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3. Dinosaur Fauna

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Dinosaur Provincial Park has long been renowned as one of the major sources of specimens of dinosaurs (Table 2). More than three hundred significant finds have been made and dinosaurs from this region are on display in more than 30 institutions throughout the world. The majority of these specimens were collected between 1910 and 1930, after which collecting activities were sharply curtailed. Since 1978, however, there has been steady increase in research and collecting in Dinosaur Provincial Park, primarily by the Tyrrell Museum of Palaeontology, with assistance from scientists from the National Museum of Canada, The University of Pennsylvania, The University of Calgary, and the Alberta Geological Survey, a department of the Alberta Research Council. Correlation with other Judithian sites in Alberta and Montana will be refined as detailed work on the fauna and flora (including palynomorphs), depositional environments, and palaeoenvironments increases our understanding of the system.

In addition to scientists, between 20 and 30 people from the Tyrrell Museum of Palaeontology work in Dinosaur Provincial Park every summer. This field crew is divided into smaller teams that have the following functions:

1. Prospecting for new fossil resources, and recording data on the occurrence of these finds;

2. Excavating significant specimens.

3. Bonebed excavation (Quarry 143).

The surveying teams look for evidence of the presence of articulated specimens suitable for research and display. Each summer more than half a dozen such prospects are found, of which about 30% turn out to be good specimens once excavated. It is evident from examination of historical records that the prime purpose of previous collections in this region was to find articulated remains for display in museums. This rich resource led people working in this region to ignore other resources that would be considered significant if found elsewhere.

Isolated fossil bones scattered throughout the park are one such overlooked resource. Careful collection and study of these isolated remains reveals new information on the palaeoecology of the Judith River Formation. Many of the animals identified by isolated remains had complex taphonomic histories. In some cases skeletons were disarticulated before being picked up by flood waters and buried in river sediments. For example, pachycephalosaurid (dome-headed) dinosaurs had extremely thick skull roofs that survived weathering much better than the rest of the skeleton. Although

TABLE 2 -- Vertebrate faunal list of the Judith River (Oldman) Formation.

CHONDRICHTHYES		
Selachii	Isuridae	Gen. et sp. indet.
	Orectolobidae	*Squatirhina*
Rajiformes	Dasyatidae	*Myledaphus bipartitus*
OSTEICHTHYES		
Acipenseriformes	Acipenseridae	*Acipenser*
	Polyodontidae	Gen. et sp. indet.
Aspidorhynchiformes	Aspidorhynchidae	*Belonostomus*
Amiiformes	Amiidae	*Kindleia fragosa*
Lepisosteiformes	Lepisosteidae	*Lepisosteus occidentalis*
Elopiformes	cf. Albulidae	*Paralbula*
Perciformes	cf. Sciaenidae	*Platacodon*
Acanthopterygia		Gen. et sp. indet.
Holostei inc. sed.		Gen. et sp. indet.
Teleostei inc. sed.		Gen. et sp. indet.
AMPHIBIA		
Salientia	Ascaphidae	Gen. et sp. nov.(Fox)
	Discoglossidae	cf. *Scotiophyrne*
	Pelobatidae	*Eopelobates*
Caudata	Scapherpetontidae	*Scapherpeton tectum*
		cf. *Lisserpeton bairdi*
	Amphiumidae	*Proamphiuma* sp.
	Batrachosauroididae	*Opisthotriton kayi*
		Prodesmodon copei
	Sirenidae	*Habrosaurus dilatus*
Allocaudata	Albanerpetontidae	*Albanerpeton* sp.
REPTILIA		
Chelonia	Baenidae	*Neurankylus eximus*
		Boremys pulchra
		Naomichelys
		Plesiobaena antiqua
	Macrobaenidae	"*Clemmys*" cf. *C. bachmani*
	Dermatemydidae	*Adocus lineolatus*
		Basilemys variolosa
	Trionychidae	*Aspideretes foveatus*
		Aspideretes alleni
	Chelydridae	Gen. et sp. indet.
Sauropterygia	Polycotylidae	Gen. et sp. indet.
Archosauromorph	Champsosauridae	*Champsosaurus natator*
Sauria	Teiidae	*Chamops*
		Leptochamops denticulatus
	Scincidae	*Sauriscus*
	Anguidae	*Pancelosaurus*
	Xenosauridae	Gen. et sp. indet.

