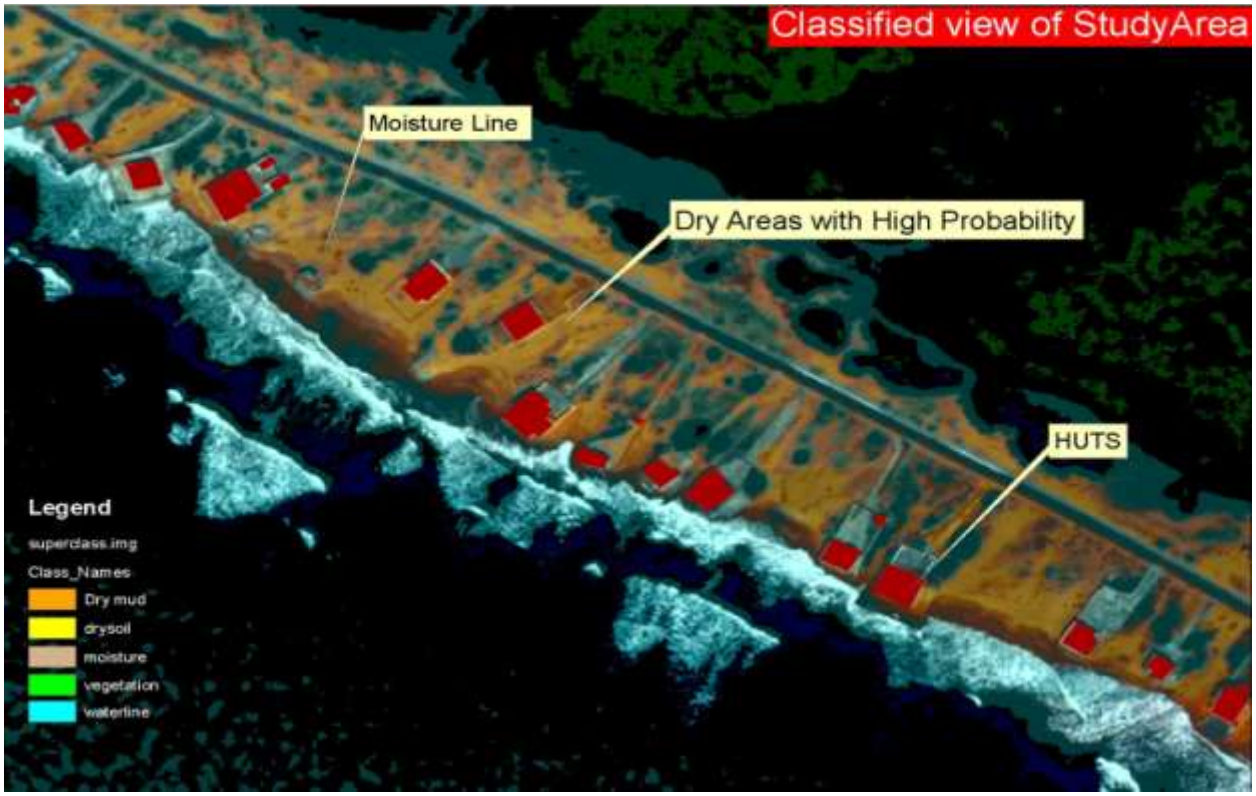
Assessing the habitat suitability for specie habitation

Case Study: Sandspit/Hawksbay Coastal Ecosystem as a Turtle Nesting Habitat



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ABSTRACT

Though green turtles enjoy a protected status in Pakistan, the Karachi beaches, where virtually all marine turtle nesting occur do not enjoy a protected area status. This is a serious hindrance in sustainable preservation of the habitat as it relates to regulating beach development and placing adequate environmental safeguards. The *Paper* documents research conducted by the *Author* during the course of two separate projects looking into establishing critical linkages between the researched habitat and species survival. There is an assessment of according the habitat protected area designation within the framework of a protected area management plan. Findings are shared of the use in the research of the *Geographic Information System (GIS)* for data mapping and processing for visualizing interactions between turtle nesting and the physical/environmental beach attributes. The product aims to assist in establishing the scientific basis for monitoring changes and impacts over time and for implementing strategic management.

Introduction

The *Paper* is sourced from the findings and assessment of two separate projects that broke new ground in marine turtle related research in Pakistan in that they went beyond the focus on the specie itself to the wider context within which it performs certain key activities of its lifecycle – the sustaining habitat. The project objectives originated from the premise that in the absence of protective legislative instruments and environmental safeguards, the potential for greater harm to sustaining turtle nesting processes stems more from the changes taking place within the turtle habitat in terms of un-regulated beach development and possible natural phenomenon altering the coastal/beach ecology then from directly targeted threats such as predators, poaching etc.

