Assessment of Scallop Stocks on Browns and German Banks — 1979

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by

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ABSTRACT

Jamieson, G.S., G. Kerr and M.J. Lundy. 1981. Assessment of scallop stocks on Browns and German Banks - 1979. Can. Tech. Rep. Fish. Aquat. Sci. 1014: iv + 17 p.

A scallop stock assessment of selected areas on Browns and German Banks (southern Scotian Shelf) is presented, based on age frequency distribution and yield per recruit analyses. Recruitment is sporadic and only five-six year old scallops were abundant in 1979. Over the past 15 years, landings were >75 MT in only five years.

Both meat yield at age and asymptotic shell size were less for southern Scotian Shelf scallops than for scallops from Georges Bank or Bay of Fundy waters <60 fathoms depth off Digby, N.S. Maximum yield per recruit is achieved at age of first exploitation of seven to nine years, and optimal meat count per kilogram is about 77-88 (35-40 meats/lb).

Alternate management strategies to allow joint exploitation of this resource by both the offshore and Bay of Fundy scallop fleets are discussed.

RÉSUMÉ

Jamieson, G.S., G. Kerr and M.J. Lundy. 1981. Assessment of scallop stocks on Browns and German Banks - 1979. Can. Tech. Rep. Fish. Aquat. Sci. 1014: iv + 17 p.

Nous présentons ici une évaluation des stocks de pétoncles à des endroits choisis des bancs Browns et German (plateau néo-écossais méridional). Cette évaluation est fondée sur des analyses de la distribution des fréquences de longueur et du rendement par recrue. Le recrutement est sporadique puisque seuls les pétoncles de cinq à six ans étaient abondants en 1979 et que, dans les 15 dernières années, la pêche ne donna plus de 75 t que dans cinq années.

Le rendement en chairs à un âge donné et la taille asymptotique des pétoncles du plateau néo-écossais méridional sont tous deux inférieurs à ceux des pétoncles du banc Georges ou des eaux de moins de 60 brasses de profondeur de la baie de Fundy, au large de Digby (N.-E.). Le rendement maximal par recrue est atteint à un âge de première exploitation de sept à neuf ans, et le nombre optimal de chairs par kilogramme est d'environ 77-88 (35-40 chairs/lb).

Nous examinons les diverses options de stratégies de gestion visant à assurer à cette ressource une saine exploitation à la fois par la flottille hauturière et celle de la baie de Fundy.

INTRODUCTION

Historically, the Scotian Shelf has never sustained a continuous scallop fishery for more than a few years (Table 1). Scallop recruitment has characteristically been intermittent, but with the large number of vessels from both the Bay of Fundy and offshore scallop fleets available to exploit any new recruitment, rapid depletion of recruits has frequently occurred. These vessels traditionally fish most of their landings from within the Bay of Fundy and from Georges Bank (Table 2), respectively, making the potential combined fleet size disproportionately large relative to Scotian Shelf scallop resources.

Past productive areas on the Scotian Shelf (Fig. 1) include Lurcher Bank, German Bank, Browns Bank, Middle Ground, and around Sable Island. In recent years, only Browns Bank has been consistently fished, although in 1979 commercial quantities of scallops were discovered on German Bank and this area was heavily exploited as well (Table 1).

Present uncertainty over whether Canada or the United States has management authority over Georges Bank has hindered the establishment of an effective management plan for the Scotian Shelf. The offshore scallop fleet in particular often fishes both Georges and Browns Bank on the same trip, and since a majority of the catch is fished on Georges Bank (Table 1) there has been resistance to imposition of a different plan for the Scotian Shelf. Although offshore vessels have to abide by a present maximum trip catch limit of 30,000 lb (13.16 MT) and a maximum meat count of 40 meats per lb (88.2 meats/kg), regardless of where they fish, the practice on these vessels of blending the small meats from new recruits with the larger meats from older scallops has resulted in particularly heavy exploitation of easily accessed concentrations of small scallops. Offshore vessels routinely pass over the Scotian Shelf while both going to and returning from Georges Bank, and it has been the custom to fish scallops there so as to provide additional scallops to keep the crews busy while steaming to or from Georges Bank.

The recent decline from above-average landings of scallop from Georges Bank and the resulting increase in scallop fishing on the Scotian Shelf has created a new impetus to provide effective management for those scallop resources clearly within present Canadian management jurisdiction. This study presents the results of a resource survey of those areas on Browns and German Banks which were productive in 1979 (Fig. 2). Limited resources preclude exploratory surveys, and this study focuses on characterizing scallop concentrations identified from fishermen's log records. Management options

are discussed in terms of both the present resource and the historic scallop production from this region.

MATERIALS AND METHODS

A scallop resource survey of selected areas on Browns and German Banks was conducted in October 1979. Areas to be surveyed were determined from commercial log records received in 1979 prior to the survey; and two areas, one on each Bank, were identified as having significant scallop landings (A and B in Fig. 2). Data received since the survey has indicated a second area of high landings on German Bank (C in Fig. 2), but since this location was not identified prior to the survey, only the surveyed regions are discussed in subsequent sections. Of the effort expended on the Scotian Shelf by commercial scallop vessels in the first seven months of 1979, 68% was reported on Browns Bank, whereas only 18% was reported on German Bank. On each Bank, expended effort was highly localized and so to establish survey strata, boundaries for a "high-density" stratum were established one minute of latitude or longitude around the contagious distribution (Elliott, 1977) of commercial fishing locations. A "low-density" stratum was established in a band two minutes wide around the "high-density" stratum. Sixty stations were surveyed, with station location randomized within each stratum; thirteen stations were in the "low-density" strata. Number of stations on each Bank was proportional to expended effort.

