

# **A study on diversity and shell utilization of hermit crabs (Families Coenobitidae and Diogenidae) in the Western coast of Sri Lanka**

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## **Abstract**

The hermit crab fauna of Sri Lanka are not well known. Present study surveys hermit crab species inhabiting the supra littoral, intertidal and sub tidal areas in the Western coast of Sri Lanka. Hermit crabs were collected using a line transect of 3m x 10m from six sampling sites along the Western coast of Sri Lanka. Eight hermit crab species belong to two families (Coenobitidae and Diogenidae) and five genera were identified in the study. The most common species were *Coenobita cavipes*, *Clibanarius longitarsus* and *Diogenes avarus*. The less common species were *Calcinus gaimardii*, *Clibanarius virescens* and *Calcinus laevimanus*. And rare species were *Calcinus areolatus* and *Dardanus lagapodes*. Empty shells of *Telescopium telescopium* is most commonly used by the estuarine hermit crabs. Hermit crabs recorded in the study utilized 27 gastropod shell types including shells of invasive mollusk *Acatina fulica*.

## **Introduction**

Sri Lanka is endowed with different types of coastal ecosystems including estuaries, lagoons, sea grass beds, coral reefs, salt marshes and intertidal rocky reefs. Coastal ecosystems with vast faunal and floral diversity support the marine food chains and in these ecosystems crustaceans play a vital role by playing an active role as predators and prey. Especially the roles played by shrimps, crabs and hermit crabs are significant in maintaining a healthy food web in coastal ecosystems.

Hermit crabs are considered as one of the most interesting groups of organisms among the decapod crustaceans. They influence whole communities of associates in a range of habitats from the terrestrial to the deep sea on a world-wide basis (Fransozo & Mantellatto 1998; Williams & Mcdermott 2004).

Hermit crabs have held particular interest amongst ecologists worldwide for many years because of their behavioral characteristics related to the use of molluscan shells. Hermit crabs have a soft abdomen and for safety from predation, desiccation and mechanical damage they keep the

abdomen inside a discarded gastropod shell appropriate to their size (Hazlett, 1996; Turra and Leita, 2000; Barnes 2003). They move in to larger shells as they grow (Bertness, 1981).

Studies have illustrated the complexity of shell selection with respect to shell species identity and selection (Gherardi, 1990; Gherardi & Vannini, 1993), shell size (Angel, 2000), migration and digging behaviour (Gherardi & Vannini, 1993) and associated agonistic behavior (Hazlett, 1996). Hermit crabs may select gastropod shells based on one or more of a number of characteristics such as shell weight, volume, height, aperture length, width and colour (Brown *et al.* 1993, Garica & Mantellato 2001, Briffira & Elwood 2006). Availability of empty gastropod shells is a limiting factor to populations of many species of hermit crabs (Scully 1979) and the sizes of shells occupied by hermit crabs are usually correlated with crab size (Hazlett 1996).

Despite the world-wide interest on hermit crabs, their distributional aspects have been studied less frequently, possibly because of the difficulties on sampling design on coastal zones, the heterogeneity and the intriguing aspects on relationship and dependence of gastropod shell for hermit crab survivorship, which complicates generalization on distributional models (Fransozo & Mantelatto, 1998).

Hermit crabs are least studied in Sri Lanka irrespective of their ecological importance in coastal food chain and biodiversity. Therefore, the objectives of the present study were to record the hermit crab species living along the Western coastal areas of Sri Lanka and to provide a preliminary account of their geographical distribution, host shell preferences and habitat type associations.

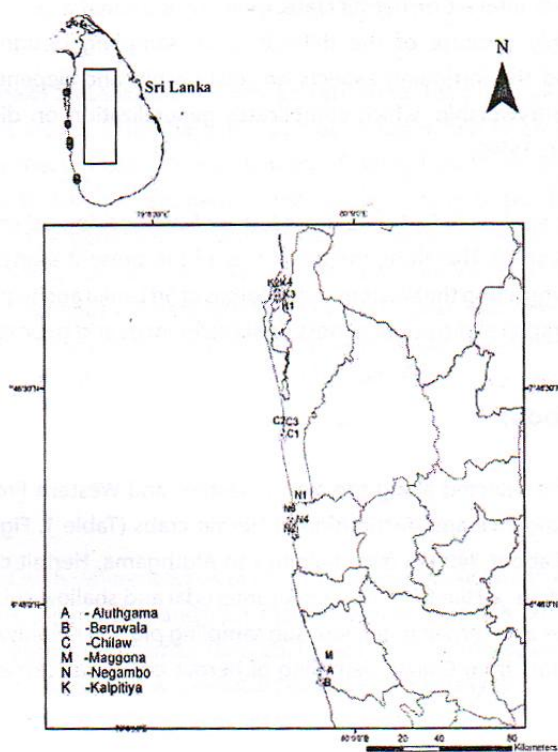
## **Material and Methods**

Six sampling sites were selected along the North Western and Western Provinces of Sri Lanka to investigate the abundance and distribution of Hermit crabs (Table 1, Fig. 1). Sampling areas covered a distance of about 240 km from Kalpitiya to Aluthgama. Hermit crabs were collected using a line transect of 3m x 10m from supra tidal, intertidal and shallow subtidal waters (Fig. 1). Replicate sampling was also carried out in four sub sampling plots in Kalpitiya and Negombo and three sub sampling plots from Chilaw. Sampling of hermit crabs was carried out from January 2010 to August 2010.



