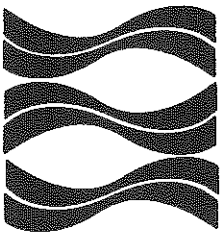
SERIES B (Marine) No. 34 1989



IRISH FISHERIES INVESTIGATIONS

Edward Fahy

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Roinn na Mara

(Department of the Marine)

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Fisheries for Ray (Batoidei) in Western statistical area viia, investigated through the commercial catches.

BY

EDWARD FAHY, Fisheries Research Centre, Department of the Marine, Abbotstown, Dublin 15

ABSTRACT

The status of the Irish Sea ray fishery is investigated using commercial catches of rays landed into two ports, Howth and Arklow. Approximately 80 45kg boxes were examined monthly over a year when approximately 100 individuals of each of the four contributing species were aged and measured. The species are *R. naevus, montagui, clavata* and *brachyura*. These are inter-mixed and casually segregated into four grades on their length. Weighting factors are provided to raise the sampled numbers to total landings.

The frequency distribution of grades at the two ports is established from an analysis of some 5,700 commercial transactions. At Arklow, the pattern is stable from one year to another and apparently seasonal. Arklow boats have a short range. The pattern of landings at Howth is more complex; these vessels have a longer range and probably exploit various ages of rays.

Growth in all four species occurs most actively during the summer months, slowing down in the winter. Annulus formation is not readily associated with the conventional birth date of 1 January.

Coefficients of total mortality (Z) are high for the four species (0.38–1.00), higher than those found in a recent study of rays in Carmarthen Bay. *R. brachyura* is the most valuable species. *R. naevus* is the most numerous, possibly because it has a competitive advantage due to its age at full recruitment being one year later than those of the other three species.

The yield of rays increases moving offshore and in a southerly direction in the Irish Sea. Landings into Irish ports by Irish vessels have increased between 1903 and 1985 although, until recently, ray as a percentage of total demersal landings was declining, from the 1950s.

INTRODUCTION

The traditional inhibitors of research on rays and skates include their being difficult to age, a problem which has been overcome in recent years (Brander, 1977, Holden, 1977) and the fact that the commercial catch is composed of a number of species which are not distinguished in the landings statistics. Their low commercial value has not stimulated expenditure on the problem and most information currently available (see, for example, Ryland and Ajayi, 1984) has been derived from research surveys rather than from data obtained at the market place.

The Irish Sea is regarded as a more valuable ray fishery than the North Sea (Brander, 1977) but information on it is sporadic. The species composition of the landings is known to vary from one part of the area to another (Brander, 1977, Holden, 1977), although research data on this point appear to be more acceptable than information gleaned from the commercial catch. There is however general agreement that the fisheries are under considerable pressure: due to the direct relationship between numbers of recruits and stock size, the ability of these species to maintain their numbers has been impaired (Brander, 1977, Holden, 1977). The problem is brought into sharpest focus by the probable local extinction of the common skate *Raja batis* in the Irish Sea (Brander, 1981). There has been a slow, steady decline in ray catch since 1965 and these fish constitute the only major demersal resource which was yielding below a 52 year average in 1977 (Brander, 1977). A recent account of the population dynamics of the rays of Carmarthen Bay (Ryland and Ajayi, 1984) concluded that although growth was insufficient to sustain present levels of exploitation there was no immediate prospect of recruitment failure.

Unlike the accounts referred to above which are based on assessments carried out in Britain, this assessment presents information on fisheries closer to the Irish coastline, all of the data and materials coming from the commercial catch.

The Irish fisheries

Historical documentation on Irish ray catches is less comprehensive than on British ones. Collection of statistics of ray landings to Irish ports by Irish vessels commenced in 1903. The "East Coast", the area of interest here, was defined (in 1915) as extending from Torr Head in the north to Carnsore Point. The northern boundary was altered in 1926 to Omeath. From 1980 the ICES statistical divisions were observed in the

presentation of figures; viia which ranges from Omeath to Helvick Head is substantially similar to the earlier definition of East Coast. Unfortunately, in the period 1961–1979 inclusive, landings from this area were not separately identified and from 1983 the catch was put down to Irish vessels landing at home and abroad. What data there are for the period 1903–1985 inclusive have been marshalled in Fig.1, where the annual ray landings in metric tonnes and as a proportion of the total demersal catch from all areas and from viia are set out.

