Paleontological Inventory of Cretaceous Rocks – Bryce Canyon National Park
Final Report for 2006-2007

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Introduction

For the past two years I, along with my students and, in 2007, a GeoCorp participant and a student from the local high school, have undertaken an inventory of the Cretaceous rocks within and along the margins of Bryce Canyon National Park. This is a long term project intended to help with resource management of paleontological resources in the park and to aid in the integration of this resource with interpretation presented to the public at BCNP.

The field aspect of this process has involved surface prospecting for fossil localities, collected of macrofossils, collection of rock to be processed for microfossils, and the processing of rock to extract microfossils. In the field and back in the laboratory fossils are picked and sorted from the processed rock. All fossils are then catalogued into the collections at the Utah Museum of Natural History (Salt Lake City) with duplicate National Park Service numbers (BRCA numbers).

Material that is considered worthy of future research is either studied by me and my students, or is transferred to many researchers throughout the world (see below). This will, over time, generate a considerable scientific literature regarding the paleontology of Bryce Canyon National Park.

Fieldwork Progress

During the 2006 field season we covered the southernmost part of the park (see Fig. 1). We had planned an orderly northward progression during the 2007 field season, but heavy rains and washed out roads made it necessary to visit accessible areas rather than the simple northward progression we had planned. Nonetheless, we managed to extend the field prospecting considerably north of where we had concluded in 2006.

In the 2006 field season 24 new fossil localities were discovered in BCNP and an additional 8 along the margins of the park in USDA Forest Service lands. During the 2007 field season we located 21 new fossils localities in BCNP, 20 new localities on adjacent Forest Service Lands, and 7 localities on adjacent lands of the Grand Staircase-Escalante National Monument. The kinds of fossils recovered from each locality within BCNP can be found as a popup on the accompanying digital geological map of the park, and as an appendix to this report.

To this point we have prospected about 60% of the park for fossils (see Fig. 1).

