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A survey of the distribution limits of  
Mytilicola intestinalis Steuer in England and Wales, 1972-74

by

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SUMMARY

A survey of the distribution limits of Mytilicola intestinalis in England and Wales during 1972-74 indicated that, since 1963, there has been no further spread of the parasite towards the major mussel fisheries of East Anglia and North Wales. These areas are protected to a large extent by natural barriers in the form of adjacent long stretches of coast where mussels are scarce or absent.

These fisheries remain at risk from accidental introductions of Mytilicola, either via infected mussels attached to shipping or through the transplantation of seed mussels dredged from close to infected stocks in north-west England.

INTRODUCTION

Mytilicola intestinalis Steuer was first reported in the British Isles at Blyth, Northumberland (Ellenby 1947). Because of this copepod parasite's potential for causing high mortalities among commercial stocks of mussels (Mytilus edulis) its geographical distribution and dispersal methods were soon investigated (Hockley 1951; Bolster 1954; Waugh 1954). By 1953 Mytilicola was known to be widely distributed in estuaries and harbours around the coasts of southern England and South Wales, from Southwold in Suffolk to Milford Haven in Pembrokeshire. Isolated infections were reported at two sites in northern England - Blyth harbour and Newbiggin in the north-east, and at Barrow-in-Furness docks in the north-west. Mytilicola is widespread again further north, in southern Scotland (Drinkwater 1971), but it is very local in Ireland (Crowley 1972). Figure 1 summarizes the reported distribution in Britain and Ireland up to 1971.

Since 1953 sporadic checks have been made by Ministry staff to ascertain any further spread of the parasite in England and Wales. A survey in 1963 showed that Mytilicola had extended its range a little further around the south coast of Wales to reach Fishguard harbour

(N. Reynolds, unpublished data). Otherwise, no notable changes were recorded up to 1971. During 1972-74, a further survey of the distribution limits was made and the results are reported below.

#### MATERIAL AND METHODS

The aim of the present survey was to determine whether Mytilicola was still spreading towards previously uninfected and important mussel fisheries in North Wales and in the Wash, eastern England. It was not concerned with resurveying already infected areas of southern England and South Wales. Figure 1 shows the regions covered by this survey. In each region the survey started at the last reported limit of Mytilicola occurrence. On the west coast mussels were collected from various sites in west and North Wales, and from Morccambe Bay in north-west England. On the North Sea coast the survey covered the mussel-producing areas of Norfolk and the Wash as well as the Northumberland shore between Blyth and the small fishery at Holy Island.

Most samples of mussels were collected intertidally, and usually from near low-water mark of spring tides, since Hepper (1955) had shown that infection rates tend to be highest at lower tide levels. Sublittoral samples were obtained from a few localities. Each sample, comprising usually 50 or 100 of the largest mussels available, was examined macroscopically, using a hand lens and scalpel to dissect the digestive gland, enclosing the mid-gut, and the hind gut. This method detected parasites > 2 mm in length but overlooked younger stages.

#### RESULTS

The distribution of Mytilicola in each region, and the percentage of mussels found to be infected at each station during 1972-74 are shown in Figures 2, 3 and 4. Tables 1 and 2 give details of samples examined and the minimum frequency of occurrence of parasites.

##### (a) Wales (Figure 2)

The northern coast was surveyed mainly during January-September 1973, with a repeat survey of the Bangor area in June 1974, and the southern coast was surveyed between July 1973 and May 1974. The results indicate that no major change in distribution has occurred since 1963. Mytilicola is still common in the south-west, in Milford Haven and the old harbour at Fishguard, though it could not be found at Porth Clais where it appeared in 1963 (N. Reynolds, unpublished data). The estuaries and fisheries of North Wales remain uninfected, although Table 2 shows that, statistically, there is a slight possibility of the parasite not being detected due to the small size of samples.

Mussels are scarce or absent along the 90 km of exposed coast in Cardigan Bay between Fishguard and Aberdovey. The chances of Mytilicola spreading northwards naturally along this "barren" coast would therefore seem to be very slender.

