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Notes on the Occurrence of *Amphiprion* (Perciformes: Pomacentridae) in Peninsular Malaysia

S.S. PALANIAPPAN, M.N. SITI AZIZAH and Y. YUSUF

World Fish Center
Jalan Batu Maung
Bayang Lepas, 11960 Penang
Malaysia

Abstract

Amphiprion sp represent the largest complex of anemonefish with approximately 25 species ranging all over the Indo-West Pacific region. It often varies morphologically due to ontogenic, geographic, melanistic, hybridization, sexual and random differentiation and is very popular among aquarists. These observations were carried out to elucidate *Amphiprion* distribution in Peninsular Malaysia. Eight species were observed and their respective symbiont hosts were recorded. Recent surveys show that *Amphiprion* populations previously recorded in Tanjung Tuan (Cape Rochado), Melaka have now perished. Rapid uncontrolled development in the Straits of *Melaka* has caused the corals and many organisms dependent on reefs to perish. It is hoped that current studies would contribute towards the preservation of the anemonefishes which are often sought after for the aquarium trade.

Introduction

Amphiprion spp. are members of the family Pomacentridae and they represent the largest genus of anemonefish complex with approximately 25 species (Fautin and Allen, (1992). Sin et al (1994) in their paper identified five species of *Amphiprion* from Malaysian waters. De Silva et al.(1982) also recorded five species from the Payar group of islands. Its common name 'clownfish' was derived from the variability in the striking ornamental coloration which, although reliant upon ingested caratenoids (Tanaka et al., 1992), shows seven types of possible variation: ontogenic, geographical, melanistic, hybridization, sexual, behavioural and a random genetic variation (Table 1) (Fautin and Allen, 1992).

Distribution of the *Amphiprion* is reliant upon the distribution of the tropical anemone host species (Allen, 1980) which are themselves constrained by water temperature (Dunn, 1981). Range for both is extended out of the tropical belt by the warm water currents allowing colonization from the Caroline Islands westwards to the Red Sea (within the vast Indo-West Pacific region).

The faunistic center of *Amphiprion* as well as for most marine taxa is within the Indo-Malayan region which is classically believed to be the center of fish speciation (Ekman, 1953). The paleogeography of the Indo-Malayan region has changed dramatically during the Quartenery period. As sea levels associated with glaciation fell to 200m below their present levels, much of the Sunda shelves would have been terrestrial. Following the formation of a large number of continentally fragmented or volcanic islands, ideal conditions for shallow water anemones and therefore anemonefishes were established (Woodlands, 1990).

The pelagic larval phase for anemonefishes is short, ranging from eight to 12 days. Planktonic larval duration is said to play a major role in determining distribution and abundance in reef fish populations (Sale et al, 1984). However despite such a short larval duration, anemonefishes range over a wide but more importantly isolated range, unbridgeable by temporal planktonic dispersal.

A mutualistic reliance is induced on a colentrate host in line with the obligate symbiotic nature of *Amphiprion*. Specifity to a host anemone is controlled by three factors; an innate preference, competitive superiority and chance(Fautin and Allen, 1992). Increasing geographical range of an *Amphiprion* decreases specificity on a host anemone species.

Like many other reef fishes, *Amphiprion* undergoes sex reversal, although it is the less encountered form of protandrous hermaphrodite (male to female). The largest and socially dominant individual is usually a female and forms a monogamous relationship with a male (Nelson et al., 2000). However any change of hierarchy would cause functional testes to be developed (Fautin and Allen, 1992). Spawning occurs throughout the year.

Amphiprion are economically valuable in the aquarium trade. These brightly colored anemonefishes are very popular among aquarists. A single fish can fetch a price between US$ 1.31 to US$ 2.63 with the host anemone costing up to US$ 7.89 in Malaysia. The exact location of collection points as well as the extent of collection rates are not clear. Most marine aquarium

Table 1. Mode of colour variation within the anemonefish (Adapted from Allen, 1980)

Variation	Cause/Effect	Species
Ontogenetic	Gradual change from transparent juvenile to coloured adult morph	Most
Geographic	Regional variation in isolated populations	*A.clarkii, A.ocellaris*
Ecological 1	Reduced/increased iridescence in response to environment (turbidity etc.). Expansion or contraction of special pigment cells.	Few
Ecological 2	Response to host anemone selection. 'Bright' or melanic' phase	*A.clarkii, A.ocellaris, A.percula*
Sexual	Slight colour changes usually in caudal fin	Few: *A. clarkii, A.perideraion*
Behavioural	Reproductive or antagonistic signaling	Few: *P.biaculeatus*
Random	Random mutation. Usually in head bar colouration.	Few: *A.ocellaris*

traders claim that these fish are from foreign waters. However, the rapid depletion of anemonefishes that were once abundant in Tanjung Tuan (Cape Rochado), off the Straits of Malacca, indicate that severe harvesting without time for recovery has almost wiped out the population there (pers. obs).

Sin et al(1994) in their paper stated the fact that studies on Malaysian pomacentrids is lacking is an unfortunate fact. This study aims to identify the anemonefishes of Peninsular Malaysia as well as determine the distribution patterns. We hope to record the diversity of *Amphiprion* in each chosen location transcending the waters of Peninsular Malaysia.

