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The impact of the corallivore gastropod *Coralliphilia violacea* on coral reefs at El-Hamrawain, Egyptian Red Sea Coast

Mohamed Abou Zeid[1], Mohamed M Kotb[2*] and Mahmoud H Hanafy[2]

1. Marine Biology and Fish Section, Zoology Department, Faculty of Science, Al-Azhar University, Cairo, Egypt.
2. Marine Science Department, Faculty of Science, Suez Canal University, Ismaillia, Egypt.

ABSTRACT

The corallivore gastropod *Coralliphilia violacea* Kiener was reported during a field survey on the Red Sea coast at El-Hamrawain, 20 km north of El-Qussyer city. The reef composition of the area was analyzed. The predator species was found to feed intensely on hard coral species belong to the genus *Porites*. The distribution of snails and their feeding pattern were studied. In addition, the percentage and intensity of damage that may be induced by this species depending on the coral coverage data were also estimated.

KEYWORDS: marine, corallivore gastropods, coral damage, Red Sea, Egypt.

INTRODUCTION

Many gastropod species are known to inhabit the coral reef ecosystem (Taylor 1968). Among these, the families Muricidae and Coralliphilidae contain a number of coral associated species which depend on corals as source of food (Robertson 1970, Patton 1976, Fujioka & Yamazato 1983). The two genera *Coralliphalia* and *Drupella* are of particular interest because their association with corals appears to be more or less specific to particular genera or species.

The relationship between the gastropods of the genus *Coralliphilia* and the corals have been studied by several scientists in different parts of the world: Maldives (Taylor 1978); Jamaica (Miller 1981); Philippines (Moyer *et al.* 1982); Japan (Fujioka & Yamazato 1983); Marshall island (Boucher 1986); Panama (Hayes 1990) and Kenya (McClanahan 1994). However, in the Egyptian Red Sea coast, this relationship is not evident and it is easy to miss during the course of more general surveys.

For a long period of time, the corallivore gastropods were normally considered to be of little importance regarding their impact on coral reefs (Robertson 1970, Ott & Lewis 1972). Recently, it has been shown that these species represent a potentially

* Address for correspondence

significant threat to coral reef on different reefs around the world (Hayes 1990; Moyer *et al.* 1982; McClanahan 1994).

Members of family Coralliphilidae have long been underestimated by researchers as a consequence of their abundance. *Coralliphilia violacea* like other members of this family lacks both jaw and radula, and is highly cryptic during the day, usually feeding at night. On the other hand it is a free ranging predator, principally upon scleractinian and soft corals (Glynn 1973; Brauley & Adey 1982; Hayes 1990). Snails of this species have also been seen feeding on only five genera of hard corals, namely *Acropora*, *Montastrea*, *Agaricia*, *Diploria* and *Colpophyllia* from different reefs around the world. When these genera of hard corals are not available, *Coralliphilia* tend to shift to other genera, which occasionally include *Favia*, *Porites*, *Madracis* and *Siderastrae* (Hayes 1990).

In light of the above introductory remarks, we present data concerning the abnormal appearance of such species in the Red Sea coast, in an attempt to draw attention to the possible threat to the Red Sea coral reefs.

MATERIALS AND METHODS

Field observations were performed in the coastal fringing reef at El-Hamrawein area (34° 12' 5.5" East; 26° 15' 10.4" North), about 20 km north of El-Quysser city, during the Red Sea reef survey in the period from Sept 1996-Aug 1997. The surveyed area of the reef was estimated to be about 5 km^2, extending from the highest watermark at shoreline over the reef flat (seaward) and up to 12 m in depth.

The reef composition survey was conducted using a number of random line-intercept transects (Wilkinson & Baker 1994) placed at roughly even intervals, extending from the shoreline to the reef edge. Another set of transects corresponding to the previous ones were laid on the reef wall to about 12 m deep. The data collected across transects included the coral species diversity and the percentage cover of the different reef components. The coral species were identified using underwater coral guide prepared by the author according to Sheppard & Sheppard (1991).

During the survey, coral heads infested with snails were marked for determination of the distribution pattern of the snails. The number of snails on the coral colony as well as the number of scars left by snails were recorded on underwater PVC sheets. The size of coral colonies were roughly determined using a measuring tape referring the shape of the colony to the nearest geometrical shape. Both snail height and the dimensions of the scars were measured using underwater plastic Vernier calpier. Samples of snails were collected from each colony and taken to laboratory for further measurements. Some of the infested coral colonies were photographed using a Nikon underwater camera.

