El agua en la llanura pampeana:

desde los humedales primigenios
hasta su transformación para las actividades agropecuarias

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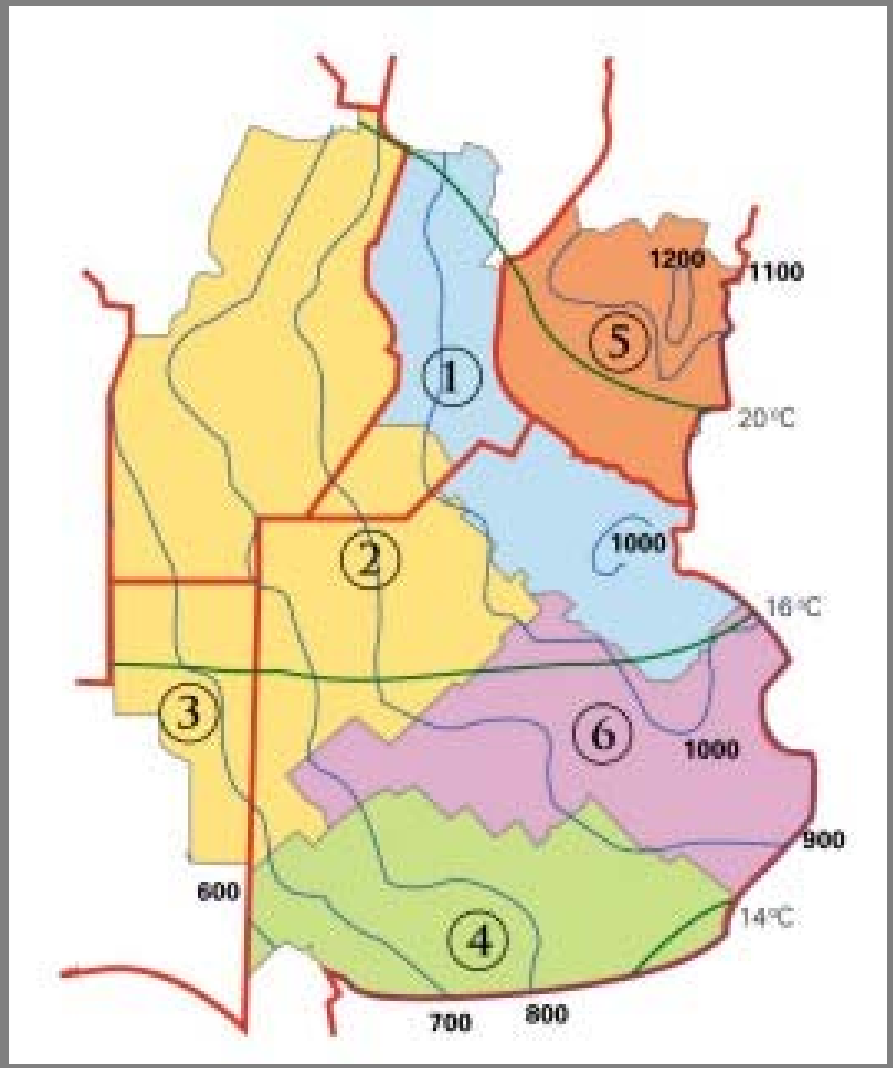
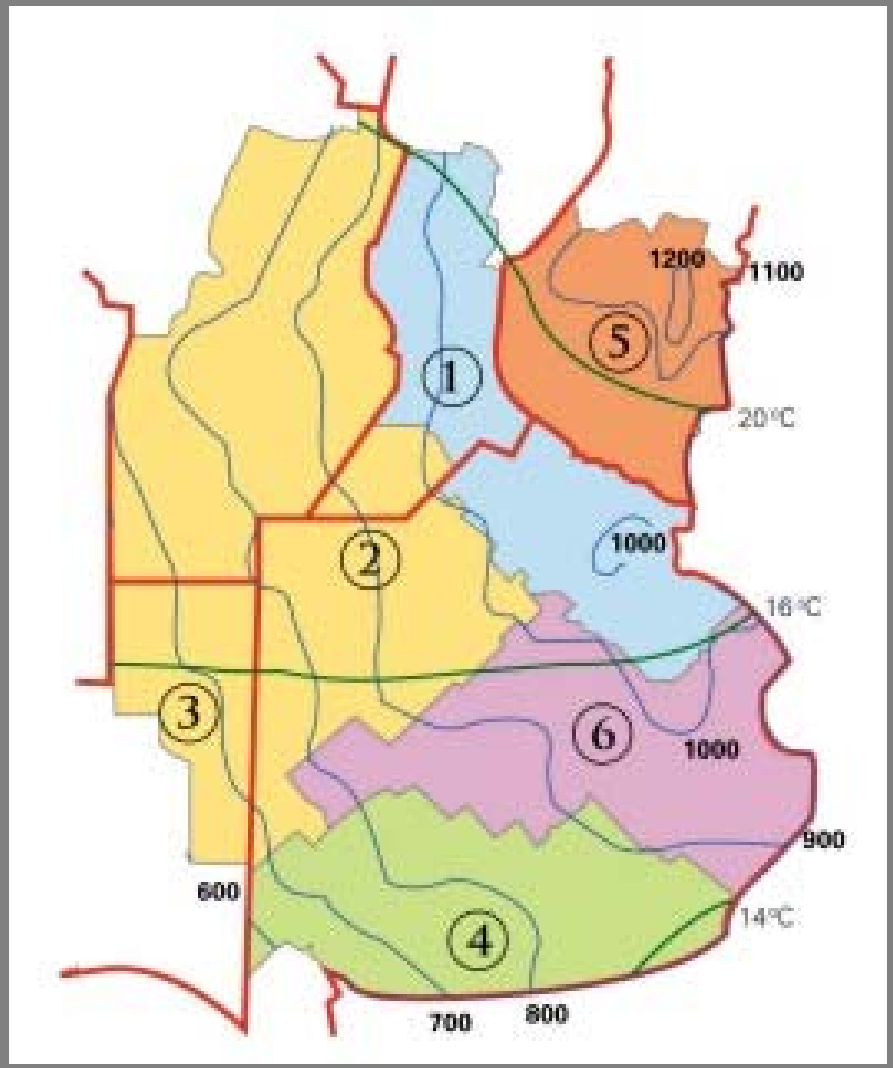


the Pampas

1. Rolling
2. Central
3. Central
4. Southern
5. Mesopotamian
6. Flooding

from Viglizzo et al., 2001



the pampean wetlands

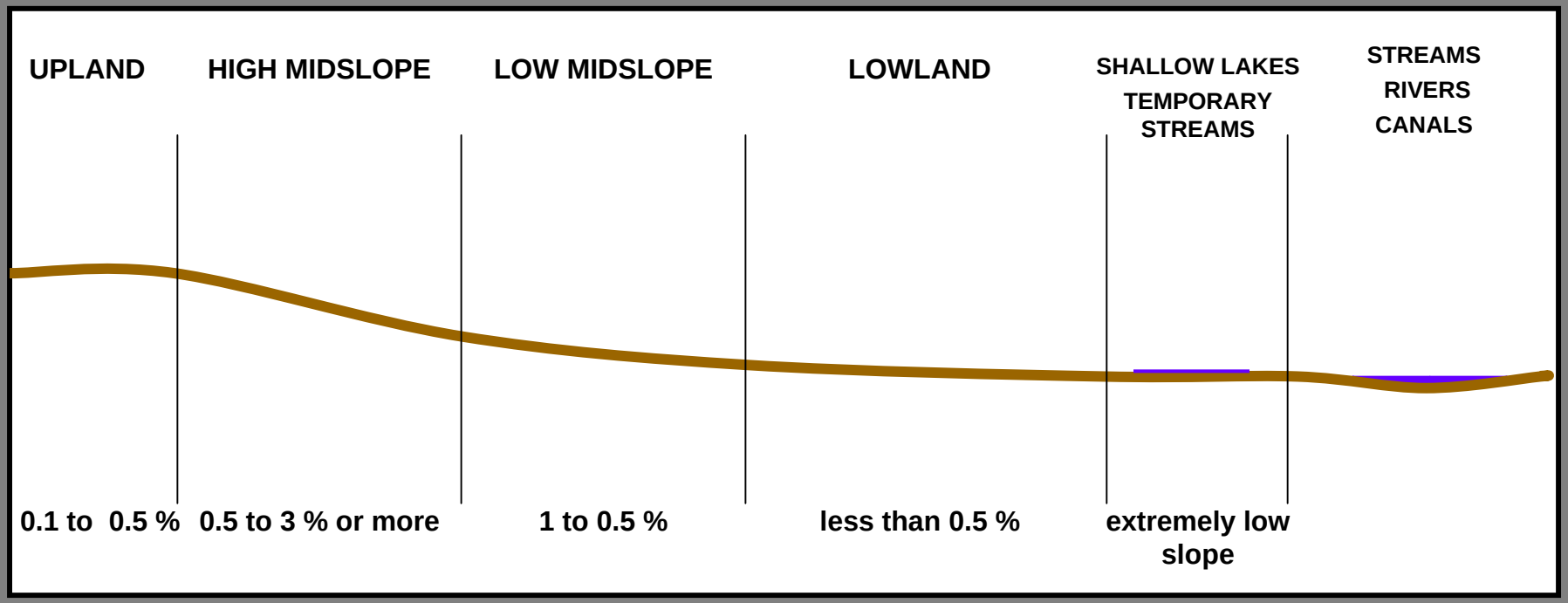
1. Rolling
2. Central
3. Central
4. Southern
5. Mesopotamian
6. Flooding

from Viglizzo et al., 2001

factors that determine the main characteristics of the pampean wetlands

- **geomorphology of the plains**
- **climate**
- **climate variability**
  - **long-term variability**
  - **short-term variability**
  - **seasonal variability**

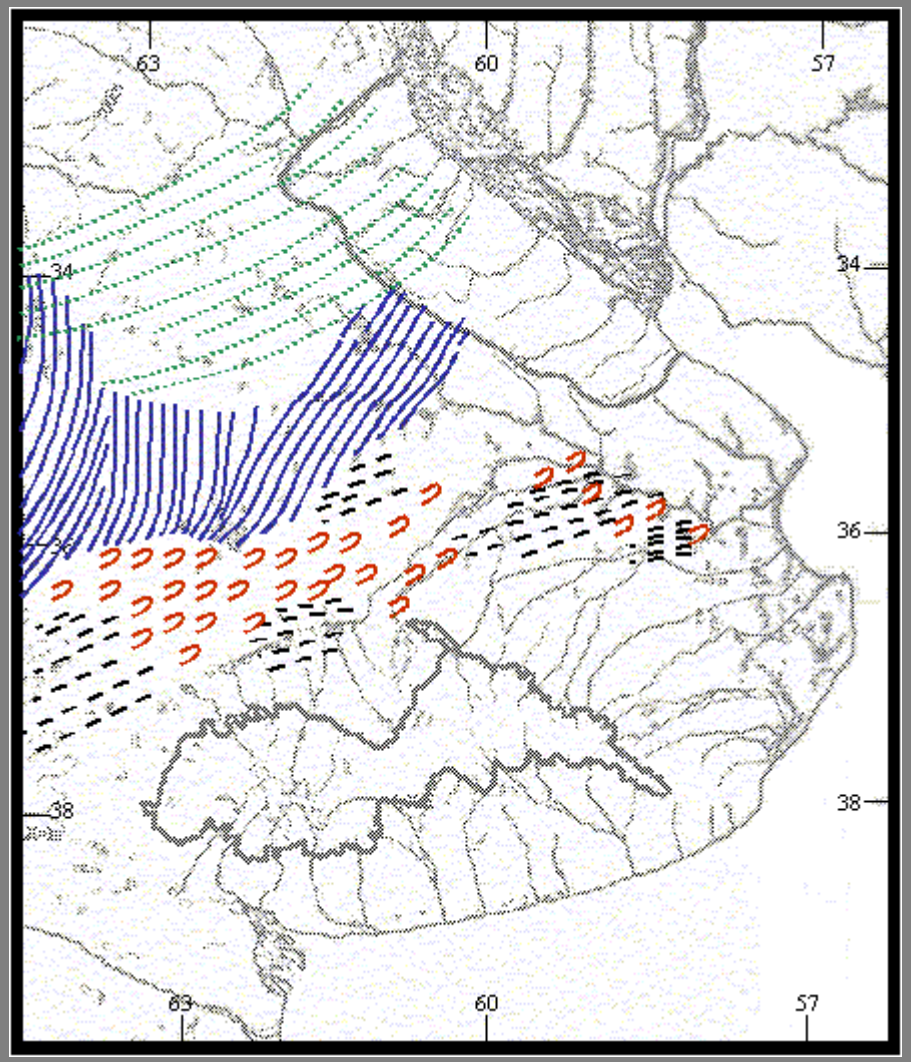
geomorphology of the plains (1)



geomorphological unit

modified from Fuschini Mejia, 1994

geomorphology of the plains (2)



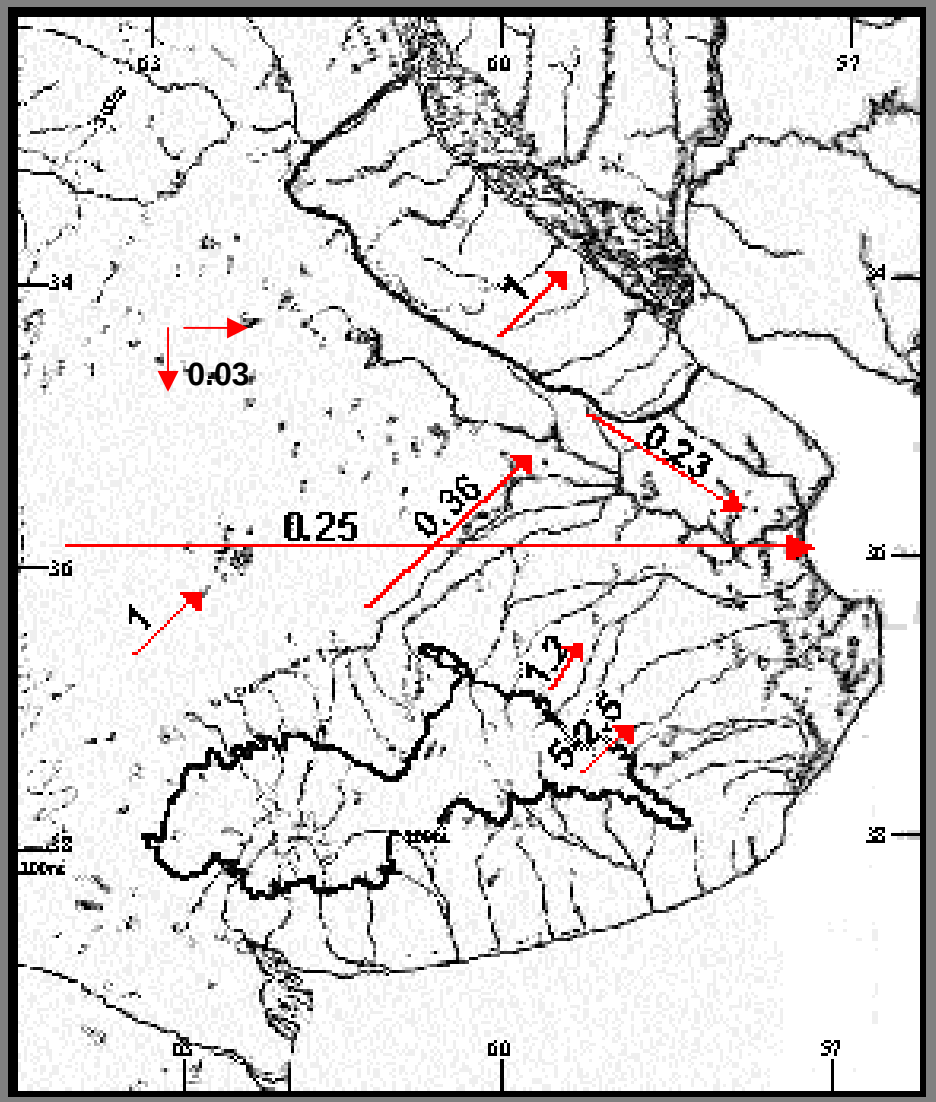
Compound longitudinal dunes (pleistocene)

Simple longitudinal dunes (holocene)

Megaparabolic dunes (holocene)

