

## Acknowledgements

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## References

- Ahmad, R. U. 1972. Quantitative ('Morphological') colour changes on prolonged black and white background adaptations of the minnow *Phoxinus phoxinus* (L.) and the effects of chromatic spinal section on these colour changes. *J. comp. Physiol.* 77: 170-89.
- Dannevig, A. 1953. The littoral cod of the Norwegian Skagerak coast. *Rapp. P.-v. Réun. Cons. perm. int. Explor. Mer*, 136: 7-14.
- Hempel, G. & Blaxter, J. H. S. 1961. The experimental modification of meristic characters in herring (*Clupea harengus* L.). *J. Cons. perm. int. Explor. Mer*, 26: 336-46.
- Jones, B. W. 1966. The cod and the cod fishery at Faroe. *Fish. Invest., Lond., Ser. 2*, 24: (5) 32 pp.
- Jones, R. 1971. Further experiments on catching roundfish in good condition. *ICES C.M.* 1971/F: 10: 6 pp. (mimeo).
- Jones, R. & Hislop, J. R. G. 1972. Investigations into the growth of haddock, *Melanogrammus aeglefinus* (L.) and whiting, *Merlangius merlangus* (L.) in aquaria. *J. Cons. int. Explor. Mer*, 34: 174-89.
- Love, R. M. 1970. The chemical biology of fishes. Academic Press, London and New York, p. 158.
- Odiorne, J. M. 1957. Colour changes. *In* The Physiology of Fishes, 2: 387-401. Ed. by Margaret E. Brown, Academic Press, New York. 526 pp.
- Sumner, F. B. & Wells, N. A. 1933. The effects of optic stimuli upon the formation and destruction of melanin pigment in fishes. *J. exp. Zool.*, 64: 377-403.
- J. Cons. int. Explor. Mer, 35 (2): 209-210, Février 1974.

## An estimate of natural mortality in an unfished population of the scallop *Pecten maximus* (L.)

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Estimates of natural mortality in populations of scallops have generally been obtained from areas that are being fished and values varying from 4% to 56.5% have been recorded (Dickie, 1955; Gibson, 1956; Gruffydd, 1972). Baird (1966) attempted to obtain a more reliable estimate from an unfished population of *Pecten maximus* but found this difficult because of uneven annual recruitment. He did, however, estimate a mean annual mortality, based on length of life, of 26%.

Because natural mortality does not necessarily remain constant throughout life, more detail was sought from the results of a search carried out in the North Irish Sea for new, unfished beds of the scallop, *Pecten maximus* (Gruffydd, 1966). Samples taken at the 30 most productive stations in unfished areas were used to construct a catch-curve by plotting the total number of scallops at each age from all 30 grounds (Table 1) against age on semi-logarithmic graph paper (Fig. 1). The effect of uneven recruitment, which was apparent in individual samples, has been largely removed by this method. It seems that

although recruitment varies from year to year on a given ground, overall recruitment is fairly constant. The curve shown in Figure 1 was drawn freehand and the assumption was made that the scallops were fully recruited into the catchable part of the population at age 6. Using the numbers estimated from the curve in Figure 1, the total mortality  $Z$  was calculated from the expression  $N_{t+1} = N_t \cdot e^{-Z}$  where  $N_t$  is the number of scallops at age  $t$  and  $N_{t+1}$  the number at age  $t + 1$  (Gulland, 1969). In an unexploited population, the coefficient of natural mortality  $M = Z$  and as shown in Table 1, it increases with age.

