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Yield per recruit assessments for Newfoundland lobster stocks

by

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Introduction

Minimum size regulations for lobsters were adopted for most areas on the east coast of Canada during the early years (1870 - 1900) of the fishery (see Wilder 1965). These regulations however were not based on biological yield assessments of any kind and were among the first attempts to conserve the already declining stocks. The ICES Working Group on _Homarus_ Stocks concluded that in most lobster (_Homarus_) stocks fishing mortality was excessive and the minimum landing size was too low (Anon. 1977). This paper represents the first attempt at yield per recruit assessment for lobster stocks in Newfoundland waters and presents recommendations for changes in size limit and exploitation rate based on these assessments.

Materials and Methods

Investigations on lobster population biology and the fishery for them have been ongoing for varying periods at five widely separated locations around the coast of Newfoundland (Fig. 1). A major part of these investigations is growth studies. Data on growth per molt are being obtained in each area by means of "sphyrion" tagging (see Ennis 1972 for details). Shell condition sampling (Ennis 1977) following the molting period is being used to provide data on proportions molting. These two components of growth in lobsters can be combined to provide estimates of growth rate (Ennis 1978). Where the data are available to compare growth per molt for two different years in the same area, no significant difference was evident (Ennis 1972, 1978) and proportion molting appears to be the component of lobster growth that is likely to vary significantly from year to year in a particular area. A model to assess yield per recruit in lobster stocks based on these growth functions has been developed and a computer program to do the analysis has been written (Ennis and Akenhead 1978). This program has been used to do yield per recruit assessments based on the growth data that is presently available for the five areas around the island.

The available data includes premolt-postmolt relationships for St. Chads, Bonavista Bay; Comfort Cove, Notre Dame Bay; and Arnold's Cove, Placentia Bay. Sphyrion tag returns to date for Boswarlos, Port au Port Bay, and Bellburns on the North-west coast are not sufficient to provide reliable premolt-postmolt relationships and in order to do a preliminary assessment for these areas, it was decided to substitute the relationships for St. Chads in each area. Data on shell condition following the molting period was collected for each area in the following years: St. Chads - 1974, 1975, 1976, 1977; Comfort Cove - 1974, 1975, 1976, 1977; Arnold's Cove - 1975, 1976, 1977; Boswarlos - 1975, 1976, 1977; Bellburns - 1977. Yield per recruit analyses were done for each year that data on proportions molting are available in each area as well as for the different years molting data for each area combined. The program produces yield per recruit values for exploitation rates from 20 to 100% (in increments of 10) at each of the following recruitment lengths: 70, 76, 81, 89, 95, and 102 mm carapace length. From the values provided, curves of yield per recruit against recruitment length at 60 and 80% rates of exploitation and curves of yield per recruit against exploitation rate at 81 and 89 mm recruitment lengths were drawn. An exploitation rate of 80% represents a fair average for the Newfoundland fishery and 60% represents an exploitation rate that may be attainable through stringent effort control. The existing recruitment length (size limit) in the Newfoundland fishery is 81 mm carapace length and 89 mm represents an increased size limit that might be acceptable to the industry.

Results

The results of the analyses show clearly that at the rates of exploitation considered yield per recruit increases with increased recruitment lengths. This applies generally for all areas (Figs. 2-6). In a number of instances however, the yield per recruit value decreased at the largest recruitment length (102 mm) considered (eg. Fig. 2, 1975 data for males; Fig. 3, 1976 data for males; Fig. 4, 1974 and 1975 data for males). Yield per recruit values are generally higher at the same recruitment length and increase more rapidly for males than females.

At recruitment lengths of 81 and 89 mm yield per recruit values increase as the exploitation rate decreases from 100% to 30 - 40% beyond which further decreases in exploitation rate usually result in decreased yield per recruit values (Figs. 8-11). The curves for Boswarlos males (Fig. 10) are exceptional. Here yield per recruit increases significantly as exploitation rate decreases to 20%.

Percentage increase in yield per recruit that would result from increasing the recruitment length from the currently enforced 81 mm carapace length to 89 mm is slightly greater for males than for females and is greater at 80% than at 60% exploitation rate (Table 1). On the average yield per recruit would increase 15 - 20% if the recruitment length was increased to 89 mm assuming that the average rate of exploitation in the fishery at the present time is around 80%.

Yield per recruit is less responsive to changes in exploitation rate than to changes in recruitment length. At a recruitment length of 81 mm, yield per recruit would increase on the average by about 6% if exploitation rates were decreased from 80 to 60% (Table 2). The increase would be less at a recruitment length of 89 mm.

Recommendations

It is recommended that the minimum legal size (recruitment length) in the Newfoundland lobster fishery be increased from 81 mm (3 3/16") carapace length to 89 mm (3 1/2") in order to increase yield per recruit by approximately 15-20%. Efforts should be made to reduce current rates of exploitation, not so much to increase yield per recruit as to improve the economic efficiency of the fishery by reducing total effort through trap limits and restricted entry. Over the long term, reduced rates of exploitation would also result in a levelling off or possibly a reversal of the present long term decline in landings by allowing a gradual increase in the abundance of lobsters.

References

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1978. Growth curves for Newfoundland lobsters from data on molt increment and proportion molting. CAFSAC Res. Doc. 78/29, 11 p.

Ennis, G. P. and S. A. Akenhead 1978. A model and computer program used to assess yield per recruit in Newfoundland lobster stocks. CAFSAC Res. Doc. 78/30.

Table 1. Percentage increase in yield per recruit by increasing recruitment length from 81 to 89 mm (Molting data for different years combined).

	Rate of Exploitation			
	60%		80%	
	Males	Females	Males	Females
Arnold's Cove	15	13	19	14
St. Chads	16	14	20	16
Comfort Cove	13	14	16	15
Boswarlos	21	14	25	15
Bellburns	16	14	19	16

Table 2. Percentage increase in yield per recruit by decreasing exploitation rate from 80% to 60% (Molting data for different years combined).

