

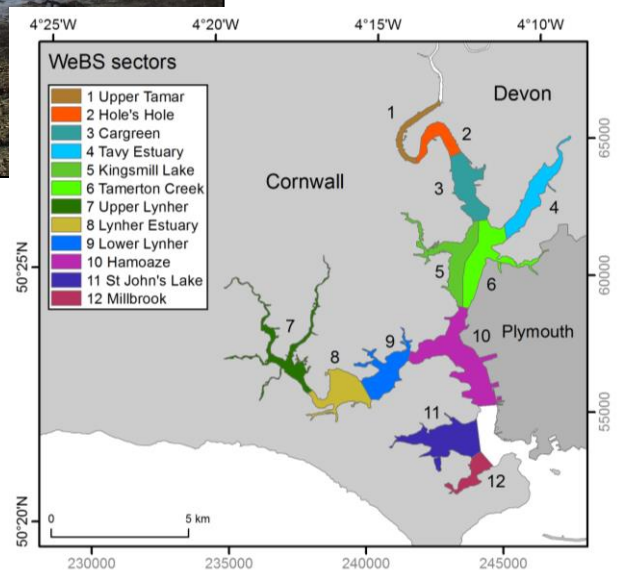


TAMAR ESTUARY SPA ATLAS

BTO WEBS SURVEYS: PIED AVOCET & LITTLE EGRET



Tamerton Creek, Tamar Estuary ©TJudy Russell



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Executive Summary

The Tamar Estuaries complex is situated to the southwest of the UK on the county border between Devon and Cornwall. The estuary is designated as a Special Area of Conservation, with much of the upper reaches further designated as Sites of Special Scientific Interest (SSSI), Marine Conservation Zones (MCZ) and Special Protection Areas (SPA).

The associated estuarine environment encompasses a suite of biodiversity rich marine habitats and provides for important feeding and roosting grounds for several over-wintering and passage waterbirds of European importance. The aim of this Atlas is to collate and present available spatial and temporal distribution data for pied avocet and little egret recorded within the boundary of the SPA together with physical and human activity data across the area.

This Atlas is produced under a collaborative agreement between Natural England and the University of Exeter.

Contents

Executive Summary	2
Contents	3
Introduction	5
Bird illustrations	7
Glossary	8
Physical environment	9
Location and features of interest	10
Protected areas	11
Substratum and depth	12
Bird surveys	13
Methods	14
WeBS sectors	15
WeBS surveys: pied avocet	
1995-96 to 2013-14 mean seasonal counts	16
1995-96 to 2013-14 mean seasonal count coefficient of variation	17
1995-96 to 1998-99 peak counts and survey effort	18
1999-00 to 2002-03 peak counts and survey effort	19
2003-04 to 2006-07 peak counts and survey effort	20
2007-08 to 2010-11 peak counts and survey effort	21
2011-12 to 2013-14 peak counts and survey effort	22
1995-96 to 2013-14 mean peak count and coefficient of variation	23
WeBS surveys: little egret	
1995-96 to 2013-14 mean seasonal counts	24
1995-96 to 2013-14 mean seasonal count coefficient of variation	25
1995-96 to 1998-99 peak counts and survey effort	26
1999-00 to 2002-03 peak counts and survey effort	27
2003-04 to 2006-07 peak counts and survey effort	28
2007-08 to 2010-11 peak counts and survey effort	29

2011-12 to 2013-14 peak counts and survey effort	30
1995-96 to 2013-14 mean peak count and coefficient of variation	31
Maritime Activity	32
Maritime access points	33
Marine craft	34
Mooring buoys	35
Acknowledgements	36

Introduction

Site and species

The Tamar Estuaries complex is situated to the southwest of the UK on the border between Devon and Cornwall. The estuary complex includes the rivers Tamar, Lynher and Tavy. Much of the upper reaches comprise of rias (drowned river valleys), with the lower reaches containing large areas of tidal mudflats bordered by saltmarsh communities. The associated estuarine environment provides for important feeding and roosting grounds for several over-wintering and passage waterbirds of European importance.

The estuary complex is designated as a Special Area of Conservation, with much of the upper reaches further designated as Sites of Special Scientific Interest (SSSI), Marine Conservation Zones (MCZ) and Special Protection Areas (SPA).

The site qualifies for SPA designation under Article 4.1 of the EU Directive on the Conservation of Wild Birds (Birds Directive 79/409/EEC) by supporting nationally important numbers of two species listed on Annex 1: pied avocet (*Recurvirostra avosetta*) and little egret (*Egretta garzetta*). At the time of designation, the site supported more than 19% and 20% of the UK population for pied avocet and little egret respectively. The site also supports important numbers of wildfowl and wader species including: shelduck (*Tadorna sp.*), black-tailed godwit (*Limosa limosa*), whimbrel (*Numenius phaeopus*), dunlin (*Calidris alpina*), curlew (*Numenius arquata*) and redshank (*Tringa totanus*).

Atlas aim

This Atlas analyses available BTO WeBS sightings data (1995-96 to 2013-14) for overwintering bird species from the Tamar Estuary complex.

The aim of this Atlas is to collate and present available spatial and temporal distribution data for pied avocet and little egret recorded within the boundary of the SPA together with physical and human activity data across the area.

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pied avocet
(*Recurvirostra avosetta*)



little egret
(*Egretta garzetta*)

Glossary

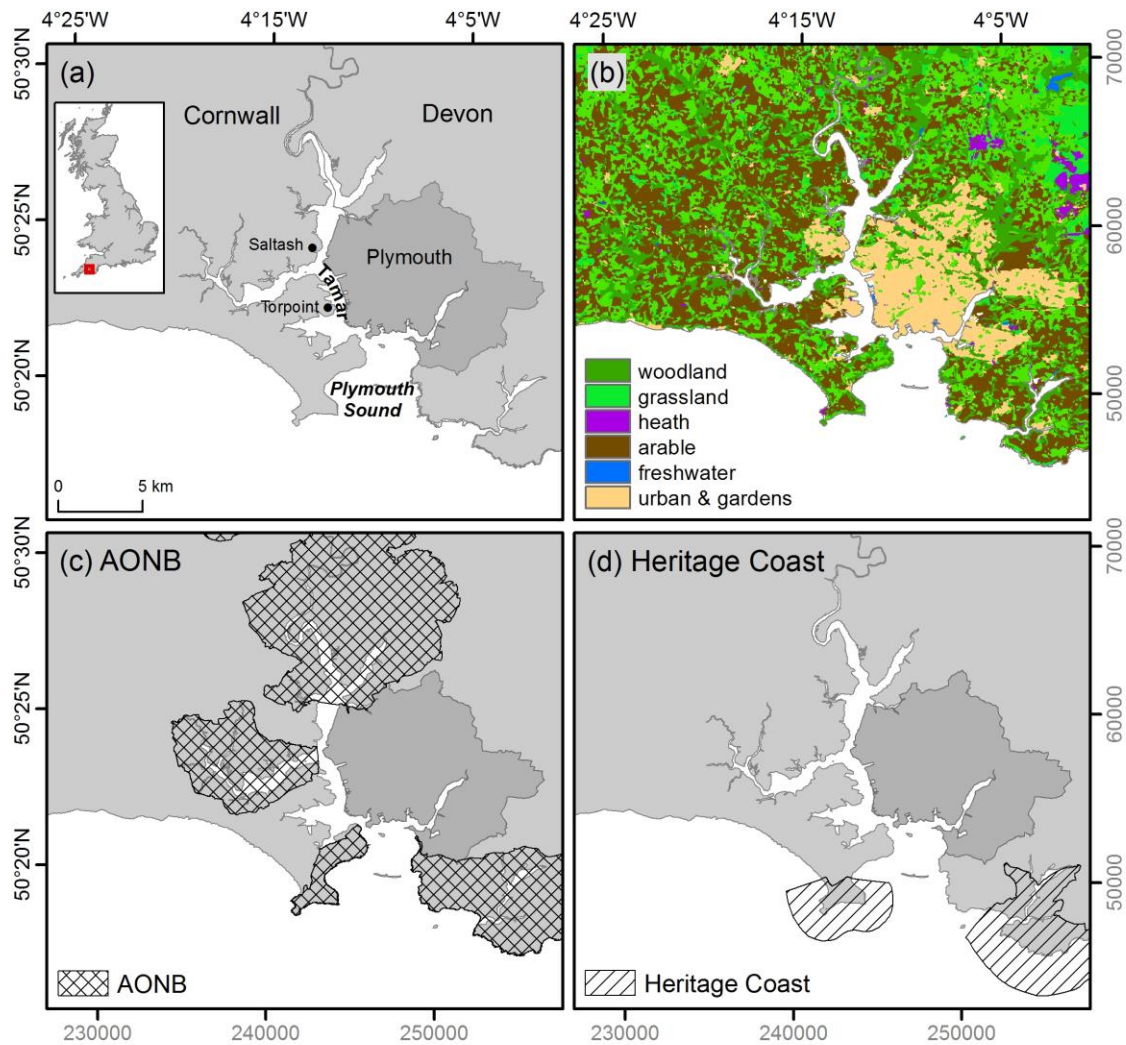
AONB	Area of Outstanding Natural Beauty
BTO	British Trust for Ornithology
DEFRA	Department for Environment, Food and Rural Affairs
JNCC	Joint Nature Conservation Committee
MCZ	Marine Conservation Zones
NE	Natural England
RSPB	Royal Society for Protection of Birds
SAC	Special Areas of Conservation
SPA	Special Protection Areas
SSSI	Sites of Special Scientific Interest
UoE	University of Exeter
WeBS	Wetland Bird Survey

Physical Environment



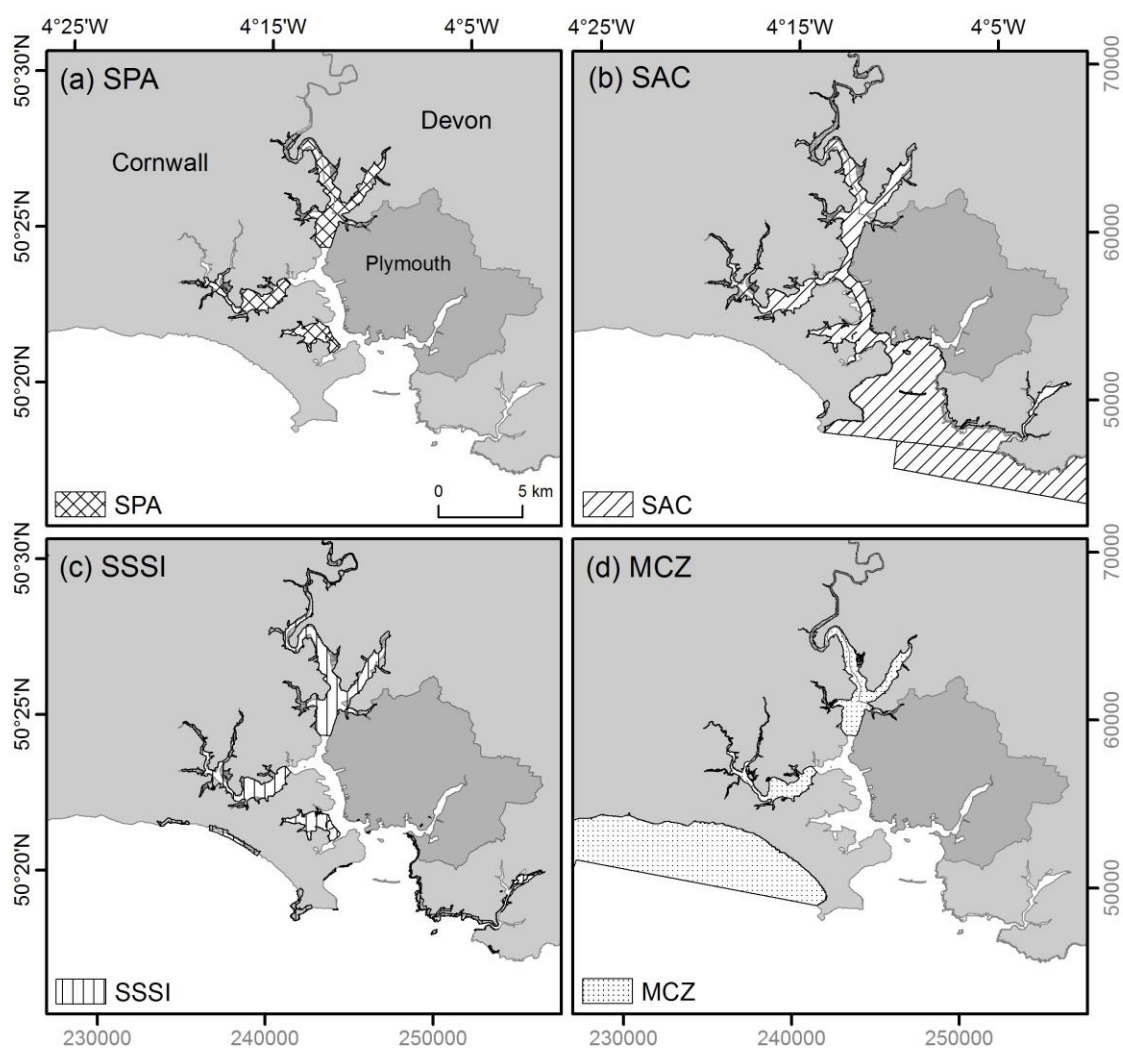
Tamerton Creek, Tamar Estuary © Trudy Russell

