1. Introduction

A pot fishery targeting spider crab (*Maja squinado*) has been in operation in Tralee and Brandon Bays (the Magharees area of Co Kerry) since the early 1980s. Fishing effort has risen over the past 15 years and landings have increased. There are currently estimated to be 10,000 pots fished in these bays for spider crabs during the summer months and there is concern for the quality of the catch and for the ability of the stocks to survive current and any additional increase in fishing effort. The purpose of this investigation is to assess the fishery and to make recommendations for its optimal management into the future.

1.1 Background

The decline of stocks of lobster (*Homarus gammarus*) in the 1960s directed the attention of fishermen towards alternative species. Effort was diverted onto brown crab (*Cancer pagurus*) and spider crab (*Maja squinado*), often in mixed fisheries for the three species. In the eastern Atlantic interest in spider crab was first expressed in France. Kergariou (1984) described the Normandy/Brittany fishery where spider crabs were harvested using tangle nets and pots. The range of the species as described by Kergariou (Fig 1) had a pronounced southern tendency. His map shows the distribution of commercial spider crab fisheries at the time it was published but that of Pawson (1995)[1] is a more accurate account of the distribution of the species in the vicinity of Ireland and Great Britain (Fig 2).

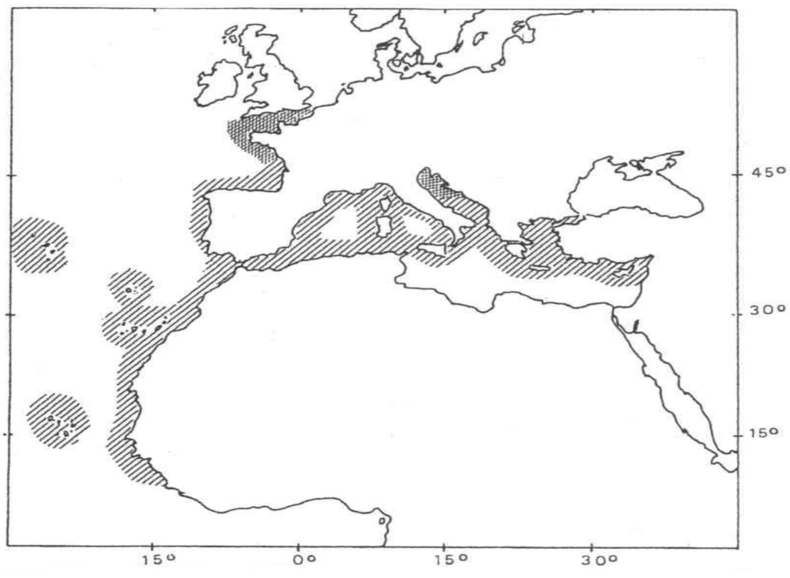


Fig. 1 The distribution (hatched) of the spider crab *Maja squinado* as described by Kergariou (1984), and the location of commercial fisheries (cross hatched).

[1] Based on data collected by David Bennett (MAFF) and Daniel Latrouite (IFREMER) in the course of an EC sponsored study of English Channel fish and shellfish stocks.

Edwards (1979a) documented the beginning of the spider crab fishery in Britain in the mid-1970s. Landings were exported live to France and Spain and by 1978 they had risen to 900 t, still a small fishery when compared with that for lobster and brown crab. Edwards considered spider crab to be a warm water species: "In our waters it is at the northernmost limit of its range although it is caught off south west Wales"

By the early 1990s it was clear that spider crab in France were in decline (Latrouite, 1992), as indicated by a reduced cpue (catch per unit effort, expressed as length of net or number of pots). Latrouite described the development of the fishery from a time when spider crab were regarded as a nuisance through its early stages of a spring fishery pursued by small vessels within 5 nautical miles of the coast; gradually involving larger boats until, after 1983, the season had extended to the entire year and virtually all vessels engaged in potting for crustaceans were harvesting spider crab.

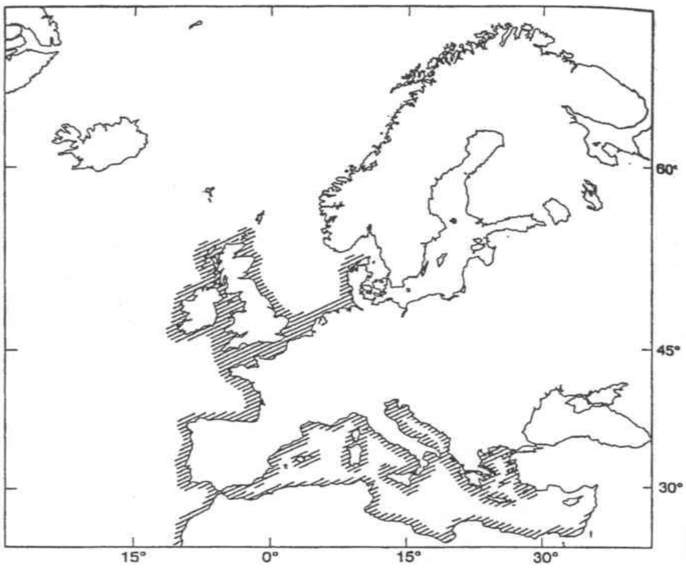


Fig. 2 The distribution of spider crab from Pawson (1995).

The first commercial evaluation of spider crab in Ireland did not take place until 1985 but Rodhouse (1984) examined the biology of the species in Kilkieran Bay, Connemara, Co Galway between November 1978 and July 1980.

In Ireland also spider crabs had been regarded as a nuisance; until the early 1980s there was no attempt to develop a fishery for them but they were frequently entangled in large numbers in nets set for crawfish (*Palinurus elephas*). The consequences of these mortalities, if any, for the stocks are not known. A preliminary survey with a view to organising a fishery for spider crab in the vicinity of Magharees took place in 1981. A memorandum from Bord Iasacaigh

Mhara announced the advent of a new fishery for spider crab in Tralee and Brandon Bays (Bates, 1981). At first, the size of landings was in excess of 700 g. By 1985 however the acceptable size was reduced to 600g. A small consignment of 3 tonnes was sent to market in 1981 and by 1984 exports had risen to 30 tonnes. Fishing effort substantially increased in 1985 when an assessment of the fishery was carried out (Fox, 1985). The fishery was conducted using pots inshore and, further offshore, tangle nets.

Fox's work (1985) is a valuable account of the fishery providing baseline data with which comparison is possible, thus identifying changes that may have taken place in the meantime.

1.2. Progress of the Magharees fishery

The principal landing place for spider crabs in the Magharees fishery is Rough Point, at the end of the central peninsula dividing Tralee and Brandon Bays (Fig 3). Some 15 half-decker boats of approximately 10 m in length are berthed there. A further five are based at Fenit (Tralee Bay) and one in Ballyheigh, north of Fenit. According to local sources, the number of vessels has not changed throughout the history of the fishery. Spider crabs occur in both Brandon and Tralee Bays, where fishing is frequently interrupted by northerly/northwesterly winds, Brandon being the more turbulent.

Local sources maintain that both bays have large concentrations of juvenile spider crabs and that the largest females are taken in deeper water where they have been harvested using tangle nets rather than pots.

The principal buyer, Brandon Bay Seafoods, provided details of landings purchased throughout the history of the fishery, details of additional landings to Fenit being supplied by the Department of the Marine and Natural Resources. Crohan O'Grady supplied estimates of the quantity of gear used per boat (Appendix 1).

Landings of spider crab increased until 1987 (Fig 4) after which they declined, stabilised until 1995 and began to rise again. Landings in 1999 were the largest to date. Effort has continued to increase steadily throughout the history of the fishery.

