RIJKSINSTITUUT VOOR VISSERIJONDERZOEK
Netherlands Institute for Fishery Investigations

Haringkade 1 - P.O. box 68 - 1970 AB IJmuiden - the Netherlands
phone.: +31 2550 64646 - telex 71044 rivo nl

Department: Aquaculture

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Final Report
Release of Mullet Fry project
In Fayoum Governorate, Egypt.

Author(s): Drs. L.J.K. Kleijn

Project: 104
Project leader Drs. R. Dijkema
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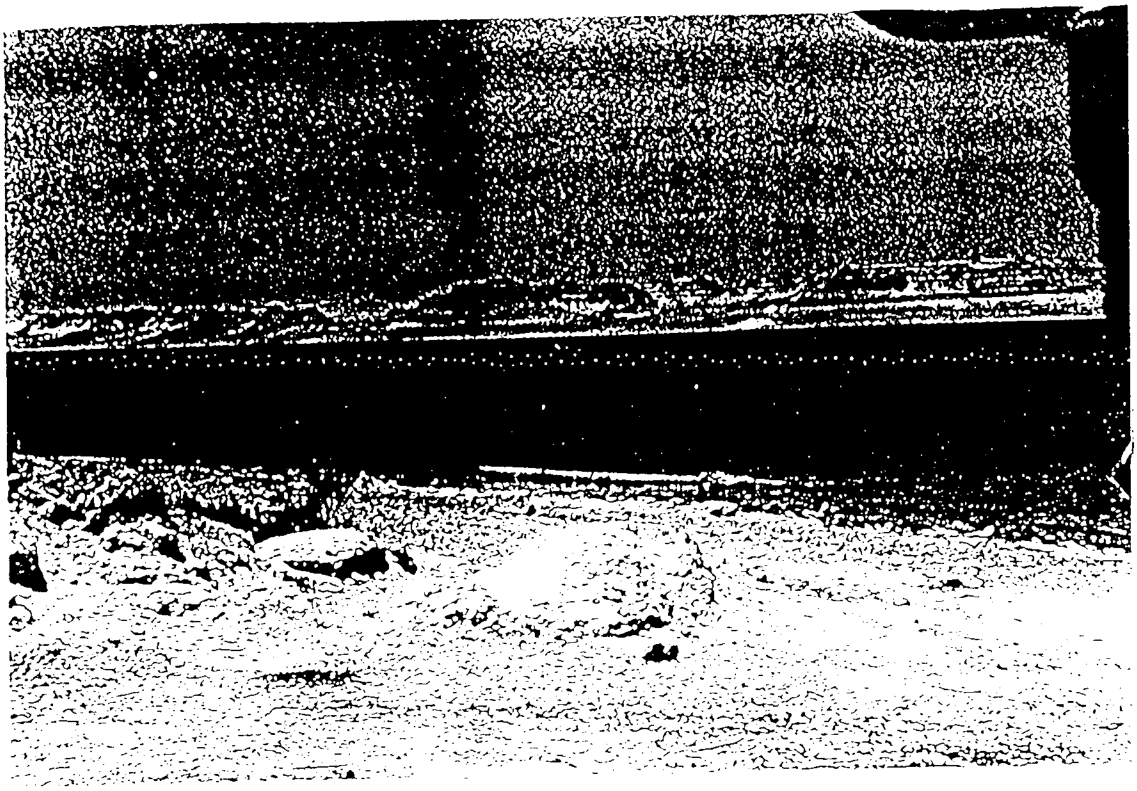
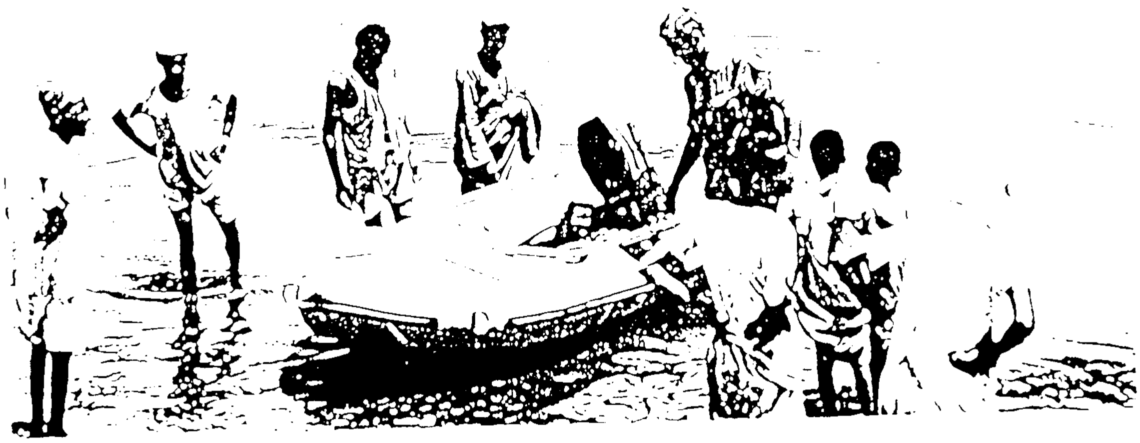


Scenery of lake Qarun near "Shell" profile.

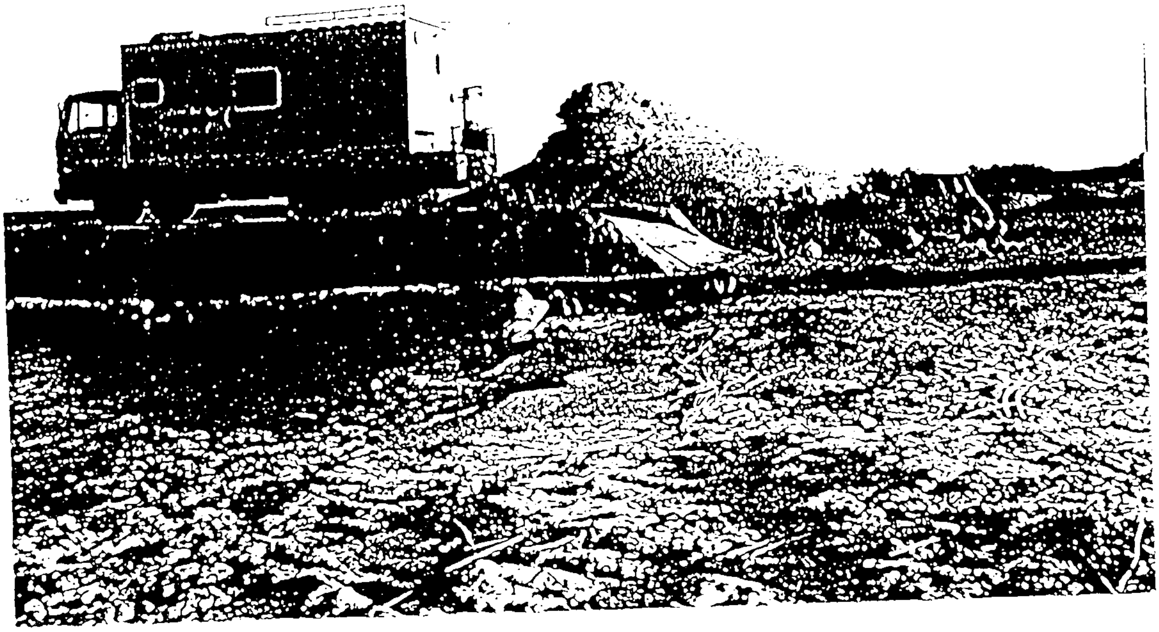


Returning from a survey on lake Qarun

ABSTRACT.

A limnological and biological study in three different lakes of the Fayoum governorate (Egypt) was carried out , to establish their maximum sustainable yield and their environmental conditions.
Transports of mullet fry were monitored to obtain insight in the mortality during the transplantation from the Mediterranean to the Fayoum.
Fish and fisheries statistics were collected and results analyzed.
Overall conclusion was that too many fry are transplanted at the moment to Fayoum.
The survival rate of the fry during their transport is well within the acceptable limits.
Some recommendations are given to improve the fisheries of the lakes and to ensure continuation of production.

Acknowledgements
The study was carried out through a grant from the Netherlands government , in their scheme of international cooperation.The RIVO (Netherlands Institute of Fisheries Research) was the executing agency , they worked in cooperation with the GAFRD (General Authority of Fish Resources Development) in Cairo. The fieldwork was carried out by mr. L.J.K.Kleijn , fishery biologist from the Netherlands together with mr.Magdi A.Saleh , veterinarian (biologist) from Egypt.
Plankton samples were analyzed by mrs. Gehan Embaby and mr. Magdi A. Saleh.
Water samples were analyzed by DRI (Drainage Research Institute, Cairo) and Ein Shams University in Cairo and by IWACO and ICW in the Netherlands.
The report was made by mr. L.J.K.Kleijn in cooperation with mr. F.Storbeck , who made the drawings and helped with the lay out. Mr K.Bijl was responsible for the financial supervision.
Mr. H.Bakkernes and mr. D. den Uijl constructed the tanks and watersupply system for the receiving station at El Gameel.
Mr.R.Dijkema had the overall supervision from the Netherlands side , his counterpart from the Egyptian side was mr. H.Barakat.



Camping site at Wadi Rayan Hake.

[illegible]

1. SUMMARY AND RECOMMENDATIONS.

<u>Summary:</u>

Short term aims of the project were:

a./To formulate a solution for the problem of fry mortality during transplantation.This proved,after monitoring a few transplantations,to be no problem at all,as the mortality rate was well within the acceptable limits.The mortality rates recorded,lay between 1 and 10% ,the latter level occured only when the trucks were delayed and had to stay overnight in Cairo or Fayoum town and the aircompressor was not used.See chapters on mullet fry transport.
GAFRD staff and staff from the fishery cooperatives were trained to use the compressor during delays and how to handle and release the fry into the lakes.

b / To find the causes of and to formulate a solution for mortality of young mullets in nursery ponds.The mortality rate of young mullets in a nursery pond in lake Qarun proved to be between 25 and 35 %,which is a very acceptable level.See chapter 5.2.1.1.3.The mortality rates in the nursing ponds of the Wadi Rayan lakes have not been established properly because of the difficult local conditions,but it is to be expected to be much higher as the ponds were of poor construction,too small and the watersupply to irregular.
Acclimatization of the fry ,when transplanted from the marine environment of the transport tanks to the fresh water environment of the Rayan lakes proved to be a delicate matter,for which responsible supervision will be indispensible.

c / To improve intermediate storage of mullet fry between capture and transportation,by installing a pilot scale storage facility.This storage facility was built in El Gameel,Port Said governorate.The fry production of the area proved to be of such a limited scale that no permission was obtained to use the facility to provide the Fayoum lakes with the needed fry.The available fry was needed for the fishponds in the province of Port Said.Practically all fry transplanted to the Fayoum came from El Girby,Damietta governorate.The existing facilities proved to be working satisfactory and the transfer of the pilot facilities to El Girby was a complicated matter,which could not be solved within the project period.
The pilot scale facilities proved to work satisfactory.There were some problems with the water supply as the site was build on an area where natural water had to be pumped from about 70 m distance and well water proved to be unsuitable.

d / To find a methology for monitoring the stock and catches of mullets in lake Qarun.This aim was included in an overall stock assessment of the three Fayoum lakes.See chapters on fish and fisheries.In order to be able to predict future production of the lakes a study was carried out into the limnological and biological features of the three Fayoum lakes.The following parameters were sampled : Dissolved oxygen (D.O.),temperature (t),electric conductivity (Ec),pH,transparency,air temperature and bottom profiles.See chapters on limnology.Beside these physical data the following biological data were collected:Quantitative plankton with a 280 μ townet ,qualitative and quantitative plankton with a 60 μ net ,see chapters on plankton and finally , length and length weight relations of the most important fish species.
The three lakes : Qarun , Wadi Rayan I and Wadi Rayan III ,show distinctive characteristics.

lake	surface in ha.	mean depth in m.	volume in $m^3 \times 10^6$	Ec in mS/cm.	average production in kg/ha/year
Qarun	23 000	4.6	1060	41.3	90-120
Rayan I	5 090	10.7	545	2.01	150-200
Rayan III	6 200*	11.8	730	5.14	40-50
	7 700**	11.0	850		

* is the situation at the moment
** is the situation when evaporation and inflow of drainage water are in balance

Dissolved oxygen is nearly always around full saturation at all depths.Except during summer,when in lake Qarun and in Wadi Rayan I lake ,there is an oxycline below which anaerobic conditions prevail but only for a short period.Wadi Rayan III is still too poor in

organic material for an oxycline to occur,but during summer there is a slow decline in oxygen content with increasing depth.
The pH is on the alkaline side for all three lakes and is about 8.5 throughout the water column.
The temperatures vary according to season .The variances between the lakes are minimal.Summer temperature averages 27.5 ^{o}C , for autumn and spring this is 19.2 ^{o}C and during winter the temperature drops to 14.9 ^{o}C.The absolute minimum registered is 13.9 ^{o}C in lake Qarun and the absolute maximum was also recorded in lake Qarun and was 32.0 ^{o}C.For Rayan I these figures are 14.6 and 28.8 ^{o}C and for Rayan III 14.4 and 30.5 ^{o}C respectively.

Lake Qarun is a saline lake with a total dissolved salt level of 32.3 to 38.2 g/l.(The difference is caused by the difference of waterlevel).The saltload of the lake increases with about 500 kiloton per year,which corresponds with an increase of about 0.5 g/l per year.It is calculated that the critical level of about 50 g/l (when most of the species which occur in the lake will cease to reproduce ,to grow or will die)will be reached in the year 2008 at a lake level of -44 m.MSL,or in 2032 at a lake level of -43 m.MSL.When the salt extraction plant ,which is supposed to remove about 250 kiloton per year,will become operational in 1990,than the critical stage at the different levels will be reached in the year 2026 or 2174 respectively.
From the original freshwater species only *Tilapia zillii* , *Oreochromis niloticus,* and *O. aureus* remain , the last two species only in areas where fresh water is drained into the lake. *O.niloticus* shows a stunted growth,they are in average about 15 % smaller than those from the other lakes.In 1928 grey mullet was introduced to replace the disappearing freshwater species.The yearly production of grey mullet varied from 88 ton in 1987/88 to 484 ton in 1985/86. The number of mullet fry stocked into lake Qarun varied from 137 000 in 1933 to 53 000 000 in 1985.There seems to be no relation between the number of fry released and the amount of fish caught (provided that the critical number of fry is stocked annually).The Maximum Sustainable Yield for grey mullet (mostly*Liza ramada* and *Mugil cephalus*) of the lake is about 500 ton and for this an estimated 3 000 000 fry per year are needed.Fry has to be stocked every year as no spawning takes place in the lake.Other important species successfully introduced in the lake are; sole (*Solea aegyptiaca*) in 1938 and shrimp (*Metapenaeus* ssp and *Penaeus* ssp) in 1976.Less successful introductions have been seabass (*Dicentrarchus labrax*) and seabream (*Sparus auratus*).Total production of the lake is officially about 1 100 ton per year but when the unrecorded fish are added,than the production is likely to be 2 000 to 2 500 ton per year.(i.c. a production of 90-115 kg/ha/year).Which is the maximum sustainable yield of this lake,with the available species.The result of stocking fry in nursery ponds , where lake water can be mixed with drainage water , is very promising. Extension of the existing ponds for full scale aquaculture seems to be feasible,provided that they are not fully dependable on lake water.The increasing salinity of the lake would shorten the usefulness of these ponds.
Dissolved oxygen of the water of the lake seems only during part of the summer , at some deeper points , to be below the critical level , but the shallowness of the lake and the frequent strong winds stir the watermass enough to guarantee a sufficient oxygen level through most of the year..

Wadi Rayan I lake is a more or less fresh water lake with a salt content of about 1.5 g/l. This lake is the most stable of the three lakes.There is a constant flushing with drainage water from the Fayoum . The lake came into being in 1974 when water was led into the depression.In 1980 the lake reached its maximum level and excess water started to flow to the next depression.(Wadi Rayan II and III).
The fish population of the lake consists of indigenous species ,which have come into the lake with the drainage water and of some introduced species.Of the latter , grey mullet are the most important .They thrive in this lake and account for about 50 % of the total catch.They are in average more than 15 % larger than those of the other lakes.The total yearly production of the lake is at the moment about 500 ton (officially),which means ,

when non recorded catches are added about 1 000 ton of fish.(a production of 200 kg/ha/year) ,which is a high yield for a natural lake.
The amount of fry released in Wadi Rayan I varied from 1 097 000 in 1984 to 20 170 000 in 1987.But here too the number of fry really needed to produce the maximum sustainable yield for this species is much less than the 20 million released in 1987 .It is estimated that between 1 and 2 million will be enough to produce the 500 ton which the lake is capable to produce.Great care should be taken to acclimatize the fry properly when they are transferred from the saline water of the transport tanks to the fresh water of the lake.Although the fry seem to be very sturdy , the number lost by bad handling can be reduced with proper treatment.
Wadi Rayan I lake is the only one with an extensive phytoplankton bloom and with a dense growth of reed along its shores.
It is also the only one where a water current is detectable by measuring the Ec.
The introduction of grass carp,common carp and maybe freshwater prawns might increase the production of the lake as new niches will be occupied.

Wadi Rayan III lake is the most unstable of the Fayoum lakes.Water only started to flow into this depression in 1980 and the maximum level has not yet been reached.This level will de reached when the total surface of the lake induces an evaporation which will be in balance with the inflow of water .There is no other way for water to disappear or it would be by seepage to another depression nearby.
The water of this lake is brackish , the salt concentration of the lake is , at the moment,about 3 gram per liter , but because of the yearly influx of salts this salt level will raise with about 0.25 gram per liter per year in about 70 years marine fish will have to be introduced as several of the existing fresh water species will disappear.The total surface of the lake is thought to be 6 200 ha at the moment and the balance of inflowing water and evaporation will be reached when the lake has a surface of approximately 7 700 ha.
Fish production of this lake is the lowest of the three lakes,about 40 kg./ha./year.,which is to be expected as the fertility of the soil is very low,and there is hardly any organic material available.This is most likely also the reason why there is no distinct oxycline in this lake during summer .In the future a raise in fish production can be expected to possibly 100 kg/ha/year this means,with a lake of 7 700 ha.,a production of 770 ton.At the moment the same species are caught as in Rayan I,but in the future this will be different.In about 70 years the salinity will be between 15 and 20 gram per liter,which is the critical level for most of the existing species.After this period,marine fish will have to be introduced to replace the disappearing fresh water species.Grey mullet species
(*Liza ramada* , *Liza aurata* and *Mugil cephalus*) have been introduced since 1986 but obviously were present in the lake before that date (they were already caught during the 1985/86 season).There seems to be a possibility that they spawn naturally in the lake as local fishermen claim,this should be studied.The actual number of fry needed to produce the maximum sustainable yield may therefore be drastically reduced.It is anyhow thought that no more than 1.5 million fry are needed to produce the maximum sustainable yield of this species.

Recommendations:

In order to improve and or maintain the fish production of the three Fayoum lakes ,the following recommendations have been made :

a. Human efforts:

1. Responsible supervision will be necessary during the unloading of the fry transporttrucks, in particular at Wadi Rayan lakes,where acclimatization is needed , in order to minimize the mortality rate and to optimize the use of the available fry.
2. The permanent employment of a responsible and capable person , to collect statistical data on the fish catches at the landing sites,will provide better information. This person should visit every landing site at least once a month and record in detail catches and measure samples of the most important species.

b. Biological efforts:

I.With the perspective of maintaining and improving mullet catches;

3. The amount of mullet fry to be stocked in the three lakes can be reduced considerably,particularly for lake Qarun.For this lake it could be calculated , with almost certainty that 3 million fry will be enough to produce the maximum sustainable yield of 400t. of mullet from the lake.

4. The construction of fry collecting stations at the Mediterranean seems to be superfluous,with the existing system of distribution at El Mex,El Girby,El Raswa and other sites.It only promotes extra manipulation of the fry.

5. More research is advisable to determine the optimal time needed for the acclimatization of fry to their new environment.

6. Use the nursery enclosures and/or ponds of the Fayoum lakes as fishponds after fingerlings have been released.For example by keeping 10 % of the fingerlings,preferably the larger ones.These can be fished and marketed in December,after which the ponds have to be prepared again for the next fry transplantation.
First the enclosures should be leveled, enlarged and modified in such a way that the water depth will be between 0.7 and 1.5 m.. They should be constructed in such away that they can receive water by gravity and do not have to be dependent on waterpumps.

7. The statement from fishermen of Wadi Rayan III lake, that they saw mullet fry from their own stock , should be studied. Faouzi 1936 states that *Liza ramada* (El Zarka, claimed that it was *Liza saliens*), spawned in lake Qarun . In a deep (5 m) spot they found eggs and larvae. It might therefore be possible that grey mullet need to have water of a certain depth, in order to be able to spawn, this in combination with an influx of water with a lower salinity. This is the case in Wadi Rayan III,where the inflowing water has half the salinity of the lake water and the maximum depth is over 25 m..

II. With the perspective of inproving the fish production of the lakes in general;

8. Introduction of milkfish (*Chanos chanos*)in lake Qarun might improve production.

9. Introduction of silver carp in Wadi RayanI could improve production (may be milkfish and grass carp (*Ctenopharyngodon idella*) too).

10. Common carp (*Cyprinus carpio*) and grass carp could increase the fertility of Wadi Rayan III lake.

The introductions mentioned under 9, 10 and 11 are in a way harmless :If the experiment does not succeed, the termination of stocking would quickly halt the presence of these species in the lakes as they will not reproduce naturally in these waters.

11. The freshwater prawn ,*Macrobrachium rosenbergii* ,might be cultured and/or stocked in the Wadi Rayan region.

12. Research should be carried out on the effect of predators , sea bass (*Dicentrarchus labrax*) for example, on the stocks of mullet and tilapias. In some cases the removal of predators has caused a negative effect on the fishery yield.

13. A study should be carried out to find a way to use the cockle ,*Cerastoderma edule* , resources of lake Qarun (for example catching - and crushing them and use the meat as food for cultured species.

c. Technical efforts:

14. A fishfarm could be constructed at the northern end of Wadi Rayan III lake, feeding the ponds with water from the channel by gravity and using the drainage water from the fish pond for irrigation.An integrated semi-extensive fishfarm would be advisable,for example fish cum ducks or chickens.

15. The construction of a small channel to let water from Wadi Rayan III to the next depression (south-east from the lake) could slow down and eventually stop the increase of salinity of this lake.

16. Special constructions in the different water outlets into the Mediterranean could improve the quality and the production of mullet fry .For example water wheels and special weirs.This also could improve the management of regulating the amount of fry caught versus the amount let through for natural stocking of the coastal lakes.

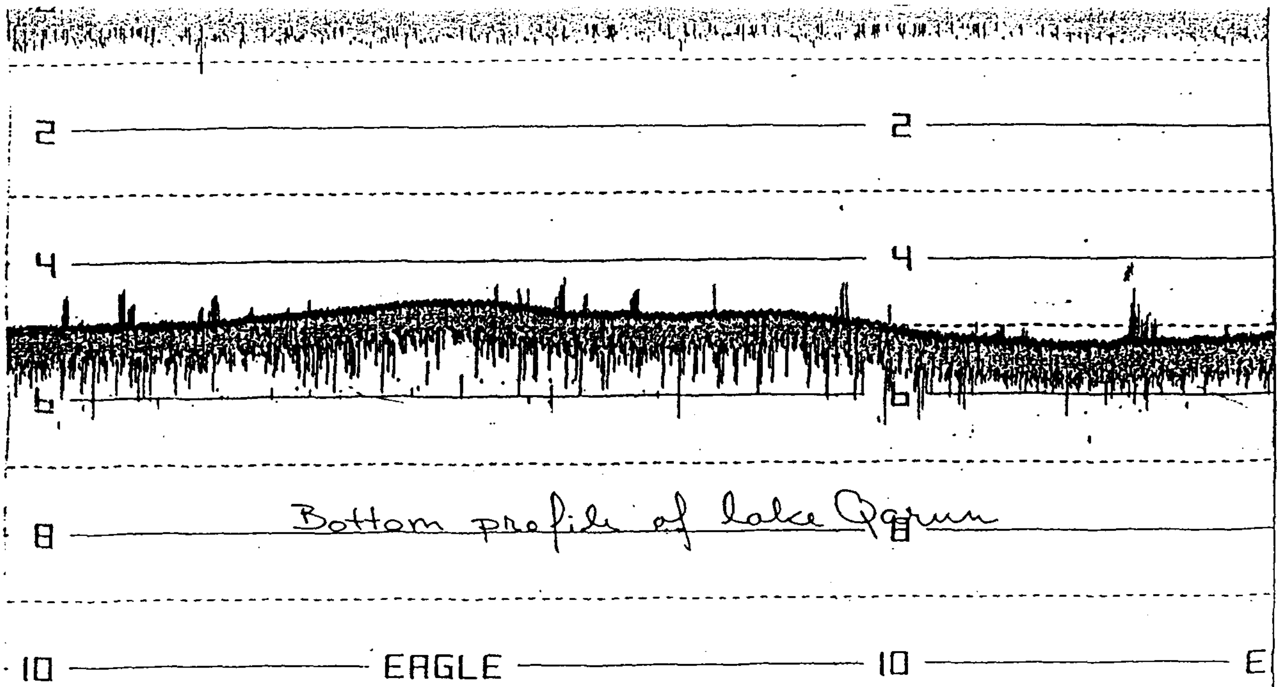
17. The construction of artificial reefs in lake Qarun , might have a positive effect on the fish production of the lake.

18. A transport boat , to collect the captured fish , carrying a supply of ice could possibly curb poaching to some extent.(see figure).

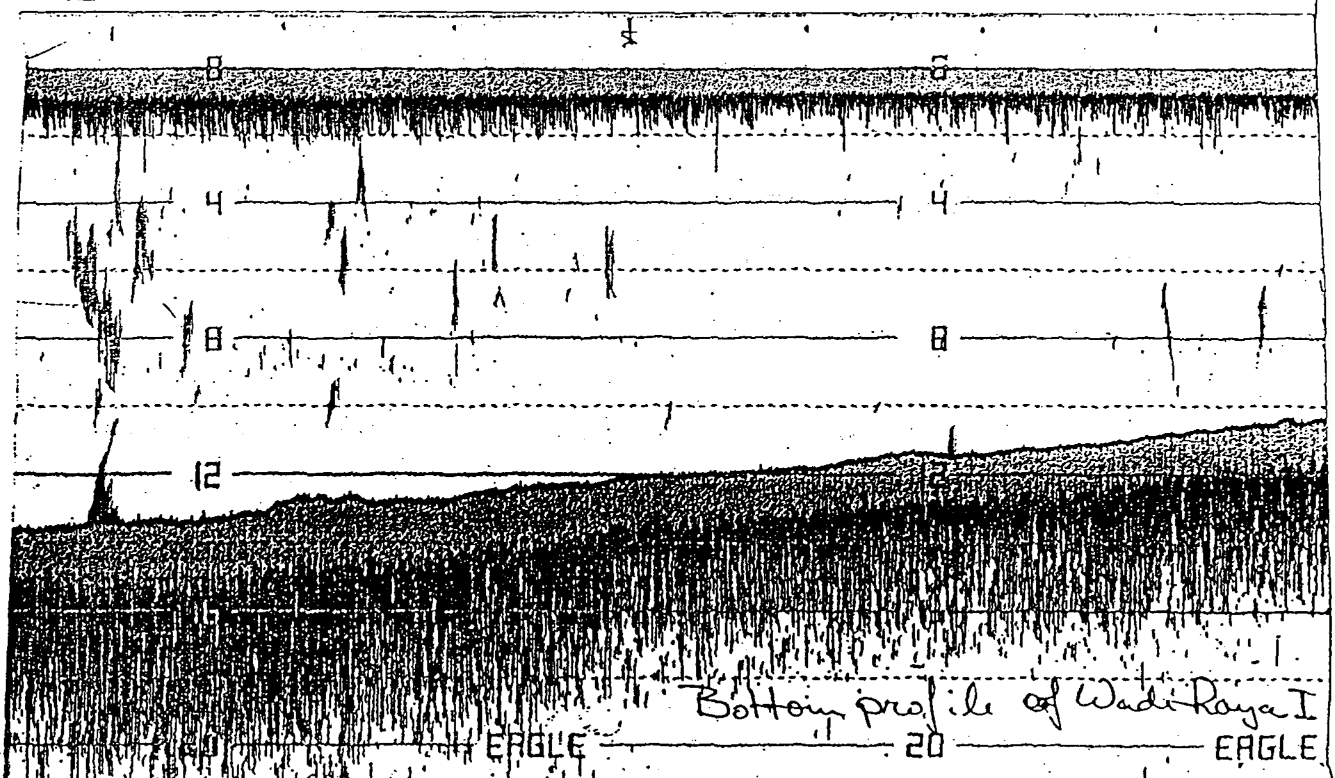
19. In order to explain the variations in salt levels of Wadi Rayan III lake, it will be necessary to install a gauge to monitor the water level.

20. It might be feasible to use the energy of the water current at the end of the tunnel and/or at the waterfall to produce electricity for an ice plant.It would be advisable to measure the levels of Wadi Rayan I and Wadi Rayan III . With the differences, and the amount of water flowing through , the available amount of energy can be calculated.(see sketch).

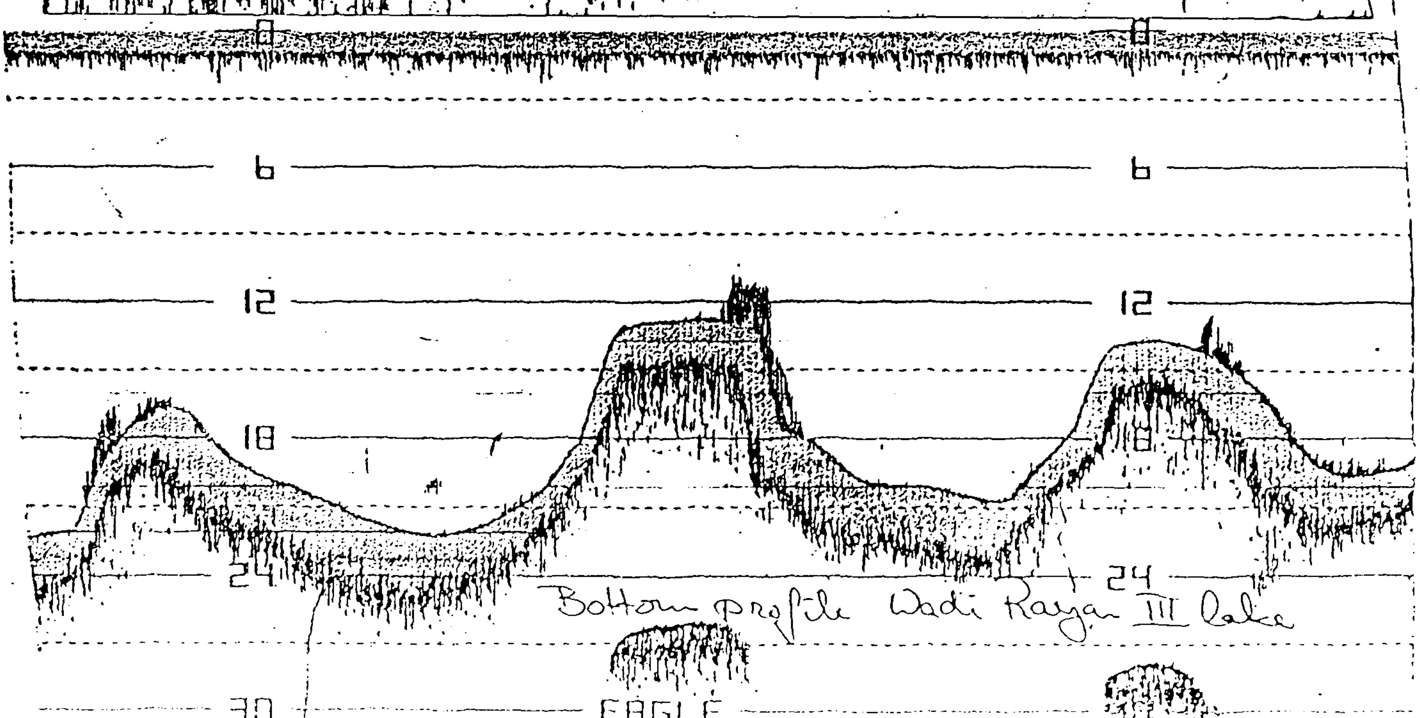
21. The effluent of the salt factory should be monitored as it might influence the salt composition of the lake.In particular the unwanted carbonates should not be disposed into the lake.



Bottom profile of lake Qarun

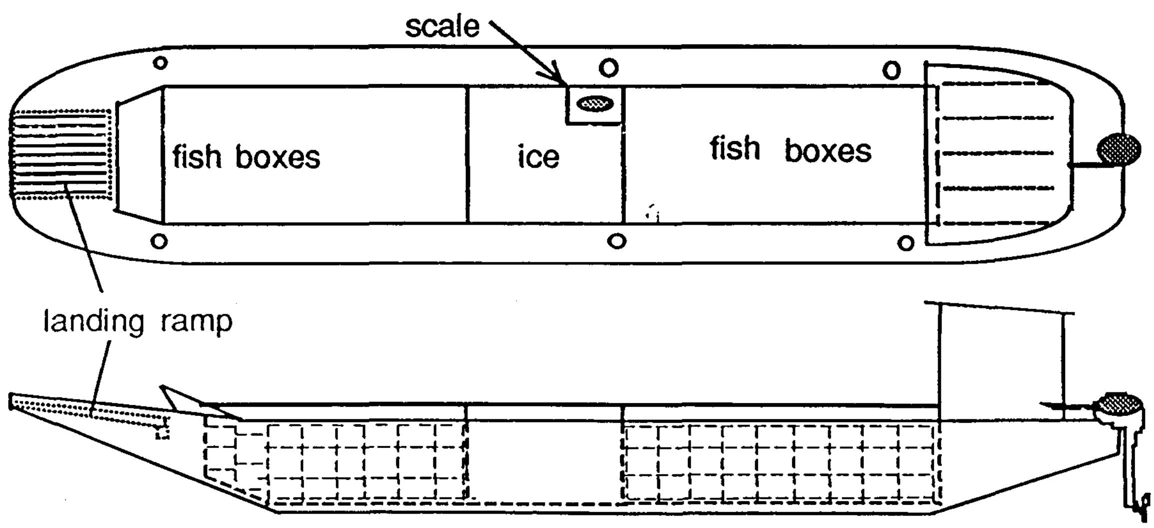


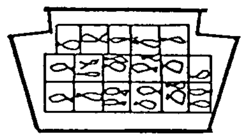
Bottom profile of Wadi Raya I



Bottom profile Wadi Rayan III lake

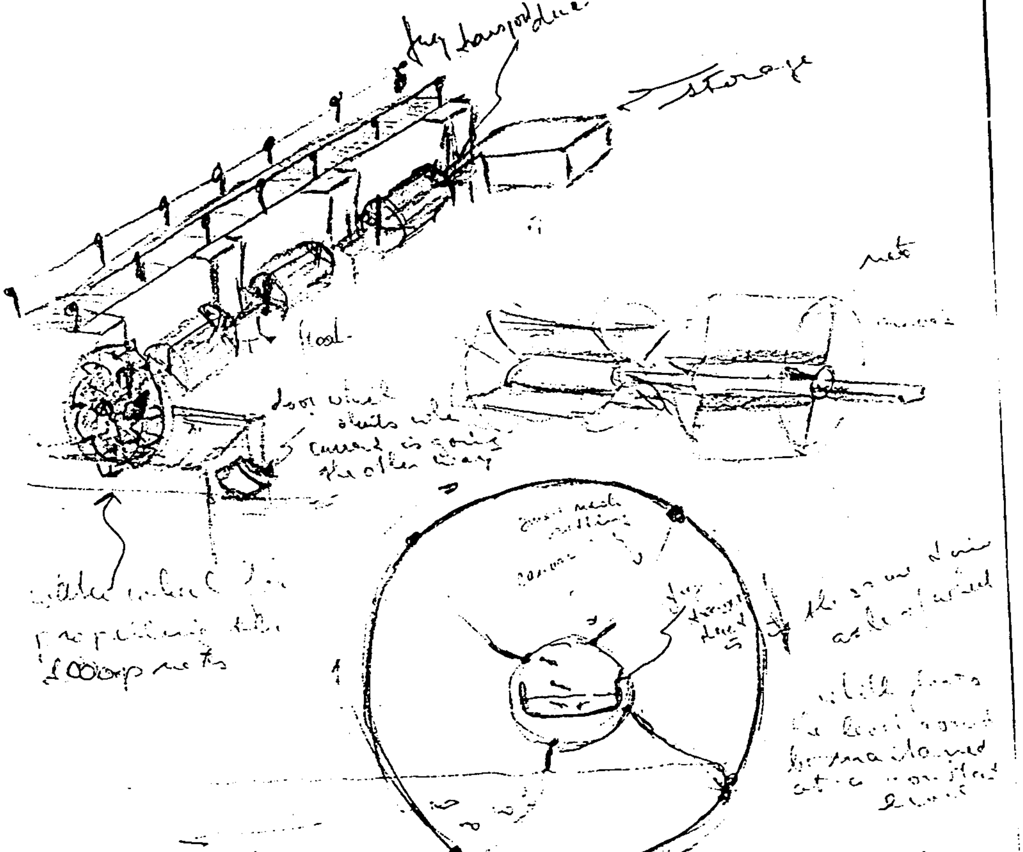
Suggestion for the layout of a transport vessel ,
to be used in the Wadi Rayan lakes.





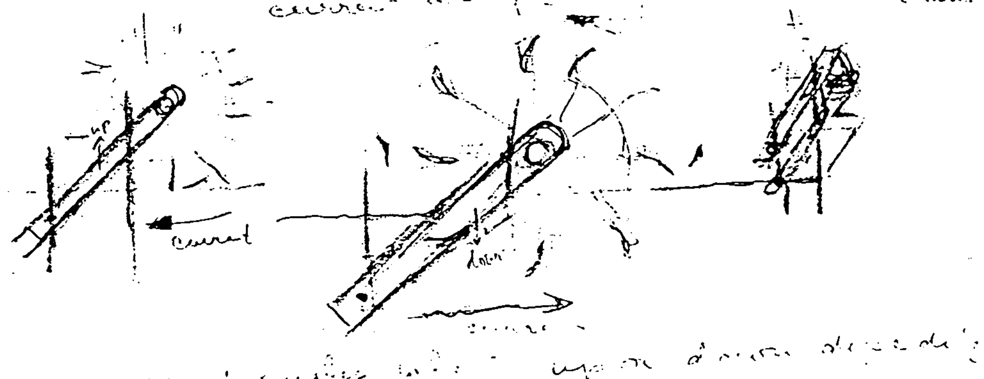
L.oa = 16 m.
L.wl = 14 m.
B.oa = 2.9 m.
B.wl = 2.8 m.
Draft = 0.7 m.
Carrying capacity 9 - 10 ton (6 ton fish + 3 ton ice).
Displacement 20 - 25 ton.
Engine 50 - 70 Hp (diesel).
Fuel tank 150 l.
Speed 12 km/hr.

Hold should be covered with an insulated lid , in order to keep the fish cool and to prevent water from entering the hold.
Empty spaces around the hold should be filled with styrofoam , for insulation and for extra buoyancy.
Vessel is capable to land head on onto the beach for unloading.
A scale on board is to be used to ensure the fishermen that they will not be cheated.



current

The wheel should be turning against the [illegible] against current as [illegible] current



current pushes [illegible] up or down depending on direction of current

2. INTRODUCTION

In the governorate of Fayoum there are three big water bodies, which are used for commercial fishing operations.

Lake Qarun, about 23 000 ha (55 000 feddan). This lake is all what is left of the historical (fresh water) lake Moeris, which in pharaoic times served as a buffer storage of Nile water. It now lays about 44 m below sea level. It is bordered in the North by the Western Desert and in the South by agricultural land of the Fayoum governorate. The lake is fed by drainage water from these agricultural lands. The only output of water from the lake is through evaporation, there is no known seepage. This has caused the lake to become saline, it now has a total dissolved salt level of about 36 ‰.

Lakes Wadi Rayan I, II and III (WR I,II and III) were created by diverting part of the drainage water of the Fayoum governorate into the Rayan depression. This happened in 1974 for WR I and 1980 for WR II and WR III. This diversion was necessary because of the increase of irrigation in the Fayoum and the limited water storage capacity of lake Qarun. Too much water inflow in lake Qarun would have led to flooding of precious agricultural lands with salt water. The two lakes have a surface of about 5 090 ha (12 000 feddan) and 6 200 ha (15 000 feddan) respectively.

Fish fry has been transplanted for many years to these lakes. Because of the decline of the local fish stocks, as result of the increase of salinity, other fish had to be introduced. In lake Qarun, this began in the 1920's with grey mullet. Some fish species only needed to be stocked once as they proved to be able to reproduce in such a way that they could be commercially fished without destroying the stocks. Examples are the sole, *Solea aegyptiaca* and several shrimp species of the genera *Penaeus* and *Metapenaeus* . But other species such as mullets, mainly *Liza ramada* and *Mugil cephalus* have to be restocked every year as their reproduction cycle requires special conditions which cannot be met in the lakes. Fry of these species have to be caught during their migration into the coastal lagoons and lakes. These migrations take place from November - January for *Mugil cephalus* and from January to April for *Liza ramada*.

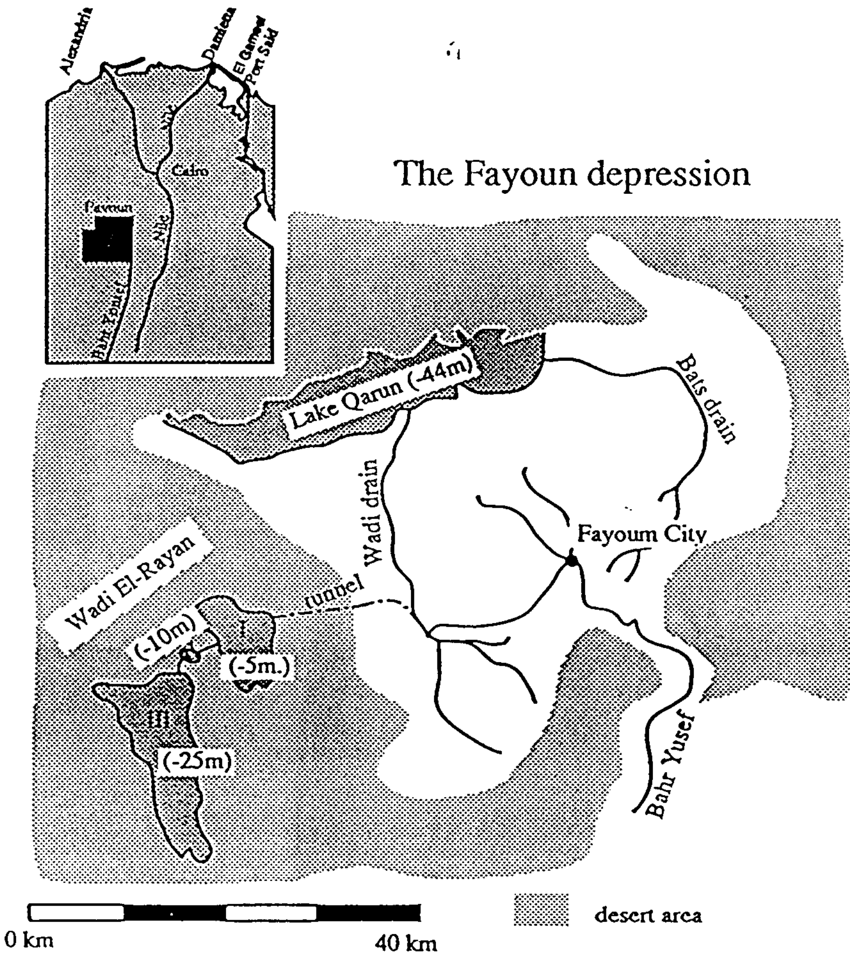
The mullets were used as fish for transplants because of several reasons:

a) It is a well accepted fish by the Egyptian population.
b) Fry is available.
c) They show good growth rates.
d) They are feeders of benthic organisms as well as feeders on phytoplankton and in young stages of zooplankton. In general they stand low in the foodchain.
e) Because of the fact that they do not reproduce in the lakes, they can be totally wiped out if they are not further wanted for whatever reason.
f) Little to no competition for food with the established fish population of the lakes.

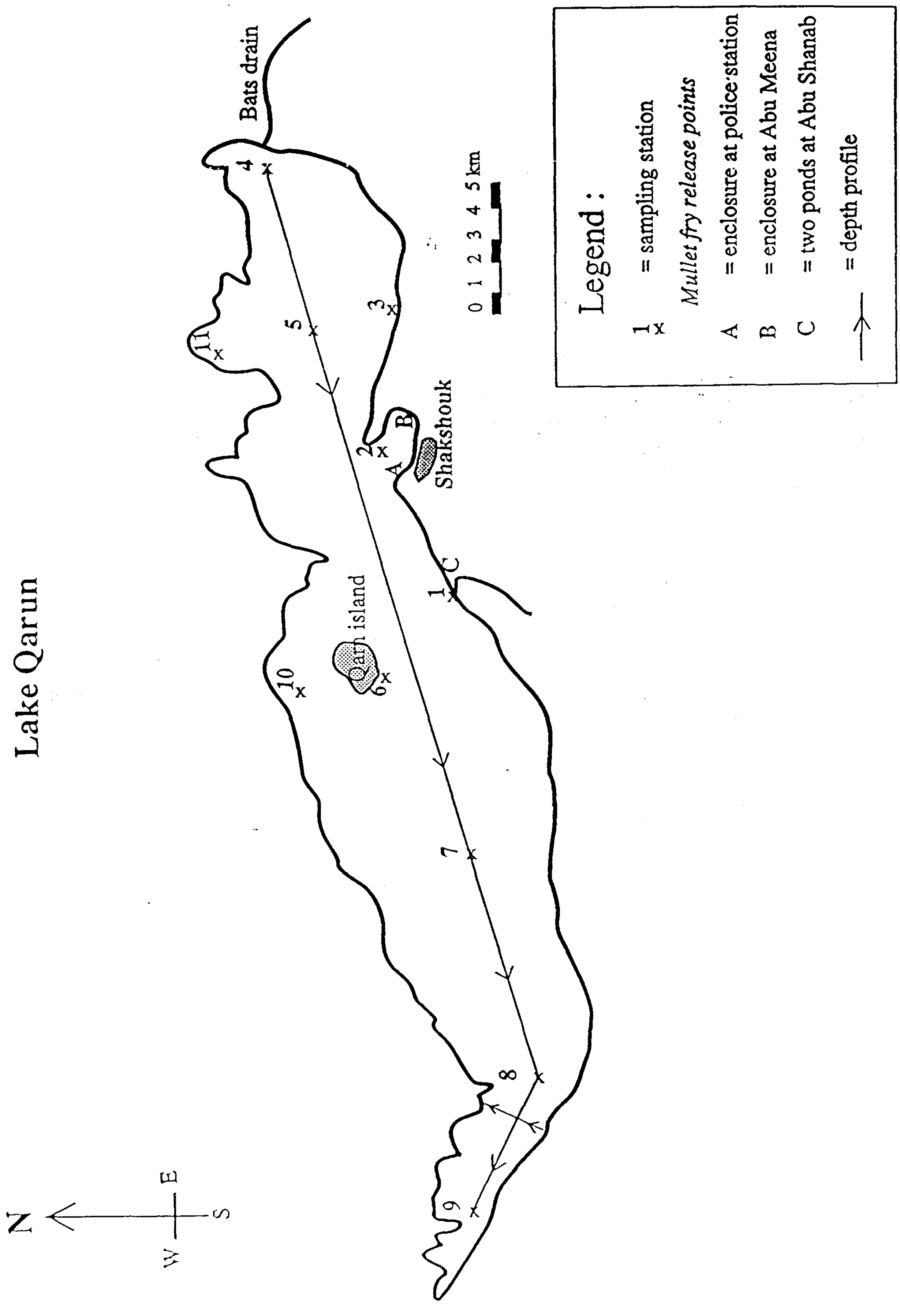
In 1978/79 a project funded by the Netherlands Government started with the donation of two fish fry transport trucks and other materials plus some technical assistance to the IOF (Institute of Oceanography and Fisheries). This institute was at that time responsible for the transplantation of fry. In 1983 another organization took over this responsibility, namely the GAFRD (General Authority of Fish Resources Development).
In order to make the most economic use of the limited mullet fry stocks the "Release of Mullet Fry Project" was conceived in 1983 to search for ways of limiting the mortality during transport, which was considered to be too high, figures up to 90 % mortality were mentioned. Also the mortality during acclimatization and growing period up to their commercial capture had to be studied.

A fact -finding mission from the Netherlands was sent to Egypt, in 1983, for a possible follow up of the 1978/79 project. An agreement had been reached that the Netherlands Government would give further financial and technical aid to Egypt to study the mortality of mullet fry during various stages of transport and development. For this 2 more transport trucks with 1000 kg of netting material for enclosures and one fully equipped laboratory truck was donated with the service of a Netherlands fisheries biologist to carry out the research with help from Egyptian counterparts. The project finally started in January 1987 and lasted till the end of May 1988.

Situation map of the Project area.



Map 1.



Lake Qarun
Bats drain
Qarn island
Shakshouk
0 1 2 3 4 5 km
N
E
S
W
1
2
3
4
5
6
7
8
9
10
11
A
B
C
Legend :
= sampling station
Mullet fry release points
A = enclosure at police station
B = enclosure at Abu Meena
C = two ponds at Abu Shanab
= depth profile

3. METHODS

During the project seasonal surveys have been carried out in the three Fayoum lakes in order to establish the water quality and the available amount of phyto- and zooplankton. For these measurements 11 stations have been established in Lake Qarun (see map 1); 9 stations in Wadi Rayan I lake and 8 stations in Wadi Rayan III lake (see map 2). Fish samples were measured and weighed.
Stations were checked each season with an inflatable dinghy (Zephyr 204) with a 18 hp Mercury outboard engine.

For the limnological survey the following parameters were measured.

A.Dissolved oxygen (D.O.)

Dissolved oxygen levels were measured with a WTW OX1 91 meter with a WTW EOT 190 probe on a 10 m long cable. Oxygen was measured in % saturation and in p.p.m. at one meter intervals to 10 m depth, after this, samples were taken at 5 m intervals with a 1.5 l Kenmerer water bottle and measured upon arrival on board with the WTW OX1 91 meter.

B.Temperature

Temperature was also measured,in ^{o}C,with the WTW OX1 91 meter at the same levels as the oxygen.

C.Electric conductivity (Ec)

The Electric conductivity was measured with a WTW LF 91 meter. The water for these measurements was collected with the Kenmerer water sampler at 1, 3, 5, 10, 15, 20, 25 m depth. Surface water was measured directly.

D.pH

The pH was measured with a pocket pH meter from the same water samples as the Ec.

E.Transparency

Transparency was measured with the help of a secchi-disk.(Ø 30 cm.)

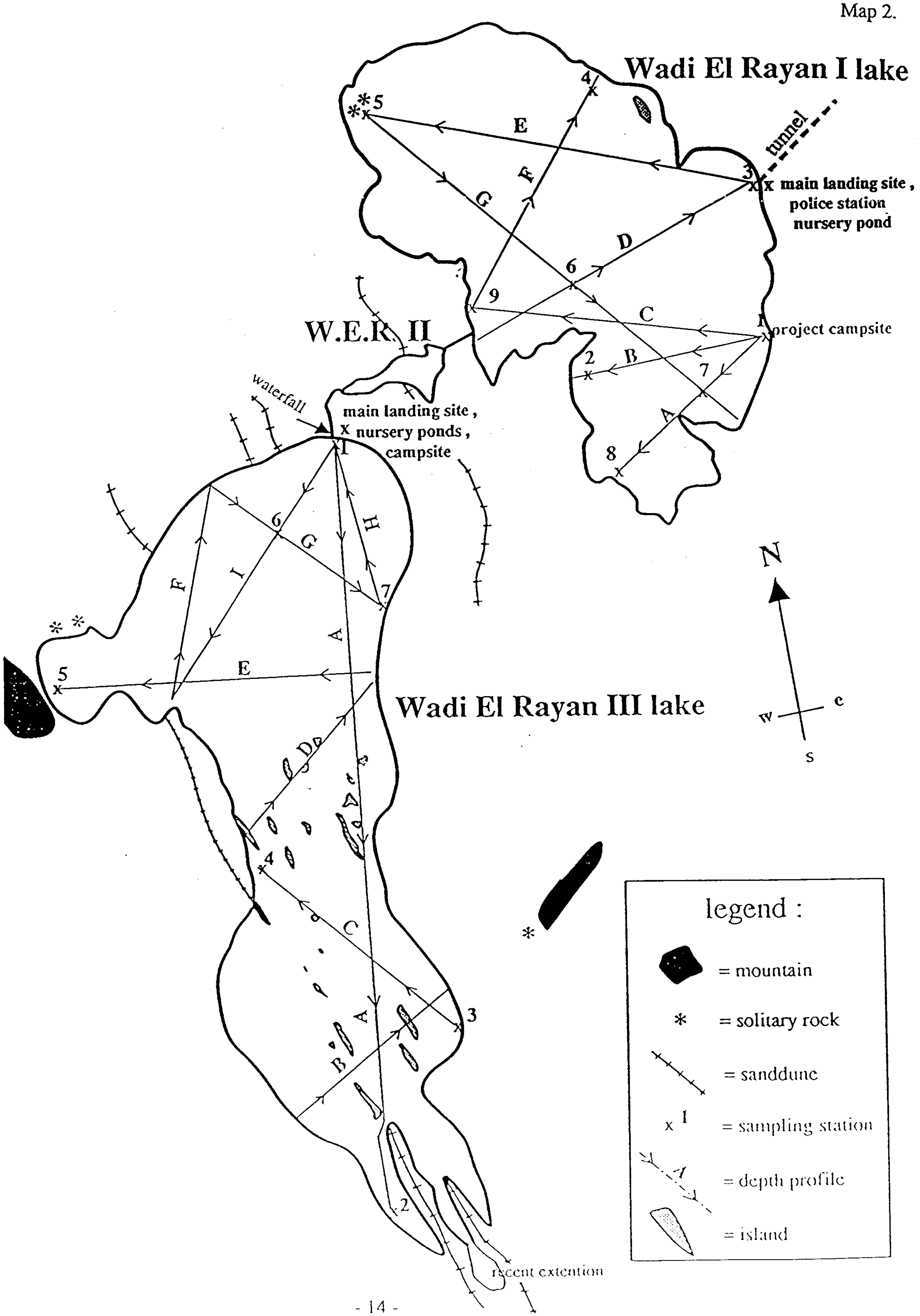
F.Air temperature

The air temperature was recorded at each station with a normal thermometer (-10 - +50^{o}C).

G.Bottom profiles

Bottom profiles were made with an Eagle Mach I, fish/depth finder. Particularly the Wadi Rayan lakes have been surveyed this way as little data on, and no maps of these lakes could be traced.

Map 2.


Wadi El Rayan I lake
tunnel
main landing site ,
police station
nursery pond
project campsite
W.E.R. II
waterfall
main landing site ,
nursery ponds ,
campsite
Wadi El Rayan III lake
recent extention
N
w
e
s
legend :
= mountain
= solitary rock
= sanddune
= sampling station
= depth profile
= island

For the biological survey the following data were sampled

H.Qualitative coarse plankton

Qualitative coarse plankton was sampled by towing a conical 280 μ mesh plankton net for about 50 m after termination of each station. Samples were preserved with formaldehyde. They were analyzed into main subdivisions, with an Olympus VMZ binoculair microscope, particularly zooplankton was observed this way.

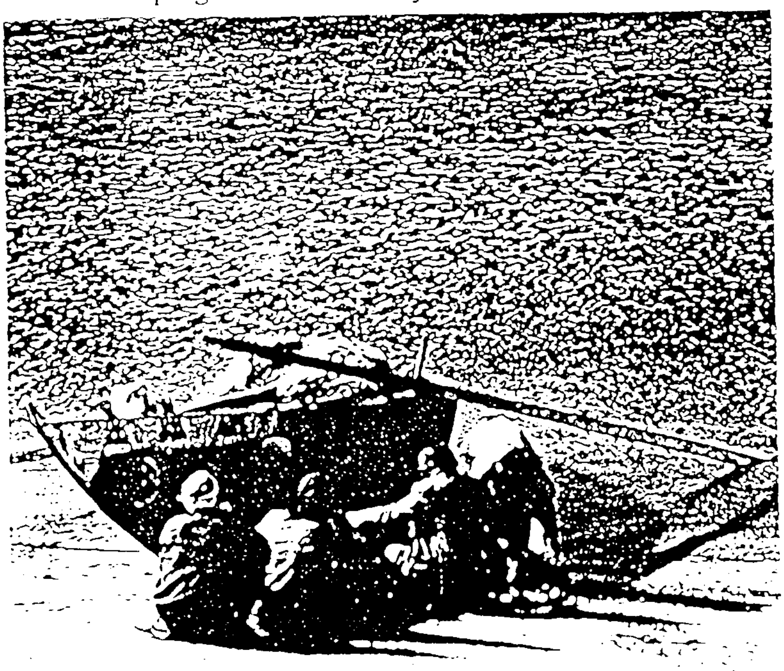
I.Quantitative and qualitative plankton

Plankton samples for qualitative and quatitative analyses were sampled by filtering 80 l of surface water through a ,60 μ mesh, conical plankton net. Samples were preserved with a phosphate buffered formaline, with a final concentration of 4 %. These samples were analyzed with the use of Leitz F13 compound stereo microscope. They were analyzed as detailed as possible with different taxonomic identification keys. The plankton was counted with the lackey drop microtransect counting method. 10 sub samples per sample were counted.

J.Fish

The most important commercials species were sampled. Fish from these samples were individually measured on a 53 cm long measuring board and weighed with a Sartorius scale (weighing range 5.0 kg , accuracy 1.0 gr).

Camping site at Wadi Rayan III lake.



4. RESULTS

4.1. Limnology

Because of the different ages of the lakes the limnological parameters show great differences between the lakes.

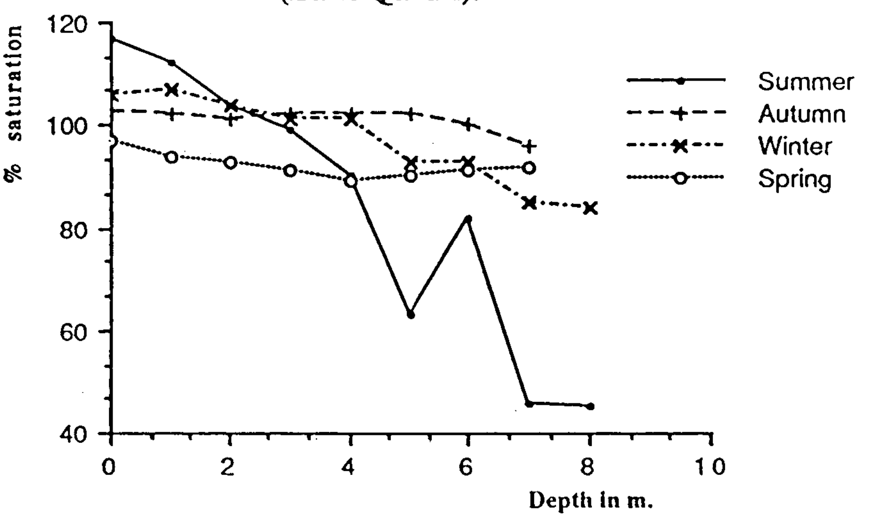
4.1.1. Qarun lake

This lake is saline and becomes more so through the years, because of the yearly influx of about 500 000 tons of salt.

4.1.1.1. Dissolved oxygen

The D.O. levels are the highest during summer in the top 1m(North of the Qarn island and near the Bats drain)below this there is a rapid decline in oxygen content with increasing depth. During the other seasons there is much more uniformity throughout the water column. The lowest values of D.O. are normally found at station 1 (near the Wadi drain). (Table 4.1.1.1.a., graph 4.1.1.1.a. and maps 4.1.1.1.a.- b.)

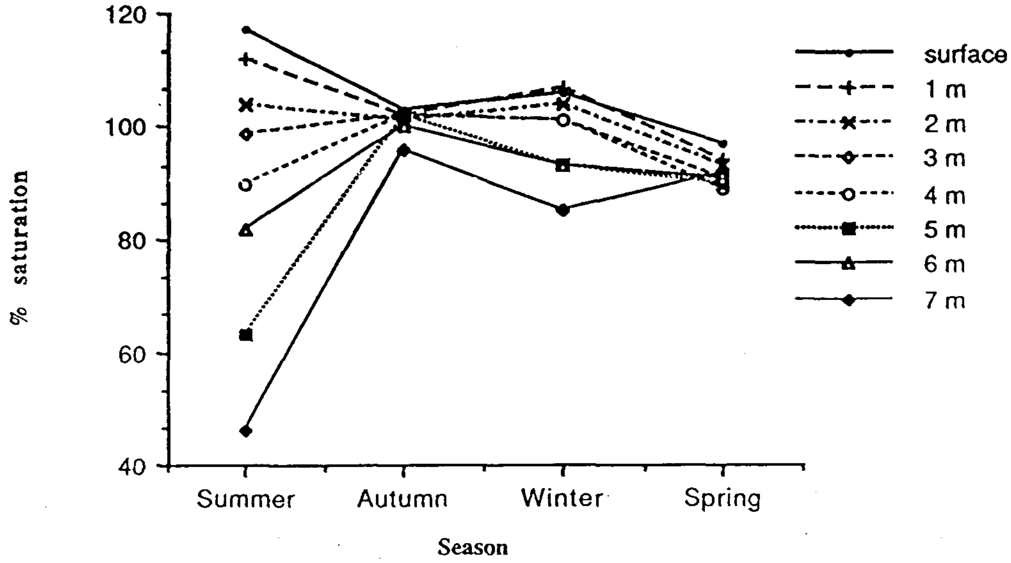
Graph 4.1.1.1 a : Dissolved oxygen at various depths. (Lake Qarun).



Because of the lack of time and the stormy weather which prevailed in spring, not all the stations have been sampled during this period. But those stations sampled, show generally the lowest D.O. levels registered during this survey.

During summer there is the greatest diversity between the D.O.levels at various depths (73 %) while the least diversity exists during autumn (7 %), (spring 8 % and winter 23 %). (Graph 4.1.1.1.b.)

Graph 4.1.1.1 b : Variation in dissolved oxygen levels during various seasons at different depths.(Lake Qarun).



4.1.1.2. Temperature

Except during summer there is very little difference between surface temperatures and temperatures at 1m. depth (Table 4.1.1.2.a.and maps 4.1.1.2.a+b).Only during summer there is a big difference between surface water temperatures and bottom temperatures, maximal 6.5°C (at station 8, 5.1 m deep). During the other seasons the temperatures vary little down the water column. The maximum variance per station is 0.5°C in spring (station 7, 4,5 m deep) and 0.6°C in autumn (station 5, 3,6 m deep) respectively while during winter this figure is 1.1°C (at station 8, 5.0 m deep).(Table 4.1.1.2.b).

In general the water temperatures at the W. side of the lake are higher than those on the E. side. There is also an increase in temperature variation per m depth from the N.E. to the S.W. The smallest differences were found at station 11, where only 0.06°C per m depth was recorded (average depth during 4 seasons 3,4 m) while the highest differences (0.52 °C per m.) were found at station 8 (average depth during 3 seasons 4,5 m) The greatest average depth was recorded for station 10 with 7.5 m and here the temperature decline per m depth was 0.13°C (Map 4.1.1.2.c.).The temperature of the lake can increase rather fast, in 1 week during spring the temperature rose with more than 1°C, this caused the rise in the curve of temperature per depth for the spring. The stations with deeper water were sampled 1 week after the stations in the shallow areas (Graph 4.1.1.2.).

Graph 4.1.1.2 : Average temperature at various depths. (Lake Qarun).

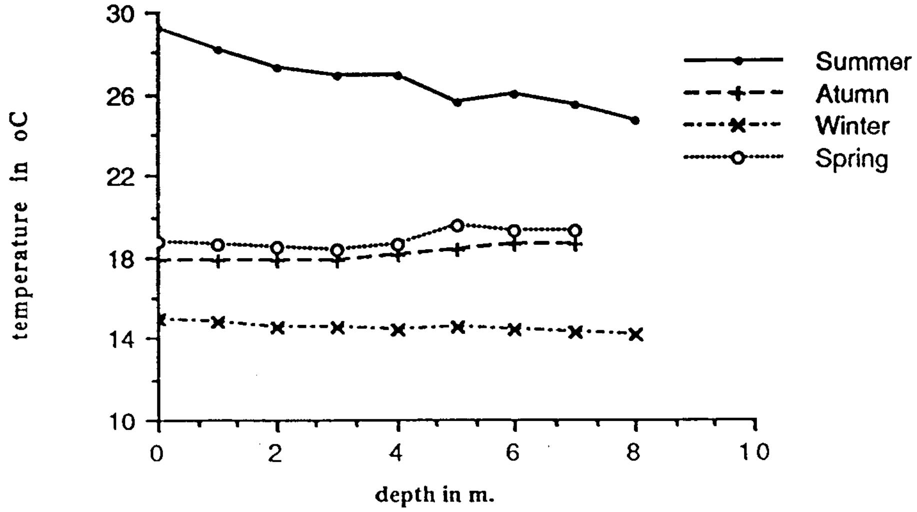


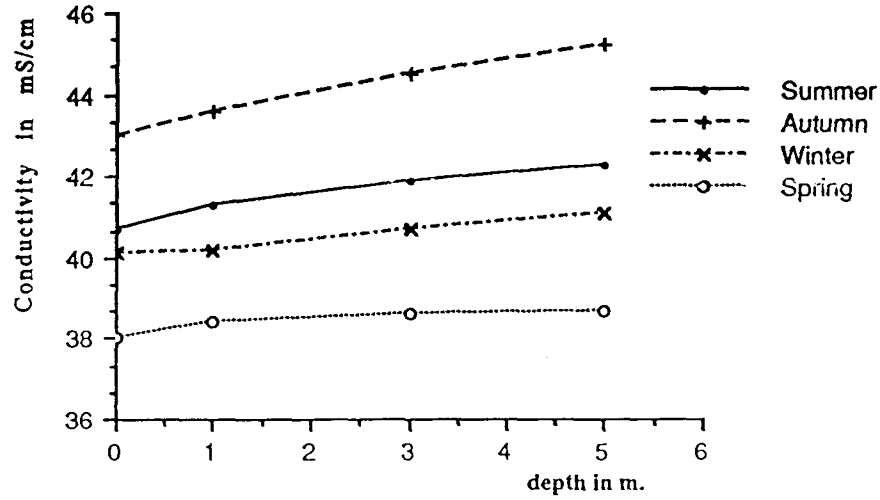
Table 4.1.1.2.b.
Maximal temperature difference per station/season (depth)

Station	Summer	Autumn	Winter	Spring
1	0 (1.2)	- -	.5 (1.0)	- -
2	1.3 (2.5)	0 (2.1)	.8 (2.6)	.3 (2.5)
3	.3 (2.0)	.1 (2.5)	.2 (2.0)	- -
4	1.3 (2.3)	.3 (2.0)	.5 (1.9)	.4 (2.8)
5	1.8 (3.7)	.2 (2.5)	.1 (4.0)	.6 (3.6)
6	6.3 (4.5)	.2 (4.7)	.6 (4.3)	.1 (5.1)
7	6.0 (6.5)	.5 (4.5)	.8 (7.2)	- -
8	6.5 (5.1)	.2 (3.5)	1.1 (5.0)	- -
9	4.5 (5.3)	.1 (3.3)	.8 (5.5)	- -
10	3.3 (7.5)	0 (6.9)	.5 (8.4)	.2 (7.1)
11	.1 (3.1)	.1 (3.1)	.2 (3.7)	.5 (3.6)
Average	2.9	.2	.6	.4
Max.	7.3	2.2	2.7	2.2

4.1.1.3. Electric conductivity

The Ec normally increases with the increase of depth (Graph 4.1.1.3.), particularly at station 4, this is very clear (Table 4.1.1.3.c. and map 4.1.1.3.d.), but here the Bats drain enters in the lake and the fresher water from the drain first gets on top of the salt water of the lake .This is also reflected in the average Ec content per station for surface and 1 m depth (Maps 4.1.1.3.a-b and table 4.1.1.3.a.) where it is clear that the eastern part of the lake is less salt than the western during spring.

graph 4.1.1.3 : Average Electric conductivity at various depths. (Lake Qarun).



The Ec at surface level was the most uniform during summer and the most diverse during autumn. At 1 m depth the most constant seasons were winter and spring and the greatest diversity was again in autumn.The highest average Ec values were measured in autumn and the lowest during spring (Table 4.1.1.3.b and map 4.1.1.3.c.).

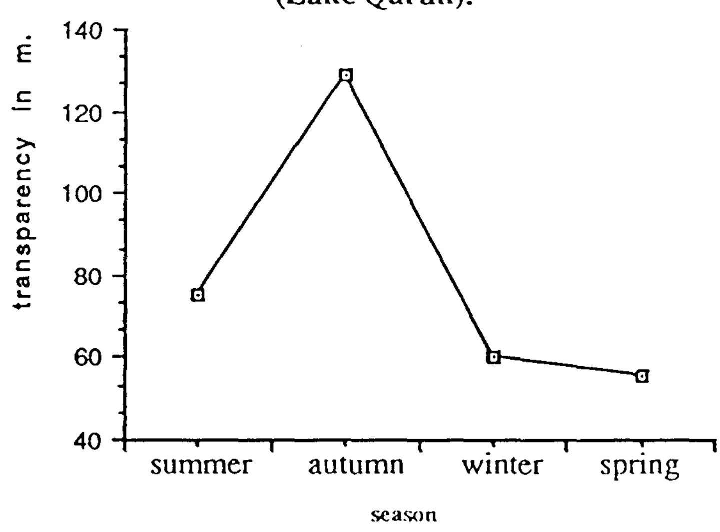
4.1.1.4. pH

The pH was rather constant throughout the whole survey and throughout the water column.The average for all stations during the whole time is 8.3. Due to problems with pH meters not all stations were sampled for pH during all the surveys (Table 4.1.1.4.).

4.1.1.5. Transparency

The transparency varied during the different seasons and ranged from 28 cm (in the summer at station 1) to 235 cm (during autumn at station 9).
(Graph , table and map 4.1.1.5.)

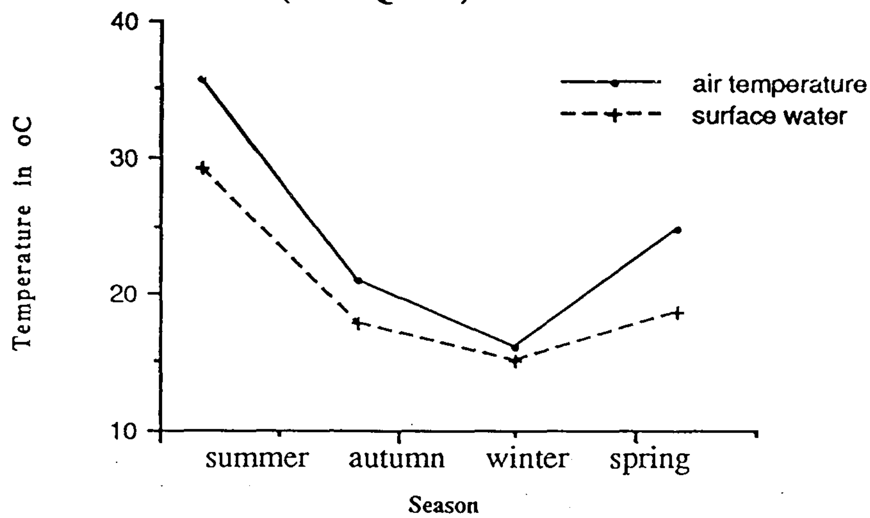
Graph 4.1.1.5 : Average transparency per season. (Lake Qarun).



4.1.1.6. Air temperature

The air temperature varied considerably during the various surveys, depending on the time of the day, the rate of overcast and the windspeed etc. (Table and graph 4.1.1.6).

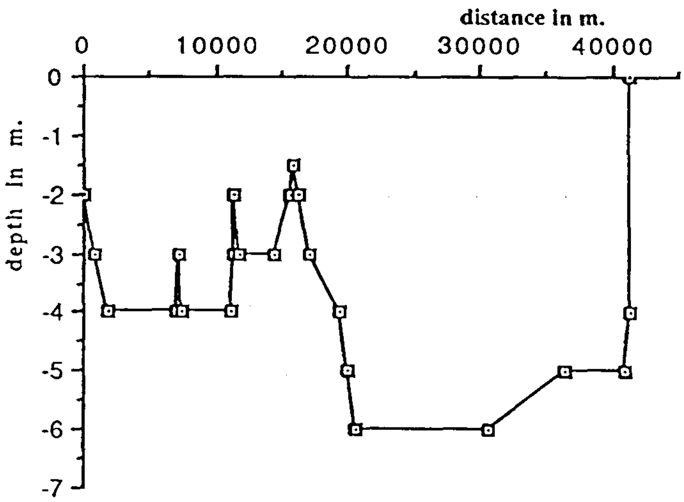
Graph 4.1.1.6 : Average air- and suface water temperature per season. (Lake Qarun).



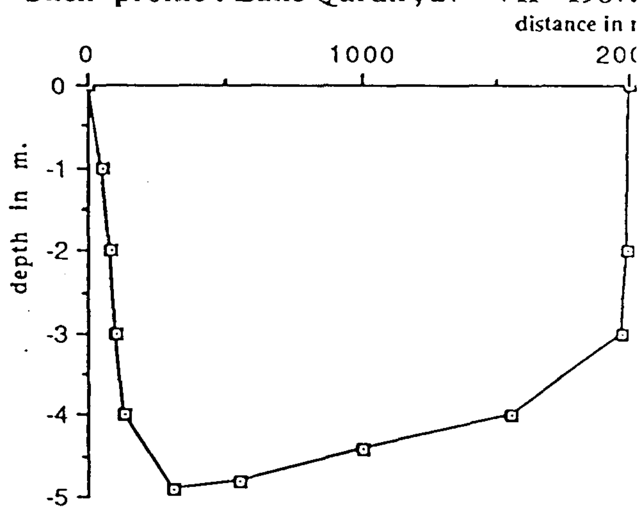
4.1.1.7. Bottom profiles

Two depth profiles have been made, one along the length axis of the lake ± 41.5 km and one of ± 2 km along one of the cross section the Shell Company was using for its geophysical study. Average depth along the length axis was 4.6 m and along the Shell cross section on the western side of the lake 4.09 m.

Length profile : Lake Qarun , 23-VI-1987.



"Shell" profile : Lake Qarun , 27 - VII - 1987.



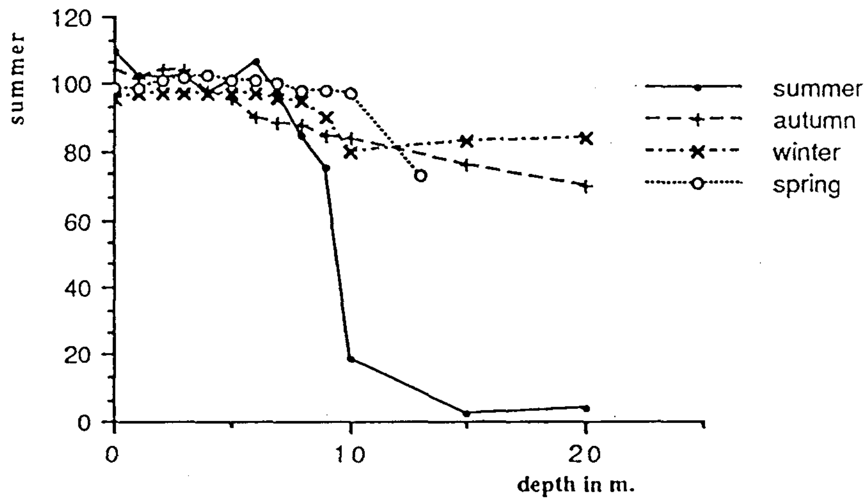
4.1.2. Wadi Rayan I lake

This lake was created in 1974 when the first drainage water from Fayoum was led through a tunnel of about 6 km into the Wadi Rayan depression. In 1980 the lake had more or less obtained its maximal level at -5 MSL and excess water flushed through a canal into Wadi Rayan III lake.

