Effect of Brine Discharge From Al-Dur RO Desalination Plant on the Infauna Species Composition in the East Coast of Bahrain

Anwar Al-Osaimi

BSc in Biology - Geology, Kuwait University

MSc in Environmental Management, AGU

Overview

Introduction

- *Development of desalination in the GCC*
- *Status of desalination in Bahrain*
- *Marine environment of Bahrain*

Methodology

- *Study area*
- *Sampling*
- *Laboratory analysis*
- *Data analysis*

Results

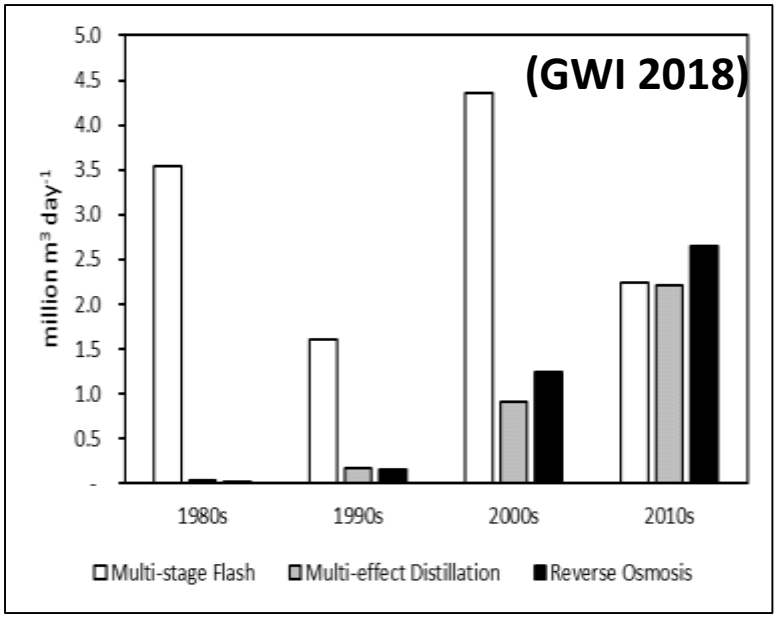
- *Salinity gradient and temperature*
- *Infauna species composition*
- *Diversity indices*

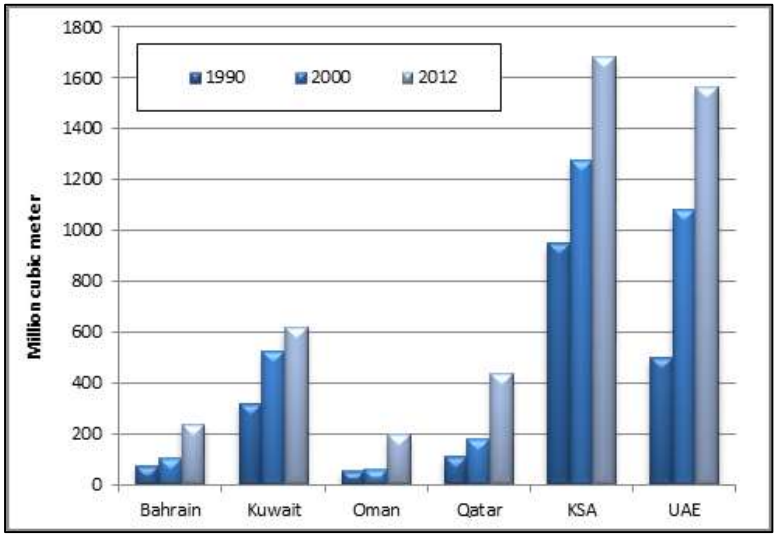
Conclusions & Recommendations

Introduction

Development of desalination in the GCC

- Rapid development (1950 – 2015) synchronized with population growth by over **1200%**.
- First plants (Kuwait and Qatar 1953) by **5000 m^3 /day**.
- GCC production has increased (**0.03- 21**) M m^3/day during (1970 – 2018).
- **567** plants producing **> 64%** of global production.
- MSF is the dominant technology, since 2010 mostly shifted to RO.



