Impact of river discharge on the primary productivity and its contribution to the biological productivity in the Indus delta creeks and shelf area

Waqar Ahmed[1], Samina Kidwai[1], Tariq Mahmood[1], Wu Ying[2], Jing Zhang[2], Zhouyi Zhu[2], Syed Mohsin Tabrez[1]

1. National Institute of Oceanography, ST 47, Block 1, Clifton, Karachi-75600, Pakistan
2. State Key Laboratory of Estuarine and Coastal Research (SKLEC), East China Normal University, Shanghai, P.R. China

China-Japan-Korea IMBER Symposium and Training, 17-19 September 2018, SKLEC, ECNU, Shanghai, China

outline

Introduction

Methodology

Results & Conclusions

Future

Introduction

Pakistan -

River, Catchment, Coast and offshore

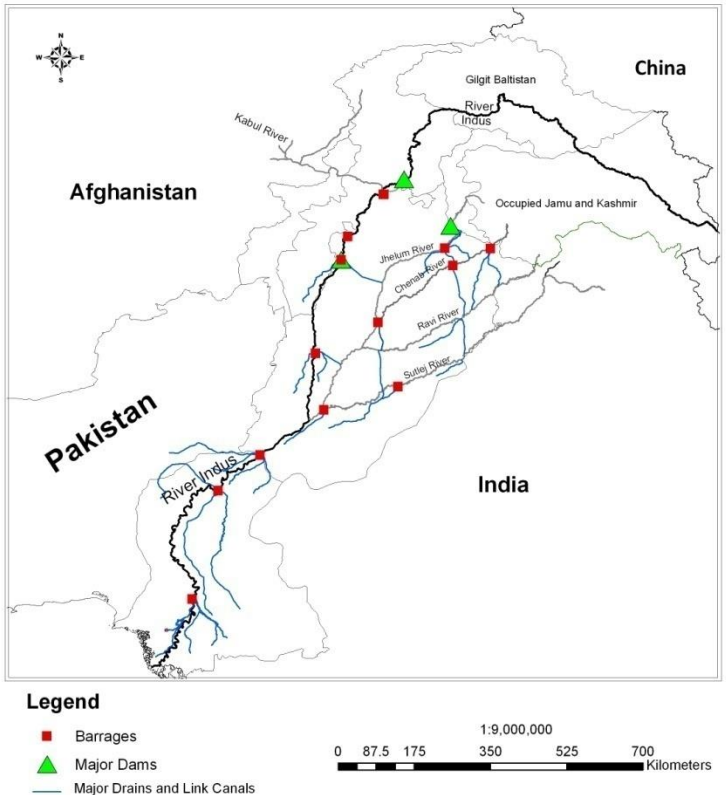
Coast line ~ 1000 km
EEZ 290,000 sq. km

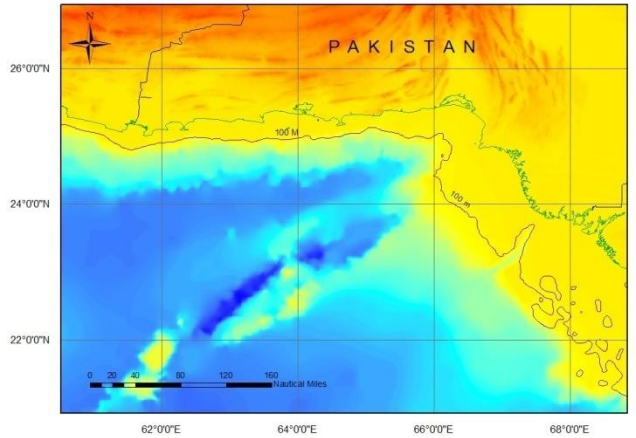
2 divides- Murray Ridge
- Makran – narrow CS
- Sindh- broad CS

Indus delta- 2500 sq km

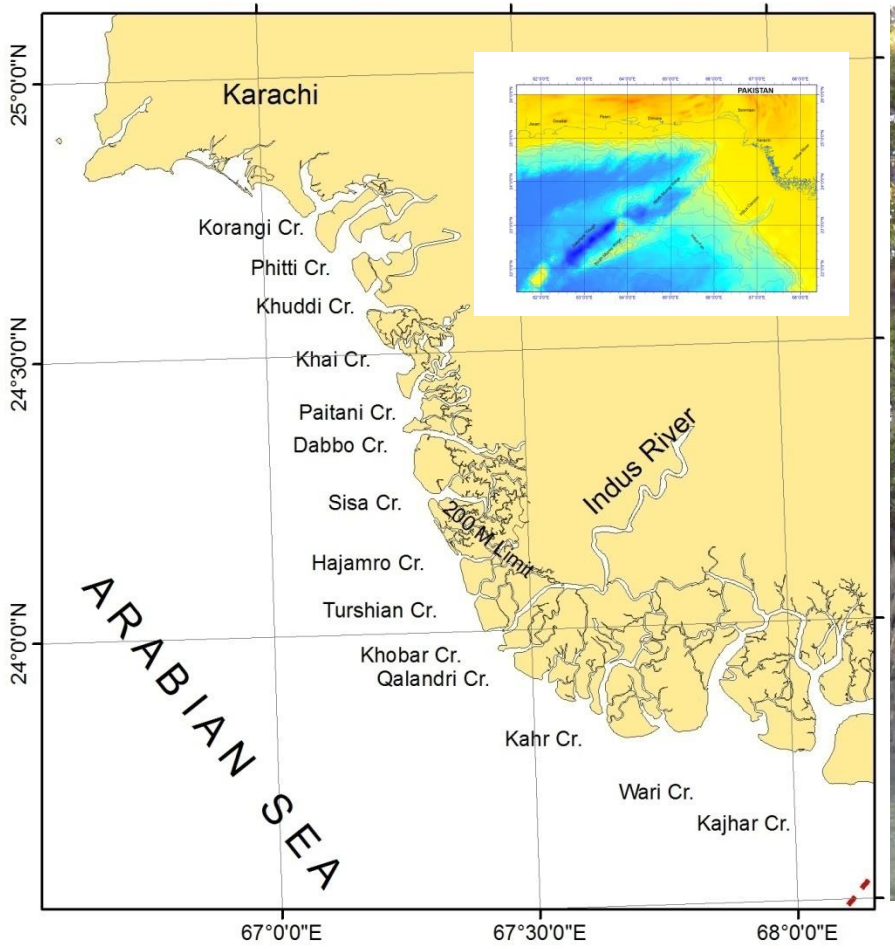
Khobar creek- main river
18 main creeks, numerous minor

