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WATER QUALITY OBSERVATIONS AT AQUA-CAGE FISHERIES (PARRY SOUND, ONTARIO)

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Murray N. Charlton, Jacqui E. Milne

Abstract

Water quality samples were collected at Aqua-Cage Fisheries, Parry Sound Ontario) for the purpose of supplying background information for study of benthic effects. At the operator's request we have summarized the data. Most of the nutrient concentrations were in the range of concentrations found in nearby Georgian Bay and were below 10 ug/l for phosphorus. Dissolved oxygen appeared to be unaffected right to the bottom. Overall these data, although limited, do not seem to indicate a water quality impairment at the site.

Observations sur la qualité de l'eau aux Aqua-Cage Fisheries (Parry Sound, Ontario)

Murray N. Charlton et Jacqui E. Milne

Résumé

On a prélevé des échantillons d'eau au site des Aqua-Cage Fisheries (Parry Sound, Ontario) en vue d'obtenir des données de référence pour une étude sur les effets benthiques. À la demande de l'exploitant, on a préparé un résumé des résultats. La plupart des concentrations d'éléments nutritifs se trouvaient dans les limites des valeurs relevées dans la baie Georgienne, située à proximité; la concentration de phosphore était inférieure à 10 ③g/L. L'oxygène dissous ne semble pas être affecté, peu importe la profondeur de l'eau. En général, les données obtenues, quoique peu nombreuses, ne semblent pas indiquer une détérioration de la qualité de l'eau au site.

NWRI RESEARCH SUMMARY

Plain language title

Water Quality Observations at Aquacage Fisheries (Parry Sound, Ontario).

What is the problem and what do scientists already know about it?

Some members of the public and regulatory agencies are concerned about environmental effects of cage fish farms. In restricted waters the farms can cause water quality damage. At some sites, there are minimal effects. There is interest in the Aquacage site and the operator has requested information.

Why did NWRI do this study?

The observations are background data for a study of benthic effects of organic waste from this fish farm.

What were the results?

Water quality in and around the fish farm was remarkably similar to that of two stations in Georgian Bay just outside Parry Sound. The very limited data do not seem to indicate a water quality impairment at the farm.

How will these results be used?

These results will be used by the operator in applications for grants and will be used by regulatory agencies for comparison with monitoring data.

Who were our main partners in the study?

Aquacage Fisheries assisted in access to the site and advice on local conditions.

Sommaire des recherches de l'INRE

Titre en langage clair

Observations sur la qualité de l'eau aux Aqua-Cage Fisheries (Parry Sound, Ontario).

Quel est le problème et que savent les chercheurs à ce sujet?

Des membres du public et des organismes de réglementation sont préoccupés par les effets de l'exploitation de piscicultures en cage sur l'environnement. Dans les eaux réglementées, ce type d'exploitation peut entraîner une détérioration de la qualité de l'eau. À certains endroits, toutefois, les effets sont minimes. Chez Aqua-Cage Fisheries, on a manifesté de l'intérêt pour cette question, et l'exploitant a demandé de l'information.

Pourquoi l'INRE a-t-il effectué cette étude?

Les observations servent de données de référence pour une étude sur les effets des déchets organiques de cette pisciculture sur le benthos.

Quels sont les résultats?

La qualité de l'eau à la pisciculture et dans les environs était étonnamment semblable à celle de deux stations situées dans la baie Georgienne, tout près de Parry Sound. Les données, quoique très peu nombreuses, ne semblent pas indiquer une détérioration de la qualité de l'eau à la pisciculture.

Comment ces résultats seront-ils utilisés?

Ces résultats seront utilisés par l'exploitant dans ses demandes de subventions et par les organismes de réglementation pour fins de comparaison avec des données de surveillance.

Quels étaient nos principaux partenaires dans cette étude?

Les Aqua-Cage Fisheries ont contribué à l'étude en permettant l'accès au site et en fournissant de l'information sur les conditions locales.

Introduction

Water sampling was conducted at Aqua-Cage Fisheries in Parry Sound Ontario for the purpose of supplying background information for a study of potential benthic effects of the farm. Aqua-Cage Fisheries is a cage fish farm. At the request of the operator we have summarized our water quality observations. We hope these data can be used to supplement and corroborate other monitoring efforts.

Methods

Sampling stations were located and recorded using Global Positioning Systems either handheld or mounted on a boat. A 3L Van Dorn bottle was used to collect discreet samples in the water column. Sample water was poured into 100 ml glass bottles then preserved with 30% sulphuric acid prior to analysis for total phosphorus. An aliquot of the water sample for soluble P was filtered through a 0.45μ cellulose acetate filter and the filtrate preserved as for total P. A third aliquot, of the filtered water, was contained in a bottle for analyses of soluble reactive phosphorus (SRP), nitrate, nitrite and ammonia. These samples were kept cold until analysis at the National Laboratory for Environmental Testing, NWRI/Environment Canada, Burlington.