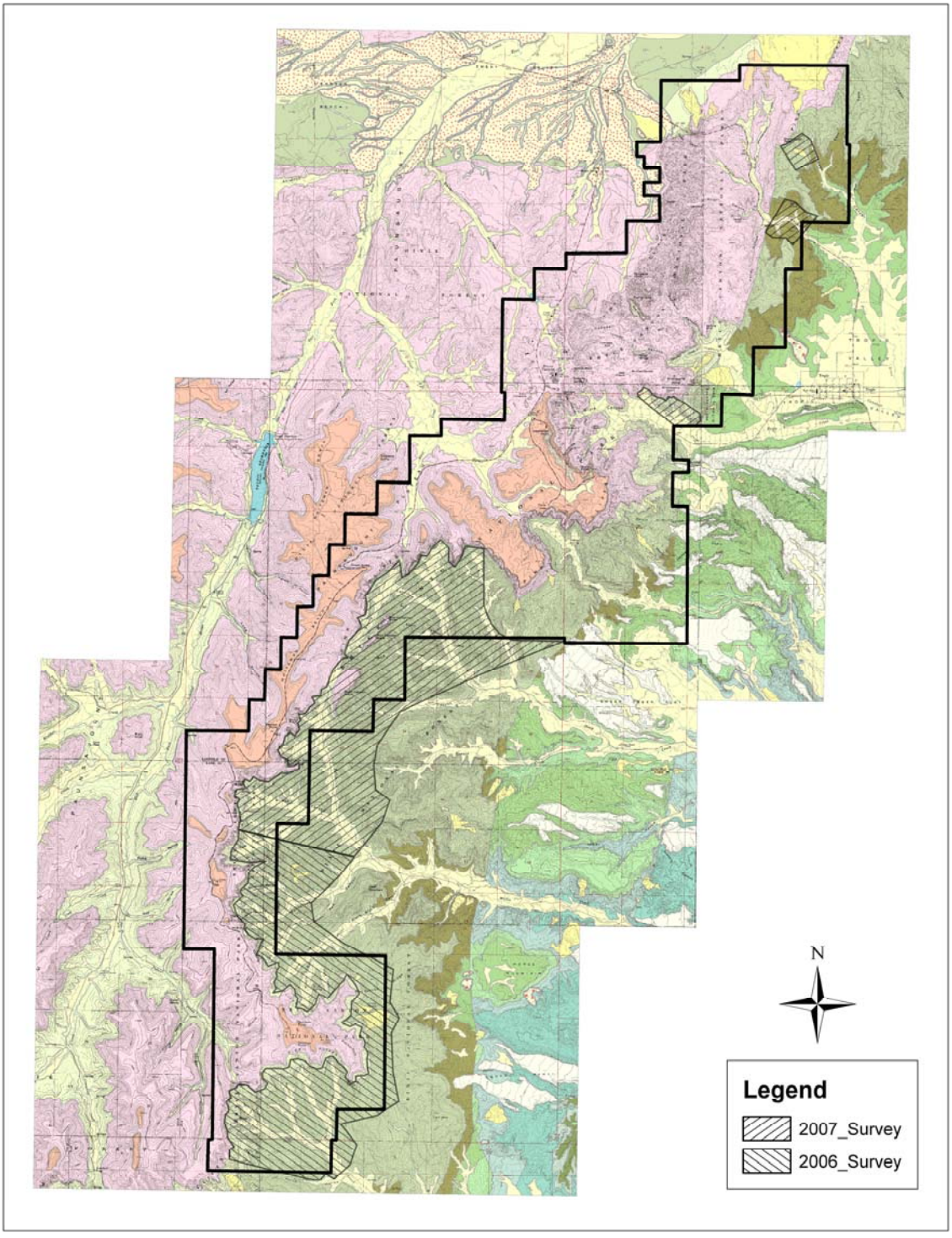

Figure 1. Geologic Map of BCNP with areas covered during the 2006-2007 field seasons.

Laboratory and Curation Progress

All of the samples collected within BCNP or on adjacent lands have been picked for microfossils, except for a few samples that require additional chemical processing (we ran out of hydrogen peroxide prior to the end of the 2007 field season). These remaining samples will be reprocessed at the beginning of the 2008 field season.

All materials collected within BCNP during the 2006-07 field seasons have been catalogued into the Utah Museum of Natural History (UMNH) collections. Over 800 BRCA numbers have been assigned to the specimens collected in BCNP. Two cabinets were purchased to house these specimens at UMNH and specimens not actively being studied will be transferred there.

Some of our larger collections come from localities adjacent to BCNP, most commonly on USDA Forest Service lands. All of the 2006 material has been catalogued, but a considerable portion of the 2007 materials remains to be catalogued. It will be a somewhat longer process to get all of these materials catalogued (the material from within BCNP has priority).

A complete electronic catalogued of BRCA numbers (Park Service catalogue system) will accompany this report on CD Rom.

Research Progress

At the end of the 2007 field season, the best terrestrial microvertebrate locality of Santonian age in our hemisphere, UMNH VP Locality 424, was closed. We removed 24 sacks of matrix from the locality in 2006, and an additional 27 in 2007 (also, sacks had been removed from the locality for several years prior to the paleontology inventory). The size of the quarry was making it obvious (the locality is visible from the Under-the-Rim Trail), as we decided to backfill the locality. I will begin research on the mammals from this locality will this year, and other aspects of the fauna will be studied by other researchers (see below).

Collections of gastropods from two major gastropod producing localities have been sent to Dr. Joseph Hartman, the leading North American expert on fresh water mollusks, for study. The frog material will be studied by Dr. Zbyněk Roček (Czech Academy of Sciences, Prague). A student of his will come here early in the summer of 2008 to sort out frog material and hand carry it back to the Czech Republic. I will go the Czech Republic in the fall of 2009 to help complete our research on the frogs and will present the results of our studies at a conference in Bristol, England (this aspect of our research is being funded by a joint America-Czech scientific agreement).

Ostracodes (small two-valved arthopods) were recovered from several localities and Dr. Neil Tibert at the University of Mary Washington (Fredericksburg, VA) will study these specimens which have been sent to him. Excellent specimens of fish vertebrae and other bones were recovered and have been loaned to Dr. Don Brinkman (Royal Tyrell Museum of Paleontology, Drumheller, Canada). I will hand carry additional material to the Royal Tyrell Museum in June, 2008, for study by him and some non-frog amphibians for study by Dr. Jim Gardner (also at the Royal Tyrell Museum). The lizard material is being studied by Dr. Randy Nydam at Midwestern University.

Recent Research Outcomes

Three student papers have been presented at Geological Society of America meetings, these are listed below:

Jenkins, J., 2008, Petrology of sandstones from the John Henry member, Straight Cliffs Formation, Late Cretaceous, southern Utah: Geological Society of America, Abstracts with Programs, Rocky Mountain and Cordilleran Section Meetings, v. 40, no. 1, p. 69. Also presented at WSU Fifth Annual Undergraduate Research Symposium, March 24, 2008.

