Spider crab

(*Maja spp.*)

Summary

Size (carapace length)	200 mm male 175 mm female (Pawson, 1995)
Lifespan	~ 6 years male ~ 5 years female (Gonçalves et al., 2020)
Size of maturity (CL_{50})	52 -137 mm
Fecundity	>6000 eggs (size dependent) (Baklouti et al., 2015)
Reproductive frequency	Annual
Capture methods	Pots and nets
Fishing Season	All year round

Description

Four species of spider crab belonging to the genus *Maja* inhabit European coasts: *M.brachydactyla*, *M.crispata*, *M.goltziana*, and *M.squinado* (Sotelo et al., 2009). Until fairly recently the main commercial species caught in Atlantic waters was assumed to be *M.squinado*. However, Neumann (1998) suggested that Atlantic and Mediterranean populations of *M.squinado* were distinct species based on morphological and biometric characters and concluded *M.squinado* in the Atlantic were in fact *M.brachydactyla*. Genetic analysis has since supported the recognition of two separate species with *M.squinado* restricted to the Mediterranean (Sotelo et al., 2009).

M.brachydactyla is distributed in the eastern Atlantic from the western Sahara in the south to the southern British Isles in the north, including the Azores and Canary Islands (d'Udekem d'Acoz, 1999 cited in Abelló et al., 2014). It is most abundant at depths between 0-70 m, although it has been recorded at 120 m (Pawson, 1995). This species of spider crab can be found on most seabed types and scavenges food including carrion, encrusting animals, and seaweed.

M.brachydactyla is known as the common spider crab but it might also be referred to as, the spinous, spiny, or European spider crab (names also used for *M.squinado*). For the purposes of this document *M.brachydactyla* will be referred to simply as spider crab.

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Reproductive Life history

There are two methods of mating in crab species; soft-shell mating which takes place shortly after the female has moulted, as is the case with most aquatic crab species such as the brown crab and hard-shell mating which is common with semi-terrestrial crab species (Jones and Hartnoll, 1997). The spider crab is an aquatic crab, but it is unusual as mating occurs between hard-shelled individuals. This is because spider crabs do not continuously moult and grow throughout their lifespans like brown crabs. Instead, a final terminal or puberty moult occurs once an individual reaches sexual maturity and growth is halted. Therefore, only one soft-shell mating is possible and all subsequent mating's must be hard-shelled (Jones and Hartnoll, 1997).

Once the terminal moult has occurred in females in late summer or early autumn their ovaries begin to develop and they are ready to spawn for the first time the following spring (Hines et al., 1995; González-Gurriarán et al., 1993). Across the North East Atlantic the spawning period ranges from March/July until September/November (Rodhouse, 1984). In the English Channel berried (egg-bearing) females are seen from April onwards and by June all females are berried (Pawson, 1995) whereas on the west coast of Ireland the season is slightly longer with berried females recorded between March and September (Rodhouse, 1984). Females mate once their eggs are close to hatching and the male may guard the female following copulation up to two days. If not guarded a female will mate with multiple males (Jones and Hartnoll, 1997).

Hatching takes place from July and is completed by the end of October as reports suggest berried females are not seen in the South of England later than October (Edwards, 1979 cited in González-Gurriarán et al., 1993; Pawson, 1995). In the northern range of the spider crab (British Isles) females generally produce one brood per year (Carlisle, 1957; Rodhouse, 1984; González-Gurriarán et al., 1993) but further south up to 3 broods can occur (González-Gurriarán et al., 1993). The number of eggs laid by a female is correlated to its size and weight (Baklouti et al., 2015). A female with a carapace length of 44 mm may release on average 6,430 eggs whilst a female measuring 73 mm releases around 12,800 eggs (Baklouti et al., 2015).

The incubation period for fertilised eggs based on laboratory experiments is between 34 and 62 days with warmer sea temperatures reducing the amount of time required to develop (González-Gurriarán et al., 1993). Once the eggs have hatched the larvae are pelagic for 2-3 weeks before settling in shallow areas (Pawson, 1995). Spider crab nurseries occur in areas less than 20 m in depth with a range of rock and gravel alternating with areas of sand and mud (Pawson, 1995; Hines et al., 1995). Within the first-year juveniles will grow to 70 mm (carapace length) and reach 115 mm in their second year (Kergariou, 1984 cited in Fahy, 2000). Whilst in nursery areas juvenile spider crabs exhibit limited movement and forage on algal-invertebrate turf during their first two years (Hines et al., 1995).

