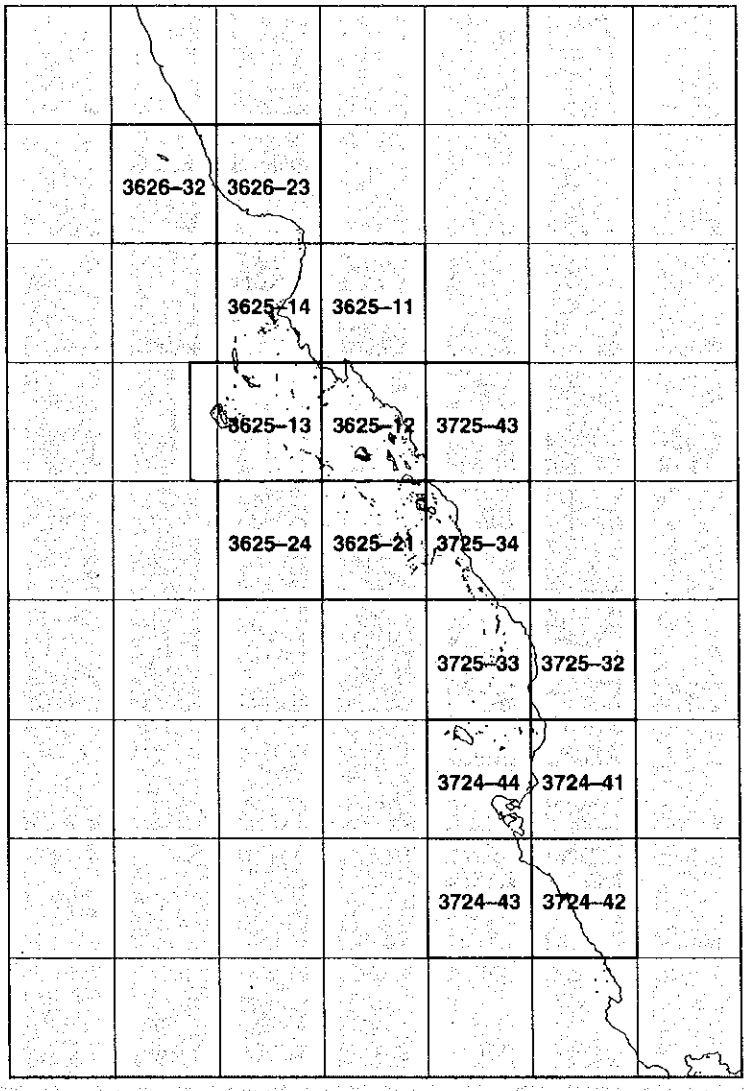
社会開発調査部報告書

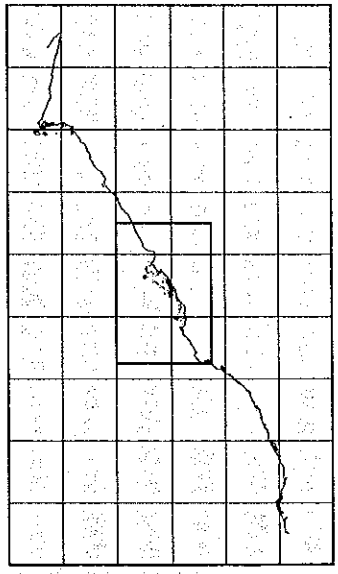
No. 51

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT (NCWCD), KINGDOM OF SAUDI ARABIA

THE STUDY ON COASTAL / MARINE HABITAT AND BIOLOGICAL INVENTORIES IN THE NORTHERN PART OF THE RED SEA COAST IN THE KINGDOM OF SAUDI ARABIA





FINAL REPORT
HABITAT MAPS OF THE MODEL AREA
SCALE 1:50,000

JAPAN WILDLIFE RESEARCH CENTER
SHIN-NIPPON METEOROLOGICAL & OCEANOGRAPHICAL CONSULTANT CO.,LTD.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT
(NCWCD), KINGDOM OF SAUDI ARABIA

THE STUDY ON COASTAL / MARINE HABITATS AND BIOLOGICAL INVENTORIES IN THE NORTHERN PART OF THE RED SEA COAST IN THE KINGDOM OF SAUDI ARABIA

HABITAT MAP

MARCH 2000

JAPAN WILDLIFE RESEARCH CENTER
SHIN-NIPPON METEOROLOGICAL & OCEANOGRAPHICAL CONSULTANT CO., LTD.

---

1. BACKGROUND OF THE STUDY

The Red Sea Coast holds a rich and valuable biological diversity of global importance. The coastal areas of the Red Sea have been undergoing increasing industrial and tourism development which is having an inevitable impact on the coastal and marine environment. However, the true state of the precious environment is not fully understood.

The Kingdom of Saudi Arabia recognises the value of this biodiversity as a national and international asset, and requested the Government of Japan to conduct a comprehensive biological study in the northern part of the Red Sea Coast of Saudi Arabia.

The Study aims to close the gap by conducting a thorough study of the area. The results will be utilised to devise a framework for the conservation and sustainable management of the coastal and marine environment. The Study consisted of the four

components; Biological Inventory (coral, seagrasses / algae, fish, benthos, marine mammals / marine turtles, mangroves / terrestrial vegetation and birds), Social Environment, Habitat Map and GIS / Database.

The JICA Study Team conducted the Study with the National Commission for Wildlife Conservation and Development (NCWCD) of Saudi Arabia, on the basis of the Scope of Work agreed upon and signed by NCWCD and the JICA Preparatory Study Team in Riyadh on 24 March 1997.

The Study covered the northern part of the Saudi Arabia Red Sea Coast, encompassing approximately 1,000 kilometres (excluding the coastal area of Jeddah city), and it was conducted from December 1998 to November 1999.

2. HABITAT MAP

2.1. Introduction

The purpose of creating habitat maps is to supply basic visual information to the Saudi Arabian authorities for the establishment of a system of conservation and appropriate management of the natural environment and biological diversity in the northern part of the Red Sea coast.

All habitats of the marine and coastal areas in the Study Area are identified and categorised into simplified habitat types. They are represented in different colours so that it is easy to understand how each habitat type is distributed and exactly where it is. This provides NCWCD with a very clear idea of the marine environment of the Study Area.

2.2.Methods

1). Aerial surveys

The mosaic habitat zones in the Duba - Tiran area and the Al-Wajh - Al-Wajh Bank area were selected to interpret zonation patterns and to make a visual estimation of benthic attributes and cover categories from their different colours, for which information from the ground truth surveys were utilised. These areas were selected on the basis of information from existing literature and maps.

Aerial surveys were undertaken on 12 and 13 (Duba - Tiran area), and on 16 (Al-Wajh - Al-Wajh Bank) February 1998. For aerial surveys in the Duba - Tiran area, a single-engined aircraft was provided by NCWCD, and in the Al-Wajh - Al-Wajh Bank area, a helicopter was provided by the Ministry of Defence and Aviation. Flying altitude ranged from 150-600 feet above sea level.

The main objective of the aerial surveys was to compare colours and coverage of the habitats. In order to do so, the member of the Aerial Photograph Analysis Team flew with the Coral and Seagrasses / Algae Team members to observe the actual habitats and to understand

their colours and coverage. Video camera and still camera were used to record all these habitats and colours.

2). Aerial photographs

A series of aerial photographs (164 lines, 3,347 prints) was taken during 3 June to 12 July 1998 covering the entire Study Area except for the Gulf of Aqaba and south of Rabigh.

