

**Paleoenvironmental Reconstruction and Landscape Interactions
in Lake Clark and other Southwest Alaska Lake Systems,
Southwest Alaska Inventory and Monitoring Network**

2004 Annual Report

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EXECUTIVE SUMMARY

In order to fully understand the dynamics of any ecosystem, it is important to have some knowledge of how that ecosystem developed through time, how it has changed in the past, and how it may change in the future. Landscape history studies such as the timing of deglaciation, location and timing of hydrologic connections or barriers, and the history of lake level change will provide a framework for understanding salmon population dynamics in terms of colonization, isolation, and bottleneck effects, as well as for the ongoing efforts to locate and date early human settlements in the area. Paleoenvironmental reconstruction using pollen and other indicators from lake sediment cores will provide a history of ecological succession and vegetation change since the last ice age. Volcanic history, also obtained from lake sediment cores, will allow us to construct a regional tephra stratigraphy useful for dating inorganic lake sediments, landforms, and archeological sites. The potential effects of ash fall into different lake systems can also be investigated through the study of such events in the sedimentary record.

The first year of this study included lake coring, associated field work and lab analyses which is still underway. Results to date include:

- Glaciers retreated from Lake Clark valley by ~15,000 yBP.
- A preliminary lake level history indicates that lake level lowering occurred early (probably prior to ~11,000 y BP) and took several thousand years.
- At least 6 tephra have been identified and dated, ranging in age from ~7,500 to 1,900 y BP.

The second year (2004) of the project included winter coring in several small lakes around Lake Clark, field mapping and coring in Katmai including lakes around Naknek, Nonvianuk, and Kukaklek. Additional coring in Lake Clark included Portage Lake, Hickerson Lake, and Kontrashibuna. Detailed surveys of beach ridge profiles, soil descriptions, and more refined lake level elevation were also conducted in the summer of 2004. Preliminary results to date include:

- Evidence of recent lake level rise at the west end of Kukaklek Lake.
- Clear chronosequence of beach ridges at east end of Kukaklek Lake.
- Beach profiles on opposite sides of Lake Clark suggest different lake level histories which may be tectonically or glacially driven.

Laboratory analysis is continuing on all cores. At least 8 cores have been split, described and sampled. Analyses of organic content, isotopes, ^{14}C , pollen, macrofossils, and tephra are all under way. Additional analyses of soil profiles and other relative age indicators on beach ridges are also underway.

ABSTRACT

In order to fully understand the dynamics of any ecosystem, it is important to have some knowledge of how that ecosystem developed through time, how it has changed in the past, and how it may change in the future. This study aims to reconstruct the deglacial history, lake level history, ecologic succession and volcanic history of selected lakes in Southwest Network Parks. The first year of this project focused on Lake Clark National Park, where approximately 14 small lakes, and Lake Clark itself, were cored during the summer of 2003 and winter 2004. Results from year one suggest: 1) glaciers retreated from Lake Clark valley by ~15,000 yBP, 2) a preliminary lake level history indicates that lake level lowering occurred early (probably prior to ~11,000 yBP) and took several thousand years, and 3) at least 6 tephras have been identified and dated, ranging in age from ~7,500 to 1,900 yBP.

The 2004 field season was productive with cores obtained around Naknek, Nonvianuk, and Kukaklek with the aim of estimating lake level histories in the lake systems of Katmai National Park and Preserve. Beach profiles and soil studies were conducted around Lake Clark during late summer. More lakes, including Kontrashibuna, Hickerson, and Portage were cored in Lake Clark National Park and Preserve as well. Analyses of topographic profiles, soil, and lake sediments are underway in laboratories at University of Alaska Anchorage and Fairbanks.

INTRODUCTION

The 2004 field season included work in both Katmai National Park (KATM) and Lake Clark National Park and Preserve (LACL). The focus of field efforts for 2004 consisted of three parts: (1) small lake coring around Naknek, Nonvianuk, and Kukaklek lakes in KATM, (2) field measurement of lake elevations and beach ridges in Lake Clark, and (3) lake sediment coring in larger lakes (Kontrashibuna, Hickerson, Portage) in Lake Clark. The Katmai work was conducted in late May – early June and the Lake Clark work occurred in August. This report is divided into two sections describing the separate field excursions, but with preliminary results included in one section at the end.