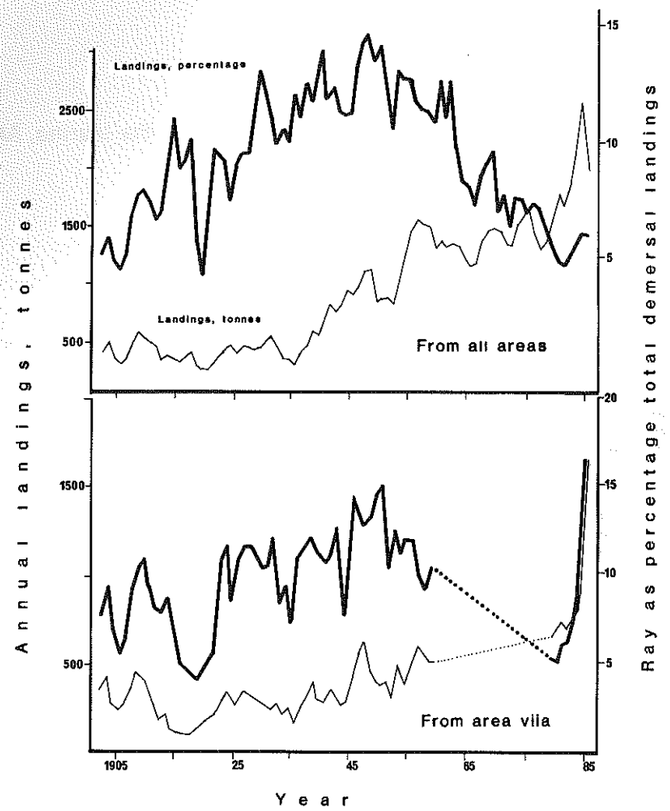

Figure 1 Ray landings by Irish vessels to Irish ports (above) from all ICES areas and (below) from viia (approximately), 1903–1985 inclusive, in tonnes and as a percentage of the total demersal catch.

Throughout the period commencing at the end of the first world war, there would appear to have been a steady increase in the tonnage of rays landed to Irish ports from viia. In some measure at least this is due to the increasing consumption of rays in Ireland. Anecdotal evidence suggests that up to 20 years ago the Irish market was sufficiently small to discourage landings, a fact which may have led to some rays being landed in Britain or even discarded.

Ray as a proportion of the total demersal landings may provide a better indication of what has been happening. The long term mean of 9.4% corresponds well with Brander's statement (1977) that about the time he wrote ray averaged approximately 10% of the total demersal catch in both viia and viif. Its decline from 1951 is also in agreement with Brander's reported reduction in catch per unit effort between 1954 and 1972.

Catch and effort

The commercial ray fishery was investigated at two centres: Howth, the largest fishing port on the Irish Sea, registering the third largest demersal catch in the Irish Republic (from data collected in 1984. Source, Department of the Marine), and Arklow, a much smaller port further south which, however, has a small fishery which could be said to be directed on rays for a part of the year.

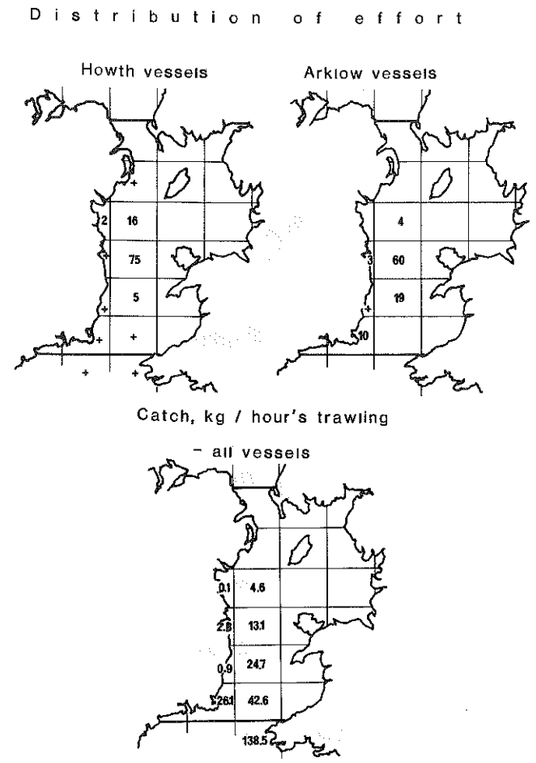

Figure 2 Catch per effort data from 12 vessels based at Howth and six at Arklow (above) percentage time distribution per statistical rectangle and (below) catch per one hour's trawling per statistical rectangle by all vessels. (+ signifies < 2 %).