Physical factors in the water such as temperature, dissolved oxygen, conductivity, pH, turbidity were measured as water column profiles using a YSI 6600 field profile instrument.

Results

Water chemistry was sampled in the farm at its winter location in Depot Harbour Oct 29, 2001 (Fig. 1). Total phosphorus (TPuf) ranged from 7 to 15 ug/L in six samples. Filtered phosphorus (TPf) and Soluble Reactive Phosphorus (SRP) were much lower with SRP near the limit of reliable quantification.

Water chemistry was sampled in the farm while in production at its summer location in Parry Sound August 13, 2002 (Fig.2). Total phosphorus ranged from 4 to 6 ug/L in five samples. Soluble P and SRP were again lower than the total as is usual in water samples.

Spring water quality sampling was done at the cage site in Parry Sound May 5-9, 2003 (Fig.3). This date was approximately 6 months after the farm had been removed and before the farm was re-located to Parry Sound. Total phosphorus ranged from 3 to 7 ug/L but most samples were in the range 5 to 7 ug/L. There was some tendency for the phosphorus values to be lower close to the bottom. Filtered or soluble P was less than Total P and SRP was less than or close to the detection limit in most of the samples.

Environment Canada's Great Lakes monitoring program has sampled two stations nearby Parry Sound in Georgian Bay during summer months. At Station 15 south of Parry Sound (45°09'58"N 80°17'14"W) from 1970 to 2002 mean Total P ranged from 2.0 to 9.9 ug/L with a mean and standard deviation of 4.0 ±1.5 ug/L; soluble P was 2.2 ±1.0 ug/L and SRP was 0.8 ±0.8 ug/L. At Station 16 north of Parry Sound (45°21'14"N 80°29'10"W) Total P ranged from 2.3 to 9.5 ug/L with a mean of 4.0 ±1.4.1 ug/L; soluble P was 2.0 ±1.1 ug/L and SRP was 0.6 ±0.3 ug/L.

Oxygen and temperature profiles were measured in-situ at the un-occupied farm site in Parry Sound May 5, 2003 (Fig 4). Sites A4, C4, D4, F4, and G4 (Fig 3) were isothermal at less than 4 °C and had 13 mg/L oxygen from surface to bottom.

Winter oxygen and temperature profiles were measured through the ice on March 7, 2001 and March 1, 2004 (Fig 5). Again, the water was nearly isothermal with copious oxygen to the bottom.

A summer oxygen and temperature profile was measured on August 13, 2002 at the farm in Parry Sound (Fig. 6). A typical summer stratification was present with hypolimnion oxygen concentrations of 12.5 mg/L which is close to saturation.

Environment Canada's Great Lakes monitoring program has sampled two stations nearby Parry Sound in Georgian Bay (Fig. 7) during summer months. At Station 15 south of Parry Sound (45°09'58"N 80°17'14"W) from 1970 to 2002 mean Total P ranged from 2.0 to 9.9 ug/L with a mean and standard deviation of 4.0 ±1.5 ug/L; soluble P was 2.2 ±1.0 ug/L and SRP was 0.8 ±0.8 ug/L. At Station 16 north of Parry Sound (45°21'14"N 80°29'10"W) Total P ranged from 2.3 to 9.5 ug/L with a mean of 4.0 ±1.4.1 ug/L; soluble P was 2.0 ±1.1 ug/L and SRP was 0.6 ±0.3 ug/L.

Discussion

We have very limited data and we do not intend to imply that these data constitute a monitoring program. Instead, we propose that the data can be seen from the viewpoint of whether they are consistent with the notions that the fish farm does or does not have a strong effect on local water quality.

In Depot Harbour, where the farm over winters, the relatively restricted water may be expected to show the most effect of the farm. We note that some of the total phosphorus values are not much higher than those at station 15 in Georgian Bay. We are not surprised at the same time that some higher values were present because there is always some probability of including some fish faecal matter in the water samples taken inside the farm. While the lower values may represent background phosphorus in the harbour plus effects of the farm, the higher values in the farm provide no evidence of overall effects in the harbour.

At the occupied farm site in Parry Sound the total phosphorus values in the farm were similar to those in the range of data from stations 15 and 16 in nearby Georgian Bay. Furthermore, at depth, we did not observe a substantial increase in phosphorus that would be consistent with the notion that there is a large phosphorus release from the bottom. While we stress that our sampling was limited these values are not consistent with the notion that the farm is having a large effect on local water quality.

At the site in Parry Sound when it was un-occupied in Feb and May 2003 total phosphorus concentrations were similar to those when the site was occupied in 2002 and to those in Georgian Bay. We have no explanation for the sample with 3 ugP/L in May except to speculate that some portion of the total P may have comprised particles such as zooplankton which may not have been sampled evenly. If we assume the typical concentrations in May 2003 represent background in Parry Sound then little or no effect can be assigned the farm in the August 13, 2002 sampling when it contained fish at full production.