Location and features of interest



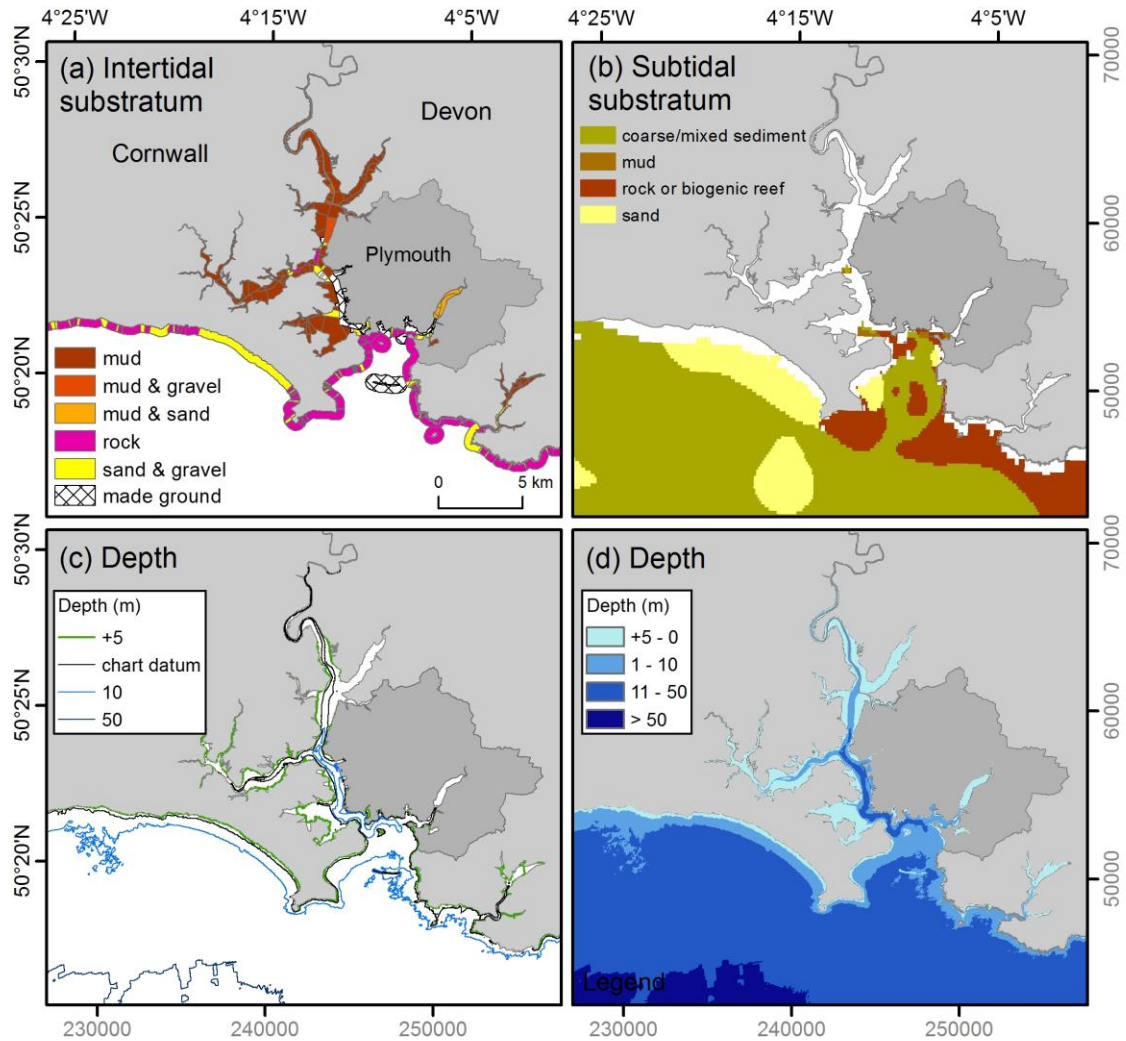
Map 1. Tamar Estuary: location map, land use, Areas of Outstanding Natural Beauty and Heritage Coast. (a) Tamar Estuary location map. (b) Land use classification for areas adjacent to the Tamar Estuary; woodland (broadleaved and coniferous: dark green), grassland (improved and semi-natural: light green), heath (purple), arable land (brown), freshwater bodies (blue) and built environment (beige). (c) Areas of Outstanding Natural Beauty (AONB: cross hatched polygon). (d) heritage coast (oblique hatched polygon). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Data sources: (b) Land use classification, Centre for Ecology and Hydrology (CEH) downloaded from EDINA Digimap Ordnance Survey Service <http://digimap.edina.ac.uk>. (c,d) AONB and Heritage Coast data © Natural England copyright (2017). Contains Ordnance Survey data © Crown copyright and database right (2017).

Protected areas



Map 2. Tamar Estuary protected areas. (a) Special Protection Areas (SPA: cross hatched polygon). (b) Special Areas of Conservation (SAC: oblique hatched polygon). (c) Sites of Special Scientific Interest (vertical hatched polygon). (d) Marine Conservation Zones (MCZ: stippled polygon). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Data sources: (a-c) SPA, SAC, SSSI and MCZ data © Natural England copyright (2017). Contains Ordnance Survey data © Crown copyright and database right (2017).

Substratum and depth



Map 3. Tamar Estuary intertidal and subtidal substratum and bathymetry. (a) Dominant intertidal substratum; mud (dark brown), mud and gravel (mid brown), mud and sand (light brown), rock and rock with boulders (purple), sand and gravel (yellow) and man-made ground (cross hatched polygon). (b) Dominant subtidal substratum: coarse or mixed sediments (olive green), mud (light brown), rock or biogenic reef (dark brown) and sand (yellow). Estuary and seabed depths are displayed as (c) depth isobaths (m) drawn in accordance with the legend relative to chart datum (lowest astronomical tide: black line) and (d) a continuous surface classified by a light blue to dark blue colour ramp in accordance with the legend. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Data sources: (a) Intertidal substratum, DEFRA (<https://data.gov.uk>) contains public sector information licensed under the Open Government Licence v3.0. (b) Subtidal substratum, EMODnet Seabed Habitats (<http://www.emodnetseabedhabitats.eu/>). (c,d) Bathymetry data © Crown copyright (2017) / SeaZone Solutions Ltd 2017. All Rights Reserved. Not to be used for navigation.

Bird Surveys



Methods

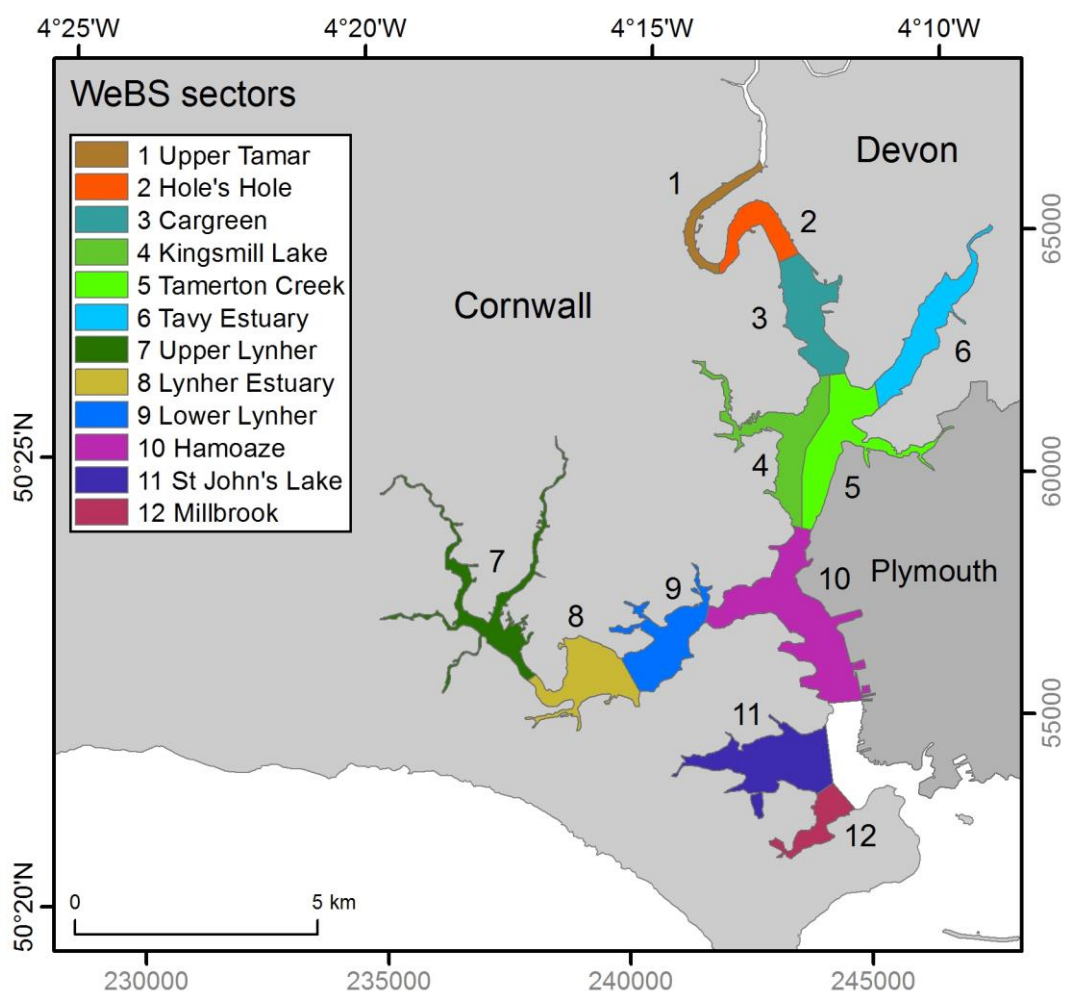
Wetland Bird Surveys (WeBS). WeBS is a partnership between the BTO, RSPB and JNCC (the last on behalf of the statutory nature conservation bodies: Natural England, Natural Resources Wales and Scottish Natural Heritage and the Department of Agriculture, Environment and Rural Affairs, Northern Ireland) in association with the Wildfowl and Wetlands Trust. The remit of WeBS is to identify and monitor key wetland sites that are crucial to the UK's internationally important non-breeding waterbirds. The principal aims of these surveys are to estimate population sizes and determine trends in abundance and distribution. The network of legally protected sites designated for their importance to wintering waterbirds depends fundamentally on the WeBS counts (<https://www.bto.org/volunteer-surveys/core-surveys>).

Shore based surveys for the Tamar Estuary complex were carried out within 12 WeBS survey sectors (Maps 4-20) over 19 winters (1995-96 to 2013-14) using the WeBS Core Count methodology (<http://www.bto.org/volunteer-surveys/webs/taking-part/core-counts-methods>). Where practicable surveys were carried out monthly by volunteer BTO 'birders'. Numbers of all waterbird species, as defined by Wetlands International¹, were recorded.

Mapped data represent mean seasonal counts per sector (July – September, October – December, January – March and April – June), peak counts by sector per season (July – June), and mean peak count per sector. Coefficients of variation (ratio of the standard deviation to the mean expressed as a percentage) have been calculated. The coefficient of variation is a measure of spread within data that describes the amount of variability relative to the mean. As the coefficient of variation is a standardised measure it enables the spread of disparate data sets with different units or means to be compared. Data sets may include repeat sightings of individuals through time (within and among years) should inter and intra annual residency occur. Distributions are not corrected for survey effort or for detectability based on observer, conditions or vantage point.

