Dataset

3D models related to the publication: Deciphering the morphological variation and its ontogenetic dynamics in the Late Devonian conodont *Icriodus alternatus*

Catherine Girard[1]*, Anne-Lise Charruault[1], Thomas Gluck[1], Carlo Corradini[2], Sabrina Renaud[3]

[1] *Institut des Sciences de l'Evolution de Montpellier (ISEM), Université de Montpellier, CNRS, EPHE, IRD, Montpellier, France*
[2] *Università degli Studi di Trieste, Dipartimento di Matematica e Geoscienze, Trieste, Italy*
[3] *Laboratoire de Biométrie et Biologie Évolutive, UMR 5558, CNRS, Université Claude Bernard Lyon 1, Université de Lyon, 69622, Villeurbanne, France*
***Corresponding author**: catherine.girard@umontpellier.fr

Abstract
This contribution contains the 3D models of a set of Famennian conodont elements belonging to the species *Icriodus alternatus* analyzed in the following publication: Girard et al. 2022: Deciphering the morphological variation and its ontogenetic dynamics in the Late Devonian conodont *Icriodus alternatus*.

Keywords: Conodonts, geometric morphometrics, Late Devonian, ontogenetic trajectory

Submitted:2021-11-16, published online:2022-02-08. https://doi.org/10.18563/journal.m3.161

Coll nr.	Spec.	Ply	Subsp.
UM BUS 031	2d3	Bu12Ic2_d2_3 *	small
UM BUS 032	1a2	Bu12Ic1_a2_2_simp	*alternatus*
UM BUS 033	1a1	Bu12Ic1_a_ic1_simp	*alternatus*
UM BUS 034	1b5	Bu12Ic1_b_5_simp *	*helmsi*
UM BUS 035	1b4	Bu12Ic1_b_4_simp *	*helmsi*
UM BUS 036	2a4	Bu12Ic2_a2_4_simp	*helmsi*
UM BUS 037	2sb2	BU12Ics_2s_b_2_simp	hybrid
UM BUS 038	1c2	BU12Ic1_c_2 *	*mawsonae*
UM BUS 039	2sa3	BU12Ics_2s_a_3_simp	*mawsonae*
UM BUS 040	2a1	Bu12Ic2_a2_1_simp	*alternatus*
UM BUS 041	1a3	Bu12Ic1_a2_3_simp *	*alternatus*
UM BUS 042	2b1	Bu12Ic2_b2_1_simp *	*alternatus*
UM BUS 043	2c3	Bu12Ic2_c2_3	small
UM BUS 044	2d1	Bu12Ic2_d2_1_simp *	small
UM BUS 045	2d2	Bu12Ic2_d2_2 *	small

Table 1. 3D models of *Icriodus alternatus*. * left element. Collection: University of Montpellier, Institut des Sciences de l'Evolution, France.

INTRODUCTION

This contribution presents 3D models of 15 Famennian (Late Devonian) conodont elements belonging to the species *Icriodus alternatus* (see Table 1). All elements correspond to platform (Icriodontan) elements, located at the rear of the conodont feeding apparatus. These elements were sampled at the Buschteich section (Thuringia, Germany), in the single level BU12, very rich in *Icriodus* elements, dated of the *Palmatolepis crepida* conodont Zone of Spalletta et al. (2017). These 15 specimens represent a small fraction of a much larger sample used for morphometric analysis, and illustrate the morphological variation within the species, including the three subspecies *Ic. alternatus alternatus, Ic. alt. helmsi* and *Ic. alt. mawsonae*. One specimen presents characters of both *Ic. alt. helmsi* and *Ic. alt. mawsonae* and is labeled as "hybrid". The 3D surface of these elements was used in a geometric morphometric analysis complementing an extensive 2D study documenting the general morphology of the elements (Girard et al. 2022). Since Icriodontan elements grew by addition of successive triads at the anterior part of the element, the landmarks were located on the posterior part of the element, which is ontogenetically oldest and therefore present in all elements. This study aimed at characterizing how differences between subspecies relate to the morphological variance arising through ontogeny. A set of distances were extracted from the landmarks, allowing to estimate changes in the height of the denticles characterizing *Icriodus* morphology, and in the distances between the first denticles to be formed. This study was complemented by a geometric morphometric analysis, allowing the characterization of the ontogenetic trajectory as the Common Allometric Component (CAC) describing shape changes with increasing length of the element (Fig. 1). Both approaches showed that elements started with well-developed median denticles and equally elevated inner and outer denticles on the first triads. Through ontogeny, the first median denticle tended to fade away due to its slow growth and the filling of the surrounding valleys due to the addition of lamellae, leading to an *Ic. alt. mawsonae* morphology. The outer denticles tended to develop more than the inner denticles of the same triad, and in a more centrifugal direction, leading to a twist of the element increasing along ontogeny and leading to *Ic. alt. helmsi* morphologies. Therefore, the subspecies *Ic. alt. alternatus, Ic. alt. helmsi* and *Ic. alt. mawsonae* appear to share the same ontogenetic trajectory, and once size-related variation is accounted for, they did not differ in any quantitative variables describing their general shape or the relationships between posterior denticles. The most prominent criterion distinguishing *Ic. alt. helmsi* and *Ic. alt. mawsonae* is their large size, suggesting that actually, the *Ic. alt. helmsi* and *Ic. alt. mawsonae* subspecies simply represent end-member geometries achieved at late growth within a single, homogeneous taxonomic and evolutionary unit, corresponding to the species *Ic. alternatus*. Although they can be seen as a way of describing an extensive morphological variation, the use of the “subspecies” concept in this context may be misleading and artificially inflate biodiversity estimates. If ever, the term “morphotype” should be preferred to describe this morphological variation possibly related to functional constraints related to occlusion and modulating late growth of the elements.

