NEARSHORE DISTRIBUTION AND ABUNDANCE OF JUVENILE ATLANTIC COD (*GADUS MORHUA*) AT TWO SITES IN COASTAL WATERS OF NEWFOUNDLAND

by

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Abstract

Juvenile Atlantic cod were sampled at two inshore sites in November 1993, measuring age specific abundance from the nearshore (8 m) down to 100 m depth. Juvenile cod were caught from a range of sizes which were related to ages 0-3 years. Significantly more cod were caught during night than daylight. Juvenile cod ages 0 and 1 were caught abundantly down to depths of approximately 40 m and up to 2-3 km from shore. In contrast, older juveniles ages 2 and 3 were caught more abundantly at depths > 40 m. The spatial separation is consitent with avoidance of predation by the smallest juvenile cod, ages 0 and 1. Demersal 0-group cod averaged 30 cod/10 min tow at 20 m depth and approximately 1 km from shore at the Kelligrews site. This high catch rate indicates that suitable habitat occurs well away from beach environments where juvenile cod have previously been sampled abundantly. Variation within the general depth-dependent patterns of distributions suggests that bottom habitat may be an important, unmeasured, variable also affecting the distribution of juvenile cod, particularly ages 0 and 1 year.

Résumé

On a échantillonné des morues de l'Atlantique juvéniles dans deux secteurs côtiers en novembre 1993 et mesuré leur abondance selon l'âge depuis la côte (8 m) jusqu'à une profondeur de 100 m. Ces morues juvéniles avaient des tailles variées, correspondant à la fourchette d'âges de 0-3 ans. On en a capturé beaucoup plus la nuit que le jour. Les juvéniles de 0 et 1 an ont été pris en abondance à des profondeurs atteignant plus de 40 m et jusqu'à 2 à 3 km du rivage. En revanche, les juvéniles de 2 et 3 ans étaient plus abondants dans les prises réalisées à des profondeurs supérieures à 40 m. La séparation spatiale correspond à l'évitement de la prédation chez les plus jeunes morues, de 0 et 1 an. Le taux de prises de morues démersales du groupe 0 était en moyenne de 30 morues/trait de 10 minutes à une profondeur de 20 m et à environ 1 km du rivage sur le site de Kelligrews. Ce fort taux de prises dénote l'existence d'un habitat adéquat bien au-delà des plages, où la morue juvénile abondait dans les échantillonnages précédents. Les variations dans les régimes généraux de distribution selon la profondeur semblent indiquer que l'habitat démersal peut être une variable importante et non mesurée qui influe sur la distribution de la morue juvénile, particulièrement celle de 0 et 1 an.

Introduction

Historically juvenile Atlantic cod have been sampled abundantly in the very nearshore environment by beach seines (Lear et al. 1980, Methven 1995). These cod were primarily 0-group and 1-group, as sampled in October during the main period of 0-group settlement of juvenile cod to the nearshore environment. However, the small-scale cross-shore abundance of cod beyond the neashore environment sampled by the beach seine has not been clearly established. The purpose of this study was to determine the cross-shore abundance of juvenile cod at the scale of several kilometers away from shore.

Methods

A small 4.9 m (17 foot) semi-ballon trawl (Figure 1) was towed for ten minute intervals alongshore at specific water depths. The catch was sorted on deck and cod were counted and measured for total length (cm). All sampling was carried out from the 21 m research vessel, SHAMOOK.

Two sites were sampled repeatedly during day and night during November 1993. The first site sampled was off Bellevue Beach, Trinity Bay where intensive beach seine sampling has been carried out over a number of years (Methven and Bajdik 1994, Methven 1995). Six locations were sampled, ranging from 8 m depth near the beach to 100 m depth approximately seven kilometers away from shore. The second site was near Kelligrews, Conception Bay where three locations were sampled from approximately 20 to 100 m depth.

Results

A total of 4-6 tows were carried out at each site, except the 100 m location sampled at the Bellevue Site (Figure 1). Cod ranged in length from 5-39 cm at both sites, with distinct modes being apparent in the length frequency distributions (Figure 2). A much broader range of lengths was sampled at the Bellevue Site, with few cod $>$ 17 cm being sampled at the Kelligrews Site. While these samples have not been aged, the length modes have been assigned to age groups as follows: 5-11 cm as 0-group; 12-19 cm as 1-group; 20-30 cm as 2-group; 31-40 cm as 3-group.