The photographs covered the area between latitudes 23°N and 28°15'N. The marine area of 0-20 m depth was analysed for mapping, while the coastal belt area on the land 1-2 km wide was taken for the maps.

Habitat maps of 1:10,000 scale were prepared through a careful analysis of the aerial colour photographs. Further information obtained by the ground truth surveys was added to finalise the maps.

3). Categorisation of habitats

Every photograph was examined individually to establish the discrepancy levels in such aspects as colour shifts until and they could be satisfactorily printed as 1:10,000 scale aerial photographs. These were carefully analysed, and the habitats in the Study Area were classified into the categories shown in Table 1.

The habitat maps include important data on the social environment, such as factories, farms and fishing ports.

4). Utilisation of the results of the ground truth surveys

Information from the ground truth surveys throughout the Study Area and in the Model Area was used to verify the categories and the coverage of coral.

5). Aerial verification

In order to verify and revise the categories of the habitat maps, aerial surveys flying at altitudes of 500 to 1,000 feet covering the Model Area were conducted on 15 and 16 February 1999. The main habitats of the Model Area were recorded on video tape and photographs were taken. An aircraft of NCWCD was utilised.

6). Satellite imageries

Aerial photographs were not taken in the areas of the Gulf of Aqaba and south of Rabigh because these areas are restricted for national security reasons. Habitat maps of both areas were completed by utilising satellite imageries taken by "JERS-1: OPS" on 6 and 7 April 1994 and 31 July 1996. JERS-1 is operated by the National Space Development Agency of Japan.

7). Summary of the process

The entire process of drawing the habitat maps was summarised as follows;

i An index list of the photographs was made in order to find in the most efficient and easiest way whichever photograph was needed for analysis.

ii Coverage of each habitat zone was hand-traced onto tracing paper.

iii The traced habitat map was reduced to a scale of 1:50,000, and then traced onto a topographical map of the same scale.

iv Supplemental data and information from the ground truth surveys and the aerial verifications were used to improve the precision of the aerial photograph analyses.

Table 1. Classification of habitat categories and their characteristics of colour and pattern.

	Terrestrial Habitats		Marine Habitats
D	Desert (yellow, orange, brown systems)	S	Sand (pale ocher, white, pale yellow)
Is	Island (yellow, orange, brown systems)	Md	Mud (brownish gray)
Tf	Tidal flat (brown, dark brown, moss green)	Rp	Sand with Reef Patches (Coral less than 10%) (scattered gray, brown)
Ro	Emerged rock (dark orange, dark brown)	C-1	Coral (coverage 11-30%) (white, gray, brown)
M	Mangrove (dark green, brown)	C-2	Coral (coverage 31-50%) (white, gray, brown)
V	Coastal vegetation (brown, greenish brown)	C-3	Coral (coverage 51-75%) (white, gray, brown)
Sk	Sabkhah (with Cyanophyceae and Salt marsh) (black, brown, gray)	C-4	Coral (coverage 76-100%) (white, gray, brown)
Sm	Salt marsh (scattered brownish green based Sabkhah)	T/Sa	Turf/Small algae (scattered pale or dark brown, black)
Fm	Farm (confirmed by forms)	Ma	Macro algae (patched pale or dark brown, black)
Lv	Fence of livestock (confirmed by forms)	Sg	Seagrass (patched dark bluish greenish black)
Fp	Fishing port (confirmed by forms)	Cy	Cyanophyceae (blue-green algae) (patched dark brown or true black)
Tw	Town area (confirmed by forms)	Se	Sea (blue, green)
Fc	Factory (confirmed by forms)		

N.B.: Colours of habitats in the marine environment appear bluer when they are deeper in the sea because of the colour of the seawater.

2.3. Results

1). Habitat maps

The habitat maps of the Study Area (1:100,000) and the Model Area (1:50,000) are presented.

In the areas of the Gulf of Aqaba and south of Rabigh habitat maps of which were completed using satellite imageries, the coral is represented in only one category as it was not possible to analysed the coral coverage in detail from prints of the satellite imageries. This is because the resolution of the satellite imagery was too lower to be able to recognise the details

of the habitats.

Distribution of habitats in the Study Area

Varied, large expanses of habitats are found at the entrance to the Gulf of Aqaba, in the area from Al-Wajh Bank to Jazirat Jabal Hassan and the area from Masurah and Rabigh.

At the entrance to the Gulf of Aqaba, the variety and extent of habitats are ranked at the middle level because of the absence of a mangrove habitat.

In the northern part of Al-Wajh Bank, the variety of habitats is ranked the same as that at the entrance to the Gulf of Aqaba. There are mangrove habitats, and the coverage of coral is monotonous compared with that of the southern part. The extent of habitats is ranked high in the northern part.

In the southern part of Al-Wajh Bank, the variety of habitats is ranked at the highest level because of the complex geomorphic features. The extent of habitats in this area is ranked higher than in the northern part.

In terms of both variety and extent of habitats, the southern part of Al-Wajh Bank is evaluated as the most important and interesting site in the Study Area.

The rest of the Study Area does not have habitats that are as varied and / or extensive.

2). Ground truth surveys and re-categorisation of habitats

Supplemental data and information from the ground truth surveys were utilised for the revision of categories on aerial photographs in order to draw up the habitat maps. Habitat information on coral came from 109 spots, on seagrass / algae from 108 spots, on fish from 45 spots, on benthos from 61 spots and on mangrove / coastal vegetation from 70 spots in the Study Area.

In addition to consideration of seasonal fluctuations in biota, the habitat maps were improved (re-categorised) using the results of the ground truth surveys throughout the Study Area and in the Model Area.

The re-categorisations and revisions as the followings were made.

"Seagrass" and "Cyanophyceae" categories

The colours of "Seagrass" and "Cyanophyceae (blue-green algae)" were the same on the aerial photographs, but it was clarified from the ground truth surveys that Cyanophyceae forms colonies on silt (mud) substrate where water flow is slow due to topographic features, while colonies of seagrass appear on sand substrate where the topographic features generate moderate water flow to sweep the silt (mud) out. Therefore, the colour on the silt (mud) substrate was re-categorised as "Cyanophyceae (blue-green algae)" and the colour on the sand substrate was categorised as "Seagrass".

"Turf / Small Algae" and "Macro Algae" categories

The colour of "Turf / Small Algae" and "Macro Algae" were the same on the aerial photographs. It was clarified from the ground truth surveys that colonies of macro algae are grow on the edge of the barrier reef facing towards the open sea, directly affected by strong wave energy. Although the reef flat is predominated by colonies of turf / small algae, colonies of macro algae also develop at the end of the reef flat where the waves strike directly on the hard substrate.

Therefore, the colour on areas exposed to strong wave action was categorised as "Macro Algae" and the rest as "Turf / Small Algae".

"Coral" categories

At the beginning hard coral coverage was ranked into five grades in the habitat maps, such as "Hard Coral 1-10%". There is one more category related to coral habitat: "Reef Patches".

The name "Hard" is misleading. This is because there are generally two types of coral: hard coral and soft coral. Soft coral does not appear on the aerial photographs at all. Therefore, the category "Hard Coral" was changed to "Coral".

It is difficult to distinguish "Reef Patches" and "Hard Coral coverage 1-10%". One new category of "Sand with Reef Patches / Coral less than 10%" was created to include both of the above two categories.

