DRAFT
Appropriate Assessment Report

Seed mussel fishery natura plan
Castlemaine Harbour SAC and SPA

May 2024

Marine Institute

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1. Introduction

This appropriate assessment investigates the potential for ecological impacts of fishing and relaying of mussels (*Mytilus edulis*) in and adjacent to Castlemaine Harbour SAC and SPA (Natura site) on the conservation objectives and special conservation interests of the Natura site. The assessment is of a 5 year mussel seed Fishery Natura Plan (FNP) submitted, by the Castlemaine Mussel Producers Co-operative, to the Department of Agriculture Food and Marine (DAFM) in 2024. The activity involves the fishing for seed mussel in inner Dingle Bay or in Castlemaine Harbour, the relay of seed onto intertidal habitats in the area covered by a Fishery Order, previously issued to the co-operative, and the relay of half grown mussels from the intertidal area to sub-tidal habitats. Some seed may also be re-laid onto intertidal and sub-tidal sites licenced for mussel Aquaculture. A screening assessment of the proposed plan was completed by the Marine Institute in March 2024 (S.I. 290/2013). This recommended that a full appropriate assessment (AA) report should be undertaken as possible effects of the proposed activity on birds and habitats could not be discounted.

The AA report is supported by a number of Annexes which are provided separately to this document.

- **Annex I**. The seed mussel fishery Natura plan 2024-2028
- **Annex II**. Screening for Appropriate Assessment: Fishery Natura Plan for Seed Mussel (2024-2028) Castlemaine Harbour SAC and SPA
- **Annex III**. Effects on inter-tidal relay of mussel on benthic communities
- **Annex IV**. Effects on sub-tidal relay of mussel on benthic communities
- **Annex V**. Distribution of birds in Castlemaine Harbour
- **Annex VI**. Effects of mussel relay on distribution of waterbirds
- **Annex VII**. Effects of human disturbance on birds

2. Details of the proposed fishery for seed mussel

- The proposed activities are described in the draft mussel fishery Natura plan 2024-2028 (Annex I).
  - The fishery is for seed mussel; “seed fishing” refers to the sub-tidal and inter-tidal collection of mussels for relaying on aquaculture sites and not for sale for human consumption.
  - Mussel seed beds do not develop each year. There is a lot of spatial temporal variability in where and when they develop. Typically, in any year the area fished is much smaller than the entire extent that fishing might have taken place historically. The areas to be fished will be approved annually through the fishery licencing process. The fishery typically occurs in Autumn.
  - Seed mussel is fished from the sub-tidal seed areas identified in surveys under taken by BIM in collaboration with the industry. The seed is either transferred for hardening to an intertidal fishery order nursery site in Castlemaine Hbr for 6 to 12 months, placed directly onto subtidal growing areas in a fishery order area within the Harbour or directly onto aquaculture sites within the harbour.
  - If seed is placed on the nursery area or onto intertidal mussel aquaculture sites it is subsequently transferred to sub-tidal plots and licenced sites for on growing until harvest. Generally, seed is moved to the subtidal between June and August but the duration and timing of stock movements from the nursery area to the subtidal is dependent on a number of factors such as market conditions, growth rates, and the size of the original seed. The seed is transplanted by pumping it, mixed with seawater, from the hold of the boat onto the nursery and grow out plots. The vessels are fitted with a pumping system. This pattern of relaying is achieved by the vessels moving across the plots during pumping in an effort to achieve an even distribution of mussel on each plot in order to maximise survival and growth. Pumping pressure is variable but does not disturb sediments and is undertaken at high tide in water depths of 3-4m
  - The rotation of fishing and subsequent husbandry is
    - Seed are fished from sub-tidal areas at the mouth of Castlemaine Hbr in the autumn.
    - Seed may be placed in other sub-tidal areas inside the Harbour for 2-3 years at density of 35-40t per hectare
    - Seed may be placed in intertidal areas inside the Harbour for 6-12 months. Mussel cover is 12% in the relay area which is a but a proportion of a larger intertidal area
    - Harvesting for sale from sub-tidal areas is from late Sept to mid March

- Fishing takes place on suitable neap tides (≤7m as predicted in the Llanelli tide tables) subject to seed availability, allocation and suitable weather conditions.
- Maximum permitted fishing days in a given year will be 70 and fishing is conducted only from 6.00 to 18.00hrs
- Currently there are 5-6 large vessels using 2-4 single dredges each that could fish seed mussel. This may increase if infrastructure and funding allows.
- Between 9-10 small vessels, using single handheld dredges, may also access the seed beds. This may increase if infrastructure and funding allows.
- On larger vessels the dredges are 2-4m wide with a flat bar that is designed to skim the surface of the substrate and separate mussel seed from the underlying substrate and remove the mussel seed.
- The volume of seed harvested will be based on annual survey estimates and a harvest control rule limiting harvests to 66% of the surveyed biomass. Mussels also occur in other areas that are not suitable for fishing.
- The plan proposes also that seed mussel can be imported from the Irish Sea in years where there is limited or no availability of seed in Castlemaine Hbr.
- The plan proposes that seed collected on rope anywhere in the country could be re-laid into Castlemaine Hbr.
- Predator control: There is a green crab predator control programme associated with the sub-tidal plots, generally focusing on the channels entering the inner harbour. Up to 10 boats using up to 100 pots each are involved in the potting of the area for green crab, using waste from white fish processing establishments as bait.

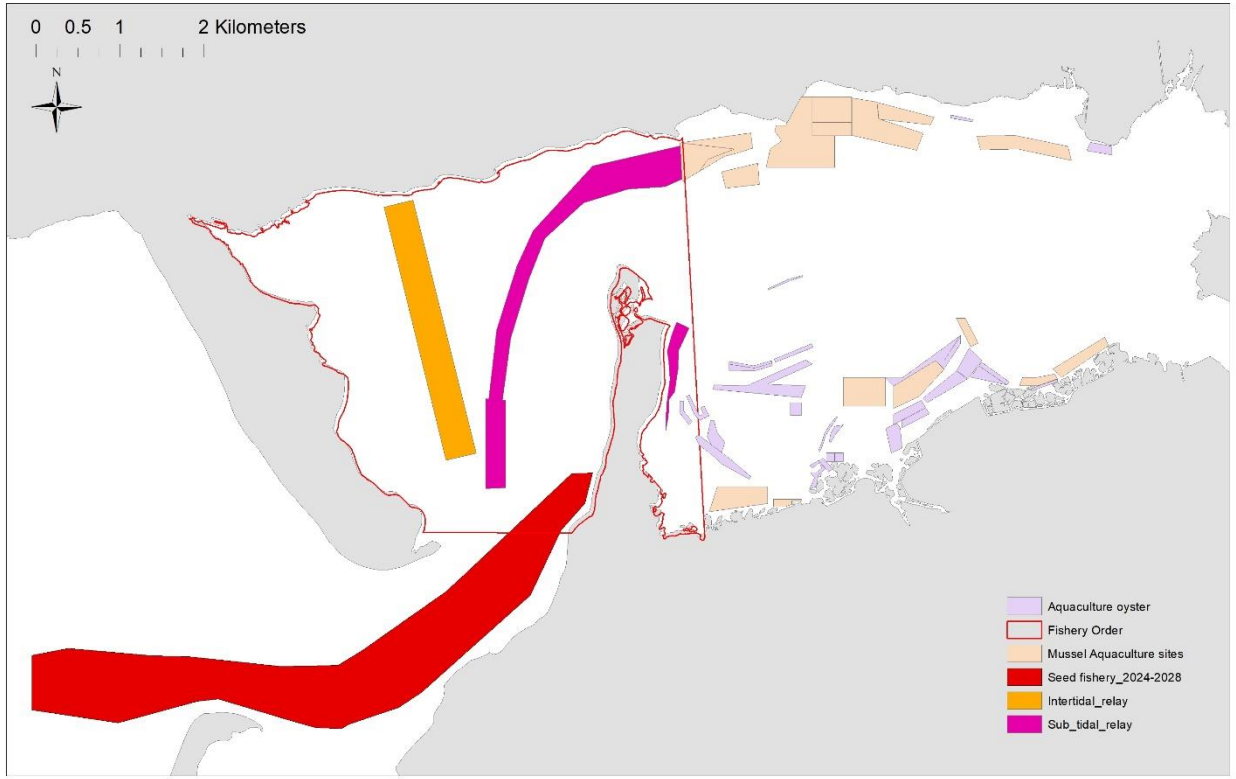

Figure 1. Location of proposed seed mussel fishing, intertidal relay of seed mussel and sub-tidal relay of mussels and licenced mussel and oyster aquaculture sites within Castlemaine Harbour.

3. Activities with potential in combination effects

Aquaculture of oysters

There are 30 licenced sites for culture of oysters in Castlemaine Hbr (April 2024 MI aquaculture database). One of these is also licenced for production of Manilla clam. Oysters are predominantly grown in trestles and bags in Castlemaine Harbour. Ortec and SEPA baskets may occasionally be used. One producer has a licence to culture pacific oyster on the seabed. Seed is imported from hatcheries in spring and autumn and packed in oyster bags at a predetermined density and taken to the inter-tidal zone, where the bags are attached to trestles for the growing process to begin. As the oysters grow, they are taken to the handling / sorting facility or foreshore area for splitting and re-packing.

The trestles are arranged in rows and blocks on site. Again the site layout varies from site to site and producer to producer. Rows are often set out in pairs with sufficient gap between pairs for flat-bottomed vessel to pass, allowing servicing. Other producers will arrange trestles in blocks e.g. block of 40 trestles where there are 4 trestles deep and 8 trestles long. There are gaps left between blocks for access and servicing. Shifting sands and water channels may cause problems in arranging trestles and working conditions on site may become unsuitable in some cases.

The majority of oyster sites are accessed by boat.

Producers generally turn each bag on site once a month. Turning takes place when the oysters are growing. This means turning takes place from March up to Oct/Nov. Both spring tides and 4-5 days around the peak tide of each month are used as opportunity to turn oysters.

Aquaculture of mussels

There are 16 licenced sites for mussel aquaculture. This is separate to mussel production activity in the fishery order area but essentially the activities in both cases are similar and as described above.

Crab Predator control

Up to 6 punts are engaged in predator control in the seed mussel intertidal nursery area throughout the year. Baited traps are laid in lines of 11 strings of 25 pots per string. The pots are left to fish for 24 hours and hauled every day weather permitting.

Periwinkle picking

Commercial picking of periwinkles occurs in intertidal areas of Castlemaine Harbour at low tide. The location, quantity of activity generated and total out-take is unknown.

Effluent Discharge

There are a small number of activities which are terrestrial in origin that might result in impacts on the conservation features of the Castlemaine Harbour SAC. Primary among these are point source discharges from domestic sewage outfalls distributed along the harbour and municipal urban waste water treatment plants. The pressure derived from these point sources may impact upon levels of dissolved nutrients, suspended solids and some elemental components e.g. aluminium in the case of water treatment facilities.

Recreation

The area supports a variety of recreational activities including bird-watching, walking, horse riding, recreational off road vehicles, angling, sailing and windsurfing (NPWS 2011a).

4. Trends in production of bivalves in Castlemaine Harbour

Mussel

Mussels have been produced from Castlemaine Harbour for many decades. Records from 1966-2014 show strong fluctuations in production between years (Figure 2). This is presumably due to variability in seed supply, in seed survival during on-growing and probably the market demand and activity of the members of the co-operative. Production peaked at over 8000 tonnes in the early 1980s and at 7000 tonnes in the late 1980s. Smaller peaks in production occurred in 1996 and 2003. From 2003 to 2013 production generally declined. Implementation of the first seed mussel fishery natura plan 2011-2015, in combination with additional mussel aquaculture licences issued during this period, did not lead to significant increases or changes in production levels. This plan envisaged harvesting between 2000-5000 tonnes of seed and that final market production volumes would be similar to this given a 1:1 ratio between seed relay and final harvest. The BIM seed survey time series indicate significant constraints to achieving 2000-5000 tonnes relay and production per year. The average production of mussels for human consumption varied from just 72 tonnes in 2018 to 1170 tonnes in 2023. The

production is constrained by the availability of seed. Although the FNP envisages import of seed from the Irish Sea the total biomass annually in the Irish Sea is about 6000 tonnes (BIM surveys) and there is very competitive demand for this biomass on the east coast. The scope to increase mussel production in Castlemaine is, therefore, limited. This is an important consideration in this appropriate assessment which assumes the scale of activity will be similar as per the previous FNP. This is very likely to be the case.

Oysters

Oyster production increased from an averae of 431 tonnes during the period 2014-2018 to just over 1000 tonnes from 2019-2023.

Clams

One site is licenced for production of clams (*Ruditapes philippinarum*). The site is also licenced for oysters. There has not been any production in recent years.

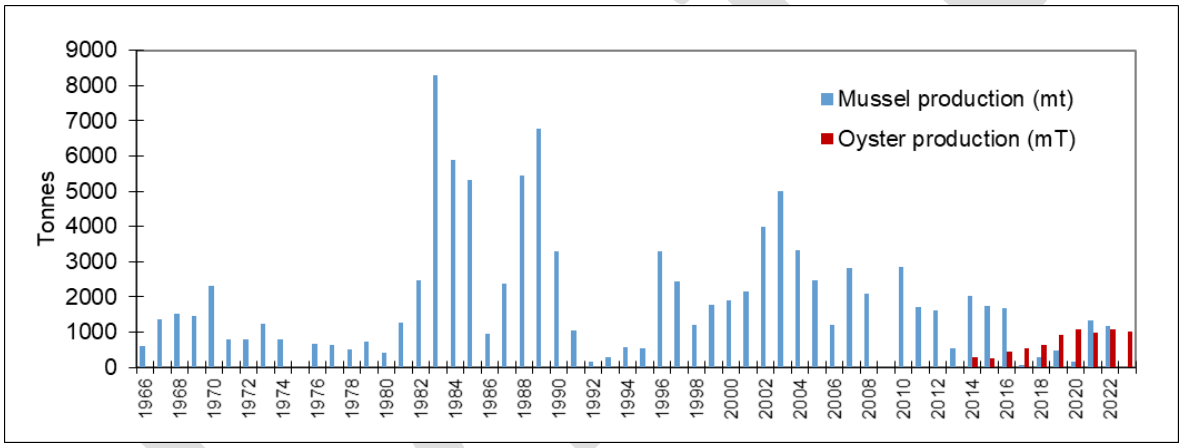

Figure 2. Trends in mussel production in Castlemaine Harbour 1966-2023 and oyster production 2014-2023. Source of recent data BIM.

