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WATERBIRD POPULATIONS ON THE GREATER THAMES ESTUARY: NUMBERS AND TRENDS BY COUNT SECTOR

Authors

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EXECUTIVE SUMMARY

1. The Greater Thames Estuary is of national and international importance for its wader and wildfowl populations, supporting c. 287,000 waterbirds during the winter and passage periods. Five Special Protection Areas (SPAs) have been designated for 23 species of waterbird, and there is one potential SPA in the area.

2. The Wetland Bird Survey (WeBS) is a long-running survey that records the number of all waterbird species on 102 different geographical count units (sectors) of the Greater Thames Estuary (as well as many other sites nationally) at monthly intervals. These data can be used to assess abundance and population trends in different parts of the estuary.

3. This study aimed to assess the abundance and population trends of waterbird species at a sector level, in order to identify important areas and variation in population trends across the area. It also aimed to outline the likely effects of warming temperatures and future sea-level rise on waterbirds in the area.

4. Abundance of each species in the last five years was estimated for each sector and for amalgamations of sectors wherever there were sufficient data. Smoothed population trends were generated for the 15-year period from 1991/92 to 2006/07, for each of the 23 waterbird species designated on the SPAs, on each count sector for which there were sufficient data. In addition, for each species the importance of each sector in relation to the whole estuary population, over time, was assessed by investigating whether the proportion of the entire estuary population supported by the sector had increased or decreased significantly.

5. Intertidal-feeding species, including most of the waders, Shelduck and Brent Goose, occurred in the highest numbers towards the mouth of the Thames, particularly on Foulness and the Swale Estuary, with intermediate numbers on the Medway Estuary and in the Leigh and Canvey area. Holehaven Creek pSPA had relatively high densities of many of these species.

6. Dabbling ducks were widely distributed but with higher numbers on the northern shore of the Swale Estuary. The Cliffe area of the North Kent Marshes also supported relatively high densities of dabbling ducks as well as the highest concentration of grebes on the estuary. Rainham Marsh in the Inner Thames Estuary held large numbers of dabbling ducks and Cormorant; populations of many of these species had increased rapidly on the site during the last 15 years.

7. Almost all species' populations had declined on the Medway Estuary, and trends in this area were usually more negative than those of the wider Thames as a whole, or than regional trends, suggesting that local environmental conditions may be unfavourable for many waterbirds on the Medway Estuary.

8. Waterbirds associated with the Thames area are likely to be much affected by climate change, with warming temperatures linked to substantial distribution shifts. In the UK, east coast estuaries are generally more productive than those on the west, but birds choosing to over-winter on the east coast are at higher risk from thermally-induced mortality. With warming winters the benefits of over-wintering in the warmer west no longer outweigh the benefits of more productive feeding. Thus east coast estuaries such as those within the Thames area are likely to host an increasing proportion of the UK's internationally important numbers of waterbirds.

9. Sea-level rise is likely to lead to loss of intertidal and coastal habitats with concomitant adverse effects on birds, although the magnitude of the impacts are uncertain. Loss of habitat due to erosion may in some instances be balanced by increases accretion, but the extent to which this will be the case depends largely on coastal management regimes. Where hard sea-defences are in place, "coastal-squeeze" will result, but there is considerable scope for managed realignment. The

uncertainty surrounding the impacts of sea-level rise are further enhanced by the difficulty of quantifying the impacts of habitat loss on birds.

10. Despite the uncertainties, it is clear that sea-level rise will have adverse impacts on waterbirds that are designated features of SPAs within the Thames area. Considerable loss of saltmarsh is predicted on these SPAs. Although few species are directly dependent on saltmarshes this may still have far reaching effects as the birds use the saltmarshes as high water refuges and roost sites. Saltmarshes are responsible for exporting a large amount of organic material to adjacent mudflats and form the base of estuarine foodwebs. A reduction in the amount of material exported would be expected to reduce the productivity of mudflats, and would adversely affect the broader range of species that are dependent on intertidal flats for feeding.

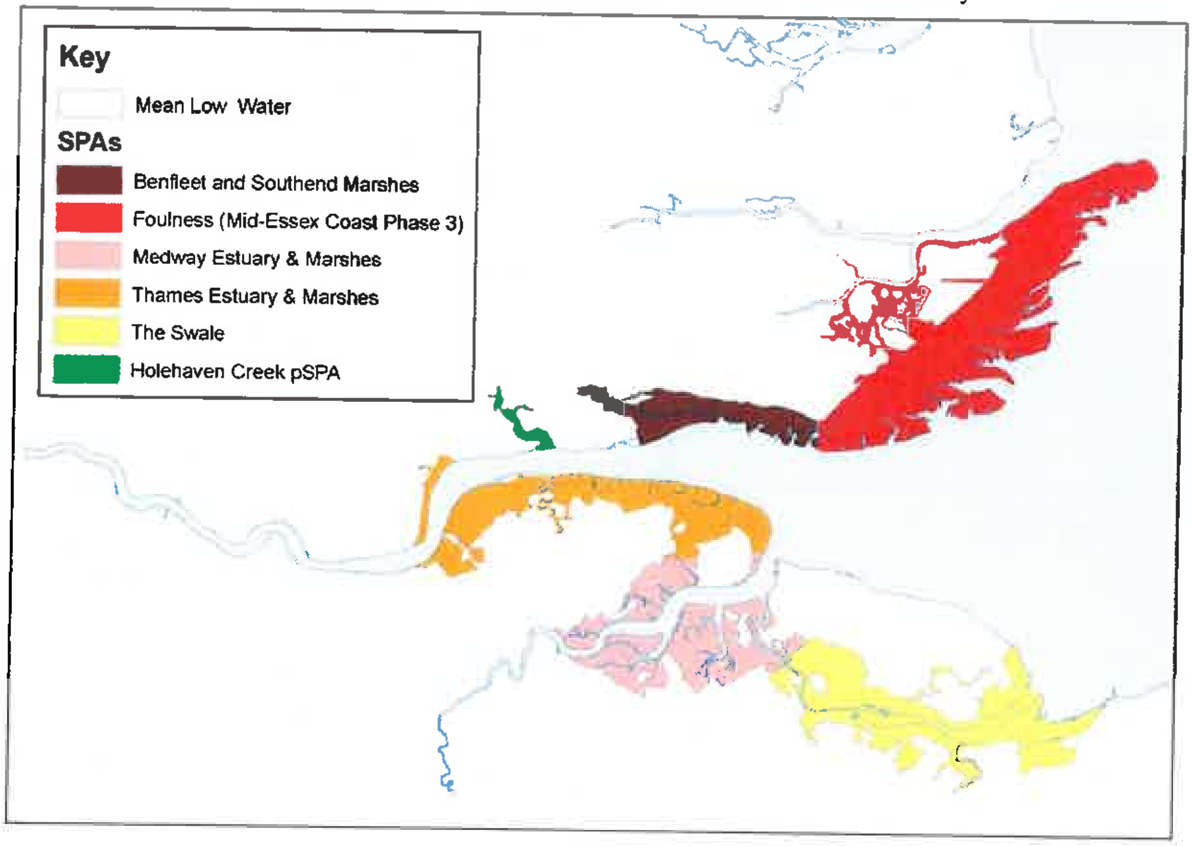
1. INTRODUCTION

1.1 Background

In order to be able to appraise flood risk management options on the Thames Estuary, the Environment Agency (EA) require information to provide a better understanding of which areas of the estuary are most important for birds and current trends. This will also help to provide better guidance to conservation managers on habitat management and creation priorities in light of climate change and changing flood risk management requirements. This information will feed into the Environment Agency's "Thames Estuary 2100" (TE2100) programme.

The five SPAs for which data are required are the Thames Estuary and Marshes, the Medway Estuary and Marshes, The Swale, Benfleet & Southend Marshes and Foulness (Mid-Essex Coast Phase 3). The area covered by these SPAs includes the Thames, Medway and Swale Estuaries (Fig. 1.1.i), but will be referred to throughout the remainder of the report as the "Greater Thames Estuary". Holehaven Creek potential SPA (pSPA) is also considered.

Figure 1.1.i Locations of the five SPAs and one pSPA on the Greater Thames Estuary.



The Thames Estuary and Marshes SPA extends for about 15 km along the south side of the estuary and also include intertidal areas on the north side of the estuary. To the south of the river, much of the area is brackish grazing marsh, although some of this has been converted to arable use. At Cliffe, there are flooded clay and chalk pits, some of which have been infilled with dredgings. Outside the sea wall, there is a small extent of saltmarsh and broad intertidal mudflats (Stroud *et al.* 2001, Maclean and Austin 2008).

The Medway Estuary feeds into the south side of the outer Thames Estuary and forms a single tidal system with the Swale. It has a complex arrangement of tidal channels, which drain around large islands of saltmarsh and peninsulas of grazing marsh. The mud-flats are rich in invertebrates and also support beds of green algae and some eelgrass. Small shell beaches occur, particularly in the outer parts of the estuary. Grazing marshes are present inside the sea walls around the estuary (Stroud *et al.* 2001, Maclean and Austin 2008).

The Swale is a complex of brackish and freshwater, floodplain grazing marsh with ditches, and intertidal saltmarshes and mud-flats. The intertidal flats are extensive, especially on the east of the site, and support dense invertebrate fauna and beds of algae and eelgrass. Locally there are large Mussel (Mytilus edulis) beds formed on harder areas of substrate. The SPA contains the largest extent of grazing marsh in Kent (although much reduced from its former extent). There is much diversity both in the salinity of the dykes (which range from fresh to strongly brackish) and in the topography of the fields (Stroud *et al.* 2001, Maclean and Austin 2008).

Benfleet and Southend Marshes SPA comprises an extensive series of saltmarshes, cockle shell banks, mud-flats, and grassland that supports a diverse flora and fauna (Stroud *et al.* 2001, Maclean and Austin 2008). Foulness is part of an open coast estuarine system comprising grazing marsh, saltmarsh, intertidal mud-flats, cockle-shell banks and sand flats. It includes one of the three largest continuous sand-silt flats in the UK.

Foulness is an integral component of the phased Mid-Essex Coast SPA (Stroud *et al.* 2001, Maclean and Austin 2008). These five SPAs support nationally and internationally important populations of 23 waterbird species (Table 1.1.i).

Table 1.1.i Five-year mean of peak winter numbers of 23 waterbird species on each of the five SPAs in the wider Thames area, based on the best match to WeBS count sectors. Numbers are also shown for the Holehaven Creek pSPA. Red shading shows numbers in excess of the international threshold and orange numbers in excess of the national threshold.

Species	Thames Estuary and Marshes	Medway Estuary	The Swale	Benfleet & Southend Marshes	Foulness (Mid-Essex Coast Phase 3)	Holehaven Creek	National Threshold	International Thershold
European White-fronted Goose	20	0	471	10	32		58	10,000
Dark-bellied Brent Goose	989	1,152	1,754	3,033	7,884	2	981	2,000
Shelduck	736	2,063	2,114	375	940	309	782	3,000
Wigeon	3,586		18,521	1,940	2,574	252	4,060	15,000
Gadwall			129	6	9	0	171	600
Teal	1,890		5,288	767	1,500	289	1,920	5,000
Pintail	147		790	1	9	1	279	600
Shoveler	212		315	63	40	3	148	400
Little Grebe	274	65	63	8	130	1	78	4,000
Great Crested Grebe	86	51	190	14	8	0	159	3,600
Cormorant	94	305	139	69	97	40	230	1,200
Oystercatcher	1,232	2,455	4,910	1,771	21,995	14	3,200	10,000
Avocet	598		595	108	360	16	35	730
Ringed Plover	231			502	109	0	330	730
Golden Plover	483	1,284	9,188	977	4,715		2,500	9,300
Grey Plover	827	1,157	1,576	1,838	4,280	1	530	2,500
Lapwing	3,771	5,184	15,470	4,650	6,568	3,874	20,000	20,000
Knot	3,467	3,159	3,331	6,753	37,947	11	2,800	4,500
Dunlin	12,672	7,451	9,202	18,887	9,516	4,448	5,600	13,300
Black-tailed Godwit	721		1,425	1,388	294	1,070	150	470
Bar-tailed Godwit	93	180	611	715	6,255	1	620	1,200
Curlew	1,125	1,050	1,201	1,189	1,269	743	1,500	8,500
Redshank	1,024		1,127	1,447	1,421	923	1,200	2,800

To help the Environment Agency to understand how waterbirds may be redistributing within the wider Thames, and identify areas where there has been a net loss or gain relative to numbers across the whole site, WeBS data are used here to calculate and compare species trends for the SPA and component units. This will in turn contribute towards gaining a better understanding of fluctuations in bird numbers on the estuary both temporally and spatially and thus inform assessment of the potential impacts of flood risk management and climate change on SPA populations. The Environment Agency has specified 23 species of concern, comprised of those for which the five SPAs are designated.

1.2 Objectives

The specific aims of the work are to:

- Assess the most recently available Wetland Bird Survey (WeBS) data (2001/02 to 2006/07) to provide five-year mean bird numbers for each designated species on each count sector within the intertidal zone of the five Special Protection Areas (SPAs) in the Thames Estuary
- To provide trends at the sector level for each designated species.
- Identify, on the basis of these analyses, which areas are of greatest importance for birds.
- Provide an assessment of how bird numbers are likely to change in response to sea level rise.

The 23 waterbird species to be analysed are:

European White-fronted Goose
Dark-bellied Brent Goose
Shelduck
Wigeon
Gadwall
Teal
Pintail
Shoveler
Little Grebe
Great Crested Grebe
Cormorant
Oystercatcher
Avocet
Ringed Plover
Golden Plover
Grey Plover
Lapwing
Knot
Dunlin
Black-tailed Godwit
Bar-tailed Godwit
Curlew
Redshank

2. METHODS

2.1 Waterbird Data

WeBS is a long-running survey that monitors waterbird numbers on sites throughout the UK by monthly site visits when numbers of all waterbird species are recorded (Musgrove *et al.* 2007). On large sites, such as the Thames, Medway and Swale Estuaries, where it is not feasible, or indeed desirable, to make a single count for the entire site, synchronous counts of smaller count sectors are undertaken. These sector counts are routinely summed to give the overall site total and during this process the completeness of the overall count assessed. This is necessary because all sectors are not necessarily counted on all occasions. This is undertaken in a species specific manner because the absence of data from a given section would not be expected to affect the overall total equally for all species. Furthermore, completeness is assessed on a month by month, year by year basis using algorithms that allow for both seasonal and long-term trends in site usage. Thus a consolidated count for a site composed of multiple sectors is considered complete when those sectors counted on the month in question would be expected to hold at least 75% of the site total for the species in question for the season and year in question. Whilst the division of large sites into sectors has evolved principally in response to the practicality of undertaking counts, the divisions between sectors typically follow distinctive features of the environment. Thus an analysis of waterbird trends on the individual sectors can inform in a biologically meaningful manner.

For the purposes of WeBS, the wider Thames area is divided into three sites; the Thames Estuary, Medway Estuary and Swale Estuary. Within these sites there are further subdivisions so that individual count sectors are grouped into distinct geographical areas (Fig. 2.1.i). In this report these geographical areas are often presented on separate maps for ease of interpretation and the North Kent Marshes grouping is further subdivided in later maps in the report for the purposes of clarity, as there are many very small sectors in this area (Fig. 2.1.ii). There are sixty-six constituent and extant sectors of the Thames, twenty-eight of the Medway and eight of the Swale (Appendix A). This hierarchical structure of the overall site (Appendix B.i, B.ii & B.iii) has evolved through time as existing sectors have been subdivided. Where this subdivision has occurred in recent years, it is necessary to recombine the counts into the older division in order to generate long-term trends. The coincidence of the WeBS count sectors in relation to the boundary of the SPAs are given in Appendix C.

Figure 2.1.i Locations of each grouping of WeBS count sectors on the Greater Thames Estuary.

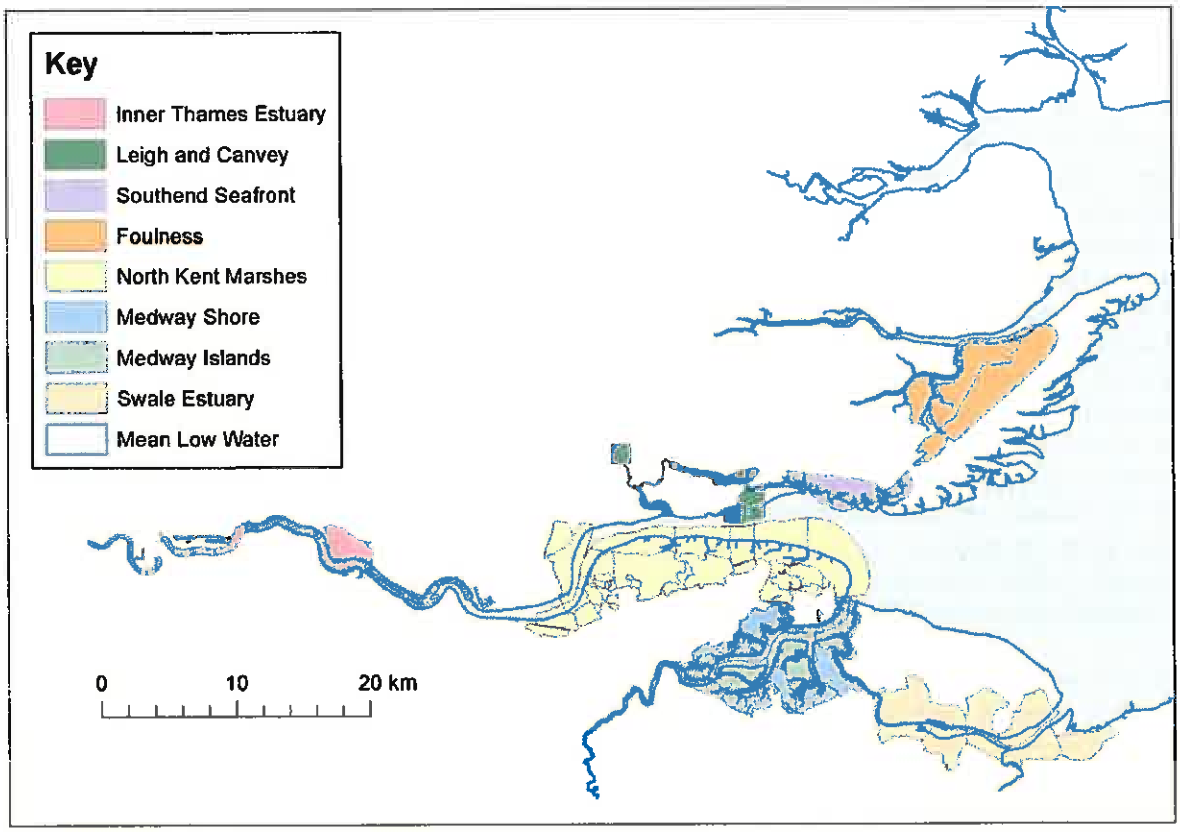
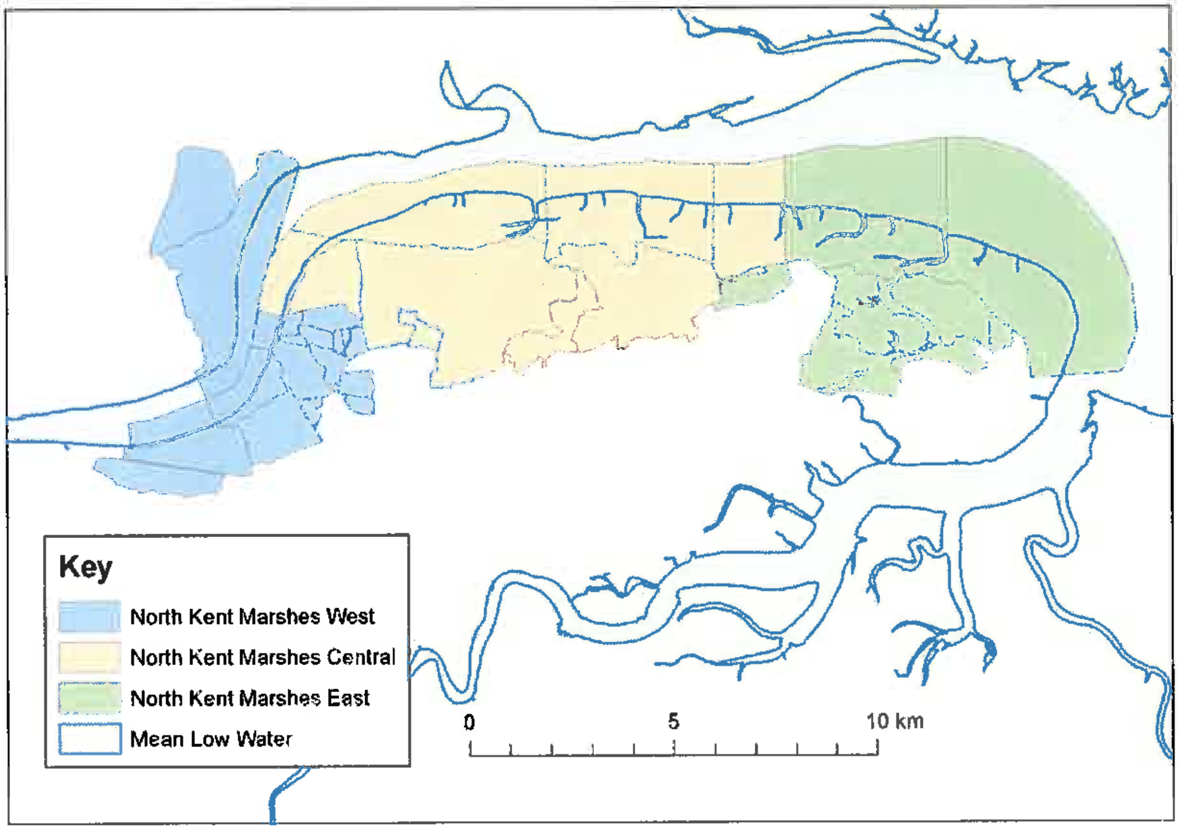


Figure 2.1.ii Subdivision of the North Kent Marshes used in later maps in this report.



2.2 Waterbird Abundance

The relative importance of different sectors, and geographical areas, of the Greater Thames Estuary for each waterbird species was assessed by calculating the five-year mean of peak winter counts for the five most recent winters for which data were available. This was calculated by taking the highest of the monthly counts in each winter and calculating the mean over a five-year period. Five-year means of peak winter counts were calculated both for individual sectors and for all 'complex sectors' (comprised of several smaller sectors) in the site tree (Appendix B.i, B.ii, B.iii).

2.3 Smoothed Waterbird Trends and Percentage Change

The methodology used to produce smoothed site, regional and national trends as reported by WeBS Alerts (Maclean and Austin 2008) can be usefully extended to generate trends on smaller areas of interest such as WeBS count sectors or appropriately grouped count sectors. It is, however, important to recognise that the numbers of birds underlying the observed trend on sectors are generally much lower than those underlying site trends reported by WeBS Alerts which are, by definition, at least equal to the national qualifying threshold. Consequently, individual trends should not be 'over-interpreted'. For example, a 50% decline from 30 birds to 15 birds would give much less cause for concern than a 50% decline from 1000 to 500 birds, the latter being much more likely to reflect a real and substantial loss of birds from an area than the former. While bearing this in mind, a consistent pattern of decline across multiple species, even when the numbers involved for some of them are comparatively low, is strongly indicative of adverse factors affecting the sector in question and the particular suite of species showing a decline in numbers can guide us in where to look for problems (e.g. does the suite of species represent those known to be particularly sensitive to disturbance or those with similar ecological requirements).

Thus, using the latest available validated WeBS data (to winter 2006/07 inclusive), following Atkinson *et al.* (2000, 2006), smoothed indices (trends) were calculated using Generalized Additive Models (GAMs) for the relevant species. The smoothing is to ensure that year-specific factors, such as poor conditions on the breeding grounds or particularly harsh weather on the wintering grounds, that are not related to changes in the quality of the Greater Thames Estuary, do not contribute overly to the trend. Percentage change has been calculated for short- (5yr) medium- (10yr) and long-term (15yr) timescales. WeBS does not have the necessary data collated at the sector level to support analysis of longer time-series. By way of analogy with the WeBS Alerts system, declines of at least 25% a but below 50% are flagged as medium-declines, and declines of 50% or greater are flagged as high-declines (we specifically do not use the terms medium- and high-Alerts because unlike the percentage change reported by WeBS Alerts, medium and high declines reported at the sector level do not constitute a formal WeBS Alert). The corresponding percentage change required to balance the numbers to their former level following a decline or increase are likewise termed medium- (at least 33% but below 100%) and high- (100% or greater) increases.

2.4 Placing The Smoothed Waterbird Indices Into Context

Once the smoothed sector indices have been produced the observed trends are placed in context of the site trends. The latest WeBS methodology (Banks & Austin 2004), as used to compare site trends with regional and national trends (Maclean and Austin 2008), is extended here to compare count sector trends with site trends. If waterbird numbers of a given species on a given count sector follow those of the species across the site as a whole then the proportion contribution of numbers on the site would remain constant. Any significant deviation from this gradient of zero would indicate that the waterbird populations on the relevant count sector are doing either better or less well than would be expected from the site trend. Consequently:

- where a decline on a sector reflects a decline across the site as a whole it is unlikely that the observed site trend is being driven by factors affecting that sector. If this is true of the majority of sectors, then this may indicate that the observed site decline in the species in question is due to factors external to the site and are thus not due to site management issues *per se*;

- where a decline on a sector is more substantial than that across the site as a whole, this may suggest that factors affecting that sector could be contributing to the overall decline;

- where a decline on a sector is less than the decline across the site as a whole, this suggests that relatively favourable conditions on that sector are helping buffer site declines;

- where an increase on a sector is less than that across the site as a whole, this suggests that the sector is already at carrying capacity for the species in question or, if historically it supported greater numbers, that the quality of the sector to that species has diminished;

- where an increase on a sector is greater than that across the whole site, this suggests that trends on that sector are driving the increase across the site or that the sector in question is relatively attractive compared to the site as a whole when increased numbers arrive at the site due to external factors.

The comparisons between sectors and site are derived from a logistic regression model with a binomial error term. The resulting plots depict the percentage contribution of the sector to the site as a whole and the associated confidence limits represent both variation in this proportion between months in a given year and the underlying sample size (e.g. we would be more confident of our estimate that a sector contributed 10% of the site total if 100 birds out of 1000 on the site were counted there than we would be if this was 10 out of 100). This is based on the winter period as routinely used for all WeBS reporting (Nov-Mar for waders and Sep-Mar for other species). Only data from months where counts consolidated across the site as a whole had been assessed as complete were available were used - following standard WeBS protocol described above.

Having considered the trends on the sectors, each in the context of trends across the site as a whole, it is worth considering the site trends in the context of the region – here South-east England (comprised of Environment Agency Anglian and Southern Regions following standard WeBS Alerts reporting), as this can modify our interpretation of the pattern of change across all sectors. This is especially important where there has been an increase or decline regionally. Consequently:

- where there has been an apparent re-distribution of a species within the wider Thames (i.e. declines on some sectors appear to be balanced by increases on other sectors), but the proportional contribution of the wider Thames to increasing regional numbers is declining, then this implies that those sectors on the wider Thames with static or declining numbers are actually of concern because we would expect them to be increasing in parallel with the other sectors. Thus, in such cases, the apparent redistribution within the wider Thames is misleading and the species in question may be facing problems on those sectors not supporting an increase in numbers;

- where a species is in regional decline we would expect declines on at least some of the sectors of the wider Thames regardless of whether birds are being affected by adverse factors locally. Thus, we would expect those sectors of least suitable habitat to a given species to be the first to show a decline in numbers.

3. RESULTS

3.1 Waterbird Abundance

The importance of individual sectors for given species can be determined by considering the five-year mean of peak counts (Table 3.1.i & Appendix D).

3.2 Sector Plots

The trends of each species on each sector are given in Appendix E, together with plots comparing the count sector trends with the site trends putting the former into the context of trends on the Greater Thames Estuary as a whole. Plots are grouped by sector and species presented in taxonomic order. This information is summarised below (Tables 3.2.i and 3.2.ii) and the underlying values representing percentage change and proportional contributions to the Greater Thames Estuary are available from Appendix G. Colour coding is used to represent declines or increases; species are listed in taxonomic order and sectors have been listed in geographical order. Caution is advisable in interpreting individual cells in these tables as, for example, a 50% decline (shown in red) could represent a decline from 10,000 to 5,000 birds or could be a decline from 20 to 10, and therefore the plots in the appendix should also be referred to. However, consistency between adjacent cells would suggest that either a group of species or a group of adjacent sectors have similar trends. Where this is the case, this may suggest that the trends represent real ecological changes.

This information is also presented in map format, which better facilitates a geographic interpretation of the trends (Fig. 3.2.i).

Population trends have also been produced for each species across the Greater Thames Estuary as a whole, along with plots showing changes in the proportion of the South-east England regional population that is supported on the wider Thames, which put the wider Thames population trends into a regional context (Appendix F).

	European White-fronted Goose	Dark-bellied Brent Goose	Shelduck	Wigeon	Gadwall	Teal	Pintail	Shoveler	Little Grebe	Great Crested Grebe	Cormorant	Oystercatcher	Avocet	Ringed Plover	Golden Plover	Grey Plover	Lapwing	Knot	Dunlin	
		4; 12	174; 204	856; 824	148; 172	1760; 1217	45; 44	213; 271	20; 35	2; 1	160; 149	4; 8	1; 3	7; 20	61; 32	3; 0	2777; 3211	0; 0	775; 701	162; 300
		0; 0	57; 61	1; 1	0; 0	157; 219		0; 0		1; 0	39; 38	5; 7	8; 2	31; 2		3; 1	331; 457		2040; 300	121; 67
to Swanscombe		6; 0	14; 10	0; 0	13; 6	35; 36	0; 0	3; 8	2; 5	0; 0	47; 38	4; 2	0; 0	29; 4		0; 0	88; 111		150; 160	33; (2)
		12; (12)	; (460)	858; 824	215; 229	3397; (2036)	; (84)	258; 296	22; 36	15; 18	407; (274)	18; 19	8; 3	56; 22	61; 32	; (1)	3284; 3804	0; 0	2765; 948	290; 436
		2; 4	309; 257	252; 57	0; 0	289; 107	1; 0	3; 9	1; 1	0; 0	40; 10	14; 15	16; 23	0; 0		1; 0	3874; 4252	11; 0	4448; 5800	1070; 22
			4; 7	81; 64	6; 9	119; 47		55; 33	6; 7	1; 0	10; 15	5; 11	3; 4	0; 0		0; 0	84; 81		1; 0	29; 11
		404; 710	44; 66	32; 25	0; 0	237; 141		3; 0	2; 1	1; 0	7; 4	26; 37	38; 73	161; 318	781; 2000	881; 820	642; 278	925; 2500	1389; 305	365; 172
	10; 0	2652; 1548	54; 62	1636; 1600	0; 0	125; 99	0; 0	20; 8	4; 3	2; 5	20; 16	289; 243	66; 60	210; 241	344; 500	516; 644	414; 350	1480; 450	3211; 3450	85; 67
		389; 270	16; 38	170; 80		112; 230	0; 0	0; 0	0; 0	11; 0	18; 17	1600; 1500	13; 65	189; 80	36; 0	392; 380	62; 0	4975; 6500	12500; 13500	97; 0
	10; 0	3033; 1976	375; 345	1940; 1600	6; 9	767; 443	1; 0	63; 34	8; 8	14; 5	69; 37	1771; 1650	108; 138	502; 553	977; 2045	1836; 1844	4650; 4882	6753; 8950	18887; 20618	1368; 22
		271; 305	10; 6	19; 0	0; 0	3; 0	7; 0	0; 0		22; 7	74; 39	1481; 249		262; 219		3; 1	10; 0	0; 0	1358; 240	15; 0
	0; 0	2293; 1889	20; 4	28; 25	0; 0	0; 0	0; 0	5; 0		3; 0	9; 8	7134; 7690	0; 0	29; 0	134; 15	880; 229	540; 205	13232; 21000	2974; 1800	3; 0
	2; 0	3620; 2203	288; 73	383; 138	2; 0	65; 30	7; 0	3; 3	47; 53	4; 0	59; 48	16688; 20005	0; 2	78; 34	943; 739	2941; 1666	816; 729	31255; 69630	5476; 3965	2; 1
	31; 0	3717; 5091	531; 647	1552; 1502	5; 0	512; 448	1; 0	22; 9	66; 72	3; 2	30; 38	101; 115	230; 294	23; 55	3050; 2300	449; 461	3362; 3387	90; 216	1151; 1172	147; 200
	8; 0	1996; 1750	437; 313	871; 722	4; 2	937; 662	2; 0	16; 11	27; 20	1; 0	22; 19	46; 45	265; 356	11; 35	982; 1330	1120; 2422	2544; 2789	28; 0	1202; 2441	190; 222
	32; 0	7884; 5957	940; 751	2574; 2143	9; 2	1500; 1125	9; 0	40; 20	130; 135	8; 2	97; 103	21995; 26022	360; 485	109; 75	4715; 2713	4280; 3625	6568; 6676	37947; 74380	9516; 7395	294; 265

	Bu	Da	Sh	Wi	Ga	Te	Pl	Sh	Li	Gr	Co	Oi	Al	Fi	Gr	Gr	Al	Kr	Da	
avel Pits	0; 0	15; 0	241; 246	44; (2)	; (13)	; (15)	3; 0	; (15)	; (23)	; (0)	29; 19	11; 6	370; 689	92; 67	18; 0	393; 329	541; (947)	9; 9	7745; 7500	345; [illegible]
			2; 2	14; 10	9; 10	10; 14				0; 0	3; 2	0; 0		5; 1	0; 1	1; 0	5; 3		1; 0	
		12; 0	5; 2	25; 4	34; 19	120; 23	5; 0	28; 14	12; 15		1; 1				0; 0		47; 94			0; 0
		12; 0	7; 2	38; 10	41; (19)	120; 23	5; 0	28; 14	12; 15	0; 0	3; 2	0; 0		5; 1	0; (1)	1; 0	55; (94)		1; 0	0; 0
		8; 0	43; 4	175; 105	44; 59	184; 327	0; 0	0; 0		0; 0	19; 7	12; 10	56; (240)	5; 0	9; 0	47; 54	55; 0	1; 4	1565; 300	33; 0
			0; 0	1; 0	7; 2	3; 3		1; 0	5; (4)	0; 0	1; 1	0; 0			0; 0	0; 0	7; 0			
			62; 69	13; 9	59; 20	3; 0		1; 0	10; 19	11; 17	3; 1	1; 1	3; 0	11; 0	0; 0	0; 0	175; 96	0; 0	42; 0	0; 0
		8; 0	92; 69	176; 105	79; 60	186; 327	0; 0	2; 0	12; 20	11; 17	20; 9	13; 11	59; (240)	16; 0	9; 0	47; 54	236; (96)	1; 4	1573; 300	33; 0
			2; 0	1; 5	1; 1	0; 0		1; 0	19; 35	33; 32	29; 12	1; 0		0; 0	0; 0	0; 0	92; 0		1; 0	0; 0
			3; 0		0; 0	1; 0		1; 0	33; 51	4; 6	0; 0	2; 0	0; 0		0; 0		135; 0		16; 0	0; 0
	0; 0		0; 0	5; 3	97; 21	56; 13	5; 3	83; 67	37; 49	6; 6	7; 13						106; 0			
			1; 0	0; 0	33; 40	0; 0		8; 7	27; 20	7; 8	8; 5						40; 0			
			0;		0;	0;		0;	1;	0;	0;	0;	0;	0;	0;	0;	0;		0;	0;
			224; 569	5; 1	2; 0	15; 4	5; 0	38; 32	48; 21	15; 1	0; 0	3; 5	25; 95	66; 112	0; 0	210; 408	321; 905	2; 0	2804; 4715	194; 7
			109; 23	8; 29	1; 0	72; 53	7; 1	15; 5	46; 47	16; 13	0; 0	0; 0	70; 0	0; 0	1; 0	110; 0	463; 317	0; 0	1363; 0	3; 0
			3; 0	15; 0	1; 0	62; 85	6; 12	26; 53	21; 31	7; 1		0; 0	0; 0	3; 0		7; 0	374; 0		167; 0	0; 0
			4; 9	17; 25	1; 5	103; 92	5; 0	8; 4	79; 154	25; 24	0; 0	0; 1	0; 0	11; 0	19; 30	0; 0	237; 362	0; 0	134; 0	7; 0
			19; 0	76; 0	13; 0	287; 0	45; 0	78; 0	45; 0	0; 0	0; 0	0; 0	0; 0	7; 0	45; 0	0; 0	396; 31	0; 0	26; 0	5; 0
	0; 0	0; 0	280; 569	137; 60	126; 59	521; (192)	82; (14)	210; (8[illegible])	224; 289	65; 74	32; 23	6; 6	90; 95	73; 112	113; 30	322; 468	1570; 1289	1; 0	3791; 4715	203; 7
			24; 2	153; 12	20; 11	14; 13	0; 0		1; 0	0; 0	3; 1	0; 0	0; 0	2; 0	0; 0	47; 43	0; 0	0; 0	787; 15	0; 0
		0; 0	0; 0			3; 0			0; 0	1; 0	0; 0				0; 0	0; 0	48; 0		0; 0	
	0; 0	15; 0	123; 113	2044; 877	14; 2	234; 60	56; 6	22; 7		1; 1	8; 6	1; 2	0; 1	19; 95	0; 0	26; 50	8; 28	0; 0	26; 1	1; 5
	20; 0	8; 0	199; 400	1868; 547	22; 8	219; 303	2; 0	28; 9	2; 1	0; 0	8; 7	3; 2	0; 0	0; 0	326; 45	0; 0	1292; 388	1; 0	129; 0	157; 0
			0; 0	0; 0	0; 0	6; 0	0; 0		1; 4		0; 1						1; 0			0; 0
	20; 0	20; 0	247; 402	3004; 885	42; 14	405; 303	58; 6	48; 10	4; 5	2; 1	16; 10	5; (4)	0; 1	21; 95	326; 45	62; 64	1304; 388	1; 0	807; 15	158; 5
			12; 11	383; 660	6; 0	678; 630	3; 4	31; 23	8; 5	0; 0	6; 5	4; 10	23; 12	0; 1	7; 0	0; 0	138; 22		1; 0	2; 1
		12; 10	41; 44	272; 175	0; 0	0; 0	0; 0	0; 0	0; 0	3; 1	2; 1	6; 3	0; 0	19; 0	0; 0	27; 0	137; 400	0; 0	27; 0	27; 0
		10; 0	0; 0	46; 2	0; 0	2; 0		0; 0	1; 1		2; 2	1; 0		0; 0	7; 0	0; 0	90; 6	0; 0	0; 0	0; 0
		1228; 205	13; 12	26; 52	0; 0	0; 0	0; 0	1; 0	0; 0	1; 1	3; 3	204; 122	0; 0	77; 60	2; 4	172; 24	5; 8	510; 600	1650; 1500	0; 0
	0; 0	1235; 215	71; 48	334; 182	0; 0	3; 0	0; 0	1; 0	1; 1	3; 1	6; 6	212; 122	0; 0	86; 60	12; 4	172; 24	222; 400	510; 600	1650; 1500	40; 0
		6; 12	0; 0								1; 1	0; 0		0; 0	0; 0		0; 0			0; 0
	1; 0	148; 22	125; 62	266; 14	3; 0	153; 3	11; 8	2; 0		1; 1	14; 7		0; 0	0; 0	17; 0	0; 0	0; 0	0; 0		
			0; 2	73; 106	15; 40	84; 230	8; 12	10; 30	7; 12	1; 1	0; 0				0; 0		47; 131		0; 0	1; 0
		0; 0	1; 4	1; 0	1; 0	4; 2		1; 2	0; 0								0; 0			
			14; 5	0; 0	6; 0	3; 0	1; 0	1; 0	1; 0	0; 0	0; 0	0; 0	0; 0	0; 0			0; 0		0; 0	0; 0
		64; 89	48; 24	0; 0							2; 2	1073; 1370	0; 1	66; 72	0; 0	163; 34	19; 0	2777; 5000	1384; 1500	9; 25
		44; 39	73; 41	0; 0		5; 2	0; 0	0; 0			0; 0		0; 0	0; 0	0; 0	43; 124	244; 110	184; 0	360; 0	36; 0
	1; 0	203; 89	164; 67	320; 106	24; 40	262; 232	16; 20	11; 32	9; 12	2; 1	14; 7	1073; 1370	0; 1	66; 72	17; 0	181; 124	288; 161	2954; 5000	1410; 1500	46; 25
		0; 0	5; 0	257; 0	16; 24	447; (145)	0; 0	15; 2	7; 9	0; 0	2; 0	0; 0		0; 0	1; 0	0; 0	405; 1			0; 0
		0; 0	0; 0	2; 0	108; 89	320; 47	0; 0	20; 3	5; 5	0; 0	1; 1	0; 0			0; 0		2; 0			0; 0
			1; 0	14; 40	48; 50	296; 28	0; 0	4; 0	3; 4	0; 0	1; 0	0; 0	0; 0		0; 0		0; 0			0; 0
		0; 0	6; 0	322; (40)	149; 137	878; (150)	1; 0	32; 3	12; 16	0; 0	4; 1	0; 0	0; 0	0; 0	1; 0	0; 0	406; 1		0; 0	1; 0
			0; 0						0; 0	0; 0	1; 3									
		0; 0	66; 35	16; 4	20; 7	55; 95	1; 0	6; 0	12; 10	0; 0	1; 0	0; 0		0; 0	56; 0	0; 0	378; 173	0; 0	0; 0	28; 44
			0; 0	0; 0	11; 0	35; 26		1; 0	5; 9	0; 0	0; 0			0; 0			0; 1			
		27; 23	81; 28	31; 64	2; 0	2; 1	2; 0	1; 0		1; 0	3; (4)	187; (176)		45; 71	1; 0	133; 15	1; 0	5; 1	812; 72	1; 0
	0; 0	27; 23	120; 39	36; 64	30; 7	69; (106)	3; 0	7; 0	15; 19	1; 0	3; (4)	187; (176)		45; 71	56; 0	133; 15	378; 173	5; 1	812; 72	29; 44
	20; 0	989; 239	736: 839	3586: 1652	: (195)	1890: (906)	147: (24)	212: 101	[illegible]	[illegible]	94; 66	1232; 1440	598: 689	231: 267	483; (45)	827; 534	3771: (2250)	3467; 5146	12672: 9018	721: 1
	54: 0	10041: 8100	2344: 1805	5944: 3566	613: (414)	6253: 3940	: (98)	[illegible]	[illegible]	[illegible]	589: 434	25216: 27836	949: 1312	866: 952	6207: 4781	6425: 5664	15052: 15676	42985: 83716	41954: 32882	2071:

			18;								1;	2;		1;		0;	0;		17;	
			6;	225;	15;	205;	2;	18;	46;		0;	1;					0;			
		0; 0	2; 2	7; 0	1; 0	3; 6	0; 0	16; 11	13; 12	1; 1	0; 0	0; 0				0; 0	0; 0			
		313; 300	1; 0	18; 0	0; 0			3; 0	6; 6					1; 0			24; 0			28; 0
		156; 300	*4; 2*	*18; 0*	*1; 0*	*3; 6*	*0; 0*	*16; 11*	*26; 18*	*1; 1*	*0; 0*	*0; 0*		*1; 0*		*0; 0*	*16; 0*			*18; 0*
		156; 300	*18; (2)*	*87; 0*	*5; 0*	*103; (6)*	*1; 0*	*21; (11)*	*49; (18)*	*1; 1*	*0; 0*	*1; 0*		*1; 0*		*0; 0*	*12; (0)*		*4; 0*	*14; 0*
	0;	224;	265;	168;	0;	69;	4;	1;	1;	1;	89;	306;	11;	8;	4;	179;	217;	765;	1817;	12;
		101;	205;	268;	6;	423;	2;	6;	6;	4;	133;	693;	0;	55;	0;	39;	271;		1046;	2;
		0;	13;	0;	5;	27;		0;	25;	0;	2;	6;		60;	0;	1;	270;		95;	0;
		535; 270	99; 134	43; 49		6; 2	6; 0		2; 4	5; 10	2; 3	1; 2	0; 0	18; 2	0; 0	0; 0	254; 207		4; 0	0; 0
	0; 0	*; (270)*	*; (134)*	*268; (49)*	*5; 0*	*443; (2)*	*4; 0*	*2; 0*	*29; (4)*	*7; (10)*	[illegible]	*698; (2)*	*0; 0*	*; (2)*	*0; 0*	*39; (0)*	*; (207)*	*0; 0*	*1111; (0)*	*1; 0*
		40; 46	232; 313	194; 350		71; (100)	24; 29	[illegible]	0; 0	3; 1	5; 10	44; 79	100; 200	7; 1		29; 20	269; 500	0; 0	1106; 2000	250; (5
		75; 130	188; 139	73; 75		27; 43	0; 0	36; 0	0; 0	5; 9	9; 15	17; 12	252; 340	52; 53		13; 7	100; 124	0; 0	1345; 1230	278; 45
		21; (32)	269; 254	31; 42		28; 20	8; 4	68; 67	0; 0	1; 2	1; 2	3; 3	65; 130	17; 30		2; 1	41; 76		128; 25	1; 0
	0; 0	0; 0	; (0)	0; 0		; (8)	0; 0	; (0)	1; (1)			; (0)		0; 0		0; 0	; (0)		0; 0	0; 0
		11; (13)	78; 35	9; 12		34; (17)	1; 2	28; 28	0; 0	1; 1	1; 1	17; 29		8; 0		3; 2	227; 203	1; 0	15; 0	19; 0
	0; 0	*96; 130*	704; 506	*361; 390*	*1; 0*	*160; 160*	*46; 31*	[illegible]	*1; (1)*	*26; 11*	*21; 25*	*120; (94)*	*352; 540*	*; (54)*		*35; 26*	*648; (797)*	*1; 0*	*3012; 3012*	*; (959)*
		220; 70	167; 114	163; 104	0; 0	16; 8	4; 4	4; 8	0; 0	0; 0		65; 0	5; 0	4; 20	0; 0	0; 0	147; 60	0; 0	1; 0	6; 0
		166; (161)	354; (419)	107; (157)	0; 0	54; 60	35; (27)	7; 0		5; 7	2; 2	6; 2	18; 0	57; (21)		30; (22)	66; (63)	10; 0	444; (610)	0; 0
		257; 400	42; 8	13; 0	0; 0	8; 5	1; 4	0; 0	0; 1		0; 0	3; 3		2; 0		0; 0	112; 0		0; 0	
		20; 0	2; 0									0; 0			4; 0	2; 0	84; 0		14; 0	
		445; 454	*402; (420)*	*271; (161)*	*0; 0*	*62; (62)*	*37; (27)*	*12; 8*	*0; 1*	*5; 7*	*2; 2*	*70; 5*	*23; 0*	*50; 27*	*4; 0*	*30; (22)*	*337; (63)*	*10; 0*	*445; (610)*	*6; 0*
		39; (71)	*305; 279*	*774; 686*	*2; (2)*	*; (436)*	*615; 471*	*10; 18*	*5; (4)*	*; (9)*	*10; (7)*	*101; 42*	[illegible]	*8; 0*	*1; 0*	*90; (29)*	*; (102)*	*1; 0*	*1188; 816*	*116; 81*
	0; 0	145; 285	388; 450	371; 550	3; (6)	301; 160	202; 164	26; 26	; (11)	5; 9	5; 9	; (880)	325; 650	43; 85	1275; 2000	35; 70	5000; 5000	275; 550	750; 1500	; (161)
	0; 0	**; (1076)**	1404; (1156)	**1502; 1429**	**7; (6)**	**; (611)**	696; 582	**; (509)**	65; (23)	44; (25)	296; (28)	**; (933)**	505; 1027	; (115)	643; 2000	**216; (95)**	5184; 5184	787; (550)	; (4032)	; (1120

		22; 4	16; 4	32; 2		43; 0	1; 0	0; 0	1; 2	0; 0	6; 17	104; 90	5; 0	0; 0	2; 0	19; 30	140; 39	34; 0	203; 350	43; 0
		18; (0)	126; (2)	25; (0)		; (15)	12; (0)		0; 0	4; (0)	3; (0)	17; (0)		22; (0)		25; (0)	68; (0)		86; (0)	0; (0)
		110; 234	53; 7	70; 120		101; 260	13; 0	2; 0	0; 0	3; 3	5; 5	155; 327	1; 0	9; 16		365; 315	9; 0	16; 0	1370; 720	0; 0
		106; 52	42; 37	18; 6		19; 0	0; 0	0; 0		0; 0	3; 0	510; 545		2; 0	0; 0	25; 8	103; 0	8; 0	129; 0	0; 0
		31; (0)	57; (0)	13; (0)		16; (0)	4; (0)	10; (0)	1; (2)	4; (0)	1; (0)	424; (0)	7; 0	0; (0)	0; (0)	99; (42)	11; (0)	299; (0)	491; (120)	6; (0)
Marshes		*229; 290*	*205; (48)*	*120; 128*		*175; 260*	*18; 0*	*8; 0*	*2; (4)*	*8; (3)*	*14; 22*	*1092; (962)*	*13; 0*	*15; (16)*	*2; 0*	*499; (395)*	*256; 39*	*249; 0*	*1822; 1190*	*47; 0*
		504;	382;	927;	5;	392;	93;	2;	0;	5;	5;	608;	366;	25;	24;	397;	408;	2436;	2328;	66;
		50;	127;	132;	0;	53;	25;	0;	0;	1;	4;	511;	62;	1;		164;	125;	13;	220;	148;
		666; (290)	[illegible]	**1135; (128)**	**4; 0**	**553; (260)**	127; (0)	**9; 0**	**2; (4)**	**11; (3)**	**19; (22)**	**1946; (962)**	407; 0	**40; (16)**	**21; 0**	[illegible]	**665; (39)**	**2143; 0**	**4264; (1190)**	**249; (0**

	0; 0	**1152; (1076)**	2063; (1156)	**; (1429)**	**; (6)**	**; (611)**	**; (682)**	**; (509)**	[illegible]	[illegible]	[illegible]	**2455; (1005)**	**; (1027)**	**; (115)**	**1284; 2000**	1117; (467)	5184; 5184	**3159; (550)**	7451; (5222)	**; (1120**

	112; 110	524; 980	518; 400	3504; 770	56; 45	880; 450	63; 70	70; 50	5; 2	67; 1	15; 16	4200; 3500	90; 112	46; 58	3580; 5800	799; 950	3160; 3200	2370; 2500	3920; 4200	231; 68
	342; 245	596; 555	374; 250	1228; 1490	19; 23	1836; 2320	35; 72	22; 18	2; 1	6; 4	8; 6	31; 31	103; 200	0; 0	3325; 4000	53; 180	4325; 6500		373; 70	44; 43
	121;	88;	1074;	13838;	30;	3807;	730;	211;	20;	31;	97;	727;	572;	123;	2560;	875;	6207;	1204;	3441;	681;
	0; 0	150; 450	358; 250	773; 2300	23; 14	146; 61	48; 103	29; 56	54; 43	14; (12)	22; 9	117; 146	42; 43	3; 0	346; 200	98; 144	1082; 300	137; 15	2163; 1450	482; (2
	0; 0	1062; 1210	149; 129	817; 410	6; 28	15; 2	0; 0	6; 0	2; 2	6; 7	18; 9	111; 56	100; 190	4; 10	532; 460	45; 54	1331; 1080	436; 2100	903; (450)	148; 21
	0; 0	12; 1	30; 0	536; 132	29; 6	265; 230	31; 2	103; 120	12; 13	6; 6	11; 8	4; 0	8; 6	20; 8	104; 9	36; 21	881; 800	15; 26	347; 350	339; 53
	0; 0	*1062; 1210*	*153; 129*	*1069; 542*	*33; 26*	*269; 230*	*31; 2*	103; 120	*13; 15*	*11; 13*	*29; 17*	*114; 56*	183; 190	*24; (10)*	*679; (460)*	*66; 54*	*1900; 1500*	*445; 2100*	*1019; (650)*	414; 3
		821; 816	89; 70	181; 535	4; 5	101; 14	9; 10	10; 4	4; 4	8; 19	6; 13	185; 255	2; 0	65; 79	448; 0	47; 17	444; 338	9; 0	324; 287	131; 0
		99; 99	1; 0	1956; 1860	1; 0	209; 5	38; 76	2; 0		23; 23	8; 6	85; 63		139; 167	130; 21	5; 1	230; 93	4; 0	317; 266	0; 0
	0; 0	*855; 915*	*89; 70*	*1955; 1860*	*4; (5)*	*; (14)*	*30; 86*	*12; 4*	*4; 4*	*42; 42*	*13; (13)*	*263; 255*	*2; 0*	*134; 167*	*644; 21*	*50; 18*	*494; 338*	*15; 0*	*566; 423*	*131; 0*
	471; (355)	1754; 2310	2114; (075)	10821; (4100)	129; (82)	5288; (2582)	790; (231)	315; (144)	63; 49	190; (51)	139; (39)	4910; 3702	895; (344)	[illegible]	9180; (10520)	1576; (1186)	15470; (10648)	3331; 4506	9202; (4612)	1425; (

by double lines around the group of sectors included in the complex sectors. Higher level groupings (those shown in Fig. 2.1.i) are shown in bold text.

	GEESE		DUCKS						GREBES			WADERS							
	European White-fronted Goose	Dark-bellied Brent Goose	Shelduck	Wigeon	Gadwall	Teal	Pintail	Shoveler	Little Grebe	Great Crested Grebe	Cormorant	Oystercatcher	Avocet	Ringed Plover	Golden Plover	Grey Plover	Lapwing	Knot	
er Pool	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
ehouse	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
enwich	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	---	---	XYZ	-YZ	-YZ	XyZ	-YZ	---	---	XYZ	---	---	---	sMl	---	s-z	---	---
	---	---	-mL	---	---	---	---	---	---	---	sYz	---	---	---	---	---	---	---	sml
k	---	---	---	---	---	---	---	---	---	---	-YZ	---	---	---	---	---	--z	---	---
Bridge (Dartford) to Swanscombe	---	---	SML	---	---	---	---	---	---	---	-YZ	---	---	---	---	---	s-z	---	Sml
ary	---	---	-YZ	XYZ	xYZ	xYZ	---	-YZ	---	---	xYZ	---	---	S-L	---	---	-YZ	---	s-L
n Creek	---	---	-ml	xYZ	---	SML	---	---	---	---	-YZ	--l	---	---	---	SML	sYZ	---	-Yz
ark	---	---	---	-yZ	---	-yZ	---	-YZ	---	---	---	---	---	---	---	---	--z	---	---
	---	---	---	---	---	-YZ	---	---	---	---	---	---	---	---	---	---	---	---	---
	---	--l	---	---	---	-yZ	---	---	---	---	---	--z	---	---	--z	XyZ	--z	X-Z	Sml
o Tree Island	---	-ml	smL	xYZ	---	-yZ	---	---	---	---	---	xYz	---	-YZ	XYZ	SML	-yz	SML	sml
	---	-ML	-ML	SML	---	---	---	---	---	---	---	sML	---	SML	---	SMl	---	-m-	---
	---	-ml	xmz	xYZ	---	-mZ	---	---	---	---	-Yz	-m-	---	---	XYZ	sML	-YZ	-m-	--z
	---	x-l	---	---	---	---	---	---	---	---	S--	SML	---	---	---	---	---	---	sml
	---	xyZ	---	---	---	---	---	---	---	---	---	XYZ	---	SML	X-z	-Yz	-ml	---	x--
	---	--L	--L	---	---	xY-	---	---	-YZ	---	xYZ	--z	---	sml	Xmz	x--	-ml	xmz	---
	xyZ	Xyz	s--	xyZ	---	-y-	---	---	XYZ	---	-ml	---	XYZ	---	-yZ	sm-	--z	SML	sm-
	---	--L	-mz	XYz	---	xYZ	---	---	---	---	smL	sml	-yZ	---	-yZ	-YZ	--Z	---	s-z
	---	--l	s--	xyz	---	-Yz	---	-mL	xYZ	---	---	xyz	xYZ	sML	--Z	--z	--z	xm-	---

Location	European W	Dark-bellie	Shelduck	Wigeon	Gadwall	Teal	Pintail	Shoveler	Little Grebe	Great Cres	Cormorant	Oystercatc	Avocet	Ringed Plo	Golden Plo	Grey Plove	Lapwing	Knot	Dunlin	Black-tailed	Bar-tailed (	
nt Marshes West Map																						
NO DATA																						
NO DATA																						
Tilbury to Mucking including Mucking Gravel Pits	---	sML	-mL	XML	---	XML	---	---	---	---	---	---	xYZ	xm-	SML	xyZ	xyz	-ML	xyZ	XYZ	---	---
Shorne Marshes Offshore	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Shorne Marshes	---	---	---	---	---	xyZ	---	---	---	---	---	---	---	---	---	---	sML	---	---	---	---	---
Filborough Marshes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	s-z	---	---	---	---	---
Shorne and Filborough Marshes	---	---	---	---	---	xYZ	---	---	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---
Higham Bight	---	---	SML	--Z	---	XYZ	---	---	---	---	---	---	XMz	---	---	SML	SML	---	sML	---	---	XYz
Higham Marsh	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---	---	sMl
Timber Lake	---	---	-ML	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---
Higham Marsh and Bight	---	---	SML	---	---	xYZ	---	---	---	---	---	---	-M-	sML	SML	SML	SML	---	SML	---	---	xy-
Cliffe Creek and Offshore	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Alpha Pool	---	---	---	---	---	---	---	---	---	X--	---	---	---	---	SML	---	SMl	---	SML	---	---	---
Elf Pools	---	---	---	---	---	---	---	---	XmZ	---	---	---	---	---	---	---	xYZ	---	---	---	---	---
North Quarry	---	---	---	---	--Z	SML	SML	Sml	smZ	---	---	---	---	---	---	---	---	---	---	---	---	---
South Quarry	---	---	---	---	---	---	---	---	SMz	---	---	---	---	---	---	---	---	---	---	---	---	---
Coastguards Pool	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Flamingo Pool	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	xYz	-yZ	---	xYZ	---	---	---
Ski Pool	---	---	---	---	---	---	---	---	xYZ	---	---	---	---	---	---	SmL	--z	---	SmL	---	---	---
Hidden Pool	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	xYZ	---	xyz	---	---	---
Radar Pool	---	---	---	---	---	---	---	---	XyZ	---	---	---	---	---	---	---	XYZ	---	SMl	---	---	---
Black Barn Pools	---	---	---	S--	---	s--	SML	--z	---	---	---	---	---	---	Xmz	sML	xyz	---	sML	---	---	---
Cliffe Pits and Pools	---	---	XYl	sml	-yZ	s-l	sMl	syz	x-Z	XyZ	x--	---	---	XYz	Sml	XYz	xYZ	---	XYz	---	---	---
nt Marshes Central Map																						
Lower Hope Point Offshore	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	S--	---	---	---
Redham Mead	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	---	---	---	SMl
Cliffe and Cooling Offshore	---	---	SML	Sm-	---	SMl	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---	---	---
Cliffe and Cooling Marshes	SML	---	Sml	xYZ	---	--z	---	---	---	---	---	---	---	---	s-l	---	S--	---	SML	---	---	sml
Rye Street RSPB Reserve	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cliffe and Cooling Marshes area	SML	---	SML	sYZ	SM-	-mL	SML	SML	---	---	---	---	---	---	SY-	-y-	SMl	---	SYZ	---	---	-m-
Northward Hill RSPB Reserve	---	---	---	-YZ	---	-YZ	---	---	---	---	---	---	---	---	SML	---	xml	---	---	---	---	---
St Mary`s Marsh Offshore	---	-ML	sml	-yz	---	---	---	---	---	---	---	---	---	-y-	---	SmL	---	---	Sml	---	---	Xyz
St Mary`s Marsh	---	smL	SmL	---	---	---	---	---	---	---	---	---	---	---	S--	---	SMl	---	S-l	---	---	---
Coombe Bay Offshore	---	Xy-	SML	XMz	---	---	---	---	---	---	---	xml	---	---	SML	SML	---	SML	Sml	S--	---	sml
St Mary`s Marsh and Coombe Bay	---	XY-	SML	-mz	---	SML	SML	---	---	---	---	XYz	---	-Yz	Syl	SmL	Sml	SY-	Syz	---	---	-y-
nt Marshes East Map																						
Dagnam Fields	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SMl
Yantlet and Allhallows Offshore	---	-ML	SML	SML	---	---	SML	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Yantlet and Allhallows Marsh	---	---	---	---	---	-YZ	---	---	---	---	---	---	---	---	---	---	SMl	---	---	---	---	---
Sluice Fleet	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Stoke Lagoon	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Yantlet Beach	---	x--	Sml	---	---	---	---	---	---	---	---	sm-	---	--l	---	SML	---	SMl	Xyz	---	SML	x--
Yantlet Saltmarsh and Creek	---	-ML	SML	---	---	---	---	---	---	---	---	---	---	---	---	XMl	SMl	XYZ	XYZ	---	---	---
Yantlett and Allhallows	---	xmL	SML	s--	---	sy-	SML	---	---	---	---	s--	---	---	---	SML	SML	S--	XYZ	SMl	SML	---
South Allhallows Marsh	---	---	---	XYZ	---	--z	---	---	---	---	---	---	---	---	---	---	sm-	---	---	---	---	SMl
Stoke Fleet	---	---	---	---	SmZ	sMl	---	SML	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Freshwater Yantlet	---	---	---	SML	---	Syz	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Stoke Fleet and Marshes	---	---	---	Xmz	smZ	sm-	---	SML	---	---	---	---	---	---	---	---	SMl	---	---	---	---	SMl
Perry`s Farm	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SMl

Location	European	Dark-bellie	Shelduck	Wigeon	Gadwall	Teal	Pintail	Shoveler	Little Greb	Great Cres	Cormorant	Oystercatc	Avocet	Ringed Plo	Golden Plo	Grey Plove	Lapwing	Knot	Dunlin	Black-taile	Bar-tailed (	
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NO DATA																						
NO DATA																						
Tilbury to Mucking including Mucking Gravel Pits	---	sML	-mL	XML	---	XML	---	---	---	---	---	---	xYZ	xm-	SML	xyZ	xyz	-ML	xyZ	XYZ	---	---
Shorne Marshes Offshore	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Shorne Marshes	---	---	---	---	---	xyZ	---	---	---	---	---	---	---	---	---	---	sML	---	---	---	---	---
Filborough Marshes	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	s-z	---	---	---	---	---
Shorne and Filborough Marshes	---	---	---	---	---	xYZ	---	---	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---
Higham Bight	---	---	SML	-Z	---	XYZ	---	---	---	---	---	---	XMz	---	---	SML	SML	---	sML	---	---	XY
Higham Marsh	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---	---	sM
Timber Lake	---	---	-ML	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---
Higham Marsh and Bight	---	---	SML	---	---	xYZ	---	---	---	---	---	---	-M-	sML	SML	SML	SML	---	SML	---	---	xy-
Cliffe Creek and Offshore	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Alpha Pool	---	---	---	---	---	---	---	---	---	X--	---	---	---	---	SML	---	SMl	---	SML	---	---	---
Elf Pools	---	---	---	---	---	---	---	---	XmZ	---	---	---	---	---	---	---	xYZ	---	---	---	---	---
North Quarry	---	---	---	---	--Z	SML	SML	Sml	smZ	---	---	---	---	---	---	---	---	---	---	---	---	---
South Quarry	---	---	---	---	---	---	---	---	SMz	---	---	---	---	---	---	---	---	---	---	---	---	---
Coastguards Pool	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Flamingo Pool	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	xYz	-yZ	---	xYZ	---	---	---
Ski Pool	---	---	---	---	---	---	---	---	xYZ	---	---	---	---	---	---	SmL	--z	---	SmL	---	---	---
Hidden Pool	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	xYZ	---	xyz	---	---	---
Radar Pool	---	---	---	---	---	---	---	---	XyZ	---	---	---	---	---	---	---	XYZ	---	SMl	---	---	---
Black Barn Pools	---	---	---	S--	---	s--	SML	--z	---	---	---	---	---	---	Xmz	sML	xyz	---	sML	---	---	---
Cliffe Pits and Pools	---	---	XYl	sml	-yZ	s-i	sMl	syz	x-Z	XyZ	x--	---	---	XYz	Sml	XYz	xYZ	---	XYz	---	---	---
nt Marshes Central Map																						
Lower Hope Point Offshore	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	s--	---	---	---
Redham Mead	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SML	---	---	---	---	SM
Cliffe and Cooling Offshore	---	---	SML	Sm-	---	SMl	---	---	---	---	---	---	---	---	SML	---	SML	---	---	---	---	---
Cliffe and Cooling Marshes	SML	---	Sml	xYZ	---	--z	---	---	---	---	---	---	---	---	s-l	---	S--	---	SML	---	---	sml
Rye Street RSPB Reserve	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cliffe and Cooling Marshes area	SML	---	SML	sYZ	SM-	-mL	SML	SML	---	---	---	---	---	---	SY-	-y-	SMl	---	SYZ	---	---	-m-
Northward Hill RSPB Reserve	---	---	---	-YZ	---	-YZ	---	---	---	---	---	---	---	---	SML	---	xml	---	---	---	---	---
St Mary`s Marsh Offshore	---	-ML	sml	-yz	---	---	---	---	---	---	---	---	---	-y-	---	SmL	---	---	Sml	---	---	Xyz
St Mary`s Marsh	---	smL	Sml	---	---	---	---	---	---	---	---	---	---	---	S--	---	SMl	---	S-l	---	---	---
Coombe Bay Offshore	---	Xy-	SML	XMz	---	---	---	---	---	---	---	xml	---	---	SML	SML	---	SML	Sml	S--	---	sm
St Mary`s Marsh and Coombe Bay	---	XY-	SML	-mz	---	SML	SML	---	---	---	---	XYz	---	-Yz	Syl	SmL	Sml	SY-	Syz	---	---	-y-
nt Marshes East Map																						
Dagnam Fields	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SM
Yantlet and Allhallows Offshore	---	-ML	SML	SMl	---	---	SML	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Yantlet and Allhallows Marsh	---	---	---	---	---	-YZ	---	---	---	---	---	---	---	---	---	---	SMl	---	---	---	---	---
Sluice Fleet	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Stoke Lagoon	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Yantlet Beach	---	x--	Sml	---	---	---	---	---	---	---	---	sm-	---	--l	---	SML	---	SMl	Xyz	---	SML	x--
Yantlet Saltmarsh and Creek	---	-ML	SML	---	---	---	---	---	---	---	---	---	---	---	---	XMl	SMl	XYZ	XYZ	---	---	---
Yantlett and Allhallows	---	xml	SML	s--	---	sy-	SML	---	---	---	---	s--	---	---	---	SML	SML	S--	XYZ	SMl	SML	---
South Allhallows Marsh	---	---	---	XYZ	---	--z	---	---	---	---	---	---	---	---	---	---	sm-	---	---	---	---	SM
Stoke Fleet	---	---	---	---	SmZ	sMl	---	SML	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Freshwater Yantlet	---	---	---	SML	---	Syz	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Stoke Fleet and Marshes	---	---	---	Xmz	smZ	sm-	---	SML	---	---	---	---	---	---	---	---	SMl	---	---	---	---	SM
Perry`s Farm	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	SM

	European White-fronted Goose	Dark-bellied Brent Goose	Shelduck	Wigeon	Gadwall	Teal	Pintail	Shoveler	Little Grebe	Great Crested Grebe	Cormorant	Oystercatcher	Avocet	Ringed Plover	Golden Plover	Grey Plover	Lapwing	Knot
r Pool																		
house																		
nwich																		
k																		
Bridge (Dartford) to Swanscombe																		
ary																		
n Creek																		
ark																		
Tree Island																		

Location	European	Dark-bellie	Shelduck	Wigeon	Gadwall	Teal	Pintail	Shoveler	Little Grebe	Great Crest	Cormorant	Oystercatc	Avocet	Ringed Plo	Golden Plo	Grey Plove	Lapwing	Knot	Dunlin	Black-tailed	Bar-tailed (
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South Quarry																					
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Ski Pool																					
Hidden Pool																					
Radar Pool																					
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Cliffe and Cooling Marshes																					
Rye Street RSPB Reserve																					
Cliffe and Cooling Marshes area																					
Northward Hill RSPB Reserve																					
St Mary`s Marsh Offshore																					
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Yantlet Saltmarsh and Creek																					
Yantlett and Allhallows																					
South Allhallows Marsh																					
Stoke Fleet																					
Freshwater Yantlet																					
Stoke Fleet and Marshes																					
Perry`s Farm																					

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re Map																					
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se Fleet																					
co Pool																					
h Level																					
co and South Level Pools																					
h Grain																					
e Saltings and Ooze																					
ham and Downhead																					
snorth Power Station																					
Marsh																					
snorth																					
rside Country Park																					
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rs Wharf																					
ley Sewage Treatment Works																					
ham Creek																					
ley and Otterham Creek																					
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way Shore																					
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and Nor and Bishop and Copperhouse Marshes																					
twick and Greenborough and Slayhills																					
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way Estuary																					
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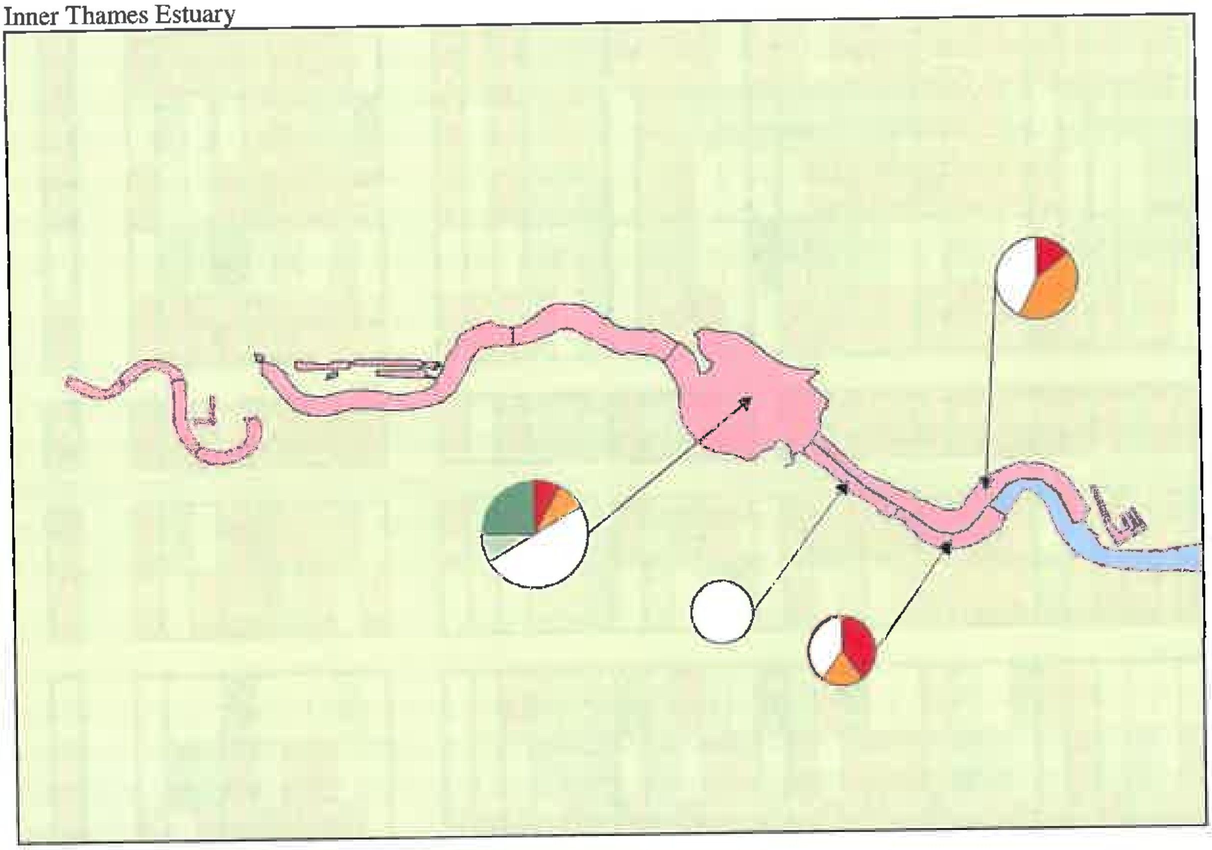
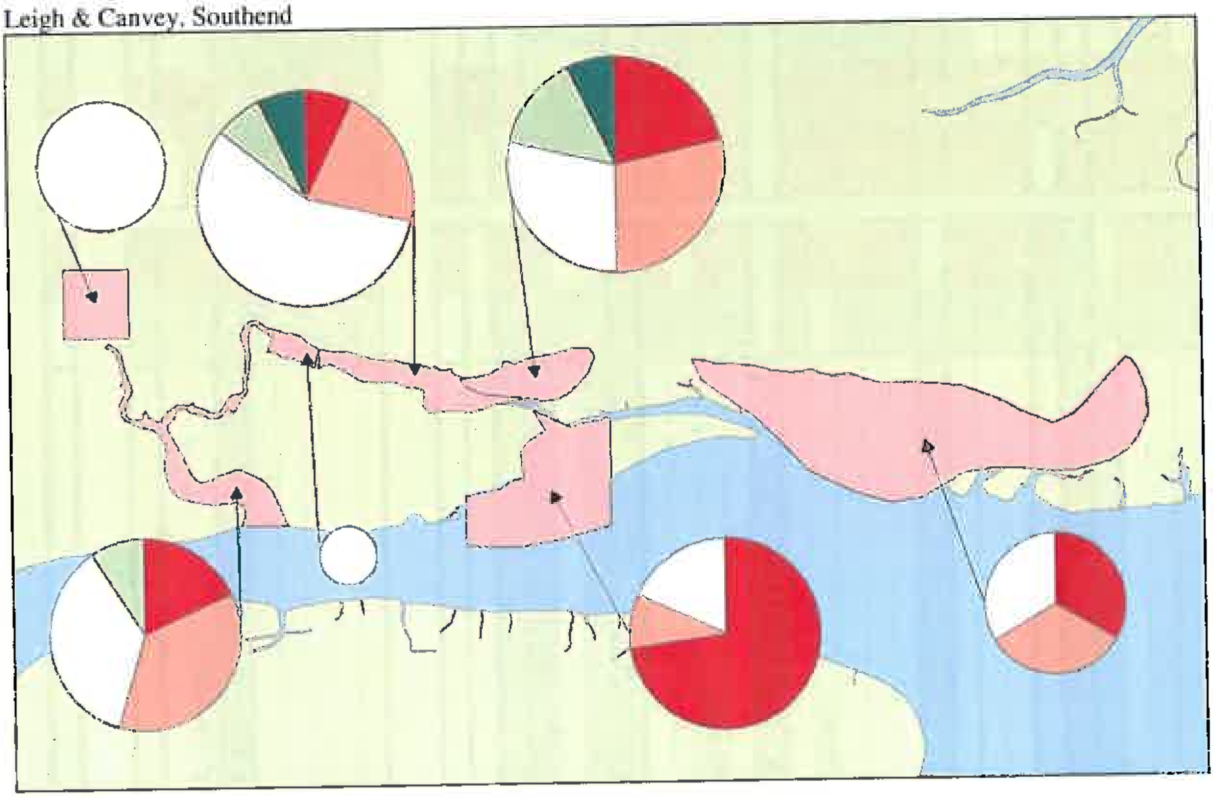
ey Marshes																					

Figure 3.2.i Population trends of species by sector in the Greater Thames Estuary. The size of each pie chart relates to the number of species for which there is sufficient data to generate trends, and within each pie chart the proportion of species whose populations have shown high declines (>50%), medium declines (25% to 50%), no medium or high change (-25% to +33%), medium increase (33% to 100%) or high increase (>100%) are represented by red, orange, white, light green and dark green respectively.

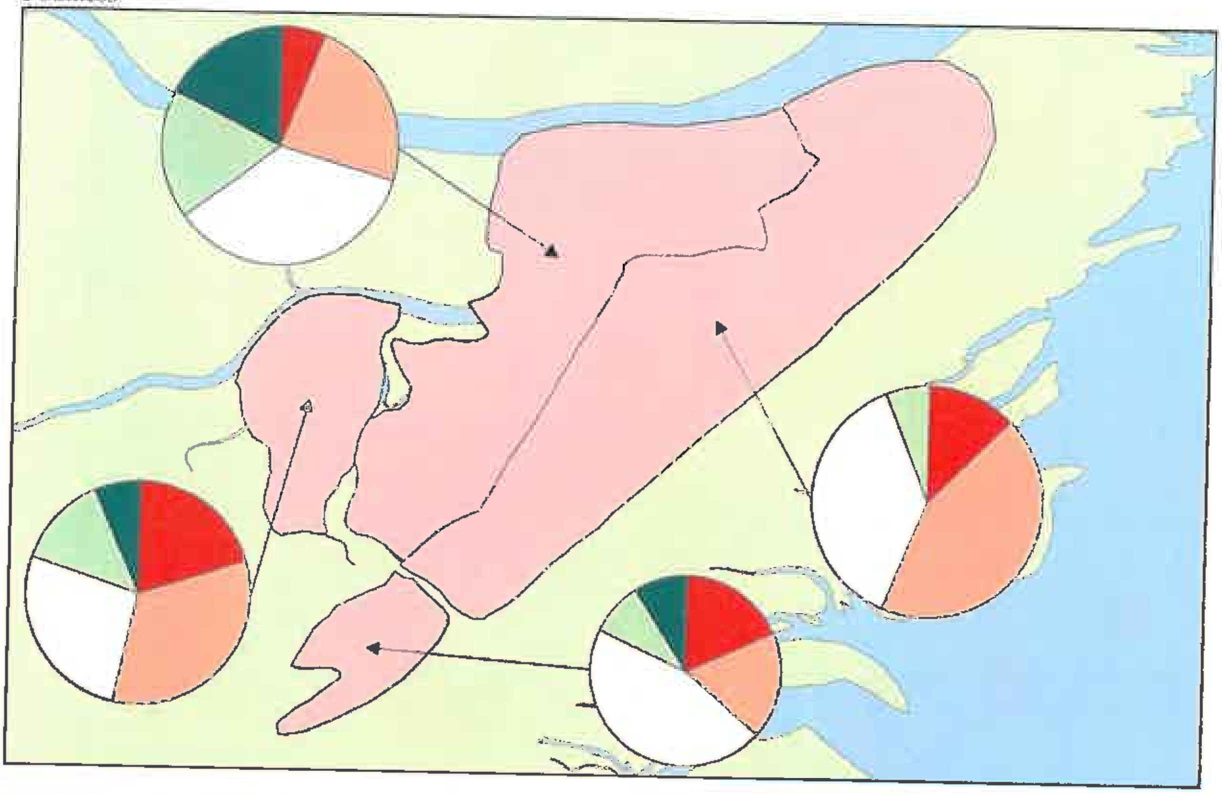
Inner Thames Estuary



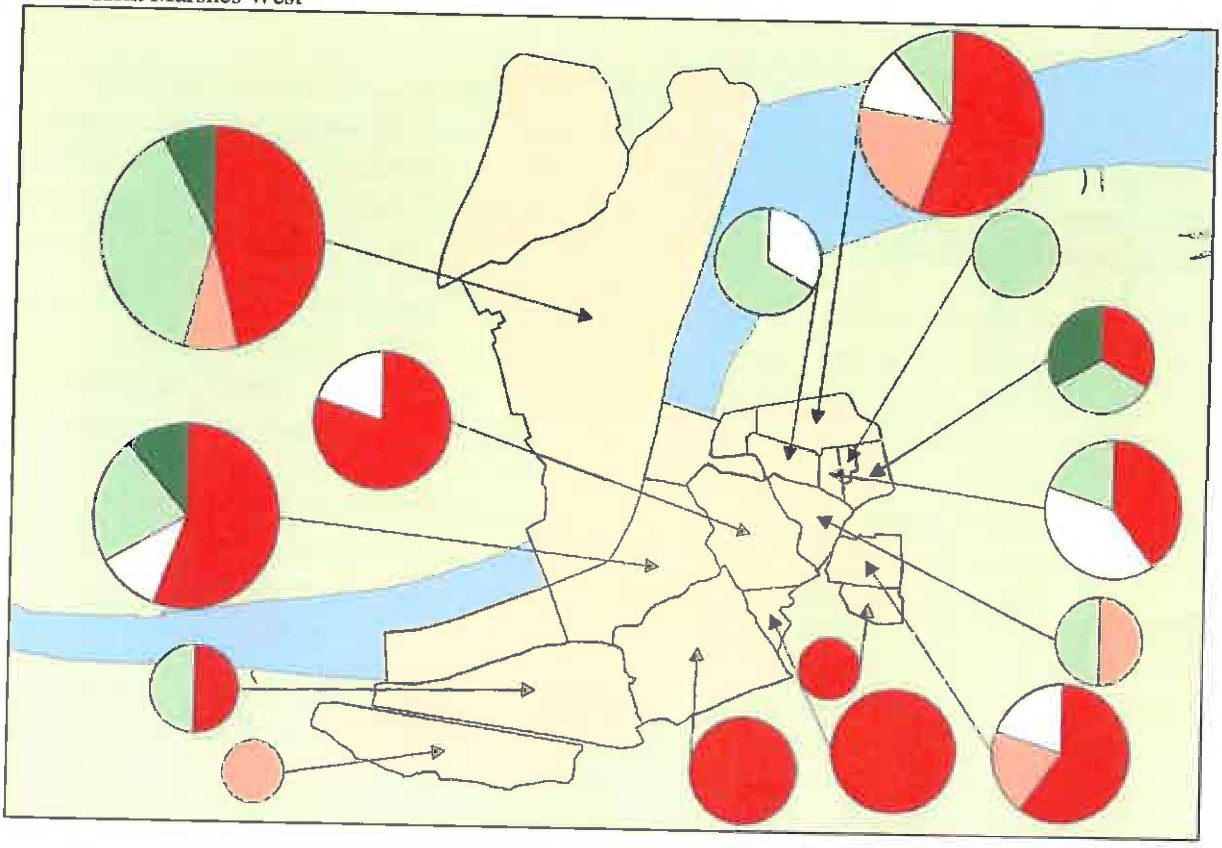
Leigh & Canvey, Southend



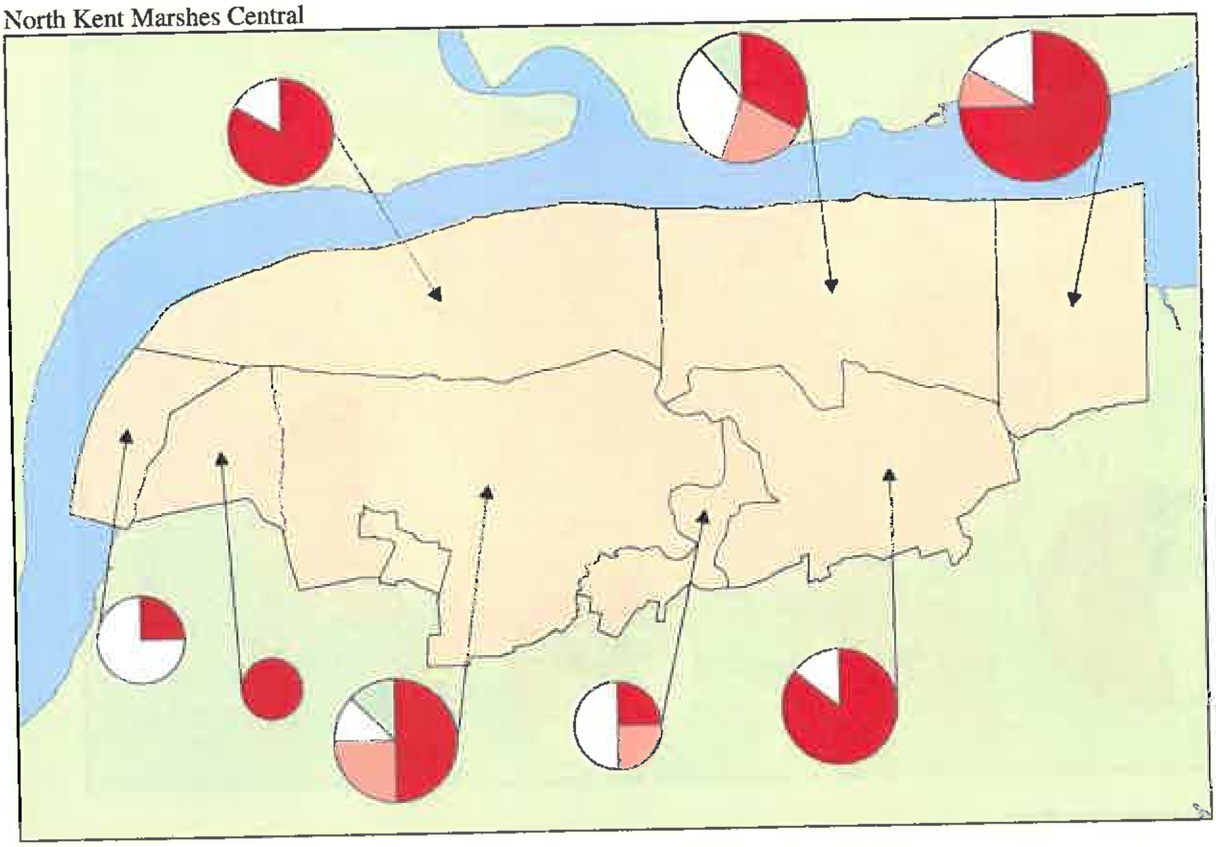
Foulness



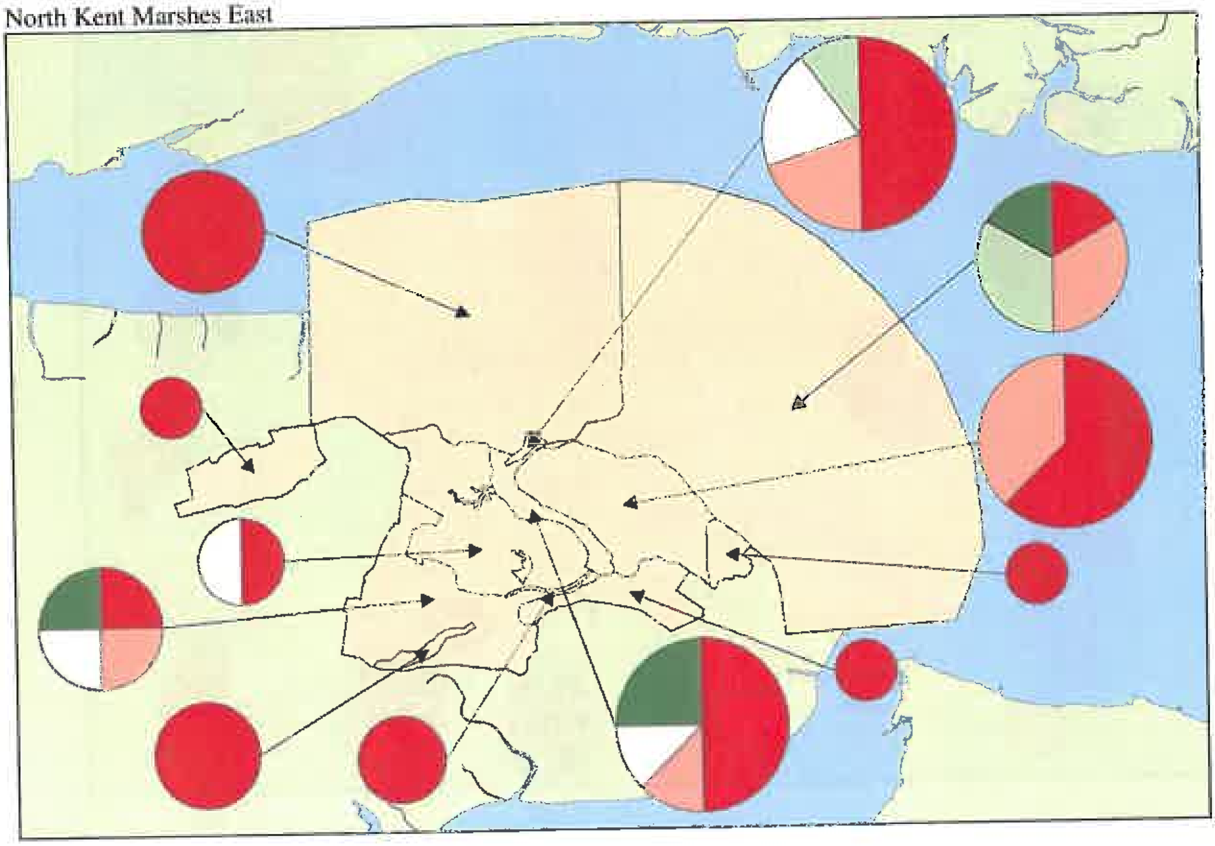
North Kent Marshes West



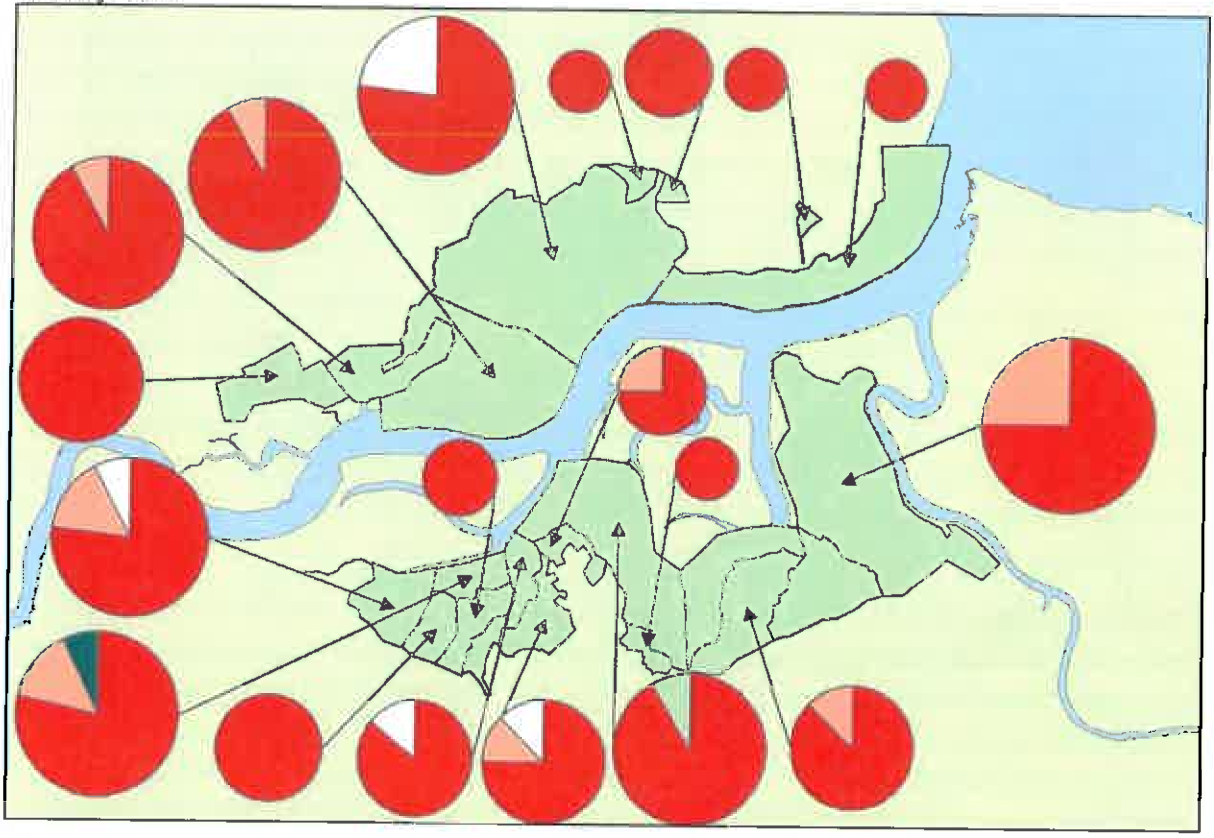
North Kent Marshes Central



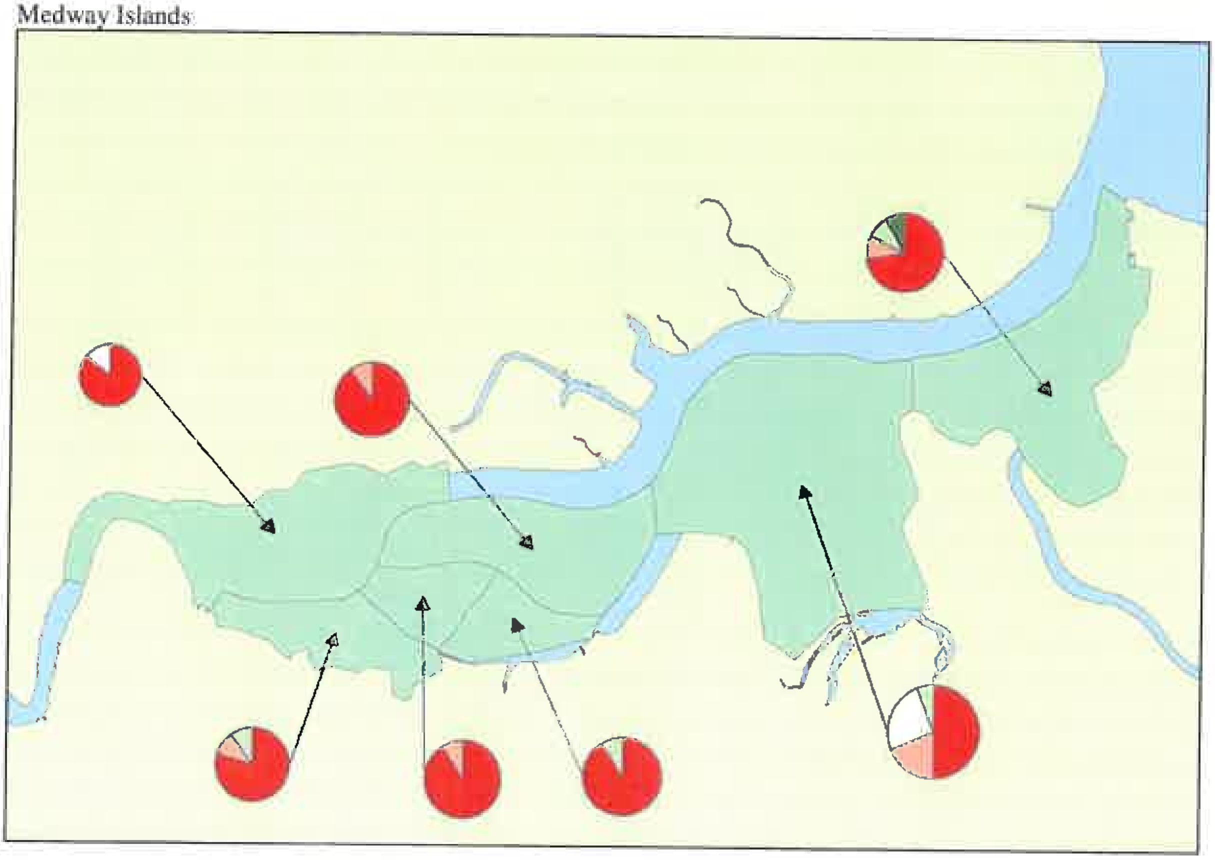
North Kent Marshes East



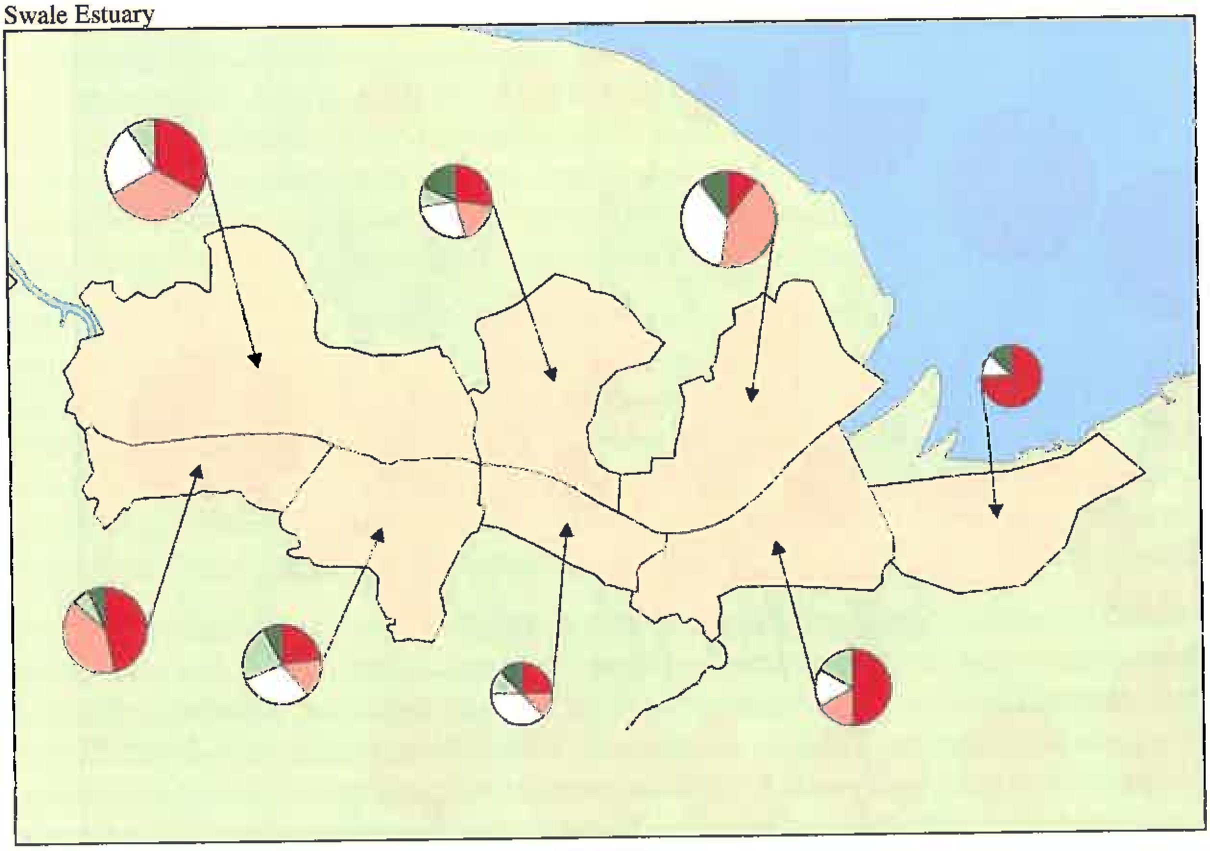
Medway Shore



Medway Islands



Swale Estuary



4. DISCUSSION AND CONCLUSIONS

4.1 Species Distribution and Trends

4.1.1 European White-fronted Goose *Anser albifrons albifrons*

During the latest five years, European White-fronted Geese have not been observed during WeBS core counts on many sectors of the Thames, Medway and Swale estuaries. However, of those sectors where the species was counted, numbers were highest on the northern shore of the Swale Estuary with sectors 22449 (Shellness and Harty Marshes), 22451 (Capel Fleet) and 22447 (Elmley Marshes) all having a mean annual peak of 100-500 individuals.

Population trends for European White-fronted Goose must be treated with caution, as for many WeBS count sectors (and the entire Medway Estuary) there were insufficient data to generate reliable trends. Medium- and long-term declines of more than 50% occurred on all three sectors of the Swale which had sufficient data to generate trends (all on the northern shore of the Swale). An overall medium-term decline of 40% and a long-term decline of 65% occurred on the Thames Estuary, which was driven by short-, medium- and long-term declines of more than 50% on the North Kent Marshes. Only one sector showed increasing trends for European White-fronted Goose: Crouchside (sector 25921) had a long-term increase of more than 50% and short- and medium-term increases of 25-50%. However these increases represent only a few individuals as the mean peak count during the last five years was only 31 birds. Of all these changes those on the Swale are likely to be the most significant as this area supports a much higher number of birds than the Thames (five-year mean peak winter count of 471 on the Swale Estuary, compared to 54 on the Thames Estuary).

4.1.2 Brent Goose (Dark-bellied) *Branta bernicla bernicla*

Brent Geese are widely distributed throughout the wider Thames, with many sectors on the Medway and Swale estuaries, and in the Leigh and Canvey area, having peak counts of more than 100 individuals. However, the highest numbers occurred in the Foulness area, with all four WeBS count sectors in this area having a mean annual peak count of between 1,500 and 3,800 individuals during the last five years. Other sectors with similarly high counts included Leigh Marsh and Two Tree Island (25412 – part of the Leigh and Canvey area), Coombe Bay Offshore (22904 – part of North Kent Marshes) and Conyer to Luddenham Gut (22454 – part of the Swale Estuary).

Brent Goose numbers have declined on the long-term (15-year) timescale across many parts of the wider Thames. However, the most notable declines were on the Medway Estuary, where declines occurred on almost all sectors on all three timescales, and showed significantly greater declines than the wider Thames as a whole. Increases in the number of Brent Geese were recorded at very few sites; however, it may be that sites with relatively stable numbers will become relatively more important for this species if numbers on the Medway continue to decline.

4.1.3 Shelduck *Tadorna tadorna*

Shelduck are widespread throughout the estuary, with counts of more than 100 birds on many WeBS sectors. However, the highest numbers of birds occur towards the outer part of the wider Thames, with counts of 200-400 birds on many sectors in the Medway and Swale Estuaries and peaks of 518 birds on Shellness and Harty Marshes (22447) and 1074 birds on Elmley Marshes (22449). High numbers also occurred in the Foulness area with peaks of 437 birds on Potton Island (25924) and 531 birds on Crouchside (25921). In the Leigh and Canvey area, sector 25414 (Vange and Holehaven Creek) had a five-year mean peak of 309 birds. This sector closely matches the area covered by Holehaven Creek pSPA.

Numbers of Shelduck have declined throughout the Greater Thames Estuary during the past 15 years. Sites with particularly steep declines were the Medway Estuary and the North Kent Marshes, but other sites also had declining numbers. Numbers on the north shore of the Thames declined less than on the site as a whole, indicating that this area may become more important as other sites become less favourable for this species.

4.1.4 **Wigeon** *Anas penelope*

Wigeon numbers are higher in the Swale Estuary compared to other parts of the wider Thames, with a five-year mean peak winter count of more than 13,000 birds on Elmley Marshes (sector 22449) and peaks of 1,200 – 3,500 birds on three other sectors of the Swale Estuary (Capel Fleet, 22451; Shellness and Harty Marshes, 22447; Graveney to Whitstable, 22943). Elsewhere, high numbers were recorded in the Cliffe area with five-year mean peak counts of 1,868 and 2,044 birds on sectors 22812 and 22912 respectively, and on the northern shore of the Thames with Leigh Marsh and Two Tree Island (sector 25412) and Crouchside (sector 25912) both having peaks of more than 1,500 birds.

Overall, Wigeon numbers have been relatively stable on the wider Thames during the last 15 years. However, numbers increased slightly in the early 1990s, then declined in the 2000s to approximately their 1991/92 levels. Wigeon numbers increased across the Inner Thames Estuary, Leigh and Canvey and North Kent Marshes, and at these sites the population trend increased compared to the wider Thames as a whole. Wigeon fared slightly worse on the Swale Estuary than the wider Thames as a whole, with small declines in the short- and medium- term at this site. However, on the Medway, Wigeon numbers declined significantly, with high declines on almost all sectors particularly in the medium- and long- term, and almost all sectors in the Medway had highly significantly greater declines than the wider Thames.