Cpue is expressed as three indices, all of them based on transformations of the monthly landings to Rough Point data in Appendix 1:

1 annual landings [kg/effort index (number of pots)].
2 annual landings [kg/effort index (number of pots*number of months fished)]
3 landings for the period April-July inclusive [kg/effort index]

All display similar trends. Following a slow beginning, cpue increased in 1985 and remained relatively high for three years. It then declined to 1990 and stabilized, increasing slowly again from 1995 (Fig 5). Landings in the period April-July appear to increase throughout the history of the fishery but the trend is not significant (r^2=0.2193; degs of freedom = 17; P>0.05).

Investigations of the spider crabs were undertaken in 2000 to ascertain any changes in the population and biology of the species. Before going into this, it is appropriate to provide a brief account of the life cycle of *Maja squinado*.

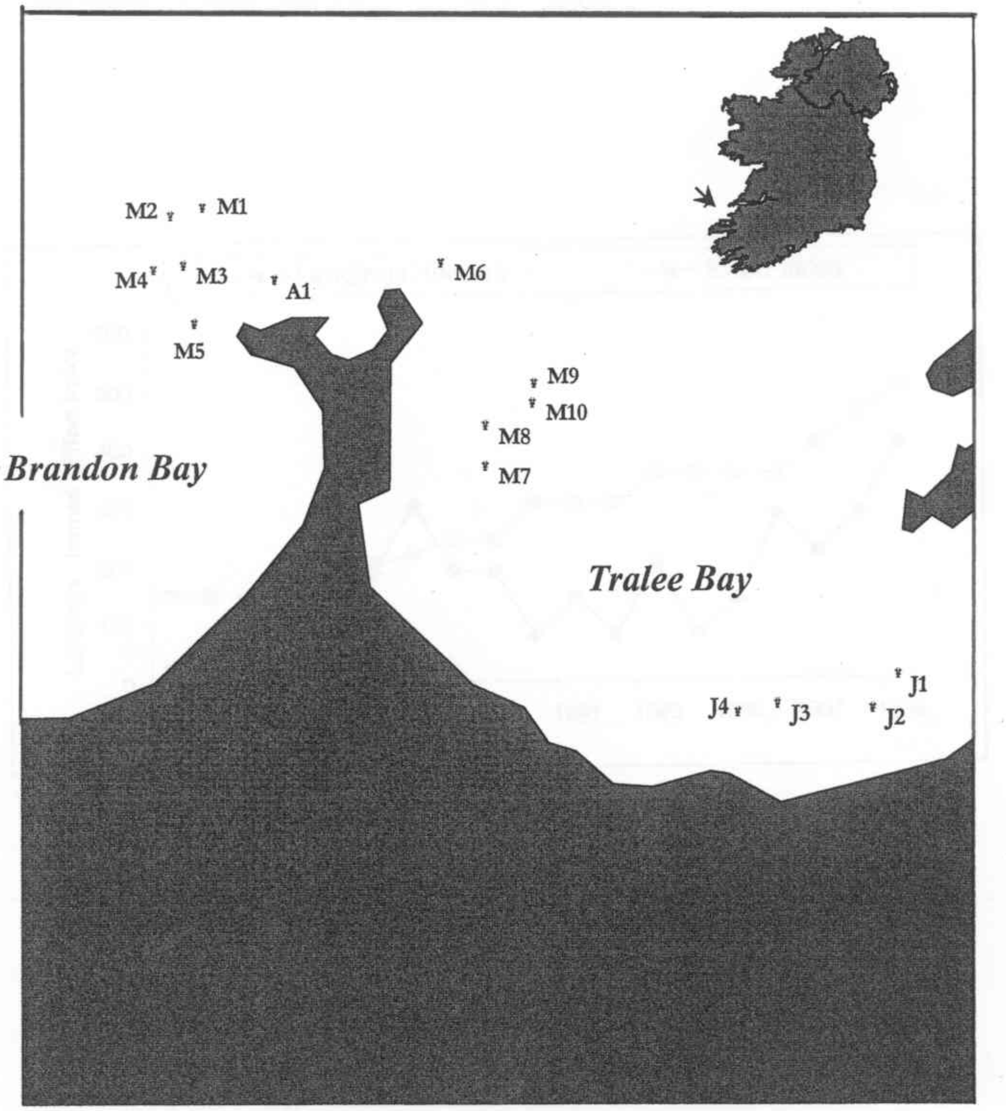


Fig. 3. The Magharees fishery: showing the locations at which pot samples were collected in 2000. M=May, J=June, A=August.

1.3. Ageing spider crab

Growth and development in spider crab are relatively fast but the animal can live for a numher of years as an adult. As described by Kergariou (1984), in France, egg development takes from 60 - 75 days and larval life three weeks; the animal grows to 70 mm CL in its first year, in the second it reaches 115 mm. It matures in the autumn of its second year.

Crustaceans grow by a series of moults, the old exoskeleton being shed at intervals to be replaced by a larger shell, initially soft, which hardens in time. Spider crabs have a terminal moult in the course of which they acquire secondary sexual characteristics and after which they do not moult again. Stadia of female *Maja squinado* have a similar morphometry until the terminal moult when the abdomen becomes domed to serve as an egg brood pouch (Fig 6).

The sequence of development in the male is slightly different. The moult which precedes the terminal one, the prepubertal moult, introduces the adolescent phase of the animal which is characterised by the presence of sperm, absent from the immature, and by a slight increase in allometry. Allometry of the chelipeds of the male greatly increases in the terminal moult and is a reliable way of distinguishing adult and immature males. The development of the cheliped is associated with sexual maturity, the male chelipeds being used to manipulate the female (Sampedro *et al*, 1999).

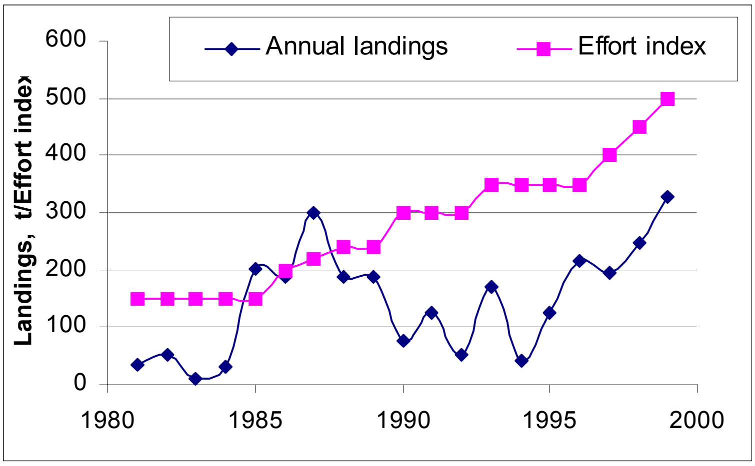


Fig. 4. An effort index (based on numbers of pots in use) and total recorded tonnes of spider crab landings from the Magharees fishery, 1980 to 1999.

There are two moult periods in the second year of the life cycle: in Spain the prepubertal moult takes place in spring (the end of March or April) and the terminal or pubertal moult takes place in autumn (July or August) (González-Gurriarán *et al*, 1995). In France they are later (Latrouite, pers *comm*) and that is more likely to be the situation in Ireland.

A protocol for recognizing the age of adults was developed by Le Foll (1993) who identified them from the following criteria:

C1: These are animals in the autumn of their second year of life which have recently moulted. They have acquired the adult characteristics described above but the shells are soft at the beginning of this stage which may last for days or weeks after which they have a recently moulted appearance and the spines at the end of the legs are sharp.