3). Improvement of the habitat maps

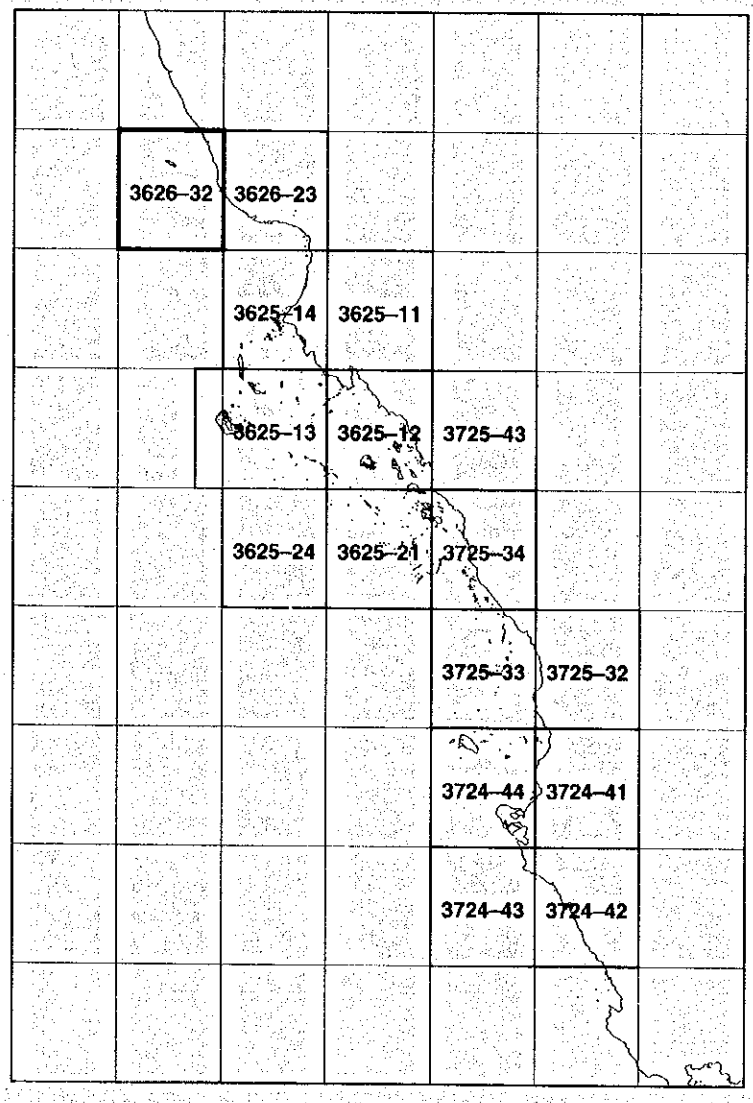
The habitat maps made in this study were based mainly on the aerial photographs taken in summer from 3 June to 12 July 1998, at an altitude of about 5,000 feet. The information from the ground truth surveys in winter (February 1999) and early summer (June 1999) in the Model Area was also incorporated into the habitat maps to improve the precision of the aerial photograph analyses. As the information from the ground truth surveys was limited because of the lack of time, only two seasons and several parts of the Study Area were covered, hurriedly; complementary studies will be needed covering the entire Study Area in the future to up-grade the precision of the habitat maps.

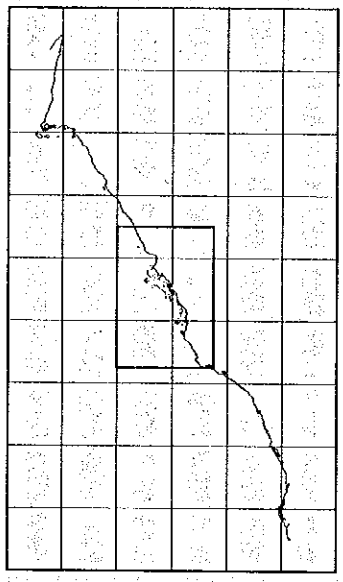
The habitats gradually change in quality and quantity. Habitats of seagrass, algae and coastal vegetation growing on the inter-tidal zone in particular, change rapidly in comparison with coral in the water. After large-scale flooding, the organisms in the inter-tidal zone and the shallow water area will be strongly affected by large amounts of soil sedimentation and freshwater discharged from the land; consequently, it is expected that the habitats of these organisms will change. Therefore, aerial surveys and ground truth surveys should be conducted at least once every 5 years, or immediately after only large scale flooding.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT (NCWCD), KINGDOM OF SAUDI ARABIA

THE STUDY ON COASTAL / MARINE HABITAT AND BIOLOGICAL INVENTORIES IN THE NORTHERN PART OF THE RED SEA COAST IN THE KINGDOM OF SAUDI ARABIA





