

= Waptia =

*Waptia fieldensis* is an extinct species of arthropod from the Middle Cambrian Burgess Shale Lagerstätte of Canada . It grew to a length of about 8 cm ( 3 in ) and resembled modern shrimp in both morphology and habit . It had a large bivalved carapace and a segmented body terminating into a pair of tail flaps . It was an active swimmer , feeding on organic particles it gathers from the seafloor substrate . It is also one of the oldest animals with direct evidence of brood care .

Based on the number of individuals , *Waptia fieldensis* is the third most abundant arthropod from the Burgess Shale Formation , with thousands of specimens collected . It was among the first fossils found by the American paleontologist Charles D. Walcott in 1909 . He described it in 1912 and named it after two mountains near the discovery site ? Mount Wapta and Mount Field .

*Waptia fieldensis* is the only species classified under the genus *Waptia* . Although it bears a remarkable resemblance to modern crustaceans , its taxonomic affinities remain unclear . It is currently classified as a stem group crustacean and tentatively included in the clade Crustaceomorpha .

= = Description = =

*Waptia fieldensis* had a maximum body length of 8 centimetres ( 3 @. @ 1 in ) . The exoskeleton was very thin and easily distorted from fossilisation . It possessed a large bivalved carapace that was narrow at the front with wide posterior margins that covered the cephalon and most of the thorax . The cephalon had five short somites ( body segments ) with three to five pairs of small and poorly preserved feeding appendages .

A single pair of long and slender antennae is present , the segments of which are relatively few and elongated . They were most probably used as sensory organs , with most segments possessing small setae ( bristles ) . A pair of short lobed structures ( possible antennules ) are also present , their position corresponding to the location of the second pair of antennae in modern @-@ day crustaceans . In between them is a small triangular rostral plate with a narrow and sharp central ridge .

The well @-@ developed compound eyes were stalked . The striking morphological similarities of the eyes of *Waptia fieldensis* to that of extant mysid shrimps make it very likely that they were capable of producing true visual images or were at least sensitive to motion . A median eye may have also been present . Nervous tissue , including a putative brain , has been identified .

The thorax is divided into two groups of somites . The anterior group is composed of four somites , each with well @-@ developed walking limbs with lengths that extend past the margins of the carapace . Their morphological details are not well preserved but their distal segments appear to possess a multitude of small spines . It is unknown if these limbs are biramous , but they are assumed to be the endopodites , the inner branches ( ramus ) of the leg , with the exopodites , or outer branches , absent or not preserved .

The posterior thoracic group is made up of six somites , each possessing a pair of long multi @-@ jointed appendages . The segments of these appendages are longer near the body and taper towards the flexible distal segments , extending past the carapace . They bear a fringe of long , slender filaments , all of which are directed towards the middle of the body , a characteristic shared by extant crustaceans . Though usually squashed into blade @-@ like shapes from the fossilisation process , the filaments were slender cylindrical tubes when the animal was alive . The filaments at the tipmost segment are often bunched together . These appendages are believed to be the exopodites and may have functioned as gills and as swimming limbs . They are possibly biramous , with some specimens showing traces of what may be small endopodites at their bases .

The abdomen is composed of five somites , all of which lack appendages except the last . The back @-@ facing margins of these somites bear small spines and four or more larger spines . The last abdominal somite forks into a pair of flattened spatulate appendages ( the uropods ) that function as a tail fan ( caudal rami ) . In addition to stabilising the body while swimming , a quick flick of the tail fan can rapidly propel the animal backwards , which may have functioned as a means of escaping

predators like in modern shrimp . Traces of four fused segments are evident in the three faint lines dividing each lobe of the tail fan . A long telson is present at the end of the body . Traces of a rounded stomach , small digestive glands , and an intestine that terminates into a tiny anal opening on the telson can also be observed in some specimens .

= = Discovery = =

*Waptia fieldensis* was one of the first fossils discovered by Charles D. Walcott from the Burgess Shale in August 1909 . A rough sketch of *Waptia* is present in his diary for August 31 , 1909 , alongside sketches of *Marrella* and *Naraoia* . A formal description for the species was published by Walcott in 1912 . The species was named after the two mountains connected by the Fossil Ridge containing the Burgess Shale locality , Mount Wapta and Mount Field of Yoho National Park , British Columbia , Canada . The name of Mount Wapta itself comes from the First Nation Nakoda word *wapta* , meaning " running water " ; while Mount Field was named after the American telecommunications pioneer Cyrus West Field .