Crustaceans grow by shedding their exoskeleton in a process called ecdysis or moulting. Growth rate varies regionally and is dependent on sex, food supply, temperature, depth, and frequency of moulting (Bennett, 1995). As previously mentioned, spider crabs stop growing after their terminal or pubertal moult at which point, they become sexually mature. The terminal moult takes place in the summer following a prepubertal moult in spring. Large pods of spider crabs are often seen close

to shore during the moulting period with the newly moulted individuals in the middle and harder shelled specimens on the outside. Copulation may also take place during these mass gatherings (Carlisle, 1957). Males begin to become sexually mature after the prepubertal moult as sperm is developed and they enter an adolescent phase, however secondary sexual characteristics such as larger chelipeds (the legs that hold the claws) are not developed until the terminal moult (González-Gurriarán et al., 1995; Fahy, 2000). The terminal moult for females involves significant morphological changes including an increase in size and widening of the abdomen and development of the pleopods which will allow for the attachment and incubation of the eggs (Jones and Hartnoll, 1997). The carapace length of spider crabs following the terminal moult varies from 85-200 mm for males and 70-175 mm for females (Pawson, 1995).

After the terminal moult newly mature and older adult spider crabs migrate in September from the shallows to their deeper overwintering grounds (depths exceeding 50 m) (Hines et al., 1995; Pawson, 1995). From April to June, they return to coastal waters (Pawson, 1995). Adults live for several years therefore complete the seasonal migration several times during their lifecycle (Hines et al., 1995). When congregating in the shallows males and females segregate with males found at about 10 m and females at 5 m. It is unknown whether segregation occurs in the overwintering grounds (Rodhouse, 1984).

Size of maturity (SOM)

Size of maturity (SOM) is often used to help establish an appropriate Minimum Conservation Reference Size (MCRS) to ensure individuals can reproduce at least once before capture. For spider crabs the SOM is commonly accepted as the carapace length (CL) at which 50% of a population are mature and is referred to as the CL_{50}.

Several definitions can be used to estimate maturity in decapod crustaceans: behavioural maturity; morphometric maturity; functional maturity and physiological maturity (Table 1.). Methods based on morphometric and behavioural maturity criteria are less difficult to determine but they may not always indicate functional maturity (Öndes et al., 2017; Haig et al., 2016).

Table 1. Four definitions of maturity used to infer sexual maturity in crabs (Haig et al., 2016; Öndes et al., 2017)

Maturity term	Description
Behavioural	Individuals show signs of the ability to physically copulate e.g. presence of sperm plugs in females and direct observations of mating behaviour. Doesn't confirm functional maturity.
Morphometric	Crustaceans demonstrate 'allometric growth' where different body parts grow at different rates. Changes in size of secondary sexual characteristics such as female abdomen width and male chelipeds length with growth can be used to estimate onset of maturity. Doesn't always indicate functional maturity.

Functional	Presence of eggs externally attached to a female indicates she is functionally capable of producing offspring. Functional maturity in males is difficult to determine therefore other methods are often used to inform male maturity.
Physiological	Estimated based on microscopic investigation of the gonads or histological observations of ovaries, testes and the vas deferens. Used interchangeably with Functional maturity.

From the reviewed literature one study analysed the SOM of spider crabs in its most northerly range of Ireland whilst the remaining studies focused on populations along the Spanish coastline and the Mediterranean Sea (all studies except Corgos and Freire (2006) refer to *M.squinado* rather than *M.brachyura* presumably because they were completed before the distribution of *M.squinado* was confirmed as being confined to the Mediterranean). Overall SOM ranged between 52-137 mm with males maturing at a slightly larger size than females (up to 6 mm larger in some populations) (table 2).

Female spider crabs in southwest Ireland were found to reach 50% maturity at 110 mm (Fahy, 2000). Females examined off the Spanish coastline all mature at a larger size of 130 mm whereas those examined in the Gulf of Gabes matured at a much smaller size of 52 mm (table 2). Females caught off the northwest coast of Corsica were found to mature at 104 mm (Duran et al., 2013). SOM of male spider crabs along the Spanish coastline varied between 96-137 mm and males in the Gulf of Gabes, like the females, matured at a much smaller size of 54 mm. It must be noted that the smallest estimated SOM for females (52 mm and 103 mm) and males (54mm and 96 mm) were all from studies that analysed the gonads on a microscopic level (Baklouti et al., 2015; Duran et al., 2013; Corgos and Freire, 2006). All other studies analysed maturity based on morphology and/or the presence of eggs. The differences in method may account for the large differences in SOM.

Table 2. Size at maturity estimates (CL_{50}) for spider crab (*Maja spp*.) in studies undertaken across the species range in the Atlantic and Mediterranean Sea. Male and female carapace length rounded and given in mm. Refer to the Appendix for more information.