METHODS

Determination of paleolake levels is an iterative and continuous process because the location of suitable sites does not occur along a consistent elevation gradient. Therefore when ancient glacial lake sediments are observed in a sediment core of a small pond, the elevation and location in reference to contemporary lake level must be considered both spatially and temporally. The transition from glacial lake sediments to isolation pond sediments provide two valuable sources of information (1) confirmation of the paleo-extent of the target lake, and (2) a date for lake level regression past a certain elevation. If glacial lake sediments are not found in cores where expected, it is then necessary to: 1) consider geomorphologic processes that may have “erased” the sedimentary

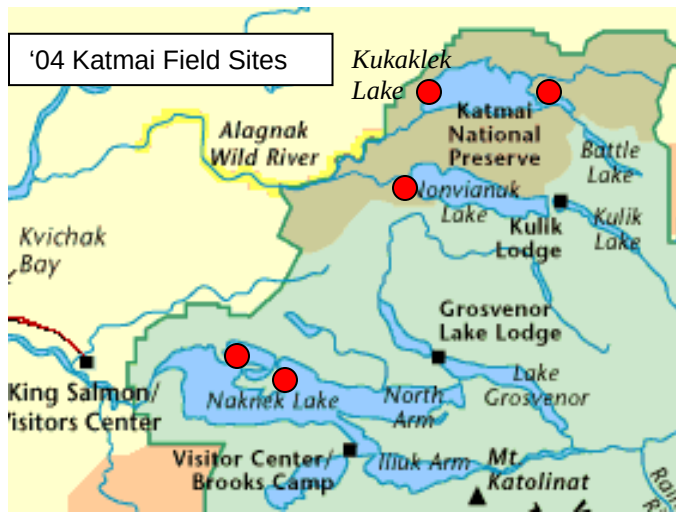
record, or 2) assume that the extent of the study lake did not reach that site.

Open water ponds were cored from a platform mounted on a 16 ft pontoon river raft anchored over the deepest or most suitable area of the pond. Bog cores were obtained from the surface. A 5 cm (2 in) diameter Livingston square-rod piston coring device was used to extract sediment from lakes, ponds, and bogs. A Universal corer was used to extract cores from deeper lakes (Kontrashibuna) and for core top and water/sediment interface sampling. Livingston cores were extracted in 1 m (3.28 ft) increments and extruded into 5 cm diameter x 1m length PVC casing for transport and storage. Core tops from the Universal corer were sampled in .5 cm intervals and packaged for transport. Cores and samples are stored under refrigeration at the University of Alaska Anchorage.

SUMMARY OF FIELD ACTIVITIES

Part I: Lake Coring in Katmai National Park and Preserve

Patricia Heiser (P.I.) and graduate students Brian Cohn and Matthew Bowes of UAA, accompanied and assisted by NPS I&M representative Laurel Bennett conducted field work in several areas of Katmai National Park as part of a broad-scale effort to reconstruct paleoenvironmental landscape changes since glaciation. The group surveyed, cored, and sampled lake sediments in small lakes surrounding Naknek, Nonvianuk, and Kukaklek Lakes. A brief summary of field activities and sample collection follows. A more detailed report on the results of the work at Kukaklek Lake is included in the results section.



1. Naknek Lake 24 May – 30 May

The field party was dropped off east of Johnny's Cove and set up camp on a small island east of the 'arm' that encloses Johnny's Cove. The first lake cored, named "Otter Lake," is perched above a moraine and beach ridges that are on the southeast outer shore of the Cove. Otter Lake is approximately 110 feet above the present surface of Naknek Lake. Two drives with the Livingston corer yielded ~135 cm of lake sediment, dominated by organic muck, volcanic ash, and bottoming out in bluish sandy clay.

A hand-level was used to survey elevations of the beach ridge sequence at the west end of Johnny's cove. Preliminary results suggest that ~15 meters (~45 feet) of lake level drop has occurred from the highest beach ridge.

A second lake, called "Buckbean Pond," which is located approximately 2 meters above current lake level, was cored and ~116 cm of sediment was retrieved. Sediments graded from organics and ash near the top, to sand and clayey sand at the bottom. A short core of approximately ~70 cm, collected using a universal corer, was obtained from the bottom of Johnny's Cove.

2. Nonvianuk Lake May 30 – 2 June

Golden Eye Pond, located on the 'bench' surrounding the east end of Nonvianuk Lake and perched ~3-4 meters above the surface of Nonvianuk, was cored and approximately 90 cm of sediments were extracted in two drives. Sediments were compact and ended in blue-grey sandy clay. The pond was ~1 meter deep. Another pond (called "Porky's Pond"), is located ~ ¼ mile south of the outlet of Nonvianuk. This pond is situated at about the same elevation and on the same 'bench' surface as Golden Eye. Several cores from Porky's yielded only about 60 -65 cm of compact organic sediments that bottomed out in sandy gravel. A "short core" using the universal corer yielded approximately 70 cm of sediment.