The project *Helping the Turtles Survive*, funded under the *Global Environment Facility (GEF)*, administered by the *United Nations Development Program (UNDP)* office in Pakistan and executed by the not for profit organization *Shehri-Citizens for a Better Environment (2004-05)* assessed the feasibility of according the turtle habitat at the Sandspit/Hawksbay beaches a protected area designation. The ecological values and functions of the projects area's turtle habitat were highlighted in detail to develop the case for a protected area designation. Various protected area options were subjected to a comparative analysis to identify the most relevant and best available options. In addition to arguing the case for designating a protected area status, a comprehensive protected area management plan framework was also discussed. The project *GIS Mapping of Karachi coast & GIS based analysis of marine turtle habitat: Sandspit/Hawksbay Eco-system,* funded under the *Indus for All Programme's Partnership Fund – WWF Pakistan* and executed by the not for profit organization *Shehri-Citizens for a Better Environment (2009-10)* looked into the establishment of a framework for the storage and retrieval of spatial data *(includes inventory of spatial features and map outputs)* – the GIS map and preparation of a tool which provides the functions to do spatial analysis on the spatial data. This tool was used for gaining an understanding of patterns and processes taking place over a period of time with a particular focus on analyzing critical interactions and linkages between turtle nesting

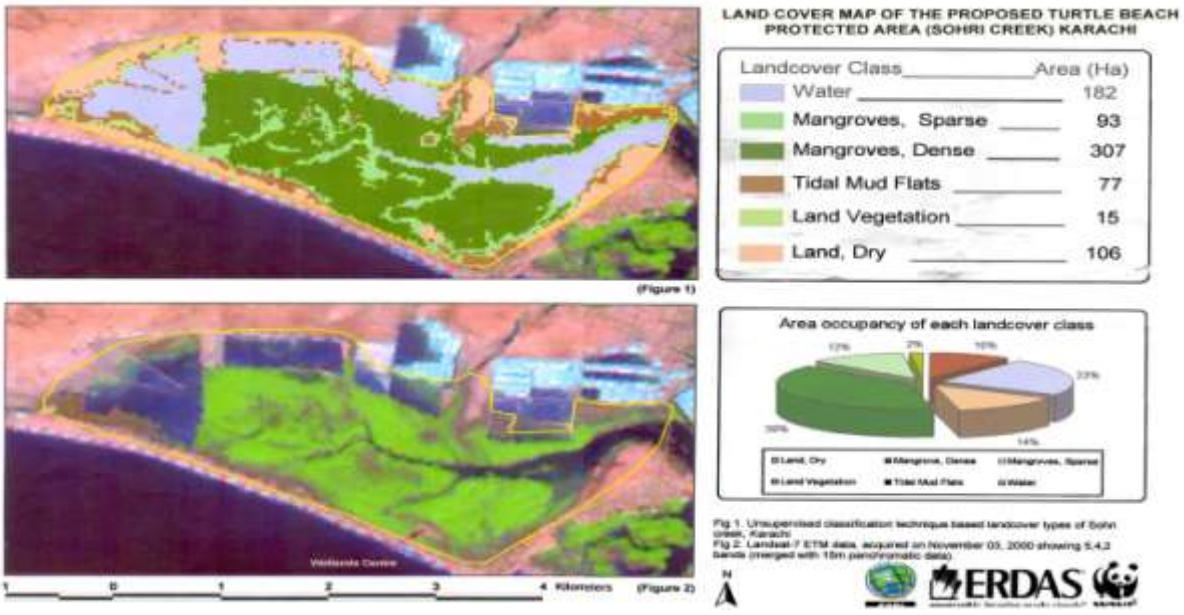
and the physical/environmental beach attributes. The *Author* had the opportunity of conceptualizing, designing and supervising both projects on behalf of *Shehri-CBE.*

While not intentionally or directly linked with each other, these projects do nevertheless revolve around a similar overarching theme that suggests that protecting the habitat and rendering it suitable for turtle nesting is a priority requirement to sustaining the turtle nesting process in the Hawksbay/Sandspit beach eco-system. The findings of the projects relate with and complement each other in that while the project *Helping the Turtles Survive* focuses on analyzing the rationale and justification of according a protected area status for the habitat within what is essentially a management based approach, the project *GIS Mapping of Karachi coast & GIS based analysis of marine turtle habitat: Sandspit/Hawksbay Eco-system,* seeks to establish a scientific bases for detailing and guiding the policy and planning contours of strategic planning and management interventions.

A. The Proposed Turtle Beach Protected Area

In the research that was undertaken in the project *Helping the Turtles Survive,* a landmass of 780 hectares, located in the Sohri Creek, on the Karachi coast and covering part of Sandspit beach and the whole of Hawksbay beach in addition to the backwaters *(sustaining mangrove forestation)* was proposed to be designated as a *Protected Area (see Figure- 1)*. The proposed protected area was termed as the *Turtle Beach Protected Area (TBPA).* Located 24º 47º – 24º 52º N, 66º 50º – 66º 59º E; on the coast southwest of Karachi City, this stretch of the coast lies in between the area west of Karachi Harbor entrance upto Buleji/Paradise Point consists of sandy beaches, which are separated from each other by rocky protruding points. The Hawksbay/Sandspit beaches lie about 15 km south west of Karachi City. They are flanked to the northwest by the Arabian Sea and to the southwest by a dense mangrove forest cover in the coastal backwaters.

