Crustacean as bycatch of tuna gillnet fishery of Pakistan

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ABSTRACT

Crustaceans are not commonly found as bycatch of commercial fishing operations in offshore waters. Studies carried out under the WWF-Pakistan's Crew Based Observer Programme conducted between 2012 and 2019 revealed that mud crab (*Scylla spp.*) and slipper lobster (*Thenus spp.*) are frequently caught in the tuna gillnets. Female mud crabs are known for their offshore migration for spawning and during their migration, these females are occasionally seen in the catches of tuna gillnets. Although slipper lobsters of genus *Thenus* inhabit comparatively shallow waters to a maximum of 100 m and are not known to be for spawning migration. Still, the present paper reports frequent occurrences of berried females in offshore waters and are caught in the tuna gillnets. The present provides information about the spatial distribution of the mud crab and slipper lobster in the coastal and offshore areas of Pakistan.

INTRODUCTION

Pakistan has a large tuna gillnet fisheries consisting of about 7000 large vessels (> 20 m) that operate in the offshore waters along the Pakistan coast, the Exclusive Economic Zone of Pakistan, Area beyond National Jurisdiction and in the waters of some other countries. This is addition to a large number of smaller gillnet vessels which operate in coastal waters, lagoons and the Indus Delta and sometime catch neritic tunas. The operation of tuna gillnets are known to be marred with high bycatch including ETP species (Moazzam, 2022a, Moazzam and Khan, 2019, Moazzam and Nawaz, 2014).

Crustaceans are not known to be an important bycatch of tuna gillnet operations, however, formation collected through the WWF-Pakistan Crew Based Observer Programme (2012-2019) revealed that small quantities of some crustaceans are also found in the catches of the tuna gillnets. The present paper provides information about such crustaceans which are frequently caught in gillnet operations of the fishing vessels of Pakistan.

MATERIAL AND METHODS

The information presented in the present study is based on the interaction with fishermen that are engaged in gillnet fishing for tuna and tuna like species in coastal and offshore waters of Pakistan. WWF-Pakistan Crew Based Programme is the major source of the data presented in this paper (Moazzam, 2019, 2022b).

RESULTS AND DISCUSSIONS

There are a number of crustacean species that are commercially harvested in coastal countries globally mainly for human consumption. Pakistan also has substantially large crustacean fisheries which target shrimp, lobsters, and crabs for local consumption but primarily for export. These crustaceans are caught mainly in the coastal waters using trawling, bottom-set

gillnets, estuarine set-bag net (ESBN) traps as well as by hand picking. Shrimp is the mainstay of fisheries of Pakistan as it supports is large processing and export industry. Lobsters are mainly harvested through bottom-set gillnetting as well as bycatch of other fisheries and almost entire catch is exported. Crabs are also harvested by many gears including trawling, bottom-set gillnets, estuarine set-bag net (ESBN) traps as well as by hand picking. A major part of the crabs are exported in various forms.

Shrimp

Penaeid shrimps are primarily bottom dwellers and are seldom found in the pelagic environment. During the study only on two occasions, *Fenneropenaeus merguiensis* (De Man, 1888) which is quite unusual because banana shrimps have limited capacity to travel long distances in pelagic environment. On one occasion a shrimp was seen swimming about 70 km (xxx m) from the coastline which was scooped from the water and photographed (Fig. 1). The presence of a free-swimming shrimp at the surface far from the coast is quite unusual. Such shrimp may get entangled in tuna gillnets and other pelagic fishing gear.

Fig. 1. A shrimp (*Penaeus sp.)* was seen swimming about 70 km (xxx m) from the coastline.

Swimming Crabs

Swimming crabs form important fisheries in the coastal area of Pakistan (Moazzam and Osmany, 2023). Crabs of genera *Portunus*, *Charybdis*, and *Scylla* support substantially large fisheries in the coastal areas and shelf waters of Pakistan. Members of these genera are occasionally caught in the tuna gillnet fisheries.

