability in marine environmental conditions (e.g. climate, oceanography)
Data gaps		• Identify/ prioritize crucial information needs	• Define gaps and priorities in ecosystem data
Objectives for Ecosystem Area	• Prescribed ecosystem objectives and principles • Zone ecosystem area for alternative uses • Minimize any impacts of fishing on EFH	• Describe Desired State of Natural ecosystem (objectives/ goal statements) • Describe Desired State of Socioeconomic ecosystem (long/ short term)	
Current Management Approach to Ecosystem Area	• Describe how habitat needs are considered in conservation and management measures • Assess buffers against uncertainty that are included in conservation and management measures		• Inventory management practices re ecosystem approach
Future Management Approach to Ecosystem Area	• Develop indices of ecosystem health as targets for management • Describe available long-term monitoring data and how they are used • Include a strategy to address the influences outside DOC authority	• Describe ecosystem management options: pros/cons • Apply indicators of ecosystem ‘health’ • Process for periodic evaluation	• Account for predator-prey interactions and other feedback effects, including impacts of fishing practices on habitat productivity • Account for variable marine environmental conditions when formulating management plans • Evaluate tradeoffs among fisheries (FMPs?) linked by interactions between species (e.g., bycatch interactions, predator-prey relationships) • Include economic and social factors in evaluating tradeoffs • Develop adaptive approaches to ecosystem management that e.g. take into account changes in knowledge, use of experimental approaches, etc.

DRAFT Aleutian Islands FEP Outline

I. Understanding of Aleutian Islands Ecosystem Area

A. Boundary

B. Impacts of fishing and non fishing resources (fishery target species, non-target species, protected/endangered/ threatened species, food web integrity)

C. Essential fish habitat

D. Effects of variability (climate, oceanography)

E. Inventory of data and information sources on the area

II. Fishery Management in the Aleutian Islands Ecosystem Area

- present and future, how does it account for general ecosystem goals?

A. Conserve and manage species (target, non-target, protected/ threatened/ endangered, biodiversity)

B. Minimize bycatch (target, non-target, p/e/t)

C. Consider tradeoffs/ reconcile conflicting goals (among sectors, fisheries, cumulative effects, w/non-fishing)

D. Account for feedback effects (predator-prey, gear on habitat)

E. Maintain ecosystem productivity (capacity, resilience)

F. Balance ecosystem structure (trophic balance)

G. Account for climate variability (frequency, regime change)

H. Use adaptive approaches (uncertainty, experimental approaches, consider multiple ecosystem states)

III. Priorities in Ecosystem Data

FISHERIES OCEANOGRAPHY

Fisheries Oceanography

Volume 14 Issue s1 - November 2005

doi:10.1111/j.1365-2419.2005.00376.x

INTRODUCTION

Introduction to processes controlling variability in productivity and ecosystem structure of the Aleutian Archipelago

PHYLLIS J. STABENO[1,], GEORGE L. HUNT, JR[2,†] AND S. ALLEN MACKLIN[1]*

[1]National Oceanic and Atmospheric Administration, Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115-6349, USA
[2]Department of Ecology and Evolutionary Biology, University of California, Irvine, CA 92697, USA
*e-mail: phyllis.stabeno@noaa.gov
† *Present address:* School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA 98195-5020, USA

Spatial and temporal variability of the Aleutian climate

SERGEI N. RODIONOV[1,], JAMES E. OVERLAND[2] AND NICHOLAS A. BOND[1]*

Abstract

The objective of this paper is to highlight those characteristics of climate variability that may pertain to the climate hypothesis regarding the long-term population decline of Steller sea lions (*Eumetopias jubatus*). The seasonal changes in surface air temperature (SAT) across the Aleutian Islands are relatively uniform, from 5 to 10°C in summer to near freezing temperatures in winter. The interannual and interdecadal variations in SAT, however, are substantially different for the eastern and western Aleutians, with the transition found at about 170°W. The eastern Aleutians experienced a regime shift toward a warmer climate in 1977, simultaneously with the basin-wide shift in the Pacific Decadal Oscillation (PDO). In contrast, the western Aleutians show a steady decline in winter SATs that started in the 1950s. This cooling trend was accompanied by a trend toward more variable SAT, both on the inter- and intra-annual time scale. During 1986–2002, the variance of winter SATs more than doubled compared to 1965–1985. At the same time in Southeast Alaska, the SAT variance diminished by half. Much of the increase in the intra-seasonal variability for the western Aleutians is associated with a warming trend in November and a cooling trend in January. As a result, the rate of seasonal cooling from November to January has doubled since the late 1950s. We hypothesize that this trend in SAT variability may have increased the environmental stress on the western stock of Steller sea lions and hence contributed to its decline.