	Recruitment length			
	81 mm		89 mm	
	Males	Females	Males	Females
Arnold's Cove	5	6	1	4
St. Chads	7	6	3	4
Comfort Cove	4	6	1	4
Boswarlos	13	6	10	5
Bellburns	6	6	2	5

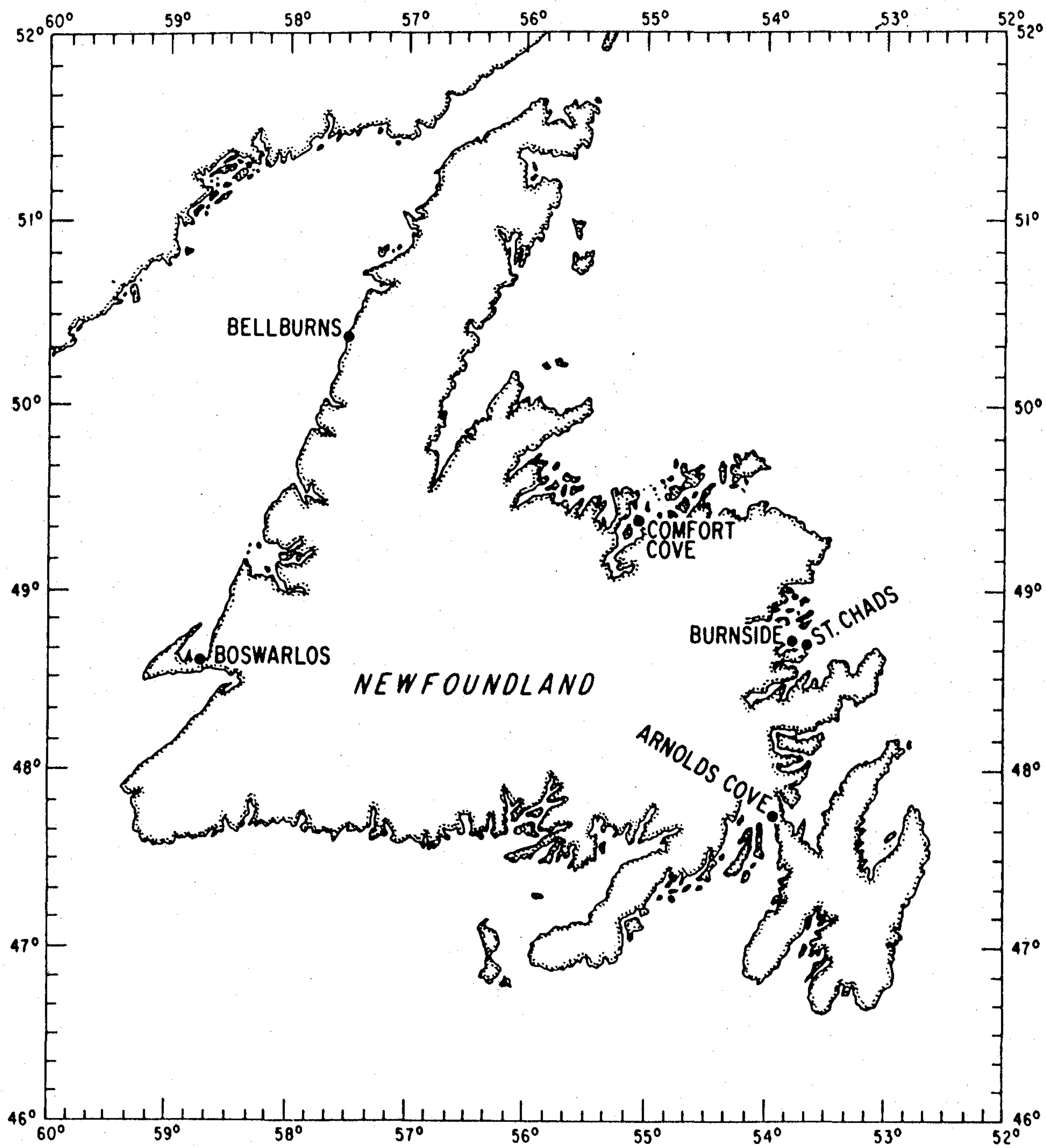

Fig. 1. A map of Newfoundland showing the location of places mentioned in the text.

