

Shellfish

Size at Maturity Review

Contents

Introduction	2
American hard-shelled clam (<i>Mercenaria mercenaria</i>)	3
Crawfish (<i>Palinurus spp.</i>)	3
Edible/brown crab (<i>Cancer pagurus</i>)	4
Grooved carpetshell clam (<i>Ruditapes decussatus</i>)	6
Lobster (<i>Homarus gammarus</i>)	7
Manila clam (<i>Ruditapes philippinarum</i>)	9
Razor clam (<i>Ensis spp.</i>)	10
Scallop (<i>Pecten maximus</i>)	11
Spinous spider crab (<i>Maja spp.</i>)	11
Velvet crab (<i>Necora puber</i>)	13
Warty venus clam (<i>Venus verrucosa</i>)	14
Whelk (<i>Buccinum spp.</i>)	15

Introduction

Southern Inshore Fisheries and Conservation Authority (IFCA) has undertaken an extensive literature review, using published and grey literature, based upon 50% size of sexual maturity for commercial and recreational species in the Southern IFC District (“the District”). The information gathered will help inform the IFCA’s Minimum Conservation Reference Sizes (MCRS) Review.

Many commercial species caught within the District are subject to a MCRS, previously known as Minimum Landing Size or Minimum Legal Size. This statutory measure prevents fish or shellfish below a set size from being removed from the fishery and is therefore recognised as an effective tool for the sustainable management of fisheries. A MCRS for a species is often set based upon the size at which 50% of the population reaches maturity. This ensures at least 50% of juveniles have an opportunity to sexually mature and reproduce at least once before potential capture. Additional factors such as market size, existing legislation, stock status and reproductive strategies can also influence whether and how a MCRS is set.

The following tables (1-10) summarise the literature reviewed for 50% size at maturity (SOM) for 13 species of crustacean, mollusc, and gastropod that are listed in Southern IFCA’s ‘Minimum Conservation Reference Size Byelaw’. Tables highlight key information from studies including 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, size at 100% maturity, age at 50% maturity and when relevant maturity definition used to assess maturity. Information for each species varies depending on the available data.

Data for 7 of the 13 species listed below has been incorporated into detailed ‘Species Profiles’ where best available evidence on reproductive biology, life history and the social and economic value of each species has been summarised. Species with a Profile have been indicated below and linked to the IFCA website where all Species Profiles can be downloaded and viewed. The following species were data deficient and thus not included in the below summary of reviews: Queen scallop (*Chlamys spp.*), Sword razor clam (*Ensis ensis*), and Surf clam (*Spisula solida*).

Important information to note about summarised data:

- Maturity length values have been rounded
- Where possible data has been extracted from peer-reviewed scientific literature
- All values are recorded in **mm**
- CW₅₀ - Carapace width at 50% maturity; CL₅₀ - Carapace length at 50% maturity; SL₅₀ - Shell length at 50% maturity
- Descriptions of maturity definitions for crab, lobster and whelk can be viewed in the associated Species Profiles
- Size at maturity estimates may vary between studies due to differences in maturity criteria used, sampling period and sample size
- Species reviewed are listed under Southern IFCA’s MCRS Byelaw. Consultation for this Byelaw took place in 2019/2020 and the Byelaw was made by the Authority in June 2020. At the time of writing this Byelaw is awaiting sign off by the Secretary of State.
- All efforts have been made to review the available literature as thoroughly as possible, however this is not an exhaustive list of maturity data. If you know of a relevant study, please provide details and the information can be incorporated into the review.

American hard-shelled clam (*Mercenaria mercenaria*)

MCRS: 63mm [Species Profile](#)

There is very limited SOM data for the American hard-shelled clam outside of its native range of North America. One study that assessed the population dynamics of the American hard-shelled clam in Southampton Water classed juveniles at 10-35 mm and brood individuals at 35-50 mm (Al-Sayed, 1988). All individuals greater than 50 mm were thought to be mature. Size at 50% maturity was not provided. Eversole (2001) reviewed sexual maturity of the hard-shelled clam across its native distribution and minimum shell length ranged from 20 to 35 mm. In the northern parts of the American hard-shelled clams' distribution, it takes up to three years to reach these sizes whereas in the southern extremes it can take as little as one year (Eversole, 2001). Sexual maturity is a function of size rather than age in this species.

