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ENGLISH COD TAGGING EXPERIMENTS TO THE NORTH OF SCOTLAND 1977-1979

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ABSTRACT

Between 1977 and 1979, four tagging cruises were carried out on RV CLIONE in the area between the Hebrides and the Shetland Isles. The purpose of these trips was to try to assess the extent of any interchange of cod between the North Sea and west coast of Scotland. This paper analyses the results of these tagging experiments which show virtually no migration from the North Sea to the west coast of Scotland. A small amount of movement from the west coast to the North Sea was indicated but most of the returns came from within 50 nautical miles of the area of release. The possibility of egg and larval drift from the west coast of Scotland to the North Sea is also discussed.

RÉSUMÉ

De 1977 à 1979, quatre campagnes de marquage ont été effectuées à bord du navire océanographique CLIONE dans la région située entre les Hébrides et les îles Shetland. Le but de ces campagnes était de tenter d'apprécier l'ampleur des échanges éventuels de morue entre la mer du Nord et la côte ouest de l'Ecosse. La présente communication analyse les résultats de ces expériences de marquage, qui ne font ressortir pratiquement aucune migration de la mer du Nord à la côte ouest de l'Ecosse. Quoique l'on ait constaté un mouvement de faible ampleur de la côte ouest à la mer du Nord, la plupart des marques récupérées provenaient d'une zone délimitée par un rayon de 50 milles marins autour du point du rejet à la mer. On aborde aussi la possibilité d'une dérive des oeufs et des larves de la côte ouest de l'Ecosse à la mer du Nord.

1. INTRODUCTION

The ICES North Sea Roundfish Working Group performs separate assessments for cod in the North Sea and west of Scotland, the dividing line being 4° west. As an aid to the accuracy of these assessments, it would be desirable to know whether there is any interchange between these areas.

Symonds and Raitt (1966) summarized the results of Scottish cod tagging experiments mainly in coastal waters during the period 1962-64. Fish were tagged on the Scottish north coast, Moray Firth, east coast and offshore in the northern North Sea. In general, the fish showed little tendency to disperse away from the release area. Only 3% of the fish tagged in the Moray Firth were recaptured west of the Orkneys. Cod tagged off the north coast of Scotland, however, showed more movement; 7% were caught in the Moray Firth, 9% east of the Orkneys and 7% moved further west.

The purpose of the English tagging experiments, described in this paper, was to provide further information from offshore grounds on the possible interchange between the North Sea and west of Scotland.

MATERIALS AND METHOD

Between 1977 and 1979, four cruises were carried out on RV CLIONE in the area between the Hebrides and the Shetland Isles. Two types of tag were used, a flexible plastic flag and the Howitt rigid plastic flag. They were attached with soft braided nylon thread between the first and second dorsal fins of the fish. Both types of tag gave similar recapture rates. A chart showing the boundaries of ICES areas IV and VIa and other areas mentioned in this paper is shown in Figure 1.

The release positions were in four areas (Table 1), Papa Bank, Sumburgh, north of Shetland and west of the Hebrides, though not all areas were covered on every cruise.

The returns from each cruise were first plotted separately but the results for each area were very similar, making it possible to combine the results of all the cruises by the area of release.

RESULTS

Table 2 gives the number released in each length group, together with the number and percentage subsequently recaptured. It shows that fish were recaptured at a fairly constant level throughout the entire length range of the released fish.

Most of the tagging was carried out on commercial fishing grounds, and a large number of fish were caught soon after tagging, which could give a false impression of the scale of any movement away from the area of tagging. Table 3 compares the total recaptures from various areas with those excluding recapture during the first three months after release. There is very little difference in the percentages caught from most of the areas. The only major difference in numbers caught occurs in the Sumburgh tagging experiment, which, excluding recaptures in the first three months, reveals a higher percentage dispersing over the northern and central North Sea. The recaptures have therefore been plotted and percentages calculated, excluding the returns for the first three months after release. For each release area, Figure 2(a-d) shows all such recaptures, and in addition quarterly data are also shown separately in Figures 3-5. In the quarterly charts, recaptures in the first full year starting three months after the month of release are shown separately from those taken in subsequent years.

