

# **The Kuril Biocomplexity Project – Second Annual Report: Cumulative for 2005-2007**

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University of Washington

Report for Project Years 1 and 2: September 15, 2005 to June 15, 2007

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## **Activities and Findings:**



### **0. Acknowledgements:**

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## I. General Overview

In the first two years of the Kuril Biocomplexity Project, efforts were divided between building the simulation model structure, planning and conducting the 2006 and 2007 field seasons, and processing data from the 2006 field season. At the date of this annual report the field team has only just returned from the 2007 field expedition, and is preparing for the processing of data from this second research expedition.

Collaborators from the University of Washington (UW) and intermittently from the University of Alaska Fairbanks (UAF) spent four academic quarters (Winter and Spring 2006 and Winter and Spring 2007) working together in seminars and meetings to refine the structure and approach for interdisciplinary modeling simulations, to identify mechanisms for integration of interdisciplinary data, and to develop a more complete understanding of the physical, biological, and cultural parameters relevant to modeling the Kuril Island system. These efforts were critical, not only as steps towards our modeling goals, but also to ensure that the data collected in the field are properly scaled and suitable for the integrative modeling needs of the project. Progress to date on the model construction includes the development of a GIS base map of the Kuril Islands; background research into the ecological dynamics among and between Kuril marine and terrestrial food webs, earth processes (volcanic eruptions, earthquakes, and tsunamis), and climate and ocean conditions; and construction of modules of the simulation. This effort was facilitated by the work of five paid graduate student research assistants and teams of PIs/senior

researchers and students in the context of intensive seminars run during through the UW's Quaternary Research Center and Atmospheric Sciences Department (see Section II – below).

With supplement funding provided by NSF OPP \_ Arctic Research and Logistics, Summer 2006 was spent in the first of three field expeditions to the Kuril Islands. In addition to the ship crew on the Russian ship "Gipanis", this expedition included 21 scientists, 8 graduate students, 4 undergraduate students, a TREC (ARCUS sponsored) middle school teacher and a photographer – 35 project participants in all (see Table 1). This group spent 43 days (July 18 to August 30) visiting the Kuril Islands and conducting archaeological, geological, and paleoecological field investigations on a number of islands from the southernmost end of Kunashir to the northernmost island of Shumshu (a linear distance of 1,140 km). In an effort to maximize the amount of research performed in a limited time frame, teams of archaeologists, geologists, and paleoecologists were deployed in remote field camps for periods of up to two weeks, while the ship took the remaining participants to other sectors of the archipelago for more rapid (1-4 day) scientific surveys. Teams went to shore at approximately 35 locations throughout the archipelago.

Fall 2006 through Spring 2007 were spent processing field samples in the U.S., Russia, and Japan. In the U.S., UW archaeologists and students processed archaeofaunal remains and lithic debitage from archaeological sites, providing information respectively for assessment of paleodiet/ecology and study of tool raw material trade/human mobility. Archaeologists and geologists prepared charcoal samples for radiocarbon analysis of cultural and natural deposits. Geologists and students analyzed tephra for the determination of tephrochronologies and volcanic histories, and they studied other sediments for determination of tsunami histories and land level changes. Palynologists and students analyzed pollen from peat accumulations for estimates of paleovegetation and climate proxy evidence. At the UAF, Dr. Bruce Finney's laboratory processed water samples for geochemical and isotopic calibrations and Dr. Amy Hirons began processing zooarchaeological bone samples from marine mammals for isotopic estimation of marine ecological structure (productivity and trophic compression).

In Russia, collaborating researchers from the Sakhalin Regional Museum processed, analyzed and curated archaeological tools (stone, bone, wood and ceramic artifacts) and modern insect collections for ecological assessment. Participating researchers from the Institute of Marine Geology and Geophysics (IMGG) in Yuzhno-Sakhalinsk analyzed their data on the history of volcanic eruptions and modern plant and insect ecology as related to volcanic geomorphology and related parameters. Partners from the Institute of Volcanology and Seismology (IVS) in Petropavlovsk-Kamchatsky and the Pacific Institute of Geography (PIG) in Vladivostok collaborated with UW researchers on paleo-tsunami histories, tephrochronology and coastal geomorphology. A team at the Near East Interdisciplinary Research Institute (NEISRI) in Magadan developed palynological and ecological results from lake cores in the south, central and northern Kurils with UW collaborators. In Japan, collaborators at the Hokkaido University and Museum contributed analyses of archaeological ceramics generated from ship-board study of collections made during the 2006 field expedition.

On November 15, 2006, a historically unprecedented (for the middle Kurils) Mw 8.3, great thrust-fault earthquake occurred in the Kuril subduction zone offshore of the central Kurils, followed in January 2007 by a Mw 8.1 normal-fault earthquake in the downgoing oceanic crust offshore of the November event.. This pair of earthquakes addressed a vigorous debate about the

tectonic processes affecting this region. The November earthquake triggered a tsunami wave that traveled the Pacific and did minor damage in Crescent City, California, but no near-field observations were made because the central Kurils are unpopulated, and very remote. The January 2007 earthquake produced a smaller tsunami. Because KBP geologists had studied the coastal profiles and paleo-tsunami histories of several locations in the 2006 season, and because affiliated geophysicists had established differential GPS stations and measurement points throughout this region, these unprecedented events opened up an unexpectedly rich research opportunity for KBP geologists and geophysicists to understand the nature of central Kuril seismic events and tsunami behavior as it could have affected people and ecosystems in the past. Because no living person witnessed the effects of the 2006 and 2007 earthquakes and tsunamis in the central Kurils, our post-seismic field research in the summer of 2007 was the best possible means of documenting the seismic slip, tsunami run-up characteristics, flow dynamics, ecological consequences, and archaeological damage caused by this pair of events. Paleo-tsunami studies simultaneously allow us to examine the extent to which these events really are as unique as the historical (written) record would lead one to believe.

Both because of the opportunity to study the effects of the 2006 and 2007 earthquakes and tsunamis and the simple addition of field time at archaeological sites, geological locations, and lake core sites, the summer 2007 field expedition to the Kuril Islands added significantly to the results of the 2006 season. While the NSF supported expedition was shortened by the high cost of the only available research ship ("Iskatel-4") to 28 days (July 18 to August 14), we were able to extend the research value of this work significantly beyond this interval through the gracious support of our collaborators at the Institute of Marine Geology and Geophysics of the Russian Academy of Sciences, Far East Branch (IMGG-FEBRAS). In an effort to better understand the 2006 and 2007 earthquakes and tsunamis, IMGG funded a brief excursion to the central Kurils from July 3 to July 13. During this expedition several of our researchers (Russian and American) traveled to the islands and established working field camps from which they conducted archaeological and geological research until our NSF funded expedition arrived to move them to other field sites. This articulation of two independently-funded research trips gave some of our team members a combined field season of 42 days, equivalent to the duration of the 2006 expedition. This report includes information gathered by field teams deposited by the IMGG funded cruise and retrieved by the NSF funded cruise, but it does not explicitly report on the results of the IMGG cruise itself, as this would be outside of the purview of this report.

With supplement logistics funding again provided by NSF OPP's Arctic Research and Logistics program the KBP project mounted a second ship-based field expedition in the summer of 2007. In addition to the ship crew on the Russian ship "Iskatel-4", the 2007 NSF funded ship-board expedition included 17 scientists, 11 graduate students, 4 undergraduate students, a PolarTREC (ARCUS sponsored) middle school teacher, two boat drivers, and a field cook – 36 project participants in all (see Table 1). This group conducted archaeological, geological, and paleoecological field investigations from the south end of Urup north to Shiashkotan and Ekarma. In an effort to maximize the amount of research performed in a shorter than idea field season, teams of archaeologists, geologists, and paleoecologists were deployed in remote field camps for periods of up to two weeks while the ship took the remaining participants to other sectors of the archipelago for more rapid (1 day) scientific surveys. Teams went to shore at approximately 18 locations throughout the archipelago.

From July 2 to early August, a small team of palynologists based out of the Near East Interdisciplinary Science Research Institute in Magadan, collaborating with UW co-PI Patricia Anderson, conducted palynological and paleoecological research on Kunashir and Iturup Island in the southern Kuril chain. This work was facilitated by the logistical coordination of Igor Samarin, historian at the Sakhalin Regional Museum, and Olga Shubina, an archaeologist regularly employed by the company Sakhalin Energy (but on vacation leave during the work reported here). This land-based excursion was facilitated by commercial ferry transport from Sakhalin Island with local transportation by rented car and truck. This small group succeeded in extracting cores from four additional lakes, complementing the cores made in 2006 from lakes on Urup, Kharimkotan, and southern Paramushir. Collectively, these cores will permit comprehensive analysis of Middle and Late Holocene paleovegetation and proxy climate reconstruction for the Greater Kuril chain ranging from Kunashir to Paramushir. Samarin and Shubina also documented several previously unknown archaeological sites on Kunashir and Iturup during this excursion and have provided a small number (n = 8) of samples to our project for chronological and material analysis.

**Table 1: Field Participants from 2006 and 2007 expeditions, including 2007 land-based palynology/paleoecology expedition.**

Year	Name	Role	Residency	Specialization	Institution <sup>1</sup>
2006	Tetsuya AMANO	Senior Researcher	Japan	Archaeology	HU
2006 2007	Patricia Anderson	co-PI	US	Palynology, Paleoecology	UW
2007	Shelby Anderson	Graduate Student	US	Archaeology	UW
2007	Akira BABA	Post-Doctoral Researcher	Japan	Volcanology, Tephrochronology	HU
2006 2007	Alexander V. Belousov	Researcher	Russia	Volcanology	IO
2006	Dena Berkey	Undergraduate Student	US	Archaeology	UW
2006 2007	Joanne Bourgeois	co-PI, Project Vice-Director	US	Coastal Sedimentology and Seismology	UW
2007	Anestasia V. Bugrei	Field Cook	Russia	cook	SRM
2007	Sergei A. Chirkov	Boat driver/ mechanic	Russia	Coastal Sedimentology and Seismology	IVS
2007	Dmitri A. Chvigian	Graduate Student	Russia	Archaeology	SRM
2006	Jesse Einhorn	Undergraduate Student	US	Coastal Sedimentology	UW
2006	Michael Etnier	Senior Researcher	US	Zoo-	UW

2007				archaeology	
2006 2007	Ben Fitzhugh	PI and Project Director	US	Archaeology	UW
2006 2007	Dmitri I. Frolov	Senior Researcher	Russia	Geophysics/ Seismology	PTI
2007	Kiril S. Ganzai	Graduate Student	Russia	Geological Mapping/ Landscape Ecology	PIG
2006 2007	Vladimir A. Golubtsov	Researcher	Russia	Archaeology	SRM
2006	Paul Hezel	Graduate Student	US	Climate Modeling	UW
2007	Yoshihiro ISHIZUKA	Researcher	Japan	Volcanology, Tephrochronology	GSJ
2006	Kenji ITO	Photographer	Japan	Professional Photography	unaffiliated
2006 2007	Andree A. Kharlamov	Researcher	Russia	Volcanology, Sedimentology, Paleoecology	IO
2006 2007	Andree K. Klitin	Researcher	Russia	Entomologist, Ecologist	SRM
2006 2007	Igor G. Koroteyev	Boat driver/ mechanic	Russia	Engineer	IMGG
2007	Dmitri N. Kozlov	Graduate Student	Russia	Volcanology	IMGG
2006 2007	Ekatarina A. Kravchunovskaya	Graduate Student	Russia	Coastal Sedimentology and Seismology	IVS
2006 2007	Anatoly Lozhkin	Senior Researcher	Russia	Palynology, Paleoecology	NEISRI
2006 2007	Breanyn MacInnes	Graduate Student	US	Coastal Sedimentology and Seismology	UW
2006	Elizabeth Martin	Graduate Student	US	Coastal Sedimentology and Seismology	UW
2006 2007	Pavel Minyuk	Researcher	Russia	Palynology, Paleoecology	NEISRI
2007	Mitsuhiro NAKAGAWA	Senior Researcher	Japan	Volcanology, Tephrochronology	HU
2006	Misty Nikula	TREC/PolarTREC	US	Middle school	Watcom Day

2007		teacher		science teacher	Prep
2006, 2007	Tatiana I. Nyushko	Graduate Student	Russia	botany/ ecology	IMGG
2007	Taku OSAKA	Graduate Student	Japan	Archaeology	MU
2006 2007	Alexander Pakhomov	Researcher	Russia	Palynology, Paleoecology	NEISRI
2006 2007	S. Colby Phillips	Graduate Student	US	Archaeology	UW
2006 2007	Tatiana Pinegina	Researcher	Russia	Coastal Sedimentology and Seismology	IVS
2007	Danielle Plante	Undergraduate Student	US	Archaeology	UW
2006 2007	Nadezhda G. Radzhegayeva	Senior Researcher	Russia	Volcanology, Sedimentology, Paleoecology	PIG
2006 2007	Alexander V. Rybin	Senior Researcher/2007 Expedition Leader	Russia	Volcanology	IMGG
2007	Nicholas Shankle	Undergraduate Student	US	Archaeology	UW
2007	Vladimir Shamraev	Graduate Student	Russia	Palynology	Magadan
2006 2007	Valery O. Shubin	Senior Researcher/2006 Expedition Leader	Russia	Archaeology	SRM
2006 2007	Dmitri V. (Dima) Shubin	Undergraduate Student	Russia	Archaeology	SRM
2006	Marina Shubina	Research Assistant	Russia	Archaeology	SRM
2006 2007	James Taylor	Graduate Student	US	Archaeology	UW
2006	Kaoru TEZUKA	Researcher	Japan	Archaeology & Ethnohistory	HMH
2006 2007	Natasha V. Toropova	Research Assistant	Russia	Archaeology	SRM
2006 2007	Nikolay F. Vasilenko	Senior Researcher	Russia	Geophysics/ Seismology	IMGG
2006 2007	Matthew Walsh	Undergraduate Student	US	Archaeology	UW
2007	Rafael V. Zharkov	Graduate Student	Russia	Volcanology	IMGG
2007	Yana V. Efimova	Medic	Russia	Medic	



1. **UW**= University of Washington, Seattle; **SRM**= Sakhalin Regional Museum, Yuzhno-Sakhalinsk; **IMGG**= Institute of Marine Geology and Geophysics, FEBRAS, Yuzhno-Sakhalinsk; **PIG**= Pacific Institute of Geography, FEBRAS, Vladivostok; **IVS**= Institute of Volcanology and Seismology, FEBRAS, Petropavlovsk-Kamchatsky; **NEISRI**= North East Interdisciplinary Scientific Research Institute, FEBRAS, Magadan; **IO**= Institute of Oceanology, RAS, Moscow; **PTI**= Physico-Technical Institute, RAS, St. Petersburg; **HU**= Hokkaido University, Sapporo; **HMH**= Historical Museum of Hokkaido, Sapporo; **GSJ**= Geological Survey of Japan, Tsukuba; **MU**= Meiji University, Tokyo; **SE**= Sakhalin Energy.