Figure -1



Evaluating the case

The case for designating the Sandspit/Hawksbay beaches/adjacent creeks coastal ecosystem as a protected area was principally argued on the basis of it is being a globally significant green turtle nesting habitat. Sea turtles enjoy a protected status in Pakistan, either directly or indirectly through a number of legal and regulatory provisions.

Assessing the ecological status

For ascertaining the value, functions and importance of the *TBPA* as a potential protected area, a particular model and methodological framework for evaluating the ecological status of protected areas developed by *Rudolf S.de Groot* [1]who served as the *Coordinator* of the *Center for Environment and Climate Studies* of the *Wageningen Agricultural University*, Wageningen, the Netherlands was applied.

Based on extensive research, *Rudolf S. de Groot* developed a checklist of functions that can be attributed to natural ecosystems. This checklist was applied to the proposed *TBPA* for identification of its values and functions that indicated that more pronounced in their impact are the regulation and information functions for the *TBPA.* The regulation functions are such that they can be attributed to both protected and unprotected areas, provided that these areas are in largely natural state. The other functions *(carrier, production and information)* are strongly related to specific human needs and objectives.

In case of the proposed *TBPA,* which can allow for certain kinds of human uses, such as recreation and research, the information function seems more important in terms of the direct economic benefit they may provide. However, when human uses such recreation and scientific research is being proposed, these activities have to be performed in a manner compatible with the habitat protection requirements. As with regulation functions, information functions are usually best performed when nature is left untouched as much as possible. It is also to be stressed that the maintenance of the regulation functions is essential to the proper functioning of all natural systems and should always be taken into account when assessing the economic benefits of the protected areas as most other functions such as recreational, scientific and educational use depend on these regulation processes. Often, the importance of protected areas to regulation functions becomes apparent only after these functions have been disturbed.

In the *Matrix 1* the values discussed above are being rated. The *de Groot Model* allows for converting qualitative values into monetary terms. However, the paucity and at times complete non-availability of the required data for the proposed *TBPA* precluded the chances of placing a monetary value on the different environmental functions. The generation of relevant data was beyond the scope of this study. As such in the *Matrix 1*, the values are only being rated based on the available ecological, social and economic data.

[1] Functions and Values of Protected Areas: A Comprehensive Framework for Assessing the Benefits of Protected Areas to Human Society, Rudolf S.de Groot, Protected Area Economics and Policy, Linking Conservation and Sustainable Development, World Bank and World Conservation Union (IUCN), 1994

Matrix - 1 Functions and values of the proposed TBPA								
	Ecological values		Social values		Economic values			
Environmental functions	Conservation value	Existence value	Health	Option value	Consumptive value	Productive use value	Employment	Ratings (Environmental functions)
Regulation	a(3)	a(3)	a(3)	c(1)	c(1)	b(2)	c(1)	14
Carrier	b(2)	b(2)	c(1)	b(2)	b(2)	b(2)	a(3)	14
Production	c(1)	c(1)	b(2)	c(1)	c(1)	c(1)	c(1)	8
Information	a(3)	a(3)	a(2)	a(3)	b(2)	a(2)	a(3)	23
Ratings *(Environmental Values)*	9	9	8	7	6	7	8	

Level	Ratings
a	(3) High
b	(2) Moderate
c	(1) Low

Conclusions:

1. The most important potential environmental function of the proposed TBPA comes out to be its information function, while regulation and carrier functions also score highly
2. The most important Environmental values of the proposed TBPA are identified as its conservation and existence values, while health and employment also score highly

Identifying basic parameters for protected area management plan: The Habitat Suitability Index

Habitat Models provide a viable tool of species and resources co-management. They are practical operational tools based on assessment of physical and compositional attributes of the habitat. *Habitat Models* thus estimate the suitability or capacity of targeted areas to provide the needs of a species. In order to develop the desired *Environmental Criteria*, the habitat modeling technique was used to assess the requirements for sustainable turtle nesting/hatching in the project area to act as a tool for policy makers and protected area managers to enhance their capacity for sound protected area management.