At all stations, tows were made with a standard 2.4 m offshore drag with 76 mm diameter rings and a 38 mm stretch mesh net liner. Live scallops and cluckers (dead scallops with both valves still hinged together) were weighed whole, and individual height frequencies were recorded with categorization by 5 mm divisions. Each tow attempted to cover 0.8 km of ocean bottom as determined from Loran A bearings.

RESULTS

A. Shell Height-Meat Weight Relationships

Data from Browns Bank collected on earlier Georges Bank resource surveys were combined with data from this cruise to allow calculation of the shell height-meat weight relationship for both Browns and German Banks scallops. Parameters derived for the equation $\ln(W) = A + B\ln(H)$ are as follows:

	Browns Bank	German Bank
n	250.00	150.00
A	-13.35	-11.48
B	3.41	2.99

where W = meat weight (gm) and H = shell height (mm). German Bank scallops less than 95 mm in shell height have a comparatively greater adductor muscle weight than do scallops from Browns Bank, whereas for scallops greater than 95 mm, the converse applies (Fig. 3).

Meat yield for any scallop shell height from both these Banks is less than that for equivalent scallops from Bay of Fundy waters less than 60 fathoms depth and from Georges Bank.

B. Growth

Von Bertalanffy growth parameters have been calculated (Allen, 1967) for both Browns and German Bank (Fig. 4) scallops:

	Browns Bank	German Bank
L_∞	108.80	124.60
W_∞	14.04	19.06
t	1.60	1.60
K	0.36	0.28

W_∞ was calculated for the scallops from each Bank using the value L_∞ in the shell height-meat weight equations presented above. Scallops on German Bank appear to grow to a greater size than scallops on Browns Bank.

C. Resource Survey

Age frequencies of scallops from each stratum on each Bank (Fig. 5) indicate that although some scallops from all age classes are present, the majority of scallops are represented by only a few adjacent age classes. Relative abundance of scallops less than age 3 is unreliable owing to poor gear retention. On Browns Bank the modal age fished is five years, whereas on German Bank the modal age is six years. Although age classes on each side of these modal peaks also appear to be relatively abundant, it is suspected that this may largely be an aging artifact due to variable growth rate and that only one year class is actually present. Aging procedures utilize

average values for each Bank as a whole, and growth conditions may vary considerably between the different regions of each Bank because of depth and/or other environmental factors.

Scallops were only abundant in the "high-density" stratum, indicating a highly contagious distribution. Prerecruits (three to four year old scallops) were not abundant on either Bank. However, because of the high degree of contagion exhibited and the limited area on each Bank surveyed, this does not necessarily imply that prerecruits may not be present elsewhere.

D. Yield per Recruit

Meat yield (kg) per 10,000 recruits has been determined utilizing the above growth parameters and M = 0.1 (Fig. 6). Maximal Y/R is about 10% greater on German Bank than on Browns Bank, but for both banks, is approximately 30% of that reported for Georges Bank (Brown et al., 1972). Optimal ages of first exploitation are 7-9 years.

DISCUSSION

Two facts are immediately obvious for both German and Browns Banks scallops: 1) average growth rate (K) is intermediate between that for both Georges Bank (Brown et al., 1972) and Bay of Fundy scallops from less than 60 fathoms depth (Jamieson and Lundy, 1979) and on the basis of yield per recruit analyses (Fig. 6A & B), the optimal age of first exploitation is about seven to nine years of age; and 2) the high degree of contagion exhibited, although sporadic in time, encourages a high rate of exploitation once a concentration of scallops is discovered.

Optimal age of first exploitation is considerably greater than the present age of first exploitation (four years). The explanation for this low age of first exploitation is in the way the present meat count regulation operates. A meat count regulation of 40 meats/lb (88.2 meats/kg), i.e. an average meat size greater than 11.3 g, is effective in optimizing age of first exploitation only so long as a majority of scallops being exploited are of a size considerably greater, since it is an average meat size that is being regulated. If this is not so, then blending of scallop meats of different sizes results. For example, scallop meats of 6 g may be combined with an equivalent number of 16 g meats to give an average meat weight of 11 g. A worse situation is that a much greater number of very small meats may be combined

with a few, very large meats (e.g. > 40 g meats). The problem in the latter example is that maximal yield per recruit is lost at both ends of the age scale; effort is directed towards fishing both scallops too young to allow benefit from subsequent high growth rates, and scallops so old that they are now at a very low abundance. These older scallops tend to be located in areas unfavourable for fishing (e.g. rough bottom).