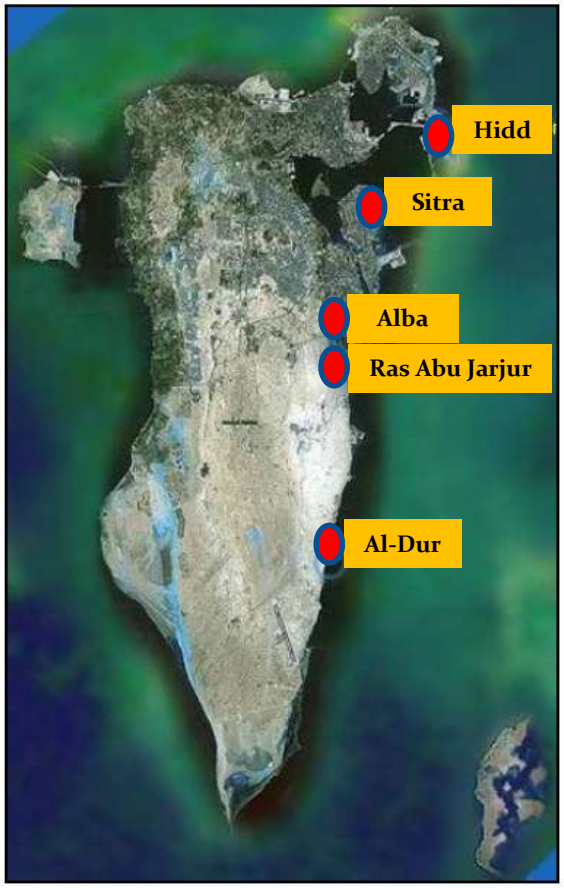


(Zubari, 2014)

Introduction

Status of desalination in Bahrain

- 1st DP was MSF established in Sitra (1975).
- Four others were established (1984-2012).
- All are located on the eastern coast of Bahrain.