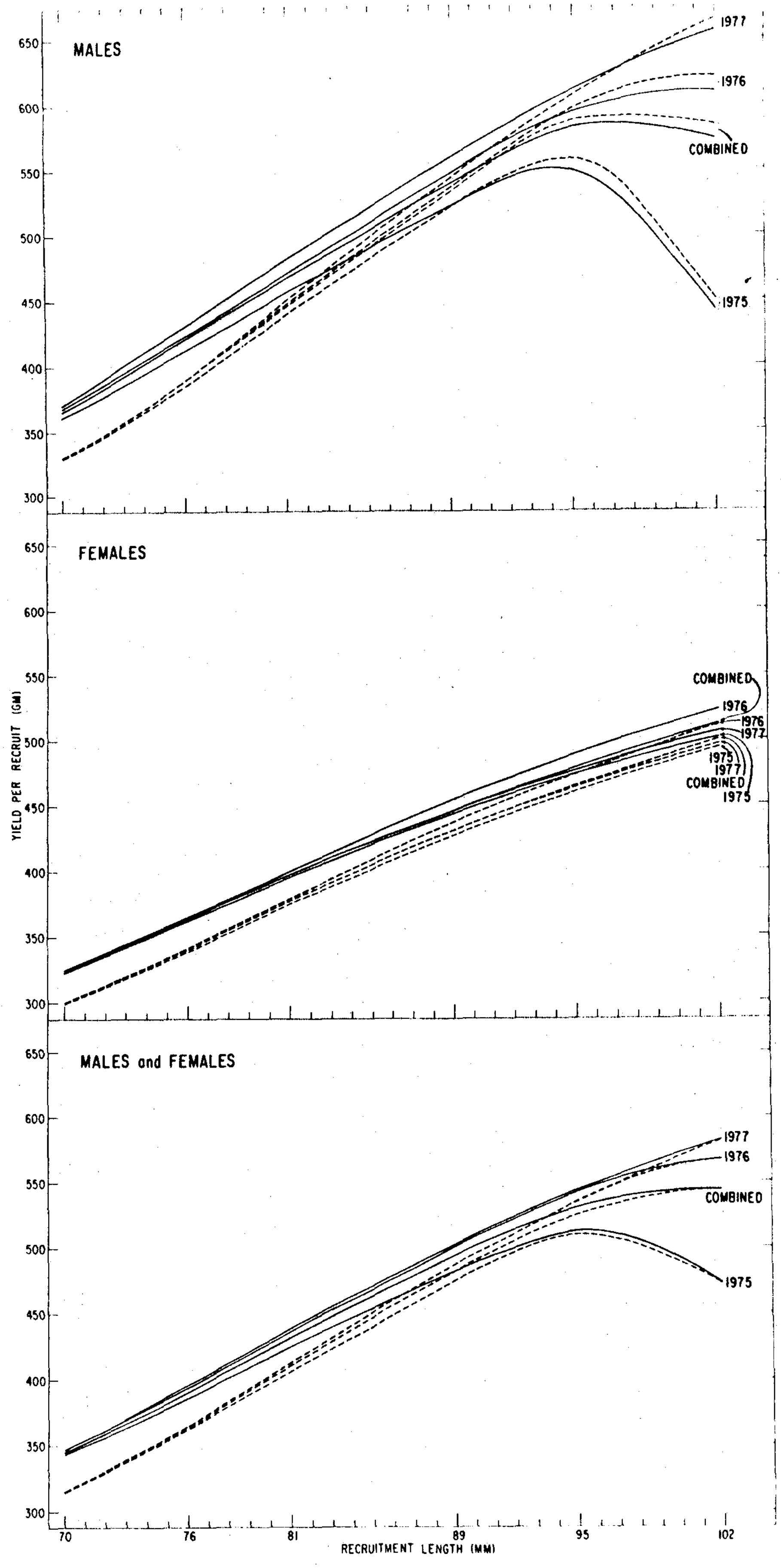

Fig. 2. Curves of yield per recruit against recruitment length for Arnold's Cove using proportions molting data for tne years indicated at 60% (————) and 80% (--------) rates of exploitation.

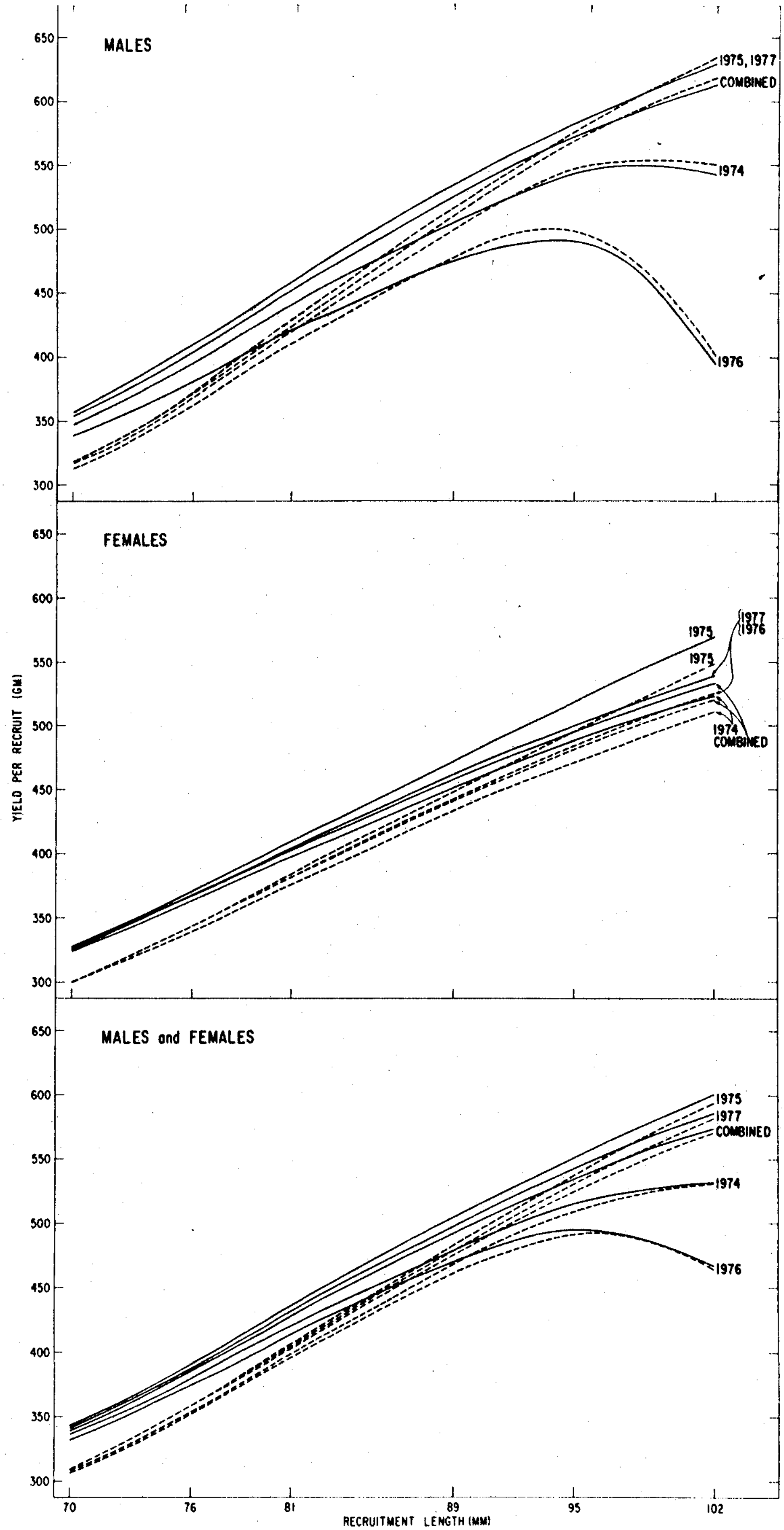

Fig. 3. Curves of yield per recruit against recruitment length for St. Chads using proportions molting data for the years indicated at 60% (————) and 80% (-------) rates of exploitation.

