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Ecological Impacts on Marine Habitats

The Gulf of Mannar Blue Swimming Crab Fishery

A sub project of the Sri Lankan blue swimming crab fishery improvement project

Field Report 2018

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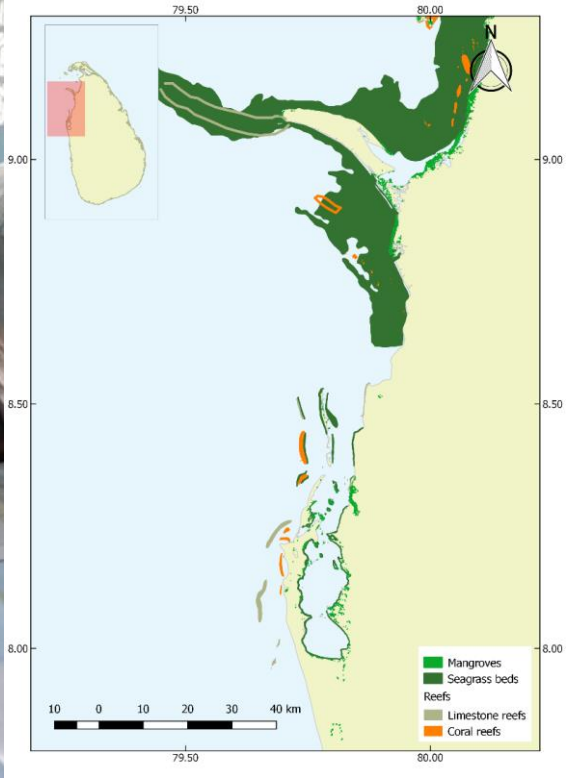

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Executive Summary

In order to understand the impact of the BSC fishery in Gulf of Mannar on marine habitats, data on both fishing grounds and distribution of marine habitats were obtained. These studies were conducted throughout three districts that encompass the Gulf of Mannar (Mannar, Puttalam).

Distribution data on marine habitats were gathered using existing literature, global databases, and community mapping efforts. Fishing ground information was gathered using GPS data of fishing points and community mapping efforts. Seagrass beds showed the greatest distribution in Palk Bay at 68,452 ha, followed by mangroves at 1,919 ha, then coral reefs at 2,598 ha, and limestone reefs at 6,001 ha

The total extent of fishing grounds derived from GPS data amounted to ~24,000 ha. Those derived from community mapping efforts amounted to ~166,000 ha. Both community based fishing grounds and GPS based fishing grounds showed the largest overlap with seagrass beds. Around 13.6% of seagrass beds in Palk Bay overlap with fishing grounds. Coral reefs showed an overlap of 7.31% and limestone reefs showed an overlap of 2.99%. Mangroves showed no overlap with fishing grounds at all.

Based on these results the BSC fishery in the Gulf of Mannar satisfies requirements set out by Seafood Watch California for sustainable fisheries recommendation. As of now, a score of 3.5 can be assigned to this fishery based on two factors: use of bottom-set gillnets and more than 50% of marine habitats being protected from coming into contact with fishing gear.

A. Distribution of marine habitats in Gulf of Mannar

Gulf of Mannar has a considerable amount of different marine habitats such as coral reefs, limestone reefs, seagrass beds, and mangroves.
In order to determine the distribution of marine habitats in fishing grounds of Gulf of Mannar we employed two methods of data collection, these being

1) Analysis of existing (secondary) global and local databases and literature on the distribution of key marine habitats (i.e. mangroves, seagrass and coral / rocky reefs) in the Gulf of Mannar (GoM).

2) Collection of primary data through community mapping exercises, where local knowledge was used to identify the distribution of key marine habitats distribution in the fishing grounds of blue swimming crab (BSC) fishermen in the Gulf of Mannar (Mannar District and Puttalam District)

1) Analysis of existing global and local databases: Existing sources/databases that were used to extract distribution data of marine habitats are listed in the table below. These sources were compiled to create a base map of marine habitat distribution in the Gulf of Mannar.

Table 1: Data sources for marine habitats

Habitat	Source	Data format	Link
Seagrass	Global distribution of seagrass (Version 5.0) by United Nations Environmental Protection program	ArcGIS Shapefile	http://data.unep-wcmc.org/datasets/7
	Bay of Bengal Large Marine Ecosystem Project, 2015	PDF/Print format	
	Marine survey report by Central Environmental Authority (CEA, 1994)	Print format	
Coral Reefs	Global distribution of warm-water coral reefs (Version 2.0) by United Nations Environmental Protection program	ArcGIS Shapefile	http://data.unep-wcmc.org/datasets/1
	Marine survey report by Central Environmental Authority (CEA, 1994)	Print format	
Limestone Reefs	Global distribution of warm-water coral reefs (Version 2.0) by United Nations Environmental Protection program	ArcGIS Shapefile	
	Nishan Perera (Blue Resources Trust)	Personal communication	
Mangroves	Global distribution of Mangroves by United States Geological Survey (Version 1.3)	ArcGIS Shapefile	http://data.unep-wcmc.org/datasets/4

2) Collection of primary data through community mapping: Local knowledge of marine habitats in the fishing grounds of BSC fishermen was used to add information to that existing in local and global databases for key marine habitats in the GoM. Pirmary data was collected using community mapping exercises with fishing communities in all the Fishery Inspector Divisions (FIDs) adjacent to the fishery in Puttalam (06) and Mannar (04) districts. Community mapping exercises were jointly involving several BSC fishing communities in each FID.

