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## The “Black Morph *Cyphoma*” from the Netherlands Antilles (Gastropoda: Ovulidae)

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With 5 Text-Figures

### Keywords

Ovulidae, *Cyphoma*, new species, Netherlands Antilles, Bonaire, Curaçao.

### Abstract

*Cyphoma cassidyae* n. sp. from Curaçao and Bonaire differs from its congeners by the pattern of the mantle consisting of a black coat with white tentmarks along the mantle edges. The shell is thin and lacks a calloused labrum. The species might be neotenic.

### Zusammenfassung

*Cyphoma cassidyae* n. sp. aus Curaçao und Bonaire unterscheidet sich von verwandten Arten durch die Musterung des Mantels, der schwarz ist und an seinen Rändern weiße zeltförmige Flecke aufweist. Das Gehäuse ist dünnwandig und hat kein kallöses Labrum; möglicherweise liegt Neotenie vor.

### Abbreviations and Acronyms

#### Public collections

MNHN Muséum national d'Histoire naturelle,  
Paris, France  
RMNH Naturalis Biodiversity Center  
Leiden, The Netherlands

### Introduction

The species described in the following is known for many years and illustrated in several publications (e.g. LORENZ & FEHSE 2009; REIJNEN & VAN DER MEIJ 2017). However, it has never been named, as divers who observed and photographed the new species did not collect a specimen that could be used as a holotype. Others who had specimens in their possession have not conducted the taxonomic procedure. The following formally describes the species hitherto known as the “black morph *Cyphoma*”.

### Systematics

Superfamily: Cypraeoidea RAFINESQUE, 1815  
Family: Ovulidae J. FLEMING, 1822  
Subfamily: Simniinae F. A. SCHILDER, 1925  
Genus: *Cyphoma* RÖDING, 1798

### *Cyphoma cassidyae* n. sp.

(Figs 1, 2, 3: 1-5)

### Description

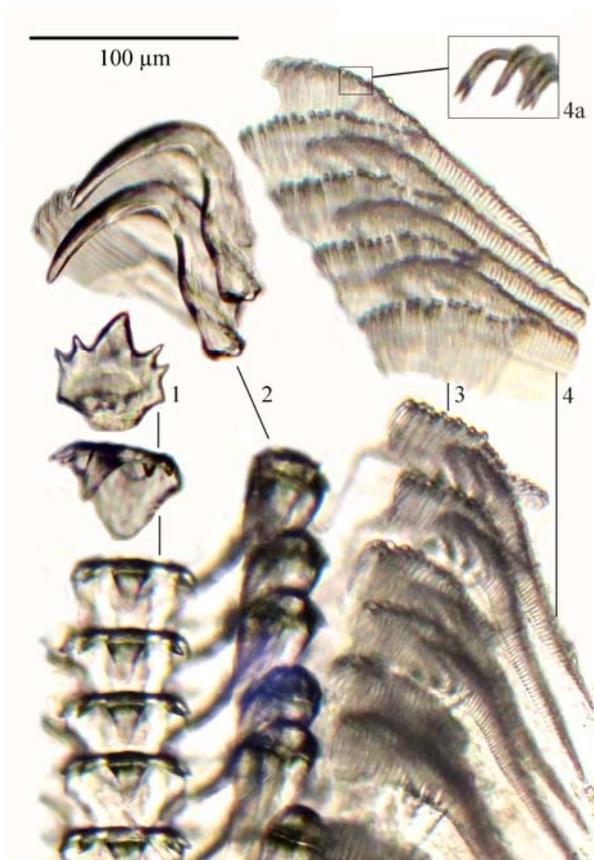
The small, glossy shell is irregularly spindle-shaped, thin, without discernible development of callus. The left side of the body whorl is evenly rounded, the right side shows a transverse bulge in the posterior third. The labrum is not developed, but thin and fragile. It has a wavy outline on account of the bulge. The anterior extremity is evenly tapering and blunt at the tip. The aperture is wide, narrowing in the posterior third. The posterior canal is slightly moved to the right, away from the axis. There are no discernible striae on the body whorl. The color of the shell is pale orange.