5. Conservation objectives

Qualifying interests in the SAC

Castlemaine Harbour SAC (site code IE 000343) is designated for the following qualifying interests:

- 1095 Sea lamprey (*Petromyzon marinus*)
- 1099 River lamprey (*Lampetra fluviatilis*)
- 1106 Salmon (*Salmo salar*)
- 1130 Estuaries with the community types outlined in
- Table 1 and Figure 3.
- 1140 Mudflats and sandflats not covered by seawater at low tide with the community types outlined in Table 1 and Figure 3
- 1210 Annual vegetation of drift lines
- 1220 Perennial vegetation of stony banks
- 1310 Salicornia and other annuals colonizing mud and sand
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)
- 1355 Otter (*Lutra lutra*)
- 1395 Petalwort (*Petalophyllum ralfsii*)
- 1410 Mediterranean salt meadows (*Juncetalia maritimi*)
- 2110 Embryonic shifting dunes
- 2120 Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)
- 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes)
- 2170 Dunes with *Salix repens* ssp. *argentea* (*Salix arenariae*)
- 2190 Humid dune slacks
- 91E0 Alluvial forests with Alnus glutinosa and Fraxinus excelsior (*Alno Padion*, *Alnion incanae*, *Salicion albae*)

The distribution of inter-tidal benthic communities within the SAC is closely related to exposure levels and sediment types (Figure 3, Table 1). In addition, the River Maine to the north, the River Laune to the south, in the main harbour, and the Caragh River, which drains into Rossbehy Creek, has significant effects on the distribution of benthic communities in the area.

Table 1. Marine communities within habitat 1140 (Mudflat and sandflat not covered by seawater at low tide) and 1130 (Estuaries) in Castlemaine Harbour (NPWS 2011)

Habitat	No.	Community	Characterising species	Area (Hectares)
1140	1	Intertidal muddy fine sand community complex.	*Tharyx sp A, Polydora cornuta, Gammarus locusta, Macoma balthica, Hediste diversicolor, Corophium volutator, Heterochaeta costata, Pygospio elegans, Crangon crangon*	*554*

1140/1130	2	Fine to muddy fine sand with polychaetes community complex	*Pygospio elegans, Eteone longa, Scoloplos armiger, Spio martinensis, Macoma balthica, Capitella capitata, Angulus tenuis*	*3555*
1140/1130	3	Intertidal sand with *Nephtys cirrosa*	*Nephtys cirrosa, Bathypoeia pilosa, Scolelepis squamata*	*861*
1140/1130	4	*Zostera* dominated community	*Zostera sp.*	*234*
1130	5	Mixed sediment community complex	*Mytilus edulis, Corophium acherusicum, Caprella acanthifera, Pholoe synophthalmica, Nemertea indet, Pomatoceros lamarckii, Microprotopus maculatus, Abludomelita obtusata, Amphipholis squamata, Jassa pusilla, Eumida sanguinea, Nephtys cirrosa, Ammothella longipes, Angulis tenuis, Gastrosaccus spinifer*	*588 (in estuary)*
1140	6	Fine sand with *Donax vittatus* and polychaetes community	*Donnax vittatus, Spiophanes bombyx, Magelona mirabilis etc.*	*5*

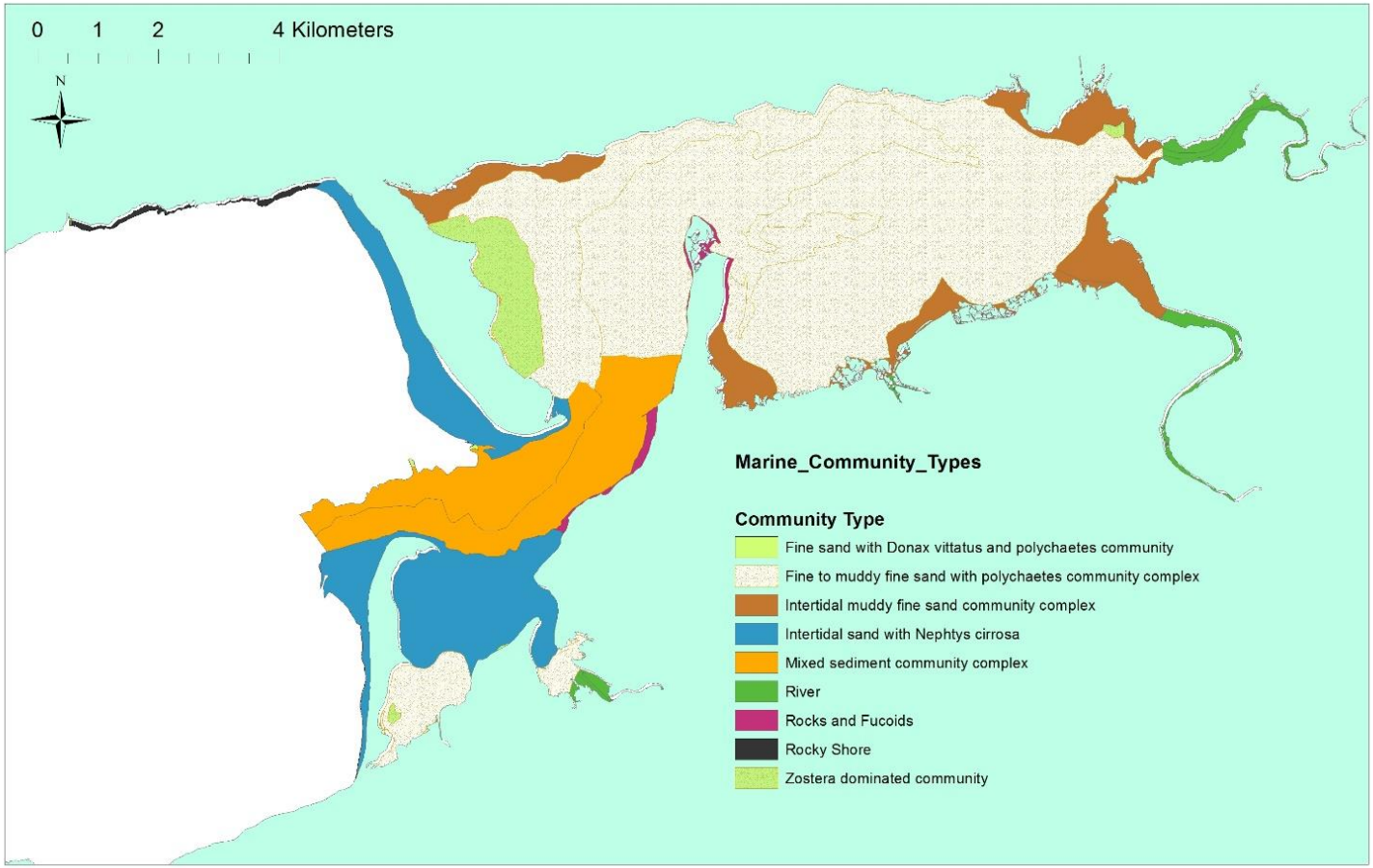

Figure 3. Distribution of inter-tidal and sub-tidal benthic marine communities in Castlemaine Harbour (NPWS 2011)

Conservation objectives for the SAC

NPWS (2011) provide a description of the conservation objectives for all qualifying interests of the SAC.

- In the case of marine communities within Habitats 1130 and 1140 the important attributes of the conservation objectives are Habitat area and Habitat structure and function.
    - 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 5696ha and 4287ha respectively
    - Habitat structure and function: The communities of habitats 1130 and 1140 should be stable in distribution and species composition (as outlined in
    - Table 1).
- Licensing of activities likely to cause continuous disturbance of each community type should not exceed an approximate area of 15%. Thereafter, an increasingly cautious approach is advocated (NPWS 2011). Disturbance is defined as activities that result in change to habitat area, structure or function. Disturbance may be continuous or episodic or temporary or occur at a given frequency. Such patterns of disturbance may enable habitats to recover between disturbance events and to remain in favourable conservation status generally. In these cases more than 15% of the habitat could be temporarily disturbed but no cumulative effects may occur due to recovery between disturbing events. These situations should be assessed case by case having regard to the sensitivity of the receiving environment and the nature of the disturbing activity.

Conservation Interests in the SPA

Special Conservation Interests for Castlemaine Harbour SPA (site code IE 4029) are:

- A001 Red-throated Diver (*Gavia stellata*)
- A017 Cormorant (*Phalacrocorax carbo*)
- A046 Light-bellied Brent Goose (*Branta bernicla hrota*)
- A050 Wigeon (*Anas penelope*)
- A053 Mallard (*Anas platyrhynchos*)
- A054 Pintail (*Anas acuta*)
- A062 Scaup (*Aythya marila*)
- A065 Common Scoter (*Melanitta nigra*)
- A130 Oystercatcher (*Haematopus ostralegus*)
- A137 Ringed Plover (*Charadrius hiaticula*)
- A144 Sanderling (*Calidris alba*)
- A157 Bar-tailed Godwit (*Limosa lapponica*)

- A162 Redshank (*Tringa totanus*)
- A164 Greenshank (*Tringa nebularia*)
- A169 Turnstone (*Arenaria interpres*)
- A346 Chough (*Pyrrhocorax pyrrhocorax*)
- A999 Wetlands & Waterbirds

Conservation Objectives for the SPA

NPWS (2011a) provide a description of the conservation objectives and targets for species of waterbirds and the wetlands which support them.

1. Conservation **Objective 1, Attribute 1**. **Population trends** of all SCI species should be stable or increasing as measured by the % change in population size over time. In particular populations are classified as being in unfavourable status if they have declined by more than 25% in the most recent 5 year period.
2. Conservation **Objective 1, Attribute 2**. The **distribution and range** of areas used (habitat use) by SCI species should be stable or increasing.
3. Conservation **Objective 2**: The **area of subtidal, intertidal and supratidal habitats** should be stable or increasing and not less than the areas of 7471, 3983 & 312 hectares for sub-tidal, intertidal and supratidal habitats, respectively other than that occurring from natural patterns of variation.

6. Screening for appropriate assessment

A screening report was prepared by the Marine Institute in March 2024 for consideration by the Minister (Annex II). Qualifying interests that were screened out are in Table 2. Given the description of the proposed mussel fishery and associated activities a number of qualifying interests were recommended for appropriate assessment (Table 2). The Minister subsequently determined that an appropriate assessment report for the seed mussel fishery natura plan be prepared in line with regulation 4(2) of SI 290/2013 (EU Birds and Habitats Regulations 2013).

Table 2. Screening assessment for qualifying interests and species of special conservation interest in Castlemaine Harbour SAC and SPA with respect to the proposed seed mussel fishery

Qualifying Interests	Annex qualifying interest	Is appropriate assessment recommended?	Justification	
Petalophyllum ralfsii (Petalwort)	Annex II	No	No spatial overlap	No effects linkage between activity and receptor identified
Salmo salar (Atlantic Salmon)	Annex II	**Yes**	Appropriate assessment recommended	Effects linkage possible

Petromyzon marinus (Sea Lamprey)	Annex II	**Yes**	Appropriate assessment recommended	Effects linkage possible
Lampetra fluviatilis (River Lamprey)	Annex II	**Yes**	Appropriate assessment recommended	Effects linkage possible
Lutra lutra (Otter)	Annex II, IV	**Yes**	Appropriate assessment recommended	Effects linkage possible
Fixed coastal dunes with herbaceous vegetation (grey dunes)	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Mediterranean salt meadows (*Juncetalia maritimi*)	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Dunes with *Salix repens ssp.argentea (Salix arenariae*)	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes)	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Embryonic shifting dunes	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Annual vegetation of drift lines	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Spartina swards (*Spartinion maritimae*)	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Estuaries	Annex I	**Yes**	Further assessment required	Effects linkage possible
Perennial vegetation of stony banks	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Salicornia and other annuals colonizing mud and sand	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae*)	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Humid dune slacks	Annex I	No	No spatial overlap	No effects linkage between activity and receptor identified
Mudflats and sandflats not covered by seawater at low tide	Annex I	**Yes**	Spatial overlap/effects possible further assessment required	Effects linkage possible

Red-throated Diver	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Cormorant	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Light-bellied Brent Goose	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Wigeon	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Mallard	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Pintail	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Scaup	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Common Scoter	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Oystercatcher	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Ringed Plover	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Sanderling	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Bar-tailed Godwit	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Redshank	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Greenshank	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Turnstone	SCI in SPA	**Yes**	Appropriate assessment recommended	Effects linkage possible
Chough	SCI in SPA	No	No spatial overlap	No effects linkage between activity and receptor identified
Wetland and Waterbirds	79/409/EEC Wetland & Waterbirds protection	**Yes**	Appropriate assessment recommended	Effects linkage possible

7. Natura Impact Statement

The screening assessment of the proposed mussel fishery recommended retention of a number of qualifying interests and special conservation interests for appropriate assessment. A natura impact statement of the possible effects of the fishery on these ecological features is presented below (Table 3).

