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Survey of paleontological research/interpretive centre best practices based on site visits August-November 2016

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Contents

To survey best practices of fossil resource management and operations relevant to proposed development at the McAbee Heritage site, I visited a series of paleontological localities/facilities in western USA and Canada in August through October 2016. These include the Hagerman Horse Fossil Beds National Monument (Idaho), Fossil Butte National Monument (Wyoming), Dinosaur National Monument (Utah and Colorado), The Cleveland-Lloyd Dinosaur Quarry (Utah), the Florissant Fossil Beds National Monument (Colorado), John Day Fossil Beds National Monument (Oregon), and the Royal Tyrell Museum (Alberta). In November 2016, I attended a conference in Denmark for promoting and strategizing procedure for their application to UNSECO for World Heritage status for the Danish Mo-Clay fossil locality. My findings follow.

Part 1: Information from localities surveyed

Hagerman Horse Fossil Beds National Monument, Idaho

https://www.nps.gov/hafo/index.htm

Hagerman Fossil beds National Monument
Minidoka National Historic Site
P.O. Box 570, 221 N. State Street
Hagerman, Idaho 83332
Phone: (208) 933-4110
Fax: (208) 837-4857

Winter Hours: from the Tuesday following Labour Day (September 6, 2016) the Visitor Center is open Thursday through Monday, 9:00 a.m.–5:00 p.m., closed every Tuesday and Wednesday until Memorial Day (May 29, 2017).
Summer Hours: Memorial Day (May 29, 2017) through Labour Day (September 4, 2017), it is open every day, 9:00 a.m. to 5:00 p.m. It is open all federal holidays except Thanksgiving, Christmas Eve (12/24), Christmas (12/25), Christmas Day Observed (12/26), New Year's Day (1/1) and New Year's Day Observed (1/2). Access to the Monument closes at dusk.

I met with the Park Superintendent Judy Geniac and Chief Paleontologist/Curator Dr. Kari Prassack.

Site description, background, and infrastructure

The park is protected as a federally-owned National Monument within the US National Parks system. It has 4,351 acres (1,761 ha) in southern Idaho along the Snake River close to Interstate 84. The park has been in existence 25 years. It is operated jointly with the Minedoka National Historic Site (Japanese internment interpretive centre). There is an administration building and an exhibit/educational outreach building in the nearby town of Hagerman (offsite). There are temporary buildings for a research centre, collections storage, fossil preparation, archives, and maintenance, also offsite, in a location outside of town across the river from the park on rented land. There is little infrastructure within the park: a boardwalk with some signage at a lookout point, a small outdoor structure with covered seating for presentations, and a trail system with some signage. Hagerman has a $1.3 million yearly operational budget (not including project money).

There are ten staff members for the two combined parks (Hagerman and Minedoka). The staff consists of a Park Superintendent, a Chief Paleontologist-Curator, an Administrative Officer, a Chief of Maintenance plus two assistants, Chief of Integrated Resources (interprets government acts that affect policy and does liaison with First Nations), Interpretation Officer (see US Parks job descriptions for paleontological National Monuments summarised below in part 2). They don't currently have an

Interpretation Officer; one starts soon. They aren't doing ranger interpretive talks yet. They have an Education Specialist, who is the media and volunteer coordinator, goes out to schools for offsite education activities, working under the Interpretation Officer. There is an IT person onsite works for numerous regional parks, but happens to be stationed here.

They are understaffed. There should be a collections manager, a full-time, trained, preparator, and a museum technician/assistant curator (database work, specimen labelling), and a staff geologist. These have been six month temporary positions, but the positions are vacant now. Some untrained work is done by students brought in by GeoCorp of America on three month contracts, paid a small amount through Parks, GeoCorp, and other bodies http://rock.geosociety.org/g_corps/index.htm . They contract an archivist to care for field forms, notebooks, *etc*. There is currently no law enforcement person, although illegal access is indicated by footprints at the fossil horse quarry. Illegal collecting (fossil theft) appears to be a problem. Currently, they rely on the fossil quarries being unmarked and relatively difficult to find within a large landscape, but a law enforcement officer is strongly needed.

They recommend:
A Park Superintendent needs a background related to the resource, some training in a relevant science. A start-up team should consist of a Superintendent, a Resource Manager (to oversee compliance with regulations, *etc*.), a Paleontologist-Curator, a Collections Manager, a law enforcement person, an Administrative Officer (does the books, operational contracts) with an assistant, a Partnership Liaison person (writes grants, works with other agencies/bodies for mutual benefit, corporate donations, business collaborations in kind, *etc*.), a Chief of Interpretation officer (public outreach, guided walks, *etc*.) with interpretation staff, a Chief of Education (works with schools under Chief of Interpretation), a Chief of Facilities (Puts contracts in place for construction), a Facilities worker (maintenance), an Ecologist, a Volunteer Coordinator. Further to these staff, there should be the following seasonal workers hired: a Park Ranger who oversees interns, a Gift Shop person, a social media and IT Person, a First Nations consultant, liaison.

(see the National Association of Interpretive Science Teachers conference: http://www.interpnet.com/NAI/interp/About/nai/_About/ABOUT.aspx?hkey=6f63cbdc-2744-4b3f-9983-27a9e4f93d4a)

Fossil management

The fossil quarry is closed to the public and closed to research collecting. Park staff does all collecting and has collections housed, curated in a temporary building. Outside researchers work on specimens in collections under permit. The National Parks system has a generic research permits that is Parks-wide: https://www.nps.gov/subjects/fossils/research-and-permits.htm .

A new addition to the research building will cost $500,000, open in 2018.

Department of Interior Museum Handbook are online through the National Parks Service, available as a series of PDFs here:
https://www.nps.gov/museum/publications/handbook.html
Hagerman Fossil Beds National Monument general management plan:
https://babel.hathitrust.org/cgi/pt?id=mdp.39015041537856;view=1up;seq=1

They recommend:
Create a scope of collections plan: what specimens go into collections and why; what kind of research is desirable under mandate? Use a database that links to GIS.
Specific issues to museum collections: temperature monitors, light monitors, fire detectors, humidity, *etc*. In collections storage areas, if expandable carriages are used, do not have a tiles floor, use concrete flooring painted with a sealant. For fire protection use dry foam, not water. For archives use special acid-free storage boxes (see museum standards). A pest management plan is needed for comparative collections (herbarium, insects) to control dermestids, *etc*. Do not use UV lighting; invest in good lighting.
Scientists' offices (stall and guest scientists' spaces), collections, collections work areas all should be joined but separate.

Figure 1: Hagerman National Monument boardwalk with interpretive signage overlooking exposures of fossiliferous rock along the Snake River, Idaho.

Dr. Vince Santucci is Head Paleontologist for National Parks Service in Washington, a useful contact:
http://nature.nps.gov/geology/nationalfossilday/kids_meet_paleo_santucci.cfm

Services offered

Education

They arrange that school teachers receive professional credit for doing the Teacher/ Ranger-Teacher intern program. They do six months of internship (or other lengths) and receive credit through the University of Colorado. Programs provided for school teachers to present to their classes meet school district curriculum requirements. They have teacher workshops to develop course material (*e.g.*, focussing on climate change, evolution, Earth history, *etc*.). They run a night sky program, which is very popular. The Hagerman long range interpretive plan is linked here:
https://www.nps.gov/parkhistory/online_books/hafo/interpretive_plan.pdf
They recommend: have Education Officer meet with teachers and the school district to see what kind of programs/standards should be matched, and have annual meetings to update/coordinate.

Figure 2: Amphitheatre for outdoor talks on park grounds at Hagerman.

Attendance/ regional impact

The site superintendent promotes the Paleontology Park as part of what drives regional business growth, as area lifestyle is important in a business choosing a location. In this

case, “CLIFF BARS” built their plant nearby in part because of Hagerman National Monument.

2015 figures:

Park	total visits	Total visitor spending	Contribution of all visitor spending			
			Jobs	Labour income	Value added	Economic output
Hagerman Fossil Beds NM	24,695	$1,414,100	23	$674,800	$1,047,100	$1,883,600

Figures for all sites are from the PDF *2015 National Park Visitor Spending Effects* linked at: https://www.nps.gov/subjects/socialscience/vse.htm See Table 3. Visits, spending and economic contributions to local economies of NPS visitor spending – 2015. See further information at that webpage. They define these terms as:
Jobs are measured as annualized full and part time jobs that are supported by NPS visitor spending.
Labor Income includes employee wages, salaries and payroll benefits, as well as the incomes of sole proprietors that are supported by NPS visitor spending.
Value Added measures the contribution of NPS visitor spending to the Gross Domestic Product (GDP) of a regional economy. Value added is equal to the difference between the amount an industry sells a product for and the production cost of the product.
Economic Output is a measure of the total estimated value of the production of goods and services supported by NPS visitor spending. Economic output is the sum of all intermediate sales (business to business) and final demand (sales to consumers and exports).

Fossil Butte National Monument, Wyoming

https://www.nps.gov/fobu/index.htm

Fossil Butte National Monument
PO Box 592
846 Chicken Creek Road
Kemmerer, Wyoming 83101
(307) 877-4455 ext 26
(307) 877-4457 FAX

Visitor Center Hours
2016 Summer Hours: May 1-September 30, daily 9:00 am-5:30 pm
2016 Fall Hours: October 1-November 30, daily 8:00 am-4:30 pm
2016/2017 Winter Hours: December 1-February 28, Monday through Saturday 8:00 am-4:30 pm, closed Sundays
2017 Spring Hours: March 1-April 30, daily 8:00 am-4:30 pm
Closed Thanksgiving, Christmas, New Year's, Martin Luther King Jr., and President's Day

I met with Arvid Aase, the Paleontologist-Curator: <arvid_aase@nps.gov>.

Site description, background, and infrastructure

Figure 3: Fossil Butte National Monument interpretive centre with fossil beds in the hill behind.

The park is 8,198 acres, 13 square miles, and the interpretive centre is 6,200 square feet. The current Interpretive Centre was opened July 7, 1990. The administration offices are included in this building in a separate wing. They also have a residency for seasonal workers and a maintenance building that also houses collections. It is protected within the US National Parks system.

Permanent, full-time staff: Superintendent, Administrative Officer, Paleontologist-Curator, Lead Interpreter (also does website), Interpreter/Education Technician (in charge of summer programs onsite, in the winter visits classrooms), and the Chief of Maintenance.

Seasonal staff includes a few people for summer season programs who assist with various projects and work the front desk, two weed control people, a seasonal maintenance person for the busy time of year, one intern for public guided walk talks, working the front desk, and assisting with research. Some are classed as “subject to

furlough", which means full time hours but could be cut back to a minimum of six months if the budget requires. Volunteers (talented students, adults) do various tasks such as fencing and training greeters, doing outreach school programs, some maintenance, and act as field assistants for research. Some require housing.

Further to these positions, they would like a biotech person, who handles issues like wildlife, invasive weed control crew, *etc*. The large size of park indicates this need. There should be a volunteer coordinator, an exhibit specialist to fabricate and install exhibits, and a law enforcement person. There is some problem with fossil theft, and a need to control hunters. They had three law enforcement specialists, but lost these positions in budget cutbacks. The law enforcement person could switch to other duties during the off-season. There is need for a video system to monitor site and a radio communications system. They strongly recommend that a Chief Interpreter have a science background, preferably in Earth/life sciences.

Fossil management

Outside researchers don't collect in the park, as the same beds extend outside the park where there are numerous opportunities to collect. If they did collect within the park, they would need to be accompanied by the Park Paleontologist or trained park staff assigned by the Park Paleontologist. Any work done in the park by outside researchers must have oversight by park personnel. All researchers, including collections-based research that has no collecting component must have a permit, which is reviewed and approved by the Park Paleontologist. Any material leaving the site requires detailed loan documentation. They contract geologists *etc*., for specific projects (*e.g*., geological mapping) funded with Parks Services money.