Papa Bank

Five hundred and eighty one cod were tagged on four cruises in 1977, 1978 and 1979 in rectangles 48E5 and 48E6. Recaptures are shown in Figures 2(a) and 3. Eighty-two percent of the recaptures came from an area on the west coast of Scotland between the north coast of Ireland and north of the Orkneys. Fourteen percent were caught around the Shetlands and 4% in the northern and central North Sea. Quarterly recaptures (1977 and 1978 cruises only) (Figure 3) show that in the third and fourth quarters most of the recaptures were taken close to the area of release. In the first and second quarters there is a wider dispersion of recaptures. Of the fish which were recaptured outside the release area, most were taken to the south west.

Sumburgh

Three hundred and eighty cod were tagged on four cruises in 1977, 1978 and 1979 on the fishing grounds off Sumburgh Head (rectangles 48E8 and 48E9). The recaptures (Figure 2(b)) showed a wide dispersion around the Shetlands (41%), northern North Sea (45%), central North Sea (12%) and Papa Bank area (2%). The quarterly distributions of recaptures from the two June cruises in 1977 and 1978 (Figure 4) do not show any clear migration pattern.

Hebrides

The 413 cod, which were tagged in April 1979 on the fishing grounds west of the Hebrides (rectangles 46E2 and 45E2), dispersed widely along the west coast of Scotland but with a general movement north eastwards towards the Papa Bank area (Figure 2(c)). Eight percent were caught in the Moray Firth and central North Sea. None was recaptured around the Shetlands. The seasonal charts (Figure 5) show a rapid dispersal away from the tagging area towards the north east. The first and second quarter recaptures one year later suggest a return migration to the area of tagging.

North Shetland

Only 51 cod were tagged in this area in January and April 1979. Most of the recaptures (71%) were close to the area of liberation (Figure 2(d)). Two were caught around the Papa Bank and one was caught east of the Orkneys. There were too few recaptures to draw any conclusions with regard to seasonal movements.

DISCUSSION

The results of the Papa Bank and Hebrides experiments suggest that there is a considerable degree of interchange between the two areas. Cod tagged off the Hebrides moved north towards the Papa Bank in late summer and autumn, whilst those released on the Papa Bank moved south in the winter and spring. Some of the Papa Bank fish also moved north east to Shetland, especially in the first two quarters, but there was little reciprocal movement.

The cod tagged on the Sumburgh Head grounds dispersed widely over the northern North Sea and around the Shetlands but few were caught around the Papa Bank and none further west.

The results from the present experiments indicate that exchange of cod between the North Sea and west of Scotland is rather limited in extent. Of the fish released north and south of the Shetlands, there were only four recaptures from west of 4° west, which is the boundary between the assessment areas IV and VIa. There was movement on a larger scale from west to east, with fish released west of the Hebrides and especially at Papa Bank being returned from the North Sea. Fifteen percent of the recaptures of fish tagged west of the Hebrides had moved across the 4°W boundary into the North Sea. The Papa Bank tagging experiments in rectangles 48E5 and 48E6 spanned the boundary between

areas IV and VIa. A total of 68% of the recaptures came from within 50 nautical miles of the tagging area while 19% of the recaptures came from east of the tagging area, mainly from around the Shetland Isles, and 13% had moved south west to the Hebrides.

The present results thus lend some support to the ICES Working Group's assessment procedure in treating the North Sea and west of Scotland as separate units.

It is possible that egg and larval drift from West of Scotland could contribute more to the North Sea stocks than do adult migrations. Cod eggs and larvae have a continuous distribution around the west, north and east coasts of Scotland (Raitt, 1967). However, Raitt drew no conclusions regarding the possible drift of eggs and larvae. Saville (1959) showed that larvae of haddock have a continuous distribution from west of Orkney/Shetland into the North Sea through both the Fair Isle-Shetland passage and to the north of Shetland. In discussing a marked shift in the distribution of larvae in 1955 Saville points to the possibility of a 'rapid and sudden drift' into the North Sea from the west, probably through the Fair Isle-Shetland passage. The ICES International 0-group Gadoid Survey covered both the west coast of Scotland and the North Sea in 1979 (Benjaminsen et al., 1979). The results showed that for cod, haddock and whiting the 0-group stage was distributed continuously between the west coast of Scotland and the North Sea. The west coast survey was made before the North Sea survey and overlapped part of the area covered by the latter. An increase in abundance was noted in the rectangles fished on both surveys and it was concluded that this could be due to an easterly drift of the 0-group stages of all three species.