The potential generic ecological effects on the qualifying interests of the site relate to the physical and biological effects of dredging and culture of shellfish species which overlap with invertebrate communities found in inter-tidal and sub-tidal habitats. Bird populations may be affected by these habitat changes and by disturbance caused by fishing vessels, by human disturbance on the shore associated with shellfish production and also by changes in the availability of prey species as a result of changes in habitat brought about by shellfish production. Birds use the area for foraging and roosting. Foraging occurs throughout the intertidal area with individual species preferences for particular habitats.

Details of potential ecological effects of each activity and the associated pressures described above, on the SAC and SPA conservation objectives, their sources and the mechanism by which the impact may occur are provided in Table 3.

The potential ecological effects on the SAC are

1. Change in habitat distribution, structure and function

The potential ecological effects on the SPA are:

1. Direct disturbance of any bird activities
2. Competition between birds and mussel producers for a common resource
3. Direct impacts of fishery/production activities on habitats of importance to birds

Table 3. Indicative effects of shellfish production on the qualifying interests and conservation interests of Castlemaine Harbour.

Potential Effect	Potential Sources
1. Smothering and shading pressure causing a change in the biological composition and/or availability of prey items for birds	Placement of mussel seed on the intertidal and subtidal habitat
	In combination effects with oyster aquaculture
2. Noise / visual disturbance causing displacement of species	Use of vessels

including birds	Use of vehicles on shore People presence on the shore
3. Changes in turbidity/ resuspension of sediments causing a change in the biological composition and/or availability of prey items	Placement of mussel seed
	Dredging of mussels
	Baffling effect of structures on shore.
4. Changes in oxygen levels causing a change in the biological composition and/or availability of prey items and a change in the redox potential layer depth	Placement of mussel seed
	Increased organic loading on seabed beneath oyster trestles
5. Introduction of non-native species causing a change in the biological composition and/or availability of prey items for birds	Cultivation of *Crassostrea gigas*
6. Abrasion/Physical disturbance/Compaction causing a change in the biological composition and/or availability of prey items for birds	Dredging of mussels
	Use of vehicles on shore
	Foot traffic on shore
8. Selective extraction of target and non-target species causing a change in the biological composition and/or availability of prey items for birds	Dredging of mussels
	Potting crab
	Potting crab

8. Appropriate Assessment: Special Area of Conservation

Effects of mussel production and in combination effects on SAC qualifying interests

Appropriate Assessment Screening (Section 6) of mussel and other aquaculture activities failed to exclude the possibility of significant impacts to a number of qualifying interests because these activities spatially overlap with the distribution of the qualifying interests concerned. Such activities are subject to appropriate assessment below on the basis that they overlap the qualifying interest and the Natura impact statement identified pathways for potential ecological effects.

Methods for Appropriate Assessment

Determining significance

The significance of the possible effects of the proposed activities on habitats, as outlined in the Natura Impact statement, is determined here in the appropriate assessment. The significance of effects is determined in relation to the Conservation Objective guidance for constituent habitats (NPWS 2011) (Figure 4).

1. The degree to which the activity will disturb the qualifying interest. By disturb is meant change in the characterising species, as listed in the Conservation Objective guidance (NPWS 2011) for constituent habitats.
2. The persistence of the disturbance in relation to the resilience of the habitat and which determines the duration of time for which the disturbance might last
3. The area of habitats or proportion of populations disturbed. In the case of habitats disturbance of less than 15% of the habitat area is deemed to be insignificant.

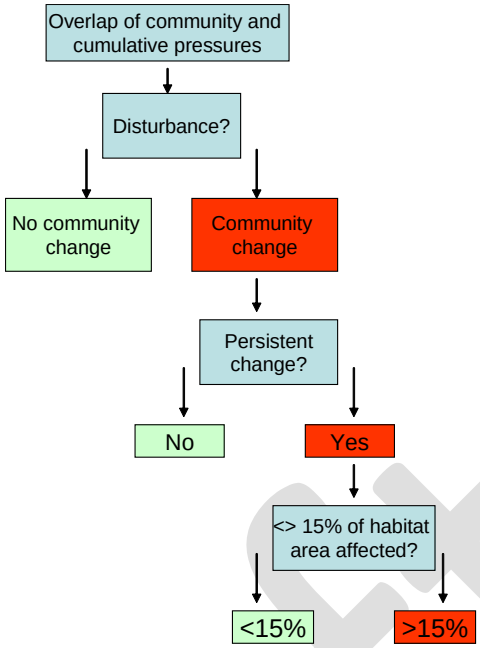

Figure 4. Determination of significant effects on community distribution, structure and function (interpreted from NPWS 2011).

Effects will be deemed to be significant when cumulatively they lead to long term change in communities in greater than 15% of the area of any constituent community listed in Table 1.

Assessment of sub-tidal fishing for seed mussel

Natura Impact Statement for this activity

Fishing for seed mussel in the sub-tidal waters of inner Dingle Bay reduces the extent and biomass of the seed mussel bed and may change the biota in the area (Table 3).

Assessment

The proposed seed mussel fishery occurs on the sub-tidal mixed sediment community complex in estuary habitat. Annual estimates of seed mussel biomass have varied from 0 to 6500 tonnes since 2009 (Table 4). The area of potential overlap of the proposed mussel seed fishery and the mixed sediment community complex is 502/802ha or 62% (Table 5). The overlap in any given year is, however, much less than this; in any given year the seed bed develops only in a proportion of this area and usually in a different location annually or less frequently than annually (Figure 5, Table 4). For instance, from 2009-2023 the average area of mussel seed beds was 46 Ha or 5% of the mixed sedimentary community complex.

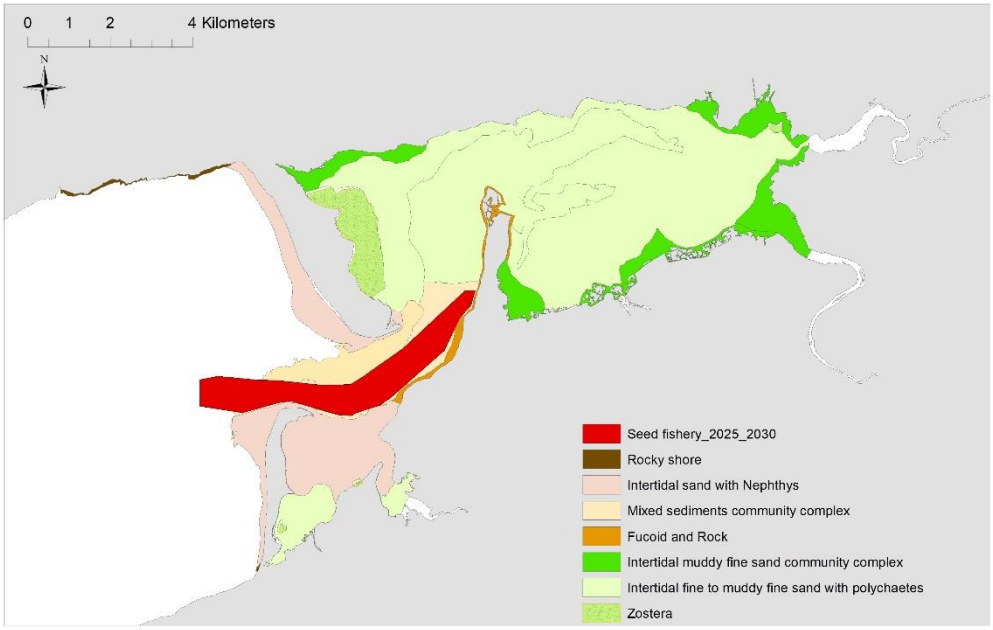

Figure 5. Location of seed mussel beds (2025-2030) in mixed sediment community (blue) at the entrance to Castlemaine Harbour. Seed bed boundaries from BIM seed mussel surveys.

Table 4. Area of distribution and tonnage of seed mussel in the seed fishery area annually 2009-2022 from BIM seed mussel surveys.

Year	Mussel bed area (Ha)	Mussel seed mTonnes	Distribution of mussel beds
2009	32.1	2000	single bed
2010	43.6	4500	single bed
2011	26.2	2500	single bed
2012	31.2	1100	Multiple beds
2013	100.8	0	
2014	77.0	2800	Multiple beds
2015	127.1	6500	Multiple beds
2016	0.0	0	
2017	36.8	1850	Multiple beds
2018	83.9	3000	Multiple beds
2019	29.7	1000	Multiple beds
2020	70.1	2289	Multiple beds
2021	0.0	0	
2022	35.0	2122	Multiple beds
2023	0.0	0	
Average	46.2	1977	

The annual exploitation of the seed mussel constitutes habitat disturbance as a principal characterising species (mussel) is the target species and its biomass is substantially reduced by

fishing. Seed mussel beds in this area are, however, ephemeral and unstable. The mussel bed and underlying sediment is prone to turn over and wash out by winter storms and by starfish predation. This is a general, although not universal, characteristic of seed mussel beds throughout Europe (Dare *et al*. 2004). In Castlemaine, seed mussel beds occur in different locations each year on sand, mud, shingle and stones and show no distinct substrate preference as shown by BIM surveys. Removal of seed mussel by dredging, therefore, occurs against a background of dynamic natural change that occurs on an annual basis in this habitat. It is considered that likely effects on the resident biological communities that might arise through abrasion by fishing gears or changes in suspended sediment loading or oxygen levels will not be significant against the natural dynamics of the site. Recoverability of the affected biotopes**,** following physical disturbance, is high (Habitat recovery assessments Marine Institute unpublished reports and www.marlin.ac.uk). The substratum required for settlement of mussel and re-establishment of the mussel bed is unlikely to be significantly altered above background levels by fishing in these dynamic high energy habitats. The types of dredge used for dredging mussel seed beds are lighter than other bivalve dredges and do not have teeth. Abrasion pressure is therefore reduced. During fishing, the mussel beds are elevated from the surrounding substratum, the dredge does not penetrate the seafloor and disturbance of the sediments below the bed is not therefore significant, again compared to natural background variability. This is supported by evidence of repeated annual settlement of mussels in the area even though commercial seed fishing has been in operation since 1977 and also the data from BIM seed surveys 2009-2023 which shows increased areas of seed settlement in 2013-2015 compared to 2009-2012 and therefore that the fishery is not affecting the suitability of the mixed sediment habitat for seed settlement.

Table 5. Spatial overlaps (%) between marine communities and mussel fishing and mussel and oyster aquaculture in Castlemaine Harbour.

Habitat	Community	Area (Hectares)	Mussel aqua	Oyster aqua	Mussel seed fishery	Mussel seed intertidal relay and dredging Fishery Order area	Mussel subtidal relay and dredging Fishery Order area	Total
1140	Intertidal muddy fine sand community complex.	*554*	2	2	0	0.4	0	4
1140	Fine to muddy fine sand with polychaetes community complex (intertidal)	*2485*	5	2	0	4	0	11
1130	Fine to muddy fine sand with polychaetes community complex (subtidal)	*1069*	9	5	0	0	11	**25**

1140/1130	Intertidal sand with *Nephtys cirrosa*	*861*	0	0	0	0	0	0
1140/1130	*Zostera* dominated community	*234*	0	0	0	0	0	0
1130	Mixed sediment community complex	*588*	0	0	62	0	0	**62**
1140	Fine sand with *Donax vittatus* and polychaetes community	*5*	0	0	0	0	0	0

Conclusion

The likelihood of significant effects of fishing for seed mussel on the mixed sedimentary community with which it overlaps can be discounted given that the annual % of the marine community affected is on average expected to be 5% and the disturbance effect on marine communities is not significant against background levels in this dynamic environment.

Assessment of relaying of seed mussel on the inter-tidal sand flat (intertidal relay area and licensed mussel areas)

Natura Impact Statement for this activity

The relaying of seed mussel on the intertidal sand flat leads to change in the existing biota and sediment due to smothering and possible changes in oxygen levels and he depth of the redox potential layer in sediments underneath mussel relay (Table 3).

Assessment of the fishery order area

Comment on baseline condition of habitat in the relay area

The mussel nursery area is part of a larger mussel bed of apparently natural origin, which has existed in this area for over 100 years (Crowley, 1973; Lee, 1975). This mussel bed is classified as a mussel biotope (LS.LBR.LMus.Myt.Sa) (O'Connor 2004). The seed mussel fishery began in 1994 and prior to this date, no intertidal relay of mussels occurred within the mussel nursery area. Relaying of seed mussels onto the mussel biotope is equivalent to the biotope receiving natural spatfall which would increase the existing mussel cover. Therefore, the baseline condition of the mussel nursery area is not an open sandflat with no mussel cover, but some undetermined and variable level of mussel cover. MI surveys have found various levels of mussel cover but generally less than 12%. Mussels in the north of the intertidal relay area and seaward of this area are generally seed mussel which is re-laid sub-tidally while mussels in the south of the nursery area are a mix of seed and fully grown

mussels. It is not clear whether these fully grown mussels are the result of previous relays or represent natural settlement as part of a mussel biotope.

Assessment

The order area occupied by the proposed relay activity in the intertidal relay area, excluding intertidal mussel aquaculture sites, is 113ha (Figure 6).The area overlaps with the intertidal muddy fine sand community complex by 0.4% (2/554ha, Table 5) and the fine to muddy fine sand community complex (intertidal) by 4% (111/2485ha). Not all of the habitat within the intertidal relay area is covered by mussels following relay (Figure 7). Typically, the mussel cover is extremely patchy. Aerial imagery collected by the Marine Institute during 2013-2015 shows relatively sparse cover in the north of the area and somewhat higher coverage in the south. This was during a period when seed mussel biomass in the seed fishing area was at its peak (6500 tonnes in 2015). Typically, mussel cover is less than 12% overall in the intertidal area and is usually less than 5% in the north of the area. Mussel relay also extends east of the nursery area to the low water mark. The occurrence of mussel in this habitat is likely due to a combination of natural settlement and relay.