The recent sequence of events is that prior to 1979 there has been an abundance of 15-18 g (4.5 to 5 year old) scallops on Georges Bank. Meat counts have thus been around 30/lb (66 meats/kg), well below that established in regulation. However, scallop abundance of this above average year class has recently been depleted, and so blending of scallop meat sizes has become prevalent. The high abundance of very small scallops on the Scotian Shelf provided a ready source of small scallops for the offshore fleet, and being half way in the long steam from port to Georges Bank, the additional time required to shuck these small scallops was also available.

Since a meat count regulation is only required by those vessels fishing Georges Bank (assumed for all offshore vessel trips), it is not applied to inshore vessel (i.e. Bay of Fundy fleets) trips directed specifically to the Scotian Shelf. Inshore vessels are required to abide by the meat count regulation only when fishing on Georges Bank, but because of their smaller size, inshore vessels cannot fish both the Scotian Shelf and Georges Bank on the same trip.

MANAGEMENT OPTIONS

Two objectives appear desirable:

1) average age of first exploitation should be increased to maximize yield per recruit;

2) any significant recruitment should be proportioned for exploitation by each of the two fleets. This is necessary because owing to their small size, the inshore fleet can only exploit the Scotian Shelf under favourable weather conditions. Without resource apportionment, the offshore fleet might have the ability to deplete this limited resource early or late in the fishing season when the inshore fleet would not have the opportunity to fish it.

Some management considerations have been previously presented by J.F. Caddy (unpublished); and although modified slightly, his comments are largely repeated in the following.

A meat count regulation can be expected to particularly improve yield from the Scotian Shelf fishery, since because of the sporadical occurrence of abundant year classes, blending of scallops of different sizes from this area alone is difficult. Since maximum meat size achieved is less than that obtained on Georges Bank, the optimal meat count is higher than the optimal count (about 20 meats/lb) recommended for Georges Bank; namely, around 35-40 meats/lb (77-88 meats/kg) for the southern Scotian Shelf.

Establishment of a unique, higher scallop meat count in regulation for vessels fishing the Scotian Shelf might pose enforcement difficulties, particularly if the Georges Bank meat count were reduced to more optimal levels. A solution might be to require that vessels, particularly those of the offshore fleet, would have to identify their designated fishing location, with a penalty for fishing both Georges Bank and the Scotian Shelf on the same trip. Directed trips have the advantage in that if the resource is portioned, it would facilitate monitoring of resource allocation between two competing scallop fleets.

Extensive commercial fishing on the Scotian Shelf is infrequent, and reported landings have been >75 MT in only five of the last 15 years, during which production has averaged 220 MT. Although relatively insignificant to average annual scallop production from Georges Bank (10 000 MT [Caddy and Jamieson, 1977]), it is significant relative to the average annual production of the Bay of Fundy (325 MT [Jamieson and Lundy, 1979]).

If resource allocation is supported, management may either require a TAC or a fixed annual season (e.g. one to two months), which could be at a time of year which would allow simultaneous fishing by both fleets. With fleet allocation and a season, Caddy suggested that a set number of fishing days, fixed on the basis of each fleet's average CPUE, be allocated to each fleet.

A complication with a TAC alone is that because of the relatively small average annual production, there may not be enough stock in most years to allow every boat in each fleet to complete a full trip. Each inshore vessel (about 70) can land about 2 MT meat per trip, whereas each offshore vessel (about 75) can presently land about 13 MT meat per trip. This might require the selection of specific vessels in each fleet to exploit that fleet's allocation. Once chosen, these vessels could apply for a permit, and the entire catch from that trip would be included in that fleet's total Scotian Shelf TAC allocation. When a fleet's allocation was reached, fishing by that fleet on the Shelf would cease.

With an open season alone, exploitation could be by whichever vessels chose to fish, with those vessels first to fish being most likely to benefit if sufficient scallops were present. This would appear to be the most convenient management option from an operational perspective.

SUMMARY

1. Average yield for scallop sizes from both Browns and German Banks is less than that from equivalent Georges Bank or Bay of Fundy scallops from <60 fathoms water depth.

2. Asymptotic size is less for southern Scotian Shelf scallops than that calculated for Georges Bank scallops and for Bay of Fundy scallops from <60 fathoms water depth.

3. The southern Scotian Shelf recruited scallop stock primarily consists of a few scallop year classes. Recruitment appears to be sporadic; and in the areas surveyed, no large quantities of prerecruits were evident.

4. Optimal yield per recruit would be achieved by fishing scallops at age of first exploitation of seven to nine years. This is equivalent to a meat count of about 35-40/lb (77-88/kg).

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Table 1. Maritime scallop landings (MT of meat) from offshore areas on the Scotian Shelf and on Georges Bank.

YEAR	LOCATION					
	Georges* Bank	Browns Bank	St. Pierre Bank	Mid Atlantic (U.S.)	Middle Ground	German Bank
1965	4434	15	14	3199	77	-
1966	4878	120	-	2790	-	-
1967	5019	171	164	6	-	-
1968	4822	54	9	424	-	-
1969	4318	-	83	1	-	-
1970	4097	-	127	-	-	-
1971	3908	-	27	16	-	-
1972	4161	0.5	29	30	-	-
1973	4223	0.5	36	-	-	-
1974	6137	-	-	-	-	-
1975	7414	-	-	-	-	-
1976	9726	658	-	19	-	-
1977	13089	87	-	-	-	0.3
1978	12189	29	-	-	-	-
1979	9207	287	1.1	-	-	421

*1965-1977: ICNAF Statistical Bulletins
1978-1979: Statistics Branch, Fisheries & Oceans Canada, Halifax, N.S.

