Juneau Center
School of Fisheries and Ocean Sciences

University of Alaska Fairbanks
11120 Glacier Highway
Juneau, Alaska 99801

(907) 465-6441 Office
(907) 465-6447 FAX

Studies in Lake Becharof and the Ugashik Lakes in 1995

Report to the Lake and Peninsula Borough

by

O.A. Mathisen, E.V. Farley Jr. and J.J. Goering

Acknowledgements

The field season 1995 represents the fourth year when the Lake and Peninsula Borough financed limnological studies in Lake Becharof and the Ugashik Lakes. In kind contributions were received from Alaska Department of Fish and Game through Richard Russel, Management Biologist at King Salmon. The U.S. Fish and Wildlife Service through the Fisheries Manager, James P. Larson, conducted all the field sampling in 1995. Monetary contributions came from the Refuge Manager, Ronald E. Hood, who paid for part of the field work and subsequent analyses. These fitted into the Ecosystem approach now in use for management of the Refuge.

Without all this help the field program and analyses could not have been executed, and a sincere thank is extended to all people involved in the 1995 studies.

Zooplankton Sampling

The purpose is to measure if the zooplankton biomass is declining or increasing or remaining constant. Since the zooplankters represent the food for the juvenile sockeye salmon in the nursery lakes, this becomes an important parameter. It is measured by taking net hauls from 50 m depth to the surface or if the station depth is less from the bottom to the surface. There are different mesh sizes, but they all are very fine in order to retain the minute organisms. The positions of the established stations are shown in Fig. 1.

The densities, measured as number of organisms per cubic meter, showed some increases at the two stations inside the Big Narrows. in Lake Becharof. For the two stations in the open lake there was a slight increase from 1994 at Station 1 and a small decline at Station 2.

The biomass of juvenile sockeye salmon feeding on the zooplankters control to a large extent the standing crop. Judging from the smolt migrations during the last three years, juveniles were strong in the lake. (Fig.3).

Both of the two Ugashik Lakes showed an increase in zooplankton densities at all stations (Fig.4), which clearly is related to the low biomass of juveniles in the lakes as measured by the smolt migration during the last three years (Fig. 5).

If we sum all observations made at one station during the last four years, the differences between the two lake systems become very clear and also within lake variations (Fig. 6). The Lower Ugashik Lake has the smallest standing crop of zooplankters followed by the Upper Ugashik Lake. In contrast Lake Becharof has higher zooplankton densities in general. Station 3 at the upper lake end represents a special case. It has been pointed out before that an organism like Bosmina is absent from the Ugashik Lakes. Further these lakes have a very simple zooplankton composition with only two dominant genera like Diaptomus and Cyclops .

Even though the food base is different between the three lakes, the annual variations are small within the lakes. With the present catch and escapement rates a level of stability has been created.

Water Chemistry

Among the many measurements which can be made of the chemical elements contained in the lake water, certain parameters apply more directly to the production of food (Fig.7). Especially important is chlorophyll a which represents the synthesizing of new organic material. In both lake systems there has been a slight increase over the years.

Another important element is nitrogen. The low values indicate that this element is absorbed very quickly in the production of zooplankters. In the same class is phosphorus with small but rather stable values over the years for which data exist.

Silicon is important in water masses dominated by diatoms. The values observed in Lake Becharof are very constant over the years (Fig. 8). The same is true for the Ugashik Lakes, but the values measured here are almost twice those observed in Lake Becharof. The basic difference is due the composition of the surrounding terrain.

Other important elements like calcium, magnesium and iron do not show any great differences between the years (Fig.9). Station 3 in the upper end of Lake Becharof does not present the typical picture seen elsewhere.

Stable Isotope Ratios

The primary function of an escapement is to provide eggs which can be fertilized and develop into returning adult sockeye salmon. A secondary function is provided by the decaying salmon, which bring nutritional elements back into the water masses. The importance of this lake fertilization differ from one nursery lake to the next one. It can be measured by the stable isotope ratios for nitrogen and carbon in the tissue of the smolts.

Past studies have shown the marine nitrogen to be extremely important in Iliamna Lake, but distincly less in Lake Becharof. In the Ugashik Lakes fertilizing by the salmon carcasses assumes a more intermediate position (Figures 10 & 11). The so-called del values fore nitrogen are around 8 in Lake Becharof and about 10 in the Ugashik Lakes. In both lake systems these values do not differ with the length or age of the smolts. In other words the food spectrum of a juvenile sockeye salmon does not differ as they grow older. Instead all age groups compete for the same food organisms. It was earlier shown that the ratio between between Age I and Age II smolts changed from year to year. Maximum production will therefore be achieved if the majority of the smolts migrated to sea as Age I. Manipulation of the escapement size probably could achieve this.

These results are preliminary ones and will be discussed fully in a more comprehensive report. Work is also in progress by Dr. Bruce Finney to study the distribution of marine nitrogen in sediment cores. This will provide a historical picture of the role of marine nitrogen long before a commercial fishery started.