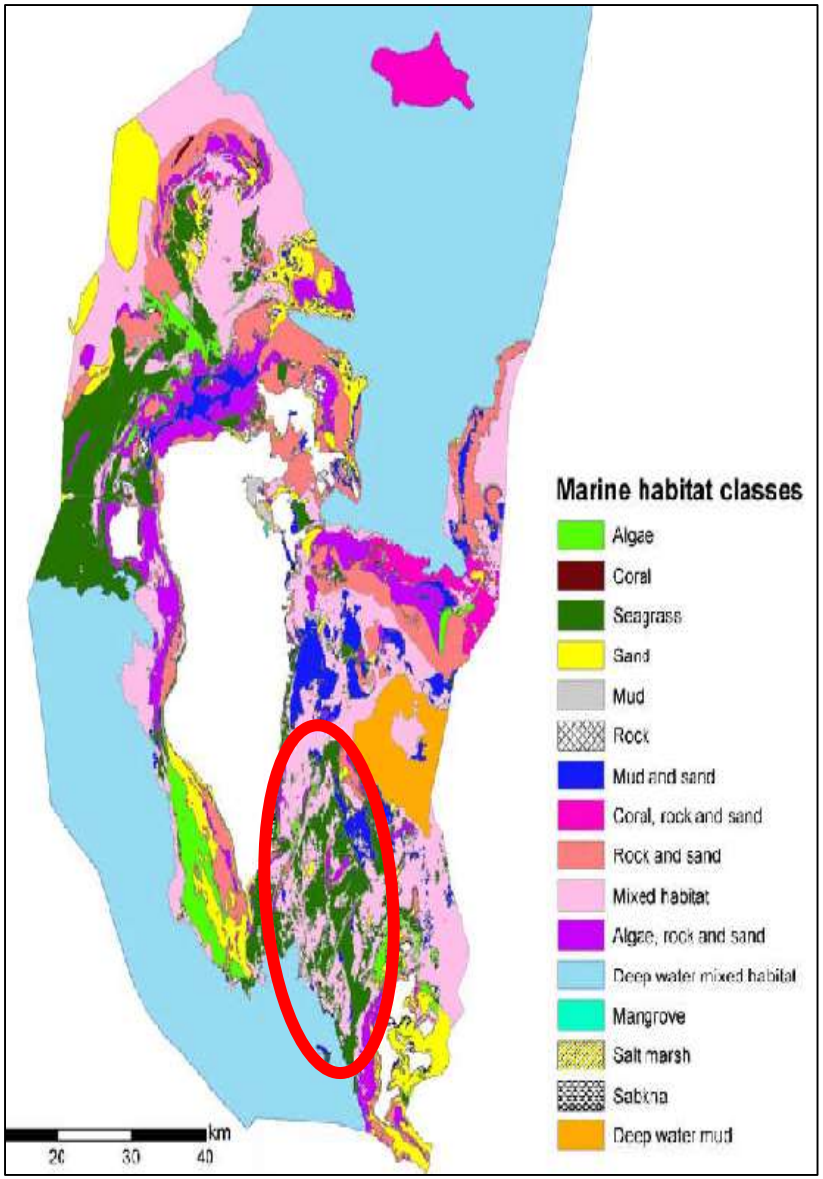


Plant	Commissioning	Technology	No. units	Capacity 1000 m³/d	Raw water	Ownership	Brine volume
Sitra	1975	MSF	6	113.6	Seawater	Government	456 M m³/y
Ras Abu Jarjur	1984	RO	10	77.3	Ground water	Government	39.5 m³/y
Hidd	1999	MSF+MED	4 MSF+ 10 MED	409.1	Seawater	Private	336 Mm3/y
Alba	2002	MED	4	31.8	Seawater	Private	
Al-Dur	2012	RO		220	Seawater	Government	
Total capacity				851.8			

Introduction

Marine environment of Bahrain

- Marine environment (~ 7,510 km²).
- Sensitive marine habitats (seagrass beds, coral reefs and mangroves).
- These habitats play an important biological role for broad scale of fishery species.
- These ecosystems are heavily exposed to anthropogenic impacts.



Introduction

Problem statement and Objectives

- The brine water potentially affect the physical, chemical and biological properties of water and sediment quality.
- Seagrass beds at Al-Dur coast provide feeding and nursery grounds for endangered megafauna species (dugong and green turtles).
- Al-Dur coast representing a fishing ground for many fishermen using barrier traps mostly located within DP discharge vicinity.
- The overall objective is to assess the impacts on the species composition of benthic community.