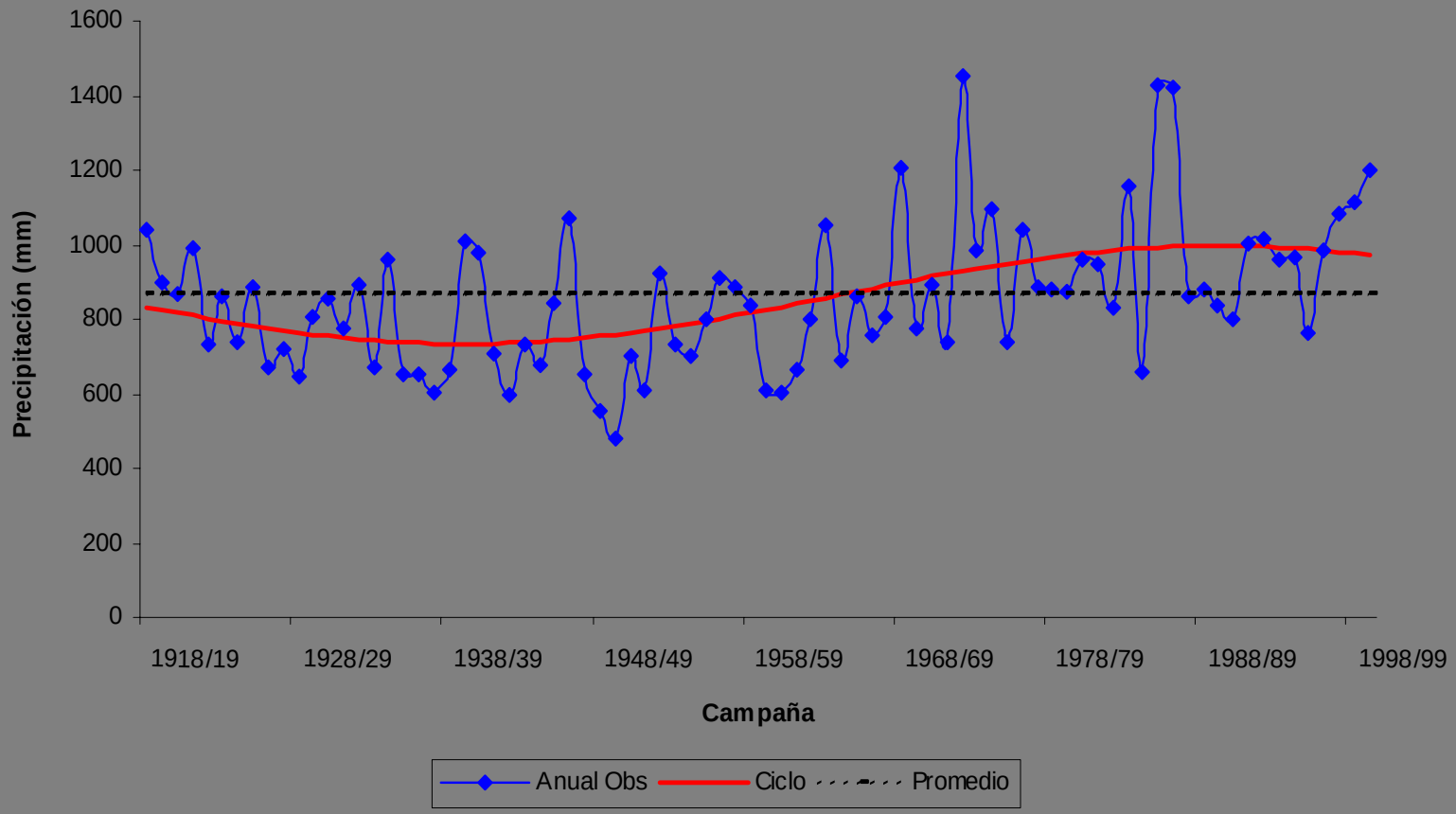
from Malagnino, 1988

geomorphology of the plains (3)



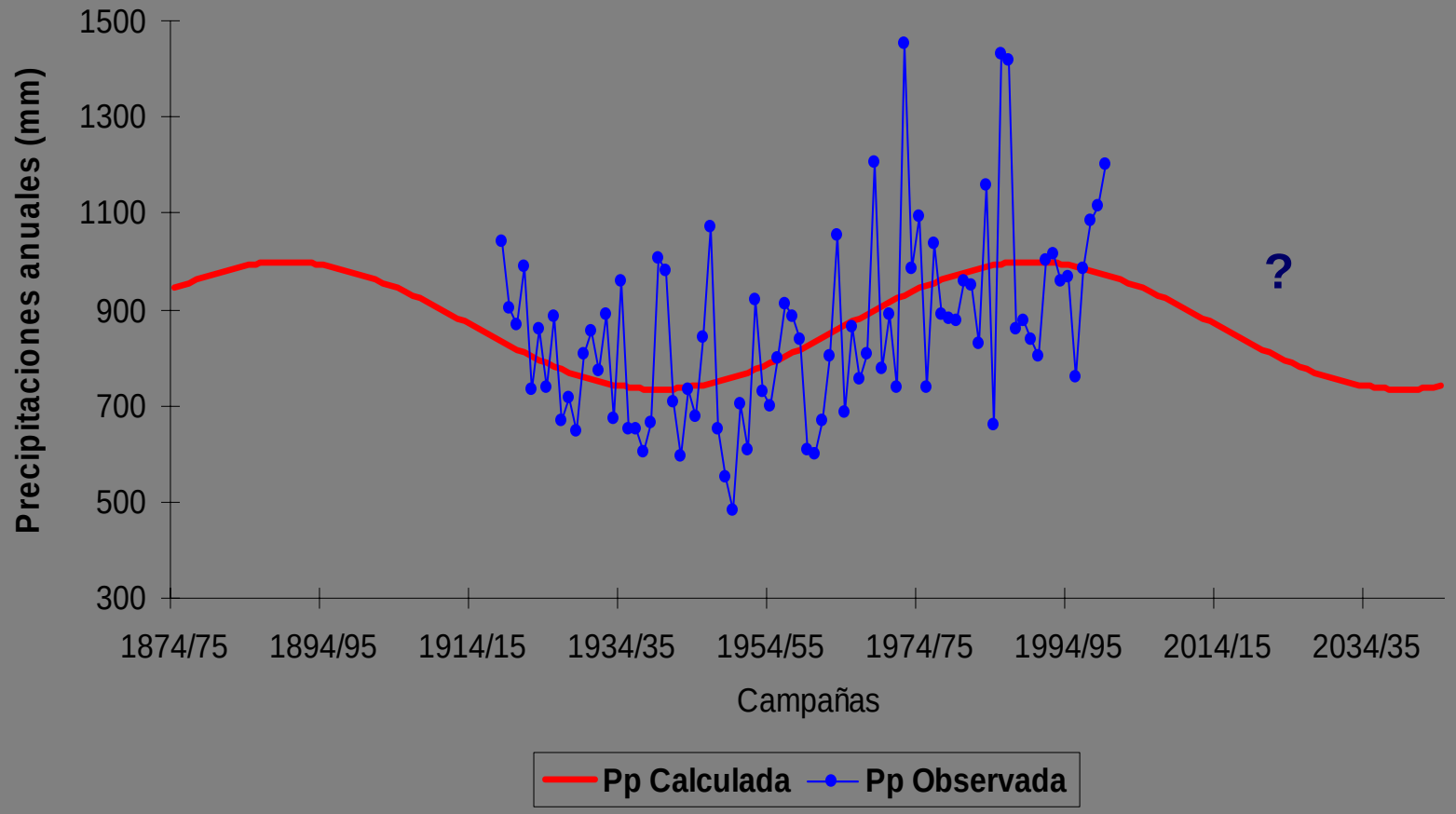
landscape slopes (m/km)

long-term climate variability of the plains (1)



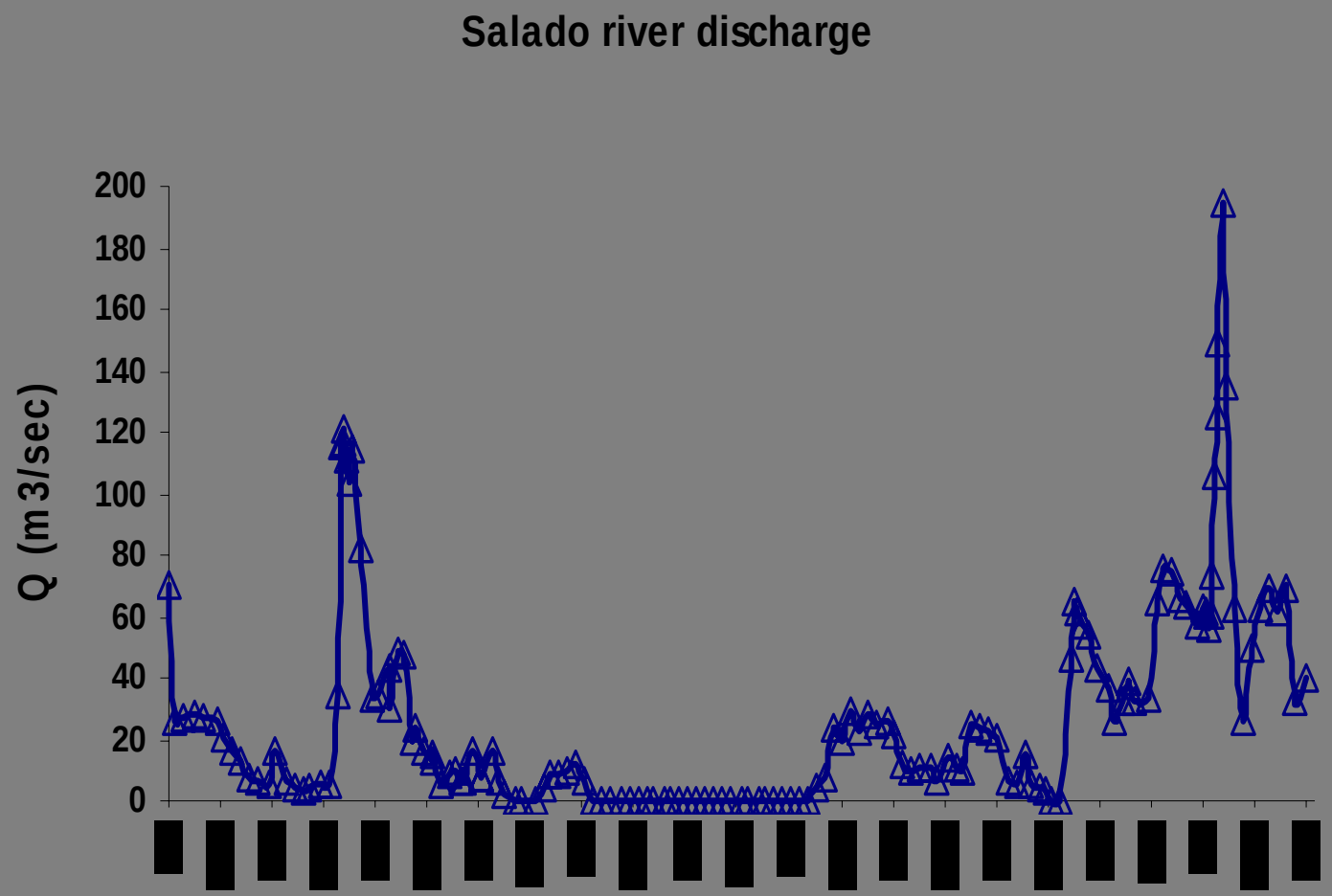
from Pérez et al., 2003

long-term climate variability of the plains (2)

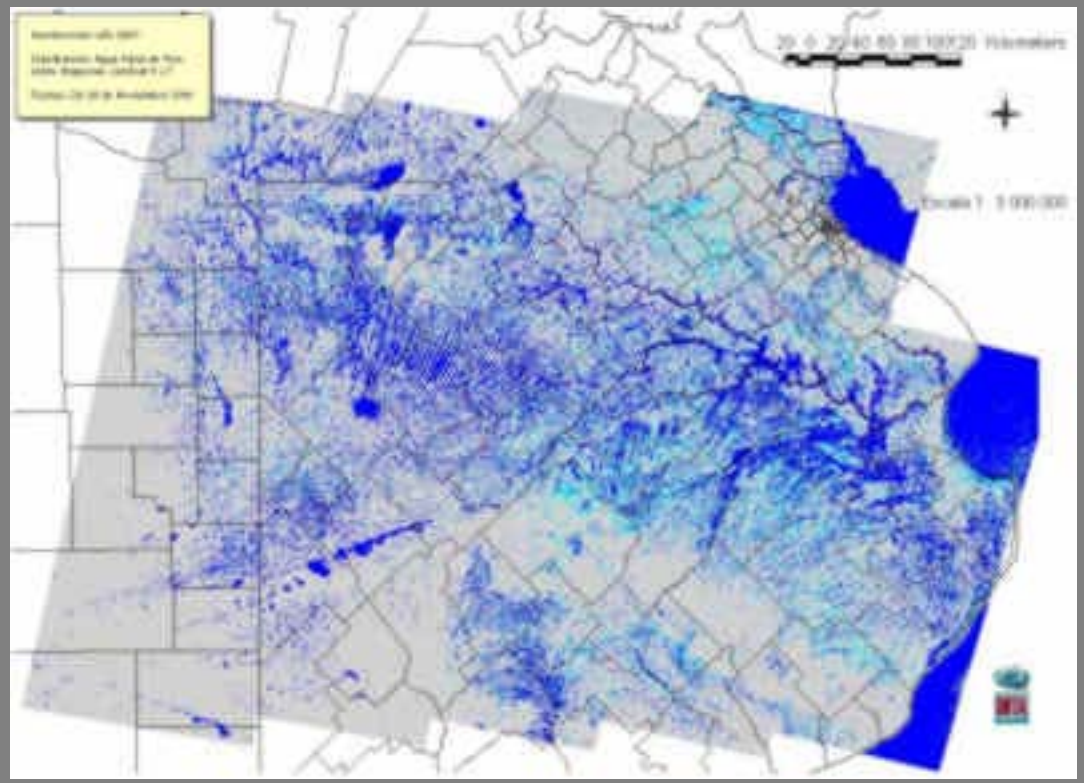


from Sierra et al., unpublished

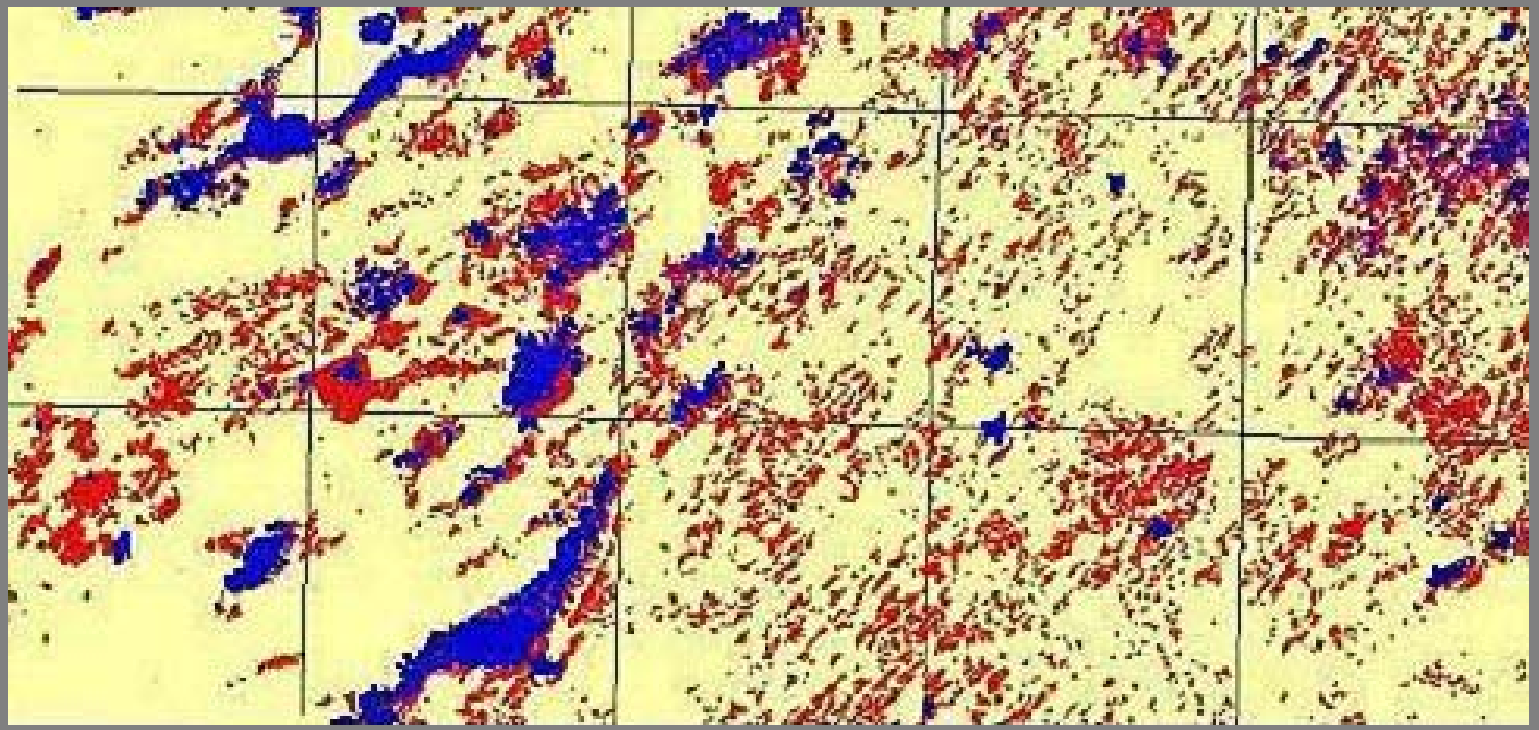
short-term climate variability in the plains



noviembre 2001

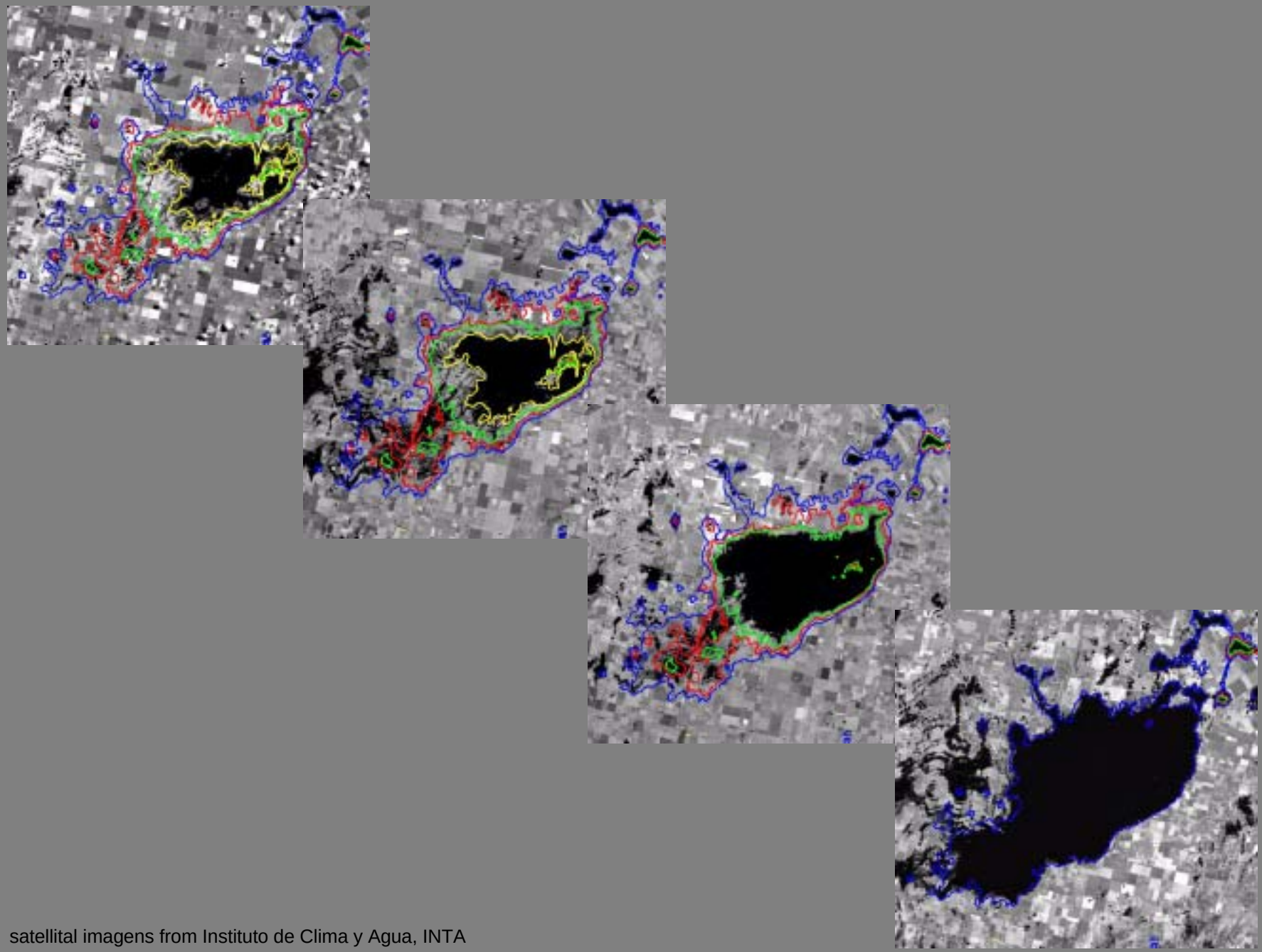


los lagos someros (lagunas):