References

Al-Sayed, H.A.Y., 1990. Population studies of a commercially-fished bivalve, *Mercenaria mercenaria* in Southampton Water (England). PhD, University of Southampton, Southampton

Eversole, A.G., 2001. Biology of the hard clam, Chapter 5 Reproduction in *Mercenaria mercenaria*. Kraeuter, J.N., and Castagna, M., (Eds), Elsevier Science B.V

Crawfish (*Palinurus spp.*)

MCRS: 110 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)		Maturity Definition	
				M	F		M	F	M	F	M			F
Brittany (France)	-	-	-	-	80-144	679	-	679 (445)	-	92	-	95	Functional	Latrouite & Noel, 1997
Ireland	-	-	-	-	-	-	-	-	-	-	85	82	Physiological	Mercer (1973) cited in Goñi & Latrouite, 2005
Corsica	-	-	-	-	-	-	-	-	-	-	-	86	Functional	Marin (1987) cited in Goñi & Latrouite, 2005
												76	Physiological	
Western Mediterranean	-	-	-	49-168	46-140	317	125	192	-	72	83	77	Physiological	Goñi et al., 2003
	-	-	-	-	46-140	683	-	683 (575)	-	-	-	77	Functional	

Number of ovigerous (egg bearing) females in brackets.

References

Goñi, R., and Latrouite, D., 2005. Review of the biology, ecology and fisheries of *Palinurus* spp. Species of European waters: *Palinurus elephas* (Fabricius, 1787) and *Palinurus mauritanicus* (Gruvel, 1911). *Cah.Biol.Mar.* 46: 127-142

Goñi, R., Quetglas, A., and Reñones, O., 2003. Size at maturity, fecundity and reproductive potential of a protected population of the spiny lobster *Palinurus elephas* (Fabricius, 1787) from the western Mediterranean. *Marine Biology*, 143: 583-592

Latrouite, D., and Noël, P., 1997. Pêche de la langouste rouge *Palinurus elephas* en France, éléments pour la pêche de la langouste rouge. ICES CM: 1997/BB : 13

Edible/brown crab (*Cancer pagurus*)

MCRS: 140 mm [Species Profile](#)

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)		Maturity Definition	
		M	F	M	F		M	F	M	F	M			F
Studies undertaken in England														
Selsey	-	-	-	-	-	-	-	-	-	-	115	125	-	Cefas, Bennett, 1996; unpubl. In Smith 2010
Norfolk	-	-	-	-	-	-	-	-	-	-	105	110	-	Cefas, Bennett, 1996; unpubl. In Smith 2010
Eastern Channel	-	-	-	-	-	-	-	-	-	-	105	126	Physiological	Cefas, Lawler, 2006; unpubl. In Smith, 2010
Western Channel	-	-	-	-	-	-	-	-	-	-	90	112	Physiological	Cefas, Lawler, 2006; unpubl. In Smith, 2010
North Sea	-	-	-	-	-	-	-	-	-	-	89	90	Physiological	Cefas, Lawler, 2006; unpubl. In Smith, 2010
Bridlington	247	82	165	71-148	80-153	-	-	-	-	80	59	104	Physiological	Haig et al., 2016
Studies undertaken in the Isle of Man, Ireland, Wales and Scotland														
Galway Bay (Ireland)	373	154	219	70-171	66-162	-	-	-	96	79	106	117	Physiological	Haig et al., 2016

Orkney (Scotland)	296	79	217	72-150	79-150	-	-	-	80	88	92	97	Physiological	Haig et al., 2016
Wales	435	229	206	30-220	68-182	-	-	-	63	68	87	103	Physiological	Haig et al., 2016
Isle of Man	274	132	142	67-137	82-152	-	-	-	67	82	85	107	Physiological	Haig et al., 2016
Cork, Donegal, Wexford (Ireland)	-	-	-	-	-	925	274	651	102	124	110-117	133-138	Functional	ICES, 2004
East & West coast of Scotland	1008	-	-	73-211	83-204	-	-	-	-	-	120-148	131-142	Morphological	Mesquita et al., 2020
East & West coast of Scotland	1008	-	-	73-211	83-204	-	-	-	86	110	101-106	127-128	Functional	Mesquita et al., 2020
Isle of Man	-	-	-	-	-	297	82	215	-	-	89	108	Physiological	Öndes et al., 2017
Isle of Man	-	-	-	-	-	309	87	222	-	-	107	155	Morphological	Öndes et al., 2017
Shetland Islands (Scotland)	-	-	-	-	-	208	94	114	-	134	126	134	Functional	Tallack, 2007
Shetland Islands (Scotland)	-	-	-	-	-	812	-	812	-	-	-	123	Behavioural	Tallack, 2007

References

Centre for Environment, Fisheries and Aquaculture Science, Cefas., 2017. Edible crab (*Cancer pagurus*): Cefas stock status report 2017