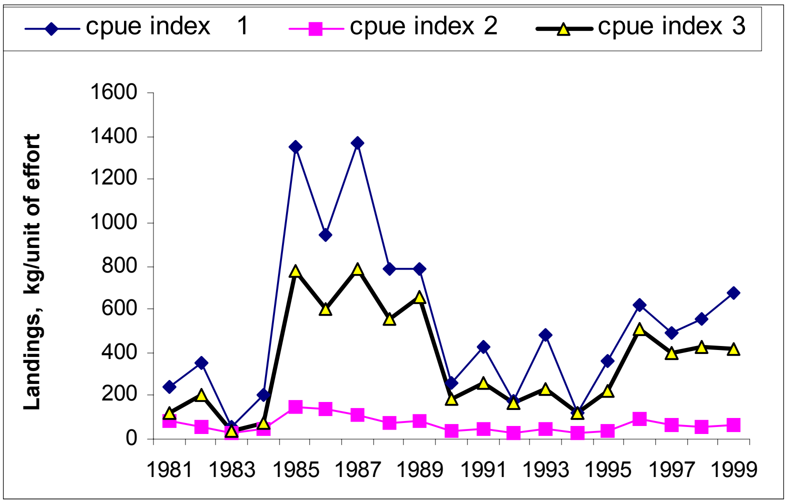


Fig. 5. Three indices of cpue in the Magharees spider crab fishery.

C2: Crabs of one winter older. These are identified by the absence of characteristics associated with the next year group. Between January and July C1 and C2 groups cannot easily be distinguished.

C3+: Are crabs, which have adopted migratory habits in the course of which they lose epifauna and flora, associated with shallow water. Fernández *et al* (1998) described the epifauna and flora of *Maja squinado* in some detail. The black spines at the end of the legs become abraded and worn.

It is feasible to break the C3+ group further into a number of year classes using radioisotopes. As the exoskeleton of the adult hardens, calcium is taken into the shell from the sea. So is radium which has a similar chemical behaviour. In time the 228 isotope of radium decays to be replaced by 228 thorium, the relative incidence of the two being used to measure the passage of time. Le Foll *et al* (1987) estimated the age of one individual (C3+, i.e., in addition to its immature stages of two years) at 9.5 +/- 3.5 years.

Some phases of the spider crab life cycle can be recognised more easily than in other crustaceans but there is considerable range in the dimensions of any one of these. In Brittany adult females range from 80-165mm in length while males range between 80 and 200 mm (Latrouite, *pers comm*).

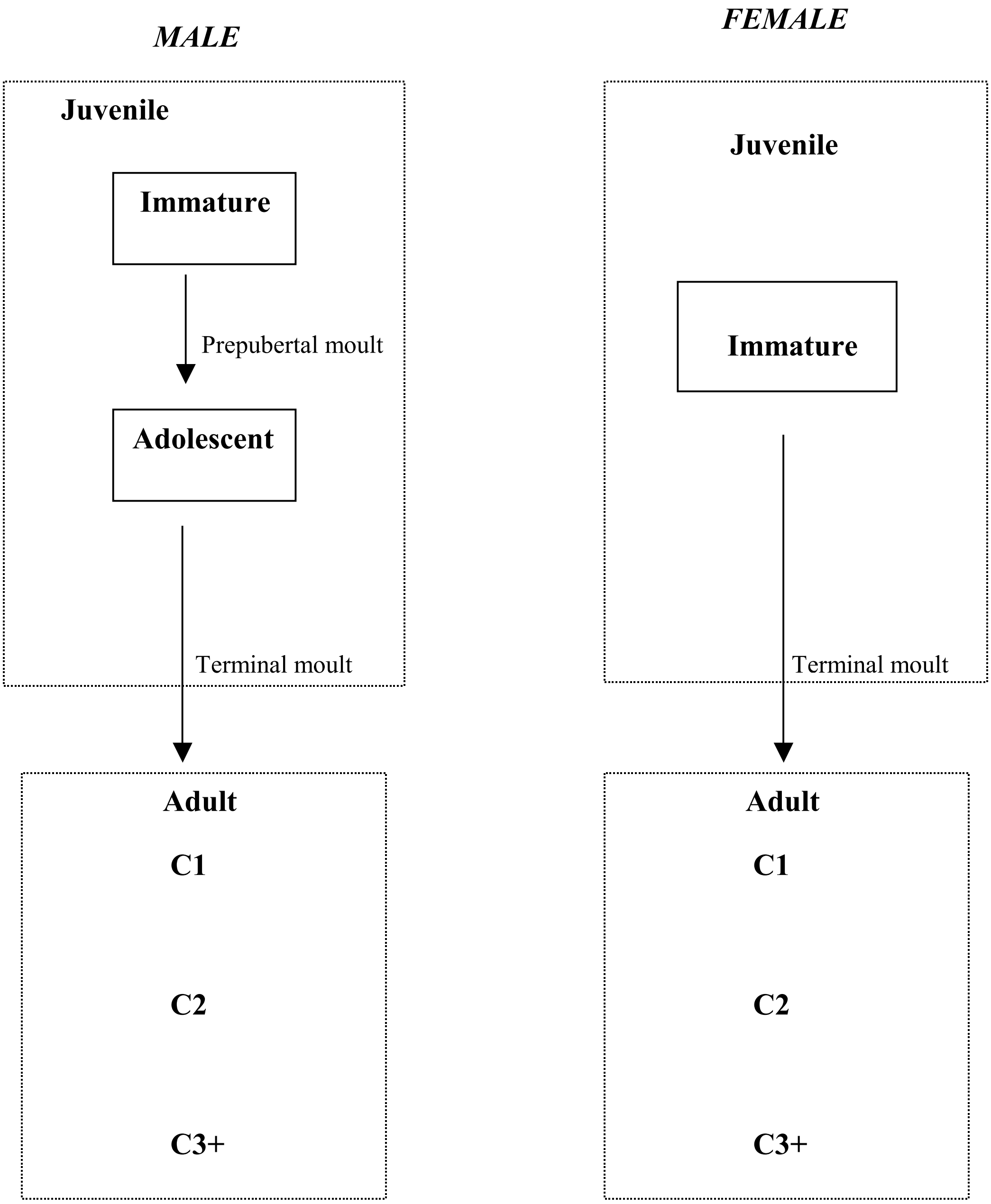


Figure 6. Schematic account of the life cycle of *Maja squinado*: the terminology is from Sampedro *et al* (1999) and the adult stages (C1 – C3+) are as described by Le Foll (1993).

2. Materials and methods

The Magharees fishery was visited on four occasions during 2000 when biological samples were examined on an opportunistic basis, as much data being collected as the circumstances permitted. The pots which yielded these samples were hauled within 1 nautical mile of shore (Fig 3).

