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The Hula Valley and Lake Kinneret Ecosystems: Ecological Rivalry or Frienship with Climate Change Perspectives

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Northern part of the Hula Valley
Hermon Mountain on top.
(Photo: Y. Waxelbaum-Stahl)

Anthropogenic intervention in the Catchment –Lake Kinneret management:

1933-South Dam operation

1957-Hula drainage

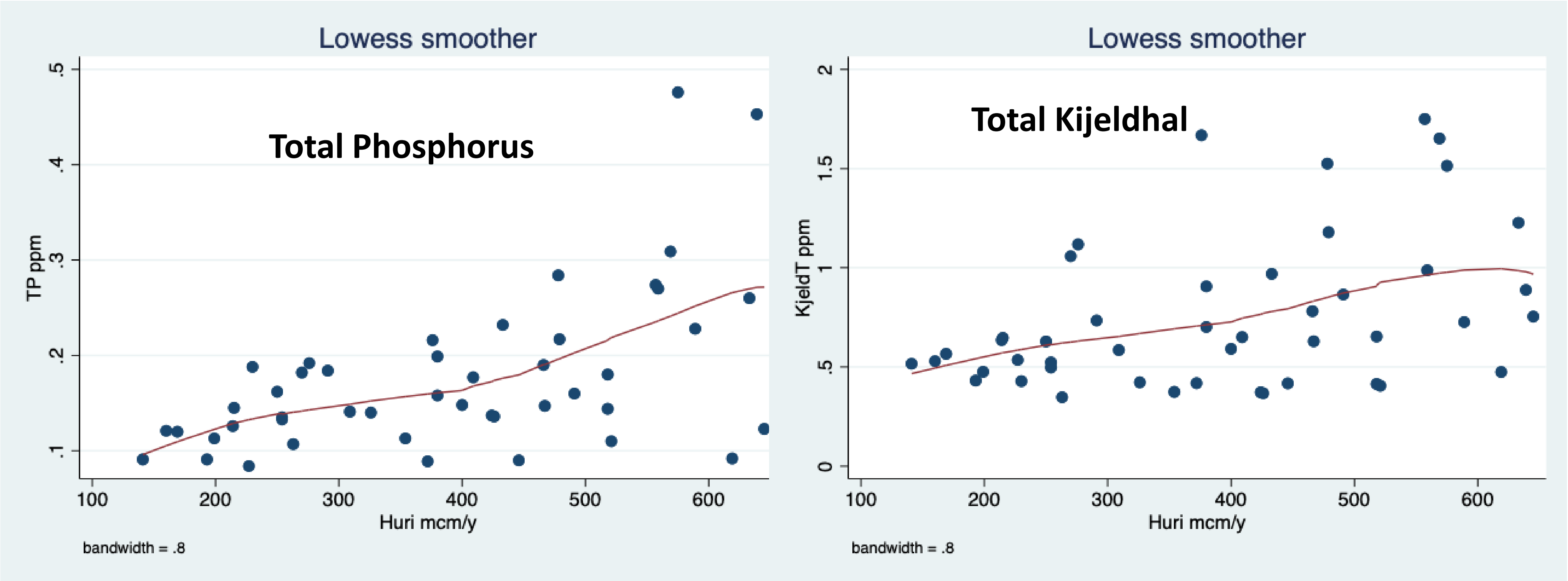
1967-Salty water (Ein Nur) diversion

1964-National Water Carrier operation

1994-2006-Hula Reclamation Project

2022-desalinized water input

The Hula Drinage demolished the natural wetland and old lake Hula ecosystem and was followed by the establishment of agricultural development which was later reclaimed by the <u>Hula Reclamation Project</u> aimed at both, improvement of Kinneret water quality protection and establishment of natural infrastructure –a basis for eco-tourism