Haig, J. A., Bakke, S., Bell, M. C., Bloor, I. S. M., Cohen, M., Coleman, M., Dignan, S., Kaiser, M. J., Pantin, J. R., Roach, M., Salomonsen, H., and Tully, O., 2016. Reproductive traits and factors affecting the size at maturity of *Cancer pagurus* across Northern Europe. *ICES Journal of Marine Science*, 73, 2572–2585

ICES, 2004. Report of the study group on the biology and life history of crabs (SGCRAB) ICES living resources committee. ICES CM 2004/G:13, ref.D

Mesquita, C., Dobby, H., Sweeting, S., Jones, C.A., and Pierce, G.J., 2020. Size-at-maturity of brown crab (*Cancer pagurus*) in Scottish waters based on gonadal and morphometric traits. *Fisheries Research*, 229, 105610

Öndes, F., Kaiser, M., and Murray, L., 2017. Relative growth and size at onset of sexual maturity of the brown crab, *Cancer pagurus* in the Isle of Man, Irish Sea. *Marine Biology Research*, 13(2), 237-245. <https://doi.org/10.1080/17451000.2016.1248849>

Tallack, S.M.L., 2007. The reproductive cycle and size at maturity observed in *Cancer pagurus* in the Shetland Islands, Scotland. *Journal of the Marine Biological Association of the United Kingdom*, 87: 1181-1189

Grooved carpetshell clam (*Ruditapes decussatus*)

MCRS: 40 mm

Study location	Total No. surveyed	No. of individuals (n)		Length Data		Total No. of individuals	Size at Maturity Data								Reference		
				Size range (mm)			No. of individuals (n)		Size of smallest mature individual (mm)		Size at 50% maturity (SL ₅₀) (mm)		Size at 100% maturity (mm)			Age at maturity (years)	
		M	F	M	F		M	F	M	F	M	F	M	F		M	F
Tunisia Mediterranean	1290	-	-	2-41		862	-	-	-	-	24	25	27		-	-	Derbali et al., 2016
Ria de Aveiro Lagoon Portugal	-	-	-	-	-	480	240	240	-	-	20	23	-	-	-	-	Maia et al., 2015

References

- Derbali, A., Taieb, A., Kammoun, W., Gouirah, J., Wannes-Ghorbel, A., Zamouri-Langar, N., ... Jarboui, O., 2016. Stock assessment, spatial distribution and biological parameters of the clam *Venerupis decussata* along the Sfax coasts (Tunisia, Central Mediterranean). *Journal of the Marine Biological Association of the United Kingdom*, 96(1); 177-184
- Maia, F., Barroso, C., and Gaspar, M., 2015. Reproductive cycle, condition index and size at first maturity of the grooved carpet shell clam *Ruditapes decussatus* (Linnaeus, 1758) in Ria de Aveiro lagoon (NW Portugal). [Poster] 10.13140/RG.2.2.15660.41607

Lobster (*Homarus gammarus*)

MCRS: 87 mm [Species Profile](#)

Maturity method key: CPI - Crusher Propodite Index; AI - Anderson Cheliped Index; Gonad – gonad stages assessed; Ovigerous – observation of berried females; AW: Abdominal width/Carapace length ratio. F – female; M – Male. Please refer to the Species Profile for more information about maturity definitions.

Study location	Total No. of individuals surveyed	No. of individuals (n)		Length Data		Size at Maturity Data								Maturity Definition	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 at 100% maturity (mm)			
				M	F		M	F	M	F	M	F	M			F
Studies undertaken in England																
Portland	1009	542	467	52-148	47-145	-	-	-	-	-	-	81*	121-125	111-115	M: CPV F: AW	Crosse, 2004
													96-100	-	M: CPI	Crosse, 2004
Mudford	1578	808	770	35-135	55-146	-	-	-	-	80*	76*	96-100	101-105	F: AW M:CPV	Hampton, 2002	
Selsey	-	-	-	-	-	-	-	-	76	-	83	-	-	Gonads & Ovigerous	Free et al., 1992	
Bridlington	-	-	-	-	-	-	-	-	81	-	90	-	-	Gonads & Ovigerous	Free et al., 1992	
Northumberland	8831	4062	4769	-	-	-	-	-	-	-	84	-	-	AW	Woodruff, 2017	
											93	-	-	Ovigerous		
Yorkshire offshore	2437	-	2437	-	-	-	-	-	-	-	100	-	-	Ovigerous	Wood, 2018	
Yorkshire Quayside	4239	-	4239	-	-	-	-	-	-	-	93	-	-	Ovigerous	Wood, 2018	
Studies undertaken in Wales, Scotland and Ireland																
Dale Wales	-	-	-	-	-	-	-	-	95	-	100	-	-	Gonads & Ovigerous	Free et al., 1992	
North West Ireland	-	-	-	-	66-114	129	-	129	-	-	-	96	-	-	Gonads & AW	Tully et al., 2001
South East Ireland	-	-	-	-	75-127	118	-	118	-	-	-	95	-	-	Gonads & AW	Tully et al., 2001
South West Ireland	-	-	-	-	61-121	108	-	108	-	-	-	94	-	-	Gonads & AW	Tully et al., 2001
West Ireland	-	-	-	-	70-115	91	-	91	-	-	-	93	-	-	Gonads & AW	Tully et al., 2001