The Natura impact statement for relay of intertidal mussel (Table 3) suggests that the activity of relaying seed mussels onto intertidal habitats could constitute a disturbance as the activity will likely lead to a shift in community composition. However, the species composition of benthic macrofauna in sand and in sand/mud under mussel cover in the intertidal mussel nursery area in Castlemaine Harbour is largely similar. Benthic core samples taken in the nursery area in April 2010 (see Annex III) shows that the benthic fauna in the nursery area is low in abundance and diversity. This is not unexpected in this brackish water area. Mussel cover has a significant effect on the abundance and species composition of polychaetes living in the sand underneath the mussel bed but not on bivalves or crustaceans. The abundance of characterising deposit feeding polychaetes *Scoloplos*, *Caulierella and Pygospio* was lower under mussel compared to sand while the polychaetes *Capitella* and *Tubificoides* were common under mussel. *Capitella* is often found in polluted waters where it out-competes less tolerant species. In this case there is likely to be a reduction in oxygen levels and a shallow redox potential discontinuity depth in the sediment under mussel. These effects of relay of mussel are presumably reverse when mussel is harvested. This study did not evaluate the species diversity associated with the mussel bed. In sub-tidal habitats (Annex IV) species diversity was higher in areas with mussel cover.

Seed mussel survey data from BIM (Table 4), in the seed fishing area, show there is little likelihood that relay volumes will increase significantly compared to the previous FNPs given that the average biomass from 2009-2023 was 1977 tonnes, and that there was no biomass and no fishing in 4/15 seasons since 2009. The conditions assessed in previous appropriate assessments of the seed mussel

fishery natura plans in 2011 and 2016 and for aquaculture in 2019 (Marine Institute and DAFM), therefore, are likely to continue for the period of the FNP 2024-2028.

Mussel aquaculture sites:

The area occupied by licenced mussel aquaculture sites is approximately 216ha. Mussel aquaculture sites overlaps with the intertidal muddy fine sand community complex by 2%, with the intertidal portion of the fine to muddy fine sand community complex by 5% and with the sub-tidal part of that community by 9% . Presuming that relay operations in mussel aquaculture sites are similar to that practised in the intertidal relay area in the fishery order then 5-12% of these sites could be covered in seed mussel. Pressure on habitats is therefore 5-12% of the 2, 5 and 9% of the relevant marine communities.

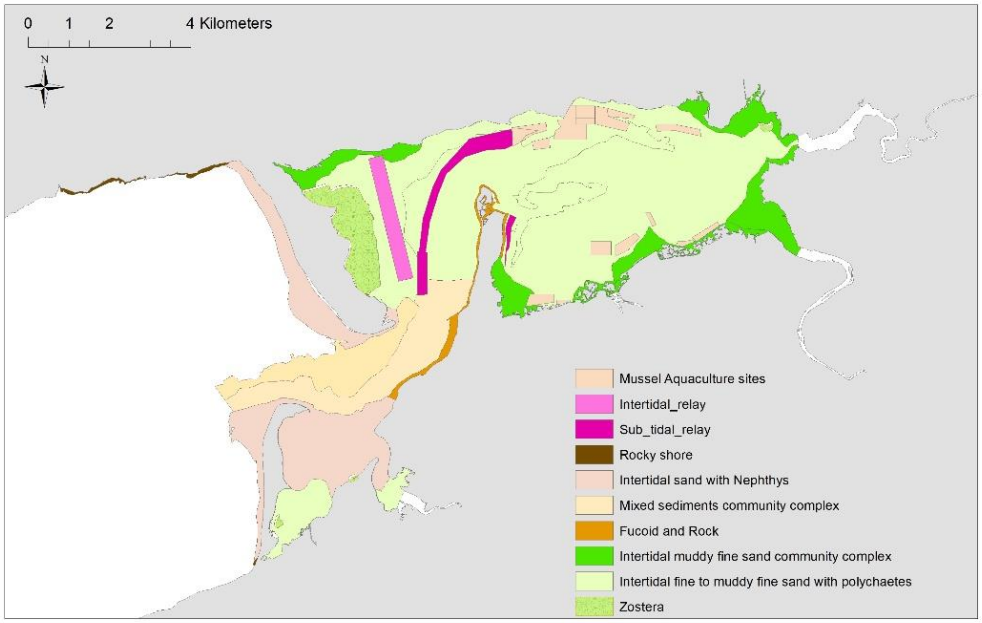

Figure 6. Location of mussel relay sites in intertidal and subtidal fishery order areas and mussel aquaculture sites in Castlemaine Harbour.

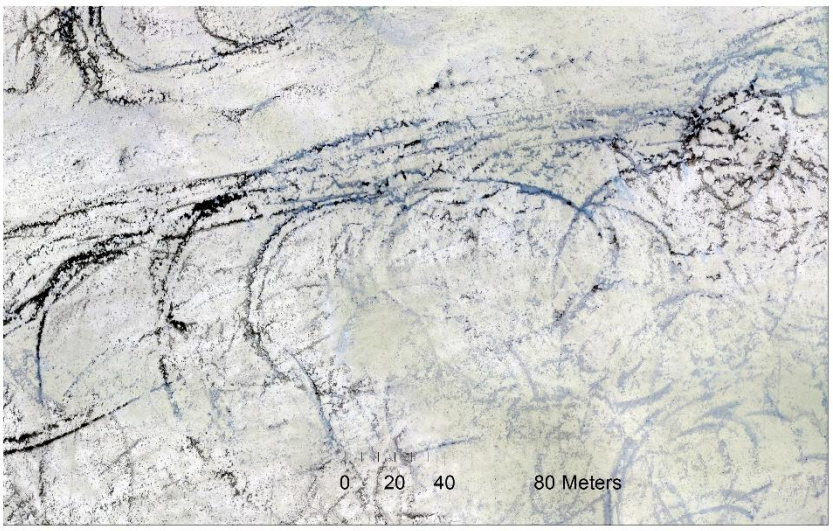

Figure 7. Aerial imagery of habitat with sparse and patchy mussel cover over the intertidal relay area and east of the area in 2015. Mussels are black dots. Mussel distribution patterns are due to the process of relaying the mussels from a vessel moving in circles.

Conclusion

Although there is some change in species composition in marine communities following relay of mussel the effective percentage overlap of the relay, at prospective levels of mussel production, with intertidal habitats is well below 15%. The disturbance is not, therefore, significant. Marine communities are also likely to recover to pre-relay condition when mussel is harvested. The disturbance is not, therefore, persistent in any one location. The mussel relay also occurs in a background of natural settlement of seed mussel. The likelihood of significant effects of the relay of mussels on intertidal habitats can, therefore, be discounted.

Habitat potentially affected indirectly:

Sea grass:

The intertidal seagrass bed east of Inch could be indirectly affected by mussel relay to the east if seed mussel or mussel mud drifts onto the seagrass and becomes established. This would reduce the area of seagrass habitat. The distribution of the seagrass bed is mapped annually by the Environmental Protection Agency (EPA) and the eastern boundary has been mapped by MI in some years. The distribution and area of seagrass has been stable since 2006 (EPA pers com). EPA distribution maps indicate an area of 160-175ha compared to NPWS estimates of 221ha. The difference is mainly accounted for on the western edge. The EPA survey data also shows that the seagrass bed extends north of the NPWS boundary and overlaps with the intertidal muddy fine sand community. The eastern edge, closest to the mussel relay areas, is remarkably stable in location and

extent (Figure 8).

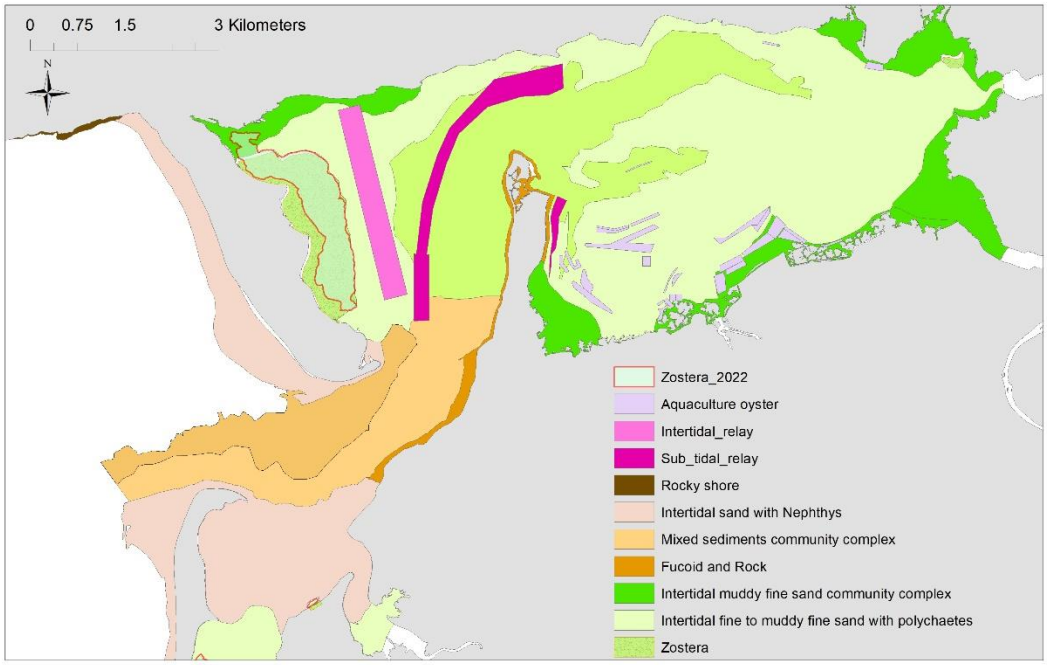

Figure 8. Distribution of seagrass in 2022 (source: EPA) relative to the distribution of marine communities and seagrass in 2011 (NPWS 2011).

Conclusion

Mussel relay has had no effect on the distribution or quality of seagrass habitat in Castlemaine harbour since monitoring began in 2006. As the scale of mussel relay will not increase in the period 2024-2028 the likelihood of significant effects of mussel relay on seagrass in Castlemaine Harbour can be discounted.

Assessment of dredging of half-grown mussel from the inter-tidal areas

Natura Impact Statement for this activity

Dredging of mussels from the intertidal sand flat may lead to changes in the sediment and benthic communities in this area and lead to re-suspension of fine sediments that could affect habitats downstream (Table 3). It presumably acts to reverse any changes brought about by relay in removing the smothering pressure on marine communities.

Assessment

The relaying of seed in the inter-tidal area leads to some changes in the species composition of macrobenthos as described above. The removal of mussel cover by dredging will, presumably, lead

to a reversal of those changes and a return to a species composition representative of the community type. The dredge essentially removes the mussel structure and the fauna associated with it. The underlying sediment remains undisturbed as the dredge detaches the bed from the underlying substrate (Saurel *et al*. 2003). The typical fauna of this underlying substrate is then re-established at a rate depending on the sensitivity of the characterising species which were affected. In this case, as described above, the change in marine communities due to relay of mussel was limited to species of polychaete.

Dredging may also release fine sediment, from the mussel mud, into the water column and the dispersal plume depends on local tidal conditions during dredging. In areas where mussels are bottom cultivated disturbance and dispersal of the mussel mud is important in facilitating the recovery of the typical fauna of the underlying sediment and to avoid raising the bed higher into the inter-tidal zone. The distribution of seagrass and in particular its eastern edge closest to mussel production activities has been shown to be stable from 2011-2015 and since 2006 when EPA surveys were initiated. Potential effects of dispersal of fine sediments onto the seagrass bed resulting from dredging activity do not therefore appear to occur in this location. Dredging activity, therefore, is not expected to have any direct or indirect significant effect on seagrass.

Conclusion

Given the area of each marine community affected is less than 15%, that the changes to marine communities resulting from relay of mussels are limited to a number of resilient polychaete species and that the subsequent dredging to remove mussel should lead to reversal of any such changes the likelihood of significant effects on intertidal marine communities of dredging to remove half grown mussels from the intertidal sites can be discounted.

Assessment of relaying and dredging of mussels in the sub-tidal channel of Castlemaine Harbour

Natura Impact Statement for this activity

Relaying and dredging of mussels in the sub-tidal channel of Castlemaine Harbour leads to changes in the sediments and benthic communities in the area (Table 3).

Assessment

Sub-tidal relay area (within Fishery Order):

The area occupied by the proposed relay activity in the sub-tidal relay area, excluding sub-tidal mussel aquaculture sites, is 136ha. This area overlaps with the fine to muddy fine sand with polychaetes community complex by 11%.

Sub-tidal portions of mussel aquaculture sites:

The area occupied by licenced mussel aquaculture sites is 216ha. Mussel aquaculture sites overlap with fine to muddy fine sand community complex by 9% in sub-tidal areas and by 5% in intertidal areas (Table 5). Not all the sub-tidal relay area is covered in mussel following relay. Survey work in 2009 (Annex IV) showed that the fauna in this area is not diverse. Mussel was detected in 10 of 27 samples and ranged in abundance from 1-104 individuals per sample. The fauna was dominated by polychaetes with isolated high levels of abundance of the amphipods *Caprella, Corophium* and *Jassa*. The average number of taxa and abundance of benthic macrofauna, in samples containing mussel, was 23 and 358 respectively. The equivalent in samples not containing mussel was 5 and 31 respectively. The diversity and abundance of macrobenthos was therefore higher in samples containing mussels than in other areas. It is not clear if this is due to the presence of mussels or is simply a spatial effect. Mussels, however, provide additional structural habitat for colonisation of macrofauna. Mussel cover was low despite previous years relay of mussel into the area. Although mussel relay in the mussel aquaculture sites and fishery order area may cumulatively overlap with 20% of the muddy fine sand community complex only a small proportion of this area is directly affected. As described above for intertidal habitats the dredging of mussel for harvest presumably negates the effects of relay. The smothering pressure is removed.