There is now good evidence of transport of herring larvae from the west coast of Scotland into the North Sea from a consideration of hydrography (Dooley and McKay, 1979), analysis of gene frequency data (Heath and Walker, 1985), and meristic characters (Saville, 1971; Saville and Morrison, 1973). A return migration of adults is also suggested from meristic, parasitological and tagging data (Heath and Baird, 1983; Mackenzie, 1985). A similar drift of gadoid larvae is therefore possible, although there is a difference in the time of occurrence of eggs and larvae, autumn for herring and spring/summer for gadoids.

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Table 1 Summary of release and recapture details

| Release area | ICES rectangle | RV cruise* | No. released | No. recaptured | % recaptured | No. recaptured with position |
|----------------|----------------|------------|--------------|----------------|--------------|------------------------------|
| Papa Bank | 48E5 | 1 | 185) | 182 | 31 | 153 |
| | 48E6 | 2 | 332) | | | |
| | | 3 | 27) | | | |
| | | 4 | 37) | | | |
| Sumburgh | 48E8 | 1 | 68) | 141 | 37 | 110 |
| | 48E9 | 2 | 299) | | | |
| | | 3 | 6) | | | |
| | | 4 | 7) | | | |
| Hebrides | 46E2 | 4 | 413 | 92 | 22 | 84 |
| | 45E2 | | | | | |
| North Shetland | 50E7 | 2 | 9) | 15 | 29 | 11 |
| | 50E8 | 3 | 42) | | | |
| | 50E9 | | | | | |

*RV CLIONE cruises: 1 10-25 June 1977
 2 8-26 June 1978
 3 4-24 January 1979
 4 29 March-19 April 1979

Table 2 Length distributions of released and recaptured cod

| Length group (mid-point) | Papa Bank | | | Sumburgh | | | North Shetland | | | Hebrides | | |
|--------------------------|--------------|----------------|--------------|--------------|----------------|--------------|----------------|----------------|--------------|--------------|----------------|--------------|
| | No. released | No. recaptured | % recaptured | No. released | No. recaptured | % recaptured | No. released | No. recaptured | % recaptured | No. released | No. recaptured | % recaptured |
| 27.5 | | | | 4 | 0 | 0 | | | | | | |
| 32.5 | | | | 14 | 5 | 36 | | | | | | |
| 37.5 | 5 | 1 | 20 | 28 | 10 | 36 | 7 | 1 | 14 | | | |
| 42.5 | 11 | 2 | 18 | 64 | 25 | 39 | 3 | 2 | 67 | 1 | 0 | 0 |
| 47.5 | 51 | 12 | 24 | 46 | 19 | 41 | 8 | 3 | 38 | 6 | 0 | 0 |
| 52.5 | 86 | 25 | 29 | 33 | 10 | 30 | 9 | 1 | 11 | 12 | 2 | 17 |
| 57.5 | 84 | 21 | 25 | 28 | 9 | 32 | 10 | 4 | 40 | 29 | 5 | 17 |
| 62.5 | 52 | 10 | 19 | 33 | 13 | 39 | 7 | 3 | 43 | 58 | 16 | 28 |
| 67.5 | 62 | 25 | 40 | 31 | 12 | 39 | 0 | | | 58 | 15 | 26 |
| 72.5 | 56 | 18 | 32 | 25 | 10 | 40 | 2 | 0 | 0 | 34 | 8 | 24 |
| 77.5 | 46 | 19 | 41 | 21 | 6 | 29 | 2 | 1 | 50 | 29 | 9 | 31 |
| 82.5 | 53 | 22 | 42 | 24 | 12 | 50 | 1 | 0 | 0 | 35 | 10 | 29 |
| 87.5 | 38 | 11 | 29 | 15 | 5 | 33 | 2 | 0 | 0 | 33 | 8 | 24 |
| 92.5 | 23 | 12 | 52 | 8 | 3 | 38 | | | | 49 | 6 | 12 |
| 97.5 | 11 | 3 | 27 | 2 | 2 | 100 | | | | 39 | 9 | 23 |
| 102.5 | 2 | 1 | 50 | 4 | 0 | 0 | | | | 22 | 3 | 14 |
| 107.5 | 1 | 0 | 0 | | | | | | | 6 | 1 | 17 |
| 112.5 | | | | | | | | | | 1 | 0 | 0 |
| 117.5 | | | | | | | | | | 1 | 0 | 0 |
| Total | 581 | 182 | 31 | 380 | 141 | 37 | 51 | 15 | 29 | 413 | 92 | 22 |

