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# Growth Rates of Yellowtail Flounder, *Limanda ferruginea*, on Three Fishing Grounds in Subarea 5

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## ABSTRACT

Yellowtail grow at slightly different rates on the three subarea 5 grounds where they are fished by United States vessels. Growth is rapid, the fish enter the commercial catch at age 2 and are fully recruited at age 4. Mathematical representation of growth in length for fish of age 2 and over in the Bertalanffy form is

$$l_t = 500(1 - e^{-0.335(t+0.26)}).$$

The United States catch of yellowtail is largely from 3 grounds in Subarea 5 (Fig. 1): the southern New England ground, Georges Bank, and the Cape Cod ground. Results from marking studies show that there is a relatively separate group on each ground, although a small amount of mixing occurs between grounds (Royce, Buller, and Premetz, 1959; Lux, 1963). No morphological differences have been found between these groups, such as the differences in finray numbers and body proportions Scott (1954) found between Sable Island (Subarea 4W) and southern New England yellowtail.

The catch has varied markedly since the beginning of the fishery in the 1930's because of variations in year class strength ranging from a low of 12 million pounds in 1954 to a high of 83 million pounds in 1963-64 (Lux, 1967). About 90 percent of the landings presently come from the southern New England ground and Georges Bank.

Growth rate of yellowtail based on scales collected from the southern New England ground commercial catch was reported by Royce, et al., (1959). An expansion of that work, the present document summarizes growth rates of pre- and post-recruit yellowtail from samples obtained in 1955-64 from all three grounds.