The animal of the holotype has a black mantle with triangular white tentmarks along both of its edges, forming a pattern that resembles beaver tail shingles. Where the mantle lobes meet, an elegant white zig-zag pattern is formed when the mantle covers the shell. There are bands of white spots and short transverse lines bordering the labral side. The foot is reddish, with a white border and distant black stripes. These are connected to a longitudinal line in the mid-section of the posterior part of the foot. The outer edge of the foot is finely framed black. The head is reddish, the proboscis grey with black dashes. The tentacles are short and lined with black. The holotype animal is a male with a well-developed penis situated on the right side towards the mid-section of the body. There is an orange area at the tip of the grey intestinal gland, which is interpreted as the testis.

Other specimens photographed by divers show a considerable variability in the pattern of the mantle. In some specimens, the mantle is reddish brown with black borders around the white tentmarks and lines. All specimens show a similar white tented pattern along the mantle edges. The amount and shape of the white tentmarks and lines may vary. The colour and pattern of the foot



**Text-Fig. 1:** *Cyphoma cassidyae* n. sp. 1: Holotype, Curaçao, coll. MNHN-IM 2000-35221, 2: Paratype 3, Curaçao, coll. RMNH.Mol 337800.



**Text-Figure 2:** Radula of *Cyphoma cassidyae* n. sp. 1: Rhachidian, 2: Lateral, 3: Inner marginal, 4: Outer marginal. 4a: detail of the ribbon-like cusps, which are often bifurcate at the tip.

are constant. The radula is typical for members of the genus (Fig. 2). The stomach contained numerous red sclerites of its gorgonian host.

Paratype 3 appears to be a more adult specimen with the same shape and colour as the holotype, but with a slightly thickened labral edge and callousities at the extremities and along the columella. Its body whorl shows transverse striae towards the extremities.

### Material

Four live-collected specimens. The holotype with preserved animal, plus three paratypes in the Naturalis Biodiversity Center, Leiden, The Netherlands (RMNH.Mol), all from Curaçao. Numerous photographs of at least seven further specimens from Bonaire and Curaçao are available.