Location	Male	Female	Maturity	Reference
Magharees, Ireland	-	110	Functional	Fahy, 2000
Galicia, Spain	96	-	Physiological	Corgos and Freire, 2006
Galicia, Spain	137	130	Morphological	Corgos and Freire, 2006
Galicia, Spain	133	130	Morphological Functional	Sampedro et al., 1999
Galicia, Spain	-	130	Functional	González-Gurriarán et al., 1993
Corsica	-	104	Morphological Physiological	Duran et al., 2013
Gulf of Gabes, Tunisia	54	52	Physiological	Baklouti et al., 2015

The Minimum Conservation Reference Size (MCRS) for spider crab caught within the Southern IFC district is 120 mm for females and 130 mm for males. The literature review does not provide conclusive evidence to identify whether the current MCRS is appropriate as SOM varies across the species distribution. Based on proximity to the Southern IFC district, females in southwestern Ireland were found to mature below the current MCRS at 110 mm. Females off Corsica and in part of the Mediterranean Sea (Gulf of Gabes) also mature below 120 mm. However, all females analysed on the Galician coast in Spain mature at a larger size (130 mm). Less data is available for male spider crabs but two of the studies outline SOM to be below the current MCRS of 130 mm and two outline SOM to be above. Of the latter two studies, SOM was 133 mm and 137 mm. However, in the same region males were also found to mature at 96 mm after microscopic analysis of the gonads which is said to be the most accurate method to assign maturity (Brown-Peterson et al., 2011).

Southern IFCA Fishery

Fishing activity

Spider crabs are the second most caught species of crab, after brown crab, in the Southern IFC district but the spider crab fishery is much smaller due to a smaller market. In 2019, 34 tonnes of spider crab was landed into ports within the District compared to 720 tonnes of brown crab. The majority of spider crab caught in our waters is exported to Spain but the Cornwall Fish Producers Organisation is currently partaking in a project to rename the species to increase its popularity in the UK (BBC, 2021). If successful, the UK market for the spider crab may increase.

Spider crabs are caught throughout the Southern IFC district, but the fishery is most prominent in the west where they are part of a targeted fishery. Spider crabs are targeted using baited inkwell pots and trammel nets or caught as bycatch in pots, gill nets and trawls. Not all spider crabs that are caught as bycatch are landed, some will be discarded if there is not a suitable market whilst others will be utilised as bait for the whelk pot fishery. The fishery is seasonal taking place between April and September when the spider crabs migrate inshore.

Recreational potting for crab and lobster does occur in the district but the number of active recreational pot fishers is not known. Greater recreational activity takes place around the Isle of Wight, Swanage, Weymouth, Portland, and Lyme Bay.

Landings & Value of Fishery

Southern IFCA do not currently hold effort or catch data for the spider crab fishery. However, landings data from the MMO can help indicate the scale of the fishery over time. In 2019 approximately 34 tonnes of spider crab worth £36,917 was landed into ports across the Southern IFC district (Fig. 1*).

Landings have remained between 28-55 tonnes between 2010 and 2019, an average of 38 tonnes per year. Prior to 2010 landings were much higher peaking at 158 tonnes

in 2006. The value of spider crabs has remained around £1000 per tonne since 2008 – in 2019 price per tonne was £1085.

The value of the recreational pot fishery in the district is not known.

*these figures represent vessels that land into ports in the Southern IFC district, some of which would have fished outside the district and be >12 metres in length.

