

A group of dugongs (manatees) are swimming in the clear blue ocean. Their heads and backs are visible above the water's surface. The background is a vast expanse of blue water meeting a clear sky at the horizon.

# Dugong-Seagrass Research and Management in Kingdom of Bahrain

Presented by

**Ali Mansoor**

**Abdulqader Khamis**

# Key Points

**Introduction**

**Objectives**

**Study Area**

**Methods**

**Dugong Herbivory**

**Seagrass Ecology**

**Threats**

**Management**



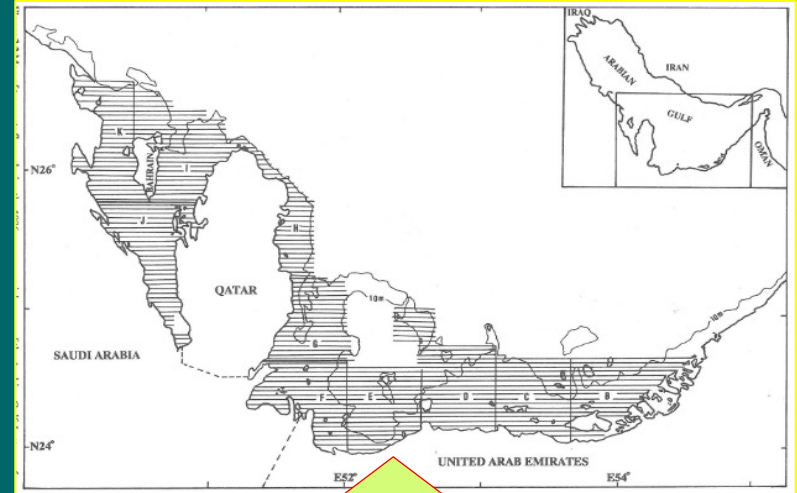
Intro.

# Arabian Gulf Dugongs

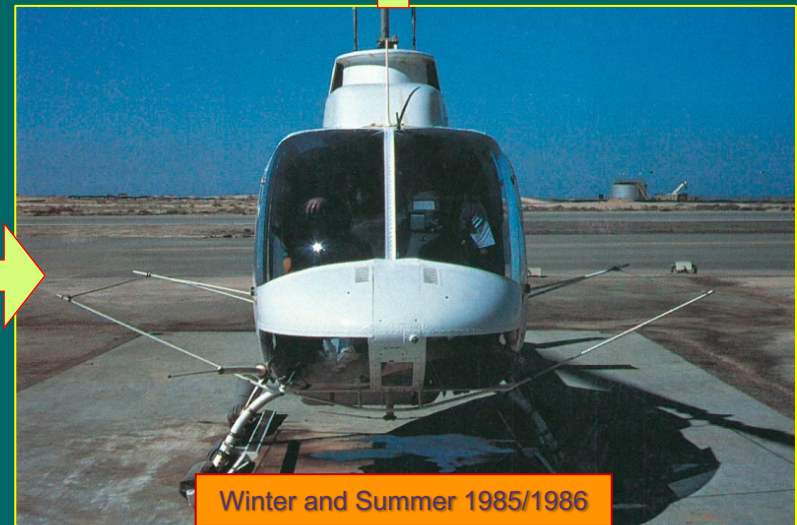
## Historical Background



1983 Nowruz Oil Field Spills



37 dugong carcasses



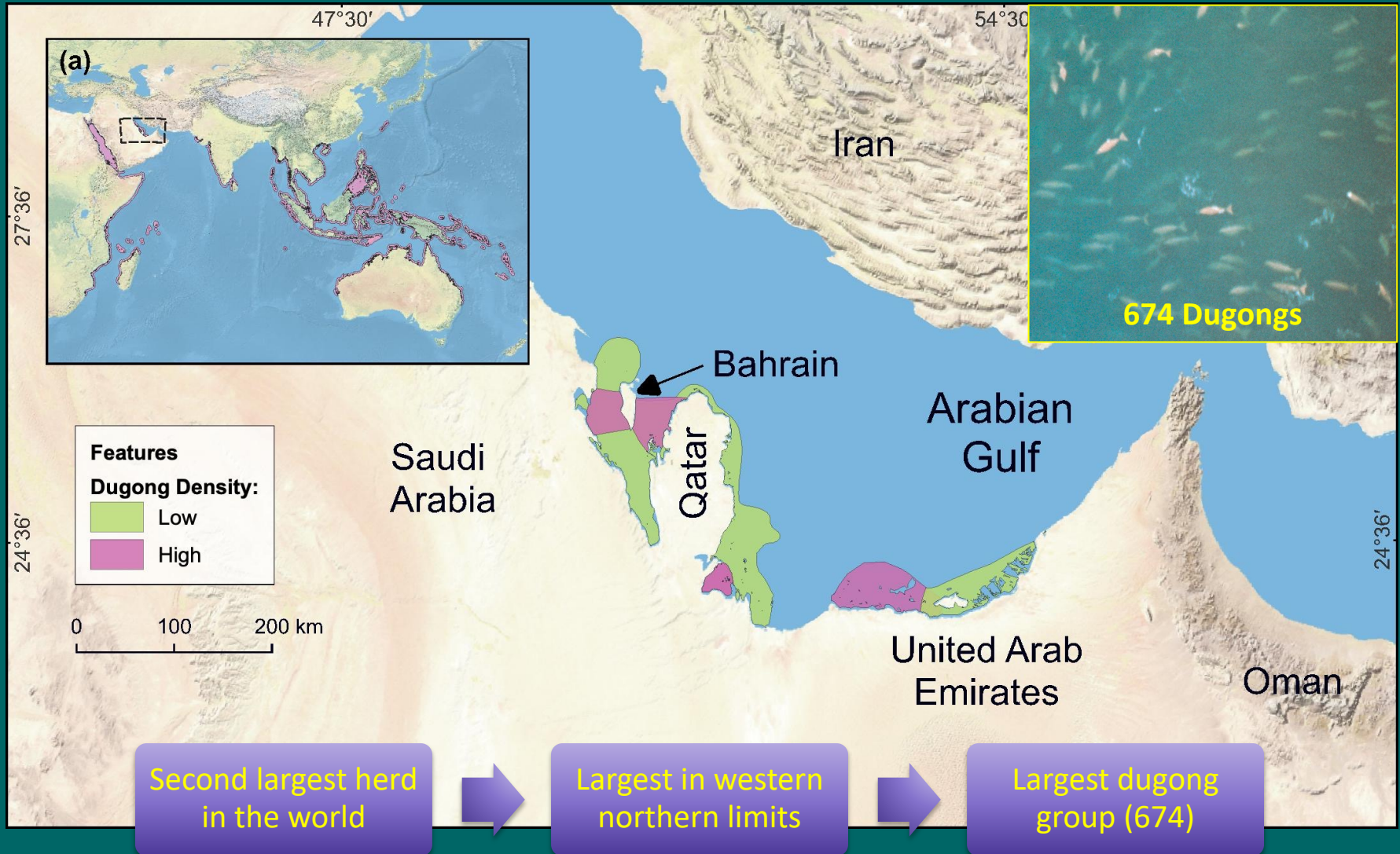
Winter and Summer 1985/1986

1: [www.takepart.com](http://www.takepart.com); 2: Heinsohn and Spain (1974); 3 & 4: Preen, A. (1989). The status and conservation of dugongs in the Arabian Region (MEPA Coastal and Marine Management Series, Report No. 10). Meteorological and Environmental Protection Administration (MEPA).

Intro.