Conclusion

Given that the area of relay and dredging for harvest of mussel in sub-tidal relay areas is less than 15% of the area of any individual marine community and that the dredging activity reverses any smothering pressure caused by relay the likelihood of significant effects on conservation objectives for sub-tidal marine communities of relay and dredging to remove half grown mussels from subtidal relay and mussel aquaculture sites can be discounted.

Assessment of activities in combination with mussel production

Oyster production

Licenced trestle production of oysters (*Crassostrea gigas*) occurs on 88ha (Figure 8). Most of this activity occurs on intertidal fine to muddy fine sand habitat and to a lesser extent on intertidal muddy fine sand. Oyster production on trestles does not have significant impacts on sedimentary habitats at the scale of operation in Castlemaine (Forde *et al*. 2015). Although sediment compaction can result from persistent use of vehicles on access routes this is not relevant to Castlemaine where oyster trestles are accessed via boats. Pacific oyster has become naturalised in some locations in Ireland (Kochmann *et al* 2012). This would lead to changes in habitats. The use of triploid (non-reproducing) stock is the main method employed to manage this risk. There is no evidence of naturalisation of Pacific oysters in Castlemaine. Naturalisation is more likely to occur in areas where

water residence times are over 21 days (Kochmann *et al*. 2013). Residence times in Castlemaine are less than 15 days.

The introduction of non-native species as 'hitchhikers' on and among culture stock is also considered a risk, the extent of which is dependent upon the duration the stock has spent 'in the wild' outside of the site of interest. Half-grown stock (15 - 30g oysters) which would have been grown for extended periods in places (in particular outside of Ireland) present a higher risk. Oysters grown in other bays in Ireland and 'finished' in the site of interest, would not appear to present a risk of introduction of non-native species assuming best practice is applied (e.g. http://invasivespeciesireland.com/cops/aquaculture/). This is the case in Castlemaine.

Clam production

Production of clams (*Ruditapes philippinarum*) is licenced on 16ha of intertidal habitat on the south west of the SAC. Clam production occurs on intertidal sand with *Nephthys cirrosa* (<1% of habitat) and on fine to muddy fine sand with polychaetes community (<1% of habitat). No production has occurred in recent years. Given the scale of the activity (currently zero) the effects on intertidal sand habitat is not significant

Cockle gathering

Castlemaine Harbour is classified for the production of cockles (https://www.sfpa.ie/What-We-Do/Molluscan-Shellfish/Classified-Areas). Cockle surveys by the Marine Institute in 2023 however showed that the age distribution of cockle in Castlemaine (the Glenbeigh area) is made up of mainly 1 year old cockles. Densities and size distribution of cockles were below commercially viable levels and the absence of older age classes suggests either high mortality or very infrequent recruitment at the site. Cockle gathering is likely to be absent or at extremely low levels.

Predator control, winkle picking, discharges

The predator control programme seeks to reduce the populations of shore crab which predate on seed mussel. Shore crab populations are productive and the capacity to control the population using the scale of control described in the management plan is limited. The control relies on behavioural attraction of the crabs to baited pots. The fishing technique is highly selective and benign on non-target fauna and on the physical environment. The creation of a seed mussel bed on the inter-tidal area is likely to increase the productivity of mobile epifauna such as shore crab through provision of habitat refuges for postlarvae and juvenile crab and a food source for crab. The predator control

balances this by removing a proportion of the crab biomass.

Periwinkles (*Littorina littorea*) are picked in the intertidal area by an unknown number of operators. Periwinkle is not a typical species of intertidal sand and mud flats. The significance of this activity in relation to habitat area, structure and function is deemed to be insignificant.

Conclusion

Given that oyster aquaculture does not lead to significant disturbance of marine communities, at the scale of operation in Castlemaine, in combination effects with mussel fishing and relay can be discounted. Other activities including clam production, periwinkle gathering and crab predatory control occur at a very small scale and in combination effects with mussel fishing, relay and harvesting can be discounted.

Assessment of the effects of shellfish production and in combination effects on the Conservation Objectives for Otter, Salmon and Lamprey

Natura Impact statement

Shellfish production activities within the SAC spatially overlap with Otter (*Lutra lutra*), Salmon (*Salmo salar*) and Lamprey and these activities may cause disturbance to these species.

*Otter (*Lutra lutra*)*

The proposed activity will not lead to any modification of the following conservation objective attributes for otter

- Extent of terrestrial habitat,
- Extent of marine habitat or
- Extent of freshwater habitat.
- The activity involves net input rather than extraction of fish biomass so that no negative impact on the essential food base (fish biomass) is expected

The number of couching sites and holts nor, therefore, the distribution, will be directly affected by mussel production activity. National surveys of otter in Ireland in 2006 found that 75% of sites surveyed in the south west of Ireland showed signs of otter occupancy. There are no specific data on otter population size in Castlemaine although they are present throughout the area. Shellfish production activities are unlikely to pose any risk to otter populations through entrapment or direct physical injury. Disturbance associated with vessel and foot traffic could potentially affect the distribution of otters at the site. However, as shown below for bird populations, the level of disturbance is likely to be very low. The crab control programme associated with the inter-tidal mussel area uses baited pots that could attract otters. The risk of entrapment is low because of the specific design of the crab gear which uses small hard-eye rather than soft-eye entrances. The latter could pose more risk to otters that may try and enter the pot through the eye.

*Salmon (*Salmo salar*)*

Salmon populations run into the Rivers Laune and Maine which flow into Castlemaine Harbour.

Shellfish production activities do not pose any risk to the following conservation attributes for salmon

- Distribution (in freshwater)
- Fry abundance (freshwater)
- Population size of spawners (fish will not be impeded or captured by the proposed activity)

- Smolt abundance (out migrating smolts will not be impeded or captured by the proposed activity)
- Water quality (freshwater)

*Sea Lamprey (*Petromyzon marinus*) and River Lamprey (*Lampetra fluviatilis*)*

There are no specific data on populations of Sea Lamprey or River Lamprey in Castlemaine

The proposed mussel fishing and relay activity will not have any effect on sea lamprey and river lamprey conservation objective attributes

- Extent of anadromy (% of river accessible)
- Access to spawning (freshwater)
- Availability of juvenile habitat (freshwater 3rd order channels)
- Spawning beds (freshwater)
- Juvenile density (freshwater
- Population structure of juveniles (freshwater)
- Extent of spawning bed habitat (freshwater)

Conclusion

Fishing and relay of mussel will not have significant effects on the conservation attributes for otter, salmon or lamprey.

9. Appropriate Assessment: Special Protection Area

Assessment of the effects of fisheries and aquaculture production activities on SCI bird species in the SPA

Introduction

This section assesses the potential impacts of proposed mussel production activities and in combination effects of aquaculture on the conservation status of bird populations of special conservation interest (SCI species) in Castlemaine Harbour SPA (site code 004029).

One SCI (Chough) was screened out (Annex II).

Conservation Objective 1

Conservation Objective 1 for the Castlemaine Harbour SPA is to "maintain the favourable conservation condition of the waterbirds" listed for the site. This objective is defined by the following attributes and targets (NPWS 2011a):

- To be favourable, the long term population trend for each waterbird species should be stable or increasing, indicating that the populations are maintaining themselves. Waterbird populations are deemed to be unfavourable when they have declined by 25% or more, as assessed by the most recent population trend analysis. [**Attribute 1**]

- To be favourable, there should be no significant decrease in the numbers or range (distribution) of areas used by the waterbird species, other than that occurring from natural patterns of variation. [**Attribute 2**]

Data and imformation sources

- Waterbird populations at Castlemaine Harbour have been monitored since the 1970s (Hutchinson, 1979; Sheppard, 1993; Crowe, 2005; I-WeBS Office, 2009) and since 1994 by the Irish Wetland Bird Survey (I-WeBS). This monitoring involves monthly high tide counts between September and March of each winter. Complete counts are not available for all months in all years. A data set was sourced from the Irish Wetland Bird Survey counts 1994/95-2022/23.
- In the winter of 2009/10, Castlemaine Harbour was included in the NPWS Baseline Waterbird Survey Programme. As part of this programme, four low tide and one high tide count were carried out between October 2009 and February 2010, as well as a dedicated diver/seaduck survey in March 2010. These counts were in addition to routine I-WeBS monitoring.

- The Marine Institute commissioned Inis Environmental Consultants Ltd to undertake low tide count data to provide data on distribution and abundance of waterbird species in winter of 2019-2020.
- The spatial extent of proposed mussel seed fishing and relay activities as described in Annex I (Seed mussel Fishery Natura Plan)
- The spatial extent of licenced mussel, oyster and clam production activities as of April 2024 (source:DAFM)
- The output of the appropriate assessment of the effects of mussel fishing and relay on SAC qualifying interests described in Section 8 above.
- Analysis of bird distribution in Castlemaine Harbour (Annex V)
- Analysis of the effects of mussel cover on habitat use by birds (Annex VI)
- Assessment of the effects of human disturbance on birds (Annex VII)

Cause, effect and conservation status

Conservation Attribute 1 (long term population trends)

The time series of iWeBs bird counts and specific bird studies in Casltemaine Harbour has increased since the first AA in 2009. Confidence in the assessment of the likelihood of significant effects is, therefore, higher in the current assessment than in previous assessments.

Trends in the number of birds in Castlemaine Hbr may provide signals of the realised effects of fishing and aquaculture in the site. However, many factors outside of the site can also influence the number of migratory overwintering birds using the site. These include the condition of habitats in other coastal areas, breeding success outside of Ireland and the effects of climate change on migration including short stopping in particular where migration pathways from northern breeding grounds become shorter due to more benign conditions in latitudes north of Ireland (Elmberg *et al.* 2014).

In Castlemaine Harbour 5 species are reported to have large (>50%) long term declines (I-WeBS Castlemaine Harbour & Rossbehy Trends Report (birdwatchireland.ie)). These are Golden plover, Turnstone, Lapwing, Ringed Plover and Curlew. Bar tailed godwit and Knot have moderate (25-50%) declines and Greenshank have intermediate declines (<25%). Sanderling has increased by 47%. Although count data are standardised to a smoothed index the trends reported are still sensitive to non-linearity and periodicity in the data. Modelling to incorporate environmental effects on count data and time series analysis to isolate linear and non-linear trend components in time series would provide more robust indices.

It is also very difficult to disentangle site specific effects from general climatic or other causes of

change in populations of these species. In some cases the effects linkage to fisheries and aquaculture can be clearly identified eg if food resources are removed by fisheries the site may become unfavourable for birds relying on those food resources. However, possible effects linkages are usually more subtle eg changes in habitat quality leading to displacement of birds. For mitigation responses to be effective an effects linkage would ideally be clearly identified so that the actual pressure causing decline is removed or reduced. Change (decline) in population or conservation status *per se* therefore does not necessarily mean that local mitigation is needed as it may be ineffective if the change is unrelated to the pressure. In the present case, therefore, the assessment of significant effects is not based on the change in status of a species but on the likelihood of a significant effect occurring due to fishing or aquaculture as inferred from an identified effects linkage pathway. However, recommendation for and the level of mitigation could be more precautionary for species whose status is already declining than for species whose status is stable or positive.

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

NPWS (2011a) are not specific about the level of change in distribution or number of areas used that could be considered significant with respect to conservation status. Change in distribution could be brought about in two ways; birds could have a direct avoidance response to human disturbance leading to temporary displacement and secondly displacement from areas could be caused by changes in habitat structure and function that could arise from fishing or relay of mussel and aquaculture activity. These displacements could be longer term than those caused by human disturbance. Although this is not habitat loss *per se* significant habitat change which renders the habitat unfavourable for certain species could effectively be seen as habitat loss for that species.

Some studies have used individual-based models (IBMs; see Stillman and Goss-Custard, 2010) to estimate 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, based on average 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 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 amounts of habitat loss are required to have significant impacts on estuarine waterbird populations, and that very low levels of spatial displacement are unlikely to cause significant impacts. However,

it is difficult to specify a threshold value from the literature.

The conservation status of bird populations in the SPA

Methods

There are 15 waterbird species that are listed as Special Conservation Interests (Section 3) and that are potentially affected by the proposed activities. The conservation status and trends in populations of these species was assessed using I-WeBS data 1994-2023. Individual species were assigned to a feeding guild, which describes their resource requirements in terms of habitat and food source. Impact linkages to mussel fishing and relay activities are expected to be different in each feeding guild.

Peak seasonal count data (all species) for each guild was calculated by summing the peak counts for each species in the guild. A standardised Underhill index for the guild was then calculated. The Underhill Index assigns a value of 100 to the last year in the time series and the preceding year value is reported relative to 100 and so on back through the time series. The index was smoothed using a 3 point running average (SMIndex). Long term (1994/95 to 2022/23), medium term (2012/13 to 2022/23) and short term (2017/18 to 2022/23) trends were then estimated by fitting a linear regression to the data. The slope of the linear regression of the SMIndex across the different time series was an index of trend. High residual values (points of high influence) or trends in residuals (non-linear patterns) were ignored.

For 15 SCI (special conservation interest) species the ratio of the average peak numbers, using raw data and the SMIndex, in long, medium and short time periods were also calculated. Ratio values less than 1 represent a decline between any two respective time periods.

Conservation status

Considering species grouped into feeding guilds (All Birds, Waders, Ducks, Gulls, Swans and Geese, Divers) trends in the slope of the linear regression of the short term (recent 5 years) SMIndex were positive in all cases (Table 6). Trends in the medium term index were negative for all birds, waders and ducks but positive for gulls, swans and geese and divers. Long term trends were more negative and only swans and geese showed an overall positive trend. Trends were not linear but showed clear periodicity; numbers increased during the mid-1990s and then declined to minima around 2002/2004 (Figure 9). There was a subsequent increase in numbers in all groups but the rate and duration of the increase varied across groups. For SCI species longterm, medium term and short term average peak numbers or index values were mostly negative although the index for all SCI

species combined was generally stable; >1 comparing short to medium trends and close to one comparing long to medium term trends (Table 8).