4.1.5 **Gadwall** *Anas strepera*

Gadwall are widely distributed throughout the western and eastern parts of the North Kent Marshes, as well as the Swale Estuary. However, only two individual sectors had five-year mean peak winter counts of more than 100 birds. These were Rainham Marsh (sector 24351) in the Inner Thames, and Stoke Fleet (sector 22092) in the eastern part of the North Kent Marshes.

Gadwall numbers have increased during the last 15 years on the wider Thames, in line with the rest of the country. As numbers were fairly small on all sites, there were few sites that had sufficient data to generate reliable trends in numbers. Overall, it seems that Gadwall numbers may have increased more slowly on the North Kent Marshes and the Swale compared to other parts of the Thames. However, as these sites have relatively high numbers of Gadwall it is possible that these sites are near carrying capacity, leading birds to colonise other sites as the population increased.

4.1.6 **Teal** *Anas crecca*

Teal are widespread throughout the wider Thames, but the highest numbers occur on the northern shore of the Swale Estuary (five-year mean peak counts of 3,807 on Elmley Marshes, 1,836 on Capel Fleet and 880 on Shellness and Harty Marshes). Other sectors with particularly high mean peak counts include Rainham Marshes (sector 24351) with 1,760 birds and Potton Island (sector 25924) with 937 birds.

Considering the wider Thames area as a whole, Teal numbers increased in line with regional trends during the period from 1991/92 to 2006/07. However, Teal showed significantly more rapid increases on the Inner Thames Estuary than elsewhere, with medium- and long-term increases of more than 100% occurring on Rainham Marsh. However, Teal numbers on the Medway Estuary declined by more than 50%, in contrast to the trends elsewhere in the study area, suggesting that environmental factors specific to the Medway Estuary have made that site less suitable for Teal.

4.1.7 **Pintail** *Anas acuta*

Although Pintail occur on a range of suitable sites throughout the wider Thames, most sites hold fewer than 100 birds. By far the best site for this species was Elmley Marshes (sector 22449) with a five-year mean peak winter count of 730. Only two other sites had five-year mean peak winter counts of more than 100 individuals and both were on the southern shore of the Medway Estuary. Chetney Marshes (sector 22961) held a mean peak of 202, while the Barksore and Funton area (an amalgamation of three sectors for which there were insufficient data to generate five-year mean peak counts – 22464, 22465 and 22466) held a mean peak of 615 Pintail.

Pintail numbers have fluctuated on the wider Thames but with no overall increase or decline since 1991/92. However, numbers fell on the North Kent Marshes, in contrast to the trend for the site as a whole. Numbers also fell slightly on the Medway Estuary, but the decline was only marginally worse than the trend for the estuary as a whole and Pintail seems to have fared better on the Medway than many other species, which have seen much steeper declines. Numbers on the Swale were relatively stable, while on the Inner Thames numbers increased significantly, largely due to an increase in numbers at Rainham Marsh (sector 24351).

4.1.8 Shoveler *Anas clypeata*

Small numbers of Shoveler occur on most WeBS sectors on the Greater Thames Estuary, but only four had five-year mean peak winter counts of more than 100 individuals. These were Rainham Marshes (24351) on the Inner Thames, Riverside Country Park (22949) on the Medway, and two sectors on the Swale Estuary: Elmley Marshes (22449) and Luddenham Gut to Faversham Creek (22455). No sector had a five-year mean peak winter count of more than 250 individuals.

Shoveler numbers on the wider Thames have fluctuated during the past 15 years, with perhaps a very slight overall increase, but little difference from regional trends. Increasing trends have occurred on several sites, notably the Cliffe Pits and Pools area at the western end of the North Kent Marshes, the Leigh and Canvey area, and Rainham Marsh in the Inner Thames. On the Medway Estuary, Shoveler numbers were relatively stable (in contrast to the declines of many other species in this area). Numbers declined on the Swale Estuary, driven largely by declines at Elmley Marshes (sector 22449) which still holds high numbers of Shoveler despite these declines.

4.1.9 Little Grebe *Tachybaptus ruficollis*

The highest concentration of Little Grebe in the wider Thames occurs in the western part of the North Kent Marshes, which held a five-year mean peak winter count of more than 200 individuals across 13 sectors, with the best individual sector being Radar Pool (22703) with 79. Elsewhere only two other sectors had five-year mean peak winter counts of more than 50 birds: Crouchside (25921) on Foulness held 66 and Murston to Conyer (22542) on the Swale held 54.

There was an increase in Little Grebe numbers in the wider Thames area, in line with regional trends. Numbers were relatively stable, perhaps with a slight increase, at this species' stronghold in the western part of the North Kent Marshes. Elsewhere, numbers increased at Foulness, but declined on the Medway and Swale Estuaries; the most significant decline was in Murston to Conyer (sector 22452) which holds a relatively high number of Little Grebes.

4.1.10 Great Crested Grebe *Podiceps cristatus*

As with Little Grebe, the highest concentration of Great Crested Grebe is in the western part of the North Kent Marshes, although the overall peak for this area was less than 100 individuals for this species. The Swale Estuary also supports relatively high numbers of Great Crested Grebe, with the best site being Shellness and Harty Marshes (22447) with a five-year mean peak winter count of 67.

Because only small numbers were counted, most sites had insufficient data to generate trends for Great Crested Grebe, and any trends that can be generated should be interpreted with caution. However, the limited data suggest that numbers may be increasing slightly on the North Kent Marshes, and declining on the Medway Estuary. Overall numbers across the wider Thames were stable.

4.1.11 Cormorant *Phalacrocorax carbo*

Small numbers of Cormorant occur throughout the wider Thames, but the highest concentrations are in the Swale Estuary and on the northern shore of the Thames. The highest five-year mean peak winter count was on Rainham Marsh (sector 24351 on the Inner Thames) at 160, followed by Oakham and Downhead (sector 22467 on the Medway) at 133 and Elmley Marshes (sector 22449 on the Swale) at 97.

Cormorant numbers have increased slightly on the Greater Thames Estuary since 1991/92. Within the site, numbers declined on the Medway and Swale Estuaries, numbers on the North Shore of the Thames were relatively stable, while numbers on the North Kent Marshes increased. However, significantly lower population increases occurred on all these sites than on the Thames as a whole, with the only area that had significantly higher population increase than the wider Thames as a whole being the Inner Thames. These increases were driven by increases of more than 100% at Rainham Marsh (sector 24351) over all three timescales, and a long-term increase of more than 850%.

4.1.12 Oystercatcher *Haematopus ostralegus*

Oystercatchers are found in the highest numbers towards the outer part of the Greater Thames Estuary, particularly on the north shore of the Thames, the Medway Islands and the Swale Estuary. By far the highest five-year mean peak winter count was at Thameside (sector 25922 on Foulness) at 16,688 individuals. High numbers also occurred at the adjacent sector Wakering Stairs (25923) at 7,134 birds. Shellness and Harty Marshes (sector 22447 on the Swale Estuary) had a mean peak count of 4,200.

On the wider Thames as a whole, Oystercatcher numbers remained relatively stable during the 1990s with a slight increase in numbers in more recent years. On the sites towards the eastern part of the site which held high numbers of Oystercatcher, numbers increased slightly in the Foulness area (significantly higher increases than the site as a whole), were relatively stable on the Swale Estuary (in line with the trends for the site as a whole) and declined on the Medway Estuary (significantly worse population trend than the site as a whole).

4.1.13 Avocet *Recurvirostra avosetta*

Although Avocets were absent from counts at many of sites, there are now large numbers at a range of sites on the Thames, Medway and Swale Estuaries with 11 sites having mean peak counts of more than 100 birds. The highest counts were on Elmley Marshes (sector 22449 on the Swale Estuary) with a mean of 572. Two amalgamations of sectors also held high numbers. On the Medway Estuary, Barksore and Funton (22963, which is an amalgamation of sectors 22464, 22465 and 22466) held a mean peak of 405 birds, while on the North Kent Marshes, sector amalgamation 25902 (Tilbury to Mucking including Mucking Gravel Pits - an amalgamation of 25222 and 25401) had a five-year mean peak winter count of 570 birds.

During the 15 years covered by this study, Avocet numbers have increased markedly on the wider Thames as a whole, in line with regional trends, suggesting that the cause of the population increase is not related to the Thames Estuary. Although there was insufficient data to generate population trends for most WeBS sectors, increases seem to have occurred on all parts of the site, with no particular area showing a significantly slower or faster increase than the overall site.

4.1.14 Ringed Plover *Charadrius hiaticula*

Areas with the highest numbers of Ringed Plover, as with other wader species, tend to be near the outer part of the Greater Thames Estuary in the Leigh and Canvey, Southend and Foulness areas on the north shore of the Thames and on the Swale Estuary. Six sectors had five-year mean peak winter counts of more than 100 birds. These included four on the north shore of the Thames (Benfleet Creek, 25416; Leigh Marsh and Two Tree Island, 25412; Canvey Point, 25411; Southend Seafront, 25415) and two on the Swale Estuary (Elmley Marshes, 22449; Graveney to Whitstable, 22943).

Ringed Plover numbers on the wider Thames have declined in line with regional trends during the 15 years covered by this study. Within the site, numbers in some areas have declined significantly faster than the overall trend, in particular in the Medway, Inner Thames and Foulness area. The Swale Estuary and Leigh and Canvey areas have fairly stable numbers and, therefore, the population trends in this area were significantly better than the wider Thames as a whole.

4.1.15 Golden Plover *Pluvialis apricaria*

Golden Plover numbers were highest in the Swale Estuary, and in the Foulness and Leigh and Canvey areas on the Thames North Shore. Five sites had five-year mean peak winter counts of more than 1,000 birds. Of these three were on the Swale Estuary (Elmley Marshes, 22449; Capel Fleet, 22451; Shellness and Harty Marshes, 22447), one was on the Medway Estuary (Chetney Marshes, 22961) and one was in the Foulness area (Crouchside, 25921).

During the fifteen years covered by this study, Golden Plover numbers fluctuated in the wider Thames area, though with an increase in the latest few years. Relative to the south-east region as a whole, numbers on the wider Thames have been stable, or perhaps declined very slightly (Appendix F). Within the estuary, numbers have increased in the Leigh and Canvey area, while declines have occurred on the Medway Estuary and the North Kent Marshes.

4.1.16 Grey Plover *Pluvialis squatarola*

Grey Plover were found throughout the Medway and Swale Estuaries, and the Thames North Shore area, with smaller numbers occurring on the North Kent Marshes and the Inner Thames Estuary. Only two sites had five-year mean peak winter counts of more than 1,000 birds. Both of these were in the Foulness area (Thameside, 25922 and Potton Island, 25924).

Grey Plover numbers have declined across the wider Thames during the 15 years from 1991/92 to 2006/07, but this trend was relatively close to the overall trend for the south-east region. Grey Plover numbers declined less on the Swale Estuary and in the Leigh and Canvey area than other parts of the site, but declined in these areas nonetheless. On the Medway Estuary, their numbers declined more rapidly than in other areas, with declines of more than 50% on all timescales occurring on almost all WeBS sectors of the Medway. The Swale and the Thames North Shore may become relatively more important for Grey Plover if numbers on the Medway continue to decline.

4.1.17 Lapwing *Vanellus vanellus*

Lapwing are distributed throughout the Greater Thames Estuary but the highest numbers occurred on the Swale and on the Thames North Shore. Eleven sectors had five-year mean peak winter counts of more than 1,000 birds. Five of these were on the Swale Estuary (22449, 22451, 22447, 22452, 22454), three were in the Thames North Shore area (25414, 25924, 25921) and one each on the Medway (22961), North Kent Marshes (22812) and Inner Thames Estuary (24351).

Lapwing numbers have fluctuated on the wider Thames, in line with regional trends. Numbers increased in the medium- and long-term on the Inner Thames and in the Leigh and Canvey area. On the North Kent Marshes and the Medway Estuary, numbers fell slightly in the medium-term and population trends were significantly lower than the average for the wider Thames. However, at the two sectors in the North Kent Marshes and Medway that held the highest numbers of Lapwing (Cliffe and Cooling Marshes, 22812, and Chetney Marshes, 22961), trends were not significantly different from those on the wider Thames. This could be because the cause of decline on other sites in the area has not affected these sectors, or it could be that birds stay on the best sites when the population declines (a buffer effect).

4.1.18 Knot *Calidris canutus*

Knot are intertidal specialists and are thus found largely on the outer parts of the wider Thames such as the Swale Estuary and Foulness. Two sectors on Foulness supported extremely high densities of Knot, with five-year mean peak winter counts of 31,255 on Thameside (sector 25922) and 13,232 on Wakering Stairs (sector 25923).

The overall trend for Knot on the Greater Thames Estuary shows that numbers have fluctuated but with no obvious trend during the last 15 years (Appendix F), and the contribution of the wider Thames to the regional population has not changed. Most parts of the estuary followed the trend for the site as a whole. The only large area with a significantly different trend from the wider Thames was the Medway Estuary, where Knot populations had increased significantly more than on other sites. This is worthy of note as most other species had poorer population trends on the Medway compared to elsewhere. However this result should be treated with caution as the Medway Estuary holds relatively few Knot compared to the wider Thames as a whole.

4.1.19 **Dunlin** *Calidris alpina*

Dunlin is the most abundant waterbird in the Greater Thames Estuary, with five-year mean peak winter counts of over 1,000 birds occurring on 26 different sectors distributed throughout the study area. One sector with an exceptionally high mean peak count was Canvey Point with 12,500 individuals. The other 25 sectors that had counts of over 1,000 birds all had a five-year mean peak winter count between 1,000 and 5,500 individuals, while many other sectors supported several hundred individuals.

Numbers of Dunlin have declined on the wider Thames during the last 15 years, but the proportion of the regional population found on the wider Thames has remained relatively stable, suggesting that declines have also occurred on a wider geographical scale and may not be related to local factors. However, within the wider Thames, numbers remained relatively stable in the North Shore area and the North Kent Marshes, while declines occurred at a faster rate on the Inner Thames and the Medway Estuary than other sites. There was a long-term decline in Dunlin numbers of 87.3% on the Medway Estuary (Table 3.2.i; Appendix G).

4.1.20 **Black-tailed Godwit** *Limosa limosa*

Black-tailed Godwit are recorded throughout the Greater Thames Estuary, but with particularly high numbers on the Swale Estuary and on some parts of the Medway and the Thames North Shore. Only two sites had five-year mean peak counts of more than 500 birds. The first of these, Vange and Holehaven Creek (sector 25414), which covers the area of the Holehaven Creek pSPA, held a mean peak of 1,070. Elmley Marshes (sector 22449 on the Swale) had a mean peak of 681 birds.

Numbers of this species have increased on the wider Thames since the early 1990s, but this increase is consistent with regional and national increases of this species, suggesting an external, rather than site-related, cause. Within the Thames, numbers increased on most WeBS sectors that had sufficient data to generate trends, with the greatest increases occurring on the Inner Thames and the Thames North Shore areas. Numbers increased less rapidly than average on the Medway Islands and the Swale Estuary.

4.1.21 **Bar-tailed Godwit** *Limosa lapponica*

Bar-tailed Godwit are mostly found on the Thames North Shore and Swale Estuary, with a few on the Medway and very small numbers on the North Kent Marshes and Inner Thames areas. Only two sites had five-year mean peak counts of more than 1,000 individuals and both of these were in the Foulness area (Thameside, 25922 and Wakering Stairs, 25923, with mean peaks of 5,828 and 1,467 respectively).

The wider Thames population of this species fluctuated during the 1990s, and the proportion of the regional population found on the wider Thames also fluctuated, but with no consistent trend (Appendix F). The only area with a significantly different trend from the wider Thames was Leigh and Canvey, where numbers increased.

4.1.22 **Curlew** *Numenius arquata*

Curlew are recorded on all parts of the study areas, but the highest concentrations were on the Thames North Shore and the Swale Estuary. The four best sites had five-year mean peak counts of between 500 and 900 birds (Vange and Holehaven Creek, 25414; Thameside, 25922; Elmley Marshes, 22449; Shellness and Harty Marshes, 22447).

Curlew numbers declined slightly on the wider Thames during the 15-year period covered by this report, and they may also have declined slightly faster than the south-east England regional population. The highest declines occurred on the Medway Estuary, with declines of more than 50% on all three timescales and a long-term decline of more than 80% over the last 15 years.

4.1.23 Redshank *Tringa totanus*

As with several other wader species, the highest numbers of Redshank were recorded on sectors on the Thames North Shore (Vange and Holehaven Creek, 25414 and Thameside, 25922 both had five-year mean peak winter counts between 500 and 1,000 birds). Elsewhere, Redshank were widely distributed throughout the estuary with moderate numbers (mean peak count between 100 and 500 birds) occurring on all sectors in the Swale Estuary, and on parts of the Medway, North Kent Marshes and Inner Thames Estuary.

Between 1991/92 and 2006/07 the Redshank population on the wider Thames declined, and the proportion of the regional population supported on the wider Thames also fell. Within the site, numbers declined most rapidly on the Medway Estuary, with smaller declines on the Swale Estuary. It is likely that the overall site trend is driven by declines on the Medway and Swale, as numbers elsewhere remained relatively stable throughout the 15-year period.

4.2 Broad Patterns

4.2.1 Waders and Shelduck

Shelduck and waders (Oystercatcher, Avocet, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew and Redshank) are discussed together because, as with waders, Shelduck feed on mudflat invertebrates, and therefore they are likely to use similar parts of the estuary and respond in similar ways to changes in the environment.

Predictably, the numbers of these species were, for the most part, highest towards the outer (eastern) part of the wider Thames where the habitat is most suitable with large areas of intertidal mudflats and saltmarsh, most notably on the Swale Estuary and Foulness, but also on the Medway Estuary and in the Leigh and Canvey area. Some species (intertidal specialists such as Knot and Bar-tailed Godwit) occurred only in very small numbers elsewhere in the Thames, while other species were more widespread (e.g. Avocet, Dunlin, Black-tailed Godwit, Curlew and Redshank) but with higher numbers towards the outer reaches of the estuary.

The individual WeBS sectors that held the highest numbers of waders and Shelduck included Elmley Marshes (22449) and Shellness and Harty Marshes (22447) on the Swale Estuary, although all sectors of the Swale supported good numbers of these species. Equally all four sectors on Foulness supported large numbers of waders, though the highest numbers in this area were on Thameside (25922). The Thameside sector covers a large geographical area, and the large numbers of birds occurring here during WeBS core (high tide) counts probably reflects the large extent of intertidal habitat available. In the Leigh and Canvey area, the sector supporting the highest numbers of waders and Shelduck was Vange and Holehaven Creek (25414), which covers approximately the same area as the Holehaven Creek pSPA.

On the wider Thames area as a whole, wader and Shelduck populations had mixed fortunes during the fifteen years from 1991/92 to 2006/07, with two species (Avocet and Black-tailed Godwit) increasing, six species declining and five with no obvious trend (Appendix F). Most of these trends were in line with regional and national population changes for these species (Maclean and Austin 2008).

In general, wader populations on the northern shore of the Thames (Leigh and Canvey area and Foulness) tended to have slightly more positive population trends than the wider Thames as a whole, while those on the Swale Estuary tended to be similar to the overall site trends. Shelduck and wader populations on the Medway Estuary had consistently more negative population trends than the wider Thames area (Table 3.1.ii), suggesting that unfavourable local conditions in this area may be driving population declines.

4.2.2 Dabbling Ducks

Dabbling ducks (Wigeon, Gadwall, Teal, Pintail and Shoveler) tended to be more widespread around the wider Thames area than the waders, with a smaller proportion of the population on the outer part of the estuary compared to waders. High numbers of dabbling ducks were found on many parts of the Swale Estuary, particularly on the northern shore of the Swale (Elmley Marshes, 22447; Shellness and Harty

Marshes, 22449; and Capel Fleet, 22451), and on Rainham Marsh (sector 24351 on the Inner Thames). However some sites on the Medway Estuary and the North Kent Marshes also held reasonably high numbers of dabbling ducks.

Wigeon, Pintail and Shoveler populations were relatively stable in the wider Thames area as a whole during the last fifteen years, and Gadwall and Teal numbers increased. Broadly, the numbers of dabbling ducks have increased on Rainham Marsh (24351), on parts of the North Kent Marshes, notably in the Cliffe area, and on sites on the north shore of the Thames. Numbers of most dabbling duck species declined on the Medway Estuary, although Shoveler numbers were relatively stable in this area.

4.2.3 Other Waterbirds

The two goose species showed quite different distribution patterns, with European White-fronted Goose found mostly on the Swale Estuary, with few records elsewhere, while Dark-bellied Brent Goose was widely distributed throughout the wider Thames area, although with the highest numbers occurring towards the outer part of the estuary, particularly on Foulness. Both goose species have declined on most parts of the wider Thames area.

The highest concentrations of the two grebe species occurred towards the western end of the North Kent Marshes (Cliffe Pits and Pools area), although they were also found in other areas throughout the wider Thames. Numbers of both species increased slightly on the North Kent Marshes but declined on the Medway Estuary. Rainham Marshes (sector 24351) was a particularly important site for Cormorant, supporting high numbers with a long-term population increase of more than 850%.

4.3 Summary

Parts of the Greater Thames Estuary that support large numbers of birds, with stable or increasing populations (or at least with declines no greater than regional or national trends for most species) included the Foulness area (all four WeBS sectors) and the Swale Estuary, particularly the northern shore of the Swale (Elmley Marshes, 22447; Shellness and Harty Marshes, 22449; and Capel Fleet, 22451). Elsewhere, Vange and Holehaven Creek (sector 25414), which is the area of the Holehaven Creek pSPA, supported large numbers of several species. On Rainham Marshes (sector 24351) several species, particularly wildfowl and Cormorant, were found in large numbers, and the populations of many species had increased significantly more than in other areas. However, as most of the sectors in the areas mentioned above are relatively large, it is likely that densities of many species are similar on parts of the North Kent Marshes, especially in the Cliffe area, where there are many small count sectors each supporting intermediate numbers of birds, largely with stable populations.

The Medway Estuary also supported fairly large numbers of a range of species, with Chetney Marshes (sector 22961) being an important site for many species. However, almost all species have experienced population declines across the Medway Estuary, the only exceptions being Shoveler, Knot and Bar-tailed Godwit (Table 3.2.i). Some species have also declined across the wider Thames or even regionally or nationally, but most of these species declined more rapidly on the Medway Estuary than elsewhere (Table 3.2.ii). This suggests that unfavourable local conditions may be contributing to the decline of many waterbird species on the Medway Estuary.

5. A REVIEW OF THE LIKELY IMPACTS OF CLIMATE CHANGE ON WATERBIRDS

5.1 Context

The internationally important waterbird numbers that occur in the United Kingdom are likely to be much affected by climate change generally and by rising sea-levels in particular (Rehfisch *et al.* 2004b). Warmer temperatures have been linked to distribution shifts (Rehfisch *et al.* 2004a; Austin & Rehfisch 2005; Maclean *et al.* in press) and sea-level rise with habitat loss (Crook 2004), with concomitant implications for birds (Hughes 2004). Such impacts are likely to affect the waterbirds that are designated features of Thames area Special Protection Areas (SPAs). In the following sections, the impacts of climate change on waterbirds are reviewed in more detail. We also present and overview of the likely future impacts on designated features of the SPAs within the Thames area.

5.2 Distribution Shifts

The distribution and abundance of most organisms is bound by ecophysiological constraints, such that climate imposes limits on their geographical range (Huntely *et al.* 2007; Monahan & Hijmans 2008). As temperatures increase, the climate at warmer sites may become increasingly unsuitable for the species occurring on that site. Conversely, the conditions at colder sites may become increasingly favourable. In many instances, these two factors result in distribution shifts, particularly retractions at warmer margins and expansions at colder margins. However, changes can also occur at sites that are not at the extremities of a species' range if there are other drivers of change that affect the balance of costs and benefits associated with a particular temperature regime.

In the UK for example, east coast estuaries are generally muddier than those on the west coast because of differences in estuary morphology and tidal influence (Austin & Rehfisch 2005). Consequently, they support relatively high invertebrate densities and in turn, much higher densities of waders (Austin *et al.* 1996; Rehfisch *et al.* 1997; Austin & Rehfisch 2003). Furthermore, the majority of the waterbird species that winter in the UK in internationally important numbers breed in the Arctic, but make landfall on the east in Autumn. Thus, wintering on east coast estuaries rather than those further west incurs lower migration costs. However, over-wintering on the east coast also incurs costs. Temperatures on the east coast are generally 1-2°C colder than on the west (Hulme & Jenkins 1998) and birds over-wintering on the east can thus be adversely affected by cold weather. Severe winter weather has both a direct effect on the birds themselves and an effect on their invertebrate prey. In most species of wader, individuals remain site faithful with the onset of harsh weather (Myers *et al.*1979; Davidson & Clark, 1985; Townshend, 1985), which, coupled with their already relatively high daily energy expenditure (Wiersma & Piersma, 1994) and decreased intake rates under such conditions (Goss-Custard *et al.* 1977; Pienkowski, 1981; Zwarts & Wanink, 1993), can result in substantial mortality when the weather is particularly severe over a prolonged period (Clark 1982). Thus, in colder winters, over-wintering waders prefer to over-winter in the west (Austin & Rehfisch 2005). However, the average minimum winter temperatures across the UK have increased by about 1.5 °C since the mid-1980s, the temperatures on the east coast during recent winters are now similar to those of the west coast during the mid-1980s. This has resulted in a smaller proportion of seven out of the nine species that occur internationally important numbers in the UK over-wintering in the south-west of Britain with the proportion being inversely related to temperature (Austin & Rehfisch 2005).

Similar changes in distribution have occurred on the non-estuarine coastline of the UK and throughout Europe. The distributions of eight out of nine species of wader commonly wintering on the non-estuarine coasts of Britain altered between the winter of 1984/85 and 1997/98, moving either eastwards perpendicular to winter isotherms or northwards. These changes in distribution broadly coincide with a distributional shift towards the species' respective breeding grounds and are correlated with the local winter weather over the period: increasingly mild extreme temperatures and changes in mean rainfall, mean wind speed and wind-chill (Rehfisch *et al.* 2004). This study also made predictions of change using UKCIP climate scenarios in 2020 and 2080 (Hulme & Jenkins 1998). The species for which non-estuarine coasts of Britain hold particularly high proportions of the international flyway populations, namely Ringed Plover, Sanderling (*Calidris alba*), Purple Sandpiper (*Calidris maritima*) and Turnstone (*Arenaria interpres*) are all expected to show continuing decline to 2080 (Rehfisch *et al.* 2004).

In Europe, the weighted (by number) centroids of over-wintering wader populations have also undergone substantial shifts. The distributions of all seven common wader species associated with estuarine sites have undergone shifts in either a northeasterly (six species) or north-westerly (one species) direction (Maclean *et al.* in press). The shifts vary in magnitude from 1.5 km to 7.5 km per year. However, in contrast to the UK, where increases towards the colder extremities of species' ranges have been balanced by decreases at the warmer margins, these shifts appear to have been primarily driven by range expansions. For all seven species, there have been no changes in numbers at warmer sites, such as along the Atlantic Coast of France. However, at the colder margins, such as along the Baltic Coast of Germany, there has been very large increases in numbers and the birds are expanding into new areas that were formerly too cold to occupy (Maclean *et al.* in press).

This highlights differences in the factors driving these changes. In the UK, there is a clear disadvantage associated with over-wintering at warmer sites as sediments in the west are less productive. However, across Europe as a whole, there appears to be no such disadvantage. However, through combination of movement and juvenile recruitment, populations are expanding sufficiently to result in shifts to the centroid of the population (Maclean *et al.* 2005). In Britain, the extent to which waders have shifted their distribution is inversely related to body-size, thus following the prediction of Stevenson & Bryant, (2000) that the impacts of climate warming should be more evident in smaller-bodied species than larger-bodied ones. Thus, smaller waders such as Sanderling and Ringed Plover are the species that have undergone the greatest shift, whereas those such as Curlew have barely moved. In Europe, it is actually larger species such as Grey Plover and Curlew that have undergone shifts. This may be related to the fact that the Baltic has not warmed sufficiently to accommodate several of the smaller-bodied species.

5.3. Sea-level rise

5.3.1 Impacts of sea-level rise on coastal habitats

Although broadly, sea-level rise is expected to lead to loss of coastal habitats, the magnitude of these losses is hard to predict and characterised by uncertainty. For example, losses of intertidal sediment due to erosion are thought, in some instances, to be balanced by sediment accretion (Cahoon *et al.* 2000). However, other interpretations suggest that coastal vegetation zones may have been in place for centuries and there has been little sediment accretion (Davy 2000; Hughes 2004). Without certainty regarding the ecological history of coastal habitats, which all-too-often is lacking, it becomes difficult to interpret how climate change and concomitant sea-level rise will affect them. Predictions are also hampered by uncertainties regarding coastal defence works. The UK coast is difficult to manage, being inhabited by humans with assets entrenched behind old flood defences and under threat from the combined risks of flooding and habitat change associated with rising sea-levels. Coastal defences prevent the landward migration of habitats, but also alter the entire dynamics of coastlines (Carpenter & Pye 1996). In East Anglia, for example, protection of cliffs prevents sediment transport to other locations, increasing erosion elsewhere and preventing a natural equilibrium in coastline morphology. Thus flood defences may result in habitat loss elsewhere, but in a manner that is spatially and temporally variable (Crooke 2004). Furthermore, coastal land forms themselves act to attenuate wave and tidal energy and respond to changing energy conditions at a range of spatial and temporal scales (Pethick 1996, Pethick & Crooks 2000). For instance, whereas beach morphology responds to seasonal wave climate, any adjacent dune complex may respond over longer (decadal) timescales to larger storm events (Richie & Penland 1990, Orford *et al.* 1999). These changes in wave-energy will also have localized effects on the sediment characteristics of estuaries (Austin & Rehfisch 2003). Although the UK government has provided relatively precise predictions of sea-level rise (4mm per year up to 2025, 8.5mm per year up to 2055, 12mm per year up to 2085 and 15mm per year up to 2115: Defra 2006), it is difficult to precisely predict how the complex tidal systems and habitats of the UK coast will respond to these changes.

5.3.2 Coastal habitat use

Three habitat types are particularly vulnerable to sea-level rise and important for waterbirds: intertidal mudflats, saltmarsh and coastal brackish lagoons.

5.3.2.1 Intertidal mudflats

Intetidal mudflats in the UK are the principal feeding habitat for waterbirds, being especially important for waders, but also valuable to wildfowl and gulls. Waterbirds are attracted in such large numbers to UK intertidal mudflats by a combination of relatively mild winters due to the influence of the Gulf Stream, large tidal amplitudes that ensure that extensive areas are exposed at low tide and the UK's position on the East Atlantic Flyway (Rehfisch *et al.* 2003). Intertidal habitat provides an important food resource to these species, notably by hosting high densities of invertebrate prey. The type of prey exploited varies between species, as indicated by the variety of ecological adaptations such as bill size and shape that different species possess. Wader species, such as Bar-tailed Godwit, with longer bills probe the mud for lugworms and other polychaetes, whereas surface or near-surface dwelling crustaceans such as *Corophium*, *Bathyporeia* and *Eurydice* spp. are an important resource for smaller waders. Shorecrabs and bivalves, particularly cockles (*Cerastoderma edule*) and mussels (*Mytilus edulis*) are a valuable food resource for some for some of the larger waders such as Oystercatcher and Curlew, but also for gulls. Other species such as Shelduck take a variety of smaller prey using a filtering feeding-action.

5.3.2.2 Saltmarsh

Although waterbirds tend not to feed in saltmarshes as invertebrates are less abundant in vegetated areas than in open mudflats, some species such as Redshank and, in particular, Snipe (*Gallinago gallinago*) may feed in the creeks and salt pans on marshes (Ferns 1992). The seeds of saltmarsh plants such as *Salicornia* and *Suaeda* are eaten by passerines (Brown & Atkinson 1996), and a range of waterbirds including Teal, Mallard and Pintail. Saltmarsh vegetation is consumed by relatively few bird species. Brent Geese and Wigeon consume saltmarsh grass (*Puccinellia* spp.) preferentially (Rowcliffe *et al.* 1995) but their diet when on an estuary is often dominated by eelgrass (*Zostera* spp.) and filamentous green algae that contain less indigestible cellulose and more protein. Brent Geese may be particularly dependent on saltmarshes late in the winter as they tend to feed on eelgrass early in the winter, then green algae (*Enteromorpha* spp.) and then short saltmarsh plants (mostly *Puccinellia* spp.) from January onward (Charman & Macey 1978). The relative lack of disturbance to birds on saltmarshes may explain why some birds feed there in preference to nearby fields where higher quality food (e.g. autumn sown cereals) is available (Ferns 1992). Saltmarshes are important roosting and nesting areas for many bird species as these areas are relatively undisturbed and close to their feeding areas. All saltmarsh vegetation is inundated by the highest spring tides that occur around the spring and autumn equinoxes, but at other times of year the highest areas may not be reached by the tides and may be a convenient and relatively undisturbed roosting area.

Saltmarshes may also benefit birds indirectly. A significant proportion of the organic material reaching other coastal habitats is exported from saltmarshes. Much of the exported organic material is as detritus or dissolved organic carbon, which, directly or indirectly, sustains invertebrates of the mudflats and deeper waters, and then birds and fish. They also absorb wave energy, and thus reduce erosion, run-up and over-topping of any sea walls, protecting from saltwater intrusion adjacent habitats of high value to birds, such as freshwater marshes and grazing marshes (Hughes 2004).

5.3.2.3 Coastal Lagoons

Coastal lagoons in the UK are essentially bodies, natural or artificial, of saline, brackish or fresh water partially separated from the adjacent sea (Bamber 1997, 1999). There are several different types of lagoons, ranging from those separated from the adjacent sea by a barrier of sand or shingle, to those arising as ponded waters in depressions on soft sedimentary shores, to those separated by a rocky sill or artificial construction such as a sea wall. These lagoons contain a variety of substrata, often soft sediments, which host a very high density of invertebrates, particularly chironomids, which are an extremely valuable resource to feeding waterbirds, particularly at high tide (Rehfisch *et al.* 1994). Many also provide predator-free havens for roosting. The importance of this habitat for waterbirds is reflected both in the high number that form parts of SPAs and other designated sites. WeBS counts also suggests that they can host very high densities of waterbirds (e.g. Maclean & Austin 2008; Musgrove *et al.* 2007). However, quantitative assessments are lacking, particularly comparative measures of densities on lagoons and on other habitats and assessments of the extent to which such lagoons contribute to the overall energy intake of waterbirds.

Coastal lagoons of natural origin are extremely vulnerable to sea-level rise and any resulting change in flood-defence works. The benthic community, particularly in relation to its value to waterbirds is highly dependent upon salinity regimes (Mitchell *et al.* 2007). These regimes are maintained by the balance of sea and freshwater water input and evaporation. Seawater input usually occurs through a natural or man-modified channel or by percolation through, or over-topping of, barriers. Freshwater input is usually from ground or surface waters (UKBAP 2008). With sea-level rise, seawater input will increase if coastal defence works are not enhanced, but can decrease where defence works are put in place. In winter months, increased inundation by seawater may enhance salinity. However during summer, when inundation is limited, salinity can increase as warm weather enhances evaporation, thereby leading to hyper-saline conditions (Mitchell *et al.* 2007). However, the majority of saline lagoons on the Greater Thames Estuary are man-made and maintained by pumping, and may therefore be less vulnerable to sea-level rise than the few natural coastal lagoons.

5.3.3 Assessing the impacts of habitat loss on birds

In general, habitat loss, such as that which might occur as a result of sea-level rise, causes a re-distribution of birds and an increase in density on the areas that remain (Goss-Custard *et al.* 1995c). Understanding the effects of such displacement requires quantification of the extent to which displaced birds, or others occupying the areas displaced birds move to, suffer from increased interference or depletion competition. Increases in competition result in a decrease in the rate at which individuals can feed and consequently leads to poorer body condition and thus lower rates of survival and reproduction (Goss-Custard 1980; Goss-Custard *et al.* 1995c). To quantify these, an understanding of the extent to which the surrounding areas are at carrying-capacity is necessary. The complexity of the issue is further enhanced by the fact that birds are unlikely to displace to just one area. A more realistic scenario is that they disperse widely over a broad area in a manner which enables them to maximise their reproductive success (Fretwell & Lucas 1970; Sutherland 1983), albeit that in some-instances redistribution may be constrained by factors such as distance and the social dominance of competing birds (Fretwell 1972). Thus a prediction of the impacts of habitat loss at any given location, also requires knowledge of the quality and closeness to carrying capacity of adjacent sites (Goss-Custard *et al.* 1995c).

The development of theoretical models based on knowledge of the individual-behaviour of birds has allowed the consequences of reduction in energy-intake on the survival and reproduction of birds to be predicted (e.g. Goss-Custard 1995a & b). Fewer studies though, have observed actual impacts of habitat loss on body condition and thus on survival and reproduction.

Where observed, habitat loss generally does have adverse impacts on birds. For example, following land-claim of the intertidal mudflats in Nordstrand Bay, Germany, the number of Brent Geese, Shelduck and most wader species declined significantly in the area (Hötker 1997). Similar declines were observed following reclamation of intertidal land on the Tees Estuary (Evans 1978-79; Evans *et al.* 1991) and Dutch Delta area (Lambeck 1991; Meire 1991; Schekkerman *et al.* 1994). However, there is a paucity of studies that specifically quantify the impacts on displaced birds. One study in which such an analysis was performed quantified the impacts of habitat loss on displaced Redshank body condition and survival. Following inundation of Cardiff Bay with freshwater, *c.* 300 Redshank relocated to adjacent habitat on the Severn Estuary. Displaced redshank had difficulty maintaining their mass post-barrage, and the annual survival of adult Cardiff Bay Redshank fell from 0·846 to 0·778 (Burton *et al.* 2006).

Another way in which sea-level rise could impact birds, is by changing the sediment characteristics of coastal areas. Wader densities are largely dependent on the availability of their invertebrate prey, which, in turn depends on the nature of the estuarine sediments, itself a function of estuary morphology. Thus changes in estuary morphology, such as might occur with sea level rise, can affect wader density (Austin & Rehfisch

2003). The nature of intertidal sediments is largely a consequence of wave action, currents and tide (Yates *et al.* 1996). Where intertidal flats are subjected to high wave action, typical of wide and open-mouthed estuaries, fine particles tend to remain in the water column and so are flushed out of the system leading to sandy sediments. In estuaries that are narrow or enclosed, finer particles are able to settle which tends to result in muddy sediments (Austin & Rehfisch 2003). The precise nature of the change that would be expected as a result of sea-level rise is estuary-specific, being dependent on both the size and shape of the estuary and any proposed flood-defence or managed-realignment schemes. Detailed predictive-modeling on the Deben and Duddon estuaries suggest that the densities of wader species such as Redshank and Dunlin, which favour muddy sediments would decrease, but birds such as Oystercatcher, which favour courser sediments would increase. This is because the predicted increases in estuarine width result in sandier sediments. However, if flood-defences were abandoned the overall area of mudflats would increase, more than compensating for the assumed degradation of habitat, and larger numbers could be accommodated overall.

5.3.4 Sea-level rise and managed realignment

The impacts of sea-level rise on coastal habitats is highly dependent on management responses. These responses have included 'holding the line' through soft or hard engineering techniques, abandonment or, more recently, managed realignment (Atkinson et al. 2001). Managed realignment (allowing the sea to penetrate sea walls and create intertidal habitats behind the sea wall rising up to higher ground or newly constructed sea defences) has been a feature of coastal sea defence policy since the 1990s. The driver behind the approach stems in part from statutory obligations associated with the EU 'Habitats' and 'Birds' directives to compensate for destruction of Natura 2000 habitats. To compensate for the loss of developed areas it is necessary to determine what communities will develop and over what time scales. A limited amount of work has been carried out to evaluate the nature conservation value of UK realignment projects. The little biological monitoring that has been conducted has largely been restricted to higher plants and invertebrates. Relatively few coastal habitat restoration projects in the UK have monitored birds. However, it is known that these realignment schemes have been very successful in ensuring development of mudflats and saltmarsh (Atkinson 2003; Atkinson *et al.* 2006).

One area, the Tollesbury and Orplands realignment site on the Blackwater Estuary is unique in the UK in that standardized bird monitoring has taken place on the sites since intertidal inundation was restored (Atkinson *et al.* 2006). This has permitted monitoring data to be analysed to determine the rate at which bird communities changed and whether, after 4–5 years of intensive monitoring, the bird populations had reached equilibrium. At this site, bird communities were dominated by terrestrial species during the first year of inundation and waterbird communities rapidly developed during the second and third years. Five years after the initial breach in the sea wall, communities were similar to surrounding mudflats but with some notable exceptions. Dunlin and Redshank that prey on the early colonizing *Nereis* worms and *Hydrobia* used the sites in the first 2 years. Oystercatcher did not occur on the realignment site as there were no large bivalves, whereas Knot used the site after 4–5 years coincidentally with the appearance of Baltic tellin (*Macoma balthica*). Thus, although understanding of the success of managed realignment schemes is limited, it appears that they can be successful in ensuring saltmarsh and biologically active mudflats are created, but they may lack the full range of biodiversity found in surrounding natural intertidal habitats, even decades after inundation (Atkinson *et al.* 2006).

5.4 A review of likely impacts on each of the Thames area SPAs

5.4.1 Thames Estuary and Marshes

The Thames Estuary and Marshes SPA includes marshes extending for about 15 km along the south side of the estuary and also includes intertidal areas on the north side of the estuary. To the south of the river, much of the area is brackish grazing marsh, although some of this has been converted to arable use. At Cliffe, there are flooded clay and chalk pits, some of which have been infilled with dredgings. Outside the sea wall, there is a small extent of saltmarsh and broad intertidal mudflats (Stroud *et al.* 2001).

Due to the eastward shift in wader distributions in response to warming temperatures, it is likely that this site will host an increasing number of waterbirds. However, coastal habitats, notably saltmarsh are potentially highly threatened by sea-level rise on this site (Table 5.4.1.i). It is predicted that 7% of saltmarsh will be lost over the next 20-years, with 70% lost over the next 100 years. Intertidal mud- and sand-flats are also moderately threatened, especially over the long term. Over the short- and medium-terms (20 and 50-years), only 1% of the extent of mud- and sand-flats are expected to be lost, but over 100-years this figure is predicted to rise to 10%.

Table 5.4.1.i. Predicted changes in the extent of coastal habitats on the Thames Estuary and Marshes SPA. Source: Environment Agency (2008).

Habitat change compared to baseline	2006 Baseline (ha)	20 year change (ha)	50 year change (ha)	100 year change (ha)
Intertidal Area	2,860	-30	-140	-520
Intertidal mudflat and sandflat	2,600	-20	-20	-260
Saltmarsh	100	-10	-30	-70
Transitional grassland		-6	-13	-52

Thus, of the waterbird species that are designated features of this site, it is those associated with saltmarsh, notably Pintail, that are likely to be the most threatened. However, the broader array of species associated with mud and sand-flats will also be adversely affected, particularly in the long-term for two reasons. Firstly because the extent of intertidal habitats is expected to decrease, but importantly also, because organic input from saltmarsh is likely to decrease substantially. This is likely affect the invertebrate community of the intertidal feeding habitat, reducing the availability of prey. This SPA is designated for the internationally important numbers of Avocet, Ringed Plover and Knot it hosts and WeBS data suggest that the Thames Estuary and Marshes SPA may also host numbers of Black-tailed Godwit (*Limosa limosa*) in excess of the threshold for international importance. These species are all closely associated with intertidal sediment flats, and the potential loss and reduction in productivity of this habitat is of concern.

It is more difficult to predict the effects that may arise as a result of changes in sediment characteristics. However, it is quite likely that, in common with the Deben and Duddon estuaries, sediments will become courser (Austin & Rehfisch 2003). If this were indeed to occur, then of the waterbird species that are designated features of this site, it is those species closely associated with muddy sediments, notably the dabbling ducks and Avocet, that would be worst affected. The extent to which managed realignment occurs will also affect the degree to which adverse impacts will occur as a result of sea-level rise. Several areas around the Thames Estuary and Marshes SPA are suitable for such management, and would provide a potentially valuable means of reducing the adverse impacts of habitat loss due to sea-level rise.

5.4.2 Medway Estuary

The Medway Estuary feeds into and lies on the south side of the outer Thames Estuary in Kent. It forms a single tidal system with the Swale and joins the Thames Estuary between the Isle of Grain and Sheerness. It has a complex arrangement of tidal channels, which drain around large islands of saltmarsh and peninsulas of grazing marsh. The mud-flats are rich in invertebrates and also support beds of green algae and some eelgrass. Small shell beaches occur, particularly in the outer parts of the estuary. Grazing marshes are present inside the sea walls around the estuary (Stroud *et al.* 2001).

As with the Thames Estuary and Marshes SPA, it is likely that this site could host an increasing number of waterbirds in the future, as a result of larger-scale eastward shifts in wader distributions. However, the fact that waterbird numbers on the site have declined, rather than increased (as at other east-coast sites), in recent years suggests that site-specific factors, rather than climate change, have been the primary driver of waterbird population change on the Medway in recent years. In contrast to the previously mentioned SPA, coastal habitats on the Medway are only moderately threatened by sea-level rise (Table 5.4.2.i). Saltmarsh is expected to decrease by between 25 and 30%, but the extent of intertidal mudflat is expected to increase. This is largely because there are numerous grassy islands located within the estuary that would be lost and become intertidal sediment flats. This will not necessarily lead to an increase in the extent of mudflats available for waterbirds to feed on, however, as it is highly likely that any new mudflats will be lost to the spread of *Spartina*. The extent of *Spartina* across the Medway has increased greatly in recent years (Blair-Myers 2003) and has been linked to the declines in bird numbers (Banks *et al.* 2005). Goss-Custard & Moser (1988), investigating changes in Dunlin numbers in Great Britain, found that the greatest declines had occurred where there had been the greatest increase in *Spartina* cover.

Table 5.4.2.i Predicted changes in the extent of coastal habitats on the Medway Estuary and Marshes SPA. Source: Environment Agency (2008).

Habitat change compared to baseline	2006 Baseline (ha)	20 year change (ha)	50 year change (ha)	100 year change (ha)
Intertidal Area	3,580	-40	+40	-540
Intertidal mudflat and sandflat	2,840	+430	+50	+210
Saltmarsh	750	-210	-110	-210
Transitional grassland		0	-17	-60

Again, it is more difficult to predict the effects that may arise as a result of changes in sediment characteristics. However, any reduction in the quality of feeding habitat might be compensated for by increases in quantity were it not for the likely spread of *Spartina* over new mudflats. As with the Thames Estuary SPA, there is also scope to mitigate for loss of saltmarsh habitat through managed realignment. However, without detailed knowledge of the extent to which this will occur, it is difficult to provide reasonable predictions of the influence such management will have on designated features of the site.

5.4.3 The Swale

The Swale is located on the south side of the outer part of the Thames Estuary. The Swale is an estuarine area that separates the Isle of Sheppey from the Kent mainland. To the west it adjoins the Medway Estuary. It is a complex of brackish and freshwater, floodplain grazing marsh with ditches, and intertidal saltmarshes and mud-flats. The intertidal flats are extensive, especially on the east of the site, and support dense invertebrate fauna and beds of algae and eelgrass. Locally there are large Mussel beds formed on harder areas of substrate. The SPA contains the largest extent of grazing marsh in Kent (although much reduced from its former extent). There is much diversity both in the salinity of the dykes (which range from fresh to strongly brackish) and in the topography of the fields (Stroud *et al.* 2001).

As with the Thames Estuary and Marshes SPA, it is likely that this site will host an increasing number of waterbirds as a result of larger-scale eastward shifts in wader distributions. Likewise, patterns of habitat loss due to sea-level rise on the Swale are broadly comparable to those on the Medway. Minimal loss of intertidal mud- and sand-flats is expected as losses due to sea-level rise area likely to be compensated for by gains due to inundation of habitats further up the shoreline, which are predicted to change into intertidal sediment flats (Table 5.4.3.i). Loss of marsh is expected, with just over one-third of the habitat predicted to be eroded by 2106 (Environment Agency 2008).As with the Medway, those species that are highly dependent on saltmarsh are likely to be adversely affected. Again, Dark-bellied Brent Geese, which occur in internationally important numbers on this site, are likely to be most at risk.

Table 5.4.3.i Predicted changes in the extent of coastal habitats on The Swale Estuary and Marshes SPA. Source: Environment Agency (2008).

Habitat change compared to baseline	2006 Baseline (ha)	20 year change (ha)	50 year change (ha)	100 year change (ha)
Intertidal Area	2,940	-30	+30	+300
Intertidal mudflat and sandflat	2,000	-20	+20	+200
Saltmarsh	360	-40	-70	-110
Transitional grassland		+20	+10	+10

Again, it is more difficult to predict the effects that may arise as a result of changes in sediment characteristics. Reduction in the quality of feeding habitat may partially be compensated for by increases in quantity. The site hosts internationally important numbers of several wader species associated with muddy sediments (Stroud *et al.* 2001). Thus, if the sediment were to become sandier, as is predicted to occur on other estuaries in the UK (Austin & Rehfisch 2003; Yates *et al.* 1993), these species may be adversely affected. As with the other Thames area SPAs, there is also scope to mitigate for loss of saltmarsh habitat through managed realignment, but lack of detailed knowledge of the extent to which this will occur, makes it difficult to predict the influence such management will have on designated features of the site.

5.4.4 Benfleet & Southend Marshes

Benfleet and Southend Marshes are located on the north shore of the outer Thames Estuary. The site comprises an extensive series of saltmarshes, cockle shell banks, mud-flats, and grassland that supports a diverse flora and fauna (Stroud *et al.* 2001). The site hosts internationally important numbers of Dark-bellied Brent Geese, Grey Plover and Knot, with Oystercatcher, Ringed Plover and Dunlin forming part of the waterbird assemblage for which this site is designated. Detailed predictions of habitat loss on this site are lacking. However it is thought that there is a high threat posed to this site by erosion of the saltmarsh and mudflat (BirdLife International 2008). It is thus likely that sea-level rise will pose a threat to this site. This is likely to have an adverse effect on the majority of designated features associated with the site, including eelgrass beds used by Dark-bellied Brent Geese.

As with the previous sites, it is more difficult to predict the effects that may arise as a result of changes in sediment characteristics. Reduction in the quality of feeding is unlikely to be compensated for by increases in quantity. Should the sediment become sandier, as is predicted to occur on other estuaries in the UK (Austin & Rehfisch 2003; Yates *et al.* 1993), several of the wader species, notably Dunlin, would be adversely affected. However, other designated features of the site, notably Oystercatcher and Ringed Plover are more associated with sandier sediments and would benefit.

5.4.5 Foulness (Mid-Essex Coast Phase 3)

Foulness is located on the coast of Essex north of the mouth of the Thames Estuary. The site is part of an open coast estuarine system comprising grazing marsh, saltmarsh, intertidal mud-flats, cockle-shell banks and sand flats. It includes one of the three largest continuous sand-silt flats in the UK. Foulness is an integral component of the phased Mid-Essex Coast SPA (Stroud *et al.* 2001). The site hosts internationally important numbers of Dark-bellied Brent Goose, Avocet, Golden Plover and Bar-tailed Godwit and several other species of duck and wader form part of the waterbird assemblage for which this site is designated (Stroud *et al.* 2001).

Detailed predictions of sea-level rise induced changes in habitat extent on this site are lacking. However, saltmarsh habitat on along the coast of Essex and Greater Thames area is known to be severely threatened by erosion (Hughes & Paramor 2004; Morris *et al.* 2004; Mitchell *et al.* 2007), with erosion rates as high as 16 ha year^{-1} at Foulness (van der Wal & Pye 2004). It is thus likely that species associated with saltmarsh, notably Dark-bellied Brent Goose, will be adversely affected by sea-level rise. The impacts of sea-level rise on birds associated with mudflats is less certain, but it is likely that the quality of this habitat may degrade as a result of both reductions in organic input from saltmarsh and changes in sediment characteristics. It is also likely that a reduction in mudflat exposure time in each tidal cycle, as a result of the higher position of the low water mark, would reduce the feeding opportunities for those species that feed on mudflats and, therefore, the carrying capacity of the site.

5.4.6 Holehaven Creek

Holehaven Creek forms a confluence with the River Thames and the mouth of the creek is directly opposite the Blythe Sands area of the south Thames Estuary and Marshes. The site comprises intertidal mudflats and saltmarsh. It is an SSSI designated for the number of Black-tailed Godwit it hosts and is a potential SPA (pSPA). Increasing temperatures may result in an increasing proportion of the UK population of Black-tailed Godwits over-wintering on the east coast (Austin & Rehfisch 2005), and hence at this site. Climate change is also partially responsible for the rapid increase in Black-tailed Godwit occurring in the UK, as warming temperatures have increased the availability of breeding habitat in Iceland (Gunnarsson *et al.* 2005).

No quantitative assessment of the impacts of sea-level rise on this site has been made. Most sites in the south-east of England are still experiencing large increases numbers of Black-tailed Godwit, suggesting that the carrying capacity of the sites has not yet been reached (Gill *et al.* 2001; Maclean *et al.* 2008). This would suggest that, at least in the short-term, increases might occur irrespective of habitat loss. The longer term impacts of sea-level rise are less certain however. It is likely that the carrying-capacity of the site will be reached at some stage in the near future. Should this happen, reductions in the quantity and quality of intertidal habitat that may result from sea-level rise, are likely to have a detrimental impact on the designated feature of this site.

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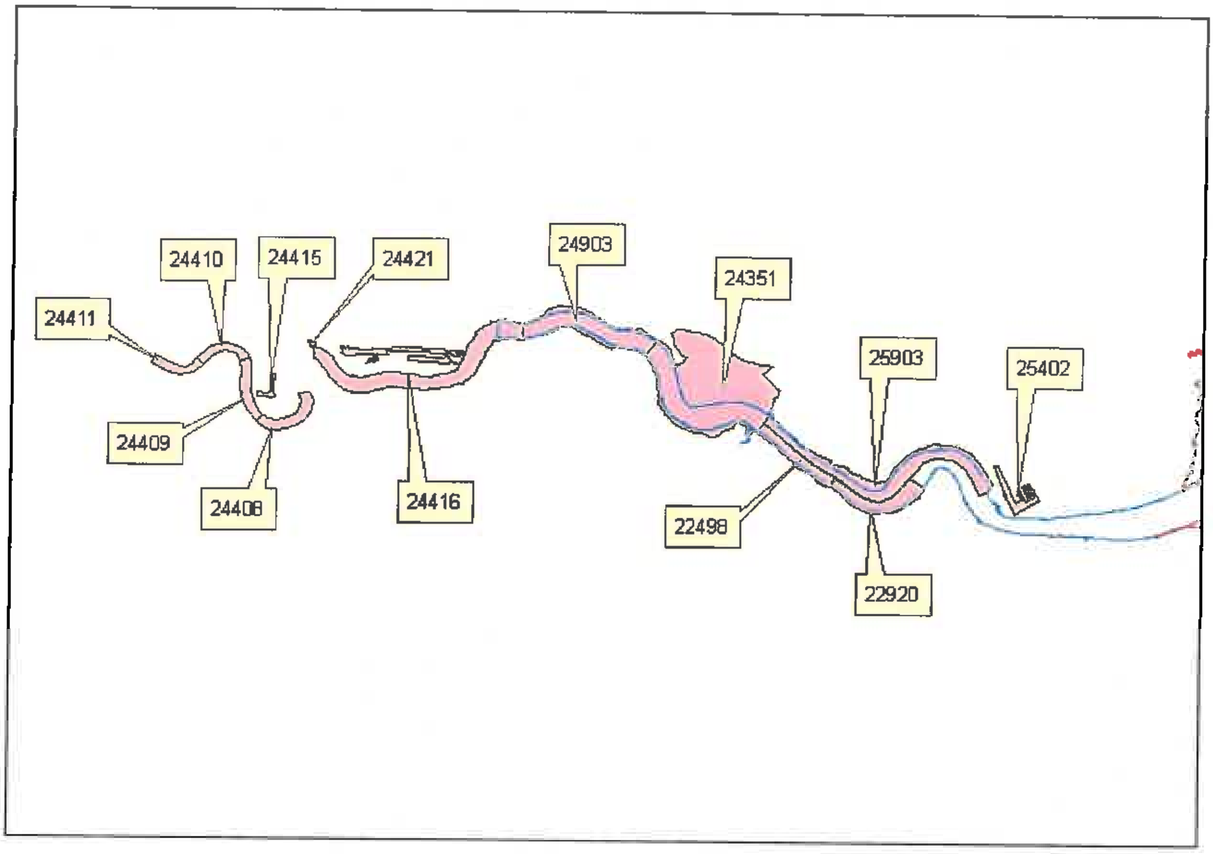
Appendix A

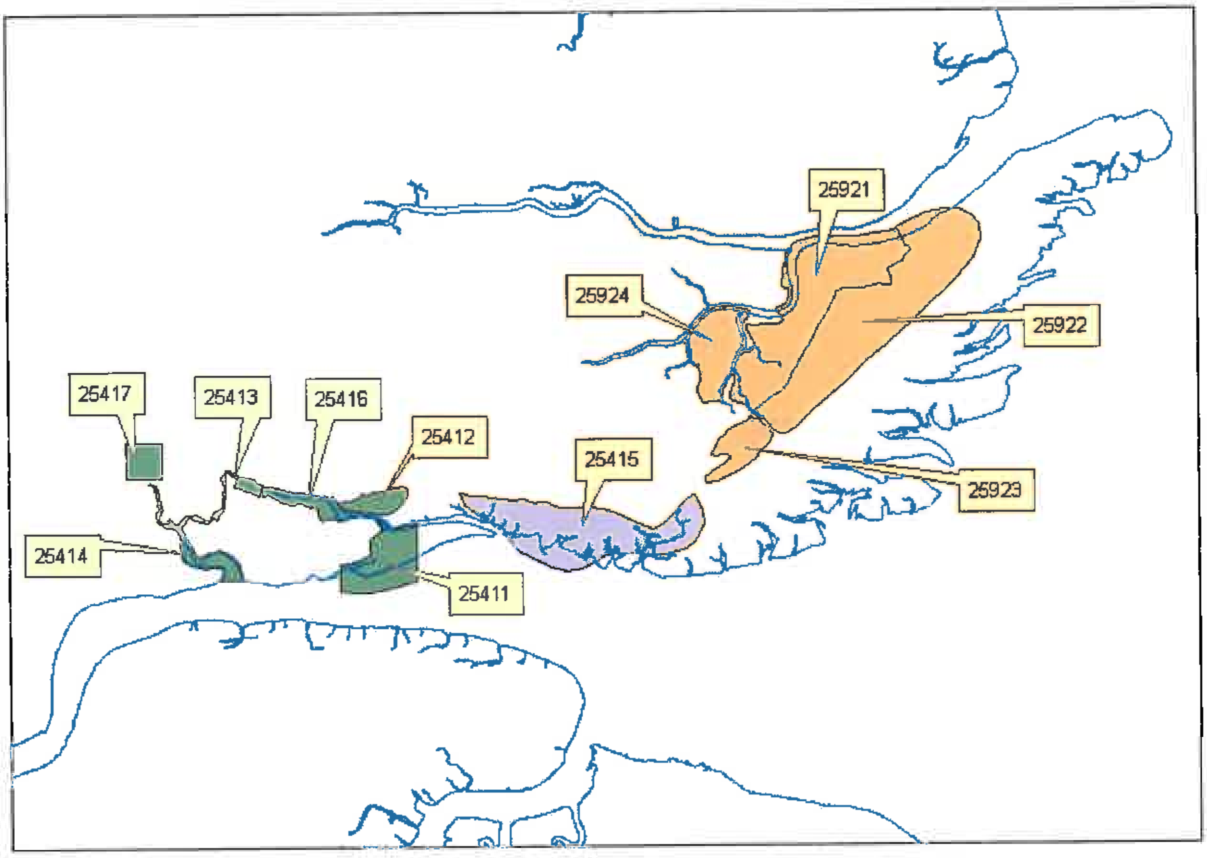
Names and locations of WeBS count sectors on the Greater Thames Estuary.

Inner Thames Estuary



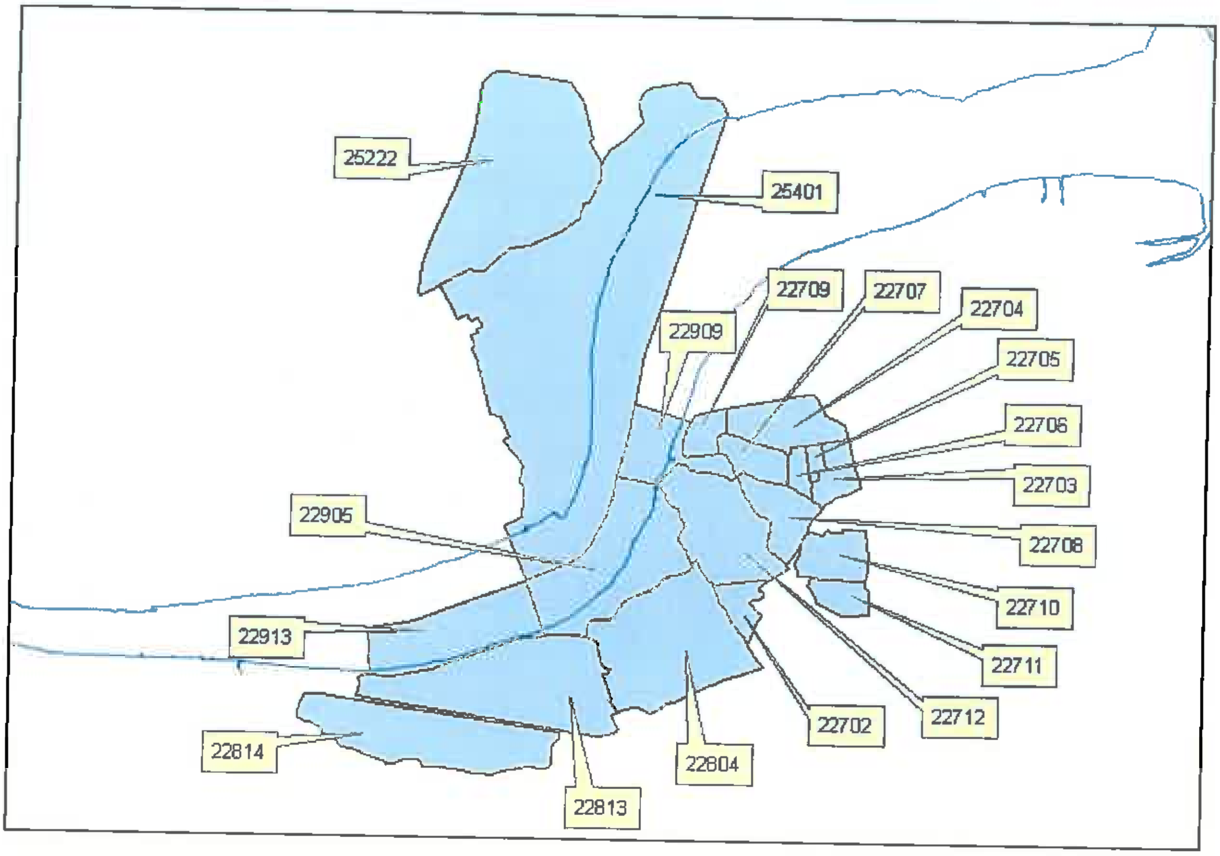
Sector Number	Sector Name
24411	*NO DATA IN RECENT YEARS*
24410	River Thames - Lower Pool
24409	River Thames - Limehouse
24415	*NO DATA IN RECENT YEARS*
24408	River Thames - Greenwich
24421	*NO DATA IN RECENT YEARS*
24416	*NO DATA IN RECENT YEARS*
24903	*NO DATA IN RECENT YEARS*
24351	Rainham Marsh
25903	Purfleet to Grays
22498	Dartford to Littlebrook
22920	River Thames - QEII Bridge (Dartford) to Swanscombe
24502	*NO DATA IN RECENT YEARS*

Thames North Shore (Leigh and Canvey, Southend, Foulness)



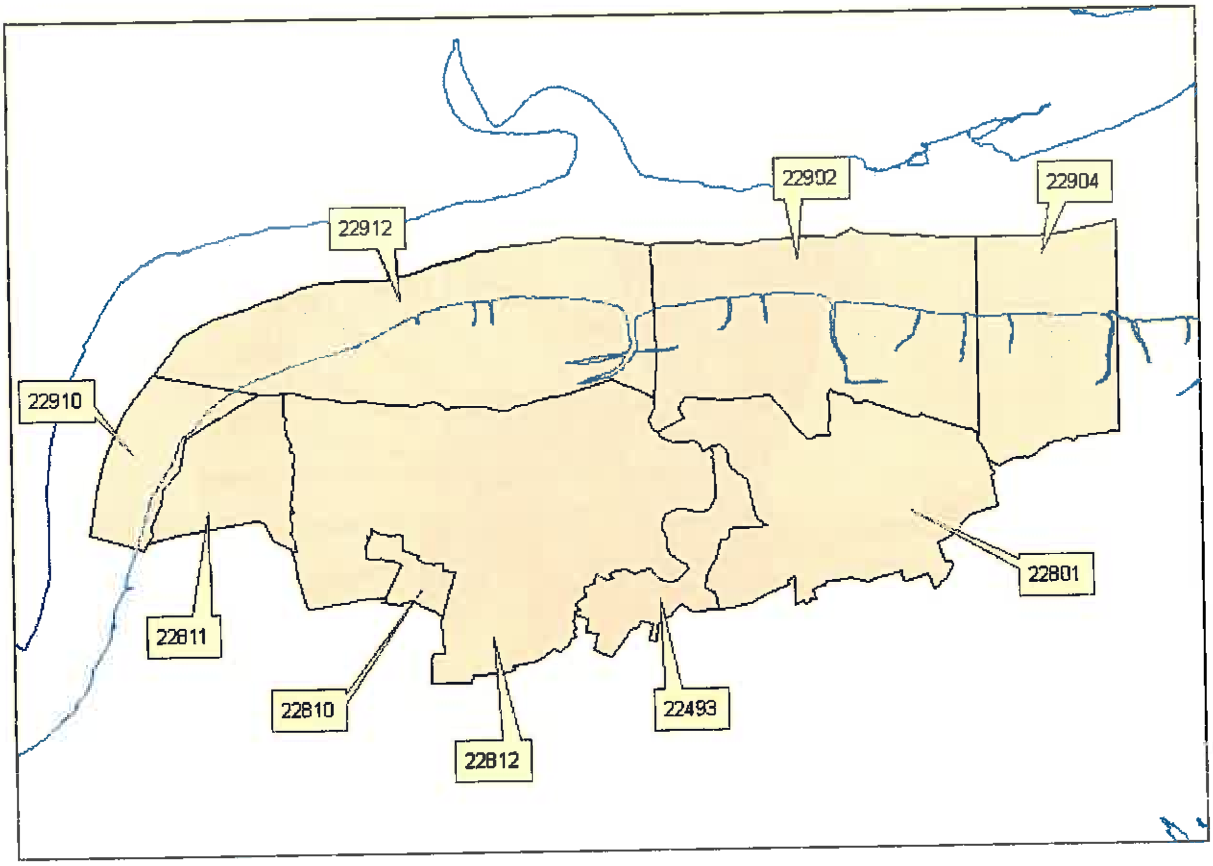
Sector Number	Sector Name
25414	Vange and Holehaven Creek
25417	Wat Tyler Country Park
25413	Easthaven Creek
25416	Benfleet Creek
25412	Leigh Marsh and Two Tree Island
25411	Canvey Point
25415	Southend Seafront
25923	Wakering Stairs
25922	Thameside
25921	Crouchside
25924	Potton Island

North Kent Marshes West



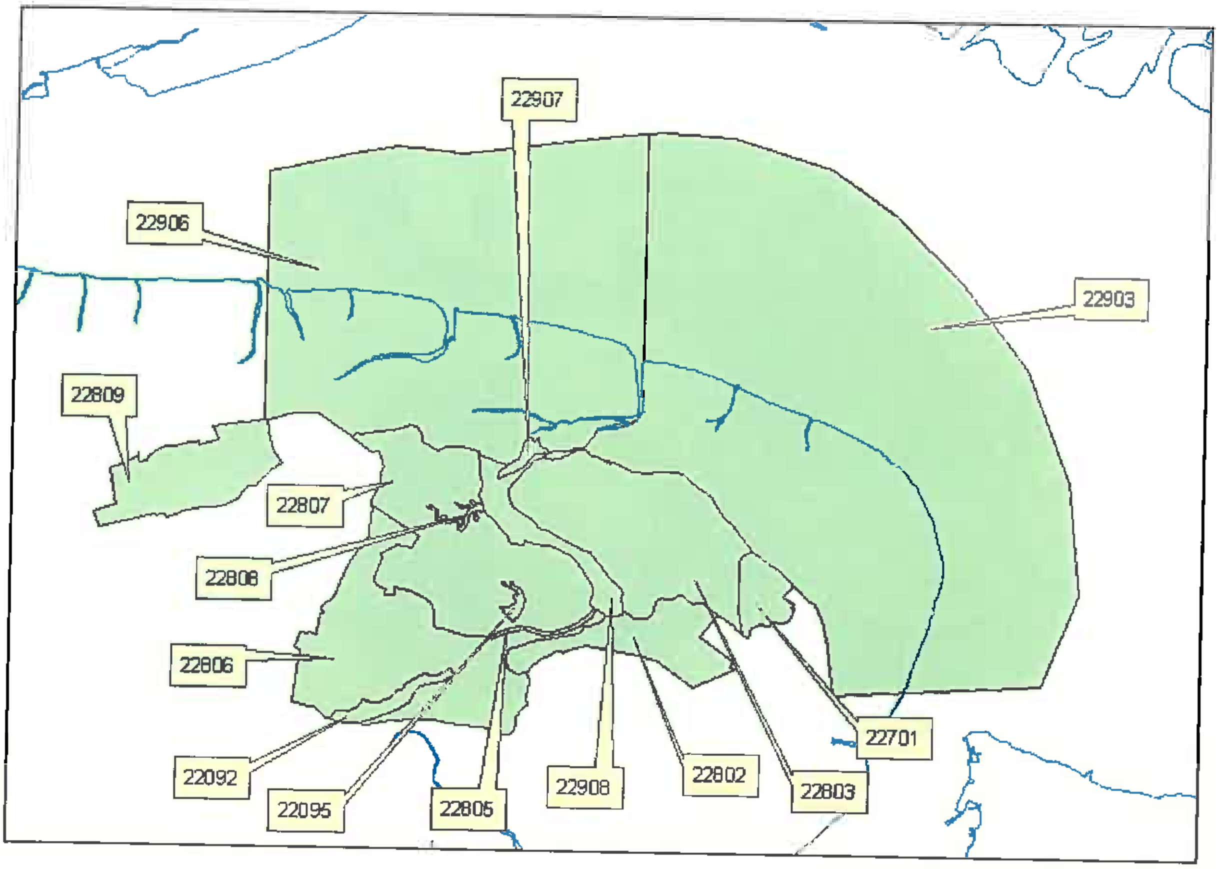
Sector Number	Sector Name
25222	*NO DATA IN RECENT YEARS*
25401	*NO DATA IN RECENT YEARS*
22913	Shorne Marshes Offshore
22813	Shorne Marshes
22814	Filborough Marshes
22905	Higham Bight
22804	Higham Marsh
22702	Timber Lake
22909	Cliffe Creek and Offshore
22712	Alpha Pool
22708	Elf Pools
22710	North Quarry
22711	South Quarry
22709	Coastguards Pool
22707	Flamingo Pool
22706	Ski Pool
22705	Hidden Pool
22703	Radar Pool
22704	Black Barn Pools

North Kent Marshes Central



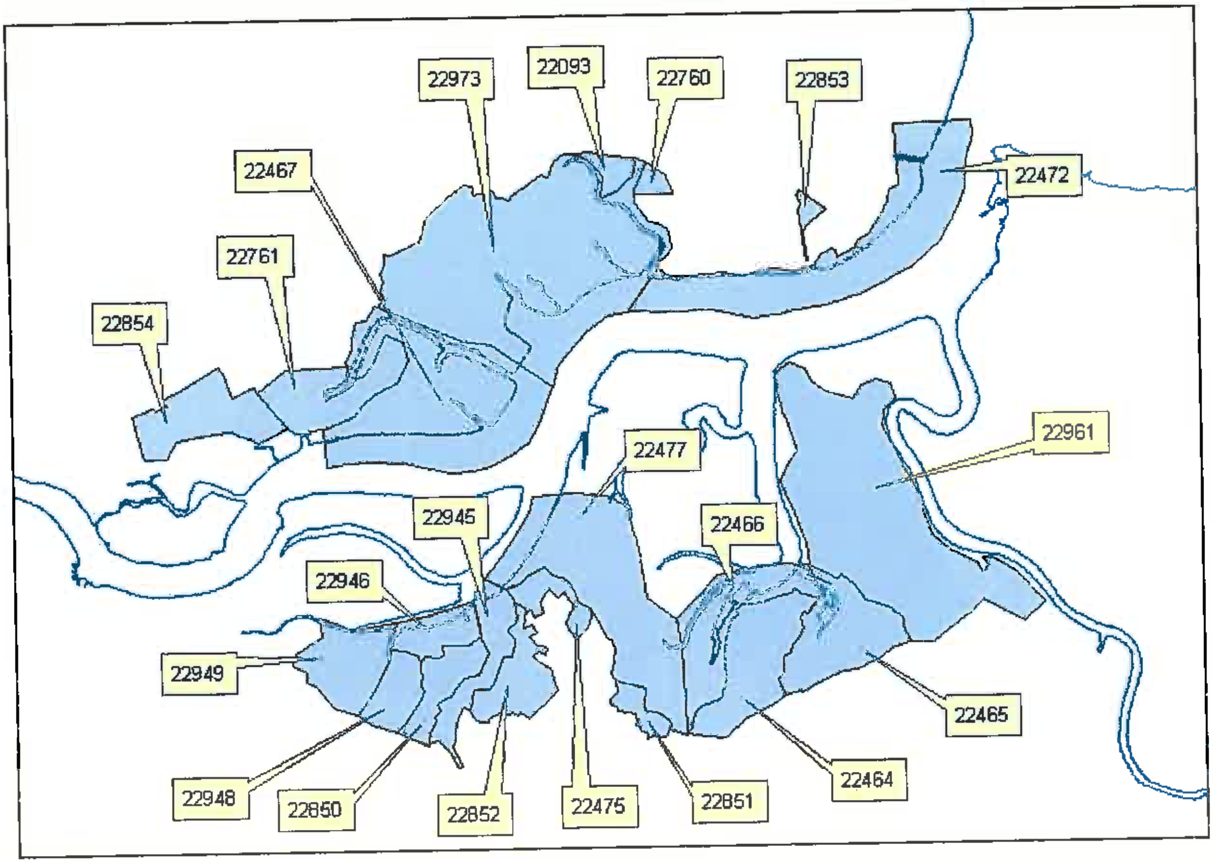
Sector Number	Sector Name
22910	Lower Hope Point Offshore
22811	Redham Mead
22912	Cliffe and Cooling Offshore
22812	Cliffe and Cooling Marshes
22810	Rye Street RSPB Reserve
22493	Northward Hill RSPB Reserve
22902	St Mary's Marsh Offshore
22801	St Mary's Marsh
22904	Coombe Bay Offshore

North Kent Marshes East



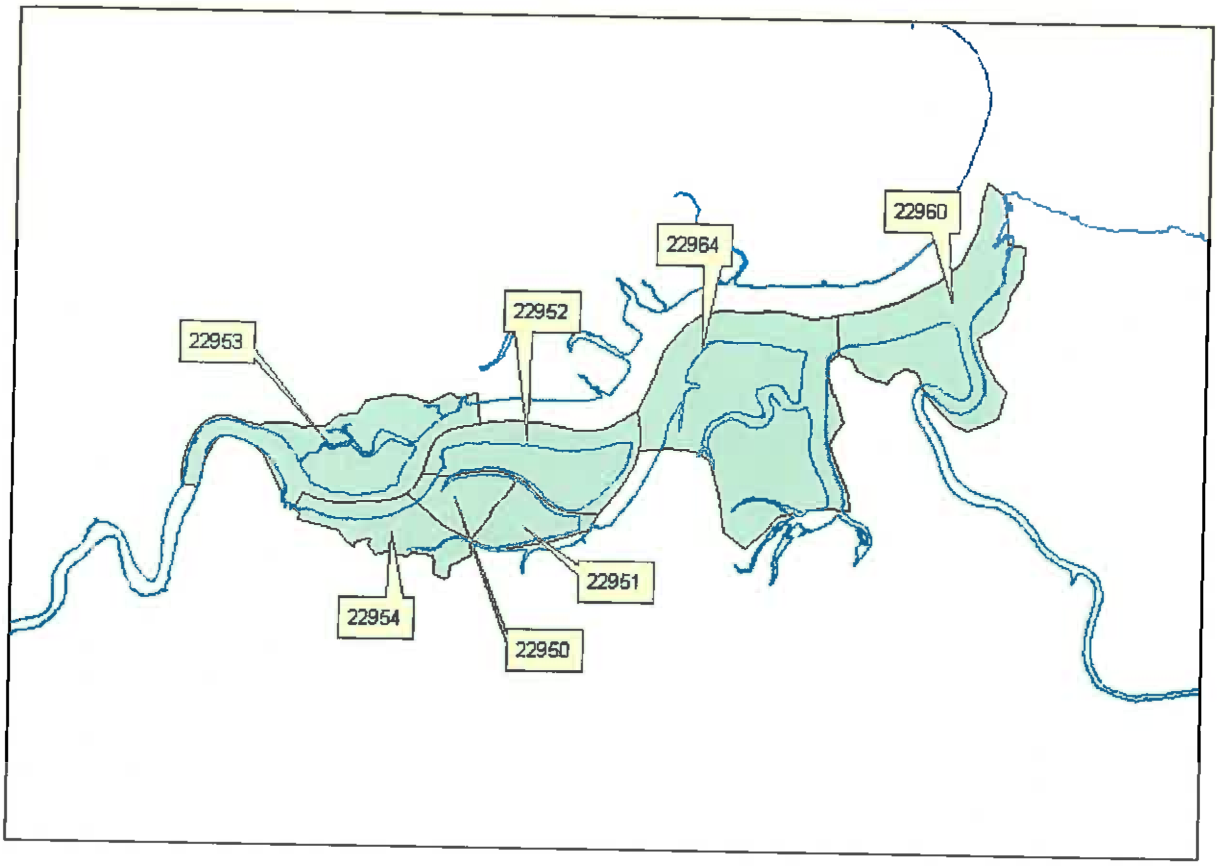
Sector Number	Sector Name
22809	Dagnam Fields
22906	Yantlet and Allhallows Offshore
22807	Yantlet and Allhallows Marsh
22808	Sluice Fleet
22095	Stoke Lagoon
22907	Yantlet Beach
22908	Yantlet Saltmarsh and Creek
22806	South Allhallows Marsh
22092	Stoke Fleet
22805	Freshwater Yantlet
22802	Perry's Farm
22803	Grain Marsh
22701	Clubb Pits
22903	North Grain Offshore

Medway Shore



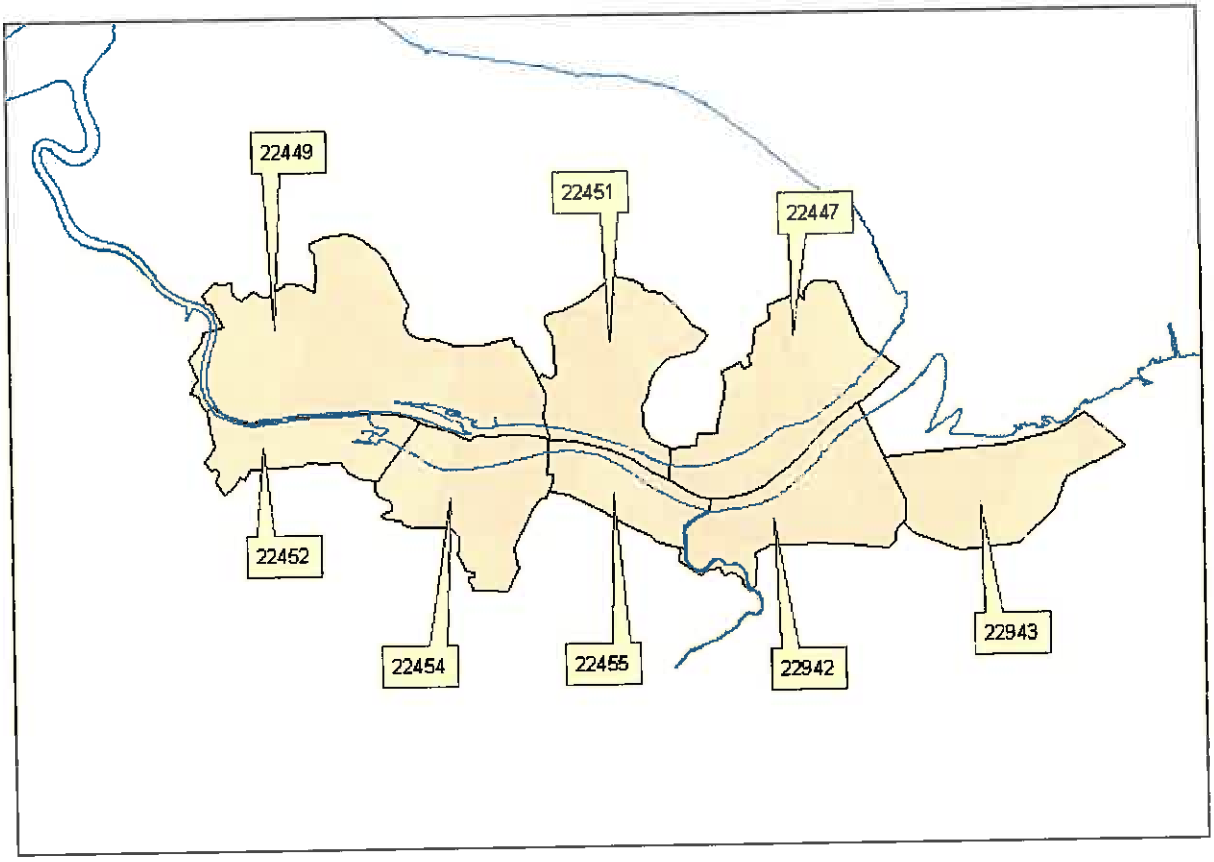
Sector Number	Sector Name
22472	South Grain Offshore
22853	House Fleet
22760	Mosco Pool
22093	South Level
22973	Stoke Saltings and Ooze
22467	Oakham and Downhead
22761	Kingsnorth Power Station
22854	Hoo Marsh
22949	Riverside Country Park
22946	Motney Saltings and Creek
22948	Bloors Wharf
22850	Motney Sewage Treatment Works
22945	Otterham Creek
22852	Horsham Marsh
22477	Ham Green and Twinney Offshore
22475	Ham Green
22851	Twinney
22466	*NO DATA IN RECENT YEARS*
22464	Barksore Marsh
22465	*NO DATA IN RECENT YEARS*
22961	Chetney Marshes

Medway Islands



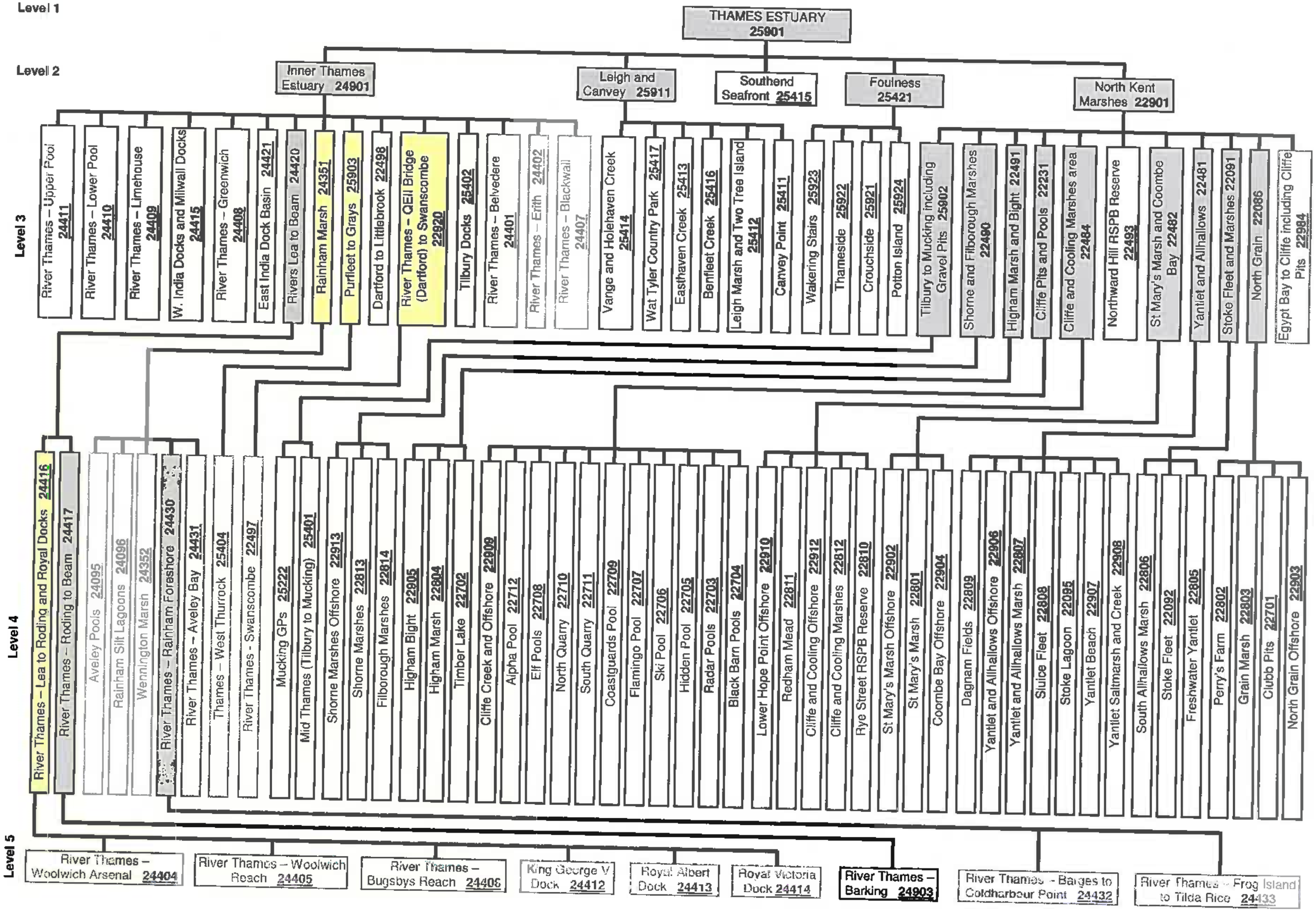
Sector Number	Sector Name
22953	Hoo Island
22954	Copperhouse Bay
22950	Nor Marsh RSPB Reserve
22952	Bishop Islands
22951	Frys Marsh
22964	Burntwick and Greenborough and Slayhills
22960	Deadmans Island

Swale Estuary

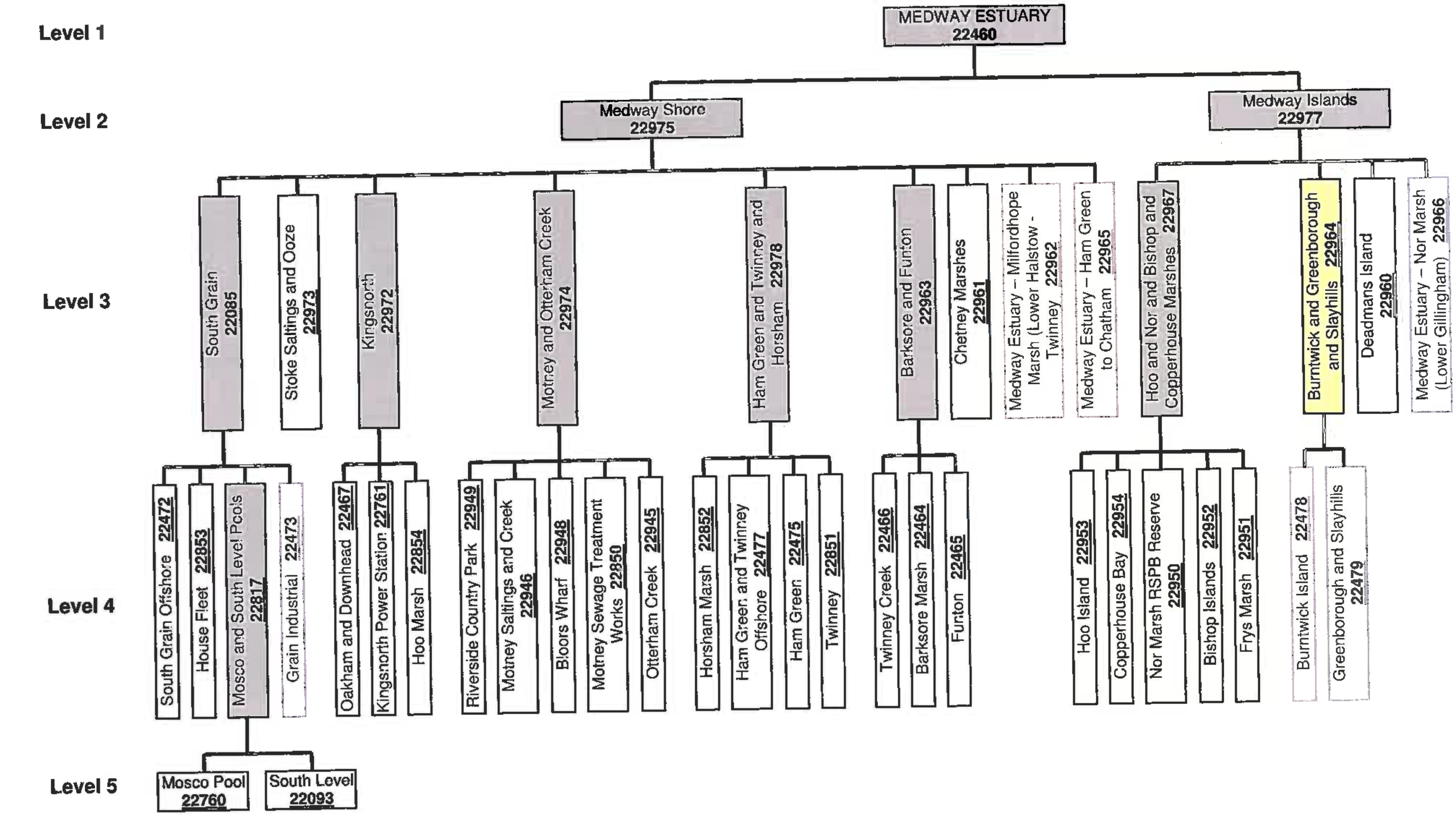


Sector Number	Sector Name
22447	Shellness and Harty Marshes
22451	Capel Fleet
22449	Elmley Marshes
22452	Murston to Conyer
22454	Conyer to Luddenham Gut
22455	Luddenham Gut to Faversham Creek
22942	South Swale NNR
22943	Graveney to Whitstable

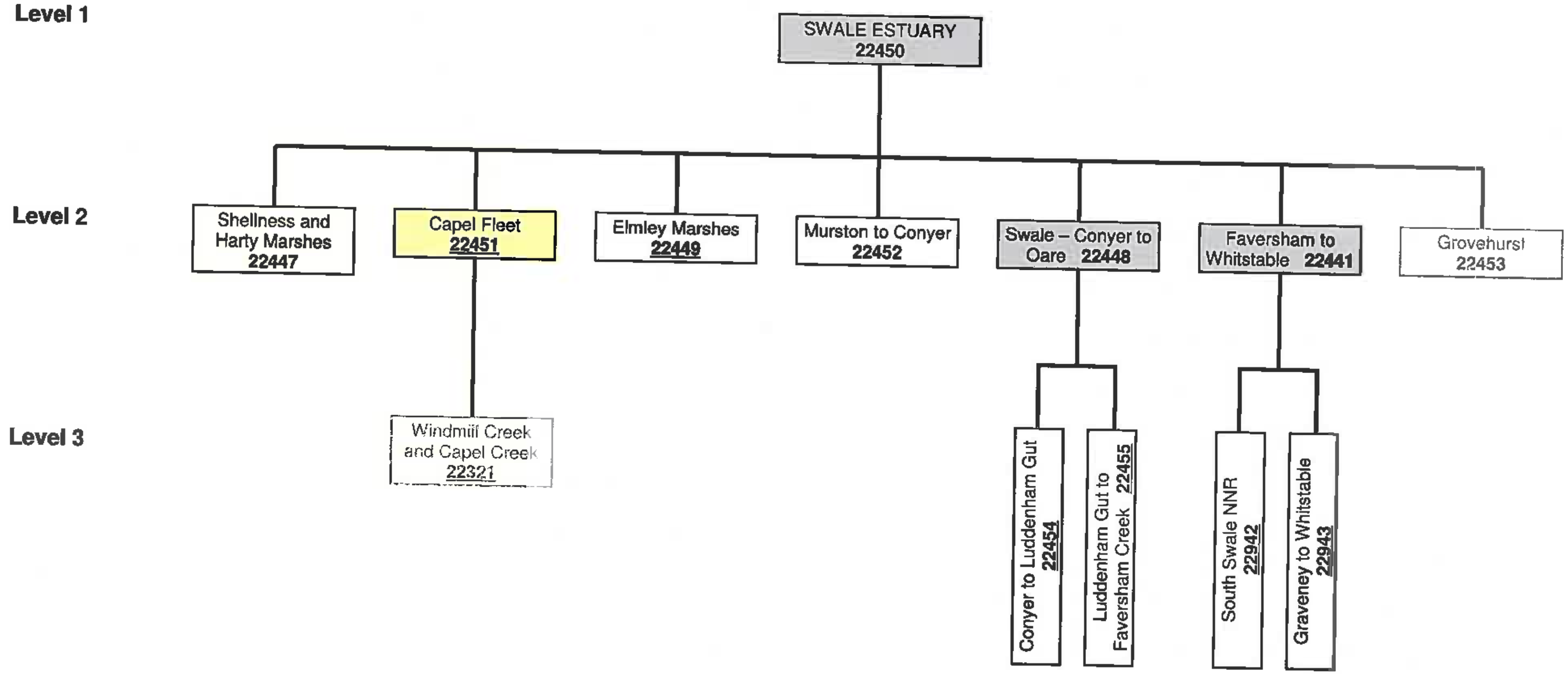
Appendix B.i Structural hierarchy of count sectors on the Thames Estuary. Grey filled boxes identify 'complex sectors' i.e. those that are sub-divided for counting purposes and toned-down information within a box identifies sectors for which data for at least the most recent five winters are unavailable. Yellow boxes identify 'complex sectors' whose subdivisions are sectors for which data for at least the most recent five winters are unavailable, so counts for these consolidations are used instead.



Appendix B.ii Structural hierarchy of count sectors on the Medway Estuary. Grey filled boxes identify 'complex sectors' i.e. those that are sub-divided for counting purposes and toned-down information within a box identifies sectors for which data for at least the most recent five winters are unavailable. Yellow boxes identify 'complex sectors' whose subdivisions are sectors for which data for at least the most recent five winters are unavailable, so counts for these consolidations are used instead.

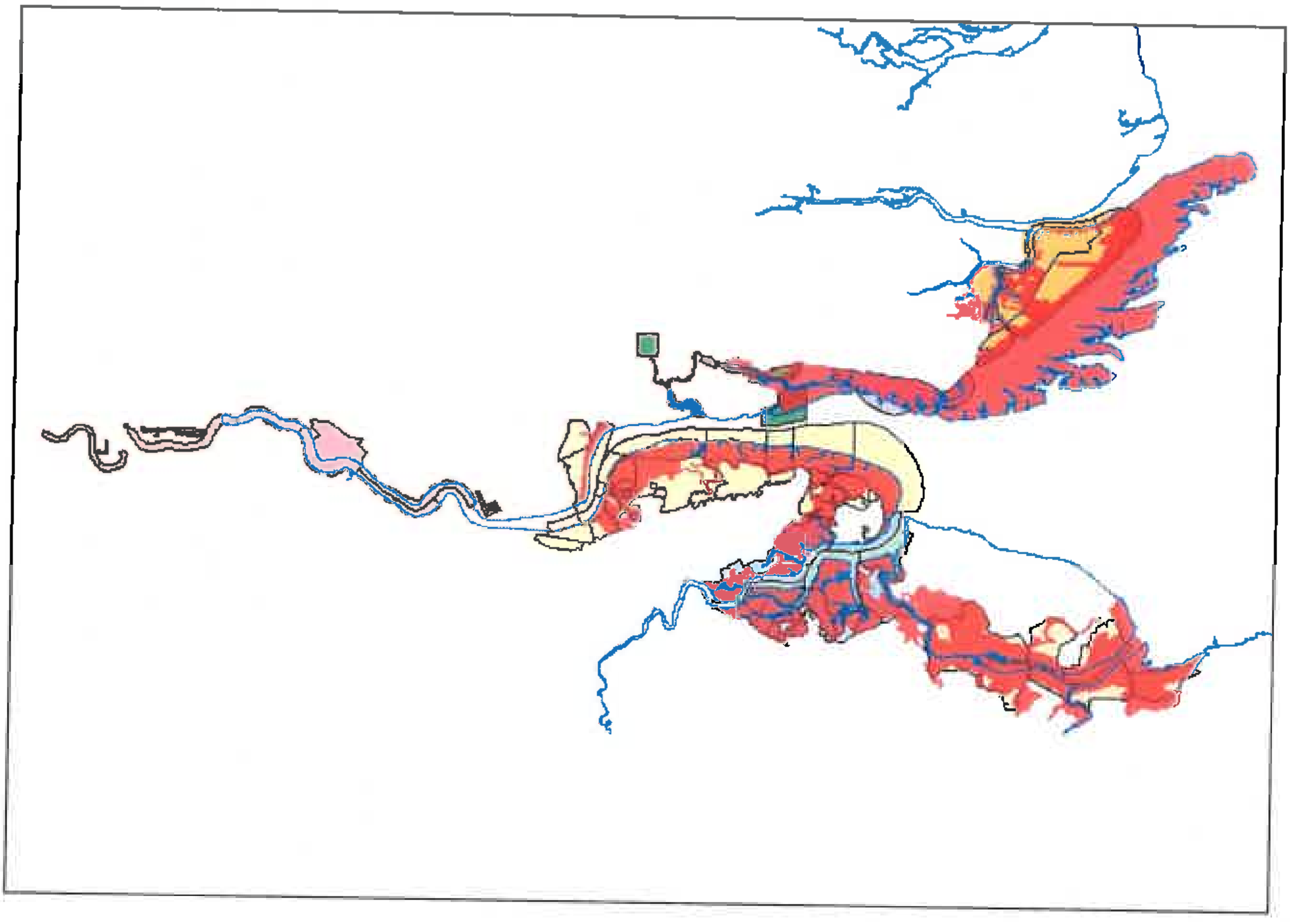


Appendix B.iii Structural hierarchy of count sectors on the Swale Estuary. Grey filled boxes identify 'complex sectors' i.e. those that are sub-divided for counting purposes and toned-down information within a box identifies sectors for which data for at least the most recent five winters are unavailable. Yellow boxes identify 'complex sectors' whose subdivisions are sectors for which data for at least the most recent five winters are unavailable, so counts for these consolidations are used instead.



Appendix C

WeBS count sectors on the Greater Thames Estuary in relation to the SPAs. Areas within the boundaries of the five SPAs are shown with a red overlay. Sectors are coloured according to broad within-estuary regions referred to in this report (pink = Inner Thames Estuary; dark green = Leigh and Canvey; lilac = Southend Seafront; orange = Foulness; yellow = North Kent Marshes; pale blue = Medway Shore; pale green = Medway Islands; beige = Swale).



Appendix D

Abundance of each species on WeBS count sectors on the wider Thames Estuary. Maps show the five-year means of peak winter counts for each species on each sector where there were sufficient data to generate reliable estimates. Scaled dots are used to represent the mean of peak counts. However, please note that while the numbers of birds represented by different sized dots are consistent between maps within each species, scales do vary between species (for example a large dot would represent more than 100 Gadwall, but more than 10,000 Knot). These scales are given in the keys for each map.

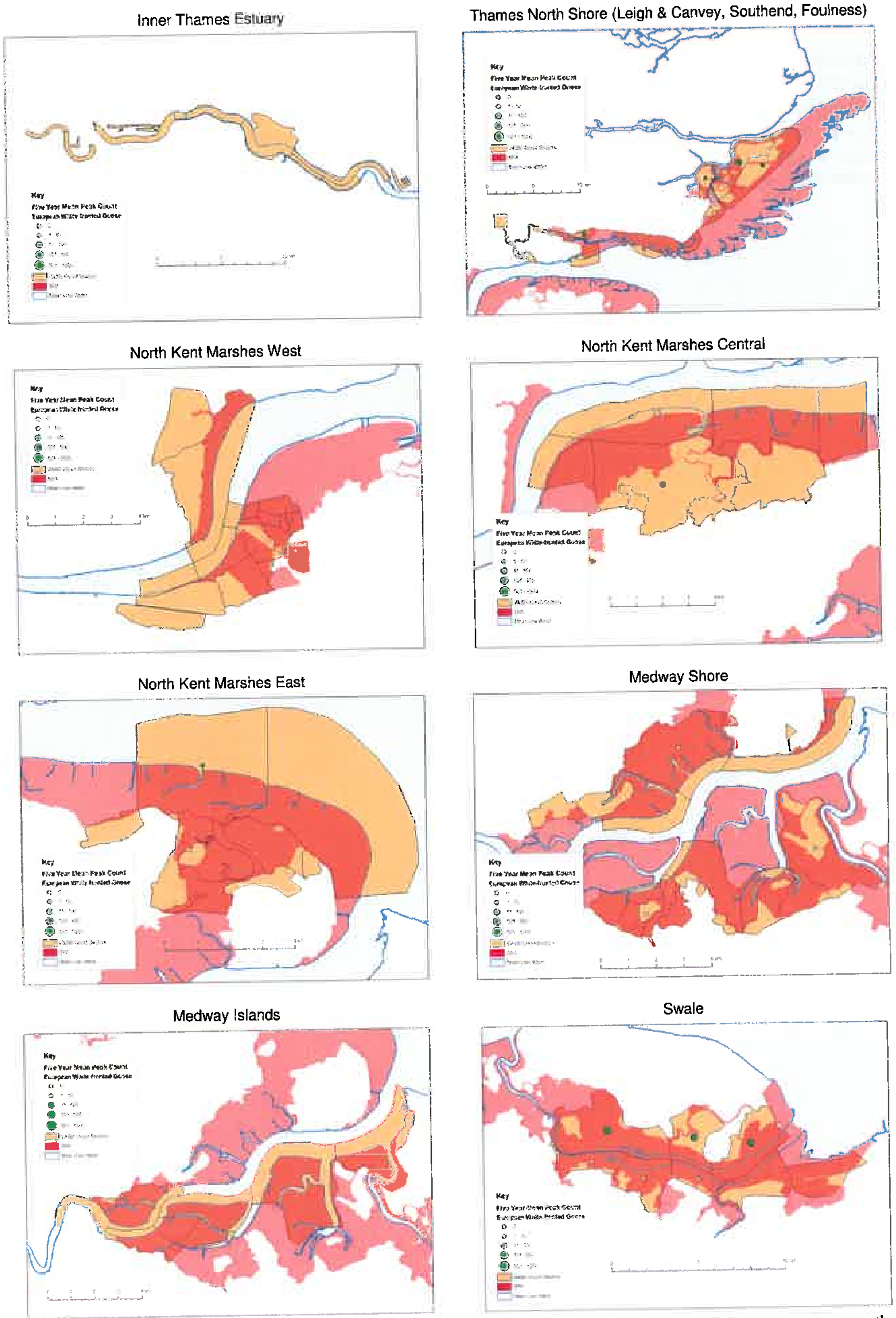


Figure D.1 Five-year mean of annual peak counts of European White-fronted Goose on WeBS count sectors on the Wider Thames Estuary.