Table 3 Comparison of total recaptures and recaptures excluding first three months
(Percentage recaptures are in parentheses)

| Release area | Total no. recaptured | No. excluding first 3 months | Recapture areas | | | | | | | | | |
|-------------------|-------------------------|---------------------------------------|-----------------|------------|------------|------------|------------|------------|-----------------------|------------|----------------------|-----------|
| | | | Papa Bank | | Hebrides | | Shetland | | Northern North Sea | | Central North Sea | |
| | | | A | B | A | B | A | B | A | B | A | B |
| Papa Bank | 153 | 101 | 110 (72) | 70 (69) | 13 (9) | 13 (13) | 25 (16) | 14 (14) | 3 (2) | 2 (2) | 2 (1) | 2 (2) |
| Hebrides | 84 | 53 | 27 (32) | 17 (32) | 51 (61) | 32 (60) | - | - | 4 (5) | 3 (6) | 2 (2) | 1 (2) |
| Sumburgh | 110 | 64 | 7 (6) | 1 (2) | - | - | 64 (58) | 26 (41) | 31 (28) | 29 (45) | 8 (7) | 8 (12) |
| North Shetland | 11 | 9 | 2 (18) | 2 (22) | - | - | 8 (73) | 6 (67) | 1 (9) | 1 (11) | - | - |

