The influence of riverine phytoplankton species on primary productivity in the San Joaquin River, California

P. W. Lehman
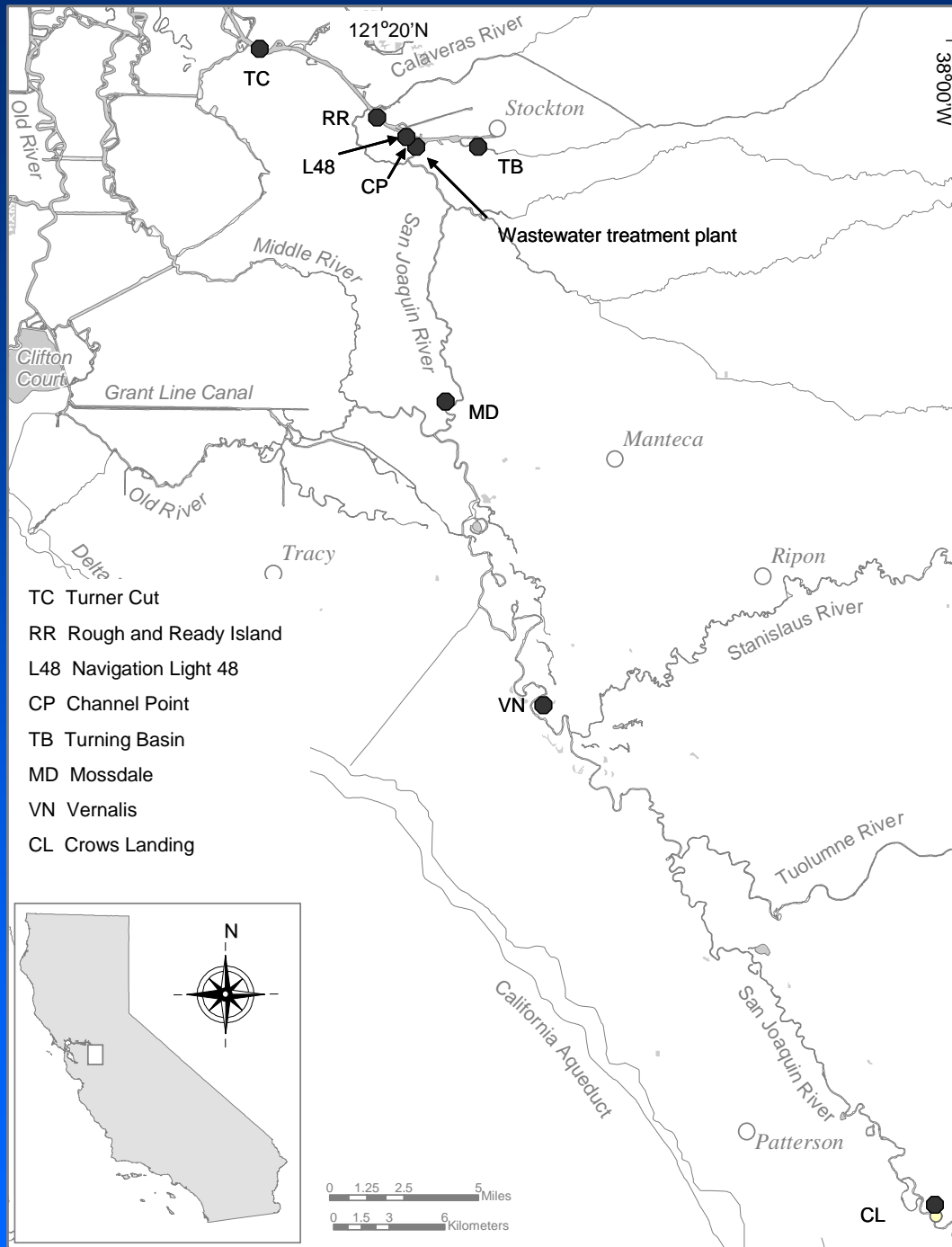
CA Department of Water Resources

Questions

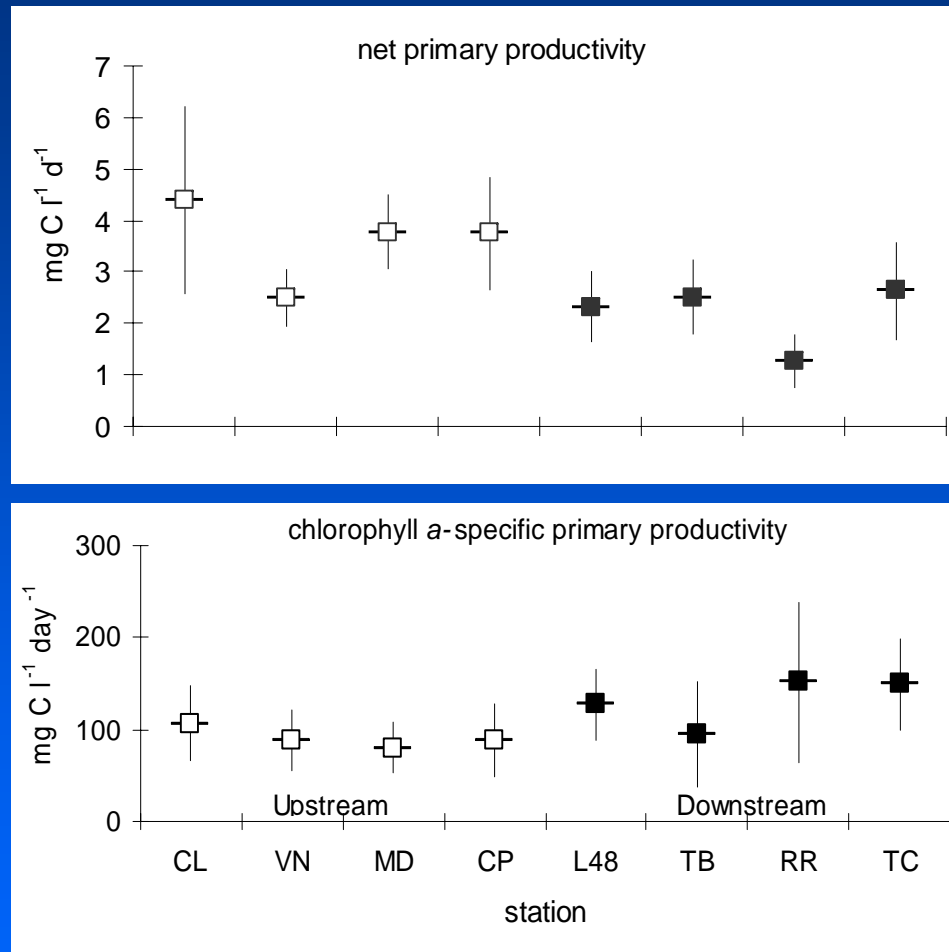How does primary productivity along the river affect carbon load to the deep water channel?

- Does the phytoplankton growth rate vary between upstream and downstream?

- Does the phytoplankton community affect primary productivity along the river?

- How do environmental conditions affect primary productivity along the river?

Methods

- Sampled at eight stations biweekly between June and October in 2001

- Conducted 24 h light and dark bottle dissolved oxygen incubations in flow-through open-air incubators at Rough and Ready Island

