Report supporting Appropriate Assessment of a Fisheries Natura Plan for Cockle (2021 – 2025) in Dundalk Bay SAC and SPA

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Contents

Section 1 – Introduction

This document assesses the potential ecological effects of a proposed Fishery Natura Plan (FNP) for cockle (*Cerastoderma edule*) on designated habitats and species in Dundalk Bay SAC and SPA. The proposed plan is 5 years in duration (2021-2025) and was submitted by the Dundalk Bay Cockle Fishermen's permit holders to the Department of Agriculture Food and Marine (DAFM) in March 2021. Pursuant to Article 4(1) of S.I. 290 of 2013 DAFM requested that the Marine Institute undertake an Appropriate Assessment of the plan. Other fishing activities that may interact with the cockle fishery, namely fishing for razor clams (*Ensis siliqua*), on the designated features of the site are also considered in an in combination assessment with the cockle fishery.

The assessment provides analysis of potential impacts of fishing activities on the conservation objectives and targets for the habitats and species in the SAC and the species of conservation interest (waterbirds and seabirds) in the SPA. It is supported by a number of Annexes which provide technical details and analysis to support the findings of the assessment:

Annex I: The cockle fishery natura plan (FNP), Dundalk Bay 2021-2025
Annex II: Effects of cockle fishing on habitats in Dundalk Bay
Annex III: Review of the Dundalk Bay cockle FNP 2016-2020
Annex IV: Distribution of waterbirds in relation to cockle fishing 2010
Annex V: Dundalk Bay report of aerial surveys January 2019

Section 2 – The proposed Cockle Fishery Natura Plan

Target species:

Cockle, *Cerastoderma edule*

Location:

Inter-tidal, Dundalk Bay SAC 000455, SPA 004026

Fishing gear:

Suction and non-suction hydraulic dredges (gear code DRM, FAO/ICES code 04.1.2). Dredge width between 0.75-1.0m. Each boat uses a single dredge. These dredges generate hydraulic jets of water to fluidise sediments in front of the dredge to displace cockles from the sediments. The suction dredge pumps the fauna and associated sediments onto the deck of the vessel where the catch is mechanically graded and sediments, undersized cockles and other fauna are returned to the seabed. Non-suction dredges fluidise the sediment but the catch is graded *in situ* at the dredge head. The toothed dredge bar penetrates approximately the top 5cm of sediment. The tooth spacing on the bar selects cockles greater than 17mm shell width. Some vessels may use blade dredges which are not selective at the dredge head.

Measures to regulate cockle fishing activity described in the FNP

Number of vessels

The number of participating vessels will not exceed 33; 28 vessels participated in the fishery during implementation of the second cockle FNP 2016-2020. Up to 33 vessels participated in the FNP 2011-2015. The FNP 2021-2025 does not propose any increase.

Spatial location of the fishery

An area of fishing of 77.8 km^2 (Figure 1) of intertidal sand flat in Dundalk Bay has been proposed to allow for inter-annual variability in location of commercial densities of cockles and to enable the fleet to avoid areas of high densities of juvenile cockles. In reality the actual fished area will be in the region of 10-20 km^2 in any given year as evidenced from the distribution of cockles in annual surveys 2008-2020 and vessel monitoring system (VMS) data from the fleet.

Timing and duration

Fishing will take place in the 14 weeks preceding the 1st November, and following the annual survey and estimation of cockle biomass and TAC advice, but annual variation in duration and timing can be expected because of variability in cockle growth, market conditions and weather.

Harvest rates

Biomass will be estimated annually using fishery independent surveys as reported during the period 2008-2020 by the Marine Institute. Harvest rates will be a proportion of the biomass as described in Table 1.

TABLE 1 SUMMARY OF HARVEST RATES AND CONDITIONS UNDER THE PROPOSED FISHERY PLAN

Harvest Rate	**Condition**
0	When biomass is <1000 tonnes
Maintain a minimum of 1000 tonnes biomass	When biomass is between 1000 - 1500
0.33	When biomass >1500

Catch rate condition

If average daily catch per vessel declines to 250kg the fishery will close. Daily catch data will be obtained from logbook and shellfish gatherer sheets submitted by vessel operators to SFPA. Average daily catch will be estimated from the catch records of all vessels for each 5day (Monday – Friday) fishing period. In calculation of daily catch rates:

i) The first weeks fishing is excluded because gear settings are still being adjusted in the first days of the fishery

ii) Only vessels that have fished the entire tidal period each day for at least 2 days each side of high tide will be included.

Minimum landing size (MLS)

The national MLS is 17mm shell width. Operationally the MLS in the Dundalk fishery will be 22mm shell width. Graders with bar spacing of 22mm will be used on board the vessels. The high minimum size is used to limit market competition with UK cockle landings which are landed at a smaller size and to obtain higher market prices.

Daily operational limits

- Each vessel will be limited to 1000kgs of cockles per day
- Fishing will be limited to tides higher than 4.2 m provided this is sufficient to allow the quota to be taken in 14 weeks.
- Fishing will be allowed on one tide per day only

Summary of conditions for annual closure of the fishery

The fishery will close when any of the following conditions are met: when the TAC is taken **or** when average daily catch is less than 250kg **or** on November 1st provided this has been preceded by a period of 14 weeks of open fishery.

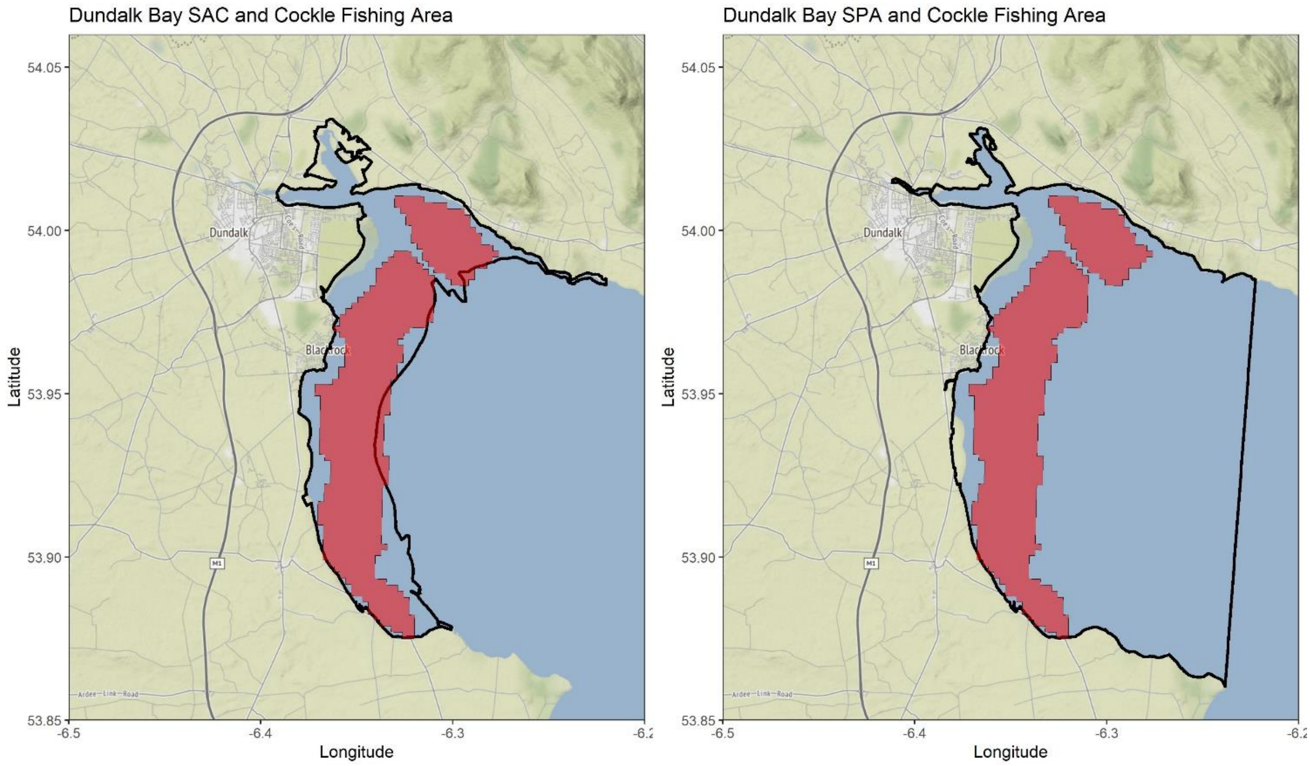

FIGURE 1 THE SAC (LEFT) AND SPA (RIGHT) BOUNDARY (BLACK LINE) AND THE PROPOSED COCKLE FISHING AREA (RED POLYGON) IN DUNDALK BAY FOR THE FNP 2021-2025

Section 3 – Conservation Objectives for Dundalk Bay SAC and SPA

Qualifying interests in the Special Area of Conservation (SAC)

The SAC is designated for the following Habitats:

1130 Estuaries (Figure 2)

1140 Mudflats and sandflats not covered by water at low tide and constituent communities (Figure 2Table 2).

1220 Perennial Vegetation on stony banks

1310 Salicornia and other annuals colonizing mud and sand

1330 Atlantic Salt meadows (*Glauco-Puccinellietalia maritimae*)

1410 Mediterranean salt meadows (*Juncetalia maritimi*)

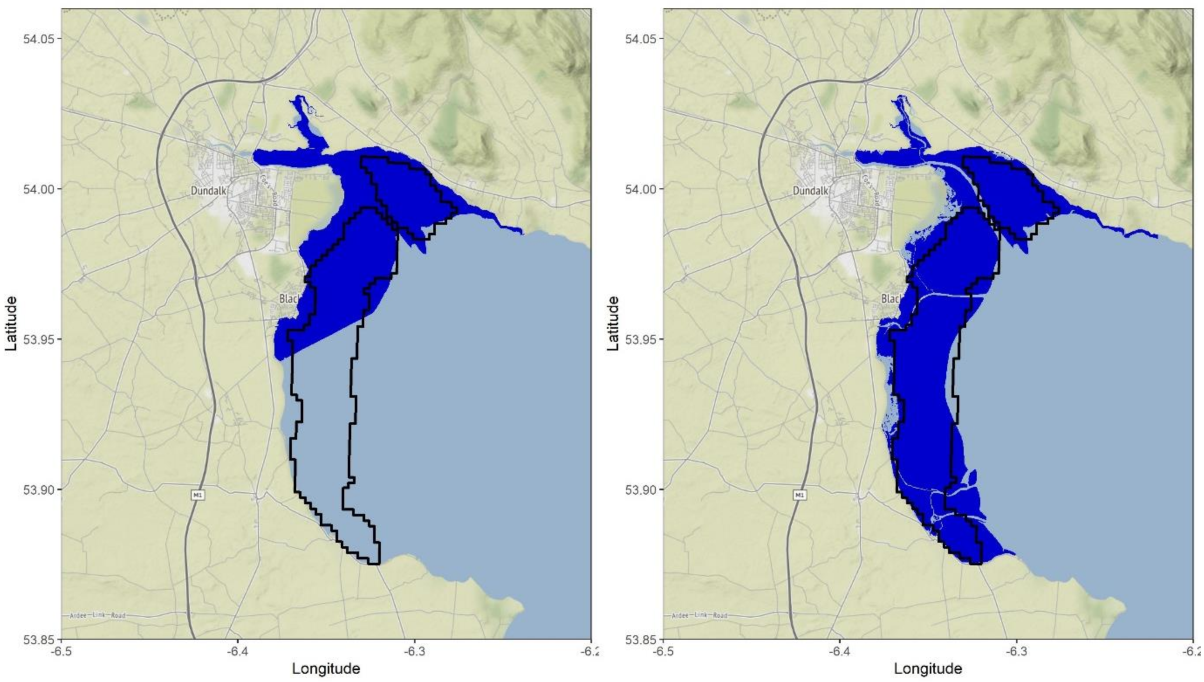

FIGURE 2 QUALIFYING MARINE INTERESTS WITHIN THE DUNDALK BAY SAC 1130 ESTUARIES (LEFT) AND 1140 MUDFLATS AND SANDFLATS NOT COVERED BY WATER AT LOW TIDE (RIGHT). THE COCKLE FISHED AREA IS OUTLINED IN BLACK.

Qualifying interest 1140 (4375 ha) and 1130 (2799 ha) (Figure 2), together, contain a number of distinct marine communities (Figure 3) (NPWS, 2011a) the distribution of which relate to the level of exposure at the site and the influence of the various rivers flowing into the bay.

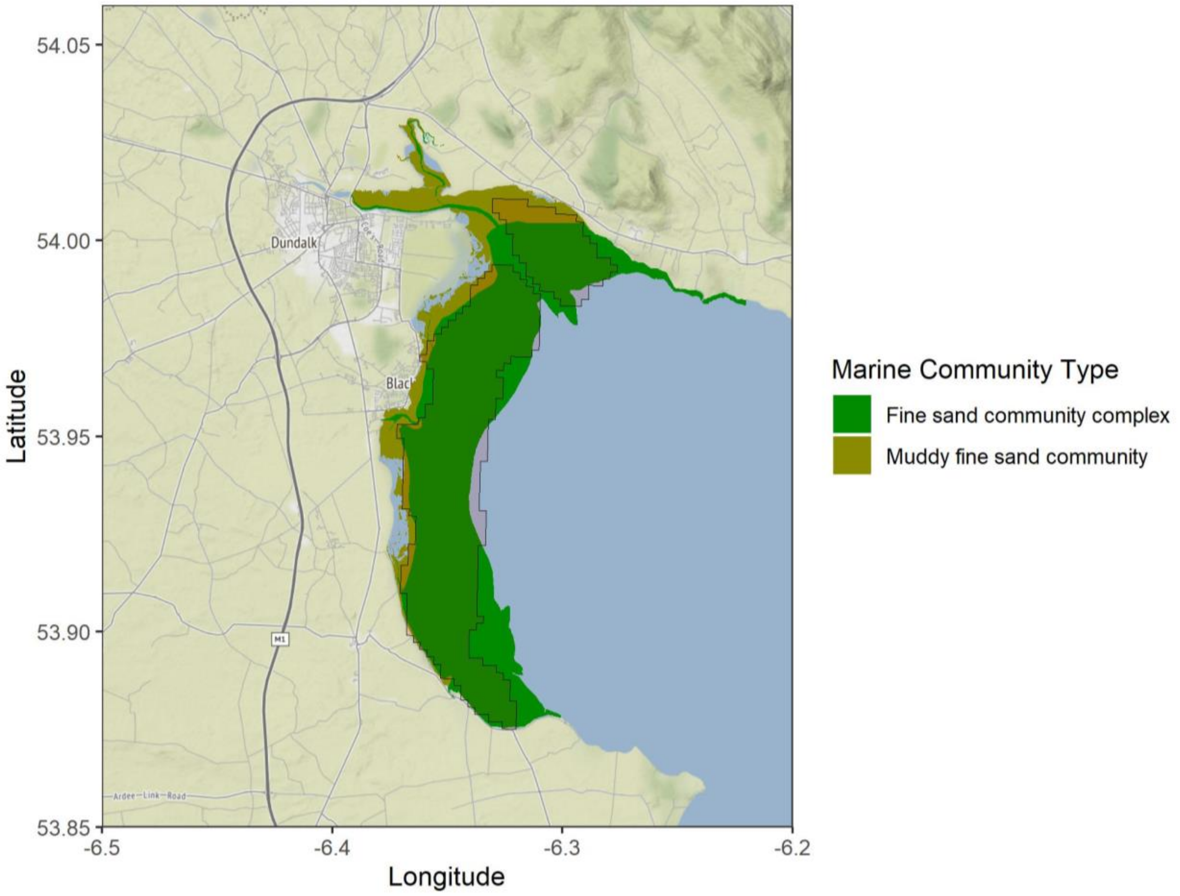

FIGURE 3 MARINE COMMUNITY TYPES IN DUNDALK BAY AND THEIR OVERLAP WITH THE COCKLE FISHED AREA (BLACK OUTLINE)

TABLE 2 COMMUNITIES WITHIN HABITAT 1140 (MUDFLAT AND SANDFLAT NOT COVERED BY SEAWATER AT LOW TIDE) AND 1130 (ESTUARIES) IN DUNDALK BAY (NPWS 2011A,B)

Habitat	No.	Community	Characterising species	Area (ha)
1130/1140	1	Intertidal muddy fine sand community.	*Tubificoides benedii, Tubificoides pseudogaster, Scrobicularia plana, Nephtys hombergii, Macoma balthica, Hediste diversicolor, Corophium volutator, Heterochaeta costata, Pygospio elegans,*	*853*
1130/1140	2	Fine sand community complex	*Pygospio elegans, Scoloplos armiger, Pygospio elegans, Cerastoderma edule, Nephtys hombergii, Lanice conchilega, Sigalion mathildae, Fabulina fabula, Spio martinensis, Macoma balthica, Capitella capitata, Angulus tenuis, Crangon crangon, Spiophanes bombyx*	*3709*

Conservation objectives for the SAC

- The area and community distribution of the biota of qualifying interest habitats must be conserved (NPWS, 2011b).
- Habitat area: The likely area occupied by the constituent communities of Habitats 1130 and 1140 should be stable or increasing with overall target areas of 2799ha and 4375ha respectively
- Habitat structure and function: The constituent communities of habitats 1130 and 1140 should be stable in distribution and species composition (as outlined in Table 2).

