Comment on Welter-Schultes' revision of *Albinaria* species in Crete (2010)

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The following critical comment is restricted to the delimitation of Cretan *Albinaria* species and their subdivision into subspecies. The subspecies concept of Welter-Schultes has already been discussed in Nordsieck (2013). A list of Cretan *Albinaria* species and a discussion of their system is given in Nordsieck (2016).

I. Diagnoses of Welter-Schultes:

The diagnoses are mostly no differential diagnoses which make possible the delimitation against other species, but descriptions of characters and variabilities. In the diagnoses the important character position of the beginning of protoconch sculpture is not considered.

II. Central and E. Crete, densely covered by Welter-Schultes' collection [Figs. 1-2]:

A. idaea (: 167-171):
Spatial variation of essential characters is presented by figs. 15D (rib density), 15E (riblet sculpture), 15G (protoconch sculpture), and 16D (length of superior lamella). The examined characters do not fully match those of related species (*A. teres*, *A. praeclara*, *A. corrugata*), because they are adopted from Welter-Schultes' PhD thesis (2000: 103-111); therefore, a comparison is difficult. Number and prominence of the protoconch ribs (figs. 15F and G) are studied, but not the position of the beginning of that sculpture, which is different in the subspecies of *A. idaea* (Nordsieck 2016). The forms from Paximadia islands are omitted (they are only considered in the thesis). Transition zones (: 169) and indicated boundaries (figs. 16B, 16F) confirm an infraspecific subdivision (as proposed in Nordsieck 2007). *A. i. lindneri* from Mt. Kefali is assumed to have evolved convergently (: 171); this is highly improbable because it cannot be distinguished from the type form.

A. hippolyti (: 171-174):
The given information is mainly that of Schilthuizen et al. (1993) and the PhD thesis (2000: 80-93). The narrow transition zones of *A. h. aphrodite* against the neighbouring *A. hippolyti* subspecies (e. g., figs. 17A position of lunellar, 17E anterior upper palatal plica) are caused by the semispecies character of *A. h. aphrodite* (Schilthuizen & Lombaerts in Schilthuizen 1994: 90; cf. Nordsieck 2013).

A. arthuriana (: 174):
The discussion of the Milatos hybrid form (*A. arthuriana* >< *A. maltzani*) is insufficient (as already in the thesis 2000: 91), because the sampling record is unjustly doubted (comm. Hemmen).

A. teres (: 174-181):
Spatial variation of essential characters is presented by figs. 19A (sculpture) and 19B (rib number); for the east of the range also fig. 18B (relative shell height) is important. The character development of cervix (essential for the separation of *A. t. vermiculata*) is not considered, though it is used for the definition of the closely related species *A. janisadana* (: 205). Sudden transitions and narrow hybrid zones (: 177, figs. 19A, B) confirm an infraspecific subdivision (as proposed in Nordsieck 2007). For further discussion see Nordsieck (2013).

A. sturanyi (: 181):
Notwithstanding a hybrid zone with *A. teres*, *A. sturanyi* is regarded as independent species because of shell characters (similarity with *A. caerulea*), in contrast to the thesis (2000: 58).

A. manselli (: 181-183):
The species exhibits no general differences to *A. teres* (: 182), except for the protoconch sculpture, but differs from neighbouring forms of *A. teres* in some characters (: 182, rib prominence, rib number, shell size). Because

of that sudden contact zone it is regarded as an independent species (contrast to *A. teres*, forms of which with such contact zones are not even regarded as subspecies).

A. praeclara (: 183-187):
Spatial variation of essential characters is presented by figs. 21B (rib number), 21C (protoconch sculpture) and 21D (riblet sculpture). *A. p. parallelifera* is said to differ from *A. p. praeclara* sensu Welter-Schultes only in protoconch sculpture (: 183, fig. 21C); a separation as independent species is thought to be an alternative (: 187). Within *A. p. praeclara* sharp transitions are observed, and intermediate rib numbers are rare (: 185, 187), but no subspecies are recognized. *A. p. drakakisi* = *A. p. rudis* is not separated as subspecies, because of the divided range of *A. p. praeclara* sensu stricto, which is assumed to have originated convergently. This is in contrast to the meaning of Gittenberger (1991), who even regarded both taxa as independent species. The syntype of *Clausilia rudis* L. Pfeiffer has not 22 ribs on the penultimate whorl, as estimated by Welter-Schultes (: 185) from the figure, but 28 (counted on the specimen).