On a moraine beside Porky's Pond and on the hill surrounding the ranger cabin, spruce trees were cored for age determination, and soil plugs were retrieved to determine thickness of recent (Katmai 1912 eruption) volcanic ash deposits. Ten trees were cored on "Porky's Ridge" and five trees were cored on the hill near the ranger cabin. A preliminary field count of the cores indicated that the trees are 90-100 years old, suggesting a cohort of trees whose germination may have coincided with the 1912 eruption. Detailed lab counts will be completed to verify this relationship. Soil cores showed 2-4 cm of grey ash underlying 1-5 cm of minimally decomposed lichen / moss litter.

3. Kukaklek Lake 2 June – 5 June

Several lakes, occupying different elevation beach ridges, were cored at the west end of Kukaklek Lake. The first lake, actually a bog named "Big Paw," is perched ~12 meters above present lake level and near the northeast 'corner' of Kukaklek Lake. Approximately 120 cm of organic sediments were recovered in two cores, both ending with blue clay or sandy clay at the bottom. Another shallow lake (Cloudberry Pond) is centered on the highest (12 m) bench along the west end of the lake. From this lake only about 50 cm of dense organic sediments and ash were recovered. A lower swale, ~3 meters above lake surface, was located directly east of Cloudberry lake. Sediments in this swale were also composed of dense organics with volcanic ash and bottomed in sand after ~ 72 cm.

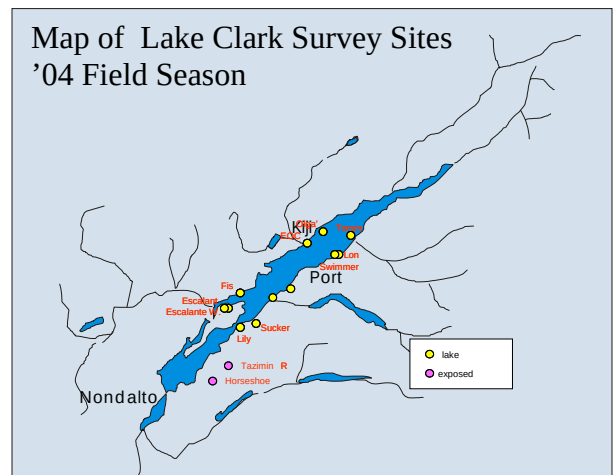
Thirty spruce trees were cored in a roughly N-S transect running along the entire western shore of Kukaklek Lake from Big Paw Bog to the dunes at the mouth of the lake and head of the Alagnak River. Most of the trees were growing on the highest terrace, and most possessed a growth form of multiple sprouts starting at ~ 40-50 cm above ground level. This form suggests that wind damage affected the trees, but that the damage was somehow mitigated by snow cover.

The dunes at the mouth of the lake possess active blow outs and a somewhat denser distribution of spruce.

A hand-level elevation survey of beach ridges at the east end of Kukaklek Lake, just east of the mouth of Moraine Creek, showed a very low gradient rising from the beach inland, rising about 8 meters over ~1.5 mile to the base of a higher, flat-topped landform. This landform likely represents a perched delta or outwash fan that was graded to a higher lake level. Hand-level sightings to other similar features in the area show the same elevation. These higher features all leveled in ~17.5 m above the present lake level. Vegetation changed distinctly along the lower, flatter surface, transitioning from sparse, low, lichen-dominated vegetation at the present beach into more Ericaceous plants (dominantly *Empetrum nigrum* or crowberry) and grasses growing in a thicker organic horizon. The sequence was terminated by ericad-dominated large hummocks near the base of the raised delta surface.

Part II: Lake Clark National Park and Preserve

Field work was conducted in Lake Clark through the month of August. Two field parties worked on separate components of the project. Graduate students Ann Maglio and Matthew Bowes surveyed beach ridge sequences and conducted soil surveys as a means of relative age dating on surfaces corresponding to paleolake surface elevations. A second party including Heiser, graduate student Brian Cohn and researcher Andy Krumhardt (UAF), was coring lakes as a collaborative effort between this project and Bruce Finney's (UAF) work on salmon history.



Beach Profile Surveys (methods): Transit level and stadial rod surveys, hand level transects, surface mapping, GPS, and barometric altimeter methods were all used to measure, map, and create surface profiles of beach ridge sequences surrounding Lake Clark. Surface elevations of other lake level related surfaces were also conducted using the transit or hand levels. Sites visited include all lakes cored in previous field seasons, and any place where observable paleobeach ridges and lake level features (deltas, fans) occurred.

Soil pits were dug on the surface of different relative age ridges to see if soil development can be used as a relative age indicator in other beach ridge studies and / or future archeological and geomorphic studies. Soils pits were opened, horizons identified, described, and sampled for laboratory analysis.

