

# Sexual Dimorphism in Early Jurassic Ammonites from British Columbia

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I am currently doing my Ph.D. at U.B.C. and my thesis work is centered on the Hettangian and earliest Sinemurian ammonites from the terranes of Western British Columbia. The Hettangian and Sinemurian are the first stages in the Jurassic Period and thus follow the mass extinction that occurred at the end of the Triassic, approximately two-hundred million years ago. The recovery of the ammonites during these stages, after their near demise in the end-Triassic mass extinction, represents one of the most spectacular but poorly understood adaptive radiations in the fossil record. As part of my thesis I am studying the material from the Taseko Lakes map area. Relevant fossil localities are widespread throughout the area due to extensive faulting and folding of the strata. I have included a map of the relevant sections and localities in case anyone feels energetic (Figure 1)! The letters on the map show sections and isolated localities are represented with a number. During my three field trips to the area, I had many exciting experiences including a grizzly bear encounter and two blizzards. I did not know that it was possible to be so cold! Despite these obstacles, I managed to collect a lot of fossils (due in large part to help from my family, VanPS and VIPS members). These collections, in combination with previous collections made by Dr. Tipper, provided me with plenty of material. Since *Badouxia* dominates the ammonite fauna from the area, I decided to begin with a comprehensive study of the genus.

Most species of *Badouxia* are endemic to the eastern Pacific and the Taseko Lakes map area has yielded the most prolific, well-preserved and diverse collection of *Badouxia* currently known. During my systematic work on the genus, I discovered conclusive evidence of sexual dimorphism in three species (Longridge *et al.* in review). Sexual dimorphism is generally poorly recognized in the Early Jurassic and is particularly badly documented in Hettangian forms. Callomon (1963) stated that the lowest point in the Jurassic where dimorphism became clearly recognizable was in the late Early Jurassic. Since then dimorphism has been proposed for several Hettangian groups (Donovan *et al.* 1981; Guex 1981, 1995) although some of these are controversial. Thus, strong evidence of dimorphism in the *Badouxia* fauna from the Taseko Lakes area is very exciting.

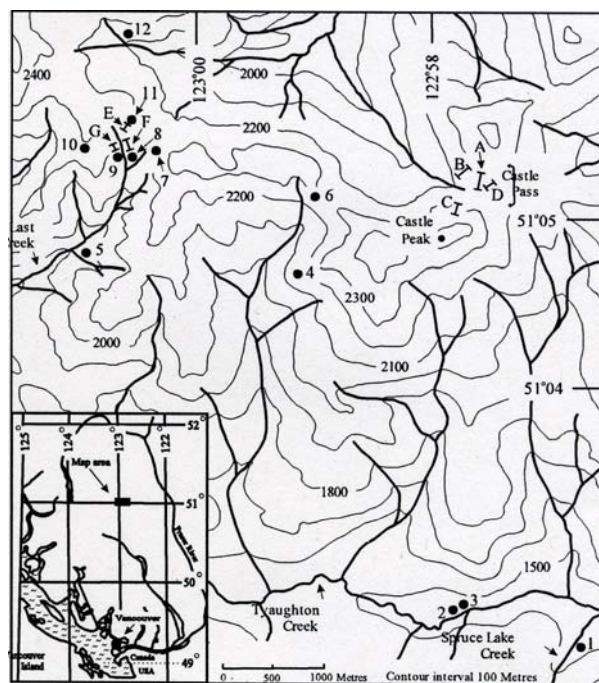
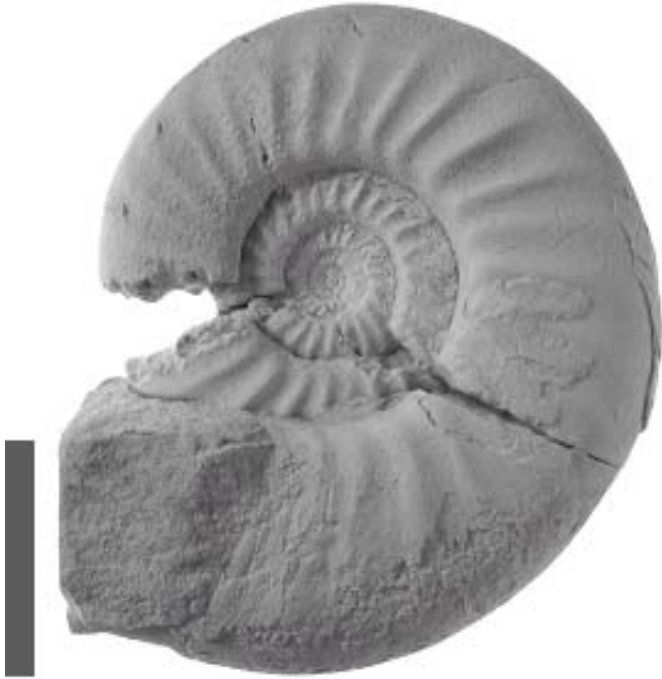


Figure 1. The Castle Peak area.