# Arabian Gulf Dugongs

## International Importance

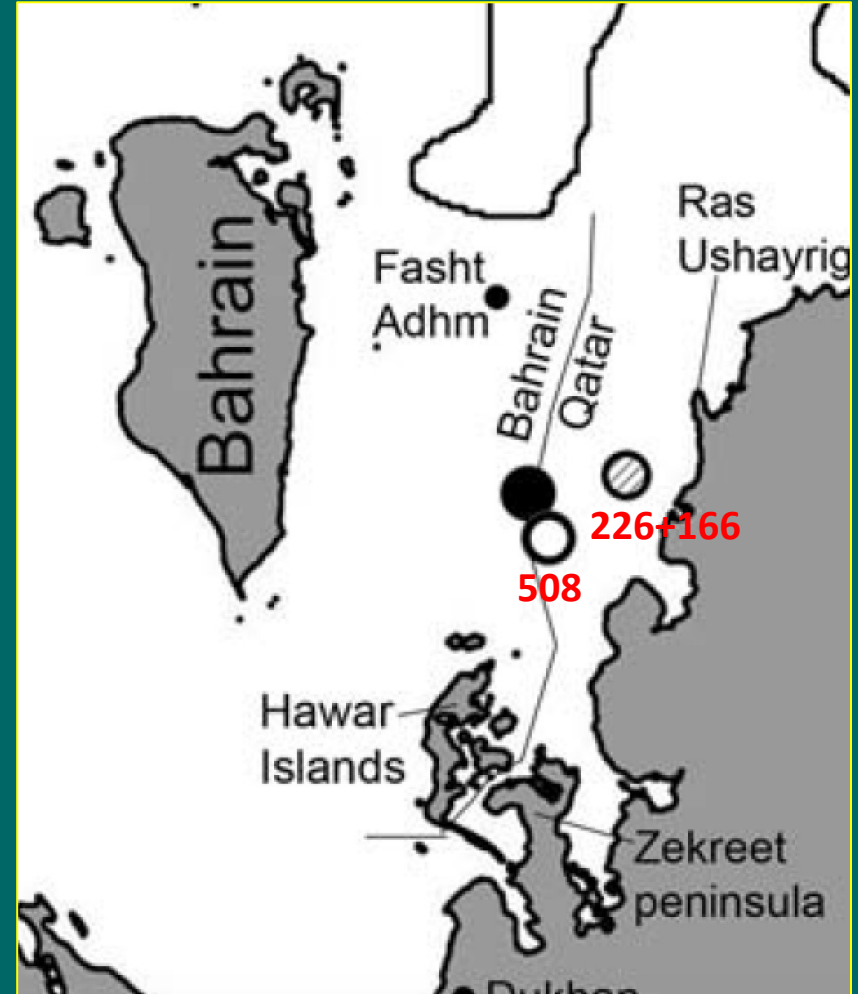
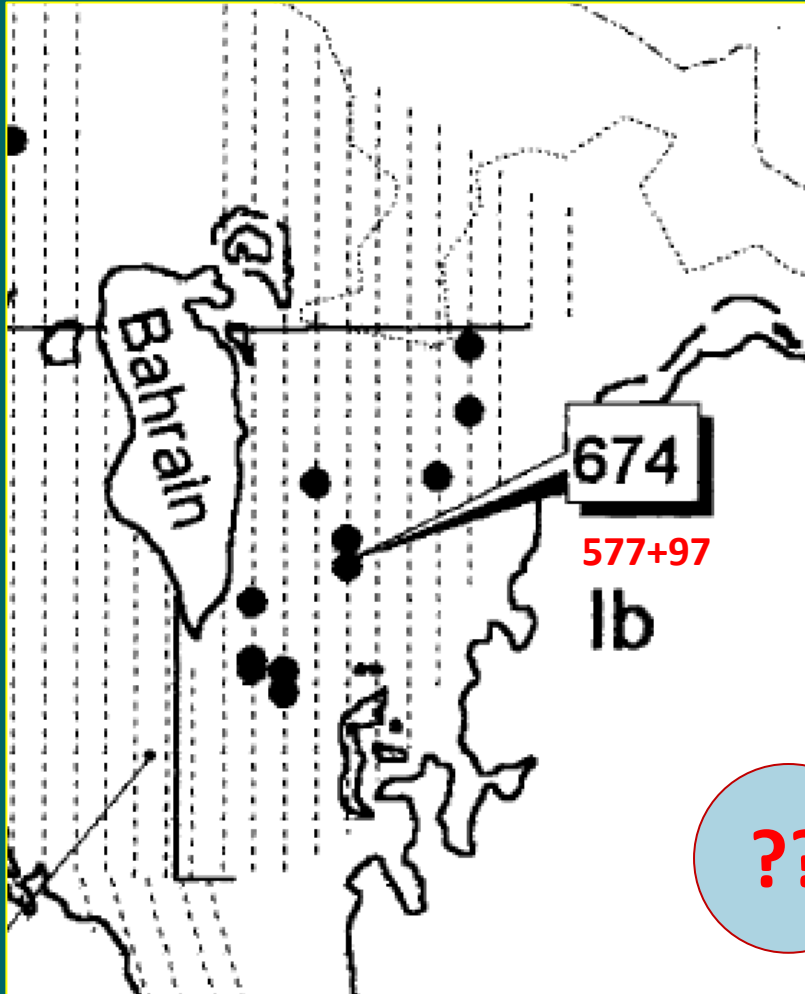


1: [www.iucnredlist.org](http://www.iucnredlist.org); 2: Preen, A. (1989). The status and conservation of dugongs in the Arabian Region (MEPA Coastal and Marine Management Series, Report No. 10). Meteorological and Environmental Protection Administration (MEPA).

Intro.

# Arabian Gulf Dugongs

## Rare Dugong Grouping Behavior



1: Preen, A. (2004). Distribution, Abundance and Conservation Status of Dugongs and Dolphins in the Southern and Western Arabian Gulf. *Biological Conservation*. Vol. 118: 205-218.

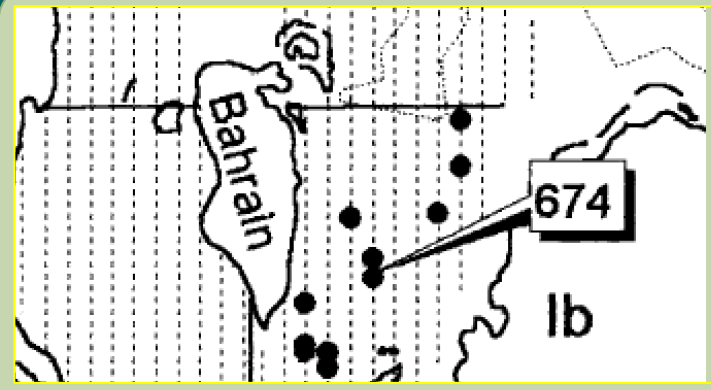
Marshall, C., Al-Ansi, M., Dupont, J., Warren, C. and Al-Shaikh, I. (2018). Large Dugong (*Dugong dugong*) Aggregations Persists in Coastal Qatar. *Marine Mammal Science*. Vol. 34(4): 1154-1163.