Special Conservation Interests in the Special Protection Area

The following species are listed as species of special conservation interest (SCI) in the SPA:

A005 Great crested grebe (*Podiceps cristatus*) – wintering
A043 Greylag goose (*Anser anser*) – wintering
A046 Light-bellied brent goose (*Branta bernicla hrota*) – wintering
A048 Shelduck (*Tadorna tadorna*) – wintering
A052 Teal (*Anas crecca*) – wintering
A053 Mallard (*Anas platyrhynchos*) – wintering
A054 Pintail (*Anas acuta*) – wintering
A065 Common scoter (*Melanitta nigra*) –wintering
A069 Red-breasted merganser (*Mergus serrator*) – wintering
A130 Oystercatcher (*Haematopus ostralegus*) – wintering
A137 Ringed plover (*Charadrius hiaticula*) – wintering
A140 Golden plover (*Pluvialis apricaria*) – wintering
A141 Grey plover (*Pluvialis squatarola*) – wintering
A142 Lapwing (*Vanellus vanellus*) – wintering
A143 Knot (*Calidris canutus*) – wintering
A149 Dunlin (*Calidris alpina*) – wintering
A156 Black-tailed godwit (*Limosa limosa*) – wintering
A157 Bar-tailed godwit (*Limosa lapponica*) – wintering
A160 Curlew (*Numenius arquata*) – wintering

A162 Redshank (*Tringa totanus*) – wintering

A179 Black-headed gull (*Chroicocephalus ridibundus*) – wintering

A182 Common gull (*Larus canus*) – wintering

A184 Herring gull (*Larus argentatus*) – wintering

A999 Wetlands and waterbirds

Conservation objectives for the SPA

The conservation objectives for the SPA are based on the principle of Favourable Conservation Condition (FCC) of each SCI species and their populations (NPWS, 2011c).

- To maintain the favourable conservation condition of the waterbird SCIs
    - Long term population (numbers of birds wintering at the site) trend of each SCI should be stable or increasing. An SCIs will be deemed unfavourable when its population has declined by more than -25%
    - The number and range (distribution) of areas used by waterbirds should be stable
- To maintain the favourable conservation condition of the wetland habitat as a resource for the waterbirds that use it
    - Wetland habitat should be stable and not less than 8136, 4374 and 649ha for sub-tidal, inter-tidal and supra-tidal habitats respectively

Section 4 – Appropriate Assessment Screening

Cockle fishing

Cockle fishing potentially affect habitats and waterbirds in Dundalk Bay SAC and SPA and are therefore subject to Appropriate Assessment in Section 6. This activity cannot be screened out for the following reasons:

The proposed FNP overlaps with two marine community types within the SAC; the fine sand community complex and the muddy fine sand community complex. The proposed FNP potentially affects 24 listed bird species within the SPA four of which; Oystercatcher, Knot, Shelduck and Common Scoter are primarily bivalve feeders and fishing for cockles which involves disturbing the marine communities in the SAC could affect how these species utilise these habitats.

In combination effects

A razor clam fishery occurs within the SPA but not in the SAC. This fishery also involves disturbance of sediments to extract razor clams. It is assessed only with respect to its potential for in combination effects with the cockle fishery within the SPA.

There are other activities at the site which may add to bird disturbance or affect habitats. These are:

- Walking
- Bait digging and mollusc gathering
- Un-powered and powered water craft
- Horse riding
- Dog walking
- Shooting
- Use of vehicles

The current appropriate assessment will deal with the potential fishery and features of interests interactions outlined in Table 3.

TABLE 3 SUMMARY OF FISHERIES AND FEATURES OF INTERESTS COVERED IN THIS ASSESSMENT

Fishery	**Feature of interest**
Cockle	SAC features
Cockle	SPA waterbirds
Cockle in combination with Razor Clam fishery	SPA waterbirds
Cockle in combination with other activities	SAC features
Cockle in combination with other activities	SPA waterbirds

Section 5 – Natura Impact Statement for the Proposed Activities

The potential effects of fishing activities on the conservation objectives relate to the physical, biological and visual (disturbing) pressures that each activity may have on each of the qualifying interests and the particular biological features of those interests (Table 4).

Dredging for cockles disturbs sediments to 5cm depth while dredging for razor clams disturbs sediments down to 25cm. Both fisheries are unselective in the capture of non-target organisms which are released back into the environment almost immediately on capture but in the case of suction gear pass through the dredge, pipes, pumps and graders before they are released. A substantial amount of sediment is disturbed and could be displaced downstream depending on currents. This might result in increased sorting and loss of fine materials at the fishing site.

Cockles and bivalves generally and other benthic invertebrates are important sources of prey for a number of species of waterbird and seabird in the SPA and depletion of these prey populations could have a significant negative impact on bird populations using the site. Bivalves are an important and necessary food source for a number of bird species such as Oystercatcher, Knot, Shellduck and Common Scoter and depletion of prey could affect the population of these species.

Bird populations may be disturbed by fishing vessels, by human disturbance on the shore and other non-fishing activity. The potential ecological effects on bird populations are:

Type 1: Direct disturbance of waterbirds

Type 2: Competition between birds and fishermen for bivalve fish resource

Type 3: Indirect impacts on bird populations through alteration of habitat structure and function and change in availability of prey species

TABLE 4 POTENTIAL INDICATIVE ENVIRONMENTAL PRESSURES OF FISHING ACTIVITIES IN DUNDALK BAY

Activity	Pressure category	Pressure	Potential effects	Duration (days)	Time of year	Factors constraining the activity
Suction and non-suction dredging for cockles	Physical	Surface disturbance	abrasion at the sediment surface	70	July-Oct	Restrictions as described in the FNP
		Shallow disturbance	sub-surface disturbance to 25mm			
		Erosion	reduction in fine materials			
		Siltation	siltation downstream of activity			
	Biological	Extraction	removal of cockles, reduction in food source for birds			
		By-catch mortality	mortality of organisms captured during the fishing process reduction in food source for birds and change in marine communities			
	Visual	Disturbance	disturbance of birds by fishing vessels			

Section 6 – Appropriate Assessment for the proposed cockle FNP in the SAC

Methods for SAC assessment

The significance of effects of cockle fishing is determined on the basis of Conservation Objective guidance for constituent marine benthic communities (NPWS, 2011a) (Figure 4).

1. The degree to which the activity will disturb the marine community.

By disturb is meant change in the characterising species and, therefore, the structure and function of the marine community, as listed in the Conservation Objective guidance (NPWS, 2011a). The likelihood of change depends on the sensitivity of the characterising species to the fishing activities. Sensitivity results from a combination of tolerance (resistance) to the activity and resilience (recovery) from the effects of the activity

2. The persistence of the disturbance in relation to the resilience of the marine community.

If the activities are persistent (high frequency, high intensity) and the receiving community has a low resilience to the activity (i.e. the characterising species are impacted) then such communities could be said to be persistently disturbed and may be at unfavourable status for a significant proportion of time.

3. The area of marine community or proportion of populations disturbed.

In the case of marine communities disturbance of less than 15% of their area is deemed to be insignificant (NPWS guidance). Effects will be deemed to be significant when cumulatively they lead to long term change in marine communities in greater than 15% of the area of any constituent community listed.

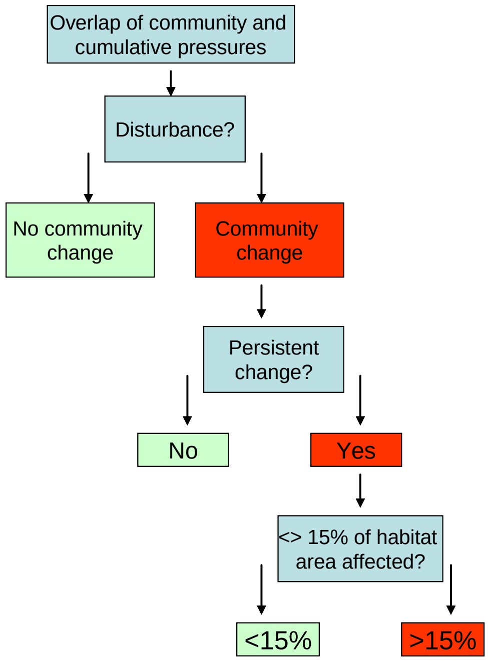

FIGURE 1. DETERMINATION OF SIGNIFICANT EFFECTS ON MARINE COMMUNITY DISTRIBUTION, STRUCTURE AND FUNCTION (FOLLOWING NPWS 2011B)

Assessment of the effects of the proposed cockle fishery on the conservation objectives for the SAC

The assessment considers the fishing activity proposed in the 2021-2025 cockle fishery Natura plan and its effect on marine benthic communities in the SAC. The data sources available for the assessment are:

- Annex I: The cockle fishery plan 2021-2025
- Annex II: Effects of cockle fishing on habitats in Dundalk Bay
- Annex III: Review of the Dundalk Bay cockle FNP 2016-2020
- Cockle survey reports for Dundalk Bay (Marine Institute 2008-2020)
- Studies on the mortality of bivalves in relation to distance from cockle dredge tracks in Dundalk Bay (Marine Institute)

Between 2016 – 2020 a proportion of the vessels in the proposed fishery reported spatial location using Vessel Monitoring Systems (VMS) (Figure 5). The fishing shown in the intertidal part of Figure 5 represents the area of cockle fishing whilst the subtidal area of fishing represents the razor clam fishery. The VMS data, despite not being a complete dataset for all fishing vessels, is a good representation of the spatial location of the actual fished area. The fished area is smaller each year than the area outlined in Figure 1 in the FNP. The south of the proposed fished area in particular has limited fishing effort in all years.

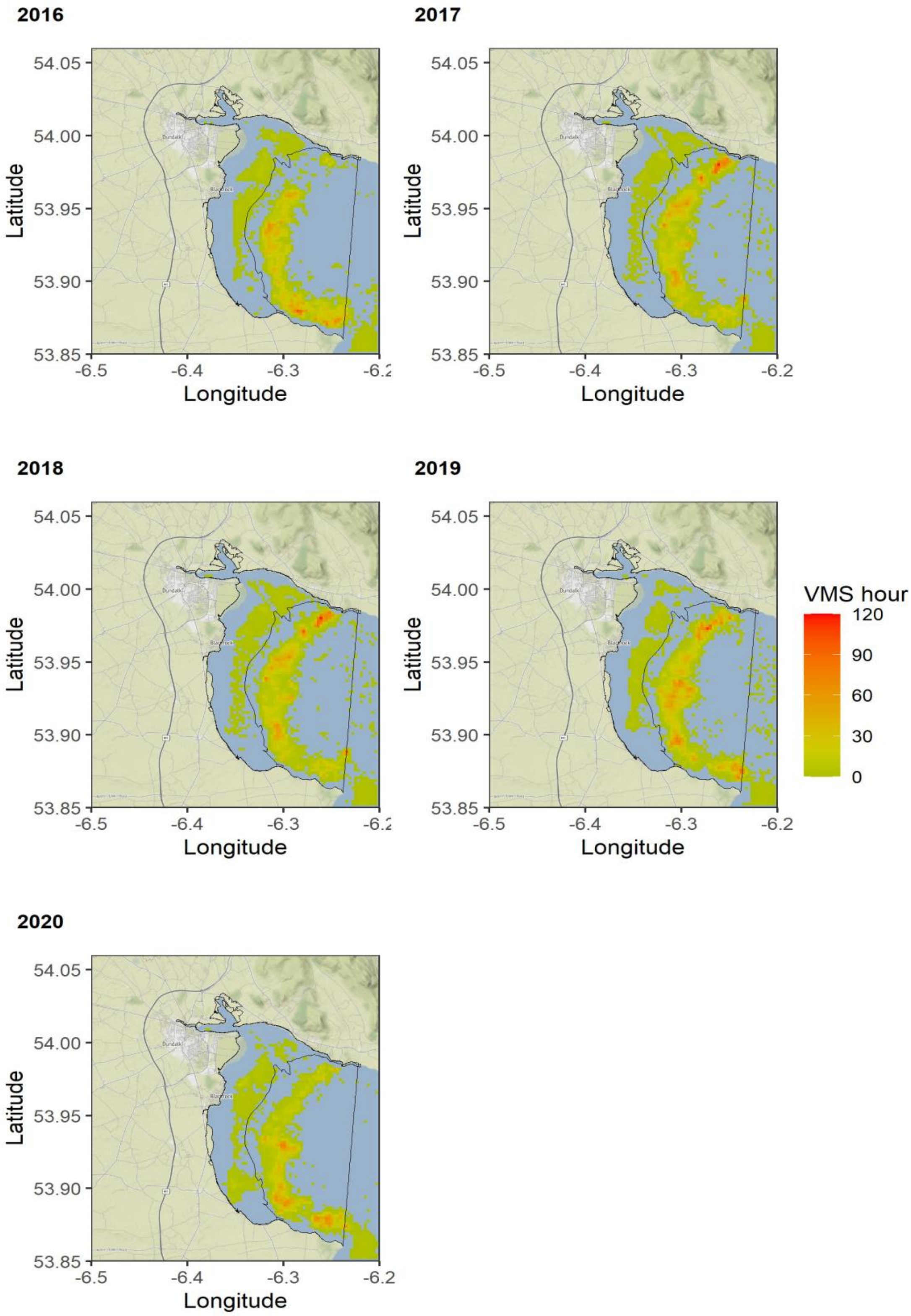

FIGURE 5 VMS HOURS FISHED BETWEEN 2016 – 2020 IN DUNDALK BAY SAC AND SPA. THE INTERTIDAL FISHING REPRESENTS A PROPORTION OF VESSELS IN THE COCKLE FISHERY WHO HAVE VMS ONBOARD. THE SUBTIDAL FISHING EFFORT REPRESENTS THE RAZOR CLAM FISHERY WHICH HAVE MANDATORY VMS ON BOARD.

Sensitivity of characterising species to physical and biological pressures

The significance of impacts of cockle fishing depends on the sensitivities of the characterising species of the marine communities defined in the conservation objectives (NPWS, 2011b). The pressures resulting from dredging for cockles are mainly physical (smothering, erosion of sediments, abrasion) and biological (extraction) as outlined in the Natura Impact Statement (Table 4). Sensitivities of the characterising species, therefore, provides a first step in assessing the potential significance of the impact of fishing on these communities and to the conservation objectives. Analysis of marine community species composition and response to pressures provides a first step in the assessment of the likely response to fishing at community level.

Sensitivity to a pressure is a composite of the resilience or resistance of the species to the pressure and its capacity to recover from the pressure. Resilience may be related to the degree to which the species encounters the activity and the physical (body) form of the species in relation to physical pressures applied to it. Recoverability is correlated with life history traits and population dynamics. Species with short generation times, high fecundity and strong dispersal capacity can recover more quickly. An assessment of the sensitivity of the characterising species of the marine communities in Dundalk Bay is provided in Table 5.

The sensitivities of the characterising species are low mainly because they have high recoverability rate due to their life histories. This first assessment of the likelihood of significant impacts of a seasonal fishery for cockles, therefore, suggests an absence of significant effects; the activity is not persistent and species with high recoverability recover between fishing seasons thereby avoiding long lasting change in marine communities. Specific studies and monitoring programmes of these communities is provided below as additional evidence in assessing whether significant effects arise or not.

TABLE 5 SENSITIVITY OF SOME CHARACTERISTIC SPECIES OF THE MARINE COMMUNITIES IN DUNDALK BAY TO THE MAIN PRESSURES EXERTED BY FISHING

Species	Life History	Community	Pressure	Resilience	Recoverability	Sensitivity	Source
Lanice conchilega	Planktotrophic	Sub-tidal fine sand	Smothering	High	High	Low	www.marlin.ac.uk
			Abrasion and physical disturbance	Moderate	High	Low	www.marlin.ac.uk
Owenia fusiformis	Generation time 1-2yrs, matures 1 yr, Planktotrophic	Sub-tidal fine sand	Smothering	Moderate	High	Low	www.marlin.ac.uk
			Abrasion and physical disturbance	High	High	Low	www.marlin.ac.uk
Fabulina fibula	Generation time 1-2yrs, life span 2-5 yrs, Planktotrophic	Sub-tidal fine sand	Smothering	Very High	High	Low	www.marlin.ac.uk
			Abrasion and physical disturbance	High	High	Low	www.marlin.ac.uk
Angulus tenuis	Unknown	Intertidal fine sand	Sediment erosion and re-suspension caused by dredging	Low	High	Low	Annex I of the AA
			Smothering	High	Low		
			Abrasion and physical disturbance	Low	High		
Cerastoderma edule	Generation time 1-2 yrs, longevity 5-10yrs, high fecundity, planktotrophic, maturity at 1+	Intertidal fine sand	Sediment erosion and re-suspension	Moderate	High	Low	www.marlin.ac.uk
			Smothering	Moderate	High	Low	www.marlin.ac.uk
			Abrasion and physical disturbance	Moderate	High	Low	www.marlin.ac.uk
			Extraction	Moderate	High	Low	www.marlin.ac.uk Annex I of AA
Nephthys hombergii	Generation time 2-3yrs, Life span 2-5 yrs, Lecitotrophic, Maturity 2+	Intertidal and sub-tidal fine sand	Smothering	Tolerant	NA	Low	www.marlin.ac.uk
			Abrasion and physical disturbance	Moderate	Very High	Low	www.marlin.ac.uk
			Smothering	Moderate	Very High	Low	www.marlin.ac.uk

Crangon crangon	Generation time <1yr, Life span 2-5yrs, Maturity <1yr, Planktotrophic	Intertidal and sub-tidal fine sand	Abrasion and physical disturbance	Low	Very High	Low	www.marlin.ac.uk
			Extraction	Moderate	Very High	Low	www.marlin.ac.uk
Abra alba		Sub-tidal gravel	Smothering	High	Immediate	Not sensitive	www.marlin.ac.uk
			Abrasion and physical disturbance	Medium	Very High	Low	www.marlin.ac.uk
Pomatoceros spp	Maturity 4 months, planktotrophic	Sub-tidal gravel	Smothering	Low	High	Moderate	www.marlin.ac.uk
			Abrasion and physical disturbance	Moderate	High	Low	www.marlin.ac.uk

Site specific BACI and CI studies of the effects of cockle fishing on marine communities

The cockle fishery occurs in the intertidal fine sand community complex of Habitat 1130 and 1140 and more specifically in the area characterised by the bivalves *Angulus tenuis, Macoma balthica* and the polychaetes *Arenicola marina* and *Nephthys* spp. The proposed fishing area is 77.8km^2 although usually less than 20km^2 is fished in any year. Based on Figure 1 showing the potential distribution of fishing, the spatial overlap with the fine sand community annually is high (Estuaries: 76%; Mudflats and Sandflats:79%) whilst overlap with the near shore muddy fine sand community is 22% in estuaries and 25% in mudflats and sandflats (Table 6). The VMS data (Figure 5) suggest that the actual fished area on the near shore muddy fine same community is actually much lower given difficulty of access to this area because of shallow depths; the fishery is very restricted tidally.