Firth of Forth Scotland	1166	555	611	-	-	-	-	-	-	-	80	79	-	-	M: CPI & AI F: AW	Lizárraga- Cubedo et al., 2003
Hebrides Scotland	588	264	324	-	-	-	-	-	-	-	98	100	-	-	M: CPI & AI F: AW	Lizárraga- Cubedo et al., 2003
Studies undertaken outside British and Irish waters																
Le Croisic France	16884	-	-	-	-	-	-	-	-	91	-	103- 106	-	115	Ovigerous	Laurans et al., 2009
Le Conquet France	1788	-	1788	-	-	-	-	-	-	-	-	99	-	-	Ovigerous	Latrouite et al., 1981
Bay of Biscay France	1635	-	1635	-	-	-	-	-	-	-	-	98	-	-	Ovigerous	Latrouite et al., 1981

*It is not clear whether values relate to 50% maturity or first maturity

References

- Crosse, W., 2004. An assessment of the offshore *Homarus gammarus* fishery operating from Weymouth, UK with respect to sex ratio, size frequency distribution, size at sexual maturity and the implications of a raised minimum landing size. Masters Thesis, University of Southampton, Southampton
- Free, E.K., Tyler, P.A., and Addison, J.T., 1992. Lobster (*Homarus gammarus*) fecundity and maturity in England and Wales. ICES Document CM 1992/K:43
- Hampton, P.A., 2002. Comparison of *Homarus Gammarus* catches between the years 1992, 1993 and 2002 with respect to size frequency distribution, size at maturity and the effects of the implementation of a raised minimum landing size. Masters Thesis, University of Southampton, Southampton
- Latrouite, D., Leglise, M., and Taguenes, G., 1981. Données sur la reproduction et taille de première maturité du homard *Homarus gammarus* (L.) d'Iroise et du golfe de Gascogne. ICES Document CM 1981/K: 28
- Laurans, M., Fifas, S., Demaneche, S., Brérette, S., and Debec, O., 2009. ICES Journal of Marine Science, 66 (9): 1892-1898
- Lizárraga-Cubedo, H.A., Tuck, I., Bailey, N., Pierce, G.J., and Kinnear, J.A.M., 2003. Comparisons of size at maturity and fecundity of two Scottish populations of the European lobster, *Homarus Gammarus*. Fisheries Research, 65: 137-152
- Tully, O., Roantree, V., and Robinson, M., 2001. Maturity, fecundity and reproductive potential of the European lobster (*Homarus gammarus*) in Ireland. Journal of the Marine Biological Association of the United Kingdom, 81: 61-68
- Wood, J.M., 2018. New estimates and complications in the assessment of female functional maturity for the European lobster (*Homarus gammarus*) on the Yorkshire Coast (UK). Journal of Fisheries. DOI: 10.17017/jfish.v6i2.2018.282
- Woodruff, J., 2017. Report: stock assessment – An evaluation of the minimum landing size and the pot limitation byelaw in the Northumberland lobster fishery. Masters Thesis, Newcastle University, Newcastle

Manila clam (*Ruditapes philippinarum*)

MCRS: 35 mm [Species Profile](#)

Note – values for ‘Size at Maturity’ refer to size at first maturity unless annotated with the following: L₅₀ size at 50% maturity; *87.5% of sample mature at this size; **56.3% of sample mature at this size.

Study location	Total No. 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 maturity (mm)		Age at maturity (years)		
		M	F	M	F		M	F	M	F	M	F	M		F
Southampton Water England	83	-	-	-	-	-	-	-	18	20	25-30*		-	-	Tumnoi, 2012
France	-	-	-	-	-	-	-	-	-	-	15-20		1	-	Devauchelle 1990, cited in Ponurovsky and Yakovlev, 1992
Tagus Portugal	-	-	-	-	-	88	-	-	28		29L ₅₀		<1		Moura et al., 2018
Simpo Korea	-	-	-	9-55		135	135	0	-	-	17 L ₅₀	-	1	-	Chung et al., 2013
Gomso Bay Korea	-	-	-	8-55		123	-	-	-	10 - 15	-	15 - 20**	-	-	Chung et al., 2005
Possjet Bay Sea of Japan	148	-	-	-	-	-	-	-	7-8		10-15	15-20	1	-	Ponurovsky and Yakovlev, 1992
Vostok Bay Sea of Japan	3031	-	-	-	-	-	-	-	-	-	20-30		-	-	Ponurovsky and Yakovlev, 1992
Melkovodnaya Bay & Olga Bay Sea of Japan	~190	-	-	-	-	-	-	-	-	-	30-35		-	-	Ponurovsky and Yakovlev, 1992

