**NPRB Use Only** APPENDIX 1

**Proposal No** 72 **Date Submitted** December 05, 2008 **Date Received**

**Project Title:** Impacts of the eruption of Kasatochi volcano on terrestrial and marine ecosystems: an integrated evaluation of geological and biological effects.

**Project Period:** from June, 2009 to June, 2010

**Name, Address, Telephone Number and Email Address of Applicant:**


Mr. Anthony Rosario DeGange
U.S. Geological Survey
907-786-7046
tdegange@usgs.gov
4210 University Drive, Anchorage, Alaska 99508, USA


**Principal Investigator(s): (Include name, affiliation and email address):**


Mr. Vernon Byrd, U.S. Fish and Wildlife Service, vernon_byrd@fws.gov
Dr. Stephen Jewett, University of Alaska, Fairbanks, jewett@ims.uaf.edu
Dr. Christopher F. Waythomas, U.S. Geological Survey, chris@usgs.gov


**Research Priority:**

Impacts of volcanic activity


**Summary of Proposed Work:** On August 7, 2008, Kasatochi Volcano, 80 km northeast of Adak, erupted catastrophically producing hot boulder and pyroclastic flows that extended the coastline of the island about 400 m. Subsequent eruptive activity covered the island with many meters of fine ash and pyroclastic surge material. The eruptions likely extirpated the terrestrial and nearshore biota. Pre-eruption data exist for many components of the terrestrial and nearshore ecosystems of Kasatochi. Seabirds, Steller sea lions, vegetation and terrestrial arthropods have been studied at Kasatochi in the past. There has been two characterizations of the nearshore marine area of Kasatochi during the Seabird, Marine Mammal, and Oceanography Coordinated Investigation Program which provided information on the distribution of birds and marine mammals at sea and documented acoustic biomass of plankton and fish and temperature and density profiles of the water column. Eruptions like this have shaped Aleutian ecosystems for millennia, but seldom has such an opportunity occurred to understand the impacts of such an event. In 2009, we propose to conduct several interdisciplinary baseline studies of Kasatochi Island to better document the acute impacts of the eruption, measure geomorphic changes in since last August, and begin a long-term comprehensive and integrated monitoring and research program to document the ecological response to the eruption. Information derived from such an effort will aid in our understanding of the ontogeny of ecosystems in the Aleutian Islands, a volcano-dominated area with high natural resource values.


**Community Involvement:** We propose to interact with the communities of Unalaska and Adak during and after our projects. During our project, we will interact with the communites as best we can. This will be easiest in Adak where the Fish and Wildlife Service maintains a summer office. Following completion of our field work and data analysis we will conduct focused outreach in each of these communities.

**Total Funding Requested From NPRB:**

| | |
|---|---|
| $ 143,728.00 | U.S. Geological Survey |
| $ 74,380.00 | University of Alaska, Fairbanks |
| $ 47,092.00 | U.S. Fish and Wildlife Service |
| **$ 265,200.00** | |

**Total Other Support:**

| | |
|---|---|
| $ 140,000.00 | U.S. Geological Survey |
| $ 97,000.00 | U.S. Fish and Wildlife Service |
| $ 20,000.00 | University of Alaska, Fairbanks |
| **$ 257,000.00** | |

**Legally Binding Authorizing Signature and Affiliation:**

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# RESEARCH PLAN

A. Project Title

Impacts of the eruption of Kasatochi volcano on terrestrial and marine ecosystems: an integrated evaluation of geological and biological effects.

Short title: Ecological impacts of the 2008 Kasatochi eruption.

B. Proposal Summary

On August 7, 2008, Kasatochi Volcano, a 1.3 by 1.2 km island volcano, 80 km northeast of Adak (Fig. 1), erupted catastrophically producing hot boulder and gravel mass flows (pyroclastic flows) that entered the sea and extended the coastline of the island about 400 m, to roughly the 20 m isobath (Fig. 2). Subsequent eruptive activity covered the island with many meters of fine ash and pyroclastic surge material that together with the pyroclastic flow debris likely extirpated the terrestrial and nearshore marine biota. Pre-eruption data exist for many components of the terrestrial and nearshore ecosystems of Kasatochi. As one of the sites in the ecological monitoring network of the Alaska Maritime National Wildlife Refuge, seabirds and Steller sea lions have been studied at Kasatochi for the past 13 years by the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Terrestrial vegetation and arthropods have recently been described from the island, and the nearshore marine area of Kasatochi has been characterized during the Seabird, Marine Mammal, and Oceanography Coordinated Investigation Program (SMMOCI) which provided information on the distribution of birds and marine mammals at sea and documented acoustic biomass and relative abundance of species of plankton and fish along with temperature and density profiles of the water column. Eruptions like this have shaped Aleutian ecosystems for millennia, but seldom has such a unique opportunity occurred to study and understand the impacts of such an event. In 2009, we propose to document the acute, short-term impacts of the 2008 eruption to answer the question, "what have been the physical and biological effects of the eruption on the Kasatochi ecosystem?" In accomplishing this purpose, we will establish a quantitative baseline for future comparisons including establishing a structured, long-term sampling scheme integrated across components (e.g., terrestrial and marine, geology and biology) to facilitate inferences about how the terrestrial and nearshore ecosystems at Kasatochi are "recovering" from this major disturbance. As far as we know this study will be the first of its kind for an Alaskan island volcano, although similar studies have been done elsewhere, notably Mount St. Helens (Dale et al. 2005), Krakatau (Thornton 1996) and Surtsey in Iceland (Fridriksson 1987, Fridriksson and Magnusson 1992, Fridriksson 2005; also see Walker 1999). The uniqueness of the Kasatochi study compared to studies elsewhere in the world is that it is an isolated marine ecosystem from which there are pre-eruption ecological data for the island and for marine waters nearby.

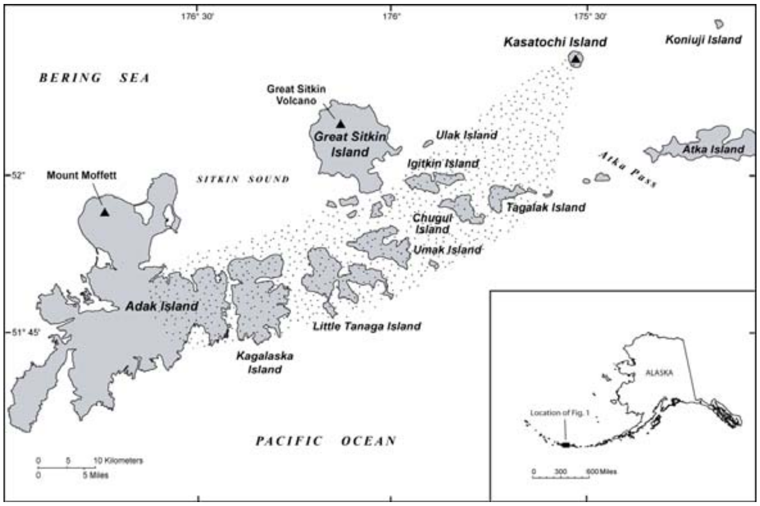


Fig. 1 Location of Kasatochi Island in the west-central Aleutian Islands of Alaska. Also shown are nearby islands and extent of ash fall from the August 7 eruption.

C. Project Responsiveness to NPRB Research Priorities or Identified Project Needs

Through documentation of the acute impacts of the Kasatochi eruption, this proposal is directly responsive to **NPRB Research Priority 6, Aleutian Islands**, specifically, **6iii. Impacts of volcanic activity** and **6i. Nearshore dynamics of the Aleutian Islands**.

D. Soundness of Project Design and Overall Conceptual Approach

Little is known about the specific role of volcanic activity in the evolution, structuring, and productivity of terrestrial and coastal marine ecosystems in the Aleutian Islands. Such information could significantly enhance our understanding of how eruptive activity affects the ecology of volcanic islands and nearby marine ecosystems. The results of this work will be important for evaluating how a severe natural disturbance affects fisheries and other natural resources which will in turn facilitate more informed management decisions.

We propose to use NPRB support along with other grant funds and substantial in-kind contributions to document the acute, short-term impacts of the Kasatochi eruption on the terrestrial and nearshore marine ecosystems of this Aleutian volcano by quantitatively comparing pre-eruption with post-eruption conditions. The specific driver of change was the cataclysmic event that occurred in August 2008 which deposited a thick layer of hot pyroclastic material over the entire surface of Kasatochi Island and in the nearshore marine zone out to at least the 20 m isobaths (Fig. 2). Secondary impacts include continued sediment deposition into the marine zone through erosion and the geochemical influence on the biota of ash-leachate.

In 2009, geological sampling will include evaluating erosion, rainfall-runoff-ash interactions, and generation and characterization of ash-leachates. Soil sampling will be directed at characterizing the substrate including pre-eruption soil surfaces if found. Because prior data are available, the overall design for biota data collection is similar to a Before-After Control Impact design (Stewart-Oaten et al. 1986). Before-after comparisons for vegetation, arthropods, birds, and marine mammals on land will be based on surveys of previously-established plots for which we have data from before the eruption. A similar approach will be used for birds, marine mammals, and biomass of plankton and fish in previously surveyed transects within 20 km of Kasatochi. Comparisons of intertidal and nearshore subtidal organisms will use data from transects established during the EMAP program elsewhere in the central Aleutians to get a sense of what would have been predicted at Kasatochi before the eruption in similar

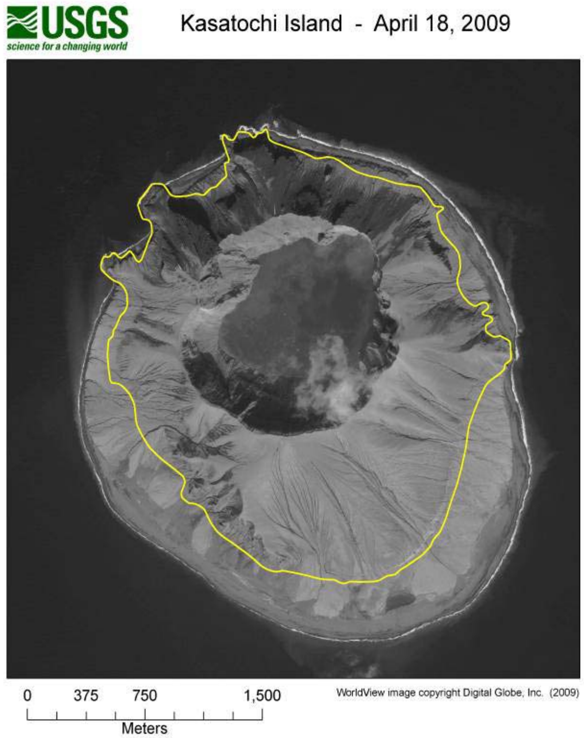


Fig. 2. Image of Kasatochi showing pre-eruption coastline (yellow) and post eruption extent as of April 2009.

habitats. Because Kasatochi is relatively small, an effort also will be made to survey most of the surface of the island to look for “hotspots” of activity by birds and marine mammals and refugia for plants and arthropods.