Materials and Methods

Field observations were carried out in four marine parks : Payar Island, Tinggi Island, Tioman Island and Redang Island (Fig 1). Tanjung Tuan (Cape Rochado) in Melaka was excluded after an initial survey failed to show the presence of any anemonefish.

Visual census was carried out at every possible location within the waters of the islands at most substrate types such as as coral cover, rubble cover and sandy bottoms using underwater photography and SCUBA diving. *Amphiprion* were identified using keys by Fautin and Allen (1992) and Lieske and Meyers (1994). The fish were photographed for confirmation of species.

Results and Discussion

Eight species of *Amphiprion* were observed cumulatively in the four locations with their respective symbiont hosts (Table 1, 2 and 3). This is more than what was previously recorded by Sin et al (1994). The additional species previously undocumented were *A. alkallapisos, A. sandaracinos, A. melanopus and A. ephippium*.

Of the marine parks, Tioman Island led the list with the most number of species, six. This was followed by Tinggi island and Redang with five species each. Payar island had the lowest number with four species.

A. clarkii, known as Clark's anemonefish, was the most widely distributed species over all the four locations which is agreeable with the fact that it is the most widely distributed species around the world and it is the species that is found in symbiosis with many host species (Fautin and

Fig 1. Map showing sampling locations in Peninsular Malaysia with Tanjung Tuan (Cape Rochado) shown as well.

Allen, 1992). Of the ten host species, in Malaysian waters, A. clarkii was observed in symbiosis with *Heteractis magnifica, H. crispa, Stichodactyla mertensii and Entacmea quadricolor* (Table 2).

A. clarkii also shows morphological variation due to ontogenic, geographic, sexual factors as well as in response to host anemones (Tanaka et al, 1992). In Payar Island, only the black and yellow variant was observed in all different species of anemones.

A. ocellaris, commonly known as false clown anemonefish, was also found in all locations. It shares an allopatric distribution with *A. percula,* a very similar species except for the dorsal spine count and middle bar length. *A. ocellaris* has 11 or ten dorsal spines as opposed to *A. percula* that has nine dorsal spines and a more protruding middle bar. *A. ocellaris* is found in symbiosis with three different species of anemones but in all locations it was only found with *H. magnifica* which was most abundant (Table 2).

This species is known to show ontogenic, geographic variation as well as morphological variation due to responses to host anemone as well as random

Table 2. Host selection specificity between the *Amphiprion* species: a comparison between this study and previous studies (adapted from Fautin and Allen, 1992 and Lieske and Myers, 1994)

Amphiprion sp.	Anemone species in this study	Anemone species in previous studies
A. alkallapisos	*H. magnifica*	*H .magnifica* and *S. mertensii*
A. clarkii	Heteractis magnifica, *H. crispa, Entecmea quadricolor* and *Stichodactyla mertensii*	*Crytodendrum adhaesivum, E.quadricolor, H.aurora, H.crispa, H.magnifica, H.malu, Macrodactyla doreensis, Stichodactyla mertensii, S.haddoni* and *S. gigantea*
A.ephippium	*H. crispa*	*H. crispa* and *E. quadricolor*
A.frenatus	*E. quadricolor*	*E. quadricolor*
A.melanopus	*E. quadricolor*	Usually *E. quadricolor,* occasionally *H.magnifica* rarely *H. crsipa*
A.ocellaris	*H. magnifica* and *S. mertensii*	*H.magnifica, S.gigantean* and *S. mertensii*
A. perideraion	*H.magnifica*	*H.magnifica, H. crispa, S. gigantean* and *Macrodactyla doreensis*
A. sandaracinos	*H. crispa*	*H. crispa and S. mertensii*

Table 3. Distribution of Amphiprion species in the Marine Parks of Pulau Payar, Tinggi, Tioman and Redang.

Species	Location			
	P.Payar	P.Tinggi	P.Tioman	P.Redang
A. alkallapisos (Bleeker, 1853)	+	-	+	-
A. clarkii (Bennett, 1830)	+	+	+	+
A.ephippium (Bloch, 1790)	+	-	-	-
A.frenatus (Brevoort, 1856)	-	+	+	+
A.melanopus (Bleeker, 1852)	-	-	-	+
A.ocellaris (Cuvier, 1830)	+	+	+	+
A. perideraion (Bleeker, 1855)	-	+	+	+
A. sandaracinos (Allen, 1972)	-	+	+	-
Total number	4	5	6	5

variation (Table 1). Variations were observed in the width of the middle bar of the fish in most locations. In addition, melanistic tendencies were observed in samples from Payar island as opposed to other locations.

A. alkallapisos is a species abundant in all locations except Pulau Redang. Commonly known as skunk anemonefish, it is symbiotic with two anemone species. However in this study it was observed to be in symbiosis with only *H. magnifica* (Table 2). This species is often misidentified as *A. sandaracinos* or *A. perideraion*. This could be due to the fact that the body coloration of these species are very similar and only distinguishable upon closer inspection.