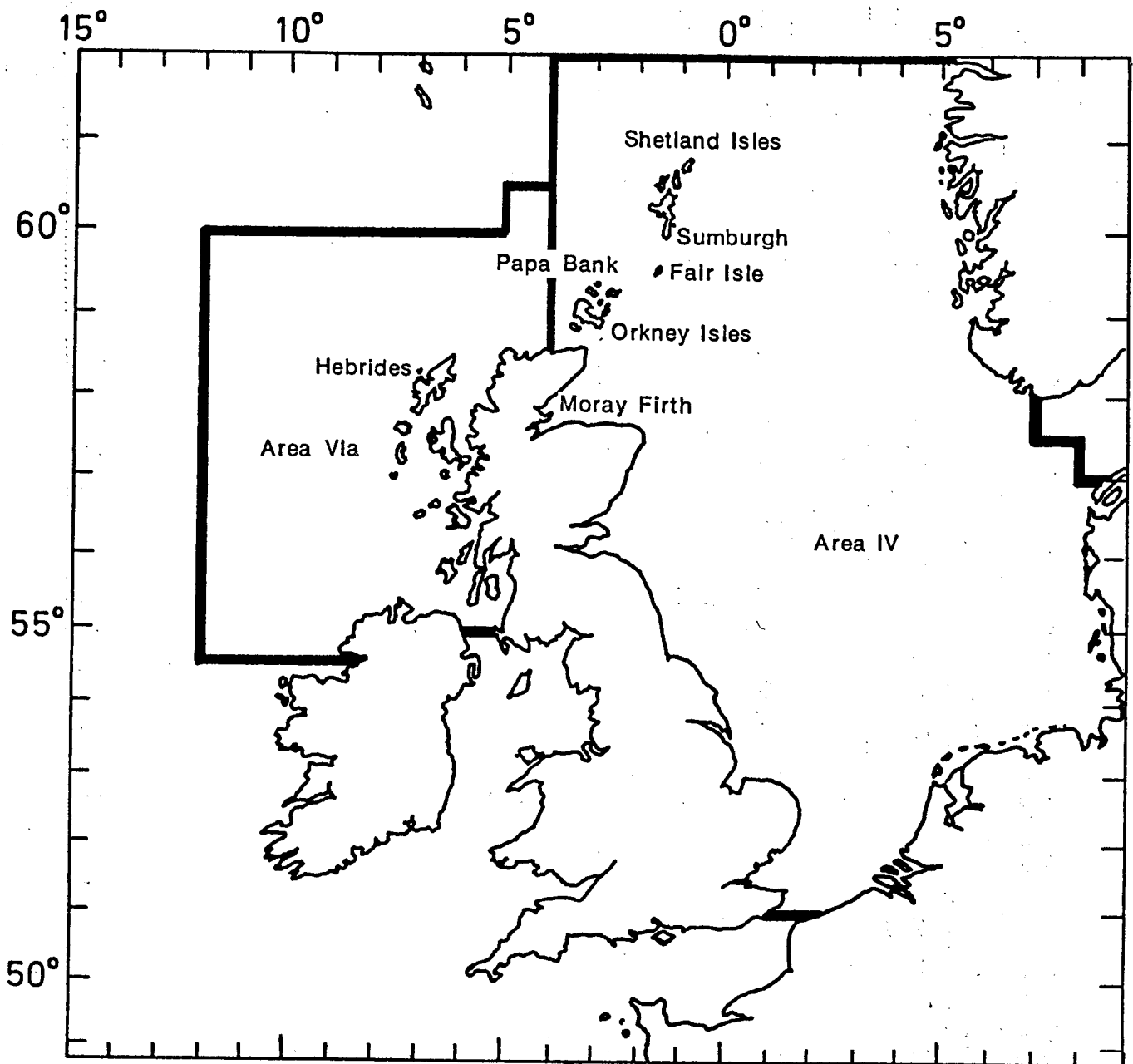


Figure 1 Boundaries of ICES areas IV and VIa and other areas mentioned in text.

