

Hazards and Impacts Group

Members Contribution and Key Themes:

Kuril Biocomplexity Project

1. Name:

- a. Ben Fitzhugh (with S. Colby Phillips + many other KBP team members)

2. Geographic Study Area:

- a. Volcanic islands of the North Pacific - Kuril Islands

3. Key Hazards

- a. Volcanic eruptions (small, medium, caldera forming/ pyroclastic flows, mud-slides, tephra deposition, effects on local and regional environments)
- b. Tsunamis (volcanogenic/landslides; Kuril Trench subduction zone earthquakes, and trans-Pacific tsunamis)
- c. Social isolation - becoming cut-off from social networks for trade, information about natural and social conditions elsewhere; demographic isolation and local extinction. (e.g., Norse Greenlanders)
- d. Social connection – to the extent that networks are maintained in spite of relative isolation, dependence on outside social networks for access to goods and patronage can render islanders vulnerable to political, economic, and environmentally driven changes in the flow of goods and support (e.g., Norse Greenlanders)
[In both cases of isolation and connection, limits to the number of independent network ties limits flexibility to respond to internal and external adverse affects, but might sometimes limit exposure to external impacts, such as diseases or contagious and adverse ideologies – such as legitimize subordination of islanders!]
- e. Ecological vulnerability (low biotic diversity, emphasis on few key resources) – counterbalanced by the moderating aspects of maritime climate and relatively high abundance of a few key resources.
- f. Climate change and effects on weather and people: storminess, fog, sea ice, boat travel, habitats and access to resources and social partners.

4. Past Impacts

- a. Volcanic eruptions occurred many times during human occupation of the Kurils. These include numerous small and local eruptions producing tephra lenses of varying thickness, several larger scale eruptions (thick and/or widespread tephra) and at least two caldera forming eruptions occurring during the period of human occupation (last 4000 years). Archaeologically, the impacts of these events have been hard to estimate. Historically, we have information of one Ainu village destroyed by a pyroclastic flow in the late 19th

century. Sarychev Volcano on Matua island has erupted about 7 times in the past 100 years, while a Japanese and later Soviet/Russian base was located on its southern slopes. A massive eruption occurred again this past summer only days after geophysicists visited the island. Impacts were minimal on the base (and known archaeological deposits), despite total destruction of the east, west, and northern sections of the island to the coast. The military base has been closed for over 9 years.

- b. Major tsunamis have hit the Pacific coast of the Kuril Islands roughly every 300-500 years throughout the past several thousand years, based on analysis of paleotsunami deposits in coastal sediment columns. In the past century approximately 10,000 people were killed in the northern town of Severo-Kurilsk as a result of a tsunami in 1952 (with impacts also in 1960 from a tsunami originating off coastal Chile). An earthquake and tsunami in December 2006 (months after our first field season) resulted in a tsunami that we later documented had an averaged 10 meters run-up in the Central Kurils with maximum of 20 meters. The wave traveled across the North Pacific and did over \$10 million damage in Crescent City, California. It was initially reported as a mild tsunami based on reports of the run-up on Hokkaido.
- c. Undoubtedly social isolation has affected colonists to the central Kurils. Current research seeks to isolate specific cases based on divergent evolution of artifact styles and raw material uses. Specific cases of impacts of isolation are not yet identified in the archaeological record, but can be noted in recent history (e.g., Russian military outposts and poor access to medical services in AD 2000, when during the International Kuril Island Project, the ship doctor was called to shore to certify the death of a young soldier who had died from an undiagnosed ailment without medical care the night before we arrived).
- d. Social connectivity effects (effects of changes in conditions in social parameters outside of the islands that affects islanders) also occurred though archaeological evidence is not yet specific. Disappearance of population from Kurils roughly 600 years ago and subsequent utilization by migrant Ainu groups, may be related to changes in Hokkaido socio-political organization... Also could relate to as yet unidentified environmental impacts - such as Little Ice Age changes in storminess, sea ice, and marine ecosystem (see below).
- e. Currently archaeological evidence does not indicate major changes in marine ecosystems resulting in local extinctions, though climate impacts are expected on marine productivity and relative abundances of resources.

- f. Palynological evidence so far suggests broad stability in the paleovegetation signals from 4000 bp to present (interval of main occupation in Central and North Kuril Islands), while diatoms and other measures suggest changes in local marine systems, sea levels, etc. More work is being done on this question with isotope biochemistry of shells and marine mammal bones.