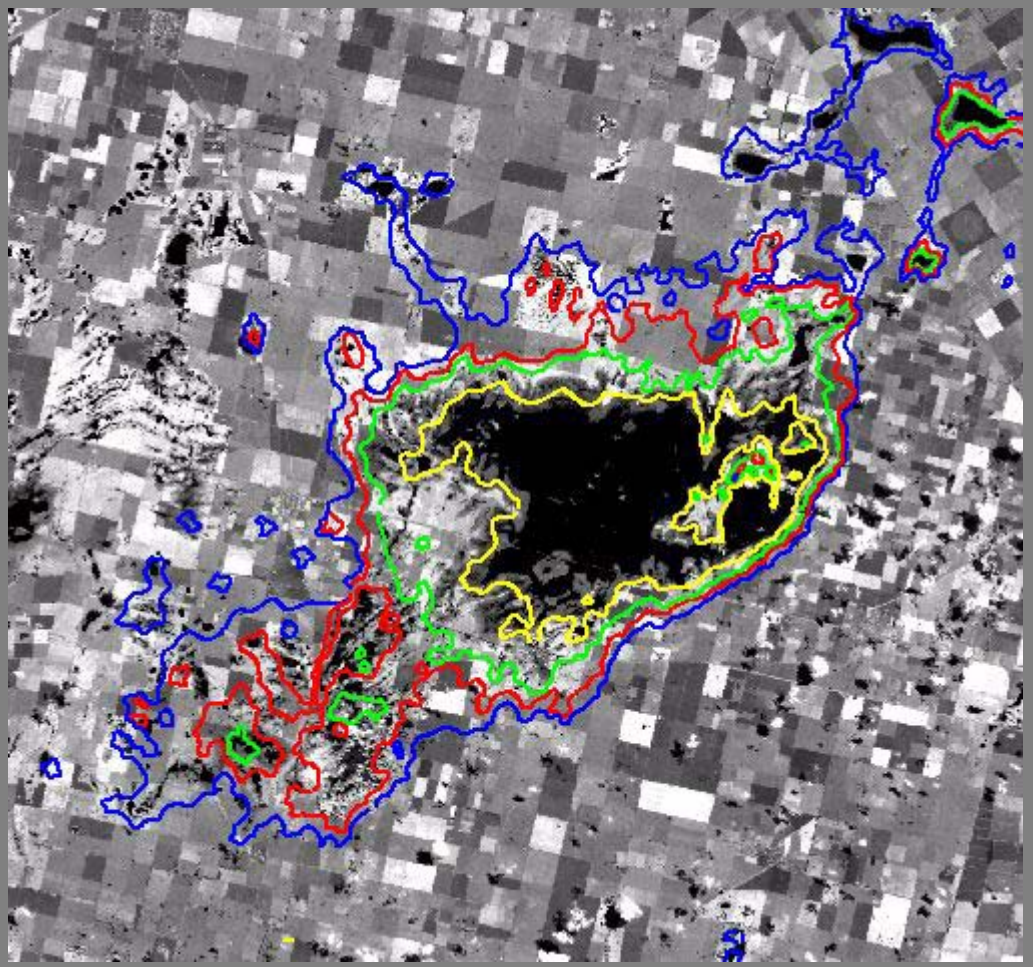


componente central

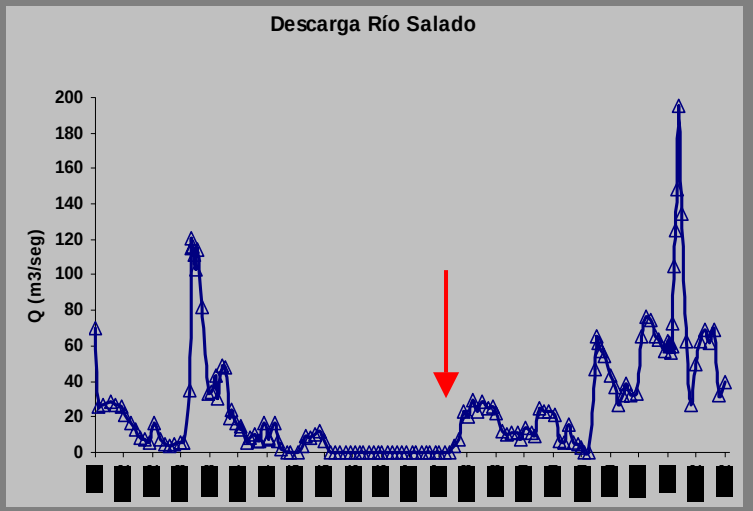
del humedal pampeano

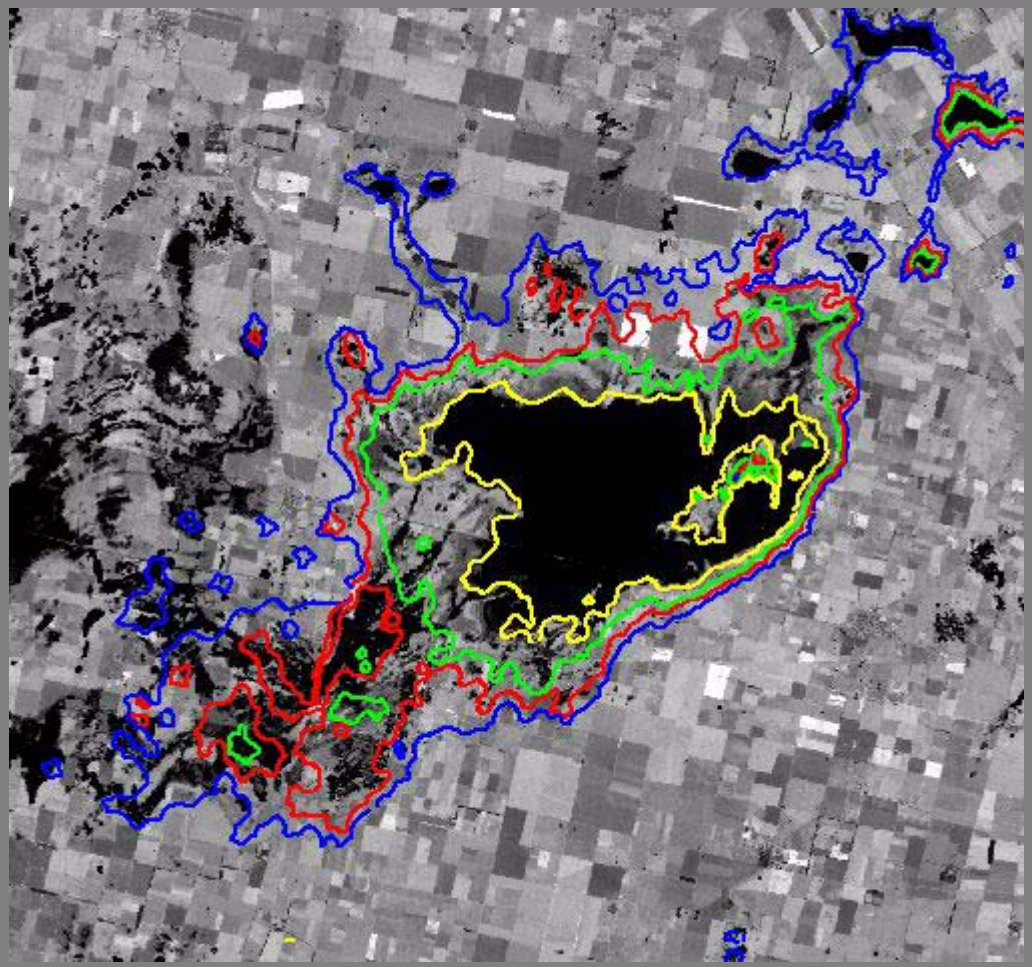


satellital imagens from Instituto de Clima y Agua, INTA

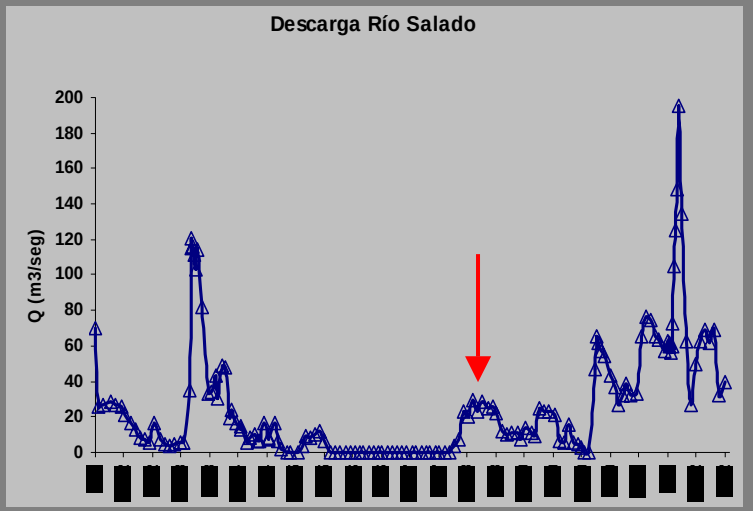


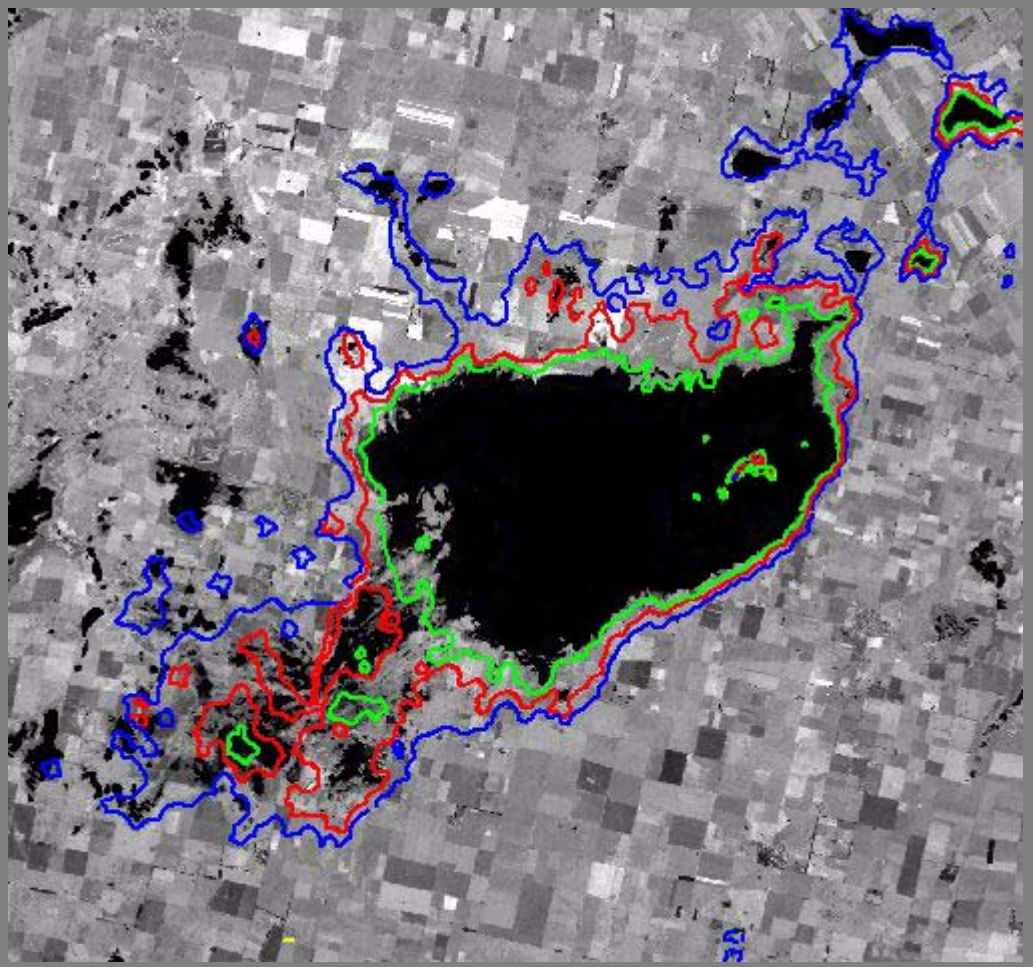
octubre 1997



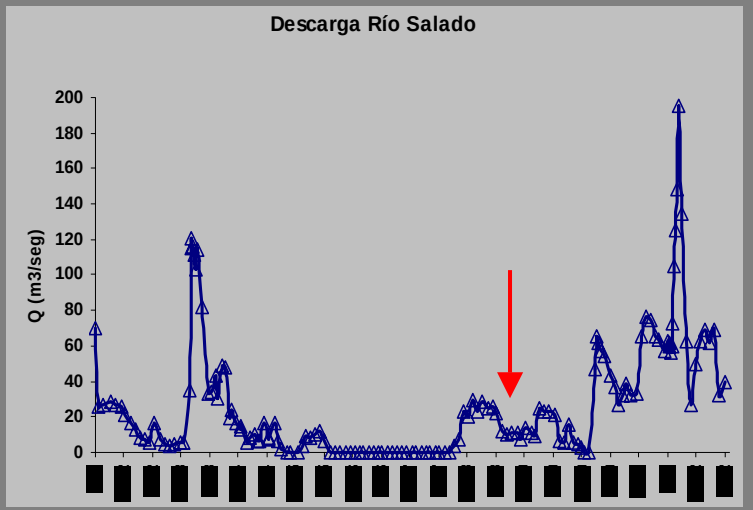


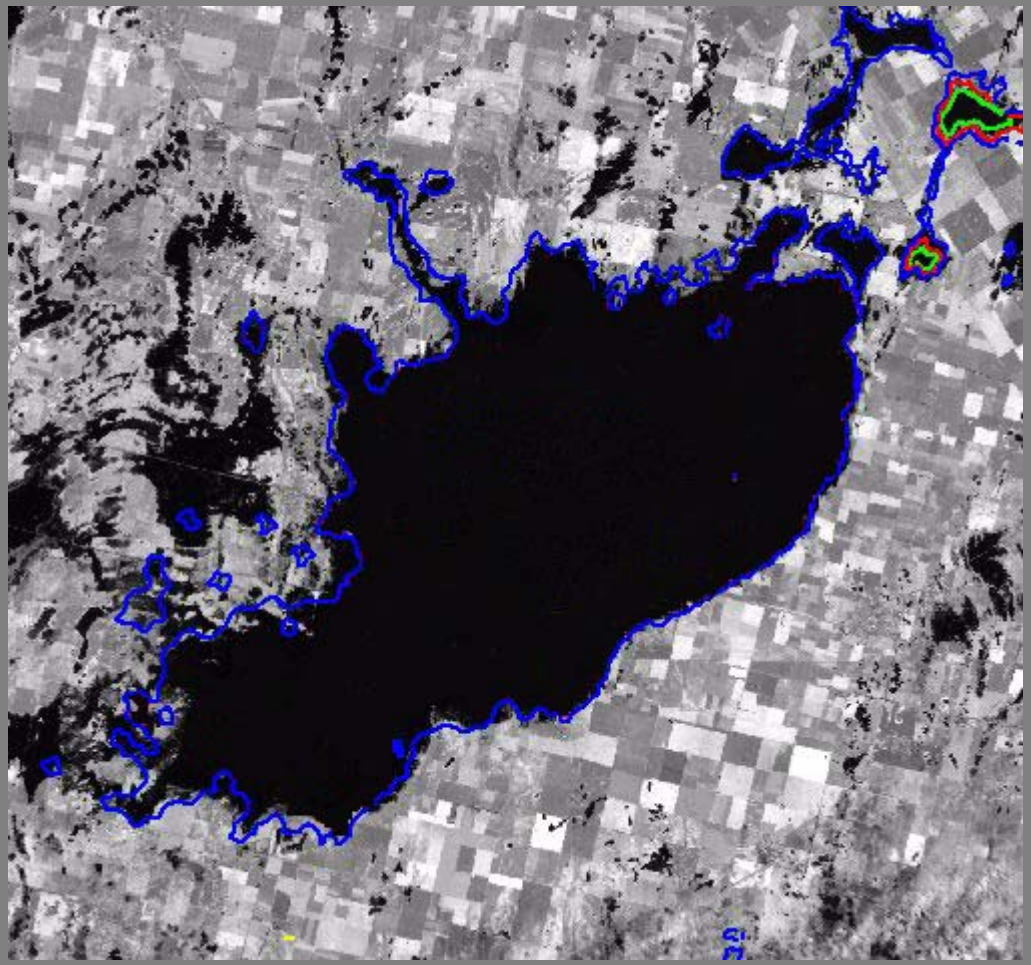
marzo 1998


Descarga Río Salado
Q (m3/seg)
200
180
160
140
120
100
80
60
40
20
0

