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Pygmy Whitefish Studies On Dina Lake #1, 2000

J. D. McPhail and R. J. Zemlak
October 2001

PWFWCP Report No. 245

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PYGMY WHITEFISH STUDIES ON DINA LAKE #1

WATERSHED: Parsnip River

DATE OF SURVEYS: May 23 to 26, 2000
June 19 to 23. 2000
July 24 to 28, 2000
September 21 and 22, 2000
October 23 to 27, 2000

FIELD CREW: Arne Langston
Don McPhail
Ray Pillipow
Randy Zemlak

PEACE/WILLISTON FISH AND WILDLIFE COMPENSATION PROGRAM

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FISH AND WILDLIFE BRANCH

REPORT PREPARED BY: J. D. McPhail and R. J. Zemlak

ABSTRACT

Pygmy whitefish *(Prosopium coulteri)* were studied in a closed lake system (Dina Lake #1) of the Williston Watershed near Mackenzie BC. Little information is known about the biology of pygmy whitefish and their distribution in the Williston Watershed. Approximately one half of the lake was examined during five sampling trips. Gee traps, pole and beach seines, a zooplankton net, and fine mesh monofilament gill nets were used to capture this fish. Pygmy whitefish were only captured by gill nets. Sampling effort was focused primarily in the benthic zone of the lake. These fish inhabit deep water but were also identified within the water column as much as 12 m off the bottom. Pygmy whitefish were captured in anoxic conditions (0.3 mg L^{-1}) but are presumed to rarely frequent these areas. These fish were found in cooler water as they were rarely observed in waters above 9° C. Their main food source is zooplankton, focussing on cyclopoida during early summer and then shifting to *Daphnia* in the fall. No young-of-the-year fish were captured. The oldest male was aged at 4^+ while the oldest female was aged at 7^+. Females were larger than the males for each age group. The largest male measured 104 mm while the largest female observed was 130 mm in length. The age of maturity for males was 1^+ while the females reached maturity a year later (2^+). Spawning is presumed to be in late November or December but has not been verified. Egg diameters in October ranged from 1.3 to 1.8 mm. The estimated female egg numbers ranged from 435 to 1012. Pygmy whitefish in Dina Lake #1 do contain one form of parasite within the stomach cavity *(Digenean* trematodes). The external morphology of this species was briefly examined. The Dina Lake #1 population had either 8 or 9 dorsal rays while most major references give a much wider range (10 - 13) dorsal rays. We do not know if this lower dorsal ray count is specific to this lake. The population of pygmy whitefish in Dina Lake #1 appears to be doing well but their abundance is unknown. Further studies are planned to gather additional information on their life history and habitat preferences in 2001.

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INTRODUCTION

Dina Lake #1 (further referred to as Dina #1) is the largest in a chain of ten lakes. Over the past 17 years, the lake has received considerable attention from fish biologists with both the Ministry of Environment, Lands and Parks (MELP) and the Peace/Williston Fish and Wildlife Compensation Program (PWFWCP). The lake contains both indigenous and introduced fish. Native species in the lake are lake chub *(Couesius plumbeus)* and longnose suckers *(Catostomus catostomus).* Brook trout *(Salvelinus fontinalis)* have been stocked sporadically in Dina #1 since 1980 and rainbow trout *(Oncorhynchus mykiss)* have been stocked annually since 1987.

A standard fisheries baseline reconnaissance level survey of Dina #1 was conducted by the Water Management Branch in 1983 (Grant 1983). The lake was surveyed again by the PWFWCP in June 1991 (McLean 1991) in an attempt to identify potential fisheries enhancement projects, and to determine if changes to the stocking program were required. Then in February 1992, BC Environment developed a Fisheries Management Plan for the Dina Lakes chain (Jesson 1992).

In 1998, as part of a stock assessment program for the Omineca Region, Dina #1 was designated a high priority for a stocking evaluation. To evaluate the existing fish stocking program, PWFWCP fish biologists investigated Dina #1 in July and October 1998. The rainbow trout population was considered adequate but brook trout abundance was low (Zemlak 1999). It was recommended that stocking of rainbow trout should continue but the stocking of brook trout should cease. It was not clear why brook trout did poorly in the lake; however, in mid-October 1998, one last attempt to find brook trout uncovered a hitherto unrecorded species in the lake. An overnight gill net set perpendicular to the shore captured 80 female pygmy whitefish *(Prosopium coulteri).*

How previous (pre-1998) studies on Dina #1 missed this species is a mystery. However, most of the past netting effort was in shallow inshore water during the summer and, if pygmy whitefish occupy deep water, they may have been out of range of the experimental nets. Also, the mesh size of gill nets used to capture juvenile and adult trout was probably too large to effectively sample small fish like the pygmy whitefish. One single whitefish was previously captured in 1991, but it was not properly identified.

Pygmy whitefish are a species of special management concern for the PWFWCP — it is a regionally important species (Omineca/Peace) under the Forest Practices Code, and is designated as an isolated species. Their distribution and status within the Williston Watershed is currently unknown and only limited information is available about their life history and habitat use. Since the PWFWCP has a scientific and ethical responsibility to ensure that fish species do not go extinct within the Williston Watershed, studies on this species are of interest to the PWFWCP. Pygmy whitefish were found in the stomachs of large trout (up to 2.5 kg) captured in 1998. Thus, it is possible that pygmy whitefish are an important link in the food chain that supports the adult rainbow trout and the few remaining brook trout in Dina #1.

It is not known if the introductions of exotic species (brook and rainbow trout) into Dina #1 have adversely affected the pygmy whitefish population. A study conducted by the Washington Department of Fish and Wildlife, however, found that pygmy whitefish populations are declining in many Washington lakes (R2 Resource Consultants 1995). In most cases, these declines have been attributed to introductions of exotic predatory fish. Consequently, the PWFWCP launched a study on Dina #1 that had two main objectives: 1) to ensure that the pygmy whitefish population in Dina #1 was thriving, and 2) to learn more about the life history and habitat use of this species at all of its life stages. This biological information will then be used at a later date to determine the species' distribution and status within the entire Williston Watershed.

The pygmy whitefish is a puzzling little fish and not much is known about either its biology or its interactions with other species. It is mainly a western North American species; however, scattered, isolated populations occur in Great Bear Lake, Lake Athabasca, Waterton Lake, Lake Superior, and lakes on the Chukotsk Peninsula in Siberia. In western North America, it occurs from Washington and Montana north through BC to the Yukon and Alaska (Figure 1). At the southern end of its distribution, this fish inhabits deep lakes and cold, glacial streams (it was first described from the Kicking Horse River). Except in the Rocky Mountains, the southern (Columbia drainage) populations are all lacustrine, widely scattered, and isolated from one another. They are thought to be glacial relicts (Weisel et al. 1973). This same scattered lacustrine distribution occurs in most of central B.C.; however, in the Peace system before construction of the W. A. C. Bennett Dam and the ponding of Williston Reservoir, there were fluvial populations in the Parsnip, upper Peace and, probably, the Finlay rivers (UBC Fish Museum records). Presumably, there was gene flow among these upper Peace fluvial populations. Nothing is known about pre-impoundment lacustrine populations but, like their southern counterparts, the populations were probably scattered and isolated from one another.

The importance of this isolation, especially in lakes like Dina #1, is that local adaptation (i.e., genetic fine-tuning to local conditions) proceeds more rapidly in isolated populations than in populations open to gene flow from other populations. With only two other native species (lake chub and longnose suckers) the pygmy whitefish in Dina #1 originally existed in an unusual environment — no piscivorous fish and, potentially, little direct competition.

Study Area

Dina #1 is 25 km north-northwest of Mackenzie B.C. (Figure 2). It is a closed lake system (there is no surface outlet) with one permanent inlet (from Dina Lake #2). This inlet has a non-game fish barrier which is located about 4 m upstream from Dina #1. The barrier was installed to prevent longnose suckers from accessing enhanced trout spawning

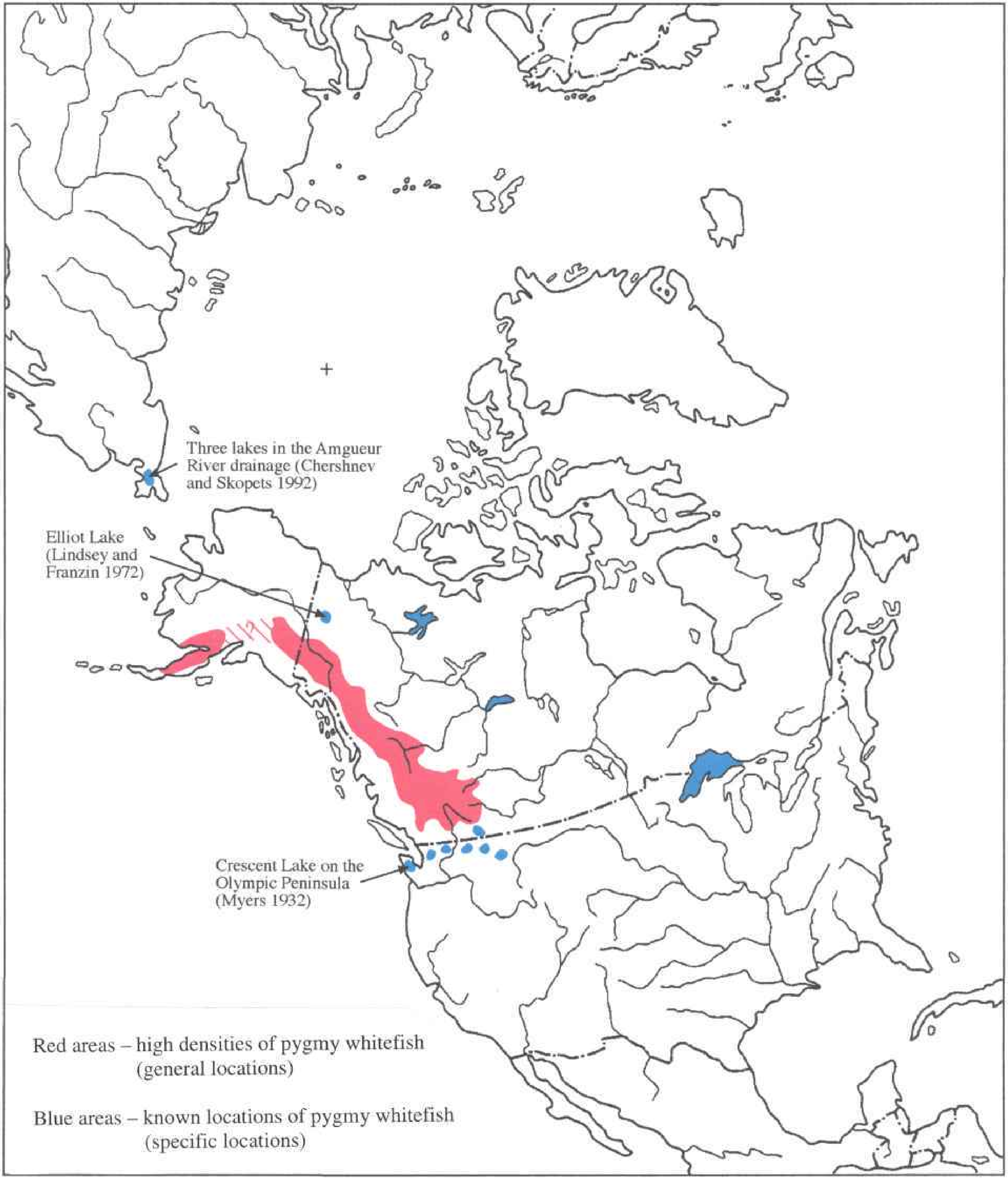


Figure 1.- Distribution of the Pygmy whitefish, *Prosopium coulteri*.

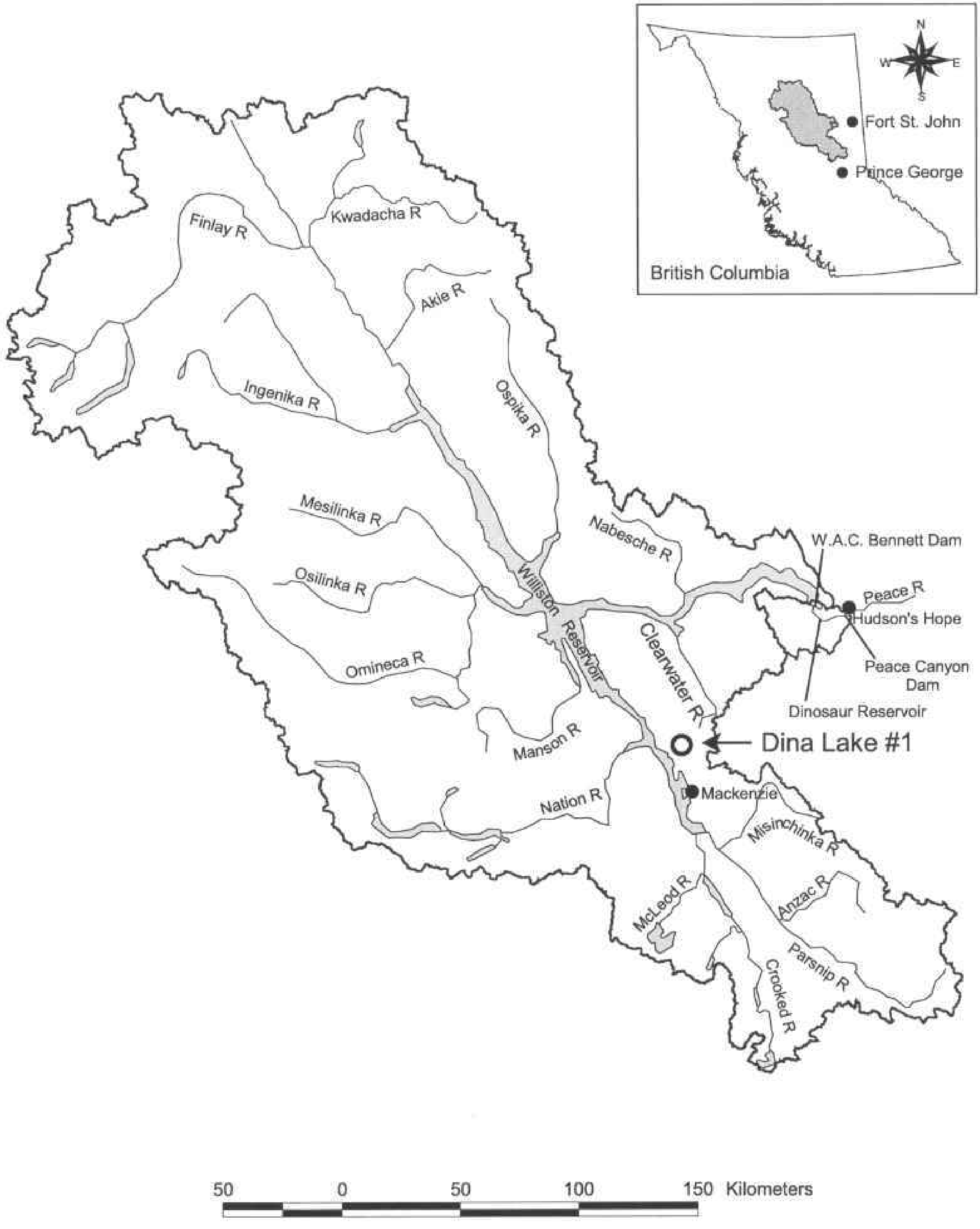


Figure 2. Location of Dina Lake #1.

habitat upstream. Dina #1 has a surface area of 158.3 ha and a complex shoreline containing two major basins (Figure 3) separated by a 5 m sill. Our sampling was confined to only the northern basin except for a one time Gee trapping attempt (May trip) and a one time gill net set (June trip) made in the southern basin to confirm the presence of pygmy whitefish in this particular basin.

At the start of the project it was not clear how abundant pygmy whitefish were in Dina #1. Consequently, we retained the southern basin as a recolonization source in the event that our sampling adversely depleted the population in the northern basin. Over the course of the sampling period we conducted five trips from May to October.

The northern basin consists of a large deep (27 m) central basin and two smaller, shallower sub-basins (the eastern and western sub-basins). The two sub-basins differ in their degree of isolation from the main basin. The east basin is connected to the main basin by a relatively deep (about 5 m) sill. The maximum depth of the east basin is about 9 metres. In contrast, the western basin is separated from the main basin by a shallow sill (about 3 m) but contains a deep (about 14 m) central region. Thus, when the main basin is strongly stratified, the sill connecting the western sub-basin to the main basin is above the metalimnion. Consequently, at times the western sub-basin is limnologically isolated from the main basin. In contrast, the eastern sub-basin limnologically remains part of the main basin.

METHODS

Lake and Creek Water Temperature

Little is known about water temperature constraints on the distribution of pygmy whitefish within a lake. To gain insights into how temperature influences habitat use by pygmy whitefish, "Stowaway" water temperature recorders were placed in the lake. These units were set to record water temperature every two hours. This data was then converted to present the daily mean temperatures throughout the study period.

The units were installed in the location where the pygmy whitefish were originally discovered in the lake during the 1998 fish stocking assessment. Five units were placed at the following depths: 1, 5, 10, 15, and 20 m. Another unit was also placed in the only inlet stream to Dina #l.

Oxygen/Temperature Profiles

Oxygen and temperature readings were collected in the northern basin at the start of each one-week field trip. The bathymetry of Dina #1 and a depth sounder allowed us to locate and repeatedly sample the deepest part of the northern basin. Two additional limnological stations were established — one each in the western and eastern sub-basins.

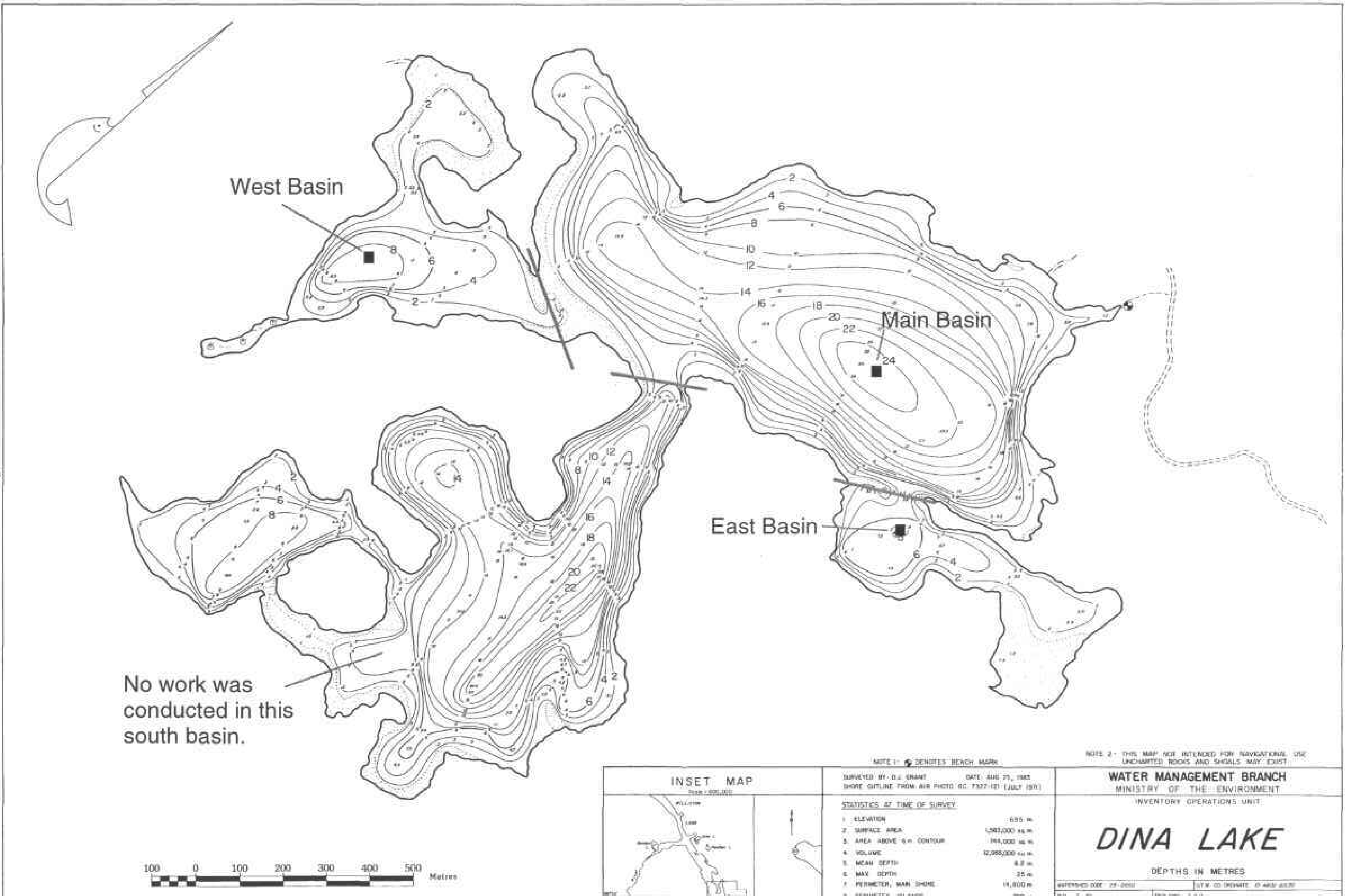


Figure 3. Location of sampling basins.

A fourth station, on the sill between the northern and southern basins, was sampled periodically.

A YSI model 58 oxygen/temperature meter was used to collect the data. Readings were taken at 1 m intervals from the surface to the bottom. These data provided information throughout the study period on the state and depth of the metalimnion, and on oxygen levels at different depths. This information was also used to examine the influence of water column temperatures and oxygen levels on the depth distribution of pygmy whitefish.

Fish Capture Techniques

At the beginning of the study, we knew that monofilament gill nets would capture adult pygmy whitefish but we did not know how to sample young-of-the-year or juveniles. Consequently, we tried five different fish capture techniques: Gee traps, pole seining, beach seining, a zooplankton net, and small (< 25 mm stretch mesh) gill nets. The first four techniques were attempts to capture young-of-the-year and juveniles while the gill nets focussed more on capturing larger sized fish. Any other fish species captured were simply enumerated and released back into the lake.

A range of sinking stretch mesh sizes (14, 19, 25, and 32 mm) were used to sample pygmy whitefish. Each gill net panel was 15.24 m long and 2.4 m deep. Most of the netting efforts focused on setting the gill nets horizontally along the bottom at a variety of different depths. To increase sampling efficiency, some panels (14 and 25 mm) were joined and fished together. A few times, nets were set in a vertical fashion (fishing up in the water column from surface to the bottom). The capture depth and size of panel for each fish caught was then recorded.

To limit the number of mortalities, the nets were generally set for a short time (< 2 hours). However, some nets were set overnight to learn more about the fishes movement patterns within the lake during a 24 hour period and also to learn about seasonal movements. The number of hours each net panel fished and the catch were recorded after each set. Any live fish captured were then released back into the lake.

Biological Information

Growth data

Pygmy whitefish (mortalities) were measured for fork length (mm) and weight (taken to the nearest tenth of a gram). The fish were examined for sex and maturity level. Scales were collected for age determination and growth studies. Most scales were taken from an area above the lateral line and just posterior to the dorsal fin. Since pygmy whitefish are susceptible to scale loss in gill nets, occasionally it was necessary to take the scales from other sites. Because scales tend to underestimate age in older fish, otoliths were also collected and stored in a glycerin/distilled water solution. North/South Consultants (Winnipeg, Manitoba) analysed both the scales and otoliths.

Diet data

The food preferences of pygmy whitefish were examined. In addition to understanding what these fish were consuming, we hoped to learn more about the habitat use of these fish based on the food species they ate the most (i.e. chironomids are benthic oriented, *Daphnia* are limnetic oriented). The entire stomachs of a subsample of pygmy whitefish were removed in the field and preserved in 70% ethanol for later analysis by Mike Stamford (Zoology Department, UBC). A detailed explanation of the methodology and results of the stomach contents is presented in "Dina Lake #1 pygmy whitefish *(Prosopium coulteri)* study, stomach contents analysis, 2000".

Fecundity

The entire skein (including eggs) of a subset of gravid females were collected in late October just prior to spawning in order to determine the relationship between body size and fecundity. Each skein was weighed and the diameters of the eggs were recorded. In the lab, the volume displacement of 100 eggs from each female was measured. Displacement was measured in a 5 ml graduated cylinder. The remaining eggs were separated from the ovarian tissue and their volume displacement measured. The total egg number was calculated by extrapolation from the volume of 100 eggs. The testes of a subset of males were also weighed in the field.

Condition factor

Mean lengths and weights were calculated for each age class, and condition factors (weight (g)/length(cm)^3 x 100) were determined for each fish and for each age class. The condition factor reflects the nutritional state or "well-being" of an individual fish. Condition factor values over 1.0 indicate a robust fish and one that is generally healthy.

Other observations

General appearance of the fish was determined visually. The fish were examined for disease and parasite presence. Photos of pygmy whitefish (on file) were also taken in the field.

Echo Sounding

Since Dina #1 is relatively large, and contains only five fish species, we tried echo sounding with the expectation that it would provide information on diel movements of pygmy whitefish. This technique actively transmits sound and information is extracted from the returning echoes. Two different types of ultrasonic depth sounders were used: a Furuno Model FG-11/200 MARK 3 and a Lowrance Model X-15. Both of these units were designed to determine the distance between the transducer and underwater objects such as fish and show the results on a graph recorder. During the June and July trip, the Furuno model was used. Three separate transects were conducted during both the afternoon and at night. The time of each transect was recorded along with each offset. From the sparse literature on pygmy whitefish, it appeared likely that this fish might make foraging migrations into the upper water column at night. If schools could be detected, then this information would provide data on diel movements and help with targeting gill net sites.

The Furuno sounder did not provide sufficient image detail to be certain of fish movements. Consequently, we switched to the Lowrance sounder for the October trip. On this trip ten different daytime transects were made. Unfortunately, weather conditions (heavy snow and wind) made night transects impractical.

RESULTS

Lake and Creek Water Temperature

On May 23, 2000, six Stowaway units were installed (Appendix 1) to record the water temperatures at five different lake depths and the creek temperature. During the July trip, we noticed that one of the lines to a unit in the lake was missing and, at the end of the study, we found that the 20 m depth unit was gone. Perhaps the line was snagged by an angler who decided to keep the entire line and the Stowaway unit. The remaining four units were retrieved on October 27, 2000 and the data downloaded. Daily mean temperatures were calculated and graphed for each unit (Appendix 2). The Stowaway unit in the inlet creek was also retrieved on October 27, 2000 and the downloaded data graphed along with the lake temperatures (Figure 4).

Temperature in the inlet creek and on the lake surface (1 and 5 m) peaked in early August and steadily declined over the rest of the study period. Interestingly, the temperature at 10 m did not peak until a month later (early September) and at 15 m the temperature peak occurred in mid-October. These time lags reflect the strength and persistence of the metalimnion in Dina #1.

Oxygen/Temperature Profiles

The habitat use of pygmy whitefish has not been well documented (McPhail and Lindsey 1970). It was anticipated that recording the lake's oxygen and temperature for each trip's sample location would be beneficial. This information would then be used in conjunction with the fish catch results in order to interpret habitat preferences for pygmy whitefish. Four different stations were used as index sites (Appendix 3).

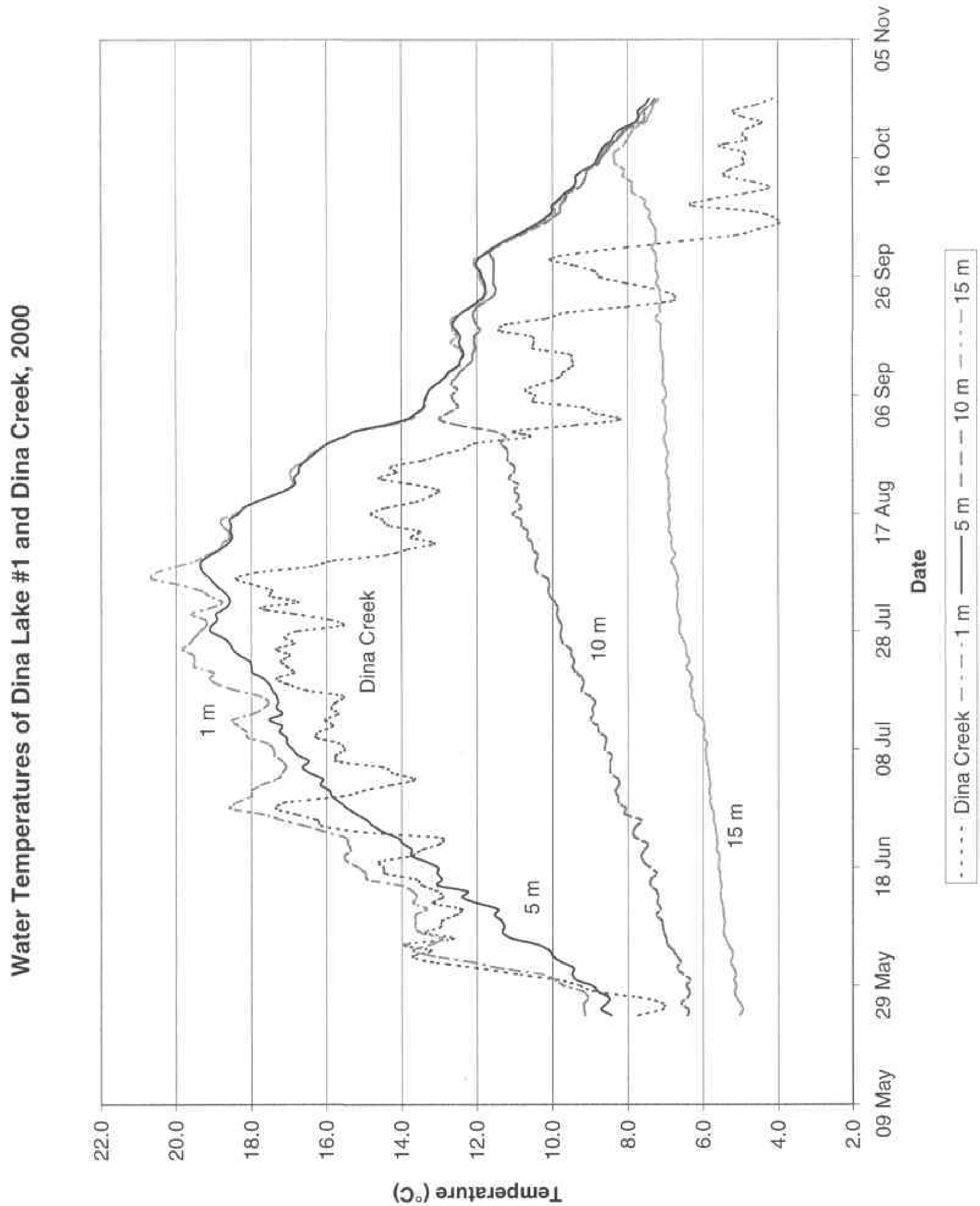


Figure 4. Mean lake and creek water temperatures from May 24 to October 26, 2000.

Oxygen/temperature profiles were created for all of these index sites (Appendix 4). During May and June, only one station was sampled (main basin). In July, all four stations were sampled. In September and October, readings from three of the four basin stations were taken.

Dina #1 appears to form a metalimnion somewhere before late May and then it starts to break down in late October. Although no readings were taken after October, Dina #1 is assumed to experience destratification during the winter. It was noted that ice cover developed on Dina #1 during mid November of 2000. Ice cover usually disappears around the first week of May. This lake does experience a gradual lowering of the metalimnion in late summer. When readings from the main basin were compared (deepest location), the metalimnion was much higher in the water column in May as compared to the readings in October. In May, the metalimnion appears to develop around the 7 to 8 m depth while in October, the metalimnion was much lower at 19 m in depth.

The oxygen levels in Dina #1 appear to be adequate for fish in May. As the lake temperature warms up during the summer, the oxygen levels decrease with depth. Almost no oxygen was present at the 22 m depth in July. By September, and continuing into October, the anoxic layer elevated to around the 18m depth. It is unknown what anoxic conditions are for pygmy whitefish, but the lower lethal oxygen concentrations for lake whitefish have been recorded at 4.25 mg L^{-1} (Ford et al. 1995). In September, this lower lethal level was reached at about the 14 m depth.

Gee Traps

Gee traps were used to capture pygmy whitefish, primarily for young-of-the-year fish (Appendix 5 and 6). The traps were used during four of the five field sampling periods (excluding September). In May, all of Dina #1 was sampled (both north and south basins). During the remaining field trips, only the main (north) basin was sampled. Sampling effort for the entire summer was relatively intense with a total of 50 traps fishing for approximately 1,295 hours. Traps were set throughout the daytime and nighttime. Approximately 80% of the traps were set on the bottom while the remaining 20 % were suspended throughout the water column. No pygmy whitefish of any age category were captured, only lake chub and a few longnose suckers were captured. The additional use of Light Sticks or live pygmy whitefish did not entice other pygmy whitefish into the Gee traps. Consequently, the biology and habitat use of young-of-the-year pygmy whitefish remains a mystery.

Seining

Seine nets were used to try and capture young-of-the-year pygmy whitefish. A pole seine was used first. Many shoreline areas were examined but were quite difficult to sample. The shoreline of Dina #1 contains numerous trees, many of which have fallen into the lake. In addition, the lakeshore drops off rapidly. As a result, only about 10 sites that were less than 1.5 m deep could be worked with a pole seine (in and outside of the boat). No pygmy whitefish were captured. A beach seine was also used in two shallow, sandy areas of Dina #1. Small young-of-the-year lake chub were captured but no pygmy whitefish.

Zooplankton Net

The zooplankton net, which had a 0.5 m opening, also was an ineffective technique in capturing young-of-the-year pygmy whitefish. The net was towed behind the boat for about 250 m (approximately 3 m below the surface). The net was also dropped a few times to the bottom of the lake (about 25 m deep) and then hauled up to the surface. In all cases, the zooplankton net captured no fish.

Gill Nets

Gill nets were the most effective sampling technique for capturing juvenile and adult pygmy whitefish (Appendix 7 and 8). Throughout this study, 41 net sets were conducted which captured 360 pygmy whitefish, of which 322 were sampled (Appendix 9). The remaining 38 fish were either released alive, too decomposed to sample, or were kept alive to place in a Gee trap to try and lure other pygmy whitefish into the trap. One netting attempt was conducted in the main southern basin (outside of the study area) to verify their presence in this other large basin. Pygmy whitefish were captured and do inhabit this southern basin.

The majority of the net sets (32) were set on the bottom of the lake. Initially, it was thought that pygmy whitefish generally inhabit the deeper part of the lake. In addition, there was less of a chance of unnecessarily killing lake chub, which could be observed near the surface during summer. The bottom netting efforts yielded anywhere from zero pygmy whitefish to 60 pygmy whitefish in a single netting effort.

During the October trip, some of the nets (8) were set vertically in the water column. The main intention here was two fold: 1) there was less likelihood of capturing high numbers of fish (i.e. 60 at a time), and 2) to understand more of the depth distribution (habitat preferences) of these fish. During September, minimal effort was used to actually try and capture the fish. More effort was put on the actual technique itself. In October, two of the vertical nets captured 17 pygmy whitefish (both in the 25 mm panel). The 14 mm vertical net did not capture any pygmy whitefish. The majority of these fish (10) were captured near the bottom (< 2 m), 3 fish were located 6 m from the bottom, 3 fish were 7 m from the bottom, and 1 fish was 12 m from the bottom.

