**Appendix 3 – List of characters**

List of characters used for build the data-matrix, arranged by characters-group mentioned in the text. Ordered characters are indicated. Continuous characters #1 and #2 are accompanied by discretization used in the morphological disparity analysis.

Characters modified from Pérez (2019) are indicated with an asterisk.

**Continuous characters**

1. Number of radial ribs.

Discretization: 0= without radial ribs, 1= up to 15, 2= from 16 to 20, 3= from 21 to 25, 4= from 26 to 30, 5= from 31 to 37, 6= more than 37 [ordered]

2. Mean size of adult shells (Length in mm)

Discretization: 0= up to 12, 1= from 12 to 22, 2= from 22 to 32, 3= from 32 to 60, 4= from 60 to 90, 5= more than 90 [ordered]

**General outline**

3. Outline in adult shells. 0= mytiliform/modioliform, 1=obtuse triangular, 2= quadrate, 3=subtrigonal, 4= subrectangular, 5= subrounded (rotund in Heaslip, 1968), 6= rectangular

4. Outline in juvenile shells. 0= subrectangular, 1= subquadrate, 2= subtrigonal, 3= subrounded

5\*. Elongation of outline in anterior-posterior direction. 0= slightly developed, 1= absent, 2=strongly developed [ordered] (State 2 added)

6. Posterior-dorsal margin inclination. 0= absent, 1= slight inclination (as in *Coripia*), 2= pronounced inclination (near to 45º from umbones, as in *Miodomeris* and *Pteromeris*) [ordered]

7\*. Posterior-dorsal margin projection. 0= absent, 1=slightly projected, 2= strongly projected (above the hinge line) [ordered] (Character added)

8. Posterior-ventral margin projection. 0=strongly projected, 1=absent, 2=slightly projected

9. Anterior-ventral margin projection. 0= absent, 1= present

10. Posterior margin outline. 0= rounded, 1=acuminated (acute with marked angle), 2=slightly truncated, 3= vertically truncated

11. Anterior margin outline. 0= rounded, 1= straight

12. Anterior-dorsal corner. 0= softly marked, 1=prominent

13. Angle between posterior and dorsal margins. 0= softly marked, 1=strongly marked, 2= absent

14. Dorsal margin development. 0= curved and descended, 1= descended, 2=regular (not included on other states), 3= straight

15. Dorsal margin elongation. 0= absent, 1= present (dorsal margin extended twice the hinge length at least)

16. Angle between posterior and ventral margins. 0= absent (rounded angle), 1=present, 2= strongly marked

17. Radial rib projected between posterior and ventral margins angle. 0= absent, 1= present (as in *Schizocardita*)

18. Notch in posterior margin. 0= absent, 1=present (as in *Glans*)

19. Byssal notch in ventral margin. 0= present (as in *Beguina*), 1=absent

20. Presence of an incubatory chamber in females. 0= absent, 1=present

21. Presence of two morphotypes with different convexity (possible sexual dimorphism). 0= absent, 1= present

22. Serrated posterior margin. 0= absent, 1=present (as in *Glans*)

23. Shell thickness. 0=not developed, 1=slightly shell thickness, 2=strongly shell thickness (as in *Megacardita*) [ordered] (States modified)

**Umbones**

24. Umbones direction. 0=prosogyrous, 1=slightly prosogyrous, 2=orthogyrous, 3=opysthogyrous [ordered]

25. Umbones placement. 0= very anteriorly placed, 1= at anterior third, 2= subcentrally placed [ordered]

26\*. Umbonal area convexity. 0= regular (slightly rounded), 1= very low (nearly flat shells), 2= very high, 3= moderately high (State 3 added)

27. Degree of umbo recurvature. 0= slightly recurved, 1= recurved, 2=strongly recurved

28. Umbonal outline in external view. 0= pointed, 1= slightly rounded, 2= strongly rounded

29. Umbonal outline in internal view. 0= umbones not visible, 1= umbones visible

30\*. Distance between umbos. 0= in contact, 1= minimum spacing, 2=umbones far away [ordered] (State 3 added)