Table 6. Short, medium and long term trends in bird species feeding guilds in Castlemaine Harbour 1994-2003. Negative trends are in red. SMindex is the smoothed Underhill index. The values are the slopes of linear regressions through the relevant data or index series.

		5 years	10 years	28 years
Data	All Birds	1358	-247	-126
SMIndex		13.74	-2.3	-1.2
Data	Waders	702	-74	-107
SMIndex		14.98	-2.8	-2.6
Data	Ducks	95	-331	-58
SMIndex		8.3	-7.8	-1.7
Data	Gulls	87.2	34.8	-6.5
SMIndex		28.1	9.8	-24
Data	Swans and Geese	449	117	48
SMIndex		17.8	5.9	2.44
Data	Divers	9.5	5	-4.2
SMIndex		25.3	5	-6.8

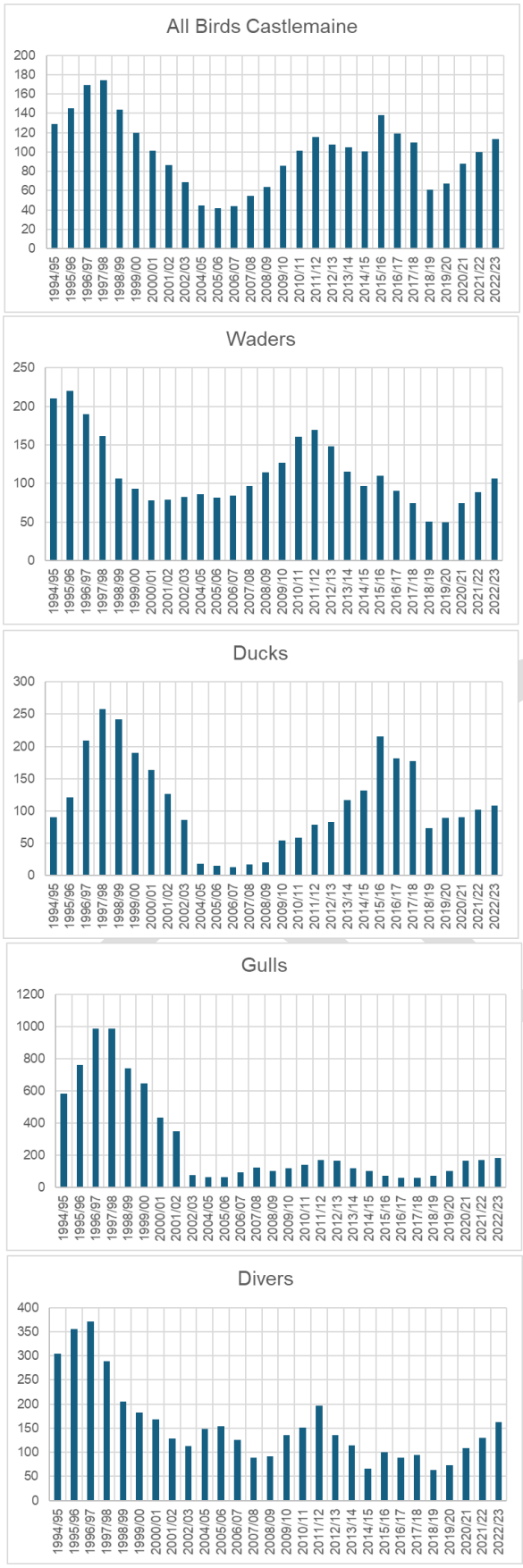

Figure 9. Trends in peak seasonal counts of species guilds in Castlemaine Harbour 1994-2022

Table 7. Annual seasonal peak numbers of SCI species in Castlemaine Harbour 1994-2023. Comparison of long term (28 years), medium term (10 years) and short term (5 years) trends are shown at the bottom. Index values less than 1 represent declines.

Season	Year	Bar-tailed Godwit	Common Scoter	Greenshank	Light-bellied Brent Goose	Mallard	Oystercatcher	Pintail	Redshank	Red-throated Diver	Ringed Plover	Sanderling	Scaup	Turnstone	Wigeon	Total
1994/95	1994	70	35	9	303	195	1713	96	270		167	78	203	112	261	3512
1995/96	1995	214	72	32	1062	602	1115	150	144		91	44	210	236	4093	8065
1996/97	1996	349		36	492	357	1487	255	397	22	583	373		81	5935	10367
1997/98	1997	836	102	31	483	449	1103	200	811	3	91	538	38	131	10000	14816
1998/99	1998	384	221	127	729	545	660	100	210	1	74	339	117	95	10024	13626
1999/00	1999	204	346	6	401	483	613	20	142		51	258		89	4044	6657
2000/01	2000	216	186	13	592	651	517	12	160	5	8	239		79	4053	6731
2001/02	2001	73	326	5	793	773	493		38			81		30	7000	9612
2002/03	2002		246	38	291	40	300	19	230	2	165	87	2	15	369	1804
2004/05	2004	58	411	7	215	70	341		186		12	326		18	410	2054
2005/06	2005	230	135	11	216	81	463		224		142	554		22	276	2354
2006/07	2006	35	462	18	20	57	526		263		35	570		29	264	2279
2007/08	2007	23	375	6	261	54	464		740		322	58	6	30	153	2492
2008/09	2008	211	146	12	1359	189	806	99	498		59	210	22	53	443	4107
2009/10	2009	221	560	9	753	224	1354	6	383		189	452		41	298	4490
2010/11	2010	250	448	43	1350	495	1030	46	651	13	100	505		90	3038	8059
2011/12	2011	115	300	8	1278	357	757	120	413	3	103	400		135	761	4750
2012/13	2012	332	685	26	1284	444	570	45	854	4	197	727	45	122	2128	7463
2013/14	2013	288		2	1091	360	506	122	817	4	27	350	2	3	4007	7579
2014/15	2014	437	14	123	1169	283	787	110	968		258	300		24	4774	9247
2015/16	2015	405	50	21	804	436	570	56	766		60			15	3880	7063
2016/17	2016	319	18	32	1893	262	1053	108	674		65	345		11	13310	18090
2017/18	2017	60	230	34	1492	171	578	100	551		38	420		3	1137	4814
2018/19	2018		450	29	420	164	434	40	350		17	80		4	3903	5891
2019/20	2019	67		3	1460	200	360	57	146		55	103		61	1900	4412
2020/21	2020	79		70	1254	556	366	90	596		149	21		39	2550	5770
2021/22	2021	420	33	20	2458	607	686	200	923	8	107	105		42	3230	8839

2022/23	2022	511	12	44	1971	231	758	90	348		90	122		57	3132	7366
Long term average		246	244	29	925	333	729	93	455	7	121	285	72	60	3406	6868
Medium term average		287	115	38	1401	327	610	97	614	6	87	205	2	26	4182	7907
Short term average		269	165	33	1513	352	521	95	473	8	84	86		41	2943	6456
Diff Long/Medium		1.17	2.12	0.77	0.66	1.02	1.20	0.96	0.74	1.08	1.39	1.39	35.83	2.30	0.81	0.87
Diff Long/Short		1.09	0.68	1.14	1.64	1.05	0.71	1.02	1.04	1.23	0.69	0.30	0.00	0.68	0.86	0.94
Diff Medium/Short		1.17	0.47	1.30	1.52	0.98	0.84	1.05	1.35	0.92	0.72	0.72	0.03	0.44	1.23	1.15

Table 8. Annual smoothed underhill index of SCI species in Castlemaine Harbour 1994-2023. Comparison of long term (28 years), medium term (10 years) and short term (5 years) trends are shown at the bottom. Index values less than 1 represent declines. Missing values have not been imputed

Season	Year	Bar-tailed Godwit	Common Scoter	Greenshank	Light-bellied Brent Goose	Mallard	Oystercatcher	Pintail	Redshank	Red-throated Diver	Ringed Plover	Sanderling	Scaup	Turnstone	Wigeon	Grand Total
1994/95	1994	47	49	59	122	101	114	61	112		100	95	97	169	38	61
1995/96	1995	45		103	159	124	105	93	43	367	328	41		177	64	74
1996/97	1996	107	23	70	84	81	151	164	218	517	382	114	32	100	80	89
1997/98	1997	149	55	1071	124	98	137	350	267	300	134	145	32	122	174	157
1998/99	1998	167	125	1081	125	94	113	333	118		391	120		110	174	152
1999/00	1999	193	122	153	71	79	112	167	255		638	202		188	79	84
2000/01	2000	195	95	137	174	1008	135		219			194		232	977	301
2001/02	2001	296	96	278	204	995	126		70		1375	60		142	994	310
2002/03	2002	25	182	303	117	72	81		103		692	43		83	119	88
2004/05	2004	341	167	62	590	114	81		84		207	78		79	127	95
2005/06	2005	278	76	181	544	124	101		60		208	540		86	139	97
2006/07	2006	273	190	175	13	67	85		92		278	505	27	77	104	76
2007/08	2007	86	141	92	100	56	59	1650	139		288	37	27	93	92	76
2008/09	2008	65	76	77	118	65	95	832	94		110	68		87	79	74
2009/10	2009	134	137	279	81	92	134	26	108	433	143	108		56	205	113
2010/11	2010	113	97	284	103	110	134	153	103	254	75	91		89	217	117
2011/12	2011	122	44	665	109	102	123	152	76	88	391	131	2250	2089	44	81

2012/13	2012	72		651	106	125	88	74	94	100	370	162	2250	2040	69	90
2013/14	2013	96	14	294	119	96	101	154	105		220	117		86	103	106
2014/15	2014	100	153	326	94	116	96	124	120		261			148	76	85
2015/16	2015	256	143	80	85	160	118	80	118		132	82		252	600	207
2016/17	2016	329	29	106	241	129	158	179	140		197	304		221	600	229
2017/18	2017	532	51	542	192	93	127	160	199		127	301		41	117	108
2018/19	2018	85		485	73	59	109	67	132		34	284		81	140	105
2019/20	2019	52		177	84	64	76	54	45		88	255		125	77	71
2020/21	2020	62	275	198	88	177	72	134	165		129	53		83	91	93
2021/22	2021	67	188	73	112	181	95	161	183	100	109	93	100	87	102	110
2022/23	2022	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
Long term average		157	109	289	148	167	108	239	127	251	278	160	546	259	206	120
Medium average		168	119	238	119	117	105	121	131	100	140	177	100	122	201	121
Short term average		73	188	207	91	116	90	103	125	100	92	157		95	102	96
Diff Long/Medium		1.07	0.92	1.22	1.24	1.42	1.03	1.97	0.97	2.51	1.99	0.91	5.46	2.11	1.03	0.99
Diff Long/Short		0.47	1.71	0.71	0.62	0.70	0.84	0.43	0.98	0.40	0.33	0.98	0.00	0.37	0.49	0.80
Diff Medium/Short		1.07	1.09	0.82	0.81	0.70	0.97	0.51	1.03	0.40	0.50	1.10	0.18	0.47	0.97	1.01

Assessment of the seed mussel fishery

Natura Impact Statement for this activity

The dredging of seed mussel and disturbance associated with this activity may reduce the quality of habitat and its suitability for waterbirds in this area of Castlemaine Harbour leading to changes in the distribution, abundance and conservation status of waterbirds.

Assessment

The seed mussel fishery is in subtidal habitat in the outer part of Castlemaine Harbour (Figure 8). The Fisheries Natura Plan (Annex 1) specifies that the exploitation rate in the area fished in any year will not be greater than 66% and the exploitation rate in areas unsuitable for dredge fishing will be zero. Only species that feed or roost in offshore (as opposed to estuarine) subtidal habitat are potentially affected by the fishery. These are Common Scoter, Cormorant and Red-throated Diver. Effects on other species can be discounted as they do not occupy or use the sub-tidal seed mussel area.

Effects on prey availability for Common Scoter

Distribution and overlap with seed mussel

Common Scoter feed on benthic bivalves (including seed mussel) in water depths of less than 20m and occur in large numbers in the sea area west of Inch but not in inner Castlemaine Harbour east of Inch. The seed mussel fishery is in an area with depths of 5-11m so the fishery could potentially reduce the Common Scoter food base.

The proposed fishery occurs on mixed sediments. Seed mussel recruits to this area in spring. By mid to late summer it reaches a size (5-15mm) suitable for harvesting. During autumn biomass declines either due to fishing, starfish predation or partial washout by storms. Some mussel usually survives overwinter as is evidenced in the annual seed mussel surveys.

Common Scoter occur in areas with <10m water depth. They largely avoid the central channel (where the seed mussel fishery is located, (O'Clery 2011), but occur regularly just to the sides of this channel. The main Common Scoter flock locations recorded during the 2009/10 waterbird counts were at least 1km from the 2009 seed mussel extraction area although a flock was recorded on one date close to the area. This represented one in twelve of the flocks recorded across seven dates between September 2009 and March 2010.

The area fished for seed mussel each year is substantially smaller than the overall extent of the area indicated as suitable (Figure 5). Interference competition is likely to limit the number of Common Scoter that can feed in this area at any one time. A large-scale study of the distribution of Common

Scoter in Liverpool Bay (Kaiser *et al*., 2005) recorded a maximum density of 334 scoter per km^2. This would suggest that the areas fished annually could support a maximum of 100 scoter at any one time.

Observations from the BIM seed surveys showing the presence of coarse sand, stone and shell, suggest that currents in the area over and surrounding the seed mussel bed are strong. Current speed is estimated to be 1.5 m/sec (3 knots; BIM, pers. comm.). A large-scale study of the distribution of Common Scoter in Liverpool Bay (Kaiser *et al*., 2005) found that scoter did not occur in areas with current speeds above 0.6 m/sec, while Woakes and Butler (1983) found that the energetic cost incurred by another diving duck (Tufted Duck) swimming against a current increased rapidly above current speeds of 0.5 m/sec. Therefore, the seed mussel bed occurs in an area that is probably unsuitable for foraging scoter.