Based on advice from scientists who have worked on similar evaluations at other volcanoes (e.g., Mount St. Helens, Dale et al. 2005), an integrated ecosystem evaluation is proposed at Kasatochi. As a way to enhance integration we will adopt common sampling approaches based on a cross-elevation gradient design. This will result in a series of transects for geological, soil, intertidal, and subtidal sampling as well as enhanced biota sampling in 2009. A preliminary post-eruption surficial geologic map and digital elevation model of Kasatochi, prepared by the Alaska Volcano Observatory of USGS based on commercially available high resolution satellite imagery, will be used as a common base layer for the multi-disciplinary team. In 2009 six transects will be systematically established, and they likely will cover the major geologic and topographic features on the island. Along each of the primary across-gradient transects, sampling will occur on systematically-selected perpendicular transects roughly parallel to the coast to provide replicates within various elevational/depth strata. Sample sizes and plot sizes may vary among disciplines, but sampling in the same areas will enhance integration. This will be referred to as the Kasatochi Coordinated Investigations Design.

Besides accomplishing the sampling needed to document the impacts of the eruption on the ecosystem in the first year following the perturbation, these 2009 sampling areas will be delineated and marked in such a way that they will become a network of permanent transects and plots, integrated among the components of the study, that can be used in the future for a comprehensive and integrated research and monitoring program to understand the long-term ecological response to the eruption. To take full advantage of the work accomplished in 2009, and the USGS and USFWS are both committed to providing salary and in-kind support to ensure some level of future research is completed and to leverage other contributions.

The components of our proposed integrated study include: geomorphology (including soil development), terrestrial biota (plants, birds, marine mammals), marine biota (intertidal invertebrates and plants, nearshore subtidal invertebrates, plants, and fish, and pelagic fish, plankton, water chemistry, birds, and marine mammals) and oceanography within 20 km of the island. Arthropods will also be sampled during 2009, but that project is funded by other than NPRB funds as is a large portion of the other terrestrial biota sampling. Each component is discussed in more detail below.

Integration of the various project elements will be the responsibility of a scientific oversight panel composed of representatives of each of the major agencies involved. This group will meet by teleconference before and after each field visit to Kasatochi and to assemble the final report to NPRB. Further integration will be necessitated by sharing of resources common to each study group, and we plan to establish a database of common data resources such as map and GIS data. A high degree of self-integration will occur among the groups of scientists working off the USFWS research vessel Tiglax who will all be sharing logistical support and working together during visits to the island.

Geological Project Components (Geomorphology and Volcanism)

*Mapping and Past Eruptive History* (C. Waythomas, U.S. Geological Survey/Alaska Volcano Observatory; C. Nye, Division of Geological and Geophysical Surveys – State of Alaska; W. Scott, U.S. Geological Survey/Cascade Volcano Observatory)

We propose to produce a standard geologic map depicting the location of major lithologies and describing their character and age. A geologic map for Kasatochi does not yet exist, and we anticipate that it will be a relevant part of documenting the return of life on the island. In the course of the geologic documentation of the island necessary to produce the map we anticipate addressing questions particularly relevant to this study: 1) How old is the island? The morphology of the island suggests that the oldest parts may be only a few hundred to several thousand years old. 2) How often have large eruptions occurred? The possibility that the ecosystem is frequently "reset" is important in terms of understanding the life cycle on the island. AVO geologists who visited the island in 2005 noted apparently very young, thick, pyroclastic deposits. They were unable to date them but it is possible that there was a 2008-like eruption sometime within the past several hundred years and that such eruptions are not atypical. 3) Have there been systematic changes in eruptive style? A single specimen of basalt has been reported from the island, although the outcrop of origin is not known. This basalt suggests that at one point the mode of eruption on the island was significantly different (lava flows instead of pyroclastic flows). This difference would be reflected in the relative destructive power of the different eruptions as well as in the type of substrate deposited and available for future colonization.

In order to produce this map we will visit, describe, and sample exposures of pre-2008 rocks and map the spatial distribution of each rock type. We will also map, if possible, the stratigraphy exposed in the crater walls, although we anticipate that we will not be able to sample these units because the cliffs are too steep.

In this study we will describe the 2008 deposits and map spatial distribution of key physical characteristics including thickness, inferred emplacement temperature, grain size distribution, cohesion, permeability, and componentry. We will collect a complete suite of samples of juvenile and non-juvenile lithologies with special attention to lithologic diversity. These observations will enable us to provide a better description of the types of eruptive events (pyroclastic flows, surges, tephra fall, etc.) which affected different parts of the island. The nature of the 2008 deposits will be key to the re-establishment of life in two major ways. 1) the intensity of the eruption will determine the extent to which plants were completely killed or removed, rather than merely charred at ground level. 2) The 2008 deposits will be the substrate on which new life grows.

In addition to the land-based work, a physical description of the subtidal areas near Kasatochi needs to include bathymetric maps since the bottom contours have changed after the eruption. We have initiated discussions with the National Marine Fisheries Service and the University of Alaska Fairbanks, and the National Oceanic and Atmospheric Administration (NOAA) about collaborating with a separately-funded research component to map changes in bathymetry around Kasatochi Island, but in 2009 bathymetry at least along the six transect lines will be mapped as accurately as possible with standard narrow-beam sonar.

*Erosion, Runoff and Sediment Delivery to the Sea* (C. Waythomas, U.S. Geological Survey)

Physical, chemical and biological processes will ultimately shape the ecological response to the Kasatochi Island eruptions. Volcanic landscapes are significant source regions for sediment and the sediment yield from these areas, typically expressed in $m^3/km^2/year$, are the highest measured worldwide (Walling and Webb, 1996; Major, et al., 2000). Soon after volcanic activity ceases, erosion of volcanic deposits begins and generally follows a cascading sequence of processes that ultimately result in the net export of sediment from the drainage basin or watershed to the ocean. Many unconsolidated volcanic deposits have a low infiltration capacity that promotes overland flow during rainfall events. If the rainfall intensity and duration exceed some threshold condition, related to the amount of water, slope angle, and microtopography of the substrate, overland flow will evolve to more channelized flow and rills will develop. Continued rainfall will enlarge the rill network and more substantial channels and gullies will form. As the rill and gully network evolves, sediment export to the sea continues until a stable channel system develops or banks and hillslopes become stabilized by vegetation.

Examination of high-resolution satellite images and oblique aerial photographs of Kasatochi Island from August and September 2008 indicates that the process of rill and gully development has begun and fine-grained sediment is being transported to the near-shore zone. This process is likely to continue for several years and possibly for decades. We propose to address rill and gully erosion of the volcanic ash mantled slopes of Kasatochi by documenting temporal changes in the evolution of the drainage network. Initially this will be accomplished by subdividing the island into smaller catchments based on the pattern of rill and gully erosion observable in satellite imagery. We will determine changes in drainage density, defined as the total channel length divided by catchment area, as a proxy for time-dependent changes in the rill and gully network.

Fieldwork in summer 2009 will focus on determining the geometry of rills and gullies at representative locations on the island so that the volume of sediment removed by fluvial erosion can be estimated. In addition to making estimates of sediment yield from satellite images and oblique photographs, we will employ several different rill and gully erosion models that have been developed to evaluate soil loss on disturbed landscapes, such as WATEM, USPED, and WEPP. These models have been successfully applied in a variety of settings and can accurately predict first-order sediment yield associated with rill and gully erosion (Jetten, et al, 2003; Grovers, et al., 2007; Bulygina, et al., 2007). The purpose of evaluating sediment yield from small catchments on Kasatochi volcano is to obtain preliminary approximations of the sediment budget so that the effects of sediment in the near-shore zone can be evaluated. These studies will also assist in evaluating the stability of the substrate for vegetation and wildlife habitat. At present we are uncertain how much reworked ash is reaching the sea. Using the above models we will be able to evaluate various rainfall-runoff scenarios using climate data from Adak Island collected from 1949-1996 and supplemented with data from a weather station we will install in 2009. Particle size data on the volcanic ash deposits will be obtained from samples collected in August 2008 and in 2009. This information will be used to provide estimates of sediment yield for various rainfall-runoff conditions. We also propose to monitor geomorphic changes on Kasatochi Island by installing two time-lapse cameras to capture representative temporal changes in the drainage network. AVO has successfully deployed time-lapse cameras at a number of volcanoes and the photographic information has been useful for documenting a variety of surficial processes. We will use the photographic data to document rill and gully development and erosion of the ash mantle. The time-lapse data also will be useful for documenting rainfall-runoff processes and will be integrated with precipitation data obtained from the rain gauge we also plan to install in summer 2009. Time lapse cameras may serve an additional purpose, as they may document the return of plant and animal life to the island.

*Rainfall-Runoff-Ash Interactions and Generation of Ash-Leachate* (C. Waythomas U.S. Geological Survey/Alaska Volcano Observatory)

Volcanic ash clouds typically contain sulfur and halogen gases and metal volatiles that become adsorbed to fine ash particles during ash transport and fallout. After the ash accumulates on the ground or falls in the ocean it becomes susceptible to reaction with rainfall, surface water and seawater, and the adsorbed sulfur and halogen compounds, which are generally soluble, produce leachates. Ash leachate has potential ecological significance because it may contain high concentrations of As, Cl, F, Hg, Pb, $SO_4$ and Se that are toxic to marine and terrestrial organisms and may inhibit growth of certain species of plants. However, a number of studies have shown that dissolution of adsorbed salts and aerosols from volcanic ash can increase the nutrient availability and this may cause a rise in marine productivity (Frogner, et al., 2001; Duggen, et al., 2007). Acid salts adsorbed on ash particles are removed easily by surface-water runoff or by seawater in the ocean and nutrients and trace metals are released rapidly. These nutrients and trace metals can increase primary productivity in the ocean and thus volcanic ash and ash-leachates may act as natural fertilizers (Frogner, et al., 2001; Duggen, et al., 2007; Jones, et al., 2008).

The August 7, 2008 Kasatochi eruption produced a significant $SO_2$ cloud that was tracked by satellite techniques around the globe. Reconnaissance observations in late August 2008 indicated significant sulfur precipitates on the surficial ash deposits and many gas escape features associated with the release of gasses trapped within the ash and pyroclastic mantle. Although we have not been able to obtain leachate data from field measurements, the nature of the eruption and fine-grained character of the surfical deposits suggests that ash leachates generated by rainfall and surface runoff at Kasatochi will likely be at least moderately acidic.

The erosion of the ash mantle and formation of ash leachate presents a dual problem. On the one hand, it is possible that the nearshore zone will be compromised by high amounts of suspended sediment and associated toxic elements and acidic solutions. On the other hand, dissolution of adsorbed constituents on the ash could increase the bioavailability of some key nutrients and increase primary marine productivity. To address this problem, we will collect and analyze ash samples from the flanks of Kasatochi volcano, and suspended sediment from the nearshore zone to determine whether the volcanic ash leachates inhibit or promote ecological recovery. We will integrate these results with those obtained from the analysis of rill/gully erosion to determine potential long-term effects of volcanic ash in the marine environment.

