English Channel King Scallops

Research Summary

Bycatch (MSC Principle 2)

Catherall, C. L., Murray, L.G., Bell, E. & Kaiser, M.J.

December 2014

Please cite as follows: Catherall, C.L., Murray, L.G., Bell, E. & Kaiser, M.J. (2014). English Channel King Scallops - Research summary: Bycatch. Bangor University, Fisheries and Conservation Report No. 47, pp. 10.

Marine Stewardship Council (MSC) assessment

The MSC assessment process is divided into three key principles that underpin their mission to recognise and reward sustainable fishing practises. A fishery is assessed and given a score for a number of performance indicators under each principle.

MSC Principle 1 – Sustainable Stocks	A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited populations and for those populations that are depleted the fishery must be conducted in a manner that demonstrably leads to their recovery.
MSC Principle 2 - Environmental Impacts	Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.
MSC Principle 3 – Effective Management	The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Certification requirements

Principle 2 of the MSC assessment criteria states that the fishery should not pose a risk of serious or irreversible harm to, or hinder recovery of, bycatch species or species groups. Main bycatch species should be within biologically based limits. If outside such limits, a full strategy of demonstrably effective mitigation measures is required. Regarding 'Endangered, Threatened or Protected' (ETP) species; the impacts of the fishery should be within limits of national and international requirements for protection of such species, and the fishery should not create unacceptable impacts to ETP species.

Under the framework of the MSC assessment, any species other than the target species present in the catches of the fishery/gear combination in question is considered either 'main' or 'minor' bycatch species. A species is considered main if it comprises 5 % or more by weight of the total catch of all species. The threshold for species classified as 'less resilient' is 2 % of the total catch. Species are not considered 'main' if they are returned to the sea alive; however good evidence of post-capture survival is required.

Background / data requirements

In terms of bycatch, fisheries have the potential to impact not only the target species population but the populations of any other species that are retained by the fishing gear (Suuronen 2005). Eco-labelling bodies such as the Marine Stewardship Council (MSC) specify requirements for the management of a fishery that consider and reduce impacts on bycatch species, whether retained or discarded. Based on MSC certification requirements, the specific research objectives were to:

a) Quantify the biomass and relative contribution, by weight, of all species retained in king scallop dredge catches in the English Channel
b) Identify 'main' bycatch species (those contributing > 5 % of catch weight) and any ETP species that may be present in catches.
c) Compare scallop dredge bycatch in the English Channel with bycatch from scallop fisheries across ICES Area VII; in the Irish and Celtic Seas.

Action

Sampling trips were conducted on board commercial scallop vessels across the eastern and western English Channel (Figure 1). Samples were taken from tows during normal scallop dredging activity. For each haul sampled, the full contents of one or two dredges were retained for sampling. All organisms were identified and body length and/or count of each individual/species was recorded. For species where body length measurements were impractical (e.g. starfish, dead man's fingers) count was recorded. It was also noted whether individuals were retained or discarded. Additional data was obtained from Cefas for scallop observer trips in the English Channel that took place between September 2011 and October 2012. King scallop dredge bycatch data from Cardigan Bay, Wales and Manx territorial waters were obtained from the Fisheries and Conservation Group, Bangor University.

Published data on standard length/weight relationships was used to calculate the total biomass of each species for which a length measurement was taken. For species where only count data was available the mean weight of an individual was calculated from data collected during a recent scientific survey. Area swept was calculated as the total width of the dredges multiplied by tow length. The total biomass of each species per tow was then calculated, by raising the biomass recorded to the total number of dredges used and values were standardised to kg km^{-2}. As each trip occurred in one localised area of the seabed, the mean biomass of each species retained per trip was calculated by pooling the data from all hauls. These values were used to ascertain the proportion of the total catch weight contributed by each species.

Environmental data (depth, tidal bed shear stress, seabed temperature range, mean seabed temperature) were obtained for each sample site and a principal components analysis was used to identify sites with similar environmental conditions.