SWATCH – River Indus enters Sea on the CS





River Indus deltaic creeks



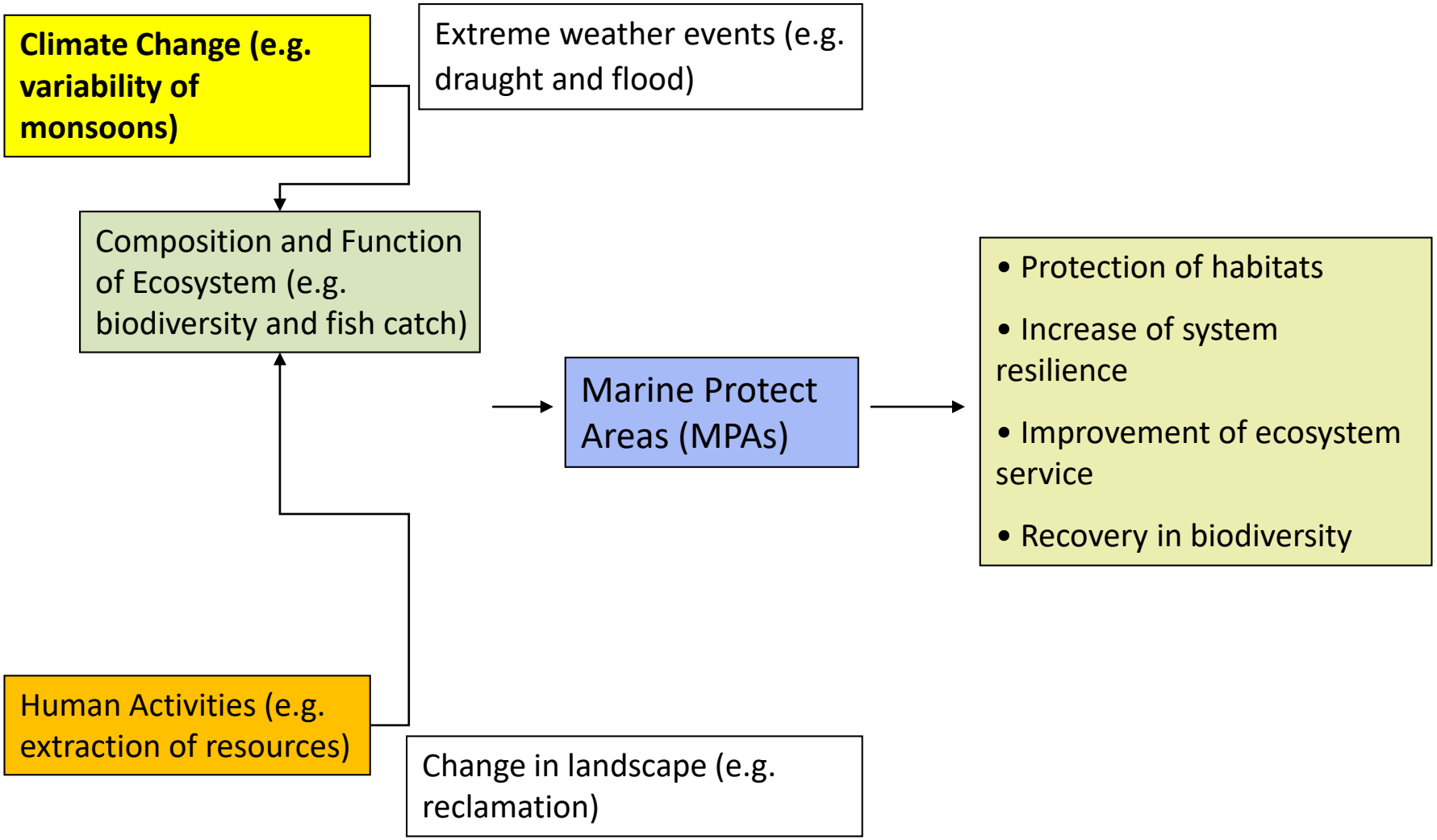

dry season
monsoon season

STATE KEY LABORATORY OF ESTUARINE AND COASTAL RESEARCH (SKLEC)- EAST CHINA NORMAL UNIVERSITY (ECNU)/P.R. CHINA- National Institute of Oceanography