(b) Morecambe Bay (Figure 3)

The western area of the bay was surveyed in September-October 1972 and, more extensively, again in May-June 1974; the eastern side was examined in September 1971 (Heysham) and October 1972 (Fleetwood). The 1971/1972 survey indicated that the Mytilicola situation had not changed significantly since 1951, with the centre of infection continuing to be mussels in the enclosed docks at Barrow-in-Furness. Outside the docks, in the tidal Walney Channel, the level of infection was still low and did not appear to extend further seawards than Roa Island (station 4 in Figure 3). However, statistically (Table 1), Mytilicola could have remained undetected, at a very low level of infection, in the more distant mussel populations just outside the entrance to the Walney Channel.

Since 1972, however, Mytilicola has extended its range and "escaped" from the Walney Channel. In May 1974 Mytilicola was reported for the first time in mussels outside the Walney Channel by P. A. Driver (internal report of Lancashire and Western Sea Fisheries Joint Committee) who found it at stations 6, 8 and 9 (Figure 3). Following this discovery a more extensive search was made by the Ministry in June 1974. Figure 3 and Table 1 combine data from both surveys, whilst Table 1 also shows the results of the 1972 survey. These indicate that by 1974 adult Mytilicola were present on these outer mussel beds (stations 8-10), including one which recently has acquired major importance as a source of young (seed) mussels for restocking fisheries in uninfected areas. The present level of adult infection of this seed resource is extremely low (< 1 per cent infected and < 0.01 adult parasites per mussel) and it remains to be seen whether Mytilicola can firmly establish itself here. The cause of this geographically small, but culturally important, change in distribution is not known.

The beds on the east and south sides of the bay, including an alternative seed resource at Heysham, apparently remain clear of Mytilicola (P. A. Driver, pers. comm.).

(c) East Anglia (Figure 4)

This region was surveyed between August 1973 and May 1974. In addition, in June 1971, samples from Blakeney (100 mussels) and Wells (50) had been examined and found to be free of Mytilicola (P. A. Ayres, pers. comm.).

Earlier surveys by Waugh (1954) had shown that the estuary at Southwold marked the northern limit of Mytilicola in East Anglia. The present survey confirms that there have been no recent changes. The mussel fisheries in the Wash and north Norfolk harbours are still uninfected although, as noted for other areas, there is a slight chance of the parasite being overlooked due to small samples (Table 2).

The fisheries are separated from the nearest site of infection (Southwold) by approximately 100 km of shingle beaches, where mussels exist only as small, stunted communities on groynes, sewer pipes and old sea defences. This "barren" coastline, like that in the south of Cardigan Bay, clearly presents a natural barrier to the spread of Mytilicola.

To the north of the Wash fisheries the nearest known site of Mytilicola is 250 km distant, at Blyth, with the intervening coastline exposed and, near the Wash, largely devoid of mussels.

#### (d) Northumberland

This region was surveyed between October 1973 and May 1974. The small mussel fishery at Holy Island, 60 km north of Blyth, remains free from Mytilicola. At Blyth the parasite still occurs, although the level of infection (Table 2) appears to have fallen significantly since Bolster's 1952 survey. The nearby open shore site at Newbiggin, where Mytilicola was found in 1952, was not sampled during the present survey.

#### DISCUSSION AND CONCLUSIONS

The distribution limits of Mytilicola in England and Wales appear to have changed little over the last 10 years, and the important mussel fisheries of East Anglia and North Wales are as yet not infected. To a large extent, these fisheries are protected on either side by natural barriers in the form of long stretches of virtually mussel-free coastline. Despite its brief pelagic stage, however, Mytilicola does sometimes establish itself in mussels on exposed coasts - as in the English Channel (Hockley 1951) - though much probably depends on the direction and strength of local currents. The lack of spread along the shores of Norfolk and Cardigan Bay might be due as much to adverse hydrographic conditions as to the scarcity of hosts.

A far greater risk to the above fisheries stems from accidental introductions of the parasite, either through infected mussels brought in attached to ships' hulls (Bolster 1954) - a possibility more relevant to the Wash - or in loads of seed mussels dredged from near the infected stocks in Morecambe Bay. At Morecambe Bay, in particular, routine monitoring of Mytilicola distribution will be essential, although the statistical

aspects of sampling indicate considerable problems in evaluating risks when thousands of tonnes of mussels may be transplanted annually. For example, the 99 per cent confidence interval for a binomial distribution showing zero observations in a sample of 500 is 0-1 per cent, indicating that an infection level of 1 per cent may be still undetected even when 500 mussels are examined. Therefore, to detect and assess Mytilicola at very low infection levels, as in the marginal areas of distribution at Morecambe Bay, very large samples (probably 1000 mussels per dredging site) will need to be examined.