**Table 1:** Sampling sites and their spatial references of latitudes and longitudes

Main Site	Latitude	Longitude
Kalpitiya	08° 15.068'	79° 58.653'
Chilaw	07° 36.423'	79° 47.505'
Negombo	07° 12.429'	79° 50.108'
Maggona	06° 30.648'	79° 58.902'
Beruwala	06° 27.142'	79° 58.653'
Aluthgama	06° 26.375'	79° 58.902'

**Figure 1:** Selected sampling sites in the Western and North Western provinces

(K1, K2, K3, K4; C1, C2, C3; N1, N2, N3, N4 – sub sampling plots in Kalpitiya, Chilaw & Negombo, respectively)

### Sampling of hermit crabs

The number of hermit crabs in each line transect was counted and identified (Figs. 2 & 3). Also a quadrat with the size of 0.5m x 0.5m was used in open water areas and hermit crabs density was calculated per m<sup>2</sup>. Representative samples of hermit crab species were preserved in 10% seawater

formalin solution and they were taken in to the laboratory for further identification using standard keys (Khan, 1992; McLaughlin, 2002a & 2003). In identification process special attention was paid to preserve minimum number of hermit crabs.

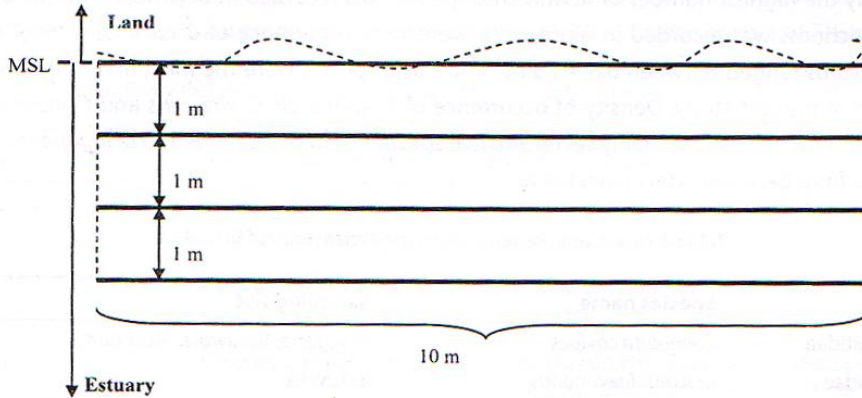


Figure 2. Line transect employed to study estuarine & shallow marine water hermit crabs

Line transect was laid towards landwards in sites where land living hermit crabs were observed (Fig. 3).

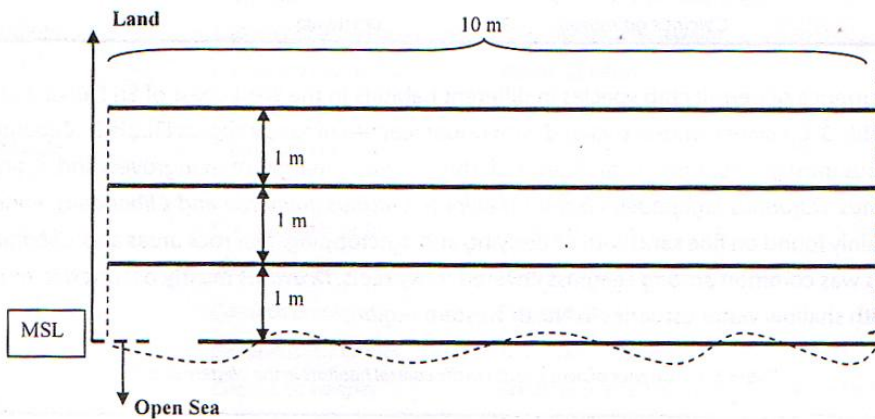


Figure 3. Line Transect employed to study land living hermit crabs

Also vegetation type and physical appearance of each vertical line transect was noted. Mollusk shells used by hermit crabs were identified using Mac-Donalds-Encyclopedia of Shells (1960).

