Aquaculture Licences Appeals Board

Castlemaine Harbour 2018 Appeals

Technical Advisor's Report – Waterbird Data Annex

Description: An assessment of available waterbird data for Castlemaine Harbour, Co. Kerry. For use in respect of the assessment of multiple aquaculture licence appeals within Castlemaine Harbour Special Protection Area.

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Document Control

Version	Date	Changes	Confidentiality	Prep	Rev	Auth
V1	26/03/2021	Final to client		EC	JT	EC

Contents

1. Introduction

This report has been designed to outline the process of designation for Special Protection Areas (SPAs), the reasoning for the designation of Castlemaine Harbour as a Special Protection Area (Site Code: 004029) and to analyse the current waterbird dataset(s) available for Castlemaine Harbour Special Protection Area to aid the Aquaculture Licensing Appeals Board (ALAB) in the determination of aquaculture licence appeals within Castlemaine Harbour.

2. Designation of Special Protection Areas

The overarching framework for the conservation of wild birds in Ireland and Europe is provided by EU Directive 2009/147/EC on the conservation of wild birds (Birds Directive). Together with the EU Habitats Directive (Council Directive 92/43/EEC), these legislative measures provide for wild bird protection via a network of protected sites across Europe known as Natura 2000 sites, of which the overriding conservation objective is the maintenance (or restoration) of 'favourable conservation status' of habitats and species (NPWS, 2011).

Under Article 4 of the EU Birds Directive, Ireland, along with other Member States, is required to classify the most suitable territories in number and size as Special Protection Areas (SPAs) for the conservation of certain wild bird species, which are:

- Species listed in Annex I of the Directive
- Regularly occurring migratory species
- Also under Article 4, Member States are required to pay particular attention to the protection of wetlands, especially those of international importance (NPWS, 2011).

The National Parks & Wildlife Service (NPWS) is responsible for the selection and designation of SPA sites in the Republic of Ireland. NPWS have developed a set of criteria, incorporating information relating to the selection of wetland sites developed under the Ramsar Convention (Ramsar Convention Bureau 1971), which are used to identify and designate SPAs. Sites that meet any of the following criteria may be selected as SPAs:

- A site holding 20,000 waterbirds or 10,000 pairs of seabirds;
- A site holding 1% or more of the all-Ireland population of an Annex I species;
- A site holding 1% or more of the biogeographical population of a migratory species;
- A site is one of the most suitable sites in Ireland for Annex I species or a migratory species.

The biogeographic population estimates and the recommended 1% thresholds for wildfowl and waders are taken from Wetlands International (Wetlands International, 2002), these thresholds reflecting the baseline data period used. All-Ireland population estimates for wintering waterbirds are taken from Crowe et al. (2008).

Site specific information relevant to the selection and designation of a SPA is collated from a range of sources including the Irish Wetland Bird Survey (I-WeBS), species-specific reports and a wide range of scientific publications, reports and other surveys. If, following collation of all the available scientific data, a site has the relevant criteria for designation and is selected as an SPA, a list of species is compiled for which the site is nationally important. These species are called Special Conservation Interests (NPWS, 2011).

The Special Conservation Interests (SCI) of a site can be divided into two categories:

Selection species

- The species (or species assemblage) that a site is selected for, including all species that are internationally important, and nationally important species where the site is

regarded as one of the most suitable sites in the country for the conservation of that species.

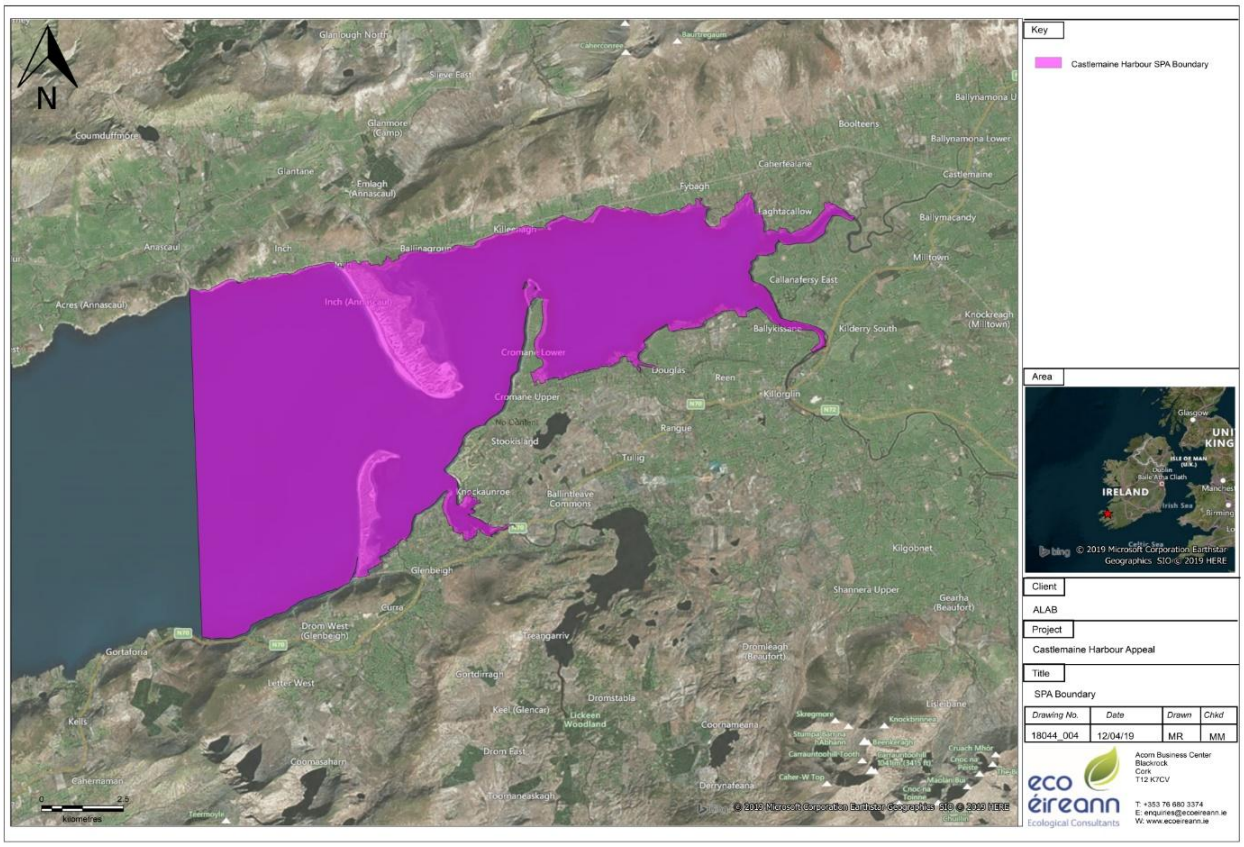
Additional Conservations Interests

- Annex I or migratory species which exceed the all-Ireland 1% threshold (but were not selection species for the site);
- Wetland and Waterbirds - in establishing their SPA network, Member States are explicitly required under Article 4 of the Birds Directive to pay attention to the protection of wetlands. To this end the wetland habitat that is contained within a specified SPA, and the waterbirds that utilise this resource, are considered of Special Conservation Interest.

3. Castlemaine Harbour Special Protection Area

Castlemaine Harbour SPA is a large coastal site occupying the innermost part of Dingle Bay. The site extends from the lower tidal reaches of the River Maine and River Laune to a point some 5km west of the Inch and Rosbehy peninsulas. At the time of designation, it was one of the most important sites for wintering waterbirds in the south-west of Ireland (NPWS, 2011).

Figure 1 Castlemaine Harbour Special Protection Area



3.1. Special Conservation Interest Species – Castlemaine Harbour SPA

Castlemaine Harbour has been identified as qualifying for SPA status because:

- The site regularly supports **1% or more of the biogeographical population of Light-bellied Brent Goose (*Branta bernicla hrota*).** The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 694 individuals.
- The site regularly supports **1% or more of the all-Ireland population of Wigeon (*Anas penelope*)**. The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 6,819 individuals.
- The site regularly supports **1% or more of the all-Ireland population of Pintail (*Anas acuta*).** The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 145 individuals.
- The site regularly supports **1% or more of the all-Ireland population of Common Scoter (*Melanitta nigra*)**. The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 3,637 individuals.
- The site regularly supports **1% or more of the all-Ireland population of the Annex I species Red-throated Diver (*Gavia stellata*).** The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 56 individuals.
- The site regularly supports **1% or more of the all-Ireland population of Ringed Plover (*Charadrius hiaticula*)**. The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 206 individuals.
- The site regularly supports **1% or more of the all-Ireland population of Sanderling (*Calidris alba*)**. The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 335 individuals.
- The site regularly supports **1% or more of the all-Ireland population of the Annex I species Bar-tailed Godwit (*Limosa lapponica*)**. The mean peak number of this species within the SPA during the baseline period (1995/96 – 1999/00) was 397 individuals.
- The site regularly supports **1% or more of the all-Ireland population of the Annex I species Chough (*Pyrrhocorax pyrrhocorax*)**. In winter, Castlemaine Harbour SPA supports 40 - 64 Chough (counts from winter 2002/03 and 2003/04 respectively) which exceeds the All-Ireland 1% threshold for this species.

The following species are identified as additional Special Conservation Interests (SCIs) for Castlemaine Harbour SPA:

- Mallard (*Anas platyrynchos*),
- Scaup (*Aythya marila*),
- Cormorant (*Phalacrocorax carbo*),
- Oystercatcher (*Haematopus ostralegus*),
- Greenshank (*Tringa nebularia*),
- Redshank (*Tringa totanus*),
- Turnstone (*Arenaria interpres*).

The wetlands contained within Castlemaine Harbour SPA have been identified of conservation importance for non-breeding migratory waterbirds. Therefore, the wetland habitats and the waterbirds that utilise this resource are considered to be an additional Special Conservation Interest (NPWS, 2011).

