SALGA
South American Lake Gradient Analysis
Newsletter, July 2004

Estimados todos,
During the week of June 21 to 25 a kick-off meeting was held in Wageningen. Marten had planned to host the whole meeting but unfortunately he had to stay at home with a pneumonia. We missed him and his input during the meeting but anyhow had very interesting discussions and advanced a lot in the preparations of the field protocol and the logistics.

Below you'll find the main topics discussed. Comments to improve the project set-up are still very welcome! Hope to see you all soon in person during our challenging fieldtrip.

People present:

Gissell Lacerot, Egbert van Nes, Andy Lotter, Erik Jeppesen, Nestor Mazzeo, Carla Kruk, Sarian Kosten, Miquel Lurling, John Beijer. And (not on the picture): Jan Clevers and Edwin Peeters

Objectives of meeting

1. To get to know the different people involved in the project;
2. To adjust and agree on focus and hypothesis of SALGA-project;
3. To elaborate and test the field sampling protocol

Hypotheses

The various hypothesis mentioned by all people involved (see previous newsletter and SALGA project proposals) where thoroughly discussed. Some were discarded as being to complicated to test or not coherent with the set-up of the overall sampling scheme. The resulting list of hypothesis is found in Table 1.

Table 1: hypotheses of SALGA project

Hypothesis	Data analyzed
• Average climatic conditions affect the **critical nutrient** level at which shallow lakes fall into a turbid state. • The phosphorus level at which submerged macrophytes disappear is a highest at (sub) tropical region. • The maximum chl-a/total-P ratio is higher towards the tropics. • The N/P ratio is lowest in macrophyte dominated lakes • N-limitation is more important in the tropics.	○ Nutrient concentration in the water column and top sediment layer. ○ Phytoplankton biomass. ○ PVI and coverage of submerged and free-floating plants.
• Average climatic conditions affect the critical **turbidity** at which macrophytes disappear	○ Water transparency. ○ PVI and coverage of submerged and free-floating plants. ○ Phytoplankton biomass.
• Smaller lakes have higher chances of shifting to the vegetation dominated state	○ Satellite images
• Extreme meteorological conditions can induce shifts between alternative stable states. • Episodes of low precipitation leading to low water levels can push lakes to the macrophyte dominated state[1].	○ Temporal variation of N, P, C, organic matter , pigments and other biological indicators in the paleolimnological cores. ○ Time series of historical data or satellite images of a subset of lakes selected a priori.
• Denitrification rates (from stable isotopes) are highest in macrophyte dominated lakes and at higher nutrient level and temperatures	○ No practical method has been found till now ○ Temperature could very well not be the main factor influencing the denitrification rate
• ~~Carbon sequestration rates in sediments are highest in macrophyte dominated lakes and increase with nutrient level, and towards the tropics~~	○ Too difficult to measure
• An increase in average temperature and nutrient level produce systematic changes in fish community leading to a reduction in the average size of zooplankton and a weakening of top-down control of phytoplankton, which can be ameliorated by the presence of aquatic vegetation • *Daphnia* (and other cladocerans ?) are smaller in the tropics ○ The average size as well as the variance in size decreases towards the tropics for fish as well as zooplankton. ○ The estimated potential predation pressure on zooplankton increases towards the tropics ○ The variation in the abundance of planktivorous fish along a latitudinal gradient explains much of the variation in zooplankton size and structure	○ Nutrient level in water and sediment. ○ Water transparency ○ Phytoplankton biomass and composition. ○ Zooplankton biomass, composition and size distribution of cladocerans and calanoids. ○ Fish community structure ○ Remaining rest in top layer sediment. ○ Stable isotope analysis ○ Historical data of subset of lakes.

[1] The opposite could happen when resuspension by wind causes a high turbidity. Also birds could cause a decrease in water vegetation at low water depths.

[2] The effects of fish kills in the tropics might cause only short term effect because of the fast recuperation of the fish community.

◦ Effect of nutrient level on the apparent fish predation pressure on zooplankton changes along the climatic gradient ◦ Effect of vegetation cover on apparent fish predation on zooplankton will diminish towards the tropics. ◦ Fish kills induced by extreme meteorological events such as droughts have cascading effects on zooplankton size and phytoplankton biomass in low latitude lakes as they do in temperate lakes.[2] ◦ The estimated grazing pressure on phytoplankton decreases towards the tropics	
• Diversity will show an optimum along the gradient for most groups[3,4] ◦ Diversity of macrophytes will peak at subtropical latitudes ◦ Diversity of zooplankton peaks at tropical latitudes. Daphnia may, however, form an exception and peak in temperate zones. ◦ Diversity of fish will peak at a tropical latitude and phytoplankton will peak at subtropical latitudes. ◦ Phytoplankton diversity does not show a latitudinal trend	◦ Plant community structure ◦ Algae community structure ◦ Zooplankton community structure ◦ Fish community structure
• Omnivory increases towards the tropics	◦ Stable isotopes analyses in a subset group of 20 lakes.[5]
• The bacterial and protozoan density in the water will increase towards the tropics	◦ Water samples for both communities[6].