Night catches of cod were significantly greater than during the day for all age groups at both sites (Figure 3). Due to the significantly higher night catches of cod, cross-shelf distributions are based on night catches only.

At the Bellevue Site, the cross-shore distribution of 0-group cod generally decreased moving away from shore (Figure 4). Catches peaked at approximately 20 m depth, but remained relatively high out to the trawl location at 42 m depth, just

over 3 km from shore. No cod were caught for any age group at the single tow at 100 m depth conducted during the day at the Bellevue Site (Figure 4).

Similarly, the cross-shelf distribution of 1-group cod at the Bellevue Site generally decreased moving away from shore (Figure 4). However, there was a greater cross-shore variation in the catches than for the 0-group cod. Highest abundance occurred at the shallowest trawl depth of 8 m and at 42 m depth, while low abundance occurred in between these locations at the 15 m and 22 m trawl locations, as well as the deeper trawl locations (Figure 4).

The distributions of 2-group and 3-group cod generally increased at deep trawl locations moving away from shore, although this observation is primarily driven by catches at approximately 65 m depth, just over 5 km from shore (Figure 4).

At the Kelligrews Site, the cross-shore abundance of 0-group and 1-group cod generally decreased at deeper depths and farther from shore (Figure 5). The highest abundances of 0-group cod were observed at the shallowest tow location at approximately 20 m depth, while highest abundance of 1-group cod were observed at 40 m depth.

Abundances of 2-group and 3-group cod were highest at the 40 m depth location, although these abundances were always low (Figure 5).

No cod were caught for any age group at the deepest trawl location at 100 m depth, similary to the Bellevue Site (Figure 5). However, it is noteworthy that American plaice (*Hippoglossoides platessoides*) were caught abundantly during all tows. This suggests that the bottom habitat at this location may have been unsuitable for juvenile cod.

Discussion

Results from this study demonstrate that 0-group and 1-group juvenile cod remained relatively abundant out to depths of 40 m, which occurred approximately 2-3 km from shore. The higher abundances of 2-group and 3-group cod observed at deeper depths at the Bellevue Site, and the virtual absence of these older cod at the Kelligrews Site, suggests there is a definite spatial separation among younger (0-group and 1-group) and older (2-group and 3-group) juvenile cod within relatively small spatial scales. At the Bellevue Site this cross-shore separation occurred within a 7 km range.

The shallowest tow location at the Bellevue Site was 8 m depth and approximately 700 m from the beach. At the Kelligrews Site the shallowest depth sampled was 20 m although this occurred witin 1,000 m from the shore. While higher abundances may have occurred shoreward of these trawl locations, it is clear that 0-group cod were abundant at deeper depths away from shore. These observations suggest that cod sampled by beach seines in the very nearshore probably represent the edge of a much greater distribution which extends into deeper water.

It is noteworthy that the mean abundance of 0-group cod sampled at the Kelligrews Site was approximately 30 cod/tow, whereas at the Bellevue Site highest mean abundances ranged around 4 cod/tow (Figures 4 and 5). This significant difference suggests that the abundance distribution of 0-group cod may be more dependent on different bottom habitats than simply water depth and distance from shore. This observation is supported by the abundance distribution of 1-group cod at the Bellevue Site, which oscillated between high and low moving away from shore into deeper depths.

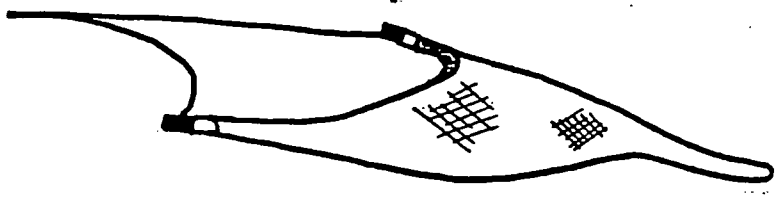
References

Lear, W. H., A. M. Fleming, and R. Wells. 1980. Results of small cod surveys in eastern Newfoundland during 1959-64. NAFO SCR Doc. 80/IX/144, Ser. No. N0218. 11 p.