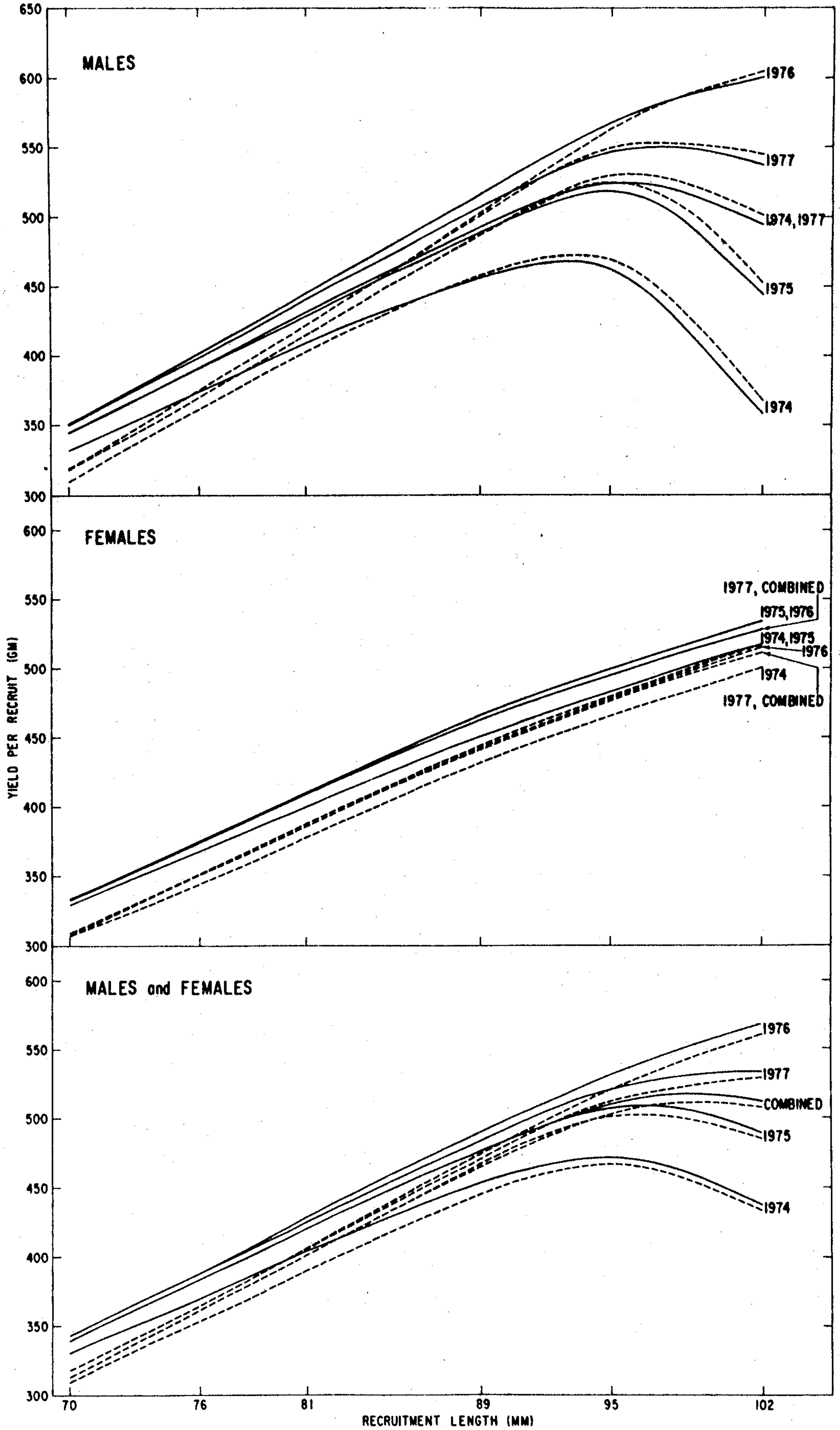

Fig. 4. Curves of yield per recruit against recruitment length for Comfort Cove using proportions molting data for the years indicated at 60% (————) and 80% (-------) rates of exploitation.

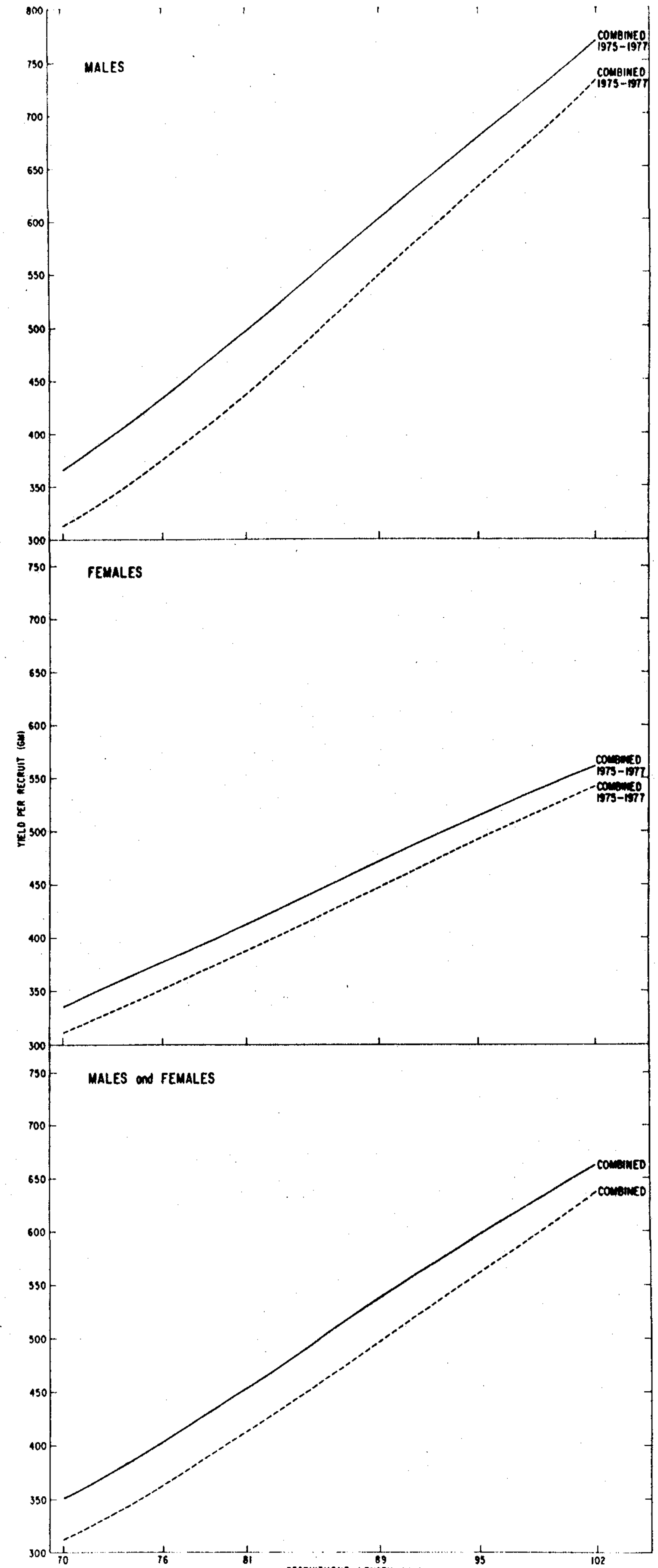

Fig. 5. Curves of yield per recruit against recruitment length for Boswarlos using proportions molting data for the years indicated at 60% (———) and 80% (-------) rates of exploitation.