Biological Project Components

*Terrestrial Biota*

All of Kasatochi Island is covered with layers of ash and pyroclastic flow material. Most, if not all, bird and marine mammal breeding habitat has been covered. It is possible that no plants or arthropods survived the eruption. Intertidal and nearshore subtidal communities were overrun by hot, fast moving pyroclastic flows and subsequently covered by ash and now form part of the periphery of the island. The following pre-eruption data are available: general distribution of nesting birds (all species); detailed maps and photographs of auklet nesting colonies; data from plots to monitor seabird abundance and productivity; point count routes for land birds; plots describing plant community structure; plots describing arthropod communities; plots for soil samples; and maps with raptor nest locations. These data are critical for assessing acute impacts of the eruption and long-term ecological response. Seabirds were the dominant vertebrates on Kasatochi Island prior to the eruption and the most prominent linkage between marine and terrestrial ecosystems. Recolonization of Kasatochi Island by seabirds will depend on the availability of suitable nesting habitat which includes steep terrain for cliff-nesting birds, boulder piles, rubble and talus for auklets, and low-growing vegetated slopes for burrow-nesting murrelets and storm-petrels. Availability of these habitats will depend on erosion of ash and pyroclastic flow material and revegetation of the island. Revegetation will depend upon development of suitable soils and source materials for plants. Our long-term research approach is to investigate physical and biological processes related to geomorphology and soil development and their influence on revegetation and recolonization of Kasatochi Island by seabirds. We are particularly interested in the potential role of marine derived nutrients in the ecological recovery of Kasatochi Island. Our short-term objective is to document acute impacts of the eruptions on the islands biota and establish benchmarks for investigating long-term change.

*Soils* (B. Wang, U.S. Geological Survey; C. Lu Ping and G. Michaelson, University of Alaska).--Soils form through the weathering of rocks, sediments, or other geologic material. Soils derived from volcanic ash exhibit unique physical and chemical properties, such as low bulk density, high water retention and phosphate sorption. Weathering studies indicate the importance of rainfall and leaching as primary factors in secondary mineral formation in volcanic soils (Zehetner 2003). Soils with ash parent materials in the Aleutian Islands and the adjacent Alaska Peninsula all exhibited mildly acidic pH with soil colloidal material dominated by allophane and Al-humus complexes (Ping et al. 1988, 1989; Shoji et al. 1988).

Soils develop rapidly on volcanic ash because of the large specific surface area and high porosity of the ash. The humid and relatively mild climate of this region may be optimal for soil development. The interaction between surface and ground water and sulfur compounds may produce acidic conditions. High acidity may enhance the initial chemical weathering of the ash. As vegetation and microbial communities reemerge, humic substances will become incorporated into the incipient soil. Rapid humus accumulation is typical of volcanic soils.

In 2009, soil studies will focus on substrate characterization. The primary objective is to evaluate the weathering of the parent ash and soil development. Priority soil/substrate activities include 1) sampling in conjunction with the vegetation study sites including pre-eruptive plot locations and new transects sites as part of the Kasatochi Coordinated Investigations Design 2) hot-spot site sampling co-identified with the vegetation and re-colonization evaluations to allow for initial (and potentially longer term) monitoring of spots likely to first receive nutrients and seeds 3) survey for and sample if found, old soil surface and mass seabird entombment sites 4) collect bulk ash samples for substrate characterization. Additionally this effort will be closely coordinated with the geomorphic and rainfall-runoff-ash interactions to be able to account for mass export from physical and chemical weathering. In 2009, we will be able to address the following short-term questions: 1) to what extent do buried soils represent a potential nutrient pool? 2) To what extent do buried carcasses represent a potential nutrient pool? 3) What are the initial effects of the ash on pH? 4) What elements are released in early stages of weathering? 5) What is the current soil/ substrate microbial activity and community structure 6) To what extent can existing soil microbial community structure be related to pre-eruptive communities?

Although the primary focus of this proposal is to characterize the volcanic substrate within one year after the eruptions, we plan to accomplish that goal in a manner that will provide the basis for longer-term study of the evolution of soil on the Kasatochi volcano. In such long-term efforts, it is important to characterize the process in its early stages with short-term assessments. The primary objective is to evaluate the weathering of the parent ash and soil development. Sampling sites will be informed by the landforms on the island (e.g., ridgetops, shoulder slopes, side slopes, etc.), the results of our geomorphology studies and study plots of seabirds, vegetation and soils from previous studies. Data loggers (such as hobos) will be deployed to obtain physical and chemical characteristic (such as soil temperature, soil moisture, pH, specific conductivity) with time. Sites will be equipped with soil cation/anion collector membranes to monitor the release of elements as the ash weathers on monthly, yearly and multi-year bases.

In the lab we propose to conduct leaching experiments on the initial ash materials to assess the leachable acidity (capacity factor) and the influence of water, nitrogen, carbonic acid, and organic acid amounts/concentrations on both the elemental releases from the ash and changes in extractable Fe/Al species. This could be then be correlated with time necessary for these kinds of input-influences to happen in the field to predict soil evolution.

This effort will set the stage for potential future integrated long term monitoring of volcanic ash weathering and determine the interactive roles of ash chemistry, pre-eruptive legacy, vegetation succession, and bird and marine mammal re-colonization of Kasatochi Island on soil formation, soil microbial community development, and nutrient cycling. Future questions for which 2009 data provide a baseline include: 1) What changes occur in the relative importance of marine versus atmospherically derived nutrients and is there a difference between roosting or upland areas? 2) What is initial rate of chemical weathering? 3) What is the rate of carbon accumulation and does it vary with plant community? 4) Are there legacy effects from buried soils or carcasses on the soil aboitic and biotic development?

*Vegetation* (S. Talbot, U.S. Fish and Wildlife Service; S. Talbot, U.S. Geological Survey).--The vegetation of Kasatochi was likely destroyed completely by temperatures of several hundred degrees before it was buried under up to 10 meters of ash and pyroclastic debris in the 2008 eruption. Lack of vegetation—as well as stability of volcanic substrates— will likely inhibit recolonization of Kasatochi Island by some burrow-nesting seabirds. We propose to monitor the reestablishment of plants and the development of vegetative communities, and compare these observations with data collected on vegetative communities prior to the eruption. We will address the following questions: 1) Do any of the vegetative communities that existed prior to the eruption remain on the island? 2) Is there potential for these communities to thrive post eruption? 3) Do any seed sources remain? 4) Are there any refugia areas (e.g., cliffs) where some vegetation escaped destruction? 5) What are the possible vectors for plant dispersal to Kasatochi?, and, 6) What role does revegetation play in the recolonization of Kasatochi by seabirds?

We will periodically search Kasatochi Island for remnant vegetation sources and signs of revegetation in 2009. We will also make observations at all pre-established plots. We will establish additional sampling sites based on geomorphic features that emerge as the result of erosion or near obvious sources of potential colonies like gull roosts (hot spots). To be consistent with the earlier pre-eruption vegetation study of Kasatochi Island, our sampling design will follow Braun-Blanquet methods (Westhoff and van der Maarel 1973). Permanent plots will be laid out along transects established for integrated sampling (see above) as part of the Kasatochi Coordinated Investigations Design. The areas adjacent to the plots will be searched for vegetation. If any plants are found, cover-abundance will be estimated for all vascular plants, bryophytes, and lichens according to the nine-point ordinal scale of Westhoff and van der Maarel (1973). Plant nomenclature will follow USDA, NRCS (2001).

Field data will be entered into the database management system TURBOVEG (Hennekens and Schaminee 2001) and numerical analysis will be accomplished with the classification methods of the MULVA-5 program (Wildi and Orloci 1996) and complemented by JUICE 6.1 (Tichy 2002). Relevé and species classification will be performed using complete linkage clustering and correspondence analysis (Hill 1979) will be used to order the relevé and species groups externally and internally along the main floristic gradient. Final vegetation table arrangement will be according to Braun-Blanquet methodology (Westhoff and van der Maarel 1973).

*Birds* (V. Byrd and J. Williams, U.S. Fish and Wildlife Service).--Birds have been studied on Kasatochi by the U.S. Fish and Wildlife Service continually since 1996 providing precise data from which to evaluate acute impacts and ecosystem recovery (Drummond and Larned 2007). Kasatochi was one of only nine colonies in the entire Alaska Maritime National Wildlife Refuge system that received intensive annual monitoring of wildlife populations. The pre-eruption avifauna on Kasatochi was dominated by massive numbers of crested and least auklets – perhaps a couple hundred thousand in total (Drummon and Larned 2007). Auklets nested in interstitial spaces in beach boulders and talus fields. Most, if not all of this auklet nesting habitat was covered by the eruption in 2008. Although many birds, particularly unfledged young, were likely killed during the eruptions, we assume that most adult birds escaped the explosion and some species may already be using the island for roosting.

We have many questions about the impact of this event on auklets. Will auklets try to reestablish colonies on the island? Future nesting will likely depend on the availability of suitable nesting habitats. Does any habitat remain or are former beach boulders and talus slopes completely covered for the foreseeable future? Was new nesting habitat created? Given the erosion of coastline that is expected, what is the potential for creation of new habitat? Where specifically will these auklets choose to nest in the future? Since auklet breeding colonies are concentrated in relatively few locations worldwide (most on volcanic islands), the loss of one colony has significant ramifications. If volcanic activity is a natural and frequent event on a geologic time scale, how do auklet colonies typically respond to this perturbation?

In order to study the response of auklets and other birds to the loss of their nesting habitat on the island, all pre-eruption data on distribution and abundance will be summarized to provide a “before” status. This will include GPS coordinates of historic plots and GIS layers of known distribution for as many species as possible on the island and in nearshore marine waters. Sampling will be conducted in 2009 of all historic plots and transects to document abundance “after” the eruption.

*(Crested and least auklets):* We will determine if birds continue to attend the site of their former colony despite the expected complete lack of breeding habitat. In northern auklet colonies, snow cover can persist late into the traditional breeding period. When this happens, birds stand around on the surface of the colony above their traditional nesting sites waiting for the snow to melt so that they may begin breeding. It is possible that returning auklets which escaped the direct effects of the eruption might act as if the ash was continuous snow cover for some period of time. Therefore we will count and photograph birds during site visits, and assess how long they remain at the colony before abandoning. To determine reuse and prospecting of the site, automated recording cameras or song meters will be set up at former colony locations to record vocalizations. Cameras and song meters will be programmed to record during traditional periods of colony attendance (e.g., early morning) to determine if birds use or continue to visit historic breeding sites.

*(Nocturnal seabirds--fork-tailed and Leach’s storm-petrel, whiskered auklet, ancient murrelet):* Our monitoring studies showed that these species were in the early process of recovery from predation of introduced arctic foxes, which were removed from the island in 1985. To determine reuse and prospecting of former breeding sites, automated recording devices or song meters will be set up to record

vocalizations and flyovers. Song meters will be programmed to record during traditional periods of colony attendance to determine if birds use or continue to visit historic breeding sites. As most of these nocturnal species burrow into the ground, we will examine terrestrial habitat for signs of burrows (athough unlikely since they usually burrow into stable vegetated banks).

*(Roosting seabirds--e.g. gulls, guillemots, cormorants):* Direct counts will be made of all roosting birds and locations of groups will be delineated with GPS during foot surveys over the island and during nearshore boat surveys around the coastline of the island.

*(Raptors):* Because of the large numbers of breeding seabirds present on the island prior to the eruption, healthy populations of breeding raptors were present on this small island. Normally 2 pairs of bald eagles and up to 5 pairs of peregrine falcons nested and hunted on the island. At least 1 falcon was seen after the eruption, but it is unknown if others survived. Will these top predators leave this location if large numbers of birds do not return? Are nearby colonies of seabirds close enough to continue to support this high density of raptors? We will count and record locations of raptors for comparison.