Catch per effort data were obtained for the period 1 January 1985–30 June 1987, inclusive, from submissions to the European Communities' log-book proforma from all vessels based at the two ports. The log-book makes no provision for ray catches but a small number of vessels, twelve from Howth and six from Arklow, reported their capture on a regular basis. Among the vessels there was some variation in size but attempts to find a correlation between their horse power and yield were unsuccessful ($P > 0.05$). A total of 22,164 hours of fishing time by the Howth boats and 5,440 by the Arklow fleet were accounted for. The percentage distribution of their effort within viia is shown in Fig 2 which indicates a considerable overlap in their fishing grounds. Howth boats have a longer range while vessels from Arklow have a more southerly concentration; local intelligence identifies their ray fishing grounds as the chain of sand banks which run parallel to the Irish coastline (Fig 3). Pooling the catch per effort of all 18 vessels and expressing the outcome by statistical rectangle demonstrates that the yield per hour's trawling increases in a southerly and offshore direction. Variations in yield with place are considerable, an effect of this being to obscure the yield per size of vessel relationship.

Landings into both ports occur throughout the year but strong tides (Orford, 1987) restrict effort in the southern part of the area to the most clement weather conditions. Winter seas curtail it and keep the usually smaller vessels based at Arklow in port.

Biological investigations

Graded catches from each port were examined in a Dublin fish dealer's, whose own vessels supplied a large proportion of the materials, for twelve months, in the case of Howth, and seven, Arklow. Four species contributed to the landings: spotted ray, *R. montagui* Fowler, blonde ray *R. brachyura* Lafont, roker *R. clavata* L. and cuckoo ray *R. naevus* Muller and Henle. In the south west, painted ray *R. microocellata* Montagu is locally abundant but was rarely encountered in the course of these investigations.

Approximately 80 45kg boxes of rays were examined monthly. Total lengths and weights of approximately 100 individuals of each of the four principal species were recorded and vertebrae removed from them for ageing purposes.

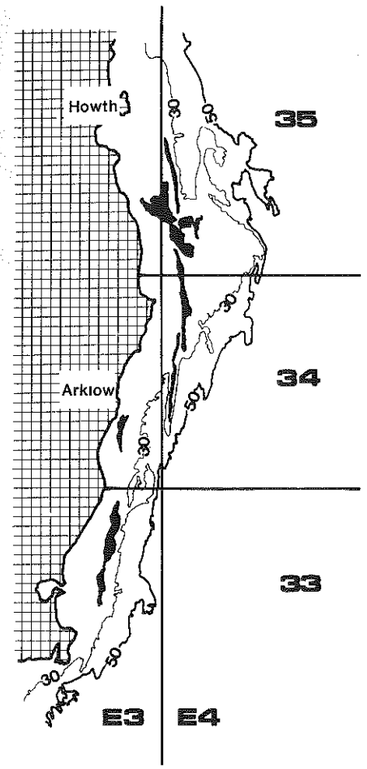

Figure 3 Inshore grounds of the ray fishery in western statistical area viia. Sandbanks are marked in black; depth contours in metres; statistical rectangles superimposed.

In the laboratory the sections of backbone were boiled, the flesh scraped off and the vertebrae separated. After being dried in a warm atmosphere they were read under magnification. A monthly length at age key was compiled for each species from this material and measured-only fish were attributed ages according to this. By integrating these observations with the graded composition of the landings, the species and age structures of the ray populations were reconstructed.

Use of the commercial grading system

A commodity which is classified in standard units has a commercial advantage over one which is not. In Ireland the grading of rays is widespread and more or less successful depending on the quantities landed by a fishing vessel; small catches providing diminished opportunity to grade.

The most prevalent criterion by which catches are sorted is size but it is not the only one. Secondary considerations include the appearance of the fish: there is a tendency to group *R.brachyura* and *R. montagui* of approximately the same size, for instance, and these will generally obtain a slightly higher price than *R. clavata* which is more difficult to handle. *R. naevus* of similar size may be separated from other species where quantities permit and any species or combination of species might be further segregated by sex, the large claspers (which reach up to 30% of the total length) and generally narrower appearance of the males making them conspicuously different from the wider and more full bodied females.