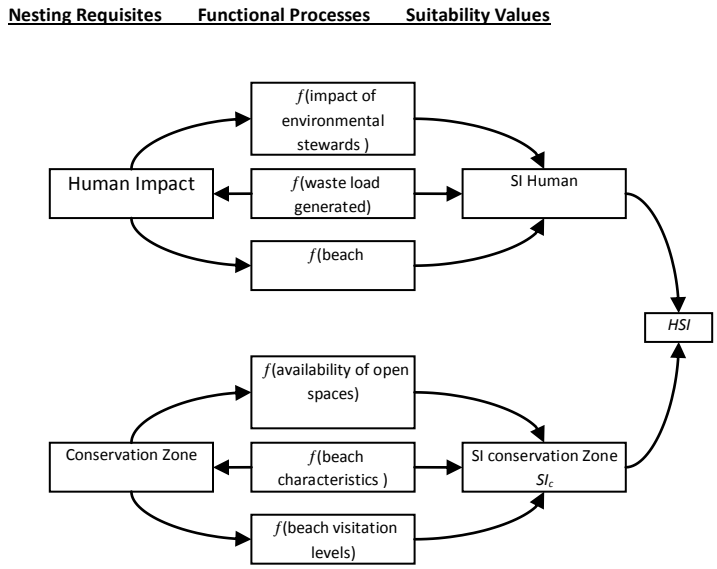
Process Oriented Habitat Suitability Model: Establishing a Habitat Suitability Index for the TBPA

A *Process Oriented Model* was used to assess the suitability of the proposed *TBPA* for turtle nesting/hatching while at the same time assisting in the development of the relevant *Environmental Criteria.* The *Model* can be used to assess the plausible causal relationships or functional processes underlying habitat use, and therefore provides a general conceptual framework for assessing species-habitat relationship. This species-habitat model aims at modeling the relative suitability of an area for the focal species. It uses known or plausible causal relationships as the base for predictions of an area's relative quality. This model can also be used to model habitat use or species distribution.

The output for the model is a *Habitat Suitability Index (HSI)* score that evaluates the aptness of the study area for the species – in this case the turtles *(their nesting hatching process). HSI* scores are on a standard scale between 0 and 1, where 0 indicates unsuitable habitat and 1 indicates optimum conditions and optimum quality and availability of resources. Process-oriented *HSI* models are based on the assumption that a species will select and use areas that are best able to satisfy its life requisites, and thus greater use should occur in higher quality habitat. The fundamental components of such *HSI* models are the environmental variables *(independent variables)* and the resultant habitat suitability values *(dependent variables)* and the classification functions or functional processes that link the two.

The variables related to the space, pollution and human impact as they relate to the *TBPA* selected for use in the *process-oriented model (Table –2)*. Available secondary data and the data generated during the project was be used as the observed data to predict the habitat suitability of the project area.

Figure 2 – Habitat Suitability Model



Variable	Abbrev.
Environmental Stewards *(%)*	es
Waste load *(t)*	wl
Beach Visitation *(no.of visitors in nesting season including hut users)*	bv
Conservation Zone *(%)*	cz
Beach characteristics / sand dunes – Habitat/Nesting *(%)*	sd

Table – 1 - Environmental variables for habitat suitability

Habitat is modeled as a function of variables *(Table-1)* known or perceived to be important components of the life requisites and having significant impact on the suitability of the habitat. A conservation suitability

index has been calculated based on three variables *(Fig-2)*: availability of open spaces *(cz),* beach characteristics *(sd)* and beach visitation levels *(bv)*. Based on available data and observations made during the physical survey some rationales for assessing the habitat suitability index are identified in *Table 2.*

Table – 2 Environmental Variables and Rationale for Perceived Impact

Environmental variables	Rationale for assessing perceived impact
Environmental stewards *(es)*	**Based on the calculation for the total number of Hut Chowkidars available and those that were trained during the project in addition to the Chowkidars employed by the Sindh Wildlife Department. The variable indicates the measure of the total number of trained environmental stewards in relation to the available space in the turtle nesting grounds**
Waste load generated *(t)*	**Based on the calculations for the total number of beach huts/ average number of people using the beach huts on a daily basis to identify waste generation levels and then estimating its impact within the overall threat scenario**
Beach visitation levels *(bv)*	**Based on the calculations for the beach visitors and their direct and indirect impact on the overall threat scenario**
Availability of open spaces *(cz)*	**Based on the documentation done on the overlap of beachfront development /beach huts) with the prime nesting grounds to identify levels of encroachment**
Beach Characteristics *(sd)*	**Based on the physical survey of the beach to assess adversely affected parts of the prime nesting areas due to garbage/construction debris and sand extraction**

- Approximately half of the prime resting space is encroached by beach huts *(Fig. 5b)* $ST_{cz} = 0.5$
- Approximately half of the beach is rendered unsuitable for nesting due to construction debris, garbage, sand extraction $SI_{sd} = 0.54$
- Beach visitation levels are having lesser impact on the habitat. $SI_{bv} = 0.1$

In the overall suitability, index, SIc the 3 SI components for availability of open spaces, beach characteristics and beach visitation levels are regarded obligate and are calculated as follows

$$SI_c = 3\sqrt{SI_{cz} x SI_{sd} x SI_{bu}}$$

$$= 3\sqrt{0.5x0.54x0.1}$$

$SI_c = 0.3$

A human impact suitability index SI_H has been calculated in a similar way as the Sic and is based on three variables *(Fig 5a)*: impact of environmental stewards *(es)*, waste load generated *(t)* and beach visitation levels.