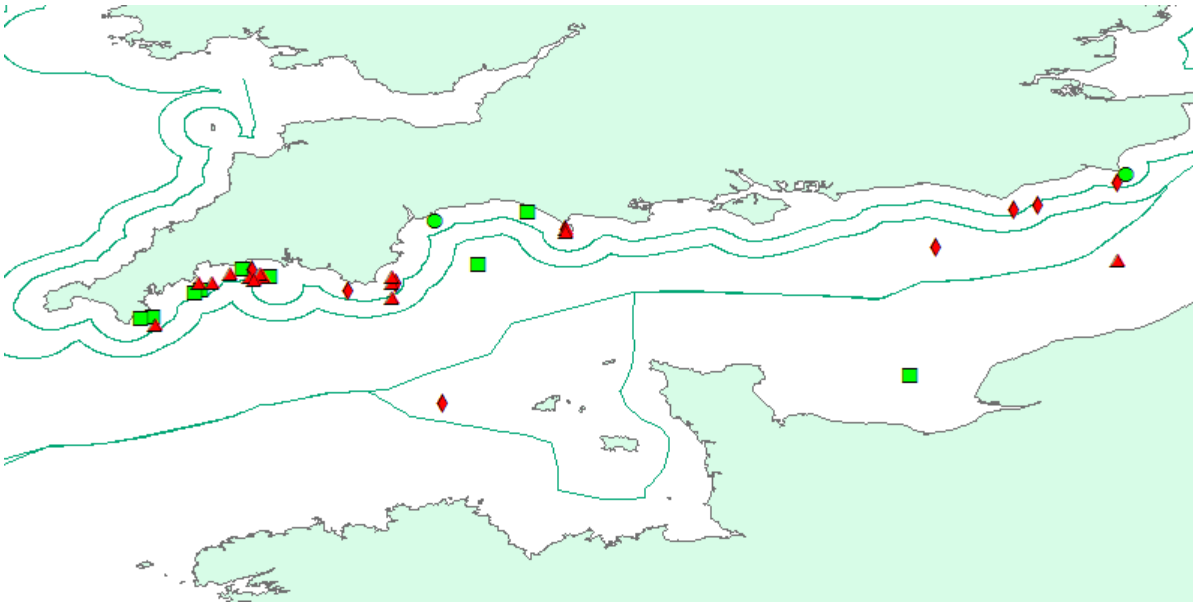

Figure 5.1: Location of the 34 sample sites in the English Channel. Sites sampled by the author indicated by green squares (spring/summer) and green circles (autumn/winter). Sites from Cefas observer trips indicated by red triangles (spring/summer) and red diamonds (autumn/winter). The English 6 and 12 NM limits, and the boundary between English/French territorial waters are shown.

Results

Three groups of sample sites (referred to as A, B & C) were identified that had similar environmental conditions; 64 % of the variation between sample sites was attributable to the four environmental variables (see above). Bycatch species contributed between 8 and 37 % to total catch weight, with an average of 19 % across all trips. The mean number of species retained per dredge sample was 10.1 (±3.8). The proportion of bycatch biomass between groups A, B and C was similar, despite the observed variation in environmental conditions (ANOVA: $F=0.237_{2, 7}$, p=0.795) (Figure 2).

P. maximus dominated catches, accounting for an average of 81 % of total catch weight. Sixteen further species contributed to the top 99 % of the total biomass across sites (Table 1). The queen scallop, *A. opercularis*, contributed the second highest mean biomass to dredge catches, and was the only species that constituted on average >5 % of the total catch weight. Species composition was significantly different between all sites, except for two sites with the closest proximity to each other. Total bycatch biomass was lower in the English Channel than Cardigan Bay, Wales and the Isle of Man (Table 2).