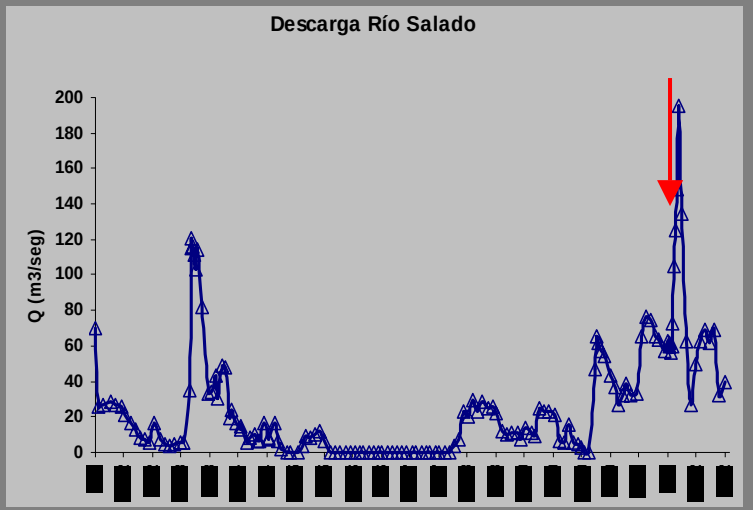


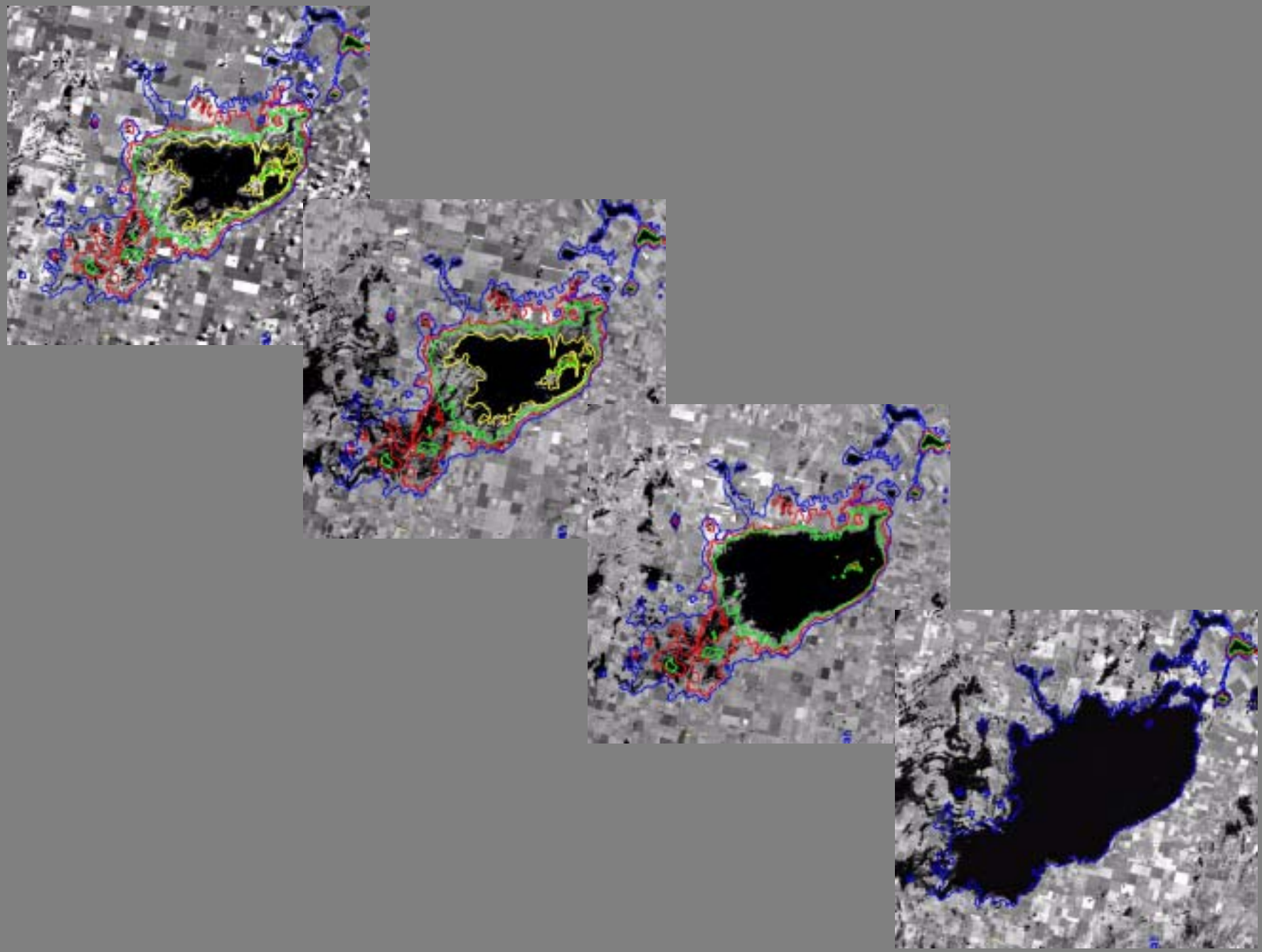
febrero 1999





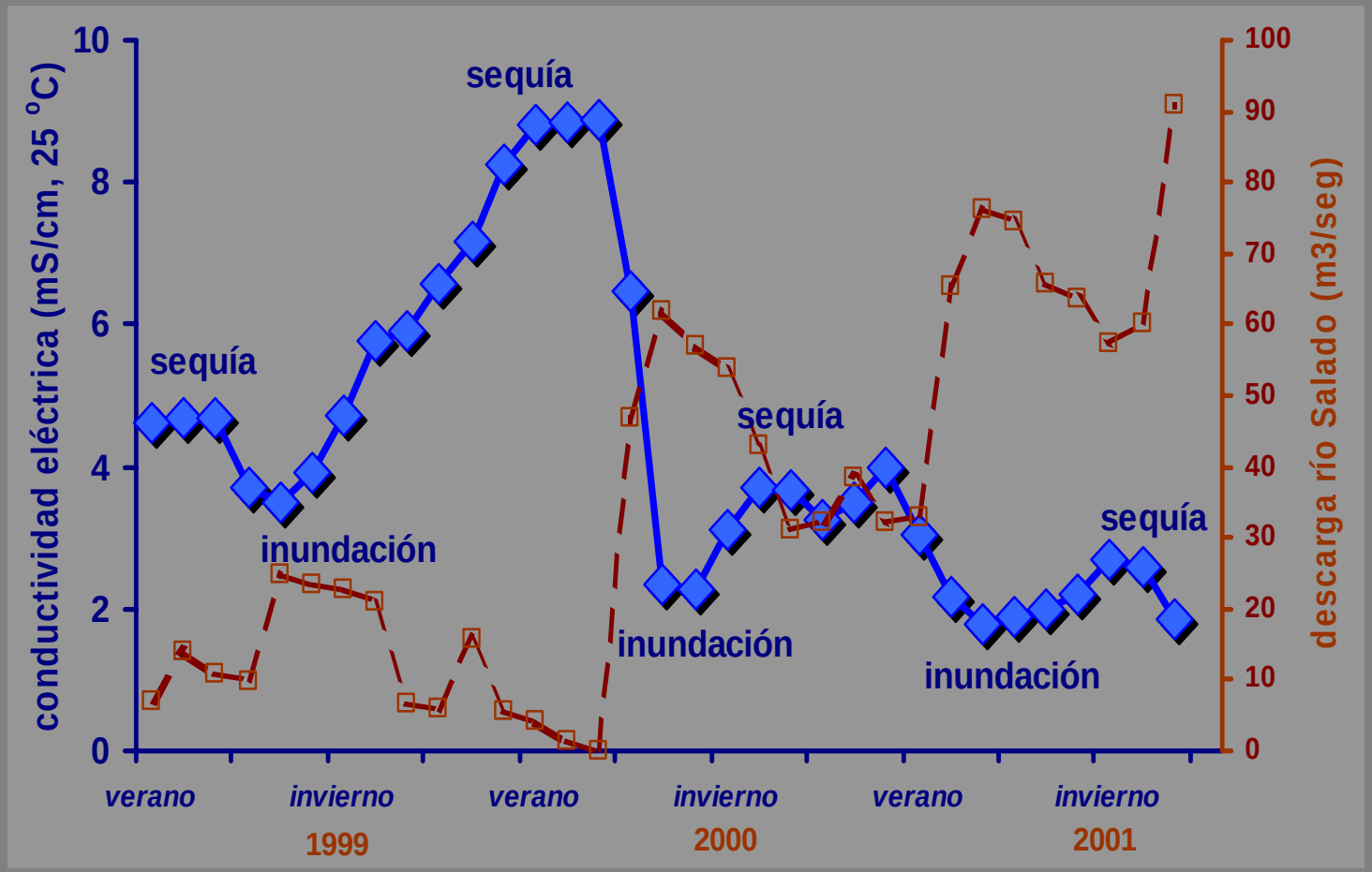
noviembre 2001





ciclo sequía – inundación característico del humedal pampeano

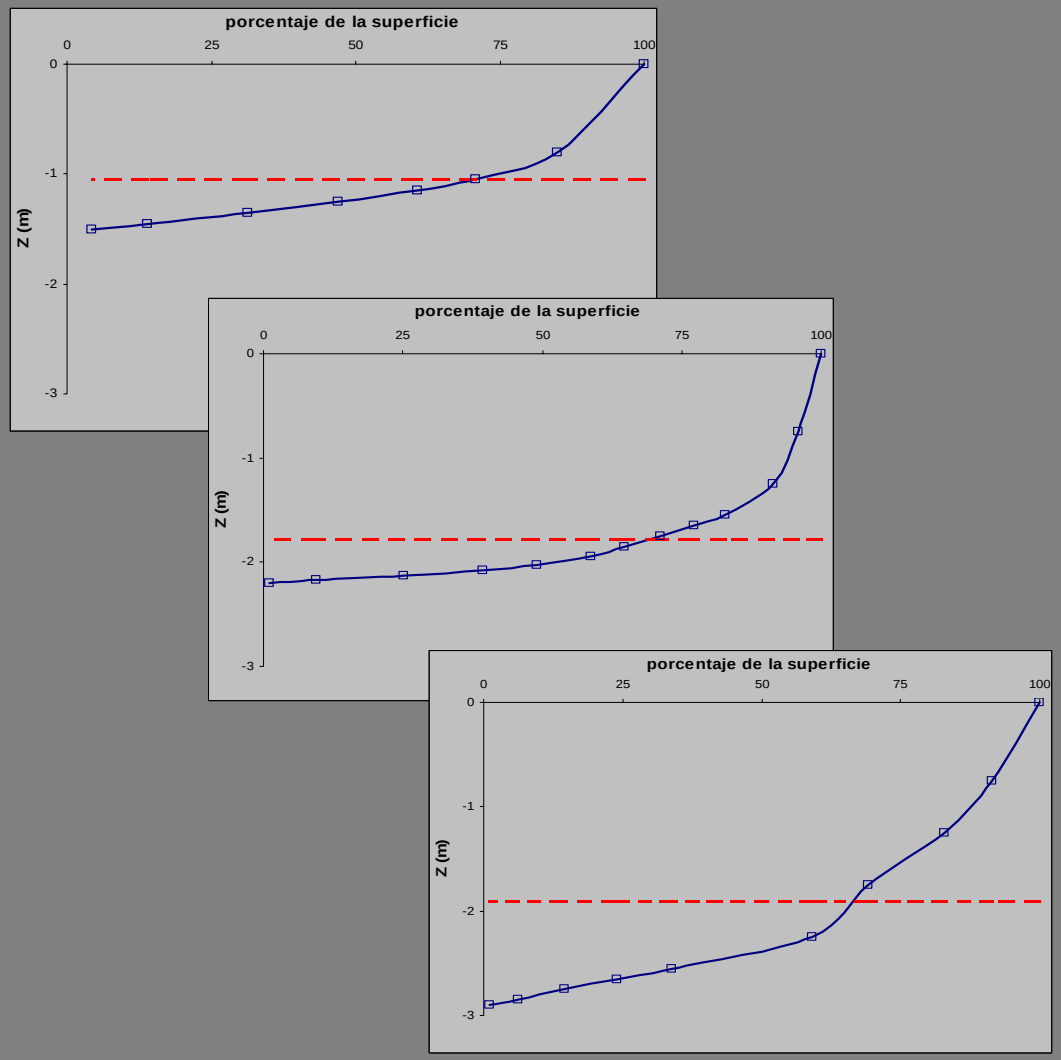
“ inundación” en la sequía y “sequía” en la inundación



seasonal variability in very shallow lake salinity is included

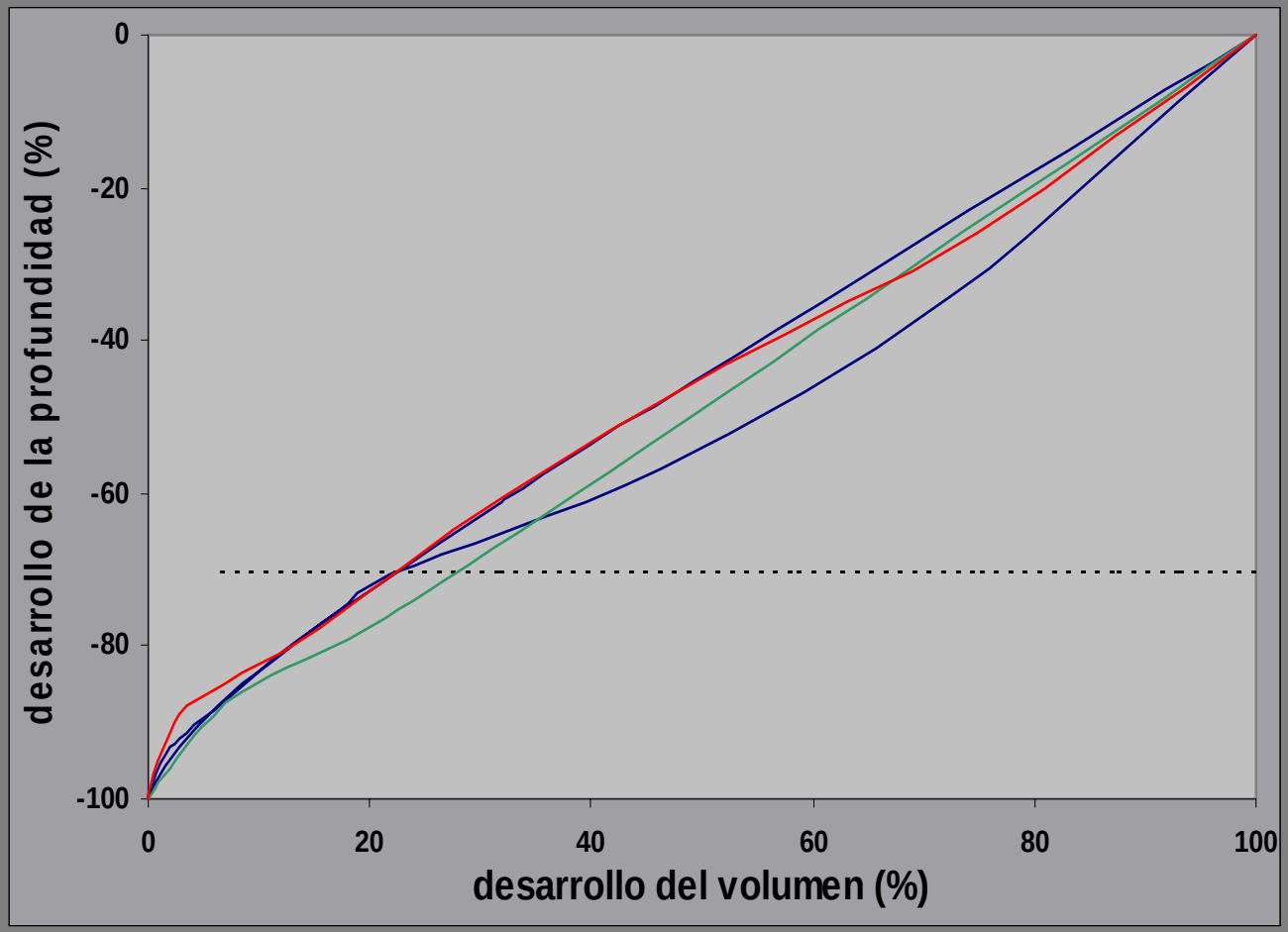
Rosso and Rennella, unpublished data

lake morphology (1)