TABLE 6 QUALIFYING INTERESTS AND MARINE COMMUNITY TYPES IN DUNDALK BAY SHOWN ALONG WITH THEIR AREA OF OVERLAP WITH THE COCKLE FISHED AREA (KM^2) AND THE PERCENTAGE OVERLAP

Qualifying Interest	**Community Type**	**Area of Overlap (km^2)**	**% of total area**
1130 Estuaries and constituent communities	Fine sand community complex	14.1	75.9
	Muddy fine sand community	1.6	22.1
1140 Mudflats and sandflats not covered by water at low tide and constituent communities	Fine sand community complex	27.8	79.0
	Muddy fine sand community	2.1	25.3

In 2009-2010 a spatially nested control-impact study before (t_0), 8-9 days after (t_1) and 4 months (t_2) following dredging and extraction of 108 tonnes of cockles from a standing stock of 2,158 tonnes was completed. This study failed to detect significant effects on benthic sediments, benthic faunal communities or, with one exception, on the dominant species of bivalve in the system. Significant spatial and temporal variability in abundance of species and taxonomic groups, unrelated to fishing effects, was observed. A short lived effect of fishing on the bivalve *Angulus tenuis* was detected. The full report of this study is published in Clarke and Tully (2014) and is described in Annex II.

A study in Dundalk in 2012 focused on mortality of bivalves in dredge tracks compared to areas outside of dredge tracks. Core samples were collected at the North Bull, Dundalk Bay during low tide from within visible dredge tracks (impact samples) and outside these tracks (control samples) the day following fishing. Three impact and three control samples were taken at each of four stations across the fishing ground on two separate dates. A higher number of dead cockles were recorded in impact stations than in controls. This is due to discard mortality associated with fishing and is approximately 7%. Mean abundances of *A. tenuis* were also higher in samples collected from control stations compared with impact samples although most of these differences were not significant.

Both the 2009-2010 and the 2012 impact studies suggest that fishing causes mortality of *A. tenuis*. The shell of this species is thin and it occurs in the top few centimetres of sediment and is, therefore, vulnerable to capture by cockle fishing gear in surface sediments. Recoverability of *A. tenuis* from impact is high due to short generation times and the fact that they mature in their first or second year of life (Table 5). Monitoring data for A. tenuis and other species however shows no significant negative trend in their populations as described below.

Monitoring data on the effects of the cockle fishing on marine communities

Nine years (2011-2020) of data on the distribution and density of *A. tenuis* supports the view that mortality effects are short lived and are insignificant relative to inter-annual variation in abundance (Table 7; Figure 6; Figure 7). Their spatial distribution is stable and abundance is highly variable across years. It is very abundant on the mid and lower shores. Short term disturbance of *A. tenuis* is not carried over (cumulative) between seasons. Density of *A. tenuis* decreased between 2014-2017 but increased steadily from 2017-2020. As such this disturbance is not significant with respect to the long term stability of marine intertidal communities at the site.

Monitoring has also been carried out on two other species; *Macoma balthica* and *Arenciola marina* since 2011 and 2013 respectively. *M. balthica* is much less exposed to the cockle fishery as it is distributed on the upper shore. Density of *M. balthica* showed a similar pattern to *A. tenuis* with a reduction in 2014-2017 and an increase since then (Table 7; Figure 6; Figure 7). Densities of *A. marina* were generally low although 2020 reported the lowest density to date of this species (Table 7; Figure 6).

TABLE 7 AVERAGE DENSITY (M^{-2}) OF ANGULUS TENUIS AND MACOMA BALTHICA AND ARENCIOLA MARINA IN INTERTIDAL HABITATS DURING THE MID SUMMER COCKLE SURVEYS 2011-2015

Year	*Angulus tenuis*		*Macoma balthica*		*Arenicola marina*	
	Average	**S.d.**	**Average**	**S.d.**	**Average**	**S.d.**
2011	26.14	38.74	13.98	36.25		
2012	55.35	62.18	17.74	41.21		
2013	95.43	89.82	28.10	57.49	6.43	8.10
2014	91.61	83.19	18.53	42.23	11.62	9.18
2015	70.56	76.90	18.80	40.06	6.08	5.33
2016	83.33	75.07	19.41	51.29	6.26	4.82
2017	67.89	90.11	12.39	30.15	5.58	4.45
2018	77.89	88.09	24.64	51.15	4.35	3.10
2019	84.66	86.40	22.91	48.60	5.26	3.27
2020	87.51	99.59	18.72	42.77	3.49	3.15

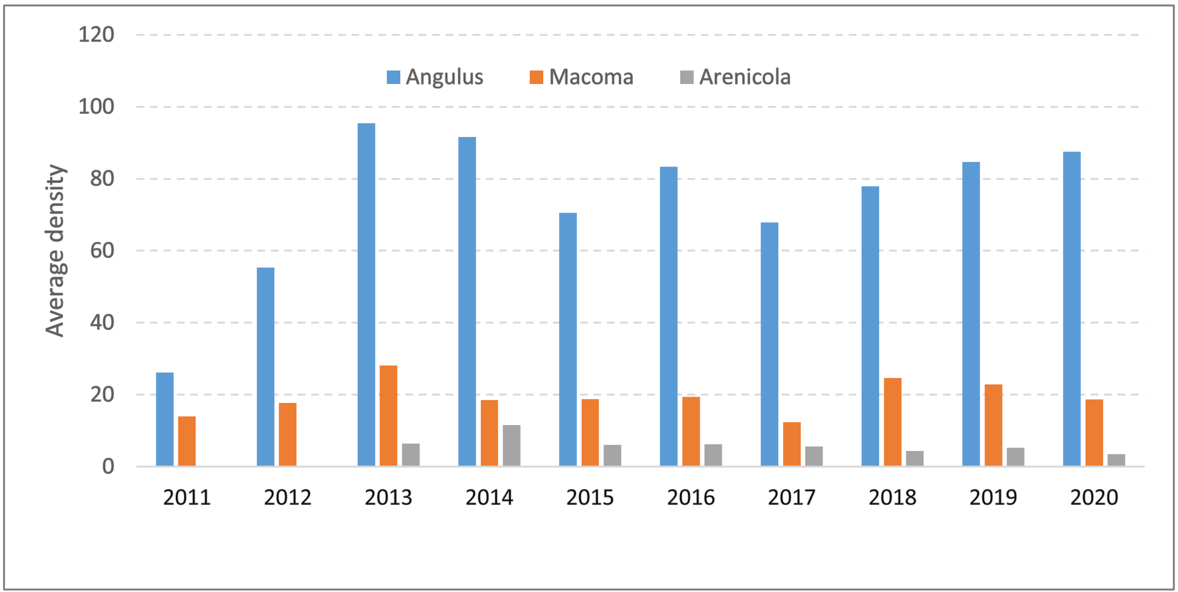

FIGURE 2 AVERAGE DENSITIES OF ANGULUS TENUIS, MACOMA BALTHICA AND ARENICOLA MARINA IN INTERTIDAL SEDIMENTS IN DUNDALK BAY 2011-2020

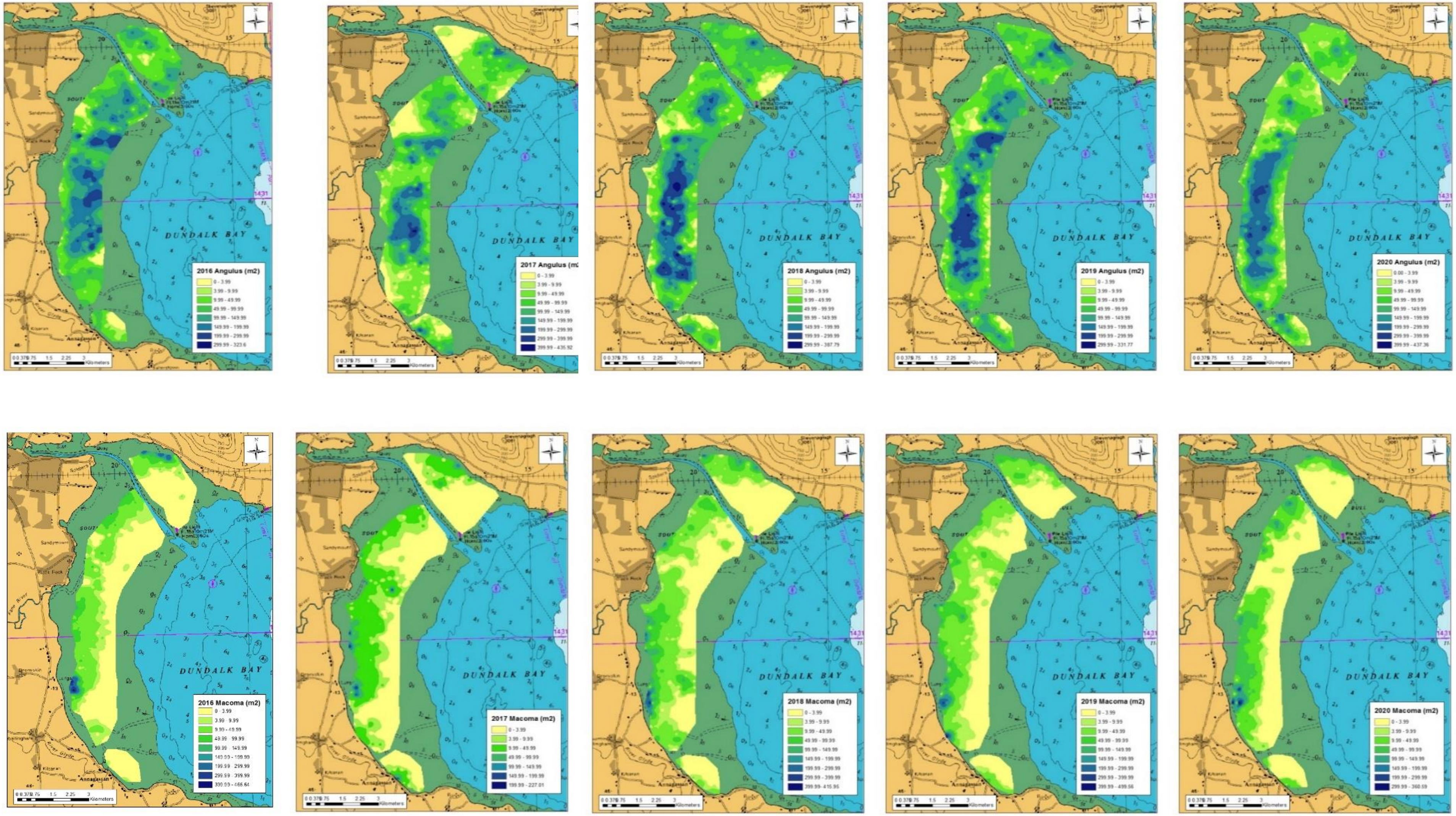

FIGURE 3 ANNUAL DISTRIBUTION OF ANGULUS TENUIS (TOP) AND MACOMA BALTHICA (BOTTOM) DURING MID SUMMER SURVEYS IN DUNDALK BAY 2016-2020

Effects of cockle fishing on cockle stocks

The relationships between cockle biomass, landings and cockle spat fall and recruitment to the fishery for the period 2007-2020 are provided in Annex III. As specified in the FNP 2016-2020 the percentage of cockle biomass removed by the fishery did not exceed 33% annually. The biomass is determined by annual survey prior to the fishery. Harvest control rules (HCR) in the FNP 2021-2025 indicate that no fishery will occur when biomass is <1000tonnes. From 2007-2010 biomass of cockles ranged from a low of 814 tonnes in 2010 to 3,588 tonnes in 2008. During the first FNP (2011-2015) biomass varied from 972 to 1,532 tonnes (Table 8). During the second FNP (2016-2020) biomass ranged from 1,785 to 3,790 tonnes. During the FNP 2016-2020 the TAC was almost always fully utilised. During the 2011-2015 FNP the TAC was not fully utilised when the biomass was less than 1500 tonnes. The expectation for 2020-2025 is that the TAC will be fully utilised in years where biomass is over 1500 tonnes but take up of the TAC may be less when biomass is 1000-1500 tonnes. The new HCR for zero TAC when biomass is less than 1000 tonnes ensures that there will be no fishing at or below this biomass. This is more conservative than the equivalent HCR limit of 750 tonnes in the previous plans.

TABLE 8 TRENDS IN BIOMASS, TAC (TOTAL ALLOWABLE CATCH) AND LANDINGS OF COCKLES IN DUNDALK BAY 2007-2020

Year	**Survey Month**	**Biomass**		**TAC (tonnes)**	**Landings**	
		Mean	95% CL		Vessels	Hand gatherers
2007	March	2277	172	950	668	Unknown
2008	August	3588	1905	0	0	0
2009	June	2158	721	719	108	0.28
2010	May	814	314	0	0	0
2011	May	1531	94	510	325	0.25
2012	May	1234	87	400	394	9.4
2013	June	1260	99	416	343	0
2014	June	972	188	324	0	0
2015	June	1034	100	345	0	0
2016	July	1878	87	626	626	0
2017	June	2316	95	772	772	0
2018	June	1785	175	542	542	0
2019	July	3790	110	600	594	0
2020	May-June	3420	870	1128	1128	0

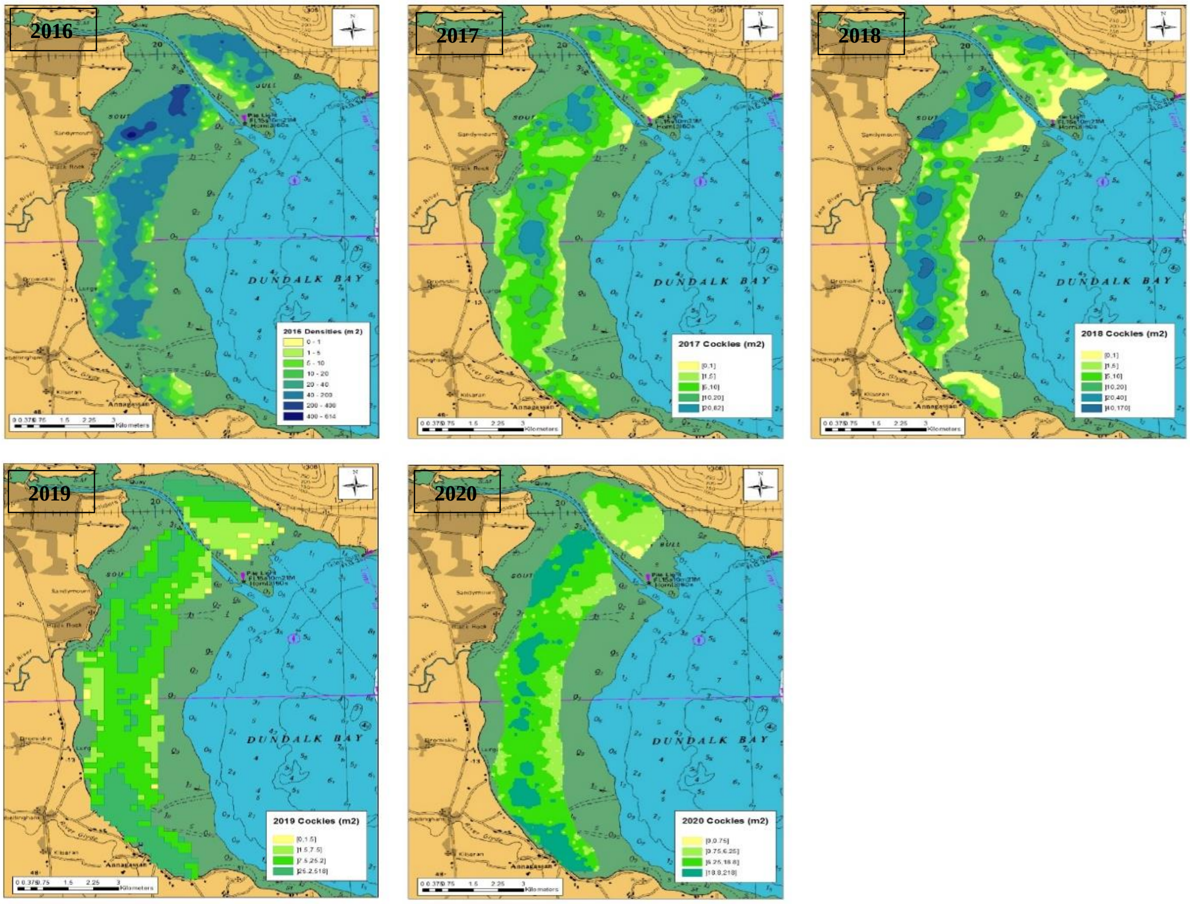

FIGURE 4 DISTRIBUTION AND ABUNDANCE OF COCKLE IN DUNDALK BAY FROM ANNUAL MID-SUMMER SURVEYS 2016-2020

In the years 2016-2020 depletion in catch rates of cockles were observed during the fishery in 2016 (28%), 2017 (21%) and 2018 (31%) (Figure 9). No depletion was observed in 2019 or 2020 where catches remained close to the 1000kg limit throughout the season. The observed depletions or absence of depletion indicates that in no case was the 33% harvest rule broken (depletions were 21-31%). This also indicates that the pre-fishery survey correctly estimates the biomass which is used to advise the TAC. The absence of a depletion effect shows the fishery actually has a limited effect on cockle densities locally. To avoid significant depletion, the fleet must move to different patches of cockle as the fishery progresses.