Preliminary elevations are included in Table 1 (below). Topographic profile construction is in progress and a draft regional profile is shown in Figure 8.

Lake Coring

Three lakes were cored in Lake Clark N.P. in late August. A deep core was attempted in Kontashibuna and approximately 3 meters were recovered in the longest core. Several overlapping cores and surface cores were also taken and the core tops extruded and packaged in the field. Sediment cores were also obtained from Hickerson Lake and from Portage Lake. These cores were taken as part of our study on the potential affects of alder invasion in higher elevation lakes that are not enriched with marine nutrients from salmon. The core from Kontrashibuna was obtained over two days from the coring platform, and the others taken from the floats of a plane. Cores from Hickerson and Portage were 1.2-1.8 m and core tops were extruded and sampled in the field. All cores showed promising and distinctive sediment layers as well as distinct volcanic ashes. These cores are now in Fairbanks and will be analyzed this fall by graduate student Brian Cohn.

All cores, sediments and soil samples are housed either at UAA or UAF and analyses and dating is underway at both labs.

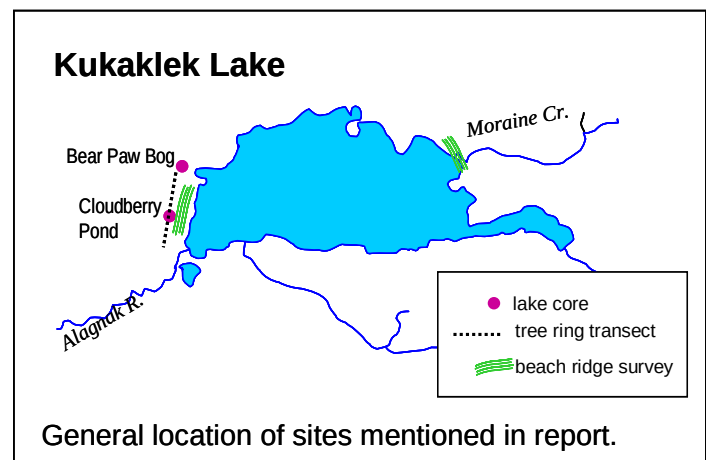
RESULTS AND CURRENT ACTIVITIES

Lake cores from in and around Nonvianuk, Naknek, and Kukaklek are currently being analyzed in the lab. Results should be available for many cores by March 2005. A more detailed report on field studies for Kukaklek Lake is included below. This portion of the report was also submitted to Bristol Bay Native Corporation, in return for access to their land at the west end of Kukaklek Lake.

Kukaklek Lake

Lake Level Changes

Field work at Kukaklek Lake in June 2004 was aimed toward determining the extent and timing of lake level change since deglaciation. Raised abandoned beach ridges, prominent at the east and west end of the lake, but visible all along the shore, clearly mark significant change in lake level. To determine the timing and rate of lake level change, we attempted to 1) measure vertical position (elevation) of paleo-shoreline features, and 2) date those features. The best way to date the timing of lake level drop is to date the change in sedimentation that occurs in small basins that were once inundated by the larger lake, and subsequently isolated when the large lake dropped below the rim of the basin. This process is recorded both in shoreline features surrounding the small lakes (Figure 1), and in lake sediments deposited in these now-isolated basins (Figure 2). The sediments, retrieved by coring the small lake, record the change from "large lake"



sedimentation (e.g. glacial clays, inorganic sediments) to small isolated pond sediments (highly organic). This transition in sedimentation can be dated by radiocarbon analysis on the first organic sediments to appear in the core (Figure 2), and tells us when the large lake dropped below this elevation.



Figure 1. Paleo beach ridges mark former surface of Kukaklek lake, and show how it once inundated small basins along the shore.

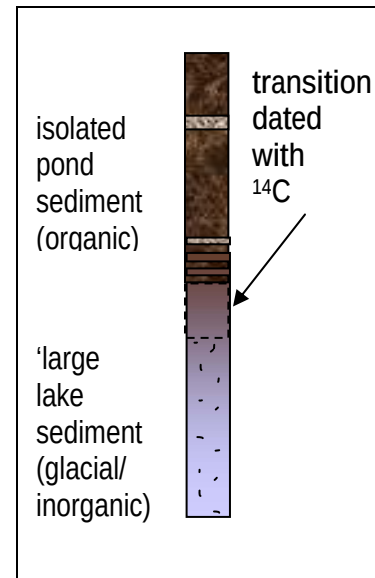


Figure 2. Representative core showing how transition from large lake to small pond can be used to date timing of lake level drop below threshold of the basin.