Food consumption by common scoter

From a literature review, Kaiser *et al*. (2005) estimated the daily consumption of Common Scoter as ranging from 600-1170g fresh weight per day. Their individual behaviour model (IBM) of Common Scoter within Liverpool Bay predicted daily consumption rates of 800-1000g per day, which is within the above range. The annual seed mussel surveys by BIM provide estimates of 3000-5000 tonnes. In addition, there are non-fishable areas, not included in the survey, where the seed settles. Based on average spat fall of 1997 tonnes the scoters' overwintering consumption would be 22-44% of seed biomass (Table 9). The fishery will not take more than 66% of the fishable seed mussel stock and additional seed mussel biomass is available in the unfishable areas and scoters are unlikely in any case to be able to access seed mussel in the area given strong currents it can be concluded that the seed mussel fishery will not affect the availability of food resources for the scoter.

Effects on food base for Cormorant and Red-throated Diver

Cormorant and Red-throated Diver are fish-eating species so the seed mussel fishery will not potentially reduce its food base. They occur in low numbers and generally not in areas where the seed fishery is proposed.

Disturbance

All three sub-tidal SCI species could potentially be affected by disturbance from boat traffic generated by dredging. However, dredging takes place over a short period of time so any disturbance impacts will be of short duration and will not affect the availability of resources in this area. Disturbance estimates are provided in Annex VII.

Table 9. Calculation of the potential consumption of seed mussel by Common Scoter in Castlemaine Harbour.

Parameter	Units	Min	Max
Daily consumption (Kaiser 2005)	g fresh weight	600	1170
Daily consumption of 3637 scoter (baseline population)	g fresh weight	2,182,200	4,255,290
Monthly consumption	g fresh weight	65,466,000	127,658,700
Monthly consumption	tonnes fresh weight	65	128
Overwinter consumption (Sept-March)	tonnes fresh weight	458	894
Biomass of seed mussel bed	tonnes	1997 (Average)	1997 (Average)
Maximum % overwintering consumption by scoter		22%	44%

Conclusion

Significant effects of the proposed fishery for seed mussel on common scoter, cormorant and red-throated diver can be discounted. There are no effects linkages identified for other species and the likelihood of significant effects can be discounted.

Assessment of the effects of intertidal mussel relay

Natura impact statement for this activity

The relay of intertidal mussels and subsequent dredging of it within the mussel nursery area and or mussel aquaculture sites may reduce the quality of habitat and its suitability for waterbird species due to changes in benthic communities and prey availability and due to direct human disturbance. These effects could lead to changes in the distribution, abundance and conservation status of these species.

Data sources

- iWeBs (1994-2023) high tide count data at sub-site level
- NPWS low tide count data 2009/2012
- INIS Environmental Consultants report to MI of low tide counts in 2019/2020.
- Annex V and VI on distribution of birds at low tide and on relationship with mussel cover
- GIS data on locations of mussel licenced sites and intertidal nursery area

Assessment

Status of SCI in iweBs sub-site count sectors close to the relay site

At low tide, a higher number of species occurs within subsites dominated by intertidal habitats and all subsites with intertidal habitat are important for at least one SCI (NPWS, 2011a). The intertidal area east of the Inch dune system and where the intertidal mussel relay area is, supports important numbers of SCI species (Figure 10, Figure 11) and in particular sub-site 0K447 [9 species] sub-site 0K446 [8 species] and subsite 0K445 [5] species. The eel grass (*Zostera*) beds are particularly important for light-bellied brent geese which move to other sub-sites, notably 0K447, when the foraging resource is depleted (NPWS, 2011a). iWeBs sub-site counts close to and overlapping the mussel relay area are incomplete with no data for subsite OK447 and missing years for OK444 and 445. The sum of the species seasonal peak counts in subsite OK446, which is north of the relay area, have been high and stable since 2014 having recovered from much lower numbers in 2009-2012 (Figure 10). Sub-sites 448 and 449 are less important for SCI species. These sites contain most of the intertidal mussel aquaculture sites. Here we presume that the mussel cover in these areas and the effects on SCIs is not higher than that of the relay area. Bird roosting sites are mainly to the west and north of the intertidal relay and not in proximity to it (Figure 12).

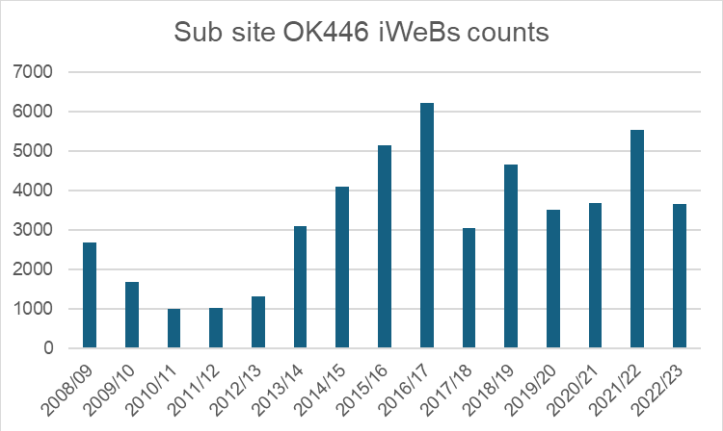

Figure 10. Sum of SCI species iWebs peak seasonal counts in sub site OK446.

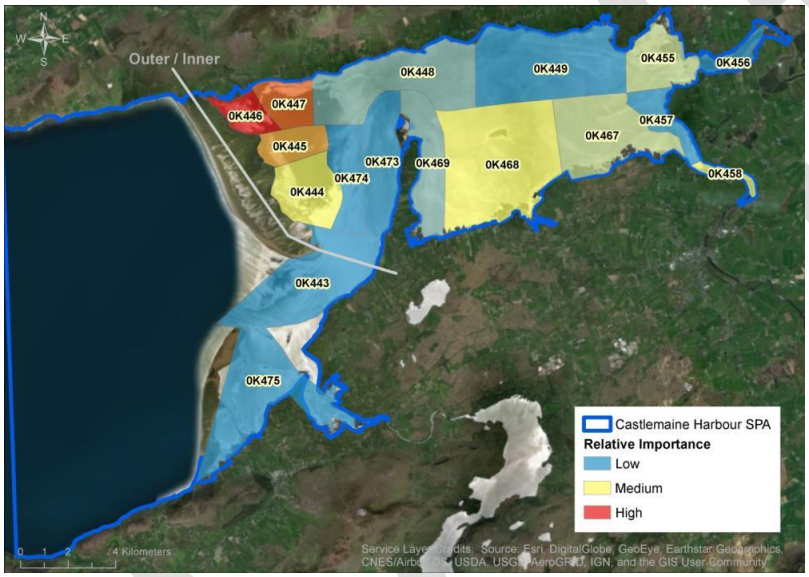

Figure 11. Relative importance of intertidal iWebs subsites for SSI species (figure from Marine Institute 2019 AA of Aquaculture activity)

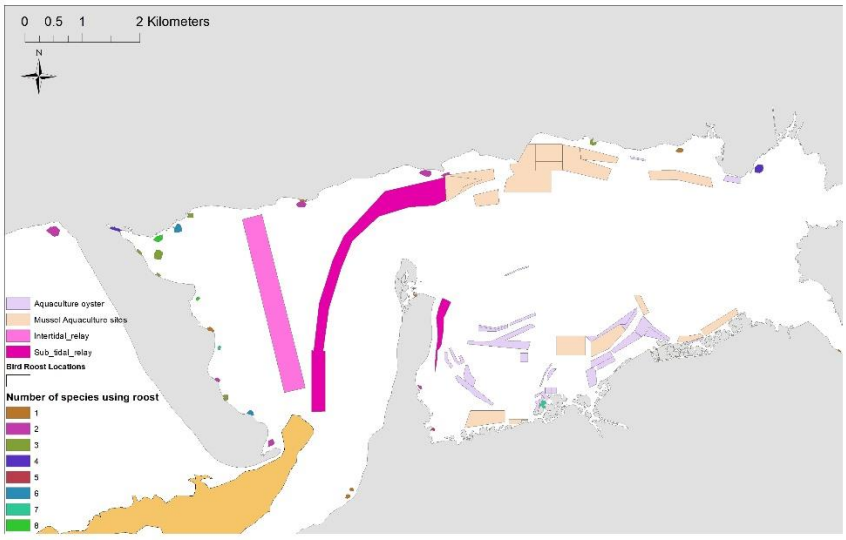

Figure 12. Location of high tide bird roost sites in Castlemaine Harbour relative to distribution of mussel fishing and relay activity. Important roost sites holding the most species are east of the Inch sand dune system.

Distribution of waterbird species in the mussel nursery area at low tide

Low tide counts and locations of flocks of waterbirds in the intertidal area east of Inch, which includes the mussel nursery area, were carried out in 2009/10 (Annex V) and in 2018/19. This section of Castlemaine Harbour was particularly important for Light-bellied Brent Goose and Pintail, holding 50% or more of the Castlemaine Harbour populations of these species. Generally, the area held more than its expected (based on the geographic area of the habitat as a proportion of total available intertidal habitat in the harbour) proportion of populations of all SCI waterbird species that use intertidal habitat. Detailed transect counts within the seed mussel nursery area indicates that the mussel nursery area is used by significant components of the Castlemaine populations of Light-bellied Brent Goose, Sanderling, Bar-tailed Godwit, Redshank, Turnstone and Herring Gull. Comparison of detailed transect counts within the seed mussel nursery area with overall counts for the wider area containing the nursery area (i.e., the low tide count sectors OK444, OK445 and OK447) indicates that Light-bellied Brent Goose and most wader species occurred in numbers equal to or greater than predicted by the availability of intertidal habitat, while Bar-tailed Godwit, Redshank and Turnstone occur in numbers equal to or greater than predicted by the availability of tideline habitat. Ringed Plover were very rare, or absent, during the transect counts despite occurring in significant numbers in the count sectors containing the nursery area. This species mainly feeds on open sandflats and so would be expected to avoid habitat with mussel. Wigeon, Mallard and Pintail were very rare, or absent, during the transect counts despite occurring in significant numbers in the count sectors. This probably reflects their association with freshwater inflows and proximity to saltmarsh (NPWS, 2011). The percentage

occurrence of Red-throated Diver and Cormorant in the vicinity of the nursery area was broadly in line with the percentage expected if the birds were randomly distributed across the sub-tidal habitat covered by the survey. High tide roost locations are distant from the intertidal nursery area.

Distribution of waterbird species in relation to mussel cover

The effect of mussel relay on the intertidal area on SCI species is assessed in Annex VI. Common Scoter and Scaup do not occur in this part of Castlemaine Harbour and are not considered further in this assessment. Work described in Annex VI was undertaken with an average of 12% mussel cover on the intertidal area. As discussed above the scale and annual variability in the volume of seed fished and relaid is highly unlikely to lead to higher mussel cover than 12%. The findings of the study 2011 can, therefore, be applied to the proposed fishery natura plan 2025-2030.

The response of bird populations to different levels of mussel cover is unlikely to be linear. The following assessment considers the effects of an average of 12% cover. Increases in this percentage may have positive effects on the use of this habitat resource by some species and negative effects on others. Mussel aquaculture sites are presumed to be used to the same degree as the intertidal nursery for relay of seed and the assessment by Gittings and O'Donoghue (2011a) in the intertidal nursery area can be applied to effects of intertidal relay in the aquaculture sites Oystercatcher and Redshank were positively associated with mussel cover. Similarly, a Welsh study found that intertidal mussel relay caused an increase in numbers of Redshank, although Oystercatcher numbers were not affected (Caldow *et al*., 2003). There is some evidence to suggest that Light-bellied Brent were also positively associated with mussel cover at the within-sector scale. Turnstone are also likely to be positively associated with mussel cover, given their general habitat preferences. There is some evidence to suggest Sanderling and Bar-tailed Godwit were negatively associated with mussel cover. However, it is also highly unlikely that mussel cover from relay will increase in the period 2025-2030 given the seed supply constraints.

Effects of human disturbance

Wigeon, Mallard, Pintail, Common Scoter and Ringed Plover do not regularly occur within, or in close proximity, to the nursery area. Therefore, these species are not considered further in this assessment.

The modelling of the effects of individual disturbance events is based on the results of survey work carried out in February and March 2010. Therefore, the assessment from this modelling refers to the level of activity that occurred during this period. These conditions still apply as the mussel relaying activity and dredging and overall production has not increased since that time. The potential impacts from significantly higher levels of activity (due to seasonal variation in activity

and or higher levels of mussel on-growing) have not been assessed but given the anticipated levels of mussel production in 2024-2028 are unlikely to increase it is also unlikely that disturbance levels will increase.

Disturbance in intertidal areas at low tide

Coincidence (in time) of disturbance caused by activities associated with mussel production and the potential time that bird populations can use the habitat in the SPA is on average 3-6% for waders and up to 12% for a number of other species (Annex VII). These are gross overestimates as they assume that any disturbance event and its effects persist for the duration of a tidal period and apply throughout the site. Mussel production related disturbance activities occurred on four out of the five days surveyed at low tide and affected a mean of 6.8% of the available habitat resource, using an alert response distance, and 2.4% using a flight response distance. Comparisons with relevant studies in the scientific literature show that these levels of disturbance are generally much lower than levels reported to affect survivorship (Annex VII). These potential disturbance effects are overestimates of the actual disturbance impacts for a number of reasons. The actual mean disturbance impact per low tide period is expected to be lower by 50-75%, and probably below the lower end of that range for a number of reasons as outlined in Annex VII.