- Measured environmental conditions at each sampling station

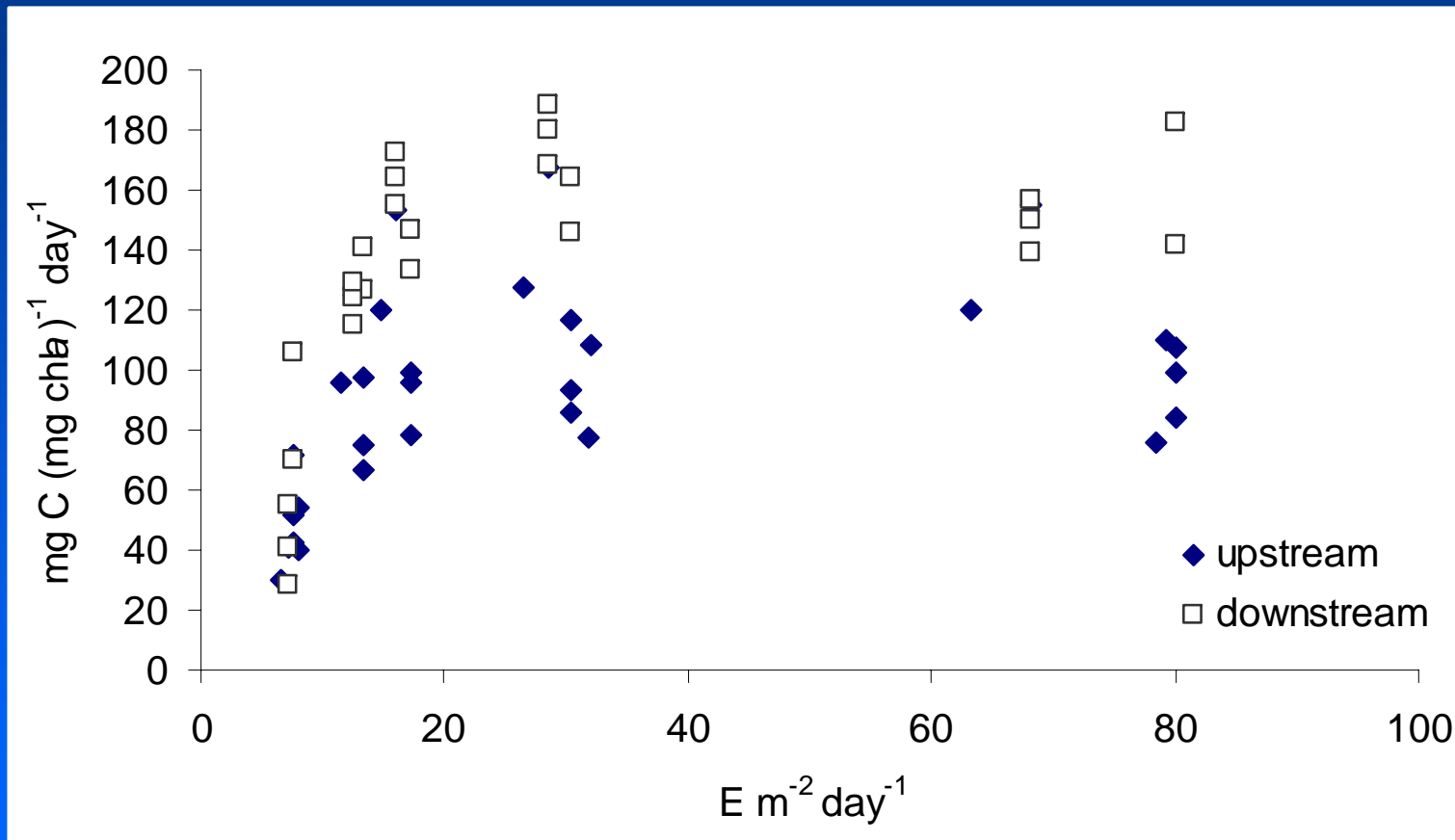- Measured chlorophyll *a* concentration and phytoplankton species composition