	Necrosauridae	Parasaniwa
		Paraderma
		Colpodontosaurus
	Varanidae	Palaeosaniwa canadensis
Sauria inc. sed.		Gen. et sp. nov.(Fox)
Ophidia	Aneliidae	Coniophis
Crocodilia	Crocodylidae	Leidyosuchus canadensis
		cf. Brachychampsa
		Albertochampsa langstoni
	Sebecosuchian	Gen. et sp. indet.
Pterosauria	Pterodactyloidea	Quetzalcoatlus sp.
		Gen. et sp. indet.
Saurischia	Segnosauridae	cf. Erlikosaurus
	Ornithomimidae	Dromiceiomimus samueli
		Ornithomimus edmontonicus
		Struthiomimus altus
	Troodontidae	Troodon formosus
		(Stenonychosaurus inequalis)
		(Pectinodon bakkeri)
	Dromaeosauridae	Dromaeosaurus albertensis
		Saurornitholestes langstoni
	cf. Dromaeosauridae	(Paronychodon lacustris)
	Caenagnathidae	Caenagnathus collinsi
		Caenagnathus sternbergi
	cf. Caenagnathidae	Chirostenotes pergracilis
		(Macrophalangia canadensis)
		(Macrophalangia elegans)
		Elmisaurus
	Tyrannosauridae	Albertosaurus libratus
		Daspletosaurus torosus
		Gracile tyrannosaur
		(Aublysodon sp.)
		(undescribed)
Ornithischia	Hadrosauridae	Brachylophosaurus canadensis
		Gryposaurus notabilis
		Kritosaurus incurvimanus
		Prosaurolophus maximus
		Corythosaurus casuarius
		Lambeosaurus lambei
		Lambeosaurus magnicristatus
		Parasaurolophus walkeri
		(Amblydactylus sp.)
	Pachycephalosaurid	Gravitholus albertae
		Ornatotholus browni
		Pachycephalosaurus sp.
		Stegoceras validus
		Full Domed

	Nodosauridae	*Panoplosaurus mirus*
		Edmontonia longiceps
	Ankylosauridae	*Euoplocephalus tutus*
	Ceratopsidae	*Anchiceratops* sp.
		Centrosaurus apertus
		Chasmosaurus belli
		Chasmosaurus kaiseni
		Eoceratops canadensis
		Monoclonius lowei
		Styracosaurus albertensis
AVES		
cf. Neognathae		Gen. et sp. indet.
MAMMALIA		
Multituberculata	Neoplagiaulacidae	*Cimexomys judithae*
		Mesodma primaeva
	Cimolodontidae	*Cimolodon electus*
		Cimolodon similis
	Cimolomyidae	*Cimolomys clarki*
		Meniscoessus major
		Gen. et sp. indet.
Theria inc. sed.	Deltatherididae	cf. *Deltatheroides*
Marsupialia	Didelphidae	*Alphadon praesagus*
		Alphadon halleyi
		Alphadon, n. sp.
	Pediomyidae	*Pediomys clemensi*
		Pediomys, n. sp.
	Stagodontidae	*Boreodon matutinus*
		Eodelphis cutleri
		Eodelphis browni
Eutheria/Insectivora	Leptictoidea	*Gypsonictops lewisi*
	cf. Nyctitheriidae	*Paranyctoides sternbergi*
	Palaeoryctidae	*Cimolestes* sp.
		Gen. et sp.nov.(Fox)

only one partial skeleton has been recovered from the park, isolated skull caps are frequently found. Study of isolated skull parts of these animals over the past five years has revealed the presence of at least three genera that were not previously known to have lived in Alberta. Pterosaurs are rare because their bones were so fragile that the chance of preservation was poor. Over the last few years, however, a number of isolated bones have been referred to Quetzalcoatlus (Currie and Russell, 1982).

Another major function of the survey teams is to take accurate records of the occurrence of articulated specimens and bonebeds. Data sheets are completed, and sites marked on air photos and topographic maps, whether or not articulated specimens are worth collecting for research or display. The main purpose of collecting data is to establish population counts. Bonebeds (accumulations of disarticulated bones of many individuals) are numerous (they may outnumber articulated skeletons by as much as ten to one) and could have been formed by a number of different processes. Some of these bonebeds are extremely large (for example, the known area of Bonebed 23 is over 185,000 m^2). They provide an independent means of sampling the fauna of the Judith River Formation. In other parts of the world, bonebeds have proven extremely useful in interpreting palaeoecology. Over the past few years, our understanding of the formation of these bonebeds and the life histories of faunal elements has improved greatly.

Dinosaur skeletons continue to be collected in Dinosaur Provincial Park. Normally during the summer there are two or three crews whose sole task is to excavate specimens. During the 1981 field season, superb specimens of Chasmosaurus, Corythosaurus, and Lambeosaurus were collected. By the middle of the 1982 field season more than five partial skeletons had been collected, including specimens of the giant carnivore Albertosaurus.