[3] Various studies have shown that the diversity at the species and genera level are comparable, so even if taxa can not be determined until species, we can still test this hypotheses.
[4] We are not including benthic invertebrates because the "snap shot approach" we are using is not suitable for benthic invertebrate analysis because of seasonality in the life cycles (you will only find those that are not flying or swimming in water column)
[5] We will analyze this in a subset of 10-20 lakes: pairs of macrophyte and algae dominated systems evenly distributed over the gradient
[6] Eloy Bécares would like to analyze this.

Lake selection

The criteria for the selection of 100 lakes mentioned in the previous newsletter were further elaborated and are listed below:

- 100 freshwater coastal lakes without riverine or oceanic influences (conductivity below 1000 μS/cm)
- Shallow ecosystems (depending on size class we will define a maximum average depth)
- Size between 15 and 40 ha (this is preliminary: first we have to have an overview of the amount of lakes in this size class (opposite to a size range of 8-15 ha for example) along the gradient)[7]
- Evenly distributed along the gradient
- At every latitude at least one macrophyte and one algal dominated lake and optionally also include lakes dominated by free floating plants
- Preferably include some lakes that are or were monitored (chemically and/or biologically) on a regular bases

Fieldwork chronogram

when	where	who
June- August 2004	Preliminary selection considering satellite images, maps, historical data	Nestor, Gisselle, Sarian with help of local teams
September-October 2004	Field visit of shallow lake previously selected in South Brazil and Uruguay	Motta-Mazzeo
	…Argentina Mar del Plata to Rawson	Lacerot, Gonzalez Sagrario, member of Paggi group?
	…Rio de Janeiro- Espirito Santo	Branco-Huszar
	…Natal-Recife	Attayde
November- December 2004	Field samples collection from South Brazil and Uruguay (20 lakes)	Nestor, Gisselle, Sarian, Andy (in first couple of lakes), John (?) + ?
January-February 2005	… Mar del Plata-Rawson (20 lakes)	Nestor, Gisselle, Sarian + ?
July-October 2005	… North and central Brazil (40 lakes)	Nestor, Gisselle, Sarian + ?
January-February 2006	… Rawson-Tierra del Fuego (20 lakes)	Nestor, Gisselle, Sarian + ?

We estimated that we will need 2 days on average per lake.

We discussed the fact that with this larger time frame we introduce inter-annual variations in climate. But concluded that changes in climate along the gradient will by far be greater than inter-annual variations. Furthermore it is not feasible to sample everything within one year. If we manage to include lakes that are sampled on a more regular bases we could get insight in this inter-annual variation.

[7] Especially in small lakes the range can not be too large because changes in ecosystem structure and processes (for example biodiversity) are highly influenced by changes in size especially in small lakes. If we take the lower size limit to low, however, we will not have any lakes in Uruguay to include. This could happen for other size ranges in other regions of the gradient as well.

Tasks and responsibilities at lake sites
There is one overall site coordinator (member of the core team). Furthermore there are team leaders responsible for collection mix sample of lake; preparation of samples for laboratory analysis; macrophytes; fish;…

We can work in 2 or 3 teams (if possible with 2 boats).
Group 1 starts with the collection of mix sample. Brings this back to shore in order to be filtrated etc. Then takes measurements at deepest point and inside and outside macrophyte bed.
Group 2 starts collecting general information and prepares mix sample
Group 3 does the macrophyte analysis and places fish nets.

Material
Based on the hypotheses mentioned above a list of materials needed was made (see Table 2).

Table 2: equipment and materials needed

Parameter/variable to be measured	**Equipment/materials**
general	
Lake coordinates	GPS
	map/ aerial photograph
	spare batteries
Altitude	GPS/Altimeter
Lake size	GPS
Overview picture	digital camera + battery(loader)
Location 5 equidistant sample points	GPS
Temperature profile	Digital thermometer Rope
Depth	echosounder (handheld) Weight Rope
chemical analysis	
water sampling	1 and 4 meter tube ruttner bottle
	metric tape
Secchi and mini disk depth	Secchi disc (color marks per10cm) Mini disc Rope
Light attenuation/Kd	map/ areal fotograph licors (or multi sensor probe) turbidity meter
chlorophyll-a	filters, filtering device, liquid N or ice
if equipment available: turbidity/in situ chl-a estimation	handheld fluorometer
suspended solids	GF/F filters electric filtering device (on car battery) manual pump