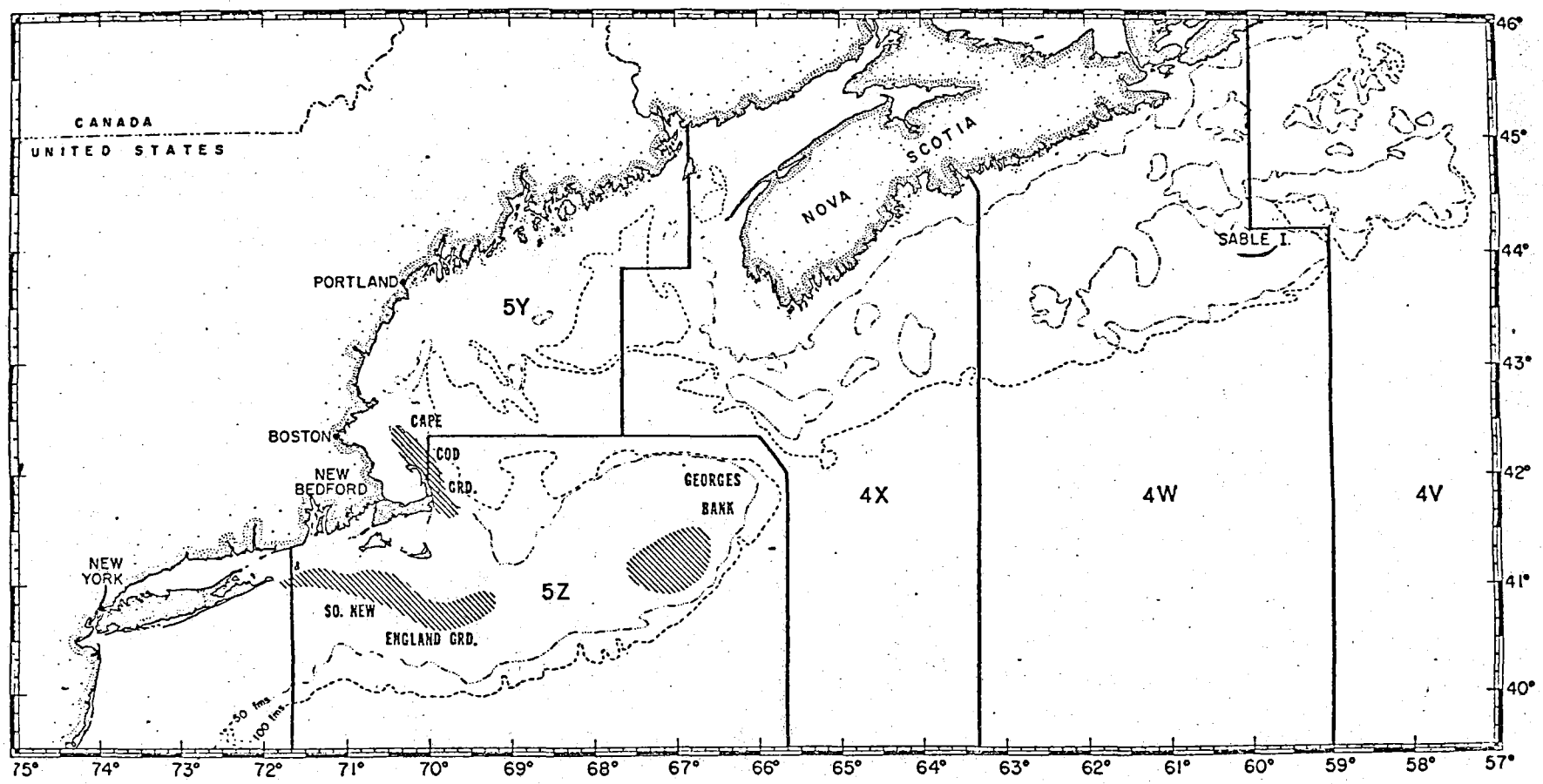


Figure 1. -- Chart showing the principal yellowtail grounds (shaded) fished by the United States fleet.

Females following age 2 grow faster than males, and sexes therefore were kept separate for age determination. Significant differences in growth were found between grounds, and growth rates are reported separately for each group (Tables 1, 2, and 3; Fig. 2). Yellowtail enter the catch at age 2 but they are not fully recruited to the commercial fishery until age 4 and , therefore, only research vessel collections from small mesh nets were used for growth rate prior to age 4.

On the southern New England ground and Georges Bank the length for a given age was less in the second quarter than in the first (Tables 1 and 2). This may stem from mixing of yellowtail of differing growth rates in some seasons since they make fairly long movements that are related to season, but the exact causes of this pattern are unknown.

Table 1. -- Numbers of fish (n) by age group and mean lengths at age ($\bar{x}$) for male and female yellowtail from combined small mesh and commercial samples from the southern New England ground in 1955-64, by calendar quarter/ (Commercial samples were included only in the summary of age 4 and older fish.)

| Calendar quarter | Number of year marks | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8&8+ | |
| | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ |
| | | | | | | | Males | | | | | | | | | |
| Jan-Mar | 26 | 6.8 | 167 | 26.5 | 207 | 33.0 | 464 | 36.1 | 136 | 38.3 | 19 | 40.1 | 4 | 40.8 | 1 | 39.0 |
| Apr-Jun | 46 | 11.6 | 59 | 25.4 | 30 | 31.9 | 122 | 35.6 | 28 | 37.2 | 2 | 39.5 | 1 | 42.0 | 1 | 39.0 |
| Jul-Sep | 164 | 18.5 | 14 | 28.7 | 3 | 33.3 | 66 | 36.7 | 9 | 38.3 | 6 | 39.7 | 2 | 39.0 | -- | ---- |
| Oct-Dec | 590 | 25.4 | 93 | 32.3 | 80 | 35.0 | 196 | 37.4 | 24 | 38.8 | 2 | 40.5 | -- | ---- | -- | ---- |
| | | | | | | | Females | | | | | | | | | |
| Jan-Mar | 1/ | | 156 | 26.7 | 232 | 34.7 | 582 | 39.5 | 313 | 42.4 | 85 | 44.5 | 28 | 46.2 | 10 | 48.2 |
| Apr-Jun | 1/ | | 76 | 26.6 | 29 | 34.3 | 174 | 38.9 | 63 | 41.8 | 17 | 44.2 | 6 | 46.4 | 1 | 47.0 |
| Jul-Sep | 1/ | | 31 | 30.6 | 3 | 36.3 | 144 | 40.3 | 52 | 43.3 | 17 | 44.1 | 3 | 43.0 | -- | ---- |
| Oct-Dec | 1/ | | 149 | 33.8 | 118 | 38.3 | 293 | 41.0 | 76 | 43.3 | 23 | 45.9 | 12 | 47.2 | 5 | 47.0 |

1/ Same as males.