They recommend:
- Get trained people *not* seasonal/temporary people for collections help (spent years finding and fixing mistakes in cataloguing, database, *etc*.).
- Make sure lots of room for collections: space fills faster than you might expect. There needs to be a plan to increase area as needed, *e.g*., an expandable back wall.
- Collections area must meet "North American Museum Association" standards https://narmassociation.org/
- Better to expand area for cabinets rather than build/stack too high (two high is good). Too high also raises heating/cooling/ humidity *etc*. control issues.
- Have a separate locked room for all non-fossil specimen storage (cultural collections, comparative collections: plant, insect, *etc*.).
- Make sure that there is good lighting, no UV.
- Have separate area for fossil prep/processing. Plan in anything like an air compressor, sink, eyewash stations, fume hood, *etc*.
- Have a separate photo room. Clean (no dust *etc*., from collections), dark when needed, *etc*. Have two cabinets for specimens being photographed. Spend some money on a

good photography equipment, macro camera and a digital camera on a microscope are essential.
- Have a separate supply/storage area.
- Have a concrete floor, appropriate for heavy collections storage cabinets. Thick enough ("4 inches with fibre reinforcing").

Services offered

Education

Fossil Butte's busy season is about three months in the summer. Everyone that interacts with the public is trained on the basics of paleontology.

Guided tours of the exhibits are done by seasonal staff. They are trained for a week each spring (right after school gets out), then have a week to create their own talk script based on this. The content is checked by park Paleontologist for accuracy. They do tours as needed when sufficient numbers of people accumulate, not regularly scheduled. At other times, they work in the bookshop, work the front desk, *etc*.

There is a public auditorium room where videos are shown regularly (perhaps use an on-demand push button start). Researchers present findings/research there as a condition for using park collections/facilities. It is also used for evening public presentations.

The porch program is an outdoor talk in an enclosed area with a roof to avoid direct sun. The audience does not exceed 40 people.

Evening programs go to local campgrounds done by seasonal adult staff. They prepare and deliver three or four different presentations. They bring sample specimens encased in bioplastic for durability.

Classroom presentations are based on curriculum standards to match teachers' needs to conform to school district requirements. There are different talks for different grade levels/age groups. These programs can be a several days in length. See website:
https://www.nps.gov/fobu/learn/education/index.htm
https://www.nps.gov/fobu/learn/education/classrooms/curriculummaterials.htm

Transportable cases with course material for teachers to present in the classroom:
https://www.nps.gov/fobu/learn/education/classrooms/travelingtrunks.htm
https://www.nps.gov/fobu/learn/education/classrooms/additional-educational-resources.htm

In onsite class presentations, an effort is made to involve teachers in the presentation. They encourage a teacher pre-visit to the park before bringing the class. There is an "Environmental Education Room" for school classes with tables for hands-on activities.

The Junior Ranger Program is extremely popular. It is done across the US National Parks system, but is tailored for each park with is a site-specific program including a site-specific booklet. Including the booklet, the program costs about $1.70 to produce per child. They complete activities in the booklet, take a "ranger oath" and receive a badge https://www.nps.gov/fobu/learn/kidsyouth/index.htm . There are also patches, pins available for donations.

There are scheduled public viewings of a "sample" (non-active) field locality at a set time of day (*e.g.*, once every afternoon). An interpreter leads a tour with a maximum of ten people (for control, safety).

There is a non-guided nature walk and hike and with interpretive signage. There is a pre-walk video available in the theatre room. The theatre also has a 13 minute main park introduction video and a short "behind the scenes" video on fossil preparation.

They recommend:
There needs to be dedicated funds in the budget for the Park Paleontologist to go to professional meetings to present work and interact with other scientists, which promotes the park and science in the park.

Exhibits

They recommend:
- Core permanent exhibits and changeable ones so that people have something new to see for a subsequent trip. There should also be a "what's new in research" exhibit.
- Fossil Butte had about 80 specimens in exhibits and upped that to about 400. This made a lot of difference, increasing positive comments in the visitors' book (but fossils displayed must be in service of overall story being presented).
- Lighted cases with lowered room light (as opposed to Florissant National Monument, which goes with a bright room concept).
- Have emergency generators for exhibits with electronics (touch screen, *etc*.) for power outages (periodic there).
- For exhibit fabrication: a large-format printer, a laser engraver, a dry mount press, a colour laser printer, and a wood shop.

Further information:
psu.sesrc.wsu.edu/vsp/reports/240_FOBU_rept.pdf (this link works if you copy and paste it into your browser). And see further information at:
https://archive.org/details/statementformana91fossilb

Figure 4: Park Paleontologist Arvid Aase with visitor centre exhibits.

Attendance/ regional impact

2015 figures:

Park	**total visits**	**Total visitor spending**	**Contribution of all visitor spending**			
			Jobs	**Labour income**	**Value added**	**Economic output**
Fossil Butte NM	19,293	$940,800	12	$358,500	$578,100	$1,008,300

16-19,000 visitors per year; 25,000 in 1993.

They recommend: After 2–3 years, pay for a professional survey to be done of visitors. Have an identity, a brand, a logo as Fossil Butte has the fish fossil logo, Florissant the hornet, Hagerman a horse. This helps provide an overall identity and is used as branding on gift-shop products (hats, pins, water bottles). Gift store: have lots of under $20 items. Lots of logo-items (coffee mugs, T-shirts, pins, fridge magnets, *etc*.). Books are good, but they should be quality paleontology/nature books. Site-specific items sell well. Sell re-usable water bottles with park logo, and offer basic granola bars/jerky. Visitors get food, beverage beyond this in town.

Dinosaur National Monument, Utah
https://www.nps.gov/dino/index.htm

Site description, background, and infrastructure

Dinosaur National Monument
11625 E 1500 S
PO Box 128
Jensen UT 84035
(435) 781-7702

Quarry Visitor Center
The visitor center features a staffed information desk, exhibits, sales area for the Intermountain Natural History Association, and monument film. It is the departure point for trips to see the Dinosaur Quarry.
Summer Hours: *Late May 2017 to mid-September 2017*
Open daily, 8:00 a.m. to 6:00 p.m.
Winter Hours: *Mid-September 2016 to late May 2017*
Open daily, 9:00 a.m. to 5:00 p.m.
Closed on Thanksgiving, Christmas (December 25) and New Year's Day (January 1) holidays.
Exhibit Hall (Dinosaur Quarry)
Summer Hours, late May 2017 to mid-September 2017
Open daily, 8:00 a.m. to 5:30 p.m.
Winter Hours, *mid-September 2017 to late May 2017*
Access to the Quarry Exhibit Hall is by vehicle caravans at set times during the day: 9:30 a.m., 10:30 a.m., 11:30 a.m., 1:00 p.m., 2:00 p.m., 3:00 p.m. and 4:00 p.m.

I met with Dan Johnson, Chief of Interpretation and Visitor Services <dan_johnsom@nps.gov>.

It is protected as a National Monument in the US Parks system. The park was established 1915 and expanded in 1938. It currently covers 210,844 acres (85,326 ha) In eastern Utah into western Colorado. Its major resource is large numbers of dinosaur skeletons. The main exposures are historically important in early vertebrate paleontology in the United States.

There are two large, public buildings (lower Visitor Centre and upper Exhibit Hall) with exhibits at the main park centre in Utah (administration is in one), and a third, smaller one on the Colorado side. There are other buildings to house summer seasonals, a few houses for permanent staff, and maintenance buildings. Stand-alone restrooms are scattered about the park. Further, historic structures (cabins, *etc*.) are part of park property. Archaeological/cultural sites are also maintained.

Figure 5: Dinosaur National Monument lower visitor centre.


Figure 6: Dinosaur National Monument upper visitor centre housing dinosaur skeletons exposed in the rock face.

This large park with high attendance has about 40 full-time staff. In the summer, this expands to about 75–80 people (including fire control people). Staffing is as outlined in other National Monuments, with a Park Supervisor, a Park Paleontologist, and various administration, interpretation, education, and maintenance personnel as above, as well as a wildlife biologist.

Law enforcement: there is some damage on trails, but vandalism and theft of fossils is not much problem where the rock encasing bones is mostly very hard. Where the rock is softer, however, there is a big problem.

Fossil management

Research

The Park Paleontologist coordinates, approves research, not just for fossil resources, but also for work on geology, modern plants and animals, *etc*. There is, however, not much new collecting. The main Morrison Formation dinosaurs have been studied extensively for over a century, but while those of some other formations within the park are lesser known, there's only a small amount of research on them. Some collections are housed onsite, although there is little collections space (note that these are large dinosaur bones, skeletons), and they are mostly housed in university/major museum collections. In the main exposures of dinosaur bones embedded in the rock that the public sees, excavation ended long ago. Any new excavation will be decided on desirability for the long-term goals of site and the stability status of the bones *in situ*.

Services offered

Education

The public education and Interpretation programs are much the same as outlined for Hagerman and Fossil Butte National Monuments above, *e.g*., bringing in teachers for a "teacher ranger program" to develop their coursework program to conform with their curriculum needs. The Junior Ranger Program is very popular. There are many school groups. The park provides guided tours by rangers on trails and evening programs at off-site campsites (*e.g*., paleontology, regional history, geology). As above, rangers make their own talks with two weeks of spring training, then have two weeks of writing their own material based on this, which is then checked for accuracy (may be one week for each at other parks). They visit schools with outreach programs, and have booths/displays at regional town festivals ("RiverFest" *etc*.). They also do distance learning by Skype to schools (also see a similar program of the Royal Tyrrell Museum, described below). Their Night Sky program is popular, as in other parks. They recommend seeking "International Dark Sky status" for this. See http://darksky.org/ and http://darksky.org/idsp/ .

Figure 7: Grade four school group at the upper visitor centre. Dinosaur skeletons are in the rock face on the right.

They strongly recommend having staff to manage a web, social media presence. This has been very successful within the US National Parks system. Facebook, Instagram, *etc*. must be continuously updated, as going stale will lose people fast. Updates as simple as "here's a photo of an elk that was spotted in the park yesterday" are some of the most popular posts. Do videos for YouTube.

Facebook: https://www.facebook.com/DinosaurNPS
Instagram: https://www.instagram.com/DinosaurNPS/
YouTube: https://www.youtube.com/user/DinosaurNM
Twitter: https://twitter.com/DinosaurNPS
Flickr: https://www.flickr.com/photos/dinosaurnps/
Also see: https://www.nps.gov/dino/learn/news/social-networking-media.htm

They have 17,700 followers on Facebook, and 1.4 million people visit their website each year: https://www.nps.gov/dino/index.htm

Exhibits

They recommend:
A good exhibit interacts with a lot of learning styles, as some learn by reading, others by touching, visuals, *etc*. Exhibits should cover the spectrum of age ranges—but *don't* dumb it down with the "Hey kids, cool!" style—go high. They recommend to not be too technology-heavy with exhibits, creating maintenance issues and they may be outdated

fast (contrary to the opinion at Fossil Butte that you should keep up-to-date on exhibit technology). As above, they recommend permanent displays and ones that have a turnover to keep it fresh, although ensure that there's budget for that. They regret splitting the separate exhibition hall and visitor centre, which increases staffing and other costs.

Attendance/ regional impact

2015 figures:

Park	**total visits**	**Total visitor spending**	**Contribution of all visitor spending**			
			Jobs	**Labour income**	**Value added**	**Economic output**
Dinosaur NM	291,800	$17,079,100	233	$6,856,700	$11,320,700	$19,279,500

About 300,000 visitors per year is usual, in some years 400,000 to 500,000.

Cleveland-Lloyd Dinosaur Quarry, Price, Utah (BLM)

https://www.blm.gov/wo/st/en/res/Education_in_BLM/Learning_Landscapes/For_Travelers/go/geology/cleveland-lloyd.html

and

https://www.blm.gov/style/medialib/blm/ut/natural_resources/cultural/paleo/Paleontology_Documents.Par.22943.File.dat/Cleveland%20Lloyd%20Brochure%20(Mar%205).pdf

contact:
The Bureau of Land Management
Price Field Office
125 South 600 West
Price, Utah 84501
Phone (435) 636-3600

The quarry is open to the public from mid-March to Memorial Day, Friday, Saturday, and Sunday; daily from Memorial Day to Labour Day; and from Labour Day to the end of October on Friday, Saturday, and Sunday. Quarry hours are 10 a.m.–5 p.m. Monday–Saturday and noon–5 p.m. on Sunday. Early or late snows can affect this schedule.