We do not imply that higher phosphorus concentrations could not be derived at the farm. Certainly, with enough sampling in the farm, some samples would likely contain particulate faecal matter that would cause higher total

phosphorus. These particles, however, would be sinking and would not represent the effect of the farm on the nearby surrounding water away from the sinking zone close by and under the cages.

The site in Parry Sound was sampled during Feb 2004 but samples have not yet been analyzed. During that sampling, intense currents were observed below the ice holes which would be consistent with mixing in the Sound. This lends some credence to the idea that our nutrient samples of May 2003 may represent background conditions in Parry Sound.

Dissolved oxygen profiles showed no appreciable oxygen depletion at the site surface or near the bottom. Thus, although organic deposition occurs from all fish farms we saw no evidence that the expected stimulation of benthic oxygen consumption was detectable in the oxygen profiles.

Overall, our data suggest the Aqua-Cage Fisheries farm is not causing a water quality impairment.

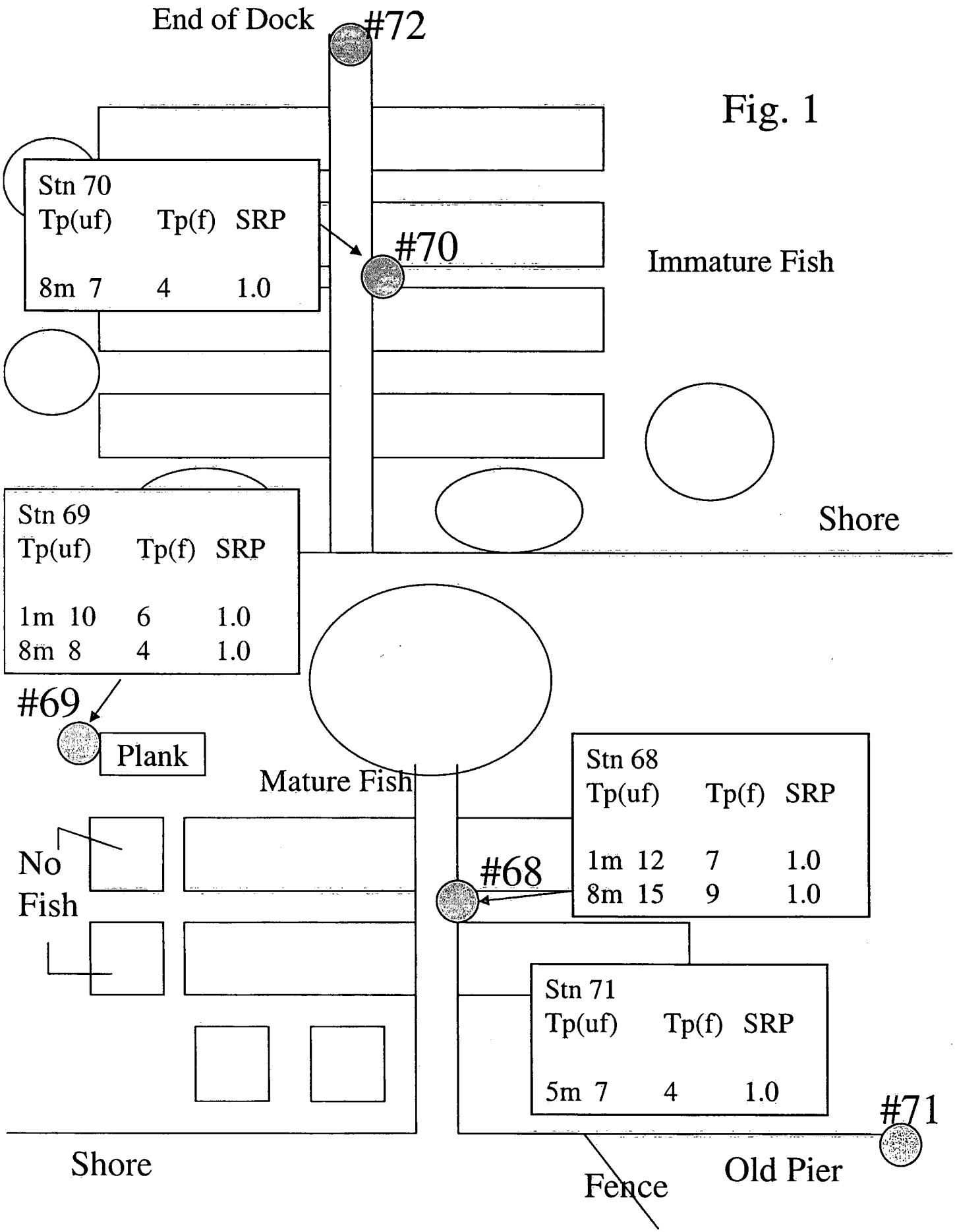

End of Dock
#72
Stn 70
Tp(uf) Tp(f) SRP
8m 7 4 1.0
#70
Immature Fish
Shore
Stn 69
Tp(uf) Tp(f) SRP
1m 10 6 1.0
8m 8 4 1.0
#69
Plank
Mature Fish
Stn 68
Tp(uf) Tp(f) SRP
1m 12 7 1.0
8m 15 9 1.0
No Fish
#68
Stn 71
Tp(uf) Tp(f) SRP
5m 7 4 1.0
#71
Shore
Fence
Old Pier