A. corrugata (: 187-196):
Spatial variation of essential characters is presented by figs. 23A (sculpture) and 25A (rib number); some forms are also recognizable by shell measurements (figs. 23B, 24B). The character cervical rib number is not studied. The named characters confirm an infraspecific subdivision (as proposed in Nordsieck 2007). Because of narrow hybrid zones (: 195) *A. fulvula* and *A. leonisorum* are regarded as conspecific with *A. corrugata* (as already in the thesis 2000: 43), notwithstanding the considerable shell differences (*A. fulvula* with basalis, *A. leonisorum* with inflated basal cervix, figs. 26A-B, both differing from *A. corrugata* also in protoconch sculpture, fig. 25B). This is in contrast to the similar case *A. sturanyi*, which is separated from *A. teres* as independent species (see above). The different cervical sculpture of the *corrugata* form from Kali Limenes is not discussed (though stated in the thesis 2000: 102, in comparison with *A. li*).

A. maltzani (: 196-198):
Spatial variation of the essential character basal keel is presented by fig. 27B. It shows a narrow transition zone to the form without prominent keel (Dilakos form), which is correctly included in *A. maltzani* (not in *A. corrugata*, as given by Nordsieck 1999: 13, see fig. 27F protoconch sculpture); a subspecies rank should be taken into consideration. The Milatos hybrid form is not mentioned here (see under *A. arthuriana*).

A. moreletiana (: 198-199):
In contrast to the thesis (2000: 43), *A. moreletiana* is regarded as independent species, because of shell differences from *A. corrugata* (: 198, development of cervix, whorl number, sculpture). The formerly assumed transitions to *A. corrugata*(2000: 63) are cancelled (: 198-199); this error is said to be induced by the wrong classification of the Dilakos form of *A. maltzani* with *A. corrugata*. The results of Schilthuizen & Gittenberger 1996 (*A. moreletiana* according to allozymes within *A. corrugata*, the latter thus being a paraphyletic species) are not considered; they speak against a reproductive isolation of both species.

A. violacea–A. ulrikae (: 199-203):
The given information is mainly that of the thesis (2000: 94-99). Spatial variation of essential characters is presented by figs. 29B-C (relative shell height, whorl number), 29D (rib number), 29E (position of lunellar), and 29F (shell colour). Other essential characters (dorsal keel, height of inferior lamella, formation of clausilium plate, Nordsieck 1999) are not studied; therefore the fusion of *A. ulrikae* and *A. violacea* to one species is premature. The narrow transition zone in Sisses (: 203) confirms the infraspecific subdivision of *A. violacea* sensu stricto (as proposed in Nordsieck 2007).

The discussion of several species (*A. ariadne* 203, *A. spratti* 203, *A. li* 203-204 (only referring to the thesis 2000: 99-102), *A. wiesei* 204 (palatal folds not
considered)., *A. christae* 204, *A. rebeli* 204, *A. torticollis* 204, *A. retusa* 204-

205, *A. jaeckeli*205, *A. janisadana* 205, *A. janicollis* 205-206) is insufficient, because nearly no comparisons with and delimitations against related species are given.

III. W. Crete, not densely covered by Welter-Schultes' collection [Figs. 1-2]:

A. cretensis group:
For the discussion of the *cretensis* group several characters are not examined (see below). Syntopies are considered (*A. tenuicostata* and others) or not (*A. byzantina*). Some informations (*A. tenuicostata*: transitions to *A. „cretensis"*, *A. eburnea*: possible polyphyly, see below) are ignored. Only a part of the available material (only from the Cismar and Budapest collections) has been examined. These deficiencies lead to an inadequate judgement of the whole group.

A. cretensis (: 206-216):
Relation *A. virginea–A. troglodytes* (: 207-213):
Spatial variation of essential characters is presented by figs. 32A (sculpture), 32B (spot intensity), and 32C (dorsal keel). The essential character presence of basalis (rudiment) is not studied (: 209);
thus *A. virginea* and *A. troglodytes* come out as not different. Sharp transitions of sculpture are stated in the east and extreme west (: 211), but an infraspecific subdivision is not discussed.
Relation *A. troglodytes–A. byzantina* (: 213-215):
The examined essential characters are the same as in the case *A. virginea–A.troglodytes*. The essential character development of inferior lamella (straightly vs. s-like ascending) is not studied, because apparently not understood (: 213). The character development of parallel lamella is not evaluated, because it is pretended to be too variable (: 213-214). The syntopy of *A. troglodytes* and *A. byzantina* (Figs. 1-4) is confirmed (: 214), but weakened by the assumption to have originated by artificial dispersal by humans (: 214-215). Several species of the *cretensis* group (*A. tenuicostata*, *A. sublamellosa*, *A. eburnea*), which do not differ generally from *A. „cretensis"*, are ranked as species because of syntopies with that species, *A. byzantina*, however, not; this is clearly an inconsistent procedure.
Relation *A. byzantina–A. cretensis* (: 215):
The examined essential characters are the same as in the other cases. Both taxa are assumed to differ only by the development of the parallel lamella (: 215). The character development of inferior lamella (see relation *A. troglodytes–A. byzantina*) is not studied.
A. rodakinensis (: 222):
This species is only described under *A. sublamellosa* without mentioning the essential difference in protoconch sculpture. No comparison with the neighbouring *A. „cretensis"* form is made.