**Holotype:** 18.0 mm, Curaçao, coll. Museum national d'histoire naturelle, Paris, MNHN-IM 2000-35221.

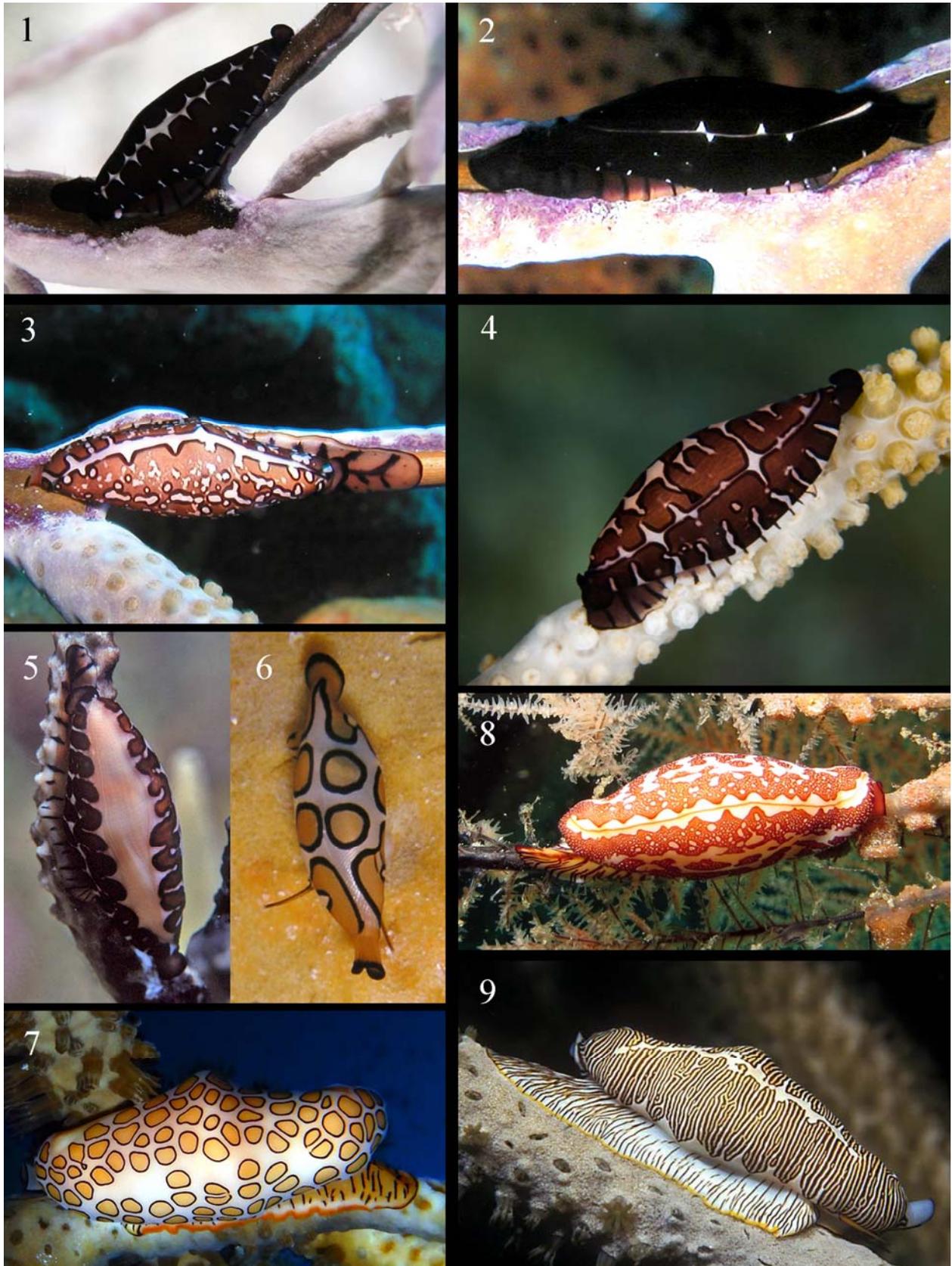
**Paratype 1:** Curaçao, coll. RMNH.Mol 337799.

**Paratype 2:** Curaçao, coll. RMNH.Mol 100770.

**Paratype 3:** Curaçao, RMNH.Mol 337800.

### Type Locality and Habitat

*Cyphoma cassidyae* n. sp. is so far known from Curaçao and Bonaire, and also Martinique, where it was collected during the Madibenthos expedition conducted by the MNHN in 2016. The type locality is Cas Abao, Curaçao, 12°13'33.16"N – 69°05'34.57"W at 10 m.



**Text-Fig. 3:** Living animals. **1:** *Cyphoma cassidyae* n. sp. Holotype, Curaçao; Photo RON WALSH. **2, 3:** *Cyphoma cassidyae* n. sp. Bonaire; Photo STEVE POWELL. **4:** *Cyphoma cassidyae* n. sp. Bonaire; Photo CHUCK CUTLETT. **5:** *Cyphoma cassidyae* n. sp. Bonaire; Photo KERI WILK. **6:** *Cyphoma gibbosum*, juvenile specimen. Bonaire; Photo ELLEN MULLER. **7:** *Cyphoma gibbosum*. Curaçao; Photo JANA KRATZSCH. **8:** *Cyphoma aureocinctum*. Canary Islands; Photo PETER WIRTZ. **9:** *Cyphoma signatum*. Grenadines; Photo KERI WILK.

