A Summary of the Ongoing Paleontological and Associated Research on the Tongass National Forest

By

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Nearly ten thousand years ago, a family sat in the shelter of a rock overhang near the cave's entrance looking out west towards the sea on northern Prince of Wales Island. The land was in transition. The land had been free of ice for possibly 4,000 years. Much of the landscape may have escaped the glaciers advance completely. The tundra vegetation of willow, spruce, alder and birch were giving way to the encroaching hemlock, spruce, and cedar forest. The climate was becoming warmer and wetter compared to the colder drier climate in the recent past. The level of the sea rose each year, maybe as much as 6 feet in the 30 years of a lifetime. Brown bear, black bear, caribou, red fox, lemming, and heather vole hunted and fed across the landscape.

Such a snapshot of life in southern Southeast Alaska ten thousand years ago was not possible before 1990. It had been thought that ice covered the land to the continent's margin with only the peaks higher than 3,000 feet exposed. Discoveries in the caves on Prince of Wales Island have spawned a multitude of research into the prehistory and paleoecology of southern Southeast. This research coupled with research in the Queen Charlotte Islands of British Columbia, Canada and on the genetics of brown bears throughout Alaska is starting to fill in some of the pieces of the prehistory puzzle.

Kevin Allred made the first discoveries in 1990 in a newly discovered passage of El Capitan Cave. The floor of the passage was littered with bear bones. In 1991 Dr. Timothy Heaton, paleontologist from the University of South Dakota, and Frederick Grady, paleobiologist from the Smithsonian Institute came to sample bones within the passage. In 1992, the ``Hibernaculum', as the bone filled passage had become know, was dug into from the surface and Dr. Timothy Heaton, and Frederick Grady returned to recover the bones and excavate portions of the passage. The remains of 4 black bear ranging in age from 11,565 $\pm$ 115 years before present (YBP) to 6,415 $\pm$ 130 YBP, three brown bear ranging in age from 12,295 $\pm$ 120 YBP to 9,760 $\pm$ 75 YBP, as well as red fox, otter, ermine, bat, shrew, various rodents, and many species of fish were recovered. These discoveries suggested that the El Capitan valley was ice-free by at least 12,300 years ago. These discoveries also showed that brown and black bears coexisted on Prince of Wales Island for at least 1,800 years; brown bear no longer inhabit the island. In January of 1992, while surveying for bats with researchers from the University of Alaska, Fairbanks, an incisor of a marmot was found within Devils Canopy Cave. The incisor was beyond the age or limits of radiocarbon dating, which means that the tooth was older than 44,500 YBP.

The field season of 1993 resulted in the discovery of bones within Bumper Cave and On-Your-Knees Cave. In 1994 Dr. Heaton returned assisted by Dave Love to excavate Bumper Cave. Weather postponed the scheduled helicopter shuttle to the cave so Dr. Heaton and Kevin Allred hiked to On-Your-Knees Cave. Here, Dr. Heaton recovered the large brown bear femur discovered the previous summer by Kevin. Also collected was a tibia from a small black bear. These bones dated to 35,363 $\pm$ 794 and 41,600 $\pm$ 1,200 YBP respectively. These bones, and the marmot incisor from Devil's Canopy Cave, were the first remains discovered which predate the late Wisconsin glacial maximum (21,000-16,000 YBP) from southeastern Alaska. Dr. Heaton and Dave Love finally were flown to Bumper Cave and excavations began. The cave contained

the remains of at least nine brown bear, a caribou, and several voles but little else. Radiocarbon dates ranged from 11,567 ± 82 to 7,205 ± 67 years before present. The caribou dated to 10,515 ± 90 YBP and proved that once caribou roamed Prince of Wales Island. The youngest brown bear dated to 7,205 ± 67 YBP suggesting that the inhabitants of the Chuck Lake Site on Heceta Island (CRG-237) some 8,200 YBP and the Thorne River Site on Prince of Wales Island (CRG-177) some 7,500 YBP, contended with the presence of grizzly in everyday life. During cave explorations on Dall Island during the summer a nearly complete skeleton of a brown bear was discovered in Enigma Cave which yielded an age of 11,714 ± 118 YBP.

Dr. Heaton returned for a limited time in 1995 and sampled On-Your-Knees and Devils Canopy Cave further. Discoveries of importance from On-Your-Knees Cave included a jaw and ulna from a ringed seal which dated to 17,565 ± 160 YBP. This was our first faunal discovery that dated to the last glacial maximum (LGM) and also suggested pack ice existed off the shore of Prince of Whales at that time. A new discovery, Kushtaka Cave, was sampled and a bone spear point was found with the remains of two black bear. Later analysis found that the bear dated to over 8,500 years old while the bone point dated to 2,900 years old.