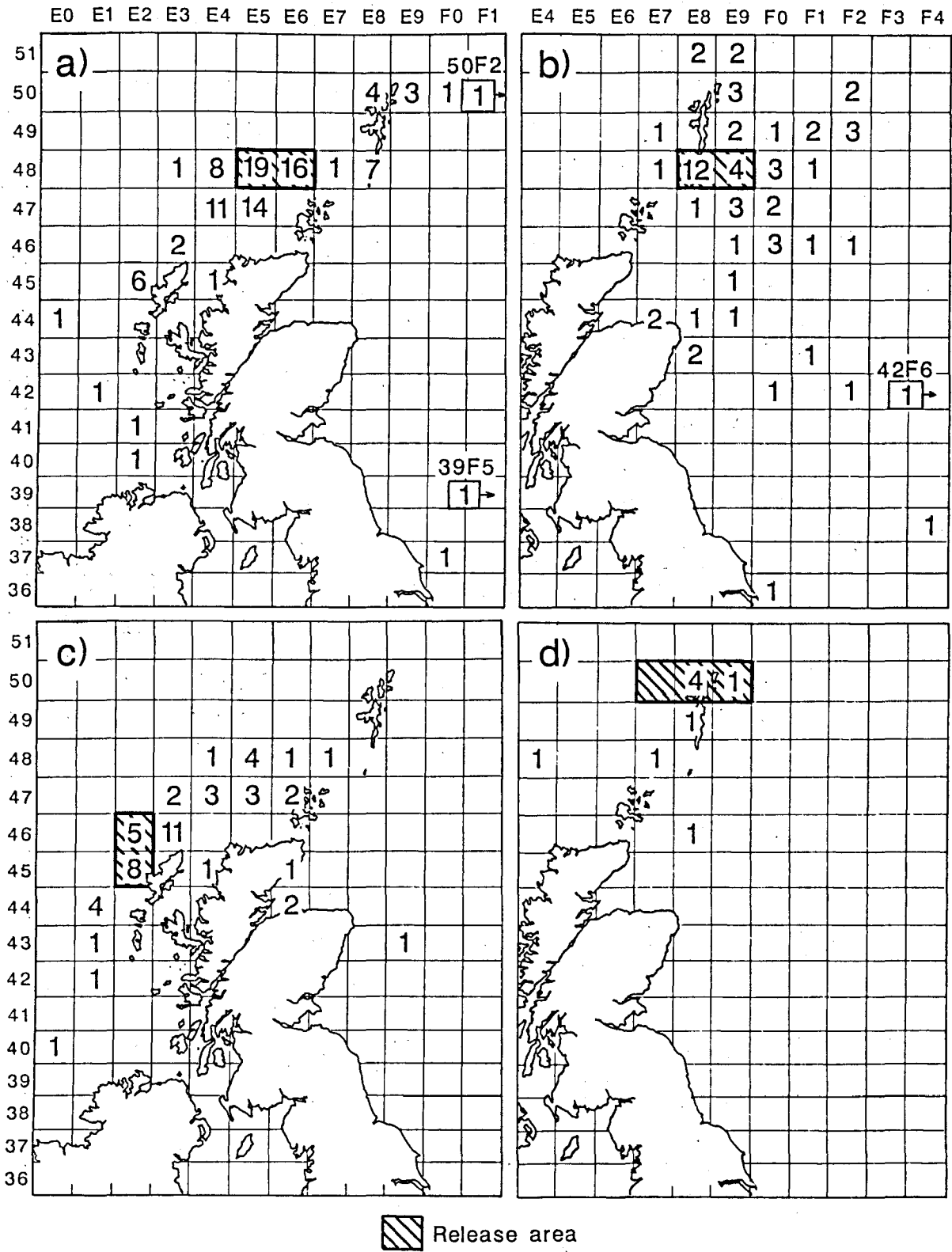


Figure 2 Total recaptures of tagged cod excluding the first three months.

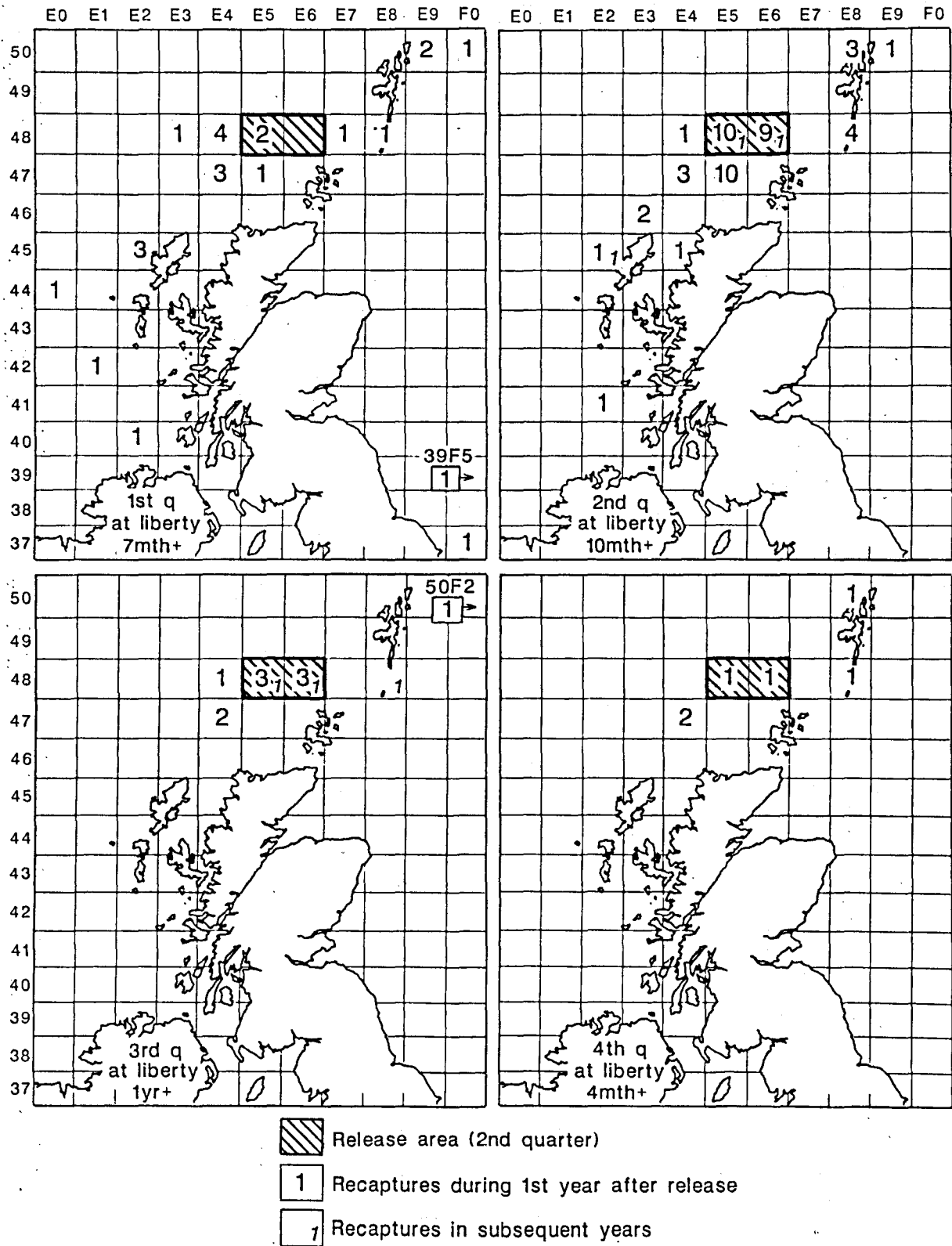


Figure 3 Quarterly recaptures excluding the first three months for tagged cod released at Papa Bank.