I met with Mike Leschin, Park Paleontologist <mleschin@blm.gov> accompanied by Dr. Greg McDonald (BLM paleontologist, see below).

Site description, background, infrastructure, and services offered

Figure 8: Entrance to the Cleveland-Lloyd Dinosaur Quarry visitor centre, with Park Paleontologist Mike Leschin.

Figure 9: Interior of visitor centre with *Allosaurus* skeleton.

This is a small park, quite a ways off main roads in central Utah near the town of Price. It has an extremely dense bed of dinosaur bones in a small outcrop: over 12,000 have been recovered, mostly of the Jurassic predator *Allosaurus*. It has been collected by researchers since 1927. The park is on Bureau of Land Management (BLM) land, who operates the interpretive centre. This is the only fossil site visited in the USA not operated by the US National Parks Service.

The park has minimal staffing and programs. Aside from the Park Paleontologist there are two interns. Interns are acquired from various programs such as GeoCorp and cost $8,000 (US) per summer, which includes a stipend, housing and to cover the providing organisation's administration costs. The park does not run educational programs beyond exhibits, guided walking tours and unguided trails with interpretive signage.

Figure 10: The Cleveland-Lloyd Dinosaur Quarry seen from the hills above: visitor center on the right, and fossil beds on the left, sheltered by two temporary structures. Large numbers of dinosaurs were historically excavated in a small area adjoining the temporary structures.

A small museum was first opened there in 1968, and the larger, current facility in 2007 with 2,000 square feet of exhibit space. The park also has two small, temporary outbuildings covering the bone bed exposure, and a trail system with interpretive signage away from the fossil site.

Fossil management

The BLM regional paleontologist (Dr. Greg McDonald, based in Salt Lake City, see below) does permitting with input from the Park Paleontologist. The BLM doesn't house specimens; they are mostly kept (with BLM accession numbers) at the Natural History Museum of Utah.

Attendance/ regional impact

The park is far from main roads, and signage and promotion are not as extensive as for National Parks. It has 3,800 visitors per year, usually 40–50 per day during busy season from (US) Memorial Day to Labour Day when it is open five days a week. About a quarter of the visitors are local, about a third are from Utah, and national and international visitors make up the rest. No records are kept on regional economic impact. The neighbouring town of Price has about nine thousand people, and there are about twenty thousand in the county.

Cleveland-Lloyd does cross promotion with other regional dinosaur parks "The Dinosaur Diamond":
http://travel.nationalgeographic.com/travel/road-trips/dinosaur-diamond-prehistoric-highway/
https://en.wikipedia.org/wiki/Dinosaur_Diamond_Scenic_Byway

Salt Lake City TV feature: http://www.ksl.com/?nid=1268&sid=34152277

Bureau of Land Management, Salt Lake City, Utah
http://publicfossils.org/
https://www.blm.gov/programs/cultural-resources/paleontology

I met with Dr. Greg McDonald, Bureau of Land Management (BLM) Regional Paleontologist <hmcdonald@blm.gov>.

The BLM is the US federal agency responsible for managing federal lands, including their paleontological resources.

Fossil management

Paleontological resources on federal land are managed by three agencies: National Parks, BLM, and the Forest Service.

They take a unified approach with the federal Paleontology Resource Protection Act (PRPA) in all matters. The act is online:
http://www.blm.gov/wo/st/en/prog/more/CRM/paleontology/paleontological_regulations.print.html

Fundamentals of Paleontological Resource Management PDF is linked here:
http://www.blm.gov/style/medialib/blm/wo/Planning_and_Renewable_Resources/coop_agencies/paleontology_library/paleo_course_materials.Par.39506.File.dat/authorities-may2008.pdf
The National Parks Service Geological Resources website:
http://www.nature.nps.gov/geology/

BLM has three permitting categories:
- Survey: small scale, quick uses. Mostly examining and evaluating the fossil resource of a region, looking over the rock.
- Excavation: longer-term, more serious projects. More carefully vetted.
- Consulting: This is rapid harm mitigation. This is useful for industry, *e.g.*, if a company wishes to build a road through a dinosaur skeleton, this process gets it out of the ground quickly. This is a collaboration with industry to ensure that conservation of paleontological resources goes smoothly and is minimally disruptive.

Permits are not only required for researchers doing fieldwork, but also for researchers doing collections based work. This creates a record of collections usage. Permits are required for any use of BLM resources including non-invasive fieldwork, *e.g.*, measuring rock sections. Paleontology on BLM Land Permits are found at:
http://www.blm.gov/ut/st/en/prog/more/cultural/Paleontology/Paleontological_Permitting.html

In the permit, researchers agree to provide raw data (field notes, *etc*.), but there will be an embargo set on the BLM publishing or sharing such data until a date negotiated with the researcher, so that there's no chance of it being released before the researcher publishes it in a professional journal. Raw data includes "materials and methods" type information, but does not include the results of analyses, which are the researcher's intellectual property. Permits include details of all people, helpers, *etc*. (*cv*s are required for everyone). This can be adjusted due to contingencies. Graduate students are applied for by their supervising professor. Permits are issued for current year, ending December 31 regardless of the date permit is granted.

All fossils and all other material such as drill cores are subject to return to BLM. All materials collected leaves with the researcher as a loan with loan paperwork completed.

Further resources:
Museum Management Plan PDFs:
https://www.nps.gov/museum/
https://www.nps.gov/museum/publications/handbook.html
Fossil Resources Conference:
http://publicfossils.org/conference-on-fossil-resources/
See Department of Interior Museum Property Handbook PDF:
https://www.doi.gov/museum/policy/DOI-Handbooks

See Museum Handbook National Parks Service:
https://www.nps.gov/museum/publications/handbook.html
"Curating Natural History Collections" course.
https://www.doi.gov/museum/classroom-training
"conserve o grams":
https://www.nps.gov/museum/publications/conserveogram/cons_toc.html
"Canadian Conservation Institute" (Canadian equivalent of conserve o grams):
http://canada.pch.gc.ca/eng/1454704828075

Dr. McDonald has been the Park Paleontologist at Hagerman National Monument and has given courses on paleontological resource management.
https://www.doi.gov/museum/classroom-training

Further, see Waco Mammoth National Monument:
https://www.nps.gov/waco/index.htm
Site special resource study:
https://parkplanning.nps.gov/document.cfm?parkID=442&projectID=12000&documentID=24485

Florissant Fossil Beds National Monument, Colorado
https://www.nps.gov/flfo/index.htm

Florissant Fossil Beds National Monument
P.O. Box 185
Florissant, CO 80816
Phone: (719) 748-3253

Winter Hours (December 1–March 12): 9:00 AM - 4:30 PM.
Fall and Spring Hours (March 13–May 30, Labor Day–November 30): 9:00 AM - 5:00 PM.
Summer Hours (June 1–Labor Day): 8:00 AM–6:00 PM.
The park is closed on Thanksgiving, Christmas, and New Year's Days.

I met with Dr. Herb Meyer (Park Paleontologist), Michelle Wheatly (Superintendent), Conni O'Connor (Collections Manager), and Jeff Walin (Lead Interpreter).

Site description, background, and infrastructure

Florissant National Monument was established to preserve fossils in Eocene lakebed sediments and a series of large petrified stumps. Its age is similar to that of McAbee, roughly 19 million years younger, and like McAbee, preserves insects, plants, and rarely other fossils of a community in a temperate upland setting. The park has 5,998 acres (2,427 ha). It is protected and operated under the US National Parks system. It is open year-round (except as noted above). The monument was established in 1969, and a

temporary visitor centre was opened in a 1929 farmhouse. A new, 4,300 square foot centre was built for US$2.5M and opened in 2013. There is also an administrative building and a small educational building for youths of grade-school and younger ages. The park also maintains an historic 1880s homestead cabin.

Figure 11: Florissant Fossil Beds National Monument visitor centre.


Figure 12: Park Paleontologist Dr. Herbert Meyer and Park Superintendent Michelle Wheatly in an outdoor structure for public talks.

Staffing is along the lines of National Parks service paleontological parks outlined above.

Year-round employees: Supervisor, Park Paleontologist, Collections manager, Interpretive Officer, Ecosystems manager (wildlife, invasive plants, *etc*.), Law Enforcement (collaborates with local sheriff), Maintenance personnel (one full-time, one part-time, also deals with snow in the winter).
Seasonal employees: seven seasonal interpretive rangers this year, was over-staffed.

Superintendents tend to stay at a National Park for about 1–7 years on average, then move on to another. Park Paleontologists, however, rarely move. Besides the Park Paleontologist, the Paleontology Division has a full-time collections manager and three interns: a student working on a fossil research project, one working on the database, and another doing a monitoring/ inventory project.

Fossil management

Outside Researchers collecting must be accompanied by Park staff. They must submit a sufficient scientific question/purpose and must collect all stratigraphic / spatial data *e.g.*, centimetres above a datum caprock, *etc*. and GPS (WGS 84 or other such standard system).

For new construction, National Parks policy on not expanding square footage footprint within a park resulted in the area for collections being cut back, and as a result, their ability to house collections suffered. Already collections are over 85% full in only three years since the new building was opened, a big problem. They plan to tear down an unused building as a trade-off for usable footprint area. It is essential to start out with a large square footage in collections, and have the ability to expand as needed.

Collections: Environmental controls are necessary for preservation of shale, stored flat, with humidity not below 30-50% (use a data logger to monitor humidity, temp. *etc*.). Consult with Sally Shelton at South Dakota School of Mines, an expert in this issue. Money for collections work comes from internal Parks money, admission fees to park, and other sources such as NRPP (Natural Resource Preservation Program) and CRPP (Cultural Resource Preservation Program).

Preparation of fossils at all stages is documented with photos. Holotype/ figured specimens *etc*. have a special secure, locked fire-proof cabinet.

Inventory and Monitoring fossil outcrops (student project). There are 77 monitoring sites: petrified stumps, shale outcrops, vertebrate sites. These are photographed on a scheduled basis to monitor theft, erosion, weather damage and are evaluated on a score sheet to log change at each locality. The results are used *e.g.*, in recommendations for law enforcement and erosion control. Camera set on fixed “monument marker” at locations for consistency and marked with waypoints in GPS.

Services offered

Education

Florissant National Monument has an extensive education/community outreach program. Interpretive / Educational Officer is one position here, unlike many other parks where they are separated.

Figure 13: A ranger gives a guided tour to the public.

Junior Ranger program: with about 75,000 visitors per year, they do about 4,500 Junior Ranger programs. Junior Paleontologist is a different program created by the Geological Resources Division within the federal government (ten geologists there created this). It is similar to Junior Ranger: the youths do activities and receive a badge. Both programs are aimed at 5 to 12-year-olds. It's online, and a PDF of the program can be downloaded remotely that the youngster can send in with completed work and have it signed and returned by mail with a badge.
https://www.nps.gov/subjects/fossils/junior-paleontologist.htm
Junior Ranger is so popular that in the summer there needs to be a ranger assigned to just doing this program.

A Friends of Florissant group supports a public seminar series. These talks may be on birds, butterflies, climate change, process of fossilization, *etc*. They are mostly held onsite. There is an agreement with a local college for continuing education credit for teachers to attend. They do 3–12 seminars per year. The public is charged $30–$50 to attend. Kid's programs are $15 per person. The money raised by this by the Friends group goes into a fund to be used by the park, *e.g*., to pay some of the cost of interns and for scientists' travels to conferences. The Friends group is not an advisory board.

Figure 14: School group learning centre in a yurt.

The park maintains several main trails: a one mile hike and a half mile hike with interpretive panels. There is a total of fourteen miles of trails without interpretive panels.

Exhibits

Exhibits are divided into themes: ancient ecosystems, geological processes that resulted in fossil beds, and the history of scientific research.