Several lakes, occupying different elevation beach ridges, were cored at the west end of Kukaklek Lake. The first lake, actually a bog named “Big Paw,” is perched ~12 meters above present lake level and near the northwest ‘corner’ of Kukaklek Lake. Approximately 120 cm of organic sediments were recovered in two cores, both ending with blue clay or sandy clay at the bottom, and showing a transition to organic sediments at the top.

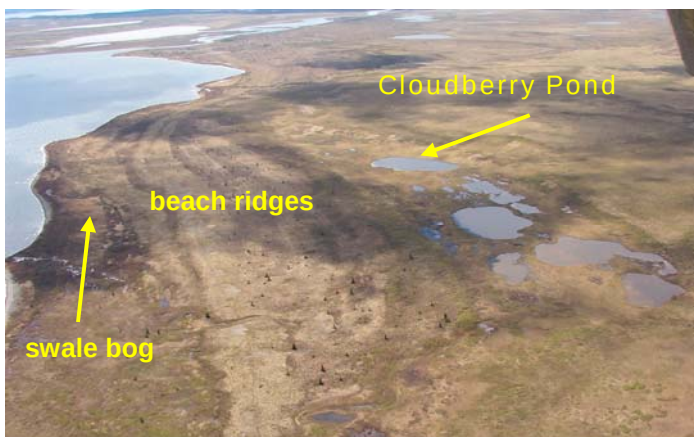


Figure 3. Location of “Cloudberry Pond on highest beach ridge. View from north with west shore of Kukaklek Lake seen to left.

Another shallow lake (informally named Cloudberry Pond), is centered on the highest (12 m) bench along the west end of the lake and was also cored (Figure 3). From here only about 50 cm of dense organic sediments and ash were recovered. A lower swale, ~3 meters above lake surface and located directly east of Cloudberry lake, contained bog sediments. Sediments in this swale were also composed of

dense organics with volcanic ash and bottomed in sand after ~ 72 cm. These cores are now stored at the University of Alaska.

In surveying the present shoreline of Kukaklek Lake, a number of observations suggest that lake level is currently rising, at least along the west



Figure 4. Encroaching storm berms bury vegetation and expose root mats.

end of the lake. The present beach seems to be transgressing (moving inland) over previously vegetated areas. This is evidenced by storm berms and ice-push ridges burying well-established vegetation, soils, and root mats (Figure 4). Large boulders located well 'offshore' and in the beach zone show remnants of lichen on the surface, and differential weathering marks where the soil line used to be (Figure 5).



Figure 5. Formerly buried rock has lichen surface and visible soil line.

At the east end of Kukaklek near the mouth of Moraine Creek, a hand-level elevation survey of beach ridges, showed a very low gradient rising from the present beach inland (Figure 6). The ridge elevations rose uniformly about 8 meters over ~1.5 miles to the base of a higher, flat-topped landform. This surface likely represents a perched delta or outwash fan that was graded to a higher lake level. Hand-level sightings to other similar features in the area show same elevation. These higher features all leveled in at approximately 17.5 m above the present lake level. Vegetation changed distinctly along the lower, flatter surface, transitioning from sparse, low, lichen-dominated vegetation at the

present beach into more Ericaceous plants (dominantly *Empetrum nigrum* or crowberry) and grasses growing in a thicker organic horizon. The sequence terminated in a zone of ericad-dominated large hummocks near the base of the raised delta surface.

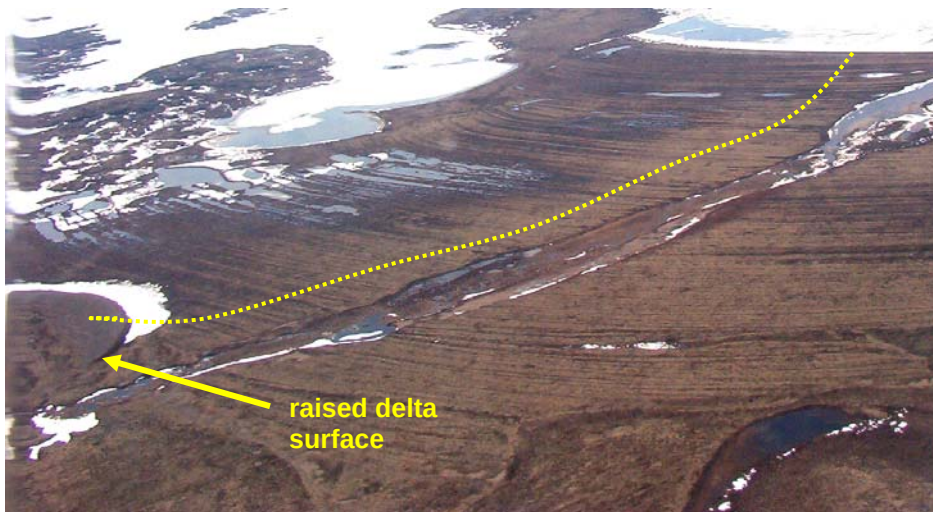


Figure 6. Low gradient beach ridges and higher delta surface near Moraine Creek, looking southeast. Dotted line approximate path of transect.