In general, the characteristic most widely used in grading is size, the aspect of size being total length. Four grades, three of them common, were recognized in the Dublin fish market:

Large rays exceeded 70 cm.

A *medium* grade contained rays of 60–70 cm.

Fish of less than 60 cm constituted the *small* grade.

The occasionally encountered *very small* grade embraced rays of less than 50 cm; they were however so infrequent in the course of this work that they are amalgamated with the small grade for practical purposes.

The grading of rays in the Dublin fish market is a casual rather than a strict exercise and the grade of a particular sample was recognized when the majority of fish fell within the limits of one of the defined categories. The medium grade could alternatively be described as containing rays of mixed lengths, more or less evenly distributed around a 60–70 cm mean.

Of the four species listed two, *brachyura* and *clavata*, can be described as large-growing and the others, *montagui* and *naevus*, as small, exceeding 70 cm in only rare instances. Small growers are infrequent in the large grade (Fig 4).

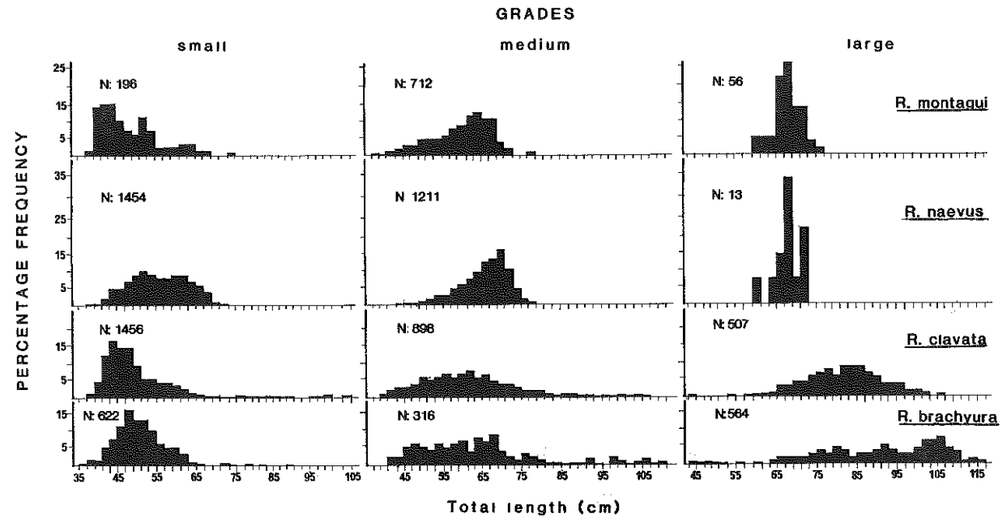

Figure 4 Length frequency histograms of four ray species in three commercial grades.

Relating samples to landings

The percentage distribution of species within grades was counted and converted to weights using the figures in Table 1.

Although rays are sorted by hand and eye and the process is a very rapid one, it appears to operate effectively. *R. naevus*, a narrow winged species, in the small grade, tends to be of greater total length than any of the other three species (Fig 4) and those *naevus* which are placed in the smallest categories tend to be substantially heavier than any of the others (Table 1). The explanation for this is in Table 2 where the wing weights of three species at four total lengths are compared, *naevus* yielding the smallest quantity of meat. To compensate, fishermen and fish auctioneers distribute *naevus* which are larger than the other species among the smallest grades.

The catch is disposed of at auction or by direct sale, the price obtained per 45 kg box being indicated on the docket recording the transaction. The grade of each box may be noted and the price per box, which is readily associated with a specific grade, is always recorded. Analysis of 4,230 transactions from the Arklow fishery and 1,452 from Howth for the period from January 1985 to March 1988 inclusive (Fig 5) suggest distinctive patterns in the frequency distribution of grades.

Growth

The length at age of rays is very variable (Table 3). Monthly mean lengths at age for a selection of age groups of the four ray species are shown in Fig 6, a selection because the variation among the oldest age groups for which least material was gathered would wholly confuse the presentation. These are omitted. Growth lines are fitted by eye. They permit certain generalisations.