## Aim

# Objectives



**Dugong Occupancy/Persistence**



**Dugong Grouping Behavior**



**Dugong-Seagrass Interactions**



**Conservation Management**

**Aim**

# Key Research Question

## Dugong-Seagrass Dynamics in a Harsh Environment

Salinity: 41.5–65‰

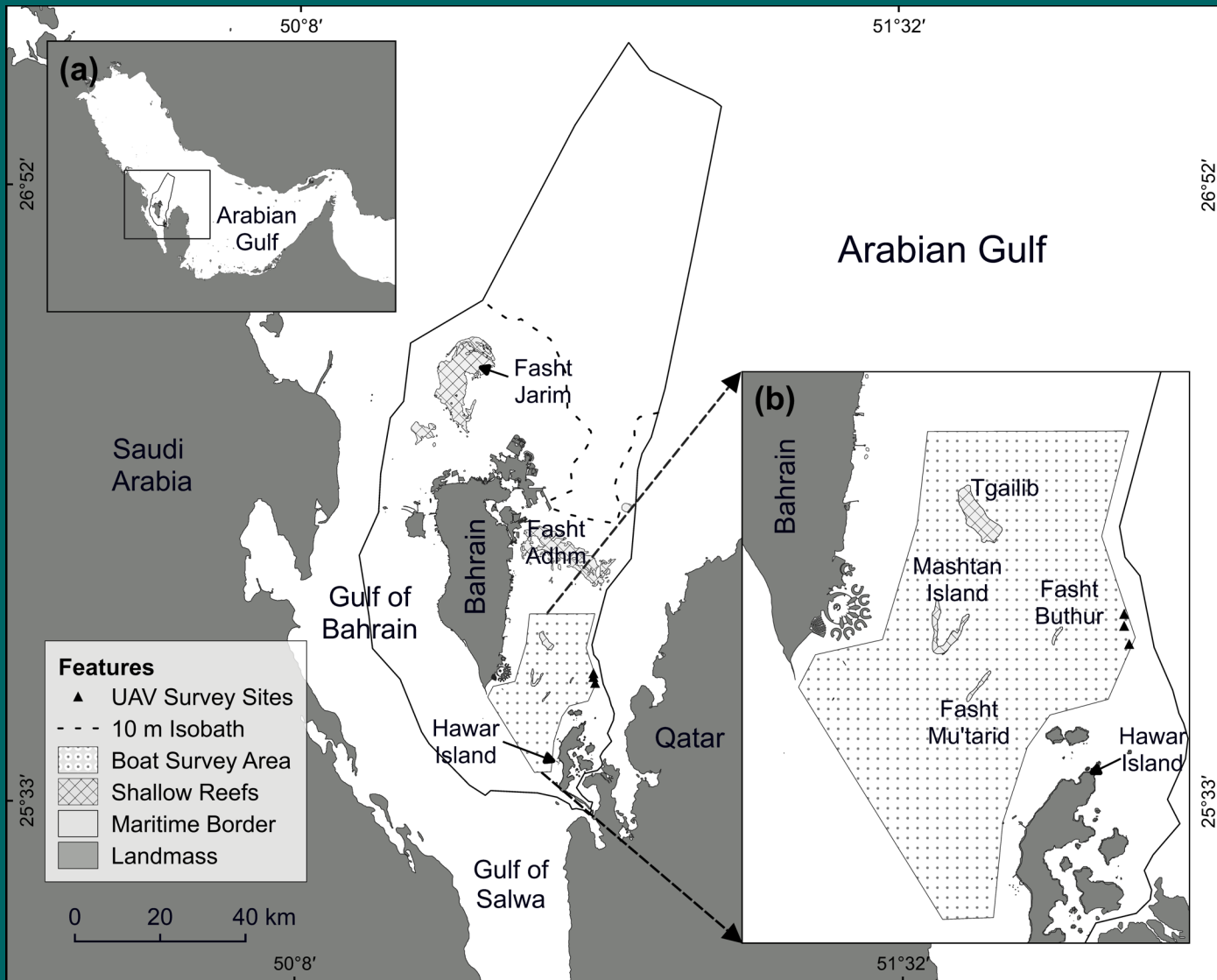


Pressure

Response



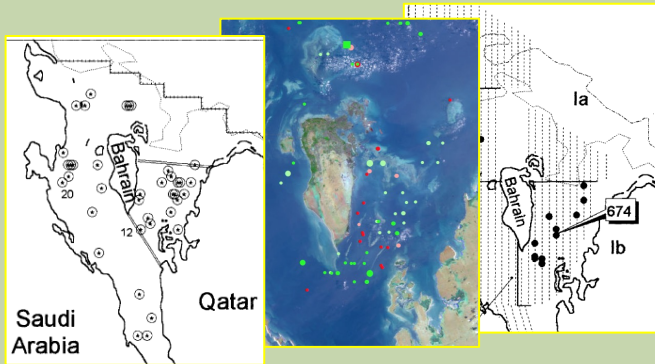
Temperature: 13.3–39 °C





# Multidisciplinary Approach

## Part-1



**Historical Records**



**Structured Interviews**



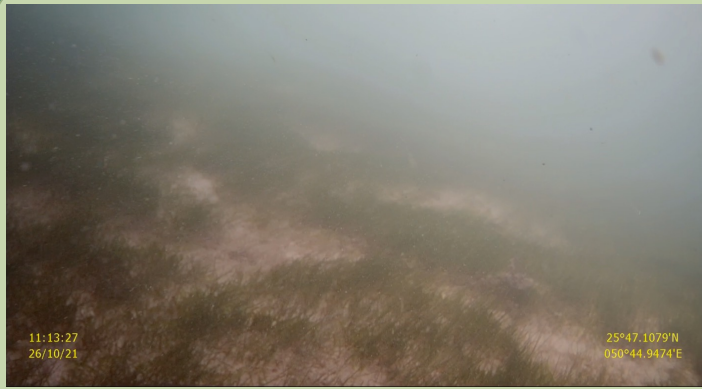
**Citizen Science Network**



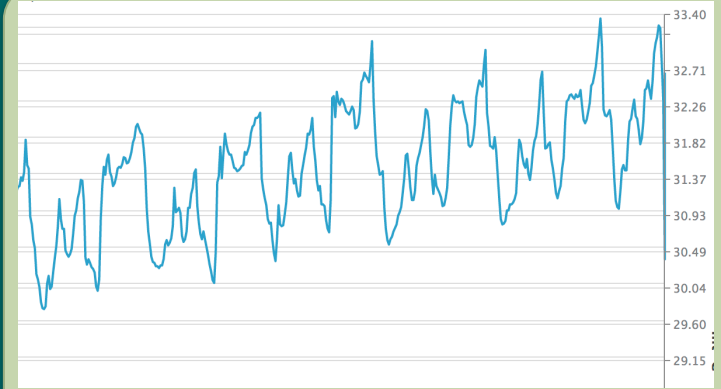
**Ad hoc Boat Surveys**

# Multidisciplinary Approach

## Part-2



**Towed Video Surveys**



**Water Quality Monitoring**



**In-water Ecological Surveys**



**In-water Experiments**

# Multidisciplinary Approach

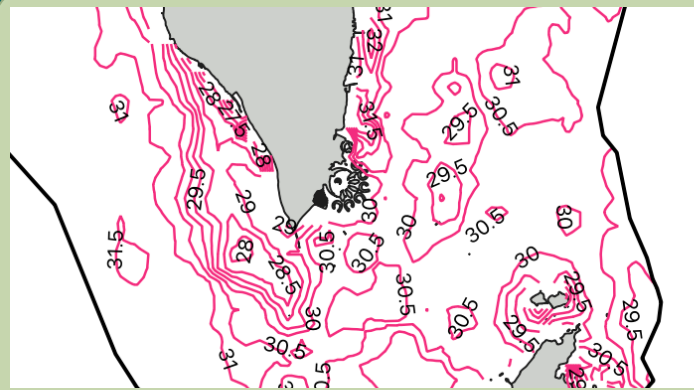
## Part-3



Ad hoc Drone Survey



Ad hoc Helicopter Survey



Remote Sensing (SST) | GIS

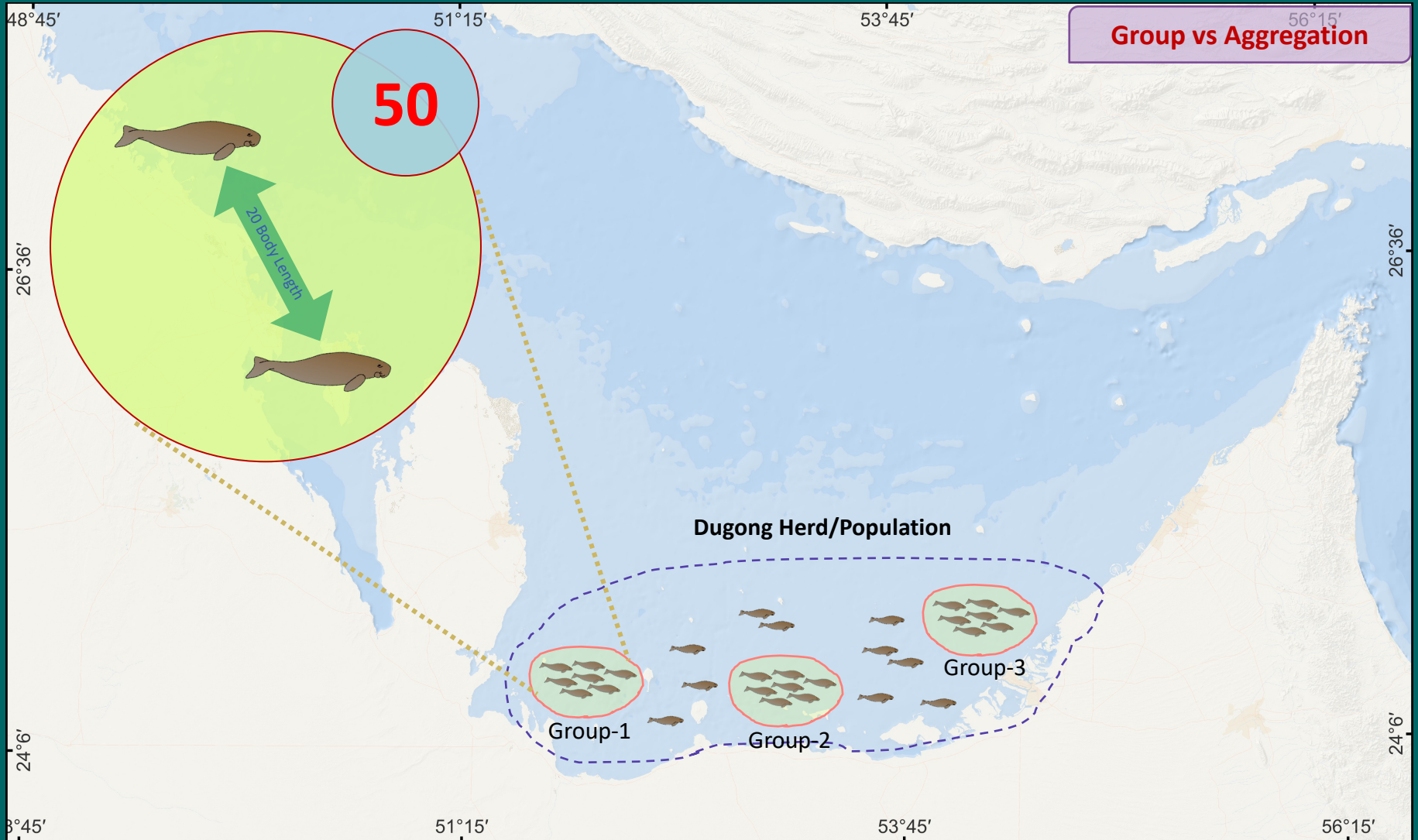


Occupancy Modelling

Method

# Dugong Occupancy

## Term Definition

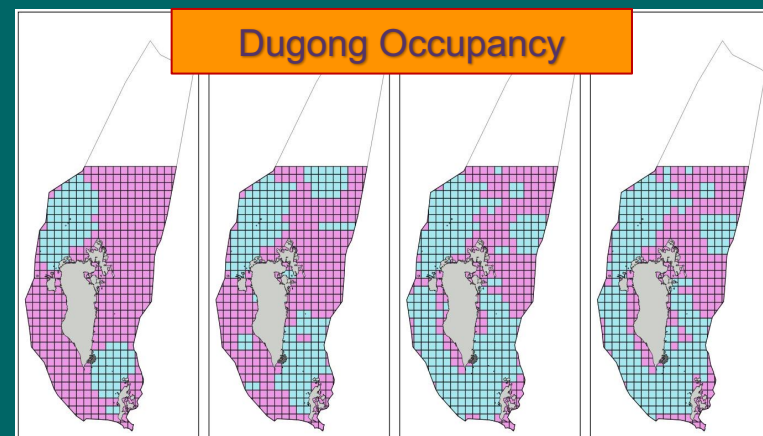


Scattered Dugong Group: Preen (1989); Marine Mammal Group: Acevedo-Gutierrez (2009)