The objective of this Executive Agreement is to develop Joint Research Projects

- Sediment transport & flux studies under climate change and human activities in the Indus and Yangtze River Deltas
- **Food web dynamics, biodiversity, biogeochemistry of the Indus Delta Creeks and their contribution to the coastal fishery productivity**
- **Eco-system approach to Indus Delta and Southern China Mangrove conservation**
- Assessment of natural hazards due to Climate Change in the coastal areas of Pakistan and Southern China

Scheme of the Project



Estuarine, Coastal and Shelf Science xxx (2016) 1–11

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

bservations at ebb tide

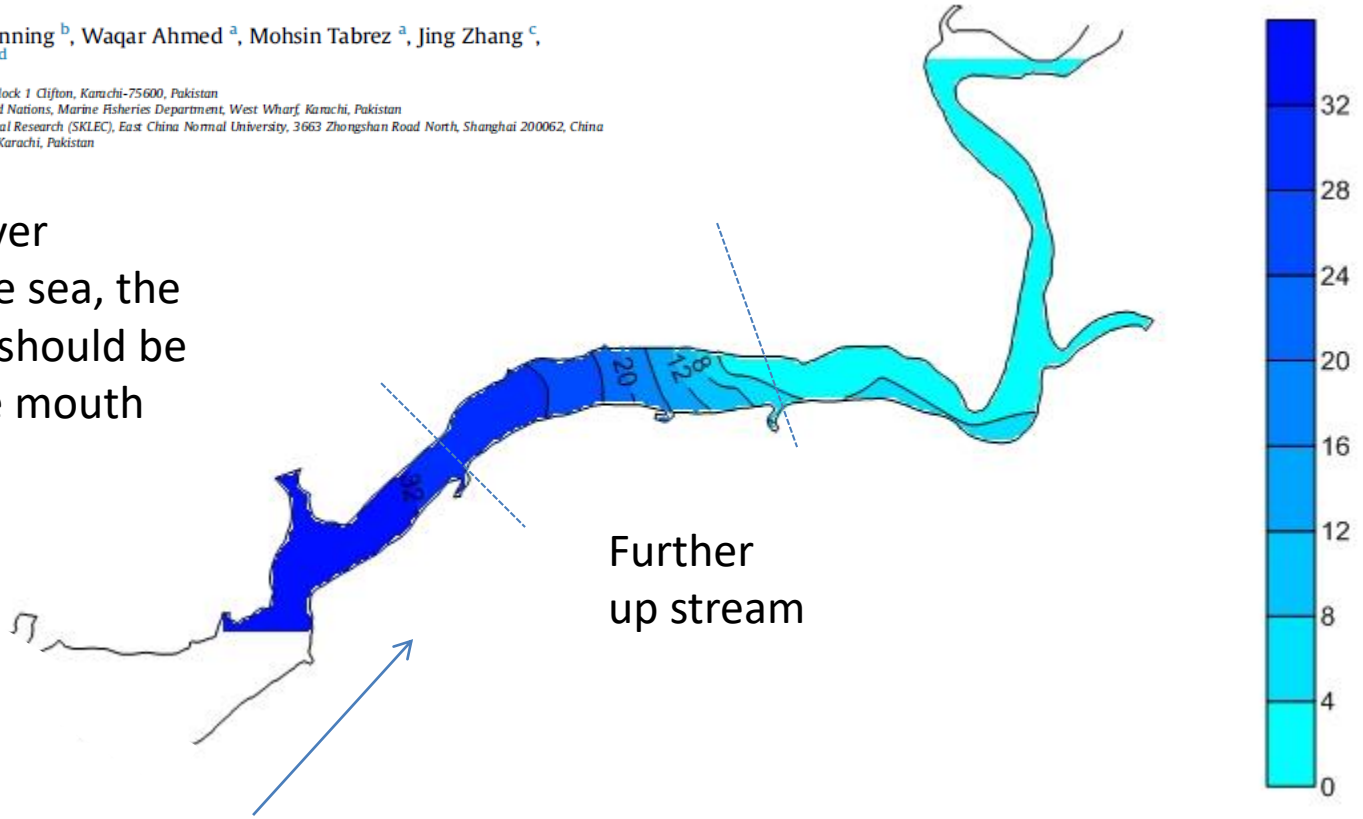
Practicality of marine protected areas - Can there be solutions for the river Indus delta?

Samina Kidwai [a, *], Paul Fanning [b], Waqar Ahmed [a], Mohsin Tabrez [a], Jing Zhang [c], Muhammad Wasim Khan [d]

[a] National Institute of Oceanography, ST 47 Block 1 Clifton, Karachi-75600, Pakistan
[b] Food and Agriculture Organization of United Nations, Marine Fisheries Department, West Wharf, Karachi, Pakistan
[c] State Key Laboratory of Estuarine and Coastal Research (SKLEC), East China Normal University, 3663 Zhongshan Road North, Shanghai 200062, China
[d] Marine Fisheries Department, West Wharf, Karachi, Pakistan

SW

With the river entering the sea, the salt wedge should be close to the mouth



Further up stream

River Indus delta

FW

What's happening to the estuarine ecosystem of the delta?