The prevailing growth pattern suggests an extension in length in the summer months, growth slowing down in the autumn. The apparent de-growth during the winter is interpreted as annulus formation. While the usual convention is to regard 1 January as the birth date of all fish, this can lead to difficulties (see Brander and Palmer, 1985 on Ryland and Ajayi, 1984), so the convention was not strictly adhered to in this case, annuli being observed rather than anticipated.

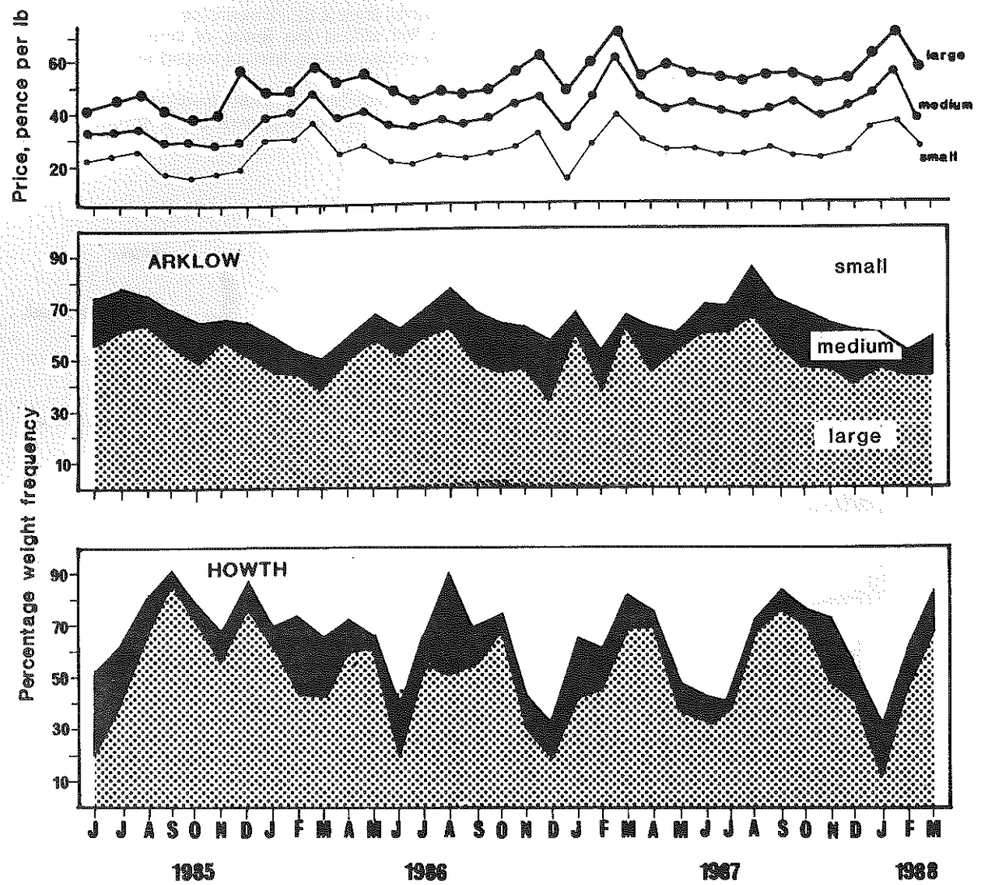

Figure 5 **Frequency distribution of three commercial grades in the landings to Howth and Arklow during a three year period and (above) the average monthly price per lb (1 lb = 454 g).**

The youngest age groups of each species were captured in too small numbers or too selectively retained to provide a coherent account of their growth. Some monthly average lengths are provided for these but growth curves are not. Only the largest of the older, pre-full recruitment age groups were retained, providing flatter curves for the youngest fish. As recruitment nears completion the curves become steeper but older fish, approaching the asymptote, grow less dramatically.

Age composition of the catches

The age composition of the four species is set out in Fig 7. In general terms there is a clear pattern for three of the species, although it is not so obvious for *R. montagui*. As the summer progresses the youngest age groups enter the catches and displace the older ones, percentage-wise.

Combining the reported landings, their percentage graded composition, and the species/age breakdown per grade, and totalling the age groups produces catch curves (Fig 8) whose characteristics are summarised in Table 4. The percentage 0–2 group age composition of the catches is shown in Table 5.

Monthly contributions to the landings by the four ray species at Howth are set out in Fig 9, expressed by numbers and weights.