- It is estimated that the number of hut chowkidars trained during the project in environmental stewardship along with the hired staff of Sindh Wildlife Department account for only about 1/3rd of the total potential for environmental stewardship. $SI_{es} = 0.93$

- Impact of waste generation has been identified on the basis of beach visitation levels and physical survey results. $SI_t = 0.97$

- Beach visitation levels are having lesser impact on the habitat. $SI_{bv} = 0.1$

$$SI_H = 3\sqrt{SI_{es} x SI_t x SI_{bu}}$$

$$= 3\sqrt{0.93x0.97x0.1}$$

$SI_H = 0.45$

Now prior to calculating the HSI, it is to be noted that in the overall context of the environmental impacts on the turtle habitat, the conservation index is being given a 30% value and human impact is being given a 70% value. This is because human influence has been identified to play a key role in all factors adversely impacting the turtle habitat.

$$HSI = (SI_H)^{0.7} x (SI_C)^{0.3}$$

$$HSI = (0.45)^{0.7} x (0.3)^{0.3}$$

$$\boxed{HSI = 0.4}$$

An HSI valued at 0.4 indicates diminishing environmental returns from the turtle habitat. It needs to be clarified at this stage that the HSI worked out for the year 2004 for the proposed *TBPA* was based on physical observations and available secondary data. The availability of data was limited while generation of extensive field data was not included in the scope of work. Therefore, the desirable level of exactness and fine calibration for the model could not be achieved. However, it was an extremely useful and important initiative that does not only set a benchmark of habitat suitability for the proposed *TBPA* but should also promote similar initiatives in other sensitive ecosystems and protected areas in Pakistan. The *Model* provides the policy makers with a tool for effective protected area management by managing the impacts of various environmental variables that have been established in order to achieve optimum suitability index for the proposed *TBPA.* Co-relations would need to be worked out between the various factors affecting the suitability levels of the turtle habitat to identify the range of parameters that produce optimum results. However, field data and data on other impacting factors would have to be continuously generated and updated in order to get the maximum output from the *Model*.

Options for protected area designation: A comparative analysis

After establishing the ecological importance and the related specified ecological and related sensitivities an analysis was made of the various protected area options that can be designated to the proposed *TBPA.* Two separate options were considered. The options are as follows:

- Nationally designated protected area
- Ramsar site

Nationally designated protected area: Three separate protected area designations can be assigned to a threatened ecosystem within the national context, namely:

- National Park
- Wildlife Sanctuary
- Game reserve

While the criteria for both the *National Park* and *Wildlife Sanctuary* put restrictions on killing/hunting of animals, damaging of vegetation and polluting of the environment *(important requirements for protecting the regulation and carrier functions of the proposed TBPA)* the *Wildlife Sanctuary* designation clearly specifies that such a protected area *shall be set aside as undisturbed breeding ground for the protection of wildlife.* This specification gives this option an edge.

Of critical importance to giving sustainability of actions in the proposed *TBPA,* provide incentives for the involvement of the community, it is required that controlled tourism activities be allowed *(information functions)*. The definition of a *National Park* says that it *shall be accessible to public for recreation, education and research.* While there is no clearly provided allowance for the use of a *Wildlife Sanctuary* for

recreational purposes, a caveat is provided that can be availed for opening the *Wildlife Sanctuary* for activities such as controlled tourism. It is stated that *provided that Government may for scientific purposes or for aesthetic enjoyment or betterment of scenery authorize the doing of certain acts, otherwise prohibited.* At another place it is mentioned that *access to public shall, accept in accordance with the rules, be prohibited.*

In case of a *National Park,* the *construction of rest houses, hostels and other buildings* are allowed. Such a provision if applied in the case of the proposed *TBPA* can easily be misused and be detrimental to the objective of protecting the turtle habitat. In a *Wildlife sanctuary entering or residing* and *introduction of any domestic animal or allow it to stray* is clearly prohibited. This prohibition goes in favor of the conservation requirements of the turtle habitat.

In case of a *Game Reserve,* restrictions are relaxed and even the hunting of animals can be allowed by issuing permits. This option does not find favor or compatibility with the essential requirements of turtle habitat protection.

It was therefore recommended that within the national context, the best available protected area option is that of a ***Wildlife Sanctuary.***

Ramsar site: Based on the analysis of the available data, it was proposed that the option exists for applying to the *Ramsar Secretariat* for designating the proposed *TBPA* as a *Ramsar site*. On the basis of the criteria as adopted by the *Conference of the Parties to the Convention* in Regina, Canada in 1987, some of the main wetland sites on Karachi coast have been identified as *Wetlands of International Importance* and includes the Sandspit/Hawksbay area. The area has already been included in the Directory of Asian Wetlands.