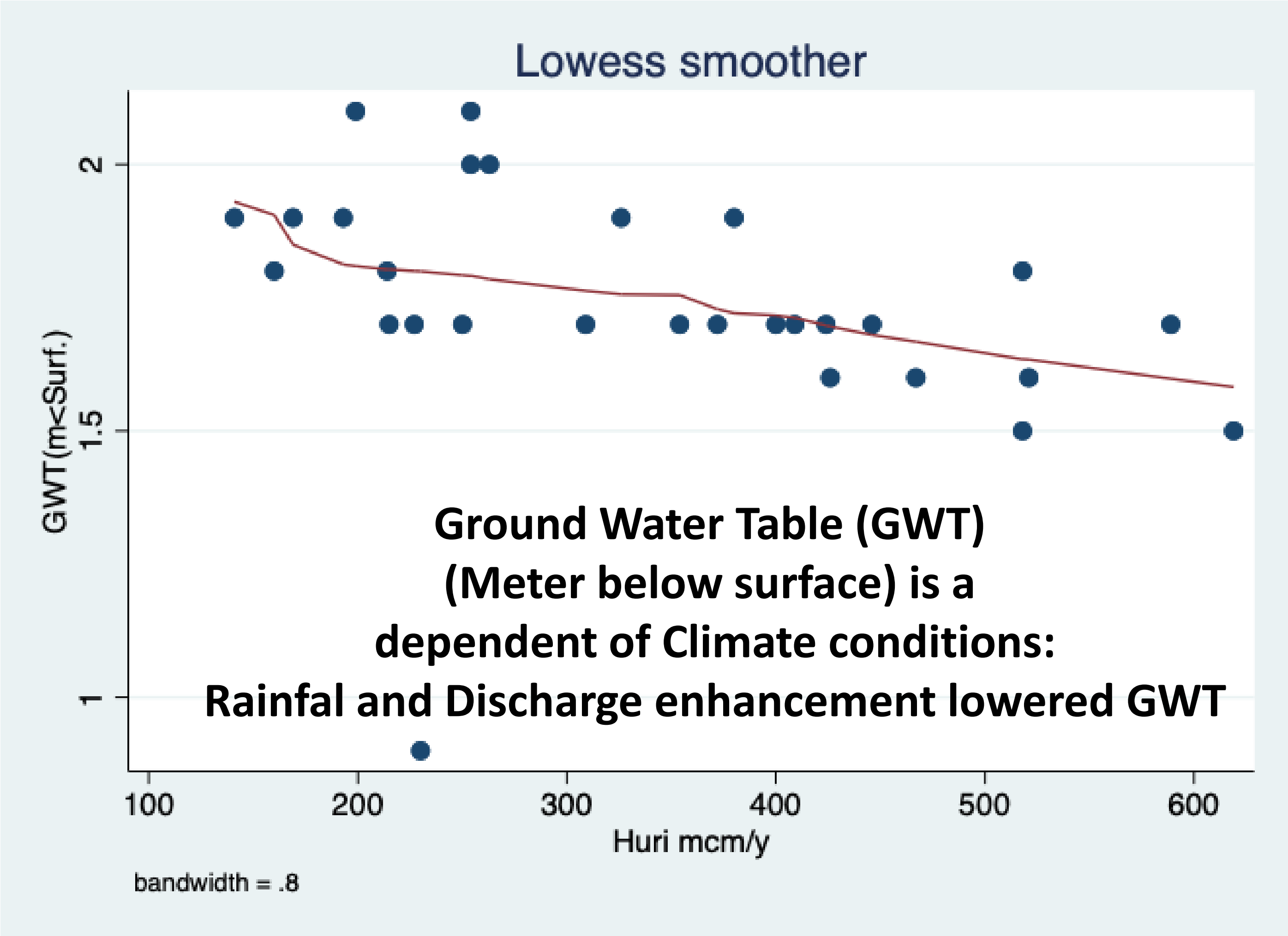


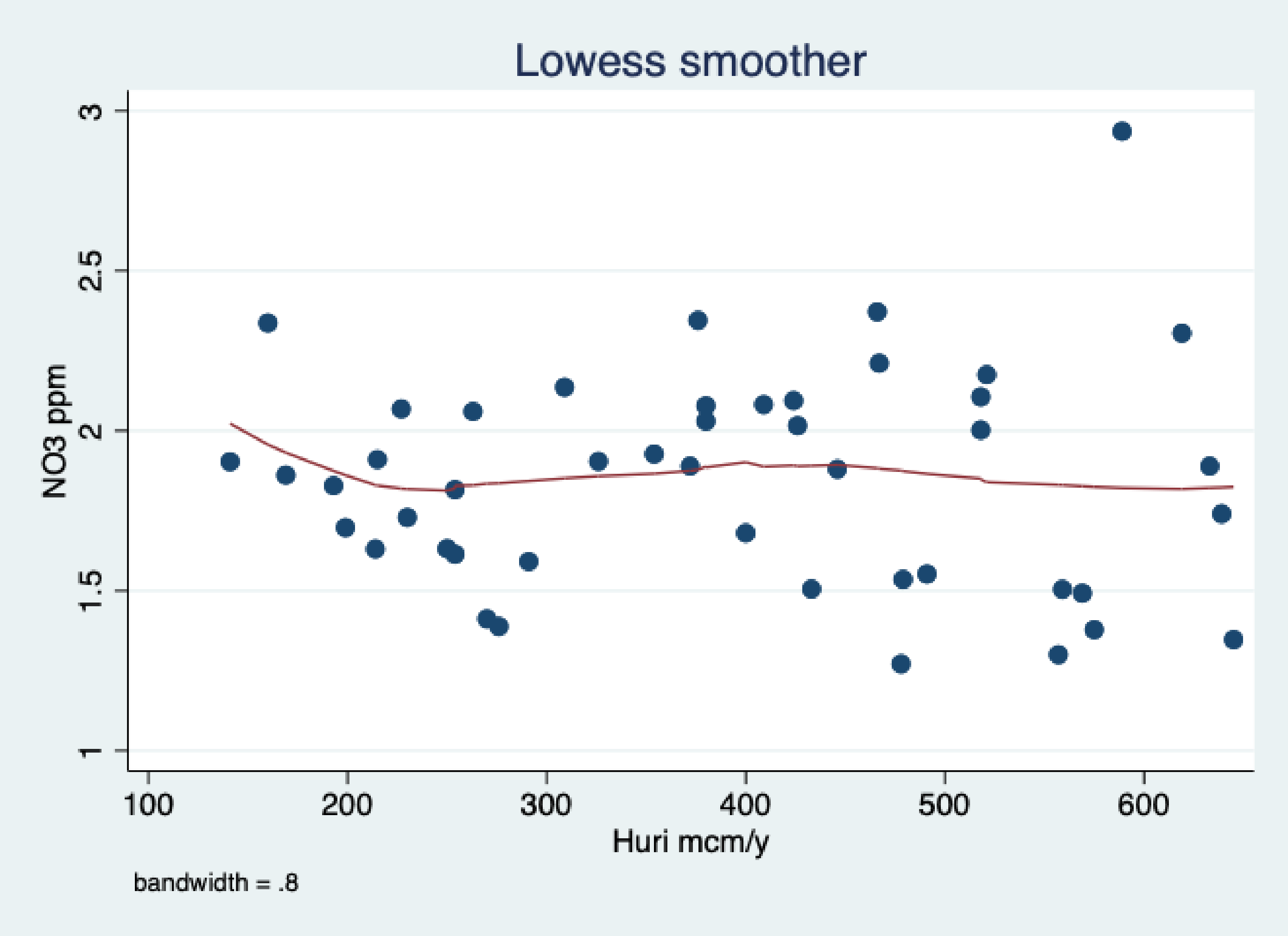
TP and KJT concentrations (ppm) and obviously total input loads are dependent of Jordan River Discharge (mcm; $10^6 m^3/y$)