A prep window like at some other sites with big vertebrate fossils is not practical given insect and plant fossils (like at McAbee). Instead, they are developing a "virtual lab tour". A staff member with GoPro camera in collections would give a live talk on screen to visitors outside, and take their questions. This would highlight intern projects, show some drawer contents and discuss collections, *etc*. A video kiosk also has pre-recorded talks like this for "on demand" viewing by button start.

They recommend: communicate content on all levels, but keep sophisticated at each level—don't dumb it down. Florissant focuses on the higher end information, which is appreciated, and works. Go high. Exhibits: add new things all the time to give repeat visitors a new experience. Avoid UV light, windows as UV may affect the fossils.

Attendance/ regional impact

2015 figures:

Park	**total visits**	**Total visitor spending**	**Contribution of all visitor spending**			
			Jobs	**Labour income**	**Value added**	**Economic output**
Florissant NM	69,131	$3,958,600	61	$2,168,200	$3,481,400	$5,740,000

Admission to park brings in $50-100,000 / year at a $5 per person charge (adult), but many people enter with discounts (kids, seniors) or having national parks passes *etc*., and so don't pay.

The major city of Colorado Springs is about an hour's drive distant. There are few facilities in the local town of Florissant, about 17 miles away (population about 8,000). The park has had about 70,000 visitors this year by late August 2016. There were 100,000 in 1994. Promotion is very important. Some visitors accidentally come across the park while travelling, and others seek it out specifically as a destination, mostly people within a 200 mile radius and fossil enthusiasts. To attract the first group of opportunistic travelers, road signage is essential. Under federal law, the park cannot purchase road signage, but the *Friends of* group can.

Beyond the *Friends of* group, there are various ways to get around going through complicated Parks budgeting process, *e.g.*, through CESU (Cooperative Ecosystem Study Unit).

Their operating budget is just under 1 million dollars per year. This year they brought in about $100,000 in admission fees from a third of the visitors (others have passes, fee waivers, *etc*.). This results in the need to constantly write grants. $20,000 / year comes from the *Friends of* society. The gift store made about $89,000 last year, run by various groups (Rocky Mountain Conservancy, Friends of Florissant, *etc*.), about $12,000 of which went to the park. So, the net $32,000 to the park helps fund projects, which are also funded by government money from various levels. The imbalance on funding results from historical contingencies.

Recommendation: going big in initial start-up money is essential.

John Day National Monument, Oregon

https://www.nps.gov/joda/index.htm

https://www.nps.gov/stateoftheparks/joda/visitorexperience/paleontologycenter.cfm

Park Paleontologist Dr. Ted Fremd has retired. His replacement, Dr. Nick Formoso had not yet started when I visited. I met with Park Superintendent Shelley Hall, Collections Manager Christopher Schierup <chris_schierup@nps.gov>, Preparator Jennifer Cavin, and Interpretive Rangers Michelle Ordway and Megan Wilkins.

John Day National Monument
32651 Highway 19
Kimberly, OR 97848
Phone: (541) 987-2333

The Thomas Condon Paleontology Center is open 10 a.m. to 5 p.m. daily, except Veteran's Day, Thanksgiving, Christmas Day, Christmas Day Federal Holiday (Dec 26), New Year's Day (Dec 31), New Year's Day Federal Holiday (Jan 1), Martin Luther King Jr Day, and President's Day.

Site description, background, and infrastructure

Figure 15: Thomas Condon Paleontology Center at the John Day National Monument. Fossiliferous beds are exposed on the hills behind.

The park has a total area of 13,944 acres (5,643 ha) divided into three units: the Sheep Rock Unit (8,843 acres, 3,579 ha), the Painted Hills Unit (3,132 acres, 1,267 ha), and the Clarno Unit (1,969 acres, 797 ha). It is protected under the National Parks system.
Its fossil resource consists most significantly of a large assemblage of numerous types of mammals, from huge rhinoceros-like brontotheres through small species. These range across a broad stretch of time from 44 million to 5 million years ago. Fossils were discovered there in 1864 and soon received extensive scientific attention, but the park was not established until 1975. Initially, a ranch house was used for exhibits and administration. The 11,000 square foot Thomas Condon Paleontology Center opened in 2005, costing US$7.5M to construct.
https://www.nps.gov/joda/learn/photosmultimedia/Thomas-Condon-Paleontology-Center.htm

The ranch house is now used as an administration building. There are three houses in the park used as residences: one for the ranger at the Painted Hills Unit, one for the law enforcement officer, and one for the collections manager. Lack of sufficient housing in the area is a significant issue in attracting qualified staff.

Figure 16: John Day National Monument administration offices in a converted ranch house.

Staffing is along the lines characterised below for National Monuments. The Paleontology Division has three permanent people: a Paleontologist-Curator (Dr. Nick Formoso starting in late 2016), Museum Technician (collections manager) Christopher Schierup, and Museum Technician (fossil preparator) Jennifer Cavin. There are three full time Interpretive Rangers. Interpretive Staff work on signage, displays, public talks, and walking tours. Educational Staff work with school groups on site, go out to schools who have contacted them. Seasonals vary from 0 to 5 people depending on the time of year, and there are some GeoCorp people. Seasonals and GeoCorp people do overflow

interpretive work with the public and other collateral duties when not otherwise busy (about 20% of their time), *e.g*., working the front desk.

They need more paleontology staff, as they have responsibility not only for all the paleontology in the park, but also for a large region of the state (the Prineville District). They could also use more law enforcement for people camping illegally, going off trail, vandalism, and theft. I was shown a fossil skull recovered from Law Enforcement people after theft that had been damaged in excavation. The education program could use more people; they turn schools away for lack of staff. With more personnel, they could be doing more with distance learning (Skype, *etc*.).

Fossil management

Outside researchers work on existing curated fossils in collections. Sometimes outside researchers go out in the field in the park, but just as an observing visitor, not to collect, and then must be accompanied by a park paleontologist. Park paleontologists do "cyclic collecting", where they collect from a circuit of localities within the park over a number of years before reaching the starting point again. The major object is to find bones exposed by weathering.

They have about 50,000 specimens in collections. The 2008 management plan predicted that the collections would be filled in ten years, and they are now about 80% full. As at other National Monuments, collections storage space is an issue.

Humidity in collections is kept at 45–50% and temperature at 70°F. There are motion sensors. They don't use compactors to save space because of vibration affecting specimens jiggled in their trays when they are opened and closed. This is a trade-off between the cost of building floor space vs issues with motion in movable cabinets.

The accessions room, prep room, and collections room are all separate, each with card-lock doors. Key cards are only issued to curation staff. All people, including researchers must fill out, sign and submit forms in advance and sign in with a book in collections before being allowed access to collections.

Geologist in the Park program with Geological Society of America.
http://rock.geosociety.org/g_corps/index_gip.htm
Geoscientist in Park positions are subsidized from the National Parks Service in Washington. They got five such positions this year, interns doing projects that the park paleontologist sets. Half of the time they work at the front desk, the other half they work on their project. They publish results, and do other things such as give talks, produce a map, do a podcast, re-do the Horse Kit notebook or work on the webpage. Sometimes they propose a project that is OKed by the Park Paleontologist. These may be students, but sometimes it's a professor on sabbatical.

Figure 17: Preparator Jennifer Cavin in the fossil prep room

Projects are contracted to various researchers. The Park Paleontologist defines a project, selects researchers, *e.g*., two people now working on tooth wear project.

Services offered

Education

2014: 36 educational programs done onsite, reached 1,082 students.
2015: 49 educational programs done onsite, reached 1,218 students.

They have developed two sets of travelling kits for educational outreach. Both are certified by the Oregon Education Department for curriculum compliance:
1- General Paleontology kits: general fossil kit at elementary school level, five kits.
2- Horse Fossil Kit. More advanced, could be high school or college level, seven kits.
There are replicas of fossils in both.

2014: the general fossil kit went out 15 times, reached 1,335 kids.
the horse fossil kit went out 41 times, reached 6,316 kids.
2015: about the same for both.

They do very little promotion on the kit programs, as it's already well-known, and teachers come to them for it. Any promotion and it gets too big very quickly.

The contents of the kits are created under direction of park paleontologist, and teachers comment on possible revisions based on usage. The park pays to ship these out and school pays to them ship them back, plus a $10 fee for upkeep. This fee should be raised

to $20, but it needs to be kept cheap because of lack of current funds in the school system.

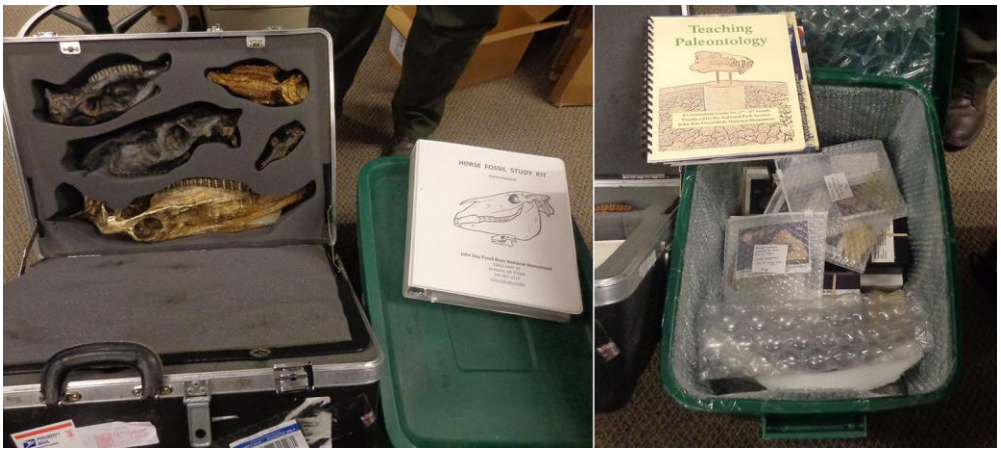

Figure 18: Travelling education kits: fossil horse kit (left) and general paleontology kit (right).

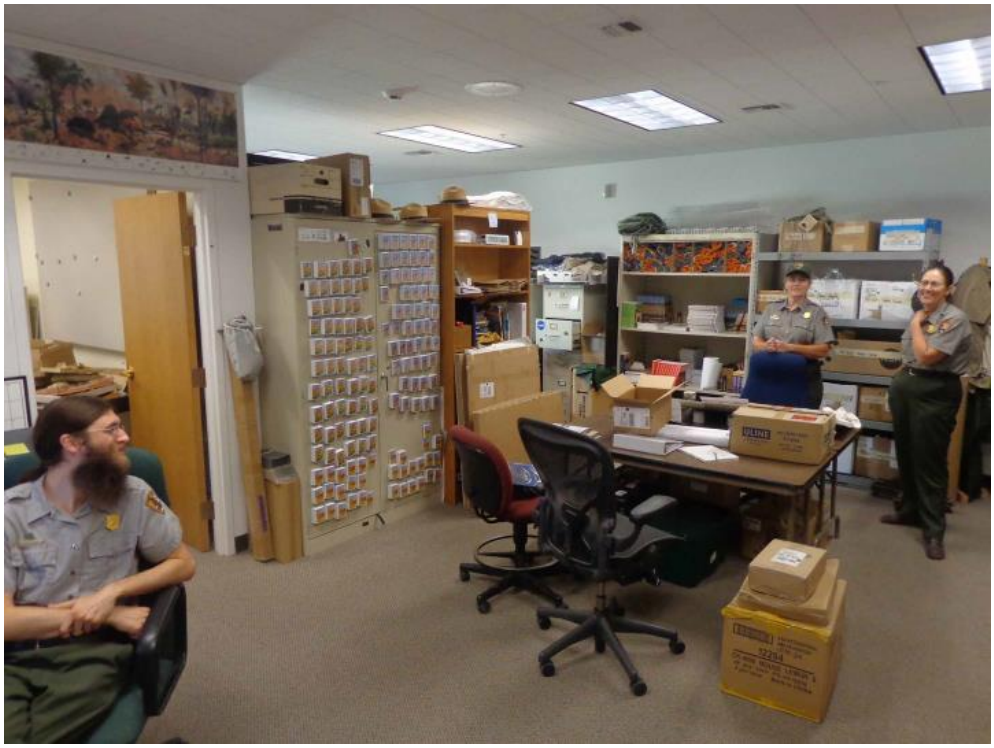
Figure 19: Interpretive/Education Rangers Michelle Ordway and Megan Wilkins (right) and a seasonal employee.