#### ACKNOWLEDGEMENTS

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Table 1 The occurrence of adult *Mytilicola intestinalis* in mussels at Morecambe Bay during May-June 1974, with corresponding data for September 1972 in parentheses. 1974 figures partly from P. Driver (report of Lancashire and Western Sea Fisheries Joint Committee), (Asterisks denote areas of seed supplies)

Station	Number of mussels examined (size range, mm)	Mussels infected		95% confidence interval (%) for binomial distribution	Total number of <i>Mytilicola</i> found	Average number of <i>Mytilicola</i> per mussel
		Number	Percentage			
1 Barrow docks (enclosed)	50 (25-70)	21	42 (72)	28-57	n.d. (55)	n.d. (1.10)
2 Barrow, outside docks	50 (45-80)	8	16 (10)	7-29	n.d. (5)	n.d. (0.10)
3 Walney Channel, Head Scar	50 (35-80)	1	2 (2)	0.05-11	1 (1)	0.02 (0.02)
4 " " , Roa Is.	25 (60-85)	1	4 (2)	0.1-20	1 (1)	0.04 (0.02)
5 " " , Piel Is.	50 (30-80)	0	0 (0)	0-7	0 (0)	0 (0)
6 " " , Haws Point	50 (20-50)	2	4	0.5-14	2	0.04
7 " " , Foulney Is.	360 (25-80)	0	0 (0)	0-1	0 (0)	0 (0)
8 Main Skear	220 (20-75)	1	0.45	0.01-3	1	0.004
9 "South America" skear*	700 (20-65)	6	0.9 (0)	0.3-2	6 (0)	0.009 (0)
10 " " " *	500 (25-65)	2	0.4	0.05-1.4	2	0.004
11 Out Skear	50 (35-55)	0	(0)	0-7	(0)	(0)
12 Heysham, skears*	300 (55-75)	0	(0)	0-1	(0)	(0)
13 " , harbour	50 (45-65)	0	(0)	0-7	(0)	(0)
14 Wyre Estuary	50 (> 50)	0	(0)	0-7	(0)	(0)
15 Fleetwood, Knott End	50 (> 50)	0	(0)	0-7	(0)	(0)

n.d. = no data.

Table 2 The occurrence of adult Mytilicola intestinalis in mussels in the areas of Wales and eastern England surveyed during 1973-74. (Asterisks mark areas of mussel fisheries or seed supplies)

Station	Number of mussels examined (size range, mm)	Mussels infected		95% confidence interval (%) for binomial distribution	Total number of <u>Mytilicola</u> found	Average number of <u>Mytilicola</u> per mussel
		Number	Percentage			
<b>WALES</b>						
Conwy, sublittoral beds*	100 (60-85)	0	0	0-4	0	0
Bangor, Flats lays*	650 (45-75)	0	0	} 0-1	0	0
" , Siliwen lays*	50 (60-75)	0	0		0	0
" , Ogwen beds*	50 (60-75)	0	0		0	0
" , Gallows Point*	50 (65-75)	0	0		0	0
Tal-y-foel*	50 (60-75)	0	0	0-7	0	0
Portmadoc*	100 (40-70)	0	0	0-4	0	0
Barmouth	50 (55-70)	0	0	0-7	0	0
Aberdovey	100 (60-80)	0	0	0-4	0	0
Fishguard, old harbour	30 (55-75)	21	70	52-84	49	1.63
Porth Clais	50 (40-55)	0	0	0-7	0	0
Milford Haven, Dale	50 (45-60)	19	38	25-53	43	0.86
" " , Milford	50 (40-60)	10	20	10-34	11	0.22
" " , Neyland	50 (50-65)	14	28	16-43	17	0.34
<b>NORTHUMBERLAND</b>						
Blyth, south harbour	50 (60-80)	1	2	0.05-11	1	0.02
" , outside ship-breaking yard	160 (55-75)	5	3	1-7	5	0.03
Budle Bay	50 (55-70)	0	0	0-7	0	0
Holy Island*	100 (50-70)	0	0	0-4	0	0

Table 2 continued.