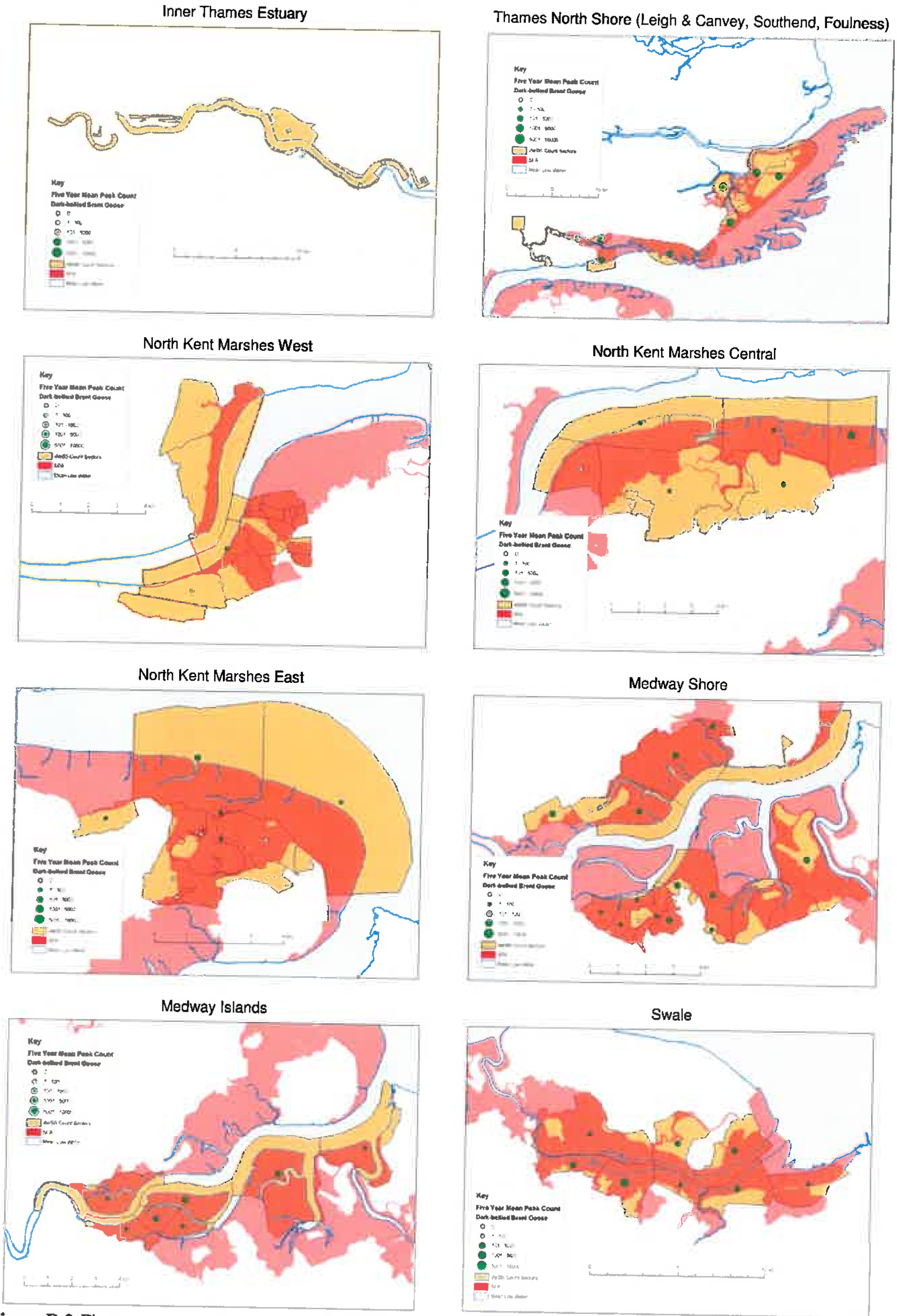


Figure D.2 Five-year mean of annual peak counts of Dark-bellied Brent Goose on WeBS count sectors on the Wider Thames Estuary.

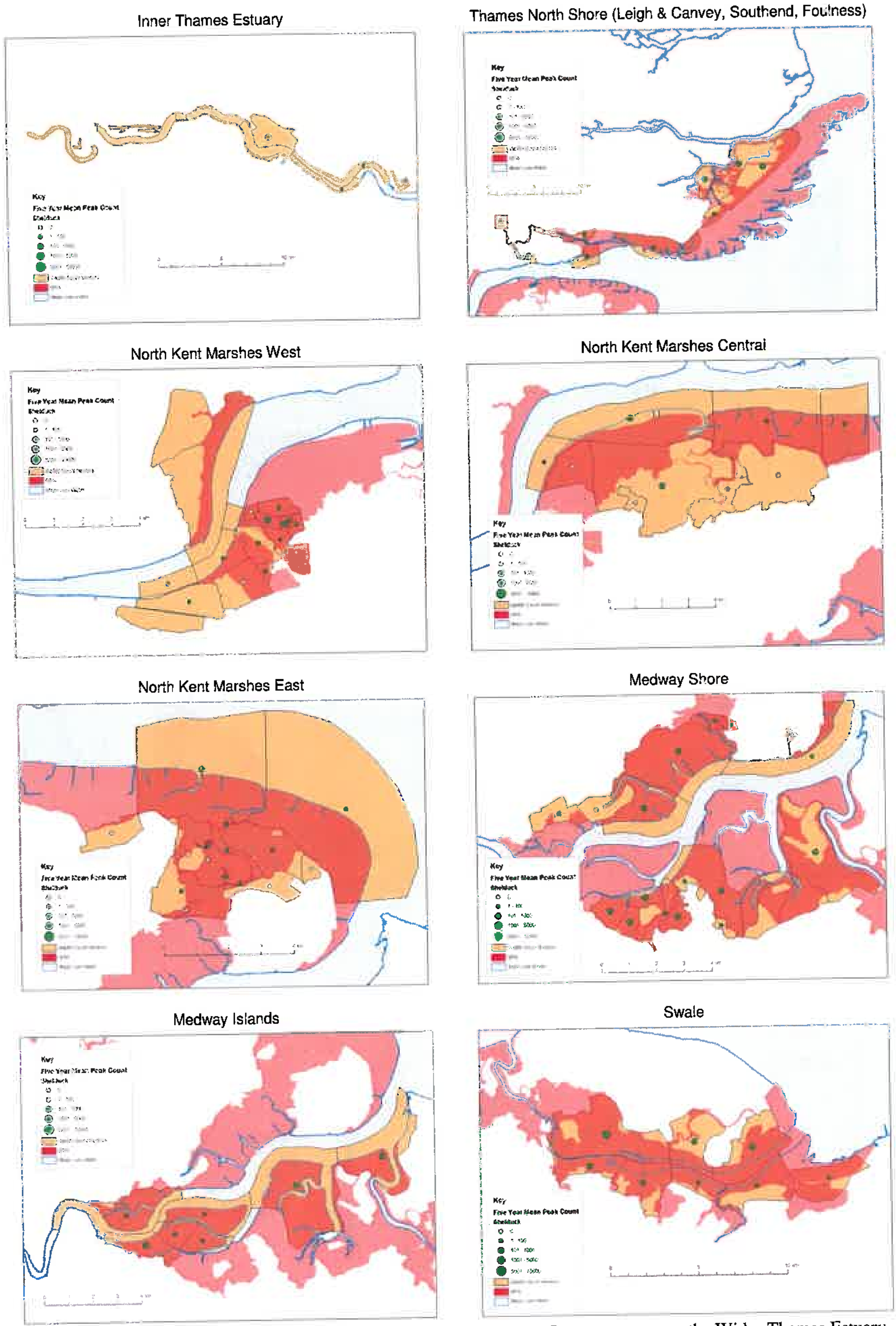


Figure D.3 Five-year mean of annual peak counts of Shelduck on WeBS count sectors on the Wider Thames Estuary.

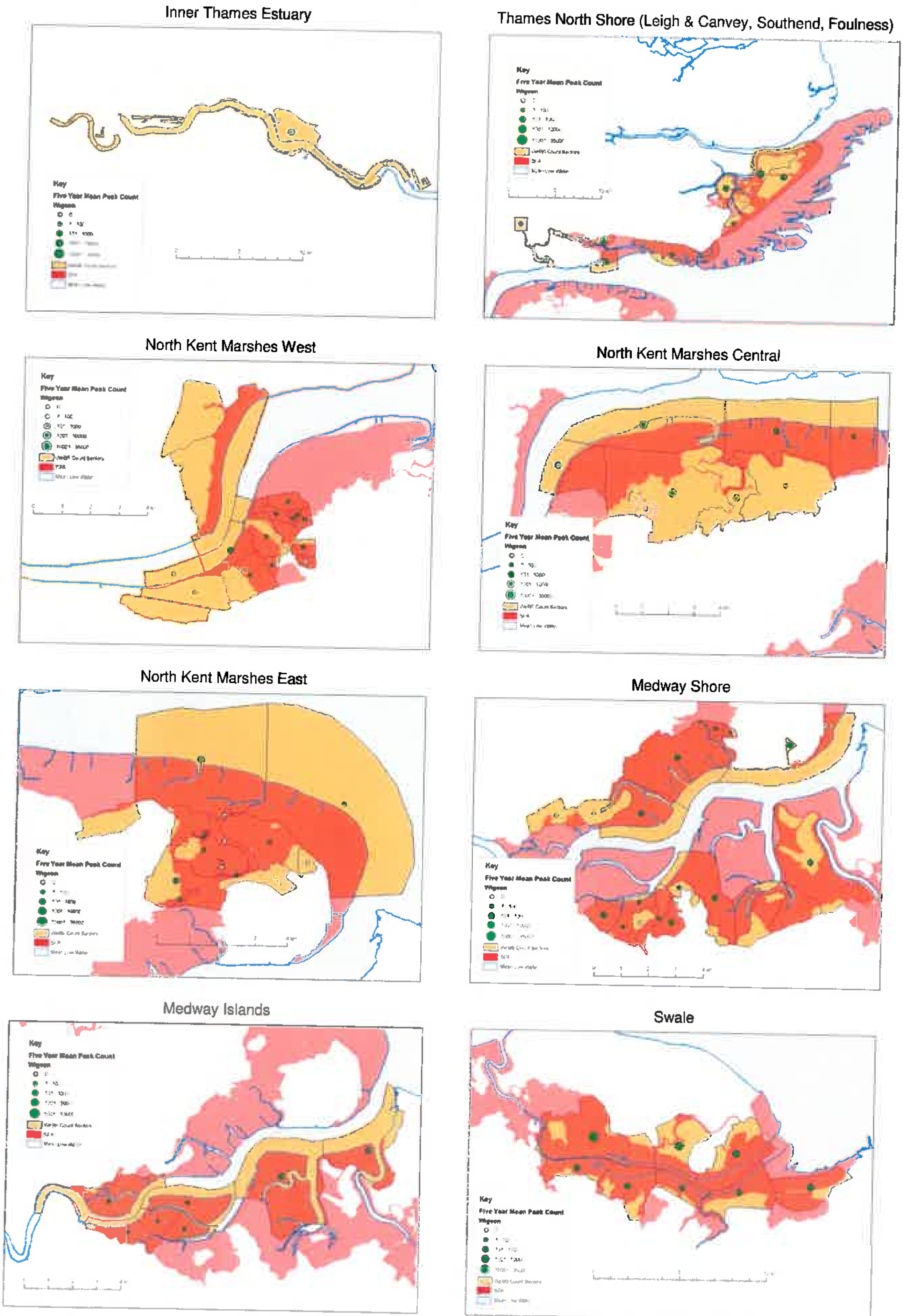


Figure D.4 Five-year mean of annual peak counts of Wigeon on WeBS count sectors on the Wider Thames Estuary.

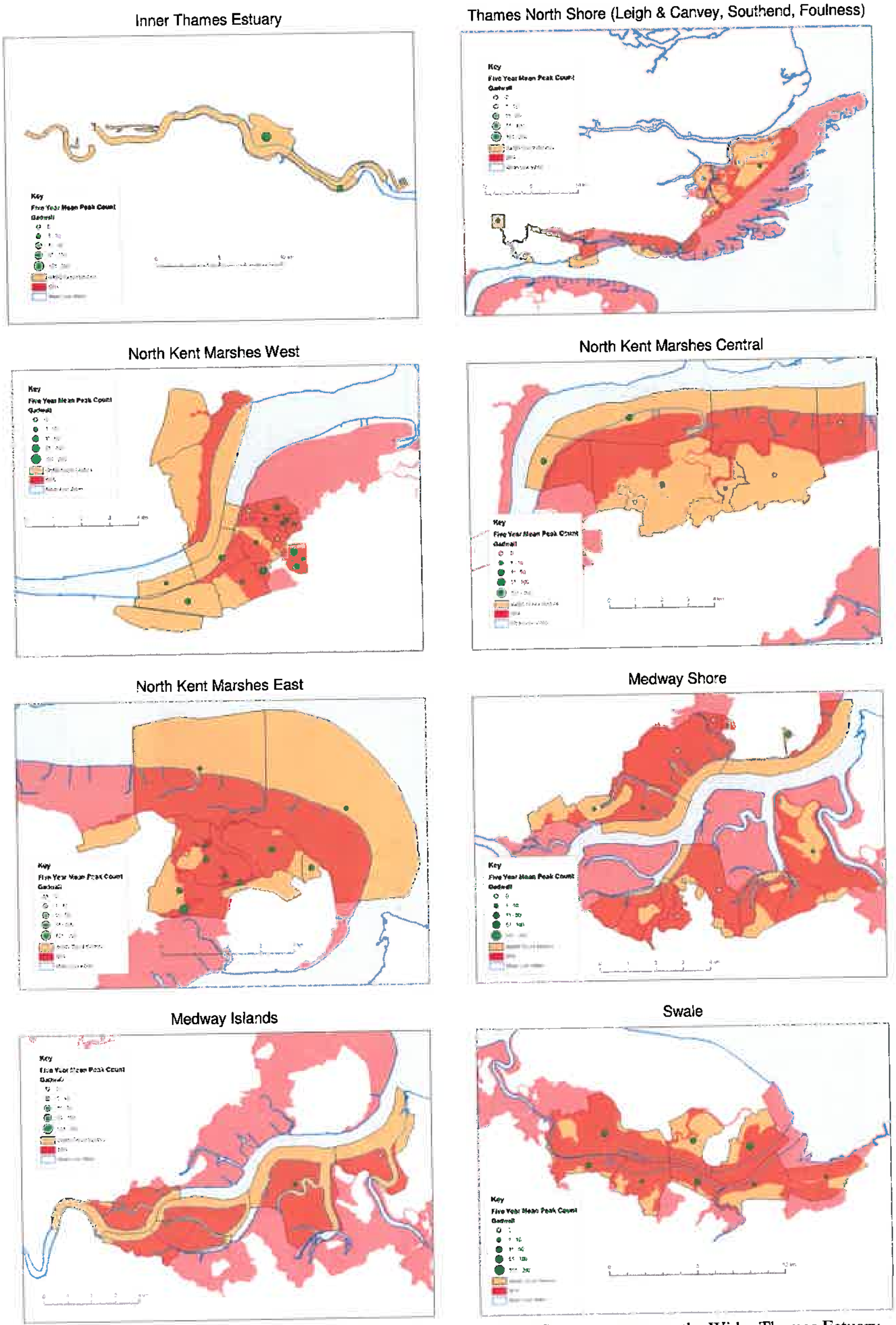


Figure D.5 Five-year mean of annual peak counts of Gadwall on WeBS count sectors on the Wider Thames Estuary.

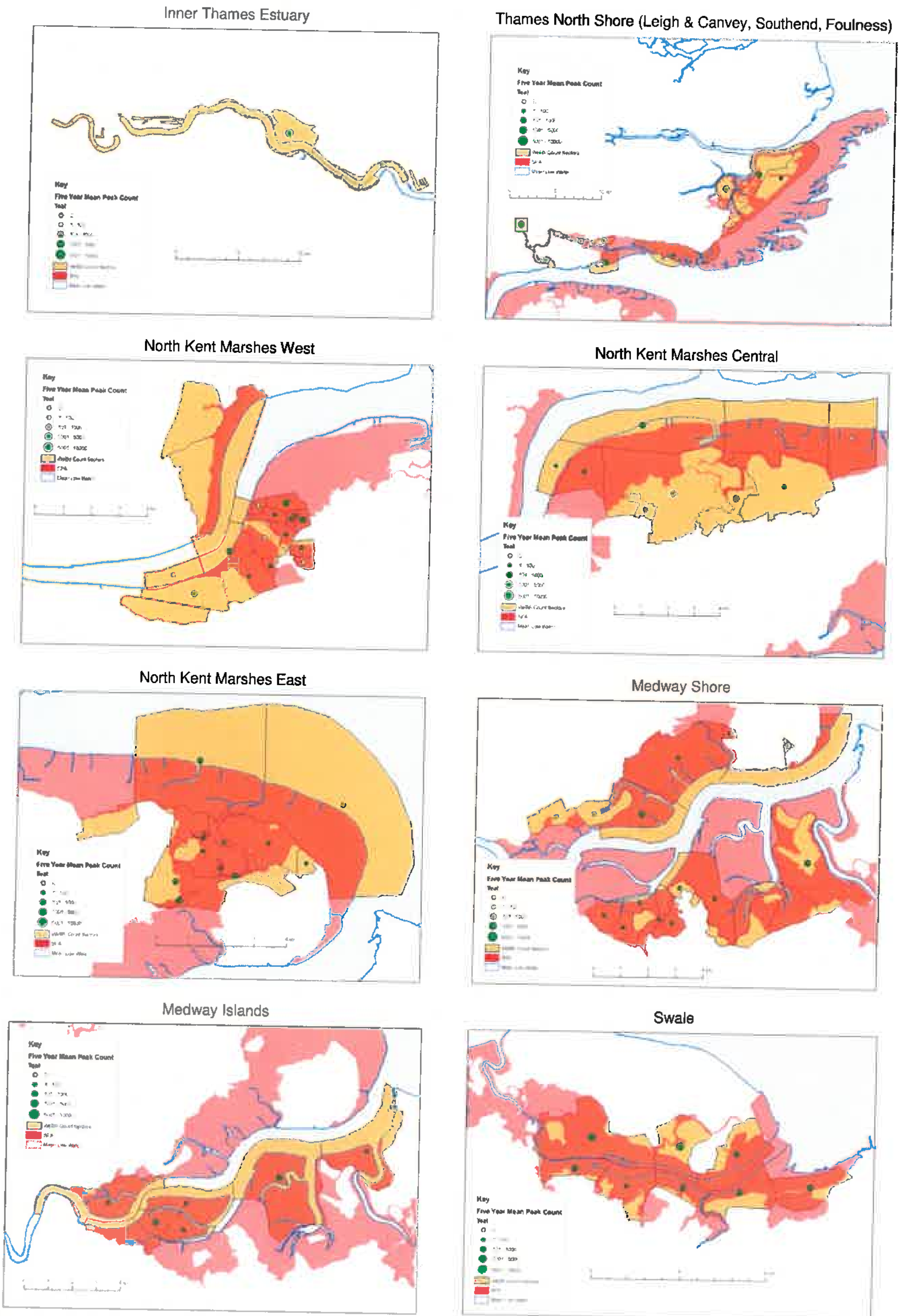


Figure D.6 Five-year mean of annual peak counts of Teal on WeBS count sectors on the Wider Thames Estuary.

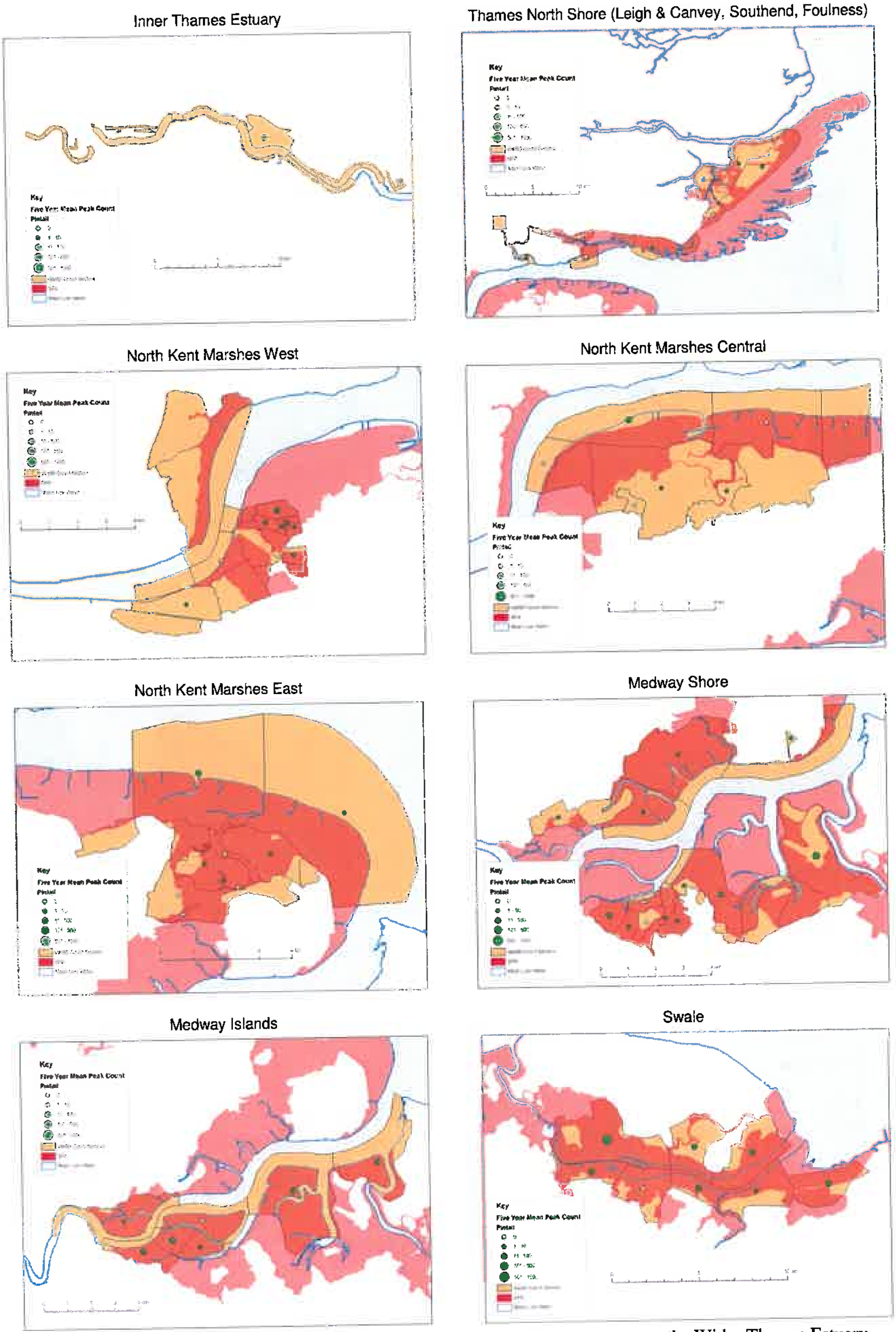


Figure D.7 Five-year mean of annual peak counts of Pintail on WeBS count sectors on the Wider Thames Estuary.

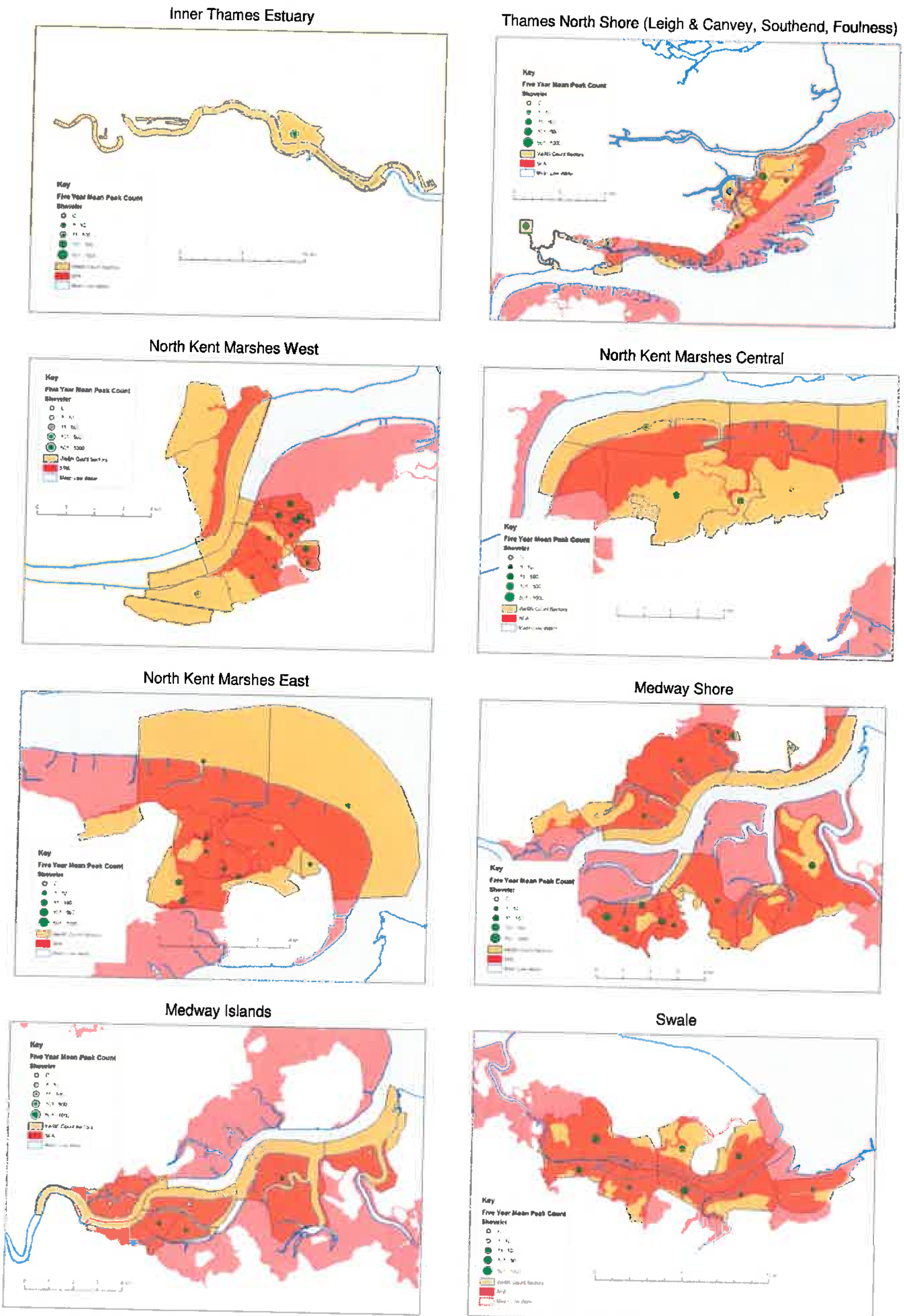


Figure D.8 Five-year mean of annual peak counts of Shoveler on WeBS count sectors on the Wider Thames Estuary.

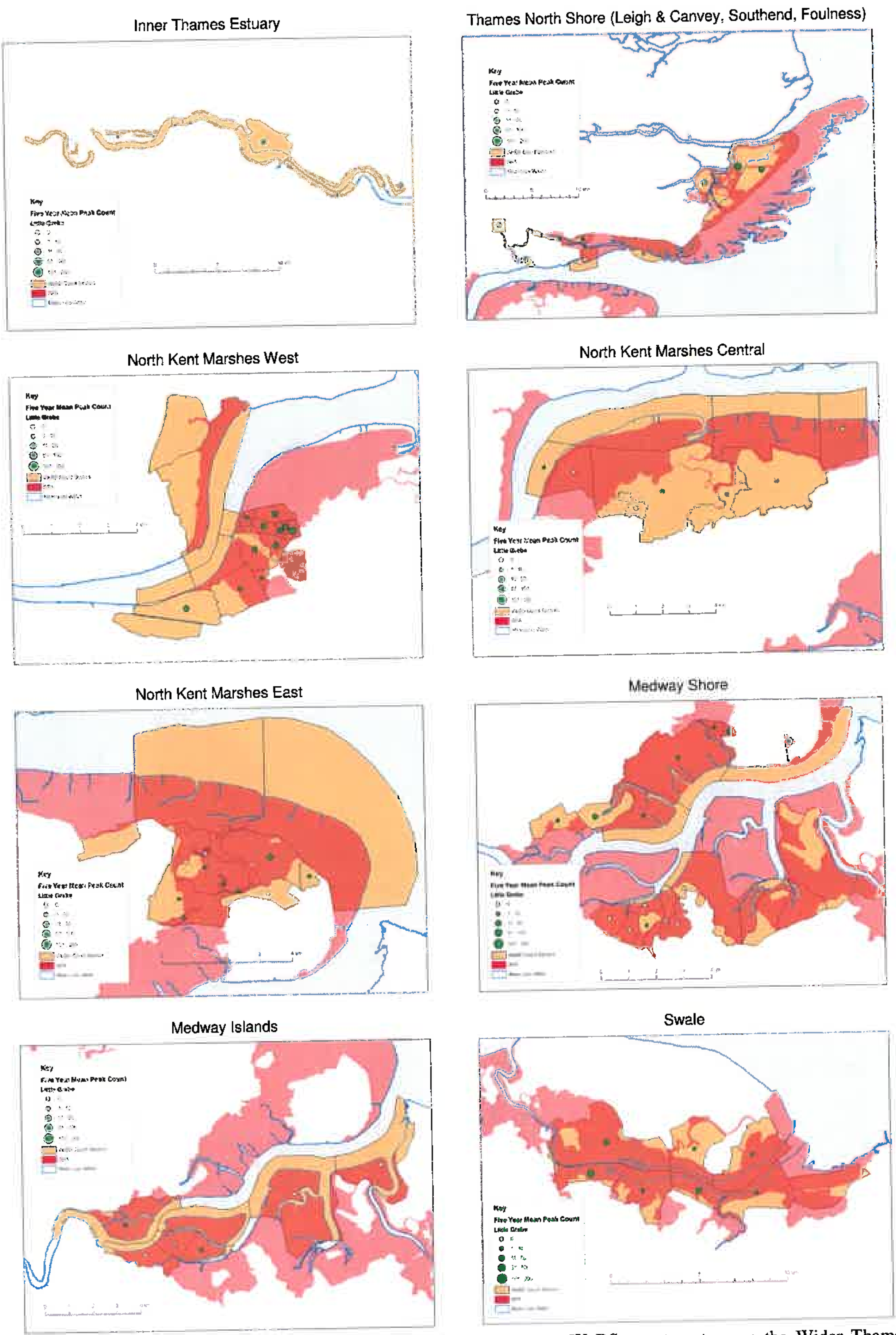


Figure D.9 Five-year mean of annual peak counts of Little Grebe on WeBS count sectors on the Wider Thames Estuary.

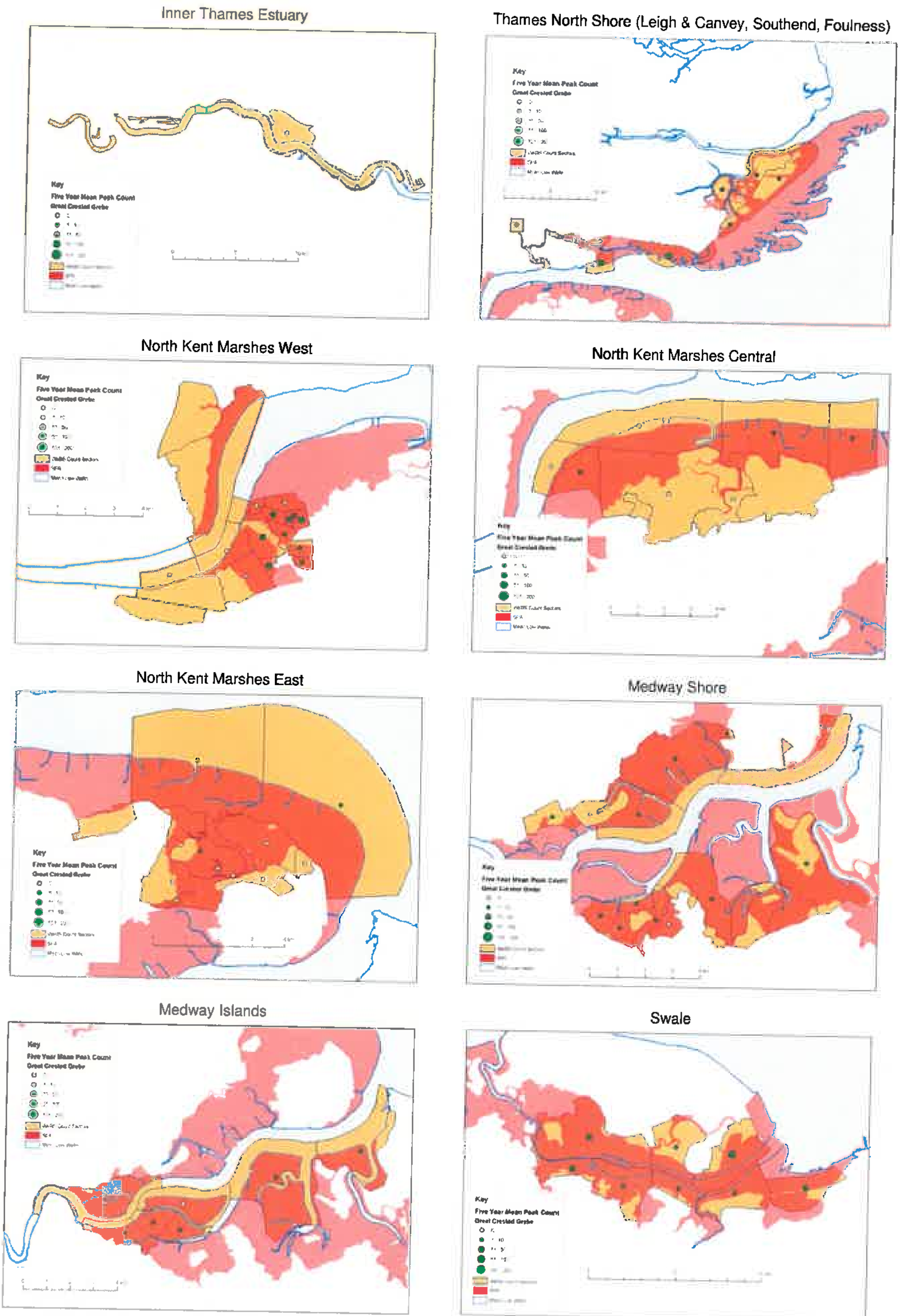


Figure D.10 Five-year mean of annual peak counts of Great Crested Grebe on WeBS count sectors on the Wider Thames Estuary.

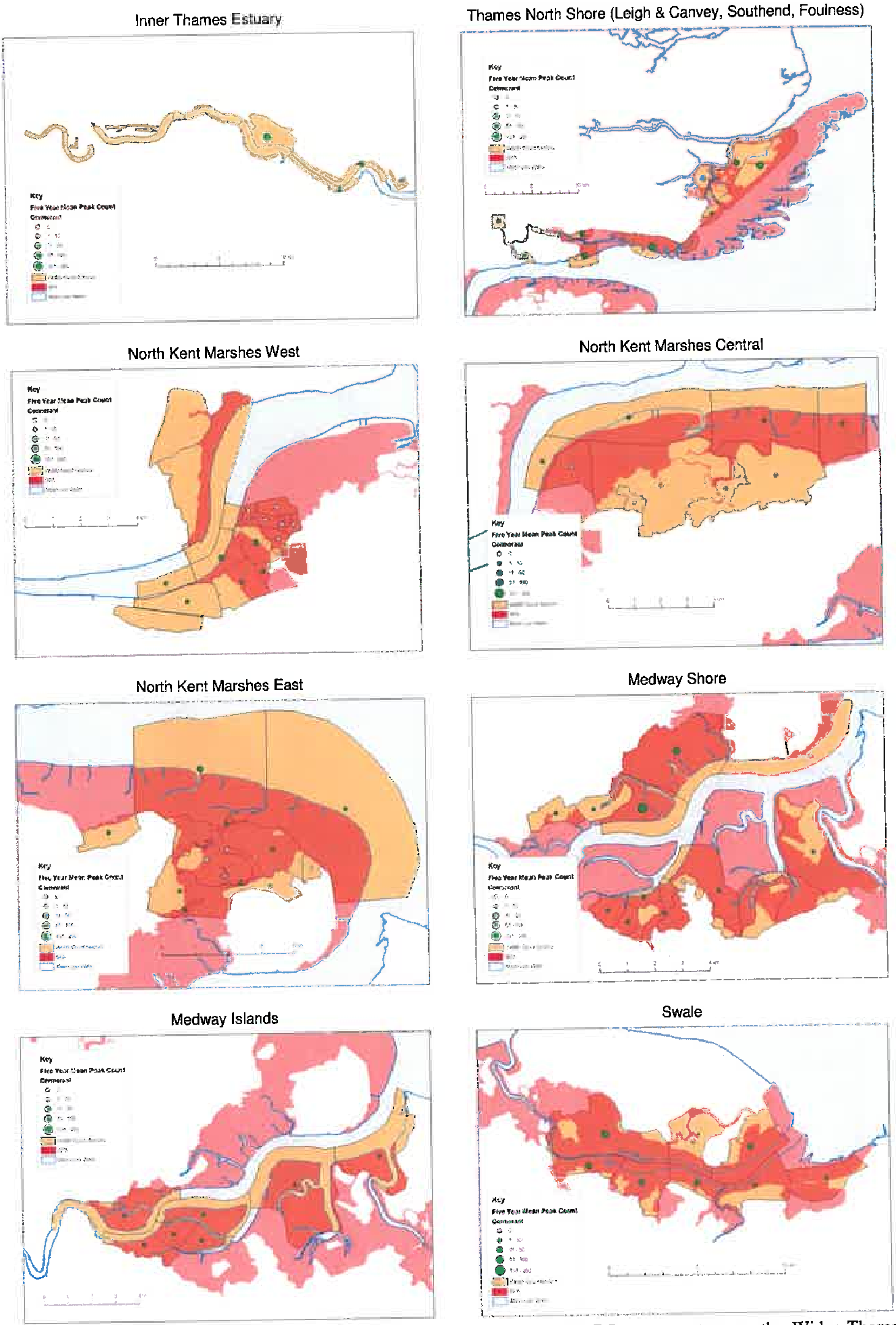


Figure D.11 Five-year mean of annual peak counts of Cormorant on WeBS count sectors on the Wider Thames Estuary.

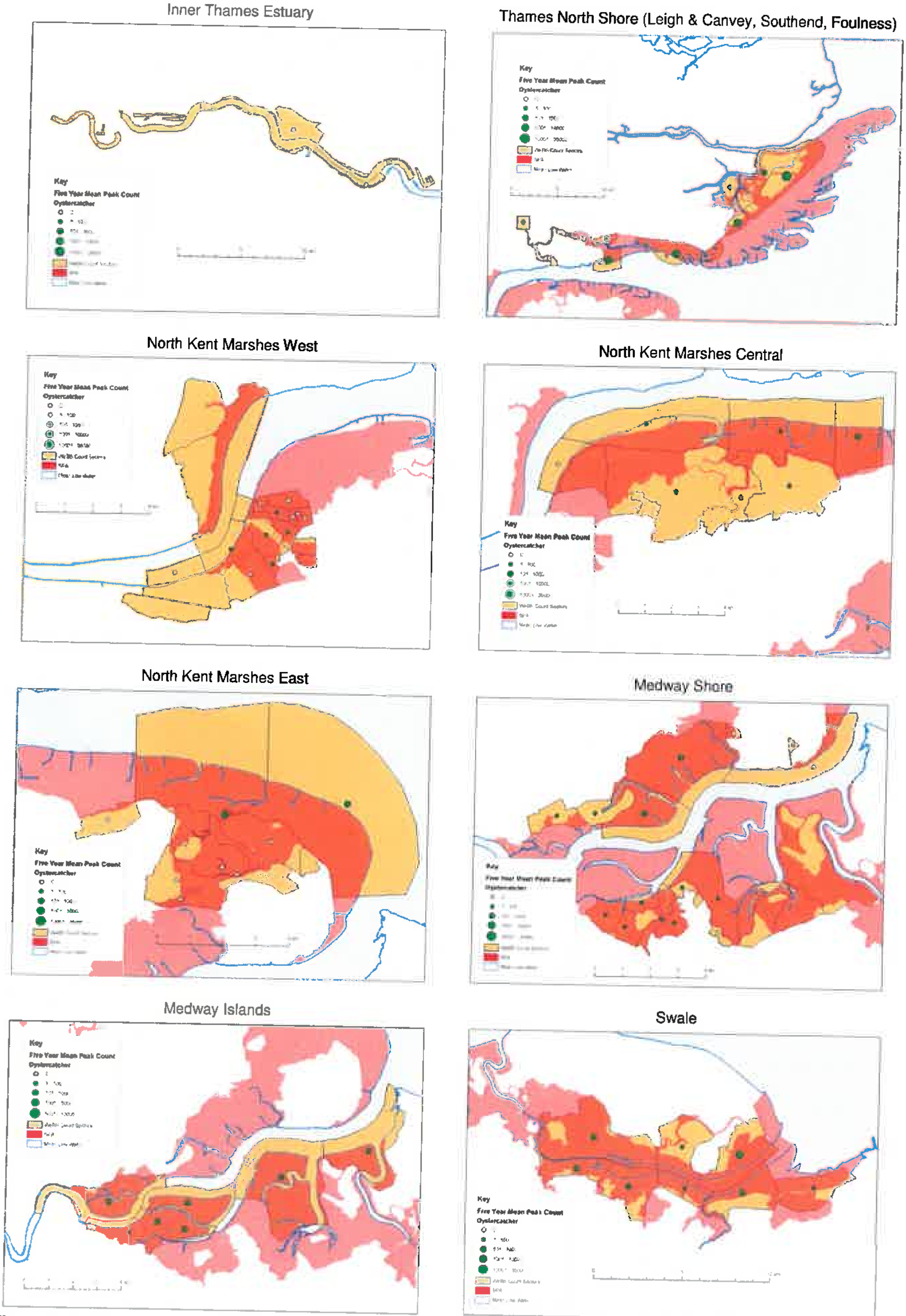


Figure D.12 Five-year mean of annual peak counts of Oystercatcher on WeBS count sectors on the Wider Thames Estuary.

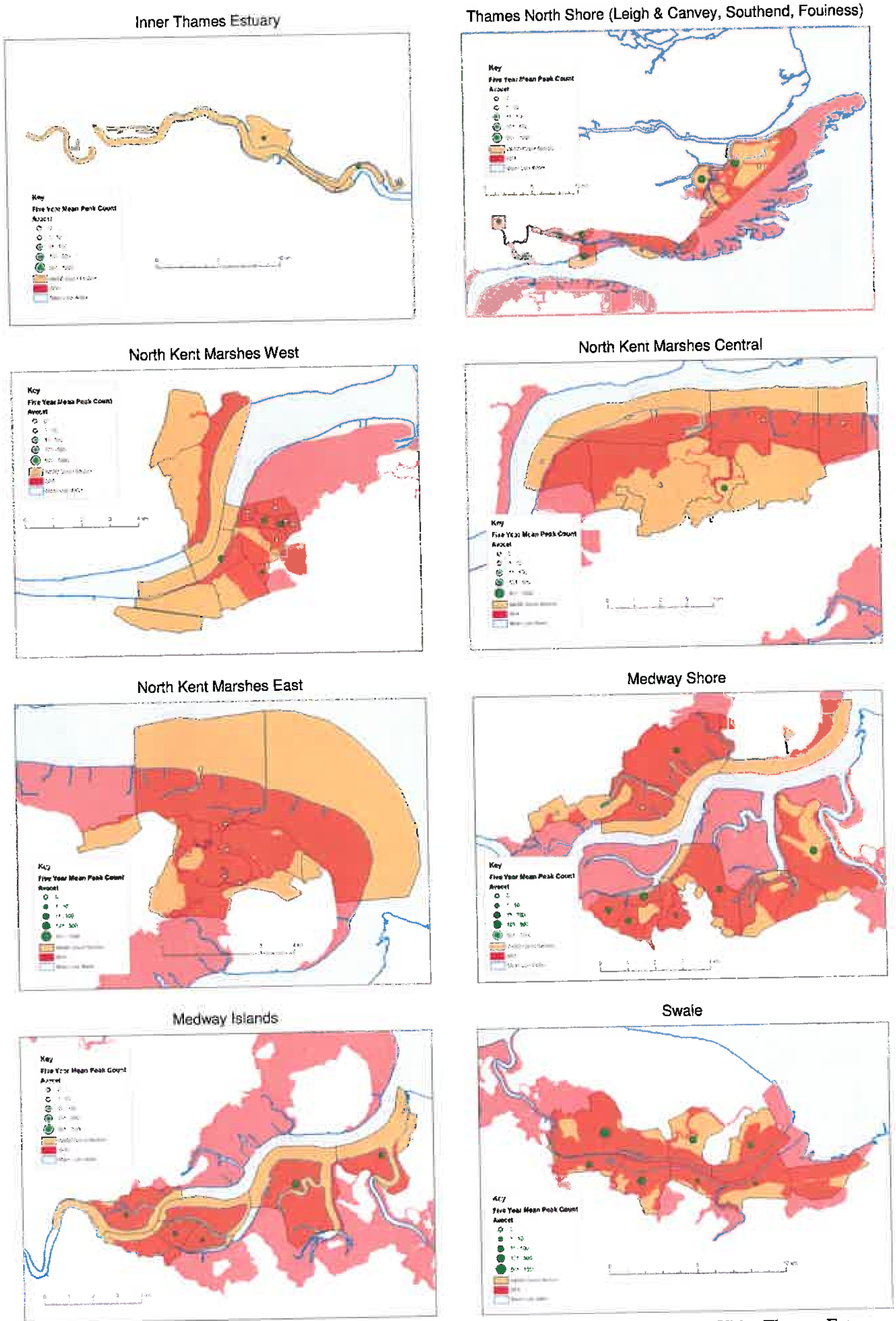


Figure D.13 Five-year mean of annual peak counts of Avocet on WeBS count sectors on the Wider Thames Estuary.

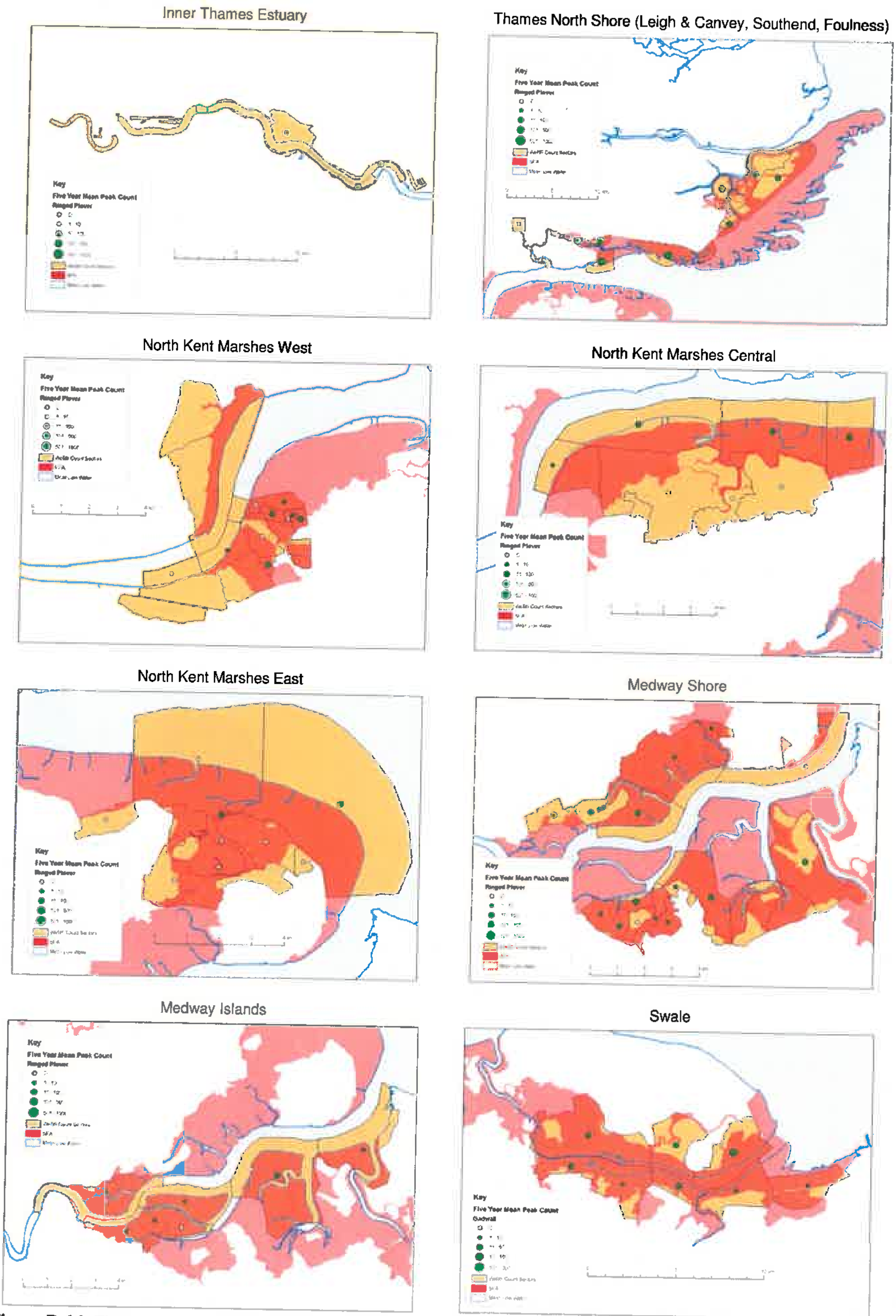


Figure D.14 Five-year mean of annual peak counts of Ringed Plover on WeBS count sectors on the Wider Thames Estuary.

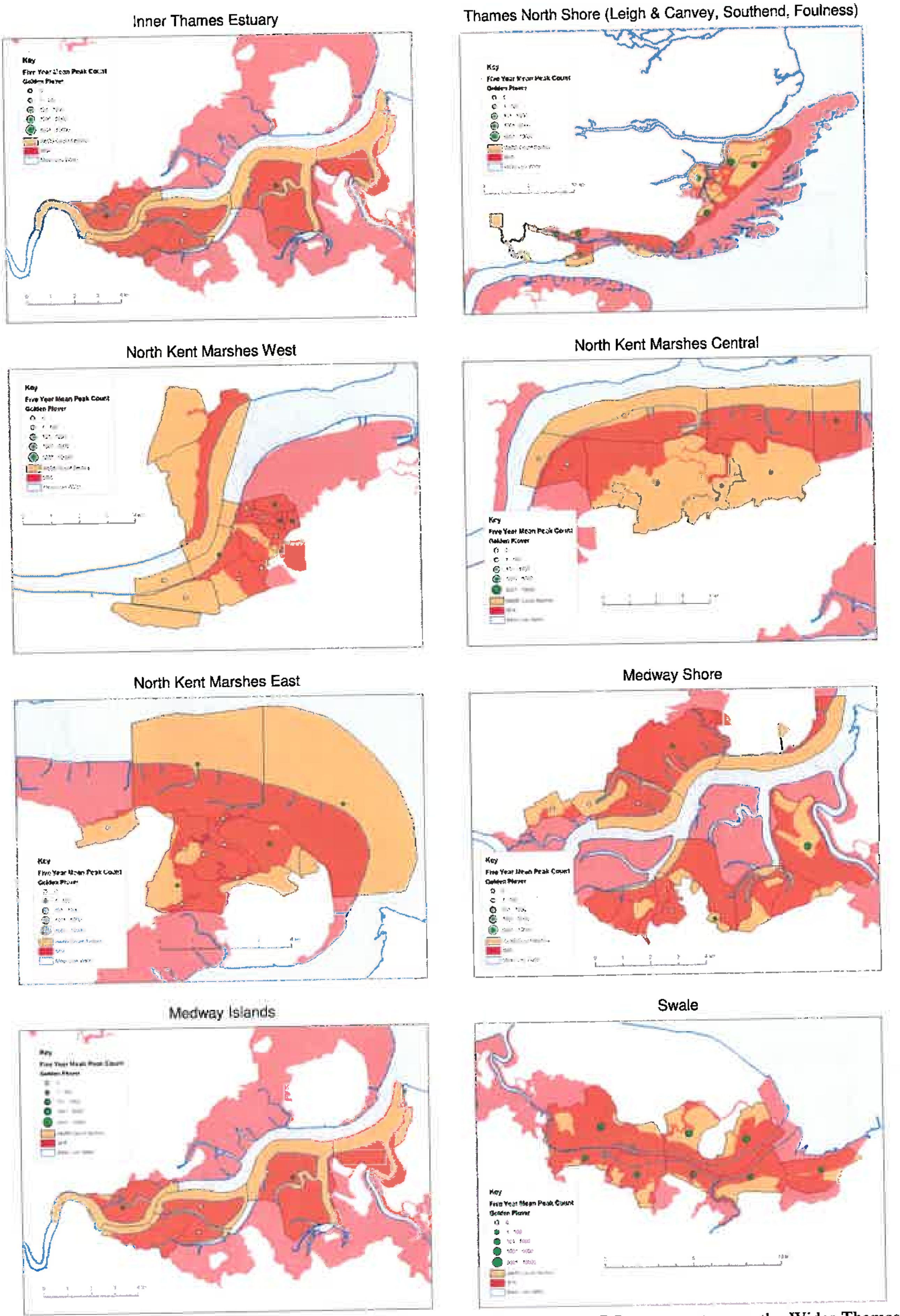


Figure D.15 Five-year mean of annual peak counts of Golden Plover on WeBS count sectors on the Wider Thames Estuary.

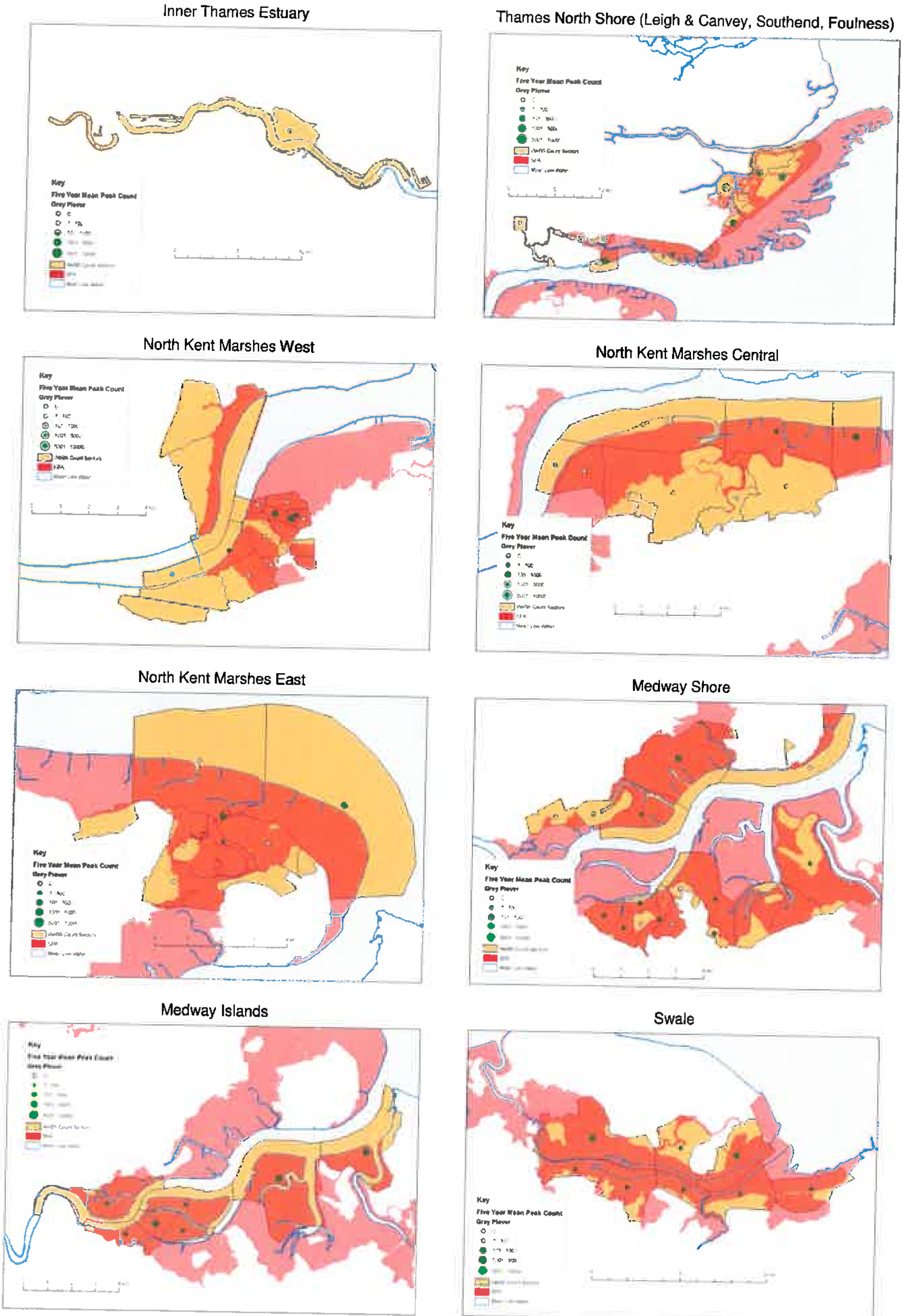


Figure D.16 Five-year mean of annual peak counts of Grey Plover on WeBS count sectors on the Wider Thames Estuary.

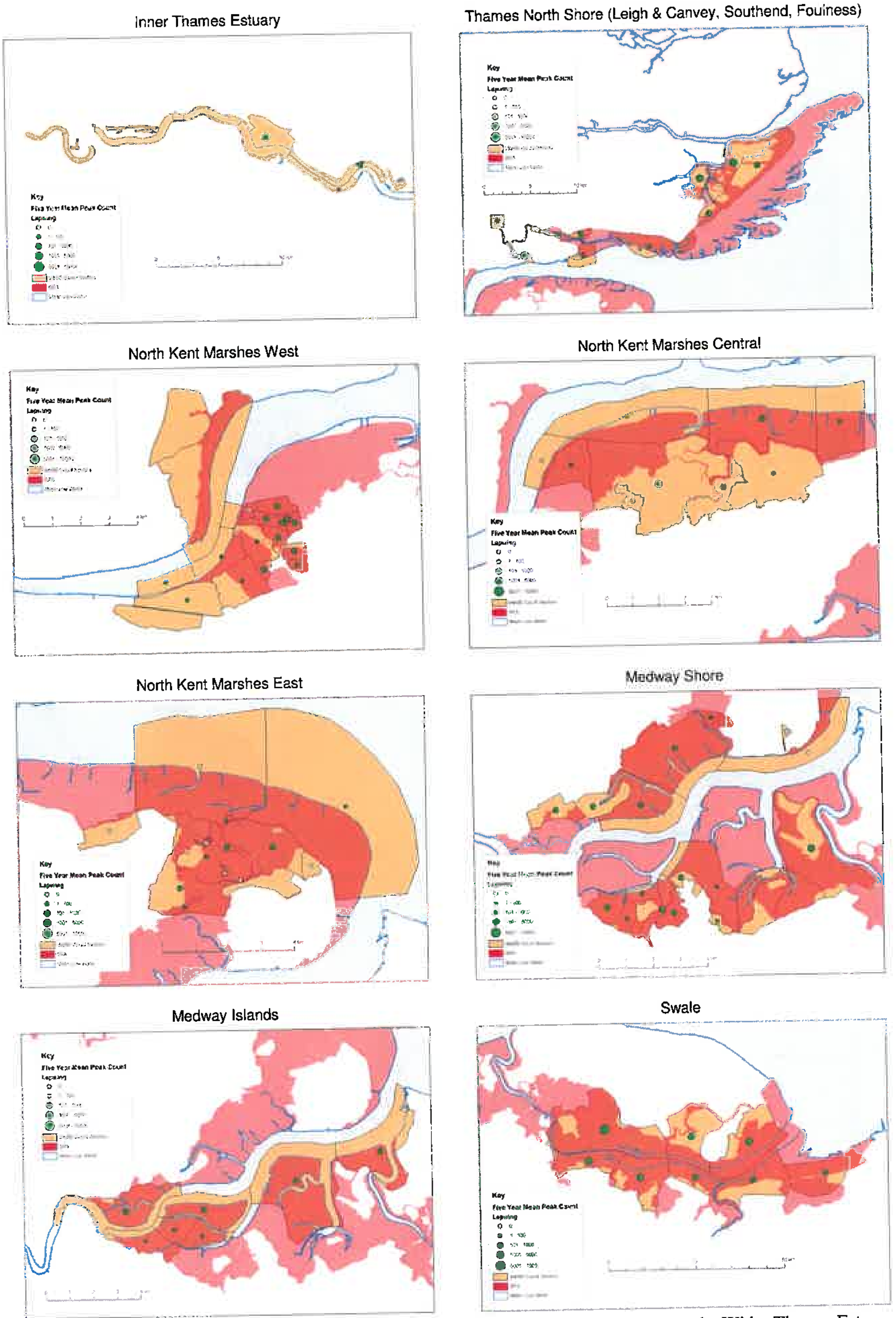


Figure D.17 Five-year mean of annual peak counts of Lapwing on WeBS count sectors on the Wider Thames Estuary.

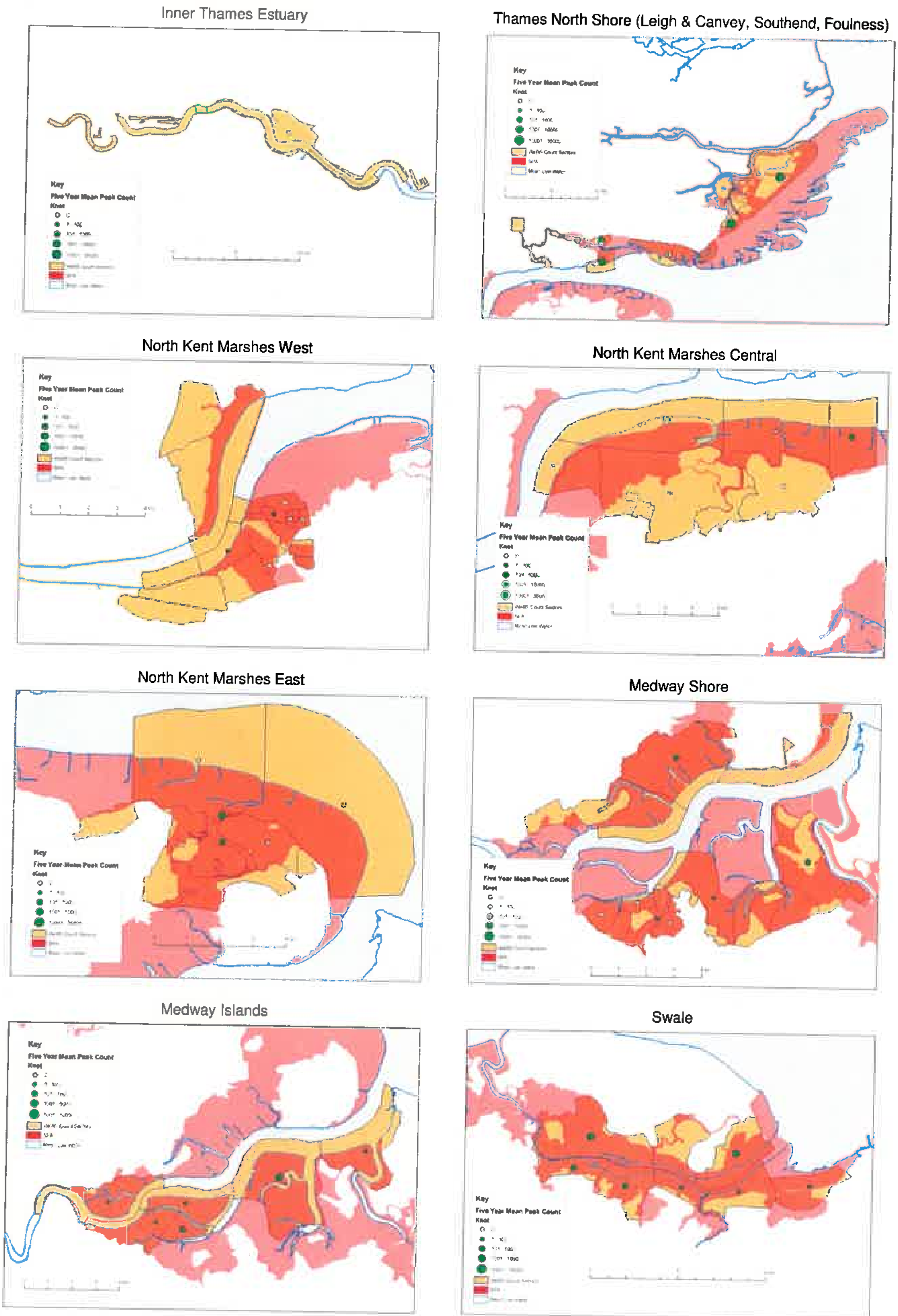


Figure D.18 Five-year mean of annual peak counts of Knot on WeBS count sectors on the Wider Thames Estuary.

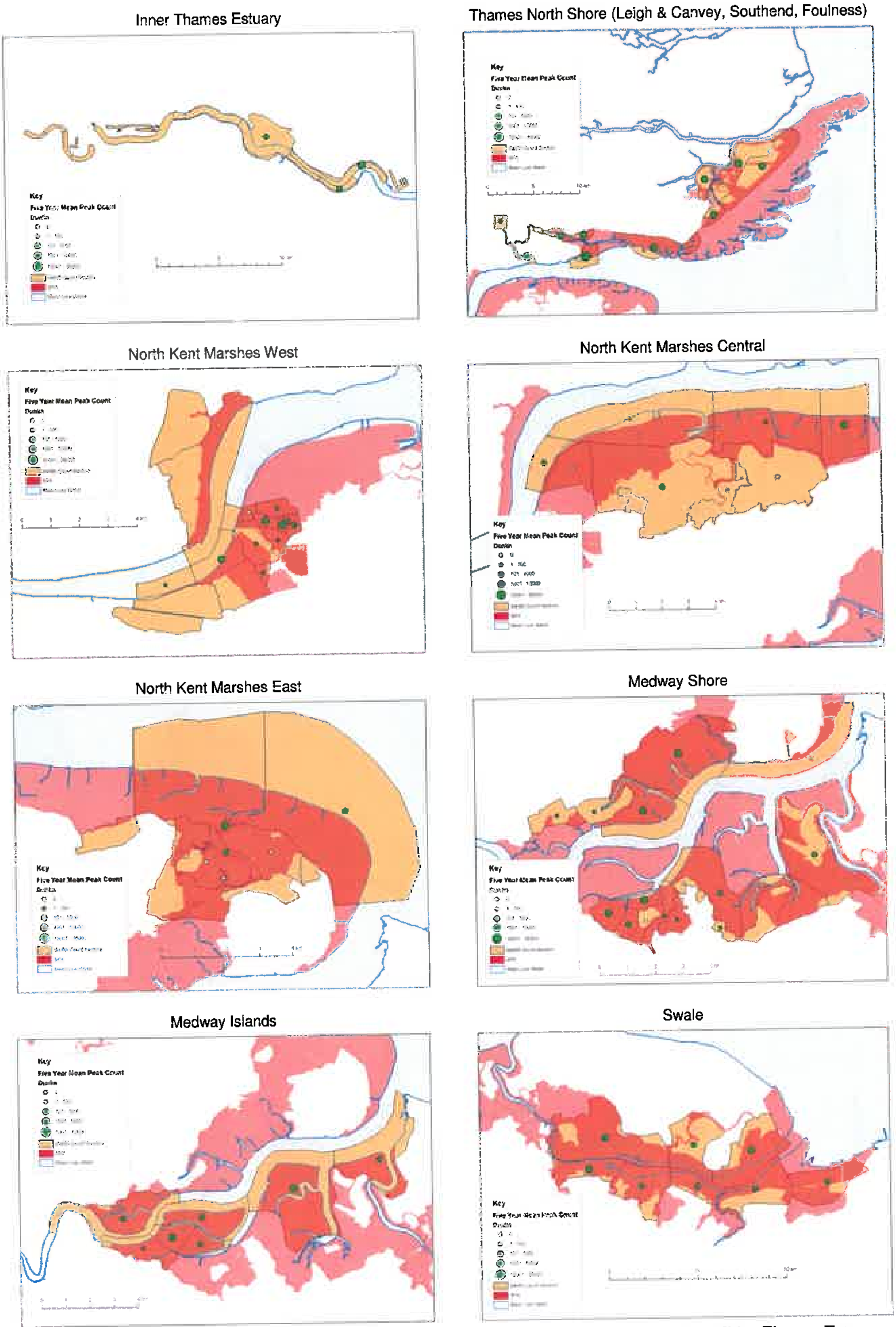


Figure D.19 Five-year mean of annual peak counts of Dunlin on WeBS count sectors on the Wider Thames Estuary.

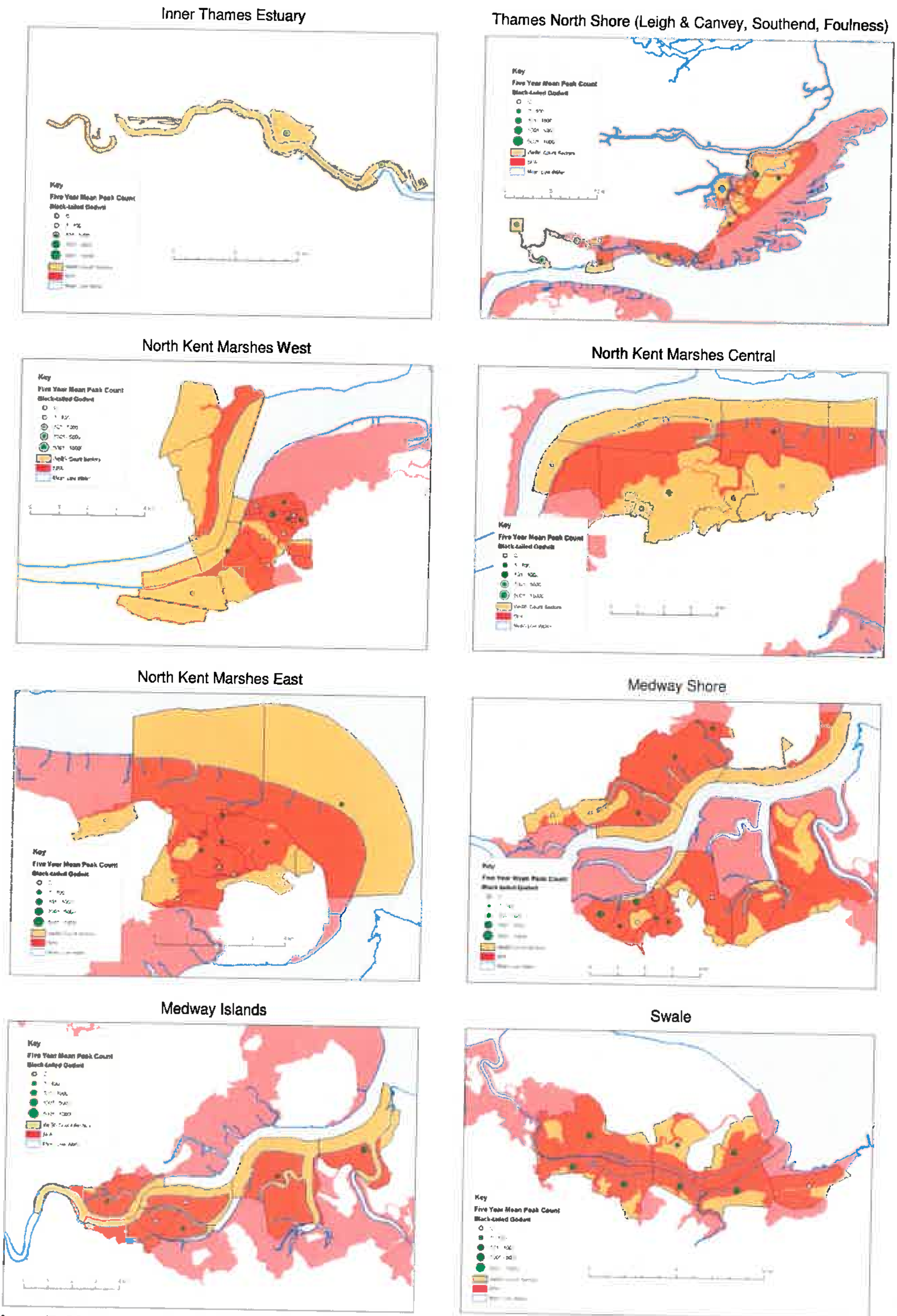


Figure D.20 Five-year mean of annual peak counts of Black-tailed Godwit on WeBS count sectors on the Wider Thames Estuary.

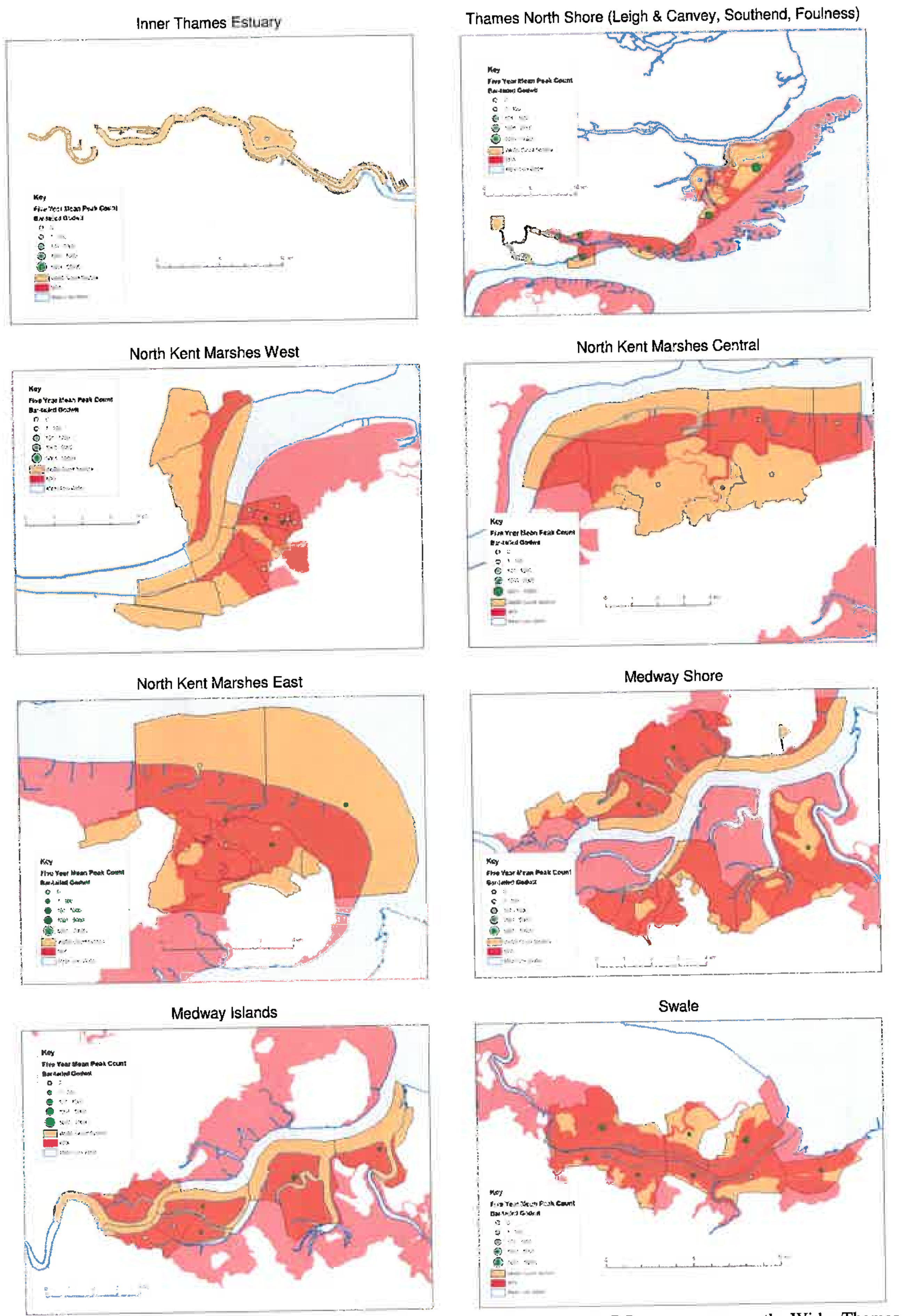


Figure D.21 Five-year mean of annual peak counts of Bar-tailed Godwit on WeBS count sectors on the Wider Thames Estuary.

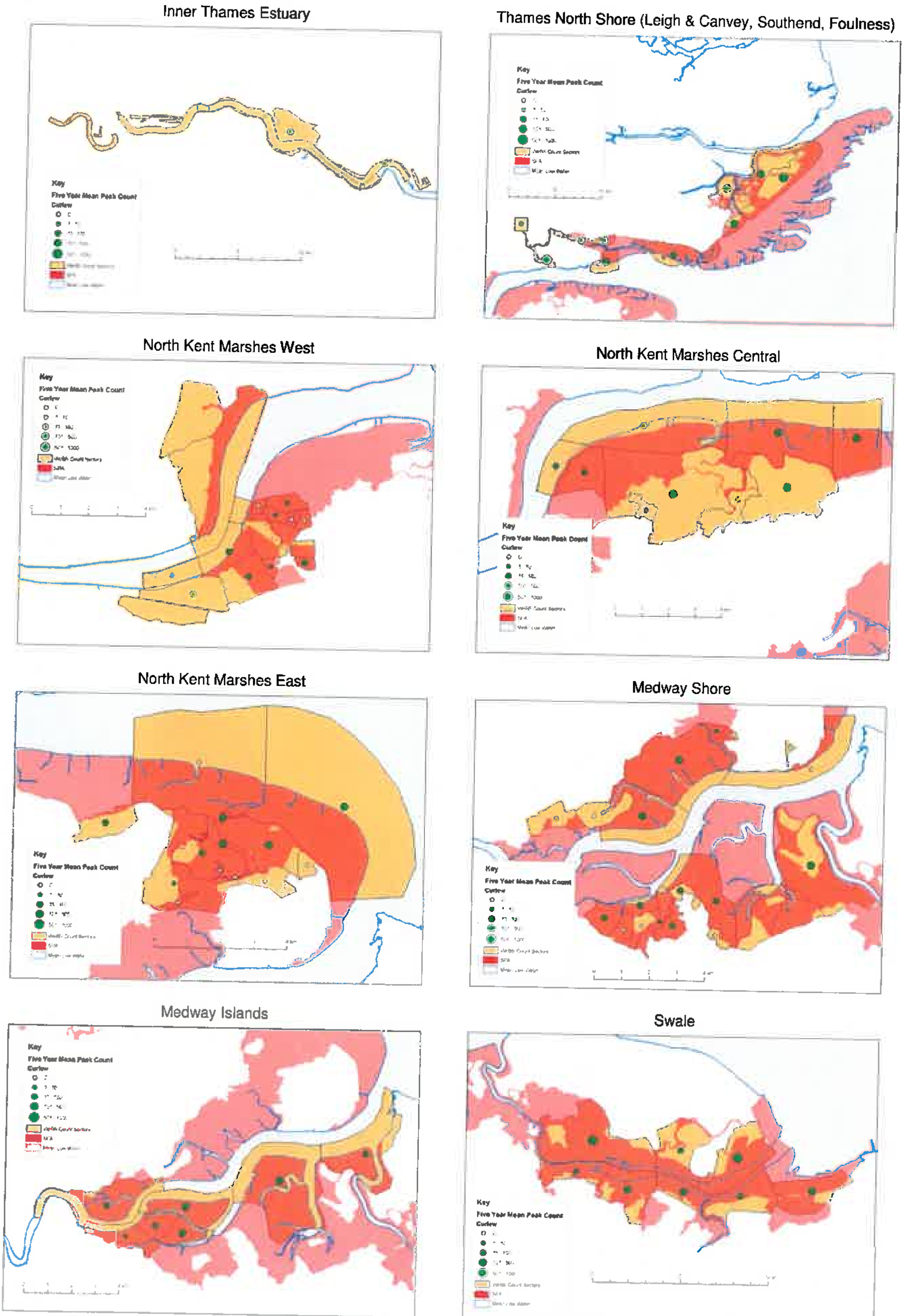


Figure D.22 Five-year mean of annual peak counts of Curlew on WeBS count sectors on the Wider Thames Estuary.

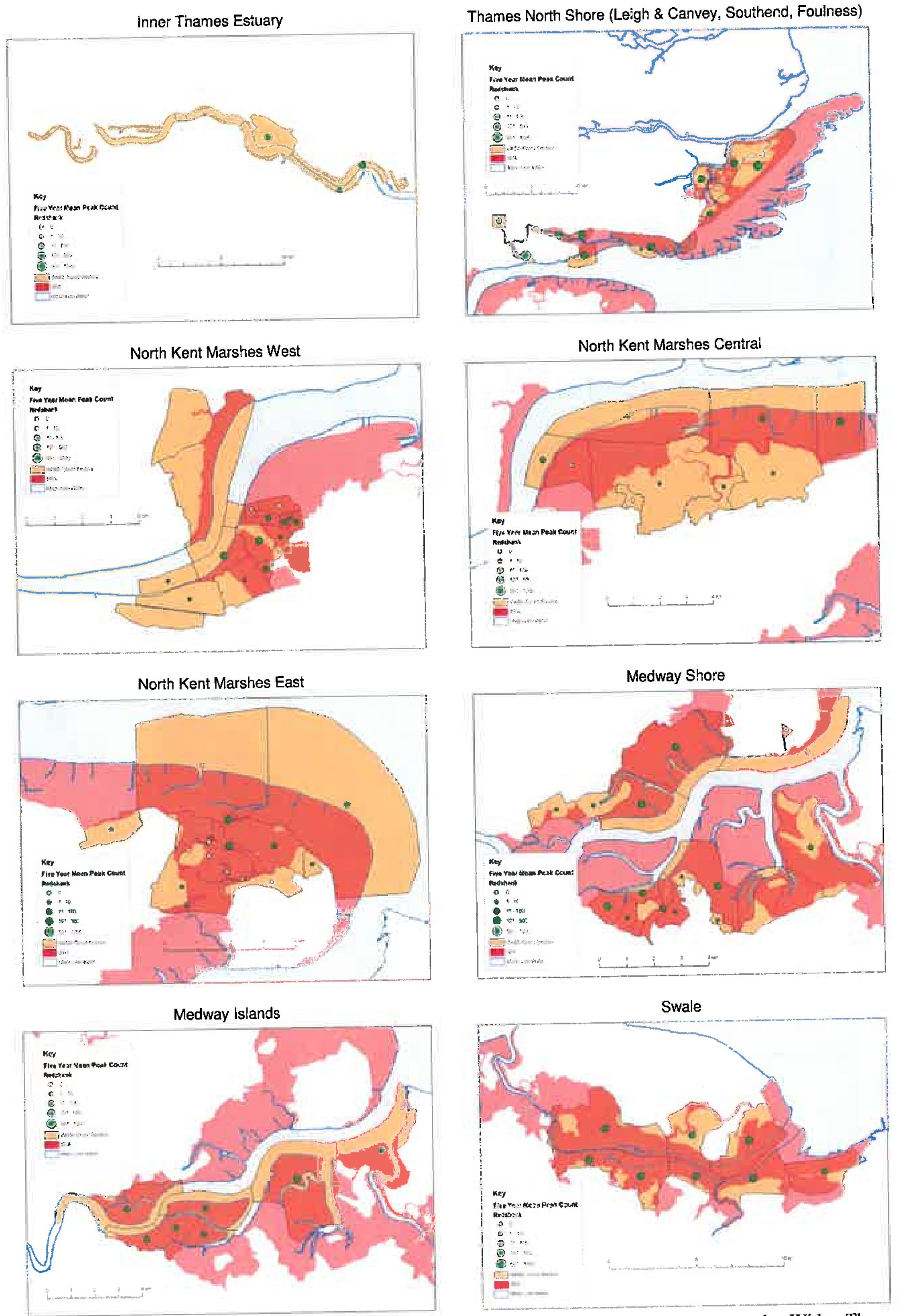


Figure D.23 Five-year mean of annual peak counts of Redshank on WeBS count sectors on the Wider Thames Estuary.

Appendix E

Population trends of each species for each sector of the wider Thames Estuary, with additional trends for multi-sector consolidations frequently used by WeBS. Two types of plot are presented for each species / sector: 1) the mean winter count (Sep to Mar) with, where average winter long-term numbers exceed 10 individuals, the smoothed trend and 2) the proportional contribution of the sector towards numbers on the estuary as a whole. Note that Figure numbering is based on WeBS count sector codes.

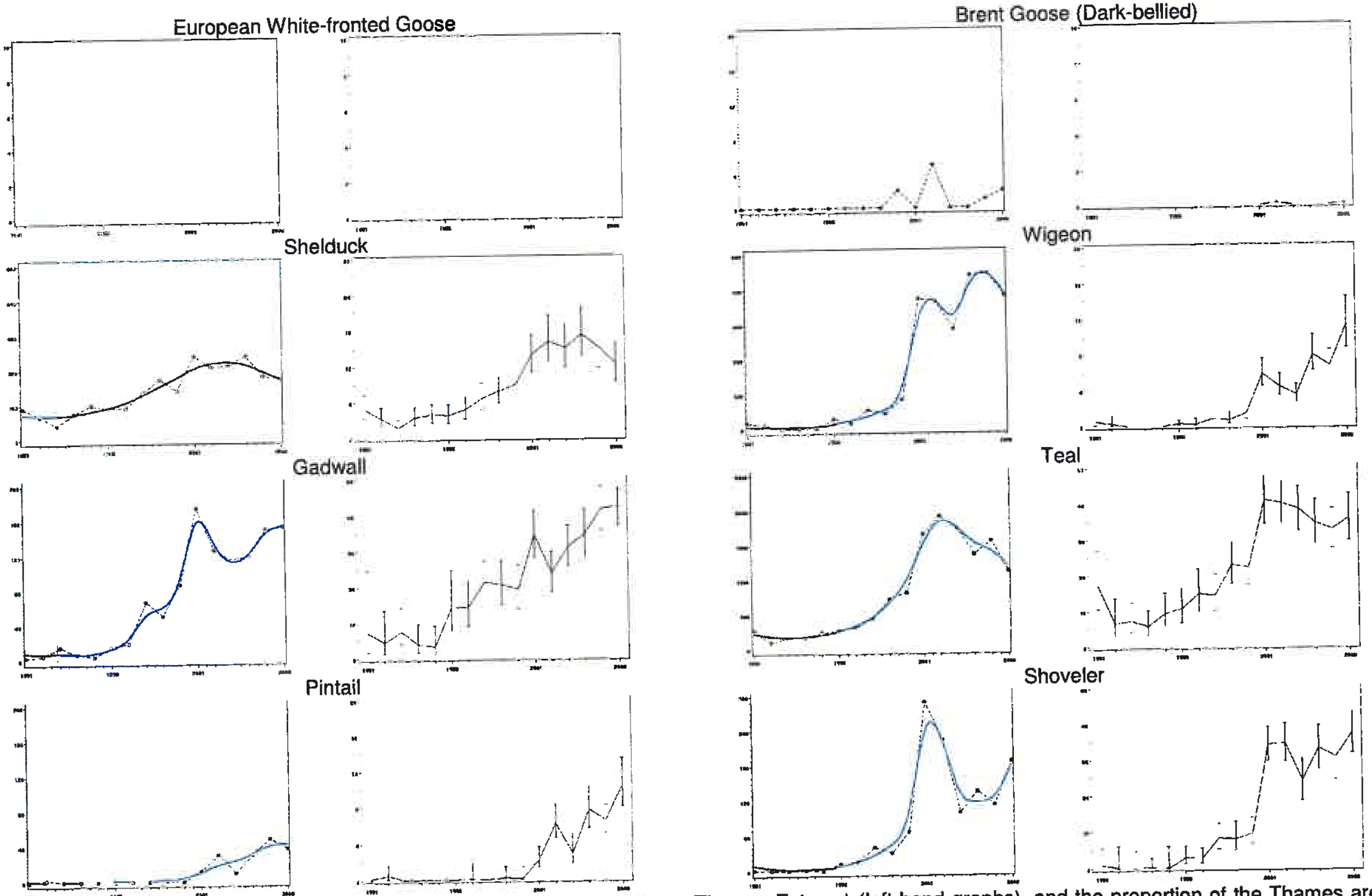
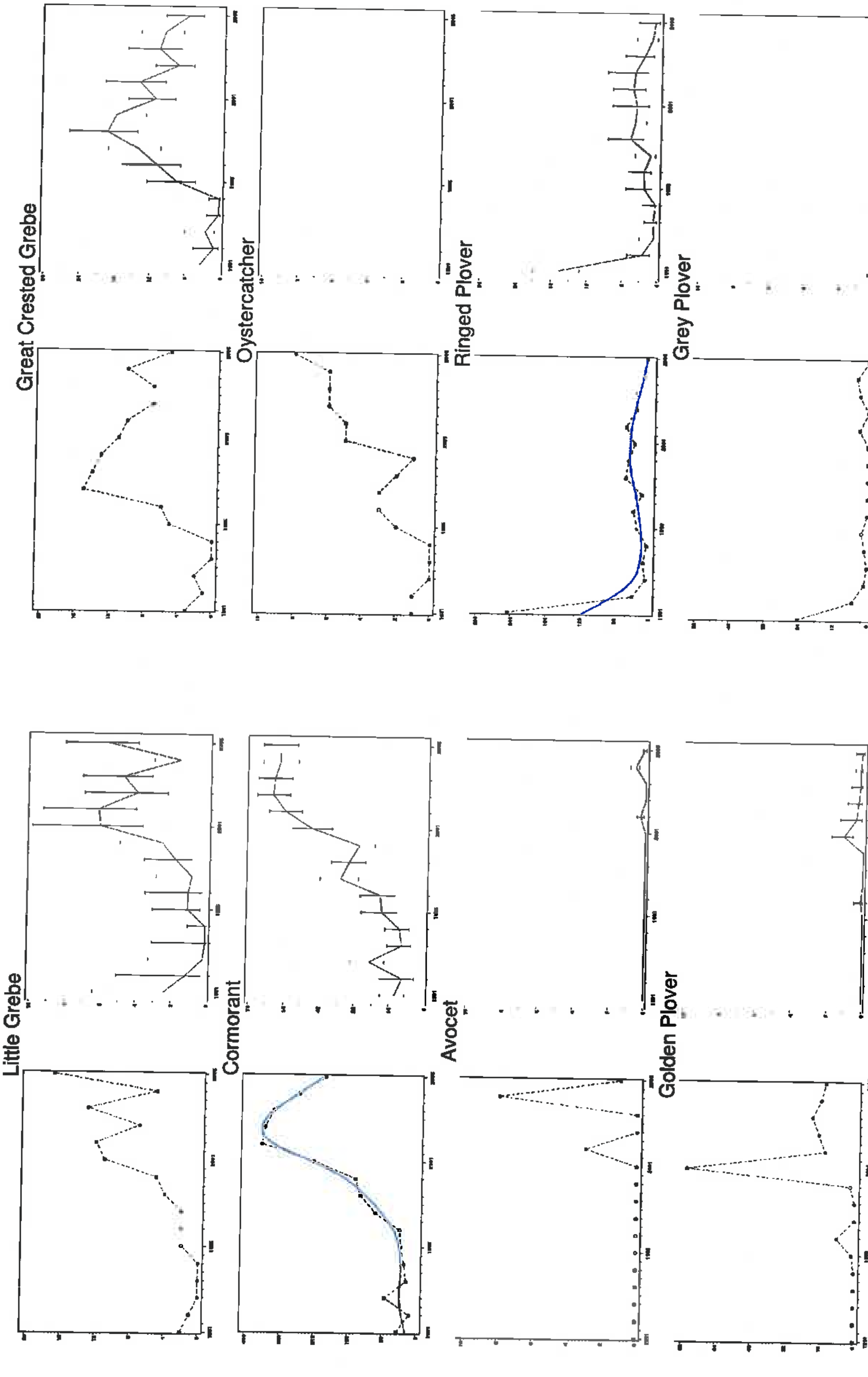


Figure E.24901 Population trends of each species in sector 24901 (Inner Thames Estuary) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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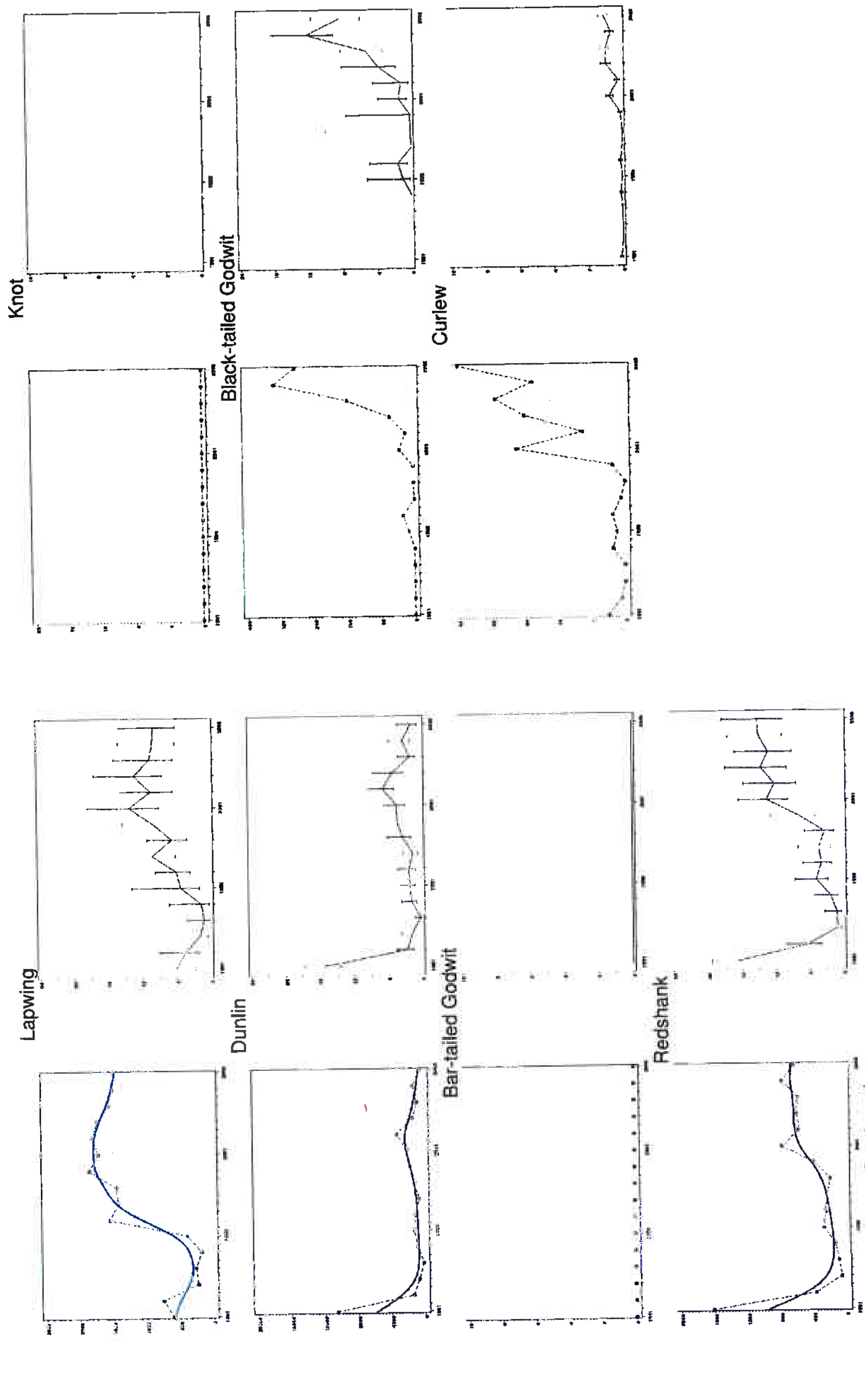


Figure E.24901 Continued.

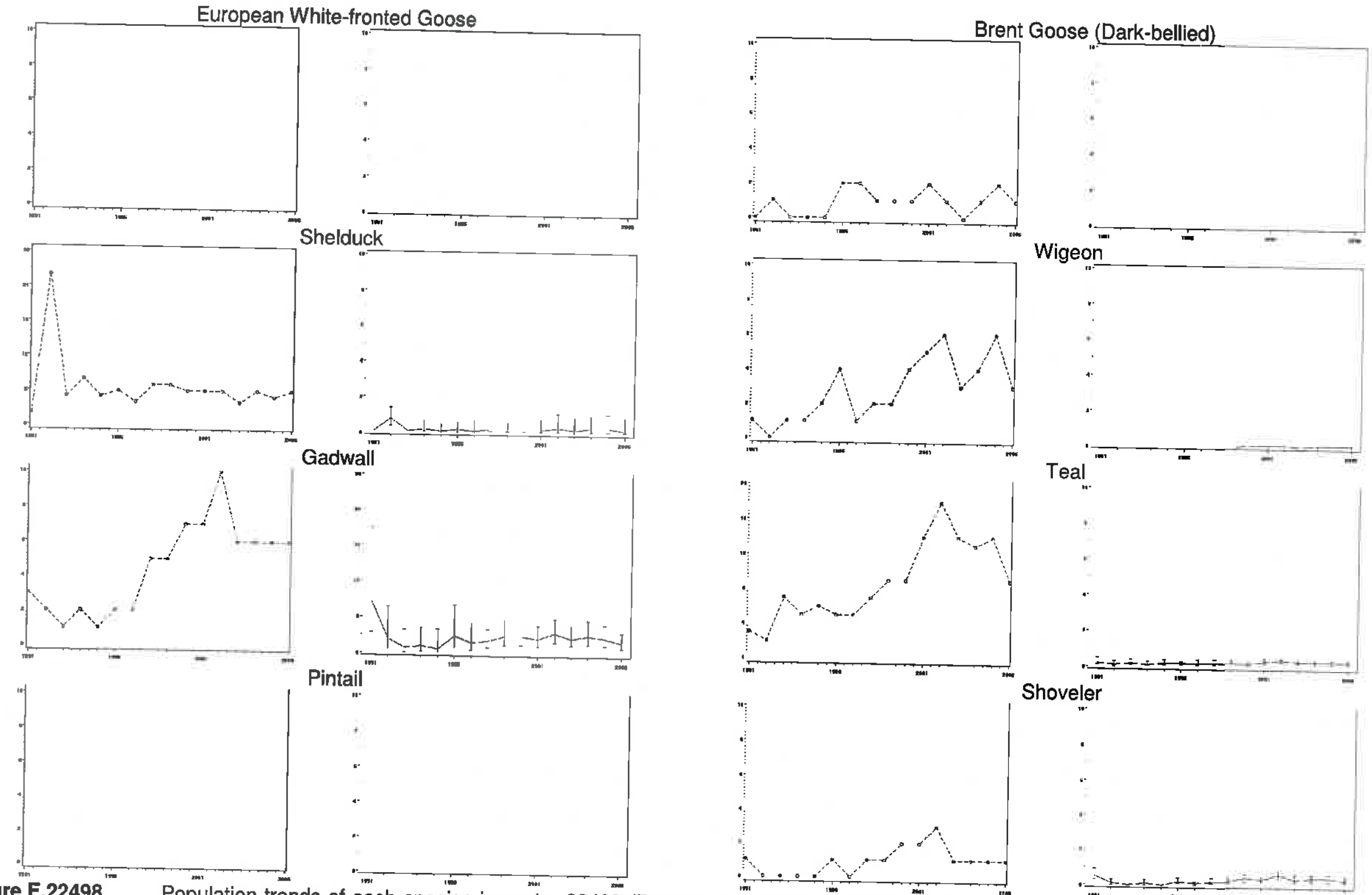


Figure E.22498 Population trends of each species in sector 22498 (Dartford to Littlebrook) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

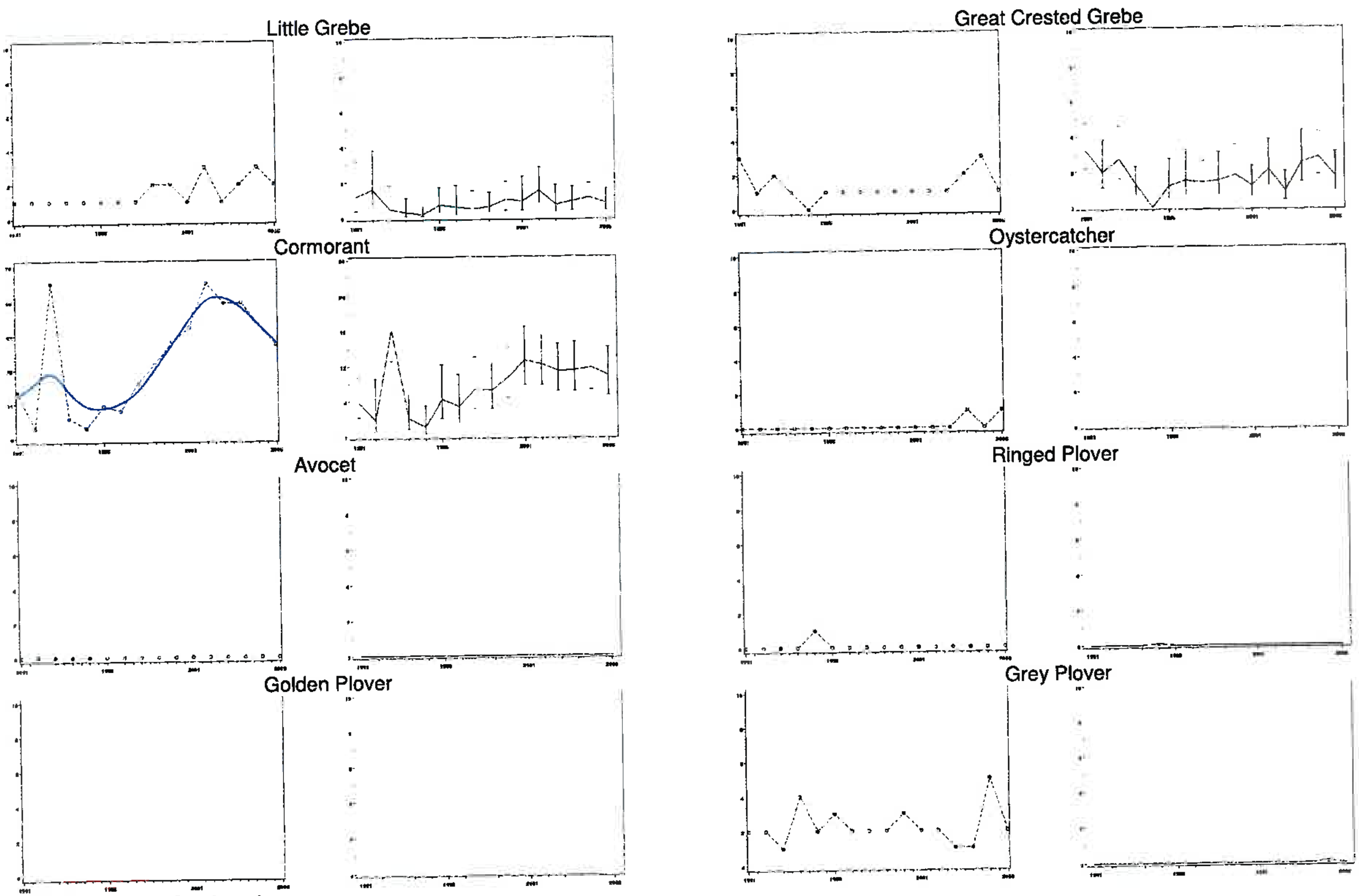


Figure E.22498 Continued.

