Velvet crab

(*Necora puber*)

Summary

Size (carapace width)	Male 78-96 mm Female 68-92 mm
Lifespan	4-6 years (Norman, 1989)
Size of maturity (CW_{50})	44-57 mm
Fecundity	5,000-278,000 eggs
Reproductive frequency	Annual
Capture methods	Pots
Minimum Conservation Reference Size	65 mm (carapace width)
Fishing Season	Year-round

Description

The velvet swimming crab (*Necora puber*) is distributed in the North East Atlantic from Norway to the Western Sahara and the Mediterranean Sea (Palomares and Pauly, 2020). It is typically found on rocky substrates from the shallows to depths of 70 m (Hayward and Ryland cited in Hearn, 2004). Velvet crabs are fast-moving, agile hunters that can catch prey such as prawns and small fish, but much of their diet consists of algal material (Norman, 1989).

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 velvet crab, and hard-shell mating which is common with semi-terrestrial crab species (Jones and Hartnoll, 1997). Moulting, known as ecdysis, is the process by which crustaceans shed their exoskeleton to grow. The male velvet crab pairs with a female pre-moult and carries her beneath him until she has moulted. Once the female is soft copulation takes place and the male may guard the female for up to two days afterwards (Tallack, 2007; Hartnoll, 1969). The female stores the sperm in a specialised organ called the spermathecae until her eggs are developed and ready for fertilisation (Hearn, 2001). Fertilisation can take place several months after copulation (Tallack, 2007). In Plymouth Sound paired crabs have been observed from July to

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November and were particularly abundant in August to October (Norman and Jones, 1983). In the Shetland Islands the peak mating period is also thought to be in the summer and early months of autumn (Tallack, 2007). Whereas in Wales copulation takes place between Spring and Autumn (Choy, 1988).

Fertilised eggs are attached to the pleopods (small appendages underneath the abdomen) of the female. Brood size is positively correlated with female body size with larger females producing more eggs (Hinchliff et al., 2015; Hearn, 2004). Fecundity estimates (number of eggs) for the velvet crab range from 5000 to 278,000 eggs (Choy, 1988; Hearn, 2004; Hinchliff et al., 2015). Choy (1988) estimated 12% of eggs are lost before the brooding period is complete whilst Norman and Jones (1993) estimated a slightly higher egg loss rate between 14-18.5%. Egg production takes place year-round but ovigerous (egg-bearing) females are most abundant from January to June/July around the British Isles with a peak in February to April (Norman and Jones, 1993; Hearn, 2004; Choy, 1988; Hinchliff et al. 2015).

Egg development is temperature dependent therefore egg brooding duration differs depending on location. Bakir and Healy (1995) examined embryonic development of velvet crabs in laboratory conditions and found at 8°C development took 125 days, at 10°C hatching occurred after 76 days and at 15°C eggs were fully developed in 42-48 days. Throughout the velvet crab's range around the British Isles larval release has been observed from April, throughout the summer into late autumn (Tallack, 2007; Norman and Jones, 1993; Bakir and Healy, 1995). After hatching their first brood some females will spawn again in the same season (Choy, 1988; Norman and Jones, 1993; Tallack, 2007).

Velvet crab larvae hatch as prezoea (a pre-larva stage with an embryonic shell) before moulting through five zoeal stages (larval stages of crustaceans that are characterised by one or more spines on the body and appendages to assist movement) and completing development as a post larva known as the megalopa stage at a length of around 1.3 mm (Rice and Ingle, 1975 cited in Hearn, 2001). During the zoeal stages the larvae are planktonic and feed, grow and moult in the water column. Once they become post-larva they settle on the seabed and undergo metamorphosis into miniature velvet crabs. Juveniles occupy the intertidal zone throughout the year, but larger numbers are found in the summer months (Tallack, 1998). Growth rates vary regionally as growth is dependent on sex, temperature, food supply, frequency of moulting and depth (Bennet, 1995; Hartnoll, 1997). Velvet crabs may moult several times within a year when young but as individuals become mature frequency of moulting declines to around once a year (Norman, 1989; Hearn, 2001). Females experience smaller growth than males as they divert energy to reproduction (Bakir, 1990). Life expectancy of velvet crabs is estimated between 4-6 years with males attaining a maximum size of 95-100 mm LCW (Long Carapace Width – includes spines) and females 85-90 mm LCW in south-west England (Norman, 1989). Maximum size based on carapace width has been estimated at 78-85 mm and 68-73 mm for males and females respectively in welsh waters (Choy, 1986 cited in Hearn, 2001) and 91-96 mm (males) and 90-92 mm (females) in Irish waters (Bakir, 1990 cited in Hearn. 2001).

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 velvet crabs the SOM is commonly accepted as the carapace width (CW) at which 50% of a population are mature and is referred to as the CW_{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 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. Does not 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. Does not 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.