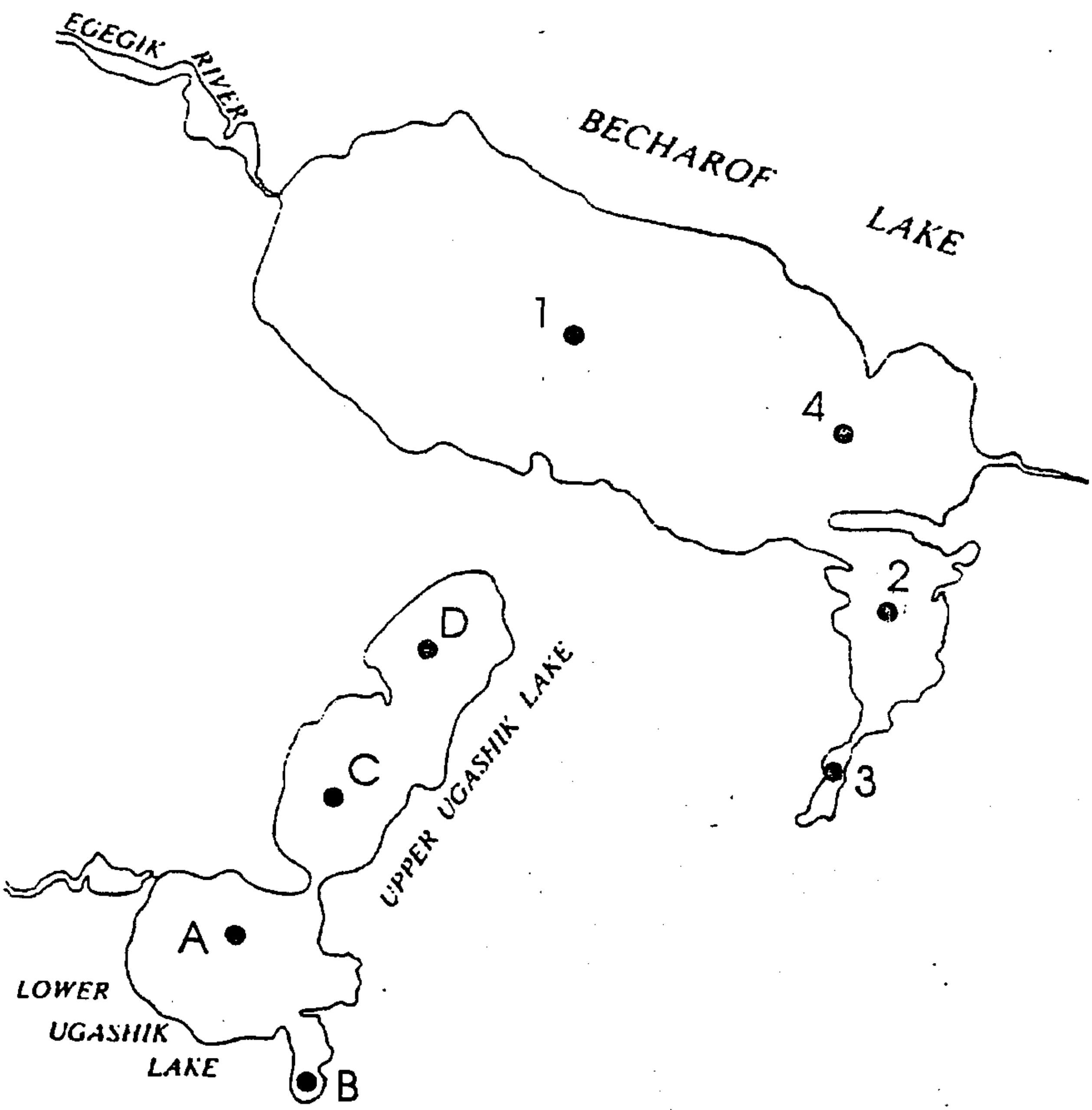


Fig. 1 Limnological Stations in Lake Becharof and the Ugashik Lakes

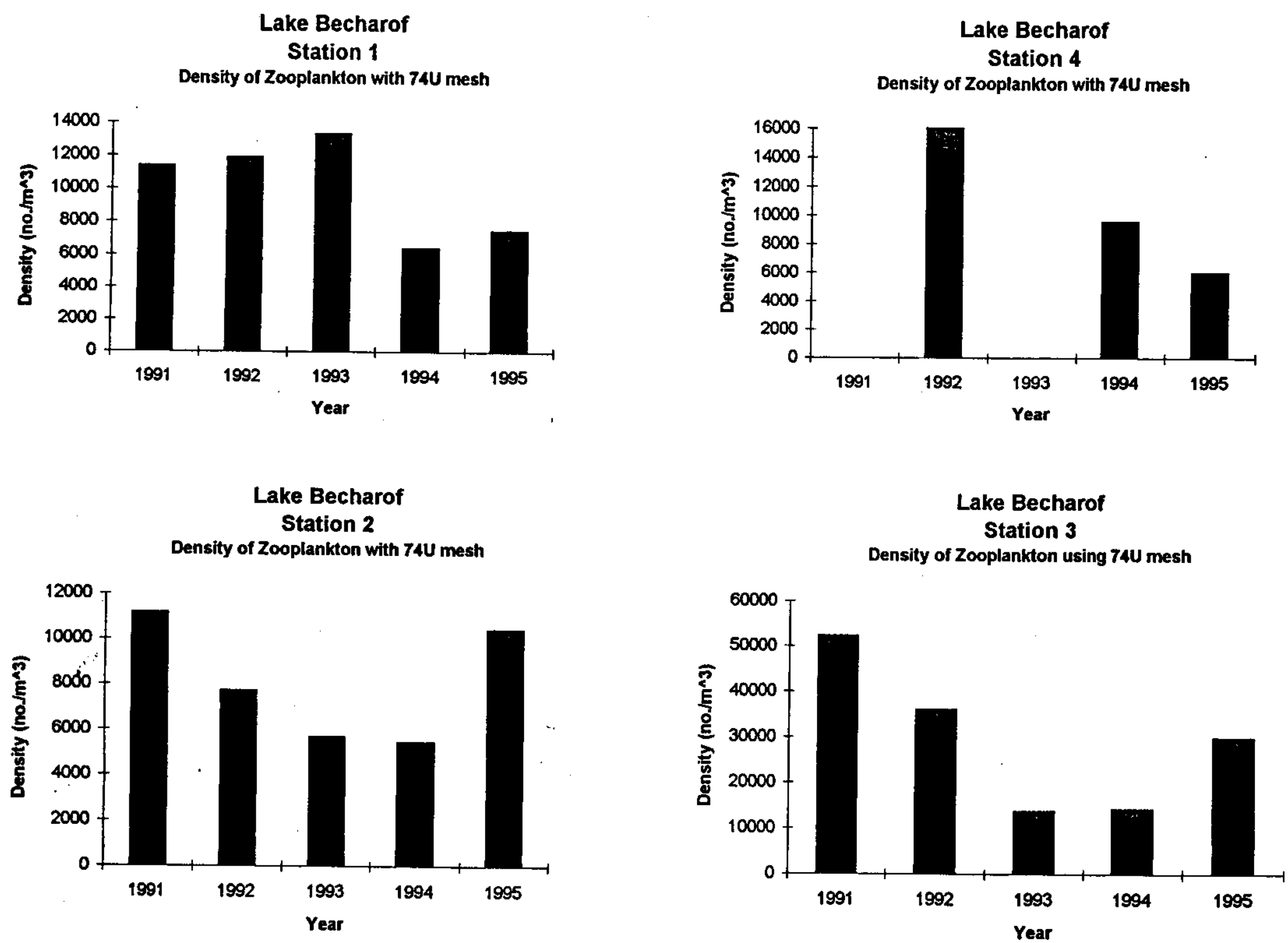


Fig. 2 Zooplankton Densities Observed in Lake Becharof with 74μ net.

