

Kotai, Krogg og Skulberg (1978)

K Mitt - Internat. Verein Limnol. 21: 413-436
(Utdrag her fra manus, NIVA). ^{12.}

reaches downstream of lakes show several phenomena related to the physical and chemical qualities of the water streaming from the lake. A vegetation and fauna rich in species and with high biomass are normally developed in these biotopes. The limnological processes in the lake with the subsequent effects on water fertility are decisive for the variations in production and water quality of the flowing water. For this reason inter alia it is necessary to investigate the watercourses as lake-river system (Lindström et al. 1973).

NB

6.1 The Halden watercourse

The Halden watercourse is a survey area for hydrobiological phenomena related to eutrophication. Water from the oligotrophic-dystrophic Lake Floen (see map, Figure 11) flows through the River Höländselv into Lake Björkelangen and southward through a complex of lakes with short river reaches in between. The water is receiving sewage from municipalities and runoff from agricultural areas. A considerable eutrophication is experienced with damage done to water quality and public health. Information on the catchment area and the watercourse is given in table 2.

Determination of algal growth potentials has been carried out to assess the fertilizing influence of pollution (Figure 11, 12 and 13). The results of the survey show that only little substantial growth of the test alga was supported in water from the upper reaches of the watercourse. As soon as the water flows into areas with agriculture and settlements substantial growth is experienced, and the water is changing to an extreme eutrophic type. Lake Björkelangen is receiving very nutrient rich water. Downstream of the lake new contributions of polluting substances increase the eutrophic state of the water masses.

Due to dilution effects by tributaries of oligotrophic nature and self-purification processes the water quality is changing to a type with relative low algal growth potential. This situation is virtually maintained through the lake system down to the estuary.

Table 2. Characteristics of the catchment area of the Halden watercourse.

Distance in km from outlet Flolangen ^x	Reference point	Catchment area km ²	Average annual discharge m ³ /sek	Forest- area km ²	Agri- cultural area km ²	Bog area km ²	Population (1973)
36	Outlet Bjørkelangen	280	4.3	158.1	58	18.4	4694
50/6	Outlet Øgderen	91	1.4	30.5	10.7	2.0	950
58/8	Outlet Mjermen	245	3.7	152.8	4.5	16.0	855
83	Outlet Rødenessjøen	1019	15.6	611.2	105.7	68.6	10952
101	Outlet Øymarksjøen	1166	17.8	705.6	120.1	77.6	12841
114	Outlet Aremarksjøen	1256	19.2	767.6	128.6	85.6	13396
127	Asperen	1394	21.3	829.6	135.5	93.5	13773
133/1	Outlet Store Ertevatn	60	0.9	24.0	0.2	4.5	61
133/7	Outlet Lille Ertevatn	2	0.03				
137	Outlet Femsjøen	1573	24.0	928.0	157.3	108.0	14255
143	Outlet Iddefjorden	1597	24.4	941.6	166.7	109.7	30495

^xTributaries. Distance in km from confluence with main river.

The lakes cause pronounced alterations on the fertility of water flowing through them (Figure 12). Lake Bjørkelangen acts as a fertility trap and becomes steadily more eutrophic. Biological activity in the lake (e.g. development of heavy algal blooms, *Oscillatoria agardhii* var. *isothrix*) reduces the algal growth potential of the surface water during the vegetation period.

Observations of the changing fertility of water and determinations of growth limiting nutrients result in information important for water management. A characteristic situation in the watercourse during summer is presented in Figure 13. On the river reaches where pollution from sewage effluents is prevailing, nitrogen is the limiting nutrient for algal growth. The runoff from agricultural areas is rich in nitrogen-compounds, and in the adjacent parts of the watercourse phosphorus is the growth limiting nutrient.

6.2 Lake Mjøsa and tributaries.

The great Norwegian fjord lakes can be characterized as fundamentally oligotrophic (Strøm 1930, 1932). The influence of civilization has a strong eutrophication effect. Lake Mjøsa belongs to the lakes which are under this influence. Already the investigations during the 1920's pointed out (Huitfeldt-Kaas 1946) that Lake Mjøsa was not so oligotrophic as other comparable fjord lakes in Norway.

The catchment area is 16.420 km², and of this 11.459 km² belongs to the main tributary - River Gudbrandsdalslågen. The geographical conditions of the area are varied and have climatic contrasts. The natural environment, mountainous and barren over the greater part of the catchment area (86%), but relatively fertile and pleasant around Lake Mjøsa and in the valleys, accounts for the distribution of settlement. The inland pattern of communities is typically linear both around the lake and in the valleys that dissect the mountains.