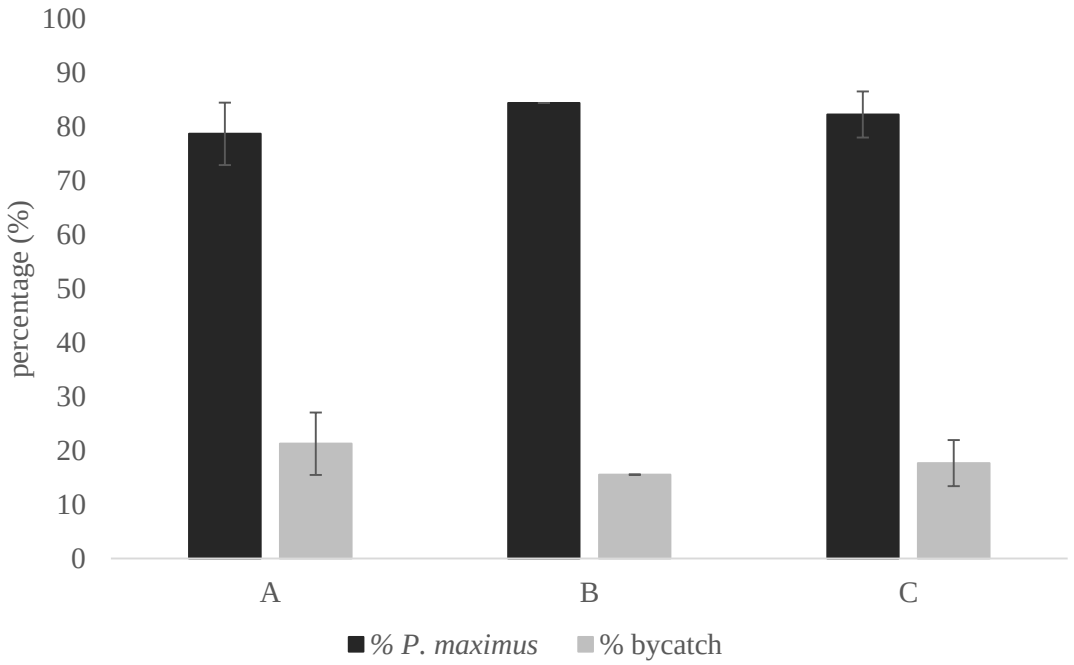

Figure 2: The proportional biomass of *P. maximus* and bycatch species in scallop dredge catches from three groups of sample sites in the English Channel (A, B, C). Sites were grouped based on similarity in environmental conditions. Standard error bars are shown for groups A and C. Group B contains only two sites, therefore calculation of standard deviation and standard error was not possible. Mean total biomass of the catches for groups A, B & C was 2068, 2822 and 1169 kg km^{-2} respectively.

ETP species

Raja clavata is classified as 'near threatened' on the ICUN red list (ICUN 2014). Eight of the recorded bycatch species are subject to TACs in the English Channel (Council of the EU, 2014). These are: thornback, undulate and cuckoo rays; Dover sole, megrim, plaice, turbot and monkfish. Of all the above species, turbot and monkfish were the only two species that accounted for >5 % of catches, each at only one site.

Table 1: Mean biomass of the species contributing to the top 99 % of biomass caught across all trips. Species of commercial importance in the English Channel are indicated by bold text. Cum. = cumulative.

species	common name	mean biomass (kg km^{-2})	mean % of catch	cum. %
Pecten maximus	**king scallop**	1476.33	81.0	81.0
Aequipecten opercularis	**queen scallop**	130.20	6.1	87.1
Marthasterias glacialis	spiny starfish	82.96	3.5	90.6
Maja squinado	**spiny spider crab**	26.96	1.4	92.0
Sepia officinalis	**cuttlefish**	26.29	1.3	93.3
Cancer pagurus	**brown crab**	15.99	1.1	94.4
Lophius piscatorius	**monkfish**	15.77	1.0	95.4
Asterias rubens	common starfish	20.65	1.0	96.4
Luidia ciliaris	seven-armed starfish	13.74	0.8	97.3
Buccinum undatum	**common whelk**	6.70	0.3	97.6
Ostrea edulis	**common flat oyster**	5.41	0.3	97.9
Raja clavata	**thornback ray**	4.96	0.2	98.1
Solea	**Dover sole**	3.20	0.2	98.3
Scyliorhinus canicula	small spotted catshark	3.51	0.2	98.5
Scophthalmus maximus	**turbot**	2.69	0.2	98.7
Pleuronectes platessa	**plaice**	2.41	0.2	98.8
Echinus esculentus	common sea urchin	1.78	0.1	99.0

Table 2: Mean number of species, total catch biomass and species diversity for scallop dredge catches from five UK fisheries. S.D.=standard deviation; n=number of samples.

Area	n	number of species		biomass (kg km^{-2})	
		mean	S.D.	mean	S.D.
Cardigan Bay	57	9.0	4.0	5677.53	5151.17
Isle of Man	20	18.9	9.2	5284.44	3052.84
English Channel (A)	59	10.8	3.1	2314.31	804.60
English Channel (B)	14	7.3	4.7	2580.51	967.11
English Channel (C)	26	10.3	5.1	1228.02	495.55

Discards

The mean biomass of scallops discarded due to being below the minimum landing size (110 mm in VIId and 100 mm in area VIIe) ranged from 1.5 – 52.9 % per trip. The mean proportion discarded was 20 % in area VIId (eastern English Channel) and 27 % in area VIIe (western English Channel) respectively (Figure 3).

The mean proportion of commercial finfish and shellfish biomass (not including king scallops) discarded during a trip ranged from 18-100 %. The mean biomass of finfish and commercial shellfish retained per haul across all trips was 36 kg km^{-2} (Figure 4). The mean biomass discarded per trip was higher in the eastern English Channel (135 kg km^{-2}) than the western English Channel (66 kg km^{-2}), although the difference was not significant at the 5 % level (t=1.375, d.f=6.75, p=0.213) due to a large degree of variation in discarded biomass in the eastern English Channel. The higher discards in Area VIId were largely attributed to three species; plaice, cuttlefish and the spiny spider crab.