Discharge enhancement correlate with nutrient input increae

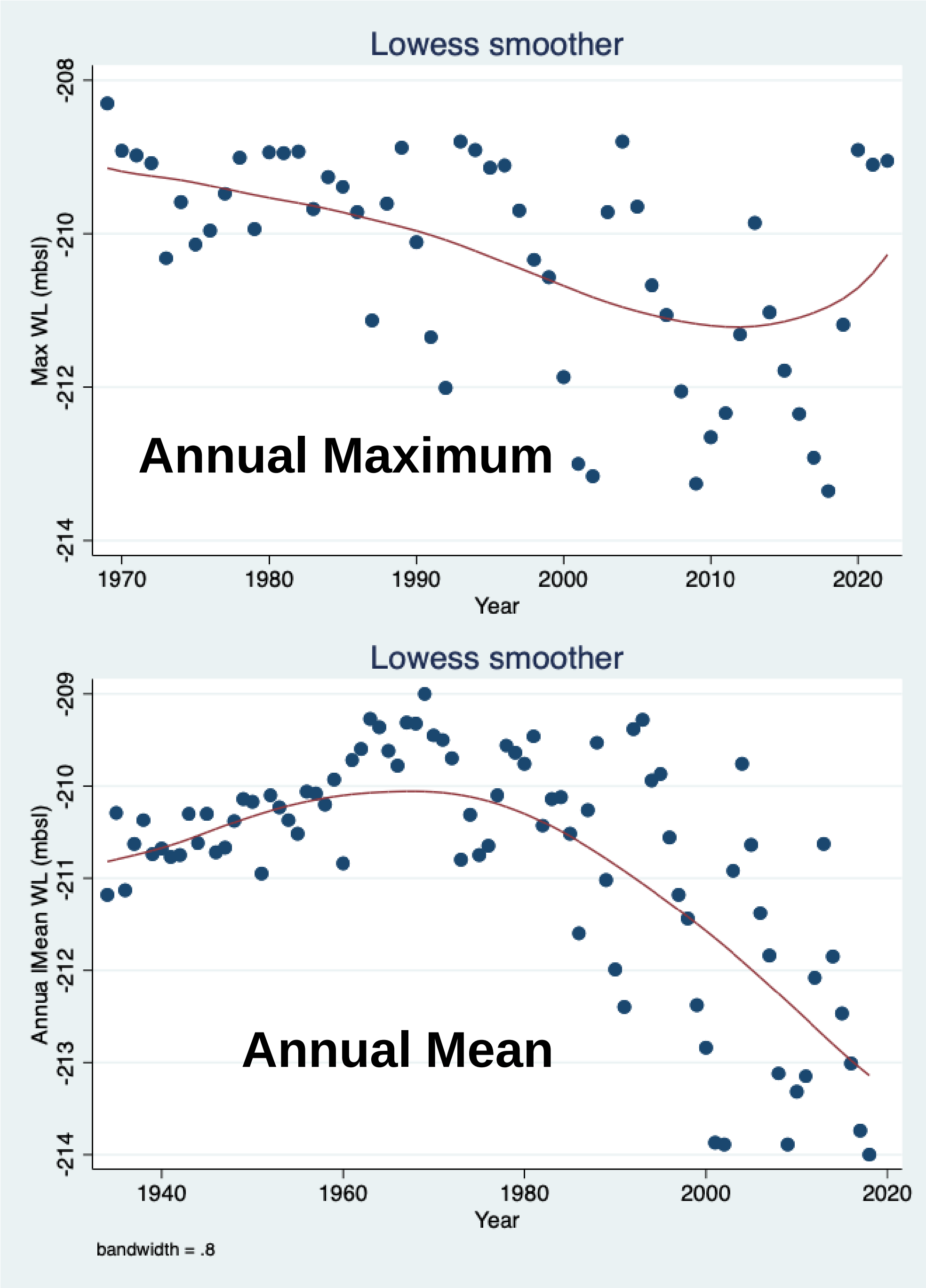
$KJT=TN-(NO_3+NO_2)$

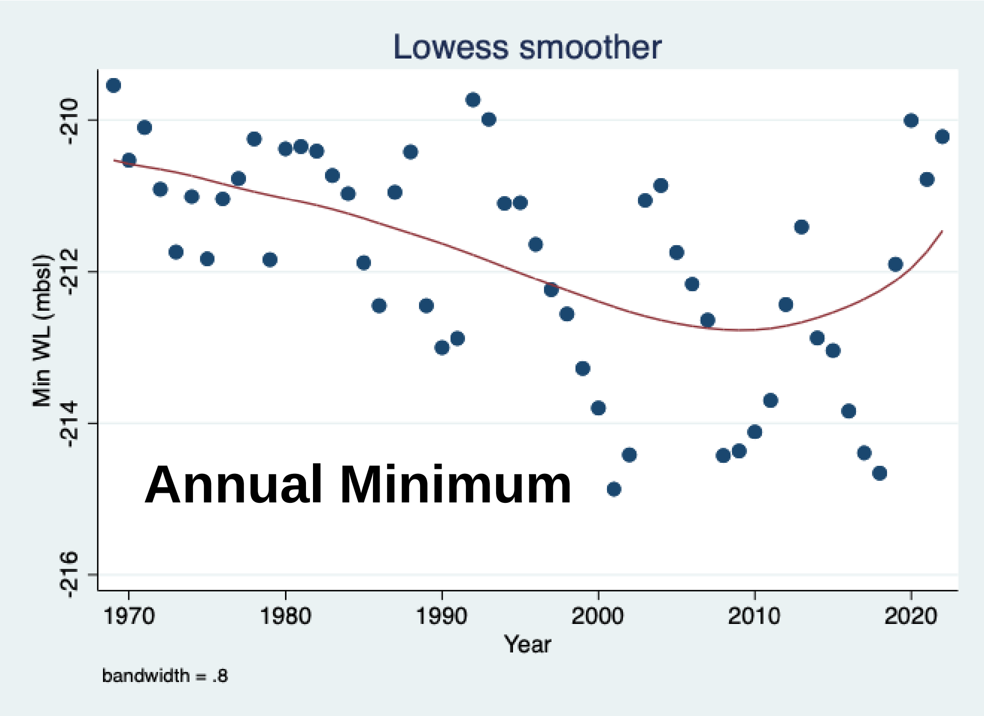
NO_3 origin is mostly Peat Soil


Lowess smoother
GWT(m<Surf.)
2
1.5
1
100
200
300
400
500
600
Huri mcm/y
bandwidth = .8
Ground Water Table (GWT)
(Meter below surface) is a
dependent of Climate conditions:
Rainfal and Discharge enhancement lowered GWT