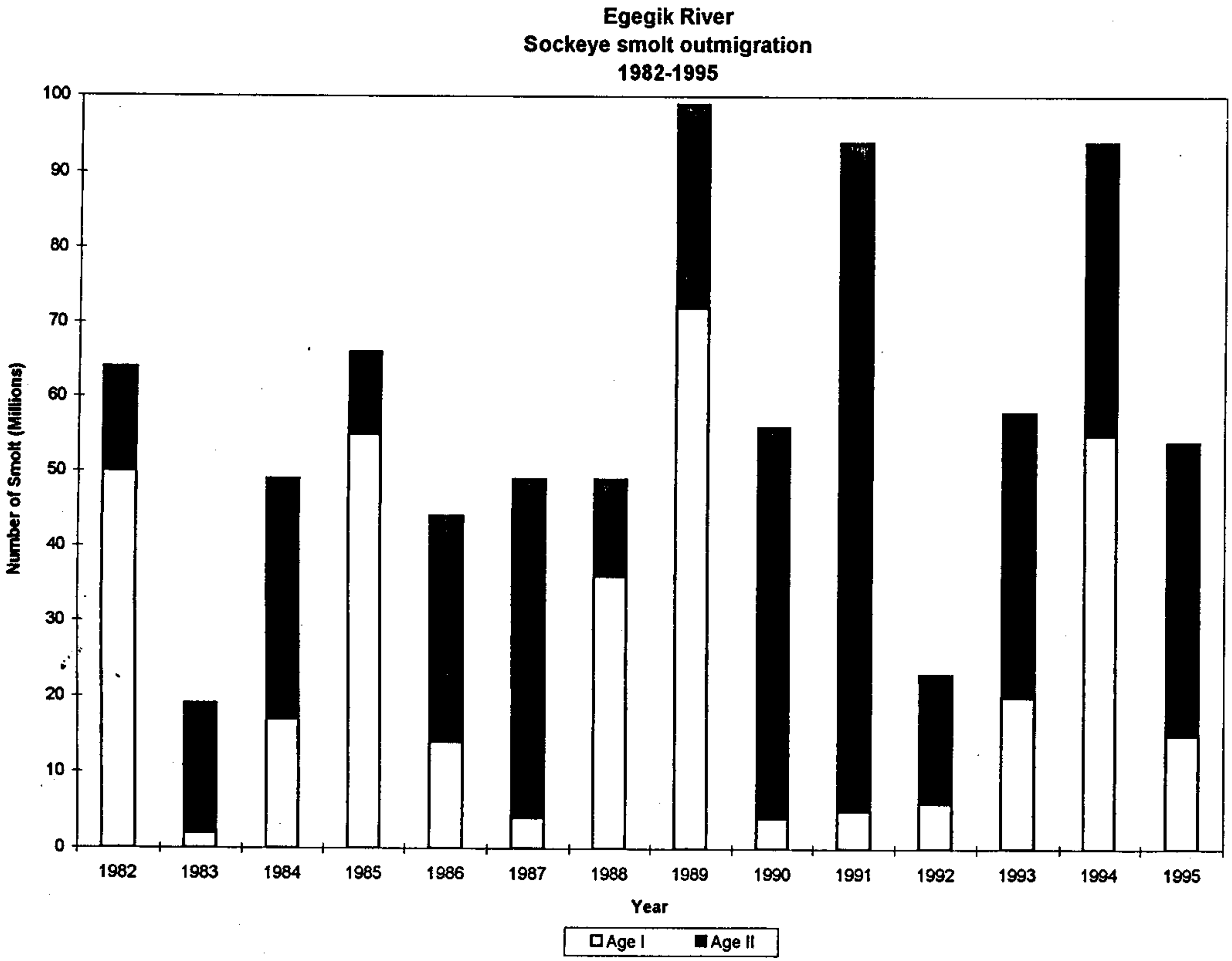


Fig. 3 Smolt Migrations in the Egegik River (Data from ADF&G)