The mean rate of 26% estimated by Baird (1966) in an unfished population comes within the range of mortality rates obtained here. However, in the absence of any other reliable estimate of natural mortality in this scallop, the values in Table 1 are preferable to Baird's figure because mortality changes quite markedly with age. The very high estimates of natural mortality that have been recorded in various exploited scallop populations in the past probably

Table 1. The distribution of scallops at each age and the relationship between age and natural mortality ( $M$ )

Age	Number at each age, original data	Number at each age from curve in Fig. 1	Natural mortality coefficient $M$	Natural mortality rate %
3	11			
4	146			
5	441			
6	583	565		
7	453	480	0.164	15.1
8	339	402	0.178	16.3
9	303	332	0.187	17.1
10	304	270	0.207	18.7
11	219	213	0.238	21.2
12	195	164	0.263	23.1
13	136	123	0.281	24.5
14	92	88	0.335	28.5
15	54	61	0.367	30.7
16	34	38	0.475	37.8
17	20	20	0.642	47.4
18	8	8.4	0.868	58.0
19	2	2.7	1.136	67.9
20	2	-		

include a high proportion of deaths due indirectly to fishing. It is likely that dredges in common use cause a great deal of fatal damage to uncaught scallops (see Gruffydd, 1972), thus increasing natural mortality estimates beyond the true level.

#### References

- Baird, R. H. 1966. Notes on an scallop (*Pecten maximus*) population in Holyhead harbour. *J. mar. biol. Ass. U.K.*, 46: 33-47.  
 Dickie, L. M. 1955. Fluctuations in abundance of the

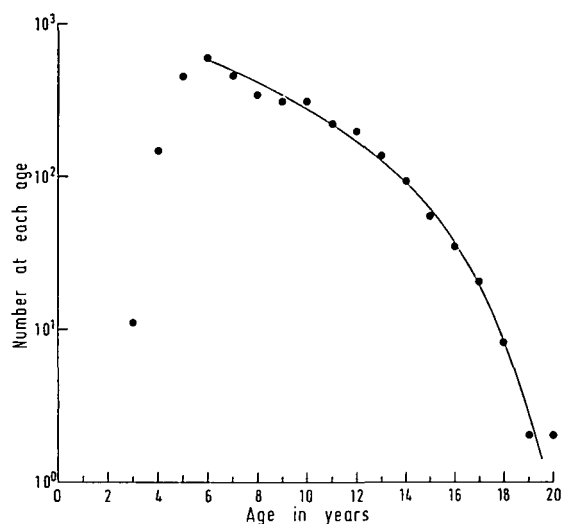


Figure 1. A plot of abundance of a year class of *Pecten maximus* against age, in an unexploited population. The curve was drawn by eye.

giant scallop *Placopecten magellanicus* (Gmelin) in the Digby area of the Bay of Fundy. *J. Fish. Res. Bd Can.*, 12: 797-857.

- Gibson, F. A. 1956. Escallops (*Pecten maximus* L.) in Irish waters. *Scient. Proc. R. Dubl. Soc.*, 27: 253-70.  
 Gruffydd, Ll. D. 1966. Report on the 1965 search for scallop (*Pecten maximus*) beds in the North Irish Sea. *Rep. mar. biol. Stn Port Erin*. 78: 35-41.  
 Gruffydd, Ll. D. 1972. Mortality of scallops on a Manx scallop bed due to fishing. *J. mar. biol. Ass. U.K.*, 52: 449-55.  
 Gulland, J. A. 1969. Manual of methods for fish stock assessment. Part 1. Fish population analysis. *FAO Man. Fish. Sci.*, 4: 1-154.

*J. Cons. int. Explor. Mer*, 35 (2): 210-212. Février 1974.

## The effect of the door-to-door tickler chain on the catch-rate of plaice (*Pleuronectes platessa* L.) taken by an otter trawl

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Fishermen believe that the door-to-door tickler chains used with an otter trawl with short bridles will double the catch-rate of plaice, but we have not been able to find any published quantitative data to confirm this. The detailed trawling logs supplied by Skipper C. F. G. Page for the Lowestoft trawlers

"Willa" in 1966-67 and "Cuttlefish" in 1969-72 provide haul-by-haul data which show the effect of the door-to-door tickler on the catch of plaice. These trawling logs have been described by Harden Jones, Scholes and Cheeseman (1969) and Scholes and Urquhart (1970). In the "remarks" column of the