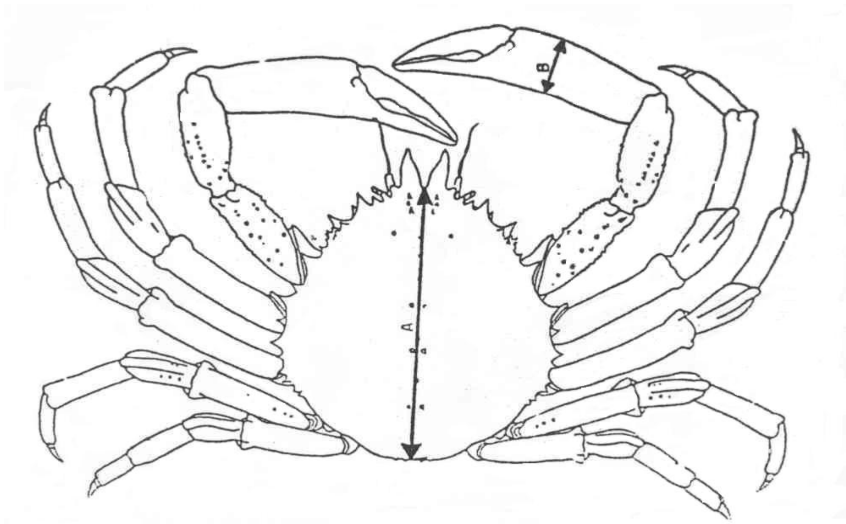


Fig. 7 Male spider crab showing how the carapace length (CL) was measured. The critical measurement of the cheliped, used to separate the adult and adolescent (B) is also shown. (Figure adapted from Meyer. 1992).

Whenever possible, animals were examined in the course of commercial operations. Carapace length (CL) of each spider crab was measured from between the two rostral points at the anterior end of the cephalothorax, to the centre of its posterior border (Fig 7), a measurement defined by EEC regulation No 3094/96. Lengths were measured using callipers and recorded to the nearest 1 mm. Sex was noted as was whether a female was mature and the condition of the eggs (orange in colour, indicating freshly laid or brown in colour, eyed) under the abdominal flap. The percentage of adult males was estimated. Sub-samples were weighed on three occasions. In April inclement weather prevented fishing and recently captured individuals held in keep boxes were examined instead. Observations on these samples were confined to weight, length and reproductive condition of the females, as described. Characteristics of samples examined on the four occasions are summarised below:

Date	Numbers examined	Source	Details	Weight data collected?
14-Apr-00	116	Holding boxes		yes
16-May-00	1,310	10 trains pots	Bandon/Tralee Bays	no
29-Jun-00	581	4 trains pots	Tralee Bay	yes
16-Aug-00	71	1 train pots	Brandon Bay	yes

3. Results

Whenever fisheries for this species have been investigated there has been seen to apply a seasonal cycle of cpue which rises to a peak in the summer; it can be explained by the inshore migration of crab which has reached a maximum, stimulated by higher sea temperatures (see discussion in Meyer, 1992). The annual migration has consequences for every aspect of sampling.

Sex ratio (males/females) was recorded on each sampling date (May, June and August) and the results are set out in Table 1. They ranged from 0.77 in June to 3.09 in May, an intermediate value of 1.84 being recorded in August.

Month	Number of males	Number of females	Ratio M/F
May	651	211	3.09
June	252	329	0.77
August	46	25	1.84

Table 1. Sex ratios of spider crabs sampled in the Magharees fishery

The length frequencies of each sex were recorded on three occasions (Fig 8). The largest individuals were male and adult males were estimated at 2.5% of the sampled males in May, and 1% in June and August. On average, females tended to be slightly larger than males, a difference which became accentuated as the year progressed. A contributory reason for this may be the fact that females moult before males (Latrouite, *pers comm*).

The developmental status of female spider crab is set out in Fig 9. In April fewer than 40% were berried and of these only one individual carried eggs which had developed eye spots. In May almost all adult females were berried and the larger sample collected in June enables the size at maturation to be discerned. All mature females in August were again unberried or bore only small numbers of eyed ova, eclosion having taken place at that time. Thus, the evidence supports the existence of a single egg brood per annum, as reported by Rodhouse (1984):Rodhouse reported berried females occurring from March to September and there was one brood annually. Berried females peaked in May/June. Males were ripe throughout the year. Berried females enter traps, unlike *Cancer pagurus*.

González-Gurriarán *et al* (1998), working on the species in the Ría de Arousa, Galicia, described first maturation as beginning in the female 1 or 2 months after the pubertal moult (that is, in primiparous females). As incubation progressed, ovaries matured again for the next spawning. Under experimental conditions, the breeding cycle began earlier in multiparous females than in first spawners. The female can store sperm to fertilize successive broods without mating again and, unlike *Cancer pagurus*, hard shelled adult females are able to mate. In Galicia, a mature female was reckoned to produce three broods annually. In France the norm was reported to be two broods per year (Kergariou, 1984). Pawson (1995) reported 1 – 2 broods annually in the English Channel.

Pooling all maturation at length data (Fig 10), the length at which females undertake the terminal moult ranges from 95 to 125 mm with a 50% value of approximately 110 mm.

Weight at length relationships of males and females are set out in Fig 11, the basis of the regressions being presented in Table 2. Of the three months for which data are available, males were in their best condition in April[2]; females were best in June, when all mature individuals were berried.

Month	Males				Females			
	No of observations	R2	Intercept	X-var.	No of observations	R2	Intercept	X-var.
April	84	0.9765	-9.4224	3.2806	32	0.7842	-8.2791	3.0285
June	59	0.9721	-8.5373	3.0871	40	0.9675	-8.6575	3.1227
August	46	0.9757	-8.1158	3.0033	24	0.9269	-5.5581	2.4594

Table 2. Details of regressions of LNweight on LNlength in male and female spider crabs at Magharees.

4. Discussion

Detailed investigations of spider crab fisheries reveal considerable local variations in age, size and representation of the sexes in the population (le Foll, 1993). Explanations for many of these have been provided by research on the biology of the species.

González-Gurriarán *et al* (1994) made observations on the movements of spider crab using telemetry in the Ría de Arousa in Galicia, which do much to explain the variation in catch rates for the different age/size groups. Juveniles make slow, non-directional movements in the kelp forests of as little as 4.5 m per day in summer. The depths at which juveniles occur vary little but they are shallow, 4.1 - 4.8 m. Adults move at higher speeds of up to 22.1 m per day at greater depths. In autumn, possibly triggered by meteorological conditions, the movements of adults

[2] These findings differ from observations recorded by the local co-operative (O'Grady*, pers comm*) where males in April had achieved 70% of their maximum weight, 80% in May, 90% one month later and peak condition in July-August. However, these weights are likely to refer to adult males only of which few were included in measurements made in 2000.

become directed towards greater depths (40 m) and at much greater speed (76 m / day). Deeper waters are believed to provide a more stable environment for the development of reproductive processes. Kergariou (1984) reported the species lived at depths of 90m and was occasionally reported at 120 m.

Hines *et al* (1995) explained the changes in movement and habitat selection which accompanied ontogeny as adaptation to predation pressure and growth optimisation while adult behaviour and migration optimise energy needs and site of larval release.