*(Passerines)*: The established point count route will be resurveyed based on GPS coordinates of the center stakes. Habitat and birds will be documented with standard point count forms. Besides the standard point counts, passerines and other birds will be recorded on terrestrial sampling plots used for geological, soil, and vegetation sampling.

*(Marine mammals):* Previous to the eruption, approximately 1,000 Steller sea lions traditionally occupied a rookery at the north side of Kasatochi (National Marine Fisheries Service, unpubl. data). That area is now covered with ash. Numbers and locations of sea lions will be recorded from small boats to determine whether this endangered species still occupies and breeds on Kasatochi in 2009.

*Marine Investigations*

*Marine bathymetry and substrate type* (J. Bodkin, U.S. Geological Survey; S. Jewett, University of Alaska; J. Williams U.S. Fish and Wildlife Service).--As noted earlier, we have initiated discussions with the University of Alaska and NOAA concerning mapping of bathymetry around Kasatochi to better characterize the extent of subsurface flows from the 2008 eruption. Dr. Jennifer Reynolds from the University of Alaska attended our workshop and said this would best be accomplished with a high resolution, multi-beam sensor deployed from a large ship. Given the uncertainty of bringing this technology to bear on the Kasatochi project in the near term, we will initiate an effort in 2009 to measure depths along transects established as part of the Kasatochi Coordinated Investigations Design from a skiff and to characterize the seafloor bottom type with a submersible camera. Depth measurements and photography will occur from a skiff every 5m along the transects to the 20m depth contour. From the 20m depth out to deeper water, depth soundings will be made from the M/V Tiglax.

*Shallow nearshore and intertidal communities* (J. Bodkin, U.S. Geological Survey; S. Jewett, University of Alaska).--The effects of the 2008 eruption of Kasatochi on subtidal communities are currently unexplored, but it is likely that widespread destruction, if not complete elimination of biota and ecological process occurred in the nearshore surrounding the island. The eruption has created a unique opportunity to 1) examine the acute effects of the eruption on the nearshore benthic community; 2) determine whether the volcanic ash leachates inhibit or promote ecological recovery; and 3) begin ecological succession experiments.

Shallow nearshore and intertidal kelp dominated habitats support some of the most productive communities in the world (Mann 2000). These communities typically are supported by high rates of primary production provided by diverse and abundant forests of understory and canopy forming brown algae that in turn support and provide habitat for diverse populations of invertebrates, fishes, birds and mammals (Stenek et al. 2003). However, the physical and ecological processes leading to the development of nearshore marine communities are not well understood.

Because little information is available on the physical or biological structure of the nearshore zone surrounding Kasatochi following the 2008 eruption, our initial approach will largely be exploratory. We will begin in both the subtidal and intertidal by a systematic reconnaissance of habitats to determine the availability and suitability of habitats and biota for sampling. If suitable hard substrates are available, permanent transects will be established and sampled using well described methods (Estes and Duggins 1995; Jewett et al.1999; Dean and Jewett 2001; Jewett et al. in press). Although there are no historical data on nearshore communities from Kasatochi, recent data are available from nearby islands in the Andreanof group (USGS unpub. data, ADEC EMAP project) for comparison.

*(Subtidal)*: In 2009 we propose to map the sea floor around the island from the intertidal out to the 20m contour (the Tiglax will go offshore from there). This would be accomplished on the 6 transects radiating out from the island. On these we would take depth measurements, ph, salinity, turbidity readings and photos at 2-4 m depth intervals. The resulting contour map will be compared to the prior NOAA charts to evaluate change. The images will allow determination of substrate type which also would be initially classified on site.

We will sample the subtidal at 3-6 sites, regardless of sediment type using the emap protocol to the extent warranted by landscape features (i.e. sediment), following the terrestrial sampling design (i.e. 4-6 radial transects) that will be common to the extent possible, among the Kasatochi coordinated investigations.

There are two primary objectives in sampling the nearshore subtidal during the summer of 2009. The first is to characterize the substrate between 0 and 20 m depth around Kasatochi. This will be achieved through surface-deployed tethered video and reconnaissance SCUBA dives distributed around the Island (see below) to depths <20m. The second objective is to establish survey transects to characterize the area based on species composition, distribution, abundance, and population size structure of benthic biota (macro algae, invertebrates, and demersal fishes). These plots will be marked for future resurvey if suitable rocky substrates allow for the placement of permanent structures (e.g. eye bolts) that will facilitate relocating transects in future years. If rocky substrates are suitably abundant (expanses > 50m x 50m) we will establish 3-5 permanent transect lines at 10m depth. If feasible the transects will be those established in the Kasatochi Coordinated Investigations Design. After the reconnaissance dives and videography, divers will layout perpendicular short transects at systematically-selected locations along the transects and select quadrats for destructive and non-destructive sampling of plants and animals following Jewett et al. (in press).

During the summer of 2009, depending on locating suitable consolidated substrates, we may also conduct sampling of benthic flora and fauna during reconnaissance dives following Estes and Duggins (1995) as follows. A grid is superimposed over the coastal perimeter of the island and using the grid intersections with shoreline to define the potential sample sites. From these, up to 30 sites are randomly selected and GPS coordinates are assigned to each. At each site a team of two SCUBA divers samples the benthic community by randomly placing ¼ $m^2$ quadrats on the sea floor. One of the divers counts the number of kelps and estimates the percent cover of the common sessile invertebrates and algae; the other diver counts and collects all of the benthic macroinvertebrates from within the quadrat.

(*Intertidal*): Intertidal sites will be established at the point nearest the intersection of the Kasatochi Coordinated Investigations Design transects with the + 0.5 m tidal elevation. The nearest 50-100 m segment of consolidated substrate to this intersection will identify the sampling site.

At each site we will measure the abundance (either percent cover or number of individuals per unit area) of visible algae and invertebrates. These data will be used to describe abundance patterns for numerically dominant taxa as well as potential changes in both algal and invertebrate diversity over time. Specific metrics to be evaluated include (but are not necessarily limited to) percent cover of bare substrate, barnacles (*Balanus* spp., *Semibalanaus* spp., and *Chthamalus dalii*), mussels (*Mytilus trossulus*), rockweed (*Fucus gardneri*), ribbon kelp (*Alaria marginata*), and red algae (*Neorhodomela* spp.); and density of slender arm sea stars (*Evasterias troschelii*), ochre sea stars (*Pisaster ochraceus*), black katy chitons (*Katherina tunicata*), dogwinkles (*Nucella* spp.) and mask limpets (*Lottia persona*). In addition, we will measure the size distribution of mussels (*Mytilus trossulus*) and limpets (*Lottidae.*) at each site. Ancillary physical data from each site will include estimates of slope and substrate type.

The abundance of algae and invertebrates will be measured in quadrats or belt transects at each site. A single 50-m transect established at the +0.5 m tidal elevation will be established and serve as the foundation for all sampling. The sizes of the sampling units employed will vary depending on the size and anticipated density of organisms. In general, sizes of sampling quadrats or transects will be selected such that dominant species would be expected to be present in more than two-thirds of the samples and that the average abundance for motile species would be in the range of 5 to 700 individuals per sampling unit, and have a mean of approximately 20 to 50 individuals per unit. Based on our experience in intertidal habitats elsewhere in the Gulf of Alaska we typically estimate percent cover of algae, sessile invertebrates, and the density of smaller motile invertebrates in 0.25 sq.m quadrats. Densities of intermediate size motile invertebrates (*Nucella* spp. and *Katherina tunicata*) are often measured in 2 sq. m. quadrats and densities of larger motile invertebrates in belt transects of up to 400 sq. m. Conditions at Kasatochi may require modification of quadrat size. Up to twelve quadrats will be sampled at the +0.5m tidal elevation. Up to 120 individual mussels and 120 limpets will be sampled from each site for estimation of size distributions. This should provide a sample size sufficient to characterize size distributions in a minimum of 8 size categories in 4 mm increments for both mussels and limpets (Blanchard and Feder 2000a and b, Milstein and O'Clair 2001). Duplicate samples of 60 large mussels each will be collected to provide tissue for determination of contaminants (either metals or organics).

Sampling of larger, more motile invertebrates will be conducted at a single tidal elevation. Four meter wide sampling transects up to 50m in length will be used that stretch parallel to shore and have their lower boundary at MLLW. Many larger, more abundant sea stars (especially *Pycnopodia helianthoides*) are highly motile and tend to congregate near the low tide level as the tide recedes. Thus, sampling at MLLW should provide near maximal estimates of abundance of larger invertebrates at a site and provide a reasonable index of abundance.

Mussels and limpets used for determination of size distributions are to be collected from a single tidal elevation at each site. The elevation will be as near to transect sampling quadrats as possible, but may need to extend higher into the intertidal in order to obtain sufficient numbers of individuals.

Abundance estimates will be made based on counts of the number of individuals (for motile species) or percent cover (for algae and sessile invertebrates). Identifications will generally be made to the species level. However, it is often impossible to distinguish species without destructively sampling and collecting organisms for later identification in the laboratory. This is because species can often only be positively identified based on characteristics that are indistinguishable with the naked eye. Identification of juveniles is especially problematic.

Procedures for sampling the intertidal will be similar to those in the subtidal, consisting of initial reconnaissance of the intertidal zone for consolidated substrate suitable for establishing permanent transects. Within the strata of rocky intertidal substrate, provided the presence of suitable habitat, 3-6 randomly located permanent transects will be established at the +0.5 M LLW tidal elevation parallel to the shoreline. Transects lengths will be 50m in length and permanent quadrats and swaths will be randomly established perpendicular or parallel to the transect and will be used to sample algae and invertebrates at appropriate spatial scales.

*Pelagic Marine Surveys* (D. Dragoo, J. Williams, U.S. Fish and Wildlife Service, G. Drew, USGS, Biological Resources Division).--Each summer, the Alaska Maritime National Wildlife Refuge conducts coordinated surveys of marine birds, marine mammals, plankton, fish and oceanography from the M/V Tiglax at one of several sites in the North Pacific and Bering Sea. These Seabird, Marine Mammal, and Oceanography Coordinated Investigations (SMMOCI) have been conducted twice in the past in the vicinity of Kasatochi Island (Drew 2005, Dragoo 2007). Although not originally scheduled for study in 2009, we propose to repeat the Kasatochi surveys in 2009 to learn how the eruption might have affected nearshore resources. The focus of SMMOCI studies has been on the abundance and distribution of marine birds and mammals, in relation to rookeries and oceanographic features of each area (Byrd et al. 1997). These data are detailed and sampling adequate enough for assessing seasonal or annual changes in marine bird communities and relative acoustic biomass (Renner et al. 2008, in prep.). Because of the emphasis on conducting a large grid of transects, however, sampling of plankton and fish has always been much more limited. By design, sampling was adequate to characterize the plankton and fish communities, but probably not adequate to detect anything but catastrophic changes among years (Byrd et al. 1997). In any case, we propose to repeat the survey of all taxa and compare, where appropriate, quantitatively or qualitatively with historical survey observations.