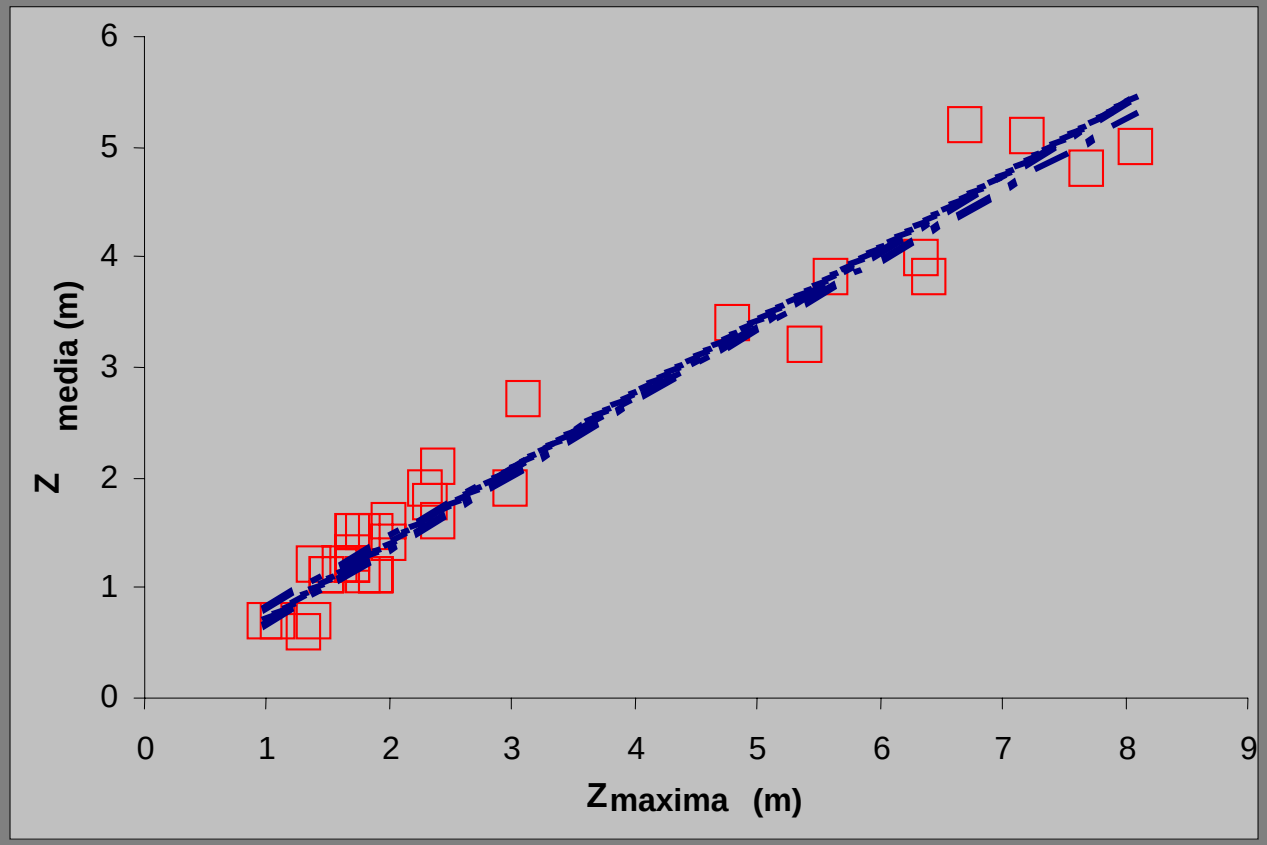
un 70% de la superficie de una laguna pampeana tiene profundidades mayores a la profundidad media

lake morphology (2)



un 75-80 % del volumen de una laguna pampeana se encuentra por encima de su profundidad media

lake morphology (3)



profundidad media = 0.7 profundidad máxima

forma de cubeta: semi elipsoide de revolución

primordial grasslands

an hypothetical landscape for primordial pampean wetlands

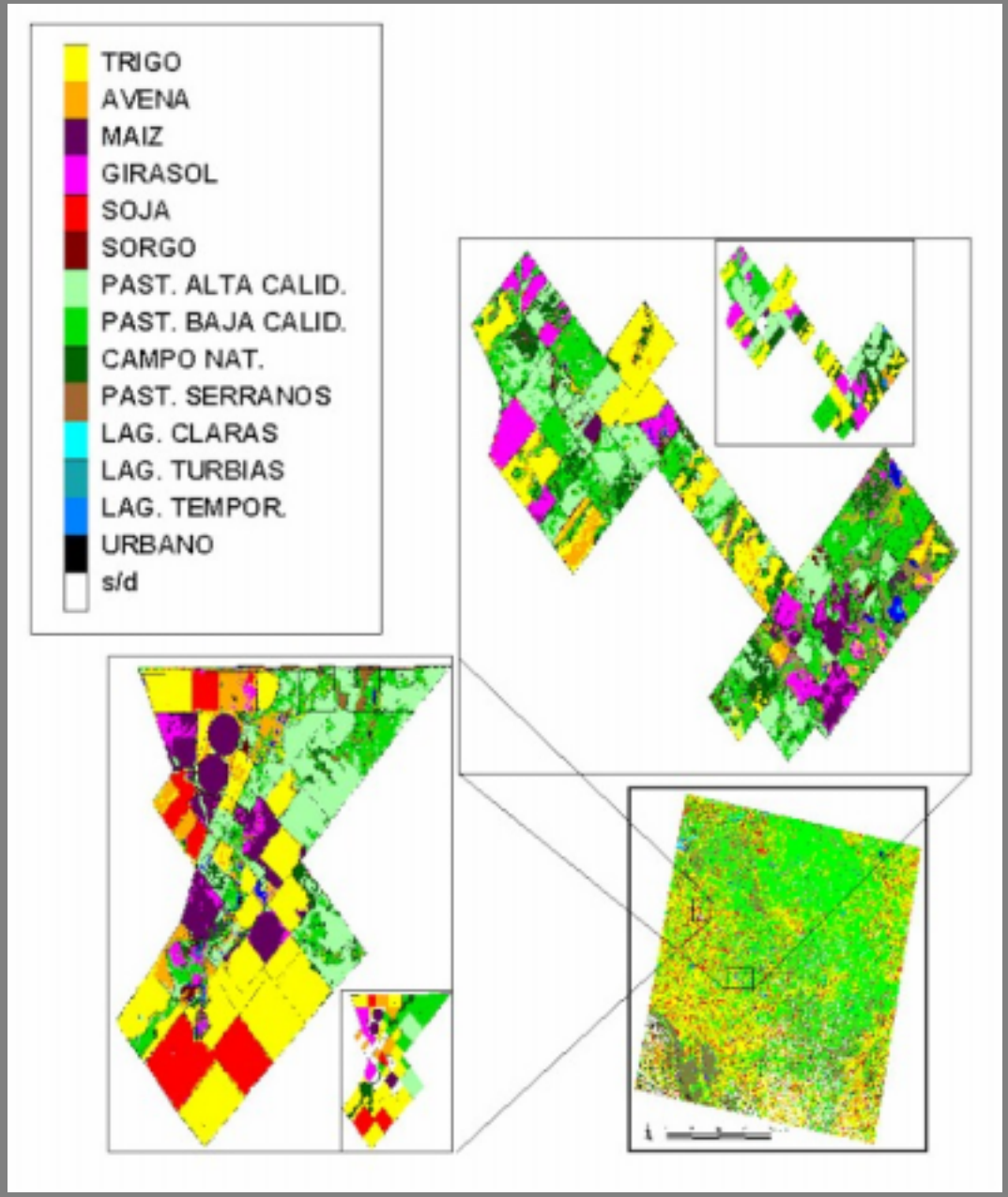
current grasslands (1)

fotos: INTA

current grasslands (2)

fotos: INTA

current grasslands (3)



from Guerschman et al., 2001

environmental efforts on the pampean wetlands

- dredging, canalization and damming of water bodies
- changes in land use patterns
- increased land erosion
- agriculture (pastures, implanted pastures, annual crops, extensive livestock growing, animal feed-lots)
- unregulated urbanization with deficient or without sewage treatment works
- unregulated land-fill usually with toxic substances

environmental effects in the pampean wetlands

- changes in natural hydrological patterns
- changed morphology of water bodies
- increased inorganic sedimentation
- increased levels of non-oxidized organic matter and its metabolites
- nutrient enrichment (mainly P and N)
- contamination of surface waters and groundwater with toxic substances commonly used in modern agriculture (herbicides, insecticides, and other agro-toxic substances)
- contamination of surface waters and groundwater (?) with highly toxic substances used in industry
- huge changes in vegetal and animal biodiversity and abundance for both terrestrial and aquatic ecosystems

“legal” canals (1)

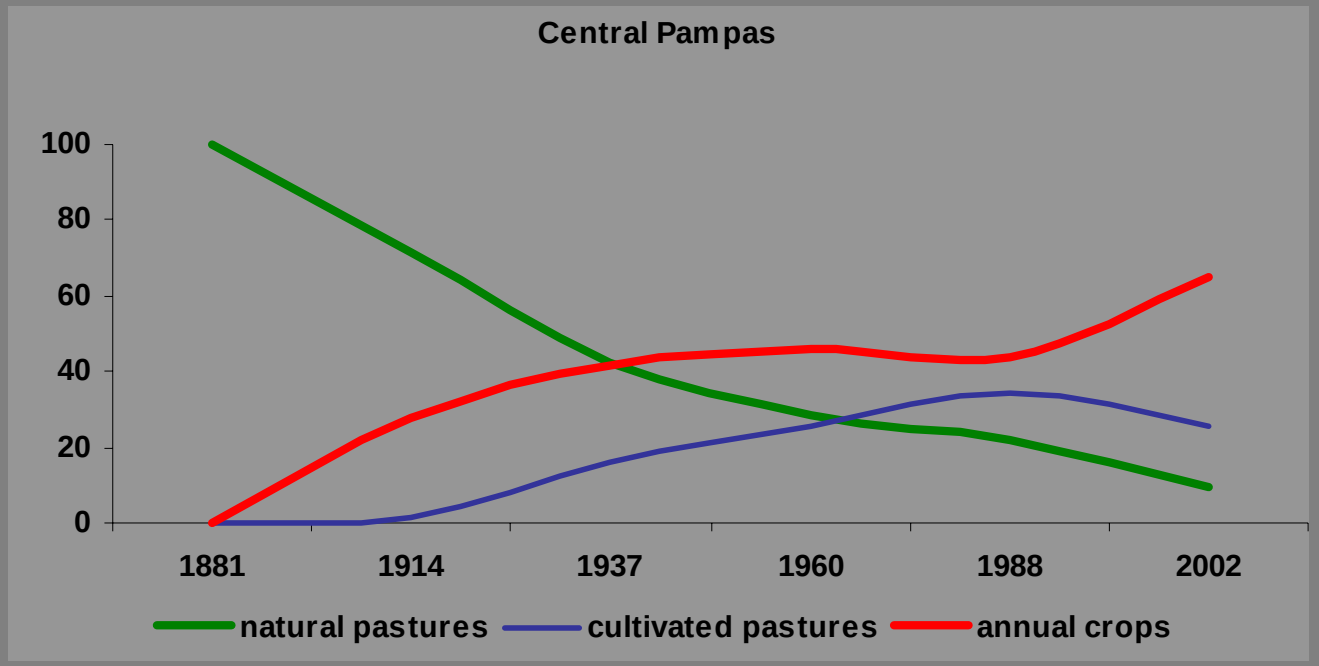
foto: INTA Anguil

“legal” canals (2)