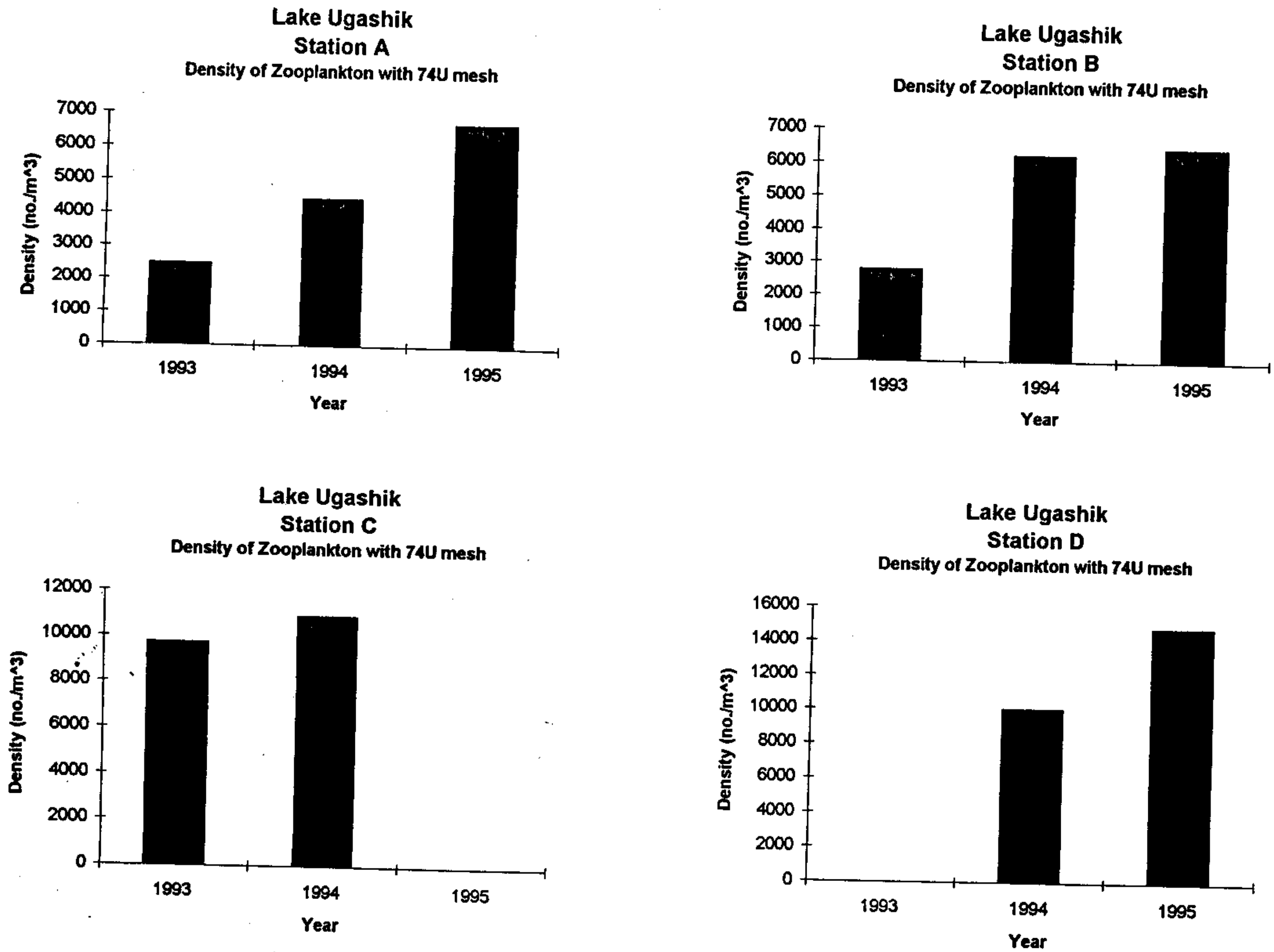


Fig. 4 Zooplankton Abundance in Lower Ugashik Lake (Stations A & B) and in Upper Ugashik Lake (Stations C & D). All samples taken in August with a 74 μ net.

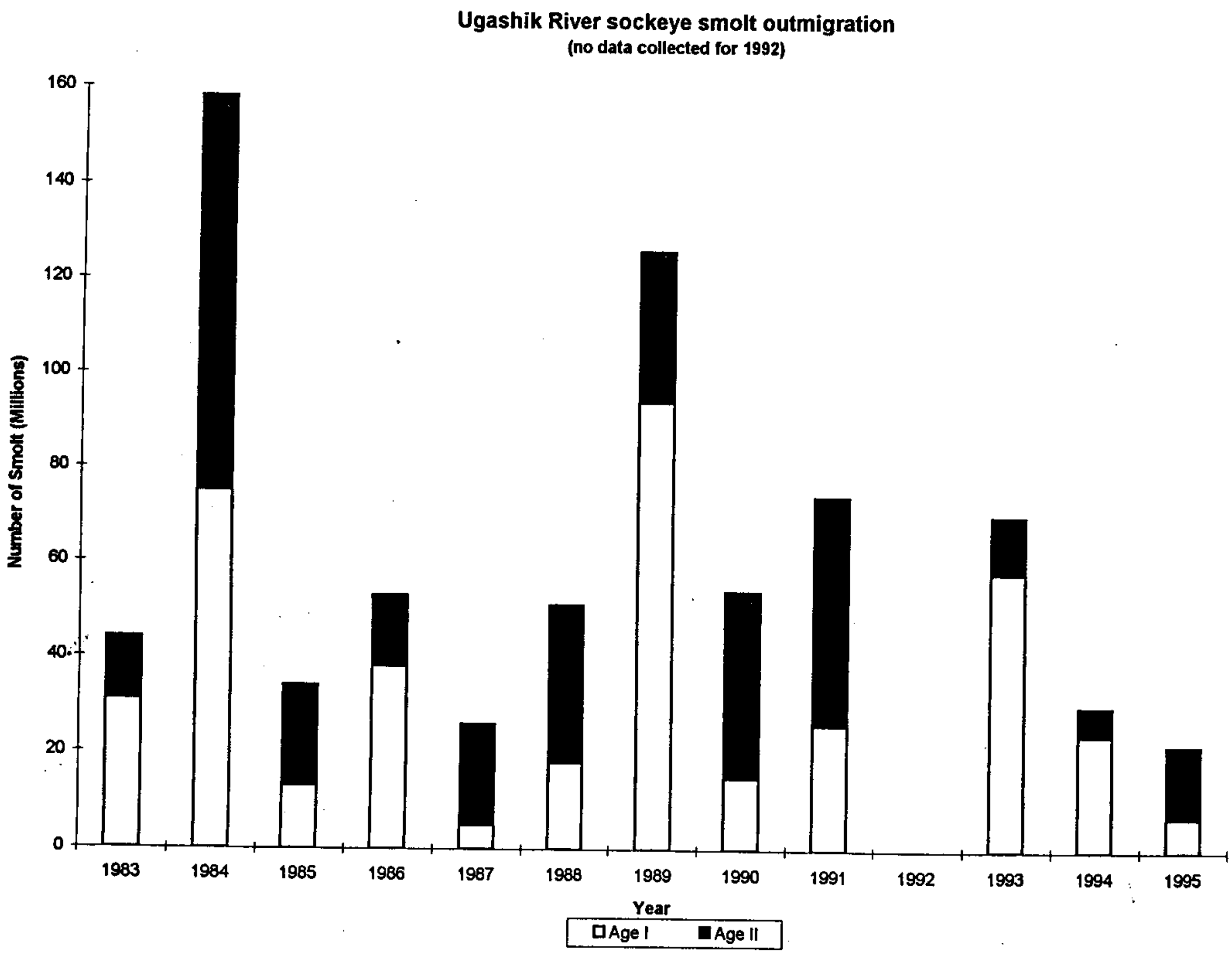


Fig. 5 Sockeye Smolt Migration in the Ugashik River (Data from ADF&G)