The fishermen were asked to indicate where they encountered different marine habitats and sketch their distribution in 1:50,000 scale topographical maps. Once these maps were completed, they were scanned and transferred to the existing database using GIS software. Using these two methods the distribution of marine habitats was mapped in the Gulf of Mannar. Because of the fact that Mannar district has areas belonging to both Gulf of Mannar and Palk Bay, we've divided the district of Mannar along the Mannar peninsular with the bottom half being designated to the Gulf of Mannar and the top half to Palk Bay.

Table 2: Distribution of marine habitats in Gulf of Mannar

Habitat type	Area of distribution in different areas (ha)			
	Sri Lanka	Gulf of Mannar	Puttalam District	Mannar District
Seagrass	343,072	68,452 (20%)	4,132 (6%)	65,600 (14%)
Limestone Reefs	6,076	6,001 (98%)	2,289 (37%)	3,773 (61%)
Coral Reefs	11,704	2,598 (22%)	1,578 (13%)	1,020 (9%)
Mangroves	21,426	1,919 (9%)	1,256 (6%)	751 (4%)

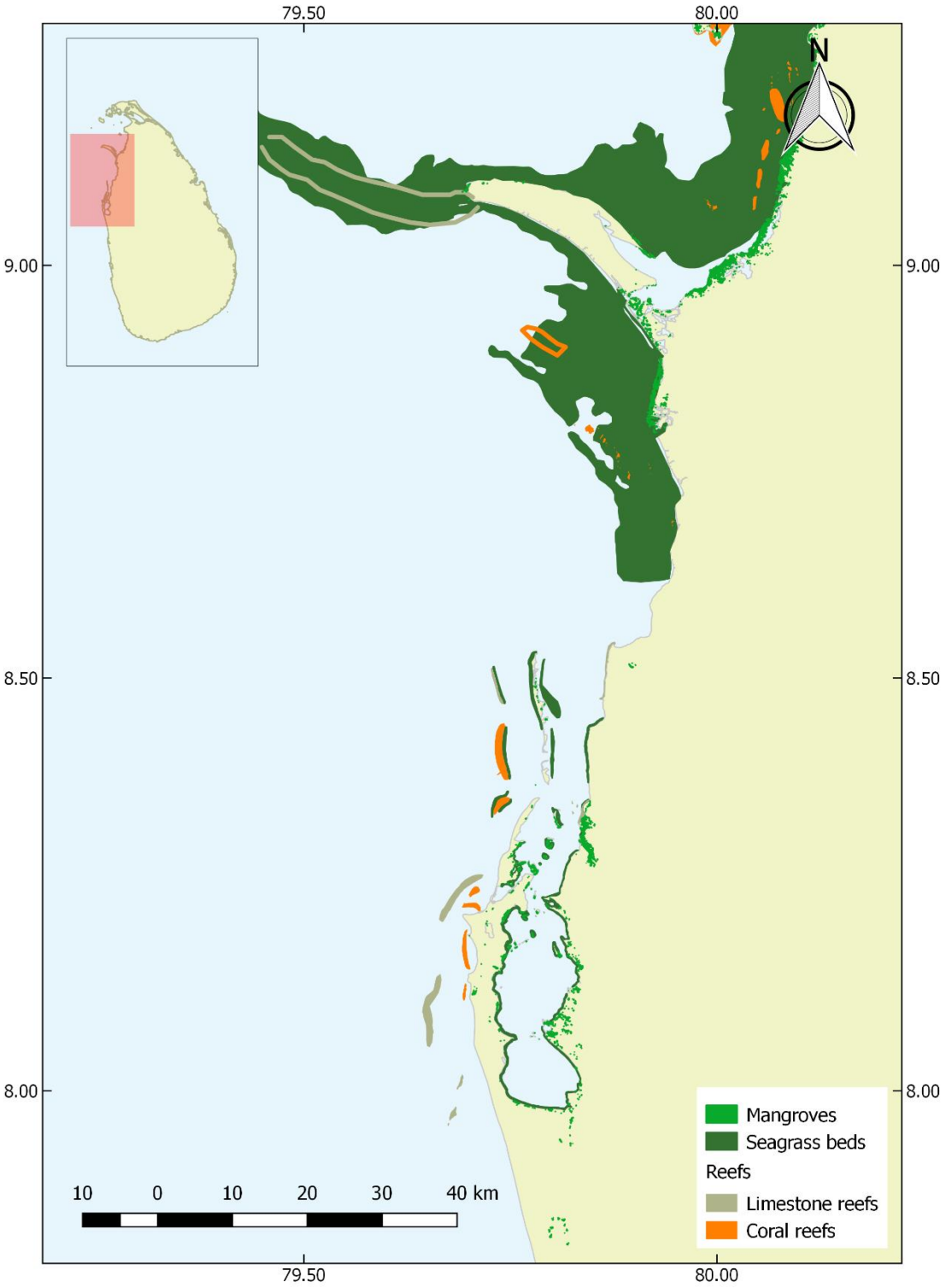

Figure 1: Distribution of marine habitats in Gulf of Mannar

B. Marine protected areas in the Gulf of Mannar

There are several marine protected areas (MPAs) that are found in the Gulf of Mannar. These include

1. Buffer Zone of the Wilpaththu National Park
2. Adam's Bridge National Park
3. Bar Reef Marine Sanctuary
    a. Core Zone
    b. Buffer Zone

Table 3: Protected areas in Gulf of Mannar

Protected Area	Type	Total designated area (ha)	Area that overlaps with Gulf of Mannar (ha)
Bar Reef Marine Sanctuary Core Zone	Sanctuary	6,750	6,750 (100%)
Bar Reef Marine Sanctuary Buffer Zone	Sanctuary	25,657	25,657 (100%)
Vidaththaltivu Nature Reserve	Nature Reserve	28,923	3,009 (10%)
Adams Bridge National Park	National Park	19,024	17,819 (93%)
Wilpaththu National Park	National Park	131,347	29,685 (22%)

Regarding the level of protection granted for these protected areas, National Parks have been granted the highest level of protection. Traditional human activities such as fishing and agriculture cannot be carried out inside a national park and the general public cannot enter their boundaries without a permit issued by the Department of Wildlife Conservation.