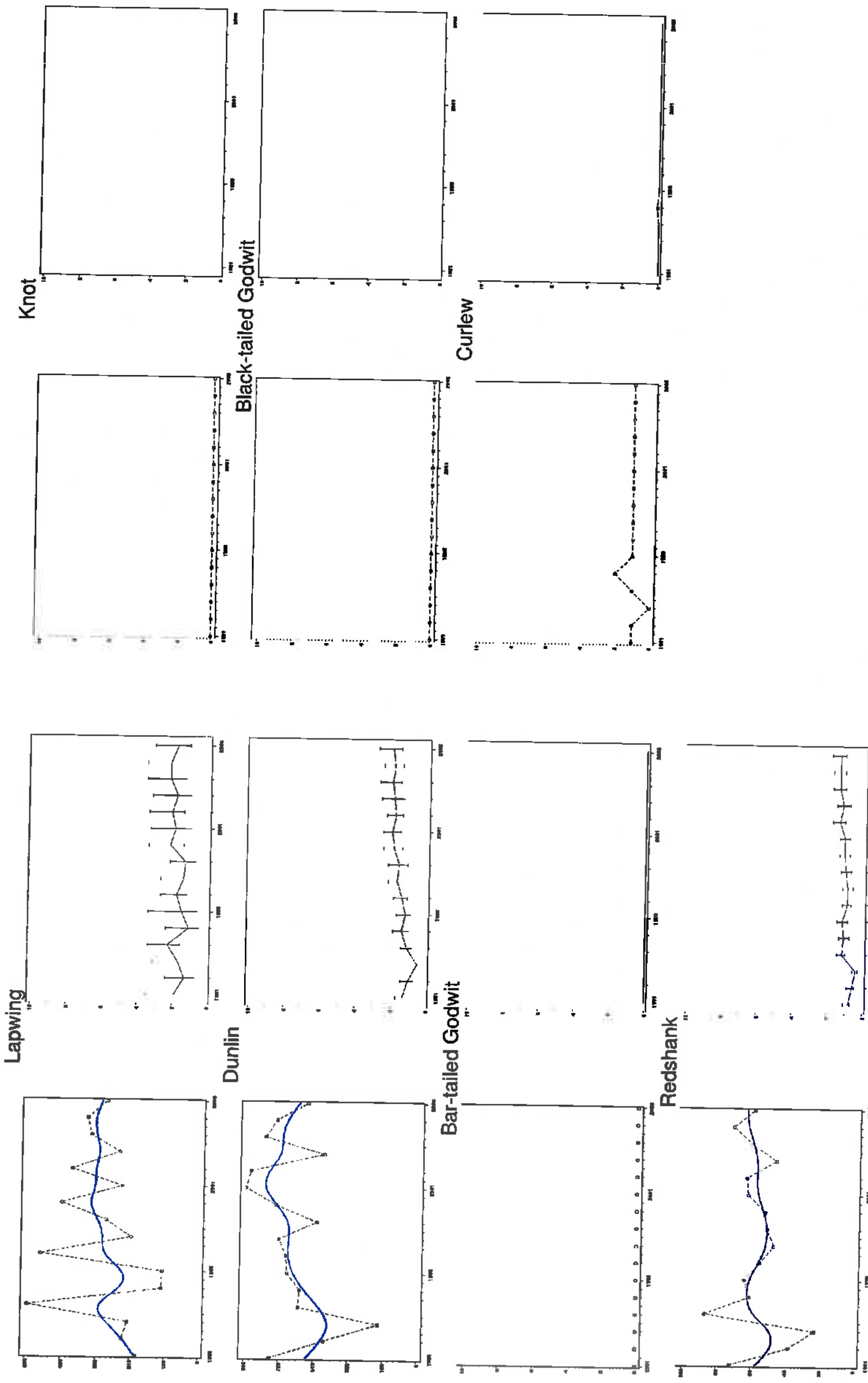


Figure E.22498 Continued.

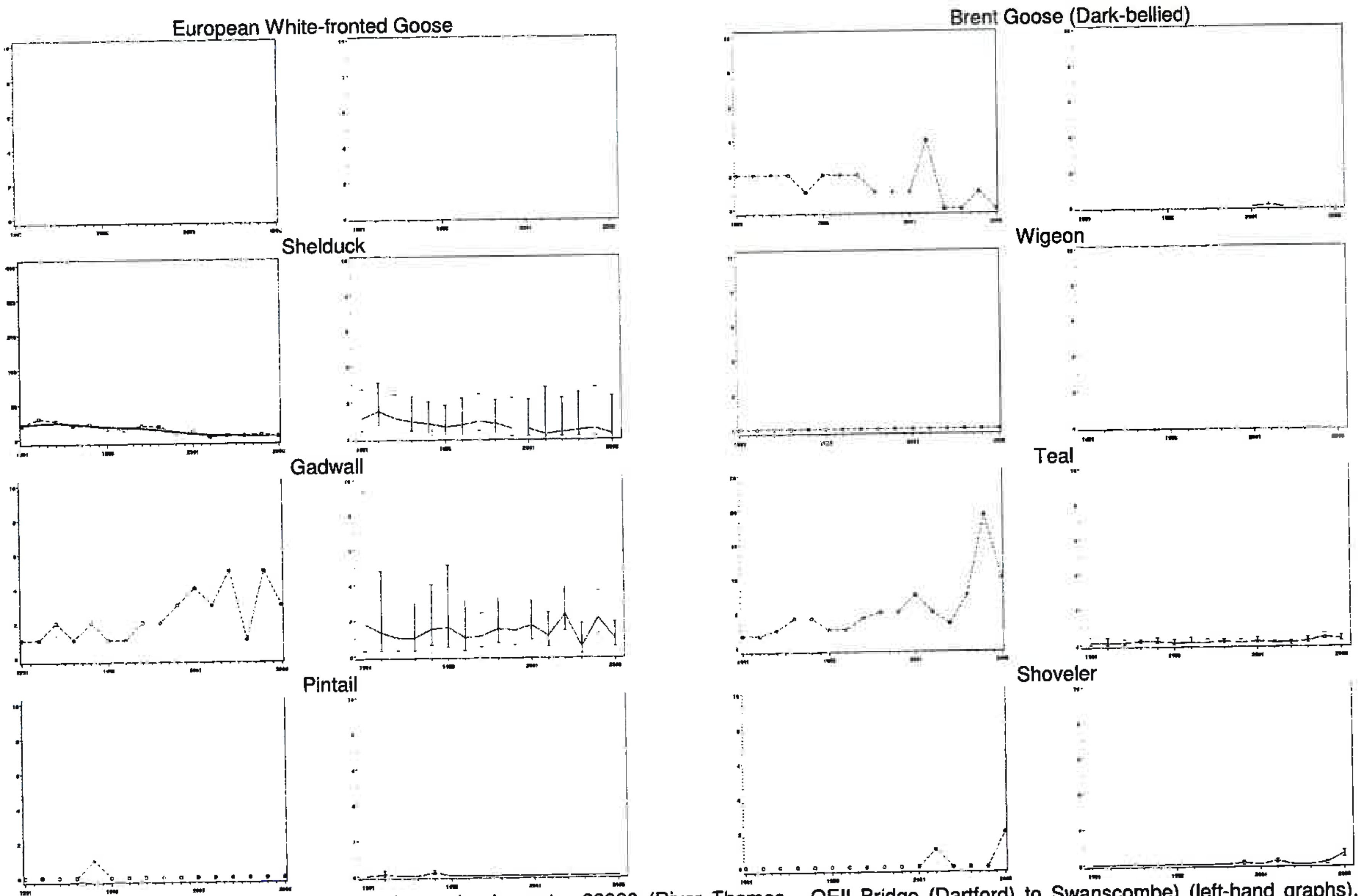
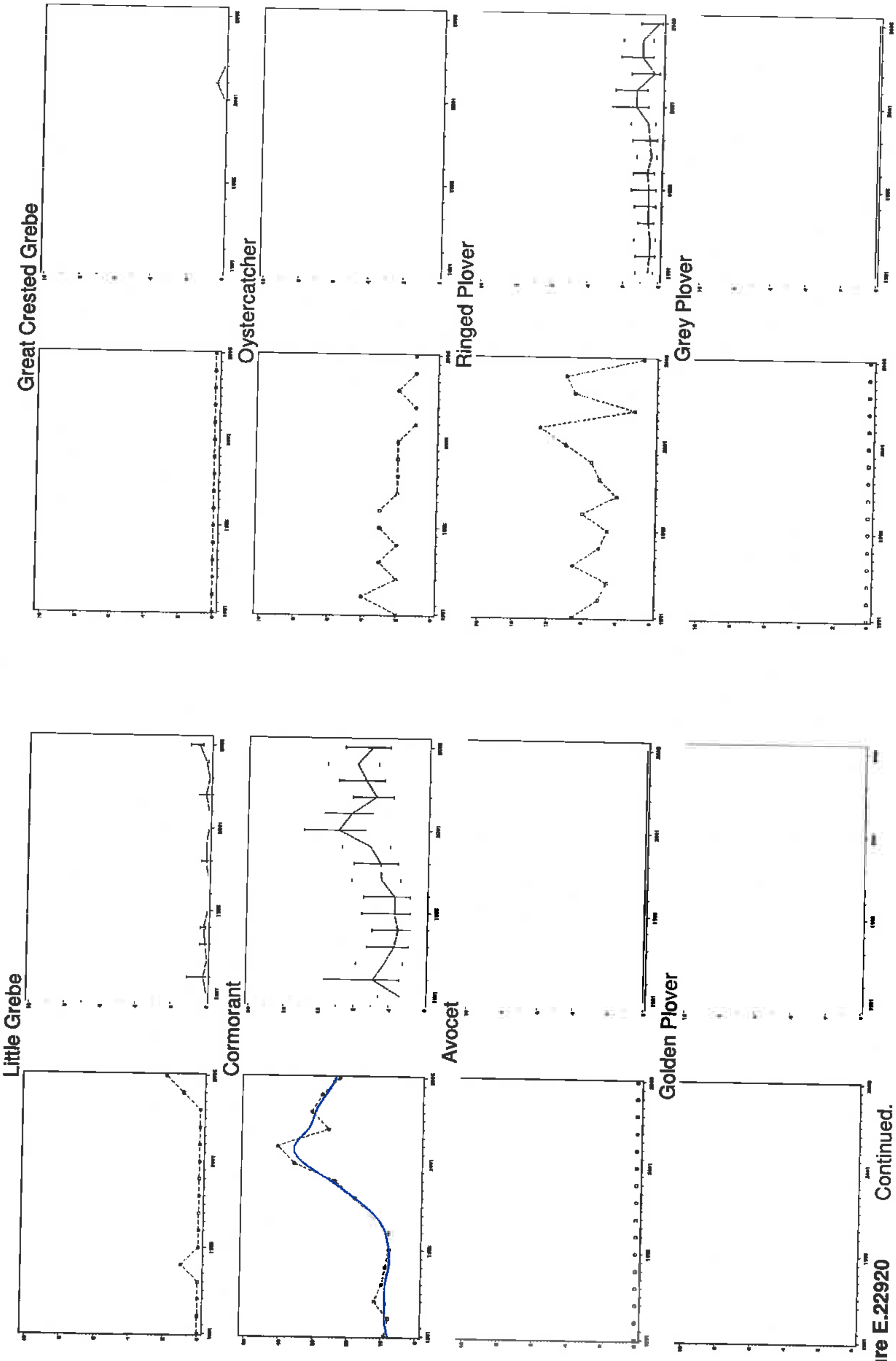


Figure E.22920 Population trends of each species in sector 22920 (River Thames - QEII Bridge (Dartford) to Swanscombe) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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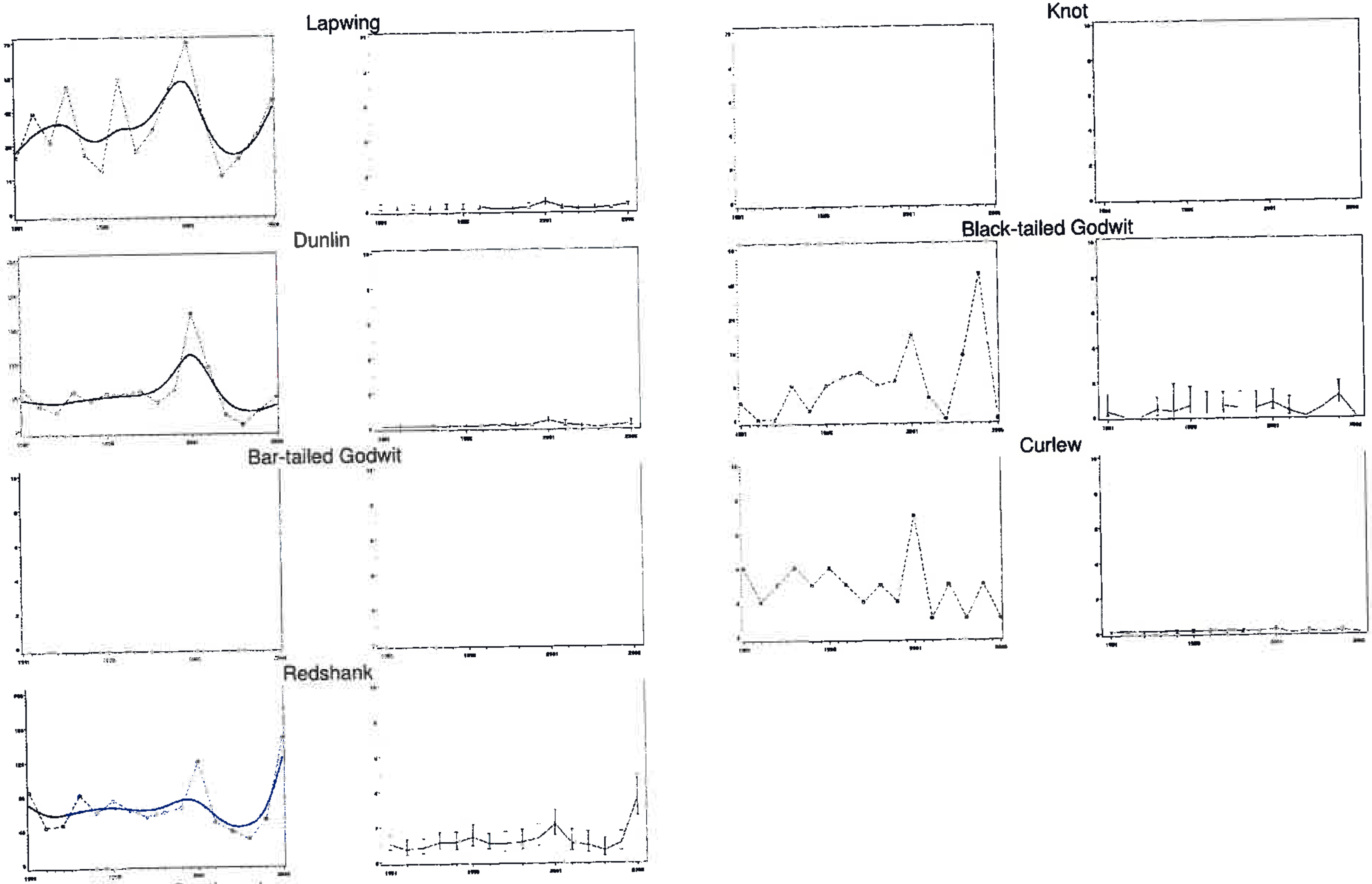

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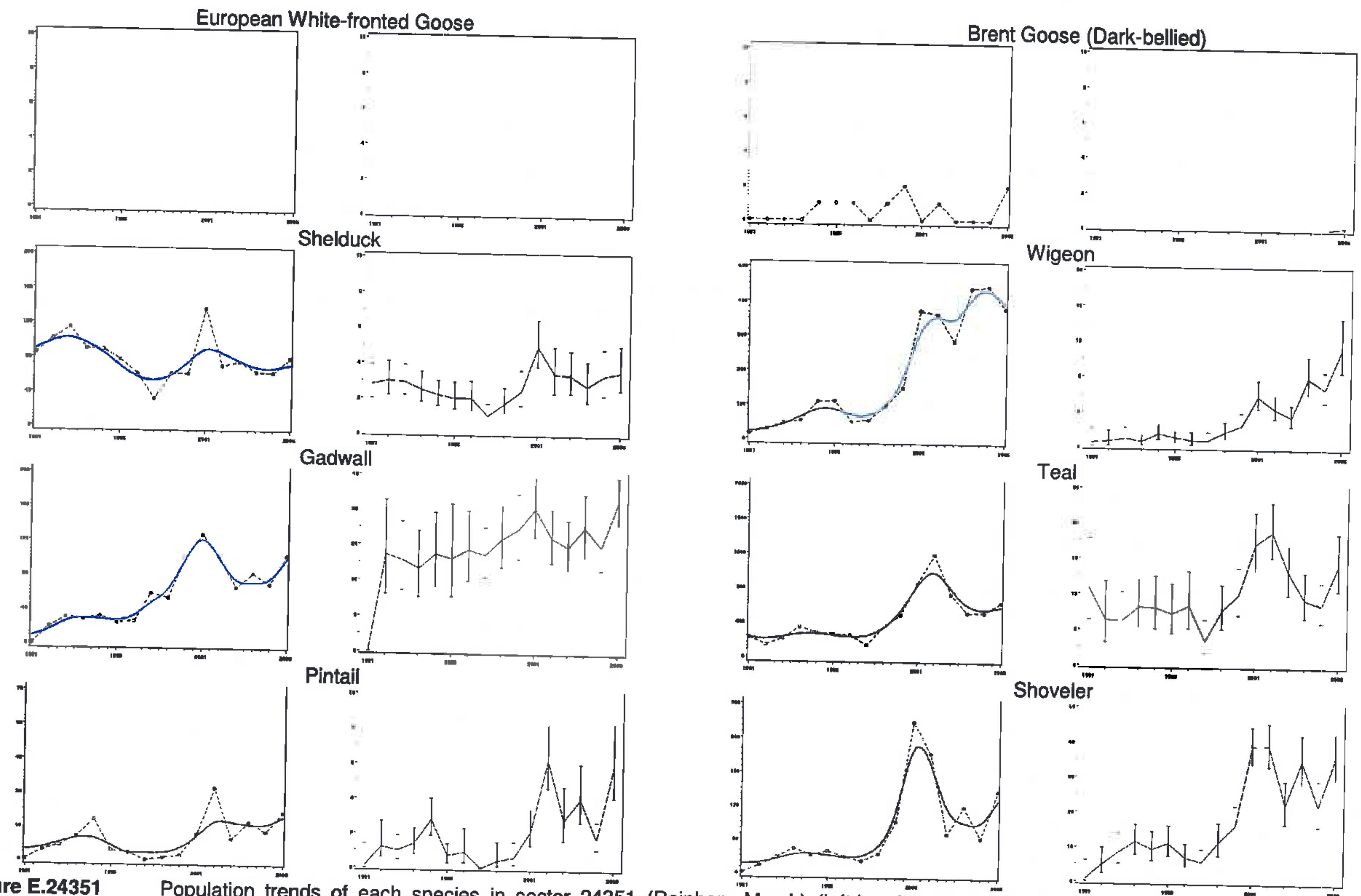
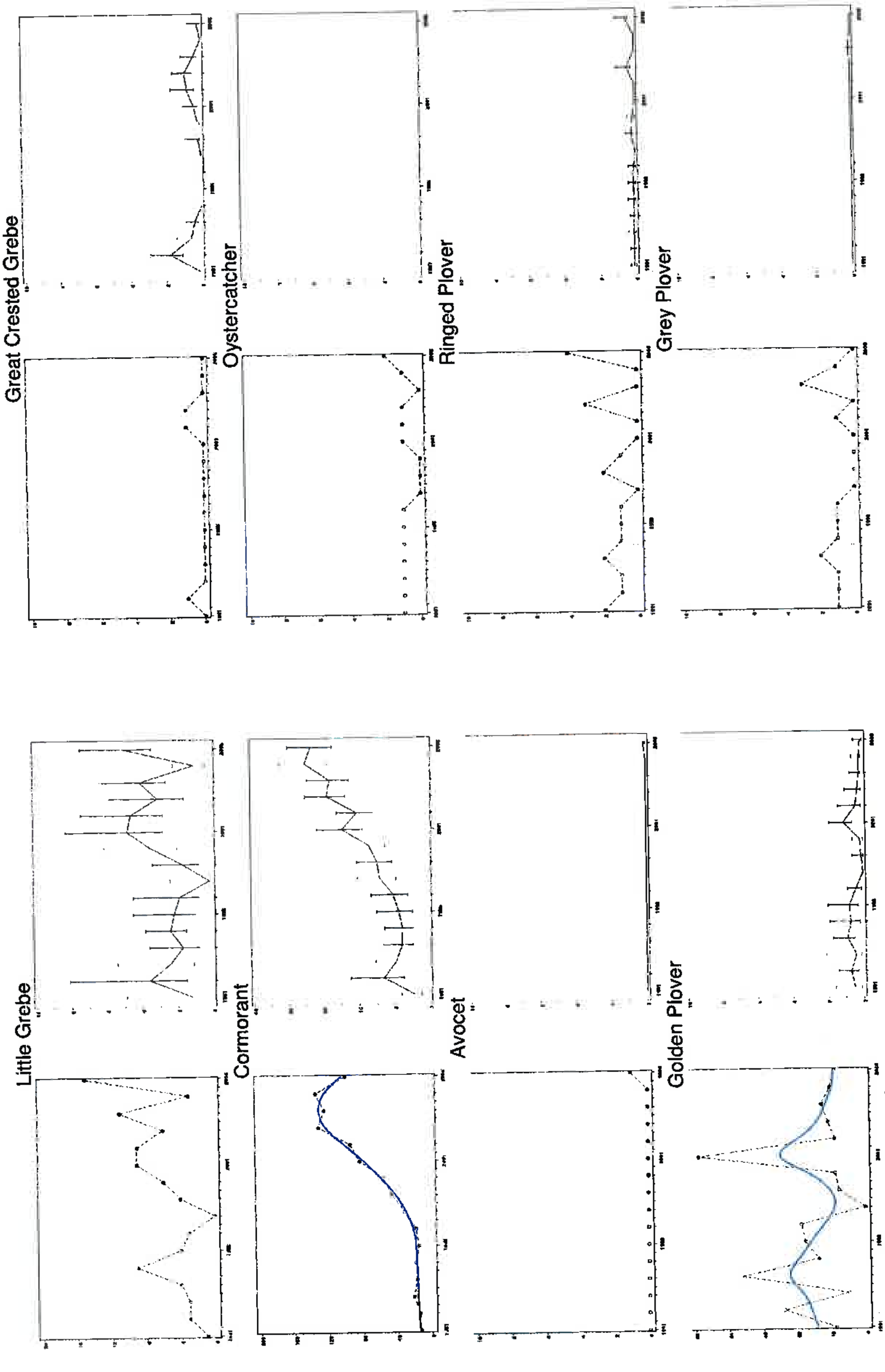


Figure E.24351 Population trends of each species in sector 24351 (Rainham Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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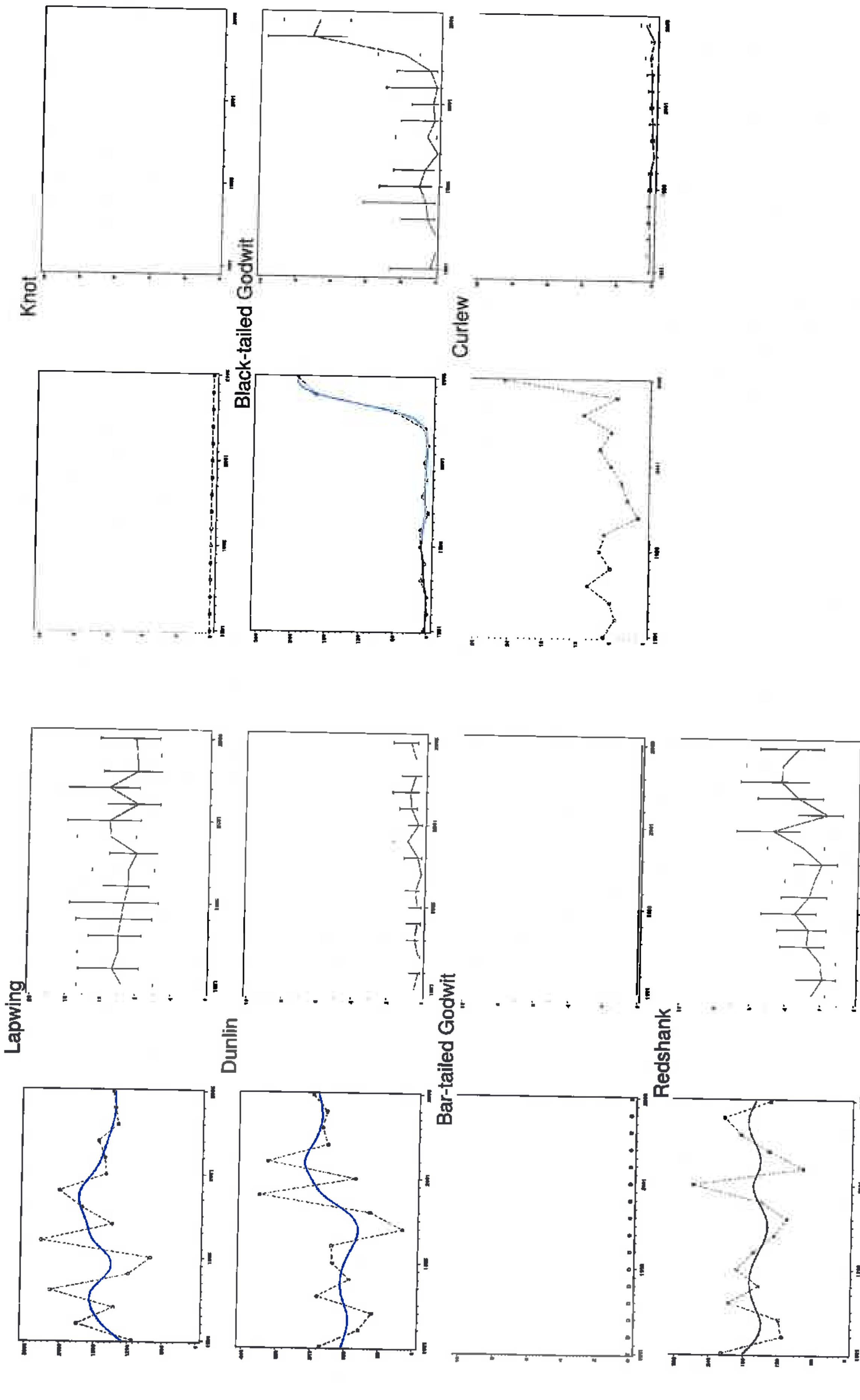

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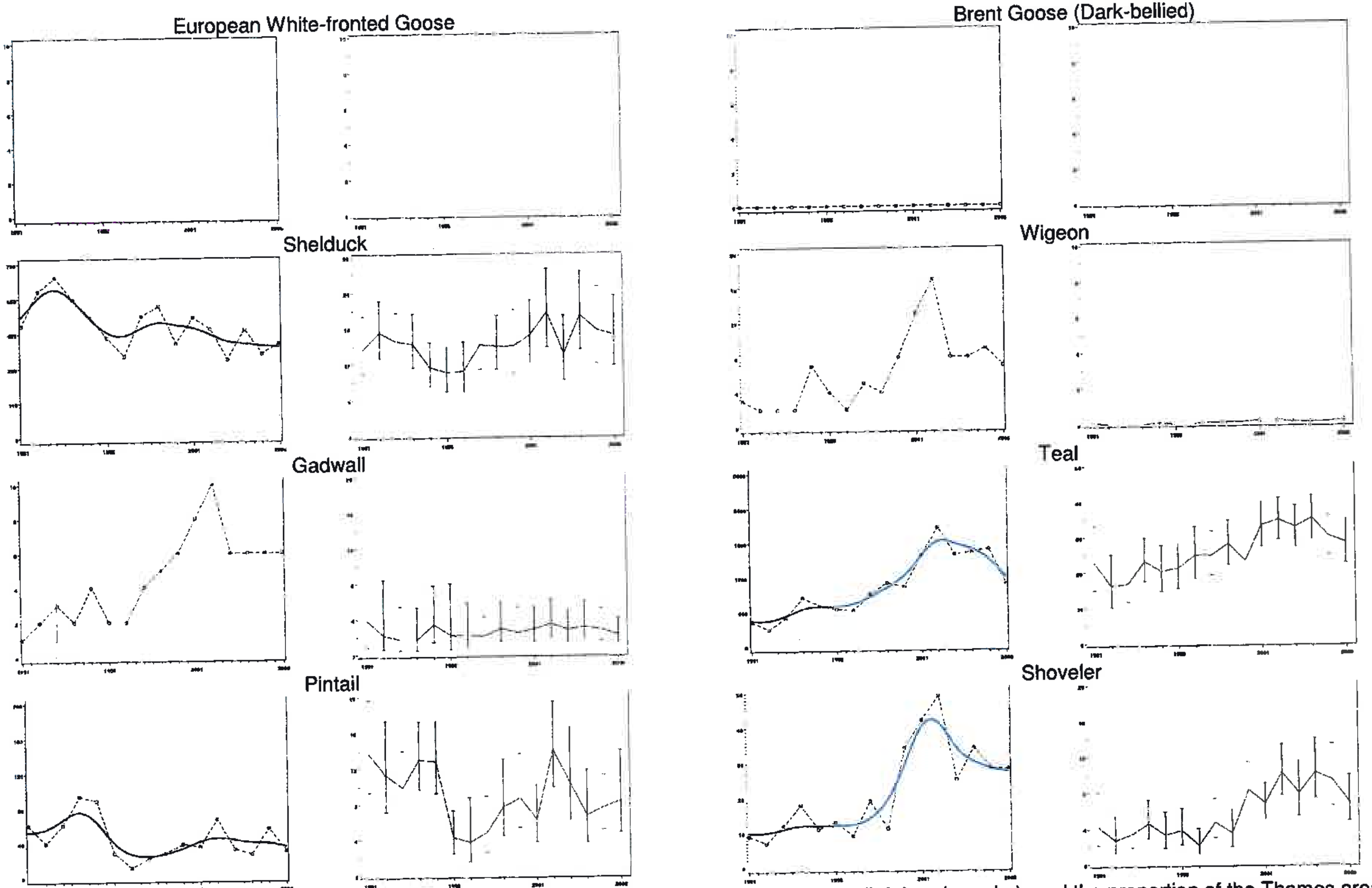
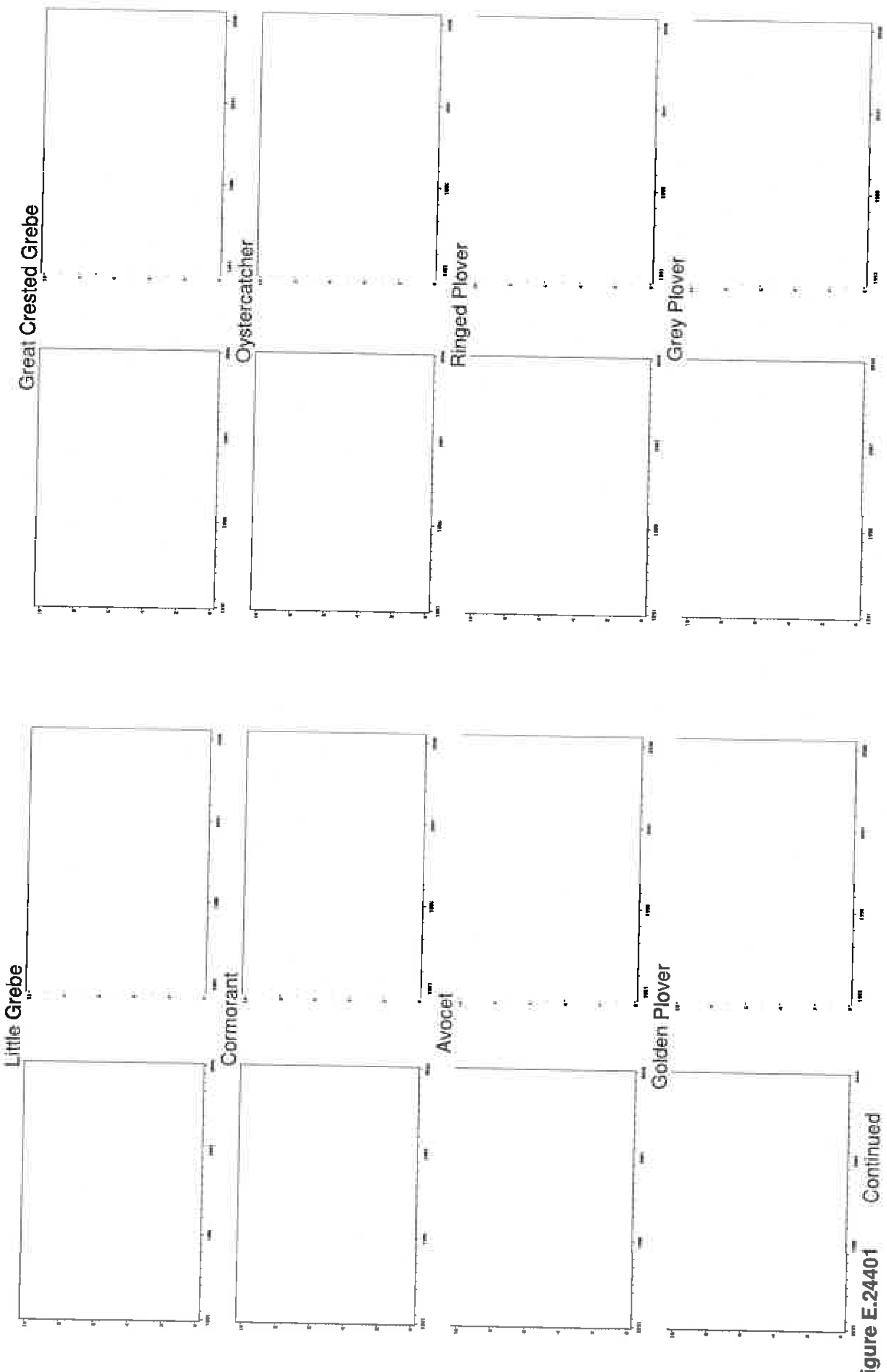


Figure E.24401 Population trends of each species in sector 24401 (River Thames - Belvedere) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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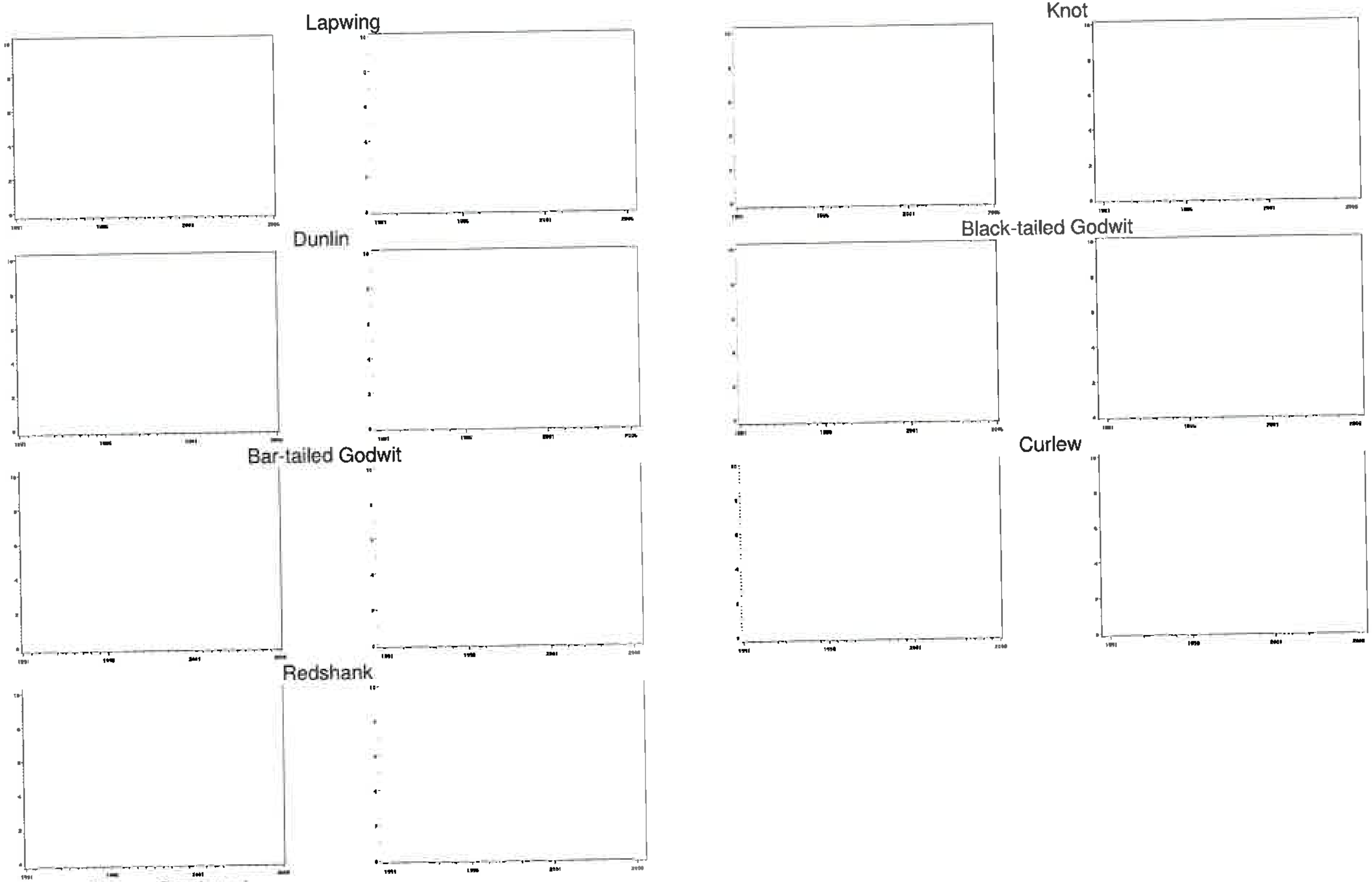

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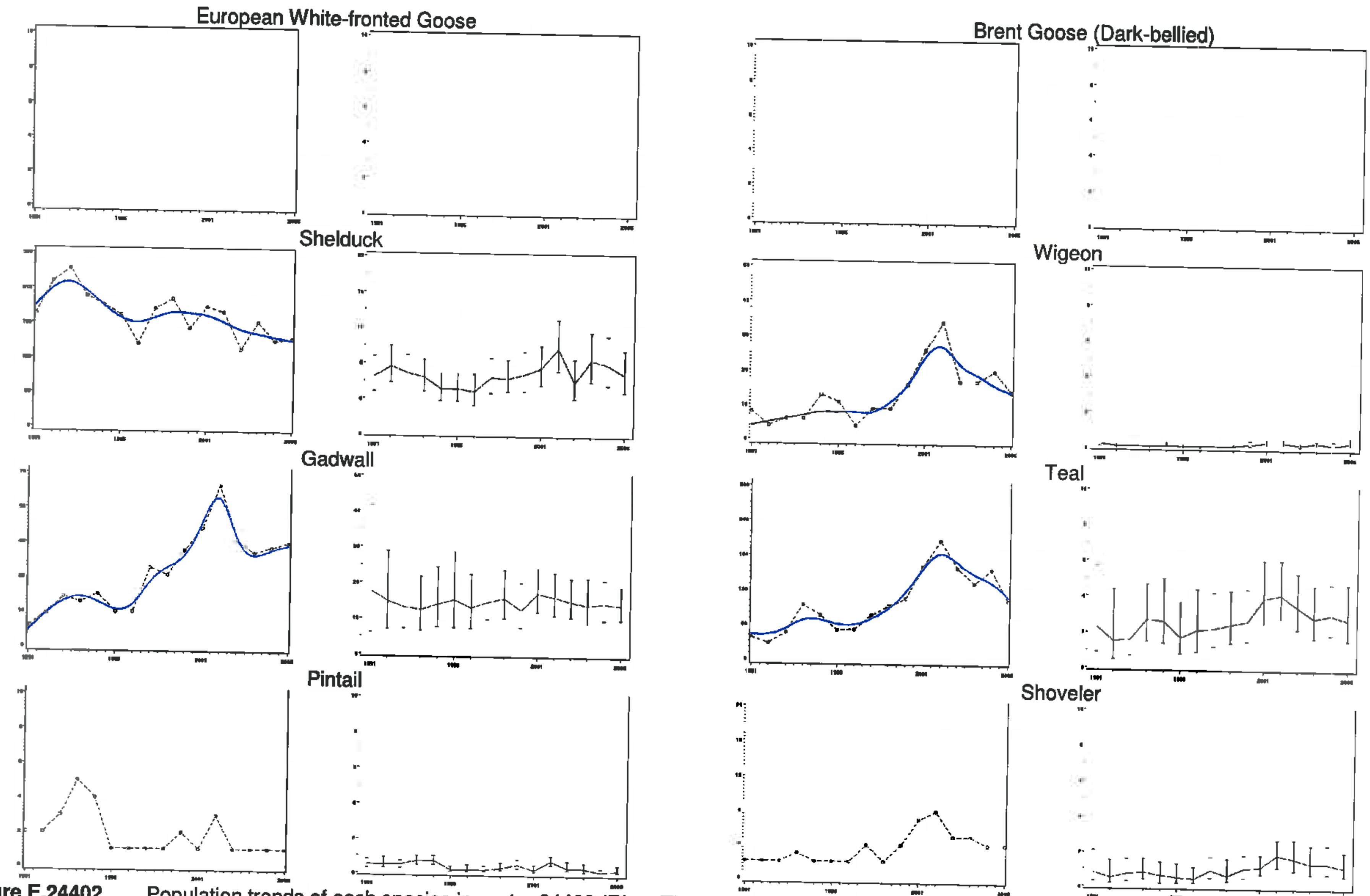
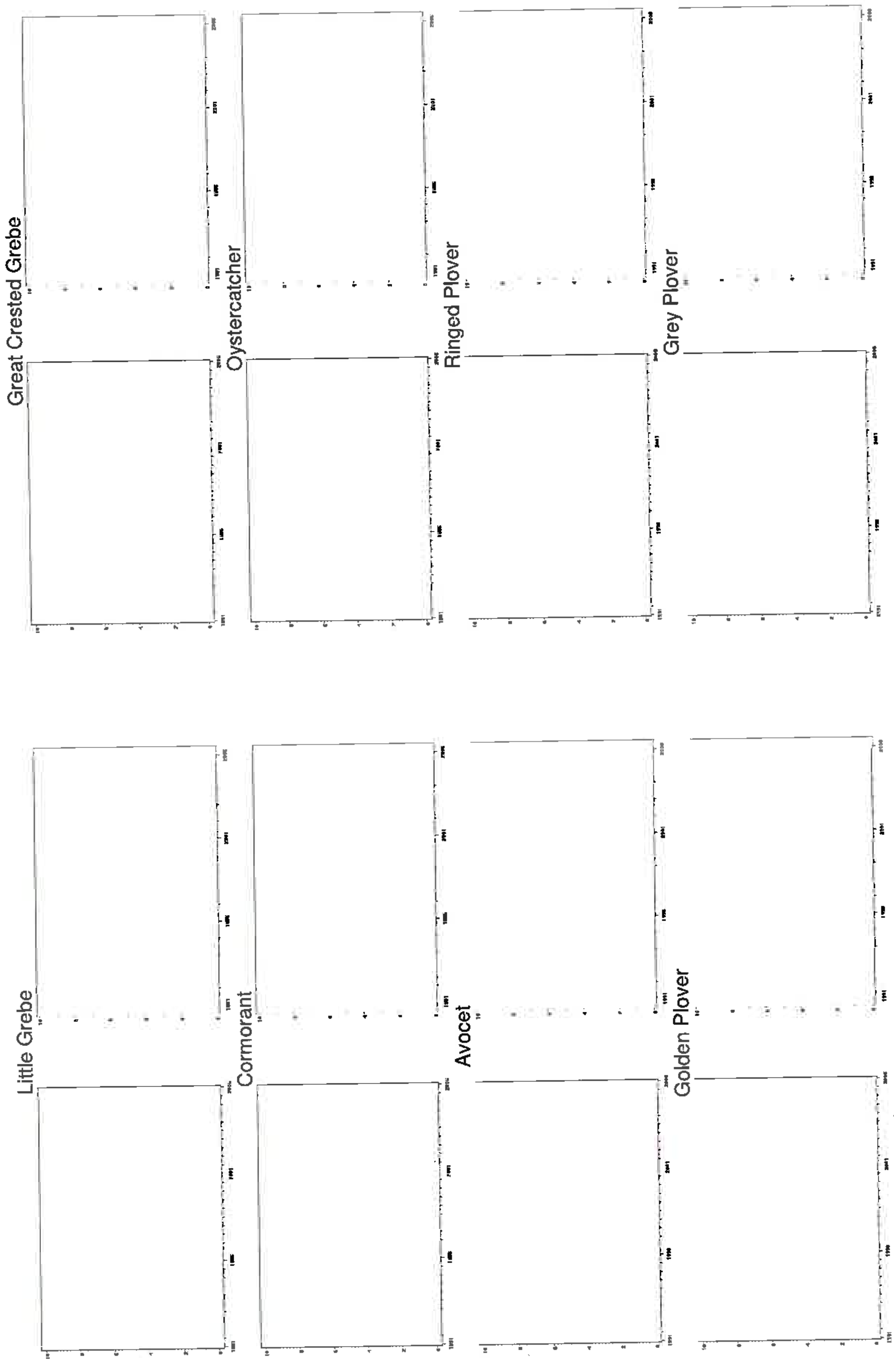


Figure E.24402 Population trends of each species in sector 24402 (River Thames - Erith) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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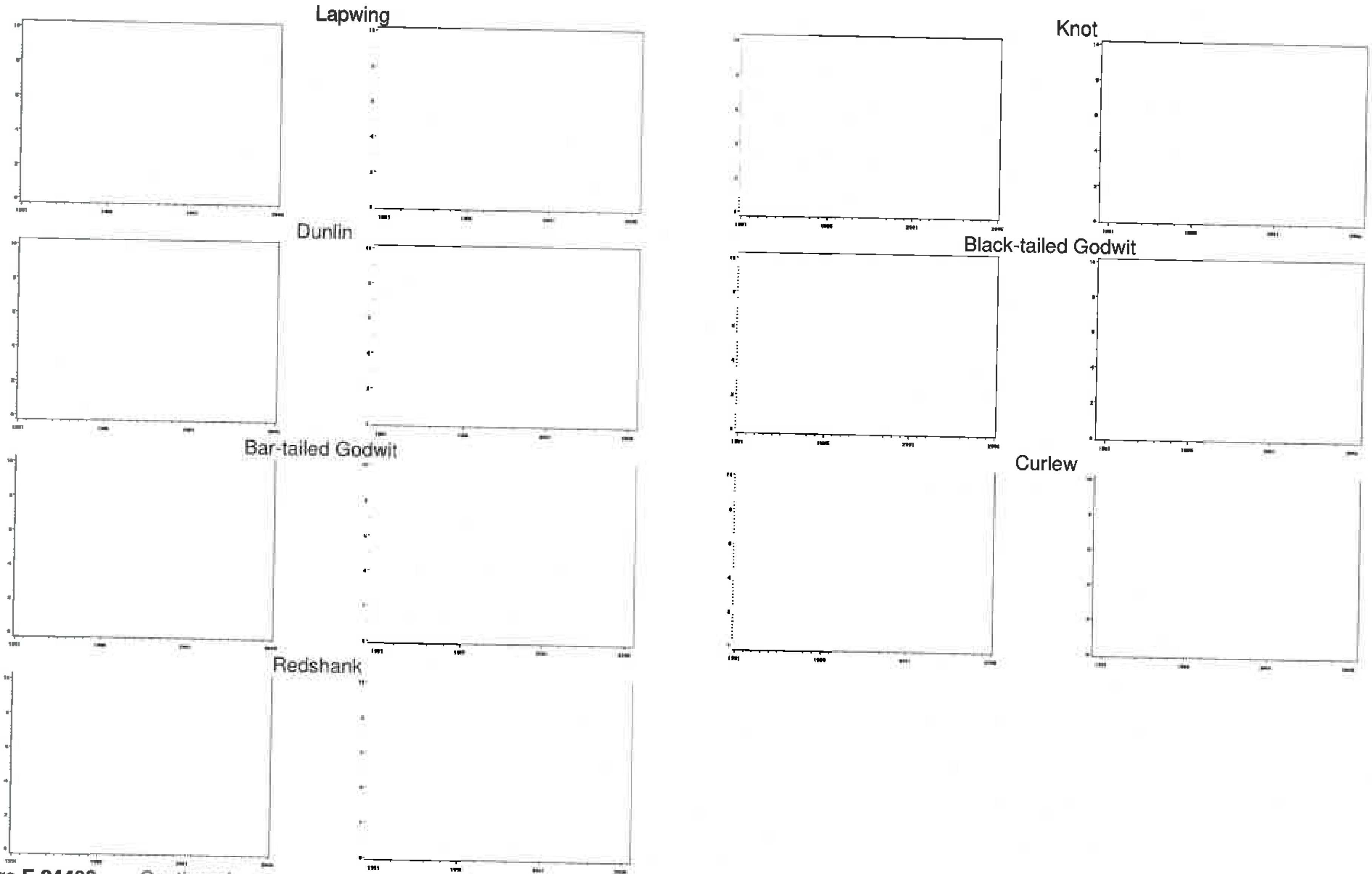

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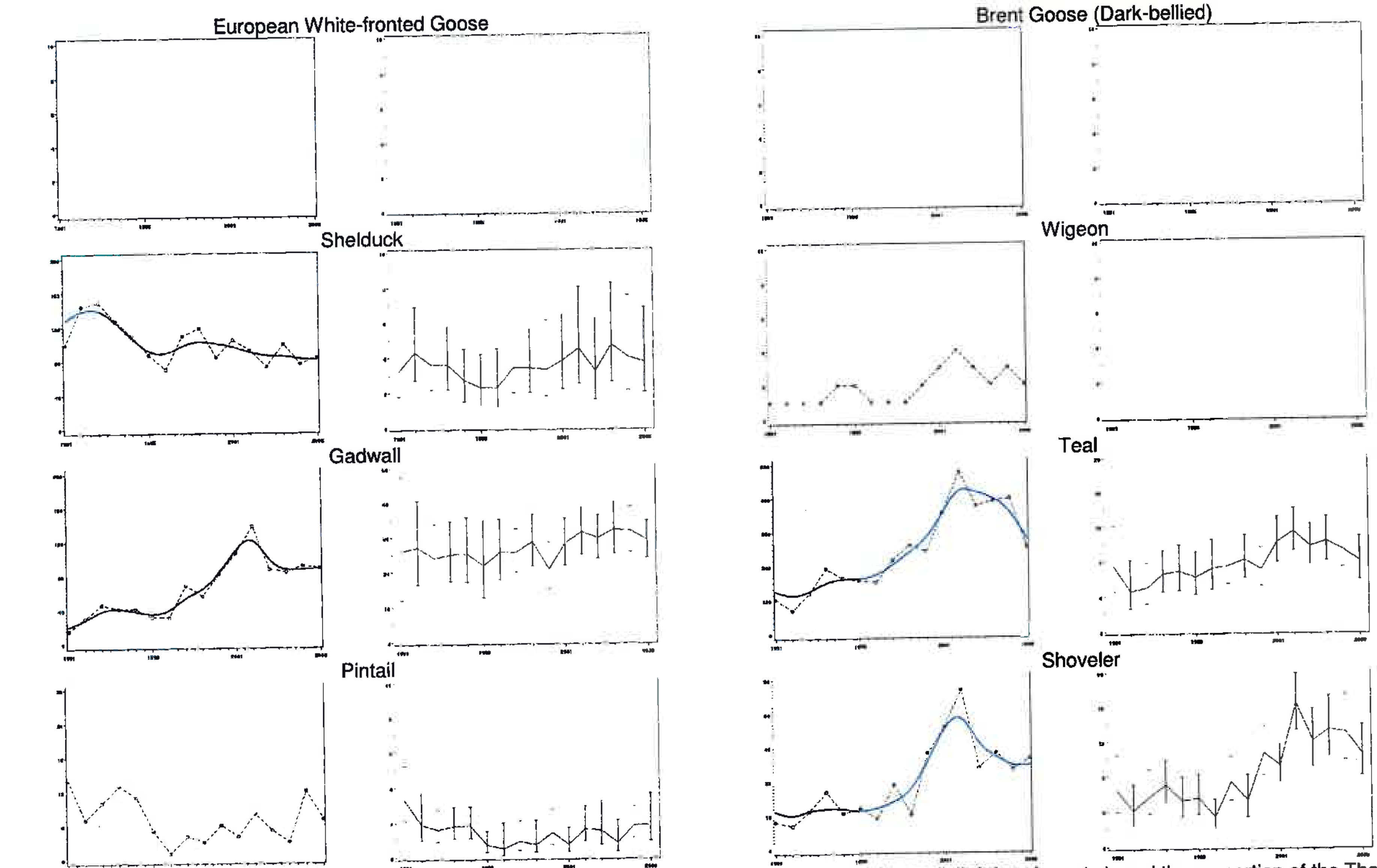
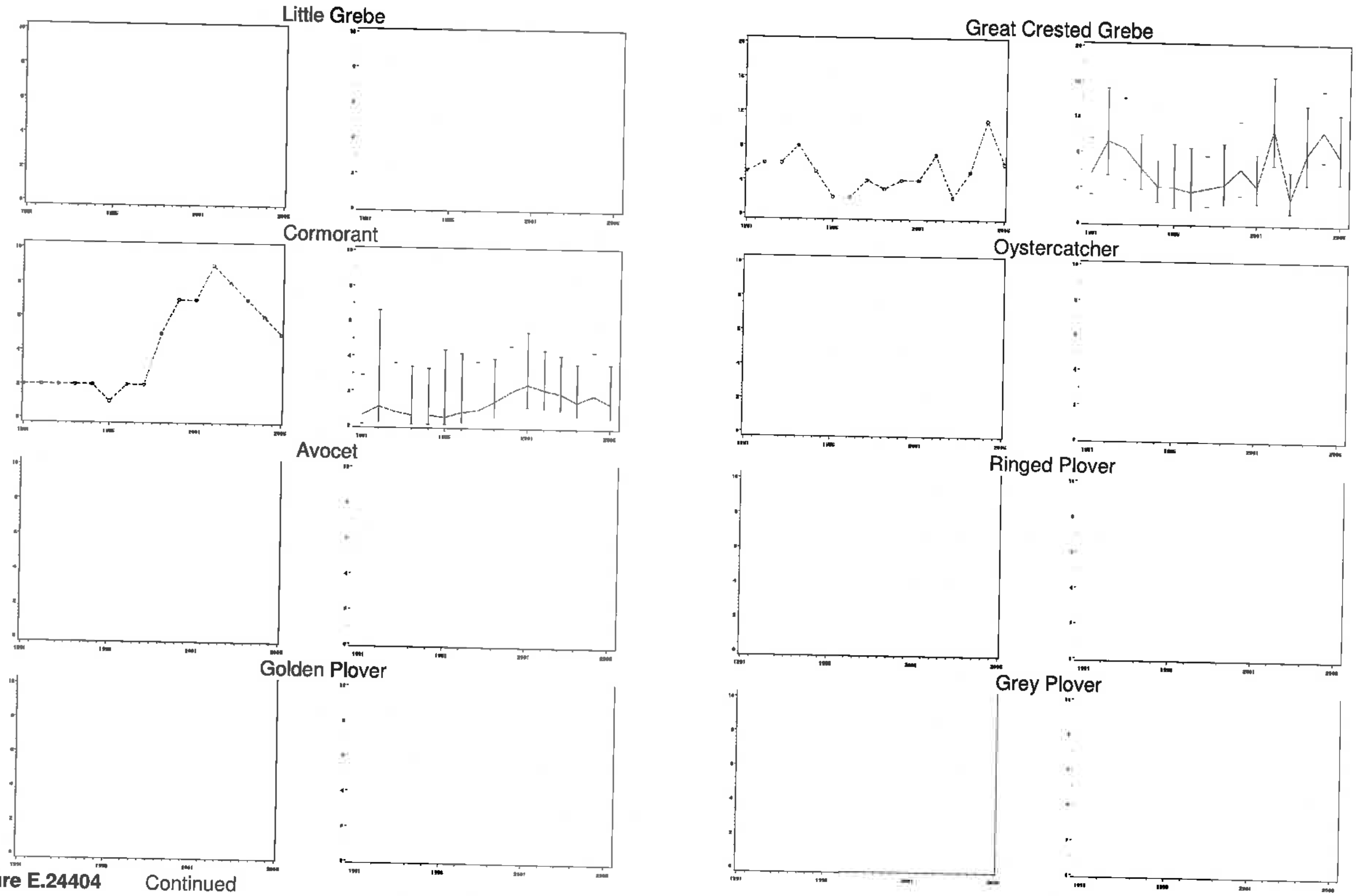


Figure E.24404 Population trends of each species in sector 24404 (River Thames - Woolwich Arsenal) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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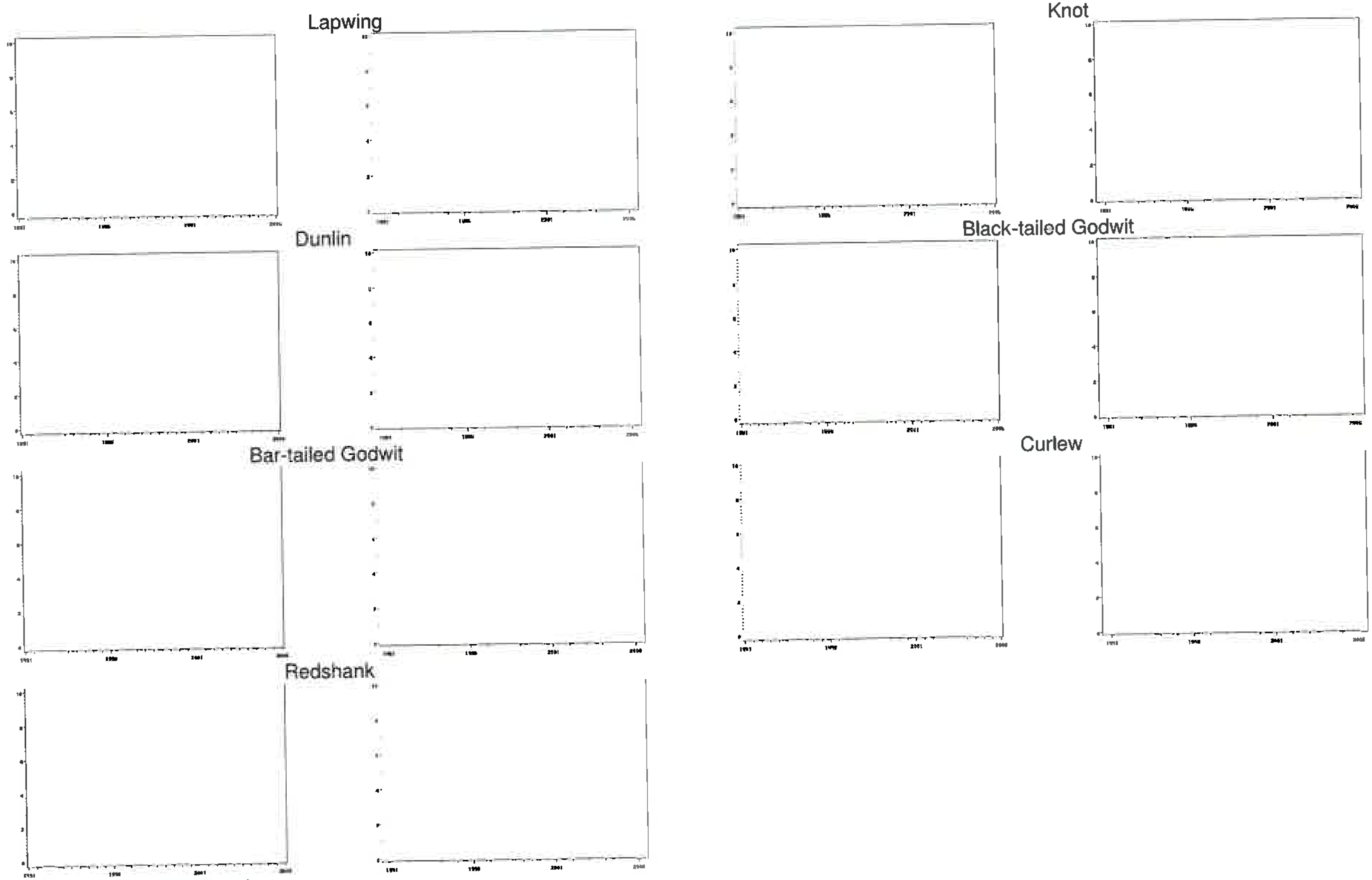

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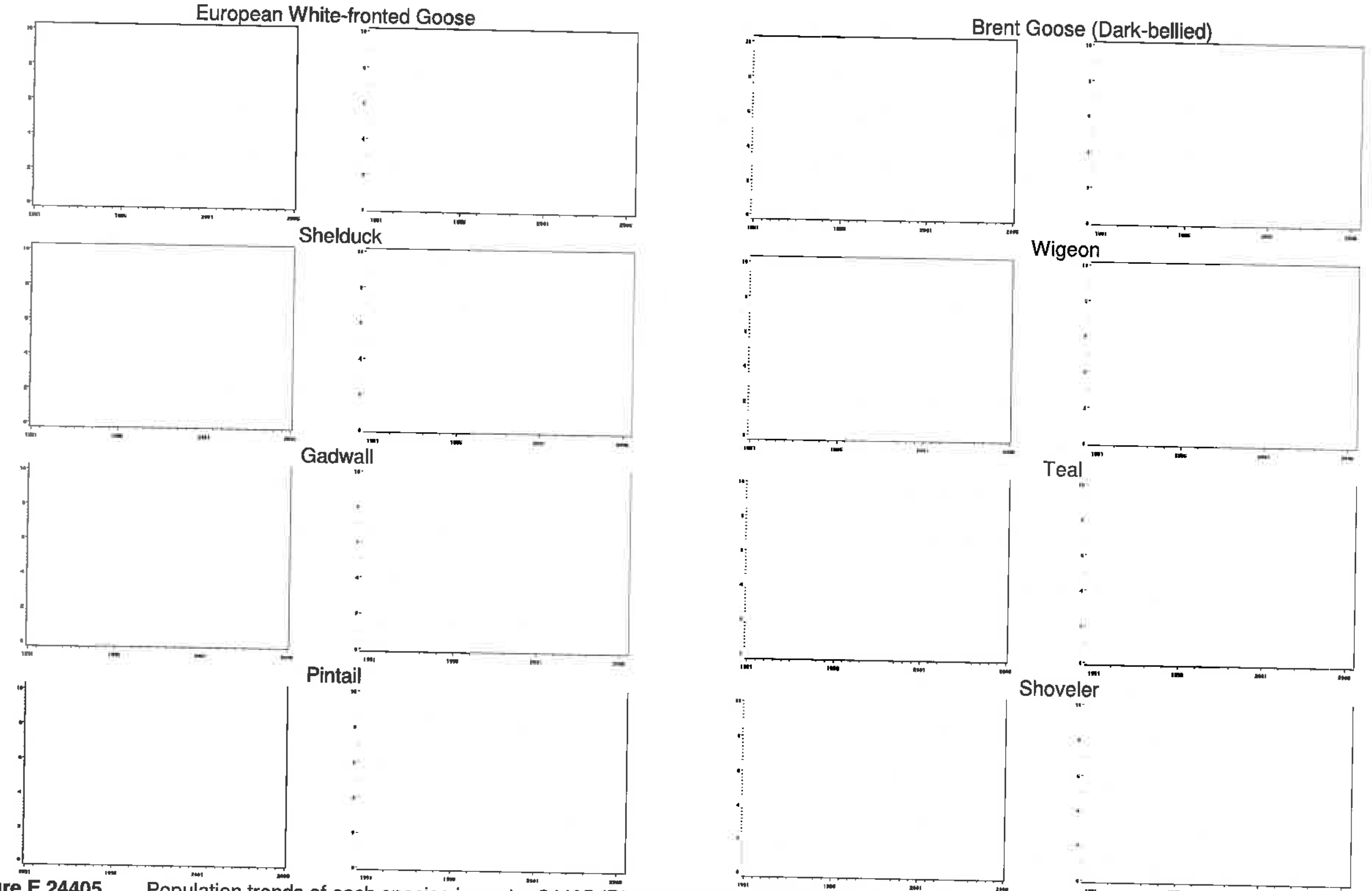
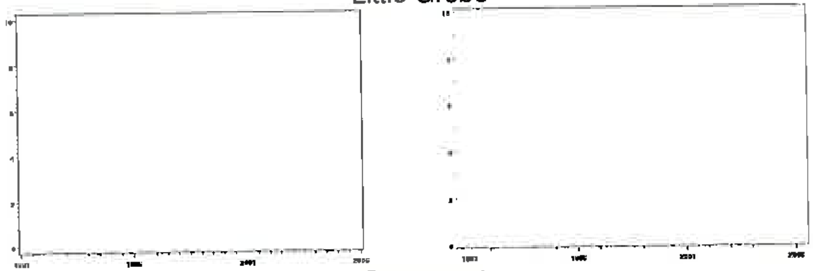
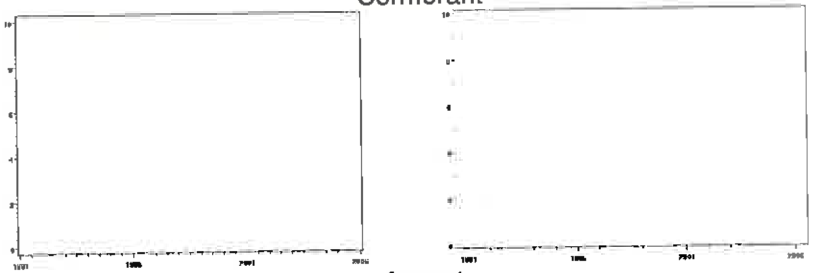


Figure E.24405 Population trends of each species in sector 24405 (River Thames - Woolwich Reach) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

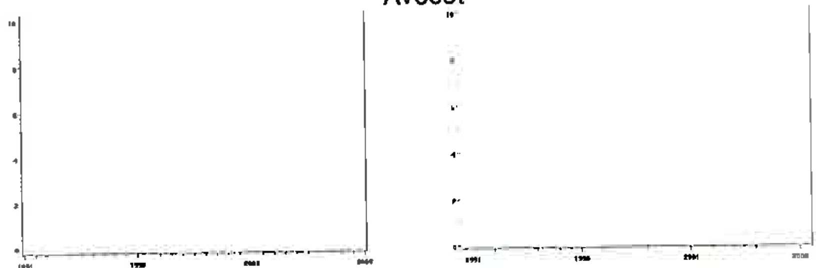
Little Grebe



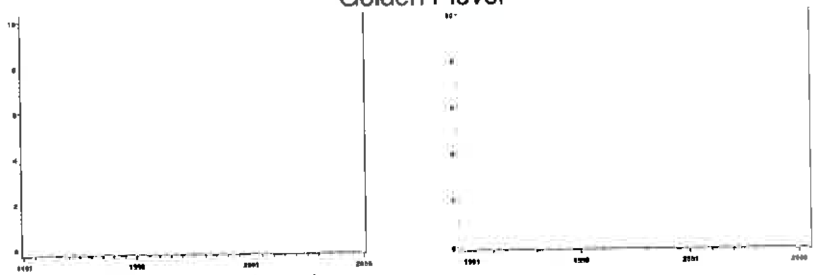
Cormorant



Avocet

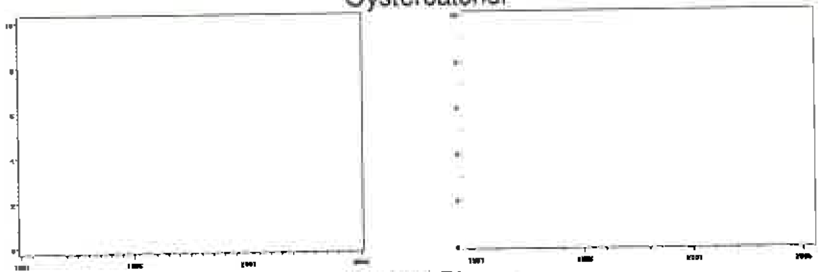


Golden Plover

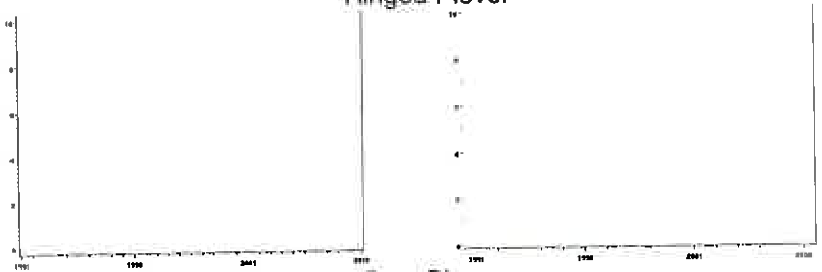


Great Crested Grebe

Oystercatcher



Ringed Plover



Grey Plover

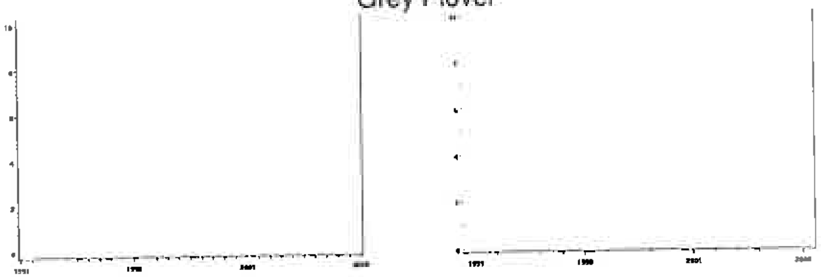
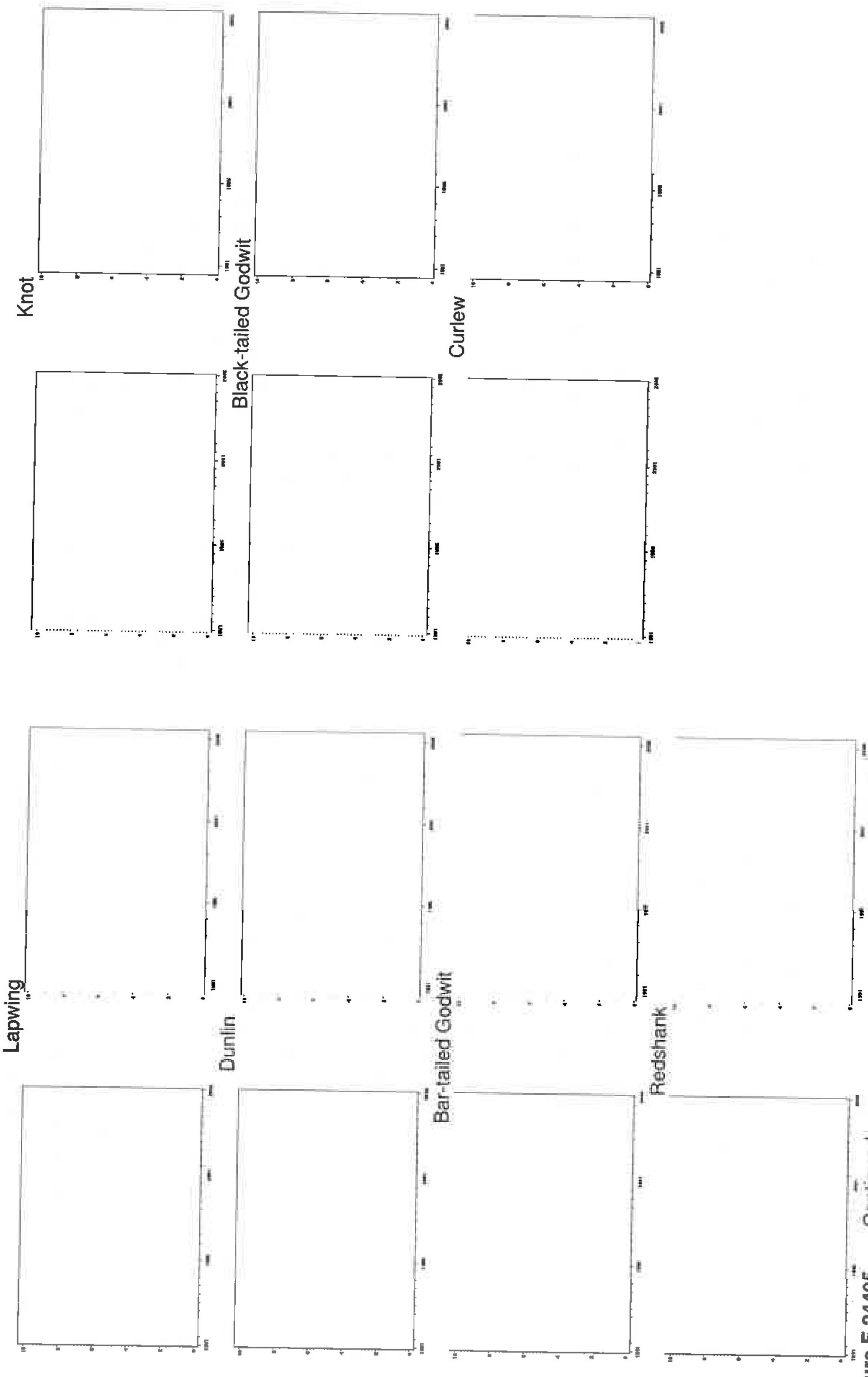


Figure E.24405 Continued



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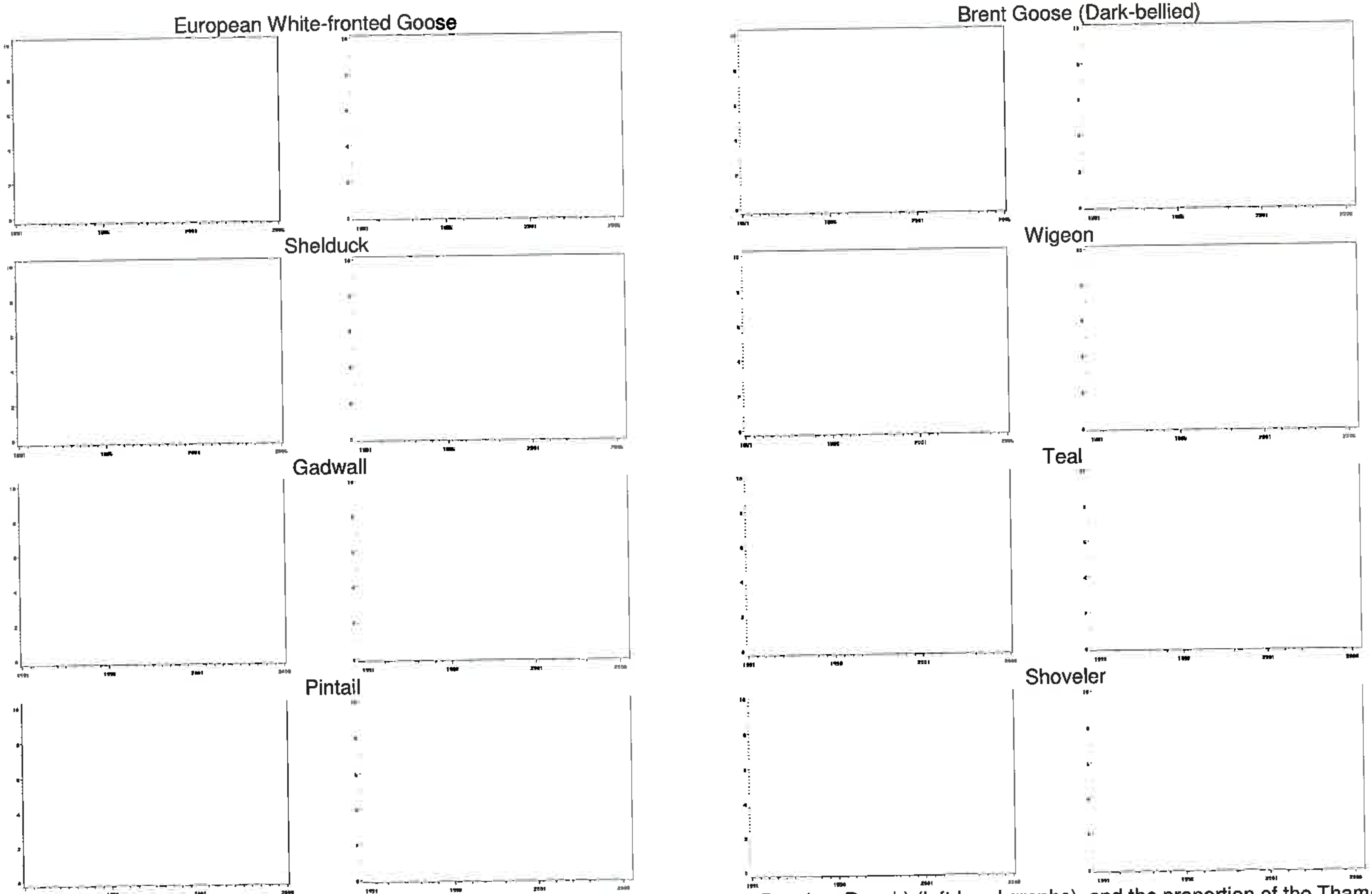
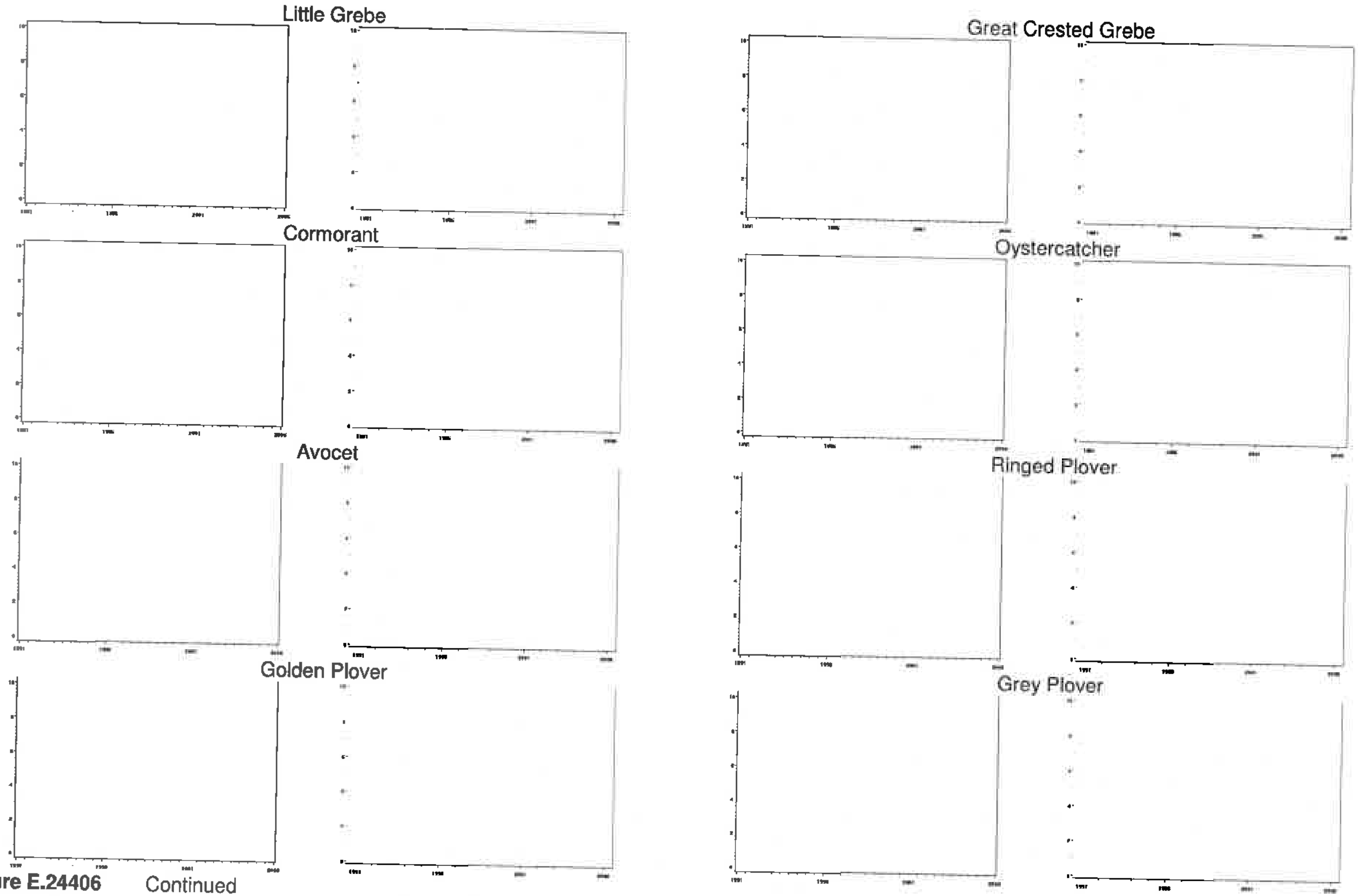


Figure E.24406 Population trends of each species in sector 24406 (River Thames - Bugsbys Reach) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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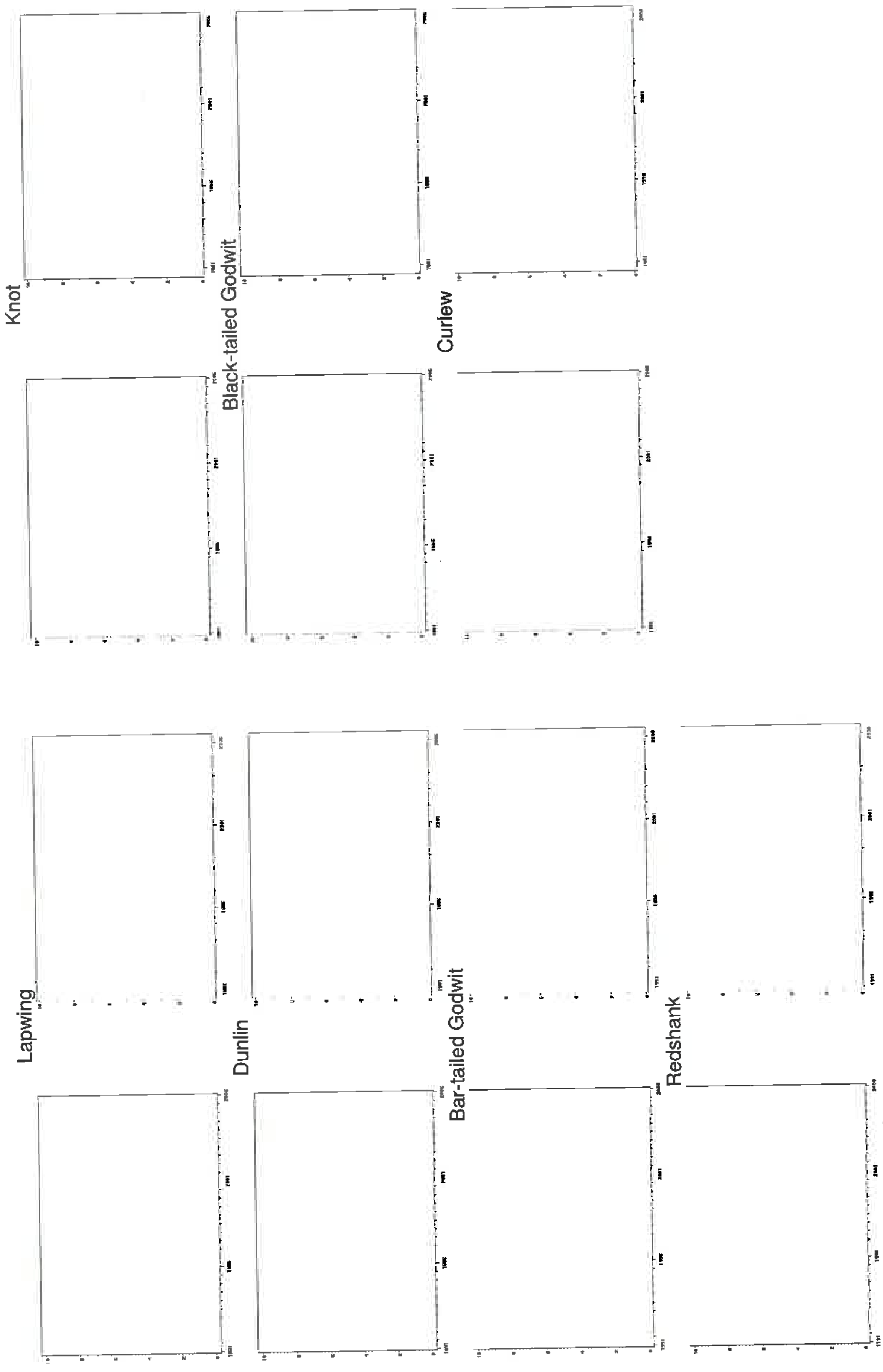

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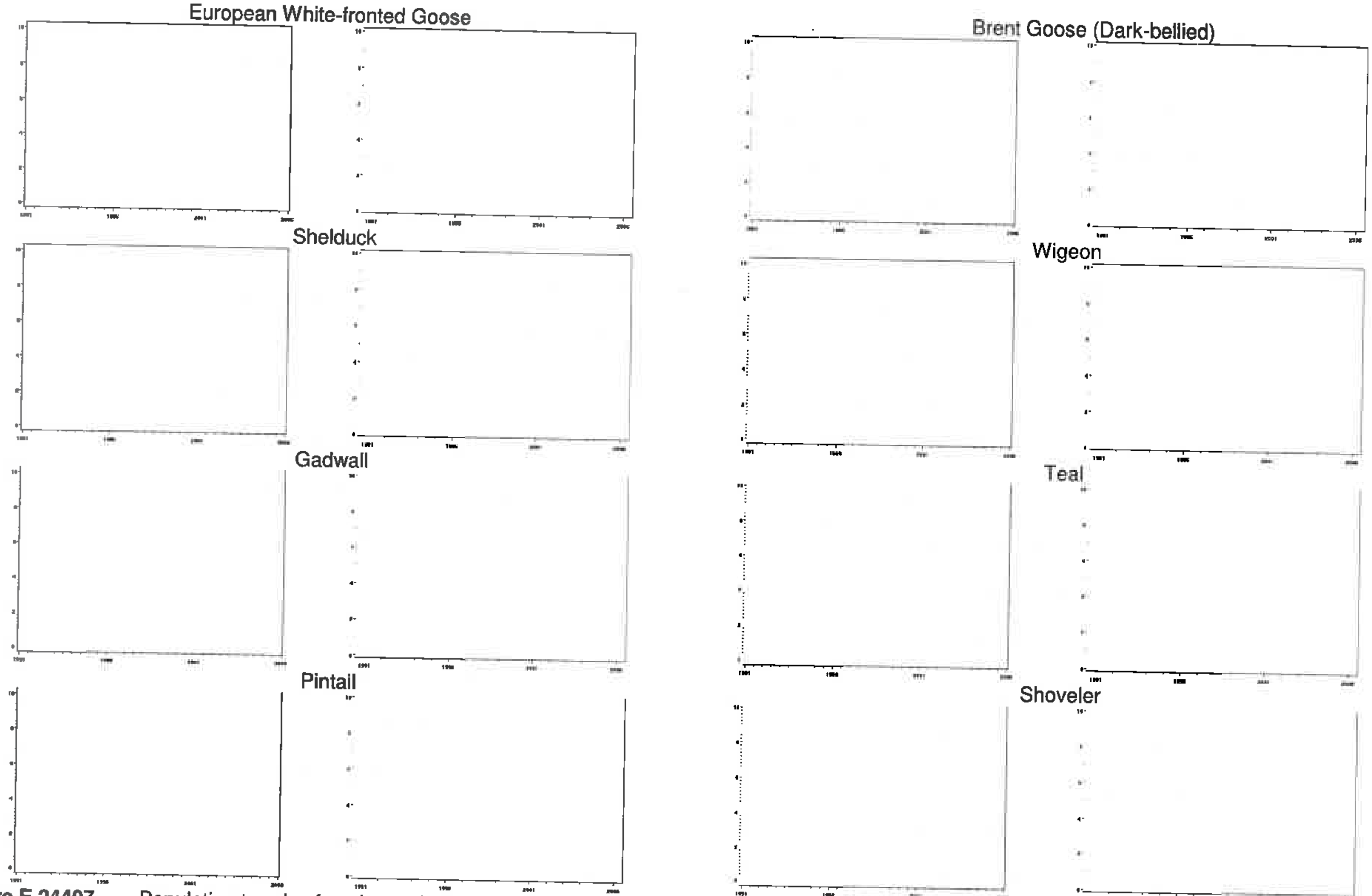


Figure E.24407 Population trends of each species in sector 24407 (River Thames - Blackwall) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

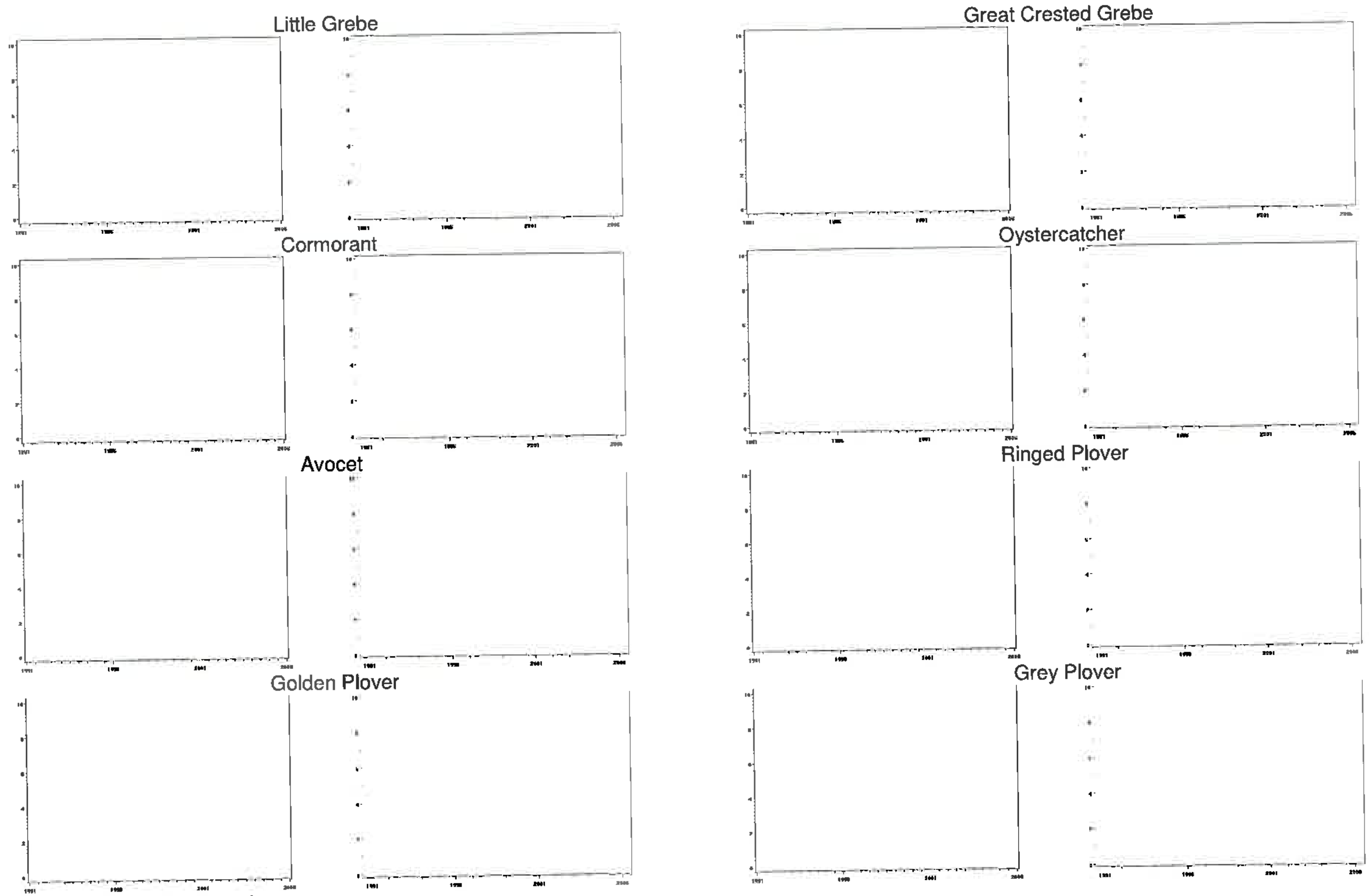


Figure E.24407 Continued

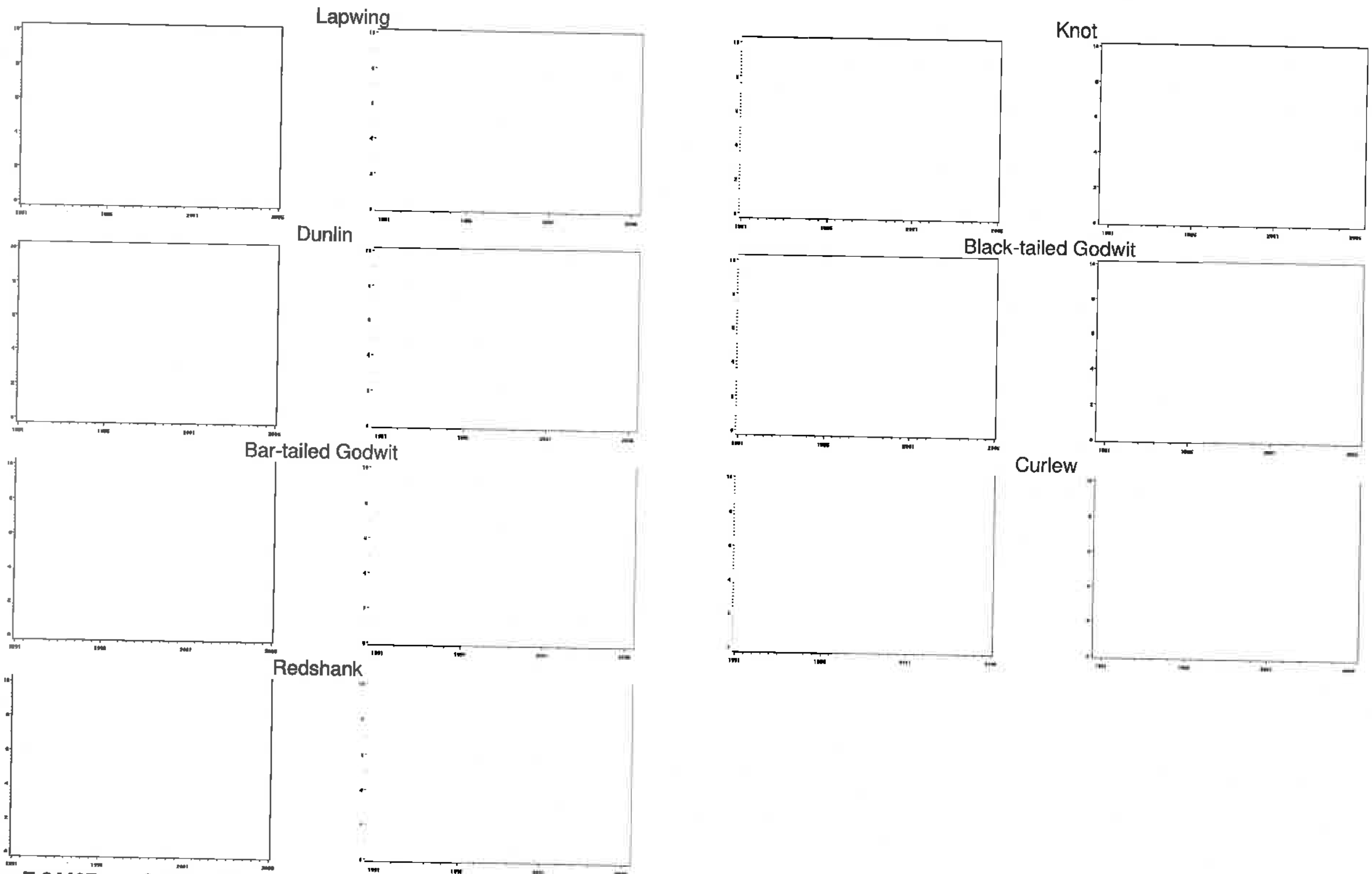


Figure E.24407 Continued

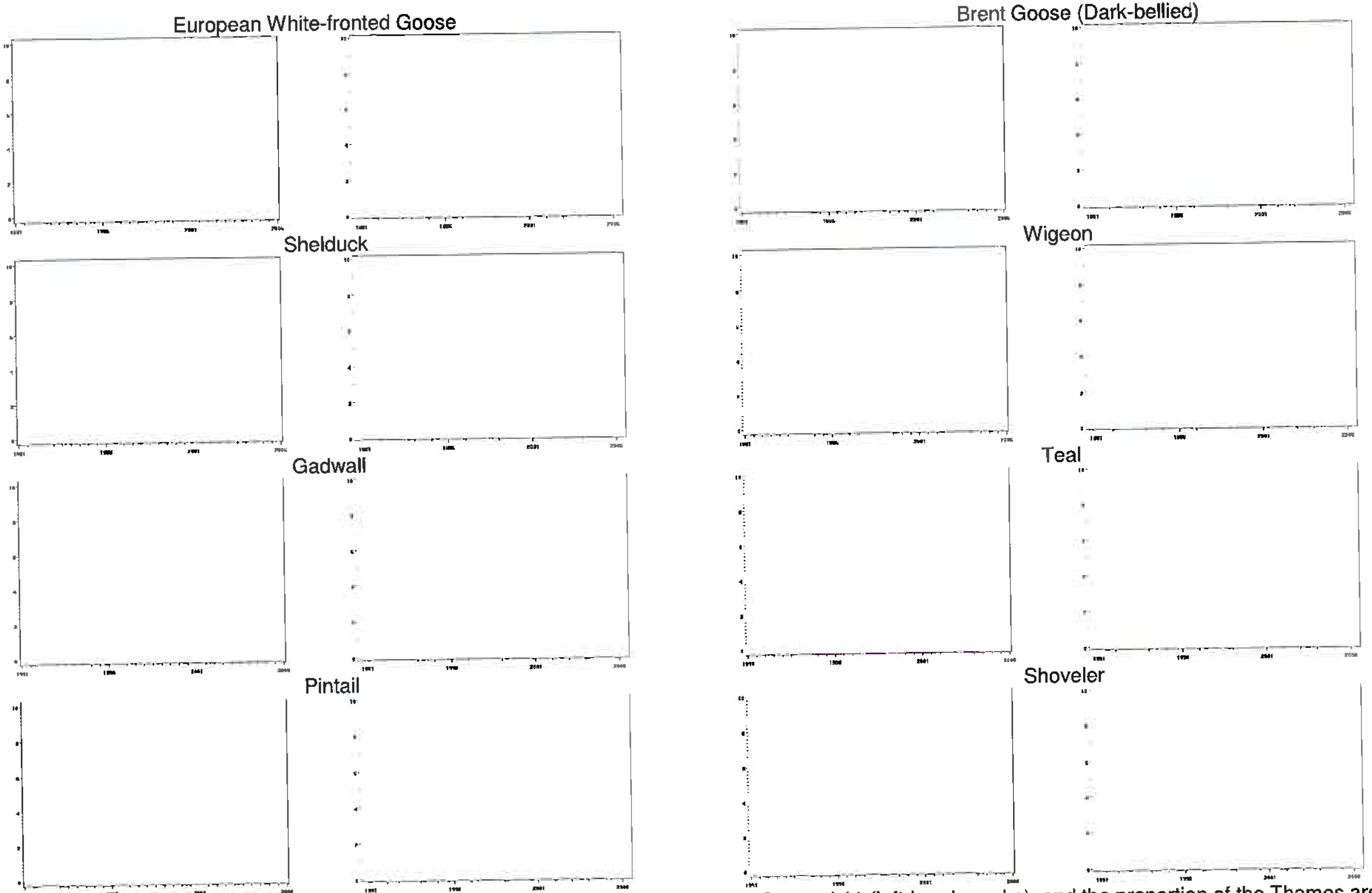
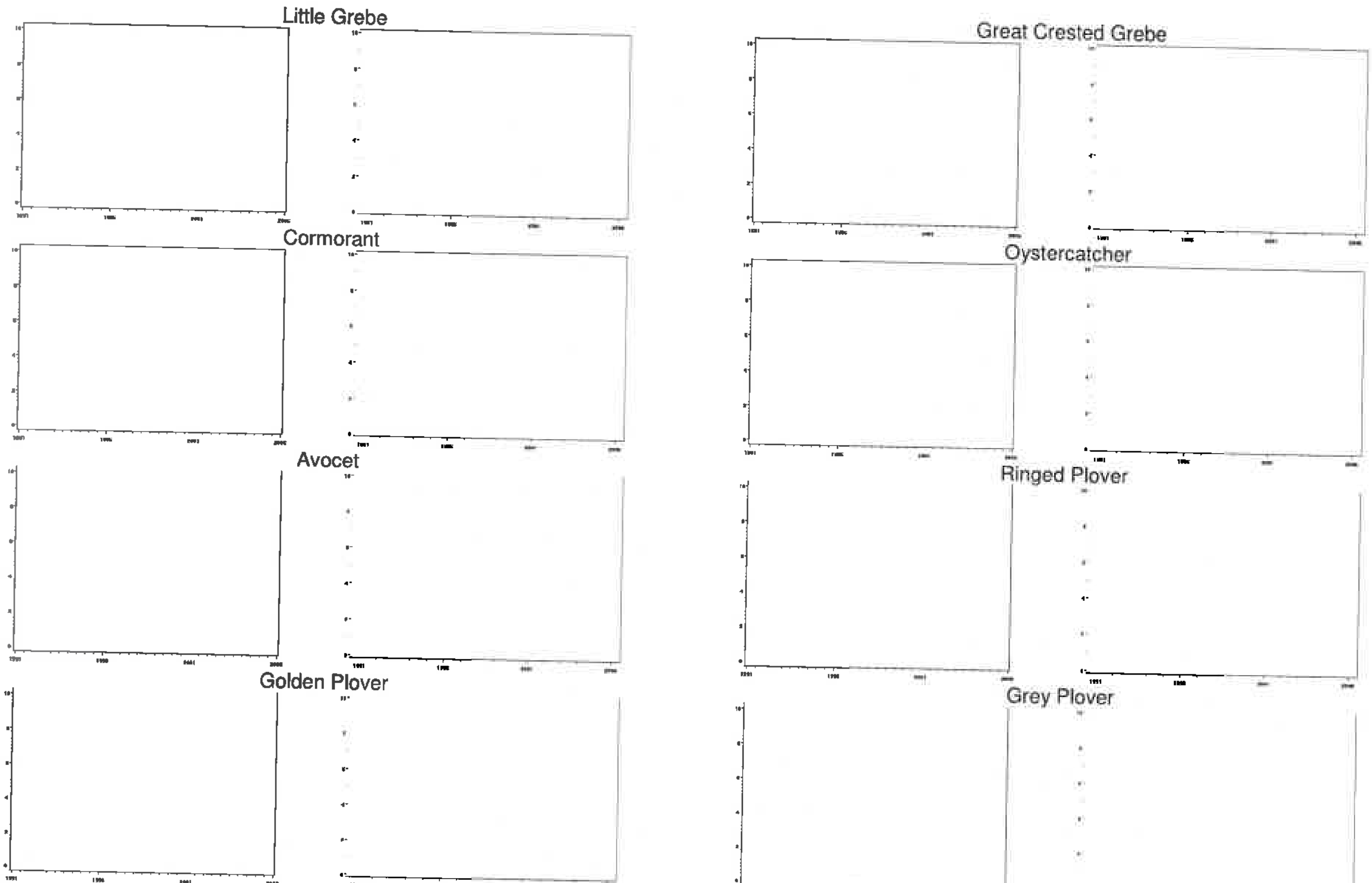