At the laboratory the data were analysed using computer based statistical analysis program (Statistica Ver. 6.0) and the photographic images were analysed using Image analysis program (Image Pro. Ver. 2.1).

RESULTS

Reef Composition

The study of reef composition at El-Hamrawain area showed that the reef profile at this area is composed of an extended reef flat reaching an average width of 50 m (Fig. 1).

The water depth ranged from 0 to 50 cm just before the reef edge. At the reef edge the profile starts to take a different turn concerning the depth where the depth at this area increases sharply from 50 cm to 200 cm within a distance of 5 m. The current and the wave action is probably responsible for this profile. The reef wall in this area is somewhat vertically sloping in the lower third toward a sandy flat; its height averaged 10.5 m.

The coral fauna of the studied area comprises 35 species belonging to 18 genera. Out of these 35 species, only three species were soft corals (Table 1). The living coral coverage averaged about 30 % on the seaward side of the reef flat, increasing at the reef edge to about 40% and then decreasing gradually at the reef wall where it reached about 20 % at the base of the reef wall. The reef edge at the studied area is higher in diversity than the other zones, and included 15 coral species dominated by *Millipora dichtoma* and *Acropora* sp. The massive coral *Porites lutea* was found bordering the upper reef wall edge. Sedimentation from the nearby Hamrawain phosphate shipping port is probably responsible for limiting the percentage of living coral coverage compared to another parts of the Red Sea (GEF 1998).

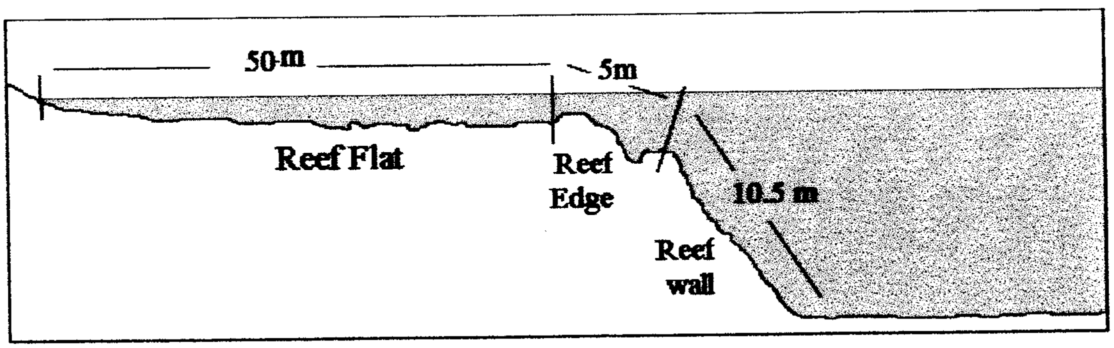

Figure 1: Diagrammatic representation of the reef profile at El-Hamrawain Area.

Table (1): The coral species list recorded at El-Hamrawain area with notes on the status of *Coralliphilia violacea* and its feeding damage.

Coral Species	Status	Coral Species	Status
Millepora dichotoma	Clean	*Montipora monasteriata*	Clean
Millepora platyphylla	Clean	*Montipora verrucosa*	Clean
Ctenactis echinata	Clean	*Acropora hyacinthus*	Clean
Blastomussa merleti	Clean	*Acropora cytherea*	2-3 scars
Hydnophora microconos	Clean	*Acropora clathrata*	Clean
Favia speciosa	Clean	*Acropora eurystoma*	Clean
Favia stelligera	Clean	*Acropora hemprichii*	Clean
Goniastrea retiformis	Clean	*Acropora valida*	Clean
Stylophora pistillata	1-3 scars	*Porites lobata*	Scars + Snails
Platygyra daedalea	Clean	*Porites lutea*	Heavily infected
Platygyra sinensis	Clean	*Porites nodifera*	Scars + Snails
Platygyra phrygia	Clean	*Porites solida*	Few scars
Plesiastrea versipora	Clean	*Coscinaraea monile*	Clean
Stylophora wellsi	Clean	*Pavona maldivensis*	Clean
Cyphastrea serailia	Clean	*Xenia impulsatilla*	Clean
Tubastraea micranthus	Clean	*Xenia* sp.	Clean
Montipora danae	Clean	*Heteroxenia* sp.	Clean
Montipora informis	Clean		Clean

Snail Distribution

During the survey, snails were observed on four species of stony corals (Table 1) mainly of the genus *Porites* (Plate 1), and most prevalent on *Porites lutea*. Very few scars (2-3/colony) were observed on individual colonies belonging to branched corals and no snails were seen on these species. The baseline pattern of the snail distribution over the host was found to follow to a great extent the texture of the coral colony (i.e. the more rigid the colony, the more snails were present).