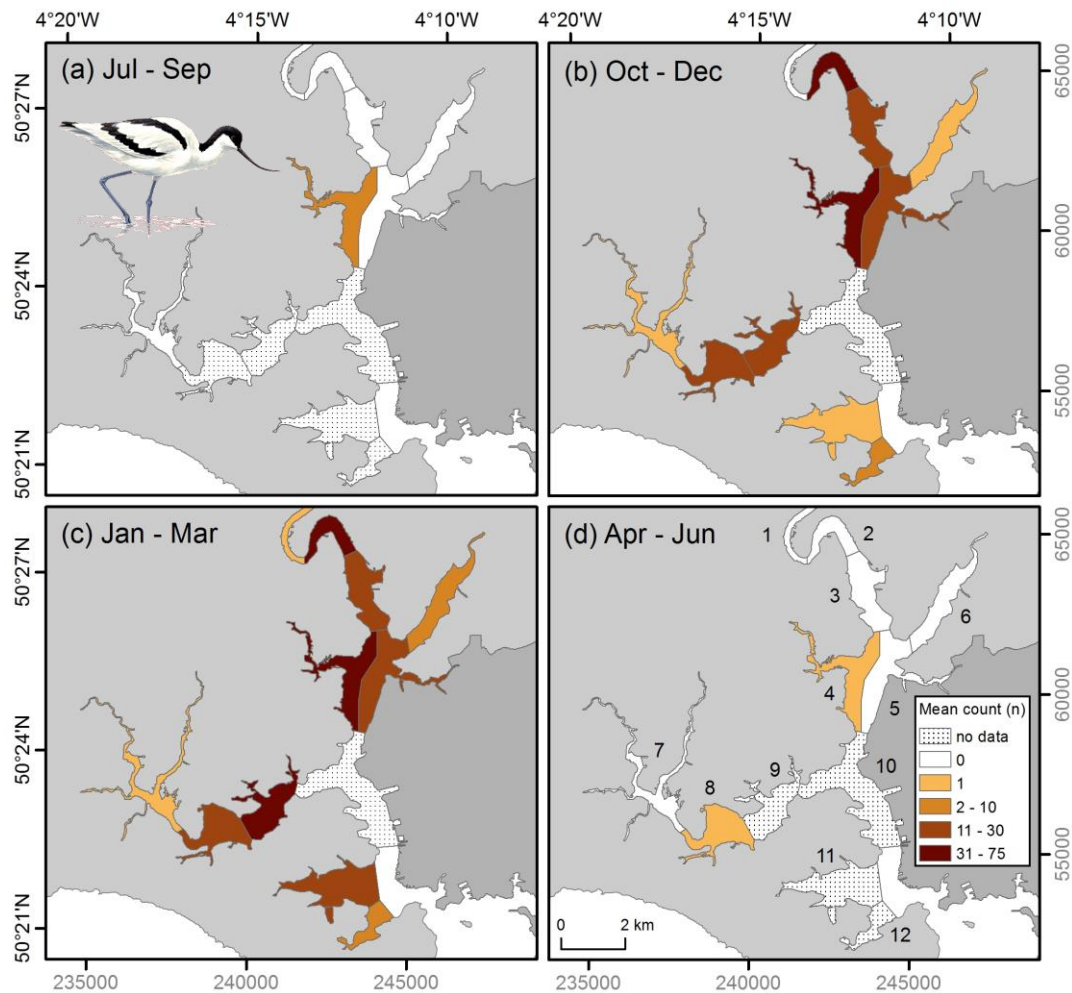
¹ Rose, P.M. & Scott, D.A. 1997. Waterfowl Population Estimates - Second Edition. Wetlands International Publ. 44, Wageningen, The Netherlands.

WeBS sectors



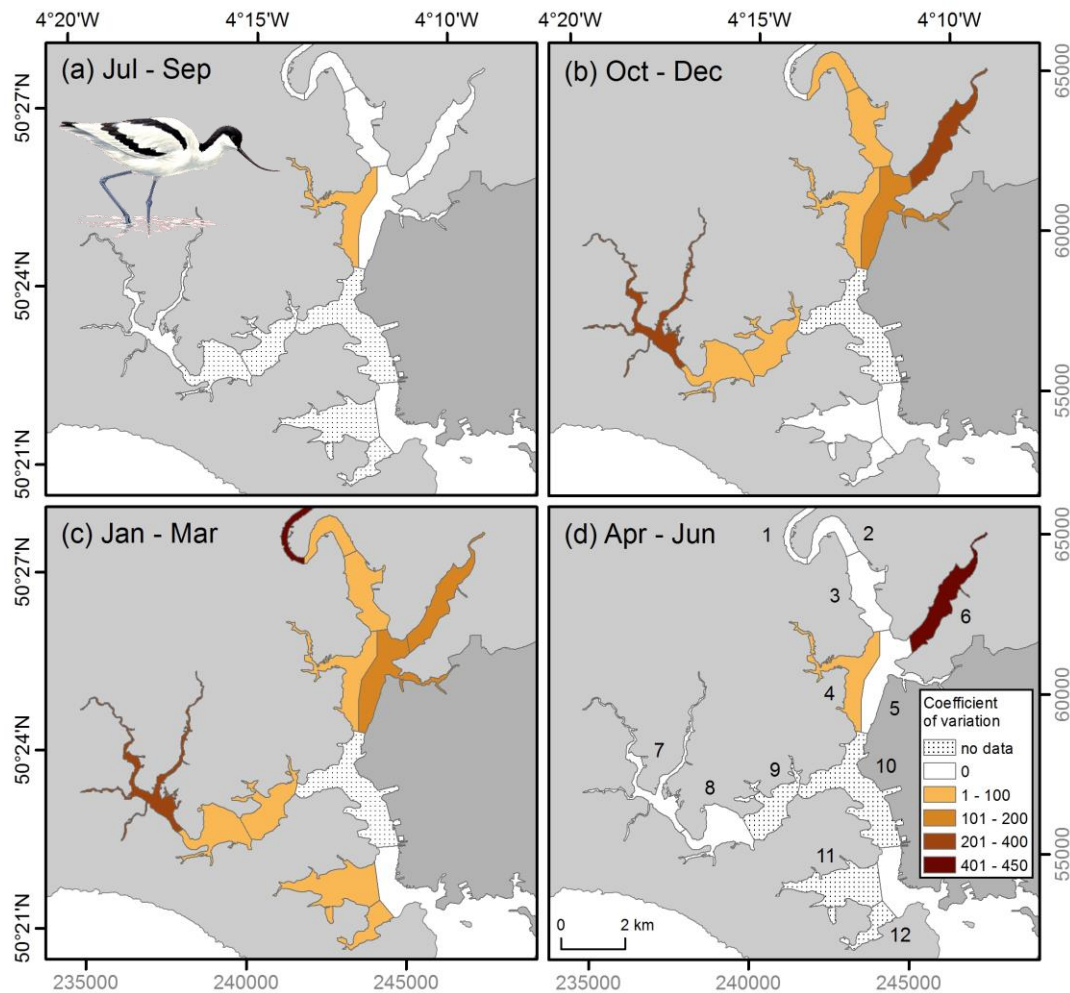
Map 4. WeBS shore-based surveys. Location map showing WeBS survey sectors. WeBS is a partnership between the BTO, RSPB and JNCC (the last on behalf of the statutory nature conservation bodies: Natural England, Natural Resources Wales and Scottish Natural Heritage and the Department of Agriculture, Environment and Rural Affairs, Northern Ireland) in association with the Wildfowl and Wetlands Trust. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator.

Pied avocet 1995-96 to 2013-14 mean seasonal counts



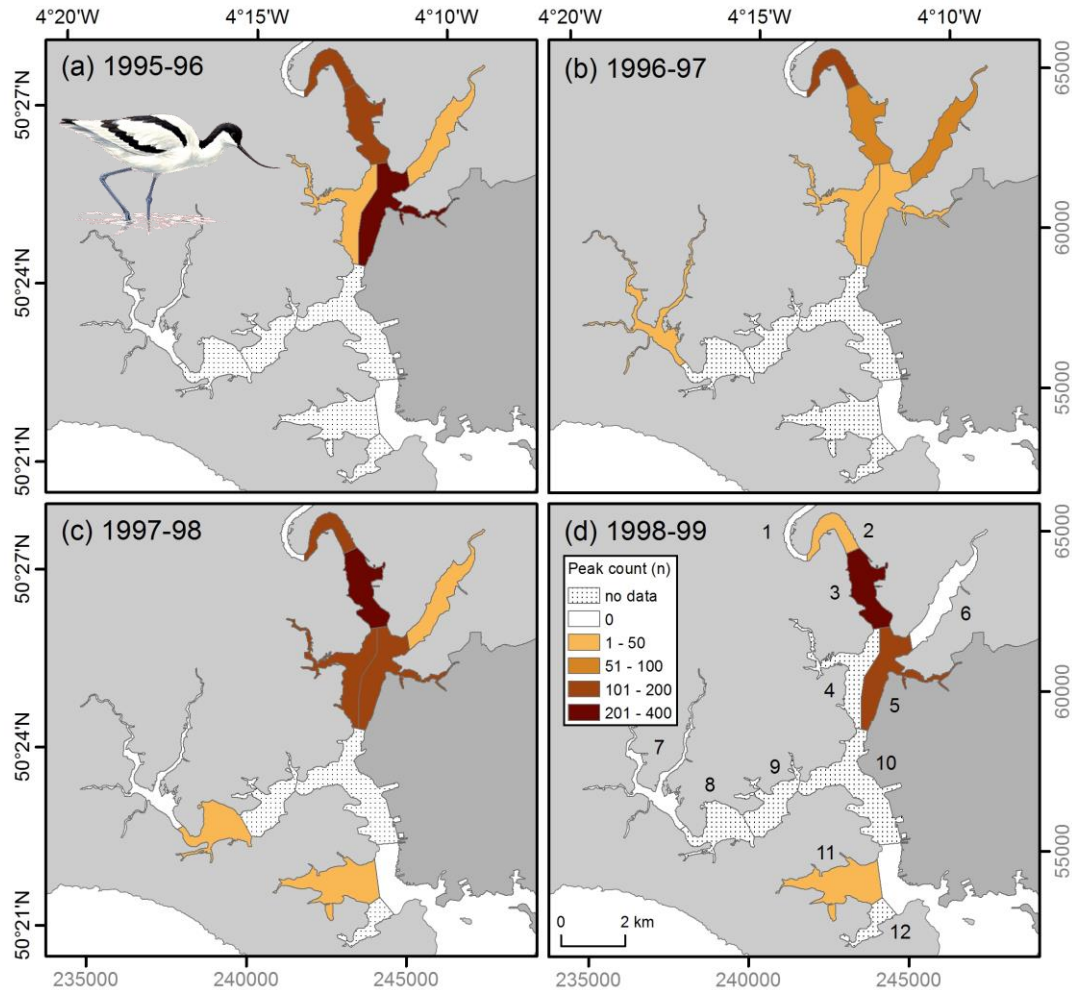
Map 5. Pied avocet mean seasonal counts (n) per WeBS sector 1995-96 to 2013-14. (a) July to September, (b) October to December, (c) January to March and (d) April to June. In parts (a-d) seasonal mean counts (n) of birds are drawn in accordance with the legend (d). In (d) WeBS sectors labelled 1- 12 in accordance with map 4. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

Pied avocet 1995-96 to 2013-14 mean seasonal count coefficient of variation



Map 6. Pied avocet mean seasonal count coefficient of variation 1995-96 to 2013-14. (a) July to September, (b) October to December, (c) January to March and (d) April to June. In parts (a-d) coefficient of variation is drawn in accordance with the legend (d). The coefficient of variation (ratio of the standard deviation to the mean expressed as a percentage) is a measure of spread within data that describes the amount of variability relative to the mean. As the coefficient of variation is a standardised measure it enables the spread of disparate data sets with different units or means to be compared. In (d) WeBS sectors labelled 1- 12 in accordance with map 4. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

Pied avocet 1995-96 to 1998-99



Map 7. Pied avocet 1995-96 to 1998-99. Peak counts (n) by sector per season for pied avocet (a) 1995-96, (b) 1996-97, (c) 1997-98 and (d) 1998-99. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). The same classification scale is used in maps 7 to 11. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