Only one net set was deployed at the surface of the lake. In October, the field crew observed some sort of fish activity at the surface during the day. This type of activity is not known for species like lake chub and longnose suckers. It was possible this activity could be some prespawning habit for pygmy whitefish. A 14 mm panel was set at the surface to fish overnight. The next morning, the net was pulled and captured no fish. No further netting efforts were conducted at the surface.

Horizontal and Vertical Fish Distribution

Our June gill net samples (Appendices 7 and 8) indicate that pygmy were distributed throughout the main northern basin and both associated sub-basins. They are absent, however, from the shallow bays that connect to each of the sub-basins. Within the main basin, 98% of the fish (89 fish; Catch Per Unit Effort (CPUE) = 1.03) were collected in bottom nets set at 8 to 20 m. Thus, most of the fish were taken below the metalimnion (Appendix 4) in water temperatures ranging from 5 to 9° C and oxygen levels of about 4 to 10.5 mg L^{-1}. Six fish were collected one time in an overnight set made at 26 m. Here, the temperature was 5° C but the oxygen level was less than 3 mg L^{-1}. It is unlikely that pygmy whitefish live permanently at such low oxygen levels.

Fifteen whitefish were collected in the western sub-basin (7 in an overnight set and 8 in a 3 hour afternoon set). Two sets were made in the eastern sub-basin: an overnight set at 8.5 m and a 2.5 hour set at 4.5 m. The shallow set caught nothing but the deeper set caught 52 whitefish. Interestingly, this was the second largest catch made over the entire study period, and all of the fish measured from this set were juveniles (1^+).

In July, the nets were set at various time frames to determine what time of the day pygmy whitefish are most active. A typical day was broken down into: morning time (about 5 A.M. to 9 A.M.), daytime (about 10 A.M. to 3 P.M.), nighttime (about 5 P.M. to 9 P.M.), and overnight (9:30 P.M. to 5 A.M.). We found the majority of pygmy whitefish were captured during the overnight net sets. The daytime nets were the second most active time followed by the evening sets. Finally, the morning net sets were the least active time in capturing pygmy whitefish.

By late July, the surface temperature had reached 19.7° C and the surface oxygen level was 9.5 mg L^{-1}. The metalimnion started at 9 m and, during the day, there was a distinct oxygen pulse (13 mg L^{-1} at 9 m). Relatively few fish (16 fish; CPUE 0.64) were collected in the main basin in July but of these 12 (75%) were collected below the metalimnion at a depth of 16 m (6° C and about 6.5 mg L^{-1}). Again, some (4) fish appeared to be making forays into oxygen depleted waters (< 3 mg L^{-1}). In the western sub-basin, however, fish were more abundant (40 fish; CPUE 1.62) than in the main basin. Nets in the western sub-basin were set at 14 m. Here, the metalimnion started at 7 m (17° C) and reached 9° C at 12 m. Again, there was a distinct oxygen pulse (an increase of about 3 mg L^{-1}) at the metalimnion. All of the fish were taken below the metalimnion but by 11 m the oxygen level had dropped to 3 mg L^{-1} and was < 1 mg L^{-1} at 12 m.

By September 21, the surface temperature in the main basin had dropped to about 11.7° C and the oxygen level was at 9 mg L^{-1}. The metalimnion was less sharp (11.5° C at 11m and about 8° C at 14 m) than in late-July. The oxygen level at the start of the metalimnion was similar to that at the surface but began dropping sharply at 13 m (6.6 mg L^{-1}) and was undetectable by 18 m. The primary purpose of the September trip was to test the feasibility of setting net panels vertically in the water column. The vertical panels were fished for a total of 8 hours and 35 minutes. No pygmy whitefish were caught. However, standard horizontal sets were made in both the east and west sub-basins. The net in the western sub-basin was at 10 to 13 m and produced 5 fish. The net set in the eastern sub-basin was a 19 mm mesh. We used this in-between mesh size to check whether our standard mesh sizes (14 and 25 mm) were missing some in-between size class. The set was in 9.2 m and produced the largest single catch (60) made over the entire study period. Fifty-one fish were measured, weighed, and sexed (12 males and 39 females). Of these fish, 11 were released alive. All fish of both sexes were mature and approaching spawning condition.

The metalimnion in the main basin had weakened and narrowed to about 2 m by the October trip. Also, it had moved down to about 18 m. Temperature and oxygen conditions above the metalimnion were good but the entire hypolimnion was virtually without oxygen. In contrast, oxygen conditions in the eastern and western sub-basins were good (about 9 mg L^{-1}) throughout the water column.

We concentrated our October 2000 sampling in the same area as where 80 gravid females were first captured in October 1998. Our goals were 1) to determine if, as pygmy whitefish approached reproductive condition, the sexes were segregated, and 2) to determine if, at this season, the fish move onshore after dark. We made three shallow water net sets (1.5 to 4.1 m) at this site. The first two sets used 14 and 25 mm and were fished between 10:30 and 16:45. They were checked at approximately 3 hour intervals and captured no fish before they were pulled by 16:45. The 19 mm net was set at 17:00 and left over night. It caught 43 pygmy whitefish (28 were sexed: 12 females and 16 males). Most of the fish from this set were badly decomposed by morning (10:30). It appears that these fish probably entered the net early on the previous night. Thus, we reset the net and checked it periodically throughout the day. No fish were caught before dark (about 18:15). The net was left in until after dark and by 21:30 there were 14 whitefish in the net (six of them still alive). These results suggest that pygmy whitefish migrate towards shore at the onset of darkness. It is unknown if there is this same migration pattern happening during the spring and summer.

Net sets were made in other parts of the main basin and in the eastern and western sub-basins during the October trip. Fourteen and 25 mm nets were suspended vertically in the western sub-basin and fished for 24 hours (10:55 overnight to 10:50). The nets were checked every 2.5 hours and caught no fish up to 14:00. When checked again at 16:20 there were 3 pygmy whitefish within 20 cm of the lead-line in the 25 mm net and nothing in the 14 mm net. Next morning there were 5 more pygmy whitefish in the 25 mm net and none in the 14 mm net. One fish in the 25 mm net was 7 m from the bottom and the other 4 were 1.5 m from the bottom.

A combined 14 and 25 mm net set for 4 hours in the eastern sub-basin caught 4 fish. A 25 mm panel suspended vertically at depths ranging from 16 to 23 m (this net was moved short distances several times over a 48 hour period) and caught 9 pygmy whitefish at varying distances from the bottom. One fish was 12 m above the bottom, 2 were 7 m, 3 were 6 m, 2 were 1.5 to 2 m, and 1 was 1 m above the bottom. Although the catches were not large, they indicate that with more effort vertically suspended nets could provide information on diel movements in Dina #1.

Diel Activity Patterns

On occasion we set nets over a 24 hour period and checked them for catch at 4 to 8 hour intervals. Most of these sets did not catch enough fish to produce a clear picture of diel activity. One exception was a series of sets in the western sub-basin in late July. The data are plotted (Figure 5) on the mid-point of the set (i.e., the catch of a 6 hour set from 11:00 to 17:00 is plotted at 14:30). This figure shows the diel distribution of the total catch (40 fish) over the 24 hour period. There is a clear mid-day peak (around 14:00), a trough in the catch between 18:00 and 22:00, and a lesser peak between 22:00 and 05:30, followed by no catch from 05:30 to 09:00. Assuming that catch is related to fish activity, this graph suggests two activity peaks — one in early afternoon, and another at about midnight.

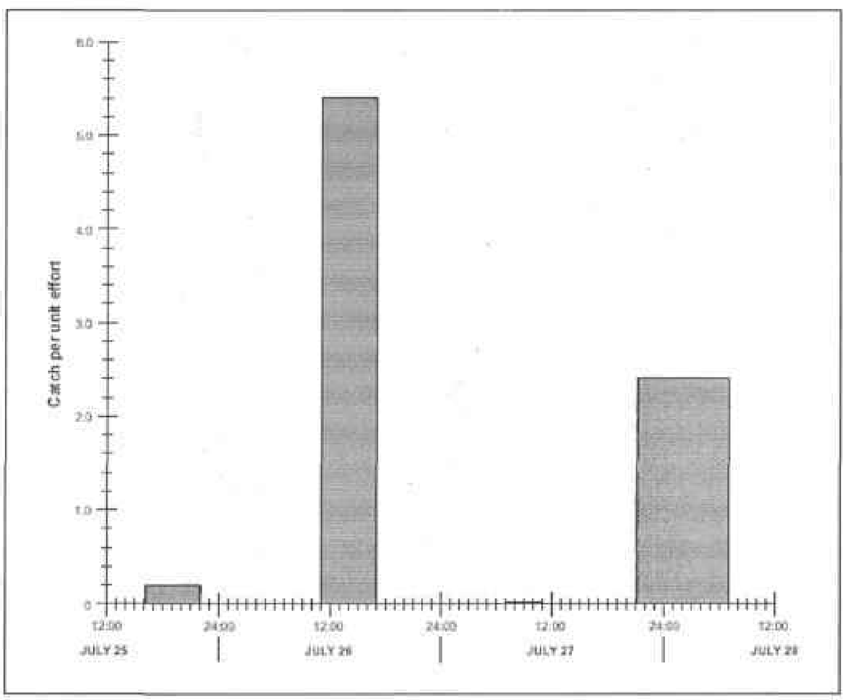


Figure 5. Diel distribution of 40 pygmy whitefish captured over a 24 hour period.

Diel Depth Shifts

Echo soundings

Our echo traces (Appendix 10) provided no concrete evidence of diel shifts in depth by pygmy whitefish. Relatively few clear fish echoes (inverted Vs) appear on the traces and most of these were in shallow water and strongly associated with the bottom. They probably represent echoes from longnose suckers. Occasional strong echoes occurred in mid-water and these were thought to represent trout. Since pygmy whitefish were by far the most abundant species in our gill net catches, the absence of concentrations of echoes is odd. During day transects, we did get peculiar echoes right on the bottom but if they were fish they were sitting tight in the oxygen depleted zone. Once the metalimnion formed, there was a clear echo on the night transects associated with the metalimnion. This echo was a diffuse scattering layer rather than specific echoes and was interpreted as a plankton concentration. The oxygen pulse during the day suggests a phytoplankton concentration. Thus, the nocturnal scattering layer may represent a diel zooplankton migration into the layer at night.

If young-of-the-year and juvenile pygmy whitefish school, we expected to detect them associated with this scattering layer. It is possible that they are there and that the echo they produce simply is masked by the generally diffuse echo associated with the metalimnion. The swim bladders on these pygmy whitefish are very small and probably produce a very small echo. Perhaps another capture technique like trawling (tow-netting) through this layer will produce some answer to this mystery.

Gill net sets

Most of the gill net sets gave no unequivocal evidence of pygmy whitefish changing their depth distribution over a 24 hour period. In retrospect, there are two reasons for the absence of a clear pattern of diel depth shifts. First, most of our sets (32 out of 41) were bottom sets and probably did not provide enough vertical distance to detect such shifts in movement. Secondly, once the metalimnion developed and the hypolimnion began to stagnate, there was only the limited depth between the anoxic layer and the metalimnion over which the fish could move. This theory assumes that the anoxic layer and the warm water above the metalimnion are barriers to pygmy whitefish movement throughout the lake.

Later in the study we experimented with vertical net sets. These sometimes fished from the surface to the bottom and, although we did not catch enough fish to produce a quantitative result, the fish we caught in the vertical sets were sometimes 12 m off the bottom. This hints at vertical movements and suggests that with appropriately systematic sets this technique will provide answers to the question of seasonal shifts in depth distribution of pygmy whitefish.

Biological Data

Length-frequency

Length-frequency charts were created for each sampling trip (Figure 6). This alternate method of age determination suggests that peaks in size-frequency distribution plots represents the modes of year classes. Fish hatched in the same year tend to be in the same size range, with most fish being close to an average size. Each bin is represented by a 5 mm change in length. This bin size was arbitrarily chosen as it was felt that these size groupings would identify fish of common age classes, and with minimal overlap.

Distinct modes of year classes can only be observed for the June data (Figure 6). Here, there appears to be three distinct modes present. The July data had a few smaller modes present. In September and October, there were two even smaller peaks. Overall, no obvious age classes (cohorts) could be identified with this length-frequency data. Fish populations generally have a larger sample size of smaller fish as compared to the larger sized fish. Our Dina #1 samples generally contained more of the larger sized fish. The size classes of smaller fish (60 to 90 FL mm) were not captured in the later sampling periods (September or October).

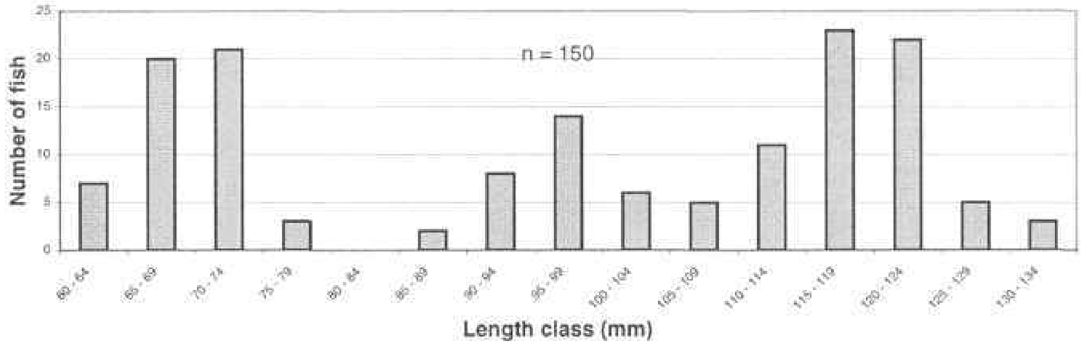
From the fish capture results, only the smaller sized fish were obtained in the early part of the summer (Figure 7). The number of age 1^+ males captured in June were the most of any other sampling period. This previous statement should be used with caution, as the gonads may have been misidentified (observation without the use of a hand lens). The most frequent number of fish captured throughout the study period for both sexes was 2^+ year old fish.

Both male and female pygmy whitefish appear to grow quite rapidly in their first few years of life (Figure 8). The female pygmy whitefish are generally larger than the size of males for each age group. No age 1^+ fish were captured in the October trip.

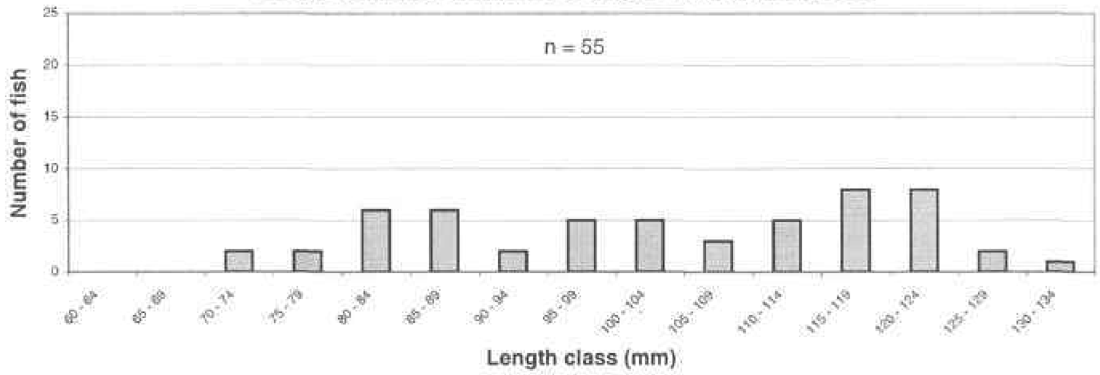
Age

North/South Consultants Inc. (Appendix 9) used both scales and otoliths to age 150 pygmy whitefish. In most cases, both scales and otoliths were available for each fish. Not surprisingly, otoliths sometimes provide older estimated ages than scales. This difference is common in fish and is usually attributed to either a poor scale focus due to reabsorption or to no first year annuli on scales. Only six of our fish had otolith ages lower than the scale age. Still, there is some conflict between the estimated ages and our length-frequency data. This conflict is clearest in the 1^+ age class. In the length-frequency data from our first sample (June 2000), there is no overlap between the 1^+ and older age classes (Figure 6). We were able to follow the growth of the 1999 (1^+) cohort from June through July. Over this time, the fastest growing members of the 1999 cohort appear to be overtaking the slowest growing members of the 1998 (2^+) cohort (Figure 6). The average length increment of the 1^+ age group over the month was approximately 16 mm.

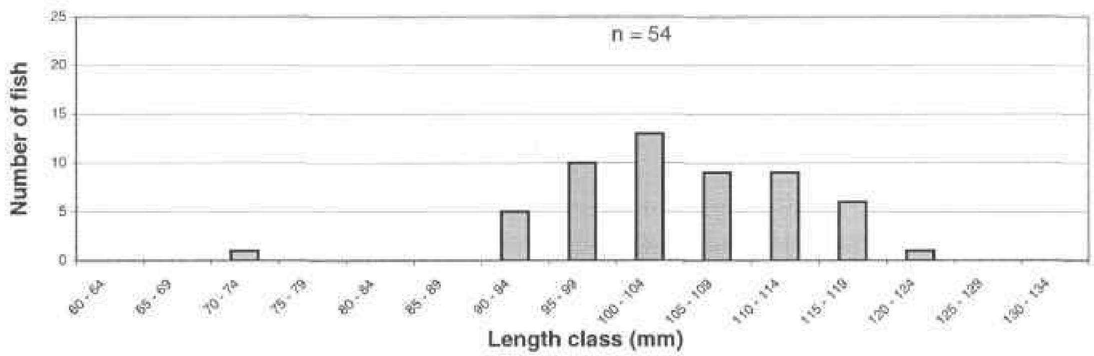
Length frequency distribution of pygmy whitefish, June 2000



Length frequency distribution of pygmy whitefish, July 2000



Length frequency distribution of pygmy whitefish, September 2000



Length frequency distribution of pygmy whitefish, October 2000

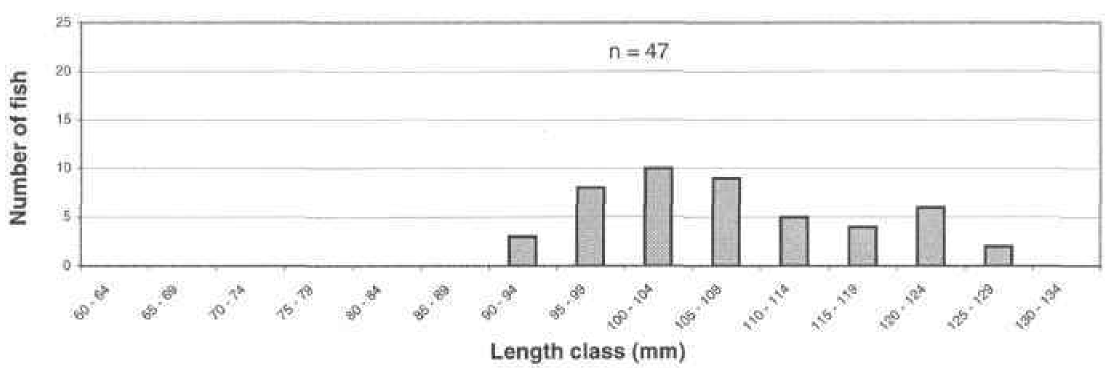


Figure 6. Length frequency comparison of pygmy whitefish by sampling period.

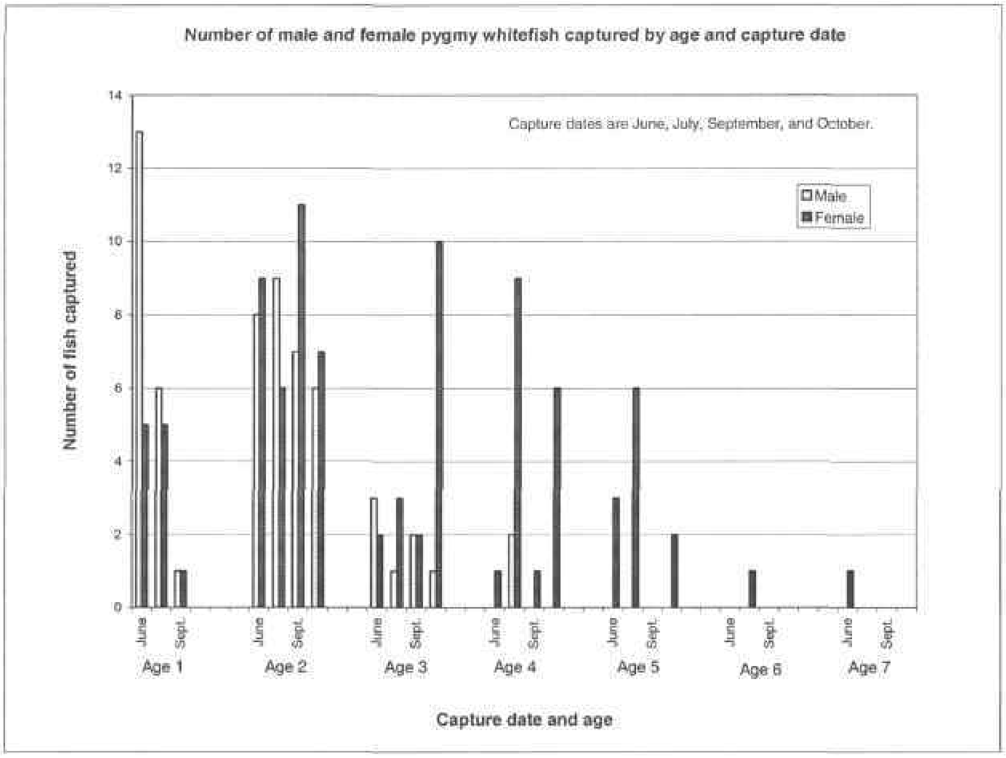


Figure 7. Male and female pygmy whitefish captures by age and date.

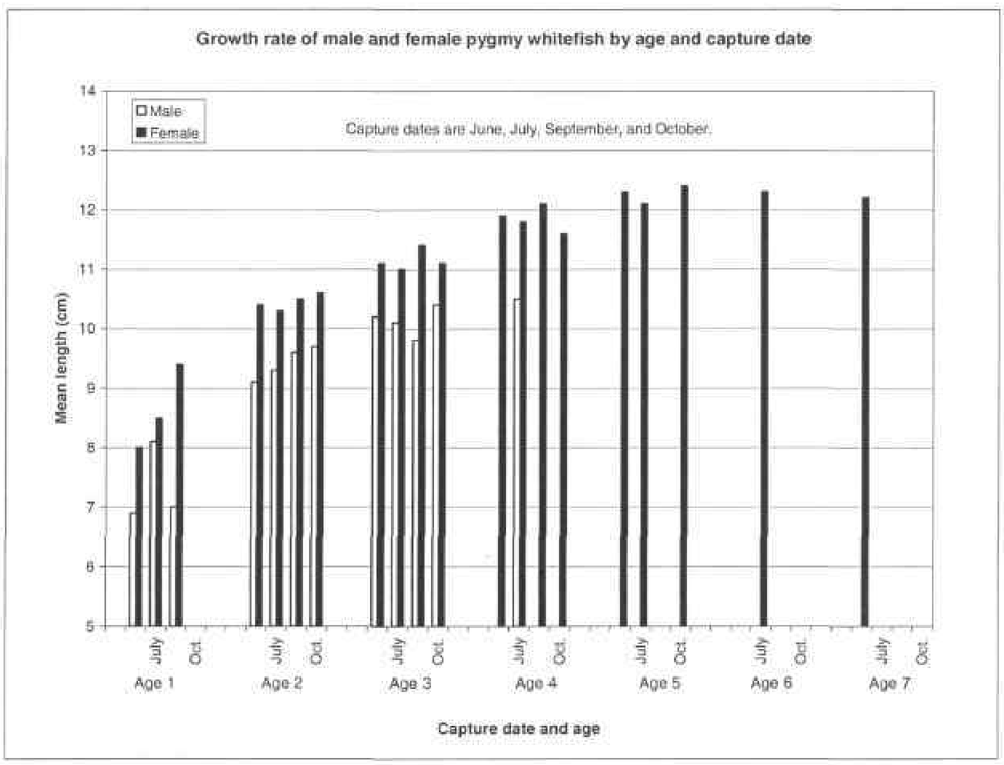


Figure 8. Growth of male and female pygmy whitefish by sampling trip.

In contrast, North/South's age estimates for June indicate a size range of 62 to 95 mm for the 1^+ age class and a range of 65 to 116 mm for the 2^+ age class. Only 38 individuals in this size range were aged (mostly by scales) but the data suggest an almost complete size overlap in June between the 1^+ and 2^+ age classes. On examination of the June age data (Appendix 9) it is clear that the discrepancy between the length-frequency data and the age data is mainly due to a small number of fish (5 individuals; 13% of the sample) that are obvious outliers in the age data. The appearance of a single 0^+ individual (70 mm FL) in September reinforces the interpretation that the discrete group of small fish in the June sample (Figure 6) are juveniles (1^+) originating from the 1999 spawning.

Regardless of the boundaries of the 1999 and 1998 cohorts, it is clear that the pygmy whitefish population in Dina #1 consists of multiple age classes. The oldest individual aged was 7^+ (i.e., in its eighth growing season) but after age 2^+ growth has slowed to the point that it obscures any clear differences among older age classes (Figure 8). Examination of the sizes of fish that would spawn in 2000 (the September and October samples), shows a major size difference between mature males and females (Figure 9). Males are smaller than females; no fish over the length of 104 mm were males. Also, most (75%) of the reproductive males are in their third year of growth (2^+). In contrast, 46% of the reproductive females are 2^+, 32% are 3^+, 19% are 4^+, and 3% are 5^+ or older. It is feasible that most males mature in their third summer of life (2^+) and that relatively few survive to a second (3^+) spawning; whereas, some females probably do not mature until their fourth growing (3^+) and probably survive for several additional spawnings.

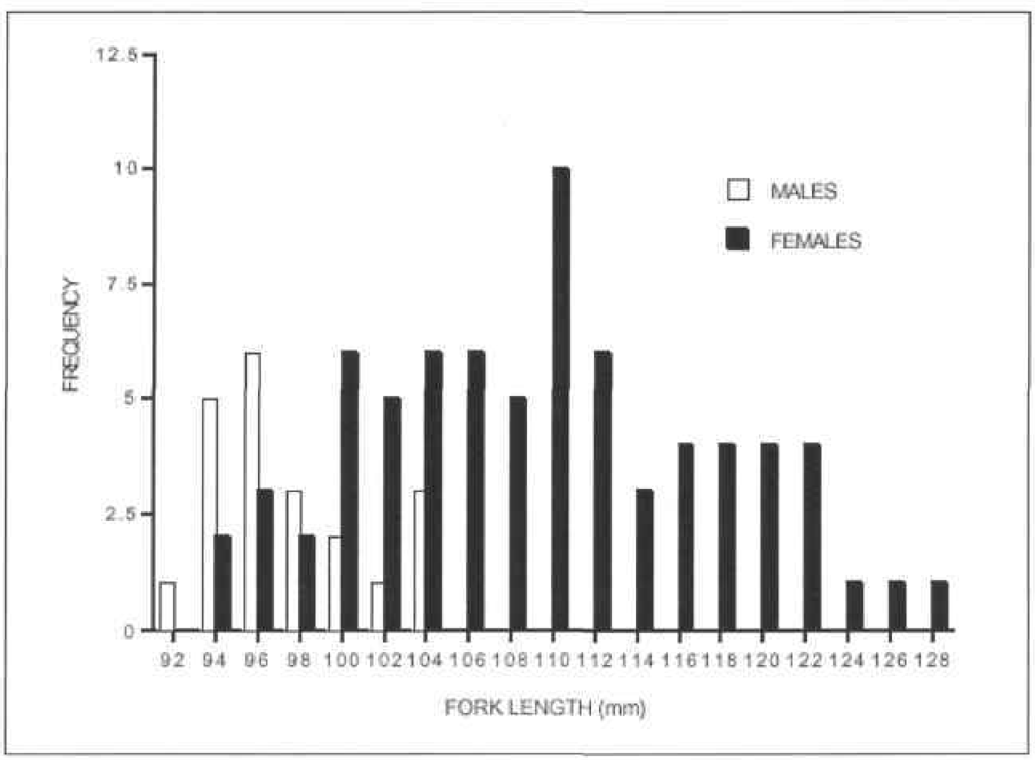


Figure 9. Size comparison of male and female pygmy whitefish captured in Sept/Oct.

Sex ratio

The overall sex ratio in our Dina #1 samples (Table 1) was approximately 2:1 (200 females to 108 males). Each trip consistently captured more females than males, although the smallest size class (1^+) in the June sample trip was difficult to sex. The gonads where very small and were hard to identify without the use of a microscope. Consequently, there probably were some errors in sex designation with the June samples. Later, we used a 10-power hand lens and improved the accuracy of our sex designations for the smaller sized fish.

Table 1. Sex ratio of pygmy whitefish captured in Dina Lake #1, 2000.

Field Trip	Female	Male	Total
June	92	58	150
July	33	18	51
September	43	11	54
October	32	21	53
Total	200	108	308

Length and weight

The majority of pygmy whitefish (322) were sampled for fork length and weight (Figure 10; Appendix 9). Each sampling trip was analysed separately to compare the size of fish between the months. Most fish were captured during the June trip. In addition, the widest range of lengths were obtained during this time span as well. As the summer progressed, the smaller sized fish (60 to 90 mm FL range) were not captured in our gill net sets. Only one of these small sized fish was captured in the fall.

Length at age

Mean lengths and weights by age group were calculated (Tables 2 and 3) for male and female fish. Female pygmy whitefish in Dina #1 appear to live longer than the males. The oldest male was 4^+ years old while the oldest female was 7^+ years old. Overall, the female fish were longer than the males for each age class. Size characteristics of males older than 3^+ and females older than 5^+ should be used with caution as the sample size for these age groups are small.

Table 2. Population characteristics of male pygmy whitefish in Dina Lake #1, 2000.

Age Class	Sample No.	Mean Length[1] (cm)	Range of Length[1] (cm)	SD for Length	Mean Weight[1] (g)	Range of Weight[1] (g)	SD for Weight
1	20	7.3	6.2-9.0	0.87	4.0	2.1-7.2	1.80
2	30	9.4	6.5 - 10.5	0.82	8.3	2.6 - 12.6	1.82
3	7	10.1	9.6 - 10.5	0.30	10.0	7.5 - 11.9	1.64
4	2	10.5	10.3 - 10.6	0.21	11.7	11.1 - 12.2	0.78

[1]Note: the mean and range of measurements represent all of the June to October samples combined.

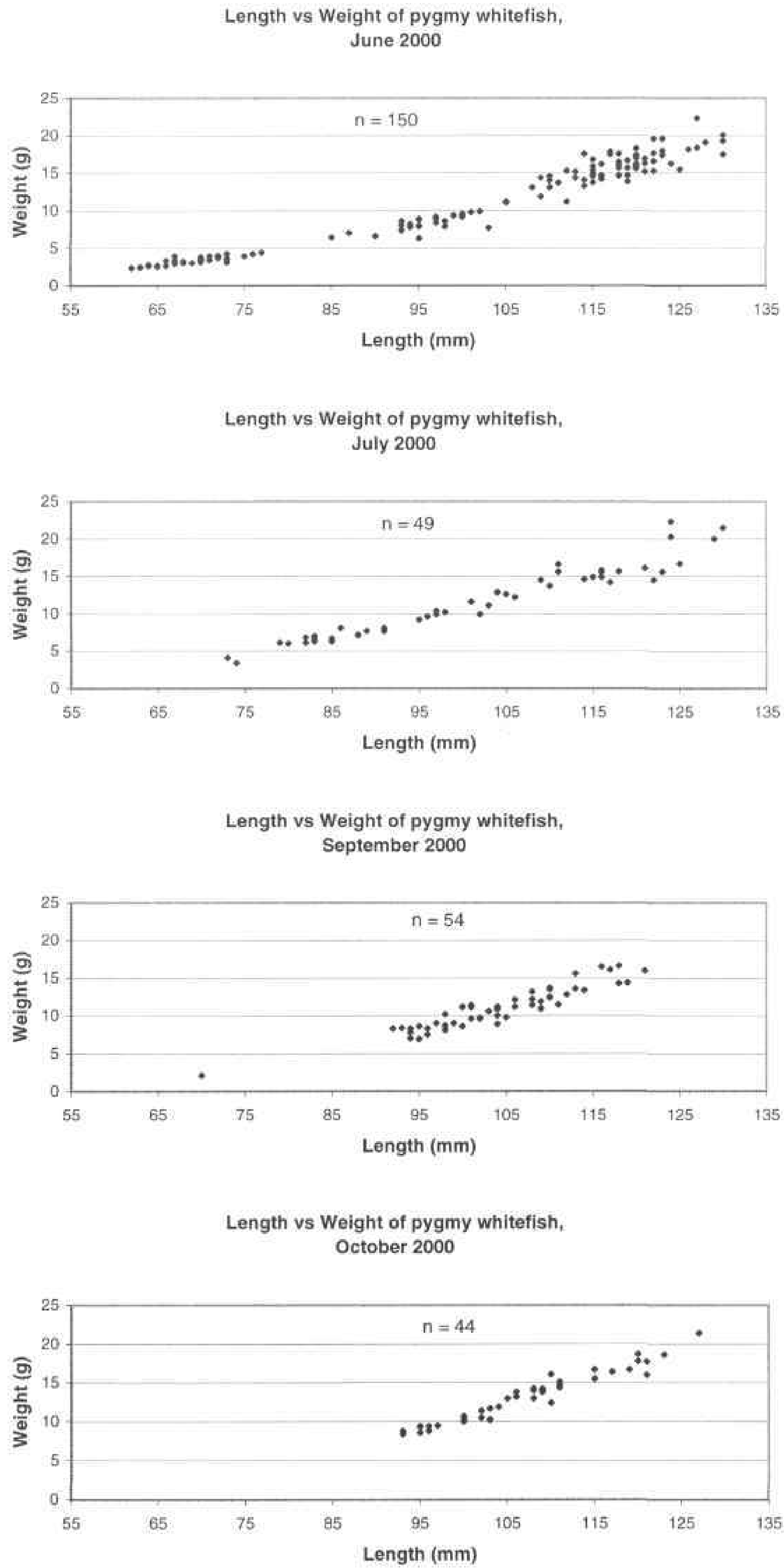


Figure 10. Length versus weight comparison for pygmy whitefish by sampling period.

Table 3. Population characteristics of female pygmy whitefish in Dina Lake #1, 2000.

Age Class	Sample No.	Mean Length[1] (cm)	Range of Length[1] (cm)	SD for Length	Mean Weight[1] (g)	Range of Weight[1] (g)	SD for Weight
1	11	8.4	6.6-9.8	1.03	6.1	2.7-8.1	2.06
2	33	10.5	7.3 - 12.4	0.95	11.8	4.2 - 22.3	3.32
3	17	11.1	10.0 - 12.1	0.48	14.4	10.6 - 17.7	1.78
4	17	11.8	11.0 - 12.9	0.52	16.0	13.7 - 20.0	1.65
5	11	12.2	11.4 - 13.0	0.54	17.3	14.6-21.5	2.72
6	1	12.3	-	-	15.6	-	-
7	1	12.2	-	-	19.6	-	-

Note: the mean and range of measurements represent all of the June to October samples combined.

