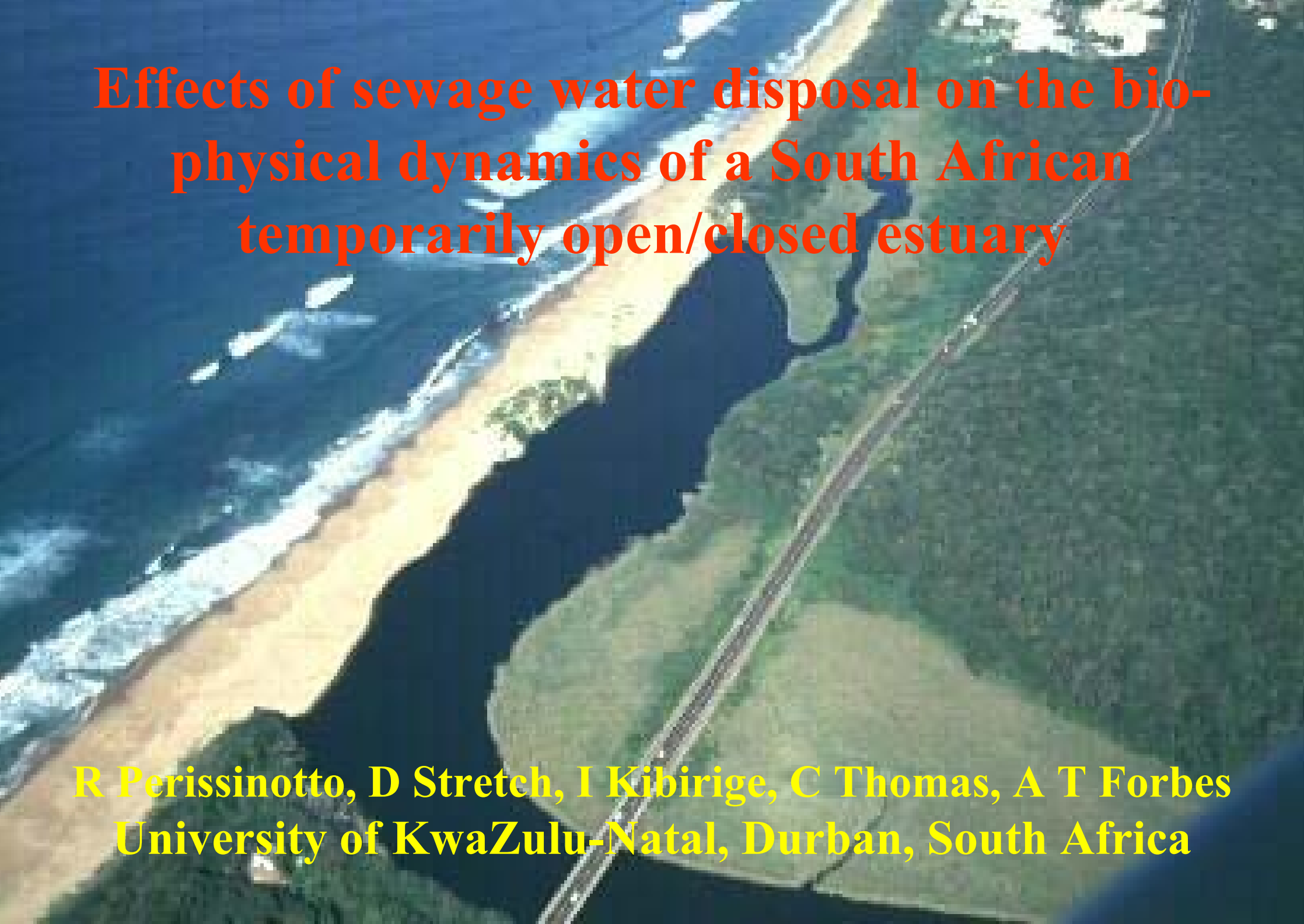


Effects of sewage water disposal on the bio-physical dynamics of a South African temporarily open/closed estuary

R Perissinotto, D Stretch, I Kibirige, C Thomas, A T Forbes
University of KwaZulu-Natal, Durban, South Africa

TEMPORARILY OPEN/CLOSED ESTUARIES

- Open during wet season (October - April)
- Closed during dry season (May-September)
- Eutrophic (open) → meso/oligotrophic (closed)

1) nutrient input → freshwater run-off (rain)

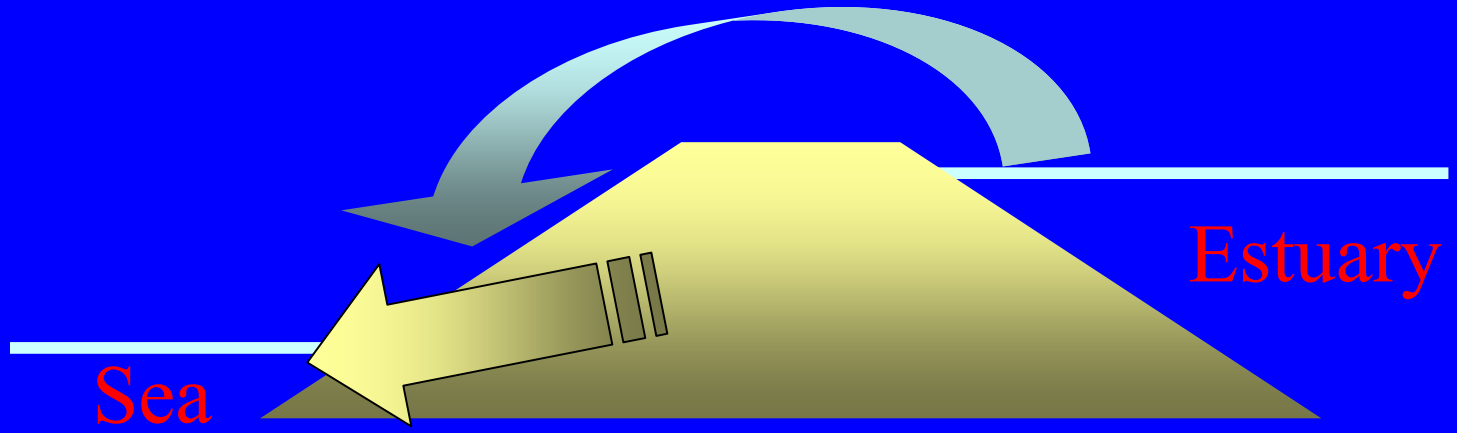
2) microalgal growth → light + nutrients