Methven, D. A., and C. Bajdik. 1994. Tempral variation in size and abundance of juvenile Atlantic cod (*Gadus morhua*) at an inshore site off eastern Newfoundland. Can. J. Fish. Aquat. Sci. 51: 78-90.

Methven, D. A. 1995. Early life history of juvenile cod (*Gadus morhua*): Spatial and temporal variability and variability due to gear. Final Report, Northern Cod Science Program. 132 p.

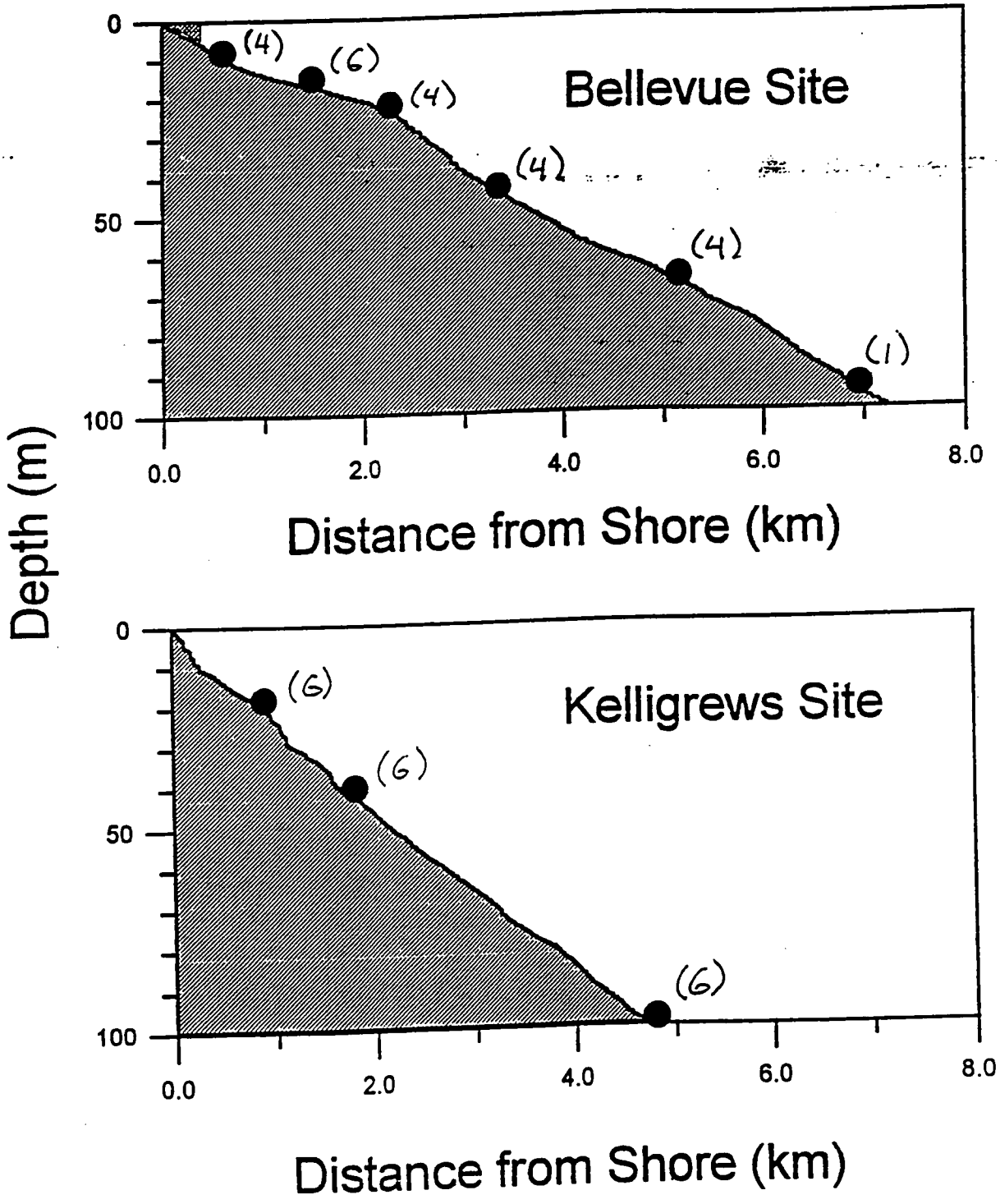
17' SEMI - BALLON TRAWL



- 17 ' Headrope, 21' Footrope
- Nylon Netting 1/2" Stretch Mesh Nylon
- Cod End 1/4" Stretch Mesh Nylon
- Chafing Gear 2 1/2" Stretch Mesh Nylon
- 3" x 3" Sponge Floats
- 3" x 5" Mud Rollers, 2/0 Galvanized Chain

Figure 1. Description of 4.9 m (17 foot) semi-ballon bottom trawl used in this study.