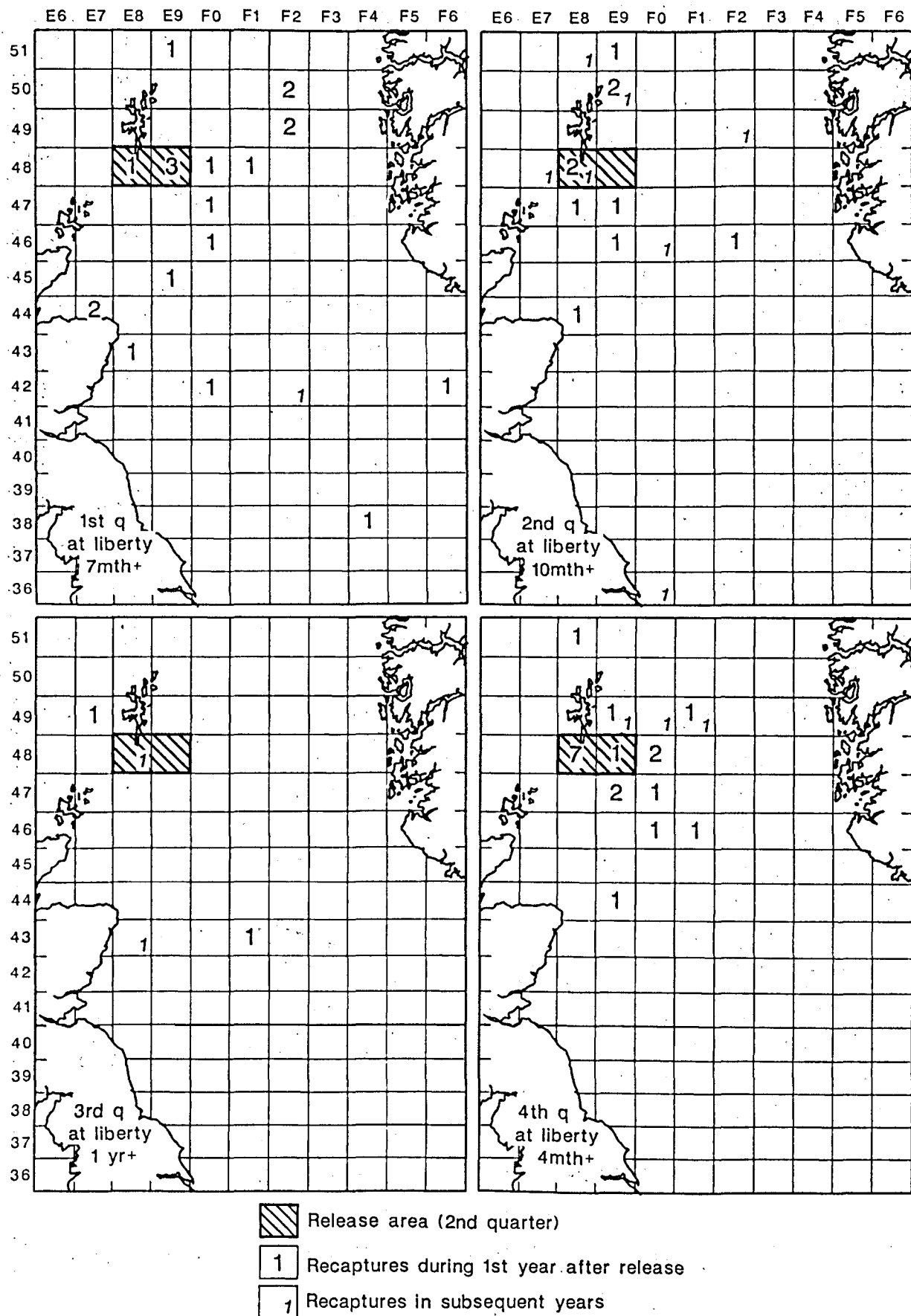


Figure 4 Quarterly recaptures excluding the first three months for tagged cod released at Sumburgh.