Vegetation Change

Spruce trees are widely spaced and appear to be colonizing along the west shore of Kukaklek. They are established only in isolated pockets around the lake and absent, in general, away from the Alagnak River. In a reconnaissance-scale attempt to determine the timing of spruce arrival at Kukaklek Lake, we cored a number of trees (n=30) along a roughly N-S transect running along the entire western shore of Kukaklek Lake from Big Paw Bog to the dunes at the head of the Alagnak River. We also cored trees along the southern shore of the lake. Most of the trees at the west end of the lake were growing on the highest terrace, and most exhibited a growth form of multiple successful sprouts starting at ~ 40-50 cm above ground level, and many dead ones surrounding the central stem (Figure 7). This form suggests that wind damage affected the trees, but that the damage was somehow mitigated by snow cover. By determining the age of the successful sprouts, as well as germination age of the tree, we may be able to identify factors contributing to both early colonization of spruce, and perhaps climatic changes, that allow successful shoots to make it past the abrasion zone at the snow surface. The dunes at the mouth of the lake possess active blow outs and a slightly more dense distribution of spruce. Initial field count of tree rings cores obtained at Nonvianuk Lake indicated a large cohort of trees that were ~95 years old. This may have corresponded to the Katmai 1912 eruption and suggests that spruce colonization in Katmai may be strongly affected by disturbance events.



Figure 7. Spruce trees exhibit growth forms that suggesting severe wind and snow cover as limiting factors.

Lake Clark Beach Surveys

Results of the beach profiles, lake elevations, and soils around Lake Clark are preliminary but show interesting trends in beach profile slope and elevation. This work is continuing and finalized elevations and profiles will be completed by March 2005. Lakes previously cored for lake level changes were surveyed to estimate lake-threshold elevation (Table 1).

Table 1. Elevations measured on lake thresholds and beach ridges around Lake Clark.

Thresholds	m above Present Lake Level
Swimmers Pond	11.8
Birch Hill Pond	10
Tommy Lake Pond	22.6
Olga's Pond	3.5
UP and Over(Escalante)	~9
Fish Lake	20
<u>Beach Ridges</u>	
Sophie's Bay	16
Chi Point) 52.38ft	
Delta surface	22
Escalante	3
Sucker Point	15.5

A draft comprehensive diagram showing beach ridge profiles and lake elevation is shown in Figure 8 below. Preliminary interpretations suggest that profiles are steeper on the northeast shore of the lake than on the SW shore. Further analysis and additional data will allow us to determine the importance of this potentially interesting pattern.