The fork lengths for each age group of fish were plotted (Figure 11). All fish captured during this study were grouped together (by age) to get an overall mean length. There was a wide range in lengths for each age group. Most of the ranges in lengths appear to be correlated with the samples taken over a four month period. The smaller sized fish for each age group were captured in the earlier part of the study while the larger size fish were captured towards the end. The gill nets appear to capture mainly 2 to 5 year old fish.

Pygmy whitefish in Dina #1 appear to be slightly smaller in size at age (Table 4) when compared to pygmy whitefish in other lakes of B.C. and Ontario. Pygmy whitefish have been sampled in Keweenaw Bay of Lake Superior, Ont., Cluculz Lake, B.C., and Maclure Lake, B.C. (Scott and Crossman 1973). In Maclure Lake, these fish live the longest and attain a maximum age of 9 years. These fish are also the largest in size at age. Whereas, the pygmy whitefish in Dina #1 appear to be the smallest and live the shortest life span.

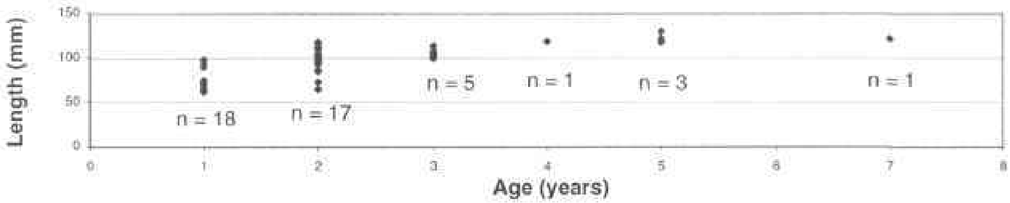
Table 4. Length at age comparison for pygmy whitefish in four separate lakes.

Location	Length measurement	Sex	1^+	2^+	3^+	4^+	5^+	6^+	7^+	8^+	9^+
Dina #1	FL (mm)	M	73	94	101	105	-	-	-	-	
		F	84	105	111	118	122	123	122	-	
L. Superior	TL (mm)	M	76	94	102	107	109	-	-	-	
		F	76	102	107	119	127	127	137	-	
Cluculz L.	FL (mm)	M	-	92	113	116	116	122	-	-	
		F	-	81	110	121	127	142	156	-	
Maclure L.	FL (mm)	M	-	121	192	210	185	225	-	-	
		F	-	117	190	219	245	248	257		271

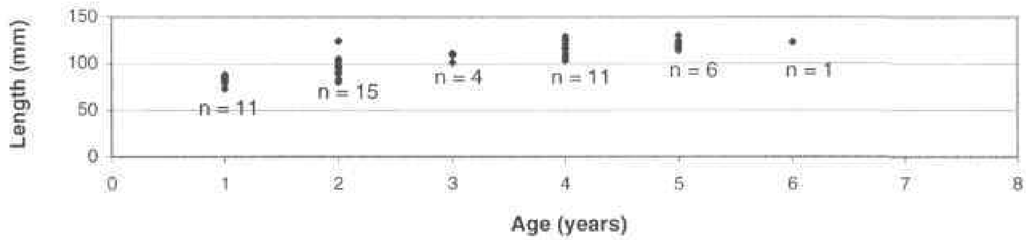
Note: "-" refers to an age group that was not observed within the sample of fish captured.

The largest mean length increment observed in Dina #1 was between the age 1^+ and the age 2^+ fish (Table 5) for both male and female pygmy whitefish. The majority of their development appears to occur quite early in their life (second growing season), however; we do not have any growth data in their first growing season. At the end of age 2^+, their growth then starts to slow down. Each year after that, their growth rate diminishes more rapidly.

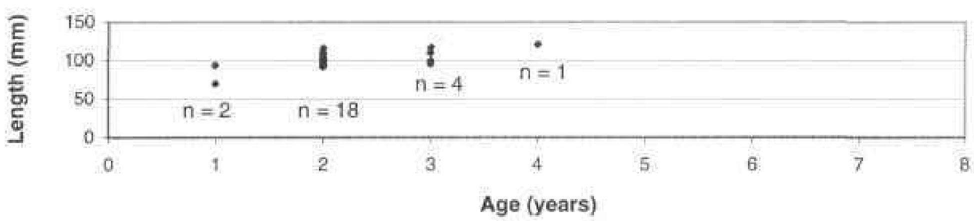
Age vs Length of pygmy whitefish, June 2000



Age vs Length of pygmy whitefish, July 2000



Age vs Length of pygmy whitefish, September 2000



Age vs Length of pygmy whitefish, October 2000

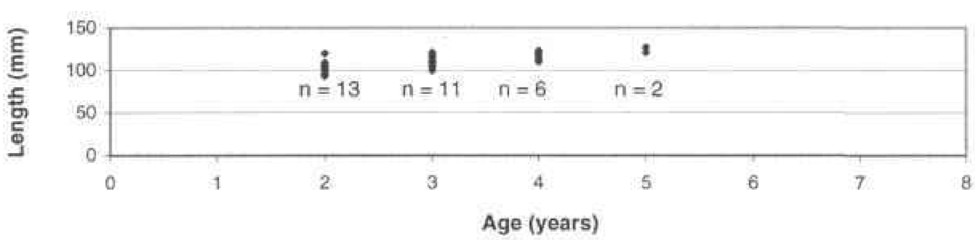


Figure 11. Age versus length comparisons for pygmy whitefish by sampling period.

Age	Males		Females	
	Mean length	Length increment	Mean length	Length increment
(years)	(cm)	(cm)	(cm)	(cm)
1+	7.3		8.4	
		2.1		2.1
2+	9.4		10.5	
		0.7		0.6
3+	10.1		11.1	
		0.4		0.7
4+	10.5		11.8	
		-		0.4
5+	-		12.2	
		-		0.1
6+	-		12.3	
		-		unknown (small sample)
7+	-		12.2	

Table 5. Length increments for male and female pygmy whitefish.

Note: "-" refers to an age group that was not observed within the sample of fish captured.

Condition factor

Condition factors were calculated for each individual male and female pygmy whitefish (Appendix 9). Twice as many females were captured as compared to males. Since the female fish are generally larger than the males, condition factors were grouped by sex (Table 6). The mean condition factors among sexes were almost identical (1.00). While the smallest sized fish observed had a condition factor as low as 0.61, the largest sized fish had a condition factor that was 1.30.

Table 6. Condition factors for pygmy whitefish captured in Dina Lake #1 in 2000.

	Males	Females
Number of fish	95	196
Minimum Condition Factor	0.61	0.80
Maximum Condition Factor	1.30	1.27
Mean Condition Factor	1.00	0.99
Lower 95 % Confidence Interval	0.97	0.97
Upper 95% Confidence Interval	1.02	1.00
Standard Deviation	0.11	0.09

Diet

Throughout the summer, 149 pygmy whitefish stomachs were preserved and later analyzed for contents: 45 in June, 49 in July, 25 in September, and 30 in October. Most of the stomach contents were classified to order but a few prey items were identified to genus. Ten different taxa were present in these samples (Stamford 2001). In an attempt to determine where the pygmy whitefish were foraging in relation to lake habitat, stomach contents were categorized into either benthic (bottom) or limnetic (water column) prey.

Five benthic taxa were discovered in the pygmy whitefish stomach samples, which included mayflies, caddisflies, true flies (larval stage), chironomids, and scuds (amphipods). The limnetic taxa discovered consisted of copepods, true flies (pupae), phantom midges, water fleas, and water mites. The scuds were further identified as *Hyalella azteca,* and the water fleas were identified as *Daphnia, Bosmina, Leptodora,* or *Alona.*

To determine seasonal shifts in diet, samples for each month were analyzed separately. If a food item occurred in 90% or more of the samples for that month, we assumed this was a primary food source for the fish. If a prey item appeared in 40% to 89% of the samples, this item was considered a secondary food source. Finally, if a prey item occurred in 15% to 39% of the samples, the item was considered a tertiary food source (Table 7).

Table 7. Stomach content preferences for pygmy whitefish by sample trip.

Month	Primary food source	Secondary food source	Tertiary food source
June	Cyclopoida (L)	Bosmina (L)	Diptera pupae (L) Daphnia (L) Chironomidae
July	Daphnia (L)	Calanoida (L) Leptodera (L) Cyclopoida (L)	Diptera pupae (L) Chaoboridae (L) Chironomidae (B)
September		Calanoida (L) Daphnia (L)	
October	Daphnia (L)	Calanoida (L) Bosmina (L)	Cyclopoida (L)

(L) = limnetic, (B) = benthic

During late spring and early summer, cyclopoid copepods were the major prey of pygmy whitefish; however, as the summer proceeded, they became a less common food source. Starting in July and continuing through October, *Daphnia* became the primary prey, calanoid copepods the secondary prey, and *Bosmina* the tertiary prey. *Bosmina* was most noticeable in the June and October stomachs. Mayflies, caddisflies, Diptera larvae, *Hyalella azteca, Alona,* and Hydracarina were present in less than 15% of the samples for each month (Stamford 2001). Almost all food sources (more than 90%) were limnetic in nature.

Pygmy whitefish appear to forage primarily in the water column and take relatively little food directly off the bottom. The only prey species that is benthic in nature was Chironomidae. There was a shift in diet from calanoid copepods to cyclopoid copepods, *Daphnia,* and *Bosmina* as summer progressed. It is not clear if this diet shift reflects a preference for certain kinds of prey or simply tracks the seasonal abundance of different prey items.

Reproduction

Age at maturity

All the fish collected in the October sample were mature. Of these, otolith ages were available for 24 females and 7 males. Twenty-five percent of the mature females were 2^+, 42% were 3^+, 25% 4^+, and 8% were 5^+. Six of the seven males were 2^+ and one was 3^+. The age range of females (wide relative to the age range of males) may indicate a higher post-spawning mortality on males than on females. Most of these fish were caught in the onshore net. Unfortunately, this net had 19 mm mesh and may have missed smaller fish. Consequently, we have no data from October on immature fish and, therefore, we can not estimate age at first maturity.

Fecundity

Although the females in our October sample had not ovulated, the eggs were enlarged (1.3 to 1.8 mm in diameter) and beginning to loosen in the skein. The estimated egg number in females containing enlarged eggs ranged from 435 to 1012. Surprisingly, although egg number tended to increase with both fork length and body weight (Figure 12) the relationships are not significant ($P > 0.2$). The scatter around the regression lines simply is too great. Consequently, neither body length nor body weight is a useful predictor of fecundity. The only measure with a significant ($P < 0.002$) relationship with egg number is relative gonad weight (i.e., gonad weight as a proportion of body weight). Figure 13 illustrates this relationship. Relative gonad weight explains about 60% of the variation in egg number.

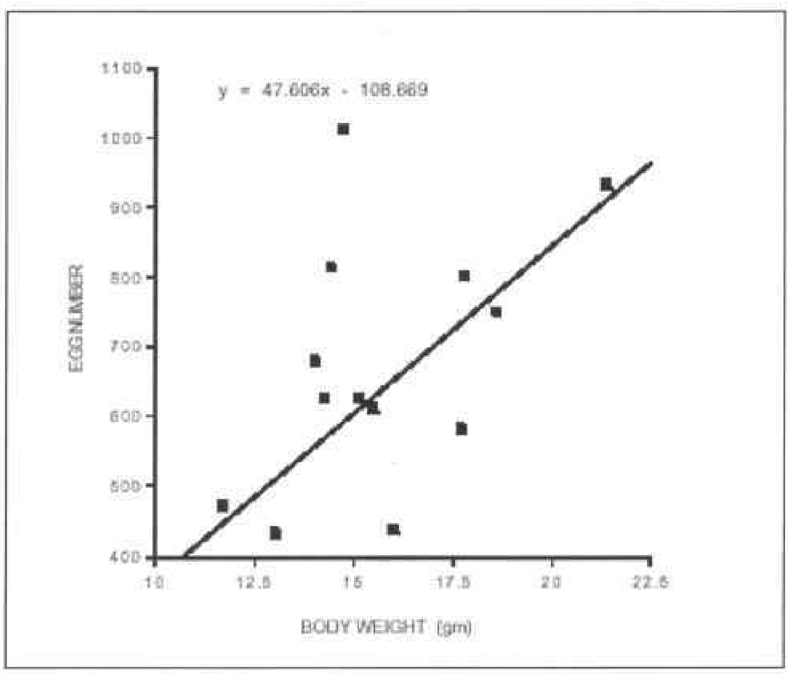


Figure 12. Egg number versus body weight of female pygmy whitefish.

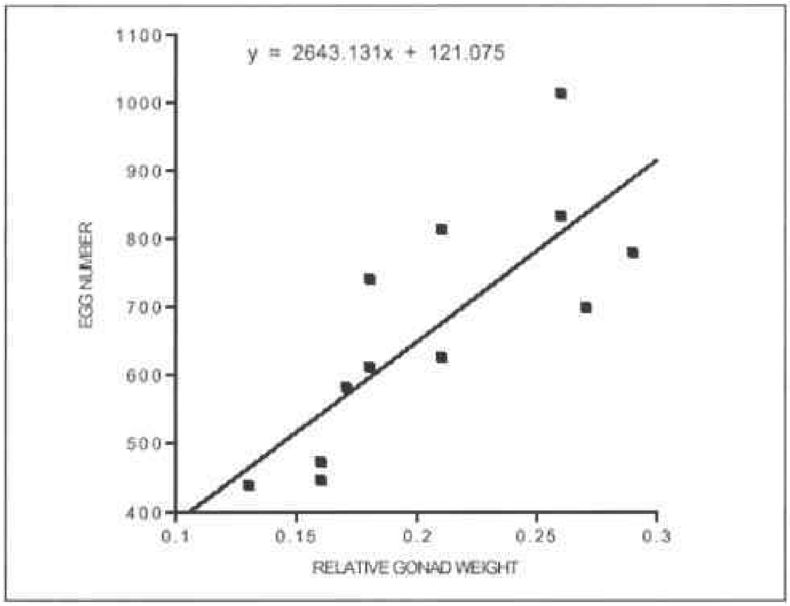


Figure 13. Relative gonad weight (g) versus egg number for female pygmy whitefish.

Egg diameter also increases with female size but, again, the relationship is not tight (Figure 14) and the regression is not significant ($P > 0.2$). Some of this scatter around this line probably reflects differences among females in the stage of egg maturation. Thus, the relationship between egg diameter and body size might become stronger as females approach ovulation.

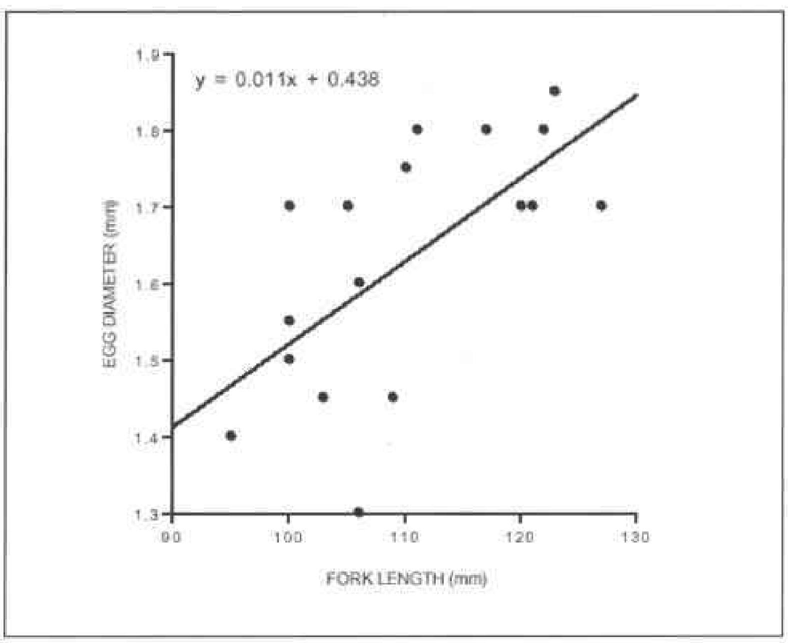


Figure 14. Fork length versus egg diameter for female pygmy whitefish.

Parasites

There were no obvious ectoparasites on any age class of pygmy whitefish; however, most fish had an unidentified encysted worm associated with the stomach and liver. Two trends are apparent in the parasite data with the Dina #1 population. First, in the June sample, 95% of the 1^+ fish examined for parasites had none; whereas, 75% of the 2^+ fish had one or more parasites. This suggests the parasite load increases with age. A second trend in the parasite data is an increase in individual parasite load as the season progresses. Thus, by October only a few of the smallest (youngest?) fish were free of parasites. Curiously, in the June sample even fish as large as 118 mm had no encysted worms but by October all fish over 100 mm had worms. Since fish as large as 118 mm in the June sample must be at least 2^+ or older, this observation suggests that they somehow lose worms over the winter.

Amanda Brown, a PhD student at U.B.C., along with Mike Stamford identified the collected parasites. These small sized parasites (about 1.5 to 2.0 mm in diameter) were identified as trematodes (Phylum: *Platyhelminthes*, Class: *Digenea)*. Further identification to species level was not possible, as the preservation of these parasites in 70% ethanol was not optimal.

DISCUSSION

Relatively little is known about the biology of pygmy whitefish. While our study population (Dina #1) is located near the geographic center of its North American range, most comparable data are from disjunct, peripheral populations (e.g., Lake Superior, Eschmeyer and Bailey 1955; Brooks Lake, Alaska, Heard and Hartman 1963; Flathead Lake, Montana, Weisel et al. 1973; Chester Morse Reservoir, western Washington, R2 Resource Consultants 1995). The only study from within the continuous range of the species is that of McCart (1965).

McCart (1965) did not list many meristic features in the four B.C. populations he examined and there is no other data from our area (the upper Peace system). When we examined the fin ray counts on the Dina #1 population, we found our population of pygmy whitefish conflicted with other reportings. In our population (Dina #1) we found pygmy whitefish had either 8 or 9 dorsal rays. In contrast, mountain whitefish in the upper Peace system have 11-15 dorsal rays. We do not know whether the low dorsal fin ray number in Dina #1 is specific to that lake or characteristic of all upper Peace populations. Major references (Scott and Crossman 1973; McPhail and Lindsey 1970) give a much wider range (10-13) of dorsal fin ray counts in pygmy whitefish; however, their descriptions include the entire distribution of pygmy whitefish (Alaska to the Great Lakes) and this could account for the wider range ray counts.

Horizontal and Vertical Distribution

Most regional works (e.g., Brown 1971; Scott and Crossman 1973; Simpson and Wallace 1978; Wydoski and Whitney 1979; Nelson and Paetz 1992) indicate that pygmy whitefish rarely occur in lakes with a maximum depth of less than 20 m. This generalization holds for Dina #1. Its maximum depth is 27 m and, with the exception of our October overnight samples, we caught no pygmy whitefish in less than 8 m of water. This suggests that in the summer adult pygmy whitefish avoid the littoral zone. In three of the four BC lakes studied by McCart (1965) pygmy whitefish also were confined to depths greater than 10 m, but in one lake he found adults at about 4.5 m. It is not clear at what season his shallow samples were collected but in late October we found adults moving into water just less than 2 m deep at night. Since, at this time, no fish were caught in shallow water during the day, they presumably moved back offshore into deeper water at daylight. Gonadal examination of the fish caught in shallow water indicated that they were almost in spawning condition. In Flathead Lake, Montana, Simpson and Wallace (1978) described a similar evening movement of pygmy whitefish into shallow inshore areas at night and a return movement to deeper water near dawn. This onshore-offshore movement also occurred at Dina #1 in October and also was associated with reproductive adults. Thus, although adult pygmy whitefish appear to avoid littoral areas in summer, they will enter shallow water in the late autumn.

McCart (1965) demonstrated that other whitefish species *(Coregonus clupeaformis* and *Prospium williamsoni)* influence the depth distribution of pygmy whitefish. He found pygmy whitefish lived deeper in lakes containing other whitefish species than in lakes without other whitefish. This suggests that interspecific interactions may influence the depth range used by pygmy whitefish. Since there are no other whitefish species in Dina #1, the summer avoidance of shallow water must have some other explanation. One obvious possibility is temperature. By June 20, 2000, surface temperatures in the lake had risen above 14° C and a metalimnion had formed at 4 m. Most (98%) of the adults caught at this time were taken below the metalimnion (at 8 to 20 m) at water temperatures ranging from 5 to 9° C. As the summer progressed, surface temperatures increased and the metalimnion strengthened and moved deeper. By late July the surface temperature reached 19.7° C and the metalimnion in the main basin had descended to 9 m.

Although there are no data available on the thermal tolerances of pygmy whitefish, they probably resemble those of lake whitefish (*C. clupeaformis).* Ford et al. (1995) reviewed literature on the preferred temperatures of adult lake whitefish and concluded that the minimum preferred range is between 8 and 14° C. Consequently, if pygmy whitefish temperature preferences are similar to those of lake whitefish, the extensive and productive littoral regions of the lake are outside the thermal preference range during the summer.

Another factor that probably influences depth distribution of pygmy whitefish in Dina #1 is oxygen availability. Again, nothing is known about the oxygen requirements of pygmy whitefish; however, Davis (1975) reviewed the oxygen requirement of a number of freshwater fish species and concluded that 7.75 mg L^{-1} was an acceptable safe level of dissolved oxygen but that prolonged exposure to oxygen levels of less than 4.25 mg L^{-1} posed a threat to a proportion of most fish populations. In June, the bottom water in the main basin was becoming anoxic and oxygen levels had declined to less than 4.25 mg L^{-1} at a depth of 19 m. Since the maximum depth of the main basin is 27 m, the bottom 8 m of the lake probably were only useable by pygmy whitefish for short time periods. By July the oxygen depleted layer had risen to 17 m and by September it was at 14 m. Thus, as the summer advanced, the metalimnion descended and the oxygen depleted layer grew upward. Consequently, for pygmy whitefish, the depth layer of water with stress-free temperature and oxygen conditions narrowed over the summer and was sandwiched between an increasingly anoxic bottom layer and a stronger and deeper metalimnion.

Not surprisingly, in the summer, most of the pygmy whitefish taken in our nets were collected below the metalimnion and above the oxygen depleted layer. By late September the epilimnion temperature had dropped to less than 12° C and, although there was still a metalimnion, apparently it was no longer a barrier to pygmy whitefish. In summary, our data indicate that both the vertical and horizontal distribution of pygmy whitefish in Dina #1 are affected by seasonal changes in temperature and dissolved oxygen. We anticipate that the use of vertical nets in 2001 will allow us to quantify these seasonal changes.

Age and Growth

Growth rates in pygmy whitefish are variable (Eschmeyer and Bailey 1955; Heard and Hartman 1963; McCart 1965; Weisel et al. 1973) and appear to depend on both physical and biological factors. Because most pygmy whitefish are collected with gill nets, young-of-the-year are rare in samples and descriptions of growth usually begin with fish in their second growing season (1^+). Back calculating from scales, however, McCart (1965) was able to estimate the average fork length of pygmy whitefish at the end of their first year in four BC lakes. His estimates range from 47 to 73 mm. This is consistent with our meager Dina #1 sample — one young-of-the-year pygmy whitefish taken in September (70 mm FL). Also, we observed schools of small, silvery fish at the surface of the lake in October that we suspect were young-of-the-year but we were unable to collect any of these fish. In June we collected small (62 - 77 mm FL) pygmy whitefish and interpreted this discrete size class (Figure 6) as the 1^+ age class. Over the next month, the average length increment of this size class was 16 mm.

By the end of the second growing season (1^+) average size varies dramatically among lakes: from about 60 mm (Heard and Hartman 1966) to about 150 mm (Rogers 1964). In Dina #1, the average size of 1^+ fish is about 95 mm. Although growth rate slows at maturity in all populations, interpopulation differences in size usually are maintained throughout life. Hence, adult size varies greatly among populations. The smallest described adults are about 65 mm (Brooks Lake, Alaska; Heard and Hartman 1966) and the largest known adults average about 250 mm (Maclure Lake, BC). In Dina #1 the average size of adults was approximately 110 mm (FL); however, this figure is rendered almost meaningless by the size differences between mature males and females. In Dina #1 all of the pygmy whitefish over 104 mm FL were females. This size difference between males and females appears to be characteristic of pygmy whitefish. In most populations males and females grow at the same rate until maturity but, since females usually mature at least a year later than males, they achieve a larger adult body size than males (McCart 1965, Weisel et al. 1973). Typically, about 50 - 70% of males mature near the end of their second growing season (1^+) while most females do not mature until the end of their third growing season (2^+). Relatively few males survive beyond their third year, however, females can reach ages of 7 or 8 years.

Dina #1 fish are typical in this regard. Our scale and otolith data indicate there are multiple age classes (0^+ to 7^+) but relatively few (<15%) males older than 2^+; whereas, at least half the adult females are over this age. In our samples, the oldest male was 4^+ and the oldest female was 7^+. A similar range of ages is reported from three other BC lakes (Tacheeda, Cluculz, and McLeese), but a little narrower than the range found in Maclure Lake. The age range here was 1^+ to 9^+ (McCart, 1965).

The two main sizes of gill nets (19 and 25 mm) used to capture pygmy whitefish targeted the mid sized fish in the population but did not provide much data on the young-of-the-year and older (near death) sized fish. Because this population of fish do not grow very large (max. 130 mm FL), the range in lengths for each age class overlapped considerably. If we were able to obtain more smaller (i.e. 16 mm) and larger (i.e. 29 mm) sized nets, then we may have had a better understanding of the growth and size at age for these young and older sized fish. The 10 and 32 mm sized nets were used minimally.

Reproduction

Neither spawning times nor spawning sites are known for BC pygmy whitefish. Fecundity in Dina #1 pygmy whitefish (435 to 1012 eggs) is similar to that recorded from other populations (156 to 918 eggs, Eschmeyer and Bailey 1955; 103 to 1153 eggs, Heard and Hartman 1966). McCart (1965) reported two females in Cluculz Lake with running eggs in July. Since these fish also contained atretic eggs, he suggested that they had failed to spawn the previous winter. In Kinbasket Lake, McCart found spent males and females in October and November. Elsewhere, the literature indicates a late autumn to early winter spawning time and both stream and lake spawning sites. In Dina #1, we collected males with tubercles and females that were close to ovulation in late October. Consequently, pygmy whitefish probably spawn at, or shortly after, freeze-up. The spawning site is unknown but is suspected to be on the coarse gravel deposits associated with the southeastern corner of the main basin.

Diet

Most sources (e.g., McPhail and Lindsey, 1970; Scott and Crossman 1973; Wydoski and Whitney 1979; Nelson and Paetz 1992) indicate that pygmy whitefish forage primarily on bottom organisms. In Dina #1, however, water column prey (mostly cladocerans and copepods) are the main summer food items. Given the summer limnological conditions in the lake — a deep, strong metalimnion and oxygen depleted bottom water — this reliance on limnetic organisms is not unexpected. However, we did catch some pygmy whitefish in oxygen depleted water (< 4.25 mg L^{-1}). Many cladocerans and copepods undertake diel vertical migrations (up at night and down during the day). If these zooplankters enter the oxygen depleted layer during the day, pygmy whitefish may make brief foraging forays into the bottom waters but most of their summer feeding probably occurs just below the metalimnion. Still, when the lake turns over and the hypolimnion is recharged with oxygen, benthic organisms may become important in the diet of Dina #1 pygmy whitefish.

Zooplankton is the main food source for pygmy whitefish in Dina #1. These food sources include mostly cladocerans and copepods. These zooplankton species generally consume plankton as their main food source. As this plankton becomes more abundant throughout the summer, the zooplankton will migrate to different areas of the lake to feed. Without keying out individual species of zooplankton, it is hard to determine where the copepods and cladocerans inhabit Dina #1, and ultimately where the pygmy whitefish are finding these food resources.

Most limnetic cladocerans undergo vertical migratory movements during each 24-hour period. These "drifting" movements of the general population are commonly upward with the onset of darkness and downward with the coming of the light of dawn. The average amplitude ranges from 2 to 10 m, depending on the species and many environmental factors (Pennak 1989).

At night, when many cladocerans and copepods migrate to the epilimnetic waters, grazing rates are often five times greater than during daylight hours (Hart 1977). Often zooplankton encounter strata of reduced oxygen concentrations as they migrate to deep, poorly illuminated water during daylight hours. Filtering and respiration rates decrease rapidly at oxygen concentrations below 3 mg L^{-1} (Kring and O'Brien 1976; Heisey and Porter 1977). Since some species of zooplankton can tolerate these low levels of oxygen, at least for some time, this may suggest that the pygmy whitefish in Dina #1 are taking advantage of these food resources where other species of fish, like trout, can't inhabit.

Copepods are much more tolerant to low oxygen levels than are the cladocerans. *Cyclopids* have been collected near the bottom substrate of stratified lakes during summer and winter periods of stagnation and oxygen depletion. However, the *cyclopoid* and *calanoid* species do exhibit a vide variety of ecological niches and are not just found near the bottom of a lake.

Like the Cladocera, some common species of copepods show a daily rhythmic cycle of vertical migrations in lakes. Greater concentrations of individuals exist in the upper waters during the hours of darkness and correspondingly large numbers in the bottom waters during daylight. Individuals of some species may move upward at dusk and downward at dawn, a vertical distance of as much as 20 m. It is believed that the primary stimulus for vertical migrations is the daily cycle of subsurface illumination (Pennak 1989).

Parasite Presence

The parasites associated with the pygmy whitefish have not yet been reported (Scott and Crossman 1973). In essence, this probably means that no biologists have specifically looked for parasites on this species of fish. According to McDonald and Margolis (1995), there has been only one parasite found associated with pygmy whitefish *(Neoechinorhynchus ratili).* The parasite found in the Dina #1 fish appear to be different than this species (Amanda Brown, U.B.C., pers. comm.). Further examination of these organisms is required to determine if the parasites located in the Dina #1 fish is a new species description or a new host record.

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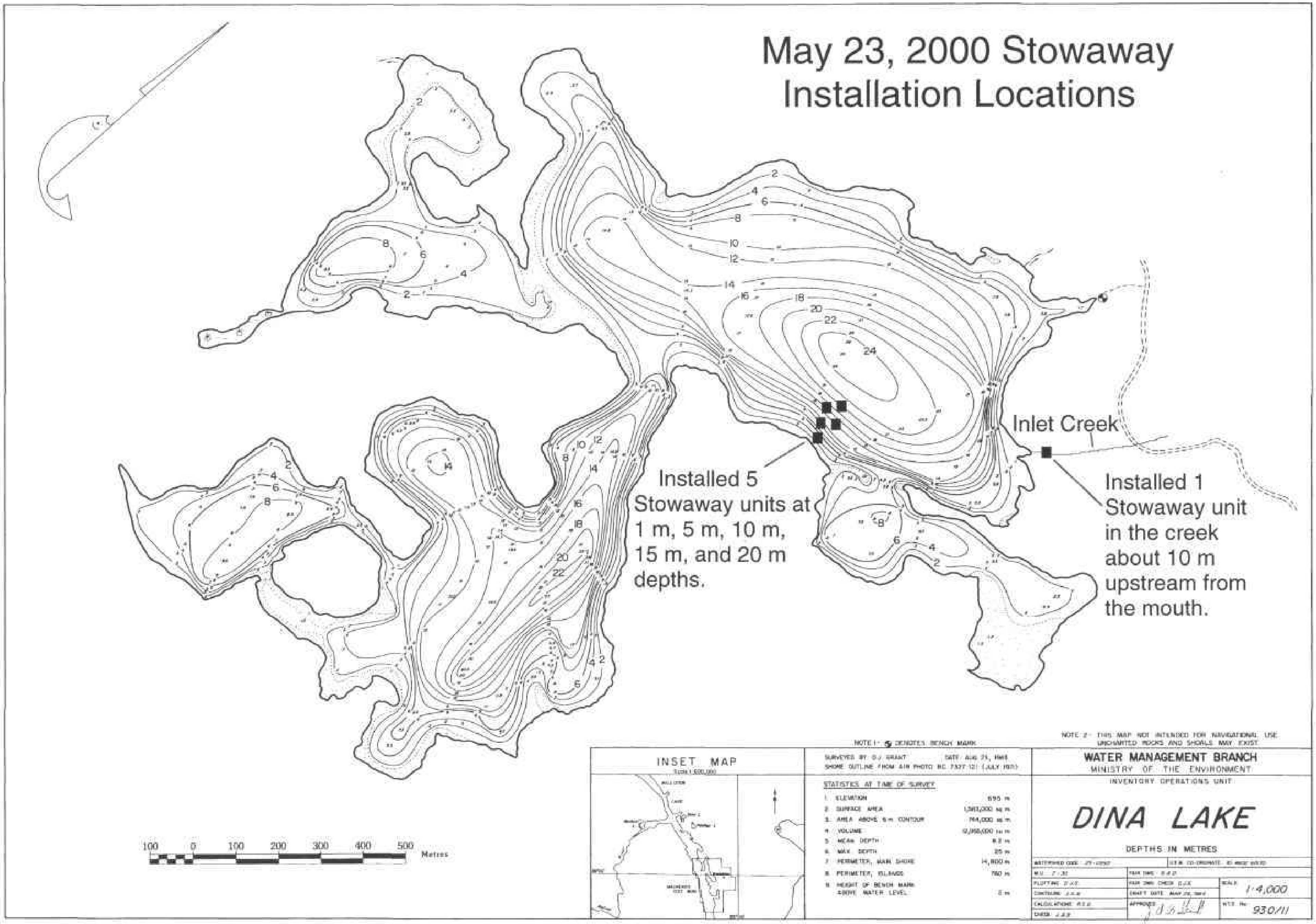
APPENDIX 1

Stowaway Installation Locations


May 23, 2000 Stowaway
Installation Locations
Inlet Creek
Installed 1 Stowaway unit in the creek about 10 m upstream from the mouth.
Installed 5 Stowaway units at 1 m, 5 m, 10 m, 15 m, and 20 m depths.
INSET MAP
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST.
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
STATISTICS AT TIME OF SURVEY
1:4,000
930/11
Metres