Disturbance at high tide to subtidal habitat

The percentage occurrence of Red-throated Diver and Cormorant in subtidal habitat in the vicinity of nursery area was broadly in line with the percentage expected if the birds were randomly distributed across the subtidal habitat covered by the survey in 2010. The populations of these species are dispersed throughout the site and only a small area will be affected by dredging at any one time.

Conclusion

Significant effects of relaying and dredging of mussels in the intertidal area on SCI species can be discounted given the high likelihood that mussel cover and associated changes in benthic communities in the area will not increase significantly over the period 2024-2028 compared to 2010-2023. Given the scale of mussel relay significant effects on SCI species from human disturbance can be discounted.

Assessment of sub-tidal relaying of mussels

Natura impact statement for this activity

The subtidal relaying of seed mussel and disturbance associated with this activity, within the mussel order area or in sub-tidal portions of the mussel aquaculture sites, may reduce the quality

of habitat and its suitability for waterbirds in this area of Castlemaine Harbour leading to changes in the distribution, abundance and conservation status of waterbirds.

Data and information sources

- Annex V, VI and VII

Assessment

Effects on prey availability

Common Scoter does not occur in this part of Castlemaine Harbour and are not considered further in this assessment. Habitat changes caused by subtidal mussel relay could potentially affect the habitat quality for species that feed in benthic zones of subtidal habitat in this area. These species are Scaup, Red-throated Diver and Cormorant. Scaup mainly feed on molluscs in depths of up to 6m. Therefore, subtidal relay of mussels will increase their food supply and is likely to have a neutral or positive effect on this species. Red-throated Diver and Cormorant are fish-eating species. In the case of Red-throated Diver NPWS found that they occur in the outer bay to the west of Rossbehy Peninsula (i.e. OK915. OK916 and OK917) and to the west of Inch Strand (OK918). They also occur to the west of Cromane (OK473 and OK474) in the inner harbour. However, they favour OK915 and OK917 in the outer bay rather than the relay area. NPWS found little pattern in the foraging distribution of Cormorant with birds recorded throughout the harbour. The relaying of mussels within the bay should not affect prey availability in these areas. It may even result in a short term increase in crabs and other scavengers feeding on mussels damaged by the relay operation, which may in turn provide a food resource or attract foraging fish species which both diver and Cormorant in turn could feed on.

Human Disturbance

Disturbance caused by relay of mussels into the subtidal plots and harvesting of mussels from these plots could potentially affect the habitat quality for species that feed or roost in subtidal habitat and/or species that roost at high tide on the shoreline close to the relay plots. In addition to the species mentioned above, Light-bellied Brent Goose, Wigeon, Mallard and Pintail may feed or roost in subtidal habitat. When these species use subtidal habitat, they usually occur in shallow water, or close to the tideline. Small high tide roosts of Oystercatcher and Greenshank have been recorded along the northern shore of Castlemaine Harbour close to the main subtidal relay area. Redshank and Turnstone are also likely to roost in this area. Detailed information on waterbird responses to these activities has not been collected, but a reasonable assessment can be made from the nature of the activities involved and knowledge of the ecology of the species potentially affected. Relay of mussels into the subtidal plots takes place in spring/early summer. Waterbird numbers are low during this period so any disturbance from this activity is not likely to have

significant impacts. As the vessels used for dredging mussels from the subtidal plots are large, they are restricted to relatively deep water. They are, therefore, unlikely to cause disturbance to waterbirds using shallow subtidal habitat, or roosting on the shoreline. The populations of Red-throated Diver and Cormorant are dispersed throughout the site and only a small area will be affected by dredging at any one time. Scaup occur in the vicinity of the subtidal relay plots on the eastern side of Cromane Point. Dredging will only affect a small area of the available habitat at any one time. As there is only a small group of Scaup present at Castlemaine, and Scaup usually feed in flocks, there will be ample alternative habitat for the Scaup to utilise, without being displaced from this area. The main subtidal relay area extends to within 100 m of a high tide roost at Lack Point. This does not appear to be a major roost site. Furthermore, roosting waders generally habituate to vehicular disturbance, while, if disturbance does occur, there are alternative roost sites nearby.

Conclusions

Effects on SCI species of sub-tidal relay of mussels in the fishery order and sub-tidal portions of mussel aquaculture licence plots can be discounted.

Assessment of potential for in combination effects of aquaculture activities

Natura Impact Statement for this activity

The combination of existing mussel, oyster and clam cultivation may reduce the quality of habitat and its suitability for waterbird species of Special Conservation Interest in leading to changes in the distribution, abundance and conservation status of these species.

Data sources

Annex V, VI and VII.

Assessment

Wigeon and Mallard

Wigeon and Mallard are not affected by intertidal mussel cultivation in the mussel order area. In this part of Castlemaine Harbour, they mainly occur in the upper shore zone, away from the nursery area, due to their association with freshwater inflows, saltmarsh and shoreline algal zones (NPWS, 2011a)

In the Douglas Strand-Cromane area, upper shoreline zones are affected, or potentially affected by intertidal mussel and oyster cultivation. The nature of the response of Wigeon and Mallard to

intertidal mussel and oyster cultivation is not known. Both species, therefore, could potentially be negatively affected by displacement from intertidal habitat due to intertidal mussel and oyster cultivation in the Douglas Strand-Cromane area. These species have relatively widespread distributions both across Castlemaine Harbour (NPWS, 2011a) and within the Douglas Strand-Cromane area (Annex V), so small levels of displacement are unlikely to cause significant increases in displacement in the remaining areas of suitable habitat. No significant disturbance impacts to these species have been identified. Therefore, disturbance is unlikely to increase the cumulative impacts discussed above.

Ringed Plover and Sanderling

The existing location and level of clam production (currently zero) will not have any negative effect on ringed plover or sanderling. The existing level of intertidal mussel cultivation in the mussel nursery area is not considered to have a significant impact on either species. However, a substantial increase in the level of mussel cover could potentially reduce habitat suitability for Sanderling. As the levels will probably remain at 12% or less mussel cover such an impact is unlikely. Intertidal mussel cultivation in the intertidal mussel licences in the Douglas Strand-Cromane area is not likely to cause impact, as these species do not use the affected areas.

No significant disturbance impacts to these species have been identified. Therefore, disturbance is unlikely to increase the cumulative impacts discussed above.

Bar-tailed Godwit

Bar-tailed Godwits are potentially negatively affected by displacement from intertidal habitat due to intertidal mussel cultivation and intertidal oyster cultivation. Intertidal mussel and oyster cultivation in the Douglas Strand-Cromane area could cause displacement of 12% of the Castlemaine Harbour population (Annex V, VI) This species has a restricted distribution at Castlemaine Harbour (NPWS, 2011a), so displacement from areas affected by intertidal mussel and oyster cultivation in the Douglas Strand-Cromane area could cause a significant increase in density in the remaining areas of suitable habitat. However, given that mussel cover within mussel aquaculture licences and the fishery order is not expected to exceed 12% no significant displacement is likely to occur.

Other species

No effects are likely to occur on other species

Conclusion

In combination effects of aquaculture with the proposed seed mussel fishery and relay operations can be discounted.

Assessment of potential for cumulative impacts: in association with aquaculture

Natura Impact Statement for this activity

The combination of existing mussel, oyster and clam cultivation and impacts from other activities may reduce the quality of habitat and its suitability for waterbird species of Special Conservation Interest in leading to changes in the distribution, abundance and conservation status of these species.

Data sources

NPWS 2009/10 waterbird counts.
Annex V, VI, VII

Assessment

The other activities included in this Appropriate Assessment are:

- Predator control
- Hand collection of shellfish
- Effluent discharge
- Recreation

Predator control

Predator control (of crabs) takes place in subtidal habitats (and in the lower intertidal at high tide) in the mussel order area. Crabs in subtidal habitat are not a significant food resource for any of the SCI species, although it is a minor prey item for Red-throated Diver (BWPi, 2004). This is a low intensity activity (generally only a single boat on any one day) and is unlikely to cause significant disturbance to any species.

Hand collection of shellfish

Hand collection of periwinkles (winkle picking) takes place at the upper shore area of Rossbehy Creek and around the southern part of the mussel nursery area in adjoining areas to the south and west. Hand collection of cockles takes place north east of the clam licenced area. One gatherer is involved. The potential impact, if any of, hand collection of shellfish on food resources for waterbirds in Castlemaine Harbour is not known. Cockles are an important food resource for larger waders such as Oystercatcher. Marine Institute survey data in 2023 shows that cockle recruit to the area but mortality rates seem to be high perhaps because of bird predation.

Disturbance from winkle picking could potentially have cumulative impacts with disturbance from mussel-related activities in the mussel nursery area. However, it is a low intensity activity and

groups of winkle pickers tend to work within the same area, so the potential level of impact is low.

Effluent discharge

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 Castlemaine Harbour are unlikely to cause adverse impacts to waterbirds.

Recreation

The main areas used for general recreation are the beach along the western side of Inch dunes, both sides of the sand dunes at Rossbehy and Cromane Strand. Recreational activities could cause disturbance to waterbird species. The species that are most likely to be affected are waders that feed on upper sandy beaches; i.e., in term of Fossitt (2000), LS2 and the drier end of the habitat variation included under LS3. Of the SCI species, these include Oystercatcher, Ringed Plover and Sanderling. The potential impacts of the aquaculture activities on Oystercatcher are neutral or positive, so cumulative impacts are not an issue for this species. Ringed Plover and Sanderling may be adversely affected by intertidal clam and mussel aquaculture. These species were recorded on Inch Beach during the 2009/10 counts. At Rossbehy Creek, their main feeding area is away from the areas affected by recreational activities, but they feed on the eastern side of the dunes when their main feeding grounds are covered, and they may roost somewhere along these dunes.

There have been several studies of the impacts of recreational disturbance of wader distribution in sandy beaches. This type of disturbance may affect the foraging behaviour of waders: e.g., Thomas *et al*. (2003) found that that the number and activity of people significantly reduced the amount of time spent foraging by Sanderling on sandy beaches in California. However, several studies have found no evidence that recreational disturbance affects the spatial distribution of waders on sandy beaches (Colwell and Sundeen, 2000; Lafferty, 2001; Yasué, 2006; Neuman *et al*., 2008), while Trulio and Sokale (2008) found no effect on intertidal mudflats from trail use around San Francisco Bay. Several of these papers include Sanderling and Semi-palmated Plover (closely related to Ringed Plover) among the species assemblages studied. In particular, Neuman *et al*., (2008) specifically report a lack of any effect of recreational disturbance on Sanderling distribution in Monterey Bay. Therefore, given the amount of evidence from the scientific literature, it seems unlikely that recreational disturbance is having significant impacts on the spatial distribution of Ringed Plover and Sanderling in Castlemaine Harbour.

Conclusion

Given the low level of recreational activity and shellfish gathering in important habitat areas for birds the significance of cumulative effects of activities in combination nwith fishing and aquaculture can be discounted

Assessment of the effects of mussel production on Conservation Objective 2 for the SPA.

Conservation Objective 2

Conservation Objective 2 for the Castlemaine Harbour Special Protection Area is defined as follows: - To maintain the favourable conservation condition of the wetland habitat at Castlemaine Harbour 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 7472, 3983 & 322 hectares for subtidal, intertidal and supratidal habitats respectively, other than that occurring from natural patterns of variation. These areas are defined by SPA boundary to MLWN, MLWM to MHWM, and MHWM to SPA boundary (the latter value is minus the sand dunes at Inch and Rossbehy) as illustrated in the Ordnance Survey Discovery 1:50,000 series database (NPWS 2011a).

Assessment

The aquaculture activities considered in this assessment take place in intertidal and subtidal habitat and do not significantly disturb these habitats according to SAC conservation objective guidance as shown above.

Conclusion

Mussel production activities will not affect the attributes and targets specified for conservation objective 2 of the SPA.

10. AA Conclusion Statement

SAC Features

The proposed seed mussel fishery and subsequent mussel relay and production activities in nursery areas in the fishery order area and in licenced mussel sites in Castlmaine Harbour SAC overlap with some conservation features in the SAC. Overlaps with individual sedimentary marine communities are generally less than 15% of these communities in any given year and are therefore considered, relative to the conservation objectives, to be non-significant. Where % overlap is greater than 15% (sub-tidal relay) the actual effective footprint is low given the likely level of activity as proposed in the fishery natura plan. The affected habitats have high resilience. Overlap with seagrass is 0% and indirect effects on seagrass have not occurred as shown by annual monitoring which shows that this habitat is stable. Oyster trestle culture is not disturbing to benthic habitats at the scale of operation in Castlemaine Harbour and effects of this activity are not significant. No in combination effects with mussel production are envisaged. Mussel and oyster or clam production is not likely to have any impact on Salmon, Otter, Lamprey, by virtue of the fact that no spatial overlap with conservation attributes for these species or no direct or indirect interactions are envisaged.

The likelihood of significant effects of the seed mussel fishery and associated activities, as described in the fishery natura plan, and in combination effects with aquaculture at the scale of activity currently licenced can be discounted. This conclusion is based on the premise that the activities occur at the scale described in the plan given that the monitoring of habitats that has been conducted since 2010 was completed under those levels of activity. The effects of significantly higher levels of activity have not been assessed.

SPA Features

The proposed seed fishery will not significantly affect Common Scoter. Relay of seed mussel on intertidal nursery areas and intertidal portions of mussel aquaculture licences will overlap with <15% of intertidal habitat. Within this area mussel cover is expected to be generally < 12%. At this level of relay significant effects on waterbirds can be discounted. In combination effects of mussel, oyster and clam production are not anticipated given the current scale of production. The most recent 5 year trends for waterbird populations in Castlemaine Harbour are positive although still lower than in the early to mid-1990s. The fishery natura plan proposed for 2024-2028 is similar in scale to previous plans. There is a high degree of confidence therefore that the 2024-2028 plan will not negatively affect waterbirds in Castlemaine Harbour.

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