## Results

### Diversity and distribution of hermit crabs

A total of eight species of hermit crabs were found in the supra tidal, intertidal and immediate subtidal zones of the Western coast of Sri Lanka (Table 2). Seven species of estuarine hermit crabs

classified under Family Diogenidae and Genera *Clibanarius*, *Calcinus*, *Diogenes*, and *Dardanus* were recorded in the study. One species of land living hermit crab *Coenobita cavipes* belonging to Family Coenobitidae was recorded in Aluthgama, Maggona and Beruwala sites. According to this study the highest number of hermit crab species was recorded in Beruwala and the lowest species richness was recorded in Aluthgama. Density of occurrence of *C. cavipes*, *C. longitarsus* and *D. avarus* ranged between 0.8 – 1.3 m<sup>-2</sup> and these species were the most abundant species recorded in present study. Density of occurrence of *C. gaimardii*, *C. virescens* and *C. laevimanus* varied between 0.3 – 0.9 m<sup>-2</sup>. Only seven and five specimens of *C. areolatus* and *D. lagapodes* were recorded from Beruwala site, respectively.

**Table 2.** Hermit crab species corded in the Western coast of Sri Lanka

Family	Species name	Sampling site
Coenobitidae	<i>Coenobita cavipes</i>	Maggona, Beruwala, Aluthgama
Diogenidae	<i>Calcinus laevimanus</i>	Beruwala
	<i>Clibanarius longitarsus</i>	Kalpitiya, Chilaw, Negombo, Maggona
	<i>Clibanarius virescens</i>	Beruwala
	<i>Diogenes avarus</i>	Kalpitiya, Chilaw, Negombo
	<i>Dardanus lagapodus</i>	Beruwala
	<i>Calcinus areolatus</i>	Beruwala
	<i>Calcinus gaimardii</i>	Beruwala

The occurrence of hermit crab species in different habitats in the West coast of Sri Lanka is given in the Table 3. *C. cavipes* were associated with upper reaches of sandy shores (Table 3). *Clibanarius longitarsus* mostly occurred in and around the seaward margin of mangroves, and *Calcinus laevimanus*, *Dardanus lagapodes*, *Calcinus areolatus*, *Calcinus gaimardii* and *Clibanarius virescens* were mainly found on fine sand with underlying and outcropping reef rock areas and *Clibanarius virescens* was common among seagrass covered rocky reefs. *D. avarus* mostly occurred in muddy areas with shallow water estuaries in North western region.

**Table 3.** Occurrence of hermit crabs in the coastal habitats in the Western coast

Hermit Crab species	Habitat types
<i>Coenobita cavipes</i>	Supra littoral sand and scrubs
<i>Diognes avarus</i>	Shallow water estuarine habitats
<i>Clibanarius longitarsus</i>	Shallow water mangrove habitats
<i>Clibanarius virescens</i>	Intertidal reef flats
<i>Calcinus laevimanus</i>	Intertidal reef flats
<i>Calcinus gaimardii</i>	Intertidal reef flats
<i>Dardanus lagapodes</i>	Intertidal Rocky pools
<i>Calcinus areolatus</i>	Intertidal Rocky reef crest



## Shell utilization by hermit crabs

Twenty seven different gastropod shell types were occupied by the hermit crabs. Empty shell of *Telescopium telescopium* was the most widely used shell by estuarine hermit crabs. Land living hermit crab, *C. cavipes* used empty shell of invasive alien mollusk *Achatina fulica* and *Thais bufo*.

**Table 4.** Empty shell were utilized by hermit crabs along the study sites in western coast of Sri Lanka

Site	Hermit crab species	Shell types used
Kalpitiya	<i>Clibanarius longitarsus</i>	<i>Terebralia palustris</i> , <i>Pugilina cochlidium</i> <i>Turbinella pyrum</i>
	<i>Diogenes avarus</i>	<i>Cerithedia</i> sp., <i>Laeviscala pyramidalis</i> <i>Truncatella</i> sp.
Chilaw	<i>Clibanarius longitarsus</i>	<i>Terebralia palustris</i> , <i>Telescopium telescopium</i> , <i>Turritella acutangula</i>
	<i>Diogenes diogenes</i>	<i>Turritella acutangula</i> , <i>Turritella nivea</i> <i>Sunum concavum</i> , <i>Pisanio pusio</i>
Negombo	<i>Clibanarius longitarsus</i>	<i>Telescopium telescopium</i> , <i>Terebralia palustris</i> , <i>Pteropurpura macroptera</i>
	<i>Diogenes avarus</i>	<i>Cerithedia</i> sp., <i>Truncatella</i> sp.
Maggona	<i>Clibanarius longitarsus</i>	<i>Telescopium telescopium</i>
	<i>Coenobita cavipes</i>	<i>Achatina fulica</i> <i>Thais bufo</i>
Beruwala	<i>Clibanarius virescens</i>	<i>Thais luteostoma</i> , <i>Clypeomorus</i> sp. <i>Tympanotonus fuscatus</i>
	<i>Calcinus gaimardii</i>	<i>Thais luteostoma</i>
	<i>Calcinus laevimanus</i>	<i>Thais luteostoma</i> , <i>Clypeomorus</i> sp.
	<i>Calcinus areolatus</i>	<i>Proclava</i> sp.
	<i>Dardanus lagapodes</i>	<i>Mancinella alouina</i>
	<i>Coenobita cavipes</i>	<i>Achatina fulica</i> , <i>Thais bufo</i> , <i>Babylonia formosae</i> , <i>Neverita</i> sp., <i>Triphora perversa</i> <i>Trochus maculatus</i> , <i>Rhinoclavis asper</i> <i>Calliostoma gloriosum</i> , <i>Umbonium gigantum</i> , <i>Tympanotonus fuscatus</i>
Aluthgama	<i>Coenobita cavipes</i>	<i>Achatina fulica</i> , <i>Thais bufo</i>