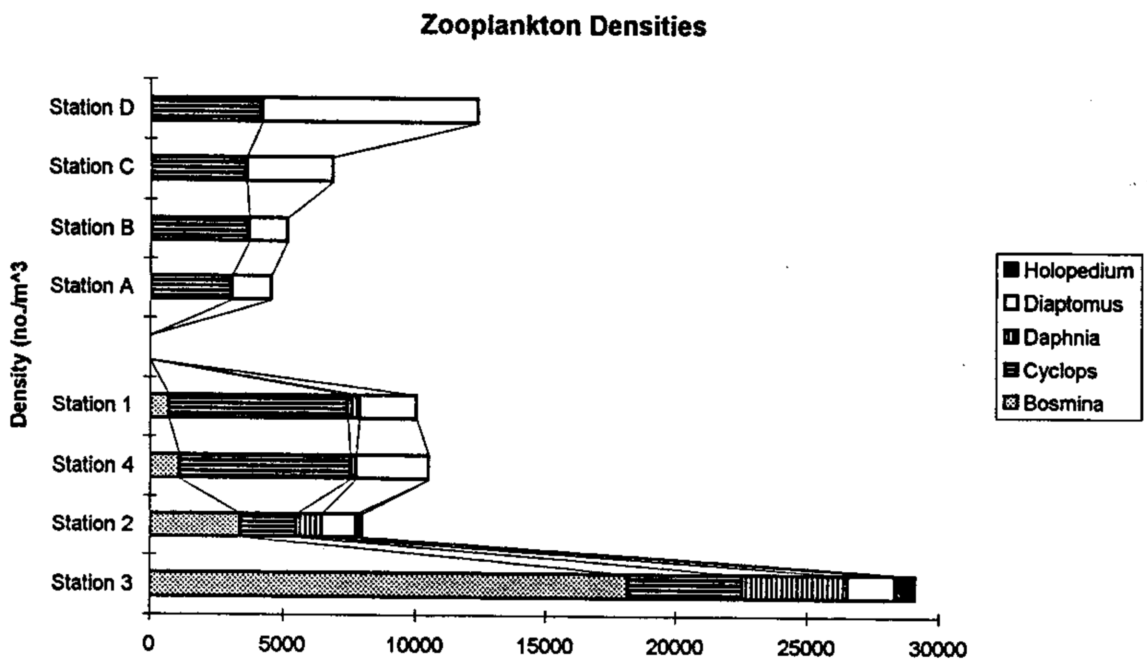


Figure 6 Number of zooplankters per cubic meter in Lake Becharof, Stations 1-4, and Lower Ugashik Lake, Stations A & B, Upper Ugashik Lake, Stations C & D. Values averaged for all observations made at a stations.

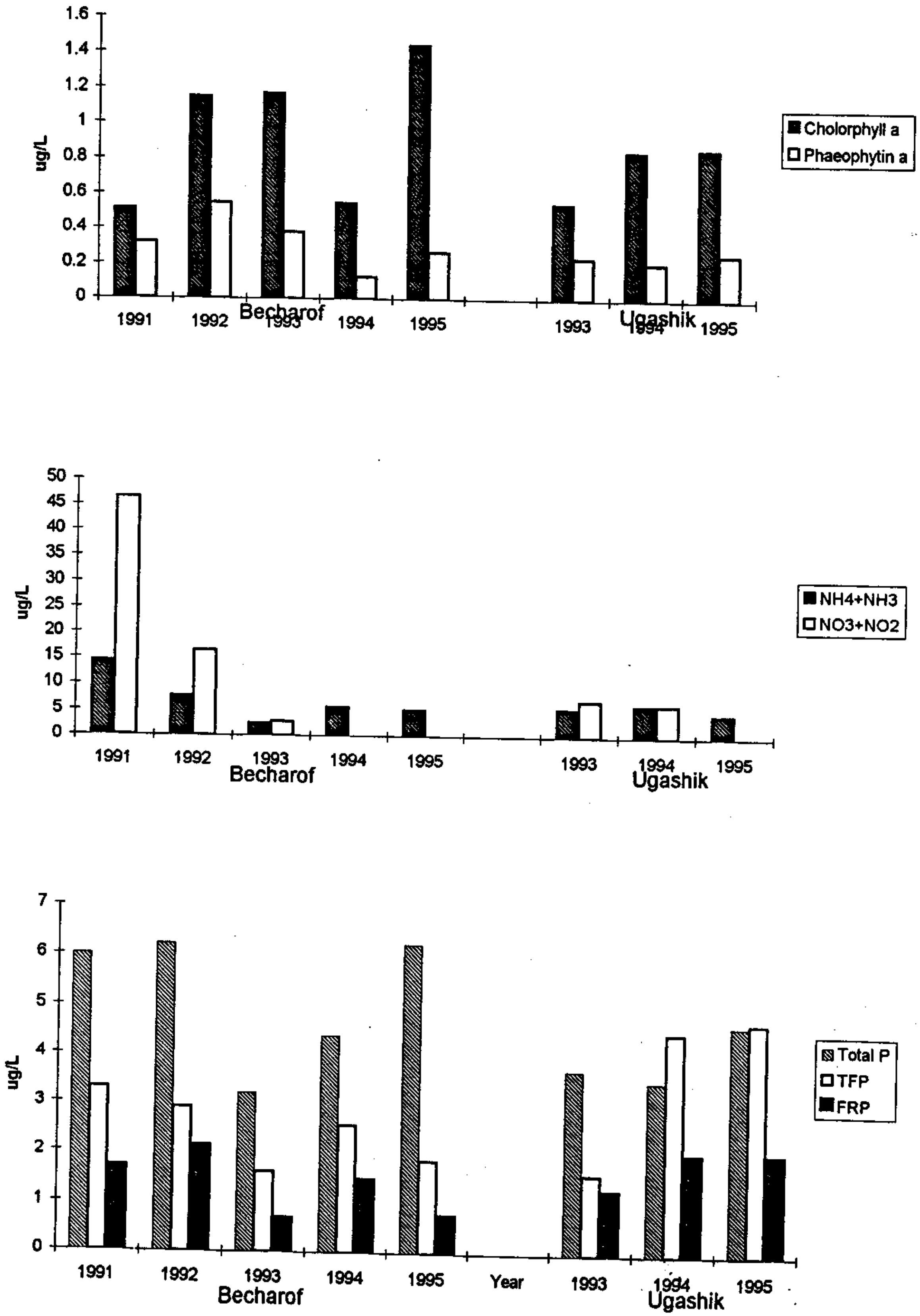
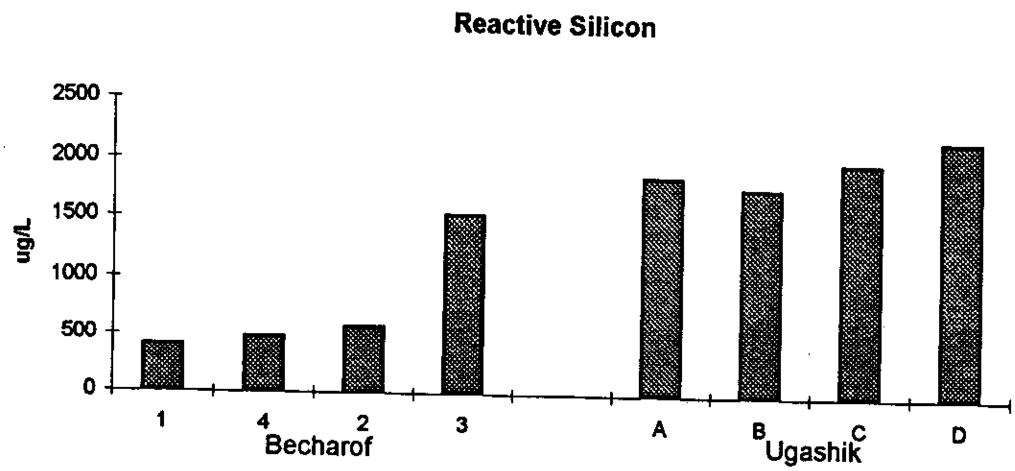