References

- Chung, E.Y., Hur, Y.B., Shin, M.S., and Kim, Y.M., 2005. Reproductive biology of the female manila clam, *Ruditapes philippinarum* (Bivalvia: Veneridae) on the West Coast of Korea. *Korean Journal of Malacology*, 21(1): 1-11
- Chung, E.Y., Chung, J.S., and Lee, K.Y., 2013. Gametogenic cycle, the spawning season, first sexual maturity, and the biological minimum size in male *Ruditapes philippinarum* (Bivalvia:Veneridae) in Western Korea. *Journal of Life Sciences*, 7(6): 613-622

Moura, P., Vasconcelos, P., Pereira, F., Chainho, P., Costa, J.L., and Gaspar, M.B., 2018. Reproductive cycle of the Manila clam (*Ruditapes philippinarum*): an intensively harvested invasive species in the Tagus Estuary (Portugal). *Journal of the Marine Biological Association of the United Kingdom*, 98(7): 1645-1657

Ponurovsky, S.K., and Yakovlev, Y.M., 1992. The reproductive biology of the Japanese littleneck, *Tapes philippinarum* (Adams and Reeve, 1850) (*Bivalvia: Veneridae*). *Journal of Shellfish Research* 11, 265–277

Turnoi, W., 2012. The autecology of *Tapes philippinarum* (Adams and Reeve, 1850) in Southampton Water, UK. PhD Thesis, University of Southampton, Southampton

Razor clam (*Ensis spp.*)

MCRS: 100 mm

Study location	Total No. 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 (SL ₅₀) (mm)		Size at 100% maturity (mm)		Age at maturity (years)		
				M	F		M	F	M	F	M	F	M	F	M		F
<i>Ensis siliqua</i>																	
Irish Sea	450	-	-	128-214		371	202	169	-	-	-	-	-	-	-	-	Cross et al., 2014
Clyde Sea West Scotland	-	-	-	-		-	-	-	118		-	-	131-140		-	-	Muir and Moore, 2003
Vilamoura Portugal	2461	1235	1226	-		100	-	-	-	-	60-100*				1**	Gaspar and Monteiro, 1998	
<i>Ensis arcuatus</i>																	
Co Galway Ireland	-	-	-	5-170		-	-	-	85	-	-	-			2-3		Fahy et al., 2001
Clyde Sea West Scotland	-	-	-	-		-	-	-	73		81-90		121-130		4-5		Muir and Moore, 2003

*size range of mature specimens sampled **all species sampled mature at 1 year old

References

Cross, M.E., O'Riordan, R.M., and Culloty, S.C., 2014. The reproductive biology of the exploited razor clam, *Ensis siliqua*, in the Irish Sea. *Fisheries Research*, 150: 11-17

Fahy, E., Norman, M., Browne, R., Roantree, V., Pfeiffer, N., Stokes, D., Carroll, J., and Hannaffy, O., 2001. Distribution, population structure, growth and reproduction of the razor clam *Ensis arcuatus* (Jeffreys) (Solenaceae) in coastal waters of western Ireland. *Irish Fisheries Investigations No.10*

Gaspar, M.B., and Monteiro, C.C., 1998. Reproductive cycles of the razor clam *Ensis siliqua* and the clam *Venus striatula* off Vilamoura, Southern Portugal. *Journal of the Marine Biological Association of the United Kingdom*, 78: 1247-1258

Muir, S.D., and Moore, P.G., 2003. Too close a shave for razor clams? *Shellfish News*, 15: 7-9

Scallop (*Pecten maximus*)

MCRS: Area 1: 110 mm

Area 2: 100 mm

Very few studies could be found for 50% maturity for king scallops. Based on an unpublished Cefas report maturity is assumed to be knife-edged at 80 mm shell height with 50% mature at 90 mm.