A. sandaracinos, commonly known as orange anemonefish was only found in symbiosis with *H.crispa*. Generally it is only found with *H. crispa* or *S. mertensii* (Table 2).

A. perideraion or pink anemonefish is usually found with *H. magnifica* but sometimes also found with *H. crispa*. It normally shows slight color changes in caudal fin due to sexual variation.

A. frenatus, commonly known as tomato anemonefish, was observed in all locations except Payar island although Lulofs (1977) had observed this species in the Payar group of islands from 1965 to 1970 and then noticed the disappearance of the species in 1975. This species is only found with *E.quadricolor* and this could explain its absence from Payar as this species of anemone was not observed as well (Table 2). *A. frenatus* is often difficult to differentiate from *A. melanopus*.

A. melanopus or red and black anemonefish was only located in Redang island. It seldom shows melanistic variation and is usually found with *E.quadricolor* and occasionally with *H. crispa* but rarely with *H. magnifica* (Table 2). This could also explain its absence from Pulau Payar as *H. magnifica* is the most abundant anemone species. However the report by De Silva et al (1982) and Rashid (1980) recorded this species in the Payar island reef system. The lack of *E. quadricolor* from these areas presently could explain the disappearance of the fish as well.

A. ephippium, the red saddleback anemonefish, was observed in symbiosis with a *H. crispa* anemone only in Pulau Payar. It has been known to occupy *E. quadricolor* elsewhere (Table 2) and is often misidentified as *A. melanopus* or *A. frenatus* due to morphological similarities.

Conclusion

The irregularities in the distribution patterns as well as the differences in species diversity denotes that more than paleogeographic history plays a role in species distribution. The ocean currents are a major factor in the inter-connectivity of marine areas and aid larval dispersion (Barber et al, 2000). The lack of species diversity in this area has to be examined not only as an individual factor but to check for inter-connectivity. For instance in the case *Amphiprion*, the fish is dependent on host anemones. Hence the lack of host species also denotes the immediate lack of the symbiont.

The commercial importance of this fish is well established and hence necessary measures to conserve have to be taken. Special management measures have to be taken to ensure that these *Amphiprion* are preserved instead of being totally eliminated due to thriving fishing for aquarium trade. An example has already been sighted in Tanjung Tuan (Cape Rochado), off Melaka, which was once a snorkeller's haven. Now due to various factors, the genus has been wiped out from the area.

This study will be furthered to include a wider range of area and also other commercially important species in coral reefs for a more comprehensive understanding of reef fish and its association with other organisms for its sustainability.

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References

Allen G.R. 1980. Anemonefishes of the world : species, care and breeding. Aquarium Systems, Mentor, Ohio.

Barber, P., S.R. Palumbi, M.V. Erdmann and M.K. Moosa. 2000. A marine Wallace's line? Nature 406: 692-693.

DeSilva, M.W.R.N. and A.R. Rahman. 1982. Coral reef survey of Pulau Paya/Segantang group of islands, Kedah: Expedition report and recommendation for management. Report produced under WWF Project Mal. 41/82. Universiti Pertanian Malaysia. Serdang.

Dunn, D.F. 1981. The clownfish sea anemones: Stichodactylidae (Coelenterata: Actinaria) and other sea anemones symbiotic with pomacentrid fishes. Transactions of the American Philosophical Society 71: 1-115.

Ekman, S. 1953. Zoogeography of the sea. Sidwick and Jackson, London.

Fautin, D.G. and G.R. Allen. 1992. Anemone fishes and their host sea anemones, a guide for aquarists and divers. Western Australian Museum, Perth. 160pp.

Lieske, E. and R. Myers. 1994. Reef fishes of the world. Periplus Editions, Hong Kong.

Lulofs, R.B. 1975. Marine national parks. Malayan Naturalist 12: 2-6

Nelson, J.S., R.J. Hodell, L.M. Chou, W.K. Chan and V.P.E. Phang. 2000. Phylogeographic structure of false clown anemonefish, *Amphiprion ocellaris*, explained by sea level changes on the Sunda shelf. Marine Biology 137: 727-736

Rashid, R. 1980. The Pulau Payar reef system. The Malaysian Agricultural Journal 52: 240-523

Sale, P.F. and W.A. Douglas. 1984. Choice of micro-habitats by coral reef fishes at settlement. Coral Reefs 3(2): 91-99

Sin,T.M., M.M. Teo, P.K.L. Ng, L.M. Chou and H.W. Khoo. 1994. The damselfishes (Pisces: Osteichthyes: Pomacentridae) of Peninsular Malaysia and Singapore: systematics, ecology and conservation. Hydrobiologia 285: 49-58

Tanaka, Y., S. Yamada and M. Sameshima. 1992. Novel apocarotenoid apoastacenal isolated from nudibranch eggmasses. Nippon Suisan Gakkaishi-Bulletin of the Japanese Society of Science Fisheries 58(8): 1549

Woodland, D.J. 1983. Zoogeography of the Siganidae (Pisces) – an interpretation of distribution and richness patterns. Bulletin of Marine Science 33(3): 713-717

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