Fig. 7 Observed Concentrations of Chlorophyll a and Phaeophytin a and Nitrogen and Phosphorus



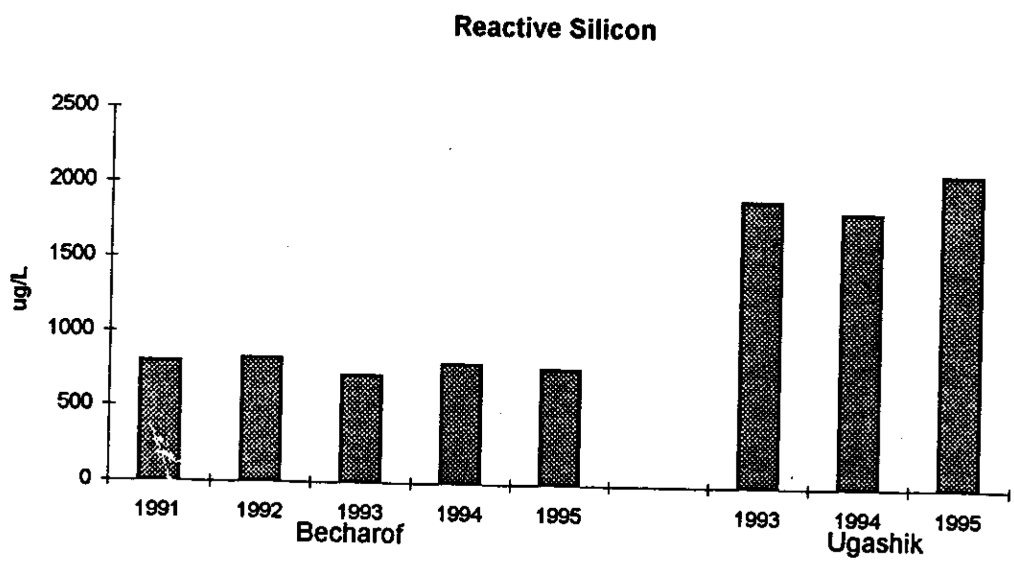


Figure 8 Averages of all Station Observations (top) and Yearly Averages for all Stations (Bottom)