The data (Table 2) demonstrate that, despite the fact that the size of the colonies of different species of genus *Porites* are more or less the same, the snails prefer to occupy the colonies of *P. lutea* in larger numbers. The same results were also reflected in the number of scars found on each species. The same impression was also taken from the results of examining the infestation pattern of snails, where more than 86 % of *Porites lutea* colonies carried at least 6 snails, while in the other three species (*P. lobata, P. nodifera* and *P. solida*) the snails were found over not more than 10 % of the colonies.

Table (2): The data collected from the different *Porites* spp. infested with *Coralliphilia violacea* snails (data expressed as average of 15 colonies + SD).

Coral Species	Head Diameter	No. of Scars	No. of Snails
Porites lobata	29.7 ± 16.2	6.7 ± 3.3	4.7 ± 1.5
Porites lutea	32.0 ± 7.9	17.5 ± 3.1	14.0 ± 6.3
Porites nodifera	44.5 ± 6.0	4.2 ± 2.2	3.5 ± 1.7
Porites solida	33.7 ± 8.9	5.5 ± 3.1	2.0 ± 0.8

Snail Population

The examination of the size range of the snails sampled from *Porites lutea* colonies showed that the snail ranged in height between 0.6 and 2.8 cm with an average of 1.5 0.4 . The examined group of snails also showed a normal distribution pattern concerning their size frequency (Fig. 2). Such pattern may reflect a stable population of snails inhabiting this species of coral.

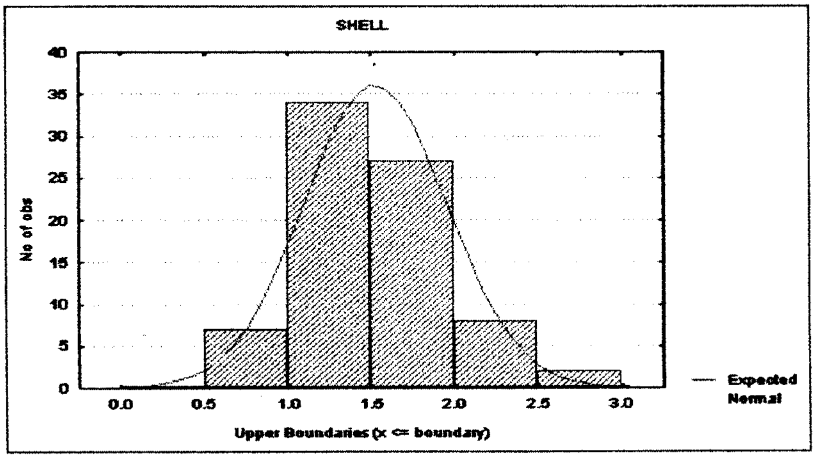

Figure 2: The size frequency distribution of *C. violacea* snails infesting *P. lutea* heads

Feeding Pattern and Impact

Examination of scars left by the snails on the *Porites* heads showed that the scar is more or less oval in shape with a more dense rounded impression at one end (Plate 1). This impression is most probably formed because the opercula of the snail is attached to the colony by adhesive material secreted by the snail itself (Plate 1). The measurement data concerning the scar size show that it ranges in size between 0.63 to 4.0 cm with an average of 2.3 0.6; its distribution is slightly different from that of the snails (Fig. 3). The relationship between the scar diameter and snail height (Fig. 4) showed a strongly positive correlation (r=0.85, p<0.05).