Sanctuaries have also been granted a high level of protection though not quite on the level of National Parks. These areas are conserved based on their biodiversity importance and there are some restrictions on carrying out traditional human activities though they aren't clearly mentioned in the legislature. The general public can enter these areas without a permit issued by the Department of Wildlife Conservation.

Nature Reserves are areas conserved for their biodiversity importance but there are no restrictions regarding the continuation of traditional human activities such as fishing and agriculture.

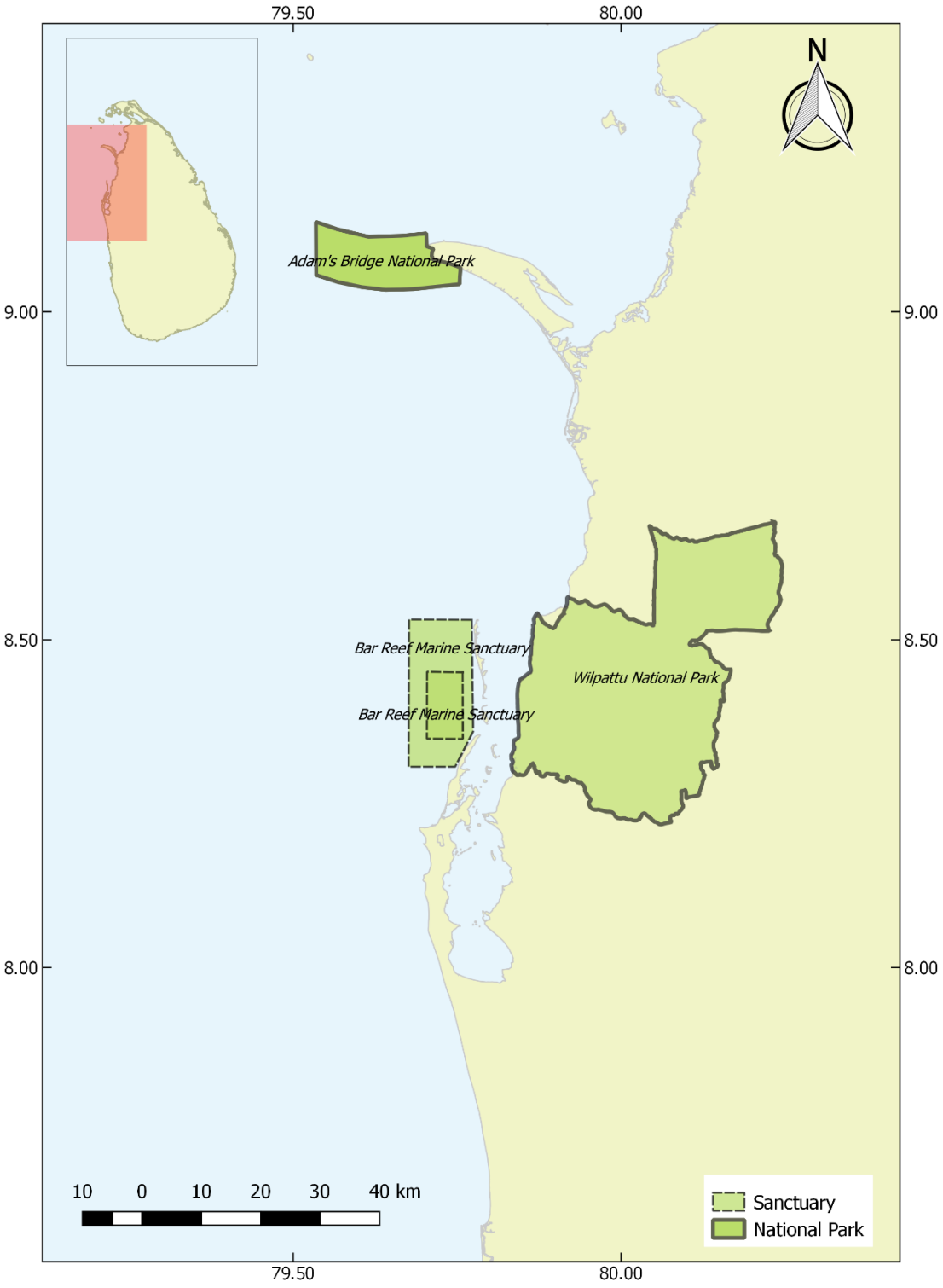

Figure 2: MPAs in Gulf of Mannar

C. Fishing grounds of the Gulf of Mannar BSC fishery

Methodology

Two methodologies were used to determine the fishing grounds of BSC fishermen in the Gulf of Mannar.

1) Global Positioning System (GPS) generated by smartphones loaded with tracking app

2) Community mapping of fishing grounds.

1) Global Positioning System (GPS): Smartphones loaded with GPS tracking application have so far been given to ***seven*** fishing communities in the Gulf of Mannar fishery. Six BSC fishing communities have used the app to track their fishing activities in Puttalam District (i.e. Pukkulam, Baththalangunduwa, Janasaviyapuram, Wannimundel, Ethale and Anakuti. Figure 8 below shows the locations of the ***seven*** fishing communities in the Gulf of Mannar fishery, which have. used the app and generated GPS data to map their fishing grounds.