With the support of the USFS and a National Geographic Society grant, Dr. Heaton and Fred Grady returned for a focus effort of excavation of On-Your-Knees Cave in 1996. Systematic excavations during the field season made several exciting discoveries. First a chert projectile point was recovered. Then the remains of a human who was dated to 9,730 ± 60 and 9,880 ± 50 YBP. These human remains predate the oldest skeletal material known anywhere in Alaska by ca. 5,000 years. The horn core of a bovid was also discovered and identified as belonging to a Saiga antelope. The horn core was later dated to 32,000 ± 2,000 YBP. Associated with the human remains was a bone flaking tool which has been dated to 10,300 ± 50 YBP. This represents the oldest dated tool found to date along the northwest coast of North America.

The discoveries of 1996 allowed Dr. E. James Dixon to secure a large National Science Foundation Grant for archaeological excavations at the site. Dr. Heaton and Fred Grady returned with the second year's funding of their National Geologic Society Grant. With increased funding and logistical support from the USFS, major excavations were planned both inside and outside On-Your-Knees Cave during the 1997 field season. Archaeological excavations focused on the entrance area of the cave and found a deeply buried cultural level ca. 9,300 years old. Artifacts, flakes, fire-cracked rocks, and abundant charcoal were recovered from excavation. Additional cultural material was recovered within the cave. Paleontological excavations focused on defining the age of the stratigraphic units within the cave. Additionally, soil was sampled for pollen analysis and to determine the depositional environment.

In January of 1998, Zina Cave was first explored and bone deposits were found at many levels within the cave. During the 1998 field season, bone deposits were tested in Zina Cave. In the spring of 1998, Dr. Heaton was awarded a $300,000 National Science Foundation Grant to be used over a 3 year period as well as a $20,000 National Geographic Society Grant. Therefore, the field season will see both the paleontological and archaeological excavations expanded at On-Your-Knees Cave. The cave discovered on Wrangell Ranger District which contained bone deposits, was sampled as well.

The paleontological research is slowly adding pieces to the paleontological puzzle of southern Southeast Alaska. Analysis is focused on three time periods: Pre-, during, and post glaciation. To date the following mammals have been identified from the following time periods:

1.) Mammals before the Last Glacial Maximum (21,000-42,000 YBP)

Brown Bear, Black Bear, Hoary Marmot, Heather Vole, Brown lemming, and Siaga antelope.

2.) Mammals during the Last Glacial Maximum (13,000-21,000 YBP)

Ringed Seal. (Since these seals appear scavenged, it is probable that terrestrial mammals survived the LGM as well.)

3.) Mammals after the Last Glacial Maximum (2,000-13,000 YBP)

Brown Bear, Black Bear, Red Fox, Caribou, River otter, Ermine, Sitka Blacktail Deer, and Human.

In summary, Dr. Heaton writes in his Final Report to the National Geographic Society for his grant No. 5617-96, ``…eight species, which no longer inhabit Prince of Wales Island, have been discovered and suggest previous climatic conditions. Species such as caribou, red fox, marmot, lemming, and heather vole indicate much more alpine conditions prior to development of the dense rain forest that now dominates the archipelago. The only species dated to the Last Glacial Maximum itself is the ringed seal, which is a climatic indicator species for coastal sea ice. The recovery of fossil brown bears dating to before and after the Last Glacial Maximum, combined with genetic studies on living populations in the archipelago, suggests that this species occupied coastal refugia in the area throughout the Ice Age. Taken together, these findings provide the strongest support yet for the Coastal Migration Theory of human entry into North America.'

Other types of research are tied to the ongoing paleontological and archaeological surveys. From research within select caves around the world, it is known that speleothems (stalactites, stalagmites, and flowstone) hold in their chemistry a wealth of paleoecological data. Speleothems build up layer after layer over the centuries. Each layer, like the pages of a book, contains specific age and climatological data. By analyzing the thorium, lead, and uranium isotopes within the layers and age can be determined for that layer. The speleothems are formed from the same mineral as the wallrock of the caves, calcium carbonate (CaCO3). Isotope analysis of the oxygen within the carbonate molecule gives clues to the paleotemperature and vegetation of an area. This is because the caves mean temperature is equal to the mean average temperature of the surrounding landscape at any given time. As average temperatures fluctuate with the ebb and flow of glaciers and climate change, the oxygen isotopes within the calcium carbonate of the speleothems records the changes.