3) zooplankton → peak 2-3 months after closure

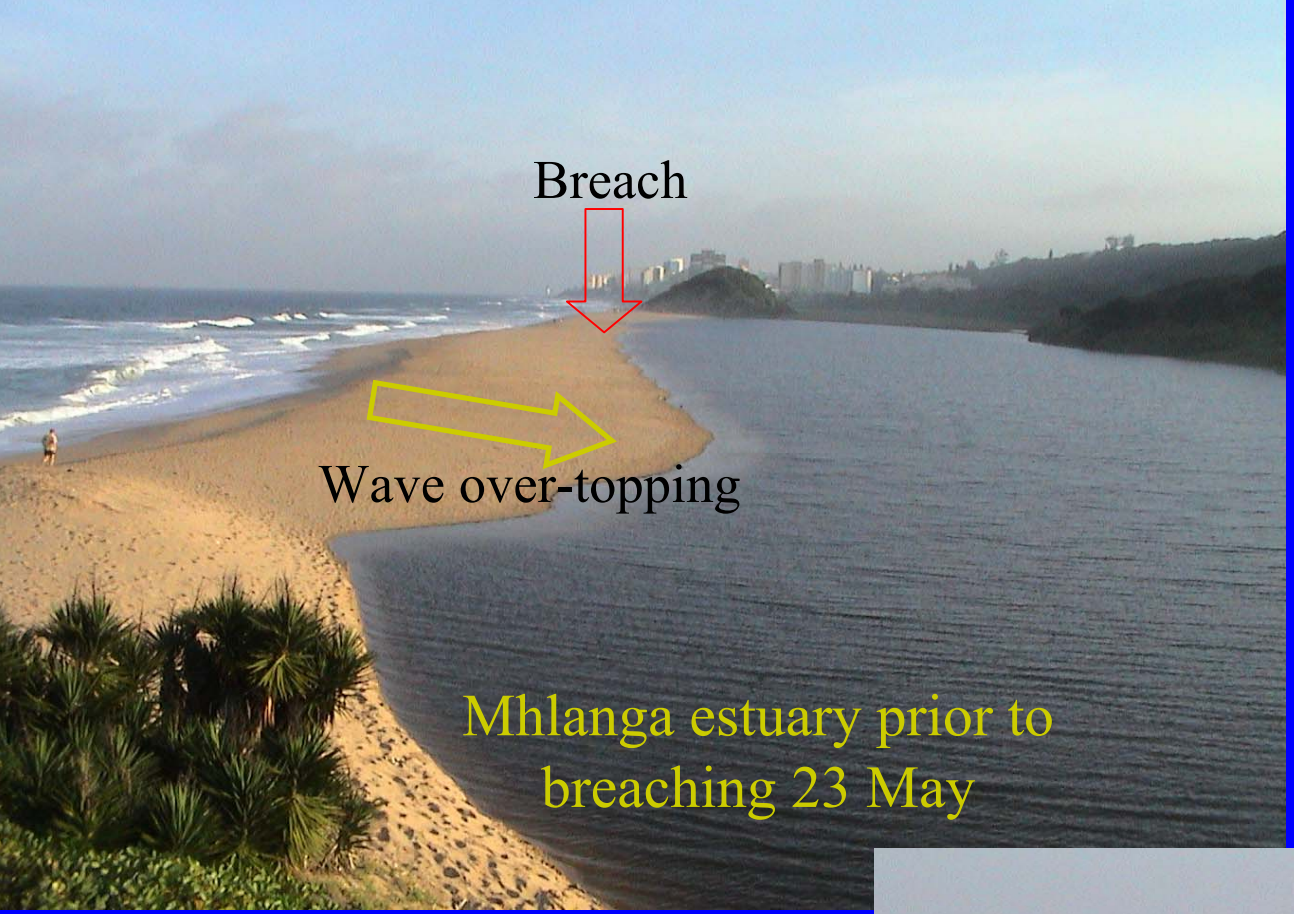
Breaching mechanisms

A) Overtopping + scour due to high, rapid inflow wave
low hydrodynamic residence time, sustained high flow

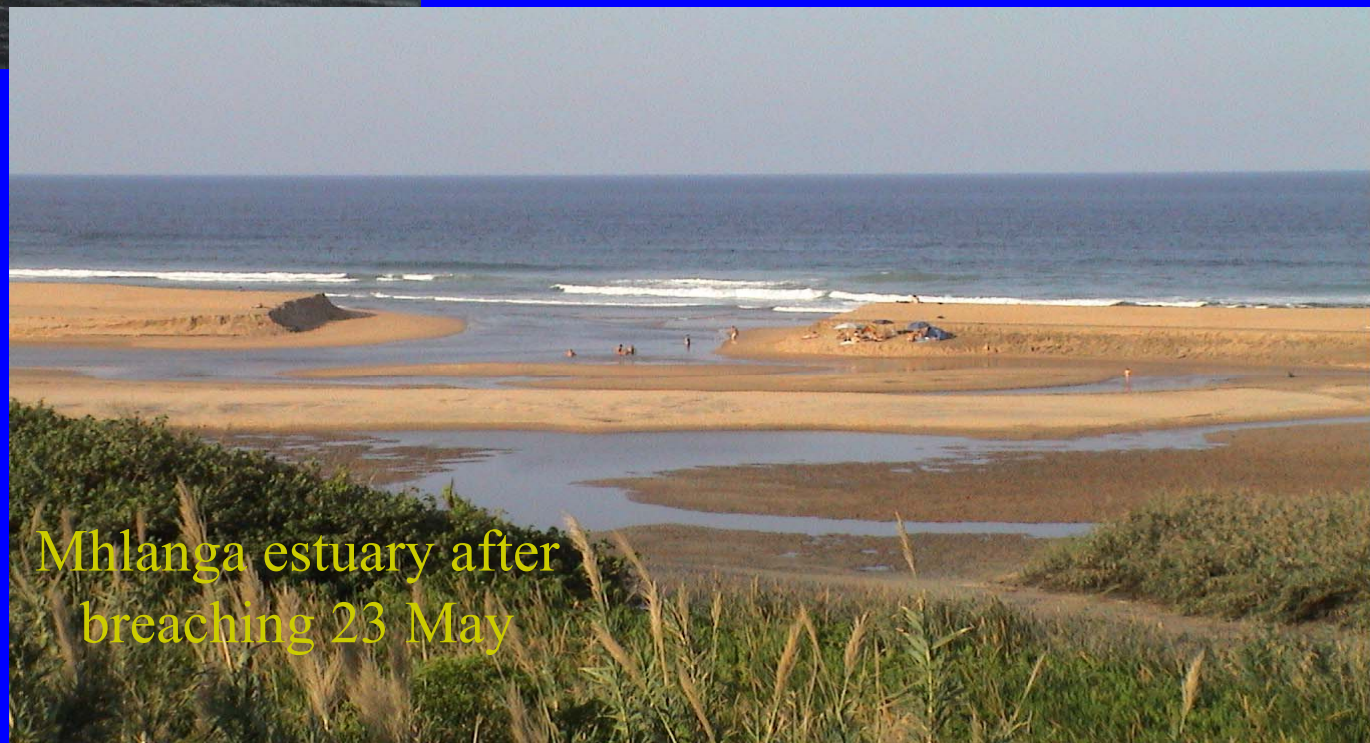
B) Seepage driven erosion and slumping of sand-bar
high WL & sustained high hydraulic gradient (neap tides)