5. Human Response/Mitigation

- a. Ironically the highest frequency of large (including caldera forming eruptions appears to have occurred during one of the periods when human population in the Kurils was at its highest (2500-1500 bp). Evidence of human occupation above and below thick tephra deposit from a nearby caldera eruption suggests relatively rapid recolonization, though interval of abandonment can not yet be estimated using available chronological controls. (see Payson and other's cogent points about chronological precision and our limitations in this regard).
- b. Archaeological evidence is inconclusive about the direct impacts of tsunamis, but the presence of most archaeological settlements on high terraces and on the Okhotsk sea side of the archipelago suggests a mitigation to minimize exposure to storms and tsunamis. Of course, tsunami prone sites of small scale hunter-gatherer groups would likely be lost to archaeological visibility with just a few high impact events (the problem of negative evidence).
- c. We are investigating a model that suggests people would have invested in increasingly costly strategies to maintain social connections across expanses of ocean following colonization episodes at least until local TEK would allow for increasingly resilient local adaptations. These mechanisms would result in changes in the structure of raw material distribution and use, stylistic affinities, innovation diffusion, and stylistic/technological differentiation. Our research is not sufficiently developed to evaluate this model but results so far are promising. In particular we see evidence of rapid networking with Kamchatka populations for obsidian sources for central and northern colonists (who originated from the south) and a geographical discontinuity across the widest straight in the central Kurils limiting connections to the southern origins. Evidence nevertheless, suggests cultural affinities remain linked to southern populations on Hokkaido.
- d. Hazards of social connection to the outside social world are expected to relate to social/political/economic dimensions and might be mitigated by selective disengagement from broader social networks. This is easier in an attenuated and linear network as would have existed in the Kurils, but we have not yet probed this issue with our analyses in any great depth. The above noted disconnect between

northern and southern portions of the archipelago might relate to strategic disengagement from the south (and the greater political complexity that is known to have existed there), but we are still working on giving this segregation a temporal dimension.

- e. Shifting resource targets (e.g., expansion of diet breadth) is an expected result of impacts to the most productive/attractive resource targets. In the Kurils and other similar low diversity environments, opportunities for such a strategy are limited, and we see the effects of this in comparison of faunal utilization between the more diverse near-mainland islands and the less diverse Central Kurils (Fitzhugh et al. 2004). Ongoing research suggests people exploited very different suites of resources on different islands, tapping whatever was available locally (and supporting the prediction that under low diversity conditions, foraging choice is severely constrained to what is available).
- f. Mitigation to changes in climate and weather patterns could include adoption of new patterns of seasonal mobility, new resource targets, modified or innovative technologies, or local abandonment of more remote areas. The gap in occupation history between 600 and 400 bp (we call it the "Ainu Gap") could be related to adjustments in climate and weather patterns. There are different hypotheses floating to explain this gap, but all would support a major change in the way the Kurils were used by people, if not temporary abandonment all together.

6. Future Risk

- a. Volcanoes, earthquakes, tsunamis. Few people live in the Kurils today, but those that do (especially in Northern and Southern most islands) continue to be vulnerable to large scale earthquakes and tsunamis. Indeed given the degree of investment in infrastructure (buildings, processing plants, airports, docks, roads, etc.), it is fairly obvious that modern settlers are much more vulnerable to natural catastrophes compared to the small scale, low infrastructure, semi-mobile populations that lived in the Kurils prior to the 20th century.
- b. Impacts of social isolation and social connectedness are both significant in the modern context. The sparse population of the Kurils today (concentrated into 3 towns in the northern and southern islands) is a product of the changing social-political and economic conditions of the globalized context. The Kurils were a strategic resource/liability during the 20th century for both Japanese and subsequent Soviet occupiers. End of the cold war, shifts in economic means and priorities, and changes in the nature of border security has rendered the Kurils less strategic, allowing some populations to emigrate (closing of military bases) and others to shift their economic activities towards intensive fishing.

The Kurils are largely abandoned now. This renders future settlers less knowledgeable about the local and regional geography, seasonality, and hazards (lack of continuity in TEK). New colonization will once again require the acquisition of new local and traditional knowledge and the renewal or restoration of mitigation strategies. We expect that this pattern of renewal of TEK has repeated itself in some form at least three times in the archaeological past of the Kurils (Jomon, Okhotsk, and Ainu colonization waves), with vulnerable colonists gradually building resilience to local and regional environmental variability and developing social network responses to increase their resilience (perhaps later weakening some of those ties when local conditions and developed TEK allow for greater local adaptations).

Significant differences exist in scale of network access and technological means for mitigating hazards in comparing past and future risks. Ironically, it appears that modern/ globally connected populations are less likely to persist in the Kurils (the logistical mobility of global agro-products to consumers reduces the need to go wherever resources are most available/under-utilized, the Kurils are too isolated from modern conveniences to draw out voluntary settlers, and modern societies have the flexibility to pull populations out more easily). This is not the same thing as being more vulnerable in the short term, but has the effect of attenuating traditions of TEK development as already noted.