During the summer of 1998, USFS geologists and cooperators will be sampling speleothems from select caves for dating and paleotemperature determinations. These samples will be forwarded to Dr. Derek Ford of McMaster University of Hamilton, Ontario, Canada for dating and oxygen isotope analysis. This research couples well with ongoing research dealing with paleontology, archaeology, palynology (study of pollen), and glacial geomorphology.

Dr. Thomas Ager, Dr. Dan Muhs, Dr. Larry Phillips, and Josh Been with the U. S. Geological Survey, the Branch of Paleontology and Stratigraphy in Denver, Colorado cored bogs, peatlands, and lakes in hopes of securing a pollen record before and during the last glacial period. Dr. Muhs also sampled marine invertebrates from modern beach environments back to the raised beach deposits. He hopes to use the oxygen isotope data from the growth rings of butter clams (Saxidomus giganteus) of various ages to create a picture of past ocean temperatures which should correlate to the oxygen isotope data collected from the speleothems within the caves.

Dr. Heaton is also researching past diets and searching for ancient DNA. Several bear bones have been tested for ancient DNA by a researcher at UCLA, but so far none has been recovered. Stable carbon isotope values of fossil bones give an indication of an animal's diet, the lowest values being a terrestrial dominated diet and the highest values being marine

dominated. Based on the analysis, the expected d-13C values in the bone collagen of mammals would be approximately as follows: ≥-21% for exclusive terrestrial plant feeders, ≤-13% for exclusive marine fish feeders, and an intermediate value for mixed feeders, i.e. river otter show a -10% d 13C value suggesting a marine diet and deer show a -25.2% d 13C value suggesting a purely terrestrial diet. Comparing d 13C values for mammals today and their modern diets can help determine the diets of the mammals in the past. In turn this gives us clues to the climate and food availability over time.

To date, we have only sampled the deposits within eight caves, this is literally the tip of the iceberg. The combined efforts and research will slowly piece together the glacial history and paleoecology of southern Southeast Alaska for the first time.

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Also visit Dr. Timothy Heaton's website at http://www.usd.edu/~ theaton/alaska/

Table 1. Summary Table of the Samples Analyzed and Dated.

Date Number	Sample Identification	d13C %	14C Age (BP)
Beta-52709	El Cap, Fish Bone, Steam Room		5,770 +/- 130
AA-10450	El Cap, River Otter, Archaeological Site	-10.0	3,290 +/- 60
AA-10449	ECC-07, Fish Bone Surface		6,810 +/- 65
AA-11514	El Cap, Sediment #123, Fish Bone Deep	-13.2	8,535 +/- 70
AA-10445	ECC-03, Brown Bear	-18.3	12,295 +/- 120
AA-7794	ECC-02, El Cap, Large Brown Bear	-18.0	9,760 +/- 75
AA-10448	ECC-06, El Cap, Black Bear (Juvenile Cranium)	-18.7	11,565 +/- 115
AA-10446	ECC-04, El Cap. Black Bear (Complete Skull)	-20.0	11,540 +/- 110
AA-07793	ECC-01, El Cap, Black bear, Complete Skeleton	-21.1	10,745 +/- 75
AA-10447	ECC-05, El Cap, Black Bear, fused cranium	-22.1	6,415 +/- 130
AA-10451	BWI-1, Juvenile Brown Bear	-18.5	9,995 +/- 95
	BWI-2, Juvenile Brown Bear		undateable
AA-15222	Bumper Cave, Brown Bear 1, rib fragment	-17.8	11,567 +/- 82
AA-16553	Bumper Cave, Brown Bear 1, rib fragment	-17.8	11,727 +/- 118
AA-15223	Bumper Cave, Brown Bear 2, humerus	-16.8	11,226 +/- 109
AA-15225	Bumper Cave, Brown Bear, large molar	-19.5	10,970 +/- 86
AA-15224	Bumper Cave, Brown Bear 3, lower jaw	-17.9	7,205 +/- 67
AA-18449	Bumper Cave, Caribou, metacarpal	-19.1	10,515 +/- 90
AA-16831	On Your Knees Cave, Black Bear 1, tibia	-20.7	41,600+/- 1,500
AA-21570	On Your Knees Cave, Black Bear 2, vertebra	-20.8	29,820 +/- 400
AA-21569	On Your Knees Cave, Black Bear 3, calcaneum	-20.7	28,700 +/- 360
CAMS-31068	On Your Knees Cave, Black Bear 4, dentary		3,970 +/- 50
AA-15227	On Your Knees Cave, Brown Bear 1, femur	-15.9	35,363 +/- 794
AA-21567	On Your Knees Cave, Red Fox 1, partial skeleton	-16.0	11,275 +/- 90
CAMS-31069	On Your Knees Cave, Deer 1, pelvis		5,250 +/- 60
CAMS-33980	On Your Knees Cave, Ringed Seal 1, ulna		20,670 +/- 80
AA-22884	On Your Knees Cave, Ringed Seal 1, humerus	-11.5	20,060 +/- 500
	On Your Knees Cave, Ringed Seal 1, ulna	-14.1	19,060 +/- 275
AA-18450	On Your Knees Cave, Ringed Seal 1, ulna	-14.7	17,565 +/- 160
AA-21564	On Your Knees Cave, Ringed Seal 2, humerus	-14.9	13,690 +/- 240
AA-21565	On Your Knees Cave, Marmot 1, incisor	-21.3	32,900+/- 2,400
AA-21566	On Your Knees Cave, Marmot 2, incisor	22.4	23,560 +/- 770
AA-22883	On Your Knees Cave, Bovid horn core, Siaga Antelope	-20.3	32,000+/- 2,200
CAMS-42381	On Your Knees Cave, Flaking tool, (?) bear rib	-21.1	10,300 +/- 50
AA-21568	On Your Knees Cave, River Otter 1, juvenile skull	-12.1	1,990 +/- 90