Table 2. Recent landings (MT) and expended effort (days fished) on Browns and German Banks by the Canadian inshore and offshore scallop fleets.

Year	BROWNS BANK			GERMAN BANK		
	Inshore*	Offshore		Inshore*	Offshore	
		A*	B†		A*	B†
CATCH						
1976	218	440	461	-	18.8	-
1977	37	50	63	0.3	-	-
1978	24	3	27	-	5	-
1979	226	50	288	228	76	144
EFFORT						
1976	Unknown	232	315	-	-	-
1977	20	37	50	-	-	-
1978	27	2	21	-	7	-
1979	244	46	311	274	85	143

* Statistics Branch, Fisheries & Oceans Canada, Halifax, N.S.

† Log data, Resource Branch, Fisheries & Oceans Canada, Halifax, N.S.

Figure 1. Areas of commercial scallop fishing on the Scotian Shelf. A. Lurcher Bank; B. German Bank; C. Browns Bank; D. Middle Ground.

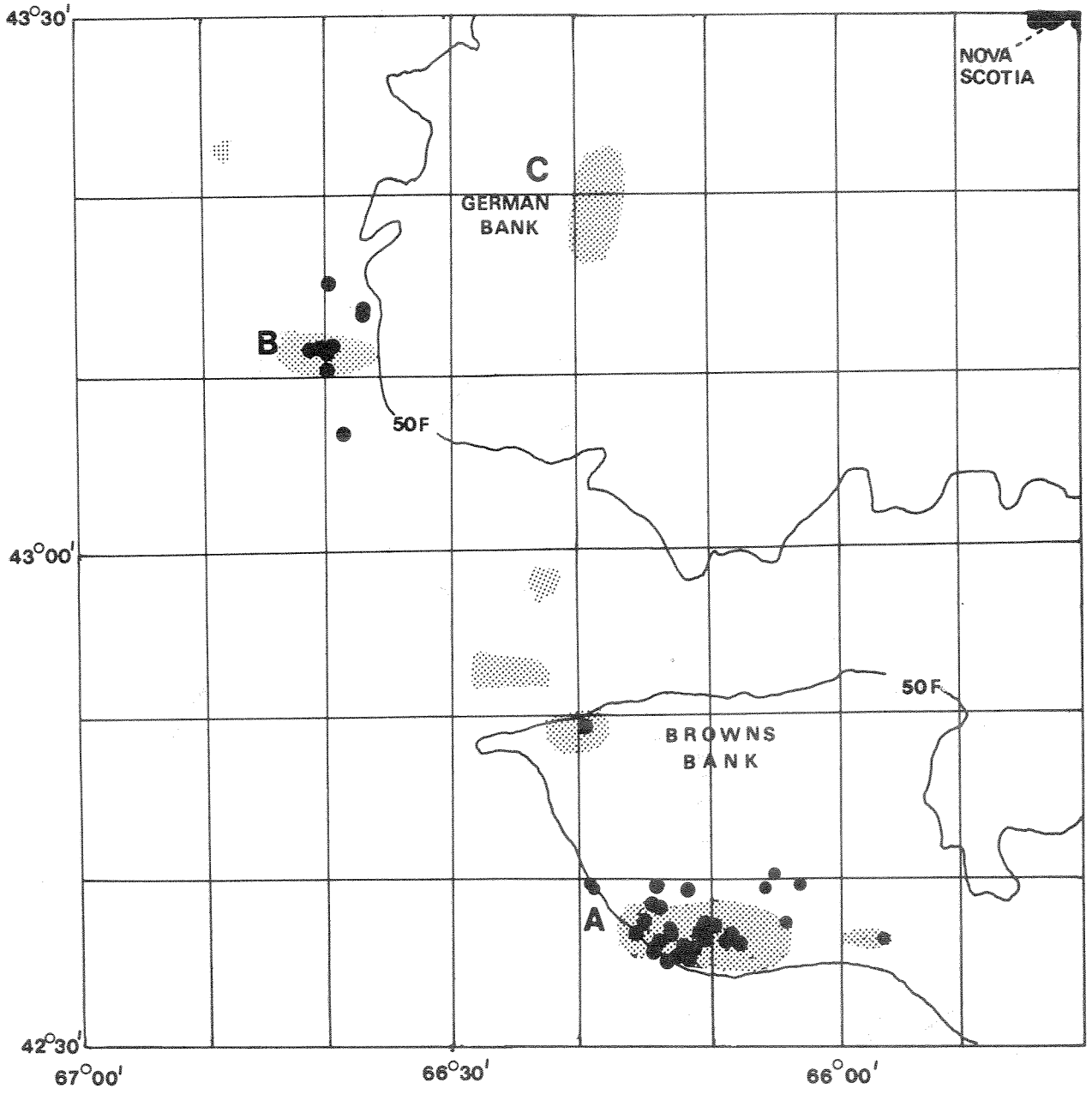

Figure 2. Areas (A,B and C) of scallop productivity on Browns and German Banks in 1979, and sample station locations. ● = station locations.