Figure E.24408 Population trends of each species in sector 24408 (River Thames - Greenwich) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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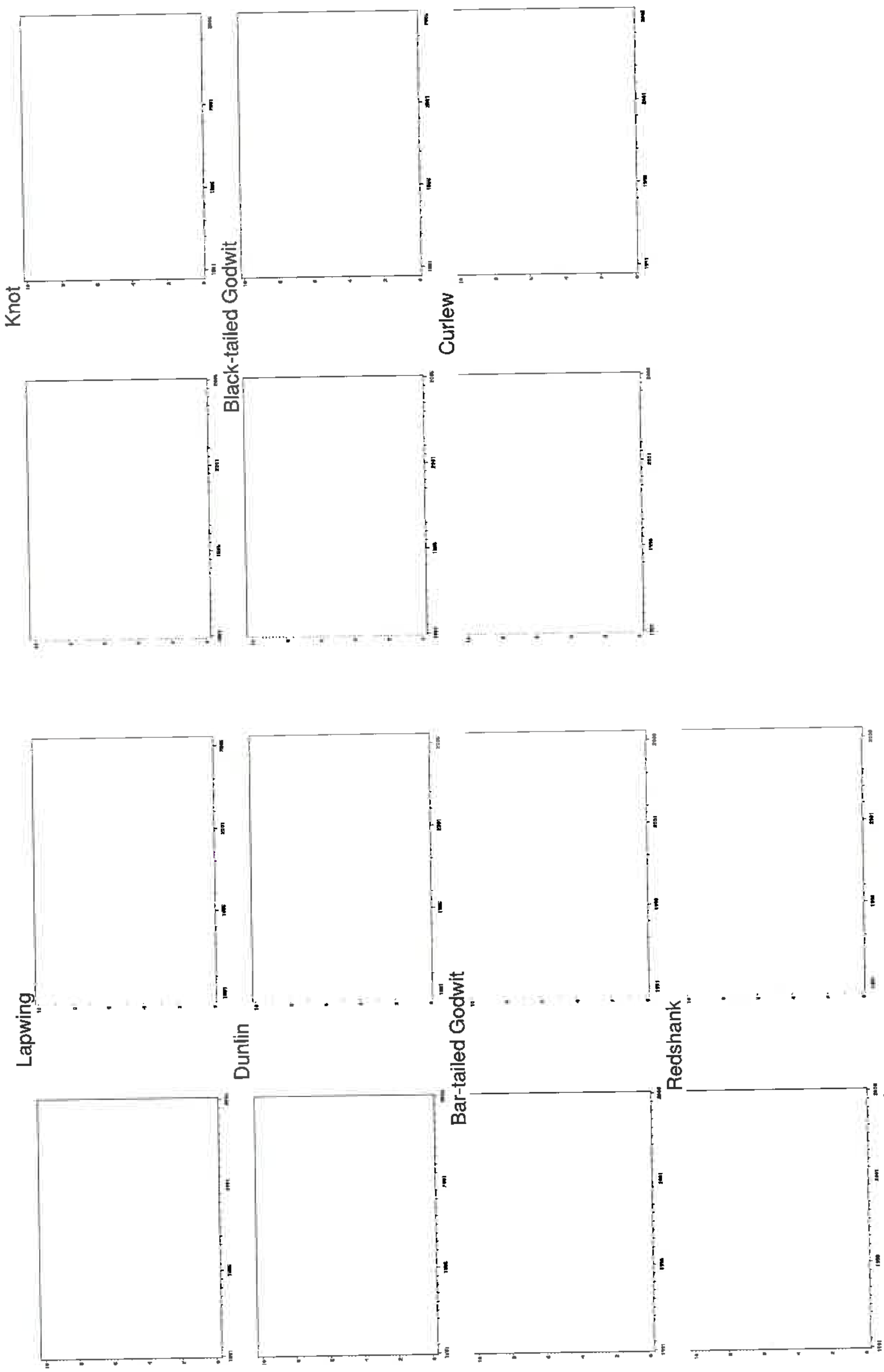

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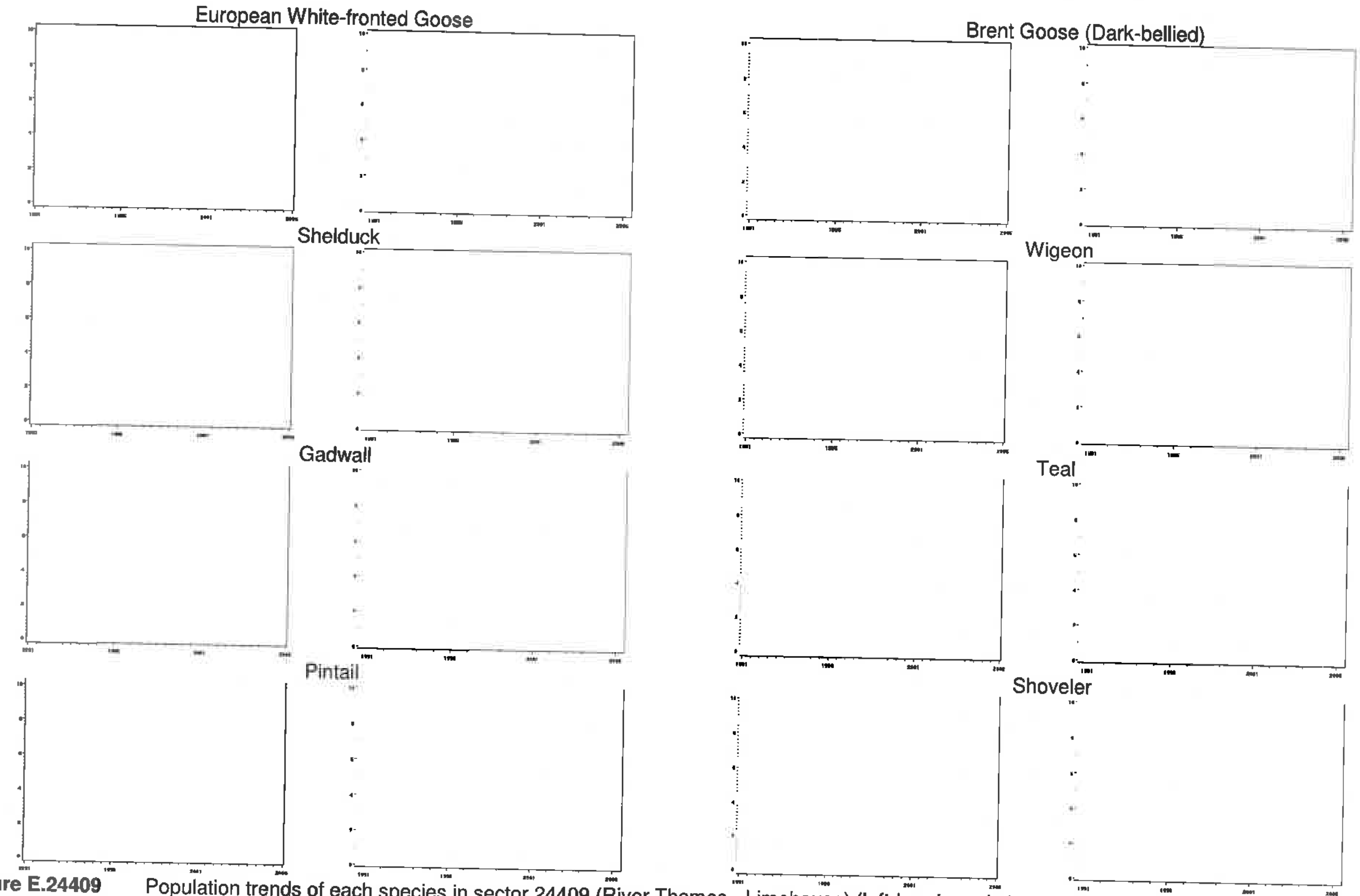
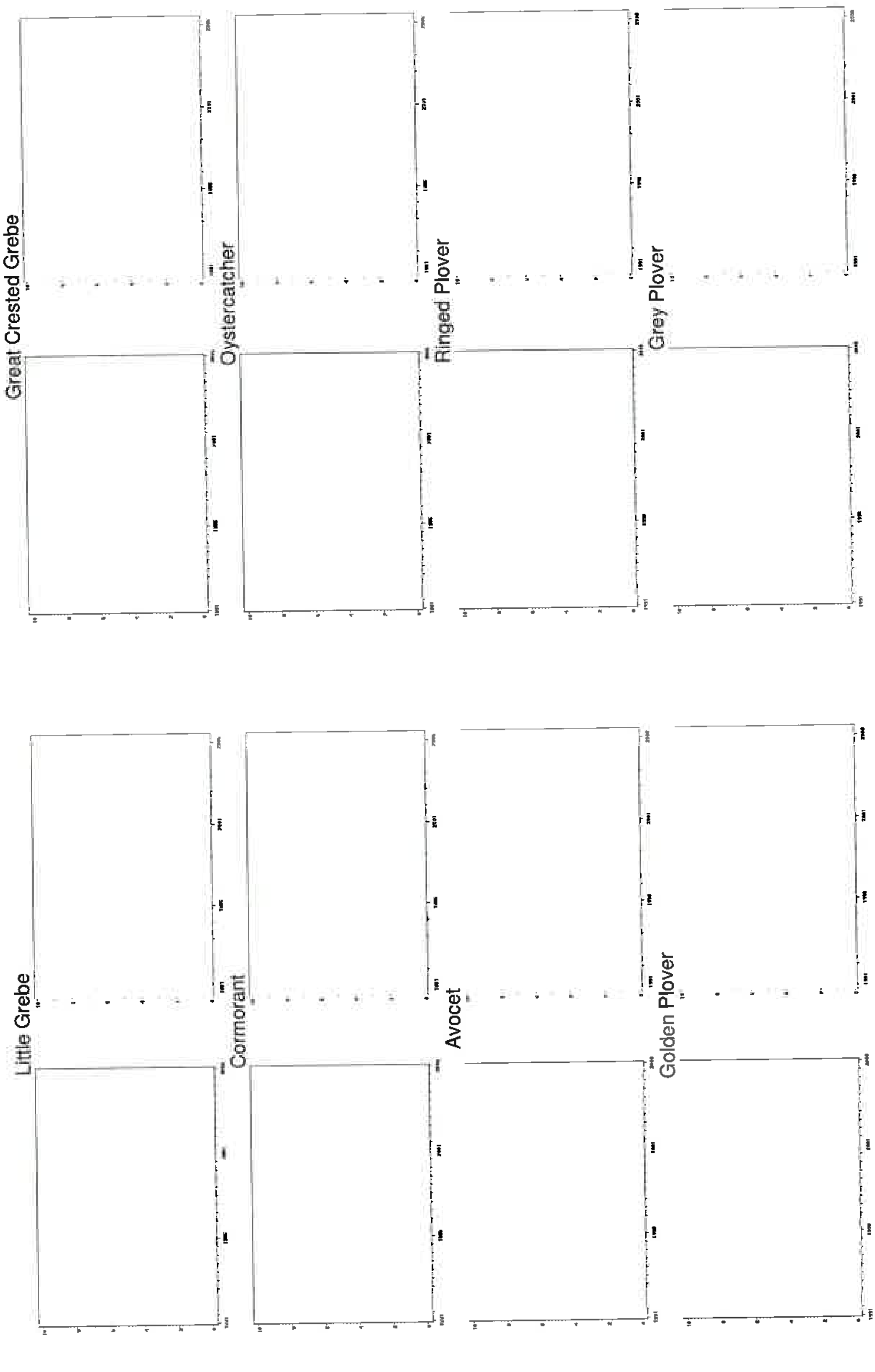


Figure E.24409 Population trends of each species in sector 24409 (River Thames - Limehouse) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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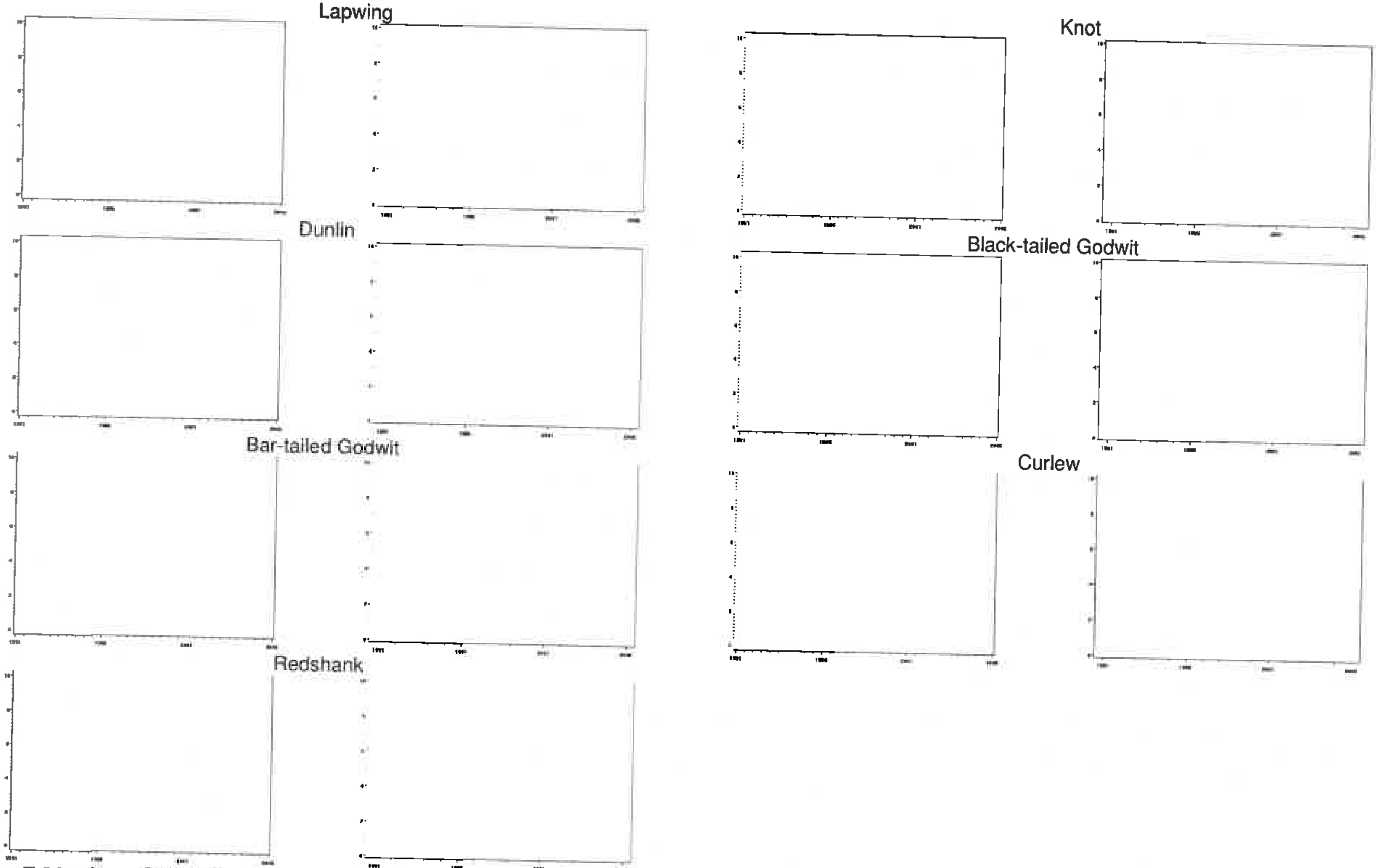


Figure E.24409 Continued

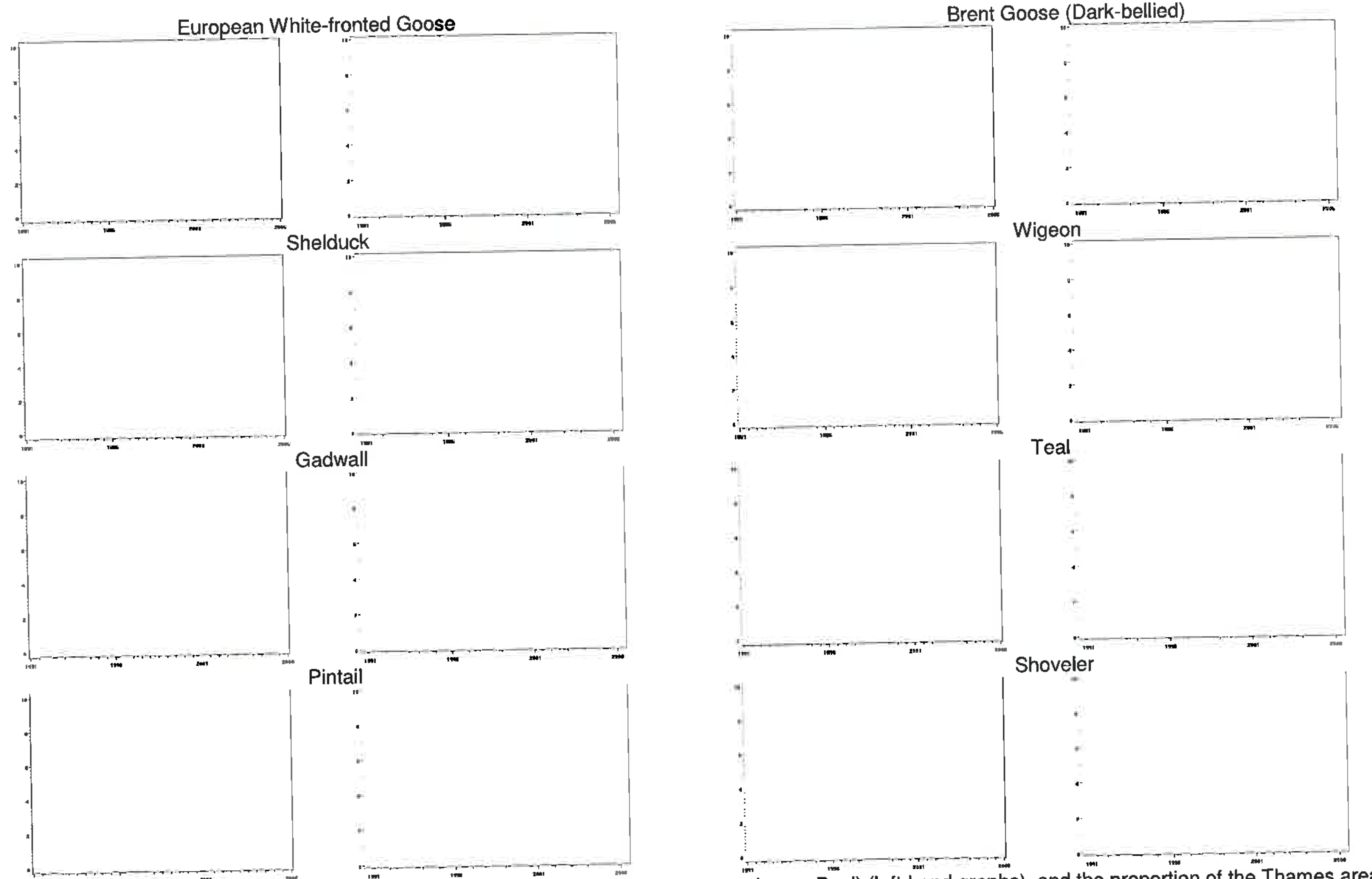
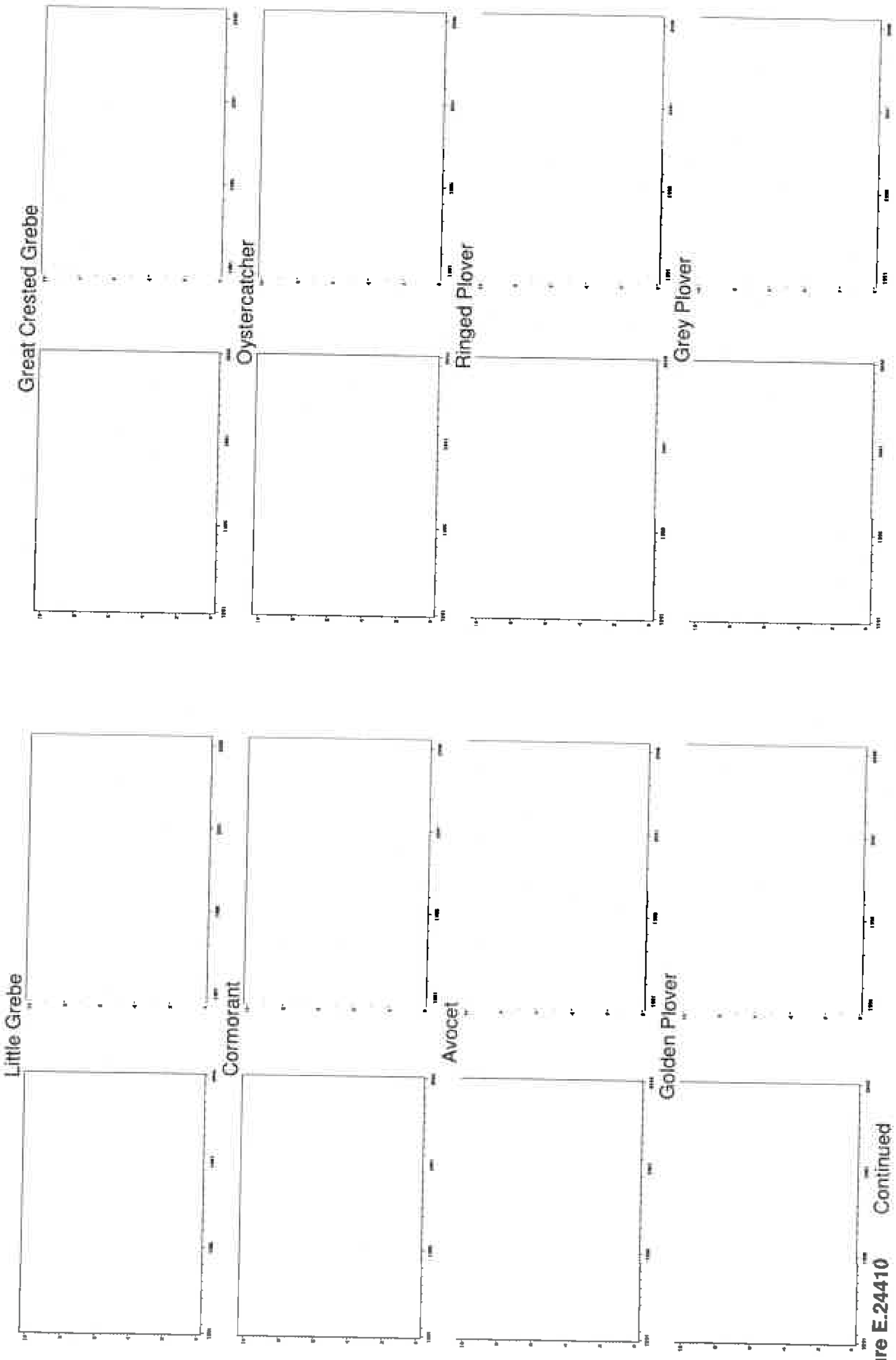


Figure E.24410 Population trends of each species in sector 24410 (River Thames - Lower Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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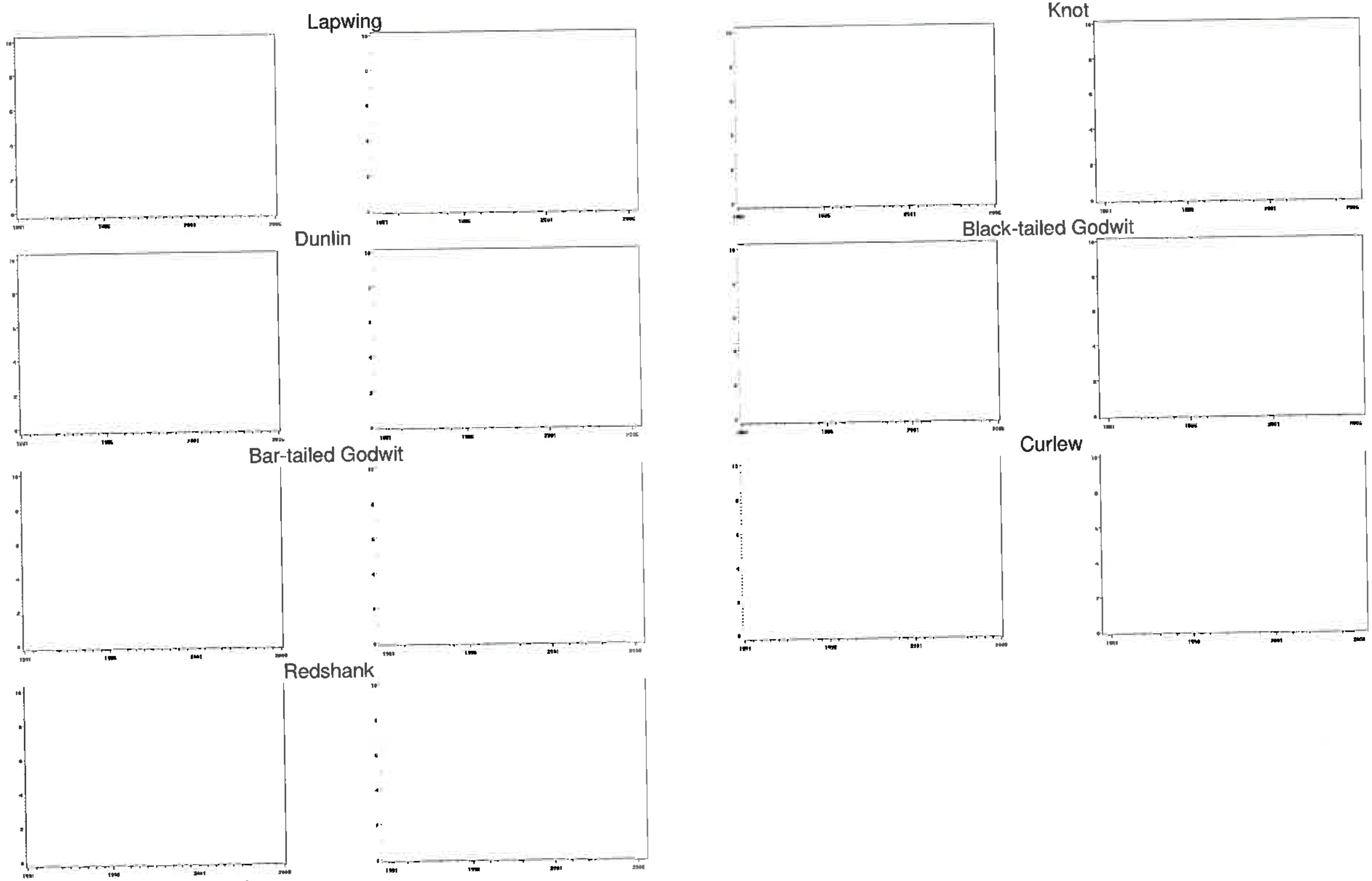

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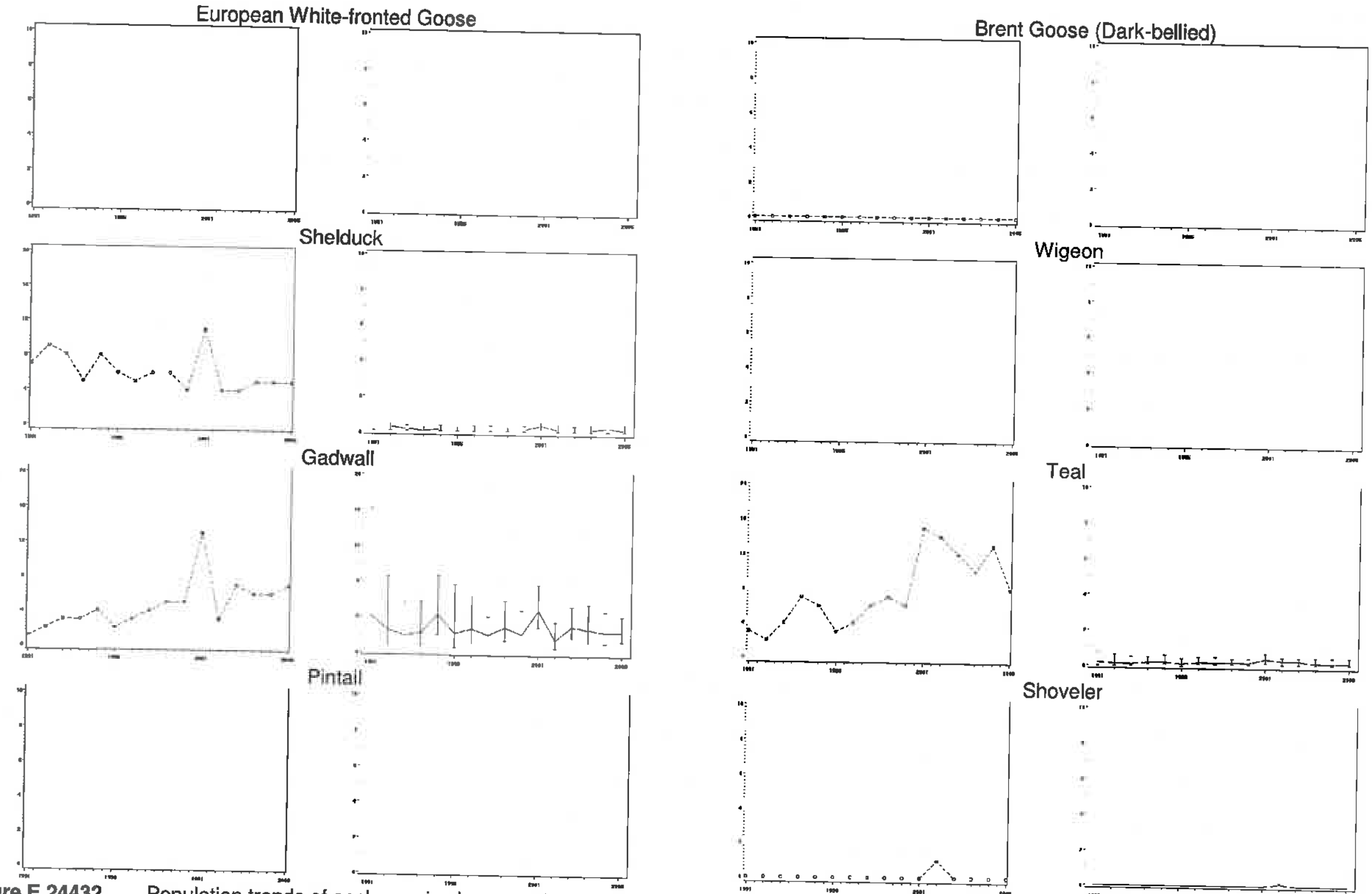
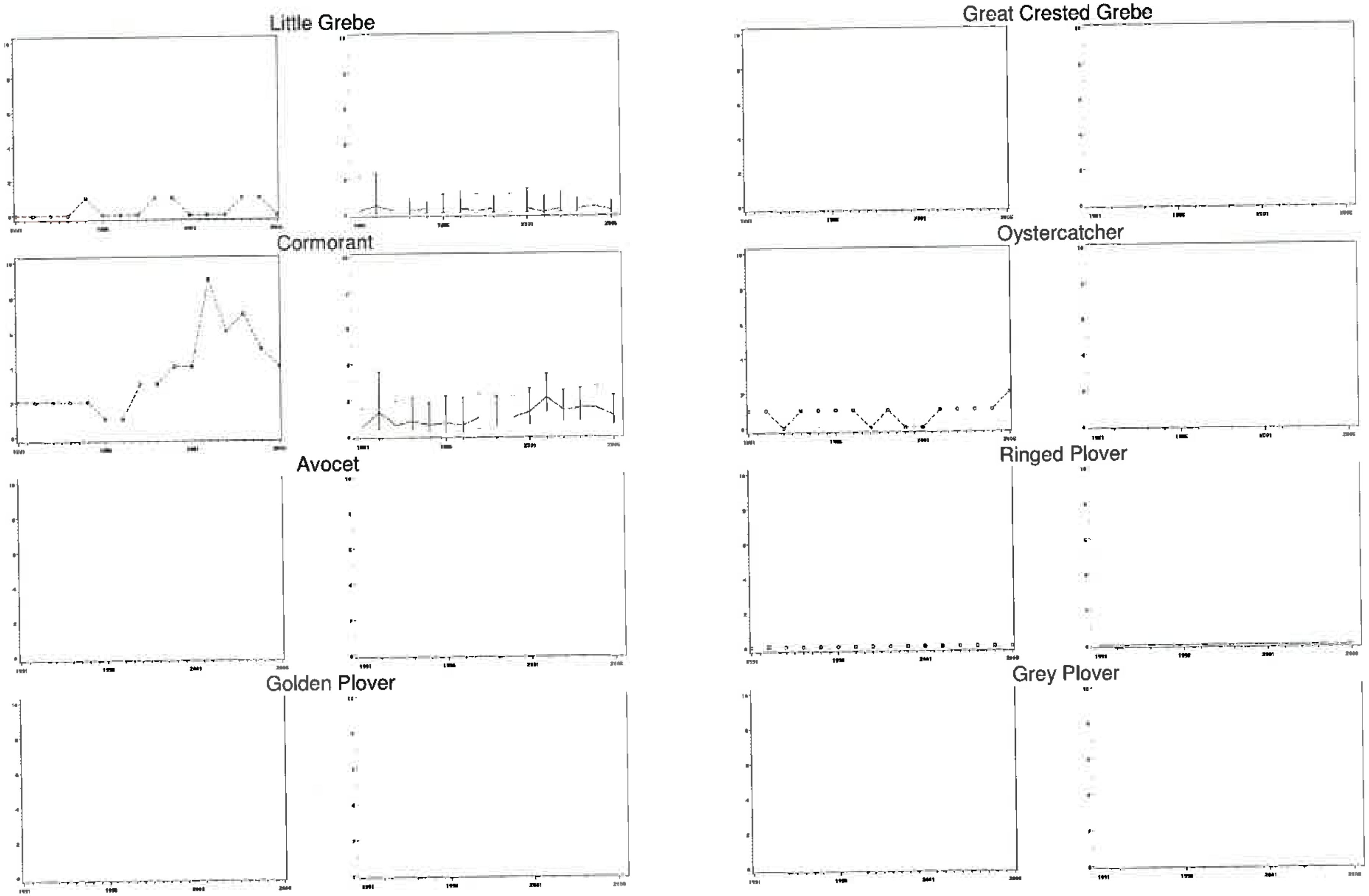


Figure E.24432 Population trends of each species in sector 24432 (River Thames - Barges to Coldharbour Point) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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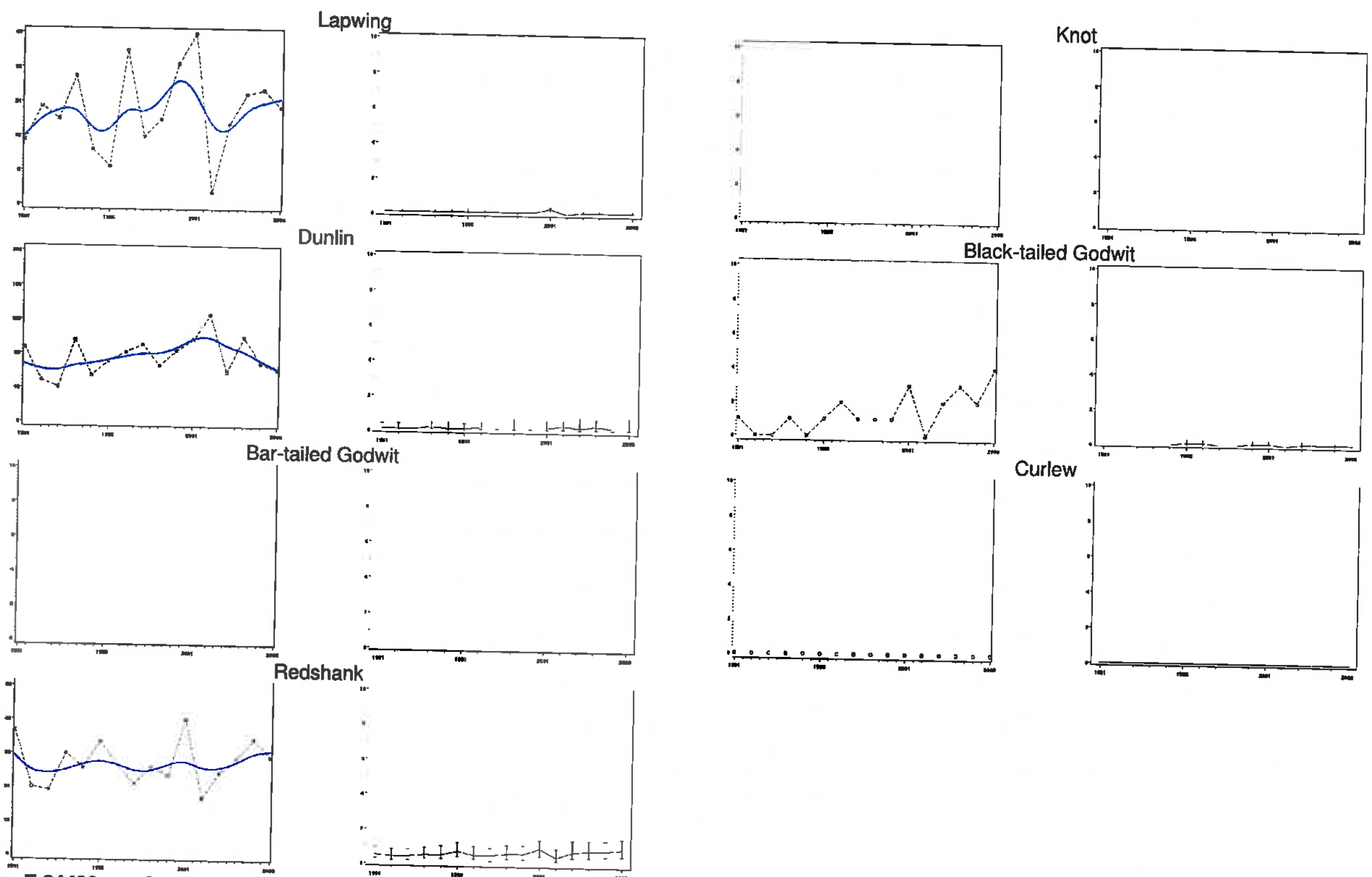

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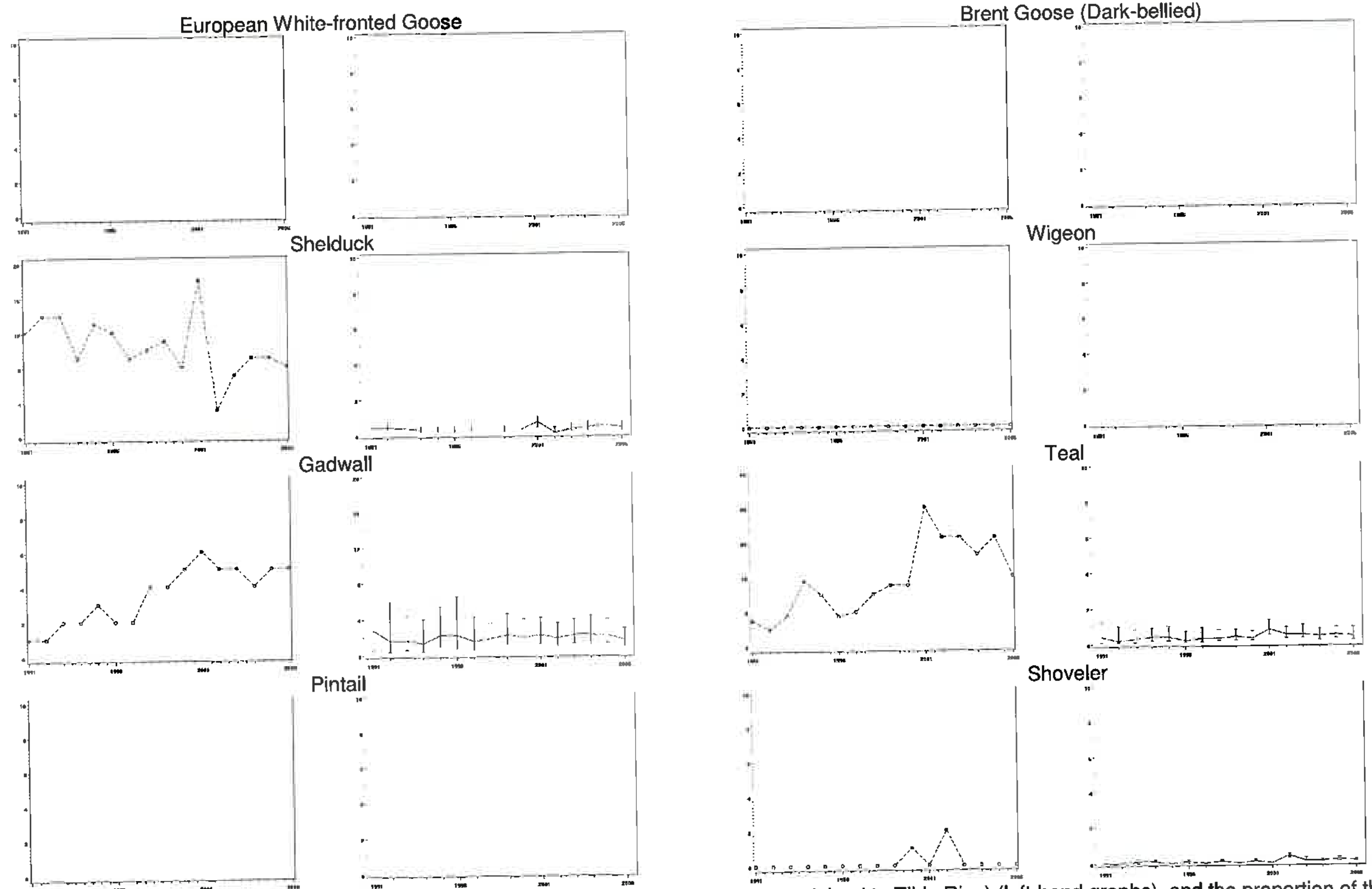
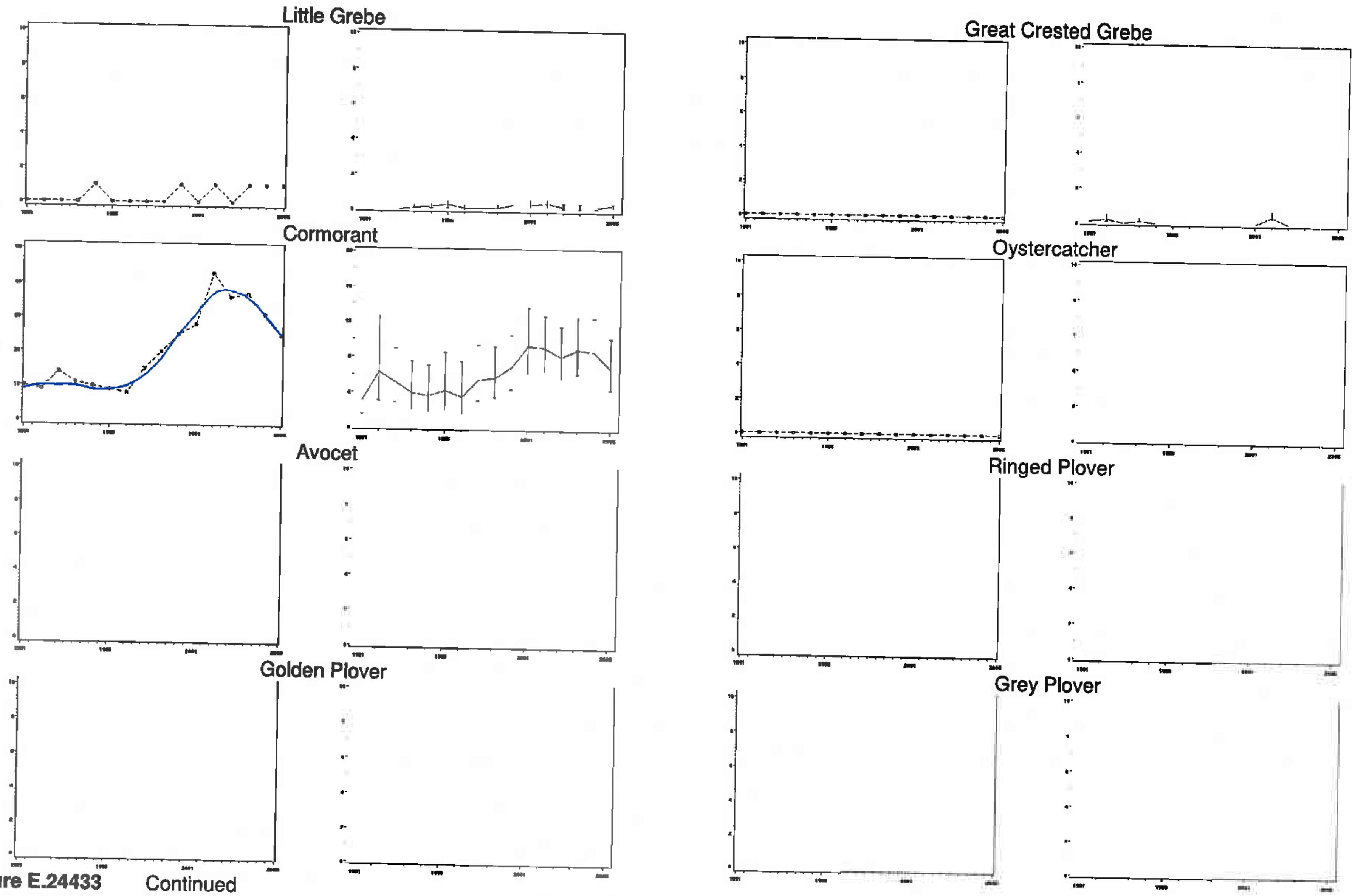


Figure E.24433 Population trends of each species in sector 24433 (River Thames - Frog Island to Tilda Rice) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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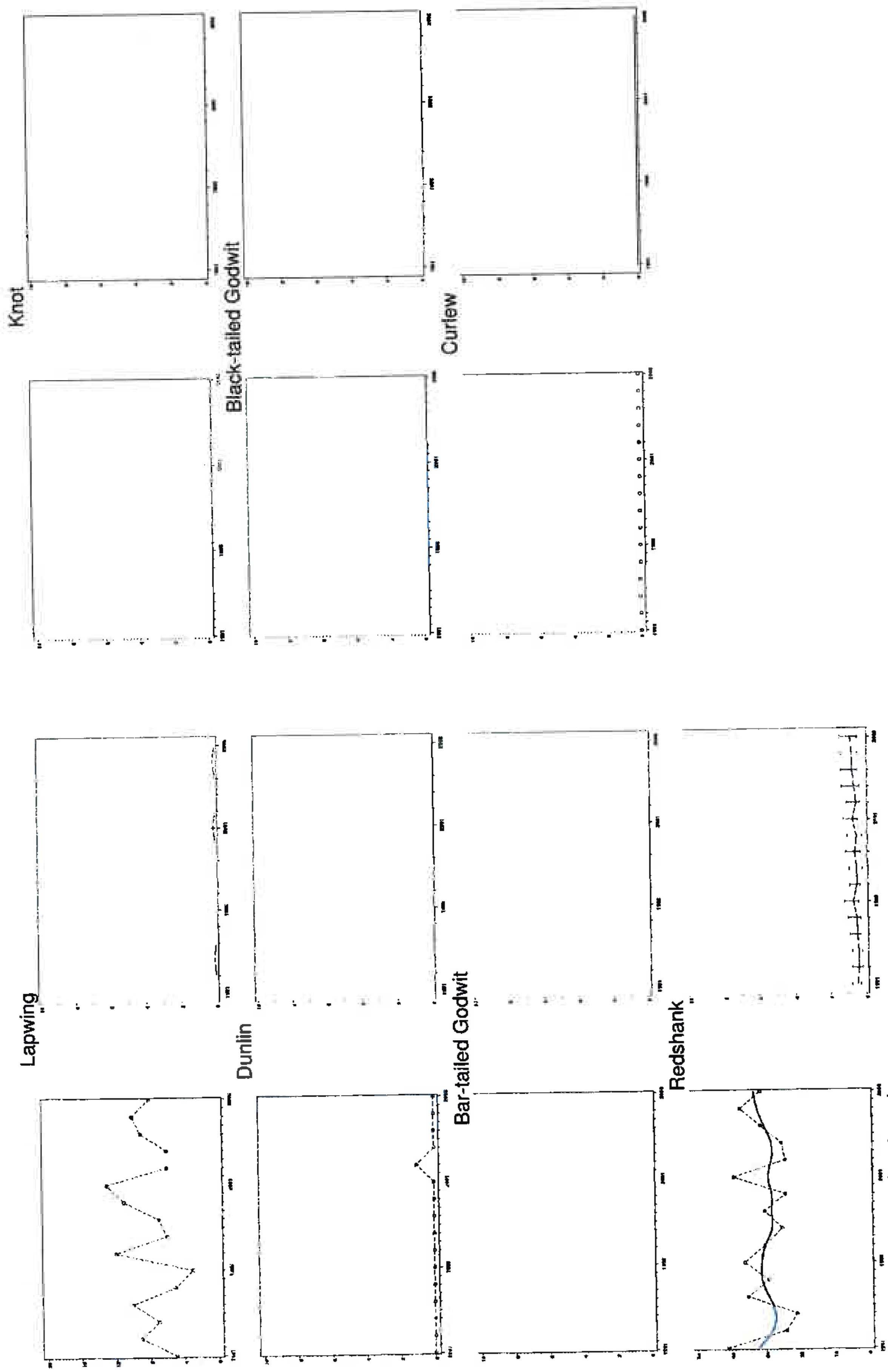

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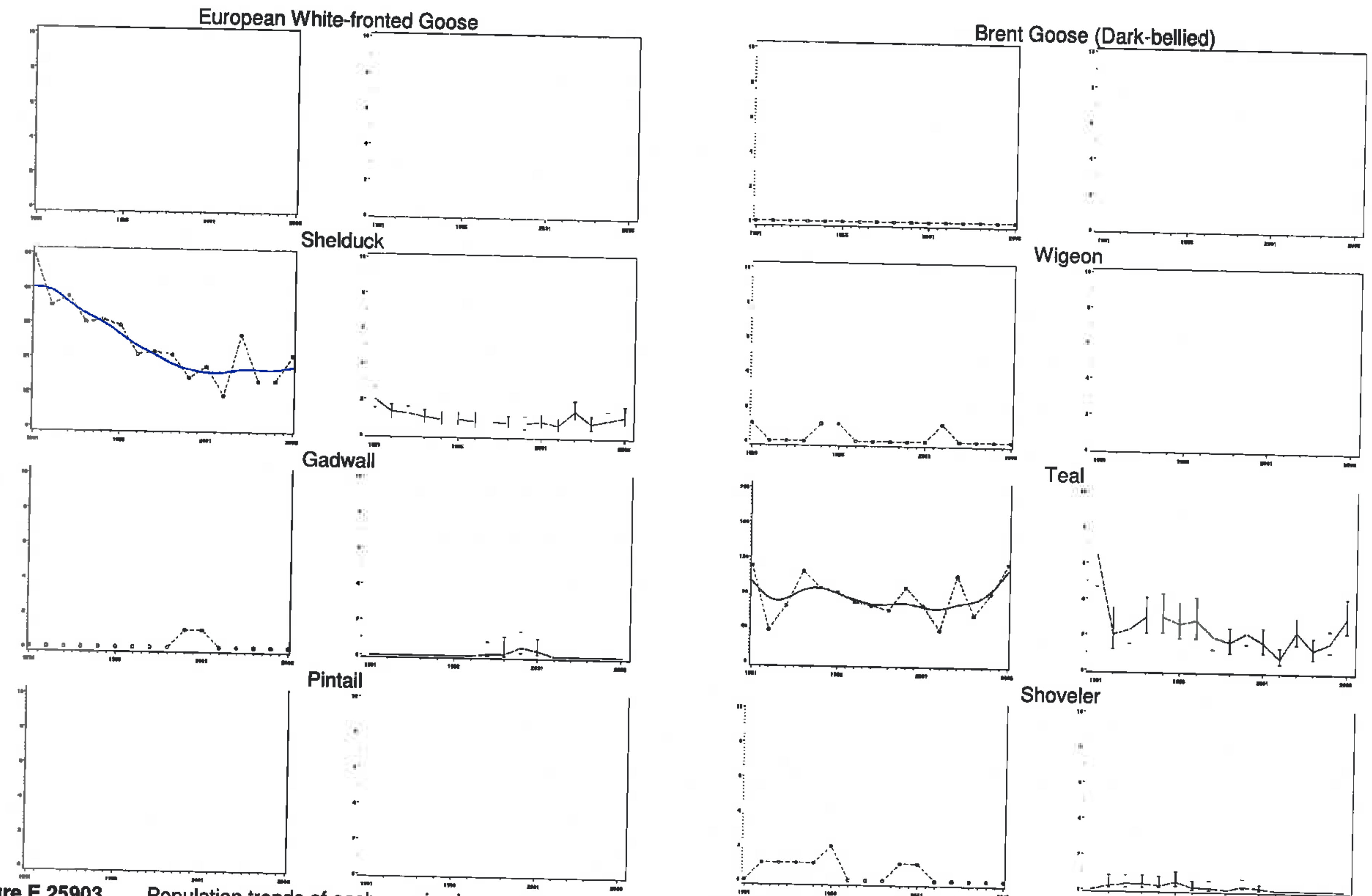
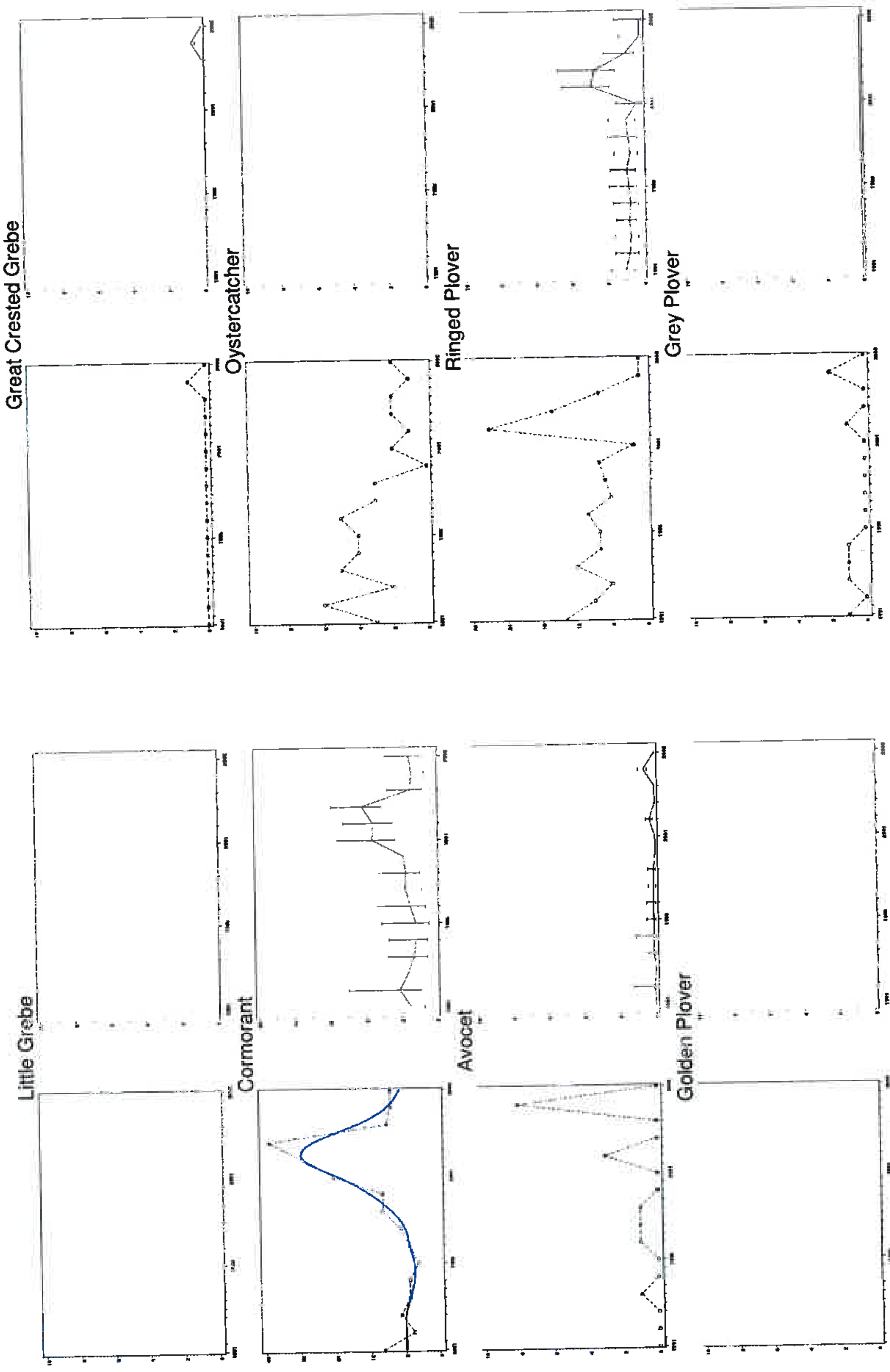


Figure E.25903 Population trends of each species in sector 25903 (Purfleet to Grays) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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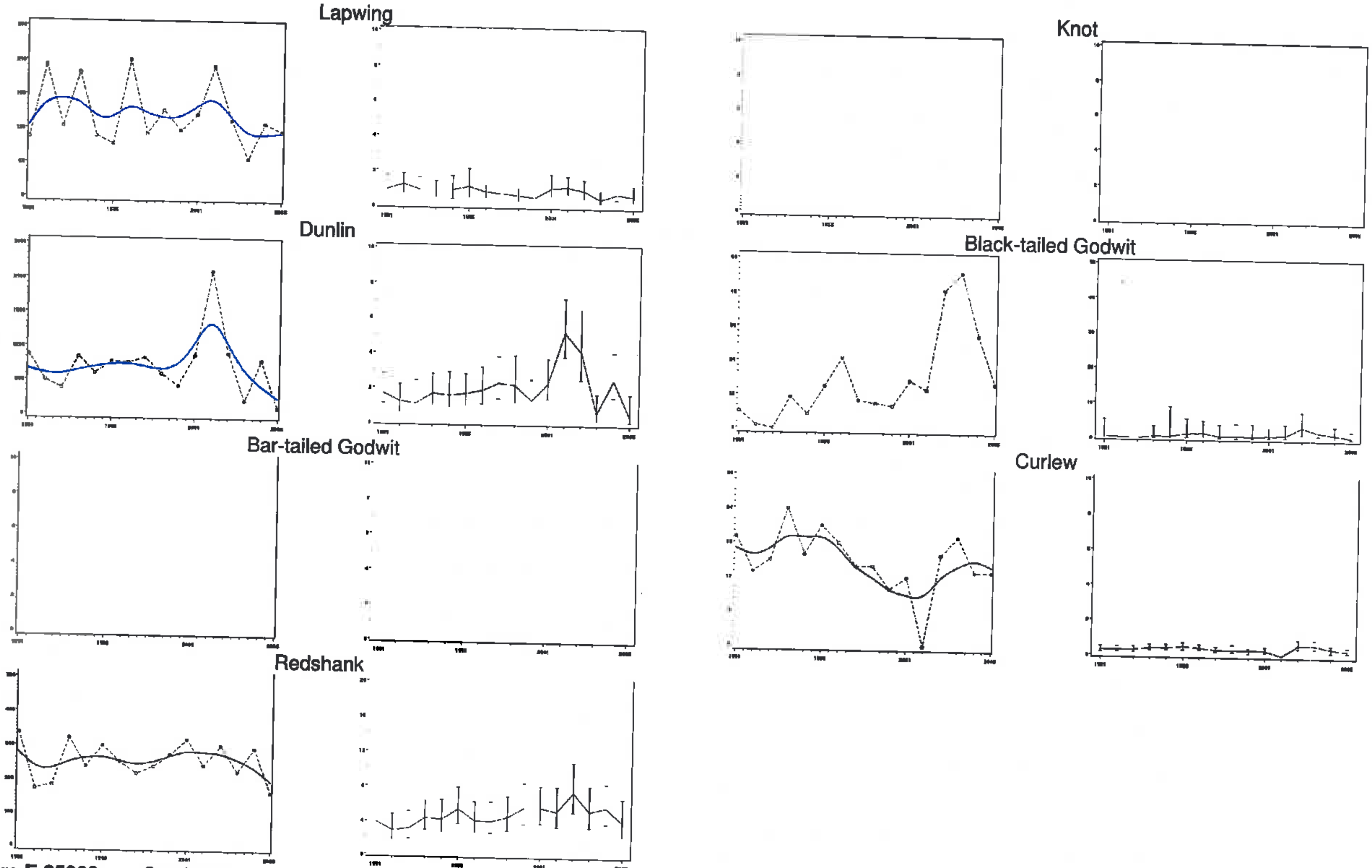

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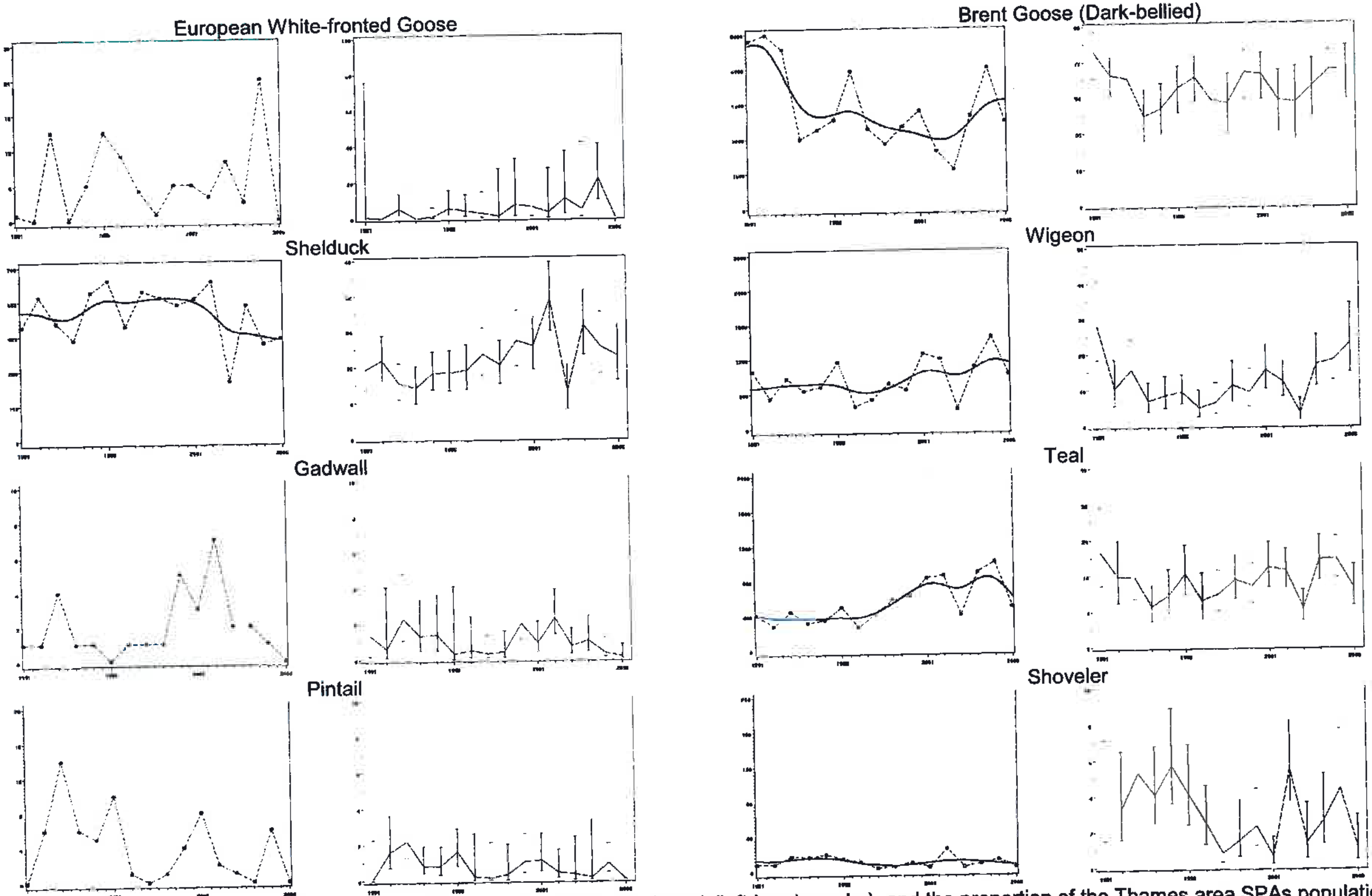
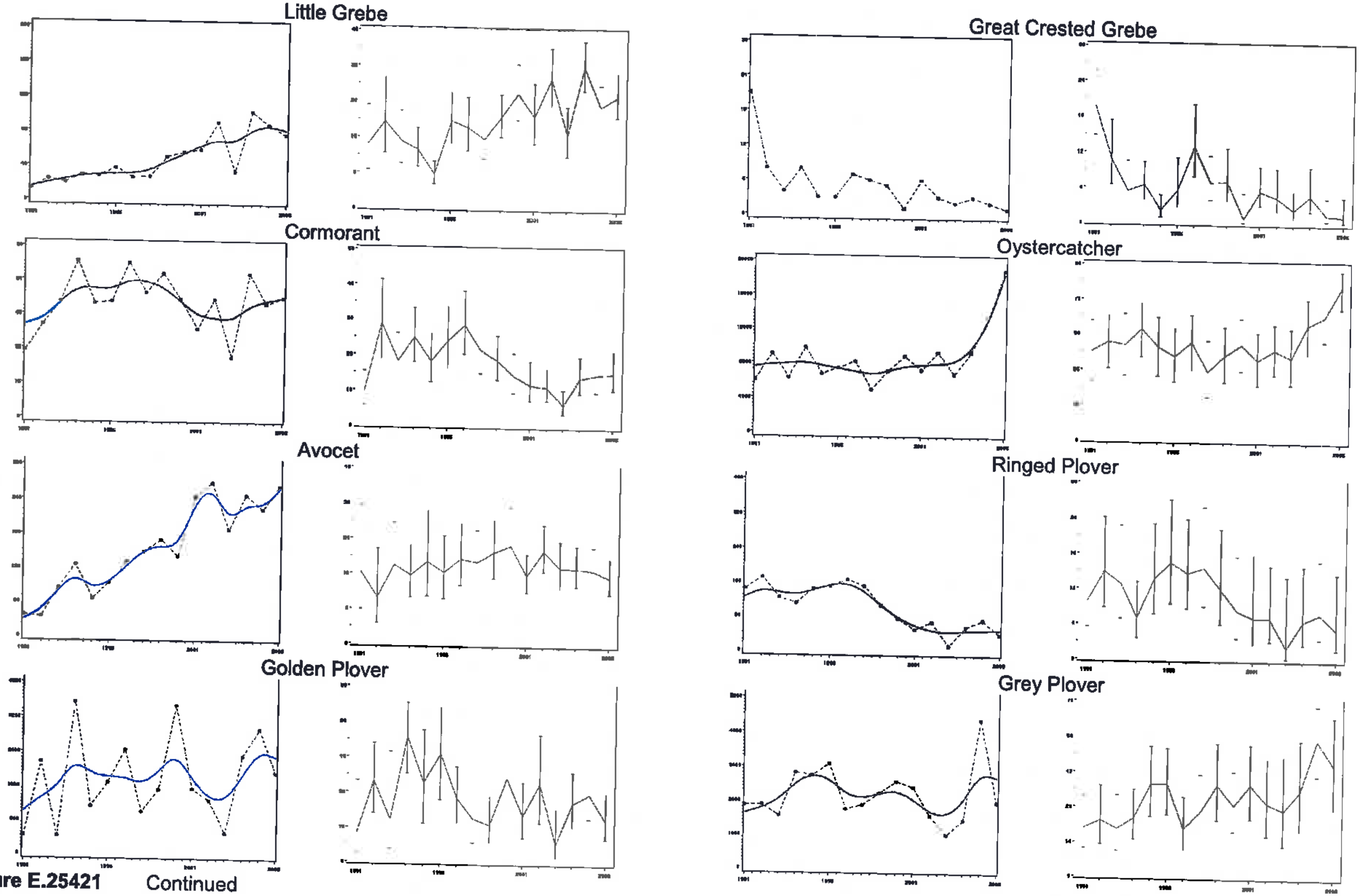


Figure E.25421 Population trends of each species in sector 25421 (Foulness) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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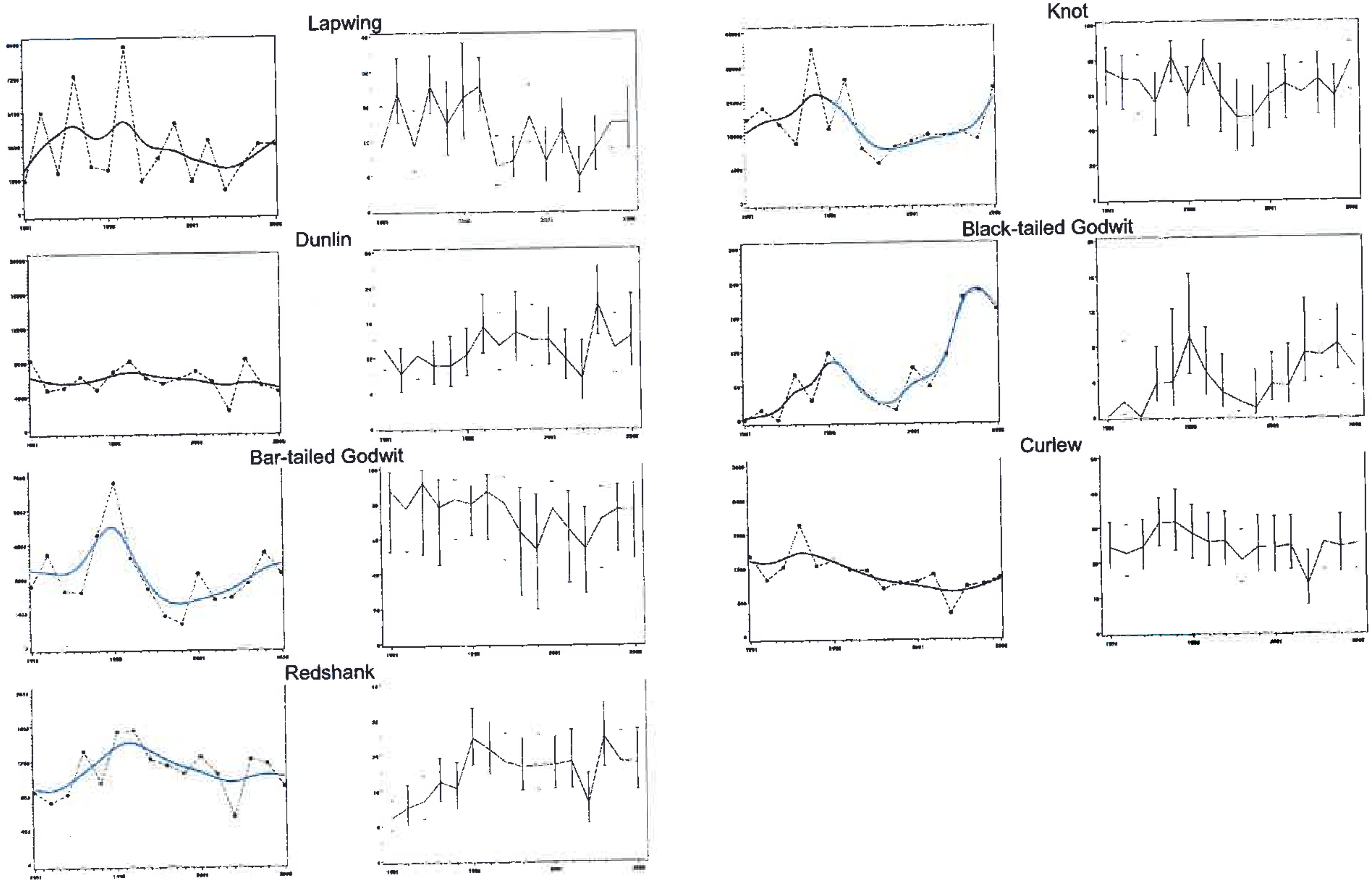

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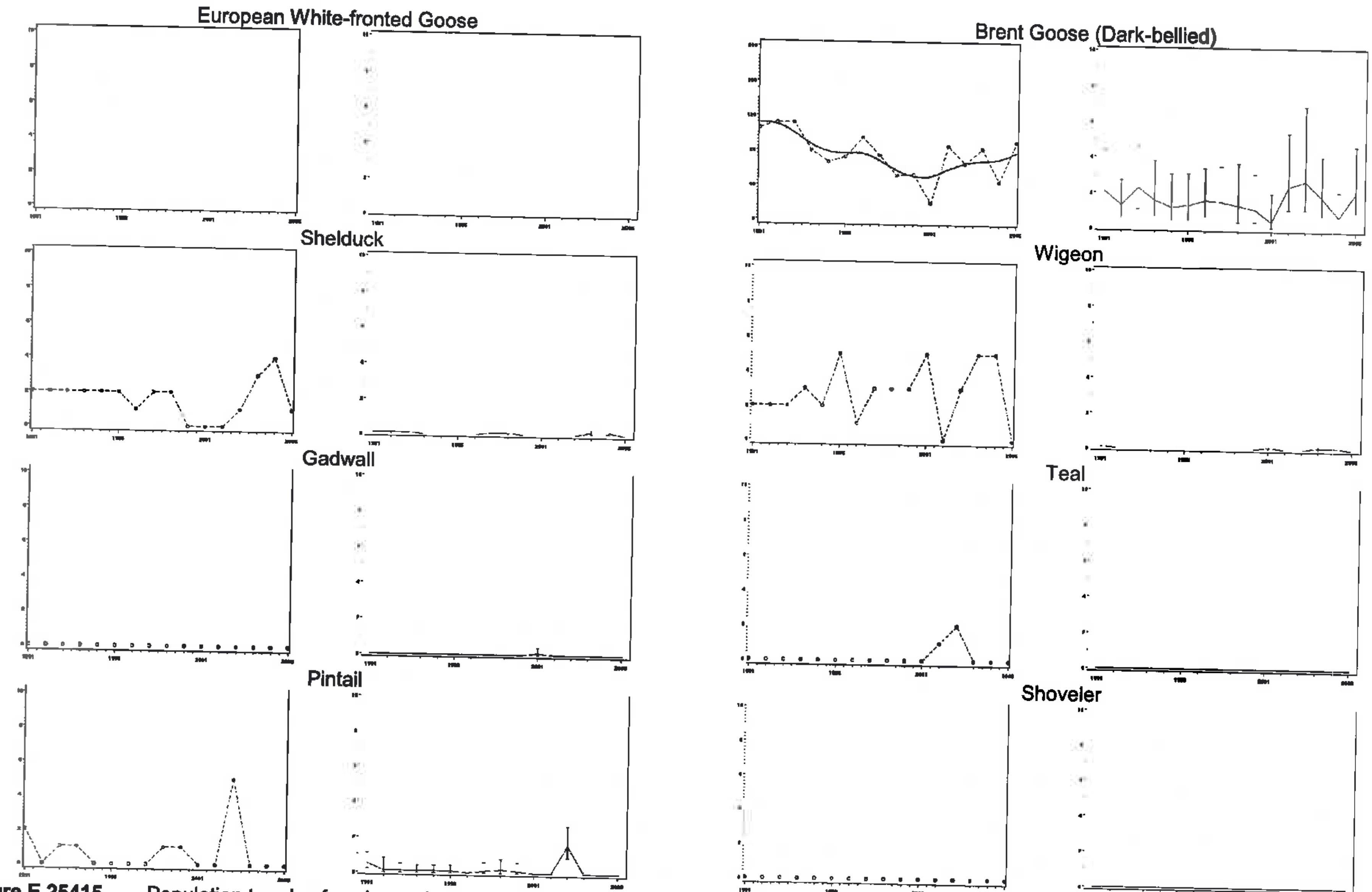
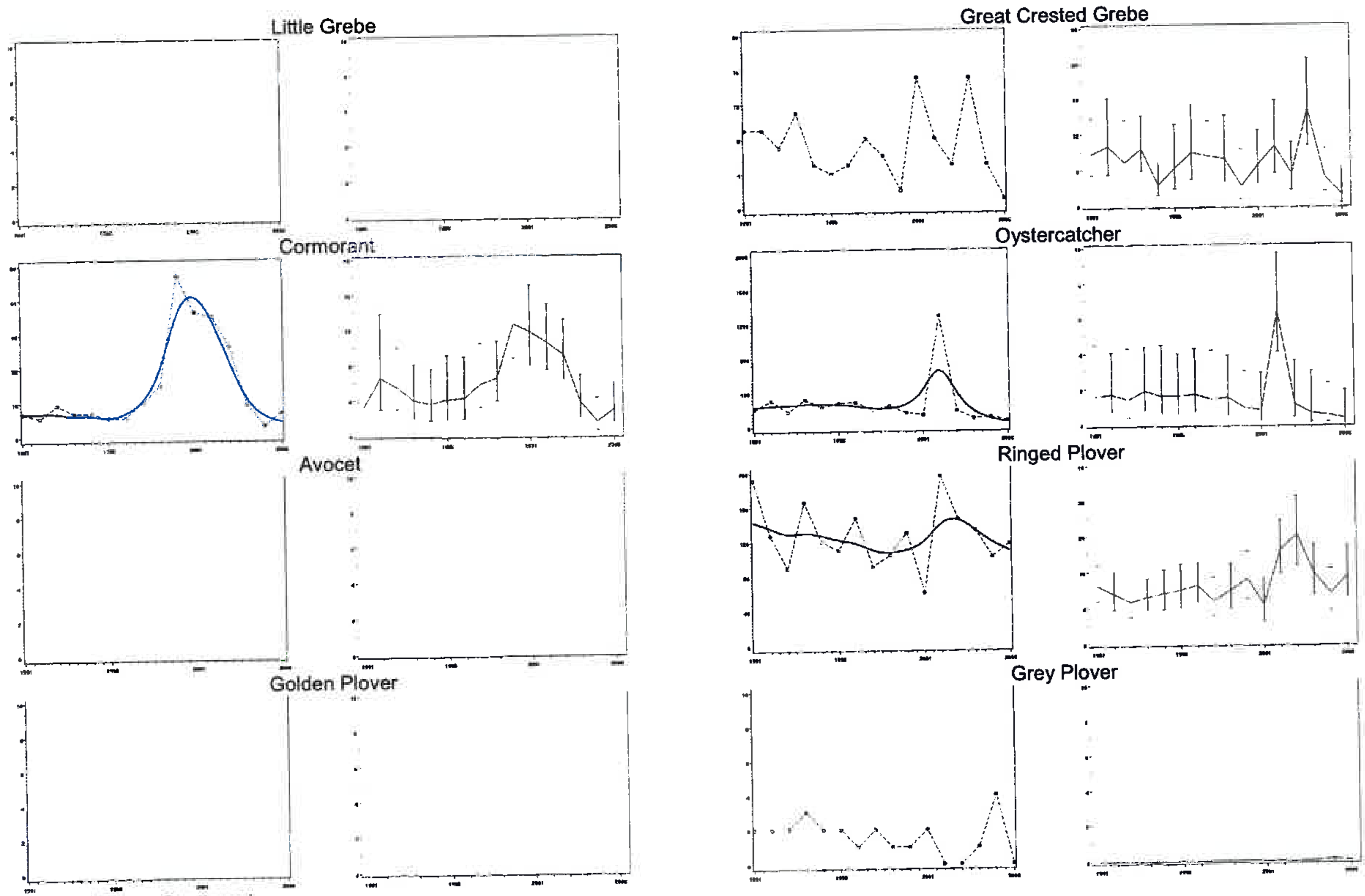


Figure E.25415 Population trends of each species in sector 25415 (Southend Seafront) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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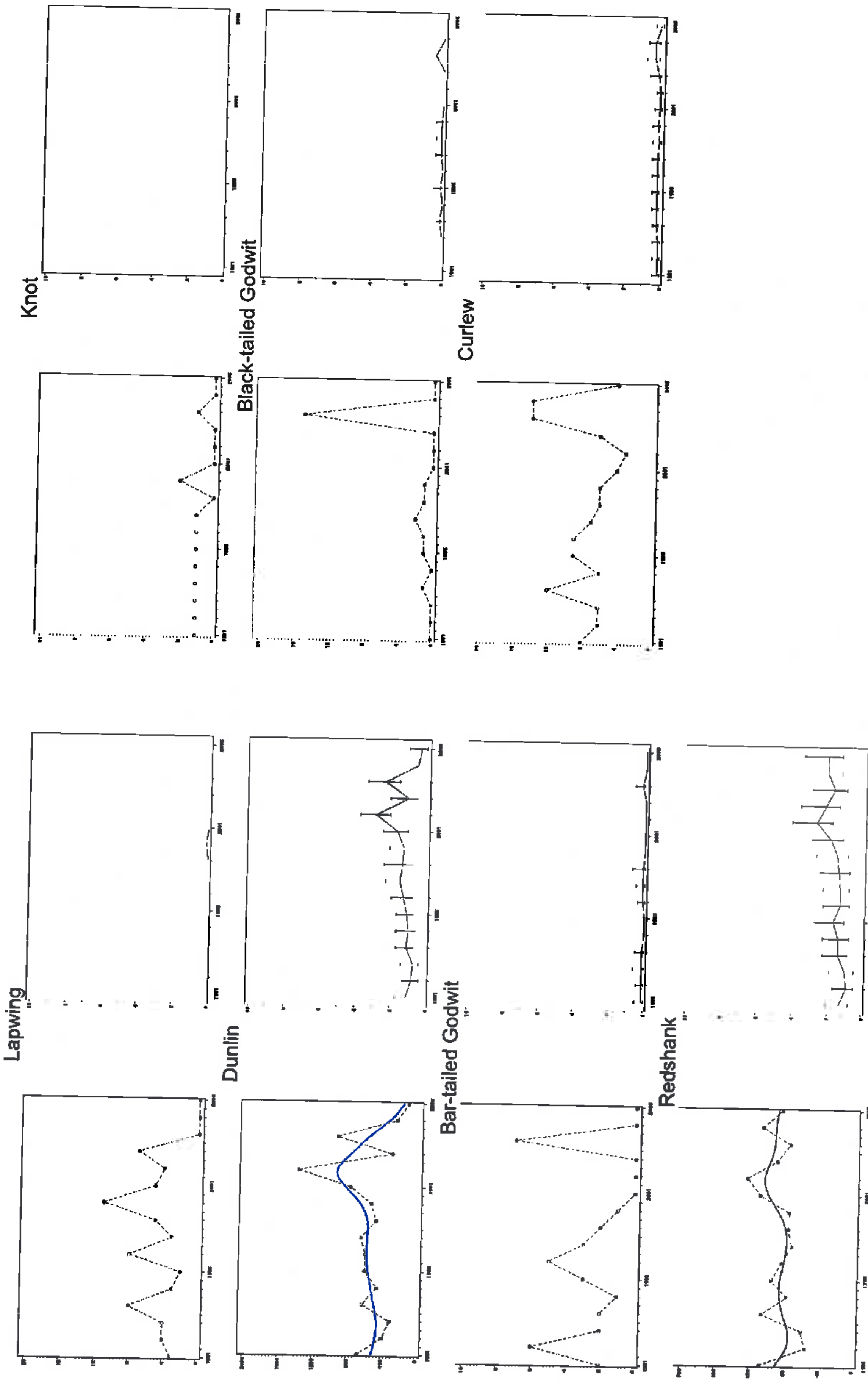

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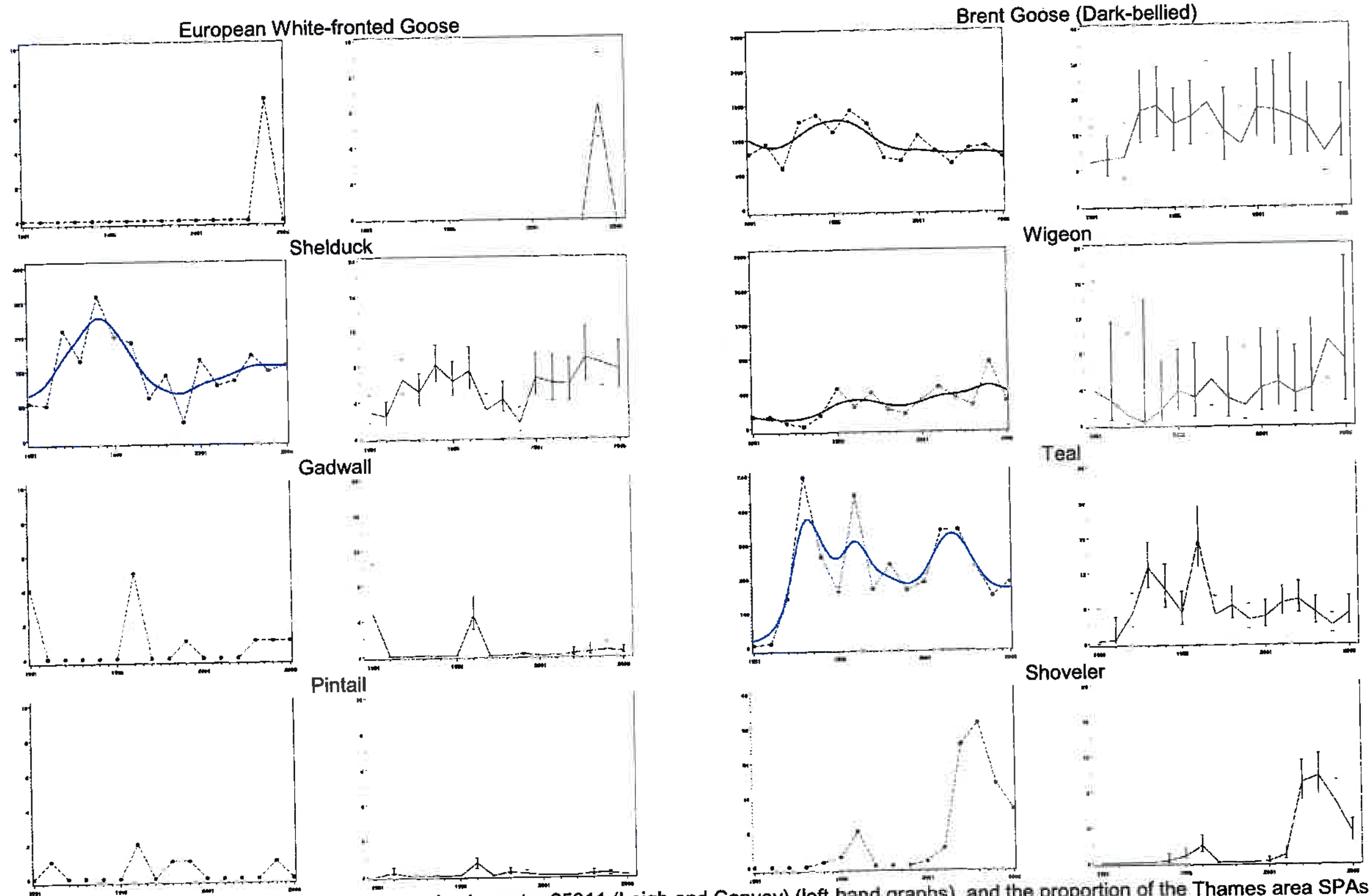
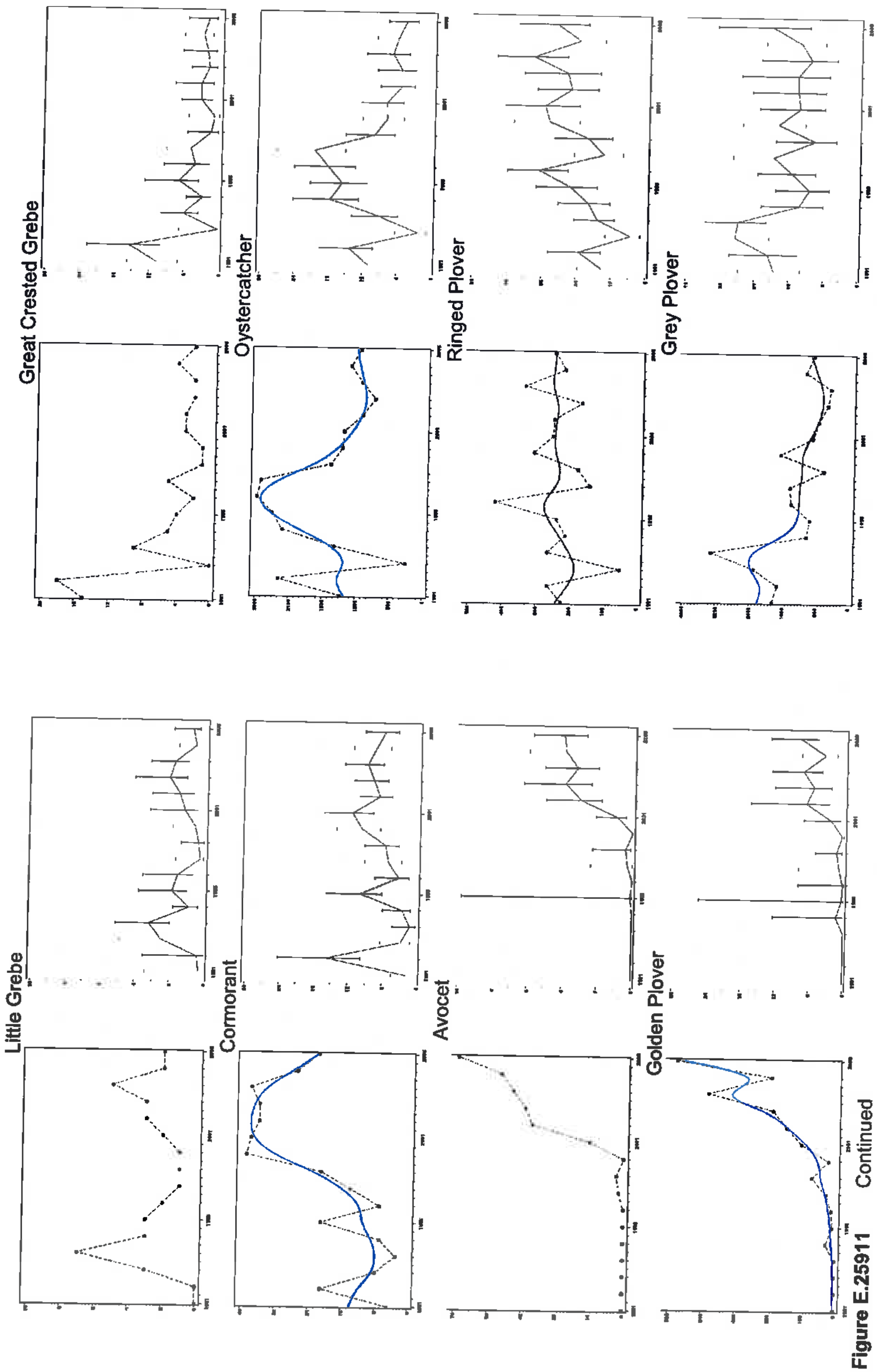


Figure E.25911 Population trends of each species in sector 25911 (Leigh and Canvey) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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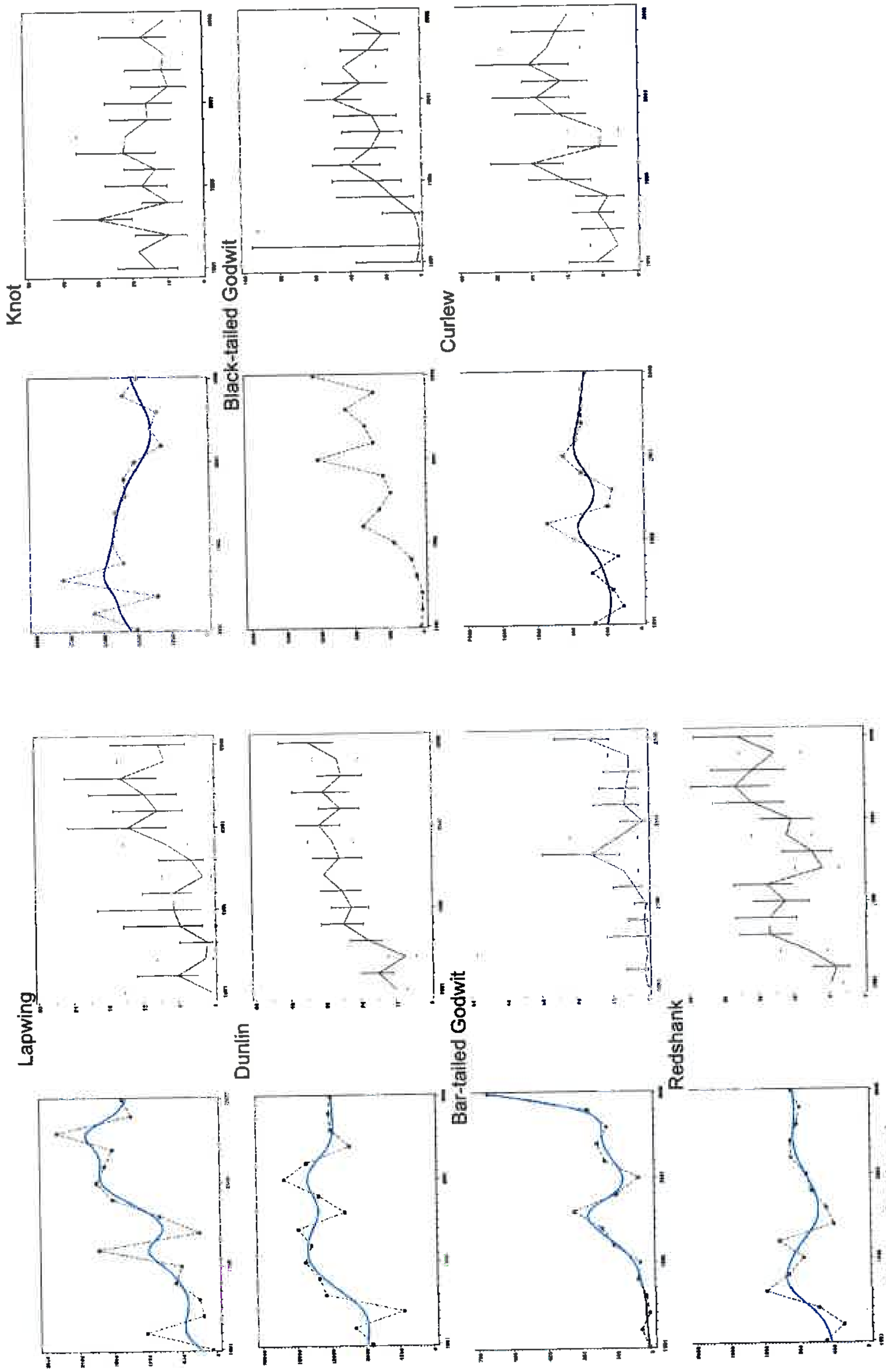

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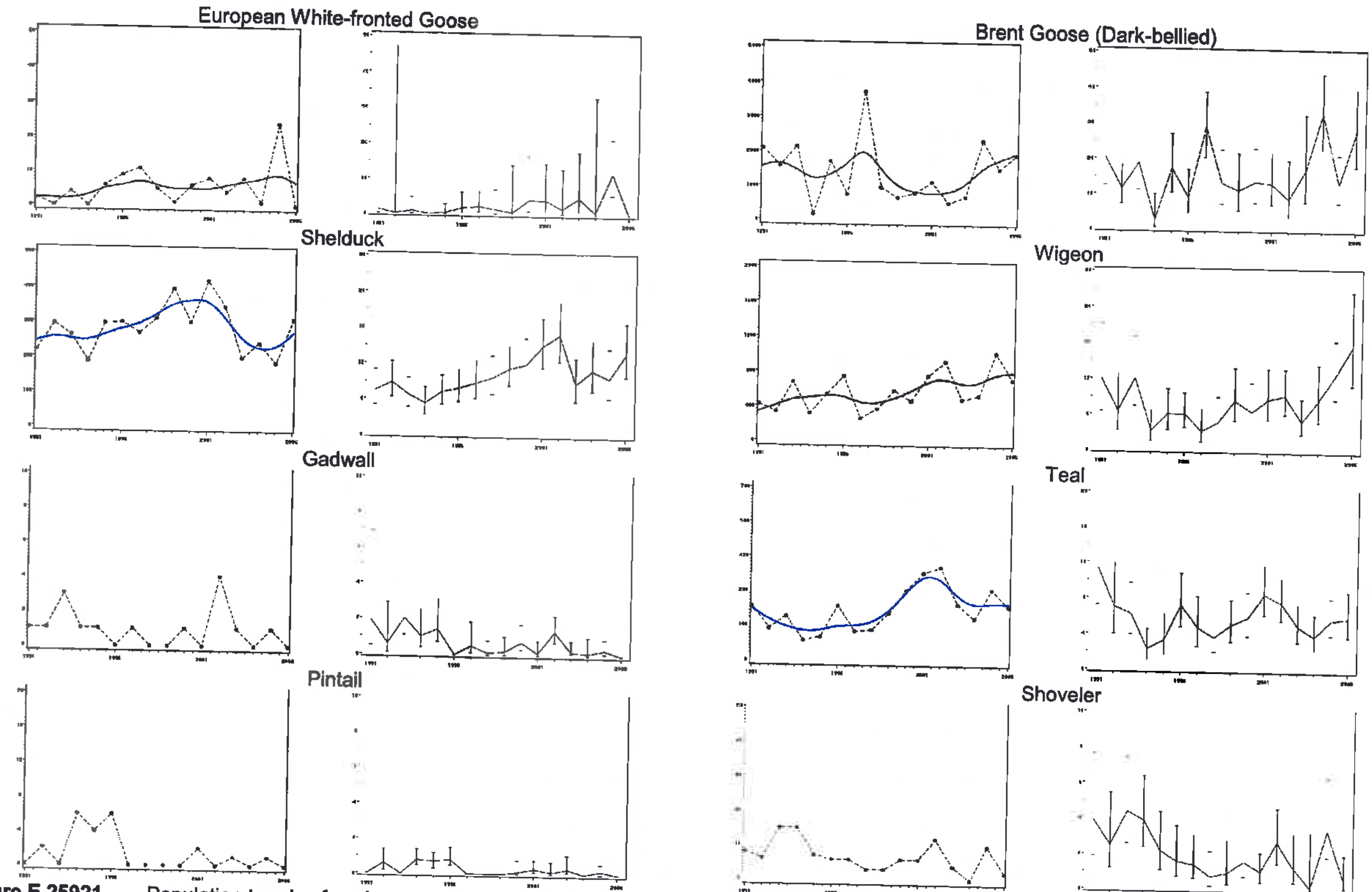
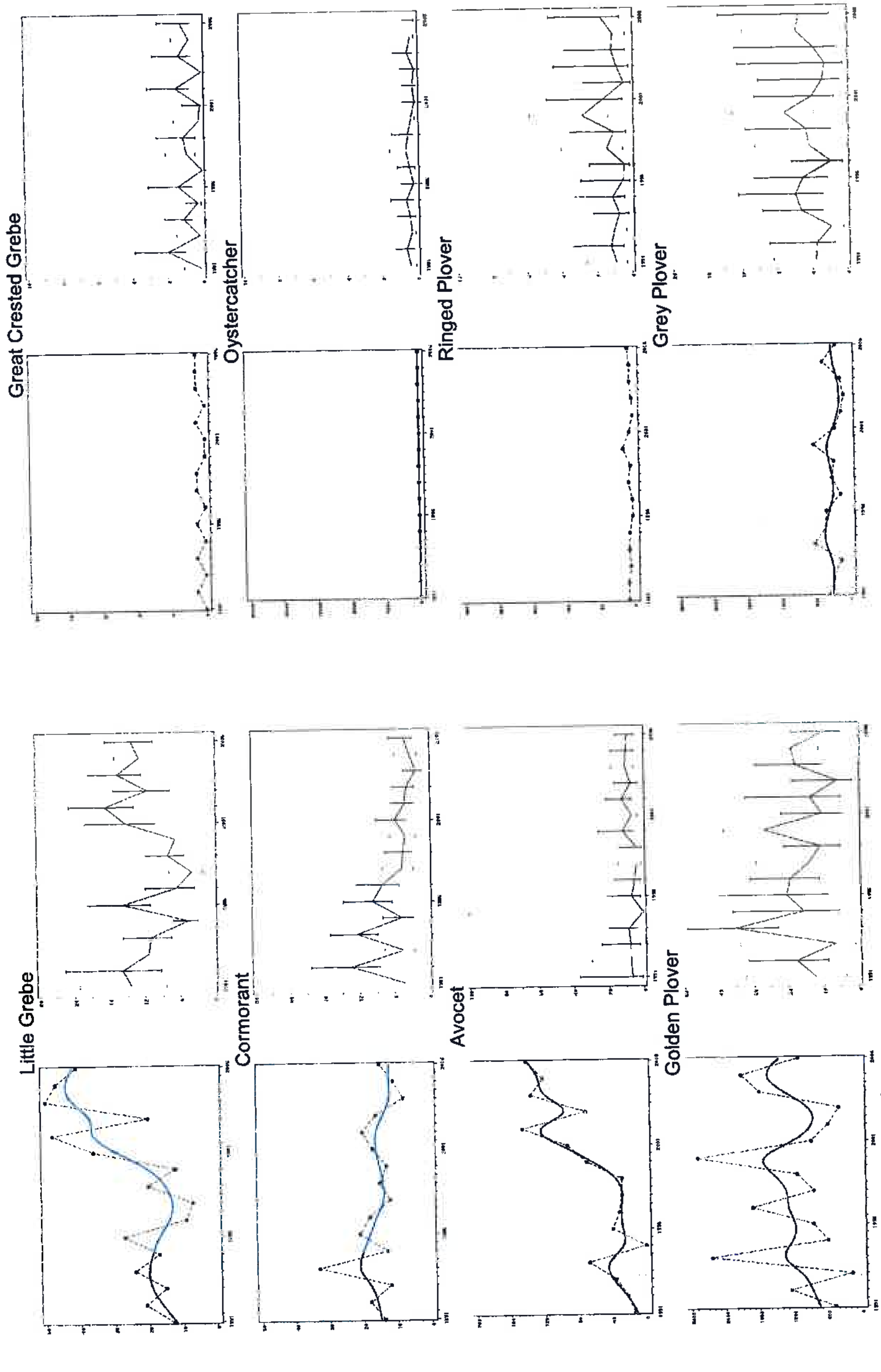