There is a well-developed in-house education program, which includes replica fossil horse skulls set in plaster for young kids to “excavate out” with actual prep tools. The kids’ education room has a wall that folds out so that two rooms become one large one when needed.

Figure 20: Education activity room for school groups.

Exhibits


Figure 21: Large murals accompany fossils on display in the public exhibits area.

Exhibits of fossils are accompanied by stunning murals of scenes of the ancient communities. https://photos.smugmug.com/Thomas-Condon-Paleontology/i-b6KcT4m/0/L/IMG_8073-Edit_4-Edit_5-Edit_Edit_tonemapped-L.jpg

Many levels of audience are served, but the standard of information presented is always high, sophisticated. There is an auditorium that shows a 20-minute video.

Attendance/ regional impact

2015 figures:

Park	**total visits**	**Total visitor spending**	**Contribution of all visitor spending**			
			Jobs	**Labour income**	**Value added**	**Economic output**
John Day NM	196,276	$9,146,900	141	$3,831,100	$5,974,800	$10,759,100

For more breakdown of effects and understanding visitor use/contributions, see here: https://www.nps.gov/subjects/socialscience/index.htm

In the last eight years, after promotion, park attendance went from 100,000 to 200,000 people per year. The Thomas Condon Paleontology Center has experienced this kind of growth since it opened in 2005.

The *Friends of* society runs the bookstore and the money goes through them, but seasonal staff operate it. Non-site specific paleontology and nature books do well. T-shirts, fridge magnets *etc*., and a regional geology book are good sellers.

Royal Tyrrell Museum, Alberta
http://tyrrellmuseum.com/

Open October 1–May 14: 10:00 a.m.–5:00 p.m. Tuesday through Sunday, closed Mondays (Open Family Day, February 20); May 15–August 31: 9:00 a.m.–9:00 p.m. every day including holidays; September 1–30: 10:00 a.m.–5:00 p.m. every day.

I met with Dr. Andrew Neuman (Executive Director), Dr. James Gardner (Curator of Palaeoherpetology), Jason Martin (Operations and Finance Director), Dan Spivak (Resource Management), Patti Ralrick (acting business manager for the Royal Tyrrell Museum Cooperating Society), Earl Wiebe (Head of Education), and Brandon Strilisky (Collections Manager).

Site description, background, and infrastructure

The Royal Tyrrell Museum (RTM) is located six kilometers from Drumheller, Alberta. The building was opened in 1985, constructed by the RTM and then rented by them from Provincial Parks. Aspects of it are operated by various ministries: Parks, Culture and Tourism, and others. It is 11,200 square metres (121,000 square feet), which includes 4,400 square metres (47,000 square feet) of exhibit space.

Figure 22: Entrance to the Royal Tyrrell Museum, Drumheller, Alberta.

Mandate: “The Royal Tyrrell Museum of Palaeontology's mandate is to be an internationally recognized public and scientific museum dedicated to the collection, preservation, presentation, and interpretation of palaeontological history, with special reference to Alberta's rich fossil heritage.”

The RTM operates on the following five principles:
1- preservation, stewardship of the fossil resource of Alberta
2- do research, have a scientific program (eight PhD researchers on staff)
3- provide educational programming to the public
4- have an economic aspect (tourism, provincial/regional economic spinoffs, etc.)
5- have a cultural impact (the cumulative influence of the above on the public perception of science).

Fossil management

Unlike the US National Monuments discussed above, the RTM does not have a fossil locality attached to it. Alberta has three designated Provincial Heritage sites for fossils: Devil’s Coulee, Grand Cache Dinosaur Track Site, and Dinosaur Provincial Park, all owned and operated by the Ministry of Parks. Any proposal for physical change at these sites is evaluated and approved by personnel at RTM with appropriate expertise, who also evaluate and issue permits for all other fossil sites in Alberta. The RTM administration then signs off on approved applications based on the expert in-house recommendation.

The RTM does not issue permits for overlapping projects (physically, overlapping area) and asks current permit holders for advice on whether a proposed application overlaps the intellectual content of an existing project. Permit applicants must possess a Master's degree or higher, must have experience in this work, and must have a professional affiliation with a recognized institution.

The RTM has the same issue as many of the institutions discussed above: their collections space is full. They now have two off-site storage facilities.

Security issues at Provincial Heritage sites include hunters discharging firearms, and vandalism and theft of fossils. At Writing On Stone Provincial Park http://www.albertaparks.ca/writing-on-stone/information-facilities/trails/hoodoo/ they have built catwalks to control where the public goes. At Dinosaur Provincial Park, the public is forbidden to leave developed trails and cannot pick up fossils, which are designated Provincial Heritage. They recommend paying close attention to control of public access, and to have sufficient security.

Services offered

Education and exhibits

Figure 23: Classroom for school groups in the Atco Tyrrell Learning Centre education wing.

http://www.tyrrellmuseum.com/programs.htm
The travelling kits program is a lot of work and has been dropped (but see US National Parks, above, where this works well), and has been replaced by distance learning

programs using Skype. They have their own media studio to produce content with high production values. This requires a production technician and a presenter. It involves games, animation, video clips, and participation/interaction with the student audience. The content is based on the Alberta school curriculum.
http://www.tyrrellmuseum.com/programs/distance_learning.htm
Teachers book these online. Most programs cost $125, a few a bit more. There is a maximum of 35 students per program. It takes 45 minutes.

They did about 150 in-house programs last year, where the teacher brings a class to the museum and a presentation is offered.
http://www.tyrrellmuseum.com/programs/school_programs.htm

Figure 24: Classroom space for younger school groups.

They do about 75 overnight programs per year:
http://www.tyrrellmuseum.com/programs/camp_ins.htm
These programs cost $1,850 for up to 32 students and $3,400 for up to 64, covering everything (food, *etc*.) except transport.

They run about 25 various programs per day for visitors, 6–7 different ones at multiple times. Tickets range from $5 to $20, also some programs are free in the amphitheatre.

They recommend to renew permanent exhibits regularly and not to go for travelling exhibits, but to generate your own. They advise that the public wants authenticity: use the real fossils.

Attendance/ regional impact

Last year had the highest paid attendance, 479,000 visitors, but not all paid admission, *e.g.*, some entered with coupons, and some have memberships. This year, the August long weekend had 20,000 visitors. Visitors register when they buy the entrance ticket, and the information goes directly into the database. There were visitors from 150 countries last year. British Columbia is a major source of tourists to the RTM. The RTM is the main driver of tourism in Drumheller. In 2005 it generated $29.8M for Alberta in jobs, tourism etc., and $11.8M in taxes to the Province. Alberta Venture magazine (May 2015 issue) called the RTM the most respected company in the province for that year (above WestJet, *etc*.).

The RTM generates two thirds of its operational funding, the remainder is provided by the Province. It has 35 government employees, about half of these paid for by RTM-generated funds. The building costs about a quarter of their budget. Money is generated from admissions, the gift shop, educational programs, and the cafeteria. An adult admission is $18, and the average admission (all age price categories) is $6. Last year it brought in about $2.5M in admissions.

The Royal Tyrrell Museum Cooperating Society (RTMCS) functions similarly to a *Friends of* society at other institutions. It is operated by a volunteer board of directors.
http://www.tyrrellmuseum.com/about/our_cooperating_society.htm
It runs the gift shop, and generates products such as logo items (T-shirts, coffee mugs, etc.). The gift shop generates about $3M per year. The RTMCS pays the Province $500,000 per year (likely to increase). They sell about 25,000 T-shirts and 22,000 plush toys per year, their biggest selling items. Pens, mugs, shot glasses with the RTM logo sell well. For logo items, the gift shop manager and assistant manager select items at “gift shows” each year, one in Edmonton, one in Toronto. The vendors send samples, and RTM management then evaluates and approves these. Processing items to get on the shelves is a full-time job for the assistant manager. Logo items are also sold offsite (around town).

The RTMCS sponsors a speaker series. Talks are free to the public: mostly locals attend, but also people from Calgary and Red Deer. Most promotion is web-based (social media), but some is in the local print media. Items for the gift shop are purchased with a corporate credit card and the rewards points help to bring in speakers. The RTMCS pays for a yearly (Christmas) social for landowners, local people, city council, *etc*., to express gratitude for support. RTMCS funds are also used, *e.g*., to cover the costs of scientists attending conferences or research travel, a new exhibit, special projects, *etc*.

They recommend to beware of having a big infrastructure with no funding for staff—the Province must dedicate money for personnel. Various operating models might be considered:
- Run by the Province, like the RTM.
- Run by a society with money from the Province.

- Run privately like the Currie Museum in Alberta with a Provincial grant and some federal money for building and development, and operated independently through local government and private funds. This is, however, an unstable, risky option.
- Run like the Glenbow Museum in Calgary: guaranteed Province money from a grant, the Province owns collections, and the museum manages it independently as a Crown Corporation. http://www.glenbow.org/

Conference at Glyngøre, Denmark:
"World Heritage and Symposium, 2–4 November 2016:
In search for Outstanding Universal Value (OUV)
Mo-clay in the Danish Limfjord area—candidate to UNSECO World Heritage List"

The Danish federal government has applied for UNESCO World Heritage status for the Mo-Clay sediments of the Limfjord region in northern Denmark. Like McAbee, this locality preserves a rich assemblage of early Eocene fossil insects as well as some plants, fish, other vertebrates, and microfossils. Of prime importance is its age, a few million years older than the McAbee, immediately following the Paleocene-Eocene Thermal Maximum event at the Paleocene-Eocene boundary, when large amounts of carbon entered the atmosphere and global temperatures rapidly rose by perhaps 5° C.

Their application for World Heritage status is part way through the process. The conference assembled politicians and scientists who have worked on the Mo-Clay and related topics to find consensus on how to proceed with the application at this point through workshop discussions and presentations. The major topic of discussion was satisfying the UNESCO concept of outstanding universal value (OUV), which must be demonstrated for a site to receive World Heritage status. I presented on the Eocene fossil insects of British Columbia—in large part featuring the McAbee assemblage—with special reference to its relevance to the Mo-Clay as a relevant comparison. The McAbee and the Mo-Clay share some closely related insects that indicate biogeographic patterns of intercontinental dispersal at that time.


Figure 25: Danish conference field trip to an exposure of the Mo-clay.

The Danish system is very different from ours. Mo-Clay collections are housed at two small local museums (the Fur "MUSE®UM" Museum and the Mors Museum), and further collections and designated type specimens at the national Geological Museum in Copenhagen. In Denmark, type specimens and other important fossils are designated national treasures, called "Danekræ" and these are treated in a special manner through federal law. Funding appears comparatively readily available, as a small, regional museum not associated with a university or other large institution of national entity is able to hire a full-time paleontologist, and the equivalent of roughly $100,000 in Canadian dollars was available to it from the federal government while I was there to purchase a single private fossil collection.

Attaining UNESCO World Heritage status is a five-step process:

1- A nation adds a potential site to their Tentative List of potential sites for consideration by UNESCO.

2- The federal government then creates a nomination file to present to UNESCO. The World Heritage Centre offers advice and assistance in preparing this file, which must be as exhaustive as possible, including all necessary documentation and maps.

3- the site is then evaluated by two independent bodies: the International Council on Monuments and Sites (ICOMOS) and the World Conservation Union (IUCN). These submit their evaluations to UNESCO. (In the case of proposals of cultural assets, a third body also evaluates the proposal).

4- The World Heritage Committee evaluates the proposal and makes a decision. This body meets once a year. It may delay a decision and ask for further information.