Methodology

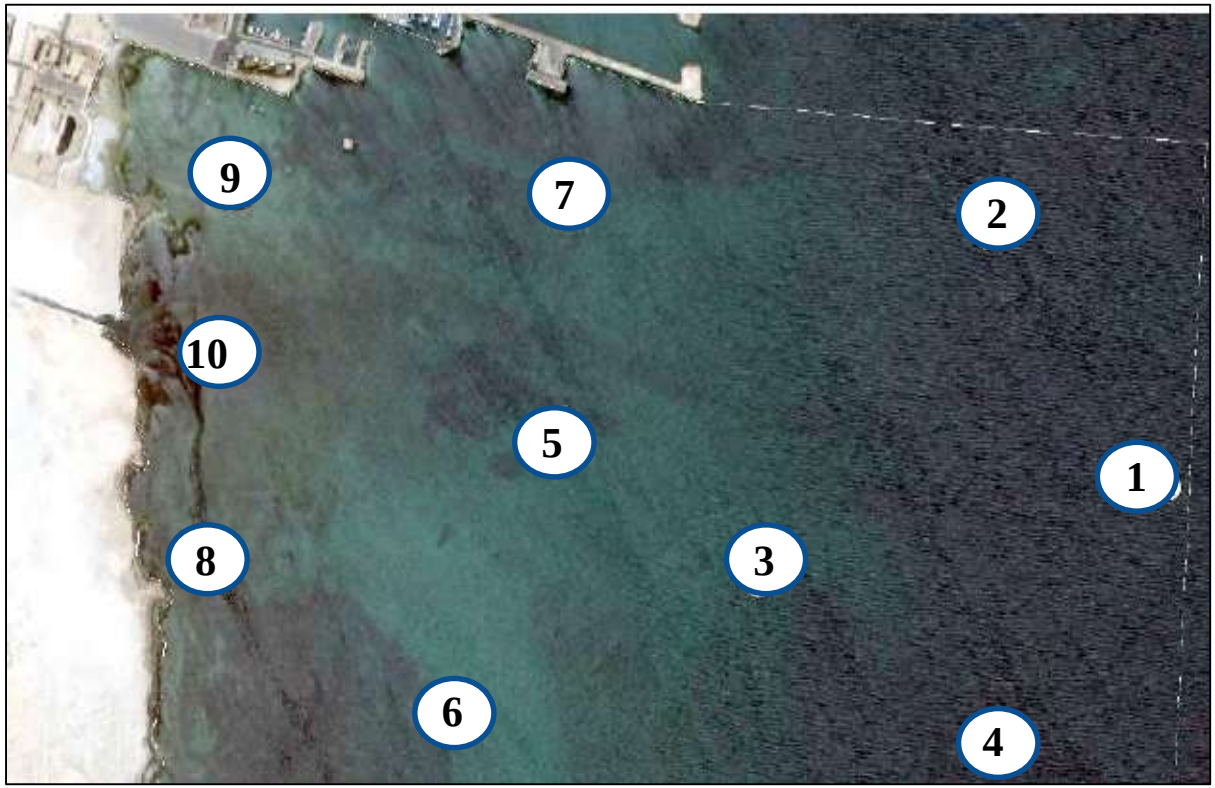
Study Area

- Al-Dur DP plant is located at SE coast Bahrain.
- ST Company for passenger is located to the north.
- ~ 20 barrier fishing traps (Hadrah).
- An old jetty for fishing speedboat berthing.
- The tidal regime is diurnal twice a day.
- Depth range between 0 - 7 m.
- Biofilms of filamentous algae.

Methodology

Sampling

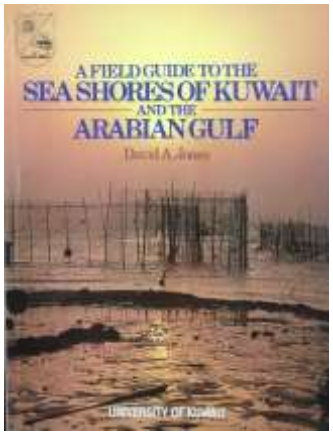
- 42 locations (WQ).
- WQ: depth, temp., sal., DO and pH).
- 10 locations (Infauna samples).

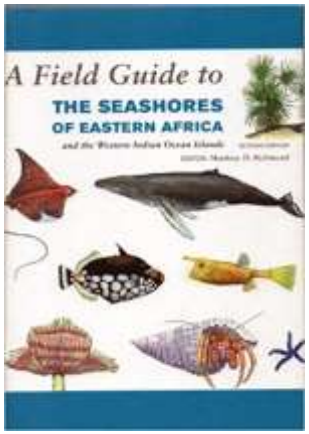


Methodology

Infauna Diagnosis

- The identification in the labs of UoB and KISR.
- Diagnosis by a dissecting stereomicroscope.
- Different field guides were used.
- Sorting was repeated 3 times for each petri dish to confirm the diagnosis.





Methodology

Data Analysis

Univariate analysis was applied (PRIMER V6).

- No. Species **(S)**: Simply the number of species present.
- No. Individuals **(N)**: Number of specimens belongs to ith species.
- Richness **(D)**: **Margalef's index:** $D = (S - 1) / \ln N$
- Diversity **(H`)**: **Shannon-Weiner index:** $H` = -[\sum (\rho i \ln \rho i)]$

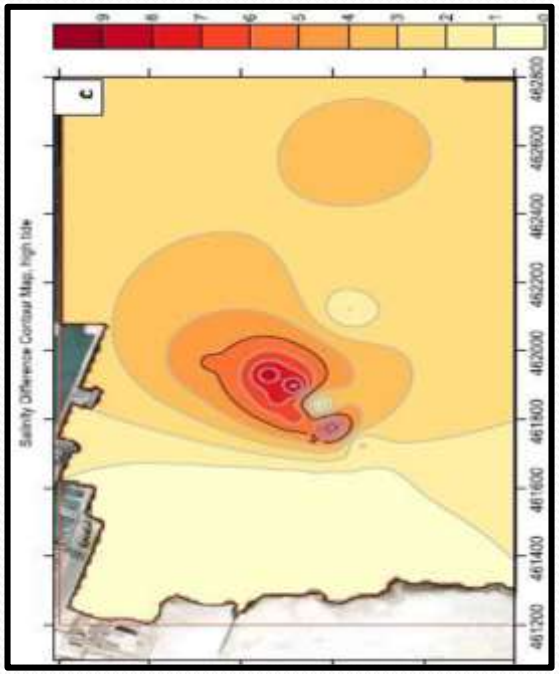
  Where pi is the proportion of individuals of ith species.