References

Lawler, A., Masefield, R., and Wynne, S., 2019. Assessment of scallop stock status for selected waters around the English Coast 2017/2018. Cefas

Spinous spider crab (*Maja spp.*)

MCRS: Male: 130 mm Female: 120mm [Species Profile](#)

Study location	Total No. of individuals surveyed	No. of individuals (n)		Length Data		Size at Maturity Data								Maturity Definition	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)		Size at 100% maturity (mm)			
				M	F		M	F	M	F	M	F	M			F
Magharees Ireland	1514	949	565	-	-	-	-	-	-	-	-	110	-	-	Functional	Fahy,2000
Galicia Spain	14,983	7,430	7,553	-	-	-	-	-	-	96	-	-	-	-	Physiological	Corgos and Freire, 2006
										137	130	-	-	Morphological	Corgos and Freire, 2006	
Galicia Spain	-	-	-	112-220	114-142	-	-	-	-	133	130	-	-	Morphological Functional	Sampedro et al., 1999	
Galicia Spain	5,365	2,843	2,522	-	-	-	-	-	-	-	130	-	-	Functional	González-Gurriarán et al., 1993	
Corsica	-	-	-	-	-	21	-	21	-	-	-	104	-	-	Morphological Physiological	Duran et al., 2013
Gulf of Gabes Tunisia	770	478	292	23-87		-	-	-	-	54	52	-	-	Physiological	Baklouti et al., 2015	

References

- Baklouti, S., Ben Abdallah Ben Hadj Hamida, O., Jarboui, O., 2015. Reproductive biology of the spider crab *Maja squinado* (Herbst, 1788) (Decapoda: Majidae) in the Gulf of Gabès (Tunisia, Central Mediterranean). *Cha. Biol. Mar*, 56: 337-347
- Corgos, A., and Freire, J., 2006. Morphometric and gonad maturity in the spider crab *Maja brachydactyla*: a comparison of methods for estimating size at maturity in species with determinate growth. *ICES Journal of Marine Science*, 63: 851-859
- Durán, J., Palmer, M., Pastor, E., 2013. Growing reared spider crabs (*Maja squinado*) to sexual maturity: the first empirical data and a predictive growth model. *Aquaculture*, 408-409: 78-87
- Fahy, E., 2000. The Magharees spider crab *Maja squinado* fishery in 2000. Marine Fisheries Services Division, Marine Institute, Dublin
- González-Gurriarán E., Fernández, L., Freire, J., Muiño, R., and Parapar, J., 1993. Reproduction of the spider crab *Maja squinado* (Brachyura: Majidae) in the Southern Galician Coast (NW Spain). Shellfish Committee ICES C.M. 1993/K:19
- Sampedro, M.P., González-Gurriarán, E., Freire, J., and Muiño, R., 1999. Morphometry and sexual maturity in the spider crab *Maja squinado* (Decapoda: Majidae) in Galicia, Spain. *Journal of Crustacean Biology*, 19(3): 578-592

Velvet crab (*Necora puber*)

MCRS: 65 mm [Species Profile](#)

Study location	Total No. of individuals surveyed	No. of individuals (n)		Length Data		Total No. of individuals	No. of individuals (n)		Size at Maturity Data				Maturity Definition	Reference		
				Size range (mm)					Size of smallest mature individual (mm)		Size at 50% maturity (CW ₅₀) (mm)				Age at 50% maturity	
				M	F				M	F	M	F			M	F
Plymouth Sound England	-	-	-	-	-	-	-	-	-	37	-	44*	-	-	Behavioural	Norman, 1989
	-	-	-	-	-	-	-	-	-	39*	49*	46*	-	-	Physiological	
Gower Peninsula Wales	1901	1212	689	2-43		-	-	-	-	-	54	48-49	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	-	-	53	44	-	-	Physiological	Hearn, 2004
Shetland Islands Scotland	1715	-	-	-	-	-	-	-	-	-	45	54	-	-	Behavioural/ Morphometric	Tallack, 2007
									-	-	-	57	-	-	Functional/ Physiological	
Galicia Spain	986	501	485	-	-	-	-	-	-	-	55	50	-	-	Physiological	González-Gurriarán and Freire, 1994
				-	-				-	53	52	-	-	Morphological		

References

- Bakir, W.M.A., and Healy, B., 1995. Reproductive cycle of the velvet swimming crab *Necora puber* (L.0 (Decapoda, Brachyura, Portunidae) on the east coast of Ireland. Irish Fisheries Investigations. Series B (Marine) No. 43 1995
- Choy, S.C., 1988. Reproductive biology of *Liocarcinus puber* and *L.holsatus* (Decapoda, Brachyura, Portunidae) from the Gower Peninsula, South Wales. *Marine Ecology*, 9 (3): 227-241
- Hearn, A., 2004. Reproductive biology of the velvet swimming crab, *Necora puber* (Brachyura: Portunidae), in the Orkney Islands, UK, *Sarsia: North Atlantic Marine Science*, 89:5, 318-325
- Norman, C.P., 1989. Ecology of the velvet swimming crab *Liocarcinus puber* (L.) (Brachyura: Portunidae). PhD Thesis, Plymouth Polytechnic, Plymouth