Fig. 1

Fig. 2

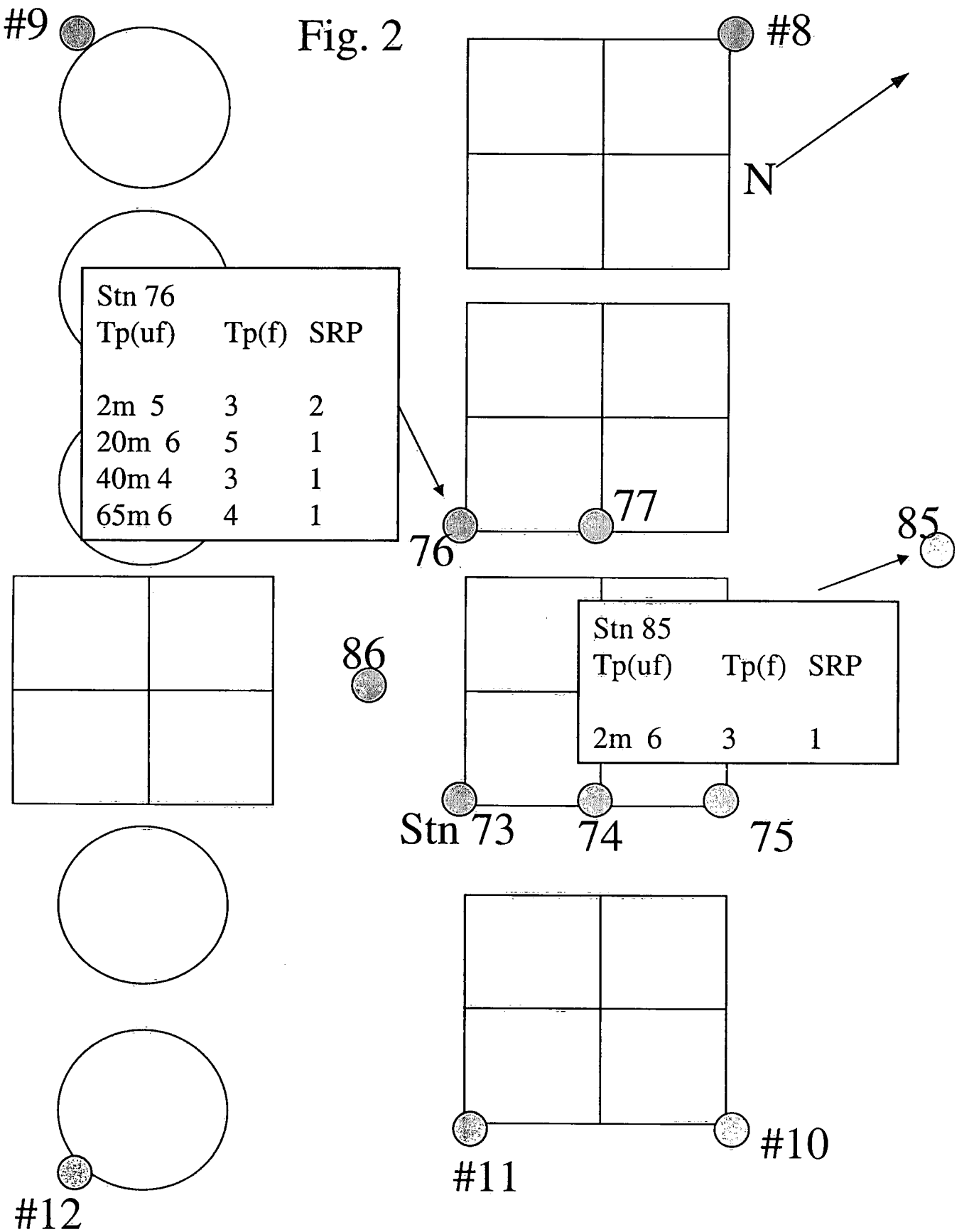

#9
#8
N
Stn 76
Tp(uf) Tp(f) SRP
2m 5 3 2
20m 6 5 1
40m 4 3 1
65m 6 4 1
76
77
85
86
Stn 85
Tp(uf) Tp(f) SRP
2m 6 3 1
Stn 73
74
75
#10
#11
#12