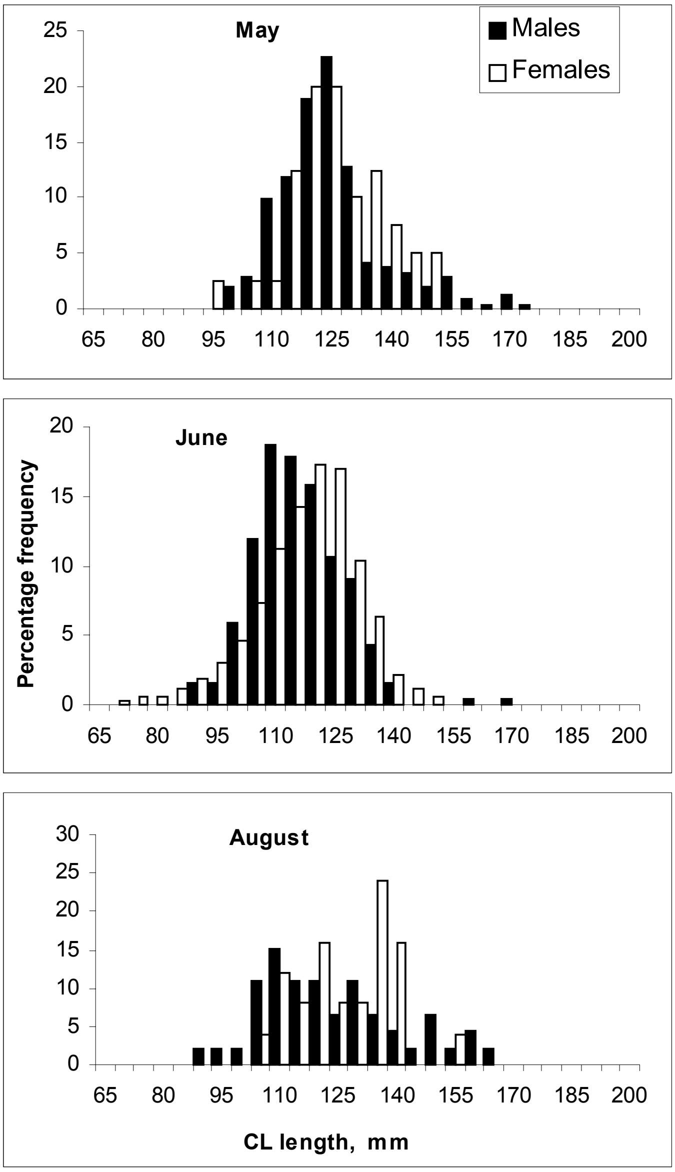


Fig. 8 Length frequencies of male and female spider crab from Magharees, grouped in 5 mm intervals

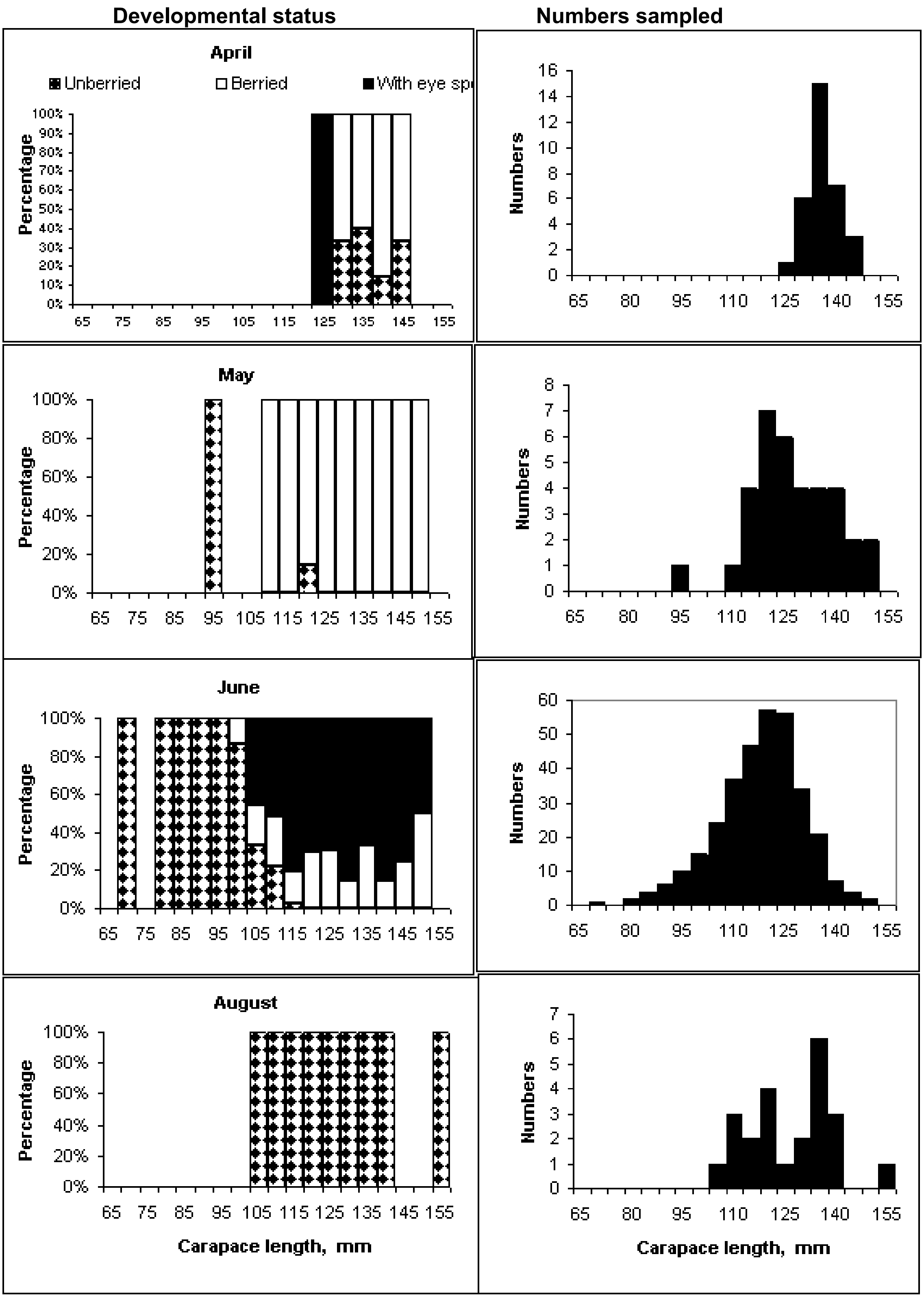


Fig 9. Developmental status of female spider crab examined on four occasions in the Magharees fishery in 2000.

Rodhouse (1984) reported the largest numbers of mature males and the highest M/F ratio in summer in Kilkieran Bay, the males occurring at a greater depth (10 m) than females (5m). The sex ratio was lowest during on and off-shore migrations. Both genders were captured in nets and pots but a lower proportion of males might be taken in pots because they display agonistic (aggressive) behaviour and become territorial, driving smaller males away. The overall sex ratio she described was 3.4 although in winter months females outnumbered males. In August 1979 the ratio was 21 and in June 1980 it stood at 82. Kergariou (1984) reported the sex ratio to be higher from tangle nets although Le Foll (1993) noted that the ratio (expressed as M/M+F) ranged from 40-85% in nets and 7-95% in pots.

Fox (1985) recorded the majority of females ranging from 120 – 130 mm, males between 130 – 140 mm in Magharees. The smallest berried female was 95 mm, a similar observation being made in 2000. He reported a local suggestion from the fishing community that the largest females (>150 mm) occurred offshore only, the smallest in shallow bays, observations already referred to.

Rodhouse's results, although recorded further northwards along the west coast than Magharees, are at variance with Fox's and comparison of the two sets emphasises the necessity to make appropriate and as nearly as possible equivalent comparisons where assessments of this kind are concerned.