**The following sections detail the specific activities and preliminary results of each research team:**

## **II. SIMULATION MODELING:**

### **TEAM:**

DR. DARRYL J. HOLMAN, CO-PI AND TEAM LEADER  
MEGAN CARNEY, GRADUATE STUDENT  
ADAM FREEBURG, GRADUATE STUDENT  
ELIEZER GURARIE, GRADUATE STUDENT  
HANS NESSE, GRADUATE STUDENT

### **GENERAL OBJECTIVES:**

One major component of the project is the development of an agent-based simulation model that will be used to investigate human population dynamics and ecology over time. The final simulation model will include (1) a geographical grid with initial simulation conditions, (2) an ecological simulator that determines changes in distributions of each biological species from one time period to the next, (3) a climate generator, (4) a geological events generator, and (5) a human agent component.

### **PRIMARY OUTPUT IN YEARS ONE AND TWO:**

Over the past two years, Holman and two graduate students have developed the core of the simulation model. The current version of the program is coded in about 24,000 lines of Pascal. The core program is capable of reading in and manipulating a geographic description of the islands. The grid and initial conditions are exported from ArcGIS as text files and read by the simulation program. Adam Freeburg compiled the basemap coverages for the GIS in Winter 2006. The ecological simulation component has been developed and is currently undergoing testing and validation with fictitious species. Coding for the climate and geological events generators has not started, although some design work has been undertaken. Work on the human agent component has not yet begun.

In support of the modeling initiative, we ran modeling seminars in Winter and Spring 2006 and Winter and Spring 2007 to link the modeling component of this project with the interdisciplinary science and to ensure field data would be appropriately calibrated to the developing model. Each seminar has included a minimum of 12 graduate and undergraduate students as well as the PI and co-PIs. These interdisciplinary sessions provided a context for project scientists and students to work on the integration and data resolution issues critical to successful synthesis and modeling. The success of the modeling depends on shared knowledge across the teams about the nature of input parameters and variables and the kinds of output that are both desirable and necessary for effective model performance. These seminars were very useful venues for project development and will continue throughout the duration of the project.

In the context of these seminars, additional small scale simulations have been developed that help us to work towards a calibrated large scale model. For example, Eli Gurarie and Hans Nesse developed a preliminary model to estimate the vulnerability of sea lion breeding populations to human hunting, using life history/ population data from ongoing sea lion census surveys in the

Kurils (NOAA-NMML, Burkhanov PI). This work showed that individual rookeries could potentially be impacted by small groups of human hunters taking relatively small numbers of animals, though the simulations were also highly sensitive to initial conditions. Similar efforts were engaged to estimate such interactions as the effects on biota of volcanic ashfall, earthquakes, tsunamis, and climate change. Data from the 2006 field expedition were presented in the seminars and used to further tailor model development and to develop hypothetical scenarios for further investigation and modeling.

### III. ARCHAEOLOGY



#### TEAM:

DR. BEN FITZHUGH, PI/PROJECT DIRECTOR AND AMERICAN TEAM LEADER  
DR. VALERY SHUBIN, LOGISTICS DIRECTOR (2006) AND RUSSIAN TEAM LEADER  
DR. TETSUYA AMANO, JAPANESE TEAM LEADER  
DR. MICHAEL ETNIER, ZOOARCHAEOLOGIST  
DR. KAORU TEZUKA, ARCHAEOLOGIST AND ETHNOHISTORIAN  
VOLODYA GOLUBTSOV, ARCHAEOLOGIST  
MARINA I. SHUBINA, ETHNOHISTORIAN  
NATASHA V. TOROPOVA, MUSEUM TECHNICIAN  
  
SHELBY ANDERSON, GRADUATE STUDENT

DENA BERKEY, UNDERGRADUATE STUDENT  
DMITRI CHVIGIAN, GRADUATE STUDENT  
TAKU OSAKA, GRADUATE STUDENT  
COLBY PHILLIPS, GRADUATE STUDENT  
DANI PLANTE, UNDERGRADUATE STUDENT  
NICK SHANKLE, UNDERGRADUATE STUDENT  
DIMA V. SHUBIN, UNDERGRADUATE STUDENT  
JAMES TAYLOR, GRADUATE STUDENT  
MATT WALSH, UNDERGRADUATE STUDENT

In addition to the above participants, we had the help of Misty Nikula (nee Misty Nikula-Ohlsen), a middle-school teacher funded through the TREC (2006) and PolarTREC (2007) programs to promote K-12 scientific education, Paul Hezel, a graduate student in atmospheric sciences program, and Kenji Ito, a professional nature photographer. We interacted with all other teams. We consulted and worked closely together with members of the Coastal Processes team, who described the sedimentological attributes of many stratigraphic sections through archaeological deposits as well as sections and topographic profiles near archaeological sites. We also consulted with other teams to assure agreement in sampling and other field protocols.

**PRIMARY OBJECTIVES IN YEAR 1 FIELD SEASON:**

- 1) to develop a chronological framework for archaeological sites throughout the Kuril Islands;
- 2) to locate, map, and sample archaeological sites throughout the Kurils;
- 3) to collect zooarchaeological materials from these sites;
- 4) to develop an understanding of environmental events and processes that affected human occupation and site preservation through collaboration with geology and paleoecology teams.

**PRIMARY OBJECTIVES IN YEAR 2 FIELD SEASON:**

- 1) to further expand the chronological framework for archaeological sites in the central Kurils
- 2) to locate, map, and sample additional archaeological sites in the central Kurils
- 3) to excavate larger volumes of archaeological deposits at selected sites in the central Kurils for the purpose of expanding samples of zooarchaeological remains, lithic debitage, stone, bone, wood, and ceramic artifacts.
- 4) to further develop an understanding of environmental events and processes that affected human occupation and site preservation through collaboration with geology and paleoecology teams.

**FIELD ORGANIZATION:**

For site survey work, which was the primary field activity in 2006 and a secondary activity in 2007, we typically worked in teams of between two and six researchers scouting for archaeological materials, documenting sites and collecting samples. Site maps were often made using a hand-held (non-differential) GPS receiver to plot the location of house depressions, test excavations, and other site characteristics. In 2007, the primary archaeological research effort was devoted to sampling three archaeological sites, one each on Urup (Ainu Creek), Simushir (Vodapodnaya 2), and Shiashkotan (Drobnyye 1). In 2006, often one or more participants

remained on the ship at any given time to process collections (catalog, clean, and organize samples). In 2007, lab work was done on the ship or in camp as time permitted.

**ARCHAEOLOGICAL NARRATIVE – 2006 AND 2007 COMBINED:**

In the course of the field expedition, 51 archaeological sites were documented, with 28 of these being new discoveries. Documentation included recording site location and size, mapping surface features (e.g., house depressions, artifact scatters, eroding exposures, and abandoned historic period features), and excavating test pits or cleaning off erosion exposures. Excavations of test pits and eroding sections involved recording stratigraphy, and collecting artifacts, faunal material, charcoal, and various sediment samples such as volcanic tephra and dune sand for stratigraphic and luminescence dating, respectively. Photography was used to document interesting aspects of site layout, stratigraphy, and the context of material remains. Video was used occasionally for this purpose as well.

Collections were documented and returned to the ship for cleaning, cataloging and preliminary analysis. Artifacts collected included pottery fragments, stone tools, chips of stone, and occasionally, bone, wood, or iron tools or tool parts. Table 2 summarizes the archaeological collections made by University of Washington and Sakhalin Regional Museum participants in 2006 and 2007.





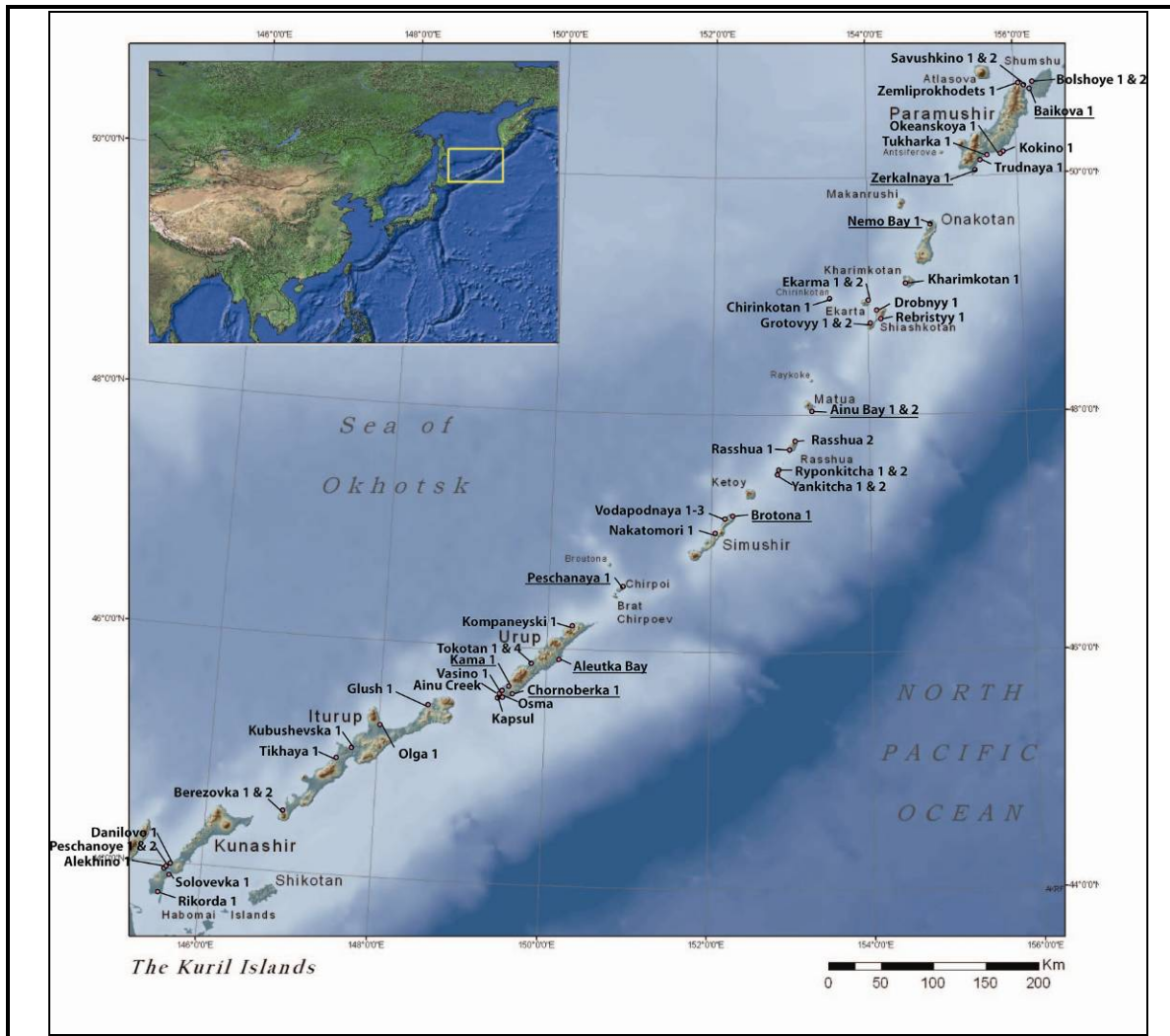


Figure 1: Kuril Island archaeological sites studied in 2006 and 2007 (KBP) as well as those documented in 2000 (International Kuril Island Project, underlined).