METHODS

Digitization of the specimens was performed using an X-ray nanotomograph (NANO-CT) Phoenix nanotomeS on the AniRA-Immos platform of the SFR Biosciences (UMS 3444, ENS Lyon) at a cubic voxel resolution of 1 µm. The scanning parameters were as follow: 100 kV, 70 µA, 3000 projections at 360° with no filter. The 3D surfaces were extracted semi-automatically within AVIZO 9 (Thermofisher Scientific) using the segmentation threshold selection tool. The 3D surfaces are provided in .ply format, and can therefore be opened with a wide range of freeware.

ACKNOWLEDGEMENTS

We acknowledge the contribution of SFR Biosciences (UMS 3444/CNRS, US8/Inserm, ENS de Lyon, UCBL) AniRa-ImmOs facility, and we particularly thank Mathilde Bouchet for their kind assistance during the scanning sessions. This work was supported by the ANR Project ECODEV (ANR-13-BSV7-005) and the LabEx CeMEB project MARCON (2018-2020). This is publication ISEM 2022-017.

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ISSN: 2274-0422

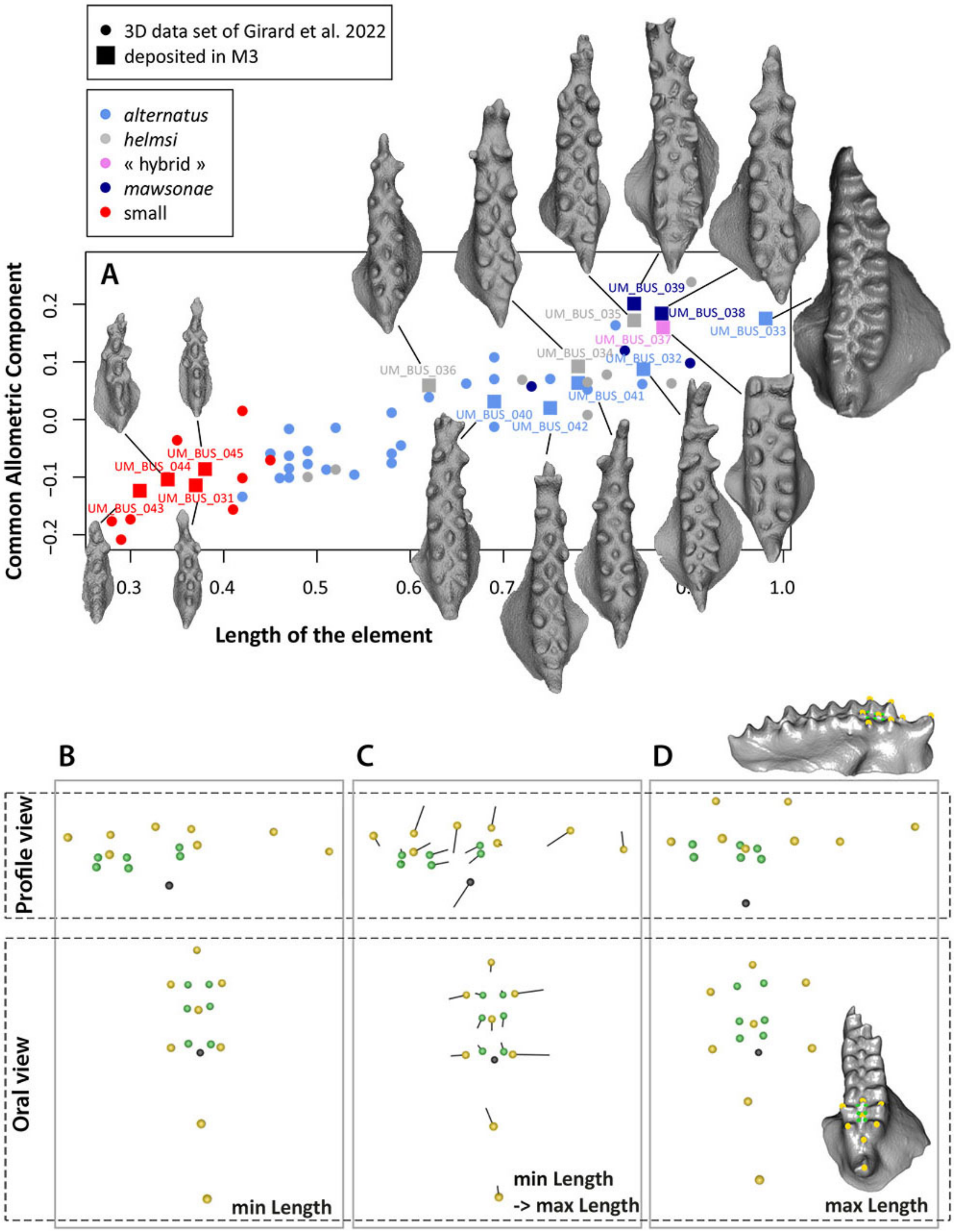

Figure 1. Allometric shape variation in *Icriodus alternatus*. A, relationship between the total length of the element and the Common Allometric Component, based on the aligned coordinates of the posterior part of the element. The elements deposited in MorphoMuseuM are highlighted with large squares. B, C, D, visualization of the deformation in profile and oral view, corresponding to extreme size values; in yellow: tip of the denticles, in green: valley landmarks, in violet: the pit. B, configuration corresponding to the minimum length. C, shape change from the minimum (dots) to the maximum (tip of the vectors) length. D, configuration corresponding to the maximum length. Figured specimen (UM BUS 033 in profile and oral views on the right)

ISSN: 2274-0422