**Escutcheon**

31. Presence of escutcheon. 0= absent, 1= present

32. Escutcheon width. 0= narrow, 1=wide, 2= escutcheon absent

33. Escutcheon demarcation. 0= slightly marked, 1= strongly marked, 2= escutcheon absent

34. Sculpture of escutcheon. 0= absent, 1= present, 2= escutcheon absent

**Lunule**

35. Presence of lunule. 0= present, 1= absent

36. Lunule depth. 0= shallow, 1=very deep

37. Lunule demarcation. 0= strongly marked by a groove, 1=slightly marked

38. Sculpture of lunule. 0= smooth, 1=only comarginal lines, 2=only radial lines, 3= radial and comarginal lines

39. Lunule outline. 0= subovate, 1=subrounded, 2= inverted tear-shaped

40. Lunule convexity. 0= flat, 1= concave, 2= convex, 3= sinuous

41. Lunule size. 0= small, 1=regular, 2= large

42. Lunule symmetry. 0= symmetric lunule, 1= right lunule larger

43. Lunule projection. 0= absent, 1= right lunule edge projected as a sheet

44\*. Excavated lunule pushing the umbones. 0= absent, 1= present (Character added)

**Hinge generalities**

45. Striated teeth. 0= absent, 1= present

46. Hinge size (Height). 0= very reduced and short, 1= regular, 2= extended towards venter

47. Internal resilifer. 0= present, 1= absent

**Right hinge**

48. Anterior lateral teeth laminar. 0= absent, 1= two teeth

49. Anterior lateral teeth pustular. 0= absent, 1=present

50. Presence of anterior tooth (3a). 0= very reduced, 1= present, 2= absent, 3= limited to a small sheet adjacent to lunular margin

51. Orientation of anterior tooth (3a). 0= vertical, 1= anterior, 2= posterior, 3= absent

52. Prominence of anterior tooth (3a). 0= little prominent, 1= conspicuous, 2= very developed, 3= absent, 4= very little prominent

53. Shape of anterior tooth (3a). 0= elongate rectangular, 1= pustular, 2= curved rectangular, 3= absent

54. Apex of anterior tooth (3a). 0= resting on anterior side of middle tooth, 1= not resting on anterior side of middle tooth

55. Division of anterior tooth (3a). 0= divided (shark tooth-like), 1= not divided

56. Posterior-ventral corner of middle tooth (3b) extension. 0= absent, 1=present (as in *Beguina* and *Cardita*)

57. Shape of middle tooth (3b). 0= triangular with broad base, 1= triangular with narrow base, 2= scimitar-like

58. Curvature of middle tooth (3b). 0= anterior side concave, 1= anterior side convex, 2= anterior side straight

59. Orientation of middle tooth (3b) (in degrees). 0= 0, 1= from 0 to 30, 2= from 30 to 35, 3= from 35 to 45, 4= from 45 to 90, 5= 90 [ordered]

60. Elevation of middle tooth (3b). 0= constant, 1= higher towards dorsal, 2= higher towards ventral, 3= higher at centre

61. Apex of middle tooth (3b). 0= not reaching the dorsal extreme of hinge, 1= reaching the dorsal extreme of hinge

62. Fusion between anterior tooth (3a) and middle tooth (3b). 0= absent, 1= present

63. Shape of posterior tooth (5). 0= straight, 1= curved

64. Orientation of posterior tooth (5) (in degrees). 0= more than 35, 1= from 20 to 35, 2= from 0 to 20, 3= 0 [ordered]

65. Elevation of posterior tooth (5). 0= lower than other teeth, 1= equals to other teeth

66. Apex of posterior tooth (5). 0= resting on posterior side of middle tooth, 1= not resting on posterior side of middle tooth

67. Spacing between ventral extreme of posterior tooth (5) and hinge margin. 0= present, 1= absent

68. Ventral extreme of posterior tooth (5). 0= protruding from ventral edge of hinge, 1=not protruding

69. Extension of posterior tooth (5). 0= not reaching the apex of middle tooth, 1= reaching the apex of middle tooth, 2= reaching the middle point of middle tooth

70. Higher tooth in the hinge. 0= 3b, 1=3a, 3= 5

71. Ventral edge of hinge. 0= invaginated to dorsal, 1= concave, 2= straight, 3= sinuous, 4= wide and inverted ‘V’-shaped, 5= irregular

72. Projection of nymph margin. 0=absent, 1= present, 2= large [ordered]

73. Posterior lateral teeth laminar. 0= present, 1= absent

74. Posterior lateral teeth pustular. 0= present, 1=absent

**Left hinge**

75. Anterior lateral teeth laminar. 0= present, 1= absent

76. Anterior lateral teeth pustular. 0= absent, 1=present

77. Orientation of anterior tooth (2) (in degrees). 0= 0, 1= from 0 to 50, 2= from 50 to 80, 3= from 80 to 90, 4= more than 90 [ordered]