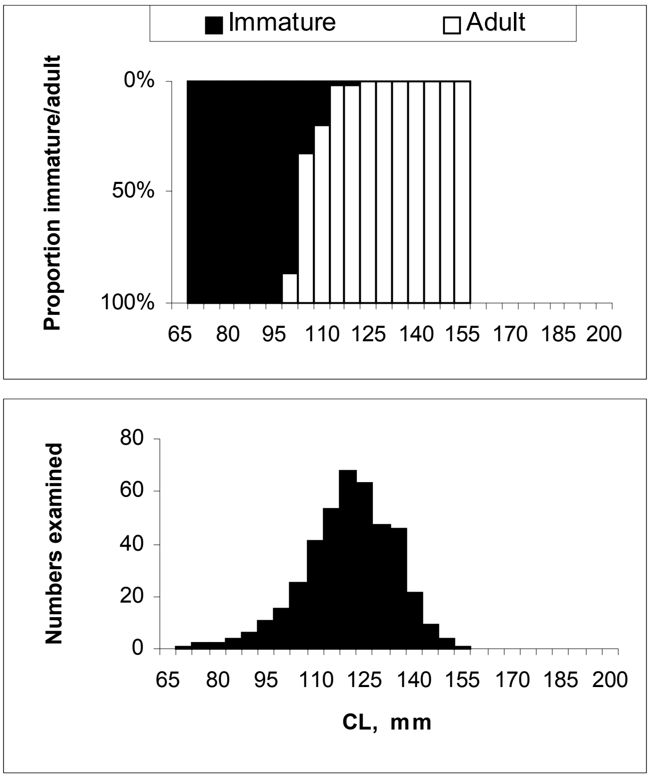


Fig. 10. Maturity ogive for female spider crabs in the Magharees fishery in 2000.

Comparison of spider crab in 2000 is most appropriately made by evaluating samples examined in June 2000 with catches examined by Fox in July 1985, their closest equivalent. The sex ratios he reported were:

	Catch	Landings	Discards
Tralee Bay	1.00:1	2.00:1	0.54:1
Brandon Bay	0.63:1	0.83:1	0.29:1

The value of 0.77 reported in 2000 is within his range.
Comparison of length frequencies is more complex. Fox divided his samples into two groups: from Brandon and Tralee Bays. All of the material examined in June 2000 came from Tralee Bay.

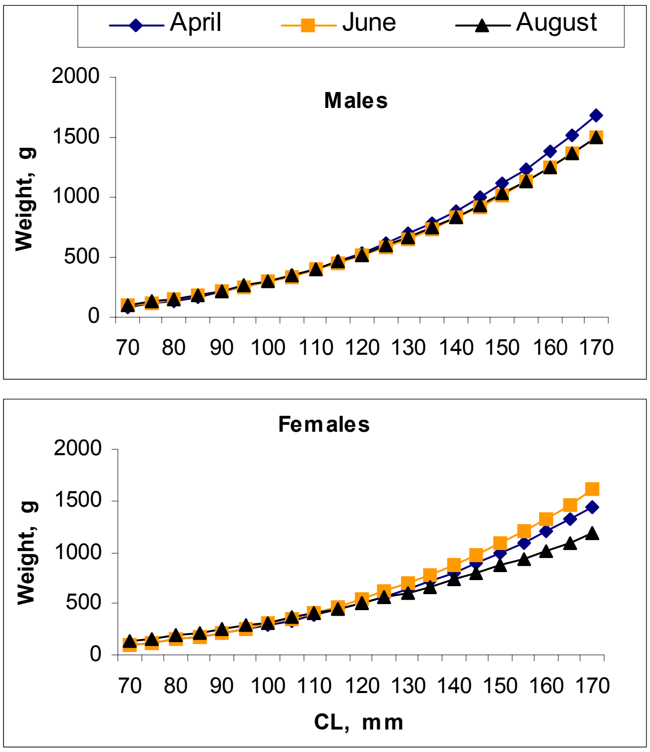


Fig. 11. Weight at length curves for male and female spider crabs in the Magharees fishery in 2000.

In 1985 the female spider length frequency distributions of the two bays differed significantly (Table 3), larger numbers of immatures occurring in Tralee Bay. The length frequencies then did not differ significantly from those in 2000; but samples collected in 2000 differed significantly from those examined in Brandon Bay in 1985.

The situation for male spider crabs is different. In 1985 similar length frequencies were reported from both Brandon and Tralee Bays and both of these differed significantly from the samples collected in 2000, there being considerably fewer large males in the later assessment (Table 4).

Results from 2000 sharply contrast with what was reported of spider crab in virtually every other assessment. Working on the English Channel crab, Edwards (1979b) stated: "Females have a smaller average size than males and there is always a higher proportion of crabs over 150 mm CL among males than females". Rodhouse (1984) described males as ranging from 100 – 219 mm CL and females 130 – 179 mm, but few females exceeded 150 mm. Anything less than 100 mm CL was virtually absent from the catch. Fox had sampled in both Brandon and Tralee Bays, which yielded significantly different length frequencies. In both places however, the average CL of males was considerably larger than for females.

Evidence would appear to support the removal of adult males from the spider crab populations in Magharees, although males are known to form clusters which might have been omitted from samples. Exactly when this occurred is not known but it is likely to have been progressive over the history of the fishery. The phenomenon has been reported elsewhere.

Latrouite (1992) remarked that before a fishery for spider crabs was established, the majority died of old age. The virgin stock would have included 5-6 generations of adults. Exploitation reduced their density and the average age. In fisheries terms reliance on a single year class for 75% of landings (which the French fishery came to do in due course) is likely to introduce larger annual fluctuations in yield.

The most probable explanation for the removal of larger males from the Magharees fishery is pot fishing although cpue would appear to have stablilized (even slightly increased) over the past few years. There are however other potential sources of mortality and it is useful to consider the explanations proffered by Latrouite (1992) who considered the question for the French spider crab fishery:

- Use of immature crabs and of soft crab as bait. The use of brown crab in south east Ireland as whelk bait has identified as such a problem (Fahy, 1999) but spider crab, which is also used for this purpose there (Fahy, unpublished) makes a small contribution to the south eastern crab fishery anyway (0.3% by weight of purchases to one buyer in the vicinity between 1990 and 1996 inclusive consisted of spider crab). Most crab bait is sourced in the vicinity of the whelk processing factories and the problem is not believed to make any impact on spider crab stocks in Co Kerry. Length frequency data for spider crab in the south east crustacean fishery are included for comparison with the Magharees data; they too would appear to show a depletion of larger males (Appendix 2).

- Latrouite (1992) was critical of the use of tangle nets to harvest spider crab, stating that the fragile nature of the animal makes it vulnerable to handling of any kind, making its survival after removal from a tangle net unlikely.

- Trawlers fishing over nursery ground were also identified as posing a threat to spider crab which may be killed, if not on their summer breeding grounds, then in the course of migration. Latrouite *et al* (1989) proposed that currents, temperature and bathymetry gradient are the orientation mechanisms employed in migratory movements.

CL range	**Tralee Bay 1985**	**Brandon Bay 1985**	**Chi-square**	
<120 mm	41.30	22.00	16.93	
>120<130	33.80	38.50	0.57	
>130	24.90	39.50	5.40	
		Total	22.90	*P<0.001*
	Tralee Bay 1985	**Samples in 2000**		
<120 mm	41.30	44.98	0.30	
>120<130	33.80	34.35	0.01	
>130	24.90	20.67	0.87	
		Total	1.18	*P>0.05*
CL range	**Brandon Bay 1985**	**Samples in 2000**		
<120 mm	22.00	44.98	11.74	
>120<130	38.50	34.35	0.50	
>130	39.50	20.67	17.16	
		Total	29.40	*P<0.001*

Table 3. Comparisons of length frequencies of female spider crabs in July 1985 with those in June 2000

CL range	**Tralee Bay 1985**	**Brandon Bay 1985**	**Chi-square**	
<120 mm	17.10	11.00	3.38	
>120<130	21.00	19.00	0.21	
>130<140	22.00	25.00	0.36	
>140	39.90	45.00	0.58	
		Total	4.53	*P > 0.05*
	Tralee Bay 1985	**Samples in 2000**		
<120 mm	17.10	58.00	28.84	
>120<130	21.00	26.59	1.17	
>130<140	22.00	13.49	5.37	
>140	39.90	2.38	591.23	
		Total	626.61	*P <0.001*
	Brandon Bay 1985	**Samples in 2000**		
<120 mm	11.00	58.00	38.09	
>120<130	19.00	26.59	2.17	
>130<140	25.00	13.49	9.82	
>140	45.00	2.38	762.88	
		Totals	812.95	*P<0.001*

Table 4. Comparisons of length frequencies of male spider crabs in July 1985 with those in June 2000.