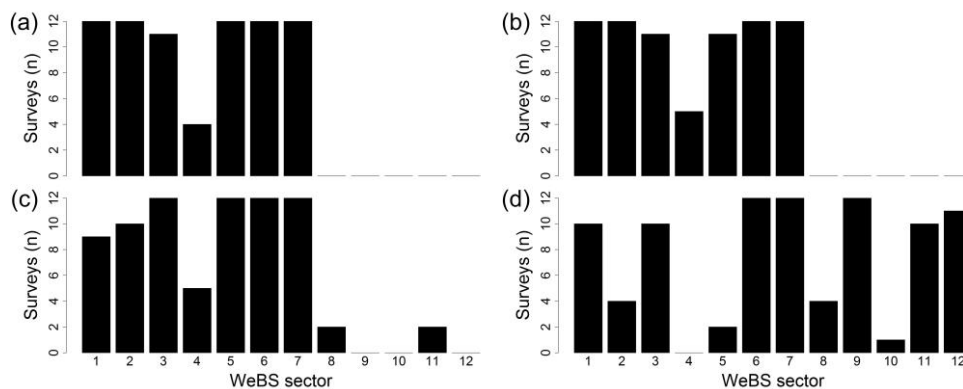
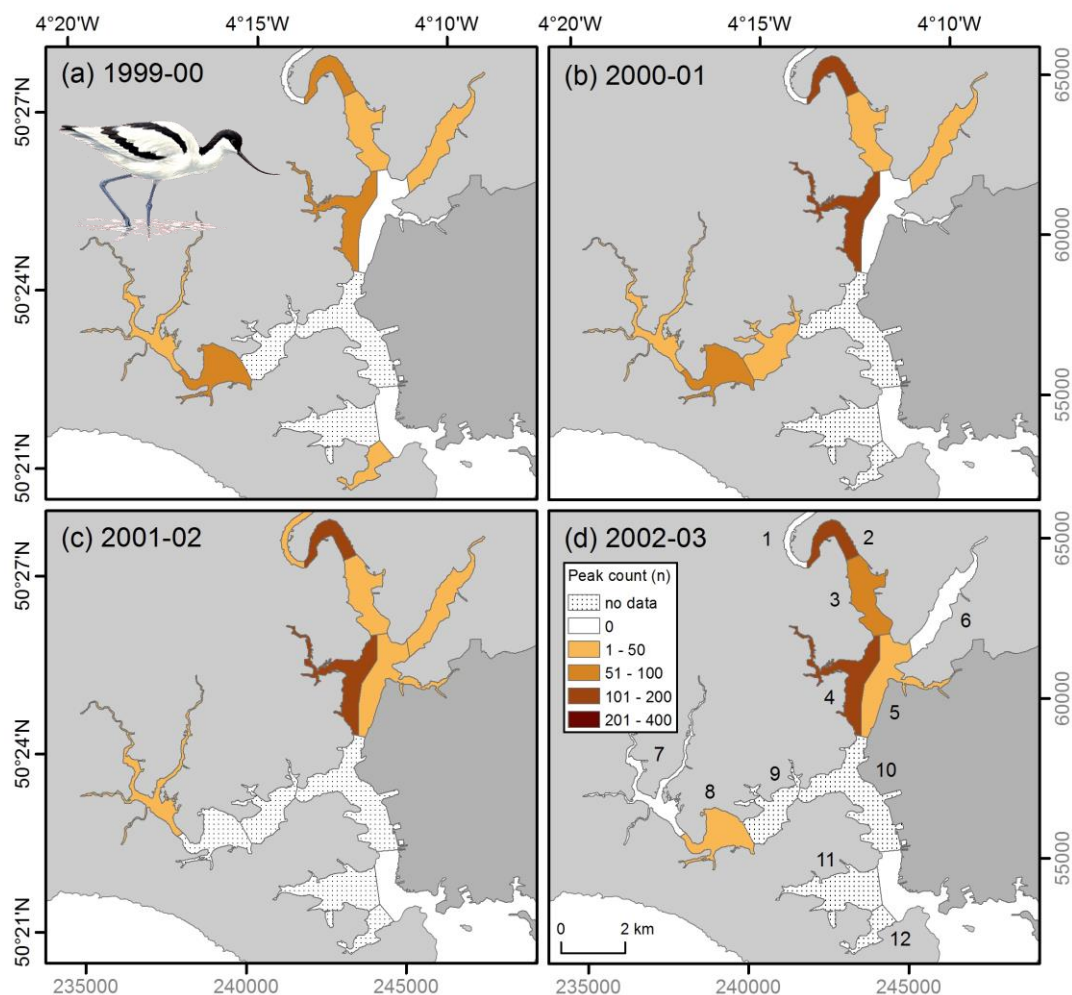


Figure 1. WeBS pied avocet survey effort 1995-96 to 1998-99. Monthly surveys (n) recorded by WeBS sector, (a) 1995-96, (b) 1996-97, (c) 1997-98 and (d) 1998-99.

Pied avocet 1999-00 to 2002-03



Map 8. Pied avocet 1999-00 to 2002-03. Peak counts (n) by sector per season for pied avocet (a) 1999-00, (b) 2000-01, (c) 2001-02 and (d) 2002-03. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

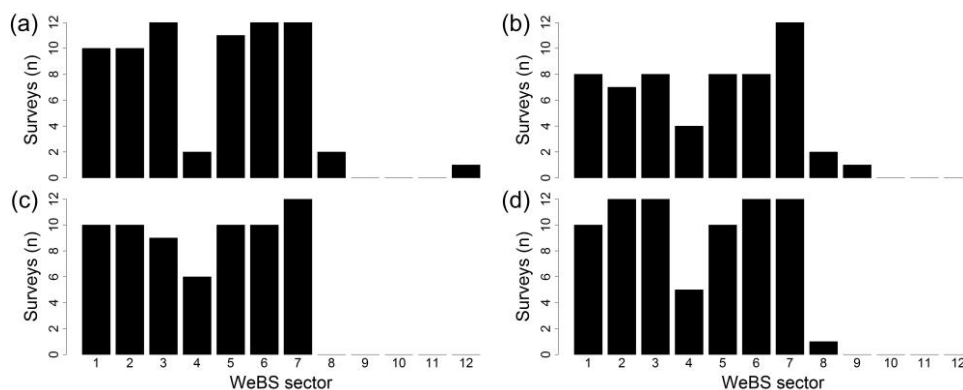
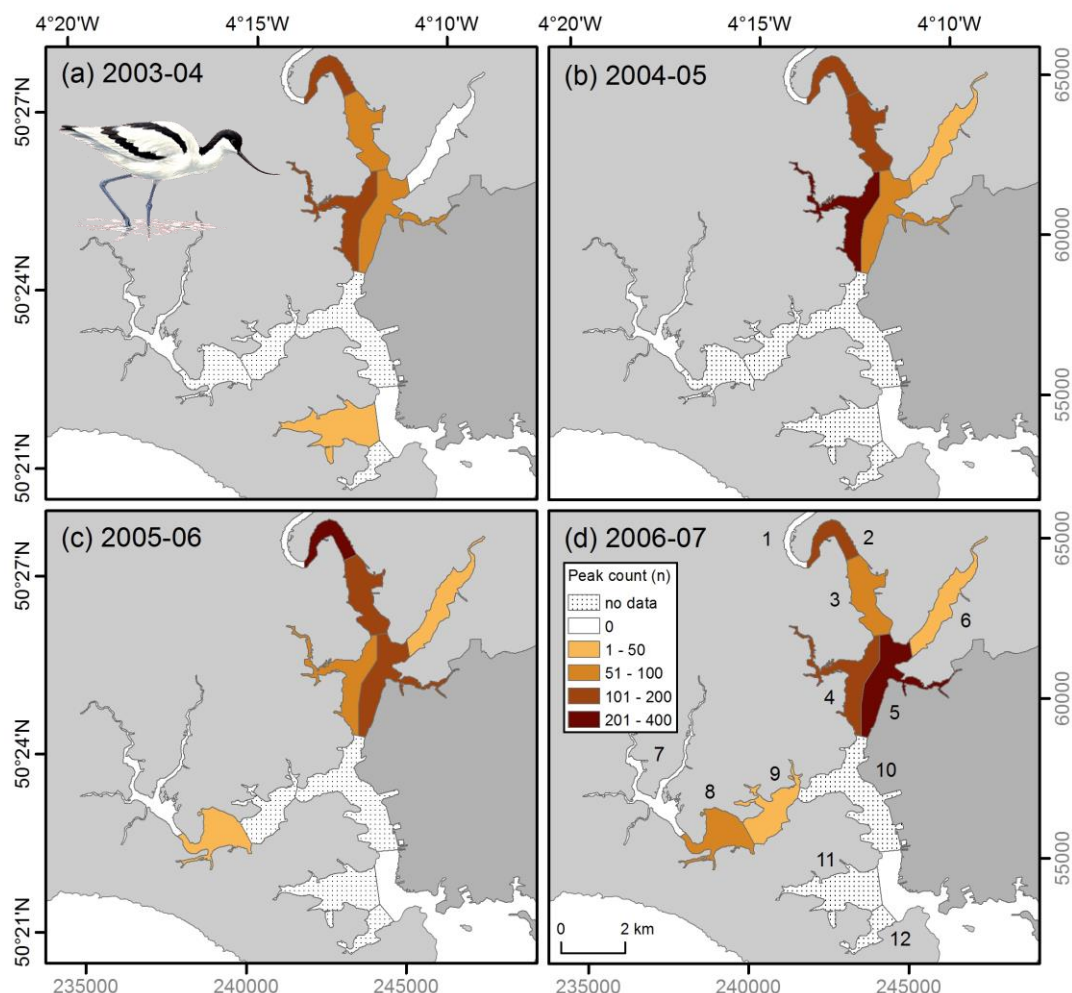


Figure 2. WeBS pied avocet survey effort 1999-00 to 2002-03. Monthly surveys (n) recorded by WeBS sector, (a) 1999-00, (b) 2000-01, (c) 2001-02 and (d) 2002-03.

Pied avocet 2003-04 to 2006-07



Map 9. Pied avocet 2003-04 to 2006-07. Peak counts (n) by sector per season for pied avocet (a) 2003-04, (b) 2004-05, (c) 2005-06 and (d) 2006-07. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

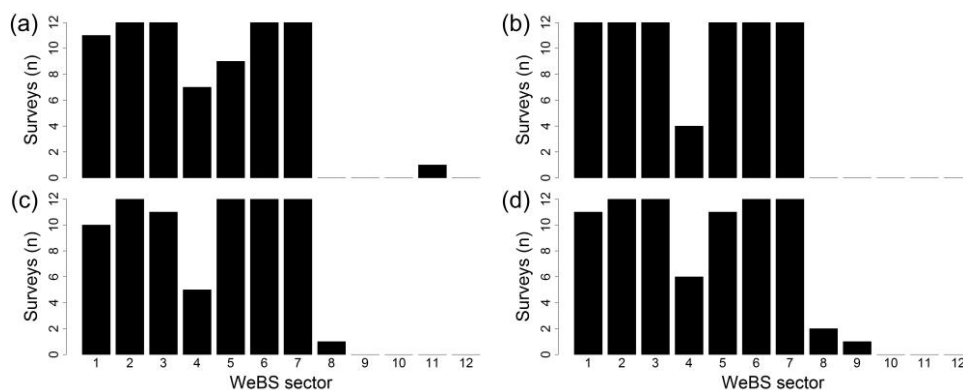
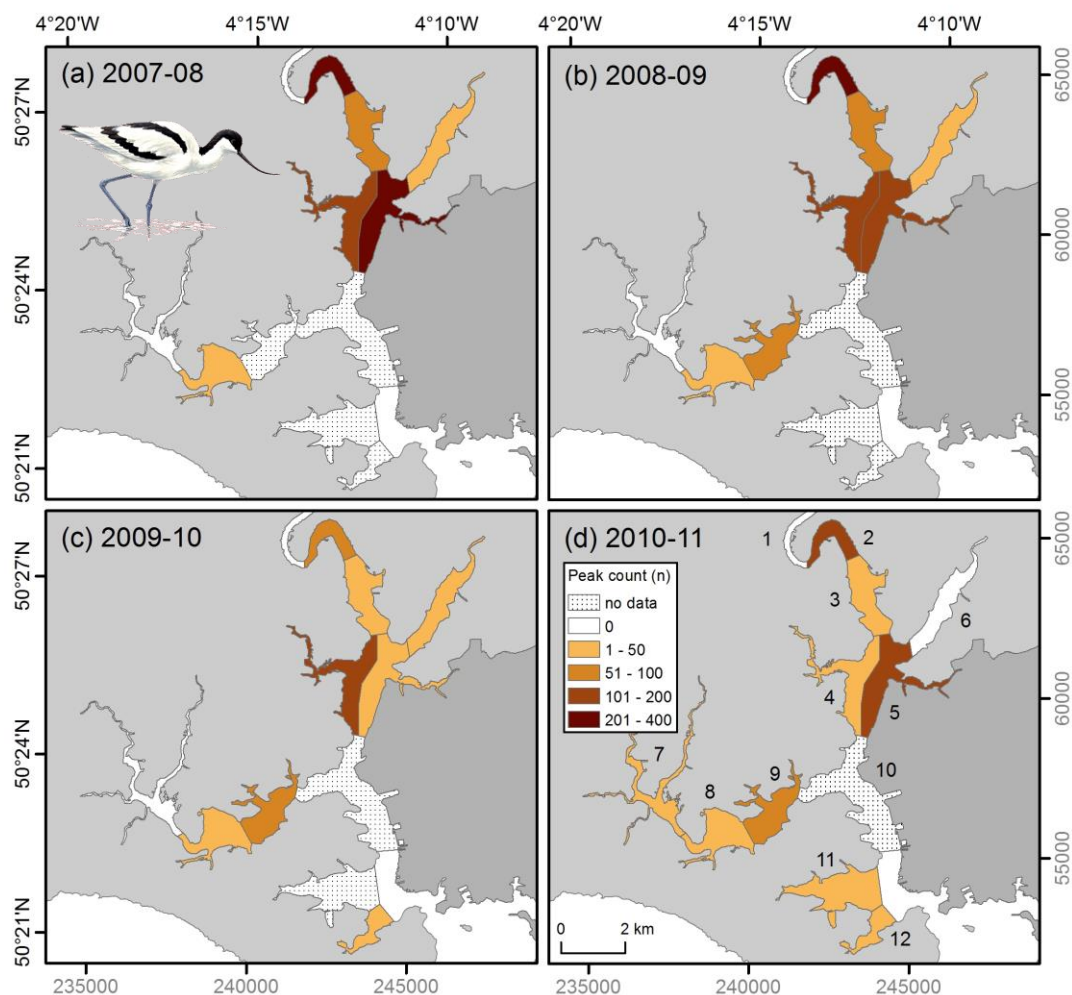


Figure 3. WeBS pied avocet survey effort 2003-04 to 2006-07. Monthly surveys (n) recorded by WeBS sector, (a) 2003-04, (b) 2004-05, (c) 2005-06 and (d) 2006-07.