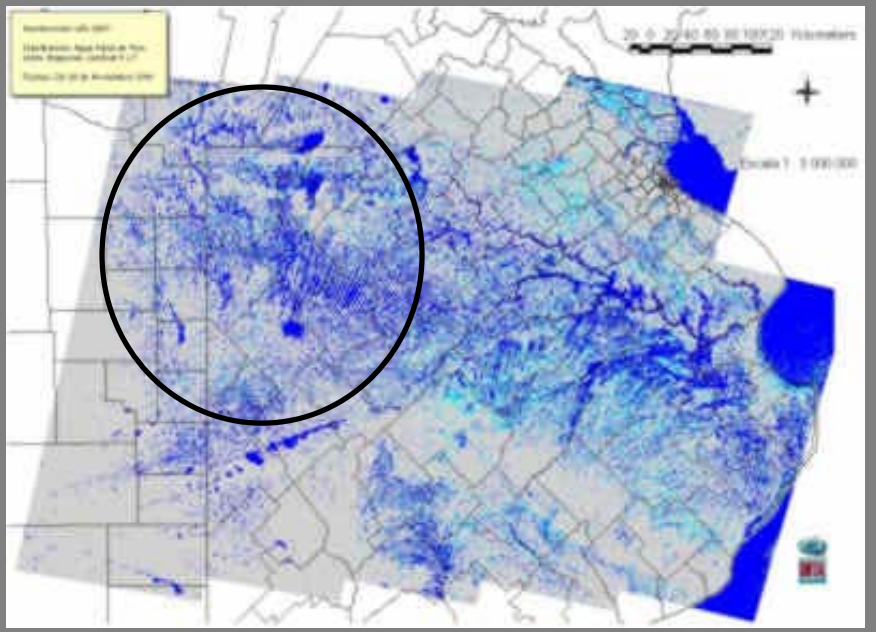
foto: Hugo Dias

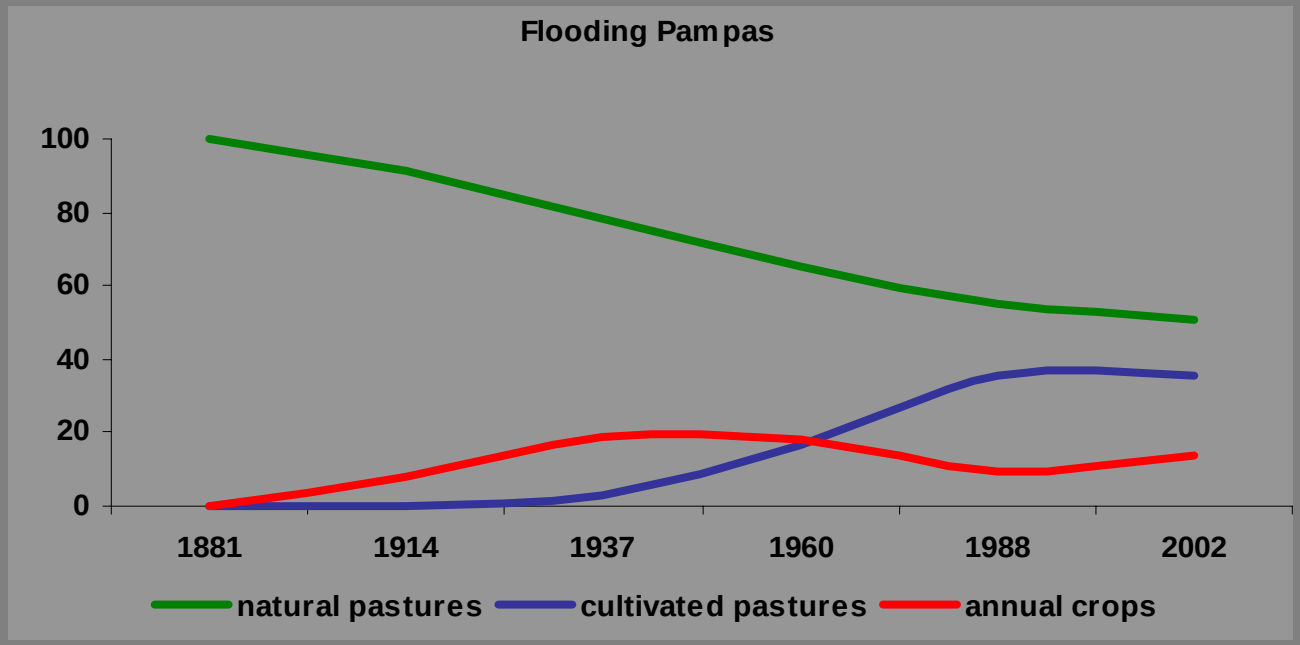
“illegal” canals

foto: Municipio Mar Chiquita

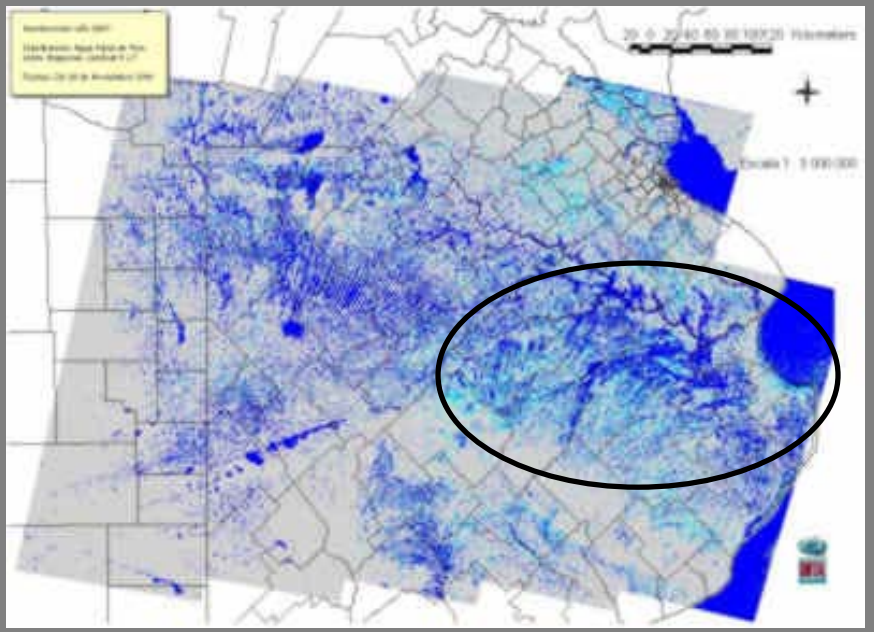


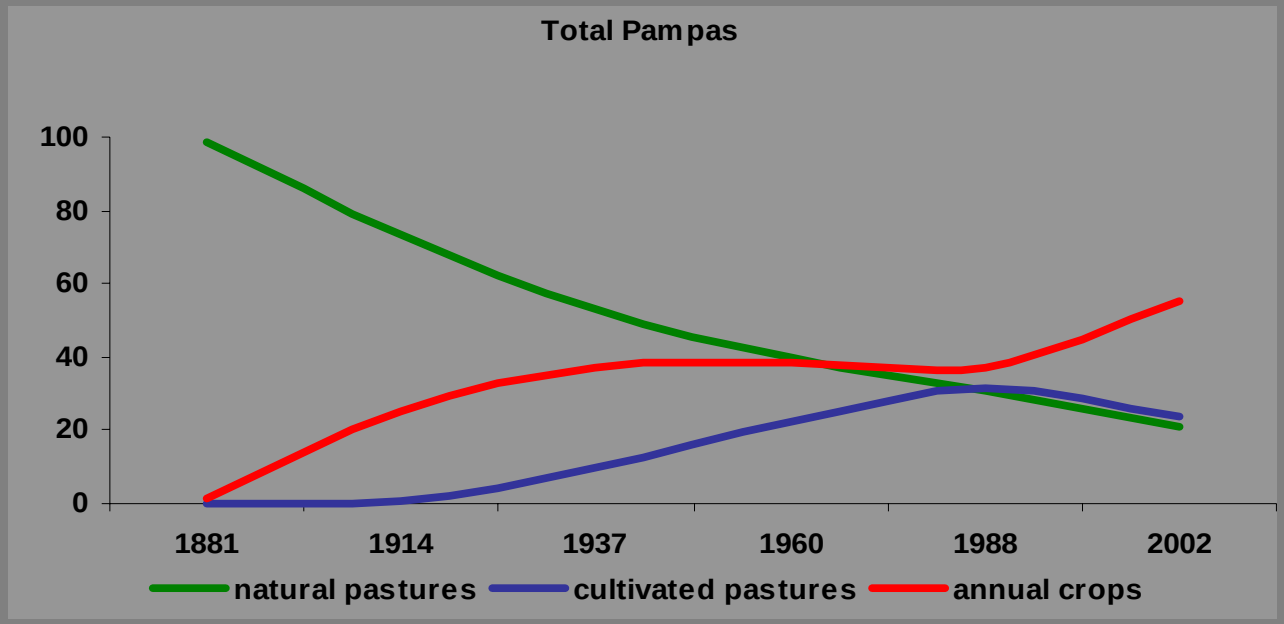
modified from Viglizzo et al., 2001

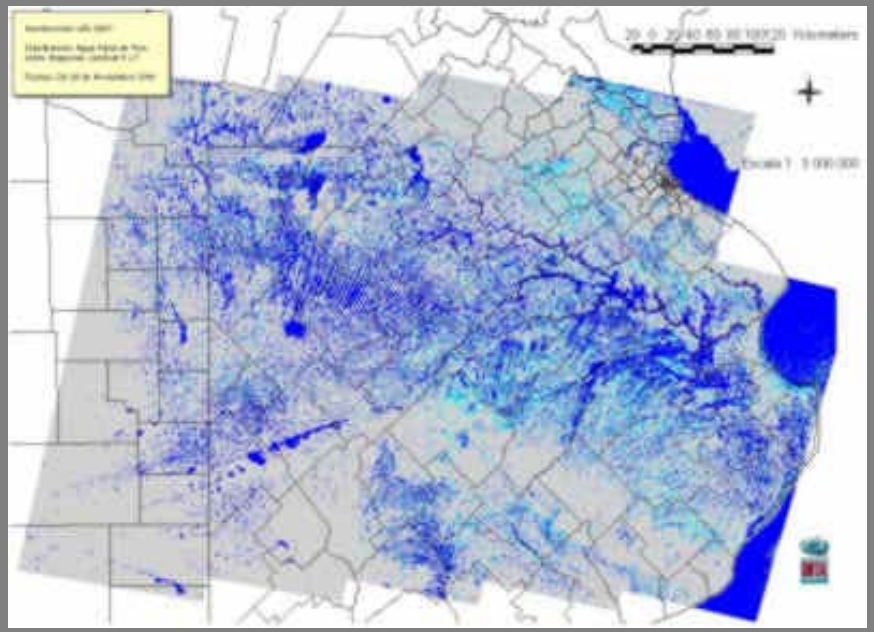


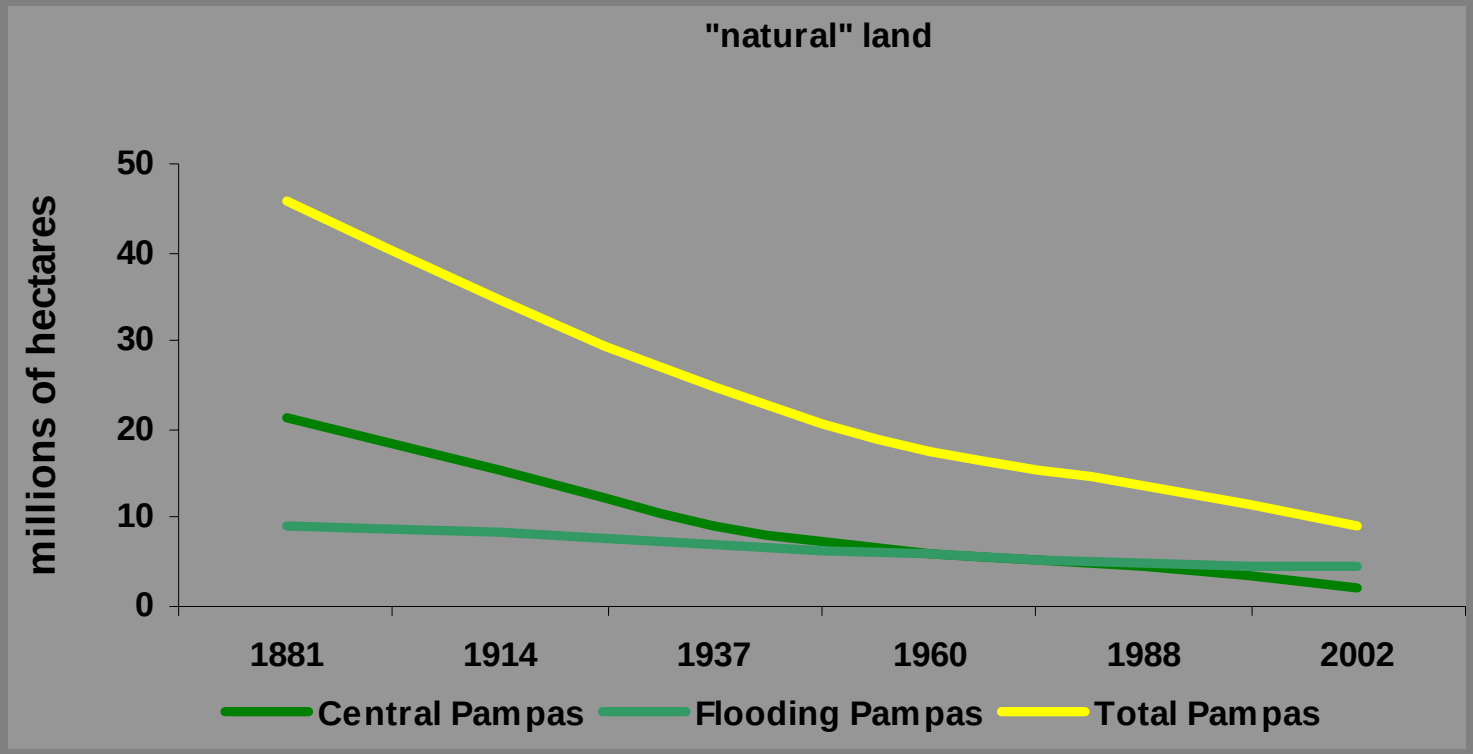


modified from Viglizzo et al., 2001

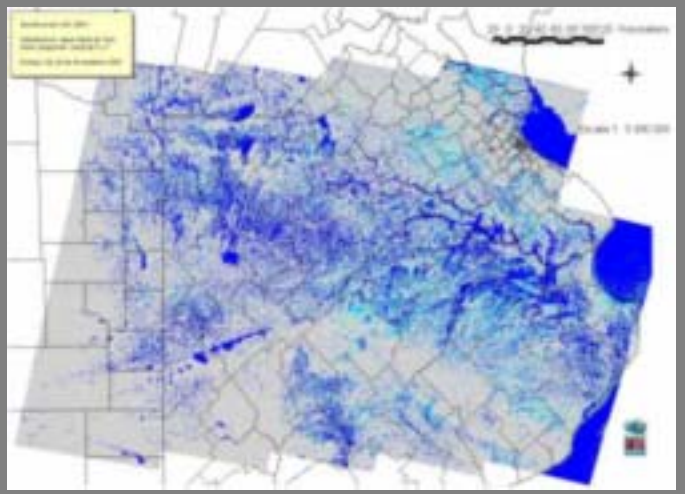



Total Pampas
100
80
60
40
20
0
1881
1914
1937
1960
1988
2002
natural pastures
cultivated pastures
annual crops