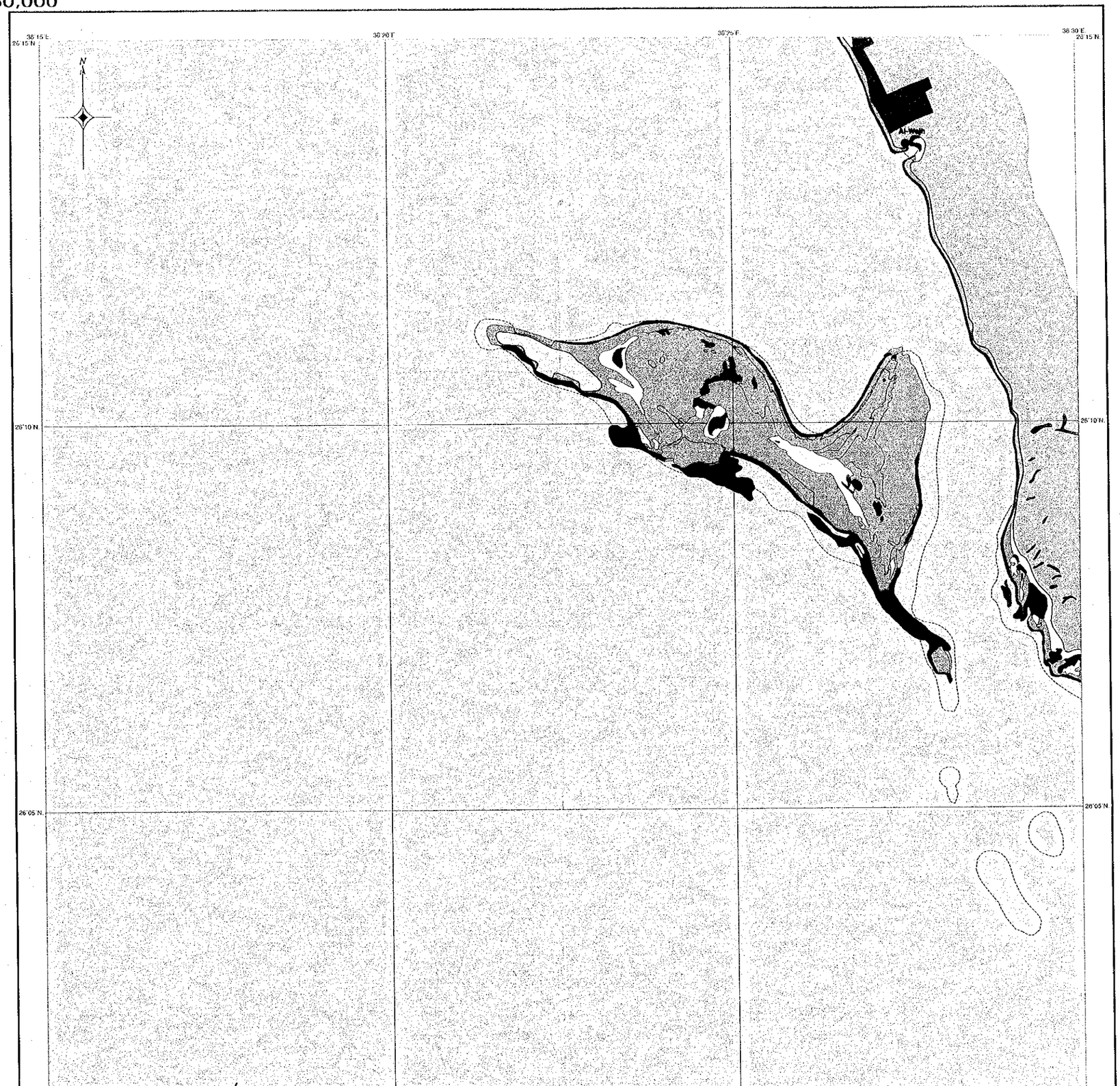
FINAL REPORT
HABITAT MAPS OF THE MODEL AREA
SCALE 1:50,000

JAPAN WILDLIFE RESEARCH CENTER
SHIN-NIPPON METEOROLOGICAL & OCEANOGRAPHICAL CONSULTANT CO.,LTD.

HABITAT MAP

1:50,000

Sheet No. 3626–32



26°05'N.

26°00'N.

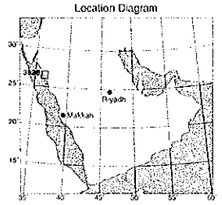
35°15'E. 35°20'E. 35°25'E. 35°30'E.

SCALE 1:50,000

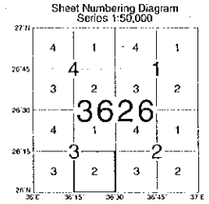
LEGEND

- Desert
- Tidal flat
- Emerged rock
- Mangrove
- Coastal vegetation
- Sabkhah (with Cyanophyceae and Salt marsh)
- Salt marsh
- Sand
- Mud
- Sand with Reef Patches (Coral less than 10%)
- Coral (coverage 11–30%)
- Coral (coverage 31–50%)
- Coral (coverage 51–75%)
- Coral (coverage 76–100%)
- Turf / Small algae
- Macro algae
- Seagrass
- Cyanophyceae (Blue-green algae)
- Sea
- Island
- Farm
- Fence of livestock
- Town area
- Factory
- Fishing port
- Coast line
- -20m (Depth)

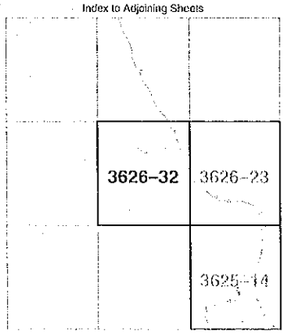
Location Diagram



Sheet Numbering Diagram
Series 1:50,000



Index to Adjoining Sheets



SOURCES:

1:150,000 Sea Chart printed in Riyadh, K.S.A., by M.S.D. Sep. 1983 under supervision of Ports Authority. Sheet No. 13, 14.
Copyright reserved by Ports Authority.
Aerial photographs taken between 3 June and 12 July 1998.
Field surveys conducted in Feb. 1998, May - July 1998, Sep. - Nov. 1998, Feb. 1999 and June 1999.

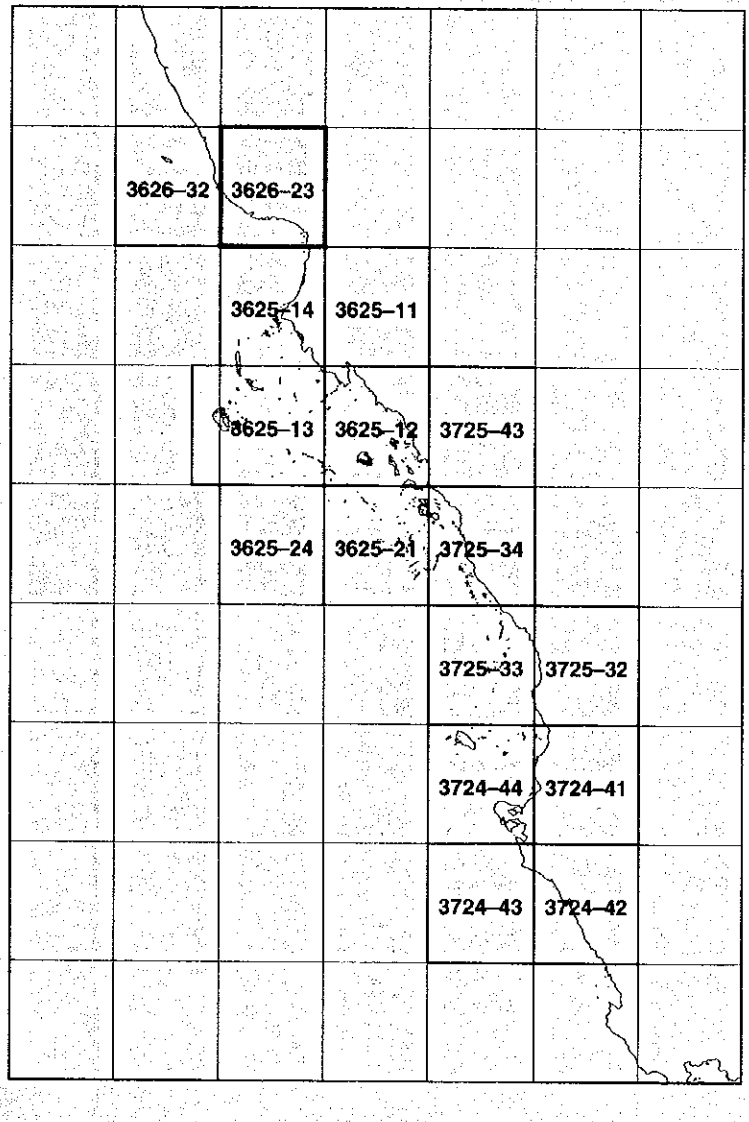
Universal Transverse Mercator Projection (U.T.M.).

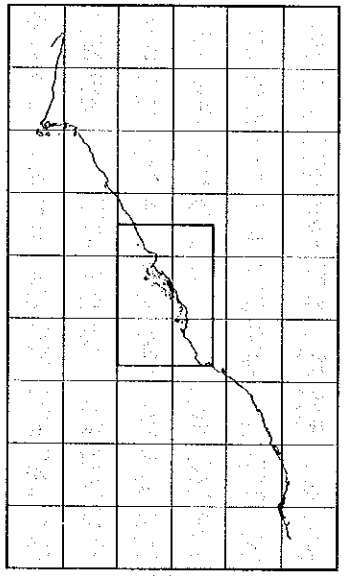
JICA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT (NCWCD), KINGDOM OF SAUDI ARABIA

THE STUDY ON COASTAL / MARINE HABITAT AND BIOLOGICAL INVENTORIES IN THE NORTHERN PART OF THE RED SEA COAST IN THE KINGDOM OF SAUDI ARABIA