Station	Number of mussels examined (size range, mm)	Mussels infected		95% confidence interval (%) for binomial distribution	Total number of <u>Mytilicola</u> found	Average number of <u>Mytilicola</u> per mussel
		Number	Percentage			
EAST ANGLIA						
Southwold	100 (55-75)	28	28	19-38	45	0.45
Pakefield	50 (45-60)	0	0	0-7	0	0
Lowestoft, harbour	50 (55-75)	0	0	0-7	0	0
Corton	50 (30-40)	0	0	0-7	0	0
Overstrand	50 (35-55)	0	0	0-7	0	0
Blakeney Harbour*	100 (60-80)	0	0	0-4	0	0
Wells Harbour*	50 (50-70)	0	0	0-7	0	0
Brancaster Harbour*	150 (50-65)	0	0	0-3	0	0
Wash: Hunstanton*	50 (60-85)	0	0	0-7	0	0
" Gat Sand*	50 (55-65)	0	0	0-7	0	0
" Main End Sand*	50 (55-65)	0	0	0-7	0	0
" South Middle Sand*	50 (60-80)	0	0	0-7	0	0



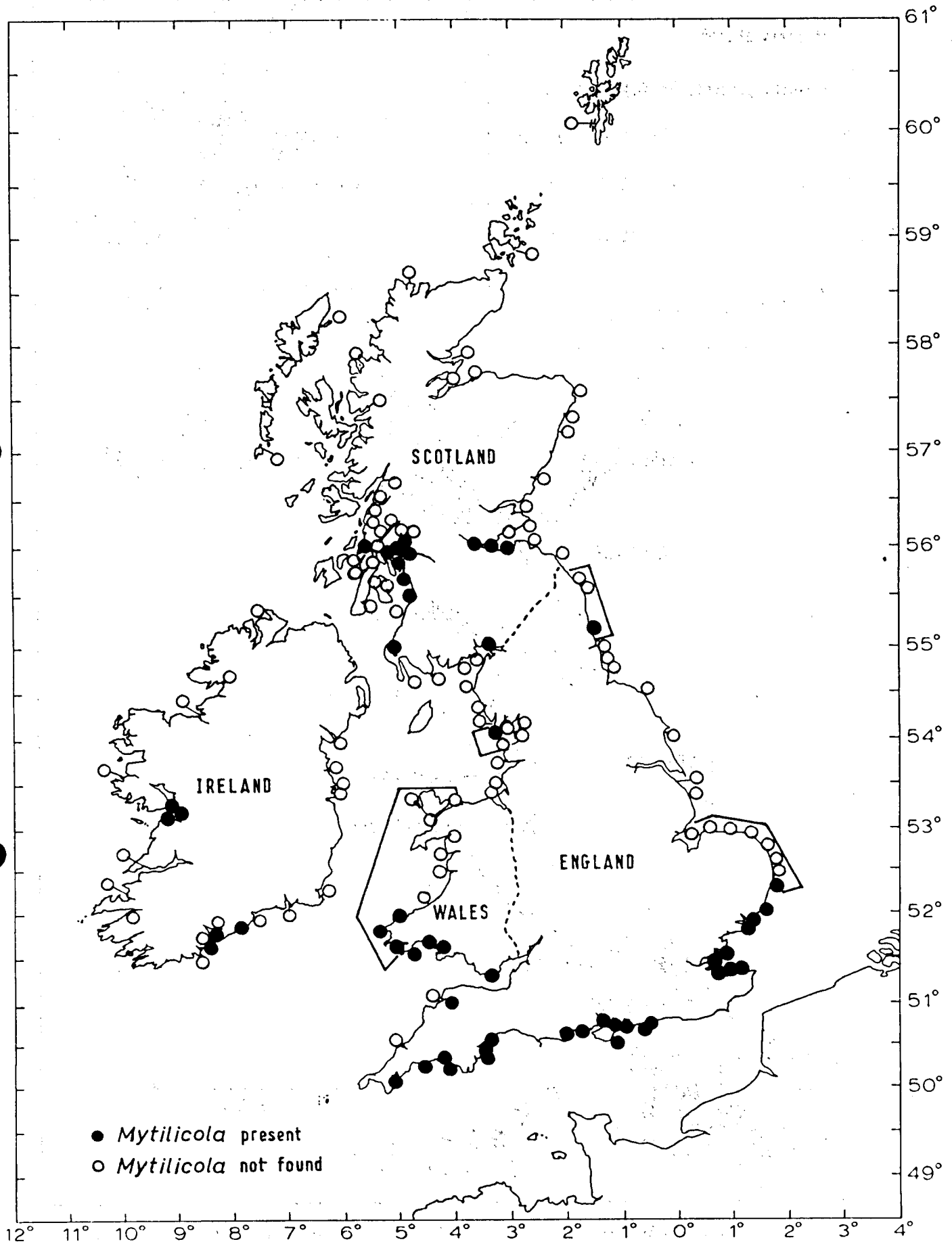


Figure 1 The recorded distribution of *Mytilicola intestinalis* in Britain and Ireland up to 1971, showing also the regions of England and Wales re-surveyed during 1972-74. Distribution data summarized from published literature and from internal MAFF Reports.

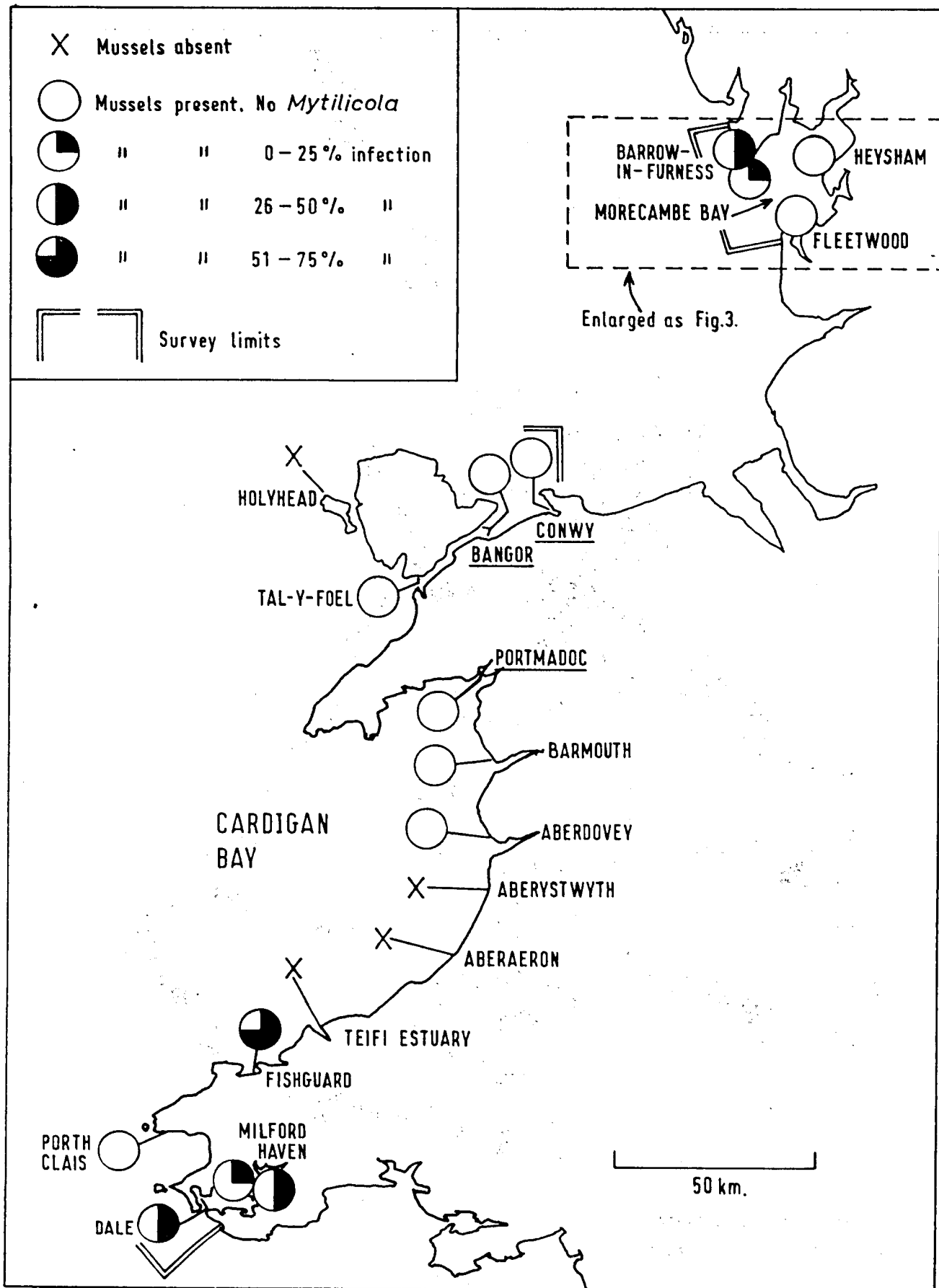


Figure 2 The stations in Wales and north-west England visited during the 1972-74 survey, showing the distribution of *Mytilicola intestinalis*. Places with mussel fisheries are underlined.