Species data for the site from the baseline period (1995/96 – 1999/00) is compared with data for the same period across all Irish wetland SPA sites to gain all-Ireland importance; and likewise against regional and county sites to gain these respective importance levels. 'Region' refers to regions as defined by Irish Regions Office and 'County' refers to wetland SPA sites in County Kerry. Table 1 below highlights the importance of the SPA for each species (NPWS,2011)

Table 1 Castlemaine Harbour SPA waterbird Special Conservation Interest Species - All-Ireland, Regional and County Importance

Castlemaine Harbour SPA Special Conservation Interest Species	National Importance Rank[1]	Regional Importance Rank[2]	County Importance Rank[3]
Light-bellied Brent Goose	10	2	2
Wigeon	3	1	1
Pintail	3	1	1
Common Scoter	1	1	1
Red-throated Diver	2	1	1
Ringed Plover	7	2	2
Sanderling	2	1	1
Bar-tailed Godwit	15	4	2
Mallard	7	2	2
Scaup	4	2	2
Cormorant	8	2	1
Oystercatcher	11	3	2
Greenshank	8	1	1
Redshank	21	5	2
Turnstone	10	3	2

[1]All-Ireland Importance rank - the number given relates to the importance of the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to the overall all-Ireland population.

[2]Regional Importance Rank - the number given relates to the importance of the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to the numbers that occur at sites within the south-west region.

[3]County Importance Rank - the number given relates to the importance of the non-breeding population of a SCI species during the baseline period (1995/96 – 1999/00) relative to the numbers that occur at wetland sites within Co Kerry.

3.2. Conservation Objectives

The overriding objective of the Habitats Directive is to ensure that the habitats and species covered achieve 'favourable conservation status' and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is being maintained in a satisfactory condition, and that this status is likely to continue into the future.

The EU Habitats Directive's definition of 'favourable conservation status' is shown below.

"The conservation status of a species is the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' when:

- the population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats; and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future; and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis".

Site-specific conservation objectives define the desired condition or range of conditions that a habitat or species should be in, in order for these selected features within the site to be judged as favourable. At site level, this state is termed 'favourable conservation condition.'

Conservation objectives for SPA sites are aimed at maintaining bird populations through the protection of habitats supporting them and against negative impacts of disturbance. Therefore, conservation objectives are determined, for not only waterbird populations, but importantly, for the biotic and non-biotic components of the site that underpin the long-term maintenance of the waterbirds abundance, distribution and range (NPWS, 2011).

To this end, conservation objectives are defined for attributes relating to waterbird species populations, and for attributes related to the maintenance and protection of habitats that support them. These attributes are:

- Population status
- Population distribution
- Habitat range and area (extent)

The overarching Conservation Objective for Castlemaine Harbour Special Protection Area is to ensure that waterbird populations and their wetland habitats are maintained at, or restored to, favourable conservation condition. This includes, as an integral part, the need to avoid deterioration of habitats and significant disturbance; thereby ensuring the persistence of site integrity (NPWS, 2011).

The site should contribute to the maintenance and improvement where necessary, of the overall favourable status of the national and European resource of waterbird species, and continuation of their long-term survival across their natural range.

Objective 1: To maintain the favourable conservation condition of the waterbird Special Conservation Interest species listed for Castlemaine Harbour SPA.

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

- To be favourable, the long-term population trend for each waterbird SCI 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.
- To be favourable, there should be no significant decrease in the numbers or range (distribution) of areas used by the waterbird species of Special Conservation Interest, other than that occurring from natural patterns of variation.

Note that disturbance of a singular or cumulative nature could result in displacement of waterbirds or a reduction in their numbers and therefore adversely affect the achievement of Objective 1.

Objective 2: 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.

Note that any activities or changes which affect the distribution of wetland habitat and reduce the available wetland habitat could adversely affect the achievement of objective 2.

The overriding objective of the Habitats Directive is to ensure that the habitats and species relevant to this directive achieve '*favourable conservation status*' and that their long-term survival is secured across their entire natural range within the EU (EU Commission, 2010). In its broadest sense, favourable conservation status means that an ecological feature is being maintained in a satisfactory condition, and that this status is likely to continue into the future.

At site level, the concept of ‘favourable status’ is referred to as ‘conservation condition.’ This relates to not only the species numbers themselves, but importantly, to factors that influence a species abundance and distribution at a site. The identification of activities and events that occur at a designated site is therefore important, as is the assessment of how these might impact upon the waterbird species and their habitats, and thus influence the achievement of favourable condition. Site-based management and the control of factors that may impact upon species or habitats of conservation importance will be fundamental to the achievement of site conservation objectives.

4. Existing Waterbird Data

To date Castlemaine Harbour has received varying levels of monitoring across differing surveys, each are described in turn below with reference to any limitations and constraints which arise when using these datasets for impact analysis at the spatial scale of an aquaculture site.

4.1. Irish Wetland Bird Survey (I-WeBS)

"The Irish Wetland Bird Survey (I-WeBS) is a scheme run by Birdwatch Ireland in partnership with the National Parks & Wildlife Service (NPWS) which aims to monitor all nonbreeding waterbirds in Ireland to provide the principal data on which the conservation of their populations and wetland habitats is based" (BirdWatch Ireland, 2009).

I-WeBS has been undertaking annual monitoring of Castlemaine Harbour every winter since 1994/95, although coverage of the site varies across years and incomplete counts occurred regularly prior to the winter of 2010/11, and on several occasions subsequent to this period. Castlemaine Harbour is a large site that presents several challenges in terms of achieving complete coverage during waterbird counts. Inch dune system poses a particular problem in terms of accessing adequate vantage points along its eastern shoreline.

Importantly, I-WeBS data is collected within three hours either side of high tide employing the "look-see" method whereby all birds within a predefined area are counted. These counts are undertaken in a consistent manner, repeated on a regular (once-monthly) basis and at the same sites, with synchronised counting at other sites, which increases the confidence that results reflect true changes rather than reflecting different areas being counted or birds being double-counted at different times (BirdWatch Ireland, 2009).

The I-WeBS dataset (1994/95 – 2018/19) was obtained from Birdwatch Ireland to assist the ALAB in its determination of licence appeals within Castlemaine Harbour.

The five-year average for the baseline period (SPA Designation qualification figures) (1995/96 – 1999/00) is given together with the site average for the period (2005/06 – 2009/10) (NPWS, 2011) and the most recent five-year average (2014/15 – 2018/19) of Castlemaine Harbour SPAs special conservation interests species below in Table 2. These averages are based on annual peak counts from the Irish Wetland Bird Survey (I-WeBS).

Table 2: Castlemaine Harbour SPA Waterbird SCI Mean Peak Counts from the Baseline period, 2005/06 – 2009/10 and the most recent 5-years.

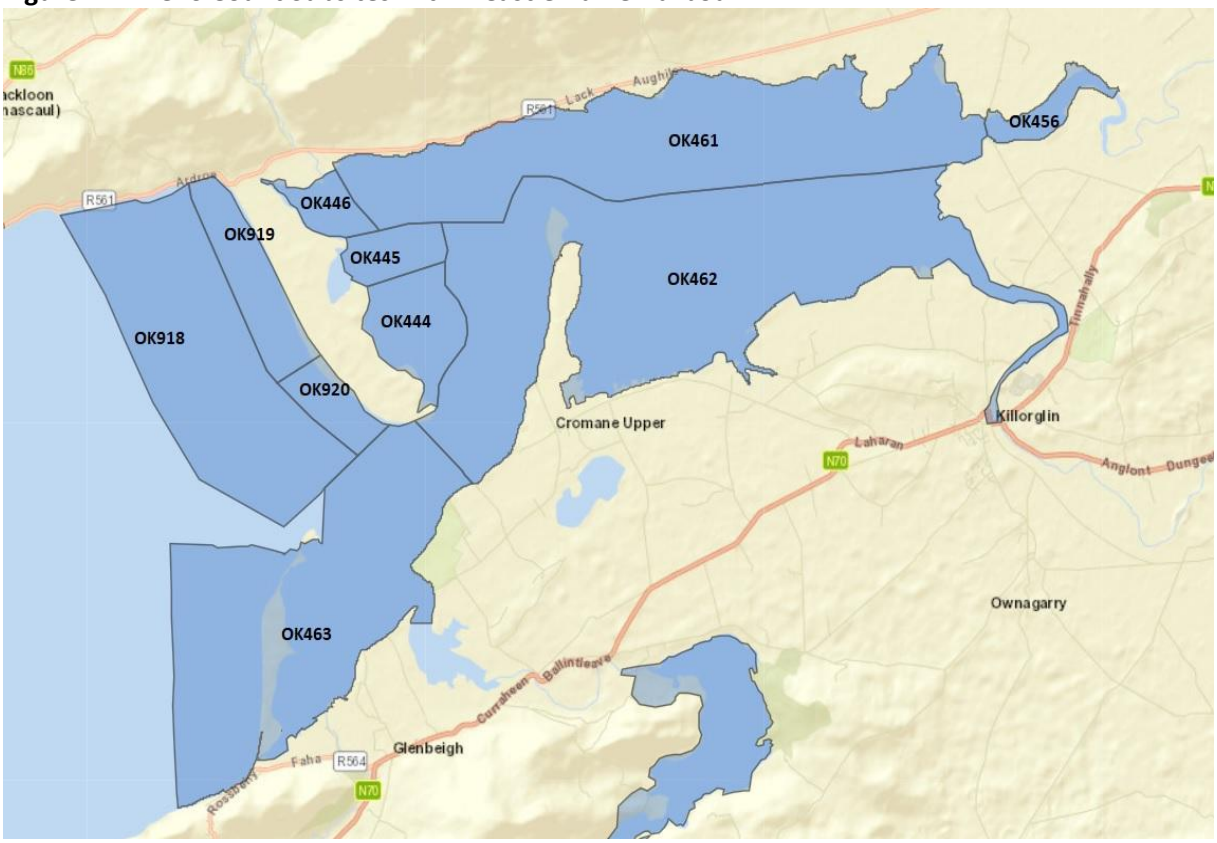
Castlemaine Harbour SPA Special Conservation Interest Species	Baseline Data Period (1995/96 – 1999/00)	Site Average (2005/06 – 2009/10)	Recent Site Average (2014/15 – 2018/19)
Light-bellied Brent Goose *Branta bernicla hrota*	694 (i)	535 (i)	1,111 (i)
Wigeon *Anas penelope*	6,819 (n)	341	4,421 (n)
Pintail *Anas acuta*	145 (n)	133 (n)	88 (n)
Common Scoter *Melanitta nigra*	3,637 (n)	n/c	78
Red-throated Diver *Gavia stellata*	56 (n)	n/c	0
Ringed Plover *Charadrius hiaticula*	206 (n)	101	105
Sanderling *Calidris alba*	335 (n)	468 (n)	266 (n)
Bar-tailed Godwit *Limosa lapponica*	397 (n)	163 (n)	305 (n)
Mallard *Anas platyrynchos*	487 (n)	149	254
Scaup *Aythya marila*	74 (n)	6	0
Cormorant *Phalacrocorax carbo*	135	48	44
Oystercatcher *Haematopus ostralegus*	1035 (n)	629	533
Greenshank *Tringa nebularia*	46 (n)	18	41 (n)
Redshank *Tringa totanus*	341 (n)	380 (n)	629 (n)
Turnstone *Arenaria interpres*	144 (n)	64	13
(i) Denotes numbers of International importance; (n) denotes numbers of all-Ireland importance.			