On another level, the abandonment of regular occupation across much of the Kurils renders the islands themselves more vulnerable to ecological degradation. With fewer eyes on the islands, mineral extraction companies have been exploiting deposits with less oversight, damaging ecosystems and in some cases archaeological sites. Russia has in the past proposed a nuclear waste storage facility in the volcanic Kuril Islands (because of their largely abandoned and insular geography), which has significant potential risks to island and marine ecosystems as well as future settlers (not to mention large segments of the more heavily populated North Pacific rim and all societies that utilize sea food from this environment).

Output:

1) New knowledge

- a. We are now beginning to be able to quantify changes in occupation intensity and periods of apparent abandonment
- b. At a coarse level, it appears that human occupation was insensitive to volcanic eruptions and tsunamis
- c. Obsidian sourcing and preliminary pottery technology studies suggests geographic segregation between southern and central-northern Kuril Islands, despite common cultural origins (three times) in the south.

2) Top 5 emerging new research questions

- a. How can we identify periods of increased and decreased storminess and sea ice in the Kurils as it may relate to changes in occupation, mobility, and ecosystems in the islands? (climate models, proxy data in marine cores, coastal sediment records, inference from paleoclimate proxys)
- b. How can we compare archaeological chronology and chronologies of natural hazards at sufficient resolution to identify impacts to people or culture? (statistical analysis of radiocarbon data, statistical comparison of event frequencies and population densities, micromorphological study of contacts between tephra and overlying cultural deposits).
- c. How can we refine paleoclimate and paleoecological reconstructions to variables relevant to people? (Palynology provides a coarse signal. Data from shell and bone isotopes should provide proxies for the marine environment that controls the majority of subsistence for prehistoric occupants.)
- d. To what degree is the archaeological record a reflection of geologically constrained archaeological visibility in the Kurils? (we will estimate the geological ages of landsurfaces - initiation of soil formation – and rates of erosion with evidence collected by paleogeography and geological teams on our project to do this).
- e. How has human history/prehistory in the Kurils been influenced by political-economic processes occurring outside of the Kurils (esp. in Hokkaido, Central/Southern Japanese Archipelago, Amur River/China, and Kamchatka)? In what way was the Kurils influenced by and insulated from the “World System” at different points in its pre/history?

3) Fundamental limits to progress

- a. Problems of chronological precision
- b. Problems of correlation between data sets of differing geographical and temporal resolution.

- c. International and multi-disciplinary communication and cultural differences in academic traditions
- d. Challenges in modeling complex (even relatively simple) systems!
- e. Limits to the availability of funding for interdisciplinary efforts.

4) Blockages that can be removed by collective action

- a. Items 3) c,d,e above

5) Action Areas

- a. Spending time in interdisciplinary seminars, field settings, and intense, problem-oriented working groups.
- b. More time in the field collecting data
- c. Better training in approaches to modeling
- d. Comparative workshops (such as this one)!

6) Synergy of research outreach, education, heritage development

- a. We have been fortunate to have support for participation of a middle school science teacher in our field project through the PolarTrec program. This teacher posted blog entries with pictures from the field, engaged in webinar sessions with other teachers from around the US, and developed elements of curriculum for interdisciplinary science education for her classroom in Bellingham, Washington. She also gave local and national presentations on her participation in this program.
- b. We are developing an education kit through the Burke Museum that will contain information and hands-on materials showing how different scientific disciplines are contributing information for understanding the history of human-environmental interaction in the Kurils. We hope to be able to include a "Sim Kurils" computer game with this kit to provide an interactive experience teaching how different initial conditions and perturbations can affect the Kuril ecosystem and human settlement. This game module depends on the successful completion of the academic modeling unit first, which is still very much a work in progress!

7) Deliverables

- a. Immediate:
 - i. Preliminary presentations to academic and public audience in Yuzhno-Sakhalinsk, Russia (October 1-2, 2009)
 - ii. Academic papers and reports have already appeared, with more in preparation.
 - iii. Public outreach -see 6)a, above and <http://www.polar-trec.com/kuril-islands-biocomplexity>
- b. +1 year
 - i. 2 PhDs (1 to be defended this month!)

- ii. Interdisciplinary academic volume summarizing the main disciplinary results and linkages for this project (American, Russian, and Japanese collaborators).
 - iii. Public and academic conference in Sapporo, Japan (Hokkaido) on near-final outcome of disciplinary results with additional emphasis on interdisciplinary synthesis as a step towards an subsequent interdisciplinary synthesis volume.
 - iv. Burke Museum education kit with (we hope) integrative "Sim Kuril" human-environmental dynamics game/ model.
- c. + 5 years
- i. Interdisciplinary results volume and papers
 - ii. Comparison between Kuril and Aleutian Island human-environmental history.
 - iii. Extrapolation of Kuril network ABM/IBM model to contemporary system parameters (climate change, global and regional social, political, and ecological networks, industrialized resource extraction, pollution, etc.)