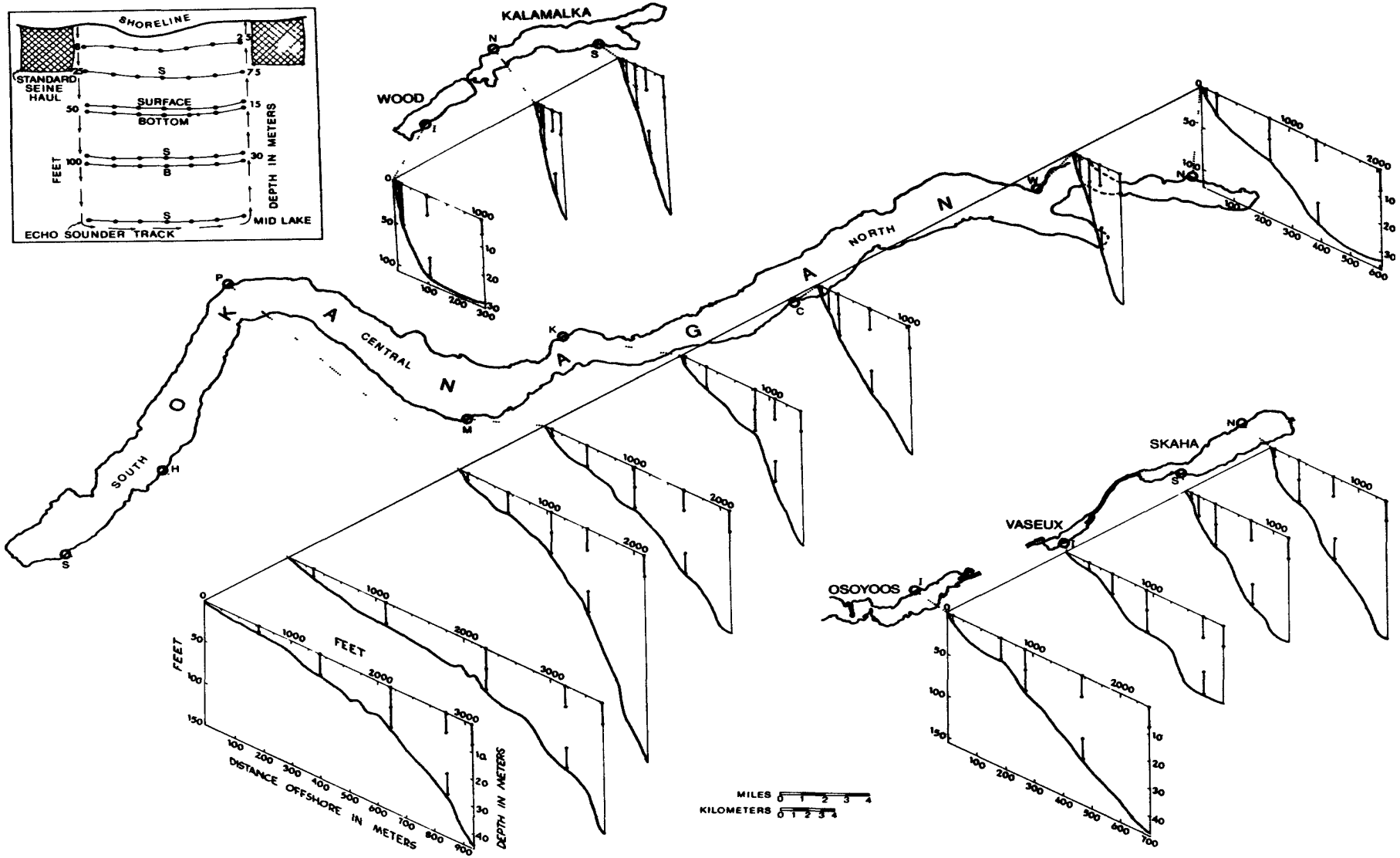
METHODS

FISH SAMPLING

Lake Netting And Beach Seining

Standard netting stations were established on the study lakes (Fig. 1) early in April, 1971. For the smaller lakes, one or two stations were located near the deeper basins but for Okanagan they were spread out to cover the northwest arm (1 station), the northern area (2 stations),