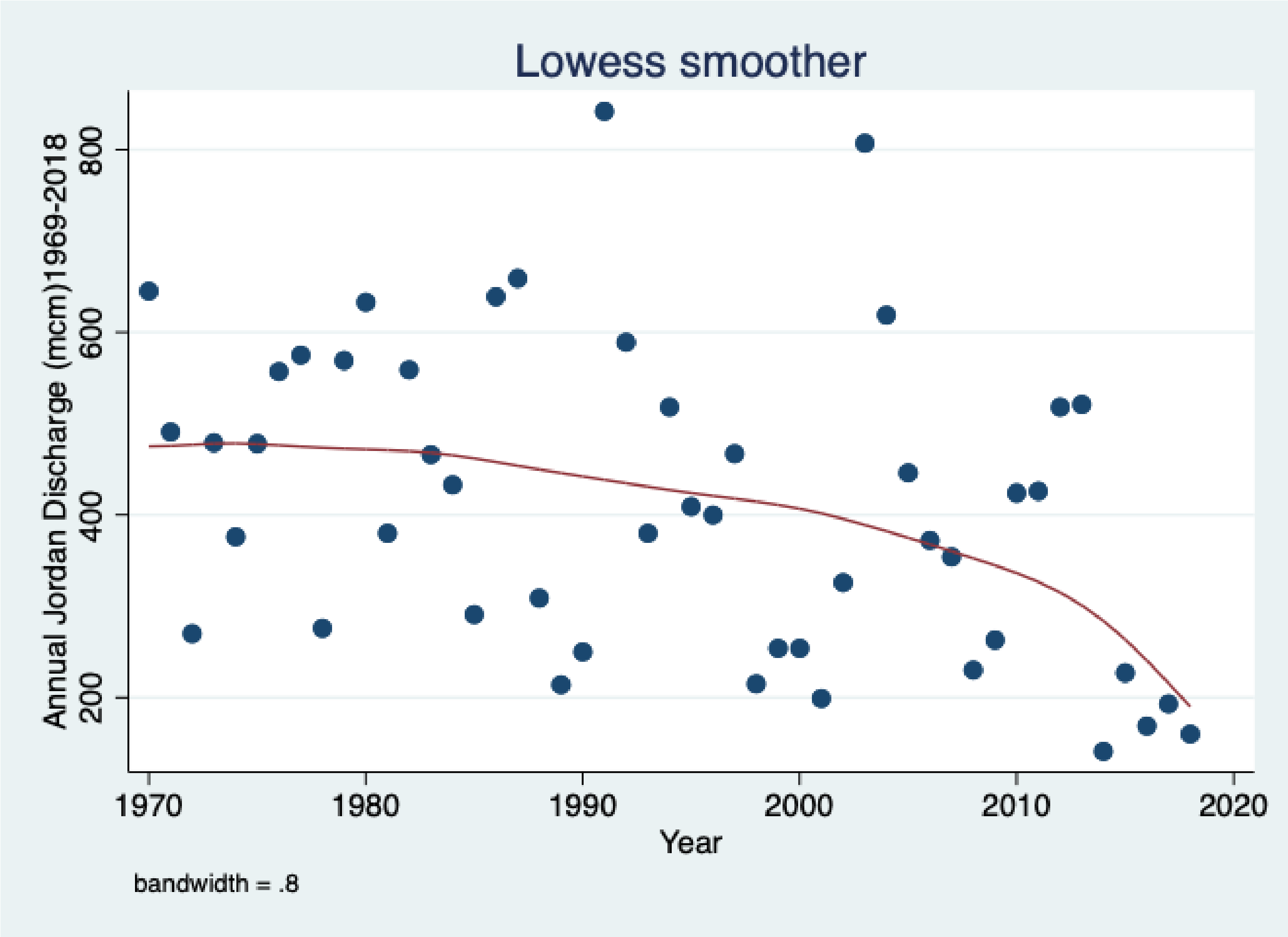


Major source of NO_3 is Peat soil in the Hula Valley
Not like other Nitrogenpus forms
Jordan discharge is not affecting the NO_3 concentration
Whilst the total input load is discharge dependent