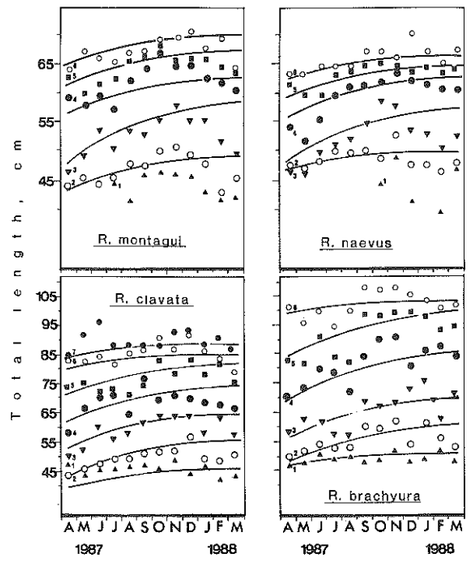

Figure 6 **Monthly mean lengths at age of selected age groups of four ray species. Age group number is associated with the first of a series of symbols in each diagram.**

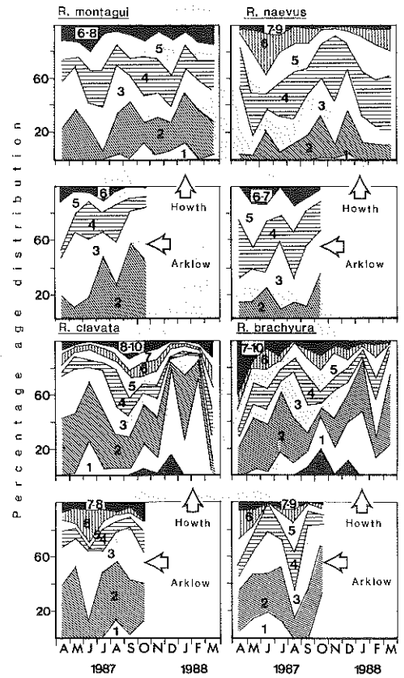

Figure 7 **Percentage age composition of four ray species in the commercial catches at Howth and Arklow.**

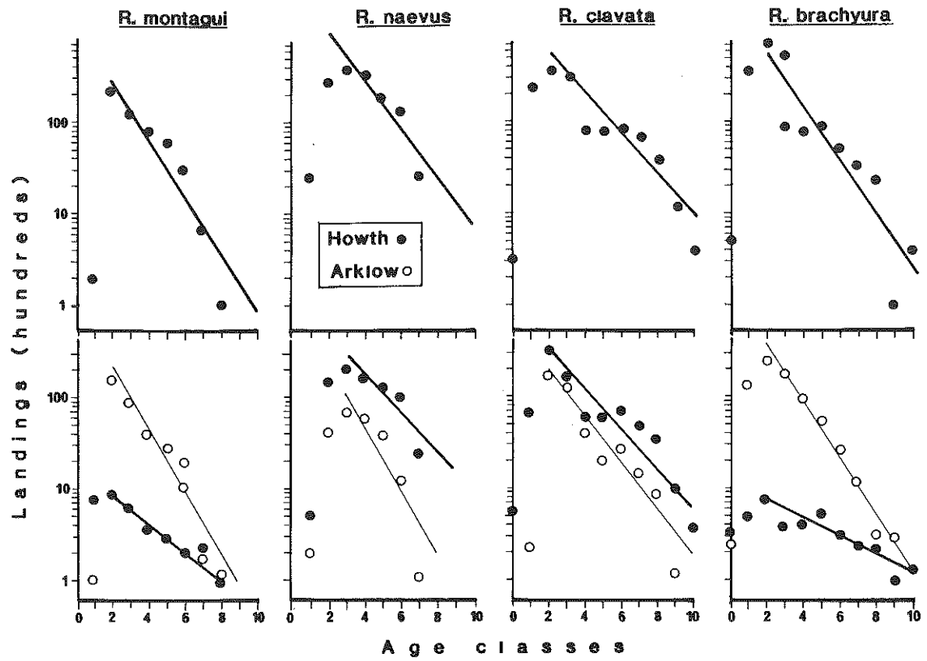

Figure 8 Catch curves for four ray species in a full year's samples (above) and part-year (below), in the landings to Howth and Arklow. Regression lines fitted by least squares.