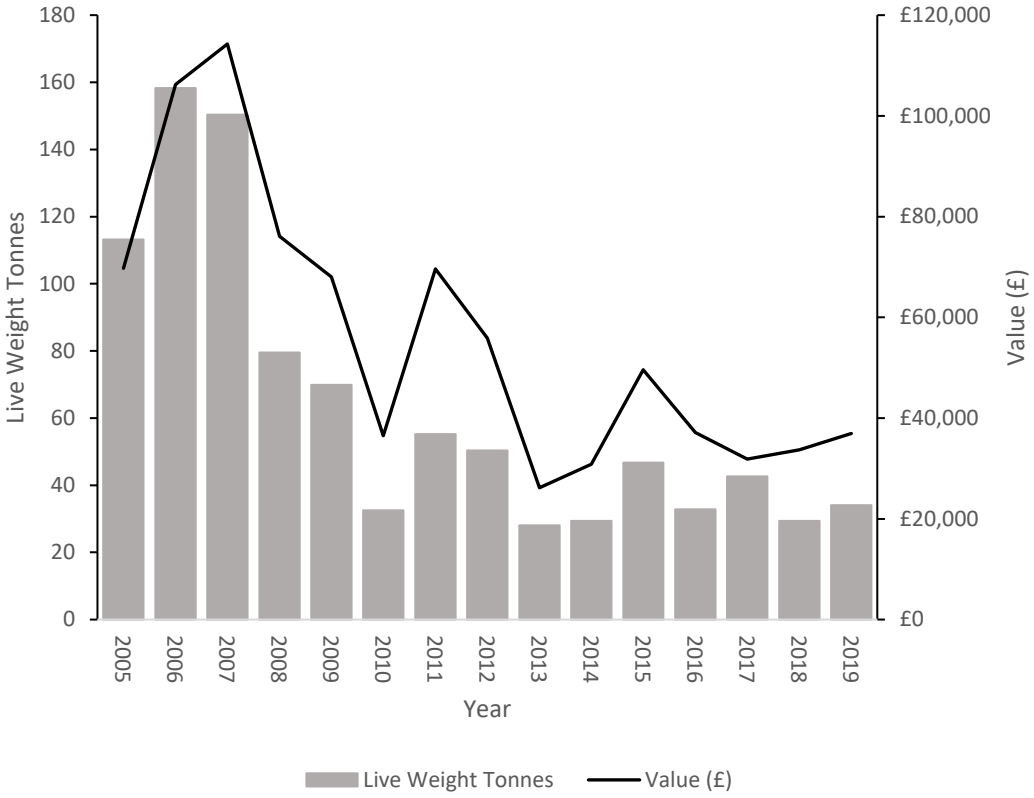

Figure 2. Landings of spider crab (*Maja spp*.) into the Southern IFC district from 2005 to 2019. Data received as a Freedom of Information request from the Marine Management Organisation (MMO).

There is no stock assessment conducted for spider crabs.

Associated management

Landings of spider crab are primarily managed through Minimum Conservation Reference Size (MCRS) restrictions to prevent the landing of sexually immature individuals. This allows individuals to grow and reproduce at least once before harvesting. In the Southern IFC district the MCRS for the commercial fishing of spider crab is 120 mm (CL) for females and 130 mm (CL) for males through European legislation (Regulation (EU) 2019/1241). These sizes are adhered to nationally except in the Cornwall IFCA and Devon and Severn IFCA districts where the MCRS for females is 130 mm, in line with the male MCRS (table 1).

Additional measures include the promotion of voluntary escape gaps in crab and lobster pots. Fishing effort is also indirectly managed through the 'Vessels used in fishing 2012' byelaw that prohibits commercial vessels over 12 metres from fishing in the Southern IFC district. The reduction in vessel size naturally restricts fishing effort as it limits the quantity of static gear that can be worked by each vessel.

Table 3. Minimum Conservation Reference Size (MCRS) for the European spider crab (*Maja spp.*) in Inshore Fisheries and Conservation Authority districts (IFCA). Measurements for carapace length in mm.

IFCA	**Minimum Conservation Reference Size (MCRS)**	
	Male	**Female**
Northumberland	130	120
North Eastern	130	120
Eastern	130	120
Kent & Essex	130	120
Sussex	130	120
Southern	130	120
Devon & Severn	130	**130**
Cornwall	130	**130**
Isles of Scilly	130	120
North Western	130	120

Bold figures highlight difference to Southern IFCA sizes.

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Appendix

Table A. Estimates of size at maturity for spider crab (*Maja spp.*) in studies undertaken in East Atlantic and Mediterranean. Table shows study location, total number of individuals sampled overall, size range sampled, total number of individuals used to assess size at maturity, size of smallest mature individual, size at 50% maturity (CL_{50}), size range of mature individuals and maturity definition used to assess maturity. All sizes based on carapace length (CL) in mm.

Study location	Total No. of individuals surveyed	No. of individuals (n)		Length Data		Size at Maturity Data										Reference
				Size range (mm)		Total No. of individuals	No. of individuals (n)		Size of smallest mature individual (mm)		Size at 50% maturity (CL_{50}) (mm)		Size range of mature individuals (mm)		Maturity Definition	
		M	F	M	F		M	F	M	F	M	F	M	F		
Magharees, Ireland	1514	949	565	-	-	-	-	-	-	-	-	110	-	95-125	Functional	Fahy,2000
Galicia, Spain	14,983	7,430	7,553	-	-	-	-	-	-	-	96.2	-	-	-	Physiological	Corgos and Freire, 2006
											136.5	130	-	-	Morphological	Corgos and Freire, 2006
Galicia, Spain	-	-	-	112-220	114-142	-	-	-	-	-	132.7	130.4	-	-	Morphological Functional	Sampedro et al., 1999
Galicia, Spain	5,365	2,843	2,522	-	-	-	-	-	-	-	-	130	-	-	Functional	González-Gurriarán et al., 1993
Corsica	-	-	-	-	-	21	-	21	-	-	-	103.6	-	-	Morphological Physiological	Duran et al., 2013
Gulf of Gabes, Tunisia	770	478	292	22.5-87		-	-	-	-	-	54.3	52.1	-	-	Physiological	Baklouti et al., 2015