Fig. 3

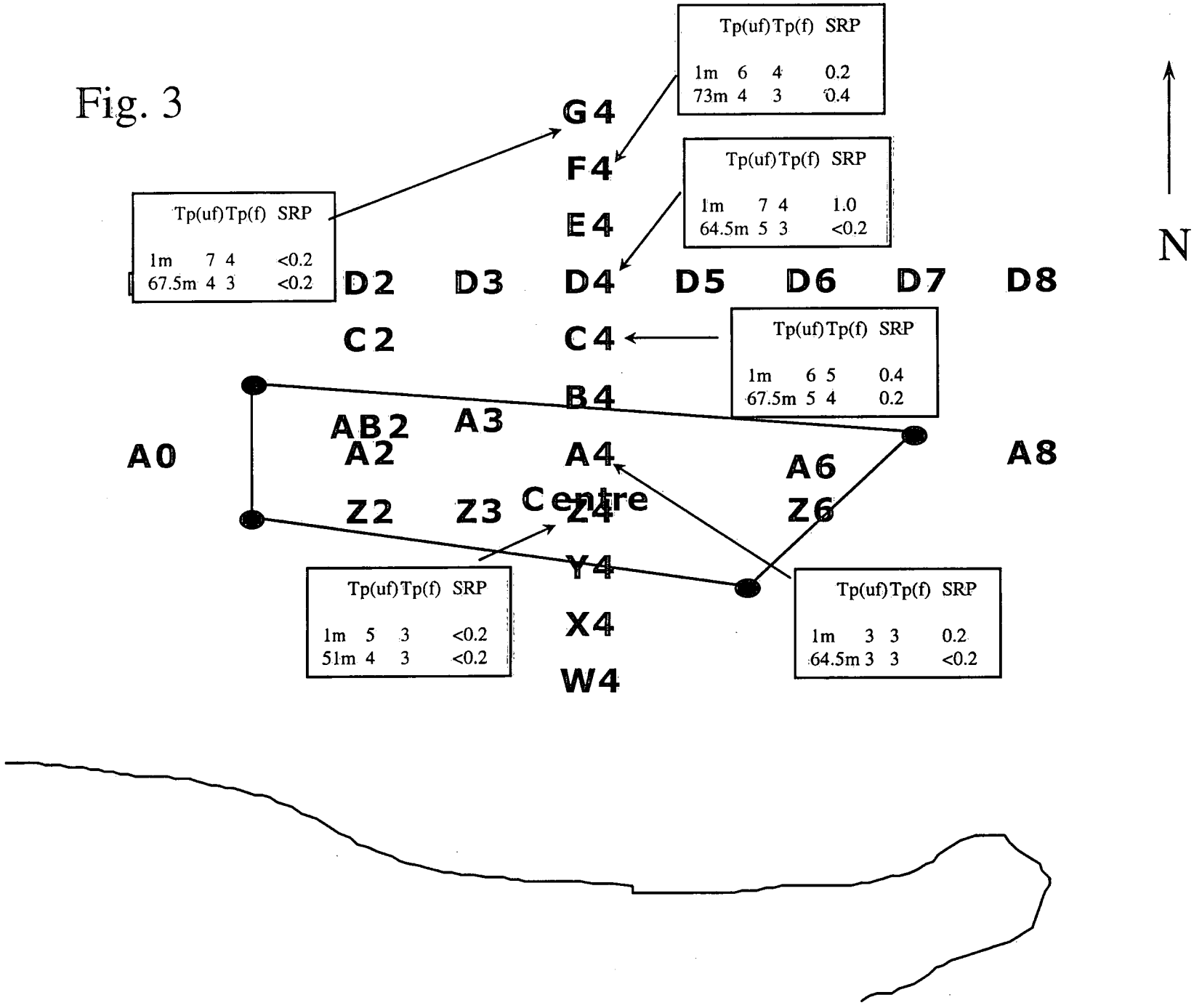

Tp(uf) Tp(f) SRP
1m 6 4 0.2
73m 4 3 0.4
Tp(uf) Tp(f) SRP
1m 7 4 1.0
64.5m 5 3 <0.2
Tp(uf) Tp(f) SRP
1m 7 4 <0.2
67.5m 4 3 <0.2
Tp(uf) Tp(f) SRP
1m 6 5 0.4
67.5m 5 4 0.2
Tp(uf) Tp(f) SRP
1m 5 3 <0.2
51m 4 3 <0.2
Tp(uf) Tp(f) SRP
1m 3 3 0.2
64.5m 3 3 <0.2
N
G4
F4
E4
D2
D3
D4
D5
D6
D7
D8
C2
C4
B4
AB2
A3
A0
A2
A4
A6
A8
Z2
Z3
Centre
Z4
Z6
Y4
X4
W4