[1]University of Washington, JISAO, Seattle, WA 98195, USA
[2]NOAA, Pacific Marine Environmental Laboratory, Seattle, WA 98115, USA
*e-mail: Sergei.Rodionov@noaa.gov

Marine environment of the eastern and central Aleutian Islands

CAROL LADD[1], GEORGE L. HUNT, Jr[2,†], CALVIN W. MORDY[1], SIGRID A. SALO[3] AND PHYLLIS J. STABENO[3]*

Abstract

To examine the marine habitat of the endangered western stock of the Steller's sea lion (*Eumetopias jubatus*), two interdisciplinary research cruises (June 2001 and May to June 2002) measured water properties in the eastern and central Aleutian Passes. Unimak, Akutan, Amukta, and Seguam Passes were sampled in both years, and three additional passes (Umnak, Samalga, and Tanaga) were sampled in 2002. In the North Pacific (and to a lesser extent in the Bering Sea), a strong front in water properties was observed near Samalga Pass in June of both years, with significantly warmer, fresher, and more nitrate-poor water east of Samalga Pass than west of the pass. These water properties reflect differences in source waters (Alaska Coastal Current versus Alaskan Stream), mixing depth, and Bering Sea influence. Strong cross-Aleutian gradients were also observed with warmer, fresher water on the North Pacific side of the archipelago. The nutrient content of the waters flowing through the passes, combined with the effects of mixing within the passes, influences the transport of nutrients into the Bering Sea. As water moves away from the strong mixing of the passes and becomes more stratified, phytoplankton can take advantage of the enhanced nutrient concentrations. Thus, the northern side of the Aleutian Islands (especially in the lee of the islands) appears to be more productive. Combined with evidence of coincident changes in many ecosystem parameters near Samalga Pass, it is hypothesized that Samalga Pass forms a physical and biogeographic boundary between the eastern and central Aleutian marine ecosystems.

[1]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA 98195-4235, USA
[2]Department of Ecology and Evolutionary Biology, University of California, Irvine, CA 92697-2525, USA
[3]Pacific Marine Environmental Laboratory, NOAA, Seattle, WA 98115-6349, USA
*e-mail: carol.ladd@noaa.gov
[†]*Present address:* School of Aquatic and Fishery Sciences, Box 355020 University of Washington, Seattle, WA 98195-5020, USA.

Observations from moorings in the Aleutian Passes: temperature, salinity and transport

P. J. STABENO[1,], D. G. KACHEL[1], N. B. KACHEL[2] AND M. E. SULLIVAN[2]*

Abstract

Between May 2001 and September 2003, a series of moorings were deployed in four of the Aleutian Passes –Tanaga Pass (12 months of data), Akutan Pass and Seguam Pass (18 months), and Amukta Pass (36 months). Instruments on each mooring measured temperature, salinity and current velocity. Tidal currents dominated the flow in each pass, including a strong fortnightly component in the three deeper passes (Tanaga, Seguam, and Amukta). Net transport in each of the passes was northward, varying from 0.1×10^6 m^3 s^{-1} in Akutan Pass and 0.4×10^6 m^3 s^{-1} in Seguam to $>4.0 \times 10^6$ m^3 s^{-1} in Amukta Pass. The transport in Amukta Pass, calculated from current meters, was approximately five times as large as previously estimated from hydrographic surveys. At monthly and longer periods, the variability in transport in Amukta Pass was related to the position and strength of the Alaskan Stream southeast of the pass. Vertical mixing was examined in Akutan and Seguam Passes. Strong tidal currents mix the water column top-to-bottom over the shallow sills in the passes, a depth of 80 m in Akutan and 140 m in Seguam Pass, providing a critical source of nutrients to the Bering Sea ecosystem.