2) Community mapping of fishing grounds: In response to the continued delay in the commencement of BSC fishing in the northern half of the Gulf of Mannar fishery, due to the extension of the cuttlefish fishing season; technical issues related to digital coverage in some coastal areas and access to the server at the University of Colombo's School of Computing, the collection of community-based maps of fishing grounds commenced at the end of February 2018 (during the stock assessment). Field data collection of BSC fishing grounds for all BSC landing sites in Mannar District was completed in early April. Community-based mapping data for Puttalam District will be completed during the fishery management meetings at the FID in May 2018.

The community-based fishing grounds mapping data adds another layer of spatial information about BSC fishing activities in Gulf of Mannar. This data has been used to provide further insight into the level of interaction between BSC fishing and marine habitats in the fishery.

Results

1) GPS based fishing grounds

Table 4: Areas of GPS based fishing grounds in Gulf of Mannar

District	Fishing Grounds	Community	Area (ha)	%
Mannar	Fishing ground #1	Vankalai	11,569	47%
Puttalam	Fishing ground #1	Baththalangunduwa & Pukkulama	8,902	36%
	Fishing ground #2	Janasavipura	153	1%
	Fishing ground #3	Serakuliya	907	4%
	Fishing ground #4	Soththupitiya & Wannimundei	2,742	11%
	Fishing ground #5	Anakuti	127	1%
Fishery	**Total**		**24,400**	

The total area of all fishing grounds for which GPS data has been collected to date amountato 24,400 ha. The largest fishing ground surveyed so far was the one located South West off Vankalai (47%), in Mannar Distirct. The smallest fishing ground was the one used by Anakuti fishermen within the Puttalam lagoon. Fishermen in Vankalai appears to have a significant fishing area which rivals the size of the joint fishing grounds of Pukkulam and Baththalangunduwa. We have not yet deployed devices in other fishing communities in South Mannar to get a clear idea of where other communities are fishing.

2) Community Based Fishing Grounds: BSC fishing communities operating from landing centres along the south coast of Mannar District identified ten (10) fishing grounds in the Gulf of Mannar Fishery, as shown in Table 4 below and Figure 11 overleaf. The data from the community-based mapping of BSC fishing grounds south of Mannar suggests that the full extent of fishing grounds could be as much as 166,621 ha.

Table 5: Areas of community based fishing grounds in Gulf of Mannar

District	Fishing ground	Community	Area (ha)
Mannar	Fishing Ground #1	Pesalai	2,560
	Fishing Ground #2	Thalupaddu	751
	Fishing Ground #3	Vankalai	115
	Fishing Ground #4	Vankalai	930
	Fishing Ground #5	Vankalai	1,393
	Fishing Ground #6	Arrippu	1,563
	Fishing Ground #7	Arrippu	1,004
	Fishing Ground #8	Silavathurai	828
	Fishing Ground #9	Silavathurai	6,827
	Fishing Ground #10	Silavathurai & Karaddikuli	691
	Total area of Mannar Fishing grounds		16,662
Kalpitiya	Fishing Ground #1	Anawasalai	1,280
	Fishing Ground #2	Anawasalai	400
	Fishing Ground #3	Talawila	1,503
	Fishing Ground #4	Kandakuliya	323
	Fishing Ground #5	Baththalangunduwa	102
	Fishing Ground #6	Baththalangunduwa & Pukkulam	1,723
	Fishing Ground #7	Talawila	1,703
	Fishing Ground #8	Kandakuliya	722
	Fishing Ground #9	Ethale	326
	Fishing Ground #10	Ethale	1,630
	Fishing Ground #11	Baththalangunduwa	305
	Total area of Kalpitiya Fishing grounds		10,017