TC Turner Cut

RR Rough and Ready Island

L48 Navigation Light 48

CP Channel Point

TB Turning Basin

MD Mossdale

VN Vernalis

CL Crows Landing

The specific growth rate was higher downstream

Higher growth rate upstream was produced by higher chlorophyll a concentration

Both the growth potential and efficiency were higher downstream

Scatter plot: x-axis "E m^{-2} day^{-1}" (0 to 100), y-axis "mg C (mg chl$a$)$^{-1}$ day^{-1}" (0 to 200). Legend: filled diamonds = upstream, open squares = downstream.
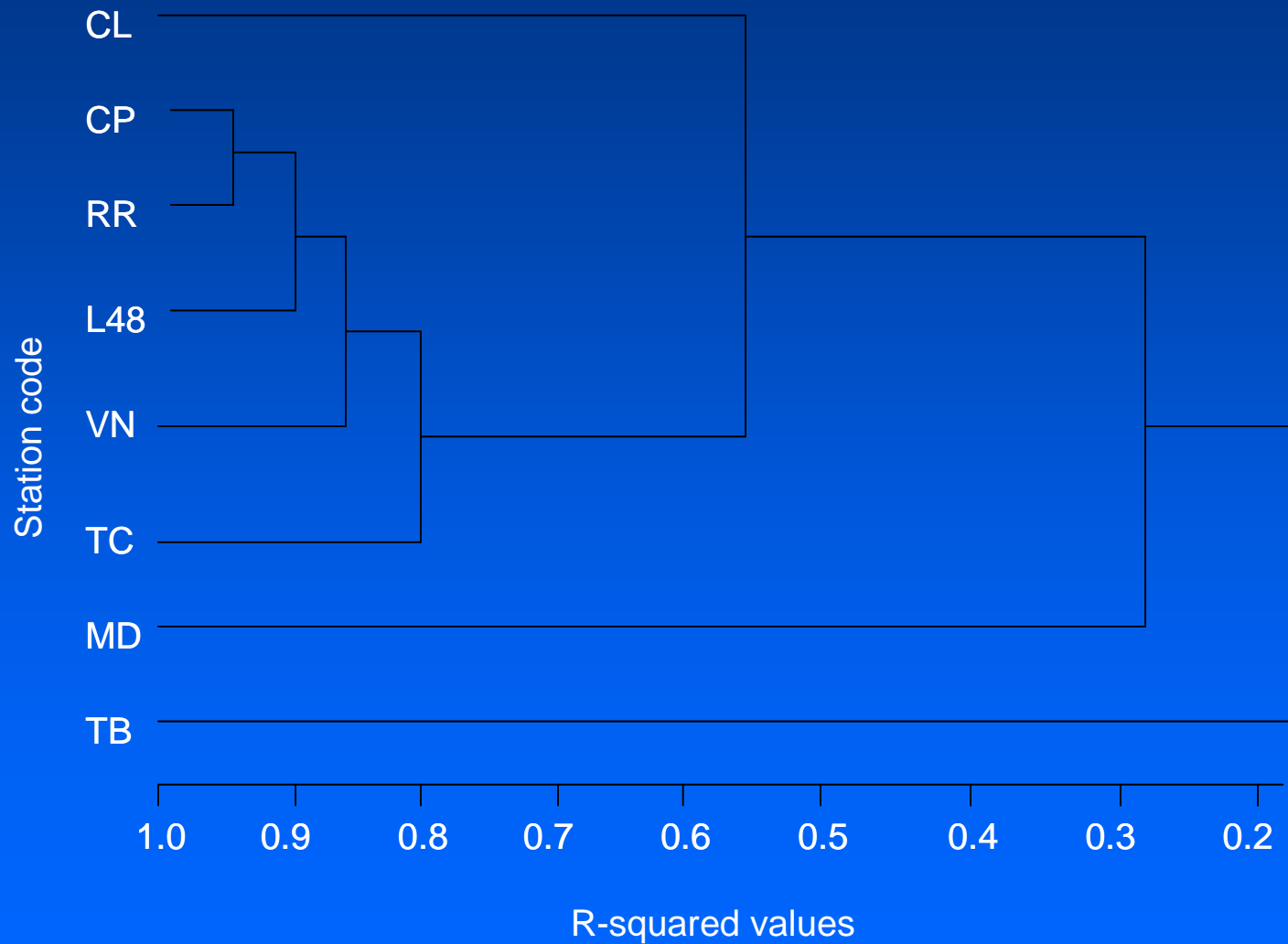
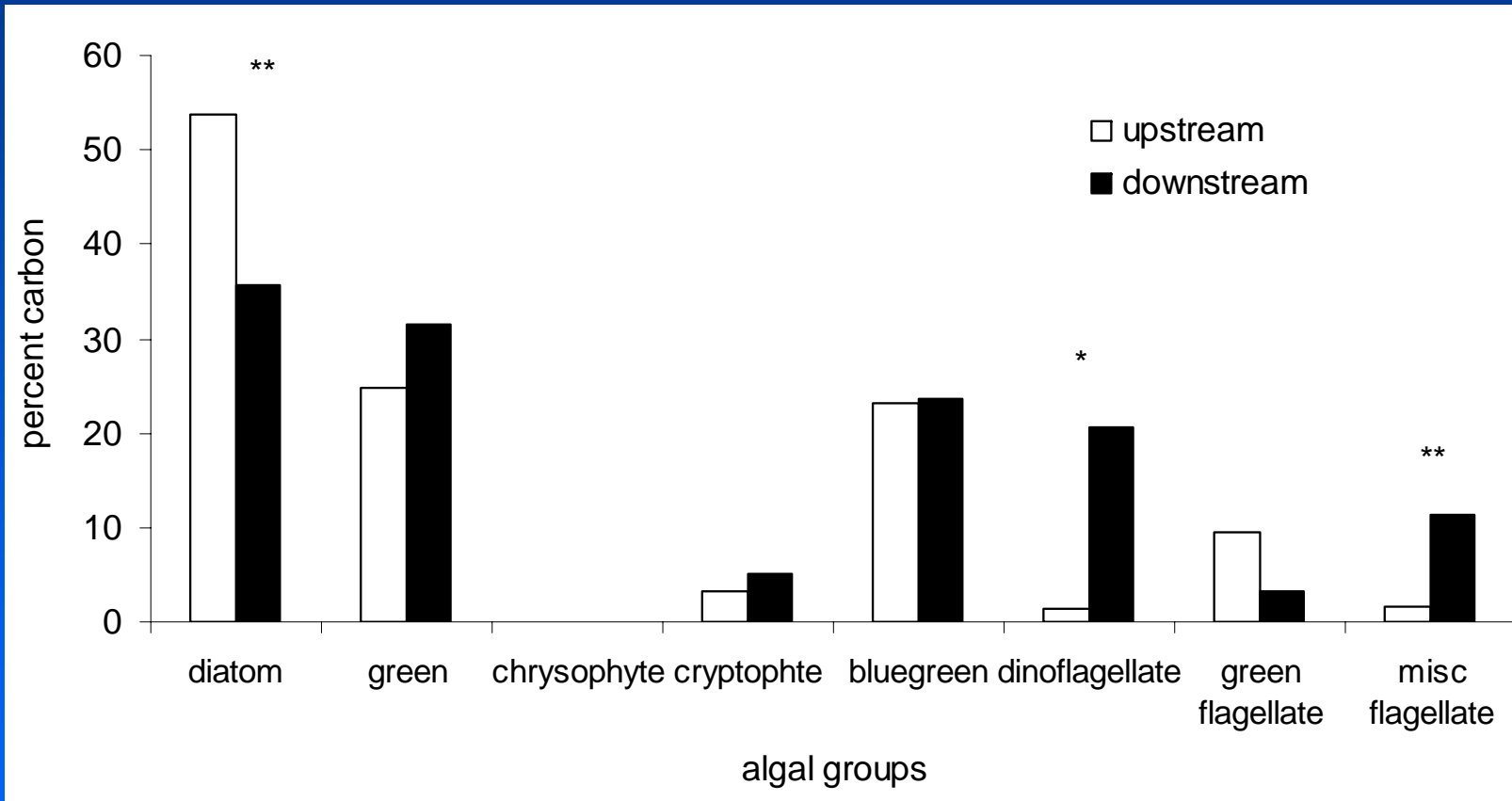# Nutrients and water temperature did not vary between upstream and downstream
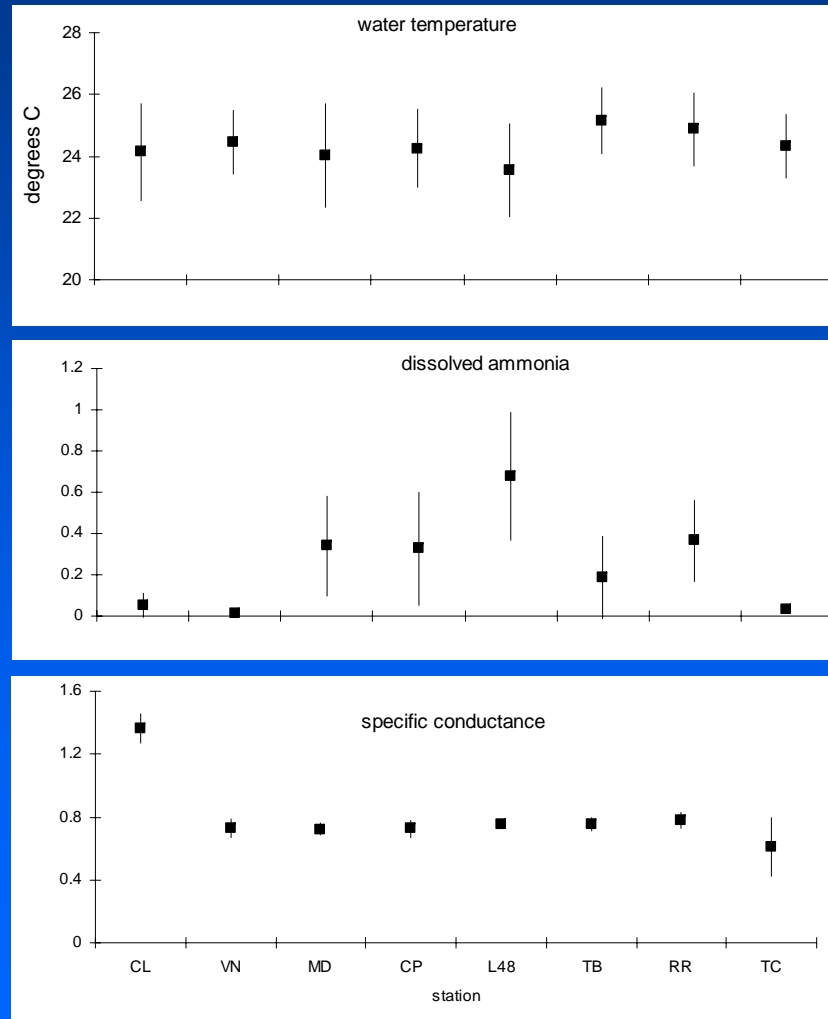
The phytoplankton differed between upstream and downstream