Fig. 4

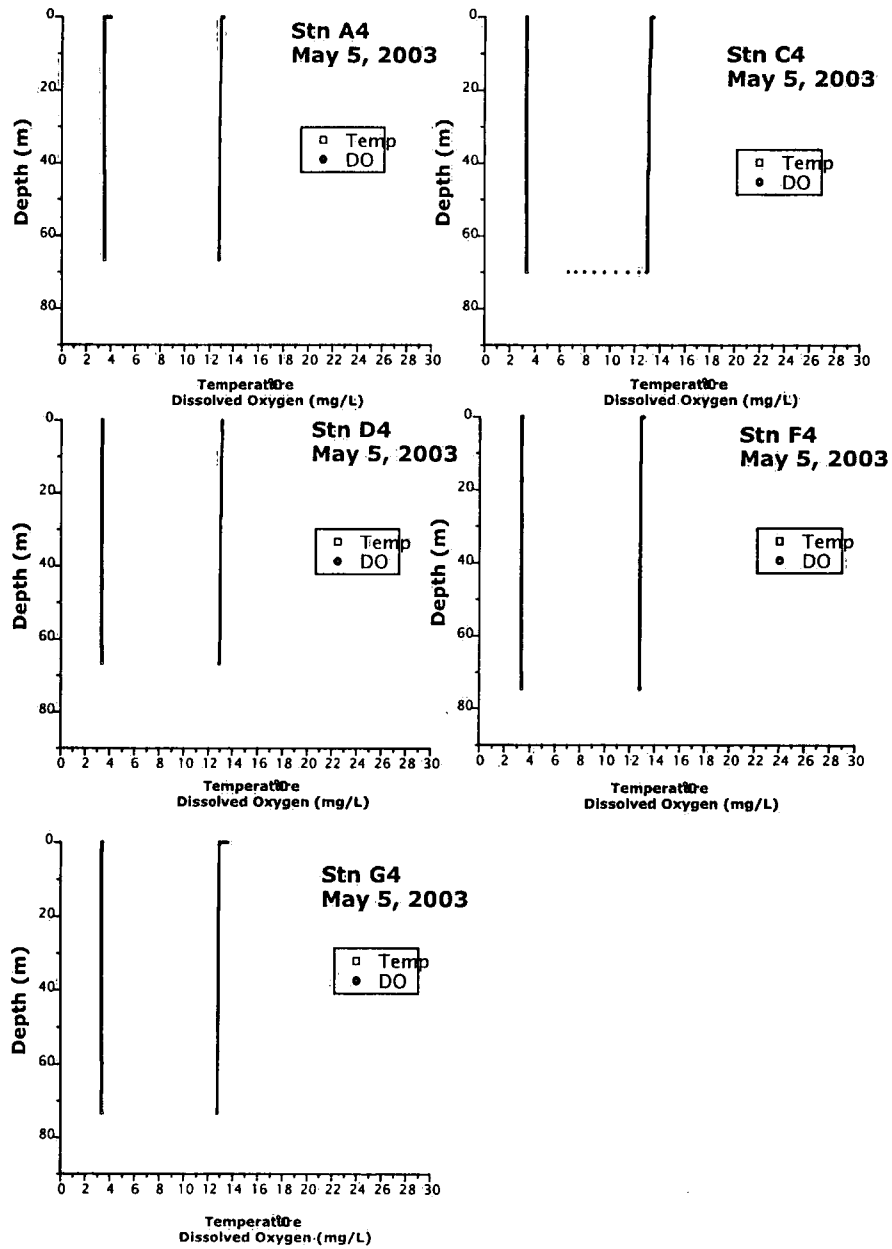
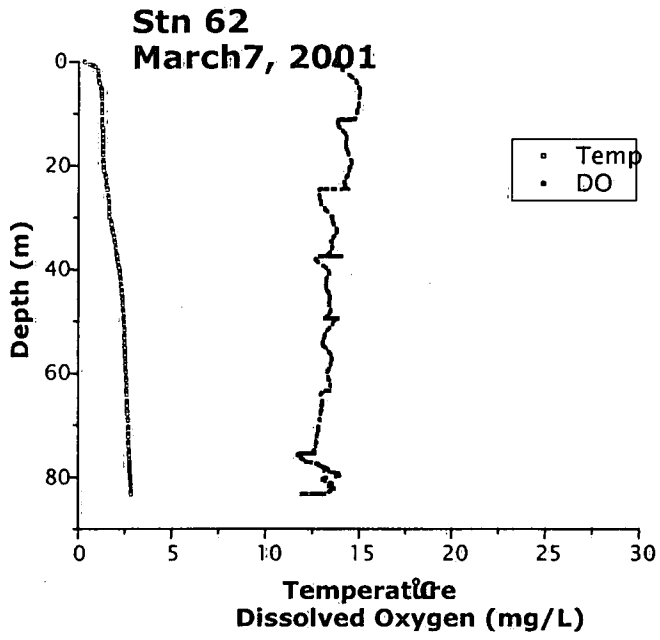

Stn A4
May 5, 2003
Stn C4
May 5, 2003
Stn D4
May 5, 2003
Stn F4
May 5, 2003
Stn G4
May 5, 2003
Temp
DO
Depth (m)
0
20
40
60
80
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Temperature
Dissolved Oxygen (mg/L)