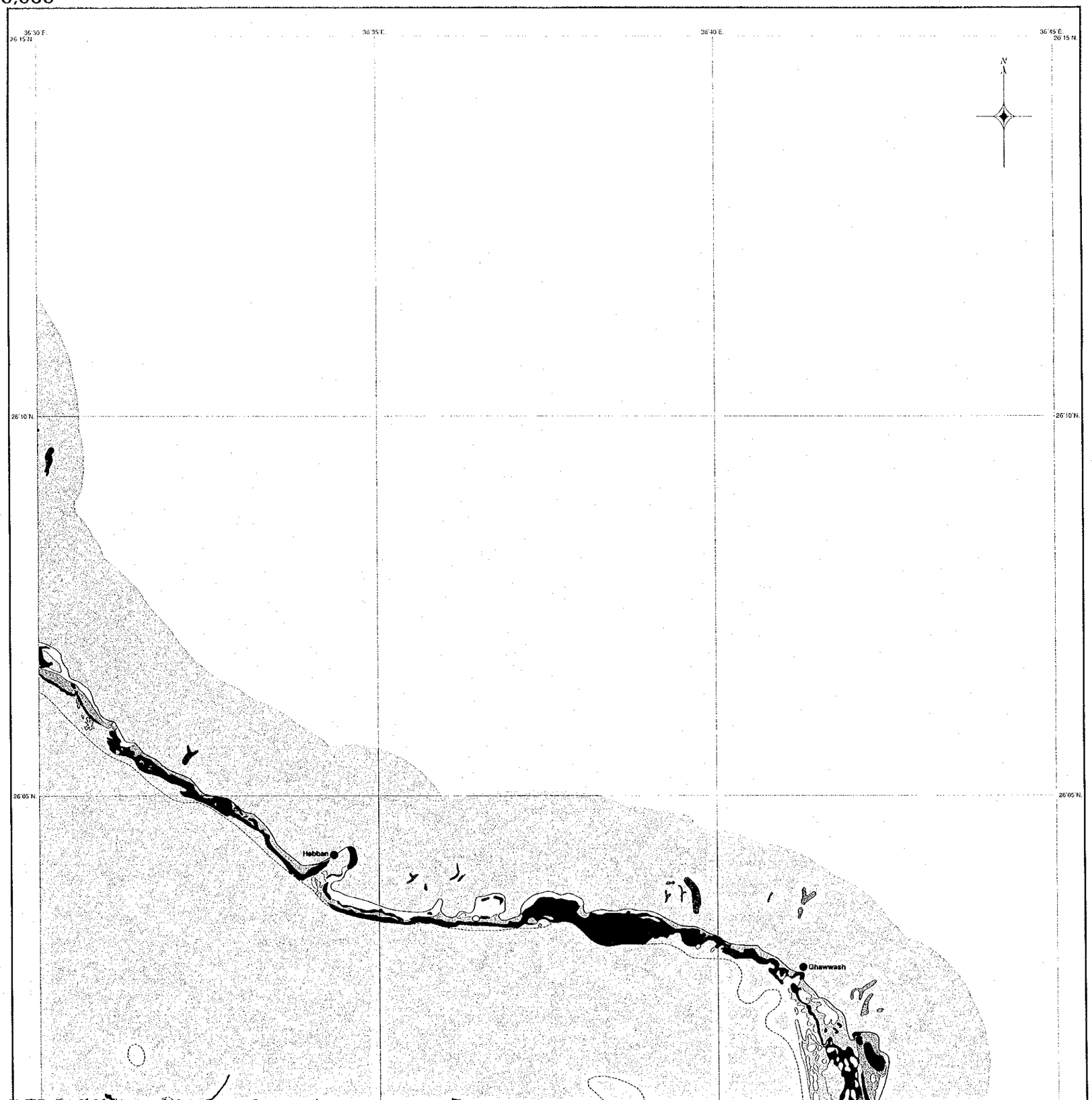
FINAL REPORT
HABITAT MAPS OF THE MODEL AREA
SCALE 1:50,000

JAPAN WILDLIFE RESEARCH CENTER
SHIN-NIPPON METEOROLOGICAL & OCEANOGRAPHICAL CONSULTANT CO.,LTD.

HABITAT MAP

1:50,000

Sheet No. 3626–23



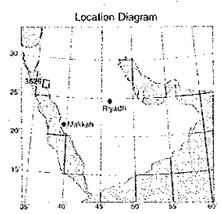
SCALE 1:50,000

Meters 1000 500 0 1 2 3 4 5 6 Kilometers
Yards 1500 1000 500 0 1 2 3 4 Statute Miles
Nautical Mile 1 0 1 2 3 4 International Miles

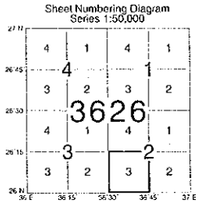
LEGEND

- Desert
- Tidal flat
- Emerged rock
- Mangrove
- Coastal vegetation
- Sabkhah (with Cyanophyceae and Salt marsh)
- Salt marsh
- Sand
- Mud
- Sand with Reef Patches (Coral less than 10%)
- Coral (coverage 11–30%)
- Coral (coverage 31–50%)
- Coral (coverage 51–75%)
- Coral (coverage 76–100%)
- Turf / Small algae
- Macro algae
- Seagrass
- Cyanophyceae (Blue-green algae)
- Sea
- Island
- Farm
- Fence of livestock
- Town area
- Factory
- Fishing port
- Coast line
- -20m (Depth)

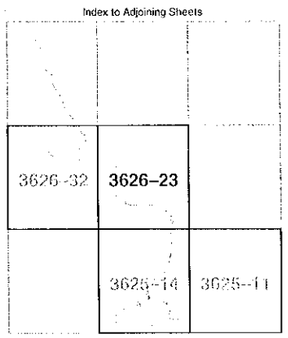
Location Diagram



Sheet Numbering Diagram Series 1:50,000



Index to Adjoining Sheets



SOURCES:

1:150,000 Sea Chart printed in Riyadh, K.S.A., by M.S.D. Sep. 1983 under supervision of Ports Authority. Sheet No. 13, 14.

Aerial photographs taken between 3 June and 12 July 1998.

Field surveys conducted in Feb. 1998, May - July 1998, Sep. - Nov. 1998, Feb. 1999 and June 1999.

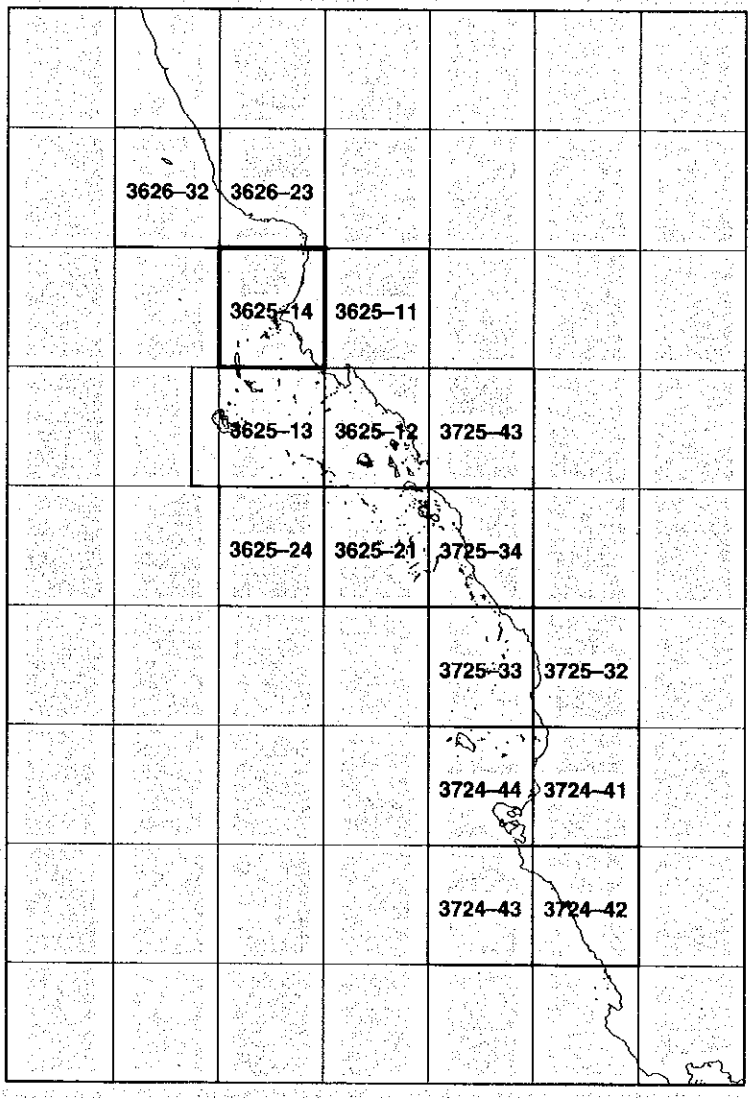
Universal Transverse Mercator Projection (U.T.M.).