The distribution of phytoplankton carbon among species groups differed upstream and downstream

Percent diatom carbon was higher upstream than downstream

upstream   **downstream**

species	CL	VN	MD	CP	station mean	region mean	TB	LT48	RR	TC	station mean	region mean	level
diatom													
Achnanthes sp.	1	0	0	0	0		0	0	0	1	0		
Actinastrum hantzschii	0	1	2	0	1		2	0	0	0	0		
Amphora sp.	0	0	0	0	0		0	3	0	0	1		
Aulacoseira granulata	0	0	0	0	0		0	1	0	0	0		
Coscinodiscus sp.	6	**17**	**30**	**12**	16		**12**	**14**	4	**14**	11		0.05
Cyclotella glomerata	9	5	1	2	4		0	0	2	0	1		0.05
Cyclotella sp.	**17**	**26**	**19**	**17**	20		8	**13**	7	**22**	12		0.05
Gomphonema sp.	6	1	3	0	3		0	6	0	0	1		
Navicula cryptocephala	2	0	0	0	0		0	0	0	0	0		
Navicula sp.	0	2	2	0	1		0	1	0	0	0		0.01
Skeletonema potamos	0	4	5	2	3		2	2	5	1	3		
Surirella ovata	2	0	1	2	1		0	0	0	0	0		0.05
Synedra acus	1	0	2	0	1		0	0	0	0	0		0.01
Synedra ulna	5	3	1	1	2		1	1	0	0	0		0.01
Thalassiosira eccentrica	1	0	3	3	2	**55**	1	1	4	**11**	4	**35**	0.01
total	50	59	69	40			26	43	22	49			

Phytoplankton canonical variable

phytoplankton species carbon	canonical variable 1	canonical variable 2
Closterium setaceum	**0.75**	0.12
Gomphonema sp.	0.40	**-0.51**
Carteria cordiformis	0.33	0.38
Cyclotella sp.	0.31	-0.21
Anacystis cyanea	0.30	**0.52**
Oocystis sp.	0.20	0.01
Gomphosphaeria naegelianum	0.12	-0.30
Carteria sp.	0.13	0.31
Unidentified flagellates	0.11	0.19
Thalassiosira eccentrica	-0.01	-0.35
Cryptomonas sp.	-0.03	-0.24
Cyclotella glomerata	-0.04	-0.02
Gymnodinium sp.	-0.06	0.22
Tracelomonas sp.	-0.11	-0.22
Anacystis nidulans	-0.23	0.18
Cosinodiscus sp.	-0.30	0.27
Coelastrum microporum	-0.31	0.05
Oscillatoria sp.	-0.40	-0.04
Scenedesmus quadricauda	**-0.53**	0.24