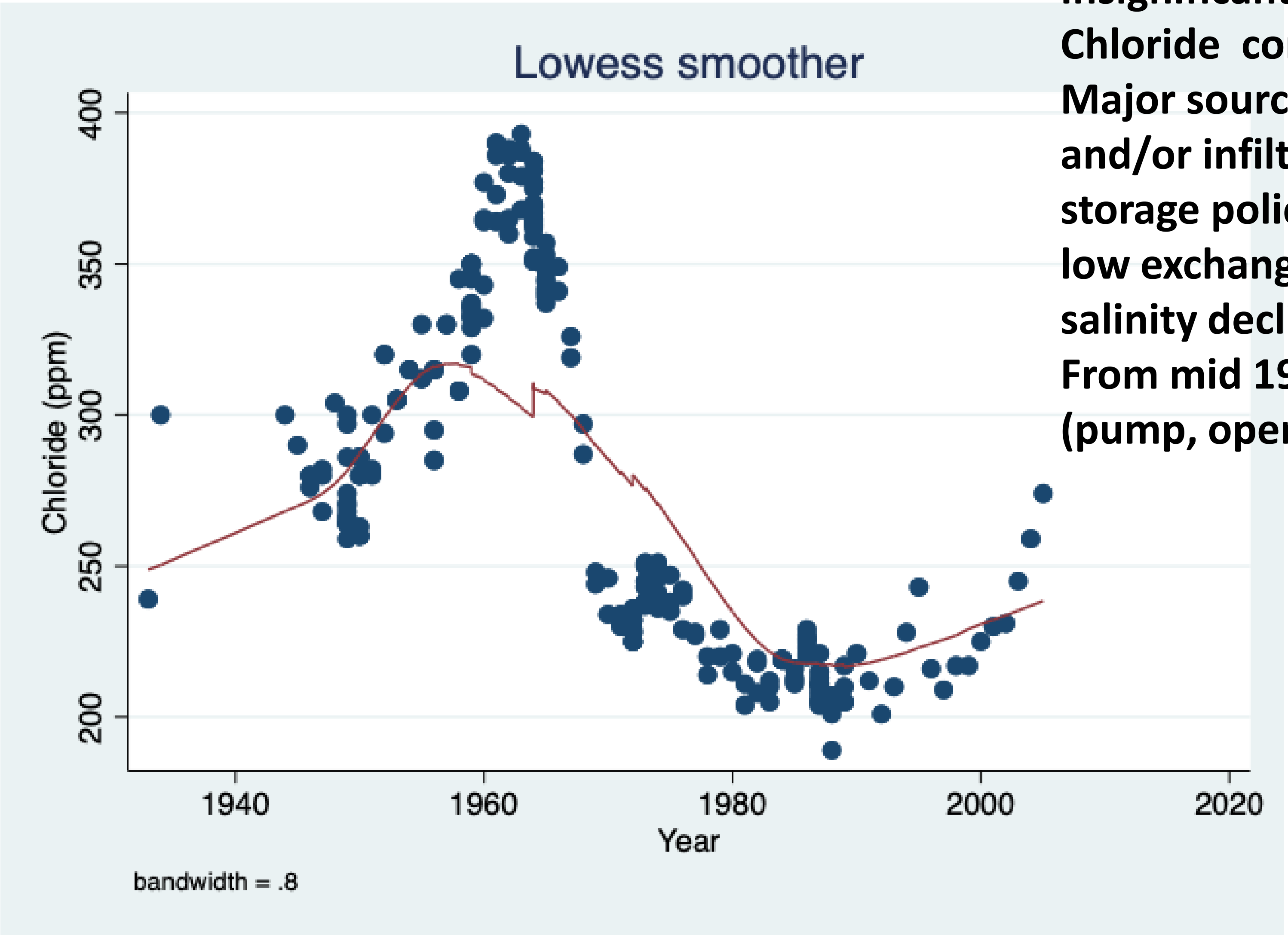




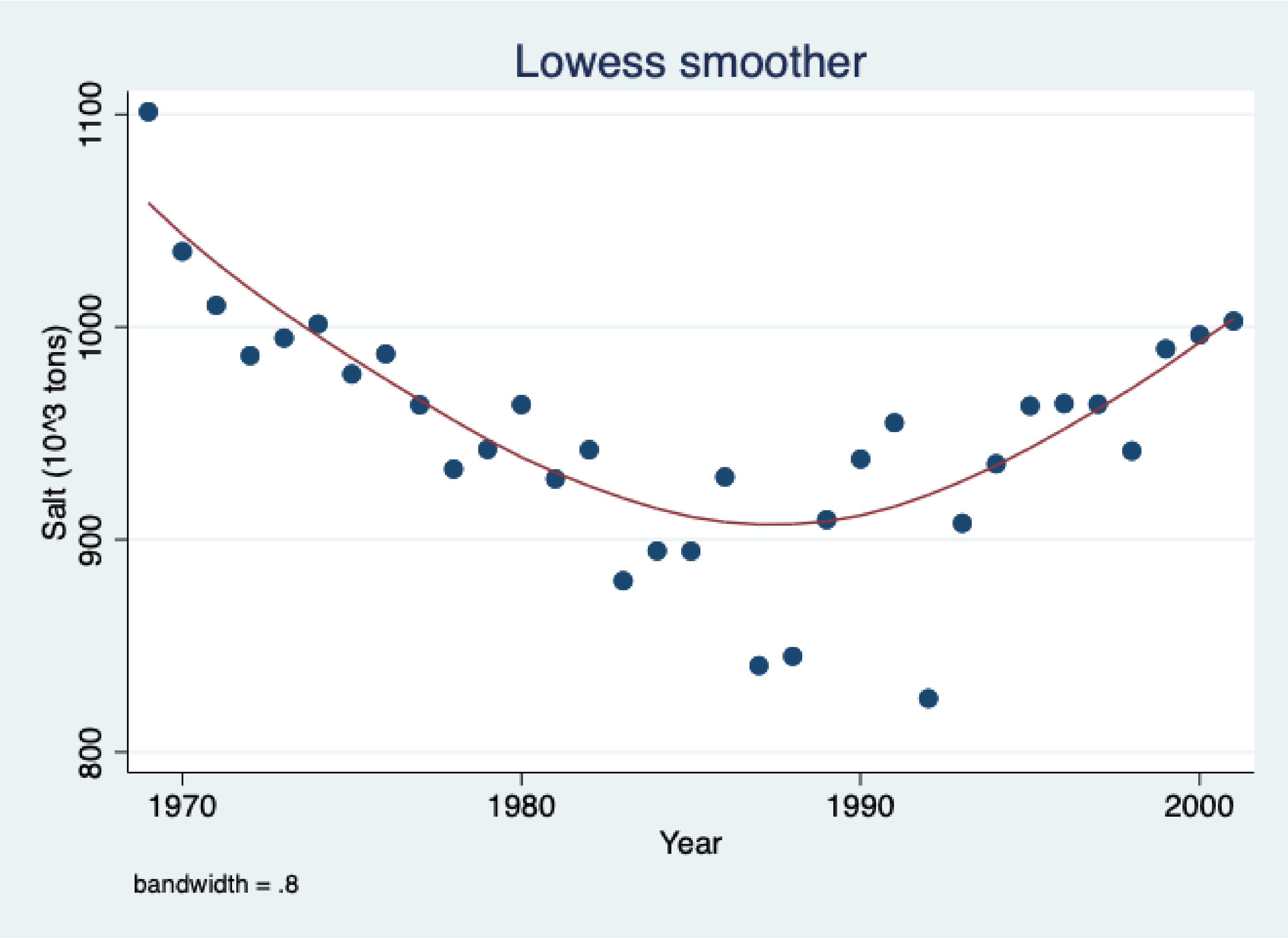
Annual Maximum,Minimum and mean WL (mbsl) in Lake Kinneret 1969-2022 (Climate change and pumping management indication)