4.1.2.1. Dissolved oxygen

Only during summer there is a clear oxycline between 9 and 10 m, with more or less anaerobic water from 10 m downwards. The build up of this oxycline can be seen in the spring when there is a considerable drop in the oxygen level. During autumn and winter there is no oxycline , the D.O. level only decreases gradually with depth, average of 0.19 % per m during autumn and 0.06 % per m during winter. (Table 4.1.2.1., graph 4.1.2.1. and maps 4.1.2.1.a -b.)

Graph 4.1.2.1 : Dissolved oxygen in % saturation. (Wadi Rayan I lake).

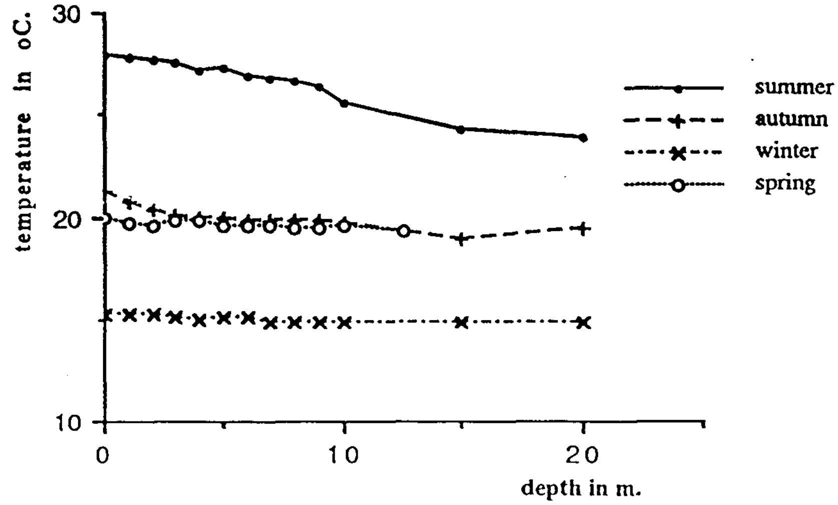


4.1.2.2. Temperature

The oxycline is not covered by a clear thermocline as temperatures decrease gradually per depth during all seasons.

Maximum temperature recorded is 28.8 °C during summer and the minimum temperature recorded is 14.6 °C during winter. Maximal difference in temperature is therefore 14.2 °C. maximal difference per season is 5.0 °C during summer while the minimum difference was found during spring 0.9 °C. (Graph 4.1.2.2., tables 4.1.2.2.a-b and maps 4.1.2.2.a).The temperature fluctuation per m. depth varies from .16 °C during summer to .01 °C during winter (Table 4.1.2.2.b.).

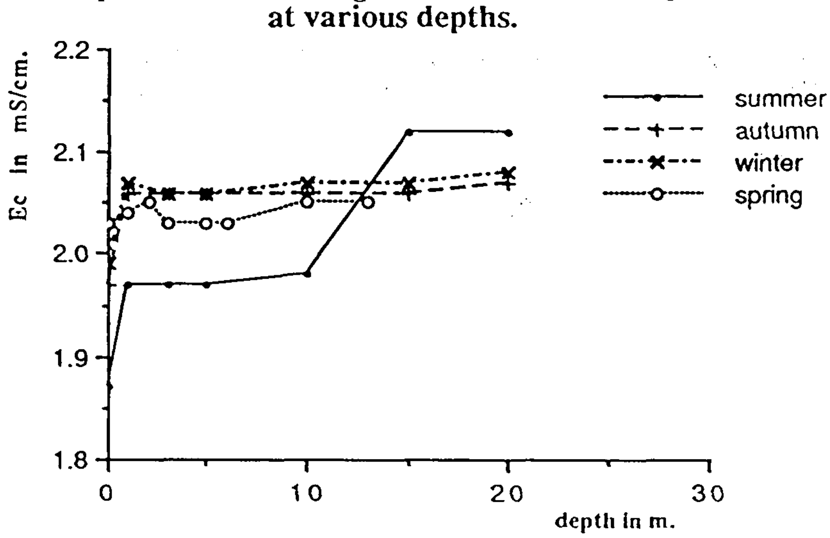
Graph 4.1.2.2 : Average temperature at various depths. (Wadi Rayan I).



4.1.2.3. Electric conductivity

The Ec showed only during summer a sudden increase at more than 10 m depth. During the other seasons there was a much smaller and regular increase with depth increase (Graph 4.1.2.3.).

Graph 4.1.2.3 : Average Electric conductivity at various depths.



The average variation per m depth is 0.03 mS/cm. The only station that gave off values was station 3, where the drainage water from the Fayoum enters the lake. The pattern from the inflowing water can be traced down the southern end of the lake. The highest Ec levels were measured at station 9, the magnitude of difference is only .01 mS/cm (i.c. .01x .760 = .076 gr salt / l). (Maps 4.1.2.3.a-d, tables 4.1.2.3.a-c)

4.1.2.4. pH

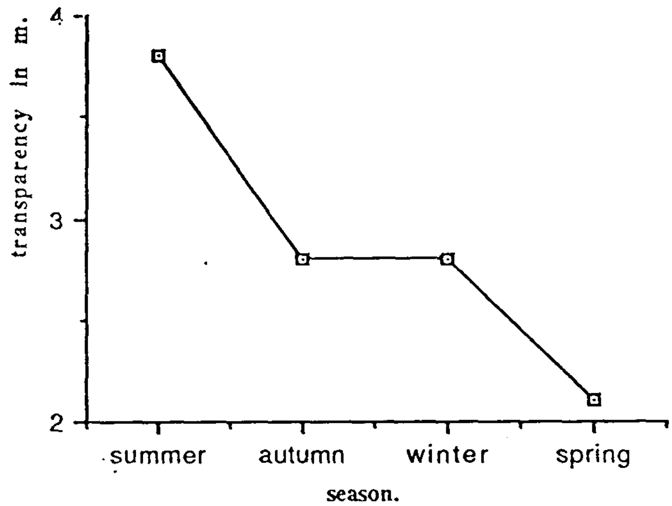
The pH varies little, average between 8.5 and 8.6 only at the inlet of the Fayoum drainage water the pH is somewhat lower : 7.8.

4.1.2.5. Transparency

The transparency was the highest during summer,when the average visibility was 3.8 m. During autumn and winter the values were more or less the same at 2.8 m. The winter

figure is a bit strange as at that time there was a bloom of blue green algae. This bloom persisted into spring and by then the transparency had diminished to 2.1 m.
The inflow from the tunnel provided water with a lot of silt and other material, here the transparency was only about 20 cm. (Table, map and graph 4.1.2.5.)

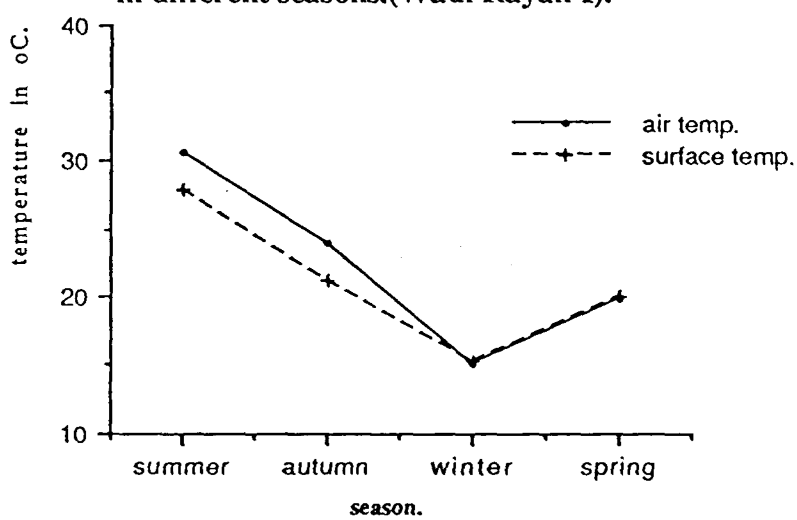
Graph 4.1.2.5 : average transparency at different seasons. (Wadi Rayan I).



4.1.2.6. Air temperature

The air temperature varied considerably during each survey, which can be explained by time of the day, the rate over overcast,the amount of wind etc. (Table and graph 4.1.2.6.)

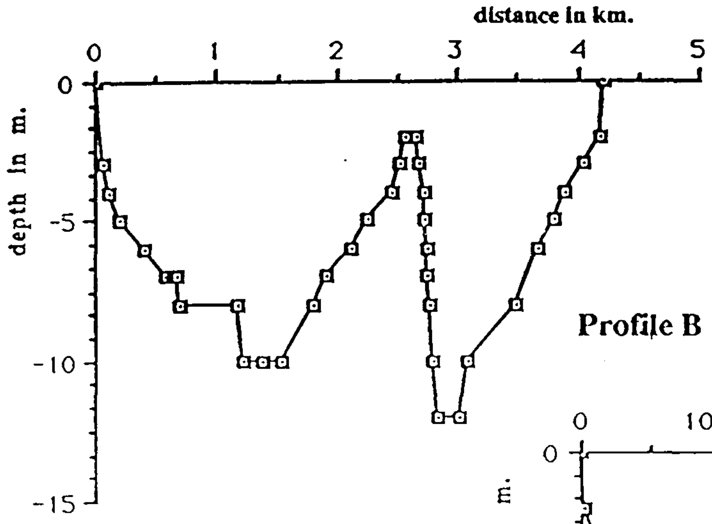
Graph 4.1.2.6 : Average air - and surface water temperature in different seasons.(Wadi Rayan I).



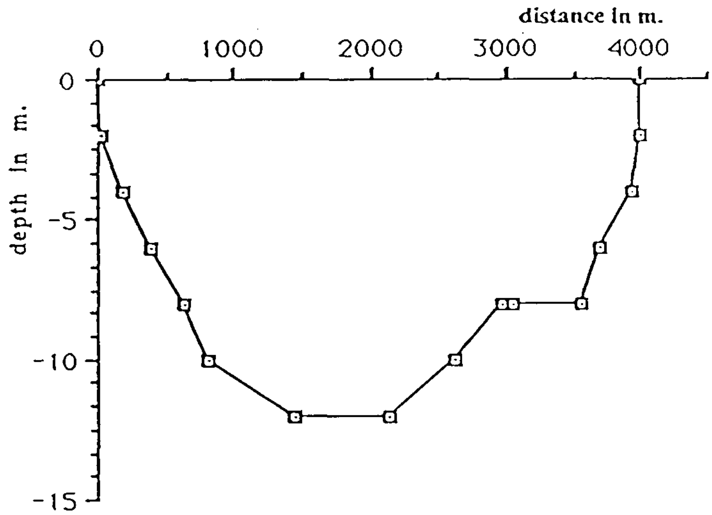
4.1.2.7. Bottom profiles

Seven depth profiles were made in Wadi Rayan I lake as to get an idea about the topography of the bottom. With this an average depth was calculated. The surface area was computed with help of satellite photographs. With these two parameters an estimate was made of the volume of the lake.
The accuracy of the profiles is not optimal as the speed of the dingy could not be controlled to such an extent that constant speed was obtained and wind drift could not be calculated. (Profiles A-G).

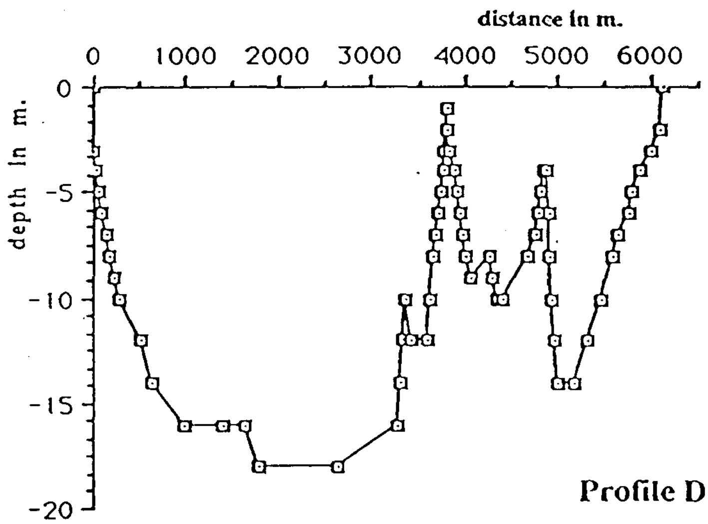
Profile A : Wadi Rayan I, 9-VII-87.



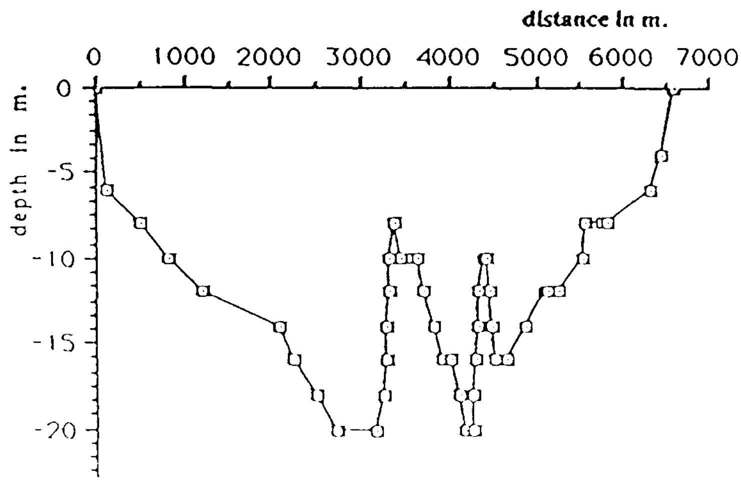
Profile B : Wadi Rayan I, 8-VII-87.



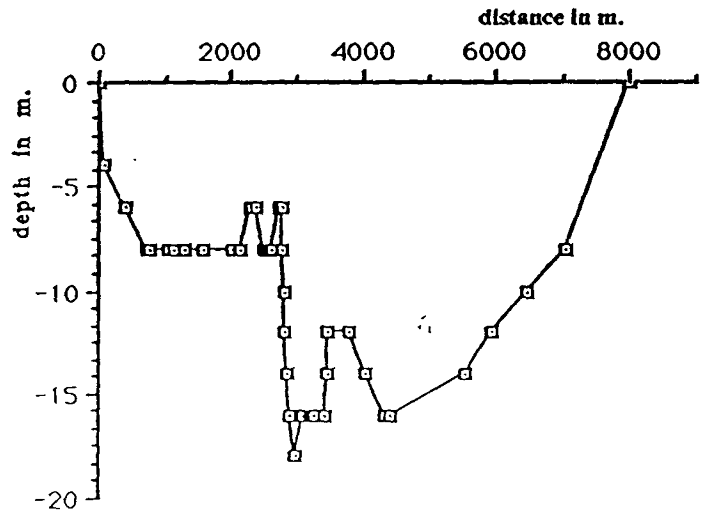
Profile C : Wadi Rayan I, 9-VII-87.



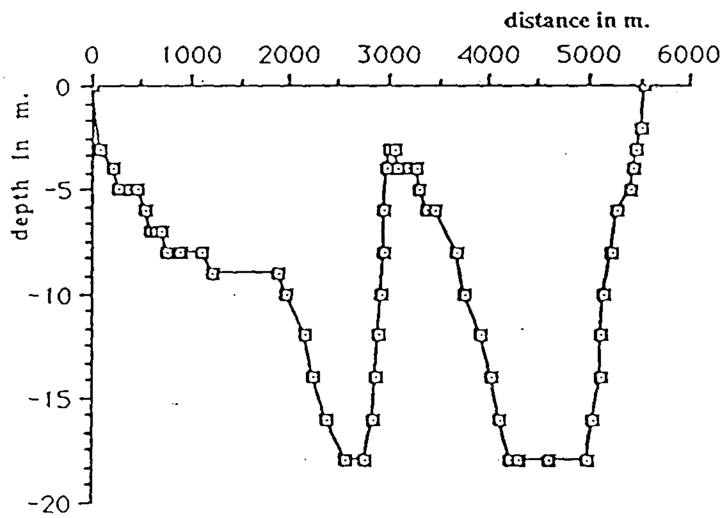
Profile D : Wadi Rayan I, 8-VII-87.



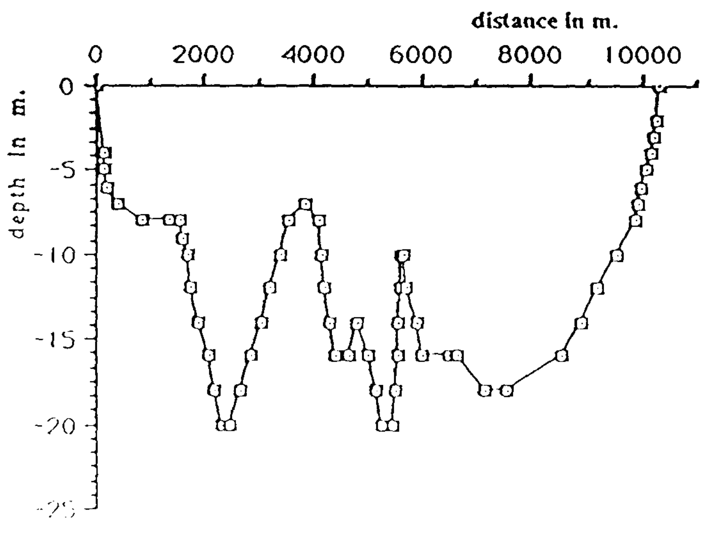
Profile E : Wadi Rayan I, 8-VII-87.



Profile F : Wadi Rayan I, 9-VII-87.



Profile G : Wadi Rayan I, 9-VII-87.



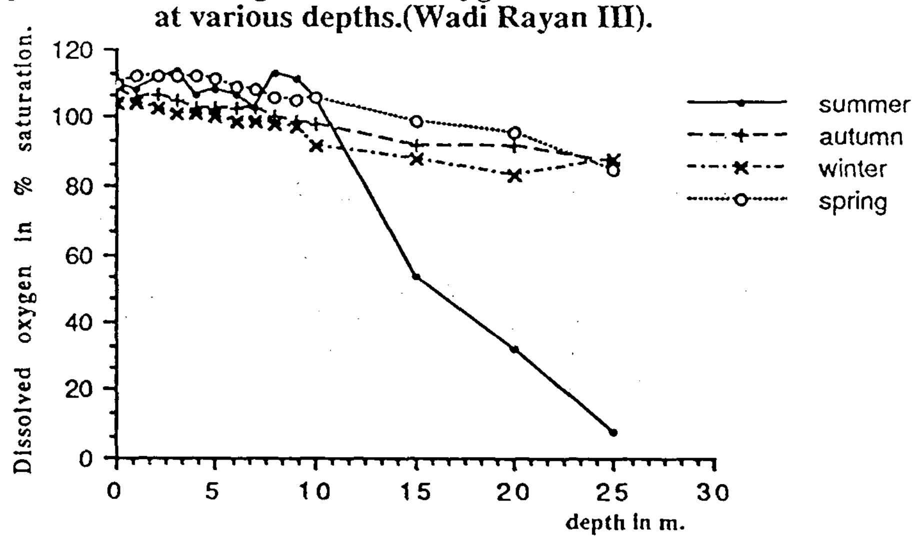
4.1.3. Wadi Rayan III lake

This lake is the newest of the Fayoum lakes. Water started flowing into the depression in 1980 and an equilibrium with the inflowing water and evaporation has not been reached yet. The lake is still growing. It is therefore extremely difficult to produce an accurate map. During the survey an area of about 20 ha was added at the southern end of the lake.

4.1.3.1. Dissolved oxygen

Only in summer there is something like an oxycline, but it is not such an outspoken one as in Wadi Rayan I. The saturation in the top 10 m is during all seasons more or less the same. This uniformity continues at greater depths for all seasons except for the summer, where values decrease rapidly. The average rate of decrease per m depth for autumn, winter and spring is 0.12% saturation. (Table, graph and map 4.1.3.1.)

Graph 4.1.3.1 : Average dissolved oxygen in % saturation at various depths.(Wadi Rayan III).

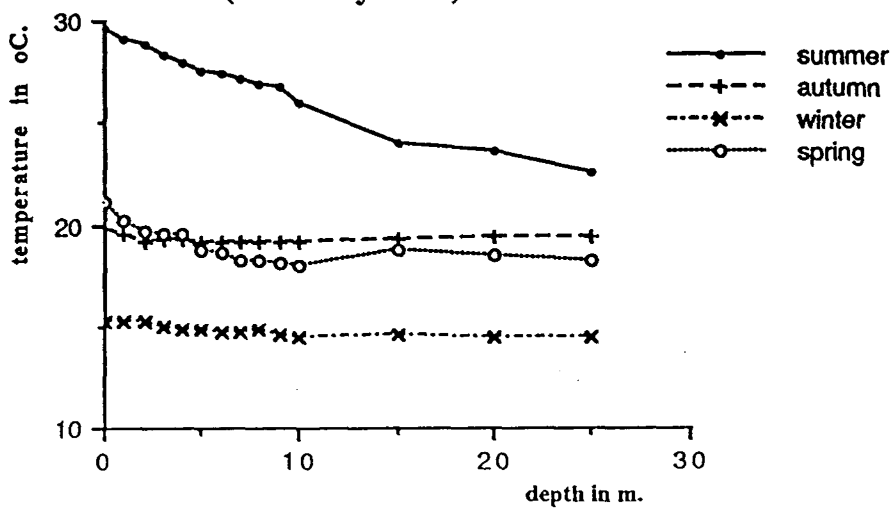


4.1.3.2. Temperature

During summer there is a decline of .28 °C per m depth, during autumn and winter this is 0.03 °C and in spring there is a heating up of the surface water and this gives a decrease of .11 °C per m depth, this heating up is only for the top 3 m for the rest the decline is negligible.

The maximum difference between seasons is 15 °C for the surface water and 8 °C at the bottom. Autumn and spring have about the same temperature levels. Maximum temperature recorded 30.5 °C at surface of station number 5 in June. Minimum temperature recorded 14.4 °C at bottom of station number 5 in February .
(Graph 4.1.3.2., maps 4.1.3.2.a-b and tables 4.1.3.2.a-b)

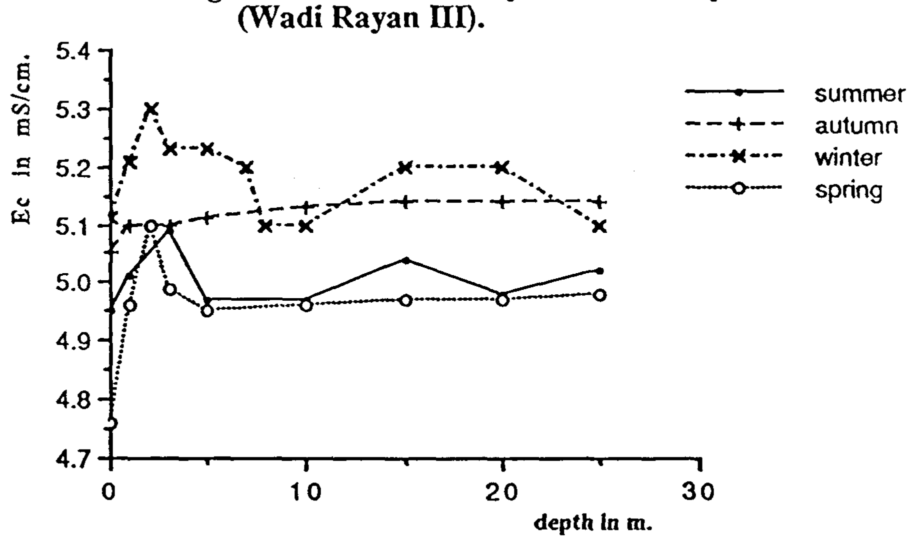
Graph 4.1.3.2 : Average temperature at various depths. (Wadi Rayan III).



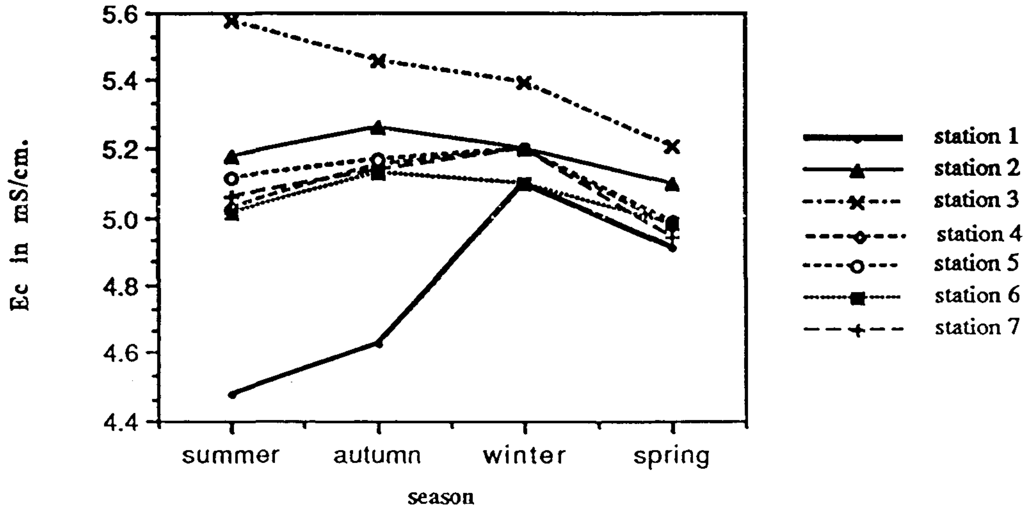
4.1.3.3. Electric conductivity

The Ec shows the greatest fluctuations during winter, which might have been caused by the way of measuring. The meter was not put on a very sensitive scale at that time. The measurements of summer were made with a too sensitive mode.because of the unfamiliarity with the equipment The lake was most saline during the winter and the least saline during the spring, there was about 4% difference between winter and spring.
When the seasons are compared per station than it seems clear that the newest inundated areas are the most salt (station 8) and that during the year the differences become smaller (stations 2 and 3). (Maps 4.1.3.3.a-d and graphs 4.1.3.3.a-b and tables 4.1.3.3.a-c)

Graph 4.1.3.3 : Average electric conductivity at various depths. (Wadi Rayan III).



Graph 4.1.3.3 b : Average electro conductivity per season per station (Wadi Rayan III).



The influx from water through the waterfall is reflected by the "fresher" water at station 1. The Ec of the water in the canal from WR II is 2.05 near the waterfall.

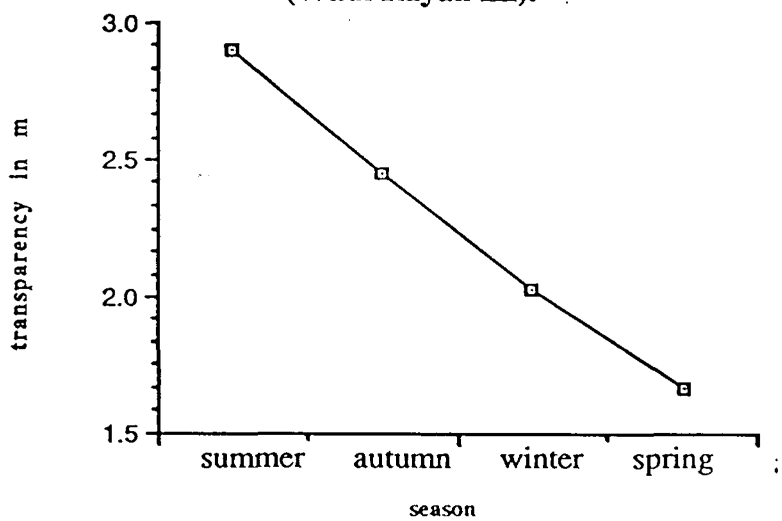
4.1.3.4. pH

The pH is between 8.4 and 8.6 for all stations and at all depths. Some lower recordings are most likely caused by malfunctioning of pH meter.

4.1.3.5. Transparency

The transparency decreases from summer till spring. This may find its origin in the increase of plankton organisms. The station with the most transparent water is station 6 where the average sight is over 3 m and the least was found in stations 2 and 3. (Table 4.1.3.5., map 4.1.3.5 and graph 4.1.3.5.)

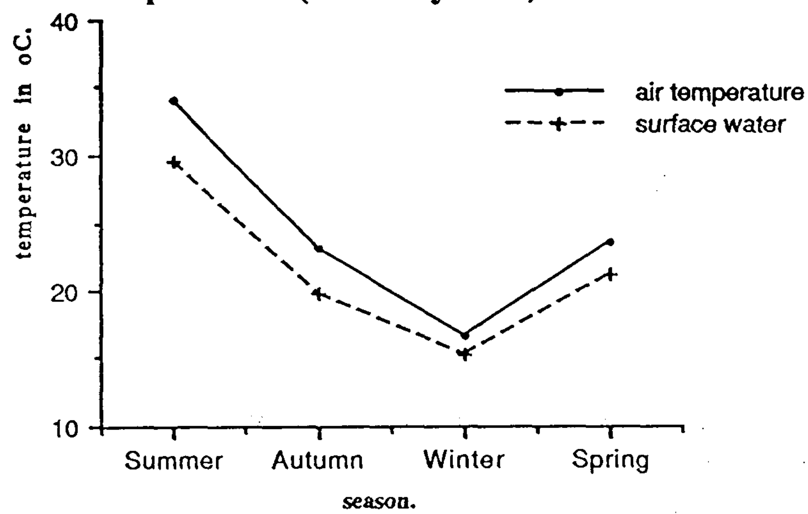
Graph 4.1.3.5 : Average transparency per season. (Wadi Rayan III).



4.1.3.6. Air temperatures

The air temperature varies considerably during the day, between early morning and midday there can be a difference of 13 °C. (Table +graph 4.1.3.6.)

Graph 4.1.3.6 : Average air - and surface water temperature per season.(Wadi Rayan III).

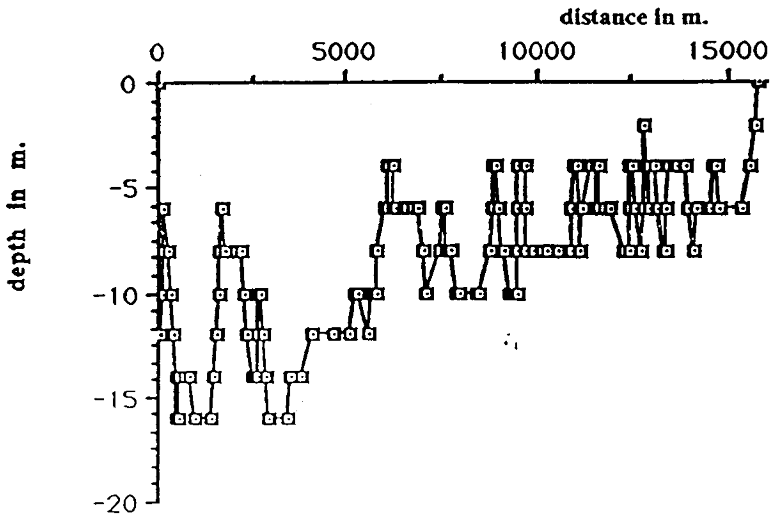


4.1.3.7. Bottom profiles

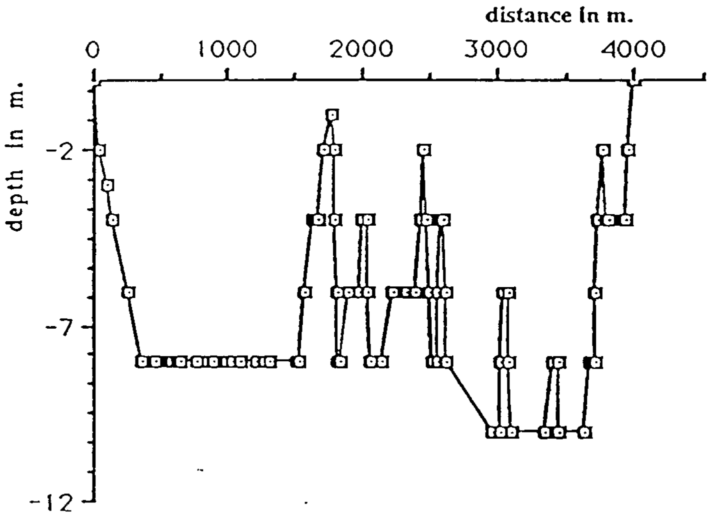
Nine bottom profiles were made in Wadi Rayan III lake as to get an idea about the topography of the bottom.(profiles A-I). A great problem with this lake is that there are no photographs available to give an idea about the actual shape and size of the lake. The satellite photographs studied are from July 1985 and the lake level has since risen by approximately 2 m, which particularly in the flat shallow areas can cause considerable expansion of the surface area. With the profiles an estimate has been made of the most likely surface area and the volume of the lake

These profiles were made on the 20 th of July 1987.Between this date and the summer of 1988 , the lake level has risen at least 50 cm..But as the waterlevels are not recorded it is not possible to give the actual changes.Other parameters used as constants such as boatspeed and course direction are not very accurate.This makes the calculation of the surface area and the volume only a rough estimate of the real situation.

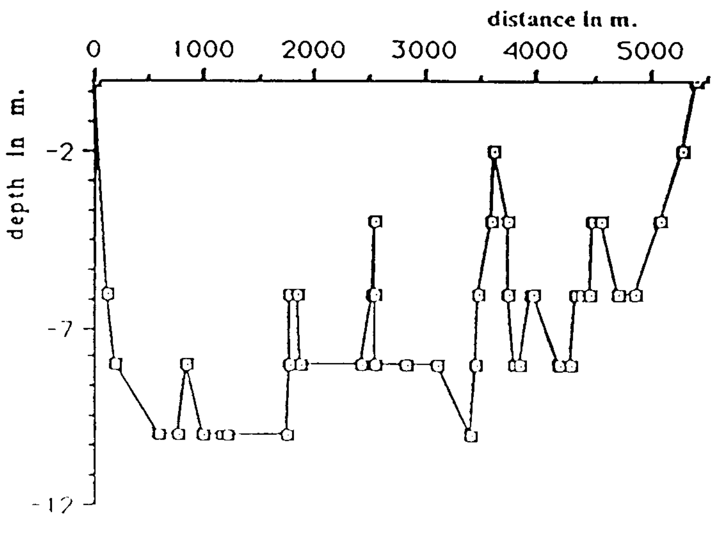
Profile A : Wadi Rayan III , 20-VII-87.



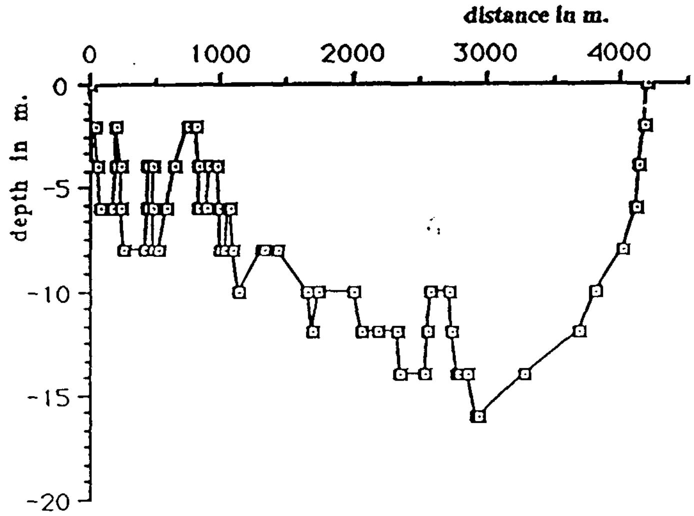
Profile B : Wadi Rayan III , 20-VII-87.



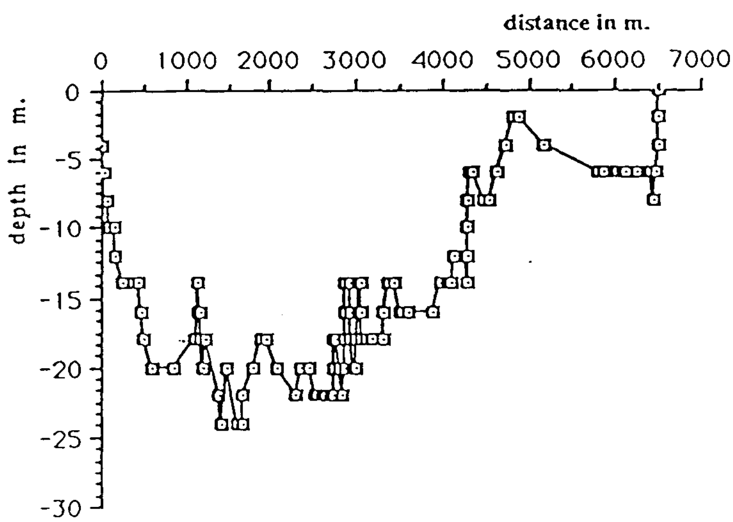
Profile C : Wadi Rayan III . 20-VII-87.



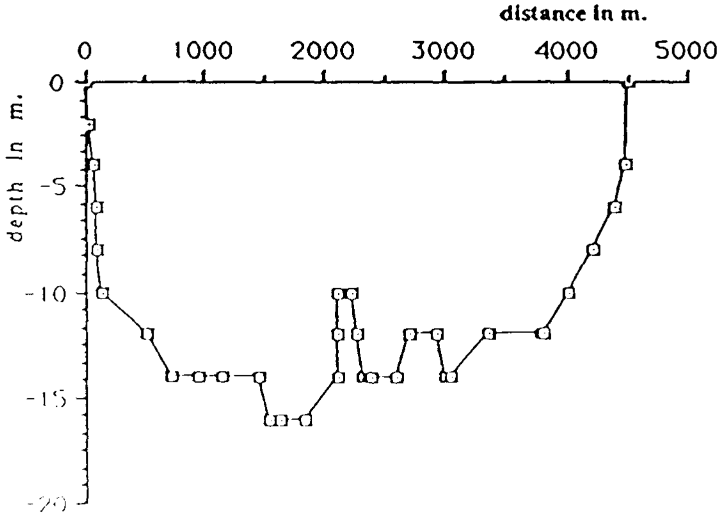
Profile D : Wadi Rayan III , 20-VII-87.



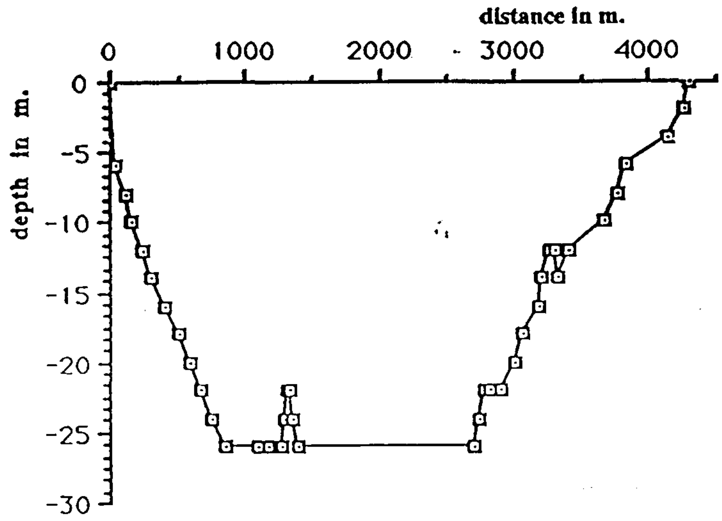
Profile E : Wadi Rayan III , 20-VII-87.



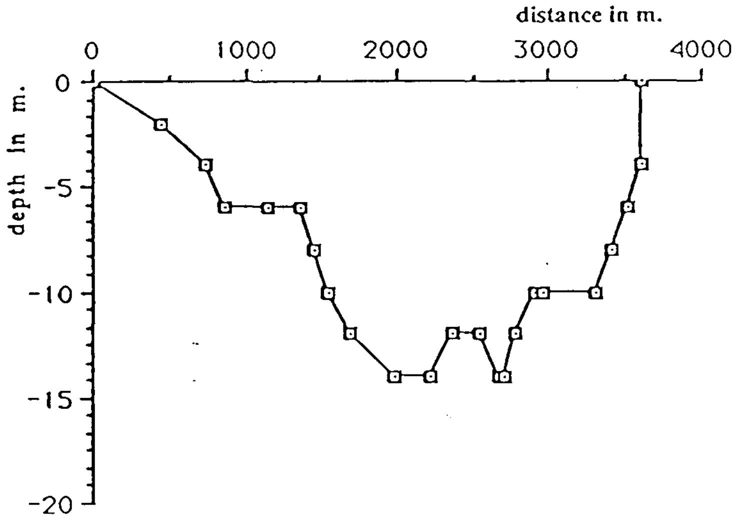
Profile F : Wadi Rayan III , 20-VII-87.



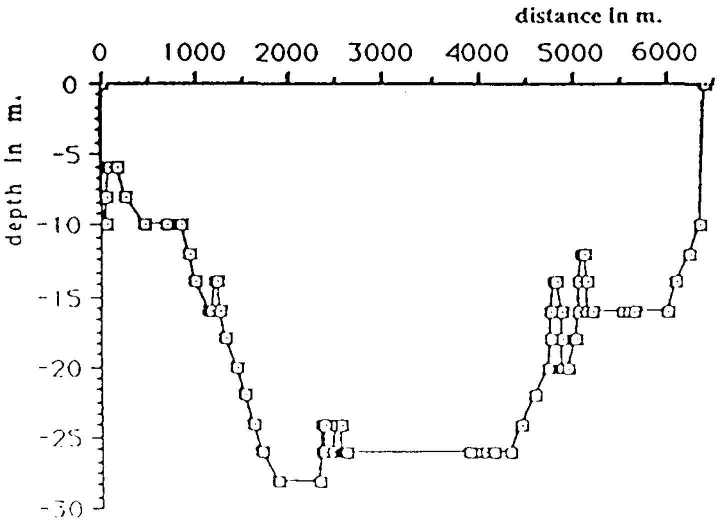
Profile G : Wadi Rayan III , 20-VII-87.



Profile H : Wadi Rayan III , 20-VII-87.



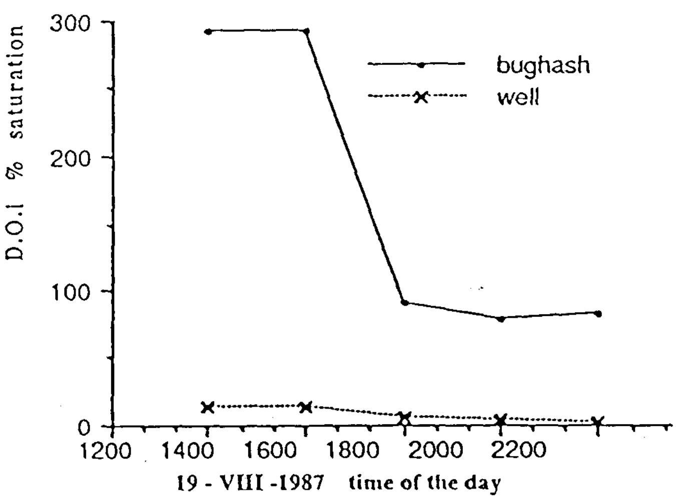
Profile I : Wadi Rayan III , 21-VII-87.

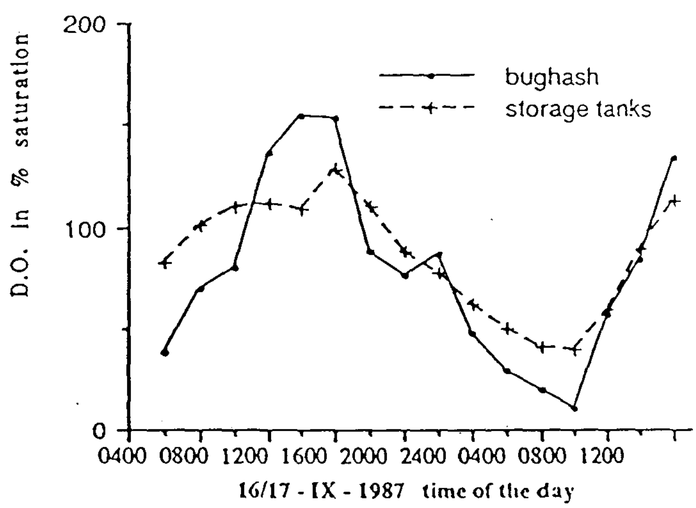


4.1.4.El-Gameel

The water from the bughash was measured at 16 and 17 September 1987 for a period of 30 hours. At 2 hours intervals D.O., Ec and temperature were measured. The influence of tidal intrusion was clearly noted, but the brackish outflow prevailed during this time. Very little time has been spent on the study of the limnology as there were many other matters to be dealt with during the visits to El Gameel and as nearly all fry came from Damietta no importance was given to the site.(tables 4.1.4.a-c and graphs 4.1.4 a-cb)
The lowest oxygen levels are found in the well water,the tanks showed the most constant high levels.Early morning samples of the bughash showed very low oxygen levels.
Dissolved Oxygen , in % saturation , in water from the bughash , the storage tanks and the 3 m. deep well,at various times of the day.

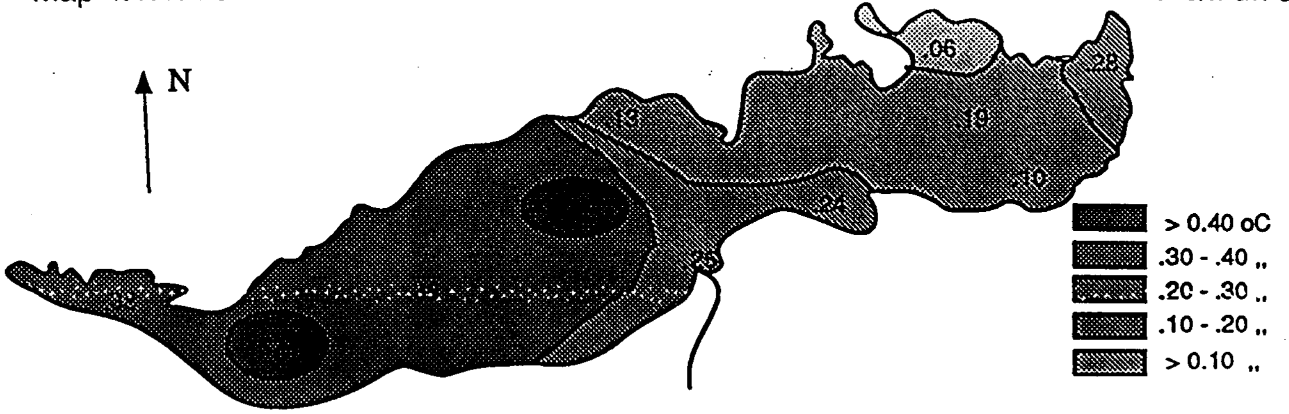
Graph 4.1.4 a : Dissolved oxygen in the water of the bughash , the storage tanks and the 3 meter deep well , at El Gameel at different hours of the day.





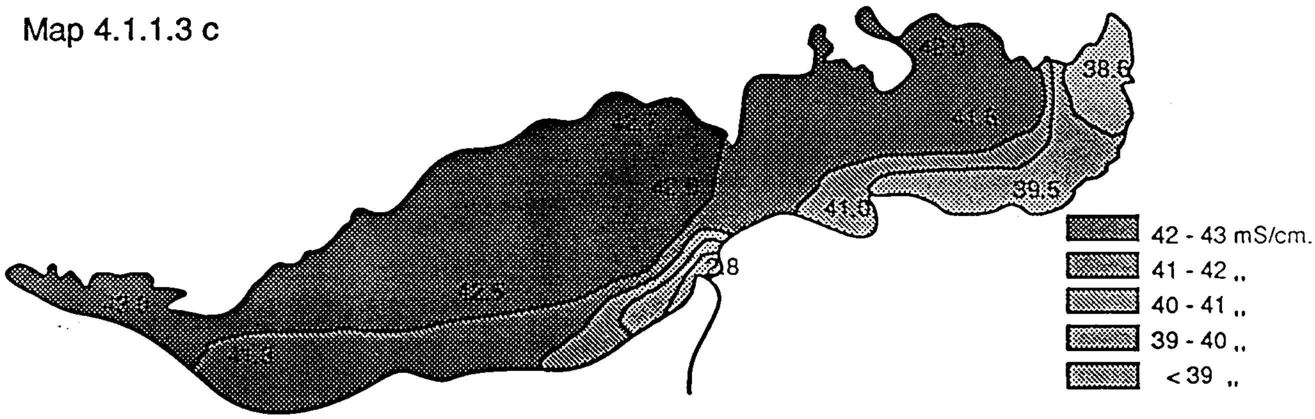
The greater variation in the tanks at 1000,1200 and 1400 hrs. is caused by the sunshine, some tanks were in the shade while others received direct sunshine.Water from the bughash shows the greatest variation and the highest temperatures.Water from the well had the most constant temperature.
Water from the bughash is least salt and that from the well is the most salty,the latter however is also the most constant .

Map 4.1.1.2 c



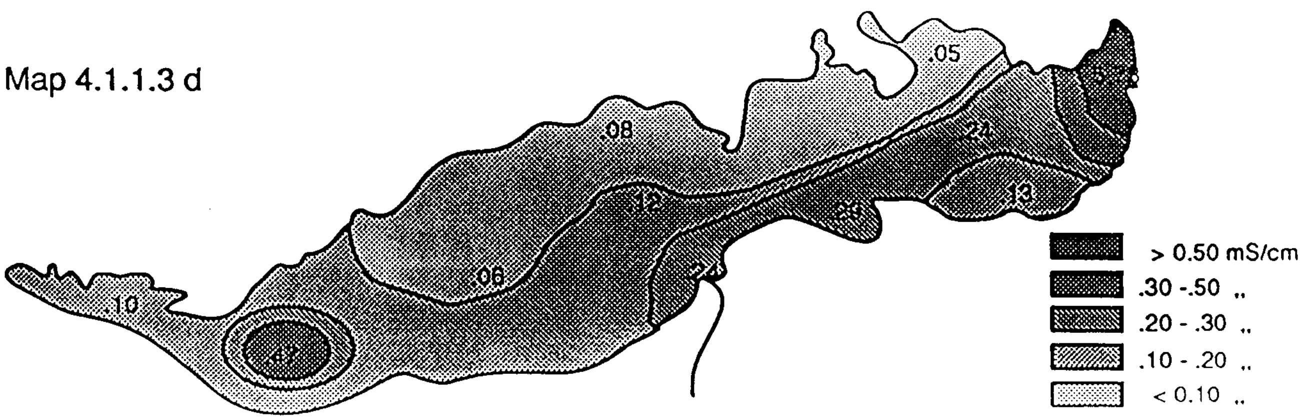
Average change in temperature , in oC , per meter depth (all seasons together).

Map 4.1.1.3 c



Average electric conductivity , of all seasons and depths together (spring not included).

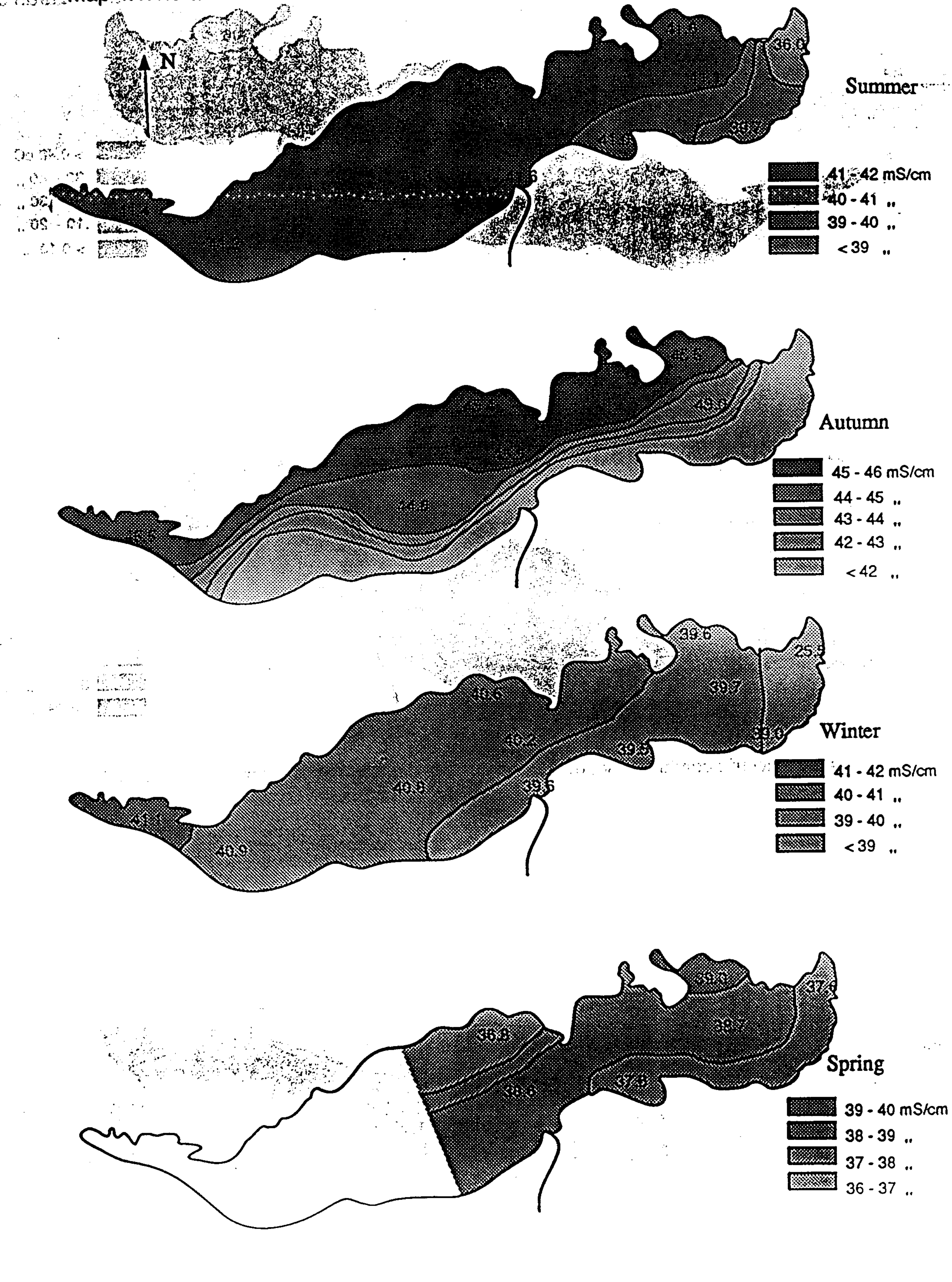
Map 4.1.1.3 d



Average change in Ec , per m. depth (all seasons together).

Map 4.1.1.3 a

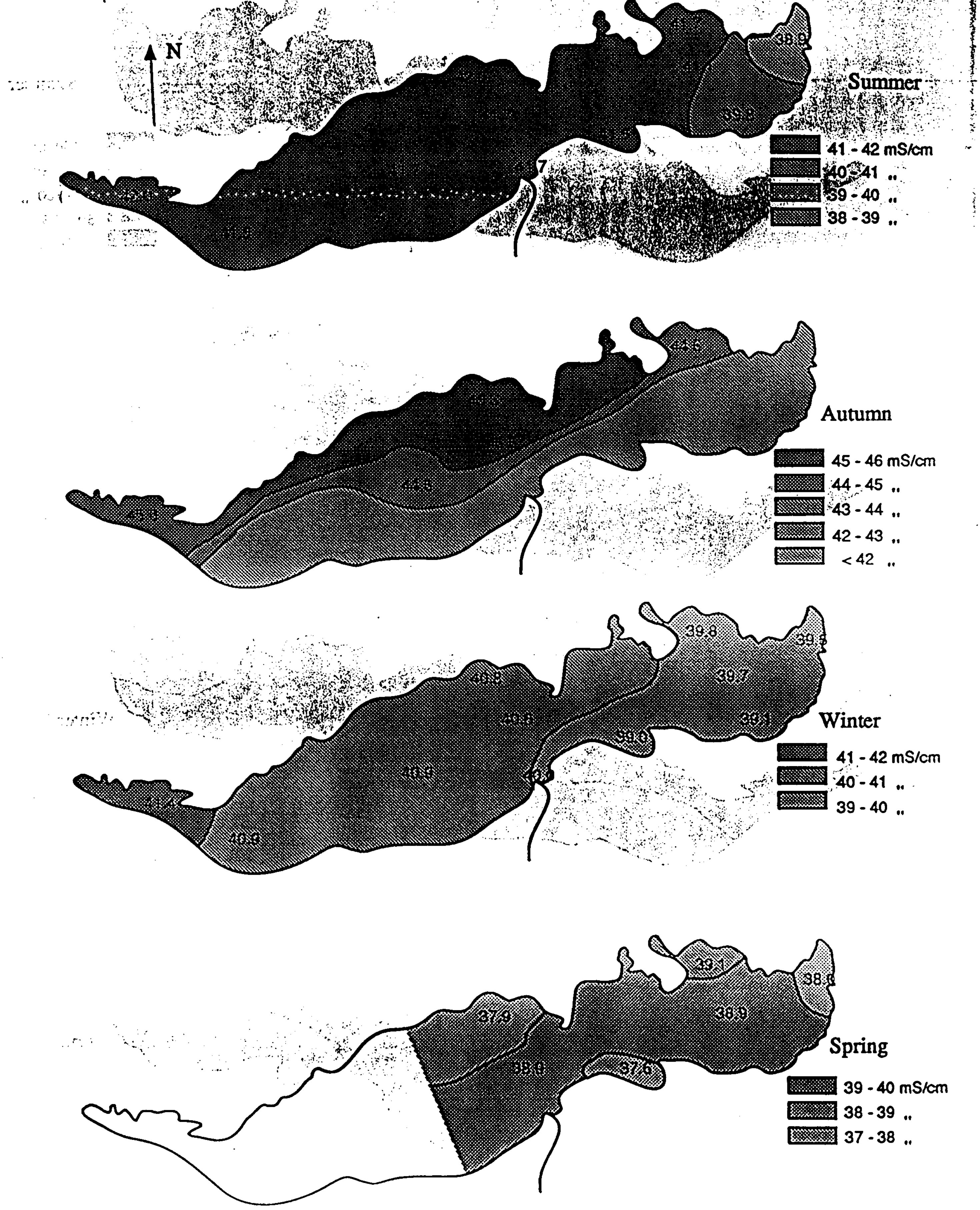
Lake Qarun 6.



Electric conductivity , in mS/cm , of surface water.

Map 4.1.1.3 b

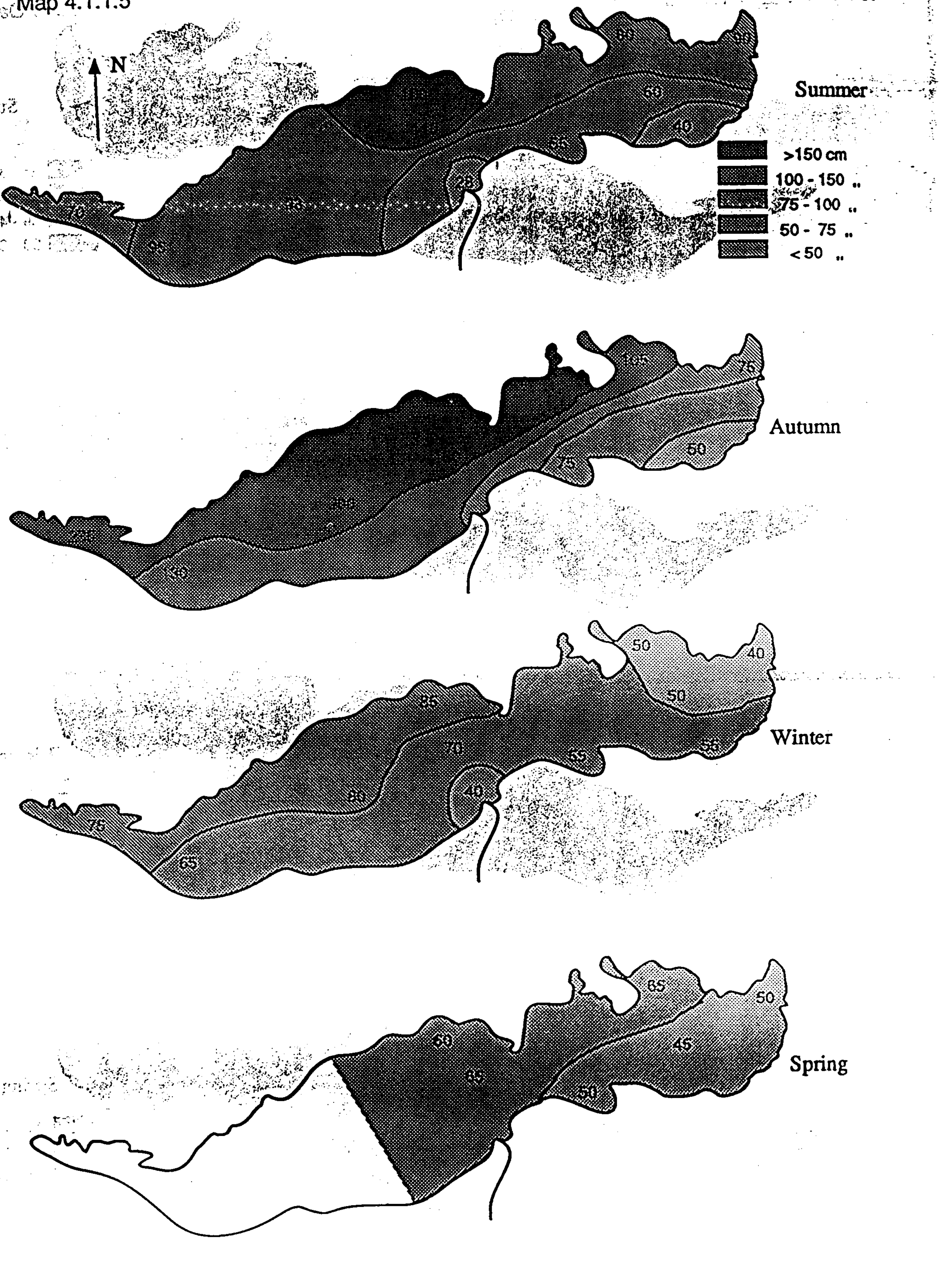
Lake Qarun 7.



Electric conductivity , in mS/cm , at 1 meter depth.

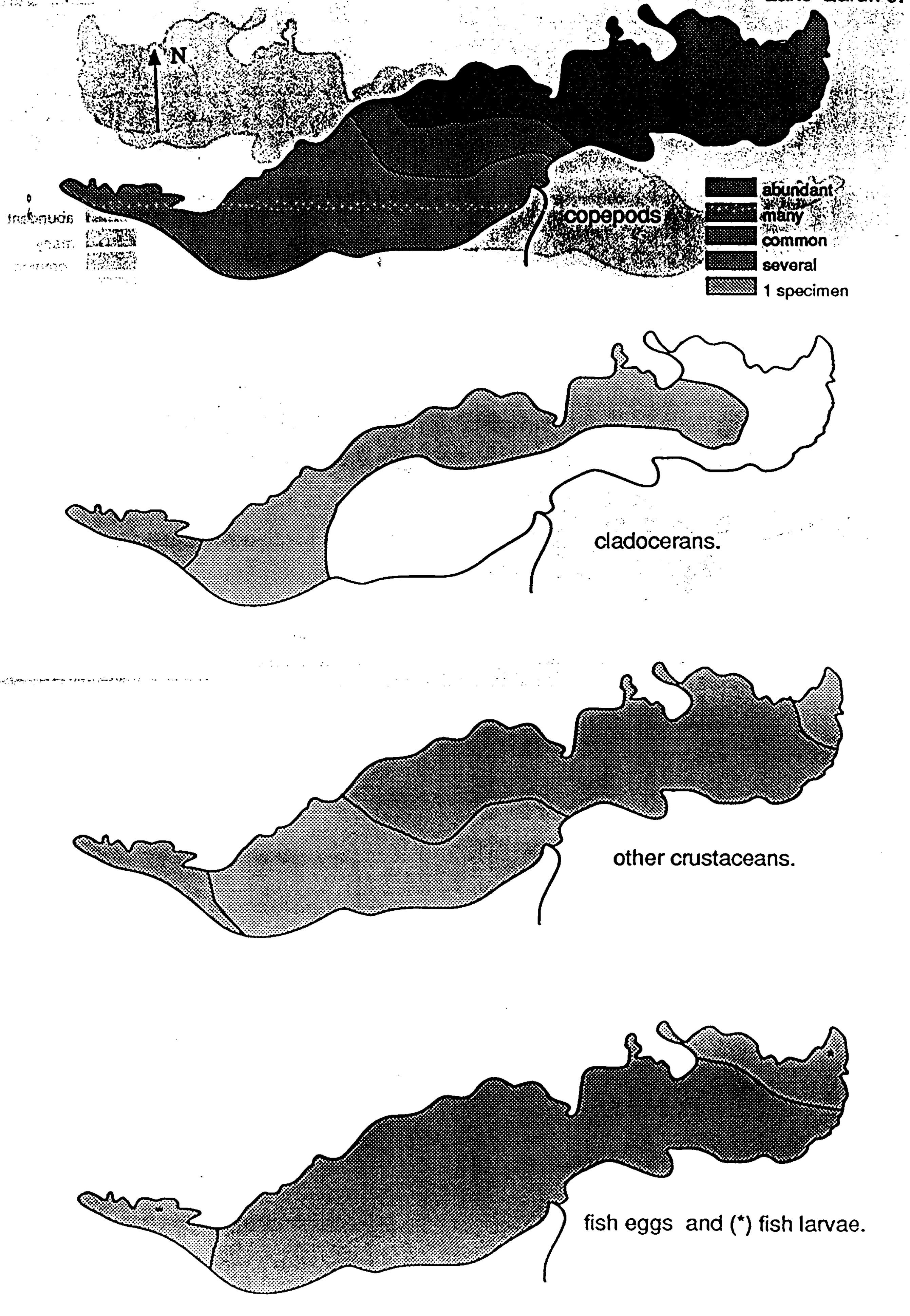
Map 4.1.1.5

Lake Qarun 8.



Transparency in cm

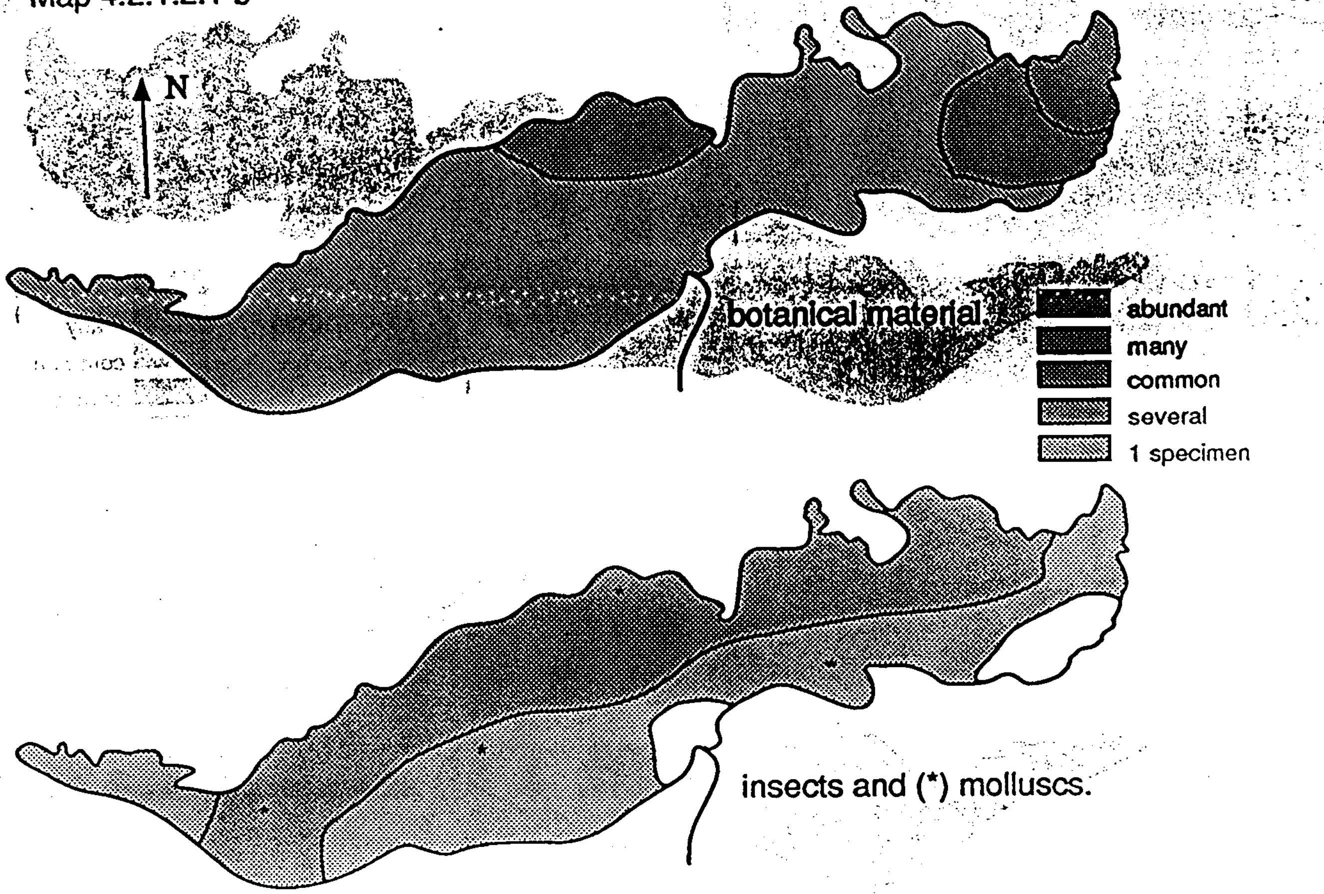
Map 4.2.1.2.1 a Lake Qarun 9.



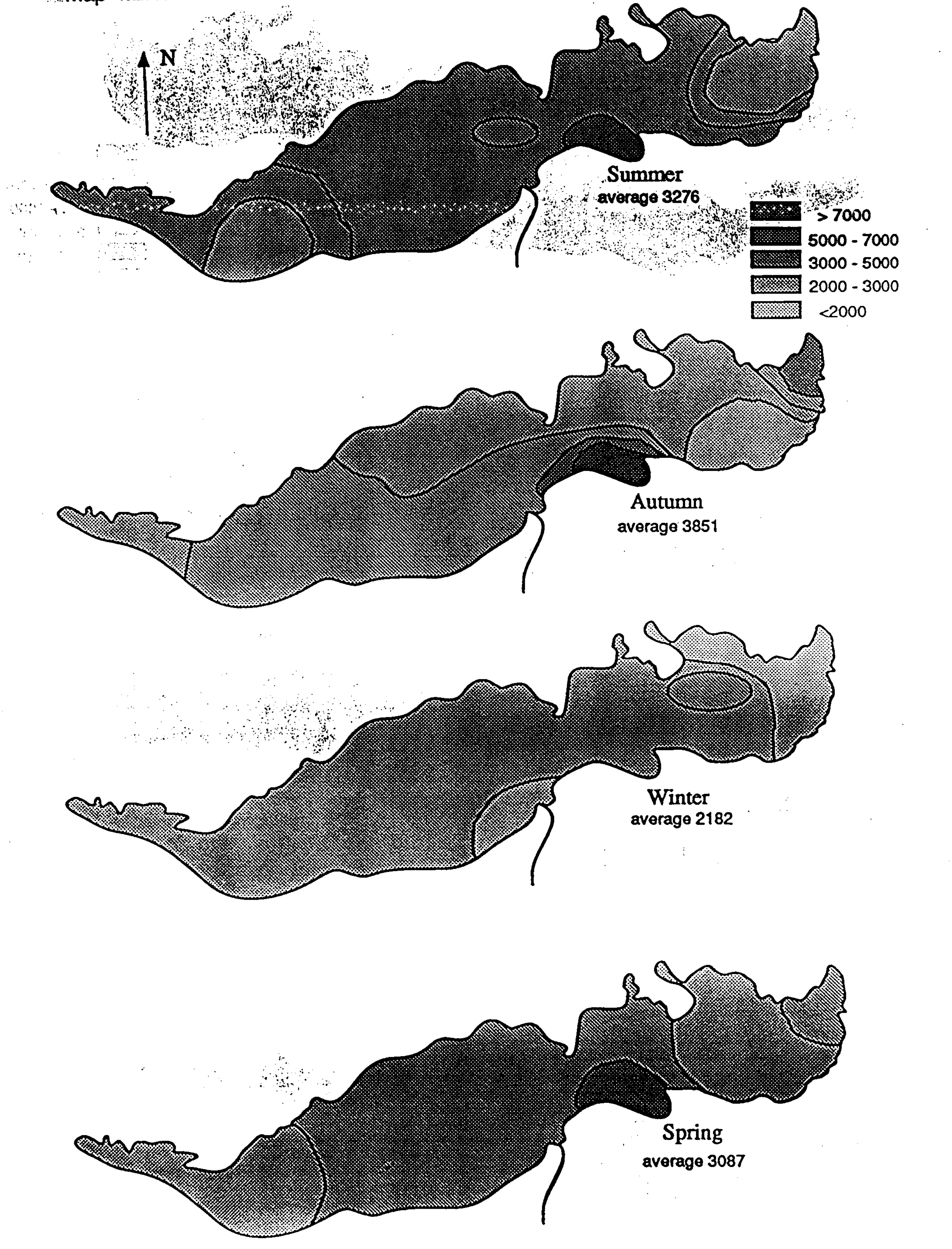
Distribution of various plankton groups found in the 280µ samples.

Map 4.2.1.2.1 b

Lake Qarun 10.



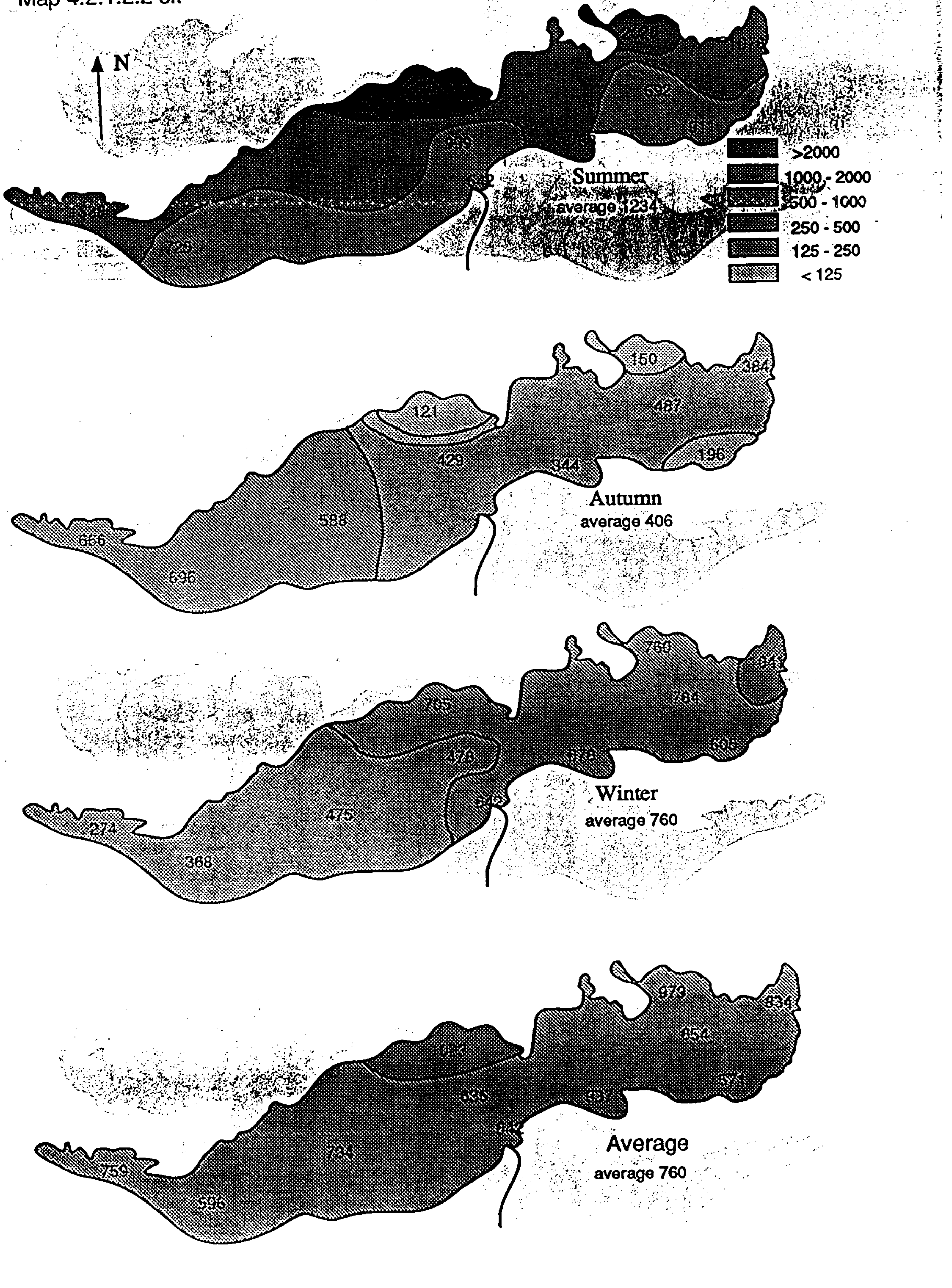
Distribution of various plankton groups and terrestial materials , found in the 280μ samples.