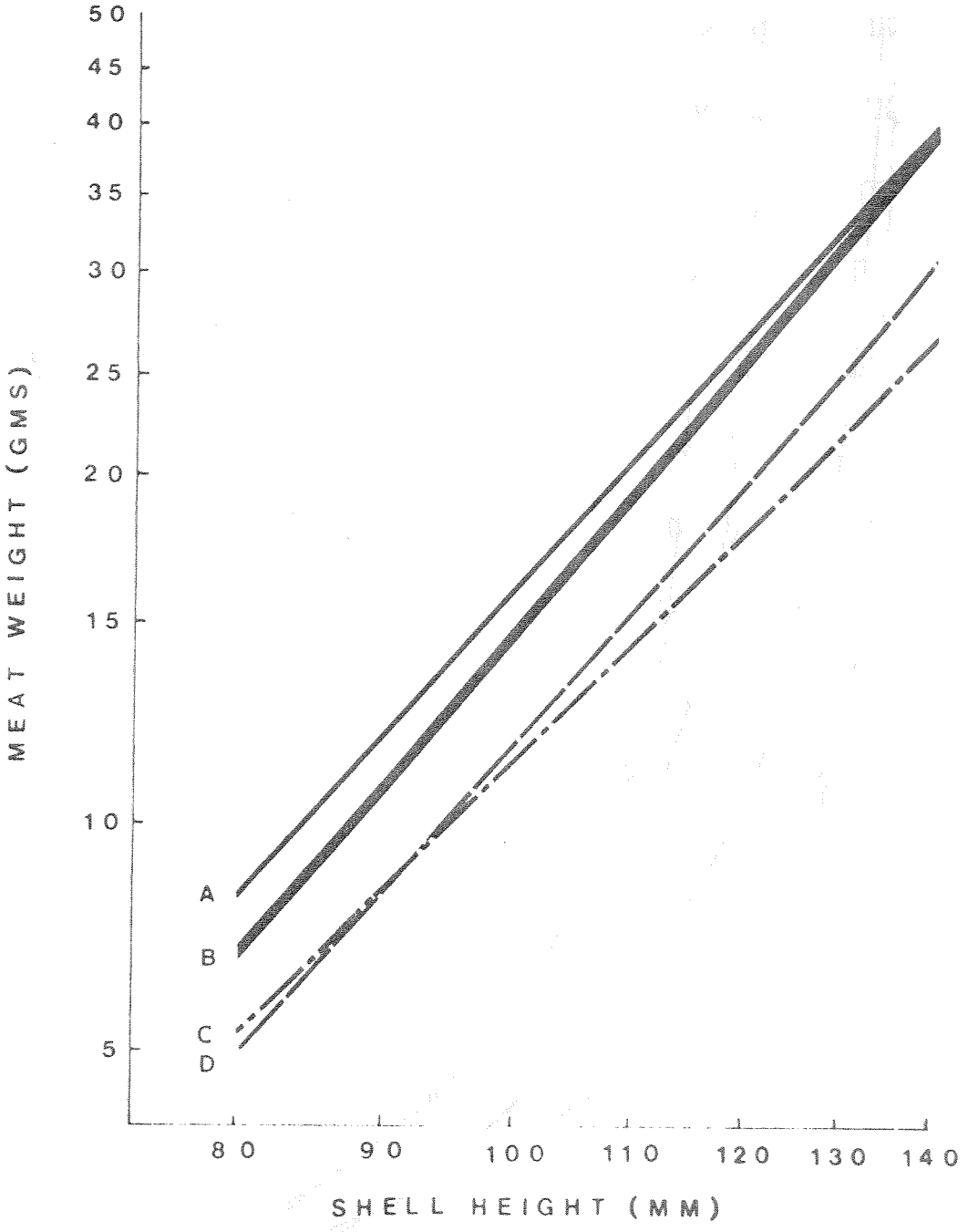

Figure 3. Shell height:meat weight relationships for scallops from A. Georges Bank; B. Bay of Fundy; C. German Bank; D. Browns Bank.