APPENDIX 2

Stowaway daily mean water temperatures

Mean Daily Temperatures, Summer of 2000

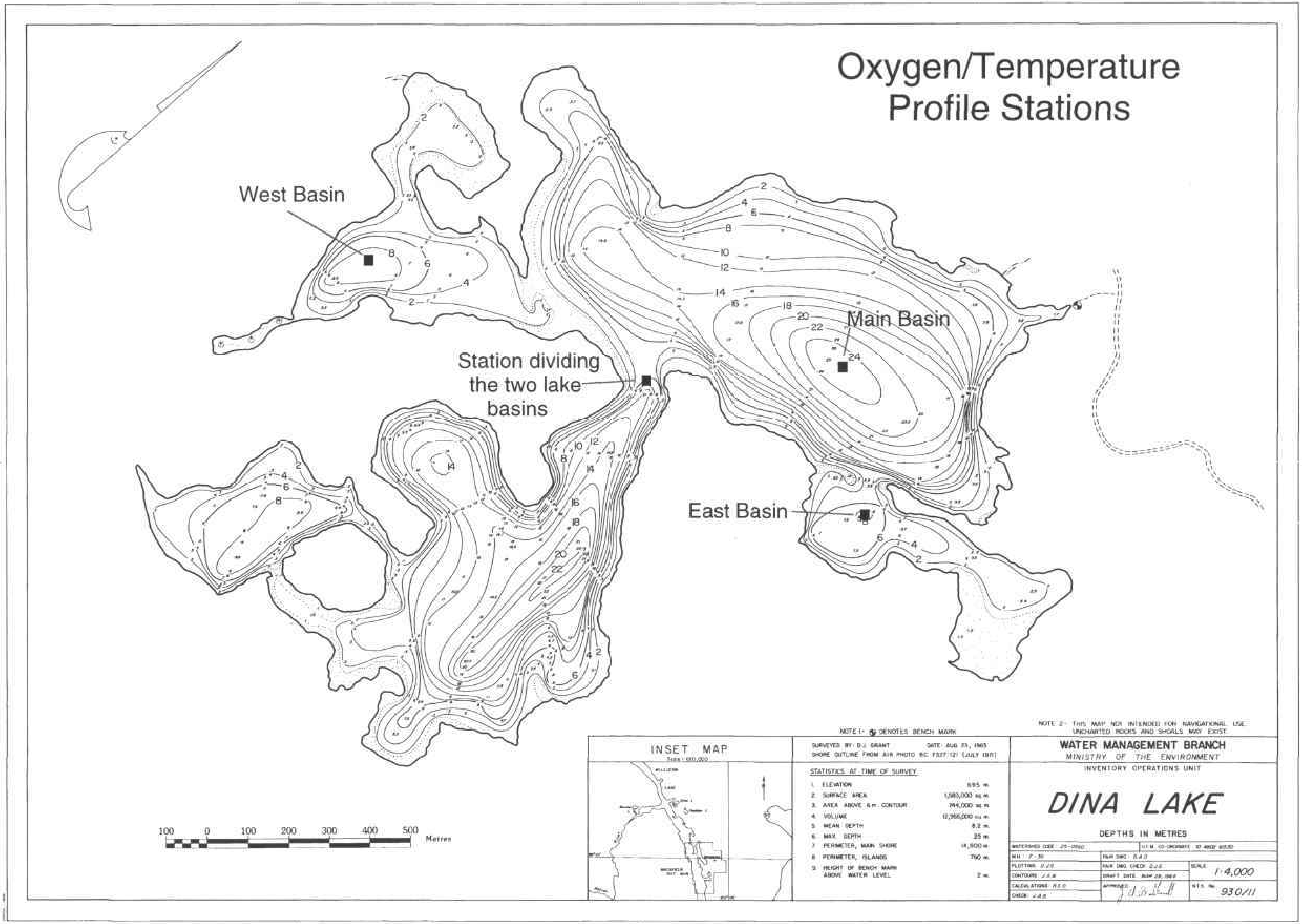
Date	Dina Creek Temperature (°C)	Dina Lake 1m Temperature (°C)	Dina Lake 5m Temperature (°C)	Dina Lake 10m Temperature (°C)	Dina Lake 15m Temperature (°C)
24 May	7.7	9.1	8.4	6.4	5.0
25 May	7.1	9.2	8.7	6.4	4.9
26 May	7.1	9.2	8.6	6.6	5.0
27 May	7.7	9.1	8.5	6.4	5.1
28 May	8.9	9.2	8.8	6.4	5.2
29 May	9.3	9.7	8.9	6.5	5.1
30 May	9.8	9.9	9.4	6.3	5.2
31 May	11.0	10.3	9.5	6.5	5.1
01 Jun	12.0	11.4	9.4	6.7	5.2
02 Jun	13.2	12.1	9.8	6.6	5.3
03 Jun	13.7	13.1	10.0	6.7	5.2
04 Jun	13.2	13.7	10.1	6.8	5.2
05 Jun	13.9	13.2	10.4	7.0	5.3
06 Jun	12.6	12.9	11.1	7.0	5.4
07 Jun	13.4	13.5	11.3	7.0	5.5
08 Jun	13.0	13.6	11.3	7.1	5.4
09 Jun	12.9	13.6	11.4	7.1	5.4
10 Jun	12.6	13.6	11.5	7.2	5.5
11 Jun	12.4	13.3	11.5	7.1	5.5
12 Jun	13.2	13.7	12.0	7.2	5.5
13 Jun	12.9	13.6	12.4	7.2	5.5
14 Jun	13.1	13.7	12.3	7.2	5.5
15 Jun	13.5	14.0	13.0	7.4	5.5
16 Jun	13.6	14.9	12.9	7.4	5.6
17 Jun	14.4	15.0	13.0	7.2	5.6
18 Jun	14.5	15.1	13.0	7.4	5.6
19 Jun	14.6	15.4	13.4	7.6	5.6
20 Jun	13.8	15.5	13.7	7.6	5.6
21 Jun	13.5	15.4	13.7	7.6	5.6
22 Jun	13.0	15.4	14.0	7.5	5.6
23 Jun	12.9	15.5	14.1	7.8	5.6
24 Jun	14.9	16.0	14.5	7.9	5.7
25 Jun	16.1	16.5	14.7	7.8	5.7
26 Jun	16.2	17.2	14.9	7.6	5.7
27 Jun	16.8	17.7	15.2	8.1	5.7
28 Jun	17.4	18.6	15.4	8.1	5.8
29 Jun	17.1	18.4	15.6	8.2	5.8
30 Jun	15.6	18.0	15.9	8.3	5.8
01 Jul	15.0	18.0	15.9	8.3	5.8
02 Jul	14.3	17.7	16.2	8.2	5.8
03 Jul	13.6	17.3	16.1	8.3	5.8
04 Jul	14.2	17.2	16.5	8.5	5.9
05 Jul	14.5	17.1	16.6	8.5	5.9
06 Jul	15.7	17.2	16.5	8.5	5.9
07 Jul	15.7	17.4	16.8	8.4	5.9
08 Jul	15.5	17.4	16.9	8.6	5.9
09 Jul	15.7	17.6	17.1	8.6	5.9
10 Jul	16.3	18.1	17.1	8.6	6.0
11 Jul	16.2	18.1	17.3	8.8	6.0
12 Jul	15.8	18.4	17.2	8.8	6.0

Date	Dina Creek Temperature (°C)	Dina Lake 1m Temperature (°C)	Dina Lake 5m Temperature (°C)	Dina Lake 10m Temperature (°C)	Dina Lake 15m Temperature (°C)
13 Jul	16.0	18.5	17.5	9.0	6.0
14 Jul	15.7	18.0	17.2	8.9	6.2
15 Jul	15.9	17.7	17.3	8.9	6.2
16 Jul	15.7	17.6	17.3	8.9	6.2
17 Jul	15.6	17.8	17.3	9.0	6.3
18 Jul	16.5	18.4	17.4	9.2	6.3
19 Jul	17.0	18.9	17.5	9.2	6.4
20 Jul	17.3	19.1	17.7	9.2	6.3
21 Jul	16.9	19.0	18.0	9.4	6.3
22 Jul	17.0	19.5	18.0	9.5	6.5
23 Jul	17.2	19.5	18.1	9.4	6.4
24 Jul	17.0	19.5	18.3	9.5	6.4
25 Jul	17.3	19.8	18.5	9.5	6.5
26 Jul	16.9	19.6	18.6	9.7	6.5
27 Jul	17.1	19.5	18.8	9.8	6.6
28 Jul	16.8	19.4	19.1	9.8	6.6
29 Jul	15.6	19.2	19.1	9.8	6.6
30 Jul	15.9	19.2	18.9	9.8	6.6
31 Jul	16.9	19.6	18.9	9.9	6.7
01 Aug	17.8	19.1	18.7	9.9	6.7
02 Aug	16.8	18.8	18.6	9.9	6.7
03 Aug	17.5	19.1	18.6	10.1	6.7
04 Aug	17.4	19.3	18.8	10.1	6.7
05 Aug	18.0	19.9	19.0	10.1	6.7
06 Aug	18.4	20.6	19.1	10.1	6.7
07 Aug	17.9	20.5	19.3	10.4	6.7
08 Aug	16.4	20.0	19.4	10.5	6.8
09 Aug	15.8	19.5	19.3	10.4	6.9
10 Aug	14.4	19.2	19.1	10.4	6.7
11 Aug	13.8	18.9	18.8	10.5	6.8
12 Aug	13.1	18.8	18.6	10.5	6.9
13 Aug	13.7	18.6	18.5	10.7	6.8
14 Aug	13.5	18.6	18.6	10.7	6.9
15 Aug	14.3	18.8	18.5	10.8	6.9
16 Aug	14.5	18.8	18.6	10.8	6.9
17 Aug	14.8	18.4	18.3	11.1	6.9
18 Aug	14.4	18.2	18.2	10.8	6.9
19 Aug	13.6	17.9	17.8	10.9	6.9
20 Aug	13.2	17.5	17.4	10.9	6.9
21 Aug	13.0	17.1	17.1	11.0	6.9
22 Aug	13.7	16.9	16.8	10.9	6.9
23 Aug	14.6	16.9	16.9	11.1	6.9
24 Aug	14.1	17.0	16.7	11.0	7.0
25 Aug	14.3	16.8	16.7	11.0	6.9
26 Aug	13.4	16.5	16.5	11.2	7.0
27 Aug	13.0	16.4	16.3	11.2	6.9
28 Aug	12.3	16.2	16.1	11.2	7.0
29 Aug	12.0	15.9	15.9	11.4	7.0
30 Aug	10.6	15.6	15.5	11.2	7.0
31 Aug	11.0	15.1	15.2	11.5	7.0
01 Sep	9.4	14.3	14.5	12.5	7.0
02 Sep	8.2	13.8	13.9	13.0	7.0
03 Sep	8.9	13.6	13.6	12.8	7.0

Date	Dina Creek Temperature (°C)	Dina Lake 1m Temperature (°C)	Dina Lake 5m Temperature (°C)	Dina Lake 10m Temperature (°C)	Dina Lake 15m Temperature (°C)
04 Sep	9.2	13.4	13.4	12.5	7.0
05 Sep	10.5	13.4	13.4	12.6	7.1
06 Sep	10.4	13.3	13.3	12.7	7.0
07 Sep	10.7	13.2	13.3	12.5	7.0
08 Sep	10.3	13.1	13.0	12.7	7.1
09 Sep	9.8	12.9	12.8	12.6	7.1
10 Sep	9.7	12.7	12.8	12.4	7.0
11 Sep	9.5	12.5	12.5	12.3	7.1
12 Sep	9.5	12.4	12.4	12.1	7.0
13 Sep	9.5	12.4	12.3	12.1	7.1
14 Sep	10.5	12.5	12.4	12.0	7.1
15 Sep	10.5	12.7	12.5	12.1	7.1
16 Sep	10.5	12.5	12.4	12.1	7.1
17 Sep	11.4	12.6	12.5	11.9	7.1
18 Sep	11.3	12.7	12.6	12.0	7.1
19 Sep	10.1	12.7	12.6	12.1	7.3
20 Sep	9.6	12.4	12.4	12.1	7.1
21 Sep	8.0	12.1	12.2	12.0	7.2
22 Sep	6.8	11.9	12.0	11.7	7.1
23 Sep	6.8	11.8	11.8	11.6	7.2
24 Sep	7.3	11.8	11.8	11.5	7.2
25 Sep	8.1	11.9	11.8	11.6	7.3
26 Sep	8.7	11.9	11.9	11.6	7.2
27 Sep	8.9	11.9	11.9	11.6	7.2
28 Sep	9.5	12.1	12.0	11.6	7.3
29 Sep	10.1	12.0	12.0	11.6	7.2
30 Sep	9.3	11.7	11.8	11.7	7.3
01 Oct	8.0	11.6	11.6	11.5	7.4
02 Oct	6.6	11.2	11.3	11.2	7.3
03 Oct	5.1	10.9	11.0	10.9	7.3
04 Oct	4.5	10.6	10.7	10.5	7.3
05 Oct	4.0	10.3	10.4	10.2	7.3
06 Oct	4.1	10.1	10.2	10.0	7.4
07 Oct	4.7	9.9	10.0	9.8	7.4
08 Oct	6.3	10.0	10.0	9.8	7.5
09 Oct	5.8	9.8	9.8	9.7	7.5
10 Oct	4.9	9.6	9.7	9.6	7.8
11 Oct	4.2	9.4	9.5	9.3	7.9
12 Oct	4.7	9.4	9.4	9.2	7.9
13 Oct	5.4	9.4	9.4	9.1	8.1
14 Oct	5.3	9.1	9.2	9.1	8.1
15 Oct	4.9	8.9	8.9	8.8	8.3
16 Oct	5.0	8.8	8.8	8.7	8.4
17 Oct	4.9	8.7	8.7	8.6	8.3
18 Oct	5.6	8.5	8.6	8.5	8.1
19 Oct	4.8	8.3	8.4	8.3	8.0
20 Oct	5.0	8.2	8.3	8.1	7.9
21 Oct	4.8	8.1	8.2	8.0	7.8
22 Oct	4.4	7.8	7.8	7.6	7.5
23 Oct	5.0	7.7	7.7	7.5	7.5
24 Oct	5.2	7.6	7.7	7.6	7.4
25 Oct	4.6	7.4	7.5	7.4	7.3
26 Oct	4.1	7.3	7.4	7.3	7.2

APPENDIX 3

Location of Oxygen/Temperature Profile Stations


Oxygen/Temperature
Profile Stations
West Basin
Station dividing
the two lake
basins
Main Basin
East Basin
Metres
100 0 100 200 300 400 500
INSET MAP
NOTE 1- DENOTES BENCH MARK
NOTE 2- THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST
STATISTICS AT TIME OF SURVEY
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
1:4,000
93O/11

APPENDIX 4

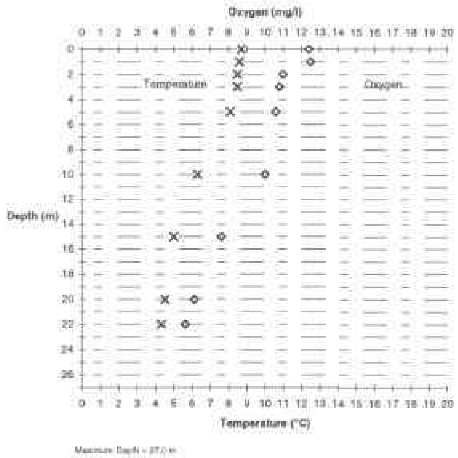
Oxygen/Temperature Profiles

(4 stations)

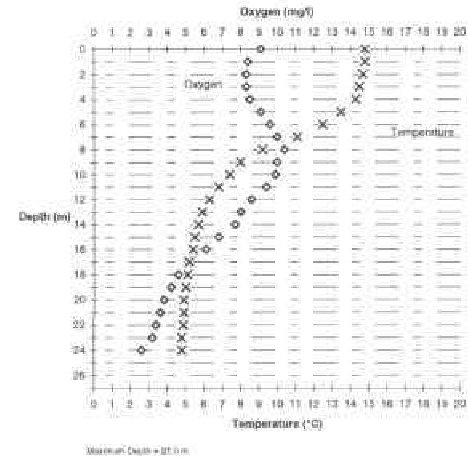
Lake: **Dina #1**

Main Basin Oxygen/Temperature Profiles

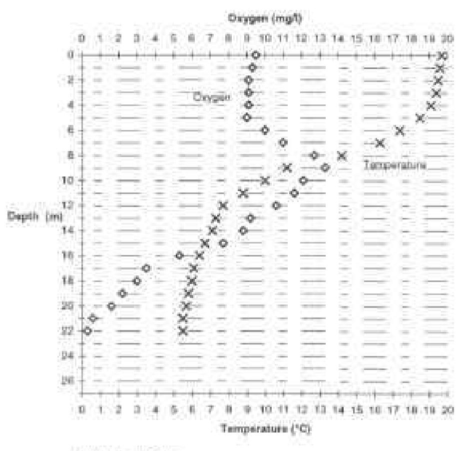
Dina Lake #1
May 24, 2000 Main Basin



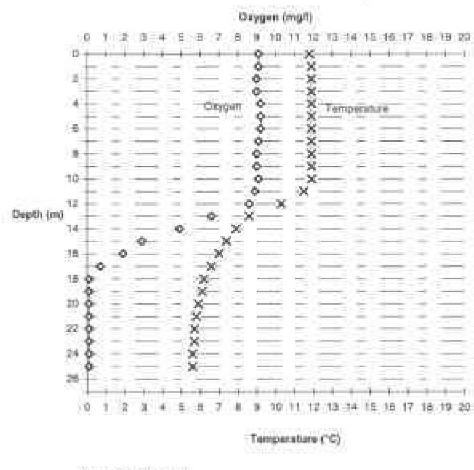
Dina Lake #1
June 20, 2000 Main Basin



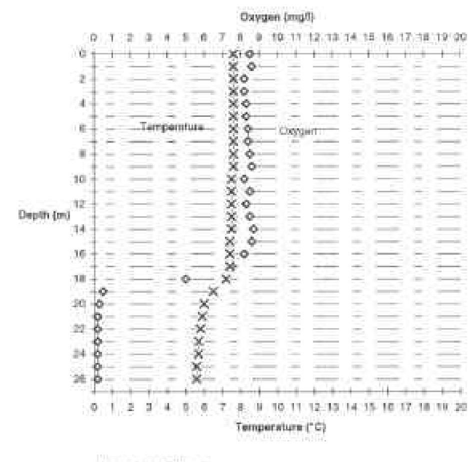
Dina Lake #1
July 24, 2000 Main Basin



Dina Lake #1
September 21, 2000 Main Basin

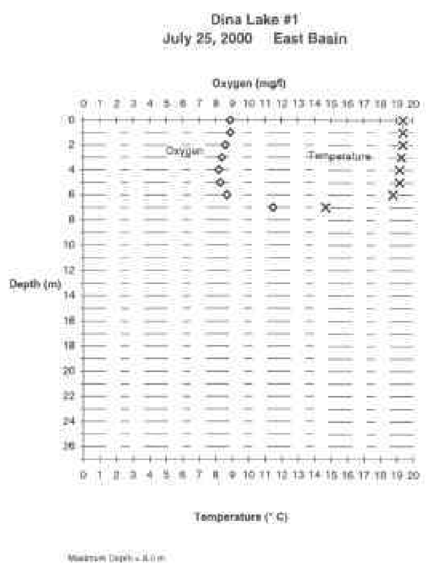


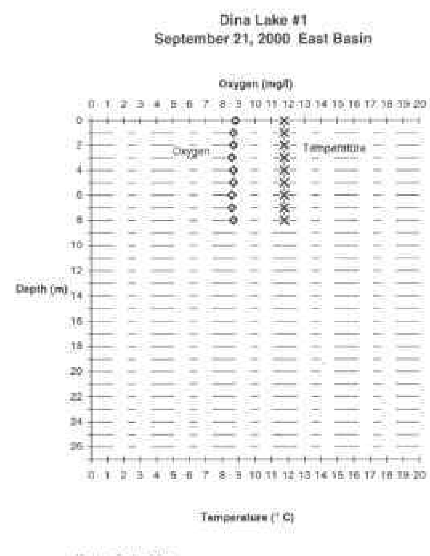
Dina Lake #1
October 23, 2000 Main Basin

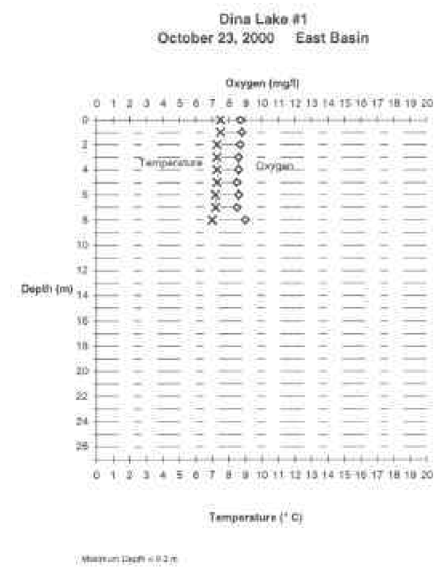


Lake: **Dina #1**

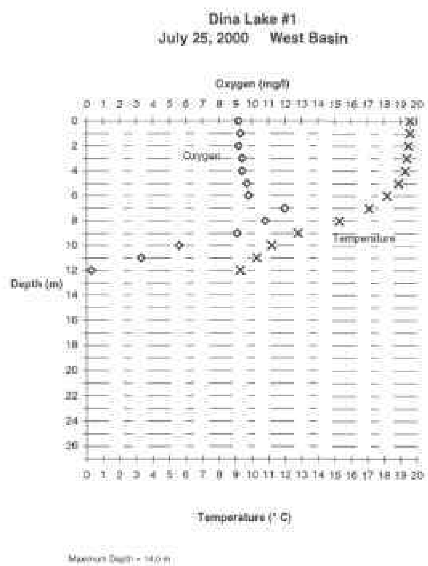
East Basin Oxygen/Temperature Profiles

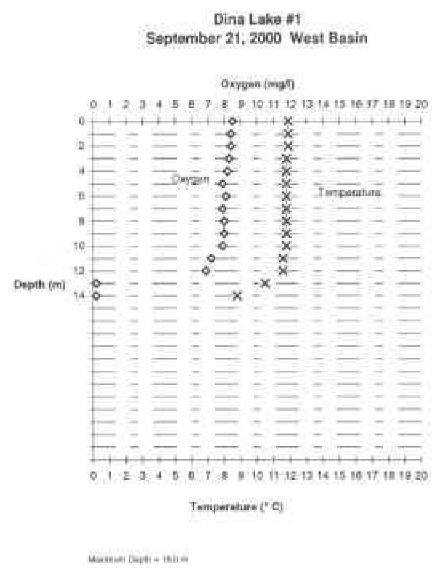


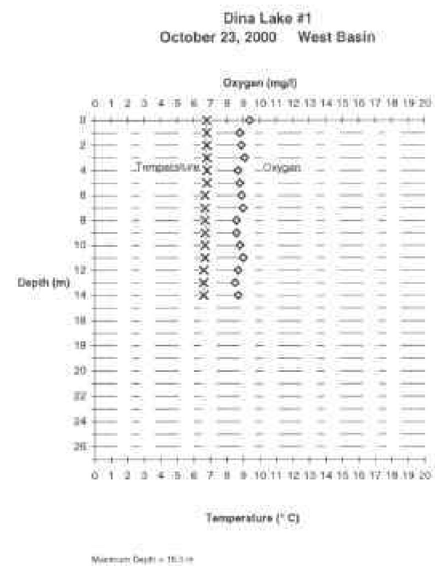




West Basin Oxygen/Temperature Profiles

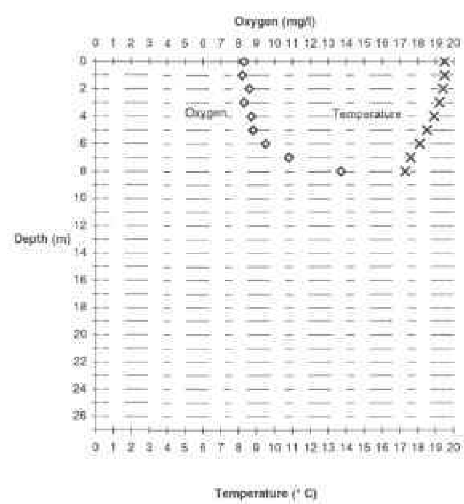






Station between the two large basins
Oxygen/Temperature Profile

Dina Lake #1 - July 25, 2000
Between two large basins



APPENDIX 5

Gee Trap Records

(Data showing hours fished, bait used, and species captured)

Lake: **Dina #1**

MAY TRIP

May 23, 2000 Gee trap sets

Trap No.	Bait	Hours Fished	Depth (m)	Substrate	Species	Number Captured	Size Range (mm)
1	Cat food, Orange Lightstick	37.5	1.0	SWD[1]/organics	LKC	3	61-63
2	Cat food, Blue Lightstick	37.5	3.0	organics	LKC	52	45-98
3	Cat food, Red Lightstick	37.5	10.0	unknown	LSU	1	93
4	Cat food, Green Lightstick	37.0	2.0	organics	LKC	0	n/a
5	Cat food, Purple Lightstick	37.0	4.0	organics	LKC	20	46-93
6	Cat food, Pink Lightstick	37.0	1.0	organics and weeds	LKC	2	80-94

[1]SWD = small woody debris

- Gee traps were set just before nightfall on May 23. The next morning, the traps were checked for fish presence. All lake chub and longnose suckers were measured, enumerated, and then released. The bait was checked and replaced if there was not enough present. The traps were reset again for another day. They were then pulled on the next morning (May 25). All new fish were measured and counted again. The number captured column contains the two day total catch for each trap.

May 24, 2000 Gee trap sets

Trap No.	Bait	Hours Fished	Depth (m)	Substrate	Species	Number Captured	Size Range (mm)
1	Cat food	25.0	1.0	Traps suspended	n/a	0	n/a
	Sardines		5.0	within the water	n/a	0	n/a
	Cat food		10.0	column.	n/a	0	n/a
	Sardines		15.0		n/a	0	n/a
	Cat food		20.0		n/a	0	n/a
	Sardines		25.0		n/a	0	n/a
2	Cat food	23.0	0.95	SWD, LWD and organics	n/a	0	n/a
3	Sardines	22.5	1.6	LWD and organics	LKC	1	80
4	Cat food	22.5	0.7	Leaves and SWD	LKC	1	62
5	Cat food	22.5	2.1	organics	LKC	1	72
6	Cat food	23.0	4.7	organics	n/a	0	n/a
7	Cat food	22.5	9.0	unknown	n/a	0	n/a
S	Cat food	22.5	1.2	SWD, LWD, and organics	LKC	27	47-93
9	Cat food	22.0	2.5	unknown	n/a	0	n/a

SWD = small woody debris, LWD = large woody debris

- Traps #2, #3, and #7 had nylon stocking put around the sides to increase capture efficiency for very small fish.

Lake: Dina #1

<u>May 25, 2000 Gee trap sets</u>

Trap No.	Bait	Hours Fished	Depth (m)	Substrate	Species	Number Captured	Size Range (mm)
1	Cat food, bacon, cheese	23.0	4.3	Organics, SWD	LKC	18	not recorded
2	Cat food, bacon, cheese	23.0	2.0	Organics, SWD	LKC	37	not recorded
3	Cat food, bacon, cheese	23.0	1.6	Organics, LWD	LKC	1	not recorded
4	Cat food, bacon, cheese	23.0	1.5	Organics, LWD	LKC	4	not recorded
5	Cat food, bacon, cheese	23.0	2.4	unknown	LKC	2	not recorded
6	Cat food, bacon, cheese	23.0	3.7	unknown	LKC	6	not recorded
7	Cat food, bacon, cheese	23.0	2.3	unknown	LKC	16	not recorded
8	Cat food, bacon, cheese	23.0	3.3	unknown	n/a	0	n/a
9	Cat food, bacon, cheese	23.0	10.0	unknown	LKC	1	not recorded
10	Sardines, bacon, cheese	23.0	1.5	Organics. LWD	n/a	0	n/a
11	Cat food	22.75	1.5	Organics, LWD	LKC	2	not recorded
12	Cat food, bacon, cheese	22.5	8.7	unknown	LKC	1	not recorded
13	Cat food, bacon, cheese	22.5	3.3	unknown	LKC	97	not recorded
14	Cat food, bacon, cheese	22.5	3.3	unknown	LKC	50	not recorded
15	Cheese and bacon was used for all suspended traps.	22.0	1.0	Traps suspended within the water column.	n/a	0	n/a
			5.0		n/a	0	n/a
			10.0		n/a	0	n/a
			15.0		n/a	0	n/a
			20.0		n/a	0	n/a
			22.0		n/a	0	n/a

[1]SWD = small woody debris, [2]LWD = large woody debris

- Traps #8, #10, #13, and all of #15 had nylon stocking put around the sides to increase capture efficiency for very small fish.

Lake: **Dina #1**

JUNE TRIP

June 22, 2000 Gee trap sets

Trap No.	Bait	Hours Fished	Depth (m)	Substrate	Species	Number Captured	Size Range (mm)
1	1 lake chub	17.0	9.3	unknown	none	0	n/a
2	cat food and 1 lake chub	17.0	10.0	unknown	none	0	n/a
3	2 dead pygmy whitefish	17.0	12.0	unknown	none	0	n/a
4	2 dead pygmy whitefish and 2 lake chub	17.0	7.9	unknown	none	0	n/a
5	4 dead pygmy whitefish	17.0	8.0	unknown	none	0	n/a

- Gee traps were set around 4:30 P.M. on June 22. Instead of using traditional Gee trap bait, different combinations of fish were used. These fish were obtained from previous gill net sets. The next morning, the traps were checked for fish presence at 9:30 A.M. on June 23. No fish were captured.

JULY TRIP

July 26, 2000 Gee trap sets

Trap No.	Bait	Hours Fished	Depth (m)	Substrate	Species	Number Captured	Size Range (mm)
1	Red blood worms and	46.0	7.5	unknown	none	0	n/a
	1 dead lake chub				leech	1	n/a
2	Red blood worms	46.0	8.4	unknown	LSU	4	n/a
					LKC	4	n/a
3	Red blood worms	46.0	8.1	unknown	LSU	1	n/a
	and 1 live lake chub				LKC	9	n/a
4	Red blood worms and 2 live	46.0	10.0	unknown	none	0	n/a
	pygmy whitefish				both	PW died	

- Gee traps were set around 11:45 A.M. on July 26. Instead of using traditional Gee trap bait, different combinations of fish/blood worms were used. These fish were obtained from previous gill net sets. The next morning, the traps were checked for fish presence at 5:45 A.M. on July 27. Lake chub and longnose suckers were captured but no pygmy whitefish were captured. The traps were reset again overnight. The next morning, the traps were finally pulled on July 28 at 9:45 A.M. No pygmy whitefish were captured.

OCTOBER TRIP

October 26, 2000 Gee trap set

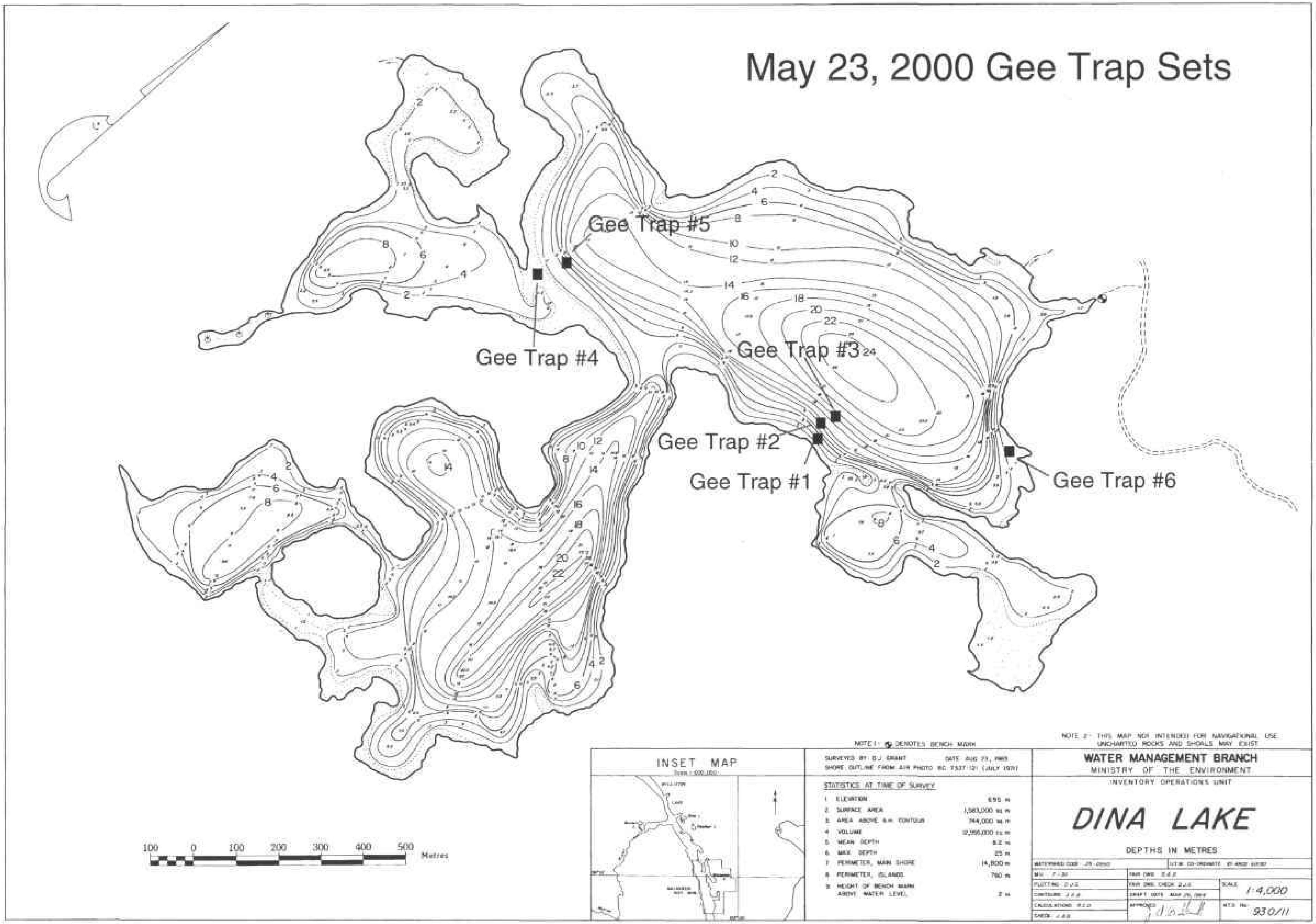
Trap No.	Bait	Hours fished	Depth (m)	Substrate	Species	Number captured	Size Range (mm)
1	4 live pygmy whitefish	20.0	1.75	Organics and SWD[1]	none	0	n/a

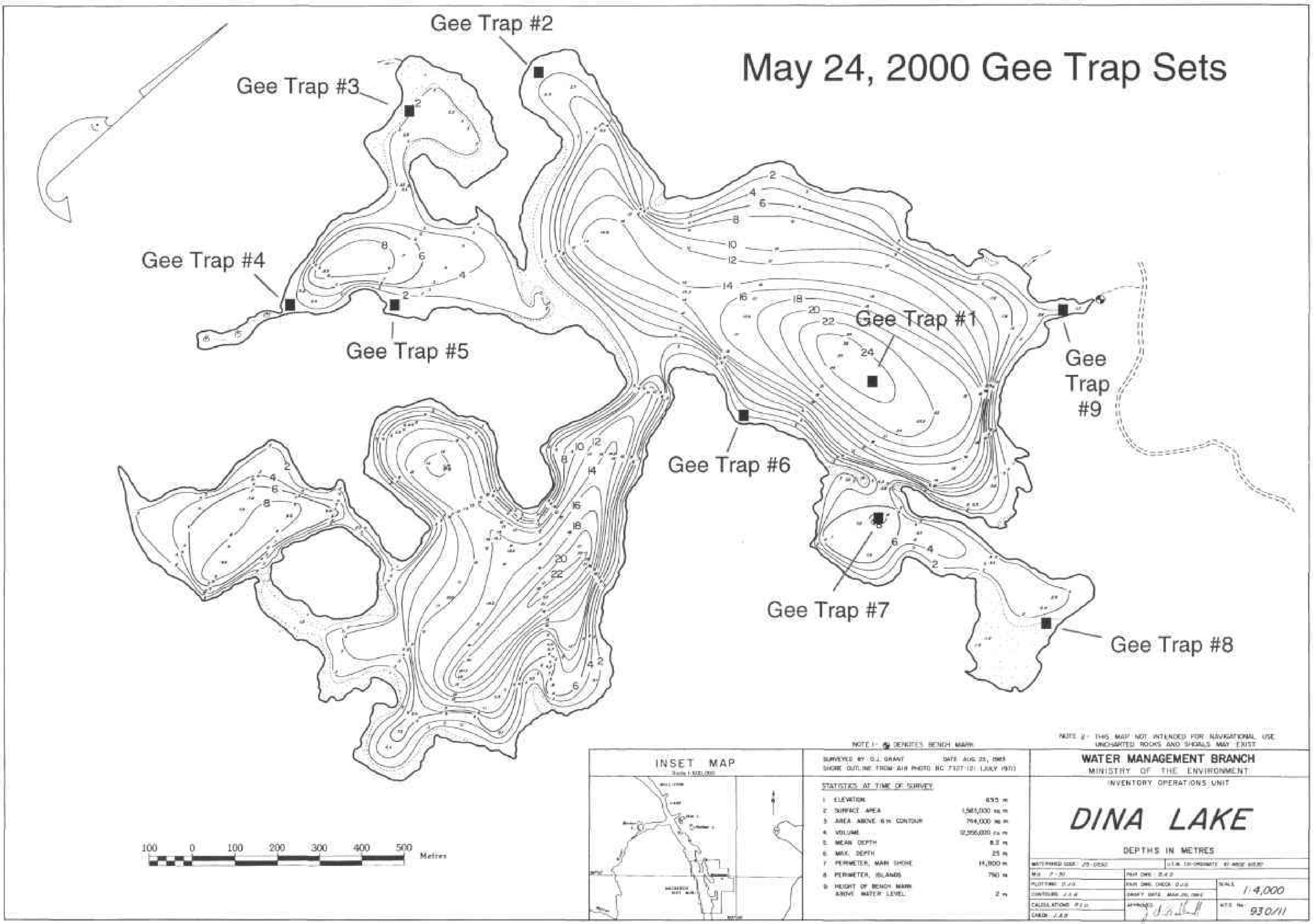
[1]SWD = small woody debris

- In gill net set #8, 4 pygmy whitefish were captured alive. These fish were put in this minnow trap and was set overnight. The next morning, the trap was checked and no new pygmy whitefish were enticed into the trap. All 4 fish were still alive.