Barwick, C., Baker, J., Jenkins, J., Hawkins, K., and Waite, C., 2008, Faunal analysis of five nonmarine microvertebrate localities, Late Cretaceous, southern Utah: Geological Society of America, Abstracts with Programs, Rocky Mountain and Cordilleran Section Meetings, v. 40, no. 1, p. 69-70. Also presented at WSU Fifth Annual Undergraduate Research Symposium, March 24, 2008.

Emerson, R., 2007, Petrology of the Cretaceous Straight Cliffs-Wahweap Formations Transition, southern Utah. Geological Society of America, Abstracts with Programs, Rocky Mountain section meetings, v. 39(5), p. 13. Also present at the WSU Fourth Annual Undergraduate Research Symposium.

Eaton presented a paper on the Bryce Canyon National Park Paleontology Inventory at the Geological Society of America meetings in St. George, Utah, May, 2007 (text included in Appendix II).

Eaton, J.G., 2007, Bryce Canyon National Park Paleontological Inventory – A model for undergraduate science education: Geological society of America, Rocky Mountain Section Annual Meeting, Abstracts with Program, v. 39, no. 5. p.15

Eaton has also given talks at Bryce and UFOP (Utah friends of Paleontology) about the inventory in April, 2008 and a presentation at BCNP to the general public in August, 2006.

Shayne Pearce, a WSU student, is doing under an undergraduate research project on UMNH IP Locality 24 over the next year. This is a brackish water locality in the Smoky Hollow Member of the Straight Cliffs Formation which was discovered during the 2007 field season. We screen washed the locality which produced an interesting association of vertebrates (fish, sharks, rays, crocodylians), invertebrates (ostracodes, bivalves, gastropods). Brackish water localities are not usually screen-washed, so we believe these associations represent a new way to look at brackish water localities. Shayne intends to present the results of his study at the Rocky Mountain Section of GSA in 2009.

The GeoCorp student who worked with me in the park during the 2007 field season, Cory Redman (Texas A&M University) will undertake part of his Ph.D. research in the park and has applied for funding from the National Science Foundation and National Geographic Society to continue his work. He will undertake a faunal analysis of both

UMNH VP Locality 424 and a locality at Mill Creek, just outside of the park boundary. This will involve material collected from Bryce Canyon National Park in a long term study of ancient paleoecology.

Future Work

As currently planned, in the 2008 field season I along with 2 students and a GeoCorp participant will spend a month continuing the paleontology inventory. We will fill in some of the small weather related voids remaining from the 2007 field season, revisit a few critical localities discovered in 2007 (e.g. UMNH VP Locality 820, the best yet found in the Coniacian of the region), and continue to look at areas to the north. We will also revisit some localities discovered years ago in Pasture Wash that have never been well sampled to assess their long term potential. We would hope to complete the survey during the 2009 field season.

Material Provided to BCNP – May, 2008

1. Final report (hardcopy and digital).
2. Complete printout of 2006 and 2007 localities (hardcopy).
3. Large scale geologic map with all BCNP localities plotted (hardcopy).
4. Digital version of geologic map with pull down windows for each locality indicating kinds of fossils recovered from that site (file type mxd = ArcMap document file).
5. Digital version of the 2007 field notes (2006 field notes were submitted last year).
6. Digital version of the BRCA catalogue indicating all catalogued specimens with Park Service and equivalent UMNH catalogue numbers.

Material Provided to CPCESU – May, 2008

1. Summary Abstract, Annual report (hardcopy and digital).

APPENDIX I

Kinds of fossil materials recovered from new localities found with BCNP, 2006-07.

Material catalogue after 2006 field season:

UMNH VP 569 – John Henry Member, Straight Cliffs Formation
Invertebrates
  Arthropoda
    Ostracodes
Vertebrates
  Fish
    Chondrichthyes - sharks
    Lepisosteiformes - gars
    misc. teleosts
  Turtle
  Crocodiles
  Dinosaurs (theropods)
  Mammals
    Multituberculata

UMNH VP 772 – Wahweap Formation
Invertebrates
  Gastropods
  Bivalves
Vertebrates
  Chondrichthyes – sharks and rays
  Crocodiles
  Turtles
  Dinosaurs – hadrosaur

UMNH VP 773 – Wahweap Formatiomn
Invertebrate
  Bivalves
Vertebrates
  Chondrichthyes – ray
  Lepisosteiformes – garpike (abundant scales)
  Crocodile
  Mammal (tooth fragments)

UMNH VP 774 – Wahweap Formation
Vertebrates
Turtle
indent. vertebrae

UMNH VP 775 – Drip Tank Member, Straight Cliffs Formation
Vertebrates
Turtle
Dinosaur