The text of the Convention *(Article 2.2)* states that:

> *'Wetlands should be selected for the List (of Wetlands of International Importance) on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology'* and indicates that ' *in the first instance, wetlands of international importance to waterfowl at any season should be indicated'*

To facilitate the implementation of this provision, the *Conference of the Parties* has developed criteria to assist in the identification of wetlands of international importance. Of the eight *(8)* criteria identified, the proposed *TBPA* fulfills the following four *(4)* criteria

- **Criterion 2:** A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities

- **Criterion 3:** A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular bio-geographic region

- **Criterion 4:** A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions

- **Criterion 5:** A wetland should be considered internationally important if it regularly supports 20,000 or more water birds

It was therefore concluded that a strong case for the designation of the proposed *TBPA* as a ***Ramsar site*** can be argued.

B. Establishing critical linkages between turtle habitat and turtle nesting patterns

The research component of the project *GIS Mapping of Karachi coast & GIS based analysis of marine turtle habitat: Sandspit/Hawksbay Eco-system* revolved around the setting up of the GIS Data base/map by making combined use of hardware, software, skills and spatial data with provisions of analysis of spatial attributes to recommend habitat conservation measures. The project used the GIS technology for mapping, processing and incorporation of available data for the whole project area in addition to base map preparation, retrieval and storage of field data and visualizing of interactions between sea turtle nests and the physical/environmental attributes at the Sandspit/Hawksbay beaches. The successful/unsuccessful nesting sites were marked and related with data on mean sand depth, beach access *(obstructions to nesting access such as huts)* and potential predation sources. This helped in analyzing and identifying causes and locations of hindrances to turtle nesting and consequently identifying habitats suitable for turtle nesting *(Fig – 3).*

Figure – 3

For a detailed analysis of turtle nests large scale ground data was required. For this purpose, high resolution satellite imageries were procured which could identify turtle nesting pits *(size ranging from 1-1.7 m)*. Imageries of *Quick Bird* were acquired for September 2009 *(acquired in October 2009)*. Nesting pits are quite prominent and clearly visible on *Quick Bird* data, showing the details of nests in various years. Through use of enhancement filters, images were further enhanced to make it more understandable and visible for a layman.

Building a GIS

For the development of a comprehensive Vector-Based GIS, enhanced satellite raster data was converted into attribute-based raster data. The raster data first projcted onto UTM Coordinates *(Zone-42 N)* and was setup on a scale of 1: 1000. By using *ArcGIS*, these were modeled as a collection of discrete features in vector format. The vector data was overlaid on raster images used as background. Tabular data were linked via SQL connection to the sea turtle nesting point data. This allows users continuing usage and update of data in more familiar office productivity software *(i.e., Excel or Access)*.The tables from these applications were linked to line feature that represent kilometers of nesting beach. Queries are then run on the linked tables. The resulting data were then overlaid as line features that represent the queried data. The main featuers which were digitized on priority bases were huts, hut boundary, hut corridor, hut encrochment, roads, garbage points, water line, moisture line, dry sand areas, and nesting sand bars *(Figuer- 4)*. Digitized land use plans, topographical maps, bathymetric and the EM of the nesting beach were utilized by using GIS.

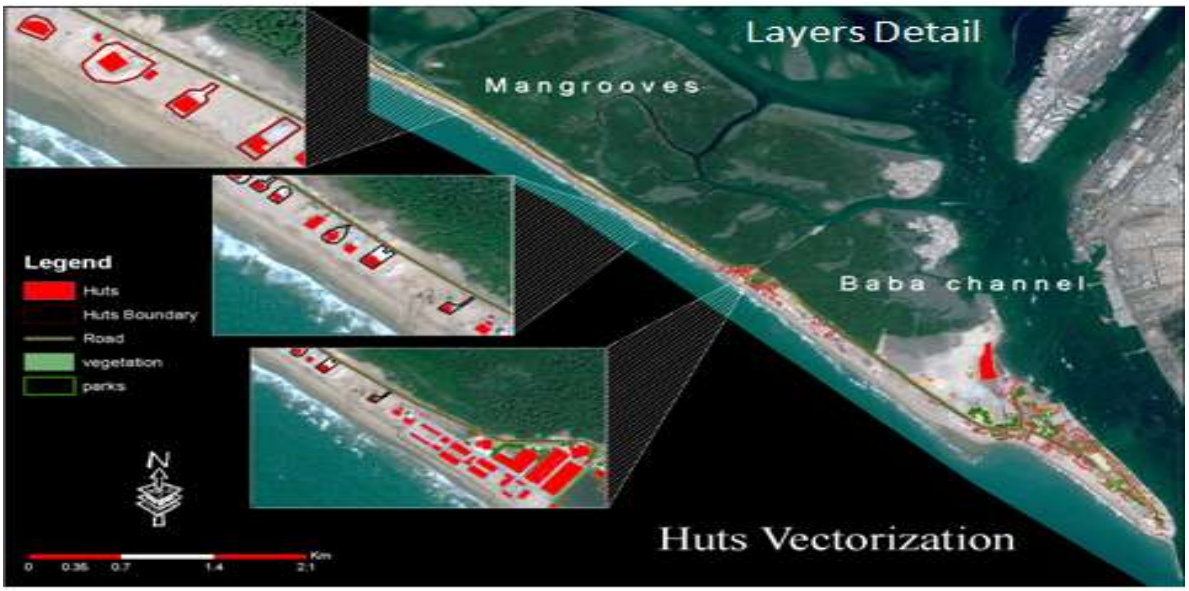


Figure – 4

The coastal GIS were prepared *(zoomed pixels)* and digitally classified *(classes being mangroves forests, water-covered areas, shallow water, vegetation, settlement areas)* satellite images. Most important of all data layers were the themes which are affecting the turtle nests. Turtle nests from 2006