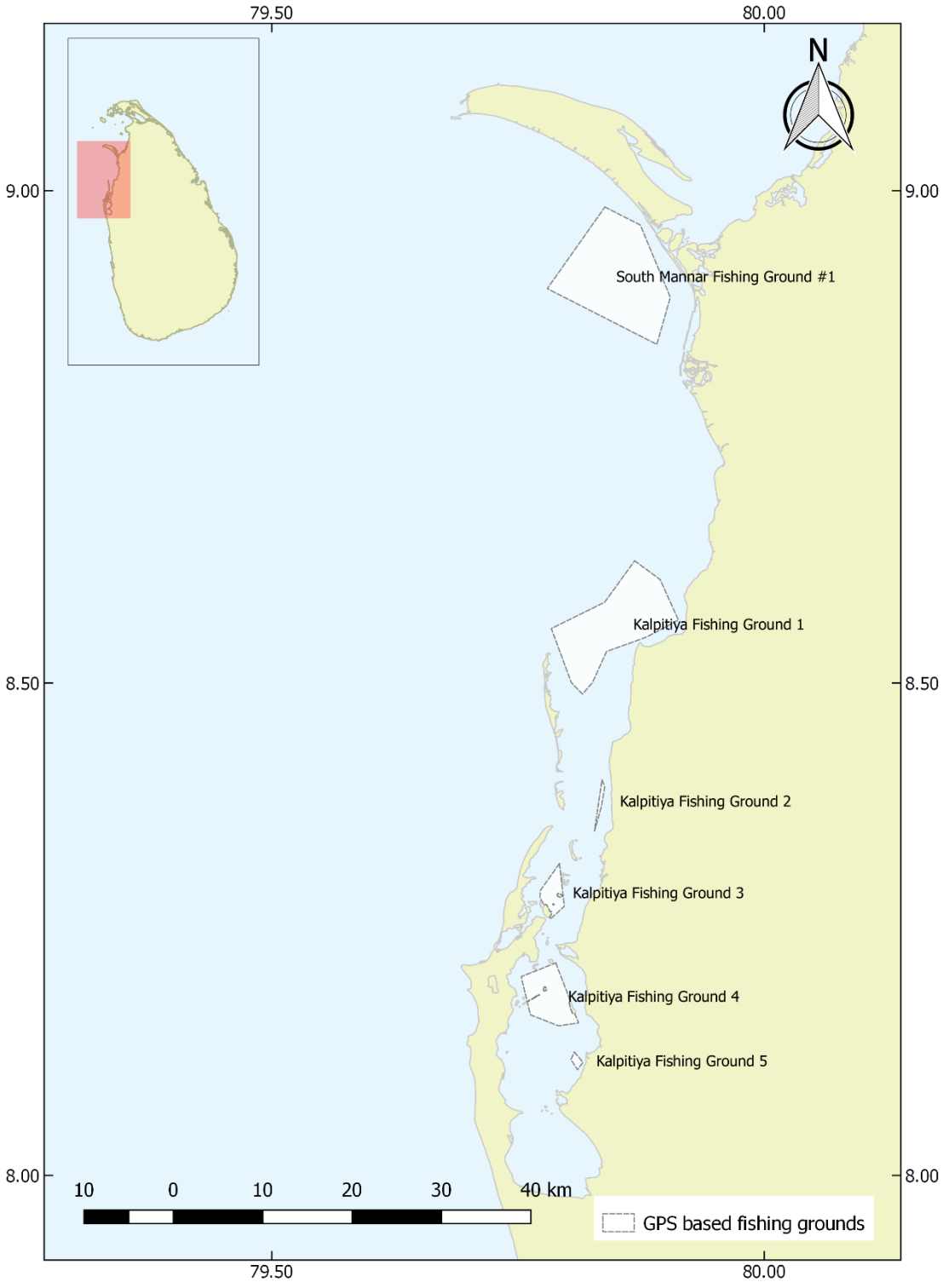

Figure 3: GPS based fishing grounds

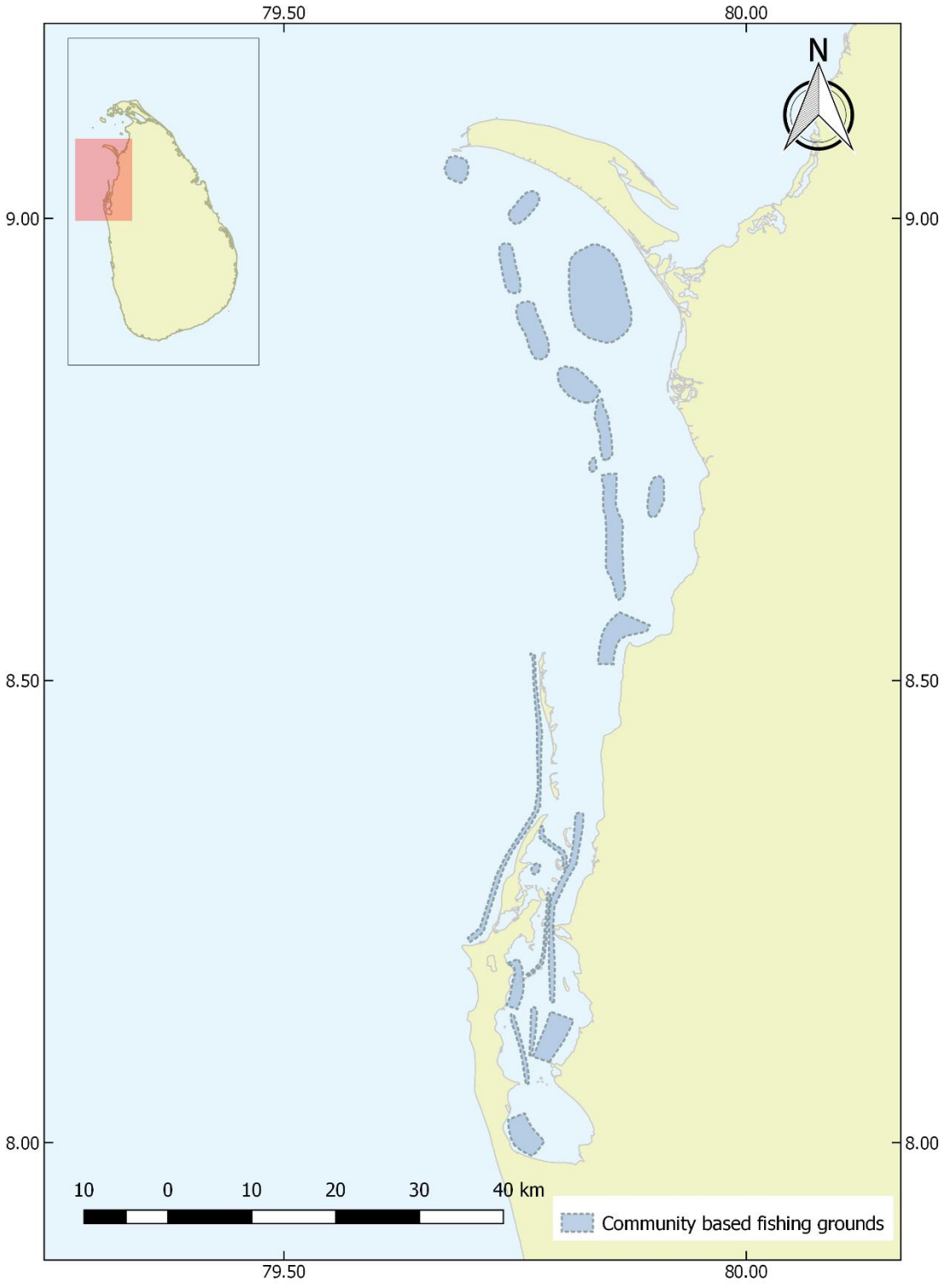

Figure 4: Community based fishing grounds

D. Overlap between fishing grounds and marine habitats

Methodology

The identified fishing grounds from the GPS data and community-based mapping data were then overlapped with marine habitats using the Shapely library for the Python programming language. The potential overlaps of fishing grounds with each key marine habitat was calculated automatically by the programme for the Gulf of Mannar fishery as well by district for the two types of spatial data (i.e. GPS and community-based) described above.