Climate change: Annual (1969-2018) Discharge of river Jordan (mcm)



Insignificant impact of the Hula Valley on Chloride concentration (salinity) in the lake.
Major sources of salt are sub-lacustrine influx (flow and/or infiltration): During 1948-1968-water storage policy by Dam operation; salinity increased , low exchange: 1968-1980 Salt removal and heavy floods, salinity decline;
From mid 1980`s – water exchange policy (pump, open dam) controled salinity level.



Annual mean load of salts (10^3 ton)
(lake volume X Chloride concentration)
Load reduction is possible
by water exchange,
pumping or open dam;
Hula valley is not involved;
1969-mid 1980`s load reduction
by salt removal
and hevy floods (river freshwaters);
Since mid 1980`s load
Decline is possible by shortening
of Hydraulic Residence Time.

Seasonal Averages of annual input of Nitrogen forms loads (ton) Into lake Kinneret through River Jordan

Period.	Ammonium.	Nitrate.	Organic –N
1967-1985.	65	877	522
1986-2001	37	804	232
2002-2018	20	753	132

Decline of Ammonium and Organic-N loads in the Jordan contribution resulted by anthropogenig management of reduction in migration from the Hula Valley by fishpond restriction and sewage removal.

Peaks of submerged vegetation biomass (ton DW) in lake Agmon-Hula And Phosphorus and Nitrogen content (Data source: Kaplan and Niv 1997-2005)