78. Size relations of anterior tooth (2). 0= higher than wide, 2= as high as wide, 3= wider than high

79. Elevation of anterior tooth (2). 0= higher towards ventral, 1= higher towards dorsal, 2= higher at centre, 3= constant

80\*. Size of anterior tooth (2). 0= very large, 1= large, 1= very reduced [ordered] (State 0 added)

81. Shape of anterior tooth (2). 0= subquadrate, 1=subrectangular, 2= subtriangular

82. Lateral profile of anterior tooth (2). 0= hook-like outline, 1= without hook-like outline

83. Orientation of posterior tooth (4b) (in degrees). 0= from 0 to 20, 1= from 20 to 30, 2= from 30 to 35, 3= from 35 to 45, 4= more than 45

84. Elevation of posterior tooth (4b). 0= higher towards ventral, 1= higher towards dorsal, 2= higher at centre

85. Curvature of posterior tooth (4b). 0= slightly curved, 1= strongly curved, 2= straight

86. Higher tooth in the hinge. 0= 4b, 1=2, 2=equal height

87. Knob placed below ventral extreme of lunular margin. 0= present, 1= absent

88. Lateral profile of posterior tooth (4b). 0= hook-like outline, 1= without hook-like outline

89. Posterior lateral teeth laminar. 0= present, 1= absent

90. Posterior lateral teeth pustular. 0= absent, 1=present

**Sculpture generalities**

91. Comarginal sculpture. 0= present, 1= absent

92. Radial sculpture. 0= absent, 1= present

93. Dominant sculpture. 0= comarginal, 1= radial

**Comarginal sculpture**

94. Comarginal lines. 0= present, 1= absent

95. Demarcation of comarginal lines. 0= more marked anteriorly, 1= equally marked throughout ontogeny, 2= comarginal lines absent

96. Elevation of comarginal lines. 0= low, 1= elevated, 2= comarginal lines absent

97. Undulations. 0= present, 1= absent

98. Undulations in juvenile shell. 0= limited to juvenile shell, 1= not limited, 2= undulations absent

**Radial sculpture**

99. Type of radial sculpture. 0= Entire radial ribs, 1= fine radial ribs, 2= radial ribs absent

100. Radial ribs width in adult shells. 0= very wide radial ribs in adult shells, 1= not very wide radial ribs in adult shells, 2= radial ribs absent

101. Radial ribs width along valve surface. 0= wider towards posterior, 1= constant width along whole valve surface, 2= wider towards anterior, 3= radial ribs absent

102. Presence of paracostal ribs. 0= absent, 1= present, 2= radial ribs absent

103. Paracostal ribs development. 0= absent, 1= present in all radial ribs, 2= less developed in anterior radial ribs, 3= more developed in anterior radial ribs, 4= radial ribs absent

104. Paracostal ribs proportions towards centre of valves. 0= absent, 1= much smaller than central rib, 2= more than middle width of central rib, 3= radial ribs absent

105. Cross-section of radial ribs in adult shell. 0= subovate, 1= subrectangular, 2= subtriangular, 3= radial ribs absent

106. Cross-section of radial ribs in juvenile shell. 0= subovate, 1= subrectangular, 2= subtriangular, 3= radial ribs absent

107. Height of radial ribs. 0= very low, 1= slightly elevated, 2= elevated (wider than high), 3= high (strongly elevated, higher than wide), 4= radial ribs absent [ordered]

108. Radial ribs in gerontic valve surface. 0= persistent, 1= obsolete, 2= radial ribs absent

109\*. Extension of obsolete radial ribs in valve surface. 0= obsolete radial ribs absent, 1=only at distal valve surface, 2= towards middle of valve surface, 3= more than middle of valve surface, 4= radial ribs absent (Character added)

110. Smoothed radial ribs in some region of valve surface. 0= never smoothed, 1= anteriorly smoothed, 2= posteriorly smoothed, 3= radial ribs absent

111. Radial ribs posteriorly inclined in cross-section. 0= absent, 1= present (as in *Carditamera radiata*)

112. Serrated flanks of radial ribs. 0= absent, 1= present (as in *Cardita variegata*)

113. Stacked radial ribs on flanks. 0= absent, 1= present (as in *Kolmeris tehuelchana*)

114. Interspaces. 0= present, 1= absent, 2= radial ribs absent

115. Interspaces width. 0= narrower than radial ribs, 1= as wide as radial ribs, 2= wider than radial ribs, 3= interspaces absent

116. Cross-section of interspaces in adult shell. 0= V-shaped, 1= U-shaped, 2= subrectangular, 3= inverted trapezoid, 4= fine line, 5= interspaces absent