Pied avocet 2007-08 to 2010-11



Map 10. Pied avocet 2007-08 to 2010-11. Peak counts (n) by sector per season for pied avocet (a) 2007-08, (b) 2008-09, (c) 2009-10 and (d) 2010-11. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

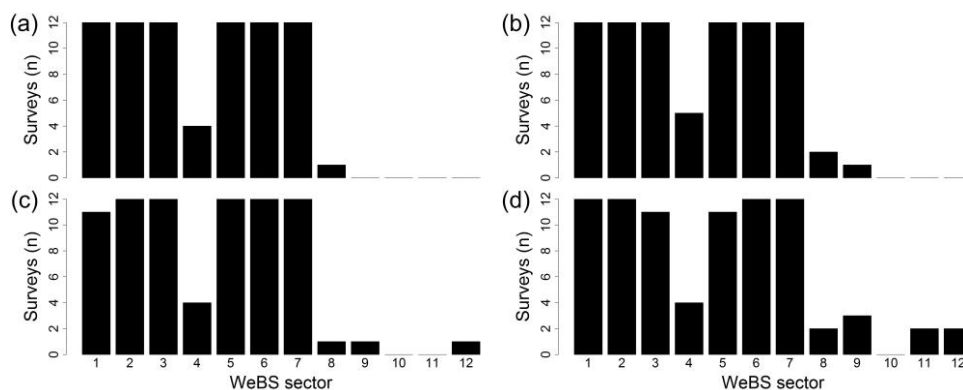
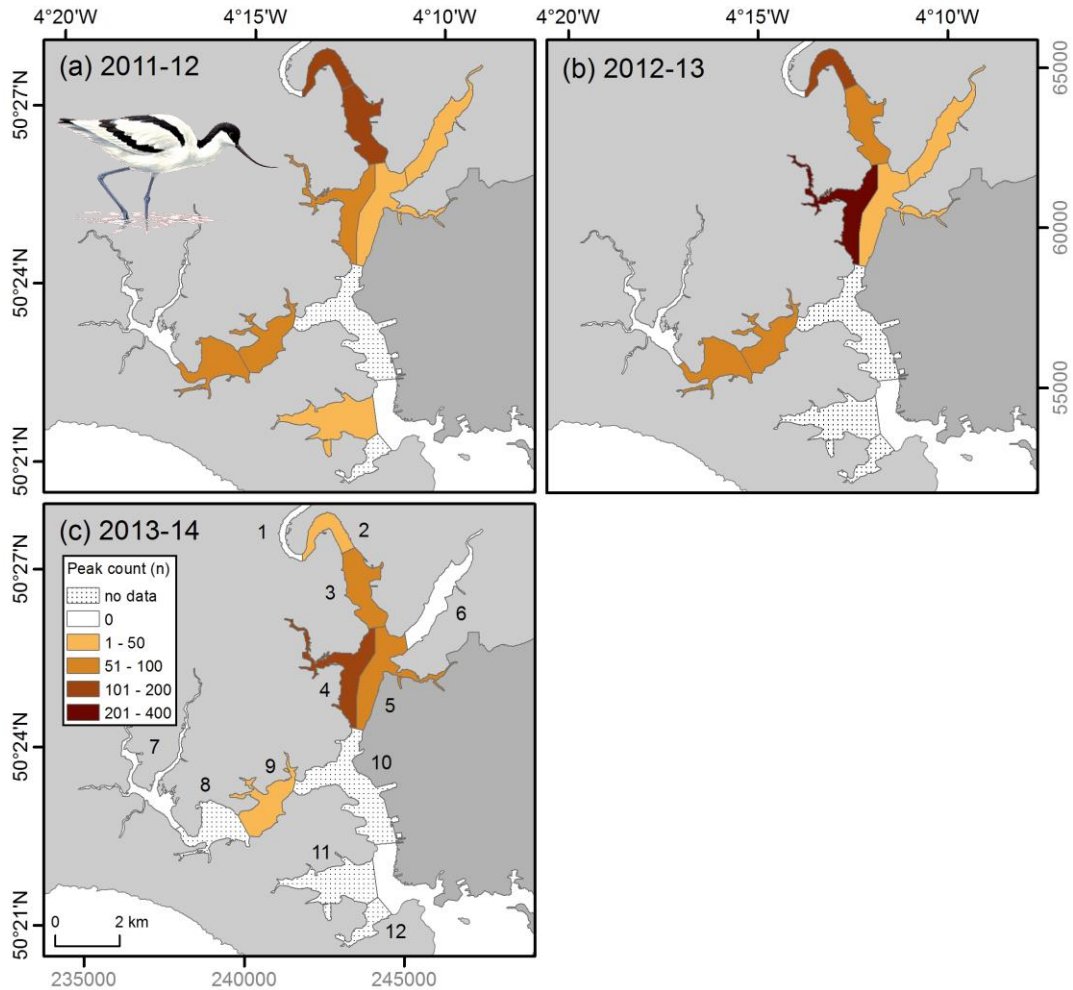


Figure 4. WeBS pied avocet survey effort 2007-08 to 2010-11. Monthly surveys (n) recorded by WeBS sector, (a) 2007-08, (b) 2008-09, (c) 2009-10 and (d) 2010-11.

Pied avocet 2011-12 to 2013-14



Map 11. Pied avocet 2011-12 to 2013-14. Peak counts (n) by sector per season for pied avocet (a) 2011-12, (b) 2012-13 and (c) 2013-14. In parts (a-c) peak counts (n) of birds are drawn in accordance with the legend (c). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

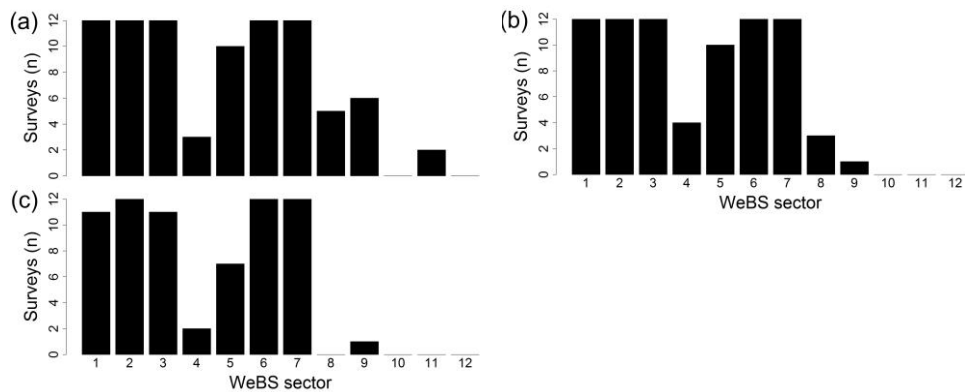
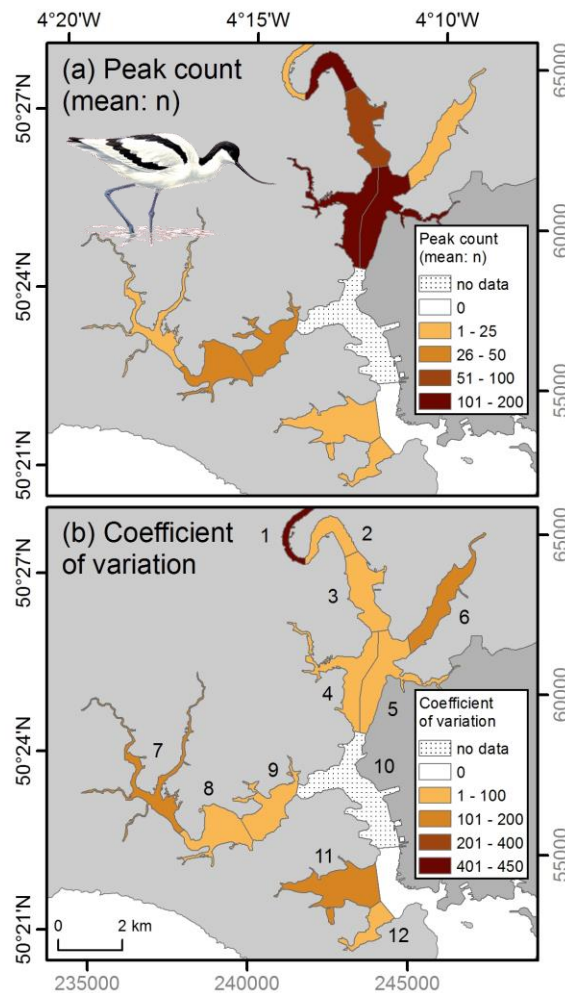


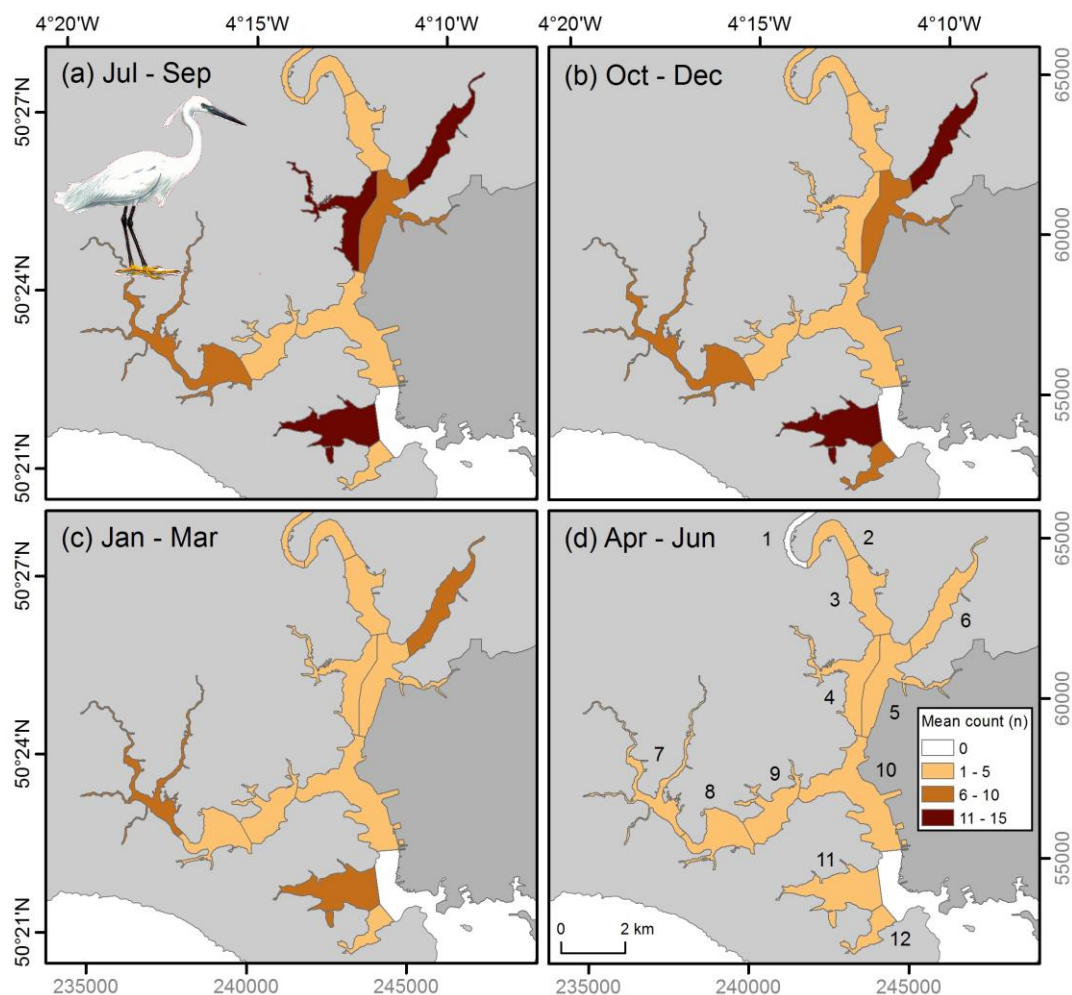
Figure 5. WeBS pied avocet survey effort 2011-12 to 2013-14. Monthly surveys (n) recorded by WeBS sector, (a) 2011-12, (b) 2012-13 and (c) 2013-14.