Fig.11

Regional survey of water fertility in the Halden watercourse

Observations at 21 stations during 1975

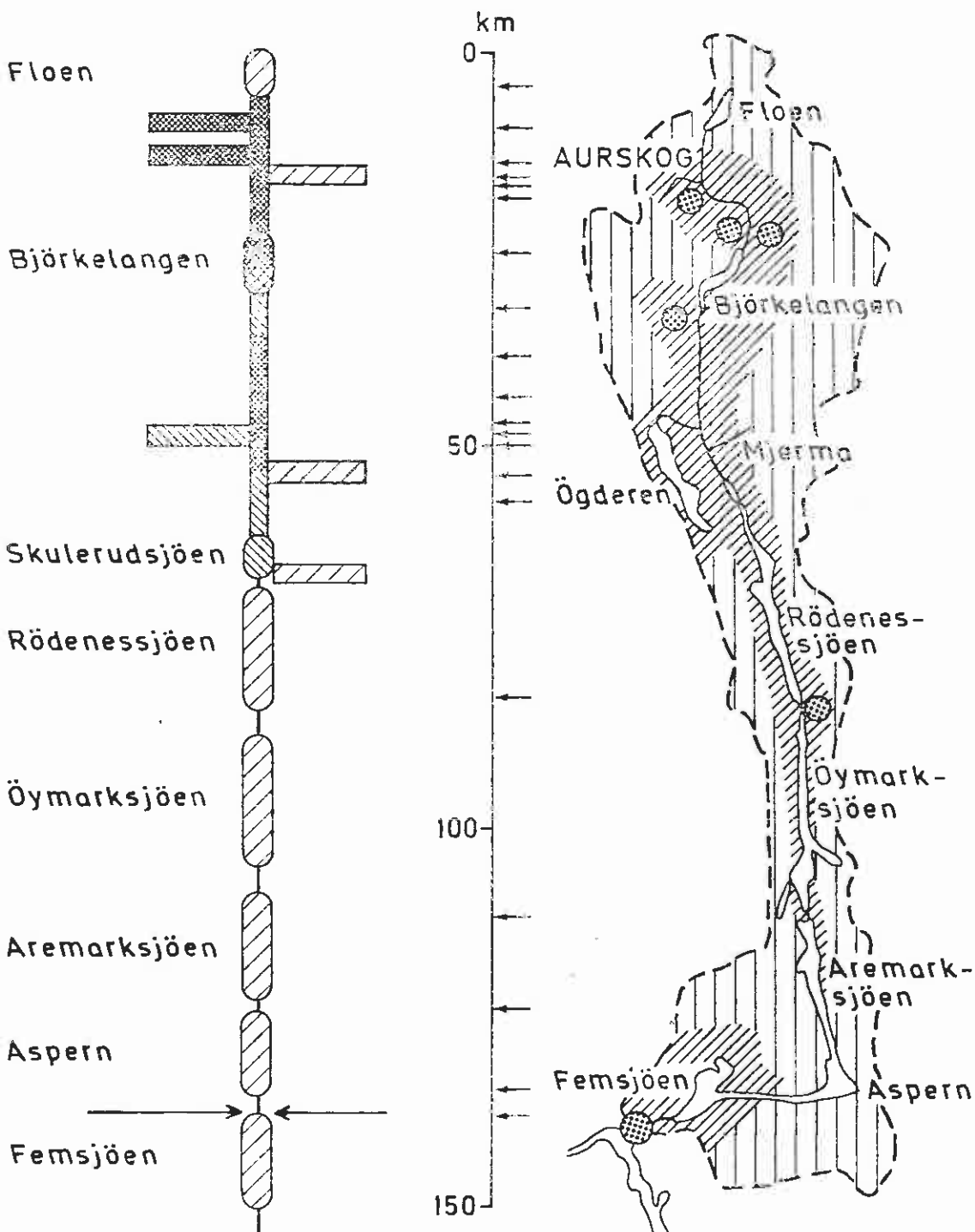
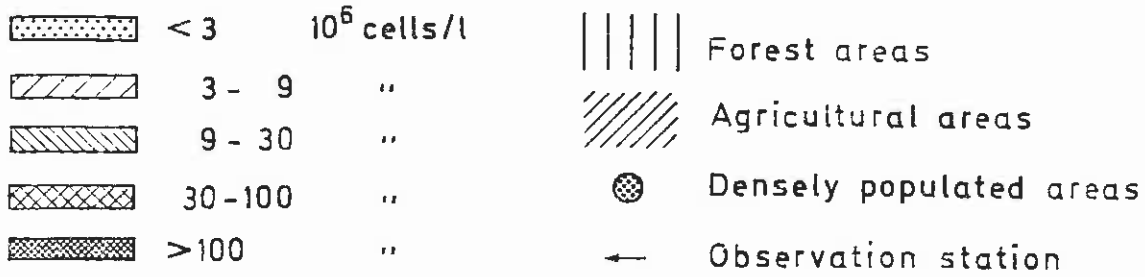