Pawson (1995) remarked that tagging of adult crab has revealed they leave coastal waters in September and migrate to deeper water whence they return the following spring, though not necessarily to the same area of coast as the year before. However, they are very coastal in their movements and local and there was no evidence of tagged animals moving for example between the French and British coasts. *Maja squinado*, on the other hand, can move considerable distances, some exceeding 50 nautical miles although 60% of males and 80% of females did not leave their area of release. A higher proportion of the crabs moving more than 10 nautical miles were males (Edwards, 1980). There is no evidence to suggest that trawling is a problem in Magharees but fleet enlargement, a shortage of whitefish and gear innovation allowing exploitation of hitherto unfishable ground, must raise the possibility of this posing a problem at some time in the future.

- Finally, an obvious problem identified by Latrouite (1992) was the fact, in the French fishery, that 80% of females in the landings had not spawned and would not do so. Similar proportions of berried females are likely to be harvested at Magharees.

Ameliorating high mortalities, reducing discarding and improving reproductive success were three options considered by Latrouite (1992) which are put forward in the context of Magharees. The introduction of all of these could well close the fishery but the limited application of some or all might have useful consequences:

- Protecting immatures might be assisted by specifically preventing the use of spider crab as bait.

- Tangle netting should be eliminated.

- A close season might be introduced from the end of August to the end of November: specifically this would reduce mortality on newly moulted individuals (adults) which have little value in this state.

- Another measure is to take fewer females before the eggs hatch.

- Additionally one might reduce effort and thus increase the value of the landings. No fishery resource is unlimited and capping effort should be a consideration in Magharees at present.

- Finally, the size limit for this species should be reviewed. A size limit of 120 mm was established for spider crab in France in 1980 (Kergariou, 1984). It has since been applied to the entire European Community.

The size at which a particular developmental stage is reached in spider crab is very variable. Sampedro *et al* (1999) pointed out that CL in adolescent males may range up to 170 mm while they measured the CL of adult males between 112 and 220 mm. Immature females have a CL of up to 140 mm, the adults ranging from

115 to 200 mm. Size, they concluded, may change depending on geographic and temporal factors and size at maturity may vary among cohorts. There may also be a spacial and bathymetric size segregation during migrations. Thus, estimates of the size at maturity might be biased by behaviour and catchability.

Sampedro *et al* (1999) observed that the male terminal moult took place at CL of 112 – 164 mm in the Ría de Arousa (Galicia) while Tessier (1935) provided dimensions of 136 – 155 mm for crab in the English Channel. Sampedro *et al* (1999) observed that the size of the smallest individual is larger in populations living further north.

Sampedro *et al* (1999) recommended an increase in MLS from 120 to 130-135 mm, pointing out that there is an overlap of 112-165 mm between immature and adult phases. The size at which 50% of males carried out their terminal moult and reached morphometric maturity was 132.7 mm CL while the size at which 50% of females became adult was 130.4 mm CL. In species with a terminal moult the median size of the adults is the best estimate of size at maturity and an average rather than a median could be a biased estimate but, where fishing mortality is heavy the CL at 50% maturity is a better approximation (Somerton, 1980).

The imposition of a size limit based on carapace length is the criterion generally used but it is not the only one. Reference has been made to the application of a weight limit in the early years of the Magharees fishery which was later discontinued. Edwards (1979) reported the absence of a size limit in Britain but remarked that animals under 500g in weight were usually rejected from the landings.

Sampedro *et al* (1999) provided some general considerations pertinent to crab selection for harvesting: females with a brood are up to 17% heavier than those without. Given the variation in size at age, berried females might well be the same CL as juveniles and spent individuals. Adult males weigh up to 17% greater than adult females and sometimes in excess of 28% more than juveniles of the same CL, due to the weight of the chelipeds in the adult male. It is proposed here that inadequate consideration of these factors is in part at least the reason for the disappearance of adult males from the population. A more careful selection of landings would result in a better quality product.

This last point is central to whatever way this fishery develops in the future. Both landings and pot fishing effort are currently increasing - they have been doing so since the fishery began in the early 1980s – and it would be appropriate to consider capping or stabilising effort in order to produce a better quality of product.

There is one further matter worthy of mention. Inshore waters host a number of species which, inevitably, inter-relate in some way or other. The Magharees spider crab fishery co-exists with the oyster fishery in Tralee Bay, notable for the absence of starfish (Colm Duggan, *pers com.*). Spider crab feed on a wide range of organisms, ranging from *Laminaria* though *Corallina* spp, molluscs,gastropods, bivalves, echinoderms and ascidians (Bernárdez *et al*, 2000). Large populations of them may account of the absence of starfish in the area, an undoubted advantage to the oyster fishery. Duggan was aware that spider crab also eat oysters but reckoned its impact on these during the summer months was preferable to the presence of starfish in the area for the entire twelve months.

Acknowledgements

I offer thanks to Mick O'Driscoll and Kevin Flannery, fishery officers of the Department of the Marine and Natural Resources who introduced me to this fishery. Crohan O'Grady in Magharees provided details of spider crab landings and much local information on the fishery; Seamus O'Grady took me to sea in Brandon Bay and western Tralee Bay and Christy and Kathleen Lynch did so on the eastern side. Finally I must express gratitude to Daniel Latrouite of IFREMER who kindly read through an early draft of this work and suggested many amendments to it.

References

Bates, D (1981), Spider crabs – ripe for exploitation. *Bord Iascaigh Mhara*. Mimeo.

Bernárdez, C, J Freire & E González-Gurriarán (2000) Feeding of the spider crab *Maja squinado* in rocky subtidal areas of the Ría de Arousa (north-west Spain). *Journal of the marine biological Association of the United Kingdom* 80 (1): 95 – 102.

Edwards, E (1979a) The spider boom. *Fishing News*, 2 November 1979

Edwards, E (1979b) Preliminary results of an investigation on a new fishery for spider crabs (*Maia squinado*) along the south coast of England. *ICES Shellfish Committee CM* 1979/K 11.

Edwards, E (1980) Preliminary results of a tagging experiment on the spider crab (*Maia squinado*) in the English Channel *ICES Shellfish Committee CM* 1980/K:12

Fahy, E (1999) Conflict between two inshore fisheries for whelk (*Buccinum undatum*) and brown crab (*Cancer pagurus*), in the southwest Irish Sea. *Proceedings of the Third International Conference on Shellfish Restoration*, Cork, September 1999.

Fernández, L, J Parapar, E González-Gurriarán & R Muiño (1998) Epibiosis and ornamental cover patterns of the spider crab *Maja squinado* on the Galician coast, Northwestern Spain: influence of behavioural and ecological characteristics of the host. *Journal of Crustacean Biology* 18 (4): 728 – 737.

Fox, P (1985) An investigation of the spider crab resource in Tralee and Brandon Bays – Summer 1985, *Resource Record Note. Bord Iascaigh Mhara*. Mimeo.

González-Gurriarán E, J Freire, J Parapar, M P Sampedro and M Urcera (1995) Growth at moult and moulting seasonality of the spider crab, *Maja squinado* (Herbst) (Decapoda: Majidae) in experimental conditions, implications for juvenile life history. *Journal of Experimental Marine Biology and Ecology* 189: 183-203.