*(Marine Birds and Mammals):* Birds and marine mammals will be counted on strip transects using methods described by Gould and Forsell (1989). Two observers, stationed on the flying bridge of the M/V Tiˆglaˆx (one on each side of the ship), will continuously record all birds observed on the water within 150 meters on either side of, and 300 meters in front of, the vessel, while the vessel travels at 9-10 knots. Distances will be estimated based on the angle of view from the ship's flying bridge to the object on the water. We will count flying birds on 360° 'scans' every one minute. Sightings will be entered into a computer using dLog (R. G. Ford Consulting, Portland, OR) which assigns all records GPS positions in real time. We will conduct surveys on 26 transects, including circumnavigations of Kasatochi, Koniuji and Ulak islands at approximately one nm offshore, and surveys through Atka, Fenimore and Tagalak passes. We will map bird and marine mammal distributions using Camris® (R. G. Ford Consulting, Portland, OR), and estimate densities for comparison with previous data.

*(Hydroacoustics):* We will record hyrdoacoustic data for zooplankton and fish biomass along the same transects and concurrently with marine bird and mammal observations. We will determine relative prey abundance on all transects using a dual frequency (38 and 120 kHz) Simrad EK500 echosounder. We will integrate acoustic data to a maximum depth of 250 m, excluding the surface bubble layer, bad data regions and the bottom. Data will be exported in 100 m long bins. Ordinary kriging will be used to produce interpolations over a 2 km-interval grid to generate maps of relative prey abundance, as implemented in the R package geoR, at 0-50 m, 0-100 m and 0-250 m depths (Renner et al. 2008).

*(Fish):* We will sample fish to help determine which species are associated with observed acoustic signals (Dragoo et al. 2007). We will set long-lines to catch large demersal fish species, use bottom trawls to describe the bottom fauna and conduct plankton tows at several sites. We propose to conduct several types of trawls to relate mid-water and surface community composition with the hydroacoustic record of biomass. Mid-water tows use a 6 m modified herring trawl (with a PVC collecting bucket containing 1 mm mesh at the end), towed for about 10 to 20 minutes at 2-3 kts speed through the water. We will attach a depth sounder to the foot rope of the mid-water trawl to give real-time measure of fishing depth. Mid-water trawl collections will be identified to the lowest practical taxonomic level. All invertebrates and fishes will be counted and total length of fishes to the nearest mm will be measured for a subsample. We will conduct bottom trawls using a 3.05 m plumb staff beam trawl with 4

mm stretched mesh at the cod end which is towed for five to 10 minutes in the direction of the water current at approximately 1.5 kts. Samples will be identified to the lowest practical taxonomic level, counted, and a sample of fishes will be measured to the nearest mm (total length) and preserved. For each long-line set, we will deploy a single skate of about 100 hooks (sizes 3.0 and 5.0) baited with salted herring and soaked for about two to three hours. We will identify fishes to species, measure them to the nearest mm (total length), weigh them and remove some of their stomachs for later diet analysis.

*(Zooplankton):* To evaluate surface zooplankton we will tow a neuston net (0.3 m by 0.5 m mouth opening; 505 micron mesh size) for about 10 min at 2-3 kts. Plankton in the water column will be sampled by deploying and recovering a plankton net vertically (not obliquely) as near to the bottom as practical while the vessel is drifting. A vertical bongo net with paired 60 cm diameter 505 micron mesh will be used. Plankton from the neuston and vertical nets will be preserved for later identification. After removing the noticeably larger or less common animals in the sample (100% split), the remaining sample will be split using a Folsom splitter to achieve a target of at least 100 individuals per haul. This sampling method probably underestimates abundance of some of the zooplankton species, since the larger animals (e.g., shrimps, euphausiids) swim strongly enough that they are not expected to be caught in proportion to their abundance with the gear we use (Brenda Holladay, Institute of Marine Science/University of Alaska Fairbanks, personal communication).

*(Phytoplankton):* We will use a fluorometer attached to the CTD to asses relative fluorescence, at all oceanographic sample sites. These samples will allow us to make inferences as to the primary productivity near Kasatochi. We will also physically sample phytoplankton at a depth of 10 m (typical photosynthetic maxima) and fix phytoplankton with formalin to preserve them for future laboratory analysis.

*(Nutrients): W*e will sample water at 10 m depth with a Niskin bottle. Water samples will be filtered and frozen for analysis at the University of Washington. These samples may allow us to identify chemical tracers related to the localized runoff from Kasatochi. *Water Column Temperature and Salinity Profile*.—We will deploy a portable CTD (Sea-Bird Seacat SBE-19 Profiler) approximately every two nautical miles along three transect lines (09, 12 and 26) and at the end of each fishing event (trawl, tow or long-line set). We used Ocean Data View® to produce water column temperature and salinity profiles (using the VG gridding algorithm).

*(Sea Surface Temperature and Salinity):* We will continuously record sea surface temperature and salinity during transects using a Sea-Bird Seacat SBE21 thermosalinograph. Ocean Data View® will be used to generate temperature and salinity contour maps (using the VG gridding algorithm) as a way of illustrating the occurrence of surface structures such as fronts.

E. <u>Education and Outreach</u>

Education and outreach for this project will include the following elements:

1) <u>Presentations of the results of our research for the general public</u>
   - At least one presentation at public forums and/or schools in the following Aleutian Island communities: Unalaska/Dutch Harbor and Adak
   - An evening presentation in Homer at the Islands and Ocean Visitors Center
   - An evening presentation in Anchorage at the Loussac Library

2) <u>Written Outreach</u>
   - USGS Color Fact Sheets summarizing our research plan and research results to be distributed widely within USGS and to the public and local communities
   - An article for USGS Coastal Newsletter “Sound Waves”

An article for the National USFWS National Wildlife Refuge System "Refuge Update"
Potential articles in Homer, Anchorage and Fairbanks newspapers

3) Displays
A temporary outreach display for the Islands and Oceans Visitor Center in Homer that can also be displayed at the Museum of the Aleutians in Unalaska and at other venues.

4) Web content (USFWS, USGS) to include narrative, still photos and video

5) Presentations at scientific conferences
At least two scientific papers on the results of the research at the Marine Science Symposium in Alaska in 2010 – likely one paper on geology and geomorphology of Kasatochi and one paper on biological impacts of the eruption. Presentations will also be given at other scientific venues as well.

6) Ned Rozelle, a professional science writer for the University of Alaska, Fairbanks, will be aboard the M/V Tiglax during its scheduled research visit to Kasatochi Island in August 2009. Mr. Rozelle writes science articles for a variety of outlets, including newspapers and magazines.

F. Timeline and Milestones

We are seeking one year of support to cover partial expenses primarily related to equipment, logistics and field work. Our proposed schedule is as follows:

| Milestone | Timeline |
|---|---|
| Experts workshop to review and finalize 2009 workplan and to discuss long-term research project. Scientists with interdisciplinary expertise from other volcano eruptions (e.g. Mount St. Helens; see Dale et al. 2005) will be invited to participate (not to be funded by NPRB). | May 2009 |
| Initial reconnaissance of Kasatochi via M/V Tiglax; make initial observations, deploy equipment and establish plots and transects. | June 2009 |
| SMMOCI investigations aboard M/V Tiglax; conduct additional observations on island. | July 2009 |
| Revisit Kasatochi to make observations, collect samples, retrieve equipment. | August 2009 |
| Summarize and analyze data | September 2009 – March 2010 |
| Progress Report to NPRB | December 31, 2009 |
| Final report to NPRB | June 30, 2010 |

Deliverables: The final product to NPRB will be an integrated report summarizing the results from the studies completed during the 2009 field season. The report will summarize major geomorphologic changes to Kasatochi Island, including establishment of a rill and gully networks, preliminary estimates of sediment yield, an initial description of the erosion of the ash mantle and results from chemical analyses of ash from the flanks of the volcano and suspended sediments. We will compare pre- and post eruption information on vegetation, arthropods, marine mammals, bird distribution and abundance on land and at sea, nearshore forage fishes and biomass and its distribution. We will include descriptions of post-eruption intertidal and subtidal habitats, and the results of our sampling for intertidal and benthic marine plants and invertebrates.

Project Management

Project Manager – Anthony R. DeGange will be overall project manager. He will ensure that timelines for the project are met and a final report to NPRB is submitted on schedule. Mr. DeGange is the Chief of the Biology Office of USGS Alaska Science Center and has over 30 years of experience working in natural resource conservation, management and research in Alaska. The following individuals are principal investigators for individual elements of the study:

Geomorphology – Dr. Christopher Waythomas, U.S. Geological Survey, Alaska Volcano Observatory (C. Nye, Division of Geological and Geophysical Surveys – State of Alaska, W. Scott, U.S. Geological Survey/Cascade Volcano Observatory, collaborators). Dr. Waythomas has been a research geologist with the USGS since 1993. His research has emphasized geologic studies and hazard evaluations of Aleutian Island volcanoes. He is one of only a few scientists to have visited Kasatochi Island since the eruptions.

Soil Science – Dr. Bronwen Wang, U.S. Geological Survey, Principal Investigator (C. Lu Ping and G. Michaelson, University of Alaska, collaborators). Dr. Wang has been a research geologist and chemist with the USGS since 1991.

Terrestrial Biota and Nearshore At-Sea Surveys (SMMOCI) - Vernon Byrd, Alaska Maritime National Wildlife Refuge, Principal Investigator (J. Williams, D. Dragoo, and, Dr. S. Talbot, U.S. Fish and Wildlife Service, Dr. G. Drew, Dr. Sandy Talbot, USGS, BRD, and Dr. D. Sikes, University of Alaska, collaborators). Mr. Byrd is Supervisory Biologist at the Refuge and has worked in the Aleutian Islands for more than 30 years.

Shallow Nearshore and Intertidal Communities – James Bodkin, U.S. Geological Survey and Steve Jewett, University of Alaska, co-Principal Investigators. James L. Bodkin has been the leader for the Department of Interior sea otter and coastal ecosystems research in Alaska since 1990. He is responsible for managing USGS science projects in nearshore marine ecosystems across the north Pacific from California to Russia. Stephen C. Jewett, Ph.D., has been employed by the Institute of Marine Science, University of Alaska Fairbanks since 1974. He currently serves as Research Professor and Scientific Diving Officer. Jewett has had four field research missions to the Aleutian Archipeligo.

Graduate Students – no graduate students will be employed during the first year of this study. We anticipate that a number of graduate students will participate in long-term studies at Kasatochi Island. The USGS Alaska Science Center has submitted a proposal for a postdoctoral fellow to conduct research on ecological responses to volcanic eruptions in Alaska through its Mendenhall Postdoctoral Fellowship Program.

Permits – The Alaska Maritime National Wildlife Refuge will issue special use permits to allow non-U.S. Fish and Wildlife Service scientists to work on Kasatochi.