Figure 2. Schematic representaion of the Bellevue and Kelligrews study sites. The dots represent the trawl locations, fixed relative to water depth (m) and distance from the shore (km). The numbers in brackets refer to the number of tows made at each location.



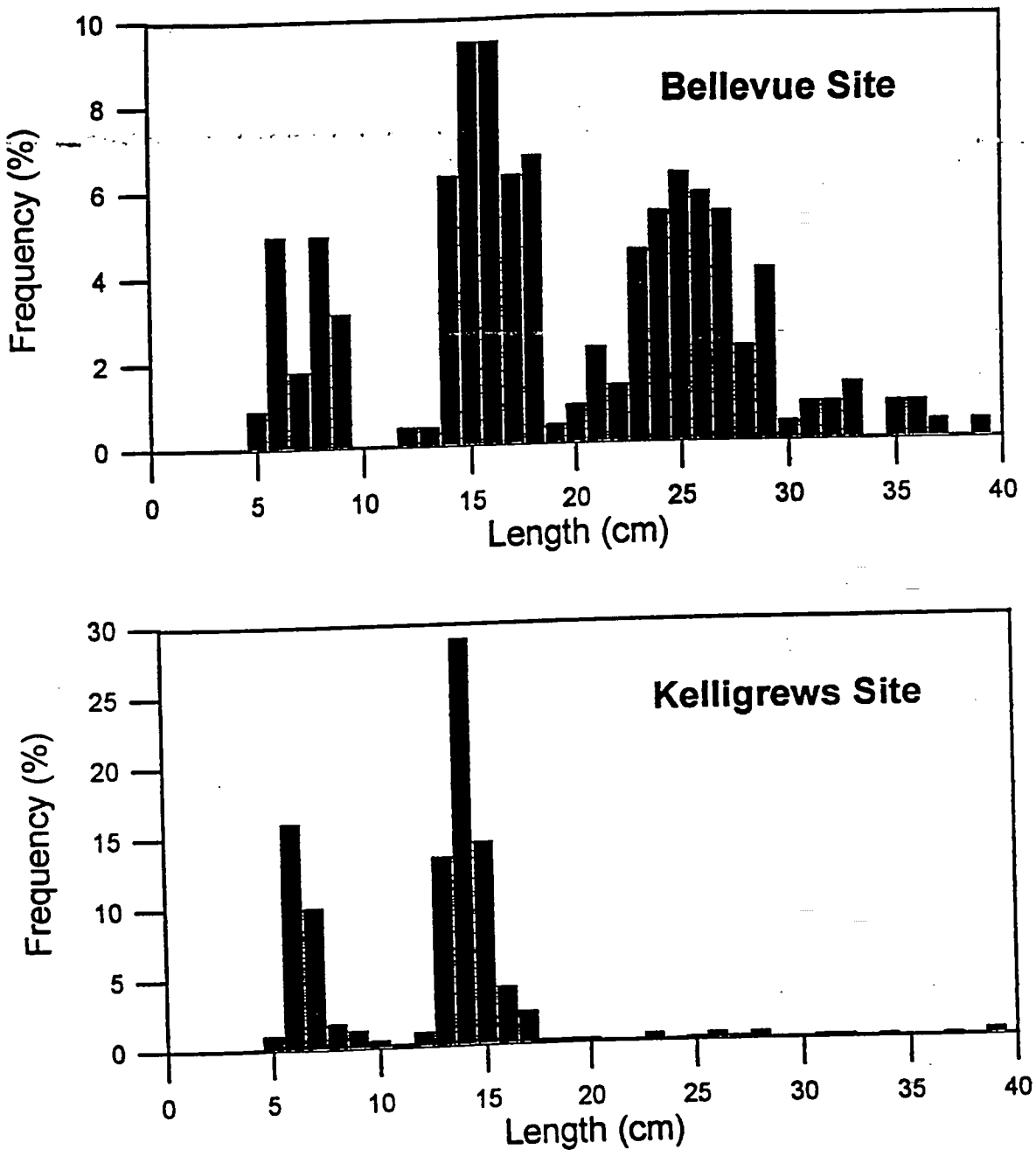


Figure 3. Length (cm) frequency (%) distributions of cod (*Gadus morhua*) sampled during all tows at the Bellevue and Kelligrews study sites.