Results

# Dugong Occupancy

## Persistence of Scattered Dugongs

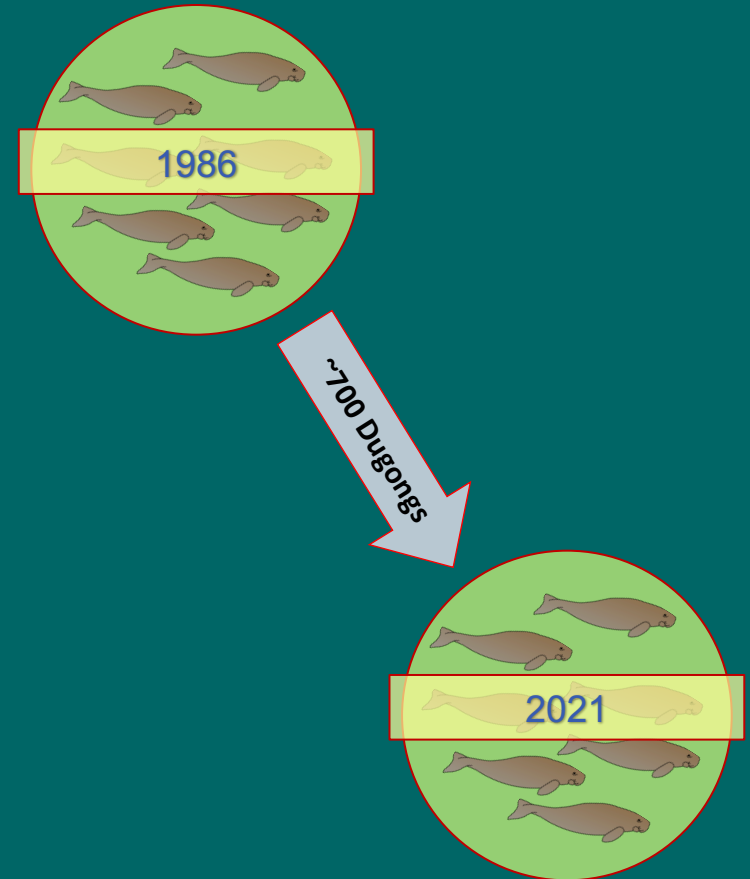
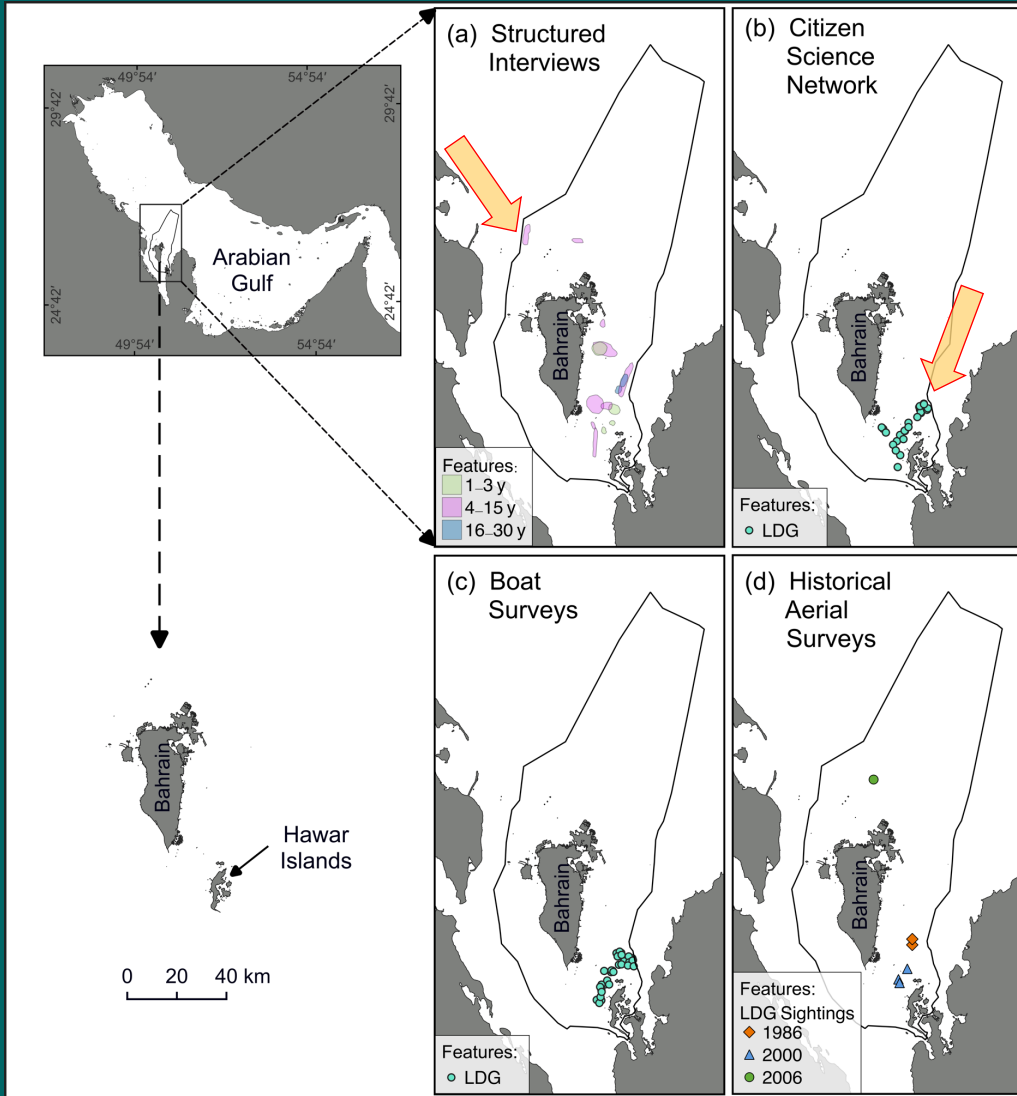


1986 vs 2006 Surveys

Results

# Dugong Occupancy

## Persistence of LDGs



Results

# Dugong Occupancy

## Difficulties in Sighting LDGs



Largest LDG (~700 Dugongs)

2.66–5.15 Correction Factor

Results

# Dugong Occupancy

## Dugong Grouping Behavior



Count Variable

Size Variable

Sizeable ( $\sim 700$ )

Clumped (Layers)