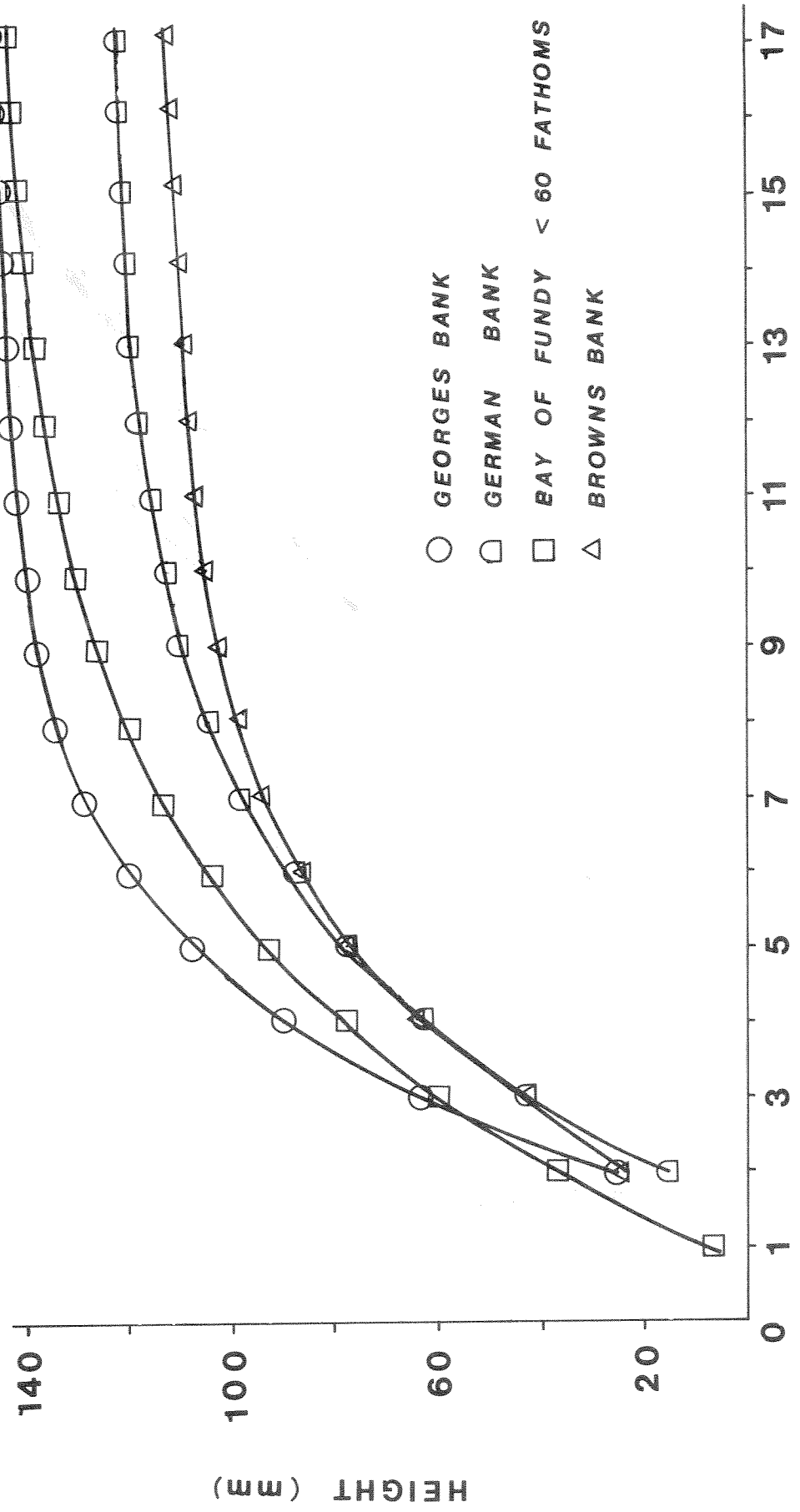

Figure 4. Von Bertalanffy growth curves for offshore scallop stocks.

