

海洋事務研究委員會專區

Maritime Affairs Research Council

澎湖西吉島海域 棘冠海星大爆發事件與管控

Management of *Acanthaster planci* Outbreak
in Penghu Xi Ji Island Offshore Areas

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▲ 澎湖南方四島的珊瑚生長良好，覆蓋率高，圖中為健康的桌形軸孔珊瑚群體，直徑超過2公尺。

Excellent coral growth and coverage in the southern island areas of Penghu. The figure shows a healthy population of *A. hyacinthus* with diameter exceeding 2 meters.

自從2004年台灣珊瑚礁學會到澎湖南方海域舉辦水中攝影和珊瑚礁總體檢活動，我在西吉島東南方珊瑚礁淺水海域首次記錄到棘冠海星在澎湖出現，當時自己覺得十分幸運能拍到牠的生態照；爾後每年到西吉島進行調查研究時均可見到，棘冠海星的數量記錄，也逐年從罕見、稀有、而成為當地海域的棘冠海星常見物種。2010年6月19日在同一地點潛水，看到超過20隻，內心驚覺問題的嚴重性，過去的調查記錄未曾出現如此高密度的族群，而且發現的都是成熟個體，是不是棘冠海星大發生或大爆發(outbreak)呢？因為過去棘冠海星在台灣各珊瑚礁海域十分罕見，往往一年的調查，也見不到一隻個體，所以在台灣沒有學者從事相關的研究，一切就必須先從國外文獻資料去進一步了解成因與解決之道。

▼ 從海上拍攝西吉島全景

View of Xi Ji Island from the Sea



▲ 西吉島上居民已於民國67年遷村成為無人島。

Local inhabitants emigrated from Xi Ji Island in 1978, making the island completely unpopulated

Since participating in the water filming and coral reef total inspection held by Taiwan Coral Reef institute in 2004, I had at the first time recorded the presence of *Acanthaster planci* in coral reefs located in the southeast shallow coastal area of Xi Ji Island. I considered myself fortunate to be able to obtain a photo about its habitat. Later, as I conducted more research at the island, I have noticed that the sighting of *Acanthaster planci* had become more and more common. In Jun 19, 2010, I have noticed the severity of the problem when more than 20 *Acanthaster planci* was observed at the same diving location, as a popular density of this degree has never been recorded before. In addition, since all *Acanthaster planci* observed were adults, a fear of *Acanthaster planci* outbreak was imminent. In the past, *Acanthaster planci* had been a rare sight near Taiwan's coral reef areas; it was rare to spot even one over a year of inspection. Consequently, there were no relevant studies performed in Taiwan, and foreign literatures must be studied first to understand the cause and solution of *Acanthaster planci* problems.

至於珊瑚礁海域中的棘冠海星密度多少時才算是大爆發呢？一般認為珊瑚覆蓋率超過50%的健康珊瑚海域，每10,000平方公尺可以供養20—30隻棘冠海星，如果數量再增加可能對該區域的珊瑚不利，若是生態的長期監測調查，當數量超過30隻時就達到警戒的範圍。根據台灣珊瑚礁學會於2010年6月在澎湖南海西吉海域進行珊瑚礁總體檢調查，發現棘冠海星的數量遠高於過去幾年的監測調查記錄，所進行穿越線調查（50m × 4m）結果，發現棘冠海星數量最多的高達10隻，換算出該海域棘冠海星的密度，在10,000平方公尺已達500隻，超過警戒值達到大爆發的等級。

棘冠海星以活體石珊瑚的珊瑚蟲為食，一隻成體的棘冠海星每年可以啃食掉6平方公尺的珊瑚，對珊瑚礁海域的珊瑚產生很大的衝擊，而且飽食的棘冠海星可以利用所儲存的能量，在飢餓狀態下存活6個月，在白天小個體大都躲藏在珊瑚群體下方或縫隙間，不易被人發覺，加上本身絕佳的防禦機制與並不多見的天敵，成體的棘冠海星幾乎很難被「移除」。在國外的記錄，1970年代在澳洲大堡礁曾發現棘冠海星大爆發，爾後就一直無法根除，後來在琉球、關島、印尼等海域，也都曾經發生過棘冠海星大爆發的事件，導致大範圍的珊瑚死亡，造成當地珊瑚礁生態系的劇烈改變，需要人力移除棘冠海星才能復原。