Table 2: Archaeological Materials Collected, 2006 and 2007

<i>Material Type</i>	<i>Number of Bags (2006 / 2007)</i>	<i>Repository</i>
Charcoal/Carbon for dating	217 / 261	University of Washington
Chipped stone	171 / 185	University of Washington
Metal	6 / 6	Sakhalin Regional Museum
Miscellaneous Materials	31 / 0	Sakhalin Regional Museum
Pottery	149 / 128	Sakhalin Regional Museum
Stone Tools	117 / 355	Sakhalin Regional Museum
Worked bone/ bone tools	12 / 30*	Sakhalin Regional Museum
Worked Leather	1 / 0	Sakhalin Regional Museum
Worked wood/ wood tools	9 / 9*	Sakhalin Regional Museum
Faunal samples	183 / 212	University of Washington
OSL samples	13 / 0	University of Washington





Ushishir		8/09/07-		
		8/10/07		
Ryponkicha -		8/09/07		X
Ushishir	Ryponkicha 2			
Shiashkotan	Grotovyie 1	8/12/06		
Shiashkotan	Grotovyie 2 (aka, "Beli Ruchey")	8/12/06		
Shiashkotan	Drobnyie 1	8/13/06 –	2.1, 3.2	X
		8/14/06;		
		8/02/07-		
		8/07/07		
Shiashkotan	Rebristyy 1	8/06/07		
Shumshu	Baikova 1	8/18/06	3	X
Shumshu	Bolshoy 1	8/20/06	3.2	X
Simushir	Vodopadnaya 1	8/06/06		
Simushir	Vodopadnaya 3	8/06/06		
Simushir	Vodopadnaya 2	8/05/06-	2, 3.2	X
		8/06/06;		
		7/23/07-		
		7/31/07		
Simushir	Nakatomori 1	7/28/07	5?	X
Urup	Ainu Creek	7/25/06,	2, 2.1, 3, 3.2	X
		7/31/06 –		
		8/01/06		
Urup	Fastritsa	8/13/06		
Urup	Kapsul	7/22/06	3.2	X
Urup	Kompaneski	8/03/06		
Urup	Osma	7/31/06		
Urup	Tokotan 1	8/02/06		
Urup	Tokotan 4	8/02/06	3.2	X
Urup	Vasino 1	7/31/06		X
Yankicha -	Yankicha 1	8/10/06	5	
Ushishir				
Yankicha -	Yankicha 2	8/10/07		
Ushishir				
TOTAL	51			

<sup>1</sup>. Codes from Table 3.

**Chronological Results:** Preliminary conclusions are possible based on analysis from the 2006 field season, supplemented by field observations in 2007 and the earlier results of the International Kuril Island Project (IKIP) survey in 2000 (Fitzhugh et al. 2002). From an initial analysis of the pottery collected during the 2006 expedition as well as house forms and other information, we can estimate the extent and intensity of past human occupation along the chain. The culture history of the Kurils is broken into several periods and sub-periods (phases) based on similarity of pottery styles and other traits with the prehistory of Hokkaido. In general, no significant northern cultural influence is observed south of northern Paramushir and Shumshu until the Russian exploration of the 18<sup>th</sup> century. Known occupation extends back to the Late Jomon phase roughly 5000 bp and possibly as early as 7000 bp (Fitzhugh et al. 2002). Subsequent

occupation is known in the Epi-Jomon, Okhotsk, Ainu, and Historic periods (Table 4). Figure 2 summarizes the results of radiocarbon analysis of archaeological deposits and provides a more quantitative, but preliminary, picture of the settlement history and demographic trends.

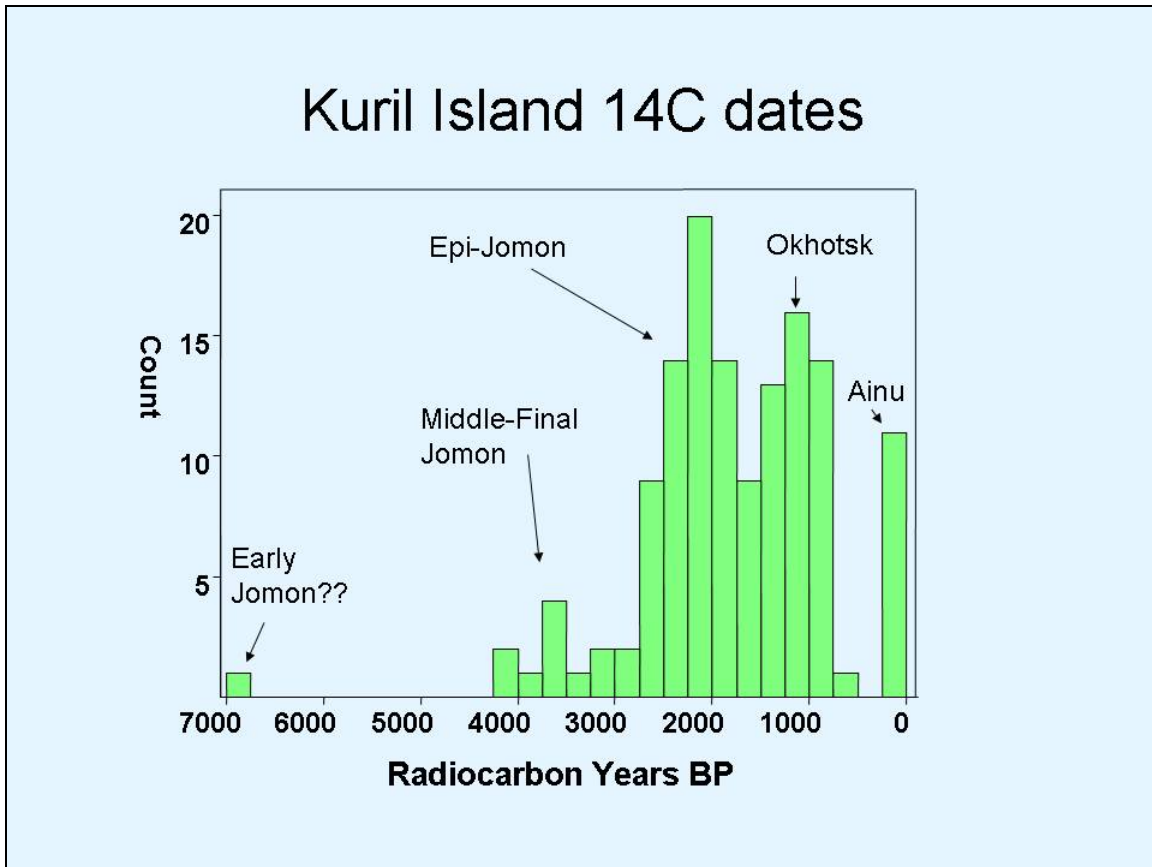


Figure 2: Histogram of uncalibrated radiocarbon dates of archaeological components in the Kuril Islands. Data combined from Fitzhugh et al. 2002 and unpublished dates from the KBP 2006 expedition.

Table 4: Culture history periods of the Kuril Islands

PERIOD	PHASE*	CODE (FOR TABLE 3)	AGE RANGES (APPROX)**
20 <sup>th</sup> Century		5	0-95 BP
Ainu/ (Russian/Japanese)		4	55-700/ (100-200) BP
Okhotsk		3	800-1,300
	Late	3.3	
	Middle	3.2	
Epi-Jomon		2	1,300-2,000
	Late	2.2	
	Early	2.1	
Jomon		1	2,000-7,000 (+/-)
	Late	1.4	

\* Only listing phases currently documented for the Kurils.

\*\* Period dates are rough estimates. Phase dates not given as these are still being worked out in the current project.

As expected the Kuril Biocomplexity Project documented occupations of all of these periods. Unexpected was the overwhelming number and scale of Epi-Jomon settlements stretching from Kunashir to Shiashkotan and perhaps onto Paramushir. Our working model led us to expect an increasing human presence on the islands with time, but it currently appears that the Epi-Jomon were one of the most successful and enduring settlers in the chain. Pottery types and radiocarbon date frequencies (Figure 2) suggest that the Epi-Jomon occupation was concentrated during the Early Epi-Jomon phase, leading us to hypothesize that some factor in climate and environment may have rendered the archipelago less attractive in the subsequent phases.

The Okhotsk period occupation was also substantial and appears to be concentrated primarily in the Middle Okhotsk phase. Although Okhotsk sites are known from Kunashir, we identified only one possible Okhotsk pottery fragment in our brief investigations on this island in 2006. Early 20<sup>th</sup> century Japanese reports note several Okhotsk sites in the southern islands, especially on Iturup (Chard 1960) where we also found Okhotsk deposits. By contrast, our more extensive research in the central and northern archipelago found numerous examples of Okhotsk occupation, including sites on Simushir, Ryponkicha (Ushishir), Rasshua, Shiashkotan, Chirinkotan, and Shumshu. These results confirm that the Okhotsk were indeed successful colonists of the central and northern islands. Some members of our team have considered the possibility that the northern manifestation of Okhotsk-like material may be derived from the Northern Okhotsk sea coast, arriving to the Kurils from the Kamchatka Peninsula, and not Hokkaido. This idea deserves more careful study, but our preliminary analyses, especially after the 2007 excavations at the Drobnyye 1 site on Shiashkotan, suggest that even the occupations in the north-central islands are marked by variants of Hokkaido and southern Sakhalin Middle Okhotsk style pottery. At present there is no known archaeological manifestations of “Okhotsk-like” ceramics present on the Kamchatka Peninsula that could bridge the northern Kuril occupations of Okhotsk age and character with the related cultural assemblages from the western Sea of Okhotsk. By contrast there is a more or less continuous archaeological record of Okhotsk ceramic styles from the Amur Delta through Sakhalin, and across northern and eastern Hokkaido to the Kurils, making this path the more likely cultural affiliation for the Kurils (Amano REF).

Of particular surprise to the archaeology team was the scarcity of evidence of Ainu occupations throughout the Kurils. Ethnohistoric documentation (Krashenenikov 1972) and earlier archaeological study (Baba 1934, 1935, 1937, 1939; Baba and Oka 1938), indicate a significant, if not abundant, record of Ainu occupation in the islands from Kunashir to Paramushir and Shumshu - with the possibility of admixture with Kamchatka Ite'emen in the Northern settlements on Shumshu (Krashenenikov 1972). Our survey in 2006 identified only one site with Ainu pottery, which typically has interior lugged handles mimicking iron pot styles from Japan. That site was on Matua (Ainu Bay 1 site). A similar but as yet unconfirmed “Ainu” occupation was inferred from a 2007 investigation on southern Rasshua (Rasshua 1) in the location indicated by the 19<sup>th</sup> century commercial fur hunter, Captain Snow, to support an abandoned village (Snow 1897). In addition we documented two sites with ‘moated’ or ‘ring-ditch’ pit houses, one on Simushir (Vodopadnaya 3 site), and at least one on Shiashkotan (Drobnyye 1) that Amano suggested might be Ainu features. Prior research in 2000 by the International Kuril Island Project (IKIP) also documented Ainu housepits on Chirpoi (Peschanaya 1) and southern Paramushir (Zerkalnaya 1). Radiocarbon dates also reinforce other evidence of late Ainu occupation on Chirpoi, Matua, and Paramushir (Fitzhugh et al. 2004). The relative lack of archaeologically visible Ainu settlements is reinforced by the radiocarbon dates presented in Figure 2. Sampling

procedures for selecting samples for these dates should have revealed more Ainu period dates, were the Ainu sites as frequent as their predecessors in the chain.

There are several possible explanations for the low visibility of Ainu sites throughout the Kurils. There may have been very few Ainu in the Kurils, and their occupation may have been concentrated in a few locations, perhaps restricted to very late in the Ainu period, as suggested by the radiocarbon dates. This interpretation is consistent with ethnohistoric notes referring to relatively low population densities in the Kurils, but the inference of a dearth of earlier Ainu settlement would seem at odds with the reported differentiation of the Kuril Ainu into two distinct dialect groups in the northern and southern islands, respectively (Krashenenikov 1972). Minimally we know from ethnohistoric accounts in the 18<sup>th</sup> and 19<sup>th</sup> centuries that Ainu had settlements on Kunashir, Iturup, Urup, Chirpoi (seasonally), Simushir, Rasshua (probably), Shiashkotan, Kharimkotan, Onekotan, Paramushir and Shumshu. At least one of these settlements was reportedly destroyed by a volcanic eruption on northern Shiashkotan that buried the village under a pyroclastic debris flow (Gorshkov 1967).