Figure E.25921 Population trends of each species in sector 25921 (Crouchside) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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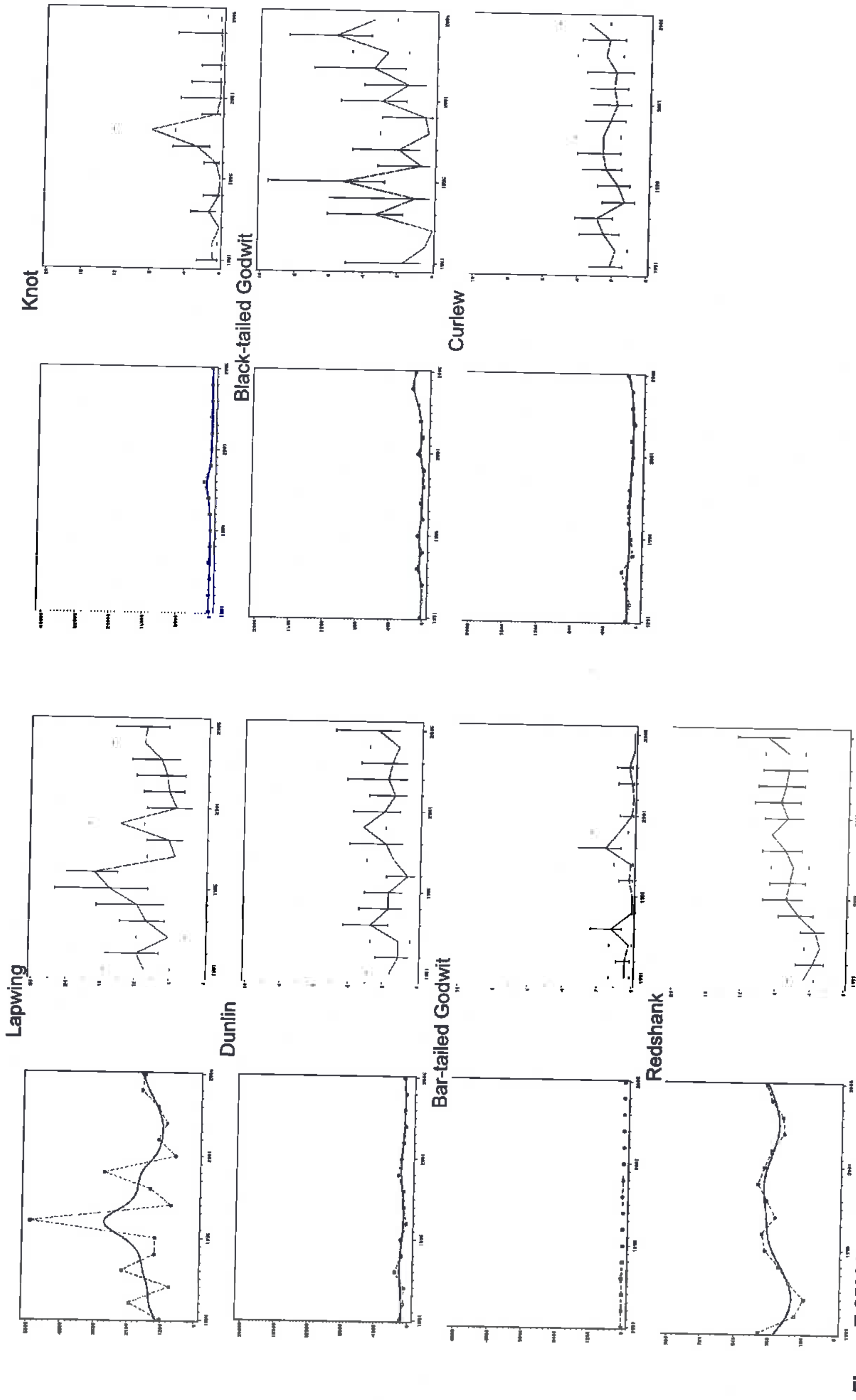

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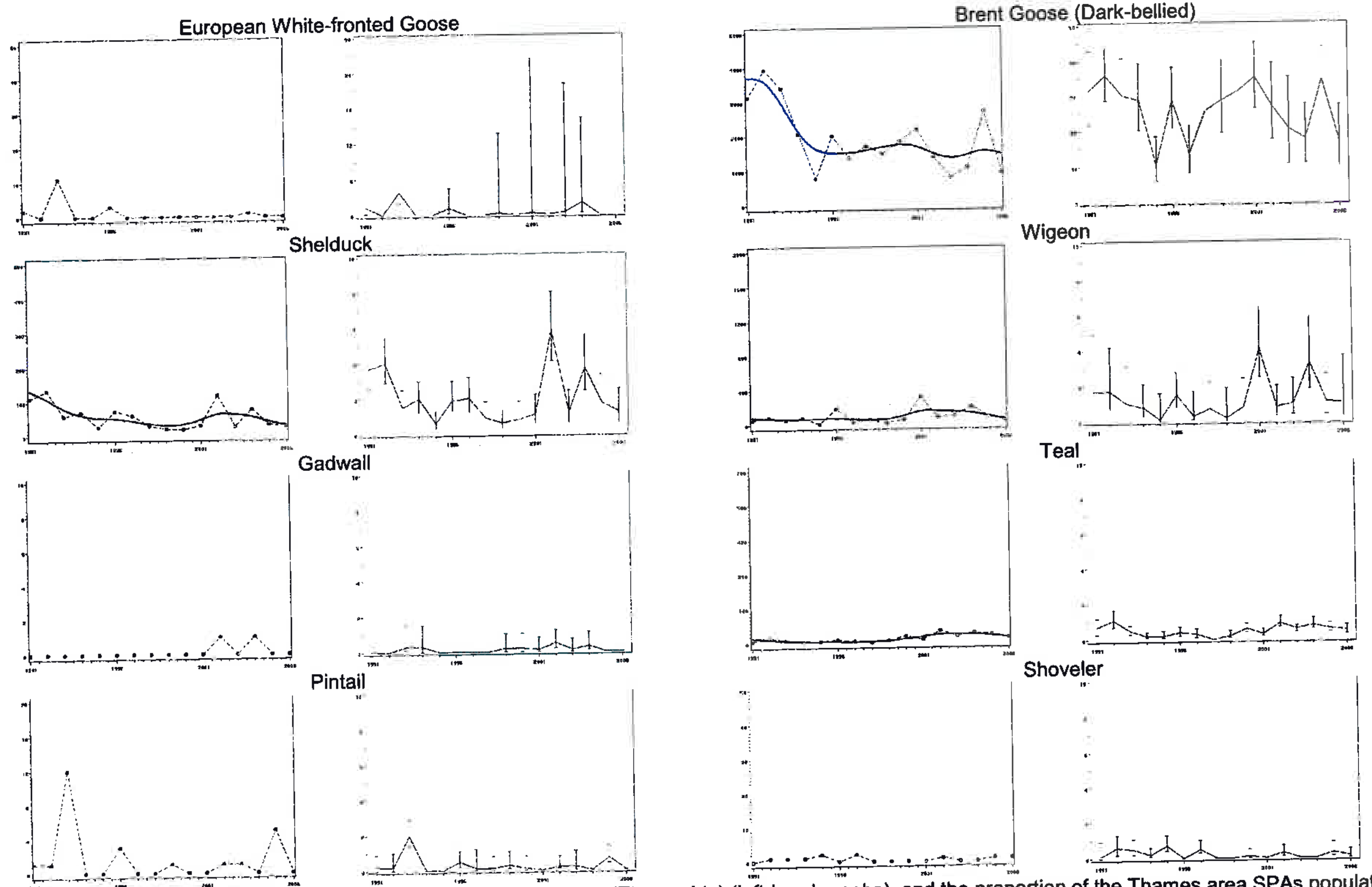
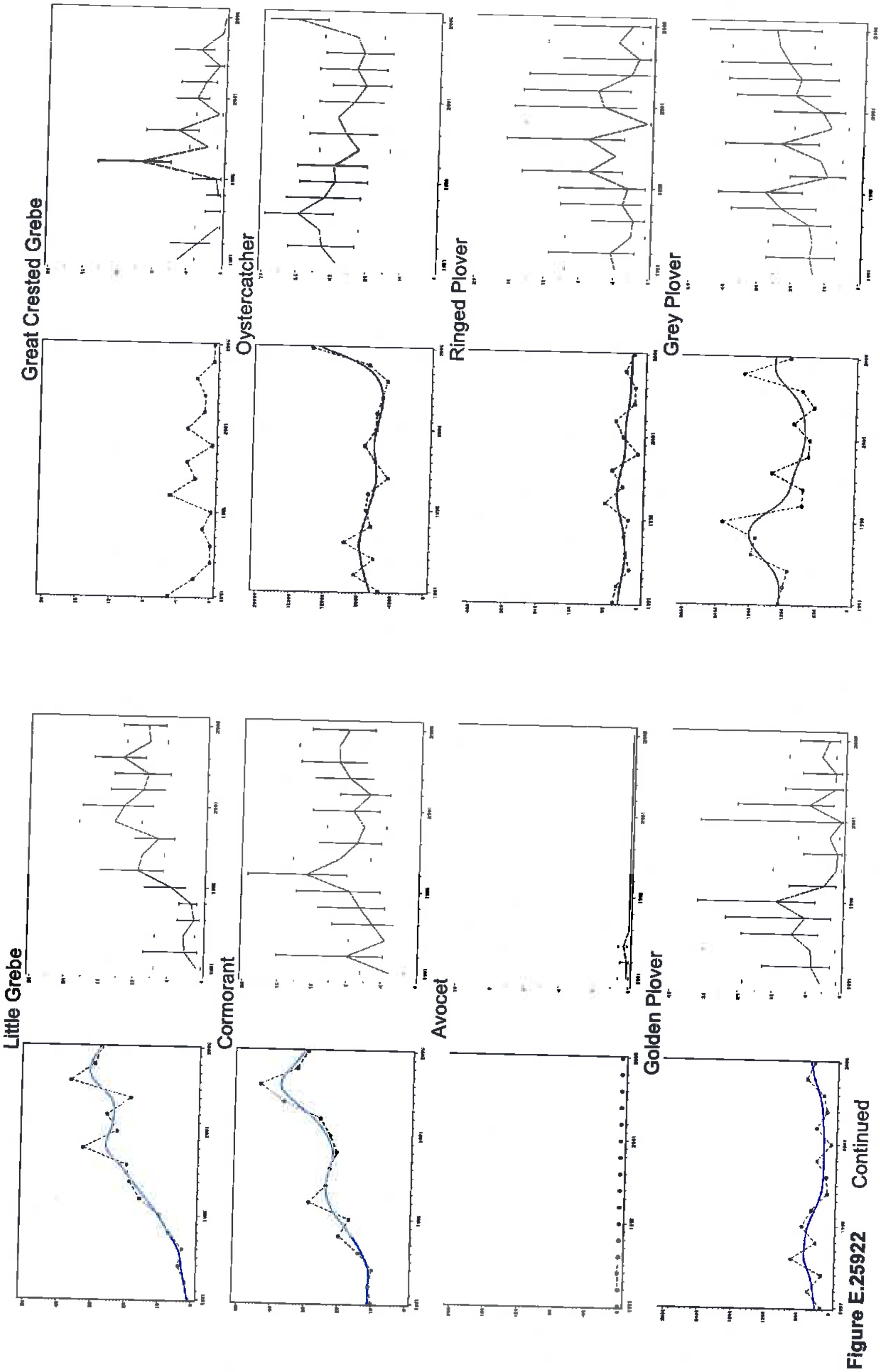


Figure E.25922 Population trends of each species in sector 25922 (Thameside) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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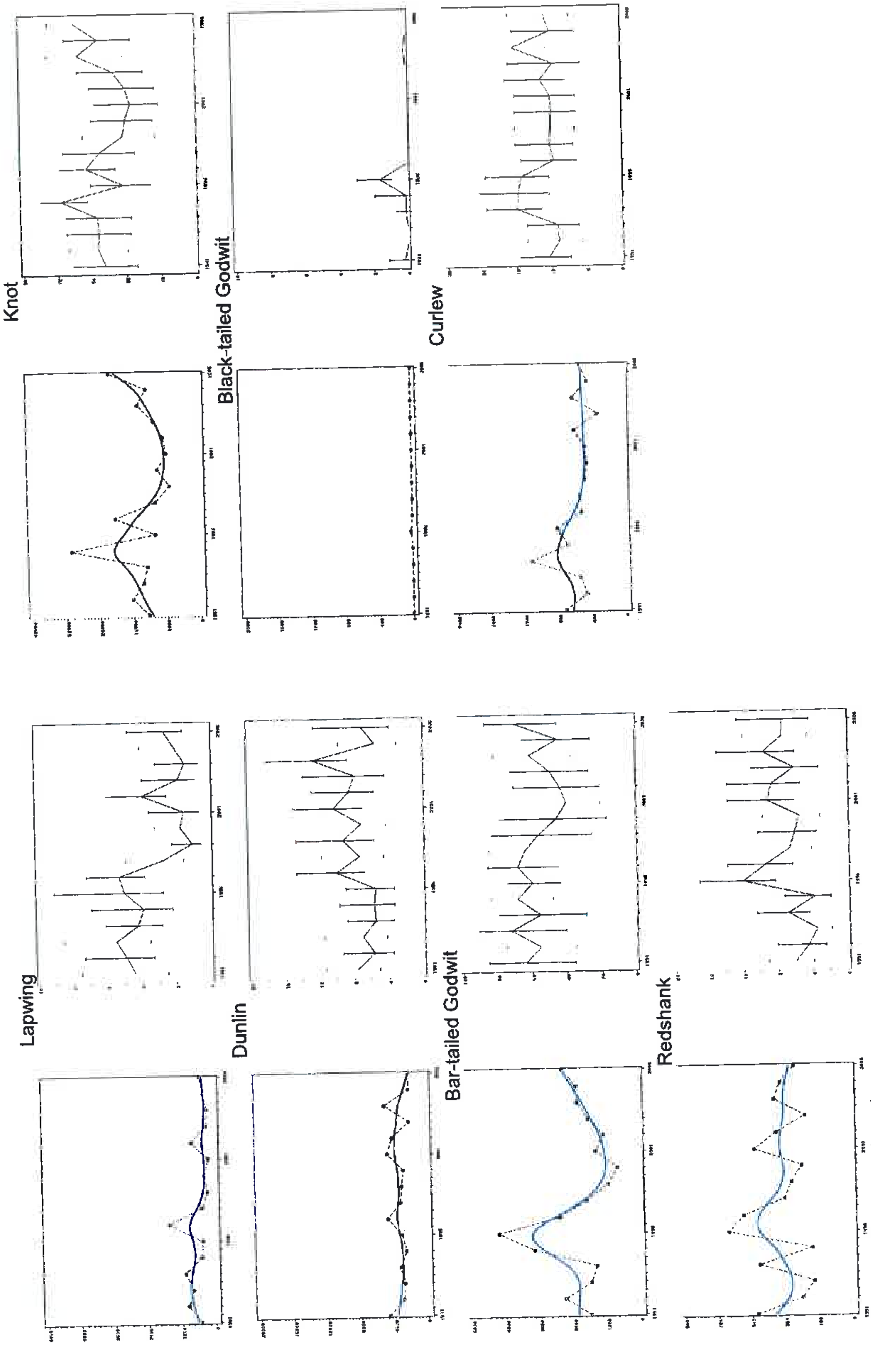

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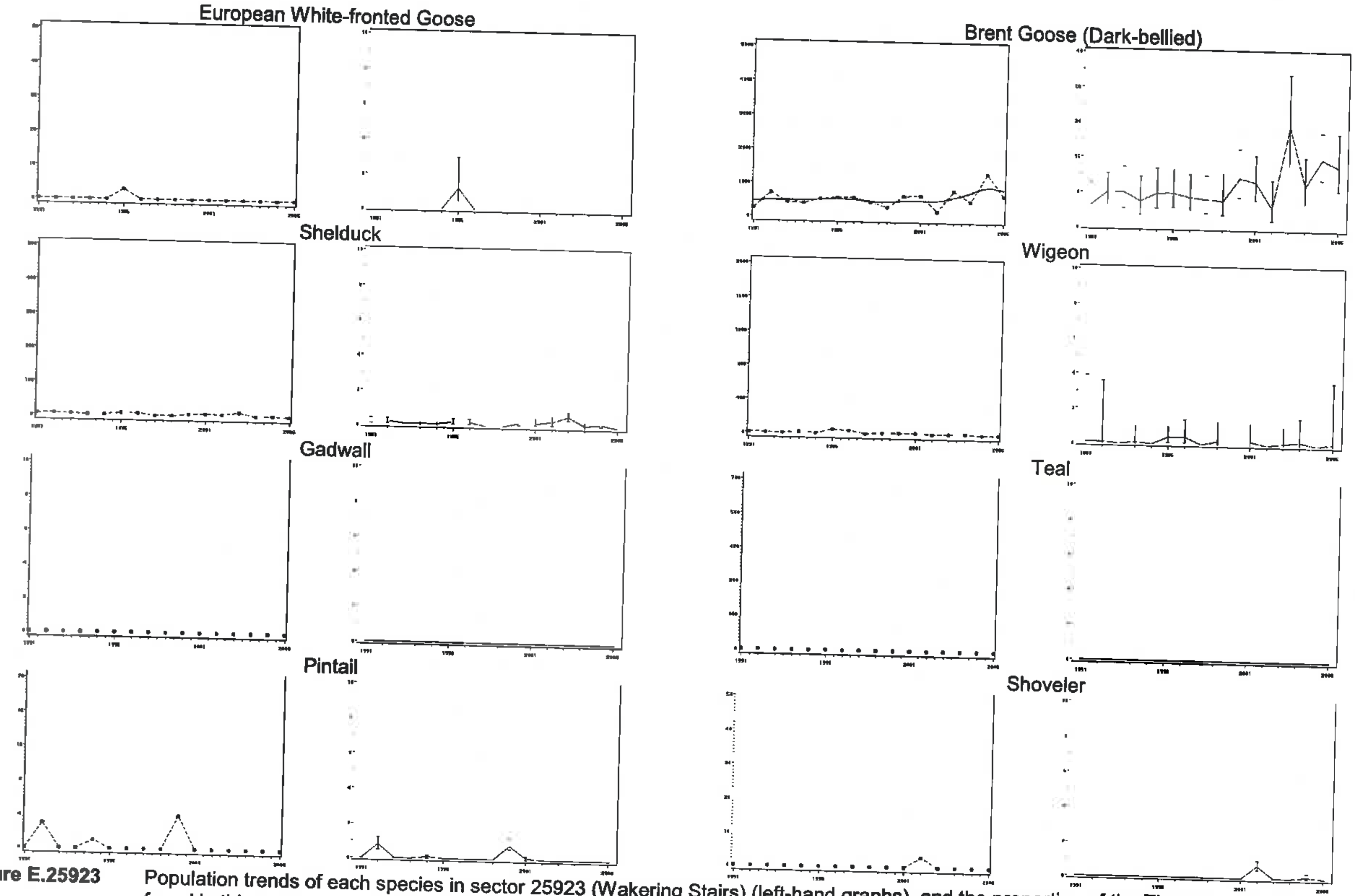
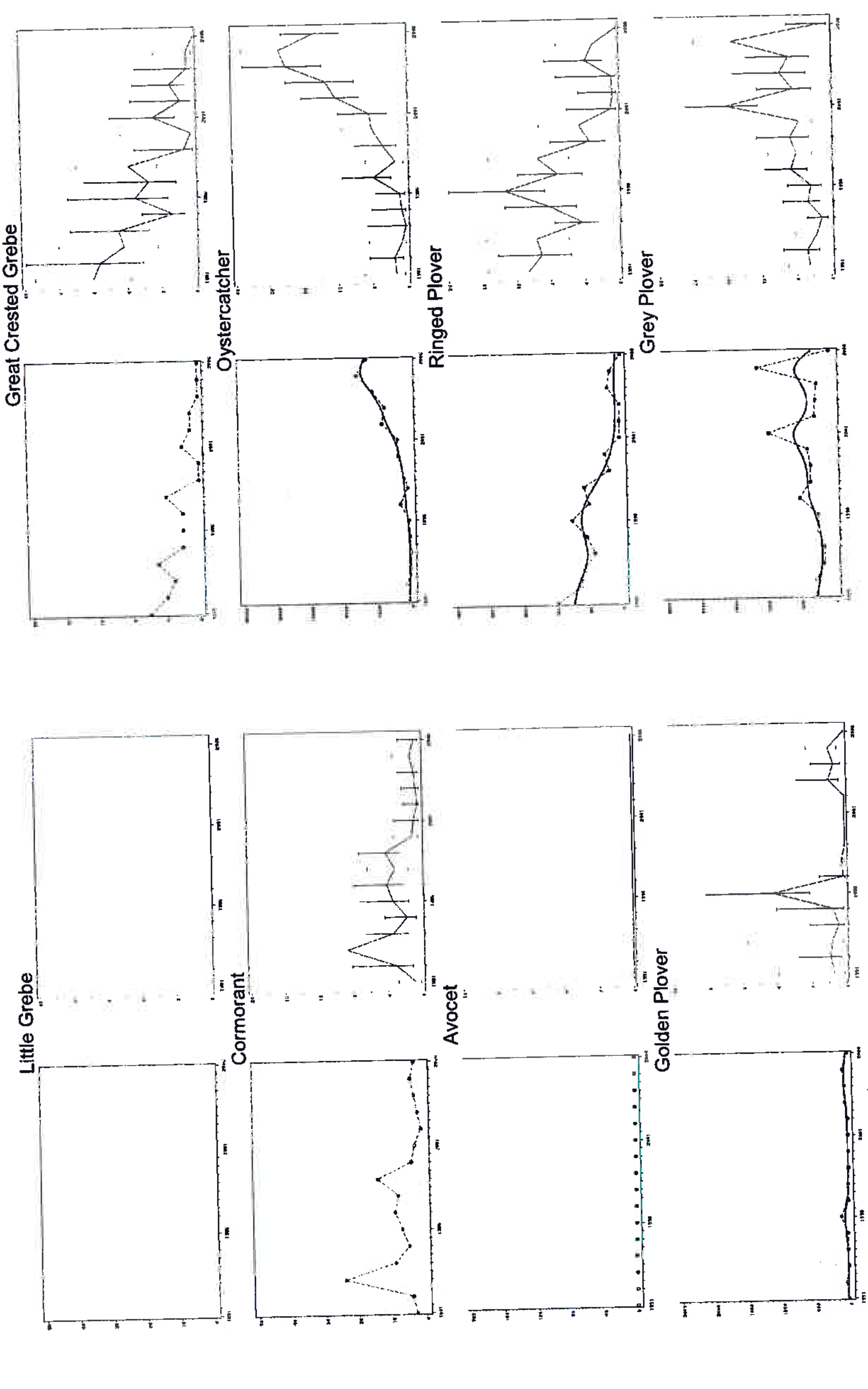


Figure E.25923 Population trends of each species in sector 25923 (Wakering Stairs) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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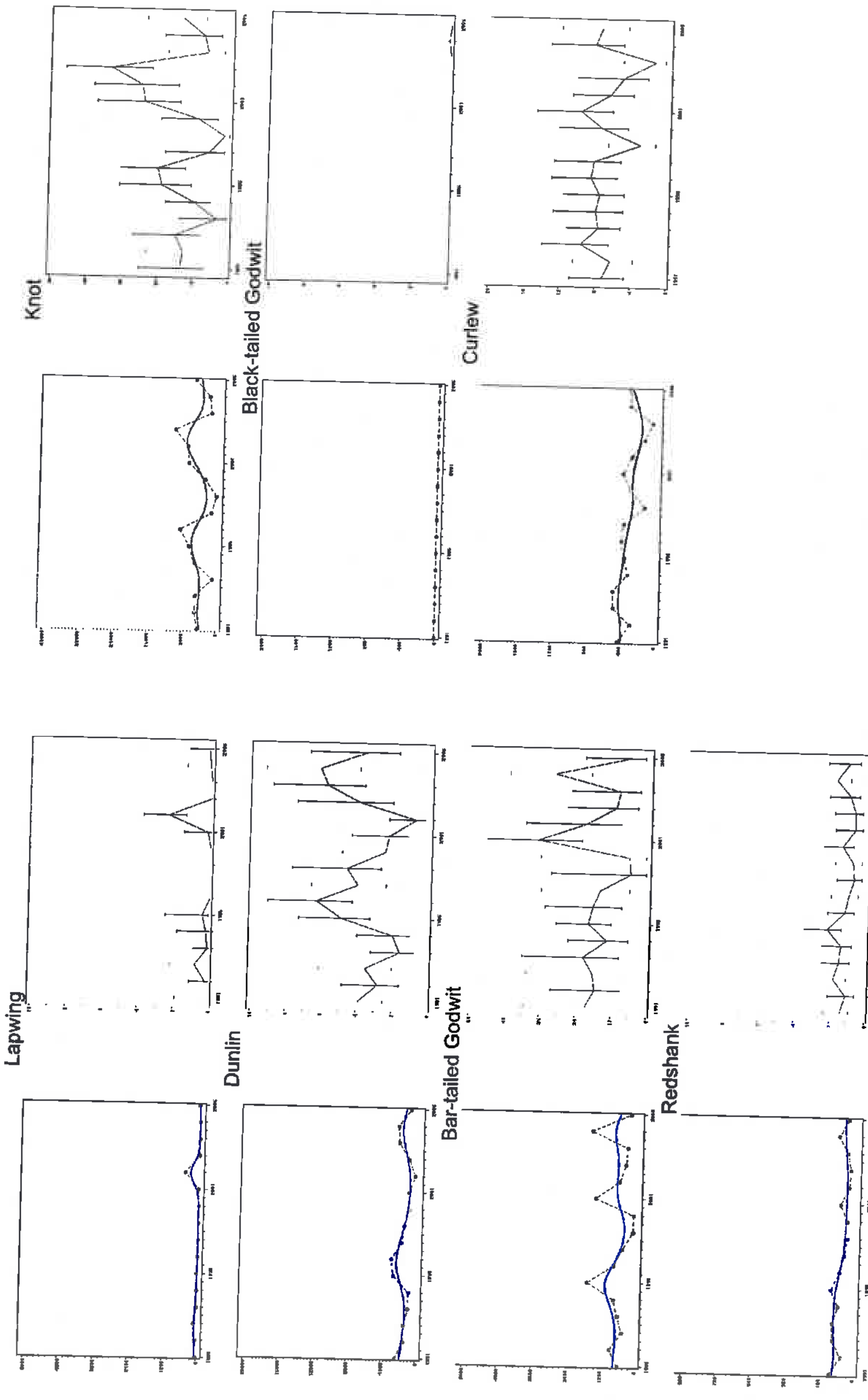

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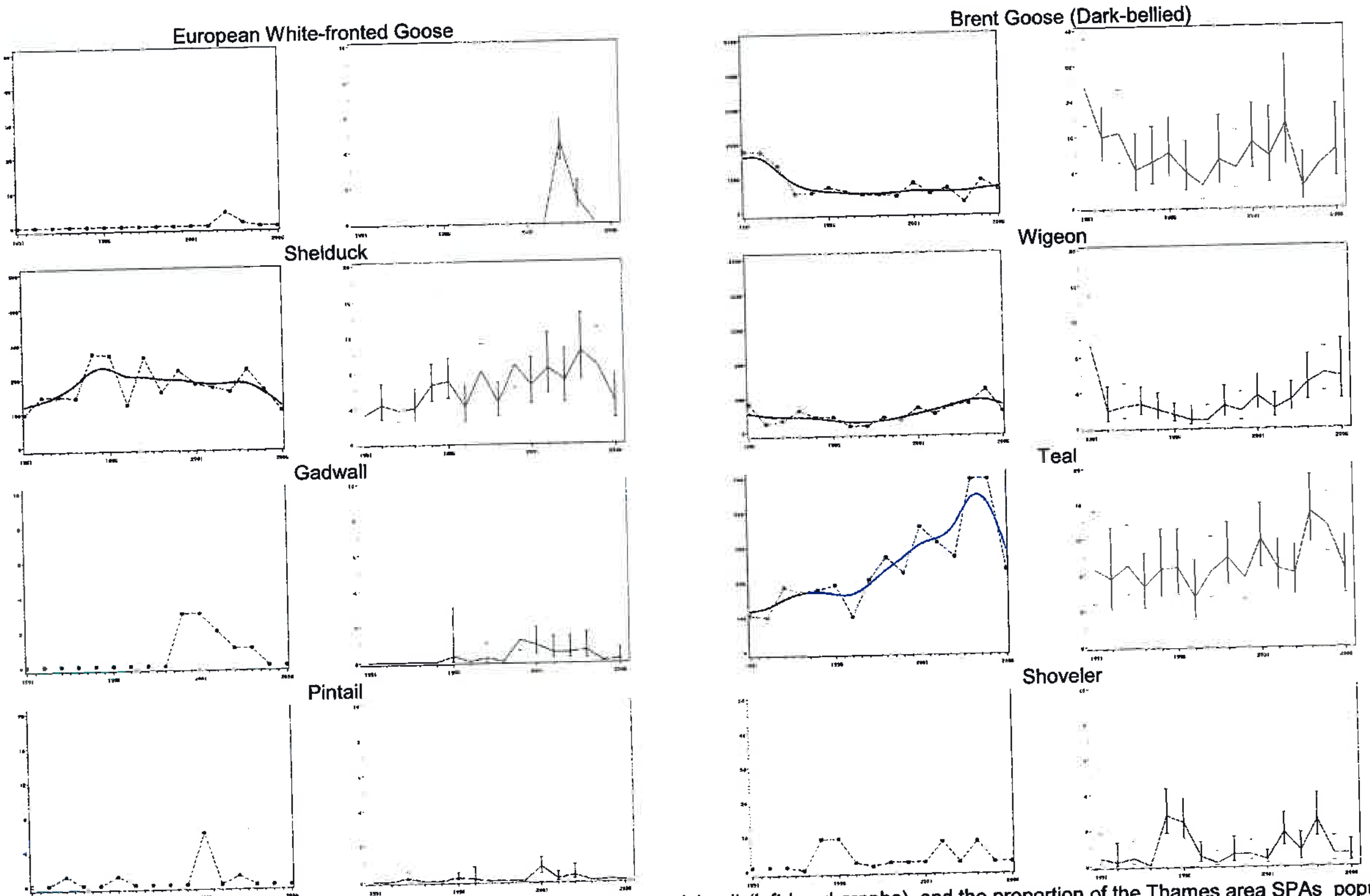
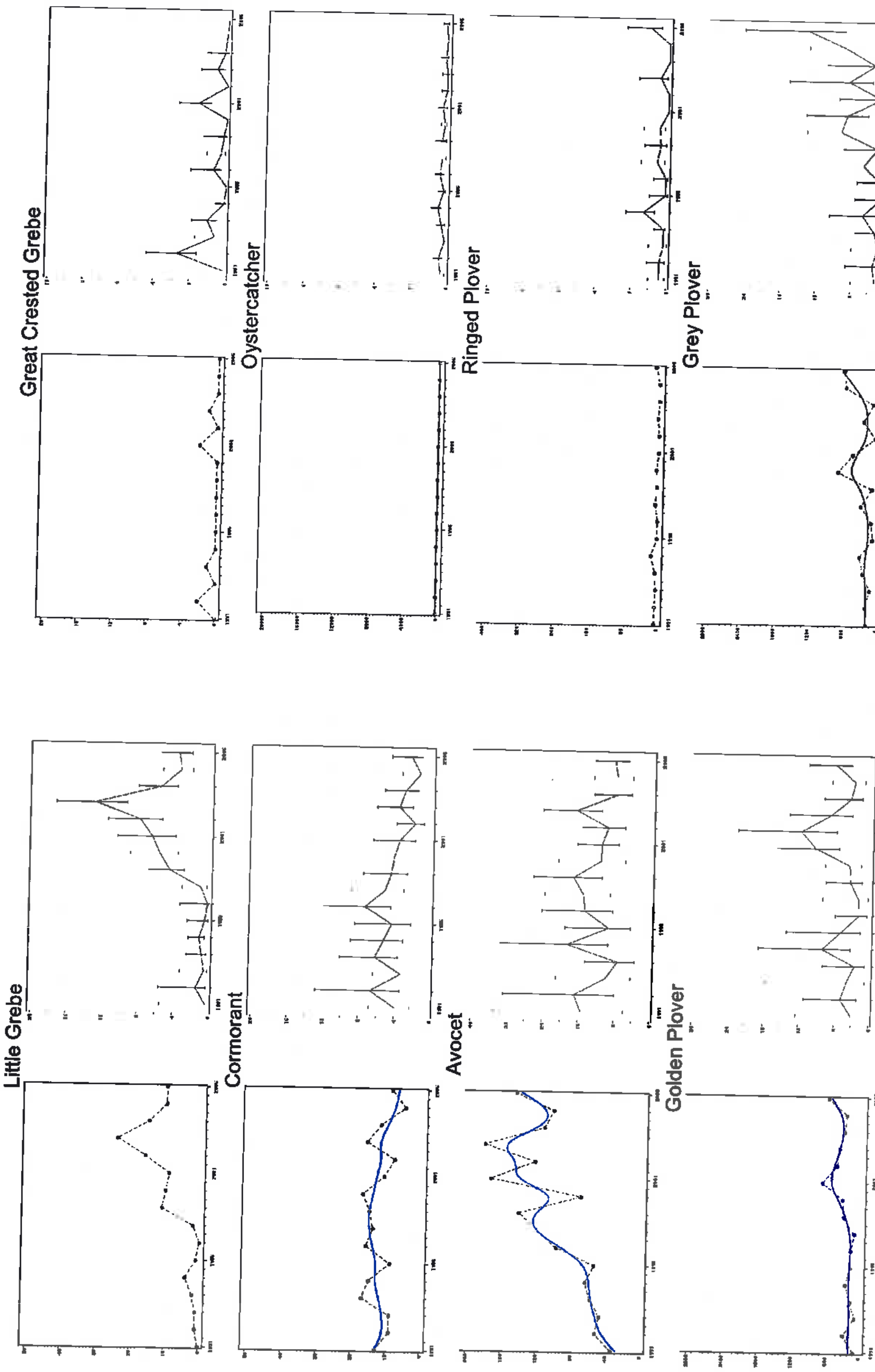


Figure E.25924 Population trends of each species in sector 25924 (Potton Island) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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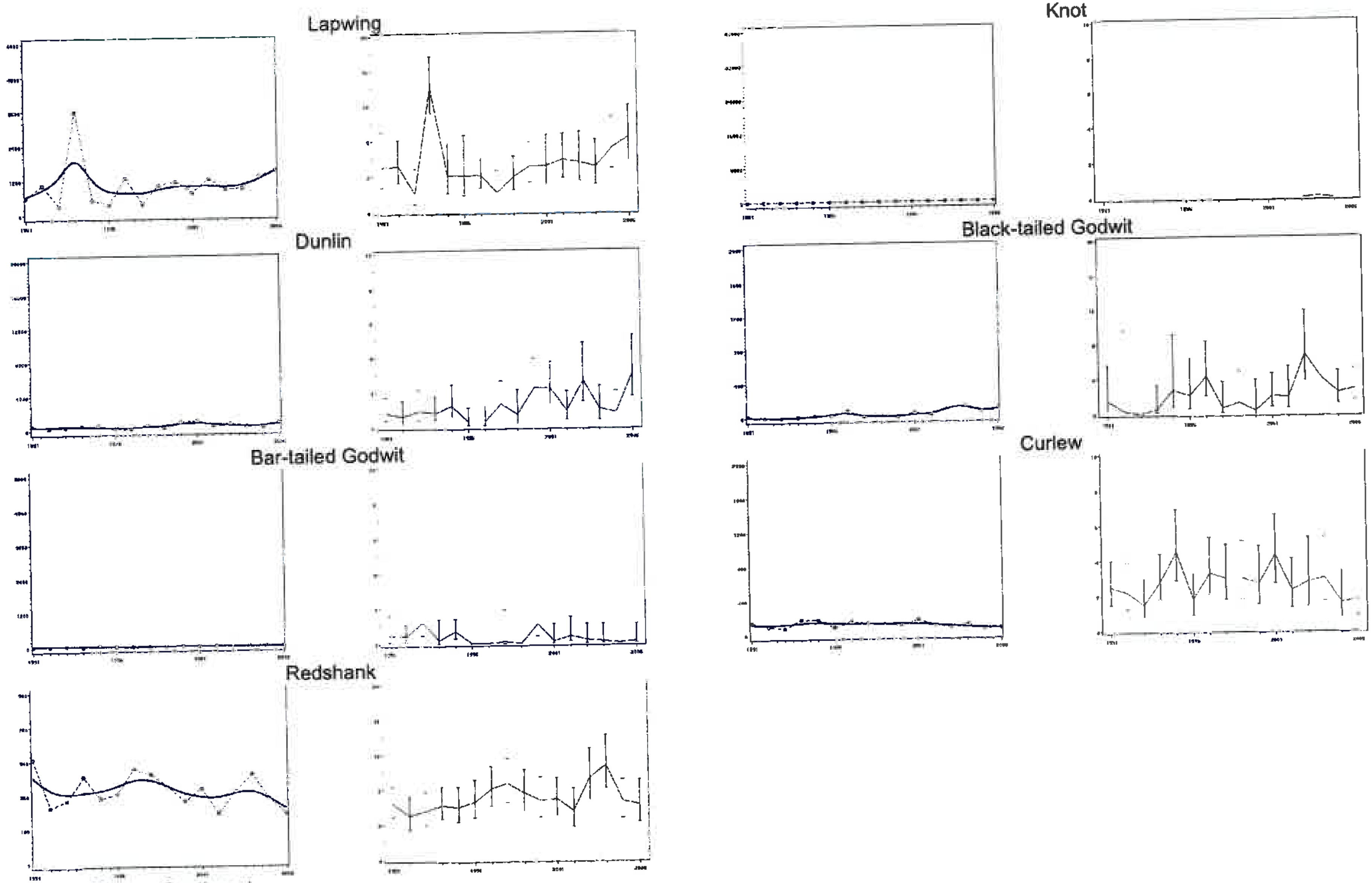

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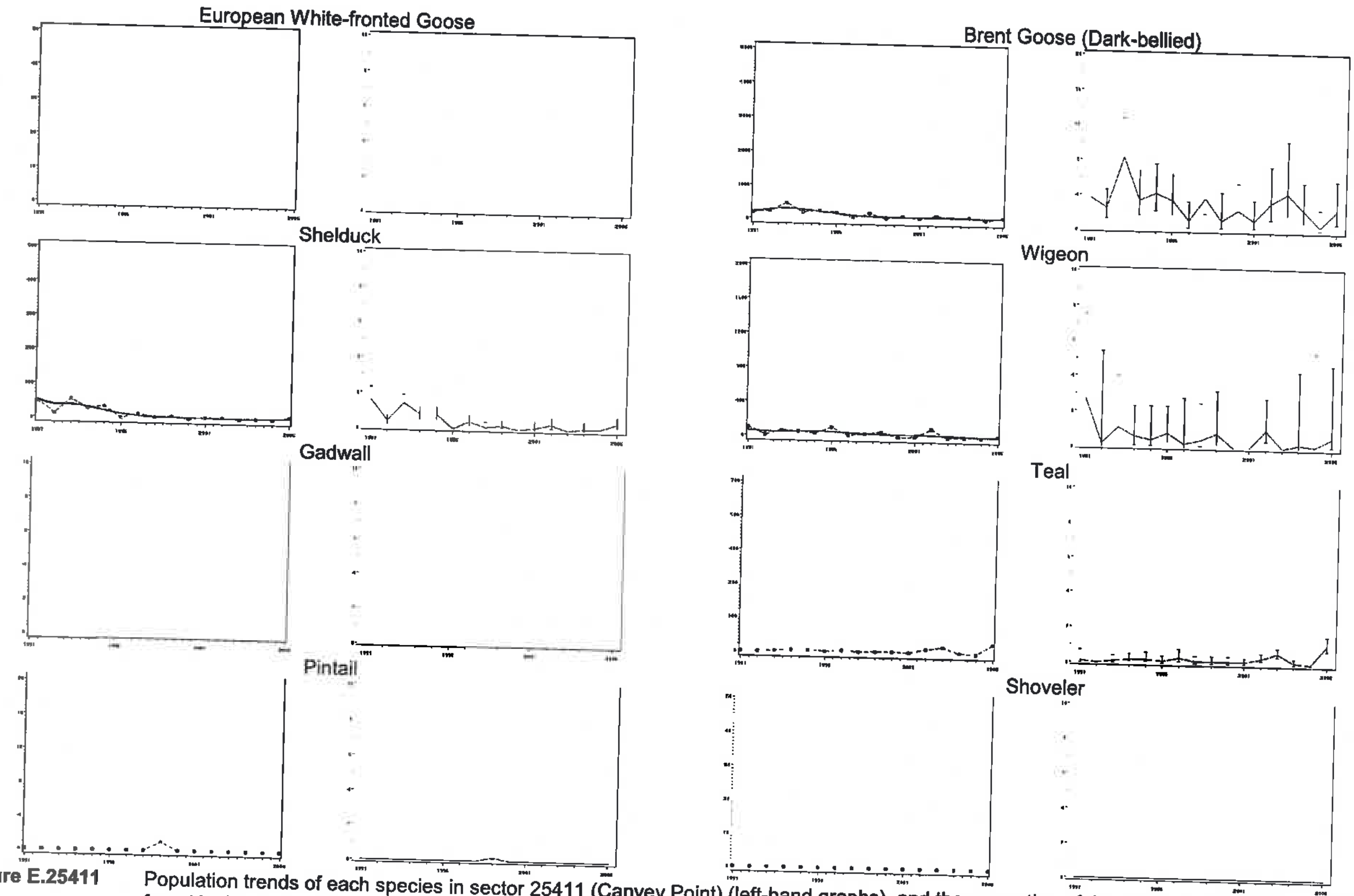
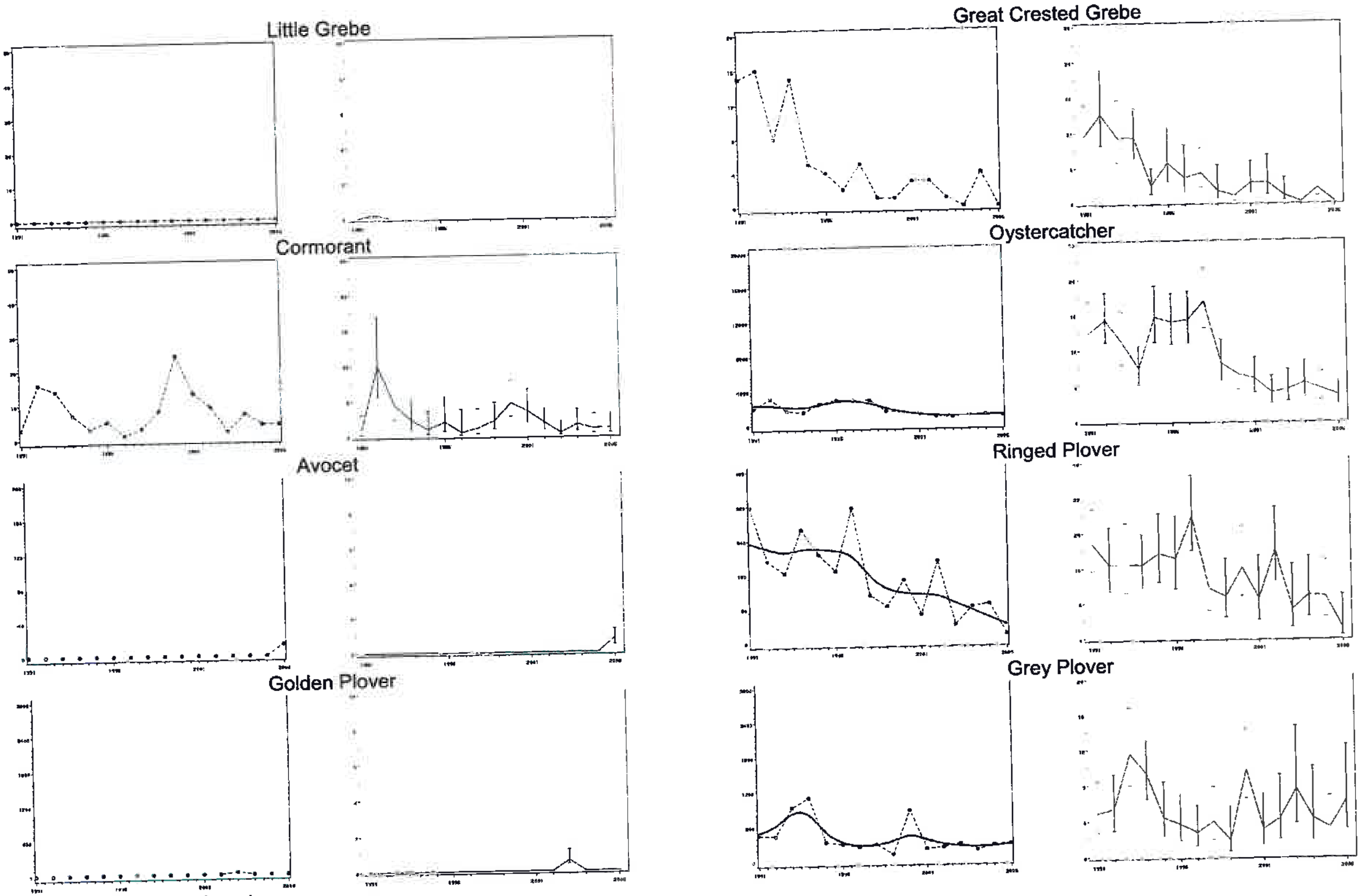


Figure E.25411 Population trends of each species in sector 25411 (Canvey Point) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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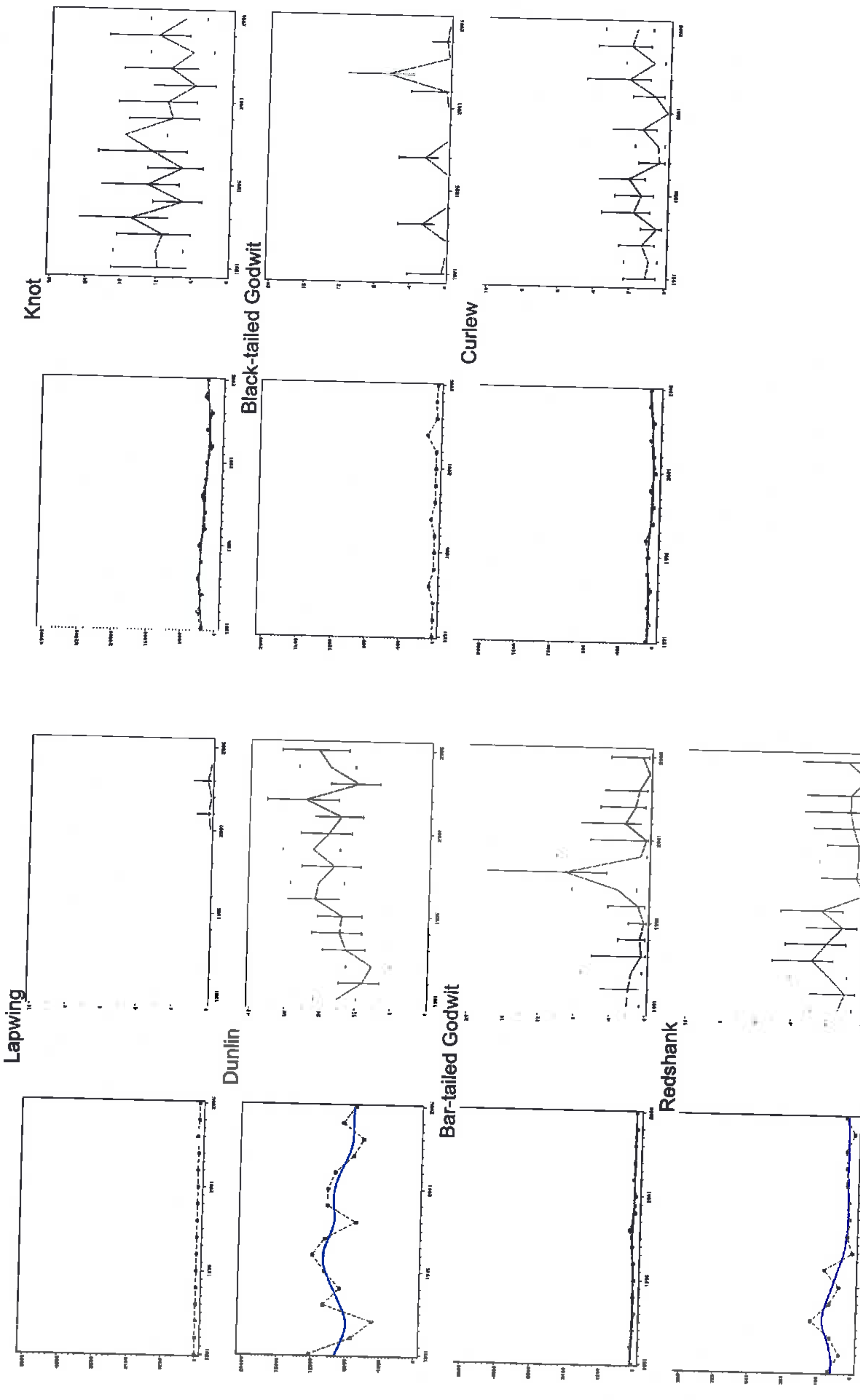

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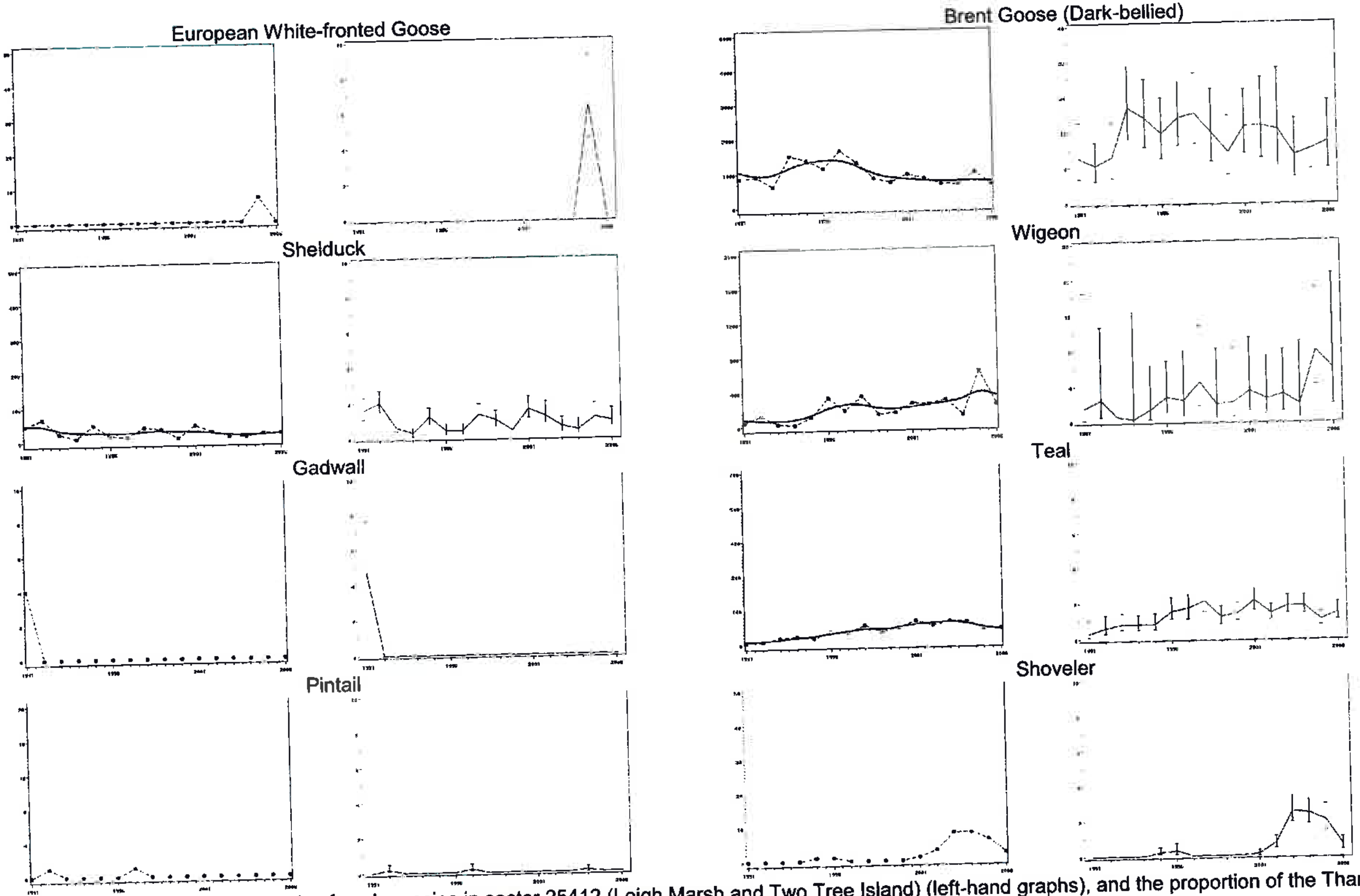
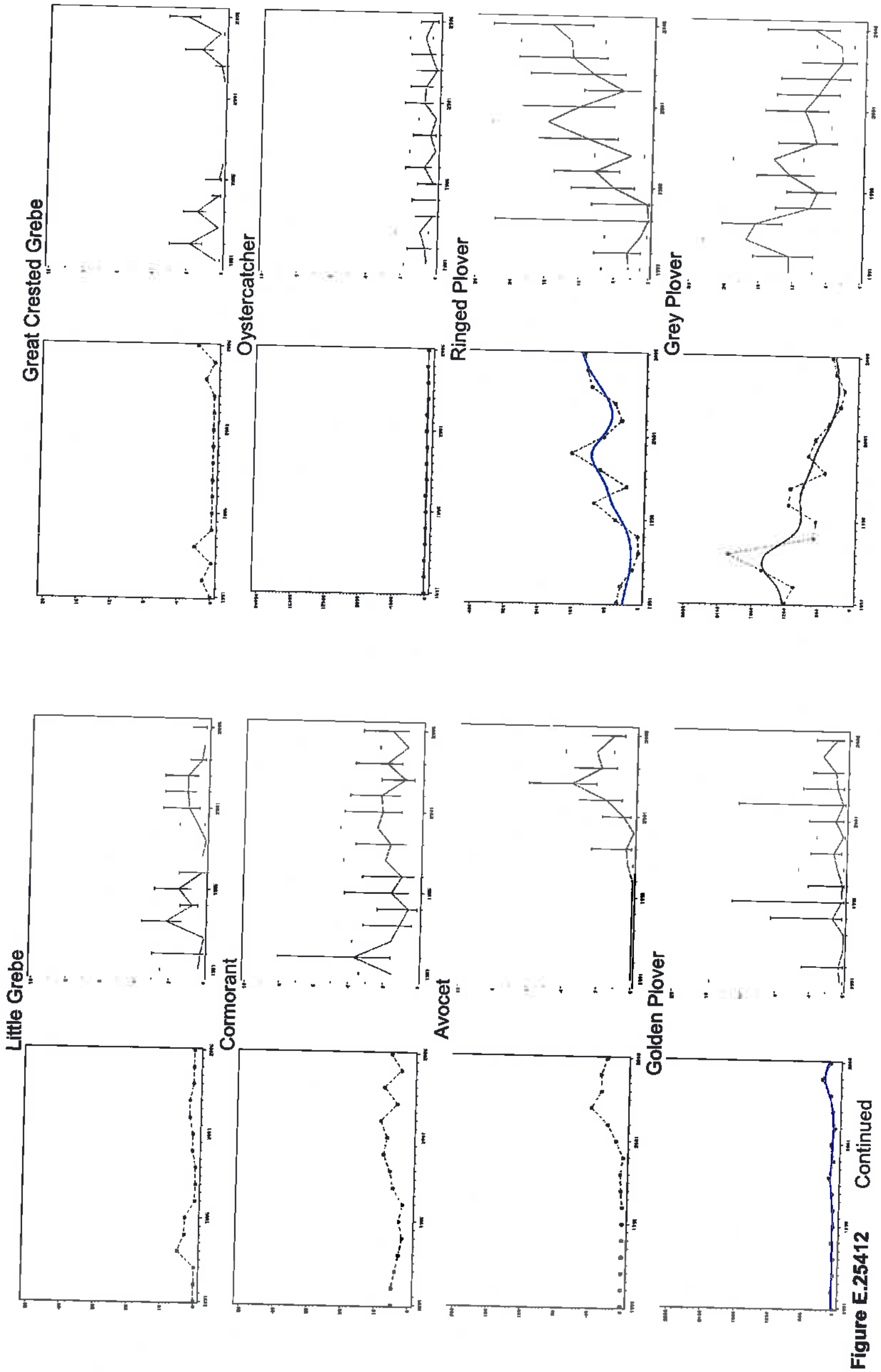


Figure E.25412 Population trends of each species in sector 25412 (Leigh Marsh and Two Tree Island) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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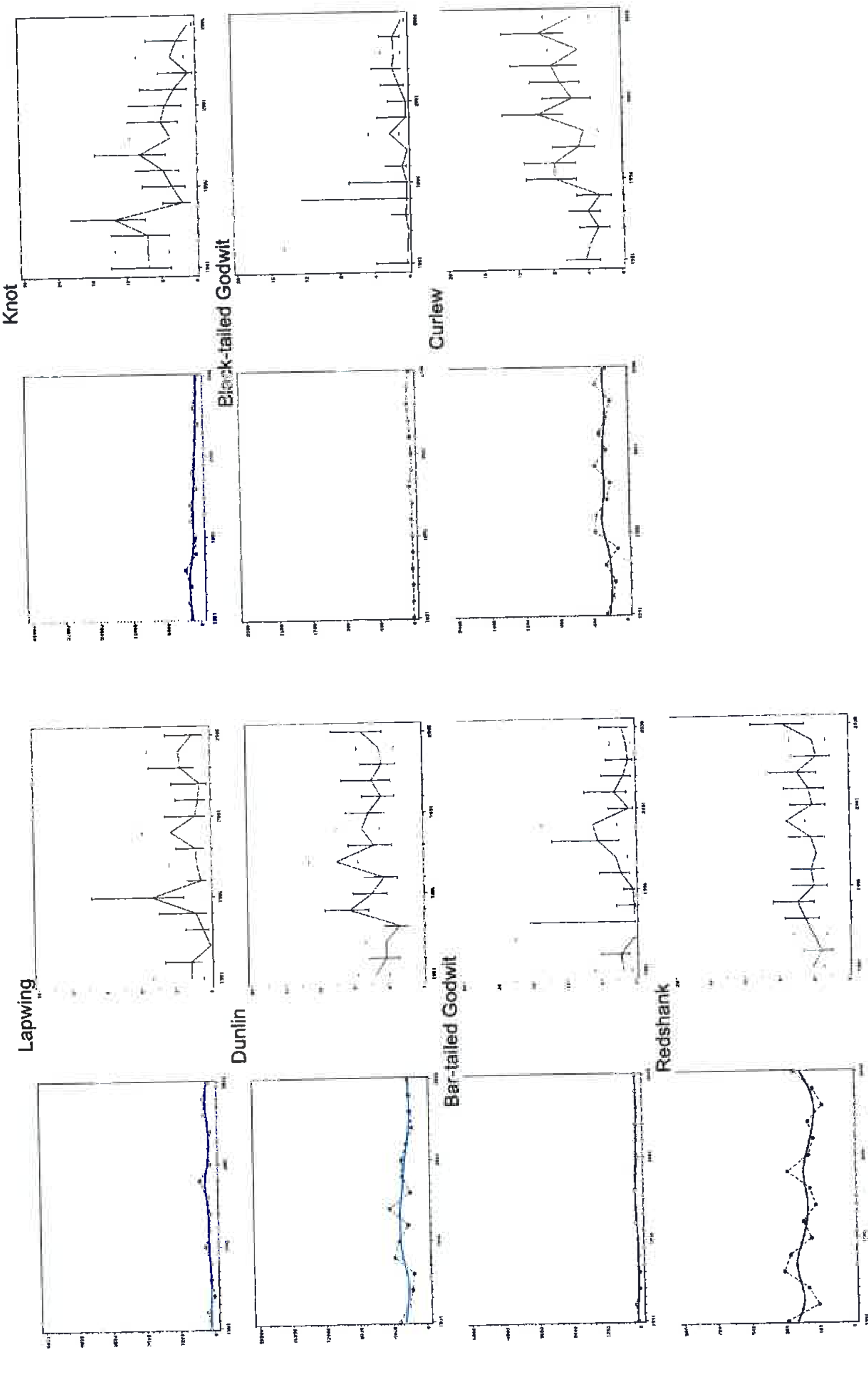

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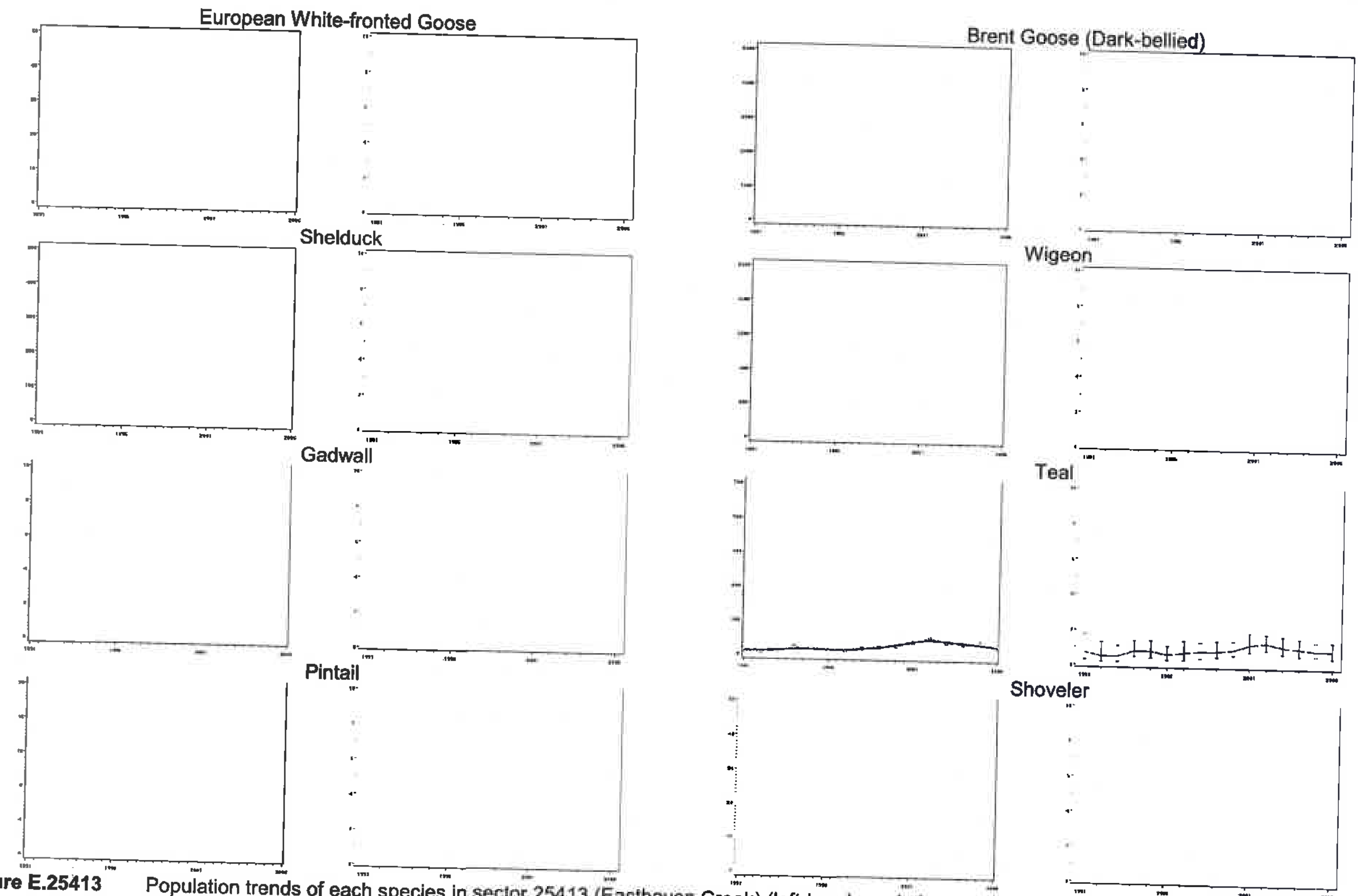
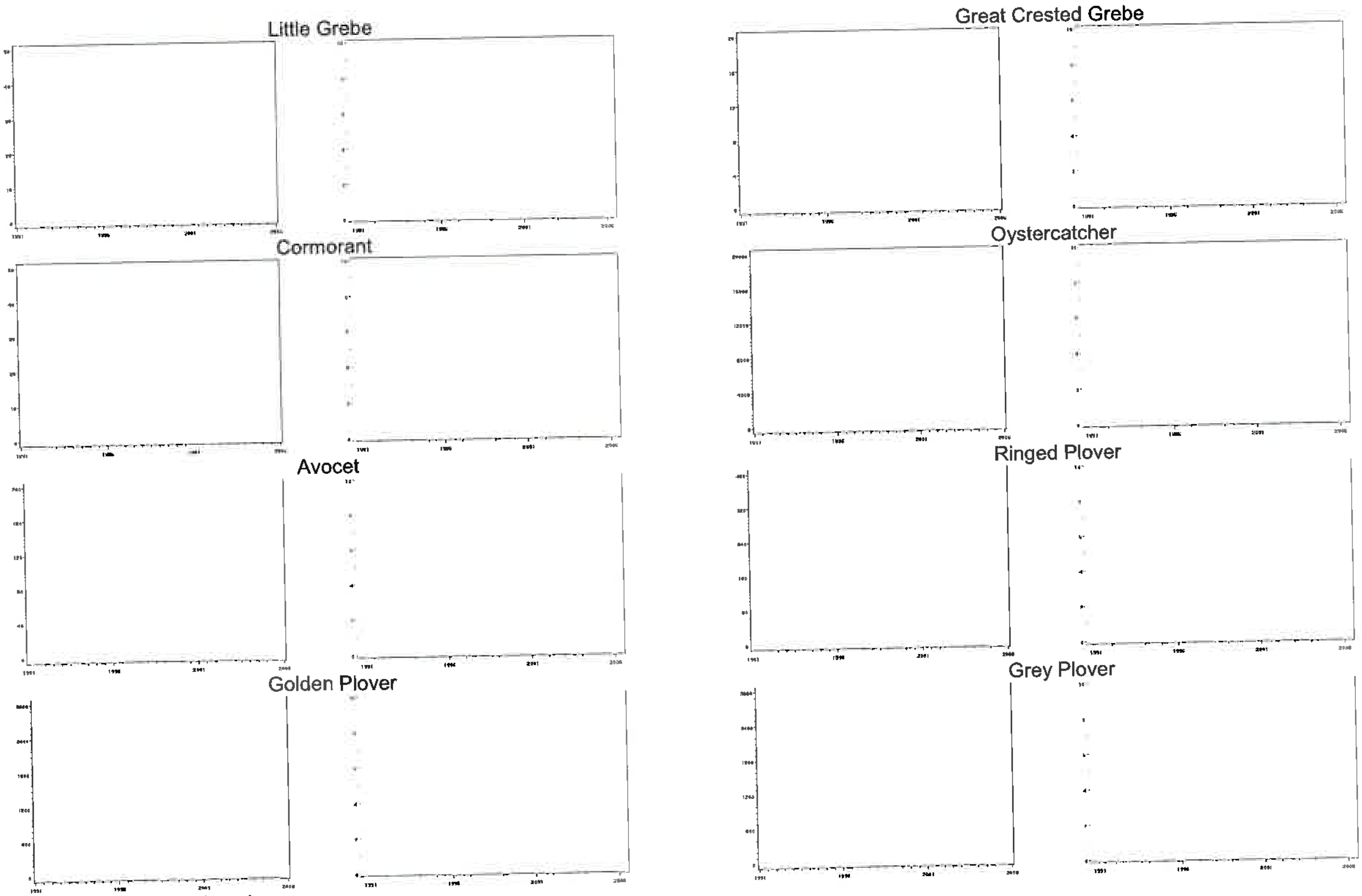


Figure E.25413 Population trends of each species in sector 25413 (Easthaven Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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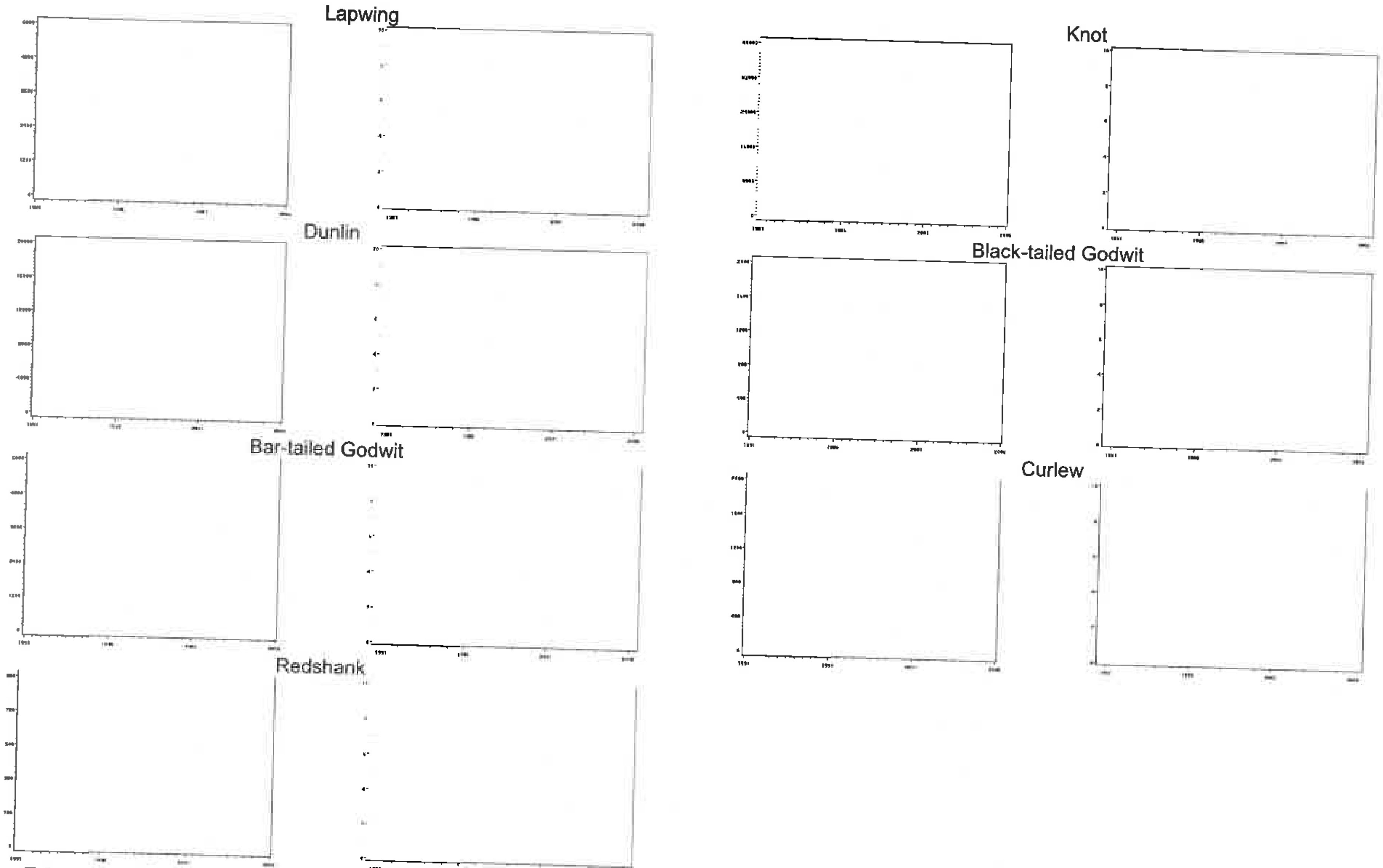

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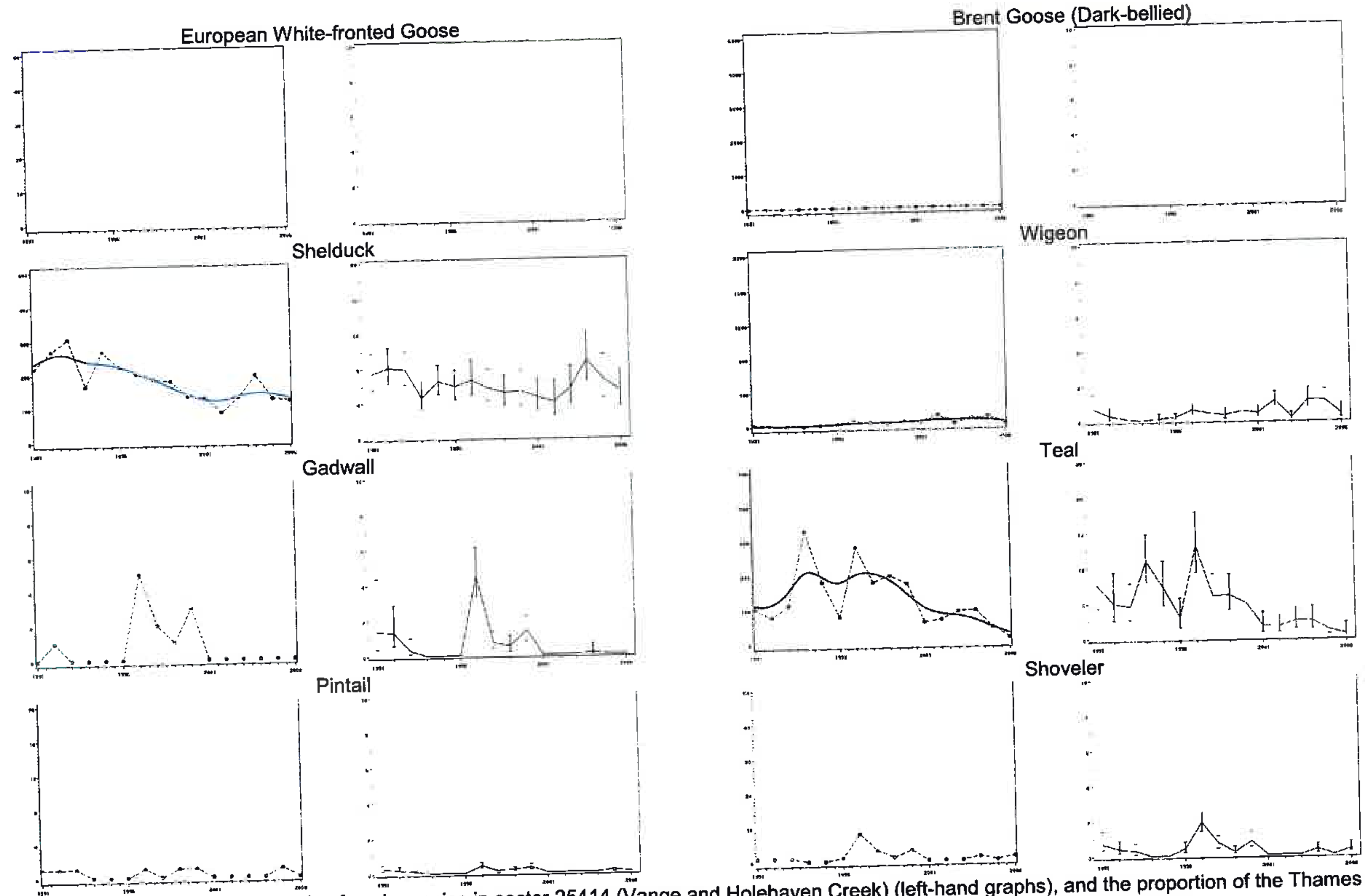
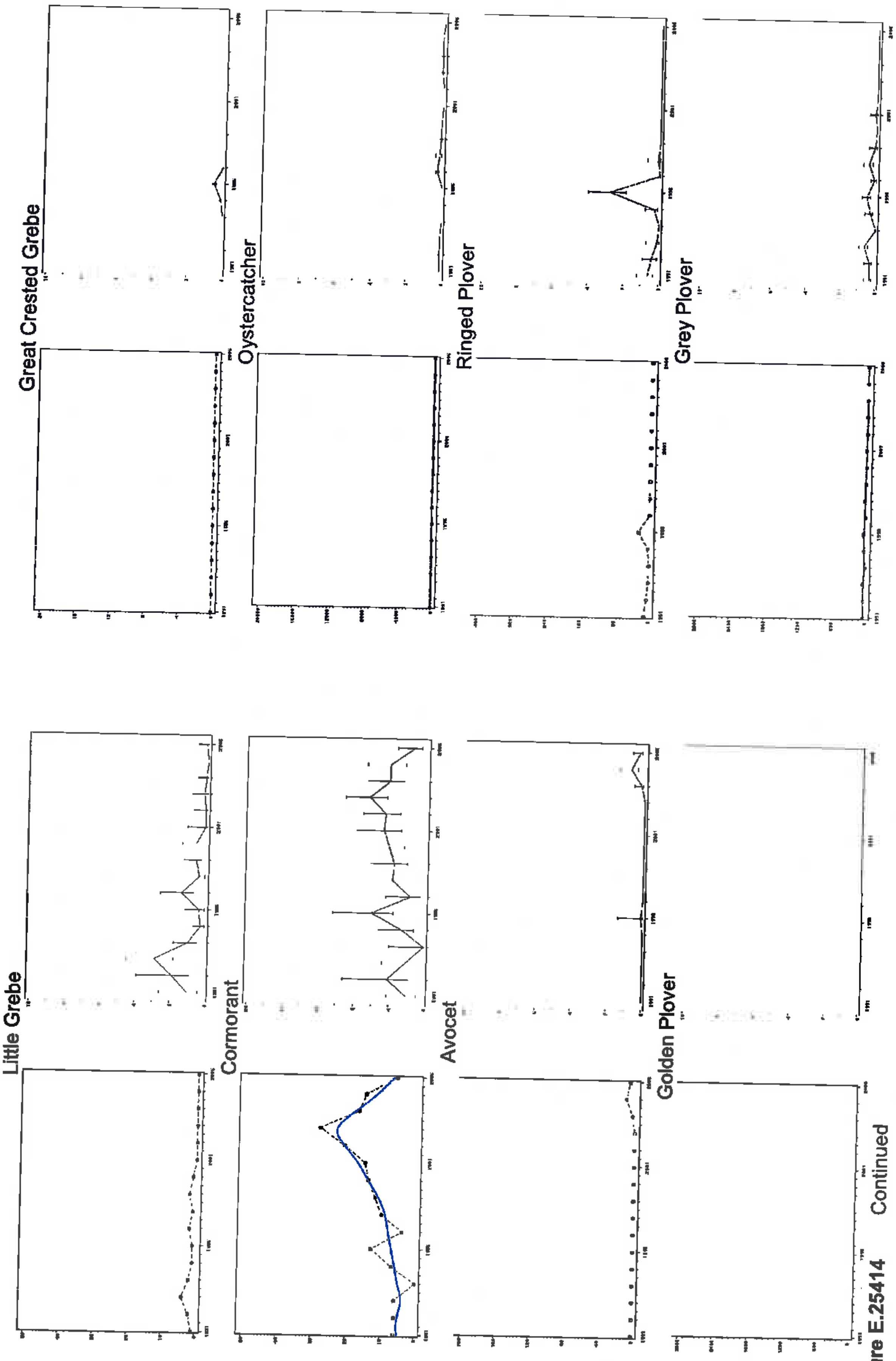


Figure E.25414 Population trends of each species in sector 25414 (Vange and Holehaven Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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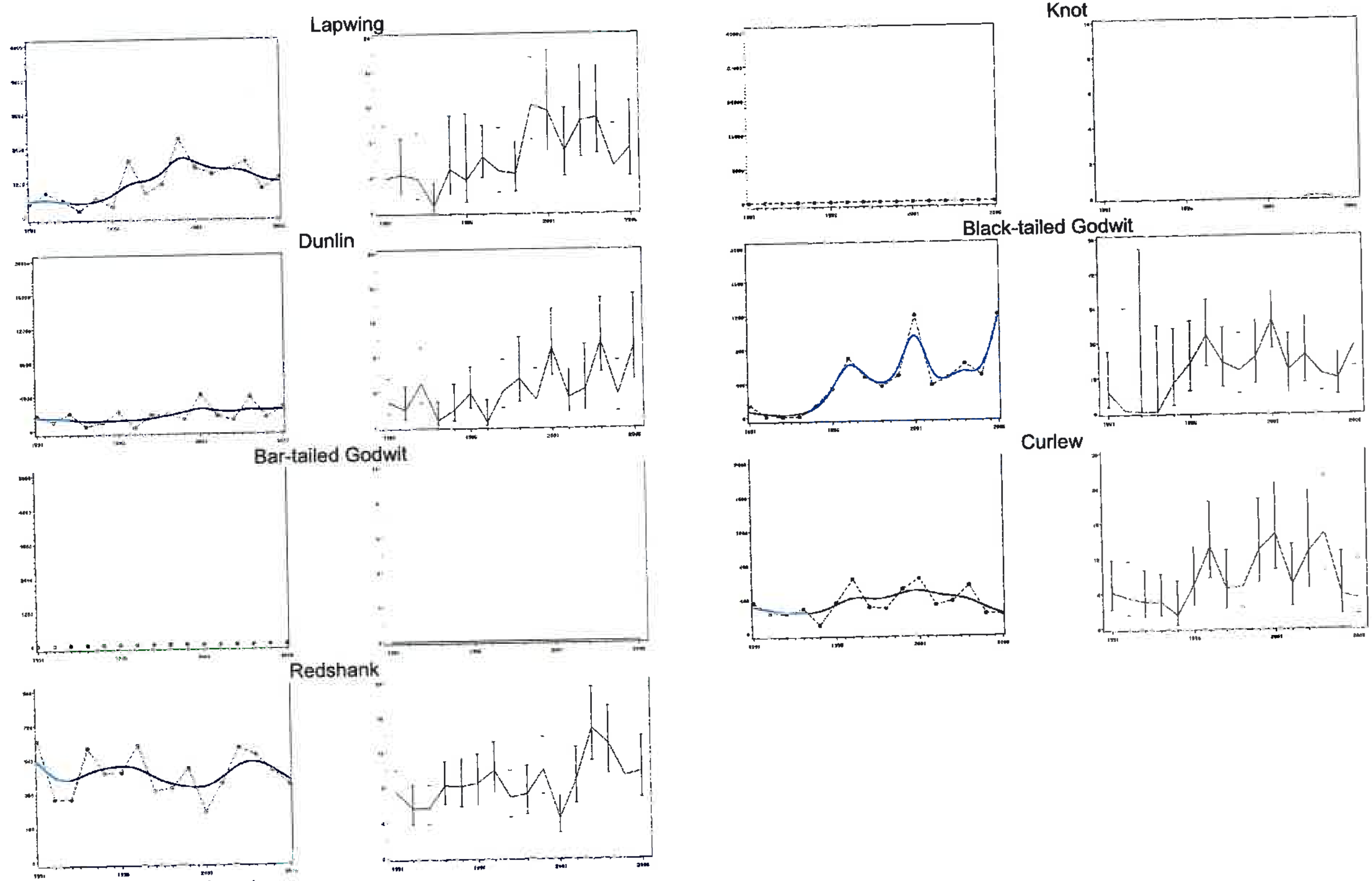

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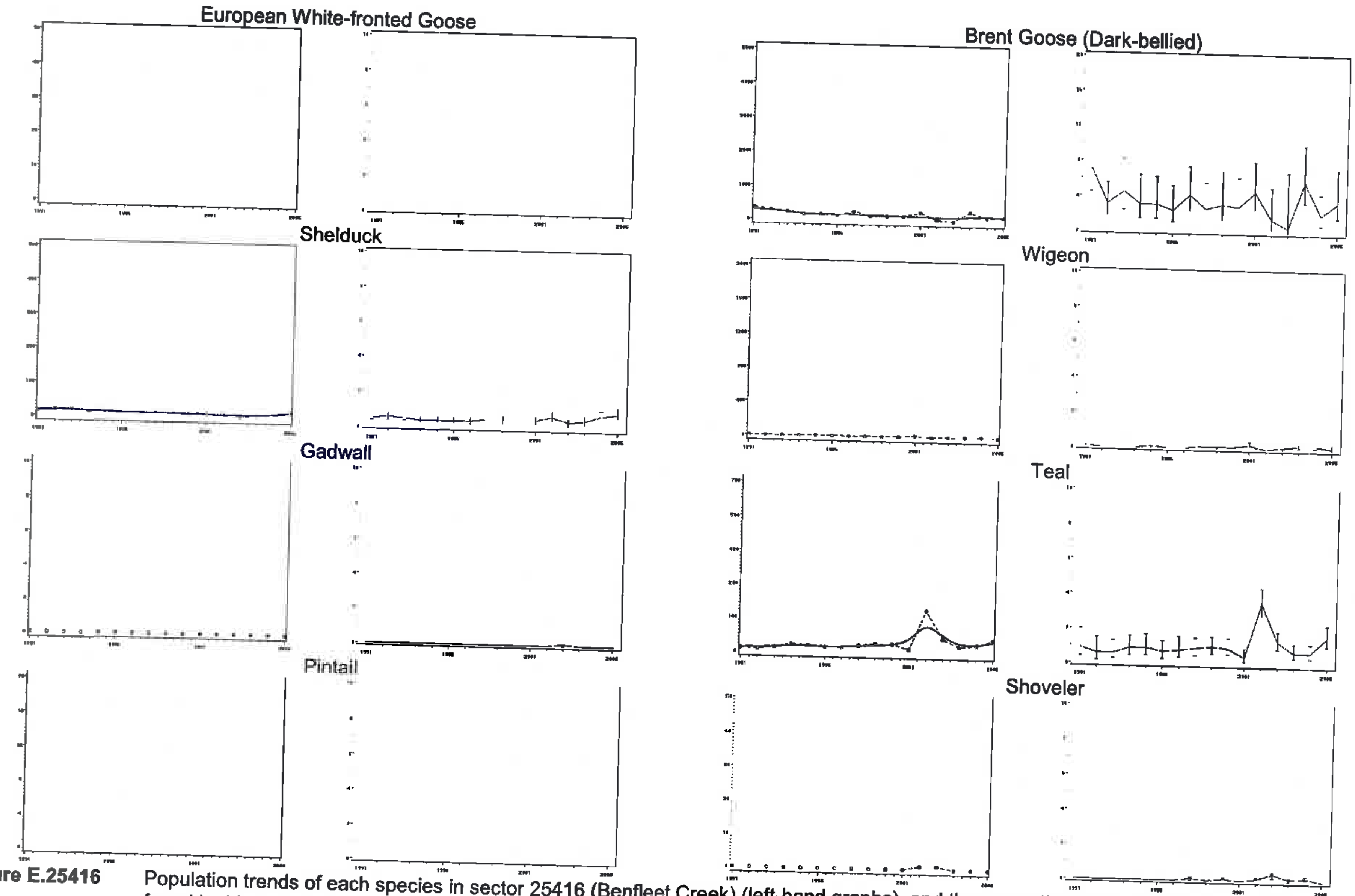
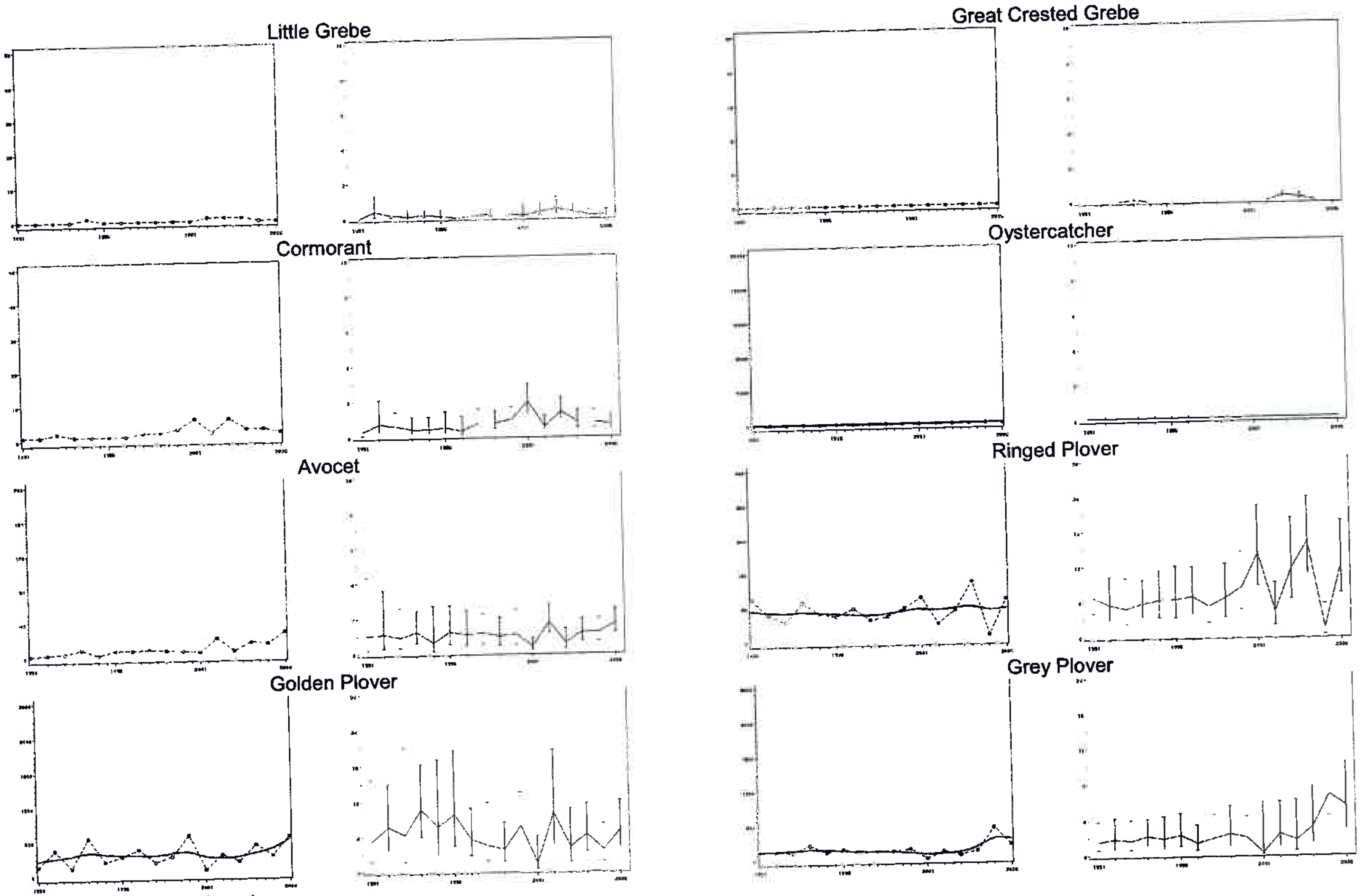


Figure E.25416 Population trends of each species in sector 25416 (Benfleet Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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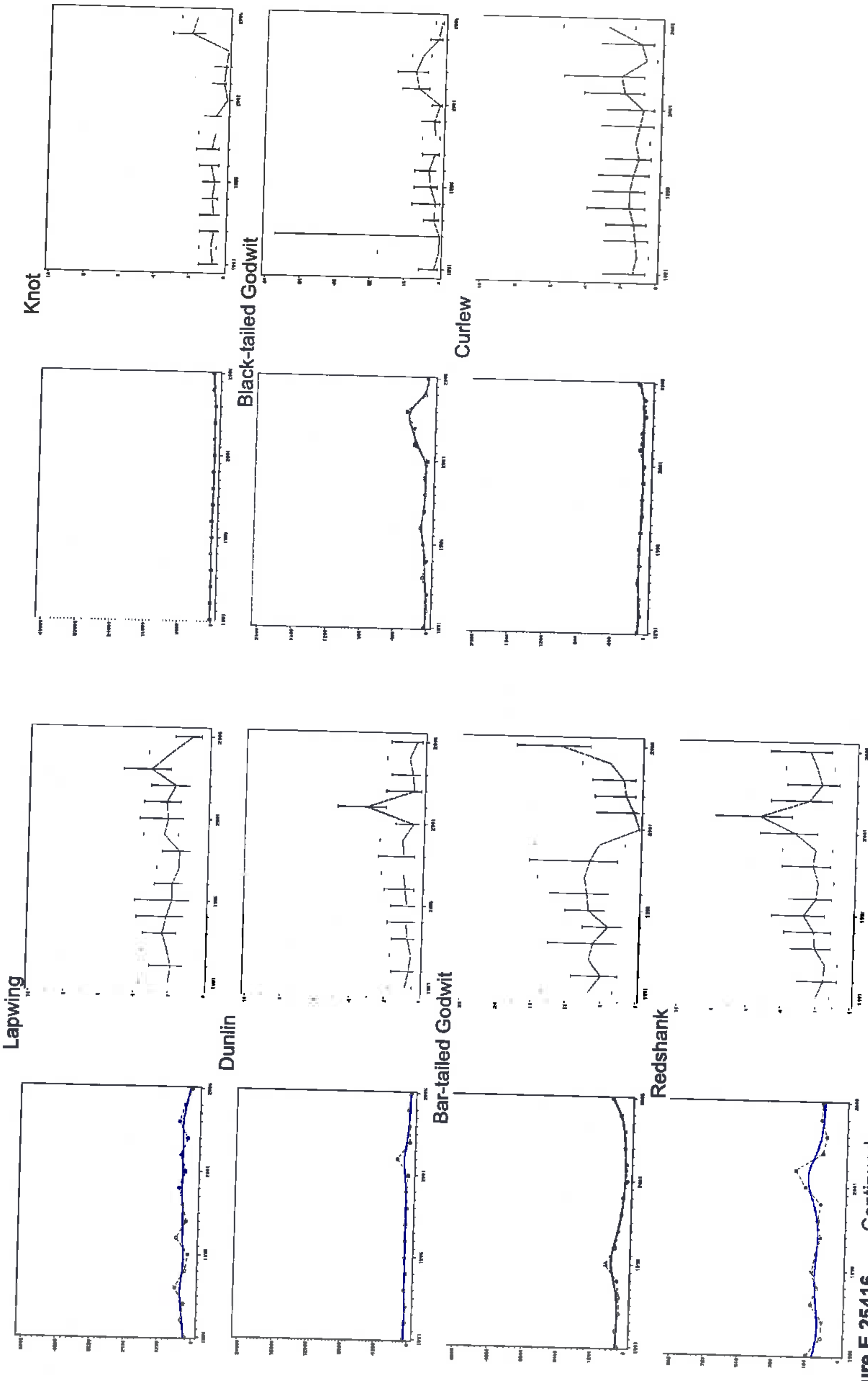

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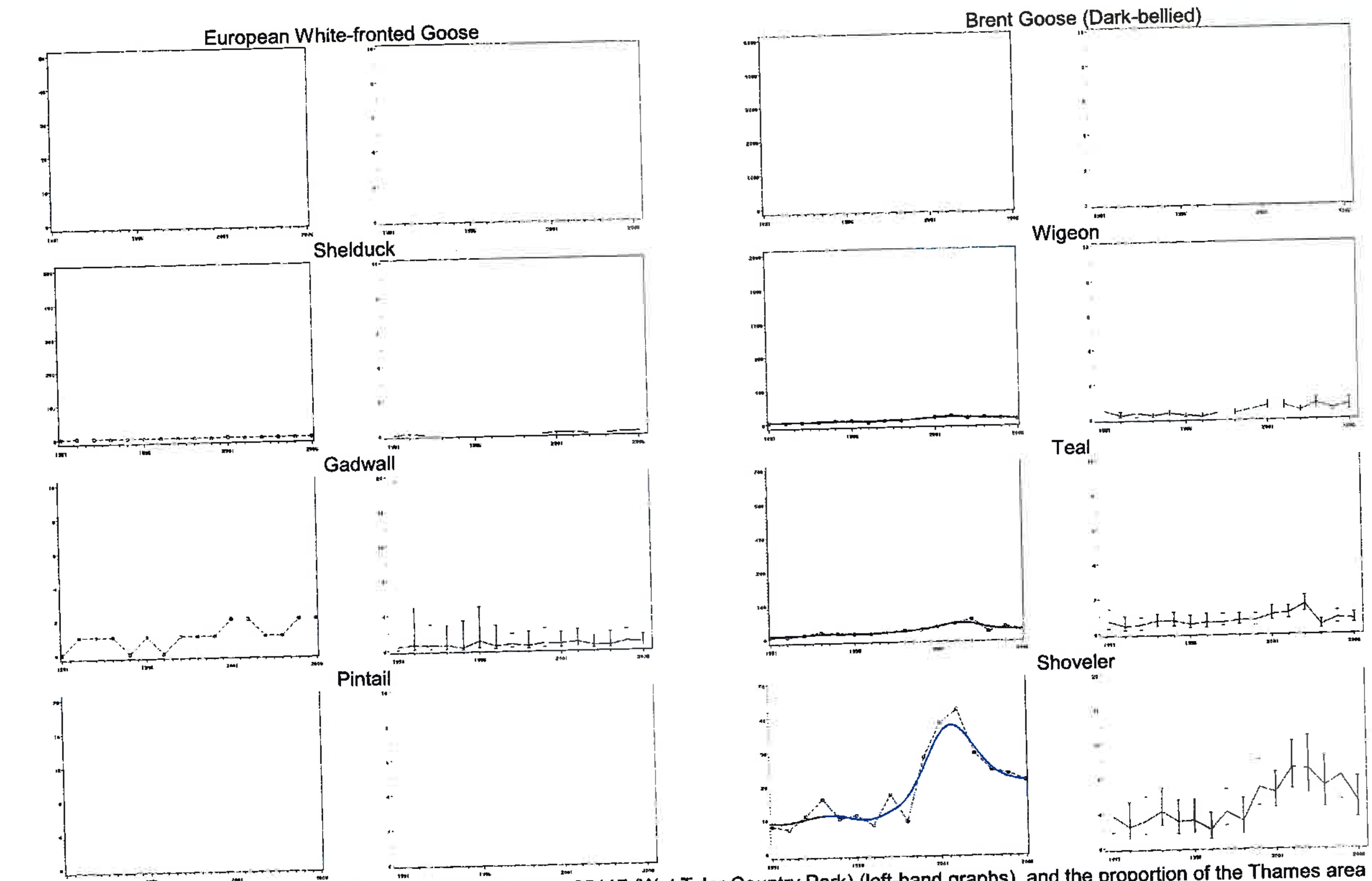
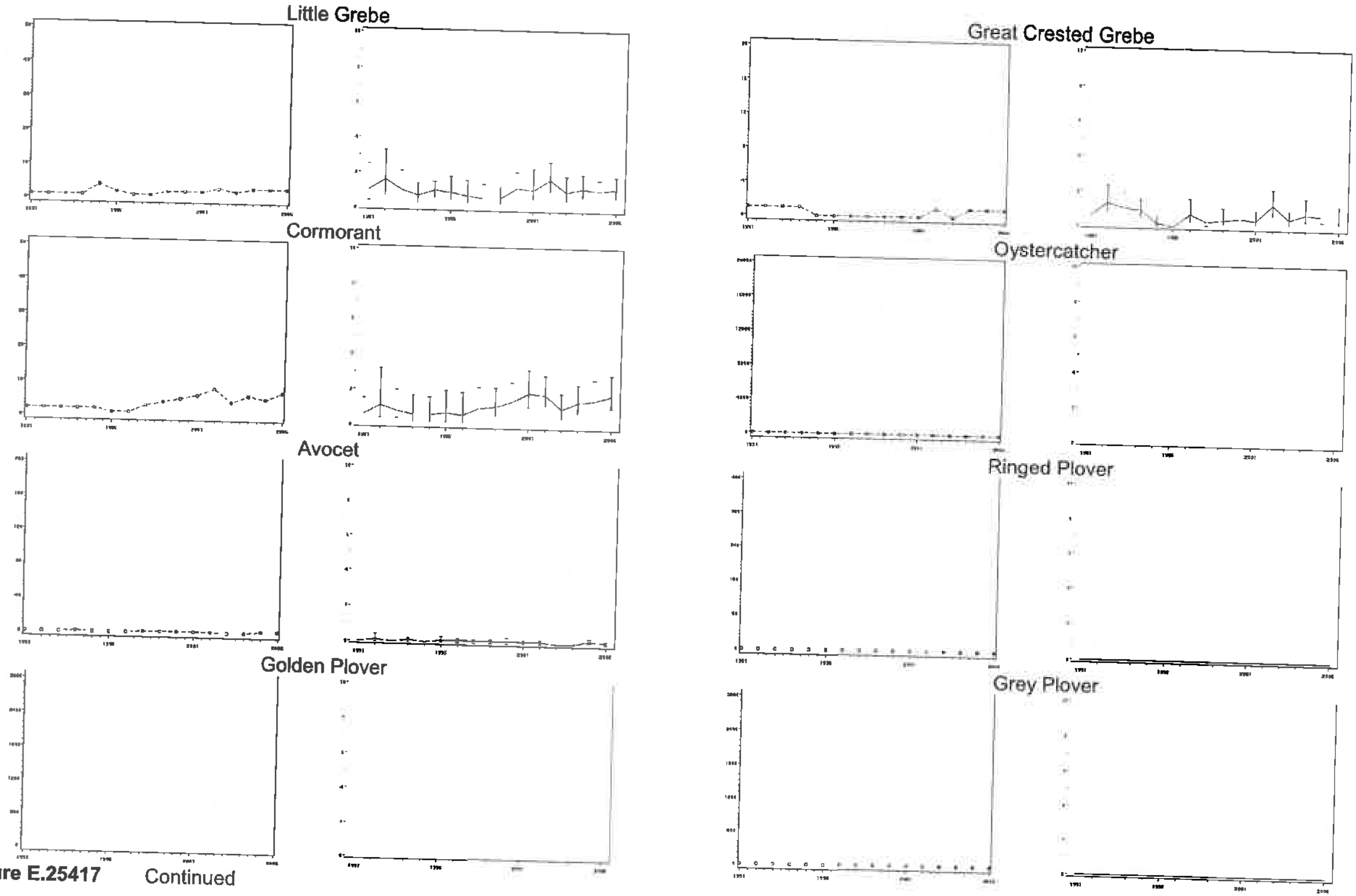