Calf (6%)-Dense



**Result**

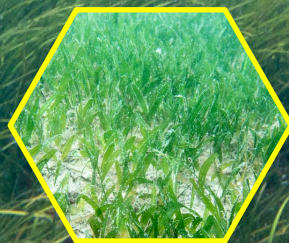
# Seagrass Ecology

## Current Status

- 1- Healthy
- 2- Extensive
- 3- Dense
- 4- Three species
- 5- Mixed meadows



*Halodule uninervis*



*Halophila stipulacea*



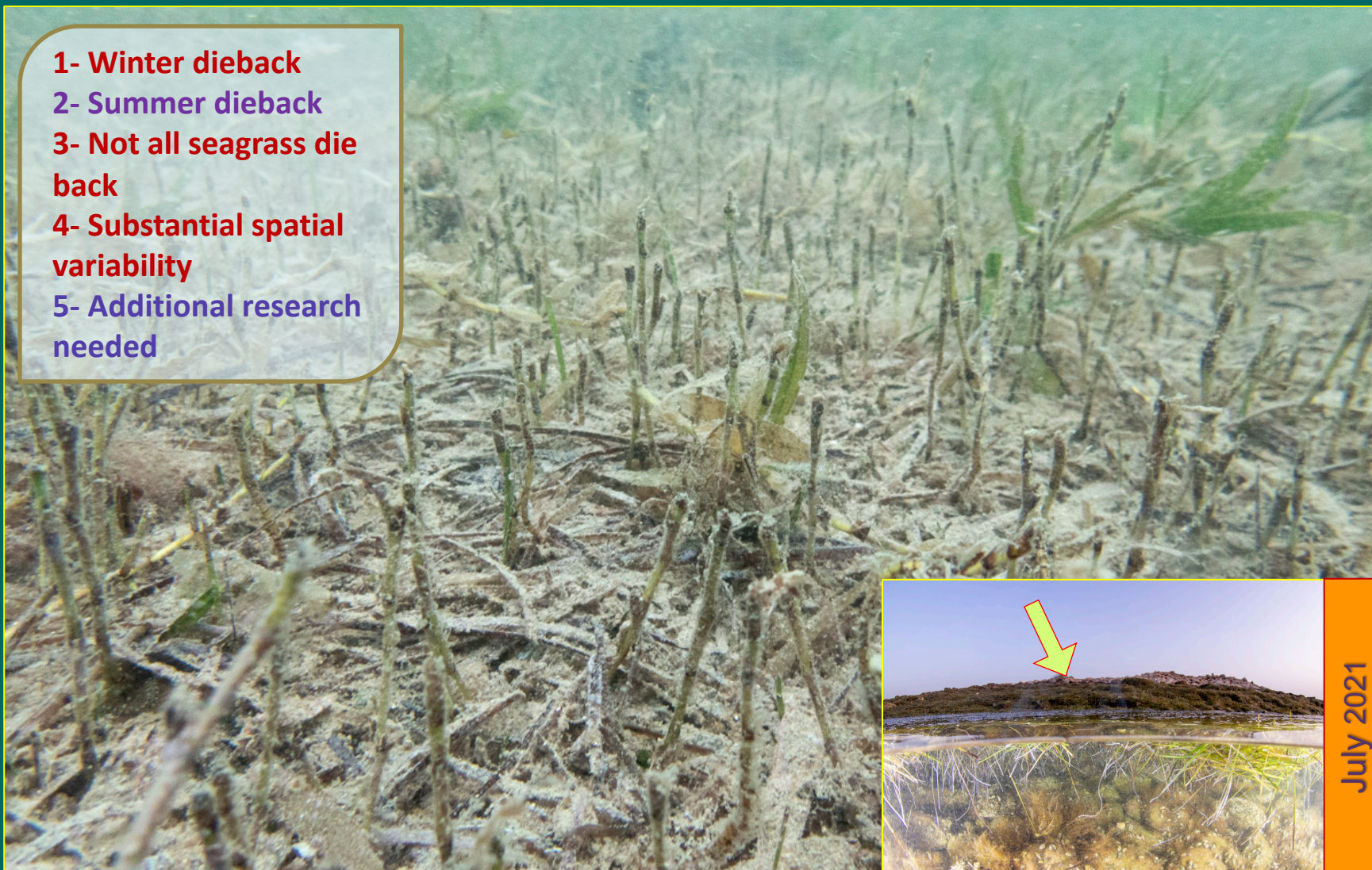
*Halophila ovalis*

**Result**

# Seagrass Ecology

## Current Status-Seasonality

- 1- Winter dieback
- 2- Summer dieback
- 3- Not all seagrass die back
- 4- Substantial spatial variability
- 5- Additional research needed

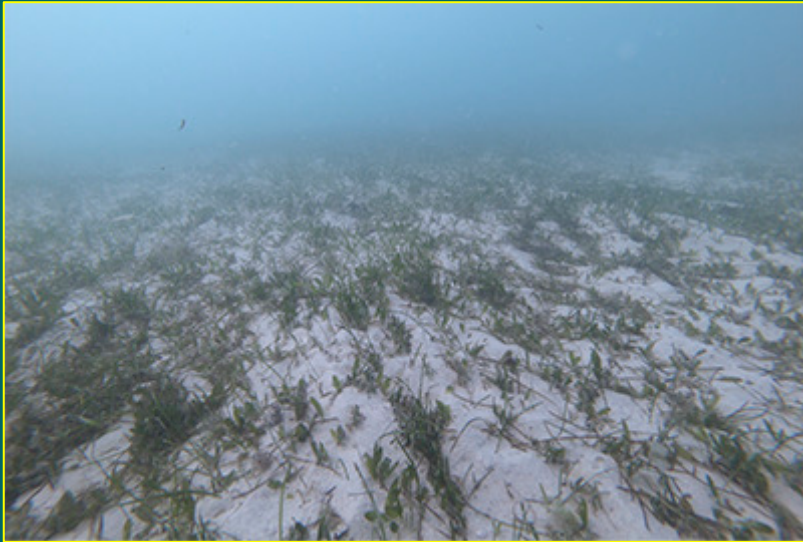


July 2021

**Result**

# Anthropogenic Threats

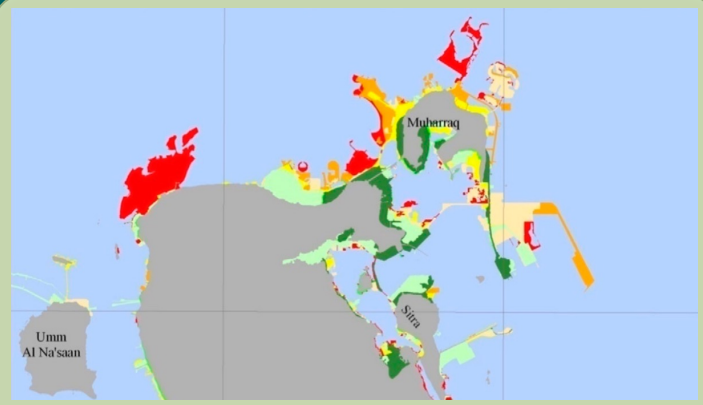
## Seagrass Die off and Eutrophication



**Intro.**

# Anthropogenic Threats

## Direct and Indirect Threats to Dugongs



**Habitat Deterioration/Destruction**



**Net Entanglement**



**Marker Buoy Entanglement**



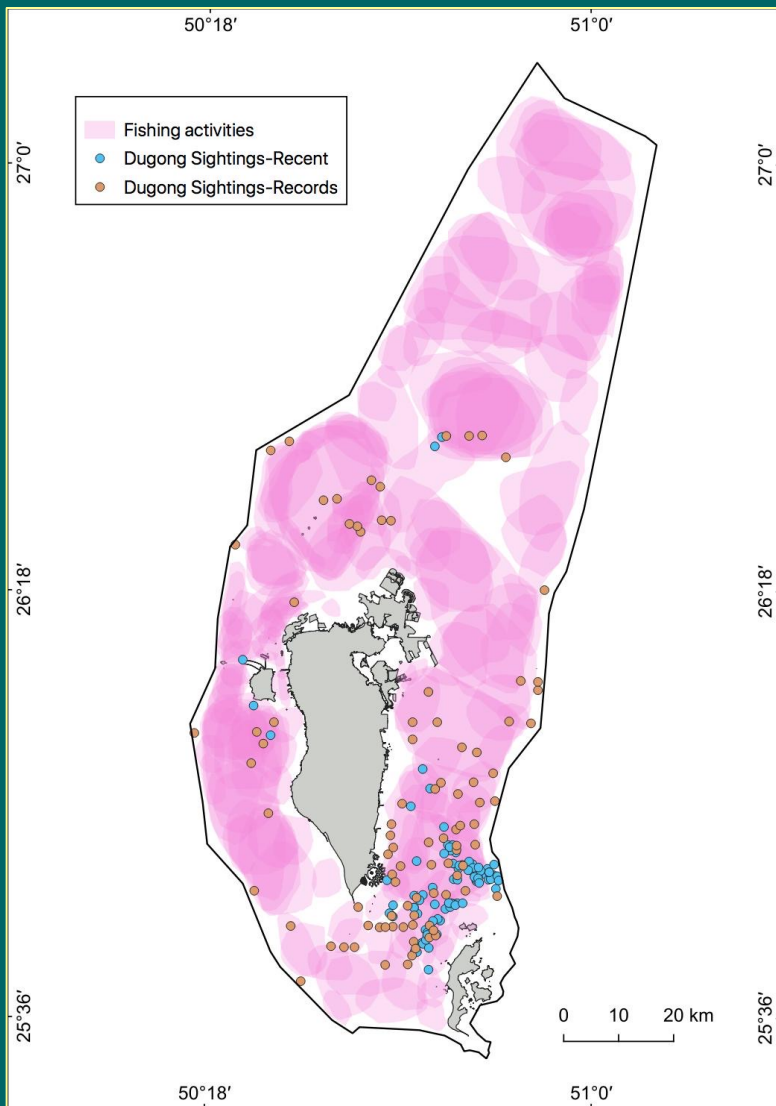
**Boat Disturbance and Strikes**

1: Zainal, K., Al-Madany, I., Al-Sayed, H., Khamis, A., Al Shuhaby, S., Al Hisaby, A., Elhoussiny, W., & Khalaf, E. (2012). The cumulative impacts of reclamation and dredging on the marine ecology and land-use in the Kingdom of Bahrain. *Marine Pollution Bulletin*, 64, 1452–1458.

<https://doi.org/10.1016/j.marpolbul.2012.04.004>; 2: [www.thenational.ae](http://www.thenational.ae)

Results

# Anthropogenic Threats Intensifying Fishing Pressures



**Multidecadal coexistence between  
dugongs and fishers**

Manag.