Other possible explanations for the observed dearth of Ainu archaeological remains might include differences in the nature of Ainu lifeways relative to the preceding culture groups. For example, the Ainu living in this region may have been more mobile than preceding groups during much of the year. When not in a few fixed settlements they may have left little archaeological record of their seasonal camps. It is also likely that the diagnostic attributes of Ainu occupation are relatively less frequent than those of the Jomon, EpiJomon and Okhotsk, leading Ainu material unidentified more often than the materials of earlier groups. For example, Ainu pottery is typically undecorated, with the primary unique attribute being the internal suspension lugs. As these occupy a relatively small portion of any pot, the resulting pottery assemblages are dominated by undecorated and non-diagnostic fragments. Earlier culture groups tended to decorate many of their pots across the exterior surfaces of the entire vessel, leaving a much more visible record. This is particularly true for the ceramics from the Jomon/Epi-Jomon period, which are often cord-marked on the exterior surfaces of vessels. House structures may have differed, as well. For example, the Ainu in Hokkaido are well known for having lived in above ground wooden structures, which leave less visible traces on site surfaces. While trees would have been scarce and structural building materials limited to drift wood in much of the Kurils (at least north of Urup), it is possible that some Ainu houses were nevertheless above ground features, reducing their archaeological visibility. Ethnohistoric reports, however, only identify semi-subterranean dwellings among the Kuril Ainu (Krashenenikov 1972; Snow 1897)

Historic sites observed during the 2006 and 2007 expeditions were primarily noted as Japanese and Soviet military installations and features from World War II and the Cold War era. We did not focus our attention on documenting these installations, but it is worth noting that military trenches, bunkers, and gun emplacements were a very common feature on the coastal landscape. It is rare to find an archaeological site from an earlier era that was not impacted to one degree or another by these WWII defensive features. Post-war, Soviet border-guard stations were positioned strategically throughout the chain and were also quite destructive of archaeological deposits in their footprints. However, the nature of the Soviet and subsequent Russian occupation left a less widespread or extensive overlay on the older archaeological patterns compared to WWII trenching and bunkering activities.

***Collections and Excavation Summary:*** Our archaeological collection strategy focuses on pottery, lithics, and other tools (under analysis and curation at the Sakhalin Regional Museum), chipped stone waste flakes, charcoal, and faunal materials (under analysis at the University of Washington). Pottery was used for the culture historical analysis already discussed and may also be subject to functional and technological analyses and as a material for luminescence dating in the future. An international team is currently assembling a project to study ceramic material culture, technology, and archaeometry of the Russian Far East, including the Kurils and surrounding regions. This team will include participants of the KBP and others from England, Russia, and the U.S. and will utilize the ceramic collections created by the KBP and other projects.

Stone tools including a number of projectile points and knives, scrapers, cores, and utilized flakes were collected and curated at the Sakhalin Museum in both 2006 and 2007. While there are currently few culturally diagnostic stone tool forms for the Kurils, further lithic analysis in conjunction with the radiocarbon dating of artifact-bearing stratigraphic layers may yield data that is useful for developing tool typologies for the region. Lithic raw materials represented among the stone tools and waste flakes include obsidian, basalt, and a variety of red, orange, yellow, beige to pink, and grey cherts. While obsidian sources in the Kuril Islands are not well known, the volcanology teams have documented outcrops of low-quality obsidian on Ketoy Island in the central Kurils and on Simushir (Zavaritski Caldera) that we hope will provide distinct mineralogical/ chemical signatures for sourcing studies of the archaeological obsidian, along with known sources from Kamchatka and Hokkaido. Initial samples of obsidian flakes are currently in analysis at the Smithsonian Nuclear Physics laboratory for XRF analysis by Dr. Jeff Speakman to relate archaeological obsidian to known sources and evaluate the possibility of as yet unknown obsidian sources. Multiple colors of radiolarian chert were also seen in natural beach gravels in a variety of locations throughout the islands, and we now believe these materials may not be useful for point-sourcing. The chipped stone waste flakes were brought back to the University of Washington where we began analysis in the Spring 2007. Results are pending continued analysis of these materials.

Organic tools were rarely encountered, but where organic preservation was particularly good, we did find both bone and wood tools. The southern end of Urup Island was particularly productive in this regard with the sites of Ainu Creek and Kapsul yielding one or more bone and wood implements in 2006. Further work was conducted at Ainu Creek in 2007 to learn more about this phenomenal site.

At Ainu Creek, a team of Russian, Japanese and American archaeologists worked for several days in 2006 exposing and mapping a deeply stratified Epi-Jomon and Okhotsk midden and other areas of the site. Organic materials recovered from this excavation include a wooden spoon and several bone harpoon tips. For 16 days in early July 2007, prior to the official start of the KBP expedition, an archaeological crew of five Russians and one American excavated a section of this site that was damaged or at risk of destruction from road development by a mining company active in the area. This salvage excavation cleared some 20 m<sup>2</sup> of cultural deposit down to culturally sterile strata. About half of this sediment was pushed out of primary context by road construction. They also excavated the disturbed deposit above intact cultural material across another 10 m<sup>2</sup>. The entire excavated deposit was about 100 cm deep with Okhotsk and Epi-Jomon layers full of bone and shell midden, as well as exquisite wood and bone artifacts. The thickness of the disturbed deposit on top appeared to be roughly 50 cm deep, with deeper disturbance on the downhill portion of the road (units A4, A5, B4, B5, V4, and V5). Conditions

were not ideal for careful stratigraphic excavations, and the matrix was excavated by somewhat arbitrary (and non-systematic) levels (each more or less 30 cm thick). Nevertheless, preliminary ceramic analysis conducted at the Sakhalin Regional Museum at the end of the field season suggests that the top and most disturbed level (1) is predominantly Okhotsk in character, while the bottom level (3) is mostly Epi-Jomon. As expected with any excavation conducted in arbitrary levels, the level that bisects two occupation strata (in this case predominantly Level 2), tends to be a mixture of the two occupations (Okhotsk and Epi-Jomon). This crude characteristic gives us some confidence that the fauna and lithics collected can be used effectively for KBP research. In particular, we expect to make careful use of the samples from the less mixed levels (Levels 1 and 3).

At Kapsul Cape, a midden excavation in 2006 turned up a barbed bone harpoon point reminiscent of Aleut and Alutiiq types. It is possible that this point was deposited during the Russian American occupation, when Alutiiq and Aleut sea otter hunters were transplanted to Urup Island (esp. Aleutka Bay about 70 km north on the Pacific side of the island; Shubin 1994). On Simushir, at the site of Vodopadnaya 2, an excavation in 2006 (Test Pit 3, or TP3) yielded a rich midden deposit with pottery and a unique engraved bone disk (probably a spindle whorl). One face of the disk was engraved with concentric circles, some with perpendicular hatch marks. In 2007, we spent nine days at this site, and excavated an additional 12 m<sup>2</sup> at Vodapodnaya 2, adjacent to TP3. Our goal was to enlarge our 2006 faunal sample but we found that the sea urchin and bone midden found in TP3 was a highly localized deposit. Despite this we did retrieve a good additional sample of fauna from the deposit identified in 2006. Beyond this small area of midden, our Vodapodnaya 2 excavation did not have yield good organic preservation, but we recovered an excellent sample of ceramics, lithic tools and flakes, charcoal and tephra samples. We were also able to gather additional information on the depositional history and formation processes of this portion of the Vodapodnaya 2 site. In addition we made a more detailed map of the surface features (i.e., house pits) of this large site and collected charcoal from cores into house floor deposits from many house pits. This will allow us to conduct radiocarbon analyses of the settlement history across the entire site, not just in the excavated portion. This practice was repeated at the Drobnyye 1 site on Shiashkotan and the Ryponkicha 1 site on northern Ryponkicha.

***Archaeofauna:*** The 2006 field season was successful in recovering faunal samples from a number of sites throughout the island chain. Specifically, 20 of 41 sites yielded fauna, with a total of 183 samples. Samples ranged in size from a single piece of bone to thousands of pieces of shell, fish bone, bird bone, and mammal bone (primarily, but not exclusively, from sea mammals). Even so, we were initially concerned about the potential to locate good fauna-bearing archaeological sites. As it turned out the slow beginning was due, in large part, to the nature of the sites we visited at the beginning of the field season. Many of the first sites we visited were heavily eroded sand dune sites, with little or no buried component. These sites were characterized by extremely poor faunal preservation. However, as the season progressed, greater effort was put into investigating buried sites that were more likely to have faunal remains preserved, with greater success.

The 2007 field season was also successful in recovering fauna, although once again we were frustrated by the difficulty of locating good midden deposits. The most useful technique was to probe the ground around house pits with a 1-inch bore soil probe, which would occasionally intersect shell or bone, indicating a pocket of preserved organic materials. Nevertheless, hours of probing at the Vodapodnaya 2 and Drobnyye 1 sites to identify well preserved middens for



sampling was only partially successful. We were able to expand our faunal sample from Vodapodnaya 2 in 2007 only by returning to the location tested successfully in 2006. At Drobnyye 1, the soil probe helped isolate a location of potential preservation after dozens of unpromising tests, and one test excavation (Unit 2) did end up generating a good sample of Okhotsk period fauna.

Currently the best faunal preservation has been found at Ainu Creek and Kapsul on southern Urup and at Bolshoy 2 and Baikova 1 on Shumshu. Sites identified on Chirinkotan (2007) and Kharimkotan (2006) may also have better than average faunal preservation, although this remains to be fully investigated. One contributing factor to this pattern of poor preservation appears to be a general low diversity and abundance of shellfish, whose shells are often critical to buffering the damaging effects of acidic volcanic soils. Despite the generally poor state of faunal preservation, we did generate reasonable samples of fauna from Ainu Creek, Kapsul, Vodapodnaya 2, Drobnyye 1, Baikova 1, and Bolshoy 2 over the past two field seasons. The samples from Ainu Creek, Baikova 1, and Bolshoy 2 include both Epi-Jomon and Okhotsk deposits, while most of the other fauna recovered appear limited to the Okhotsk period. The Ainu Creek preservation may be attributed to a unique mineral solution filtered through the deposit from the underlying bedrock. A blue mineral was found adhering to much of the matrix – and archaeological materials - in the lower levels of the excavation at this site. We believe the mineral is a copper precipitate, which acts as a fungicide and often delays organic deterioration. We will analyze samples of the precipitate in Fall 2007 to determine its identity, origin, and possible contribution to the uniquely preserved nature of the Ainu Creek site.

Because the 2006 field season was primarily designed to be extensive, rather than intensive, field recovery techniques for fauna were typically limited to hand-sorting of sediment with occasional use of 1/4" (3.2 mm) mesh hardware cloth. In some cases, the nature of the faunal deposit dictated that 1/8" (6.4 mm) mesh hardware cloth be used. Finally, some faunal deposits were so densely packed with shell and bone that the most efficient means of sampling was to bring bulk samples back to be screened and sorted in the lab, either ship-board or at UW.

In 2007, at Vodapodnaya 2, we settled on a procedure of water screening 25% of the excavation (one bucket out of each 4 removed) in 1/8 inch (3.2 mm) mesh screen. Initial attempts to dry screen the other 75% in 1/4 inch (6.4 mm) mesh were abandoned when it was found to add relatively little to our collection and slowed work down considerably. Midden deposits were either bulk sampled or wet screened in their entirety, as was the floor matrix of a small section of house floor excavated in Unit 4.

The 2006-2007 lab analysis focused primarily on general identifications of faunal remains. Preliminary results indicate that for mammals, harbor seal, sea otter, and Steller sea lion are ubiquitous. Shellfish are dominated by marine gastropods such as whelks and periwinkles. Birds consist primarily of various species of auklets, with low frequencies of sea eagle and albatross. Fish consist of salmon, cod, and halibut, with low frequencies of a large shark species, probably salmon shark. Preliminary analyses of the mammal fauna and radiocarbon dates were presented at the Society for American Archaeology annual meeting in Austin, Te in April 2007.

With few exceptions, the species represented in the faunal samples are locally common in the Kurils today. In that regard, the faunal data we have thus far provided few surprises. Subsequent analyses of the 2006 samples, along with increased sample sizes from 2007 and 2008

field seasons will establish, age and sex composition, differential body-part representation of selected species, metrics for examining degrees of resource depression, isotopic analyses to detect marine productivity and trophic complexity, and the potential of discovering the bones of currently extinct fauna (e.g., Japanese sea lion, *Zalophus japonicus*). These derived data will be used to evaluate the hypotheses that the ancient distributions of the resource species were significantly affected by changes in climate or as a consequence of human predation pressure.

#### SUB-REPORT ON THE KBP 2006 FAUNAL ANALYSIS



##### 1. Current status of analyses:

The analysis of the faunal remains recovered in the 2006 KBP field season is progressing well. The primary accomplishments of the analysis thus far have been to

- clean and dry all samples
- sort samples by Class (mollusk, fish, bird, mammal)
- individually label identifiable bone specimens, each with a unique catalog number
- identify all mammalian remains from selected sites
- identify selected bird and fish remains opportunistically

Identification of mollusks, fish, and birds has not been systematic, but a few identifications have been made. Full analysis of these Classes will in the 2007-2008 academic year.

As of May 2007, nearly 2000 hours of work has been expended in the lab. The bulk of this work was expended in cleaning, drying, sorting, and labeling the samples, or in supervising/directing these activities. A total of 181<sup>1</sup> faunal samples were fully processed in the lab, with

approximately 3600 individual pieces of bone cleaned, sorted, and labeled. This count does not include ~1000 gastropod [snail] shells, which will not be individually labeled.