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# NPRB BUDGET SUMMARY FORM

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT TITLE:** | Ecological impacts of the 2008 Kasatochi eruption. | | | | Annual cost category breakdown for Other Support should be detailed in the budget narrative. |
| **PRINCIPAL INVESTIGATOR:** | S. Jewett, University of Alaska Fairbanks | | | | |
| **FUNDING SOURCE** | **YEAR 1** | **YEAR 2** | **YEAR 3** | **TOTAL** | |
| **NPRB Funding** | 74,380 | 0 | 0 | 74,380 | |
| **Other Support** | | | | 20,000 | |
| **TOTAL** | 74,380 | 0 | 0 | 94,380 | |

| **Cost Categories** | **NPRB Year 1** | **NPRB Year 2** | **NPRB Year 3** | **NPRB TOTAL** | **Match/In kind TOTAL (all years)** |
|---|---|---|---|---|---|
| **1. Personnel Salaries** | 34891 | | | 34,891 | |
| **2. Personnel Fringe Benefits** | 13,384 | | | 13,384 | |
| **3. Travel (include 1 trip to review mtg in Anchorage each year plus for the year following project conclusion)** | 2,236 | | | 2,236 | |
| **4. Equipment** | 0 | | | 0 | 20,000 |
| **5. Supplies** | 250 | | | 250 | |
| **6. Contractual/Consultants** | 0 | | | 0 | |
| **7. Other (Include $2000 for education and outreach if not already accounted for in other spending categories)** | 500 | | | 500 | |
| **Total Direct Costs** | **51,261** | **0** | **0** | **51,261** | **20,000** |
| **Indirect Costs** | 23,119 | | | 23,119 | |
| **TOTAL PROJECT COSTS** | **74,380** | **0** | **0** | **74,380** | **20,000** |

# NPRB BUDGET SUMMARY FORM

| | | | | |
|---|---|---|---|---|
| **PROJECT TITLE:** | Ecological impacts of the 2008 Kasatochi eruption. | | | |
| **PRINCIPAL INVESTIGATOR:** | Bodkin, Waythomas, Wang, US Geological Survey | | | |
| **FUNDING SOURCE** | **YEAR 1** | **YEAR 2** | **YEAR 3** | **TOTAL** |
| **NPRB Funding** | 143,728 | 0 | 0 | 143,728 |
| **Other Support** | | | | 140,000 |
| **TOTAL** | 143,728 | 0 | 0 | 283,728 |

Annual cost category breakdown for Other Support should be detailed in the budget narrative.

| Cost Categories | NPRB Year 1 | NPRB Year 2 | NPRB Year 3 | NPRB TOTAL | Match/In kind TOTAL (all years) |
|---|---|---|---|---|---|
| **1. Personnel Salaries** | 0 | | | 0 | 100,000 |
| **2. Personnel Fringe Benefits** | 0 | | | 0 | |
| **3. Travel (include 1 trip to review mtg in Anchorage each year plus for the year following project conclusion)** | 28,000 | | | 28,000 | |
| **4. Equipment** | 31,000 | | | 31,000 | 40,000 |
| **5. Supplies** | 4,000 | | | 4,000 | |
| **6. Contractual/Consultants** | 24,840 | | | 24,840 | |
| **7. Other (Include $2000 for education and outreach if not already accounted for in other spending categories)** | 6,100 | | | 6,100 | |
| **Total Direct Costs** | **93,940** | **0** | **0** | **93,940** | **140,000** |
| **Indirect Costs** | 49,788 | | | 49,788 | |
| **TOTAL PROJECT COSTS** | **143,728** | **0** | **0** | **143,728** | **140,000** |

# NPRB BUDGET SUMMARY FORM

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT TITLE:** | Ecological impacts of the 2008 Kasatochi eruption. | | | | Annual cost category breakdown for Other Support should be detailed in the budget narrative. |
| **PRINCIPAL INVESTIGATOR:** | Byrd, US Fish and Wildlife Service | | | | |
| **FUNDING SOURCE** | **YEAR 1** | **YEAR 2** | **YEAR 3** | **TOTAL** | |
| **NPRB Funding** | 47,092 | 0 | 0 | 47,092 | |
| **Other Support** | | | | 97,000 | |
| **TOTAL** | 47,092 | 0 | 0 | 144,092 | |

| **Cost Categories** | **NPRB Year 1** | **NPRB Year 2** | **NPRB Year 3** | **NPRB TOTAL** | **Match/In kind TOTAL (all years)** |
|---|---|---|---|---|---|
| **1. Personnel Salaries** | 0 | | | 0 | 49,000 |
| **2. Personnel Fringe Benefits** | 0 | | | 0 | |
| **3. Travel (include 1 trip to review mtg in Anchorage each year plus for the year following project conclusion)** | 12,000 | | | 12,000 | |
| **4. Equipment** | | | | 0 | |
| **5. Supplies** | | | | 0 | |
| **6. Contractual/Consultants** | 24,000 | | | 24,000 | |
| **7. Other (Include $2000 for education and outreach if not already accounted for in other spending categories)** | 2,600 | | | 2,600 | 48,000 |
| **Total Direct Costs** | **38,600** | **0** | **0** | **38,600** | **97,000** |
| **Indirect Costs** | 8,492 | | | 8,492 | |
| **TOTAL PROJECT COSTS** | **47,092** | **0** | **0** | **47,092** | **97,000** |

# NPRB BUDGET SUMMARY FORM - MULTIPLE ORGANIZATIONS

| | | | | |
|---|---|---|---|---|
| **PROJECT TITLE:** | Ecological impacts of the 2008 Kasatochi eruption. | | | |
| **PRINCIPAL INVESTIGATOR(S):** | S. Jewett, University of Alaska Fairbanks; Bodkin, Waythomas, Wang, US Geological Survey; Byrd, US Fish and Wildlife Service; PI names | | | |
| **FUNDING SOURCE** | **YEAR 1** | **YEAR 2** | **YEAR 3** | **TOTAL** |
| **NPRB Funding** | 265,200 | 0 | 0 | 265,200 |
| **Other Support** | | | | 257,000 |
| **TOTAL** | 265,200 | 0 | 0 | 522,200 |

Annual cost category breakdown for Other Support should be detailed in the budget narrative.

| Cost Categories | NPRB Year 1 | NPRB Year 2 | NPRB Year 3 | NPRB TOTAL | Match/In kind TOTAL (all years) |
|---|---|---|---|---|---|
| **1. Personnel Salaries** | 34,891 | 0 | 0 | 34,891 | 149,000 |
| **2. Personnel Fringe Benefits** | 13,384 | 0 | 0 | 13,384 | 0 |
| **3. Travel (include 1 trip to review mtg in Anchorage each year plus for the year following project conclusion)** | 42,236 | 0 | 0 | 42,236 | 0 |
| **4. Equipment** | 31,000 | 0 | 0 | 31,000 | 60,000 |
| **5. Supplies** | 4,250 | 0 | 0 | 4,250 | 0 |
| **6. Contractual/Consultants** | 48,840 | 0 | 0 | 48,840 | 0 |
| **7. Other (Include $2000 for education and outreach if not already accounted for in other spending categories)** | 9,200 | 0 | 0 | 9,200 | 48,000 |
| **Total Direct Costs** | **183,801** | **0** | **0** | **183,801** | **257,000** |
| **Indirect Costs** | 81,399 | 0 | 0 | 81,399 | 0 |
| **TOTAL PROJECT COSTS** | **265,200** | **0** | **0** | **265,200** | **257,000** |

# NPRB BUDGET SUMMARY FORM

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT TITLE:** | Ecological impacts of the 2008 Kasatochi eruption. | | | | Annual cost category breakdown for Other Support should be detailed in the budget narrative. |
| **PRINCIPAL INVESTIGATOR:** | S. Jewett, University of Alaska Fairbanks | | | | |
| **FUNDING SOURCE** | **YEAR 1** | **YEAR 2** | **YEAR 3** | **TOTAL** | |
| **NPRB Funding** | 74,380 | 0 | 0 | 74,380 | |
| **Other Support** | | | | 0 | |
| **TOTAL** | 74,380 | 0 | 0 | 74,380 | |

| **Cost Categories** | **NPRB Year 1** | **NPRB Year 2** | **NPRB Year 3** | **NPRB TOTAL** | **Match/In kind TOTAL (all years)** |
|---|---|---|---|---|---|
| **1. Personnel Salaries** | 34891 | | | 34,891 | |
| **2. Personnel Fringe Benefits** | 13,384 | | | 13,384 | |
| **3. Travel (include 1 trip to review mtg in Anchorage each year plus for the year following project conclusion)** | 2,236 | | | 2,236 | |
| **4. Equipment** | 0 | | | 0 | |
| **5. Supplies** | 250 | | | 250 | |
| **6. Contractual/Consultants** | 0 | | | 0 | |
| **7. Other (Include $2000 for education and outreach if not already accounted for in other spending categories)** | 500 | | | 500 | |
| **Total Direct Costs** | **51,261** | **0** | **0** | **51,261** | **0** |
| **Indirect Costs** | 23,119 | | | 23,119 | |
| **TOTAL PROJECT COSTS** | **74,380** | **0** | **0** | **74,380** | **0** |

# NPRB BUDGET SUMMARY FORM - MULTIPLE ORGANIZATIONS

| | | | | | |
|---|---|---|---|---|---|
| **PROJECT TITLE:** | Ecological impacts of the 2008 Kasatochi eruption. | | | | |
| **PRINCIPAL INVESTIGATOR(S):** | S. Jewett, University of Alaska Fairbanks; PI names from 2nd organization - organization affiliation; PI names from 3rd organization - | | | | |
| **FUNDING SOURCE** | **YEAR 1** | **YEAR 2** | **YEAR 3** | **TOTAL** | |
| **NPRB Funding** | #REF! | 0 | 0 | #REF! | |
| **Other Support** | | | | 0 | |
| **TOTAL** | #REF! | 0 | 0 | #REF! | |

Annual cost category breakdown for Other Support should be detailed in the budget narrative.

| Cost Categories | NPRB Year 1 | NPRB Year 2 | NPRB Year 3 | NPRB TOTAL | Match/In kind TOTAL (all years) |
|---|---|---|---|---|---|
| **1. Personnel Salaries** | #REF! | 0 | 0 | #REF! | 0 |
| **2. Personnel Fringe Benefits** | 13,384 | 0 | 0 | 13,384 | 0 |
| **3. Travel (include 1 trip to review mtg in Anchorage each year plus for the year following project conclusion)** | 2,236 | 0 | 0 | 2,236 | 0 |
| **4. Equipment** | 0 | 0 | 0 | 0 | 0 |
| **5. Supplies** | 250 | 0 | 0 | 250 | 0 |
| **6. Contractual/Consultants** | 0 | 0 | 0 | 0 | 0 |
| **7. Other (Include $2000 for education and outreach if not already accounted for in other spending categories)** | 500 | 0 | 0 | 500 | 0 |
| **Total Direct Costs** | **#REF!** | **0** | **0** | **#REF!** | **0** |
| **Indirect Costs** | 23,119 | 0 | 0 | 23,119 | 0 |
| **TOTAL PROJECT COSTS** | **#REF!** | **0** | **0** | **#REF!** | **0** |

**Resume**

**James L. Bodkin**
Project Leader, Research Wildlife Biologist
U.S. Geological Survey, Alaska Science Center
4210 University Drive
Anchorage, Alaska 99508, USA
Phone: 907-786-7164
Fax: 907-786-3636
E-mail: James_Bodkin@usgs.gov

**Education**

1985 - MS, California Polytechnic State University, San Luis Obispo, CA. (Wildlife Biology)
1976 - BS, Long Beach State University (Biology), Long Beach, CA

**Current Activities**

I lead the Alaska sea otter research project and the coastal marine ecosystems team of the Alaska Science Center, US Geological Survey. Research is organized into three programs: 1) Sea otter population assessment, 2) Processes structuring coastal ecosystems and, 3) Effects and status of recovery of the nearshore ecosystem from the 1989 Exxon Valdez oil spill in Prince William Sound. Each of these programs consists of several independent research projects. I supervise and manage all activities associated with this complex and diverse array of research projects internal to the Alaska Science Center and collaborate with at least 14 agencies, academic or private institutions on cooperative, multi-disciplinary projects. I lead a scientific team of six, and manage annual budgets of about $700,000 that include USGS and cyclic funds. The coastal marine ecosystem team programs include research in rocky and soft-sediment nearshore habitats, biological and physical oceanography, seabirds and other marine mammals, marine invertebrates, and marine fishes.