Pied avocet 1995-96 to 2013-14 peak count (mean) and coefficient of variation



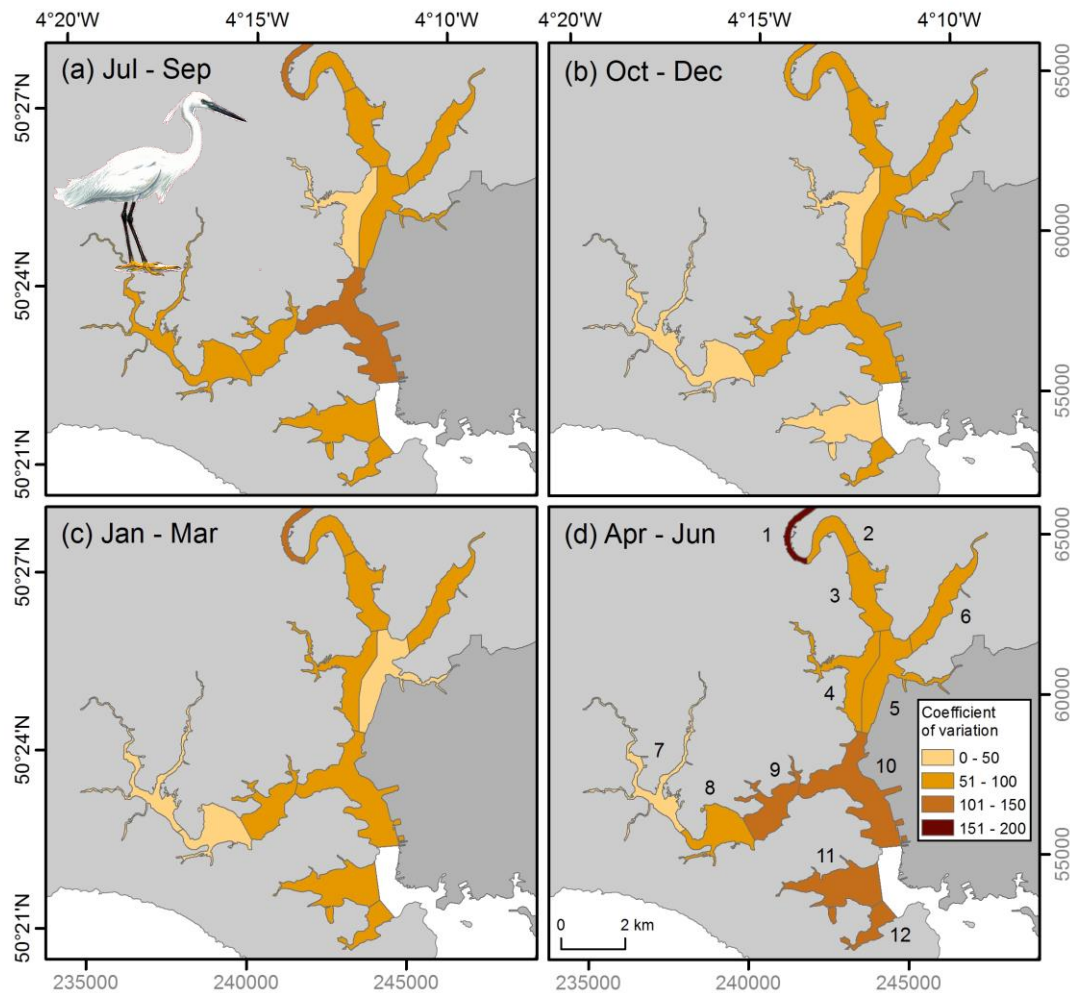
Map 12. Pied avocet peak count (mean) and coefficient of variation 1995-96 to 2013-14. (a) Peak counts (mean: 1995-96 to 2013-14) by sector. (b) Coefficient of variation ($[(SD/mean)*100]$) by sector. In parts (a) and (b) mean peak counts and coefficient of variation are drawn in accordance with the respective map legends. The coefficient of variation (ratio of the standard deviation to the mean expressed as a percentage) is a measure of spread within data that describes the amount of variability relative to the mean. As the coefficient of variation is a standardised measure it enables the spread of disparate data sets with different units or means to be compared. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

Little egret 1995-96 to 2013-14 mean seasonal counts



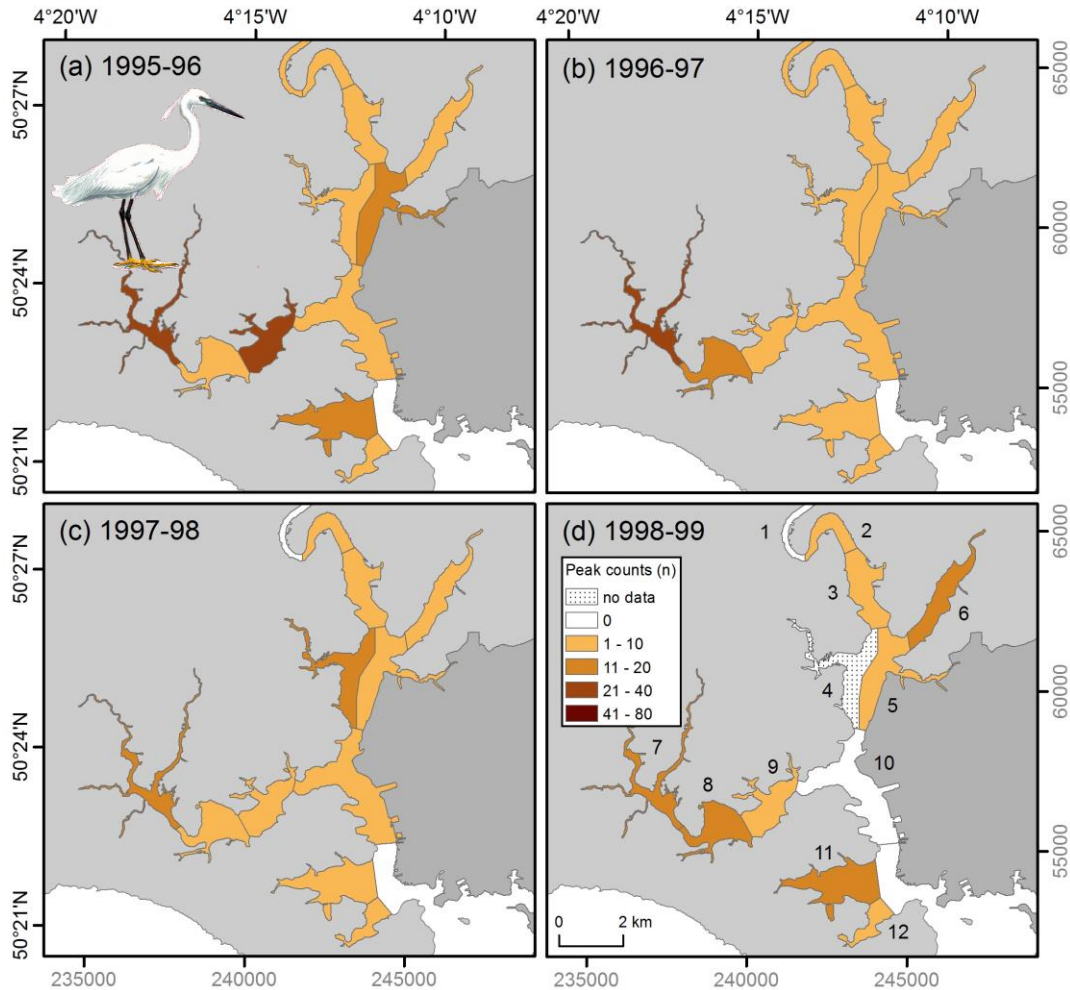
Map 13. Little egret mean seasonal counts (n) per WeBS sector 1995-96 to 2013-14. (a) July to September, (b) October to December, (c) January to March and (d) April to June. In parts (a-d) seasonal mean counts (n) of birds are drawn in accordance with the legend (d). In (d) WeBS sectors labelled 1- 12 in accordance with map 4. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

Little egret 1995-96 to 2013-14 mean seasonal count coefficient of variation



Map 14. Little egret mean seasonal count coefficient of variation 1995-96 to 2013-14. (a) July to September, (b) October to December, (c) January to March and (d) April to June. In parts (a-d) coefficient of variation is drawn in accordance with the legend (d). The coefficient of variation (ratio of the standard deviation to the mean expressed as a percentage) is a measure of spread within data that describes the amount of variability relative to the mean. As the coefficient of variation is a standardised measure it enables the spread of disparate data sets with different units or means to be compared. In (d) WeBS sectors labelled 1- 12 in accordance with map 4. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

Little egret 1995-96 to 1998-99



Map 15. Little egret 1995-96 to 1998-99. Peak counts (n) by sector per season for little egret (a) 1995-96, (b) 1996-97, (c) 1997-98 and (d) 1998-99. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). The same classification scale is used in maps 15 to 19. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rsps-images.com).

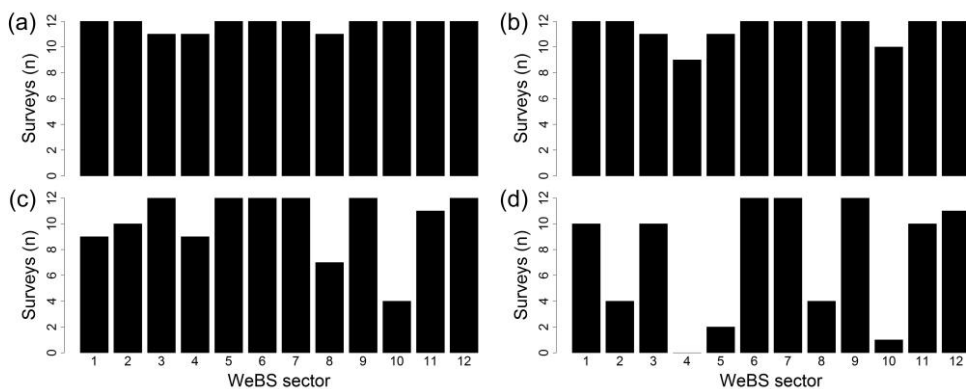
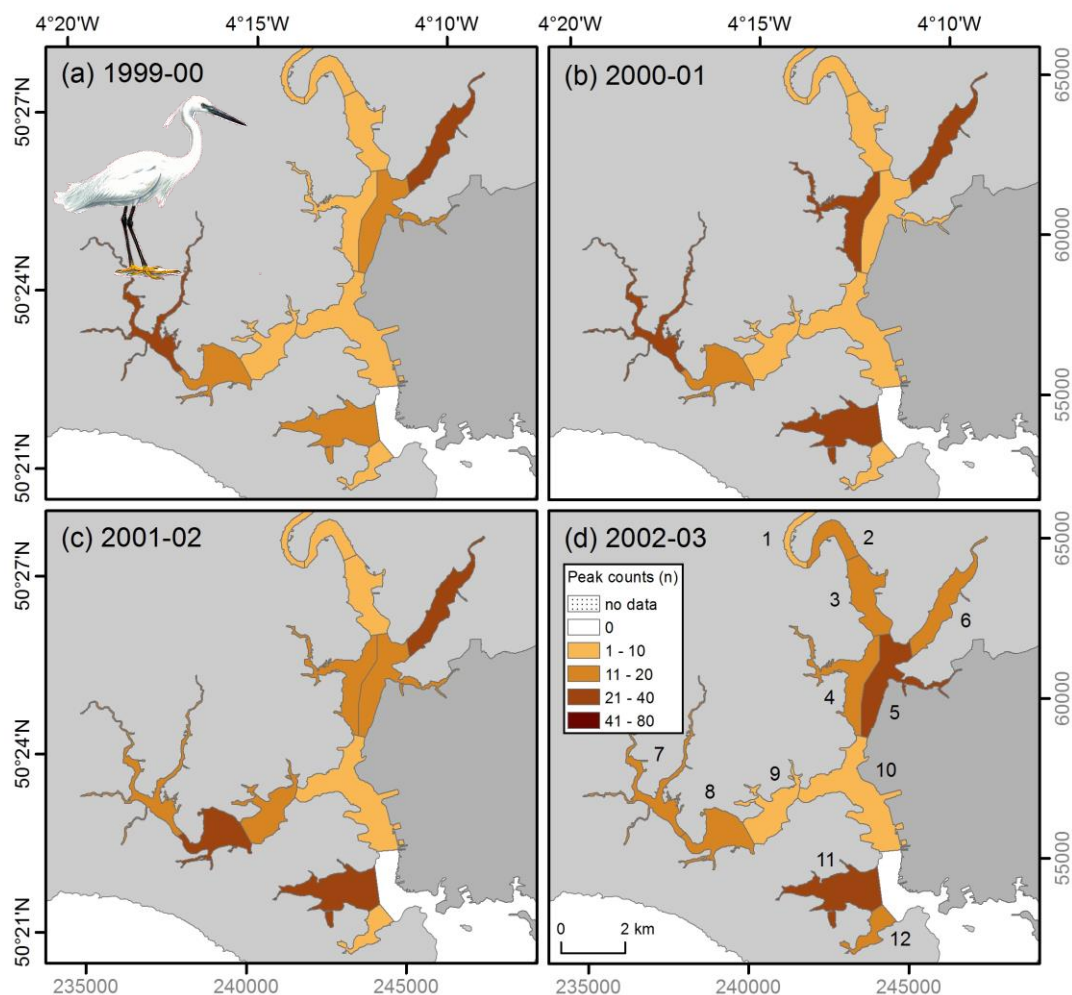


Figure 6. WeBS little egret survey effort 1995-96 to 1998-99. Monthly surveys (n) recorded by WeBS sector, (a) 1995-96, (b) 1996-97, (c) 1997-98 and (d) 1998-99.