C Shelf 36 PSS

Kidwai et al., 2016

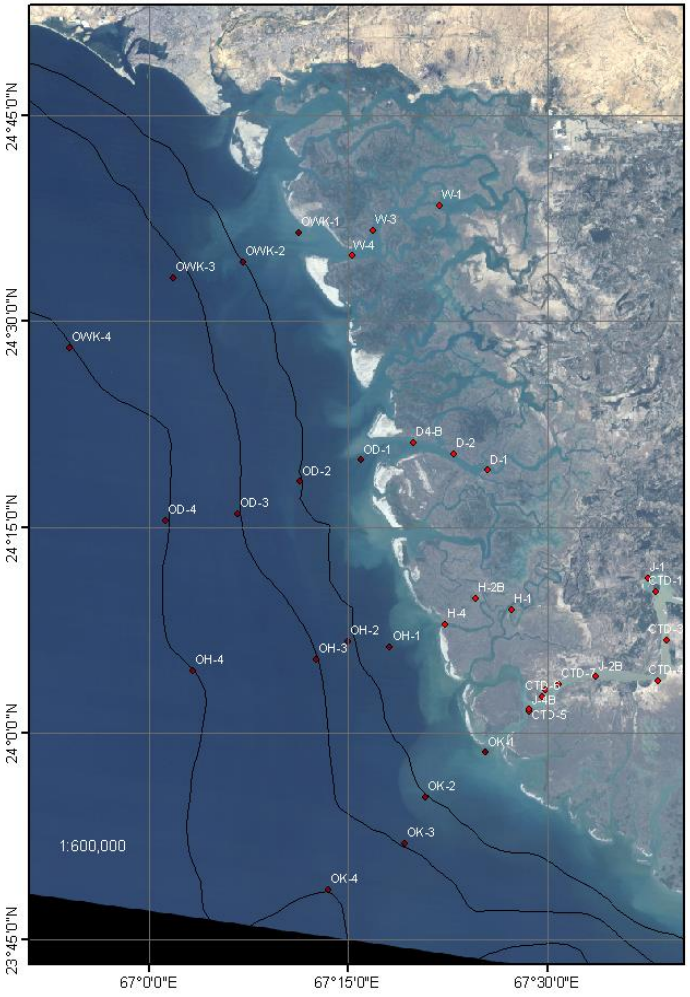
"Variation of phytoplankton pigments composition and their ecological implications in the major four Creeks of Indus Delta (Pakistan) and to determine variations in phytoplankton pigment concentration and the factors effecting on it "

SKLEC Open Research Grant 2016-18

Methodology

Study Area

Four creeks and their offshore has been identified for sampling, four times in an annual cycle (monsoon driven)



Approach

- Establish significant links of the energy flow and inter-dependence within trophic levels within the delta's ecosystem

Methodology

Bio-markers (SI, FA)

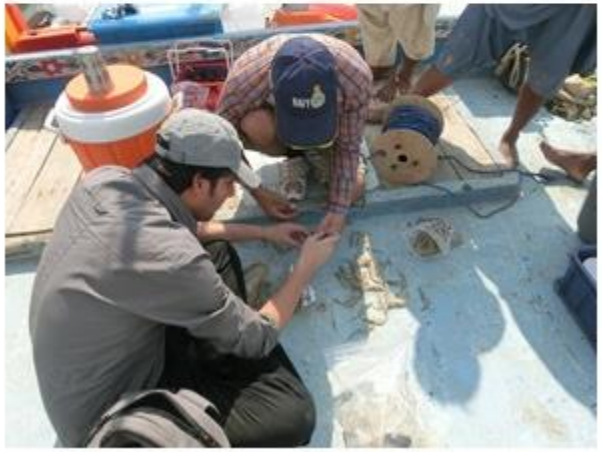
Physical and bio-geochemical (POC, TOC, Nutrients, Chl a , Pigment analysis, PA, TSL).

In-situ incubation experiments **Primary Productivity (DO method),** Leaf Liter composition and assessment, meso-zooplankton grazing experiments (gut extraction/evacuation etc.).