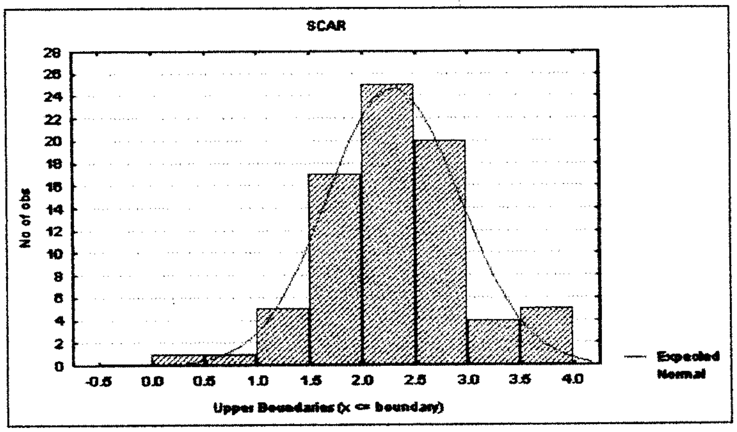

Figure 3: The size frequency distribution of *C. violacea* scars measured on *P. lutea* heads

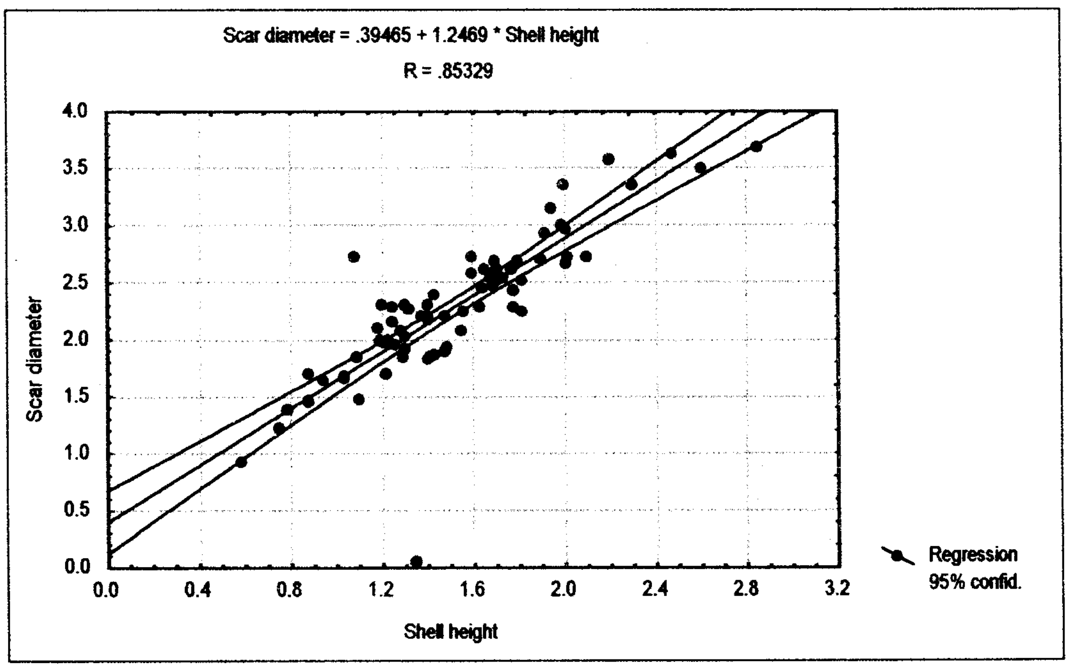

Figure 4: The Correlation between shell height and its corresponding scar diameter (cm)

Several attempts were made to observe snail movement by removing them from their attachment sites and releasing them again on the same or different colony. The results of these attempts proved that the snail does not show any movement during the daytime, and the soft part is kept retracted inside the shell. Removal of the snail from the *Porites* head revealed that the scars are probably formed very recently or probably from feeding during the previous night.

The impact of the snail feeding pattern was quite obvious in the *Porites* heads examined during the underwater observations (Plate 1) and could be classified visually into slight, moderate or heavy. A more quantitative analysis or assessment of the amount of damage number of underwater photographs of the affected colonies was analysed using Image analysis software. The results of the analysis showed that the total area consumed by the snails was dependent on the number of snails inhabiting the colony. The percentage of damage was found to represent from 10 % to 30 % of the colony area for a moderate-sized head with 25 - 35 cm in diameter. The results also showed that some smaller colonies lost almost 45 % of their tissue. The shape and texture of the colony seems to play an important role in the amount of damage, i.e. the more rigid the colony the more snails probably inhabit it.