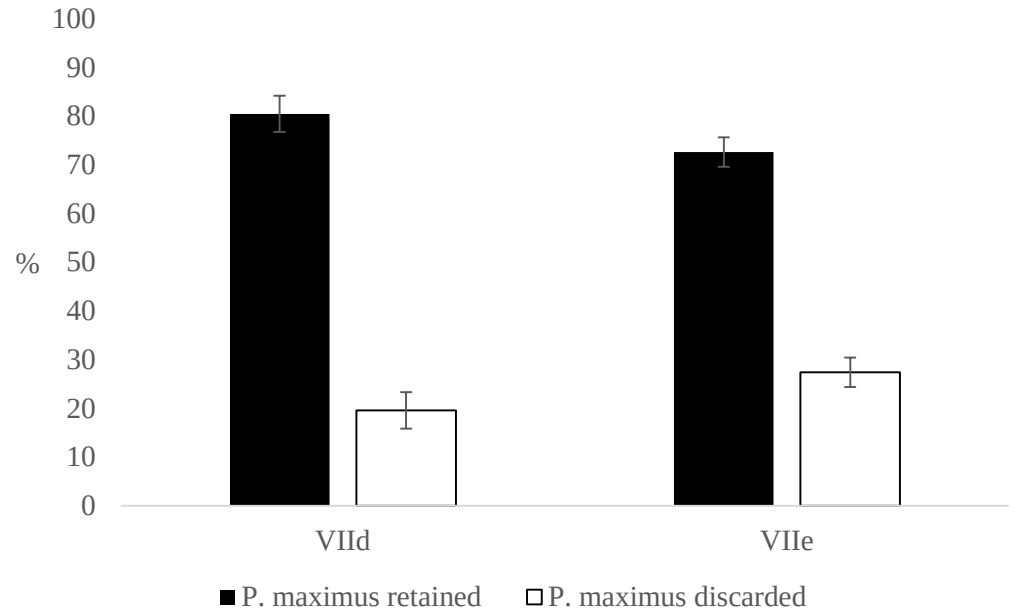

Figure 3: Mean proportion of *P. maximus* in dredge catches that were retained or discarded. Error bars represent one standard error of the mean.

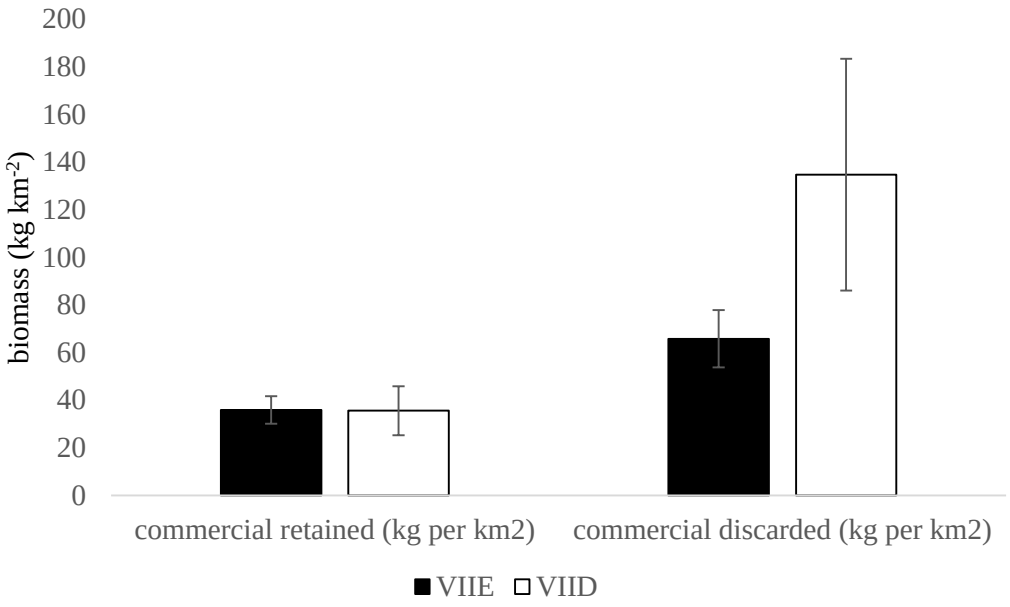

Figure 4: Mean biomass (kg km^{-2}) of finfish and commercial shellfish retained and discarded in the eastern (VIId) and western (VIIe) English Channel. Error bars represent one standard error of the mean.