Environmental canonical variable

environmental variable	canonical variable 1	canonical variable 2
total phosphorus	**1.02**	0.04
specific conductance	**0.80**	-0.04
Secchi disk depth	0.36	**0.93**
pH	0.29	0.36
streamflow	0.08	-0.18
dissolved oxygen	-0.09	-0.05
irradiance	-0.06	-0.23
water temperature	-0.08	-0.17
soluble reactive phosphorus	-0.59	-0.40
total dissolved solids	-0.61	-0.32
dissolved ammonia	**-0.70**	0.05

The first phytoplankton and environmental canonical variables
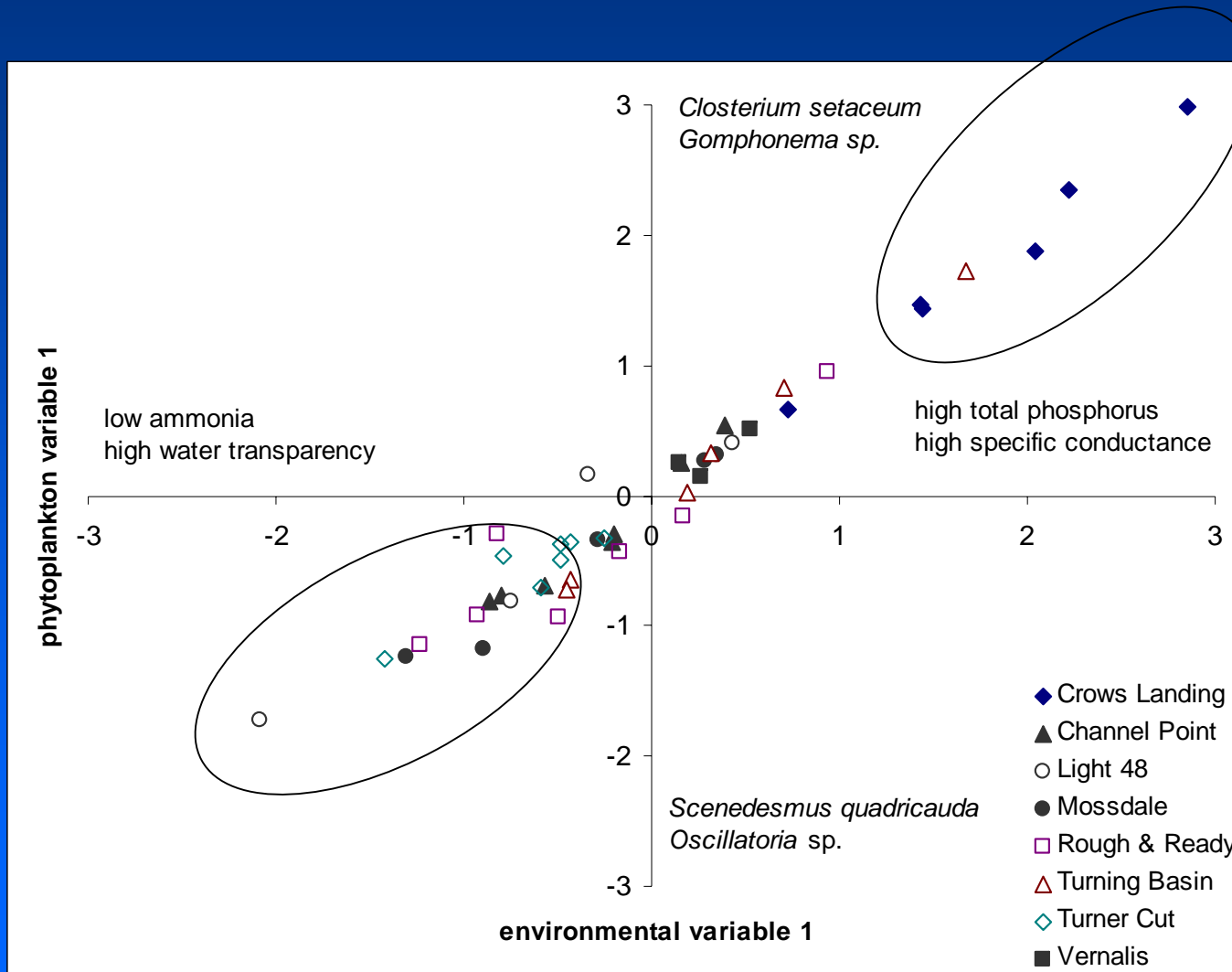
The second canonical phytoplankton and environmental variables
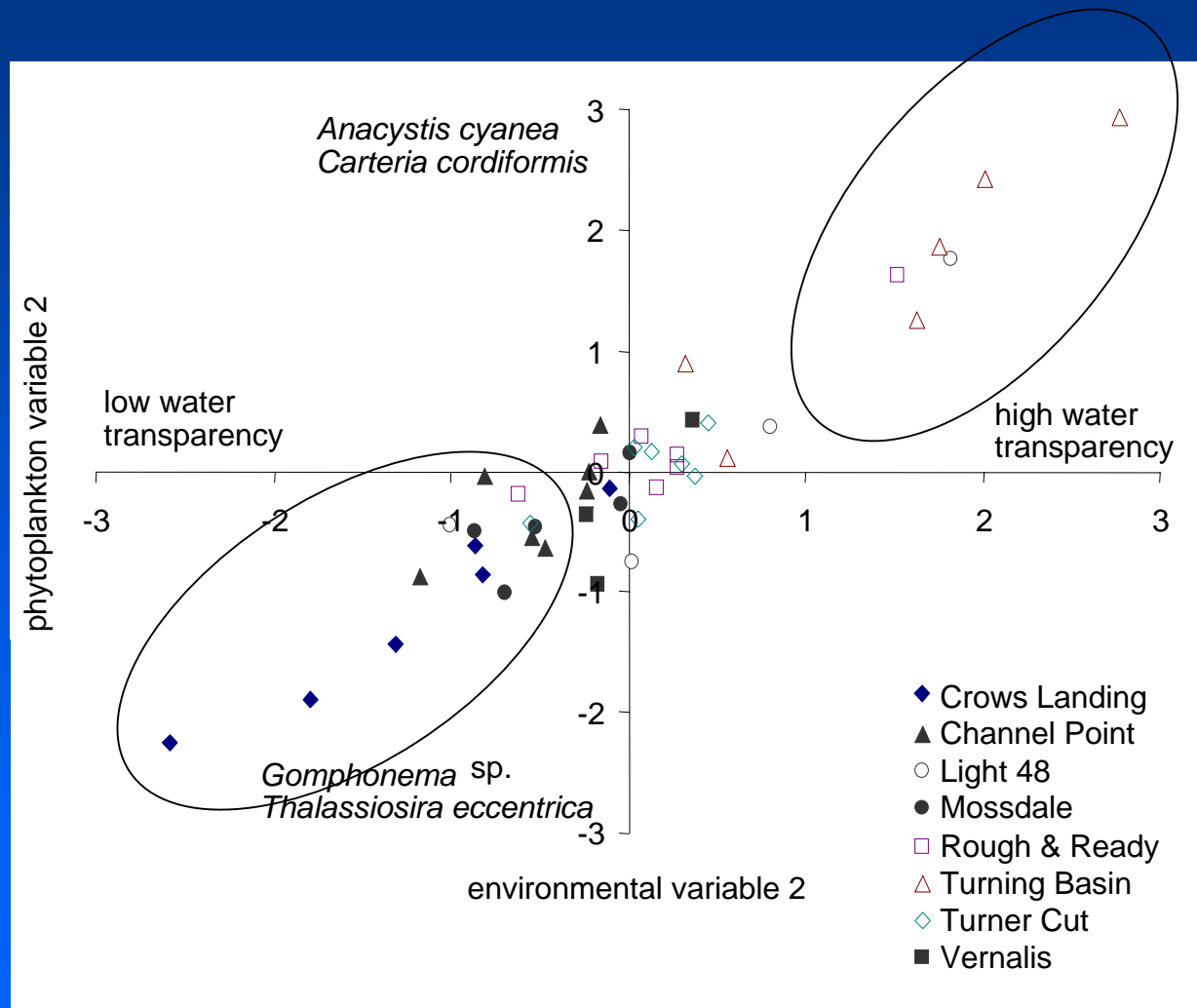
Summary

- **Chlorophyll *a* specific growth rate, growth potential and growth efficiency were higher downstream**

- **Phytoplankton species varied between upstream and downstream**

- **Change in phytoplankton species composition was associated with environmental factors along the river**