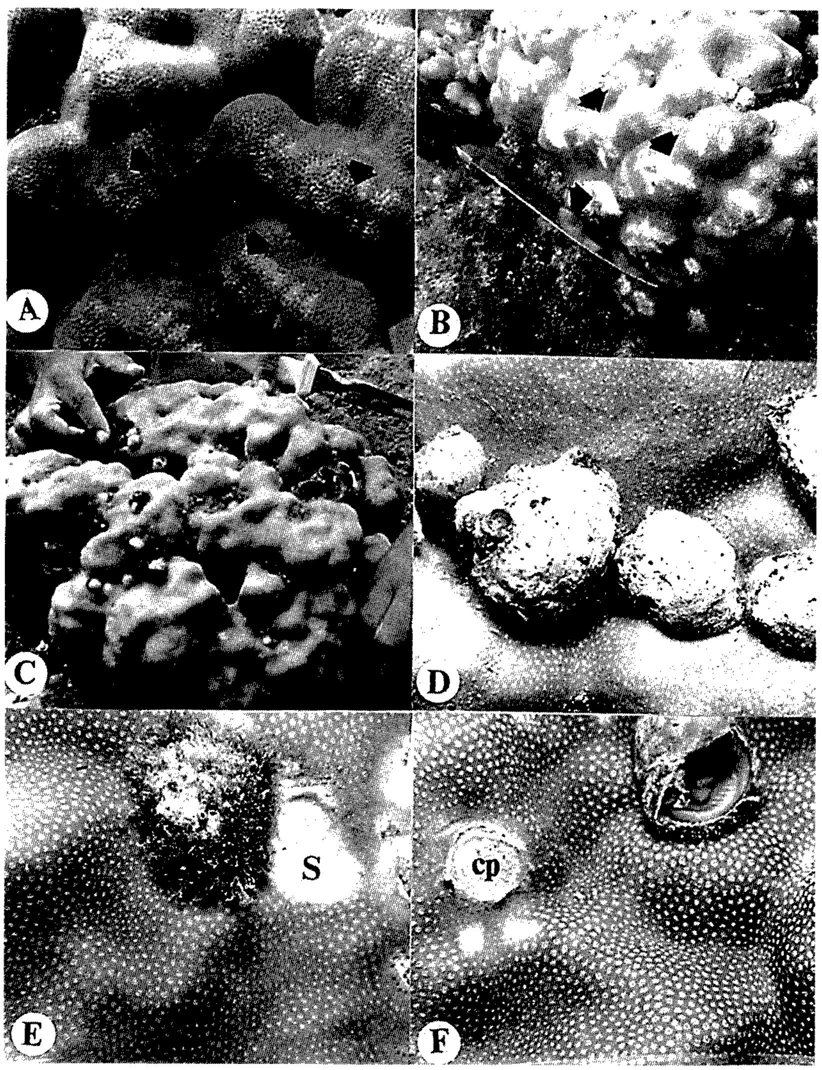

Plate I:

A. Arrows indicating moderate damage at *Porites* head.
B. Heavily damaged *Porites* colony as result of *Coralliphilia violacea* predation.
C. Group of *Coralliphilia violacea* snails over *Porites* head.
D. Individuals of *Coralliphilia violacea* representing different sizes resting during day time.
E. Scar left by one of *Coralliphilia violacea* snails (S).
F. Circular part (cp) of the scar formed by *Coralliphilia violacea* snails in the start.

DISCUSSION

Despite the fact that, the coral diversity in the surveyed area is relatively low (35 species) compared to other sites of the Red Sea coast (GEF 1998), the number of coral species infested with *Coralliphilia violacea* snails represents 11 % of the population. However, if we take into consideration that only one species of *Porites* was particularly affected, it represents 25 % of the *Porites* population; these species play an important role as reef building corals. The same situation was also reported by Hayes (1990) in some Panamanian reefs, where *C. abbreviata* was more concentrated in *Montastrea annularis* than any other species in the coral community.

The potentially alarming situation is that species of *Coralliphilia* are known from different parts of the world to prefer the branched corals (Glynn 1973; Brauley & Adey 1982; Moyer *et al.* 1982; Hayes 1990; McClanahan 1994), but in our study the branched corals of several genera are present in the area but are unaffected by the snails. The most probable reason for this odd distribution of the snails is that the branched corals are in slightly deeper and more exposed areas of the reef (reef crest and lower reef wall).