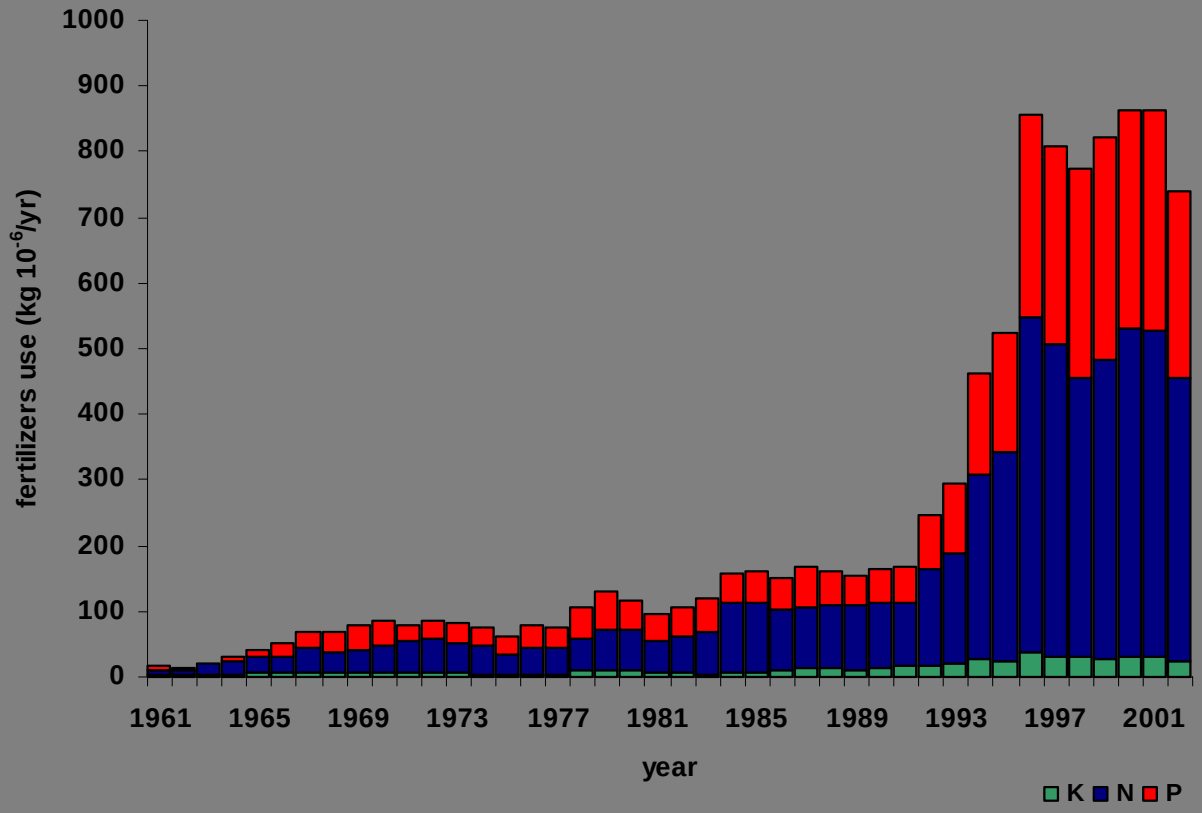




modified from Viglizzo et al., 2001

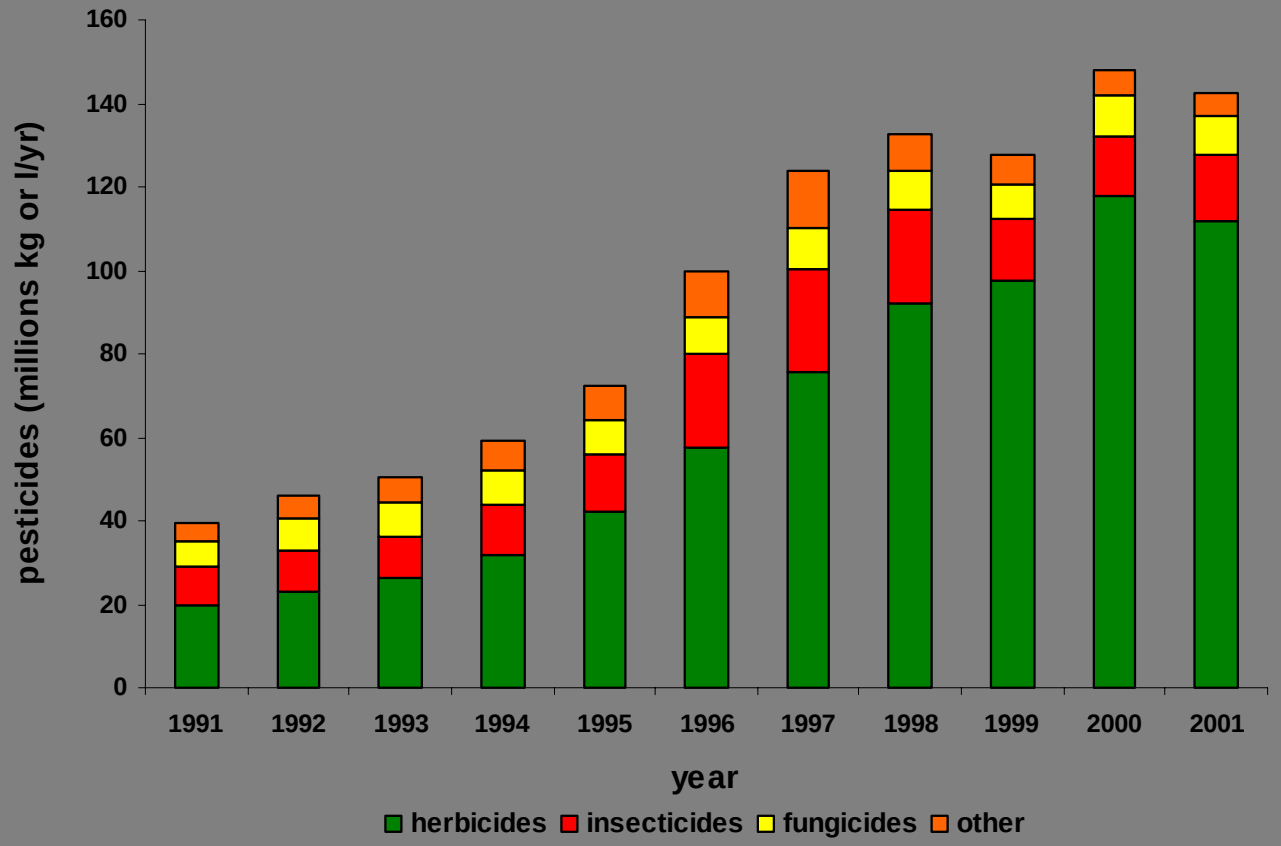


fertilizers use



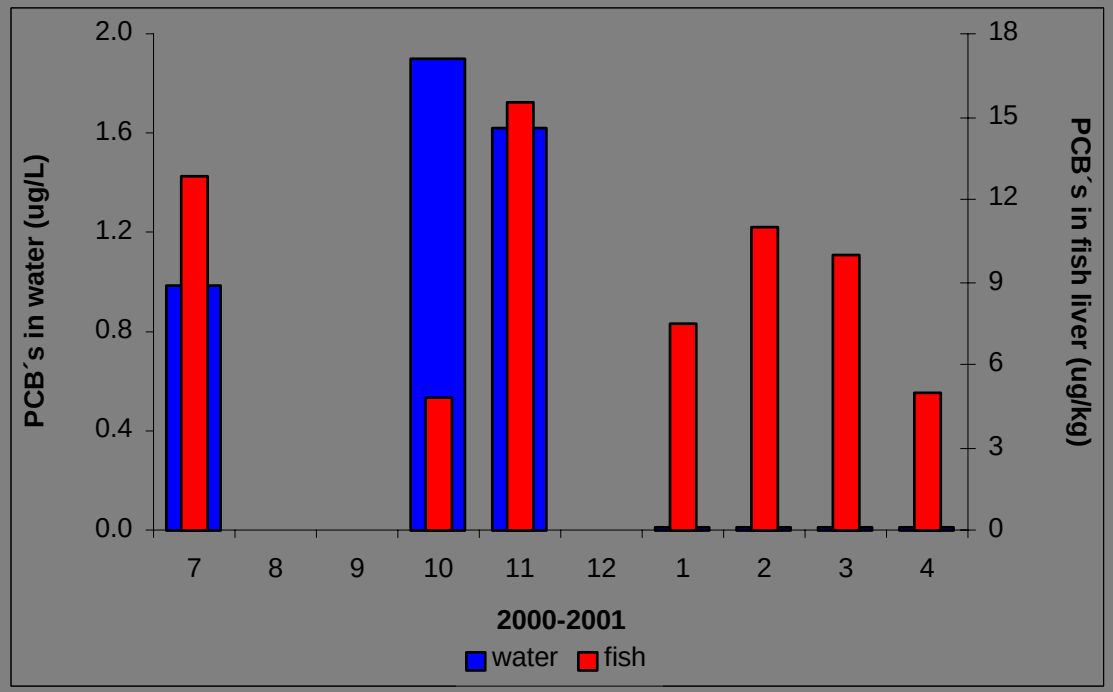
source: FAO

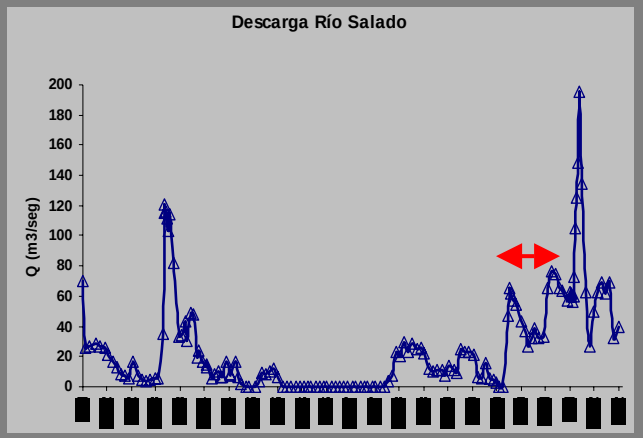
pesticides use



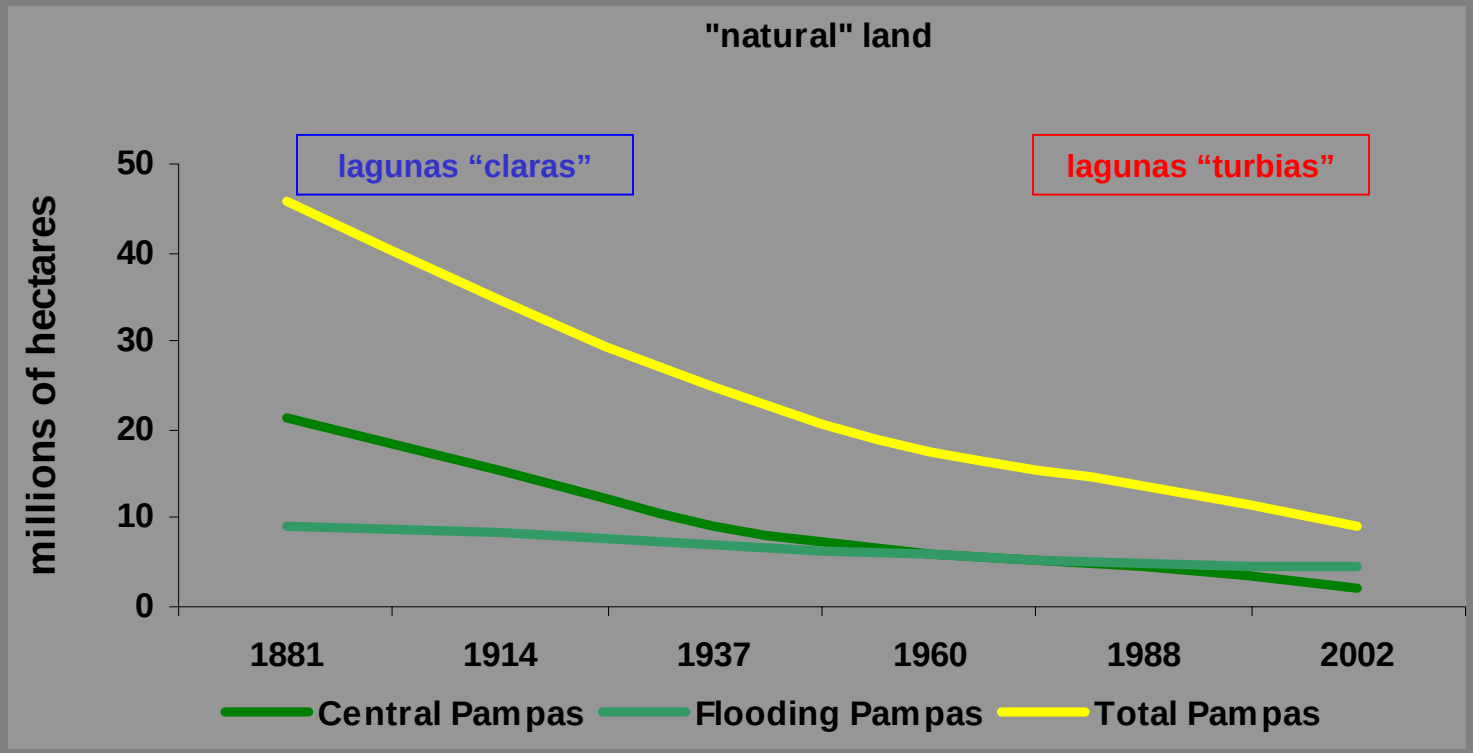
source: SAGPyA

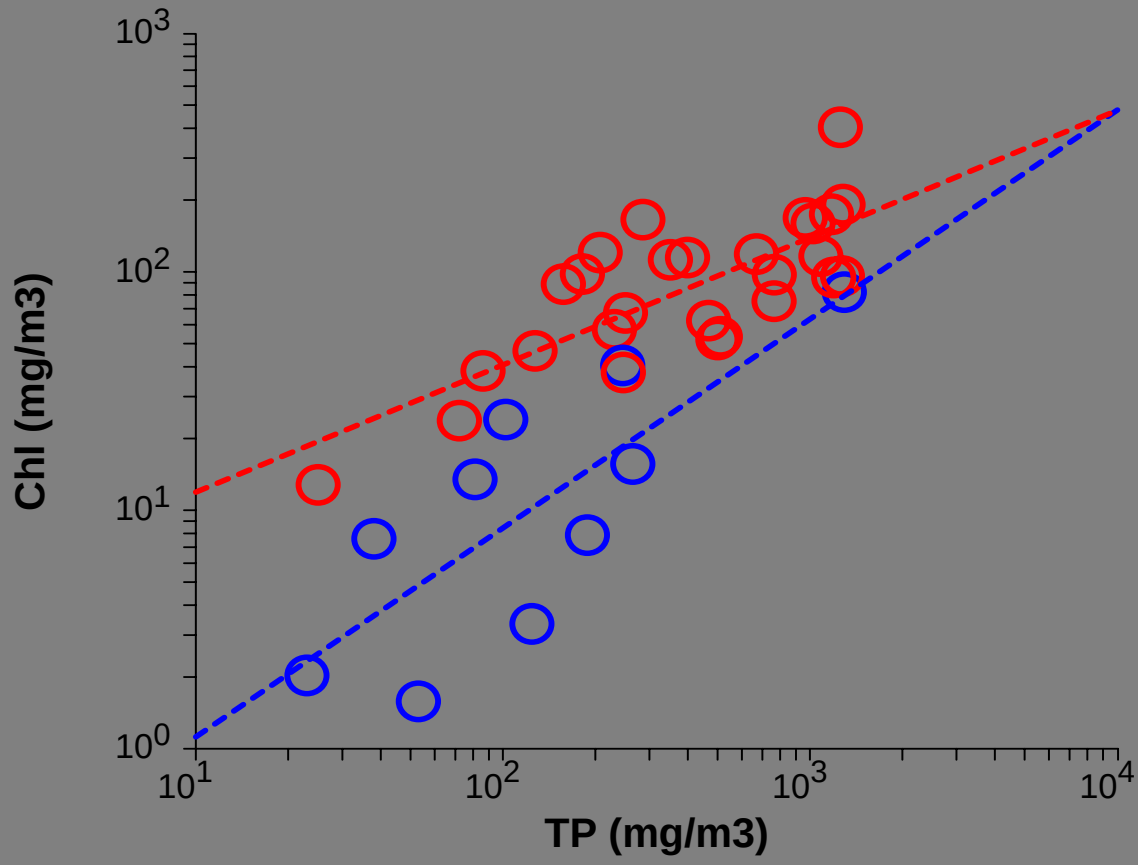
PCB´s in water and fish





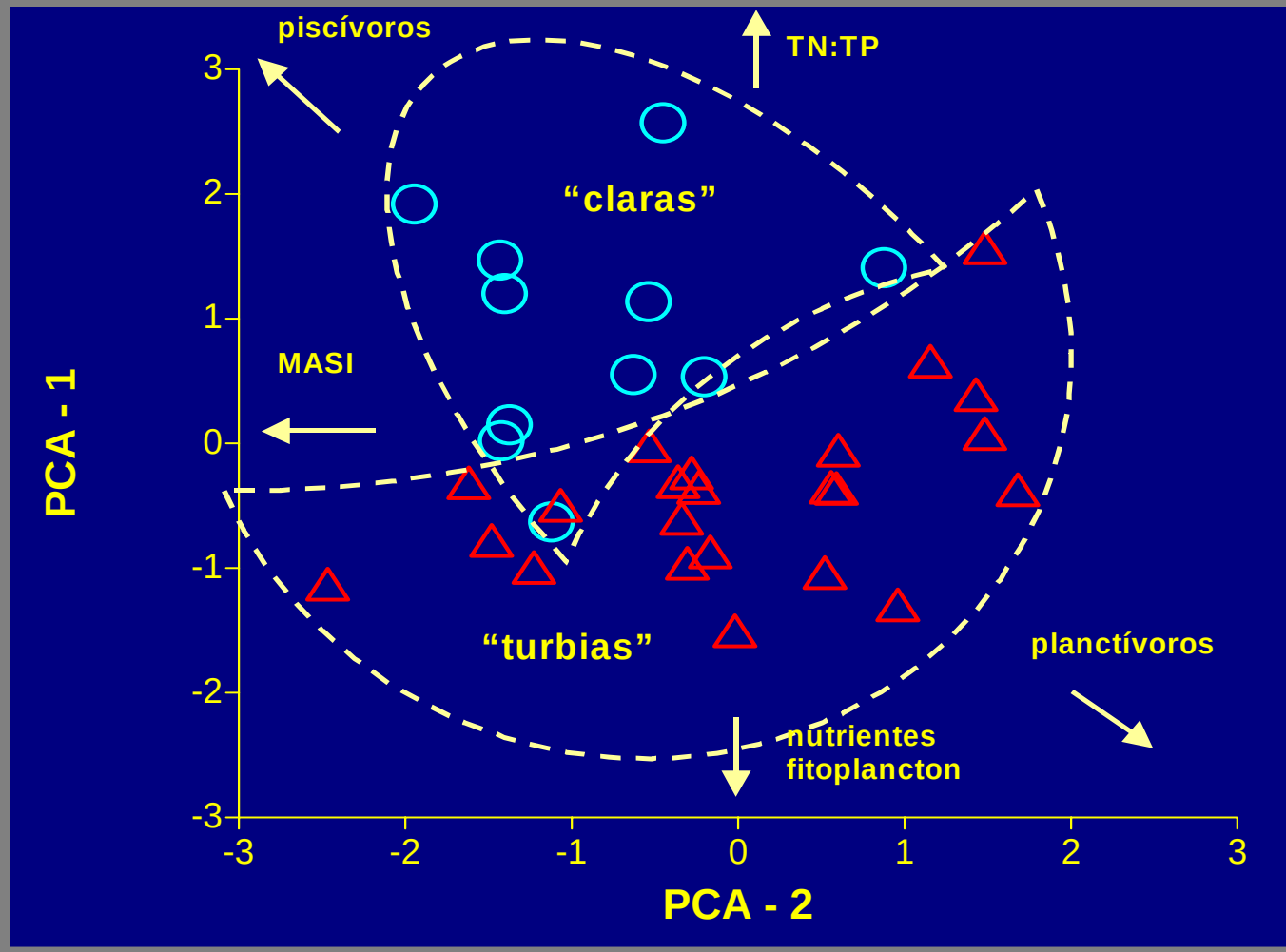
lagunas “claras” y “turbias” como indicadores de la intensidad de acción antrópica sobre el humedal pampeano



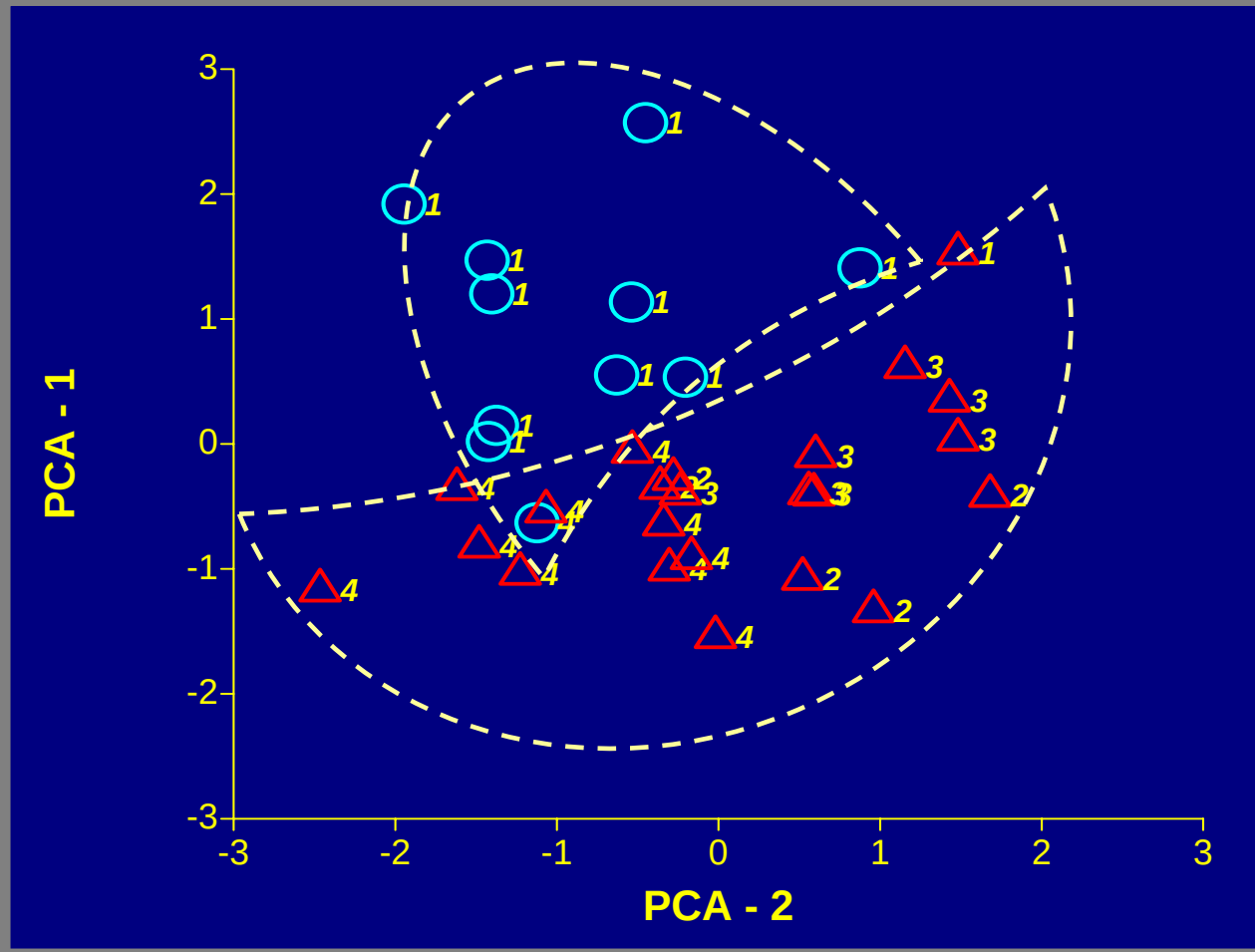


37 lagunas pampeanas, “turbias” (O) y “claras” (O)

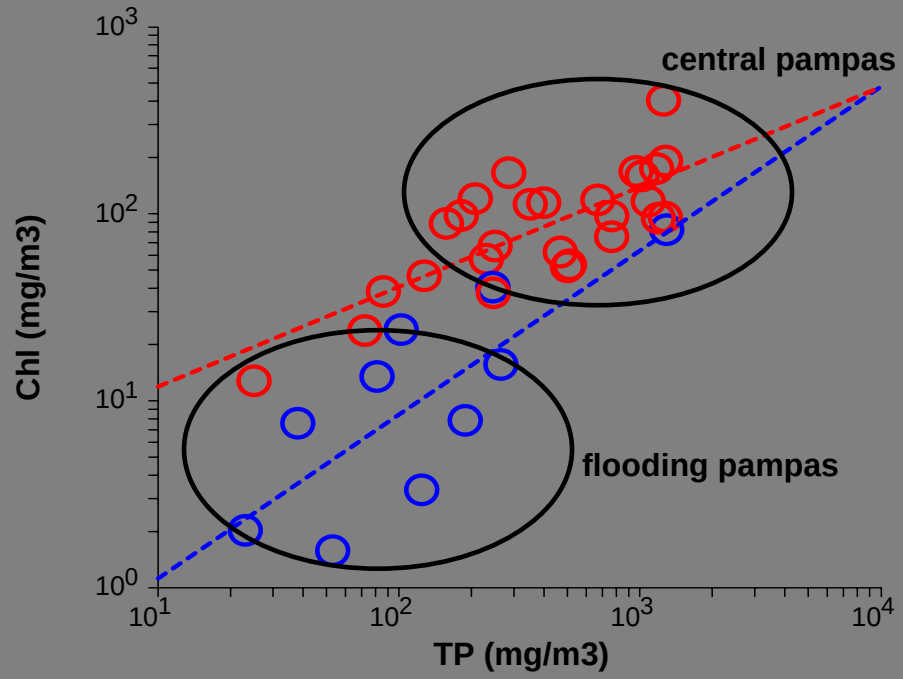
“claras” y “turbias”