Results

The results of the potential overlap of BSC fishing grounds estimated by using GPS tracking of fishing boat activities and from community-based surveys are presented by marine habitat below.

Mangroves: The GPS tracking data suggests that the BSC fishing crab fishery may interact with as much as 13.56 hectares of mangroves in the Gulf of Mannar fishery (see Table 5). This represents 0.71% of mangroves found in the Gulf of Mannar (1,919 ha see Table 1) and 0.06% of mangroves found in Sri Lanka (21,426 see Table 1). All of the potential interaction is result of BSC fishing in Puttalam District.

The community-based data collected to data corroborates the GPS findings, suggesting that there is no interaction between BSC fishing and mangroves in the Gulf of Mannar fishery. Community-based data has yet to be collected from Puttalam District.

Table 6: Overlap of BSC fishing grounds with mangroves in the Gulf of Mannar

	GPS Data			Community-based Data		
	ha	Gulf of Mannar	National	ha	Gulf of Mannar	National
Gulf of Mannar	**13.56**	**0.71%**	**0.06%**	**0**	**-**	**-**
Mannar District	*0.00*	*-*	*-*	*0*	*-*	*-*
Puttalam District	*13.56*	*0.71%*	*0.06%*	*0*	*-*	*-*

Seagrass: The GPS tracking data suggests that the BSC fishing crab fishery may interact with as much as 11,397 hectares of mangroves in the Gulf of Mannar fishery (see Table 6). This represents 16.73% of seagrass found in the Gulf of Mannar (68,131 ha see Table 1) and 3.33% of seagrass found in Sri Lanka (342,751 see Table 1). 99.8% of this potential interaction is a result of BSC fishing activities tracking in Mannar District (*i.e.* Vankalai).

The community-based mapping data collected from Mannar District is a little lower, but nevertheless consistent with the GPS findings, suggesting that the BSC fishing crab fishery may interact with as much as 9,365 hectares of seagrass in the Gulf of Mannar fishery (see Table 6). This is equivalent to 13.68% of seagrass coverage at the fishery level and 2.73% at the national level.

Table 7: Overlap of BSC fishing grounds with seagrass in Gulf of Mannar

	GPS Data			Community-based Data		
	ha	Gulf of Mannar	National	ha	Gulf of Mannar	National
Gulf of Mannar	**11,397**	**16.73%**	**3.33%**	**9,365**	**13.68%**	**2.73%**
Mannar District	*11,260*	*16.53%*	*3.29%*	*9,277*	*13.55%*	*2.7%*
Puttalam District	*137*	*0.20%*	*0.04%*	*87*	*0.13%*	*0.03%*

Coral reefs: The GPS tracking data suggests that the BSC fishing crab fishery may interact with as much as 479 hectares of coral reefs in the Gulf of Mannar fishery (see Table 7). This represents 5.57% of coral reefs found in the Gulf of Mannar (8,599 ha; see Table 1) and 2.69% of coral reefs found in Sri Lanka (17,780 see Table 1). Again it was the fishing grounds in South Mannar district that contributed the most to this overlap with 5.52% of the total observed overlap with coral reefs being accounted by these fishing grounds. The largest area of coral reef in the Gulf of Mannar is found in Puttalam District in the Bar Reef Marine Sanctuary.

The community-based mapping data collected from Mannar District is a little lower, but nevertheless consistent with the GPS findings, suggesting that the BSC fishing crab fishery may interact with as much as 190 ha of coral reefs in the Gulf of Mannar fishery (see Table 7), equivalent to 7.31% at the fishery level and 1.62% at the national level.

Table 8: Overlap of BSC fishing grounds with coral reefs in the Gulf of Mannar

	GPS Data			Community-based Data		
	ha	Gulf of Mannar	National	ha	Gulf of Mannar	National
Gulf of Mannar	**479**	**5.57%**	**2.69%**	**190**	**7.31%**	**1.62%**
Mannar District	*475*	*5.52%*	*2.67%*	*133*	*5.11%*	*1.13%*
Puttalam District	*4*	*0.05%*	*0.02%*	*57*	*2.2%*	*0.49%*

Limestone reefs: The GPS tracking data suggests that the BSC fishing crab fishery may interact with 4 ha of limestone reefs in Gulf of Mannar. The only area in which fishing grounds interacted with limestone reefs was within the Puttalam lagoon. This corresponded to 5.57% of limestone reef coverage in the Gulf of Mannar and 2.69% of limestone cover nationally.
Community based fishing grounds on the other hand overlapped with 181 ha of limestone reefs. This corresponded to 2.99% of limestone reef coverage in Gulf of Mannar and 3.00% nationally. Both the overlap percentages for GPS based fishing grounds and community mapped fishing grounds showed less than 10% overlap with limestone reefs.