Little egret 1999-00 to 2002-03



Map 16. Little egret 1999-00 to 2002-03. Peak counts (n) by sector per season for little egret (a) 1999-00, (b) 2000-01, (c) 2001-02 and (d) 2002-03. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

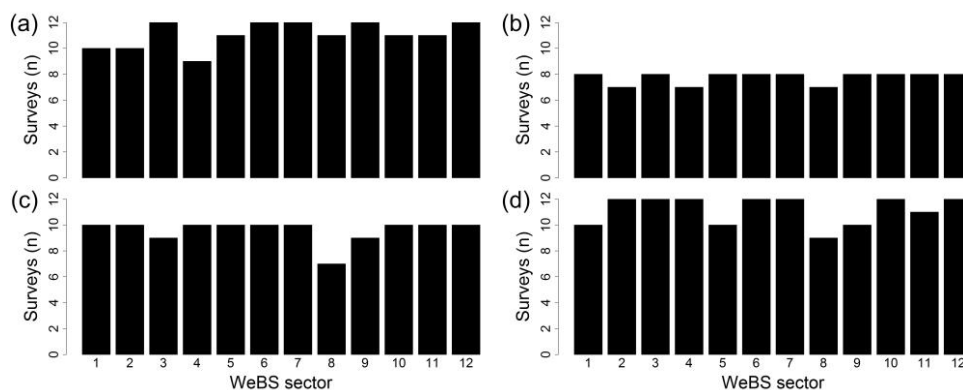
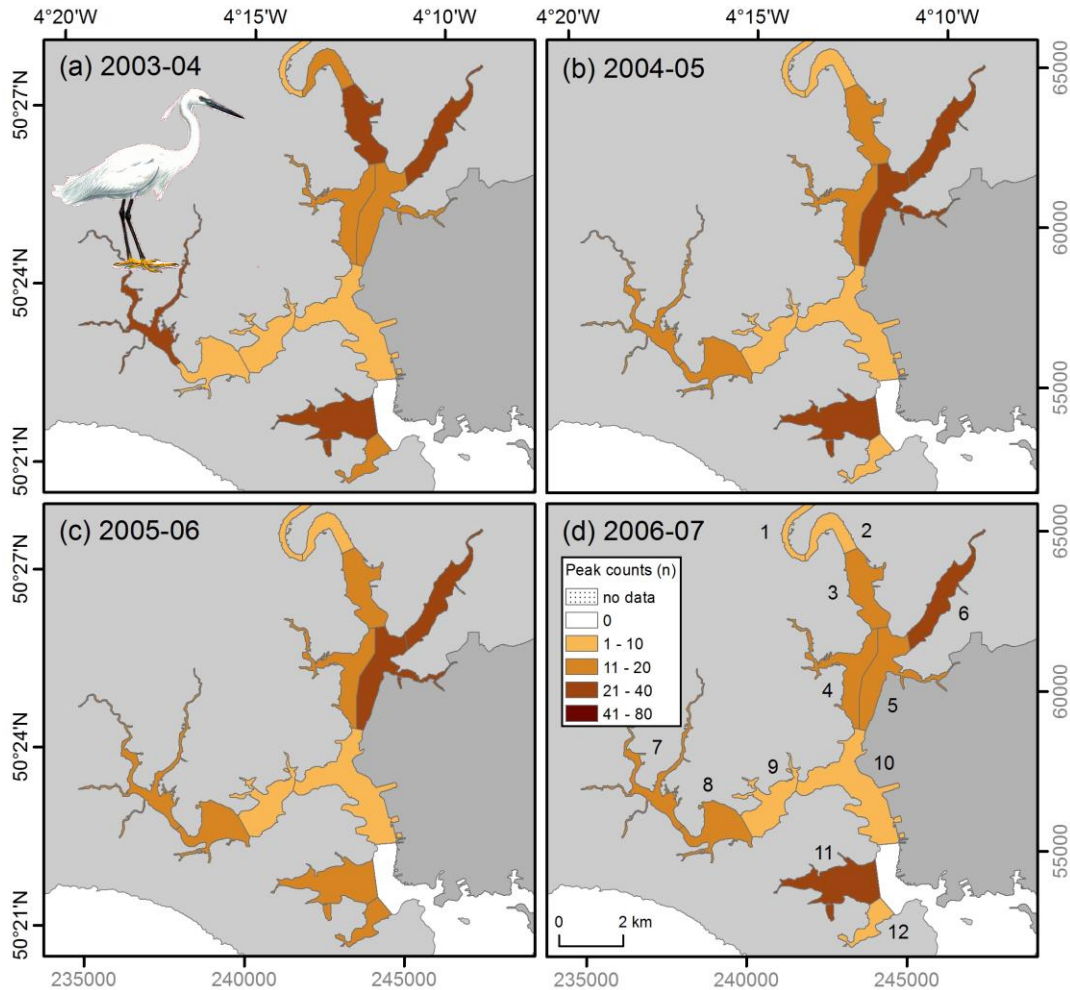


Figure 7. WeBS little egret survey effort 1999-00 to 2002-03. Monthly surveys (n) recorded by WeBS sector, (a) 1999-00, (b) 2000-01, (c) 2001-02 and (d) 2002-03.

Little egret 2003-04 to 2006-07



Map 17. Little egret 2003-04 to 2006-07. Peak counts (n) by sector per season for little egret (a) 2003-04, (b) 2004-05, (c) 2005-06 and (d) 2006-07. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

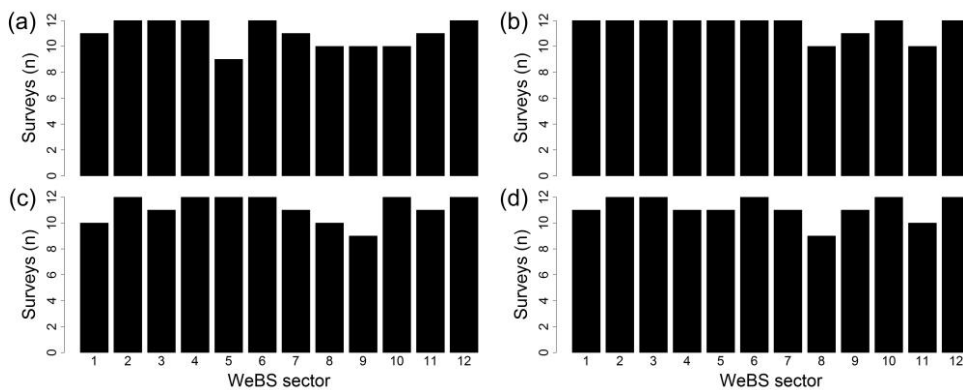
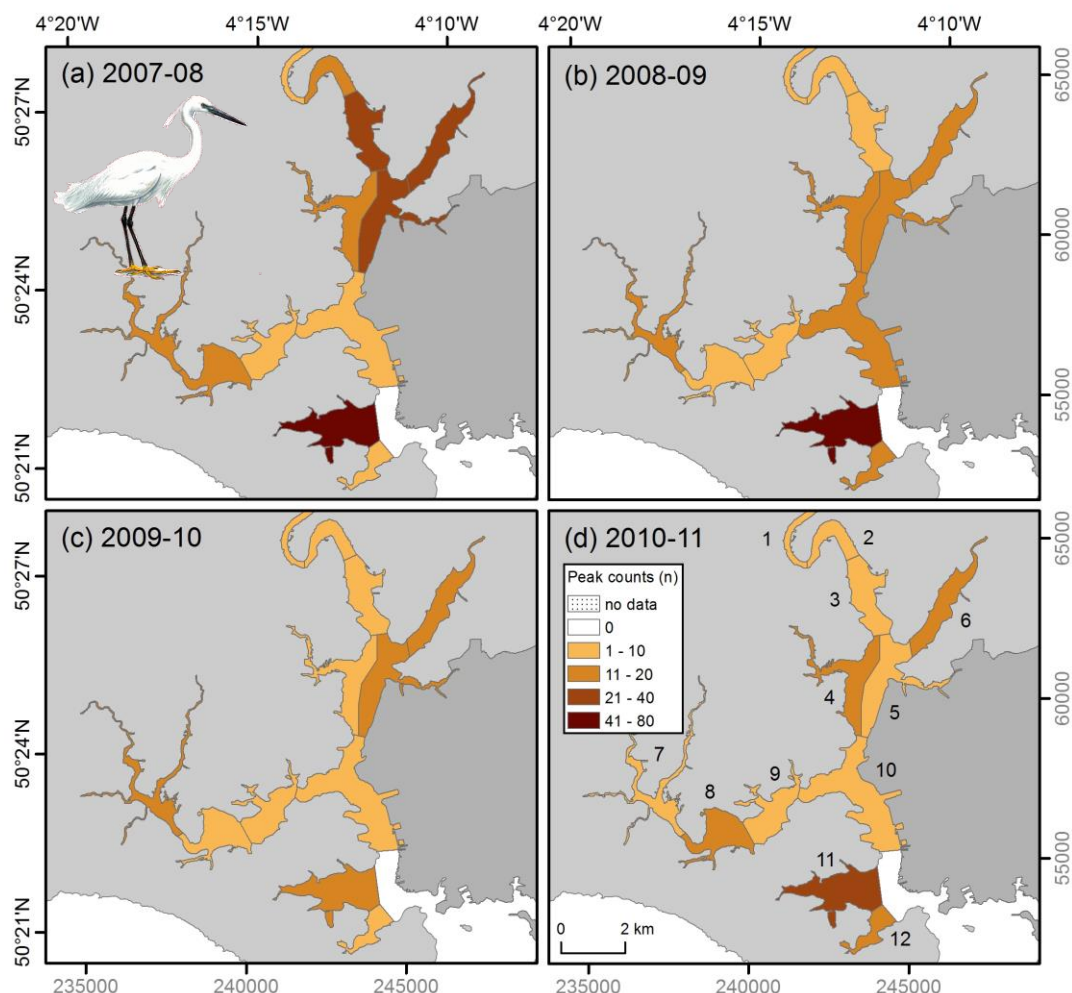


Figure 8. WeBS little egret survey effort 2003-04 to 2006-07. Monthly surveys (n) recorded by WeBS sector, (a) 2003-04, (b) 2004-05, (c) 2005-06 and (d) 2006-07.

Little egret 2007-08 to 2010-11



Map 18. Little egret 2007-08 to 2010-11. Peak counts (n) by sector per season for little egret (a) 2007-08, (b) 2008-09, (c) 2009-10 and (d) 2010-11. In parts (a-d) peak counts (n) of birds are drawn in accordance with the legend (d). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

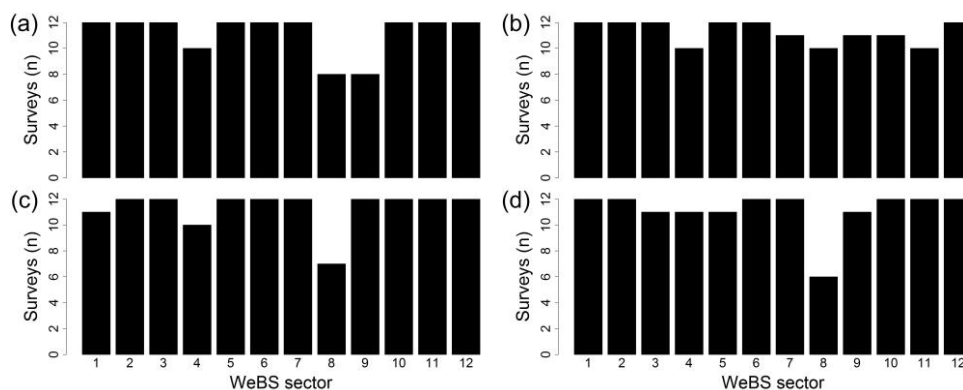
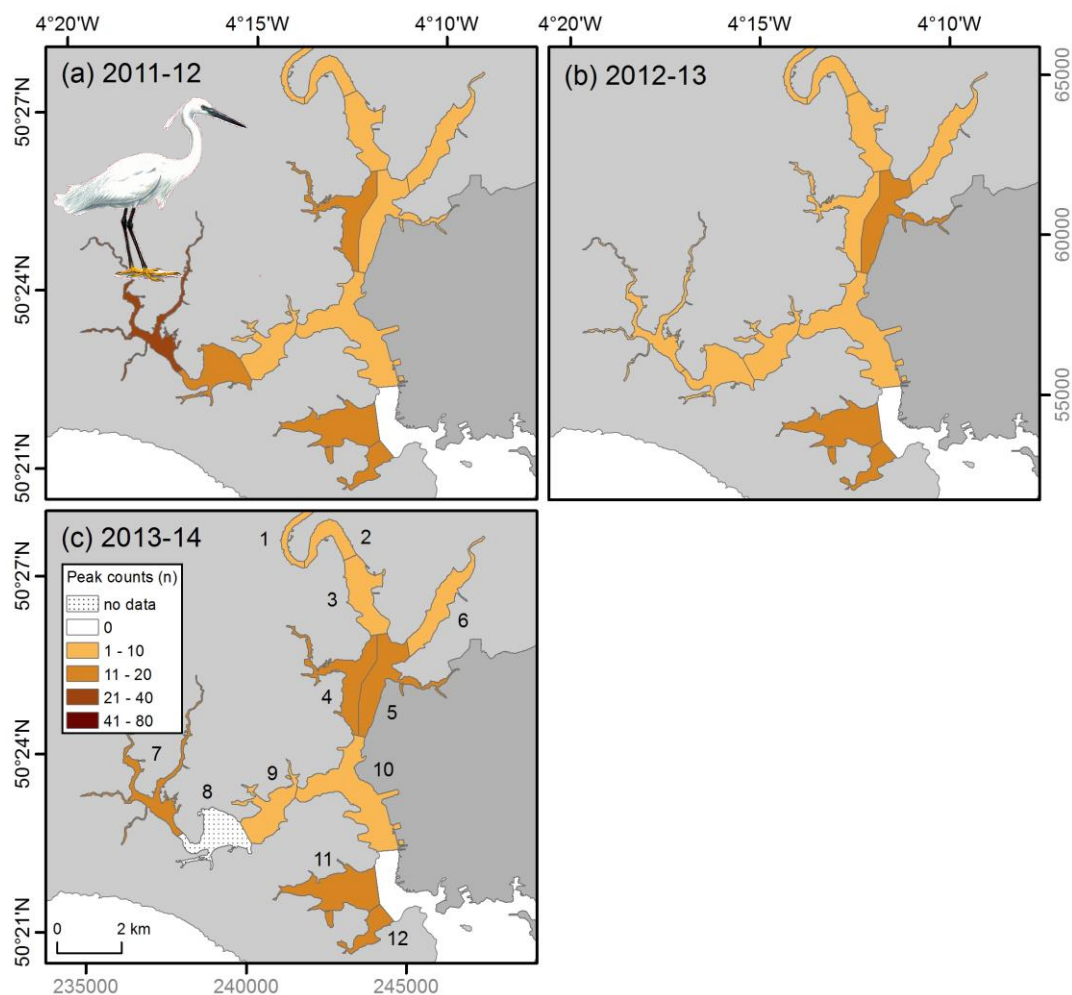


Figure 9. WeBS little egret survey effort 2007-08 to 2010-11. Monthly surveys (n) recorded by WeBS sector, (a) 2007-08, (b) 2008-09, (c) 2009-10 and (d) 2010-11.