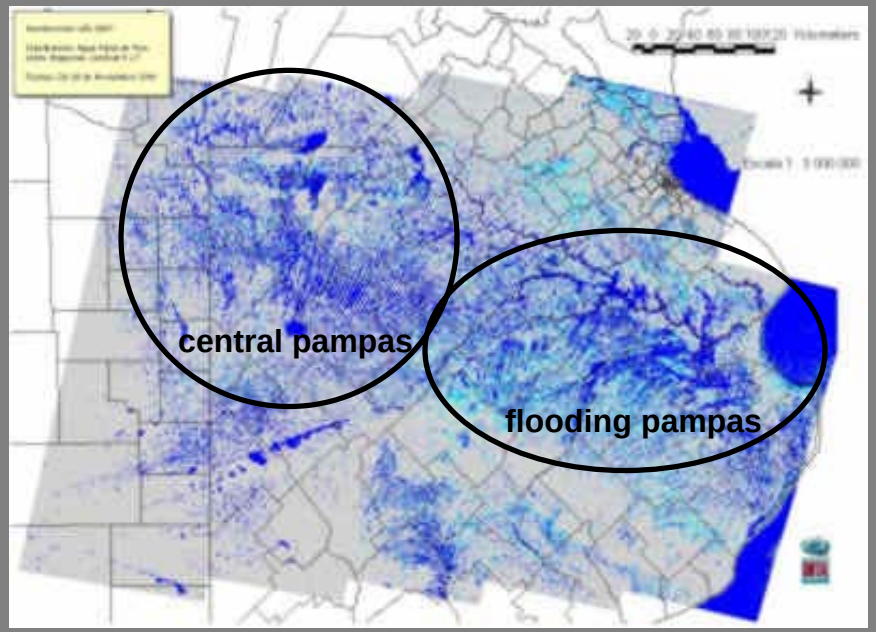


“claras” y “turbias”



“claras” y “turbias”

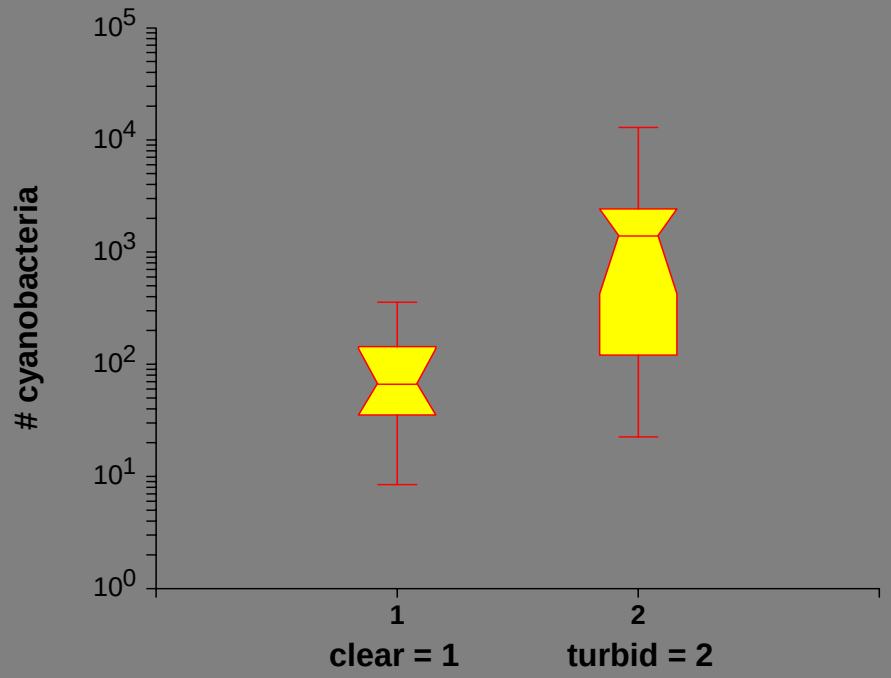


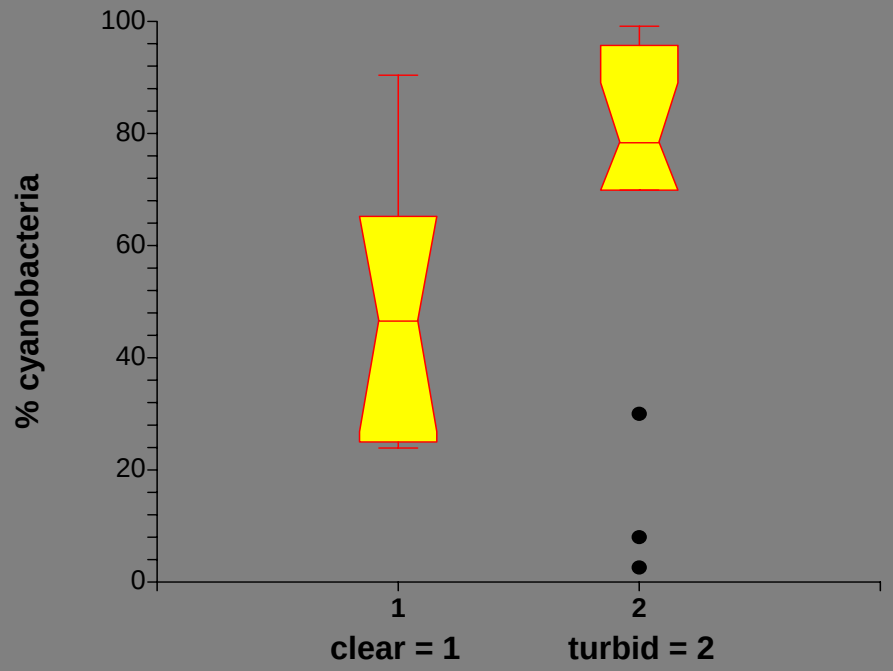


for pampean terrestrial ecosystems, dramatic changes in weighted biodiversity have been widely documented for vegetal and animal communities, therefore, only some changes in the biota of the aquatic component of the pampean wetlands will be presented here:

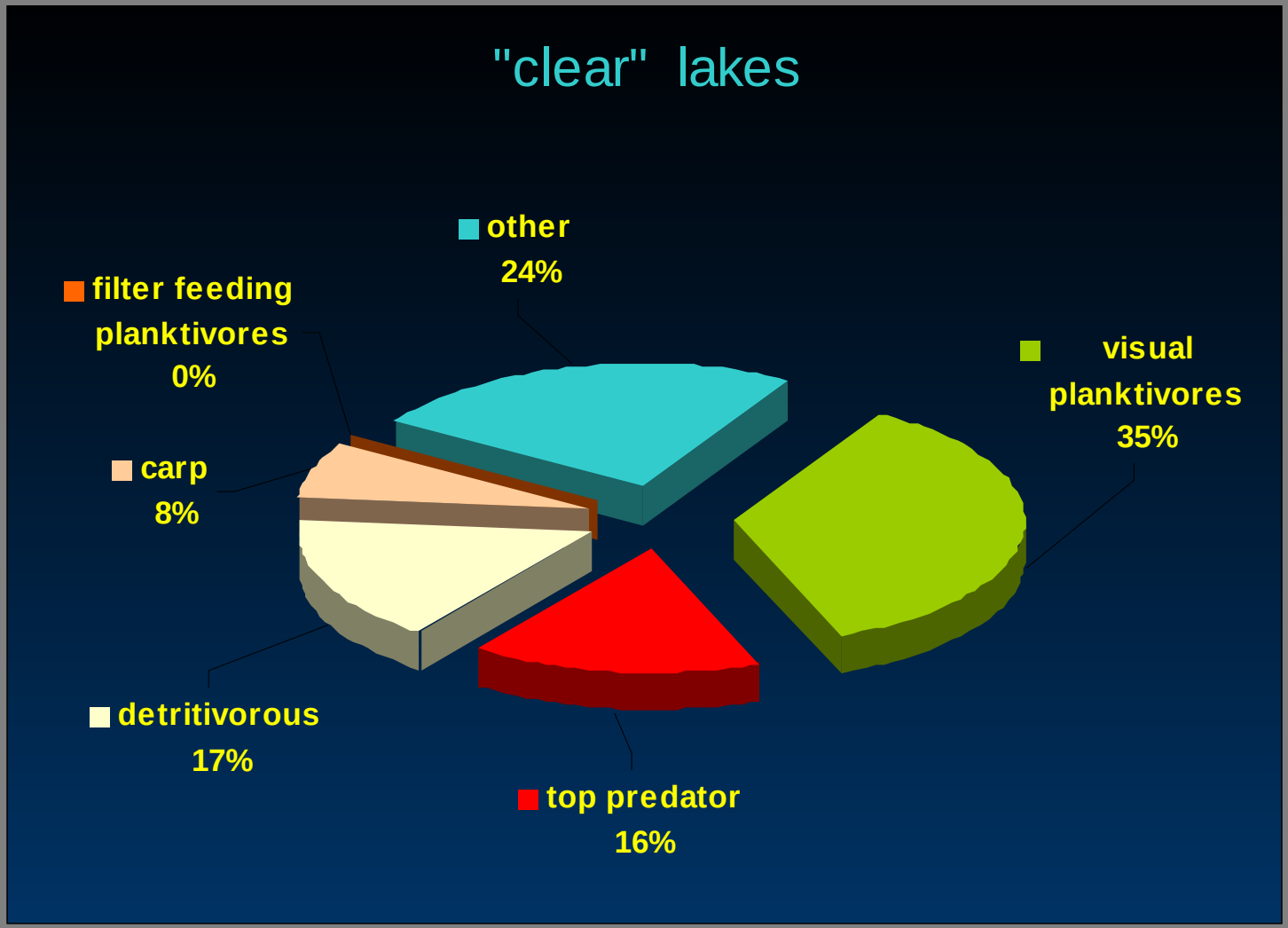
lake phytoplankton

“clear” and “turbid” lakes

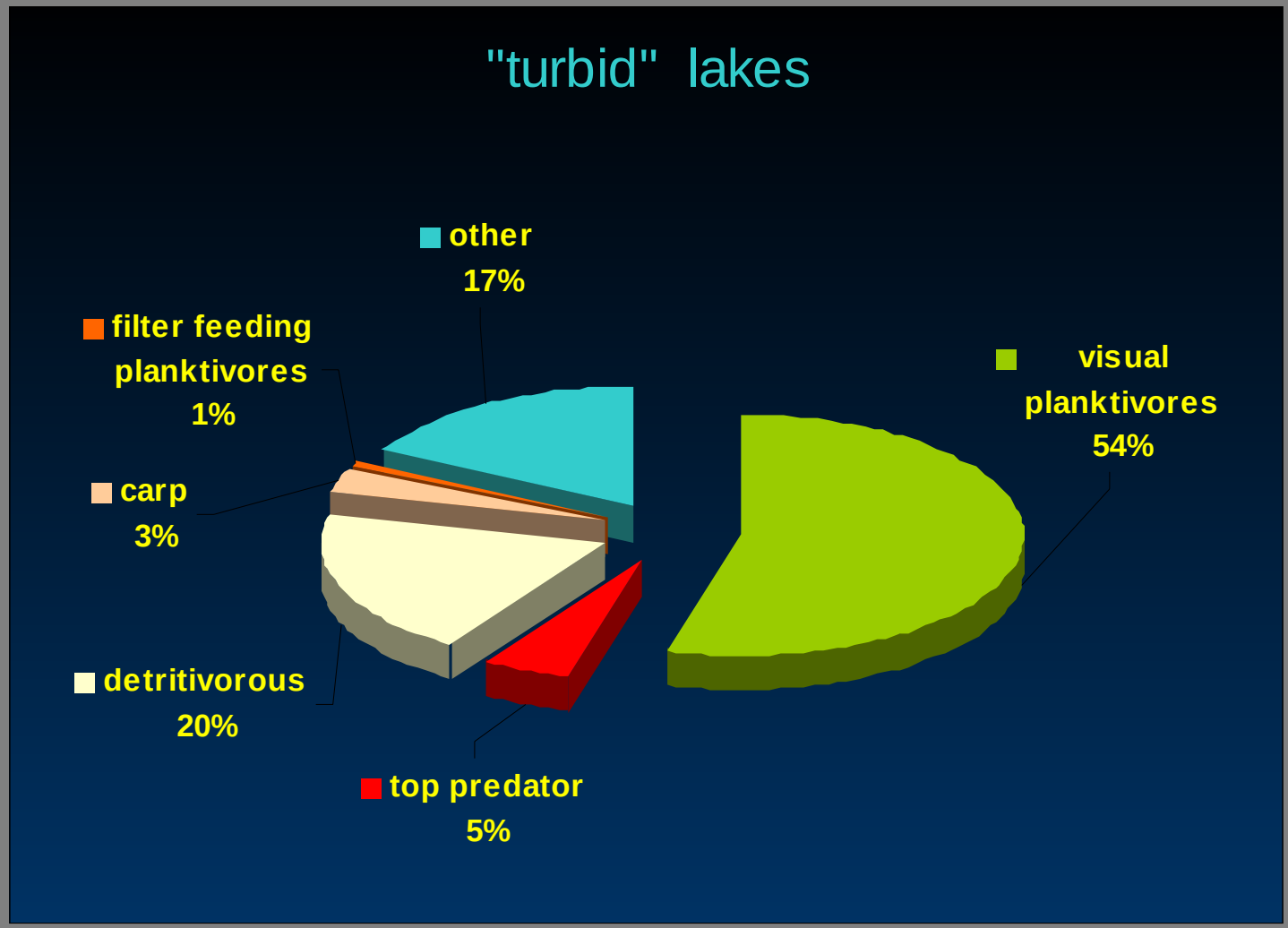




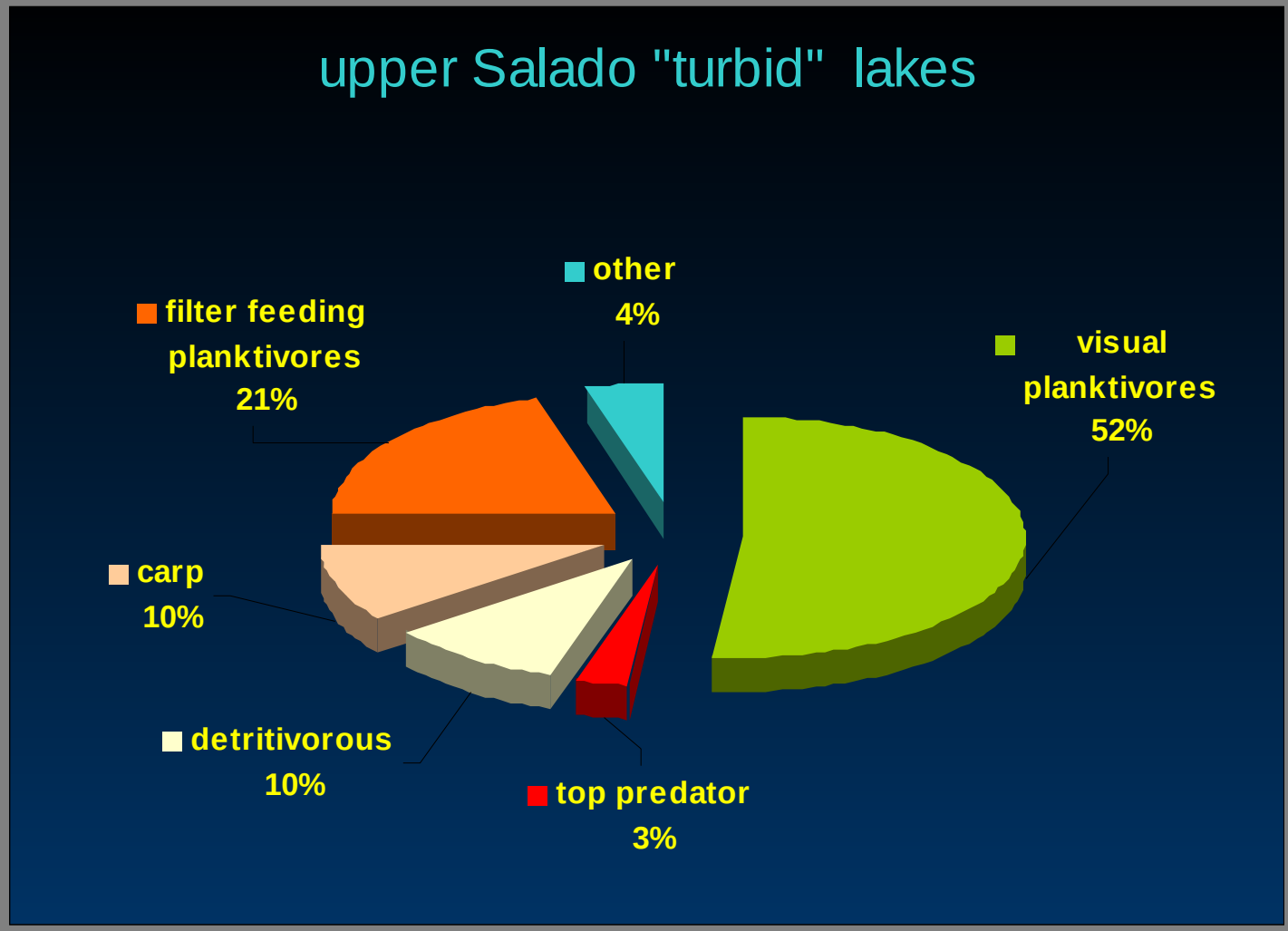
lake fish changes
from “clear” to “turbid” very shallow pampean lakes



water transparency = 1.50 m



water transparency = 0.38 m



water transparency = 0.23 m

from primordial wetlands to agricultural land

past

- natural grasslands
- natural drainages

- "clear" lakes
- macrophyte dominated
- usually with oxic, P unsaturated sediments
- balanced vegetal and animal communities
- relatively low levels of organic matter, more oxidative environments
- nutrient levels according to drainages on highly productive soils

present

- agriculture, human settlements and highly modified grasslands
- drainages medium to highly modified

- "turbid" lakes
- phytoplankton dominated
- hypoxic and anoxic, P saturated sediments
- simplified vegetal and animal communities
- high levels of organic matter, reductive environments
- very high nutrient levels due to agriculture and urbanization
- extended fish and avian mortalities
- human health hazards

“son preferibles dos años de inundación a un año de sequía”

Anónimo