What does the *Acanthaster planci* density in coral reef areas need to be before it is considered an outbreak? Typically, a healthy coral reef area with more than 50% coral coverage is able to sustain 20-30 *Acanthaster planci* per 10,000m². Any more *Acanthaster planci* presence is detrimental to the growth of local coral reefs. When more than 30 *Acanthaster planci* are observed during long-term monitoring, the situation should be viewed as an alert. According to the investigation performed by Taiwan Coral Reef Institute in June 2010 near the offshore area of Xi Ji Island in southern Penghu, it was discovered that the number of *Acanthaster planci* had far exceeded the number recorded in the past few years. Transect sampling over the area of (50m × 4m) had recorded as many as 10 *Acanthaster planci*, which translate to 500 *Acanthaster planci* within the 10,000m² area. This had far exceeded the warning value and was a sign of massive outbreak.

Acanthaster planci feeds on the coral polyps of living stony corals, and an adult *Acanthaster planci* is capable of consuming 6m² of corals, causing a large impact on coral reefs. In addition, *Acanthaster planci* that has finished eating is able to survive for 6 months without eating using the energy stored. At day time, those small bodies are not easily spotted since they are often hidden under corals or in rock gaps. Furthermore, their excellent defense mechanism and few natural enemies make it difficult to remove matured *Acanthaster planci*. In 1970, an *Acanthaster planci* outbreak was recorded in Australia's Great Barrier Reef in 1970's and, threat of *Acanthaster planci* was never completely eliminated ever since. Similar outbreaks had also occurred in offshore areas in Ryukyu, Guam, and Indonesia, causing massive coral deaths in the process and drastically altering local coral reef ecosystems. Human removal of *Acanthaster planci* was needed for the coral reefs to recover.



▲ 棘冠海星多為夜行性，白天喜歡躲藏在礁石下方或珊瑚縫隙內。
Acanthaster planci is mostly nocturnal and prefers to hide under rocks or coral gaps at daytime

▼ 西吉島上現無人居住，大部分房舍無人維修都已傾毀

Xi Ji Island is currently unpopulated, and most buildings are damaged or destroyed due to lack of maintenance



根據國外的長期監測調查報告，發現棘冠海星有週期性爆發的現象，其個體需要2—3年到達成熟階段，成熟的個體每年可以產下2—6千萬個卵，並持續存活5—7年，2—3年成熟體長直徑約30—40公分；最大體長直徑可達1公尺。就棘冠海星的生殖能力而言，小族群即具有大量增生的潛力，目前推測造成族群個體大量增生的原因，除了自然的週期性變動外，可能的原因有二：第一為天敵的消失，大法螺已知是棘冠海星最主要的天敵，另外油彩臘膜蝦、蘇眉魚等都會吃小的棘冠海星，而浮游幼生時期的棘冠海星更是許多珊瑚礁魚類的食物；若是這些能抑制棘冠海星數量的物種減少時，即可能造成棘冠海星數量的增加，特別是大法螺常被人拿去做觀賞用貝殼，導致大法螺在台灣幾乎滅絕可能是主要原因之一。第二是人類對海洋的污染，含豐富營養鹽的水流入海中，造成微細藻類的大量增生，也提供棘冠海星幼生時期足夠的食物來源，有機會讓大量的棘冠海星長成成體。2008年2月初澎湖發生百年罕見的寒災事件，海水溫度驟降，造成大量野生魚類及養殖魚類死亡，甚至淺海珊瑚發生大規模的白化、死亡，許多海域珊瑚覆蓋率降低，藻類大量增生，是否提供棘冠海星大量繁衍的條件，值得進一步探究。

▼ 本文作者在海底移除棘冠海星作業情形
The author removing *Acanthaster planci*



▲ 棘冠海星棘刺含劇毒。水試所研究人員在移除中，不小心被一根棘刺到中指，傷口呈紅腫情形。

Acanthaster planci is highly toxic. The figure shows the swelling and redness caused by stinging of *Acanthaster planci*