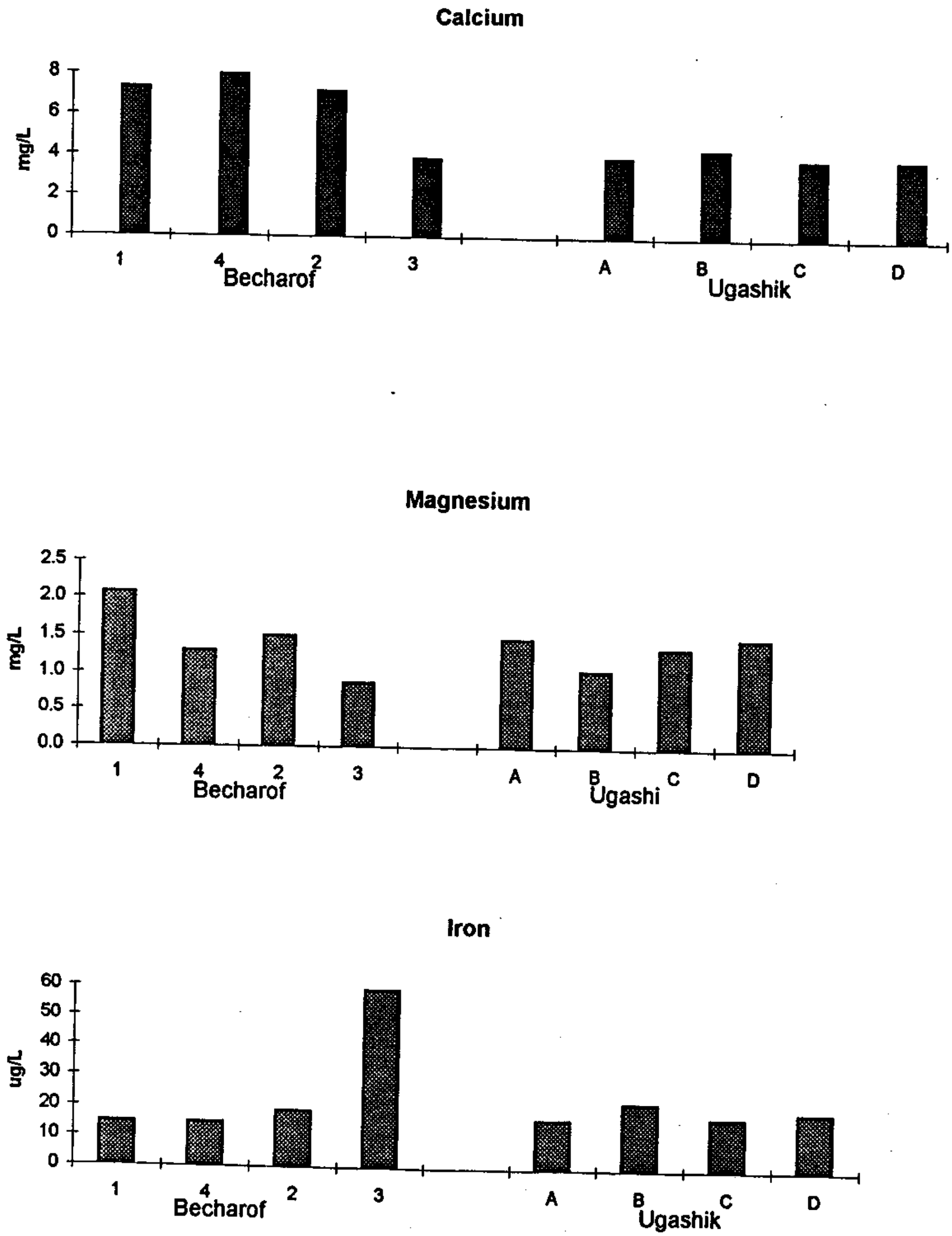
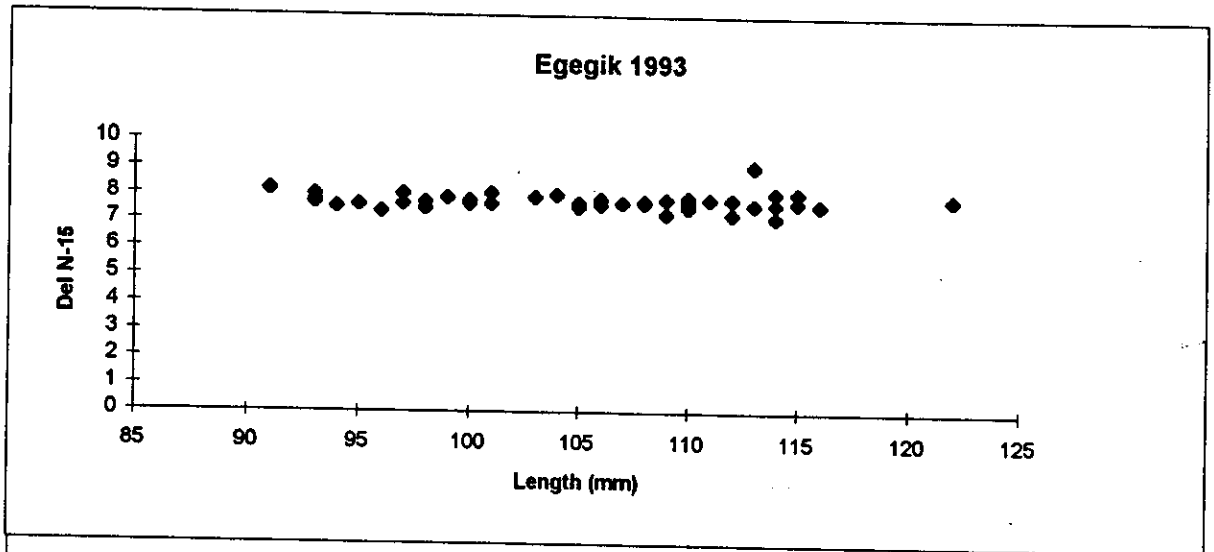
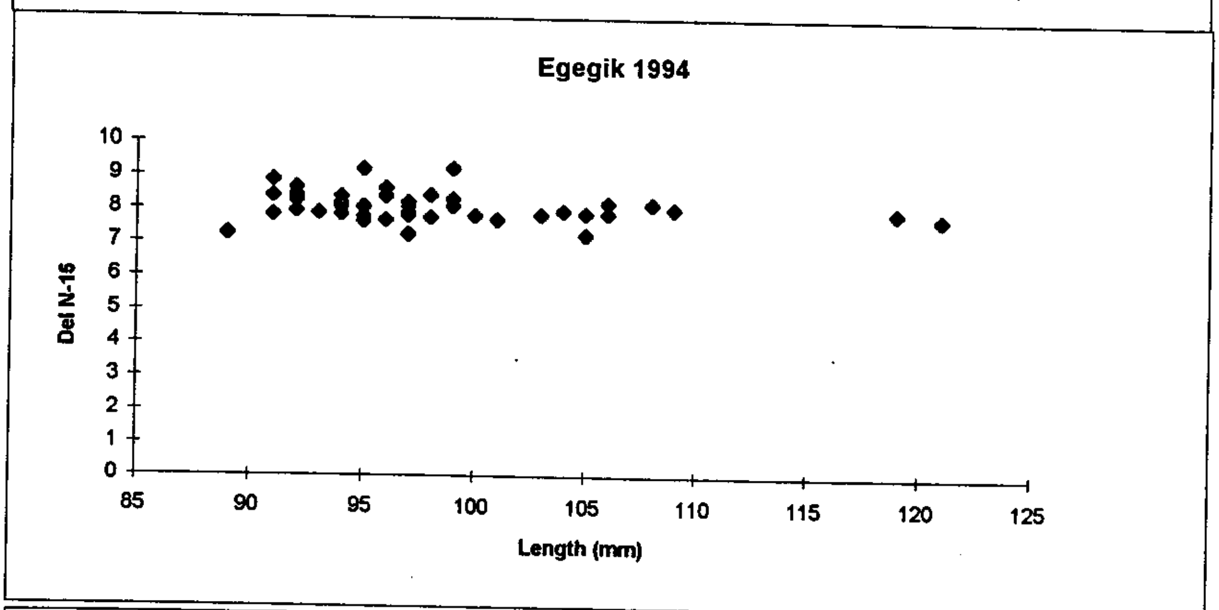