5- To be designated World Heritage, the proposed site must demonstrate *outstanding universal value* (OUV) and fulfill at least one of the following criteria:

> (i) to represent a masterpiece of human creative genius;
>
> (ii) to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;
>
> (iii) to bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;
>
> (iv) to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history;

(v) to be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;

(vi) to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance. (The Committee considers that this criterion should preferably be used in conjunction with other criteria);

(vii) to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

(viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;

(ix) to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

(x) to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

Figure 26: Workshop strategizing procedure to move the application forward for UNESCO World Heritage status for the Mo-clay.

Danekræ: http://snm.ku.dk/english/samlinger/danekrae/dokument/
Geological Museum, Copenhagen: http://geologi.snm.ku.dk/english/
Fur Museum: http://www.visit-skive.com/ln-int/fur-museum-gdk602095
http://www.muserum.org/kom-og-besog-os/fur-fossiler/?setlanguage=2 (in Danish)

Mors Museum http://museummors.dk/en/fossil-og-mo-clay-museum/history/

Part 2: Summary and Recommendations

Not all sites surveyed combine all aspects particularly relevant to the McAbee Heritage site: a significant, world-class heritage fossil locality combined with a (proposed at McAbee) interpretive/research centre. For example, neither the Royal Tyrrell Museum in Alberta nor the museums in Denmark own the fossil resources that they are most associated with. Like the McAbee, however, paleontological National Monuments within the US National Parks system do have such a combination, and their operations are most relevant. There are well-established and consistent best practices at these sites, conserving their resources and maximising scientific research, and public and school education at all levels, resulting in rich opportunities for tourism that provide significant contributions to their local economies and beyond. To a large degree, these National Monuments provide an appropriate, ready-made template to follow. The summaries of relevant existing operations and recommendations will, therefore, concentrate on that system, with other institutes' policies and programs considered in cases where they differ and are successful.

Organisational structure

Summary

Following is the standard organisational structure and job descriptions for paleontological US National Monuments. Each may differ slightly, *e.g*., some join the Interpretive and Education Officer positions or class a Collections Manager as a Museum Technician, *etc*.

Superintendent

Performs supervisory and administrative duties, ensuring the successful achievement of operation objectives, sets goals for growth and development and works to realise these. Sets an operational budget, does purchasing of supplies for ongoing operations, payroll, and seeks additional funds from external sources (industry, grants, *Friends of* society, *etc*.). The Superintendent is responsible for personnel: hiring and training, assigning, scheduling, and monitoring work and evaluating performance. Works with the government to plan new and improved facilities, works with architects, oversees construction, *etc*. Coordinates services, maintenance, and liaison with the community and varying levels of government.

Administrative Officer

Works under the Superintendent, assuming some roles outlined above, such as budgeting, purchasing and doing the accounts, if the Superintendent is not doing this.

Paleontologist-Curator

Sets policy and procedures for management of fossil resources and oversees all other matters concerning the fossil resource and its use, reviews and approves research permit proposals for use of fossil and other geological and biological resources

(extractive and non-extractive research, and research in collections). Develops a unified central theme and set of subthemes, and creates specific content based on this for exhibits, signage, guided tours, interpretive materials, education materials, programs, *etc*., in conjunction with the chiefs of interpretation and education and their staff. Develops a scope of collections policy and organizes the intake of collections that have been made available for accession in conjunction with the collections manager. Advises the Superintendent and architect on needs for the collection area, prep room and accessions room, and on equipment necessary for collections operations: cabinets, trays, cameras, microscopes, *etc*. Conducts original research, publish this and attends professional meetings, congresses to present work and interact with scientific community. As curator, oversees collections and paleontological staff (collections manager and any others, *e.g*., preparator, volunteers, students, *etc*.). Identifies needed areas of research and seeks out and facilitates the work of qualified outside researchers based on the needs of the park. May be an adjunct professor at a regional university and have associations with large museums.

Collections Manager
Works under the paleontologist to maintain collections, processing fossils into collections (prep, trimming, numbering, databasing, and their safe, proper storage), development of collections space (including environmental and security controls), and acquiring equipment. Should have training in museum procedures. Assists in fieldwork.

Interpretation Officer
Works with paleontologist to develop exhibits, signage, guided tour content, other content presenting the science of the park to the public. Is responsible for front-line workers who interact directly with the public (seasonal employees, volunteers, *etc*.).

Education Officer
Works with the paleontologist to develop content for educational outreach, both on-site for visiting school groups, student groups, and an off-site program to go to school classes of varying levels. Interacts with teachers, ensures that programs conform to the curriculum.

Interpretive/Education staff
- Media: a full-time media person in charge of social media outreach (FaceBook, Instagram, Twitter, Flickr, *etc*.) and press releases, YouTube presence, and other promotion, such as creating and maintaining a TV, radio, and press profile.
- Frontline interpreters and education personnel: a number are needed to work under the Interpretation and Education Officers (full-time, interns, seasonal employees, volunteers). They have direct contact with the public, translating the meaning of the resource into language that is clear to the visitor or school group in on-site (guided visitor centre exhibit tours and trail tours) and off-site (campground talks) presentations. They work the front desk.

Volunteer coordinator
Selects, trains, is responsible for volunteers. Works under supervisor, coordinating with paleontologist and chiefs of interpretation and education where indicated.

Security/Law Enforcement
Patrols the site, controls fossil theft, vandalism, and other security issues, provides security for the facilities.

Maintenance People
Cleans, keeps infrastructure/equipment running smoothly, repairs electrical, plumbing, *etc*. (some aspects contracted out to local business).

Recommendations
A transition team should be hired in a timely manner to oversee development of a McAbee Centre, including a Superintendent, an Administration Officer, a Paleontologist-Curator, a Collections Manager, Interpretation and Education Officers (and their appropriate staff, *e.g*., media specialist), and a Security Officer. A Volunteer Coordinator, frontline Interpretive Staff (interns, seasonal employees, volunteers) and maintenance personnel could be hired as the project nears completion.

Site security

Summary
Various sites control vandalism and fossil theft differently, depending on the nature of their resource. In some, large bones embedded in very hard rock are relatively impervious to theft and require a low level of monitoring, but elsewhere, a heavier presence of law enforcement officers is necessary to provide security for the resource. Locations that are under-funded struggle with this and apparently suffer problems. Further programs monitor resource degradation issues such as at Florissant, where resource locations (fossiliferous rock outcrops, *etc*.) are monitored on a regular program, constantly photographed and examined for change.

Recommendations
McAbee is vulnerable to fossil theft and vandalism, as a popular culture of fossils as commercial items has been fostered over the years of its operation as a commercial quarry. Full-time security personnel should be hired without delay.

Interpretation/education/outreach programs

Summary
The following summarises successful programs at all parks and museums visited where all portions of the public are served in on-site and off-site programs.

Interpretive staff (full-time, interns, seasonal employees, volunteers) receive training for and then develop their own presentations, checked by the Park Paleontologist. Seasonal staff do this each spring, with a week (two at some parks) training and a week (or two) individual presentation development.

Schools/youths
Education programs coordinated with regional curriculum.

Off-site:
- Teacher/teacher ranger program: internship for teachers with credit available for professional development, perhaps also through regional university. The teacher goes through training and develops course material with input, checking by park staff. This content is delivered to the class with no park staff presence.
- Travelling kits program: see above in the John Day National Monument section.
- Class presentations by interpretive staff.
- Distance learning (Skype): highly developed by the Tyrrell Museum, see details above.

On-site:
- visiting classes. Teachers should do an advance visit for training by interpretive staff, and are encouraged to participate in interpretive staff presentations to students.
- educational room. Age-appropriate set activities are presented by staff in conjunction with teachers at tables in education rooms. Having removable walls allows these to be multi-functional.
- sleepovers. The Tyrrell Museum has an overnight program for school children.

The US National Parks service has a program where a fourth grade student and their family has free admission: https://www.nationalparks.org/our-work/campaigns-initiatives/every-kid-park
They have determined this as the age where lasting impressions are made, fostering life-long interest and repeat visits.

Junior Ranger/Junior Paleontologist program. An extremely popular way to get youths between the ages of five and twelve involved. These are discussed in detail above in the Fossil Butte and Florissant sections and in the links provided there.

At Florissant, sandboxes are set up as an area for very young children, monitored by their parents. This is seeded with bones of horses and cattle and other durable items that they can discover and then have a park staff member tell them something about. Having them return the bone to the sandbox fosters conservation values.

Visiting public programs/activities
Outdoor structure, amphitheatre seating for open-air programs delivered by interpretive staff (full-time, interns, seasonal employees, volunteers). There may be shorter, more informal “porch talks” in an area by the visitor centre with shade.

Theatre in the visitor centre for video presentations: overview of the park and more detailed videos on specific topics. These either run at set times or are viewer-initiated with push buttons (recommended). The theatre is also used for live presentations by researchers during the day and evening events.

Managing social media (FaceBook, Instagram, Twitter, Flickr, *etc*.) and a YouTube profile is essential, along with more traditional press releases and other promotion such as creating and maintaining a presence on TV, radio, and other media.

They have a presence at regional town festivals (*e.g*., a booth, displays).

Guided tours by interpretive staff of exhibits in the visitor centre and on trials with signage. They commence on an as-needed basis, when sufficient people are assembled, not at regular times. At some parks, there is a guided tour to a sample outcrop (a demonstration outcrop, not an active research outcrop) done with a limited number of people (a maximum of ten at Fossil Butte) once a day.

These parks have two types of trails: those that go to the fossil beds and are used for guided tours (non-guided at parks where resource conservation/security permits), and trails away from fossil sites that are non-guided. Both types have interpretive signage.

Evening talks at local campgrounds by interpretive staff on paleontology and a variety of topics apart from it (*e.g.*, local history and wildlife) that the interpretive staff rotate.

Sites with large vertebrates (or fish as at Fossil Butte) have prep widows where the public can see fossil preparation through a window and on a TV screen above the window. At Florissant, where this is not practical by the nature of the fossils (mostly insects and plants like at McAbee), they are replacing a prep window by developing a virtual tour of collections by an intern with a GoPro camera to show visitors the behind-the-scenes view and take questions.

Other, non-paleontological programs are successful such as talks on geology, local birds, ecology, *etc*., and a night sky program.

Exhibits

Exhibits have a main theme or related themes and a variety of sub-themes. They start with the overarching story in core exhibits, displaying and interpreting fossils that serve this narrative. Showing lots of fossils succeeds, but they must all serve the story. Periodically change non-core (low-cost) exhibits to keep the park experience fresh. A "what's new in research" exhibit contributes to the idea of science at the park being an active, ongoing process. This may be in lobby (start) or at the end as public is going out.

Parks differ in their idea of the "darkened room with lighted cabinets" versus "light room" concepts of presentations. They also differ in their thoughts on simple exhibit technology versus using up-to-date electronic interactive exhibits. They all agree, however, that many learning styles must be engaged: those who learn by reading, seeing, touching, *etc*.

They all stress that for all age groups, even young children, exhibits should "go high" with information presentation, and not be dumbed-down with the "Hey kids, cool! Check it out!" route. Sophisticated content communicates well if well presented. The content that I saw presented at all parks and museums was of consistently high quality.

The Cleveland-Lloyd Dinosaur Quarry has an "artist in residence" program, which appears to work well.

Recommendations

Interactions with the visiting public and school groups through the on-site and off-site programs described above have been finely developed by these institutions to run smoothly with problems largely resolved. They could be mostly copied as they are for McAbee with very little if any modification for specific conditions. The exhibit styles and other manners of engaging the public in a museum setting are effectively realised, and McAbee could easily replicate these successful programs and presentation styles with sufficient personnel and resources.

A prep window, while successful at some sites, wouldn't work at McAbee due to the nature of its fossils, but the "GoPro Intern talk" being developed at Florissant in place of this would surely work well.

An "Eocene Garden" exhibit should be considered with live plants of types that are found in the fossil beds. This would include trees, some of which would grow quite large, *e.g*., *Metasequoia* (dawn redwood), sequoia, *Pseudolarix* (Chinese golden larch), *Ginkgo*, beech, elm, maple, sassafras, fir, cedar, pine, *etc*., perhaps growing outside or in an enclosed space depending on climatic tolerances, attached to or part of the main visitor building.

The successful "fourth grade and family free" program should be copied, encouraging increased visitorship and creating lasting memories and return visits.