Berm mechanisms



Mhlanga estuary prior to breaching 23 May



Mhlanga estuary after breaching 23 May

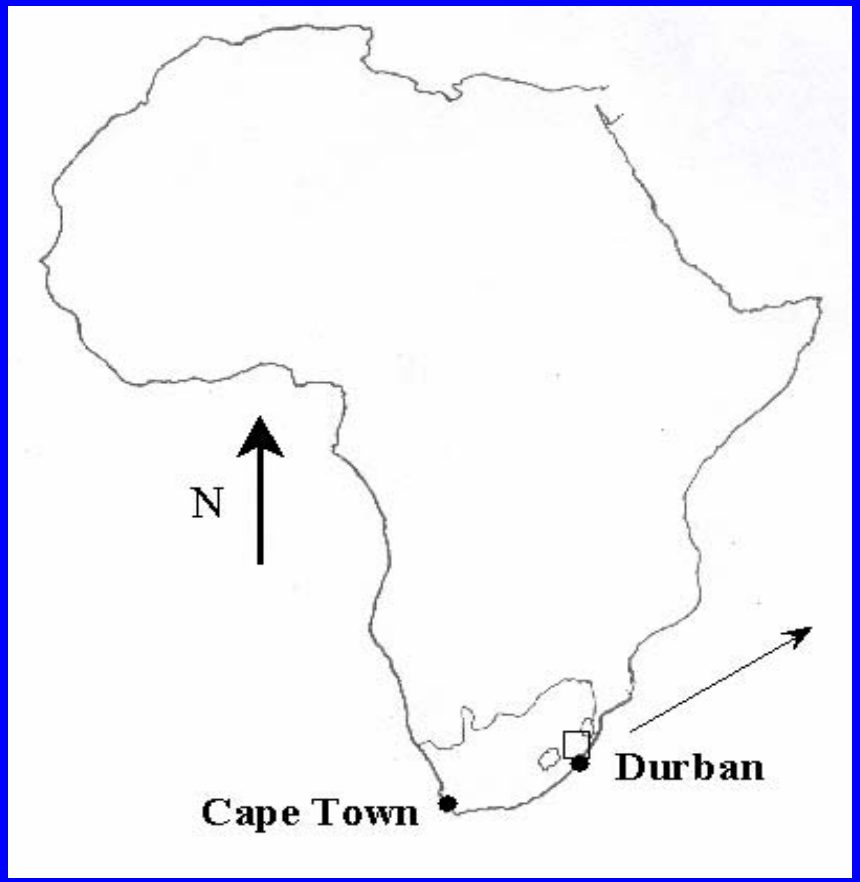
MHLANGA ESTUARY

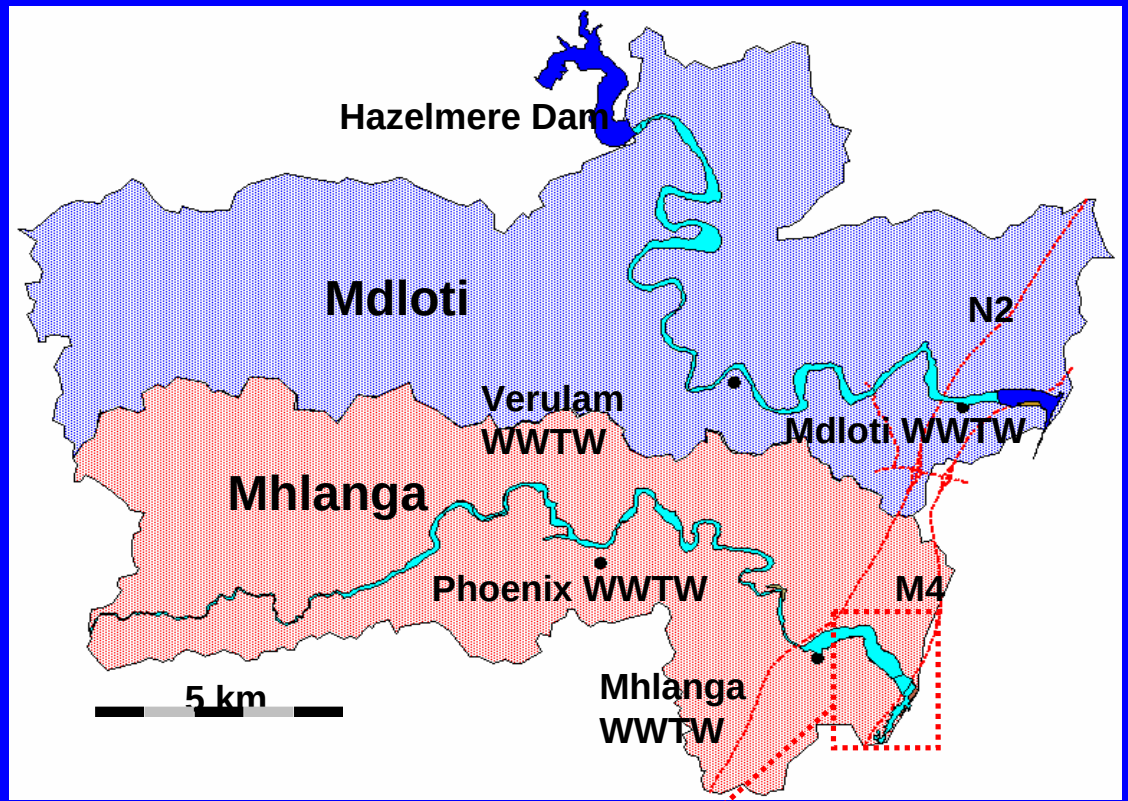
Catchment size: 100 km^2

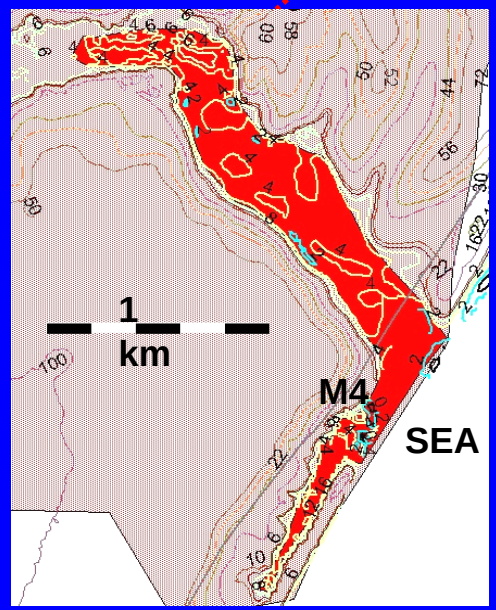
Impoundment: small

Sewage input: 20 $ML.d^{-1}$

- key nursery area on the KZN north coast
- Major survey undertaken in the 70s-80s ⮝ comparison with pre-eutrophic state
- Proposed increase in sewage flow capacity