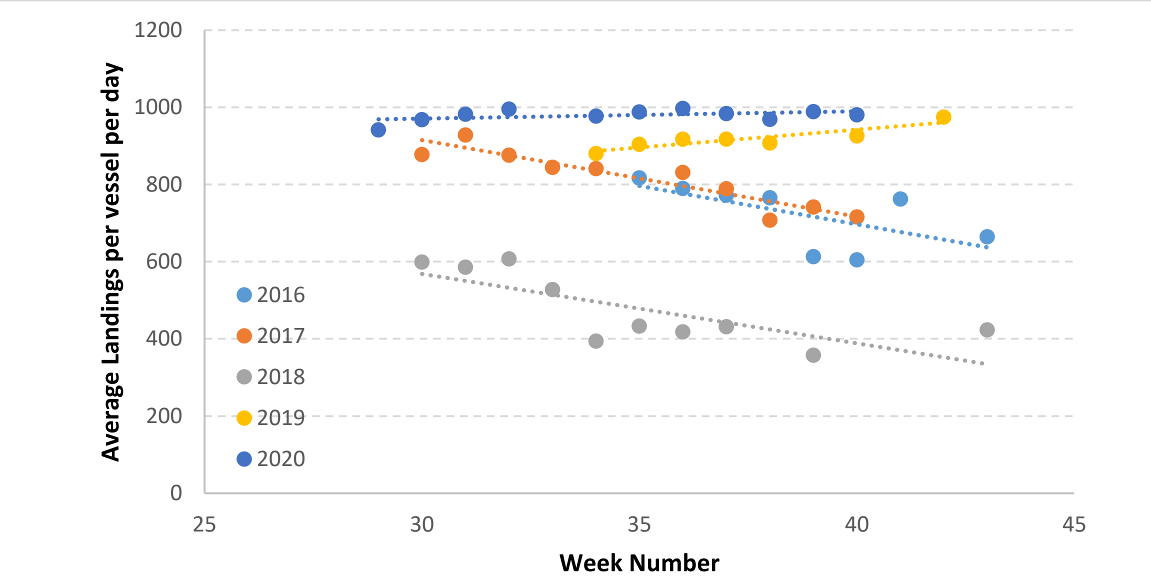

FIGURE 9 IN SEASON CHANGES IN AVERAGE LANDINGS PER VESSEL PER DAY GROUPED BY WEEK FOR EACH WEEK OF THE COCKLE FISHERY IN 2016-2020

Cockle spat settlement occurred in every year between 2008-2020. In all years, other than 2014 and 2019, the 0+ cohort was clearly evident in size distribution data from the survey. The annual spat index, derived from survey data, declined sharply from 2008 to 2009 and continued to decline from 2009 to 2013 prior to a partial recovery in 2014 and 2015 (Figure 10). The index increased generally from 2013-2019 and fell again in 2020 (Figure 10).

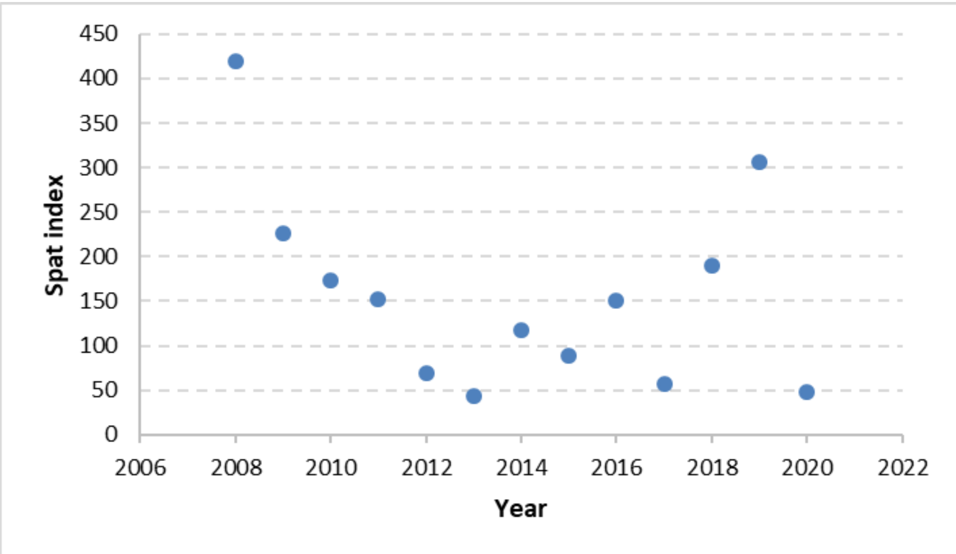

FIGURE 10 ANNUAL SPAT INDEX FOR COCKLES IN DUNDALK BAY 2008-2020. THE INDEX IS STANDARDISED FOR SAMPLING EFFORT AND TIME OF YEAR

Years of high landings were not followed by years of low biomass; in fact high biomass in a given year, leading to high TACs, were generally followed by a year of high biomass. This indicates limited impact of the TAC on biomass in subsequent years (Figure 11). This relationship might be due to density dependent effects on recruitment; high landings reduces density dependent mortality during spat fall and high biomass the following year.

Years with a strong spat index generally led to higher biomass in the following year. There is generally therefore successful transfer of spat fall, through winter, into stock biomass in the following summer (Figure 12).

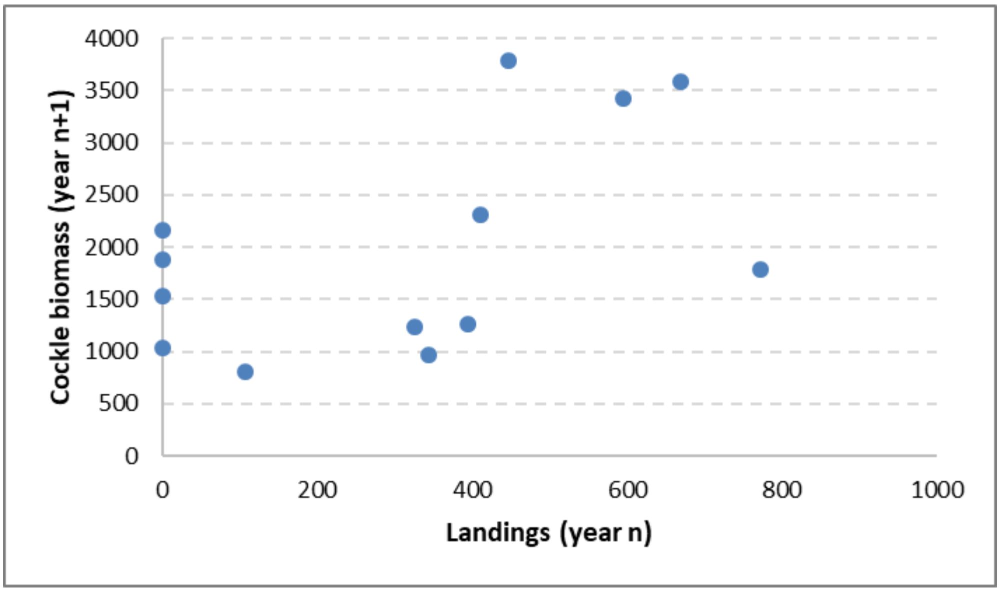

FIGURE 5 RELATIONSHIP BETWEEN COCKLE LANDINGS IN A GIVEN YEAR WITH BIOMASS IN THE SUBSEQUENT YEAR IN DUNDALK BAY, 2008-2020

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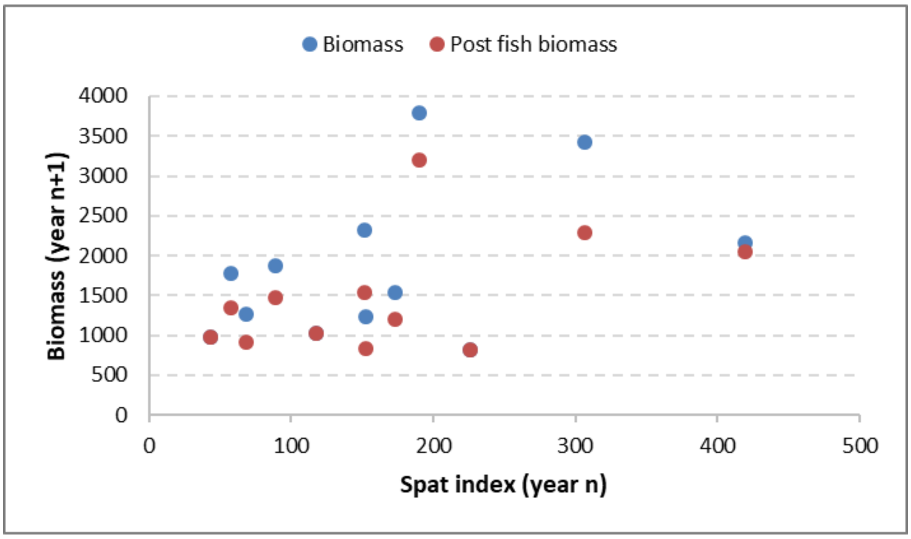

FIGURE 12 DEPENDENCY OF COCKLE BIOMASS ON PREVIOUS YEAR SPAT INDEX IN DUNDALK BAY, 2008-2020.

Conclusions on the significance of effects of cockle fishing on marine communities in the SAC

TABLE 9 CONCLUDING ASSESSMENT FOR THE EFFECTS OF THE FNP ON MARINE COMMUNITIES WITHIN THE SAC

Assessment parameter	Significance assessment
The degree to which the activity will disturb the qualifying interest.	Characterising species of marine intertidal communities in Dundalk Bay have low sensitivity to physical disturbance caused by fishing. Empirical control impact studies in Dundalk Bay failed to detect significant effects of cockle fishing on benthic sediments and communities. Cockle fishing causes some mortality of the characterising species *Angulus tenuis* and obviously causes mortality of cockle through extraction. However, 12 years of monitoring indicates that densities of *A. tenuis* and cockle fluctuate and vary between years but their distribution and densities are generally stable without trend. **The assessment concludes no significant effects for marine communities in the SAC.**
The persistence of the disturbance in relation to the resilience of the habitat.	As the fishery is seasonal and characterising species have high resilience to mortality (high landings do not result in low biomass the following year) or high recoverability (*A.tenius*) disturbance is not persistent or cumulative. **The assessment concludes no significant effects for marine communities in the SAC.**
The area of marine community types (MCT) or proportion of populations disturbed.	Overlap with marine communities is significantly higher than the 15% threshold; 76% for fine sand communities and 25% for muddy fine sand communities. However, as per assessment on the degree to which the activity will disturb the qualifying interest and the persistence of the disturbance in relation to the resilience of communities the effects do not cumulatively lead to long-term change in marine communities. **The assessment concludes no significant effects for marine communities in the SAC.**

Section 7 – Appropriate Assessment for the proposed cockle FNP in the SPA

Methods for SPA Assessment

The SCI species were assessed using information on the diet and habitat use and their spatial and temporal distribution in Dundalk Bay to identify those species that may overlap with the activity and/or use resources affected by the fishery. Information on diet and habitat use was taken mainly from literature sources. In addition, direct studies on diet of oystercatcher in Dundalk Bay were completed in 2011-2014. Information on spatial distribution of birds in Dundalk Bay was derived from two surveys in 2019; one low tide ground counts and an aerial survey carried out on the same day. iWeBs data provide monthly maximum high tide counts from 1994-2018 (2019/20 and 2020/21 data were not available at time of writing). There are two main pressures for which the cockle fishery might exert on waterbirds:

1. *Direct (Cockles) or indirect (change to marine communities) reduction in food resources*

The impact of any reduction in food resource availability due to direct removal (cockle) and/or indirect changes due to damage to species discarded or impacted by fishing and its impact on bird species depends on:

i) How reliant the species is on food resources affected by the fishing activity and

ii) The degree of change in availability of the food source

All SCIs utilise the intertidal or sub-tidal areas of Dundalk Bay as a food resource. Some species specialise on bivalves, others are piscivores or generalist feeders and they have different feeding behaviours and utilise different niches in these habitats. The status of the intertidal marine communities is, therefore, important for most of the SCIs. These communities and the potential effects of cockle fishing on them have been assessed above in the SAC section.

2. *Disturbance*

Information on the spatial and seasonal patterns of occurrence of the SCI species in Dundalk Bay, their typical habitat preferences, and the spatial and seasonal variation in the occurrence and intensity of the activity were available.

The assessment of potential disturbance impacts was based mainly on:

i) The degree of overlap, in time and space, of the activity and the SCI population and,

ii) Where relevant, the proportion of the Dundalk Bay population that may be displaced by the activity.

This approach can be considered as a simple form of habitat association model and represents a conservative form of assessment (see Stillman and Goss-Custard, 2010): the population-level consequences of displacement will depend upon the extent to which the remaining habitat is available (i.e., whether the site is at carrying capacity). In general, this assessment method "will be pessimistic because some of the displaced birds will be able to settle elsewhere and survive in good condition" (Stillman and Goss-Custard, 2010).

It should be noted that, where there is limited availability of alternative habitat, or where the energetic costs of moving to alternative habitat is high, disturbance may not cause displacement of birds but may still have population-level consequences (e.g., through increased stress, or reduced food intake, leading to reduced fitness) (Gill et al., 2001).

Assessment of significance

The significance of any potential impacts identified has been assessed with reference to the attributes and targets specified by NPWS (NPWS, 2011) in conservation objective documentation.

Attribute 1 – Long term population trends

1. If the impact is predicted to cause an effect on marine communities leading to decline of 25% or more of the population of any SCI species, then the impact could cause the long term population trend to show a decrease of 25% or more. In this case the impact is regarded as significant.

2. If the long-term population trend within Dundalk is outside the threshold (25%) for long-term population trends relative to similar sites along the east coast, then effects from the fishery could not be ruled out. In this case, the impact is regarded as

significant. This is similar to a pseudo 'control impact' evaluation given that other sites do not have cockle or other intertidal fisheries and comparison of trends across sites could show effects of cockle fishing.

3. If following the removal of cockles by the fishery it is evident that the remaining cockle stock would result in a >25% decline in the population of any species, then the effects are significant.
4. Disturbance of 25% or more of the total Dundalk Bay population leading to displacement of 25% of the population of any species

Attribute 2 – Number or range (distribution) of areas used

Assessing significance with reference to attribute 2 is more difficult because the level of decrease *in the numbers or range (distribution) of areas* that is considered significant has not been specified in conservation objective guidance. The significance threshold can be assessed from

1. The level of habitat loss or disturbance leading to spatial displacement and
2. The level of habitat loss or disturbance above which there is a reduction in waterbird populations

There have been some studies that have used individual-based models (IBMs; see Stillman and Goss-Custard, 2010) to model the effect of projected intertidal habitat loss on estuarine waterbird populations. West *et al.* (2007) modelled the effect of percentage of feeding habitat of average quality that could be lost before survivorship was affected. The threshold for the most sensitive species (Black-tailed Godwit) was 40%. Durell *et al.* (2005) found that loss of 20% of mudflat area had significant effects on Oystercatcher and Dunlin mortality and body condition, but did not affect Curlew. Stillman *et al.* (2005) found that, at mean rates of prey density recorded in the study, loss of up to 50% of the total estuary area had no influence on survival rates of any species apart from Curlew. However, under a worst-case scenario (the minimum of the 99% confidence interval of prey density), habitat loss of 2-8% of the total estuary area reduced survival rates of Grey Plover, Black-tailed Godwit, Bar-tailed Godwit, Redshank and Curlew, but not of Oystercatcher, Ringed Plover, Dunlin and Knot. Therefore, the available literature indicates that generally quite high levels of habitat loss are required to have significant impacts on estuarine waterbird populations, and that very low levels of displacement are unlikely to cause significant impacts.

If a given level of displacement is assumed to cause the same level of population decrease (i.e., all the displaced birds die or leave the site), then displacement will have a negative impact on the conservation status of the species.

Summary

TABLE 10 SUMMARY OF ASSESSMENT OF SIGNIFICANCE FOR THE APPROPRIATE ASSESSMENT

Attribute	**Criteria**
Attribute 1: Significant negative impact (long term population trends) that could lead to change from favourable condition to unfavourable condition	An effect on marine communities, leading to a decline of 25% or more of the total Dundalk Bay population; or
	Long-term Dundalk Bay population trends outside the long-term population range of other east coast sites.
	The minimum cockle biomass would result in a >25% decline in long-term population trends.
Attribute 2: Significant negative impact on range of areas used that could lead to change from favourable condition to unfavourable condition	The % displacement caused by habitat loss or disturbance in Dundalk Bay due to fishing and knock on effects on distribution and population of a SCI species. If the % displacement is proportional to % population change then displacement of 25% would be deemed to be significant in that it could lead to change from favourable to unfavourable condition.

Assessment of the effects of fisheries on the Conservation Objectives for waterbirds and seabirds in the SPA

The assessment considers the fishing activity proposed in the 2021-2025 cockle FNP and its effect on SCI waterbird species within the SPA. The data sources available for this assessment are:

- NPWS Baseline Waterbird Survey 2009/10 counts (see Cummins and Crowe, 2010; NPWS, 2011 data supplied by NPWS).
- iWeBs data 1994-2019
- Annex III: Review of the Dundalk Bay cockle FNP 2016-2020.
- Annex IV: Distribution of waterbirds in relation to cockle fishing 2010
- Annex V: Dundalk Bay report of aerial surveys January 2019
- Low tide counts conducted in January 2019 of waterbirds in Dundalk Bay SPA

Current status of waterbirds in the SPA

The highest numbers of all bird species, 61,255, in Dundalk Bay were recorded in winter 2003/2004 (Figure 13). The long term (1994-2019) average is stable with a range between 30,000 and 61,000 birds. Year on year declines during the period 2011-2015 were reversed in the period 2015-2019.

Data for the most abundant bird species were divided into five feeding groups namely bivalve feeders, fish feeders, generalist feeders, invertebrate feeders and vegetation feeders (Figure 14). Bivalve feeders declined in 2012/13 and remained, on average, at lower levels but similar to levels in the 1990s, up to 2018/19. Numbers were higher in the period 2005-2012. This decline in 2012/13 also occurred in the generalist group with the exception of 2017/18.

The individual species average population between 2015/2016-2018/2019 (the time frame during the last FNP) and the percentage difference from the baseline population (mean peak numbers during 1995/1996 – 1999/2000) is in Table 11. In January 2019 a low tide count for intertidal waterbirds was conducted alongside a concurrent aerial survey for intertidal waterbirds. The seasonal peak numbers during monthly counts between Sept and March 1994-2019 and the calculated 10 year and 5 year trends is in Table 12.

The 10 year trends and difference from the baseline figures for Knot, Oystercatcher and Shelduck are all greater than -25% indicating an unfavourable status. The 5 year trends (2014-2019) were, however, positive at 6%, 30% and 4% respectively. The fourth bivalve feeder, Common Scoter, showed the opposite trend, a positive 10-year trend and a negative 5-year trend and an overall positive change from the baseline. However, the main population of Common Scoter occurs on the periphery of and outside of the SPA (Annex V).