inorganic susp solids	GF/F filters filtering device
total-P concentration	filters, filtering device
Reactive P	filters, filtering device
total-N concentration	filters, filtering device
nitrate concentration	filters, filtering device
carbon	use part of the GF/F filter
dissolved organic carbon	?
Reactive Silicate	filters, filtering device
pH/temp	probe + spare one
conductivity	probe + spare one
alkalinity	buret, chemicals
oxygen	probe + spare one Rudnafles
denitrification	?
reflectance	
photometric and colorimetric measurements	PR650
biota	
macrophytes	key to identify macrophytes waterglass snorkel/glasses
colonization depth of macrophytes	rake/grapnel
fish	multi mesh and minnow traps key to identify fish inflatable buoys formaldehyde
	board with raster scale digital camara
fish size	ruler
fish weight	balance, albatros weighing equipment
omnivory of fish	knife to cut dorsal muscle of fish cutting board scalpel, tweezers subsampler
zooplankton	zooplankton net sieves (20 and 50) funnel alcohol
bacterial and protozoan density	
phytoplankton	lugol solution
Paleolimnology and other sediment analyses	
Top sediment sample from 0 to 2 cm 2-5cm	Kajak corer plastic bags
Top 50 to 100cm	gravity core perpex tubes taps duck tape red and black pipe cutter oasis (type of sponge)
carbon, PCBs and PAKs	
sample storage	**containers**
	Coolbox and cooling elements/ car fridge

macrophytes for stable isotope analysis (dry)	plastic container
macrophytes (wet)	25 l plastic container
water sample	25 l plastic container
total-P	200 ml plastic bottle
total-N	200 ml plastic bottle
fytoplankton	50 ml plastic bottle
fish	alcohol
zooplankton	
bacteria	20 ml plastic bottle
protozoa sample	50 ml plastic bottle
SS and ISS filters	petri disk?
dorsal muscle of fish	(you need 2 mg for the analyses) in glass bottle and then freeze it
measuring cylinder	

Other materials
car/pickup truck boat (preferably 2) peddles/small engine yerry can with gasoline watertight bags (containers) to store chemicals and samples) labels pencils cleanex labels preprinted waterproof booklet for in book grid map with random selected points (40 points plus extra ones in case they are located on the shore) herbarium/paper grapper or sledge to catch macroinvertebrates waders boots gloves life vest first aid kit tool box boat repair kit wind screen table chairs parasol permission/ telephone contacts telephone

Field protocol
A draft field protocol was thoroughly discussed during the meeting, the resulting protocol is attached to this newsletter.

Sample storage and analysis
Contrary to what was decided before as much of the analysis as possible will be conducted in the laboratory and not in the field to get as accurate results as possible.

Most samples will be analyzed in Uruguay.

The storage of the various samples will be described into detail in the specific protocols we are preparing. As far as the sediment cores concerns, we think about storing some in the North of Brazil (since we will fly there) and some in the Uruguay in a 4^{o}C storage room and analyze and sub sample them there.
Sediment samples for carbon, PCBs and PAKs will be send to The Netherlands.

Things to do
Obviously there are still a lot of things to do before we actually can start working in the field and team work will be very important to bring this large field campaign to a success. The following actions are proposed:

what	**who**
Make inventory of different lake sizes	Local support teams with help from Nestor, Gissell and Sarian
Make decision about lake size range that we are going to sample	Nestor, Gissell, Sarian
Finalize field protocol	Gissell, Sarian
Form teams that will participate in the various field trips	Nestor
Finalize all specific protocols of different measurements	Gissell, Sarian
Find additional funding (ideas are very welcome!)	Sarian and Gissell
Contact Dutch embassy in Uruguay, Brazil and Argentina	Gissell and Sarian
Decide in which subset of lakes we are going measure stable isotopes	Gissell and ?
Which type of mussel or snail occurs along the gradient that we can use for stable isotop analysis	Nestor/Gissell?
Check possibility to buy a car	Nestor
Check whether Paruelo or others have satellite images of Lakes in Uruguay	Nestor
Arrangements with customs in Uruguay	Nestor and Gissell
Arrangements with customs in Brazil	?
Arrangements with customs in Argentina	?
Arrangements with customs in the Netherlands	John
Permissions to sample in Uruguay	Gissell
Permissions to sample in Natal-Recife	?
Permissions to sample around Rio de Janeiro-Espirito Santo	?
Permissions to sample in South Brazil	?
Permissions to sample in Mar del Plata-Rawson	?
Permissions to sample in Rawson-Tierra del Fuego	?

Arrange space to store samples during field campaign (this should be preferable a climate room kept at 4°C) in Uruguay	Gissell and Nestor
… in Natal	
… in Rio de Janeiro	
… in Mar del Plata	
… Rawson	
Send protocol used in Greenland	Erik
Send new fish catch protocol	Erik