Distribution of plankton from 60μ samples in organisms per liter.

Map 4.2.1.2.2 cII

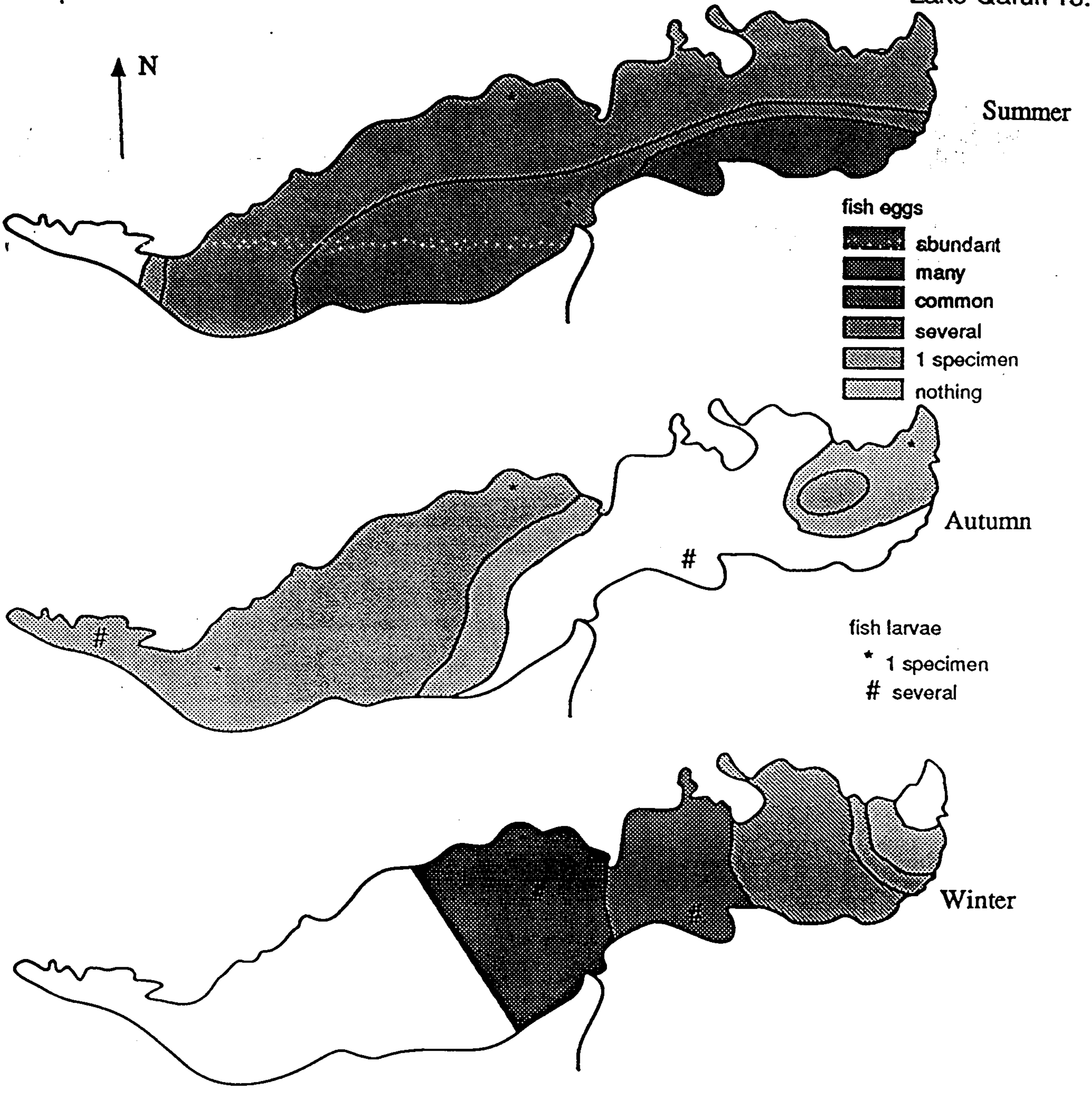
Lake Qarun 12



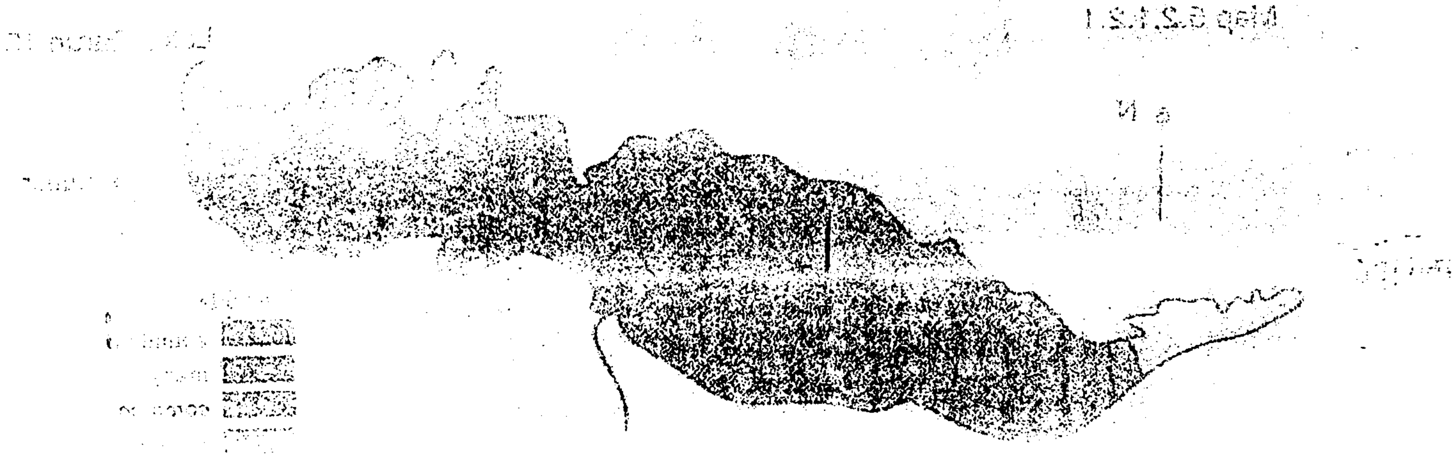
Zooplankton distribution in number of organisms per liter.
(60μ samples)

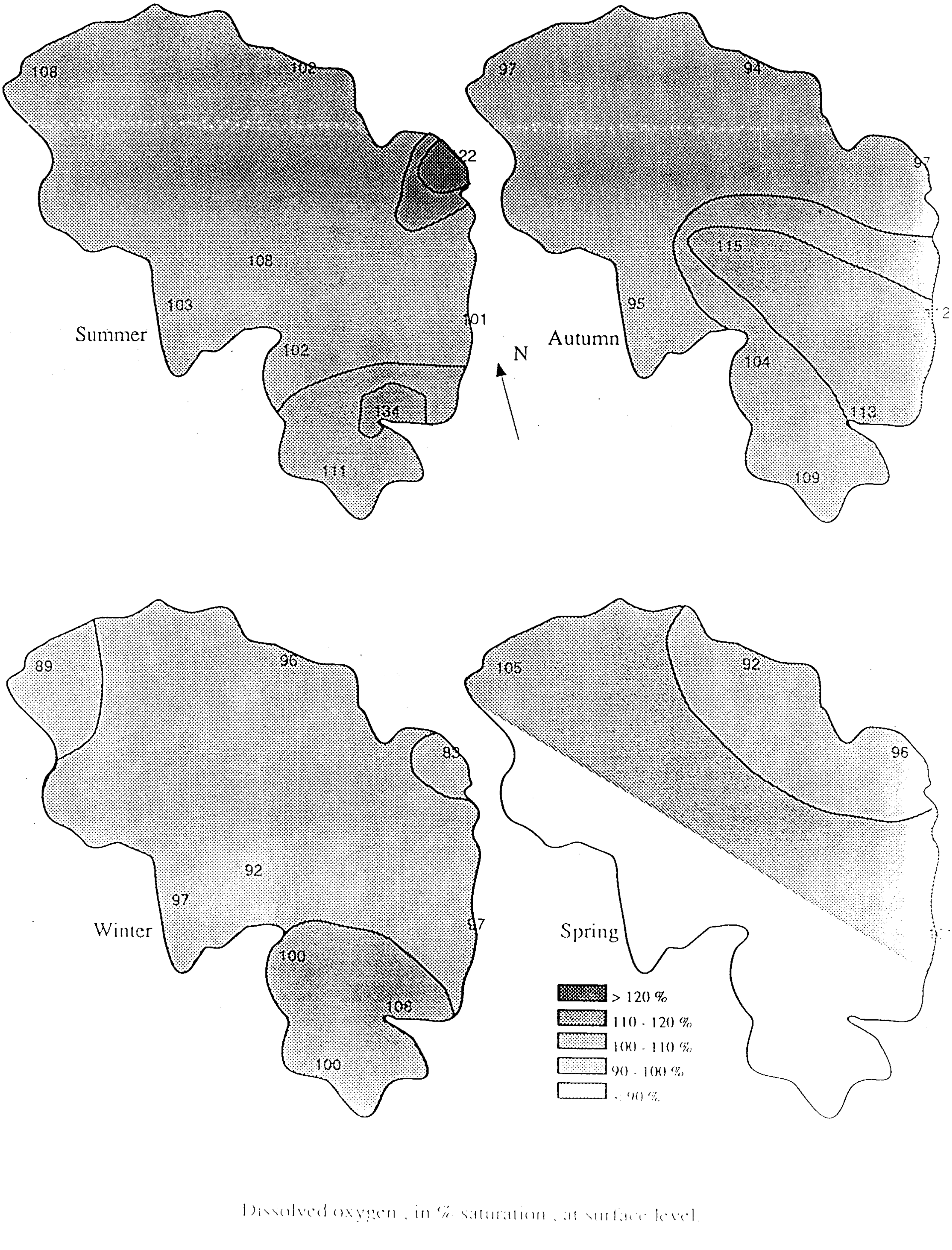
Map 5.2.1.2.1

Lake Qarun 13.



Distribution of fish eggs and larvae during different seasons.

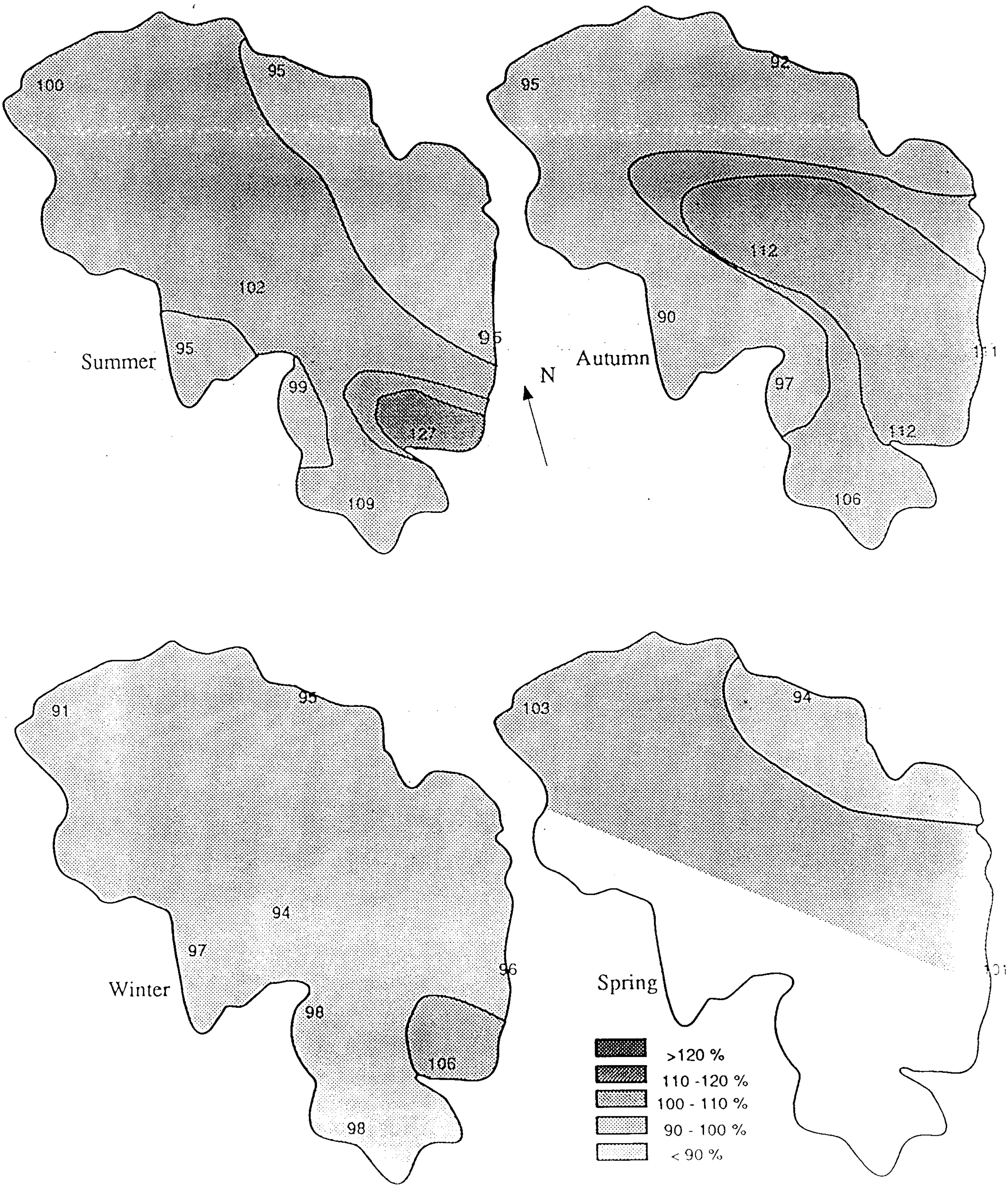




Dissolved oxygen , in % saturation , at surface level.

Map 4.1.2.1 b

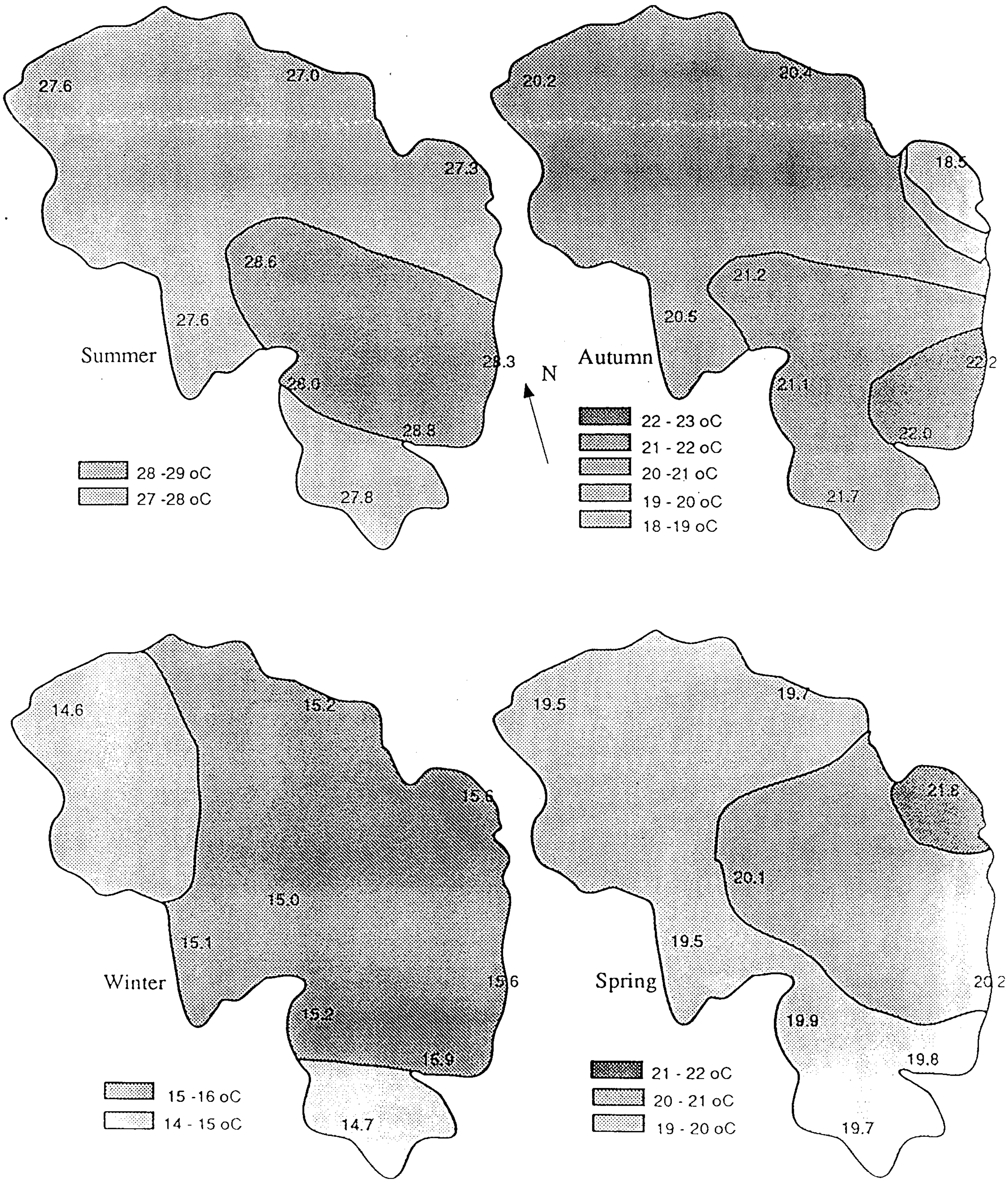
Wadi Rayan I . 2



Dissolved oxygen in , % saturation , at 1 m. depth.

Map 4.1.2.2 a

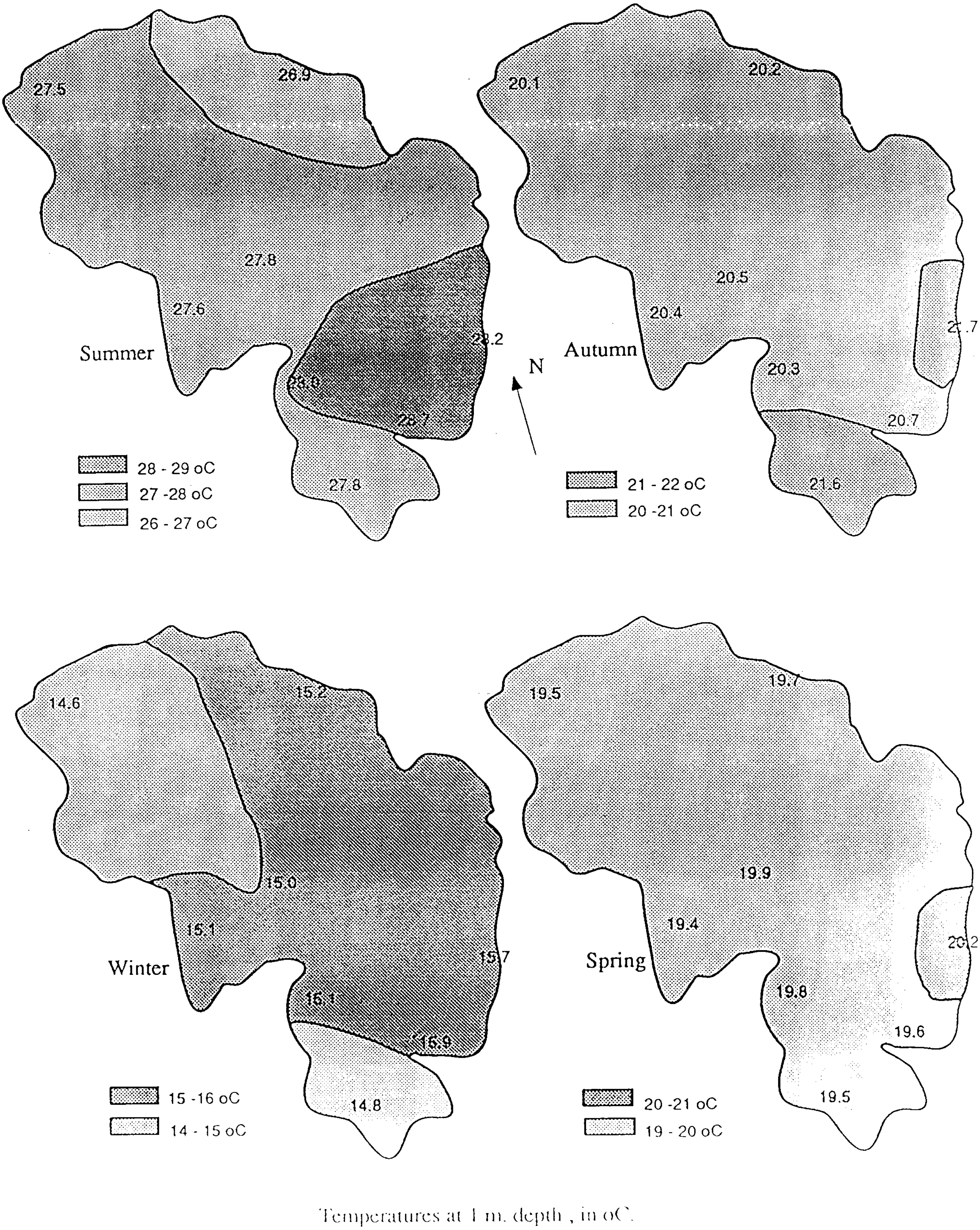
Wadi Rayan I . 3.



Temperatures at surface , in oC.

Map 4.1.2.2 b

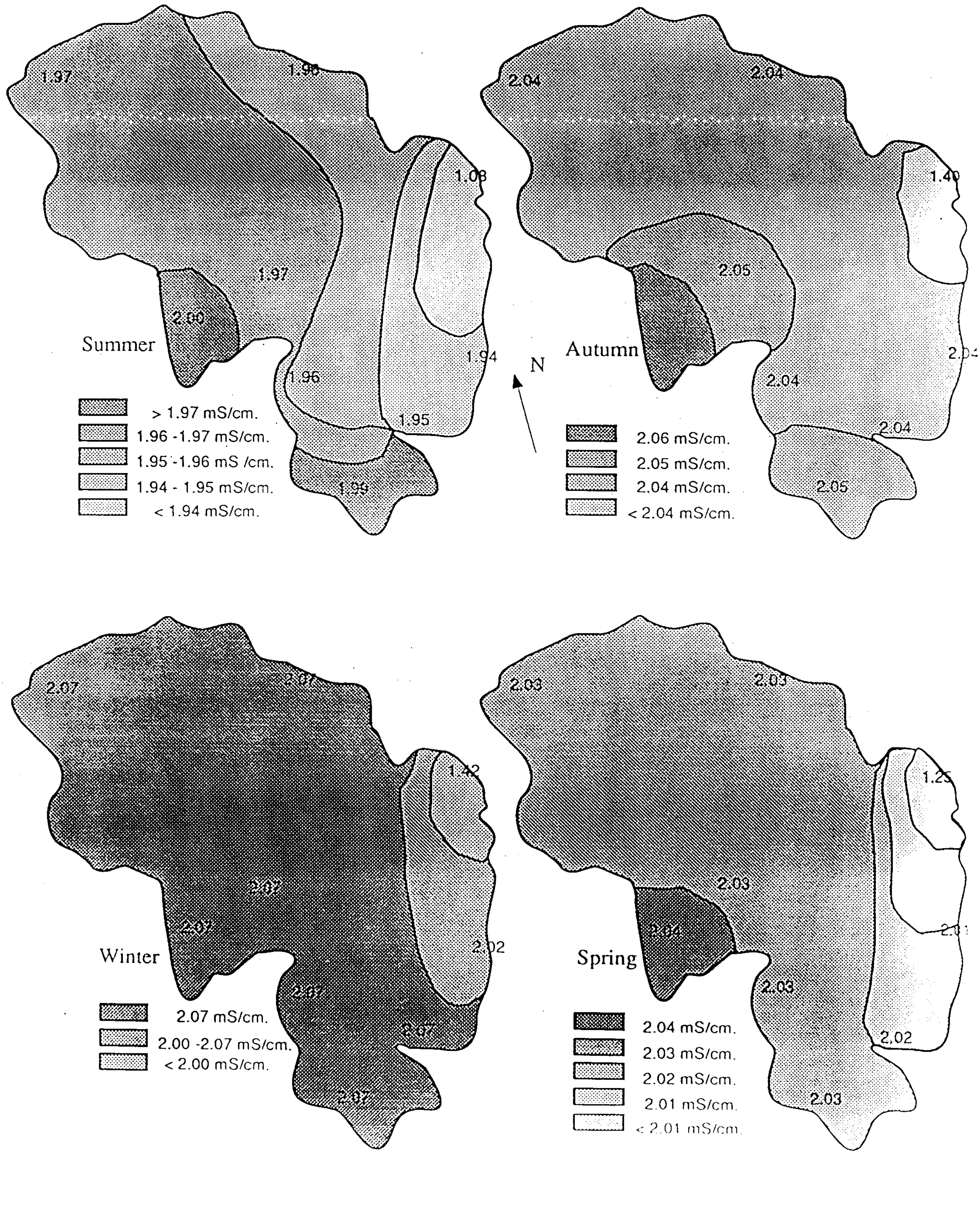
Wadi Rayan I . 4.



Temperatures at 1 m. depth , in oC.

Map 4.1.2.3 a

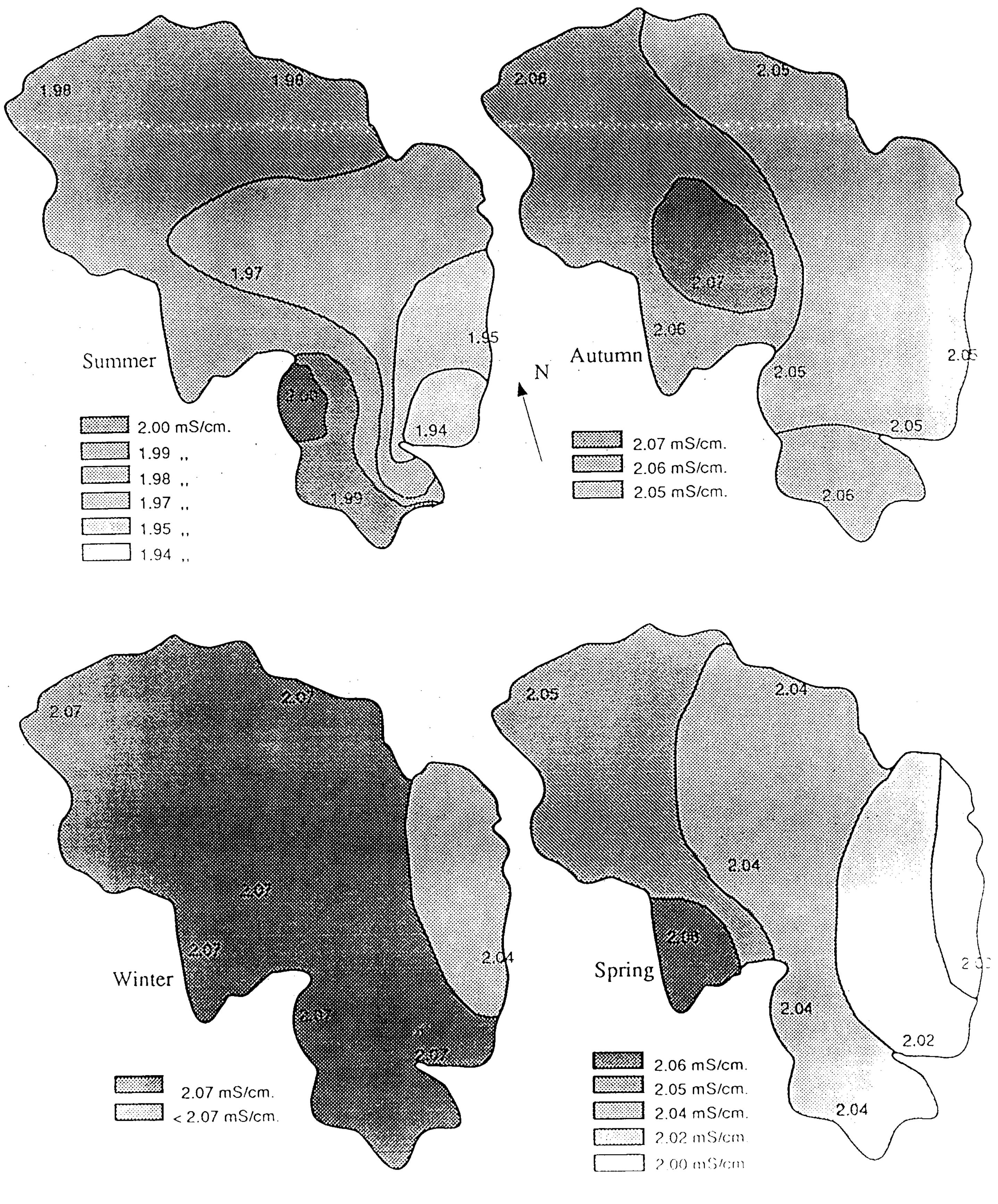
Wadi Rayan I. 5.



Electric conductivity in mS/cm. at the surface

Map 4.1.2.3 b

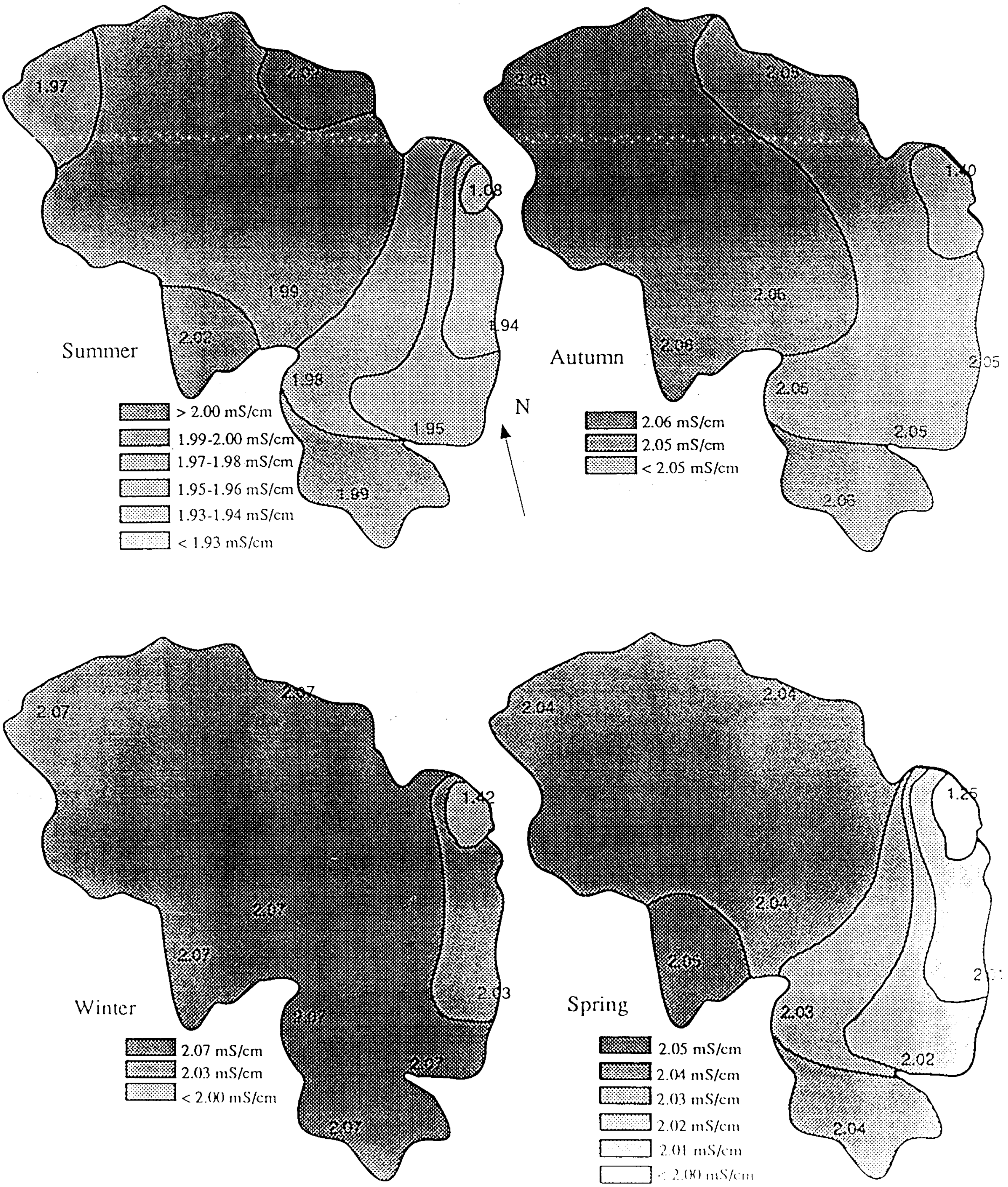
Wadi Rayan I . 6.



Electric conductivity , in mS/cm. , at 1 m. depth.

Map 4.1.2.3 c

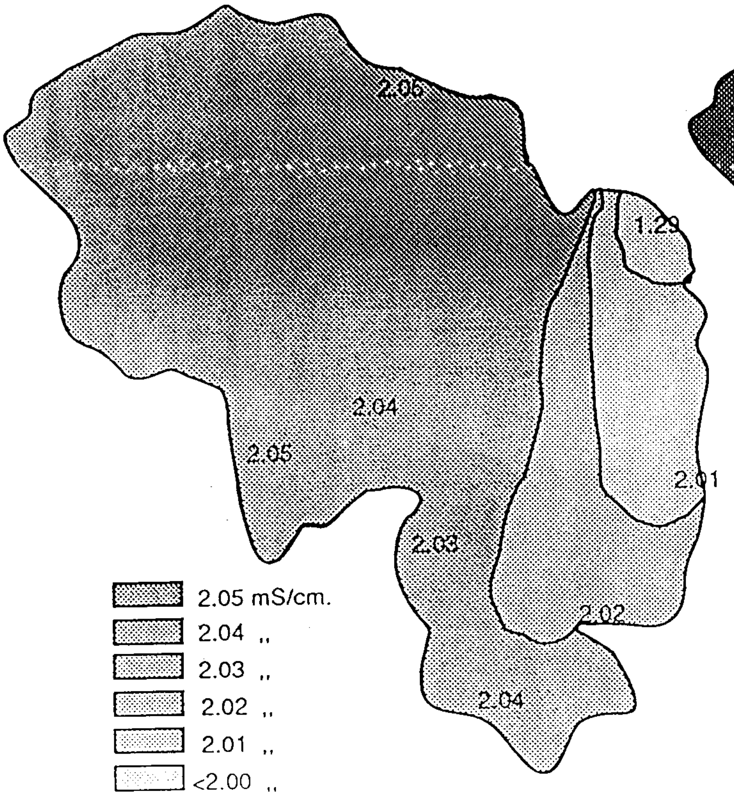
Wadi Rayan I. 7.



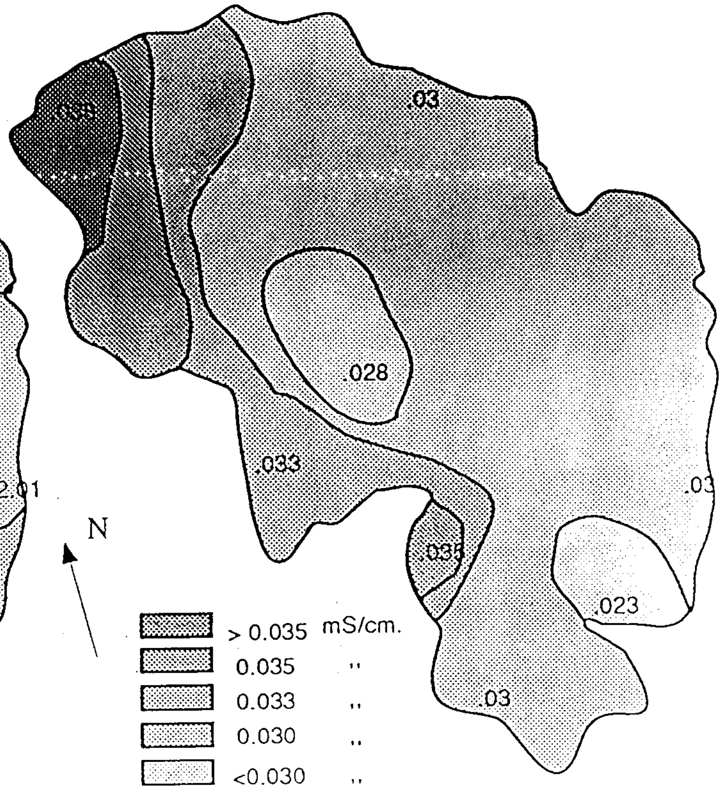
Average Ec for all depths per station per season

Map 4.1.2.3 d

Wadi Rayan I . 8.

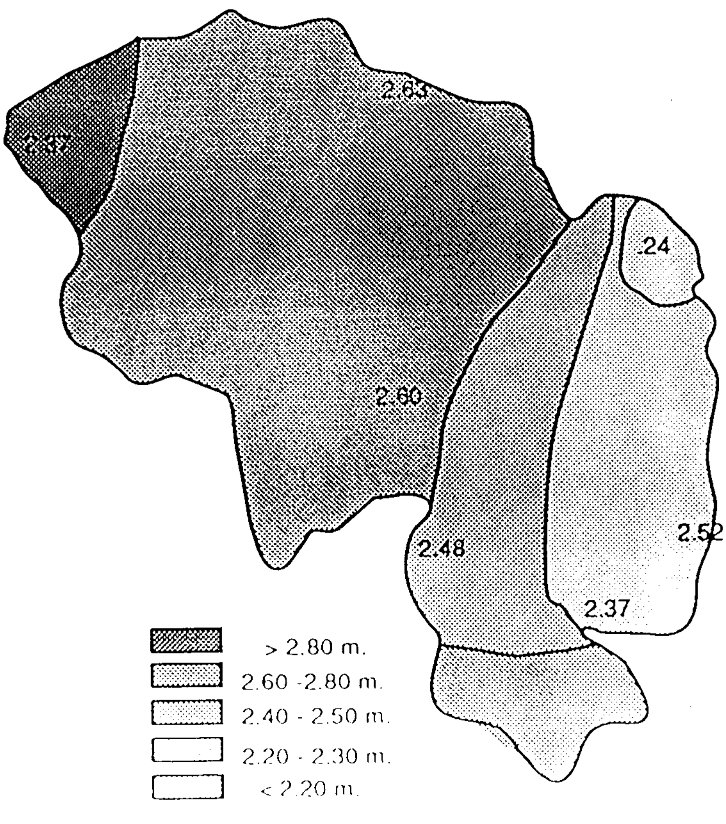


Average Ec for all measurements during all seasons.



Average decrease of Ec per m. depth.

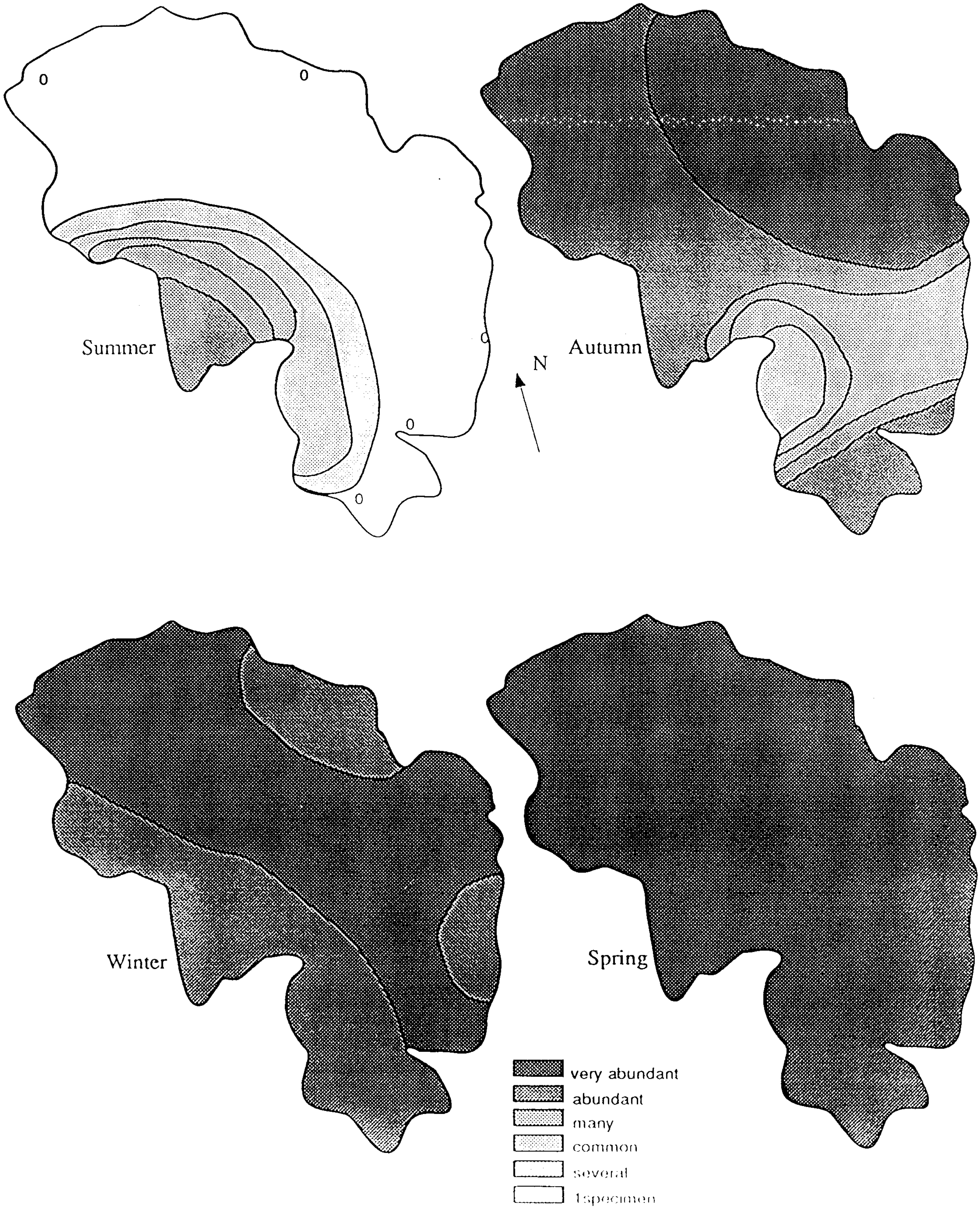
Map 4.1.2.5



Average transparency in m.

Map 4.2.2.2.1 a

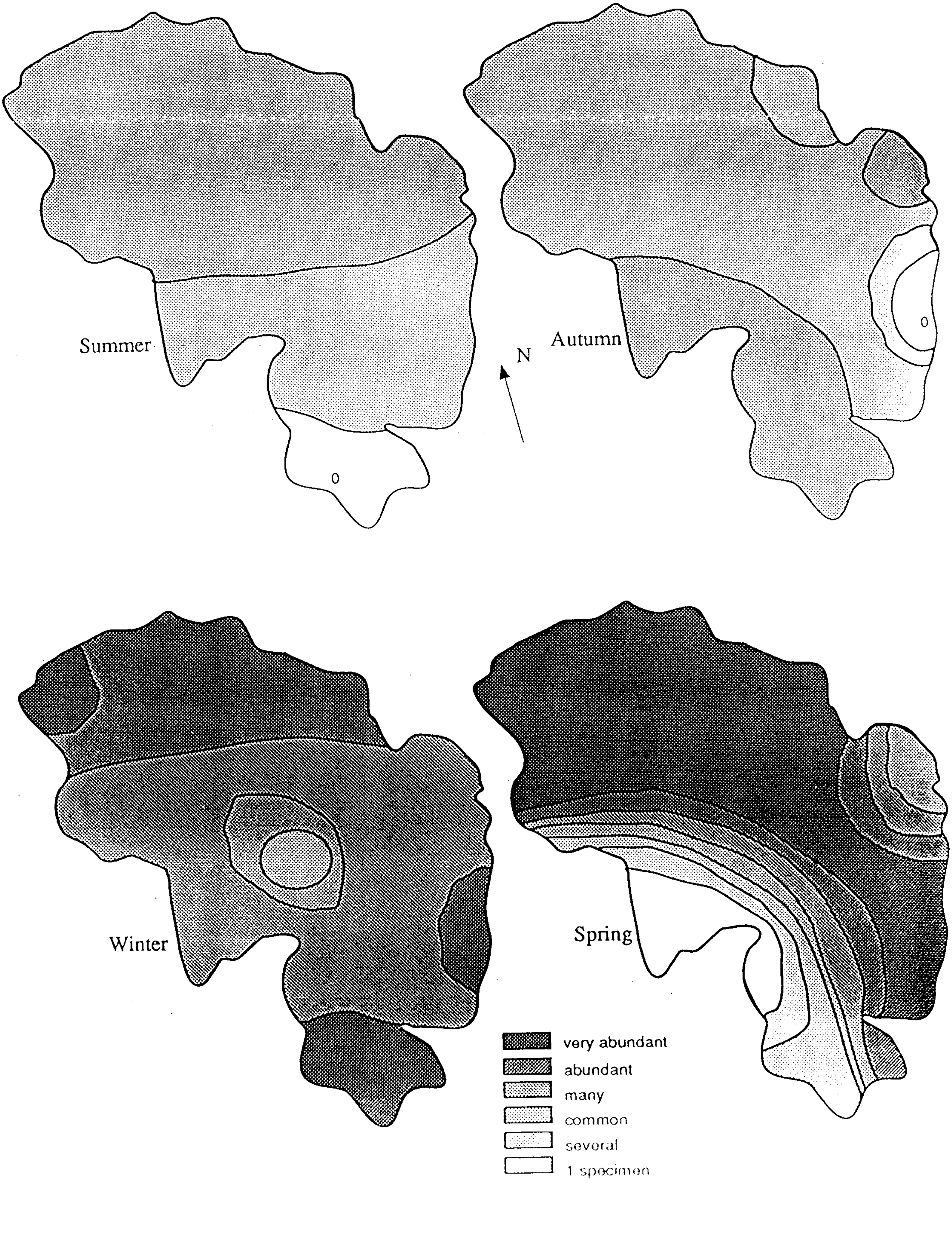
Wadi Rayan I . 9.



Distribution of botanic material from the 280μ samples, predominantly blue green algae

Map 4.2.2.2.1 b

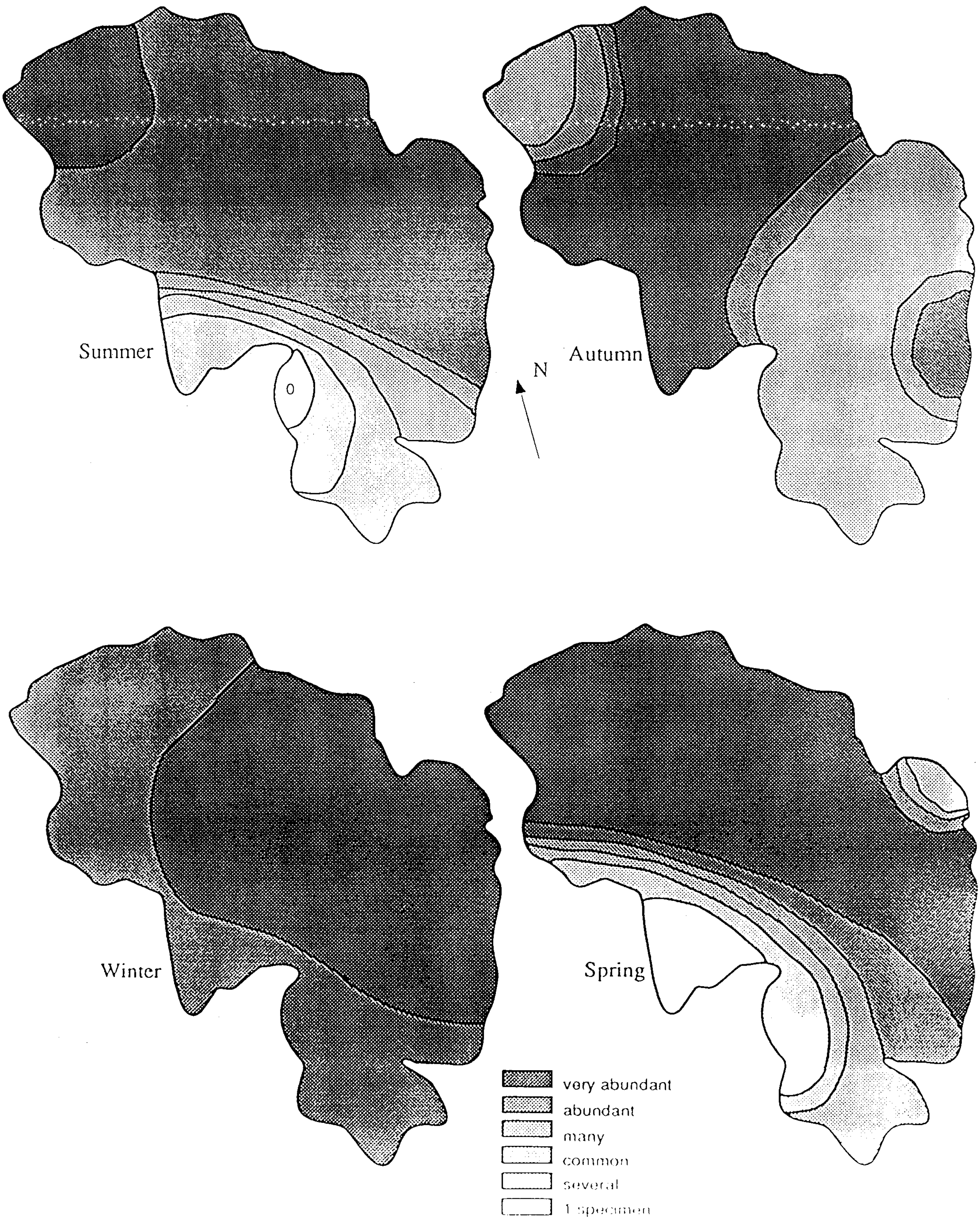
Wadi Rayan I . 10.



Distribution of the copepods from the 280μ samples.

Map 4.2.2.2.1 c

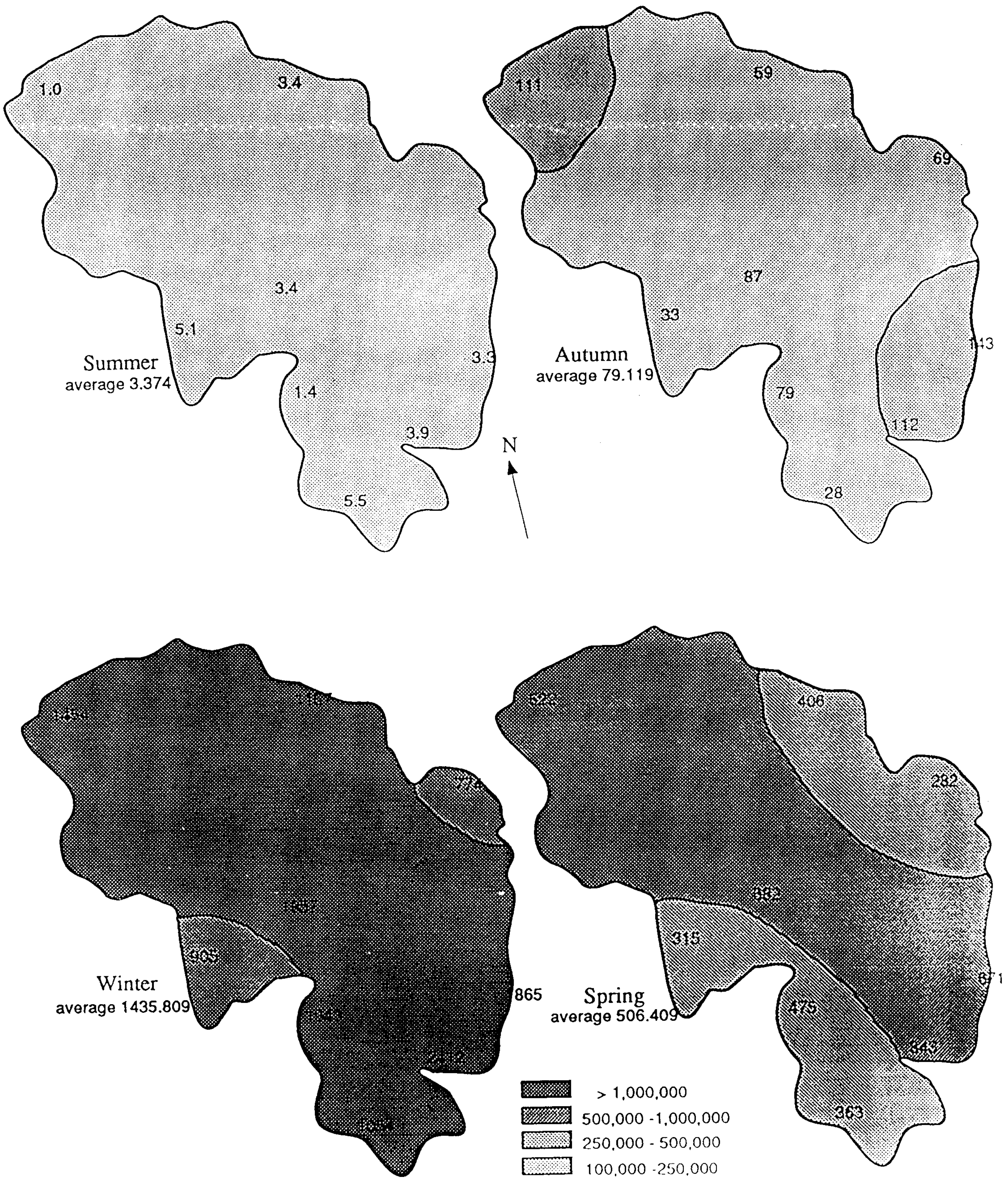
Wadi Rayan I .11.



Distribution of the cladocerans from the 280 samples

Map 4.2.2.2.2 cl.

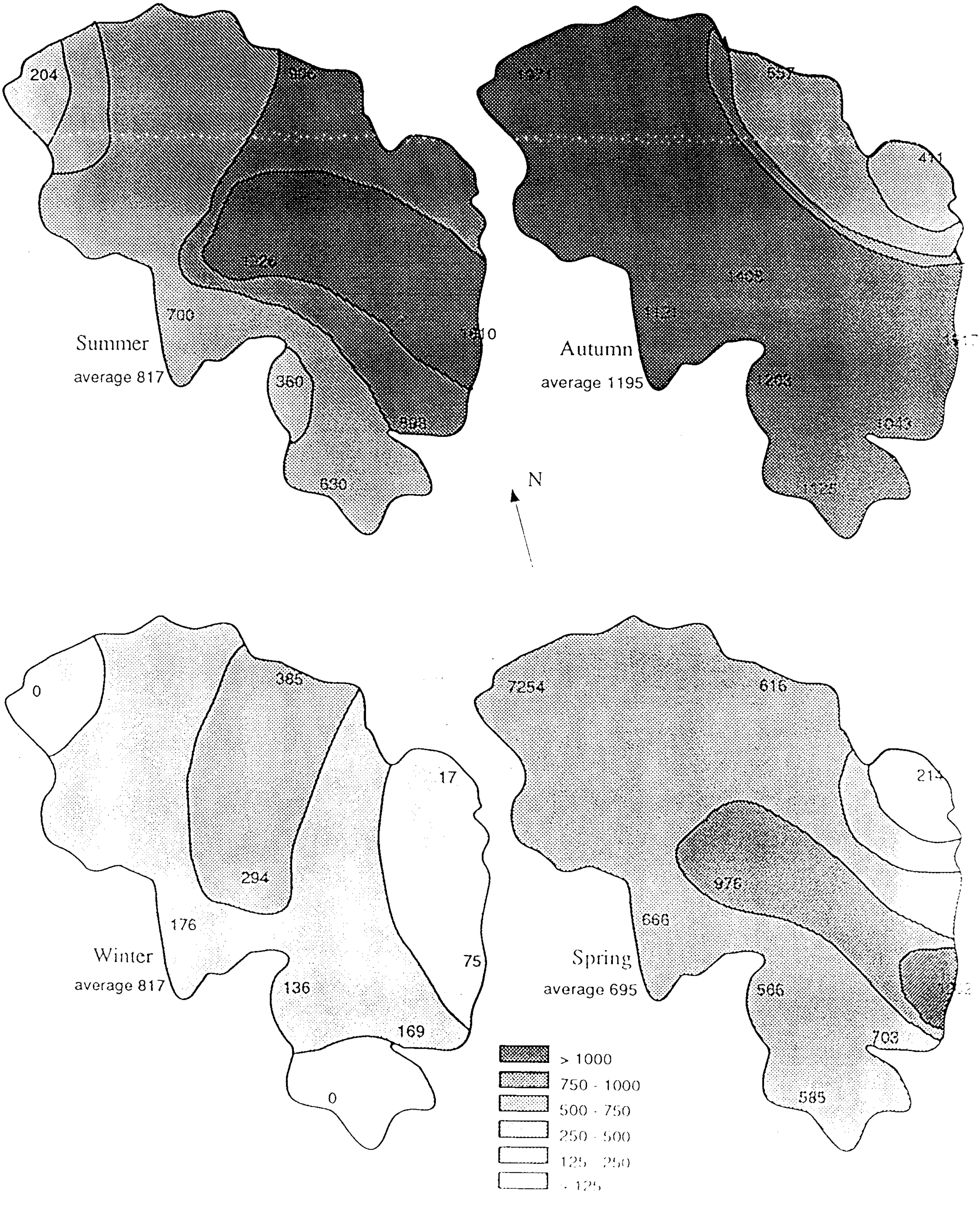
Wadi Rayan I . 12.



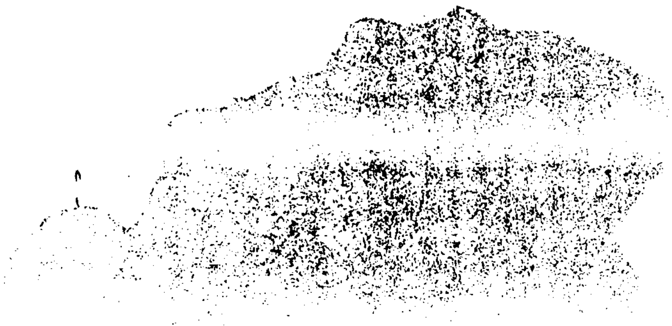
Plankton densities in number of organisms per liter.
(60μ samples)

Map 4.2.2.2.2 cII

Wadi Rayan I . 13.

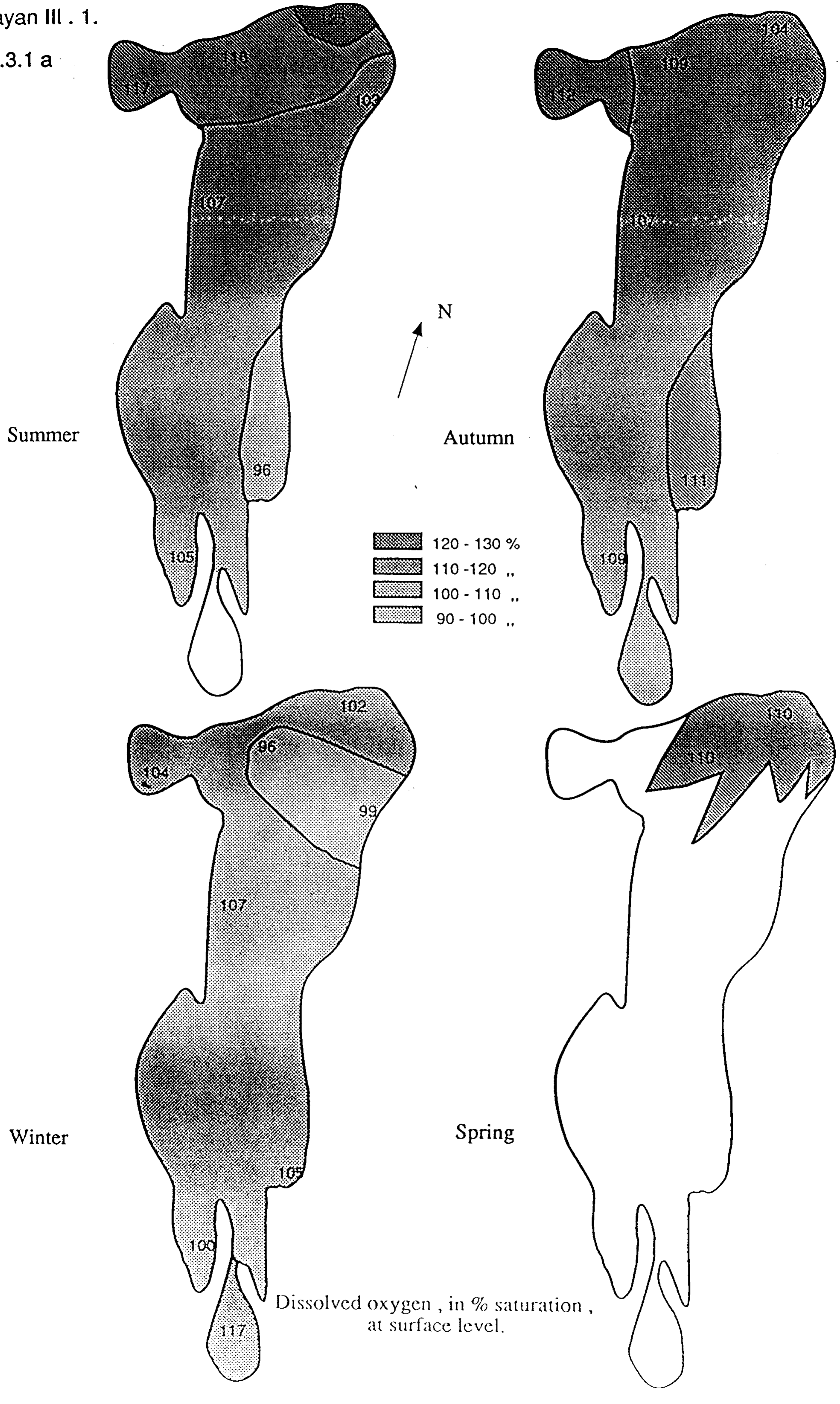


Plankton densities of zooplankton only,in number of organisms per liter (60μ samples).



Wadi Rayan III . 1.

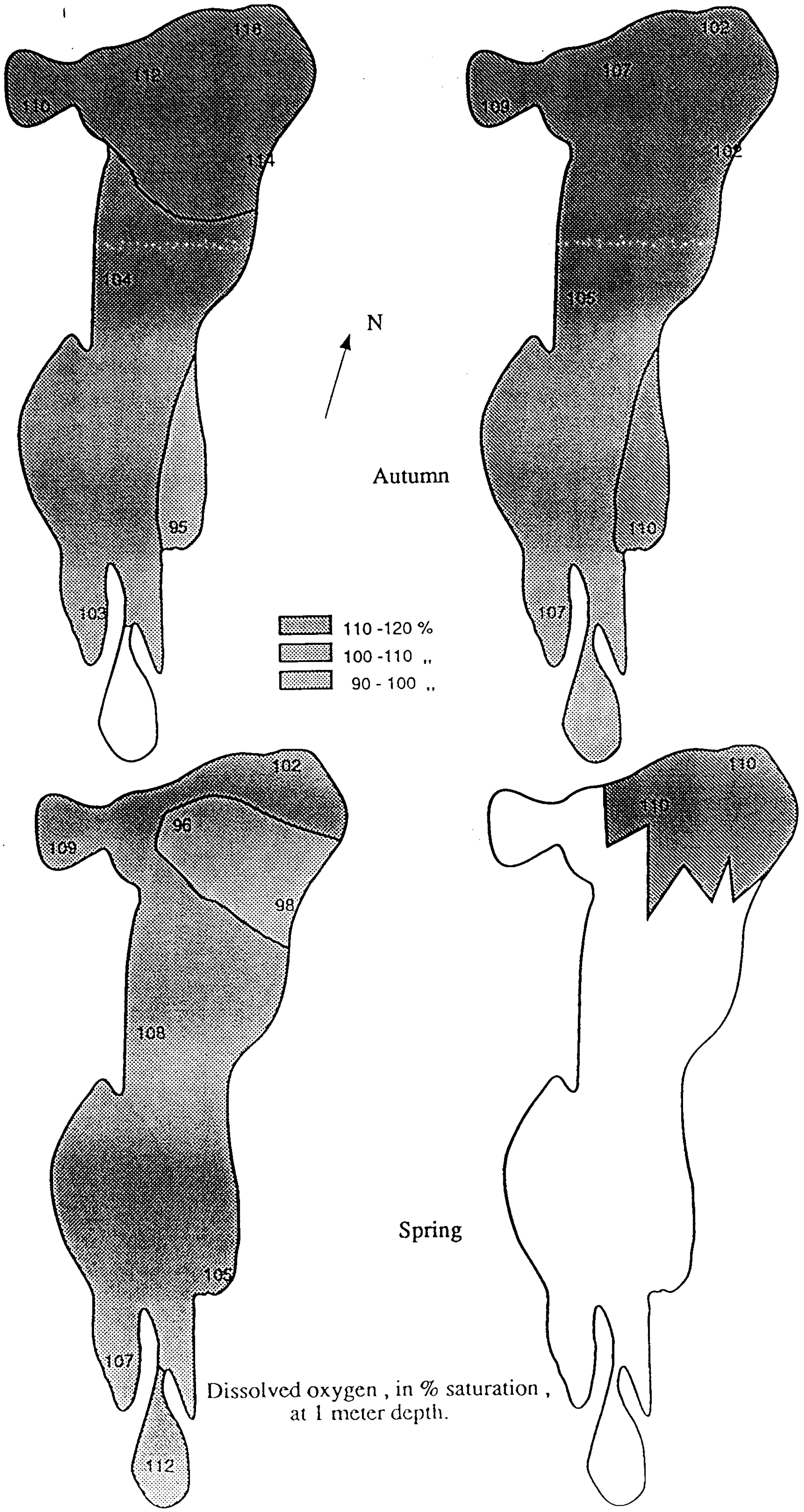
Map 4.1.3.1 a



Dissolved oxygen , in % saturation , at surface level.

Wadi Rayan III .2

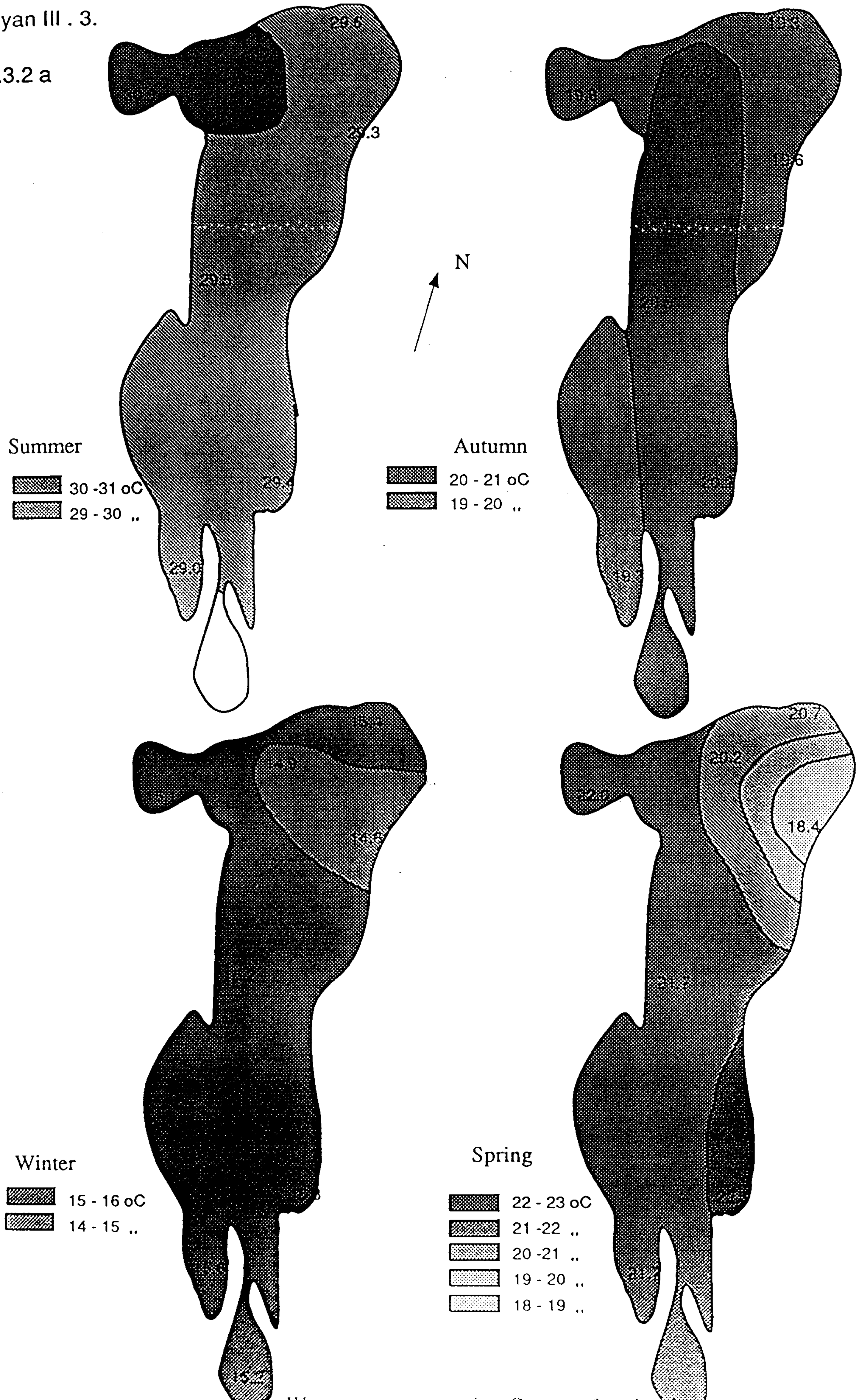
Map 4.1.3.1 b



Dissolved oxygen , in % saturation , at 1 meter depth.

Wadi Rayan III . 3.

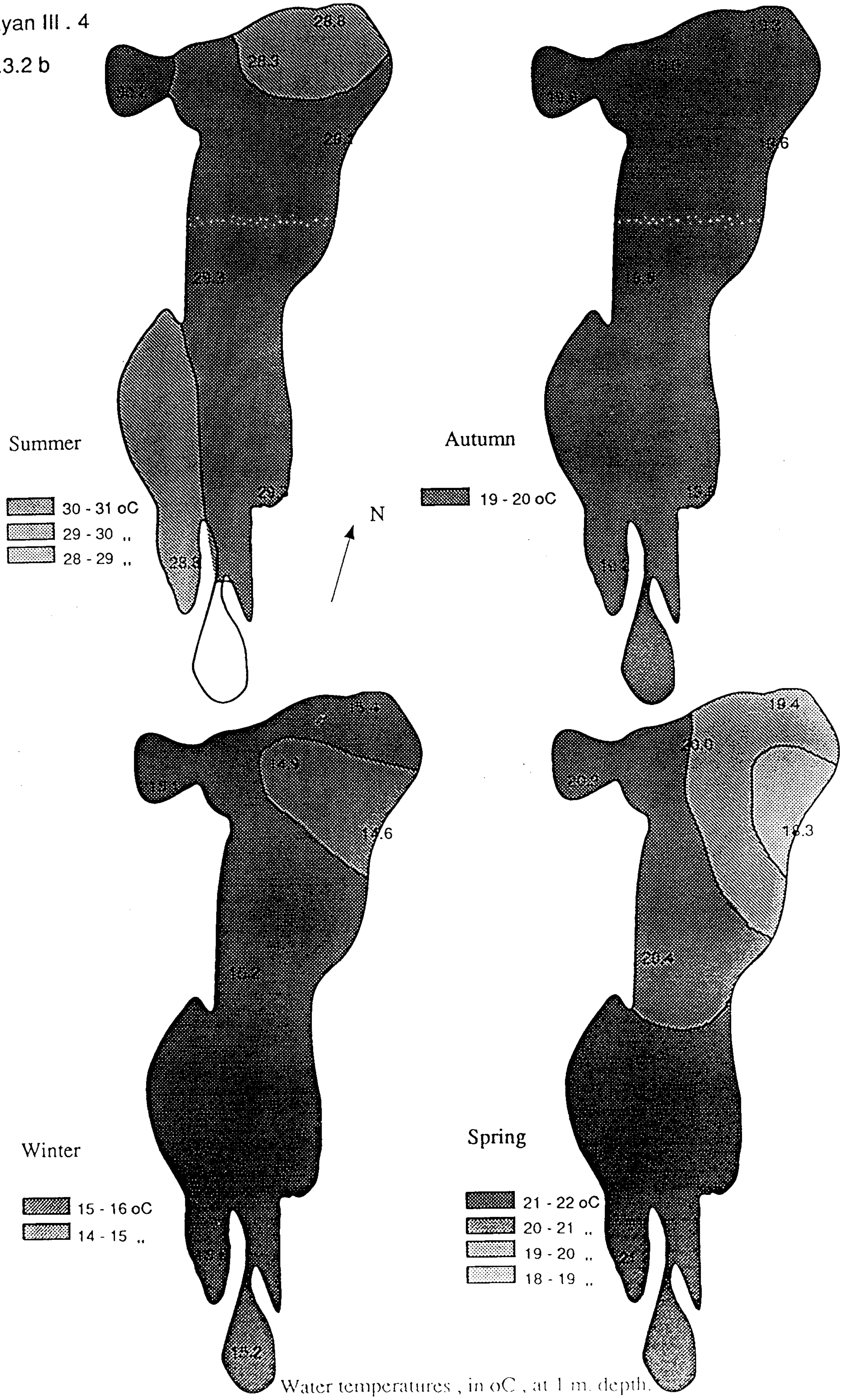
Map 4.1.3.2 a



Water temperatures ,in oC , at surface level

Wadi Rayan III . 4

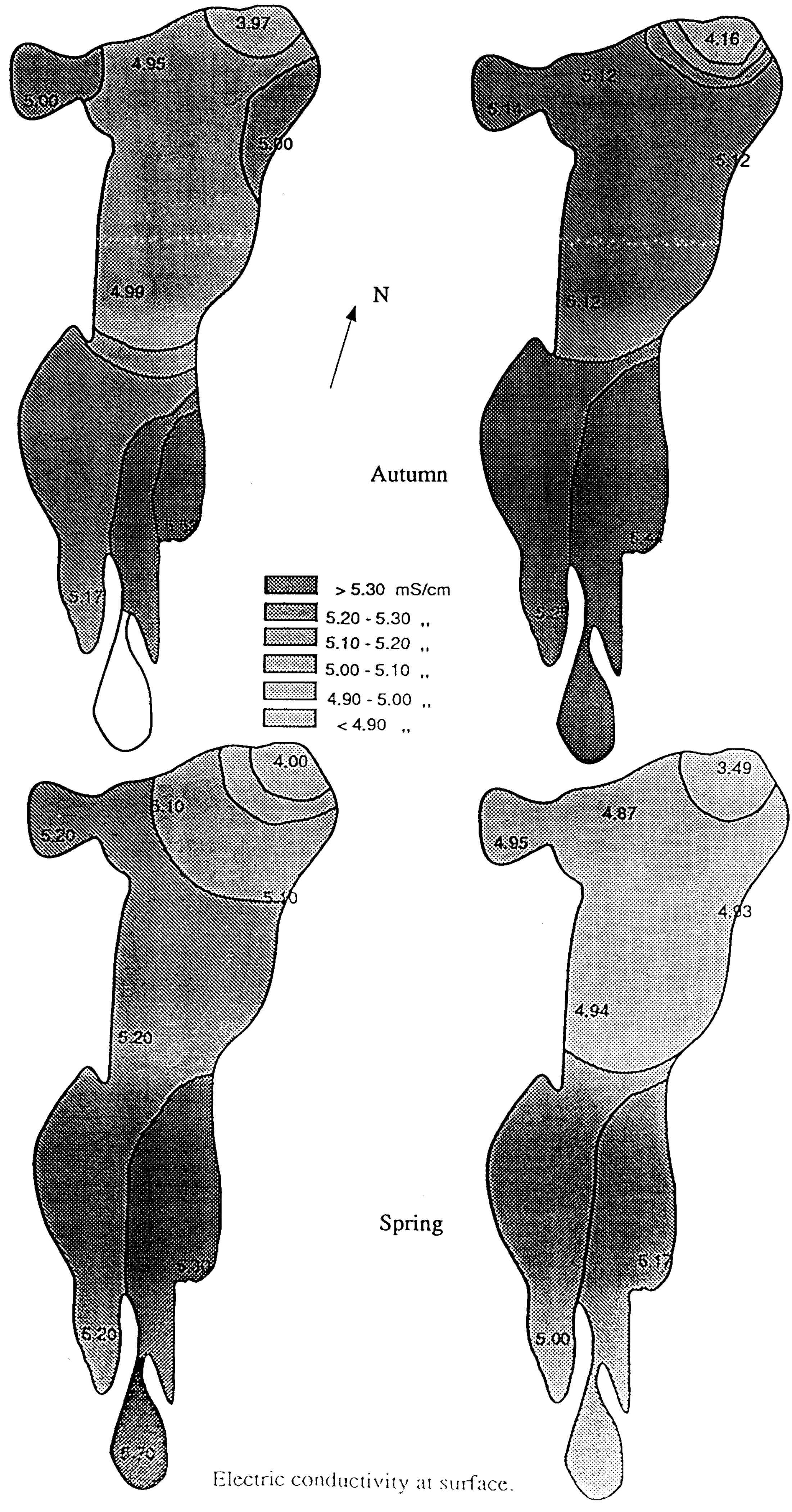
Map 4.1.3.2 b



Water temperatures , in oC , at 1 m. depth.