The difference in snail size classes as indicated in Figure 2 can have different level of impacts, since high density of small snails were less damaging than low density of large snails. On the other hand, the normal frequency distribution curve indicates a healthy growing population which soon will be represented by large number of adult individuals, with high needs for energy to perform reproduction. Wells & Lalli (1977) observed similar change in the population structure during their study on the reproduction of two *Coralliphilia* species from the Caribbean.

Another interesting subject here is the movement pattern of the snails. In other parts of the world they are known to be nocturnally active, hiding during the daytime (Ott & Lewis 1972). According to our observation made during the day, the snails were always there on the top of the coral colonies, indicating a change in the daily pattern of movement and feeding.

Since algal and micro-sponge colonisation occurs mainly within 15 to 21 days after the bare carbonate surface of the coral becomes available (Robertson 1970; Brawley & Adey 1982), scars formed by *Coralliphilia violacea* found without any algal coverage must have been created within no more than the previous fifteen days.

The observed percentages of coral damage might be evaluated by some scientists as negligible, or tolerable or even within the naturally occurring range of damage. But with a simple calculation, we could estimate the amount of damage caused by the snails to one coral species (*Porites lutea*) which averaged about 10 % within a month period; the rate of mortality could add up to an annual rate of 120 % which means a complete wipe-out of this species. The coral growth and reproduction will replace some of the damage, but there are also other coral predators (e.g. Parrot fish).

We can conclude that, if mortality is greater than the sum of growth and recruitment of corals the situation will result in loss of stability of prey and predator populations. Different studies conducted in the same field of coral mortality concluded that the snail's predation alone is insufficient to drive the coral population to zero (Brawley & Adey 1982; Colgan 1987; Hayes 1990; McClanahan 1994). However, most of these studies also suggest that the situation should be monitored, and perhaps certain measures implemented.

The fact that the Red Sea, especially the Egyptian coast, is under a lot of stress as result of rapid development, a problem of this size should be closely monitored, and further detailed studies of the distribution and biology of this species are urgently needed.

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الملخص العربى

تأثير أحد أنواع البطنقدميات (*كوراليوفيليا فيوليسى*) على الشعاب المرجانية فـــى مدينة الحمراوين على ساحل البحر الأحمر بمصر

محمد أبو زيد[١]، محمد قطب[٢]، محمود حنفى[٢]

١- قسم علم الحيوان ــ كلية العلوم ــ جامعة الأزهر ــ القاهرة ــ مصر

٢- قسم علوم البحار ــ كلية العلوم ــ جامعة قناة السويس ــ الإسماعيلية ــ مصر

أجريت الدراســـة علـــى مدينـــة الحمراويـــن والتـــى تقـــع علـــى ســـاحل البحـــر الأحمـــر علـــى بعـــد ٢٠ كـــم شـــمال مدينـــة القصـــير، إشـــتملت الدراســـة علـــى تـــأثير أحـــد أنـــواع البطنقدميـــات الـــذى يتغـــذى علـــى الشـــعاب المرجانيـــة الصلبـــة والتـــى تنتمـــى الـــى نـــوع *كوراليوفيليـــا فيوليســـى*، تضمنـــت الدراســـة مســـح حقلـــى دقيـــق لـــتركيب مســـطح الشـــعاب المرجانيـــة بالمنطقـــة، أثبتـــت الدراســـة أن القواقـــع مـــن النـــوع المدروس يمكن إعتبارهـــا مـــن مفترســـات الشـــعاب الصلبـــة فـــهى تتغـــذى بحـــدة علـــى الأنـــواع المرجانيـــة الصلبـــة والمنتميـــة لجنـــس *البورايتـــس*، كمـــا تضمنـــت الدراســـة أيضـــا التوزيـــع ونمـــط التغذيـــة لـــهذا النـــوع، قـــدرت الدراســـة تقديـــرا إفتراضيـــا نســـبة وكثافـــة الضـــرر الـــذى يحتمـــل أن يحدثـــه هـــذا النـــــوع مـــن البطنقدميـــات للشعاب المرجانية إذا مـــا إســـتمر فـــى نفـــس الســـلوك إعتمـــادا علـــى معلومـــات كثافـــة الشـــعاب الصلبـــة وكذلـــك النـــوع المنتشـــر مـــن البطنقدميـــات بالمنطقـــة (*كوراليوفيليـــا فيوليســـى*)،