[1]NOAA/Pacific Marine Environmental Laboratory, 7600 Sand Point Way NE, Seattle, WA 98115-6349, USA
[2]JISAO/UW, 7600 Sand Point Way NE, Seattle, WA 98115-6349, USA
*e-mail: phyllis.stabeno@noaa.gov

Nutrients and primary production along the eastern Aleutian Island Archipelago

CALVIN W. MORDY[1,] , PHYLLIS J. STABENO[2] , CAROL LADD[1] , STEPHAN ZEEMAN[3] , DAVID P. WISEGARVER[2] , SIGRID A. SALO[2] AND GEORGE L. HUNT, JR[4,†]*

Abstract

The distribution of nutrients (nitrate, phosphate, and silicic acid), chlorophyll and primary productivity were examined in the central and eastern Aleutian Archipelago. The data were collected from moorings (temperature, salinity, nitrate, and currents) and two hydrographic research cruises (June 2001 and May–June 2002). During the hydrographic cruises salinity, temperature, nutrients, chlorophyll and primary production were measured in and around the eastern and central Aleutian Passes. The net nutrient transport through the passes was northward, and it was relatively low in the eastern passes compared to the central passes. In the shallow eastern passes the source water from the Pacific was the nutrient-poor Alaska Coastal Current, while in the deeper central passes it was the nutrient-rich Alaskan Stream. Within the passes, vigorous tidal mixing resulted in enriched surface concentrations, especially in the central passes. Chlorophyll sections and satellite composites from summer indicate high chlorophyll east of Samalga Pass and very low chlorophyll between Samalga and Seguam Passes. Production was relatively low across the study area, except at the northern end of Seguam Pass and in the vicinity of the shelf edge in the southeastern Bering Sea. Production and chlorophyll concentrations were lowest in the deep passes. These results suggest that, within the passes, deep mixing inhibits new production, but substantial blooms may occur downstream of the passes subsequent to stratification.

[1]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA 98195-4235, USA
[2]Pacific Marine Environmental Laboratory, NOAA, Seattle, WA 98115-6349, USA
[3]University of New England, 11 Hills Beach Road, Biddeford, ME 0400, USA
[4]Department of Ecology and Evolutionary Biology, University of California, Irvine, CA 92697-2525, USA
*e-mail: Calvin.W.Mordy@noaa.gov
†*Present address:* School of Aquatic and Fishery Sciences, Box 355020 University of Washington, Seattle, WA 98195-5020, USA.

Zooplankton distribution, abundance and biomass relative to water masses in eastern and central Aleutian Island passes

*KENNETH O. COYLE**

Abstract

Conductivity–temperature–depth (CTD), acoustic and net samples were taken through a series of passes in the eastern and central Aleutian Island archipelago to document regional differences in the physical and biological conditions. The water column in central passes had elevated salinity and depressed temperatures, indicating upwelling of deep water through the passes. The zooplankton community included the oceanic genera *Neocalanus* and *Eucalanus*, and the euphausiid *Euphausia pacifica*, all oceanic taxa. Eastern passes had significantly lower salinity and elevated temperature relative to the central passes, suggesting a more neritic environment. *Calanus marshallae*, *Pseudocalanus*, *Acartia* and *Thysanoessa inermis*, common neritic species, were observed in the eastern passes. Canonical correlation indicated that up to 50% of the observed variance in mean zooplankton abundance in the passes could be explained by salinity and temperature. Elevated sound scattering was observed in fronts and eddies in the passes, particularly at the northern ends of the passes, in association with elevated zooplankton abundance and biomass. The central passes were characterized as an oceanic environment, influenced primarily by Alaskan Stream water with its associated interzonal copepod species, while the eastern passes were influenced by the Alaska Coastal Current, which contains a mixture of oceanic and neritic zooplankton species.

School of Fisheries and Ocean Science, Institute of Marine Science, University of Alaska, Fairbanks, AK 99775-7220, USA
*e-mail: coyle@ims.uaf.edu

Geographic patterns in the demersal ichthyofauna of the Aleutian Islands

E. A. LOGERWELL[1,] , K. AYDIN[1] , S. BARBEAUX[1] , E. BROWN[1] , M. E. CONNERS[1] , S. LOWE[1] , J. W. ORR[1] , I. ORTIZ[2] , R. REUTER[1] AND P. SPENCER[1]*

Abstract

The goals of this research were to investigate geographic patterns in the Aleutian Island region's demersal ichthyofauna and to determine whether they reflected the physical and biological oceanographic patterns documented by other authors in this volume. The analyses were structured according to the level of organization: at the community level, patterns in species occurrence and community structure were investigated; at the population level, distribution and abundance were examined; at the individual level, food habits and growth were studied. There were step-changes in species occurrence, diversity, population distribution and food habits at Samalga Pass and at sites farther west. These longitudinal trends indicated physical and biological variation along the length of the Aleutian Islands chain; however, depth-related patterns were as common as longitudinal patterns in demersal fish distribution. In addition, high catches of patchily distributed species occurred in areas expected to be biological 'hot spots' because of increased productivity and prey availability. These patterns suggest linkages between demersal fish ecology and the biophysical processes described by other authors in this volume and indicate that inter-disciplinary research is needed to elucidate the underlying mechanisms.