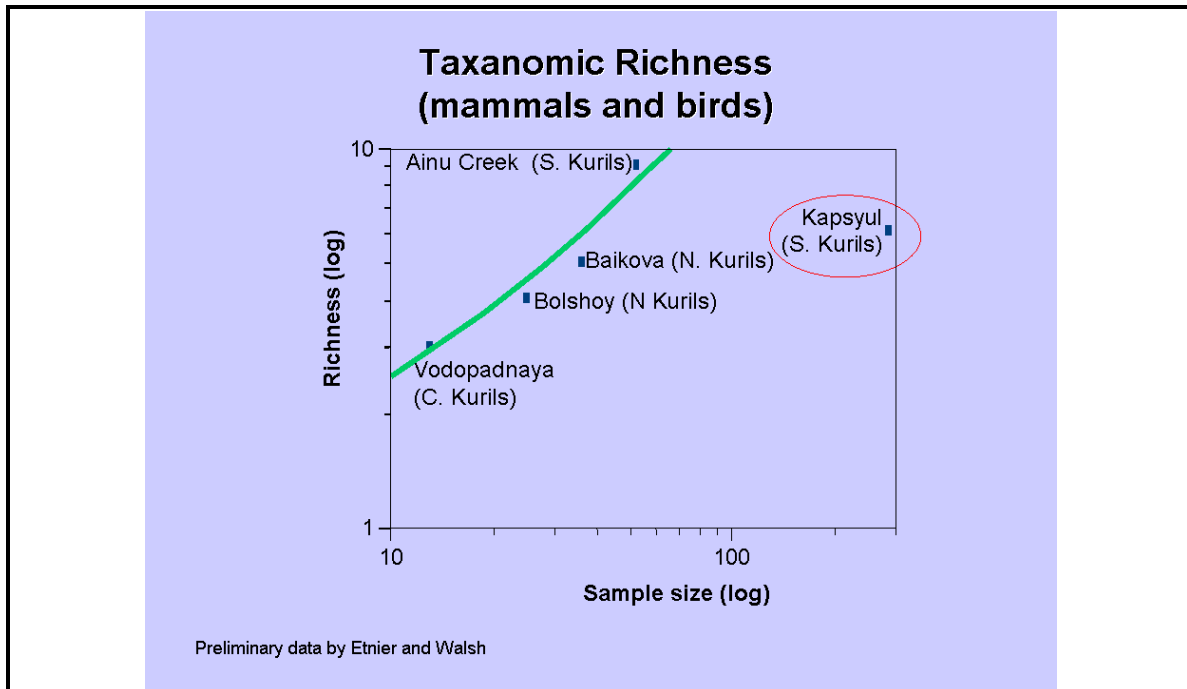
Thus far, only the mammalian remains from Ainu Creek, Kapsul, Vodopadnaya, Ryponkicha, Yankicha, Bolshoy, and Baikova have been systematically identified, resulting in an NISP (number of identified specimens) of approximately 700. Of the remaining ~2900 pieces of bone (primarily bird and fish), approximately 1000 of these should be identifiable beyond Class. Other classes besides mammals have been rough sorted, allowing for general and provisional conclusions.

## *2. Preliminary results*

Some preliminary patterns are evidence in the faunal data, despite the unfinished nature of the analyses. First, taxonomic richness (combined marine mammal and birds) suggests that an expected relationship between the faunal diversity and the relative insularity of the different islands (Table 5; Figure 3). Vodopadnaya 2 on Simushir has the lowest richness compared to the sites from the southern and northern islands. A plot of richness against sample size however, leads us suspect that the richness (diversity) numbers could be largely a function of sample sizes, with the exception of Kapsyul. Larger samples will make it possible to better isolate geographic patterns in faunal variation and the expanded Vodapodnaya 2 samples from 2007 will prove directly relevant to the question of sample size bias. Kapsyul has a very low diversity of fauna considering its very large sample size. This pattern is driven largely by a high frequency of sea otter parts (50%). The late radiocarbon date and possible Aleut barbed-bone projectile found at this site suggest that this may have been an extraction location for commercial sea mammal harvesting by Russian American Company workers. This could explain the unusually high proportion of sea otters remains.

**Table 5: Faunal diversity by site and sample size (2006).**

<b>Site Name</b>	<b>Richness (# taxa)</b>	<b>Sample size (N)</b>
Ainu Creek	12	65
Baikova 1	7	75
Bolshoy 2	6	34
Kapsyul	9	493
Kubushevskaya 1	2	4
Vodapodnaya 2	2	15
Yankicha 1	3	20



**Figure 3: Log-log plot of faunal richness, indicating that sample richness is likely a function of sample size in this collection, with the clear exception of Kapsyul, which is much lower in diversity than expected for its large sample size.**

Analysis of marine mammal remains suggests the relative importance of fur seal/sea lions, sea otter, and harbor seal in various sites of the chain. Kapsyul is unusual in its high frequency of sea otter bones, as discussed above. Baikova 1 also distinguishes itself as a major sea otter producer, however, in this case the site was about 1000 years too old to be a Russian company settlement. Interestingly Ainu Creek, just a few miles around the corner of Urup from Kapyul Cape, is almost devoid of sea otter remains. This difference is probably due to local biogeographical variation. According to Snow (1897), sea otters prefer the Pacific side of the archipelago and, during the late 19<sup>th</sup> century at least, were rarely seen in numbers on the Okhotsk sea side.

#### IV. COASTAL PROCESSES GEOLOGY



**TEAM:**

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DR. TATIANA K. PINEGINA, TEAM LEADER

DR. NADEZHDA RAZHEGAEVA, TEAM LEADER

M. ELIZABETH MARTIN, GRADUATE STUDENT

BREANNYN MACINNES, GRADUATE STUDENT

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JESSE EINHORN, UNDERGRADUATE STUDENT

DENA BERKEY, UNDERGRADUATE STUDENT

BRET BUSKIRK, UNDERGRADUATE STUDENT

AMY TICE, UNDERGRADUATE STUDENT

ANDREI KHARLAMOV, SCIENTIFIC ASSISTANT

SERGEI CHIRKOV, SCIENTIFIC ASSISTANT

In 2007, a subset of our team [Bourgeois, Pinegina, Razhegaeva, MacInnes, Kravchunovskaya, Ganzei, Kharlamov, Chirkov] participated in a pre-KBP cruise sponsored by the Institute of Marine Geology and Geophysics, 3-13 July. This expedition visited southern Urup, northern Urup [GPS only], Simushir and Ketoi. All members of our team remained in the middle Kurils

between the two expeditions and collected data on Simushir Island. This expedition focused on GPS and tsunami observations, and we are writing a joint report of our tsunami findings, the lead IMGG scientists being Boris Levin [director] and Victor Kaistrenko [Head, Tsunami laboratory]. We are also collaborating with Mikhail Nosov, a tsunami modeler from Moscow State University.

In addition, on the KPB expedition, we consulted in particular in the field (and on ship) with Drs. Nakagawa and Ishizuka, and other members of the Russian Volcanology team with regard to tephra stratigraphy. We have consulted extra-field with other experts on the geological history of the Kuril Islands outside of our KPB group, particularly with Dr. Vera Ponomareva.

We have also had the help of Misty Nikula[-Ohlsen], resident middle-school teacher, and we interact with all other teams. We have provided to other teams some basic training in geological techniques, and also consult with other teams to assure consistency in sampling and other protocols.

#### **GOALS:**

Our primary objectives in the first field season were geological reconnaissance, and assisting other teams in understanding the geological histories of their sites. In the second season, we conducted more detailed studies in the middle Kuril Islands, and as noted in the introduction, we focused also on the effects of the November 2006 [and January 2007] middle Kurils earthquakes and tsunamis. In particular our aims for this first stage of the KPB have been

- 1) to develop a tephrochronological framework for (relevant sites in) the Kuril Islands;
- 2) to develop a paleoseismological framework for the same, including earthquake and tsunami history; and
- 3) to develop a coastal and relevant geological history of studied sites.

#### **FIELD ORGANIZATION:**

Typically we are divided into three different kinds of groups or teams:

- 1) a geological group developing framework information;
- 2) one or more geologists working directly with archaeologists on their excavations; and
- 3) a geological group working on-site with paleoecology camps.

#### **FIELD OUTPUT:**

Our primary field output completed in the first year included:

- 1) 170 described sections, most already drawn to scale – about half of our geological sections are tied directly to archaeological site information and test pits, including tentative correlations of tephra and other marker layers
- 2) 625 samples organized and catalogued [divided between Bourgeois and Pinegina; Razhegaeva's samples are not included in this number but we have noted them on drawn sections]
  - a. tephra (volcanic ash) samples [303 samples to UW]
  - b. charcoal samples for radiocarbon dating—turned over to a combined collection with archaeological samples [see Table 2]
  - c. peat samples for paleoecological analysis and radiocarbon dating—split amongst Razhegaeva, Bourgeois and Pinegina [100 samples to UW]
  - d. sand and other sediment samples for evaluation of origin (e.g., diatom analysis for tsunami deposits) [52 samples to UW]



- 3) about 20 measured profiles (not including simple beach profiles), tied to excavations and outcrops, already entered as spreadsheets, calculated and plotted
- 4) notes on geomorphology, especially marine terraces and coastal morphology
- 5) notes on vegetation distribution, including a comparison of landsat-interpreted data [student project of Jesse Einhorn]

Our primary field output completed in the second year included:

- 1) More than 100 surface profiles, focusing on tsunami runup from 2006; inundation line mapped in detail in four bays [Dushnaya, Sarychevo, South Bay, Ainu Bay].
- 2) Measurements of tsunami erosion and deposition, and other tsunami effects, on most profiles.
- 3) Modern tsunami deposits systematically sampled from 15 profiles. [about 200 samples]
- 4) 63 described sections, not yet including Razhegaeva's
- 5) Paleotsunami deposits sampled at several localities, particularly in Dushnaya Bay.
- 6) Tephra described and sampled, particularly from key peat sections [about 200 samples, not including Razhegaeva's]

#### **ACTIVITIES BETWEEN FIELD SEASONS 1 AND 2:**

In the 2006-2007 academic year, we:

- 1) Cleaned all 2006 tephra samples and identified key samples, we have made our sections available to other team members and offered to share samples.
- 2) Analyzed key tephra samples
  - a. Petrographically –descriptions of tephra from key localities on northern Iturup, southern Urup, and northern Simushir [undergraduates Einhorn, Tice and Buskirk, supervised by MacInnes and Bourgeois]
  - b. Chemically – Einhorn conducted microprobe analyses of key tephra from northern Iturup, shared the data with Japanese colleagues who have studied this region, and identified a key marker tephra from Hokkaido, Taramai 2500.
- 3) We prioritized radiocarbon dates, in consultation with archaeologists, paleoecologists and volcanologists and requested dates for key tephra. In particular, two dates from Einhorn's section confirmed the chemical correlation of Taramai 2500. Razhegaeva also obtained key radiocarbon dates from labs in Moscow and St. Petersburg.
- 4) We develop tephra stratigraphy, by testing field correlations with analyses; in particular, Einhorn, Tice and Buskirk worked on this activity, as part of their ESS Honors research projects.
- 5) We began to develop tephra chronology with radiocarbon dates and correlations with known and dated tephra layers.
- 6) We have begun to develop (preliminary) earthquake and tsunami chronologies.
- 7) MacInnes has evaluated other geomorphic and geologic observations, summarized what is known of active volcanoes in the Kurils, and worked with volcanologists' reports
- 8) We have not yet put field data onto a project website, but have posted some powerpoints; we are developing best means to share data within project and also with other scientists. We have scanned all our measured sections and provided them to other team members.
- 9) We have collaborate with Misty Nikula[-Ohlsen] and other educators on ways to utilize our results for various forms of public education. We have visited Misty's school, and her students have visited us. We have also visited the Pacific Science center.

- 10) We worked to develop the 2007 field plan; identify key sites. This activity was significantly affected by the two earthquakes and tsunamis that occurred during the academic year.
- 11) In addition to the Kuril Biocomplexity seminar run in winter and spring, we organized a seminar on "tsunami science and its applications" for winter quarter. Participants included faculty from geology, seismology, urban planning and applied math; students came from backgrounds in geology, urban planning and anthropology.
- 12) In addition to popular presentations, Bourgeois gave invited talks at Berkeley and the Cascade Volcano Observatory.

**GOALS FOR ACADEMIC YEAR 2 [2007-2008]:**

- 1) Publish the runup measurements for the 2006 tsunami in Russian and English; submit data to tsunami databases.
- 2) Model tsunami runup in collaboration with NOAA PMEL tsunami modelers and applied mathematicians at UW and Moscow State University; this activity involves developing more detailed bathymetry for the Kuril Islands.
- 3) Submit manuscripts on tsunami and paleotsunami data from key sites.
- 4) Host visits by Vera Ponomareva, Tanya Pinegina and [tentative] Mitsuhiro Nakagawa to University of Washington. The former two visits will be sponsored by prior NSF support to Bourgeois [Kamchatka].
- 5) Make presentations at annual meetings of the Geological Society of America and the American Geophysical Union.
- 6) Analyze tsunami deposits and model tsunami erosion and deposition from the 2006 tsunami [and possibly some key paleotsunami deposits].
- 7) Continue to develop tephra chronology, in collaboration with Russian and Japanese colleagues [includes acquisition of additional radiocarbon dates].
- 8) Continue outreach activities as for Year 1.
- 9) Continue collaboration with UW, Russian and Japanese colleagues, and develop field and science plans for following years.