Table 2. -- Numbers of fish (n) by age group and mean lengths at age ($\bar{x}$) for male and female yellowtail from combined small mesh and commercial samples from Georges Bank in 1957-64, by calendar quarter. (Commercial samples were included only in the summary of age 4 and older fish.)

| Calendar quarter | Number of year marks | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 8+ | |
| | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ |
| | | | | | | | | Males | | | | | | | | | | |
| Jan-Mar | 1 | 7.0 | 4 | 25.5 | 12 | 33.4 | 135 | 37.3 | 55 | 39.6 | 21 | 40.2 | 6 | 42.0 | 1 | 43.0 | - | ---- |
| Apr-Jun | --- | ---- | -- | ---- | --- | ---- | 263 | 37.2 | 84 | 38.5 | 15 | 39.2 | 5 | 41.6 | 1 | 40.0 | - | ---- |
| Jul-Sep | 75 | 18.1 | 48 | 30.2 | 37 | 34.9 | 244 | 37.4 | 39 | 39.1 | 11 | 39.8 | 4 | 42.7 | - | ---- | - | ---- |
| Oct-Dec | 285 | 22.8 | 74 | 32.1 | 110 | 35.8 | 97 | 38.1 | 25 | 40.6 | 3 | 39.7 | 1 | 45.0 | - | ---- | - | ---- |
| | | | | | | | | Females | | | | | | | | | | |
| Jan-Mar | 1/ | | 4 | 23.0 | 5 | 36.4 | 135 | 41.3 | 63 | 43.6 | 48 | 45.7 | 32 | 47.9 | 15 | 49.0 | 7 | 50.6 |
| Apr-Jun | --- | ---- | -- | ---- | --- | ---- | 351 | 41.3 | 132 | 43.8 | 71 | 45.3 | 31 | 46.9 | 14 | 47.7 | 8 | 49.5 |
| Jul-Sep | 1/ | | 41 | 30.6 | 27 | 37.5 | 330 | 41.7 | 143 | 44.3 | 48 | 45.7 | 13 | 48.2 | 5 | 49.4 | 4 | 51.2 |
| Oct-Dec | 1/ | | 56 | 34.7 | 108 | 39.7 | 121 | 42.6 | 55 | 45.3 | 14 | 46.9 | 7 | 47.7 | 4 | 50.0 | 1 | 48.0 |

1/ Same as for males.

Table 3. -- Numbers of fish (n) by age group and mean lengths at age ($\bar{x}$) for male and female yellowtail from combined small mesh and commercial samples from the Cape Cod ground in 1957-64, by calendar quarter. (Commercial samples were included only in the summary of age 4 and older fish.)

| | Number of year marks | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | |
| Calendar quarter | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ | n | $\bar{x}$ |
| | | | | | | | | Males | | | | | | | | | | |
| Jan-Mar | 4 | 9.0 | 126 | 23.4 | 87 | 33.5 | 56 | 37.8 | 6 | 40.3 | -- | ---- | - | ---- | - | ---- | - | ---- |
| Apr-Jun | --- | ---- | --- | ---- | -- | ---- | 13 | 37.2 | 3 | 39.7 | 3 | 41.3 | - | ---- | - | ---- | - | ---- |
| Jul-Sep | 8 | 15.3 | --- | ---- | -- | ---- | 2 | 36.5 | -- | ---- | -- | ---- | - | ---- | - | ---- | - | ---- |
| Oct-Dec | 249 | 21.4 | 209 | 31.0 | 32 | 35.4 | 40 | 38.7 | 8 | 41.2 | -- | ---- | - | ---- | - | ---- | - | ---- |
| | | | | | | | | Females | | | | | | | | | | |
| Jan-Mar | 1/ | | 109 | 23.4 | 44 | 33.8 | 74 | 40.2 | 22 | 41.8 | 4 | 46.8 | - | ---- | - | ---- | - | ---- |
| Apr-Jun | --- | ---- | --- | ---- | -- | ---- | 35 | 41.2 | 7 | 43.9 | 5 | 45.5 | 1 | 46.0 | 1 | 46.0 | - | ---- |
| Jul-Sep | 1/ | | --- | ---- | -- | ---- | 19 | 41.3 | 1 | 45.0 | -- | ---- | - | ---- | - | ---- | - | ---- |
| Oct-Dec | 1/ | | 126 | 31.9 | 47 | 38.9 | 86 | 42.7 | 43 | 45.6 | 13 | 47.0 | 4 | 47.2 | 3 | 49.0 | 1 | 50.0 |