[1]Alaska Fisheries Science Centre, 7600 Sand Point Way, Seattle, WA 98115, USA
[2]School of Aquatic and Fisheries Science, University of Washington, Seattle, WA 98195, USA
*e-mail: libby.logerwell@noaa.gov

Estimating movement and abundance of Atka mackerel (*Pleurogrammus monopterygius*) with tag–release–recapture data

SUSANNE F. MCDERMOTT[1,] , L. W. FRITZ[1] AND V. HAIST[2]*

Abstract

A mark–recapture experiment was conducted in Seguam Pass, Alaska, to estimate local Atka mackerel (*Pleurogrammus monopterygius*) abundance and to evaluate the efficacy of trawl exclusion zones around Steller sea lion (*Eumetopias jubatus*) rookeries. Atka mackerel were found in dense aggregations near the Aleutian Islands where they are a major prey item of endangered Steller sea lions. In 1999, 1375 tagged fish were released and a biomass of 76 679 metric tonnes (t) was estimated outside a trawl exclusion zone using a simple Petersen model. In 2000, 8773 tagged fish were released and the estimated biomasses were 117 900 t inside and 82 057 t outside the trawl exclusion zones using an integrated tagging model. Movement into the open zone was small after 107 days (0.6%), whereas movement from the open area was potentially large but highly uncertain after 107 days (81%). Our model suggests that trawl exclusion zones in Seguam Pass are effective in separating a large biomass of potential prey for Steller sea lions from the immediate effects of local fisheries. Atka mackerel do not appear to move substantially outside their local aggregations (<70 km), and they show strong habitat preferences within their local home ranges. In one instance, fish released in an area of low Atka mackerel abundance returned to their capture location about 2 miles away. Thus individual Atka mackerel may have an affinity for particular areas within their home range, perhaps resulting from adaptations to local oceanic conditions along the Aleutian Island archipelago.

[1]National Marine Fisheries Service, Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115, USA
[2]6224 Groveland Drive, Nanaimo, Canada
*e-mail: susanne.mcdermott@noaa.gov

Corals of the Aleutian Islands

JONATHAN HEIFETZ , BRUCE L. WING , ROBERT P. STONE , PATRICK W. MALECHA AND DEAN L. COURTNEY*

Abstract

A unique feature of the benthic habitat in the Aleutian Islands is the presence of a highly diverse and abundant coral and sponge community. These communities likely provide important habitat for a variety of fish and invertebrate species. Summaries of historical data and recent direct observations with a submersible indicate that the Aleutian Islands may harbour the highest diversity and abundance of coldwater corals in the world. There are 69 documented taxa (species and subspecies) of coral in the Aleutians of which 25 are endemic. Within the Aleutian Islands, there is an increase in diversity of corals west of about longitude 169°W. This shift in diversity is consistent with the hypothesis of an ecological boundary in the vicinity of Samalga Pass. Given the endemism and high diversity and abundance of corals in the Aleutians, there is evidence that this region is the evolutionary centre of origin for some taxa of coldwater corals.

Auke Bay Laboratory, National Marine Fisheries Service, Alaska Fisheries Science centre, 11305 Glacier Highway, Juneau, AK 99801, USA
*e-mail: jon.heifetz@noaa.gov

Distribution patterns and population trends of breeding seabirds in the Aleutian Islands

G. VERNON BYRD[1] , HEATHER M. RENNER[1] AND MARTIN RENNER[2]*

Abstract

The 1800-km-long Aleutian Archipelago is a breeding area for more than 10 million seabirds of 26 species. We evaluated the distribution of breeding colonies of 24 common breeding species in relationship to ocean passes of two sizes, availability of nesting habitat and the distribution of introduced predatory mammals. Further, we evaluated population trends and reproductive rates to amplify information about distribution. We compared distributions and demographic parameters based on proposed differences in marine habitats in the eastern, central and western Aleutians. Samalga Pass did not appear to be a break point for breeding seabird distribution as is suggested for oceanographic characteristics and other species groups by papers in this volume. Factors affecting distribution varied with foraging and nesting strategies of various species groups. The three largest breeding aggregations of seabirds in the Aleutians (Buldir, Chagulak and Kiska) all have relatively high species diversity and are located next to large passes. However, when other predictors were considered, proximity to medium or large passes was important mainly for surface-feeding piscivores. The extent of nesting habitat apparently does not limit the distribution of surface- or burrow-nesting species (including planktivores and piscivores). Instead, the distribution of these species probably has been shaped by introduced mammals. Nesting habitat for ledge- and crevice-nesting species is more limited than for surface and burrow nesters but is still fairly widespread. Ledge- and crevice-nesting species are less susceptible to fox predation than are surface and burrow nesters. These species may have been reduced by predation but were not extirpated.