# Conservation Management

## Dugong-Seagrass Interaction Dynamics

### DUGONGS

Largest groups

Most clumped groups



Rapid Recovery

### SEAGRASS

Shallow

Sheltered

Soft sediment

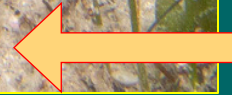
Dense seagrass

Extensive meadows

High temperature  
(16–37 °C)

High Salinity  
(42–53 ‰)

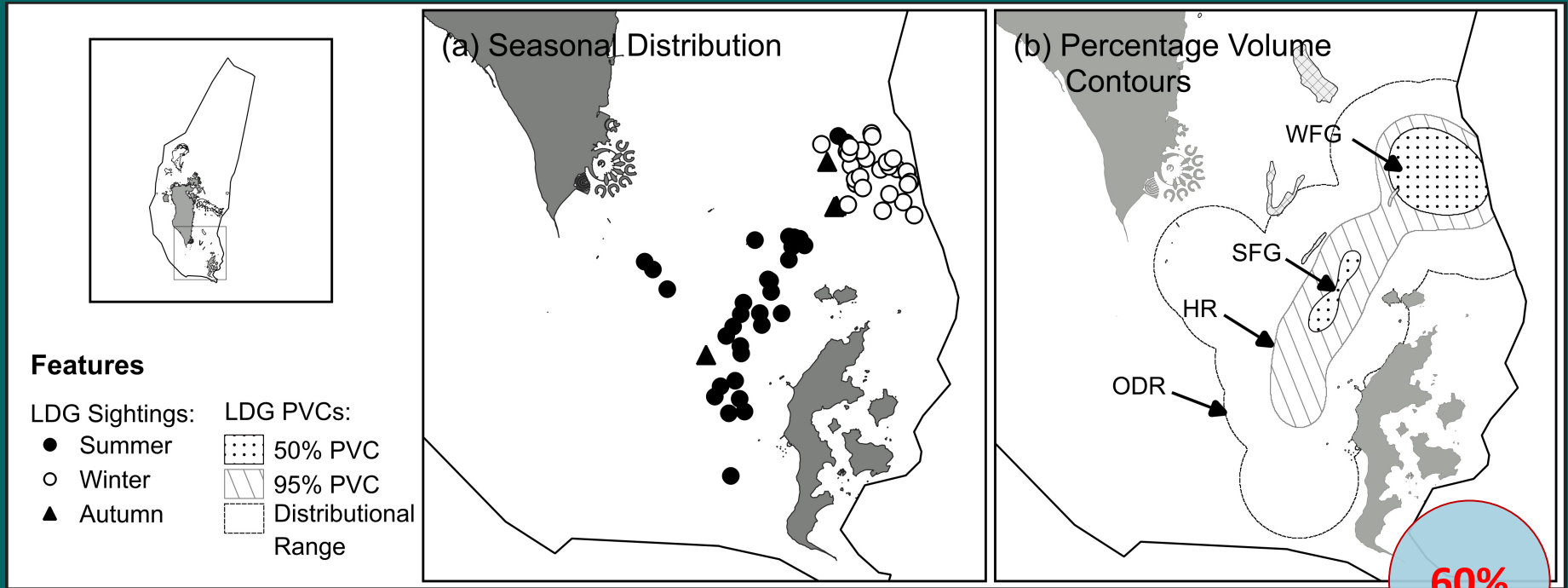
Only 3 pioneers



Manag.

# Conservation Management

## Dugong Core Aggregation Sites



Sparse vs Dense Dugong Population

High-use Areas (Pragmatic Approach)

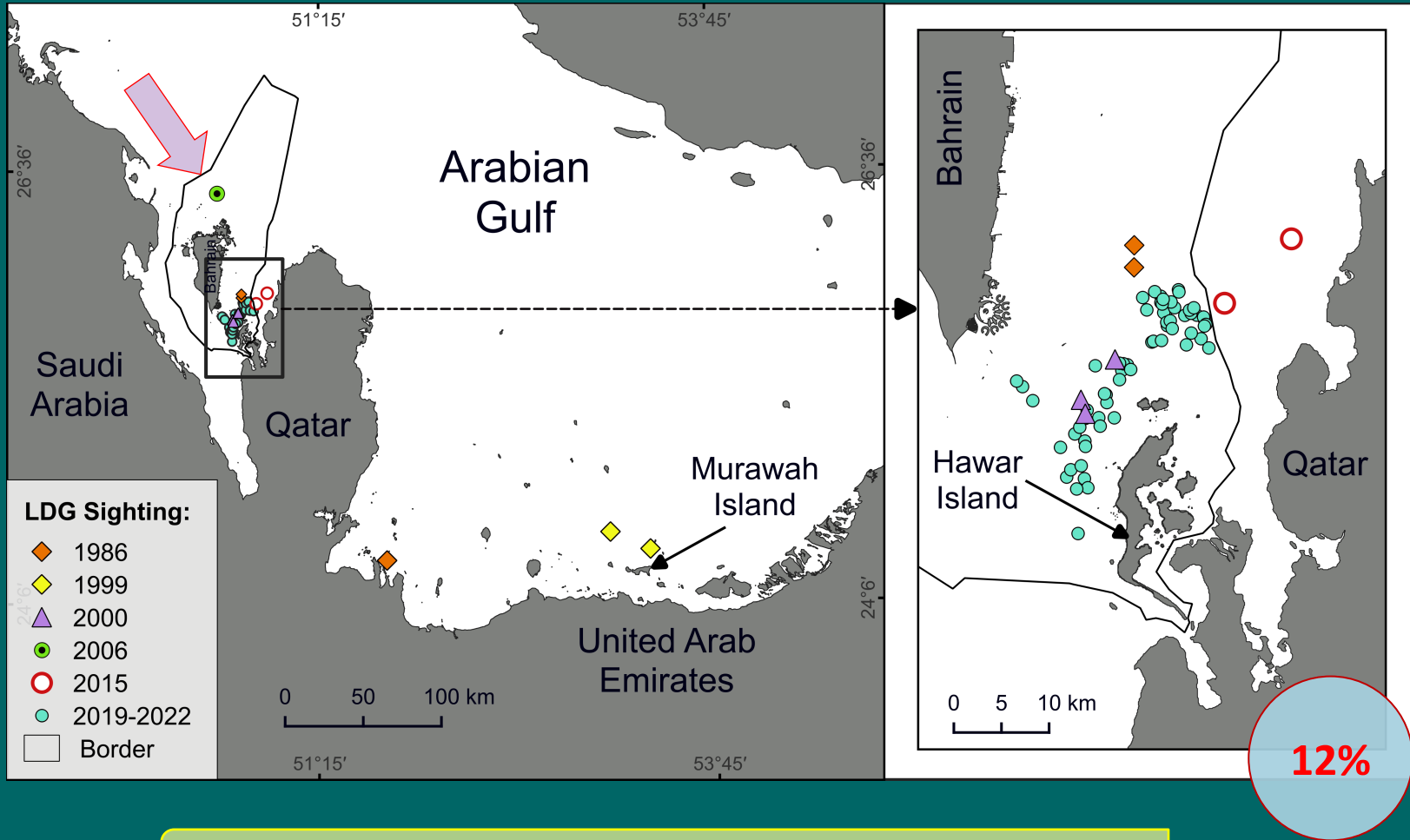
Site-level Threats (High Vulnerability)

Seasonal Management

Manag.

# Conservation Management

## The Role of Regional Collaboration



**Incorporating Grouping Behavior in Dugong Conservation Management**

**Characteristic Feature**

**Socially Transmitted Knowledge**

**Reduced Vulnerability to Threats**



Manag.

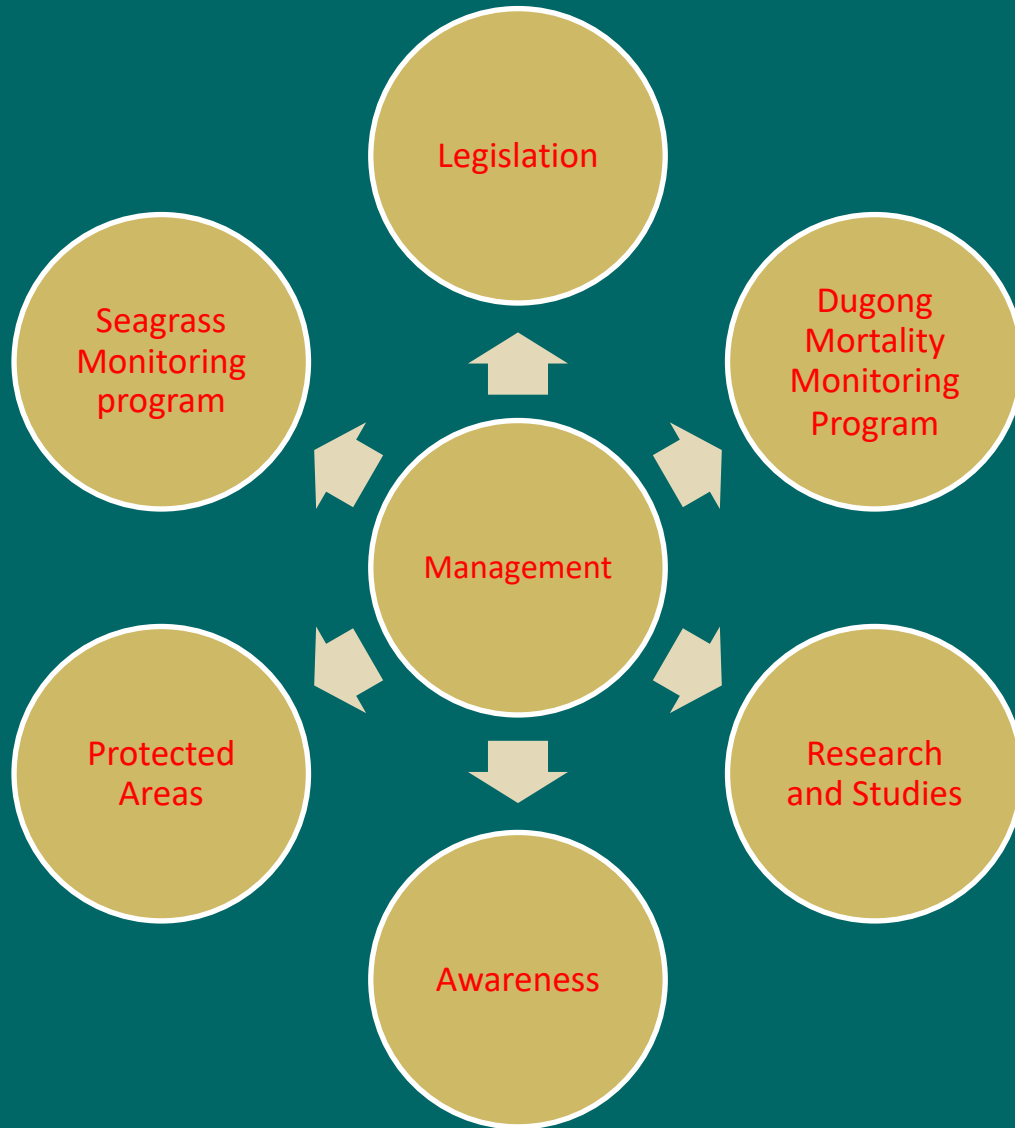
# Conservation Management Stressing the Human Dimension