117. Cross-section of interspaces in juvenile shell. 0= V-shaped, 1= U-shaped, 2= subrectangular, 3= inverted trapezoid, 4= fine line, 5= interspaces absent

118. Seventh or eighth anterior radial rib more marked than the remaining. 0= absent, 1= present, 2= radial ribs absent

119. Posterior area. 0= defined by thicker radial ribs than the remaining, 1= defined by less thick radial ribs than the remaining, 2= defined by a convexity change, 3= absent

120. Fifth or sixth posterior radial rib. 0= stronger than previous ones, 1= equally developed than previous ones, 3= radial ribs absent

121. Posterior-ventral prosocline radial ribs. 0= absent, 1= present, 2= radial ribs absent

122. Presence of umbonal carinae towards posterior margin. 0= absent, 1= present

**Comarginal nodes**

123. Presence of comarginal nodes. 0= absent, 1= present

124. Type of comarginal nodes in adult shell. 0= scales, 1= smooth radial ribs, 2= subrectangular nodes, 3= reticulate valve surface, 4= subrounded nodes, 5= funginated nodes, 6= saw-like nodes, 7= comarginal nodes absent

125. Size of comarginal nodes. 0= large, 1= small, 2= comarginal nodes absent

126. Separation between comarginal nodes along radial rib. 0= regular, 1= very close, 2= without separation, 3= very spaced, 4= absent, 5= comarginal nodes absent

127. Cancelled aspect given by comarginal nodes and radial sculpture. 0= absent, 1= present, 2= comarginal nodes absent, 3= incipient, 4=smooth radial ribs

128. Development of comarginal nodes in post-juvenile shell (horizontal). 0= equally developed throughout ontogeny, 1= posteriorly marked, 2= anteriorly marked, 3= comarginal nodes absent

129\*. Development of comarginal nodes in post-juvenile shell (vertical, across ontogeny). 0= present throughout ontogeny, 1= nodes disappearing in gerontic regions, 2= nodes disappearing at the middle of valve, 3= nodes disappearing before the middle of valve, 4= smooth radial ribs, 5= comarginal nodes absent (Character added)

130. Presence of comarginal nodes in juvenile shell. 0= present, 1= absent, 2= comarginal nodes absent

131. Comarginal nodes more marked around lunule. 0= absent, 1= present, 2= comarginal nodes absent

132. Spiny nodes in juvenile shell. 0= absent, 1= present in all umbonal region, 2= more developed towards anterior side of umbonal region, 3= comarginal nodes absent

133. Tubular nodes in posterior surface of valve. 0= absent, 1= present, 2= comarginal nodes absent

**Internal morphology**

134. Flat zone between anterior adductor muscle scar and anterior margin. 0= absent, 1= present

135. Prominence of adductor muscle scars. 0= slightly marked, 1= marked, 2= strongly marked

136. Size of adductor muscle scars. 0= regular, 1= very large

137. Placement of anterior adductor muscle scar. 0= displaced towards hinge margin, 1= not displaced

138. Size relation between both adductor muscle scars. 0= posterior larger, 1= anterior larger, 2= equal

139. Height of pallial line. 0= less than a fifth of total valve height, 1= a fifth of total valve height, 2= a quarter of total valve height [ordered]

140. Intersection between pallial line and anterior adductor muscle scar. 0= at middle of anterior adductor muscle scar, 1= at posterior side of anterior adductor muscle scar

141. Shape of pallial line. 0= inclined towards posterior margin, 1= uniform curve

**Ventral margin crenulations**

142. Presence of ventral margin crenulations. 0= absent, 1= present

143. Correspondence of ventral margin crenulations. 0= not corresponding to interspaces, 1= corresponding to interspaces

144. Shape of crenulations. 0= subrectangular, 1= subtriangular, 2= crenulations absent

145. Extreme tip of crenulations. 0= truncated, 1= rounded, 2= crenulations absent

146. Extensions of crenulations toward valve inside. 0= gentle extended towards valve inside, 1= limited to ventral edge, 2= crenulations absent

147. Extension of crenulations on margins. 0= to dorsal side of posterior adductor muscle scar, 1= reaching posterior adductor muscle scar, 2= below posterior adductor muscle scar, 3= to point of contact between posterior and ventral margins, 4= crenulations absent

148. Radial ribs between crenulations on internal view. 0= extreme tips of radial ribs not visible, 1= extreme tips of radial ribs extending over the shell margin on internal view, 2= crenulations absent