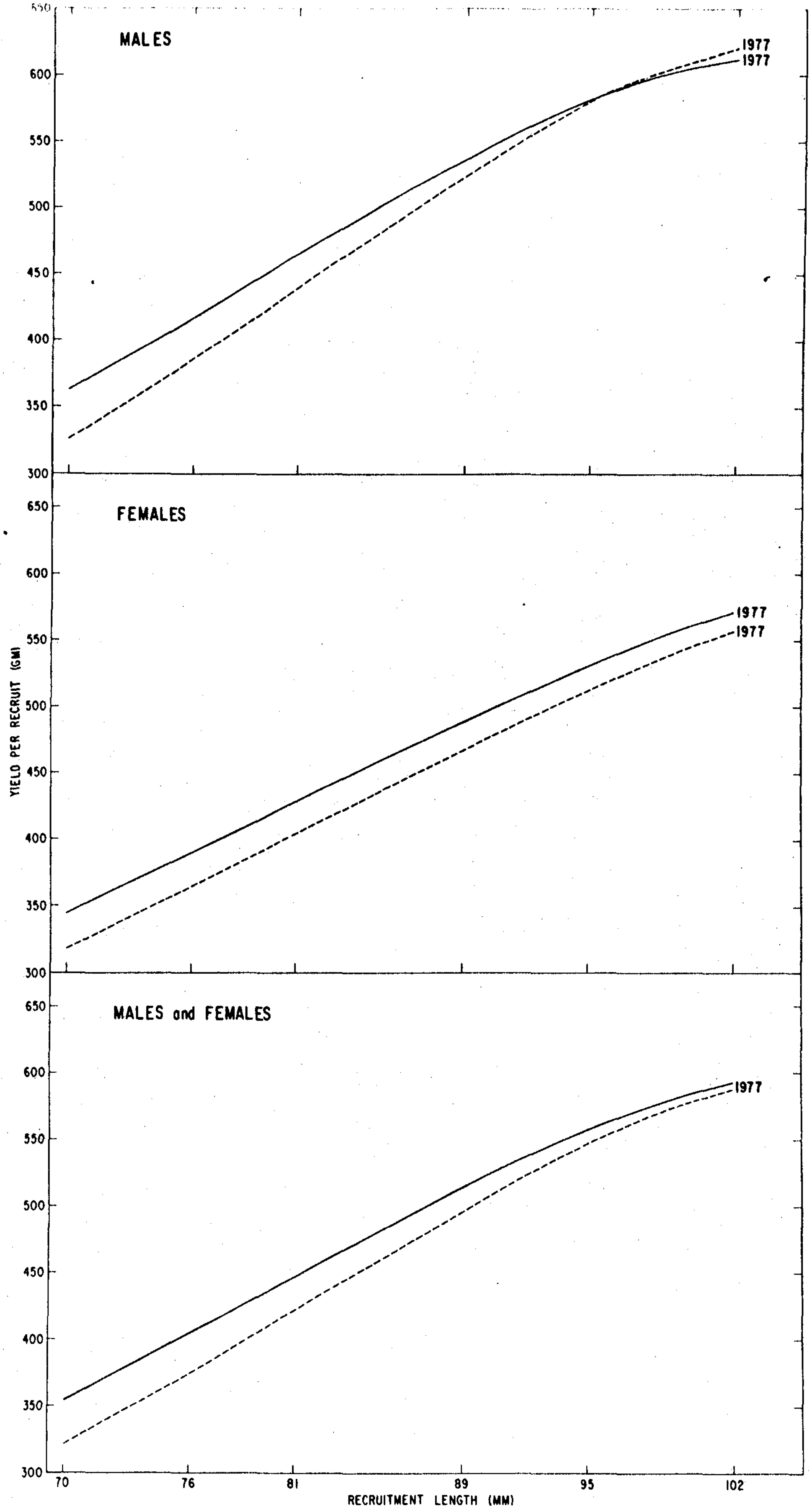

Fig. 6. Curves of yield per recruit against recruitment length for Bellburns using proportions molting data for the years indicated at 60% (————) and 80% (-------) rates of exploitation.