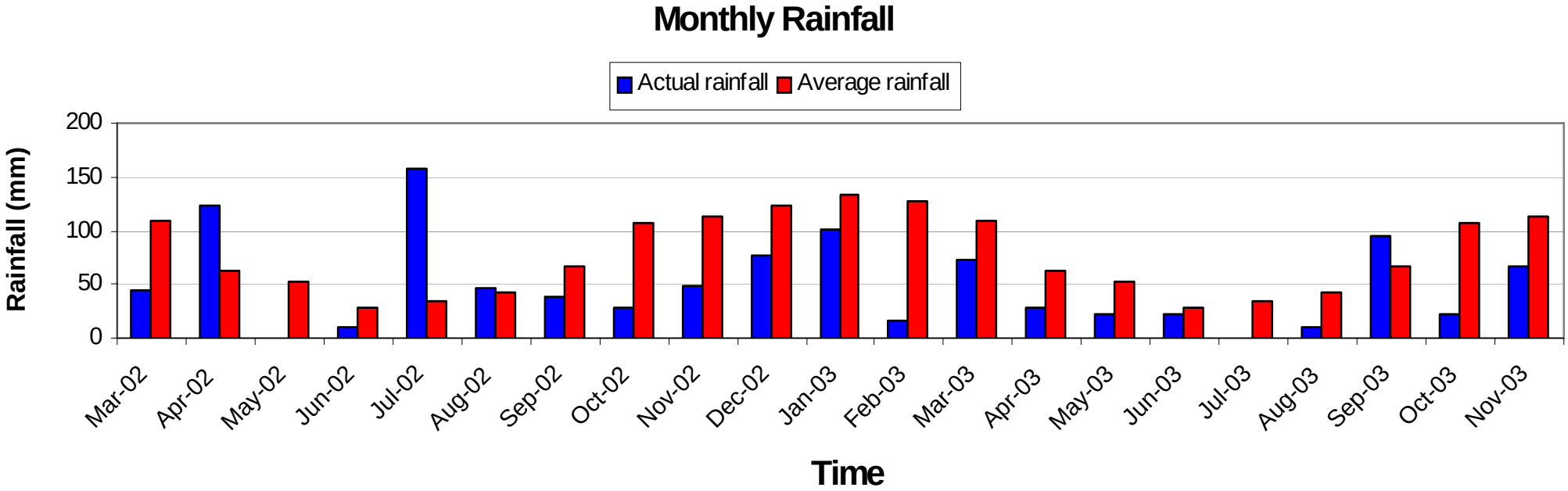


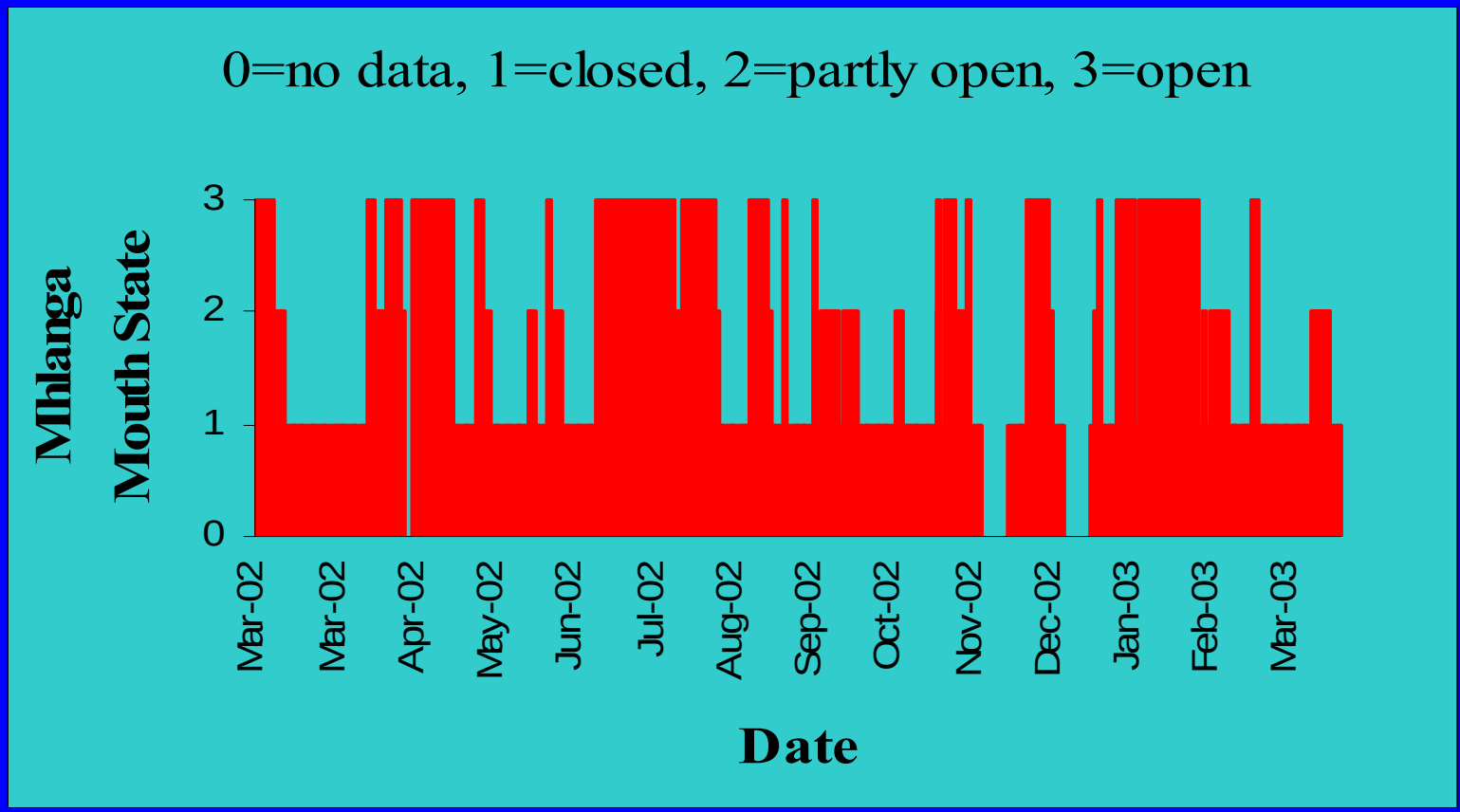
Mhlanga Estuary and its Catchment

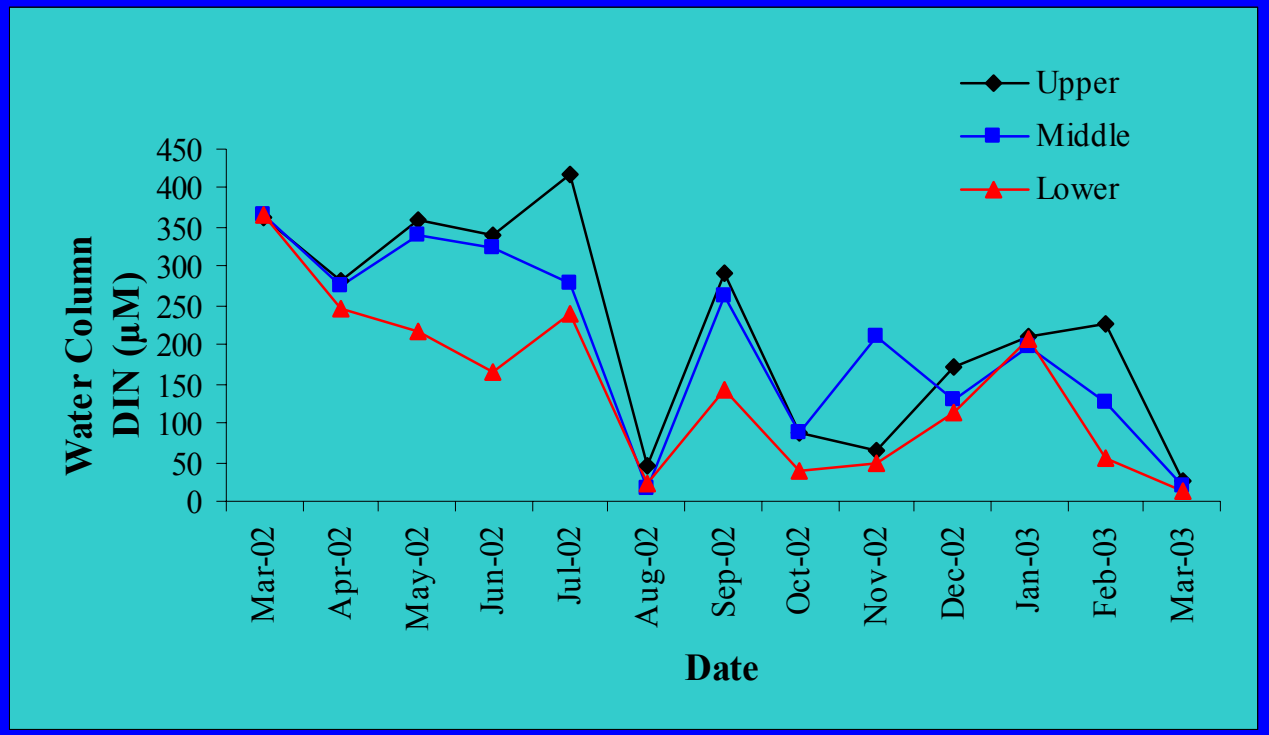
RESEARCH SURVEY: Mar 2002 - Mar 2003

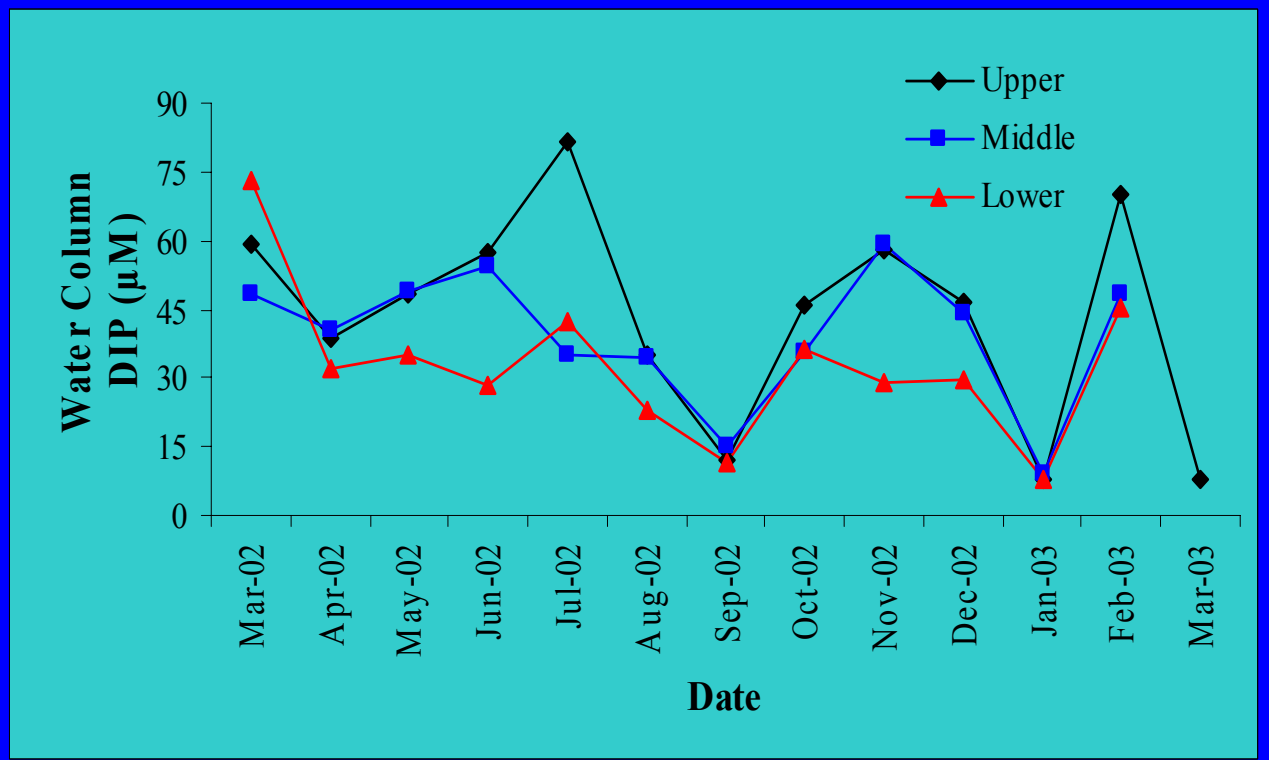
- Current state of the estuary (bio-physico-chemical)
- Comparison with results obtained in 1980 (Whitfield)
- Recommendations for management/rehabilitation

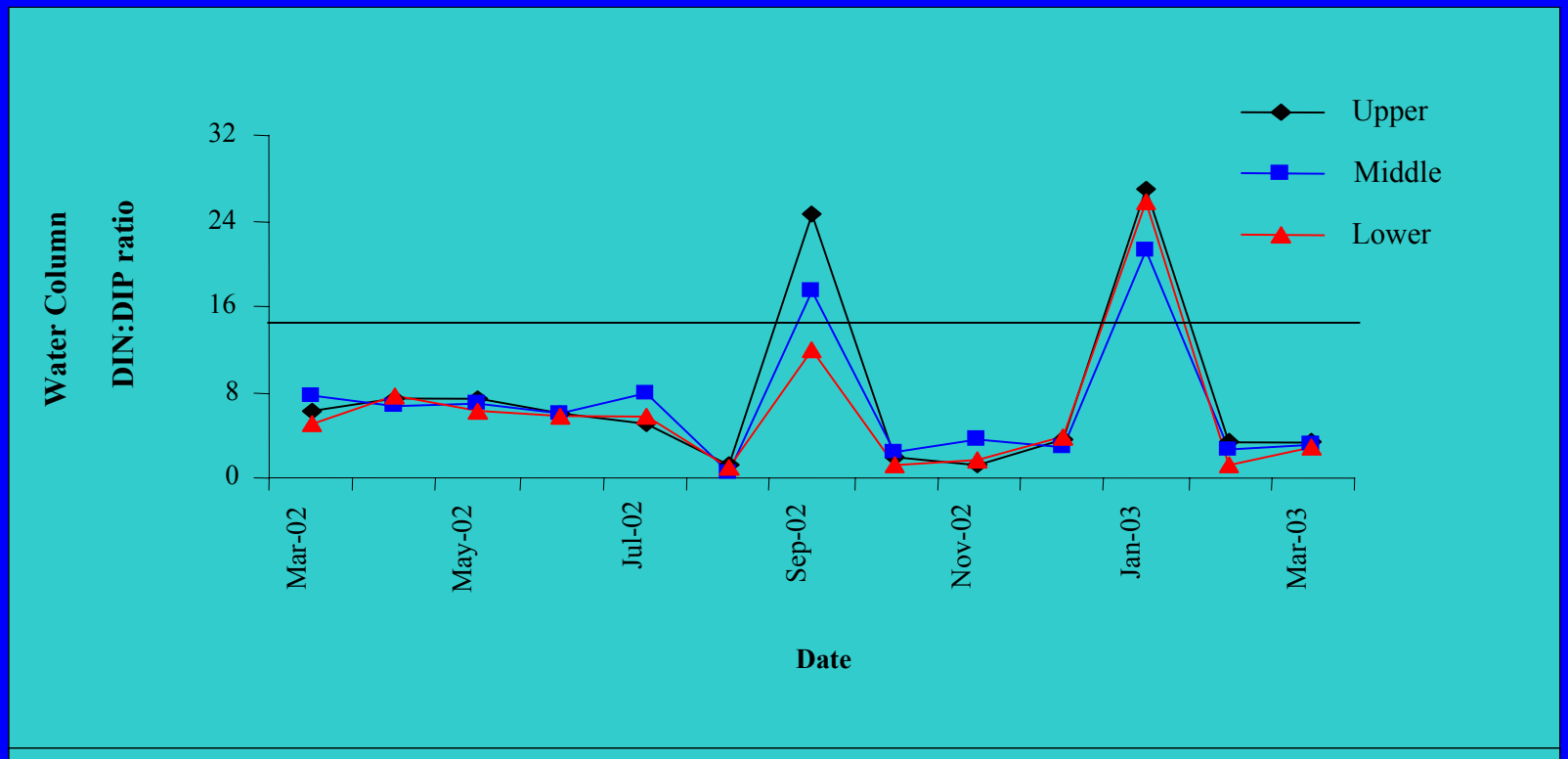
Rainfall pattern during the study period