Wadi Rayan III . 5

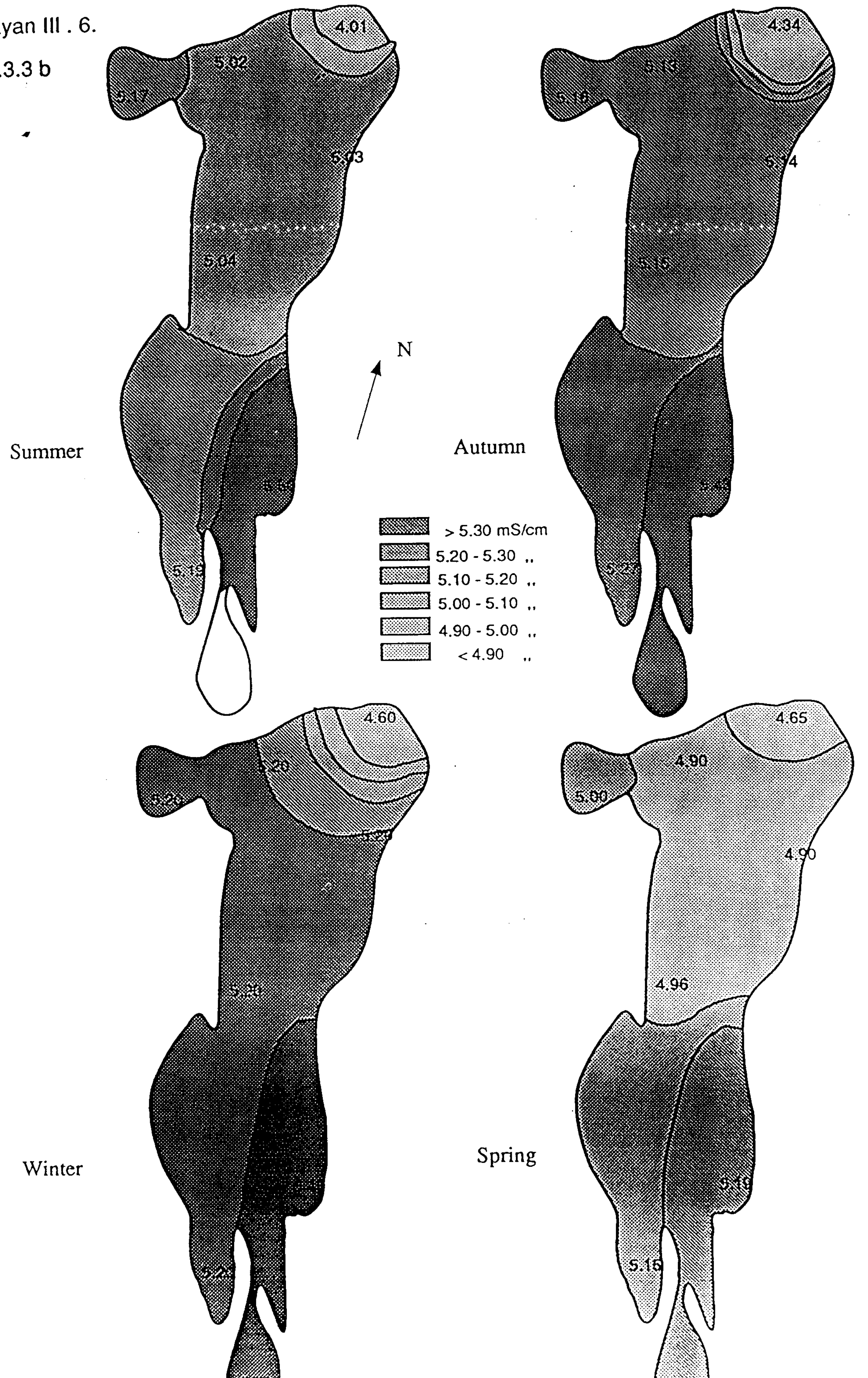
Map 4.1.3.3 a



Electric conductivity at surface.

Wadi Rayan III . 6.

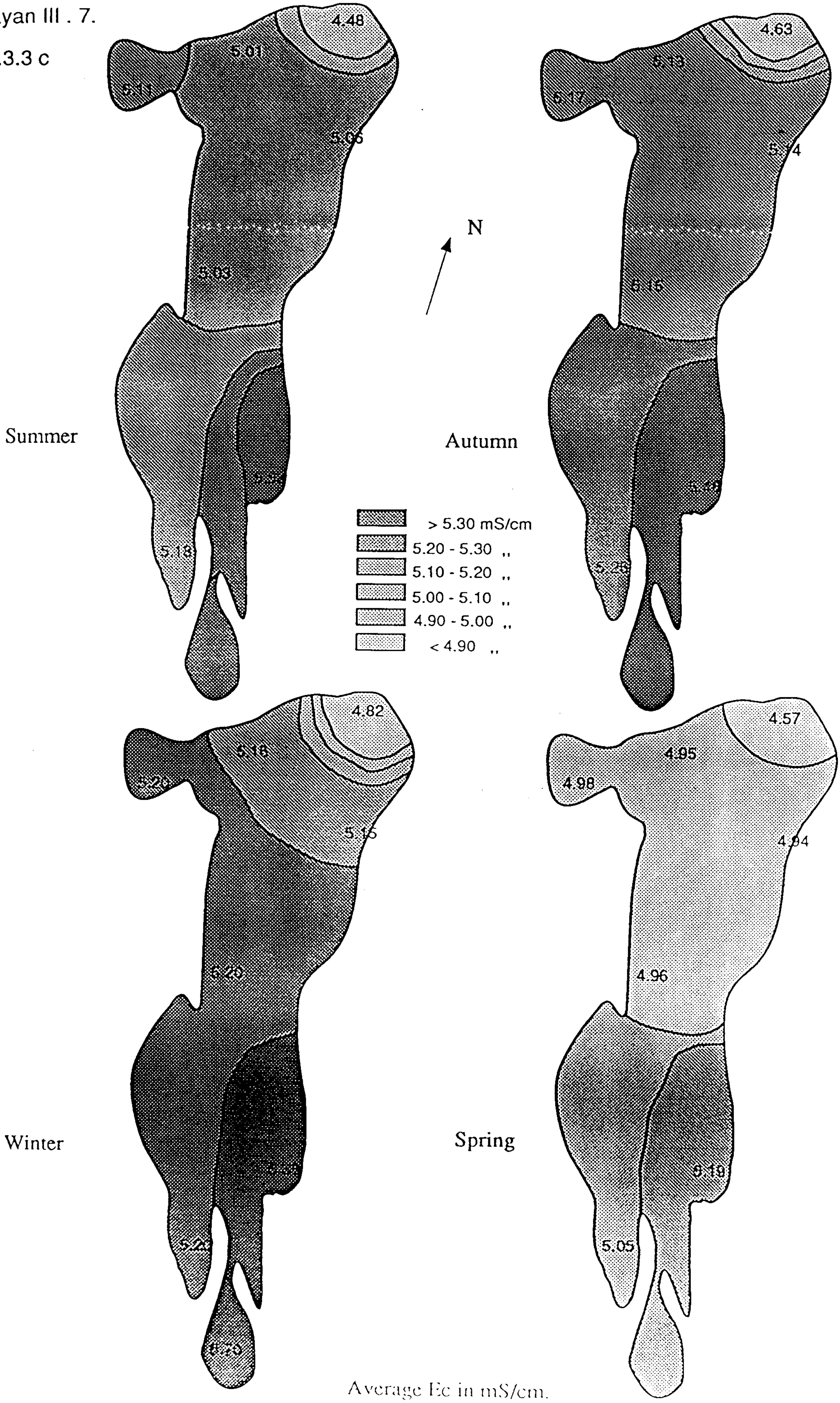
Map 4.1.3.3 b



Electric conductivity at 1 meter depth.

Wadi Rayan III . 7.

Map 4.1.3.3 c

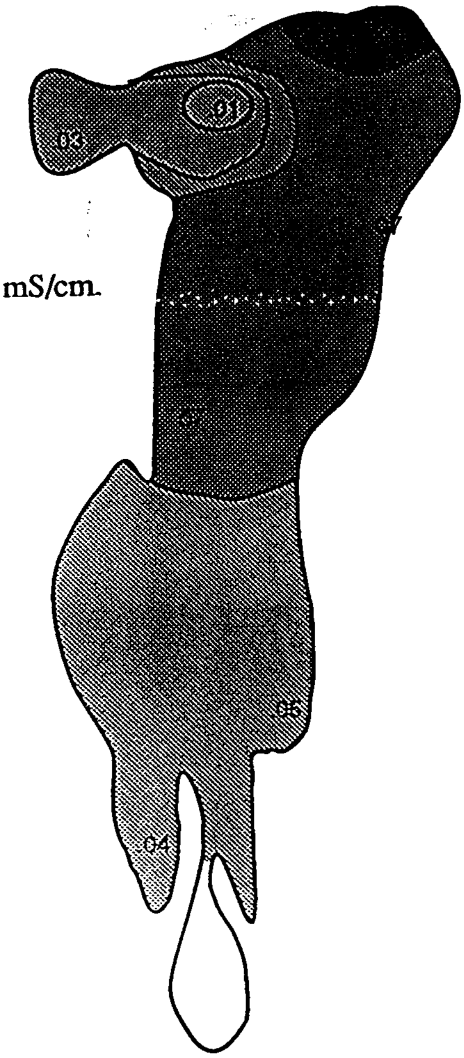


Average Ec in mS/cm.

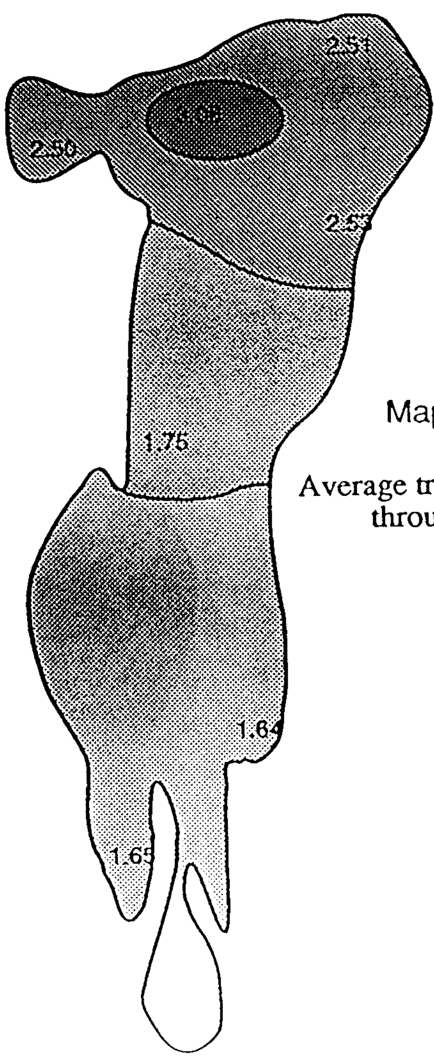
Wadi Rayan III . 8.

Map 4.1.3.3 d

Average decrease of Ec per meter depth , in mS/cm.



N

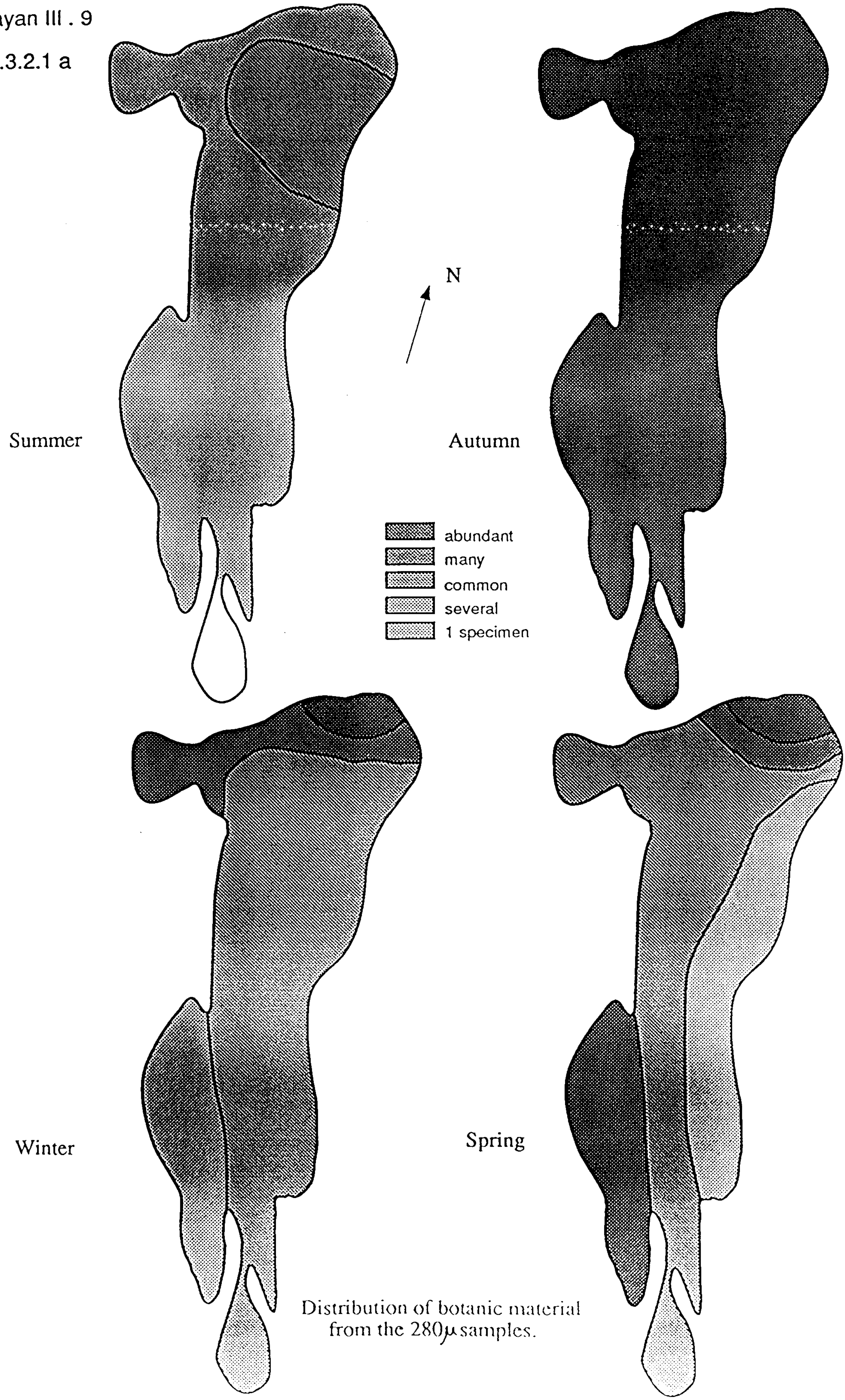


Map 4.1.3.5

Average transparency in meter, throughout the year.

Wadi Rayan III . 9

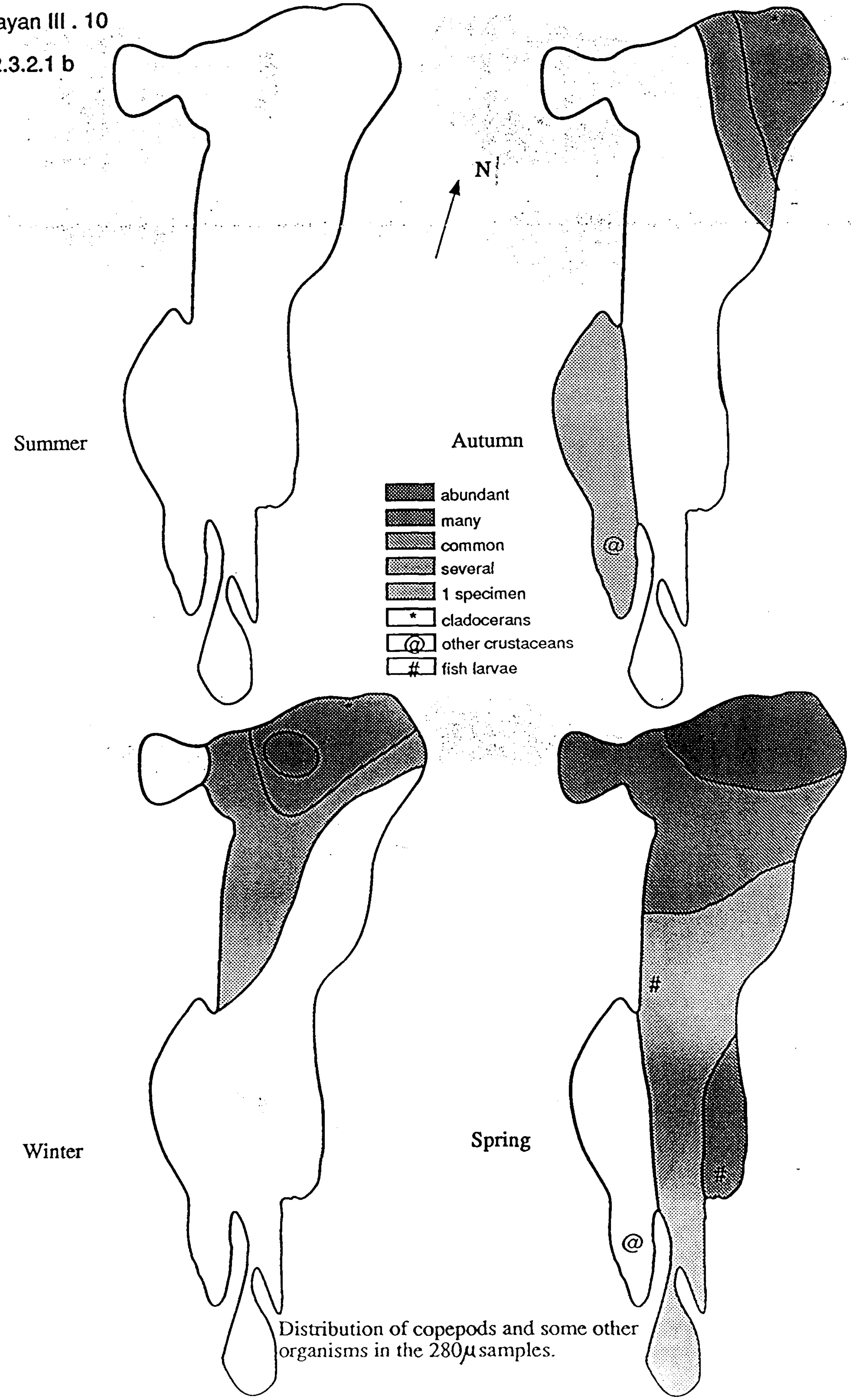
Map 4.2.3.2.1 a



Distribution of botanic material from the 280μ samples.

Wadi Rayan III . 10

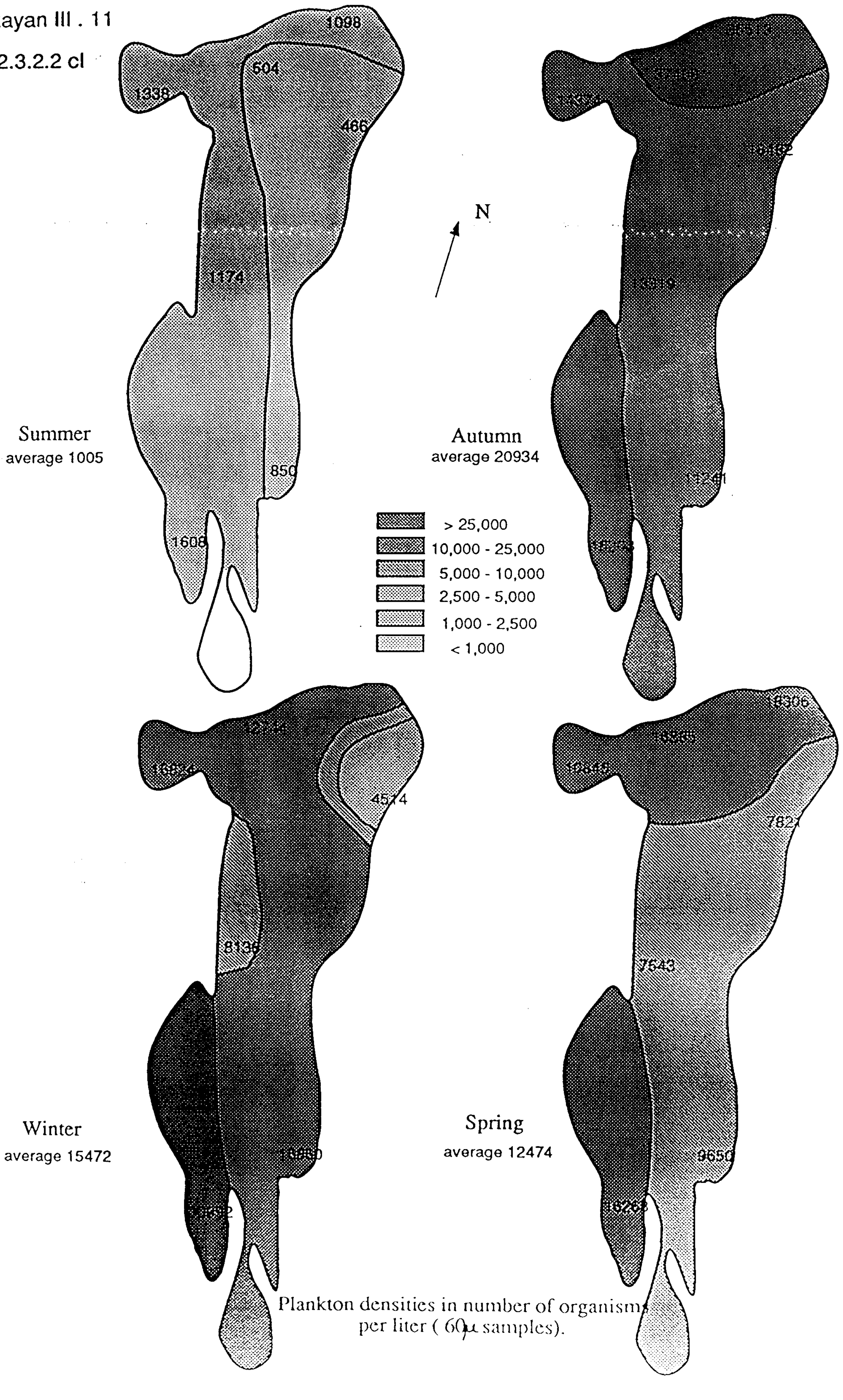
Map 4.2.3.2.1 b



Distribution of copepods and some other organisms in the 280μ samples.

Wadi Rayan III . 11

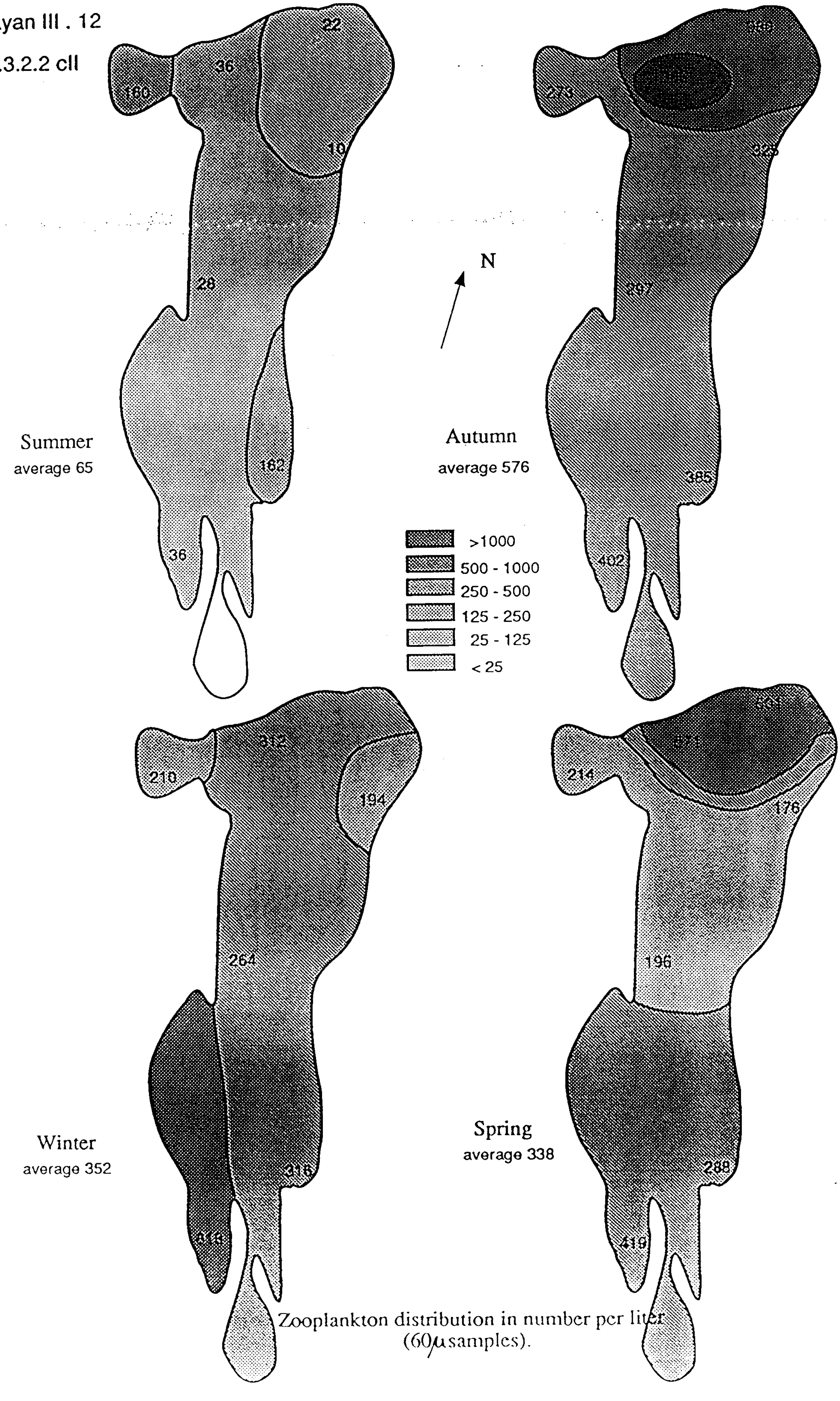
Map 4.2.3.2.2 cl



Plankton densities in number of organisms per liter (60μ samples).

Wadi Rayan III . 12

Map 4.2.3.2.2 cII



Zooplankton distribution in number per liter (60μ samples).

table 5.2.1.1.1.b.
Length frequency of *Solea aegyptiaca* in cm groups.

length group in cm.	1958-60 El Zarka		1982-1983 IOF		1987-1988 own data	
	nr	%	nr	%	nr	%
10	12	.8				
11	15	1.0			2	.2
12	23	1.6				
13	37	2.6	22	4.2		
14	64	4.4	30	5.8	11	1.0
15	99	6.9	36	6.9	25	2.2
16	96	6.7	42	8.1	68	6.1
17	173	12.0	38	7.3	151	13.5
18	241	16.7	29	5.6	221	19.7
19	248	17.2	32	6.2	223	19.9
20	223	15.5	36	6.9	167	14.9
21	93	6.5	30	5.8	93	8.3
22	43	3.0	22	4.2	53	4.7
23	24	1.7	21	4.0	38	3.4
24	23	1.6	24	4.6	29	2.6
25	10	.7	29	5.6	16	1.4
26	4	.3	25	4.8	8	.7
27	3	.2	17	3.3	7	.6
28	5	.3	19	3.7	5	.4
29	2	.1	22	4.2	2	.2
30			18	3.5	2	.2
31	1	.1	13	2.5		
32	1	.1	15	2.9		
33	1	.1				
total	1441		520		1121	
average length	18.1 ± 2.9		21.2 ± 5.4		19.2 ± 2.5	

Table 5.2.1.1.1.c
Average lenght of the four most important species from the three Fayoum lakes.(Jauary data not included).Lenght in cm. and (number of specimen)

	Liza ramada	*Oreochromis niloticus*	*Oreochromis aureus*	*Tilapia zillii*
Qarun	33.3±3.0(176)	17.9±2.2(85)	19.1±2.1(24)	15.9±2.0(38)
Rayan I	39.0±6.7(681)	23.4±6.4(491)	20.8±5.2(119)	17.7±2.7(51)
Rayan III	32.6±3.7(1041)	23.4±7.8(359)	17.8±4.0(243)	17.7±3.8(384)

Table 5.2.1.1.2.a

Length weight relation of the *Solea aegyptiaca* Chabanaud in gram per cm length group and the (Kf.)

length group in cm	own data		data from El Zarka	
9			8.6	(1.18)
10			9.2	(.92)
11	20.0	(1.50)	10.7	(.80)
12			12.9	(.75)
13			18.5	(.84)
14	30.0	(1.09)	21.9	(.80)
15	47.1	(1.40)	26.8	(.79)
16	47.9	(1.09)	33.7	(.82)
17	53.4	(1.09)	40.4	(.82)
18	60.0	(1.03)	48.9	(.84)
19	70.1	(1.02)	54.0	(.80)
20	78.5	(.98)	62.9	(.79)
21	97.0	(1.05)	74.8	(.81)
22	117.9	(1.11)	83.9	(.79)
23	124.7	(1.02)	87.2	(.72)
24	132.0	(.95)	104.8	(.76)
25	174.0	(1.11)	101.3	(.65)
26			96.5	(.55)
27	182.5	(.93)	139.0	(.71)
28	211.7	(.96)	148.5	(.68)
29	225.0	(.92)		
30	327.5	(1.21)		
31			227.0	(.76)
average weight	76.1		49.7	
average Kf	1.09 ± .15		.79 ± .11	

Table 5.2.1.1.3.a.

Mullet fry introduced in various years to lake Qarun in numbers x 1000.

Year	Mugil cephalus	Liza ramada	total	source
1928	20	0	20	Faouzi
1929	0	0	0	,,
1930	0	0	0	,,
1931	0	0	0	,,
1932			154	,,
1933			136	,,
1934			257	,,
1935			259	,,
1971	955	200	1155	Ishak '82
1972	1329	1210	2539	,,
1973	1199	1226	2425	,,
1974	1098	1226	2324	,,
1975	3612	4452	8064	,,
1976	1948	6107	8055	,,
1977	6065	8844	14909	,,
1978	0	14940	14940	,,
1979	1608	5262	6870	El Bolock '83
1980	1280	26330	27610	,,
1981	0	21183	21183	,,
1982	500	21780	22280	GAFRD (coop)
1983	0	26000	26000	,,
1984	7500	37000	44500	,,
1985	18000	35000	53000	,,
1986	0	52000	52000	,,
1987	0	48612	48612	,,
1988	-	-	29618	,,

Table 5.2.1.1.3.b.

Catch statics of grey mullet in tons

1929	0.2	Faouzi '36
1930	0.4	,,
1931	0.1	,,
1932	1.2	,,
1933	2.8	,,
1934	42.3	,,
1935	341.7	,,
1962	452.	El Zarka '68
1963	285.	,,
1964	288.	,,
1965	205.	,,
1966	125.	,,
1967	136.	Ishak '81
1968	141.	,,
1969	130.	,,
1976	303.	El Bolock '83
1977	244.	,,
1978	237.	,,
1979	382.	,,
1980	463.	,,
1981	212.	,,
1982	338.	,,
1983	365.	GAFRD (coop)
1984	184.	,,
1985	299.	,,
1986	484.	,,
1987	222.	,,
1988	88.	,,

Table 5.2.1.1.3.d
Comparison of the number of fry released and the amount of fish caught.

year	A number of fry stocked x 1000	B catch 2 years after stocking in tons	C number of fish caught x 1000	A/B	C/A
1974	2324	303	1010	7.7	43.5
1975	8064	244	813	33.0	10.1
1976	8055	237	790	34.0	9.8
1977	14909	382	1273	39.0	8.5
1978	14940	463	1543	32.3	10.3
1979	6870	212	707	32.4	10.3
1980	27610	338	1127	81.7	4.1
1981	21183	365	1217	58.0	5.7
1982	22280	184	613	121.1	2.8
1983	26000	299	997	87.0	3.8
1984	44500	484	1613	91.9	3.6
1985	53000	222	740	238.7	1.4
1986	52000	88	293	590.9	.6

A/B = number of fry needed for the production of 1 ton of fish
C/A = survival rate in %.

Table 4.1.2.

Limnological features during different seasons at various depths

Average D.O. in % saturation

	Surface	1	2	3	4	5	6	7	8	9	10	15	20
Summer	110	103	102	103	97	101	107	98	85	75	19	2	4
Autumn	104	102	104	104	98	96	90	89	88	85	84	76	70
Winter	96	97	97	97	97	97	97	96	95	90	80	83	84
Spring	99	99	101	102	103	101	101	100	98	98	97	-	-

Average D.O. in p.p.m.

Summer	8.7	8.2	8.2	8.3	7.8	8.1	8.7	8	6.8	6.4	1.5	0.2	0.3
Autumn	9.5	9.4	9.5	9.7	9.2	8.9	8.5	8.4	8.2	8	7.9	6.7	6.2
Winter	9.8	10.0	10.0	10.0	10.0	10.1	10.0	9.9	9.9	8.9	8.8	8.4	8.9
Spring	9.1	9.3	9.4	9.5	9.6	9.5	9.6	9.4	9.2	9.2	9.1	-	-

Average temperature in oC

														Decl./m depth
Summer	27.9	27.8	27.6	27.5	27.1	27.3	26.8	26.7	26.6	26.4	25.6	24.2	23.8	0.21
Autumn	21.2	20.7	20.3	20.1	19.9	19.9	19.8	19.8	19.8	19.8	19.7	18.9	19.4	0.09
Winter	15.2	15.2	15.2	15.1	15.0	15.1	15.1	14.9	14.8	14.8	14.8	14.9	14.9	0.02
Spring	20.0	19.7	19.6	19.8	19.8	19.6	19.5	19.5	19.4	19.4	19.5			0.06

Average Ec in mS/cm

	Surface	1	2	3	5	6	10	15	20	Total	n
Summer	1.87	1.97	-	1.97	1.97	-	1.98	2.12	2.12	1.96	37
Autumn	1.97	2.06	-	2.06	2.06	-	2.06	2.06	2.07	2.04	34
Winter	1.99	2.07	-	2.06	2.06	-	2.07	2.07	2.08	2.05	38
Spring	2.03	2.04	2.05	2.03	2.03	2.03	2.05	-	-	2.01	36

	Transparency in m	**Air temp.in oC.**
Summer	3.8	30.5
Autumn	2.8	23.9
Winter	2.8	15.1
Spring	2.1 - 1.9 (with st. 3)	19.9

Table 4.1.2.a.

Summer . 8/9-VII-87

D.O. in % saturation

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	Bottom	Depth in m
1	101	95	94	89	84	82*								82	4.5
2	102	99	95	98	95	94								94	5.2
3	122														
4	102	95	96	102	100	100	94	72	46	42	12	2	4*	4	19.2
5	108	100	98	95	70									69	4.2
6	108	102	104	104	107	110	111	109	109	104	17			9	13.7
7	134	127	128	126	117	110	115	113	99	80	29*			29	9.5
8	111	109	110	109	109	108*								108	5.1
9	103	95	94*											94	1.7
Average	110	103	102	103	97	101	107	98	85	75	19	2	4		

D.O. in p.p.m.

1	8.1	7.5	7.5	7.2	6.7	6.6*								6.6	4.5
2	8.1	7.8	7.8	7.7	7.7	7.5								7.5	5.2
3	9.7														
4	8.1	7.6	7.8	8.2	8.3	8.1	7.8	6	3.7	3.5	0.9	0.2	0.3*	0.3	19.2
5	8.6	8.1	7.8	7.7	5.6									5.7	4.2
6	8.5	8.3	8.4	8.4	8.7	8.9	9	8.9	8.8	8.6	1.4			0.6	13.7
7	10.6	10.0	10.0	10.2	9.2	8.8	9.2	9.2	7.9	7	2.2*			2.2	9.5
8	8.7	8.8	8.6	8.8	8.7	8.7*								8.7	5.1
9	8.2	7.6	7.4*											7.4	1.7
Average	8.7	8.2	8.2	8.3	7.8	8.1	8.7	8	6.8	6.4	1.5	0.2	0.3		

Temperature in oC

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	Bottom	Depth in m
1	28.3	28.2	28.0	27.8	27.7	27.6*								27.6	4.5
2	28.0	28.0	27.9	27.7	27.4	27.4								27.3	5.2
3	27.3														
4	27.0	26.9	26.8	26.7	26.3	26.2	26.0	26.0	25.8	25.7	25.4	24.2	23.8*	23.8	19.2
5	27.6	27.5	27.2	27.2	25.8									25.8	4.2
6	28.6	27.8	27.3	27.2	27.0	27.0	26.9	26.8	26.7	26.5	25.4			25.1	13.7
7	28.8	28.7	28.3	28.1	27.9	27.7	27.6	27.4	27.3	27.0	26.0*			26	9.5
8	27.8	27.8	27.9	27.8	27.9	27.8*								27.8	5.1
9	27.6	27.6	27.5*											27.5	1.7
Average	27.9	27.8	27.6	27.5	27.1	27.3	26.8	26.7	26.6	26.4	25.6	24.2	23.8		

Ec in mS/cm

Station	Surface	1	3	5	10	15	20	Bottom	(m)	Av./station	Transp.	Air temp.	pH
1	1936	1953	1949	1937*				1937	4.5	1944	3.5	33.5	-
2	1964	1998	1977	1982*				1982	5.2	1980	-	27.5	8.6
3	1080	-	-	-	-	-	-	-	-	1080	-	31.2	7.8
4	1962	1975	1978	1984	1988	2120	2120*	2120	19.2	2018	3.6	33.5	-
5	1967	1982	1968	1978*	-	-	-	1978	4.2	1974	-	30.1	8.4
6	1970	1975	1970	1967	1995	-	-	2080	13.5	1993	-	32.4	-
7	1945	1942	1954	1951	1970*	-	-	1970	9.5	1952	-	-	-
8	1986	1990	1990	1989*	-	-	-	1989	5.1	1989	4.3	26	-
9	1992	-	-	-	-	-	-	2040	1.7	2016	-	30	-
Average													
- st.3	1965	1974	1969	1970	1984	2120	2120	-	-	-	3.8	30.5	8.3
+ st.3	1867												

Average of all measurements - st.3 = 1984 (n = 36)
+ st.3 = 1960 (n = 37)
* are bottom values.

Table 4.1.2.b

Autumn . 17-XI-87

D.O. in % saturation

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	Bottom	Depth in m
1	112	111	116	116										111	3.1
2	104	97	99	97	98*									98	3.9
3	97													-	-
4	95	92	88	88	87	86	85	85	85	85	82	76	70*	70	19.5
5	97	95	95	94	94	92*								92	4.5
6	115	112	111	108	105	103	95	93	91	85	85			80	11.5
7	113	112	111	111	108	102								100	5.3
8	109	106	107	113*										113	2.9
9	95	90	92*											92	1.5
Average	104	102	102	104	98	96	90	89	88	85	84	76	70		

D.O. in p.p.m.

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	Bottom	Depth in m
1	10	10.1	10.4	10.7										10.3	3.1
2	9.4	9.0	9.2	9.0	9.2*									9.2	3.9
3	9.4													-	-
4	8.8	8.6	8.2	8.2	8.1	8.0	8.0	8.0	7.9	7.9	7.8	6.7	6.2*	6.2	19.5
5	9.1	8.9	8.9	8.8	8.8	8.6*								8.6	4.5
6	10.5	10.4	10.2	10.1	9.8	9.6	8.9	8.7	8.4	8.0	7.9			7.7	11.5
7	10.1	10.3	10.3	10.3	10.0	9.5								9.3	5.3
8	9.8	9.5	9.9	10.5*										10.5	2.9
9	8.8	8.4	8.5*											8.5	1.5
Average	9.5	9.4	9.5	9.7	9.2	8.9	8.5	8.4	8.2	8.0	7.9	6.7	6.2		

Temperature in oC

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	Bottom	Depth in m
1	22.2	21.7	21.0	20.5										20.4	3.1
2	21.1	20.3	20.1	19.9	19.9*									19.9	3.9
3	18.5													-	-
4	20.4	20.2	20.1	20	19.8	19.8	19.7	19.7	19.7	19.7	19.6	19.9	19.4*	19.4	19.5
5	20.2	20.1	19.9	19.6	19.5	19.5*								19.5	4.5
6	21.2	20.5	20.2	20.1	20.0	20.0	19.9	19.9	19.8	19.8	19.8			19.9	11.5
7	22.0	20.7	20.4	20.3	20.1	20.1								20.0	5.3
8	21.7	21.6	20.5	20.3*										20.3	2.9
9	20.5	20.4	20.3*											20.3	1.5
Average	21.2	20.7	20.3	20.1	19.9	19.9	19.8	19.8	19.8	19.8	19.7	19.9	19.4		

Ec in mS/cm **Transp. Air temp pH**

Station	Surface	1	3	5	10	15	20	Bottom	(m)	Ave./station	Transp.	Air temp	pH
1	2.04	2.05	2.05*					2.05	3.1	2.05	2.85	26.0	-
2	2.04	2.05	2.06					2.06	3.9	2.05	2.35	25.0	-
3	1.4							-	-	1.40	0.3	18.0	-
4	2.04	2.05	2.05	2.04	2.06	2.06	2.07*	2.07	19.5	2.05	3.00	21.5	-
5	2.04	2.06	2.07	2.07*				2.07	4.5	2.06	2.80	23.0	-
6	2.05	2.07	2.06	2.06	2.06			2.05	11.5	2.06	2.50	27.0	-
7	2.04	2.05	2.05	2.06*				2.06	5.3	2.05	2.90	26.5	-
8	2.05	2.06	2.06*					2.06	2.9	2.06	2.90	25.0	-
9	2.06	2.06*						2.06	1.5	2.06	-	23.0	-
Average													
- st 3	2.05	2.06	2.06	2.06	2.06	2.06	2.07				2.45	23.9	
+ st 3					1.97								

Average of all stations - st 3 2.05 (33)
\+ st 3 2.04 (34)

* are bottom values.

Table 4.1.2.c.

Winter . 23-II-88

DO in % saturation

stat.	surf.	1	2	3	4	5	6	7	8	9	10	15	20	bottom	(depth)
1	97	96	97	97	97	97	96*							96	5.8
2	100	98	100	99	99	97*								97	4.6
3	83														
4	96	95	95	94	94	92	92	91	90	89	79	83	84*	84	19.5
5	89	91	91	91	91									89	4.1
6	92	94	93	3	93	93	94	91	92	91	89			83	12.7
7	108	106	106	109	108	106	107	106	104*					104	8
8	100	98	97	98	97*									97	3.5
9	97	97	96*											96	1.6
average	96	97	97	97	97	97	97	96	95	90	80	83	84		

DO in p.p.m.

1	9.8	9.8	9.9	9.8	9.9	9.9	9.8*							9.8	5.8
2	10.2	10.1	10.3	10.3	10.3	10.2*								10.2	4.6
3	8.3														
4	9.8	9.7	0.7	9.7	9.7	9.6	9.6	9.5	9.4	8.2	8.2	8.4	8.9*	8.9	19.5
5	9.3	9.6	9.6	9.5	9.5									9.2	4.1
6	9.5	9.7	9.6	9.5	9.6	9.6	9.6	9.3	9.5	9.5	9.3			8.6	12.7
7	10.8	10.7	10.9	11.2	11.0	11.1	10.9	11	10.8*					10.8	8.0
8	10.2	10.2	10.0	10.2	10.1*									10.1	3.5
9	10.0	9.9	10.3*											10.3	1.6
average	9.8	10.0	10.0	10.0	10.0	10.1	10	9.9	9.9	8.9	8.8	8.4	8.9		

Temperature in oC

1	15.6	15.7	15.7	15.7	15.6	15.6	15.6*							15.6	5.8
2	15.2	15.1	15.1	15.0	14.9	14.8*								14.8	4.6
3	15.6														
4	15.2	15.2	15.2	15.0	15.0	14.9	14.9	14.8	14.8	14.8	14.8	14.9	14.9*	14.9	19.5
5	14.6	14.6	14.7	14.7	14.7									14.7	4.1
6	15.0	15.0	15.0	15.0	15.0	15.0	14.9	14.9	14.8	14.8	14.8			14.8	12.7
7	15.9	15.9	15.9	15.7	15.5	15.3	15.0	14.9	14.9*					14.9	8.0
8	14.7	14.8	14.7	14.6	14.6*									14.6	3.5
9	15.1	15.1	15.1*											15.1	1.6
Av.	15.2	15.2	15.2	15.1	15..0	15.1	15.1	14.9	14.8	14.8	14.8	14.9	14.9		

Conductivity in mS/cm

Station	Surface	1	3	5	10	15	20	Bottom	Depth	Aver.Ec/Stat.	Transp	air temp
1	2.02	2.04	2.03	2.03				2.03	5.8	2.03	2.5	16.0
2	2.07	2.07	2.07	2.07*				2.07	4.6	2.07	2.8	16.0
3	1.42									1.42	-	14.0
4	2.07	2.07	2.06	2.06	2.06	2.07	2.08*	2.08	19.5	2.07	2.5	14.0
5	2.07	2.07	2.07					2.07	4.2	2.07	3.7	-
6	2.07	2.07	2.07	2.07	2.07			2.08	12.7	2.07	3.0	14.0
7	2.07	2.07	2.07	2.07				2.07	8.0	2.07	2.3	16.0
8	2.07	2.07	2.08*					2.08	3.5	2.07	2.8	15.0
9	2.07	2.07						2.07	1.6	2.07	-	-
Average	1.99	2.07	2.06	2.06	2.07	2.07	2.08					
- St.3	2.06											

Table 4.1.2.d.

Spring . 20/21-IV-88

DO in % saturation

station	surface	1	2	3	4	5	6	7	8	9	10	15	20	bottom	depth
1	101	101	101	101	101									100	4.5
2	-														
3	96														
4	92	94	96	99	101	101	101	100	98	98	97			73	13.1
5	105	103	105	106	106									106	3.8
6	-														
7	-														
8	-														
9	-														
average	99	99	101	102	103	101	101	100	98	98	97				

DO in p.p.m.

station	surface	1	2	3	4	5	6	7	8	9	10	15	20	bottom	depth
1	9.3	9.3	9.4	9.4	9.4									9.3	4.5
2	-														
3	8.5														
4	8.7	8.9	8.9	9.3	9.4	9.5	9.6	9.4	9.2	9.2	9.1			6.7	13.1
5	10	9.7	9.8	9.9	9.9									9.9	3.8
6	-														
7 -	-														
8	-														
9	-														
average	9.1	9.3	9.4	9.5	9.6	9.5	9.6	9.4	9.2	9.2	9.1				

Temp. in oC

station	surface	1	2	3	4	5	6	7	8	9	10	15	20	bottom	depth
1	20.2	20.2	20.1	20.1	19.9									19.9	4.5
2	19.9	19.8		19.7		19.5	19.4*							19.4	6.0
3	21.8														
4	19.7	19.7	19.8	19.7	19.7	19.7	19.6	19.5	19.4	19.4	19.3			19.3	13.1
5	19.5	19.5	19.5	19.6										19.6	3.8
6	20.1	19.9		19.9		19.7					19.7			19.7	12.5
7	19.8	19.6		19.7		19.5								19.4	6.2
8	19.7	19.5	19.4*											19.4	2.1
9	19.5	19.4	19.4*											19.4	2.1
Av.	20	19.7	19.6	19.8	19.8	19.6	19.5	19.5	19.4	19.4	19.5				

Ec in mS/cm

Station	Surface	1	2	3	5	6	10	Bottom	Depth	Aver.Ec.stat.	Transp.	Air temp.
1	2.01	2.00		2.01	2.01*			2.01	4.5	2.01	1.60	23.0
2	2.03	2.04		2.04	2.03	2.03*		2.03	6.0	2.03	2.30	19.0
3	1.25									1.25	0.18	25.0
4	2.03	2.04		2.04	2.04		2.04	2.05	13.1	2.04	2.40	22.0
5	2.03	2.05		2.04*				2.04	3.8	2.04	2.10	21.5
6	2.03	2.04		2.04	2.04		2.06	2.05	12.5	2.04	2.30	19.0
7	2.02	2.02		2.03	2.02			2.02	6.2	2.02	1.90	15.0
8	2.03	2.04	2.04*					2.04	2.1	2.04	2.10	16.0
9	2.04	2.06	2.06*					2.06	2.1	2.05	2.10	19.0
Avecrage	2.03	2.04	2.05	2.03	2.03	2.03	2.05				1.89	19.9
+ st.3	1.94											

Average of all 35 measurements 2.03 (station 3 not included).

* are bottom values.

Table 4.1.2.1.
D.O. in % saturation at surface and (1 m depth)

Station	Summer		Autumn		Winter		Spring	
1	101	(95)	112	(11)	97	(96)	101	(101)
2	102	(99)	104	(97)	100	(98)	-	
3	112		97		83		96	
4	102	(95)	95	(92)	96	(95)	92	(94)
5	108	(100)	97	(95)	89	(91)	105	(103)
6	108	(102)	115	(112)	92	(94)	-	
7	134	(127)	113	(112)	108	(106)	-	
8	111	(109)	109	(106)	100	(98)	-	
9	103	(95)	95	(90)	97	(97)		
average	110	(103)	104	(102)	96	(97)	99	(99)

Table 4.1.2.2.a.
Temperature in °C at surface and (1 m)

Station	Summer		Autumn		Winter		Spring	
1	28.3	(28.2)	22.2	(21.7)	15.6	(15.7)	20.2	(20.2)
2	28.0	(28.0)	21.1	(20.3)	15.2	(15.1)	19.9	(19.8)
3	27.3		18.5		15.6		21.8	
4	27.0	(26.9)	20.4	(20.2)	15.2	(15.2)	19.7	(19.7)
5	27.6	(27.5)	20.2	(20.1)	14.6	(14.6)	19.5	(19.5)
6	28.6	(27.8)	21.2	(20.5)	15.0	(15.0)	20.1	(19.9)
7	28.8	(28.7)	22.0	(20.7)	15.9	(15.9)	19.8	(19.6)
8	27.8	(27.8)	21.7	(21.6)	14.7	(14.8)	19.7	(19.5)
9	27.6	(27.6)	20.5	(20.4)	15.1	(15.1)	19.5	(19.4)
average.	27.9	(27.8)	20.9	(20.7)	15.2	(15.2)	20.0	(19.7)
σn	.6	(.5)	1.1	(.6)	.4	(.4)	.7	(.2)

Table 4.1.2.2.b.
Temperature decrease in °C/m depth

Station	Summer	Autumn	Winter	Spring
1	.16	.58	.02	.07
2	.12	.31	.09	.08
3	-	-	-	-
4	.17	.05	.02	.04
5	.42	.16	.02	.03
6	.26	.12	.02	.03
7	.27	.38	.13	.06
8	.02	.48	.06	.14
9	.06	.13	.00	.05
average	.16	.07	.01	.02

Table 4.1.2.3.a.
Ec at surface and (1 m) in mS / cm.

Station	Summer		Autumn		Winter		Spring		Average	
1	1.936	(1.953)	2.04	(2.05)	2.02	(2.04)	2.01	(2.00)	2.00	(2.01)
2	1.964	(1.998)	2.04	(2.05)	2.07	(2.07)	2.03	(2.04)	2.03	(2.04)
3	1.080	(-)	1.40	(-)	1.42	(-)	1.25	(-)	1.29	(-)
4	1.962	(1.975)	2.04	(2.05)	2.07	(2.07)	2.03	(2.04)	2.03	(2.03)
5	1.967	(1.982)	2.04	(2.06)	2.07	(2.07)	2.03	(2.05)	2.03	(2.04)
6	1.970	(1.975)	2.05	(2.07)	2.07	(2.07)	2.03	(2.04)	2.03	(2.04)
7	1.945	(1.942)	2.04	(2.05)	2.07	(2.07)	2.02	(2.02)	2.02	(2.02)
8	1.986	(1.990)	2.05	(2.06)	2.07	(2.07)	2.03	(2.04)	2.03	(2.04)
9	1.996	(-)	2.06	(2.06)	2.07	(2.07)	2.04	(2.06)	2.04	(2.05)
Aveerage	1.867		1.97		1.99		1.94		1.94	
Aveerage-st3	1.965	(1.974)	2.05	(2.06)	2.06	(2.07)	2.03	(2.04)	2.03	(2.04)

Table 4.1.2.3.b.
Average Ec over all depths Ec in mS/cm.

Station	Summer	Autumn	Winter	Spring	Average
1	1.94	2.05	2.03	2.01	2.01
2	1.98	2.05	2.07	2.03	2.03
3	1.08	1.40	1.42	1.25	1.39
4	2.02	2.05	2.07	2.04	2.05
5	1.97	2.06	2.07	2.04	2.04
6	1.99	2.06	2.07	2.04	2.04
7	1.95	2.05	2.07	2.02	2.02
8	1.99	2.06	2.07	2.04	2.04
9	2.02	2.06	2.07	2.05	2.05
Total					
Aveerage	1.96(37)*	2.04(34)	2.05(38)	2.01(36)	2.01(145)
Average-st.3	1.98(36)	2.05(33)	2.06(37)	2.03(35)	2.03(141)

* nr of measurements

Table 4.1.2.3.c.
Average Ec variation per m depth

Station	Summer	Autumn	Winter	Spring	Average
1	.04	.03	.03	.02	.03
2	.07	.05	.00	.02	.035
3	-	-	-	-	-
4	.08	.02	.01	.01	.03
5	.03	.07	.00	.05	.038
6	.08	.02	.00	.01	.028
7	.03	.04	.00	.02	.023
8	.01	.03	.03	.05	.03
9	-	.00	.00	.10	.033
Aveerage	.05	.03	.01	.04	.033

Table 4.1.2.5.
Transparency in m.

Station	Summer	Autumn	Winter	Spring	Average
1	3.50	2.85	2.50	1.60	2.32
2	-	2.35	2.80	2.30	2.48
3	-	0.30	-	.18	.24
4	3.60	3.00	2.50	2.40	2.63
5	-	2.80	3.70	2.10	2.87
6	-	2.50	3.00	2.30	2.60
7	-	2.90	2.30	1.90	2.37
8	4.30	2.90	2.80	2.10	2.60
9	-	-	-	2.10	
1+4+8	3.80	2.92	2.60	2.03	
Average					
+ st.3	-	2.45	-	1.89	
- st.3	3.80	2.76	2.80	2.10	

Table 4.1.2.6.
Air temperature in °C

Station	Summer	Autumn	Winter	Spring
1	33.5	26.0	16.0	23.0
2	27.5	25.0	16.0	19.0
3	31.2	18.0	14.0	25.0
4	33.5	21.5	14.0	22.0
5	30.1	23.0	-	21.5
6	32.4	27.0	14.0	19.0
7	-	26.5	16.0	15.0
8	26.0	25.0	15.0	16.0
9	30.0	23.0	16.0	19.0
aveerage	30.5	23.9	15.0	19.9

Table 4.1.2.7.
Average depth per profile

profile	average depth
A	6.7 m
B	8.9 m
C	12.1 m
D	12.1 m
E	10.1 m
F	10.3 m
G	13.0 m

Average = 10.7 m
Surface = 5090 ha
Volume= 5.44×10^6 m^3

Table 4.2.2.1.3.

Fry transport from El Girby (Damietta) to Wadi Rayan I lake (predominantly grey mullet).

	water in transport tanks				water in unloading areas				number of fry x 1000	number trucks loads
date	Ec	t.	D.O.	pH	Ec	t.	D.O.	pH		
9-I-88	-	-	-	-	-	-	-	-	1200	3
12-I-88	-	-	-	-	-	-	-	-	1450	3
30-I-88	-	-	-	-	-	-	-	-	2500	3
2-II-88	32.1	11.8	9.4	8.2	3.2	12.2	11.6	8.7	2400	3
13-II-88	35.2	13.1	10.1	8.2	3.1	13.3	9.5	8.3	2400	3
24-II-88	36.2	14.9	(coop. truck)		3.2	18.4	-	-	200	1
24-II-88	37.3	11.6	(DAF trucks)		3.2	18.4	-	-	2000	2
9-IV-88	-	-	-	-	-	-	-	-	30	1

Total number of fry unloaded in Wadi Rayan I lake 12,180,000

Table 4.2.2.2.1.

Plankton composition and distribution in the 280 μ samples

Station	1	2	3	4	5	6	7	8	9
Season	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d
Botanic	o # • +	x x • +	- + + +	o + • +	o • + +	x + + +	o + + +	o + • +	• • • +
Copepods	. o • +	. * # o	- * # *	x . • +	x x + +	x x x .	. x # +	o * • x	.* # o
Cladocerans	• + + +	o x • x	- # + *	• + + +	+ * • +	• # + .	* # • •	x # • #	. + • .
Other crust.	. . o o	. x o o	- o o o	o o o o	x o o o	x o o o	. o o o	x o o o	o o o o
Fish larvae	o o o o	o o o o	- o o o	o o o o	o o o o	o o o o	o o o o	o o o o	o o o o
Fish eggs	o o o o	o o o o	- o . o	x o o o	o o o o	o o o o	o o o o	o o o o	o o o o
Insects	o . . o	o . x •	- x x x	o * o x	. x x o	o x x #	o x o *	o . # x	o . . *
Others	o o * o	o o o o	- x x x	. o o o	. . o o	o o o x	o x o o	o x o o	. o o o

a = summer
b = autumn
c = winter
d = spring

- no sample take
o not found in sample
. 1 specimen
x several

* common
\# many
• abundant
\+ very abundant

Table 4.2.2.2.2.a.

Systematic list of net plankton species collected during June 1987 - April 1988

Division: Cyanophyta				
(I) Order: Oscillatoriales				
(I) Family: Oscillatoriaceae				
(I) Genus: Oscillatoria (vaucher)				
1.- O. princeps	6	175	-	-
2. - O. limosa	7	-	18	-
(II) Genus: Lyngbya (Agardh)				
3. - L. martensiana	-	232	52	-
(III) Genus: Phormidium				
4. P. mucicola	4	-	-	1600
Family: Nostocaceae				
(IV) Genus: Anabaena (Bory)				
5. - A. circinalis	-	215	30	1050
(V) Genus: Nostoc				
6. - N. mircroscopicum	-	200	-	-
7. - N. pscinale	-	210	18	-
(VI) Genus: Spirolina				
8. - S. platenensis	-	-	200	-
(VII) Genus: Nodularia				
9. - N. spurnigena	9	190	-	-
(II) Order: Chroococales				
Family: Chroococaceae				
(VIII) Genus: Merismopedia (Meyen)				
10. - M. tenuissima	1000	-	-	-
11. - M. glauca	200	-	-	-
12. - M. punctata	-	250	-	-
13. - M. elegans	-	-	1400	-
(IX) Genus: Anacystis (Meneghini)				
14. - Anacystis sp.	1500	-	-	-
(X) Genus: Microcystis (Kutzing)				
15. - M. marginata	3800	6800	300	160
16. - M. aerogenosa	200	700	157700	580840
(XI) Genus: Chroococcus (Nageli)				
17. - C. minutus	10	200	300	38
19. - C. turgidus	-	253	-	-
20. - C. limneticus	-	279	900	-
(XII) Genus: Coelosphaerium (Nageli)				
21. - C. kutzingianum	2500	-	1200	210
22. - C. dubium	315	169	2400	460
23. - A. pulchara	2000	120	80000	2000
(XIV) Genus: Holopedia				
24. - H. dieteli	-	111	-	-
Division: Chlorophyta				
Class: Chlorophyceae				
(I) Order: Chlorellales				
Family: Chlorelaceae				
(I) Genus: Oocystis (Nageli)				
25. - Oocystis sp.	-	-	-	280
(II) Genus: Ankistrodesmus (Corda)				
26. - A. falcatus	-	1706	-	-
(III) Genus: Sphaerocystis				
27. - S. schroeteri	6	287	-	-

Family: Scendesmaceae				
(IV) Genus: Scendesmus (Meyen)				
28. - S. dimorphus	3	-	-	-
29. - S. bijuga	-	44	-	-
30. - S. acuminatus	-	110	-	-
31. - S. quadricanda	-	15	-	-
32. - S. obliqus	-	-	33	-
(V) Genus: Actinastrum				
33. - A. nanzschii	-	347	-	-
(VI) Genus: Coelastrum (Nageli)				
34. - C reticulatum	60	218	-	-
35. - C. microporum	-	209	178	1000
36. - C. cambricum	-	139	-	-
(II) Order: Zygnematales				
Family: Zygnemataceae				
(VII) Genus: Zygnema (C.A. Agardh)				
37. - Zygnema sp.	60	-	-	-
(VIII) Genus: Spirogyra (Link)				
38. - S. azygospora	11	-	60	-
39. - S. ionia	-	-	3	-
40. - S. prolifica	-	-	132	-
41. - S. Ahmedabadensis	-	-	99	500
(IX) Genus: Mougeotia				
42. - M. scalaris	4	-	-	-
(X) Genus: staurastrum				
43. - S. gracille	4	-	104	300
Family: Desmidiaceae				
(XI) Genus: Gonatozygon				
44. - G. aculatum	29	187	103	10
(XII) Genus: Closterium				
45. - C. gracile	-	-	-	1800
(XIII) Genus: Micrasterias (C.A. Agardh)				
46. - Micrasterias sp.	4	-	-	-
(III) Order: Chlorococcales				
Family: Hydrodictyacrae				
(XIV) Genus: Pediastrum (Meyen)				
47. - P. clathratum	4	-	-	-
48. - P. duplex	6	88	-	-
49. - P. boryanum	4	112	-	-
50. - P. ovatum	5	136	-	-
51. - P. simplex	7	29	-	-
52. - P. microporum	-	222	-	-
(IV) Order: Oedogoniales				
Family: Oedogoniaceae				
(XV) Genus: Oedogonium (Link)				
53. - O. undulatum	4	144	-	-
(V) Order: Volvocales				
Family: Volvocaceae				
(XVI) Genus: Volvox (Linnaeus)				
54. - V. aucus	11	-	17	-
Family: Chlamidomonadaceae				
(XVII) Genus: Protococcus				
55. - P. viridis	-	129	-	-

(VI) Order: Ulothrichales				
Family: Ulothricaceae				
(XVIII) Genus: Ulothrix (Kützing)				
56. - U. zonata	-	9	-	-
(VII) Order: Tetrasporales				
Family: Palmellaceae				
(XIX) Genus: Palmella (Lyngbye)				
53. - P. miniata	-	-	119	-
Division: Chrysophyta				
Class: Bacillariophyceae				
(I) Order: Pennales				
Suborder: Araphidinae				
Family: Diatomiaceae				
(I) Genus: Fragillaria				
58. - F. copucina	15	107	-	-
59. - F. cortonerais	-	334	-	-
(II) Genus: Synedra				
60. - S. affinis	20	202	-	-
61. - S. ulna	40	165	117	185
62. - S. acus	-	143	134	-
(III) Genus: Asterionella				
63. - A. gracillima	-	254	-	-
64. - A. formosa	-	322	-	-
Suborder: Biraphidineae				
Family: Noviculaceae				
(IV) Genus: Novicula				
65. - N. pygmaea	8	-	-	1300
66. - N. bacillum	-	72	-	1210
(V) Genus: Cymbella				
67. - C. ventricosa	-	181	-	-
(VI) Genus: Amphora				
68. - A. ovales	-	171	-	-
(VII) Genus: Anomoeneis				
69. - A. sphaerophoca	-	116	-	-
Family: Nitzschiaceae				
(VIII) Genus: Nitzschia				
70. - N. synoidea	4	116	-	-
71. - N. paradoxa	32	-	-	-
(IX) Genus: Cymbella				
72. - C. ventricosa	-	181	-	-
(X) Genus: Gyrosigma				
73. - G. acuminatum	4	-	33	-
Family: Tabellariaceae				
(XI) Genus: Tabellaria				
74. - T. fenestrata	28	-	-	-
Family: Epithemiaceae				
(XII) Genus: Epithemia				
75. - E. zebra	-	63	-	-
Family: Surirellaceae				
(XIII) Genus: Surirella				
76. - S. elegans	4	-	-	-
77. - S. ovalis	-	174	-	-

Suborder: Monoraphidineae				
Family: Acananthaceae				
(XIV) Genus: Cocconis				
78. - C. pediculus	4	-	-	-
Order: Centrales				
Suborder: Coscinodiscineae				
Family: Coscinodisciaceae				
(XV) Genus: Melosira				
79. - M. granulata	6	266	32	210
80. - M. agussizzii	4	(74	-	-
81. - M. islandica	-	-	17	-
(XVI) Genus: Cyclotella				
82. - C. comta	7	-	17	300
83. - C. meneghiana	-	182	-	-
Family: Surirellaceae				
(XVII) Genus: Campylodiscus				
84. - C. hibernicus	4	116	-	-
Division: Pyrrhophyta				
Class: Dinophyceae				
(I) Order: Peridiniales				
(I) Genus: Peridinium (Ehrenberg)				
85. - P. gatuneras	6	-	-	-
86. - P. bipes	6	-	-	-
(II) Genus: Glenodinium				
87. - G. berolinerse	9	-	-	-
Family: Ceratidae				
(III) Genus: Ceratium (Schrank)				
88. - C. hirundinella	140	95	1763	1495
89. - Certaium sp.	236	-	2073	500
(IV) Genus: Didinium				
90. - D. balbiarii	-	28	-	-
(V) Genus: Sphaerodinium				
91. - S. cinctum	60	-	-	-
Phylum: Nemathelminthes				
Class: Rotifera				
(I) Order: Monagonta				
Suborder: Ploima				
Family: Brachionidae				
(I) Genus: Brachiones				
92. - B. bala	3	150	-	4
(II) Genus: Keratella				
93. - K. quadrata	6	30	176	2
94. - K. vagla	18	-	-	-
(III) Genus: Ascomorpha				
95. - A. ecaudis	7	169	3	-
Family: Asplanchnidae				
(IV) Genus: Polyarthra				
96. - P. vulgaris	29	-	-	-
97. - P. caryptera	4	-	-	-
Family: Synchaetidae				
(V) Genus: Synchaeta				
98. - S. calva	3	-	-	-
99. - S. pectinata	14	-	-	-

Suborder: Flosculariaceae				
Family: Testudinellidae				
(VI) Genus: Hexarthra				
100. - H. intermedia	68	-	-	-
101. - H. mira	91	-	-	-
Family: Conochilidae				
(VII) Genus: Conochillus				
102. - C. unicornis	12	-	-	-
Phylum: Arthropoda				
Subphylum: Mandibulata				
Class: Crustacea				
Subclass: Branchiopoda				
(I) Order: Diplostraca				
Suborder: Cladocera				
Family: Bosminidae				
(I) Genus: Bosminopsis				
103. - B. deiterai	-	-	24	-
(II) Genus: Bosmina				
104. - B. longirostris	6	101	-	-
105. - B. coregoni	4	-	27	-
Family: Daphniadae				
(III) Genus: Daphnia				
106. - D. rosea	-	62	-	-
107. - D. catwaba	-	-	15	-
(IV) Genus: Ceriodaphnia				
108. - C. megalops	-	-	15	-
(V) Genus: Moina				
109. - M. brachiata	4	-	-	-
Family: Sididaes				
(VI) Genus: Diaphanosoma				
110. - D. brachyarum	112	351	201	200
(VII) Genus: Sida				
111. - S. crystallina	10	-	-	-
Family: Chydoridae				
(IV) Genus: Alona				
112. - A. monocantha	5	46	-	-
(V) Genus: Alonella				
113. - A. nana	-	72	-	-
Subclass: Copepoda				
Order: Cyclopeda				
Family: Cyclopeda				
Genus: Cyclops				
114. - C. fimbriatus	11	173	-	-
Order: Calanoida				
Family: Diaptomedae				
Genus: Diaptomus				
115. - D. kenai	9	141	-	-
116. - D. cyclopaid	-	115	-	13
117. - D. siciloides	-	138	-	-
118. - D. cannexus	-	176	-	20
119. - D. miasiaipplensis	-	182	6	-
Genus: Eudiaptomus				
120. - E. japonicus	3	126	-	-
121. - E. gracillis	6	19	-	-

Order: Harpacticoida
Family: Harpacticaidae
Genus: Canthocamptus

122. - C. staphylinus	4	-	-	-
nauplius	47	184	24	70

Table 4.2.2.2.2.b.

Average plankton distribution of the 60 μ samples, per season in number of plankters per l. (and % of total) data obtained from Mr. Magdi Abas Saleh May 1988.

	Summer	Autumn	Winter	Spring
Blue green algae	11846 (89.5)	11759 (51.7)	260456 (97.5)	586668 (98.4)
Green algae	240 (1.8)	3656 (16.1)	930 (.3)	3890 (.7)
Diatoms	204 (1.5)	4954 (21.8)	1516 (.6)	3205 (.5)
Dinoflagelates	457 (3.5)	123 (.5)	3836 (1.4)	1995 (.3)
Phytoplankton	12747 (96.3)	20492 (90.2)	266738 (99.8)	595758 (99.9)
Rotifers	266 (2.0)	349 (1.5)	183 (.1)	50 (.+)
Cladocerans	156 (1.2)	632 (2.8)	282 (.1)	203 (.+)
Copepods	71 (.5)	1254 (5.5)	24 (.+)	70 (.+)
Zooplankton	493 (3.7)	2235 (9.8)	489 (.2)	323 (.1)
Total plankton	13,240	22,727	267,227	596,081

Without blue green algae:

	Summer	Autumn	Winter	Spring
Green algae	240 (17.2)	3656 (33.3)	930 (13.7)	3890 (41.3)
Diatoms	204 (14.6)	4954 (45.2)	1516 (22.4)	3205 (34.0)
Dinoflagelates	457 (32.8)	123 (1.1)	3836 (56.7)	1995 (21.2)
Phytoplankton	901 (64.6)	8733 (79.6)	6282 (92.8)	9090 (96.6)
Rotifers	266 (19.1)	349 (3.2)	183 (2.7)	50 (.5)
Cladocerans	156 (11.2)	632 (5.8)	282 (4.2)	203 (2.2)
Copepods	71 (5.1)	1254 (11.4)	24 (.4)	70 (.7)
Zooplankters	493 (35.4)	2235 (20.4)	489 (7.2)	323 (3.4)
Total	1,394	10,968	6,771	9,413

Table 4.2.2.2.2.c.

Total number of plankton organisms per liter water, taken from the 60 μ net samples, per season and station (zooplankton only). Data obtained from Mr. Magdi Abas Saleh just after each analysis.

Station	Summer	Autumn	Winter	Average
1	3,304 (1610)	143,265 (1917)	1,865,396 (75)	670655 (1201)
2	1,420 (360)	79,352 (1203)	1,343,456 (136)	474743 (566)
3	- -	69,191 (411)	773,722 (17)	281638 (214)
4	3,418 (906)	59,332 (557)	1,156,593 (385)	406448 (616)
5	982 (204)	110,649 (1971)	1,454,386 (0)	522006 (725)
6	3,378 (1226)	86,562 (1408)	1,957,158 (294)	682366 (976)
7	3,888 (898)	111,567 (1043)	2,412,128 (169)	84528 (703)
8	5,480 (630)	28,425 (1125)	1,054,311 (0)	362739 (585)
9	5,114 (700)	33,451 (1121)	905,117 (176)	314561 (666)
Average	3373 (817)	80199 (1195)	1435807 (139)	506409 (695)

Table 5.2.2.1.1.a.