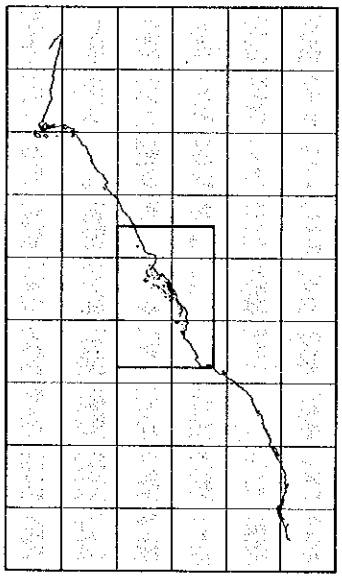
JICA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT (NCWCD), KINGDOM OF SAUDI ARABIA

THE STUDY ON COASTAL / MARINE HABITAT AND BIOLOGICAL INVENTORIES IN THE NORTHERN PART OF THE RED SEA COAST IN THE KINGDOM OF SAUDI ARABIA





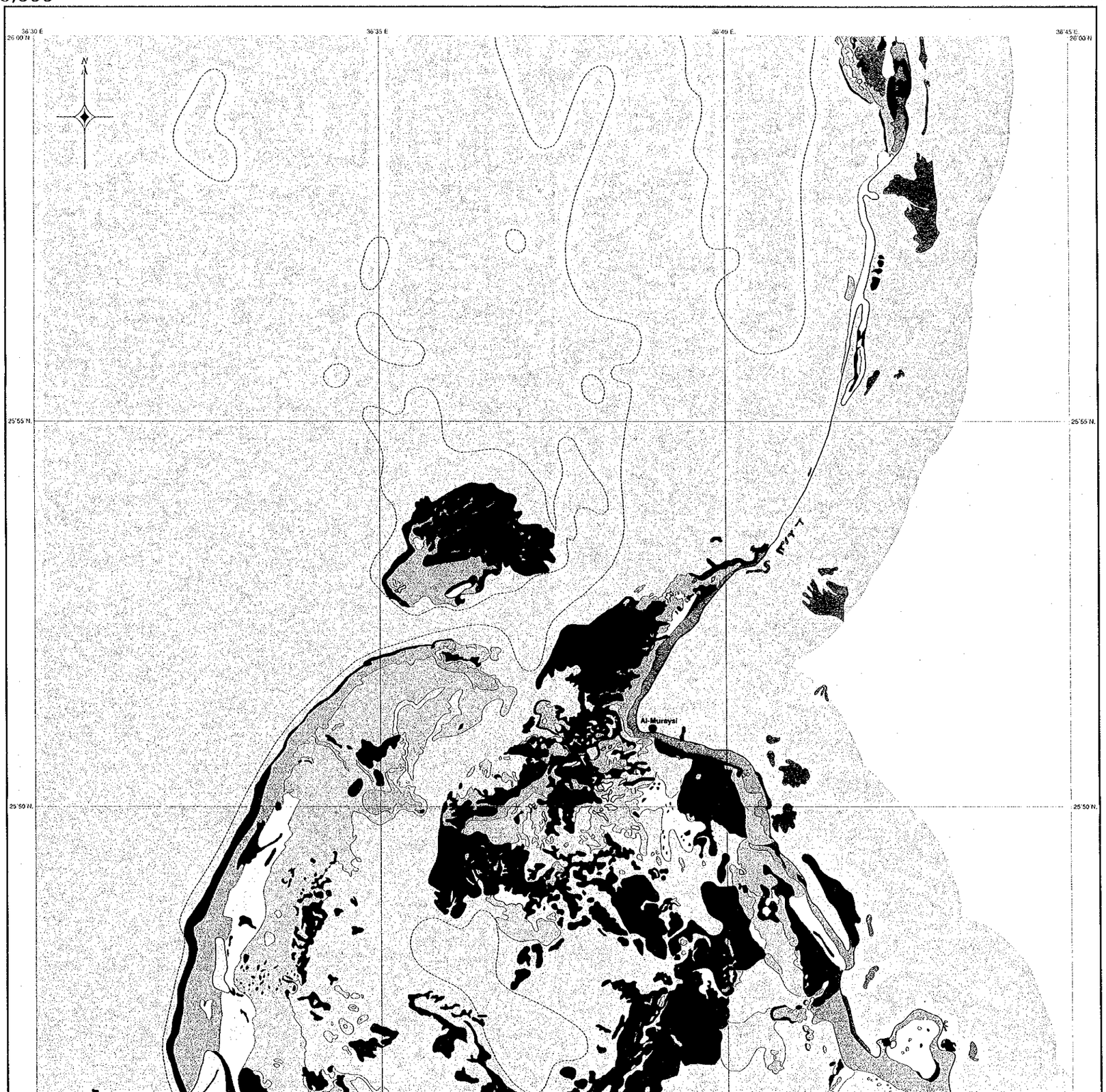
FINAL REPORT
HABITAT MAPS OF THE MODEL AREA
SCALE 1:50,000

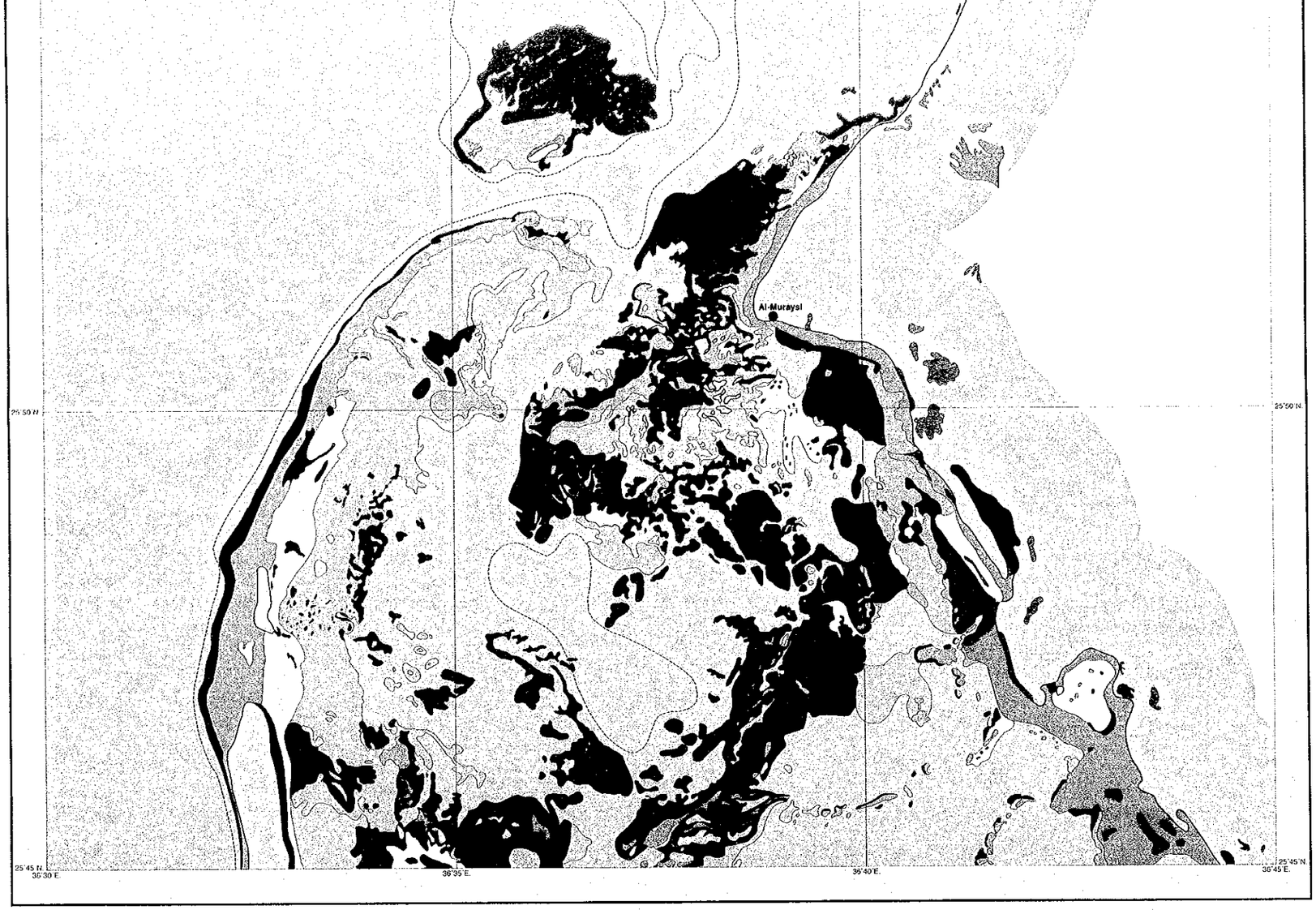
JAPAN WILDLIFE RESEARCH CENTER
SHIN-NIPPON METEOROLOGICAL & OCEANOGRAPHICAL CONSULTANT CO.,LTD.

HABITAT MAP

1:50,000

Sheet No. 3625–14



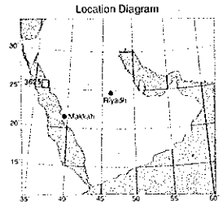


SCALE 1:50,000

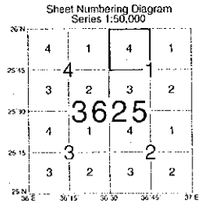
LEGEND

- Desert
- Tidal flat
- Emerged rock
- Mangrove
- Coastal vegetation
- Sabkhah (with Cyanophyceae and Salt marsh)
- Salt marsh
- Sand
- Mud
- Sand with Reef Patches (Coral less than 10%)