The available literature suggests velvet crabs in waters around the British Isles become sexually mature between 43.8 mm and 57.4 mm (CW) (table 2). In the Plymouth Sound physiological maturity was recorded at 46 mm for females and 48.5 mm for males (based on long carapace length). The smallest ovigerous female observed was 38.6 mm and smallest inseminated female 37.3 mm (Norman, 1989). Choy (1988) used multiple physiological methods to analyse maturity of velvet crabs in the Gower Peninsula, Wales, and found female SOM ranged between 47.5 – 49.3 mm and males matured at 54 mm. In the Orkney Islands females smaller than 40 mm were generally immature and those over 50 mm were mature (Hearn, 2004). Whereas males under 50 mm were found to be immature and all males above 55 mm were mature. Females and males reached 50% maturity at 43.8 mm and 52.8 mm, respectively. Velvet crabs examined along the east coast of Ireland were found to

mature at around 50 mm, irrespective of sex (Bakir and Healy, 1995). Generally, females mature at a smaller size than males however, Tallack (2007) found female velvet crabs in the Shetland Islands matured at a much larger size than males. Based on behavioural and morphometric criteria male SOM was calculated at 45 mm compared to 54.2 mm for females. Female maturity based on functional/physiological criteria (gonad analysis and presence of eggs) estimated SOM to be larger at 57.4 mm. For comparison, southerly populations of velvet crab off the coast of Spain mature within a similar range to populations around the British Isles. González-Gurriarán and Freire (1994) estimated SOM between 49.8-52.3 mm for females and 53.3-54.8 mm for males. Age at 50% maturity for velvet crabs has been estimated at one year (Choy, 1988; Bakir and Healy, 1995).

Table 2. Size at maturity estimates (CW_{50}) for velvet crab (*Necora puber*) in studies undertaken around the UK, Ireland and Spain. Male and female carapace width given in mm. Refer to the Appendix for more information. *long carapace length (including measurement of spines).

Location	Male	Female	Maturity	Reference
Plymouth Sound, England	-	44*	Behavioural	Norman, 1989
	48.5*	46*	Physiological	
Gower Peninsular, Wales	54	47.5-49.3	Physiological	Choy, 1988
East coast of Ireland	50	50	Physiological	Bakir and Healy 1995
Orkney Islands, Scotland	52.8	43.8	Physiological	Hearn, 2004
Shetland Islands, Scotland	45	54.2	Behavioural/Morphometric	Tallack, 2007
	-	57.4	Functional/Physiological	
Galicia, Spain	54.8	49.8	Physiological	González-Gurriarán and Freire, 1994
	53.3	52.3	Morphological	

Size at maturity cannot be absolutely compared between studies due to the differences in methods used to establish 50% maturity. Estimates based on functional/physiological criteria (internal gonad staging and external reproductive condition) are generally larger than estimates based on morphometric and behavioural criteria (Tallack, 2007). However, the literature review has established that velvet crabs mature at significantly smaller sizes than the current MCRS of 65 mm. Therefore, velvet crabs in the Southern IFC district do have an opportunity to reproduce at least once before potential removal from the fishery.

Southern IFCA Fishery

Fishing activity

Velvet crab is not a key fishery in the Southern IFC District and is not commonly targeted unless there is a specific demand. Elsewhere in the UK and Ireland the velvet crab is a commercially significant species which is exported to southern European nations such as France and Spain where it is very popular (Hinchliff et al., 2015; Fahy et al., 2008). The principal fishing method for velvet crabs is potting where most fishers use 'D' creel/parlour pots to target crabs. On average vessels will work around 420 pots; however, the number of pots worked can vary greatly, from as few as 50 to as many as 1,200, depending on the size of the vessel and frequency of trips. In the Southern IFC district pots are used to target brown crab and lobster with velvet crabs caught as bycatch and often returned rather than landed. The escape gaps used in pots reduces the likelihood of catching velvet crabs due to their small size in comparison to lobster and brown crab, therefore if velvet crabs are to be targeted the pots must be modified by covering the escape gaps.

Recreational potting for crab 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

Velvet crab is not actively targeted within the Southern IFC District as highlighted by figure 1. In 2019, just over one tonne* of velvet crab was landed into ports within the District worth an estimated £1,780. Between 2013 and 2019 annual landings never exceeded two tonnes. Prior to 2013 velvet crab was landed in greater quantities with a high of 19 tonnes in 2011 valued at £13,700. Price per tonne of velvet crab declined from around £1,800 between 2015-2017 to £1,400 in 2019. In 2018 the value of velvet crab increased to £2,000 per tonne.

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.

There is no stock assessment conducted for velvet crab, therefore the stock status in the English Channel is unknown.