Charybdis* (*Charybdis*) *feriata (Linnaeus, 1758)

This species is commonly known as crucifix crab and found on a few occasions to be entangled in the tuna gillnets. Most of these crabs were found along the continental margin between a depth of 110 and 280 m (Fig. 2). All the observed specimens were non-berried female or undetermined sex (ventral view not observed) indicating that their presence in the offshore waters is not associated with the breeding migration therefore entanglement. *Charybdis (Archias) smithii* Macleay, 1838 (Indian Ocean swimming crab) is another species of genus *Charybdis* known to be abundant in the offshore water Pakistan and the Indian Ocean, however, no specimen of this species was found to be entangled in tuna gillnets. Since the mesopelagic

distribution of this species, it was not observed as bycatch in surface and subsurface (2 m below the surface) gillnets in the area.

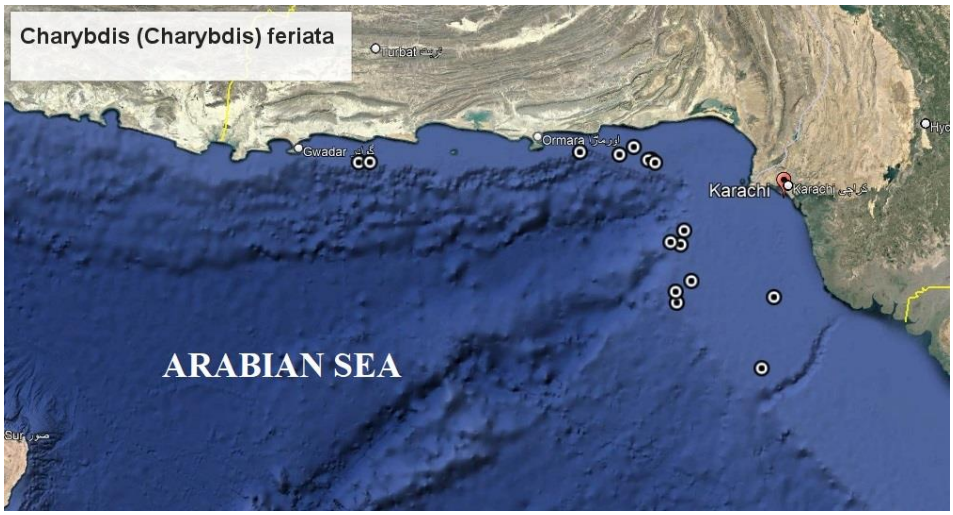

Fig. 2. Area of entanglement of crucifix crab *Charybdis* (*Charybdis*) *feriata*.

Portunus (Portunus) sanguinolentus (Herbst, 1783)

Three-spots swimming crab is known to occur in coastal waters as well as on the continental shelf of Pakistan. There is a large fishery of this species which is primarily based on its harvesting from offshore waters along Indus Delta and along sandy-cum-muddy stretches on the continental shelf along the Balochistan coast. This species was observed to be frequently entangled in the tuna gillnets along the Pakistan coast. Both males and females were observed in the bycatch, however, no berried female was observed which tends to suggest that their presence in offshore pelagic environment is not associated with breeding migration. This species was found entangled in tuna gillnets all along the offshore continental shelf and continental margin areas (Fig. 3). Major area of entanglement was observed to be off the Phor, Sapat, and Kund Malir area which is one of the main fishing ground of three-spot swimming crab. Bathymetric distribution of entanglement indicates that this species may entangle where the depth was less than 100 m. (67 m to be the minimum) near off Karachi to a maximum depth of 2,627m in the Murray Ridge area. Another species *Portunus* (*Portunus*) *segnis* (Forskål, 1775) which is commonly known as the African blue swimming crab is abundantly found along the coast of Pakistan, however, was not observed as bycatch of tuna gillnet operations. This may be because of the comparatively shallower water distribution of this blue swimming crab.