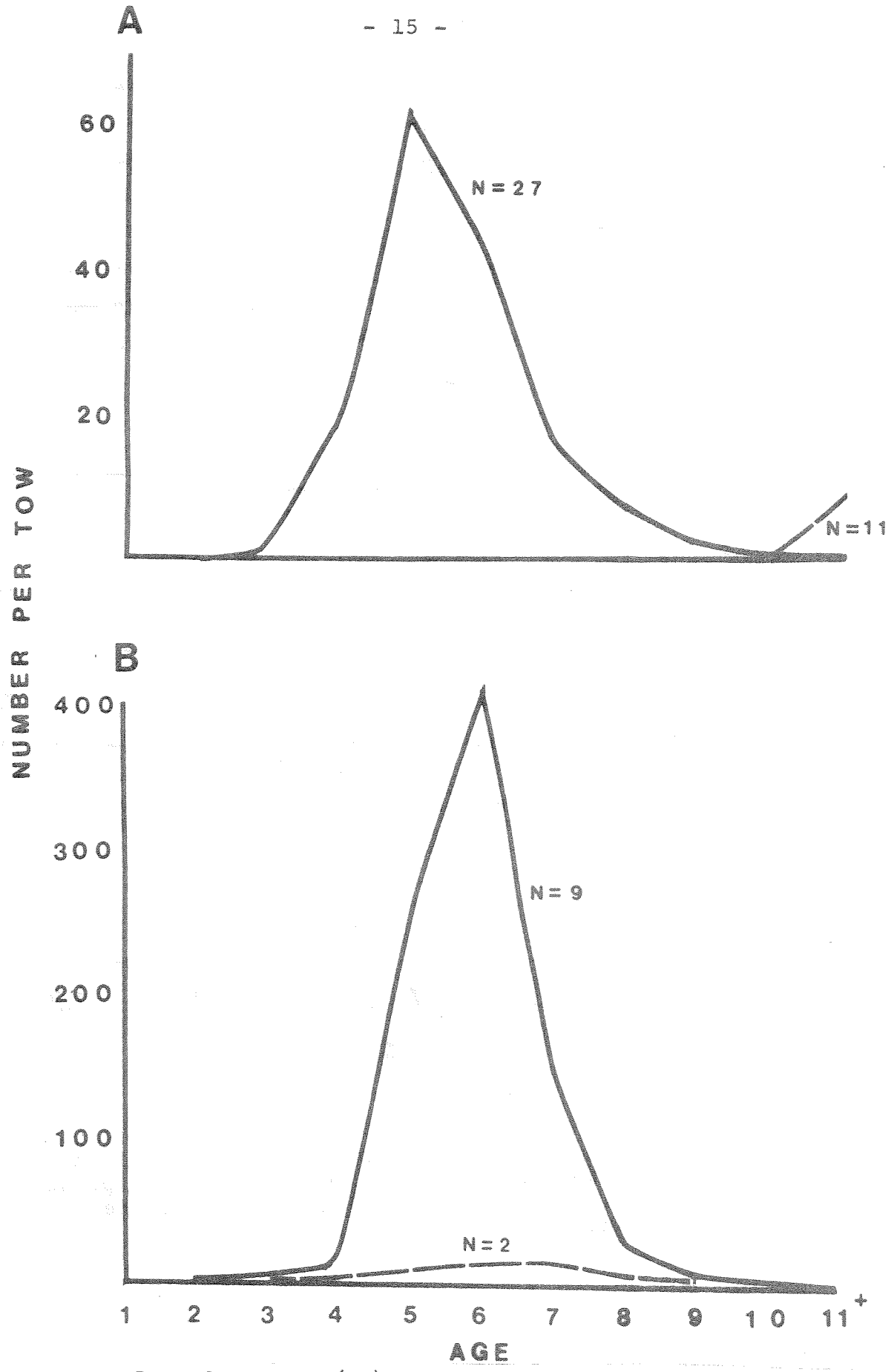

Figure 5. Relative age (yr) frequencies of scallops fished in each stratum in each region. A. Browns Bank; B. German Bank. n = number of tows. Solid line = high density stratum; dashed line = low density stratum.