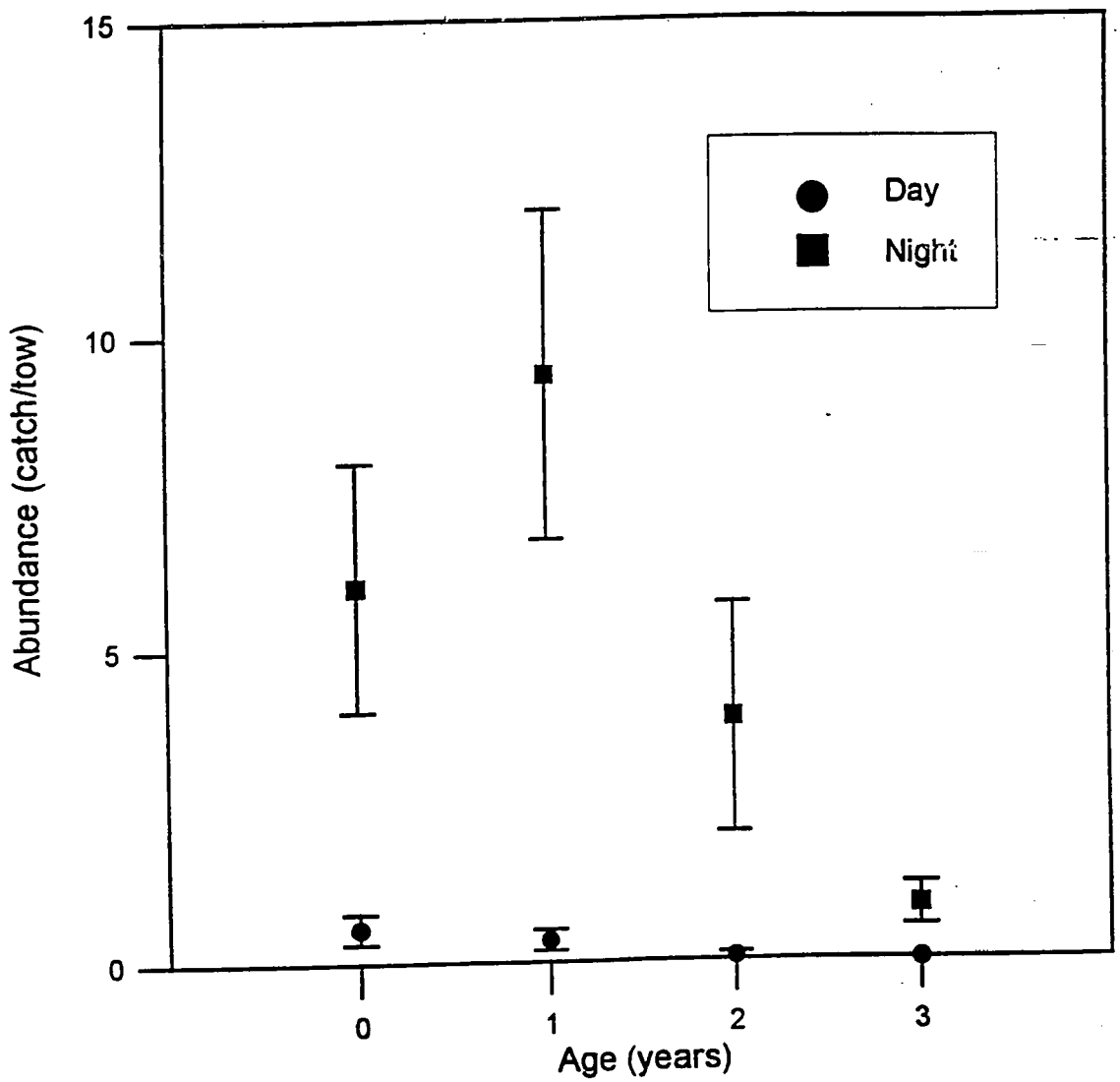


Figure 4. Comparison of the abundances (number/tow) of cod sampled at different ages (years) during all daytime and nightime tows, combined for both the Bellevue and Kelligrews study sites. The error bars represent one standard deviation of the population mean.