Length frequency of *Liza ramada* (Risso) in numbers and (% of total)

length group in cm	November		December		January		February		Total	
25	-	-	-	-	1	(.5)	-	-	1	(.1)
26	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-
28	-	-	1	(.3)	6	(2.7)	1	(.5)	8	(.9)
29	-	-	-	-	6	(2.7)	3	(1.4)	9	(1.0)
30	-	-	1	(.3)	15	(6.8)	5	(2.3)	21	(2.3)
31	-	-	7	(2.0)	14	(6.4)	9	(4.1)	30	(3.3)
32	11	(10.2)	12	(3.4)	41	(8.7)	14	(6.5)	78	(8.7)
33	15	(13.9)	36	(0.1)	25	(1.4)	30	(3.8)	106	(11.8)
34	16	(14.8)	53	(4.9)	26	(1.9)	38	(7.5)	133	(14.8)
35	28	(25.9)	30	(8.4)	24	(1.0)	25	(1.5)	107	(11.9)
36	11	(10.2)	14	(3.9)	11	(5.0)	19	(8.8)	55	(6.1)
37	6	(5.6)	10	(2.8)	8	(3.7)	14	(6.5)	38	(4.2)
38	1	(1.0)	2	(.6)	3	(1.4)	3	(1.4)	9	(1.0)
39	2	(2.0)	-	-	-	-	-	-	2	(.2)
40	-	-	7	(2.0)	-	-	-	-	7	(.8)
41	1	(1.0)	11	(3.1)	3	(1.4)	-	-	15	(1.7)
42	-	-	15	(4.2)	5	(2.3)	2	(.9)	22	(2.4)
43	3	(3.0)	14	(3.9)	5	(2.3)	4	(1.8)	26	(2.9)
44	3	(3.0)	19	(5.3)	1	(.5)	3	(1.4)	26	(2.9)
45	-	-	31	(8.7)	4	(1.8)	3	(1.4)	38	(4.2)
46	4	(4.0)	12	(3.4)	2	(.9)	3	(1.4)	21	(2.3)
47	1	(1.0)	16	(4.5)	3	(1.4)	9	(4.1)	29	(3.2)
48	2	(2.0)	19	(5.3)	4	(1.8)	6	(2.8)	31	(3.4)
49	1	(1.0)	12	(3.4)	2	(.9)	7	(3.2)	22	(2.4)
50	-	-	12	(3.4)	5	(2.3)	6	(2.8)	23	(2.6)
51	1	(1.0)	5	(1.4)	-	-	2	(.9)	8	(.9)
52	1	(1.0)	8	(2.2)	3	(1.4)	2	(.9)	14	(1.6)
53	-	-	1	(.3)	1	(.5)	6	(2.8)	8	(.9)
54	-	-	4	(1.1)	-	-	1	(.5)	5	(.6)
55	1	(1.0)	4	(1.1)	-	-	-	-	5	(.6)
56	-	-	-	-	1	(.5)	1	(.5)	2	(.2)
76	-	-	-	-	-	-	1	(.5)	1	(.1)
Totalnumber	108		356		219		217		900	
average lenght	36.5 ± 4.9		40.5 ± 6.6		35.3 ± 5.8		37.7 ± 7.1		38.1 ± 6.7	

Table 5.2.2.1.1.c.

Length frequency of *Oreochromis niloticus* in numbers and (%) of total.

length group in cm	November	December	January	February	Total
11	- -	- -	2 (1.3)	- -	2 (.3)
12	- -	3 (2.9)	- -	- -	3 (.5)
13	- -	3 (2.9)	3 (2.0)	- -	6 (.9)
14	1 (1.3)	3 (2.9)	3 (15.4)	1 (.3)	28 (4.4)
15	- -	3 (2.9)	51 (34.2)	6 (1.9)	60 (9.4)
16	1 (1.3)	1 (1.0)	22 (14.8)	16 5.1)	40 (6.2)
17	1 (1.3)	4 (3.9)	9 (6.0)	28 (8.9)	42 (6.6)
18	2 (2.7)	5 (4.9)	5 (3.4)	35 (11.1)	47 (7.3)
19	2 (2.7)	7 (6.9)	2 (1.3)	45 (14.3)	56 (8.7)
20	2 (2.7)	5 (4.9)	- -	45 (14.3)	52 (8.1)
21	2 (2.7)	12 (11.8)	- -	24 (7.6)	38 (5.9)
22	4 (5.3)	8 (7.8)	2 (1.3)	16 (5.1)	30 (4.7)
23	6 (8.0)	3 (2.9)	2 (1.3)	12 (3.8)	23 (3.6)
24	8 (10.7)	2 (1.9)	1 (.7)	7 (2.2)	18 (2.8)
25	6 (8.0)	2 (1.9)	- -	11 (3.5)	19 (3.0)
26	2 (2.7)	- -	- -	7 (2.2)	9 (1.4)
27	2 (2.7)	1 (1.0)	- -	6 (1.9)	9 (1.4)
28	6 (8.0)	1 (1.0)	2 (1.3)	5 (1.6)	14 (2.2)
29	- -	7 (6.9)	- -	8 2.5)	15 (2.3)
30	6 (8.0)	6 (5.9)	- -	6 (1.9)	18 (2.8)
31	4 (5.3)	- -	2 (1.3)	9 (2.9)	15 (2.3)
32	2 (2.7)	5 (4.9)	3 (2.0)	6 (1.9)	16 (2.5)
33	2 (2.7)	4 (3.9)	1 (.7)	2 (.6)	9 (1.4)
34	3 (4.0)	4 (3.9)	- -	3 (1.0)	10 (1.6)
35	4 (5.3)	6 (5.6)	2 (1.3)	8 (2.5)	20 (3.1)
36	2 (2.7)	1 (1.0)	2 (1.3)	2 (.6)	7 (1.1)
37	2 (2.7)	4 (3.9)	2 (1.3)	1 (.3)	9 (1.4)
38	2 (2.7)	- -	4 (2.7)	2 (.6)	8 (1.2)
39	- -	- -	2 (1.3)	2 (.6)	4 (.6)
40	2 (2.7)	1 (1.0)	2 (1.3)	- -	6 (.9)
41	1 (1.3)	1 (10)	4 (2.7)	- -	6 (.9)
42	- -	- -	- -	1 (.3)	1 (.2)
43	- -	- -	- -	- -	- -
44	- -	- -	- 1	(.7) -	1 (.2)
total	75	102	149	314	641
-	127.5 ± 6.2	24.6 ± 7.5	19.3 ± 8.4	22.0 ± 5.5	22.5 ± 7.2

Table 5.2.2.1.1.d.
Average lenght of *Oreochromis niloticus* per yearclass,own data from Wadi Rayan I compared with data from IOF from lake Qarun

yearclass	I	II	III	IV	V+	average (n)
own data 87/88	15.1	20.6	29.9	34.7	39.0	22.5 (641)
IOF 82/83	8.2	10.6	14.1			11.0 (166)

Table 5.2.2.1.1.e.

Length frequencies for *Oreochromis aureus* and *Tilapia zillii* in numbers and (%) of total

length group in cm	*Oreochromis aureus*		*Tilapia zillii*	
10	1 (.4)			-
11	7 (3.1)		7 (4.2)	
12	26 (11.5)	n=120	13 (7.9)	n=117
13	21 (9.3)	(52.9)	3 (19.5)	(71.3)
14	31 (13.7)	13.5 cm	43 (26.2)	13.5 cm
15	26 (11.5)		22 (13.4)	
16	8 (3.5)		11 (6.7)	
17	8 (3.5)		9 (5.5)	n=34
18	10 (4.4)	n=78	8 (4.9)	(20.7)
19	13 (5.7)	(34.4)	6 (3.7)	17.3 cm
20	12 (5.3)	19.9 cm	3 (1.8)	
21	17 (7.5)		5 (3.0)	n=13
22	18 (7.9)		3 (1.8)	(7.9)
23	2 (.9)		2 (1.2)	21.3 cm.
24	4 (1.8)			
25	1 (.4)	n=16		
26	3 (1.3)	(7.0)		
27	4 (1.8)	25.6 cm		
28	2 (.9)			
29	2 (.9)			
30	3 (1.3)			
31	4 (1.8)	13		
32	- (5.7)			
33	1 (.4)	31.3 cm		
34	3 (1.3)			
total	227		164	
average length	1.76 ± 5.3		14.9 ± 2.6	

Table 5.2.2.1.2.a.

Length, weight relation of *Liza ramada* (Risso)
Average weight in gram per length group and (Kf)

length group in cm	November	December	January	February	Total
25	- -	- -	375 (2.40)	- -	375 (2.40)
26	- -	- -	-		
27	- -	- -	-		
28	- -	201 (.92)	227 (1.03)	229 (1.04)	224 (1.02)
29	- -	- -	221 (.91)	193 (.79)	212 (.87)
30	- -	192 (.71)	239 (.89)	203 (.75)	228 (.84)
31	- -	215 (.72)	264 (.89)	207 (.69)	236 (.79)
32	249 (.76)	250 (.76)	286 (.87)	223 (.68)	264 (.81)
33	281 (.78)	267 (.74)	314 (.87)	248 (.69)	275 (.77)
34	309 (.79)	296 (.75)	363 (.92)	272 (.69)	304 (.77)
35	324 (.76)	324 (.76)	364 (.85)	295 (.69)	326 (.76)
36	349 (.75)	351 (.75)	381 (.82)	340 (.73)	353 (.76)
37	391 (.77)	402 (.79)	438 (.86)	365 (.72)	394 (.78)
38	411 (.75)	455 (.83)	575 (1.05)	354 (.65)	456 (.83)
39	500 (.84)	-	- -	- -	500 (.84)
40	- -	544 (.85)	- -	- -	544 (.85)
41	572 (.83)	603 (.87)	608 (.88)	- -	602 (.87)
42	- -	612 (.83)	650 (.88)	590 (.80)	619 (.84)
43	710 (.89)	648 (.82)	765 (.96)	603 (.76)	669 (.84)
44	642 (.75)	715 (.84)	725 (.85)	660 (.77)	709 (.83)
45	- -	790 (.87)	831 (.91)	836 (.92)	798 (.88)
46	844 (.87)	844 (.87)	913 (.94)	761 (.78)	839 (.86)
47	850 (.82)	923 (.89)	908 (.87)	833 (.80)	891 (.86)
48	914 (.83)	996 (.83)	938 (.85)	868 (.78)	959 (87)
49	1087 (.92)	1050 (.89)	938 (.80)	934 (.79)	1004 (.85)
50	- -	1144 (.92)	1051 (.90)	1117 (.89)	1117 (.89)
51	1186 (.89)	1203 (.91)	- -	1066 (.80)	1167 (.88)
52	1339 (.95)	1291 (.92)	1342 (.95)	1042 (.74)	1270 (.90)
53	- -	1379 (.93)	1450 (.97)	1209 (.81)	1261 (.85)
54	- -	1538 (.98)	- -	1271 (.81)	1484 (.94)
55	1554 (.93)	1729 (1.04)	- -	- -	1694 (1.02)
56	- -	- -	1425 (.81)	1298 (.74)	1362 (.78)
76	- -	- -	- -	4750 (1.08)	4750 (1.08)
total	108	356	219	217	900
average weight	411.0	600.9	425.4	457.3	504.7
average Kf	.83 ± .07	.85 ± .08	.96 ± .30	.78 ± .10	.91 ± .28

table 5.2.2.1.2.b.
Length weight relation of *Oreochromis niloticus* average weight in gram per length group and(Kf)

length group in cm	November	December	January	February	Total
11	- -	- -	50.0 (3.76)	- -	50.0 (3.76)
12	- -	330 (1.91)	- -	- -	33.0 (1.91)
13	- -	40.0 (1.82)	100.0 (4.55)	- -	70.0 (3.19)
14	48.0 (1.75)	51.0 (1.86)	76.1 (2.77)	56.0 (2.04)	71.7 (2.61)
15	- -	62.7 (1.86)	88.8 (2.63)	68.2 (2.02)	85.4 (2.53)
16	64.0 (1.56)	72.0 (1.76)	101.4 (2.48)	75.4 (1.84)	89.3 (2.18)
17	100.0 (2.04)	94.8 (1.93)	109.4 (2.23)	89.8 (1.83)	94.7 (1.93)
18	93.5 (1.60)	103.6 (1.78)	127.0 (2.18)	105.3 (1.81)	106.9 (1.83)
19	115.5 (1.68)	130.8 (1.91)	180.0 (2.62)	126.5 (1.84)	128.6 (1.87)
20	156.0 (1.95)	151.6 (1.90)	- -	142.3 (1.78)	143.7 (1.80)
21	187.5 (2.02)	168.1 (1.82)	- -	160.3 (1.73)	164.2 (1.77)
22	198.4 (1.86)	188.8 (1.77)	250.0 (2.35)	191.3 (1.80)	195.5 (1.84)
23	213.8 (1.76)	220.3 (1.81)	275.0 (2.26)	218.1 (1.79)	222.2 (1.83)
24	224.5 (1.62)	251.0 (1.82)	300.0 (2.17)	224.6 (1.62)	231.7 (1.68)
25	271.5 (1.74)	254.0 (1.63)	- -	282.3 (1.84)	275.9 (1.77)
26	286.5 (1.63)	- -	- -	328.1 (1.87)	318.9 (1.81)
27	388.5 (1.97)	348.0 (1.77)	- -	358.7 (1.82)	364.1 (1.85)
28	403.0 (1.84)	435.0 (1.98)	450.0 (2.05)	397.4 (1.81)	410.0 (1.87)
29	- -	454.4 (1.86)	- -	474.4 (1.95)	465.1 (1.91)
30	509.8 (1.89)	513.8 (1.90)	- -	511.7 (1.90)	511.8 (1.90)
31	566.0 (1.90)	- -	725.0 (2.43)	558.9 (1.88)	582.9 (1.96)
32	663.0 (2.02)	643.0 (1.96)	650.0 (1.98)	613.0 (1.87)	635.6 (1.94)
33	717.0 (2.00)	668.5 (1.86)	950.0 (2.64)	656.0 (1.83)	707.8 (1.97)
34	760.7 (1.94)	741.0 (1.89)	- -	711.3 (1.81)	738.0 (1.88)
35	803.4 (1.87)	818.8 (1.91)	987.5 (2.30)	793.5 (1.85)	822.5 (1.92)
36	829.5 (1.78)	891.0 (1.91)	975.0 (2.09)	921.5 (1.98)	906.1 (1.94)
37	920.0 (1.82)	961.3 (1.90)	1137.5 (2.25)	1011.8 (2.01)	997.6 (1.97)
38	966.0 (1.76)	- -	1218.8 (2.22)	1057.5 (1.93)	1115.3 (2.03)
39	- -	- -	1100.0 (1.85)	1178.5 (1.99)	1139.3 (1.92)
40	1293.0 (2.02)	1286.0 (2.01)	1300.0 (2.03)	- -	1293.0 (2.02)
41	1502.0 (2.18)	1471.0 (2.13)	1431.3 (2.08)	- -	1449.7 (2.10)
42	- -	- -	- -	1343.0 (1.81)	1343.0 (1.81)
43	- -	- -	-		
44	- -	- -	1750.0 (2.05)	- -	1750.0 (2.05)
total	75	102	149	314	641
average weight	449.1	359.9	274.1	237.7	292.0
average Kf	1.85 ± 0.16	1.87 ± 0.09	2.43 ± 0.59	1.86 ± 0.09	2.04 ± 0.42

Table 5.2.2.1.2.c.

Length weight relations for all *Oreochromis aureus* and *Tilapia zillii* measured , average weight in gram per 1 cm length group and (Kf).

length group in cm	*Oreochromis aureus*	*Tilapia zillii*
10	25.0 (2.50)	-
11	53.6 (4.03)	32.9 (2.47)
12	47.2 (2.73)	41.9 (2.42)
13	58.7 (2.67)	50.1 (2.28)
14	71.1 (2.59)	56.0 (2.04)
15	84.4 (2.50)	67.6 (2.00)
16	90.0 (2.20)	71.7 (1.75)
17	96.0 (1.95)	100.3 (2.04)
18	108.1 (1.85)	98.5 (1.69)
19	130.7 (1.91)	132.5 (1.93)
20	144.9 (1.81)	155.0 (1.94)
21	163.7 (1.77)	168.0 (1.81)
22	189.9 (1.78)	178.0 (1.67)
23	224.5 (1.85)	209.0 (1.72)
24	248.5 (1.80)	
25	301.0 (1.93)	
26	309.7 (1.76)	
27	374.5 (1.90)	
28	477.5 (2.18)	
29	428.0 (1.75)	
30	630.3 (2.33)	
31	562.8 (1.89)	
32	-	
33	720.0 (2.00)	
34	800.3 (2.04)	
total	227	164
average weight	144.1	72.0
average Kf	2.16 ± 0.50	1.98 ± 0.26
Average Kf:		
November	1.76 ± 0.10	1.74 ± 0.13
December	1.86 ± 0.20	1.74 ± 0.15
January	2.68 ± 0.61	2.25 ± 0.21
February	1.87 ± 0.13	1.80 ± 0.10

Table 4.1.3.

Limnological features during different seasons at various depths

Average DO in % saturation

	Surface	1	2	3	4	5	6	7	8	9	10	15	20	25
Summer	110	108	111	114	107	108	107	103	113	111	106	53	32	8
Autumn	108	106	107	105	103	103	103	103	100	99	98	92	92	87
Winter	104	104	103	101	101	100	99	99	98	97	92	88	83	88
Spring	110	112	112	112	112	111	109	108	106	105	106	99	96	85

Average DO in p.p.m.

	Surface	1	2	3	4	5	6	7	8	9	10	15	20	25
Summer	8.5	8.4	8.7	9	8.6	8.7	8.6	8.3	9.1	9.1	8.8	4.5	2.8	0.7
Autumn	10.2	10.1	10.2	10	9.8	9.8	9.8	9.9	9.5	9.5	9.3	8.8	8.4	8.5
Winter	10.7	10.7	10.7	10.5	10.5	10.4	10.3	10.3	10.1	10.1	9.7	9.1	8.7	8.9
Spring	10.1	10.4	10.6	10.6	10.7	10.6	10.5	10.4	10.2	10.1	10	9.3	8.7	8.5

Average temperature in oC.

	Surface	1	2	3	4	5	6	7	8	9	10	15	20	25
Summer	29.6	29.1	28.8	28.3	27.9	27.5	27.4	27.1	26.9	26.7	25.9	24.0	23.6	22.6
Autumn	19.8	19.6	19.2	19.3	19.3	19.2	19.1	19.1	19.2	19.2	19.2	19.3	19.4	19.4
Winter	15.2	15.2	15.2	15.0	14.9	14.8	14.7	14.7	14.9	14.6	14.5	14.6	14.5	14.5
Spring	21.1	20.2	19.7	19.5	19.6	18.7	18.6	18.2	18.2	18.1	18.0	18.7	18.5	18.3

Average Ec in mS/cm

	Surface	1	2	3	5	7	8	10	15	20	25	Ave.of all	(n) measurements
Summer	4.95	5.01	-	5.09	4.97	-	-	4.97	5.04	4.98	5.02	5.03	(32)
Autumn	5.05	5.10	-	5.10	5.11	-	-	5.13	5.14	5.14	5.14	5.10	(31)
Winter	5.11	5.21	5.30	5.23	5.23	5.20	5.10	5.10	5.20	5.20	5.10	5.18	(33)
Spring	4.76	4.96	5.10	4.99	4.95	-	-	4.96	4.97	4.97	4.98	4.93	(37)

Average Ec in mS/cm (all stations - st.1) **Transp. in m.** **Air temp.**

	Surface	1	3	5	10	15	20	25	Ave of all	(n)measurements	Transp. in m.	Air temp.
Summer	5.11	5.18	5.16	5.05	4.97	5.04	4.98	5.02	5.14	(27)	2.90	34.1
Autumn	5.20	5.22	5.23	5.16	5.13	5.14	5.14	5.14	5.20	(26)	2.45	23.1
Winter	5.26	5.30	5.45	5.27	5.10	5.20	5.20	5.10	5.27	(27)	2.03	16.6
Spring	4.98	5.01	5.01	4.97	5.01	4.97	4.97	4.98	4.99	(32)	1.67	23.5

Table 4.1.3.a.

Summer . 20/21-VII-87

DO in % saturation

station	surface	1	2	3	4	5	6	7	8	9	10	15	20	25	bottom	(depth)
1	125	116	113	119	113	115	114	114	113*						113	8.5
2	105	103*													103	1.0
3	96	95	97	98	84*										84	4.0
4	107	104	105	122											121	3.3
5	117	110	106	117	104	101	95	85*							85	6.8
6	116	112	110	108	109	109	110	111	112	108	106	53	32	8	6	25.2
7	103	114	119	122	125*										125	3.5
average	110	108	111	114	107	108	107	103	113	111	106	53	32	8		

DO inp.p.m.

station	surface	1	2	3	4	5	6	7	8	9	10	15	20	25	bottom	(depth)
1	9.6	9.2	10.2	9.5	9.2	9.2	9.2	9.2	9.2	9.2*					9.2	8.5
2	8.1	8.2*													8.2	1.0
3	7.4	7.4	7.5	7.6	6.5*										6.5	4.0
4	8.2	8.1	8.2	9.6											9.5	3.3
5	9	8.4	8.2	9.2	8.2	8.1	7.7	6.7*							6.9	6.8
6	8.9	8.9	8.8	8.5	8.8	8.7	8.8	8.9	9	8.9	8.8	4.5	2.8	0:7	0.6	25.2
7	8	8.8	9.2	9.6	9.9*										9.9	3.5
average	8.5	8.4	8.7	9	8.6	8.7	8.6	8.3	9.1	9.1	8.8	4.5	2.8	0.7		

Temperature oC

station	surface	1	2	3	4	5	6	7	8	9	10	15	20	25	bottom	(depth)
1	29.5	28.8	28.0	27.1	27.0	27.0	27.0	26.9	26.7	26.7*					26.7	8.5
2	29.0	28.8*													28.8	1.0
3	29.4	29.3	29.2	29.1	28.8*										28.8	4.0
4	29.5	29.3	29.0	28.6											28.5	3.3
5	30.5	30.2	29.5	28.8	27.9	27.8	27.6	27.2*							27.2	6.8
6	30.0	28.3	27.9	27.8	27.7	27.6	27.5	27.3	27	26.6	25.9	24.0	23.6	22.6	22.2	25.2
7	29.3	29.1	29.0	28.4	28.3*										28.3	3.5
Av.	29.6	29.1	28.8	28.3	27.9	27.5	27.4	27.1	26.9	26.7	25.9	24.0	23.6	22.6		

Ec in mS/cm **Transp.Air temp. pH**

Station	Surface	1	3	5	10	15	20	25	Bottom	(m)	Aver.Ec/station	Transp.	Air temp.	pH
1	3.97	4.01	4.71	4.82					4.88	(8.5)	4.48	2.6	33.0	8.4-8.5
2	5.17	5.19*							5.19	(1.0)	5.18	> 1	-	8.4
3	5.53	5.60	5.57						5.62	(4.0)	5.58	1.8	-	8.4
4	4.99	5.04	5.06*						5.06	(3.3.)	5.03	2.2	33.8	8.4
5	5.04	5.17	5.09	5.10					5.14	(6.8)	5.11	3.0	36.1	-
6	4.95	5.02	4.99	5.00	4.97	5.04	4.98	5.02	5.16	(25.2)	5.01	4.5	34.5	8.4-7.8
7	5.00	5.03	5.10						5.09	(3.5)	5.06	3.3	33.0	8.5
8												2.9	34.1	-
Av.5.11	5.18	5.16	5.05	4.97	5.04	4.98	5.02							

Average of all measurements (- st.1) 5.14 (n = 27)
(+ st.1) 5.03 (n = 32)

Table 4.1.3.b.

Autumn . 24-XI-87

Average D.O. in % saturation

Station Surface	1	2	3	4	5	6	7	8	9	10	15	20	25		Bottom	(m)
1	104	102	101	99	98	98	99	98	98	98	96*				96	(99.5)
2	109	107	116												115	(2.2)
3	111	110	109	113											112	(3.4)
4	107	105	108												108	(2.2)
5	112	109	108	107	107	107	107	110							112	(7.1)
6	109	107	105	105	104	104	102	101	101	100	99	92	92	87	85	(26.7)
7	104	102	103	100											105	(3.4)
Average	108	106	107	105	103	103	103	103	100	99	98	92	92	87		

D.O. in p.p.m.

1	9.9	9.7	9.6	9.4	9.3	9.3	9.4	9.4	9.4	9.4	9.2*				9.2	(9.5)
2	10.4	10.3	11.2												11.1	(2.2)
3	10.4	10.4	10.3	10.8											10.7	(3.4)
4	10.0	10.0	10.3												10.4	(2.2)
5	10.5	10.3	10.3	10.3	10.3	10.3	10.3	10.3	10.7						10.7	(7.1)
6	10.2	10.1	10.0	9.9	9.9	9.8	9.7	9.7	9.6	9.5	9.4	9.8	8.4	8.5	7.9	(26.7)
7	9.9	9.8	9.8	9.6											10.1	(3.4)
Average	10.2	10.1	10.2	10.0	9.8	9.8	9.8	9.9	9.5	9.5	9.3	8.8	8.4	8.5		

Temperature in oC.

1	19.3	19.3	19.3	19.3	19.2	192	19.2	19.2	19.1	19.1	19.1				19.1	(9.5)
2	19.3	19.2	18.5												18.5	(2.2)
3	20.2	19.9	19.3	18.9											18.8	(3.4)
4	20.5	19.8	18.9												18.8	(2.2)
5	19.8	19.8	19.3	19.2	18.9	18.8	18.7	18.7							18.6	(7.1)
6	20.0	19.9	19.9	19.8	19.7	19.6	19.4	19.4	19.3	19.3	19.3	19.3	19.4	19.4	19.4	(26.7)
7	19.6	19.6	19.3	19.1											18.8	(3.4)
Average	19.8	19.6	19.2	19.3	19.3	19.2	19.1	19.1	19.2	19.2	19.2	19.3	19.4	19.4		

Ec in mS/cm

Station	Surface	1	3	5	10	15	20	25	Bottom	(m)	Average Ec/station	Transp	Airtemp
1	4.16	4.34	4.57	5.01	5.08*				5.08	(9.5)	4.63	2.5	22
2	5.25	5.27							5.26	(2.2)	5.26	2.05	23.5
3	5.44	5.48	5.47*						5.47	(3.4)	5.46	1.85	21.5
4	5.12	5.15							5.17	(2.2)	5.15	2.2	22.5
5	5.14	5.16	5.17	5.19					5.21	(7.1)	5.17	3.15	23.5
6	5.12	5.13	5.13	5.12	5.13	5.14	5.14	5.14	5.12	(26.7)	5.13	3.1	23
7	5.12	5.14	5.16*						5.16	(3.4)	5.14	2.3	26
Av.- st 1	5.20	5.22	5.23	5.16	5.13	5.14	5.14	5.14					
Av.+ st 1	5.05	5.10	5.10	5.11	5.11								

Average for all measurements - station 1 = 5.20 (n = 26)
Average for all measurements + station 1 = 5.10 (n = 31)
* are bottom values.

Table 4.1.3.c.

Winter : 9-XII-87

D.O. in % saturation

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	25	Bottom	(m)
6	102	100	101	99	99	96	98	95	95	95	96	92	91	92	93	(25.5)
5	109	108	107	110	107	106									108	(5.4)
Average	106	104	104	105	103	101	98	95	95	95	96	92	91	92		
Av.+febr.	104	104	103	102	102	100	99	98	97	96	94	90	87	90		

D.O. in p.p.m.

6	9.8	9.7	9.7	9.6	9.6	9.4	9.5	9.3	9.3	9.3	9.4	8.9	8.6	8.7	8.7	(25.5)
5	10.7	10.5	10.4	10.9	10.6	10.6									10.7	(5.4)
Average	10.3	10.1	10.1	10.3	10.1	10.0	9.5	9.3	9.3	9.3	9.4	8.9	8.6	8.7		
Av.+febr.	10.6	10.6	10.6	10.4	10.4	10.3	10.1	10.0	9.8	9.7	9.6	9.0	8.7	8.8		

Temperature in oC.

6	18.9	18.5	18.3	18.3	18.3	18.3	18.2	18.2	18.2	18.2	18.2	18.3	18.4	18.2	18.3	(25.5)
5	18.3	18.3	18.2	17.7	17.5	17.4									17.4	(5.4)
Average	18.6	18.4	18.3	18.0	17.9	17.9	18.2	18.2	18.2	18.2	18.2	18.3	18.4	18.2		
Av.+febr.	15.9	15.8	16.0	16.0	15.9	15.8	15.6	15.6	16	16.4	16.4	16.5	16.5	16.4		

Ec in mS/cm

Station	Surface	1	3	5	10	15	20	25	Bottom	(m)	Av.of all meas.	Transp.	Air temp.	pH
6	5.03	5.09	5.09	5.10	5.11	5.10	5.11	5.15	5.15	(25.5)	5.10	3.3	20.5	8.3-8.4
5	5.11	5.16	5.17	5.17*					5.17	(5.4)	5.15	3.2	21.0	8.5
Av.	5.07	5.13	5.13	5.14	5.11	5.10	5.11	5.15				3.25	20.8	
Av.+febr.	5.22	5.26	5.21	5.22	5.11	5.15	5.16	5.13				2.27	17.4	8.5

Average of all 13 measurements 5.1

Table 4.1.3.d.

Winter . 15/16-II-88

D.O. in % saturation

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	25	Bottom	(depth)
1	102	102	102	100	100	99	98	98	98*						98	(8.0)
2	100	100	99*												99	(1.8)
3	105	105	105	104	103	101*									101	(4.6)
4	107	108													107	(1.3)
5	104	109	101	103	104	104	104	104							103	(7.2)
6	96	96	97	97	97	96	96	95	97	97	92	88	83	88*	88	(25.0)
7	99	98*													98	(0.7)
8	117	112	116*												116	(2.1)
Av.	104	104	103	101	101	100	99	99	98	97	92	88	83	88		

Temperature in oC.

1	15.4	15.4	15.7	15.5	15.3	15.2	15.1	15.1	15.1*						15.1	(8.0)
2	15.6	15.6	15.6*												15.6	(1.8)
3	15.3	15.3	15.3	15.2	15.0	14.9*									14.9	(4.6)
4	15.2	15.2													15.1	(1.3)
5	15.1	15.1	14.6	14.5	14.4	14.4	14.4	14.4							14.4	(7.2)
6	14.9	14.9	14.9	14.8	14.8	14.7	14.6	14.6	14.6	14.6	14.5	14.6	14.5	14.5*	14.5	(25.0)
7	14.6	14.6*													14.6	(0.7)
8	15.2	15.2	15.2*												15.2	(2.1)
Average	15.2	15.2	15.2	15.0	14.9	14.8	14.7	14.7	14.9	14.6	14.5	14.6	14.5	14.5		

Ec in mS/cm.

Station	Surface	1	2	3	5	7	8	10	15	20	25	Bottom	(depth)	Av./per station
1	4.0	4.6	5.0	5.1	5.1		5.1*					5.1	(8.0)	4.82
2	5.2	5.2	5.2*									5.2	(1.8)	5.2
3	5.3	5.4		5.4	5.4*							5.4	(4.6)	5.38
4	5.2	5.2*										5.2	(1.3)	5.2
5	5.2	5.2		5.2	5.2	5.2*						5.2	(7.2)	5.2
6	5.1	5.2		5.2	5.2			5.1	5.2	5.2	5.1*	5.1	(25.0)	5.16
7	5.1	5.2*										5.2	(0.7)	5.15
8	5.7	5.7	5.7*									5.7	(2.1)	5.7
Av.-st.1	5.26	5.30	5.45	5.27	5.27									
Average	5.10	5.21	5.30	5.23	5.23	5.20	5.10	5.10	5.20	5.20	5.10			

Average of all measurements - station 1 = 5.27 (n = 27)
Average of all 33 measurements 5.18
* are bottom values.

pH

Station	Surface	1	3	5	10	15	20	25	Bottom	(depth)	Transp.	Air temp.
1	-											
2	8.5	8.6							8.5	(1.8)	2.55	18
3	8.5	8.5	8.6						8.5	(4.6)	1.6	14
4	8.5								8.5	(1.3)	1.85	17
5	8.5	8.5	8.5	8.5					8.5	(7.2)	1.3	18
6	8.4	8.5	8.5	8.5	8.4	8.4	8.5	8.5*	8.5*	(25.0)	2.45	17
7	8.5*								8.5*	(0.7)	<.7	13
8	8.5	8.6	8.6*						8.6*	(2.1)	2.05	18
Av.	8.5	8.5	8.6	8.5	8.4	8.4	8.5	8.5			2.03	16.6

Table 4.1.3.e.

Spring ; 13/14-IV-88

D.O. in % saturation

Station	Surface	1	2	3	4	5	6	7	8	9	10	15	20	25	Bottom	(depth)
1	110	113	114	111	111	108	108	106	103	100	103				93	(10.2)
2	-															
3	-															
4	-															
5	-															
6	110	110	110	113	113	113	110	110	109	109	108	99	90	85*	85	(24.5)
7	-															
Average	110	112	112	112	112	111	109	108	106	105	106	99	96	85		

Temperature in oC.

1	20.7	19.4	18.6	18.5	18.3	18.2	18.1	18	17.9	17.9	17.8				18.3	(10.2)
2	21.9	21.2	21.1*												21.1	(2.0)
3	22.5	22.0	-	21.7	21.4*										21.4	(4.1)
4	21.7	20.4	-	20	20.0*										20.0	(4.3)
5	22.0	20.3	-		19.7		19.4	19.3*							19.3	(6.2)
6	20.2	20.0	19.3	18.9	18.8	18.6	18.5	18.4	18.4	18.3	18.2	18.7	18.5	18.3*	18.3	(24.5)
7	18.4	18.3	-	18.2*											18.2	(2.5)
Average	21.1	20.2	19.7	19.5	19.6	18.7	18.6	18.2	18.2	18.1	18	18.7	18.5	18.3		

Ec in mS/sec.

Station	Surface	1	2	3	4	5	10	15	20	25	Bottom	(m)	Av.Ec/station
1	3.49	4.65		4.90		4.90	4.91*				4.91	(10.2)	4.57
2	5.00	5.05	5.10*								5.10	(2.0)	5.05
3	5.17	5.19		5.2	05.21*						5.21	(4.1)	5.19
4	4.94	4.96		4.97	4.97*						4.97	(4.3)	4.96
5	4.95	5.00		4.98		4.98					4.99	(6.2)	4.98
6	4.87	4.90		4.94		4.96	5.01	4.97	4.97	4.98*	4.98	(24.5)	4.95
7	4.93	4.94		4.94*							4.94	(2.5)	4.94
Average	4.98	5.01	5.10	5.01	5.09	4.97	5.01	4.97	4.97	4.98			
+ st.1	4.76	4.96		4.99		4.95	4.96						

Average of all stations (- st.1) 4.99 (32)
(+ st.1) 4.93 (37)

Transparency in m.	Air temp.in oC.
2.4	32.0
1.3	21.0
1.05	24.0
1.3	22.0
1.45	23.0
2.2	-
2.0	19.0
1.67	23.5

Table 4.1.3.1.
D.O.in % saturation at various seasons per station at surface and(1 m)

Station	Summer		Autumn		Winter		Spring	
1	125	(116)	104	(102)	102	(102)	110	(113)
2	105	(103)	109	(107)	100	(100)		
3	96	(95)	111	(110)	105	(105)		
4	107	(104)	107	(105)	107	(108)		
5	117	(110)	112	(109)	104	(109)		
6	116	(112)	109	(107)	96	(96)	110	(110)
7	103	(114)	104	(102)	99	(98)	-	
Average	110	(108)	108	(106)	104	(104)	110	(112)

Table 4.1.3.2.a.
Temperature per station per season at surface and (1 m)

Station	Summer		Autumn		Winter		Spring	
1	29.5	28.8)	19.3	19.3)	15.4	15.4)	20.7	19.4)
2	29.0	28.8)	19.3	19.2)	15.6	15.6)	21.9	21.2)
3	29.4	29.3)	20.2	19.9)	15.3	15.3)	22.5	22.0)
4	29.5	29.3)	20.5	19.8)	15.2	15.2)	21.7	20.4)
5	30.5	30.2)	19.8	19.8)	15.1	15.1)	22.0	20.3)
6	30.0	28.3)	20.0	19.9)	14.9	14.9)	20.2	20.0)
7	29.3	29.1)	19.6	19.6)	14.6	14.6)	18.4	18.3)
8	-	-	-	-	15.2	15.2)	-	-
aveerage	29.6	29.1)	19.8	19.6)	15.2	15.2)	21.1	20.2)
σ_n	.5	.5)	.4	.3)	.3	.3)	1.3	1.1)

Table 4.1.3.2.b.
Average decrease of temperature per m depth.

Station	Summer	Autumn	Winter	Spring
1	.33	.01	.08	.28
2	.20	.36	.00	.40
3	.15	.41	.09	.27
4	.30	.77	.08	.40
5	.49	.17	.10	.44
6	.31	.02	.02	.08
7	.29	.24	.00	.08
Average per m depth	.28	.03	.03	.11
Absolute difference between all stations	8.2 °C	2.0 °C	1.2 °C	4.7 °C

Table 4.1.3.3.a.
Ec values at various stations at surface and (1 m)

Station	Summer		Autumn		Winter		Spring	
1	3.97	4.01)	4.16	4.34)	4.0	4.6)	3.49	4.65)
2	5.17	5.19)	5.25	5.27)	5.2	5.2)	5.00	5.05)
3	5.53	5.60)	5.44	5.48)	5.3	5.4)	5.17	5.19)
4	4.99	5.04)	5.12	5.15)	5.2	5.2)	4.94	4.96)
5	5.00	5.17)	5.14	5.16)	5.2	5.2)	4.95	5.00)
6	4.95	5.02)	5.12	5.13)	5.1	5.2)	4.87	4.90)
7	5.00	5.03)	5.12	5.14)	5.1	5.2)	4.93	4.94)
8	-	-	-	-	5.7	5.7)	-	-
Average	4.95	5.01)	5.05	5.10)	5.10	5.21)	4.76	(4.96)
-st.1	5.11	5.18)	5.20	5.22)	5.26	5.30)	4.98	5.01)

Table 4.1.3.3.b.
Average Ec in mS/cm

Station	Summer	Autumn	Winter	Spring
1	4.48	4.63	4.82	4.57
2	5.18	5.26	5.20	5.05
3	5.58	5.46	5.38	5.19
4	5.03	5.15	5.20	4.96
5	5.11	5.17	5.20	4.98
6	5.01	5.13	5.16	4.95
7	5.06	5.14	5.15	4.94
8	-	-	5.70	-
Average +1	5.03 (32)*	5.10 (31)	5.18 (33)	4.93 (37)
Average -1	5.14 (27)	5.20 (26)	5.27 (27)	4.99 (32)

* Between brackets, number of measurements

Table 4.1.3.3.c.
Average Ec increase per m depth per station.

Station	Summer	Autumn	Winter	Spring
1	.11	.10	.14	.14
2	.02	.09	.00	.05
3	.03	.12	.02	.01
4	.02	.23	.00	.01
5	.01	.10	.00	.01
6	.01	.00	.00	.01
7	.03	.12	.14	.00
8	-	-	.00	-
Average	.03	.11	.04	.03

Table 4.1.3.3.d.
Water sample of 9-VII-87 analysed by DRI 13-VIII-87

Ec	Ca	Mg	Na	K	CO3	HCO3	SO4	Cl
4.5*	5.2	7.34	33.3	.78	-	5.64	18.16	22.82**
		46.62						

* in mS/cm
** in meq/l

Salts are:

NaHCO3	- 5.64	meq/l
NaCl	- 22.82	"
CaCl2	-	"
NaSO4	- 5.62	"
CaSO4	- 12.54	"

Calculated Ec, with the equation: $\Delta Ec_{Si} = \frac{Si}{\sum cat} a(\sum cat)^b$

Ec NaHCO3	- 5.64/46.62	x	0.100150	(46.62)	0.942497	=	.453
Ec NaCl	- 22.82/46.62	x	0.135698	(46.62)	0.948705	=	2.543
Ec NaSO4	- 5.62/46.62	x	0.135698	(46.62)	0.920797	=	.549
Ec CaSO4	- 12.54/46.62	x	0.134600	(46.62)	0.82067	=	.847
					Ec total	=	4.392 (A)

Conversion from meq/l to m gram/l.

Ca++	20.04	x	5.2	=	104.208
Mq++	12.1525	x	7.34	=	98.199
Na+	22.9398	x	33.3	=	736.895
K+	39.102	x	.78	=	30.500
CO3--	30.0046	x	-	=	--
HCO3-	61.0172	x	5.64	=	344.137
SO4--	48.0288	x	18.16	=	872.203
Cl-	35.453	x	22.82	=	809.037

3013.180 = 3.0 g/l (B)

B/C gives conversion factor i.c. .670

Table 4.1.3.5.
Transparency in cm.

Station	Summer	Autumn	Winter	Spring	Average
1	260	250	255	240	251
2	-	205	160	130	165
3	180	185	185	105	164
4	220	220	130	130	175
5	300	315	240	145	250
6	450	310	245	220	306
7	330	230	-	200	253
8	-	-	205	-	205
Average	290	245	203	167	-

Table 4.1.3.6.
Air temperature

Station	Summer		Autumn		Winter		Spring	
	temp.	time	temp.	time	temp.	time	temp.	time
1	33.0	12.45	22.0	15.45	18.0	16.00	32.0	13.45
2	-	10.45	23.5	11.00	14.0	09.35	21.0	09.35
3	-	09.40	21.5	11.50	17.0	10.10	24.0	09.55
4	33.8	11.50	22.5	12.20	18.0	12.30	22.0	10.30
5	36.1	13.40	23.5	13.15	18.0	13.10	23.0	10.55
6	34.5	11.15	23.0	14.30	17.0	14.00	-	14.45
7	33.0	12.15	26.0	10.20	13.0	08.50	19.0	08.30
8	-	-	-	-	18.0	11.35	-	-
Average	34.1		23.1		16.6		23.5	
% of water surf.tem.	115%		117%		109%		111%	

Table 4.1.3.7.
Table average depth per profile

Profile	Depth
A	8.2 m
B	7.0 "
C	7.4 "
D	9.6 "
E	13.5 "
F	12.3 "
G	18.7 "
H	8.3 "
I	19.8 "

Average - 11.8 m
Surface - 6 200 ha
Volume - 730 x 10^6 m^3

Table 4.2.3.1.3.
Fry transport from El Girby (Damietta) to Wadi Rayan III lake (predominantly grey mullet)

	water in transport tanks				water in unloading areas				number of fry x 1000	number truck loads
Date	Ec	t.	D.O.	pH	Ec	t.	D.O.	p.H		
7-XII-87	32.2	15.6	10.3	-	2.9	16.6	11.2	-	200	1
24-I-88	29.8	11.6	5.0	8.1	2.6	11.9	11.3	8.6	2200	2
27-I-88	29.4	11.9	5.8	8.2	2.7	-	-	-	2400	2
17-II-88	36.9	12.8	8.9	8.1	2.7	15.5	-	-	1000	1
Subtotal of fry unloaded in pond										5,800,000
17-II-88	36.7	12.9	8.6	8.1	5.1	15.7	-	-	1000	1
22-II-88	37.1	14.1	10.0	8.1	5.2	18.4	-	-	2000	2
4-IV-88									30	1
Subtotal fry unloaded in enclosure										3,000,000
Total number of fry released in Wadi Rayan III lake										8,800,000

Table 4.2.3.2.1.
Plankton composition and distribution in the 280 μ samples.

Station	1	2	3	4	5	6	7
Season	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d	a b c d
Botanic	x • • •	x • x #	x • * x	x • * *	x • # *	* • * *	* • * x
Copepods	o x x #	o . o o	o o o x	o o . .	o o o *	o o * #	o x o .
Cladocerans	o x x #	o o o o	o o o o	o o o o	o o o o	o o o x	o o o o
Other crust.	o o o #	o . o x	o . o o	o o o .	. o o o	o o o o	o o o o
Fish larvae	o o o #	o o o o	o o o x	o o o x	o o o o	o o o o	o o o o
Fish eggs	o o o #	o o o o	o o o o	o o o o	o o o o	o o o o	o o o o
Insects	x # o *	x o * *	o o . *	o x o .	o o x .	o # . •	o o x #
Others	o o x #	o . o o	o o o o	o o o o	o o x o	o o o o	o o x o

a = summer
b = autumn
c = winter
d = spring

o = not found
. = 1 specimen
x = several
* = common

many
• abundant

Table 4.2.3.2.2.a.
Systematic list of net plankton species collected during June 1987 - April 1988

Division: Cyanophyta				
Order: Oscillatoriales				
Family: Oscillatoriaceae				
(I) Genus: Oscillatoria (vaucher)				
1. - O. formosa	6	-	-	-
2. - O. limosa	43	75	67	51
3. - O. princeps	8	-	-	-
(II) Genus: Lyngbya (Agardh)				
4. - L. contorta	4	-	-	-
5. - L. birgei	4	161	-	-
(III) Genus: Plectonema				
6. - P. comasiniana	3	-	-	-
Family: Nostocaceae				
(IV) Genus: Anabaena (Bory)				
7. - A. circinalis	98	150	144	121
8. - A. spiroides	8	-	-	-
(V) Genus: Anabaenopsis				
9. - A. elenkinii	19	-	-	-
(VI) Genus: Nostoc				
10. - N. lanchia	25	111	43	30
(VII) Genus: Spirolina				
11. - S. platensis	3	-	-	-
(VIII) Genus: Spirotaenia				
12. - Spirotaenia sp.	3	-	-	-
(IX) Genus: Nodularia				
13. - N. spumigena	27	90	20	16
14. - N. miror	26	-	-	-
(X) Genus: Aphanizonemon				
15. - A. flosaquae	102	-	-	-
16. - A. gracille	-	66	-	-
(II) Order: Chroococales				
Family: Chroococaceae				
(XI) Genus: Merismopedia (Meyen)				
17. - M. elegans	260	1179	438	192
18. - M. punctata	550	1735	255	432
19. - M. glauca	465	1088	-	-
20. - M. tenuissima	510	-	-	-
(XII) Genus: Chroococcus (Nageli)				
21. - C. giganticus	3	174	42	7
22. - C. limneticus	35	210	795	180
(XIII) Genus: Microcystis (Kützing)				
23. - M. viridis	-	1350	2316	893
(XIV) Genus: Polycystis				
24. - P. incerta	400	15309	12113	7863
(XV) Genus: Anacystis (Meneghini)				
25. - Anacystis sp.	150	-	-	-
(XVI) Genus: Coelosphaerium (Nageli)				
26. - C. dubium	4	-	-	-
(XVII) Genus: Gomphospheria				
27. - G. aponina	4	-	96	30
(XVIII) Genus: Aphanocapsa				
28. - A. pulchara	-	-	1463	-

Division: Chlorophyta				
Class: Chlorophyceae				
(I) Order: Chlorellales				
Family: Chlorelaceae				
(I) Genus: Ankistrodesmus (Corda)				
29. - A. falcatus	3	-	-	-
(II) Genus: Oocystis (Nageli)				
30. - O. lacustris	-	54	-	-
Family: Scendesmaceae				
(I) Genus: Scendesmus (Meyen)				
31. - S. dimorphus	-	38	-	-
32. - S. quadricauda	-	54	-	-
(II) Order: Zygenematales				
Family: Zygnemataceae				
(IV) Genus: Spirogyra (Link)				
33. - S. azygospora	4	34	-	2
34. - S. abmedabadensis	-	38	-	2
(V) Genus: Mougeotia				
35. - M. scalaris	-	-	12	-
Family: Desmidiaceae				
(VI) Genus: Gonatozygon				
36. - G. aculatum	21	97	71	32
(VII) Genus: Hyalotheca				
37. - H. mucosa	11	-	-	-
(VIII) Genus: Closterium (Nitzsch)				
38. - C. acerosum	4	-	13	6
39. - C. calosporum	-	19	-	-
40. - C. rectimarginatum	-	33	-	-
(III) Order: Ulvales				
Family: Schizomeridaceae				
(IX) Genus: Schizomeris (Kützing)				
41. - S. leibleinii	3	-	-	-
(IV) Order: Oedogoniales				
Family: Oedogoniaceae				
(X) Genus: Oedogonium (Link)				
42. - O. crassum	10	-	-	-
(V) Order: Ulothrichales				
Family: Microsporaceae				
(XI) Genus: Microspora (Thuret)				
43. - H. willeana	3	91	-	-
(VI) Order: Chlorococcales				
Family: Hydrodictyaceae				
(XII) Genus: Pediastrum (Meyen)				
44. - P. simplex	-	-	6	-
(VII) Order: Volvocales				
Family: Volvocaceae				
(XIII) Genus: Volvox (Linnaeus)				
45. - Volvox sp.	3	-	-	-
Family: Phacotaceae				
(XIV) Genus: Phacus				
46. - P. acuminata	4	30	-	8

Division: Chrysophyta				
Class: Bacillariophyceae				
(I) Order: Pennales				
Suborder: Araphidinae				
Family: Diatomiaceae				
(I) Genus: Fragillaria				
47. - F. construens	54	163	53	78
(II) Genus: Synedra				
48. - S. tabulata	5	-	-	-
49. - S. affinis	5	63	-	6
50. - S. ulna	8	102	19	7
(III) Genus: Diatoma				
51. - D. elongatum	12	73	-	16
52. - D. valgara	129	-	-	-
Family: Achnanthaceae				
(IV) Genus: Achnanthes				
53. - A. lancedata	6	-	-	-
Suborder: Biraphidineae				
Family: Naviculaceae				
(V) Genus: Navicula				
54. - N. placentula	4	78	18	9
55. - N. distans	4	-	-	-
56. - N. gastrum	-	70	-	-
(VI) Genus: Amphora				
57. - A. ovalis	4	-	3	3
(VII) Genus: Anomoeneis				
58. - A. sphaerophora	4	-	-	-
(VIII) Genus: Gyrosigma				
59. - G. attenuatum	4	49	9	6
(IX) Genus: Stouroneis				
60. - S. anceps	12	80	-	-
(X) Genus: Bacillaria				
61. - B. paradoxa	9	256	-	-
Family: Epithemiaceae				
(XI) Genus: Epithemia				
62. - E. zebra	-	136	-	-
Family: Surirellaceae				
(XII) Genus: Surirella				
63. - S. ovalis	-	68	-	16
64. - S. robusta	-	59	-	17
65. - S. elegans	-	52	-	-
Family: Tabellariaceae				
(XIII) Genus: Tabellaria				
66. - T. fenestrata	5	-	-	-
(II) Order: Centrales				
Suborder: Coscinodiscineae				
Family: Coscinodisciaceae				
(XIV) Genus: Melosira				
67. - M. islandica	4	-	-	-
68. - M. varians	4	29	-	-
69. - M. granulata	-	81	12	7
(XV) Genus: Cyclotella				
70. - C. eutzingians	6	-	-	-
71. - C. comta	3	59	3	6
72. - C. meneghiniana	50	111	-	36

Family: Surinellaceae				
(XVI) Genus: Campylodiscus				
73. - C. hibernicus	-	155	-	29
Division: Pyrrhophyta				
Class: Dinophyceae				
Order: Peridiniales				
Genus: Peridinium (Ehrenberg)				
74. - P. platinum	8	1	-	-
Genus: Glenodinium				
75. - G. berolinense	12	3	-	-
Phylum: Nemathelminthes				
Class: Rotifera				
(I) Order: Monogonta				
Suborder: Ploima				
Family: Brachionidae				
(I) Genus: Brachiones				
76. - B. plicatilis	-	60	30	43
77. - B. pala	-	41	20	29
78. - B. rubens	-	162	-	-
79. - B. havanaensis	-	162	42	48
(II) Genus: Keratella				
80. - K. valga	-	98	43	71
81. - K. hiemalis	-	102	78	84
82. - K. surrulata	-	67	-	-
83. - K. testuda	-	93	-	-
84. - K. qudrata	-	63	63	50
85. - K. cochlearis	-	-	80	-
86. - K. serrularis	-	74	-	-
Family: Asplanchnidae				
(III) Genus: Polyarthra				
87. - P. vulgaris	4	40	197	23
(IV) Genus: Asplanchna				
88. - A. priodonta	-	36	-	-
Family: Lecanidae				
(V) Genus: Monostyla (Licane)				
89. - M. lunaris	-	5	-	-
Family: Synchaetidae				
(VI) Genus: Synchaeta				
90. - S. pectinata	11	-	-	-
Family: Trichocercidae				
(VII) Genus: Trichocerca				
91. - T. cylindrica	3	-	-	-
Family: Lindidae				
(VIII) Genus: Lindia				
92. - L. pallida	-	-	53	-
Family: Notommatidae				
(IX) Genus: Scaridium				
93. - S. longicaudum	3	-	-	-

Suborder: Flosculariaceae				
Family: Testudinellidae				
(X) Genus: Hexarthra				
94. - H. intermedia	3	-	-	-
95. - H. mira	19	58	128	38
(XI) Genus: Filinia				
96. - F. brachiata	4	-	-	-
Phylum: Arthropoda				
Subphylum: Mandibulata				
Class: Crustacea				
Subclass: Copepoda				
(I) Order: Cyclopeda				
Family: Cyclopedae				
(I) Genus: Cyclops				
97. - C. fimbriatus	4	58	29	11
(II) Order: Calanoida				
Family: Diaptomedae				
(II) Genus: Diaptomus				
98. - D. siciloides	4	-	-	-
99. - D. pygmaeus	4	40	12	10
100. - D. kenai	-	18	2	12
(III) Genus: Eudiaptomus				
101. - E. gracilis	-	39	-	-
Nauplius of Cyclops	5	78	25	15
Nauplius of Diaptonus	-	33	11	7
Subclass: Branchiopoda				
(I) Order: Diplostraca				
Suborder: Cladocera				
Family: Daphniadae				
(I) Genus: Daphnia				
102. - D. pulex	-	39	-	-
Family: Sididae				
(II) Genus: Diaphanosoma				
103. - D. brachyarum	30	50	41	30
Family: Bosminidae				
(III) Genus: Bosminopsis (				
104. - B. deitersi	-	-	34	-

Table 4.2.3.2.2.b.
Average plankton distribution of the 60 μ samples per season in number of plankters per l. and (% of total). Data obtained from Mr. Magdi Abas Saleh May 1988.

	Summer	Autumn	Winter	Spring
Blue green algae	2807 (83.7)	21488 (84.6)	17831 (94.3)	9635 (90.4)
Green algae	66 (2.0)	607 (2.4)	102 (.5)	50 (.5)
Diatoms	400 (11.9)	1787 (7.0)	117 (.6)	426 (4.0)
Dinoflagelates	20 (.6)	103 (.4)	14 (.1)	16 (.2)
Phytoplankton	3293 (98.2)	23985 (94.5)	18064 (95.5)	10127 (95.0)
Rotifers	42 (1.3)	1061 (4.2)	734 (3.9)	371 (3.5)
Cladocerans	- -	80 (.3)	34 (.2)	54 (.5)
Copepods	17 (.5)	266 (1.0)	79 (.4)	112 (1.1)
Zooplankton	59 (1.8)	1407 (5.5)	847 (4.5)	537 (5.0)
Total plankton	3352	25392	18911	10664
Without blue green algae:				
Green algae	66 (12.1)	607 (15.5)	102 (9.4)	50 (4.9)
Diatoms	400 (73.4)	1787 (45.8)	117 (10.8)	426 (41.4)
Dinoflagelates	20 (3.7)	103 (2.6)	14 (1.3)	16 (1.6)
Phytoplankton	486 (89.2)	2497(64.0)	233 (21.6)	492 (47.8)
Rotifers	42 (7.7)	1061 (27.2)	734 (68.0)	371 (36.1)
Cladocerans	- -	80 (2.0)	34 (3.1)	54 (5.2)
Copepods	17 (3.1)	266 (6.8)	79 (7.3)	112 (10.9)
Zooplankton	59 (10.8)	1407 (36.0)	847 (78.4)	537 (52.2)
Total	545	3904	1080	1029

Table 4.2.3.2.2.c.
Total number of plankton organisms per liter water taken from the 60 μ samples per season and per station (zooplankton only). Data obtained from Mr. Magdi Abas Saleh just after the analysis.

Station	Summer	Autumn	Winter	Average
1	1098 (22)	35513 (980)	- -	18306 (501)
2	1608 (36)	16203 (402)	30992 (818)	16268 (419)
3	850 (162)	11241 (385)	16860 (316)	9650 (288)
4	1174 (28)	13319 (297)	8136 (264)	7543 (196)
5	1338 (160)	14374 (273)	16824 (210)	10845 (214)
6	504 (36)	37408 (1366)	12744 (312)	16885 (571)
7	466 (10)	18482 (325)	4514 (194)	7821 (176)
Average	1005 (65)	20934 (576)	15472 (352)	12474 (338)

Table 5.2.3.1.1.a.

Length frequency of *Liza ramada* in numbers and (%) of total.

length group in cm	November		December		January		February		Total	
21	-	-	-	-	4	(1.7)	-	-	4	(.3)
22	-	-	1	(.2)	6	(2.5)	-	-	7	(.5)
23	-	-	-	-	20	(8.3)	-	-	20	(1.6)
24	-	-	4	(.7)	25	(10.4)	-	-	29	(2.3)
25	-	-	6	(1.1)	21	(8.8)	1	(.8)	28	(2.2)
26	1	(.3)	9	(1.6)	7	(2.9)	3	(2.3)	20	(1.6)
27	4	(1.1)	18	(3.2)	7	(2.9)	-	-	29	(2.3)
28	11	(3.1)	42	(7.6)	10	(4.2)	5	(3.8)	68	(5.3)
29	16	(4.5)	49	(8.8)	12	(5.0)	16	(12.3)	93	(7.3)
30	39	(11.0)	64	(11.5)	22	(9.2)	19	(14.6)	144	(11.2)
31	38	(10.7)	55	(9.9)	26	(10.8)	20	(15.4)	139	(10.9)
32	57	(16.0)	49	(8.8)	21	(8.8)	14	(10.8)	141	(11.0)
33	42	(11.8)	58	(10.5)	12	(5.0)	23	(17.7)	135	(10.5)
34	53	(14.9)	51	(9.2)	11	(4.6)	10	(7.7)	125	(9.8)
35	43	(12.1)	42	(7.6)	10	(4.2)	7	(5.4)	102	(8.0)
36	28	(7.9)	26	(4.7)	7	(2.9)	6	(4.6)	67	(5.2)
37	13	(3.7)	11	(2.0)	3	(1.3)	3	(2.3)	30	(2.3)
38	4	(1.1)	10	(1.8)	1	(.4)	1	(.8)	16	(1.2)
39	1	(.3)	12	(2.2)	1	(.4)	1	(.8)	15	(1.2)
40	-	-	6	(1.1)	2	(.8)	-	-	8	(.6)
41	1	(.3)	5	(.9)	4	(1.7)	1	(.8)	11	(.9)
42	3	(.8)	14	(2.5)	2	(.8)	-	-	19	(1.5)
43	1	(.3)	11	(2.0)	1	(.4)	-	-	13	(1.0)
44	-	-	6	(1.1)	-	-	-	-	6	(.5)
45	-	-	1	(.2)	-	-	-	-	1	(.1)
46	-	-	3	(.5)	1	(.4)	-	-	4	(.3)
47	-	-	1	(.2)	3	(1.3)	-	-	4	(.3)
48	1	(.3)	-	-	1	(.4)	-	-	2	(.2)
49	-	-	1	(.2)	-	-	-	-	1	(.1)
total		356		555		240		130		1281
average length	32.9 ± 2.8		32.7 ± 4.4		27.9 ± 8.8		31.8 ± 2.7		32.1 ± 4.3	

Table 5.2.3.1.1.b.

Length frequency of *Oreochromis aureus* from in numbers and (%) of total per 1 cm length group.

length group in cm	November		December		January		February		Total	
12	-	-	2	(1.0)	1	(3.6)	-	-	3	(1.1)
13	-	-	15	(7.2)	-	-	-	-	15	(5.6)
14	4	(11.8)	36	(17.3)	7	(25.0)	-	-	47	7.3)
15	5	(14.7)	33	(15.9)	1	(3.6)	-	-	39	4.4)
16	3	(8.8)	20	(9.6)	2	(7.1)	-	-	25	(9.2)
17	3	(8.8)	18	(8.7)	-	-	-	-	21	(7.7)
18	1	(2.9)	16	(7.7)	1	(3.6)	-	-	18	(6.6)
19	2	(5.9)	17	(8.2)	2	(7.1)	-	-	21	(7.7)
20	3	(8.8)	11	(5.3)	1	(3.6)	-	-	15	(5.5)
21	2	(5.9)	12	(5.8)	2	(7.1)	-	-	16	(5.9)
22	1	(2.9)	2	(1.0)	-	-	-	-	3	(1.1)
23	1	(2.9)	6	(2.9)	1	(3.6)	-	-	8	(3.0)
24	-	-	6	(2.9)	1	(3.6)	-	-	7	(2.6)
25	1	(2.9)	5	(2.4)	-	-	-	-	6	(2.2)
26	6	(17.6)	5	(2.4)	3	(10.7)	-	-	14	(5.2)
27	-	-	3	(1.4)	1	(3.6)	-	-	4	(1.5)
28	2	(5.9)	-	-	-	-	-	-	2	(.7)
29	-	-	-	-	2	(7.1)	-	-	2	(.7)
30	-	-	-	-	3	(10.7)	-	-	3	(1.1)
31	-	-	1	(.5)	-	-	-	-	1	(.4)
32	-	-	1	(.5)	-	-	-	-	1	(.4)
total	34		209		28		-		271	
average length	19.7 ± 4.6		17.5 ± 3.9		20.5 ± 6.0				18.1 ± 4.4	

Tabel 5.2.3.1.1.c.

Length frequency of *Sarotherodon galilaea* in numbers and (%) of total

length group in cm	November	December	January	February	Total
10	- -	- -	2 (1.2)	- -	2 (.5)
11	- -	- -	28 (16.3)	- -	28 (6.4)
12	1 (.6)	2 (2.7)	78 (45.3)	- -	81 (18.6)
13	2 (1.2)	3 (4.0)	35 (20.3)	1 (4.0)	41 (9.4)
14	4 (2.5)	4 (5.3)	13 (7.6)	10 (40.0)	31 (7.1)
15	1 (.6)	6 (8.0)	6 (3.5)	5 (20.0)	18 (4.1)
16	5 (3.1)	8 (10.7)	3 (1.7)	2 (8.0)	18 (4.1)
17	18 (11.0)	7 (9.3)	4 (2.3)	- -	29 (6.7)
18	12 (7.4)	12 (16.0)	3 (1.7)	1 (4.0)	28 (6.4)
19	27 (16.6)	15 (20.0)	- -	1 (4.0)	43 (9.9)
20	30 (18.4)	4 (5.3)	- -	1 (4.0)	35 (8.0)
21	23 (14.1)	4 (5.3)	- -	3 (12.0)	30 (6.9)
22	12 (7.4)	2 (2.7)	- -	- -	14 (3.2)
23	7 (4.3)	1 (1.3)	- -	1 (4.0)	9 (2.1)
24	5 (3.1)	- -	- -	- -	5 (1.1)
25	1 (.6)	2 (2.7)	- -	- -	3 (.7)
26	6 (3.7)	1 (1.3)	- -	- -	7 (1.6)
27	6 (3.7)	1 (1.3)	- -	- -	7 (1.6)
28	- -	2 (2.7)	- -	- -	2 (.5)
29	2 (1.2)	- -	- -	- -	2 (.5)
30	- -	- -	-		
31	- -	- -	-		
32	1 (.6)	1 (1.3)	- -	- -	2 (.5)
total	163	75	172	25	435
average length	20.2 ± 3.2	1.84 ± 3.8	12.6 ± 1.5	16.1 ± 2.9	16.6 ± 4.4

Table 5.2.3.1.1.d.

Length frequency of *Oreochromis niloticus* in numbers and (%) of total.

length group in cm	November	December	January	February	Total
11	- -	- -	1 (1.0)	- -	1 (.2)
12	- -	1 (1.4)	8 (7.6)	- -	9 (1.9)
13	- -	1 (1.4)	14 (13.3)	- -	15 (3.2)
14	1 (.8)	2 (2.9)	14 (13.3)	15 (9.2)	32 (6.9)
15	- -	- -	5 (4.8)	21 (2.9)	26 (5.6)
16	4 (3.1)	3 (4.3)	1 (1.0)	15 (9.2)	23 (5.0)
17	7 (5.5)	- -	- -	10 (6.1)	17 (3.7)
18	15 (11.8)	5 (7.2)	2 (1.9)	6 (3.7)	28 (6.0)
19	14 (11.0)	2 (2.9)	3 (2.9)	9 (5.5)	28 (6.0)
20	22 (17.3)	5 (7.2)	5 (4.8)	13 (8.0)	45 (9.7)
21	13 (10.2)	6 (8.7)	4 (3.8)	9 (5.5)	32 (6.9)
22	11 (8.7)	6 (8.7)	6 (5.7)	4 (2.5)	27 (5.8)
23	6 (4.7)	6 (8.7)	6 (5.7)	5 (3.1)	23 (5.0)
24	5 (3.9)	3 (4.3)	4 (3.8)	1 (.6)	13 (2.8)
25	6 (4.7)	3 (4.3)	- -	3 (1.8)	12 (2.6)
26	2 (1.6)	2 (2.9)	2 (1.9)	4 (2.5)	10 (2.2)
27	1 (.8)	1 (1.4)	- -	1 (.6)	3 (.6)
28	1 (.8)	1 (1.4)	- -	4 (2.5)	6 (1.3)
29	1 (.8)	1 (1.4)	- -	6 (3.7)	8 (1.7)
30	1 (.8)	2 (2.9)	2 (1.9)	2 (1.2)	7 (1.5)
31	- -	1 (1.4)	1 (1.0)	8 (4.9)	10 (2.2)
32	- -	1 (1.4)	1 (1.0)	6 (3.7)	8 (1.7)
33	- -	- -	5 (4.8)	4 (2.5)	9 (1.9)
34	1 (.8)	2 (2.9)	4 (3.8)	3 (1.8)	10 (2.2)
35	1 (.8)	- -	2 (1.9)	5 (3.1)	8 (1.7)
36	- -	5 (7.2)	2 (1.9)	3 (1.8)	10 (2.2)
37	1 (.8)	- -	1 (1.0)	2 (1.2)	4 (.9)
38	1 (.8)	1 (1.4)	2 (1.9)	2 (1.2)	6 (1.3)
39	1 (.8)	1 (1.4)	5 (4.8)	- -	7 (1.5)
40	- -	2 (2.9)	3 (2.9)	- -	5 (1.1)
41	4 (3.1)	2 (2.9)	2 (1.9)	1 (.6)	9 (1.9)
42	3 (2.4)	1 (1.4)	- -	- -	4 (.9)
43	3 (2.4)	1 (1.4)	- -	- -	4 (.9)
44	- -	2 (2.9)	- -	- -	2 (.4)
45	1 (.8)	- -	- -	- -	1 (.2)
46	- -	- -	- -	1 (.6)	1 (.2)
47	- -	- -	-		
48	1 (.8)	- -	- -	- -	1 (.2)
total	127	69	105	163	464
average length	23.3 ± 7.5	26.0 ± 8.5	22.4 ± 9.5	22.3 ± 7.5	23.1 ± 8.2

Table 5.2.3.1.1.e.

Length frequency of *Tilapia zillii* in numbers and (%) of total

length group in cm	November		December		January		February		Total*	
9	-	-	-	-	1	(.5)	-	-	1	(.2)
10	-	-	-	-	6	(3.2)	-	-	6	(1.1)
11	-	-	2	(.8)	10	(5.4)	-	-	12	(2.1)
12	1	(.9)	5	(2.1)	42	(22.6)	2	(7.1)	50	(8.8)
13	-	-	35	(14.5)	53	(28.5)	5	(17.9)	93	6.3)
14	-	-	44	(18.2)	39	(21.0)	5	(17.9)	88	5.4)
15	2	(1.9)	26	(10.7)	10	(5.4)	6	(21.4)	44	(7.7)
16	5	(4.6)	29	(12.0)	12	(6.5)	5	(17.9)	51	(8.9)
17	4	(3.7)	21	(8.7)	4	(2.2)	-	-	29	(5.1)
18	15	(13.9)	15	(6.2)	-	-	-	-	30	(5.3)
19	15	(13.9)	16	(6.6)	1	(.5)	-	-	32	(5.6)
20	16	(14.8)	13	(5.4)	1	(.5)	1	(3.6)	31	(5.4)
21	19	(17.6)	12	(5.0)	1	(.5)	2	(7.1)	36	(6.3)
22	13	(12.0)	4	(1.7)	1	(.5)	2	(7.1)	23	(4.0)
23	7	(6.5)	10	(4.1)	2	(1.1)	-	-	19	(3.3)
24	1	(.9)	4	(1.7)	1	(.5)	-	-	7	(1.2)
25	5	(4.6)	3	(1.2)	-	-	-	-	8	(1.4)
26	1	(.9)	2	(.8)	-	-	-	-	3	(.5)
27	1	(.9)	-	-	-	-	-	-	1	(.2)
28	1	(.9)	-	-	-	-	-	-	1	(.2)
29	-	-	-	-	1	(.5)	-	-	1	(.2)
30	-	-	-	-	1	(.5)	-	-	1	(.2)
31	1	(.9)	-	-	-	-	-	-	1	(.2)
32	-	-	-	-	-					
33	-	-	-	-	-					
34	1	(.9)	1	(.4)	-	-	-	-	2	(.4)
total	108		242		186		28		570	
average length	20.4 ± 3.1		16.6 ± 3.5		13.7 ± 2.8		15.5 ± 2.9		16.4 ± 4.0	

* 6 specimen from July included

Table 5.2.3.1.2.a.

Length weight relation of *Liza ramada* per length group of 1 cm in grams and (Kf).

length group in cm	November		December		January		February		Total	
21	-	-	-	-	92.5	(1.00)	-	-	92.5	(1.00)
22	-	-	70.0	(.66)	105.0	(.99)	-	-	100.0	(.94)
23	-	-	-	-	105.3	(.87)	-	-	105.3	(.87)
24	-	-	101.8	(.74)	124.6	(.90)	-	-	121.5	(.88)
25	-	-	114.5	(.73)	138.8	(.89)	128.0	(.82)	133.2	(.85)
26	146.0	(.83)	123.9	(.70)	137.9	(.78)	149.0	(.85)	133.7	(.76)
27	160.0	(.81)	144.7	(.74)	165.7	(.84)	-	-	151.9	(.77)
28	166.5	(.76)	161.1	(.73)	188.5	(.86)	183.0	(.83)	167.7	(.76)
29	184.7	(.76)	180.7	(.74)	222.9	(.91)	204.2	(.83)	190.9	(.78)
30	205.4	(.76)	199.7	(.74)	243.6	(.90)	220.8	(.82)	210.7	(.78)
31	226.0	(.76)	224.1	(.75)	259.0	(.87)	250.2	(.84)	234.9	(.79)
32	246.2	(.75)	256.1	(.78)	288.1	(.88)	271.2	(.83)	258.4	(.79)
33	270.6	(.75)	275.7	(.77)	320.8	(.89)	301.1	(.84)	282.4	(.79)
34	305.0	(.78)	305.0	(.78)	350.9	(.89)	298.3	(.76)	308.6	(.79)
35	319.6	(.75)	338.5	(.79)	363.5	(.85)	356.3	(.83)	334.6	(.78)
36	355.4	(.76)	366.5	(.79)	385.7	(.83)	384.5	(.82)	365.7	(.78)
37	384.1	(.76)	394.7	(.78)	408.3	(.81)	388.0	(.77)	390.8	(.77)
38	428.8	(.78)	415.4	(.76)	400.0	(.73)	401.0	(.73)	416.9	(.76)
39	502.0	(.85)	456.3	(.77)	450.0	(.76)	512.0	(.86)	462.6	(.78)
40	-	-	486.5	(.76)	525.0	(.82)	-	-	496.1	(.78)
41	578.0	(.84)	502.0	(.73)	643.8	(.93)	688.0	(1.00)	577.4	(.84)
42	605.7	(.82)	577.6	(.78)	700.0	(.94)	-	-	594.9	(.87)
43	589.0	(.74)	627.6	(.79)	700.0	(.88)	-	-	625.5	(.79)
44	-	-	643.2	(.76)	-	-	-	-	643.2	(.76)
45	-	-	732.0	(.80)	-	-	-	-	732.0	(.80)
46	-	-	732.3	(.75)	800.0	(.82)	-	-	749.2	(.77)
47	-	-	804.0	(.77)	775.0	(.75)	-	-	782.3	(.75)
48	751.0	(.68)	-	-	750.0	(.68)	-	-	750.5	(.68)
49	-	-	917..0	(.78)	-	-	-	-	917.0	(.78)
total n	356		555		240		130		1281	
average weight	276.3		284.1		248.7		271.3		272.5	
average Kf	.77± .04		.76 ± .03		.86 ± .07		.83 ± .06		.80 ± .06	

Table 5.2.3.1.2.b.

Length weight relation of *Oreochromis aureus* in gram per cm group and the (Kf)

length group in cm	November		December	January		Total
12	-	-	29.5 (1.71)	50.0	(2.89)	36.3 (2.10)
13	-	-	36.8 (1.68)	-	-	36.8 (1.68)
14	44.3	(1.61)	45.6 (1.66)	75.0	(2.73)	49.9 (1.82)
15	52.8	(1.56)	56.4 (1.67)	75.0	(2.22)	56.4 (1.67)
16	66.0	(1.61)	67.6 (1.65)	100.0	(2.44)	70.0 (1.71)
17	83.7	(1.70)	84.2 (1.71)	-	-	84.1 (1.71)
18	103.0	(1.77)	98.1 (1.68)	150.0	(2.57)	101.3 (1.74)
19	124.5	(1.82)	118.3 (1.72)	150.0	(2.19)	121.9 (1.78)
20	140.7	(1.76)	144.6 (1.81)	175.0	(2.19)	145.8 (1.82)
21	182.0	(1.97)	160.7 (1.74)	225.0	(2.43)	171.4 (1.85)
22	179.0	(1.68)	203.0 (1.91)	-	-	195.0 (1.83)
23	178.0	(1.46)	217.0 (1.78)	300.0	(2.47)	222.5 (1.83)
24	-	-	252.0 (1.82)	300.0	(2.17)	258.9 (18.7)
25	292.0	(1.87)	268.8 (1.72)	-	-	272.7 (1.75)
26	344.8	(1.96)	337.2 (1.92)	400.0	(2.28)	353.9 (2.01)
27	-	-	313.3 (1.59)	475.0	(2.41)	353.8 (1.80)
28	435.0	(1.98)	- -	-	-	435.0 (1.98)
29	-	-	- -	600.0	(2.46)	600.0 (2.46)
30	-	-	- -	678.3	(2.51)	678.3 (2.51)
31	-	-	608.0 (2.04)	-	-	608.0 (2.04)
32	-	-	623.0 (1.90)	-	-	623.0 (1.90)
total n	34		209	28		271
average weight	165.2		106.5	265.5		130.3
average Kf	1.75 ± .16		1.76 ± .11	2.43 ± .20		1.90 ± .22

Table 5.2.3.1.2.c.

Length weight relation of *Sarotherodon galilaea* in gram per cm group and the (Kf).

length group in cm	November	December	January	February	Total
10	- -	- -	40.0 (4.00)	- -	40.0 (4.00)
11	- -	- -	39.8 (2.99)	- -	39.8 (2.99)
12	30.0 (1.71)	33.5 (1.94)	47.3 (2.74)	- -	46.7 (2.70)
13	36.5 (1.66)	40.7 (1.85)	56.4 (2.67)	42.0 (1.91)	53.9 (2.45)
14	42.8 (1.56)	47.5 (1.73)	71.2 (2.59)	44.4 (1.62)	55.8 (2.03)
15	56.0 (1.66)	59.5 (1.76)	79.2 (2.35)	54.4 (1.61)	64.5 (1.91)
16	70.0 (1.71)	77.3 (1.89)	116.7 (2.85)	66.0 (1.61)	80.6 (1.97)
17	85.3 (1.74)	87.8 (1.79)	112.5 (2.29)	- -	89.7 (1.83)
18	105.7 (1.81)	106.0 (1.82)	141.7 (2.43)	112.0 (1.92)	109.9 (1.88)
19	126.5 (1.84)	124.8 (1.82)	- -	110.0 (1.60)	125.5 (1.83)
20	145.0 (1.81)	133.2 (1.67)	- -	153.0 (1.91)	143.9 (1.80)
21	161.8 (1.75)	163.3 (1.76)	- -	167.3 (1.81)	162.6 (1.76)
22	201.4 (1.89)	185.5 (1.74)	- -	- -	199.1 (1.87)
23	232.4 (1.91)	215.0 (1.77)	- -	194.0 (1.59)	226.2 (1.86)
24	275.4 (1.99)	- -	- -	- -	275.4 (1.99)
25	315.0 (2.02)	313.0 (2.00)	- -	- -	313.7 (2.01)
26	350.0 (1.99)	349.0 (1.99)	- -	- -	349.9 (1.99)
27	386.8 (1.97)	335.0 (1.70)	- -	- -	379.4 (1.93)
28	- -	450.0 (2.05)	- -	- -	450.0 (2.05)
29	492.5 (2.02)	- -	- -	- -	492.5 (2.02)
30	- -	- -	-		
31	- -	- -	-		
32	693.0 (2.11)	637.0 (1.94)	- -	- -	665.0 (2.03)
total n	163	75	172	25	435
average weight	164.4	129.8	55.1	78.4	110.3
average Kf	1.84 ± .14	1.84 ± .11	2.77 ± .49	1.73 ± .14	2.14 ± .51

Table 5.2.3.1.2.d.