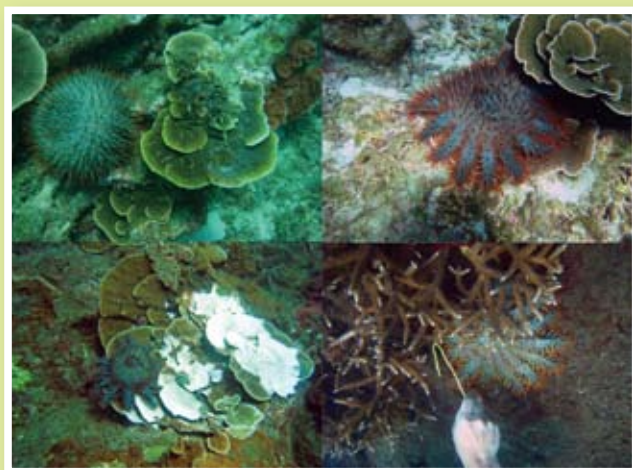
According to long term monitor research reports aboard, *Acanthaster planci* outbreak happen on a periodic basis. Individual takes 2-3 years before reaching maturity and is capable of laying 20-60 million eggs and continue to live for another 5-7 years. Adults 2-3 years in age are 30-40cm in diameter and can be as long as 1m. A small population of *Acanthaster planci* is capable of massive reproduction. Beside periodic variation two reasons of present outbreak have been proposed. The first is the disappearance of natural enemies. *Charonia tritonis* is the primary natural enemy of *Acanthaster planci*, and species like *Hymenocera picta* and *Cheilinus undulatus* prey on smaller *Acanthaster planci*. Furthermore, floating juvenile *Acanthaster planci* also acts as food source for many species of fish living in coral reef areas. When these natural of predators of *Acanthaster planci* decrease, the number of *Acanthaster planci* increases. *Charonia tritonis* is often used as decoration, and consequently is almost completely extinct in Taiwan. The second reason is ocean pollution. When water rich in nutrient salt flows into the sea, the growth of microalgae is greatly accelerated, offering sufficient food for juvenile *Acanthaster planci* in the process and allow for a significant growth in the population of adult *Acanthaster planci*. In February 2008, an unusual cold weather hit Penghu, lowering ocean temperature and killing large numbers of both wild and cultivation fish in the process. Large scale of bleaching and death of shallow sea corals was also recorded, the coral coverage of many sea areas was reduced, and the number of algae increased dramatically. Whether this offered an ideal breeding condition for *Acanthaster planci* remained to be determined.

目前已知澎湖海域除了西吉島之外，其它海域亦有發現棘冠海星的蹤跡，根據澎湖海洋生物研究中心於7月21日至8月中旬利用潛水拖曳調查方法，動員百餘潛水人次，大規模進行澎湖14處海域的棘冠海星普查及熱點區的人工移除工作。調查結果發現澎湖山水(約一百六十隻/一萬平方公尺)、鎖港(約六十隻/一萬平方公尺)、西吉(約一百六十隻/一萬平方公尺)沿岸海域有棘冠海星出沒外，共捕獲139隻，其餘海域並未發現其蹤跡，未來該中心仍會持續進行監測與調查。

同時台灣珊瑚礁學會與澎湖共生藻協會已於8月7日發起潛水志工及會員參與移除活動，有效結合政府與民間的力量，對棘冠海星進行特定區域的重點清除，共計在西吉島東南海域水深6－10公尺處採獲96隻，體長最小7公分到最大44公分，平均體長直徑約30公分的棘冠海星個體，進行移除與後續的處理工作。

Aside from Xi Ji Island, there are other spotting of *Acanthaster planci* in the Penghu sea area. Penghu Marine Biology Research Center had conducted diving towing investigation and mobilized more than one hundred divers to look for and remove *Acanthaster planci* from hotspots. *Acanthaster planci* was identified in the offshore areas of Shan Shui (160/ 10,000m²), Suo Gang (60/ 10,000m²), and Xi Ji (160/ 10,000m²) and a total of 139 *Acanthaster planci* was removed. No *Acanthaster planci* was spotted in other sea areas, and the Research Center will continue to monitor and investigate the situation.

The Taiwan Coral Reef Institute and Penghu Zooxanthellae Association have recruited volunteers to help remove *Acanthaster planci* from key coral reef areas, combining the government and people's efforts. A total of 96 *Acanthaster planci* with length of 7-44 cm (average of 30cm) were removed from sea areas 6-10 meters deep in the southeast Xi Ji offshore area. Subsequent removal and cleaning followed.