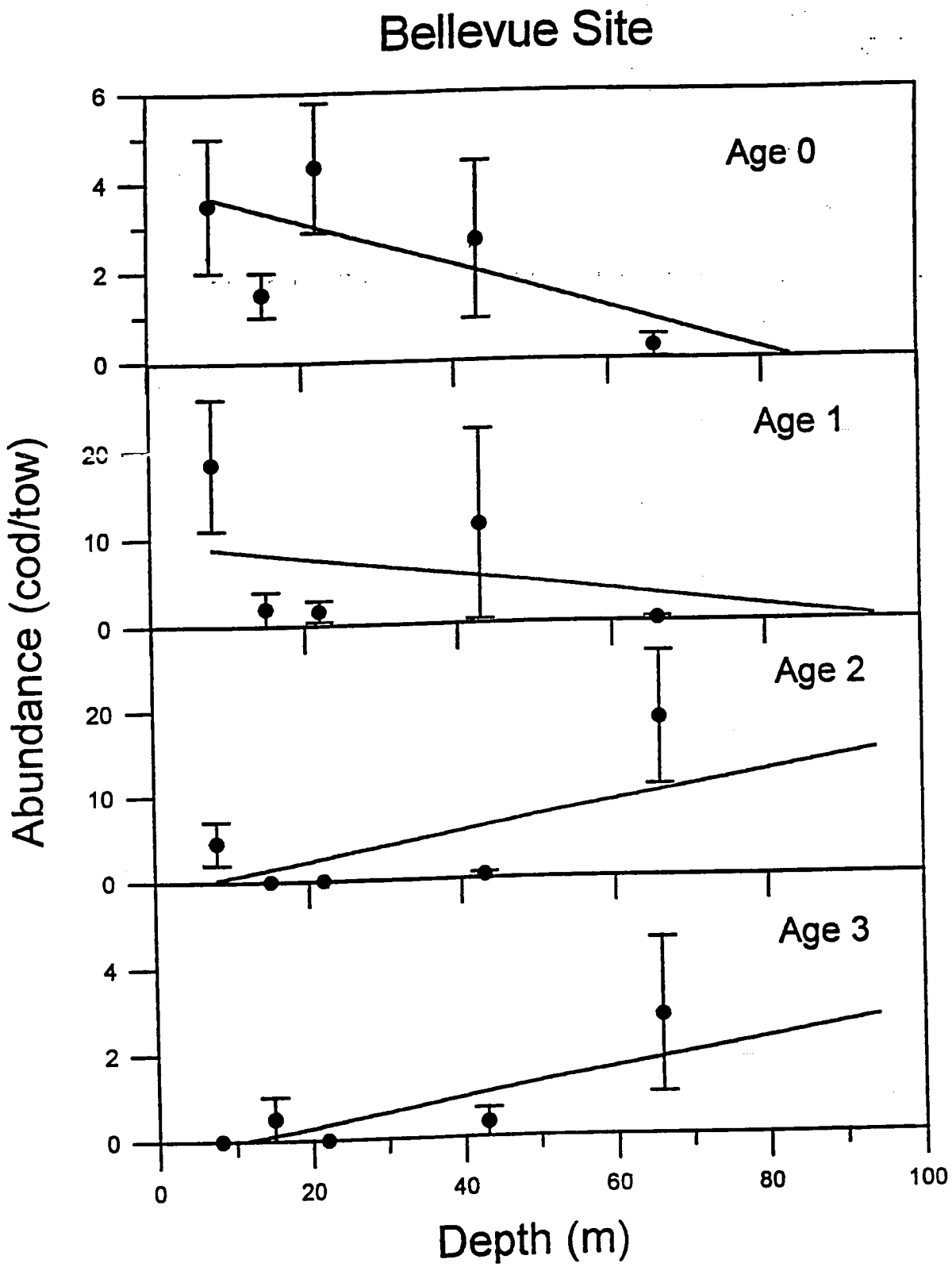


Figure 5. The abundance (number/tow) of cod sampled at the Bellevue study site at the different trawl locations plotted as a function of the water depth (m) for each age. The error bars represent one standard deviation of the population mean.