Little egret 2011-12 to 2013-14



Map 19. Little egret 2011-12 to 2013-14. Peak counts (n) by sector per season for little egret (a) 2011-12, (b) 2012-13 and (c) 2013-14. In parts (a-c) peak counts (n) of birds are drawn in accordance with the legend (c). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

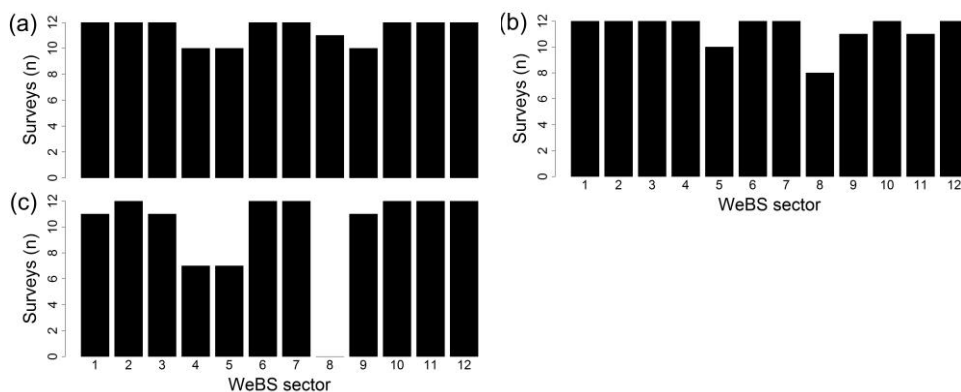
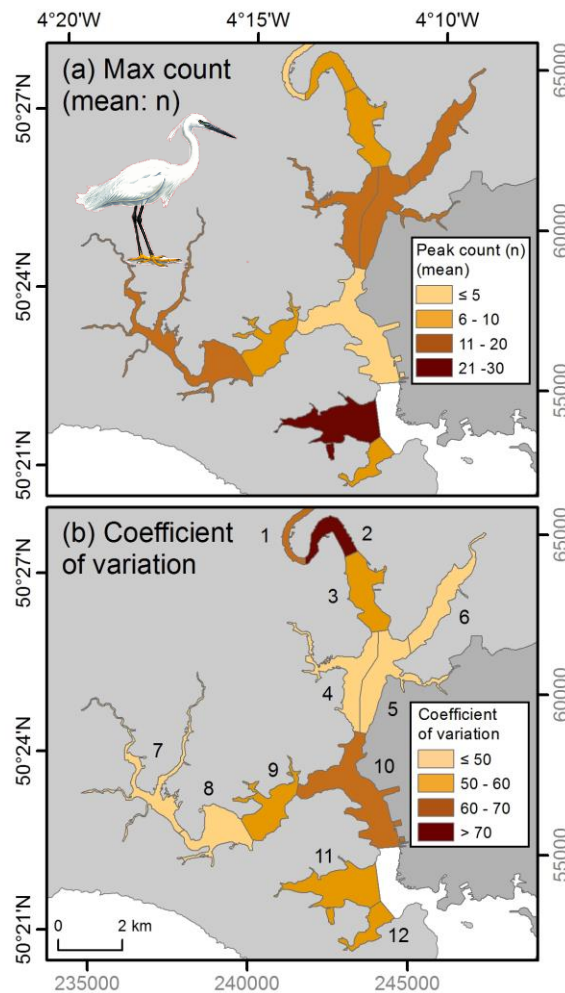


Figure 10. WeBS little egret survey effort 2011-12 to 2013-14. Monthly surveys (n) recorded by WeBS sector, egret (a) 2011-12, (b) 2012-13 and (c) 2013-14.

Little egret, peak count (mean) and coefficient of variation 1995-96 to 2013-14

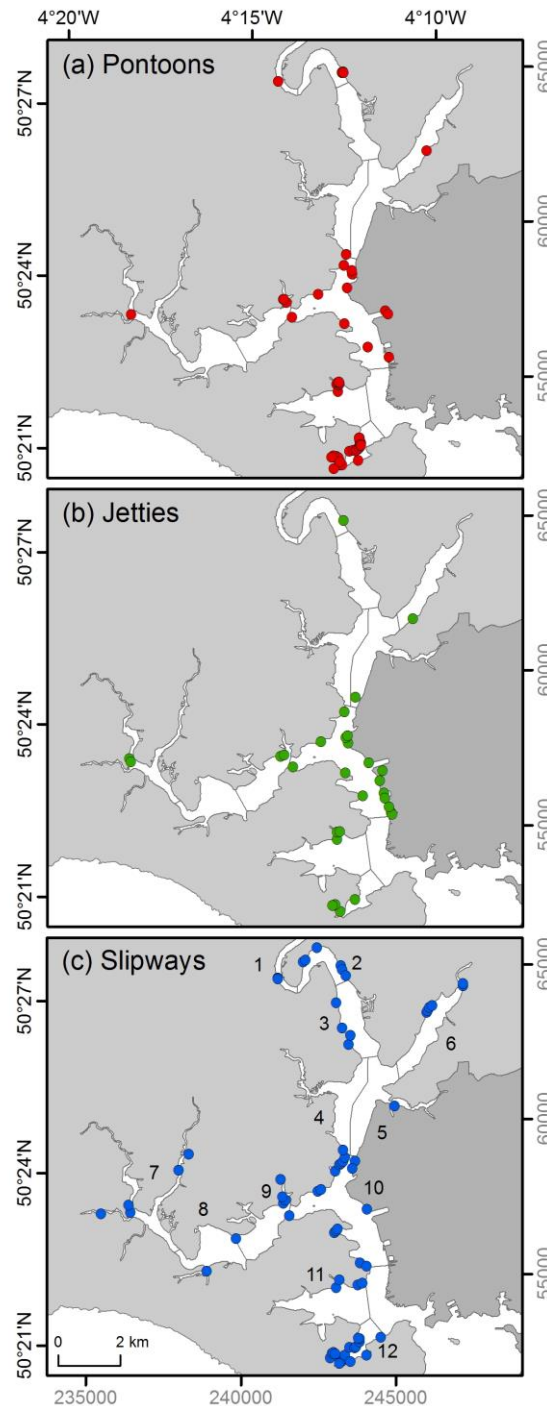


Map 20. Little egret peak count (mean) and coefficient of variation 1995-96 to 2013-14. (a) Peak counts (mean: 1995-96 to 2013-14) by sector. (b) Coefficient of variation ($[(SD/mean)]*100$) by sector. In parts (a) and (b) mean peak counts and coefficient of variation are drawn in accordance the respective map legends. The coefficient of variation (ratio of the standard deviation to the mean expressed as a percentage) is a measure of spread within data that describes the amount of variability relative to the mean. As the coefficient of variation is a standardised measure it enables the spread of disparate data sets with different units or means to be compared. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator. Artwork illustrations: Mike Langman (rspb-images.com).

Maritime Activity

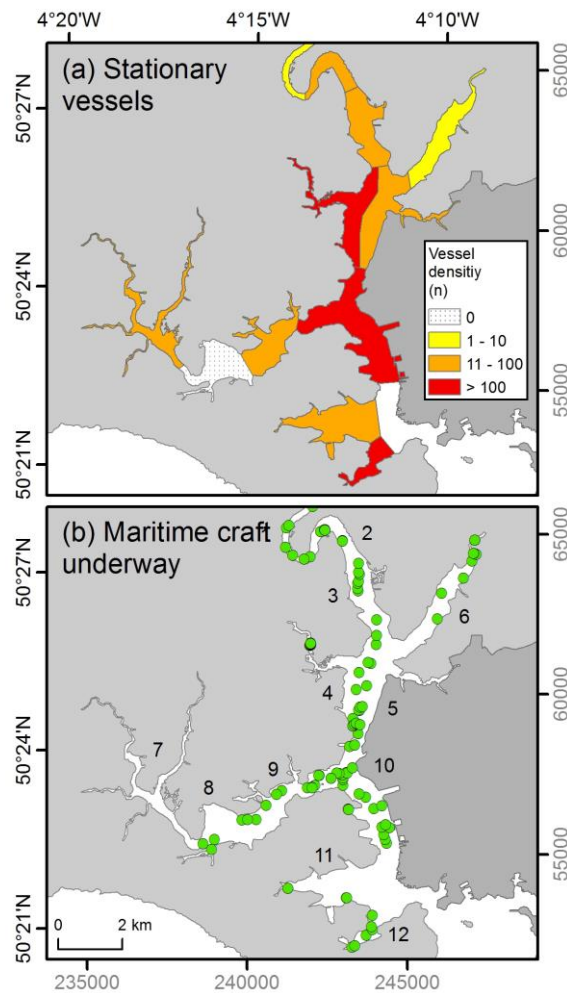


Maritime access points



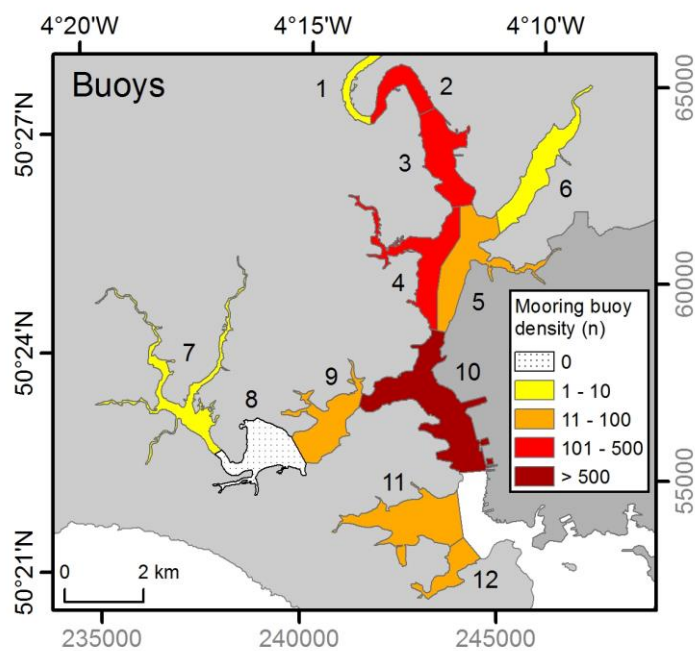
Map 21. Pontoons, jetties and slipways detected from optical satellite imagery. Positions of maritime access points detected within the Tamar Estuaries complex from Google Earth satellite imagery (08/08/2015), (a) pontoons (floating structures connected to land where a boat may tie up: $n = 59$, red circles), (b) jetties (solid structures projecting from land where a boat may tie up: $n = 30$, green circle) and (c) slipways (solid structures projecting from land with vehicular access where a boat may be launched from: $n = 69$, blue circles). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator.

Marine craft



Map 22. Stationary vessels and maritime craft underway detected from optical satellite imagery. Marine craft detected from Google Earth satellite imagery (08/08/2015), (a) stationary vessels (< 40 m in length: $n = 1102$) summed by WeBS survey sectors are drawn using a yellow/orange/red classification in accordance with the legend in part (a), and (b) maritime craft underway (includes vessels under power/sail and propelled by oar (e.g. canoe, punt): $n = 120$, green circle). All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator.

Mooring buoys



Map 23. Mooring buoys detected from optical satellite imagery. Mooring buoy density within the Tamar Estuaries complex. Mooring buoys ($n = 1251$) were detected from Google Earth satellite imagery (08/08/2015) and summed by WeBS survey sectors. Mooring buoy density is drawn using a yellow/orange/red classification in accordance with the legend. All map parts are drawn to the same spatial scale. Maps drawn to Projected Coordinate System: British National Grid Transverse Mercator.

Acknowledgements

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