Length weight relation of *Oreochromis niloticus* in gram per length group and (Kf)

Length group in cm	November	December	January	February	Total
11	- -	- -	35.0 (2.63)	- -	35.0(2.63)
12	- -	30.0 (1.74)	48.1 (2.78)	- -	46.1(2.67)
13	- -	36.0 (1.64)	54.3 (2.47)	- -	53.1(2.42)
14	41.0 (1.49)	37.0 (1.35)	67.9 (2.47)	52.7 (1.92)	58.0(2.11)
15	- -	- -	77.0 (2.28)	60.0 (1.78)	63.3(1.88)
16	79.0 (1.93)	66.7 (1.63)	75.0 (1.83)	70.8 (1.73)	71.9(1.76)
17	92.3 (1.88)	- -	- -	90.2 (1.84)	91.1(1.85)
18	111.4 (1.91)	98.6 (1.69)	150.0 (2.57)	109.5 (1.88)	111.5(1.91)
19	128.4 (1.87)	134.5 (1.96)	158.3 (2.31)	133.9 (1.95)	133.8(1.95)
20	151.0 (1.89)	145.2 (1.82)	175.0 (2.19)	154.2 (1.93)	153.9(1.92)
21	168.5 (1.82)	166.5 (1.80)	200.0 (2.16)	170.3 (1.84)	172.6(1.86)
22	185.3 (1.74)	181.5 (1.70)	219.2 (2.15)	212.0 (1.99)	198.2(1.86)
23	225.3 (1.85)	211.4 (1.74)	241.7 (1.99)	229.8 (1.89)	226.9(1.86)
24	233.8 (1.69)	255.0 (1.84)	283.8 (2.05)	242.0 (1.75)	254.7(1.84)
25	294.5 (1.88)	306.0 (1.96)	- -	265.7 (1.70)	290.2(1.86)
26	352.5 (2.01)	340.5 (1.94)	275.0 (1.56)	299.5 (1.70)	313.4(1.78)
27	439.0 (2.23)	375.0 (1.91)	- -	375.0 (1.91)	396.3(2.01)
28	418.0 (1.90)	377.0 (1.72)	- -	406.8 (1.85)	403.7(1.84)
29	433.0 (1.78)	482.0 (1.98)	- -	452.3 (1.85)	453.6(1.86)
30	546.0 (2.02)	546.0 (2.02)	612.5 (2.27)	499.5 (1.85)	551.7(2.04)
31	- -	610.0 (2.05)	575.0 (1.93)	553.9 (1.86)	561.6(1.89)
32	- -	616.0 (1.88)	650.0 (1.98)	635.5 (1.94)	634.9(1.94)
33	- -	- -	745.0 (2.07)	646.8 (1.80)	701.4(1.95)
34	734.0 (1.87)	799.5 (2.03)	867.5 (2.21)	743.3 (1.89)	803.3(2.04)
35	821.0 (1.91)	- -	1000.0 (2.33)	789.2 (1.84)	845.9(1.97)
36	- -	985.2 (2.11)	1075.0 (2.30)	851.3 (1.82)	963.0(2.06)
37	1076.0 (2.12)	- -	975.0 (1.92)	995.0 (1.96)	1010.3(1.99)
38	1096.0 (2.00)	1188.0 (2.17)	1162.5 (2.12)	949.0 (1.73)	1084.5(1.98)
39	1100.0 (1.85)	1281.0 (2.16)	1292.0 (2.18)	- -	1263.0(2.13)
40	- -	1349.0 (2.11)	1386.7 (2.17)	- -	1371.8(2.14)
41	1358.5 (1.97)	1304.5 (1.89)	1477.5 (2.14)	1367.0 (1.98)	1373.9(1.99)
42	1619.3 (2.19)	1374.0 (1.85)	- -	- -	1558.0(2.10)
43	1436.7 (1.81)	1755.0 (2.21)	- -	- -	1516.3(1.91)
44	- -	1618.5 (1.90)	- -	- -	1618.5(1.90)
45	1741.0 (1.91)	- -	- -	- -	1741.0(1.91)
46	- -	- -	- -	1750.0 (1.80)	1750.0(1.80)
47	- -	- -	-		
48	971.0 (.88)	- -	- -	- -	971.0 (.88)
total n	127	69	105	163	464
average weight	322.8	473.1	383.1	281.8	342.5
average Kf	1.86 ± .24	1.89 ± .19	2.19 ± .26	1.85 ± .08	1.96 ± .27

Table 5.2.3.1.2.e.

Length weight relation of *Tilapia zillii* , in grams per cm length group and (Kf)

Length group in cm	November	December	January	February	Total
9	- -	- -	25.0 (3.43)	- -	25.0 (3.43)
10	- -	- -	24.2 (2.42)	- -	24.2 (2.42)
11	- -	21.0 (1.58)	37.5 (2.82)	- -	34.8 (2.61)
12	25.0 (1.45)	29.8 (1.72)	45.5 (3.63)	28.5 (1.65)	42.8 (2.48)
13	- -	35.5 (1.62)	56.9 (2.59)	32.0 (1.46)	47.5 (2.16)
14	- -	42.6 (1.55)	66.5 (2.42)	44.4 (1.62)	53.3 (1.94)
15	52.0 (1.54)	54.2 (1.61)	75.0 (2.22)	50.8 (1.51)	58.4 (1.73)
16	63.2 (1.54)	62.6 (1.53)	97.5 (2.38)	66.6 (1.63)	71.3 (1.74)
17	84.5 (1.72)	77.4 (1.58)	106.3 (2.16)	- -	82.4 (1.68)
18	103.3 (1.77)	97.5 (1.67)	- -	- -	100.4 (1.72)
19	121.1 (1.77)	118.6 (1.73)	150.0 (2.19)	- -	120.8 (1.76)
20	146.9 (1.84)	140.1 (1.75)	175.0 (2.19)	136.0 (1.70)	144.6 (1.81)
21	165.0 (1.78)	161.3 (1.74)	200.0 (2.16)	148.5 (1.60)	164.2 (1.77)
22	191.8 (1.80)	182.3 (1.71)	300.0 (2.82)	172.0 (1.62)	193.9 (1.82)
23	203.3 (1.67)	199.3 (1.64)	300.0 (2.47)	- -	220.3 (1.81)
24	301.0 (2.18)	249.3 (1.80)	350.0 (2.53)	- -	271.3 (1.96)
25	262.4 (1.68)	272.3 (1.74)	- -	- -	266.1 (1.70)
26	324.0 (1.84)	321.5 (1.83)	- -	- -	322.3 (1.84)
27	380.0 (1.93)	- -	- -	- -	380.0 (1.93)
28	419.0 (1.91)	- -	- -	- -	419.0 (1.91)
29	- -	- -	650.0 (2.67)	- -	650.0 (2.67)
30	- -	- -	650.0 (2.41)	- -	650.0 (2.41)
31	522.0 (1.85)	- -	- -	- -	522.0 (1.85)
32	- -	- -	-		
33	- -	- -	-		
34	605.0 (1.54)	767.0 (1.95)	- -	- -	686.0 (1.75)
total n	108	242	186	28	570
average weight	161.5	88.3	72.5	66.2	97.1
average Kf	1.75 ± .17	1.69 ± .11	2.56 ± .41	1.60 ± .07	2.03 ± .42

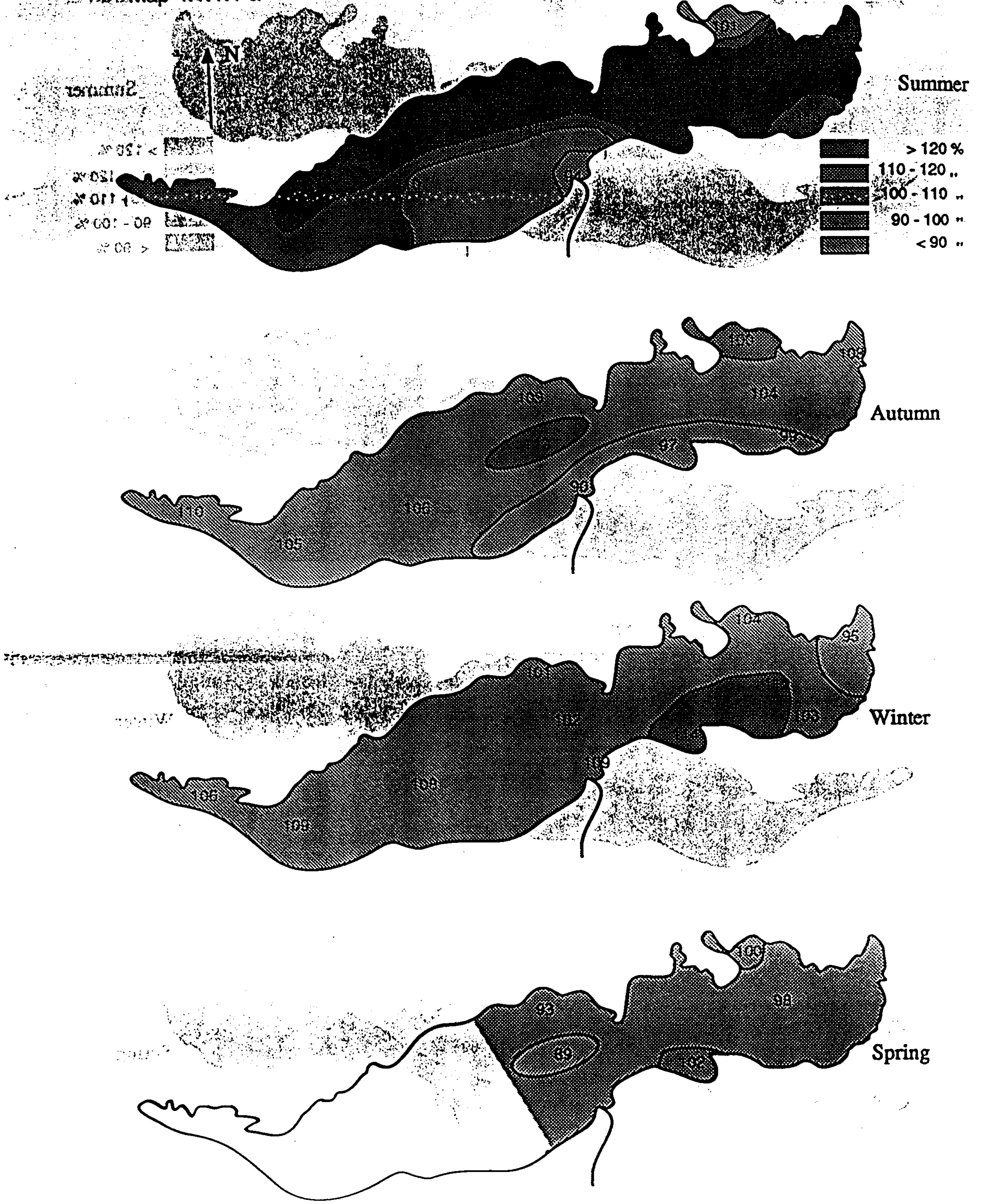
Table 5.2.3.1.2.f
Condition factor (Kf) from the most important species of the two Rayan lakes (january data not included)

	Liza ramadaniloticus	*Oreochromis aureus*	*Oreochromis zillii*	*Tilapia*
Wadi Rayan I	.81±.09	1.85±.13	1.85±.15	1.77±.13
Wadi Rayan III	.87±.05	1.87±.19	1.76±.13	1.70±.14

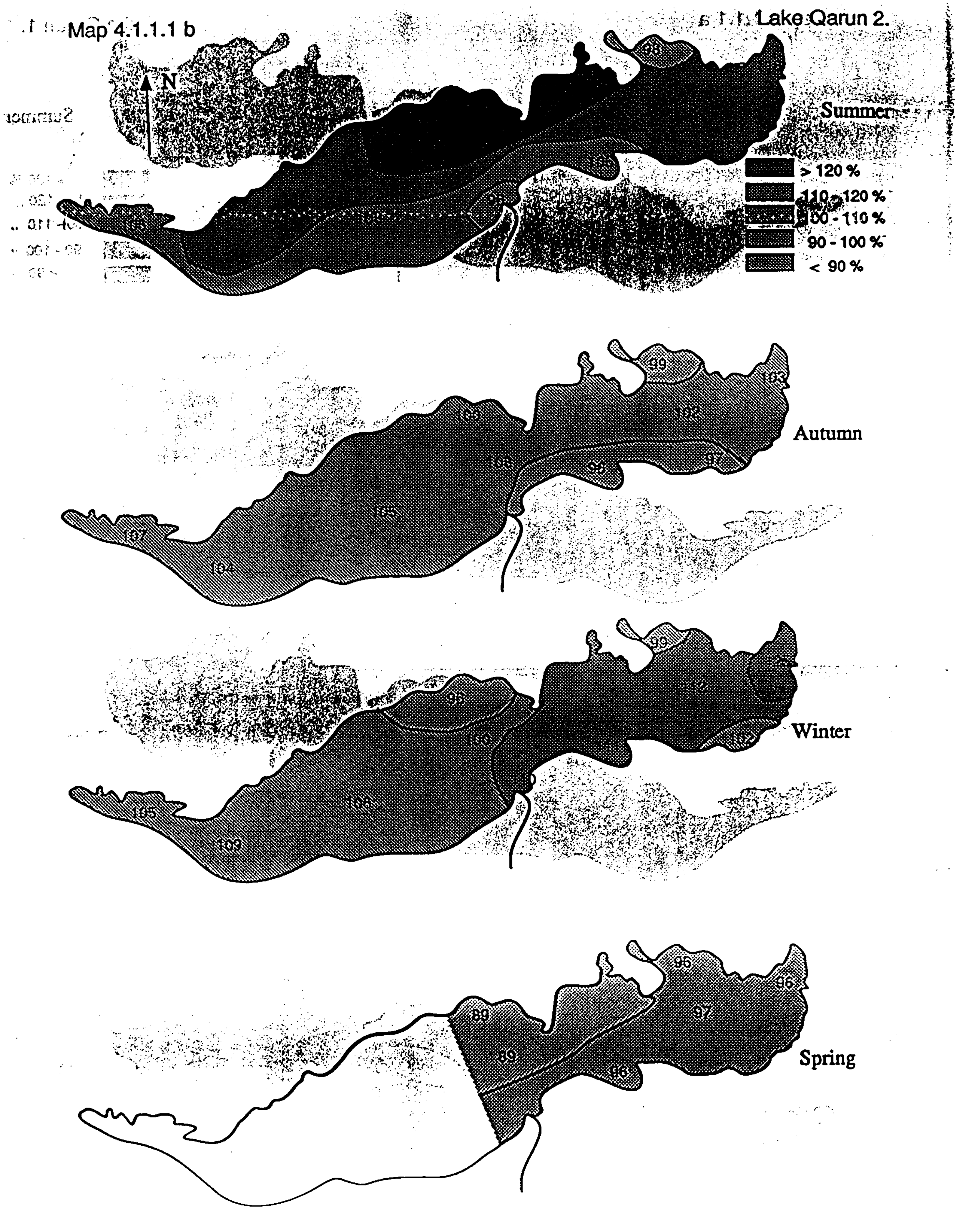
Appendix II : Maps.

Map 4.1.1.1 a

Lake Qarun 1.



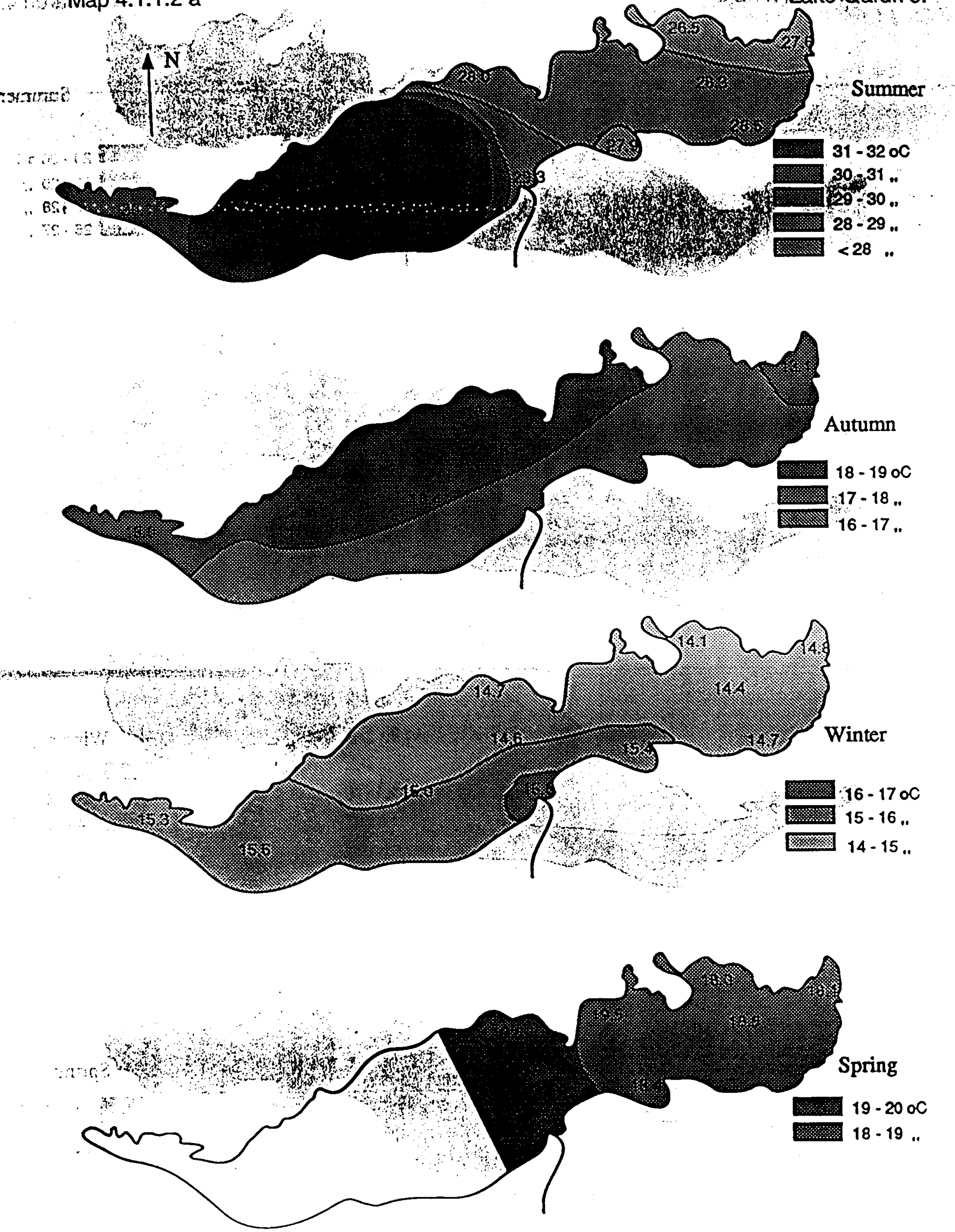
Dissolved oxygen , in % saturation , at surface level.



Dissolved oxygen , in % saturation , at 1 meter depth.

Map 4.1.1.2 a

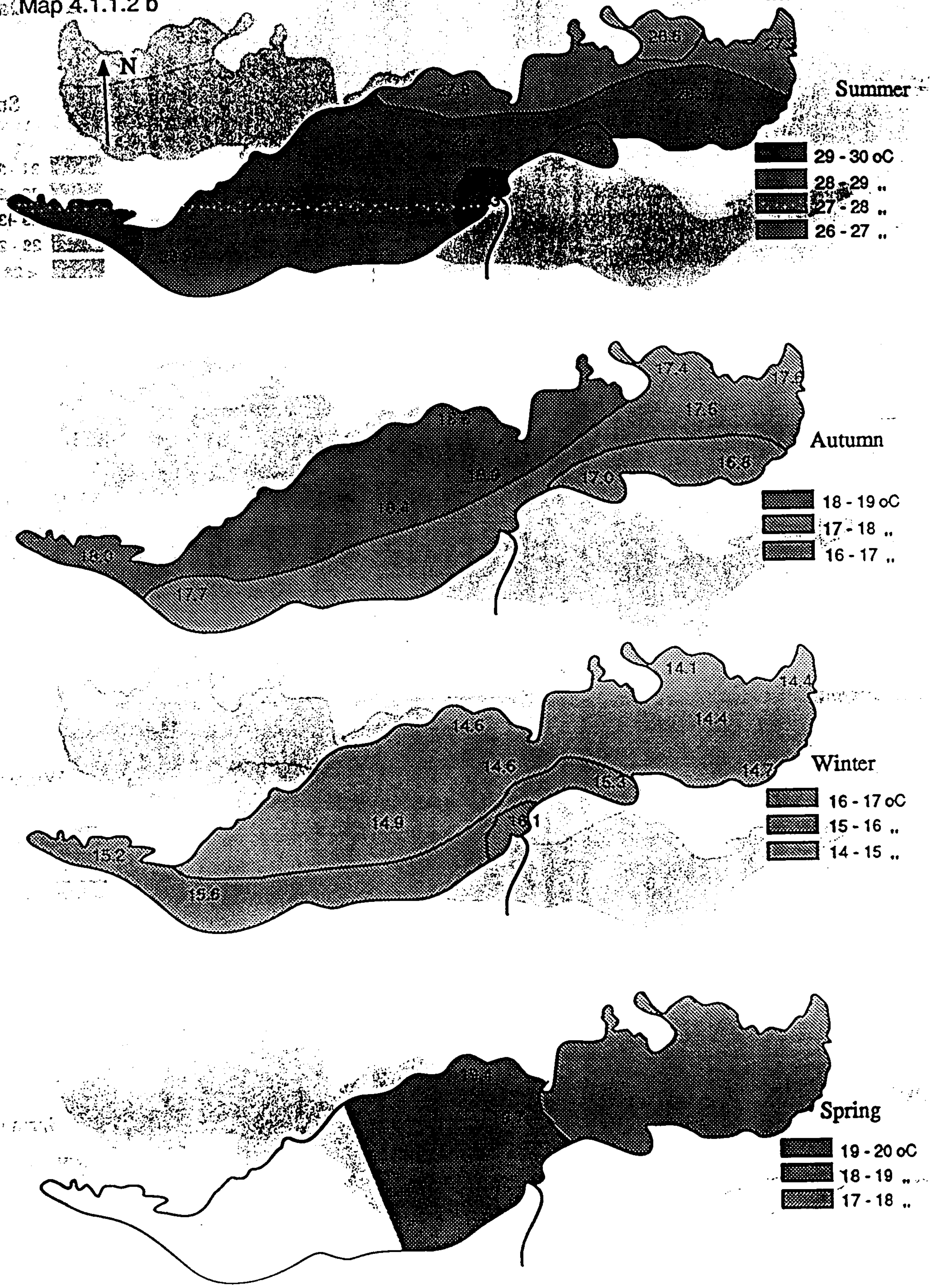
Lake Qarun 3.



Temperatures , in oC , at surface.

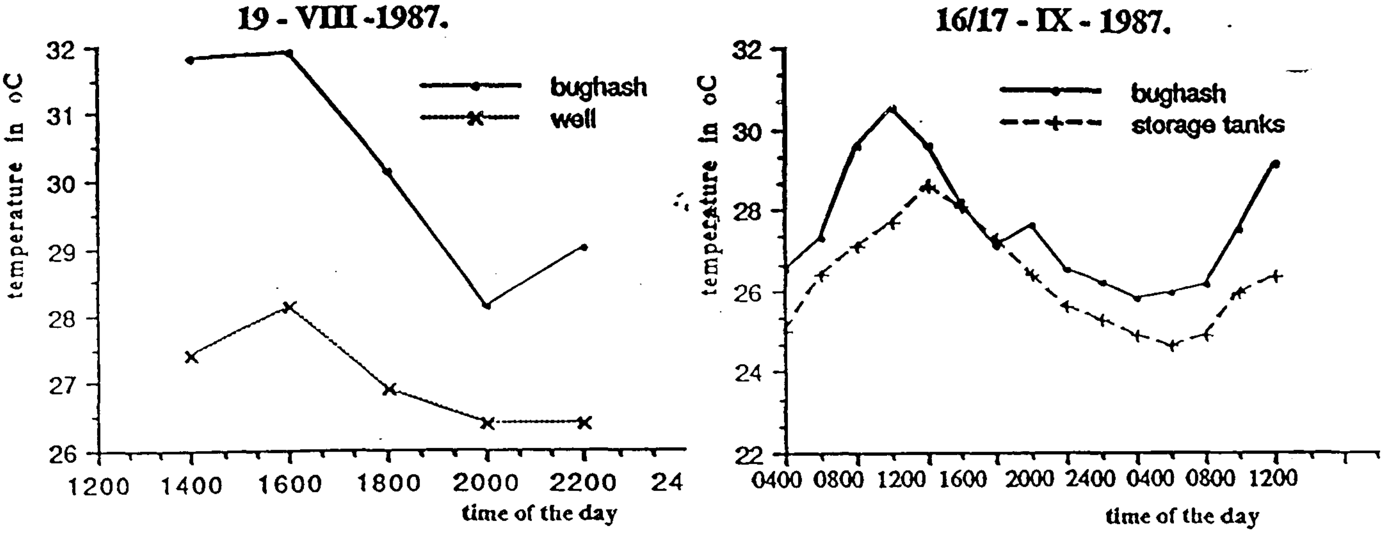
Map 4.1.1.2 b

Lake Qarun 4.



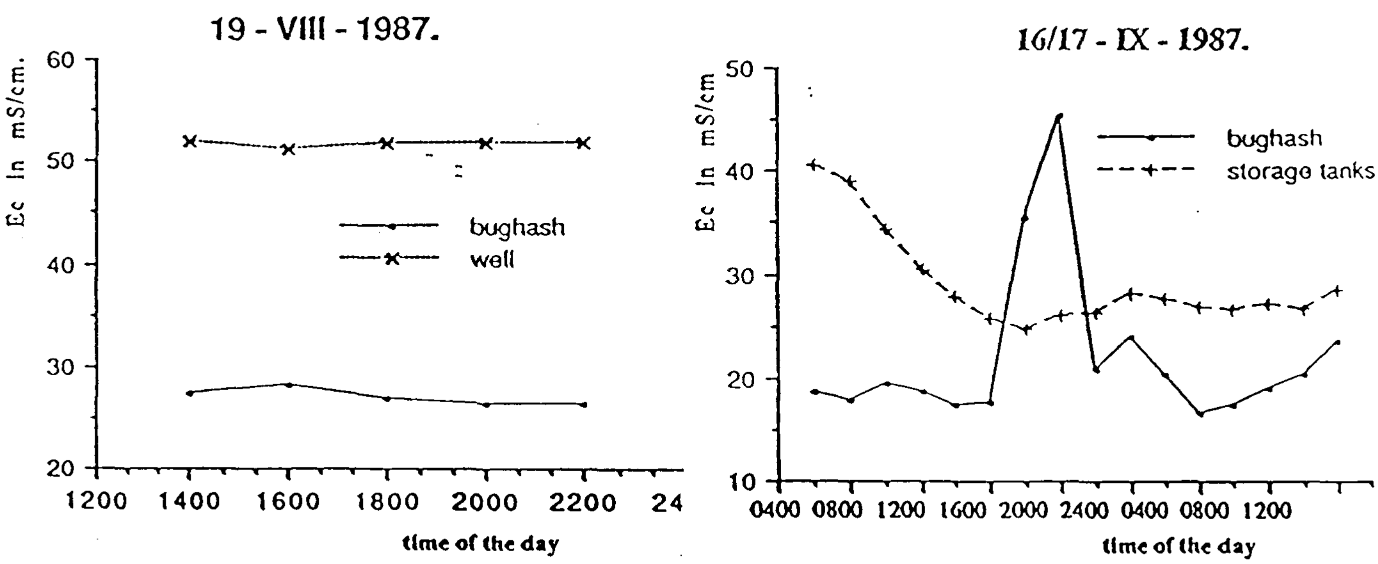
Temperatures , in oC , at 1 meter depth.

Graph 4.1.4 b : Temperature of the water of the bughash , the storage tanks and the 3 meter deep well , at El Gameel at different hours of the day.



Water from the bughash is least salt and that from the well has the highest salt content,the latter however is also the most constant .

Graph 4.1.4 c : Electric conductivity of the water of the bughash , the storage tanks and the 3 meter deep well , at El Gameel at different hours of the day.



Local fishermen cleaning their nets.

[illegible]

4.2. Biology

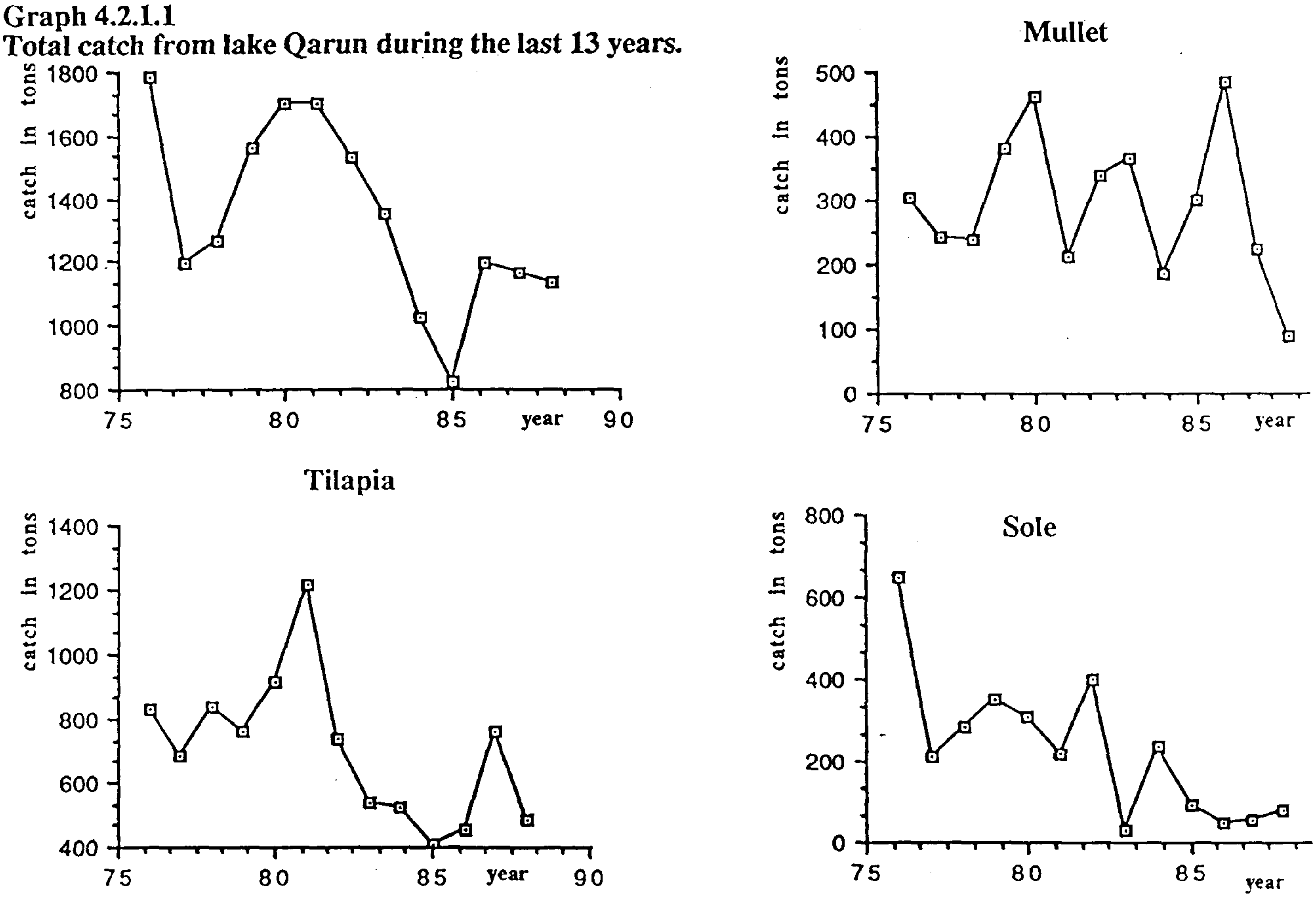
The biological measurements and determinations,carried out during this project are:
a. Measuring and weighing fish.
b. Sampling plankton, qualitatively with a 280 μ net and qualitatively/quantitatively with a 60 μ net.
c. Observing fish fry during transport and after releasing them in enclosures.

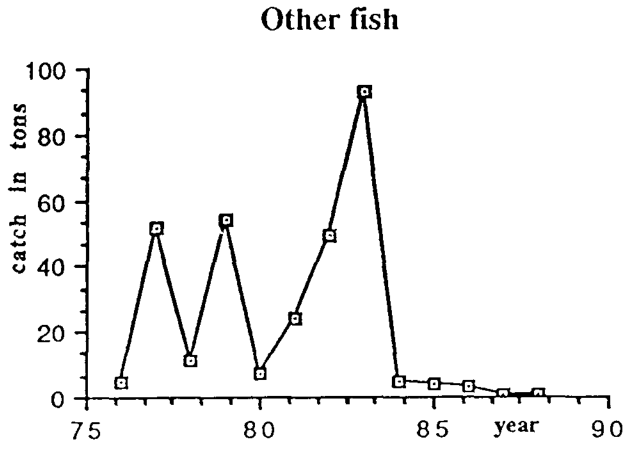
4.2.1. Lake Qarun

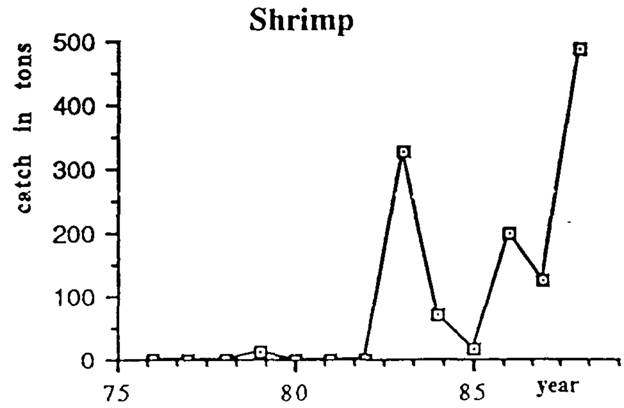
4.2.1.1. Fish and fisheries.

Although reliable catch statistics are virtually lacking,the following table 4.2.1.1. and graph 4.2.1.1. have been compiled from literature and data obtained from the fishermen's cooperative.

Graph 4.2.1.1
Total catch from lake Qarun during the last 13 years.







4.2.1.1.1. Length frequency

From the most important species length frequencies have been recorded. 176 *Liza ramada* (grey mullet) have been measured and their distribution has been compared with the data found by the IOF during their 1982/83 study. 1121 *Solea aegyptiaca* (sole) have been measured and their distribution compared with length frequency data mentioned by El Zarka and by IOF. From the tilapia species, 79 *Tilapia zillii*, 85 *Oreochromis niloticus* and 24 *O. aureus* have also been measured.

4.2.1.1.2. Length/weight relations

L/w measurements have only been taken from 377 soles. These data have been compared with information of 345 soles given by El Zarka.

4.2.1.1.3. Mullet fry transport

During the period of the project 29,968,000 fry have been transplanted, 29,618,000 were supposed to be mullet fry. The actual numbers are considerably lower, maybe only 20 % of the amount given. This is because the counting in El Girby (Damietta) is deliberately higher than in reality in order to get higher prices for their stocks. So about 6 million fry have been transplanted to lake Qarun. During transport the mortality rate was about 5 % or less, at least, those which were transported with the DAF trucks. An important reason for this might be the low temperatures during the transport season 10.7 - 15.4 ^{o}C. This fry was released in areas with temperatures between 13.9 and 17.6 ^{o}C.
The fry have been released in three different areas:

a. Enclosure in a not used harbor at police station of Shakshouk (± 0.4 ha = ± 1 feddan).
b. Enclosure in the Abu Meema bay near IOF station (± 1.5 ha = ± 4 feddan).
c. Two ponds at Abu Shanab (1.8 and 1.4.ha = ± 4.5 and 3.5 feddan respectively)

See table 4.2.1.1.3. for amounts and environmental conditions, during transplants.
From the first two areas the fry escaped rapidly into the lake as the enclosures were not sufficiently anchored and protected against the stormy weather which prevailed after the stocking.
The fry released in the ponds showed good growth and healthy behavior patterns.

4.2.1.2. Plankton

4.2.1.2.1. 280 μ samples

The 280 μ samples have been analyzed into seven groups and a rough estimate has been made of the abundance of the available plankters.

The groups were: a. botanic material
b. copepods
c. cladocerans
d. other crustaceans
e. fish larvae and fish eggs
f. insects
g. molluscs

Qualification was: o not observed, . 1 specimen, x several specimen, * common, # many, • abundant and + very abundant.

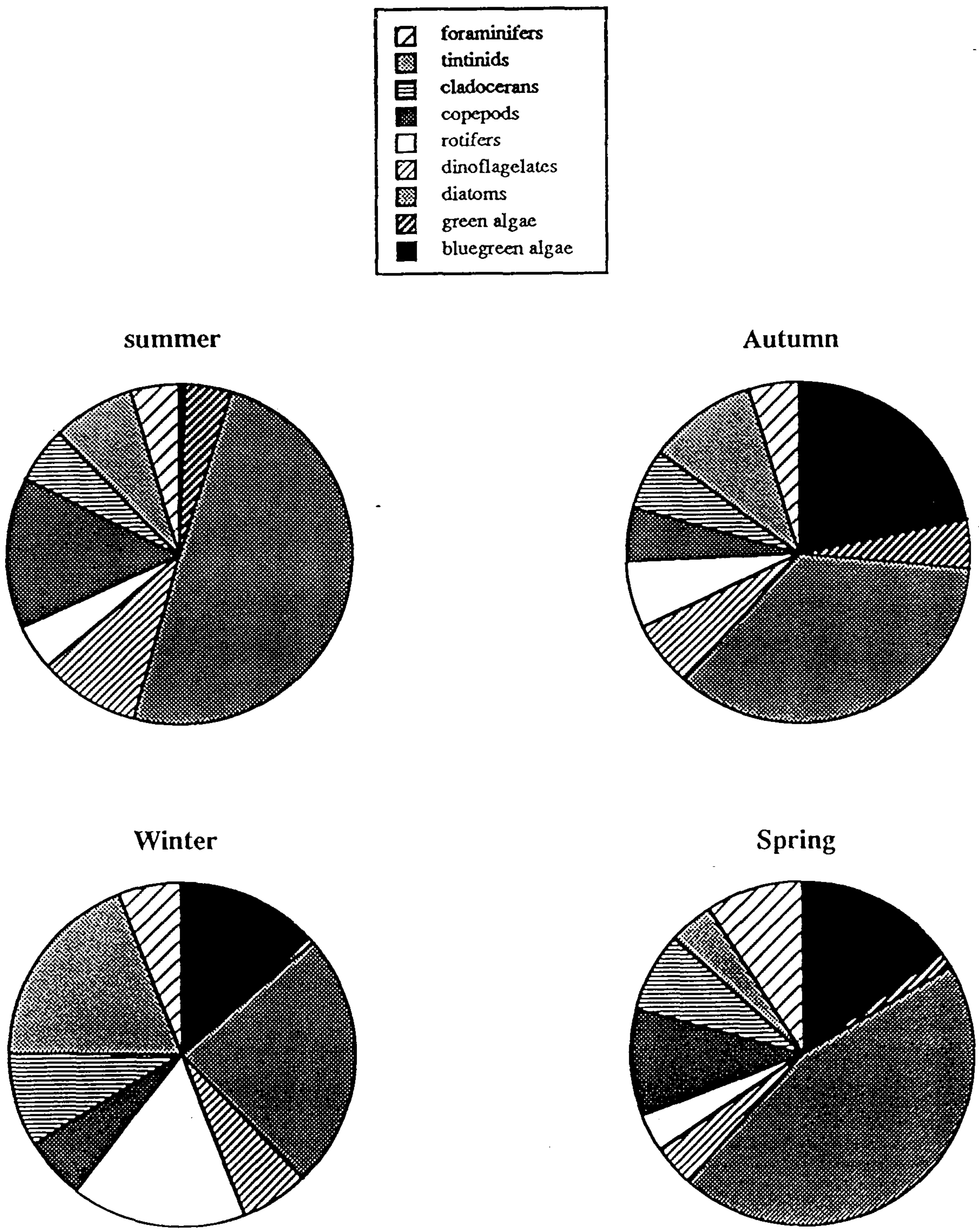
The results are shown in table 4.2.1.2.1. and maps 4.2.1.2.1.a-f.

4.2.1.2.2. 60 μ samples

The 60 μ samples have been analyzed into species level as far as possible and their number per liter has been recorded. In total 153 species belonging to 99 genera, 51 families and 20 orders have been identified (see table 4.2.1.2.2.a.).

In table 4.2.1.2.2 b and graph 4.2.1.2.2. the number of organisms of the 10 main plankton groups are given per season.

Graph 4.2.1.2.2. : Average plankton distribution of 60µ samples from lake Qarun in number of plankters per liter



In table 4.2.1.2.2.c. and maps 4.2.1.2.2.c. the total number of plankton organisms per liter are given per station and season.

4.2.2. Wadi Rayan I

4.2.2.1. Fish and fisheries

Fisheries statistics of the lake are rather basic and unreliable. It is thought that 50 to 60 % of the catch is not recorded, but is smuggled away and sold on the black market.

4.2.2.1.1. Length frequency

For the length frequency study 900 *Liza ramada*; 640 *Oreochromis niloticus*; 227 *O. aureus*; 164 *Tilapia zillii;* 17 *Sarotherodon galilaeus*;3 *Sardinella* ssp;2 *Barbus bynni*; 2 *Mugil cephalus* and 1 *Lates niloticus* were measured. But only from the first 4 species length curves have been made.

4.2.2.1.2. Length /weight relations

All the specimen measured from W.R. have also been weighed. Length/weight curves have been drawn for *Liza ramada, Oreochromis niloticus, O. aureus* and *Tilapia zillii.*

4.2.2.1.3. Mullet fry transport

During the project 12,180,000 fry have been transported from El Girby to Wadi Rayan I. All fry have been released in a shallow area of about 1.2 ha., which was excavated and protected from the lake by a stone wall. Water had to be pumped into this pond reguarly in order to maintain the required level.Prior to stocking the area had to be cleared from reed and weed .The growth of these plants was supposed to be kept under control until the fingerlings would be released into the lake.
It took 5 to 6 hours to acclimatize the fry from the water of the transport tanks to their new environment.
Table 4.2.2.1.3.gives the amount of fry and the environmental conditions during transplantations.

4.2.2.2. Plankton

4.2.2.2.1. 280 μ samples

The 280 μ samples have been analyzed into seven groups and a rough estimate has been made of the abundance levels of these groups.
The groups are:

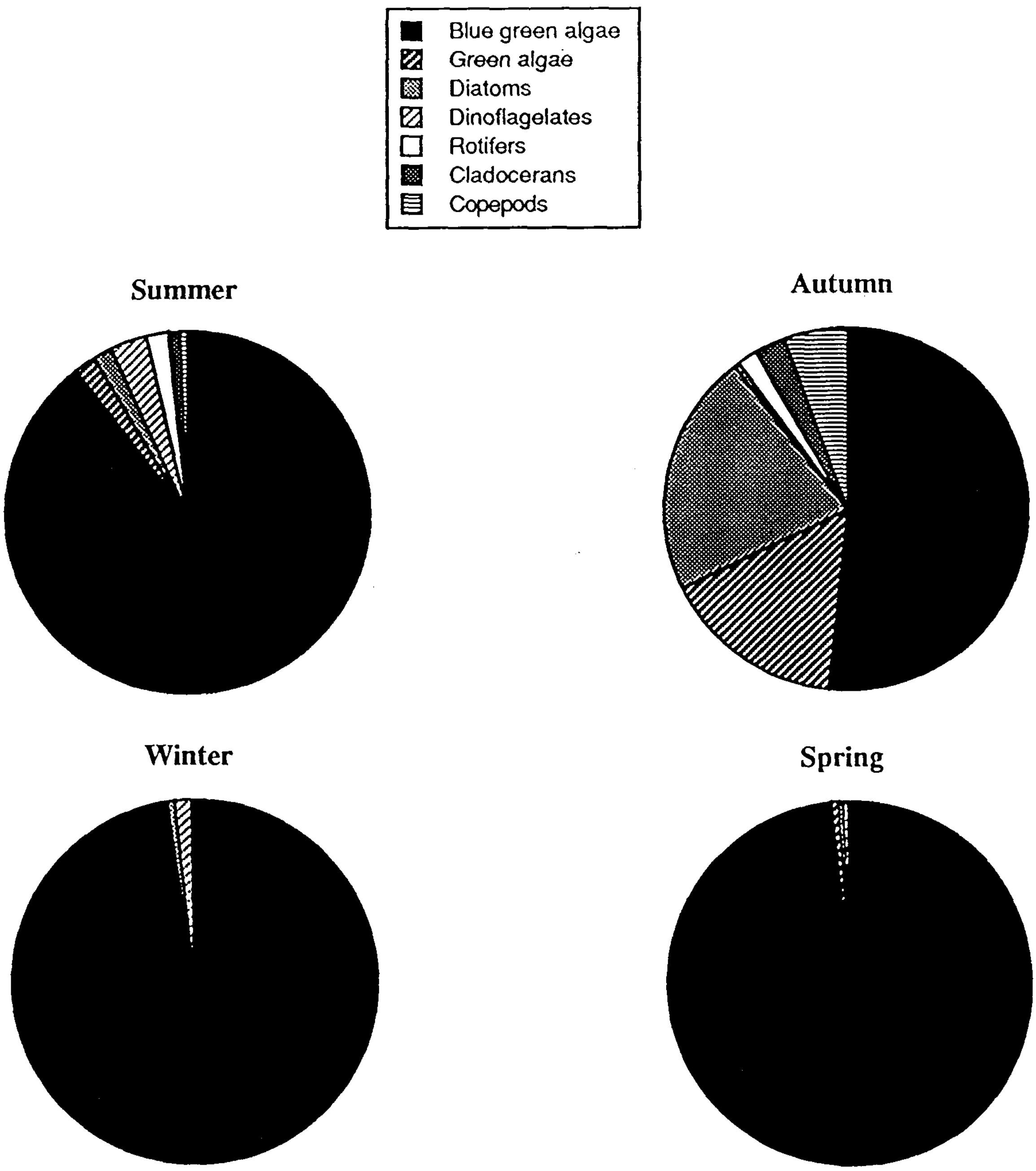
a. botanic material
b. copepods
c. cladocerans
d. other crustaceans
e. fish larvae and eggs
f. insects
g. others

Qualification is: o not found, . 1 specimen, x several specimen, * common, # many, • abundant, + very abundant.
The results are shown in table 4.2.2.2.1. and maps 4.2.2.2.1. a-c.

4.2.2.2.2. 60 μ samples

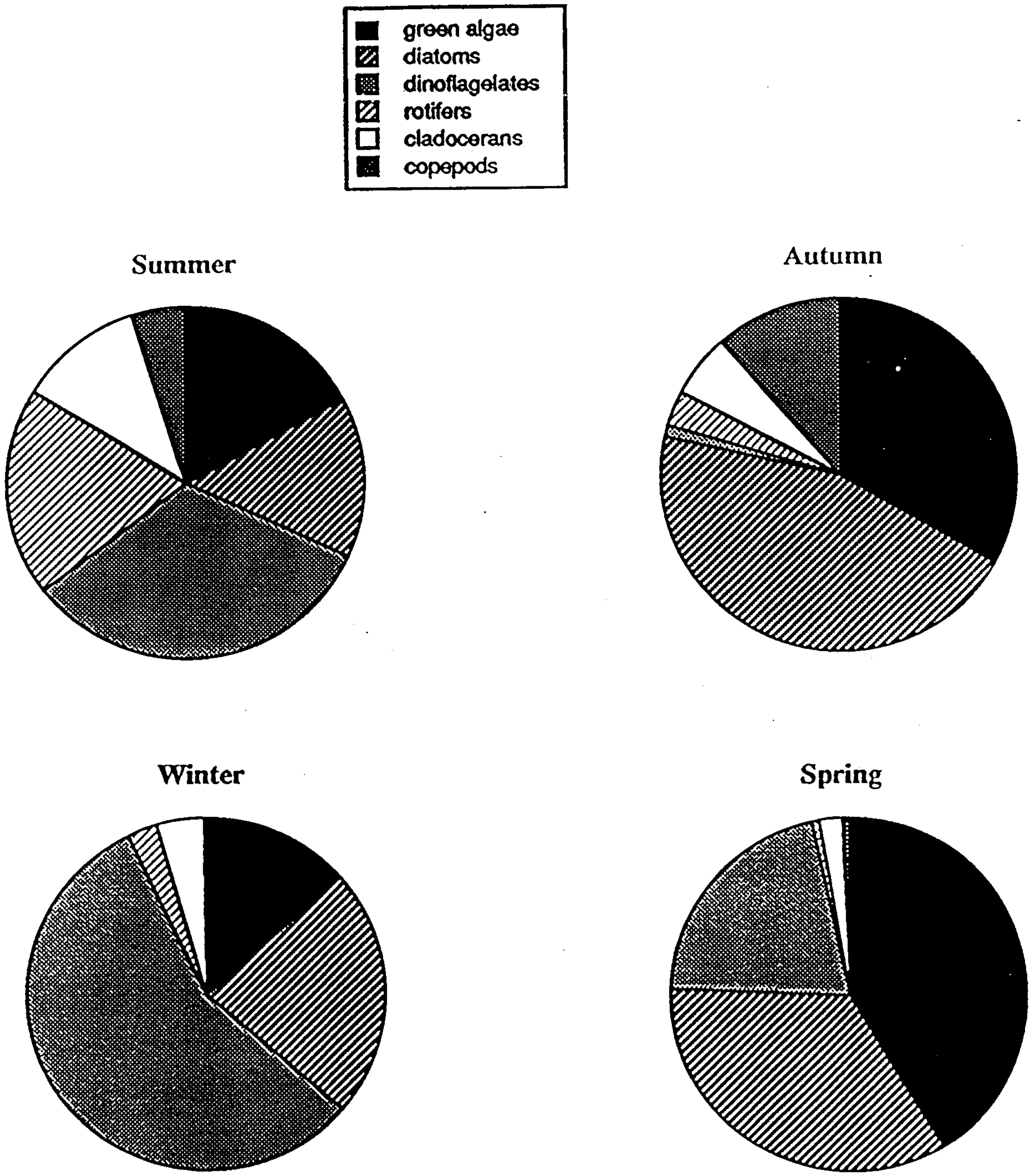
The 60 μ samples have been analyzed into species level as far as possible and their number per liter were recorded. In total 122 species, belonging to 75 genera, 35 families and 20 orders,have been identified (Table 4.2.2.2.2.a).
In table 4.2.2.2.2 b and graphs 4.2.2.2.2.a-b. the number of organisms of the main plankton groups are given per season and as % of total number.

Graph 4.2.2.2.2 a : Average plankton distribution of the 60μ samples from Wadi Rayan I lake.



Graph 4.2.2.2.2 b : Average plankton distribution of the 60 µ samples per season from Wadi Rayan L

blue green algae excluded



In table - and map 4.2.2.2.2.c. I and II the total number of plankton organisms per liter are given per season and station.

4.2.3. Wadi Rayan III lake

4.2.3.1. Fish and fisheries

The first fisheries in the lake were carried out in 1983, but no statistics have been found. The only available statistics are from the 85/86 season.

4.2.3.1.1. Length frequency

For the length frequency study 1281 *Liza ramada*; 570 *Tilapia zillii*; 464 *Oreochromis niloticus*; 435 *Sarotherodon galilaeus*; 271 *Oreochromis aureus*; 16 *Liza aurata* and 15 *Mugil cephalus* have been measured. Length frequency curves have been made for all, but the last two species.

4.2.3.1.2. Length /weight relations

From the specimen from which the length was measured also the weight was recorded, which is shown in the length/ weight curves.

4.2.3.1.3. Fry transport

During the project 8,830,000 mullet fry have been transplanted to W.R. III lake. They were released in two different locations: 5,800,000 , in an earthen pond of 1/2 ha. and 3,030,000 , more or less directly into the lake, as the enclosure in which they were supposed to be kept was not functioning and the fry disappeared directly into the lake. It took about 5 - 6 hours to transfer the fry from the transport tanks to their new environment.A sudden change of salinity and/or temperature can be fatal for the fry. table 4.2.3.1.3.gives the amount of fry and environmental conditions during transplantations.

4.2.3.2. Plankton

4.2.3.2.1. 280 µ samples

The 280 µ samples have been analyzed into seven groups and a rough estimate was made of the abundance of these groups.

The selected groups are:

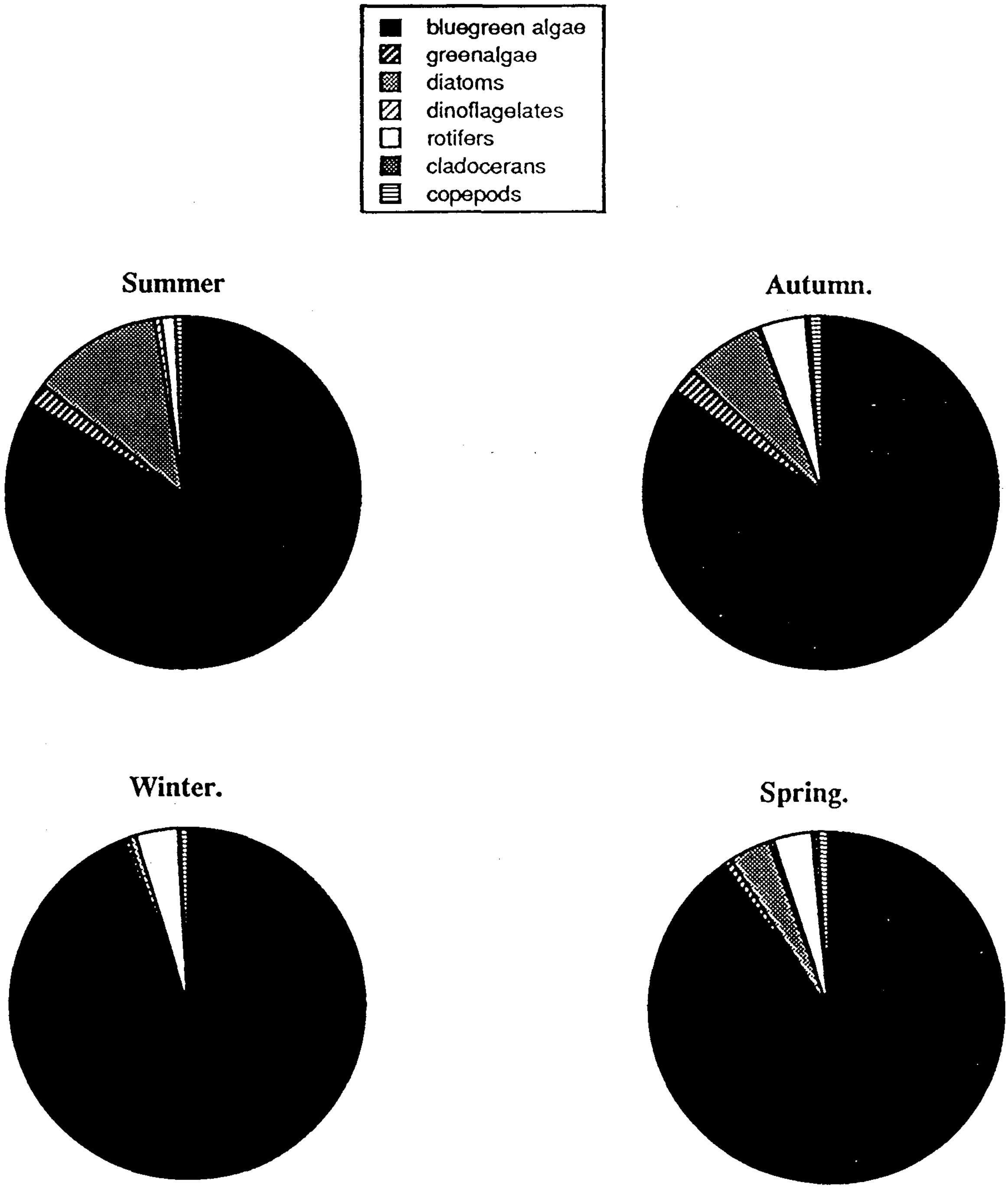
a. botanic material
b. copepods
c. cladocerans
d. other crustaceans
e. fish eggs and larvae
f. insects
g. others

The levels of occurrence are: o is not found, . 1 specimen, x several, * common, # many, • abundant and + very abundant. The result are shown in table and graph 4.2.3.2.1.a -b.

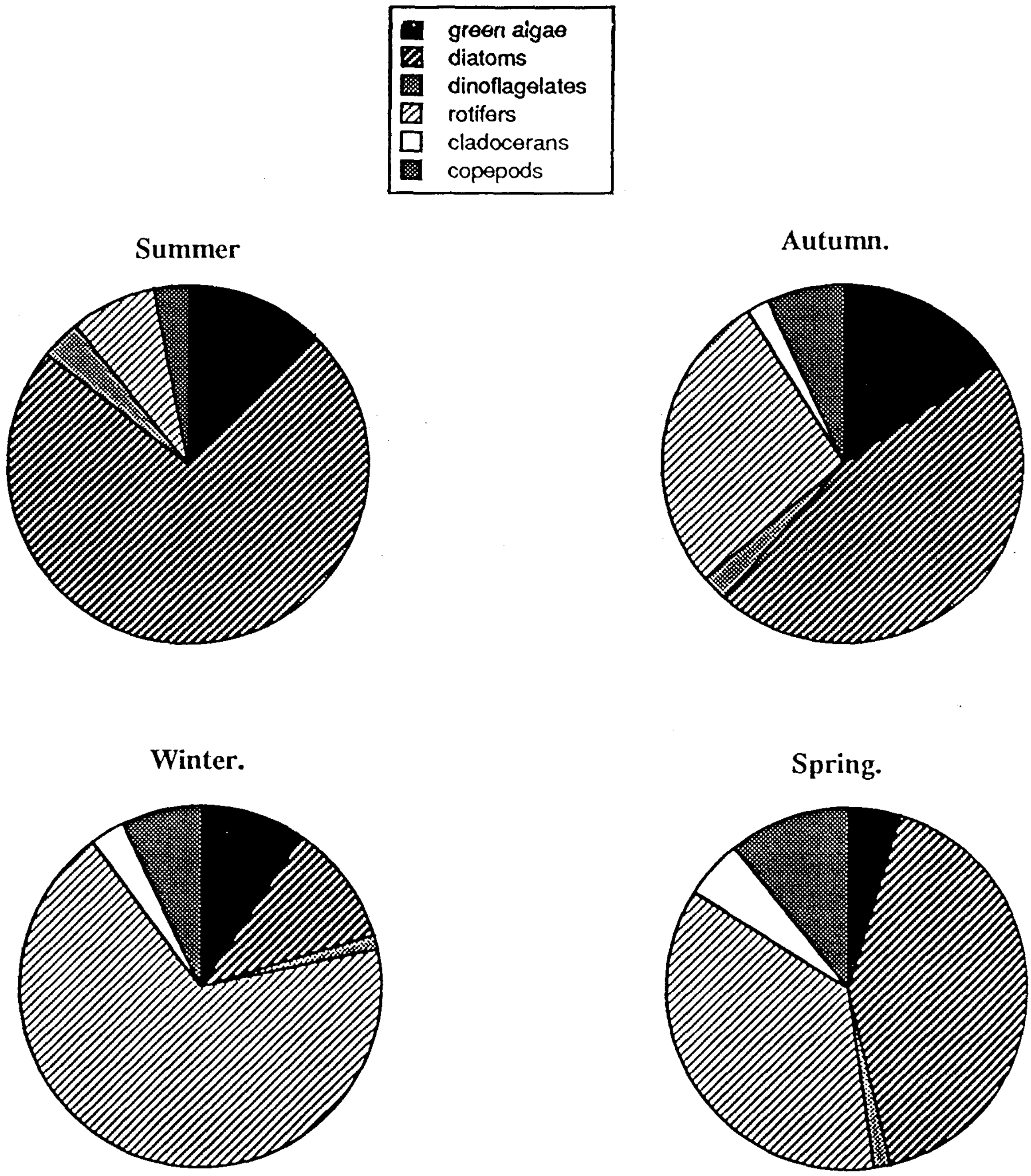
4.2.3.2.2. 60 µ samples

The 60 µ samples have been analyzed into species level as far as possible and their number per liter were recorded. In total 104 species, belonging to 67 genera, 35 families and 17 orders have been identified (Table 4.2.3.2.2.a.).
In table 4.2.3.2.2 b and graphs 4.2.3.2.2.a-b. the number of organisms of the main plankton groups are given per season as % of the total number.

Graph 4.2.3.2.2.a : Average plankton distribution of the 60 µ samples, from Wadi Rayan III lake.



Graph 4.2.3.2.2.b : Average plankton distribution of the 60 μ samples blue green algae excluded (Wadi Rayan III lake).



In table 4.2.3.2.2.c. and maps 4.2.3.2.2.c. I and II, the total number of plankton organisms per liter are given per season and station.

4.2.4. El Gameel

Seven batches of grey mullet fry (total 78 000) were used in an experiment to test the fish receiving station in El Gameel. 72 000 fry came from the New Gameel collecting site ± 12 km from the station (transported in aerated tanks with truck, max. 25 000 fry per 750 l.,transport time 15 min.), 6 000 fry were caught near the station at old Gameel collecting site and brought to the station in plastic buckets. All fry reached the station in good health. The fry composition was 87 % grey mullet and 13 % other species. From these 13 %, 23% were *Gammarus* ssp., 53 % ribbon fish (*Lepidopus caudatus* ?)and the rest were silverside (*Atherina boyeri*), half beaks (*Hemiramphus far*), sole, mackerel (*Scomber* ssp)and sea bass (*Dicentrarchus labrax*). Jellyfish were also abundant.
The grey mullet fry weighed 0,6 ± 0,08 gr and were 19.5 ± 1.16 mm. long.
The water of the tanks was obtained from the bughash and first pumped in a 3 m3 overhead tank. The conductivity varied between 45,1 and 48,5 mS/cm (average 46.5 ± 1.16). Oxygen concentration varied between 10.5 and 1,8 mg/l and the water temperature varied between 11.9 - 20.4 ^{o}C. Transparency was between 22 and 30 cm.
Water was led continually into the fry tanks from the overhead tank, which had to be filled every 35 minutes as the submersible pump gave too much water for continuous operation. An outlet at about 50 cm above the bottom of the fry tanks was covered with fine mesh netting to prevent the fry from escaping. Jellyfish and other material such as algae caused occasional clogging, Heavier materials concentrated on the bottom of the tanks.
One experiment was carried out with 53 000 fry in one tank and a control tank without fish.
And for the other experiment these 53 000 fry and a supplementary 25 000 fry were transported to lake Qarun in different concentrations per transport tank.

Experiment 1

On day 1, 13 000 fry were transported from New Gameel to the station in water of 45.3 mS/cm, 17 ^{o}C and D.O. of 130 % saturation. They were stocked in a tank with water of 46.6 mS/cm, 16.3 ^{o}C and a D.O. of 96 % saturation. After 20 hours the fry were observed. The fry were swimming in a natural way in circkels and showed no stress. There was no mortality. The D.O. in the tank had dropped to 67 % saturation and the temperature to 12.6 ^{o}C., 28.5 hours after the first introduction 12 000 fry were added to the tank. After 4 hours the D.O. concentration had dropped to 56 %, but the fry did not show any stress. A third batch of fry, 28 000, was added about 40 hours after the first fry were introduced. In total 53 000 fry were at that moment in the tank. After 1 hour the D.O. level had dropped to 36 % saturation, the fry started to swim near the surface and in the area of the water inflow. After 1 more hour the D.O. level had further dropped to 20 % and now all the fry were swimming at the surface. Compressed air was led into the tank and after 1 hour the D.O. level had risen to 32 %. 1 hour later the D.O. level reached 41 % and after another 2 hours, the D.O. level was 56 % and now the fry was swimming around in their normal way. During the period of low oxygen levels all ribbon fish and mackerel fry had died, while no mortality was observed with the other species.
The oxygen levels in the control tank, where no aeration took place, show the same pattern as shown in 4.1.4.
The temperature in the tank with fry was always higher than in the control tank. (table 4.2.4)

Table 4.2.4.

Temperature differences between tanks with fry and without fry.

Time	17^{00}	18^{00}	19^{00}	06^{00}
Temp fry tank	15°	14.8°	14.7°	11.8°
Temp control tank	13°	12.6°	11.9°	10.0°

Experiment 2

This experiment was carried out to determine the survival rate of the fry during their transplantation from the Mediterranean to the Fayoum.
The 53 000 fry from experiment 1 with an additional 25 000 fry were transported with one DAF truck to Qarun, this operation took 7 hours.
The stocking rates per transport tank (each with about 750 l of water) was as follows: tank 1, 25 000 fry; tank 2, 20 000 fry; tank 3, 15 000 fry; tank 4, 10 000 fry and in tank 5, 8 000 fry.
The mortality upon arrival in Qarun was 230 dead in tank 1 (0.9%); 270 dead in tank 2 (1.4%); 180 dead in tank 3 (1.2%)and no dead in tank 4 and 5 (0 % mortality).
During transport there was no aeration except for tank 1, where after 2 hours the fry showed stress and the compressor was used for 45 minutes to provide some extra oxygen.

5 DISCUSSION

5.1. Limnology

In general it can be said that lake Qarun, and Wadi Rayan I lake are more or less in equilibrium and are eutrophic , while Wadi Rayan III lake is not yet stabilized and is oligotrophic.

5.1.1 Lake Qarun

5.1.1.1. Dissolved oxygen

From the data collected it becomes clear that the oxygen level is only during the summer near the bottom lower than 50% saturation. However, there is no real threat that this will cause fish mortalities. During the other seasons the oxygen levels are near full saturation at all levels. The shallowness of the lake plus the frequent strong winds cause enough turbulence to avoid the build up of an oxycline for a prolonged period.

5.1.1.2. Temperature

The absolute maximum registered was 32 ^{o}C at the surface of station 6 during summer and the absolute minimum recorded was 13.8 ^{o}C at the surface of station 8 during winter. For the species of fish which live in the lake, these temperatures are well within their range and there are no problems to be expected from extreme temperatures on the survival and growth of the fish.

5.1.1.3. Electric conductivity

The measured Ec varied considerably during the various measuring dates. This was mainly caused by the difference in water level of the lake. The total salt load of the lake remains more or less the same, see table and graph 5.1.1.3.1.

Graph 5.1.1.3.1 : Ec,lake level and saltload per month

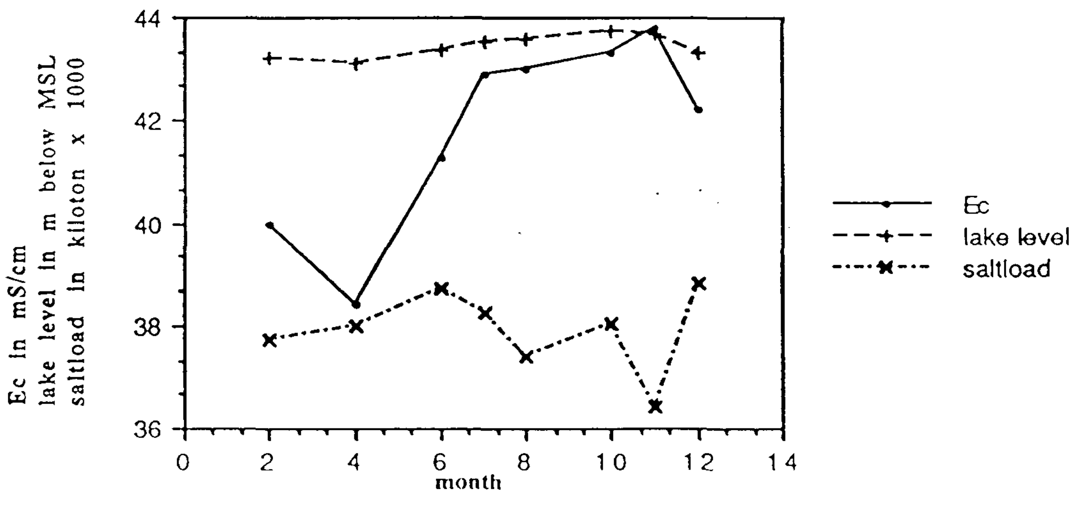


Table 5.1.1.3.1.

Measured Ec and the total saltload of lake Qarun.

date	nr of measurements	Ec in mS/cm	TDS** in g/l	lake level*** in m.s.l.	Salt load in kiloton
22/23- VI	39	41.3	34.6	- 43.35	40344
2 - VII	4 (E side of lake)	42.4*	35.5	- 43.51	40065
13- VIII	1 (Shakshouk)	45.3*	38.0	- 43.60	42028
5- X	2 (Shakshouk)	45.6*	38.2	- 43.75	40874
10/11- XI	34	43.8	36.7	- 43.68	39269
28- XII	7 (E side of lake)	41.2*	34.5	- 43.34	40310
7/10- II	41	40.4	33.9	- 43.23	40504
6/12- IV	21(W+middle of lake)	38.5*	32.3	- 43.065	39871
Average of	149 measurements	41.3	34.6	-43.36	40408 ±756

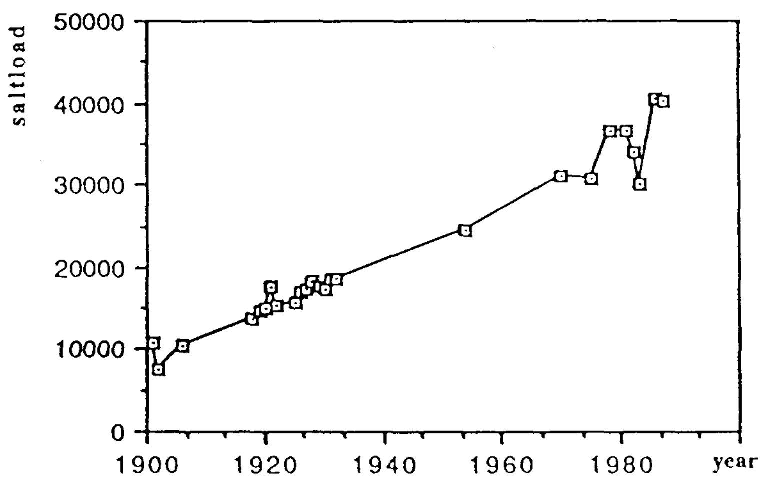
* Values are the adjusted figures. E side values are multiplied with .98 the Shakshouk figures with 1.05 and the W+ middle of lake with 1.003 in order to get an average which counts for the whole lake.

** The conversion factor from Ec to Total Dissolved Salts (T.D.S.) was calculated with the help of the results of the analysis of water samples by the Drainage Research Institute and the Ein Shams University in Cairo,and by IWACO and the ICW in The Netherlands. In these Institutions the anion and cation concentrations were established. At the DRI, some samples were evaporated and the residue weighed. From all these data the conversion factor has been established to be 0.838. The equation becomes TDS = 0.838 Ec.

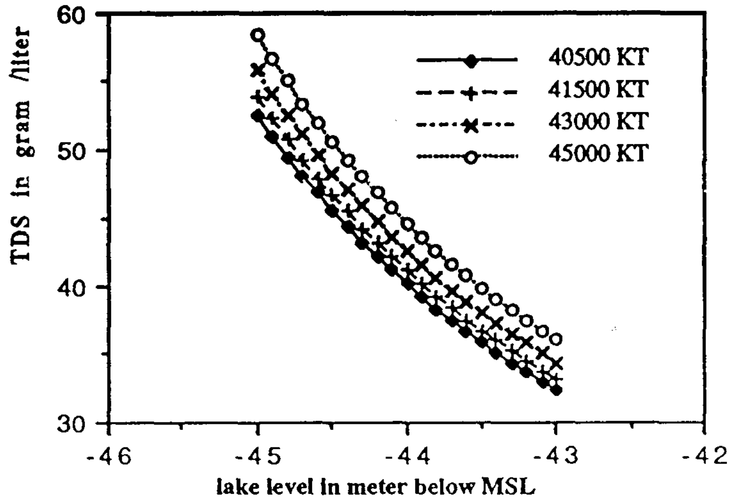
*** The equation of the calculation of the water volume of the lake to the lake level is taken from the Fayoum Water and salt Balance model project technical note 21 (Dec. 1987). Volume = 11570 + 240 x lake level in meters MSL.

When the salt content of the lake is compared with data from earlier recordings than it becomes clear that there is a steady increase of the amount of salt in the lake throughout the years,salt load is given in kilotons. (see graph and table 5.1.1.3.2.) At the moment the yearly increase is about 500 kiloton. The lake level has an important influence on the TDS level of the water.
(Graph and table 5.1.1.3.3.)

Graph 5.1.1.3.2 : Total saltload of lake Qarun through the years.



Graph 5.1.1.3.3 : Saltconcentrations at various lake levels and saltloads (Lake Qarun).



A fluctuation of 50 cm causes a difference from 2.7 till 9.7 g/l. in salinity of the water. When the salt factory will become operational the yearly increase of the salt load will be reduced. This factory is scheduled to produce in the beginning of the 1990's 247 kiloton of salt ($MgSO_4$, Na_2SO_4, KCl, NaCl and MgO). The yearly influx of salts with the drainage water is about 500 kiloton. At the moment this results in a yearly increase of the TDS of about .5g/l with the fully operational salt factory this will be .25 g/l.
If we take a TDS of 50 g/l as the critical level for most of the fish living in lake Qarun and assume that the lake level will not drop below -44 meters MSL, this would mean a salt load of 50 500 kiloton, and this will be reached in the year 2026 when the salt factory becomes operational in 1990. When the salt extraction will not take place, this level will be reached in 2008. If water level can be kept at -43.5 m than the critical point will be reached, with a saltload of 56 500 kiloton, in 2050, with salt factory or 2020 without salt extraction.At a level of -43 m. these figures will be 62 500 kiloton and this will be reached in 2174 and 2032 respectively.A good water management will extent the productivity of the lake for many years.
A comparison of the anion and cation distribution of the lake water with previous recordings (table 5.1.1.3.4.) shows a more or less equal composition, except for the amount of SO_4. The sulfates seem to be the main source of the increase of the salt load.

5.1.1.4 pH

The water of lake Qarun seems to be well buffered and very small variations of pH can be observed. The pH levels are on the alkaline side but this will not affect the fish population of the lake.

5.1.1.5. Transparency

Transparency can be an indicator for the productivity of a lake : the more plankton (food) the lower the transparency. Other factors that influence the transparency are the wave and wind action. Particularly during winter and spring long lasting strong winds often with sand and dust, caused the transparency to decrease. The winds are prevailing from the north and wave action, specially on the shallow southern and eastern areas , causes a lot of silt to be stirred into the water and thus decreasing the transparency.

5.1.1.6. Air temperature.

Air temperatures change during the daytime Early morning measurements and measurements at about noon, can differ over 10 ^{o}C during summer. After 15.00 hrs the air temperature. tends to drop rapidly. There is a close relation between the average air temperature and the average surface water temperatures . (see graph 4.1.1.6.)