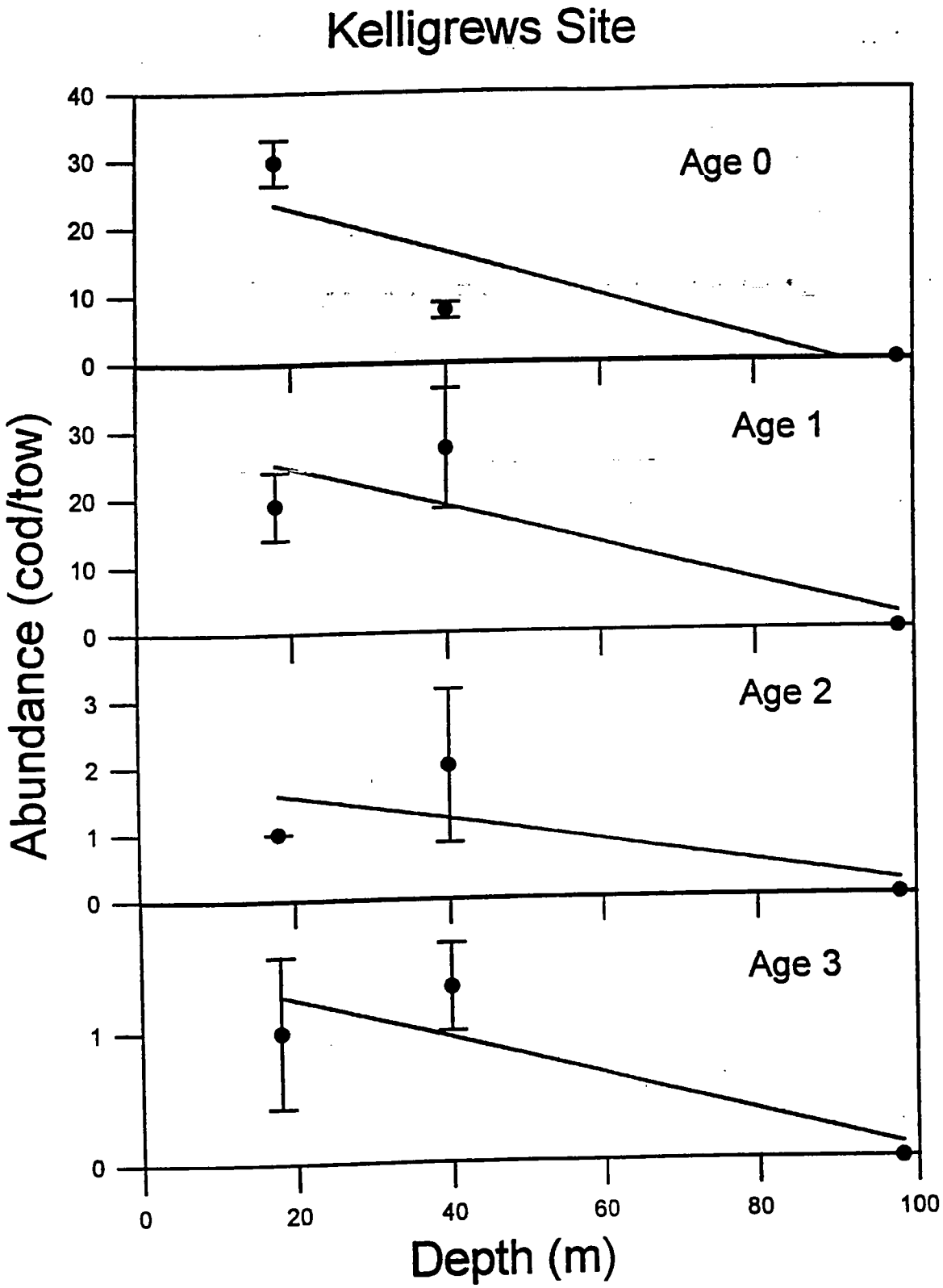


Figure 6. The abundance (number/tow) of cod sampled at the Kelligrews study site at the different trawl locations plotted as a function of the water depth (m) for each age. The error bars represent one standard deviation of the population mean.