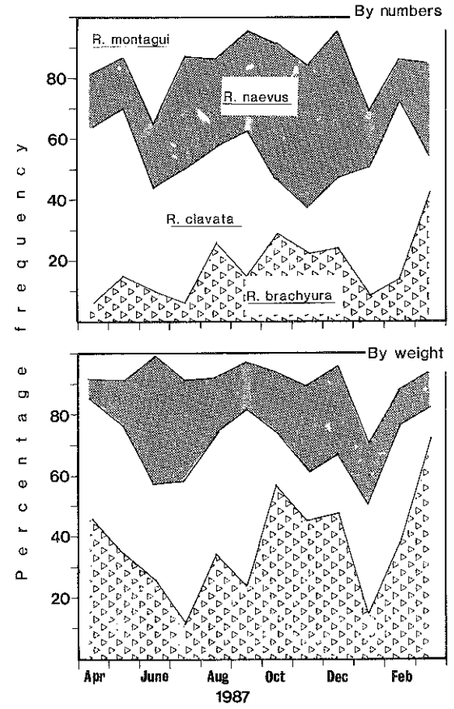

Figure 9 Monthly percentage frequency of four ray species, by numbers and by weight, in the Howth landings.

DISCUSSION

The most obvious influence on the gradings of rays from the western Irish Sea, most clearly exemplified by the Arklow catches, is the annual growth cycle of the fish (Fig. 6), the large grade making up the largest proportion of the total in the late summer and autumn. In the case of Arklow, whose vessels have a short range and are confined to local grounds, the gradings would appear to reflect the annual cycle which is similar in the three years examined (Fig. 4). The annual growth cycle also clearly influences the age composition of the catch as the year progresses (Fig. 7).

In the Howth landings the position is not so straightforward and interpretation is complicated by the fact that the vessels are capable of moving grounds. Rays are known to make migrations and to form shoals of fairly uniform size (Steven, 1932, 1936) and this is likely to exercise an influence on the frequency distribution of grades in the Howth fishery, suggesting those vessels exploit different sectors of the populations throughout the year (Fig. 4). Expressing the Howth data as the numbers of each species and their weight per month (Fig 9) indicates that the most valuable species is *R. brachyura* which is more heavily concentrated at the southern end of the Irish Sea; it becomes more abundant in the catches during the winter months.

The other recent assessment of the population dynamics of ray, in Carmarthen Bay (Ryland and Ajayi, 1984), was based on research catches. Because it attempted an appraisal of the full populations the present work is not strictly comparable with it. Of the three commercial species examined, for example, age groups 0–2 inclusive, comprised between 71 and 92 % of the samples. In the present case the percentages were much lower (Table 5), higher in the large growing species. Coefficients of total mortality (Z) vary in this work (Table 4), depending on the landings from which they are estimated. They are however within a range and slightly higher than those calculated by Ryland and Ajayi (1984) who reported values of Z of 0.45 for *R. clavata*, 0.54 for *R. microocellata* and 0.46 for *R. montagui*. That the ray fisheries in the Irish Sea are under considerable pressure there can be little doubt; some, at one time productive, ray grounds to the north of the area currently yield little (Fig. 2). That some recruitment failure has already occurred is a possibility that cannot be discounted.

One of the few comments on the commercial ray catches of the Irish Sea was made by Holden who remarked (1977) that their composition at Milford appeared to have altered, all species (the four important ones being those considered here) but *R. naevus* having declined over a ten year period between 19 and 39%; *R. naevus* increased by 6%. Because of its small size *R. naevus* has the advantage of being recruited at a later age than the other species and may for that reason have a competitive advantage (Table 4).

The use of commercial catches to ascertain the population dynamics of rays requires information from a number of sources. It is facilitated by the grading of rays being a straightforward process, as is the case in the Howth and Arklow fisheries, being based on a system of three grades identified by the size of fish. This is not however the only system in operation. Further sub-divisions on size are known and the grades may additionally be distinguished by the species they contain. In this case the occurrence of the main species ("roker" and "blonde") was established on the frequency with which they were encountered. A general observation would be that the more elaborate methods of grading are not strictly observed anyway (Anon, 1984) because they are imperfectly understood by fishermen and, very likely, the quantities of fish coming from a single vessel are insufficiently large to allow sub-division of the catch.