to 2009 were mapped with the help of HRS data. For the year, 2005 mosaic of archived image was used to identify the spatial distribution of turtle nests with the help of visual interpretation, all the nests were marked in appoint theme *(Figure-5)*.

Figure – 5

For the year 2009, recently procured image for this project was used to identify nests. In addition to documenting nesting numbers/patterns through use of satellite imagery, field documentation was also done extended over a period of one month and the data was correlated with the satellite imagery findings with good results. The nesting grounds were then divided into three separate categories – low level nesting, medium level nesting and high level nesting. In doing so, an interesting observation was made. It was found that while the entire stretch of the beach had an area of 13120 sq.m. and was approximately 9 km in length, however, 52% of the entire documented nests along the 9 km beach strip were located on the 0.78 km sand bar *(an elevated platform of the beach delineated through satellite imagery and field data generation).* This finding of this most frequented stretch of the beach *(Fig – 6)* that had never been considered or documented earlier became the basis for further investigations on the habitat – specie interaction and they are discussed below.

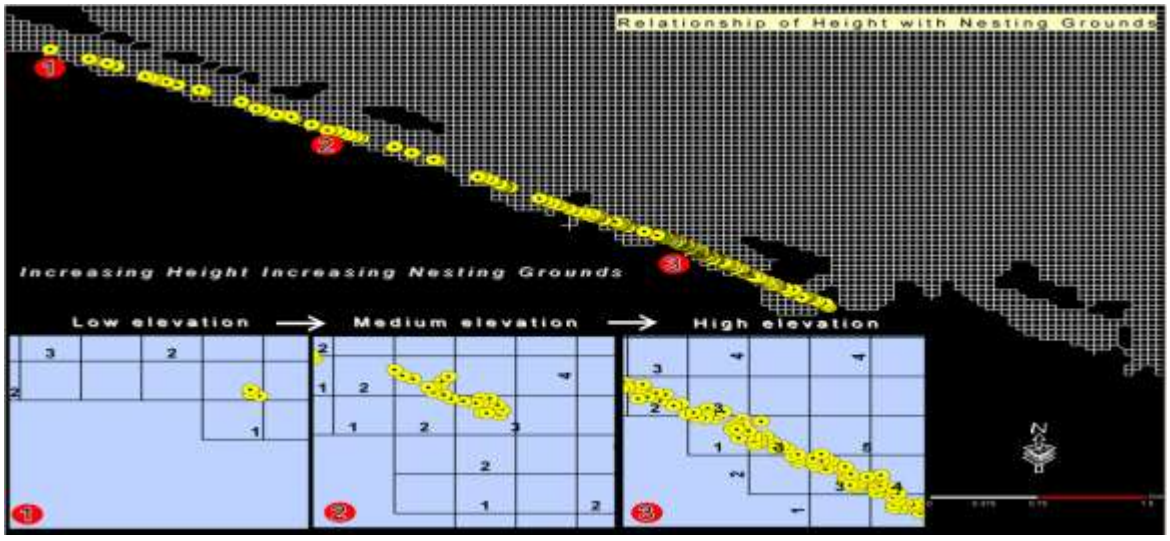
All the high nesting areas in the sand bar having an average height 3 – 5 meters, where in the range of "low nests zone" is only 1 – 1.5 meters. For the further evaluation of sand bar "Nesting Layers" of all the years, along with water and moisture line, were plotted. The polygons *(Sand bar)* are about 24, 447 sq. meters. Sand bar confirmation was further strengthened with the help of "Soil and Grain analysis" and peizometer data. Sand profiling of 10 No. turtle nesting pits in the project area *(Soil Core – 6 ft from Ground Level)* was done for determining - moisture content, soil classification & grain size. In addition, sub-surface water level determination was made using piezometer at 6 No. monitoring points in the project area – both the soil sampling and water level determination done in each of three categorized zones in the project area *(based on the turtle nesting counts).*