Fig. 1. The Okanagan basin study lakes showing location and depth profiles for the standard netting



stations, as well as position of the gill nets (I) set at regular depth intervals offshore. Inset shows typical plan view of gill nets, beach seine sites, and echo sounding track.

the central area (3 stations) and the southern area (2 stations). Despite the fact that an attempt was made to place stations over only moderately sloping bottom there was wide variation in bottom profile between stations (Fig. 1). Often other considerations (marinas, swimming beaches, shipping and boating lanes, etc.) dictated station location.

At each station a standard series of gill net sets were made (Fig. 1). All gangs were set approximately parallel to shore, following the designated depth contours. At the 2.5 and 7.5 m (ca 8 and 25 ft) contours, nets of those respective depths were set, at the 15 m contour (ca 50 ft) surface and bottom gangs each 7.5 m deep fished the whole depth zone. At the 30 m contour (ca 100 ft) floating and bottom gangs each 7.5 m deep, left a 15 m midwater stratum unfished. Further offshore a 7.5 m deep gang was set at the surface to fish the upper layer only. Each gang consisted of 6 mesh sizes - 38, 51, 63, 76 102 and 127 mm stretched mesh (1.5, 2, 2.5, 3, 4 and 5 inch) with 15 m (50 ft) of each mesh size. The webbing was made of 0.20 mm diameter monofilament nylon (Grylon fiber). The nets were set in the evening and lifted in the morning, fishing for about a 12 hour overnight period. A spring (May 2 - 23), summer (July 19 -August 10) and autumn (October 2 - November 3) series was run, each station received the complete standard net set once during the seasonal period indicated. Other sets were made periodically over the year to obtain more scales for some species, to obtain additional samples for pesticide or heavy metal analysis or for other purposes.

An echo sounder tracing was usually made around the whole netting

area (Fig. 1) in the evening after the nets were set and again in the morning before they were lifted. A 50 Kc/sec Furuno F701 sounder was used at gain 6 to make all tracings. In conjunction with each standard netting station (spring and autumn only), one or two beach hauls were made in late evening with a 32 m seine. The seine had a central panel of 6 mm stretched mesh 6 m in length and depth joined at each end by a 2.4 m length (6 m deep) of 12 mm stretched mesh and a 10 m "wing" section of 25 mm mesh which tapered to 0.9 m in depth at the bridle end. All webbing was knotless green nylon.

Fish were left gilled in the nets when lifted and were removed onshore later in the morning, the catch from each gang (but not each mesh size) being recorded separately. Usually the total net catch of each species was measured (fork length in mm) and many were weighed to the nearest gram on a Mettler P3 balance (9 kg + 2 kg tare). Exceptionally large or long fish were weighed on a Swiss spring scale (Oskar L•di Co., "Pesola"). Sex was recorded routinely where it was obvious from the state of maturation and occasionally by internal examination. Scales were taken for aging from most species as described by McHugh (MS 1936) and Clemens et al. (1939). Otoliths were taken from burbot (Appendix 1) as well as from a few other species (lake trout, kokanee).

Fish captured by seining were usually preserved in a 10% formalin solution, although large individuals often were sampled similarly to netted fish. Small fish (< 150 mm) made up the bulk of the seine catch and these were measured, weighed (Mettler K7 T balance) and scale sampled (where feasible) in the laboratory. No adjustments in length or weight

were made for changes which might have occurred during the preservation period (< 9 months at the most).

The present survey was conducted entirely in 1971, starting in April and ending in December. Information from recent years was available from files of the British Columbia Fish and Wildlife Branch. Earlier data were obtained from a summer study on Skaha Lake (Ferguson, MS 1949) and from the work of Clemens and others on the basin in 1935 (Clemens et al., 1939; McHugh, MS 1936).