Fig. 5


Stn 62
March7, 2001
Temp
DO
Depth (m)
0
20
40
60
80
0
5
10
15
20
25
30
Temperature
Dissolved Oxygen (mg/L)

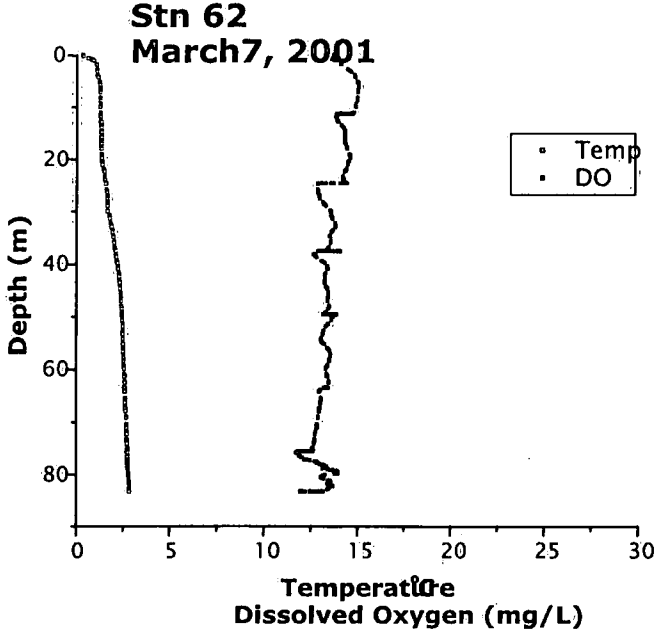

Stn 62
March7, 2001
Temp
DO
Depth (m)
0
20
40
60
80
0
5
10
15
20
25
30
Temperature
Dissolved Oxygen (mg/L)