Table 9: Overlap of BSC fishing grounds with limestone reefs in the Gulf of Mannar

	GPS Data			Community-based Data		
	ha	Gulf of Mannar	National	ha	Gulf of Mannar	National
Gulf of Mannar	**4**	**0.07%**	**0.07%**	**181**	**2.99%**	**3.02%**
Mannar District	*4*	*0.07%*	*0.07%*	*173*	*2.85%*	*2.89%*
Puttalam District	*-*	*-*	*-*	*8*	*0.14%*	*0.13%*

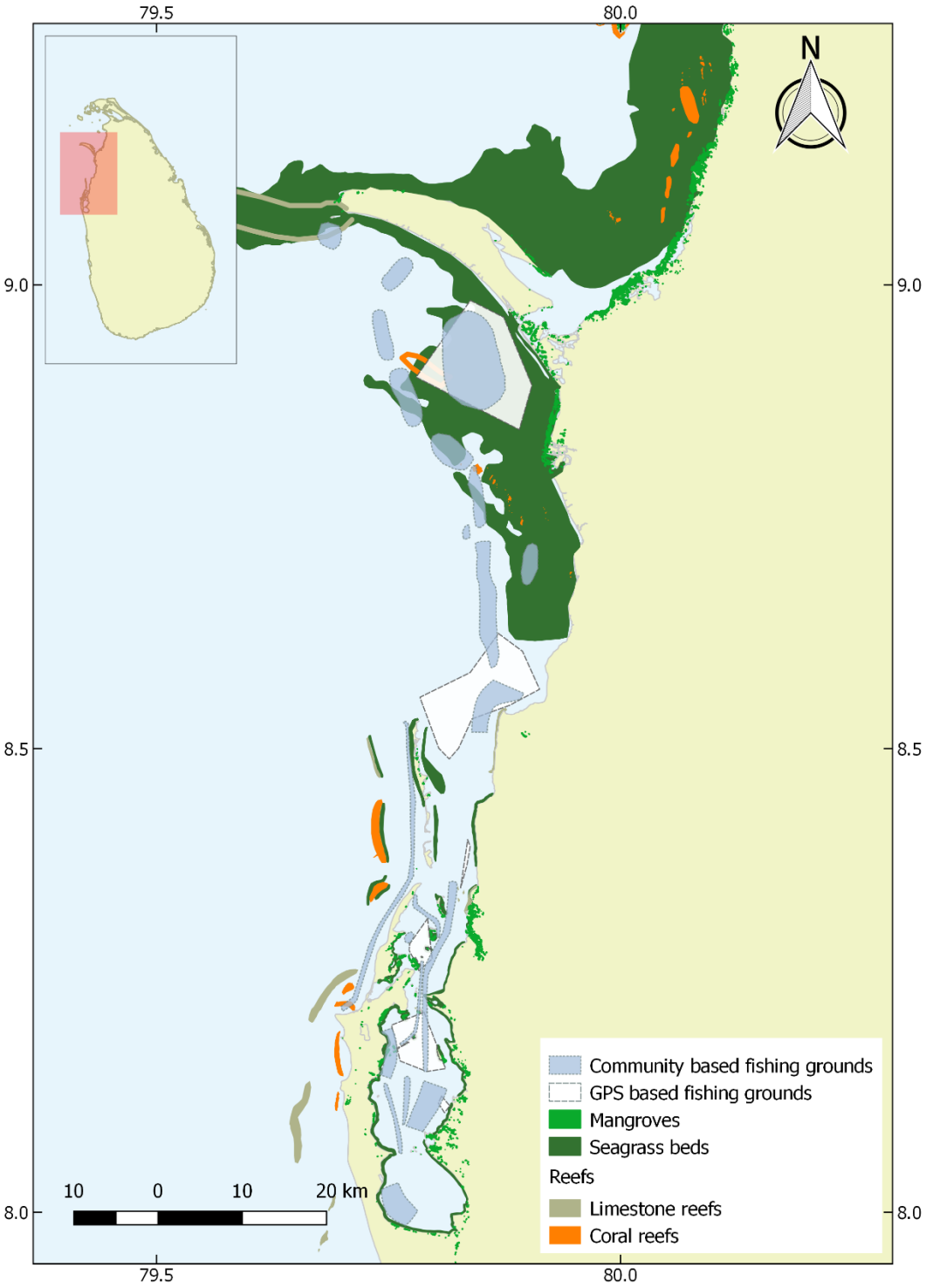

Figure 5: Overlap between marine habitats and fishing grounds

E. Overlap between fishing grounds and MPAs

Marine Protected Areas: The GPS tracking data suggests that the BSC fishing crab fishery does not interact with marine protected areas (MPAs) in the Gulf of Mannar (see Table 8). Marine Protected Areas in the Gulf of Mannar include the Bar Reef Marine Sanctuary, a portion of the Adam's Bridge National Park, and the Buffer Zone of the Wilpattu National Park.

Community based fishing grounds from in Kalpitiya showed an overlap of 530 ha (2.07%) with the buffer zone of the Bar Reef Marine Sanctuary. One fishing ground from South Mannar showed an overlap of 691 ha (3.88%) with the Adam's Bridge National Park.