Intro.

# Dugong conservation Management

## Supreme Council for Environment



Thank you ...



Abdulqader Khamis

# Arabian Gulf Dugongs

## Data Deficient Sizeable Gregarious Dugong Population

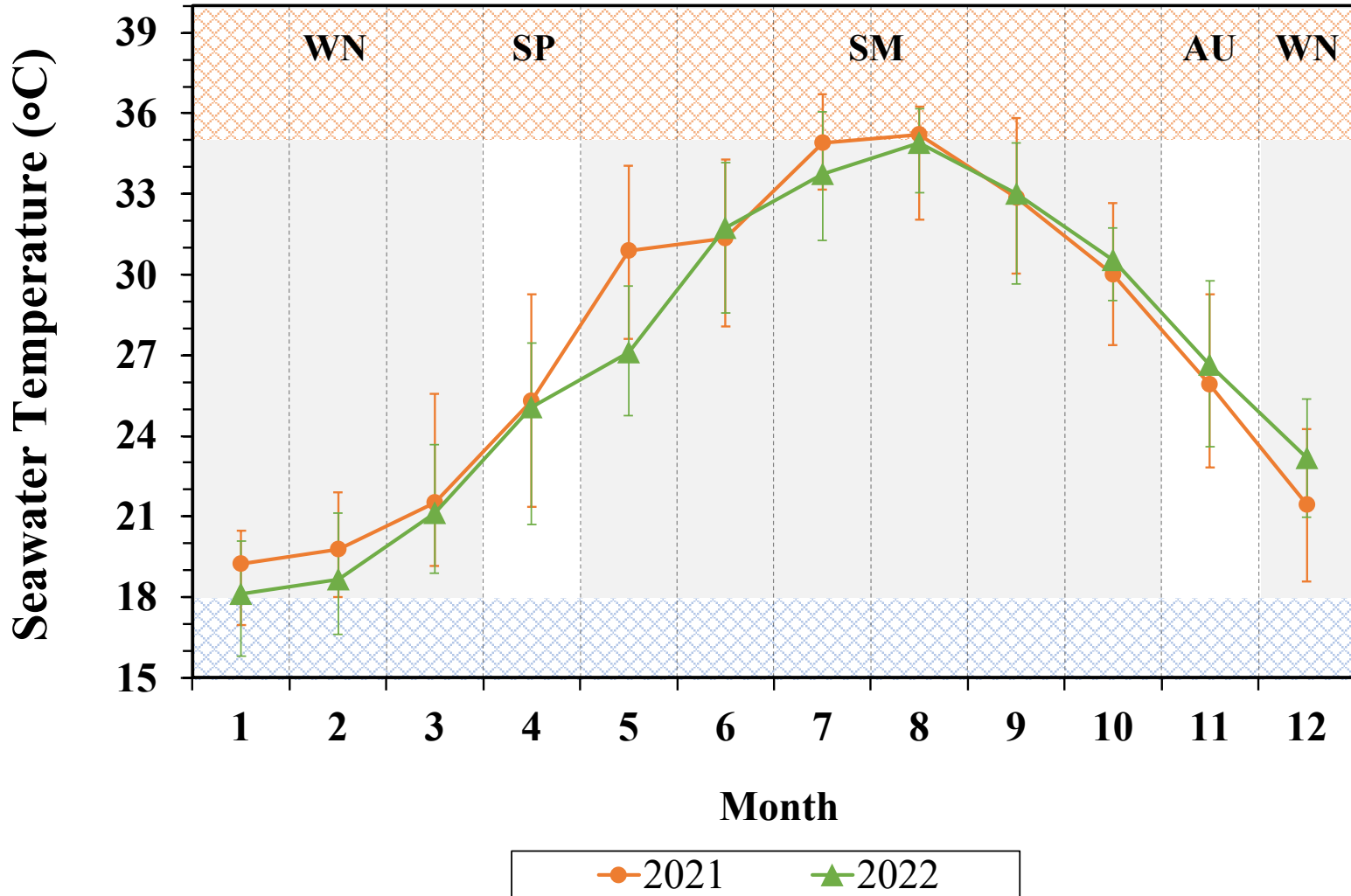
### Rationale

- Globally-important **dugong population** (population size & grouping behavior).
- Ecologically and socio-economically important **seagrass meadows**.
- **Research** on seagrass and dugongs is very scarce.
- **No study** has investigated dugong-seagrass interactions.
- Intensifying anthropogenic **threats** at habitat and species levels.
- Difficulty in designing **dugong MPAs** (large dugong home range & extensive seagrass beds).
- Dugong is a **flagship** species (promote seagrass conservation).