A. tenuicostata (: 216-219):
Spatial variation of essential characters is presented by figs. 33C (rib number), and 33D (sculpture), but not useful for the relation to *A. „cretensis"*, because in comparison with *A. „amalthea"*. No general differences to *A. „cretensis"* have been found. The separation as independent species is obviously based only on the syntopies with that species. Both species are assumed to be reproductively isolated (: 219); this assumption is in contrast to the presence of forms transitional to *A. „cretensis"* (Nordsieck 2004: 56, 64), which are not discussed by Welter-Schultes.

A. sublamellosa (: 220-223):
Spatial variation of essential characters is presented by figs 34F (rib number) and 34G (basalis). Other essential characters (prominence of dorsal keel, position of lunellar) are not studied. The species is asserted to differ from *A. „cretensis"* mainly by the development of the inferior lamella. *A. troglodytes* (within *A. „cretensis"*), however, has a similar inferior lamella. As in other species, the separation of *A. sublamellosa* as independent species is mainly based on the syntopies with *A. „cretensis"*.

A. eburnea (: 223):

No general differences to *A.* „*cretensis*" are given; again, the separation as independent species is mainly based on the syntopies with *A.* „*cretensis*". The possible polyphyly of *A. eburnea* as discussed in Nordsieck (2004: 65) is not considered. The true *A. glabella* (Fig. 4) is very similar to *A. byzantina*, while *A. glabella* sensu auct. belongs together with *A. eburnea.A. e. inflaticollis* resembles the sympatric *A. v. strigata* and is geographically more distant.
The form occurring north of Epanochori (Agia Irini) determined as *A. eburnea* by Welter-Schultes (: 223, fig. 34A) is only superficially similar to that species; it is a big form of *A. tenuicostata*.

A. amalthea–A. candida (: 224-228):
Spatial variation of essential characters is presented by figs 35A (subcolumellar lamella), 35B (basalis), 35C (anterior upper palatal plica), and 35D (inferior lamella). Other essential characters (prominence of dorsal keel, position of lunellar, development of clausilium plate) are not studied. A sudden transition zone between *A. amalthea* and *A. xanthostoma* is not stated (because of a collection gap), but a general difference in the development of the subcolumellar lamella. Both taxa, however, are not separated, with the argument that this difference could be weakened within the collection gap (: 227-228). Also, notwithstanding the differences, *A. loosjesi* is not separated (: 227). A sudden transition between *A. amalthea* and *A. candida* is stated near Nerokouros (sculpture, subcolumellar lamella, inferior lamella), therefore these taxa are separated as species (: 228). The infraspecific forms of the three species (in part not yet described) are not discussed, though they differ considerably in several characters (e. g., sculpture, dorsal keel, position of lunellar).

Implications for other clausiliid groups (: 237, 239):
The critical annotations of Welter-Schultes concerning the system of *Cochlodina*, *Medora*, and *Bulgarica* need no comment, because they are not based on deeper knowledge and (or) own work on these groups.

Figs. 1-4. Syntopic *Albinaria troglodytes* and *A. byzantina* from Chania prov., Crete.
Frontal view, dorsal view on body whorl and view into the aperture; phot. S. Hof.
Abbreviations: NNM = Nationaal Natuurhistorisch Museum Leiden, SMF = Forschungsinstitut Senckenberg Frankfurt.
Arrow pointing at parallel lamella.
Shell height = H (mm).
Fig. 1. *A. t. troglodytes*, Likotinarea, ex NNM 252921a; H 17.1.
Fig. 2. *A. b. byzantina*, Likotinarea, ex NNM 252921b; H 17.8.
Fig. 3. *A. t. troglodytes*, Kambi, ex SMF 93199; H 20.0.
Fig. 4. *A.* "*eburnea*" *glabella* = *A. byzantina glabella*, Kambi, ex SMF326060; H 20.0.

Figs. 5-6. Syntopic *Albinaria tenuicostata* and *A. virginea* from Chania prov., Crete.
Abbreviations see Figs. 1-4.
Fig. 5. *A. t. tenuicostata*, Spileon Agia Sofia near Topolia, ex SMF 349083; H 17.7.
Fig. 6. *A. v. strigata*, Spileon Agia Sofia near Topolia, ex SMF 349084; H 16.6.

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