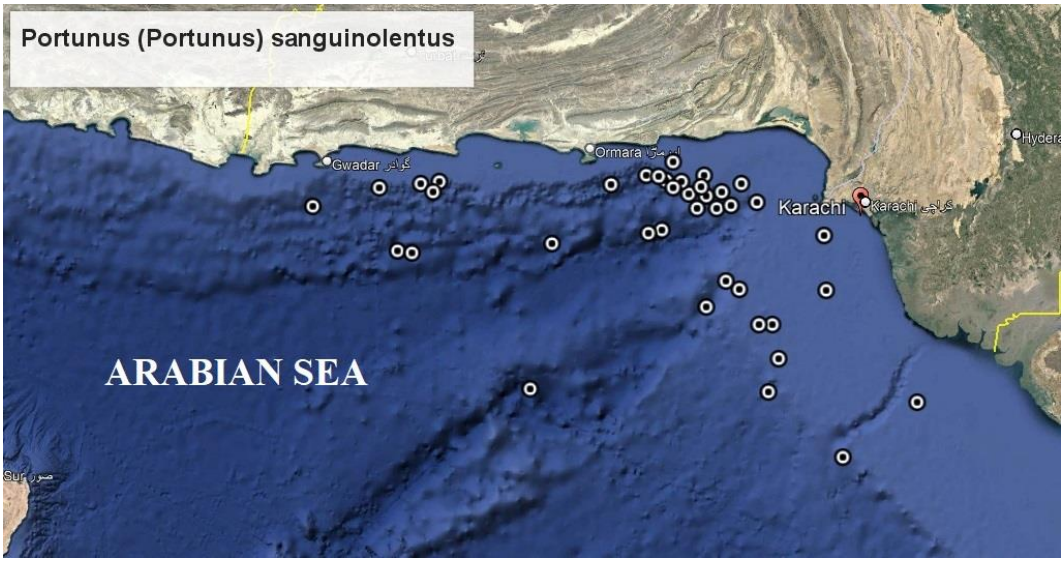

Fig. 3. Area of entanglement of three-spots swimming crab *Portunus (Portunus) sanguinolentus*.

Scylla serrata Complex

Mud crabs are known to be represented by *Scylla tranquebarica* (Fabricius, 1798), *Scylla olivacea* (Herbst, 1796) and *Scylla serrata* (Forskål, 1775) which are mainly caught in the coastal waters, lagoon, mangrove habitats and from the mudflats of the Indus Delta. Mud crabs are usually not found along the open coastline. Mud crabs use different habitats according to their life stage and sex. Estuaries, deltas, and mangrove areas are the main residence of juveniles, subadults and adults during most of their lifespan (Adnan, 2023; Alberts-Hubatsch *et al*., 2016; Charles *et al*., 2024; Demopoulos *et al*., 2008; Hill *et al*., 1982). In most of the area of its distribution, ovigerous females of mud crabs are known to leave estuaries and mangrove areas and migrate seawards towards deeper ocean parts to release eggs (Hewitt *et a*l., 2022; Hill, 1994). Mustaquim *et al.* (2001) also reported 3 ovigerous females from Pakistan.