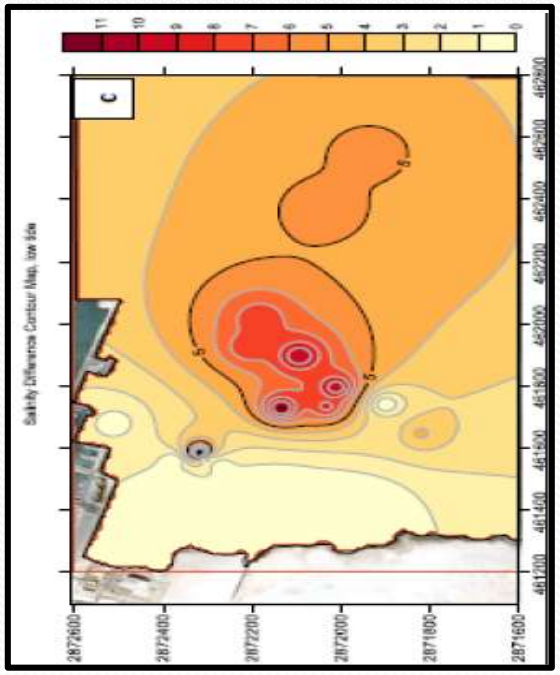
- Evenness **(J)**: **Pielou index:** $J = H` / H_{max}$

  Where H_{max} is the maximum possible diversity = ln S.