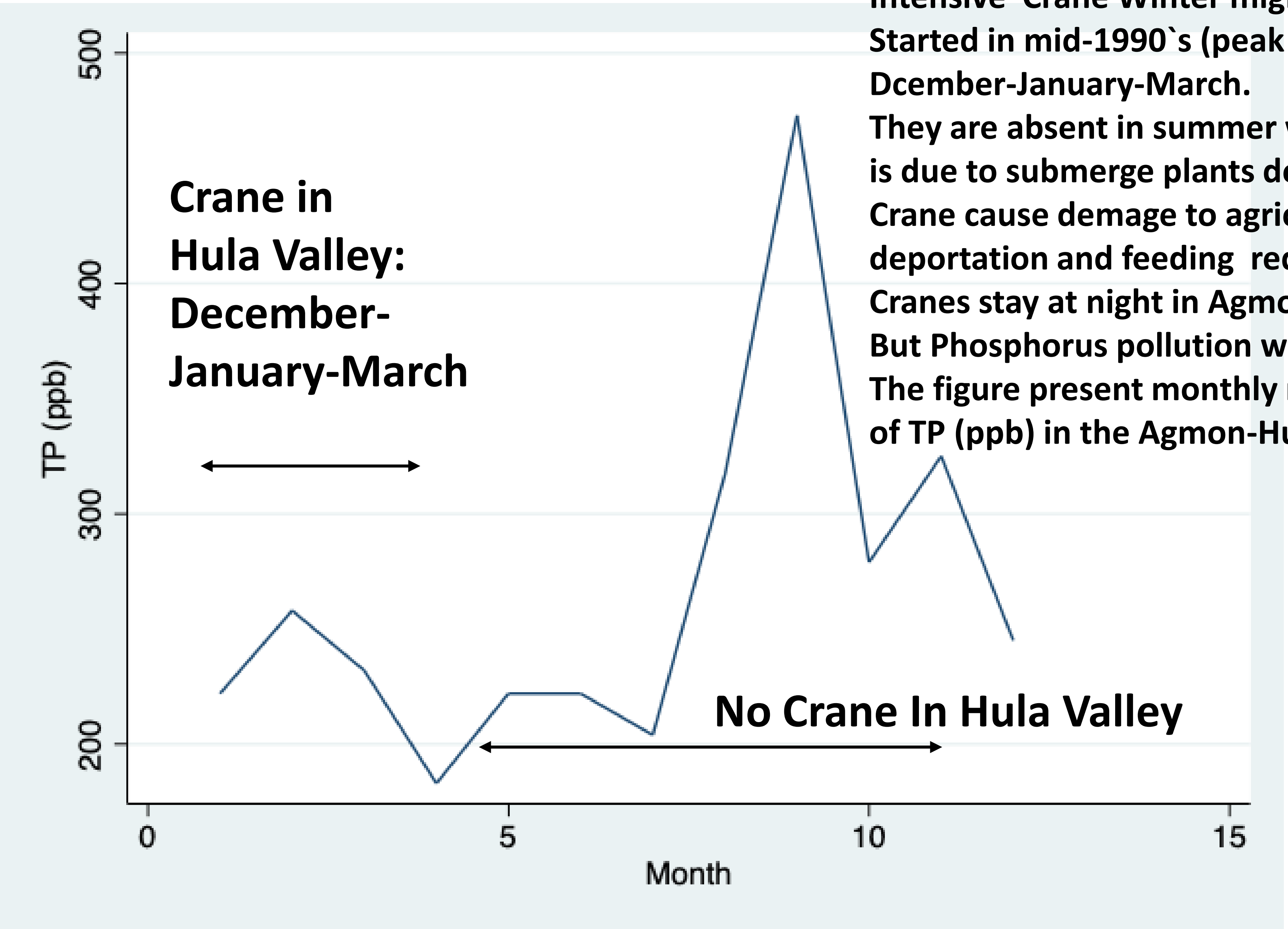
Year.	Total Biomass(t(dw).	Phosphorus (T).	Nitrogen (T)
1997.	268	0.9	7.4
1998.	213.	0.7	6.3
1999.	432	0.8	7.8
2000.	343	0.9	6.6
2001.	740	1.2	9.8
2002.	817	1.2	9.8
2003.	140	0.3	2.7
2004.	698	1.1	10.5

Major contribution of Phosphorus in the Agmon-Hula effluent (1.1-1.5 ton/y) and part of the Nitrogen originate from the submerged vegetation degradation.

Annual Means of Nutrient loads (ton) in the Jordan discharge (1970-2018) and in the Agmon-Hula effluent (1994-2018) (% of Jordan inputs)

Nutrient.	Jordan.	Agmon (%)
TN.	1071.	35 (3.3%)
TP	72	0.9 (1.3%)
NO_3	771	24.5(3.2%)
NH_4	39	7.5 (19.2%)

Intensive Crane Winter migration to the Hula vlley Started in mid-1990`s (peak -56,000):They stay- Dcember-January-March.
They are absent in summer when TP increase is due to submerge plants degradation.
Crane cause demage to agriculture, costly deportation and feeding reduced damage significantly.
Cranes stay at night in Agmon-Hula
But Phosphorus pollution was not confirmed.
The figure present monthly means (1994-2018) of TP (ppb) in the Agmon-Hula effluent



Taking home message

1) **Chloride is conservative ion therefore water balance and consequently climate change (rainfall, river discharge) control its dynamic whilst non-conservative ions are dependent of outsourcing inputs such as Hula Valley and internal processes.**

2) **Major part of external Nitrogenous and Phosphorus nutrients input originate in the drainage basin and aeolic - outside the Hula Valley.**

3) **The present agricultural management policy in the Hula Valley does not deteriorate the quality of Kinneret waters.**

4) **The Kinneret water quality is not deteriorated by nutrient migration from the Hula Valley although the costly management of the Eco-touristic infrastructure in the Hula Valley require financial arrangements.**

5) **Last but not least: Nutrient dynamics is a key factor: Surplus P enhance eutrophication, if accompanied by N defficiency enhanced Harmfull Cyanobacteria is posasible; Consequently, Hula Valley maintain benefitial friendship with lake Kinneret whilst Climate Change interfere.**