Fig.12 Changing fertility of water along a watercourse
River Hölandselv, arithmetical means of results during
June - October 1975

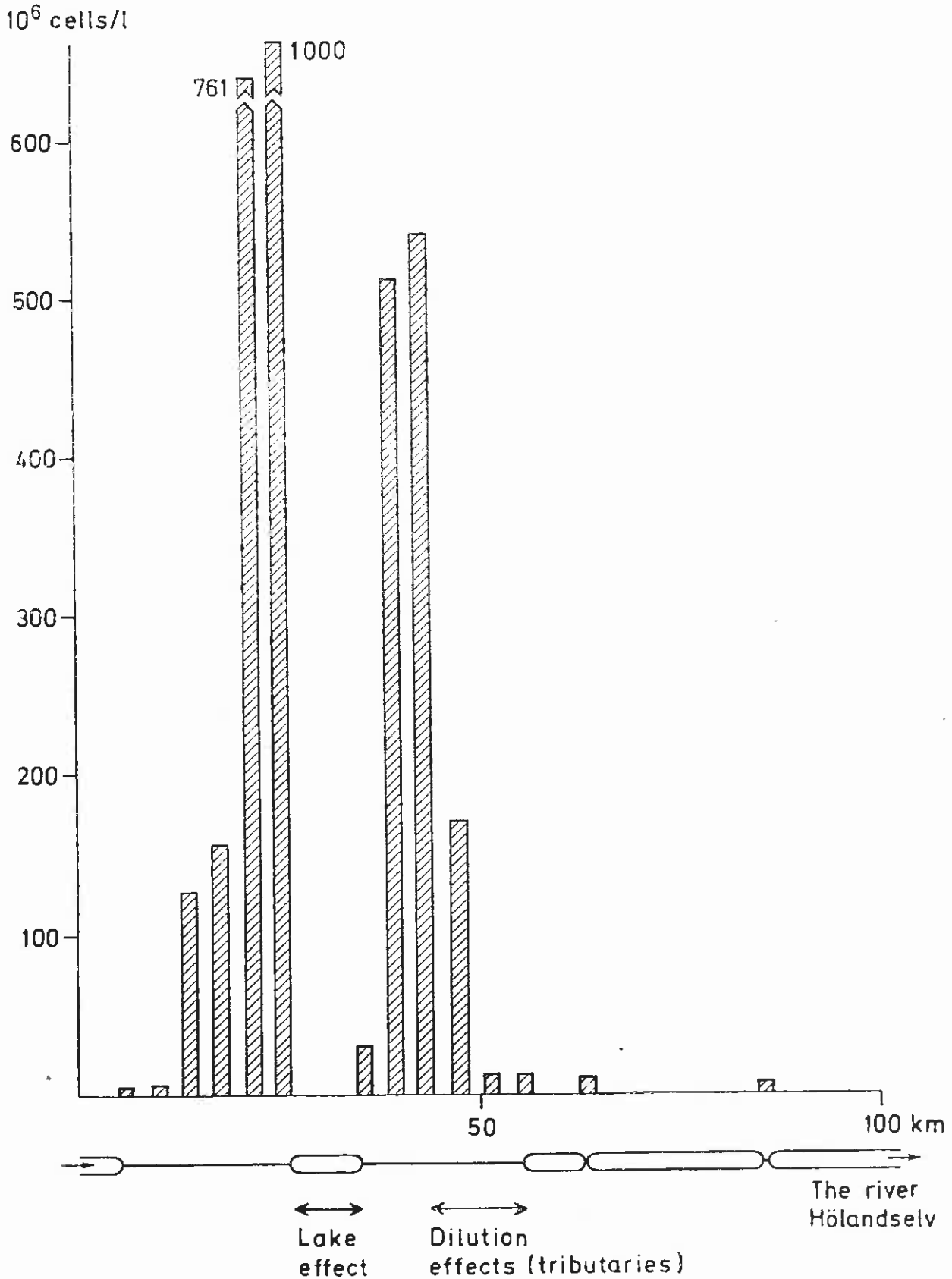


Fig.13 Growth potentials of waters and the influence of nutritive substances on water fertility

River Hölandselev, observations on July 23th 1975