I-WeBS count subsite details for Castlemaine Harbour are shown below in Table 3 and Figure 2.

Table 3: I-WeBS Count Subsites within Castlemaine Harbour

Subsite Code	Subsite Name
OK444	Dromdarrig
OK445	Midden
OK446	Inch East
OK456	Lower Maine Estuary
OK461	Laughtalla - Inch
OK462	Killorglin - Cromane
OK463	Dooks - Glenbeigh
OK918	Outer Inch Strand
OK919	Inch Strand North
OK920	Inch Strand South

Figure 2: I-WeBS Count Subsites within Castlemaine Harbour.



NPWS (2011) have used the long term annual I-WeBS dataset for Castlemaine Harbour to calculate and analyse population trends and the conservation condition of the SCI species of the SPA. Trends were calculated for the long-term 12-year period (1995/96–2007/08) and the recent five-year period (2002/03-2007/08) and are shown in Table 4 below. Positive values equate to increases in population size while negative values reflect a decrease in population size across the specified time period. Trend analysis was not carried out for four species (Pintail, Red-throated Diver, Common Scoter and Scaup) due to inconsistent counts and counting effort with these species preferred habitat, although for Pintail and Scaup a measure of population change was calculated using the generic threshold method (JNCC, 2004) comparing population size at two time intervals, based on five-year means.

Trends generated from the long-term datasets are necessary to detect real long-term changes; waterbirds are relatively long-lived birds and changes in population size can take several years to become evident. The short-term trend can be useful as an indicator to assess whether species numbers at the site are remaining stable, showing signs of recovery or continuing to decline. For example, although a species' long-term trend may be negative, the short-term trend could be

positive if numbers have increased during the five-year period being assessed. Furthermore, the short-term trend may detect more rapidly where a species population is beginning to decline.

Conservation condition of waterbird species is determined using the long-term (12-year) site population trend. For Pintail and Scaup, conservation condition is assigned using % population change but this is tentative given the inconsistent counts for these species.

Table 4: Site Population Trends for Waterbird SCI Species of Castlemaine Harbour SPA as of 2011 (NPWS, 2011).

Special Conservation Interest Species	Site Population Trend 12 Yr	Site Population Trend 5 Yr	Site Conservation Condition
Light-bellied Brent Goose	-6.1	-7.2	Intermediate (Unfavourable)
Wigeon	-60	-54.8	Highly Unfavourable
Pintail	-8	N/C	Intermediate (Unfavourable)
Common Scoter	N/C	N/C	N/C
Red-throated Diver	N/C	N/C	N/C
Ringed Plover	-57.7	+2.5	Highly Unfavourable
Sanderling	+158	+124	Favourable
Bar-tailed Godwit	-46.6	-44.8	Moderately Unfavourable
Mallard	-13.9	-6.2	Intermediate (Unfavourable)
Scaup	N/C	N/C	Highly Unfavourable
Cormorant	-40.8	+1.83	Moderately Unfavourable
Oystercatcher	-53.1	+10.4	Highly Unfavourable
Greenshank	-31.4	-19.4	Moderately Unfavourable
Redshank	+41.1	+79.3	Favourable
Turnstone	-59.8	+31.6	Highly Unfavourable

N/C = Not Calculated.

This I-WeBS data is very useful in the overall site context for the determination of species population trends and habitat use at the site level but significant limitations exist when using data captured at a site scale and tidal state (high) to determine impact significance on the spatial scale and tidal state of an intertidal aquaculture site. These limitations are discussed further in the conclusion section.

4.2. NPWS Waterbird Survey Programme

The 2009/10 waterbird survey programme was designed by NPWS to investigate how waterbirds are distributed across coastal wetland sites during the low tide period. The surveys run alongside and are complementary to the Irish Wetland Bird Survey (I-WeBS) which is a survey undertaken primarily on a rising tide or at high tide (NPWS, 2011).

At Castlemaine Harbour SPA, a survey programme of four low tide counts (Oct & Nov 2009 and Jan & Feb 2010) and a single high tide count (Jan 2010) was completed across the site. Waterbird species were counted across a series of 24 count sections (subsites), shown in Table 5 and Figure 3, below. Behaviour was recorded within two categories (foraging or roosting/other) and position of birds was noted in relation to broad habitat types (NPWS, 2011).

In addition to the main survey programme described above, an additional 'roost survey' was undertaken at high tide on 26th February 2010. During this survey, roost sites were located, species and numbers counted, and the position of the roosts marked onto field maps.

Table 5: Castlemaine Harbour NPWS Waterbird Survey Programme Count Subsites

Subsite Code	Subsite Name
OK443	Inch Point
OK444	Dromdarrig
OK445	Midden
OK446	Inch East
OK447	Ballinagroun
OK448	Lack Point
OK449	Roscullen Island
OK455	Laghtcallow
OK456	Lower River Maine
OK457	Pointantirig
OK458	Clash Island
OK466	Cloon Island
OK467	Reennacannana Point
OK468	Douglas Strand
OK469	Crow's Point, Cromane East
OK473	Cromane West
OK474	Inch 5
OK475	Rosbehy Creek
OK915	Kells Point
OK916	Feaklecally
OK917	Knockatinna
OK918	Outer Inch Strand
OK919	Inch Strand North
OK920	Inch Strand South

Figure 3: Castlemaine Harbour NPWS Waterbird Survey Programme Count Subsites

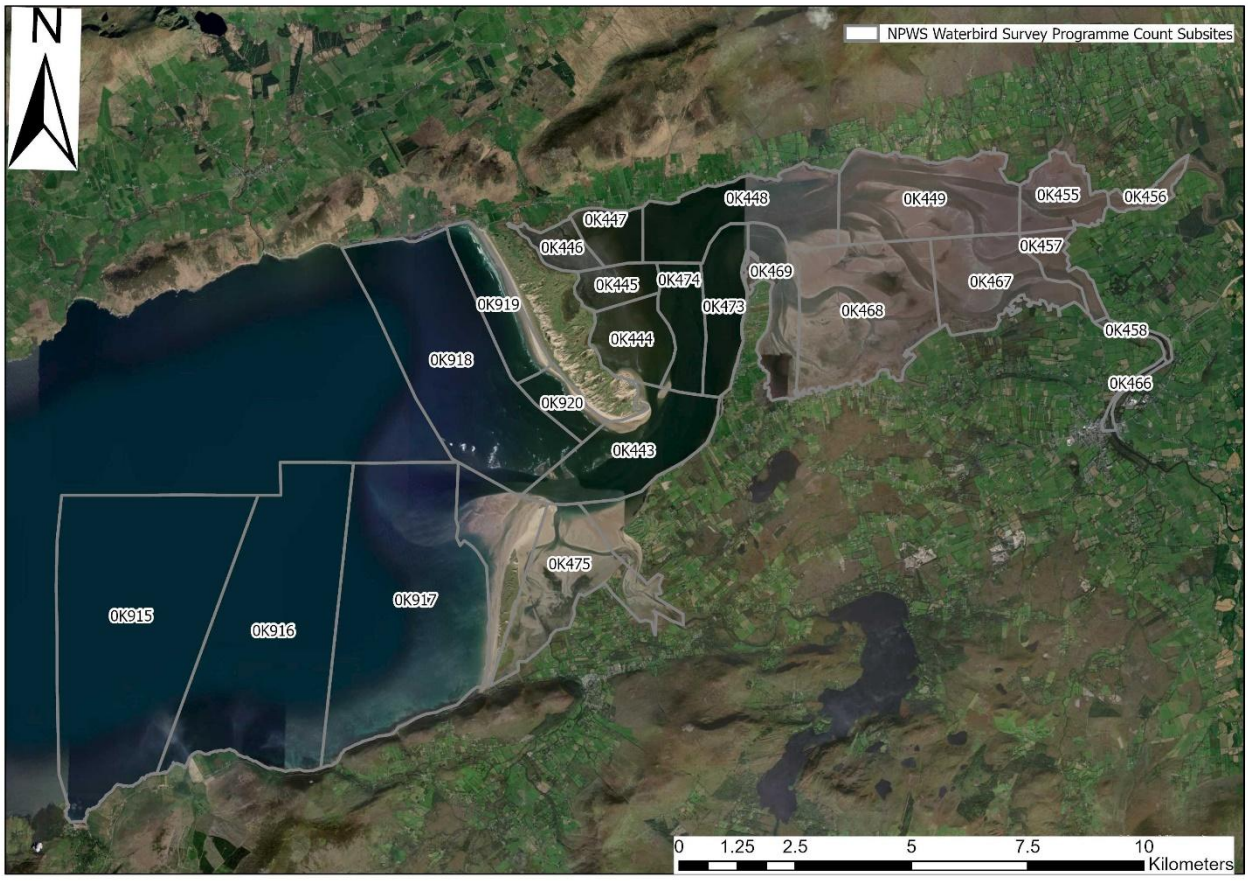


Table 6, below, shows peak numbers of each SCI species (whole site) recorded during both the low tide (4 counts) and high tide (1 count) surveys. The average subsite % occupancy defined as the average proportion of subsites in which species occurred during low tide counts, has been calculated for each species as well as the proportion of the whole site which each species occurred in.

