

## 4. FIELD AND LABORATORY METHODS



### 4.1. SAMPLING TECHNIQUES

#### 4.1.1. PISTON CORING

Kazimierz Więckowski

The sediment cores from Lake Gościąg were collected by means of the piston corer of K. Więckowski's own construction, its functioning principles similar to those of Livingstone corer. The first version of this corer was produced in 1958 at the Limnological Station of Geographical Institute, Polish Academy of Sciences, located at Miłokójki, and since then several improved types of the corer have been constructed (Więckowski 1961, 1970, 1989). The corer in its last version can take cores 50–70 mm in diameter in 1 m or 2 m segments, and it can be operated in lakes with water depth up to 30 m and sediment depth 30–40 m. It can also be used to core mires and mud deposits, etc. It is reliable and easy to operate.

The core collection from Lake Gościąg and neighbouring lakes proceeded during the winters 1985, 1986, 1987, and 1991 from the ice surface and in the summers of 1990–91 from a platform supported by two military pontoons. The cores in 2-m segments were collected in plastic tubes with inner size of 58 mm placed inside the corer steel tube. After the coring the plastic tubes filled with sediment were pulled out and their ends closed tightly.

During the last field expeditions the cores were taken directly in plastic tubes of 70-mm inner size, accelerating the field work and increasing the volume of sediment obtained. The collection of cores in plastic tubes makes them safe during transport; they can be stored fresh in a cold room for a long time without any damage. For sampling, the tubes are cut along the axis on both sides, the half of the tube is taken away and the core exposed.

During the field work the position for getting particular cores was fixed with help of an old Lencewicz's (1929) bathymetric plan (the new survey was made much later, see Fig. 3.2 in Chapter 3), first in places of maximum water depth, and then distributed properly to get the image of depth differentiation in particular parts and zones of lake (see Fig. 5.2 in Chapter 5.1). In that way the preliminary data about the infilling of the lake basin and the configuration of its original mineral bottom were obtained.

#### 4.1.2. SEDIMENT FREEZING *IN SITU*

Adam Walanus\*

The uppermost metres of sediment are not compacted because of lack of overlaying mass. Its density is extremely low, i.e. almost equal to that of water. Lake Gościąg in its deepest place is 24 m deep. This means that pressure at the bottom is three times higher than the normal atmospheric pressure. The gas dissolved in water, which is the main constituent of the sediment, is liberated and makes bubbles when the sample of sediment is lifted. Rising bubbles mix the sediment and disturb the laminations. The best way to avoid such disturbances is to make sediment absolutely rigid *in situ*, before lifting. It is performed by means of dry ice (carbon dioxide below  $-70^{\circ}\text{C}$ ) with addition of alcohol; cooling mixture fills a metal tube or box, which is inserted into the sediment (Saarnisto 1986). As a result, after 10–30 min., layers of frozen sediment 1–3 cm thick are attached to the device. The solid sediment is lifted and kept frozen (well below  $0^{\circ}\text{C}$ ) during transport to the laboratory, where many different scenarios of further processing are possible.

During the Lake Gościąg explorations two types of samplers were used: the flat wedge sampler and the tubes of 6 cm external diameter (Fig. 4.1). The former is used for taking samples from the sediment/water transition (Renberg 1981). By increasing its weight up to 50 kg, sediment from a depth of 2 m may be reached.

To get deeper sediment, tubes were used. Especially the longest (5 m) and heaviest steel tube was useful. Because of the large amount of cooling medium which the tube may contain, a continuous sample may be obtained up to 1.6 m long. Kinetic energy is the agent forcing the tube to penetrate the sediment down to 4 m. The tube, filled with cooler and lead weights, falls freely through water and plunges into the sediment. No significant increase of sample disturbance is visible as compared with the rope-controlled tube.

About 20 frozen short cores have been taken from the deepest part of the lake. Their relative vertical positions

\* Thanks due to Matti Saarnisto, who introduced the author to the "cold finger" technique, and to Ingemar Renberg, whose valuable remarks made possible the construction of the wedge-type sampler. Tomasz Goslar actively participated in the coring expeditions.