- Coral (coverage 11–30%)
- Coral (coverage 31–50%)
- Coral (coverage 51–75%)
- Coral (coverage 76–100%)
- Turf / Small algae
- Macro algae
- Seagrass
- Cyanophyceae (Blue-green algae)
- Sea
- Island
- Farm
- Fence of livestock
- Town area
- Factory
- Fishing port
- Coast line
- -20m (Depth)

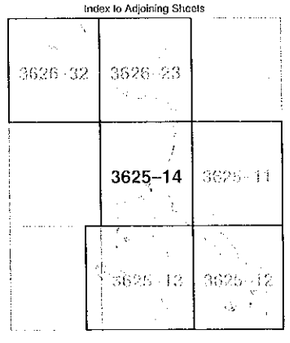
Location Diagram



Sheet Numbering Diagram
Series 1:50,000



Index to Adjoining Sheets



SOURCES:
1:150,000 Sea Chart printed in Riyadh, K.S.A., by M.S.D. Sep. 1983 under supervision of Ports Authority. Sheet No. 14, 15.
Copyright reserved by Ports Authority.
Aerial photographs taken between 3 June and 12 July 1998.
Field surveys conducted in Feb. 1998, May - July 1998, Sep. - Nov. 1998, Feb. 1999 and June 1999.

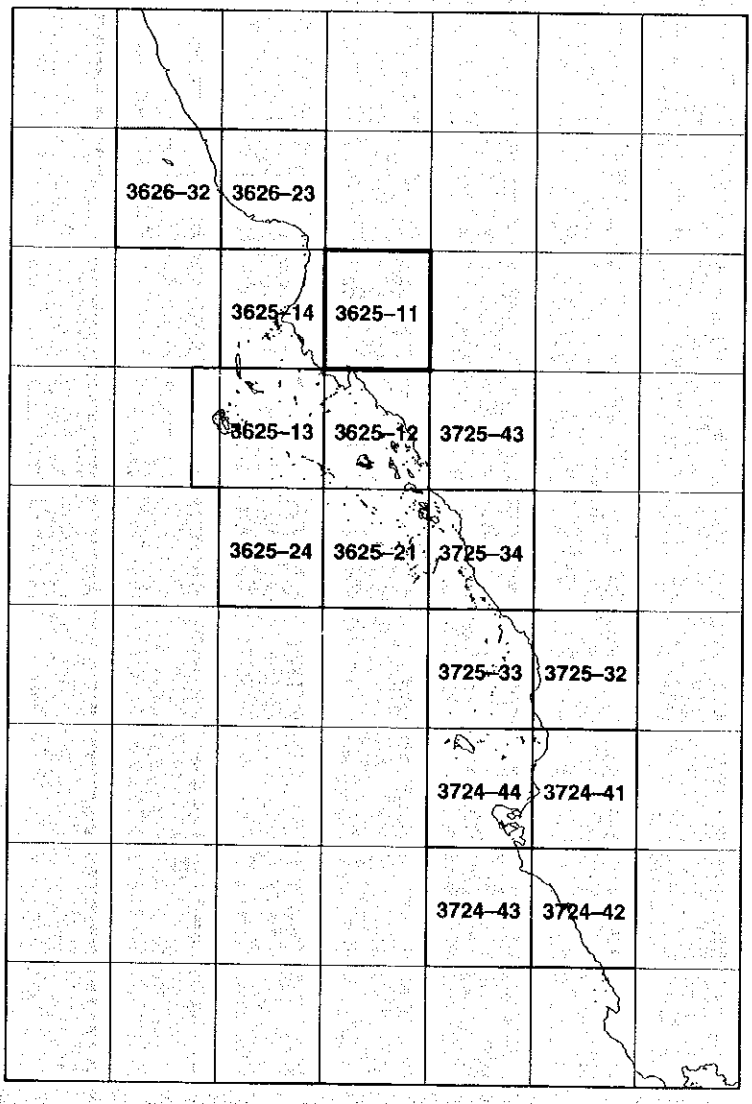
Universal Transverse Mercator Projection (U.T.M.).