This study undertook a detailed data analysis to understand how waterbirds are distributed across Castlemaine Harbour SPA during the non-breeding season (i.e. over-wintering period). This study assessed patterns of waterbird distribution at low tide (and high tide), together with examination of data on sediment and invertebrate distribution and abundance, aimed at identifying areas (subsites) within the site that support critical waterbird functions (i.e. foraging & roosting) on a species by species basis.

Table 6: Castlemaine Harbour SPA - 2009/2010 Waterbird Surveys Summary Data

Castlemaine Harbour Special Conservation Interests (SCIs) (BTO Species Code)	Peak Number Recorded during Low Tide Surveys	Peak Number Recorded during High Tide Surveys	Average Subsite % Occupancy*	Average % Area Occupancy*
Light-bellied Brent Goose (PB)	1,374 (i)	819 (i)	31.3 (7.2)	30.6 (23.0)
Wigeon (WN)	1,612 (n)	567	32.8 (7.1)	21.9 (8.4)
Pintail (PT)	105 (n)	49 (n)	7.3 (2.1)	2.1 (0.8)
Common Scoter (CX)	1,892 (n)	979 (n)	9.3 (4.0)	27.3 (11.2)
Red-throated Diver (RH)	33 (n)	2	8.3 (3.4)	19.9 (3.8)
Ringed Plover (RP)	731 (n)	205 (n)	18.8 (7.2)	12.4 (2.7)
Sanderling (SS)	325 (n)	428 (n)	15.6 (7.9)	10.2 (3.9)
Bar-tailed Godwit (BA)	284 (n)	318 (n)	22.9 (4.2)	17.1 (5.3)
Mallard (MA)	1,401 (n)	380 (n)	55.2 (8.6)	31.2 (7.6)
Scaup (SP)	14	0	3.1 (2.1)	4.2 (3.1)
Cormorant (CA)	141(n)	48	45.8 (13.2)	36.3 (10)
Oystercatcher (OC)	1,897 (n)	1,049 (n)	80.0 (2.1)	51.5 (3.0)
Greenshank (GK)	77 (n)	47 (n)	50 (12.3)	30.2 (6.4)
Redshank (RK)	1,170 (n)	822 (n)	60.4 (8.0)	36.8 (6.2)
Turnstone (TT)	136 (n)	147 (n)	29.2 (7.6)	22.4 (8.6)

(i) Denotes numbers of International importance; (n) denotes numbers of all-Ireland importance.
* Mean (± s.d.) calculated across low tide counts.

The data produced within this analysis is comprehensive and highlights important patterns of distribution within the site, although limited to only a single season of low tide surveys and therefore it should not be considered absolute.

The study found that subsite species richness (total number of species) across the site as a whole was relatively constant varying from 37species – 42species across the survey period. Subsite species richness however, varied greatly ranging from 25 species in Subsite OK468 to subsites that recorded only a single species (OK915 & OK916).

Average subsite species richness (at low tide) was highest in OK468. While generally higher diversity was found within subsites dominated by intertidal habitats. There was no relationship between subsite size (area) and species richness. Subsite species richness is shown in Table 7, below.

Table 7: Subsite Species Richness recorded during the NPWS WSP Castlemaine Harbour 2009/2010

Subsite	Average Low-tide Species Richness (Mean +/- S.D)
OK443	15(4)
OK444	14(3)
OK445	20(3)
OK446	17(5)
OK447	19(4)
OK448	13(1)
OK449	13(3)
OK455	18(3)
OK456	13(2)
OK457	12(2)
OK458	11(2)
OK466	3(2)
OK467	20(3)
OK468	23(3)
OK469	16(3)
OK473	9(3)
OK474	7(3)
OK475	9(4)
OK915	2(2)
OK916	1(1)
OK917	4(1)
OK918	6(5)
OK919	4(3)
OK920	2(1)

This study used data analyses to determine the proportional use of subsites by each Special Conservation Interest (SCI) species, relative to the site as a whole. The categories used to indicate the proportional use of each subsite by each species are as follows:

- L – Low
- M – Moderate
- H – High
- V – Very High

The fact that different subsites may be categorised as 'Very High' for the same species highlights the fact that several subsites may be equally important for the aspect of the species' wintering ecology in question. This approach, rather than averaging across all low tide surveys, allows for equal weightings to be given for temporal differences – e.g. concentrations of foraging birds in

different subsites at different times reflecting the natural pattern of distribution across time as species move in response to changing prey densities and availabilities (NPWS, 2011).

Table 8: Castlemaine Harbour SPA Subsite Assessment - Total Numbers (all behaviours) during Low Tide Surveys

Species	OK443	OK444	OK445	OK446	OK447	OK448	OK449	OK455	OK456	OK457	OK458	OK466	OK467	OK468	OK469	OK473	OK474	OK475	OK915	OK916	OK917	OK918	OK919	OK920
PB	H	V	H	V	V	H							M	M	H	M	H	H						
WN			H	V	V	H	M	H	H		M		V	H	H		H	H						
PT				H	V												H							
CX																				H	V	V		
RH																M	V		V	M	V	H		
RP	H	V	H	M	V		H	M					V		M			H						
SS		M	H	H	V								V	V									M	
BA	M	V	H	V				M		H			H	V	H		H	H						
MA	L	H	V	V	V	H	M	H	M	M	M	H	H	H	M		H	H						
SP													V	V										
CA	H	M	V	H	M	H	H	H	H	M			H	V	M	M	L					H		V
OC	M	H	H	V	V	H	H	H	M	H	M		H	H	H	L	L	M		L	L	M	H	L
GK	H		H	V	V	M	V	H	V	M	H		M	V	H	L	M	H						
RK	M	M	H	H	V	H	H	V	H	H	V	M	H	H	H	L	L	M						
TT	H	H		V	V	H	H	H		H	H		H	V	H	H		V						

The study highlighted the importance of a number of subsites for many different species within the Castlemaine Harbour SPA, most notably being subsites OK446, OK447 and OK468. The study also highlighted where species have a relatively restricted distribution across the site, most notably in divers and ducks but also for species such as Bar-tailed Godwit and Sanderling.

The authors note that overall, the survey provides comprehensive information on the distribution and abundance of non-breeding waterbirds at Castlemaine Harbour SPA. However, this has been caveated as the study was based on a single season of surveys. "Information provided should not be considered as absolute because waterbirds by their nature are highly mobile and various factors including temperature, direction of prevailing winds, changing prey densities/availabilities and degree of human activity across the site, could lead to patterns that may change in different months and years" (NPWS, 2011).

This NPWS Study also recorded and assessed activities and events that have the potential to cause disturbance to waterbirds across the survey period. The disturbance assessment included any activity that was considered to potentially cause disturbance to waterbirds. In practice, the subject is complex and behavioural responses to disturbance can vary from subtle declines in intake rates to more drastic changes such as avoidance of entire estuaries (Mitchell et al. 1989). The scoring system and definitions and rationale are outlined in Tables 9 & 10, below.

Table 9: Scoring System for Disturbance Assessment (NPWS, 2011)

Frequency/ Duration	(A) Timing Score	Intensity	(B) Scope Score	Response	(C) Severity Score	Total Impact Score of Threat (A+B+C)
Continuous	3	Active, high level	3	Most birds disturbed all the time	3	9
Frequent	2	Medium level	2	Most birds displaced for short periods	2	6
Infrequent	1	Low level	1	Most species tolerate disturbance	1	3
Rare	0	Very low level	0	Most birds successfully habituate to the disturbance	0	0

Table 10: Scoring System - Definitions and Rationale

Frequency/ Duration	Rationale
Continuous	Continuous motion or noise; not necessarily 24-hours per day but zones of fairly continuous activity such as a port or marina.
Frequent	Frequently observed during the survey programme, can be up to several times per 6-hour tidal cycle; and/or known to occur on a frequent basis.
Infrequent	Observed only once or twice during the survey programme and known/considered likely to be infrequent
Rare	Known to occur but not observed during the survey programme and considered likely to be rare in occurrence.
Intensity	**Rationale**
Active, high level	Would indicate an active event that is likely to displace waterbirds during its presence e.g. active shipping channel, speed boats, quad bikes, loose dogs.
Medium level	Lower intensity events such as non-powered watercraft, vehicles, people walking along a shoreline (without dogs) – that are likely to result in waterbirds moving but birds will be less 'alarmed' than (1) and response will be species-specific.
Low level	Although activity may be of a nature to displace waterbirds, birds move only slightly, resume normal behaviour quickly or show no determinable response at all; e.g. solitary walkers close to site but not impacting on waterbirds' immediate location; cars passing on an adjacent road
Very low level	Any activities considered to impart little effect upon waterbird
Response	**Rationale**
Most birds disturbed all the time	Birds do not return – therefore equivalent to habitat loss.
Most birds displaced for short periods	Birds return once disturbance has ceased.
Most species tolerate disturbance	Weak response, birds may move slightly away from disturbance source.
Most birds successfully habituate to the disturbance	Little determinable effects.