González-Gurriarán, E., and Freire, J., 1994. Sexual maturity in the velvet swimming crab *Necora puber* 9Brachyura, Portunidae): morphometric and reproductive analyses. ICES Journal of Marine Science, 51: 133-145

Tallack, S.M.L., 2007. The reproductive cycle and size at maturity observed in the velvet swimming crab, *Necora puber*, in the Shetland Islands, Scotland. Journal of the Marine Biological Association of the United Kingdom, 87; 1161-1168

Warty venus clam (*Venus verrucosa*)

MCRS: 40 mm

Study location	Total No. surveyed	No. of individuals (n)		Length Data		Total No. of individuals	No. of individuals (n)		Size at Maturity Data						Reference		
				Size range (mm)					Size of smallest mature individual		Size at 50% maturity (SL ₅₀) (mm)		Size at 100% maturity (mm)			Age at maturity (years)	
		M	F	M	F		M	F	M	F	M	F	M	F			
Kastela Bay Adriatic	750	-	-	-	-	390	-	-	-	-	26		-	-	-	-	Popović et al., 2013

References

Popović, Z., Mladineo, I., Ezgeta-Balić, D., Trumbić, Z., Vrgoč, N., and Peharda, M., 2013. Reproductive cycle and gonad development of *Venus verrucosa* L. (Bivalvia: Veneridae) in Kaštela Bay, Adriatic Sea. Marine Biology Research: 9(3): 274-284

Whelk (*Buccinum spp.*)

MCRS: 45 mm [Species Profile](#)

Maturity methods key: Visual - an assessment of the differentiation of the digestive whorl; PL - penis length; and Histology – microscopic analysis. Refer to the Species Profile for more information.

Study location	Total No. of individuals surveyed	No. of individuals (n)		Length Data		Size at Maturity Data								Maturity Method	Reference		
				Size range (mm)		Total No. of individuals	No. of individuals (n)		Size of smallest mature individual (mm)		Size at 50% maturity (SL ₅₀) (mm)		Age at 50% maturity (years)				
		M	F	M	F		M	F	M	F	M	F	M			F	
Studies undertaken inside the Southern IFCA District																	
Portsmouth	98	58	40	-	-	-	-	-	-	-	57	-	-	-	PL	Bell and Walker, 1998	
Portsmouth	294	-	-	-	-	-	-	-	-	-	46	45	-	-	Visual	McIntyre et al., 2015	
Solent (Nab Tower)	320	146	174	-	-	-	-	-	-	-	55	-	-	-	PL	Bell and Walker, 1998	
Poole	310	-	-	-	-	-	-	-	-	-	66	64	-	-	Visual	McIntyre et al., 2015	
Weymouth	339	-	-	-	-	-	-	-	-	-	59	55	-	-	Visual	McIntyre et al., 2015	
Studies undertaken inside the English Channel (excl. SIFCA district)																	
Selsey	254	-	-	-	-	-	-	-	-	-	65	60	-	-	Visual	McIntyre et al., 2015	
Eastbourne	243	-	-	-	-	-	-	-	-	-	51	57	-	-	Visual	McIntyre et al., 2015	
Exmouth	1600*	-	-	-	-	-	-	-	-	59	59	71	69	-	-	Visual	DSIFCA, 2015
Exmouth	245	-	-	-	-	-	-	-	-	-	69	72	-	-	Visual	McIntyre et al., 2015	
Jersey	277	-	-	-	-	-	-	-	-	-	61	57	-	-	Visual	Hollyman, 2017	
Jersey	953	-	-	-	-	-	-	-	-	-	56-63	-	-	-	PL	Morel, 1997	
Start Bay	175	86	89	-	-	-	-	-	-	52	55	64	58	-	-	Visual	DSIFCA, 2016
Eastbourne	497	245	252	-	-	-	-	-	-	-	57	-	-	-	PL	Bell and Walker, 1998	
Worthing	799	343	456	-	-	-	-	-	-	-	56 - 62	-	-	-	PL	Bell and Walker, 1998	