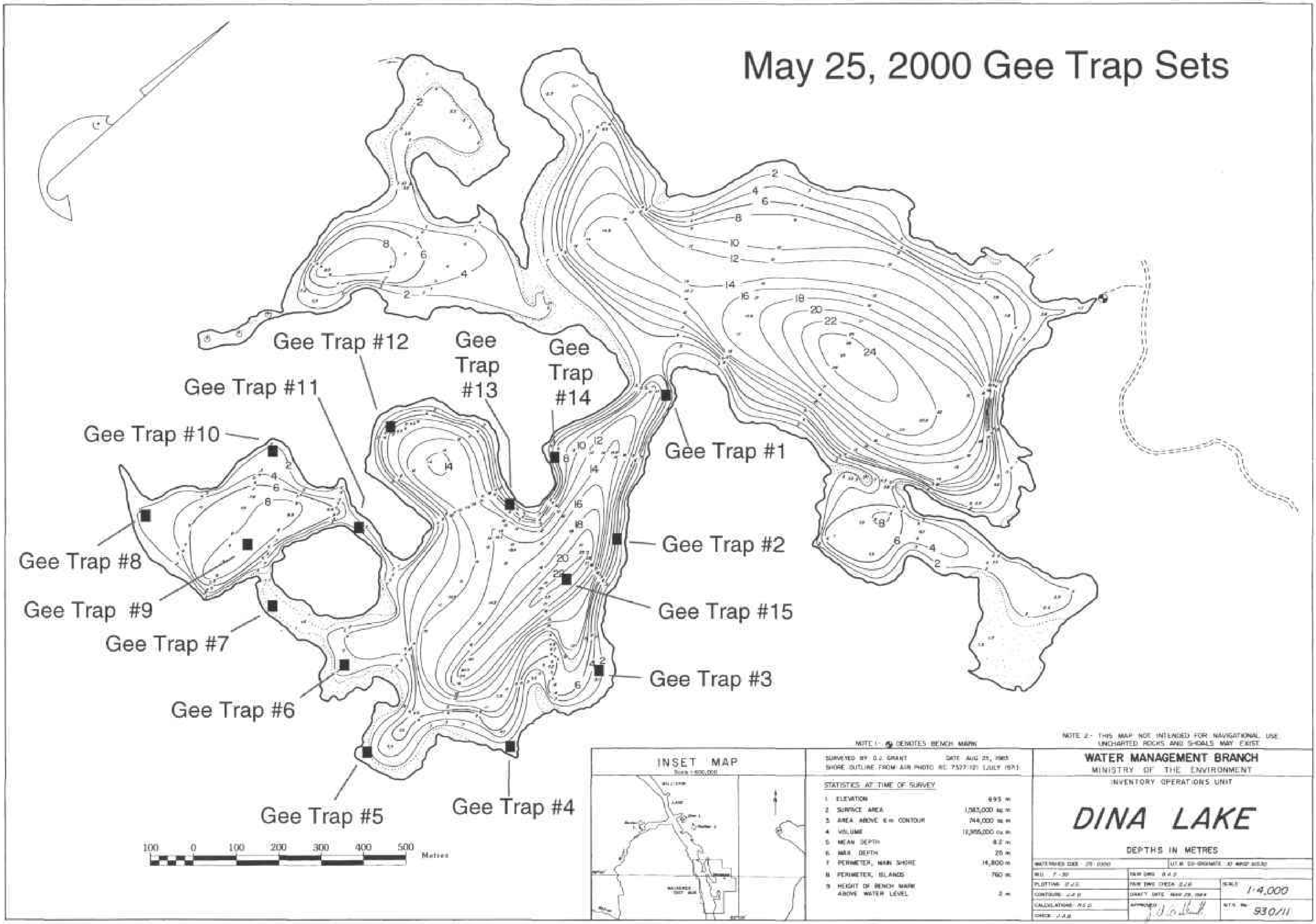
APPENDIX 6

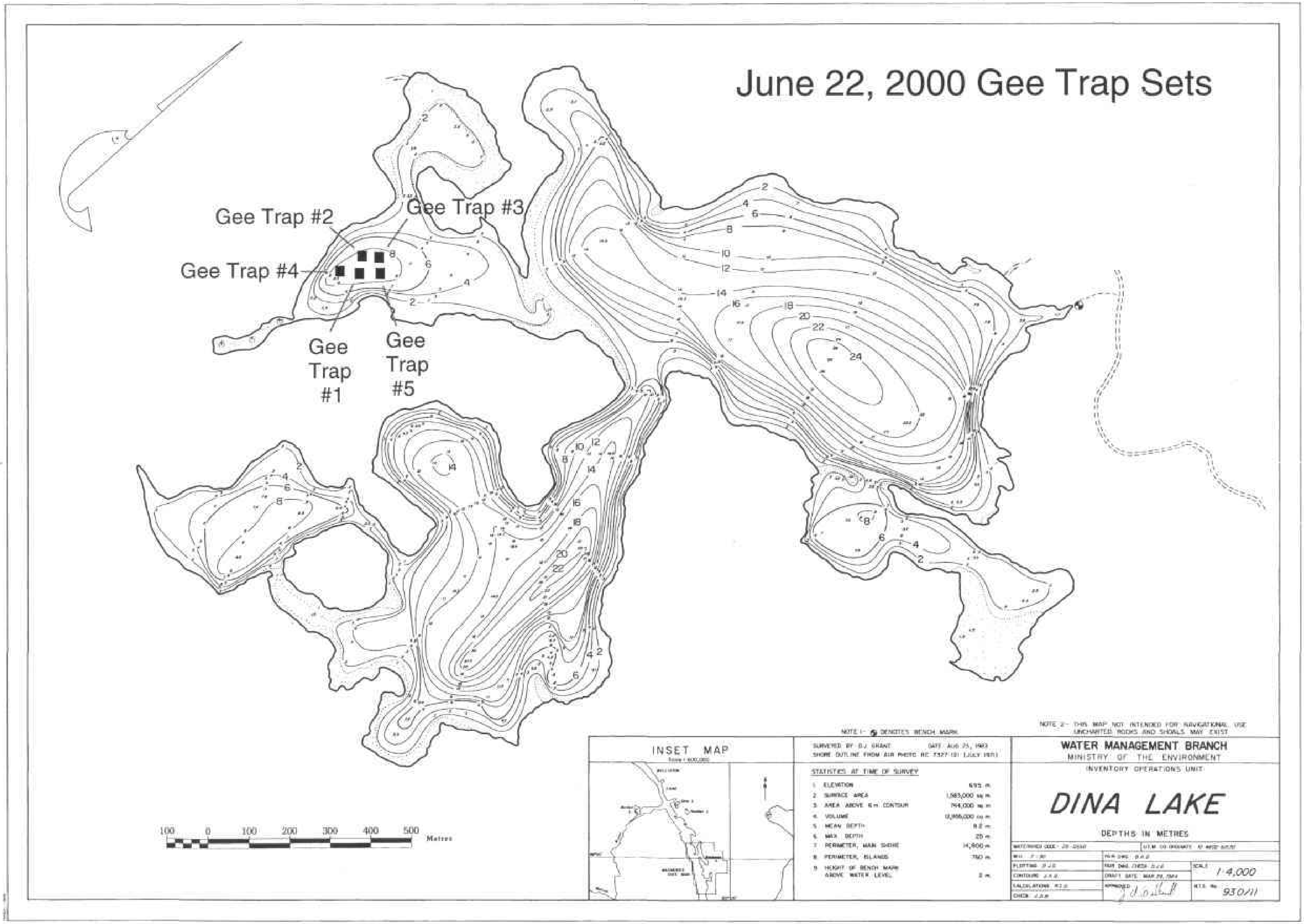
Gee Trap Locations


May 23, 2000 Gee Trap Sets
Gee Trap #1
Gee Trap #2
Gee Trap #3
Gee Trap #4
Gee Trap #5
Gee Trap #6
100 0 100 200 300 400 500 Metres
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY D.J. GRANT
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m
2 SURFACE AREA 1,583,000 sq m
3 AREA ABOVE 6 m CONTOUR 744,000 sq m
4 VOLUME 12,955,000 cu m
5 MEAN DEPTH 8.2 m
6 MAX. DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 760 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
930/11

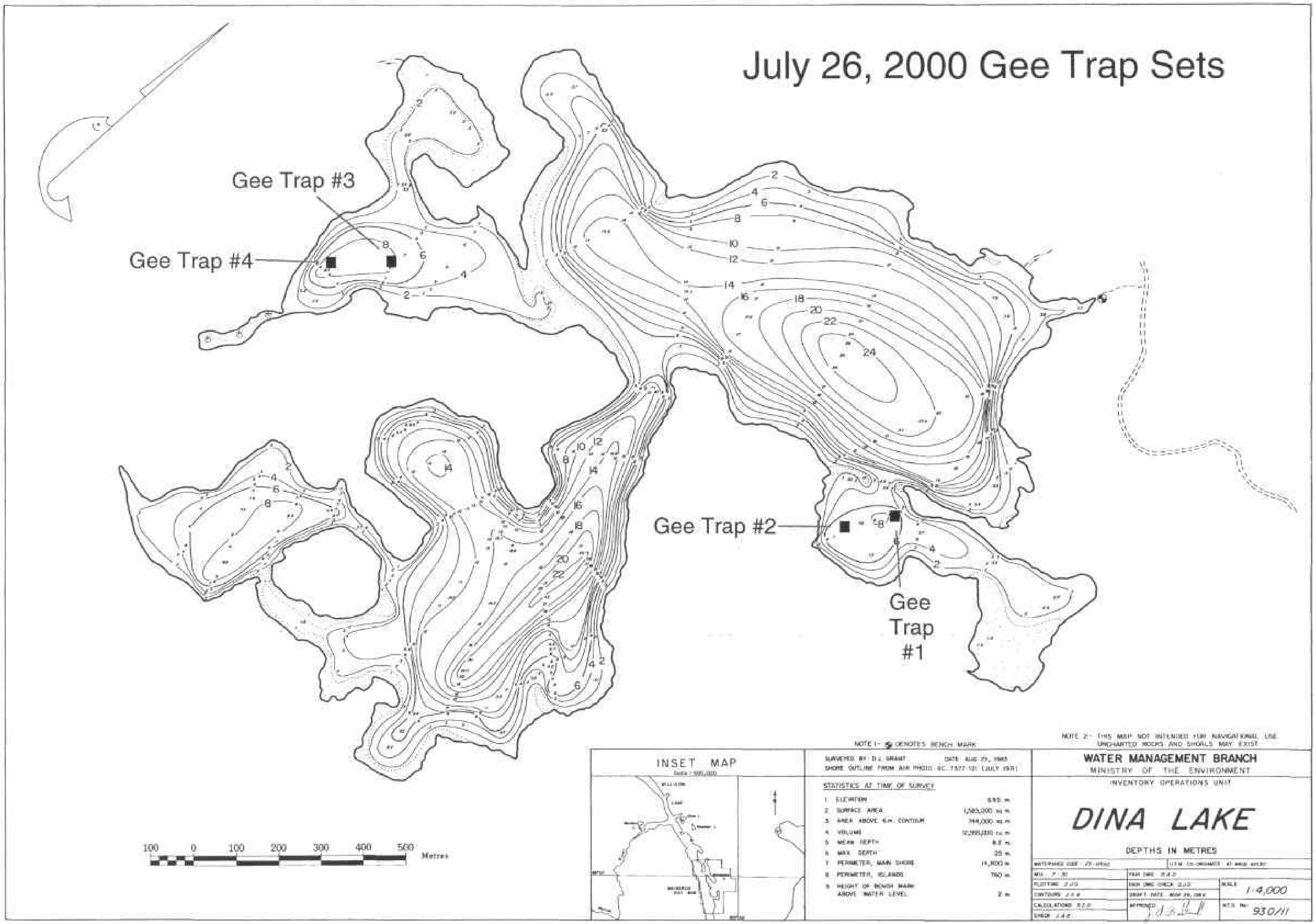

May 24, 2000 Gee Trap Sets
Gee Trap #1
Gee Trap #2
Gee Trap #3
Gee Trap #4
Gee Trap #5
Gee Trap #6
Gee Trap #7
Gee Trap #8
Gee Trap #9
INSET MAP
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE UNCHARTED ROCKS AND SHOALS MAY EXIST
SURVEYED BY D.J. GRANT DATE AUG 23, 1983
SHORE OUTLINE FROM AIR PHOTO BC 7327 (JULY 1971)
STATISTICS AT TIME OF SURVEY
1 ELEVATION 835 m
2 SURFACE AREA 1,583,000 sq m
3 AREA ABOVE 6 m CONTOUR 794,000 sq m
4 VOLUME 12,355,000 cu m
5 MEAN DEPTH 8.2 m
6 MAX. DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 750 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
930/11
100 0 100 200 300 400 500 Metres

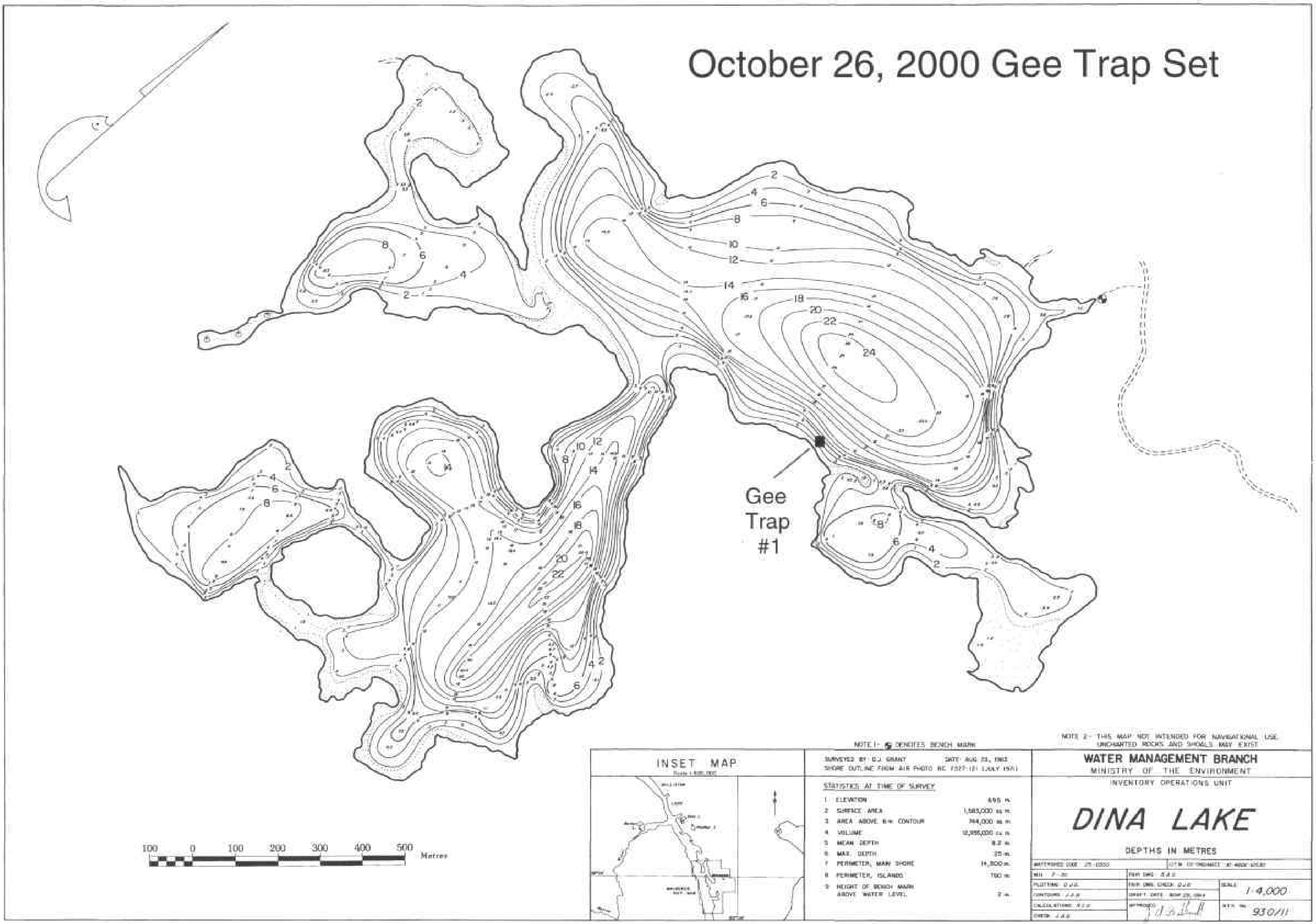
May 25, 2000 Gee Trap Sets





June 22, 2000 Gee Trap Sets
Gee Trap #1
Gee Trap #2
Gee Trap #3
Gee Trap #4
Gee Trap #5
100 0 100 200 300 400 500 Metres
INSET MAP
NOTE 1- DENOTES BENCH MARK
NOTE 2- THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m
2 SURFACE AREA 1,083,000 sq m
3 AREA ABOVE 6 m CONTOUR 744,000 sq m
5 MEAN DEPTH 8.2 m
6 MAX DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 780 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
93O/11


July 26, 2000 Gee Trap Sets
Gee Trap #1
Gee Trap #2
Gee Trap #3
Gee Trap #4
100 0 100 200 300 400 500 Metres
NOTE 1- DENOTES BENCH MARK
NOTE 2- THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY: D.J. GRANT
DATE: AUG 25, 1983
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m
2 SURFACE AREA 1,585,000 sq m
3 AREA ABOVE 6 m CONTOUR 744,000 sq m
4 VOLUME 12,995,000 cu m
5 MEAN DEPTH 8.2 m
6 MAX DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 760 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
N.T.S. No. 93O/11


October 26, 2000 Gee Trap Set
Gee Trap #1
100 0 100 200 300 400 500 Metres
NOTE 1- DENOTES BENCH MARK
NOTE 2- THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY D.J. GRANT DATE: AUG 23, 1983
SHORE OUTLINE FROM AIR PHOTO BC 7327-121 (JULY 1971)
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m.
2 SURFACE AREA 1,583,000 sq. m.
3 AREA ABOVE 6 m CONTOUR 744,000 sq. m.
4 VOLUME 12,955,000 cu. m.
5 MEAN DEPTH 8.2 m.
6 MAX. DEPTH 25 m.
7 PERIMETER, MAIN SHORE 14,800 m.
8 PERIMETER, ISLANDS 750 m.
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m.
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
930/11

APPENDIX 7

Gill Netting Records

(Data showing hours fished, substrate, and species captured)

JUNE TRIP

NETTING SITE #1

Type:	Sinking monofilament gill net		
	1 panel		
Date Set:	June 20, 2000	Time:	1315 hrs
Date Lifted:	June 21, 2000	Time:	1115 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	15.0m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	16.0m unknown

Comments:

Net pulled at 1610 on June 20, no fish captured. Net was reset to fish overnight. Net pulled at 1115 on June 21, captured one pygmy whitefish near the lead line.

NETTING SITE #2

Type:	Sinking monofilament gill net		
	2 panels		
Date Set:	June 20, 2000	Time:	1330 hrs
Date Lifted:	June 21,2000	Time:	1125 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	26.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	26.0 m unknown

Comments:

Net pulled at 1615 on June 20, no fish captured. Net was reset to fish overnight. Net pulled at 1125 on June 21, captured 6 pygmy whitefish. These six fish were captured in both panels near the lead line.

NETTING SITE #3

Type:	Sinking monofilament gill net 1 panel		
Date Set:	June 21, 2000	Time:	1415 hrs
Date Lifted:	June 21, 2000	Time:	1620 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	7.8 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	8.3 m unknown

Comments:

Net pulled at 1620 on June 21, captured 9 pygmy whitefish.

NETTING SITE #4

Type:	Sinking monofilament gill net 1 panel		
Date Set:	June 21, 2000	Time:	1430 hrs
Date Lifted:	June 22, 2000	Time:	0950 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	18.0m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	18.0m unknown

Comments:

Net was set to fish overnight. Net was pulled at 0950 on June 22, captured 28 pygmy whitefish.

NETTING SITE #5

Type:	Sinking monofilament gill net 2 panels		
Date Set:	June 21, 2000	Time:	1435 hrs
Date Lifted:	June 22, 2000	Time:	0925 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	20.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	24.0 m unknown

Comments:

Net was set to fish overnight. Net pulled at 0925 on June 22, captured 47 pygmy whitefish. There were 25 pygmy whitefish captured in the 14 mm panel while 22 pygmy whitefish were captured in the 25 mm panel.

NETTING SITE #6

Type:	Sinking monofilament gill net 1 panel		
Date Set:	June 21, 2000	Time:	1455 hrs
Date Lifted:	June 22, 2000	Time:	1015 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	10.0 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	12.0 m unknown

Comments:

Net was set to fish overnight. Net pulled at 1015 on June 22, captured 7 pygmy whitefish.

NETTING SITE #7

Type:	Sinking monofilament gill net 2 panels		
Date Set:	June 22, 2000	Time:	1045 hrs
Date Lifted:	June 22, 2000	Time:	1430 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	10.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	10.0 m unknown

Comments:

Net was set in the second main basin of the lake to verify pygmy whitefish presence. Net pulled at 1430 on June 22, captured 8 pygmy whitefish. There were 3 pygmy whitefish captured in the 14 mm panel, while a total of 5 pygmy whitefish were captured in the 25 mm panel.

NETTING SITE #8

Type:	Sinking monofilament gill net 1 panel		
Date Set:	June 22, 2000	Time:	1100 hrs
Date Lifted:	June 22, 2000	Time:	1500 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	8.0 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	8.0 m unknown

Comments:

Net pulled at 1500 on June 22, captured zero fish.

NETTING SITE #9

Type:	Sinking monofilament gill net 1 panel		
Date Set:	June 22, 2000	Time:	1525 hrs
Date Lifted:	June 23, 2000	Time:	0915 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	8.5 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	8.5 m unknown

Comments:

Net was set to fish overnight. Net pulled at 0915 on June 23, captured 52 pygmy whitefish. Of these fish, 6 were released alive and 2 were crushed (not sampled).

NETTING SITE #10

Type:	Sinking monofilament gill net 1 panel		
Date Set:	June 23, 2000	Time:	1000 hrs
Date Lifted:	June 23, 2000	Time:	1230 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	4.5 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	5.0m unknown

Comments:

Net pulled at 1230 on June 23, captured zero fish.

JULY TRIP

NETTING SITE #1

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 24, 2000	Time:	1550 hrs
Date Lifted:	July 24, 2000	Time:	1740 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	4.5 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	5.5 m unknown

Comments:

Net pulled the same day (June 24), captured zero fish.

NETTING SITE #2

Type:	Sinking monofilament gill net 2 panels		
Date Set:	June 25, 2000	Time:	1810 hrs
Date Lifted:	June 25, 2000	Time:	2129 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	26.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	26.0 m unknown

Comments:

Net was set during the evening for about three hours. Net was pulled and captured zero fish. This area (where the nets were fishing) could be anoxic for pygmy whitefish.

NETTING SITE #3

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 25, 2000	Time:	1825 hrs
Date Lifted:	July 25, 2000	Time:	2142 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	9.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	9.0 m unknown

Comments:

Net was set during the evening for about three hours. Net was pulled and 2 pygmy whitefish were captured. These two fish were netted in the 14 mm panel.

NETTING SITE #4

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 25, 2000	Time:	1845 hrs
Date Lifted:	July 25, 2000	Time:	2200 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	14.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	14.0m unknown

Comments:

Net was set during the evening for about three hours. Net was pulled and 1 pygmy whitefish was captured. This fish was netted in the 25 mm panel.

NETTING SITE #5

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 26, 2000	Time:	1020 hrs
Date Lifted:	July 26, 2000	Time:	1610 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	19.0m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	19.0m unknown

Comments:

Net was set throughout the day. Net was pulled and captured 3 pygmy whitefish. All 3 fish were captured in the 25 mm panel (2 were by the lead line and one was by the float line).

NETTING SITE #6

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 26, 2000	Time:	1033 hrs
Date Lifted:	July 26, 2000	Time:	1623 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	9.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	9.0 m unknown

Comments:

Net was set throughout the day. Net was pulled and captured zero fish.

NETTING SITE #7

Type:	Sinking monofilament gill net		
	2 panels		
Date Set:	July 26, 2000	Time:	1058 hrs
Date Lifted:	July 26, 2000	Time:	1658 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth:	14.0 m
		Substrate:	unknown
Deep End Mesh Size:	25 mm	Depth:	14.0 m
		Substrate:	unknown

Comments:

Net was set throughout the day. Net was pulled and captured 27 pygmy whitefish and 1 rainbow trout (preying on a pygmy whitefish). There were 22 pygmy whitefish captured in the 14 mm panel and the remaining 5 were captured in the 25 mm panel.

NETTING SITE #8

Type:	Sinking monofilament gill net		
	2 panels		
Date Set:	July 27, 2000	Time:	0510 hrs
Date Lifted:	July 27, 2000	Time:	0820 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth:	22.0 m
		Substrate:	unknown
Deep End Mesh Size:	25 mm	Depth:	22.0 m
		Substrate:	unknown

Comments:

Net was set and pulled in the morning and captured 1 pygmy whitefish. This fish was captured in the 25 mm panel and was still half alive.

NETTING SITE #9

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 27, 2000	Time:	0517 hrs
Date Lifted:	July 27, 2000	Time:	0835 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	9.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	9.0 m unknown

Comments:

Net was set and pulled in the morning and captured zero pygmy whitefish. There was one lake chub captured in the 25 mm panel.

NETTING SITE #10

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 27, 2000	Time:	0527 hrs
Date Lifted:	July 27, 2000	Time:	0859 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	14.0m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	15.0m unknown

Comments:

Net was set and pulled in the morning and captured zero pygmy whitefish. The pygmy whitefish do not appear to be very active just after the onset of daylight at this time of year based on the results of net sets 8 to 10.

NETTING SITE #11

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 27, 2000	Time:	2037 hrs
Date Lifted:	July 28, 2000	Time:	0655 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	16.0m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	16.0m unknown

Comments:

Net was set, pulled the next morning, and captured 12 pygmy whitefish. The 14 mm panel captured 1 pygmy whitefish while the 25 mm panel captured 11 pygmy whitefish.

NETTING SITE #12

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 27, 2000	Time:	2042 hrs
Date Lifted:	July 28, 2000	Time:	0705 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	9.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	9.0 m unknown

Comments:

Net was set, pulled the next morning, and captured zero pygmy whitefish. The 25 mm panel captured 3 lake chub. It is speculated that a possible reason why no pygmy whitefish were captured at this location at this time is based on the oxygen/temperature readings (too warm water).

NETTING SITE #13

Type:	Sinking monofilament gill net 2 panels		
Date Set:	July 27, 2000	Time:	2051 hrs
Date Lifted:	July 28, 2000	Time:	0730 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	14.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	14.0m unknown

Comments:

Net was set, pulled the next morning, and captured 12 pygmy whitefish. The 14 mm panel captured 5 pygmy whitefish while the 25 mm panel captured 7 pygmy whitefish.

NETTING SITE #14

Type:	Sinking monofilament gill net 1 panel		
Date Set:	July 28, 2000	Time:	0745 hrs
Date Lifted:	July 28, 2000	Time:	0935 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	40 mm	Depth: Substrate:	15.5 m unknown
Deep End Mesh Size:	40 mm	Depth: Substrate:	15.5 m unknown

Comments:

This larger sized net was used to try and see if pygmy whitefish get any larger than the ones already previously captured (> 130 mm fork length). The net was set for about two hours and captured zero pygmy whitefish. One rainbow trout (about 1/2 of a kg) was captured.

Lake: **Dina #1**

SEPTEMBER TRIP

NETTING SITE #1

Type:	Sinking monofilament gill net 1 panel		
Date Set:	September 21, 2000	Time:	0955 hrs
Date Lifted:	September 22, 2000	Time:	1010 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	32 mm	Depth: Substrate:	see below unknown
Deep End Mesh Size:	32 mm	Depth: Substrate:	see below unknown

Comments:

This size of net was used to try and determine if pygmy whitefish get any larger than the ones already previously captured (> 130 mm fork length). The net was first set at 19 m to 20 m in depth (an area of very little to no oxygen). It was pulled at 1222 and captured one large longnose sucker. The net was reset at 16 m to 17 m in depth. The net was pulled again at 1400 and captured zero fish. The net was reset again at 14 m to 15 m in depth (little oxygen). It was pulled again at 1610 and captured zero fish. The net was set again at 12 m to 13 m in depth (more oxygen present). The net was left to fish overnight. The next morning, the net was pulled at 1010 (September 22), and captured 9 longnose suckers, 2 rainbow trout, and zero pygmy whitefish. The rainbow trout was 155 mm long and was gilled in the net.

NETTING SITE #2

Type:	Sinking monofilament gill net 1 panel (suspended)		
Date Set:	September 21, 2000	Time:	1235 hrs
Date Lifted:	September 21, 2000	Time:	1555 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	26.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	26.0 m unknown

Comments:

This net (and net set #3) was set in a vertical fashion (not horizontal). This way, the net could fish within the water column. It is unknown if the pygmy whitefish in Dina Lake #1 inhabit the midwater area of the lake. It was presumed at the time that they mainly inhabit benthic type habitat, but has not been proven. Therefore, this netting attempt was mainly to see if the net could be used in this fashion without collapsing in on itself. Plastic PVC pipes were used to separate the lead line and the float line. Both lines were marked to indicate how far off the bottom a fish was located (if it was captured). After about three hours of netting, it was pulled. The net captured no fish and stayed straight (not tangled). As a result, this type of netting will be used during the October trip. It is anticipated that the number of mortalities should be less when the net is fished in this vertical fashion.

NETTING SITE #3

Type:	Sinking monofilament gill net		
	1 panel (suspended)		
Date Set:	September 21, 2000	Time:	1300 hrs
Date Lifted:	September 21, 2000	Time:	1600 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	22.0 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	22.0 m unknown

Comments:

This net was also set in a vertical fashion (not horizontal). This way, the net could fish within the entire water column. Plastic PVC pipes were also used to separate the lead line and the float line. Both lines were also marked to indicate how far off the bottom a fish was located (if it was captured). After about three hours of netting, it was pulled. The net captured no fish and stayed fairly straight (only one small twist).

NETTING SITE #4

Type:	Sinking monofilament gill net		
	1 panel		
Date Set:	September 21, 2000	Time:	1625 hrs
Date Lifted:	September 22, 2000	Time:	0945 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	19 mm	Depth: Substrate:	9.2 m unknown
Deep End Mesh Size:	19 mm	Depth: Substrate:	9.2 m unknown

Comments:

This new net size was used to determine if there may be another age class present (between the 14 mm size net and the 25 mm net). The net was set to fish overnight. The net was pulled the next morning and captured 60 pygmy whitefish were released alive). This netting effort captured mature males getting ready to spawn and suggests that the males are generally smaller than the females. In 1998, no males were captured in the 25 mm panel at this time of year.

NETTING SITE #5

Type:	Sinking monofilament gill net 2 panels		
Date Set:	September 21, 2000	Time:	1634 hrs
Date Lifted:	September 22, 2000	Time:	0928 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	10.0m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	13.0m unknown

Comments:

Net was set to fish overnight. Net pulled the next morning and captured 5 pygmy whitefish. The 14 mm panel captured 1 pygmy whitefish while the 25 mm panel captured the remaining 4 pygmywhitefish.

OCTOBER TRIP

NETTING SITE #1

Type:	Sinking monofilament gill net 1 panel		
Date Set:	October 24, 2000	Time:	1020 hrs
Date Lifted:	October 24, 2000	Time:	1640 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	1.5 m organics, SWD
Deep End Mesh Size:	25 mm	Depth: Substrate:	4.1 m organics, LWD

Comments:

Net was set along the shoreline. It was placed here to see if there were any movements of pygmy whitefish looking for areas to spawn. Net set #2 was placed next to this one as well. Net set #1 was checked at 1350 and captured no fish. The net was checked again at 1640 and still captured no fish. The net was then pulled. After net #1 and #2 were pulled, net set #5 was placed in this location to fish overnight.

NETTING SITE #2

Type:	Sinking monofilament gill net 1 panel		
Date Set:	October 24, 2000	Time:	1030 hrs
Date Lifted:	October 24, 2000	Time:	1645 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	1.5 m organics, SWD
Deep End Mesh Size:	14 mm	Depth: Substrate:	4.1 m organics, LWD

Comments:

Net was set along the shoreline (by net set #1). Net set #2 was checked at 1355 and captured no fish. The net was checked again at 1645 and still captured no fish. The net was then pulled. Once net #1 and #2 were pulled, net set #5 was placed in this location to fish overnight.

NETTING SITE #3

Type:	Sinking monofilament gill net 1 panel (suspended)		
Date Set:	October 24, 2000	Time:	1055 hrs
Date Lifted:	October 25, 2000	Time:	1050 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	14.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	14.0 m unknown

Comments:

The net was suspended throughout the entire water column. The net was checked at 1400 and captured no fish. The net was checked again at 1620 and captured 3 pygmy whitefish. All three fish were located 20 cm off of the bottom. The net was reset to fish overnight. The net was pulled in the morning and captured 5 pygmy whitefish. One pygmy whitefish was located 7 m from the bottom while 4 pygmy whitefish were located 1.5 m from the bottom.

Lake: **Dina #1**

NETTING SITE #4

Type:	Sinking monofilament gill net 1 panel (suspended)		
Date Set:	October 24, 2000	Time:	1100 hrs
Date Lifted:	October 25, 2000	Time:	1055 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	14.0m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	14.0m unknown

Comments:

The net was suspended throughout the entire water column, approximately 15 m apart from net set #3. The net was checked at 1405 and captured no fish. The net was checked again at 1625 and captured no fish. The net was reset to fish overnight. The net was pulled in the morning and captured no fish.