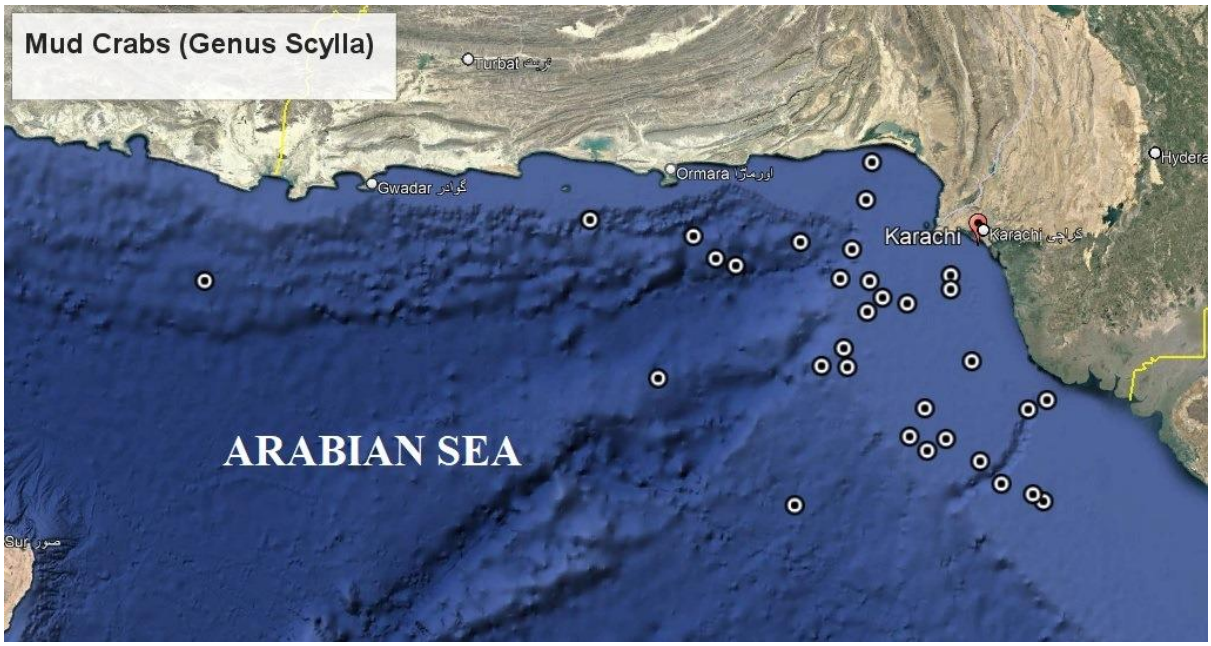

Fig. 4. Area of entanglement of mud crab Genus *Scylla.*

Fig. 5. Berried mud crab (Genus *Scylla*) left: Maturing eggs; Right: Matured eggs

The species identification of mud crabs was not done because of difficulty in observing identification characters such as spines on appendages etc. Entanglement of berried females is

frequently observed during the present study. The depth of the sea, at the location of the entangled mud crab, was found to be between 42 m to 1,836 m. Since the tuna gillnets are placed on the surface or subsurface (2 m. below the surface) it indicates that the females were in the process of migration. Maturing (eggs usually orange) matured (black because of eyes of zoea), or spent (after releasing eggs). Most of the entanglements of the mud crabs were reported on the outer continental shelf facing the Indus Delta which tends to suggest that females who inhabit on the mudflats and mangrove habitat of the Indus Delta migrate offshore along the Sindh coast. The other area where mature females were found was in the Sonmiani Bay which faces Miani Hor, another area known for mangroves and mudflats.

Charles *et al*. (2024) did not detect any female crabs returning to the estuaries once they had migrated to sea, which tends to suggest that the seaward movements of female mud crabs represent a "terminal compensatory spawning migration". In the present study, we have noticed that some spent crabs are heavily encrusted with epibionts; mostly pedunculate and sessile barnacles (Fig. 6) which indicates that females are no longer moulting and may die after spawning.

Fig. 6. Spent female mud crabs heavily encrusted with epibionts

Ocean and coastal waters are short-term habitats for the earliest pre-settlement larval (zoea) of mud crabs (Alberts-Hubatsch et al., 2016) and post-larval (megalopae) stages, before larvae metamorphose into the first instar (crablets) and enter estuaries, mudflats and mangrove habitats (Webley and Connolly, 2007).

Slipper Lobster- *Thenus* Leach 1816

Thenus Leach, 1815, belongs to the family Scyllaridae and considered to be a monotypic genus, with only *T. orientalis* (Lund, 1793), however, Burton and Davie (2007) identified five species; of which four species including *Thenus indicus* Leach, 1816 , *Thenus orientalis* (Lund, 1793), *Thenus parindicus* Burton and Davie, 2007 and *Thenus unimaculatus* Burton and Davie, 2007are known to have distribution in the Arabian Sea including the coast of Pakistan. Genus *Thenus* is a commercially significant species and is a component of many demersal trawl and gillnet fisheries operating in shallow coastal waters in the tropical Indian and Western Pacific regions (Burton and Davie, 2007). This species was observed to be most dominating

crustacean found as bycatch of tuna gillnet fishing (Fig. 7). The species identification of slipper lobster of genus *Thenus* was not done because of difficulty in observing identification characters such as marking on the appendages etc.