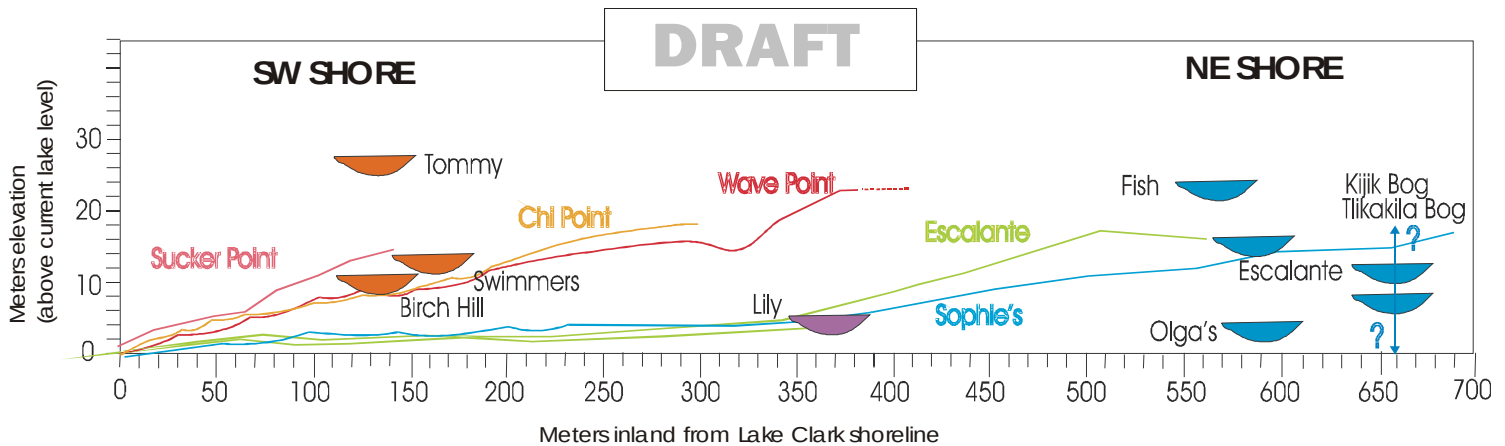


Figure 8. Draft comprehensive diagram of beach profiles and lake elevation around Lake Clark.

WORK IN PROGRESS

Cores are being split, described and analyzed in labs at UAA and UAF. At least 8-10 cores have been sampled for sediment analysis (organic carbon, isotopes, ^{14}C , magnetic susceptibility, and tephra analysis). Approximately 40 samples of tephra (volcanic ash) have been obtained and are presently being processed here at UAA, Alaska Volcano Observatory Tephra Lab, and at UAF Tephra Lab.

Heiser has submitted a proposal to the National Science Foundation Biocomplexity in the Environment Program that expands on this current project. With David Natcher of Memorial University, and Dan Mann, Scott Rupp, and Pamela Groves of UAF, we are proposing to look at the linkages between natural geologic, biologic, climatic, and human drivers to ecosystem change and response to change. The study encompasses the Lake Clark–Iliamna system and focuses on salmon as both an indicator and a driver of other system components. The proposal is for four years, requests ~1.8 million dollars, and provides support for one 4-year undergraduate fellowship for a student from Nondalton, as well as comprehensive public outreach and education. This project, if funded, should contribute to NPS efforts to monitor, understand, and mitigate changes in the Lake Clark ecosystems. A copy of the proposal is available upon request.

Student Theses

Currently there are three masters students beginning work on this project. One student, Brian Cohn, is funded dominantly through the project. The others (and Brian during some semesters) are supported at the university through teaching assistantships. Field work and analytical work for all students are funded through the project. The students presented their thesis proposals at the Cultural and Natural Resources meeting at NPS during March 9-12, 2004. In total four papers were presented, including an overview by P.I. Heiser followed by the three students each presenting their proposed thesis research.

In March 2005, Heiser will present another talk and graduate student Brian Cohn will present a poster on his research.

Abstracts from March 2004 meeting (overview of student thesis topics).

Paleoenvironmental Reconstruction and Landscape History of Southwest Area Network Parks: An Overview

Patricia Heiser, Department of Geology, University of Alaska Anchorage

In order to fully understand the dynamics of any ecosystem, it is important to have some knowledge of how that ecosystem developed through time, how it has changed in the past, and how it may change in the future. Landscape history studies such as the timing of deglaciation, location and timing of hydrologic connections or barriers, and the history of lake level change will provide a framework for understanding salmon population dynamics in terms of colonization, isolation, and bottleneck effects, as well as for the ongoing efforts to locate and date early human settlements in the area. Paleoenvironmental reconstruction using pollen and other indicators from lake sediment cores will provide a history of ecological succession and vegetation change since the last ice age. Volcanic history, also obtained from lake sediment cores, will allow us to construct a regional tephra stratigraphy useful for dating inorganic lake sediments, landforms, and archeological sites. The potential effects of ash fall into different lake systems can also be investigated through the study of such events in the sedimentary record.

Results to date include:

- Glaciers retreated from Lake Clark valley by ~15,000 yBP.
- A preliminary lake level history indicates that lake level lowering occurred early (probably prior to ~11,000 yBP) and took several thousand years.
- At least 6 tephras have been identified and dated, ranging in age from ~7,500 to 1,900 yBP.
- Exploratory research into using microbial DNA as sensitive indicators of environmental change in lake sediments shows initial success with the identification of 5 distinct microbial communities extracted from 5 different sediment facies.

Work is continuing on all aspects of this study and will expand into Katmai lakes in the summer of 2004.

