



# FIG Working Week 2012

Rome, Italy 6–10 May

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**Technical Session: TS 07B - GIS Applications (Number # 5463)**

## **Beaches Carrying Capacity Assessment in Kuwait Based on Photointerpretation and Ground Survey**

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## PRESENTATION OUTLOOK

- INTRODUCTION
- KUWAIT PROFILE
- STUDY AREA
- ADOPTED METHODOLOGY
- CARRYING CAPACITY ASSESSMENT
- RESULTS & DISCUSSION

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## INTRODUCTION: Previous Studies

- Carrying Capacity (CC) is the amount of activity or use that can be handled by a system before it begins to deteriorate.
- Carrying Capacity in coastal zones is often determined by physical CC using aerial photography, in addition to the social CC determined by visitor interviews.
- United Nations Environment Program (UNEP) has set up a program for the Mediterranean region for CC assessment for tourism development.
- The Regional Organisation for the Protection of the Marine Environment (ROPME), based in Kuwait, was established for the protection of marine environment in the Gulf region.
- The coastal zones of Kuwait were classified according to their geology, biology & vulnerability. The oceanographic Atlas of Kuwait waters was produced. Hot-spot areas of coastal zones of Kuwait bay were determined based on geology & water quality.

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## INTRODUCTION: Research Objectives

- The aim of this research is to investigate the concept of Carrying Capacity as a tool for beach management in Kuwait through focusing on two public beaches.
- This has been done in order to establish a balance between the nature of the beaches and the current and future uses of the available resources.
- This main goal will be achieved through the following sub-goals:
  - ✚ Describe the current status of the beaches chosen for this study in terms of land use categories.
  - ✚ Identification of services and activities available in beaches.
  - ✚ Assessment of Carrying Capacity of the two beaches.

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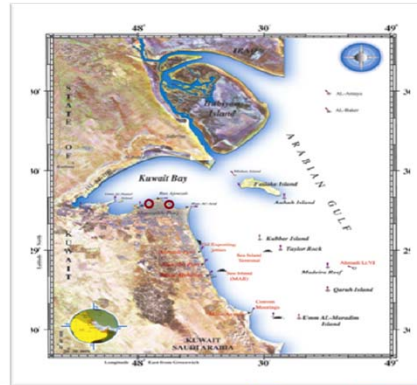
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## KUWAIT PROFILE: Geographic Location and Population

- The state of Kuwait is situated between the Arabian Gulf from the East, Iraq from the North and Saudi Arabia from the South.
- Geographic coordinates: between the Latitudes 28°45' & 30°06' North Equator and the Longitudes 46°30' & 48°30' East of Greenwich.
- Area of Kuwait is 17818 km<sup>2</sup> and Population is 2991189 peoples in 2005. The climate is desert, topography is flat and geomorphology is uniform.

Geographic Location of Kuwait with two study beaches (Red Circles)



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## KUWAIT PROFILE: Main Beach Categories

- Kuwait has about 300 km length of coastlines from North to South, overlooking the Arabian Gulf .
- The main beaches were subdivided into three categories:
  - ✚ Muddy beaches in the North of Kuwait Bay, formed as a result of deposition of fine clay particles carried by water from the Shatt Al-Arab.
  - ✚ Rocky beaches stretching south from the Kuwait Bay.
  - ✚ Sandy beaches spread in the most exposed areas and especially in the inter-tidal areas.

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## STUDY AREA SELECTION

- The study area consists of two public beaches, which are:
  - ✦ Green Island Beach, and
  - ✦ Al-Shuwaikh Beach.
- Chosen according to the following considerations:
  - ✦ The type and nature of the beaches.
  - ✦ Geographical location of the beaches.
  - ✦ Availability of sea water quality monitoring stations.
  - ✦ Easy access to beach facilities and services.

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## STUDY AREA: Green Island Beach

- Located in the Eastern of Kuwait city and characterized by the presence of some of the major tourist landmarks (e.g. Green Al-Jazeera, Kuwait Towers).
- The management of the beach is supervised by the Touristic Enterprises Company, while the hygiene is the responsibility of the Kuwait Municipality.
- The area of the beach is 123422 m<sup>2</sup> and the services available to visitors include surfing, swimming, running, walking and playing balls.

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## STUDY AREA: Green Island Beach (Cont.)