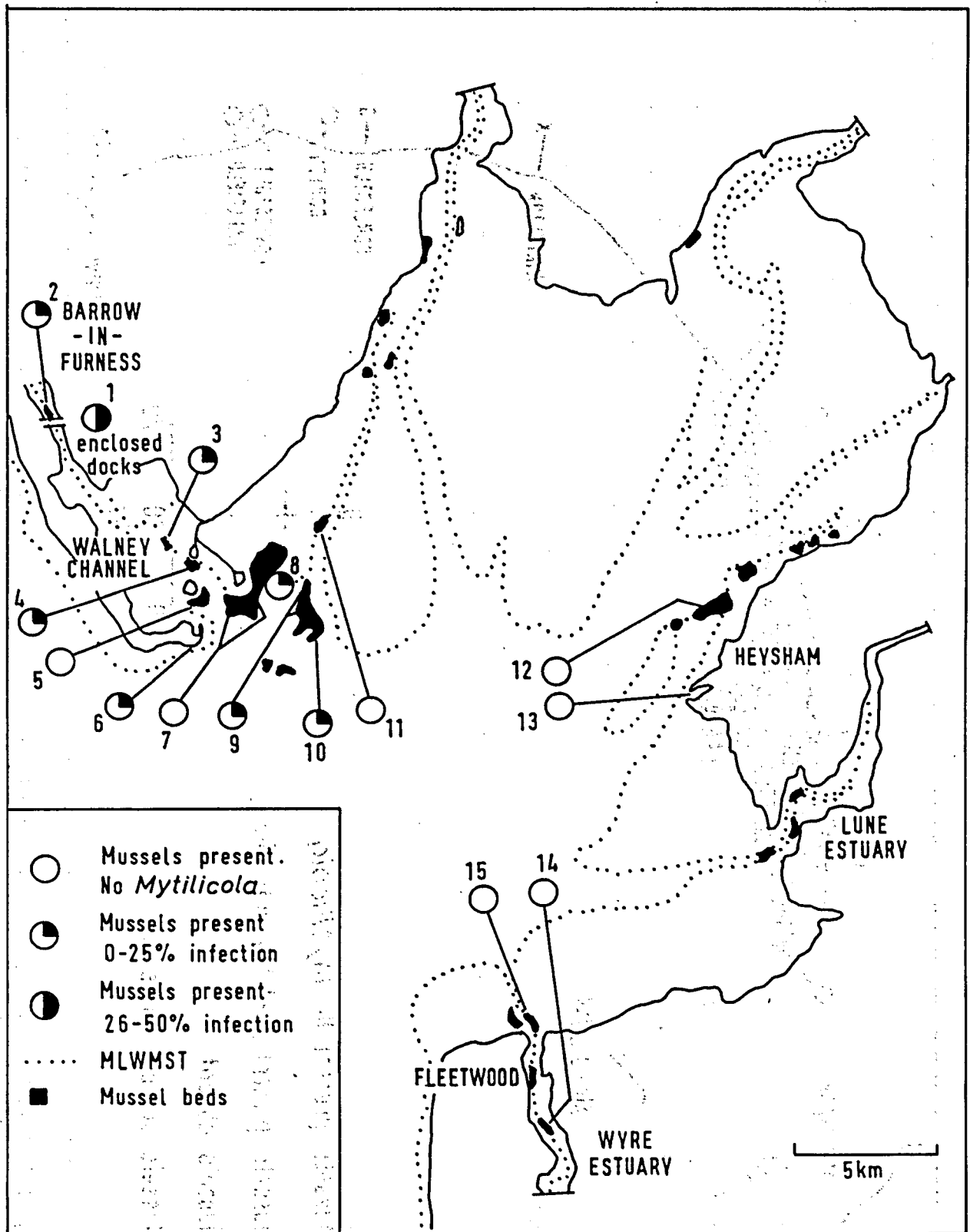


Figure 3 Map of Morecambe Bay showing the stations sampled in 1974 and the distribution of *Mytilicola intestinalis* (Stations 11-15 were sampled in autumn 1972). Based in part on data of Lancashire and Western Sea Fisheries Joint Committee.