1/ Same as for males

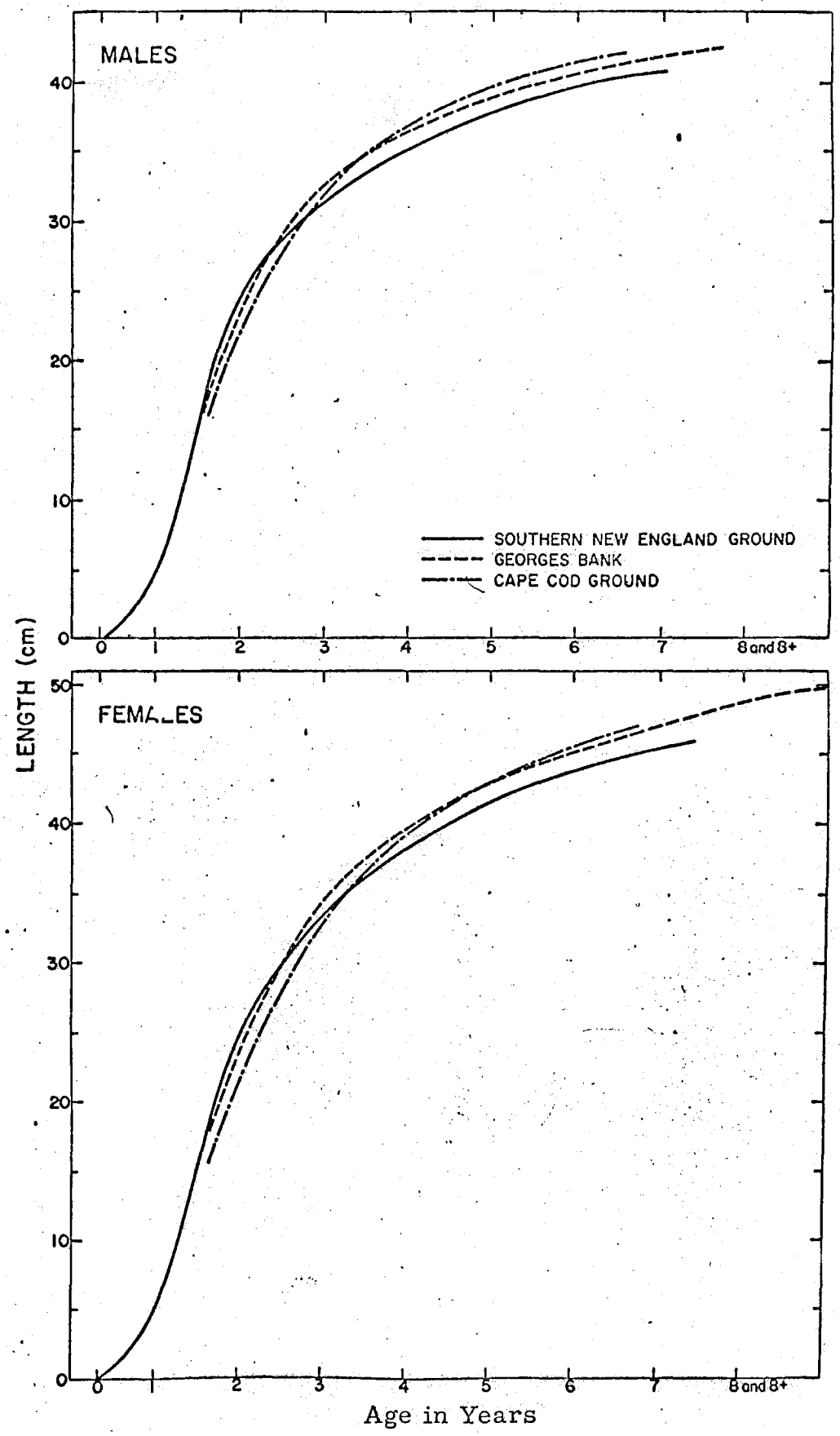


Figure 2. -- Smoothed growth curves for yellowtail flounder from the principal fishing areas.

We obtained an approximate growth rate for the most intensively fished part of the New England yellowtail population by combining the first calendar quarter growth rate for the southern New England ground with that of the third quarter for Georges Bank (Tables 1 and 2). These quarters are times of relatively high fishing effort on the respective grounds (Lux, 1964). Male and female growth rates for each ground, adjusted with the sex ratio of fish in commercial catches, were combined to give a growth rate for the population as a whole. The plotted data followed a smooth curve (Fig. 3).