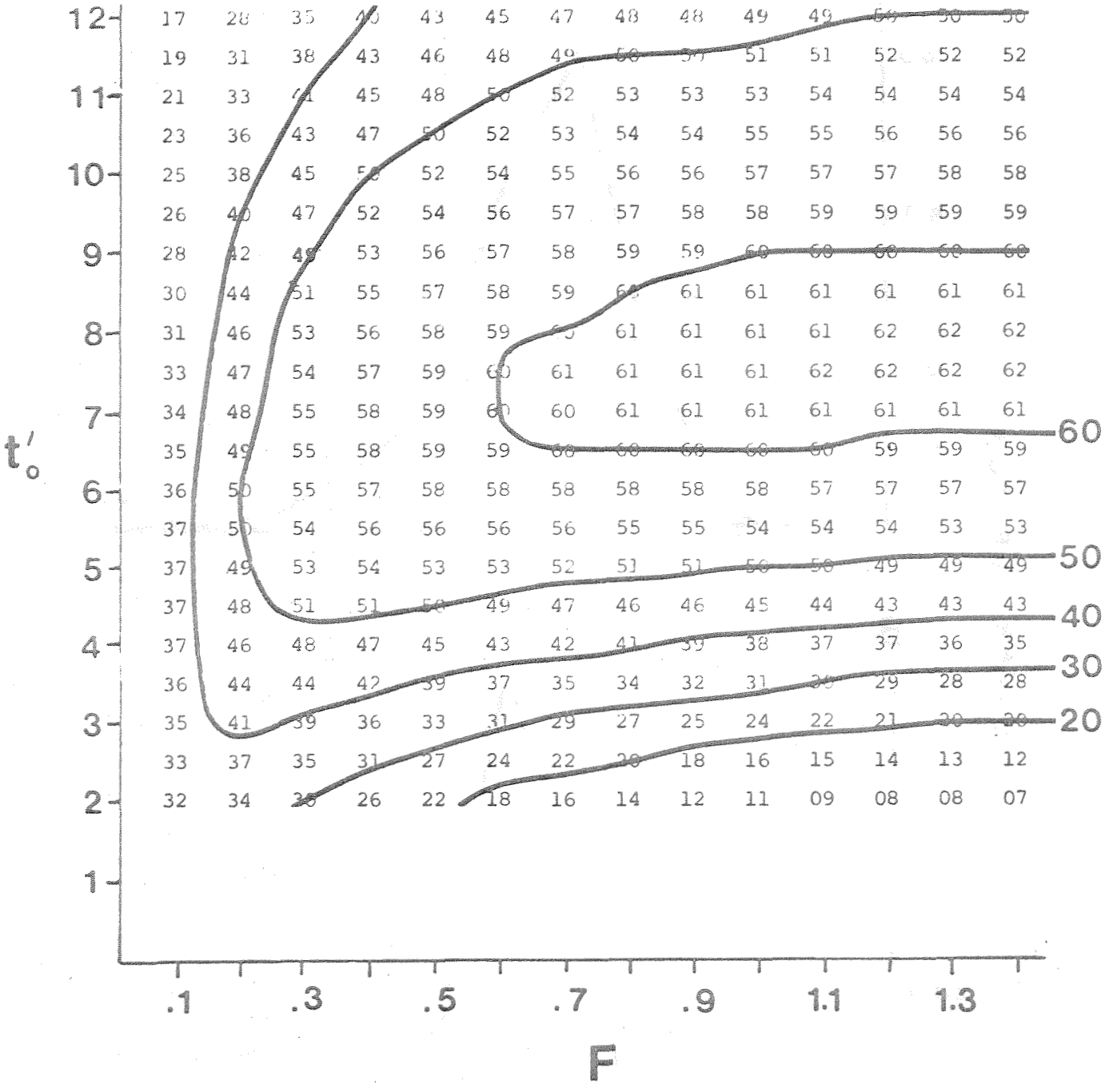

Fig. 6A. Yields and yield isopleths (kg) per 10,000 recruits calculated for Browns Bank scallops, based on M = 0.1 and the Von Bertalanffy growth parameters presented in the text. t'_0 = age (years) of first capture; F = fishing mortality.

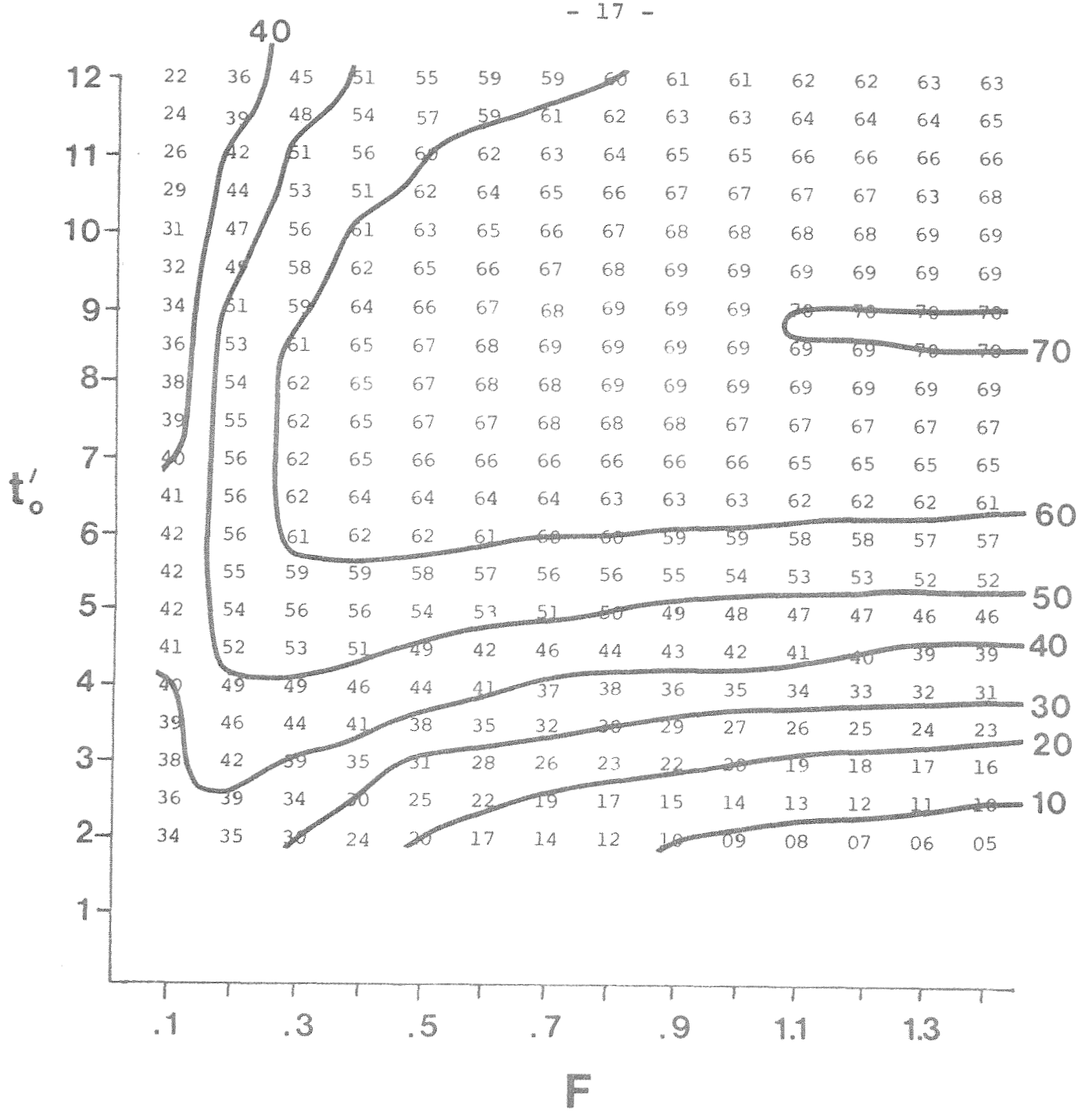

Fig. 6B. Yields and yield isopleths (kg) per 10,000 recruits calculated for German Bank scallops, based on M = 0.1 and the Von Bertalanffy growth parameters presented in the text. t_0' = age (years) of first capture; F = fishing mortality.