Management recommendations

Overall, scallop dredge catches in the English Channel king scallop fishery comprise 19 % by weight of bycatch. The proportion of bycatch was similar across all areas sampled, however discards of finfish and commercial shellfish were higher in the eastern English Channel mainly due to a high biomass of cuttlefish, plaice and spider crabs.

Scallop dredge bycatch is dominated by commercially important (spiny spider crab, monkfish, queen scallop, brown crab and cuttlefish), rather than non-commercial species, with the exception of the spiny starfish, *Marthasterias glacialis* that was prevalent in catches. Other types of bycatch species included a number of flatfish and finfish species, starfish, echinoderms, small crustaceans, bivalves, hydroids and bryozoans. The individual proportion of each of these species in catches was low. Low catches of commercial fish species may relate to low local abundance of those species (Craven *et al.* 2013). However, where the boundaries of scallop and demersal beam trawl fisheries overlap, particularly in the western English Channel, this suggests a low catch susceptibility of ground fish and commercially important shellfish species to scallop dredges. Plaice, Dover sole and oysters are classified as species 'of principal importance for the purpose of conserving biodiversity' under the UK Biodiversity Action Plan. Each of these species contributed <0.5 % of overall catch biomass from scallop fisheries in the English Channel, therefore the scallop fishery is unlikely to be a major concern in the preservation of these species. Management should combine data on local abundances with predicted mortality from all relevant fisheries to ensure no single species is at risk of population decline.

Bycatch from scallop fisheries can vary between location, vessel, gear configuration, season, environmental and weather conditions, tow duration, trip and haul. Seasonal variations in fish abundance and behaviour are also likely to influence the prevalence of certain species in catches (Wilberg *et al*. 2010). Bycatch can be reduced by identifying hotspots or certain times or year when bycatch species are more prevalent, or more susceptible to capture, and implementing appropriate spatial or seasonal area closures. Such measures also serve to reduce overall fishing effort.

Due to inherent variation in bycatch assemblages, coupled with seasonal variation in abundance of certain species (e.g. Veale *et al*. 2001), accurate estimates of bycatch can only be obtained through regular sampling, covering an appropriate spatial and temporal scale. Although the results of the present study indicate that overall bycatch in the English Channel king scallop fishery is low and there are few commercial species that warrant concern or additional consideration in fishery management plans, regular monitoring is recommended. Bycatch can be reduced further by using improved fishing gear designs that reduce the capture of, and impacts on, organisms (Catherall & Kaiser 2014).

Acknowledgements

Many thanks to the numerous vessel owners and skippers who accommodated sampling trips. This work was funded by members of the UK Scallop Association, Morrisons and the Fishmongers Company, in collaboration with CEFAS.

This document is a non-technical summary of research undertaken as part of a PhD at Bangor University. The full manuscript will be available as the submitted PhD thesis in 2015.

Author contact

Claire Catherall: c.catherall@bangor.ac.uk

References

Catherall, C.L. & Kaiser, M.J. (2014). Review of king scallop dredge designs and impacts, legislation and potential conflicts with offshore wind farms. *Fisheries & Conservation Report* No. 39, Bangor University. pp. 40.

Council Regulations (EU) No 1262/2012 of 20 December 2012, No 713/2013 of 23 July 2013, No 1180/2013 of 19 November 2013, No 24/2014 of 10 January 2014, No 43/2014 of 20 January 2014, No 315/2014 of 24 March 2014 and No 432/2014 of 22 April 2014. Accessed at: http://ec.europa.eu/fisheries/cfp/fishing_rules/tacs/index_en.htm

Craven, H. R., Brand, A. R. and Stewart, B. D. (2013). Patterns and impacts of fish bycatch in a scallop dredge fishery. *Aquatic Conservation: Marine and Freshwater Ecosystems* 23: 152–170.

ICUN (2014). *IUCN Red List of Threatened Species*. Version 2014.3. Accessed at: www.iucnredlist.org

Suuronen, P. (2005). *Mortality of fish escaping trawl gears*. FAO Fisheries Technical paper 478. Rome, pp. 72.

Veale, L.O., Hill, A.S., Hawkins, S.J., Brand, A.R. (2001). Distribution and damage to the by-catch assemblage of the northern Irish Sea scallop dredge fisheries. *Journal of the Marine Biological Association of the UK* 81: 85–96.

Wilberg, M.J, Thorson, J.T., Linton, B.C., Berkson, J (2010). Incorporating Time-Varying Catchability into Population Dynamic Stock Assessment Models. *Reviews in Fisheries Science* 18(1): 7–24.