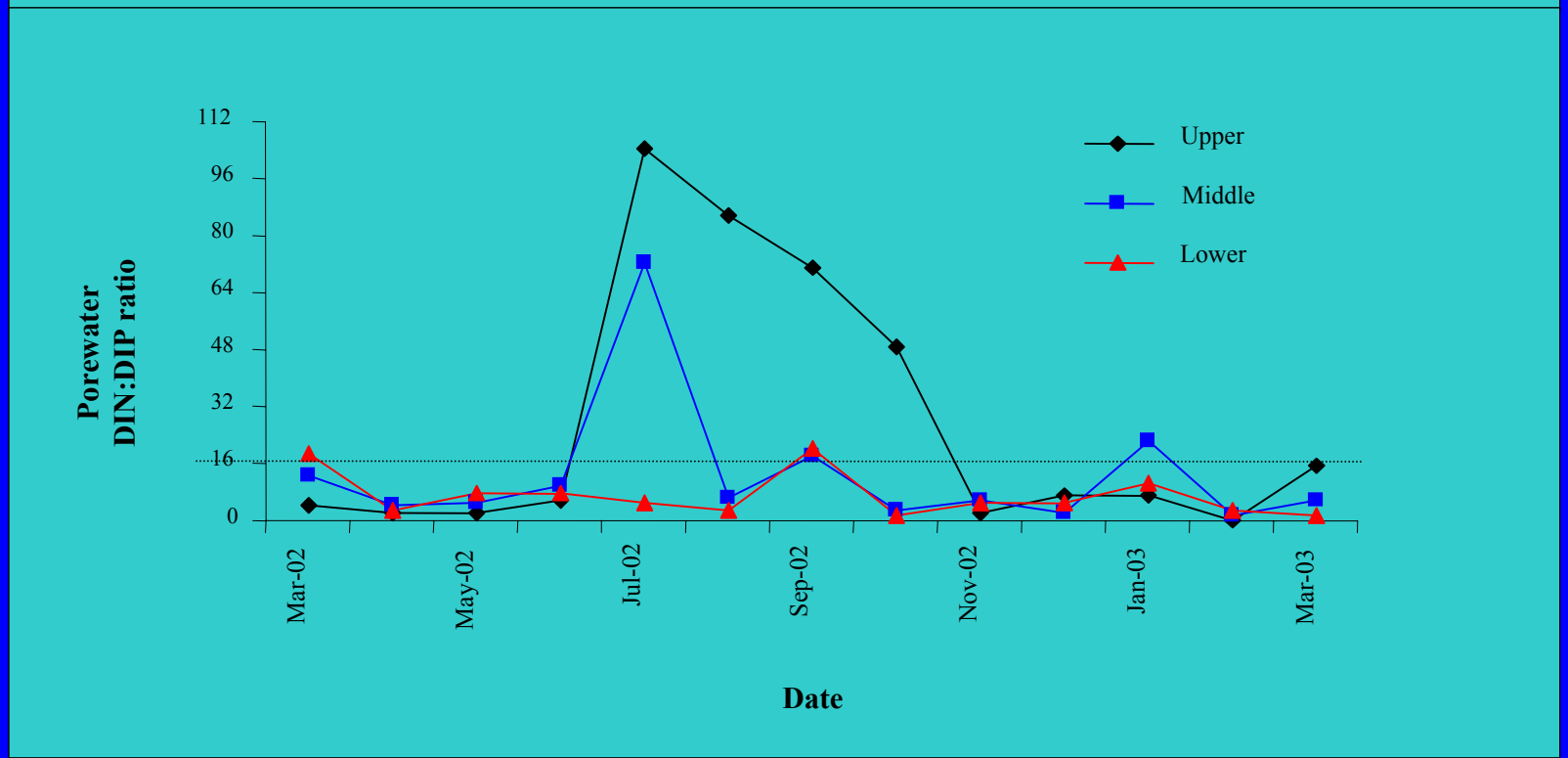



0=no data, 1=closed, 2=partly open, 3=open
Mhlanga Mouth State
3
2
1
0
Mar-02
Mar-02
Apr-02
May-02
Jun-02
Jul-02
Aug-02
Sep-02
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Date

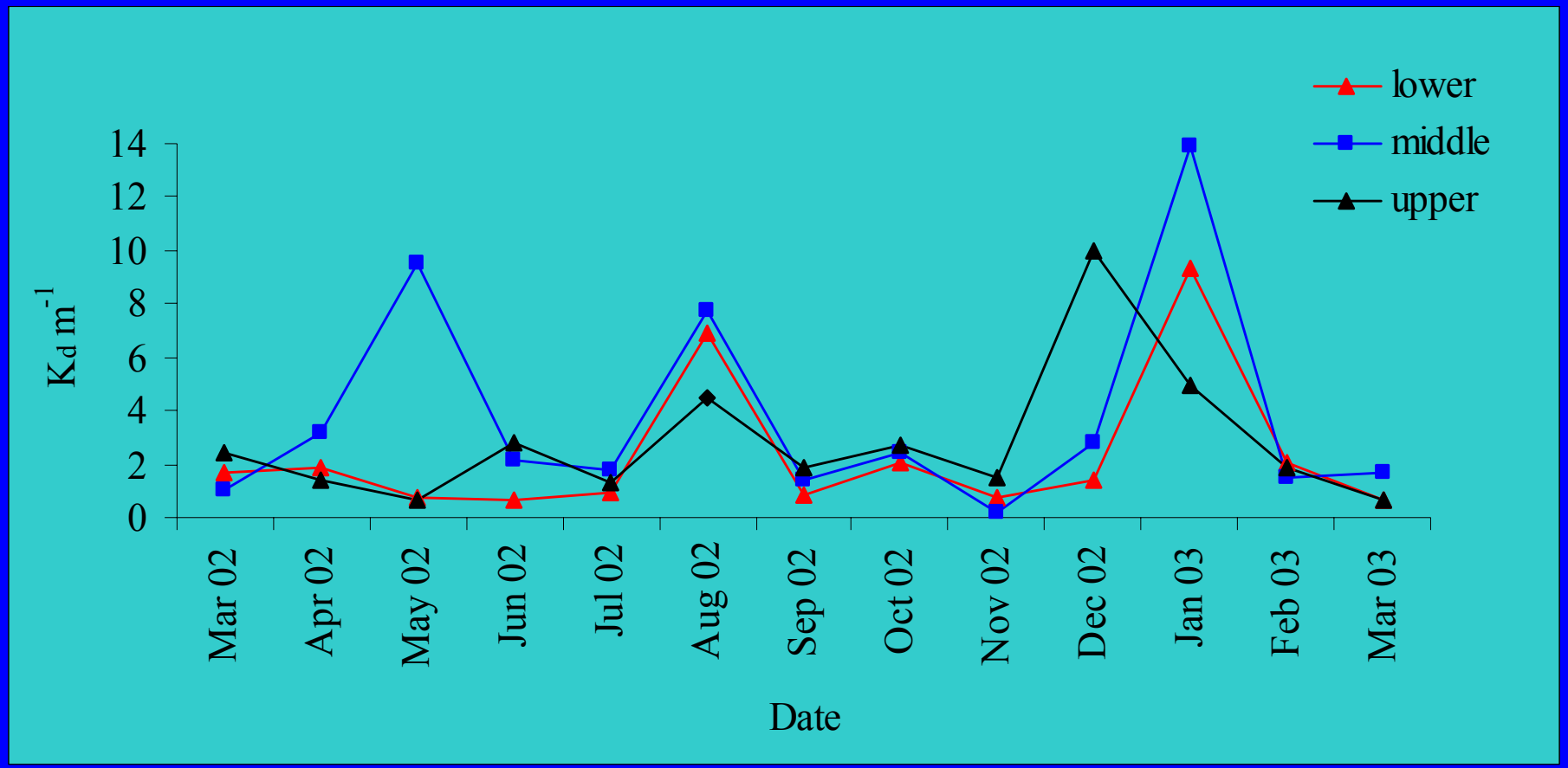

Upper
Middle
Lower
Water Column DIN (µM)
450
400
350
300
250
200
150
100
50
0
Mar-02
Apr-02
May-02
Jun-02
Jul-02
Aug-02
Sep-02
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Date