A Bertalanffy growth equation of the form

$$l_t = l_{oo} ( 1 - e^{-K(t-t_o)} )$$

in which l is length in mm., t is age in years, and K is a constant determining the rate of change in length increment was fitted, by the method of Ricker (1958), to the part of the curve for fish of commercial size (age 2 and over). The resulting equation

$$l_t = 500(1 - e^{-0.335(t+0.26)})$$

fits the empirical points well over the range of ages considered (Fig. 3).

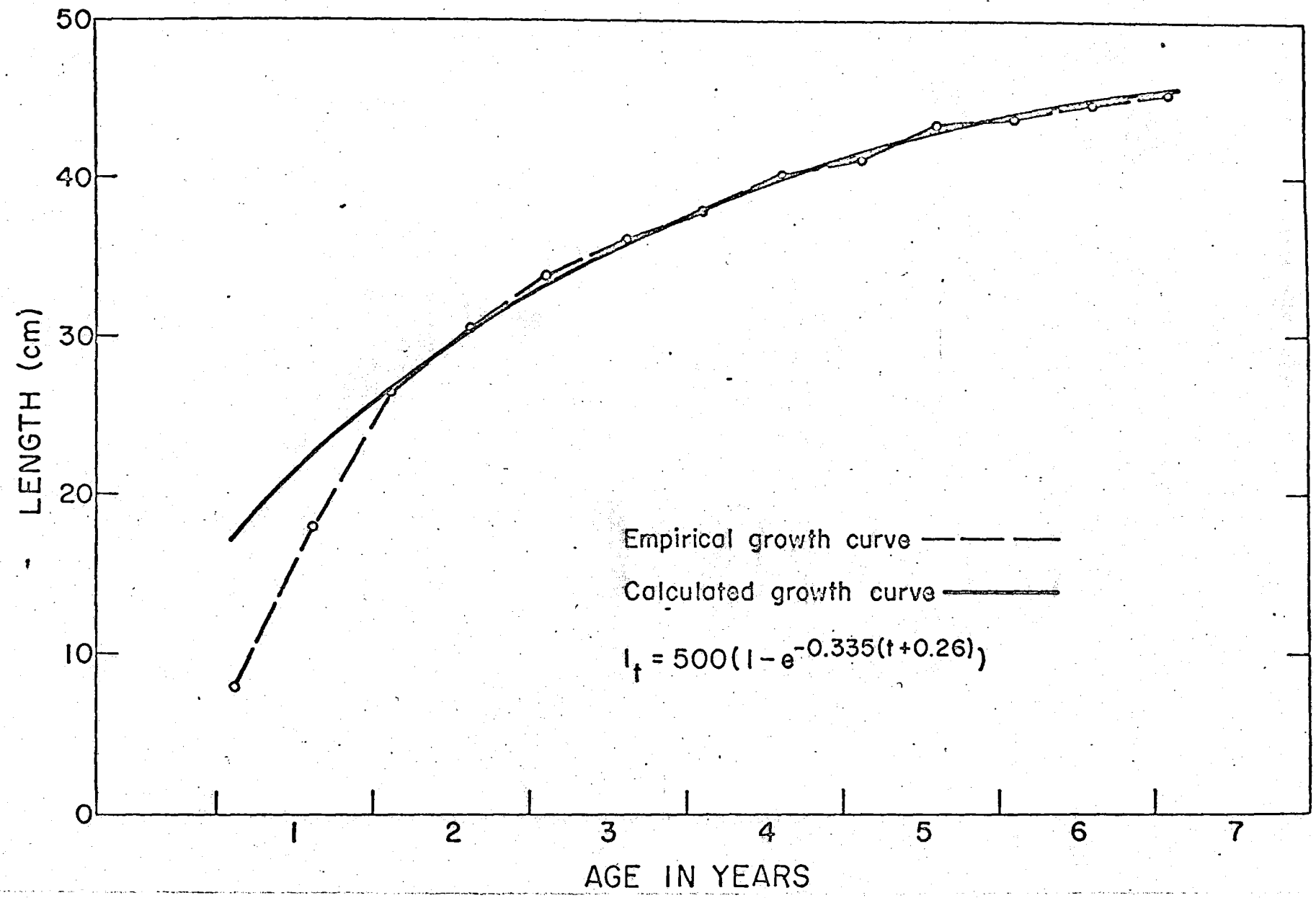


Figure 3. -- Estimated growth rate of yellowtail (sexes combined) from the southern New England ground and Georges Bank.

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