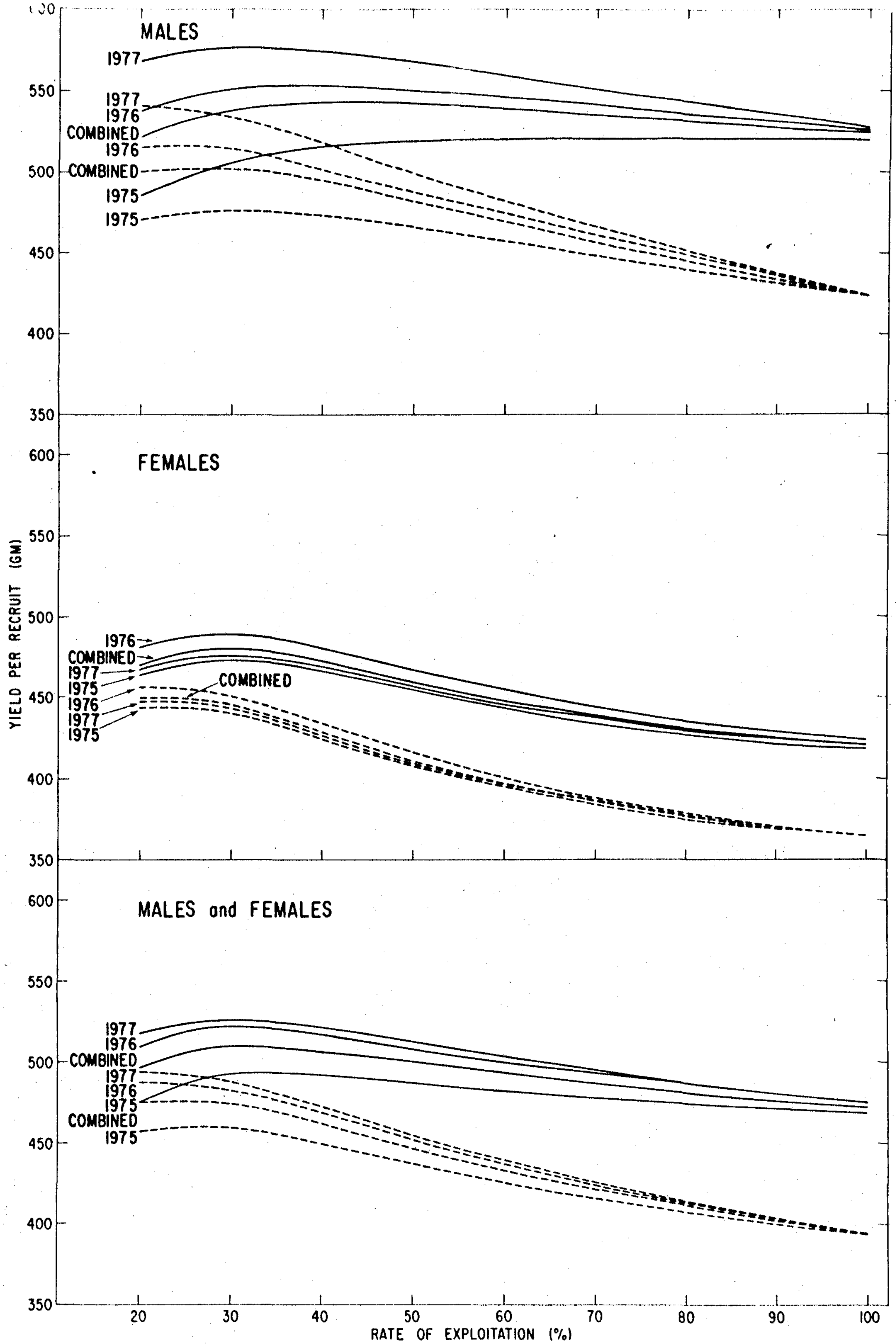

Fig. 7. Curves of yield per recruit against exploitation rate for Arnold's Cove using proportions molting data for the years indicated at 81 mm (-------) and 89 mm (———) recruitment lengths.

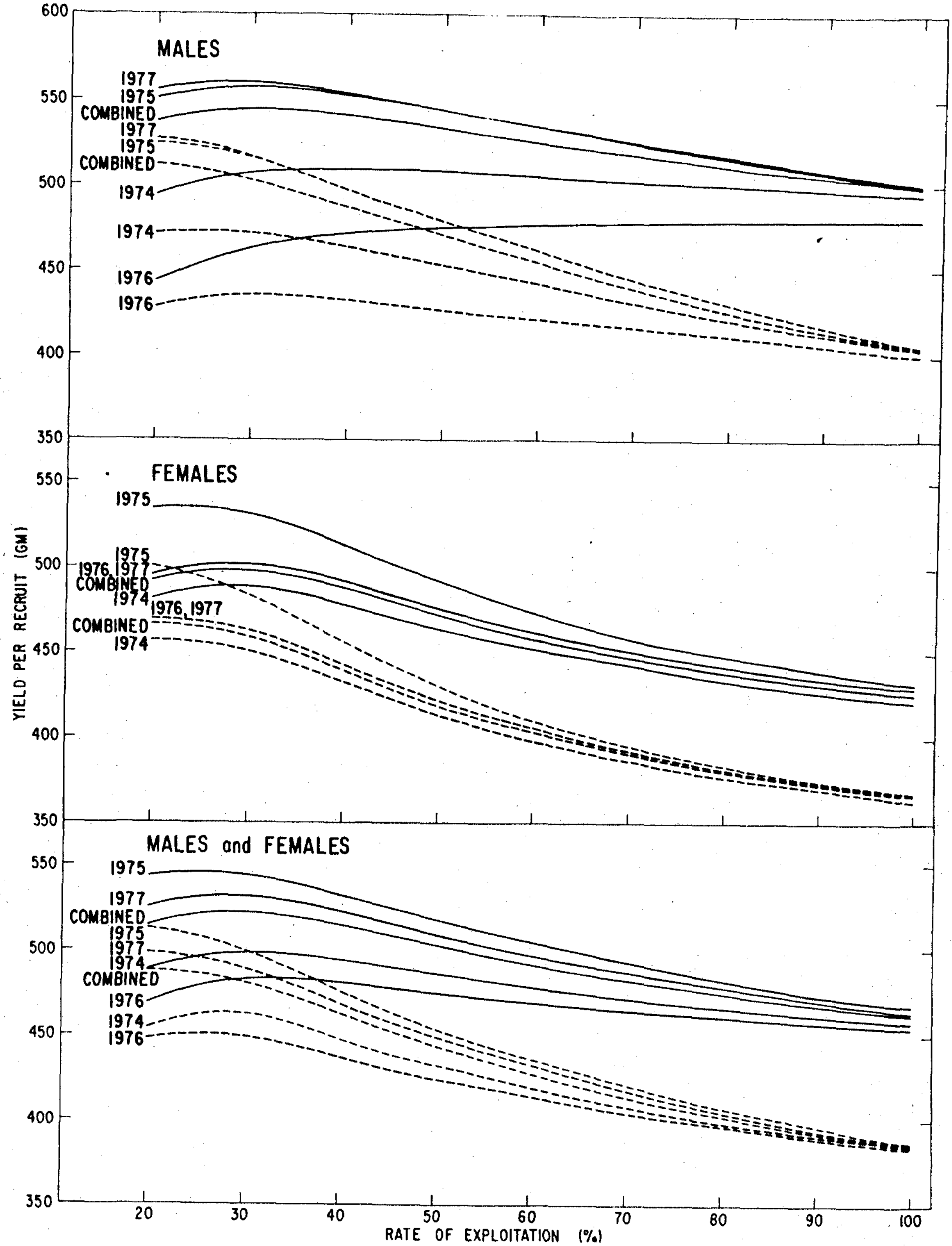

Fig. 8. Curves of yield per recruit against exploitation rate for St. Chads using proportions molting data for the years indicated at 81 mm (-------) and 89 mm (————) recruitment lengths.