## V. GEOPHYSICAL STUDIES OF SEISMICITY

### TEAM:

DR. MIKHAIL G. KOGAN, TEAM LEADER (COLUMBIA UNIVERSITY)  
DR. NIKOLAI F. VASILENKO, FIELD CO-INVESTIGATOR  
DR. DMITRI I. FROLOV, FIELD CO-INVESTIGATOR  
DR. MARK SIMONS, TEAM CO-LEADER (CALTECH)  
DR. JEFFREY T. FREYMUELLER, TEAM CO-LEADER (UNIVERSITY OF ALASKA, FAIRBANKS)

### FIELD OBJECTIVES OF YEAR ONE:

The GPS team was included in the KBP summer 2006 and 2007 field expedition on a space available basis to link the studies of past earthquakes and tsunamis, conducted by the Coastal Processes Team, with the studies of the mechanical coupling between the subducting Pacific plate and overlying North American (or Okhotsk) plate by methods of precise space geodesy. Continuous or repeated GPS position measurements with the millimeter accuracy on many islands along the whole 1200-km long arc from Hokkaido to Kamchatka allow us to determine interseismic surface velocities, which can be inverted for the distribution of the strength of coupling within the seismogenic and tsunamigenic plate interface. Drs. Vasilenko (IMGG, Yuzhno-Sakhalinsk) and Frolov (Physical Technic Institute, St. Petersburg) joined the expedition and performed survey-mode GPS (SGPS) observations on several islands: Ketoy, Matua, Kharimkotan, and Paramushir (southern end). They also installed a continuous GPS (CGPS) station in the town of Severo-Kurilsk, an important extension of the Kuril CGPS network, which also comprises Urup, Iturup, Kunashir, and Shikotan Islands.

### PRIMARY FIELD OUTPUT:

1. Established survey-mode GPS stations on Ketoy, Matua, Kharimkotan, and southern Paramushir Islands. Stations were installed and left recording for periods of between 2 hours and several days.
2. Installed a continuous GPS station on northern Paramushir Island.

The great  $M_w=8.3$ , November 15, 2006 Kuril earthquake happened in the seismic gap of the central/northern Kurils, the region with no big earthquakes for over a century. This event, which occurred after the 2006 field season, dramatically modified the scientific goals of the GPS component of KBP. It has given a chance to examine the great earthquake and its transient response, a daring scientific challenge. Specifically, we will study the following problems: (1) coseismic surface displacements and their inversion for the spatial distribution of the coseismic slip in the rupture; (2) rapid postseismic signal and its interpretation in terms of the afterslip; (3) slow postseismic signal and its analysis to understand viscous relaxation in the mantle.

### GOALS FOR YEAR 2:

1. Reoccupy GPS stations on Ketoy, Matua, Kharimkotan, and the southern end of Paramushir, and convert them to continuously operating stations powered by air-cell batteries.

If this happens, we will capture coseismic (by comparison with 2006) and postseismic signals at the sites nearest to the November 15, 2006 earthquake rupture as outlined by its vigorous aftershocks. The NetRS GPS systems with Zephyr geodetic antennas will collect the data continuously until the next field season in 2008. These observations will allow us to make a step forward in understanding how much of the strain built up from the subduction of the Pacific plate has been released in the great 2006 earthquake coseismically and postseismically, and what is the danger of further great earthquakes in the central and northern Kurils.

We do not need to visit permanent stations on Kunashir, Shikotan, Iturup, and Paramushir, since we receive the data from these sites by regular mail about every three months. The permanent station on Urup (a lighthouse with a permanent service team at it) is scheduled for a visit with a Russian hydrographic ship by the end of summer. If, however, there is a chance to visit one or both sites on Urup with the KBP cruise, it will be fine.

#### **VALUE ADDED SCIENCE:**

Project PIs approved the addition of the geophysical team to the 2006 Kuril expedition when it became apparent that there would be room on the research vessel and that the logistics of the main project could support the addition of this team. Importantly, this geophysical research is already shedding new light on the dynamics of the Kuril subduction zone that will help us to parameterize the Geological Events simulator, with regard to the periodicity, magnitudes and probabilities of infrequent large tsunamigenic earthquakes in the central and northern Kurils.

The fact that the Geophysical team conducted GPS measurements on Ketoy and Matua in late July and early August and the Coastal Processes team conducted benchmark work from camps on northeast Simushir and southern Matua in early August 2006 provides critical background data given that these locations were impacted 3 months later by the 8.3Mw earthquake and tsunami on November 15<sup>th</sup> 2006. That event was historic as the first large magnitude earthquake recorded in the historic period in what has been known as the "Central Kuril gap." Revisiting these camps and upgrading survey-mode GPS stations in this region to the continuous recording in 2007 will show both how much plate movement was generated by the Nov. 15<sup>th</sup> event and related aftershocks and provide greater context for interpreting the geological record of past tsunamis in the region.

## VI. PALEOECOLOGY AND PALEOCLIMATE



PHOTO COURTESY KENJI ITO

[Note: This team was supported in the field in 2006 from the research ship “Gipanis”. In 2007, the field work was conducted independently of the larger ship-based expedition, and was instead fielded by means of commercial ferry transport to Kunashir and Iturup Islands and managed by Drs. Igor Samarin and Olga Shubina, who participated in the land-based expedition as guides, while also conducting their own historical and archaeological investigations.]

### **TEAM (2006 & 2007):**

DR. PATRICIA ANDERSON TEAM LEADER

DR. ANATOLY LOZHKIN TEAM LEADER

DR. PAVEL MINYUK, GEOCHEMIST

DR. ALEXANDER PAKHOMOV, GEOMORPHOLOGIST

PAUL HEZEL, GRADUATE STUDENT, ATMOSPHERIC SCIENCES (2006)

M. ELIZABETH MARTIN, GRADUATE STUDENT, EARTH & SPACE SCIENCES (2006)

VLADIMIR SHAMRAEV, GRADUATE STUDENT (ASPIRANT), DIATOMIST (2007)

MISTY NIKULA-OHLSSEN, RESIDENT MIDDLE SCHOOL TEACHER (2006)

We also consulted with Dr. Joanne Bourgeois, Dr. Tatiana Pinegina, Dr. Nadia Razhegaeva, Dr. Valery Shubin, and Ekaterina Kravchunovskaya about history and development of island landforms, with the Dr. Cecelia Bitz about climate dynamics, with Dr. Marina Cherepanova (diatoms, Institute of Biology & Soil Science, Russian Academy of Sciences, Vladivostok), Natalya Eremenko (botanist; Kunashir Island Preserve), and Bruce Finney (University of Alaska).

### **FIELD OBJECTIVES OF YEAR ONE (2006):**

- 1) Collect multiple sediment cores from 3 lakes in the central and northern portions of the Kuril Island chain;
- 2) Document modern vegetation, lake bathymetry, and lake catchment characteristics needed for interpretation of paleodata obtained from lake sediments;
- 3) Work in conjunction with the geological team to compare tephra found in lake and nonlake deposits as aids for development of a tephrochronology;
- 4) Collect modern reference material for use in calibration of pollen, diatoms, radiocarbon dates, and water chemistry;

The lake coring team typically comprised 4-5 people. When not coring, the group broke into smaller groups to document characteristics of the site and its surroundings. Evenings were typically spent in discussion with members of the geological team, including making preliminary descriptions of the lake cores. Final core description and subsampling were done at NEISRI in Magadan, Russia, by Anderson, Lozhkin and Minyuk. Parallel cores were supplied to Dr. Pinegina for further examination in her Kamchatka lab of tephra and tsunami deposits.

**PRIMARY FIELD OUTPUT IN 2006:**

- 1) 11 lake cores from 3 lakes, totaling ~40 m of sediment (see Table 2).
- 2) Modern water, diatom, and pollen samples from the 3 sites.
- 3) Compilation of a photo-archive of vegetation (plant communities and species) surrounding the lakes (over 1000 photographs).
- 4) Collection and documentation of over ca. 1775 subsamples for pollen, diatom, paleomagnetism and elemental and isotopic geochemistry.

Additionally, we had discussions with Dr. Marina Cherepanova (Institute of Biology & Soil Science, Russian Academy of Sciences) in Vladivostok concerning diatom analysis. She will provide her services at no charge to the project. We finalized plans with Dr. Thomas Brown (CAMS, Lawrence Livermore National Laboratory) to work with us at no additional cost to the project to develop high quality chronologies for the tephra and tsunami deposits using AMS dating of peat and lake materials.

SITE NAME	ISLAND	LAT/LONG	ELEV (M)	# CORES COLLECTED
Tokotan	Urup	45 51.345 N 149 47.963 E	10	4
Lazurnoye	Kharimkotan	49 09.32 N 154 27 598 E	12	3
Pernatoye	Paramushir	50 02.429 N 155 23.711 E	20	4

#### **PRIMARY RESEARCH GOALS OF YEAR 2, PRIOR TO FIELD WORK IN 2007:**

- 1) Photograph, describe and subsample lake cores (this work to be done at the North East Interdisciplinary Scientific Research Institute (NEISRI) Russian Academy of Sciences).
- 2) Analyze modern pollen samples from lake sediments as aids for interpretation of fossil pollen spectra.
- 3) Prepare lake-core samples for pollen counting and paleomagnetic and geochemical analyses.
- 4) Construct a preliminary pollen diagram for each of the three lakes.
- 5) Construct final diagrams of paleomagnetic and geochemical changes for the lake cores.
- 6) Prepare and count pollen samples from key peat sections from Paramushir, Urup, and Kharmikotan islands (collected by Pinegina and Kravchunovskaya).
- 7) Prepare preliminary pollen diagrams for the peat sections.
- 8) Work with Brown and Geology team to target, prepare and submit radiocarbon dates from peat samples. Work with NEISRI and Geology team to target, prepare, and submit radiocarbon dates for the lakes.
- 9) Construct preliminary to final chronologies for the lake and peat records.
- 10) Prepare final bathymetric maps of each lake site.
- 11) Complete documentation and plant identification of the photo archive.
- 12) Work with other project members to develop itinerary and strategy for field work, 2007.
- 13) Work with Misty Nikula-Ohlsen and other educators to disperse information about the project to students and the general public.

Note: much of the lake sediment analysis is being done at NEISRI at no cost to the NSF budget.

#### **FIELD OBJECTIVES OF YEAR TWO:**

- 1) Collect multiple sediment cores from 4 lakes in the southern Kuril Island chain;
- 2) Document modern vegetation, lake bathymetry, and lake catchment characteristics needed for interpretation of paleodata obtained from lake sediments;
- 3) Work in conjunction with the geological team to compare tephras found in lake deposits as aids for development of a tephrochronology;
- 4) Collect modern reference material for use in calibration of pollen, diatoms, radiocarbon dates, and water chemistry;

The lake coring team typically comprised 4-5 people. When not coring, the group broke into smaller groups to document characteristics of the site and its surroundings.

#### **PRIMARY FIELD OUTPUT IN 2007:**

- 1) Nine (9) long cores and 9 short cores from 4 lakes, totaling ~60 m of sediment (Table 6).
- 2) Modern water, diatom, and pollen samples from the 8 sites.
- 3) Compilation of a photo-archive of vegetation (plant communities and species) surrounding the lakes (over 1500 photographs).
- 4) Photographing cores and describing their sedimentology.
- 5) Initial subsampling of cores for pollen, radiocarbon, and geochemical analysis. Final subsampling will be completed upon delivery of paleomagnetic sampling cubes, which



also provide sediment for diatom and geochemical analyses (expected delivery mid-September, 2007).

- 6) Submission of a manuscript describing modern pollen-vegetation relationships based on 2006 samples. The paper will be published (in English) in a special book compiled by the Far East Branch, Russian Academy of Sciences, on environments of the Russian Far East.

Sites with short cores only were located in stabilized dune fields. Thus the sediment records are young and too sandy for use in paleoenvironmental work. Only 1 long and 1 short core were taken from Kasatka Lake because we had to abandon the area due to military maneuvers.

Core descriptions and preliminary subsampling were done in mid to late August at the North East Interdisciplinary Science Research Institute (NEISRI) in Magadan by Anderson, Lozhkin and Minyuk. Tephra preserved in the lake sediments were sampled and will be given to Dr. Pinegina for further examination in her Kamchatka lab of tephra and tsunami deposits. Anderson will carry samples for stable isotope analysis and send to Finney upon her return to Seattle in September, 2007. Modern diatom samples were carried to Cherepanova by Shamraev. Most of the lake sediment analysis is being done at NEISRI and diatom analysis at the Institute of Biology and Soil Sciences at no cost to the NSF budget.