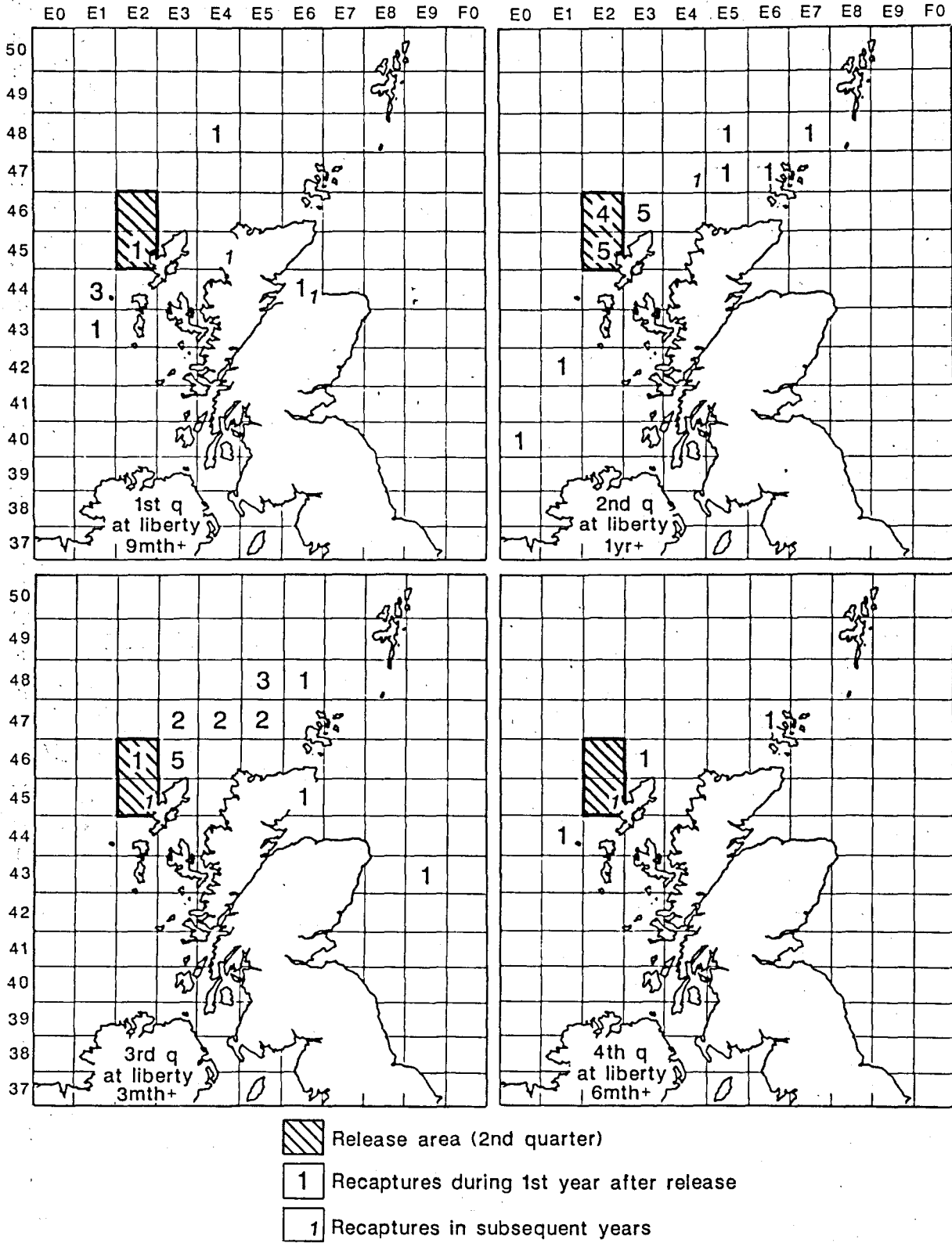


Figure 5 Quarterly recaptures excluding the first three months for tagged cod released at the Hebrides.