The fish feeders, Great Crested Grebe and Red Breasted Merganser also show negative trends overall compared to the baseline reference population level (-72% and -32% respectively).

The three gull species (generalist feeders) show differing patterns. The common and herring gull have positive percentage difference between the average of the last FNP and the baseline figures (17% and 250%) whilst the black-headed gull had a negative difference (-88%).

Of the invertebrate feeders only the Dunlin (-58%) and Curlew (-88%) had greater than -25% reduction (Table 11), though both had positive 5 and 10 year trends suggesting that whilst populations had declined from the baseline there was some recovery in recent years (Table 12). Ringed Plover (-28%), Bar-tailed Godwit (-27%) and Redshank (-30%) however all had negative trends below -25% in the 5 year trend suggesting that numbers are currently in decline (Table 12).

Of the vegetation feeders only the Greylag Goose had a negative difference between the average during the last FNP and the baseline figure (-27%). All other species have increased in number since the baseline figures. Mallard however, had a -25% 5-year trend suggesting recent numbers were in decline.

The most recent available data is a low tide survey on January 2019, this resulted in maximum counts of 9678 Oystercatcher, 11% more than the baseline figures during the 1990s (Table 11). Shelduck also had a higher count than the average for the last FNP and similar count to the baseline population (Table 11). Knot had a lower count than both the average figure for the last FNP and the baseline (Table 11) (-58% from baseline population). Common Scoter had a much lower value possibly due to the timing of counts during low tide however large populations of Common Scoter have been shown to be present seaward of the SPA. In general, most other species had similar counts to the average counts during the last FNP. Of note was an increase in Red Breasted Merganser and positive trends compared to the baseline in Bar and Black-tailed Godwit species and an increase in Ringed Plover (Table 11).

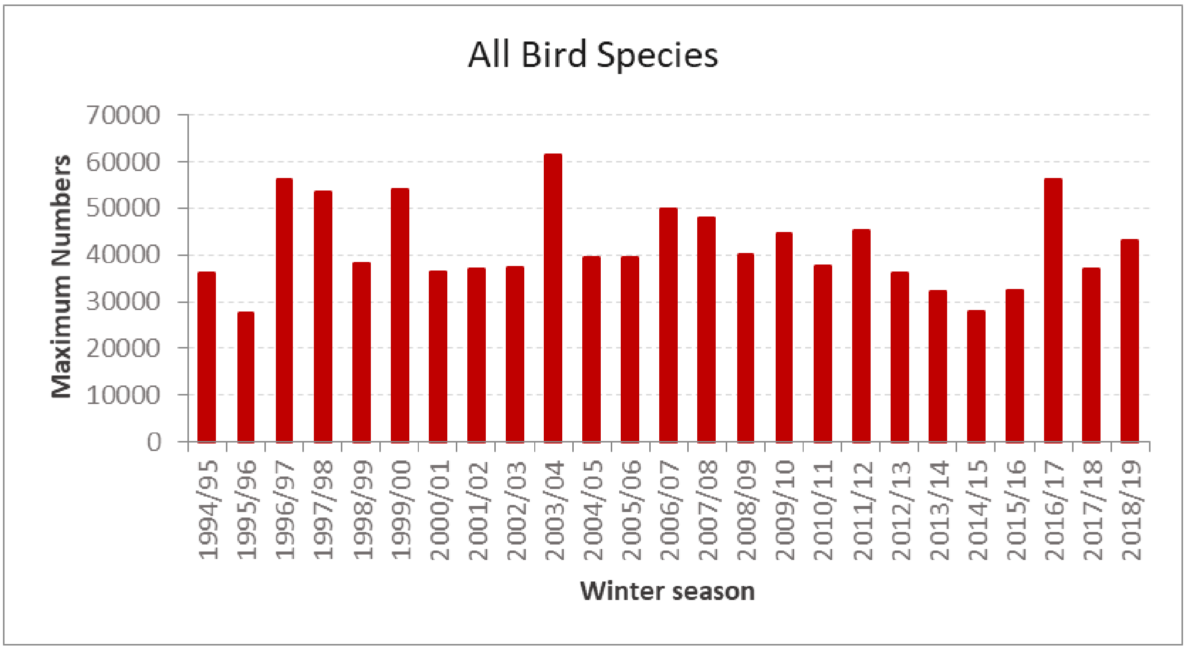

FIGURE 13 TRENDS IN THE NUMBER OF ALL BIRD SPECIES FROM SEPTEMBER TO FEBRUARY DURING THE WINTER SEASONS FROM 1994/1995 TO 2018/2019 IN DUNDALK BAY.

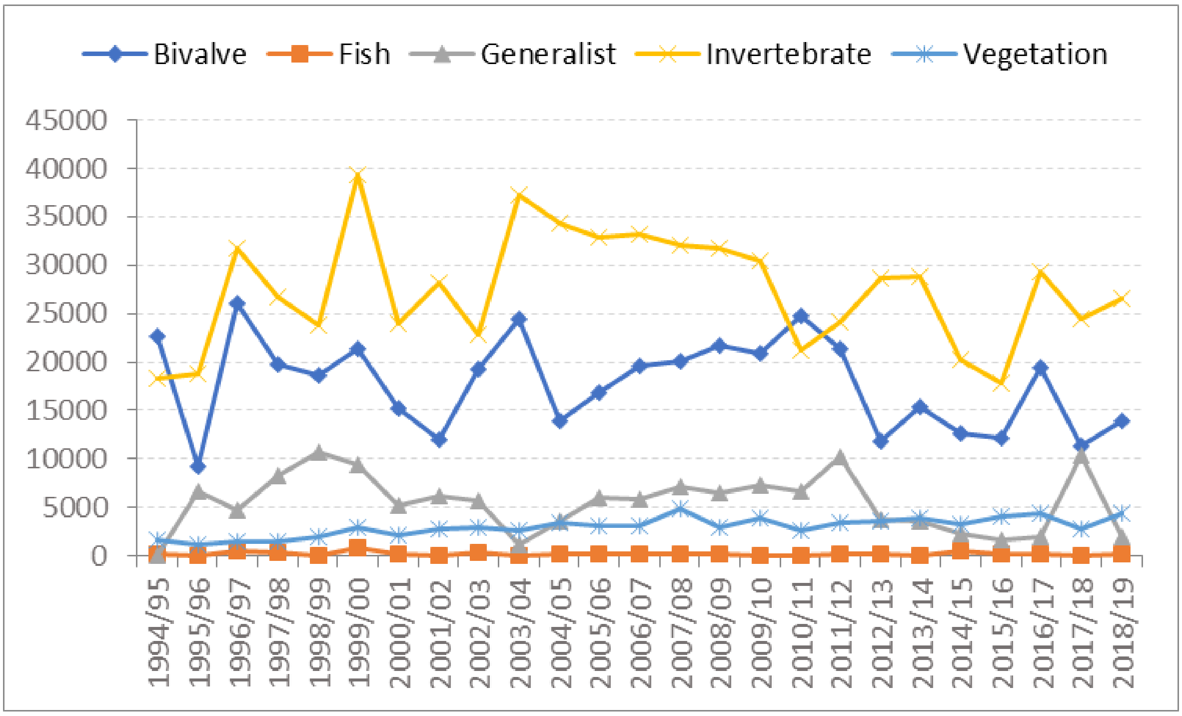

FIGURE 14 TRENDS IN THE NUMBER OF BIRDS IN DIFFERENT FEEDING GROUPS FROM SEPTEMBER TO FEBRUARY IN DUNDALK BAY 1994-2019.

TABLE 11 THE AVERAGE MAXIMUM POPULATION SIZE OF BIRD SPECIES DURING THE COCKLE FNP (DATA FOR 2016-2019) (SOURCE IWEBS) IN DUNDALK; THE COUNTS FROM THE LOW TIDE SURVEY IN JANUARY 2019 AND THE BASELINE POPULATIONS PER SPECIES FROM THE NPWS CONSERVATION OBJECTIVES ARE SHOWN

Feeding Type	Species	Average during 2016-2019	January 2019 low tide counts	Baseline population (mean peak 1995/1996–1999/2000)	%Change between average during FNP and Baseline	%Change between Jan 2019 and Baseline
Bivalves	Knot	6316	4123	9710	-35	-58
Bivalves	Oystercatcher	6434	9678	8746	-26	11
Bivalves	Shelduck	314	568	522	-40	9
Bivalves	Common Scoter	1178	79	581	103	-86
Fish	Great crested Grebe	84	17	303	-72	-94
Fish	Red Breasted Merganser	83	179	121	-32	48
Generalist	Black Headed gull	778	1826	6643	-88	-73
Generalist	Common Gull	646	864	551	17	57
Generalist	Herring Gull	2640	575	754	250	-24
Inverts	Dunlin	4871	4463	11,518	-58	-61
Inverts	Bar-tailed godwit	1670	2532	1950	-14	30
Inverts	Black tail godwit	3086	2792	1100	181	154
Inverts	Curlew	866	909	7264	-88	-87
Inverts	Golden plover	7472	5010	5967	25	-16
Inverts	Grey Plover	215	304	204	5	49
Inverts	Lapwing	4902	3217	4892	0	-34
Inverts	Redshank	1264	1261	1659	-24	-24
Inverts	Ringed plover	190	14	151	25	-91
Vegetation	Light Bellied Brent Goose	2003	2439	370	441	559
Vegetation	Mallard	839	588	765	10	-23
Vegetation	Pintail	196	67	117	68	-43
Vegetation	Teal	561	1622	538	4	201
Vegetation	Greylag Goose	316	230	435	-27	-47

Table 12 Seasonal peak numbers of birds species in Dundalk Bay during monthly counts between Sept and March 1994-2019. Source: iWeBs office. Species for which overall, 10year and 5 year trends are greater than -25% are highlighted in red.

Species	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	10yr trend (% change)	5yr trend (% change)
Knot (B)	15545	5195	15350	11700	10290	5981	6215	3745	7113	11099	5989	7410	3083	7448	7801	8921	14692	12837	3740	6578	6460	5535	7404	4470	7856	-37	6
Oystercatcher (B)	6605	3586	10055	7515	7876	14696	8487	7871	10820	11468	6995	8580	15367	10404	13215	10830	8920	7095	6502	8094	3993	4377	9660	6113	5586	-35	30
Shelduck (B)	355	391	659	449	490	623	408	307	353	565	538	698	846	520	434	742	447	265	184	463	254	248	308	360	338	-38	4
Common Scoter (B)	185	28	65	41	23	69	77	22	1003	1348	415	124	256	1715	223	467	775	1137	1443	220	2000	2089	2121	413	90	79	-39
Great crested Grebe (F)	152	29	388	203	58	839	80	32	293	30	103	52	137	79	109	48	22	45	73	1	19	43	113	10	171	64	367
Red Breasted Merganser (F)	122	60	216	195	51	70	139	37	132	61	150	94	104	158	76	45	27	247	181	109	455	90	132	26	83	63	-63
Black Headed gull (G)	0	5095	3995	7010	8931	8185	4544	5588	5099	594	2798	4919	4858	5452	4952	5066	4362	5047	1148	2041	1295	680	492	764	1176	-83	-39
Common Gull (G)	0	820	63	500	916	458	191	386	224	480	588	587	685	1153	932	1694	1496	2855	2276	1193	894	752	602	557	671	-56	-36
Herring Gull (G)	0	730	629	730	929	753	499	238	364	147	277	603	364	514	670	570	888	2300	329	407	204	269	930	9145	216	384	1069
Dunlin (I)	4515	5834	13464	12634	6780	18880	8985	6071	3372	8897	8095	3625	5734	5490	3184	2678	3221	2030	4063	3989	3086	3662	3653	5280	6890	74	47
Bar-tailed godwit (I)	1660	544	4175	1211	2285	1537	2163	2112	3816	3300	1770	3477	2687	2630	2369	4533	3119	3135	4755	3431	1821	1637	1052	1958	2034	-50	-27
Black tail godwit (I)	360	42	416	1140	897	895	1745	1170	1440	1694	2725	4471	2535	4151	2701	5167	2631	3381	2897	4647	3749	2062	4227	3796	2260	-2	-2
Curlew (I)	2278	603	1977	1100	1051	1176	1513	1241	2174	975	1239	973	1094	593	672	842	1079	796	1105	707	349	607	1322	612	922	10	72

Golden plover (I)	3120	7240	2919	3785	7126	8250	3200	8600	4820	15330	14780	9957	14467	12544	15500	7235	4984	8797	9060	8450	5150	4729	11200	6840	7118	-9	37
Grey Plover (I)	185	284	131	271	90	93	129	165	89	22	79	152	261	90	97	57	140	64	340	333	128	289	187	227	157	94	-24
Lapwing (I)	4188	3675	6395	5030	3388	5971	4130	6435	4733	4965	2951	5447	4045	3859	3878	5284	4073	4511	4135	5506	4202	2862	6732	4460	5555	27	33
Redshank (I)	1857	592	2044	1330	1982	2345	1935	2169	2218	1908	2440	4378	2196	2302	3181	4532	1745	1178	1995	1485	1588	1696	820	1072	1468	-64	-30
Ringed plover (I)	123	40	142	229	157	189	141	153	125	145	226	353	222	389	168	146	226	285	316	187	241	262	167	166	163	-8	-28
Light Bellied Brent Goose (V)	334	447	268	412	352	109	306	591	286	175	442	529	432	1840	1177	1396	722	1802	1861	1800	1462	2337	1856	1066	2752	72	1
Mallard (V)	946	169	599	916	668	1472	611	846	970	883	1167	1102	1231	1140	865	807	694	840	766	964	538	1281	1084	538	454	-12	-25
Pintail (V)	46	112	112	130	114	117	135	105	123	136	291	397	115	394	175	110	78	120	213	132	191	149	302	223	111	75	35
Teal (V)	273	471	541	50	610	917	941	1145	953	692	1020	978	1154	1156	644	1065	512	220	625	681	358	321	656	600	667	-13	41
Greylag Goose (V)			60		268	395	81	170	651	745	514	98	209	345	30	489	650	384	97	324	702	5	550	347	360	8	22

Reduction in food resource

Indirect (changes to the marine community)

The assessment undertaken for habitats in the SAC above presented data on the sensitivity of species in intertidal marine communities, before after control impact studies on the effects of cockle fishing on benthic fauna and annual monitoring data (2008-2020) of the distribution of the main characterising bivalves in Dundalk Bay(*A. tenuis, M. balthica)* and the polychaete *A. marina* (Table 7; Figure 6). The assessment shows that whilst there is high inter-annual variation in density of the three species the overall trend is stable and there are not any significant long term effects of the cockle fishery on marine communities in Dundalk Bay. The 2014 BACI study highlighted potential effects on *A. tenuis,* however, this effect is short-term due to high recoverability of *A. tenuis* and therefore the cockle fishery has not had any long-term effects on the this species which is a constituent of marine benthic communities in the intertidal area.

Direct (removal of food resource)

Non-Cockle prey

A study of waterbird distribution in Dundalk Bay was carried out in February/March 2010 (Annex IV). This examined the distribution of waterbirds between areas affected by cockle fishing in the autumn of 2009 and areas that were unfished. The main area studied was at Dromiskin, while some additional data was also collected at Annagassan. Most species did not show consistent differences in distribution between the control and impact zones and the spatial distribution of waterbirds between the control and impact zones across different counts was quite variable.

Overall, for Oystercatcher, Dunlin, Bar-tailed Godwit, Curlew and Common Gull, the mean proportion of birds in the Dromiskin impact zone was close to 50%. Therefore, if cockle fishing in the autumn of 2009 caused habitat differences between the control and impact zones, any such habitat differences were not having detectable effects on the distribution of these species, in this part of Dundalk Bay, in February and March 2010.

Significantly higher numbers of Knot occurred in the control zone across the Dromiskin sector counts and transect counts, indicating a possibility that habitat differences exist between the control and impact zone and that these habitat differences affected Knot distribution. However, because of the lack of effective replication, it is not possible to say whether any such habitat differences were due to cockle fishing or to other causes, such as underlying habitat differences, or the effects of prey depletion earlier in the winter. The BACI study (Annex IV) indicated that in March 2010 the abundance of bivalves and polychaetes were higher in the impact areas contrary to expectation. Differences in the distribution of Knot between these zones were therefore not correlated with abundance of prey. In addition, on one of the four count days the main Knot flock occurred in the impact zone (which had higher abundance of bivalves and polychaetes). Because Knot tend to feed in a few large flocks, they have a highly aggregated distribution. At the relatively small spatial scales considered in this study, random factors may have a major influence on the distribution of Knot between the control and impact zones.

The conclusions that can be drawn from this study are limited by its timing late in the winter and by constraints in its design due to logistical issues (see Annex IV). However, it does provide supporting evidence indicating that the fishery did not lead to significant depletion of invertebrate prey for waterbirds given that no significant changes in waterbird distribution occurred.

The appropriate assessment for the SAC (above) and possible effects of cockle fishing on intertidal habitats concluded that there are no significant or long-term effects on habitats. It is unlikely, therefore, that a reduction in the availability of benthic invertebrate prey due to cockle fishing is significant. Changes in the distribution of waterbirds in the SPA have not been observed. This conclusion is supported by direct evidence for the site presented in low tide count data and in control impact studies.

Cockle prey

Several of the waterbird SCI species have been recorded feeding on cockles including Oystercatcher, Grey Plover, Knot, Dunlin, Curlew, Redshank, Black-headed Gull, Common Gull and Herring Gull (BWPi, 2004). However, waterbird species can feed on a wide variety of invertebrate prey and there are only a few waterbird species for which cockles are likely to be a significant component of their diet. Leopold *et al*. (2004) provide data on the diet of several benthic invertebrate-feeding waterbird species. The only species for which bivalves form more than 20% of their diet are, Oystercatcher (80%), Knot (75%), Curlew (46%), Black-headed Gull (24%), Common Gull (36%) and Herring Gull (68%). BWPi (2004) states that the diet of

Common Scoter in marine and brackish-water areas is "*predominantly mussels…fewer cockles Cardium (up to 40 mm)*" and quotes a Danish study that reported 42.5% of stomachs containing cockles compared to 95.9% that contained mussels. Little information is available on the diet of Golden Plover and Lapwing in intertidal habitats (BWPi, 2004) but, given their use of terrestrial habitats for feeding, cockles are unlikely to form a significant component of their diet in Dundalk Bay. Studies of prey selection in Black-tailed Godwit have not recorded cockles as a prey item for this species (BWPi, 2004; Gill et al., 2001; Goss-Custard et al., 1991; Moreira, 1994). Gulls have very wide diets (BWPi, 2004) and are unlikely to be dependent on a single prey item. Furthermore, they may benefit from by catch discarded by the cockle fishery, which will provide dead or dying invertebrates that can be a food source for scavenging gulls.