NETTING SITE #5

Type:	Sinking monofilament gill net 1 panel		
Date Set:	October 24, 2000	Time:	1700 hrs
Date Lifted:	October 25, 2000	Time:	2130 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	19 mm	Depth: Substrate:	1.5 m organics, SWD
Deep End Mesh Size:	19 mm	Depth: Substrate:	4.0 m organics, SWD

Comments:

Net was set along the shoreline to fish overnight. The net was checked in the morning (1030) and captured 43 pygmy whitefish, 1 lake chub, and 1 brook trout (45 cm long, spent female). Many of the pygmy whitefish were decomposed. These fish were located about 30 cm from the bottom and in deeper water (2.5 m to 3.5 m). The net was cleaned of all fish and then reset. With many of the pygmy whitefish being decomposed, it was assumed that these fish were probably captured just after dusk. Therefore, the net was to remain in the water during the day (with periodic checks) and it would be left in the water for the first 3 hours of nightfall. The intent here was to see if the onset of darkness brings the pygmy whitefish up from the depths of the lake towards the shallows (at this time of year).

The net was checked after almost four hours (1415) and captured no fish. The net was checked again at 1652 and had no fish. The onset of darkness was at 1815 (almost dark). The net was finally pulled at 2130 (dark) and captured 14 pygmy whitefish (of which 6 of them were still alive). So it does appear that the pygmy whitefish adults do move up to the shallows at the onset of nightfall in October. These fish could be looking for areas to spawn in the future. It also appears that they are still actively eating at this time. The stomach samples appeared quite full.

Lake: **Dina #1**

NETTING SITE #6

Type:	Sinking monofilament gill net 1 panel (suspended)		
Date Set:	October 25, 2000	Time:	1120 hrs
Date Lifted:	October 27, 2000	Time:	1000 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	23 m to 16 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	23 m to 16 m unknown

Comments:

Net was set at 1120 at 23 m of depth (Oct. 25). Net was pulled at 1425 and captured no fish. The net was reset at 20 m of depth at 1430 to fish overnight. Net was pulled in the morning and captured no fish. The net was then moved to 16 m in depth (net fishing entire water column). Net was checked at 1425 (Oct. 26) and captured no fish. The net was checked again at 1640 and captured no fish. The net was left to fish overnight. The net was pulled in the morning of October 27 and captured no fish.

NETTING SITE #7

Type:	Sinking monofilament gill net 1 panel (suspended)		
Date Set:	October 25, 2000	Time:	1122 hrs
Date Lifted:	October 27, 2000	Time:	1012 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	23 m to 16 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	23 m to 16 m unknown

Comments:

Net was set at 1122 at 23 m of depth (Oct. 25). Net was pulled at 1435 and captured no fish. The net was reset at 20 m of depth at 1438 to fish overnight. Net was pulled in the morning and captured 6 pygmy whitefish. One fish was located at 12 m from the bottom, 2 were locatd at 7 m from the bottom, and 3 were located at 6 m from the bottom. The net was then moved to 16 m in depth (net fishing entire water column). Net was checked at 1430 (Oct. 26) and captured 1 pygmy whitefish (1 m from the bottom). The net was checked again at 1645 and captured no fish. The net was left to fish overnight. The net was pulled in the morning of October 27 and captured 2 pygmy whitefish and 2 longnose suckers. The pygmy whitefish were located between 1.5 m and 2.0 m off of the bottom while the suckers were located 0.5 m off of the bottom.

NETTING SITE #8

Type:	Sinking monofilament gill net 2 panels		
Date Set:	October 26, 2000	Time:	1130 hrs
Date Lifted:	October 26, 2000	Time:	1630 hrs
Net Dimensions:	Length: 30.48 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	9.5 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	9.5 m unknown

Comments:

Net was checked at 1415 and captured 1 pygmy whitefish. This fish was captured in the 25 mm panel near the lead line. The net was reset. The net was then pulled at 1630 and captured 4 pygmy whitefish. The 14 mm panel captured 3 pygmy whitefish while the 25 mm panel captured 1 pygmy whitefish. All four of these fish were still alive (and were put in a Gee trap to try and see if other pygmy whitefish could be lured into the trap).

NETTING SITE #9

Type:	Floating monofilament gill net (1 panel)		
Date Set:	October 26, 2000	Time:	1715 hrs
Date Lifted:	October 27, 2000	Time:	1030 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	Surface unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	Surface unknown

Comments:

While working on the lake, we observed some sort of fish activity at the surface but could not get close enough to them to determine what species it was. It appeared to look like something herring do when schooling at the surface. As a result, a net was set at the surface to try and determine which species this may be. The depth of the water was 13.5 m. The net was set to fish overnight. The net was pulled the next morning and captured no fish.

NETTING SITE #10

Type:	Sinking monofilament gill net 1 panel (suspended)		
Date Set:	October 27, 2000	Time:	1003 hrs
Date Lifted:	October 27, 2000	Time:	1230 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	16.0 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	16.0 m unknown

Comments:

Net was pulled after 2.5 hours and captured no fish (end of trip).

NETTING SITE #11

Type:	Sinking monofilament gill net 1 panel (suspended)		
Date Set:	October 27, 2000	Time:	1018 hrs
Date Lifted:	October 27, 2000	Time:	1233 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	16.0 m unknown
Deep End Mesh Size:	25 mm	Depth: Substrate:	16.0 m unknown

Comments:

Net was pulled after 2.5 hours and captured no fish (end of trip).

NETTING SITE #12

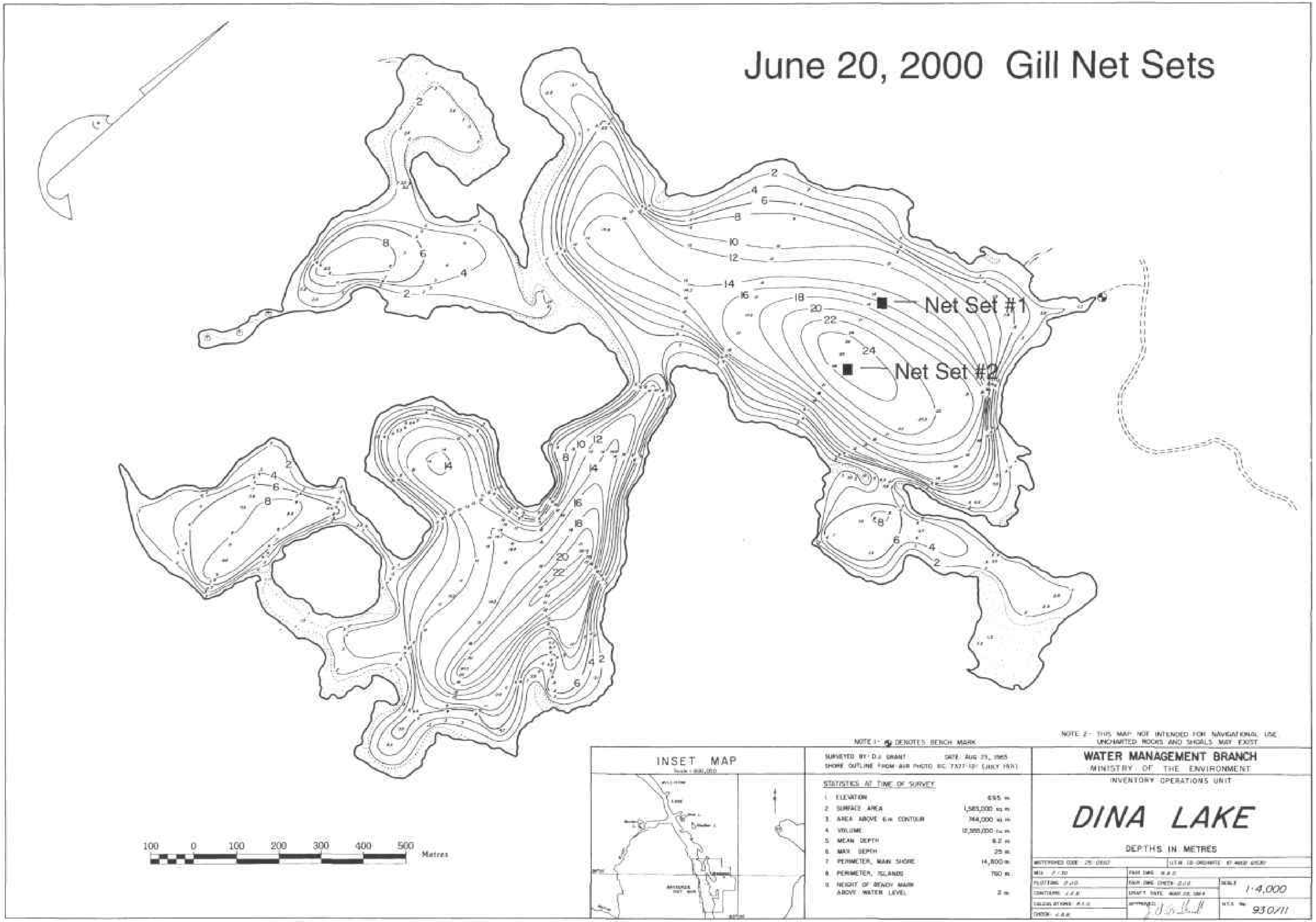
Type:	Sinking monofilament gill net 1 panel		
Date Set:	October 27, 2000	Time:	1101 hrs
Date Lifted:	October 27, 2000	Time:	1242 hrs
Net Dimensions:	Length: 15.24 m	Depth:	2.4 m
Shallow End Mesh Size:	14 mm	Depth: Substrate:	9.5 m unknown
Deep End Mesh Size:	14 mm	Depth: Substrate:	9.5 m unknown

Comments:

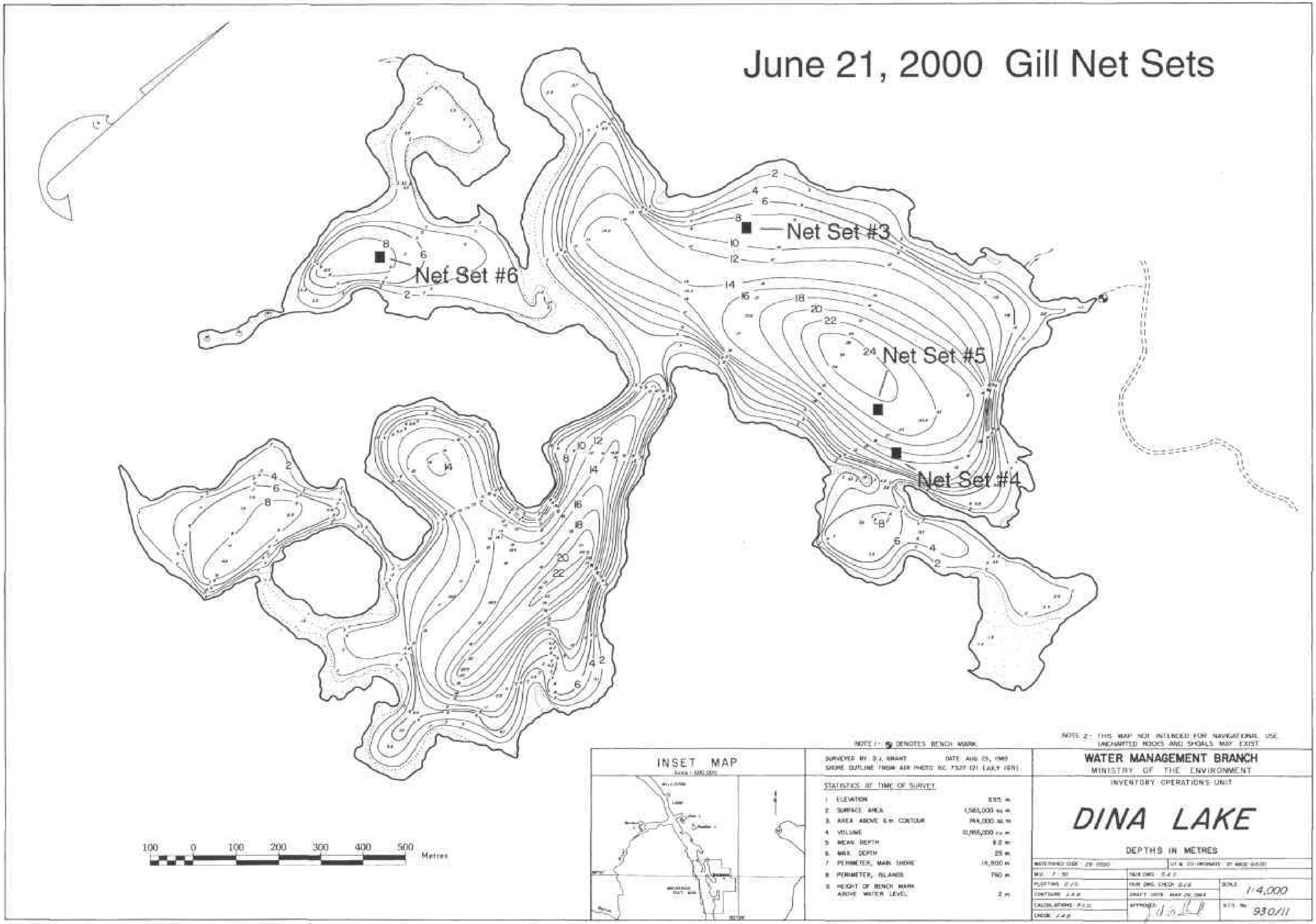
Net was pulled after 1.5 hours and captured no fish (end of trip).

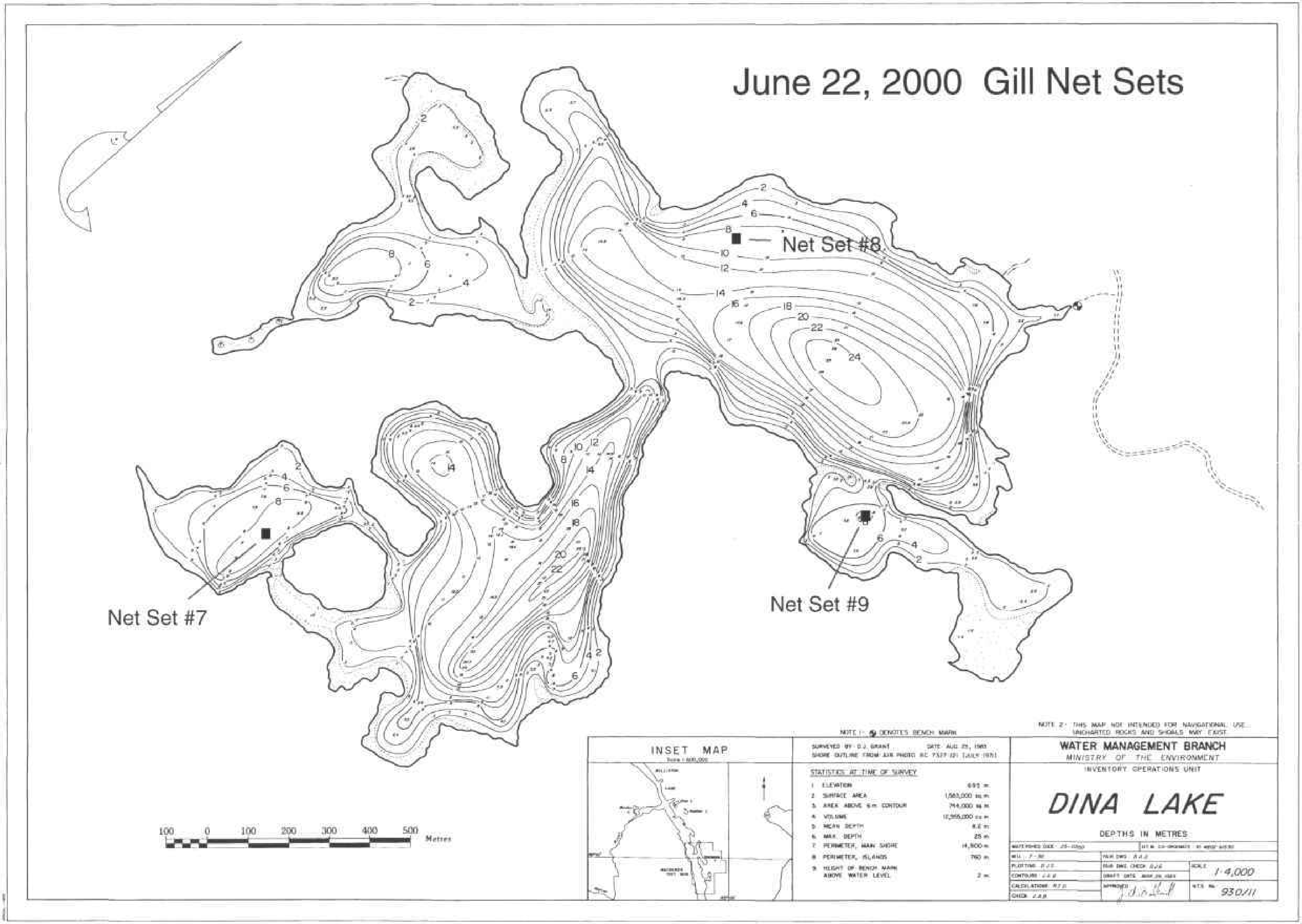
APPENDIX 8

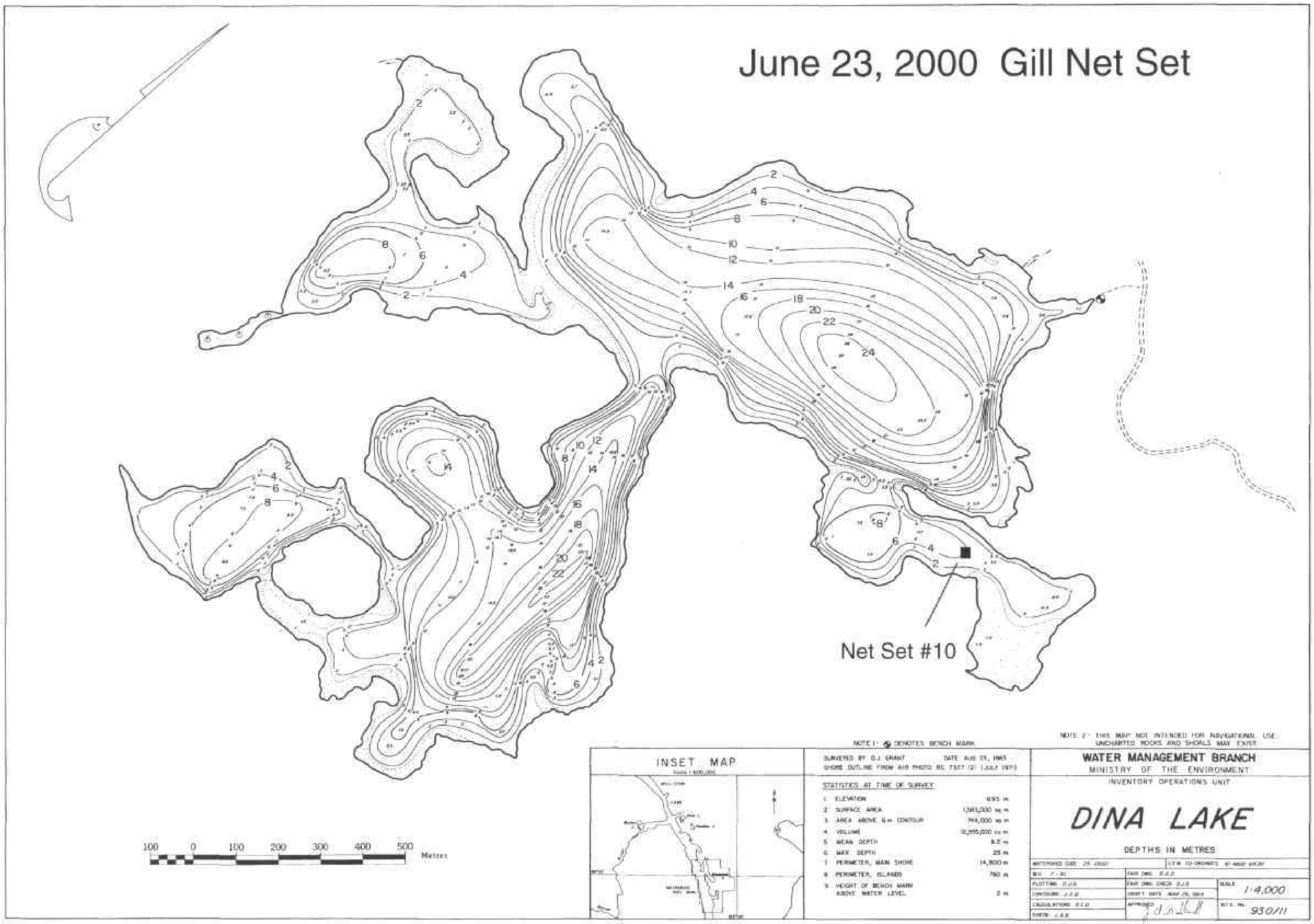
Gill Netting Locations

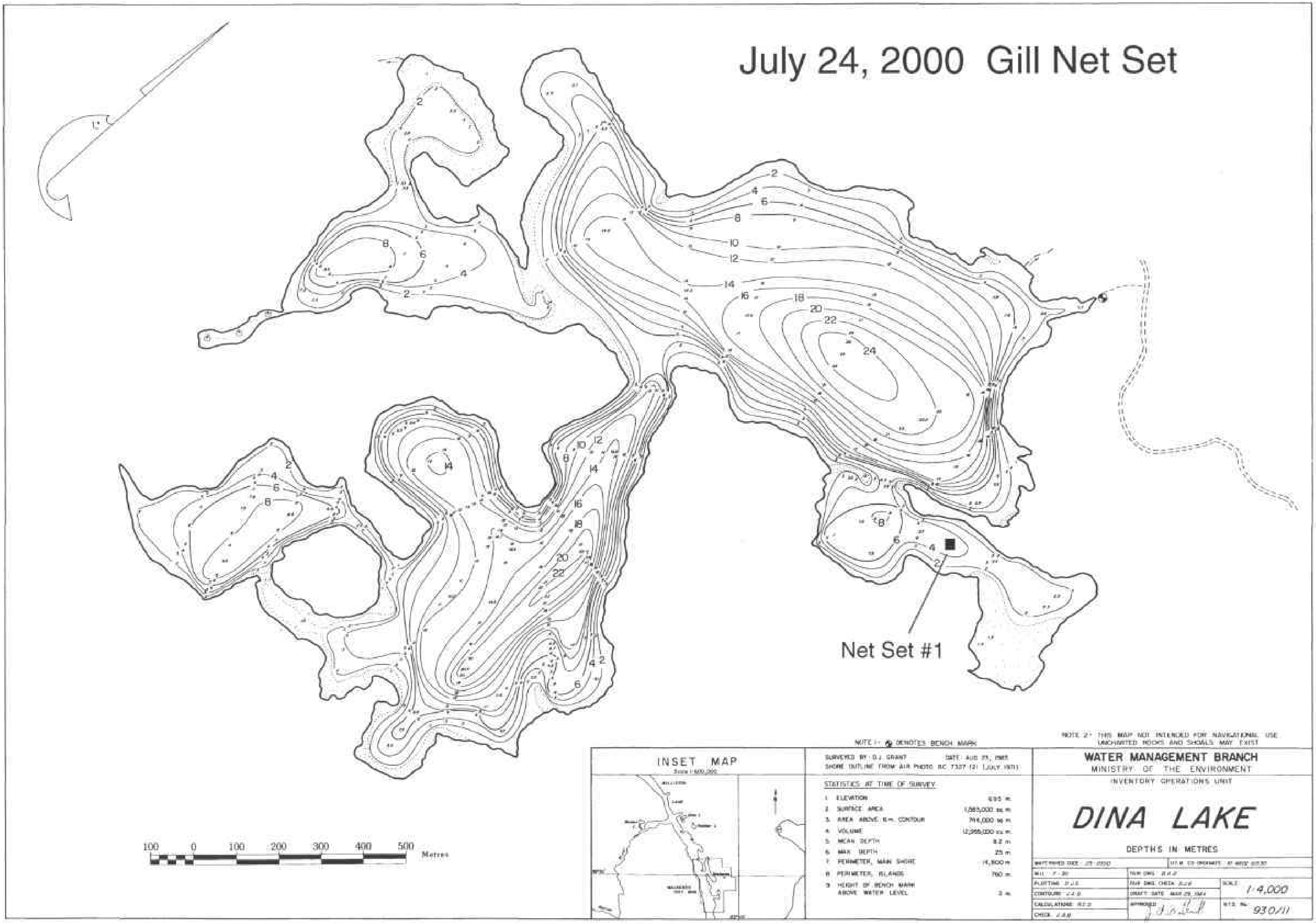


June 20, 2000 Gill Net Sets
Net Set #1
Net Set #2
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY: D.J. GRANT DATE: AUG 25, 1985
STATISTICS AT TIME OF SURVEY
1. ELEVATION 695 m
2. SURFACE AREA 1,585,000 sq m
3. AREA ABOVE 6 m CONTOUR 744,000 sq m
4. VOLUME 12,585,000 cu m
5. MEAN DEPTH 8.2 m
6. MAX DEPTH 25 m
7. PERIMETER, MAIN SHORE 14,800 m
8. PERIMETER, ISLANDS 760 m
9. HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
93O/11
100 0 100 200 300 400 500 Metres

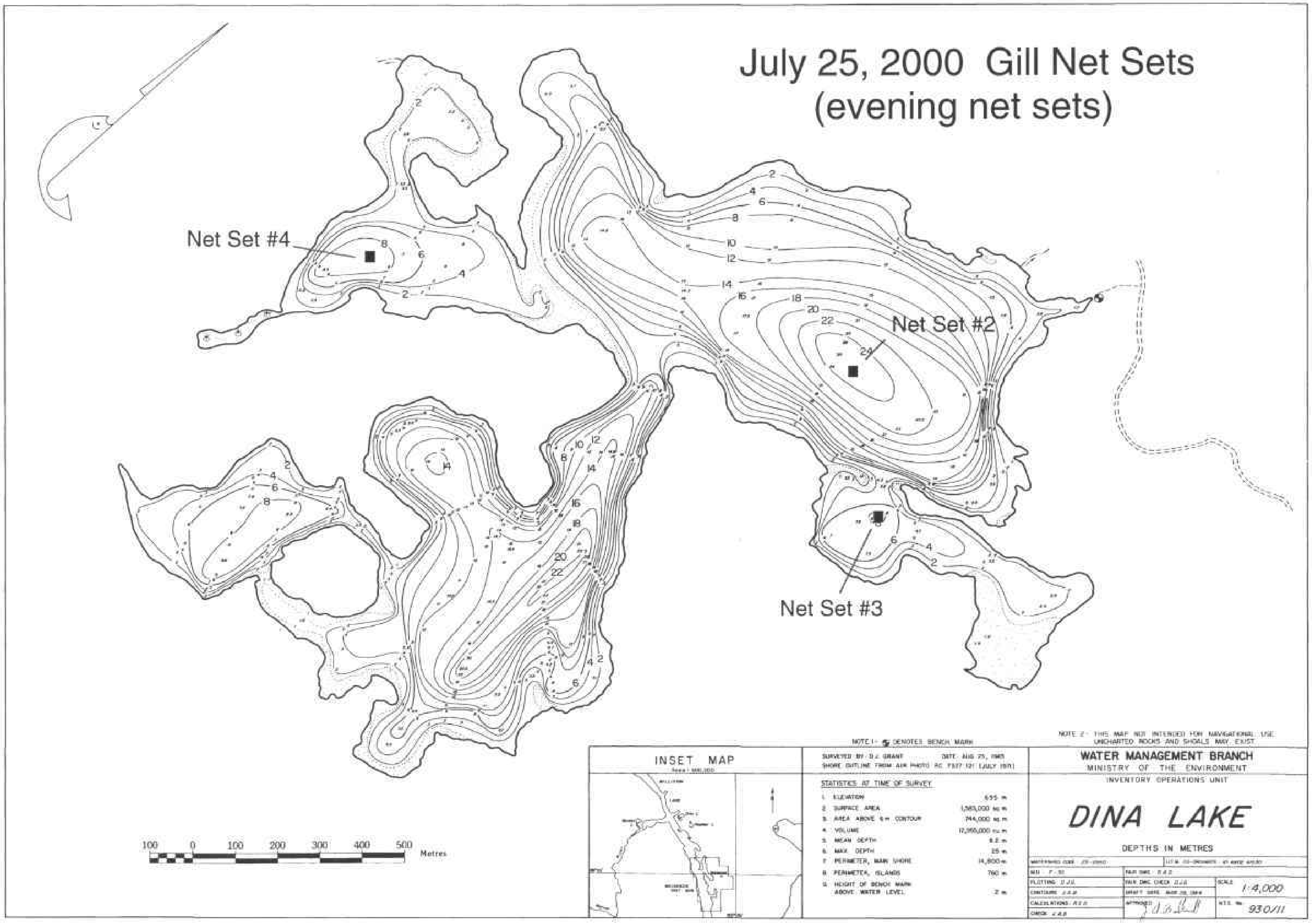

June 21, 2000 Gill Net Sets
Net Set #3
Net Set #4
Net Set #5
Net Set #6
INSET MAP
100 0 100 200 300 400 500 Metres
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST
STATISTICS AT TIME OF SURVEY
1 ELEVATION 835 m
2 SURFACE AREA
3 AREA ABOVE 6 m CONTOUR
4 VOLUME
5 MEAN DEPTH
6 MAX. DEPTH 25 m
7 PERIMETER, MAIN SHORE
8 PERIMETER, ISLANDS 760 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
930/11

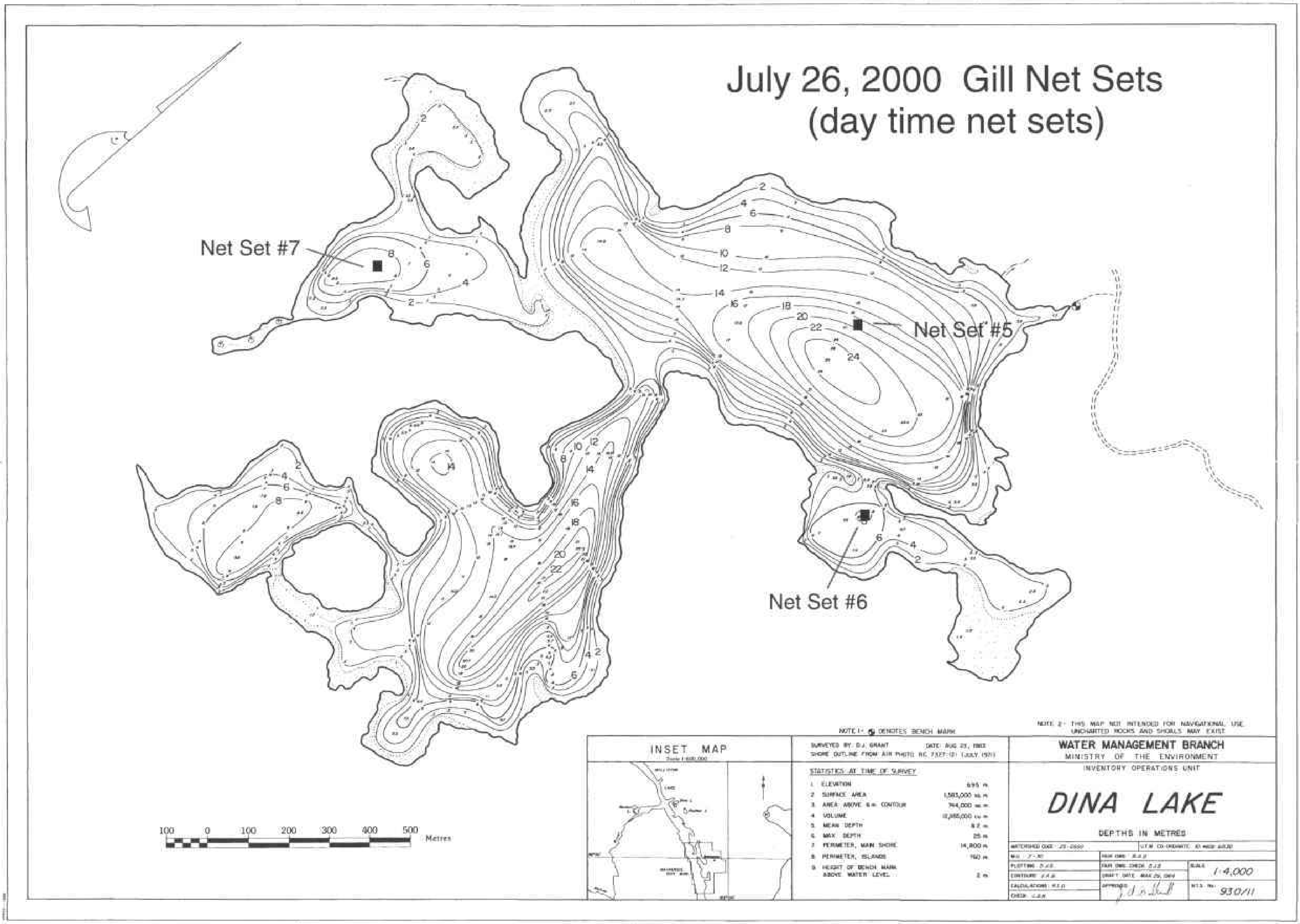

June 22, 2000 Gill Net Sets
Net Set #7
Net Set #8
Net Set #9
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST.
INSET MAP
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m
2 SURFACE AREA 1,563,000 sq m
3 AREA ABOVE 6 m CONTOUR 714,000 sq m
4 VOLUME 12,955,000 cu m
5 MEAN DEPTH 8.2 m
6 MAX. DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 760 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
N.T.S. No. 93O/11
100 0 100 200 300 400 500 Metres


June 23, 2000 Gill Net Set
Net Set #10
Metres
INSET MAP
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST.
SURVEYED BY D.J. GRANT
STATISTICS AT TIME OF SURVEY
1 ELEVATION
2 SURFACE AREA
3 AREA ABOVE 6 m CONTOUR
4 VOLUME
5 MEAN DEPTH
6 MAX. DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 760 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
93O/11