**Selected Publications**

**Bodkin, J.L**., D.H. Monson, and G.G. Esslinger. 2007. Population status and activity budgets derived from time-depth recorders in a diving mammal. J. Wildlife Management 71(6):2034-2044.

Estes, J.A., **J.L. Bodkin**, and M Ben-David. 2008. Marine Otters. In W.F. Perrin, B. Wursig,, J.G.M. Thewissen and C.R. Crumly (eds) Encyclopedia of Marine Mammals, 2nd Edition. Academic Press.

Springer, A.S., S. J. Iverson and **J.L. Bodkin**. 2007. Marine Mammal Populations. Page 352-375, *in* Robert Spies (ed.). Long term ecosystem change in the northern Gulf of Alaska. Elsevier, Amsterdam, the Netherlands.

Iverson, S.J., A.M. Springer, and **J.L. Bodkin.** 2007. Harbor seals, sea lions, and sea otters, fundamental life history characteristics: similarities, differences, and gradations. In Robert Spies (ed.). Ecosystem change in the northern Gulf of Alaska.

**Bodkin, J.L**., G.G. Esslinger and D.H. Monson. 2004. Foraging depths of sea otters and implications to coastal marine communities. Marine Mammal Science 20(2):305-321.

**Bodkin, J.L**., B.E. Ballachey, T.A. Dean, A.K. Fukuyama, S.C. Jewett, L.M. McDonald, D.H.Monson, C.E. O'Clair and G.R. VanBlaricom. 2002. Sea otter population status and the process of recovery from the Exxon Valdez oil spill. Marine Ecology Progress Series. 241:237-253.

Estes, J.A. and **J.L. Bodkin.** 2002. Marine Otters. In W.F. Perrin, B. Wursig,, J.G.M. Thewissen and C.R. Crumly (eds) Encyclopedia of Marine Mammals. Academic Press 843-858.

**Bodkin**, J.L. 2001. Marine Mammals: Sea otters. Pages 2614-2621. in Steele, J. S.Thorpe and K. Turekian (eds.) Encyclopedia of Ocean Sciences. Academic Press, London UK.

**Bodkin, J.L**., A.M. Burdin and D.A. Ryzanov. 2000. Age and sex specific mortality and population structure in sea otters. Marine Mammal Science 16(1):201-219.

Monson, D.H., D.F. Doak, B.E. Ballachey, A. Johnson, and **J.L. Bodkin**. 2000. Long-term impacts of the *Exxon Valdez* oil spill on sea otters, assessed through age-dependent mortality patterns. Proceedings National Academy of Sciences, USA.97(12):6562-6567.

**Collaborators**

Ballachey, Brenda, Alaska Science Center, Anchorage, AK 403-288-9184
Burn, Douglas, US Fish and Wildlife Service, Anchorage, AK, 907-786-3807
Dean, Thomas, Coastal Resources Associates, San Diego, CA 760-603-0612
Esler, Dan, Simon Fraser University, Victoria, B.C. 604-940-4652
Estes, James, University of California, Santa Cruz, CA 831-459-2820
Snyder, Paul, Purdue University, West Lafayette, IN 765-494-9676
Staedler, Michelle, Monterey Bay Aquarium, Monterey, CA 831-648-4976
Tinker, Tim, USGS, University of California, Santa Cruz, 831-459-2357

*Biographical Sketch-**VERNON BYRD***, Alaska Maritime National Wildlife Refuge, 95 Sterling Hwy., Suite 1, Homer, Alaska 99603; 907-235-6546; fax 907-235-7783; vernon_byrd@fws.gov

**PROFESSIONAL PREPARATION**

M.S. Wildlife Biology, University of Idaho, 1989
B.S. Wildlife Management, University of Georgia, 1968

**APPOINTMENTS**

Supervisory Wildlife Biologist, Alaska Maritime National Wildlife Refuge, 1992 to present
Wildlife Biologist, Aleutian Islands Unit, Alaska Maritime National Wildlife Refuge, 1988-1992
Wildlife Biologist, Bering and Chukchi Sea Units, Alaska Maritime National Wildlife Refuge, 1984-1992
Wildlife Biologist, Yukon Delta National Wildlife Refuge, 1980-1984
Wildlife Biologist and Refuge Manager, Hawaiian Islands National Wildlife Refuge 1977-1980
Wildlife Biologist and Refuge Manager, Aleutian Islands National Wildlife Refuge, 1972-1977

**SYNERGISTIC ACTIVITIES**

Instituted and now coordinate seabird monitoring on the far-flung Alaska Maritime National Wildlife Refuge
Organized and led the Endangered Species Recovery Team for Aleutian Canada goose 1975-2001
Member of Hawaiian Waterbird, Kauai Forest Bird, and Steller Sea Lion Recovery Teams
Member of the team that wrote the vision statement for the National Wildlife Refuge System, AFulfilling the Promise@ (1997)
Member of the North American Waterbird Conservation Council

**PROFESSIONAL COLLABORATIONS IN THE PAST FOUR YEARS**

Doug Causey, Univerisity of Alaska Anchorage
Don Croll, Univ. of California, Santa Cruz
Jim Estes, USGS, BRD, Univ. of California, Santa Cruz
Ian Jones, Memorial University, St. Johns, Newfoundland
Daniel Gibson, University of Alaska, Fairbanks
Scott Hatch, USGS, BRD, Alaska Science Center, Anchorage
George Hunt, Univ. of Washington, Seattle
John Piatt, USGS, BRD, Alaska Science Center, Anchorage
Alan Springer, Univ. of Alaska, Fairbanks
William Sydeman, Point Reyes Bird Observatory

**SELECTED PUBLICATIONS**

Byrd, G.V., J.A. Schmutz, and H.M. Renner. 2008. Contrasting population trends of piscivorous seabirds in the Pribilof Islands: A 30-year perspective. Deep Sea Research II. 55: 1846-1855

Byrd, G.V., W.J. Sydeman, H.M.Renner, S. Minobe. 2008. Responses of Piscivorous Seabirds at the Pribilof Islands to Ocean Climate. Deep Sea Research II 55: 1856-1867.

.D.D. Gibson and G.V. Byrd. 2007. Birds of the Aleutian Islands. Series in Ornithology No. 1. Nutall Ornithological Club and American Ornithologists Union.

Major, H.L., I.L. Jones, G.V. Byrd, and J.C. Williams. 2006. Assessing the affects of introduced Norway rats (*Rattus norvigicus*) on survival and productivity of least auklets (*Aethia pusilla*). Auk 123: 681-694.

Byrd, G.V., Renner, H.M., and Renner, M. 2005. Distribution patterns and population trends of breeding seabirds in the Aleutian Islands. Fisheries Oceanography 14: 139-159.

Croll, D.A., J.L. Moran, J.E. Estes, E.M. Danner, and G.V. Byrd. 2005. Introduced predators transform subarctic islands from grasslands to tundra. Science 307:1959-1961.

Ebbert, S.M. and G.V. Byrd. 2002. Management of island invasive species to restore natural biological diversity on Alaska Maritime National Wildlife Refuge. Pages 102-109 *in* Viech, C.R. and M.N. Clout (eds.). Turning the tide: The eradication of Invasive Species. Proceed. of Intern. Symposium on eradication of island invasives. Wellington, N.Z. Occas. Paper of the IUCN Species Survival Comm. No. 27.

G.L. Hunt, Jr. and G.V. Byrd. 1999. Marine bird populations and carrying capacity of the eastern Bering Sea. Pages 631-650 in Loughlin, T.R. and K. Ohtani, eds. Dynamics of the Bering Sea. Univ. of Alaska Sea Grant, AK0SG-99-03, Fairbanks.

Byrd, G.V., R.L. Merrick, J.F. Piatt, and B.L. Norcross. 1997. Seabird, marine mammal, and oceanography coordinated investigations (SMMOCI) near Unimak Pass, Alaska. Pages 351-364 in Forage fishes in marine ecosystems: proceedings of the International Symposium on the role of forage fishes in marine ecosystems. Alaska Sea Grant Program: AK-SG-97-01.

Byrd, G.V., E.P. Bailey, and W. Stahl. 1997. Restoration of island populations of black oystercatchers and pigeon guillemots by removing introduced foxes. Colonial Waterbirds 20:253-260.

Byrd, G.V., C.F. Zeillemaker, and J.L. Trapp. 1994. Removal of introduced foxes: A case study in restoration of native birds. Trans. 59th No. Am. Wildl. and Nat. Resour. Conf. 59:317-321.

Byrd, G.V. 1984. Vascular Vegetation of Buldir Island, Aleutian Islands, Alaska, Compared to Another Aleutian Island. Arctic 37:37-48.

Byrd, G.V., G.J. Divoky, and E.P. Bailey. 1980. Changes in marine bird and mammal populations on an active volcano in Alaska. Murrelet 61:50-62.

**Anthony R. DeGange**
Chief, Biology Office
U.S. Geological Survey, Alaska Science Center
4210 University Drive
Anchorage, Alaska 99508, USA
Phone: 907-786-7046
Fax: 907-786-7021
E-mail: tdegange@usgs.gov

## Education

1976 - MA, University of South Florida, Tampa, FL (Zoology)
1973 - BS, University of Connecticut, Storrs, CT (Natural Resources Management)

### Appointments

1976 – 2005: Various appointments in the U.S. Fish and Wildlife Service in Alaska and California, conducting research on seabirds and marine mammals, management activities related to marine mammals, marine birds and threatened and endangered species, and restoration of freshwater anadromous fish habitats.

2005 – present: Chief, Biology Office, U.S. Geological Survey, Alaska Science Center. I lead a biological research team of about 60-70 employees involved in research on fish and wildlife in Alaska. I am involved in all aspects of managing this office including setting research direction, allocating budgets and hiring staff.

### Selected Publications

Sowls, A.L., **A.R. DeGange**, J.W. Nelson and G.S. Lester. 1980. A catalog of California seabird colonies. U.S. Fish and Wildl. Serv., FWS/OBS-80/37

Ainley, D.G., **A.R. DeGange**, L.L. Jones, and R.J. Beach. 1981. Mortality of seabirds in high-seas salmon gillnets. Fishery Bulletin 79:800-806.

**DeGange, A.R**., and G.A. Sanger. 1987. Marine birds of the Gulf of Alaska. Pgs. 479-524. In D.W. Hood and S. Zimmerman (eds.). The Gulf of Alaskla: physical environment and biological resources. NOAA/MMS, OCS Study MMS 86-0095.