Color Ortho-photo showing the study site of Green Island public beach (year 2004, scale 1/2000), provided by Kuwait Municipality

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## STUDY AREA: Al-Shuwaikh Beach

- Located in the Western of Kuwait city close to the Arena of Science in the South side of Kuwait Bay.
- The Kuwait Municipality is responsible for both the management and hygiene of the beach.
- The area of the beach is 381465 m<sup>2</sup> and the services available to visitors are the following: sport practicing, fishing, swimming and walking.

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## ADOPTED METHODOLOGY

- Data Acquisition: color Aerial Photography for the year 2004 (scale 1/2000) provided by Kuwait Municipality, along with data related to the quality of water of the beaches and geographical and socio-economical datasets.
- Data Analysis & Interpretation: the aerial photo has been rectified to produce the Ortho-photo, which has been in turn classified by photo-interpretation process using (ERDAS Imagine) software, in order to produce the land use map composed of various land use categories. Development of visitor's density map in three different levels of density (Low, Moderate, High) using ground survey of the beach.
- Results Output & Discussion: the two produced maps in the previous step were overlaid using (ArcGIS) software to finally develop the Carrying Capacity map for each single beach.

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## CARRYING CAPACITY ASSESSMENT

- The Carrying capacity Approach (CCA) was adapted to the culture and traditions of Kuwaiti society and built on two established approaches adopted earlier in the previous studies .
- GIS techniques and tools were used to produce thematic maps for the two beaches that included the land use categories and density distribution of visitors.
- Data on the environmental quality of the coastal water at these beaches as well as information on the perception of visitors through interviews based on questionnaire were also collected and analyzed.

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## CARRYING CAPACITY ASSESSMENT: Green Island Beach

- The visitor's density map produced into three levels (Low, Moderate and High).
- The land use map produced into 13 various categories (parking, shop, toilet, greenery, games, etc...).
- The Carrying Capacity map indicating both the locations with high/low density of visitors, corresponding to high/low risk along with the indications about the required services on the beach if they are sufficient or not.



Playground Soap Water

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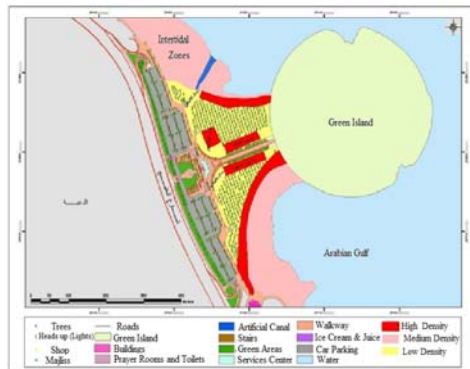
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## CARRYING CAPACITY ASSESSMENT: Green Island Beach



Carrying Capacity map of Green Island beach for the year 2004, Incorporating land use categories overlaid on visitors's density.

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## CARRYING CAPACITY ASSESSMENT: Al-Shuwaikh Beach

- The visitor's density map was produced into three levels (Low, Moderate and High).
- The land use map was also produced into 16 various categories (e.g. walking, fishing, games, shop, toilet).
- The overlay of the two maps has allowed producing the Carrying Capacity map indicating both the locations with high/low density of visitors, thus high/low risk along with the indication about the required services on the beach if they are sufficient or not.

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## RESULTS & DISCUSSION

- The CC maps produced for both beaches revealed that visitor's distribution density was not uniform across the beaches. High density zones were concentrated at the intertidal zones; the sports and children playgrounds and the greenery areas.
- The percentage of visitors to Al-Shuwaikh public beach was greater than the Green Island beach and the visitor's distribution was different too. This was related to a number of reasons including the availability of more services and leisure activities .
- A geodatabase was developed for the beaches containing all available data (land use map, visitor's density map, water quality, visitor's interviews, facilities & services).

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## RESULTS & DISCUSSION (Cont.)

- The majority of visitors frequent both beaches during summer season (May to August). All the visitors prefer the farthest distance (9 m) between visitors. The visitors to Al-Shuwaikh beach prefer to have an area of (6 m<sup>2</sup>) per visitor, compared to (12 m<sup>2</sup>) in Green Island beach.
- The majority of visitors agreed on for both beaches that (toilet are not clean, there is no lifeguard, number of showers are insufficient).
- The study has recommended implementing and increasing the number of studies on carrying capacity of beaches for better management and planning of beaches in Kuwait.

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