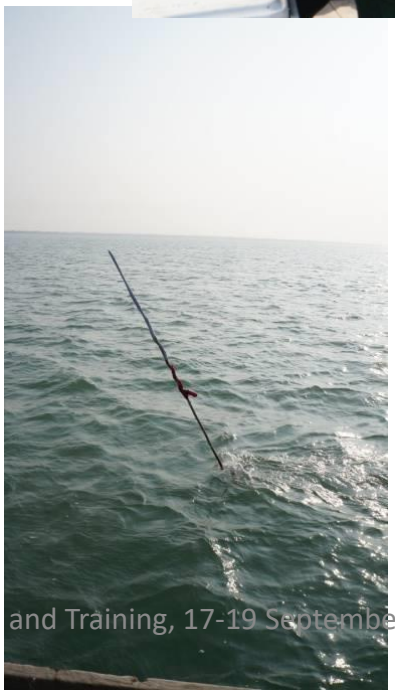
NIO-SKLEC COLLABORATIVE RESEARCH



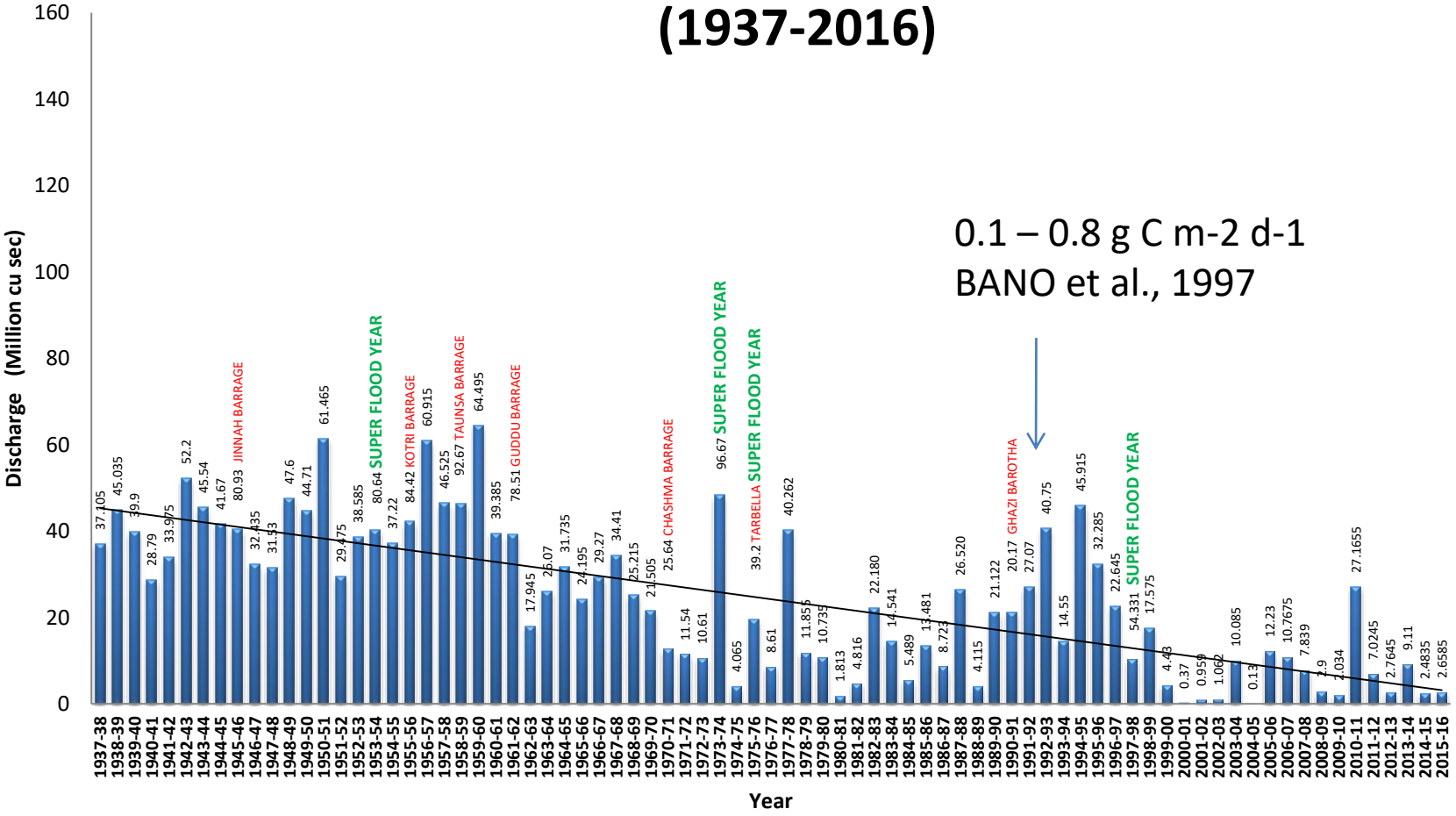




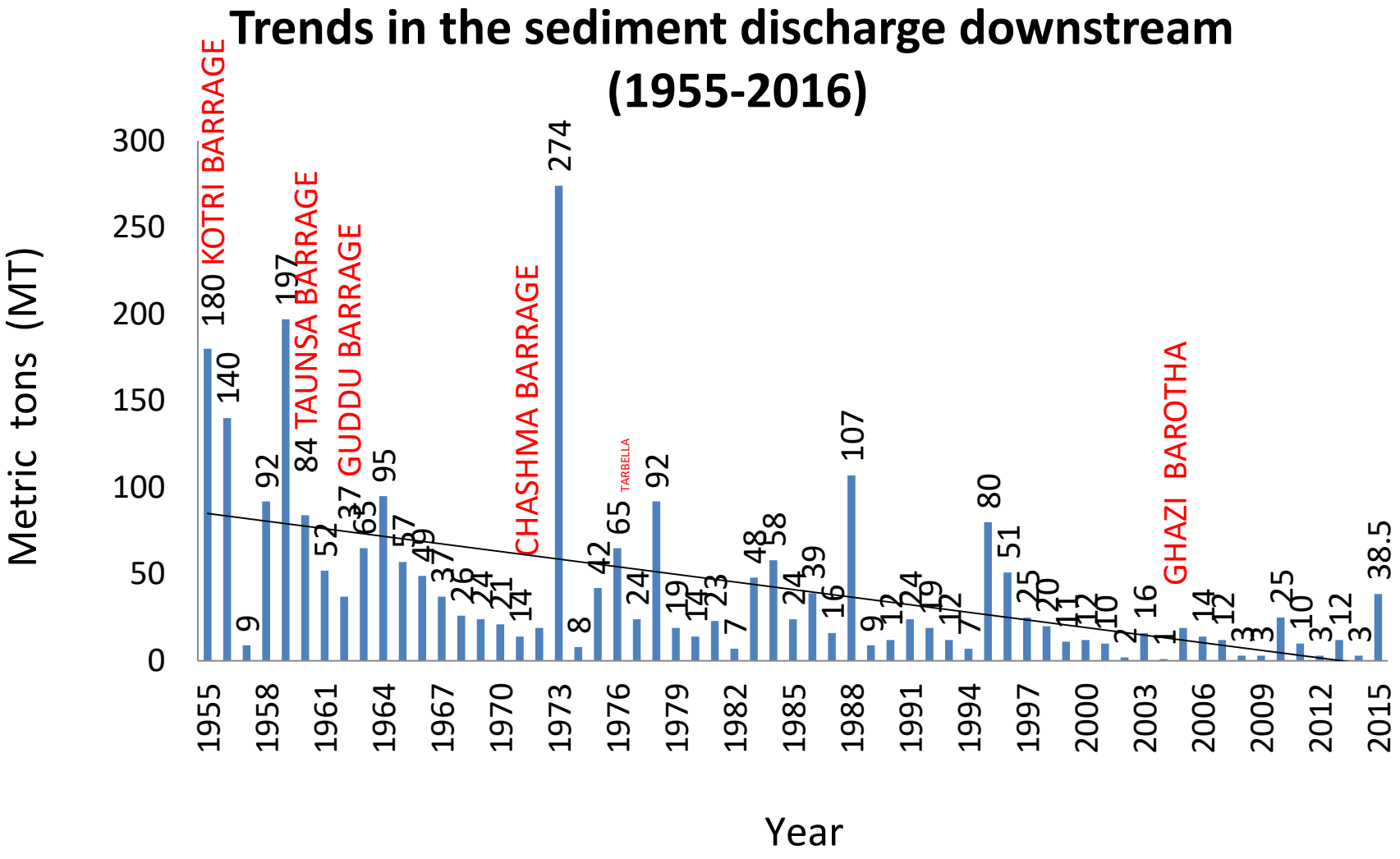

Field activities- Primary Productivity, Leaf liter traps, zooplankton grazing experiments



Trends in the water discharge downstream (1937-2016)



Kidwai et al. 2018 In Press


Trends in the sediment discharge downstream (1955-2016)
Metric tons (MT)
Year
KOTRI BARRAGE
TAUNSA BARRAGE
GUDDU BARRAGE
CHASHMA BARRAGE
TARBELLA
GHAZI BAROTHA
180
140
9
92
197
84
52
37
65
95
57
49
37
26
24
21
14
274
8
42
65
24
92
19
14
23
7
48
58
24
39
16
107
9
12
24
19
12
7
80
51
25
20
11
12
10
2
16
1
14
12
3
3
25
10
3
12
3
38.5
0
50
100
150
200
250
300
1955
1958
1961
1964
1967
1970
1973
1976
1979
1982
1985
1988
1991
1994
1997
2000
2003
2006
2009
2012
2015