Specimens have been photographed at 5 to 15 m, on a variety of gorgonian genera: *Briareum*, *Eunicea*, *Plexaurella*, and *Pseudoplexaura*, to which this ovulid causes visible tissue damage.

### Etymology

Dedicated to DONNA CASSIDY of Sydney, NSW, Australia, who photographed and collected the holotype.

### Discussion

Together with the new taxon, fifteen species are presently accommodated in the genus *Cyphoma*, most of them with distributions in the Caribbean. Two are found along the Pacific coast of Central America (*arturi* FEHSE, 2007; *emarginatum* (G. B. SOWERBY I, 1830)), and two species have ranges that extend from the Caribbean across the Atlantic to the Canary and Cape Verde Islands, as well as St. Helena (*aureocinctum* (DALL, 1889); *eludens* LORENZ & J. BROWN, 2015). In the northern half of the Caribbean, a group of species is found from Florida to Puerto Rico (*mcgintyi* PILSBRY, 1939; *rhomba* C. N. CATE, 1978; *sedlaki* C. N. CATE, 1976). Shells labelled *alleneae* C. N. CATE, 1973; *gibbulum* (C. N. CATE, 1978); and *lindae* PETUCH, 1987 were listed by PETUCH & SARGENT (2011) as additional valid species from Florida, but these taxa are usually considered synonyms, or doubtful (LORENZ & FEHSE 2009). Another group is restricted to the south of the Caribbean, from Colombia to the southeast of Brazil (*christahemmenae* (FEHSE, 1997); *guerrinii* FEHSE, 2001; *intermedium* (G. B. SOWERBY I, 1828); *macumba* PETUCH, 1979; *versicolor* FEHSE, 2003). The most widely distributed species in the Caribbean are *gibbosum* (LINNAEUS, 1758) and *signatum* PILSBRY & MCGINTYI, 1939, reaching from Florida to the Netherland Antilles. These two species are restricted to shallower water and they are the only other *Cyphoma* whose occurrence within the geographical and bathymetrical range of *cassidyae* n. sp. is confirmed. Other species recorded from the Netherlands Antilles (*intermedium* and *christahemmenae*) are usually found at greater depths.

The main feature setting *Cyphoma cassidyae* n. sp. apart from its congeners is the striking black mantle pattern that does not form narrow zebra-stripes or patches with such stripes (*christahemmenae*, *guerrinii*, *intermedium*, *signatum*), or circular patches of varying density

(*eludens*, *gibbosum*, *mcgintyi*, *rhomba*, *sedlaki*). In fact, the closest resemblance of its mantle is with *aureocinctum*, which shows similar white tents along its mantle edge.

The shell of *cassidyae* n. sp. is thinner and less calloused than that of any other congener. It resembles species of the genus *Simnialena* and has been confused with them in the past (REIJNEN et al. 2010: Fig. 1E, 2F-2G). A solid labrum as in other species of *Cyphoma* has not yet been observed in *cassidyae* n. sp., and the dorsal bulge is reduced to the area above the labrum and the aperture itself.

Nearly all specimens of *cassidyae* n. sp. photographed so far appear to be subadult, without a calloused labral margin. However, as Paratype 3 shows, callus deposition is present but restricted to the extremities and the area along the columella. The labral edge is only slightly strengthened along its edge. The differences between shells of *cassidyae* n. sp. and juveniles of other *Cyphoma* becomes apparent when they are viewed side by side (Fig. 4), as juveniles have a very thin shell lacking completely any callus deposit at the extremities. The development of gonads in the holotype of *cassidyae* n. sp. supports the neotenic character of this species. Further study on freshly preserved animals is necessary to ascertain this.