5.1.1.7. Bottom profiles

The depth profiles show that the eastern end of the lake is shallow, average depth 3.3 m. There is a ridge of about 1.5 m near Abuksa. The western end is deeper and has a more regular bottom, average depth 5.2 m. The bottom looks suitable for trawling, on the other hand trawling might induce overfishing. With the gears used, the fish have enough chances to escape.

5.1.2 Wadi Rayan I lake

Wadi Rayan I lake is a fresh water lake with a total dissolved salt content of about 1.5 g/l. The salinity of this lake is most likely to remain at this level, as there is a constant flushing of the lake. Fresh drainage water from Fayoum flows into the lake and the outflow goes through a canal to Wadi Rayan II and Wadi Rayan III lakes.

5.1.2.1. Dissolved oxygen

Dissolved oxygen shows only during summer a clear oxycline at about 10 m, below which there is hardly any oxygen available to support life. But this is only relatively short time and will probably not effect the carrying capacity of the lake. At the top 8 m, the oxygen levels are always about full saturation. They range from ca. 8 gram O_2 per liter during summer to ca. 10 gram O_2 per liter during winter.

5.1.2.2. Temperature

The temperature range at the surface is from 28.8 oC maximum ,to 14.6 ^oC minimum . Which is a difference of 14.2 ^oC, which is considerable lower than the 17.9 ^oC difference in lake Qarun. But Wadi Rayan I. lake has more protection in the form of an extensive reed collar around the lake and the greater depth also provides a greater buffer. This stability in temperature is an advantage for fish growth, providing the available species do not need temperature shocks for their propagation etc. The north and north east have as a rule the lowest temperatures, which might be explained by the fact that these are the shallowest parts of the lake. The average decrease of temperature per m. depth is maximal 0,21 ^0C in the SE part, while it is only 0,06 ^0C at the outlet of the lake, which is not very deep.

5.1.2.3. Electric conductivity

The pattern of the Ec values shows, particularly for the surface values and the average values for all depths combined, a clear flow from the tunnel inlet along the south east coast and then to the north (see maps 4.1.2.3.). The differences are however minimal. The total average of all 145 measurements gives an Ec of 2,01 mS/cm which is, when the normal conversation factor of 0,670 is taken, 1.35 gram salt per liter. This value is about the same as the value of the drainage water which is led into lake Qarun, but the drainage water from the tunnel drain has an average Ec of 1.29 mS/cm i.c. a TDS content of 0.86 g/l. Average inflow is 250 x $10^6 m^3$ water with a salinity of 0.86g/l, this gives a yearly salt influx of 215 kiloton.Outflow is inflow - evaporation, which is about 90 x $10^6 m^3$ per year, i.c. 250 - 90 = 160 x $10^6 m^3$ per year. This water has a salinity of 1,35 g/l and the discard of salt is hence about 216 kiloton per year. The lake will remain a fresh water lake (slightly brackish if fresh water is defined as water with a salt level below 0.5 g/l). If the drainage water will reach the same salt level as the drainage water of lake Qarun i.c. 1.35 g/l , than the yearly salt influx will be 337.5 KT and when the outflow will remain the same,than the salt level of this lake will raise till 2.1 g/l, which still is well in the tolerance range of the fish species in the lake.The higher salt levels during autumn and winter are caused by the decrease of water inflow,which is clearly seen in map 4.1.2.3.c.

5.1.2.4. pH

The pH level is on the alkaline side, which will not give any problems with the productivity of the lake.

5.1.2.5. Transparency

The degree of transparency seems to be reflected by the flow of the drainage water which flows along the SE side of the lake to the cape just S. from the cattle station and is than pushed to the north till it hits the next cape. (map 4.1.2.5.) The lowest transparencies correspond with the lowest salt concentrations.

5.1.2.6. Air temperature

There is a strong correlation between the air temperature and the surface water temperature. (see graph 4.1.2.6.)

5.1.2.7. Bottom profiles

When the critical 10 m.line of the oxycline during summer is drawn in the depth profile, it becomes obvious that a big part of the bottom surface of the lake will become useless to support live which needs oxygen.But this is only happening for a short time and the overturn which occurs during autumn mixes the water column so that during most of the time there is no thread of toxic water.Particular during winter and spring when most fish spawn there is no problem with the water

5.1.3. Wadi Rayan III lake

Wadi Rayan III lake is not yet stabilized and real stability will never be achieved as this lake will become more saline throughout the years and it will have a fluctuating lake level depending on the amount of incoming water and water evaporation at any given time. We have the situation of an oligotroph lake.

5.1.3.1. Dissolved oxygen

The outspoken oxycline which occurs in summer in W.R. I, is not so clear in W.R. III although the lake has even deeper points. Down to more than 15 m the oxygen saturation is still over 50% (4.5 mg/m^3.) during summer. The oxygen levels are nearly always near 100% saturation in the first 10 m. In summer this is a little over 8 mg/m^3 and in winter over 10 mg/m^3 O_2/l. This lack of oxycline might be explained by the low amount of organic material in the water, this will most likely change in the future and an oxycline will occur for at least part of the year.

5.1.3.2 Temperature

The temperature extremes at surface measured during the survey are 30.5 ^oC in summer and 14.6 ^oC in winter. This is a difference of 15.9 ^oC, which lays between the W.R. I and lake Qarun values. There is a very little growth of reed around the lake as the water is still rising and the reeds have not enough time to settle properly. The influence of the sun.on the shallow parts of the lake is not dampened by reed. The range does not cause any problems for the fish species in the lake. In general there seems to be a good mixing of the water column as the temperature remains very constant throughout the water column.

5.1.3.3. Electric conductivity

The Ec values for Wadi Rayan III lake are at the moment about double the values of Wadi Rayan I. The inflow of water is the drainage water from Wadi Rayan I. The influence of Wadi Rayan II lake on the water quality is not known, but is thought to be of little importance.

The yearly inflow of drainage water into the Rayan depression is about 250 x $10^6 m^3$ *. The equilibrium between evaporation and inflow will be reached when the total surface of the Wadi Rayan lakes is about 130 km^2, assuming that the evaporation rate for the area is 1928 mm per year **. Wadi Rayan I lake has a surface of 51 km^2 and Wadi Rayan II is 2 km^2 which leaves 77 km^2 for Wadi Rayan III lake. This situation has not yet been reached. When this balance between evaporation and inflow is reached, there will be fluctuations in the lake level, depending on the monthly inflow and on the seasonal variations in the evaporation.

* This figure is obtained from a DRI report 1987 (see table 5.1.3.3.1.)

** This figure is obtained from v.d. Linden 1984 (see table 5.1.3.3.2.)

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* This figure is obtained from a DRI report 1987 (see table 5.1.3.3.1.)

** This figure is obtained from v.d. Linden 1984 (see table 5.1.3.3.2.)

Table 5.1.3.3.1.

Annual drainage into Wadi Rayan depression

1983	249 x $10^6 m^3$
1984	211 x ,,
1985	258 x ,,
1986	272 x ,,
Average about	250 x $10^6 m^3$

Table 5.1.3.3.2.

Annual evaporation in mm/year for Wadi Rayan region

1973	1928 mm/year
1974	1887 ,,
1975	1908 ,,
1976	1987 ,,
Average	1928 mm/year

When the lake has reached this surface and we estimate the mean depth to be about 11 m than the volume of the lake will be about 850 x $10^6 m^3$. The yearly influx of salt will be, as seen in chapter 5.1.2.3. about 215 kiloton. This means a yearly increase of the salinity with 0.25 g/l. The lake has, at the moment, a salinity of 2 g/l. Because of the gradual increase, most of the fresh water species which occur in the lake at the moment will survive for another 50 to 70 years, but then *Lates niloticus*, *Oreochromis niloticus* , *Clarias gariepinus*, *Labeo nilotica*, *Barbus bynni* and some other species will have problems with their survival or with their reproduction.With the slow change in salt concentration of the lake, the existing fish species will have time to adapt themselves to higher salt levels than they normally would be able to stand. A TDS level of 15 to 20 g/l is thought to be the critical salt level for most of the species occurring in the lake,after this they will show problems with reproduction and growth.Marine fish will have to be introduced by than. Sole can be introduced when the salinity is over 10 g/l. (Fonds 1975). Soles were successfully introduced in lake Qarun when the salinity was about 20 g/l.

If a small channel could be made to the next depression,S.E. from the lake,than the increase of salinity could be stopped.The salt level would than be determined by the surface area of the lake.See table;

surface area in ha	evaporation in $m^3 \times 10^6$	rest (outflow) in $m^3 \times 10^6$	final salinity in g/l
6500	125	35	6.1
7000	135	25	8.6
7500	145	15	14.3
8000	154	6	35.8

5.1.3.4. pH

The pH level of W.R. III lake is about the same as from W.R. I

5.1.3.5. Transparency

The transparency is the lowest in the southern part of the lake. This is most likely caused by wave action in the still unsettled area where many sand dunes are slowly disintegrating into the lake through wave action and seepage.

5.1.3.6. Air temperature

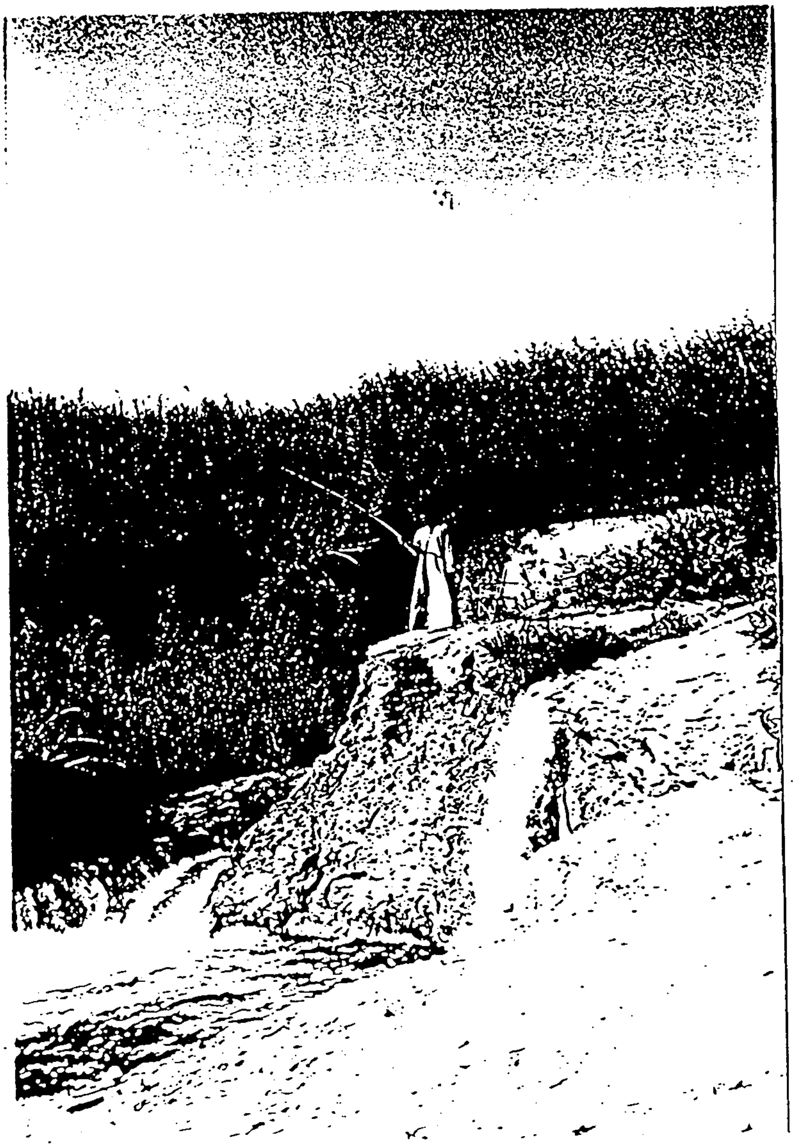
The air temperature and the surface water temperature are closely related.Air temperature is between 9 and 15% higher.

5.1.3.7. Bottom profiles

The bottom profiles show a rugged pattern with many submerged ridges. It is to be expected that these will become less pronounced in the future due to wave and current action on the not too stable soils. These consist of mostly sands and sandy silts with gypsum.

5.1.4. El Gameel

The observation made in El Gameel shows that the water from the bughash is brackish most of the time, but during rising tide an influx from sea water takes place. The normal diurnal variations in D.O. are only disrupted during the rising tide. The buffering effect of the sea water becomes noticeable. When the station would be used for storing fry until transport, it should be born in mind that acclimatization has still to be carried out when the fry come to their final destination, at least when they have to live in a fresh water environment.Water from the 3 m. deep well proved to be less suitable for use in the tanks as it was anaerobic but more seriously ,contained too much NH_4 (ammonia) to support life.



Waterfall at water inlet of Wadi Rayan III lake.

5.2. Biology

5.2.1. Lake Qarun

5.2.1.1. Fish

The total production of lake Qarun averages 1 794 tons over the 37 years mentioned in the table 4.2.1.1. The decline during the 1970 and 1980's is partially to be blamed on the poaching and withholding fish from the official market. The most popular species for smuggling are mullet, because when the fish go back in quality, they still can be salted and sold. Further the soles, because they are strong fish and take much longer to spoil. Shrimp are not so much smuggled, as they spoil too quickly. It is thought that about 50 % of the fish caught are traded though the official channels. This would mean that at least the figures from the cooperative should be doubled. If that is done than the averages becomes 2 680 tons per year (116 kg/ha.), which is a more acceptable yield of the lake with its unbalanced fish population .There are hardly any predators to use the available annual protein sources such as zoo plankton (mainly copepods), and small fish such as silversides which are probably not fully exploited. The composition of fish species in the catch has changed, because of the increase in salinity. *Lates niloticus* and most tilapias and all catfishes have disappeared. Other species have been introduced from the sea. Grey mullet has been introduced in 1928, sole in 1938.

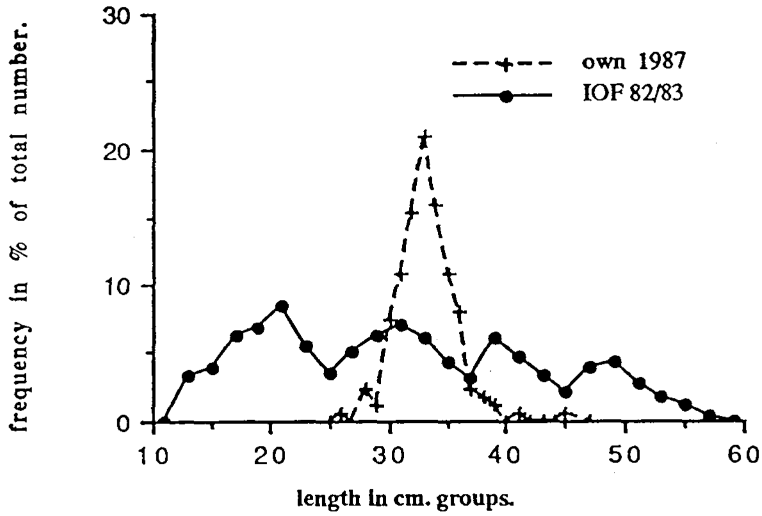
Silversides were introduced unintentionally in about 1960 and eel (*Anguila anguila*)also by accident with the mullet from early on, as the glasseel come to the shore at the same time as *Liza ramada* fry. Sea bass (*Dicentrarchus labrax*) and sea bream (*Sparus auratus*) have also been introduced to the lake with the mullet fry. But in 1970 an official trial has been made to introduce sea bream, but so far they have not become a substantial part of the catch.

Fishing season is from 30 June till 1 April. There is an additional closed season for sole during December and January, when they are spawning.There are over 500 rowing boats licenced to fish in the lake.

5.2.1.1.1. Length frequency

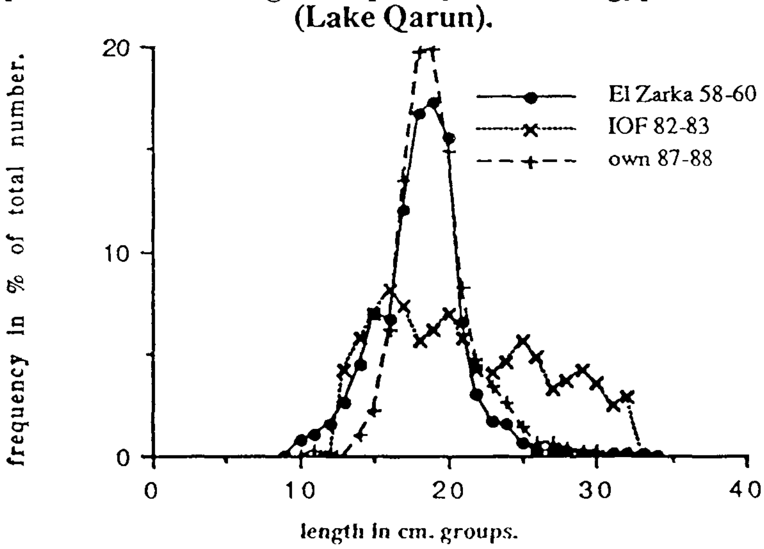
The length frequency curves of *Liza ramada* (table +graph 5.2.1.1.1.a) shows that the catch consists of practically 1 year class only, with an average length of about 33 cm. The curve of the length frequency distribution given by IOF in their 1985 report shows 4 distinct year classes, but it is not known how they obtained their sample.

Graph 5.2.1.1.1 a : Length frequency of Liza ramada (Risso).
(Lake Qarun).



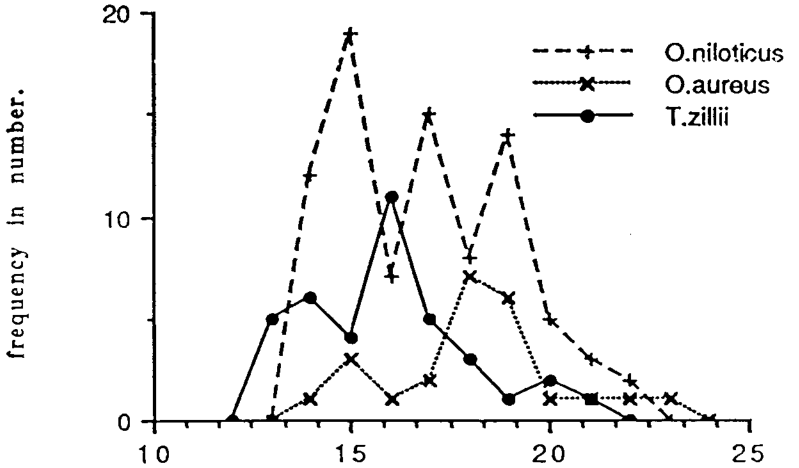
Length frequency curves of *Solea aegyptiaca* (table and graph 5.2.1.1.1.b) from own data compared with data from El Zarka (1963) and the IOF report of 1984 show that the data from El Zarka from the catches 1958 - 1960 are very similar to the data obtained during the study. The catch consists virtually of one year class only. There is a wide range in length distribution, but no distinct peaks can be distinguished. The curve of the IOF data shows 5 clear peaks, which might represent year classes, but it is unclear how they obtained this sample, it looks a bit too good. The length frequency distribution curves of the three samples taken during this study show all the same pattern , predominantly 1 year class and some vague peaks which may be older year classes.

Graph 5.2.1.1.1 b : Length frequency ofSolea aegyptiaca. Chabanaud.
(Lake Qarun).



Length frequency curves of tilapia species from lake Qarun do not give much information as the samples are too small.(graph 5.2.1.1.1.c).

Graph 5.2.1.1.1 c : Length frequencies of three tilapia species. (Lake Qarun).

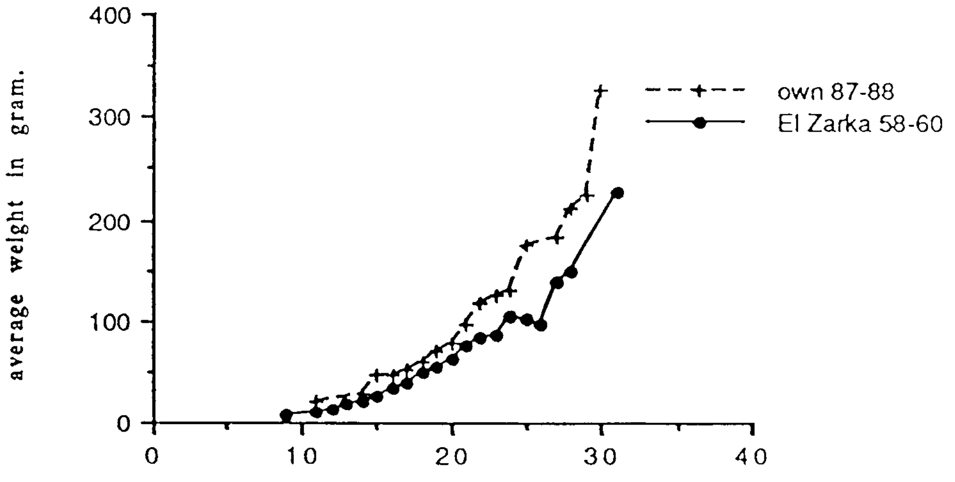


A comparison of the average length of the different species of the three lakes is given in table 5.2.1.1.1.c.From this it seems that the environment for *Liza ramada* is most favorable in Wadi Rayan I lake.This might be caused by the difference in salinity or by the ban on the use of a deep trammelnet. For *Oreochromis niloticus* and *Tilapia zillii* the growth rate in lake Qarun is the lowest,(stunted growth ?),*Oreochromis aureus* grows best in Wadi Rayan I.
In general it can be said that the conditions in Wadi Rayan I are the most favorable for the four mentioned species , while the conditions in lake Qarun are the poorest.

5.2.1.1.2. Length / weight relation

Only for *Solea aegyptiaca* length/weight relation have been established. These data have been compared with the data of El Zarka (1963) (see graph and table 5.2.1.1.2 a).

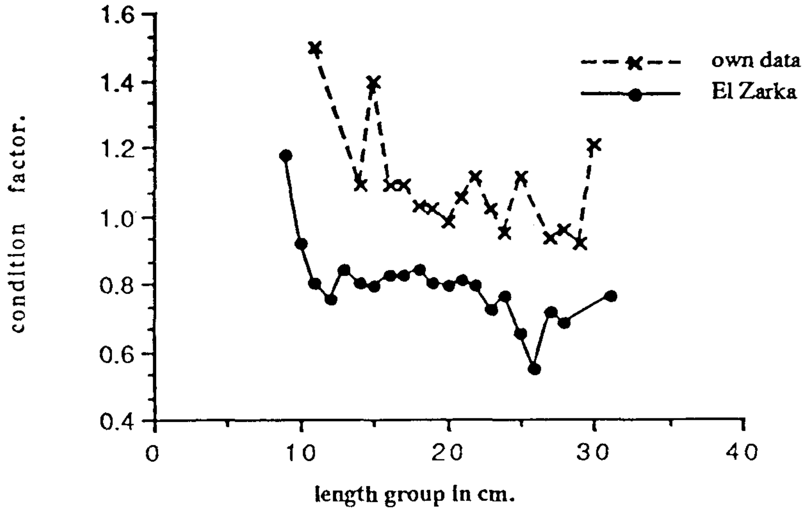
Graph 5.2.1.1.2 a : Length , weight relation of Solea aegyptiaca Chabanaud.(Lake Qarun).



The difference could be explained by the fact that the sample of 1988 was taken in the beginning of February when all fish are with ripe gonads. But also by the fact that these data have been collected by the same person into measured fish in January in the Rayan

lakes, see the variations of this month's data with the data from other months in chapters 5.2.1.2.2. and 5.2.1.3.2.
Because of this the condition factor (Kf) for our own data are on the high side when compared with those from El Zarka and those found in literature (Graph 5.2.1.1.2 b).

Graph 5.2.1.1.2 b : Condition factor (Kf) per cm. lenght group of Solea aegyptiaca.(Lake Qarun).



5.2.1.1.3. Mullet Fry Transport

Mullet were first transplanted to lake Qarun in 1928, 20 000 fry of *Mugil cephalus*. In 1931, the second year with transplantation operations, not only *Mugil cephalus* but also *Liza ramada* was transplanted to lake Qarun. From 1931 yearly transplantations took place. The first shipments were monitored carefully till 1931 to see whether there would be spawning, but no eggs and larvae have been seen. But from the later shipments the presumed *Liza ramada* spawned and reproduced. Later investigators claim that these were not *Liza ramada* but *Liza saliens*. But from experience it turned out that yearly stocking is necessary in order to maintain a catch of mullet. Table and graph 5.2.1.1.3.a. show the number of mullet fry that have been transplanted during various years.

Graph 5.2.1.1.3 a : Release of mullet fry through the years in lake Qarun.

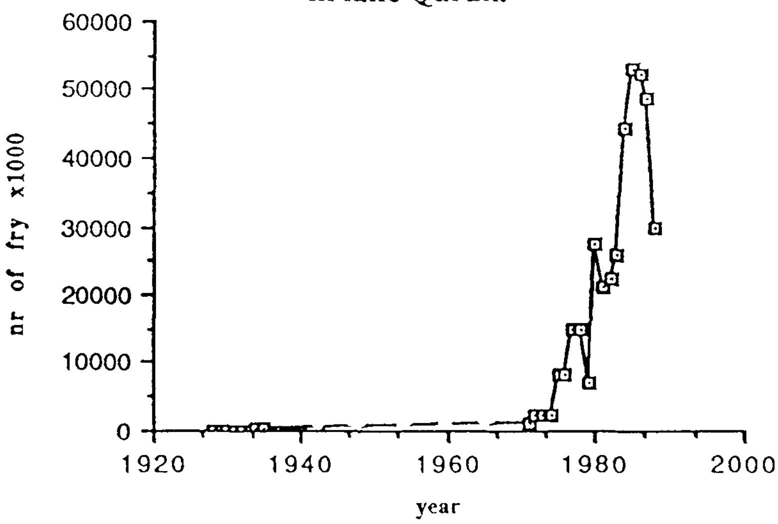
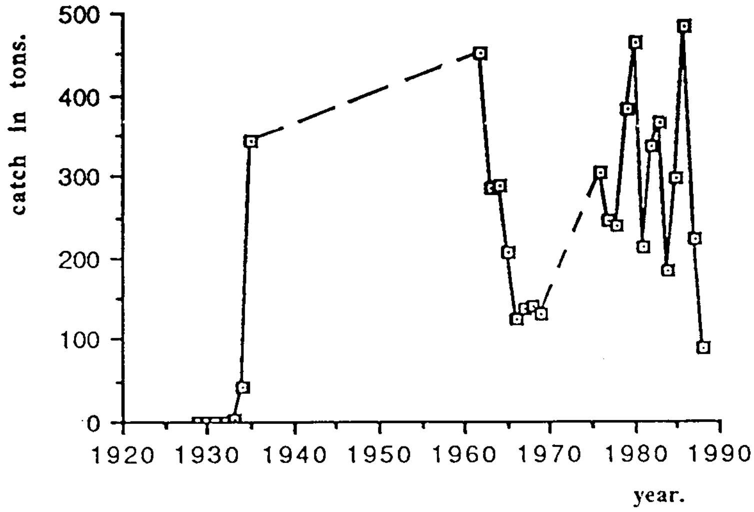


Table and graph 5.2.1.1.3.b. show the amount of grey mullets caught during the various years as mentioned by different authors.

Graph 5.2.1.1.3 b : Catches of grey mullets from lake Qarun through the years.



From the figures given by Faouzi ('36) and the weight per year class calculated by the IOF in 1984 the following could be calculated (see table 5.2.1.1.3.c).

Table 5.2.1.1.3.c.

	nr of fry transplanted	year class	catch weight		% of original
1928	20.000*				
1929		I	181 kg*	at average weight 110 gr** = 1645 fish	= 8,2 %
1930		II	427 kg*	at average weight 265 gr** = 1611 fish	= 8,1 %
1931		III	52 kg*	at average weight 574 gr** = 91 fish	= ,5 %
1932	154.000	IV	1154 kg*	at average weight 1070 gr** = 1079 fish	= 5,4 %
1933		V	2792 kg*(of which 1389 kg for year class I) =	1403 kg at 1581 gr **/fish = 888 fish	= 4,4 %
				total = 5314 fish	= 26,5 % survival
Total catch			3217 kg Average weight 605 gr		

* Faouzi 1936
** IOF 1984

This is a high survival rate , particularly when it is known that the number of predators i.c. nileperch and catfish were quite abundant in those years, which might give an indication on the relatively low influence of predators on the mullet stock.

If this is applied for later stockings and catch rates than the survival rates have dropped drastically down to about 6 % and the average weight has declined to about 300 gram.

Mullet catch in 1935 was 342 tons, which is about the average amount recorded for the last 12 years, but the stocking rates have increased from an average of ± 200.000 fry in the beginning of the 30's to over 28,000,000 per year during the last 12 years.
From the last 12 years it becomes obvious that there is no relation between stocking rate and catch.When we consider that most of the fish are caught 2 years after their transplantation,than the following table can be drawn from the available statistics of lake Qarun since 1974.When we take an average weight of 300 gram per fish than we can

calculate the number of fish caught.With these parameters we can calculate the number of fry needed to produce 1 ton of fish and the survival rate.
From these figures it seems that the sustainable yield for mullet of lake Qarun is about 350 tons per year and that this is only related to a minimal amount of fry released. The total nr. of fry needed for optimal stocking, might not necessary to be more than 3 million per year (actual counting) i.c. between 10 and 20 million by the El Girby counting .Which means that only 12 truck loads at the right time would be sufficient. The right time might be influenced by the availability of special plankters in the lake at the time of stocking, in order to have the right food available.More research will be needed to investigate this properly.
From Magdi A.Saleh the following information was received:
The fry that was stocked in the pond at Abu Shanab ,from February till April,were released from these ponds on the third of June.The fingerlings had reached an average length of 7.8 cm.(range 5.6-9.2 cm.).The 1 000 fry stocked separately in a net enclosure (2 x 2 m.) in one of the ponds in February,produced 769 fingerlings with an average length of 11.65 cm. The size of the fry during transplantation was about 2 cm.The survival rate during and nursing has been about 65 % , which shows that the transportation and stocking in enclosures are not the limiting factor for the mullet production.

5.2.1.2. Plankton

5.2.1.2.1. 280 µ samples

From table and graph 4.2.1.2.1. it is obvious that copepods are the main group of zooplankton and that they are more dominant in the eastern side of the lake than the western part, this is the same during all seasons. With fish eggs and fish larvae there is a different pattern during the various seasons, see map 5.2.1.2.1.
In summer most fish eggs are found in the S.E. while no eggs were found in the western part, fish larvae were only found in the central part of the lake. During winter most eggs were found in the western part, but nowhere in great quantities. Fish larvae were found spread all over the lake, and during spring fish eggs were abundant in the central part of the lake and their numbers decreased to the east, no samples from the west during this period. Fish larvae were only found in the central part of the lake. The fish larvae and eggs have not been identified, but they belonged to various species. Cladocerans were mostly found during winter in the western part of the lake.

5.2.1.2.2. 60 µ samples

From table 4.2.1.2.2.a. it becomes clear that the most dominant group during all seasons were the diatoms with an average of 2 525 specimens per liter divided over 39 species. The most common species were *Microcystys* sp. (832) and *Bacillaria paradox* (525). The most common genus was *Coscinodiscus* (935). The most common species of the zooplankters was *Globigerinoides conglobata* , a foraminifer, while the most common genera were *Tintinnopsis* (211), *Favella* (162), *Bosmina* (147), *Cyclopis* (128) and *Brachionus* (125).(between brackets the number of organisms per liter).
From table and graph 4.2.1.2.2.b. it can be seen that the phytoplankton, zooplankton ratio is roughly 2:1 , when numbers are considered , except during winter , when they are more or less equal. The fluctuation in numbers per liter varies from 8 046 during autumn to 2 613 during winter for the phytoplankters. During spring there is about the same amount of plankton as in winter.With zooplankters , summer, autumn and winter show more or less the same amount while during spring they show a decrease of more than 50% This can have two reasons:

a. The sharp decrease of phytoplankton in winter does not provide enough food for the zooplankton.

b. The increasing number of fish larvae that feed on the zooplankton.
The distribution of plankton in the lake (map 4.2.1.2.2.c.) shows that the most fertile area is the bay of Shakshouk. Both far ends of the lake seen to be the least productive, except during autumn when the eastern part is quite productive, which is most likely caused by the water inflow through the Bats drain, why there is such a low productivity at this point during summer is not clear. The yearly closure of the drainage system in January is most likely the cause of the low productivity during winter throughout the lake, this together with the low temperatures and the periods with overcast conditions.

5.2.2. Wadi Rayan I

In 1974 Wadi Rayan I lake was created by letting drainage water from the Fayoum, through an 8 km long tunnel, into the Wadi Rayan depression. It took until 1980 until the lake was fully filled. By this time excess water from the lake flowed through a man -made channel into Wadi Rayan II lake and further to Wadi Rayan III lake. The water level of W.R.I. is stable at about -5 m MSL. The lake will remain a fresh water lake. There is a dense growth of reed around the lake, and it has a rich plankton population.

5.2.2.1. Fish and fisheries

From the beginning of the lake fish have been transplanted into the lake to speed up natural stocking of the lake. One of the most important transplants were the grey mullet because of their food habits and high acceptance by the local population. Their introduction started in the autumn of 1980. Other fish that have been introduced intentionally are common carp, in 1983,1984 and 1985. Unintentionally, some species have been introduced with the mullet fry like *Atherina* sp, *Dicentrarchus labrax* and maybe others. Naturally came into the lake : *Bagrus bayad* , *Clarias gariepinus* , *Barbus bynni* , *Lates niloticus*, *Oreochromis aureus*, *Oreochromis niloticus*, *Sarotherodon galilaeus*, *Tilapia zillii* and various other species.
Fisheries statistics of the lake are rather basic and unreliable. It is thought that 50 to 60 % of the catch is not recorded. There is a well-organized smuggling system, which takes the fish from the lake to the black market in Fayoum, but also to Cairo.
Table 5.2.2.1.a. gives the available statistics. Data from before 1984 are not available, there has been a lot of political manipulation before the GAFRD in 1983 became the authorized authority to deal with the fish resources of the lake.

Table 5.2.2.1.a.

Catch statistics of Wadi Rayan I lake in tons

year	mullet	tilapia	carp	sea bass	catfish	labeo	nile perch	others	total
84/85+	117.	618.	17.	-	-	-	-	68.	820.
84/85*	116.966	617.606	.015	.282	3.085	52.513	10.646	-	801.113
84/85**	39.96	360.25	.01	.19	3.17	14.73	5.75	-	424.06
85/86*	138.573	271.972	.481	.464	2.680	10.032	7.713	-	431.915
85/86**	157.994	274.248	.480	1.663	8.986	10.037	5.778	-	459.186
86/87**	145.122	182.030	.154	.393	2.312	10.980	.378	-	341.369◊
86/87*	62.34	92.43	.09	.09	2.35	4.06	4.95	-	166.31
87/88	243.21	158.47	.14	.04	3.31	-	9.40	6.70	421.27

+, * and ** are different sources at the GAFRD**
◊ = data from 1987 missing, only 1986 part of the season.
When 50 % of catch is not recorded than the average catch comes between 800 and 1000 ton per year, which is between 150 and 200 kg./ha.
Fishing season in W.R. I lake is from 1/2 November till beginning of May.Fishing is being carried out with 95 unmotorized vessels.
The sustainable yield can be theoretically calculated with a formula given by Ryder 1957.This formula is Y(ield) = 14.3136 MEI $^{0.4681}$ in kg./ha./year.

MEI = Morpho Edaphic Index and can be the electric conductivity,in µS/cm,of a water body divided by the mean depth of this water body.In our case MEI = 2010/10.7 = 187.85,with this the yield is 166 kg./ha./year.The total surface of the lake is 5090 ha., which means a total production of 845 ton per year.This would mean that the actual production is close to the maximum sustainable yield of the lake.

5.2.2.1.1. Length frequency

From table and graph 5.2.2.1.1.a. it becomes clear that for *Liza ramada*, the main part of the catch consists of 1 year class. In this case year class II (66% of the catch), the rest of the catch are fish from older year classes. The year class distribution is roughly 66 % year class II; 16 % year class III; 13 % year class IV and 5 % year class V and older.
The average length per year class is about the same as mentioned in the IOF (1984) report about lake Qarun (see table 5.2.2.1.1.b.).

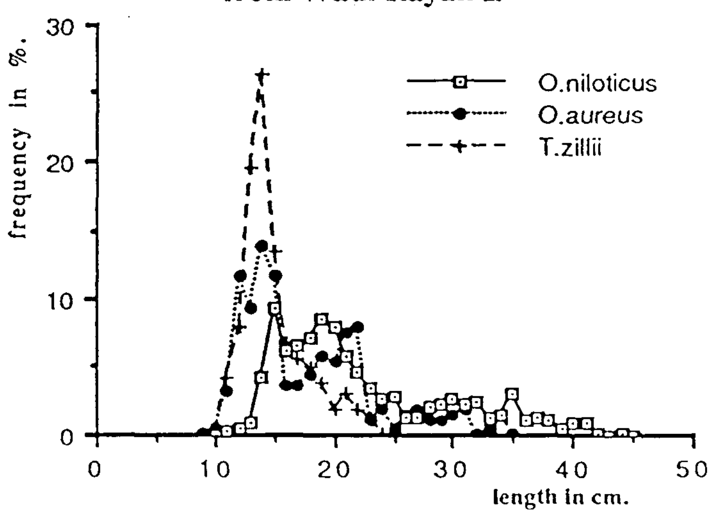
Table 5.2.2.1.1.b.

Average length of *Liza ramada* in cm per year class

Year class	I	II	III	IV	V+
own data	25.0	33.7	43.4	48.3	53.6
IOF	21.2	30.7	41.5	52.7	64.2

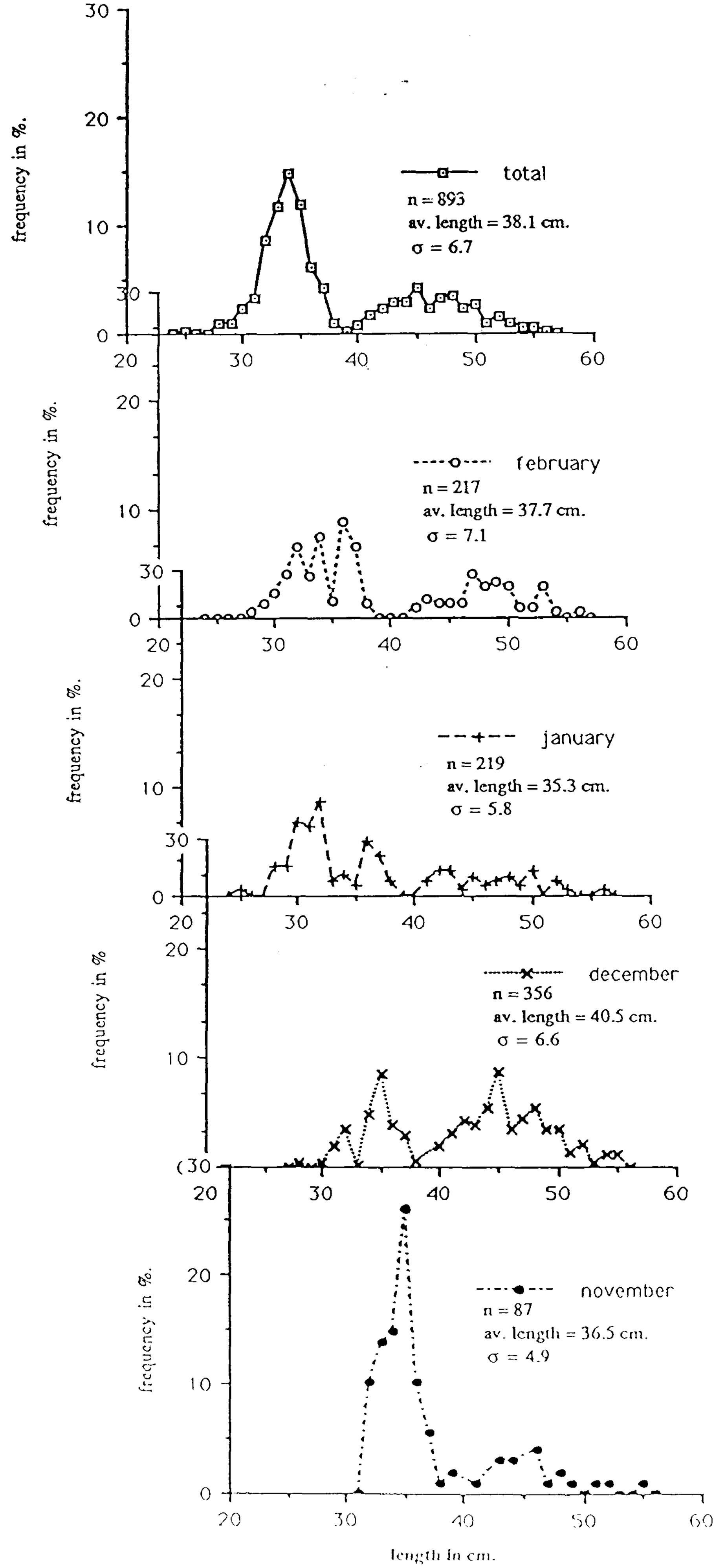
In table 5.2.2.1.1.c and graph 5.2.2.1.1.b.the length frequency of *Oreochromis niloticus* is depicted. Here the main catch seems to exist of two year classes (A and B).
The year class distribution is roughly 25 % year class A; 49 % year class B; 14 % year class C; 6 % year class. D and 5 % year class E and older. When year class A corresponds with year class II of the IOF report than the average length per year class is considerable higher than the figures given in the IOF report for Qarun.(table 5.2.2.1.1.d) This is most likely to be explained by the marginal living conditions for this tilapia species in lake Qarun.
In table 5.2.2.1.1.e. and graph 5.2.2.1.1.c. length frequencies are given for *Oreochromis aureus* and *Tilapia zillii*..

Graph 5.2.2.1.1 c : Length frequency of three tilapias from Wadi Rayan I.

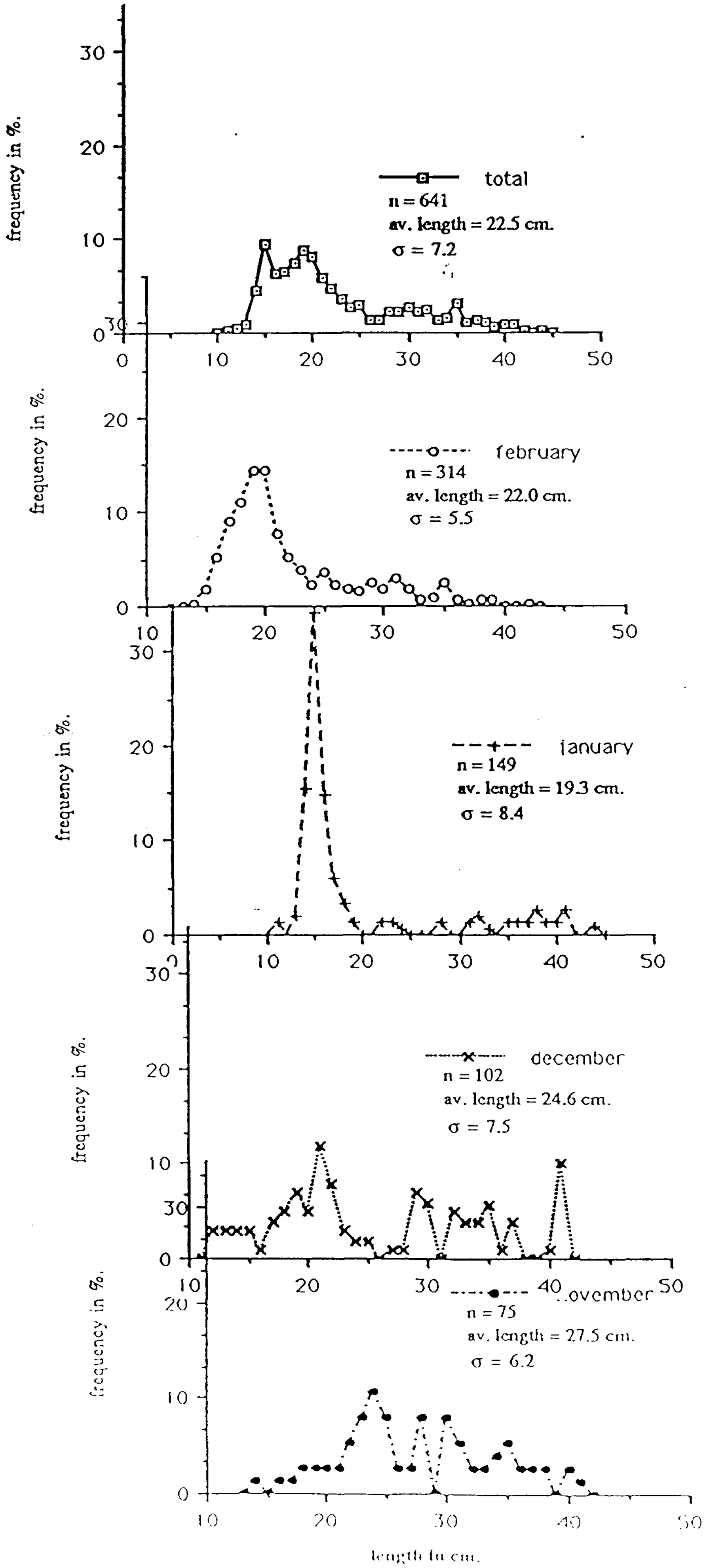


With *O. aureus* 4 year classes might be distinguished and for *T. zillii.* three The catch of *O. aureus* seems to be spread over a few classes while the catch of *T. zillii* is dominated by one year class

Graph 5.2.2.1.1 a : Length frequency of Liza ramada. (Wadi Rayan I).



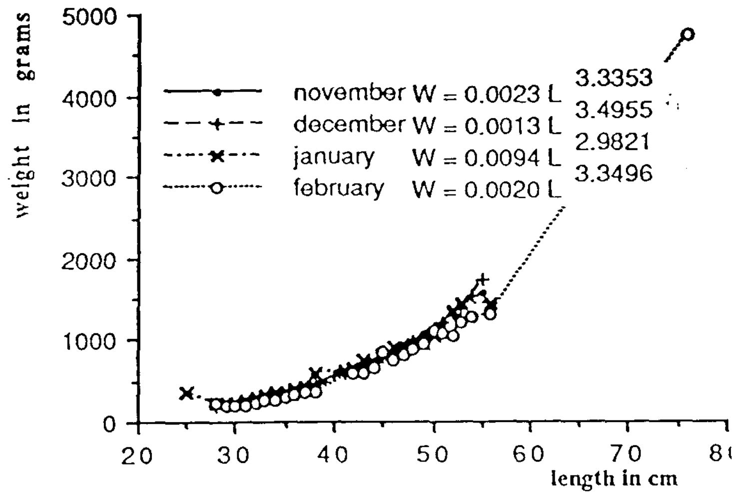
Graph 5.2.2.1.1 b : Length frequency of Oreochromis niloticus from Wadi Rayan I lake.



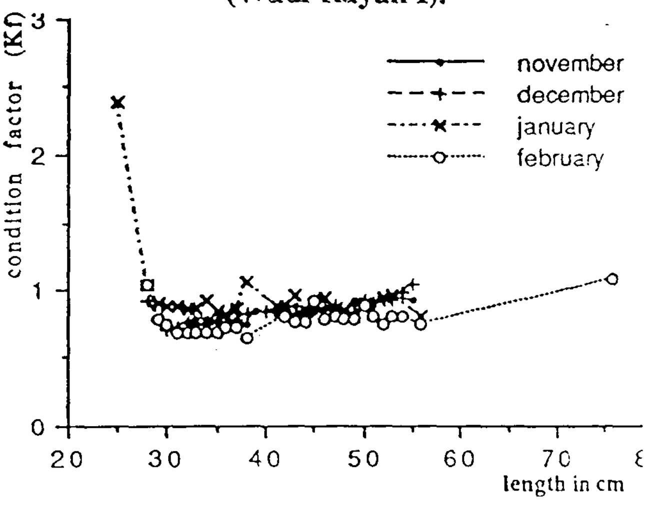
5.2.2.1.2. Length/weight relation

In table and graph 5.2.2.1.2.aa. the length/weight relation for *Liza ramada* is presented.

Graph 5.2.2.1.2 aa : Length / weight relation of Liza ramada from Wadi Rayan I lake.

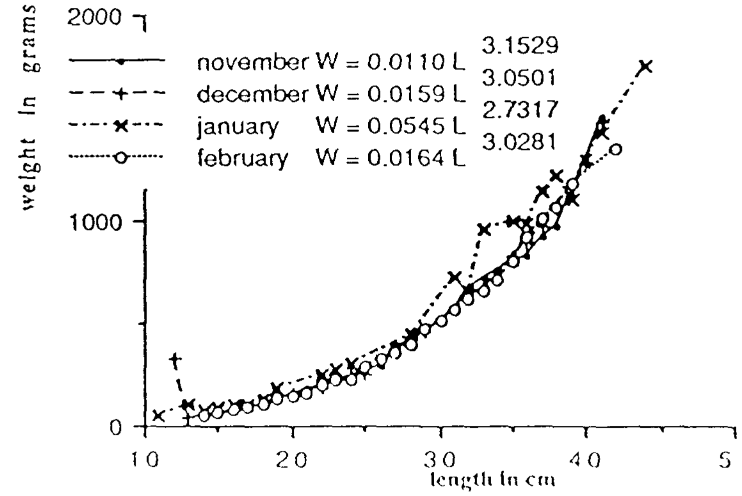


Graph 5.2.2.1.2 ab : Condition factor of Liza ramada in different months (Wadi Rayan I).

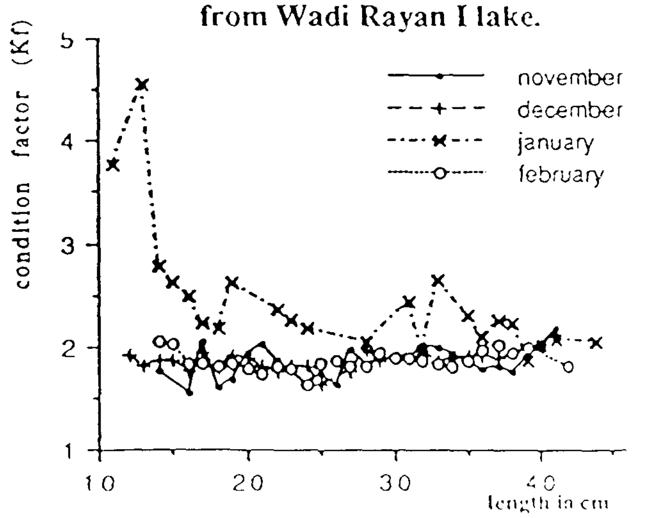


The weight values of the January sample are probably too high, or the length values are 2 cm too small,whwn compared with the values from the other months, these data have been obtained by another observer who used a less accurate scale and measuring board. The Kf values of November and December are higher than those of February, which is to be expected as the fish were all ripe and full of gonads during November and December, while most were spent in February,graph 5.2.2.1.2 ab.In December 35 ripe fishes had an average Kf value of .88 while the unripe females and all the males had a Kf value of .80. For *Oreochromis niloticus* the length/weight relation is given in table and graph 5.2.2.1.2.ba. Here the same observation can be made for the high weight values in January. Particularly in the lower weight ranges, the effect of the less accurate balance can be noticed. The other three months show the same pattern as can be seen in the Kf values graph 5.2.2.1.2 bb.

Graph 5.2.2.1.2 ba : Length/weight relation of Oreochromis niloticus from Wadi Rayan I.

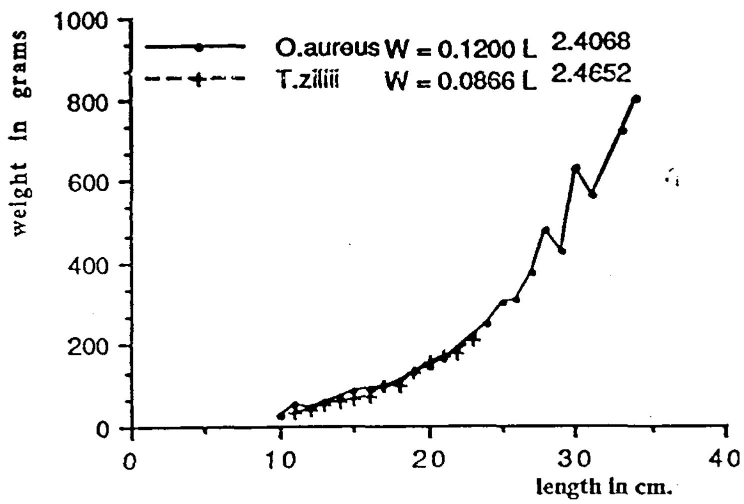


Graph 5.2.2.1.2 bb : Condition factor of Oreochromis niloticus in different months from Wadi Rayan I lake.

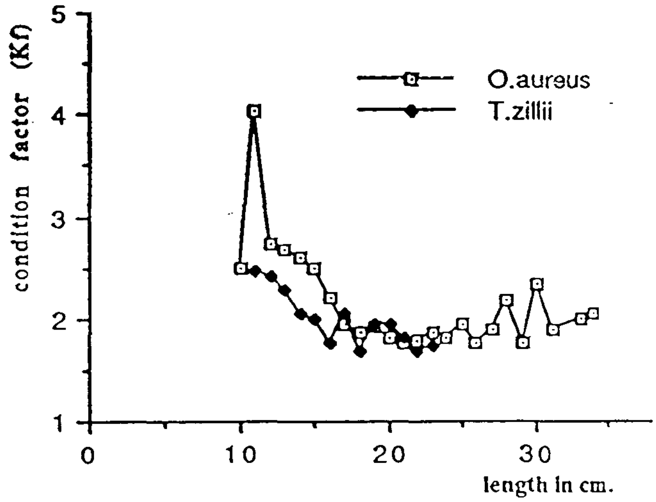


The same can be said about *Oreochromis aureus* and *Tilapia zillii* (table 5.2.2.1.2 c and graphs 5.2.2.1.2 ca-cb)

Graph 5.2.2.1.2 ca : Length/weight relation of two tilapia species from Wadi Rayan I lake.



Graph 5.2.2.1.2 cb : Condition factor of two tilapia species from Wadi Rayan I lake.



5.2.2.1.3. Mullet fry transport

All fry designated for W.R. I lake, 12.8 million, have been released in an 1.2 ha pond. This pond is an area adjacent to the lake and separated by a stone wall. The bottom was roughly excavated with a bulldozer. The result is a very shallow pond with a tendency to get overgrown with reeds and aquatic weeds. In order to have at least some depth of water, water has to be pumped into the pond from the lake. But due to malfunctioning of several pumps, this adding of water was very irregular and the water level has often been very low. For the amount of fry released into this pond there was little evidence of their presence in the pond. Beside mullet fry there seemed to be a big population of tilapia species, which were breeding in the pond. No work was carried out to keep the reeds and weeds under control.

It will be difficult to release the surviving fingerlings into the lake as the outlet is hardly under water. Great improvements will be necessary to make optimal use of the stocked fry and the total number of fry could than be reduced. When the fry is well treated during the stay in the pond(s) than 1 - 2 million fry will be sufficient (actual counting) to produce about 300 ton of mullet per year. Adult fish have an average weight of 500 gr in W.R. I and about 280 gr in lake Qarun and W.R. III lake.

Another advantage that could be obtained from better acclimatization ponds, is that they could be used for fish culture during the months after the fingerlings have been released into the lake. The official number of fry released into the lake are:

Year nr x 1000	1980-1982	1983	1984	1985	1986	1987	1988
nr of Mullet fry	?	?	1 097	37 211	16 000	20 170	12 180
carp fry	?	2 000	4 000	?	-	-	-

5.2.2.2. Plankton

5.2.2.2.1. 280 µ samples

In general the plankton samples were rich. In summer the samples consisted mainly of zooplankton but later with the bloom of *Microcystis* and other blue green algae the samples contained lots of botanic material which often clogged the net. The predominant zooplankton organisms were Cladocerans, mainly from the species *Diphanosoma brachyurum*. Copepods were only abundantly found in the spring samples, but they were not found in the western part of the lake near the outlet. Fish larvae have not been observed in the samples and only twice in the 35 samples, some fish eggs have been found. Summer was the poorest season and spring the richest.(maps 4.2.2.2.1 a-c).

5.2.2.2.2. 60 µ samples

From table 4.2.2.2.2.a. it can be seen that blue green algae were the dominant group in the 60 µ samples, during the bloom in winter and spring over 97 % of the total number of plankton organisms were blue green algae. Most are from the family *Chroococaceae*. The main species is *Microcystis aerogenosa*, which produces big colonies, which sometimes formed a mat on the surface at the leeside of the lake.

The main zooplankton group in the 60 µ samples were the Copepods and they were mainly caught in autumn, which is not in accordance with the results from the 280 µ samples. It is possible that because of the enormous amount of the blue green algae, during winter and spring, the samples had to be diluted to such an extent that the distribution of other organisms was not in perspective. Particular the *Diphanosoma*, which are quite transparent can be overlooked easily in the enormous mass of blue green algae.

The heavier, torpedo shaped, copepods might thus be over represented in comparison with the cladocerans.

The ratio phytoplankton : zooplankton is 9 : 1 in autumn when the amount of zooplankton was the highest. During the other seasons this ratio is much higher (see table 4.2.2.2.2.b.). This is caused by the great amount of the blue green algae. When the number of zooplankton organisms, during the different seasons are compared then there is not much difference between the seasons except during autumn when there are 4x the number of zooplankters found during the other seasons.

The increase of the importance of phytoplankton in the total amount of plankton, can be seen in graph 4.2.2.2.2.a-b The plankton distribution found during the various seasons is shown in table 4.2.2.2.2.c. and maps 4.2.2.2.2.cI-cII The total amount of plankton organisms is highest in winter, but this is due to the *Microcystis* bloom, the lowest numbers are found in summer. But when the zooplankton is taken separately than the highest number of zooplankters is found during autumn and the lowest during winter. The figures for spring are not available per station.

5.2.3. Wadi Rayan III lake

The Wadi Rayan III lake only became a lake in 1980 when the first water ran through a channel between W.R. I lake and the depression. In the about 4 km long channel is a small lake W.R. II which has not been part of the survey, as it was rather difficult to reach because of the dense and extended growth of reeds and not commercial important because of its small size. There are several water falls and rapids in the channel. The difference in water level between lake I and lake III is thought to be about 15 m. at the moment. The deepest point of lake III is over 25 m. this means that in 1980, 40 m difference existed between the surface of W.R. I and W.R. III. This lake is still not in equilibrium. The inflow though the channel and the rate of evaporation are not balanced yet. The level is still raising, which makes it difficult for the reeds to get a good hold and vegetation around the lake is scanty in comparison to lakes I and II. There are numerous little islands, old sand dune ridges which eventually will disappear through wind and wave action. Because of the desert climate very little organic material was available in the soil and therefore the lake is still oligotroph.

5.2.3.1. Fish and Fisheries

The scarcity of statistics makes it impossible to give any information on the state of the fisheries. The only data available are given in table 5.2.3.1.

Table 5.2.3.1.

Catch statistics from Wadi Rayan III lake for the season 1985-1986 in tons.

	mullet	tilapia	carp	sea bass	sea bream	cat fish	nile perch	others	total
*	40.	40.	+	-	-	-	-	54.	134.
**	9.878	28.026	.014	2.068	-	.535	-	.95	40.616 !
***	4.0	40.0	.02	5.6	0.006	.112	.741	-	50.817

*, ** and *** are various sources at the GAFRD.
+ is less than 1 t.
! seems to be catch of the 1986 part of the season only.

Catch statistics from W.R. III lake for the year 1986 in tons (1/2 season 85/86 + 1/2 season 86/87).

mullet	tilapia	carp	sea bass	labeo	nile perch+bagrus	clarias	total
48.169	44.467	.196	7.164	.052	23.453	.285	123.786

The fishing season in this lake is from 15 November till the 1st of May.There are 45 unmotorized vessels operating in the lake.
When the sustainable yield is calculated with the MEI method of Ryder,than the total production of the lake could be 1500 ton (240 kg./ha.).But at the moment this is a far cry from the actual catches.This can be caused by the following causes : a/ because of the unstable conditions ,the formula is not explicable.b/ the formula is only usable up to special salt concentrations above which other factors have to be included in the calculations.

5.2.3.1.1. Length frequency

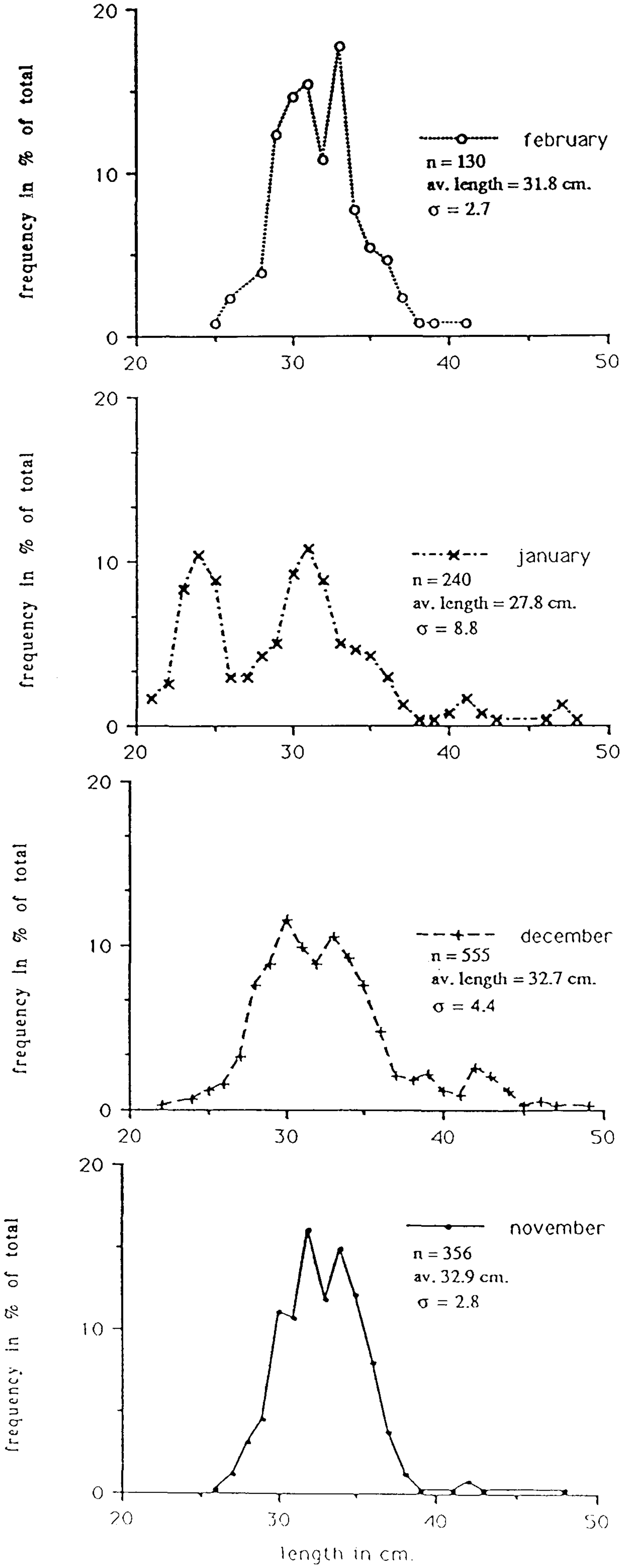
From the length frequency table and graph 5.2.3.1.1.a. for *Liza ramada* 4 year classes can be distinguished. The average length per year class (y.cl.) is about the same as seen in 5.2.2.1.1., year class I = 24.0 cm; y. cl. II = 32.1 cm; y. cl. III = 42.2 cm and y. cl. IV = 47.0 cm. The catch is predominantly from the year class II, 87.3 %.
Length frequency distributions of the tilapia species are given in tables and graphs 5.2.3.1.1.a-e.
From these data it is possible to differentiate 4 year classes for each species. Table 5.2.3.1.1.f. shows the average length per year class and the percentage of the total catch per year class for the species. Most of the tilapia caught, are from year class A and B.
When we compare year class A etc with the average length per year class given in the IOF report than year class A corresponds with year class III. This would mean that either year class I and II are too small to be caught with the gear used or that the living conditions in lake Qarun are that marginal that the fish is stunted in their growth.Even if we assume that the length measurements taken by the IOF are standard length, while during this study total length was used,which makes a difference of about 20 % ,the IOF values are much lower than the results of the present Wadi Rayan study. There is not much difference between the length distribution of the two Wadi Rayan lakes. *Oreochromis niloticus* are the biggest of the tilapias and *Tilapia zillii* are the smallest.

Table 5.2.3.1.1.f.

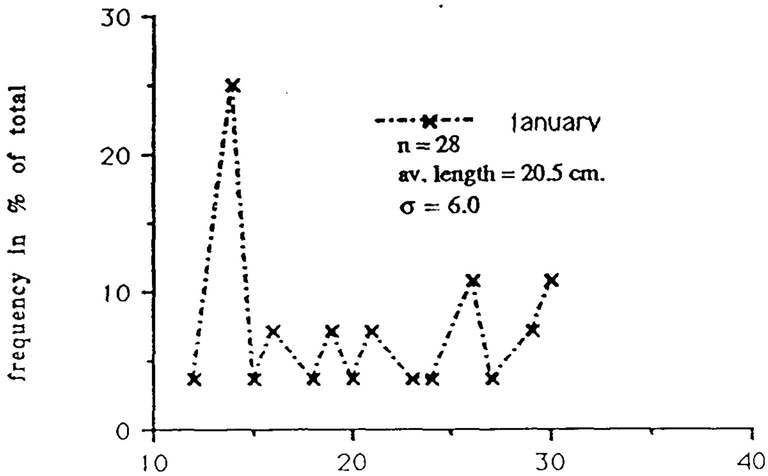
Average length per year class and(%) in total catch for each of the Tilapia species from Wadi Rayan III lake,compared with data from IOF

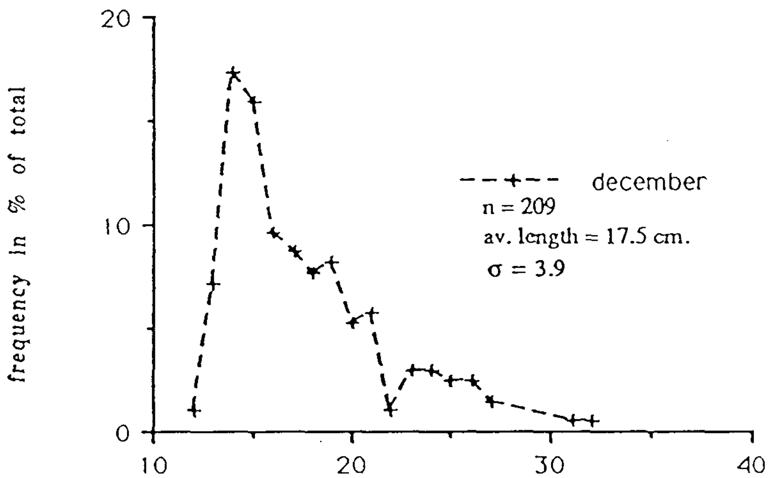
	Year class A	Year class B	Year class C	Year class D	average(nr)
Oreochromis niloticus	14.5 (24.4)	21.0 (49.6)	32.3 (17.0)	40.7 (9.1)	23.1 (464)
O. aureus	15.1 (58.7)	19.7 (23.2)	25.0 (15.5)	30.1 (2.6)	18.1 (271)
Sarotherodon galilaea	12.6 (46.2)	19.3 (48.7)	26.8 (4.6)	32.0 (.5)	16.6 (435)
Tilapia zillii	13.8 (63.9)	20.2 (32.5)	26.1 (3.3)	34.0 (.4)	16.4 (570)
IOF data	Y cl I	Y. cl.II	Y. cl. III	Y. cl. IV	average(nr)
O.niloticus	8.2 (44.0)	10.6 (28.3)	14.1 (18.7)	19.1 (9.0)	11.0 (166)
T. zillii	9.5 (32,7)	12.7 (27.3)	15.5 (21.3)	20.3 (18.8)	13.7 (352)

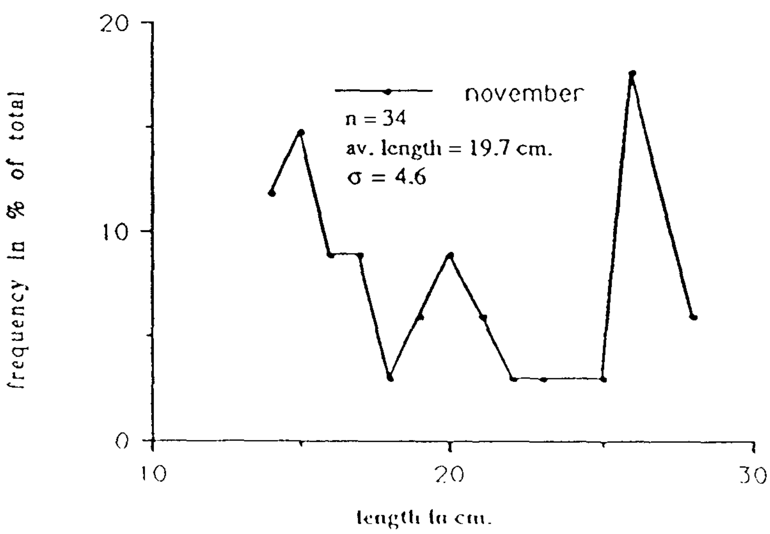
Graph 5.2.3.1.1 a : Length frequency of Liza ramada, from Wadi Rayan III lake.



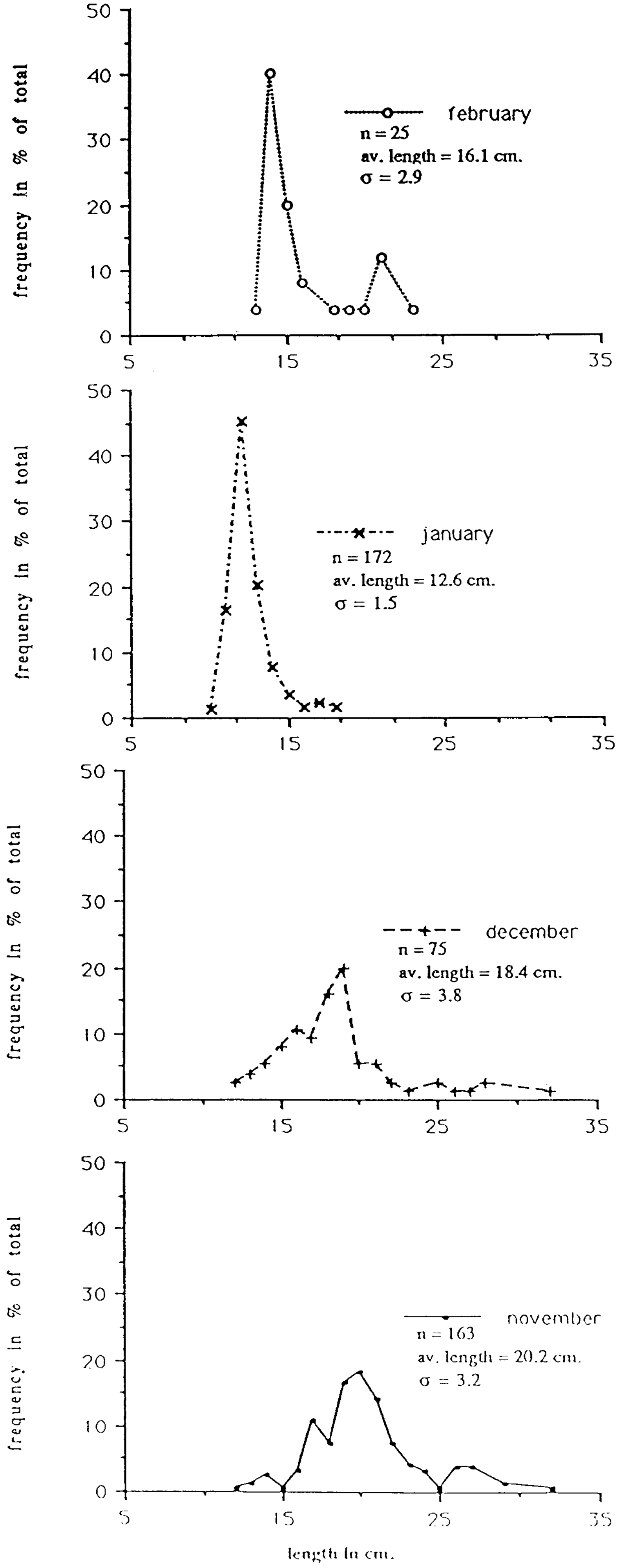
Graph 5.2.3.1.1 b : Length frequency of Oreochromis aureus, from Wadi Rayan III lake.