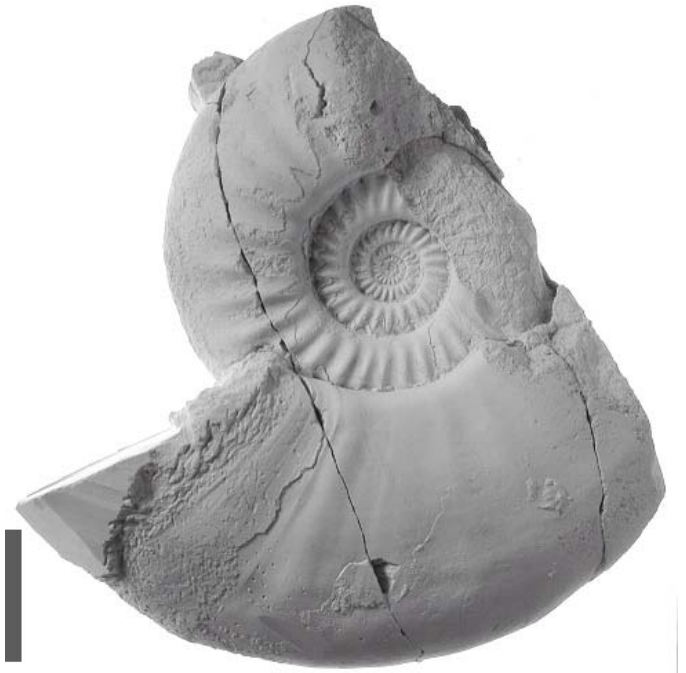
In order to recognize dimorphism an examination of mature forms is necessary because in dimorphic pairs the juveniles of both sexes are identical. Callomon (1963) lists several characteristics that are useful in identifying mature forms including (1) uncoiling of the umbilical seam, where the ammonite body chamber begins to uncoil from the whorl below; (2) the smoothing out of ornament or constrictions on the body chamber; (3) crowding together of the last few septal sutures; (4) the presence of a rostrum; and (5) lappets or long rostra in Middle and Late Jurassic forms. As discussed by Callomon (1963, 1981), sexual dimorphism is established if two groups of shells of the same age are virtually identical on the inner whorls and show the simultaneous appearance of new characters in both branches. Material should clearly divide into two groups based primarily on differences in shell size and ribbing style within mature forms. Maximum adult shell diameter is sharply defined in ammonites and varies slowly with time. Thus, assuming there are no forms of intermediate size, a significant difference in size within a group is strong evidence of dimorphism. Often, one group is between two and four times larger than the other. The larger form of the pair is called the

macroconch and is believed to be the female of the species. The smaller form is the microconch and is thought to represent the male. Several further characteristics are also useful in the identification of sexual dimorphism. These include variocostation of the macroconch (when ribbing style on the outer whorls differs markedly from that on the inner), differences in the number of whorls in mature specimens, and lappets or long rostra on the peristome of the microconch (only Middle and Late Jurassic forms).



**Figure 2. *Badouxia* microconch.**

As Lehmann (1981) discusses, the male/female assignment of the two forms is largely based on the macroconch of an Eleganticeratid from the Early Toarcian. In this specimen, the living chamber contains a pyritized structure which was once organic material. This structure consists of between 50 and 100 hollow spheres some of which are touching and some of which are isolated. Since present day cephalopod eggs are cemented in bunches or strings and correspond in size to the organic structure found in the Eleganticeratid it is easy to see why this structure is believed to represent a female egg case. Further evidence is found in a modern day relative of the ammonite, *Argonauta*, where the male form is between 10 and 20 times smaller than the female.



**Figure 3. *Badouxia* macroconch.**

As discussed in Longridge *et al.* (in review), the three *Badouxia* species that show sexual dimorphism contain one or more small, mature specimens ranging in size from 43 to 89 mm (Figure 2 – originally figured in Frebold 1967). In addition, collections for each species also contain much larger though incomplete material (Figure 3). *Badouxia columbiae* shows the most extreme size difference including a small, mature specimen of 43 mm total shell diameter and a fragment of body chamber with a whorl height of 190 mm. In addition to differences in size, the small specimens of each species remain strongly ribbed until maturity, smoothing out in some cases at the adoral end of the body chamber. The larger specimens are smooth on the outer whorls except the unusually large specimen of *B. columbiae* which is smooth on the penultimate whorls and bears large nodes (bullae) on the body chamber. The inner whorls of specimens from both groups fall within the variation attributed to each species. Further, the differences in ribbing style that define different species of *Badouxia* become apparent in both groups over the same stratigraphic interval suggesting they are phylogenetically linked. Bimodal size distribution and differences in ornament as well as simultaneous changes in ribbing style within both groups of each species strongly suggest that *Badouxia* was sexually dimorphic. The small, ribbed specimens represent the microconchs and the large, smooth forms are the macroconchs for each species.

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