Since 2007 the operational minimum landing size in the Dundalk cockle dredge has been 22 mm shell width (27 mm shell length). The reported size range of bivalves or cockles that the bivalve-feeding species take are: up to 40 mm for Common Scoter (BWPi, 2004); 15 mm up to the maximum length present for Oystercatcher (Goss-Custard et al., 2006); 5-14 mm for Knot (Goss-Custard et al., 2006); and 8-19 mm for Curlew (Goss-Custard et al., 2006). All figures from Goss-Custard *et al*. (2006) are presumed to refer to shell length.

No data is available for the size range of bivalves taken by Shelduck. However, the Shelduck diet is usually dominated by the gastropod *Hydrobia ulvae*, with percentages of up to 89.5% reported. Two studies indicate that the main bivalve taken is *Macoma* (Buxton and Young, 1981; BWPi, 2004). Therefore, cockles are unlikely to be a significant component of the Shelduck diet.

Rates of damage to discarded cockles were only 2% for cockles of shell lengths up to 20 mm (Fahy et al., 2005). Therefore, damage to discarded cockles is unlikely to significantly affect the availability of cockles in the size classes predated by Knot and Curlew.

A 2019 aerial and ground count survey for waterbirds provided an updated map of the main areas utilised by the four main bivalve feeding species; Knot, Oystercatcher, Common Scoter and Shelduck (Figure 15). Shelduck has limited overlap with the area where cockles are distributed and given its varied diet is unlikely to be affected by prey reduction due to the fishery (Figure 15). Common Scoter has a clear subtidal distribution and feeds outside the main cockle fishing area (Figure 15). Knot overlaps with the fishery, cockles make up >20% of their diet, however, these are smaller than those targeted by the fishery so the fishery is unlikely to affect their prey availability (Figure 15; Figure 16). Oystercatcher has significant overlap with the fishery, cockles make up 80% of their diet in the size class targeted by the fishery (Figure 15; Figure 17).

Therefore, the potential direct effects of cockle extraction on species other than oystercatcher can be discounted based on information on diet. The assessment of potential effects on oystercatcher is continued below.

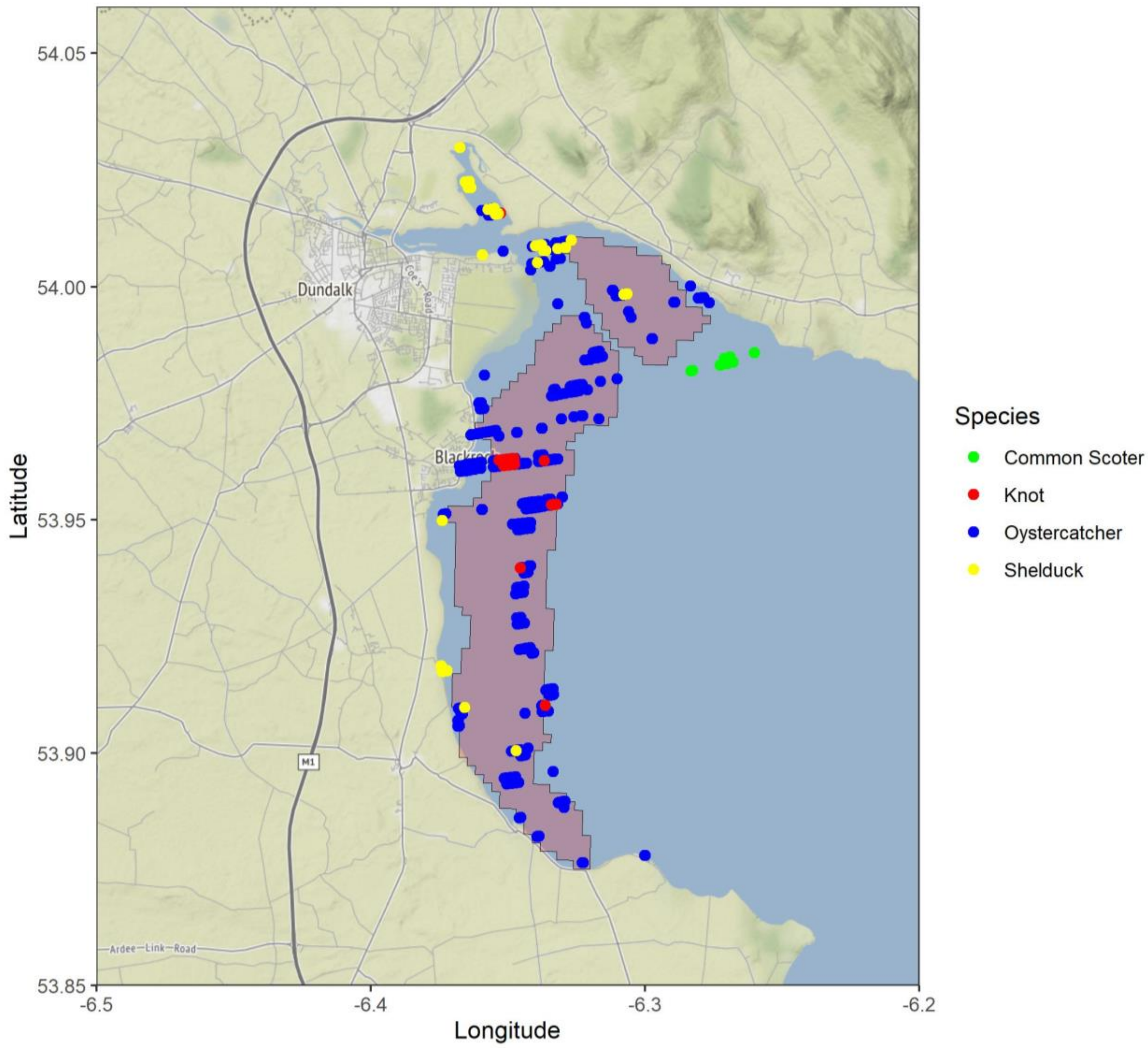

FIGURE 15 SIGHTINGS OF BIVALVE FEEDERS FROM THE 2019 AERIAL SURVEY

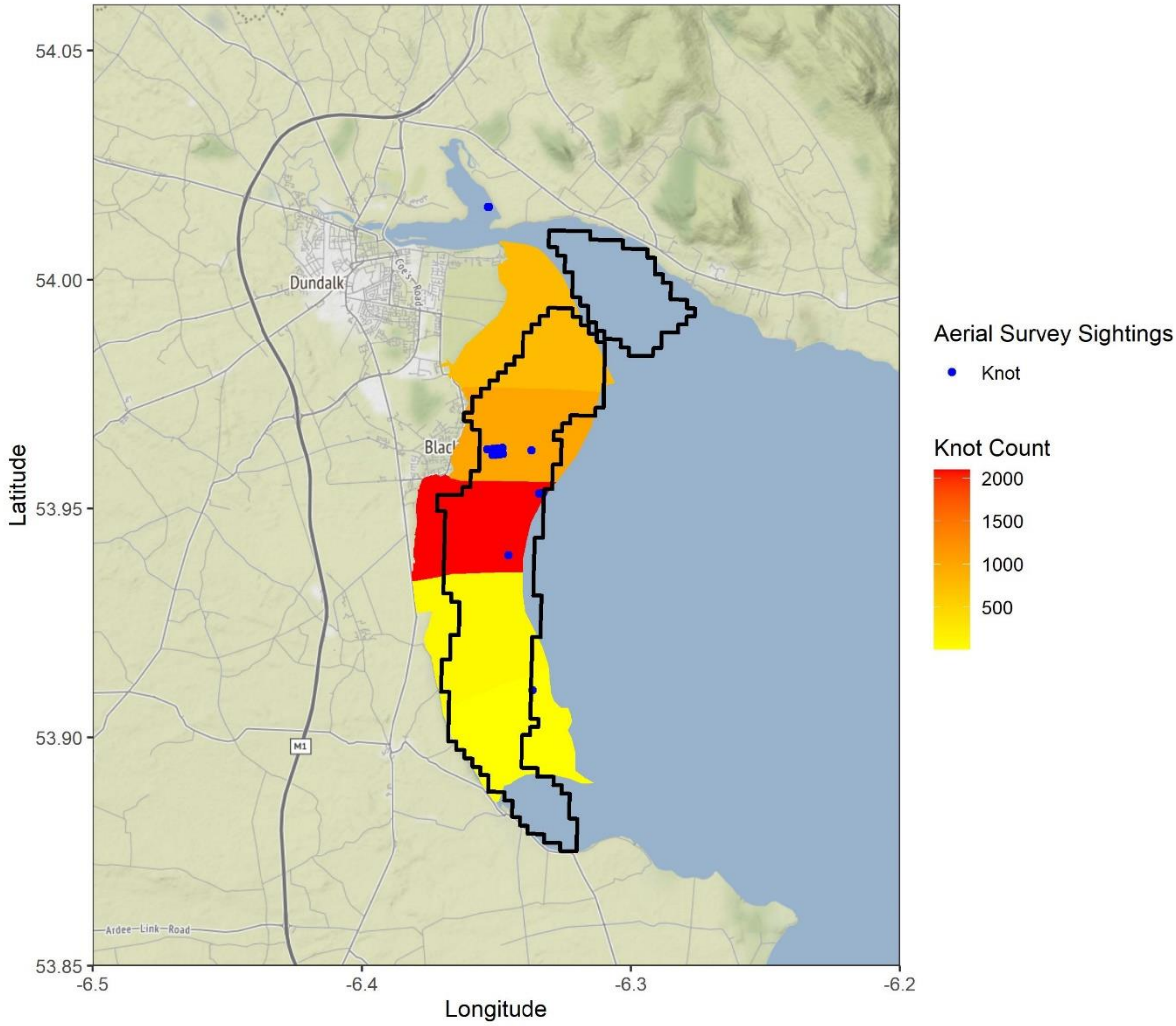

FIGURE 16 THE LOW TIDE COUNT PER SUB-SITE FOR KNOT IN THE JANUARY 2019 SURVEY AND THE AERIAL SURVEY SIGHTINGS CONDUCTED CONCURRENTLY

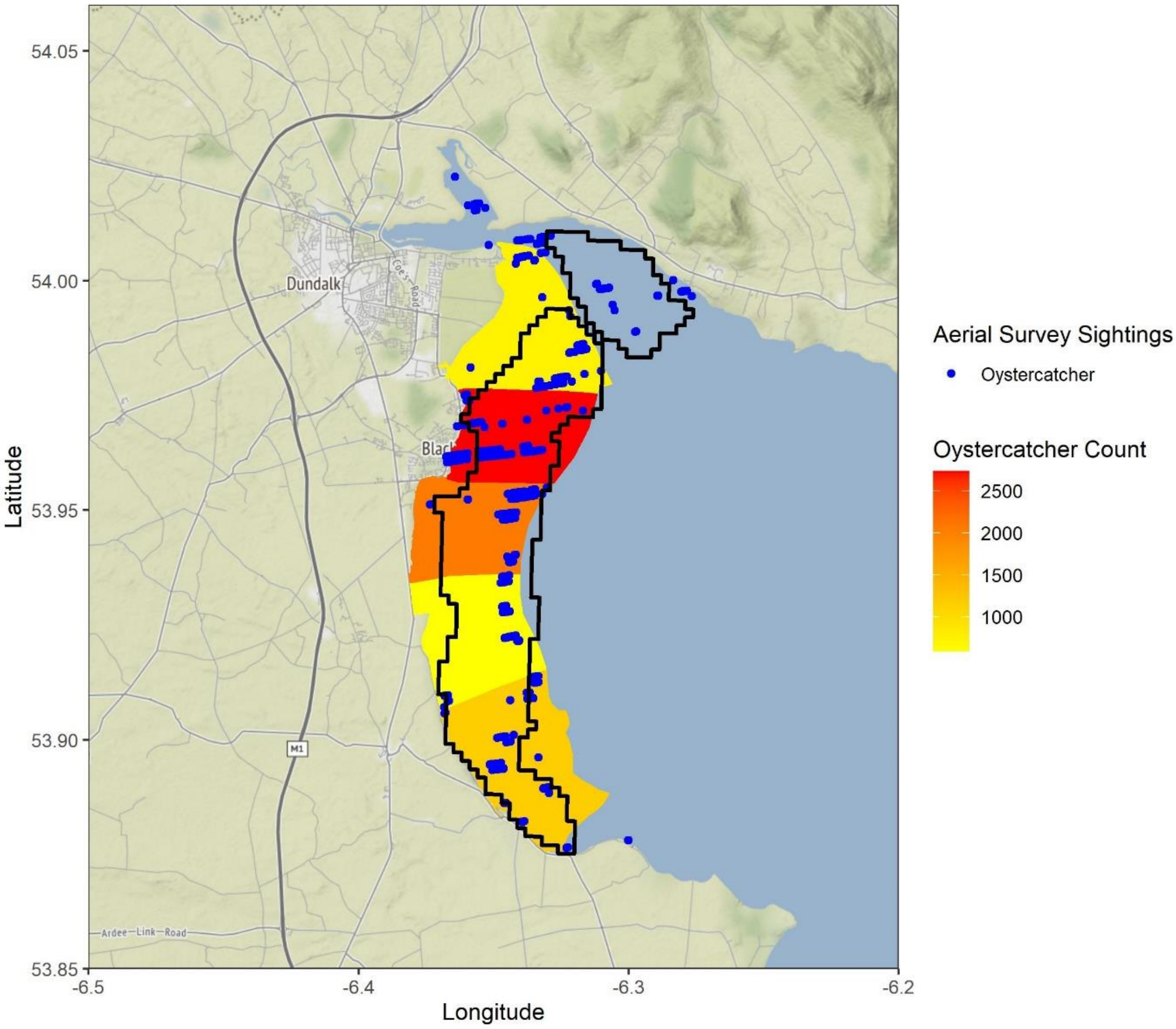

FIGURE 17 THE LOW TIDE COUNT PER SUB-SITE FOR OYSTERCATCHER IN THE JANUARY 2019 SURVEY AND THE AERIAL SURVEY SIGHTINGS CONDUCTED CONCURRENTLY.

Assessment for prey availability and Oystercatcher

Oystercatchers predominantly feed on cockles, however, work by the MI in Dundalk Bay also shows that it feeds on other prey and in particular it feeds extensively in grasslands bordering Dundalk Bay. NPWS report average maximum counts of 8,746 birds in their reference period 1995/96 to 1999/00. iWeBs counts of over 14,000 oystercatchers in 1999/00 and 2006/2007 were the highest counts in 24 years (Figure 18). Recent 5 year averages and longer term 10 year averages were 5,945 and 7,117 birds, respectively. A year on year decline occurred from 2008/09 to 2014/15. Numbers increased from 2014/15 to 2018/19 during the time the FNP 2016-2020 was operational in the area. The most recent count from a low tide survey contracted by the MI in January 2019 counted a maximum of 9678 Oystercatcher (Table 11). This was significantly higher than the iWEBs winter count for the same year and higher than the baseline figures for Oystercatcher outlined by the conservation objectives. This indicates an underestimate of the total number of wintering Oystercatchers in the iWEBs data and indicates that the status of Oystercatcher in Dundalk Bay in 2019 was favourable.

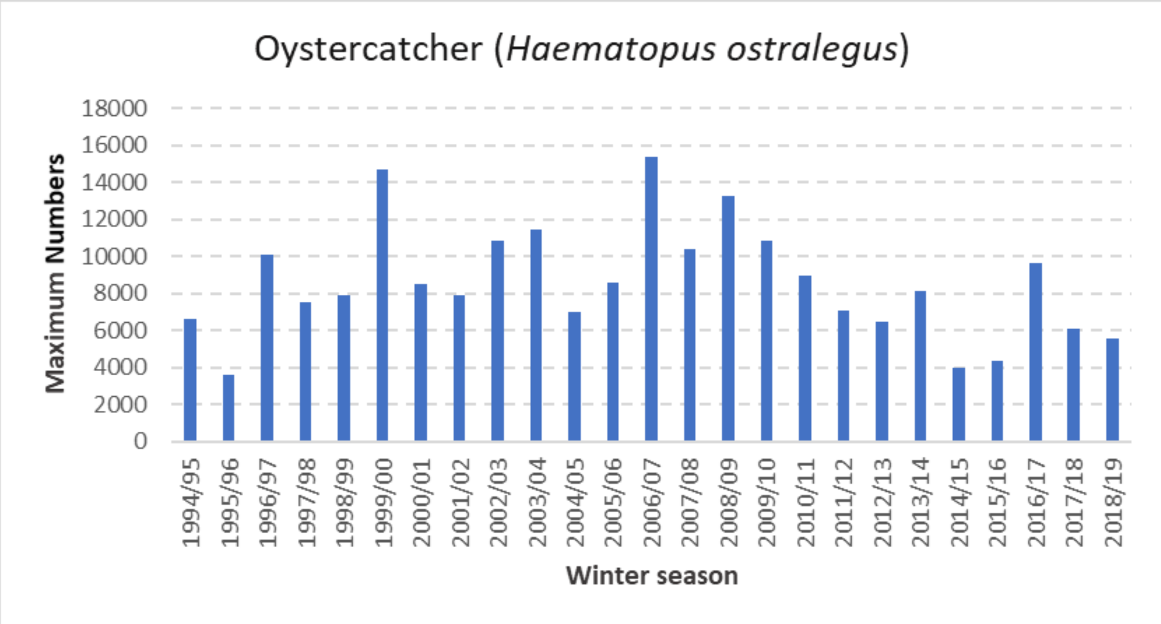

FIGURE 6 TRENDS IN THE PEAK NUMBER OF OYSTERCATCHER (HAEMATOPUS OSTRALEGUS) FROM SEPTEMBER-FEBRUARY FROM 1994/1995 TO 2018/2019 IN DUNDALK BAY

The number of Oystercatchers at other east coast sites south of Dundalk Bay hold lower numbers of birds than Dundalk Bay (Figure 19; Table 13). Five year trends in Oystercatchers are stable or negative at most of these sites. There is a small upward trend in Dublin Bay. The year on year variation in counts is much higher in Dundalk than in other sites. This is probably due to difficulties in counting this large site and also significant numbers of birds feed inland in fields surrounding the Dundalk Bay. Overall there is no indication that the trends in Dundalk Bay are diverging from other sites. This suggests that population trends are related to factors other than the presence of the cockle fishery.