Due to the vulnerable nature of the resource at McAbee, trails to the fossil beds should be used for guided tours only; those sufficiently away from the fossil beds may be non-guided.

Cell phone QR codes on exhibits and walking trails (connectivity might be an issue on trails?) http://www.mobile-qr-codes.org/how-do-i-use-qr-codes.html could provide audio commentary with options for English, First Nations languages, French, Mandarin,

Cantonese, Punjabi, *etc*., enhancing inclusiveness, welcoming a broad visitor demographic.

Travelling evening public talks could be scheduled, perhaps in the winter, for regional towns, probably in conjunction with local naturalist groups.

Non-paleontological programs for many age groups such as regional geology, birding, grasslands ecology and a night sky program could be easily implemented and provide for a wide range of interests and visitor experiences.

Short-term (immediate) programs
Highway signage outside of the site should give a brief overview of the importance of the site and of buildings and programs to come. Anything further would be premature, without the detailed planning by core staff setting major and minor interpretive themes with signage and guided tour content coordinated with these, and training interpretive staff to deliver this content. Beginning programs without all proper elements in place in a thought-out, professional manner would, I believe, harm the overall goals of the site, establishing half-measures that may be difficult to grow from once these have become established and the initial momentum is lost.

Long-term (future) programs
These would include all of those outlined above, including exhibits, guided and non-guided tours, school presentations on-site and off-site (travelling kits, teacher training, etc.), regional talk tours, and other community outreach programs. Creating and implementing these programs should commence as practical soon as core staff is hired.

Gift shop

A gift shop run by a *Friends of* society is universal among sites visited. A *Friends of* society may be constituted in a number of fashions, but it is not an advisory body. Logo items (*e.g.*, T-shirts, caps, pens, fridge magnets, shot glasses) and paleontology books sell well. Other children's items such as plush toys sell very well. These may also be sold in town. Funds from this contribute significantly to support various park operations. Logo water bottles and water should be available and limited small food items sold, with the public encouraged to purchase food beyond this in town.

UNESCO status

Summary
Denmark has gone through a portion of the process of nominating the Mo-clay formation for UNESCO World Heritage status. It justifies this nomination by the following outstanding universal value as defined by UNESCO:

(viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features.

The Danish application is at the stage of deciding how to define and present the outstanding universal value of the Mo-clay under this category.

UNESCO: http://en.unesco.org/
UNESCO World Heritage: http://whc.unesco.org/
http://whc.unesco.org/en/list/
http://whc.unesco.org/en/nominations/
I asked at various US National Monuments if they were seeking UNESCO status, but was always told that there is strong local antagonism towards the United Nations, precluding this. This is not an issue with the McAbee, however.

A further, more readily achievable category is Geopark status. The Global Geoparks Network is also supported by UNESCO:
https://en.wikipedia.org/wiki/Global_Geoparks_Network
Although this is a lower category than World Heritage, this status also enhances local education and tourism opportunity. https://en.wikipedia.org/wiki/Geopark
http://www.globalgeopark.org/
http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/frequently-asked-questions/what-is-a-unesco-global-geopark/
Tumbler Ridge, BC has achieved Geopark status for its paleontological, geological, and human history assets: http://trgg.ca/

Recommendations
Achieving World Heritage status would internationally highlight the importance of the McAbee, bringing global attention. I believe that it would be a strong candidate under the category eight of the UNESCO outstanding universal value list: "(viii) to be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features."

An application would need the support of various levels of government, federally and provincially as well as locally, and possibly require a full-time advocate who is expert in navigating through high-level government bodies for at least part of the process. To be successful, management of the site would be carefully examined by UNESCO, and must be to the highest international standards.

Connectedness with related parks

Summary

Paleontological parks and museums gain great benefit from interconnectedness with similar institutions. One means is by sister park relationships:
https://www.nps.gov/oia/topics/sisterparks/sisterparks.htm
Fossil Butte and Florissant, for example, are sister parks, with many mutual benefits. US National Parks are sister parks with parks internationally, for example, Hagerman National Monument has a sister park relationship with Sibiloi National Park In Kenya: https://www.nps.gov/hafo/sister-park-agreement.htm

Another way to create cross-promotion and foster mutually beneficial community would be creation of a version of "The Dinosaur Diamond", linking other paleontological centres in western Canada (in BC: Tumbler Ridge, the Courtenay Museum, the Princeton Museum, *etc*.) and the USA (Florissant, Fossil Butte, *etc*.).
http://travel.nationalgeographic.com/travel/road-trips/dinosaur-diamond-prehistoric-highway/
https://en.wikipedia.org/wiki/Dinosaur_Diamond_Scenic_Byway

Recommendations
Sister park relationships and cross-promotion through other means such as a "Dinosaur Diamond" model would be of great benefit for McAbee. Such connections should be pursued as soon as a centre is announced and core staff are hired.

Mandate

Recommendations
The core staff (supervisor, paleontologist, chiefs of interpretation and education) should collectively create a mandate that sets objectives for the site, for example: *To preserve and protect the fossil heritage of the McAbee site; to interpret the fossil life of the site and related sites of similar age in British Columbia to the public; to create and maintain collections of fossils and related materials from the McAbee Heritage site and comparative BC sites; to conduct, encourage and coordinate research on this material, and to present this to the public and the scientific community.*

Identity

Summary
All parks and museums surveyed had a successful identity/brand as a marketing device through effective use of a logo, for example a fish fossil at Fossil Butte, a wasp at Florissant, and a *Tyrannosaurus* at the Tyrrell Museum.

Recommendations
The McAbee could utilise something like the magnificent, huge and colourful fossil scorpionfly *Dinokanaga hillsi*, only found there.

Collections

Summary

There is less collections space than is necessary at all institutions visited. Lack of collections space was invariably their most pressing problem. An accessioning room and prep room were each separate, but adjoining the collections room. The environment in these is strictly controlled for temperature, humidity and light quality. An adjoining photography room is also separate. Each of these has motion detectors and separate card-lock security, with access only to curation staff. Access by outside researchers is by permit. Most institutions prefer stacked cabinets over expandable units to avoid constant jarring of specimens. A scope of collections policy determines its mandate.

Recommendations

Collections must be housed on site. Collections, prep, photography and accessioning rooms should be configured and have environmental controls and security (access protocols, motion sensors, *etc*.) as above. A scope of collections policy should be developed by the Paleontologist-Curator. I recommend that it include fossils of McAbee and related sites. McAbee Centre collections could begin by accession of existing collections of fossils from McAbee and related sites made available to it. Negotiations should be sought with BC Parks to assign the McAbee Centre as the designated repository for fossils from Driftwood Canyon Provincial Park. Wording of the scope of collections should not be so restrictive as to preclude comparative fossils from other regions, and comparative collections of modern insects, plants, and other living organisms closely related to fossil taxa.

Collecting and research

Summary

Almost all sites with heritage paleontological resources (US National Monuments) have trained staff collect, and outside research is collections-based (the Royal Tyrrell Museum has responsibility for all paleontological resource management in Alberta, and evaluates and issues permits). Non-extractive research (*e.g*., measuring, photographic outcrops) is done by permit. Outside researchers access the site for any reason accompanied by park staff. All material leaves the park by documented loan, including non-fossil material such as drill cores and other geological samples, and, *e.g*., material related to living plants and animals.

Recommendations

I recommend a collecting policy as outline above for the US National Monuments. There should be no non-research collecting—all collecting should be done in an organised, systematic manner by McAbee Centre personnel. There should be a moratorium on fossil collecting at McAbee, as further loss of the most important, limited resource without utilising the specific collecting protocols described below could seriously compromise the site. Specially trained site staff should perform systematic and complete collecting once the paleontologist-curator and collections manager and proper

onsite storage facilities are in place and prepared to accession new fossils. Following this, if an outside researcher requires samples collected in a certain fashion for a particular study, onsite staff should do so on their behalf in collaboration with them.

All fossil insects, even the most fragmentary, should be collected and catalogued. This is important for unbiased community analyses, and further as important specimens may be only recognised as such later, in the laboratory under a microscope. All vertebrate remains should be treated similarly. Although every conifer needle need not be collected, all flowers, fruits and seeds should be. Foliage should be over-collected, with specific protocols set in consultation with paleobotanists. It should be kept in mind that damaged leaves carry important information; for example, damage from insect feeding is useful in understanding plant-insect interactions, and therefore the ecology of the community. Detailed location information must be kept with all fossils including GPS data and precise stratigraphic position. Ash layer stratigraphy should be thoroughly characterised, and the stratigraphic position of fossils recovered should be recorded in centimeters below a numbered ash layer.

This manner of procedure is important for three reasons: 1), it follows established standards of best practice for treatment of heritage paleontological resources at comparable institutions discussed above, creating a standardised on-site collection created under controlled and uniform protocols, confidently comparable in studies in perpetuity; 2), it satisfies the need to carefully and completely collect the apparent small amount of remaining high-quality resource at McAbee, and; 3), it appropriately addresses the specific difficulties involved in recovering the fossil insects that make this site of world-class importance.

Established best practices

Consistent with best practices established at the above institutions that include heritage fossil sites, collecting should be done by properly trained and experienced McAbee Centre staff. They should intensively collect these beds in a complete manner, systematically and carefully quarrying section by section, accessioning these fossils into a properly curated, databased collection housed onsite that includes all relevant data as outlined above. These collections would be the subject of study by outside scientists. This is consistent with the highest value of stewardship of the heritage resource at McAbee as set by the Ministry of Forests, Lands, and Natural Resource Operations. Without a well-curated on-site collection, collected in a consistent, rigorous manner, in a few years (five? ten?) the finest shale at McAbee will be exhausted, and existing collections made with differing protocols will be dispersed among varying institutions. There will be nothing of value left at the site.

The remaining amount of high quality resource at McAbee

At McAbee, this takes on a greater importance by the limited nature of this resource due to its significant maltreatment in the past. Given the current state of knowledge, the most significant fossil resource, the beds of the most diverse, plentiful, and finely-

preserved fossils at the McAbee site are on the Hoodoo Face (former Zugg claim and areas immediately adjoining it to the east and west facing Highway 1). Although the fossils of the Eastern Beds (east of the Hoodoo Face in and near the old "kitty litter quarry") has known significance, particularly concerning fish, and likely has further and greater currently unrealised significance, this area is not known to bear fossils in the plentiful, rich, finely-preserved and diverse manner as does the Hoodoo Face. The West Section ("Perry Ranch" unit) has not been thoroughly evaluated for quality and abundance of fossils. While there is the possibility that it may contain material comparable to the quality of the Hoodoo Face, it's not reasonable to expect this. From examination of the Hoodoo Face, the finest beds of the portion previously mined under the Zugg claim have been mostly (completely or almost completely?) destroyed. Any of the most important shale remaining there is surely not in quantity. Therefore, the most likely regions to contain important material are those on the Hoodoo Face immediately adjoining the old Zugg claim to its east and west where these important beds likely extend. This should be the region of highest concentration of effort in collecting for a McAbee Centre, bearing in mind that thorough examination of the other areas of the site might reveal these most important beds extending there.

The necessity of collecting by properly trained personnel

The McAbee is set in an interval in Earth's history when life on the planet had recovered from the extinction event that killed the dinosaurs, and its modern form was emerging. The fossils of the McAbee are particularly suited to increase our understanding of this important time, and hold strong potential for interpreting it to the public. Although the other fossils of the McAbee are certainly important, the fossil insect community of the site is outstanding, unprecedented world-wide for these purposes. The fossil insect assemblage of the McAbee must be treated as the highly important world-class resource that it is, a resource of *outstanding universal value*. These insect fossils, however, are mostly undetectable to untrained eyes during collecting. Although avid amateur collectors and even highly trained paleontologists who are not paleoentomologists (fossil insect specialists) may recover a quantity of fossil insects in a day, they miss so many highly important specimens that a major portion is lost in their discarded rock. I've spent afternoons going through cast-off piles from the commercial and amateur collectors who were previously most active at the site as well as from trained paleontologists of other disciplines, and found large numbers of important specimens unknowingly discarded. In my experience, they do not see the tiny wings that make this site important. This resource must be handled with utmost care to maximise the fossils recovered from the restricted amount of the most important shale left.