▲ 2010年6月在澎湖西吉島海域測站所拍攝到棘冠海星覓食珊瑚的情形；最下左圖為表孔珊瑚被棘冠海星攝食後白化情形，下圖右為躲藏在軸孔珊瑚叢下的棘冠海星。

Acanthaster planci predation of coral reefs recorded in the offshore area of Xi Ji Island of Penghu in June 2010. The bottom left figure showed the bleaching of *Montipora aequituberculata* after *Acanthaster planci* predation. The bottom right figure shows *Acanthaster planci* hidden inside *A. hyacinthus*.



▲ 大法螺正在吃棘冠海星（翻攝自Kurt Amsler, 1995；馬爾地夫）
Charonia tritonis preying on *Acanthaster planci* (adapted from Kurt Amsler, 1995; Maldives)



◀ 澎湖南方四島東嶼坪、西嶼坪、東吉島和西吉島相對位置，圖中所示為7公尺和20公尺等深線。建議劃設澎湖南海海洋保護區位置(N23°12'~23°18'; E119°28'~119°42')。

The relative positions of the 4 islands in south Penghu: Dong Yu Ping/Xi Yu Ping, Dong Ji island/Xi Ji island. Isobaths of 7m and 20m are displayed in the figure. The locations recommended for Penghu South Sea Ocean Protected Area are (N23°12'~23°18'; E119°28'~119°42')。

根據各項資料顯示，要減輕棘冠海星大量繁生所造成的危害，現今以水肺潛水方式(SCUBA)進行清除是最有效，而且後遺症最少的方法之一。由於棘冠海星並非群聚分布，牠們的棲息環境偏好石珊瑚群體覆蓋率較高的地區，因此在軟珊瑚較多區反而較少見到。其次是牠們背部覆滿許多棘刺，約2—3公分長且尖，具有毒性，被刺到後隨個人體質的差異，而有不同程度上的傷害。我個人曾在東沙環礁內被刺到手指，1小洞傷口竟然超過1天後還可擠出血來；有些人傷口可能紅腫疼痛超過2—3週，因此在移除過程中需要格外小心。同時我也要建請農委會，早日將其天敵「大法螺」列入野生動物保護法中的保育類動物，讓自然界物的生態平衡不會遭人為干擾而破壞。

Data indicates that (SCUBA) removal is the most effectively way to reduce the threat posed by the massive reproduction of *Acanthaster planci*. Since *Acanthaster planci* do not live in high density populations and prefer areas with high stony coral reef coverage, they are not as readily spotted near soft corals. In addition, they are covered by thorns 2-3cm long and are toxic, so people can be injured to different degree depending on the individual's body constitution. The author was personally hurt by *Acanthaster planci* near the Dongsha Coral Ring, and hemorrhage continued even after one day. Redness and pain may persist for 2-3 weeks in some cases, so people must be careful in the removal process. It is also suggested that The Council of Agriculture adds *Charonia tritonis* to the list of protected wild life in order to preserve natural habitat balance from human disruption.



◀ 從海底所採獲棘冠海星先放入儲水箱中，再運回澎湖青灣水試所養殖場蓄養，做進一步分析研究。

Acanthaster planci captured is first placed in tanks and transported back to the breeding pools of Tsing Wan Water Testing Facility for further studies

有鑑於近年來台灣各地漁業資源枯竭，2008年寒災後澎湖縣的漁獲量遠低於過去的平均值，如何復育、休魚、禁魚已迫切需要，這幾年來本人研究調查澎湖各海域生態資源，從各項研究成果中顯示澎湖南方四島（含東、西嶼坪、東、西吉島，如圖示），在珊瑚礁生物多樣性是比澎湖北海和內海要高出許多，而且這四島現住居民不足50人，若能劃設海洋保護區或設立國家公園，將有助於保存澎湖漁業資源和水產種原庫，同時也較能有效執法，也可就近針對棘冠海星族群變動及所造成的生態影響，持續投入人力與經費進行長期調查與監測，期使澎湖海域生態資源能得到保育，進而達成永續利用的目標。

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Fishery resources have been depleting in Taiwan in recent years. After the severe cold weather in Penghu in 2008, fish harvest has been far lower than the average before. This indicates that conservation, rest seasons, and fishing bans are all necessary. My own research of marine ecosystems over the past few years indicated that the biodiversity of Penghu Coral Reef Systems near the southern islands (including Dong Yu Ping/Xi Yu Ping and Dong Ji island/Xi Ji island, as fig. shown) is much higher than that of North Sea and Inner Sea. Since the total number of inhabitants on these 4 islands is fewer than 50, it will be helpful to conservation of Penghu fisheries resources and the aquatic species reservoir if a marine protected area or national park is established in this area. At the same time, it is easier to establish laws and provide long term monitoring and investigation on the effects of *Acanthaster planci* on the ecosystem. By doing so, not only can the ecological resources of Penghu offshore areas be preserved, the goal of sustainable utilization is also achieved.