González-Gurriarán, E, L Fernández, J Freire & R Muiño (1998) Mating and role of seminal receptacles in the reproductive biology of the spider crab *Maja squinado* (Decapoda, Majidae). *Journal of Experimental Marine Biology and Ecology* 220: 269 – 285.

Hines, A H, T G Wolcott, E González-Gurriarán, J L González-Escalante & J Friere (1995) Movement patterns and migrations in crabs: telemetry of juvenile and adult behaviour in *Callinectes sapidus* and *Maja squinado. Journal of the marine biological Association of the United Kingdom* 75: 27 – 42.

Latrouite, D (1992) Araignées de mer: recommandations pour une meilleure gestin du stock. *Equinoxe* 37: 21 – 25.

Latrouite, D & D le Foll (1989) Donnees sur les migrations des crabes torteau *Cancer pagurus* et les arignees de mer *Maja squinado*. *Océanis* 15 (2): 133 – 142.

Le Foll, D (1993) Biologie et exploitation de l'araignée de mer *Maja squinado* Herbst en Manche Ouest. *Thèse de Doctorat de l'Université de Bretagne Occidentale soutenue le 16 janvier 1993 à Brest*. 517 pp.

Le Foll, D, E Brichet & J L Reyes (1987) Determination de l'age d'araignées de mer *Maja squinado* per mesure des radioisotopes 228 Th and 228 Ra de la carapace. *ICES, Shellfish Committee C.M*. 1987/K:43.

Kergariou, G de (1984) L'araignée de mer, *Maia squinado* H, biologie et exploitation. *La Pêche Maritime* 20 October 1984, 575 – 583.

Meyer, C G (1992) Seasonal variation in composition of trap catches of the spider crab *Maja squinado Herbst*, 1788 in a known inshore nursery area on the south coast of Jersey (British Channel Islands) *ICES Shellfish Committee CM* 1992/K: 11.

Pawson, M G (1995) Biogeographical identification of English Channel fish and shellfish stocks. *Fisheries Research Technical Report* No 99 pp 72 Ministry of Agriculture, Fisheries and Food, Lowestoft.

Rodhouse (neé Brosnan), D M (1984) Experimental fishing for the spider crab, *Maia squinado*: sea and laboratory trials *Journal of the marine biological Association of the UK.* 64: 251 – 259.

Sampedro, M P, E González-Gurriarán, J Freire & R Muiño (1999) Morphometry and sexural maturity in the spider crab *Maja squinado* (Decapoda: Majidae) in Galicia, Spain. *Journal of Crustacean Biology* 19 (3): 578 – 592.

Somerton, D A (1980) A computer technique for estimating the size at sexual maturity in crabs *Canadian Journal of Fisheries and Aquatic Sciences* 37: 1488 – 1494.

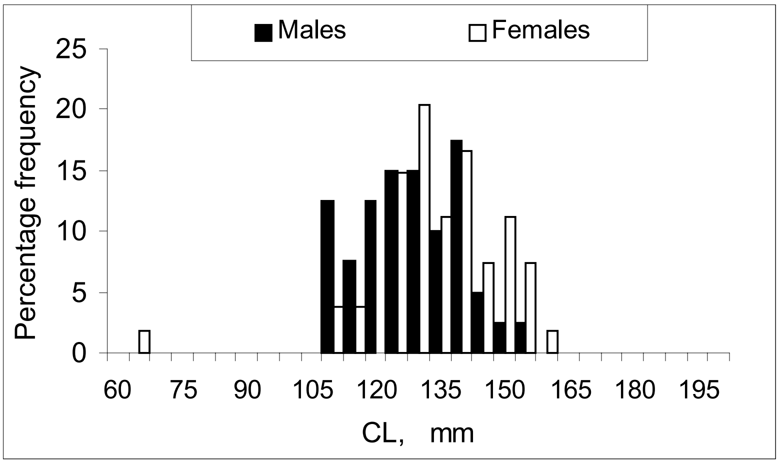
Tessier, G (1935) Croissance des variants sexuels chez *Maia squinado* L. *Travaux de la Station Biologique de Roscoff* 13: 93 – 130.

Appendix 1. Summarised landings to Maharees, with details of effort (numbers of pots fished per vessel).

PART 1, Monthly landings to Rough Point

MONTH	**Landings in kg.**																		
	1981	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
January							4500					2000							
February							6000	3705				2000	2500					1000	
March		6400			4736		43838	13862	1300				28700			22800	7500	30300	85000
April		11500	6000		19294	6557	65800	59613	67005	15612	19564	9140	16602	11937	10700	72700	48200	88700	52000
May	18000	14400		11000	64314	81884	47600	27355	63748	25039	27096	8800	31961	13582	33785	75000	55900	69200	93000
June					13194	16600	26500	30575	17576	7144	15727	16047	19717	10350	20000	18500	32200	22500	44000
July		4000			19600	15650	33480	16383	10361	7700	14406	15425	12268	6012	14300	13300	24100	9000	20000
August	14000	8100			25700	25882	22500	6345	3465	1660	13825		13130		9200	8800	16100	13000	18000
September	4000	8300			27500	35550	12300	7843	7983	3400	11976		8043		9730	5900	8100	7000	8000
October				7500	15500	7000	14000	12975	9425	16740	6350		21512		8700		4700	6500	2500
November				8500	12305		12000	4815	1960		8784		10200		11800				5300
December			3000	3500			12638	6127	6023		8644		5000		7500			1500	8400
Annual total	**36,000**	**52,700**	**9,000**	**30,500**	**202,143**	**189,123**	**301,156**	**189,598**	**188,846**	**77,295**	**126,372**	**53,412**	**169,633**	**41,881**	**125,715**	**217,000**	**196,800**	**248,700**	**336,200**
Landings to Fenit											15,000	25,000	25,000	38,500	11,500	62,000	20,000	37,300	66,500
Total recorded landings	36,000	52,700	9,000	30,500	202,143	189,123	301,156	189,598	188,846	77,295	141,372	78,412	194,633	80,381	137,215	279,000	216,800	286,000	402,700
Landings, tonnes	**36**	**53**	**9**	**31**	**202**	**189**	**301**	**190**	**189**	**77**	**141**	**78**	**195**	**80**	**137**	**279**	**217**	**286**	**403**
PART 2, cpue estimates																			
Effort index	150	150	150	150	150	200	220	240	240	300	300	300	350	350	350	350	400	450	500
cpue index 1	240	351	60	203	1348	946	1369	790	787	258	421	178	485	120	359	620	492	553	672
(Annual landings, Kg/Effort index)																			
No of months fished	3	6	2	4	9	7	12	11	10	7	9	6	11	4	9	7	8	10	10
No months * No pots	450	900	300	600	1350	1400	2640	2640	2400	2100	2700	1800	3850	1400	3150	2450	3200	4500	5000
cpue index 2	80	59	30	51	150	135	114	72	79	37	47	30	44	30	40	89	62	55	67
(Annual landings, Kg/Effort index*number of months fished)																			
Apr-Jul catch as cpue																			
catch in Apr-Jul	18,000	29,900	6,000	11,000	116,402	120,691	173,380	133,926	158,690	55,495	76,793	49,412	80,548	41,881	78,785	179,500	160,400	189,400	209,000
This catch as % total annual	50	57	67	36	58	64	58	71	84	72	61	93	47	100	63	83	82	76	62
cpue index 3	120	199	40	73	776	603	788	558	661	185	256	165	230	120	225	513	401	421	418
(April-July landings, Kg/Effort index)																			

Appendix 2



Length frequencies of male and female spider crab from the Kilmore Quay fishery, July/September 2000 (N=94).