Overall disturbance scores ranged from 0 (low) to 6 (moderate). Although some high-intensity activities were recorded (such as speed boats, quad bikes, motorised vehicles) their frequency was not continuous, so an overall 'high' disturbance score was not attained (NPWS, 2011). As Castlemaine Harbour has little/no adjacent industrial development or shoreline development such as ports, the maximum response of birds is likely to be '2' i.e. birds will be displaced for a

period of time but with the potential to return once the disturbance event has ceased (NPWS, 2011).

The highest disturbance scores were recorded for subsites 0K443, 0K444, 0K446/0K447, 0K468, 0K469, 0K919 and 0K920. Activities related to intertidal aquaculture scored moderately (5-6) depending on the maximum observed frequency. Note that this activity has been scored in terms of maximum intensity and response but in practice the effects are likely to vary from day to day; disturbance levels being related to various factors such as number of people, type of boat used (motorised/non-motorised), frequency of visits during a low-tide period, type and length of activity undertaken etc. Response of waterbirds will also be species-specific (NPWS, 2011).

4.3. Detailed Trestle Study (Gittings & O'Donoghue, 2012)

Castlemaine Harbour was one of six sites included in a study carried out on the relationship between intertidal oyster culture using trestles and bags and wintering waterbird distribution. The Castlemaine study site was located along the southern side of Castlemaine Harbour, comprising 1391 ha or 32% of the 4287 ha of the mudflats and sandflats not covered by seawater at low tide in Castlemaine Harbour SPA and a large proportion of the total intertidal area of the intertidal fine to muddy fine sand with polychaetes community complex, between Cromane Point and Douglas Strand (Gittings & O'Donoghue, 2012).

The study area was divided into sectors, defined by biotope type. Counts were carried out on four dates in January and February 2011 during spring low tide conditions when the exposure of the oyster trestles was maximal. Oyster husbandry activity was recorded during 3 of the 4 counts carried out. There were 5 count sectors containing trestles, these trestles only occupied small portions of each sector (Gittings & O'Donoghue, 2012).

It was noted by the author at the time of writing that there were a number of applications for aquaculture licenses within their study area and some of the count sectors were defined so that they can provide baseline data for future monitoring of the impact of aquaculture within these areas.

Minor impacts, involving birds being disturbed by husbandry activity but not being displaced from the count sector were noted during one count at Castlemaine Harbour. A high impact, involving disturbance of all birds within a 200 m radius by a dog accompanying workers, was recorded at Castlemaine Harbour (Gittings & O'Donoghue, 2012).

This study conducted detailed and robust data analysis on the results of the detailed surveys, using various analytical methods (focusing on assemblage of birds and specific species assessments). These methods produced broadly similar results, but with some specific differences between the apparent patterns of association with oyster trestle blocks indicated by the different analyses (Gittings & O'Donoghue, 2012). Table 11, below, outlines the responses of species to intertidal oyster cultivation as presented by Gittings & O'Donoghue (2012). Species with an unknown response are species that did not occur within the study sites, or for which the study did not produce sufficient data to assess their response. Their possible response was categorised based on knowledge of their behaviour and habitat preferences and, in some cases, similarity to species which were evaluated.

Table 11: Response of Intertidal Waterbirds to Intertidal Oyster Cultivation

Species	Response
Oystercatcher	**Neutral/ Positive**
Curlew	Neutral/ Positive
Greenshank	**Neutral/ Positive**
Redshank	**Neutral/ Positive**
Turnstone	**Neutral/ Positive**
Light-bellied Brent Goose	**Variable**
Black-headed Gull	Variable
Common Gull	Variable
Herring Gull	Variable
Shelduck	Negative
Ringed Plover	**Negative**
Lapwing	Negative
Sanderling	**Negative**
Dunlin	Negative
Black- tailed godwit	Negative
Bar-tailed Godwit	**Negative**
Great Black-backed Gull	Negative
Grey Plover	Exclusion
Knot	Exclusion
Little Egret	Unknown (neutral/ positive)
Grey Heron	Unknown (neutral/ positive)
Lesser Black-backed Gull	Unknown (Variable)
Wigeon	**Unknown (negative)**
Teal	Unknown (negative)
Mallard	**Unknown (negative)**
Pintail	**Unknown (negative)**
Golden Plover	Unknown (negative)

Castlemaine Harbour SCI species are highlighted and in **Bold.**

The species that showed a neutral/positive response are all waders that tend to feed in small flocks (Turnstone) or as widely dispersed individuals/loose flocks (Oystercatcher, Curlew, Greenshank and Redshank). The species that showed a negative response are mainly species that tend to feed in large flocks of tightly packed individuals (Knot, Sanderling, Dunlin, Black-tailed Godwit and Bar-tailed Godwit, and to a lesser extent Ringed Plover). Furthermore, for the two species out of the latter group where good data was available, the negative response appears to be stronger when large flocks are involved (Gittings & O'Donoghue, 2012).

Previous studies (Folmer et al., 2010) found that Knot and Dunlin are more clustered than predicted by their food resources suggesting that they follow each other when selecting foraging patches, implying that visual contact between flock members is important. Therefore, the above suggests that the negative response to oyster trestle blocks may be a behavioural response by species where the oyster trestles interfere with their flocking behaviour by making it difficult for

individuals in large flocks to remain in contact as they become dispersed across several lines of trestles (Gittings & O'Donoghue, 2012).

It is also notable that the species that show a negative response to oyster trestles generally favour open mudflats or sandflats and usually do not occur in large numbers in mixed sediment or rocky shores. Therefore, selection of mixed sediment or rocky shore sites for intertidal oyster culture would be likely to reduce the potential impact on waterbirds (Gittings & O'Donoghue, 2012).

Gittings & O' Donoghue (2012) used the above calculated responses of waterbirds (Table 9) to intertidal oyster cultivation to devise an impact assessment methodology for the provision of Appropriate Assessment (assessment of potential impact on designated habitats and species within SACs & SPAs, required under the EU legislation of the Habitats Directive) of intertidal oyster culture activities. The methodology is outlined further in Section 5.

4.4. Recent Low-tide Wintering Waterbird Survey 2019/20 (Inis Environmental, 2020)

The Marine Institute commissioned INIS Environmental Consultants Ltd. to co-ordinate and conduct a series of waterbird surveys at Castlemaine, Co. Kerry during the 2019/2020 winter season, this survey followed standard methodology used for surveying wintering waterbirds at low tide (Lewis & Tierney, 2014), as developed by the NPWS Waterbird Survey Programme, and included four low tide surveys and a single high tide survey. The results of this survey (INIS, 2020) have been provided by the Marine Institute to further assess the implications of the proposed aquaculture site on the SCIs of Castlemaine Harbour SPA.

The surveys covered the same count area and count subdivisions (subsites) of Castlemaine Harbour SPA as used during the 2009/10 NPWS Waterbird Survey Programme (see Figure 12, above).

In addition to counts of each species, the behaviour of waterbirds during counts was attributed to one of two categories (foraging or roosting/other) while the position of the birds was recorded as per one of four broad habitat types (intertidal, subtidal, supratidal and terrestrial). Information on the presence of activities that could cause disturbance to waterbirds was also recorded. Following Lewis & Tierney (2014), activity types were categorised as follows:

1. Human, on-foot – shoreline
2. Human, on foot – intertidal aquaculture
3. Bait-diggers
4. Non-powered watercraft
5. Powered watercraft
6. Water-based recreation (e.g. wind-surfers)
7. Horse-riding
8. Dogs
9. Aircraft
10. Shooting
11. Other
12. Winkle pickers
13. Aquaculture machinery
14. Other vehicles

Activity observed to cause a disturbance to waterbirds was recorded, including the species affected and a letter code system used to indicate the bird's response to the activity as follows:

- **W**- Weak response, waterbirds move slightly away from the source of the disturbance.
- **M** – Moderate response, waterbirds move away from the source of the disturbance to another part of the subsite; they may return to their original position once the activity ceases.
- **H** – High response, waterbirds fly away to areas outside of the subsite and did not return during the current count session.

The length of the activity was also recorded by adding the codes **A – D,** and a record was made as to whether the activity was already occurring within the subsite at the start of counts:

- **A –** short/ discrete event
- **B –** activity occurs for up to 50% of the count period.
- **C –** activity length estimated at >50% but <100% of the count period.
- **D –** activity continues after the count period has ended.

A total of 42 waterbird species were recorded during the 2019/20 surveys, along with three unidentified taxa. The total species list includes five species (red-throated Diver, Great Northern Diver, Little Egret, Golden Plover and Bar-tailed Godwit) listed on Annex I of the EU Bird's Directive, and 28 species that are on the Birds of Conservation Concern in Ireland lists (BoCCI) (Colhoun & Cummins, 2013), including seven that are Red-listed and are of highest concern. All Special Conservation Interest (SCI) species listed for Castlemaine Harbour SPA were recorded except Scaup which was not recorded across the survey period, see Table 12, below (INIS, 2020).

Whole site species diversity during low tide surveys ranged between 33 species (December 2019 and March 2020) and a peak of 37 species, recorded during the January high tide survey. 23 species were recorded in all five surveys undertaken.

Subsite species diversity ranged from a total of three species within the open water subsite 0K474, to a peak of 28 species within 0K467, a large intertidal subsite in the south-east of the site.