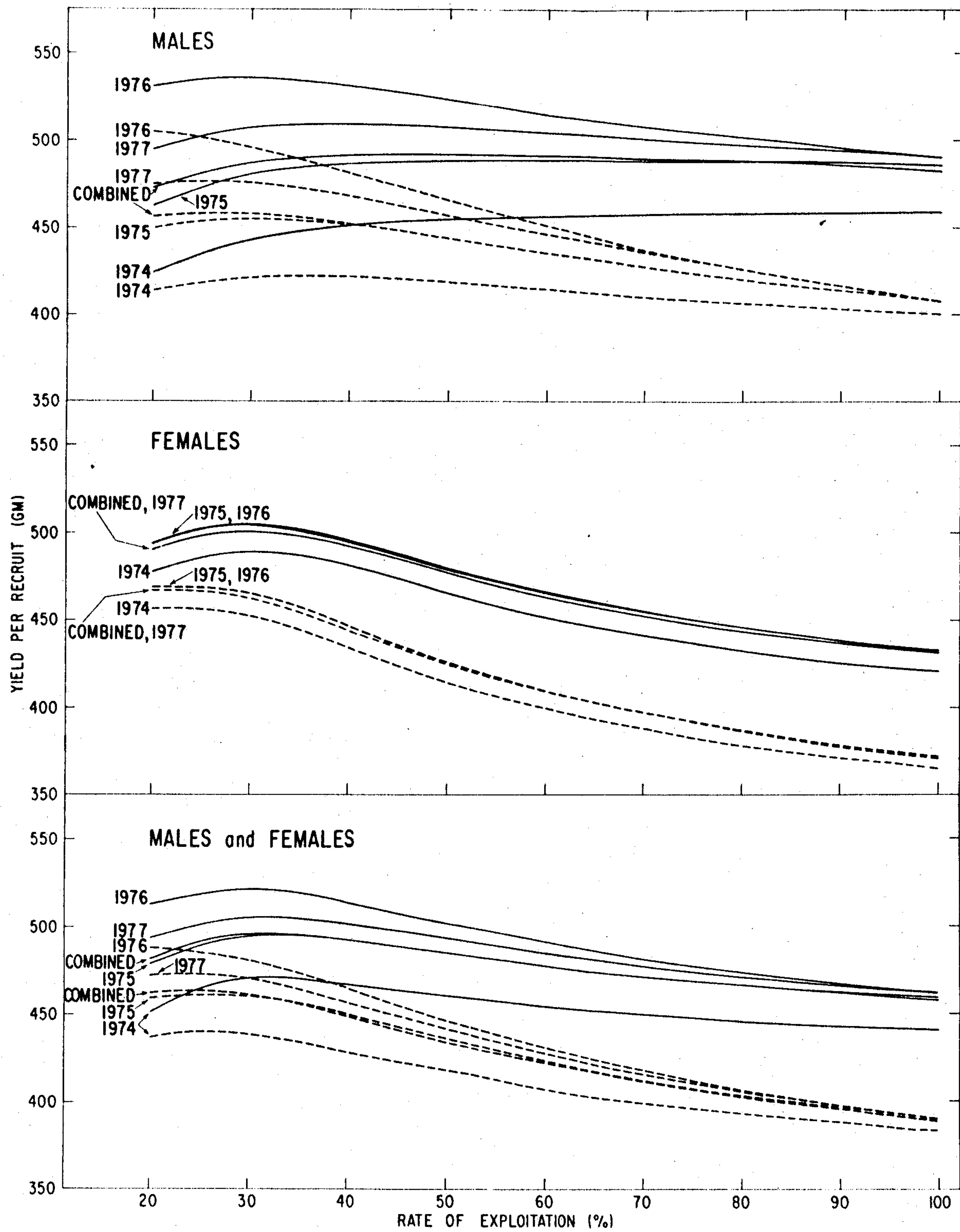

Fig. 9. Curves of yield per recruit against exploitation rate for Comfort Cove using proportions molting data for the years indicated at 81 mm (-------) and 89 mm (————) recruitment lengths.