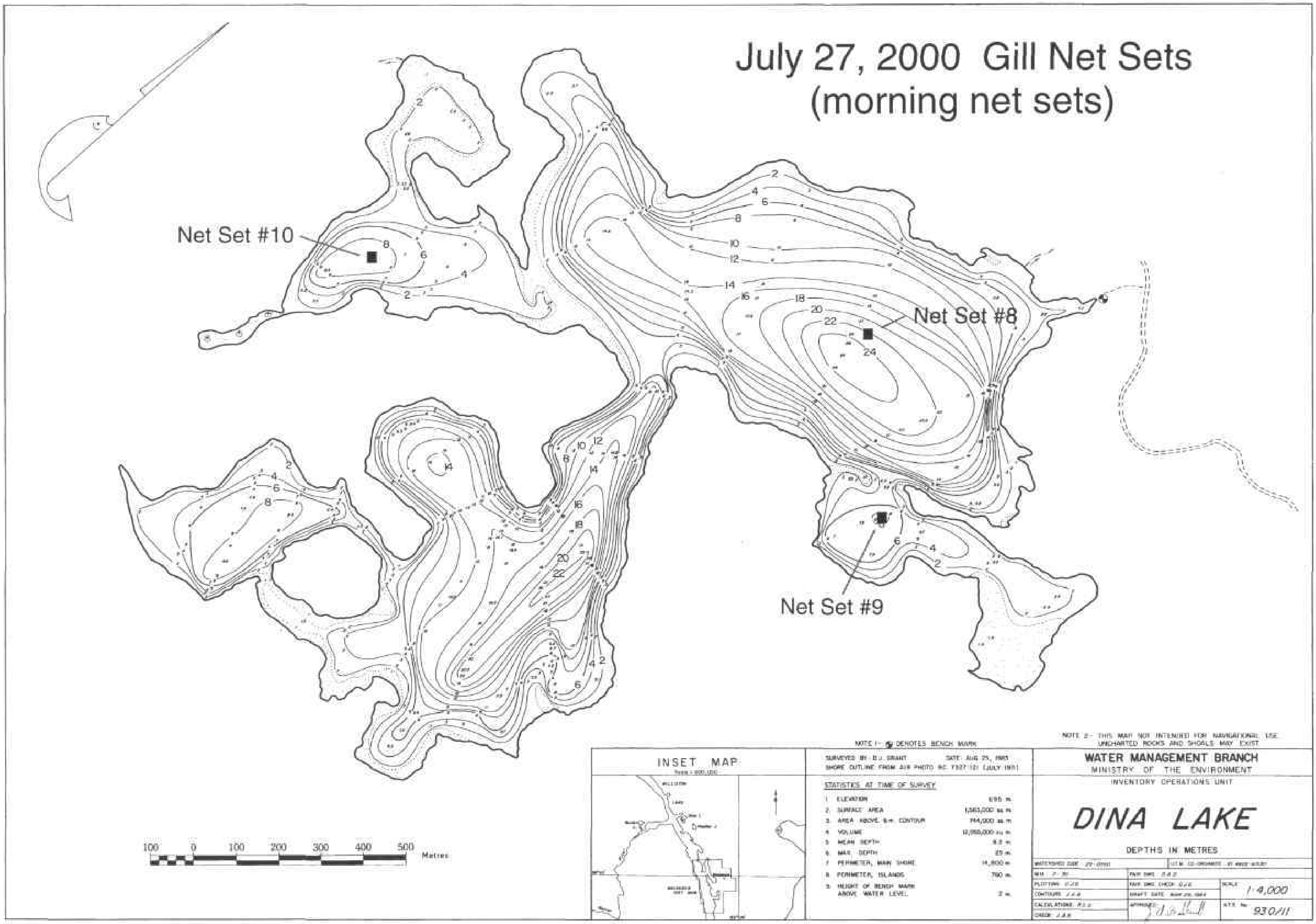


July 24, 2000 Gill Net Set
Net Set #1
DINA LAKE
DEPTHS IN METRES
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST
SURVEYED BY: D.J. GRANT
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1 ELEVATION
2 SURFACE AREA
3 AREA ABOVE 6 m. CONTOUR
4 VOLUME
5 MEAN DEPTH 8.2 m
6 MAX DEPTH 25 m
7 PERIMETER, MAIN SHORE
8 PERIMETER, ISLANDS 760 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
INSET MAP
SCALE 1:4,000
930/11
100 0 100 200 300 400 500 Metres


July 25, 2000 Gill Net Sets
(evening net sets)
Net Set #4
Net Set #2
Net Set #3
2
4
6
8
10
12
14
16
18
20
22
24
100 0 100 200 300 400 500
Metres
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY: D.J. GRANT
DATE: AUG 25, 1985
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1. ELEVATION 655 m
2. SURFACE AREA 1,583,000 sq m
3. AREA ABOVE 6 m CONTOUR 744,000 sq m
4. VOLUME 17,955,000 cu m
5. MEAN DEPTH 8.2 m
6. MAX. DEPTH 25 m
7. PERIMETER, MAIN SHORE 14,800 m
8. PERIMETER, ISLANDS 780 m
9. HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
N.T.S. No. 93O/11

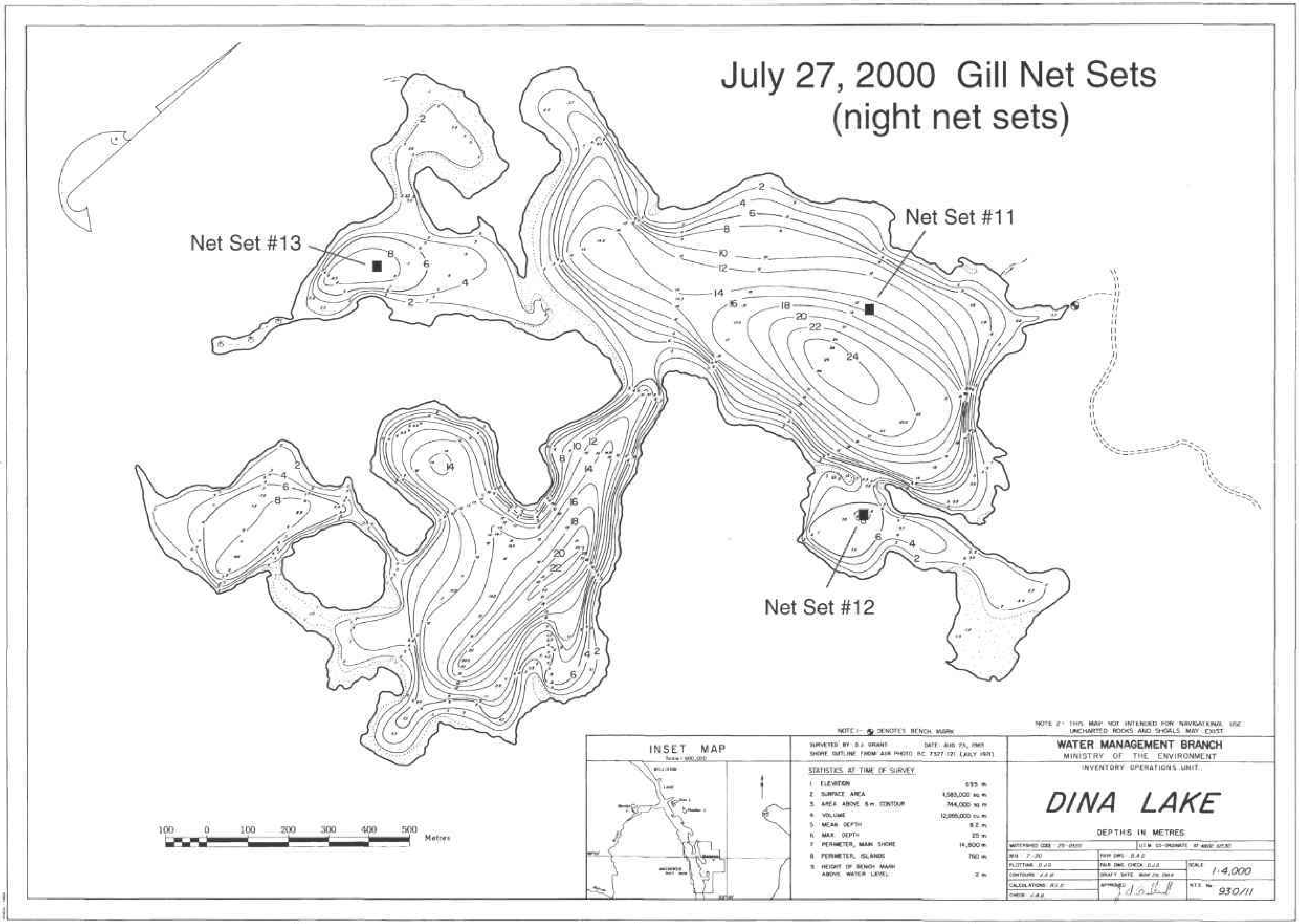


July 26, 2000 Gill Net Sets
(day time net sets)
Net Set #5
Net Set #6
Net Set #7
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY: D.J. GRANT
DATE: AUG 23, 1983
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m
2 SURFACE AREA 1,583,000 sq. m
3 AREA ABOVE 6 m CONTOUR 744,000 sq. m
4 VOLUME
5 MEAN DEPTH
6 MAX DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
N.T.S. No. 93O/11
100 0 100 200 300 400 500 Metres

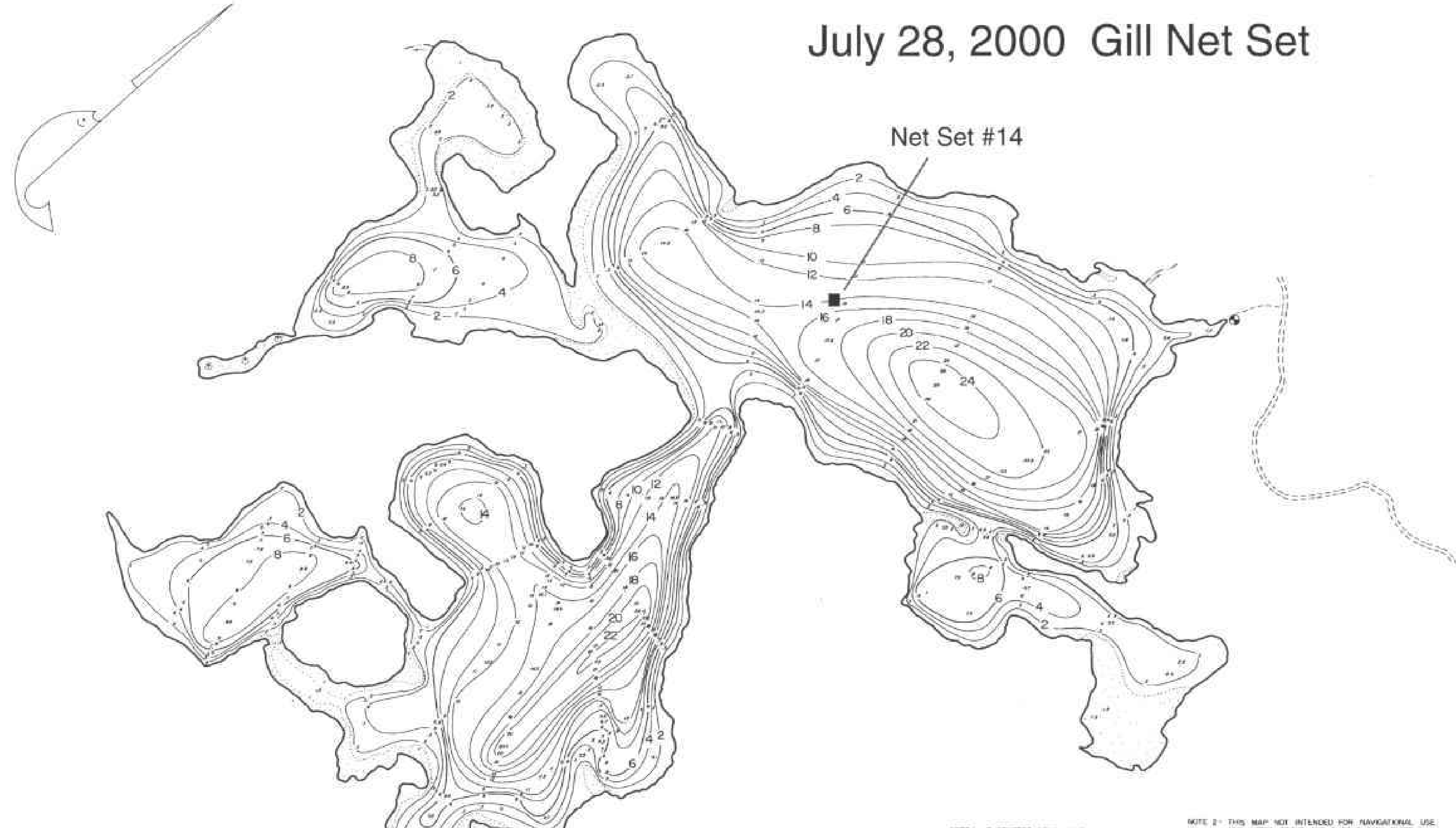


July 27, 2000 Gill Net Sets
(morning net sets)
Net Set #8
Net Set #9
Net Set #10
100 0 100 200 300 400 500 Metres
INSET MAP
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST
SURVEYED BY: D.J. GRANT DATE: AUG 25, 1985
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m
2 SURFACE AREA 1,563,000 sq m
3 AREA ABOVE 6 m CONTOUR 744,000 sq m
4 VOLUME 12,950,000 cu m
5 MEAN DEPTH 8.3 m
6 MAX. DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 790 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
930/11

July 27, 2000 Gill Net Sets (night net sets)



July 28, 2000 Gill Net Set



NOTE 1 : ⊕ DENOTES BENCH MARK

NOTE 2 : THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST

INSET MAP

SURVEYED BY D.J. GRANT DATE AUG 23, 1983
SHORE OUTLINE FROM AIR PHOTO BC 7327:121 (JULY 1971)

STATISTICS AT TIME OF SURVEY

1	ELEVATION	695 m
2	SURFACE AREA	1,583,000 sq m
3	AREA ABOVE 6 m CONTOUR	784,000 sq m
4	VOLUME	12,955,000 cu m
5	MEAN DEPTH	8.2 m
6	MAX DEPTH	25 m
7	PERIMETER, MAIN SHORE	14,800 m
8	PERIMETER, ISLANDS	780 m
9	HEIGHT OF BENCH MARK ABOVE WATER LEVEL	2 m

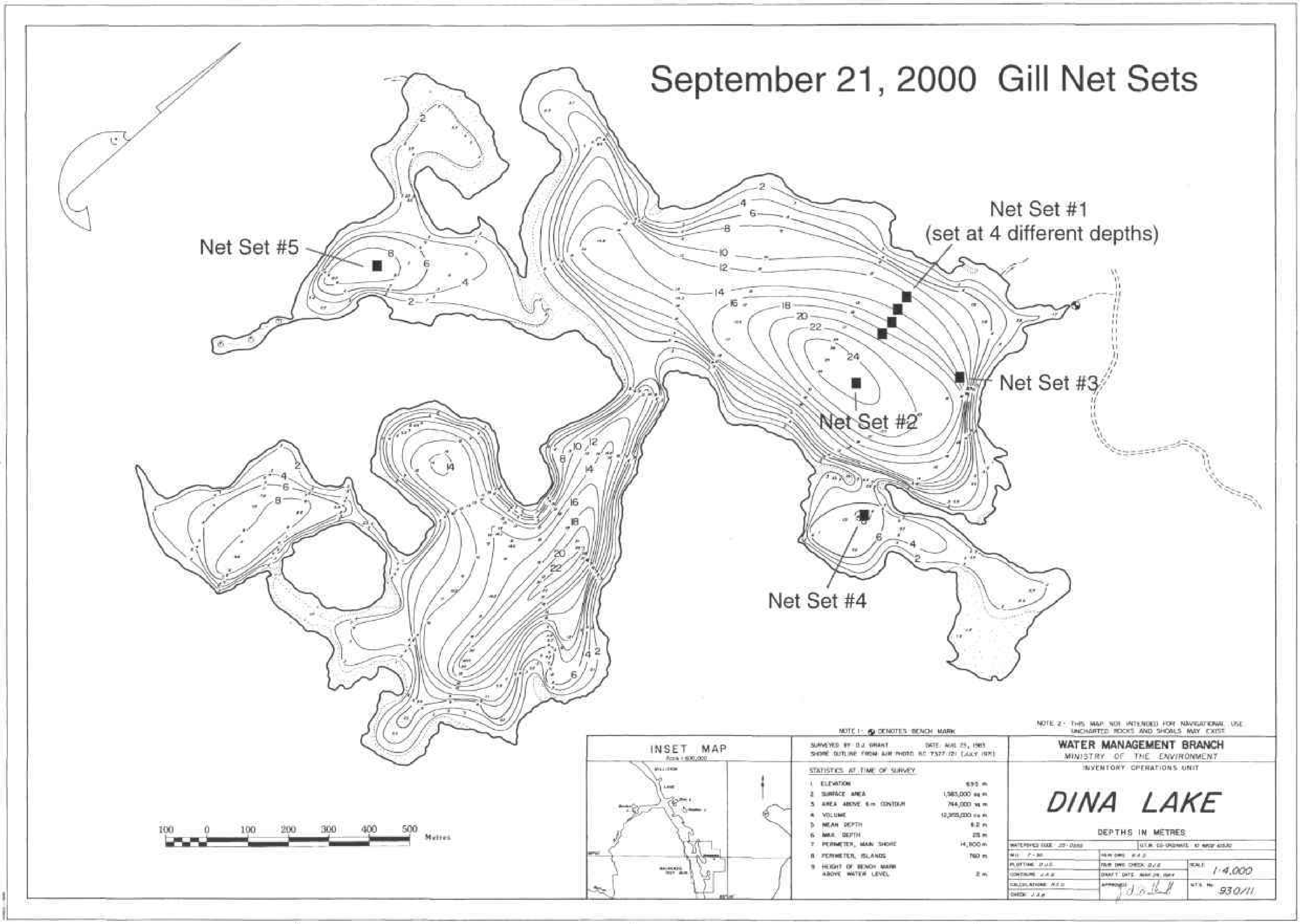
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT

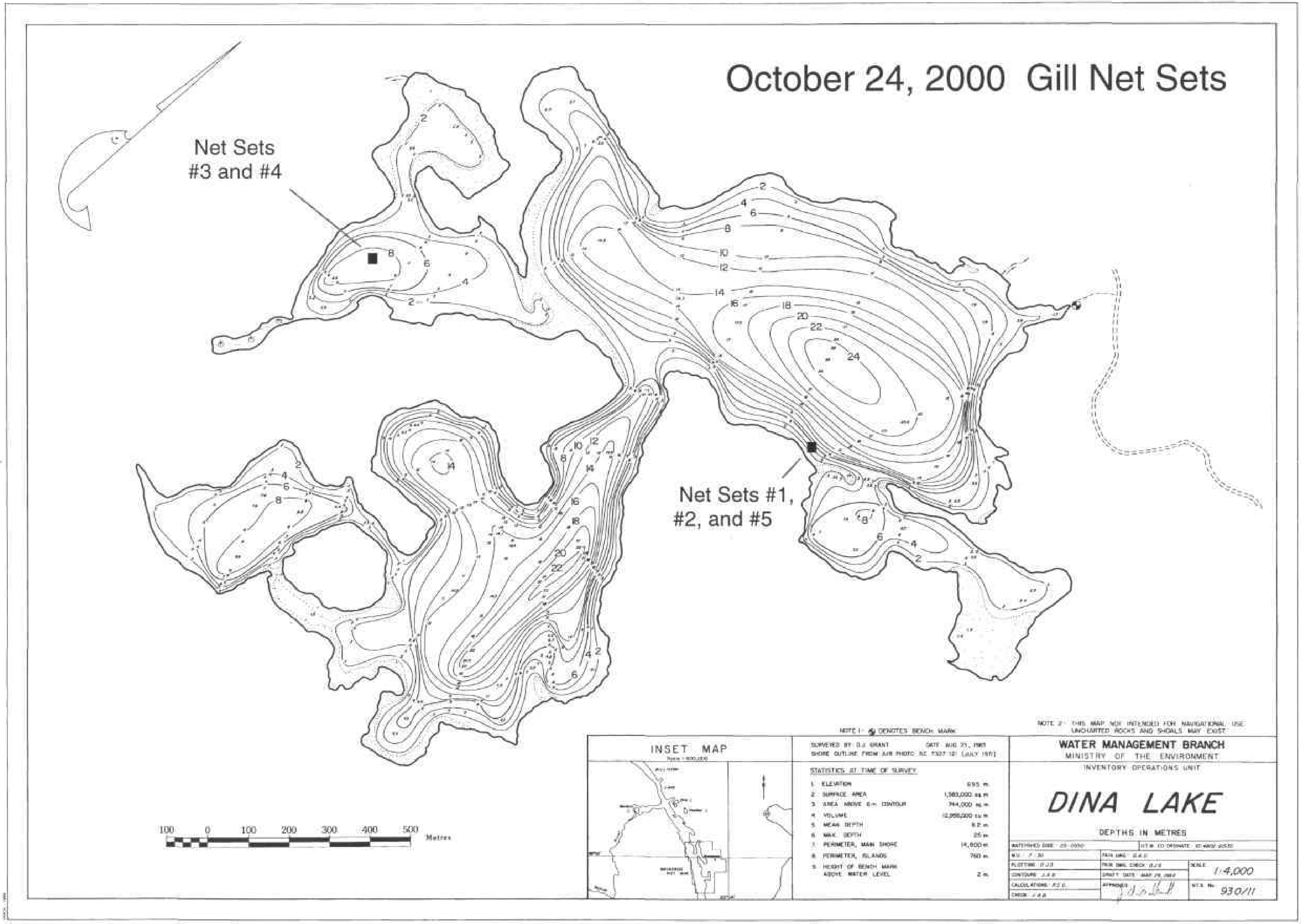
DINA LAKE

DEPTHS IN METRES

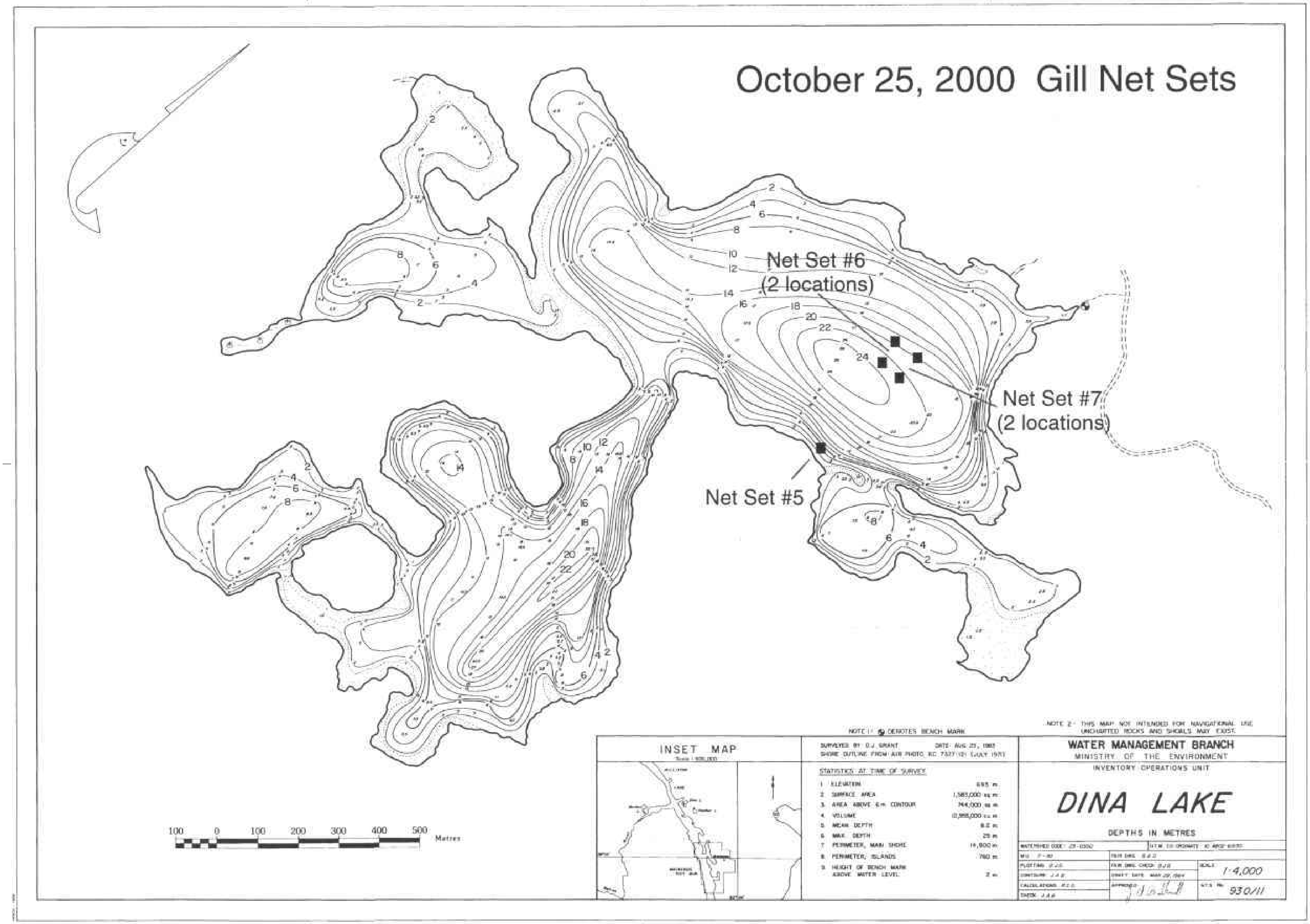
SCALE 1:4,000

N.T.S. No. 93 O/11


September 21, 2000 Gill Net Sets
Net Set #1
(set at 4 different depths)
Net Set #2
Net Set #3
Net Set #4
Net Set #5
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
STATISTICS AT TIME OF SURVEY
1 ELEVATION
2 SURFACE AREA
3 AREA ABOVE 6 m CONTOUR
4 VOLUME
5 MEAN DEPTH
6 MAX. DEPTH
7 PERIMETER, MAIN SHORE
8 PERIMETER, ISLANDS
9 HEIGHT OF BENCH MARK
ABOVE WATER LEVEL
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
1:4,000
93O/11
100 0 100 200 300 400 500 Metres

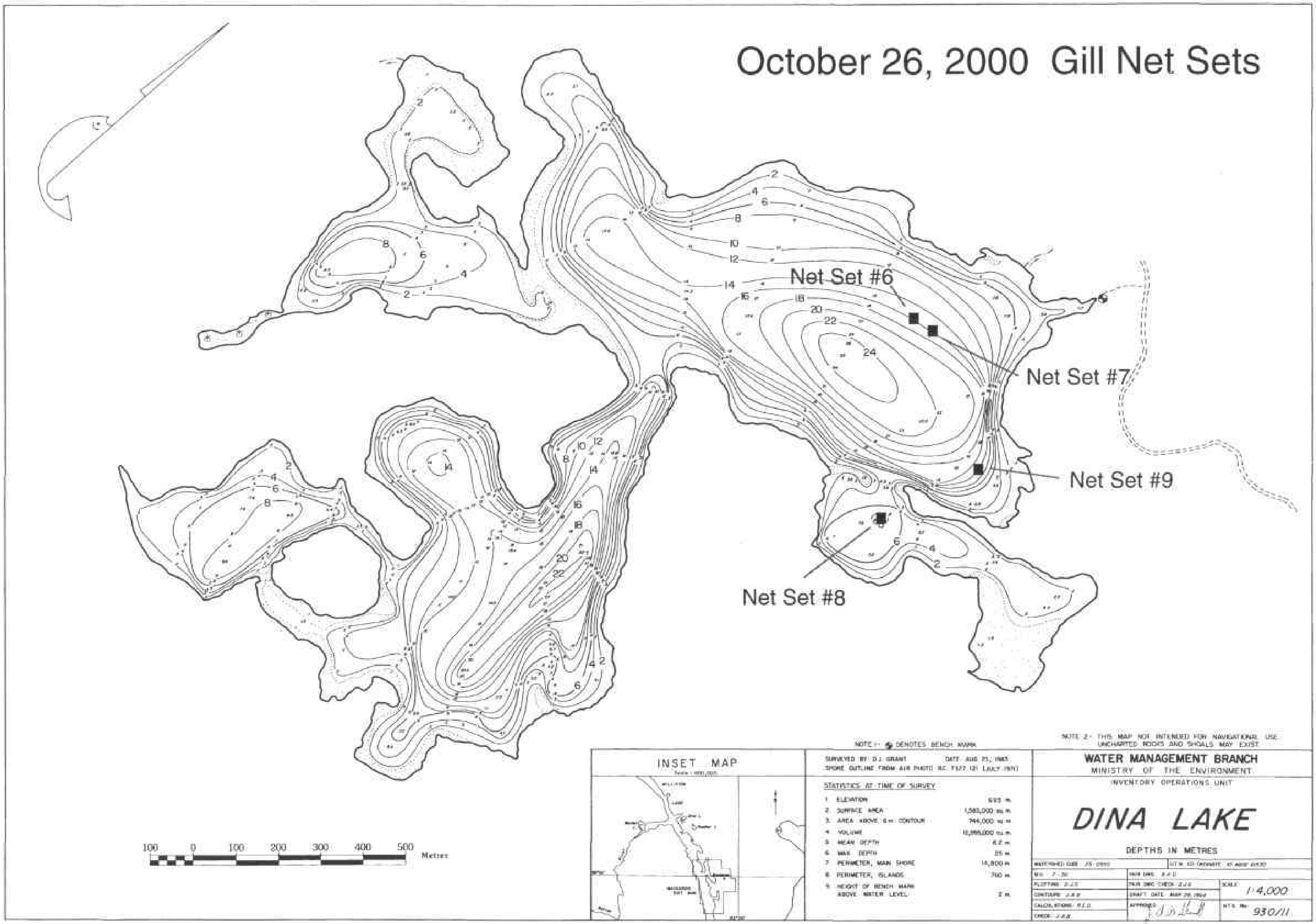


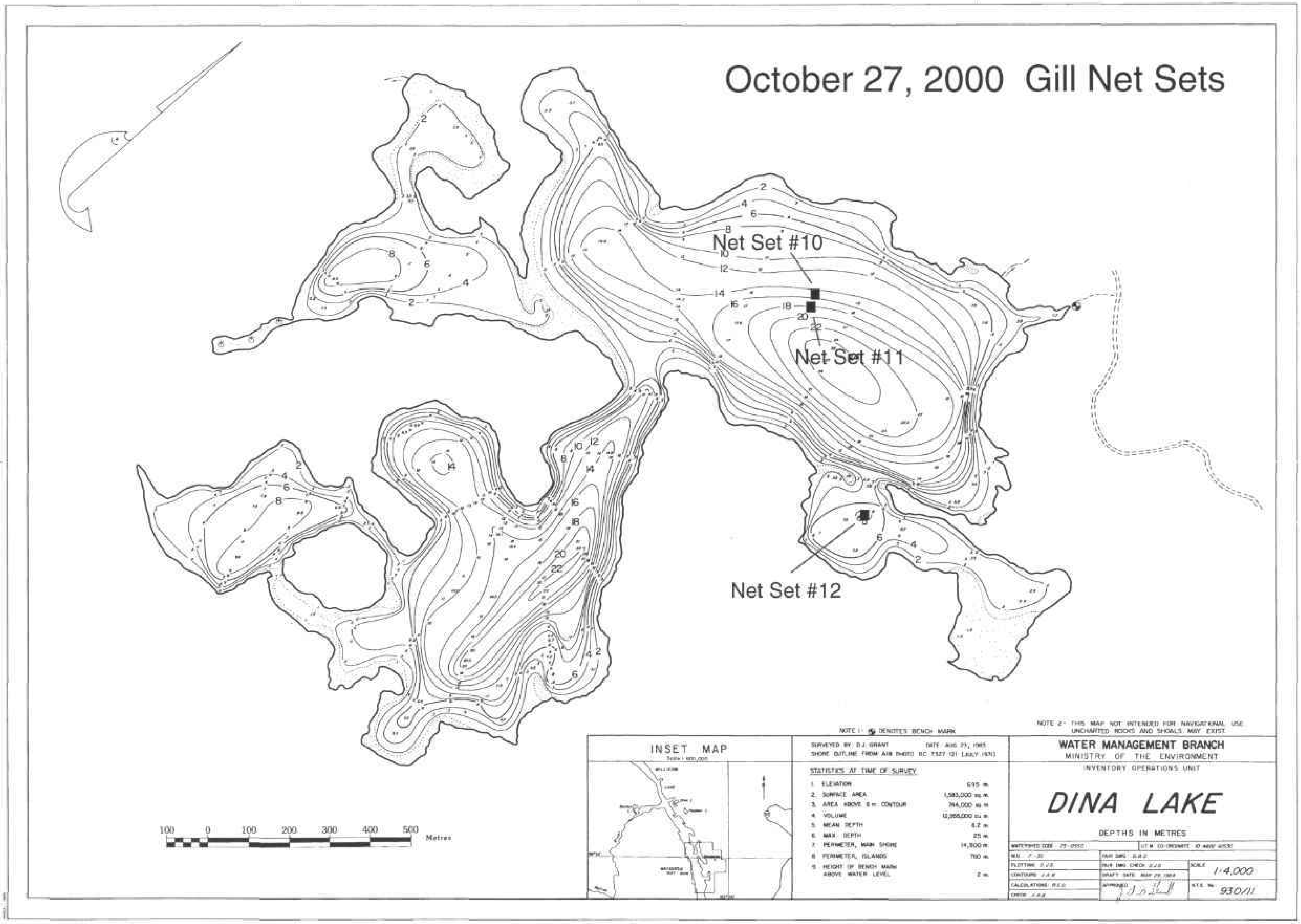
October 24, 2000 Gill Net Sets
Net Sets #3 and #4
Net Sets #1, #2, and #5
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY D.J. GRANT
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1. ELEVATION 695 m.
2. SURFACE AREA 1,583,000 sq m
3. AREA ABOVE 6 m CONTOUR 744,000 sq m
4. VOLUME 12,958,000 cu m
5. MEAN DEPTH 8.2 m
6. MAX. DEPTH 25 m
7. PERIMETER, MAIN SHORE 14,800 m
8. PERIMETER, ISLANDS 760 m
9. HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m.
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
93O/11
Metres



October 25, 2000 Gill Net Sets
Net Set #5
Net Set #6
(2 locations)
Net Set #7
(2 locations)
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE
UNCHARTED ROCKS AND SHOALS MAY EXIST.
INSET MAP
SURVEYED BY: D.J. GRANT
DATE: AUG 25, 1983
SHORE OUTLINE FROM AIR PHOTO
STATISTICS AT TIME OF SURVEY
1 ELEVATION 695 m
2 SURFACE AREA 1,583,000 sq m
3 AREA ABOVE 6 m CONTOUR 744,000 sq m
4 VOLUME 10,988,000 cu m
5 MEAN DEPTH 8.2 m
6 MAX DEPTH 25 m
7 PERIMETER, MAIN SHORE 14,800 m
8 PERIMETER, ISLANDS 760 m
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
930/11
100 0 100 200 300 400 500 Metres

October 26, 2000 Gill Net Sets




October 27, 2000 Gill Net Sets
Net Set #10
Net Set #11
Net Set #12
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE. UNCHARTED ROCKS AND SHOALS MAY EXIST.
INSET MAP
SURVEYED BY D.J. GRANT
STATISTICS AT TIME OF SURVEY
1. ELEVATION 695 m
2. SURFACE AREA 1,583,000 sq m
3. AREA ABOVE 6 m CONTOUR 744,000 sq m
4. VOLUME
5. MEAN DEPTH
6. MAX. DEPTH 25 m
7. PERIMETER, MAIN SHORE 14,300 m
8. PERIMETER, ISLANDS 760 m
9. HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
93O/11
100 0 100 200 300 400 500 Metres

APPENDIX 9

Individual Fish Data

Lake: **Dina #1**

INDIVIDUAL PYGMY WHITEFISH DATA

Date Captured: June 19-23, 2000

M - Male
F - Female
? - Not Obvious
Y Yes
N No

IMM - Immature
MG - Maturing
MT - Mature
GV - Gravid
SP - Spent
? - Not Obvious

EG - Egg
ML - Milt
HD - Head
TG - Fish Tag
ST - Stomach

SC - Scale
FR - Fin Ray
OT - Otolith
WF - Whole Fish

Method of Capture: Sinking monofilament gill net.
Condition Factor (K) = $W / L^3 \times 100$