Jones, L.L., and **A.R. DeGange**. 1987. Interactions between seabirds and fisheries in the North Pacific Ocean. Pgs. 269-290. In J. Burger (ed.), Seabirds and other marine vertebrates: competition, predation, and other interactions. Columbia Univ. Press.

**DeGange, A.R**., J.W. Fitzpatrick, J.N. Layne and G.E. Woolfenden. 1989. Numbers of acorns used by Florida scrub jays. Ecology 70: 348-356.

**DeGange, A.R.** , and M.M. Vacca. 1989. Sea otter mortality at Kodiak Island during summer 1987. J. Mammal. 70:836-838.

**DeGange, A.R.**, and R.H. Day. 1990. Mortality of seabirds in the Japanese land-based fishery for salmon. Condor 93:251-258.

Drummer, T., **A.R. DeGange**, L.F. Pank, and L.L. McDonald. 1990. Adjusting for group size influence in line transect sampling. J. Wildl. Manage. 54: 511-514.

Kvitek, R.G., **A.R. DeGange**,and M.K. Beitler. 1991. Paralytic shellfish toxins mediate feeding behavior of sea otters. Limnol. Oceanogr. 36:393-404.

Kvitek, R.G., J.S. Oliver, **A.R. DeGange**, and B.A. Anderson. 1992. Changes in Alaska soft-bottom prey communities along a gradient in sea otter predation. Ecology 73:413-428.

**DeGange, A.R**., R.H. Day, J.E. Takekawa, and V.M. Mendenhall. 1993. Losses of seabirds in gill nets in the North Pacific. Pgs. 204-211, In: K. Vermeer, K. Briggs, K.T. Morgan, and D. Siegel-Causey (eds.). The status, ecology, and conservation of marine birds of the North Pacific. Can. Wildl. Serv. Spec. Publ., Ottawa

**DeGange, A.R**., A.M. Doroff, and D. H. Monson. 1994. Experimental recovery of sea otter carcasses at Kodiak Island, Alaska, following the Exxon Valdez oil spill. Marine Mammal Science 10:492-496.

Doroff, A.M, and **A.R. DeGange**. 1994. Sea otter prey composition and foraging success in the northern Kodiak Archipelago. Fishery Bull. 92:704-710.

Monson, D.H., and **A.R. DeGange**. 1995. Reproduction and survival of sea otters at Kodiak Island, Alaska. Canadian J. Zool. 73:1161-1169.

**Collaborators**

Laverne Smith, U.S. Fish and Wildlife Service
Rosa Meehan, U.S. Fish and Wildlife Service
Eric Taylor, U.S. Fish and Wildlife Service
Robert Blohm, U.S. Fish and Wildlife Service, Seaduck Joint Venture Board
Steve Frenzel, U.S. Geological Survey, Water Resources Division
Carl Markon, U.S. Geological Survey, Geography Division
John Payne, Bureau of Land Management, North Slope Science Initiative

**Resume**

**Stephen Jewett, Ph.D.**

Research Professor and Diving Safety Officer
Institute of Marine Science
School of Fisheries and Ocean Sciences
University of Alaska Fairbanks
Fairbanks, Alaska 99775-1080

jewett@ims.uaf.edu

phone (907) 474-7841
fax (907) 474-7204

Education
B.A. Biology, John Brown University (1971)
M.S. Biology, University of Alaska Fairbanks (1977)
Ph.D. Fisheries, University of Alaska Fairbanks (1997)

Current Positions
1998 – present **Research Professor,** Institute of Marine Science (IMS), University of Alaska Fairbanks (UAF)
1974 - 98 **Research Associate**, IMS/UAF
1988 – present **Diving Safety Officer**, University of Alaska
1973 - 74 **Fishery Biologist**, Alaska Department of Fish and Game

Recent RelevantActivities
1. EPA/EMAP coastal assessment 2005-09: analyses of infauna and epifauna from the Aleutian Islands. I served as Co-PI and coordinated the diving operations. Funded by EPA thru ADEC 2005-09.
2. Investigating ecological change in the nearshore Kotzebue Sound ecosystem: simultaneous application of traditional and scientific ecological knowledge. Co-PI. Funded by NSF 2002-2008.
3. Retrospective analyses of Norton Sound benthic fauna. As Co-PI I am analyzing trawl records for the past 30 years along with environmental variable data. Funded by North Pacific Research Board 2006-2008.
4. Assess radionuclide levels in marine biota around Amchitka Island – Phase I. As Co-PI I coordinated the diving operations. Funded by Department of Energy as part of the CRESP II – 2001-05.

Publications

*Recent/relevant*

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Jewett, S.C., R. Brewer, H. Chenelot, R. Clark, D. Dasher, S. Harper, & M. Hoberg. In Press. Scuba techniques for the Alaska Monitoring and Assessment Program (AKMAP) of the Aleutian Islands, Alaska. Diving for Science 2008. Proceedings of the American Academy of Underwater Sciences 27th Annual Diving Symposium.

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*Other significant*

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Past Collaborators

Ambrose, W. Ph.D., Biology Department, Bates College, Lewiston, ME.

Ben-David, M. Ph.D., Department of Zoology and Physiology, Laramie, WY.

Blundell, G. Ph.D., Alaska Department of Fish and Game, Juneau, AK.

Bodkin, J. USGS, Anchorage, AK.

Burger, J. Ph.D., Div. of Life Sciences, Rutgers U., Piscataway, NJ.

Clough, L. Ph.D., Department of Biology, East Carolina U., Greenville, NC.

Duffy, L. Ph.D., Department of Chemistry and Biochemistry, UAF.

Gochfeld, M. Ph.D., Environmental and Occupational Medicine, UMDNJ-Robert Wood Johnson Medical School, Piscataway, NJ.

Stegeman, J. Ph.D., Biology Department, Woods Hole Oceanographic Institution, Woods Hole, MA.

**Resume**

**Bronwen Wang, Ph.D.**

USGS
Alaska Science Center
4200 University Dr.
Anchorage, AK 99508

bwang@usgs.gov

phone (907) 786-7110
fax (907) 786-7140

Education

| | | |
|---|---|---|
| University of California, Davis | Ph.D. | Agricultural and Environmental Chemistry |
| San Diego State University | M.S. | Chemistry |
| University of California, Davis | B.S. | Chemistry |

Positions

2000 – present **Research Geologist,** United States Geological Survey (USGS), Anchorage, Alaska
1995 - 2000 **Water Quality Specialist**, Water Resources Division, United States Geological Survey (USGS), Anchorage, Alaska
1991 – 1995 **Chemist,** Water Resources Division, United States Geological Survey (USGS), Sacramento, California

Recent Relevant Activities

1. USGS Geochemical Landscapes Project, 2003-Present: Tri-national Soil Geochemical Survey for North America . Coordinated a north-south transect in 2007 and now serve as the Alaska contact. Funded by the USGS Minerals Program.
2. Geologic and Mineral Deposit Data for Alaska Economic Development, 2004-Present. Co-project leader, task leader for the environmental geochemical evaluation of the Taylor Mountain Quadrangle with a focus on organic carbon and mercury dynamics. Funded by the USGS Minerals Program.
3. USGS Tintina Metallogenic Province Integrated Studies on Geologic Framework, Mineral Resources, and Environmental Signatures. 2003-2007. Evaluated metal mobility in soil, water, and vegetation near mineralized area in theYukon-Tananna Uplands. Funded by Minerals program.

## Publications


Gough, L.P., Crock, J.G., Wang, B., Day, W.C., Eberl, D.D., Sanzolone, R.F., and Lamothe, P.J., 2008, Substrate geochemistry and soil development in boreal forest and tundra ecosystems in two regions of Alaska: U.S. Geological Survey Scientific Investigations Report.

Wang, B., Gough, L.P., Wanty, R.B., Crock, J.G., Lee, G.K., Day, W.C., and Vohden, Jim, 2007, Landscape geochemistry near mineralized areas of east-central Tintina Gold Province, in, Gough, L.P. and Day, W.C., eds., Recent U.S. Geological Survey studies in the Tintina Gold Province Alaska, USA, and Yukon Territory, Canada--summary results of a five-year project: U.S. Geological Survey, Scientific Investigations Report 2007-5289.

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Brabets, T.P., Wang, B., Meade, R.H., 2000, Environmental and Hydrologic overview of the Yukon River Basin Alaska and Canada: US Geological Survey Water- Resource Investigations Report 99-4204, 106 p.

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Wang, B., and Burau R.G., 1995, Oxidation of Dimethylselenide by manganese oxide: Oxidation product and factors affecting oxidation rate: ES&T, 1504.


## Past Collaborators

Aiken,G., USGS, Bolder, CO.
Gough, L., USGS, Reston, VA.
Krabbenhoft, D., USGS, Middleton, WI
Michaelson, G. J., Palmer Research Center, University of Alaska Fairbanks, Palmer, AK.
Ping, C. L. Ph.D., Palmer Research Center, University of Alaska Fairbanks, Palmer, AK.
Ridely, I., USGS, Denver, CO.
Taggart, S. J., USGS, Juneau

*Biographical Sketch*-***CHRISTOPHER F. WAYTHOMAS***, U.S. Geological Survey, Alaska Science Center, Alaska Volcano Observatory, 4210 University Drive, Anchorage, AK 99508; 907-786-7122; fax, 907-786-7150; chris@usgs.gov

## PROFESSIONAL PREPARATION

Ph.D. Geology, University of Colorado, 1990
M.S. Geology, Southern Illinois University, 1982
B.S. Geology, Grand Valley State University, 1978

## APPOINTMENTS

Research Geologist, USGS, 1992 to present
USGS-National Research Council Post-Doctoral Scholar, 1990-92

## SYNERGISTIC ACTIVITIES

Member, Alaska Volcano Observatory, 1993-present

Geological studies and hazard evaluations of Aleutian Island volcanoes, 1993-present

Member of AGU, GSA

Chair and Executive Committee Member, IAVCEI Commission on Glacier-Volcano Interactions, 2006-present

## PROFESSIONAL COLLABORATIONS IN THE PAST FOUR YEARS

Philip Watts, Applied Fluids Engineering, Long Beach, CA
James Kirby, University of Delaware
Feng-Yung Shi, University of Delaware
Darrell Kaufman, N. Arizona University, Flagstaff, AZ
Alan Werner, Mt. Holyke College, Holyoke, MA
Chris Nye, Alaska Division of Geological and Geophysical Surveys, Fairbanks, AK
Steve McNutt, Univ. of Alaska-Fairbanks, Geophysical Institute, Fairbanks, AK
Christian Hugel, University of Zurich, Zurich, Switzerland
Jackie Caplan-Auerbach, Western Washington University, Bellingham, WA

## SELECTED PUBLICATIONS

Waythomas, C.F., 1991. Surficial geologic maps of the Sagavanirktok A-1, A-2, and B-2 Quadrangles, Alaska. Alaska Division of Geological and Geophysical Surveys Open-File Report 91-21a, 3 sheets, 1:63,360 scale.
Waythomas, C.F., and Jarrett, RD., 1994. Flood geomorphology of Arthurs Rock Gulch, Colorado: paleoflood history. Geomorphology, v.11, p. 15-40.
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