Mangroves Forests

8 species reported- (Saifullah 1982)

Species	Area
1. Rhizophoraceae	
Bruguiera gymnorhiza	and Delta
Ceriops tagal	and coast of : Mouth of Indus
C. decandra	Tidal zone, existence doubtful
Rhizophora apiculata	Tidal marshes at the mouth of
R. mucronata	Mouth of on muddy shores and
2. Myrsinaceae	tidal creeks
Aegicera corniculata	Mouth of Delta
3. **Avicenniaceae**	All along the coast
***Avicennia marina** **97%**	Mouth of delta
4. Sonneratiaceae	
Sonneratia caseolaris	

* Salinity tolerance – high (Ahmed et al., 1995- Pakistan Journal of Marine Science 1:73-86)

Mangrove stands (1950-2010)

27 % of the forest on the tidal creeks
Shrinking of the delta has a serious impact on the forest cover

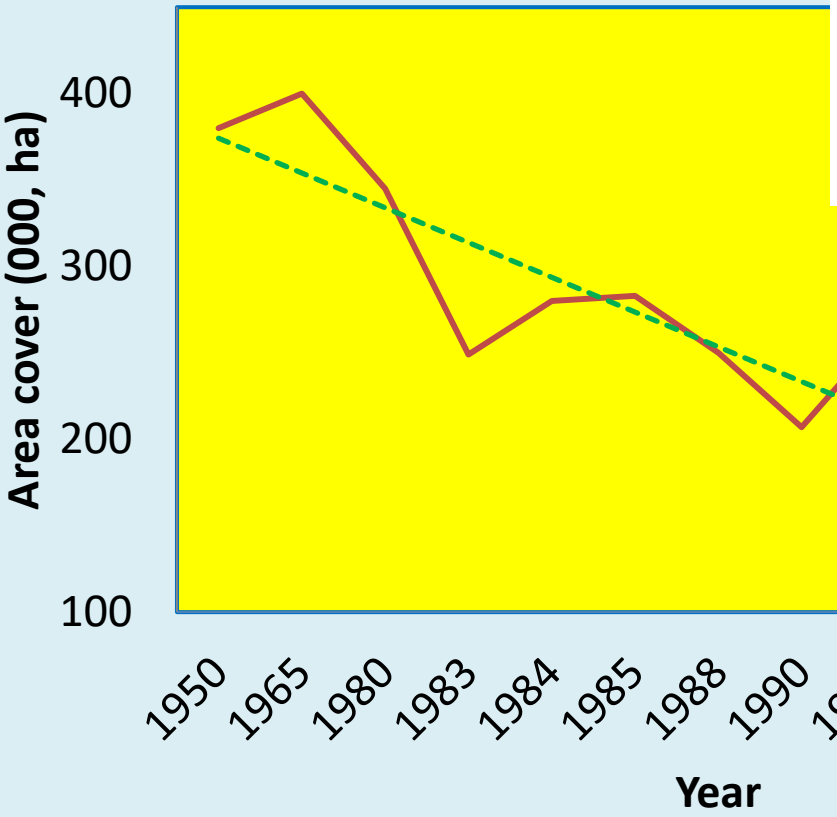
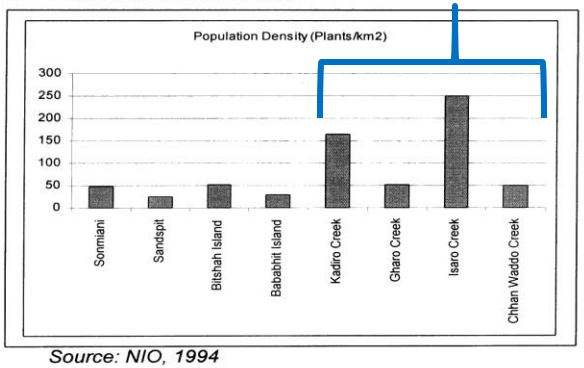