Table 10: Overlap of BSC fishing grounds with MPAs in the Gulf of Mannar

Protected Area Type	Name	Overlap with Kalpitiya Fishing Grounds (ha)	Overlap with Mannar Fishing Grounds (ha)
Sanctuary	Bar Reef Marine Sanctuary Core Zone	*0 (0%)*	*0 (0%)*
	Bar Reef Marine Sanctuary Buffer Zone	*530 (2.07%)*	*0 (0%)*
Nature Reserve	Vidattalthivu Nature Reserve	*0 (0%)*	*0 (0%)*
National Park	Wilpaththu National Park	*0 (0%)*	*0 (0%)*
	Adam's Bridge National Park	*0 (0%)*	*691 (3.88%)*

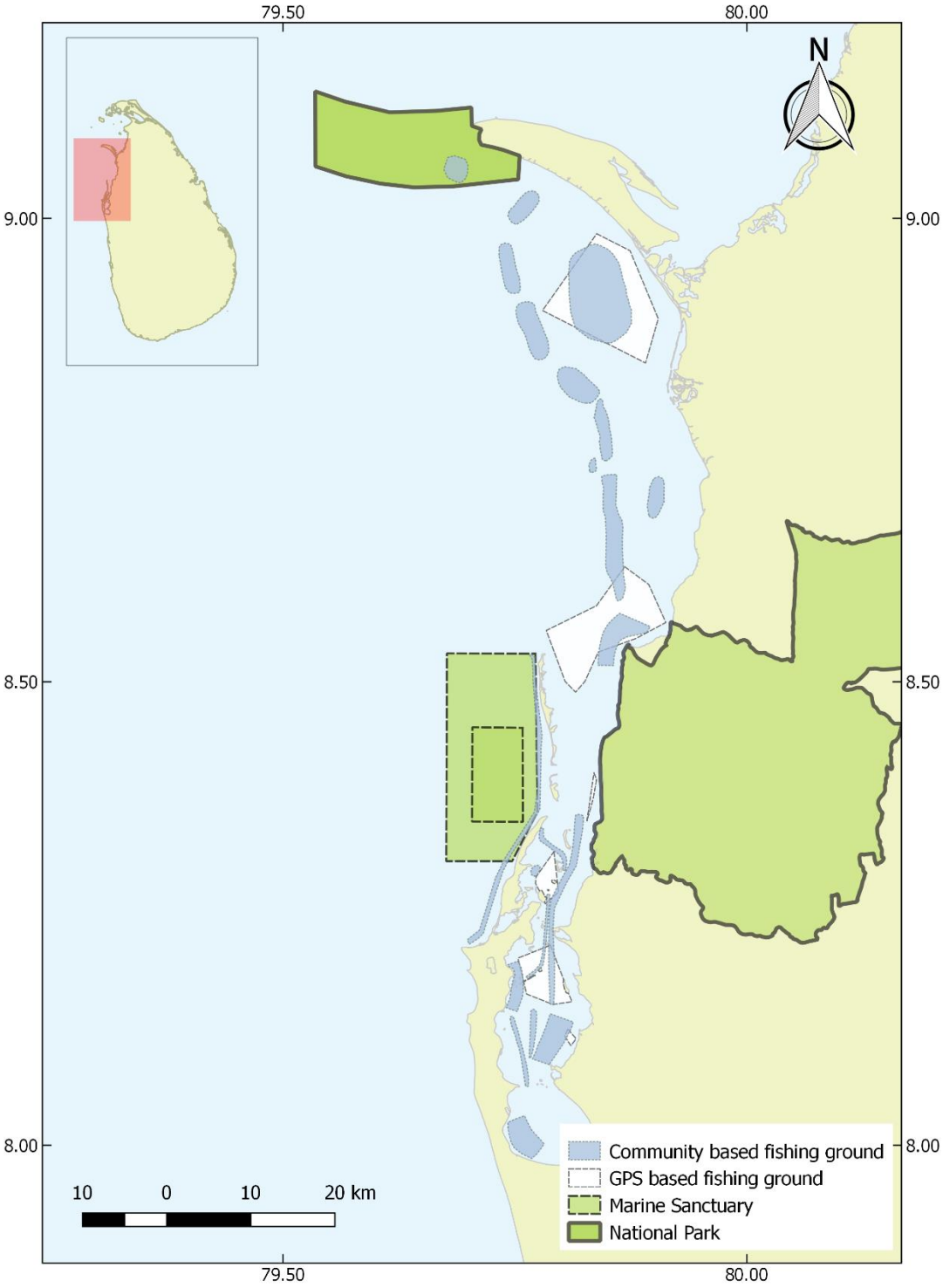

Figure 6: Overlap between fishing grounds and MPAs

Conclusion

The observations from the tracking GPS for the blue swimming crab fishery of the Gulf of Mannar and the recent collection of community-based fishing data shows low (<20%) potential overlap with the marine habitats of the area. The highest level of observed overlap was shown between fishing grounds and seagrass beds (16.7% for GPS data and 13.6% from community based data) in the Gulf of Mannar Fishery). The shallow, nutrient rich waters south of Mannar Islands are a perfect habitat for seagrass, which is exemplified by the extensive seagrass beds as shown in Figure 12. The results of the GPS and community-based fishing ground surverys in the Gulf of Mannar indicated a low (<20%) to very low (<5%) interaction between the fishery and key marine habitats in the Gulf of Mannar. Based on GPS data there were no evident on fishermen setting their nets within the MPAs, however 2 community mapped fishing grounds showed some overlap with protected areas though the overlap was minimal (<10%)

In Puttalam District bottom set crab nets used in the fishery are mainly set within the Puttalam Estuary (i.e. Puttalam Lagoon, Dutch Bay and Portugal Bay). The majority of coral / rocky reefs in the district are located outside the estuary. Bottom-set nets are not set close to the shore, in very shallow (<2m), where mangroves are ubiquitous. Bottom-set nets are set middle of the Puttalam Lagoon, Dutch Bay, and Portugal Bay where the chance of interacting with seagrass beds is also very low.

Based on these results, the BSC fishery in the Gulf of Mannar qualifies for a score in excess of 3.2 on the Seafood Watch assessment criteria. Since the fishery operates using bottom-set gillnets, that automatically gives it a score of +3. And based on these results, less than 50% of all marine habitats are affected by fishing gear. This gives it a score of +1 which amounts to a total of 4.
This is the highest level of sustainability attainable on the Seafood Watch recommendation program.