Alder vs. Salmon as Sources of Nitrogen In Lake Systems: Potential Effects on Lake Productivity and Sediment Records Salmon History

Brian Cohn and Patricia Heiser, Department of Geology, University of Alaska Anchorage

Recent studies have used stable nitrogen isotopes (^{15}N) to reconstruct historical changes in salmon abundance. Nitrogen content of lake sediments has also been used as an indicator of lake productivity. While the potential influence of marine derived nutrients (dominantly N) from anadromous salmon, and the terrestrial input of nitrogen from vegetation have been investigated

in numerous studies, no attempt has yet been made to distinguish between the two sources or between the potential influence of these two different sources on lake productivity. A study of sediment record of Snipe Lake (in LCNPP) showed a response in lake productivity to an “alder rise” that occurred in the early Holocene (Hu et al. 2001). A similar “alder rise” is occurring today in Lake Clark and other regions of the state. This study will examine the different sources of nitrogen in lake systems by investigating the sedimentary record of N and other nutrients by comparing lakes dominated by alder vegetation, by salmon spawning, and a control lake that has neither alder or salmon as a source of nitrogen or other nutrients. This study will also allow comparisons between the climate driven ‘alder rise’ of the early Holocene and the one that appears to be occurring today.

Timing and Mechanism of Lake Level Change in Lake Clark

Ann Maglio and Patricia Heiser, Department of Geology, University of Alaska Anchorage

Lake Clark has experienced significant changes in lake level since deglaciation. The potential mechanisms behind lake level change include: 1) isostatic rebound following deglaciation, 2) downcutting of an outlet or dam (such as a moraine), or 3) tectonic activity. Because Lake Clark is subject to all of these potential drivers, a detailed spatial and temporal chronology of lake level history is required. This study will include the detailed elevation survey (surface profile construction) at numerous sites around Lake Clark including beach ridge sequences, delta surfaces, and abandoned stream outlets. These features will be dated using isolation pond sediments that record the transition from ‘large glacial lake’ sedimentation to “small isolated pond” sedimentation. Other methods of dating will include tephra chronology and radiocarbon dating of any material found in beach or delta sediments. Reconstruction and dating at numerous sites will allow us to determine there has been tilting, episodic versus gradual change, and differences in rate of change between sites. These data will provide tests of the hypotheses regarding mechanism of lake level change in Lake Clark, as well as a need framework for the timing of formation of outlet fans, deltas and shorelines. These later dates will aid in the reconstruction of salmon habitat and early human settlement patterns and resource use.

The Record and Potential Effect of Volcanic Ash Fall in Southwest Alaska Lakes

Matthew Bowes and Patricia Heiser, Department of Geology, University Alaska Anchorage

Lake Clark and other Lake in the Southwest Alaska Network (SWAN) have received numerous significant volcanic ash falls which are preserved and recorded in lake sediments. A study of these ashes (or tephra) will provide valuable information regarding the age of volcanic eruptions, geographic variability in thickness and mineral composition, and potential clues to source volcanoes. This study will also investigate the potential effects of ashfall into lakes of different size hydrologic regime. The major objective of the study is to establish a regional tephra stratigraphy using ashes embedded in organic lake sediments that can be easily and accurately dated. Morphologic characteristics such as grain size, mineralogy, and glass shard morphology will be determined for each major ash layer. Detailed geochemical and microprobe analyses will be conducted on selected samples. The potential effects of ash fall on lake ecosystems will be explored by analysis of lake sediments below and above tephra layers. In at least two lakes of different size and hydrologic regime (flow-through version ground water fed) the sediments above and below selected ashes will be analyzed for changes in diatoms, testate amoeba, pollen, and pore water/sediment geochemistry. The results of this study will provide 1) a regional tephra stratigraphy for use in dating inorganic lake sediments, landforms, and archeological features, 2) valuable data for ongoing studies of volcanic history and event history of Aleutian volcanoes, and 3) data on the potential effects of ashfall of different types into different lake systems.

PLANS FOR COMING YEAR

Laboratory work will continue on the cores that were collected in the Winter/Summer 2004 season. This includes all analyses discussed above. Additional coring will be attempted in the winter in Lake Clark National Park and Preserve. We hope to core Lake Clark itself and some possibly a lake up the Tlikakila valley. In Katmai we will core for a pollen record in the spruce zone near the Alagnak River, and also small lakes near Kukaklek and Brooks camp. Summer of 2005 will focus on finishing work in Katmai (Kukaklek beaches and Alagnak R), and 'clean up' work in Lake Clark as determined necessary after winter analyses are completed.

Appendix 1.

Progress on Selected Lakes, Field Sites, and Analyses

Lake cores split, described, and sampled for 14 C, magnetic susceptibility and tephra:

Tommy 1	(MS only)
Tommy 2	Escalante
Olga	Fish
Lily	

Cores currently being described, sampled, and processed for pollen record

Tommy 3

Cores sampled and analyzed for preliminary 14 C analysis

Escalante
Lily
Kijik
Tlikakila
Tommy
Olga

Cores described, sampled and analyzed for 15N, BSi, elemental analysis, and 14C

Kontrash
Hickerson

Example of MS and LOI data for Hickerson Lake