（The author is currently works at the Biodiversity Research Center, Academic Sinica）

小檔案 (I)



棘冠海星

中文名：棘冠海星（俗稱：魔鬼海星、長棘海星）

學名：Acanthaster planci

分佈：紅海、印度洋、太平洋熱帶海域

描述：棘冠海星分類上屬於長棘海星科（Acanthasteridae），又被稱為魔鬼海星或長棘海星，體表佈滿細長且尖銳的棘刺而得其名，刺的表皮上具有毒腺細胞，被刺到會有紅腫、疼痛等症狀。棘冠海星為大型的海星種類，僅次於向日葵海星第二大海星種類，棲息於珊瑚礁海域，偏向於夜行性的物種，活體時全身多為紅色或磚紅色，反口面呈青灰色，腕足數多在9-20隻，而以14-16隻最為常見，最大個體含腕足的直徑接近1公尺。分布於紅海、印度洋與太平洋的熱帶珊瑚礁海域，過去台灣珊瑚礁海域偶而可見，根據相關的記錄並未曾發現有棘冠海星大爆發的事件。

Common Name : Devil Starfish, Crown-of-Thorns Starfish

Scientific Name : Acanthaster planci

Distribution : The Red Sea, Indian Ocean, tropical regions of the Pacific Ocean

Description : Commonly known as the devil starfish and for its sharp thorns, Acanthaster planci belong in the genus Acanthasteridae. The thorns contain poison glands, and the redness and swelling occur when one is struck by the thorns. Acanthaster planci is the second largest starfish, next to Pycnopodia helianthoides, and nocturnal that resides in offshore areas near coral reefs. Living species are often red or brick-red, and blue-gray on the aboral surface. The averred number of arms observed are 9-20, with 14-16 as the most frequent occurrence. The largest Acanthaster planci is 1 meter in diameter, including arms. They are distributed in coral reef areas in the Red Sea, Indian Ocean, and tropical Pacific Ocean. In the past, they are rarely seen in the coral reef regions in Taiwan, and no recorded outbreaks have been recorded.

► 2010年8月7日潛水志工在馬公港合照後，即搭船前往西吉島海域移除棘冠海星。

Volunteers participated in the removal of *Acanthaster planci* in the Xi Ji Island offshore area on August. 7, 2010.



小檔案 (II) 大法螺

中文名：大法螺（大陸稱鳳尾螺）

學名：Charonia tritonis

分佈：印度洋、太平洋、大洋洲、日本南部

描述：本種是法螺科最大型的種類，殼長可超過30公分，殼為白色具不規則的深褐色粗紋，螺塔尖而高，殼口大，殼口內呈橘紅色，外唇有黑斑，內唇有細斑馬紋甚有光澤。喜歡棲息於珊瑚礁海域，偏好攝食海星與芋螺，是棘冠海星的天敵，因此為了保護珊瑚，有許多國家均已立法保護大法螺，例如：澳洲、菲律賓、馬來西亞就嚴禁捕捉大法螺。因為具有高度的食用與觀賞價值，過去在台灣曾被大量的採捕，目前已經不易見到野生個體。

Common Name : Triton's Trumpet (Triton Phoenix Tail in Mainland)

Scientific Name : Charonia tritonis

Distribution : Indian Ocean, Pacific Ocean, Oceania, Southern Japan

Description : It is the largest specie in the Charonia family, with shell lengths exceeding 30cm. The shell is white and contains irregular dark-brown lines. The shell is spiky and tall, and the orifice is wide. The inside of the orifice is orange-red and black markings can be spotted on the outer labra and fine lines as well as luster are found on the inner labra. Charonia tritonis is the natural predator of *Acanthaster planci* and many countries have established laws to protect *Charonia tritonis* in order to protect corals. For example, it is illegal to catch *Charonia tritonis* in Australia, the Philippines, and Malaysia. Since it was highly valued as food and decoration, *Charonia tritonis* was heavily harvested in Taiwan in the past. Currently it is difficult to spot wild individuals.