UMNH VP 776 – Wahweap Formation
Invertebrates
Gastropods (abundant)
Ostracodes
Vertebrates
Fish
Chondrichthyes - sharks
Teleosts – amiid – *Melvius*?
Turtle
Lizards
Crocodiles
Dinosaur – hadrosaur
Mammals
Multituberculates
Marsupials

UMNH VP 777 – John Henry Member, Straight Cliffs Formation
Vertebrates
Coprolite (vertebrate trace fossil)
Turtle – *Neoclemys* sp.
Dinosaur indeterminate

UMNH VP 778 - John Henry Member, Straight Cliffs Formation
Vertebrates
Turtle
Indeterminate vertebra

UMNH VP 779 – Wahweap Formation
Vertebrates
Turtle

UMNH VP 780 – Wahweap Formation
Invertebrates
Gastropods (poorly preserved)
Vertebrates
Turtle
Crocodile

UMNH VP 783 – Wahweap Formation
Invertebrates
Bivalves
Gastropods
Ostracodes
Vertebrates
Chondrichthyes – sharks and rays
Teleosts
Mammals
Multituberculate tooth fragment

UMNH VP 785 - John Henry Member, Straight Cliffs Formation
Vertebrates
Turtle

UMNH VP 786 - John Henry Member, Straight Cliffs Formation
Vertebrates
Turtle – *Neoclemys* sp.

UMNH VP 787 – Drip Tank Member, Straight Cliffs Formation
Vertebrates
Dinosaur – hadrosaur
misc. vertebrate material

UMNH VP 789 – Wahweap Formation
Vertebrates
Dinosaur?

UMNH VP 790 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Fish – *Lepisosteus* scale (gar)
Turtle
Dinosaur – hadrosaur (teeth)

UMNH VP 791 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Fish – *Lepisosteus* scale (gar)
Turtle
Crocodile (tooth)

UMNH VP 792 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Fish
Chondrichthyes – rays
Turtle
Crocodile
Dinosaurs
Mammals – multituberculate

UMNH VP 793 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Turtle
Crocodile
Dinosaur

UMNH VP 794 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Fish
Chondrichthyes – sharks and rays
Teleosts
Turtle
Crocodiles
Dinosaur – theropod
Mammals – multituberculates

UMNH VP 795 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Fish
Chondrichthyes – sharks and rays
Turtle
Crocodiles
Herptiles (lizards and small amphibians)
Dinosaur – hadrosaur

UMNH VP 796 - John Henry Member, Straight Cliffs Formation
Vertebrates
Turtle

UMNH VP 797 - John Henry Member, Straight Cliffs Formation
Vertebrates
Fish
Turtle
Dinosaur

UMNH VP 800 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Dinosaur (limb bones)

UMNH VP 801 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Turtle
Crocodiles

UMNH VP 802 – Wahweap Formation
Invertebrates
Gastropods
Vertebrates
Crocodile
Dinosaur

UMNH VP 803 – Wahweap Formation
Vertebrates
Turtle
Dinosaur - hadrosaur

UMNH IP 21 – Wahweap Formation
Invertebrates
Gastropods
Bivalves

UMNH IP 22 – Wahweap Formation
Invertebrates
Gastropods
Bivalves

UMNH PB 27 – John Henry member, Straight Cliffs Formation
Plantae
Leaf impression

UMNP PB 28 – Wahweap Formation
Plantae
Fossil leaves

Material catalogue after 2007 field season:

UMNH VP 417 – Straight Cliffs Formation, John Henry Member
Invertebrata
Bivalves

UMNH VP 424 Vertebrata - Straight Cliffs Formation, John Henry Member
Chondrichthyes (cartilaginous fish)
Shark
Teleost (bony fish)
Amphibia
Frogs
Reptilia
Lizards
Crocodylians
Turtle
Theropod dinosaur
indeterminate
Mammals
Multituberculates
Marsupials

UMNH VP 786 - Straight Cliffs Formation, John Henry Member
Plantae
Fossilized wood

UMNH VP 805 - Straight Cliffs Formation, John Henry Member
Vertebrata
  Osteichthyes
        Lepisosteus (fish)
  Reptilia
        Turtle
        Crocodylian

UMNH VP 806 – Wahweap Formation
Invertebrate
   Arthropoda
        Ostracodes
Vertebrata
    Chondrichthyes
        Rays
    Reptilia
        Crocodylians
        Dinosaur

UMNH VP 807 – Wahweap Formation
Vertebrata
   Chondrichthyes
        rays
   Reptilia
        Lizards
        Crocodylians
        Theropod dinosaur
        indeterminate