A good example is the small piece of shale illustrated below (Figure 27). To non-specialists, there appears to be only a couple of leaves at best, both incomplete, one of them only a fragment. This rock would surely have been discarded by an amateur collector, and most likely would also have been even by an experienced paleontologist not trained to detect fossil insects. This single piece of rock, however, bears at least ten new species of insects spread across seven orders: a parasitoid wasp (order

Hymenoptera: ants, bees and wasps), a march fly (order Diptera: true flies); two species of green lacewings (order Neuroptera: lacewings); two spittlebugs (order Hemiptera: true bugs); a beetle (order Coleoptera: beetles); a previously unknown family of scorpionfly (order Mecoptera: scorpionflies); a mayfly (order Ephemeroptera: mayflies); and several more, poorly preserved small insects.

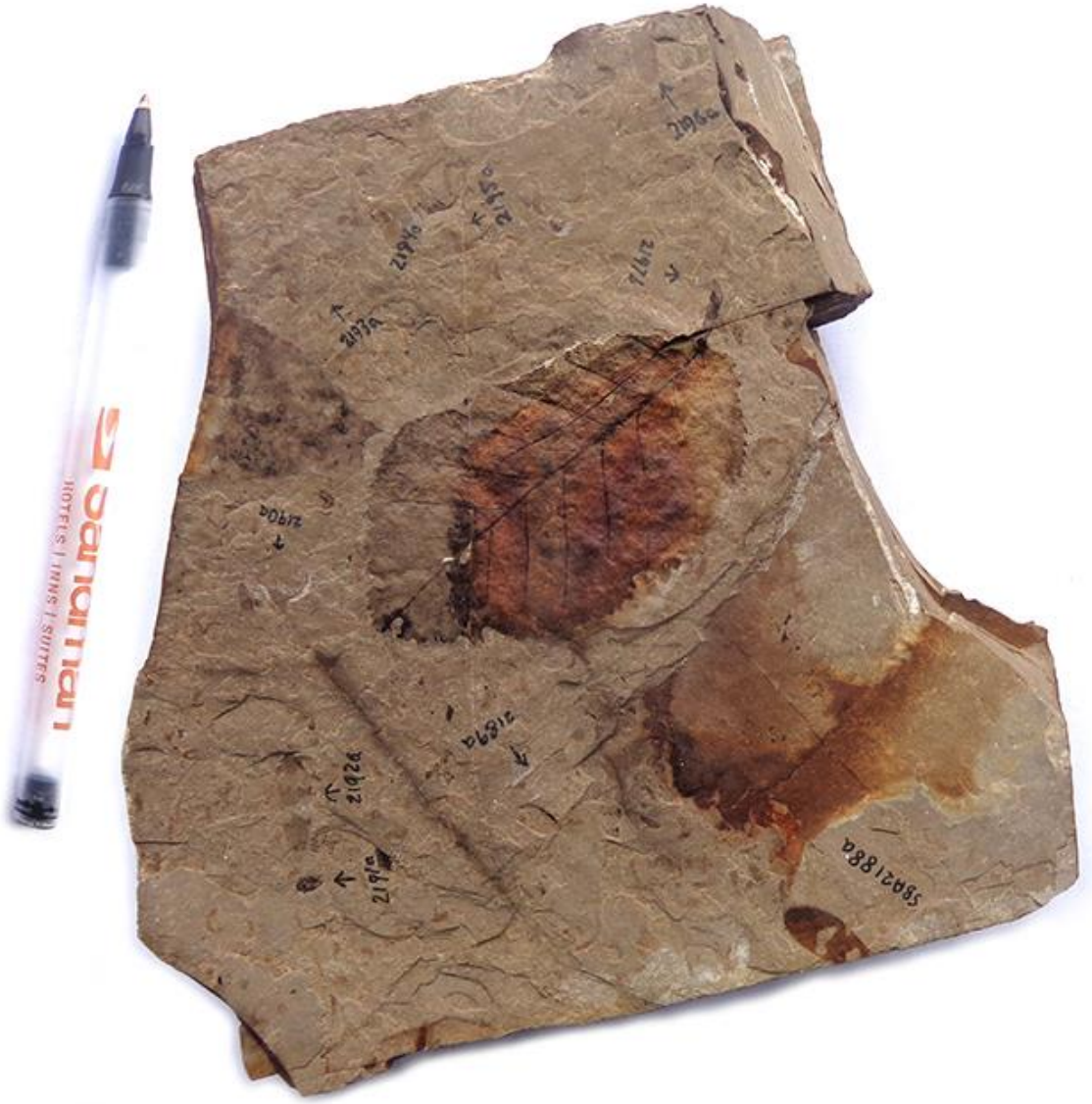

Figure 27: Small piece of McAbee shale from the richest, most important beds.

Fossils of this one rock have been featured in three scientific papers already, one in which the two lacewings were named as the new species *Protochrysa fuscobasalis* and *Okanaganochrysa coltsunae*, a second that described the new scorpionfly species *Eorpa ypsipeda* and its new family and in a third that provided on overview of the McAbee and related sites in British Columbia and northern Washington. One lacewing species is the last member of its subfamily, a group that was large in dinosaur times, in the Mesozoic,

but that has its last appearance at McAbee. This highlights the McAbee as a time of transition: the end of some ancient lineages that stretch back to dinosaur times and the emergence or diversification of many important modern ones. This new lacewing species is also important by being very closely related to species found in the Danish Mo-clay, highlighting the connections between Europe and North America at that time, the early Eocene.

The plants found on this same rock include not only the easily seen birch leaf and the less easily seen possible cherry leaf; but also, an even less easily detectable seed cluster; a fruit of the flowering plant *Dipteronia* (only known to live in China today, further highlighting intercontinental dispersal of life at that time); and conifer needles of various, unidentified species. Beyond all of this, there is a feather on this rock. Without special training, all this would have been lost when the rock was discarded as seemingly unimportant. It's a little rock with a lot of information carried in it. Such small rocks packed with significant specimens in my experience arise most days at McAbee, but all, or surely almost all that were found without a specifically trained eye are lost.

Building plan

Recommendations

I recommend that architectural plans for the centre be reviewed by the core staff for suitability to needs. This includes sufficient area and configuration for an expandable collections space and its position in relation to the fossil preparation and accessioning rooms. All must meet museum standards for collections (security, environmental control: humidity, temperature, *etc*.). There should be a paleontology staff library, and sufficient room for school group education, outreach, a theatre (video presentations, informal talks, professional seminars), sufficient exhibit space and other interpretation needs, a board room, *etc*. Administration and maintenance would likely be in separate buildings. A security expert should review the plans. Sufficient large wall space for mural scenes of Eocene McAbee should be planned. A landscape architect should be consulted, particularly with regard to an "Eocene Garden" exhibit. A security expert should be consulted (general site security, building security, collections security).

Conclusions

The McAbee Heritage site could be a great success, with a significant impact regionally, provincially, nationally, and internationally. It would have high value in helping to understand the dawn of the modern world through its outstanding research possibilities and afford a significant opportunity to interpret this to the public. It has the potential to be a great asset to the people of British Columbia, providing educational opportunities at all levels, directly engaging the public and becoming an important, long-term, sustained and stable driver of the regional economy. Sufficient government investment is essential for success at McAbee—it should be kept in mind that for every dollar that

US National Parks puts into a National Monument, $10 is generated for the local community.

The potential conservation, scientific, educational and economic benefits of a McAbee Centre are by no means guaranteed, however. The various parks/localities that I visited have had varying degrees of success, with some highly successful, but others significantly challenged, not preforming to meet these goals. Without a consistent, carefully carried out collecting program of trained McAbee Centre staff with specimens housed on site as described above, in five to ten years there may be no significant resource left at McAbee, with recovered material scattered among various institutions. The organisation and operation of a McAbee Centre must be carefully considered, most importantly to preserve the heritage value of the site, but further to utilise it in a fashion that enhances its potential, creating the maximum possibility for it to become the world-class asset that it should be.

Section 3: Researchers' opinions surveyed

Opinions on fossil resource management at McAbee were asked of various researchers. Responses were received from the following.

Dr. Nancy Van Wagoner, Thompson Rivers University:

I think the entire site is very important in terms of shedding light on past climates. The entire site should be managed for research. It isn't just about the fossils, and it certainly is not about recreational collecting. It is about preserving the site for legitimate research, and interpreting that research to the public so the significance of using sophisticated tools to understand geologic history and what that means to humanity can be fully appreciated.

Dr. David Greenwood, Brandon University, with Christopher West, PhD candidate, University of Saskatchewan, and Alex Lowe, MSc student, Brandon University:

1. Collection protocols .
   - 1.1. **If** non-research collecting is to be allowed, this should be in designated areas only where these have been selected by a paleontologist on the basis of advice from scientists currently active in research on the site so as to prevent disruption of any active research projects by research students or professional paleontologists.
   - 1.2. **If** non-research collecting is to be allowed, all fossils collected should be seen by a person with knowledge of fossils from McAbee, such as a current graduate student or professional paleontologist.
     - 1.2.1. Ideally, non-research collecting should be limited to scree piles.
   - 1.3. Research collecting should be under a valid permit along similar lines to the S.12 permits. This could be improved.
   - 1.4. For all fossils the location of where fossils were collected should be recorded, where this has these attributes:
     - 1.4.1. The horizontal quarry site position relative to the sections in Hebda 2012 (i.e. distance left or right of the numbered section) or the equivalent;
     - 1.4.2. The vertical position relative to the site stratigraphy based on Hebda 2012 or the equivalent (e.g., using the detailed site stratigraphy being developed by Lowe, West and Greenwood as part of Lowe's MSc project);
     - 1.4.3. The date of collection as quarrying alters the exposure;

1.4.4. The **collector's name should be recorded** (e.g., the Botanical Code of Nomenclature (Melbourne code) requires a statement of the collector when first naming a new plant species, including fossils).

1.5. **Safety**: any work at the site must include protocols that take into account the risks associated with working at the exposed rock faces and the screes where there exists a risk of rock falls, rock slides, and general danger to the public and other users.

1.6. **Site preservation**: fossil resources at McAbee are finite and must be preserved for future generations. Insofar, protocols must be established to preserve the limited resources at McAbee so that they may be enjoyed by future scientists and other visitors, and remain part of the heritage and cultural landscape of British Columbia. This would require the development of a plan to reduce active collecting over a specified period of time.

2. Curation of specimens.

2.1. The information noted above under 1.4, where known, should be included with any specimens placed in permanent collections.

2.2. Private collectors should be encouraged to donate specimens to appropriate museums, preferably the RBCM, and if not the RBCM then a museum that:

2.2.1. Offers curatorial standards that permits long term safe storage and offers security of tenure (i.e., the museum will be there in 50 years time);

2.2.2. Has a protocol in place for scientific loans to professional paleontologists at Universities, other museums, and similar accredited institutions.

2.3. Scientific collections can reside in a University or similarly legal entities for the duration of a research project, but must be moved to a permanent repository at project completion or otherwise specified in the collection permit;

2.4. The best permanent repository is the RBCM as the 'provincial museum'.

2.4.1. In some instances, specimens may be loaned or gifted to museums elsewhere in Canada (e.g., Canadian Museum of Nature in Ottawa, Royal Tyrrell Museum of Palaeontology, Alberta) as they historically have McAbee material.

2.4.2. Type specimens of species described from McAbee collections must be clearly designated as such, and kept in a suitable separate part of a museum collection, with the publication creating the new name recorded with the specimen(s) in the museum's collections catalog, whether electronic or paper.

3. Uses of specimens.

3.1. Under no circumstances should fossils from McAbee be available for sale.

3.2. Destructive use of specimens for the purposes of geochemical investigation, or for palynological preparation should be permitted, but excluding type specimens.
3.3. Preferably, specimens put on display should provide information about the age of the McAbee site, who collected the fossil (if known), and preferably an identification in both lay terms and a scientific name.