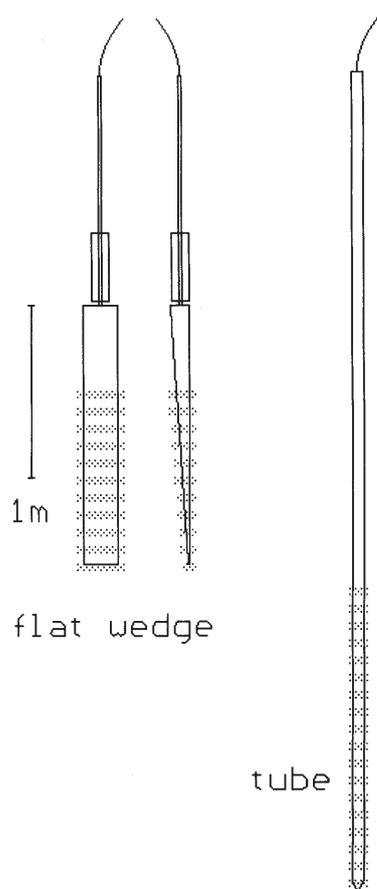


Fig. 4.1. Two types of freezing samplers.

and the age of samples are given by Goslar (Chapter 9.2.2).

#### 4.1.3. SEDIMENT SUBSAMPLING

*Magdalena Ralska-Jasiewiczowa, Tomasz Goslar & Adam Walanus*

In the case of annually laminated sediments the samples to be used for the majority of analyses (mineralogy, chemistry, stable isotopes, pollen, cladocera, diatoms, etc.) were collected from the same sediment slices, and their resolution followed the sediment laminations. Slices of a known number of laminae couplets were cut with a sharp knife or scalpel through the whole or half of the cleaned core. Laid flat, they were then divided into  $1\text{ cm}^2$  squares by pressing in a metal grid (Fig. 4.2). The full sediment squares were then used for the volumetric (influx) analyses. Routine sampling included 10 couplets, with 40 couplets left inbetween, but some sediments sections were sampled additionally for special purpose with higher time resolution, or continuously. The samples from non-laminated sections were collected in a similar way from slices 1 cm thick or with a  $1\text{ cm}^3$  volumetric device.

The samples were packed in plastic tubes and stored in a cold room. In profile T1/90 the halves of slices were packed in  $25\text{ cm}^3$  or  $50\text{ cm}^3$  samples for macrofossil analysis (Demske 1995).

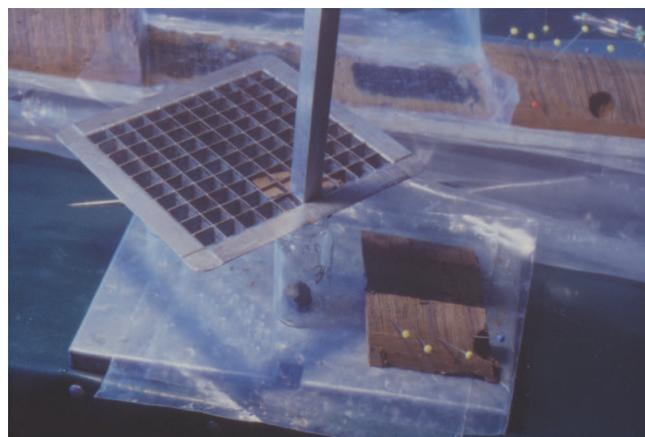


Fig. 4.2. Subsampling of laminated core section. The sediment slices of known number of yearly couplets are divided into  $1\text{ cm}^2$  samples to enable later calculation of microfossils influx values (Phot. T. Goslar).

The subsampling of frozen cores was done by two different methods, depending on device (tubular or wedge) used for freezing *in situ*. The subsamples from tubular cores were cut out with a scalpel from the core surface air-dried in a deep-freezer. This procedure, however, had two serious drawbacks. First, in order to get sufficient amount of dried sediment, the cores had to be stored in a freezer for several months. Besides, the freeze-dried sediment was very light and loose, and it was extremely difficult to handle it without any loss or mixing material from adjacent subsamples. The subsampling of cores collected with a wedge sampler was much easier, for two large flat pieces of sediment could be cut out and melted with no risk of collapse. The subsamples were then taken from melted surface of core pieces with a small brass trough. All subsamples were collected continuously, with a time resolution of 1–2 years, sometimes 3 years, depending on sampling difficulties. Their volume, attempted to be  $1\text{ cm}^3$  per year, appeared in practice not quite uniform.

## 4.2. CHRONOLOGICAL METHODS

*Tomasz Goslar*

### 4.2.1. RADIOCARBON DATING

Since its introduction (Libby 1946) radiocarbon dating has become well established and the generally accepted method of age determination of organogenic sediments. The discovery that the concentration of radiocarbon in the atmosphere (and hence in the biosphere) was not con-