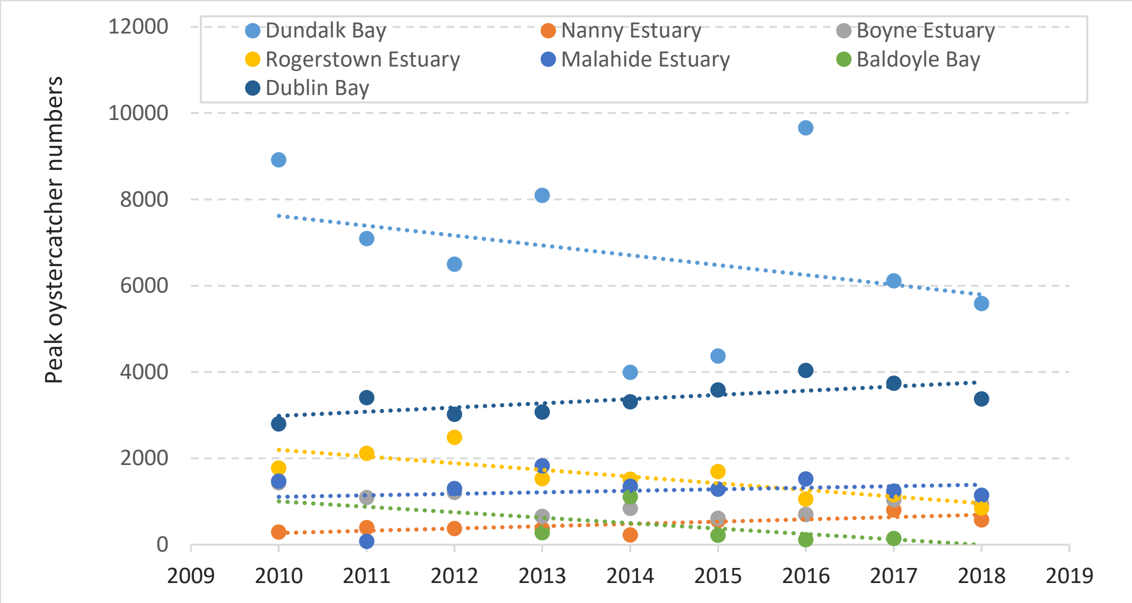

FIGURE 19 TRENDS IN THE PEAK NUMBER OF OYSTERCATCHER (HAEMATOPUS OSTRALEGUS) FROM SEPTEMBER-FEBRUARY 2010/2011 TO 2018/2019 FROM SEVERAL WINTERING SITES ALONG THE EAST COAST INCLUDING DUNDALK BAY.

TABLE 13 PEAK NUMBERS OF OYSTERCATCHER (HAEMATOPUS OSTRALEGUS) FROM WINTER 2010/2011-2018/19 (SEPTEMBER-FEBRUARY) AT SEVERAL SITES ALONG THE EAST COAST INCLUDING DUNDALK BAY.

Wintering Site	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	5 year trend
Dundalk Bay	8920	7095	6502	8094	3993	4377	9660	6113	5586	30
Nanny Estuary	291	396	378	369	228	560	700	803	575	80
Boyne Estuary	1435	1099	1211	655	844	610	704	1042	944	28
Rogerstown Estuary	1781	2116	2491	1531	1519	1697	1057	1161	852	-35
Malahide Estuary	1471	78	1300	1833	1355	1291	1523	1242	1150	-13
Baldoyle Bay				277	1113	219	117	144		-76

Dublin Bay	2804	3408	3025	3074	3315	3588	4042	3740	3378	12

Oystercatcher in Britain are declining. The 25-year trend is -23% and the 10 year trend shows a -12% decline. Northern Ireland shows similar declines with a -14% decline across 25 years and -20% decline over 10 years. These figures are not as high as the declines reported in Dundalk Bay (Frost et al., 2020). Data on trends of the last 5 years in these areas are not currently available.

Effects of removal of cockles on Oystercatcher

In winter Oystercatchers in north-western Europe generally specialise in large bivalve molluscs, particularly cockles and mussels. Other benthic invertebrate prey are less profitable due to the increased searching and handling time required because of the greater depth at which they are buried in the sediment (Zwarts et al., 1997). For example, in a ten year Dutch study, the intake rate of Oystercatchers feeding on cockles averaged around 1.25-2.0 mg/sec during November-March, while their intake rate on Macoma and Scrobicularia averaged around 0-0.75 mg/sec (Zwarts et al., 1997). However, intake rates vary with prey weight and prey density (Zwarts et al., 1996), so the relative profitability of different prey will depend upon their relative abundance and size. Oystercatchers predate cockles with shell lengths of 15 mm or greater (Goss-Custard et al., 2006), which is equivalent to a shell width of around 11 mm. At Dundalk Bay, the size range varies seasonally due to growth and recruitment and ranges from 3-36 mm. The percentage of the biomass above 11 mm will be highest in late summer and autumn due to summer growth of 0+ cockles.

Oystercatchers in Dundalk also feed on other marine invertebrates and may also feed on earthworms in terrestrial fields, either as supplementary high tide feeding, or as their main food supply. In Dundalk over 1000 birds have been observed in fields. The numbers using fields depends on weather conditions; usually numbers using fields is higher following wet weather.

Previous studies in Dundalk Bay (Annex IV) have shown that cockles were a significant component of the Oystercatcher diet throughout the winter of 2011/2012, but with a higher frequency of captures of cockles in September and late December and a low frequency in February (Table 14). Worms were generally the next most frequent major prey item. Many prey captures in these studies could not be identified as the prey item was caught while probing and ingested without being removed from the sediment: these prey captures were not cockles (as Oystercatchers feeding on cockles show very distinctive handling actions) and were likely to be mainly worms and some small clams. Sea squirts were a significant prey item in early November after large numbers were washed up on the sandflats following storms. Small prey items (probably small surface-active invertebrates) were frequently caught but are unlikely to be significant energetically.

The size distribution of predated cockle shells (identified from shell damage caused by stabbing by oystercatcher) collected from the sandflats was very similar to the size distribution of cockles recorded in a December cockle survey in 2012. However, analysis shows that the handling times of cockles consumed without the shell being removed from the sediment was significantly shorter than the handling times of cockles when the shell was removed (even when the time involved in carrying the cockle is excluded). As handling time is strongly correlated with cockle size, this suggests that the size distribution of predated cockle shells collected from the sandflats underestimates the proportion of smaller cockles predated. Analysis of both the size distribution of predated cockle shells, and handling time durations does not show much evidence of seasonal variation in the size distribution of cockles predated by Oystercatchers.

Although cockles are a significant food resource for the Oystercatcher population at Dundalk Bay they are more flexible in their feeding behaviour than generally indicated by the literature. Oystercatchers appear to select disproportionately smaller cockles than are available and there is no evidence of a preference for cockles above the 22 mm shell width operational size limit.

The rate of capture of cockles by oystercatchers showed a large decline between September and October 2012, coinciding with the start of the cockle fishery (Table 15). This could be due to disturbance or to reduction in density of cockles. Theoretically dredging may interfere with cues that Oystercatchers use to locate cockles. This would explain both the reduction in capture rate between September and October, and the increase in late December. However, there is no evidence in the literature of Oystercatcher feeding behaviour being affected by disturbances to sediment. Also, the limited information on spatial patterns does not indicate high levels of impact in the areas with greatest intensity of fishery activity. Oystercatchers in September were mainly feeding in patches of high density cockles. By late October, Oystercatcher predation and the cockle fishery had reduced the densities in these patches and a significant reduction in the capture rate occurred. Densities of cockles may therefore have reached a critical low threshold that reduced capture rates by Oystercatcher. However, it would not explain, the recovery in capture rate in late December.

In 2012/13, the proportion of birds feeding on cockles remained high (60-90%) between July and October but was lower in late winter (Table 15).

TABLE 14 FREQUENCY OF SUCCESSFUL CAPTURES OF VARIOUS PREY ITEMS, SHOWN AS THE PERCENTAGE OF OBSERVATIONS DURING WHICH THE PREY ITEM WAS CAUGHT.

Date	Clams	Cockles	Sea squirts	Worms	Other	Unknown	Small prey	Focal observations
Sep	3%	72%	0%	1%	3%	20%	25%	75
Oct	5%	43%	0%	28%	0%	18%	51%	88
early Nov	4%	29%	20%	16%	0%	15%	64%	97
late Nov	1%	49%	6%	14%	6%	31%	44%	77
early Dec	3%	37%	0%	25%	0%	15%	31%	118
late Dec	0%	61%	0%	5%	0%	21%	11%	38
Jan	10%	36%	2%	12%	1%	24%	12%	105
Feb	5%	12%	0%	18%	2%	27%	21%	104
Mar	4%	31%	0%	5%	2%	42%	24%	83

TABLE 15 FREQUENCY OF SUCCESSFUL CAPTURES OF VARIOUS PREY ITEMS, SHOWN AS THE PERCENTAGE OF OBSERVATIONS DURING WHICH THE PREY ITEM WAS CAUGHT.

	2011/12	2012/13		
Date	Cockles (all)	Cockles (all)	Cockles (normal)	Cockles (small)
July		68%	68%	1%
Aug		70%	66%	19%
Sep	72%	90%	44%	77%
Oct	43%	73%	43%	34%
early Nov	29%			
late Nov	49%			
early Dec	37%			
late Dec	61%			
Jan	36%			
Feb	12%	53%	44%	21%
Mar	31%			

Correlation between oystercatcher population and cockle biomass

The number of oystercatchers overwintering in Dundalk Bay is positively correlated with the post fishery cockle biomass (Figure 20). This is the biomass that is available in autumn when the fishery is closed and is simplistically estimated as the June survey biomass minus the landings. The relationship is leveraged by the cockle biomass and high Oystercatcher count in 2008/09 and the data needs to be updated for winters of 2019/20 and 2020/21 which were not available at time of writing (Figure 21). At cockle biomass between 1,000-2,000 tonnes

Oystercatcher numbers are variable. At the minimum biomass suggested in the current FNP of 1000 tonnes the relationship would predict an oystercatcher population of ~6500. This number is in line with the population of Oystercatcher reported in 2017/2018 and 2010-2019.

The cockle biomass limit below which there will be no fishery will, on average, enable the site to support about 6500 oystercatchers based on the observed data for Dundalk Bay over the period 2008-2018. As the exploitation rate above 1500 tonnes is to be limited to 33% the site should support more than 6500 oystercatcher where biomass is at these levels. During the FNP 2016-2020 cockle biomass was over 1500 tonnes in all 5 years. In the FNP 2011-2015 the exploitation rate on cockles when cockle biomass was less than 1000 tonnes was generally zero i.e. by voluntary agreement the fishery did not open in those years and landings were lower than the TAC when biomass was less than 1400 tonnes. Generally, therefore, the post fishery biomass will enable significantly more than 6500 oystercatchers to be supported given that fishing will not occur at biomass <1000 tonnes, is unlikely to occur when biomass <1300 tonnes and is limited to 33% of biomass at biomass >1500 tonnes. Significant effects of the removal of cockle on oystercatcher can be discounted.

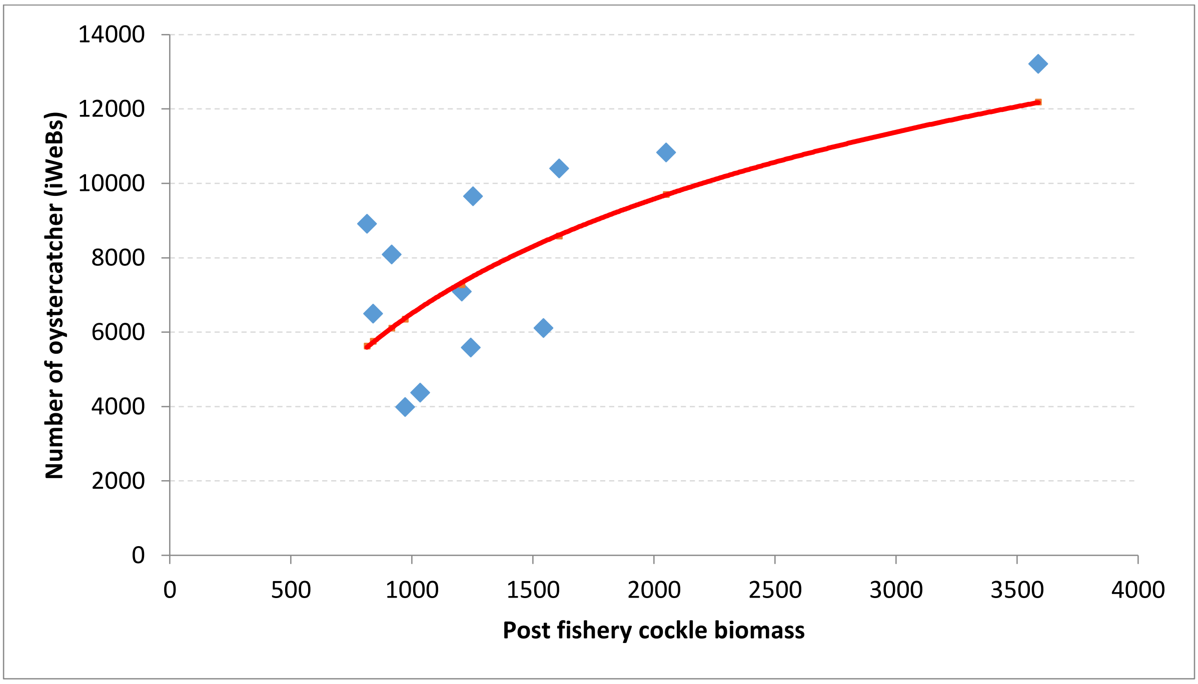

FIGURE 20 RELATIONSHIP BETWEEN PEAK OYSTERCATCHER NUMBERS (IWEBS DATA) AND POST FISHERY COCKLE BIOMASS IN DUNDALK BAY 2007-2018. THE FITTED CURVE IS A BEVERTON AND HOLT STOCK (COCKLE) AND RECRUITMENT (OYSTERCATCHER) FUNCTION R=AS/(B+S), A = 18587 (THE ASYMPTOTE OF CURVE)

Summary of assessment for the *effects of the cockle fishery on the reduction of food resource for waterbirds*

TABLE 16 FINAL ASSESSMENT FOR THE EFFECTS OF THE COCKLE FISHERY ON WATERBIRD POPULATIONS

Criteria	Final assessment
An impact on 25% of marine communities leading to a decline of more than 25% or more of the total Dundalk Bay population of any species	There are no significant changes in marine communities due to cockle fishing. Habitat loss is estimated to be zero. **Effects of cockle fishing on waterbirds are assessed as non-significant given that no change in marine communities have occurred during the period 2008-2020 or are likely to occur during the FNP 2021-2025** The long-term trend of Oystercatcher is just above unfavourable condition (-26%) compared to the baseline, however, the 5-year trend during the time of the last cockle FNP 2016-2020 showed a positive population trend (+30%). Therefore, there is no evidence that the long-term decline is being caused by the cockle fishery. Peak numbers in 2019 were over 9500 birds and above baseline reference levels in the 1990s. Harvest rules in the cockle FNP 2021-2025 are more conservative than those in previous FNPs. **The assessment concludes that the cockle FNP will not have significant effects on oystercatcher populations.**
Long-term Dundalk Bay population trends outside the long-term population range of other east coast sites.	Long term population trends for waterbirds in Dundalk are stable. The 5-year population trend for oystercatcher in Dundalk Bay is in line with or better than the 5-year population trend in other east coast sites without a cockle fishery indicating that the fishery in Dundalk Bay is not adversely affecting oystercatcher populations. **Therefore, the assessment concludes that the cockle fishery will not have significant effects on waterbird populations or on oystercatcher populations specifically.**

The minimum cockle biomass would result in a >25% decline in long-term population trends for oystercatcher	The stock (cockle) recruitment (of oystercatcher) assessment indicates that the proposed minimum biomass of 1000 tonnes pf cockle below which there is no fishing would support populations of approximately 6500 oystercatcher. This is more conservative than the 750 tonnes minimum biomass for a fishery to open in the 2016-2020 FNP and during which time oystercatcher trends were positive. Furthermore harvest rate is also limited above 1000 tonnes. **Therefore, the assessment concludes that the cockle FNP 2021-2025 will not adversely affect oystercatcher populations.**

Disturbance leading to displacement

All birds are subject to disturbance of one kind or another, in this assessment we are interested in:

1. The degree of overlap of the activity and the SCI population and,
2. Where relevant, the proportion of the Dundalk Bay population that may be displaced by the activity

In the proposed FNP fishers will fish on one tide per day at high tide only, usually 2 hours either side of high water. Therefore, only species which forage at high tide are likely to be subjected to disturbance. Other species can be screened out with respect to disturbance effects. In addition, gull species have been well documented to interact with fishing vessels and to rely on discards as a main food source (Foster et al., 2017; Gutowsky et al., 2021), therefore, we discounted the three gulls species as being significantly negatively affected by the presence of fishing vessels. We have, therefore, screened in the SCI species which forage in the SAC when the mud and sand flat and estuary is covered by water and for which fishing vessels could cause disturbance:

A005 Great crested grebe (*Podiceps cristatus*) – wintering
A048 Shelduck (*Tadorna tadorna*) – wintering
A052 Teal (*Anas crecca*) – wintering
A053 Mallard (*Anas platyrhynchos*) – wintering
A054 Pintail (*Anas acuta*) – wintering
A065 Common scoter (*Melanitta nigra*) –wintering
A069 Red-breasted merganser (*Mergus serrator*) – wintering

Of the seven species; Shelduck, Great-Crested Grebe and Red-Breasted Merganser are currently in unfavourable condition given their average population from the four years of the last FNP (2016-2019) and their difference from the baseline populations (-40%, -72% and -32% respectively) (Table 11).