## Discussion

This study recorded the species diversity and some ecological aspects of hermit crabs found in the Western coast of Sri Lanka. *C. longitarsus* was the most abundant species found among estuarine mangrove habitats. According to Vine (1986) *C. longitarsus* is typically found in mangrove habitats. They were abundant in mangrove areas of Indo-Pacific ocean regions (Khan 1992; Mclaughlin 2003), Quirimba Islands in Mosambique (Barnes 1997), Red Sea Coast in Egypt (El-Wakeil *et al.* 2009), Gulf of Oman in Iran (Moradmand & Sari 2007) and Kenyan coastal areas (Reay & Haig 1990). *D. avarus* was abundant in very shallow estuarine waters. This agreed with Kohn (2003), who indicated that *D. avarus* is typically found in inshore of the Inter-tidal flats.

Only *C. virescens* was found among the sea grasses at Beruwala rocky reef. According to Reay & Haig (1990), Moradmand & Sari (2007) *C. virescens* can be seen in intertidal rocky reefs. *C. virescens*, *C. laevimanus*, *C. gaimardii*, *D. lagapodes* and *C. areolatus* species were found in intertidal rocky reef in Beruwala. *C. gaimardii* were observed among the brown algae that covered the reef flat in seaward side and some individuals were also observed in tide pools. This observation also agreed with Reay & Haig (1990). In Kenyan coastal areas *C. gaimardii* observed in seaward side reef crest or tide pools of lower shore hard substrates. According to Mclaughlin (2003) *C. gaimardii* were abundant on eulittoral rock platforms which adjacent to sand areas in West Indian Ocean to Central Pacific Oceans.

In the present study *D. lagapodes* was observed only in very shallow tide pools which not exceed 5 cm depth. These reef areas were covered with sea grasses. Barnes (1997), who studied in Quirimba Islands in Mosambique also observed this pattern of distribution. Barnes (1997) stated that *D. lagapodes* species occurred in the lower regions of the sea grass meadows. According to Reay & Haig (1990) This species is common in hard substrates of the shallow sublittoral, including coral heads of lagoons in Kenyan coastal areas. Also similar pattern of distribution recorded from Red sea coast in Egypt (El-Wakeil *et al.* 2009) and Indo-Pacific regions by Mclaughlin (2003). However, in the present study *D. lagapodes* was not observed in estuarine environments.

*C. laevimanus* was observed around the deep tide pools which exceed the 50 cm depth and occasionally they co-occur with *C. virescens* among the sea grasses in Beruwala rocky reef. According to Reay & Haig (1990) in Kenyan coastal areas *C. laevimanus* were particularly common and conspicuous on inter-tidal hard substrates co-dominance with *C. virescens*. Also present results agreed with Barnes (1997) and Mclaughlin (2003) in Quirimba Islands in Mosambique and West Indian ocean to Central Pacific ocean respectively.

*C. cavipes* was observed along the land side of the coast of Beruwala, Maggona and Aluthgama. They were observed in open beach areas that were covered by domestic wastes and terrestrial vegetation. The distribution pattern of *C. cavipes* observed in the present study is in agreement with with Reay & Haig (1990) for Kenyan coastal areas, Barnes (1997 & 1999) for Quirimba Islands in Mosambique, Khan (1992) for Parangipettai Coast in India and Mclaughlin (2003) for West Indian and West Pacific Oceans.



According to our results hermit crabs used 27 types of empty gastropod shells. Abundance and distribution of hermit crabs depend on the availability of empty mollusk shells in their habitats. According to Barnes (1999) host shell seems to act as a limiting factor on population growth. Comparatively lower number of empty gastropod shells was observed in Kalpitiya, Chilaw and Negombo sites. It may be the reason for low diversity of hermit crabs observed in those sites. According to our results the highest species diversity of hermit crabs was found in Beruwala and it may related to the higher abundance of empty mollusk shells.

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