ACKNOWLEDGEMENTS

The biological material on which this appraisal was prepared was collected mainly on the premises of Lett-Doran and Co. Ltd., Dublin, and prepared for interpretation by our technician Paddy Mulligan. Computer software for the analysis of the population data was devised by Dr Richard Grainger, of the Fisheries Research Centre. Details of the commercial transactions on which the populations are reconstructed, came from East Coast Inshore Fishing Company Ltd., their extraction carried out by Angela Lavin of the Regional Technical College, Sligo, who held a summar bursary at the Fisheries Research Centre. Peter Snow, also a student bursar, extracted and computerised the Irish landings statistics.

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Table 1. Average weights (g) of four ray species in four grades (Numbers are those in Fig. 1)

Species	Grades			
	Very small	Small	Medium	Large
clavata	679	786	1 765	3 755
brachyura	690	938	2 265	6 349
naevus	986	1 040	1 394	1 525
montagui	866	770	1 538	2 002

Table 2. The wing weight of three ray species at four total lengths

Species	Total length (cm)			
	40	50	60	70
clavata	314	474	813	1 283
montagui	237	479	857	1 403
naevus	189	362	616	967

Table 3. Characteristics of four ray species from the commercial catches of western statistical area viia

	Age	Nos. examined	Range in length (cm)	Mean length	Mean weight (g)
R. montagui					
	1+	4	42.1–45.9	44.5	515
	2+	59	36.0–54.2	45.1	555
	3+	99	40.6–64.3	50.5	830
	4+	135	43.9–69.9	61.2	1561
	5+	116	48.2–72.0	64.0	1759
	6+	73	55.1–71.9	66.4	1967
	7+	13	60.2–72.0	67.3	2056
	8+	2	62.1–70.0	67.9	2138
	9+	1	—	75.3	2951
R. naevus					
	1+	8	37.1–51.0	44.0	488
	2+	112	37.2–58.9	48.8	669
	3+	211	41.0–64.8	53.9	925
	4+	214	43.1–70.8	60.5	1305
	5+	159	50.7–73.0	63.9	1533
	6+	85	57.0–71.0	65.4	1645
	7+	26	58.9–70.9	65.4	1635
	8+	1	—	66.0	1677
	9+	2	63.0–67.0	65.0	1687
R. clavata					
	0+	5	35.1–42.9	42.1	459
	1+	69	37.0–58.7	45.5	593
	2+	265	35.1–61.0	47.9	705
	3+	257	38.8–77.0	55.8	1161
	4+	144	46.9–88.8	66.1	1953
	5+	111	55.2–94.9	76.0	2930
	6+	110	65.3–101.0	84.6	4026
	7+	74	74.0–101.4	88.4	4608
	8+	46	77.1–102.9	91.8	5163
	9+	12	84.9–103.0	96.2	5921
	10+	4	90.9–101.0	98.6	6415
R. brachyura					
	0+	25	33.1–49.1	43.9	557
	1+	94	37.3–58.9	48.7	787
	2+	147	41.1–74.8	55.1	1201
	3+	91	49.0–89.1	63.1	1946
	4+	79	62.9–103.0	81.4	4310
	5+	94	67.0–113.0	92.8	6464
	6+	60	74.9–116.7	101.9	8474
	7+	40	97.0–117.0	103.7	9018
	8+	22	97.0–115.0	106.5	9626
	9+	3	95.0–109.1	105.1	9231
	10+	1	—	114.0	11898

Table 4. Summary of the characteristics of four exploited ray species in statistical area viia

	R. clavata	*R. brachyura*	*R. naevus*	*R. montagui*
Age range in catch	0–10	0–10	1–9	1–8
Age at full recruitment	2	2	3	2
Z:				
Howth — full year	0.48	0.58	0.65	0.74
Howth, Apr–Oct	0.46	0.42	0.47	0.38
Arklow, Apr–Oct	0.62	0.70	1.00	0.87
Averages of Apr–Oct data, Howth & Arklow	0.54	0.56	0.74	0.63

Table 5. The presence in the commercial catches of rays aged 0–2 years, expressed as a percentage.

Assessment	*R. clavata*	*R. brachyura*	*R. naevus*	*R. montagui*
Howth full-year	54.4	49.0	22.4	33.6
Howth, Apr–Oct	45.8	41.5	20.5	30.4
Arklow, Apr–Oct	45.2	50.2	19.8	38.2

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