= = Taphonomy = =

Specimens of *Waptia fieldensis* were recovered from the Burgess Shale Lagerstätte of Canada , which dates from the Middle Cambrian period ( 510 to 505 million years ago ) . The locality was once about 200 m ( 660 ft ) underwater ; it was located at the bottom of a warm and shallow tropical sea adjacent to a submarine limestone cliff ( now the Cathedral Limestone Formation ) . Undersea landslides caused by the collapse of parts of the limestone cliff would periodically bury the organisms in the area ( as well as organisms carried by the landslides ) in fine @-@ grained mud that later became shale .

Based on the number of individuals , *Waptia fieldensis* constitutes about 2 @.@ 55 % of the total number of organisms recovered from the Burgess Shale , and 0 @.@ 86 % of the Greater Phyllopod bed . This makes them the third most abundant arthropods of the Burgess Shale ( after *Marrella* and *Canadaspis* ) . The National Museum of Natural History alone houses more than a thousand specimens of the species from the Burgess Shale . *Waptia fieldensis* are often found disarticulated , with parts remaining in close proximity to each other .

Several possible specimens of *W. fieldensis* were also recovered from the Middle Cambrian Spence Shale member of the Langston Formation in Utah in 2008 .

= = Taxonomy = =

*Waptia fieldensis* is the only species accepted under the genus *Waptia* . It is classified under the family Waptiidae ( established by Walcott in 1912 ) , the order Waptiida ( established by Leif Størmer in 1944 ) , and ( tentatively ) the clade Crustaceomorpha . Early restorations of *Waptia fieldensis* by Charles R. Knight in 1940 erroneously depicted it as a primitive shrimp , but modern paleontologists now consider it among the Burgess Shale arthropods that are of unknown and uncertain taxonomic placement .

Some authors have suggested that it may be allied to crustaceans , but like many Cambrian crustaceomorphs , the mouthparts were not preserved , making it impossible to reliably classify them within the crustacean crown group . Others propose that it may be only distantly related to crustaceans , being at least a member of a stem group of crustaceans , or even of all arthropods . Despite being one of the first species recovered and being the third most abundant fossils of the Burgess Shale , there is still no in @-@ depth work on the morphology of *Waptia fieldensis* .

In 1975 , an apparently very similar species was described from the Lower Cambrian ( 515 to 520 million years ago ) Maotianshan Shale Lagerstätte of Chengjiang , China . It was originally placed within the " ostracod " -like genus *Mononotella* , as *Mononotella ovata* . In 1991 , Xian @-@ Guang Hou and Jan Bergström reclassified it under the new genus *Chuandianella* when additional discoveries of more complete specimens made its resemblance to *W. fieldensis* more apparent .

Like *W. fieldensis* , *Chuandianella ovata* had a bivalved carapace with a median ridge , a pair of caudal rami , a single pair of antennae , and stalked eyes . In 2004 , Jun @-@ Yuan Chen tentatively transferred it to the genus *Waptia* . However , *C. ovata* had eight abdominal somites in contrast to five in *W. fieldensis* . Its limbs were biramous and were undifferentiated , unlike those of *W. fieldensis* . Other authors deemed these differences to be enough to separate it from *Waptia* to its own genus .

In 2002 , a second similar species , *Paulotermius spinodorsalis* , was recovered from the Lower Cambrian Sirius Passet Lagerstätte of the Buen Formation of northern Greenland . It was also identified as a possible waptiid . Like *C. ovata* it had biramous undifferentiated appendages , but it also had only five abdominal somites like *W. fieldensis* . However , the poor preservation of the *P. spinodorsalis* specimens , particularly of the appendages on the head , make it difficult to ascertain its taxonomic placement . This difficulty is further compounded by evidence that the fossils of *P. spinodorsalis* may in fact be moults ( *exuviae* ) , and not of the actual animal .

= = Ecology = =

In addition to their striking , superficial similarity to contemporary shrimp , *Waptia fieldensis* were also very shrimp @-@ like in their habits . They were bottom @-@ dwelling ( nekto-benthic ) deposit feeders . The lack of strong feeding appendages indicates that they were more likely to feed by sifting through the sea bottom for edible organic particles . Their tails and the feather @-@ like filaments on their posterior thoracic somites also imply that they were active swimmers .

In 2015 , egg clutches were identified in six specimens from the Burgess Shale . The clutch sizes were small , only containing up to 24 eggs , but each egg was relatively large , with an average diameter of 2 mm ( 0 @-@ 079 in ) . They were tucked inside the carapace , attached along the inner surface . Along with *Kunmingella douvillei* from the Chengjiang biota ( around 7 million years older than the Burgess Shale ) , which also had fossilized eggs preserved inside the carapace , they constitute the oldest direct evidence of brood care and of K @-@ selection among animals . It indicates that they probably lived in an environment which required them to take special measures to ensure the survival of their young .