Five species (Cormorant, Oystercatcher, Black-headed Gull, Herring Gull and Great Black-backed Gull) occurred in twenty or more subsites overall and were therefore the most widespread. Twenty waterbird species occurred in ten or more subsites, including Light-bellied Brent Goose, Shelduck, Common Scoter, Great Northern Diver, and Dunlin. The most scare species, occurring in one subsite only, were Pink-footed Goose, Surf Scoter, Spoonbill, Water Rail and Moorhen.

Table 12: Waterbird Species Recorded during the 2019/20 Winter Surveys (INIS, 2020)

Species Name	Latin Name	BTO Code	BoCCI 2013	Annex I
Mute Swan	*Cygnus olor*	MS	A	
Pink-footed Goose	*Anser Brachyrhyncus*	PG		
Light-bellied Brent Goose	*Branta bernicla hrota*	PB	A	
Shelduck	*Tadorna tadorna*	SU	A	
Wigeon	*Anas Penelope*	WN	A	
Teal	*Anas crecca*	T.	A	
Mallard	*Anas platyrhynchos*	MA		
Pintail	*Anas acuta*	PT	R	
Common scoter	*Melanitta nigra*	CX	R	
Surf scoter	*Melanitta perspicillata*	FS		
Red-breasted Merganser	*Mergus serrator*	RM		
Red-throated Diver	*Gavia stellatta*	RH	A	Yes
Great Northern Diver	*Gavia immer*	ND		Yes
Unidentified Diver	*Gavia asp.*	UL		
Great Cresdted Grebe	*Podiceps cristatus*	GG	A	
Cormorant	*Phalacrocorax carbo*	CA	A	
Shag	*Phalacrocorax aristotelis*	SA		
Little Egret	*Egretta garzetta*	ET		Yes
Grey Heron	*Ardea cinerea*	H.		
Spoonbill	*Platalea leucorodia*	NB		
Water Rail	*Rallus aquaticus*	WA	A	
Moorhen	*Gallinula chloropus*	MH		
Oystercatcher	*Haematopus ostralegus*	OC	A	
Ringed Plover	*Charadrius hiaticula*	RP	A	
Golden Plover	*Pluvialis apricaria*	Gp	A	Yes
Grey Plover	*Pluvialis squatarola*	GV	A	
Lapwing	*Vanellus vanellus*	L.		
Knot	*Calidris canutus*	KN	R	
Sanderling	*Calidris alba*	SS		
Dunlin	*Calidris alpina*	DN	A	
Jack Snipe	*Lymnocryptes minimus*	JS		
Snipe	*Gallinago gallinago*	SN	A	
Black-tailed Godwit	*Limosa limosa*	BW	A	
Bar-tailed Godwit	*Limosa lapponica*	BA	A	Yes
Curlew	*Numenius arquata*	CU	R	
Greenshank	*Tringa nebularia*	GK	A	
Redshank	*Tringa totanus*	RK	R	
Turnstone	*Arenaria interpres*	TT		

Unidentified Wader Sp.		U.		
Black-headed Gull	*Chroicocephalus ridibundus*	BH	R	
Common Gull	*Larus canus*	CM	A	
Lesser Black-backed Gull	*Larus fuscus*	LB	A	
Herring Gull	*Larus argentatus*	HG	R	
Great Black-backed Gull	*Larus marinus*	GB	A	
Unidentified gull		UU		

During winter 2019/20, total numbers of waterbirds during low tide ranged from 3,315 (March 2020) to a peak count of 10,579 waterbirds (November 2019). A total of 7,162 waterbirds was counted during the January 2020 high tide survey. The peak count of 2019/20 represents a drop in numbers of some 4,900 waterbirds (over 30%) in comparison with the peak count of 2009/10 (Table 13, below) (INIS, 2020). It should be noted that the site totals from individual surveys are not directly comparable, due to the variance of the months within which they were counted.

Table 13: Total Numbers of Waterbirds Counted at Castlemaine Harbour during Winter 2019/20 and 2009/10 and the Percentage Difference.

Winter	Total Numbers of Waterbirds (Site Totals)				
	LT1	LT2	LT3	LT4	HT
2019/20	10,579	10,571	7,216	3,315	7,162
2009/10	15,510	11,327	14,917	14,687	12,087
% Change (2009/10 – 2019/20)	-31.8	-6.67	-51.6	-77.4	-40.8

During low tide surveys, one species was recorded in numbers of international importance (Light-bellied Brent Goose) and a further 18 species occurred in numbers of all-Ireland (national) importance, eight of which are listed as waterbird SCI species for Castlemaine Harbour SPA (INIS, 2020). During the high tide survey, one species was recorded in numbers of international importance (Light-bellied Brent Goose) and a further 15 species occurred in numbers of all-Ireland importance (Table 14, below) (INIS, 2020).

Table 14: Peak Counts of Waterbird Species during Low Tide (LT) and High Tide (HT) Surveys at Castlemaine Harbour during 2019/20 and 2009/10.

Recorded Waterbird Species Name	Peak No. LT Surveys 2019/20	Peak No. HT Surveys 2019/20	Peak No. LT Surveys 2009/10	Peak No. HT surveys 2009/10
Mute Swan *Cygnus olor*	7	0	17	0
Pink-footed Goose *Anser Brachyrhyncus*	1			
Light-bellied Brent Goose *Branta bernicla hrota*	**2,160 (i)**	**1,727 (i)**	**1,374 (i)**	**819 (i)**
Shelduck *Tadorna tadorna*	237 (n)	221 (n)	235 (n)	189 (n)
Wigeon *Anas Penelope*	**3,201 (n)**	**459 (n)**	**1,612 (n)**	**567**
Teal *Anas crecca*	227	316	557 (n)	225
Mallard *Anas platyrhynchos*	**670 (n)**	**262**	**1,401 (n)**	**380 (n)**
Pintail *Anas acuta*	**45 (n)**	**70 (n)**	**105 (n)**	**49 (n)**
Common scoter *Melanitta nigra*	**618 (n)**	**519 (n)**	**1,892 (n)**	**979 (n)**
Surf scoter *Melanitta perspicillata*	1	0	0	0
Red-breasted Merganser *Mergus serrator*	37 (n)	28 (n)	49 (n)	20
Red-throated Diver *Gavia stellatta*	**3**	**22 (n)**	**33 (n)**	**2**
Great Northern Diver *Gavia immer*	102 (n)	121 (n)	33	19
Great Crested Grebe *Podiceps cristatus*	2	1	5	0
Cormorant *Phalacrocorax carbo*	**181 (n)**	**38**	**141 (n)**	**48**
Shag *Phalacrocorax aristotelis*	53	35	0	0
Little Egret *Egretta garzetta*	44 (n)	25 (n)	109	15
Grey Heron *Ardea cinerea*	9	6	62	10
Spoonbill *Platalea leucorodia*	0	1	0	0
Water Rail *Rallus aquaticus*	2	0	0	0
Moorhen *Gallinula chloropus*	2	0	1	0
Oystercatcher *Haematopus ostralegus*	**494**	**751 (n)**	**1,843 (n)**	**1,049 (n)**
Ringed Plover *Charadrius hiaticula*	**310 (n)**	**59**	**731 (n)**	**205 (n)**
Golden Plover *Pluvialis apricaria*	95	88	345	0
Grey Plover *Pluvialis squatarola*	22	1	87 (n)	99 (n)
Lapwing *Vanellus vanellus*	747	213	2,000	1,211
Knot *Calidris canutus*	184 (n)	229 (n)	616 (n)	190 (n)
Sanderling *Calidris alba*	**214 (n)**	**60**	**325 (n)**	**428 (n)**
Dunlin *Calidris alpina*	968 (n)	527 (n)	1,777 (n)	2,530 (n)
Jack Snipe *Lymnocryptes minimus*	1	0	0	0
Snipe *Gallinago gallinago*	23	14	50	29
Black-tailed Godwit *Limosa limosa*	365 (n)	0	366	175
Bar-tailed Godwit *Limosa lapponica*	**296 (n)**	**200 (n)**	**284 (n)**	**318 (n)**
Curlew *Numenius arquata*	691 (n)	483 (n)	1,502 (n)	690 (n)

Recorded Waterbird Species Name	Peak No. LT Surveys	Peak No. HT Surveys	Peak No. LT Surveys	Peak No. HT surveys
	2019/20	2019/20	2009/10	2009/10
Greenshank *Tringa nebularia*	**32 (n)**	**61 (n)**	**77 (n)**	**47 (n)**
Redshank *Tringa totanus*	**1,044 (n)**	**297 (n)**	**1,170 (n)**	**822 (n)**
Turnstone *Arenaria interpres*	**31**	**17**	**136 (n)**	**147 (n)**
Black-headed Gull *Chroicocephalus ridibundus*	677	116	2,351	657
Common Gull *Larus canus*	382	17	552	125
Lesser Black-backed Gull *Larus fuscus*	23	1	84	0
Herring Gull *Larus argentatus*	496	136	835	13
Great Black-backed Gull *Larus marinus*	87	38	210	4

Table highlights numbers of international (i) and national (n) (all-Ireland) importance. The thresholds used are applicable to the timing of the survey hence all-Ireland thresholds currently follow (Burke et al. 2019) while Crowe et al. (2008) was used for the baseline survey. International thresholds currently follow AEWA (2018) with Wetlands International, 2006 used previously. SCI species highlighted and in **Bold.**

The percentage change in numbers between the peak low tide count of 2019/20 and the peak low tide count recorded during the winter of 2009/10 was calculated. Of the 34 species assessed, 21 species (62%) exhibit a large decline based on this assessment (Table 15, below) and include eight waterbird SCI species for Castlemaine Harbour SPA. A further four species including Sanderling, a SCI species, exhibit a moderate decline in numbers. Four species (Light-bellied Brent Goose, Wigeon, Great Northern Diver and Cormorant) exhibit a moderate or large increase, while five species are considered stable.