The proportion of the population potentially displaced

Shelduck can forage in subtidal habitat but were rarely recorded doing so during the 2009/10 surveys (0-2% of Shelduck). Teal, Mallard and Pintail were recorded foraging in subtidal habitats. Mallard generally forage in waters with depths of less than 1 m (NPWS, 2011) and this is also likely to be true of Teal and Pintail. Therefore, these species are unlikely to forage in the dredge fishery area when water depths are sufficient for boats to access the area.

At any one time, the maximum potential disturbance impacts from the dredge fishery will only affect a small proportion of the dredge fishery area activity: e.g. assuming a very precautionary response distance of 400 m, and a non-overlapping distribution of 33 boats, the area affected would be 16.5km^2 out of a total possible fishing area of 77.8 km^2. The vessels do not maintain distances of 400m from each other and are often aggregated in relatively small areas so this estimate of disturbance is inflated.

There is no particular reason to suppose that particular stretches of water are of higher value than other stretches as roosting habitat, given the very uniform nature of the habitat and topography. Therefore, any flocks disturbed by boats in the dredge fishery should be able to move to alternative subtidal roost areas nearby.

Red-breasted Merganser and Great Crested Grebe are fish eating species that forage and roost in subtidal water, typically of 3-6 m depth (Red-breasted Merganser) or 2-4 m (Great Crested Grebe), although the latter species can dive up to 30 m (BWPi, 2004). Both species typically occur in dispersed small groups in coastal Irish wintering sites, while Great Crested Grebe can also occur in larger flocks. According to BWPi (2004), Great Crested Grebe mainly feeds during the daytime, while Red-breasted Merganser is described as most active early morning and evening. However, in Irish wintering sites, Red-breasted Merganser actively feed during the daytime. As a visual predator (BWPi, 2004), nocturnal feeding is unlikely to be important.

Suitable habitat (in terms of water depth) occurs throughout most of the SPA and extends up to 4 km outside the SPA along the northern and southern sides of the bay. However, both species tend to favour more sheltered coastal waters and, therefore, may occur more frequently in the inshore sections of the bay.

The dredge fishery will be active in three out of the eight months (August-March) during which Great Crested Grebe and Red-breasted Merganser are present at Dundalk Bay and these months may represent the peak seasonal occurrence of these species at Dundalk Bay. During these months the fishery can be active for up to 92 days (38% of the available days); although in practise this is unlikely to occur due to tidal and other limitations. On each day, the fishery can be active for up to four hours out of an average daytime period of 13 hours (30%). The fishery will not affect the entire available habitat simultaneously it is likely that it would affect substantially less than 50% of the populations of these species on any one day. Therefore, under a worst-case scenario, the potential disturbance between the dredge fishery and Great Crested Grebe and Red-breasted Merganser occurrence can be calculated as:

0.38% of the available days * 0.3 of the daylength * 0.5 of the population distribution = 0.05 or 5% of the total foraging space/time.

The distribution of Great Crested Grebe and Red-breasted Merganser is unlikely to be uniform throughout the dredge fishery area, so it is possible that concentrations of one or both species may happen to coincide with areas of high dredge fishery activity. However, the assumptions listed above are very precautionary. Also, at any one time, any potential disturbance impacts from the dredge fishery will only affect a small proportion of the dredge fishery area.

Summary for the assessment of disturbance on waterbirds in the SPA

TABLE 17 SUMMARY FOR THE ASSESSMENT OF DISTURBANCE ON WATERBIRDS IN THE SPA

Criteria	**Final assessment**
Disturbance of 25% or more of the total Dundalk Bay population leading to displacement of 25% of the population of any species	Overall, the area of overlap between the fishery and SCI species is small and the likelihood of significant disturbance leading to displacement on any SCI species can be discounted. **Therefore, the assessment concludes that the cockle FNP will not lead to any significant displacement or change in the number of areas of the Bay used by waterbirds.**

Conservation Objective 2 – Habitat loss

Conservation Objective 2 for the Dundalk Bay Special Protection Area is defined as follows:

To maintain the favourable conservation condition of the wetland habitat at Dundalk Bay SPA as a resource for the regularly-occurring migratory waterbirds that utilise it.

This objective is defined by the following attribute and targets:-

To be favourable the permanent area occupied by the wetland habitat should be stable and not significantly less than the areas of 8136, 4374 and 649 hectares for subtidal, intertidal and supratidal habitats respectively, other than that occurring from natural patterns of variation.

A map of these broad habitat zones is provided in Appendix 1 [of NPWS, 2011].

Source: Dundalk Bay Special Protection Area (Site Code 4026). Version 1. Conservation Objectives Supporting Document (NPWS, 2011).

Summary for objective 2

TABLE 18 SUMMARY FOR THE ASSESSMENT OF HABITAT LOSS IN THE SPA

Criteria	Final assessment
The % displacement caused by habitat loss or disturbance in Dundalk Bay due to fishing and knock on effects on distribution and population of a SCI species. If the % displacement is proportional to % population change then displacement of 25% would be deemed to be significant in that it could lead to change from favourable to unfavourable condition.	The fishery activities covered in this assessment take place in intertidal and/or subtidal habitat and do not change the area of these habitats in terms of these categories. Therefore, these activities will not affect the attributes and targets specified for this conservation objective. **Therefore, the assessment concludes that there will not be any significant effects of the cockle FNP on wetland habitats or migratory waterbirds.**

Conclusions of Appropriate Assessment of the cockle FNP in the SPA

1. Greylag Goose, Light-bellied Brent Goose, Shelduck, Teal, Mallard, Pintail, Red-breasted Merganser, Great Crested Grebe, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Dunlin, Black-tailed Godwit, Bar-tailed Godwit and Redshank are not susceptible to any potential impacts from reduction in cockle biomass because these species do not typically feed on cockles.
2. Reduction in cockle biomass by the cockle fishery will not affect the conservation objective to maintain the favourable conservation condition for Common Scoter because their distribution in Dundalk Bay does not indicate that cockles are a major component of their diet and they occur mainly outside the SAC and SPA.
3. Reduction in cockle biomass by the cockle fishery will not affect the conservation objective of Knot and Curlew populations because they feed on cockles that are smaller than the size classes that are fished, and the damage rate to these size classes which may be caused by dredging is minimal.
4. Reduction in cockle biomass by the cockle fishery will not affect Black-headed Gull, Common Gull and Herring Gull populations because they have very wide diets and may also benefit from by catch discarded by the cockle fishery.
5. There is no evidence that the cockle fisheries that occurred between 2016-2020 had any significant effects on Oystercatcher populations (population has been trending upwards since 2014) and a January 2019 survey counted a maximum population of over 9000 birds which is higher than the baseline reference period figures for Dundalk Bay.
6. Nevertheless, as Oystercatcher are partially dependent on cockles and given the observed correlation between estimated autumn biomass of cockles and the number of Oystercatcher using the SPA the following winter it is important to maintain cockle biomass at levels that will minimise the risk to the baseline oystercatcher population. The FNP proposal of not fishing at cockle biomass less than 1000 tonnes would predict a recruitment of 6500 Oystercatchers in subsequent years which will maintain conditions in the Bay that will enable it to support a stable population. Fishing will also be limited at cockle biomass above 1000 tonnes.

7. The reduction in cockle biomass by the cockle fishery will not cause a decrease in the numbers or range (distribution) of areas used by the Oystercatcher population and will not affect Attribute 2 of the conservation objective.
8. The potential effects of disturbance from the dredge fishery is spatially limited compared to the total area available for fishing. Suitable roosting habitats are available at multiple sites throughout Dundalk Bay therefore the effects of disturbance are assessed as non-significant.
9. The SAC assessment on the effects of cockle dredging on marine communities concluded that there are no long-term effects of community abundance and composition. Therefore habitat changes which might affect waterbirds is also assessed as non-significant.

Section 8 – Appropriate Assessment for in combination effects of other fishing activities

There are two fisheries considered in this assessment which target bivalves;

- Intertidal fishing for cockles
- Subtidal fishing for razor clams

The vessel monitoring system data (iVMS) (2016-2020) for the two fisheries (Figure 5) show spatially distinct fisheries with the cockle fishery taking place in the more intertidal region whilst the razor clam fishery occurs in the subtidal region. Therefore, there are no in combination effects on habitats as the razor clam fisheries occur outside of the SAC.

However, a number of bird species rely on bivalves as a food resource and therefore in combination effects are possible.

There are two possible pressures from in combination effects of both fisheries:

1. Disturbance from two spatially segregated fisheries may reduce available habitat for foraging.

2. Whilst the two fisheries have different target species they both cause similar effects on benthos potentially effecting the prey availability of waterbirds.

Disturbance

Common Scoter are highly sensitive to disturbance however and possible in combination effects of both fisheries have potential to reduce the foraging area of Common Scoter and increase the energetic costs associated with foraging. Common Scoter distribution is mainly subtidal to the east of the SPA, disturbance from razor clam fishing might force displaced birds into inshore areas where they are then subsequently displaced by the cockle fishery.

Recent study by the MI (Breen et al., n.d.) which modelled aerial survey data from 2018/2019 alongside the iVMS data found evidence the Common Scoter were displaced by the small, slow moving razor clam vessels to the extent that it affected their overall distribution. This study used an 800m grid cell size so it is possible that any disturbance effects are at a very local scale and unlikely therefore to interact with the cockle fishery. Therefore, we conclude that there are not significant in combination effects between the cockle fishery and the razor clam fishery for disturbance of Common Scoter.

Prey availability

Both fisheries are targeting different bivalve prey. The main species which are likely to be affected by in combination effects, therefore, are:

1. Oystercatcher prey on cockles and mussels (among other items of prey).
2. Other waterbirds such as Knot feed on cockles but are either less reliant on these species or feed on size classes not taken by the fishery.

Oystercatcher and Knot distribution is based largely over the cockle fished area and not in the region of the razor clam fishery (Figure 16; Figure 17) therefore there is no evidence that oystercatcher or knot are foraging in the region of the razor clam vessels. Therefore significant effects from the razor clam fishery in combination with the cockle fishery can be discounted.

Section 9 – Appropriate Assessment of the in combination effects of other activities

A number of recreational activities and effluent discharges occur in the Dundalk Bay SAC/SPA. Recreational activities are listed in (NPWS, 2011) from observations at the site in 2009-2010 by ornithologists counting birds at the site. Categories of activity included:

- Walking
- Bait digging and mollusc gathering
- Bait digging operates throughout the area where access to the beach is safe (at Annagassen in the south and Gyles Quay area in the north). Mollusc gathering is presumably the collection of cockles although periwinkle picking occurs on the south of the Bay
- Un-powered and powered water craft
- Horse riding
- Dog walking
- Shooting
- Use of vehicles
- The use of motorised vehicles is prohibited in bye-law by Louth County Council

Of these activities bait digging and mollusc collection, horse riding and use of vehicles (which is prohibited) could have disturbing effects on habitats. The total area over which these activities may occur is probably low. Access to the main intertidal sand flat east of Dundalk-Blackrock-Castlebellingham is limited by health and safety concerns and warnings are in place at Blackrock advising the public not to venture past the channel of the River Fane which is approximately 200m seaward of the coast. The in combination effects of these activities with fishing is deemed to be insignificant.

Effluent discharge and agricultural runoff

Organic and nutrient inputs to estuaries increase productivity and may increase food resources for waterbirds. Adverse impacts to waterbirds may be caused by declines in organic and nutrient inputs, although there is no hard evidence to date of this happening (Burton et al., 2003). Therefore, effluent discharges to Dundalk Bay are unlikely to cause adverse impacts to waterbirds.

The Water Framework Directive (WFD) (2000/60/EC) seeks to consolidate measures to deal with both point and diffuse pollution sources to receiving waters, including estuarine waters around Ireland’s coast. Point sources include for example waste water treatment plants from large urban conurbations, such as Dundalk, while diffuse sources include nutrient loss associated with agricultural activities. With respect to point sources since 2000 the waste water treatment plant at Soldier’s Point, Dundalk, has been discharging biologically treated effluent to Inner Dundalk Bay, with resultant improvements in nutrient loading to be expected.

With respect to agricultural runoff the objective is to reduce the loss of both nitrogen and phosphorus from agricultural lands to surface waters that ultimately drain to bays such as Dundalk. Working from the northern end, Dundalk Bay is fed by the Flurry River, Kilcurry / Castletown River (into Dundalk Harbour), Fane River, River Glyde, and the River Dee. The Nitrates Action Programme (NAP), which was given statutory effect by the European Communities (Good Agricultural Practice for Protection of Waters) Regulations S.I. 378 of 2006, should also see a progressive reduction in the level of nitrates entering coastal estuaries from diffuse source pollution, which resultant reduction in nutrient loading in the estuary.

Castletown Estuary is defined by the EPA in *Water Quality in Ireland 2004-2006* as Eutrophic; Inner Dundalk Bay is defined as of Indeterminate Status; while Outer Dundalk Bay is defined as Unpolluted (EPA, 2008). By 2019 (*Water Quality in Ireland 2019*), Castletown Estuary was classified to be in poor ecological status (EPA, 2019). Contrary to expectations, in 2012 Inner Dundalk Bay therefore underwent an improvement in trophic status between 2004-2006 and 2010-12 being assessed as unpolluted (EPA, 2015).

There is evidence that nutrient loading in coastal and estuarine waters can increase the carrying capacity of such waters for wintering waders and wildfowl and the water quality improvements proposed under the WFD may reduce this capacity with resultant negative impacts on bird numbers. Available water quality data would suggest that no such alteration in water quality and associated influence on bird numbers is likely to have occurred in Dundalk Bay in recent years.

Section 10- Appropriate Assessment Conclusion Statement

SAC features

Commercial dredging for cockles overlaps with the conservation features in the SAC (communities of designated habitats 1130 and 1140). The characterising species of the benthic communities of these habitats have low sensitivity (high resilience and high recoverability) to physical disturbance and biological extraction pressures due to cockle fishing. Low sensitivity can be inferred from life history characteristics of most of these species and was also demonstrated through 12 years (2008-2020) of monitoring of benthic communities following fishing in Dundalk Bay. The proposed cockle fishery will not have a significant effect on the constituent communities of designated habitats.

SPA features

The proposed cockle fishery could affect SCI waterbirds through reduction in prey availability, change to marine communities in benthic habitats and disturbance from fishing vessels. No significant persistent changes in marine communities, and therefore in prey availability, were observed during the period 2008-2020. Disturbance leading to displacement is also assessed to be non-significant. Cockle extraction potentially affects oystercatcher populations as they feed on larger cockles. Oystercatcher diet is predominately cockles including those of landing size although a study at the site showed that oystercatcher are also feeding on a variety of other species including foraging in surrounding farmland. The final assessment concludes non-significant effects on oystercatcher because the 5 year population trend, during the previous FNP, shows a positive trend in oystercatcher numbers, Dundalk Bay does not deviate outside the inter annual range for oystercatcher population at other east coast sites, which do not have a cockle fishery, and finally the minimum cockle biomass below which there will be no fishing, in the proposed FNP, is sufficient to support a stable population of Oystercatcher at the site. The measures proposed in the cockle FNP are sufficient and mitigate against any significant effects on oystercatcher populations and are more conservative than measures in previous cockle FNPs.

The Razor clam fishery in the SPA has escalated in scale and intensity in recent years. However, the two fisheries are spatially distinct. As such, the in combination effects from both fisheries on waterbirds is assessed as not significant.

Recommendations

Specific actions related to site monitoring, the rationale for these and implications for cockle and razor clam fisheries are described in Table 19.

TABLE 19 CONCLUDING ASSESSMENT, WITH RECOMMENDATIONS AND MITIGATIONS WHERE REQUIRED, OF THE EFFECTS OF FISHING ON THE CONSERVATION OBJECTIVES FOR DESIGNATED HABITATS AND SCIS IN DUNDALK BAY SAC AND SPA

Activity	Conclusion	Monitoring and research	Recommendation
Hydraulic dredging for cockles	Dredging for cockles inter-tidally has short term effects on cockles and on the bivalve *Angulus tenuis*. Characterising species of the habitats have low sensitivity to disturbance and recover between fishing seasons. There are no significant persistent disturbing effects on habitats. Twelve years of data shows that characterising species of marine communities are stable Low cockle biomass may reduce prey availability for oystercatchers. This may be more likely if the cockle biomass declines significantly below 1000 tonnes although the site has supported a population well above the baseline level at cockle biomass below this. There will not be any fishing if biomass is <1000 tonnes of cockles.	The Marine Institute will undertake the following measures to continue to inform the effectiveness of management measures in the cockle FNP 1. The activity of the cockle fleet (effort and landings) will be monitored annually through use of the GPS monitoring system currently installed in a significant number of the eligible vessels. Daily catch data will be obtained from records submitted to SFPA and by inspection of landings by SFPA. 2. The distribution, abundance and biomass of characterising bivalves will be assessed annually 3. Improved estimates of post fishery biomass of cockles, using at least a partial survey in autumn in years when a fishery operates and a stock projection assessment based on growth and mortality estimates, will be derived. 4. Data will be collated to continue to evaluate the stock recruitment relationship for cockle biomass and oystercatcher 5. Overwintering bird data should be made available in the spring of the same year so that the	The proposed cockle fishery can proceed, as described in the FNP, on the basis that habitat effects are not significant and that effects on bird species have been found to be not significant.

		relationship between birds and cockle biomass can be updated prior to any subsequent fishery in autumn.	
Interaction between hydraulic dredging for razor clams and hydraulic dredging for cockles.	The two fisheries are spatially distinct and therefore in combination effects are not significant. Effects of disturbance on Common Scoter have recently found to be non-significant for the razor clam fishery and the effects are likely to be similar for the cockle fishery. There is no evidence of in combination effects between the two fisheries.	The distribution of flocks of Scoter, Merganser and Grebe in the absence and presence of fishing vessels should be mapped and monitored.	

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