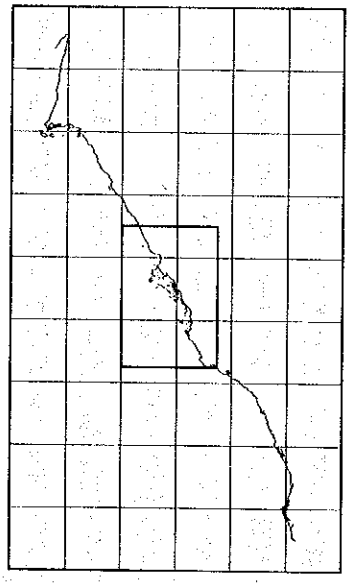
JICA

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NATIONAL COMMISSION FOR WILDLIFE CONSERVATION AND DEVELOPMENT (NCWCD), KINGDOM OF SAUDI ARABIA

THE STUDY ON COASTAL / MARINE HABITAT AND BIOLOGICAL INVENTORIES IN THE NORTHERN PART OF THE RED SEA COAST IN THE KINGDOM OF SAUDI ARABIA





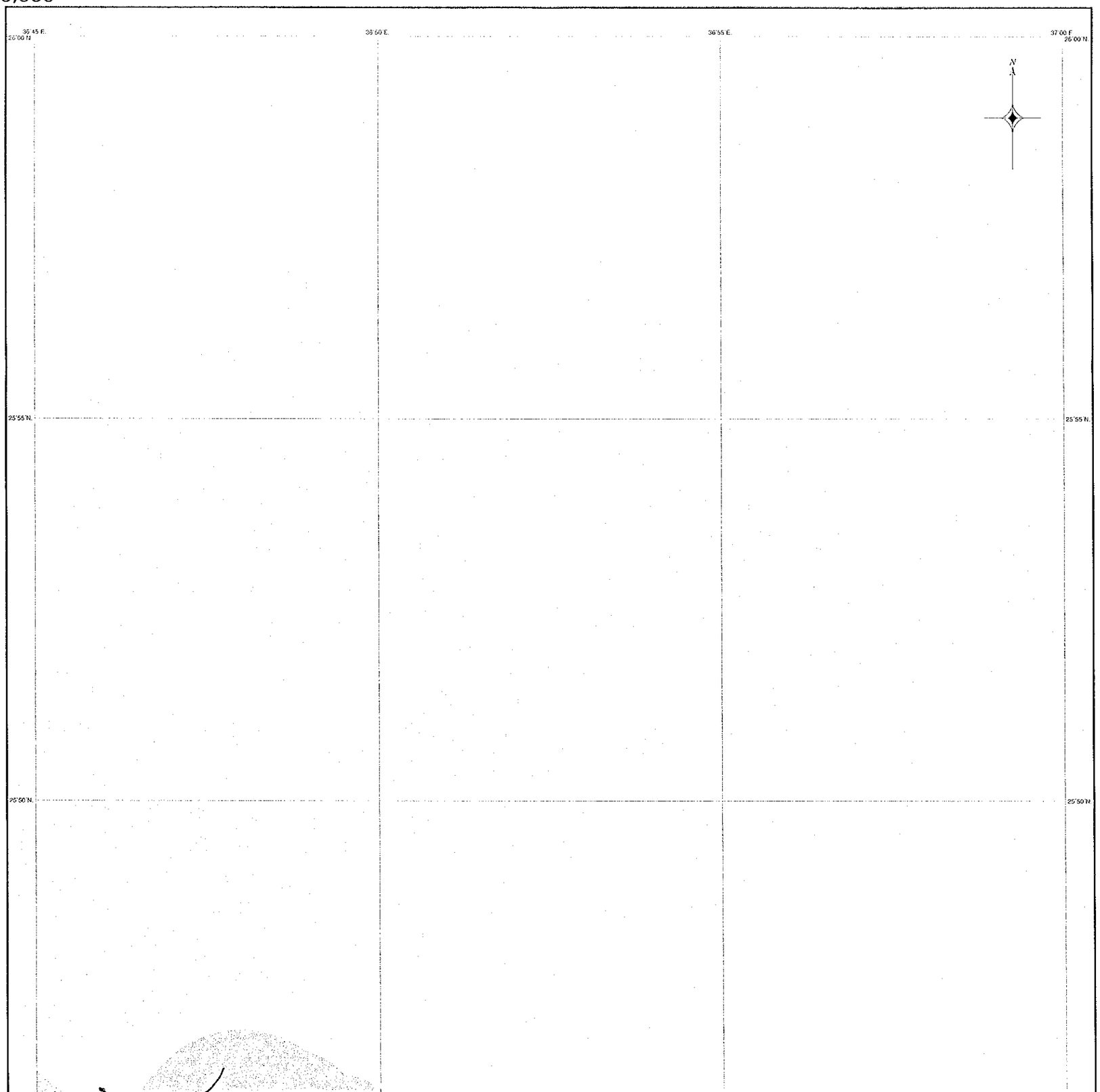
FINAL REPORT
HABITAT MAPS OF THE MODEL AREA
SCALE 1:50,000

JAPAN WILDLIFE RESEARCH CENTER
SHIN-NIPPON METEOROLOGICAL & OCEANOGRAPHICAL CONSULTANT CO.,LTD.

HABITAT MAP

1:50,000

Sheet No. 3625–11



25°50 N.

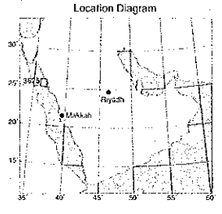
25°45 N.
36°45 E.
36°50 E.
36°55 E.
37°00 E.

SCALE 1:50,000

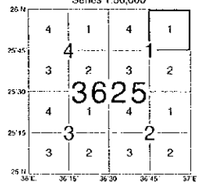
LEGEND

- Desert
- Tidal flat
- Emerged rock
- Mangrove
- Coastal vegetation
- Sabkhah (with Cyanophyceae and Salt marsh)
- Salt marsh
- Sand
- Mud
- Sand with Reef Patches (Coral less than 10%)
- Coral (coverage 11–30%)
- Coral (coverage 31–50%)
- Coral (coverage 51–75%)
- Coral (coverage 76–100%)
- Turf / Small algae
- Macro algae
- Seagrass
- Cyanophyceae (Blue-green algae)
- Sea
- Island
- Farm
- Fence of livestock
- Town area
- Factory
- Fishing port
- Coast line
- -20m (Depth)

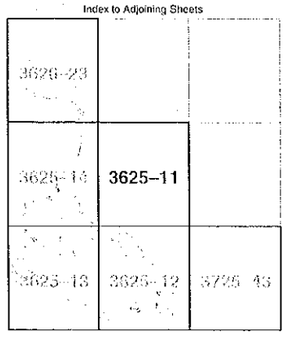
Location Diagram



Sheet Numbering Diagram
Series 1:50,000



Index to Adjoining Sheets



SOURCES:
1:150,000 Sea Chart printed in Riyadh, K.S.A., by M.S.D. Sep. 1983 under supervision of Ports Authority. Sheet No. 14, 15.
Copyright reserved by Ports Authority.
Aerial photographs taken between 3 June and 12 July 1998.
Field surveys conducted in Feb. 1998, May - July 1998, Sep. - Nov. 1998, Feb. 1999 and June 1999.

Universal Transverse Mercator Projection (U.T.M.).

JICA