Upper
Middle
Lower
Water Column DIP (µM)
90
75
60
45
30
15
0
Mar-02
Apr-02
May-02
Jun-02
Jul-02
Aug-02
Sep-02
Oct-02
Nov-02
Dec-02
Jan-03
Feb-03
Mar-03
Date

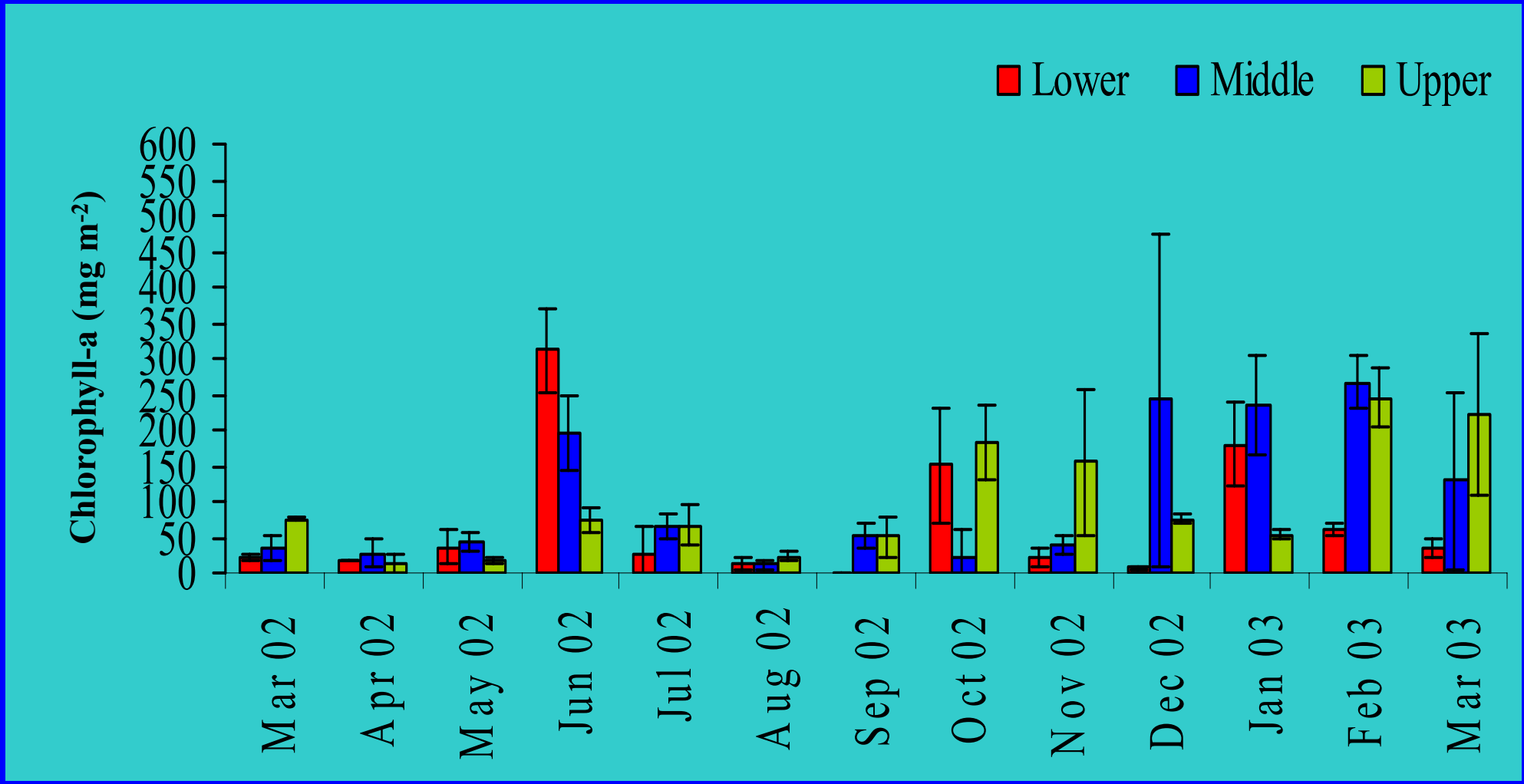

Water Column
DIN:DIP ratio
32
24
16
8
0
Upper
Middle
Lower
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
Date


Porewater
DIN:DIP ratio
112
96
80
64
48
32
16
0
Upper
Middle
Lower
Mar-02
May-02
Jul-02
Sep-02
Nov-02
Jan-03
Mar-03
Date

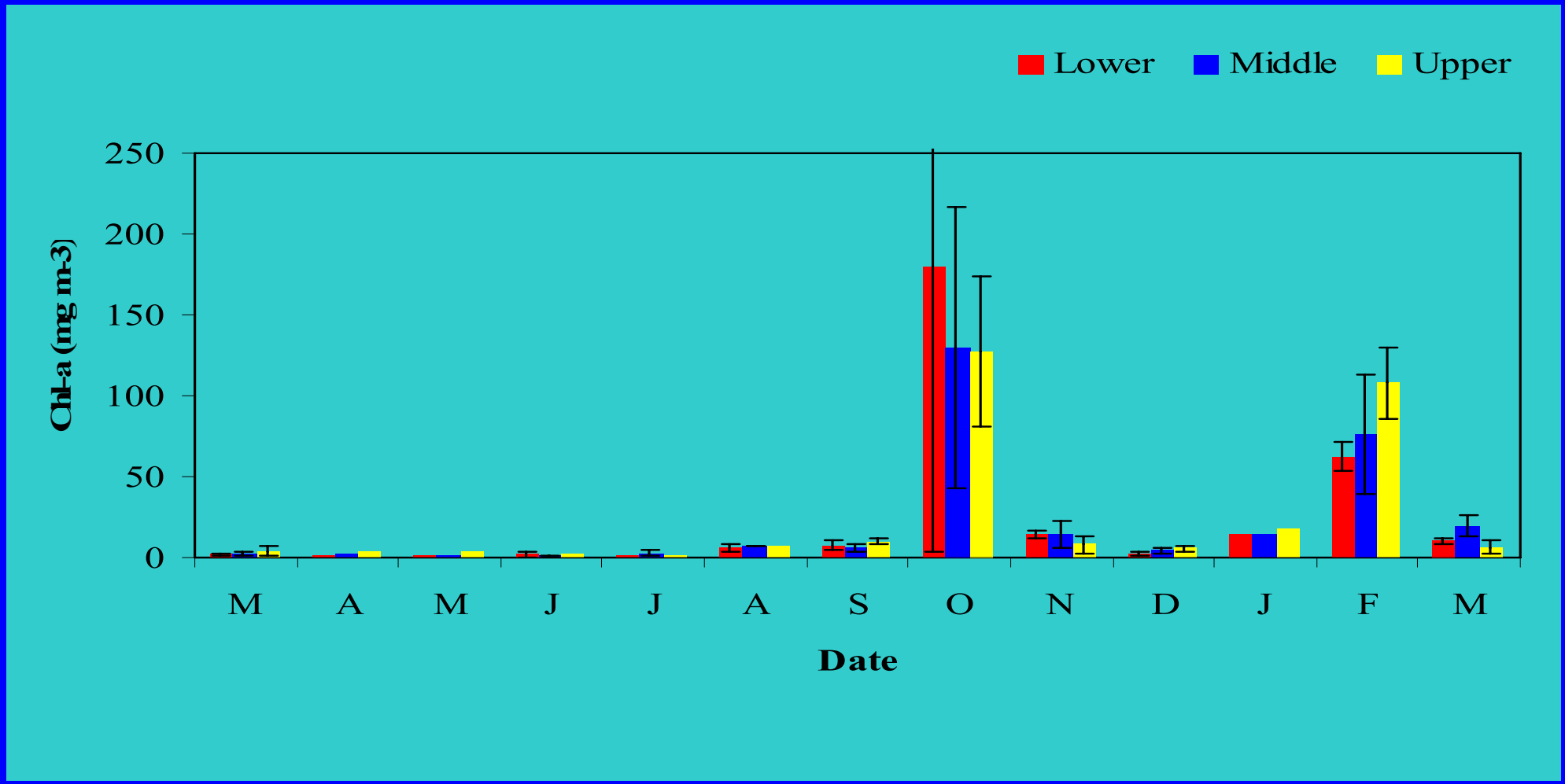
LIGHT ATTENUATION COEFFICIENT, K_d (Fig. 2.5)