[1]Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy, Homer, AK 99603, USA
[2]Department of Biology, Memorial University of Newfoundland, St Johns, NL, Canada A1B 3X9
*E-mail: vernon_byrd@fws.gov

Seabird distribution, abundance and diets in the eastern and central Aleutian Islands

J. JAHNCKE[1,*] , K. O. COYLE[2] AND GEORGE L. HUNT, Jr[1,†]

Abstract

We examined the hypothesis that seabird distribution, abundance and diets differ among the eastern and central Aleutian Islands in response to distinct marine environments and energy pathways in each region. Research cruises were conducted in June 2001 and May–June 2002. We determined the distribution, abundance, diet and prey consumption of seabirds, and related these to zooplankton abundance and water masses that possess different physical properties. We found that distribution, abundance and diets of seabirds could be partitioned into two regions that correspond to marine environments determined by the extent of the Alaska Coastal Current along the eastern and central Aleutian Islands. Short-tailed shearwaters (*Puffinus tenuirostris*) were the most abundant seabird in the coastal waters of the eastern Aleutian Islands, and northern fulmars (*Fulmarus glacialis*) were the most abundant seabird in the oceanic waters of the central Aleutian Islands. Seabird communities in the central and eastern Aleutian Islands were likely associated with different food webs. In the central Aleutian Islands, short-tailed shearwaters and northern fulmars consumed shelf-break species of euphausiids (*Thyssanoesa longipes*) and oceanic copepods (*Neocalanus cristatus*), respectively; in the eastern Aleutian Islands, both short-tailed shearwaters and northern fulmars consumed shelf species of euphausiids (*T. inermis*). Carbon transport to seabirds was highest in Unimak and Akutan Passes where shearwaters removed large quantities of shelf euphausiids, followed by Samalga and Seguam Passes where northern fulmars removed large amounts of oceanic copepods.

[1]Ecology and Evolutionary Biology Department, University of California, Irvine, CA 92697-2525, USA
[2]Institute of Marine Science, University of Alaska, Fairbanks, AK 99775-7220, USA
*e-mail: jjahncke@uci.edu
†Present address: School of Aquatic and Fishery Sciences, Box 355020 University of Washington, Seattle, WA 98195–5020, USA.

Hydrographic features and seabird foraging in Aleutian Passes

CAROL LADD[1,*] , JAIME JAHNCKE[2] , GEORGE L. HUNT, Jr[2,†] , KENNETH O. COYLE[3] AND PHYLLIS J. STABENO[1]

Abstract

Strong tidal currents crossing over the abrupt topography of the Aleutian Passes result in regions with high horizontal property gradients. These frontal regions vary with the tidal cycle and form the boundary between vertically mixed and stratified regions. Concentrations of seabirds were associated with convergence zones in the mixed water (MW) and with the front between North Pacific (NP) water and MW. Species that were foraging by picking at prey from the surface were associated with surface convergences that appeared to be associated with Langmuir circulation cells or tidal features (all fulmar aggregations) in the central passes (Samalga, Seguam). In contrast, subsurface foraging puffins and small alcids were mostly observed in areas of turbulent, well-mixed water near the shallow regions of the passes. Short-tailed shearwater flocks that were plunge-diving for prey were associated with the front between the NP water and MW in the passes. On our transects, we observed no significant aggregations of seabirds associated with Bering Sea water or NP water away from the frontal zones. The interaction of strong currents with bathymetric features results in zones of vertical advection, mixing, and surface convergences that make island passes attractive foraging regions for seabirds. Deep passes lacking these features, such as many of the passes in the western Aleutian Archipelago, are not as likely to facilitate trophic transfer to top predators as shallow passes, such as those found in the eastern Aleutian Islands.

[1]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, WA 98195-4235, USA
[2]Ecology and Evolutionary Biology Department, University of California Irvine, Irvine, CA 92697-2525, USA
[3]Institute of Marine Science, University of Alaska Fairbanks, Fairbanks, AK 99775-7220, USA
*e-mail: carol.ladd@noaa.gov
†*Present address*: School of Aquatic and Fishery Sciences, Box 355020 University of Washington, Seattle, WA 98195–5020, USA.