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grains)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grains)	Comments
1	1	11.8	14.6	0.8886	F	MG	4	5	Y	1		
2	2	11.2	11.2	0.7972	F	MG	3	2	Y	1		
2	3	10.2	9.9	0.9329	M	MG	2	3	Y	1		
2	4	10.0	9.5	0.9500	M	MG	2	3	Y	1		
2	5	9.0	6.6	0.9053	M	MG	1	1	Y	1		
2	6	9.5	7.9	0.9214	M	MG	2	2	Y	1		
2	7	10.5	11.2	0.9675	M	MG	2	3	Y	1		
3	8	12.2	15.3	0.8426	F	MG	4	5	Y	1		
3	9	11.8	14.7	0.8947	F	MG	3	2	Y	1		
3	10	11.4	13.3	0.8977	F	MG	3	3	Y	1		
3	11	11.9	14.7	0.8723	F	MG	4	4	Y	1		
3	12	11.0	13.1	0.9842	F	MG	2	2	Y	1		
3	13	13.0	19.3	0.8785	F	MG	4	5	Y	1		
3	14	10.8	13.1	1.0399	F	MG	3	3	Y	1		
3	15	11.1	13.7	1.0017	F	MG	2	2	Y	1		
3	16	11.6	14.2	0.9097	F	MG	2	2	Y	1		
5	17	11.8	16.5	1.0042	F	MG			N	4		
5	18	12.2	19.6	1.0794	(M)	MG	5	7	Y	1	could be female	
5	19	12.8	19.1	0.9108	F	MG			N	1		
5	20	12.4	16.3	0.8549	F	MG			N	3		
5	21	12.7	18.4	0.8983	F	MG			N	6		
5	22	12.3	17.4	0.9350	F	MG			N	1		
5	23	12.5	15.5	0.7936	F	MG			N	1		
5	24	12.2	16.6	0.9142	F	MG			N	1		
5	25	11.4	14.1	0.9517	F	MG			N	2		

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grains)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grains)	Comments
5	26	11.5	14.6	0.9600	F	MG			N	0		
5	27	11.9	13.9	0.8248	F	MG			N	2		
5	28	11.5	15.9	1.0455	F	MG			N	1		
5	29	11.8	16.1	0.9799	F	MG			N	1		
5	30	11.4	17.6	1.1879	F	MG			N	1		
5	31	11.9	15.7	0.9317	F	MG			N	9		
5	32	10.9	14.4	1.1119	F	MG			N	1		
5	33	12.0	16.3	0.9433	F	MG			N	5		
5	34	11.5	14.9	0.9797	F	MG			N	2		
5	35	11.0	14.6	1.0969	F	MG			N	0		
5	36	12.3	18.0	0.9673	F	MG			N	5		
5	37	11.3	14.4	0.9980	F	MG			N	3		
5	38	11.6	14.6	0.9354	F	MG			N	4		
5	39	9.9	9.3	0.9585	F	MG	2	2	Y	0		
5	40	10.5	11.1	0.9589	F	MG	2	2	Y	2		
5	41	9.8	7.9	0.8394	F	MG	2	1	Y	1		
5	42	10.3	7.7	0.7047	M	MG	2	2	Y	2		
5	43	9.7	9.2	1.0080	M	MG	2	2	Y	2		
5	44	10.9	11.9	0.9189	F	MG	2		N	1		
5	45	9.5	8.8	1.0264	M	MG			N	2		
5	46	9.3	8.0	0.9946	F	MG			N	2		
5	47	9.9	9.4	0.9688	F	MG			N	1		
5	48	9.5	8.9	1.0381	M	MG			N	?		
5	49	8.5	6.4	1.0421	M	MG	1	2	Y	0		
5	50	9.5	6.3	0.7348	M	MG			N	0		
5	51	9.5	8.0	0.9331	F	MG	2	2	Y	0		
5	52	9.7	8.4	0.9204	M	MG			N	1		
5	53	9.8	8.6	0.9137	M	MG			N	5		
5	54	9.7	9.1	0.9971	M	MG			N	2		
5	55	9.9	9.4	0.9688	F	MG			N	1		
5	56	9.4	7.8	0.9391	F	MG	1	1	Y	0		
5	57	9.7	8.9	0.9752	M	MG			N	4		
5	58	9.3	8.5	1.0567	M	MG			N	1		

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grams)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grams)	Comments
5	59	9.3	8.6	1.0692	M	MG			N	0		
5	60	10.0	9.6	0.9600	F	MG			N	1		
5	61	10.1	9.8	0.9512	F	MG			N	1		
5	62	9.4	8.2	0.9873	M	MG			N	5		
5	63	9.3	7.4	0.9200	M	MG			N	1		
4	64	12.6	18.2	0.9098	F	MG			N	3		
4	65	11.6	14.7	0.9418	F	MG			N	6		
4	66	12.3	19.6	1.0533	F	MG			N	2		
4	67	11.8	15.7	0.9556	F	MG			N	9		
4	68	12.1	16.3	0.9201	F	MG			N	2		
4	69	11.5	15.4	1.0126	F	MG			N	0		
4	70	12.0	17.2	0.9954	F	MG			N	0		
4	71	11.5	16.8	1.1046	F	MG			N	3		
4	72	11.7	17.5	1.0926	F	MG			N	1		
4	73	11.3	15.2	1.0534	F	MG			N	2		
4	74	11.2	15.3	1.0890	F	MG			N	8		
4	75	12.7	22.3	1.0887	F	MG			N	2		
4	76	11.9	16.7	0.9910	F	MG			N	1		
4	77	12.0	15.6	0.9028	F	MG			N	3		
4	78	11.7	17.9	1.1176	F	MG			N	2		
4	79	12.0	17.4	1.0069	F	MG			N	3		
4	80	12.2	17.7	0.9748	(M)	MG			N	1	female ?	
4	81	11.0	14.0	1.0518	F	MG			N	4		
4	82	12.0	15.9	0.9201	F	MG			N	2		
4	83	12.3	17.4	0.9350	F	MG			N	6		
4	84	12.1	16.9	0.9540	F	MG			N	4		
4	85	11.8	17.6	1.0712	F	MG			N	0		
4	86	11.6	16.2	1.0379	F	MG			N	3		
4	87	12.0	18.3	1.0590	F	MG			N	2		
4	88	12.0	17.0	0.9838	F	MG			N	6		
4	89	12.0	18.3	1.0590	F	MG			N	1		
4	90	11.5	13.8	0.9074	F	MG			N	6		
4	91	13.0	20.1	0.9149	F	MG			N	2		

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grams)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grains)	Comments
6	92	7.3	3.5	0.8997	M	IMM	1		Y	2		No otoliths
6	93	7.3	3.5	0.8997	M	IMM	1		Y	0		
6	94	6.5	2.5	0.9103	M	IMM	1		Y	0		No otoliths
6	95	7.3	3.1	0.7969	F	IMM	1		Y	0		No otoliths
6	96	6.4	2.6	0.9918	M	IMM	1		Y	0		No otoliths
6	97	6.3	2.4	0.9598	M	IMM	1		Y	0		No otoliths
6	98	6.2	2.4	1.0070	M	IMM	1		Y	0		No otoliths
7	99	9.3	7.3	0.9076	M	MG	2	2	Y	4		
7	100	8.7	7.0	1.0630	M	MG	2	2	Y	3		
7	101	10.0	9.2	0.9200	M	MG	2	2	Y	7		
7	102	12.0	16.2	0.9375	F	MG			N	3		
7	103	11.5	14.7	0.9665	F	MG			N	5		
7	104	12.1	15.2	0.8580	F	MG			N	5		
7	105	13.0	17.5	0.7965	F	MG			N	3		
7	106	12.0	15.6	0.9028	F	MG			N	2		
9	107	6.5	2.6	0.9467	M	IMM	1	2	Y	0		
9	108	6.2	2.3	0.9651	M	IMM	1		Y	0		No otoliths
9	109	6.6	2.7	0.9391	M	IMM	1		Y	0		No otoliths
9	110	7.1	3.4	0.9500	M	IMM	1		Y	0		No otoliths
9	111	6.6	2.6	0.9044	M	IMM	1		Y	0		No otoliths
9	112	7.0	3.4	0.9913	F	IMM	1		Y	0		No otoliths
9	113	7.0	3.3	0.9621	M	IMM	1		Y	0		No otoliths
9	114	7.3	4.2	1.0796	F	IMM	2		Y	0		No otoliths
9	115	7.5	3.9	0.9244	M	IMM	1		Y	0		No otoliths
9	116	6.6	2.7	0.9391	F	IMM	1		Y	0		No otoliths
9	117	6.7	3.3	1.0972	M	IMM			N	9		
9	118	7.0	3.3	0.9621	F	IMM			N	?		
9	119	6.8	3.2	1.0177	M	IMM			N	?		
9	120	7.2	3.8	1.0181	M	IMM			N	?		
9	121	7.6	4.2	0.9568	M	IMM			N	9		
9	122	6.8	3.2	1.0177	M	IMM			N	9		
9	123	7.1	3.9	1.0897	M	IMM			N	9		
9	124	7.0	3.8	1.1079	M	IMM			N	9		

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grains)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grams)	Comments
9	125	6.8	3.2	1.0177	F	IMM			N	9		
9	126	7.0	3.4	0.9913	M	IMM			N	?		
9	127	6.9	3.0	0.9132	M	IMM			N	?		
9	128	6.4	2.8	1.0681	F	IMM			N	?		
9	129	7.7	4.4	0.9638	F	IMM			N	?		
9	130	6.7	3.9	1.2967	M	IMM			N	?		
9	131	7.0	3.6	1.0496	F	IMM			N	?		
9	132	7.2	3.9	1.0449	M	IMM			N	?		
9	133	7.2	4.0	1.0717	M	IMM			N	?		
9	134	7.1	3.4	0.9500	M	IMM			N	?		
9	135	6.9	3.0	0.9132	F	IMM			N	?		
9	136	6.6	3.3	1.1478	F	IMM			N	?		
9	137	6.7	3.0	0.9975	M	IMM			N	?		
9	138	7.2	3.7	0.9913	M	IMM			N	?		
9	139	6.7	2.9	0.9642	M	IMM			N	?		
9	140	7.3	3.6	0.9254	M	IMM			N	7		
9	141	7.0	3.4	0.9913	F	IMM			N	9		
9	142	7.0	3.4	0.9913	F	IMM			N	7		
9	143	6.8	3.0	0.9541	F	IMM			N	9		
9	144	6.4	2.8	1.0681	M	IMM			N	9		
9	145	6.7	3.0	0.9975	F	IMM			N	9		
9	146	7.0	3.1	0.9038	F	IMM			N	9		
9	147	6.5	2.7	0.9832	M	IMM			N	9		
9	148	6.8	3.1	0.9859	M	IMM			N	9		
9	149	6.6	2.7	0.9391	M	IMM			N	9		
9	150	6.3	2.5	0.9998	F	IMM			N	9		

Lake: **Dina #l**

INDIVIDUAL PYGMY WHITEFISH DATA

Date Captured: July 24-28. 2000

M - Male	IMM - Immature	EG - Egg	SC - Scale
F - Female	MG - Maturing	ML - Milt	FR - Fin Ray
? - Not Obvious	MT - Mature	HD - Head	OT - Otolith
Y Yes	GV - Gravid	TG - Fish Tag	WF - Whole Fish
N No	SP - Spent	ST - Stomach	
	? - Not Obvious		

Method of Capture: Sinking monofilament gill net.
Condition Factor (K) = $W / L^3 \times 100$

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grains)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grams)	Comments
3	151	7.4	3.4	0.8390	F	IMM	1		Y	?		Unageable otolith
3	152	7.3	4.1	1.0539	M	IMM	1	1	Y	?		
4	153	12.3	15.6	0.8383	F	MT	4	6	Y	?		
5	154	10.6	12.2	1.0243	M	MT	4	4	Y	2		
5	155	11.6	15.6	0.9994	F	MT	3	4	Y	0		
5	156	11.4	14.6	0.9855	F	MT	4	5	Y	6		
7	157	10.4	12.8	1.1379	F	MT	2	2	Y	0		
7	158	11.1	15.6	1.1407	F	MT	2	3	Y	1		
7	159	10.4	12.9	1.1468	F	MT	2	2	Y	2		
7	160	11.1	16.6	1.2138	F	MT	4	3	Y	4		
7	161	10.1	11.6	1.1259	M	MT	2	3	Y	0		
7	162	9.5	9.2	1.0730	F	MT	2	2	Y	?		
7	163	9.7	10.4	1.1395	F	MT	2	2	Y	?		
7	164	9.8	10.2	1.0837	M	MT	2	2	Y	2		
7	165	10.3	11.1	1.0158	M	MT	4	4	Y	3		
7	166	10.2	9.9	0.9329	M	MT	2	2	Y	1		
7	167	8.8	7.2	1.0565	M	IMM	1	1	Y	?		
7	168	8.3	6.7	1.1718	M	IMM	1	1	Y	?		
7	169	8.9	7.7	1.0922	M	IMM	2	2	Y	7		
7	170	8.2	6.1	1.1063	M	IMM	1	1	Y	?		
7	171	9.1	7.7	1.0218	M	IMM	2	2	Y	0		
7	172	8.3	7.0	1.2242	M	IMM	1	2	Y	?		
7	173	8.5	6.7	1.0910	F	MT	1	1	Y	?		
7	174	9.7	9.9	1.0847	M	MT	2	2	Y	?		
7	175	8.6	8.1	1.2735	F	MT	1	1	Y	?		

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grams)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grains)	Comments
7	176	8.3	6.3	1.1018	F	MT	1	1	Y	1		
7	177	8.8	7.1	1.0419	F	MT	1	1	Y	?		
7	178	8.2	6.8	1.2333	M	MT	1	1	Y	?		
7	179	?	?		?	?			N	?		
7	180	?	?		?	?			N	?		
7	181	?	9		?	?			N	?		
7	182	12.3	9		F	MT			N	?		
7	183	11.2	9		F	MT			N	?		
8	184	11.5	14.9	0.9797	F	MT	4	4	Y	1		
11	185	12.2	14.5	0.7985	F	MT	4	4	Y	5		
11	186	12.5	16.7	0.8550	F	MT	4	4	Y	0		
11	187	11.6	14.9	0.9546	F	MT	4	4	Y	6		
11	188	11.7	14.2	0.8866	F	MT	3	4	Y	?		
11	189	11.6	15.6	0.9994	F	MT	3	4	Y	5		
11	190	12.1	16.1	0.9088	F	MT	5	5	Y	3		
11	191	11.8	15.7	0.9556	F	MT	3	5	Y	4		
11	192	11.6	15.8	1.0122	F	MT	3	5	Y	1		
11	193	12.3	?		?	?			N	?		
11	194	12.0	?		?	?			N	?		
11	195	11.5	?		9	?			N	?		
11	196	7.5	?		?	?			N	?		
13	197	13.0	21.5	0.9786	F	MT	4	5	Y	4		
13	198	12.9	20.0	0.9317	F	MT	3	4	Y	0		
13	199	10.9	14.5	1.1197	F	MT	2	3	Y	?		
13	200	12.4	22.3	1.1696	F	MT	3	2	Y	0		
13	201	12.4	20.3	1.0647	F	MT	4	5	Y	1		
13	202	11.0	13.7	1.0293	F	MT	3	4	Y	1		
13	203	10.5	12.6	1.0884	M	MG	2	2	Y	0		
13	204	9.6	9.6	1.0851	F	MG	2	2	Y	0		
13	205	9.1	8.1	1.0749	M	MG	2	2	Y	1		
13	206	7.9	6.1	1.2372	M	MG	1	1	Y	0		
13	207	8.5	6.3	1.0258	F	IMM	1	1	Y	0		
13	208	8.0	6.0	1.1719	M	MG	1	2	Y	0		

Lake: **Dina #1**

INDIVIDUAL PYGMY WHITEFISH DATA

Date Captured: September 21-22, 2000

M - Male	IMM - Immature	EG - Egg	SC - Scale
F - Female	MG - Maturing	ML - Milt	FR - Fin Ray
? - Not Obvious	MT - Mature	HD - Head	OT - Otolith
Y Yes	GV - Gravid	TG - Fish Tag	WF - Whole Fish
N No	SP - Spent	ST - Stomach	
	? - Not Obvious		

Method of Capture: Sinking monofilament gill net.

Condition Factor (K) = $W / L^3 \times 100$

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grains)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grains)	Comments
5	209	7.0	2.1	0.6122	M	MT	1	1	Y	Y	could be yoy	
5	210	12.1	16.0	0.9032	F	MT	3	4	Y	Y		
5	211	11.7	16.1	1.0052	F	MT	4	3	Y			
5	212	11.6	16.5	1.0571	F	MT	2	2	Y			
5	213	11.0	13.7	1.0293	F	MT		3	Y			No scales
4	214	10.1	9.6	0.9318	F	MT	2	2	Y			
4	215	9.4	7.8	0.9391	F	MT	1	1	Y			
4	216	9.8	8.2	0.8712	M	MT	2	2	Y			
4	217	9.3	8.4	1.0443	M	MT	2	2	Y			
4	218	11.0	13.5	1.0143	F	MT	2	2	Y	Y		
4	219	9.5	6.9	0.8048	M	MT	2	2	Y			
4	220	9.4	7.0	0.8428	M	MT	1	2	Y			
4	221	9.6	7.5	0.8477	M	MT	2	3	Y	Y		
4	222	10.4	10.0	0.8890	F	MT	2	2	Y			
4	223	10.0	8.6	0.8600	M	MT	2	3	Y	Y		
4	224	10.2	9.6	0.9046	F	MT	2	2	Y	Y		
4	225	9.4	8.3	0.9993	F	MT	2	2	Y			
4	226	9.8	8.7	0.9244	M	MT	2	2	Y	Y		
4	227	9.2	8.3	1.0659	M	MT	2	2	Y	Y		
4	228	10.4	10.9	0.9690	M	MT	2	2	Y			
4	229	9.9	9.0	0.9275	F	MT	2	2	Y			
4	230	10.8	12.2	0.9685	F	MT	2	2	Y			
4	231	10.9	10.9	0.8417	F	MT	2	2	Y	Y		
4	232	10.4	11.2	0.9957	F	MT	2	2	Y			
4	233	10.3	10.6	0.9701	F	MT	2	2	Y			

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grains)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grams)	Comments
4	234	11.3	13.6	0.9425	F	MT			N	?		
4	235	11.8	16.6	1.0103	F	MT			N	?		
4	236	10.9	11.9	0.9189	F	MT			N	?		
4	237	10.2	9.7	0.9141	F	MT			N	?		
4	238	10.9	11.0	0.8494	F	MT			N	?		
4	239	11.3	15.6	1.0812	F	MT			N	?		
4	240	11.4	13.4	0.9045	F	MT			N	?		
4	241	9.7	9.0	0.9861	M	MT			N	?		
4	242	10.0	11.1	1.1100	F	MT			N	?		
4	243	10.8	11.4	0.9050	F	MT			N	?		
4	244	11.9	14.4	0.8545	F	MT			N	?		
4	245	11.2	12.8	0.9111	F	MT			N	?		
4	246	10.8	13.2	1.0479	F	MT			N	?		
4	247	10.5	9.8	0.8466	F	MT			N	?		
4	248	11.0	12.5	0.9391	F	MT			N	?		
4	249	10.6	11.2	0.9404	F	MT			N	9		
4	250	11.8	14.3	0.8703	F	MT			N	9		
4	251	10.6	12.1	1.0159	F	MT			N	?		
4	252	10.1	11.4	1.1065	F	MT			N	?		
4	253	11.6	16.5	1.0571	F	MT			N	?		
4	254	10.1	11.1	1.0774	F	MT			N	?		
4	255	9.6	8.3	0.9381	F	MT			N	?		
4	256	9.5	8.6	1.0031	F	MT			N	?		
4	257	9.8	10.2	1.0837	F	MT			N	?		
4	258	10.4	8.9	0.7912	F	MT			N	?		
4	259	11.0	12.4	0.9316	F	MT			N	?		
4	260	10.0	11.2	1.1200	F	MT			N	?		
4	261	9.8	8.1	0.8606	F	MT			N	9		
4	262	11.1	11.5	0.8409	F	MT			N	?		plus 11 fish released alive

Lake: **Dina #l**

INDIVIDUAL PYGMY WHITEFISH DATA

Date Captured: October 23-27 . 2000

M - Male	IMM - Immature	EG - Egg	SC - Scale
F - Female	MG - Maturing	ML - Milt	FR - Fin Ray
7 - Not Obvious	MT - Mature	HD - Head	OT - Otolith
Y Yes	GV - Gravid	TG - Fish Tag	WF - Whole Fish
N No	SP - Spent	ST - Stomach	
	7 - Not Obvious		

Method of Capture: Sinking monofilament gill net.

Condition Factor (K) = $W / L^3 \times 100$

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grams)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grams)	Comments
3	263	12.0	17.8	1.0301	F	MT	3	4	Y	5	?	collected eggs for fecundity
3	264	11.5	15.5	1.0192	F	GV	2	3	Y	5	2.2	collected eggs for fecundity
3	265	12.1	16.0	0.9032	F	GV	4	5	Y	?	1.8	collected eggs for fecundity
5	266	10.0	10.7	1.0700	F	GV	2	2	Y	5	?	
5	267	10.4	11.9	1.0579	M	MT	2	3	Y	5	1.5	
5	268	12.2	9		F	GV	2		N	?	?	poor condition
5	269	10.6	13.2	1.1083	F	GV	2	3	Y	?	1.8	
5	270	9.5	9.4	1.0964	F	GV	1	2	Y	7	1.4	empty stomach
5	271	12.0	18.7	1.0822	F	GV	3	2	Y	3	3.3	
5	272	10.6	13.8	1.1587	F	GV	1		N	?	2.4	
5	273	10.0	10.6	1.0600	F	GV	1	3	Y	2	1.0	
5	274	10.3	10.2	0.9334	M	MT	2	2	Y	4	1.0	
5	275	9.3	?		M	MT	1		N	?	?	
5	276	9.3	8.8	1.0940	M	MT	2	2	Y	4	0.7	
5	277	9.5	9.3	1.0847	M	MT	1		N	?	1.0	
5	278	9.6	9.4	1.0625	M	MT	1		N	?	1.1	
5	279	11.7	16.4	1.0240	F	GV	2	3	Y	1	2.8	
5	280	10.3	10.3	0.9426	F	GV	1		N	0	1.7	
5	281	10.0	10.0	1.0000	F	GV			N	5	1.7	
5	282	?	?		F	GV			N	?	?	
5	283	?	?		F	GV			N	?	?	
5	284	?	?		M	MT			N	?	?	
5	285	?	?		M	MT			N	?	9	
5	286	?	?		M	MT			N	?	?	
5	287	?	?		M	MT			N	9	?	

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grams)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grams)	Comments
5	288	9	7		M	MT			N	?	?	
5	289	?	7		M	MT			N	?	?	
5	290	?	?		M	MT			N	7	?	
5	291	7	?		M	MT			N	7	?	
5	292	?	?		M	MT			N	7	7	
5	293	7	7		M	MT			N	7	7	plus about 15 others decomposed
3	294	12.5	7		?	?			N	7	7	kept alive
3	295	10.9	14.1	1.0888	F	GV	2	3	Y	5	2.6	
3	296	11.0	16.1	1.2096	F	GV	3	4	Y	0	2.5	
3	297	10.5	13.0	1.1230	F	GV	2	2	Y	7	2.2	
3	298	?	7		F	GV			N	7	?	cut in half
5	299	10.8	13.0	1.0320	F	GV		3	Y	7	?	full stomach, scales unageable
5	300	11.1	15.1	1.1041	F	GV	2	4	Y	6	2.6	
5	301	10.3	11.7	1.0707	F	GV	2	2	Y	2	2.2	
5	302	9.6	8.8	0.9946	M	MT	2	2	Y	6	0.6	
5	303	10.2	10.5	0.9894	M	MT	2	2	Y	1	0.9	
5	304	11.0	12.4	0.9316	F	GV	2	3	Y	2	7	
5	305	9.6	8.9	1.0059	M	MT	2	2	Y	6	1.2	
5	306	9.3	8.4	1.0443	M	MT	2	2	Y	0	0.8	
5	307	11.1	14.4	1.0529	F	GV	3	3	Y	2	2.4	plus 5 others kept alive in MT
7	308	12.3	18.6	0.9995	f	GV	4	4	Y	3	2.9	
7	309	12.1	17.7	0.9991	F	GV	3	3	Y	3	2.6	
7	310	10.8	14.0	1.1114	F	GV	2	2	Y	0	3.2	
7	311	11.1	14.7	1.0749	F	GV	2	3	Y	2	3.0	
7	312	10.9	13.8	1.0656	7	7			N	?	7	voucher specimen
7	313	10.8	14.3	1.1352	?	7			N	?	7	voucher specimen
5	314	10.2	11.4	1.0742	7	7			N	?	7	voucher specimen
5	315	9.5	8.6	1.0031	?	7			N	?	7	voucher specimen
5	316	9.7	9.5	1.0409	?	7			N	?	7	voucher specimen
5	317	10.0	10.2	1.0200	M	MT			N	?	7	voucher specimen

Lake: **Dina #1**

Gill Net Number	Fish Sample Number	Fork Length (cm)	Weight (grains)	K	Sex	Gonadal Maturity	Scale Age	Otolith Age	Stomach Sample Taken	Parasites Present	Gonad Weight (grams)	Comments
5	318	9.5	8.6	1.0031	?	9			N	7	9	voucher spec.
8	319	10.9	14.2	1.0965	F	GV	2	2	Y	1	2.5	
7	320	12.7	21.4	1.0447	F	GV	5	5	Y	6	4.4	
7	321	11.9	16.7	0.9910	F	GV	4	4	N	4	9	
7	322	11.5	16.7	1.0981	F	GV	3	4	N	2	?	

AGE DETERMINATION COMPLETED BY:

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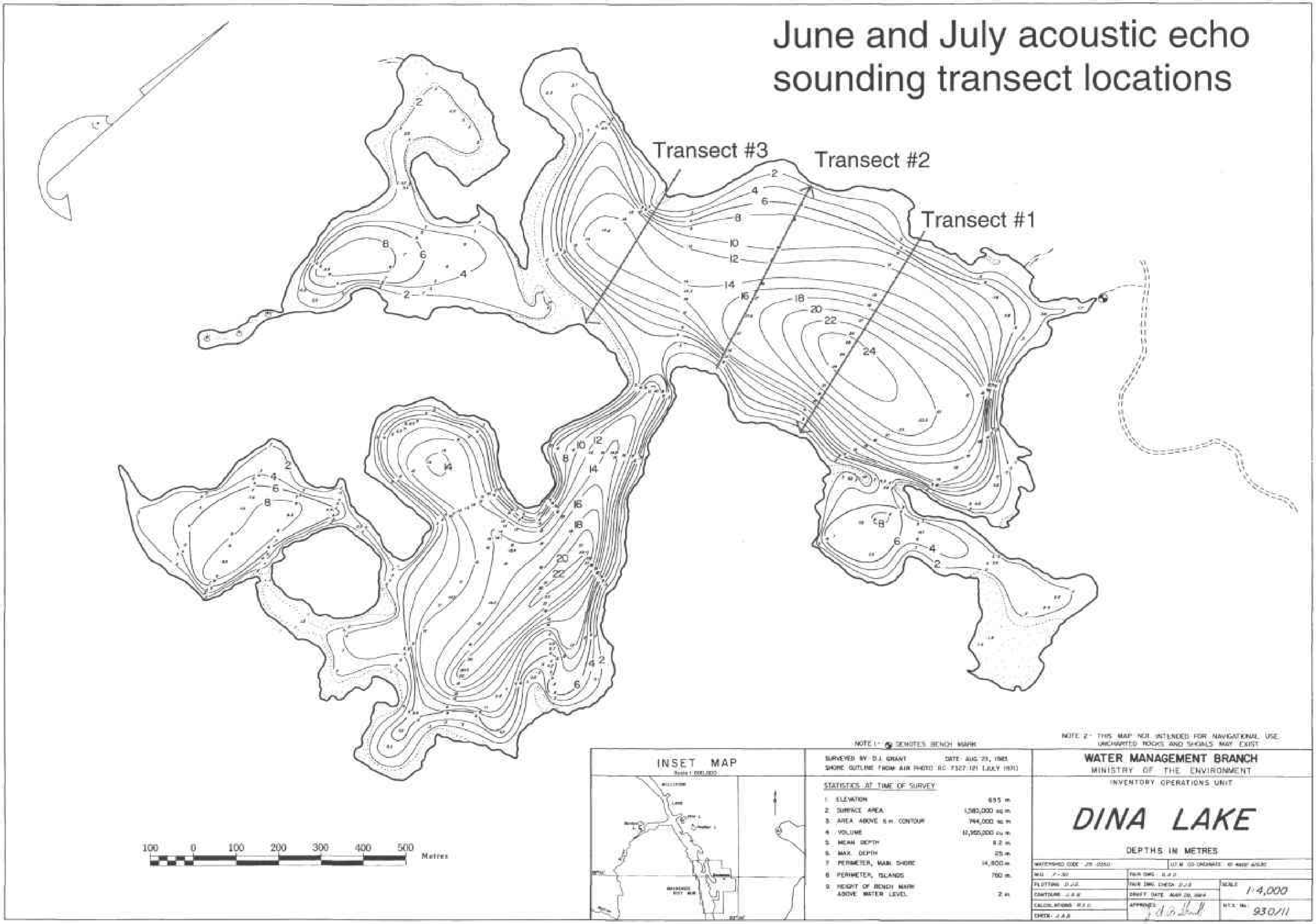
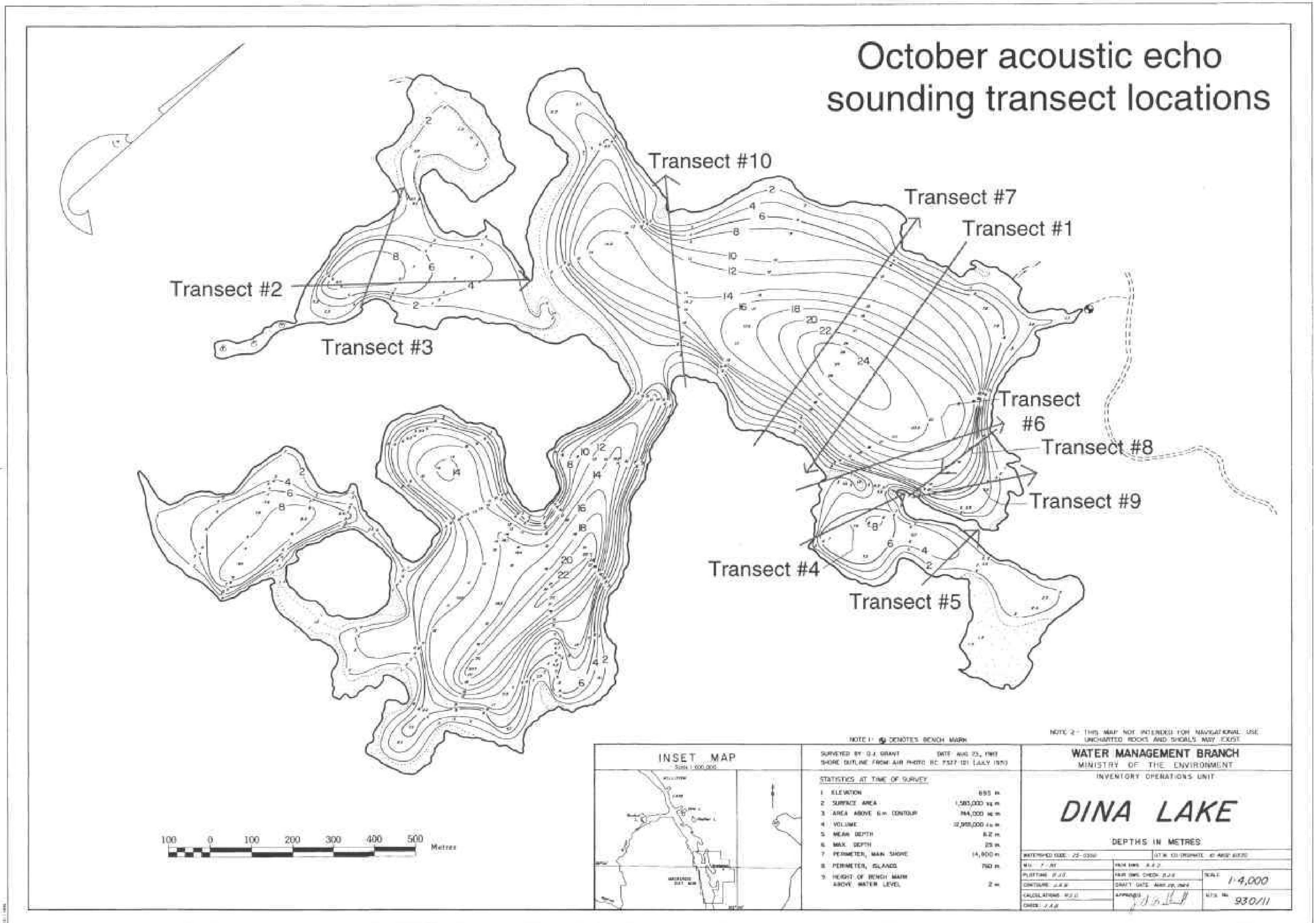
APPENDIX 10

Location of echosounding transects


June and July acoustic echo sounding transect locations
Transect #3
Transect #2
Transect #1
NOTE 1 - DENOTES BENCH MARK
NOTE 2 - THIS MAP NOT INTENDED FOR NAVIGATIONAL USE UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
SURVEYED BY D.J. GRANT DATE AUG 21, 1985
SHORE OUTLINE FROM AIR PHOTO BC 7327 121 (JULY 1971)
STATISTICS AT TIME OF SURVEY
1. ELEVATION 695 m
2. SURFACE AREA 1,580,000 sq m
3. AREA ABOVE 6 m CONTOUR 744,000 sq m
4. VOLUME 12,965,000 cu m
5. MEAN DEPTH 8.2 m
6. MAX. DEPTH 25 m
7. PERIMETER, MAIN SHORE 14,800 m
8. PERIMETER, ISLANDS 760 m
9. HEIGHT OF BENCH MARK ABOVE WATER LEVEL 2 m
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
N.T.S. No. 93O/11
100 0 100 200 300 400 500 Metres


October acoustic echo sounding transect locations
Transect #10
Transect #7
Transect #1
Transect #2
Transect #3
Transect #6
Transect #8
Transect #9
Transect #4
Transect #5
100 0 100 200 300 400 500 Metres
NOTE 1: DENOTES BENCH MARK
NOTE 2: THIS MAP NOT INTENDED FOR NAVIGATIONAL USE UNCHARTED ROCKS AND SHOALS MAY EXIST
INSET MAP
STATISTICS AT TIME OF SURVEY
1 ELEVATION
2 SURFACE AREA
3 AREA ABOVE 6 m CONTOUR
4 VOLUME
5 MEAN DEPTH
6 MAX DEPTH
7 PERIMETER, MAIN SHORE
8 PERIMETER, ISLANDS
9 HEIGHT OF BENCH MARK ABOVE WATER LEVEL
WATER MANAGEMENT BRANCH
MINISTRY OF THE ENVIRONMENT
INVENTORY OPERATIONS UNIT
DINA LAKE
DEPTHS IN METRES
SCALE 1:4,000
930/11