**Text-Fig. 4:** *Cyphoma gibbosum*, juvenile shell lacking any development of callus. Explanations in the text.

The knowledge about the ontogenesis of tropical Ovulidae is poorly documented (LILTVED 2000, LORENZ & FEHSE 2009), but the life cycle of *Simnia patula* (PENNANT, 1777) has been well-documented by LÉBOUR (1932). Observations on



**Text-Fig. 5:** 1: *Ovula ovum*, adult, approx. 80 mm. Oman. Photo JANA KRATZSCH. Note the yellow tips of the papillae. 2: *Ovula ovum*, juvenile, approx. 10 mm, in relation to 1. Note that the size of the papillae is the same in these different growth stages. Kwajalein Atoll. Photo JEANETTE & SCOTT JOHNSON. 3: As 2, magnified. 4: *Phyllidia* sp. Kwajalein Atoll. The toxic nudibranchs of this genus are mimicked by juvenile *Ovula ovum*. Photo JEANETTE & SCOTT JOHNSON. Explanations in the text.

a change of mantle structure and -coloration from the juvenile to the adult stage cannot be confirmed. For example, the seemingly different appearance of the juvenile *Ovula ovum* (LINNAEUS, 1758) and the adult are based on the fact that the size of the papillae, as well as the colour pattern, are the same and hence disproportional to the size of the shell. The juvenile has comparatively gigantic papillae with conspicuous yellow tips, closely resembling the toxic nudibranch *Phyllidia* sp. This type of mimicry in the family Ovulidae is so far only known from *Ovula ovum* (TIEN-HSI et al. 1986, LILTVED 1989, JOHNSON 1991). As the animal grows, this mimicry becomes unnecessary, and predominantly whitish tipped papillae are formed. This gives the impression that the papillae change their colour. Yellow papillae are also present in the adult, but mainly along the shell's margins. The general structure and colour pattern of the mantle does not significantly change in *Ovula ovum*, it only has different functions during larval development and adult stage (see Fig. 5).

Juvenile *Cyphoma* display a pattern that agrees with that of the adult in size, even in a very early larval stage. Figure 3: 6 depicts a juvenile *gibbosum* of 8 mm in comparison with a 31 mm adult (Figure 3: 7), showing that the size of the

orange rings on the mantle is the same in both stages of development, only their number will increase as the animal grows. Based on this observation, the possibility that the unique mantle pattern of *cassidyae* n. sp. is a “juvenile pattern” that will convert into a different pattern in a yet to determine adult is more than unlikely.

Species of the genus *Cyphoma* have recently been the subject of a molecular study by REIJNEN & VAN DER MEIJ (2017), with the prejudging title: “Coat of many colours – DNA reveals polymorphism of mantle patterns and colouration in Caribbean *Cyphoma*”, which has led to some irritation among researchers in this field (P. BOUCHET, pers. comm. 2017, FEHSE 2019). The authors used four molecular markers (COI, 16S, H3 and 28S) of several species of *Cyphoma*: *gibbosum*, *mcgintyi*, *signatum*, and “black morph” (the species described herein). As no consistent differences in the sequenced ribosomal DNA were found, they postulated that the three younger taxa should be synonymized with *gibbosum*. It is therefore necessary to briefly comment on the REIJNEN & VAN DER MEIJ paper herein.

The sequences they have used are rather conservative and have proven a useful tool in evaluating the higher phylogeny of the Cypraeoidea (MEYER 2003, 2004). However, the

method only delivers reliable data in one direction: differences in the sequences of mtDNA indicate speciation, but their lack thereof, does not denote synonymy. There are numerous taxa in the group of cowries and their allies that have clearly been proven to represent valid species, despite the lack of differences in the sequences tested (MEYER 2004, LORENZ & MELAUN 2011, LORENZ 2017).

REIJNEN (2015) postulated the synonymy of the deep water Ovulid *Crenavolva chiapponii* LORENZ & FEHSE, 2009 with the shallow water *C. aureola* (FEHSE, 2002). He claimed the discovery of *chiapponii* in shallow water, alongside *aureola*, and demonstrated that their molecules do not differ. In fact, he misidentified a banded variation of *aureola* and compared it with typical *aureola*. In this case, the method itself delivered a correct result, but other factors abrogated the conclusions drawn.