# Harsh Environmental Settings

## Seawater Temperature



37

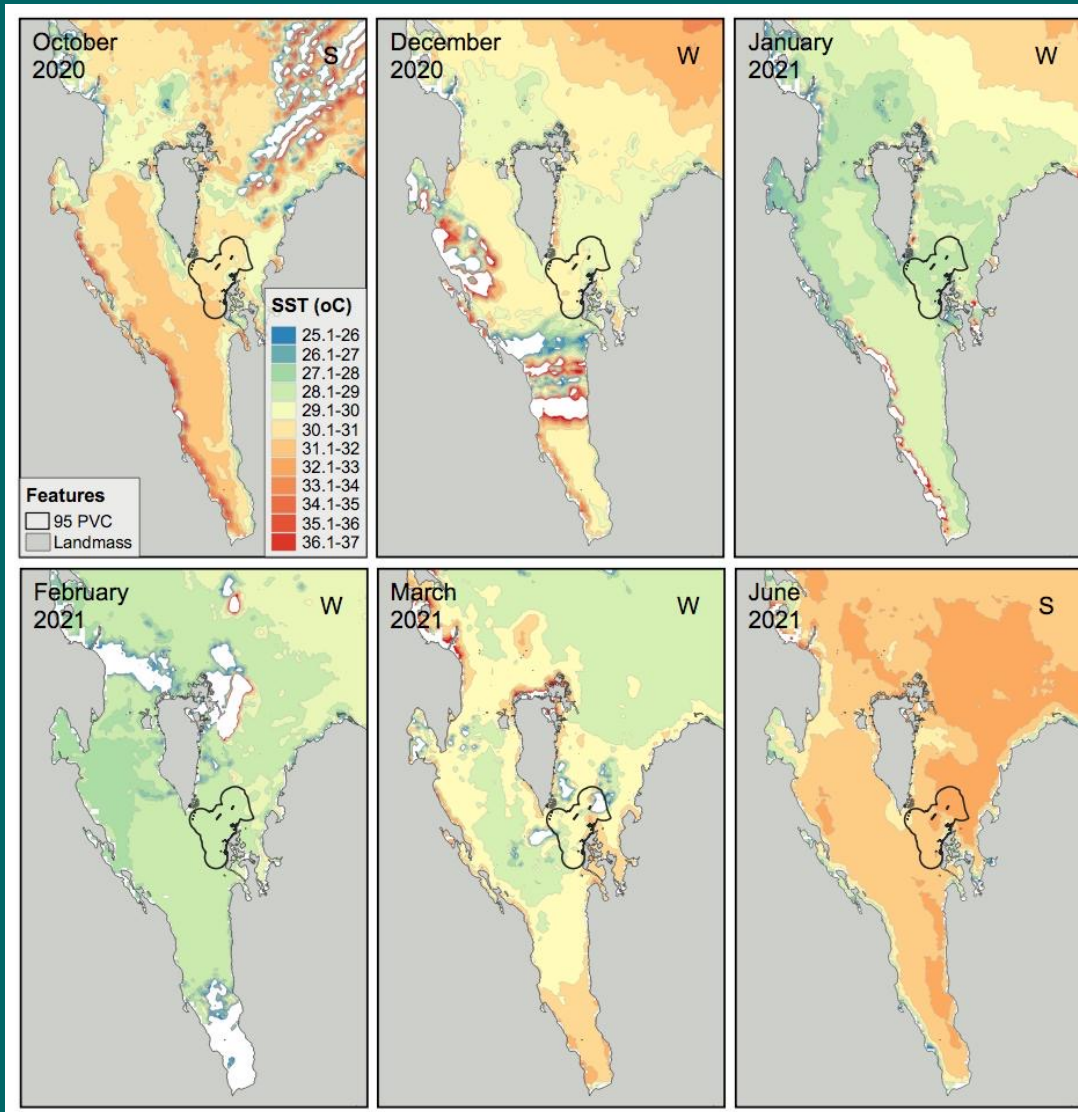
21°C

16

Results

# Harsh Environmental Settings

## Sea Surface Temperature (SST)



**No localized warm water discharges (underwear springs).**

**No distinctive localized thermal trend.**

Results

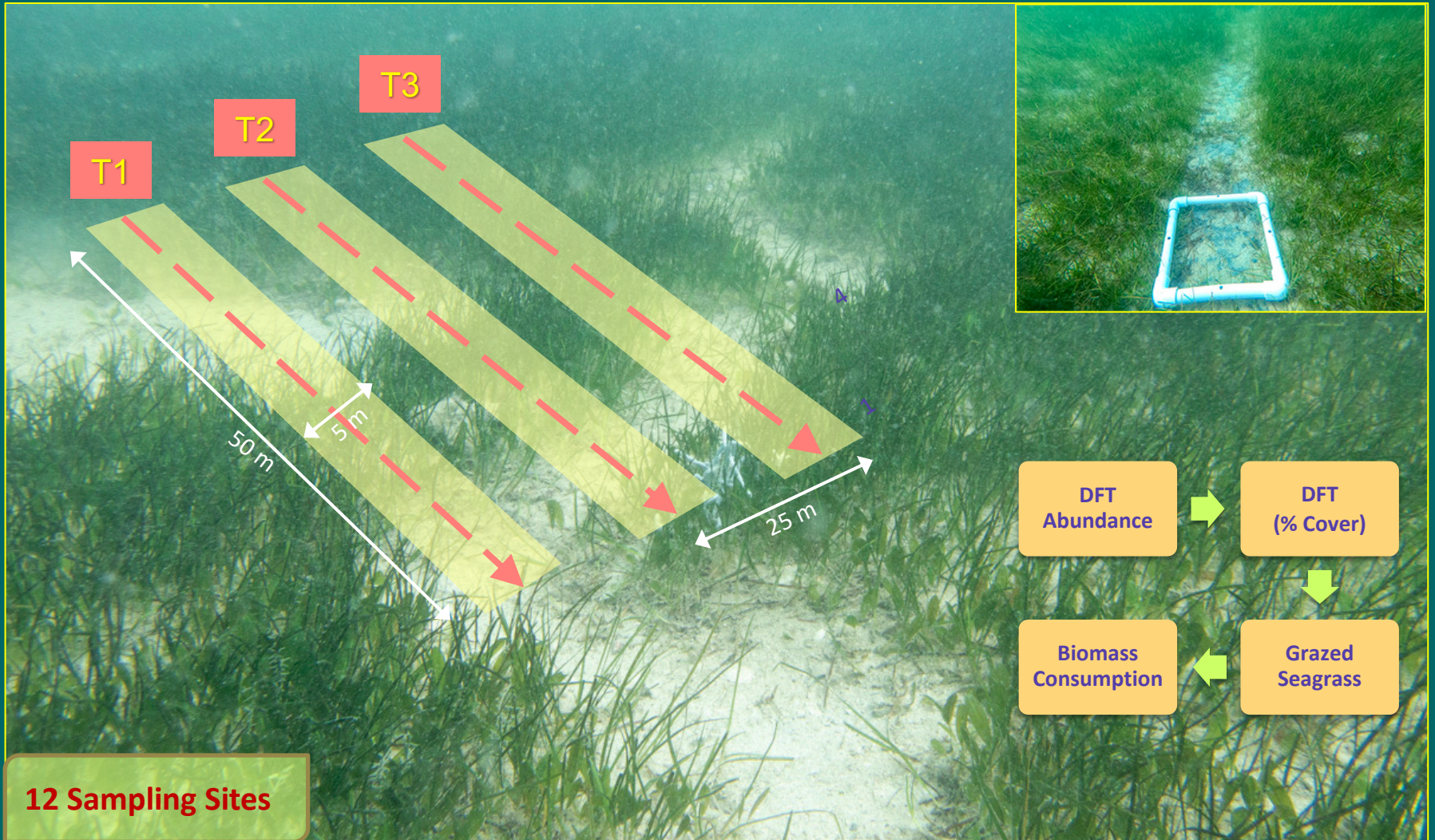
# Anthropogenic Threats

## High Maritime Traffic



Method

# Dugong Herbivory In-water Survey

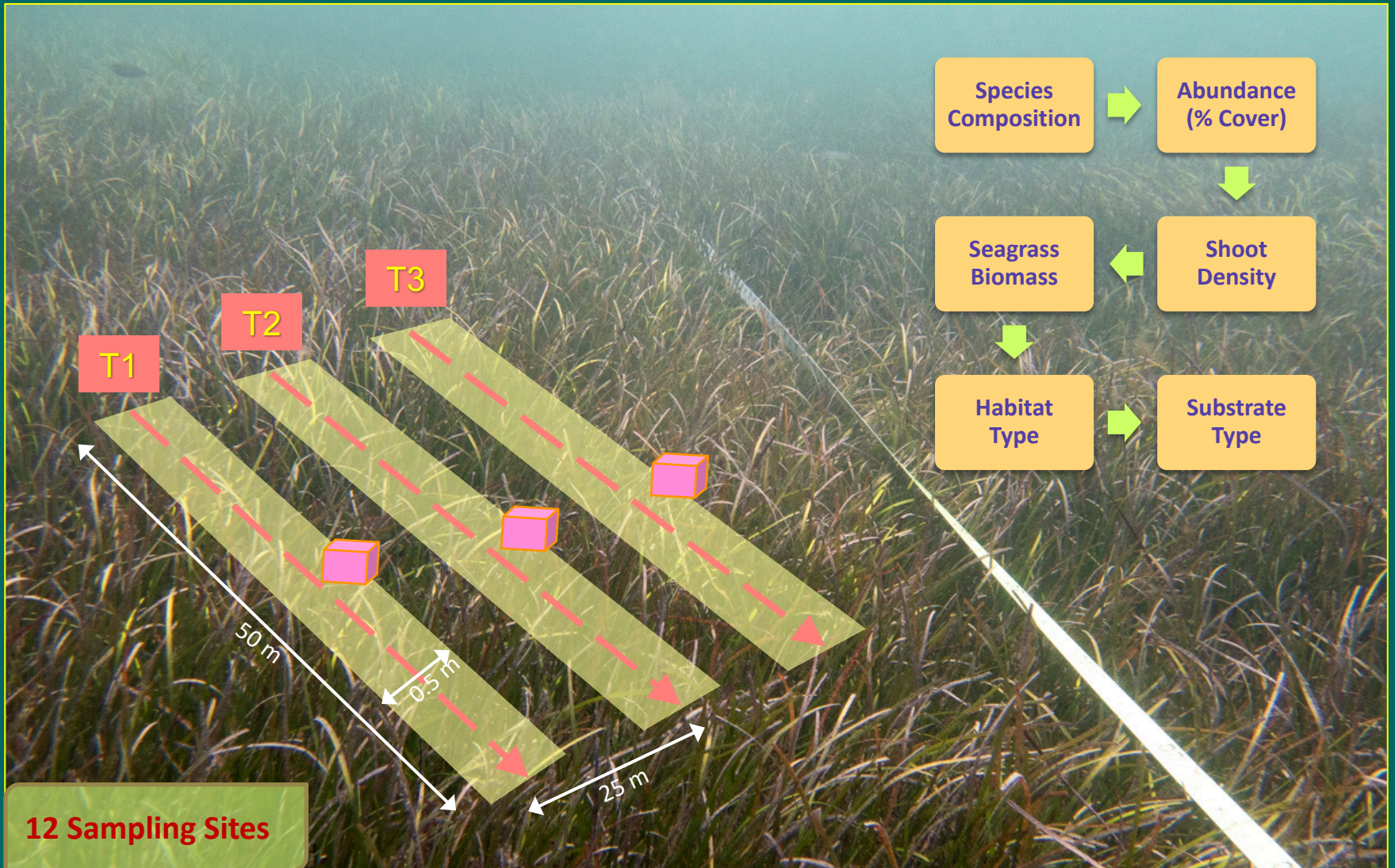




Method

# Seagrass Ecology

## In-water Survey



Conc.

# Lessons Learned

## Lessons Learned

- Fishers have a wealth of **information**.
- Fishers share their knowledge if they feel their **interests are respected**.
- They never share their **secrets**.
- They may give **misleading** information (e.g., fishing tools).
- **Personal** relationship matters a lot.
- **Trust** is important.
- **Skippers** who are experienced fishermen are the most beneficial.
- Fishers are **busy** catching fish ... dugongs are not their priority.