Figure 9 Values for Stations Averaged over all Years with Data





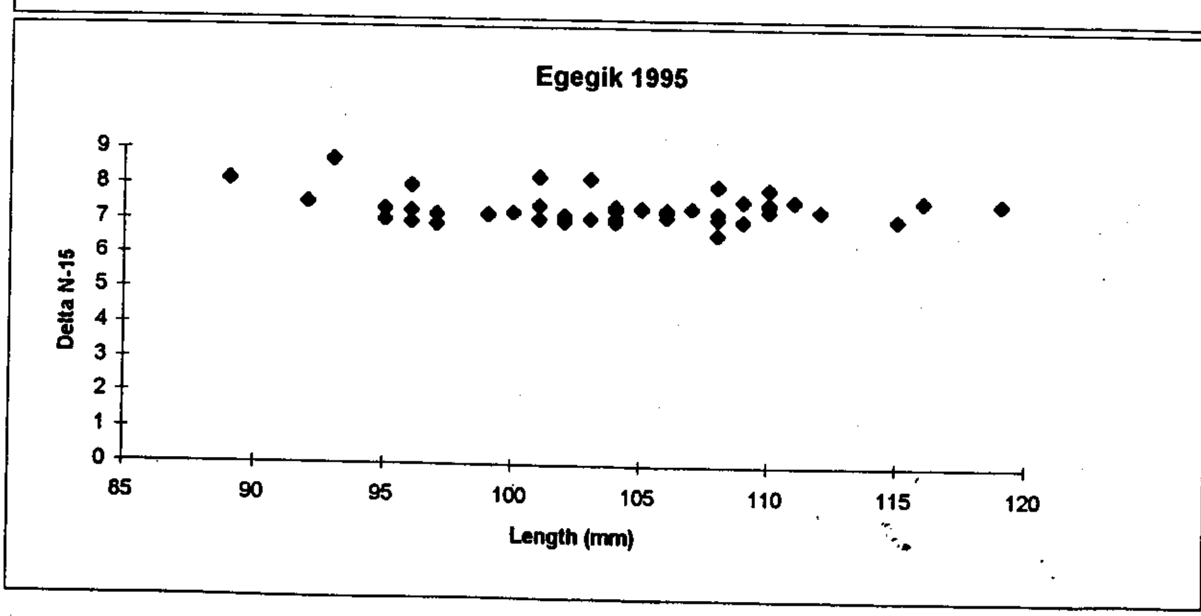


Figure 10 Del-N values plotted against length of smolts in Lake Becharof

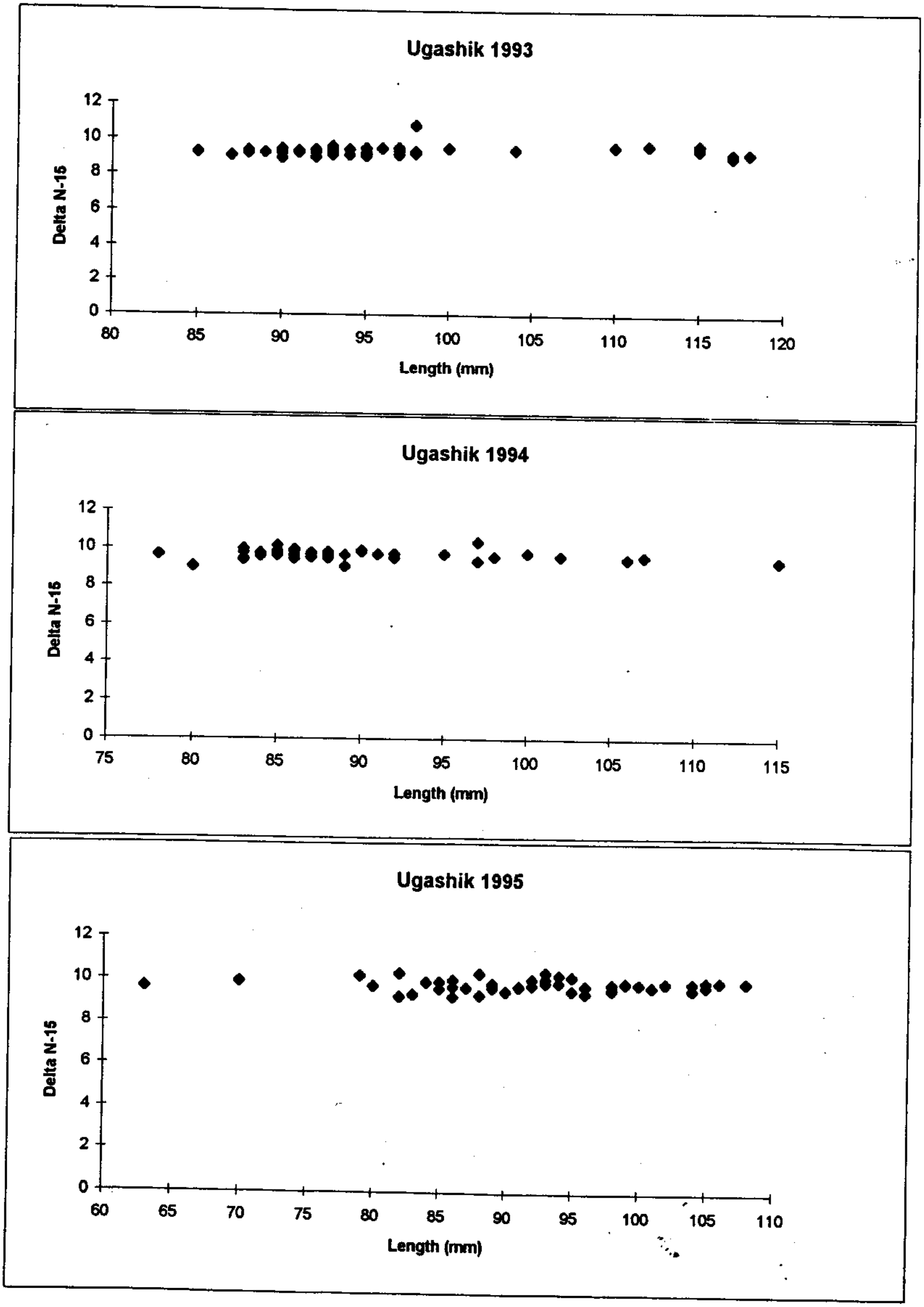


Figure 11 Del-N values plotted against length of smolts in Ugashik River