Figure – 6

Findings

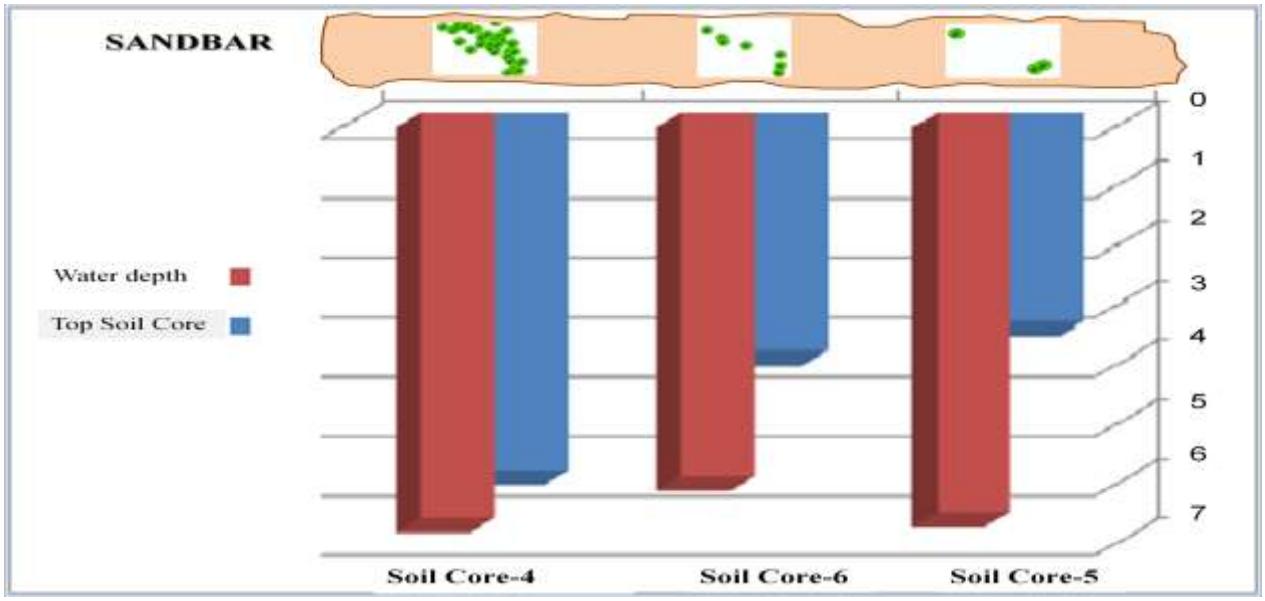
- 52% of the entire documented nests along the 9 km beach strip were located on the 0.78 km sand bar
- A direct relationship was established between increasing elevation of the sand bar and the increasing numbers of successful turtle nests *(Fig – 7)*

Figure - 7



- A direct relationship was established between decreasing ground water level and increasing number of successful turtle nests *(Fig – 8)*

Figure – 8



- Legally covered area allowable for the 823 beach huts constructed in the beach stretch was 68813 sq.m. while the area of actual constructed structure was 189148 sq.m. Area of extended encroached space *(car park/fencing)* was 256689 sq.m.
- An area of 280 sq.m. of a total of the total 13120 sq.m. *(sand bar – prime nesting habitat)* is already encroached by beach huts *(Fig – 9)*

Figure – 9

Concluding Remarks

1. The significance of finding this unique and specific habitat characteristic *(sand bar)* and the critical linkages between the environmental, physical and human induced factors again related with the habitat lies within finding a solution that is based on focusing on habitat planning and management in a manner that renders it suitable for sustained and unhindered turtle nesting. The use of GIS as a planning tool has also pointed to the importance and need of applying technological insight into issues related with planning, development, and monitoring of urban ecosystems and thinking in terms of applying the principles of *Integrated Coastal Zone Management (ICZM).*
2. Some key characteristics such as soil composition, ground water level, slope and gradient and high water mark have been studied and linkages established with turtle nesting. Possible linkages with changing coastal and wave dynamics have also been considered and it is recommended that detailed field studies and analysis that are sustained over time are initiated to study this phenomenon.
3. Studies have been conducted in the past to determine the turtle nesting patterns and change in densities over time. However, this project for the first time tackles the extremely critical linkages that exist between the turtle habitat in terms of the physical, ecological and environmental features that determine its landscape and the changing trends and patterns in turtle nesting. The survival of the specie is linked to the protection and sustainable development of its habitat – that would require continued and detailed monitoring of the physical and natural landscape and human influences and appropriate planning to facilitate greater suitability of the habitat to, as is the case in our project area – nesting of green sea turtles.

References

Rudolf S.de Grooth, Functions and Values of Protected Areas: A Comprehensive Framework for Assessing the Benefits of Protected Areas to Human Society (1994) Protected Area Economics and Policy, Linking Conservation and Sustainable Development, World Bank and World Conservation Union -IUCN

Shehri-CBE (2004), Conserving the Turtle Nesting Grounds of Sandspit/Hawksbay Coastal Ecosystem: A Strategic Framework for Habitat Management

Farhan Anwar (2005), Habitat Management Plan for the Proposed Turtle Beach Protected Area: A Framework for Action

Key Words

Sandspit, Hawksbay, Ramsar, Buleji, Shehri, Turtle, Stewards, Hut

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