Figure E.25417 Population trends of each species in sector 25417 (Wat Tyler Country Park) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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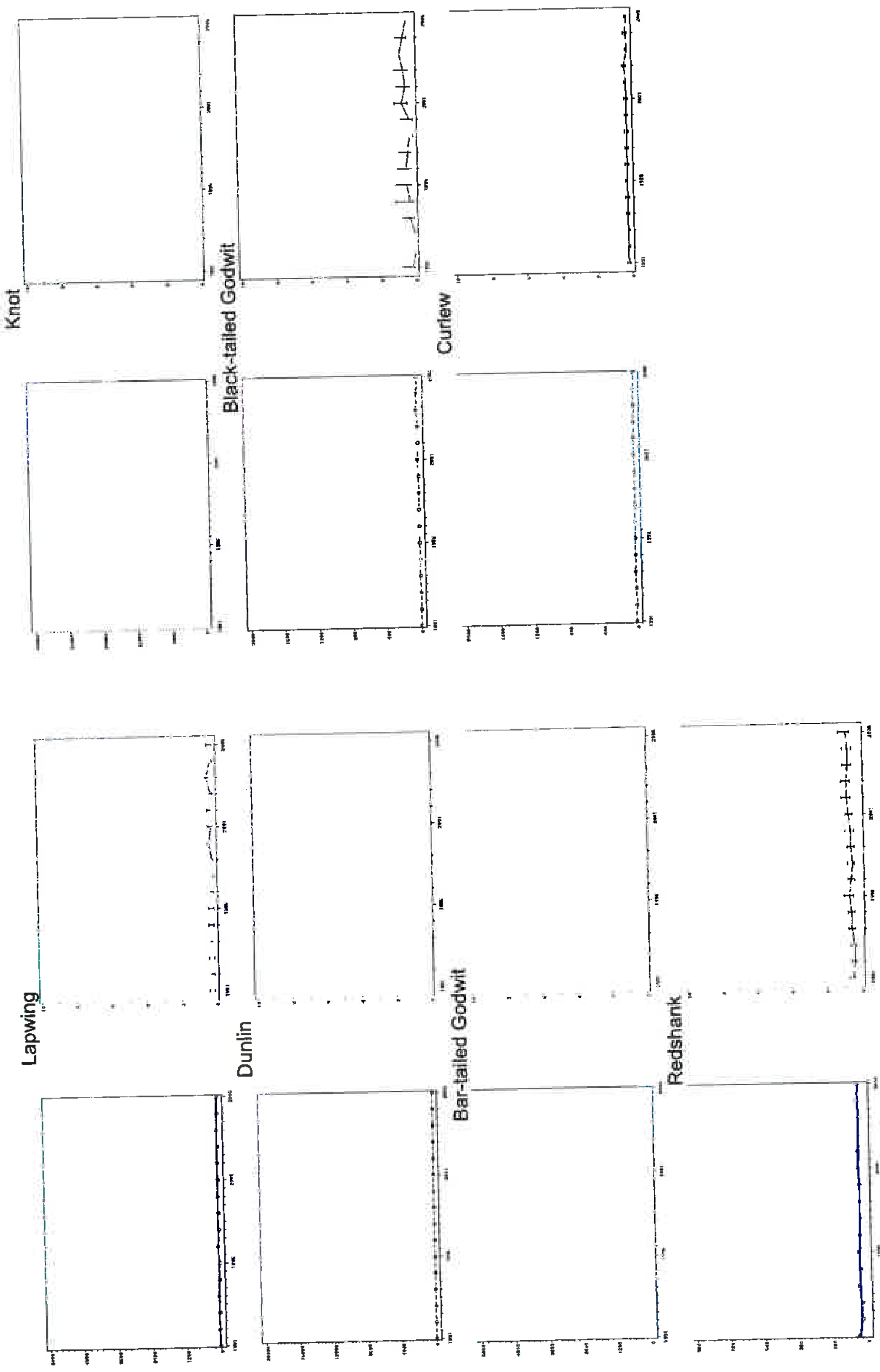

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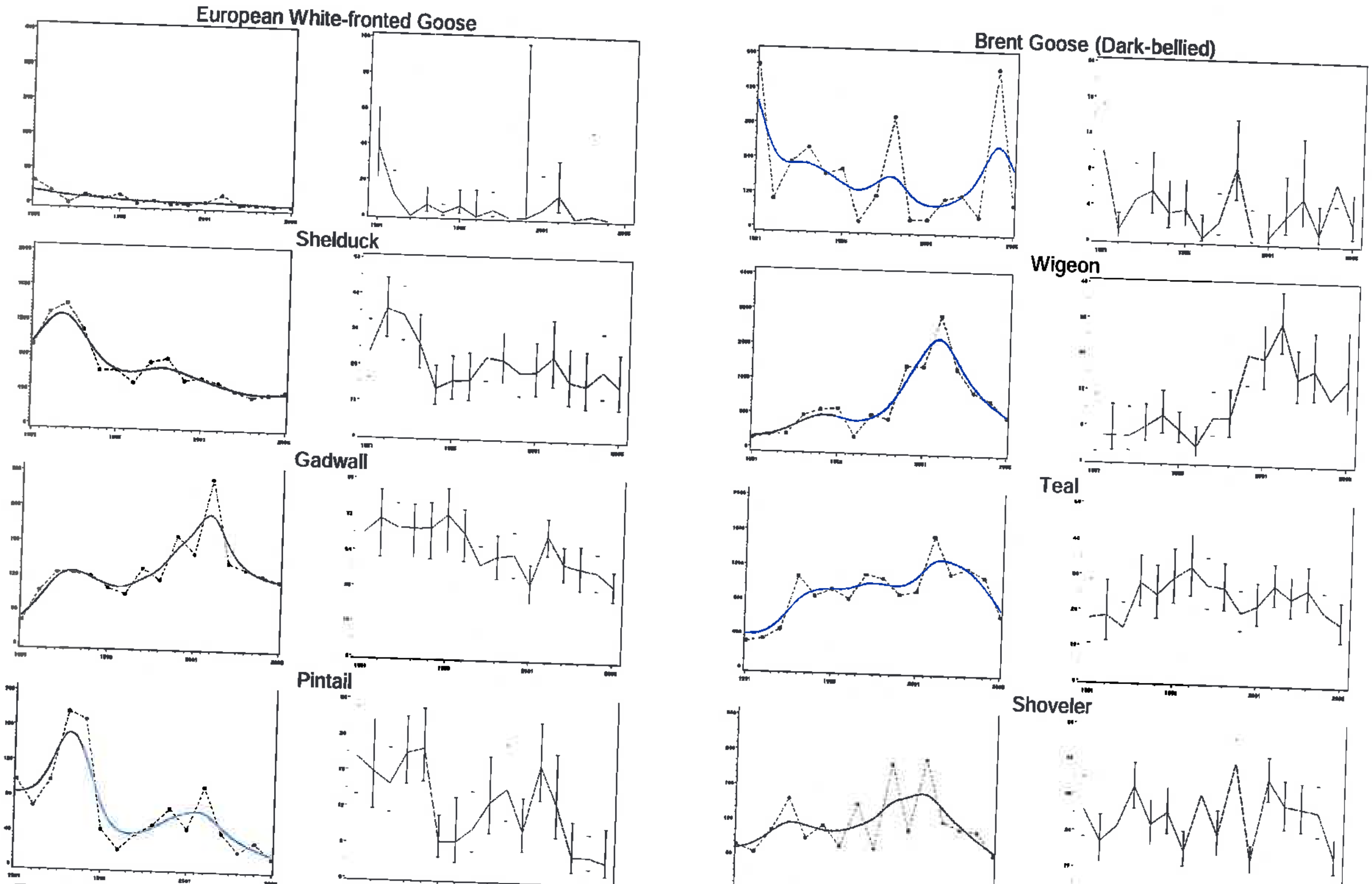
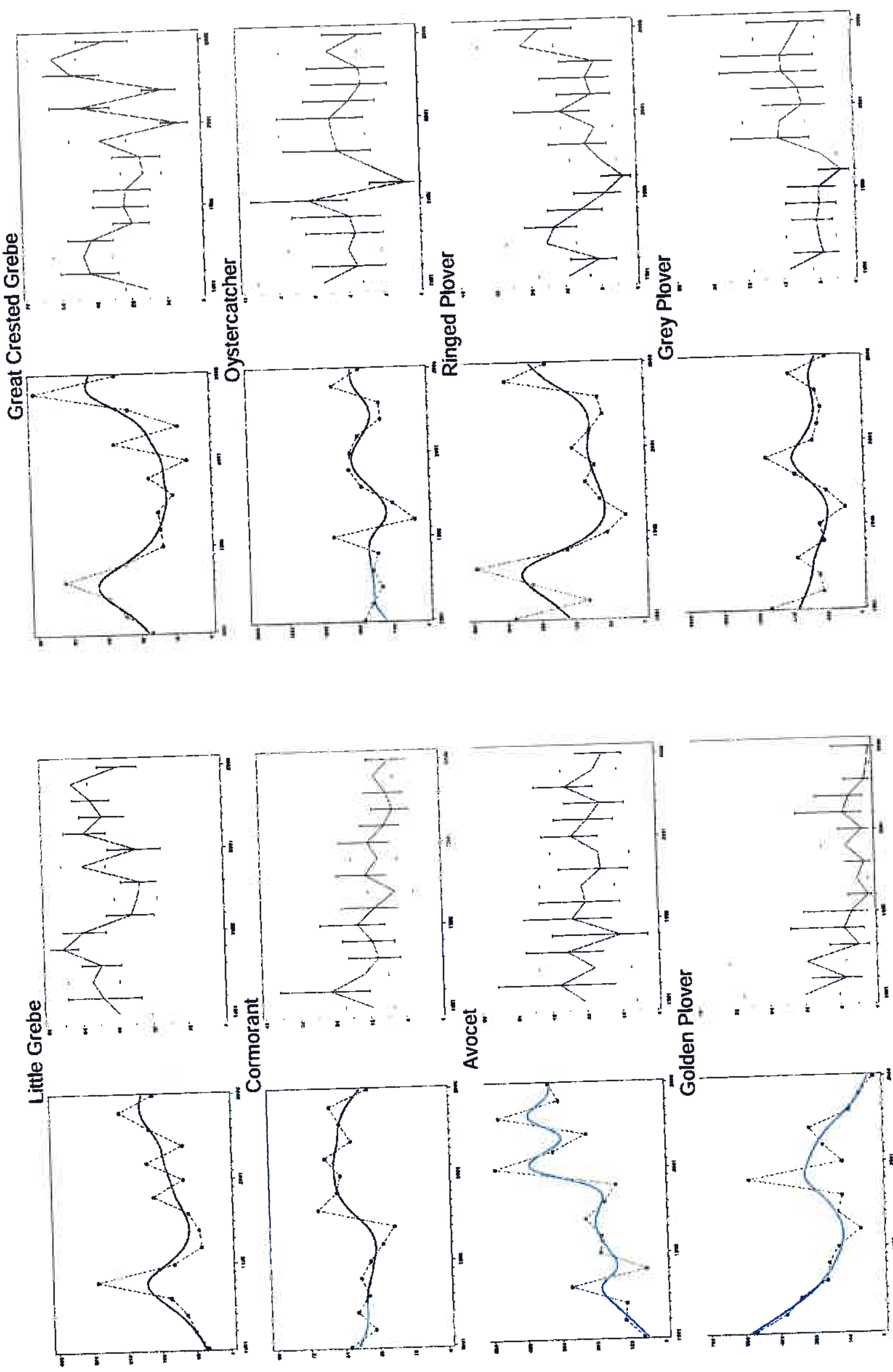


Figure E.22901 Population trends of each species in sector 22901 (North Kent Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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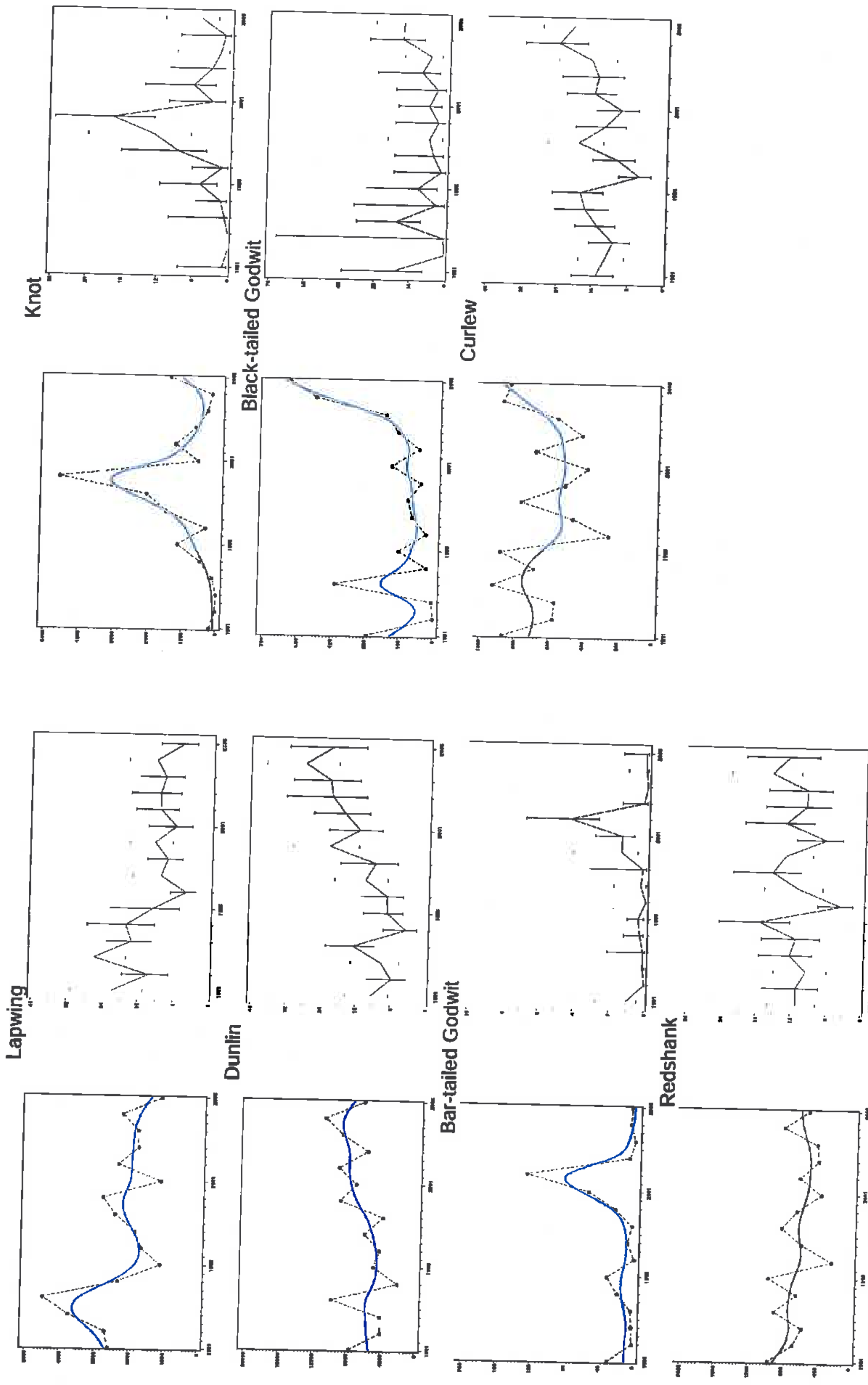

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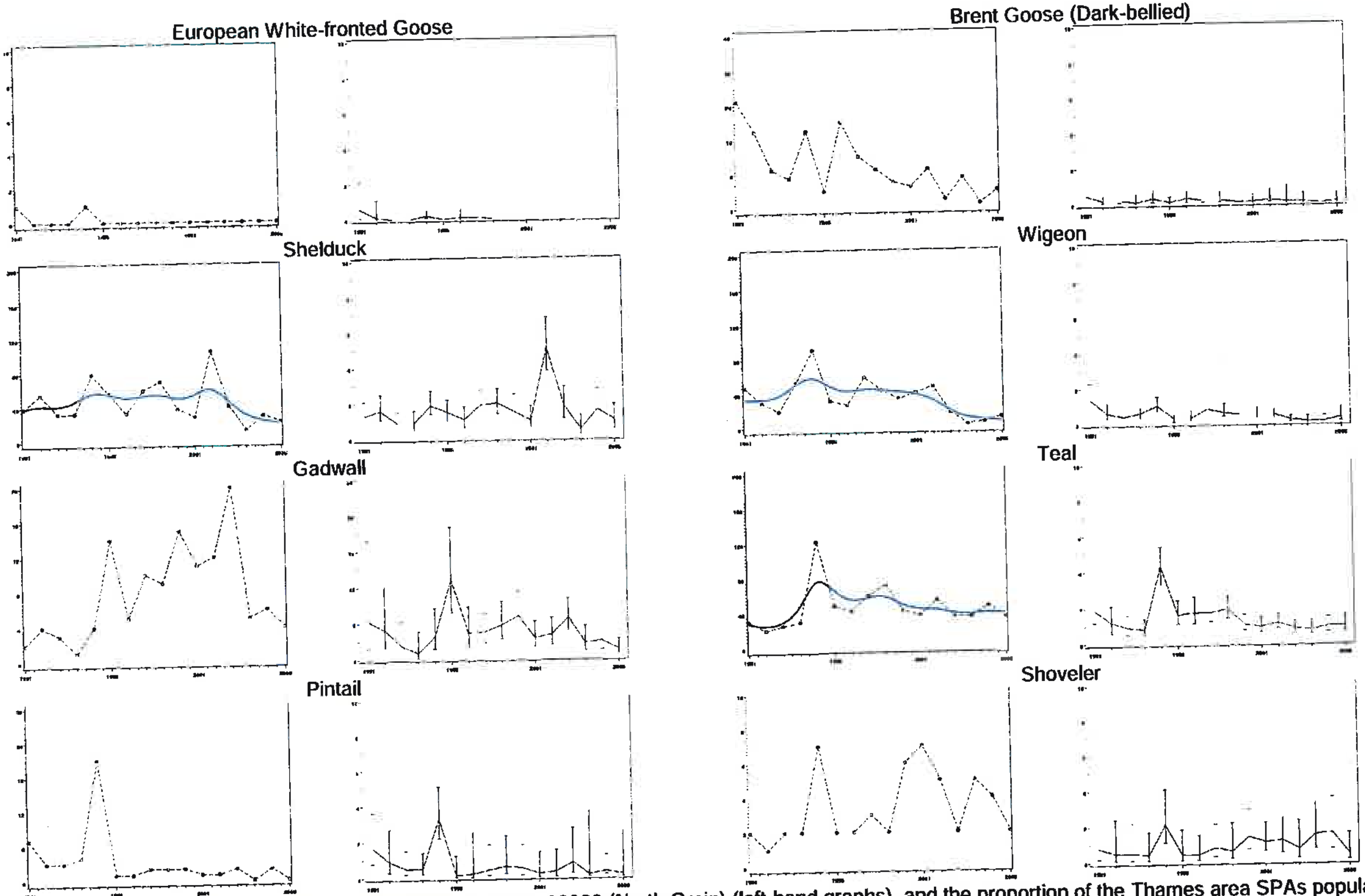
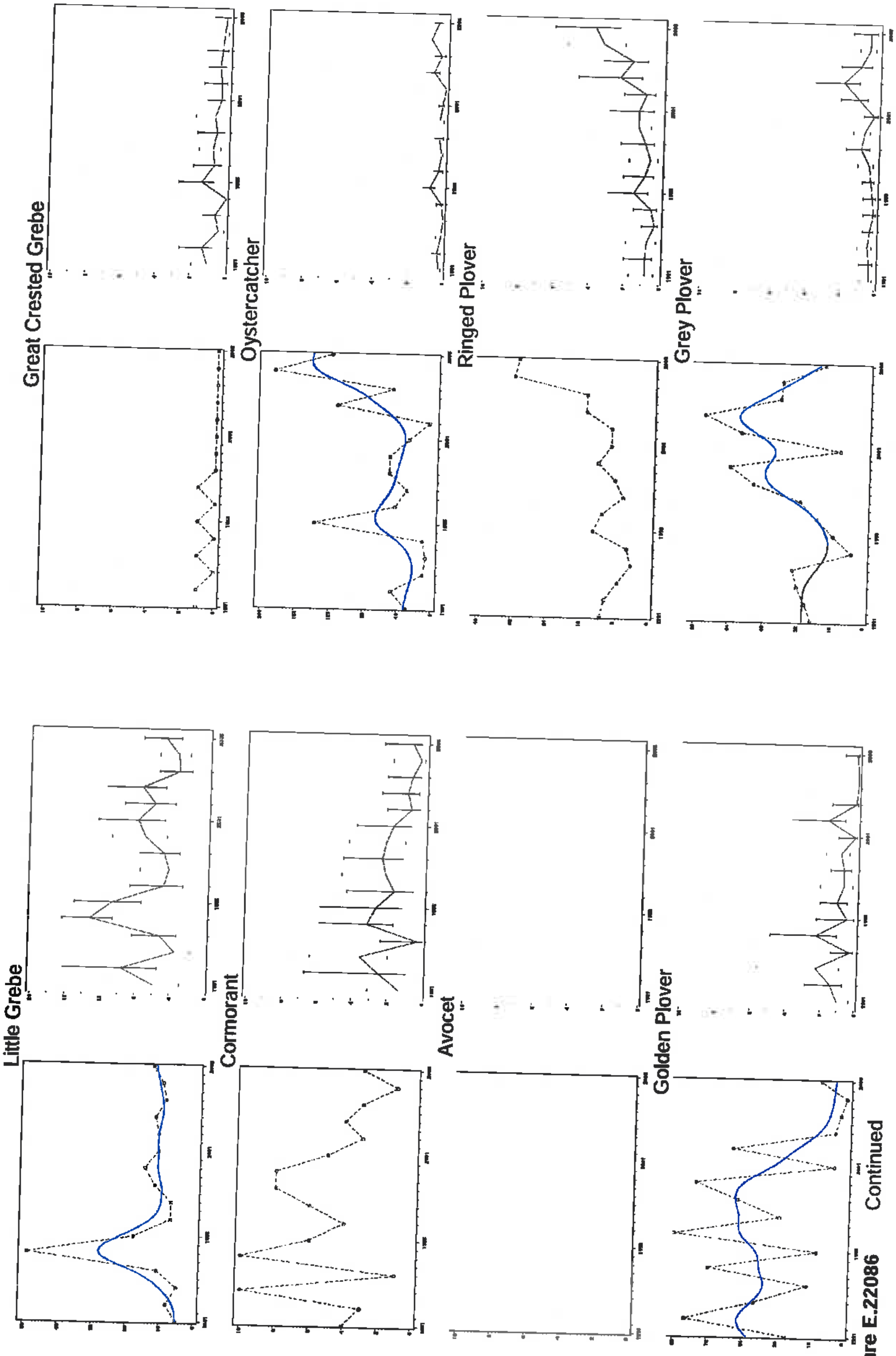


Figure E.22086 Population trends of each species in sector 22086 (North Grain) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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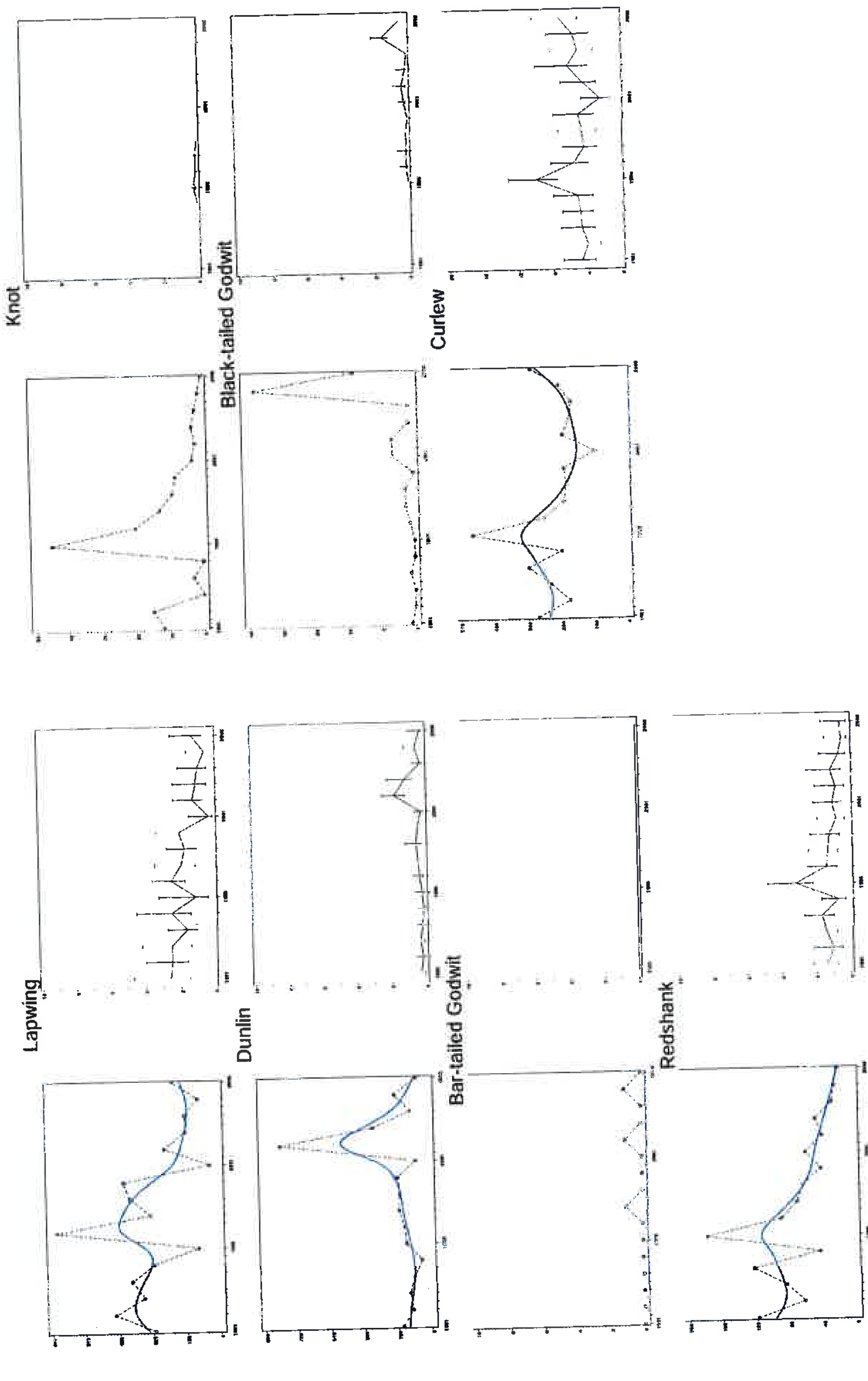

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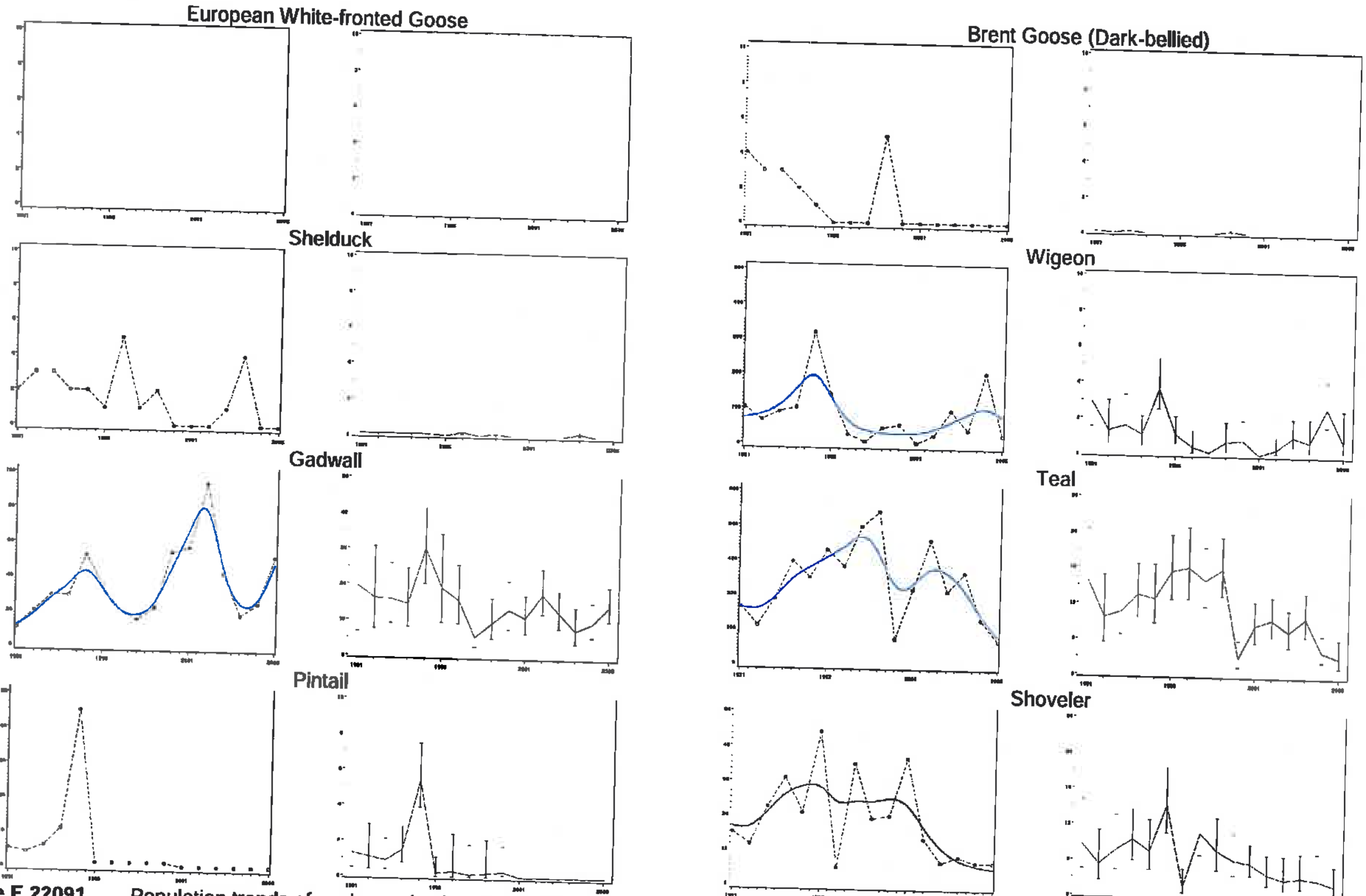
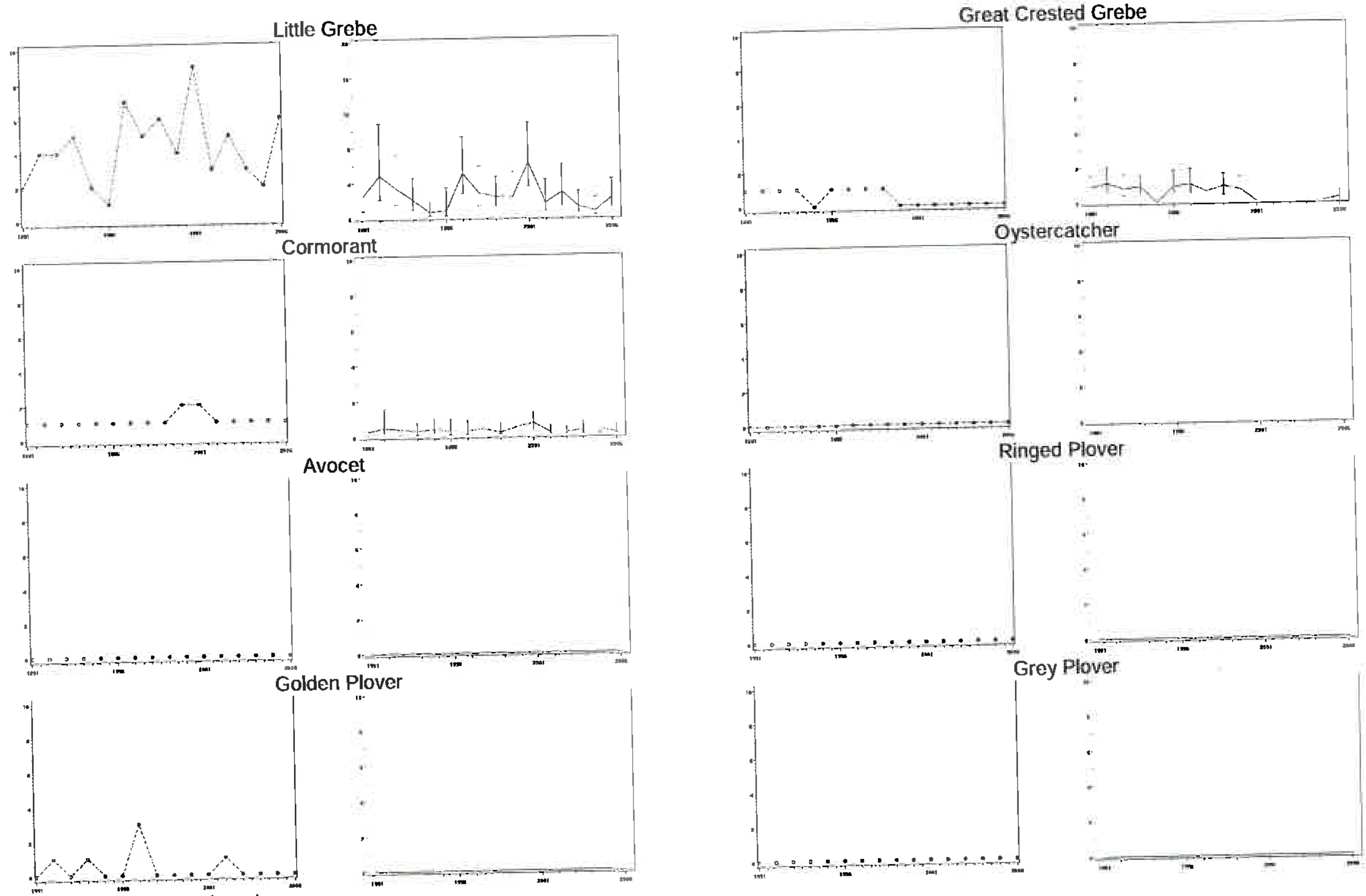


Figure E.22091 Population trends of each species in sector 22091 (Stoke Fleet and Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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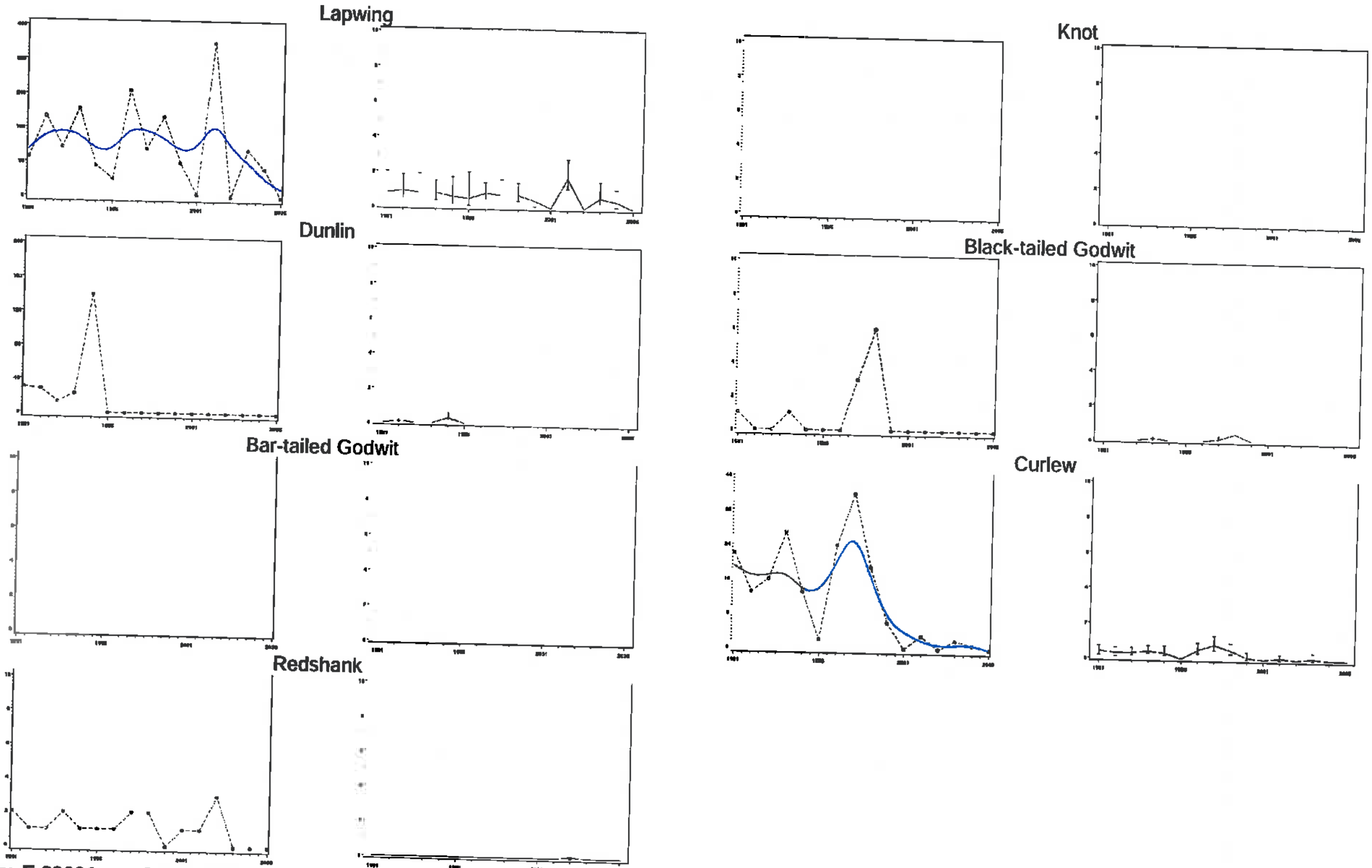

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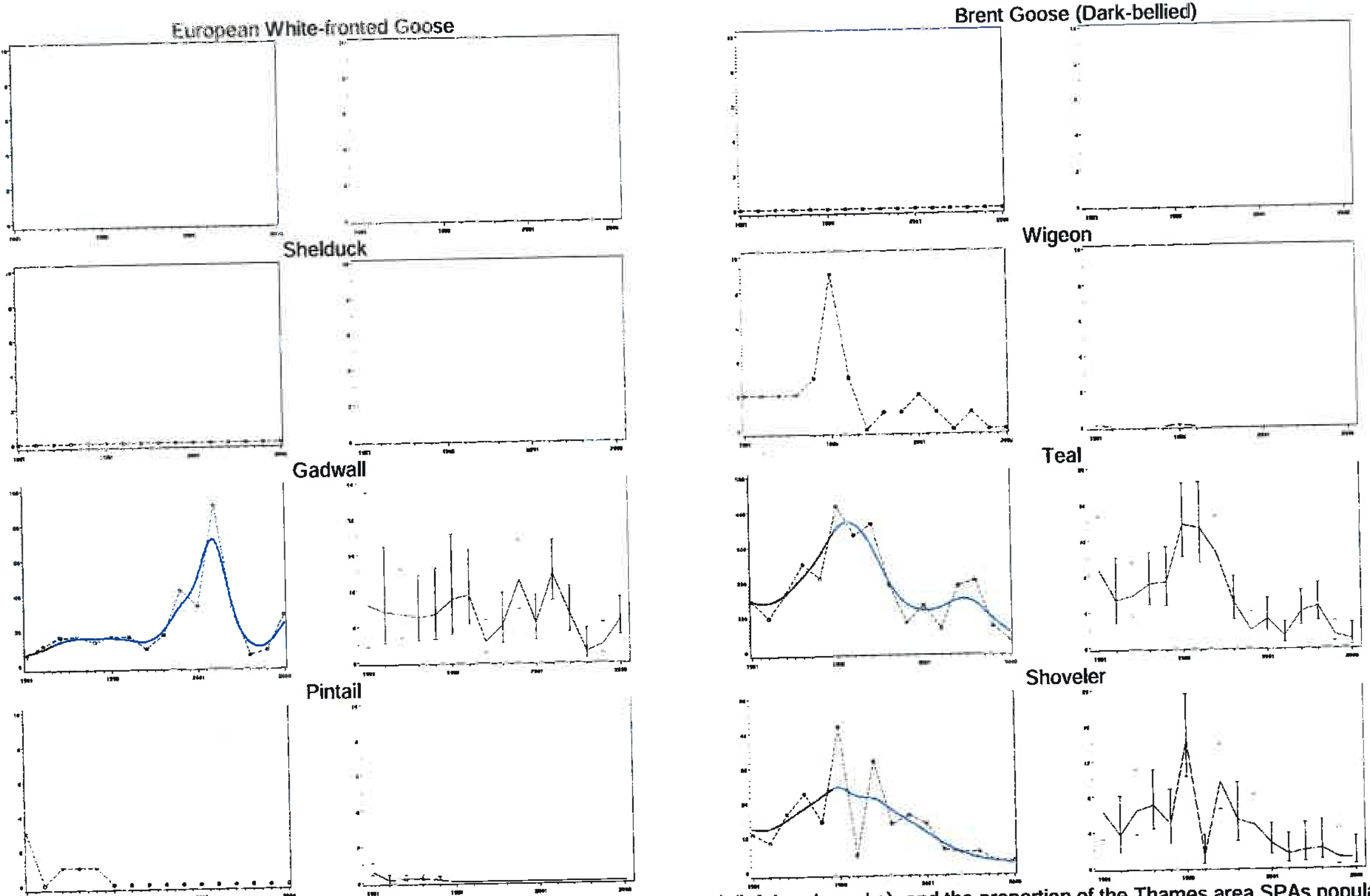
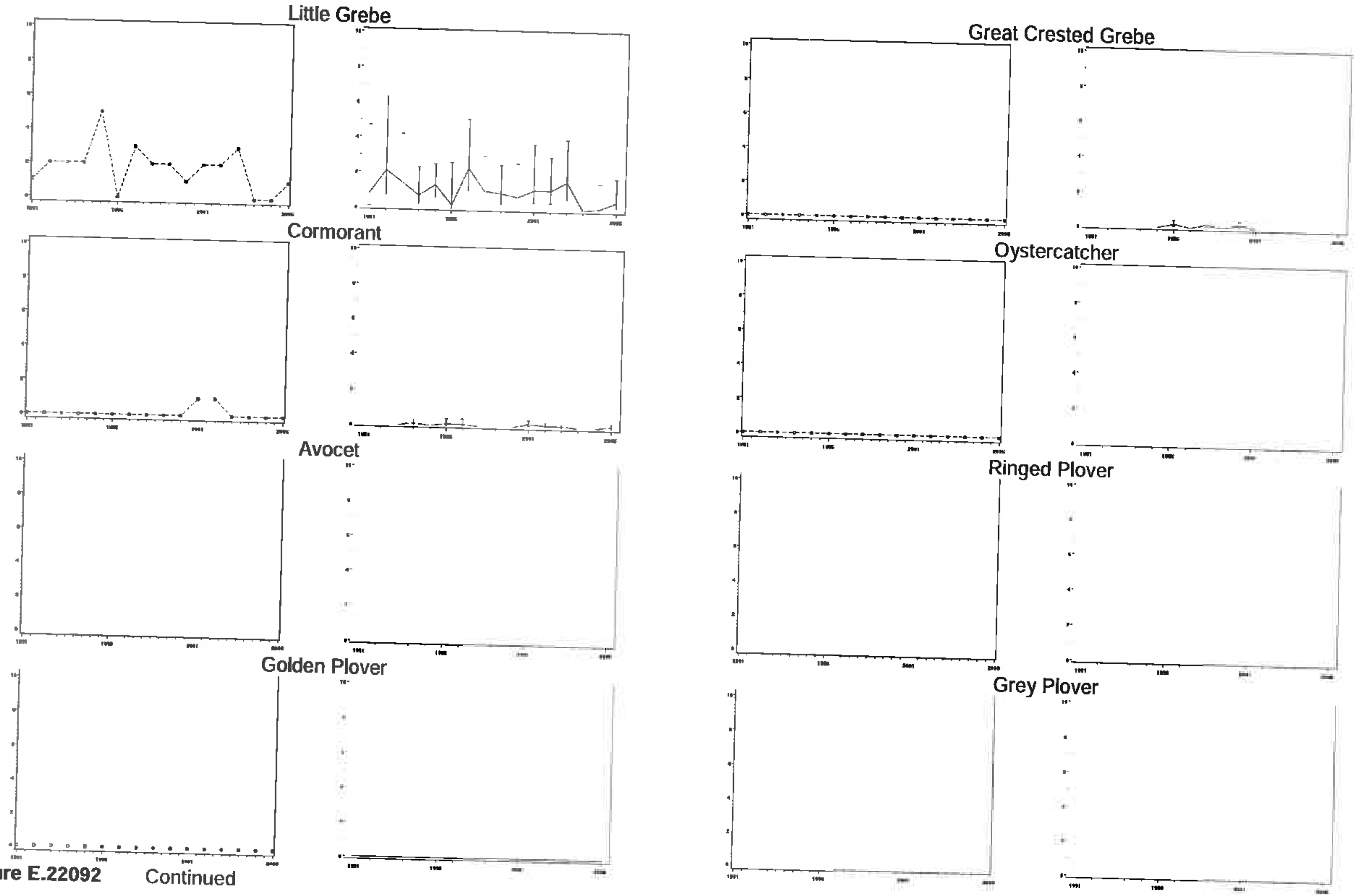


Figure E.22092 Population trends of each species in sector 22092 (Stoke Fleet) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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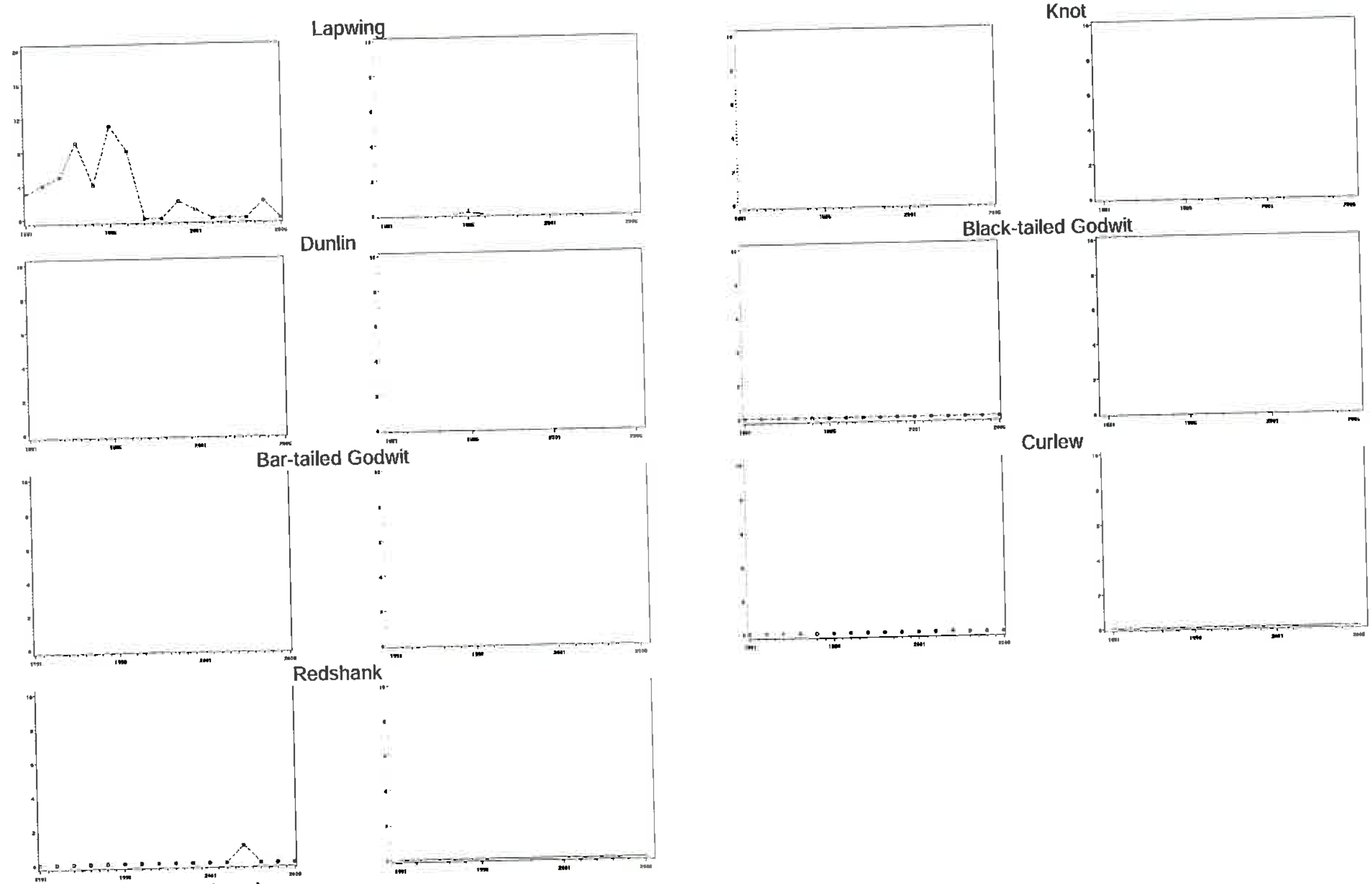

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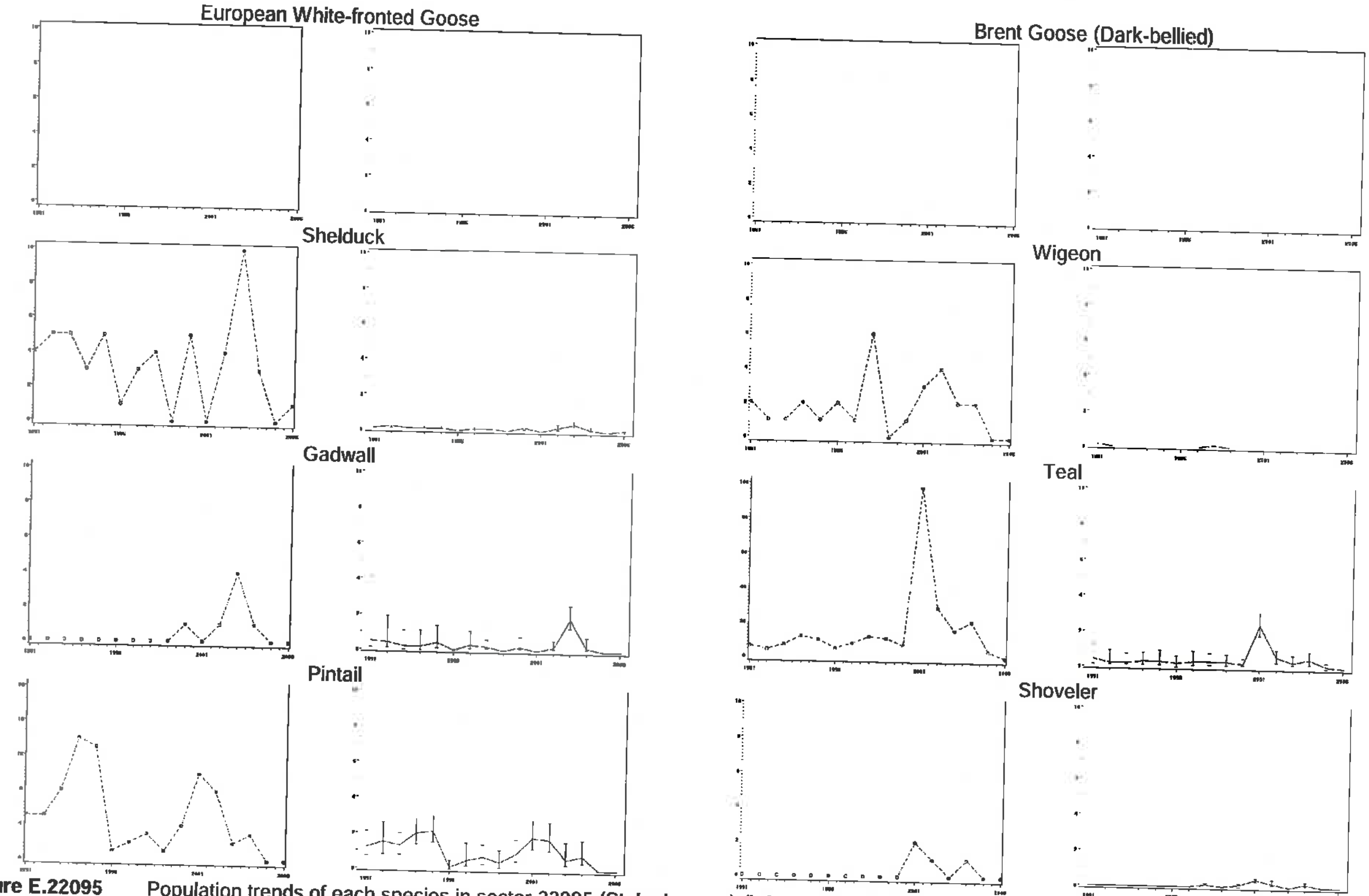
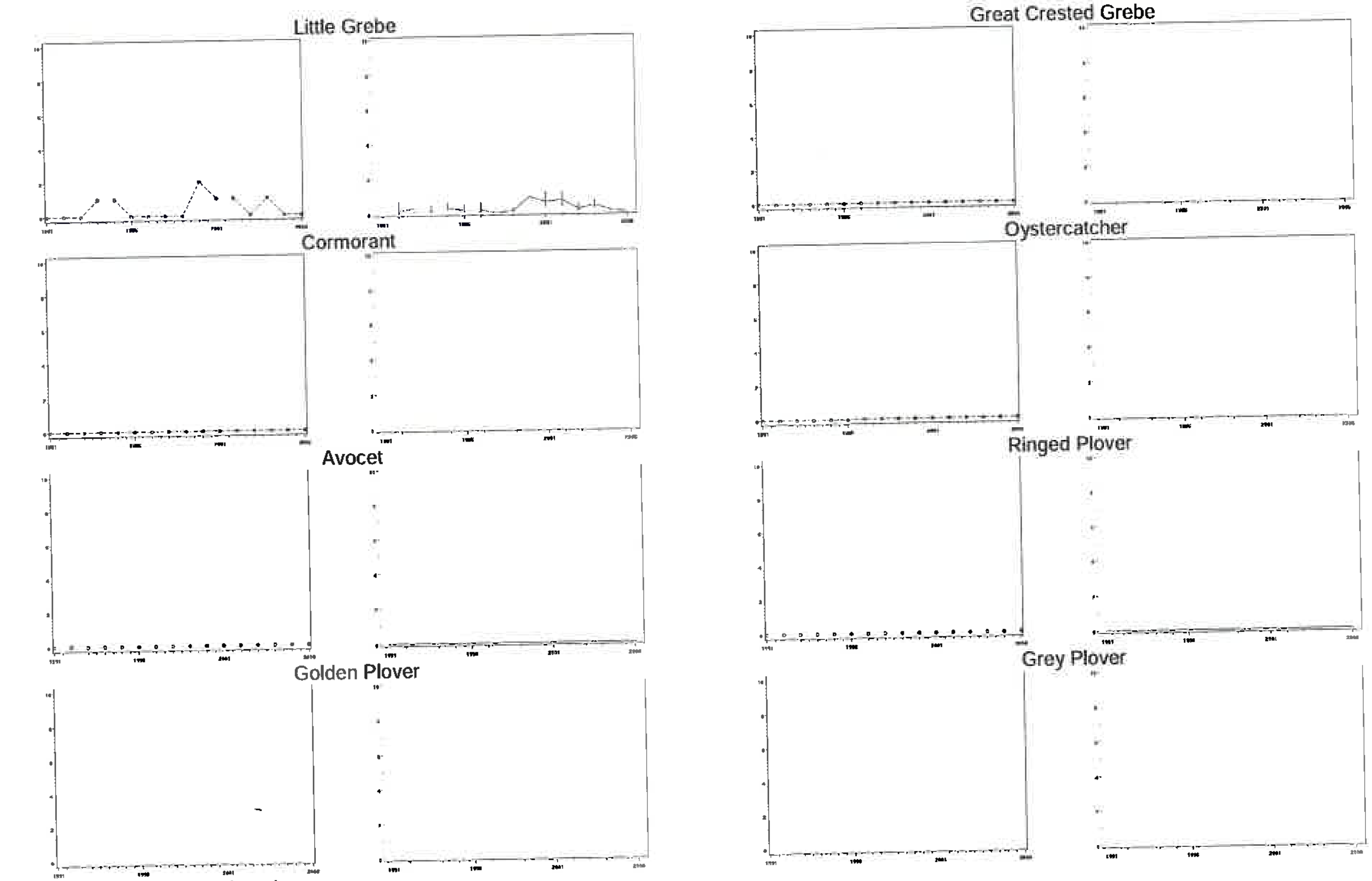


Figure E.22095 Population trends of each species in sector 22095 (Stoke Lagoon) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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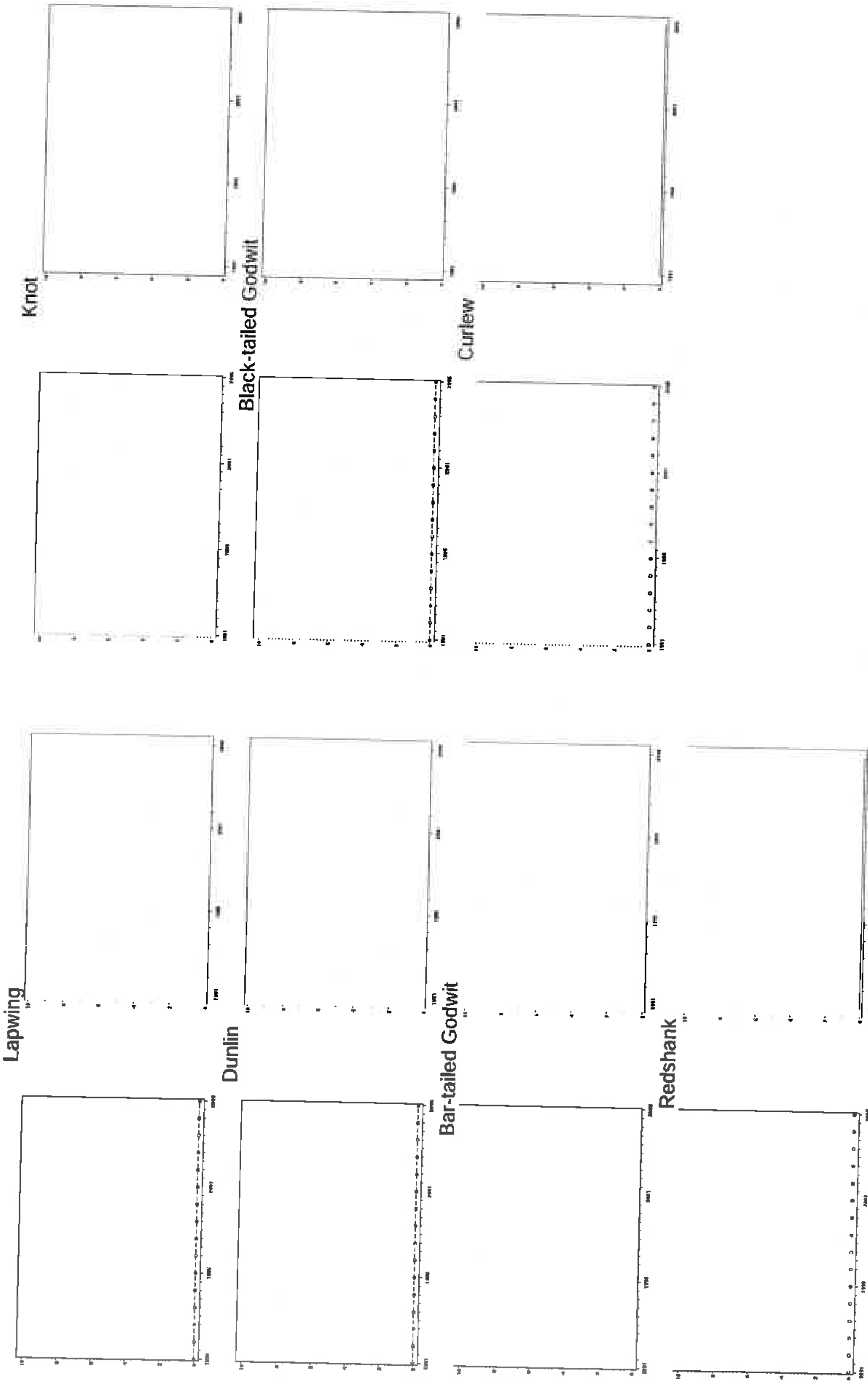

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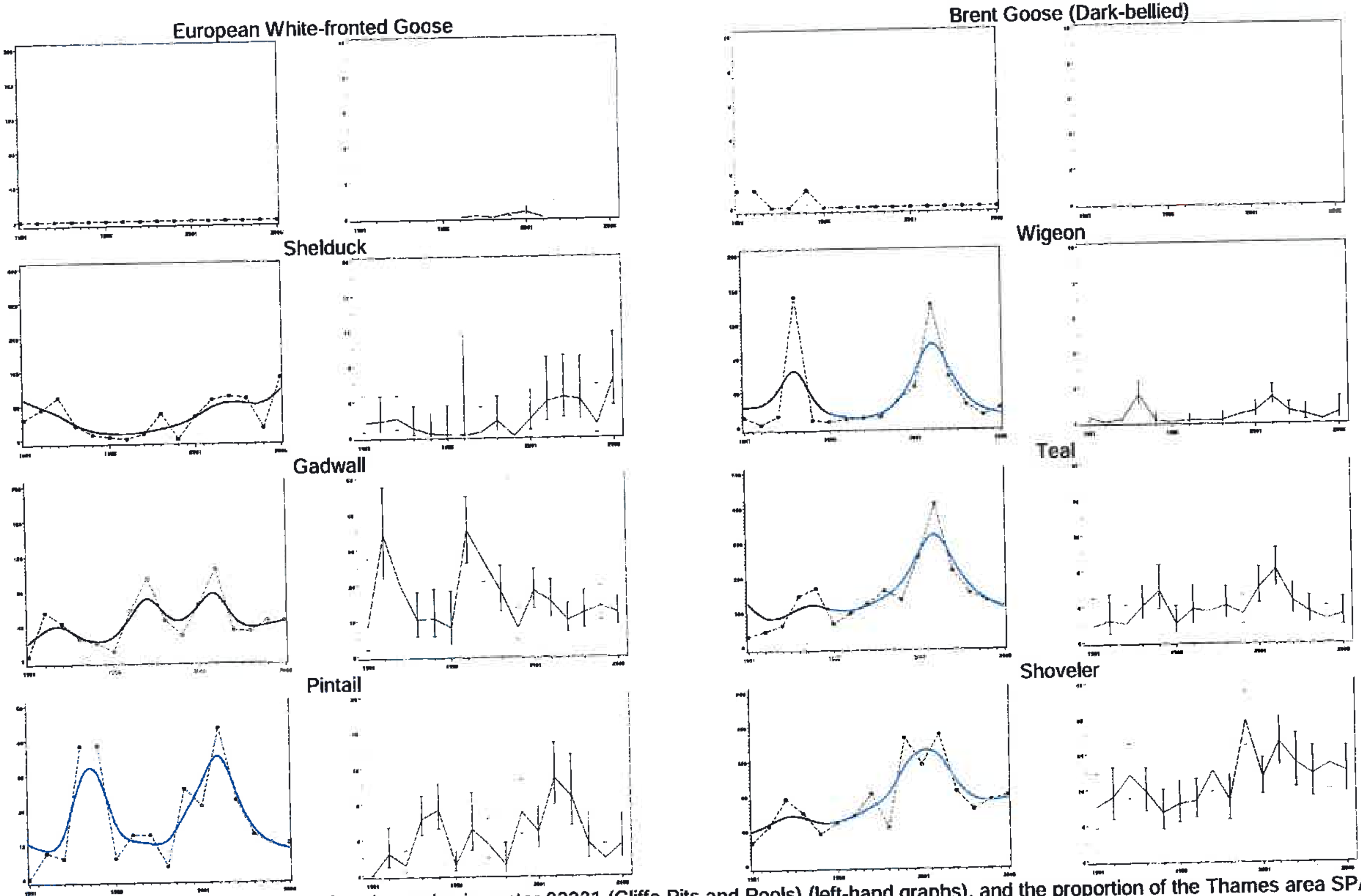
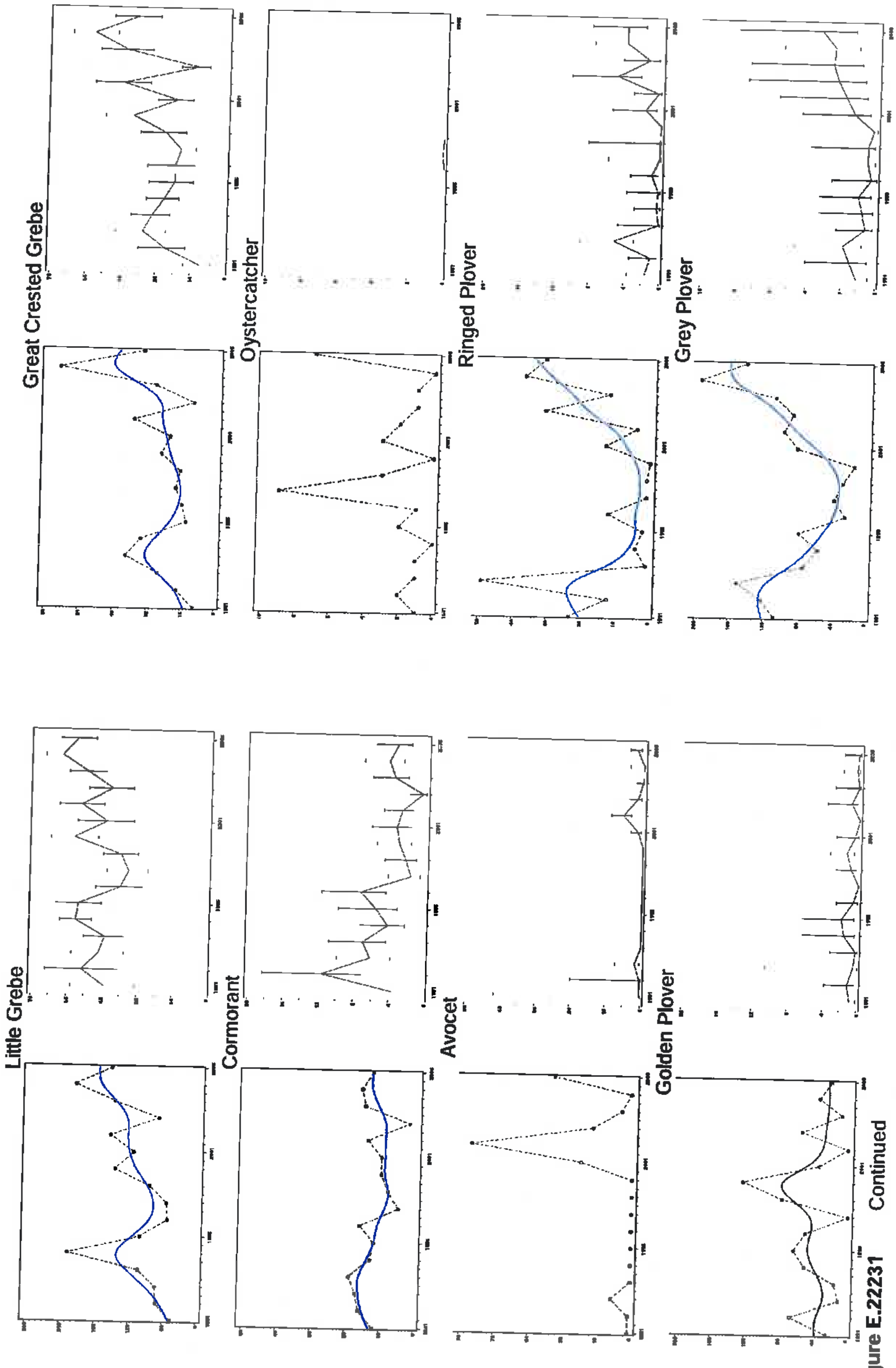


Figure E.22231 Population trends of each species in sector 22231 (Cliffe Pits and Pools) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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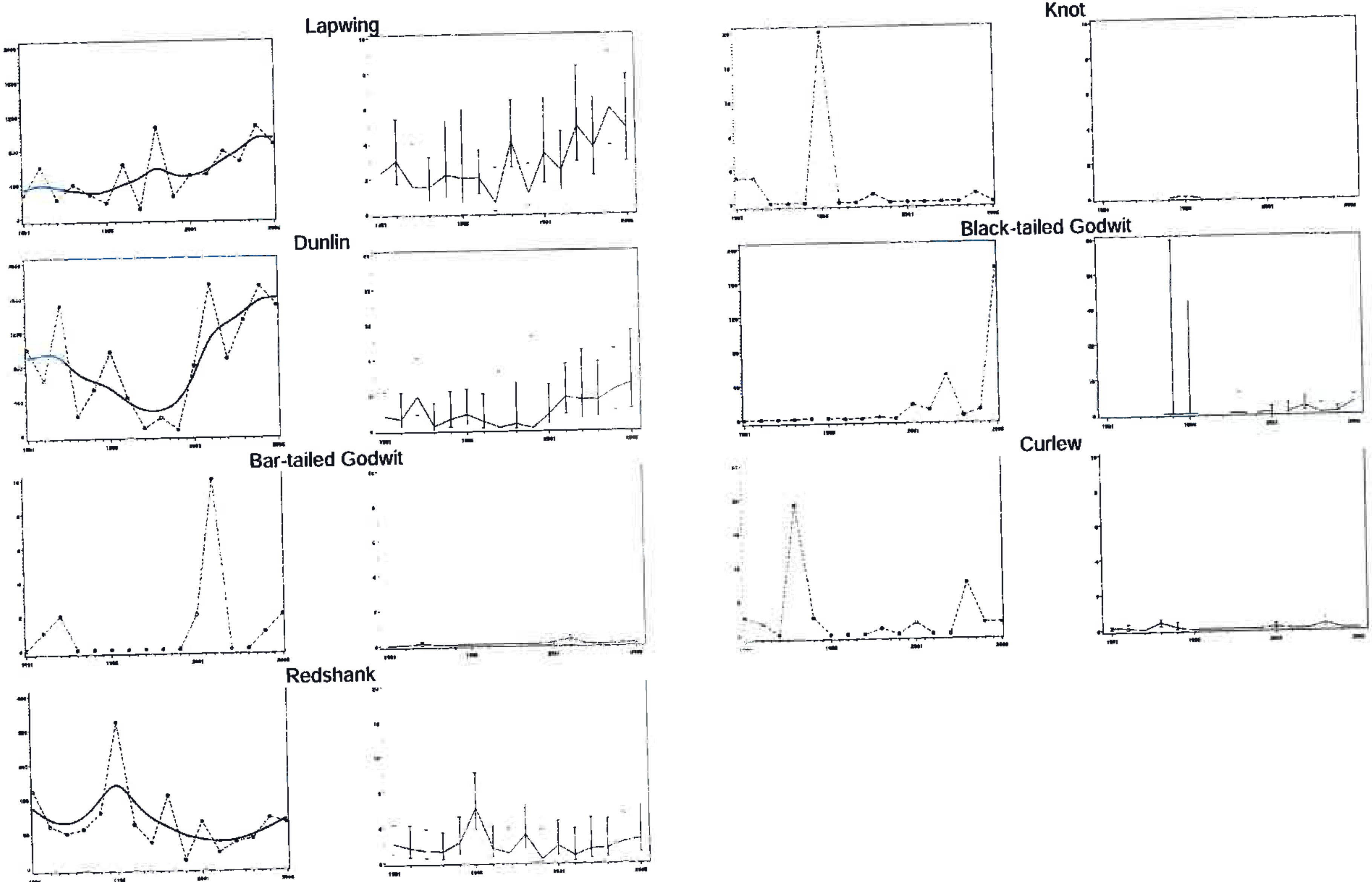

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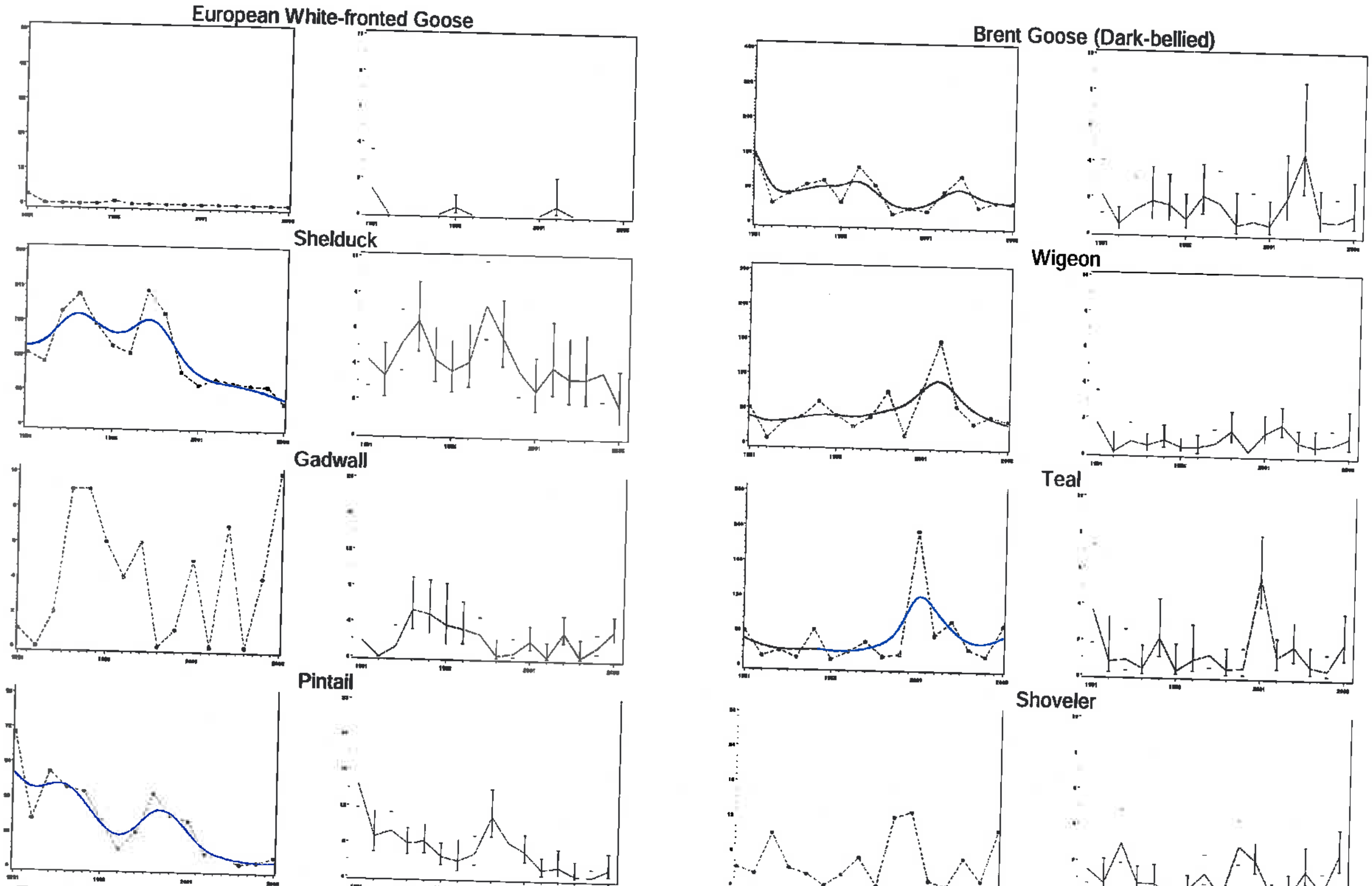
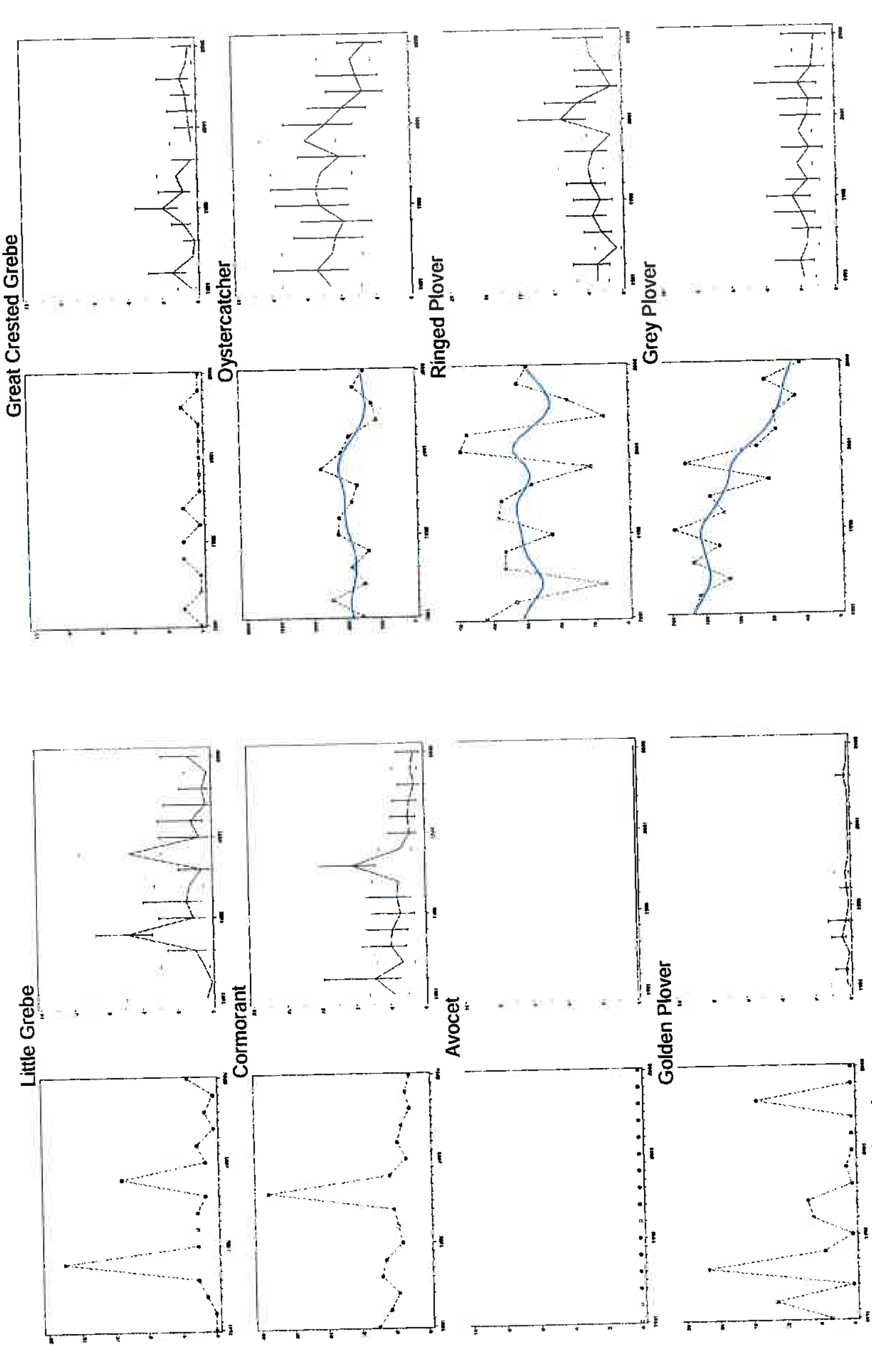


Figure E.22481 Population trends of each species in sector 22481 (Yantlett and Allhallows) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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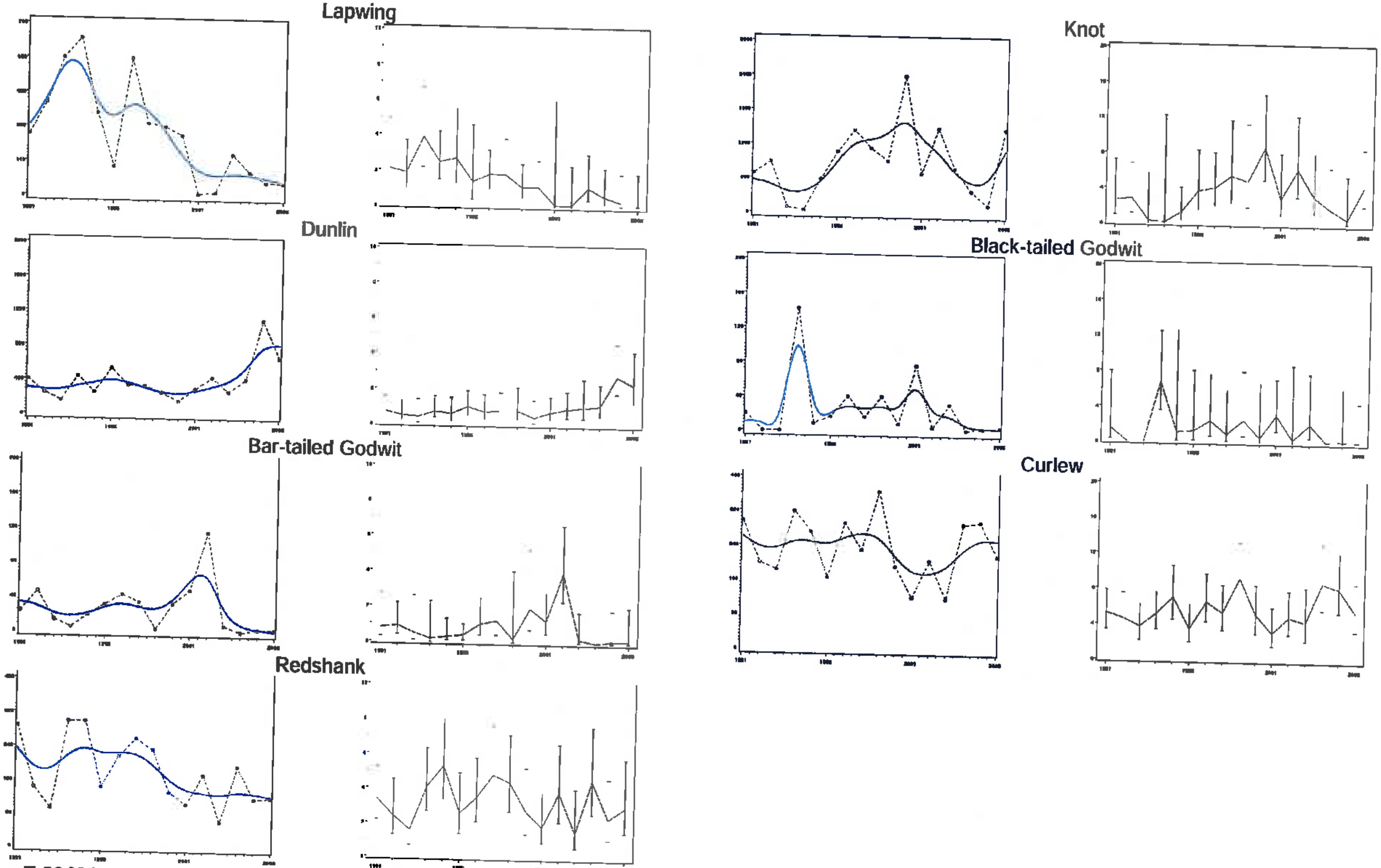

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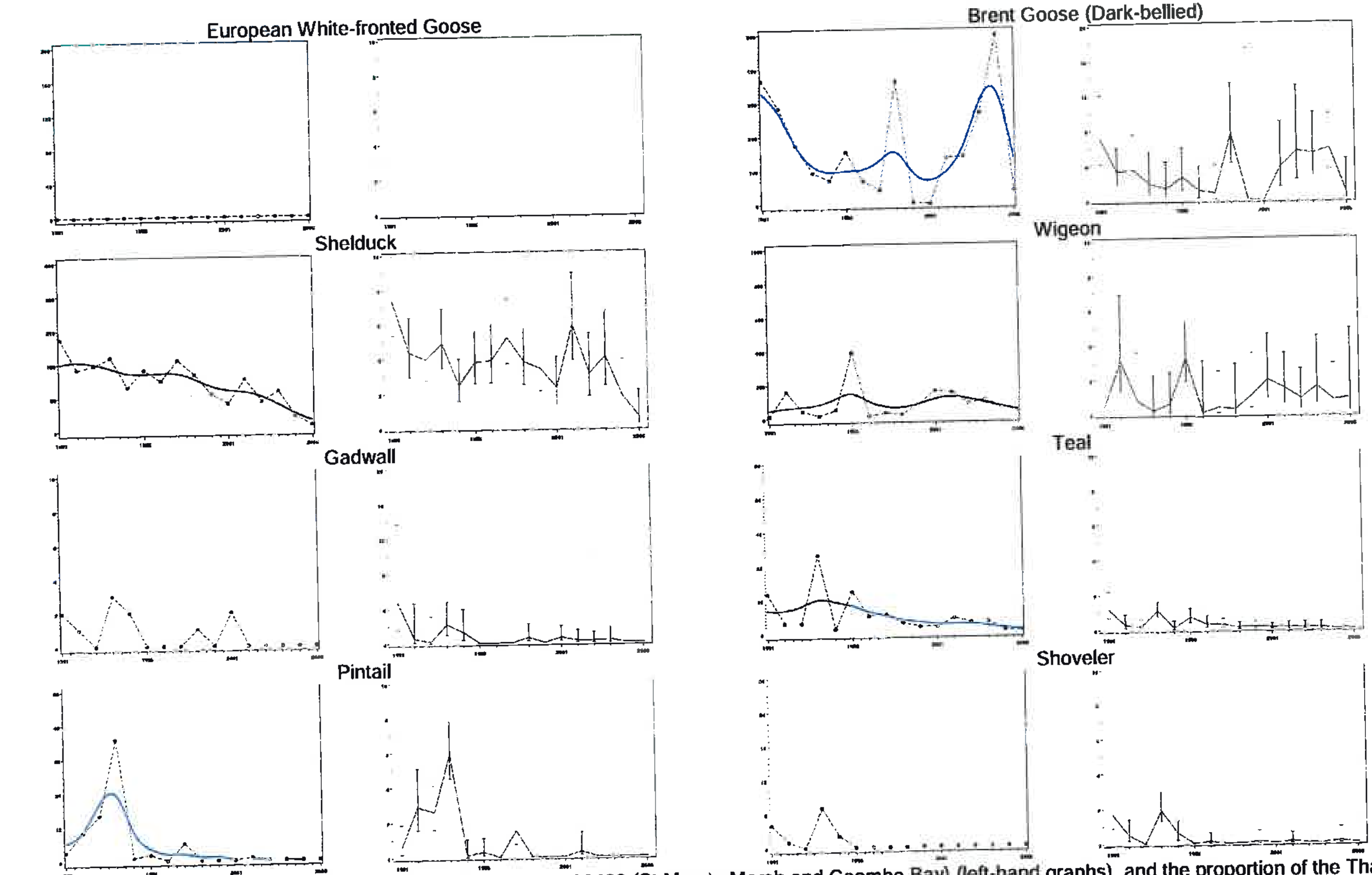
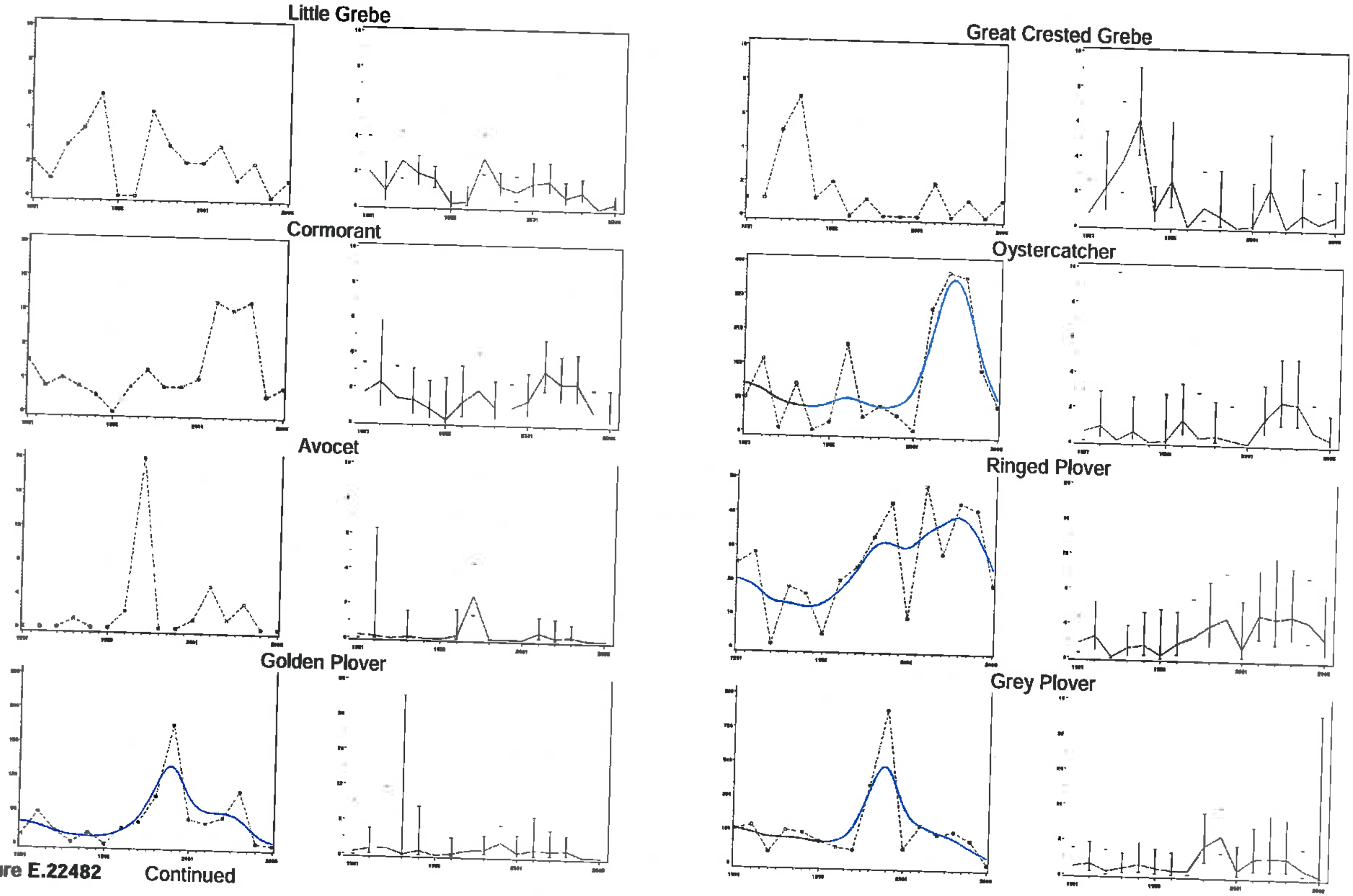


Figure E.22482 Population trends of each species in sector 22482 (St Mary`s Marsh and Coombe Bay) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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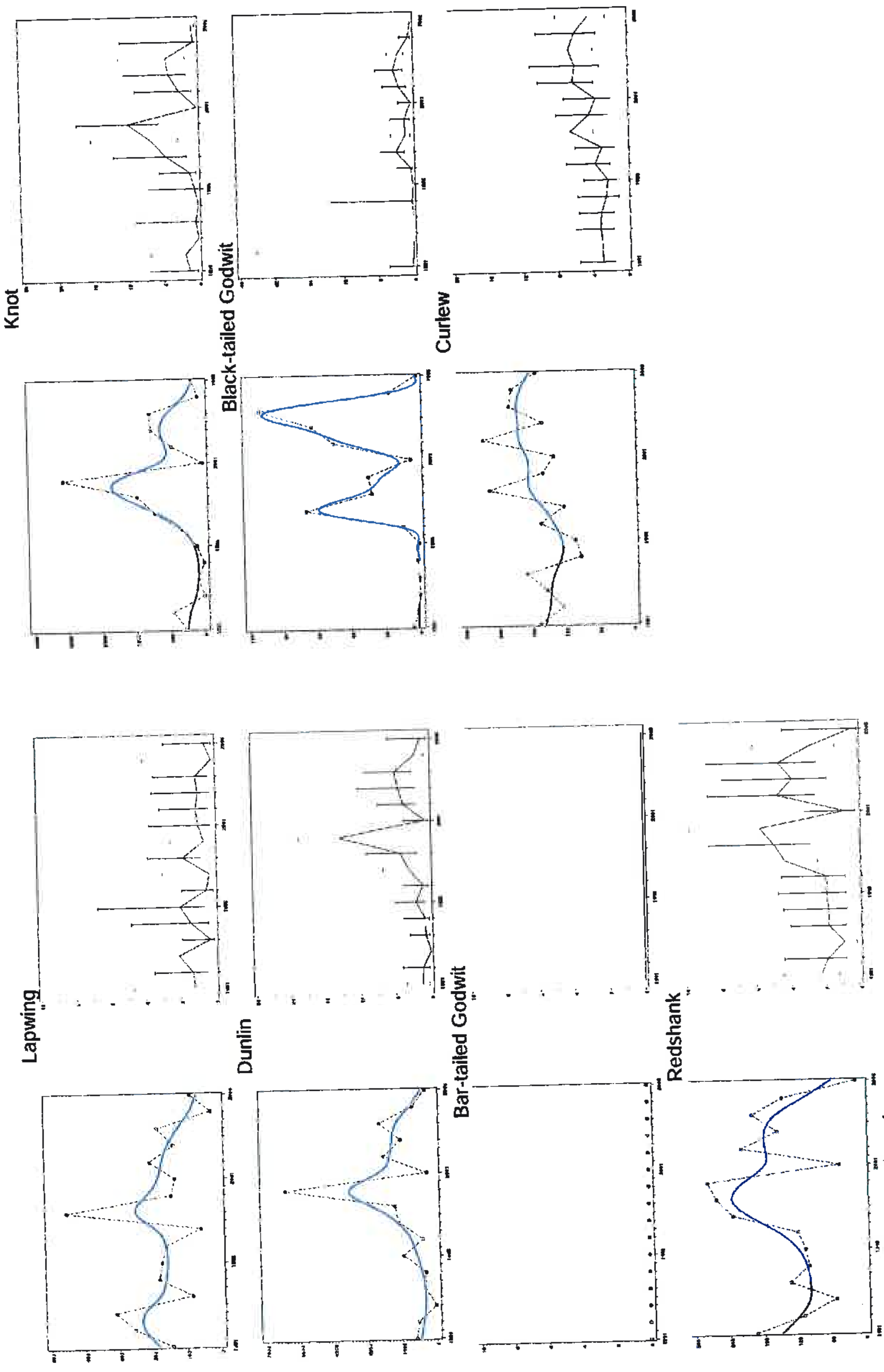

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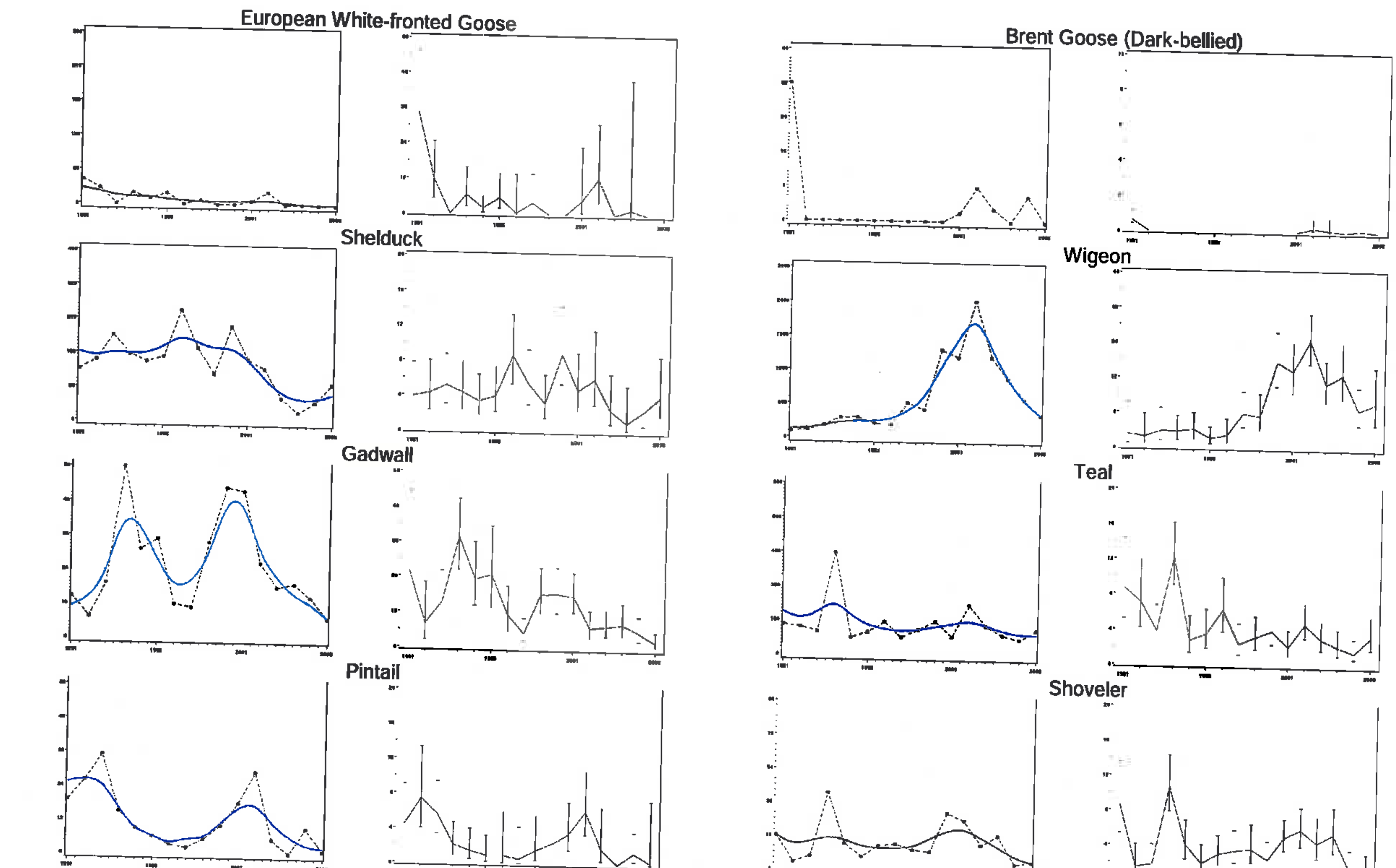
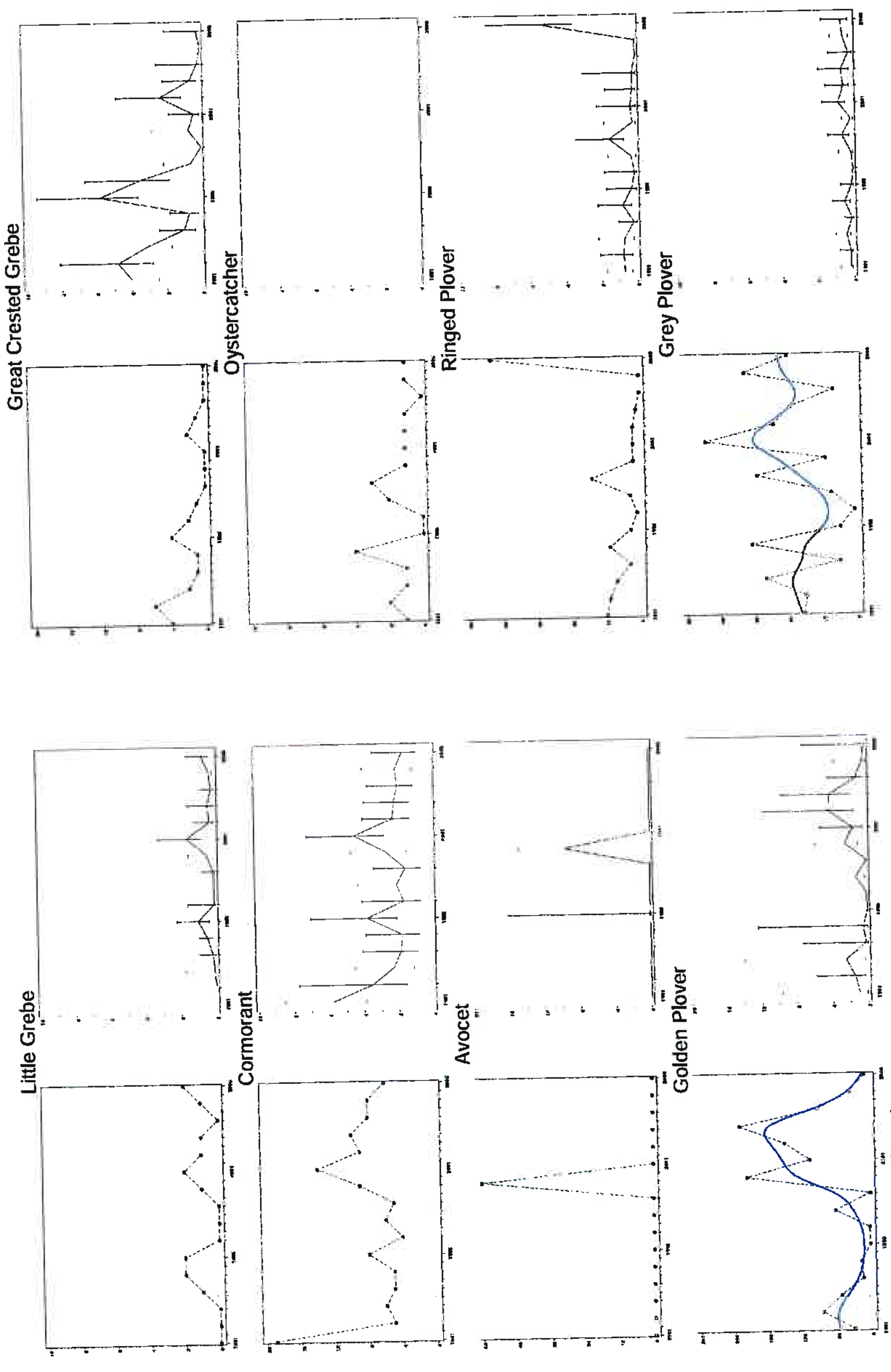


Figure E.22484 Population trends of each species in sector 22484 (Cliffe and Cooling Marshes area) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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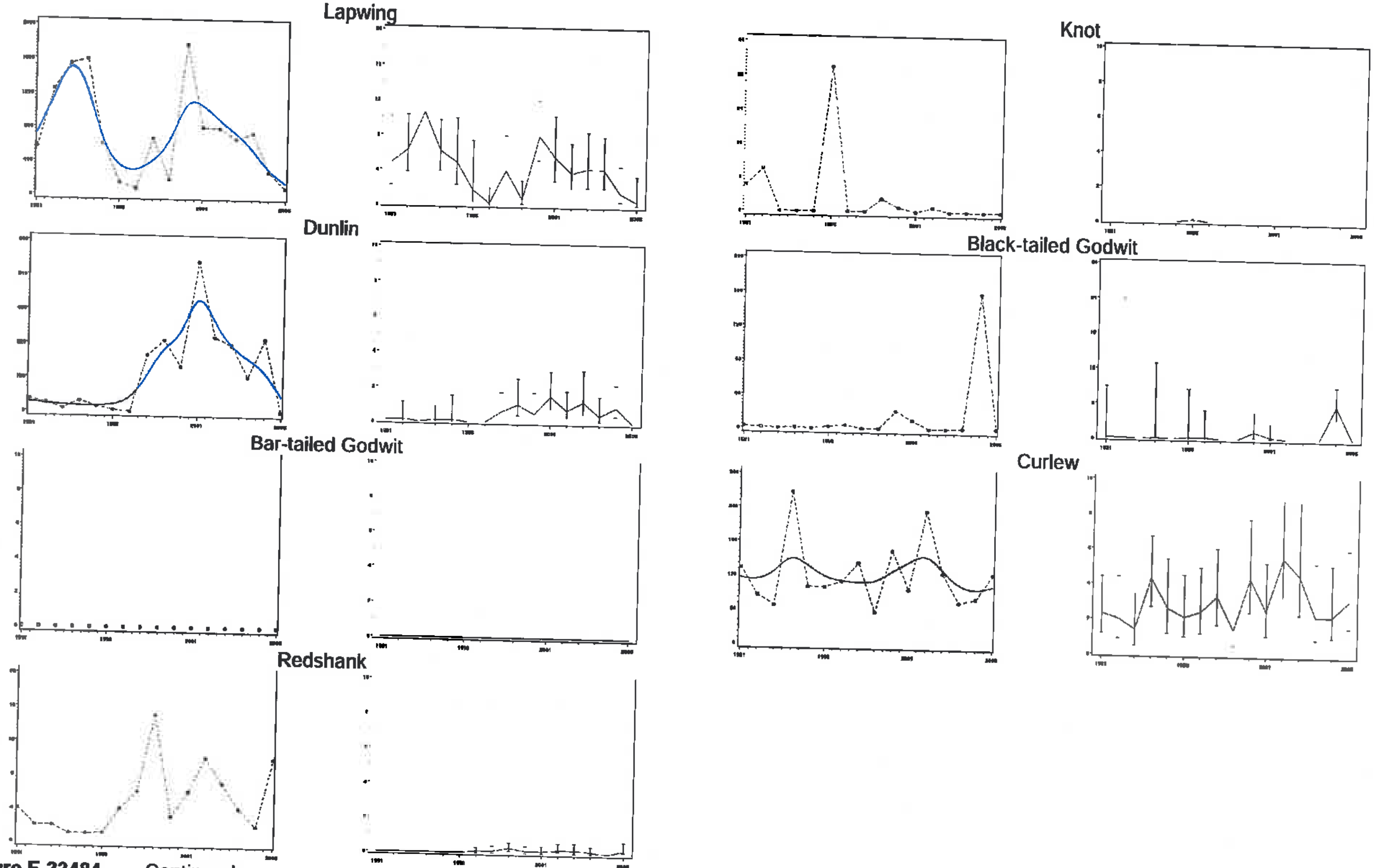