Changes of between 25 and 49% are deemed to be moderate, while changes of greater than 50% are considered to be 'large'. The threshold levels of >25% and >50% follows standard convention used for waterbirds (e.g. Lynas et al. 2007; Leech et al. 2002).

Table 15: Trend (% Change) between the Peak Low Tide Count of 2019/20 and the Peak Low Tide Count of 2009/10.

Species Name	2019/20	2009/10	% Change	Difference
Mute Swan	7	17	-58.8	Large Decline
Light-bellied Brent Goose	**2,160**	**1,374**	**+57.2**	**Large Increase**
Shelduck	237	235	+0.9	Stable
Wigeon	**3,201**	**1,612**	**+98.6**	**Large Increase**
Teal	227	557	-59.2	Large Decline
Mallard	**670**	**1,401**	**-52.2**	**Large Decline**
Pintail	**45**	**105**	**-57.1**	**Large Decline**
Common Scoter	**618**	**1,892**	**-67.3**	**Large Decline**
Red-breasted Merganser	37	49	-24.5	Stable
Red-throated Diver	**3**	**33**	**-90.9**	**Large Decline**
Great Northern Diver	102	33	+209.1	Large Increase
Great Cresdted Grebe	2	5	-60.0	Large Decline
Cormorant	**181**	**141**	**+28.4**	**Moderate Increase**
Little Egret	44	109	-59.6	Large Decline
Grey Heron	9	62	-85.5	Large Decline
Oystercatcher	**494**	**1,843**	**-73.2**	**Large Decline**
Ringed Plover	**310**	**731**	**-57.6**	**Large Decline**
Golden Plover	95	345	-72.5	Large Decline
Grey Plover	22	87	-74.7	Large Decline
Lapwing	747	2,000	-62.7	Large Decline
Knot	184	616	-70.1	Large Decline
Sanderling	**214**	**325**	**-34.2**	**Moderate Decline**
Dunlin	968	1,777	-45.5	Moderate Decline
Black-tailed Godwit	365	366	-0.3	Stable
Bar-tailed Godwit	**296**	**284**	**+4.2**	**Stable**
Curlew	691	1,502	-54.0	Large Decline
Greenshank	**32**	**77**	**-58.4**	**Large Decline**
Redshank	**1,044**	**1,170**	**-10.8**	**Stable**
Turnstone	**31**	**136**	**-77.2**	**Large Decline**
Black-headed Gull	677	2,351	-71.2	Large Decline
Common Gull	382	552	-30.8	Moderate Decline
Lesser Black-backed Gull	23	84	-72.6	Large Decline
Herring Gull	496	835	-40.6	Moderate Decline
Great Black-backed Gull	87	210	-58.6	Large Decline

Waterbird SCI species are highlighted and shown in bold font

A comparison of the high tide count from 2019/20 with the baseline mean peak number for the period 1995/96-1999/00 (I-WeBS data, high tide counts; SPA site selection data) was undertaken for waterbird SCI species of Castlemaine Harbour SPA (Table 16). Table 16, below, shows a long-term (20 year) trend for declining numbers for 14 out of the 15 species assessed, while a short-term trend (10 year) is highlighted for declining numbers in 10 of the 15 species assessed, with one species data deficient (Scaup) (INIS,2020).

Table 16: Trend (% Change) between the Peak High Tide Count of 2019/20 and the 5-year Baseline Mean Peak (1995/96 – 1999/00) and the Trend Between the Peak High Tide Count of 2019/20 and the Peak High Tide Count of 2009/10.

Species Name	(A) Peak HT Count 2019/20	(B) 5-year Mean Peak (1995/96 – 1999/00)	Long Term Trend (20 Year) (B vs A)	(C) Peak HT Count 2009/10	Short Term Trend (10 Year) (C vs A)
Light-bellied Brent Goose	1,727	1,374	Increase	819	Increase
Wigeon	459	1,612	Decrease	567	Decrease
Mallard	262	1,401	Decrease	380	Decrease
Pintail	70	105	Decrease	49	Increase
Scaup	0	74	Decrease	0	-
Common Scoter	519	1,892	Decrease	979	Decrease
Red-throated Diver	22	33	Decrease	2	Increase
Cormorant	38	141	Decrease	48	Decrease
Oystercatcher	751	1,843	Decrease	1,049	Decrease
Ringed Plover	59	731	Decrease	205	Decrease
Sanderling	60	325	Decrease	428	Decrease
Bar-tailed Godwit	200	284	Decrease	318	Decrease
Greenshank	61	77	Decrease	47	Increase
Redshank	297	1,170	Decrease	822	Decrease
Turnstone	17	136	Decrease	147	Decrease

It should be noted, further to Tables 15 & 16 above, that the highlighted trends are based only on a single season of overwintering surveys and as such are only indicative of trends, further overwintering low tide surveys are required on a frequent basis, preferably annually, to establish trends at both high and low tide using datasets covering multiple years.

Five types of activity were recorded during the study, four of which were observed to cause disturbance, within six subsites only. The majority of activity occurred within Subsite OK919, the northern section of Inch Strand. Activities relating to aquaculture occurred within three subsites (OK449, OK468 and OK469). Activities that were observed to cause disturbance to waterbirds were: (1) People walking along shore, (2) Aquaculture machinery, (3) Aquaculture personnel on shore, and (4) Vehicles. All were observed to cause moderate or high responses in that the waterbirds either flew to another part of the subsite or flew out of subsite and out of the observers view. Table 17, below, lists the activities recorded within each subsite.

Table 17: Activities Recorded Within Castlemaine Harbour during the 2019/20 Wintering Survey

Subsite Code	Activity	Number of survey occasions activity recorded
OK445	Person walking along shore	1
OK449	Aquaculture Machinery	2
OK468	Aquaculture personnel on shore	1
OK469	Person walking along shore	1
	Bait diggers	1
	Vehicle	1
	Aquaculture Machinery	1
OK475	Person walking along shore	2
	Bait diggers	1
OK919	Person walking along shore	3
	Vehicle	1

5. Impact Assessment Procedure

Gittings & O'Donoghue (2012) used the data, outlined above in Section 4.4, to devise an impact assessment methodology for the provision of Appropriate Assessment of intertidal oyster culture on wintering waterbirds, using the categorisation of species responses to oyster trestles outlined in Table 9, and therefore, applies to intertidal oyster cultivation in mud/sandflats. In effect, this method assesses whether or not there is Adverse Effects on Site Integrity (ASEI), in terms of the conservation objectives of the SCI's for the SPA, based on statistical calculations of observed interactions of waterbirds with intertidal oyster culture.

This methodology does not apply to intertidal oyster cultivation on mixed sediment/rocky shores. In coastal SPAs designated for waterbirds, mixed sediment/rocky shores will occupy relatively small proportions of the site and are therefore unlikely to hold large proportions of the populations of most SCI species (apart from Turnstone and, possibly, Oystercatcher). Therefore, in most cases, development of intertidal oyster cultivation in such habitat is unlikely to cause displacement of 5% or more of the site population, and therefore unlikely to cause a significant impact. (Gittings & O'Donoghue, 2012).

The methodology is outlined below for clarity.

The waterbird SCI species present within the site are categorised according to their potential response to intertidal oyster cultivation, outlined in Table 9, above.

Species with a neutral/positive response can be excluded from further assessment and no impact can be determined for these species with the following confidence levels:

- High – Oystercatcher, Redshank and Turnstone
- Moderate – Curlew
- Low - Greenshank

For the other species, their spatial distribution within the site should be assessed to determine whether the intertidal oyster cultivation area(s) are within the area(s) they occupy.

In sites where the assessment is being carried out on existing intertidal oyster cultivation, this assessment will have to consider whether the existing cultivation occupies habitat that would otherwise be suitable for the species, and which would fall within the species pattern of occurrence at the site.

If the intertidal oyster cultivation area(s) are clearly outside the area(s) occupied by the species, and areas that have the potential to be occupied by the species based on sediment characteristics/invertebrate community data etc., then the species can be excluded from further assessment.

For the remaining species, the importance of the intertidal oyster cultivation area(s) should be calculated as follows:

- In sites where the assessment is being carried out on proposed intertidal oyster cultivation, the percentage of the site population using the intertidal oyster cultivation area(s) should be calculated. This is preferably done by targeted counts, where birds within the intertidal oyster cultivation area(s) are counted separately. However, it is likely that assessments may be carried out using existing datasets that were collected for other purposes and did not clearly differentiate birds within the intertidal oyster cultivation area(s). In these cases, the percentage of the site population using the intertidal oyster cultivation area(s) can be calculated by taking a *pro-rata* fraction of the count from the count sector(s) containing the intertidal oyster cultivation area(s). However, expert judgment will be required in these situations to determine whether there are any factors (such as habitat variation or species behaviour) that might cause this method to produce a biased estimate of the percentage of the site population using the intertidal oyster cultivation area(s).

- In sites where the assessment is being carried out on existing intertidal oyster cultivation, the percentage of the site population using several defined areas of control habitat should be calculated. These control habitats should be defined so that they contain similar habitat to that which would have been present in the intertidal oyster cultivation area before cultivation started, and have similar availability to birds in terms of tidal exposure, bird movement patterns, etc. Several control areas should be used to control for factors that we cannot measure such as differences in prey availability, patchy prey distributions, etc. The predicted percentage of the site population that would occur in the intertidal oyster cultivation area in the absence of cultivation can then be derived from a pro-rata calculation.

For species with an Exclusion response, a significant negative impact is predicted where the intertidal oyster cultivation area supports or is predicted to support in the absence of cultivation, 5% or more of the site population. The confidence levels for predictions for these species are high.