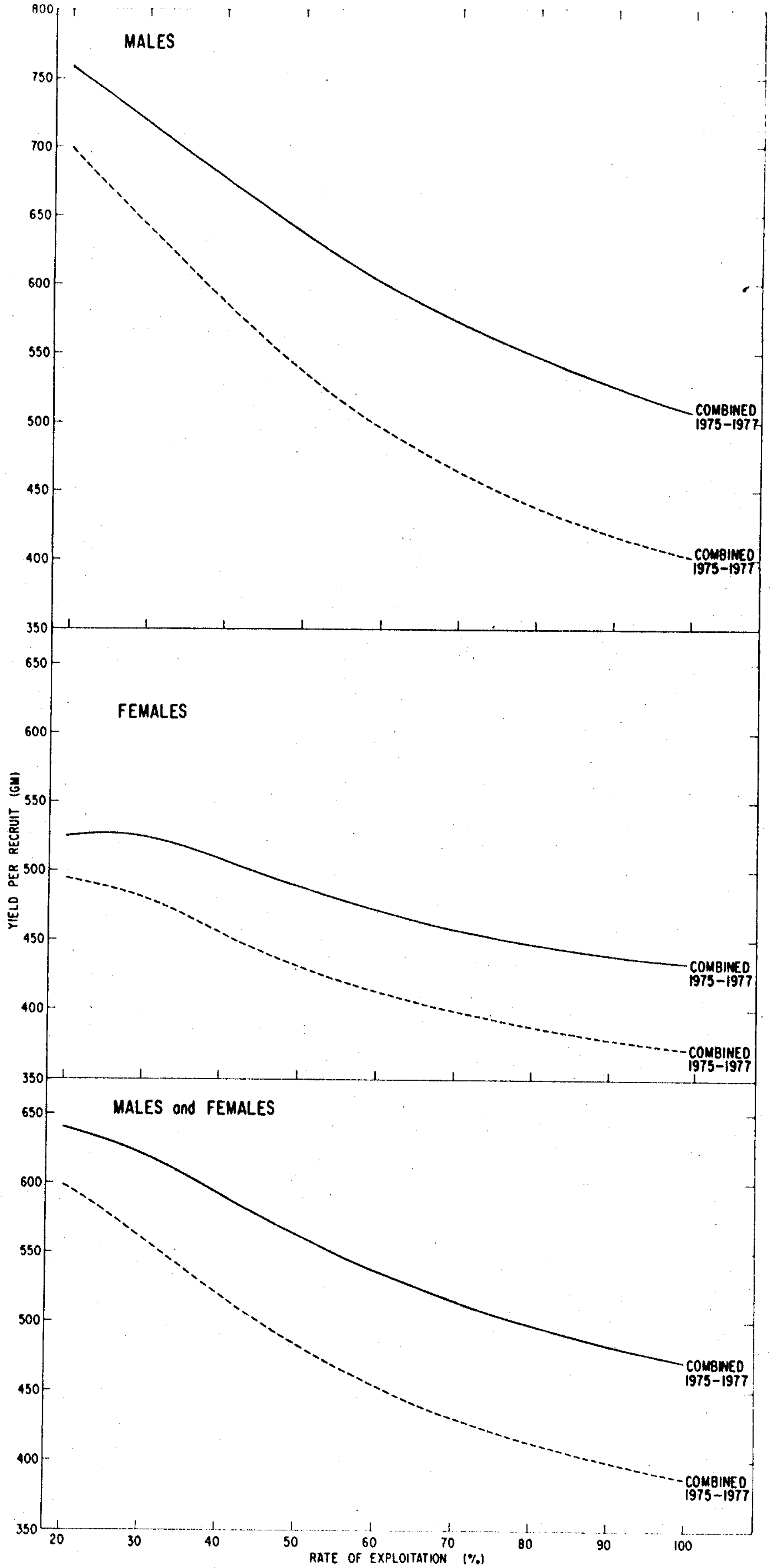

Fig. 10. Curves of yield per recruit against exploitation rate for Boswarlos using proportions molting data for 81 mm (------) and 89 mm (———) recruitment lengths.

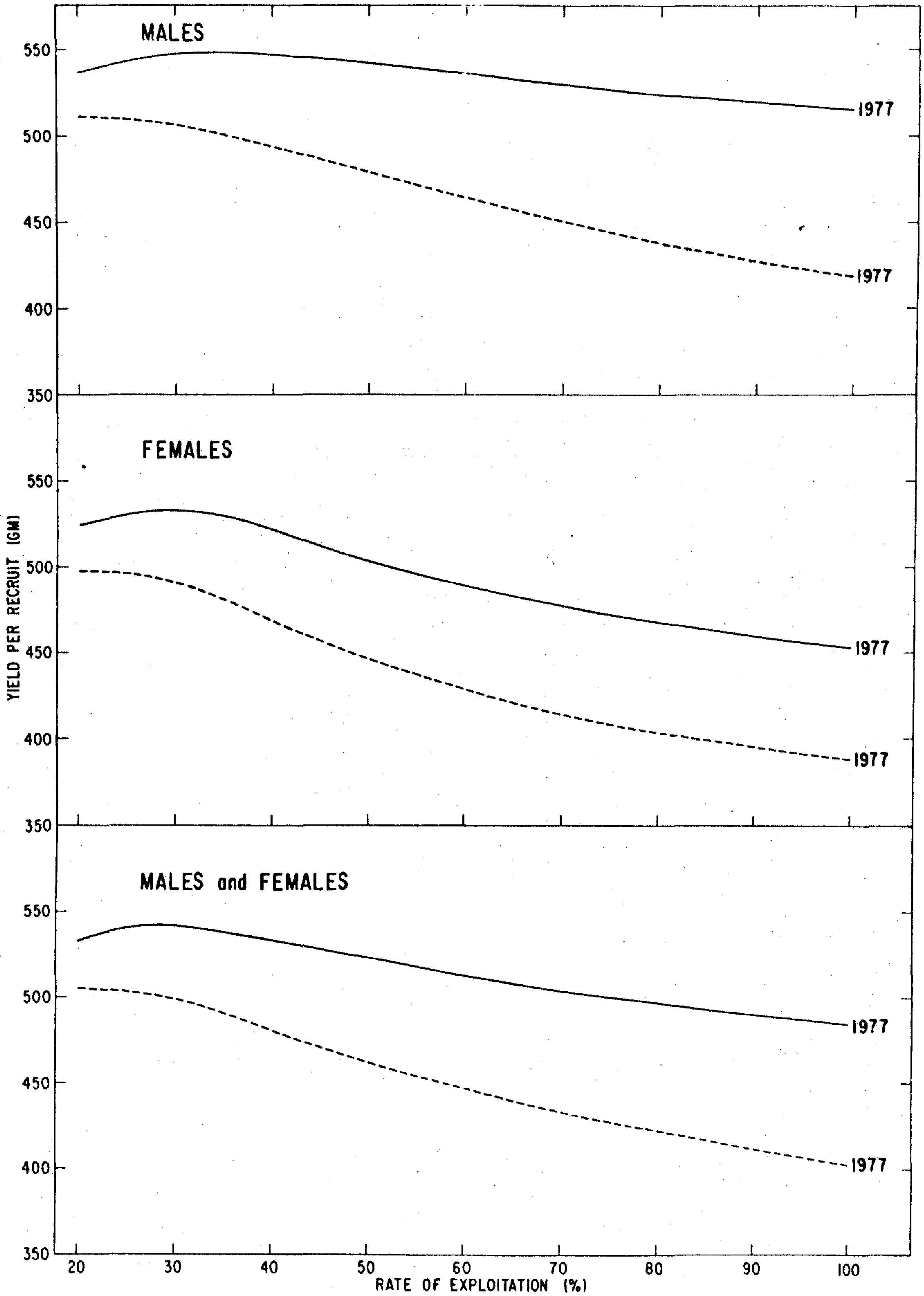

Fig. 11. Curves of yield per recruit against exploitation rate for Bellburns using proportions molting data for the years indicated at 81 mm (------) and 89 mm (———) recruitment lengths.