All data were transferred from original field sheets to Fortran coding forms and then single computer cards were punched for each individual fish to maximize flexibility of analysis. A total of 23,288 fish were analyzed, 1257 from 1935; 2,406 from 1948; 755 from 1949 to 1970, and 18,870 from 1971.

KOKANEE SPAWNER ENUMERATION

Stream Spawners

Of 26 streams inspected in autumn, 1971 only 9 supported more than 500 spawning kokanee and the runs in these streams were subsequently enumerated. Additional streams have provided kokanee spawning habitat in other years when sufficient water has been available.

In Mission Creek the kokanee were counted through a fish fence across the stream 1.2 km upstream from the lake. In the Okanagan River between Okanagan and Skaha lakes kokanee were counted from a helicopter. In all other streams, estimates of kokanee were made visually (using Polaroid sun glasses) while walking the length of stream used by spawners.

These counts were made about weekly until numbers decreased on two consecutive counts. An average of 6 counts were made over the spawning period on each stream (Appendix 3).

A measure of the residence time of spawners in the creek was made by tagging newly-arrived fish and recording the time that they died after spawning. This was done in Peachland Creek only and the average residence time (12.6 days) used for estimating total spawner population in all streams. The numbers of fish for each day were summed, the number of "fish-days" computed and then divided by the residence time to obtain an estimate of the total number of spawners (Method 1). This method was checked by comparing it with a technique (Method 2) developed by the International Pacific Salmon Commission (Goodman, MS 1965). Estimates in Okanagan River at Penticton and Equesis Creek (Fig. 15) were made using this technique.

In addition to estimated spawner population, fork length, weight, and fecundity were determined on samples from each spawning population (Appendix 4).

Shore Spawners

Visual estimates of numbers in several spawning groups were made from vantage points on cliffs bordering spawning sites. One group was then captured by beach seine and a count made of individuals. Several spawning sites were then marked with one square meter areas that were readily visible from the air. The shoreline of all basin lakes was inspected from the air for the presence of shore-spawning kokanee on October 28, 1971. Some spawning groups were recorded on 35 mm film from an altitude of about 30

meters; the number in each group and the area covered by it was visually estimated using the one meter-square areas as reference points. Location of sites was recorded on maps. An estimate was made of the total shore spawning population by multiplying the total spawning area by the spawner density estimate as outlined above.

About 25 males and 25 females taken from one spawning group were tagged with spaghetti-type tags to determine residence time of individual fish on the spawning site. At about 5 sites, the type of substrate, distribution of spawning groups and spawning behavior and egg deposition were briefly investigated by the use of SCUBA. A small sample of kokanee was taken for determination of size, weight and fecundity.

PESTICIDE AND HEAVY METAL ANALYSES

Sampling Procedure

Analyses of 284 samples was planned using pooled samples of 10 individuals of selected sizes, rather than single fish. Fish were taken from a sample of gill netted fish taken from the regular net catches and some additional nettings.

A pooled sample was made up of 10 one-ounce sections taken from the epaxial musculature of 10 individual fish. The samples of flesh including skin and adipose tissue were preserved in ethyl alcohol in glass bottles with aluminum foil under plastic lids; samples analyzed for organphosphates were preserved in alcohol and kept at about 0°C.

Analytical Methods

Analyses were conducted by the Pesticide Laboratory, B. C.

Department of Agriculture. Difficulty was experienced with the analysis of cadmium copper and zinc particularly, in the first 30 samples (indicated in Table 9 by an asterisk). It was decided that the temperature at which these samples were ashed was too high. Subsequent samples were treated as outlined in Appendix 2. Nonetheless, in the first 30 samples analyzed, cadmium was detected, copper undetected and the highest zinc concentrations recorded. In all subsequent samples (same species from same lakes), cadmium was undetected, copper detected and zinc, where detected, was generally in lower concentrations.