Selsey	387	183	204	-	-	-	-	-	-	-	45	-	-	-	PL	Bell and Walker, 1998
Normandy France	9087	-	-	-	-	-	-	-	49	52	49	52	3	4	Histology	Heude-Berthelin et al., 2011
Studies undertaken outside the English Channel																
Ilfracombe	1600*	-	-	-	-	-	-	-	66	62	76	77	-	-	Visual	DSIFCA, 2015
Lundy	348	-	-	-	-	-	-	-	-	-	76	76	-	-	Visual	McIntyre et al., 2015
Irish Sea	9234	-	-	-	-	2451	-	-	-	-	70	68	-	-	Visual	Emmerson et al., 2018
Whitehaven	397	-	-	-	-	-	-	-	-	-	74	70	-	-	Visual	McIntyre et al., 2015
Wells	833	-	-	-	-	-	-	-	-	-	63	61	-	-	Visual	McIntyre et al., 2015
Inner Cromer Knoll	278	-	-	-	-	-	-	-	-	-	76	78	-	-	Visual	McIntyre et al., 2015
Ramsgate	613	-	-	-	-	-	-	-	-	-	50	53	-	-	Visual	McIntyre et al., 2015
Whitstable	264	-	-	-	-	-	-	-	-	-	62	61	-	-	Visual	McIntyre et al., 2015
Kent & Essex IFCA District	1000	-	-	-	-	-	-	-	-	-	45- 56		-	-	Visual	Hollyman and Richardson 2018
South west Irish Sea	-	-	-	-	-	-	-	-	-	-	63-68	-	6.1 – 7.2	-	Visual	Fahy et al., 2000
North west Ireland	-	-	-	-	-	322	146	176	-	-	83	83	8.9-11.1	8.8-11.1	M -PL F - Histology	Hemer et al., 2006
Shetland Scotland	218	-	-	-	-	-	-	-	-	-	85	83	-	-	Visual	Hollyman, 2017
Wales	5080	-	-	-	-	1659	-	-	-	-	51-76		2.7 - 3		PL	Haig et al., 2015
Menai Strait Wales	900	-	-	-	-	-	-	-	-	-	62	58	-	-	Visual	Hollyman, 2017
Amlwch Wales	151	-	-	-	-	-	-	-	-	-	81	75	-	-	Visual	Hollyman, 2017
Holyhead Wales	107	-	-	-	-	-	-	-	-	-	70	69	-	-	Visual	Hollyman, 2017
Newfyn Wales	107	-	-	-	-	-	-	-	-	-	78	70	-	-	Visual	Hollyman, 2017

References

- Bell, M.C., and Walker, P., 1998. Size at maturity in common whelks *Buccinum undatum* L. in England and Wales. ICES Report CM 1998/CC:9
- DSIFCA, 2015. Determination of the size of maturity of the whelk *Buccinum undatum* within the Devon and Severn IFCA District. Research report KS012015 by Stephenson, K
- DSIFCA, 2016. Determination of the size of maturity of the whelk *Buccinum undatum* within the Devon and Severn IFCA District. Supplementary report: Start Bay. Research report KS012016 by Stephenson, K
- Emmerson, J.A., Haig, J.A., Bloor, I.S.M., and Kaiser, M.J., 2018. The complexities and challenges of conserving common whelk (*Buccinum undatum* L.) fishery resources: spatio-temporal study of variable population demographics within an environmental context. *Fisheries Research*, 204: 125-136
- Haig, J.A., Pantin, J.R., Salomonsen, H., Murray, L.G., Kaiser, M.J., 2015. Temporal and spatial variation in size at maturity of the common whelk (*Buccinum undatum*). *ICES J. Mar. Sci. J. Cons.* 72, 2707–2719
- Hemer, J.A., 2006. An assessment of biological and population parameters of the common whelk, *Buccinum undatum* (L.) in the region of the North West Irish whelk fishery. Masters Thesis, Galway-Mayo Institute of Technology, Ireland
- Heude-Berthelin, C., Hégron-Macé, L., Legrand, V., Jouaux, A., Adeline, B., Mathieu, M., Kellner, K., 2011. Growth and reproduction of the common whelk *Buccinum undatum* in west Cotentin (Channel), France. *Aquat. Living Resour.* 24, 317–327
- Hollyman, P., 2017. Age, growth and reproductive assessment of the whelk, *Buccinum undatum*, in coastal shelf seas. PhD Thesis, Bangor University, Anglesey
- Hollyman, P., Richardson, C., 2018. Age and growth rate of whelks, *Buccinum undatum*, in Kent and Essex waters. Bangor University report funded by Kent and Essex IFCA
- Fahy, E., Masterson, E., Swords, D., and Forrest, N., 2000. A second assessment of the whelk fishery *Buccinum undatum* in the southwest Irish Sea with particular reference to its history of management by size limit. Marine Fisheries Services Division, Marine Institute, Dublin
- McIntyre, R., Lawler, A., Masefield, R., 2015. Size of maturity of the common whelk, *Buccinum undatum*: is the minimum landing size in England too low? *Fish. Res.* 162: 53–57
- Morel, G., 1997. Determination of the size at sexual maturity of the common whelk, *Buccinum undatum*, off the Isle of Jersey (Channel Islands) as a basis for the assessment of the minimum landing size. Masters Thesis, University of Southampton, Southampton