**Table 6**

Modern Sample #	Site Name	Latitude (N)	Longitude (E)	Elev. (m)	Island	# Cores	General Vegetation
KIM-4	Serebry-anoye Lake (SER)	44° 03.271'	145° 49.217'	~8	Kunashir (Pacific side)	3 long cores; 3 short cores	Mosaic of <i>Abies-Picea</i> forest, mixed <i>Betula</i> -broadleaf and conifer forest, and meadow
KIM-5	Glukho ye Lake (GLUK)	43° 54.247'	145° 38.135'	~10	Kunashir (Pacific side)	3 long cores; 2 short cores	Mixed <i>Betula</i> -broadleaf-conifer forest with local meadows
KIM-6	KUN-1	43° 39.517'	145° 32.338'	~7	Kunashir (Izmeny Gulf)	Surface sample only	Coastal meadow
KIM-7	Aliger Lake	44° 02.821'	145° 44.717'	~5	Kunashir (Okhotsk side)	1 short core	Mosaic of <i>Abies-Picea</i> forest, mixed <i>Betula</i> -

							broadleaf and conifer forest, and coastal meadow
KIM-8	KUN-2	43° 56.923'	145° 35.589'		Kunashir (Okhotsk side)	1 short core	Mixed broadleaf-conifer forest
KIM-9	Maloye Lake (MAL O)	45° 05.067'	147° 41.722'	~10	Iturup (Okhotsk side)	2 long cores; 2 short cores	Mosaic of <i>Betula</i> -broadleaf forest, <i>Larix</i> forest, mixed conifer-broadleaf forest, and Poaceae- <i>Sasa</i> meadows
KIM-10	Kasatka Lake	45° 00.748'	147° 43.688'	~15	Iturup (Pacific side)	1 long core; 1 short core	Mosaic of <i>Betula</i> -broadleaf forest, mixed <i>Betula</i> -broadleaf and <i>Larix</i> forest, and meadows
KIM-11	Tonya Lake	45° 00.551'	147° 41.253'	~15	Iturup (Pacific side)	1 short core	Mosaic of <i>Betula</i> -broadleaf forest, mixed <i>Betula</i> -broadleaf and <i>Larix</i> forest; regional vegetation includes coastal meadows

**PRIMARY RESEARCH GOALS OF YEAR 3:**

- 1) Complete sampling of 2007 cores; this work will be done at NEISRI.
- 2) Analyze modern pollen samples from lake sediments as aids for interpretation of fossil pollen spectra.
- 3) Prepare lake-core samples for pollen counting and paleomagnetic and geochemical analyses.
- 4) Construct preliminary pollen diagrams for each of the 4 lakes; finalize pollen counts on 2006 cores, focusing on the Little Ice Age.
- 5) Construct final diagrams of paleomagnetic and geochemical changes for the 2007 lake cores.
- 6) Prepare and count pollen samples from key peat sections from Paramushir, Urup, and Kharmikotan islands (collected by Pinegina and Kravchunovskaya).
- 7) Work with Brown and Geology team to target, prepare and submit radiocarbon dates from peat samples. Work with NEISRI and Geology team to target, prepare, and submit radiocarbon dates for the 2006 and 2007 lakes.
- 8) Construct preliminary to final chronologies for the lake and peat records.
- 9) Prepare final bathymetric maps of each 2007 lake site.
- 10) Work with Misty Nikula and other educators to disperse information about the project to students and the general public.

## VII. CLIMATE MODELING:

### TEAM:

DR. CECILIA BITZ, CO-PI  
PAUL HEZEL, GRADUATE STUDENT

### PRIMARY ACTIVITIES:

The climate modeling team spent the 2006-2007 year gathering information about basic climate interactions and existing paleoclimate data. In our working group (including several members of the Paleoecological team as well as seminar students), we are gathering information about how climate affects Kuril Island and Okhotsk Sea ecosystems. We are working with the simulation modeling team to incorporate the leading-order relations into our model of Kuril Island ecology and human settlements. We are also working in collaboration with Dr. LuAnne Thompson (University of Washington, School of Oceanography) on the development of a high-resolution ocean and sea ice model of the Okhotsk Sea to investigate the coupled dynamics that give rise to variability in the sea ice and ocean conditions that affect fisheries and marine mammals. A present day climatology (averaging the instrumental record into twelve monthly means) of surface temperature precipitation, and sea ice cover was constructed to facilitate selection of field sites and to inform estimates about current vegetation being prepared by the botany group.

## VIII. PALEOCEANOGRAPHY:

### TEAM:

DR. BRUCE P. FINNEY, UAF SUBCONTRACT PI  
DR. AMY HIRONS, SENIOR RESEARCHER

### PRIMARY ACTIVITIES:

Activities in the first two years included consultation with Pat Anderson's team (Paleoecology and Paleoclimate) on the sub-sampling of lake sediment cores for isotopic indicators of paleo-productivity (Nitrogen and Carbon). Water samples from lakes, streams, bays and marine settings were collected in the field and sent to the University of Alaska Fairbanks (UAF) for analysis of modern  $\delta^{18}\text{O}$  and  $\delta\text{D}$  signatures. These analyses will guide calibrations of paleo-productivity and temperature measures from archaeological midden samples, marine and lake cores. This team also participated in planning sessions and modeling discussions throughout the year via teleconference and email, and Dr. Finney traveled to Seattle and presented a talk in the Modeling seminar in Winter 2006. The off-shore paleo-oceanographic field research is scheduled for the end of Year 3. We are in the process of reviewing prior paleo-oceanographic research in the Okhotsk Sea, NW Pacific Ocean, and Kuril Island regions. We have begun contacting Russian marine geologists in preparation for nearshore coring during the 2008 expedition. In June 2007, zooarchaeological specimens of sea otter bone (*Enhydra lutris*) were sent to UAF –affiliate, Dr. Amy Hirons, to begin isotopic analysis of bone chemistry for estimation of paleoecological parameters. Preliminary results from the samples show large  $\delta^{13}\text{C}$  variability between islands and among levels while the  $\delta^{15}\text{N}$  values were within one trophic level.

## IX. VOLCANOLOGY:



Photo courtesy Kenji Ito

### TEAM:

DR. ALEXANDER V. RYBIN, RUSSIAN TEAM LEADER  
DR. ALEXANDER B. BELOUSOV  
DR. NADEZHDA G. RAZZHIGAEVA  
DR. IGOR G. KOROTEYEV  
DR. ANDREE A. KHARLAMOV  
DR. MITSUHIRO NAKAGAWA, JAPANESE TEAM LEADER  
DR. YOSHIHIRO ISHIZUKA  
DR. AKIRA BABA

### INTRODUCTION:

The Kuril Islands occupy a region of intensive volcanism since Pleistocene times. Different researchers have distinguished 68-70 (Markhinin 1985; Fedorchenko 1969; Fedorchenko et al. 1989), 104 (Submarine Volcanism..., 1992), 160 (Gorshkov 1967) and more subaerial volcanoes in Kurile arc as well as from 55 (Bezrukov et al. 1958) to 98 submarine volcanoes (Submarine Volcanism..., 1992).

Volcanoes of the Kurile arc are characterized by highly explosive and thus very dangerous types of eruptions, with radius of devastation zones exceeding 30 km. Such eruptions are commonly associated with formation of hot pyroclastic flows and surges, as well as lahars with lengths exceeding several tens of kilometers.

Volcanoes of Kurile Islands produced more than 15 large caldera-forming eruptions during last 45,000 years with the total volume of ejected pyroclastic material about 720 km<sup>3</sup>. The violence of

some of these eruptions exceeded that of such famous historical eruptions as Tambora (1815), Krakatau (1823), and Katmai (1912).

Thirteen active volcanoes are located in the central part of the Kurile arc; eight of them erupted in the 20th century. Although currently there is no permanent population in the region, the volcanoes of Central Kurils pose serious volcanic hazard, generating volcanic clouds (dangerous for aircraft traffic) and potentially tsunamis of volcanic origin. Even so, the volcanoes of Central Kurils are poorly studied. The main source of information about their geological structure is the famous book of G.S. Gorshkov, published in 1967, as well as few papers of researchers of Sakhalin and Kamchatka conducted more than 25 years ago.

#### **GOALS OF OUR WORK**

- 1) To compose detailed sketches of geological structures of the volcanic edifices.
- 2) To suggest composite geochronological scale frequencies of catastrophic events in Pleistocene-Holocene for the region (for biocomplexity modeling).
- 3) To help estimate impact of the volcanism on past human activity in the region.

#### **METHODS OF THE STUDY IN 2006 AND 2007:**

1. Estimation of the present-state activity of the volcanoes: general description of morphology of crater areas, measurements of temperatures of fumaroles and hot springs; determination of their changes in comparison with the published data.
2. Echosounding of caldera and crater lakes for determination of their bottom morphology, search of underwater hydrothermal vents, submerged craters etc.
3. Tephrochronological studies of soil and peat sections to reconstruct past activity of the volcanoes in Holocene (with sampling of organic matter for radiocarbon dating and sampling of soil and surface waters for pollen spectrums and diatom analyses).
4. Large-scale geological mapping of Pleistocene-Holocene deposits of catastrophic volcanic events to get general view of the volcanic history of the islands.
5. Sampling of the erupted products with the goal to investigate their mineralogy and geochemistry.

#### **FIELD LOCATIONS AND ACTIVITIES IN 2006:**

*Ketoy Island: July 20 - August 8*

1. We completed investigation of the main stratigraphic units of volcanic rocks composing the island.
2. Rocks erupted before, during and after the caldera-forming eruptions of the Pallas volcano were distinguished.
3. 96 rock samples for petrological studies were collected.
4. The first ever echosounding surveys of the Malakhitovoe caldera lake and Glazok crater lake were completed; these data will allow to make digital maps of bottom morphology of the lakes.
5. To investigate past activity of the Pallas volcano, 5 sections of paleosol containing tephra layers, as well as 6 profiles of soils formed under different types of vegetation were studied.
6. A cross section of peat (altitude 70 m., N 47°18.008' E 152°30.629' thickness 2.82 m.) in the southern part of the island includes 24 layers of volcanic ash from the Pallas volcano as well as ash from distant volcanoes of the arc. We believe that this section will serve as the



reference section of the Holocene for the Central Kurils. 17 samples for C<sup>14</sup> dating and 67 samples for pollen and diatom analysis were taken from the section.

7. Additionally, from different deposits in different parts of the island 23 samples of soil for pollen spectrum and 7 water samples (from rivers and springs) were taken for diatom analyses.

*Rasshua Island: August 9 – 11*

1. We completed an investigation of the main stratigraphic units of Holocene volcanic rocks composing the SW part of the caldera and NE part of the island. Twenty six rock samples were collected for petrological and geochemical studies were collected.
2. We sampled a section of lake deposits in the SE part of the caldera (section 7406, N 47°43.195', E 153°125'), where lakes Belaye and Tikhoe are located. The section includes 17 tephra layers. Nine samples were taken from the section for C<sup>14</sup> dating and 46 samples for pollen and diatom analysis. The tephra layers were sampled as well.
3. Additionally, water samples and sediment samples for diatom and pollen analyses were taken from the lakes.

*Kharimkotan Island: August 12*

1. A cross section of peat (section 8106, N 49°09.330', E 154°27.364', thickness 0.88 m.) located to the E from the Lazurnoye Lake. The peat rests on the surface of the deposit of large-scale volcanic landslide about 2000 years old.
2. Three samples for C<sup>14</sup> dating and 18 samples for pollen and diatom analysis were taken from the section.
3. Water samples and sediment samples for diatom and pollen analyses have been taken from the Lazurnoye Lake and two other small lakes.
4. Three echosounding profiles of the submarine part of the large-scale volcanic landslide about 2000 years old were completed in order to determine their surface morphology as well as to try to identify the outer (submarine) boundary of the landslide deposit.

*Shiashkotan Island: August 13-16*

1. Volcanic rocks of Pleistocene-Holocene age were studied in the sea cliffs from the Grotovy Cape to Obval'ny Cape.
2. Reconnaissance of the debris avalanche from Sinarka volcano was completed. This avalanche probably destroyed an Ainu village in the middle of 19th century as reported by Captain Snow (1910).
3. On the Grotovy Cape (sections 8306 and 8706, N 48°46.766', E 154°2.203'; N 48°46.873', E 154°02.046', altitude 60m) two peat sections were studied. Six samples for C<sup>14</sup> dating and 46 samples for pollen and diatom analysis were taken from the thickest section (1.9m).

*Onekotan Island: August 17-24*

1. We have completed investigation of the main stratigraphic units of volcanic rocks composing the SW part of the island.
2. Rocks erupted before, during and after the caldera-forming eruption of the Krenitsyn volcano were identified.
3. Fifty two rock samples were collected for petrological studies.
4. In the Koltsevoye caldera lake several echosounding profiles were made for the first time; the data will allow to make digital maps of bottom morphology of N and NW part of the lake.