In 1978 a large bonebed was discovered (Quarry 143, see Danis, this field guide) in the central region of the badlands. This site covers an area half the size of a football field, and the bone accumulation is very dense. Minimal overburden makes it a relatively easy site to work. The most interesting aspect relates to population statistics: ceratopsians (horned dinosaurs) make up almost 95% of the identifiable bones. In the rest of the park, ceratopsians comprise only about 25% of the dinosaur specimens. This figure has been established by calculating the relative abundance of articulated skeletons, as well as isolated bones and teeth in bonebeds and microvertebrate sites. Furthermore, with one exception, all diagnostic bones of the ceratopsians from Quarry 143 are from Centrosaurus. Examination of other sites throughout Alberta shows that there are also monogeneric bonebeds containing Anchiceratops, Chasmosaurus, Monoclonius, Pachyrhinosaurus, and Styracosaurus. The fact that ceratopsians tend to be found in large monogeneric bonebeds suggests either that the bonebeds accumulated over a long period of time and that the animals lived in different areas or that the bonebeds formed rapidly from the mass death of herds. (Mass deaths of herding herbivores such as Connochaetes, Rangifer, and Bison are common in the fossil record, and still occur today.) The ceratopsian bonebeds are less than 5 cm thick and are usually found within sandstone units, suggesting high energy environments and accumulation of bone over short periods of time.

To date at least 50 individuals have been identified in the <u>Centrosaurus</u> bonebed. These range in size from small (possibly yearlings) up to very large individuals. Study of the size distribution of the specimens produces a number of results. First, the majority of animals in the bonebed are young adults. If mortality was attritional rather than catastrophic, one would expect to find the weakest individuals (juveniles and old animals) to be dominant in the death assemblages, simply because the average-sized animals would tend to be healthy and less susceptible to death. Second, there are three size ranges known from the 50 individuals recovered. Three of these are very small and five appear to be almost double this size, with no individuals between these two sizes. The remaining animals are at least 50% larger than those in the second size range.

Similar size distributions exist in modern organisms that breed seasonally. For example, Caribbean turtles sampled one month after hatching produce three size categories: small, one month old juveniles; yearlings that are twice the size of the juveniles; and adults. Many reptiles tend to double their size within their first year of life. The following year, however, the growth rate slows and two year old animals are only about 50% larger than the yearlings. After two years, the growth rate is so slow that it is masked by individual variation. That is, a male that is two years old may be larger than a female that is three years old. By analogy, the best explanation for the size distribution pattern seen in the <u>Centrosaurus</u> bonebed is that:

1. <u>Centrosaurus</u> bred on an annual or other regular basis (It is known that there was seasonal variation in Judithian time because of growth rings found in the bones of crocodiles and champsosaurs, and in trees.)

2. All animals represented in that particular bonebed died at approximately the same time.

3. The smallest specimens represent animals that are less than a year old.

If the evidence continues to support this hypothesis as excavation continues, then other kinds of information can be obtained. For example, it should be possible to calculate the growth rate of ceratopsians for the first few years of life. This in turn could indicate something of the physiology of horned dinosaurs. Furthermore, it might be possible to see what changes take place in morphology and proportions of the skeleton as the animals grew.

It is uncertain what caused the death of the herd of <u>Centrosaurus</u>. Perhaps it was flood, perhaps it was drought, or it may even have been disease. However, we do know that after death carcasses were scavenged by carnivorous dinosaurs. These carnivores lost teeth while feeding, and these are found mixed among the bones of the ceratopsians. Tooth-marked bone has been recovered from the bonebed. Carnivores also trampled on bones of the herbivores, creating green bone fractures. It would appear that the skeletons then were exposed for a time, allowing the bones to disassociate completely as the connective tissue rotted away. After scavenging and disarticulation, the bones were hydraulically sorted and many elements were preferentially oriented relative to the flow of the water.

After four summers of excavation, only about 15% of the Centrosaurus bonebed has been excavated. Present estimates suggest that the total number of individuals contained in the entire bonebed may exceed three to four hundred. Excavation will continue for a least three more field seasons, after which excavation will begin on a different bonebed.

The fieldtrip will include a visit to the Centrosaurus bonebed. A second stop will be made at a nearby quarry where an articulated specimen of Hadrosaurus was collected in 1980, and the depositional environment of this site discussed. A stop will then be made at a mollusc bed and microsite (a site where small vertebrate remains and the teeth of dinosaurs are found), where dinosaur eggshell has been found in past years. Time permitting, two other stops will be made: a mixed faunal bonebed dominated by hadrosaurs, and one of the very few sites in Dinosaur Provincial Park that has yielded fossilized leaves. Finally, there will be an opportunity to see one of the articulated skeletons on display in Dinosaur Provincial Park.