For species with a **Negative** response, species-specific criteria should be used as detailed below:-

Dunlin - Intertidal oyster cultivation is predicted to reduce the occupancy of the affected area by a factor of 8. Therefore, the percentage displacement (D) can be calculated, using the number occurring within the intertidal oyster cultivation area (N) and the site population (P), as **D = (N-N/8)/P*100**

If D ≥ 5% then a significant negative impact is predicted, in effect causing Adverse Effects on Site Integrity (AESI), in terms of the conservation objectives of the SPA.

The reduction factor is conservative, so if D < 5% the confidence level for predicting no significant impact is high. If D > 5%, the confidence levels for predicting significant impacts are moderate for large flocks (>~ 50 birds) and low for small flocks (<~ 50 birds).

Bar-tailed Godwit - If large (>~ 100 birds) flocks occur, or are likely to occur within the intertidal oyster cultivation areas then intertidal oyster cultivation is predicted to reduce the occupancy of the affected area by a factor of 7. Therefore, the percentage displacement (D) can be calculated as: - **D = (N-N/7)/P*100**

- If small (<~ 100 birds) flocks occur, or are likely to occur within the intertidal oyster cultivation areas then intertidal oyster cultivation is predicted to reduce the occupancy of the affected area by a factor of 2. Therefore, the percentage displacement can be calculated as: - **D = (N-N/2)/P*100**

- If D ≥ 5% then a significant negative impact is predicted. The confidence level for predictions for this species is high.

Shelduck, Ringed Plover, Lapwing, Sanderling, Black-tailed Godwit and Great Black-backed Gull - These species appear to be negatively affected by oyster trestles, but there was insufficient data to calculate reductions in densities. Therefore, impact prediction has to make the conservative assumption that all birds are excluded from the affected area.

- A significant negative impact is predicted where the intertidal oyster cultivation area supports, or is predicted to support in the absence of cultivation, 5% or more of the site population.

- The confidence levels for predictions for these species are low.

For species with a **Variable** response, further site-specific assessment will have to be carried out.

6. Conclusion

It is important to note that the significance of the impact of even short-term displacements of waterbirds should not be underestimated. In terms of critical foraging habitat, displacement from feeding opportunities will not only reduce energy intake but also lead to an increase in energy expenditure as a result of the energetic costs of flying to an alternative foraging area.

Another important consideration is whether birds have alternative habitat to move to during a disturbance event. Birds that show the greatest response to disturbance and fly away (traditionally seen to be the ones that 'respond' the most to disturbance) many do so because they have alternative habitats to go to. In contrast, birds that are apparently less-disturbed and do not move away from a patch may be forced to behave in this way because they do not have alternative disturbance-free sites to go to. From a population point of view therefore, the birds most affected will be the ones whose fitness (defined as a measure of the relative contribution of an individual to the gene pool of the next generation) is reduced by them being constrained to stay and 'cope' with the disturbance as opposed to those birds that can move to an alternative habitat of similar quality (Gill et al. 2001).

The significance of disturbance events is therefore highly species-specific. Furthermore, significance will vary according to timing (birds may be more vulnerable pre- and post-migration) and other factors such as weather; birds being more vulnerable during periods of severe cold weather (NPWS, 2011).

I-WeBS data, which is collected within 2-3 hours of high tide, has almost consistently recorded annual wintering waterbird datasets at Castlemaine Harbour SPA, which are very useful, and used (Lewis *et al*., 2019), for the determination of population trends and habitat use within 3 hours of high tide when bird densities are higher as a result of a reducing area of exposed intertidal habitat.

Due to the timing of the I-WeBS surveys in respect of the tidal cycle the spatial extent of the areas surveyed do not correspond to the spatial extent of the count sectors of the NPWS Baseline Waterbird Surveys (which were conducted at low tide) due to the significant difference in the extent of exposed habitat to be surveyed between low tide and I-WeBS (high tide) counts. Highlighting that these two datasets, due to the dissimilarity in the timing and area covered by each respective survey, are not directly comparable with each other.

Husbandry of intertidal shellfish generally occurs within two or three hours either side of low tide. I-WeBS data is therefore not appropriate for the determination of impact significance of most intertidal shellfish culture activities when bird densities are lower as a result of an increasing area of exposed intertidal habitat.

In essence only three datasets of wintering waterbirds recorded within Castlemaine Harbour were recorded at a tidal and spatial scale commensurate with the calculation of impact assessment of intertidal aquaculture upon designated species, which are;

- NPWS Waterbird Survey Programme 2009/10: Castlemaine Harbour Surveys (NPWS, 2011)

- Castlemaine Harbour 2011 Trestle Study (Gittings & O'Donoghue, 2012)

- 2019/20 Castlemaine Harbour Wintering Waterbird Survey (Inis Environmental, 2020)

One of the above datasets (the Trestle study (Gittings & O'Donoghue, 2012)) did not cover the entire inner harbour and only covered the southern shore and central intertidal flats. The northern shore where there are a number of aquaculture licence appeals, was not covered therefore there is no data for this time period for these sites.

Two of the above datasets are now nearly 10 years old and must be considered out of date for the provision of impact assessment due to the significant decrease in numbers of species and overall waterbirds using the site reported from the most recent 2019/20 wintering dataset (highlighted in Table 18 below) and the annual I-WeBS datasets.

The most recent bird survey dataset (Inis Environmental, 2020) has highlighted Large Declines (i.e. - >50%) in numbers of eight SCI species (listed in Table 18 below) and a Moderate Decline (i.e. - 25-50%) in numbers of one SCI species (Sanderling). Two SCI species have been assessed as being Stable (i.e. + and/or - <25%) (Bar-tailed Godwit and Redshank). One SCI species has undergone a Moderate Increase (Cormorant) (i.e. +25-50%) and two SCI species (Light-bellied Brrent Goose and Wigeon) have undergone a Large increase (i.e. +>50%). This generally downward trend in numbers recorded has implications on the conservation objectives of the SPA and therefore must be investigated further. It is therefore recommended that further surveys are carried out to fully ascertain the change in numbers using the Harbour and the potential reasons behind said change.

For an intertidal aquaculture licence to be granted on mud/sandflats within an SPA; a determination of No Significant Impact (i.e. No Adverse Effect on Site Integrity) upon the SCIs of the SPA from the implementation of the project is required. This determination must be reached through a conclusion which is supported by data where no reasonable scientific doubt exists. Therefore, in order to calculate this impact, the relative abundance of each species within the area of each site is required. This data currently does not exist at a spatial or tidal scale similar to that of an intertidal aquaculture site, therefore, further survey is required to determine whether the area of any future proposed intertidal aquaculture site is utilised by bird species protected within the SPA, with more than half of these species currently undergoing Large Declines.

In order for an estimate of potential impact to be robust, mean peak figures for each species should be used, therefore, it is recommended that more than a single wintering season of data is collected to be used in the impact assessment.

Therefore, in order for new aquaculture licences to be assessed within Castlemaine Harbour further detailed surveys (preferably annual) at a spatial and tidal scale commensurate with

intertidal oyster culture (i.e. low tide) are required in order to fully assess the impact of the introduction of new intertidal aquaculture sites.

Table 18 Trend between the Peak Low Tide Count of 2019/20 (Inis Environmental, 2020) and the Peak Low Tide Count of 2009/10 (NPWS, 2011).

Species Name	2019/20	2009/10	% Change	Difference
Mute Swan	7	17	-58.8	Large Decline
Light-bellied Brent Goose	**2,160**	**1,374**	**+57.2**	**Large Increase**
Shelduck	237	235	+0.9	Stable
Wigeon	**3,201**	**1,612**	**+98.6**	**Large Increase**
Teal	227	557	-59.2	Large Decline
Mallard	**670**	**1,401**	**-52.2**	**Large Decline**
Pintail	**45**	**105**	**-57.1**	**Large Decline**
Common Scoter	**618**	**1,892**	**-67.3**	**Large Decline**
Red-breasted Merganser	37	49	-24.5	Stable
Red-throated Diver	**3**	**33**	**-90.9**	**Large Decline**
Great Northern Diver	102	33	+209.1	Large Increase
Great Cresdted Grebe	2	5	-60.0	Large Decline
Cormorant	**181**	**141**	**+28.4**	**Moderate Increase**
Little Egret	44	109	-59.6	Large Decline
Grey Heron	9	62	-85.5	Large Decline
Oystercatcher	**494**	**1,843**	**-73.2**	**Large Decline**
Ringed Plover	**310**	**731**	**-57.6**	**Large Decline**
Golden Plover	95	345	-72.5	Large Decline
Grey Plover	22	87	-74.7	Large Decline
Lapwing	747	2,000	-62.7	Large Decline
Knot	184	616	-70.1	Large Decline
Sanderling	**214**	**325**	**-34.2**	**Moderate Decline**
Dunlin	968	1,777	-45.5	Moderate Decline
Black-tailed Godwit	365	366	-0.3	Stable
Bar-tailed Godwit	**296**	**284**	**+4.2**	**Stable**
Curlew	691	1,502	-54.0	Large Decline
Greenshank	**32**	**77**	**-58.4**	**Large Decline**
Redshank	**1,044**	**1,170**	**-10.8**	**Stable**
Turnstone	**31**	**136**	**-77.2**	**Large Decline**
Black-headed Gull	677	2,351	-71.2	Large Decline
Common Gull	382	552	-30.8	Moderate Decline
Lesser Black-backed Gull	23	84	-72.6	Large Decline
Herring Gull	496	835	-40.6	Moderate Decline
Great Black-backed Gull	87	210	-58.6	Large Decline

Waterbird SCI species are highlighted and shown in bold font

The provision of sufficient robust data in determining aquaculture licensing decisions is demonstrably very important given the extent of decline reported for many of the Castlemaine

Harbour SPA SCI features. While the decline in populations may be attributed to a range of factors, licensing of further aquaculture activities which may effect populations of a number of species further should be informed by robust and up to date information on the potential specific effects of each proposal.

7. References

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