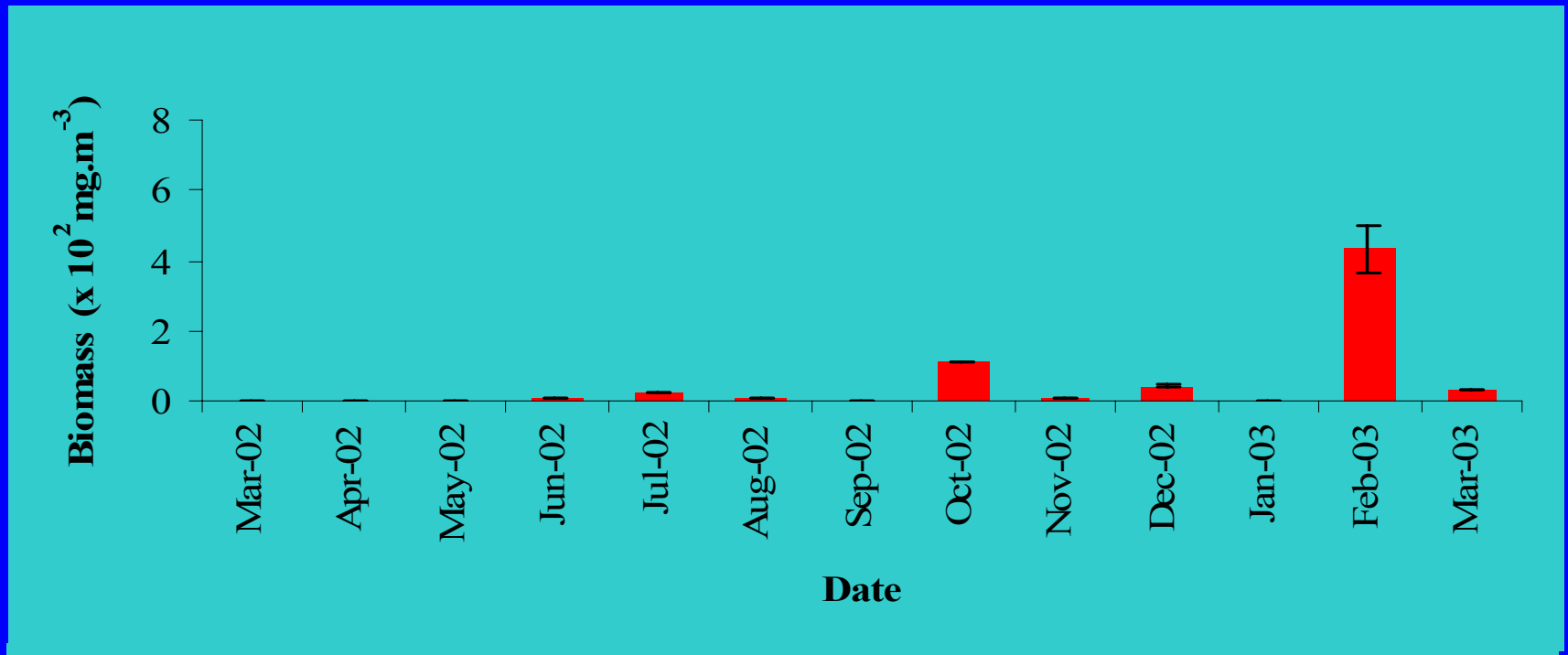
MICROPHYTOBENTHOS

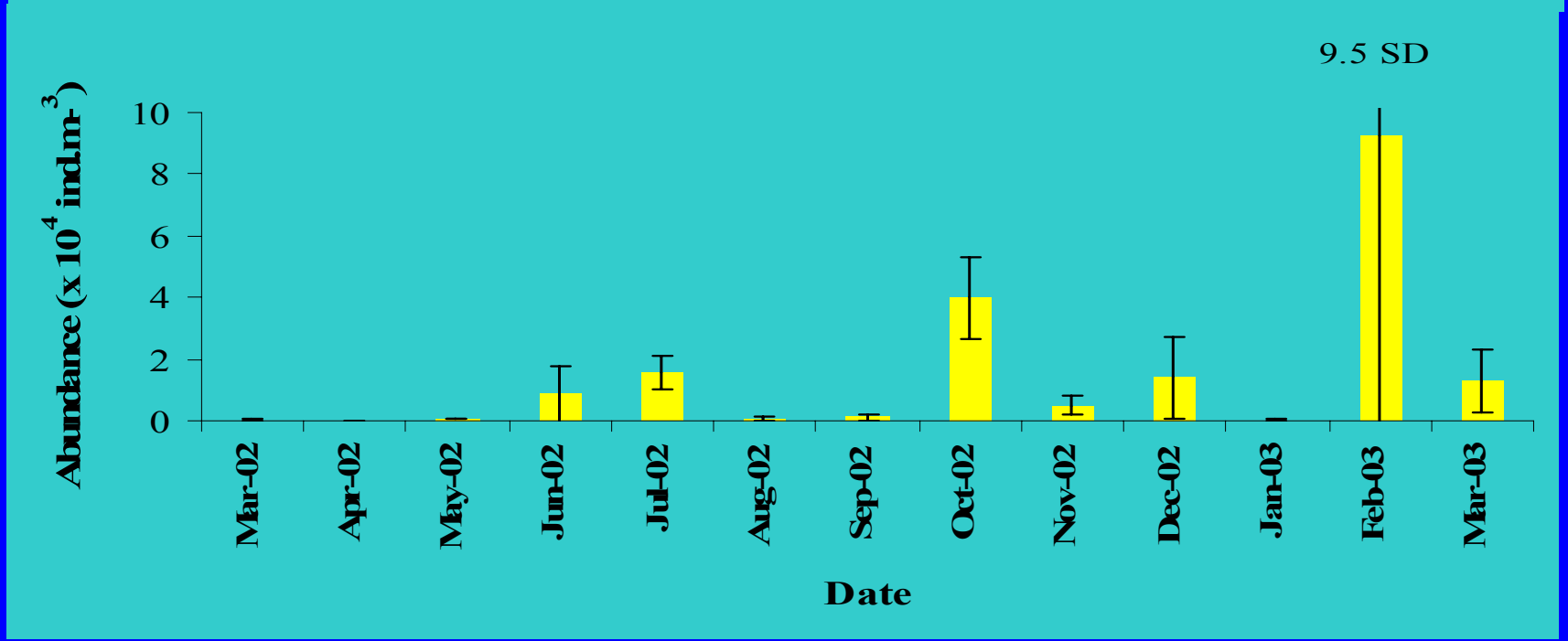


PHYTOPLANKTON

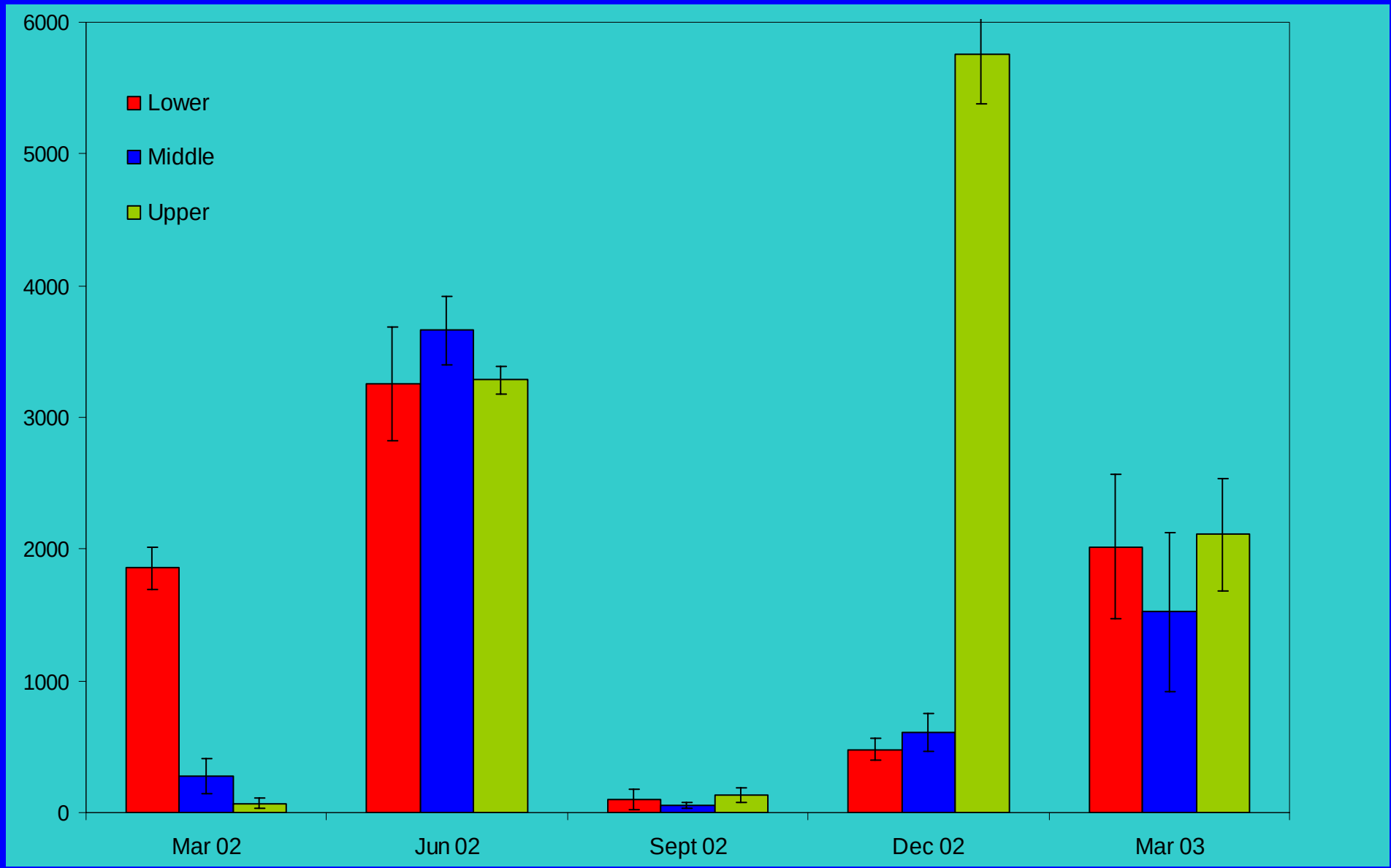


ZOOPLANKTON

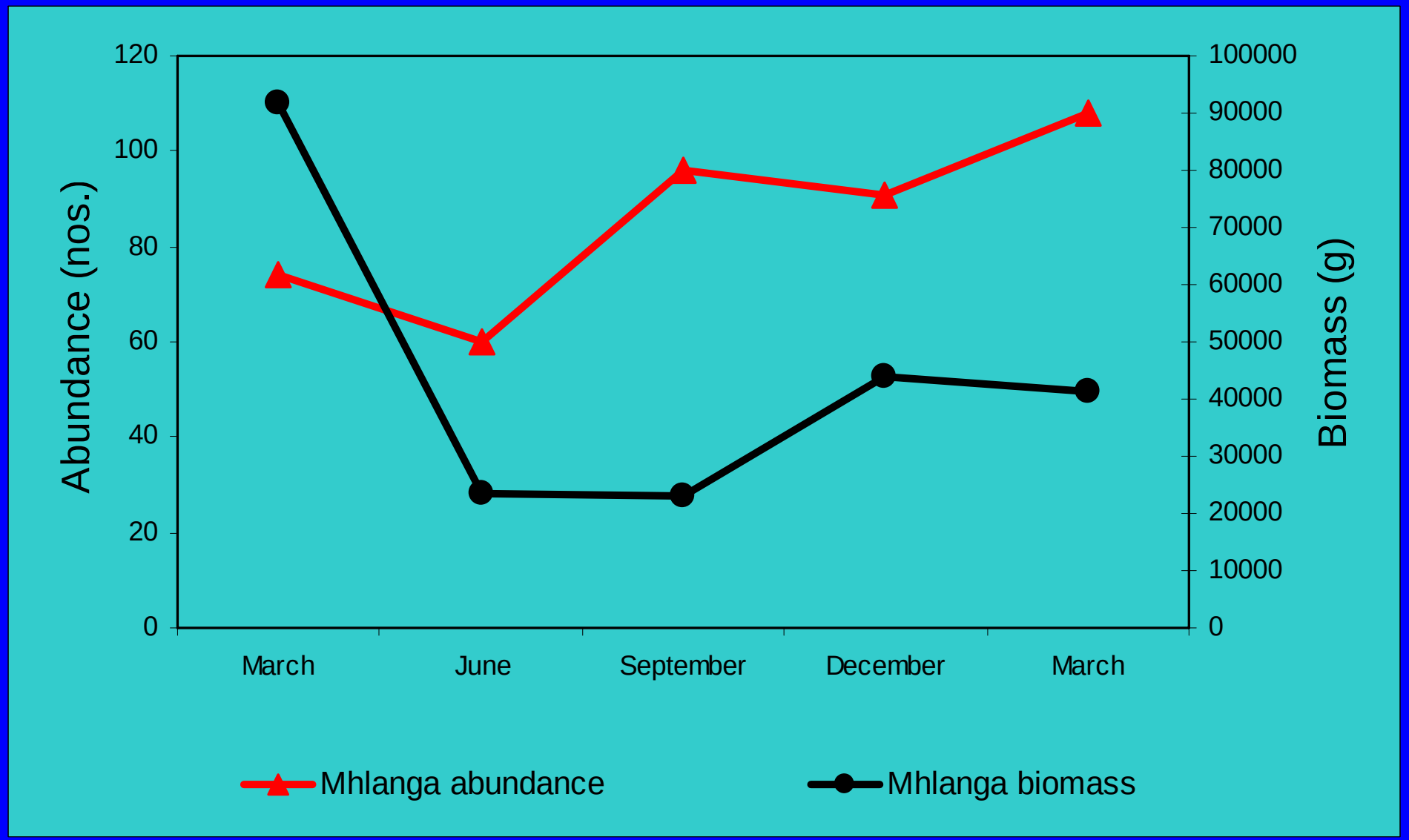




BENTHIC MACROFAUNA (Fig 6.1)



FISH ABUNDANCE AND BIOMASS (Fig. 7.1)



FISH DIVERSITY - 1980 vs 2003 (Fig. 7.4)

CONCLUSIONS

1) Hypereutrophic conditions → microalgal blooms