In their study on *Cyphoma*, REIJNEN & VAN DER MEIJ (2017) stated that one of their markers (Histone H3) is too conservative to even resolve the generic level of Ovulidae, while S28 clearly separated between unrelated genera (*Cyphoma* and *Cymbovula*). They claim that the COI and 16S markers are suitable to synonymize taxa, and based this statement on REIJNEN's above-mentioned *aureola* publication of 2015. All four markers are mitochondrial genes that do not influence the evolution of the animal and its biology.

The authors suggested that mantle coloration is not a suitable feature for species separation in Ovulidae, but acknowledged, that in *Cyphoma*, the obviously different animals are linked to consistently different shells. In the traditional approach of taxonomy, the different units represent separate species. They interpreted the sympatric occurrence of the different “morphs” as proof for their conspecificity, as no reproductive isolation exists: “These different morphotypes co-occur on reefs and feed on the same host species, which refutes the idea of reproductive isolation.” However, the same observation may as well be viewed in the opposite way: the absence of reproductive isolation, while retaining consistent animal features linked to shell differences, is a proof for their validity.

The authors ignored that their paradigm – giving priority to molecular data over all traditional approaches in taxonomy – may be incorrect, and sensed this dilemma: “The discrepancy between

the different mantle colours/patterns, shell morphological characters, and the molecular results in this study are difficult to reconcile. Various scenarios can, however, explain the findings presented here. Possible hypotheses include rapid diversification, supergenes/balanced polymorphism, and discontinuous variation.”

The scenario of rapid diversification was discussed and questioned, because trophic specialization does not seem to exist among the taxa of *Cyphoma*, which are found on a variety of at least 20 different hosts. But, rapid divergence can underlie a complex of numerous other factors, which REIJNEN & VAN DER MEIJ did not consider: the relationship between hosts and parasites, may involve immune responses, tolerances to toxins secreted by the host, differences in breeding seasons, and durations of the planktonic phase, tolerances to water temperature, and many other factors that may support the speciation processes.

Not considered in their study is the different distributions of the species (“morphs”), some of which have a quite restricted range. Had “morphs” such as *mcgintyi*, *rhomba*, and *cassidyae* n. sp. been the result of a switching supergene of *gibbosum*, then one would expect that they occasionally occurred throughout the wide range of that species, which is not the case.

Another aspect questioning the taxonomical approach chosen by REIJNEN & VAN DER MEIJ (2017) is the fact that two different “morphs” of *Cyphoma* are not observed mating, which could also explain why no hybrids or intermediate stages between the taxa of *Cyphoma* are known.

Instead, the morphological diversity in combination with the results of the molecular analysis observed in this group can be interpreted as a proof for rapidly proceeding evolution, which has led to numerous species in which differences simply have not yet manifested in the mitochondrial DNA. Most molecular studies conducted on closely related species of the family Ovulidae have delivered results that point in the same direction: possibly as response to the arms race between the host and the parasite, the speciation processes of Ovulids cannot be directly derived from sequencing conservative genes that have no impact on the morphology and biology of their bearer (SCHIAPARELLI et al. 2005, LORENZ 2005, LORENZ & MELAUN 2011, C. P. MEYER, pers. comm. 2014).

Also REIJNEN & VAN DER MEIJ mentioned the scenario “that *Cyphoma gibbosum*-morphs are

incipient species in the process of diverging, which is reflected by the discontinuous variation in morphology, but (not yet) in the studied genes”. However, their conclusion was that *cassidyae* n. sp. (= “black morph”), *mcgintyi*, and *signatum* must be listed as synonyms of *gibbosum*. The statement: “It is very likely that more ovulid species should be placed in synonymy, rather than described as new species,” seems to reveal a pre-conceived mindset on future taxonomy and systematics: having a computer compare datasets from sequencing, replacing time-consuming, complex morphological studies and biological fieldwork altogether.

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