UMNH VP 808 - Straight Cliffs Formation, John Henry Member
Vertebrata
   Chondrichthyes
        rays
   Reptilia
        Lizards
        Crocodylians
        indeterminate

UMNH VP 809 - Straight Cliffs Formation, John Henry Member
Invertebrata
Gastropods
Vertebrata
Chondrichthyes
rays
Reptilia
Theropod dinosaur
indeterminate

UMNH VP 813 – Wahweap Fm.
Vertebrate
Reptilia
Turtle

UMNH VP 814 – Wahweap Fm.
Vertebrata
Reptilia
Turtle
Crocodylian

UMNH VP 828 – Drip Tank Member, Straight Cliffs Fm.
Plantae
Fossil wood
Vertebrata
Reptilia
Turtle
indeterminate

UMNH VP 829 - Straight Cliffs Formation, John Henry Member
Vertebrata
Reptilia
Turtle
indeterminate

UMNH VP 833 - Straight Cliffs Formation, John Henry Member
Vertebrata
Reptilia
Dinosaur
Indeterminate

UMNH VP 834 – Drip Tank Member, Straight Cliffs Fm.
Vertebrata
  Osteichthyes
        Lespisosteus (fish)
  Reptilia
        Turtle
        Crocodylian
        indeterminate

UMNH VP 835 - Straight Cliffs Formation, John Henry Member
Vertebrata
  Reptilia
        Turtle
        Crocodylian
        indeterminate

UMNH VP 836 - Straight Cliffs Formation, John Henry Member
Vertebrata
  Reptilia
        Turtle
        Crocodylian

UMNH VP 840 - Straight Cliffs Formation, John Henry Member
Invertebrata
   Bivalvia (clams)
Vertebrata
  Osteichthyes
        Lespisosteus (fish)
  Reptilia
        Turtle
        Indeterminate

UMNH VP 841 - Straight Cliffs Formation, John Henry Member
Vertebrata
  Reptilia
        Turtle
        Crocodylian

UMNH VP 846 - Straight Cliffs Formation, John Henry Member
Vertebrata
- Chondrichthyes
  - rays
- Reptilia
  - Turtle
  - Crocodylian
  - Dinosaur
  - Indeterminate

UMNH IP 24 – Smoky Hollow Member, Straight Cliffs Fm.
Invertebrata
- Arthropoda
  - Ostracodes
- Gastropoda
- Bivalves
  - Clams
  - Oysters

Vertebrata
- Chondrichthyes
  - Rays
  - Sharks
- Osteichthyes
  - *Lepisosteus*
  - Amiid
- Reptilia
  - Crocodylian

UMNH IP 25 - Straight Cliffs Formation, John Henry Member
Invertebrata
- Bivalves

UMNH IP 26 - Smoky Hollow Member, Straight Cliffs Fm.
Invertebrata
- Bivalves (oysters)

Appendix II

Text of Eaton, J.G., 2007, Bryce Canyon National Park Paleontological Inventory – A model for undergraduate science education: Geological Society of America, Rocky Mountain Section Annual Meeting, Abstracts with Program, v. 39, no. 5. p. 15:

Public lands inventories are ideally suited to undergraduate science education. The results of such inventories may or may not lead to significant discoveries or the data may not be adequate for research until a study is completed which may take many years. In this regard, inventories are often not well suited to graduate students who need short term and well-defined significant research projects for their theses. However, inventories are well suited to undergraduates because they learn the processes used in undertaking research and are not looking for thesis scale research projects. Inventories can teach students process and methods as well as provide an almost endless supply of topics appropriate for undergraduate research. I am currently involved in a paleontological inventory of the Cretaceous rocks of Bryce Canyon National Park. There is both a field and laboratory component to this project. During the field season students do extensive measuring of stratigraphic sections, rock description, sampling, prospecting for fossils and making documented collections. Fossil collecting has involved surface collection, extracting large specimens from matrix in the field, and the collecting of matrix to process for microfossils. Field data is collected both by taking traditional field notes and by using GPS instruments and digital imagery. The laboratory aspect of the project involves sorting of field collections, sorting of concentrate produced by screen-washing of microfossil samples, identification of fossils, cataloguing of fossils, petrographic analysis of rock samples, drafting of stratigraphic columns, and generating a GIS data base. In the first year of the project five undergraduate students participated in the field work and eight have been involved in the laboratory aspect of the project. As a result of the first year of the inventory, two undergraduate research projects have developed and there is almost an unlimited potential for other undergraduate projects. In subsequent years students will have the opportunity to build on the previous work of their colleagues and learn that science is an ever evolving process dependent upon the work of other researchers.