Table – 20 Plant Population Density



Source: NIO, 1994

Figure Average values at different stations

1) Sonmiani
2) Sandspit
3) Bitshah Island
4) Bababhit Island
5) Kadiro Creek
6) Gharo Creek
7) Isaro Creek
8) Chhan Waddo Creek

Qamar 2007

Primary Production mg C m^{-2} d^{-1} (DO Method)

Season					
Stations	NEM2016-17	Spring IM- 2017	SWM2017	Fall IM2017	NEM 2018
H	0.10	**0.149**	0.082	**0.815**	0.508
J	0.33	**0.351**	NE	NE	NE
D	0.037	**0.179**	0.014	**0.643**	0.478
W	0.101	**0.101**	0.175	**1.32**	**2.25**

*

NE- no visibility of Secchi disk

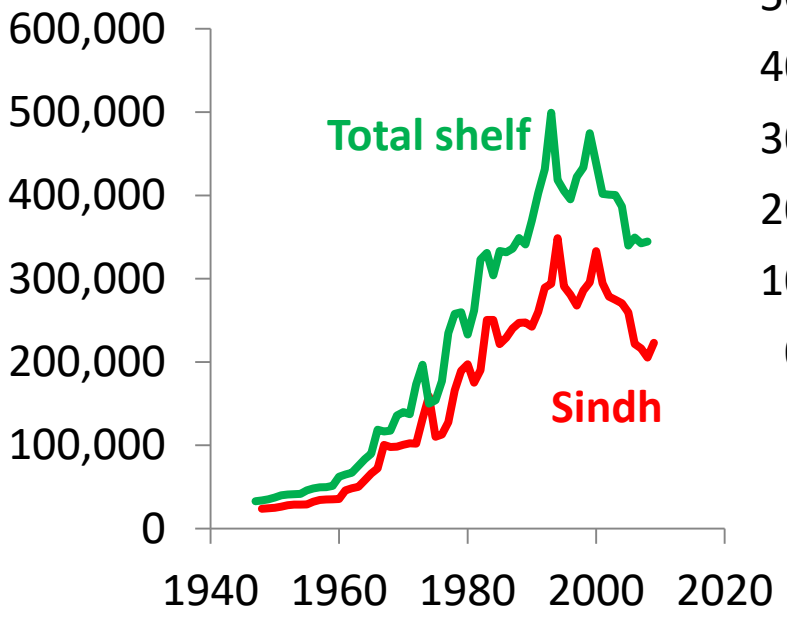
Main Findings

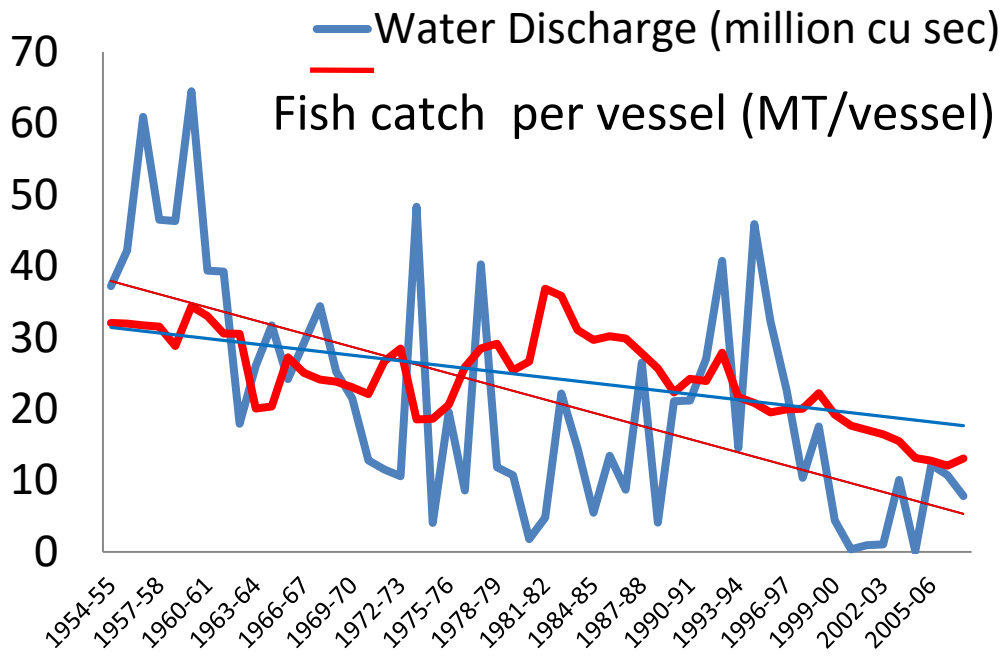
- ✓ General reduction in PP – reflected in the fish catch in the creeks
- ✓ Inter-monsoon show higher PP
- ✓ J- Main River- Floodwater, highly turbid, light limitation
- ✓ W- Creek has natural mangrove stand
- ✓ H & D have no to mixed vegetation, short and stunted mangrove in H