Tidal front affects the size of prey used by a top marine predator, the short-tailed shearwater (*Puffinus tenuirostris*)

LUCY S. VLIETSTRA[1,] , KENNETH O. COYLE[2] ,NANCY B. KACHEL[3] AND GEORGE L. HUNT, Jr[1,†]*

Abstract

Oceanographic features are known to influence the distribution of marine predators by affecting the abundance and distribution of their prey. We tested the hypothesis that oceanographic features also affect predator distribution by enhancing the profitability of small-sized prey. During July and August 1999, short-tailed shearwaters feeding in Akutan Pass, Alaska (Aleutian Islands) fed upon small (11.6 ± 0.2 mm) euphausiids present in high density near the sea surface. Conductivity–temperature–depth (CTD) casts, hydroacoustic surveys, and net tows revealed that high densities of small euphausiids were associated with a tidal front on the north side of Akutan Pass. At most sites elsewhere in the Bering Sea, away from tidal fronts, shearwaters selected larger (14.2–20.1 mm) euphausiids, even when small euphausiids were present. This study provides evidence that, by promoting high densities of easily accessible prey, oceanographic features can broaden the range of prey sizes taken by marine predators.

[1]Department of Marine Safety and Environmental Protection, Massachusetts Maritime Academy, Buzzards Bay, MA 02532, USA, E-mail: lvlietstra@maritime.edu
[2]Institute of Marine Sciences, University of Alaska, Fairbanks, AK 99775-7220, USA
[3]NOAA/Pacific Marine Environmental Laboratory, 7600 Sandpoint Way NE, Seattle, WA 98115-6349, USA
*Department of Marine Safety and Environmental Protection, Massachusetts Maritime Academy, Buzzards Bay, MA 02532, USA, E-mail: lvlietstra@maritime.edu
†*Present address:* School of Aquatic and Fishery Sciences, Box 355020 University of Washington, Seattle, WA 98195-5020, USA.

An ecological classification of Alaskan Steller sea lion (*Eumetopias jubatus*) rookeries: a tool for conservation/management

KATHERINE A. CALL AND THOMAS R. LOUGHLIN*

Abstract

As the western stock of Steller sea lions continues to decline, government managers may place additional controls on commercial fisheries as protective measures. Currently, management decisions regarding rookeries are based largely on the geographic location of a site, and little effort has been made to describe sea lion rookeries in an ecosystem context. We provide a broad ecological characterization of rookeries for the western stock of Steller sea lions, which can be used in making management decisions to facilitate their recovery. We gathered data on habitat (bathymetry, sea surface temperature, substrate type, and orientation), diet and population trends from available literature and National Marine Fisheries Service databases (1990–98), and we used a Geographic Information System to group sea lion rookeries into ecologically related regions. Ecological attributes were assigned to rookeries within a 10-nm radius of land. Regions were determined using cluster analysis. Five distinct classes of rookeries (i.e. potential management regions) were identified based on their relatedness to the ecological factors we defined. Several of the regional breaks occur at major oceanic passes including Amchitka, Samalga, and Unimak Passes and are associated with ocean currents.

National Marine Mammal Laboratory, NOAA Fisheries Alaska Fisheries Science Center, 7600 Sand Point Way NE, Seattle, WA 98115, USA
*e-mail: kate.call@noaa.gov

Do patterns of Steller sea lion (*Eumetopias jubatus*) diet, population trend and cetacean occurrence reflect oceanographic domains from the Alaska Peninsula to the central Aleutian Islands?