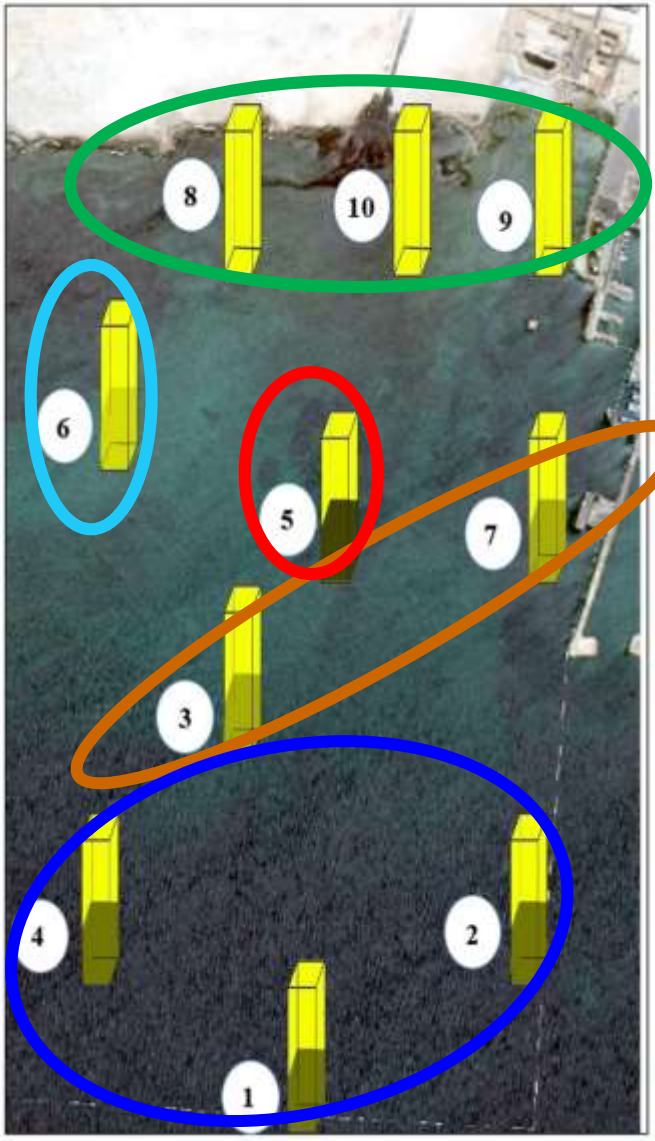
Results

Thermal and Saline Stratification



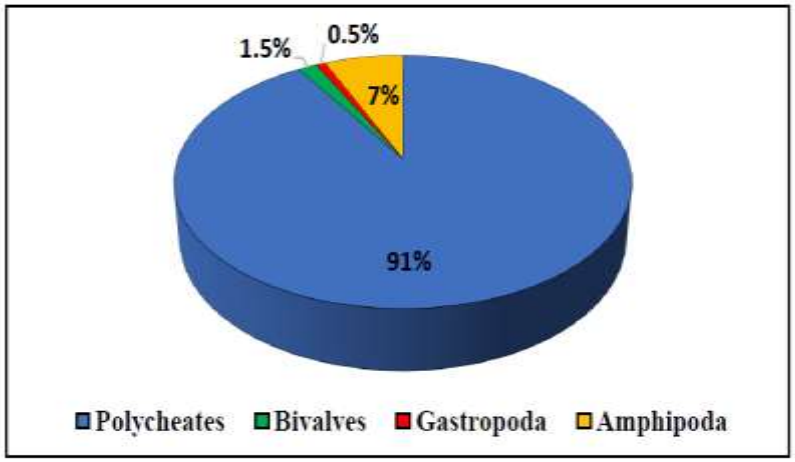


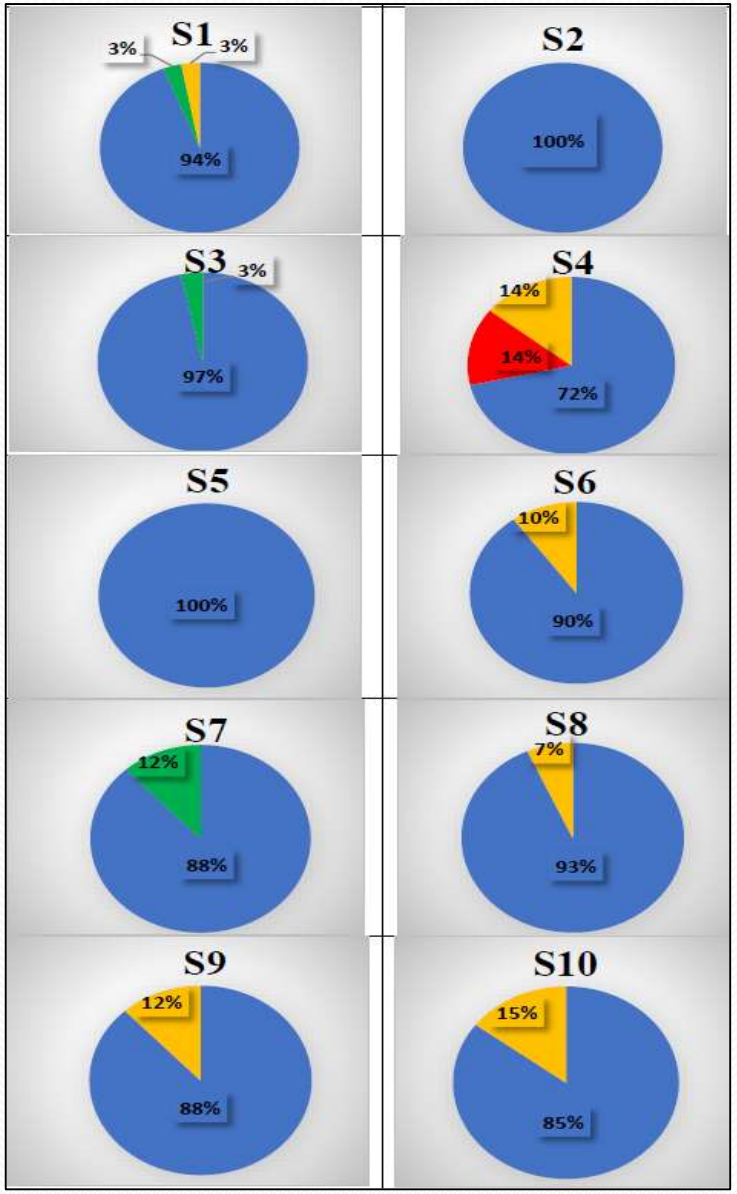
- *Non: Well mixed water column*
- *Less: Difference (1 ‰ – 2 ‰)*
- *Moderate: Difference (2 ‰ – 4 ‰)*
- *High: Difference (3 ‰ – 5 ‰)*
- *Extreme: Difference (9 ‰ – 11 ‰)*