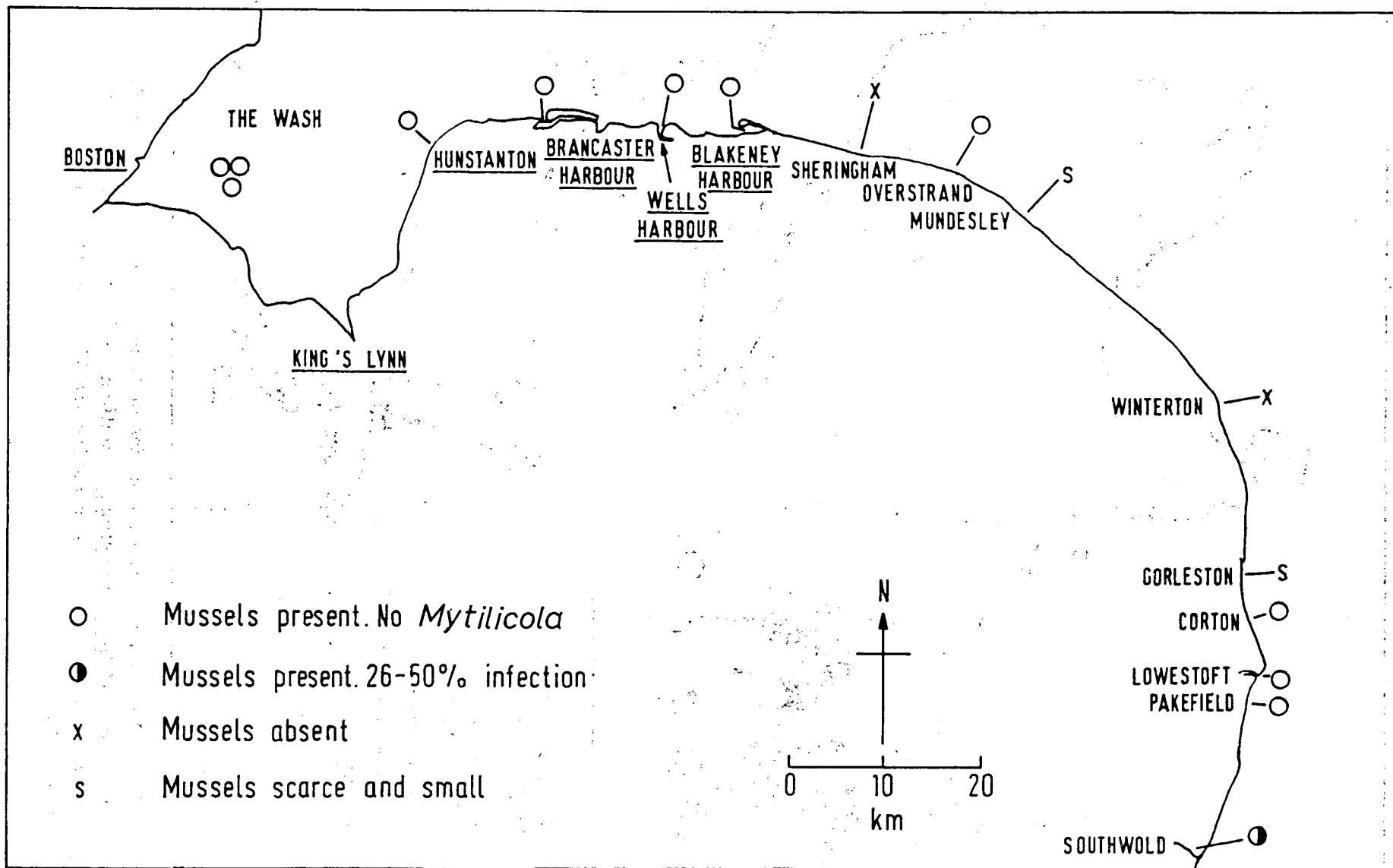


Figure 4 Map of East Anglia showing the stations visited in 1973-74 and the distribution of *Mytilicola intestinalis*. Places with mussel fisheries are underlined.