2) Capping flow (sewage discharge) → frequent breaching

+3) Short residence time → few blooms & no anoxic waters

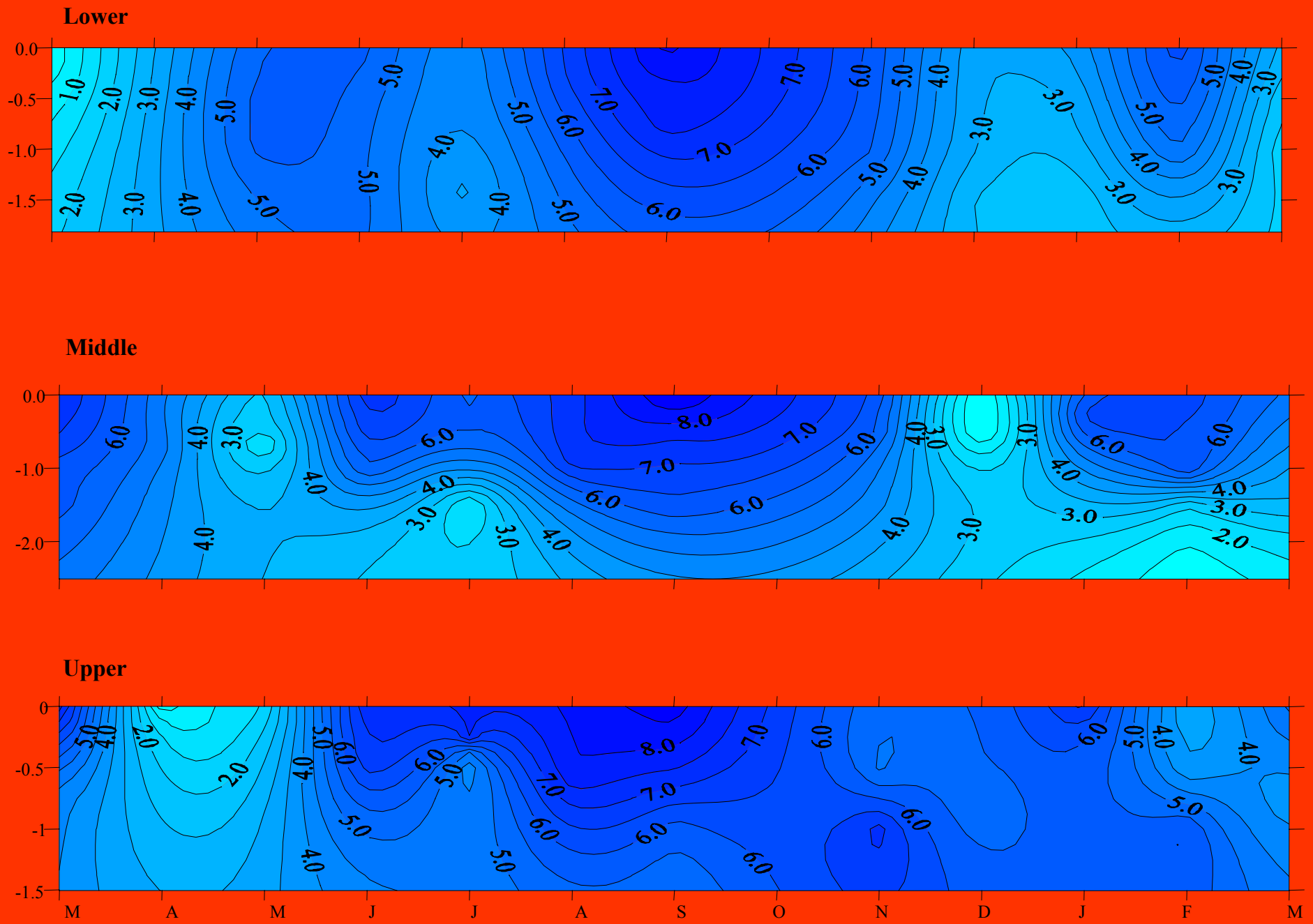
-4) No prolonged closed phase → no nursery function

SOLUTION(S)

a) Treated water to by-pass estuary, straight into ocean

b) Treated water re-directed to permanently open estuary

DISSOLVED OXYGEN (Fig. 2.5)



THANKS FOR YOUR ATTENTION