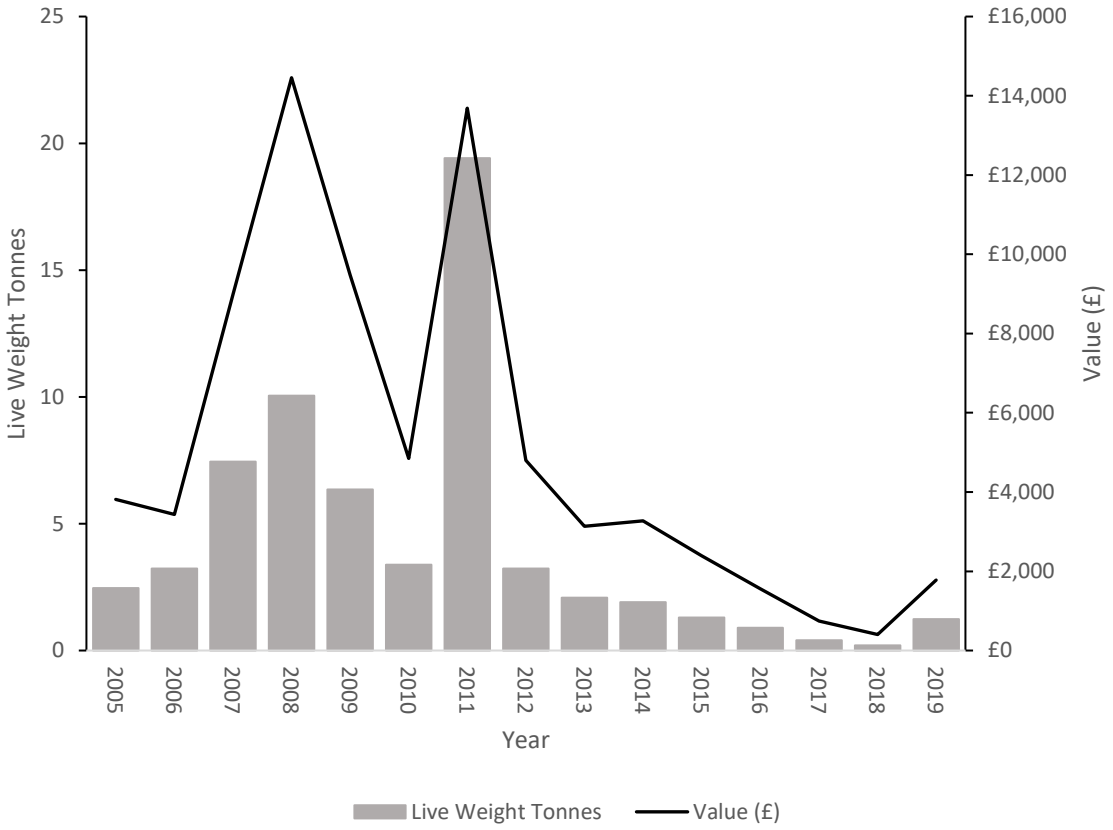

Figure 2. Landings of velvet crab (*Necora puber*) into the Southern IFC District from 2005 to 2019. Data sourced from the Marine Management Organisation (MMO).

Associated management

Velvet crab landings 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 velvet crabs is 65 mm (CW). This size is adhered to nationally.

Additionally, voluntary escape gaps in crab and lobster pots are promoted within the Southern IFC District. Pots are designed to target brown crab and lobster which are considerably larger than velvet crabs. Therefore, escape gaps are sufficiently large enough to allow velvet crabs to escape pots.

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Appendix

Table A. Estimates of size at maturity for velvet crab (*Necora puber*) in studies undertaken in the UK, Ireland and Spain. 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 (CW_{50}), size range of mature individuals and maturity definition used to assess maturity. All sizes based on carapace width (CW) in mm. *long carapace width (including length of long spines)

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 (CW_{50}) (mm)		Age at 50% maturity		Maturity Definition	
		M	F	M	F		M	F	M	F	M	F	M	F		
Plymouth Sound, England	-	-	-	-	-	-	-	-	-	37.3	-	44*	-	-	Behavioural	Norman, 1989
	-	-	-	-	-	-	-	-	-	38.6*	48.5*	46*	-	-	Physiological	
Gower Peninsula, Wales	1901	1212	689	2-43		-	-	-	-	-	54	47.5 - 49.3	1	1	Physiological	Choy, 1988
East coast of Ireland	-	-	-	45-98	48-89	-	-	-	-	-	50	50	1	1	Physiological	Bakir and Healy, 1995
Orkney Islands, Scotland	-	-	-	-	-	524	289	235	-	-	52.8	43.8	-	-	Physiological	Hearn, 2004
Shetland Islands, Scotland	1715	-	-	-		-	-	-	-	-	45	54.2	-	-	Behavioural/ Morphometric	Tallack, 2007
									-	-	-	57.4	-	-	Functional/ Physiological	
Galicia, Spain	986	501	485	-		-	-	-	-	-	54.8	49.8	-	-	Physiological	González-Gurriarán and Freire, 1994
				-					-	-	53.3	52.3	-	-	Morphological	