CAMS-29873	On Your Knees Cave, Human 1, jaw	-12.5	9,730 +/- 60
CAMS-32038	On Your Knees Cave, Human 1, pelvis		9,880 +/- 50
CAMS-43991	On Your Knees Cave, Cultural Layer, inside cave		8,760 +/- 50
CAMS-43990	On Your Knees Cave, Cultural Layer, 2m outside cave		9,210 +/- 50
CAMS-43989	On Your Knees Cave, Cultural Layer, 4m outside cave		9,150 +/- 50
	Puffin Grotto, Whale vertebra		5,115 +/- 100
AA-15226	Enigma Cave, Brown Bear humerus, complete skeleton.	-16.0	11,714 +/- 118
AA-10574	Nautilus Cave, deer humerus	-25.2	8,180 +/- 70
AA-17415	Kushtaka Cave, Black Bear, femur	-23.2	8,725 +/- 70
CAMS-24378	Kushtaka Cave; Black Bear, rib		8,660 +/- 70
CAMS-27263	Kushtaka Cave, Bone Point		2,900 +/- 00
AA-8871A	Devils Canopy Cave, Marmot, incisor	-23.7	> 44,500

Table 2. Summary of Excavations and Discoveries.

1990 Bear bones discovered in El Capitan Cave.

1991 Dr. Heaton and Fred Grady sample the bones from El Capitan Cave. USFS supports sampling.

1992 The ``Hibernaculum' in El Capitan Cave was excavated into and systematic sampling and recovery of bones began. Marmot remains found in Devils Canopy Cave. 2 juvenile brown bear recovered from Blowing-in-the-Wind Cave. Dr. Heaton was operating on a small grant form the National Geographic Society and USFS support.

1993 Bones Discovered in On-Your-Knees Cave and Bumper Cave.

1994 Dr. Heaton and Dave Love returned to excavate Bumper Cave. Dr. Heaton and Dave Love work under a National Speleological Society Grant and USFS support. Kevin Allred and Dr. Heaton do limited sampling in On-Your-Knees and Devil's Canopy Caves. Bear Remains discovered on Dall Island.

1995 Dr. Heaton returned and samples On-Your-Knees Cave, Devils Canopy, and Kushtaka Cave. Bear remains removed from Enigma Cave on Dall Island. Dr. Heaton works with USFS support.

1996 Dr. Heaton, Dave Love, and Fred Grady return to focus excavations on On-Your-Knees Cave. Human remains and chert point recovered. Dr. Heaton and Fred Grady work under a National Geographic Society Grant and USFS support.

1997 Dr. Heaton, Fred Grady, and Dr. E. James Dixon return working under a National Science Foundation Grant and USFS support. Dr. Dixon focuses on the cultural deposits and Dr. Heaton and Mr. Grady on the paleontological deposits. Cave discovered on Wrangell Ranger District with bone deposits.

1998 Zina cave discovered and bone deposits found. Dr. Heaton, Fred Grady, and Dr. E. James Dixon return working under a National Science Foundation Grant, a National Geographic Society Grant, and USFS support. Dr. Dixon will expand the cultural deposit excavations and Dr. Heaton and Mr. Grady the paleontological sampling. The cave on the Wrangell Ranger District and Zina Cave will be sampled as well.

(Note: There have been many individuals who have helped with the excavations at these sites. Though it would not be practical to list them all, recognition must be given to Kevin Allred, Dave Love, Steve Lewis, Pete Smith, Dan Monteith, volunteers from Port Protection/Point Baker and Whale Pass, and many USFS employees.)

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