Fig. 7. Berried Slipper lobster (Genus *Thenus*) in commercial catches of tuna gillnets

Entanglement of berried and spent females is frequently observed during the present study (Fig. 8). The depth of the sea, at the location of the entangled mud crab, was found to be between 32 m to 2,804 m. Since the tuna gillnets are placed on the surface or subsurface (2 m. below the surface) it indicates that the female slipper lobster was in the process of migration. No record of migration of female to deeper water is known and their presence in pelagic environments is interesting. Maturing (eggs usually orange) were observed to be most dominating whereas matured (black because of eyes of zoea), or spent (after releasing eggs) were seldom observed. No male was, however, observed during the present study. Most of the entanglements of the mud crabs were reported along the upper part of the Indus Swatch (Canyon) and the shallow water along the continental shelf facing the Indus Delta and Miani Hor Genus *Thenus* is known to inhabit the upper continental shelf area along the coast and seldom enter in the estuarine area or mangrove swamps. The other area where mature females were found was in the along Balochistan coast.

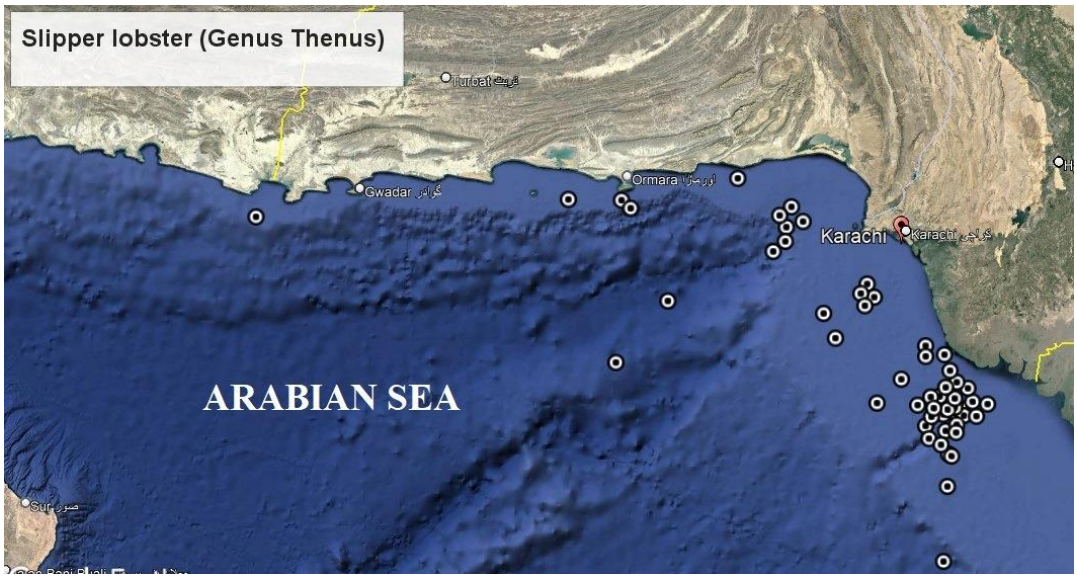

Fig. 8. Area of entanglement of slipper lobster Genus *Thenus.*

CONCLUSION

Crustaceans, as a bycatch of tuna fishing operations, are not studied in other parts of the Indian Ocean. It would be interesting to investigate this issue mainly because of the variety of species involved. It may also help in understanding some aspects of the biology of commercially important species such as slipper lobsters whose migration and presence/abundance in pelagic habitat is not well understood.

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