Fig. 6

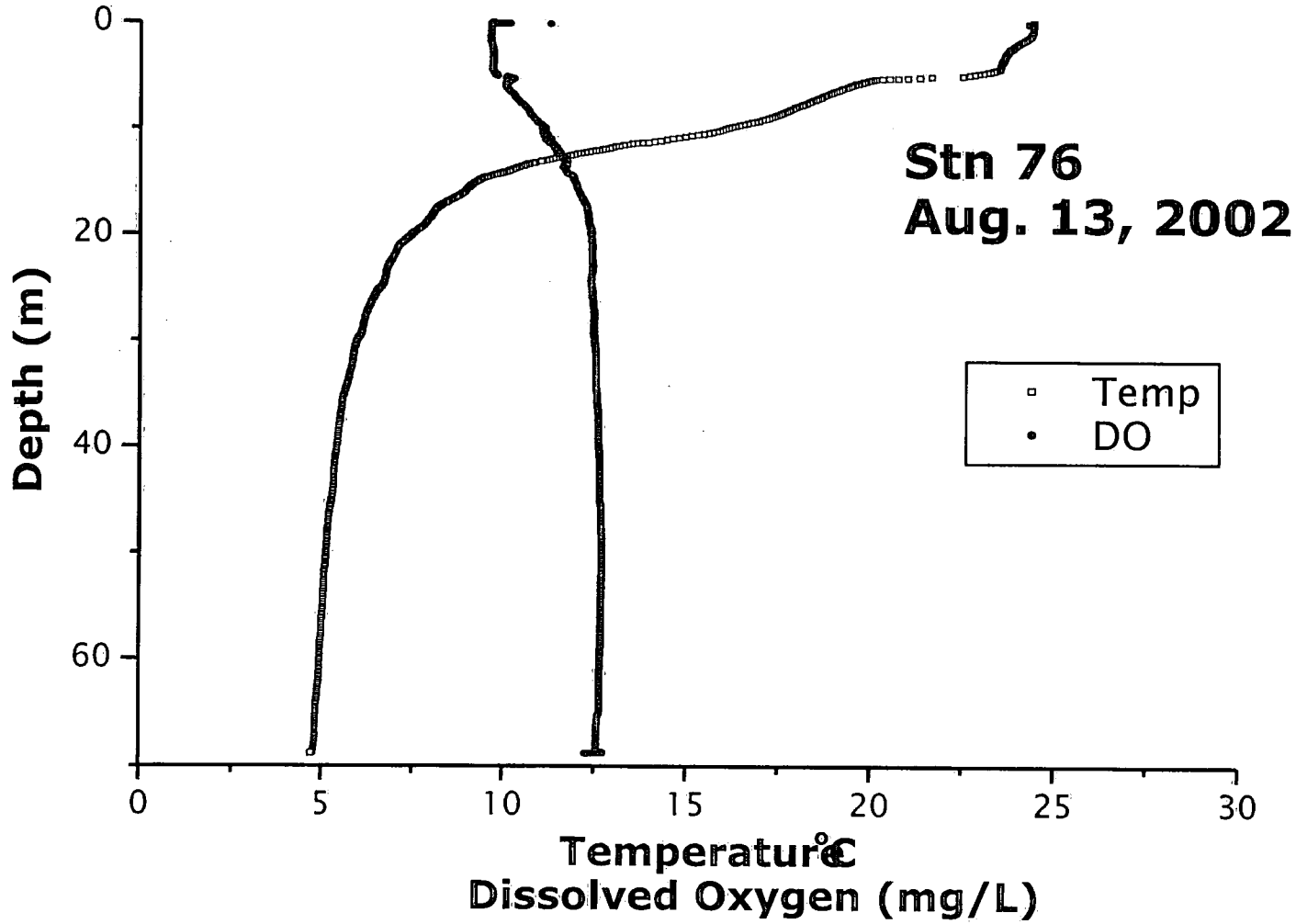
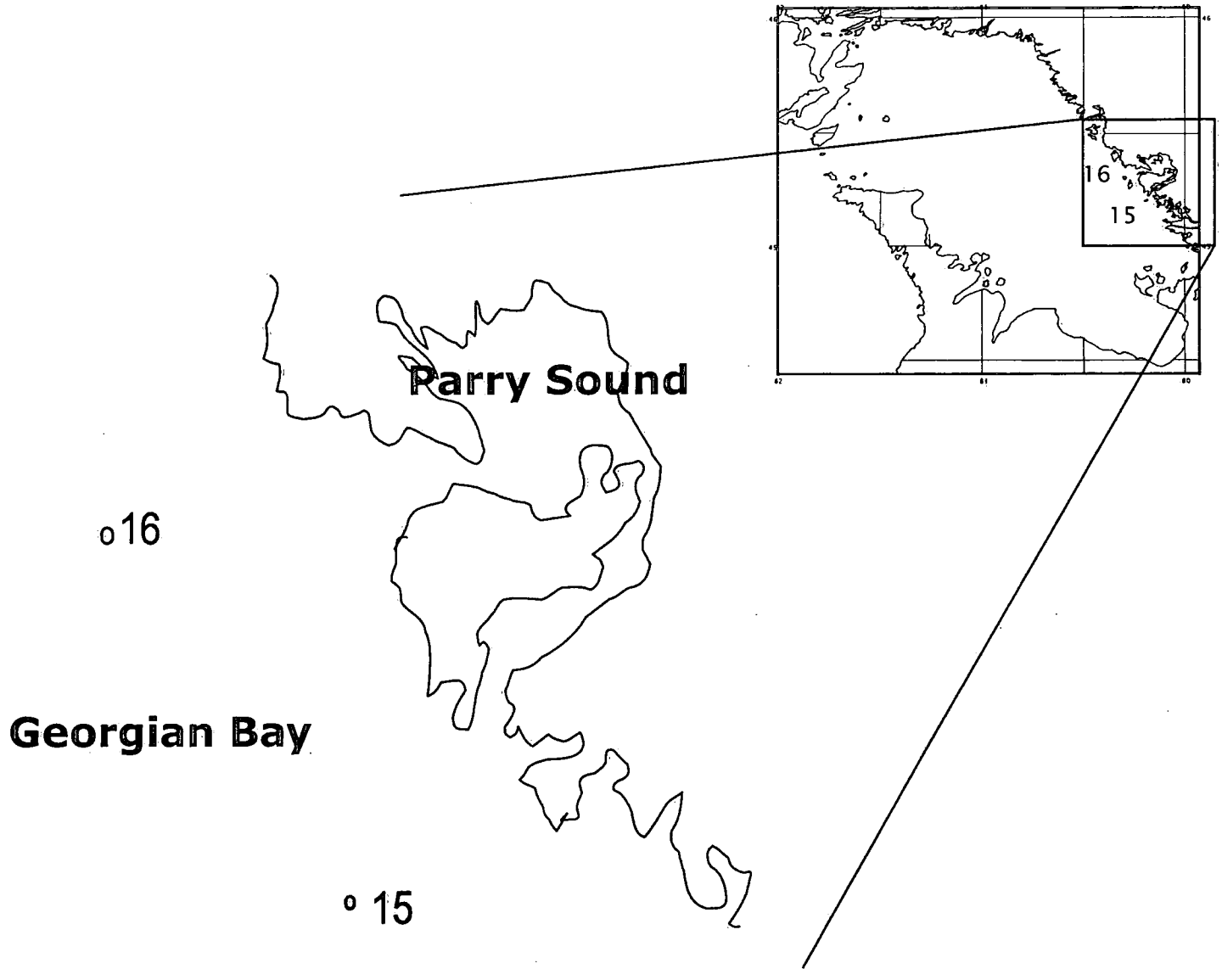

Stn 76
Aug. 13, 2002
Temp
DO
Depth (m)
0
20
40
60
0
5
10
15
20
25
30
Temperature °C
Dissolved Oxygen (mg/L)

Fig.7



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