ELIZABETH H. SINCLAIR , SUE E. MOORE , NANCY A. FRIDAY , TONYA K. ZEPPELIN AND JANICE M. WAITE*

Abstract

Shipboard surveys were conducted along the Aleutian Islands in 2001 and 2002 to assess the influence of a suite of biophysical parameters on regional patterns in the distribution of cetaceans and Steller sea lions (SSL; *Eumetopias jubatus*). Distributions of four large whale species: fin (*Balaenoptera physalus*), humpback (*Megaptera novaeangliae*), minke (*B. acutorostrata*) and sperm (*Physeter macrocephalus*) aligned with proposed metapopulation breaks in diet and population trend of SSLs. Dall's porpoise (*Phocoenoides dalli*) and killer whales (*Orcinus orca*) were widely distributed throughout the study area, and killer whales were particularly prevalent along the north Aleutian Island coastlines between Unimak Pass and Samalga Pass. Biopsies determined that most killer whales (92%) were of the piscivorous (resident) ecotype as opposed to the mammal-eating (transient) ecotype observed in 2002 only. Generalized additive models (GAMs) were used to explore relationships between these multispecies patterns in distribution, oceanographic variables (salinity, temperature, fluorescence and depth) and proximity to six Aleutian passes. The GAMs indicated the best-fit models and most significant correlations as determined by the Akaike function and Cp-statistics were: depth and proximity to the nearest measured pass for SSLs and all cetaceans, respectively; frequencies of herring and salmon in SSL diet with population trend; fluorescence in the top 50 m with occurrence of humpback, minke, and killer whales; and surface temperature with occurrence of humpback, killer, and sperm whales. Results of the GAM analyses suggest foci for future investigation of relationships between physical variables and interspecific patterns of marine mammal distribution.

National Marine Mammal Laboratory, NOAA/NMFS Alaska Fisheries Science Centre, 7600 Sand Point Way, NE, Seattle, WA 98115, USA
*e-mail: beth.sinclair@noaa.gov

Immature Steller sea lion (*Eumetopias jubatus*) dive activity in relation to habitat features of the eastern Aleutian Islands

BRIAN S. FADELY[1] , BRUCE W. ROBSON[1,†] , JEREMY T. STERLING[1] , ANGIE GREIG[2] AND KATHERINE A. CALL[1]*

Abstract

Current flow and bathymetry in the Aleutian Islands define unique habitats that influence prey distribution and foraging behaviour of top-level predators. We explored whether oceanographic features and bathymetry influenced the diving activity of 30 immature sea lions (ages 5–21 months) equipped with satellite-linked depth recorders in the eastern Aleutian Islands (EAI) during 2000–02. Sea surface temperature (SST) and chlorophyll *a* concentrations were obtained from remote sensing satellite imagery and associated with locations where sea lion diving was recorded. Most locations associated with diving to >4 m were within 10 nautical miles (nm) of shore and associated with onshelf waters <100 m deep. Use of offshore and deeper waters in the Bering Sea increased during May, as did trip durations. General movements at that time were generally northwesterly from the North Pacific Ocean to the Bering Sea. Diving activity varied coincidently with increases in SST and chlorophyll *a* concentrations, but also with sea lion age. Associations with habitat features did not consistently explain variability in dive count, time at depth, dive focus or focal depth. Nearshore diving tended to be influenced by distance from shore or seafloor depth, whereas increased SST coincided with activity of sea lions diving >30 nm offshore. Immature sea lions developing into independent foragers in the relatively shallow pass areas of the EAI do so at a time of rapid changes in oceanography and prey availability.

[1]National Marine Mammal Laboratory, NOAA Fisheries Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115, USA
[2]Resource Ecology and Fisheries Management, NOAA Fisheries Alaska Fisheries Science Center, 7600 Sand Point Way, NE, Seattle, WA 98115, USA
*e-mail: brian.fadely@noaa.gov
†*Present address:* Bartomeu Rossello Porcel No. 11, Apt. 4 Iz. Palma de Mallorca 07014, Spain.

The palaeoenvironment of humans and marine birds of the Aleutian Islands: three millennia of change

DOUGLAS CAUSEY[1,2,] , DEBRA G. CORBETT[3] , CHRISTINE LEFÈVRE[4] , DIXIE L. WEST[5] , ARKADY B. SAVINETSKY[6] , NINA K. KISELEVA[6] AND BULAT F. KHASSANOV[6]*

Abstract

A unique window into the biological history of the Aleutian Islands is provided by the zooarchaeology of early human sites. We focus on the palaeoavifauna hunted by early Aleuts who inhabited Amchitka and Buldir islands (central Aleutians), and Shemya Island (western Aleutians) from *c.* 3500 yr ago to the present. Most of the seabird species recovered from these early sites varied widely in distribution and abundance through time and space. Pelagic procellariids such as short-tailed albatrosses and short-tailed shearwaters were present and abundant at most sites and at most times. During periods of increased temperatures and precipitation (e.g. 650–1100 yr BP), nearshore foragers such as cormorants and parakeet auklets increased in abundance, but during periods of cooling (e.g. 1800–2100 yr BP), piscivorous birds feeding offshore, such as murres and kittiwakes, predominated. Over three millennia, we found that marine bird populations were negatively correlated with temperature and positively correlated with precipitation. We detected hunter-related depletions of populations breeding in accessible colonies at small scales of space and time, but we did not observe widespread or long-term effects. We conclude that local oceanography and regional changes in prey bases caused by environmental and climate change in the past had a significant impact on the distribution and abundance of Aleutian marine birds.