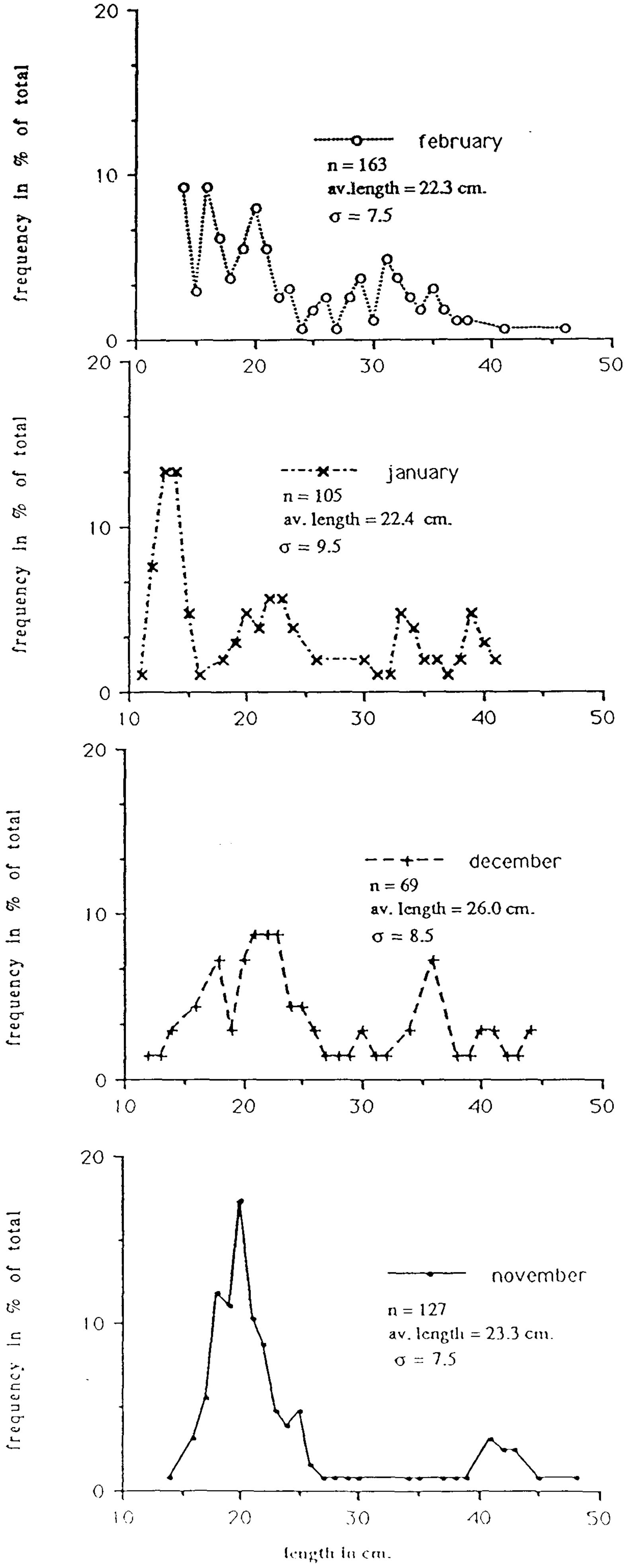




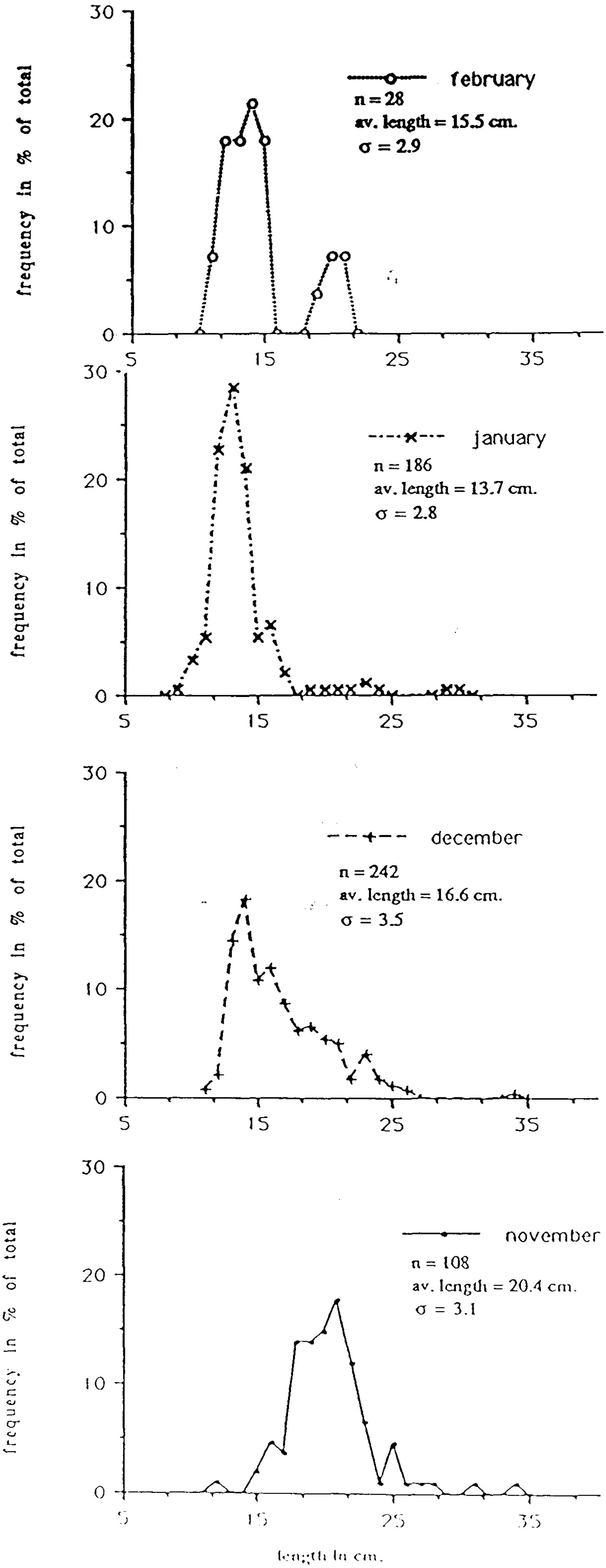
Graph 5.2.3.1.1 c : Length frequency of Sarotherodon galilaea, from Wadi Rayan III lake.



Graph 5.2.3.1.1 d : Length frequency of Oreochromis niloticus, from Wadi Rayan III lake.



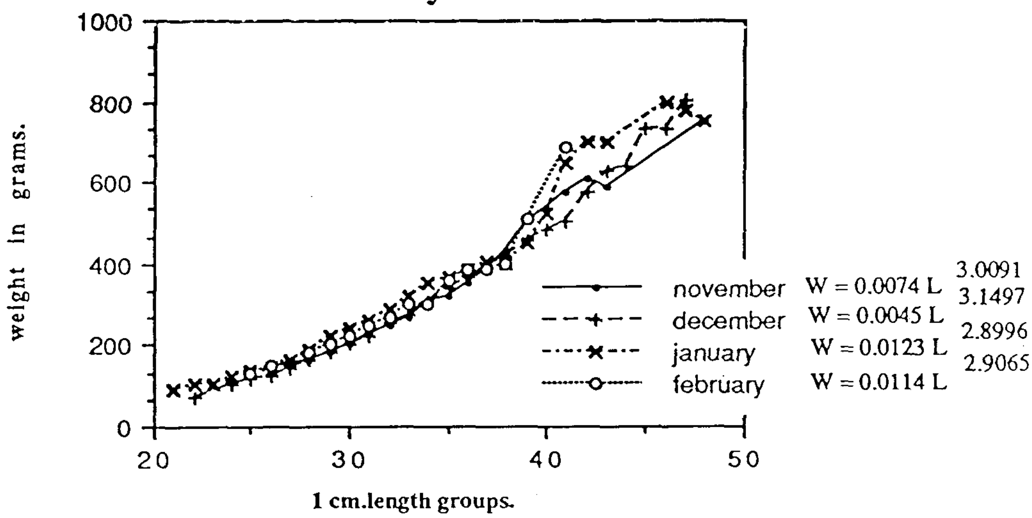
Graph 5.2.3.1.1 e : Length frequency of Tilapia zillii, from Wadi Rayan III lake.



5.2.3.1.2. Length/weight relation

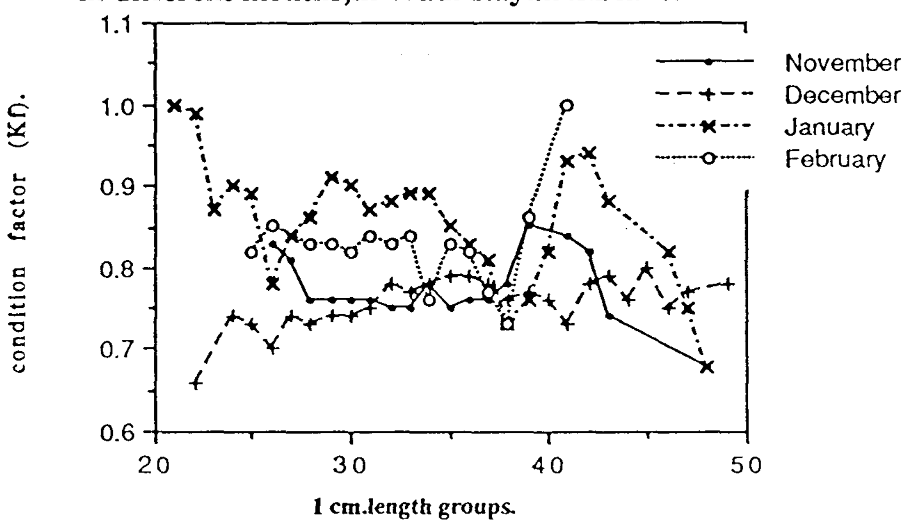
The length/weight relation for *Liza ramada* is presented in graph and table 5.2.3.1.2.aa.

Graph 5.2.3.1.2 aa : Length / weight relation of Liza ramada, from Wadi Rayan III lake.



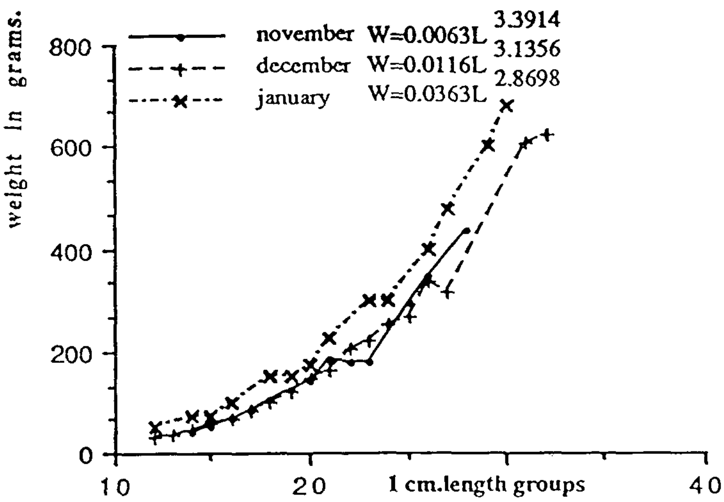
When the data are compared with those from Wadi Rayan I than it appears that the Kf values of the Wadi Rayan III fishes are lower than those of Wadi Rayan I. Except for the values of February, for which at the moment no explanation can be found. The lower Kf is most likely caused by the poorer living conditions in Wadi Rayan III, much less food available (see chapter or plankton),graph 5.2.3.1.2 ab.

Graph 5.2.3.1.2 ab : Condition factor of Liza ramada , in different months,in Wadi Rayan III lake.

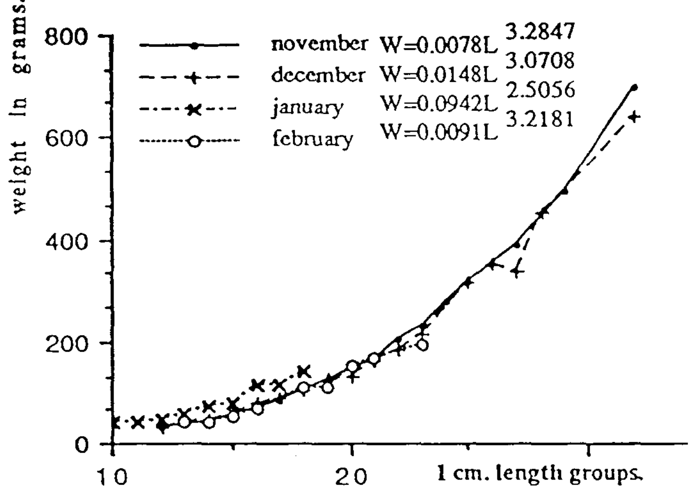


Length/weight relations for the tilapia species are given in tables 5.2.3.1.2.b-e and graphs 5.2.3.1.2 ba-ea. Here are the data from January unacceptable, which proves that it will be necessary to have qualified and trained people to collect the statistical data.(see chapter 5.2.2.1.2.)

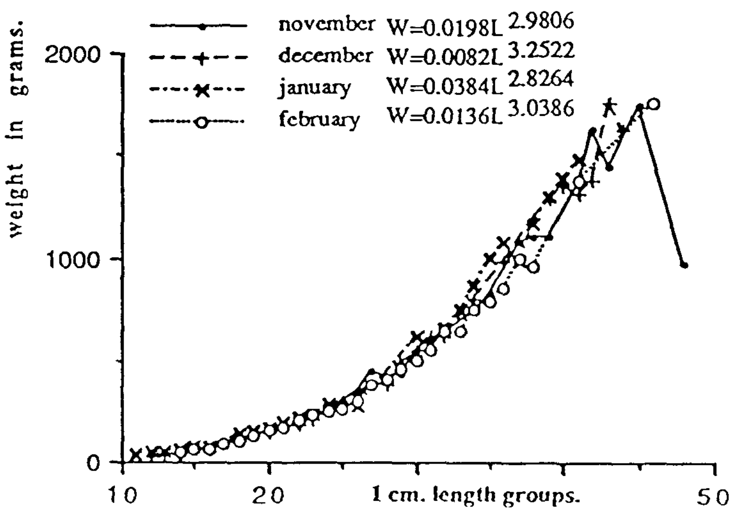
Graph 5.2.3.1.2 ba : Length / weight relation of Oreochromis aureus,from Wadi Rayan III lake.



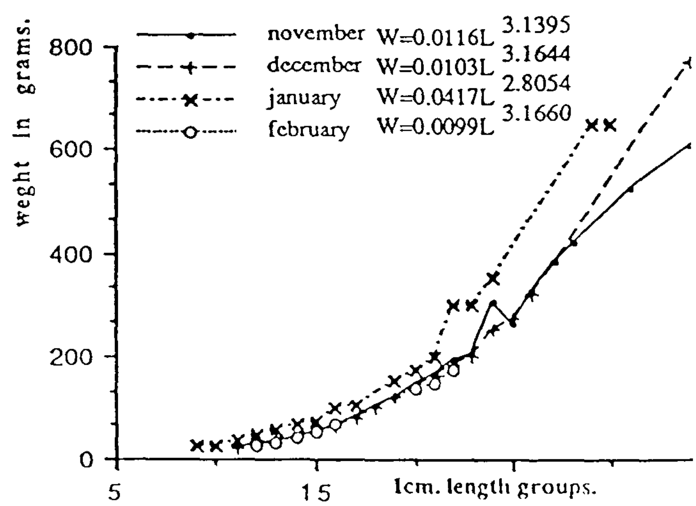
Graph 5.2.3.1.2 ca : Length / weight relation of Sarotherodon galilaea,from Wadi Rayan III lake



Graph 5.2.3.1.2 da : Length / weight relation of Oreochromis niloticus,from Wadi Rayan III lake.

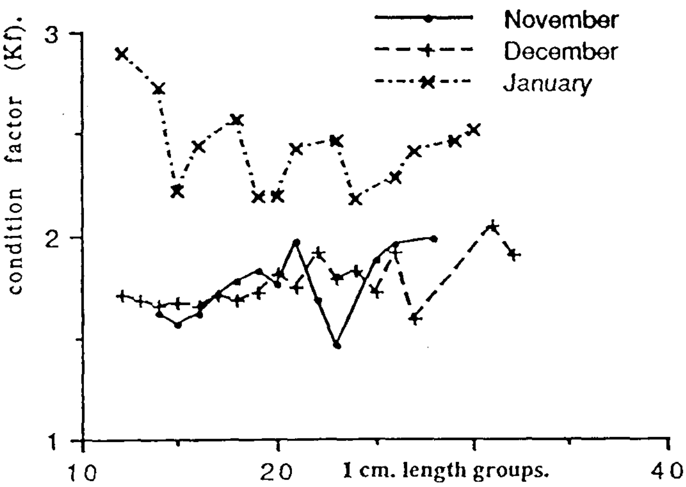


Graph 5.2.3.1.2 ea : Length / weight relation of Tilapia zillii,from Wadi Rayan III lake.

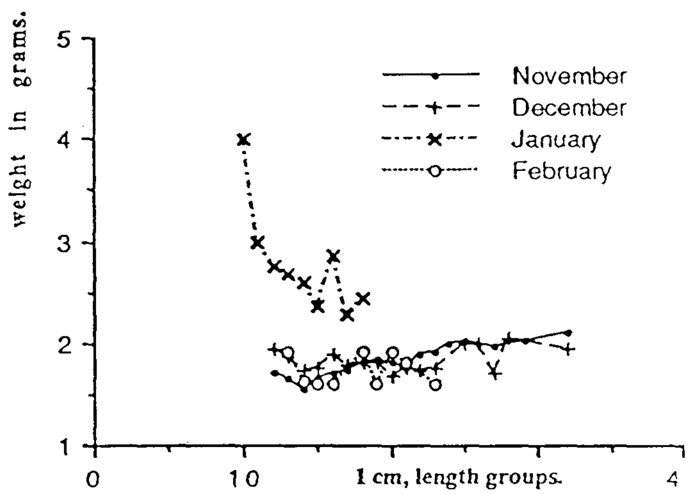


Here too the Kf values are lower than those found in Wadi Rayan I except for *Oreochromis niloticus* which seem to thrive in this lake.(table 5.2.3.1.2.f)
Graphs 5.2.3.1.2 bb-eb show the Kf values of the four tilapia species

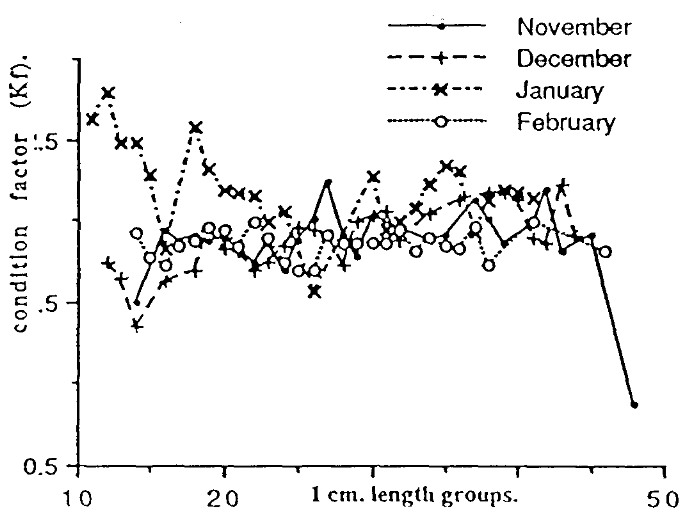
Graph 5.2.3.1.2 bb : Condition factor of Oreochromis aureus,during different months.



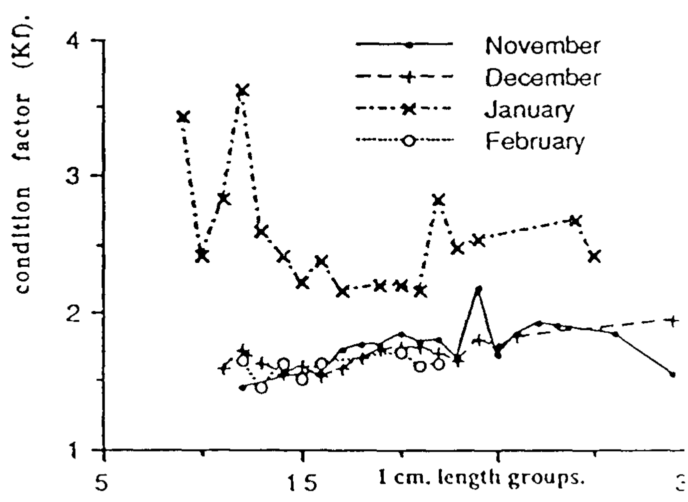
Graph 5.2.3.1.2 cb : Condition factor of Sarotherodon galilaea,during different months.



Graph 5.2.3.1.2 db : Condition factor of Oreochromis niloticus,during different months.



Graph 5.2.3.1.2 eb : Condition factor of Tilapia zillii,during different months.



5.2.3.1.3. Mullet fry transport

From the 8 830 000 fry that have been transported to Wadi Rayan III, 5 800 000 have been released in an earthen pond of about 1/4 ha. Even when we consider that only 20 % of this number is the actual number released, this amount is too high for the size of the pond. From regular visits to the pond it became obvious that the survival rate in the pond was very low, but there are no exact figures to prove this.
3 000 000 fry have been transplanted into an enclosure in the lake. But due to bad construction of this enclosure the fry escaped directly into the lake.
The first mullet fry was officially released in 1983 but from the statistics it is clear that mullet has arrived in the lake through the canal from Wadi Rayan I lake.Officially in 1986 6 000 000 and in 1987 7 500 000 fry were released into the lake.
According to the fishermen there seems to be spawning of mullet in the lake. This might be an error as young silversides were shown to us, as being mullet fry. But it still would be advisable to study this statement, and if the mullets spawn, try to figure why this happens here.
It might be that ripe mullets from Wadi Rayan I come into Wadi Rayan III where the difference in salinity, the depth of the water and the temperature are enough to trigger of the spawning.
Beside the mullet fry one other fish has been introduced in the lake, in 1986 1/2 million grass carp were released.

5.2.3.2. Plankton

5.2.3.2.1. 280 µ samples

In general the plankton samples caught,were poor to very poor and the material obtained from the 280 µ net was mainly terrestrial and blue green algae of the genus *Lyngbya* and/or *Oscillatoria*. There seems to be an increase of zooplankton through the time, with a maximum in spring (see map 4.2.3.2.1.b.).

5.2.3.2.2. 60 µ samples

From table 4.2.3.2.2.a. it can be seen that here too the blue green algae are the main group of plankton organisms, 84 to 94% of the total number of plankton belongs to this group. The main order is that of the *Chroococcales* and the main genus is *Polycystis*.
Zooplankton forms about 5% of the total catch and the main group is the *Rotifera* with the main genus *Keratella*..Cladocerans are hardly found (see table 4.2.3.2.2.b and graphs 4.2.3.2.2 a-b).
The northern and south western part seem to be the most productive areas of the lake (table 4.2.3.2.2.c. and maps 4.2.3.2.2.c.I and II).For spring there are no figures available per station.
The most productive season is autumn. This goes for phytoplankton as well as for zooplankton. Summer is the poorest season.

5.2.4. El Gameel

From the results of the experiment with the stocking prior to transportation the following observations can be made:

a. A constant water flow through a 1/2 inch tap provides enough oxygen to sustain 25 000 fry in a 1.5 m^3 tank for a longer period.

b. Regular checking of the flow system is needed, because of possible clogging of the system.

c. Regular cleaning of the bottom of the tanks will be necessary in order to prevent a build up of possible toxic rotting material.

d. Greater numbers of fry (up to about 50 000) can be kept in the tanks when they are aerated with compressed air.

e. The collection of fry, from the storage tanks, for further transport ,proved to be rather complicated.

f. The mortality of the fry proved to be very low. There were 160 dead fry out of the 53 000 fry stored for 20 -72 hours (0.3 % mortality).

During the transport of fry , from El Gameel to lake Qarun , in tanks with about 750 l water, the mortality was negligible, between 0 and 1.4 %.From the results of the experiment with different stocking rates during transportation from El Gameel to lake Qarun it can be seen that the mortality is very low even with the highest stocking densities.There seems to be no need for aeration during the 7 hours trip. With aeration probably higher numbers can be transported.

5.2.5. Fish species caught in the Wadi Rayan lakes.

	Scientific name	English name	Local name
1.	*Oreochromis niloticus* (L)	tilapia	boulti abied *
2.	*O. aureus* (Steindacher)	"	boulti *
3.	*Sarotherodon galilaeus* (L)	"	boulti mawlawi
4.	*Tilapia zillii* Gervais	"	boulti akhdar *
5.	*Cyprinus carpio* (L)	common carp	?
6.	*Ctenopharyngodon idella* (Valerencianes)	grass carp	?
7.	*Labeo nilotica* Forskal	nile carp	?
8.	*Barbus bynni* Forskal	barbel	?
9.	*Sardinella* ssp.	sardinella	raya
10.	*Mugil cephalus* L.	flathead grey mullet	bouri **
11.	*Liza ramada* (Risso)	thinlip grey mullet	tobar **
12.	*Liza aurata* (Risso)	golden grey mullet	halili **
13.	*Atherina boyeri* (Risso) = *A. mochon*	silverside	bisaria
14.	*Atherina* ssp.	"	"
15.	*Aphanius dispar* (Rüppell)	tooth carp	?
16.	*A. fasciatus* Nando	"	?
17.	*Clarias gariepinus* (Burchell) = C. lazera	sharptoothed catfish	?
18.	*Bagrus bayad* (Forskal)	catfish	bayad
19.	*B. docmac* (Forskal)	"	"
20.	*Bagrus* ssp.	"	"
21.	*Synodontis schall* (Block)	?	?
22.	*Dicentrarchus labrax* (L)	European seabass	karus
23.	*D. punctatus* (Block)	spotted seabass	"
24.	*Sparus auratus* (L)	gilthead seabream	denis
25.	*Hemiramphus far* (Forskal)	halfbeak	abu mingar
26.	*Lates niloticus* (L)	nile perch	laffash
27.	*Haplochromis* ssp.	cichlid	?

5.2.6 Fish species caught in lake Qarun

	Scientific name	English name	Local name
1.	*Solea aegyptiaca* Chabanaud	Egyptian sole	samak musa
2.	*Mugil cephalus* L.	flathead grey mullet	bouri **
3.	*Liza ramada* (Risso)	thinlip grey mullet	tobar **
4.	*L. aurata* (Risso)	golden grey mullet	halili **
5.	*L. saliens* (Risso)	leaping grey mullet	garan **
6.	*Tilapia zillii* Gervais	tilapia	boutli akhdar *
7.	*Oreochromis niloticus* (L.)	"	boulti abied *
8.	*O. aureus* (Steindacher)	"	boulti *
9.	*Dicentrarchus labrax* (L.)	European seabass	karus
10.	*Sparus auratus* L.	gilthead seabream	denis
11.	*Anguila anguila* L.	eel	hanesh
12.	*Atherina boyeri* ((Risso) = A. mochon	silverside	bisaria
13.	*Gobius* ssp.	goby	abu kirsh
14.	*Hemiramphus far* (Forskal)	half beak	abu mingar

* generally no distinction between the species all are called boulti
** generally no distinction between species,big fish are called bouri and small ones tobar

5.2.7 Shrimp species found in lake Qarun (source Ishak et al 1980)

1.	*Penaeus keraturus* (Forskal)	triple grooved shrimp	gambari

2.	*P. japonicus*	kuruma prawn	"
3.	*Metapenaeus monoceros*	speckled shrimp	"
4.	*M. stebbingi*	peregrine shrimp	"

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Appendix I : Tables.

Table 4.1.1.
Lake Qarun. Limnological features during different seasons at various depths

Average DO in % saturation

	Surf	1	2	3	4	5	6	7	8
Summer	117	112	104	99	90	63	82	46	45
Autumn	103	102	101	102	102	102	100	96	-
Winter	106	107	104	101	101	93	93	85	84
Spring	97	94	93	91	89	90	91	92	-

Average temperature in .C

	Surf	1	2	3	4	5	6	7	8
Summer	29.2	28.2	27.3	26.9	26.8	25.6	26	25.4	24.7
Autumn	17.8	17.8	17.8	17.8	18.1	18.4	18.6	18.6	-
Winter	15	14.9	14.6	14.6	14.5	14.6	14.4	14.3	14.2
Spring	18.7	18.6	18.5	18.4	18.6	19.5	19.3	19.3	-

Average Ec in mS/cm

	Surf	1	3	5
Summer	40.7	41.3	41.9	42.3
Autumn	43.0	43.6	44.5	45.2
Winter	40.1	40.2	40.7	41.1
Spring	38.0	38.4	38.6	38.7

Ec measurements by date, lake level, TDS (= Ec x 0.808) and total salt load

Date	nr	Ec	lake level	TDS gr/l	total salt load of the lake x106 ton
22/23-VI	39	41.3	-43.35	33.4	38.724
27-VII	4	42.9	-43.51	34.7	38.271
13-VIII	1	43.0	-43.60	34.8	37.401
5- X	2	43.3	-43.75	35	38.027
10/11-XI	34	43.8	-43.68	35.4	36.422
28-XII	7	42.2	-43.34	34.1	38.806
7/10-II	41	40.0	-43.23	32.4	37.749
4/12-IV	21	38.4	-43.1	31	38.006

	Transparency in m.	Air temp.
Summer	0.75	35.7
Autumn	1.3	20.9
Winter	0.6	16.1
Spring	0.56	24.7

Table 4.1.1.a.

Lake Qarun 22/23-VI-87

D.O. in % saturation

Station	Surface	1	2	3	4	5	6	7	8	Bottom	Depth in m	Transparency
1	94	96								98	1.2	0.28
2	127	106	97	92*						92	2.5	0.55
3	110	115	110*							110	2.0	0.40
4	133	116	75							26	2.3	0.90
5	121	115	108	99	90*					90	3.7	0.60
6	118	125	116	103	91	35*				35	4.5	1.10
7	110	108	106	100	92	84	80	33*		33	6.5	0.98
8	120	117	112	102	94	51				48	5.1	0.95
9	112	106	103	89	74	58				43	5.3	0.70
10	136	130	120	114	100	88	83	58	45*	45	7.5	1.00
11	101	98	96	95*						95	3.0	0.80
Average	117	112	104	99	90	63	82	46	45			0.75

Temperature in oC .

												Air temp.
1	29.3	29.3								29.3	1.2	32.0
2	27.9	27.8	26.8	26.6*						26.6	2.5	34.0
3	28.5	28.4	28.2*							28.2	2.0	36.0
4	27.6	27.3	26.3							26.0	2.3	29.9
5	28.3	28.3	27.9	27.4	26.5*					26.5	3.7	-
6	32.0	28.4	27.0	26.7	26.3	25.7*				25.7	4.5	41.3
7	31.9	28.2	27.4	27.1	26.8	26.8	26.8	25.9*		25.9	6.5	37.3
8	31.4	28.9	28.3	27.9	27.8	24.9				24.9	5.1	38.3
9	30.1	29.3	28.0	27.6	26.2	25.6				25	5.3	39.8
10	28.0	27.8	26.3	25.8	25.7	25.2	25.2	24.9	24.7*	24.7	7.5	35.5
11	26.5	26.5	26.5	26.4*						26.4	3.0	33.0
Average	29.2	28.2	27.3	26.9	26.8	25.6	26.0	25.4	24.7			

Ec in mS/cm

Station	Surface	1	3	5	Bottom	Depth in m	Aver. Ec/station
1	41.6	41.7*	-	-	41.7	1.2	41.7
2	41.0	41.5	41.7*	-	41.7	2.5	41.4
3	39.7	39.8	-	-	39.8	2.0	39.8
4	36.0	38.9	-	-	39.6	2.3	38.2
5	41.1	41.1	-	41.7*	41.7	3.7	41.3
6	41.1	41.7	42.0	42.0*	42.0	4.5	41.7
7	41.3	41.7	41.9	41.9	42.0	6.5	41.8
8	41.2	41.5	41.9	42.4*	42.4	5.1	41.8
9	41.4	42.0	42.2	42.8*	42.8	5.3	42.1
10	41.9	42.0	42.2	42.2	42.3	7.5	42.1
11	41.6	41.7	41.5*	-	41.5	3.0	41.6
Average	40.7	41.3	41.9	42.3			

Average of all measurements 41.3 (n = 39)

* are bottom values.

Table 4.1.1.b.

Autumn 9/12-XI-88

D.O. in % saturation **Transparency**

Station	Surface	1	2	3	4	5	6	7	8	Bottom	Depth in m	Transparency
1	90											
2	97	96	96							96	2.1	0.74
3	99	97	97	97*						97	2.5	0.5
4	108	103	99*							99	2	0.75
5	104	102	102	96	96*					96	3.5	-
6	112	108	108	108	107	104*				104	4.7	1.6
7	106	105	104	102	102	104*				104	4.5	2
8	105	104	104	104	106*					106	3.5	1.3
9	110	107	103	107						109	3.3	2.35
10	103	100	100	100	100	99	100	96*		96	6.9	-
11	100	99	99	98						100	3.1	1.05
Average	103	102	101	102	102	102	100	96				1.29

Temperature in oC Air temp.

Station	Surface	1	2	3	4	5	6	7	Bottom	Depth in m	Air temp.
1	17.1										21.0
2	17.0	17.0	17.0						17.0	2.1	18.5
3	16.8	16.8	16.7	16.7*					16.7	2.5	20.0
4	18.1	17.6	16.8*						17.8	2.0	20.0
5	17.6	17.6	17.6	17.5	17.5*				17.5	2.5	21.0
6	18.9	18.9	18.9	18.8	18.7	18.7*			18.7	4.7	22.0
7	18.4	18.4	18.4	18.2	17.9	17.9*			17.9	4.5	23.0
8	17.8	17.7	17.4	17.6	17.6*				17.6	3.5	22.0
9	18.0	18.0	17.9	17.9					17.9	3.3	21.0
10	18.6	18.6	18.6	18.6	18.6	18.6	18.6	18.6*	18.6	6.9	20.0
11	17.5	17.4	17.4	17.4					17.4	3.1	21.5
Average	17.8	17.8	17.8	17.8	18.1	18.4	18.6	18.6			20.9

Ec in mS/cm

Station	Surface	1	3	5	Bottom	Depth in m	Aver.Ec/station
1	2.5						2.5
2	41.0	41.9			42.0	2.1	41.6
3	39.6	39.6	40.3*		40.3	2.5	39.8
4	40.2	43.8			44.4	2.0	42.8
5	43.0	43.0	44.7*		44.7	3.5	43.6
6	45.5	45.5	45.5	45.5*	45.5	4.7	45.5
7	44.6	44.6	44.7	44.9*	44.9	4.5	44.7
8	41.0	42.0	44.9*		44.9	3.5	42.6
9	45.5	45.6	45.5*		45.5	3.3	45.5
10	45.4	45.3	45.3	45.3	45.4	6.9	45.3
11	44.5	44.6	44.6*		44.6	3.1	44.6
Average	43.0	43.6	44.5	45.2			

Average of all measurements station 1 excluded 43.8 (n = 34)

* are bottom values

Table 4.1.1.c

Winter. 7/10-II-88

D.O. in % saturation

Station	Surface	1	2	3	4	5	6	7	8	Bottom	Depth in m.	Transparency
1	109	110*								110	1	0.4
2	114	111	100	94*						94	2.6	0.55
3	103	102	100*							100	2	0.55
4	95	125	106*							106	1.9	0.4
5	112	113	113	109	104*					104	4	0.5
6	102	100	99	92	88					83	4.3	0.7
7	108	106	106	103	103	101	97	80		78	7.2	0.8
8	109	109	110	109	109	73*				73	5	0.65
9	106	105	106	105	104	103	89*			89	5.5	0.75
10	101	96	96	94	94	93	92	89	84	82	8.4	0.85
11	104	103	102	103	102*					102	3.7	0.5
Average	106	107	104	101	101	93	93	85	84			0.6

Temperature oC

												Air temp.
1	16.6	16.1*								16.1	1.0	17.5
2	15.4	15.3	14.6	14.6*						14.6	2.6	16.0
3	14.7	14.7	14.5*							14.5	2.0	16.0
4	14.8	14.4	14.3*							14.3	1.9	15.0
5	14.4	14.4	14.3	14.3	14.3*					14.3	4.0	15.5
6	14.6	14.6	14.5	14.3	14.0					13.9	4.3	19.0
7	15.0	14.9	14.8	14.7	14.7	14.6	14.4	14.2		14.2	7.2	-
8	15.6	15.6	15.4	15.3	15.2	14.5*				14.5	5.0	16.0
9	15.3	15.2	15.2	15.2	15.1	15.0	14.5*			14.5	5.5	16.0
10	14.7	14.6	14.5	14.5	14.4	14.4	14.3	14.3	14.2	14.2	8.4	16.0
11	14.1	14.1	14.0	14.0	13.9*					13.9	3.7	14.0
Average	15.0	14.9	14.6	14.6	14.5	14.6	14.4	14.3	14.2			16.1

Ec in mS/cm

Station	Surface	1	3	5	Bottom	Depth in m	Aver.Ec/station
1	39.6	40.0*			40	1	39.8
2	39.5	39.8	40.4*		40.4	2.6	39.9
3	39.0	39.1			39	2	39.0
4	25.5	39.5			39.7	1.9	34.9
5	39.7	39.7	40.0		40.1	4	39.9
6	40.2	40.6	41.0		40.8	4.3	40.7
7	40.8	40.9	40.9	40.9	40.9	7.2	40.9
8	40.9	40.9	40.9	41.2*	41.2	5	41.0
9	41.4	41.4	41.4	41.5*	41.5	5.5	41.4
10	40.6	40.8	40.8	40.9	40.9	8.4	40.8
11	39.6	39.8	39.9		39.9	3.7	39.8
Average.-4	40.1						
average +4	38.8	40.2	40.7	41.1			

Average of all measurements: - surface st 4.40.4 (n = 40)
+ surface st 440.0 (n = 41)

* are bottom values.

Table 4.1.1.d.

Spring 6/12-IV-88

DO in % saturation

Station	Surface	1	2	3	4	5	6	7	8	Bottom	Depth in mtr	Transparency
1	-											-
2	102	96	97	95*						95	2.5	0.5
3	-											-
4	98	96	94	83*						83	2.8	0.5
5	98	97	95	91	82*					82	3.6	0.45
6	89	89	89	89	89	88				86	5.1	0.65
7	-											-
8	-											-
9	-											-
10	93	89	90	90	91	92	91	92*		92	7.1	0.6
11	100	96	95	95	94*					94	3.6	0.65
Average	97	94	93	91	89	90	91	92				0.56

Temperature in oC

											Air temp.
1	-										-
2	18.4	18.4	18.1	18.1*					18.1	2.5	25
3	-										-
4	18.1	17.9	17.8	17.7*					17.7	2.8	27
5	18.5	18.5	18.3	18.2	17.9*				17.9	3.6	25
6	19.7	19.7	19.7	19.6	19.6	19.6			18.5	5.1	21
7	-										-
8	-										-
9	-										-
10	19.5	19.4	19.4	19.4	19.3	19.3	19.3	19.3*	19.3	7.1	23
11	18.0	17.8	17.6	17.6	17.5*				17.5	3.6	27
Average	18.7	18.6	18.5	18.4	18.6	19.5	19.3	19.3			24.7

Ec in mS/cm

Station	Surface	1	3	5	Bottom	Depth in m	Aver.Ec/station
1	-						
2	37.6	37.6	37.7*		37.7	2.5	37.6
3	-						
4	37.5	38.0	38.8*		38.8	2.8	38.1
5	38.7	38.9	39.4*		39.4	3.6	39.0
6	38.6	38.9	39	39.0*	39	5.1	38.9
7	-						
8	-						
9	-						
10	36.8	37.9	38.1	38.3	38.4	7.1	37.9
11	39.0	39.1	39.1*		39.1	3.6	39.1
Average	38.0	38.4	38.6	38.7	38.7		

Average for all measurements 38.4 (n = 21)
* is value for bottom.

Table 4.1.1.1.a.
D.O. in % saturation at surface and (1 m)

Station	Summer	Autumn	Winter	Spring
1	94 (96)	90 (-)	109 (110)	--
2	127 (106)	97 (96)	114 (111)	102 (96)
3	110 (115)	99 (97)	103 (102)	--
4	133 (116)	108 (103)	95 (125)	98 (96)
5	121 (115)	104 (102)	112 (113)	98 (97)
6	118 (125)	112 (108)	102 (100)	89 (8)
7	110 (108)	106 (105)	108 (106)	--
8	120 (117)	105 (104)	109 (109)	- -
9	112 (106)	110 (107)	106 (105)	- -
10	136 (130)	103 (100)	101 (96)	93 (89)
11	101 (98)	100 (99)	104 (103)	100 (96)
Average	117 (112)	103 (102)	106 (107)	97 (94)

Table 4.1.1.2.a.
Temperature in ^{0}C at surface and (1 m)

Station	Summer	Autumn	Winter	Spring
1	29.3 (29.3)	17.1 (-)	16.6 (16.1)	- -
2	27.9 (27.8)	17.0 (17.0)	15.4 (15.3)	18.4 (18.4)
3	28.5 (28.4)	16.8 (16.8)	14.7 (14.7)	- -
4	27.6 (27.3)	18.1 (17.6)	14.8 (14.4)	18.1 (17.9)
5	28.3 (28.3)	17.6 (17.6)	14.4 (14.4)	18.5 (18.5)
6	32.0 (28.4)	18.9 (18.9)	14.6 (14.6)	19.7 (19.7)
7	31.9 (28.2)	18.4 (18.4)	15.0 (14.9)	- -
8	31.4 (28.9)	17.8 (17.7)	15.6 (15.6)	- -
9	30.1 (29.3)	18.0 (18.0)	15.3 (15.2)	- -
10	28.0 (27.8)	18.6 (18.6)	14.7 (14.6)	19.5 (19.4)
11	26.5 (26.5)	17.5 (17.4)	14.1 (14.1)	18.0 17.8)
Greatest differ	5.5 (2.8)	2.1 (2.1)	2.5 (2.0)	1.7 (1.9)
Average	29.2 (28.2)	17.8 (17.8)	15.0 (14.9)	18.7 (18.6)
σ_n	1.8 (.8)	.6 (.6)	.7 (.6)	.7 (.7)

Table 4.1.1.2.c.
Average temperature decrease per m/station (rank order)

Station	Summer	Autumn	Winter	Spring	Average
1	0.00 (11)	-	0.50 (1)	-	.25
2	.52 (6)	0.00 (9)	.31 (2)	.12 (4)	.24
3	.15 (9)	.04 (6)	.10 (8)	-	.10
4	.57 (5)	.15 (1)	.26 (3)	.14 (2)	.28
5	.49 (7)	.08 (4)	.03 (11)	.17 (1)	.19
6	1.40 (1)	.09 (3)	.14 (6)	.02 (6)	.41
7	.92 (3)	.11 (2)	.11 (7)	-	.38
8	1.27 (2)	.06 (5)	.22 (4)	-	.52
9	.85 (4)	.03 (7)	.15 (5)	-	.38
10	.44 (8)	0.0 (9)	.06 (9)	.03 (5)	.13
11	.03 (10)	.03 (7)	.05 (10)	.14 (2)	.06

Table 4.1.1.3.a.
Ec in mS/cm.per season and per station at surface and (1 m)

	Summer	Autumn	Winter	Spring
1	41.6 (41.7)	2.5 (-)	39.6 (40.0)	-
2	41.0 (41.5)	41.0 (41.9)	39.5 (39.9)	37.6 (37.6)
3	39.7 (39.8)	39.6 (39.6)	39.0 (39.1)	-
4	36.0 (38.9)	40.2 (43.8)	25.5 (39.5)	37.6 (38.0)
5	41.1 (41.1)	43.0 (43.0)	39.7 (39.7)	38.7 (38.9)
6	41.1 (41.7)	45.5 (45.5)	40.2 (40.6)	38.6 (38.9)
7	41.3 (41.7)	44.6 (44.6)	40.8 (40.9)	-
8	41.2 (41.5)	41.0 (42.0)	40.9 (40.9)	-
9	41.4 (42.0)	45.5 (45.6)	41.4 (41.4)	-
10	41.9 (42.0)	45.4 (45.3)	40.6 (40.8)	36.8 (37.9)
11	41.6 (41.7)	45.5 (44.6)	39.6 (39.8)	39.0 (39.1)
average	40.7 (41.3)	43.0 (43.6)	40.1 (40.2)	38.0 (38.4)

Table 4.1.1.3.b.
Ec/season/station (average of all measurements per station)

Station	Summer	Autumn	Winter	Spring	average minus spring
1	41.7	2.5	39.8	-	28.0
2	41.4	41.6	39.9	37.6	41.0
3	39.8	39.8	39.0	-	39.5
4	38.2	42.8	34.9	38.1	38.6
5	41.3	43.6	39.9	39.0	41.6
6	41.7	45.5	40.7	38.9	42.6
7	41.8	44.7	40.9	-	42.5
8	41.8	42.6	41.0	-	41.8
9	42.1	45.5	41.4	-	43.0
10	42.1	45.3	40.8	37.9	42.7
11	41.6	44.6	39.8	39.1	42.0
Average	41.3	43.8	40.0	38.4	41.7

Table 4.1.1.3.c.
The maximal differences between Ec levels at the different stations and (depth)

	Summer	Autumn	Winter	Spring
1	.1 (1.2)	-.-	.4 (1.0)	- -
2	.7 (2.5)	1.0 (2.1)	.9 (2.6)	.1 (2.5)
3	.1 (2.0)	.7 (2.5)	.1 (2.0)	- -
4	3.6 (2.3)	4.2 (2.0)	4.0 (1.9)	1.3 (2.8)
5	.6 (3.7)	1.7 (3.5)	.4 (4.0)	.7 (3.6)
6	.9 (7.5)	.0 (4.7)	.8 (4.3)	.4 (5.1)
7	.7 (6.5)	.3 (4.5)	.1 (7.2)	- -
8	1.2 (5.1)	3.9 (3.5)	.3 (5.0)	- -
9	1.4 (5.3)	.1 (3.3)	.1 (5.5)	- -
10	.4 (7.5)	.1 (6.9)	.3 (8.4)	1.5 (7.1)
11	.2 (3.0)	.1 (3.1)	.3 (3.7)	.1 (3.6)

Table 4.1.1.4.
Average pH (range)

	Summer		Autumn		Winter		Spring
1	8.5	(-)	-	(-)	8.4	(-)	-
2	8.0	(-)	8.3	(-)	8.3	(8.3- 8.4)	-
3	8.5	(-)	8.0	(-)	8.3	(-)	-
4	8.3	(8.2-8.4)	-	(-)	8.2	(8.1-8.3)	-
5	8.0	(-)	7.5*	(-)	8.3	(8.1-8.4)	-
6	8.4	(8.3-8.4)	-	(-)	8.3	(-)	-
7	8.4	(8.3-8.4)	-	(-)	8.3	(-)	-
8	8.4	(8.3-8.4)	8.4	(8.3-8.5)	8.4	(8.3-8.4)	-
9	8.4	(8.3-8.4)	-	(-)	8.4	(8.3-8.4)	-
10	8.4	(-)	-	(-)	8.4	(8.3-8.4)	-
11	8.0	(-)	-	(-)	8.5	(8.4-8.5)	-
average	8.3		8.2		8.3		-

* measured with pH paper

Table 4.1.1.5.
Transparency at various stations during different seasons, in cm.

Station	Summer	Autumn	Winter	Spring
1	28	-	40	-
2	55	75	55	50
3	40	50	55	-
4	90	75	40	50
5	60	-	50	45
6	110	160	70	65
7	98	200	80	-
8	95	130	65	-
9	70	235	75	-
10	100	-	85	60
11	80	105	50	65
Average	75	129	60	56

Table 4.1.1.6.
Air temperatures in ˚C at various stations per seasons (time)

	Summer		Autumn		Winter		Spring	
1	32.0	(16.55)	21.0	(08.50)	17.5	(15.15)	-	-
2	34.0	(13.15)	18.5	(10.15)	16.0	(12.10)	25.0	(10.30)
3	36.0	(14.10)	20.0	(11.50)	14.0	(11.40)	-	(-)
4	29.9	(9.25)	20.0	(14.55)	15.0	(-)	27.0	(12.20)
5	-	(14.30)	21.0	(12.35)	15.5	(11.15)	25.0	(12.55)
6	41.3	(15.00)	22.0	(16.00)	19.0	(10.30)	21.0	(10.05)
7	37.3	(14.10)	23.0	(14.00)	-	(12.00)	-	(-)
8	38.3	(13.15)	22.0	(13.20)	16.0	(12.40)	-	(-)
9	39.8	(12.15)	21.0	(12.20)	16.0	(13.20)	-	(-)
10	35.5	(15.45)	20.0	(16.40)	16.0	(11.15)	23.0	(09.30)
11	33.0	(15.55)	21.5	(14.10)	14.0	(10.00)	27.0	(11.50)
Average	35.7		20.9		16.1		24.7	

Table 4.2.1.1.

Fish and shrimp production of lake Qarun in tons.

fishing seasons	Mullets	Tilapias	Soles	other fish	shrimp	total catch	source
1921	-	1478.1	-	64.9	-	1543.0	Faouzi '36
22	-	2645.9	-	51.9	-	2697.8	,,
23	-	1069.9	-	37.9	-	1107.8	,,
24	-	1526.7	-	20.3	-	1547.0	,,
25	-	2576.6	-	25.1	-	2601.7	,,
26	-	2649.6	-	13.1	-	2662.7	,,
27	-	5026.1	-	13.3	-	5039.4	,,
28	-	2521.4	-	23.1	-	2544.5	,,
29	.2	474.8	-	8.0	-	482.8	,,
30	.4	874.3	-	40.0	-	914.3	,,
31	.1	1728.6	-	18.8	-	1747.4	,,
32	1.2	1569.2	-	6.8	-	1576.0	,,
33	2.8	1869.9	-	4.7	-	1874.6	,,
34	42.3	2485.8	-	18.1	-	2503.9	,,
35	341.7	1283.0	-	7.0	-	1290.0	,,
					average	2009.6	
61/62	451.2	1071.1	899.6	39.1	-	2461.0	El Zarka 68
62/63	284.6	1084.3	527.9	126.4	-	2022.6	,,
63/64	287.7	979.4	601.7	144.1	-	2012.9	,,
64/65	205.5	928.5	336.5	111.6	-	1582.2	,,
65/66	125.0	856.3	1004.7	100.5	-	2086.6	,,
					average	2033.1	
66	106.	-	-	2120.	-	2226.	Ishak 82
67	136.	-	-	1922.	-	2058.	,,
68	141.	-	-	1620.	-	1761.	,,
69	130.	-	-	1530.	-	1660.	,,
					average	1926.3	
75/76	303.	832.	647.	5.	-	1782.	coop
76/77	244.	684.	212.	52.	-	1193.	,,
77/78	237.	835.	284.	11.	-	1268.	,,
78/79	382.	763.	350.	54.	13.	1563.	Ishak 80
79/80	463.	918.	310.	7.	-	1698.	coop
80/81	212.	1214.	219.	24.	-	1696.	,,
81/82	338.	742.	403.	49.	-	1532.	,,
82/83	365.	537.	29.	93.	329.	1353.	,,
		average untill GAFRD took over				1511.	
83/84	184.	526.	236.	5.	70.	1021.	,,
84/85	299.	411.	93.	4.	15.	822.	,,
85/86	484.	456.	50.	3.	199.	1192.	,,
86/87	222.	761.	55.	1.	127.	1166.	,,
87/88	88.	482.	76.	*	492.	1137.	,,
					average	1068.	
					average	1794.	

Table 4.2.1.1.3.

Fry transport from El Girby (Damietta) to lake Qarun (predominantly grey mullet).

	water in transport tanks				water in unloading areas				number of fry x 1000	number truck loads
date	Ec	t.	D.O.	pH	Ec	t.	D.O.	pH		
17-XII-87	-	-	-	-	-	-	-	-	1200	2
6-I-88	-	-	-	-	-	-	-	-	440	2
9-I-88	-	-	-	-	-	-	-	-	460	2
12-I-88	-	-	-	-	-	-	-	-	400	1
16-I-88	-	-	-	-	-	-	-	-	1290	3
17-I-88	28.9	10.7	10.1	8.2	38.5	13.9	-	8.4	650	1
19-I-88	29.5	14.1	8.4	8.2	39.5	16.5	9.3	8.4	400	1
Subtotal; fry unloaded in enclosure near police station										4,840,000
19-I-88	28.9	12.8	9.2	8.2	38.9	14.9	11.8	8.4	1800	2
23-I-88	-	-	-	-	-	-	-	-	450	1
24-I-88	-	-	-	-	-	-	-	-	1400	2
26-I-88	-	-	-	-	-	-	-	-	400	1
27-I-88	-	-	-	-	-	-	-	-	1500	2
30-I-88	-	-	-	-	-	-	-	-	2000	3
Subtotal; fry unloaded in enclosure near IOF station										7,550,000
2-II-88	-	-	-	-	-	-	-	-	850	2
6-II-88	33.6	15.1	8.7	-	35.1	16.4	-	-	4100	5
8-II-88	19.3	15.4	9.1	8.1	35.0	17.6	-	-	3800	5
10-II-88	34.1	15.4	9.9	8.1	38.3	17.4	-	-	3800	5
6-III-88	-	-	-	-	-	-	-	-	1000	2
9-III-88	-	-	-	-	-	-	-	-	1200	2
13-III-88	-	-	-	-	-	-	-	-	1200	2
16-III-88	-	-	-	-	-	-	-	-	1200	2
25-III-88	-	-	-	-	-	-	-	-	78	1*
13-IV-88	-	-	-	-	-	-	-	-	200	1**
14-IV-88	-	-	-	-	-	-	-	-	150	1
Subtotal; fry unloaded at Abu Shanab ponds										17,578,000
Total number of fry unloaded in lake Qarun up to June-88 =										29,968,000

* fry from El Gamil (Port Said).

** fry from Suez, mostly other species (*Sparus* and *Dicentrarchus* etc.)

Table 4.2.1.2.1.

Plankton composition and distribution in the 280 μ samples

station	1	2	3	4	5	6	7	8	9	10	11
season	a b c	a b c	a b c	a b c	a b c	a b c	a b c	a b c	a b c	a b c	a b c
Botanic	o x -	o x .	o x -	o # •	x x x	o x o	o x -	o x -	o * -	o x x	o x -
Copepods	• . -	• + •	• + -	• • •	• • #	x # #	x # -	x # -	x # -	• * +	+ + -
Cladocerans	o o -	o o o	o o -	o o o	o o .	o x o	o . -	o . -	o * -	o . o	o o -
other crustaceans	. . -	o x x	x . -	o . x	o x *	. x x	o . -	. x -	o . -	x . x	x . -
Fish larvae	. o -	o x x	o o -	o . o	o o o	o o x	o o -	o . -	o x -	. . .	o o -
Fish eggs	* o -	# o #	# o -	x . o	x x *	x o •	* x -	x x -	o x -	x x •	x o -
Insects	o o -	o x o	o o -	o x o	x x o	x . o	x o -	x . -	x o -	x . o	x x -
Molluscs	o o -	x o o	o o -	o o o	o o o	o o o	x o -	. . -	o o -	o o .	o o -

Botanic material existed mainly of macrophytes and seeds and rests of terrestial plants.

a = summer	- no sample taken	* common
b = winter	o not found in sample	# many
c = spring	. 1 specimen	• abundant
	x several specimen	+ very abundant

Table 4.2.1.2.2.a.

Systematic list of net plankton species collected during June 1987 - April 1988.

Division: Cyanophyta				
(I) Order : Oscillatoriales				
Family: Oscillatoriaceae				
(I) Genus: Oscillatoria (vaucher)				
1. - O. brevis	47	70	18	50
2. - O. limosa	-	15	-	-
(I) Genus: Lyngbya (Agardh)				
3. - Lyngbya sp.	-	15	-	-
Family: Nostocaceae				
(II) Genus: Anabaena (Bory)				
4. - A. augstumails	-	9	-	-
5. - Anabaena sp.	-	14	-	-
(IV) Genus: Nodularia				
6. - N. spumigena	-	38	-	-
(V) Genus: Aphanizonemon				
7. - A. gracille	-	53	34	35
(VI) Genus: Trichodesmium				
8. - T. lacustre	-	61	-	-
(II) Order: chroococales				
Family: Chroococaceae				
(VII) Genus: Microcystis (Kutzing)				
9. - Microsystis sp.	-	2045	733	550
(VIII) Genus: Dactylococcopsis				
10. - D. acicularis	-	30	-	-
(III) Order: Chamaesiphonales				
Family: Chamaesiphonaceae				
(IX) Genus: Chamaesiphon (Braun)				
11. - C. incrustans	-	63	-	-
Division: Chlorophyta				
Class : chlorophyceae				
(I) Order: Chlorellales				
Family: Chlorellaceae				
(I) Genus: Ankistrodesmus (carda)				
12. - Ankistrodesmus sp.	-	371	-	-
(II) Order: Zygnematales				
Family: Zygenmataceae				
(II) Genus: Spirogyra (link)				
13. - Spirogyra sp.	-	25	5	10
Family: Desmidiaceae				
(III) Genus: Gonatozygon				
14. - G. aculatum	128	51	35	33
(III) Order: Volvocales				
Family: Volvocaceae				
(IV) Genus: Volvox (linnaeus)				
15. - Volvox sp.	126	-	-	-

Family: Phacotaceae				
(V) Genus: Phacotus (Perty)				
16. - Phocotus sp.	120	-	-	-
(IV) Order: Chlorococcales				
Family: Hydrodictyaceae				
(VI) Genus: Pediastrum (Meyen)				
17. - P. simplex	69	8	-	68
18. - P. ovatum	-	13	-	-
19. - P. duplex	-	63	-	-
Division: Chrysophyta				
Class: Bacillariophyceae				
(I) Order: Pennales				
Suborder: Araphidinae				
Family: Diatomiaceae				
(I) Genus: Fragillaria				
20. - F. crotonensis	-	148	-	36
(II) Genus: Synedra				
21. - S. capitata	-	87	68	14
22. - S. acus	-	56	102	20
(III) Genus: Astorionella				
23. - A. notata	-	63	39	40
(IV) Genus: Diatoma				
24. - D. elongatum	-	42	-	174
Suborder: Biraphidineae				
Family: Naviculaceae				
(V) Genus: Navicula				
25. - N. pupula	-	79	21	30
26. - N. cryptocephala	-	113	-	-
(VI) Genus: Cymbella				
27. - C. lanceolata	-	62	-	-
28. - C. helvetica	-	-	36	-
(VII) Genus: Amphora				
29. - A. ovales	218	92	20	28
30. - A. hendeyi	188	-	-	-
(VIII) Genus: Anomoconeis				
31. - A. sphaerophora	-	58	-	-
(IX) Genus: Gomphonema				
32. - Gomphonema sp.	-	189	-	174
(X) Genus: Gyrosigma				
33. - G. attenuatum	-	64	47	6
(XI) Genus: Rhizosalina				
34. - R. firma	-	153	-	-
35. - R. alata	-	109	-	-
36. - R. calcar	-	83	-	-
(XII) Genus: Bacillarla				
37. - B. paradox	1842	87	100	72
Family: Epithemiaceae				
(XIII) Genus: Epithemia				
38. - E. zebra	-	80	-	-

Family: Nitzschiaceae				
(XIV) Genus: Nitzschia				
39. - N. bilobata	-	52	14	30
40. - N. sigmoida	-	65	-	-
41. - N. palea	-	45	-	-
Family: Surirellaceae				
(XV) Genus: Surirella				
42. - S. robusta	-	69	-	24
43. - S. ovalis	-	81	29	9
(II) Order: Centrales				
Suborder: Coscinodiscineae				
Family: Coscinodisciaceae				
(XVI) Genus: Coscinodiscus				
44. - C. radiatus	279	148	-	209
45. - C. centralis	310	95	130	149
46. - C. perforatus	358	111	127	139
47. - C. nodulifer	297	94	105	184
48. - C. alboranis	-	55	117	-
49. - C. thori	-	141	-	-
50. - C. auruatulus	-	189	-	-
51. - C. excentricus	-	-	90	153
52. - C. lineatus	-	-	84	174
(XVII) Genus: Melosira				
53. - M. granulata	28	-	-	-
54. - M. sulcata	-	-	16	-
(XVIII) Genus: Cyclotella				
55. - C. meneghiniana	220	-	-	-
(XIX) Genus: stephanopyxis				
56. - S. palmeriana	398	34	-	-
Family: Surirellaceae				
(XX) Genus: Campylodiscus				
57. - C. noricus	-	76	52	12
Suborder: Biddulphiineae				
Family: Biddulphiineaceae				
(XXI) Genus: Biddulphia				
58. - B. regia	-	95	-	71
59. - B. pulchella	-	63	42	30
Division: Pyrrhophyta				
Class: Dinaphyceae				
Subclass: Dinophysiales (lindmann)				
(I) Order: Thecatales (lind.)				
Family: prorocentridae (Schüt)				
(I) Genus: Prorocentrum (Ehrenborg)				
60. - P. scultellum (sch)	215	72	37	12
61. - P. micans (Ehrbg)	-	95	36	12
62. - P. perforatus	215	-	-	-
(II) Genus: Exuviella (ienk)				
63. - Ex. compressa (Osten.)	142	56	-	-
(III) Genus: Cenchridium (Ehrenb.)				
64. - C. globosum (stein.)	-	53	-	-

(II) Order: Gymnodiales (Lindemann)				
Family: Gymnosclerotidae (schiller				
(IV) Genus: plectodinium (Biech.)				
65. - P. nucleovolvatum (Biecheler)	**185**	-	-	-
(III) Order: Peridiniales				
Family: Goniaulacidae (Lindemann)				
(V) Genus: Goniaulax (Diesing.)				
66. - G. polygramma (Stein.)	146	-	-	-
Family: Ceratidae (Sch.)				
(VI) Genus: Ceratium (Schrank.)				
67. - C. pentagonum (Go.)	177	48	-	18
68. - C. candelabrum (Ehrenb.)	-	66	-	33
Sub. genus: Euceratium				
69. - E. platycome (Dad.)	-	104	-	-
Sub. genus: Biceratium				
70. - B. furca	-	68	146	-
71. - B. belone	-	-	61	87
(IV) Order: Blastodiniales (Schiller)				
Family: Coccidinidae (Chatton)				
(VII) Genus: Duboscquella (Chatton)				
72. - D. anisospora (Grassé)	-	118	67	-
73. - D. grasse (Grassé)	-	-	28	-
(V) Order: Dinococcales (Pascher.)				
Family: Dinococcidae (Pascher.)				
(VIII) Genus: Pyrocystis (Murr.)				
74. - P. fusifrormis (Tho.)	-	78	-	-
Subphylum: Sarcomastigophora				
Superclass: Sarcodina				
Class: Rhizopodeo				
Subclass: Granuloreticulosia				
(I) Order: Foraminiferida				
Family: Globigerinidae (Brady)				
Subfamily: Globigeriniinae (Cushman.)				
(I) Genus: Globigerinoides (Cushman)				
75. - G. conglobata (Brady)	196	88	54	68
76. - G. sacculifera (Brady)	-	90	62	65
77. - G. helicina (Orb.)	-	72	23	71
(II) Genus: Globigerina (Orbig)				
78. - G. inflata (Orbig)	113	58	53	69
(III) Genus: Globigerinella (Cushman)				
79. - G. aequilateralis (Brady)	143	109	60	66
(IV) Genus: Hastigerinella (Crushman)				
80. - H. digitata (Rhumbler.)	-	70	51	-
Subfamily: Orbuliniinae (Cushmann)				
(V) Genus: Orbulina (Orb.)				
81. - O. universa (Orb.)	-	43	23	27
Family: Globorotalidae (Cushmann)				
(VI) Genus: Globorotalla (Cushmann)				
82. - G. truncatuloides (Orb.)	-	19	-	-

Family: Cymbaloporidae (Cushmann)				
(VII) Genus: Tretomphalus (Moeb.)				
83. - T. bulloides (Orb.)	-	-	14	5
Family: Hyperamminidae (Cushmann)				
(VIII) Genus: Iridia (Heron)				
84. - I. lucida (Calvez)	-	-	36	-
Class: Ciliatea				
Subclass: Spirotrichla				
(I) Order: Tintinnida				
(I) Family: Tintinnididae (Kof.)				
(I) Genus: Tintinnidium (Kent.)				
85. - T. neapolitanum (Dad.)	-	83	46	60
86. - T. fluviatile	-	120	-	-
Family: Codonellidae (Kent)				
(II) Genus: Tintinnopsis (Brandt)				
87. - T. lobiancoi (Daday)	222	85	44	19
88. - T. nucula (Fol.)	182	-	19	-
89. - T. cylindrica (Daday)	-	62	-	-
90. - T. vosmaeri (Daday)	-	75	96	30
91. - T. beroidea (Stein)	-	9	-	-
(III) Genus: Codonella (Haeck)				
92. - C. galea (Haeck)	-	105	-	-
Family: Coxliellidae (Campb)				
Subfamily: Coxliellinae (Campb)				
(IV) Genus: Coxliella (Brandt)				
93. - C. helix (Clef.)	-	100	-	-
94. - C. decipiens (Jørg)	-	-	35	-
Subfamily: Metacylinae				
(V) Genus: Metacylis (Jorgensen)				
95. - M. meresekowskil (Jorg.)	-	83	72	-
(VI) Genus: Helicostomella (Jorgen.)				
96. - H. subulata (Ehr.)	149	55	-	29
97. - H. edentata (Fauré)	-	62	-	43
Family: Ptychocylidae (Campb.)				
(VII) Genus: Poroecus (Cleve)				
98. - P. apiculatus (Cleve)	-	62	292	45
(VIII) Genus: Favella (Jorgensen)				
99. - F. adriatica (Imh.)	-	28	91	20
100. - F. serrata (Mobius)	-	126	92	23
101. - F. brevis (Laackm.)	-	-	131	-
102. - F. fistulicauda (Jorgensen)	-	-	136	-
Family: Epiplocylidae (Kof.)				
(IX) Genus: Epiplocylis (Jorgenson)				
103. - E. blanda (Daday)	-	-	61	-
Family: xystonellidae (Campbell)				
(X) Genus: Xystonella (Brandt)				
104. - X. treforti (Daday)	129	-	-	-
105. - X. longicauda (Brandt)	-	44	-	-
106. - X. lohmanni (Daday)	-	88	-	-
Family: Tintinnidae (Campbell)				
Subfamily: Tintinninae (Campbell)				
(XI) Genus: Bursaopsis (Campbell)				
107. - B. striata (Daday)	-	(1) 33	-	-

Family: Dictyocystidae (Haeck.)				
(XII) Genus: Dictyocysta (Ehrbg.)				
108. - D. obtussa (Jorgensen)	103	-	-	-
Phylum: Arthropoda				
Subphylum: Mandibulata				
Class: Crustacea				
Subclass: Copepoda				
(I) Order: Cyclopoida				
(I) Family: Cyclopedeae				
(I) Genus: Cyclops				
109. - C. fimbriatus	-	-	73	-
110. - C. vicinus	-	78	-	-
Cyclops larvae	161	95	105	-
(II) Order: Calanoida				
Family: Diaptomedae				
(II) Genus: Diaptomus				
111. - D. kenai	104	-	-	-
Diaptonus larvae	111	-	-	-
112. - D. siciloides	-	74	-	-
(III) Genus: Eudiaptomus				
113. - E. graciloides	-	-	51	-
(IV) Genus: Sinodiaptomus				
114. - S. chofranjoni	-	37	-	-
Family: Corycaeidae				
(V) Genus: Calanus				
115. - C. helgolandicus	124	88	-	64
(VI) Genus: Centropages				
116. - C. typicus	112	35	-	-
(VII) Genus: Euchaeta				
117. - E. heben	-	30	-	-
(VIII) Genus: Acartia				
118. - A. danae	-	30	-	-
(IX) Genus: Amallothrix				
119. - A. auropecten	244	-	-	-
(X) Genus: Caligus				
120. - C. rapax	-	43	-	-
121. - larvae or parapaeneus longirostris	136	-	-	-
Phylum: Nemathelminthes				
Class: Rotifera				
(I) Order: Monogonta				
Suborder: Ploima				
Family: Brachionidae				
(I) Genus: Brachiones				
122. - B. plicatilis	-	45	54	-
123. - B. pala	-	44	-	-
124. - B. leydigi	-	288	-	-
125. - B. urceolaris	-	95	-	-
(II) Genus: Keratella				
126. - K. cochlearis	-	11	5	5
(III) Genus: Epiphanes				
127. - E. senta	-	55	-	-
128. - E. brachionus	-	61	104	-
(IV) Genus: Colurella				
129. - C. adriatica	-	-	68	-
(V) Genus: Notholca				
130. - N. acumirata	-	35	-	-
(VI) Genus: Cyrtonia				
131. - C. tuba	-	53	62	-

Family: Trichocercidae				
(VII) Genus: Elosa				
132. - E. woralli	-	28	-	10
Family: Gastropodidae				
(VIII) Genus: Ascomorpha				
133. - A. ecaudis	-	-	47	-
(IX) Genus: Ascomorphelia				
134. - A. volvocicola	-	-	46	-
Family: Asplanchnidae				
(X) Genus: Polyanthra				
135. - P. vulgaris	-	-	56	-
Family: Synchoctidae				
(XI) Genus: Pleosoma				
136. - P. triacanthum	-	-	35	-
(XII) Genus: Synchaeta				
137. - S. pectinata (1)	213	-	54	-
138. - S. oblonga	-	-	59	-
(XIII) Genus: Microcodon				
139. - M. clavus	-	-	44	-
Family: Lecanidae				
(XIV) Genus: Lecane				
140. - L. lunar	-	-	30	-
(XV) Genus: Proales				
141. - P. decipiens	-	-	39	-
Family: Asplanchnidae				
(XVI) Genus: Asplanchna				
142. - A. priodonts	-	-	63	-
Family: Lindidae				
(XVII) Genus: Lindia				
143. - L. truncata	-	25	-	-
Family: Notommatidae				
(XVIII) Genus: Cephalodella				
144. - C. forficula	-	-	34	-
Suborder: Flosculariaceae				
Family: Testudinellidae				
(XVIV) Genus: Hexarthra				
145. - H. intermedia	107	-	-	-
146. - H. mira	133	-	-	-
147. - H. fennica	-	45	104	-
(I) Order: Diplostraca				
Suborder: Cladocera				
Family: Bosminidae				
(I) Genus: Bosminopsis				
154. - B. deiterai	-	28	-	14
(II) Genus: Bosmina				
155. - B. coregoni	157	58	59	65
156. - B. longirostris	-	70	147	32

Family: Daphniadae(IV)
(III) Genus: Daphnia
157. - D. pulex
158. - D. longispina

(IV) Genus Diaphanosoma
59. - D. brachiurum
(V) Genus Ceriodaphnia
60. - C. rigaudi

Table 4.2.1.2.2.b.

Average plankton distribution of the 60 μ samples per season in number of plankters per l. and (in % of total). Data obtained from Mr. Magdi Abbas Saleh May '88.

	Summer	Autumn	Winter	Spring	Average
Blue green algae	47 (.5)	2591 (21.9)	785 (13.2)	635(15.3)	1015(12.6)
Green algae	443 (4.4)	531 (4.5)	40 (.7)	61 (1.5)	269 (3.4)
Diatoms	4993 (49.2)	4166 (35.2)	1413 (23.8)	1863(44.9)	3109(38.7)
Dinoflagelates	980 (9.7)	758 (6.4)	375 (6.3)	162 (3.9)	569 (7.1)
Phytoplankton	6463 (63.7)	8046 (67.9)	2613 (44.0)	2721(65.5)	4962(61.8)
Rotifers	453 (4.5)	769 (6.5)	973 (16.4)	154 (3.7)	587 (7.3)
Copepods	1439 (14.2)	587 (5.0)	346 (5.8)	418(10.1)	698 (8.7)
Cladocerans	525 (5.2)	642 (5.4)	521 (8.8)	314 (7.6)	501 (6.2)
Tintinids	785 (7.7)	1220 (10.3)	1115 (18.8)	174 (4.2)	824 0.3)
Foraminifers	485 (4.8)	582 (4.9)	376 (6.3)	371 (8.9)	454 (5.7)
Zooplankton	3687 (36.3)	3800 (32.1)	3331 (56.0)	1431(34.5)	3064(38.2)
Total	10150	11846	5944	4152	8026
number of species	50	135	86	61	83

Table 4.2.1.2.2.c.

Total number of plankton organisms per liter water, taken from the 60 μ net samples, per season and station (zooplankton only), data obtained from Mr. Magdi Abbas Saleh just after each analysis.

Station	Summer		Autumn		Winter		Average	
1	4920	(642)	-	-	1904	(642)	3412	(642)
2	5608	(1788)	8197	(344)	2097	(678)	5301	(937)
3	3251	(911)	1291	(196)	1544	(605)	2029	(571)
4	1975	(1076)	6031	(384)	1877	(1041)	3294	(834)
5	1415	(692)	1863	(487)	3259	(784)	2179	(654)
6	2208	(999)	4771	(429)	2290	(478)	3090	(635)
7	3625	(1139)	4256	(588)	2724	(475)	3535	(734)
8	1682	(725)	3868	(696)	2382	(368)	2644	(596)
9	2589	(1338)	2873	(666)	2025	(274)	2496	(759)
10	4696	(2243)	2716	(121)	2024	(705)	3145	(1023)
11	4061	(2026)	2642	(150)	1779	(760)	2827	(979)
Average	3276	(1234)	3851	(406)	2182	(619)	3087	(760)

Table 5.1.1.3.2
Total salt load of lake Qarun

year	TDS g/l	Level in m MSL	Volume x 106m3	saltload in kiloton	reference
1901	13.42	-44.90	794.0	10,655.5	lucas 1906
1902	8.56	-44.62	861.2	7,371.9	,,
1906	11.06	-44.31	935.6	10,347.7	,,
1906	11.17	-44.28	942.8	10,532.1	Ball 1939
1918	18.0	-45.00	770.0	13,860.0	,,
1919	18.4	-44.86	803.6	14,786.2	,,
1920	17.6	-44.62	861.2	15,157.1	,,
1921	19.2	-45.00	770.0	17,784.0	,,
1922	21.5	-45.25	708.3	15,228.3	,,
1925	21.1	-45.10	736.4	15,538.0	,,
1926	22.4	-44.99	761.4	17,055.4	,,
1927	22.3	-44.95	782.0	17,438.6	,,
1928	24.4	-45.10	746.0	18,202.4	,,
1929	24.6	-45.23	714.8	17,584.1	,,
1930	23.5	-45.15	734.0	17,249.0	,,
1931	27.4	-45.37	681.2	18,664.9	,,
1932	31.6	-45.77	585.2	18,492.3	,,
1954	31.49	-44.98	774.8	24,398.5	Naquib 1958
1954	31.5	-44.40	914.0	28,791.0	v.d.Linden 1984
1970	30.0	-43.90	1034.0	31,020.0	,,
1970	31.73	-43.89	1036.4	32,885.0	Meshal 1977
1975	30.16	-43.98	1014.8	30,606.4	Nasr salines 1976
1975	36.05	-44.30	938.0	33,814.9	,,
1975	36.1	-44.12	978.8	35,334.7	DRI 1987
1978	36.0	-43.99	1012.4	36,446.4	IOF 1984
1981	31.98	-43.45	1142.0	36,521.2	,,
1982	31.28	-43.70	1082.0	33,845.0	,,
1982	35.5	-43.69	1084.4	38,496.2	DRI 1987
1983	27.23	-43.59	1108.4	30,181.7	IOF 1984
1986	35.2	-43.41	1151.6	40,536.3	DRI 1987
1987	34.6	-43.36	1163.6	40,260.6	own data

Table 5.1.1.3.3
Total dissolved salts at various lake levels

salt load		40500 KT TDS in g/l	41500 KT TDS in g/l	43000 KT TDS in g/l	45000 KT TDS in g/l
lake level meters below MSL	volume in $m^3 \times 10^6$				
-43.0	1250	32.4	33.2	34.4	36.0
-43.1	1226	33.0	33.8	35.1	36.7
-43.2	1202	33.7	34.5	35.8	37.4
-43.4	1154	35.1	36.0	37.3	39.0
-43.5	1130	35.8	36.7	38.1	39.8
-43.6	1106	36.6	37.5	38.9	40.7
-43.7	1082	37.4	38.4	39.7	41.6
-43.8	1058	38.3	39.2	40.6	42.5
-43.9	1034	39.2	40.1	41.6	43.5
-44.0	1010	40.1	41.1	42.6	44.6
-44.1	986	41.1	42.1	43.6	45.6
-44.2	962	42.1	43.1	44.7	46.8
-44.3	938	43.2	44.2	45.8	48.0
-44.4	914	44.3	45.4	47.0	49.2
-44.5	890	45.5	46.6	48.3	50.6*
-44.6	866	46.8	47.9	49.7	52.0
-44.7	842	48.1	49.3	51.1*	53.4
-44.8	818	49.5	50.7*	52.6	55.0
-44.9	794	51.0*	52.3	54.2	56.7

* critical point.

Table 5.1.1.3.4
Anions and cations in mg/l

ions	1987*	1978**	1967***	seawater
Ca	470	423	606	422
Mg	1220	1236	1117	1326
Na	10100	10576	8885	11050
K	235	232	-	410
CO3	-	-	102	-
HCO3	375	503	195	146
SO4	10000	8800	6277	2780
Cl	14200	14184	12873	19870
Total Dissolved Salts	36600	35954	30055	36004

* IWACO
** Nassr Saline Cy
*** Ministry of Industry

Table 5.2.1.1.1.a.

Length frequencies of *Liza ramada* in cm groups

lenghth group in cm.	30-VI-87	27-VII-87	Total (% of total)	IOF (% of total)
13.0				16 (3.4)
15.0				18 (3.9)
17.0				29 (6.2)
19.0				32 (6.9)
21.0				39 (8.4)
23.0				25 (5.4)
25.0				17 (3.6)
26.0	1		1 (.6)	
27.0				24 (5.1)
28.0	1	3	4 (2.3)	
29.0	1	1	2 (1.1)	29 (6.2)
30.0	3	10	13 (7.4)	
31.0	14	5	19 (10.8)	33 (7.1)
32.0	20	7	27 (15.3)	
33.0	22	15	37 (21.0)	28 (6.0)
34.0	16	12	28 (15.9)	
35.0	12	7	19 (10.8)	20 (4.3)
36.0	9	5	14 (8.0)	
37.0	1	3	4 (2.3)	15 (3.2)
38.0		3	3 (1.7)	
39.0		2	2 (1.1)	28 (6.0)
40.0				
41.0	1		1 (.6)	22 (4.7)
42.0				
43.0				16 (3.4)
44.0				
45.0	1		1 (.6)	10 (2.1)
47.0				18 (3.9)
49.0				20 (4.3)
51.0				13 (2.8)
53.0				8 (1.7)
55.0				5 (1.1)
57.0				2 (.4)
total	102	73	175	467
average length	33.2	33.3	33.3± 3.0	31.1± 11.36