Results

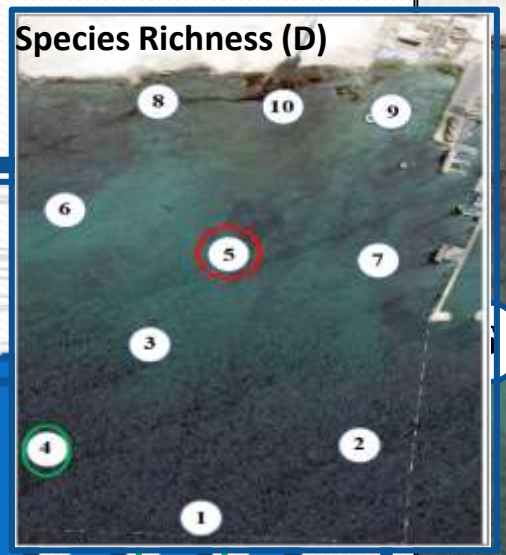
Infauna Species Composition



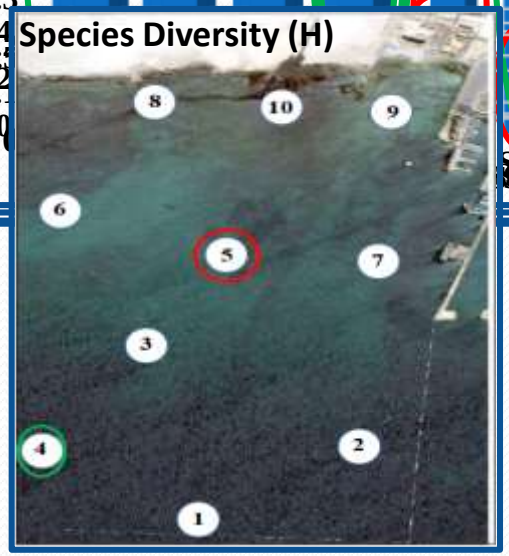


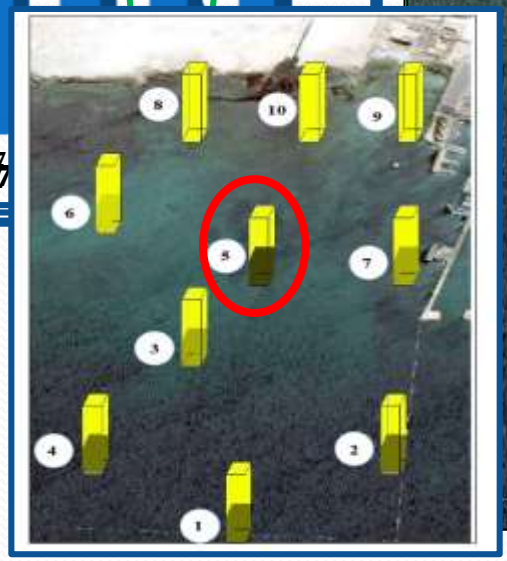
Results


Evenness (J)


Species Richness (D)


No. Individuals (N)


Species Diversity (H)




No. Species (S)

Conclusions

- Hypersaline water mass was observed at bottom of locations associated with depths > 3 m.
- The species composition found to be related to the water quality rather than sediment texture.
- The lowest diverse species composition found at locations characterized by exceptional elevation of temperature and salinity near bottom.

Recommendations

- Expand the routine monitoring program by SCE to cover locations associated within the vicinity of DPs.
- Extend the discharge outlet to deep water to promote better mixing of the brine and seawater.
- Adopt hydrodynamic models to determine the impact extent generated by each DP.
- Establish regional standards for the brine discharge in the GCC countries.

Thank You