Work in Progress- validate this with other observations

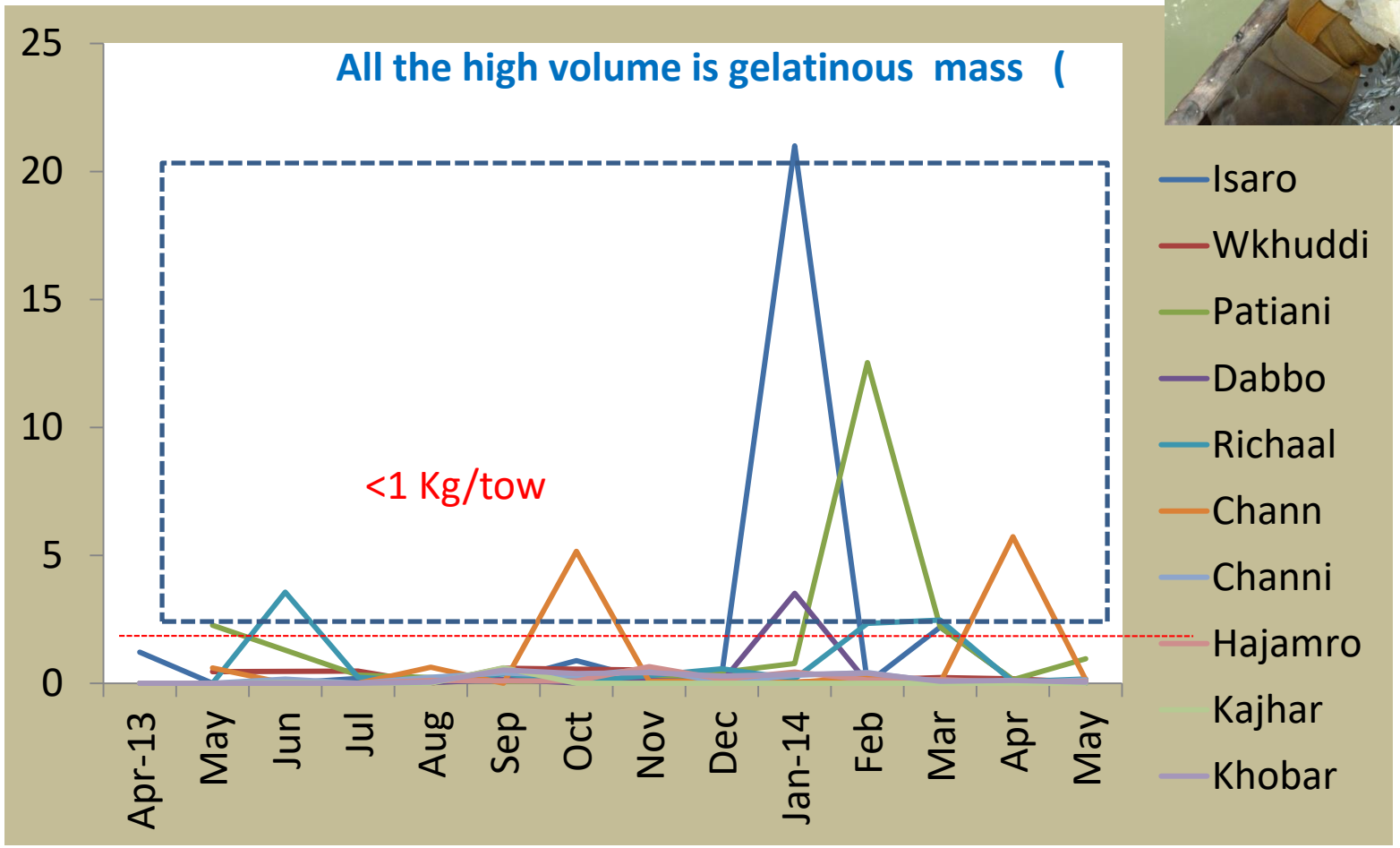
Relation of fish catch per vessel against the freshwater discharge downstream to the shelf area

Traditional information > 60% fishery on the shelf is supported by the Indus delta





Fish (mixed) catch per tow over the study period April 2013 – May 2014 in the creeks of the Indus delta



Future

Work in Progress- samples under analysis

Looking for more answers!

Thank you for your attention