5. To investigate past activity of the volcanoes of Onkotan, 2 sections of peat were examined, one in the upper part of Olkhovaya river (section 9606, altitude 200 m., N 49°26.954', E 154°45.051') and one on the slope of Tao-Rusyr caldera (section 9706, N 49°23.243', E 154°42.606'; altitude 430 m). Thickness of these peat sections was about 2.05 m. Each section included multiple layers of volcanic ash (more than 30). In the bases of the sections the key tephra of Kurilskoye Lake was identified. Ten samples for C<sup>14</sup> dating and multiple samples were systematically collected at 5cm intervals throughout each section for pollen and diatom analysis.
6. Additionally, 8 samples of surface soils formed under different types of vegetation were collected for pollen spectrum.
7. Water samples from Koltsevoye Lake and small marshes and lakes were collected for diatom analyses.

*Simushir Island: August 25-26*

1. Erupted products of Goriashaya Sopka volcano were investigated (very briefly).
2. Eight samples of surface soils were collected for pollen spectrum.

**PRIMARY RESEARCH GOALS OF YEAR 2:**

Analyses was conducted on samples from the 2006 expedition at the Institute of Marine Geology and Geophysics in Yuzhno-Sakhalinsk, at the Pacific Institute of Geography in Vladivostok. Data is in the process of synthesis for reports and publications, but has not been made available for this report.

*NOTE: REPORT OF THE 2007 FIELD SEASON IS PENDING. IN 2007, THIS TEAM CONDUCTED A SIMILAR VARIETY OF VOLCANOLOGICAL RESEARCH IN THE CENTRAL KURILS, PARTICULARLY ON SIMUSHIR, KETOY, USHISHIR (YANKICHA AND RYPONKICHA), RASSHUA, MATUA, SHIASHKOTAN, EKARMA, AND CHIRINKOTAN, ADDING TO THE 2006 TEAM SEVERAL RUSSIAN GRADUATE STUDENTS. A SMALL JAPANESE TEAM HEADED BY DR. MITSUHIRO NAKAGAWA, WITH DRs. YOSHIHORO ISHIZUKA, AND AKIRA BABA, VISITED SEVERAL ISLANDS AND MADE SAMPLES OF TEPHRA AND OTHER VOLCANIC PRODUCTS FOR VISUAL AND GEOCHEMICAL ANALYSIS AT HOKKAIDO UNIVERSITY. IN ADDITION, THEY RECEIVED SAMPLES OF VOLCANIC TEPHRA SUPPLIED BY THE ARCHAEOLOGICAL AND COASTAL GEOLOGY TEAMS TO ADD TO THEIR ANALYSES AND BETTER CORELATE .*

## X. ECOLOGY



PHOTO COURTESY KENJI ITO

### TEAM

DR. ANDREE K. KLITIN

TATIANA NYUSHKO

In 2006 and 2007 Dr. Klitin and Ms. Nyushko worked independently but on related contemporary phenomena. Dr. Klitin's work was focused on contemporary entomology as well as the biogeography of plants. Ms. Nyushko's work was focused more exclusively on contemporary floristics/botany. Both were oriented to the study of contemporary ecological patterning in the Kuril Islands. Their work builds on the research of the International Kuril Island Project (IKIP) from 1994-2000, by studying particular locations for several days or weeks, allowing for longer time series of collecting (over multiple diurnal cycles) that was not possible earlier given IKIP logistics. Ms. Nyushko studied and collected a large variety of plant samples from Simushir, Ketoy, Ushishir, Rasshua, Matua, Shiashkotan, Chirinkotan, Ekarma, and Onekotan islands as a member of the volcanology team. In 2006, Dr. Klitin joined the archaeology camp in southern Urup between July 21 and August 1, participated in the ship based mobile surveys from August 2 through August 17, and joined the volcanology team on southern Onekotan from August 18-23. He provided the following report on his activities.

#### **KURIL ENTOMOLOGY AND ECOLOGY:**

#### **SUMMARY OF A. KLITIN'S SUMMER 2006 FIELD RESEARCH**

**BY A. KLITIN**

During the 2006 field expedition on RV Gipanis through the Kuril Islands, Dr. Andre A. Klitin conducted research on entomofauna and variation in vegetative communities on Krenitsina

volcano (Onekotan Island). He gathered invertebrates and seaweed on the coasts of Urup, Shaishkotan, and Onekotan islands for their further definition in SaxNIRO (СaxНИРО), and he gathered herbarium and geological samples for the Sakhalin Regional Museum of Local Lore. In the course of the expedition route and survey of the sea coast by small boat, all land and sea mammals encountered were inventoried. Additionally, all waterfalls were counted. Many of the waterfalls deserve the designation of nature monument (first and foremost those on the island of Urup). All items gathered are being turned over for care and storage to the Sakhalin Regional Museum of Local Lore.

The entomological research involved installation of "Barbera" ground traps on the islands of Urup, Ketoy, Rasshua and Onekotan, as well as observations enroute. The most detailed researches were conducted on the island Urup where four lines of ground traps were installed (three in the south end of the island and one at the isthmus at Tokotan). In this research, Klitin collected representative series of *Carabus opaculus*, *C. arcensis*, *C. kurilensis*, *Cychnus morawitzi* and other beetles (*Carabidae*, ground beetles), including the local subspecies of rare beetles *Carabus kolbei*. From these collections and observations, such quantity indicators as a relative abundance, frequency of occurrence, etc. are being calculated. Additionally, on Urup I. three kinds of butterfly (Macrolepidoptera) were noted. The ground traps that were established on a slope of the sea terrace of Ketoy I. were plundered by foxes. Nevertheless even here we captured the local subspecies *Carabus kolbei* (exclusive to Central Kuriles). This subspecies had never before been observed on Ketoy Island. Research visits to Rasshua and Onekotan islands were brief and during periods of prevailing rainy and cold weather, but even there entomological materials were collected.

Among the botanical finds we must note the Yatabe orchid that we found on Urup and Rasshua islands, which had not been documented previously on these islands. Without a doubt the Krenitsina volcano in the Tao-Rusyr caldera (Onekotan Island) should be recognized as one of the unique natural phenomena of Kurils. With volcanist A. Belousov, we carried out ecosounding of the bottom of the Koltseva (Ring) caldera lake surrounding the volcano and a maximal (but not limiting) depth of 264 m was documented. Currently this is the deepest internal body of water of the Sakhalin Oblast. It is possible that the Koltseva Lake surpasses other fresh bodies of water in the Sakhalin Oblast in volume of a fresh water. Several morphometric parameters of the Krinitisina volcano were carried out in particular the height of the lava dome which emerged during the 1952 eruption, which measured 464 m or 64 m above the level of the caldera lake. Of the higher altitude plants only the *Saxifraga merki* reaches the top of Krinitisina volcano.

In 2007, Dr. Klitin joined the volcanology camp on Nakatomori in central Simushir between July 23 and July 30, and on Matua between August 1 and August 8. He also participated in the ship based mobile surveys from August 9 through August 11 on Yankicha, Ryponkicha and Rasshua. He provided the following report on his activities.

**KURIL ENTOMOLOGY AND ECOLOGY:  
SUMMARY OF A. KLITIN'S SUMMER 2007 FIELD RESEARCH  
BY A. KLITIN**

In the course of expedition on the motor ship "Iskatel-4" along Kurils next works were conducted:

- Insect fauna investigations;
- Observations for changing of plant communities on Sarychev volcano (island Matua);
- Gathering of invertebrates and water plants on Matua and Yankicha islands littoral shelf for its further determination in SakhNIRO;
- Gathering of herbarium and geological specimens for the Sakhalin Regional Museum of Local Lore.

And also in the course of itinerary researches and investigations registration of the all terrestrial and sea mammals, which we met on our way, was conducted. All collections were handed over and will keep in the Sakhalin Regional Museum [ditto].

In the course of entomology investigations itinerary observations were conducted, and Barber soil traps were set up for trapping of ground beetles (Carabidae, Coleoptera) on the Simushir, Matua, Yankicha islands

Most enduring investigations were conducted on the island Simushir, there it was set up two lines of soil traps (in the Srednya bay and on the Vodopadny brook – in middle part of island). As a result of these investigations two rare of species *Carabus* genus –*Carabus kolbei* Roeschke and *Carabus rugipennis* Motschulsky were detected on the island Simushir for the first time. Quantitative data like: relative abundance, frequency of occurrence, etc were calculated.

It is known *C. kolbei* forms on the island Hokkaido and the island Risiri (situated near Hokkaido) eleven regional subgenus's (Imura, 1990; Imura, Mizusawa, 1996). And *C. kolbei* forms on the Kurils three subgenus's minimum, one of these (*Carabus kolbei ushishirens* Obydov et Saldaitis, 1996) are met only on the island Ushishir (Obydov, Saldaitis, 1996; Obydov, 2005), *C. kolbei chishimanus* (Nakane, 1961) is met on the island Iturup and the island Ketoy (Lafer, 2002). Subgenus *C. kolbei aino* Rost lives on the island Kunashir and the nearest to Kunashir peninsulas Siretoko and Nemuro. During the course of Kuril Biocomplexity Project expedition in 2006-year author found *C. kolbei* on the Tokotan isthmus island Urup, and in 2007 year –on the Vodopadny brook and in the Srednya bay- Simushir island. As author knows (Kryzhanovsky and etc, 1975; Lafer, 1989, 2002; Imura, 1990; Imura, Mizusawa, 1996, Lafer, 1998; Obydov, 2005) *Carabus kolbei* was not found on the island Simushir up to now. So as a result of Kuril Biocomplexity Project expedition 300 km gap of area of species *C. kolbei* was removed. It is determined that this species constantly lives on the all islands from Hokkaido to Ushishir.

*Carabus rugipennis* dates to subgenus Damaster, other species of this subgenus are limited in own expansion by Japan archipelago. Presence by this species of narrow-width stretched prothorax is morphologic adaptation to nutrition with littoral and land shellfishes. So far expansion of this species was limited among islands: Kunashir, Iturup (Krivolutskaya, 1973), Brother Chirpoev, Shikotan and Hokkaido; it was supposed its habitation on the island Urup (Lafer, 2002). Finding of *C. rugipennis* in Srednya bay on the island Simushir widen area of this species on 120 km to north-east. *C. rugipennis* is included in the Russian Federation Red Book and Sakhalin Red Book. *C. rugipennis* and *C. kobeli* date from group of island's endemic. Finding of these species on the island Simushir essentially increases this island's bio-diversity.

Author observed massive flight of Cranberry Blue (*Vacciniina optilete* Knoch ) among other insects on the island Rasshua August 11,2007 year. Other butterfly - *Cynthia cardui cardui* (*Vanessa cardui* Linnaeus) was found here, this butterfly known by own extended migration.

Accounting of arctic foxes (*Alopex lagopus*) was conducted on the Ryponkicha island by S. Chirkov. Their density consists of five family (proximally 20 individuals) on the one kilometer bank line. On the next Yankicha island arctic foxes live on the main island and on extrusive dome folds- disconnected from other part of caldera in summer.

It is investigated sealing of northern fur seals (*Callorhinus ursinus*) ground on Yuzhny cape of Rasshua island. There are about 60 individuals in this sealing ground, including youngster. Storing of fur seals is situated as on the littoral as in grass-wrack in about ten meters from shore. Big sealing of northern fur seals ground in several hundreds individuals is situated on north cusp of Rypkonkicha island.

Biology analyze of sea urchins *Strongylocentrotus droebachiensis.*, which are obtained from deepness less then one meter, is conducted in Kraternaya bay of Yankicha island. Though species had small size (11-37 mm) they were nobileous.

Great outliers of sea urchins *Strongylocentrotus polyacanthus* (diameter 70-100 mm) were on the ocean side of the Matua island (Dvoynaya bay, cusp Krokolil - Yurlov cusp ). This is tsunami result happened 15th of November 2006 year. Density of sea urchins in some places was 8 exemplars/q. [individuals/m<sup>2</sup>] meter, average density was 0,3 exemplars/q. [individuals/m<sup>2</sup>] meter.

In waterfowl hole on the Vodopadny stream Simushir island malma trout (*Salvelinus malma*) was finding; tests of Amphipoda was selected for specification in SakhNIRO. On the littoral of center part Dushnaya bay (Simushir island) 10 July 2007 year participant of expedition K. S. Ganzey found long-snouted lancetfish (*Alepisauris nikparini*). It is predatory pelagian sea fish, which enters in Kuril islands water from subtropical zone.

Stary-backed gull (*Larus schistisagus*) lives on the Zavaritsky caldera rocks. Bird's colonies were investigated on rock Kolpak and on the opposite rock near enter in Kraternaya bay.

Investigation of mountain fauna distribution the Sarychev volcano flanks (Matua island) was conducted. It was found only two plants in near apical zone: saxifrage Merk (*Saxifraga merki*) and *Pennellianthus frutescens*. It should be note that island Matua is one of some volcanos of Kuril ridge where is absent cedar elfin wood (*Pinus pumila*). Similar situation is observed on other Holocene's Kuril volcanoes: Atconopuri (Iturup island), Phussa (Paramushir island).



## XI. REFERENCES

(incomplete: waiting on references from Russian and Japanese colleagues)

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