[1]Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, USA
[2]Department of Biological Sciences, University of Alaska Anchorage, Anchorage, AK 99516, USA
[3]US Fish and Wildlife Service, 1011 E. Tudor Road, Anchorage, AK 99503, USA
[4]Département Écologie et Gestion de la Biodiversité du Muséum national d'Histoire naturelle and UMR 5197 du Centre National de la Recherche Scientifique, Paris, France
[5]Biodiversity Research Center and Natural History Museum, University of Kansas, Lawrence, Kansas 66045, USA
[6]A. N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, 33 Leninsky pr., Moscow 119071, Russia
*e-mail: dcausey@uaa.alaska.edu

GUEST EDITORIAL

Toward sustainable ecosystem services from the Aleutian Archipelago

J. D. SCHUMACHER (a.k.a. TWO CROW)[1,] AND GORDON H. KRUSE[2]*

Abstract

The new research reported in this special issue of *Fisheries Oceanography* expands our understanding of the Aleutian Archipelago ecosystem. Yet our knowledge remains very limited, while the use of this ecosystem for commercial activities, recreation and other purposes expands. Given this situation, how can we sustain the ecosystem services (food, fuel, fibers as well as spiritual, recreational, educational and other non-material benefits to society) of this region? The region has a mixed history; healthy populations of many species exist, but so do species extinctions (e.g. Steller sea cow, *Hydrodamalis gigas*) and population depletions, including the sea otter (*Enhydra lutris*), Steller sea lion (*Eumetopias jubatus*), whiskered auklets (*Aethia pygmaea*), Pacific ocean perch (*Sebastes alutus*), and red king crabs (*Paralithodes camtschaticus*), associated with human impacts. The solution to our limited knowledge in this poorly studied region is increased funding for ecosystem research, including its responses to climate change and human impacts. Knowledge is not sufficient, however; a change in management approach is also needed. We emphasize the need to maintain a broader set of ecosystem services objectives rather than the traditional narrower focus on commercial fishery yields. To do so, we recommend the development of an integrated ecosystem services management plan for the Aleutian Islands. Such a plan requires that state and federal regulatory agencies coordinate with a broad stakeholder community involving sectors of commercial and recreational fishing, subsistence, conservation, oil and gas development, coastal development, shipping, tourism, and others.

[1]Two Crow Environmental, Inc., PO Box 345, Gila, NM 88038, USA
[2]Juneau Centre, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, 11120 Glacier Highway, Juneau, AK 99801, USA
*e-mail: twocrow@gilanet.com

SUMMARY

Oceanography and ecology of the Aleutian Archipelago: spatial and temporal variation

GEORGE L. HUNT, JR[1,] AND PHYLLIS J. STABENO[2]*

Abstract

This compilation of new information and summaries of earlier work emphasizes variability within marine waters of the Aleutian Archipelago. From the Alaska Peninsula to Near Strait, net flow through the passes is northward, with four passes (Amukta, Amchitka, Buldir, and Near Strait) contributing most of the flow. East of Samalga Pass (169°W), waters derived from the Alaska Coastal Current predominate, whereas west of Samalga Pass, waters of the Alaskan Stream predominate. The pattern of storm tracks creates a climatological (interannual and long term) transition zone in weather features (e.g. surface air temperature) near 170°W. The marine ecosystem of the Aleutian Archipelago also has a strong discontinuity at Samalga Pass, where cold-water corals, zooplankton, fish, marine mammals and foraging seabirds show a step change in species composition. Diets of ground fish, Steller sea lions (*Eumetopias jubatus*) and some seabirds also change there. Lower growth rates of some fish species and stable isotope data indicate that productivity declines westward along the archipelago. The available data demonstrate considerable ecosystem variability over time scales of decades to millennia. Abrupt changes in composition of fish communities at several of the major passes suggest that Samalga Pass may mark only one of several ecological divisions of Aleutian waters. This spatial and temporal heterogeneity provides an important context within which to view recent declines in populations of Steller sea lions and other species, and has important implications for the management of regional marine resources. We conclude that the marine waters of the Aleutian Archipelago are divided into at least two different ecological regions, with potential for a concomitant separation of some fishery resources.

[1]Department of Ecology and Evolutionary Biology, University of California, Irvine, CA 92697, USA
[2]National Oceanic and Atmospheric Administration, Pacific Marine Environmental Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115, USA
*e-mail: geohunt2@u.washington.edu.