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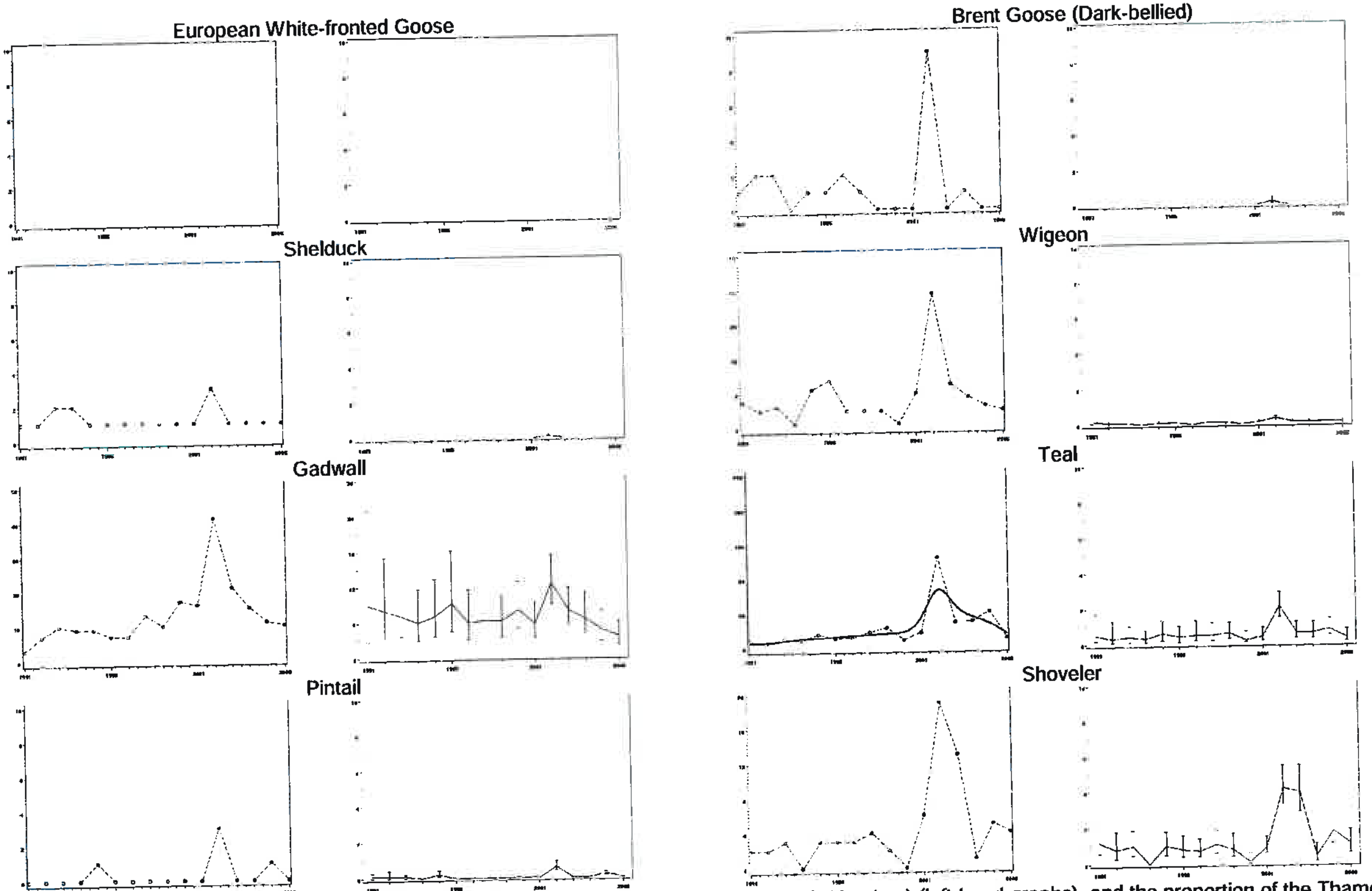
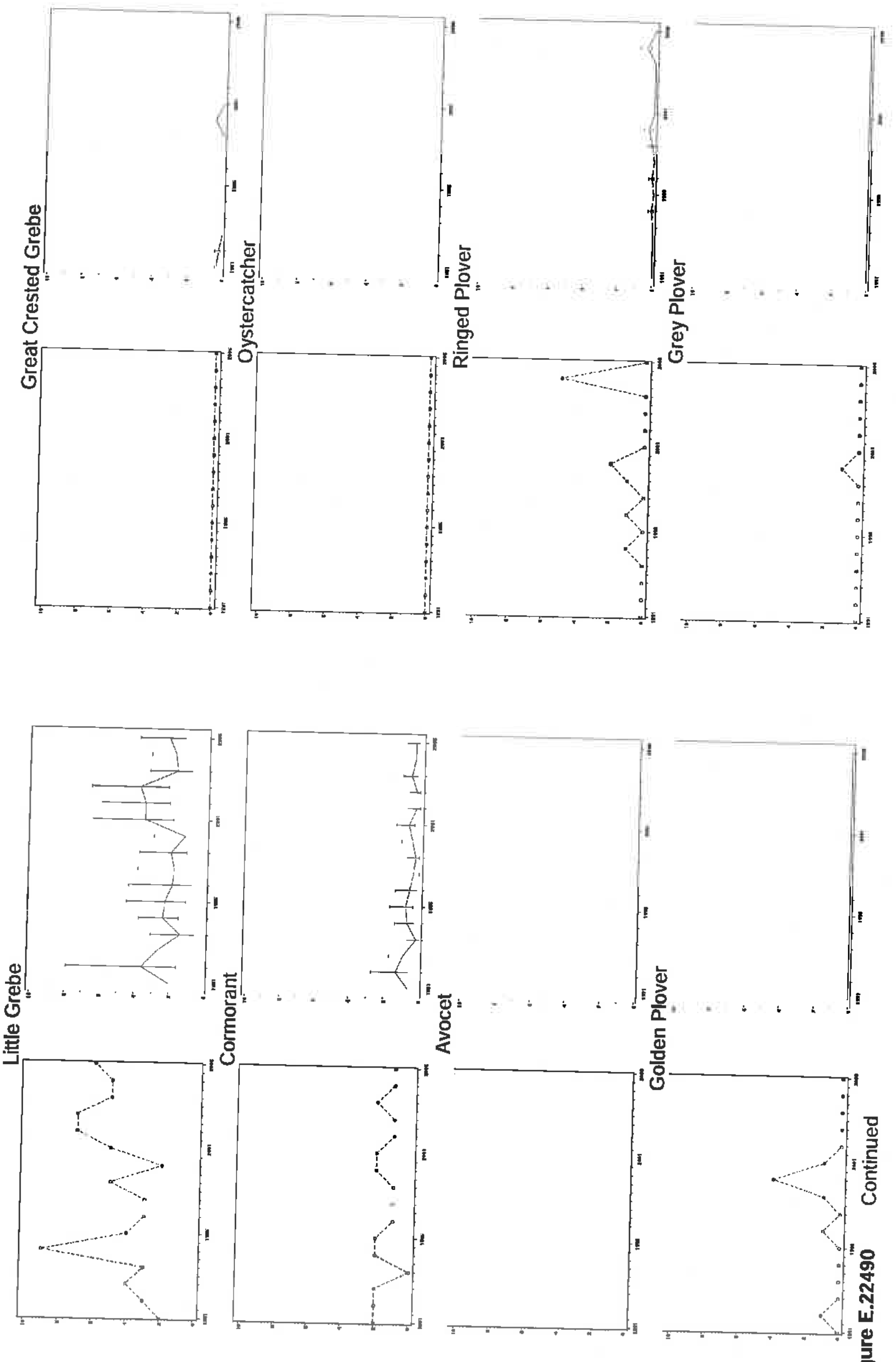


Figure E.22490 Population trends of each species in sector 22490 (Shorne and Filborough Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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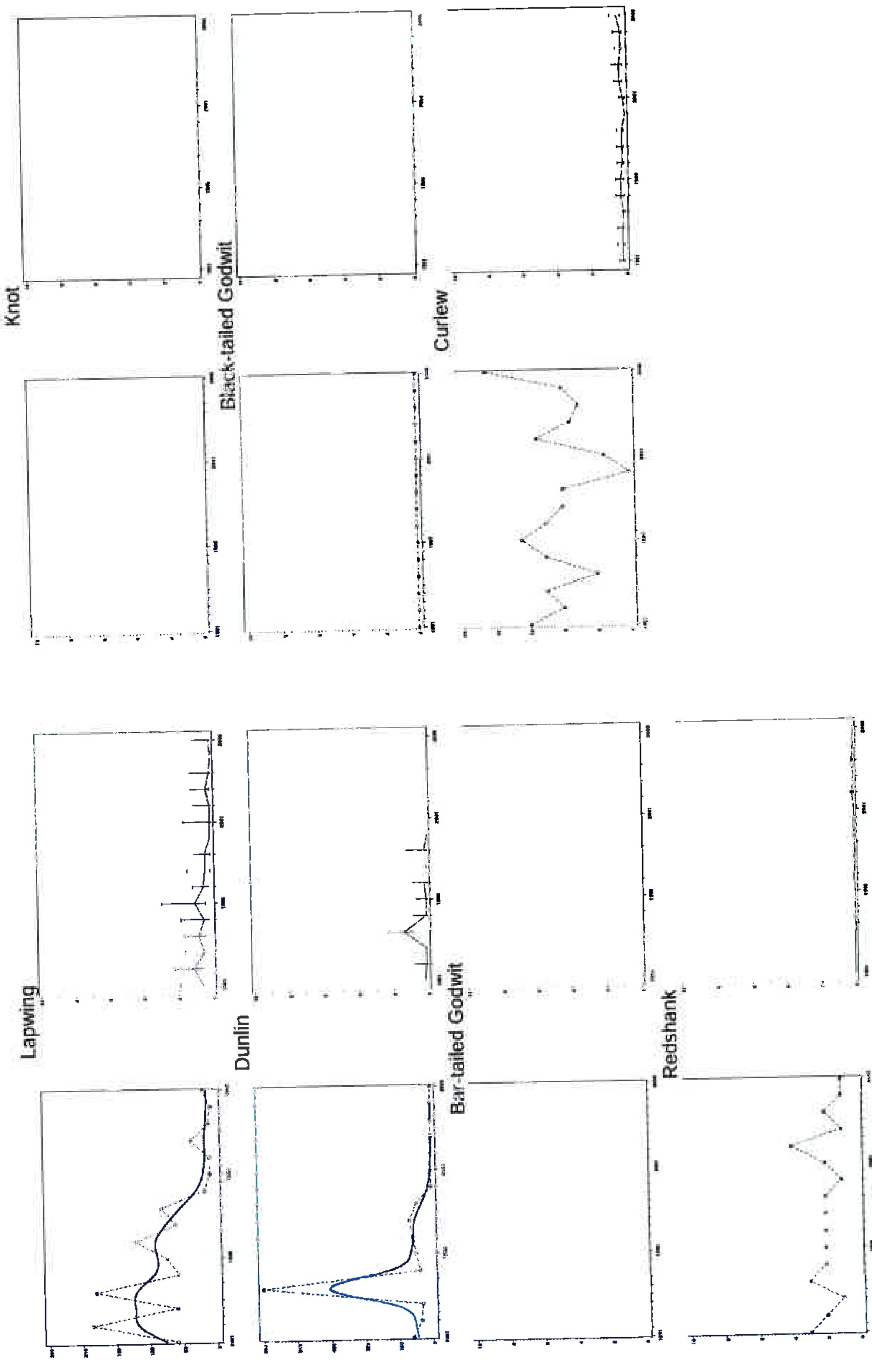

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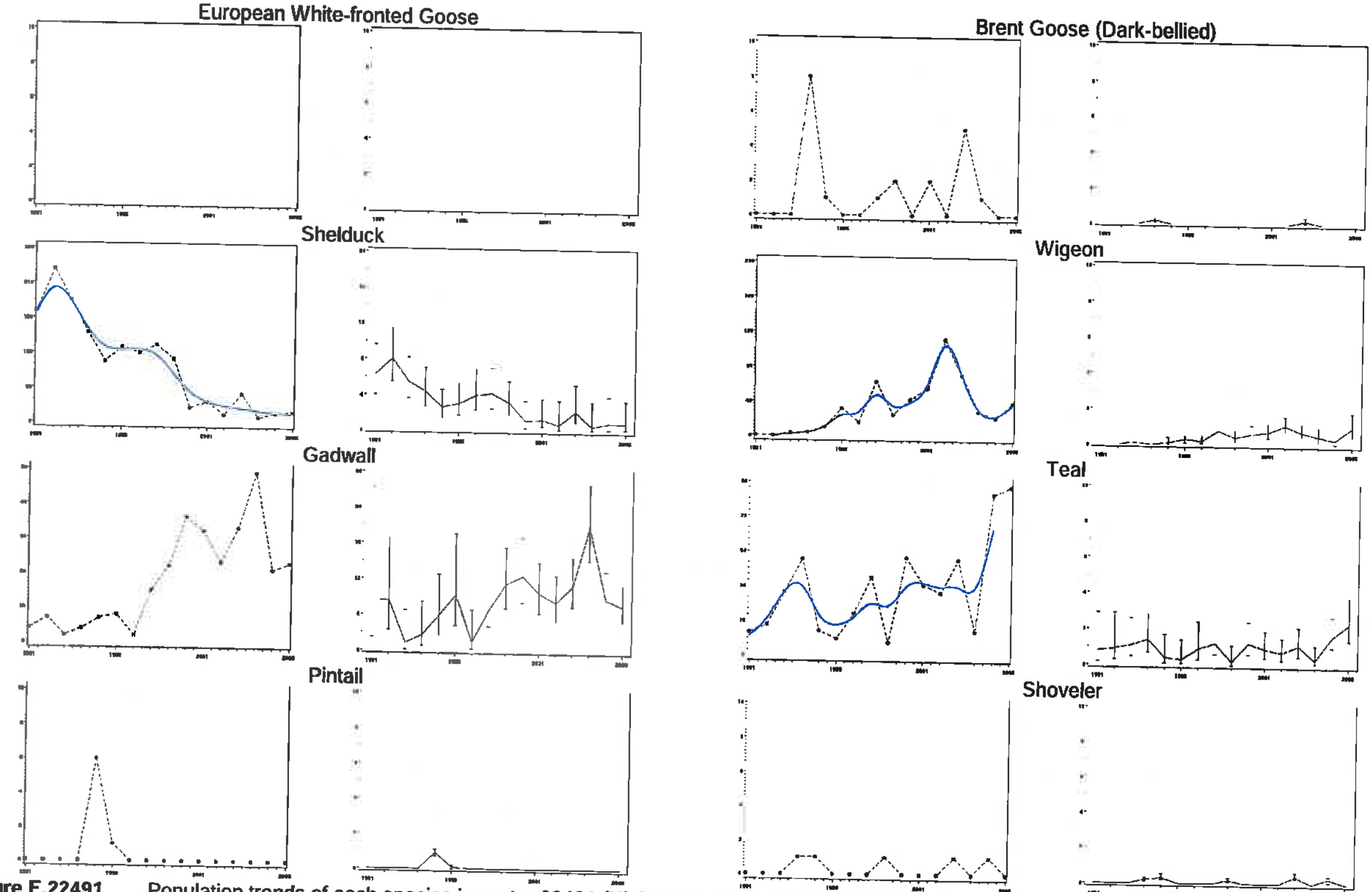
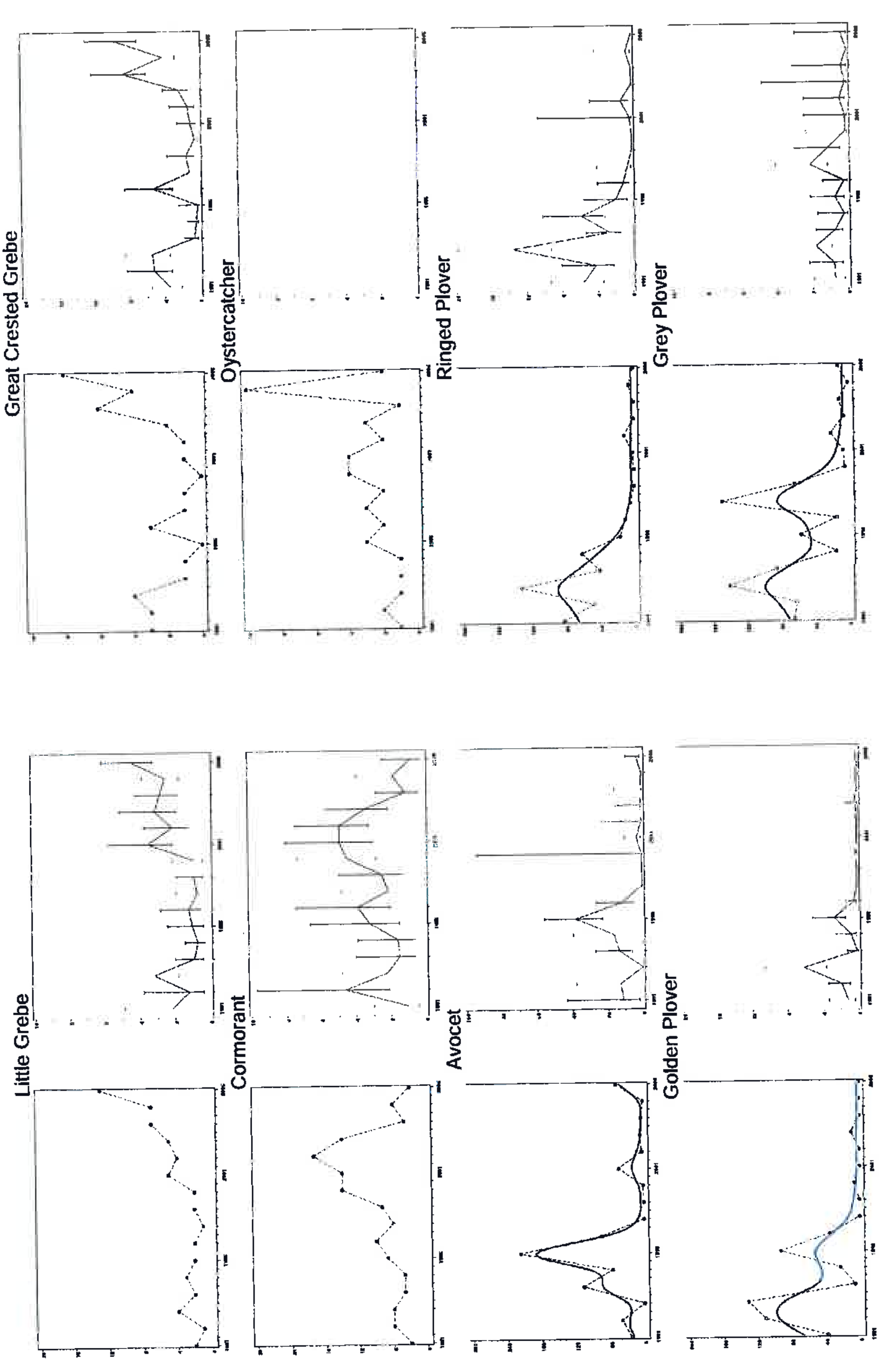


Figure E.22491 Population trends of each species in sector 22491 (Higham Marsh and Bight) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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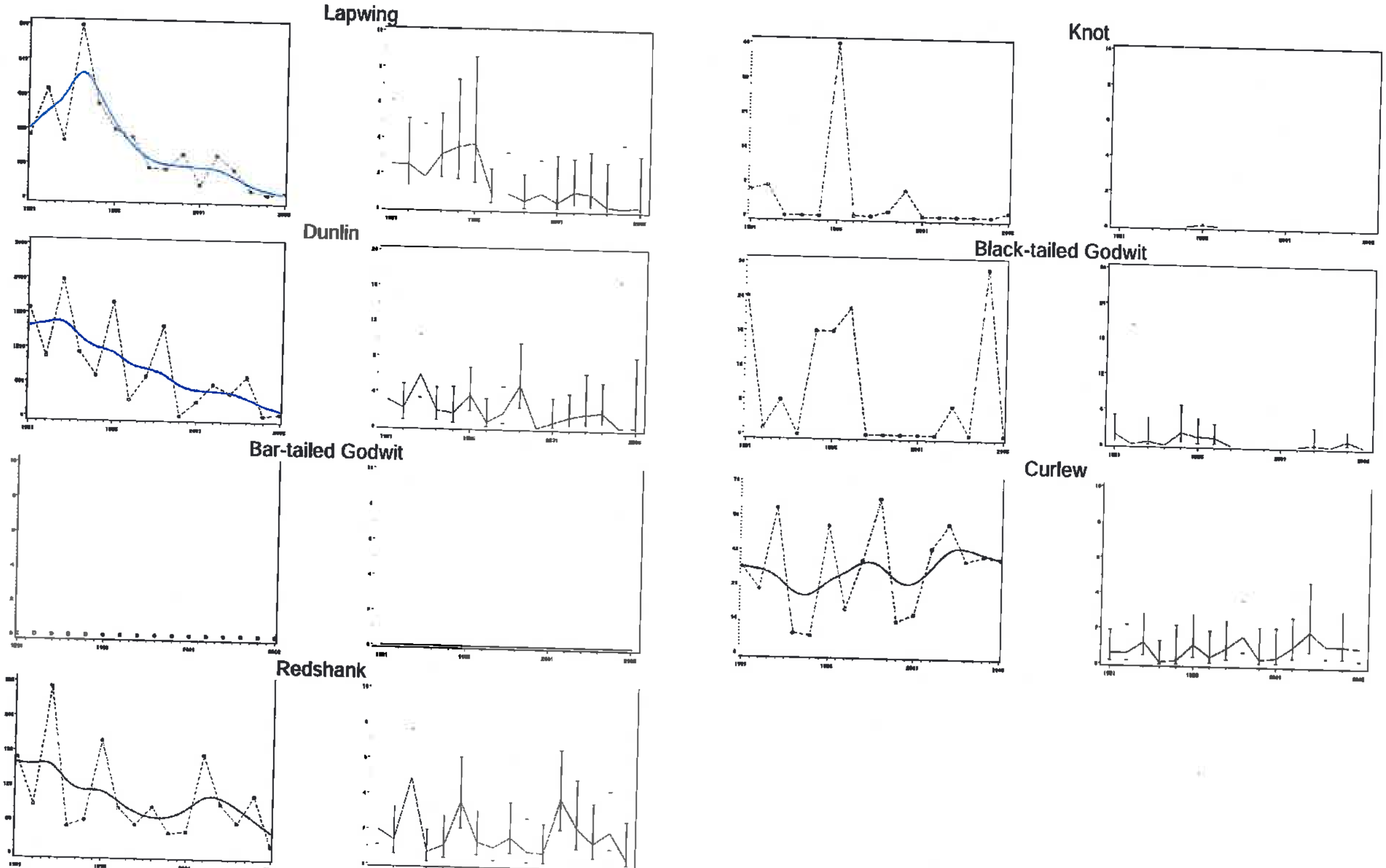

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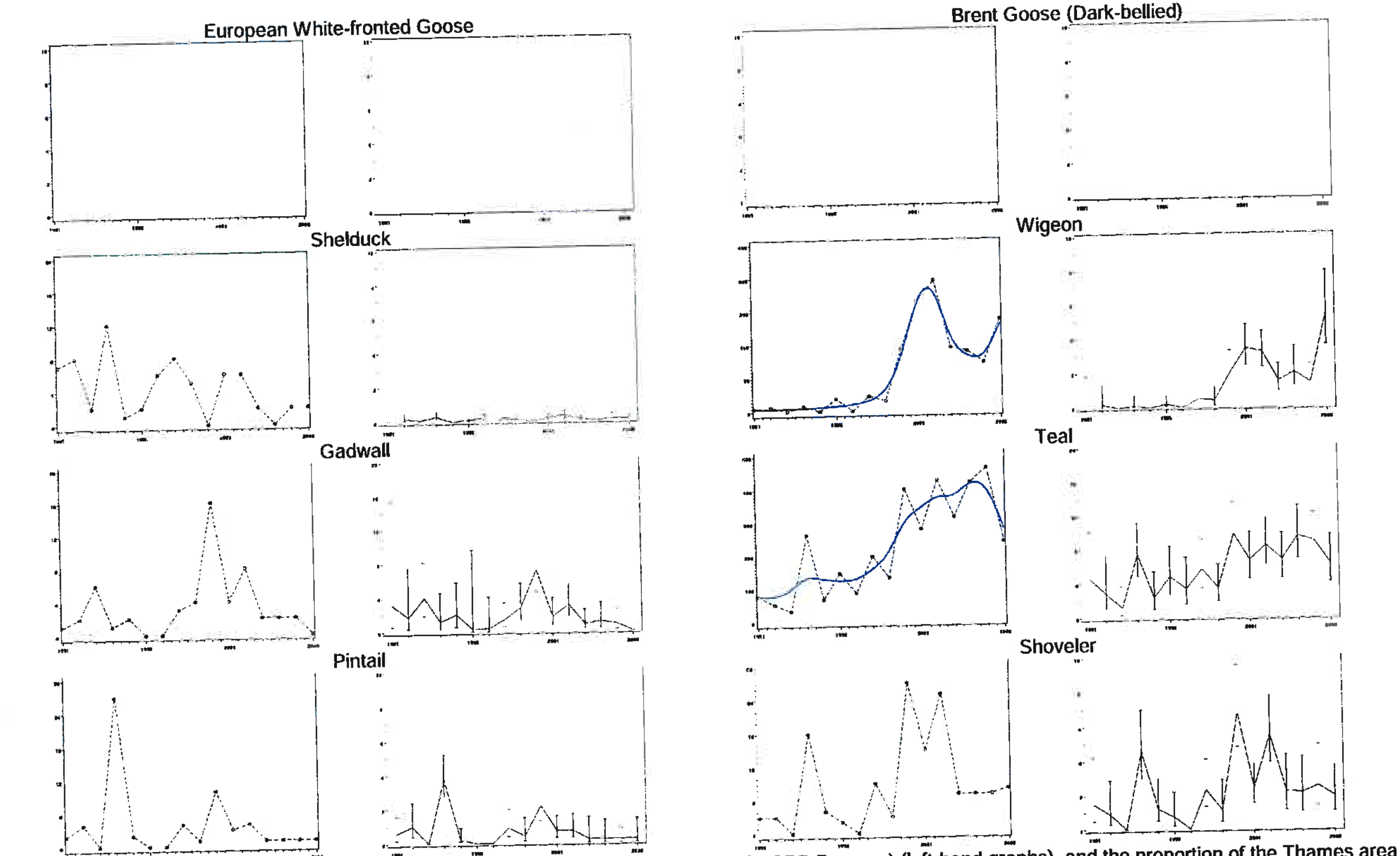
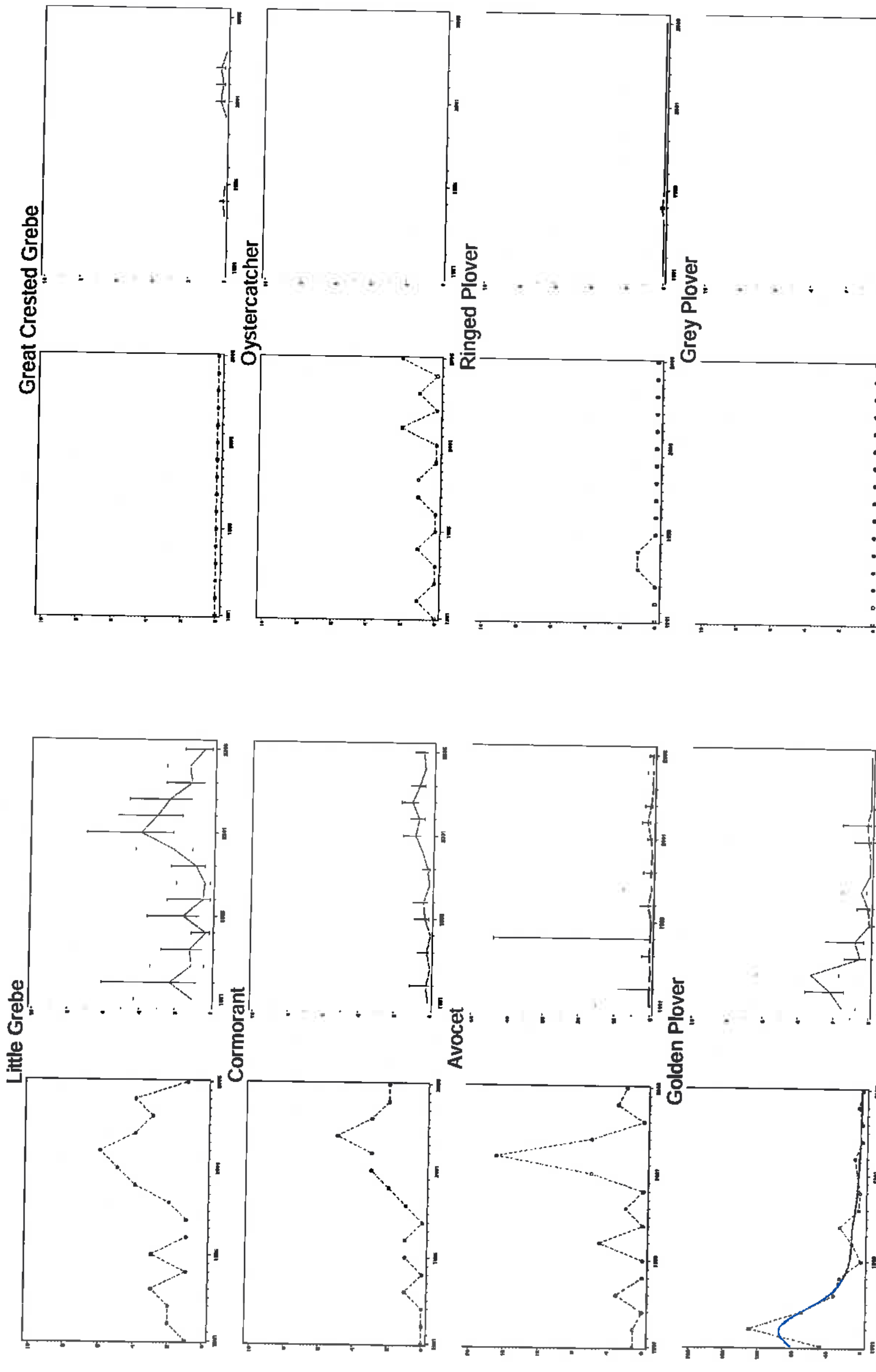


Figure E.22493 Population trends of each species in sector 22493 (Northward Hill RSPB Reserve) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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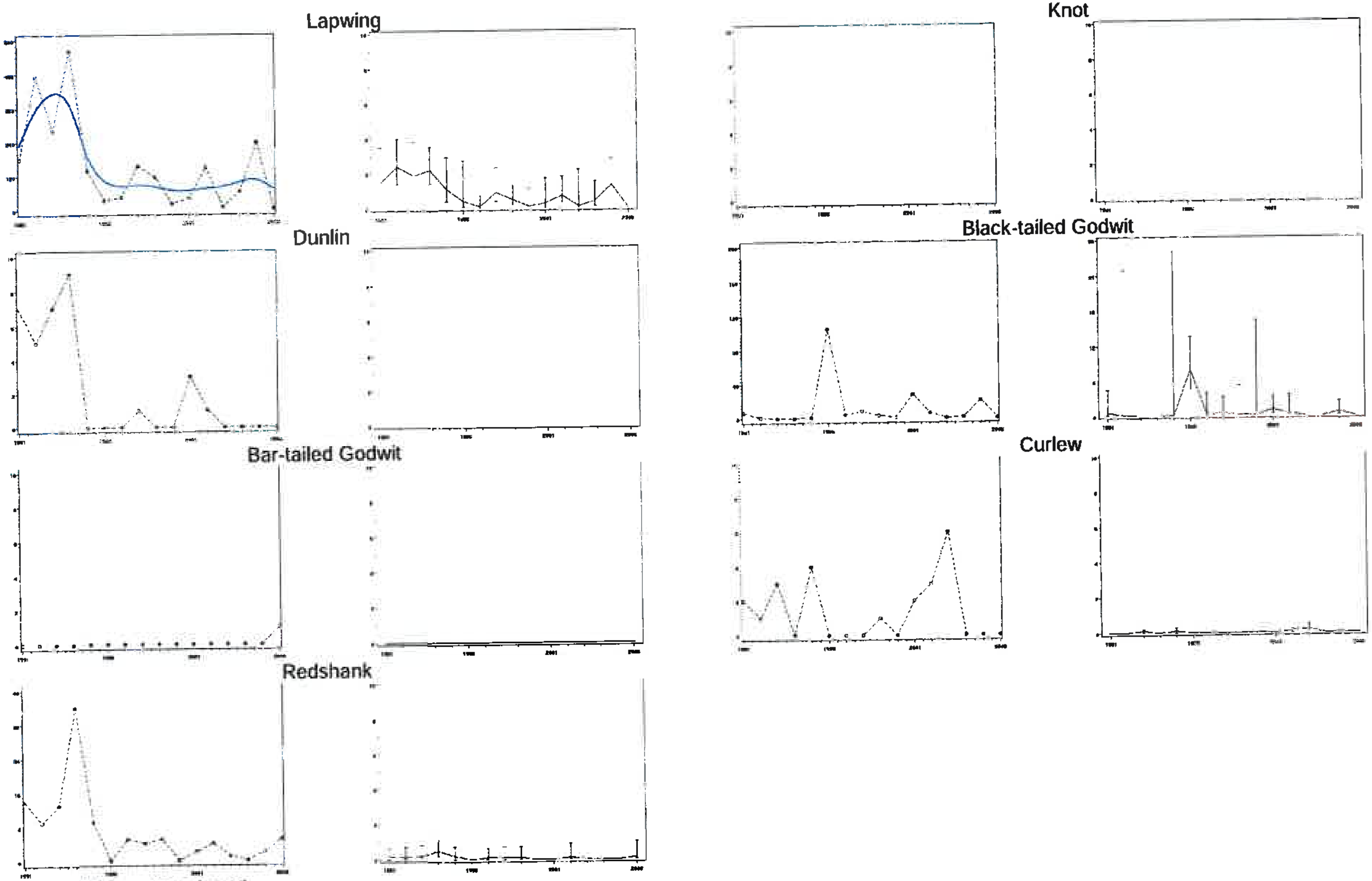

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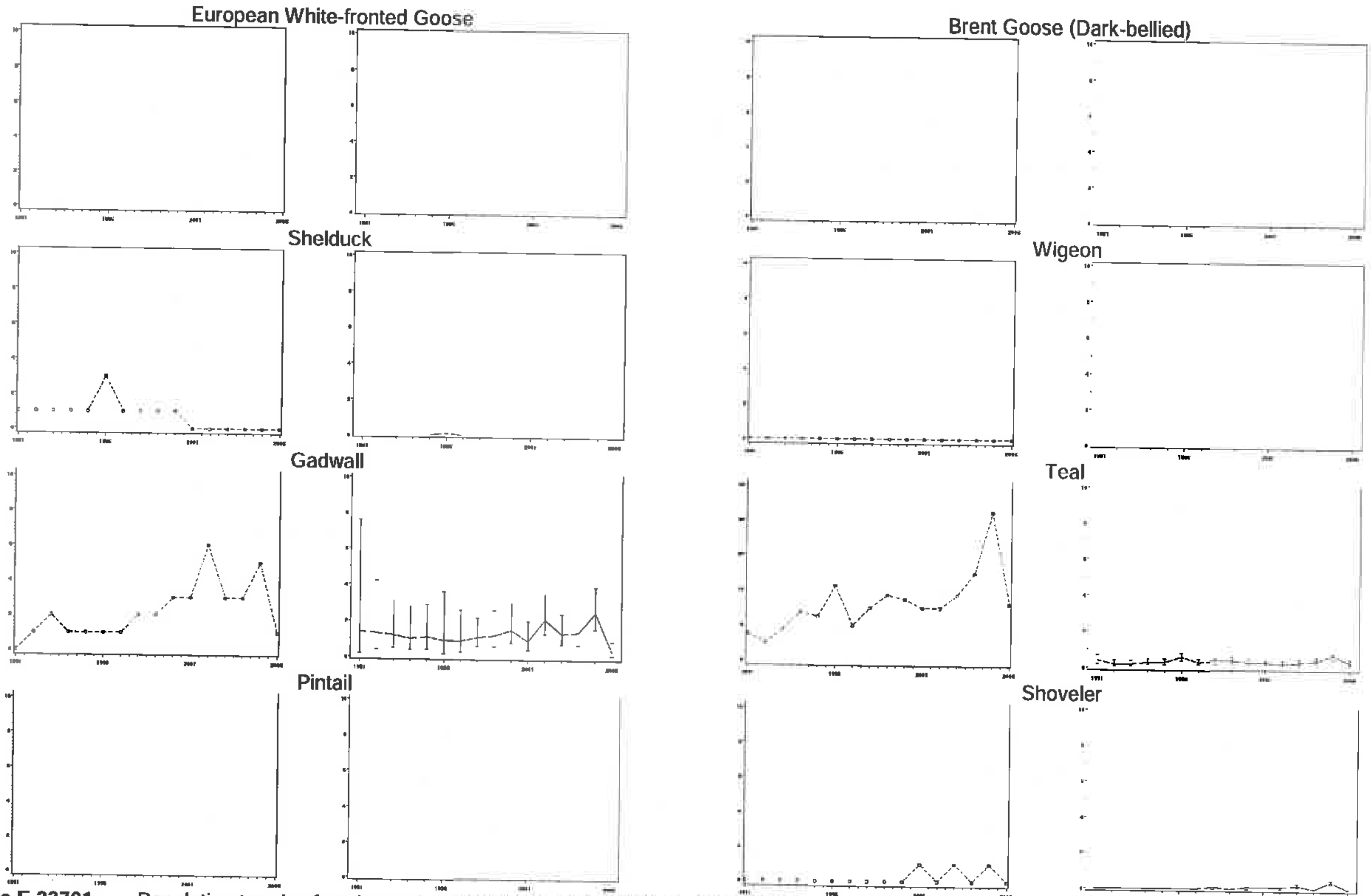
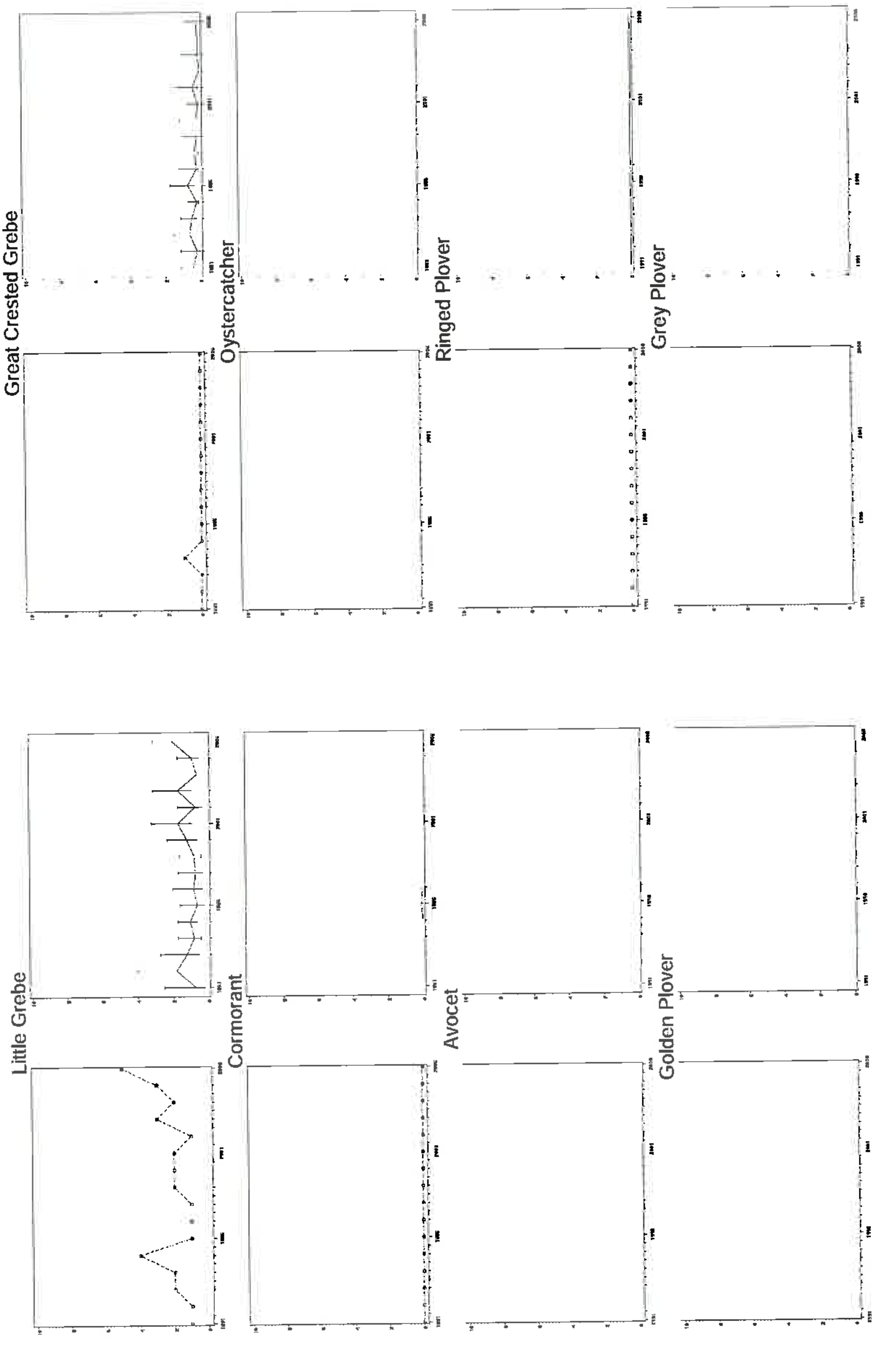


Figure E.22701 Population trends of each species in sector 22701 (Clubb Pits) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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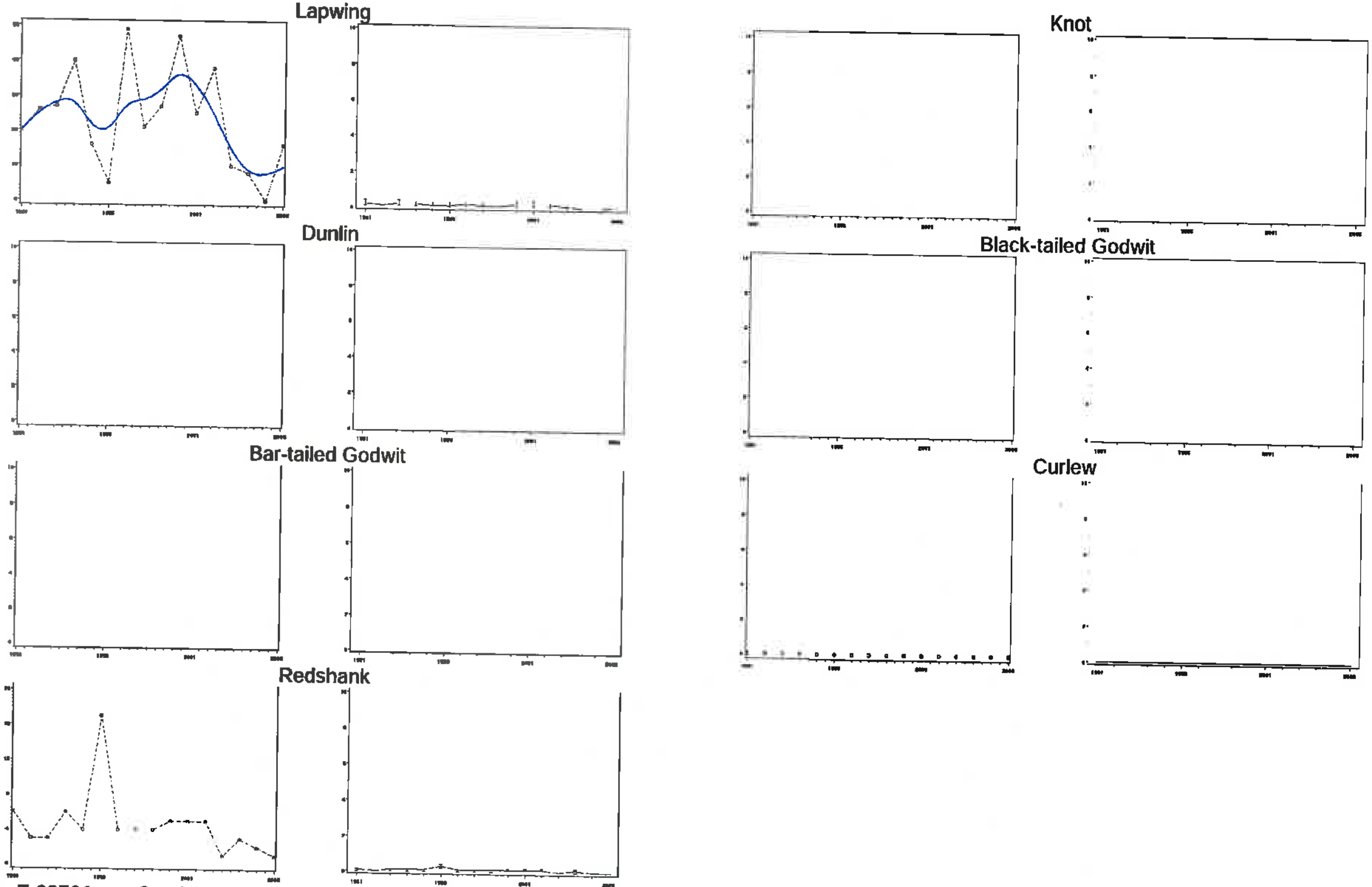

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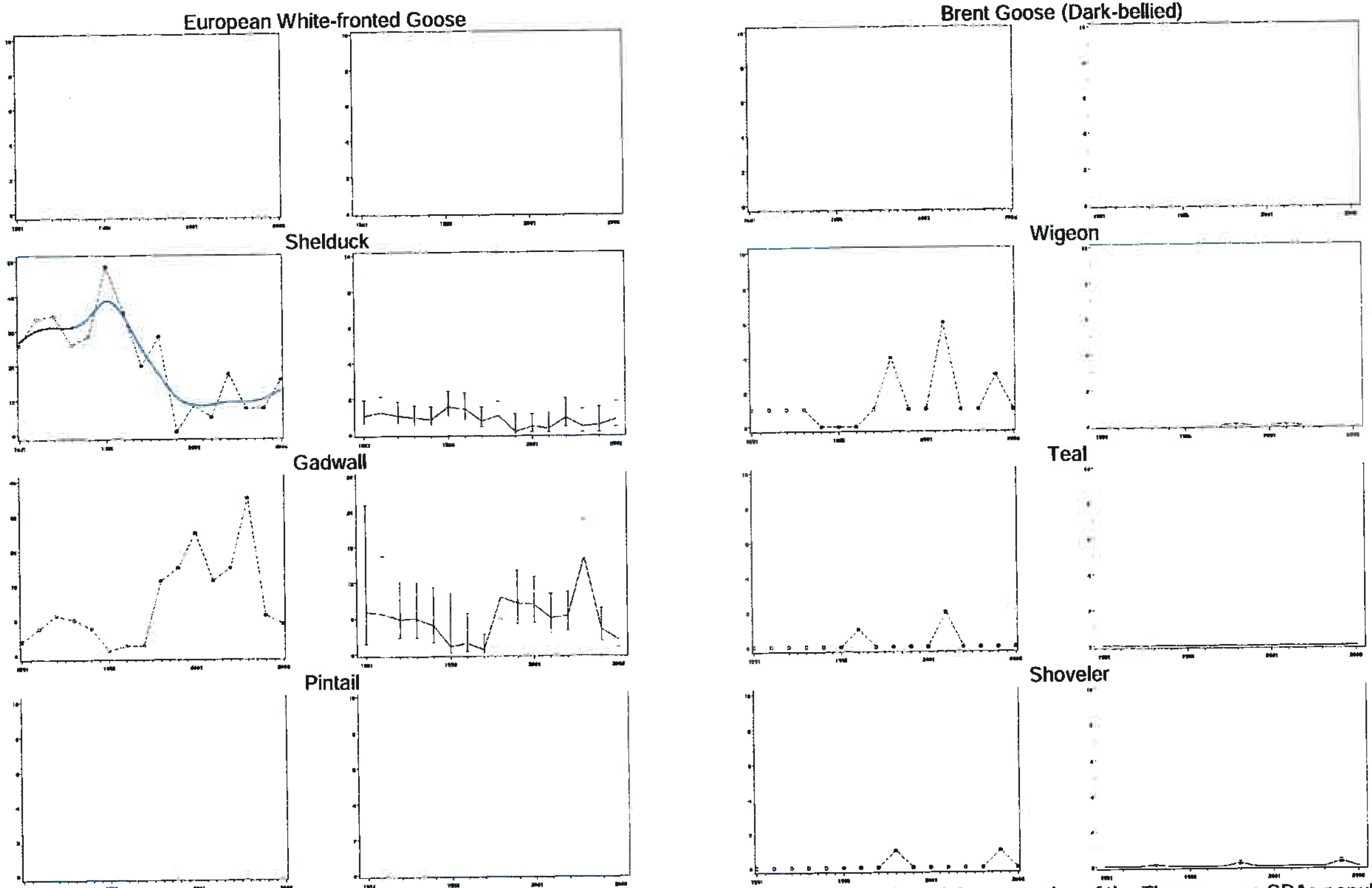
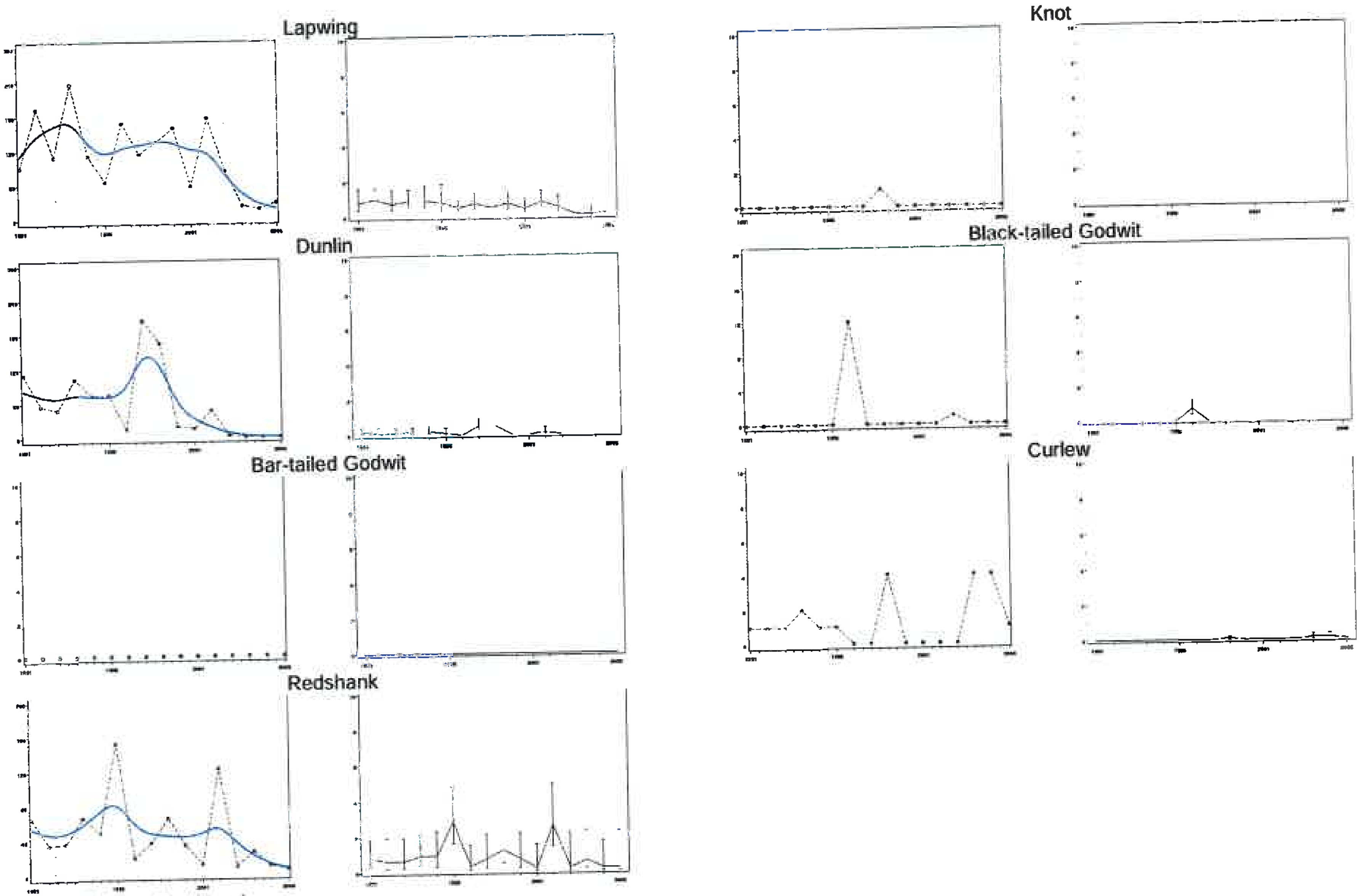


Figure E.22702 Population trends of each species in sector 22702 (Timber Lake) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

Figure E.22702 Continued



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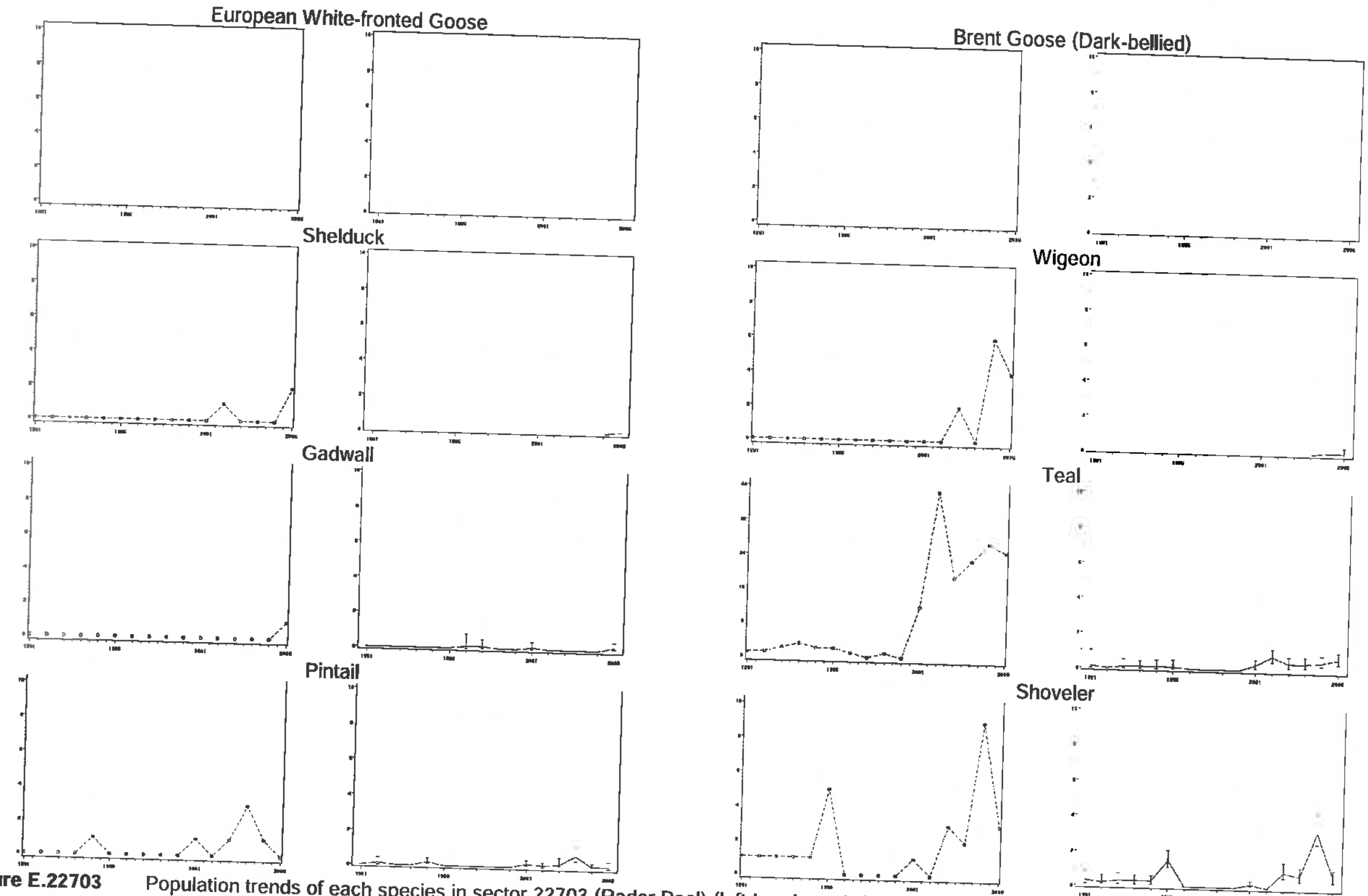
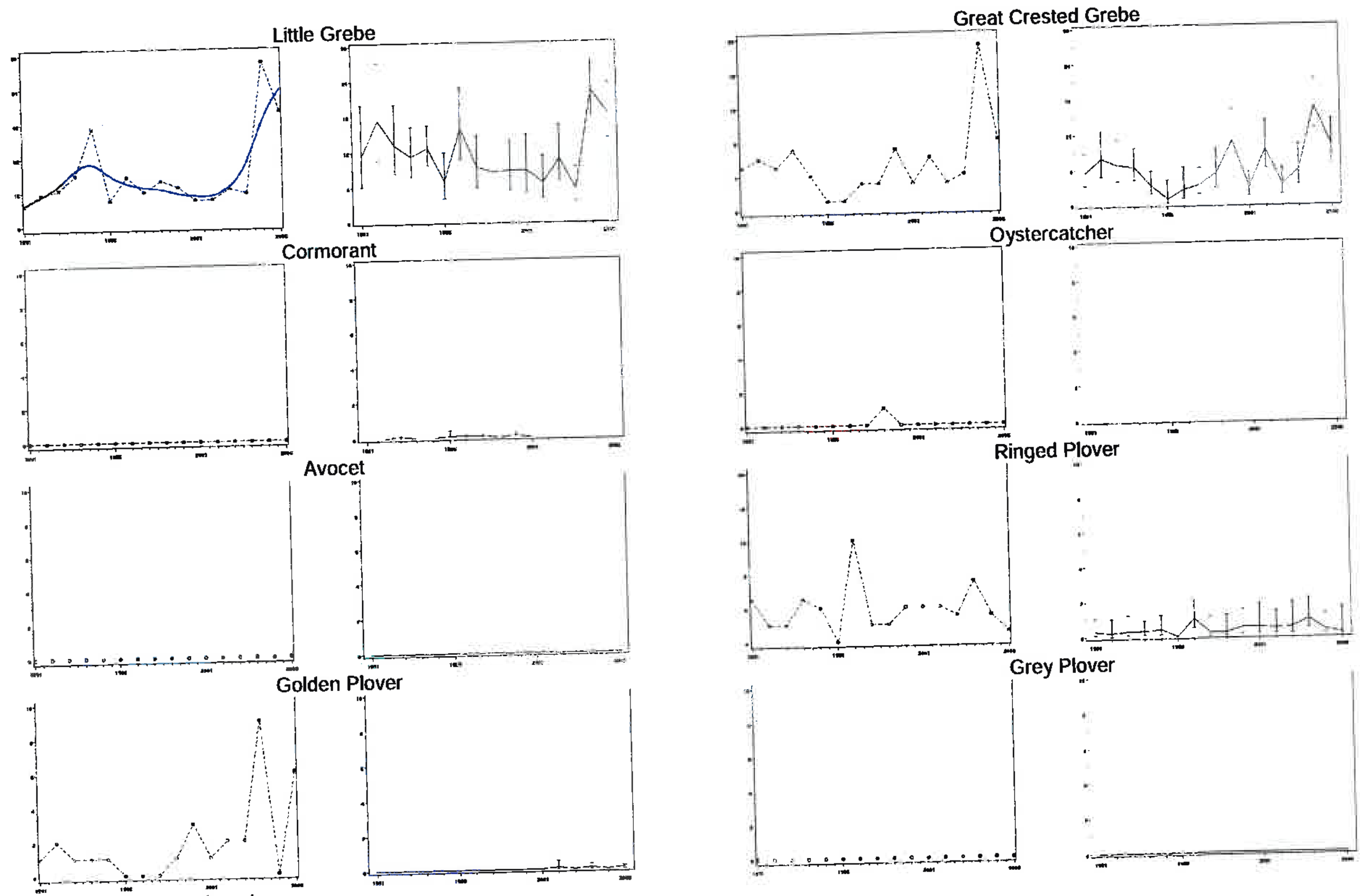


Figure E.22703 Population trends of each species in sector 22703 (Radar Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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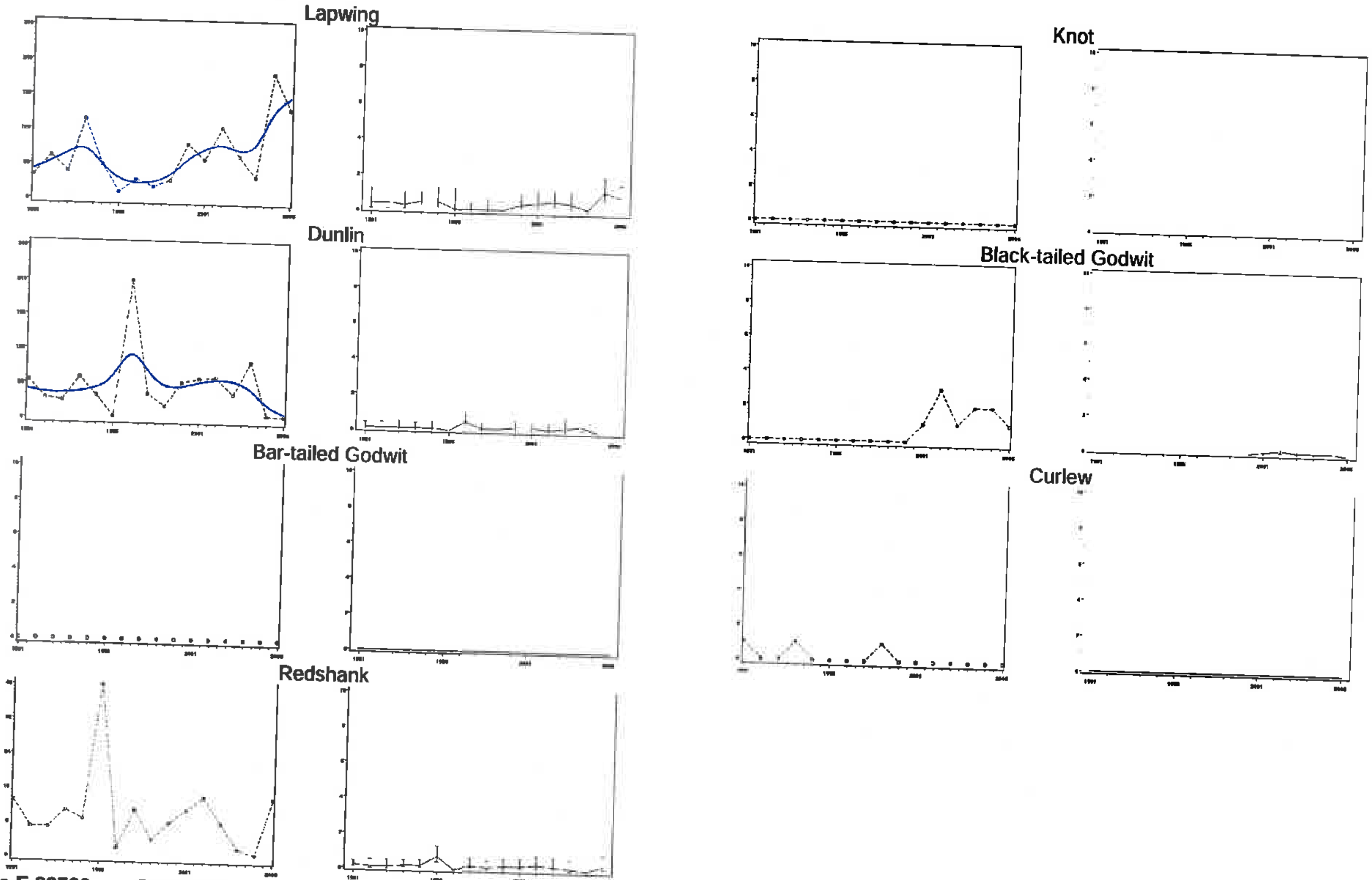

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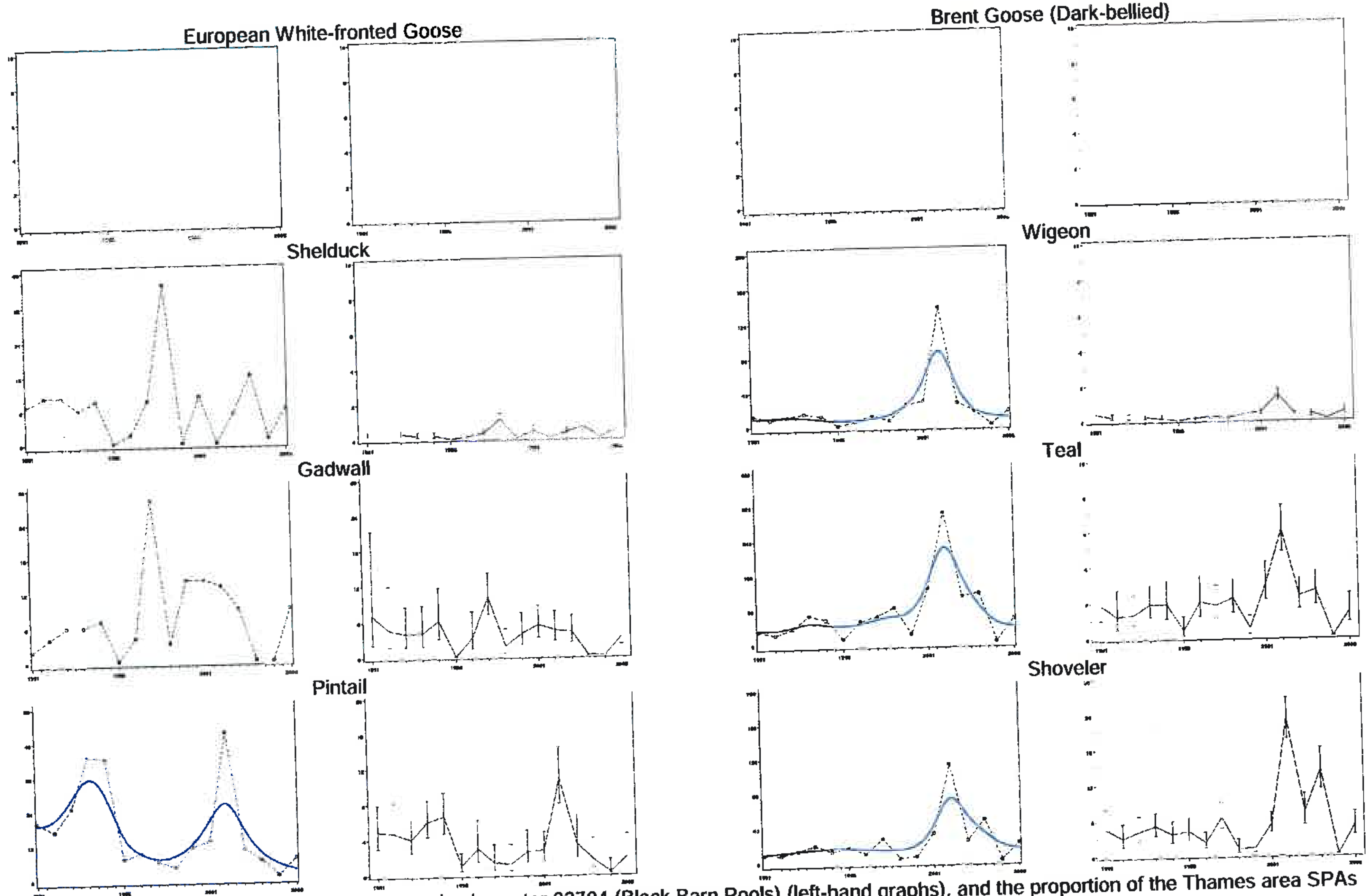
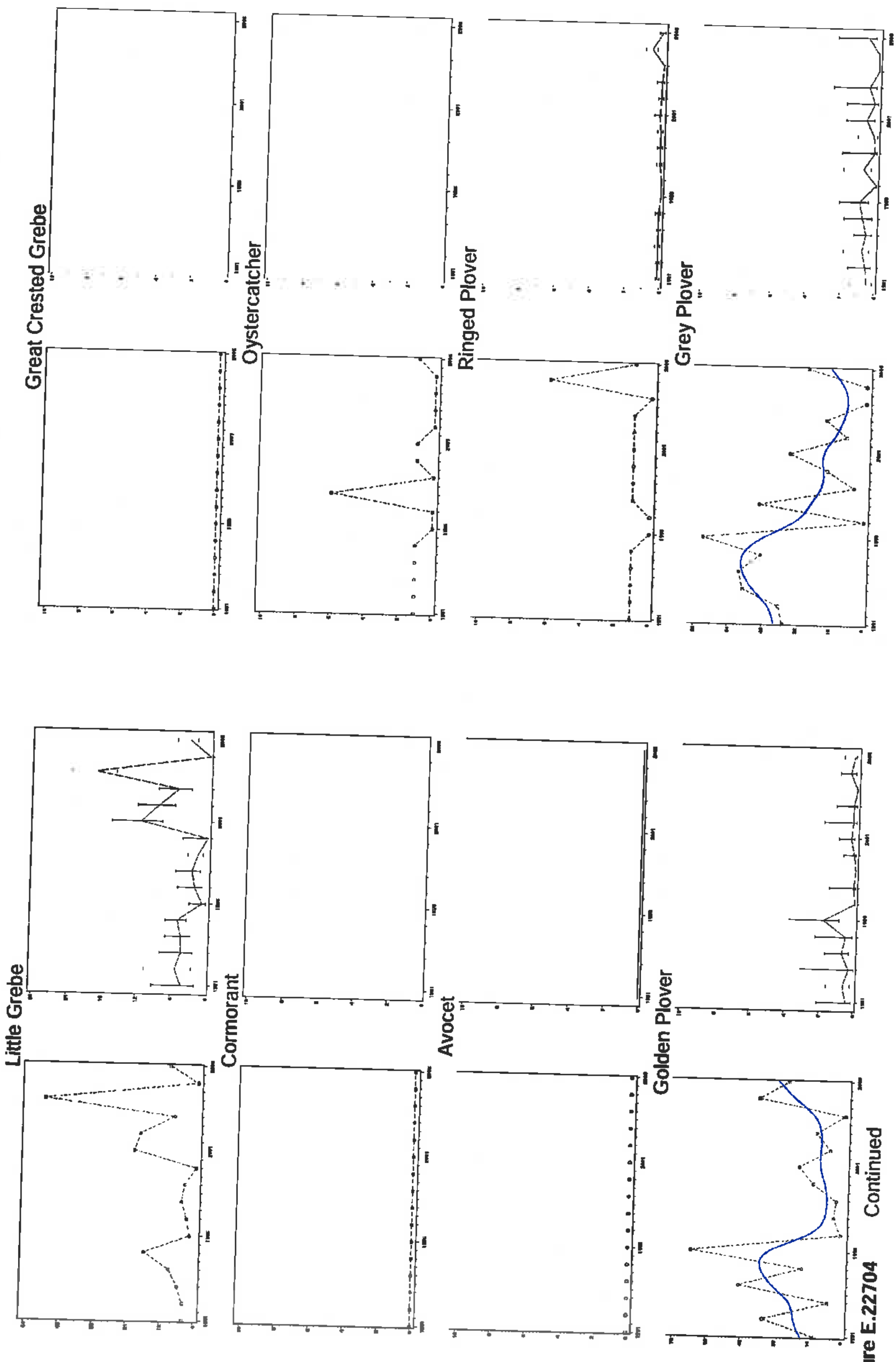


Figure E.22704 Population trends of each species in sector 22704 (Black Barn Pools) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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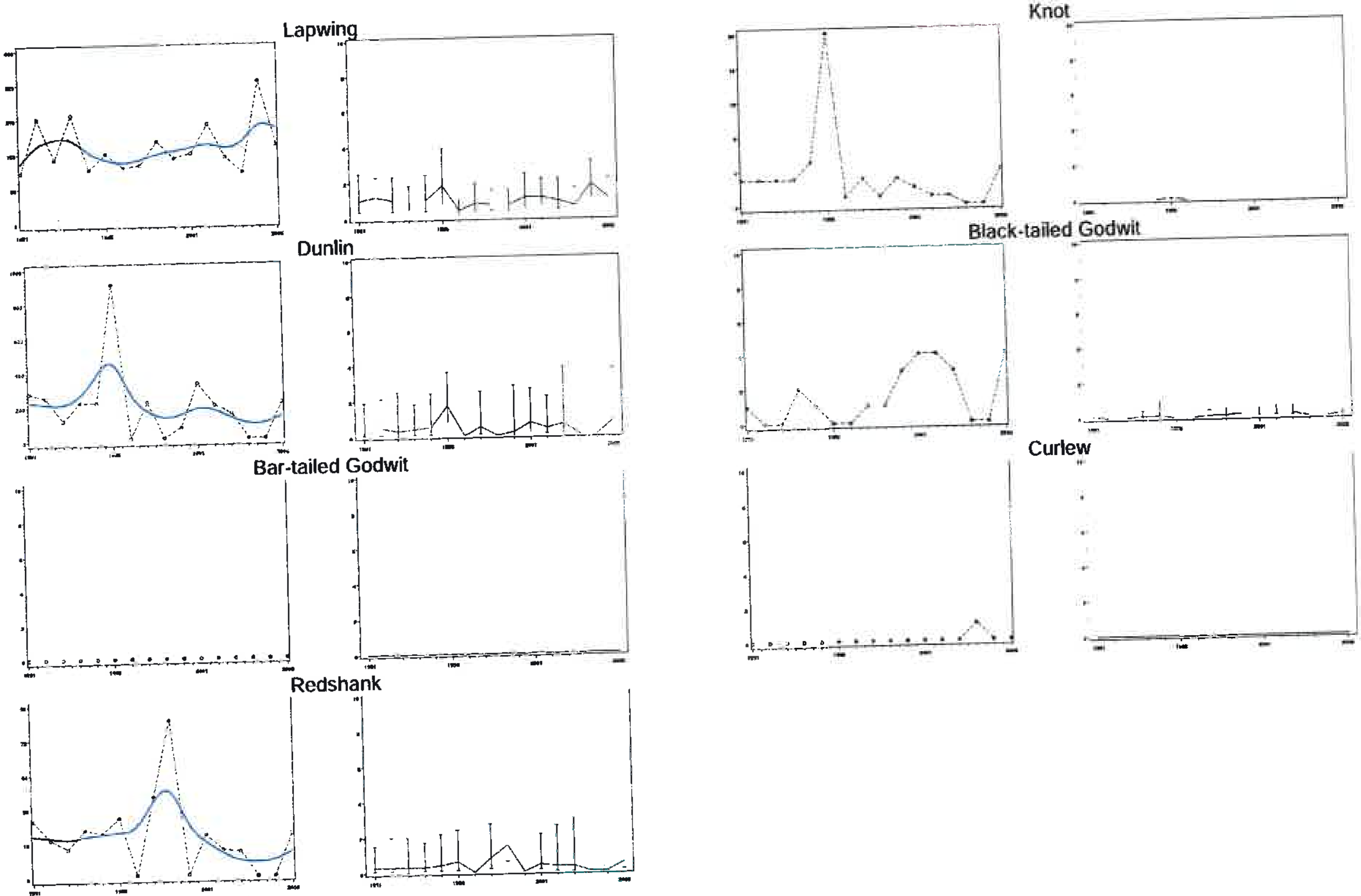

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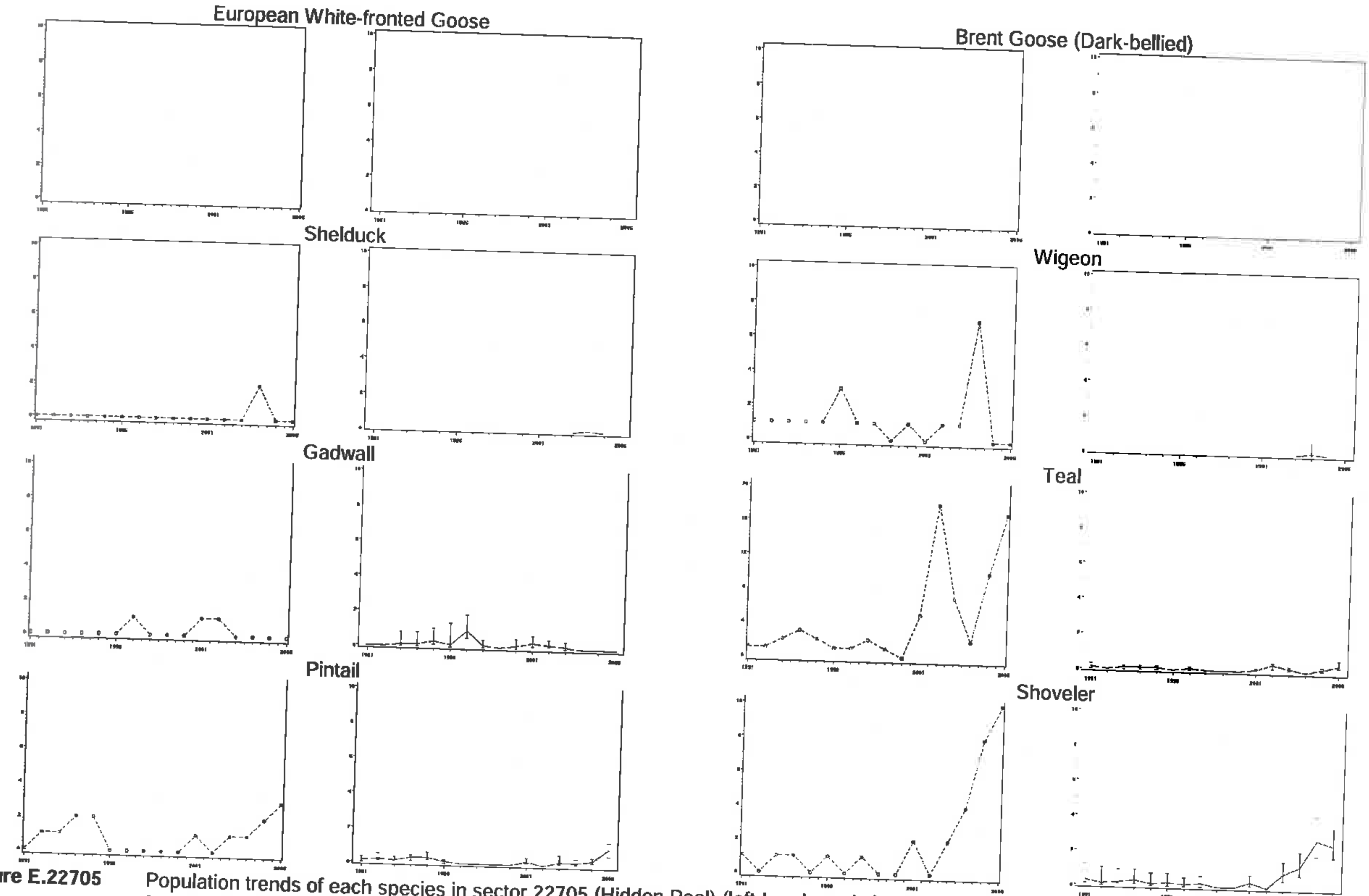
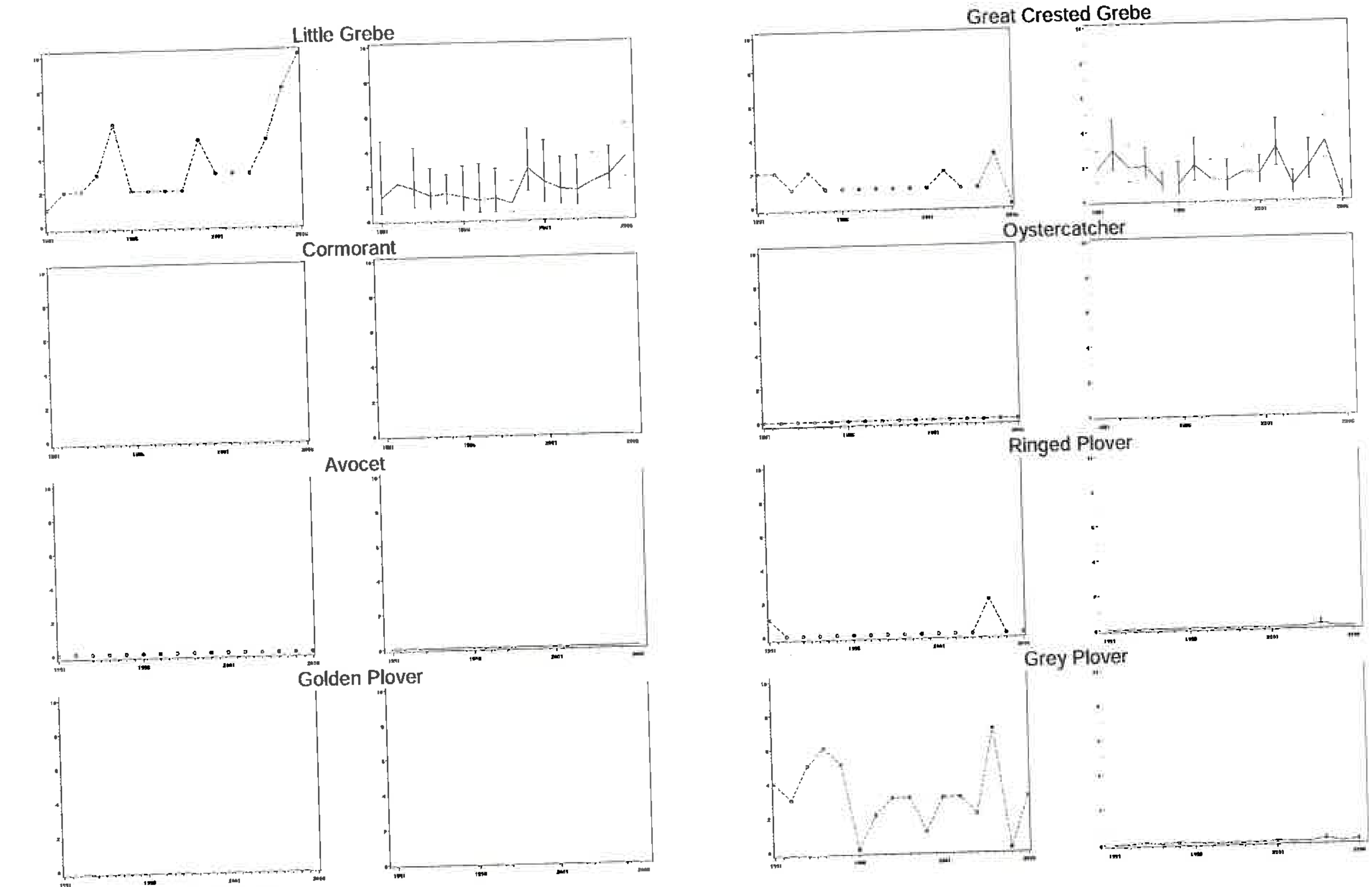


Figure E.22705 Population trends of each species in sector 22705 (Hidden Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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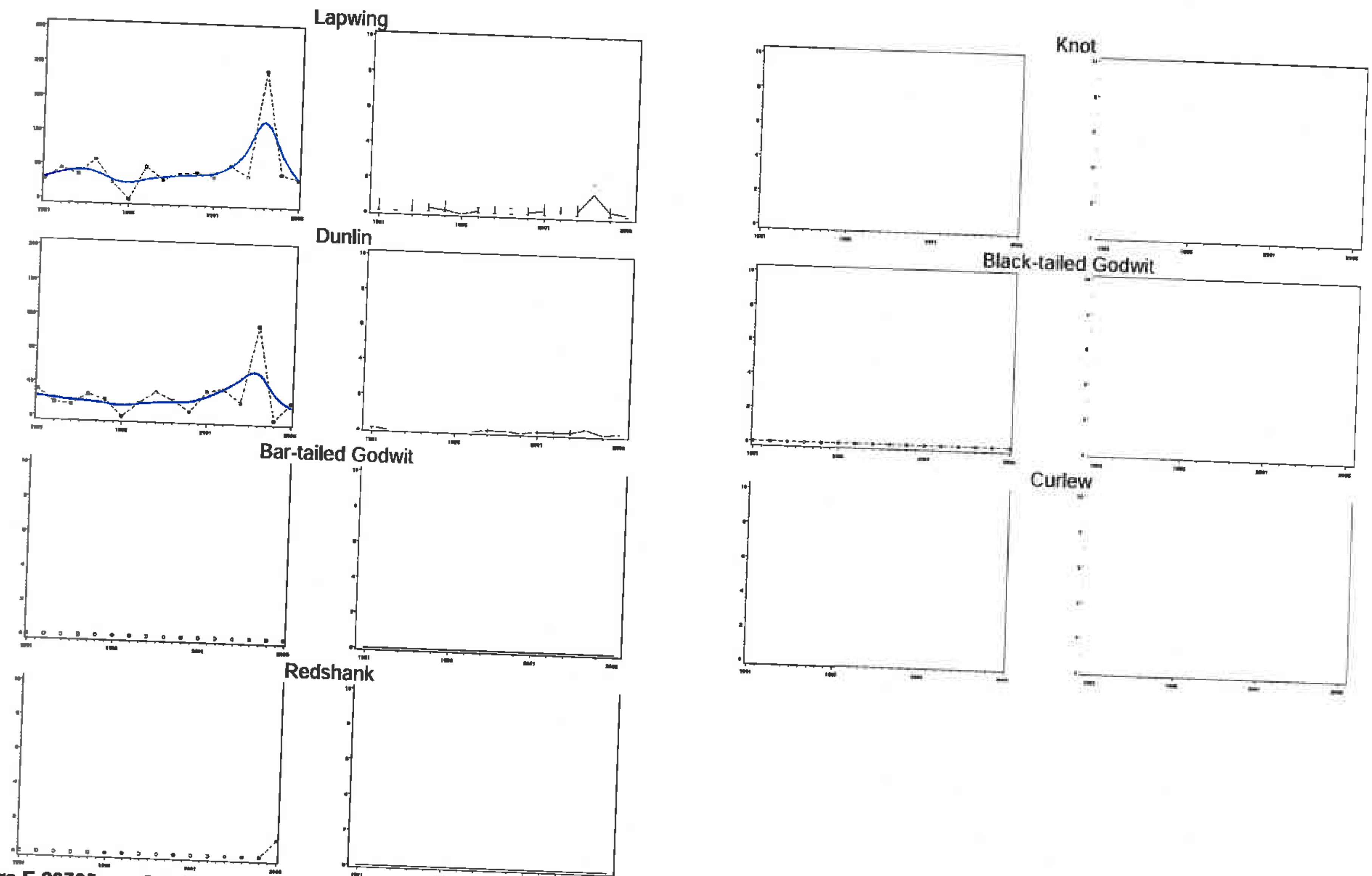

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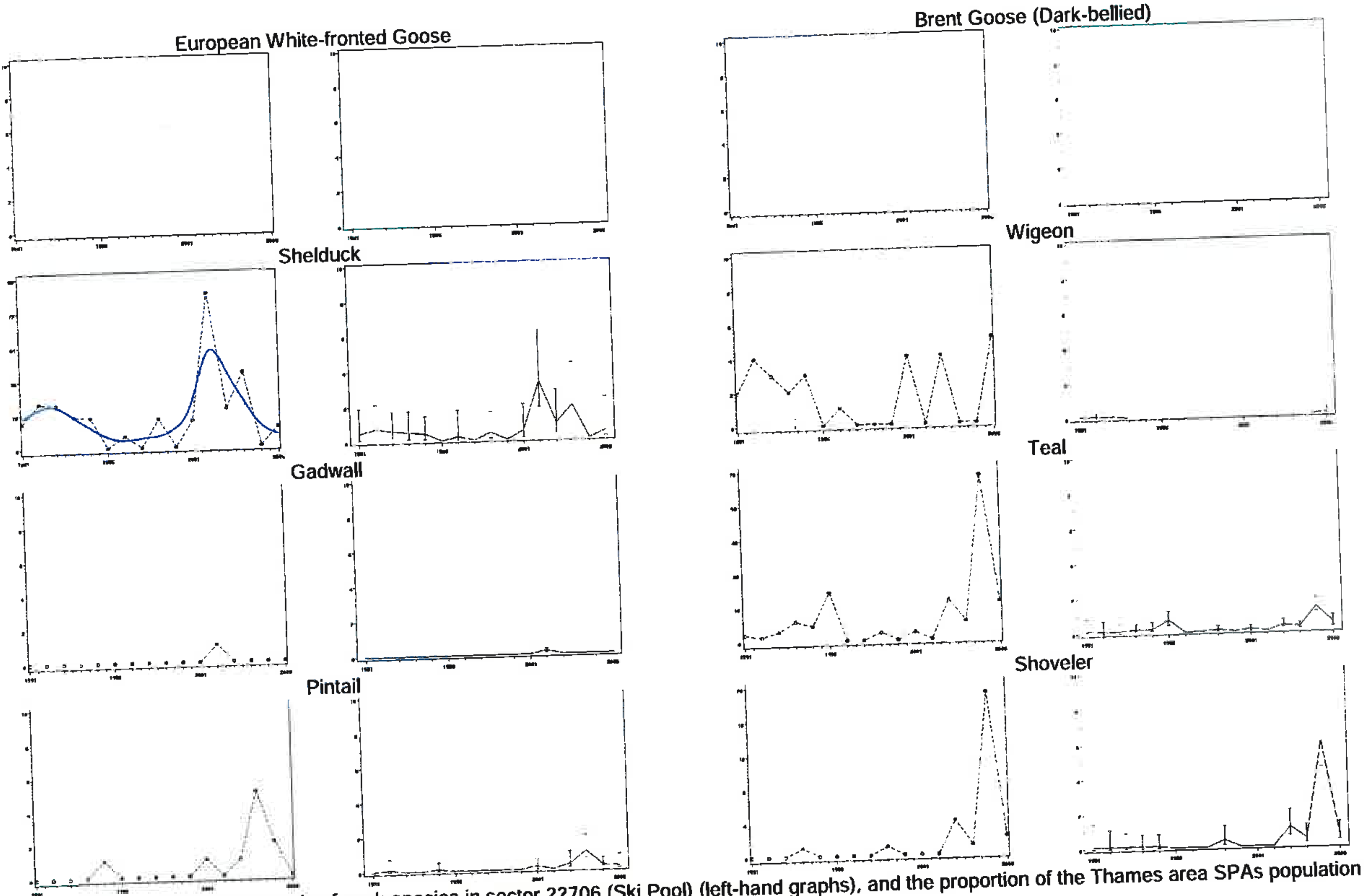

Figure E.22706 Population trends of each species in sector 22706 (Ski Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

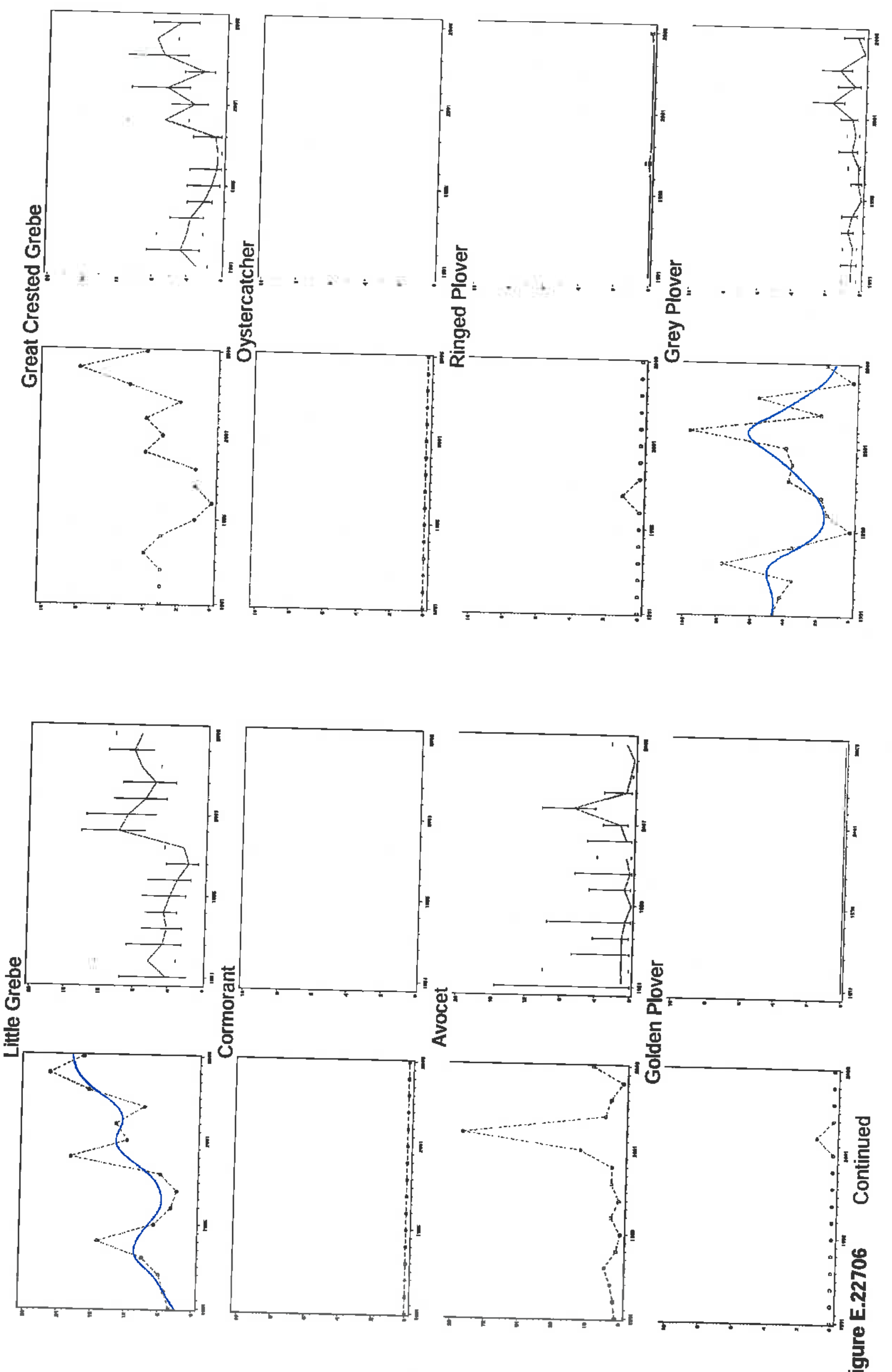

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Figure E.22706 Continued

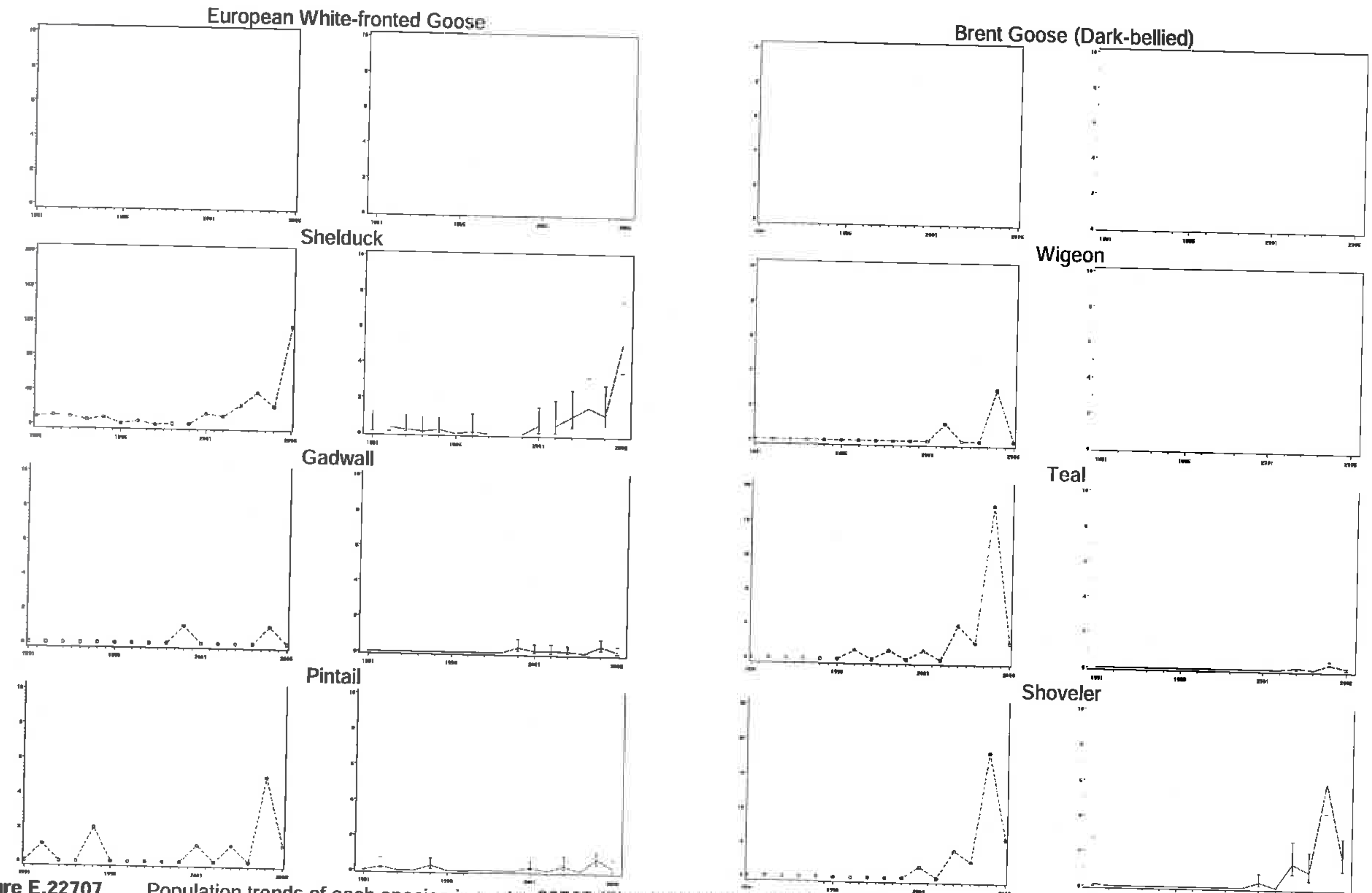
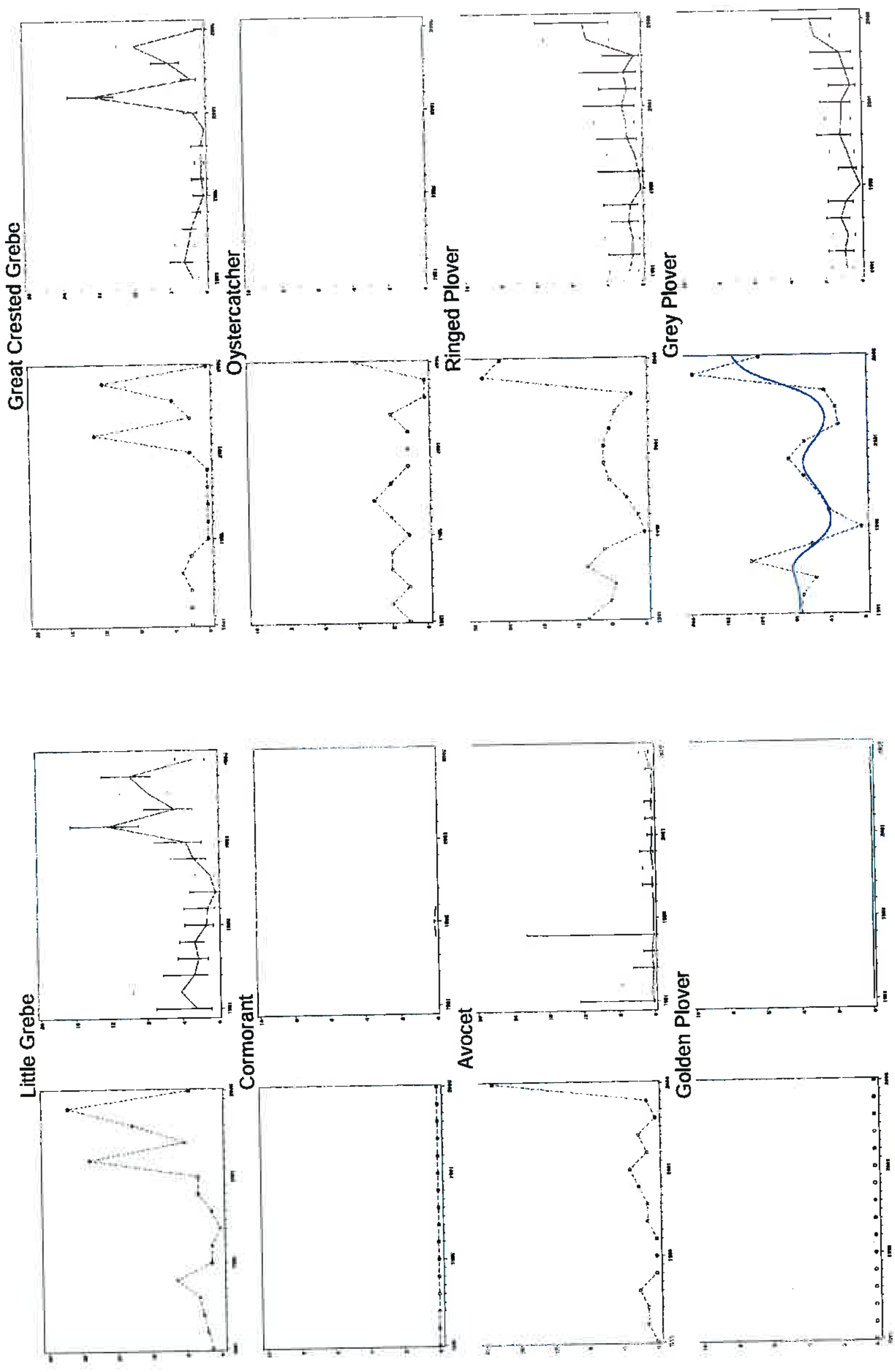


Figure E.22707 Population trends of each species in sector 22707 (Flamingo Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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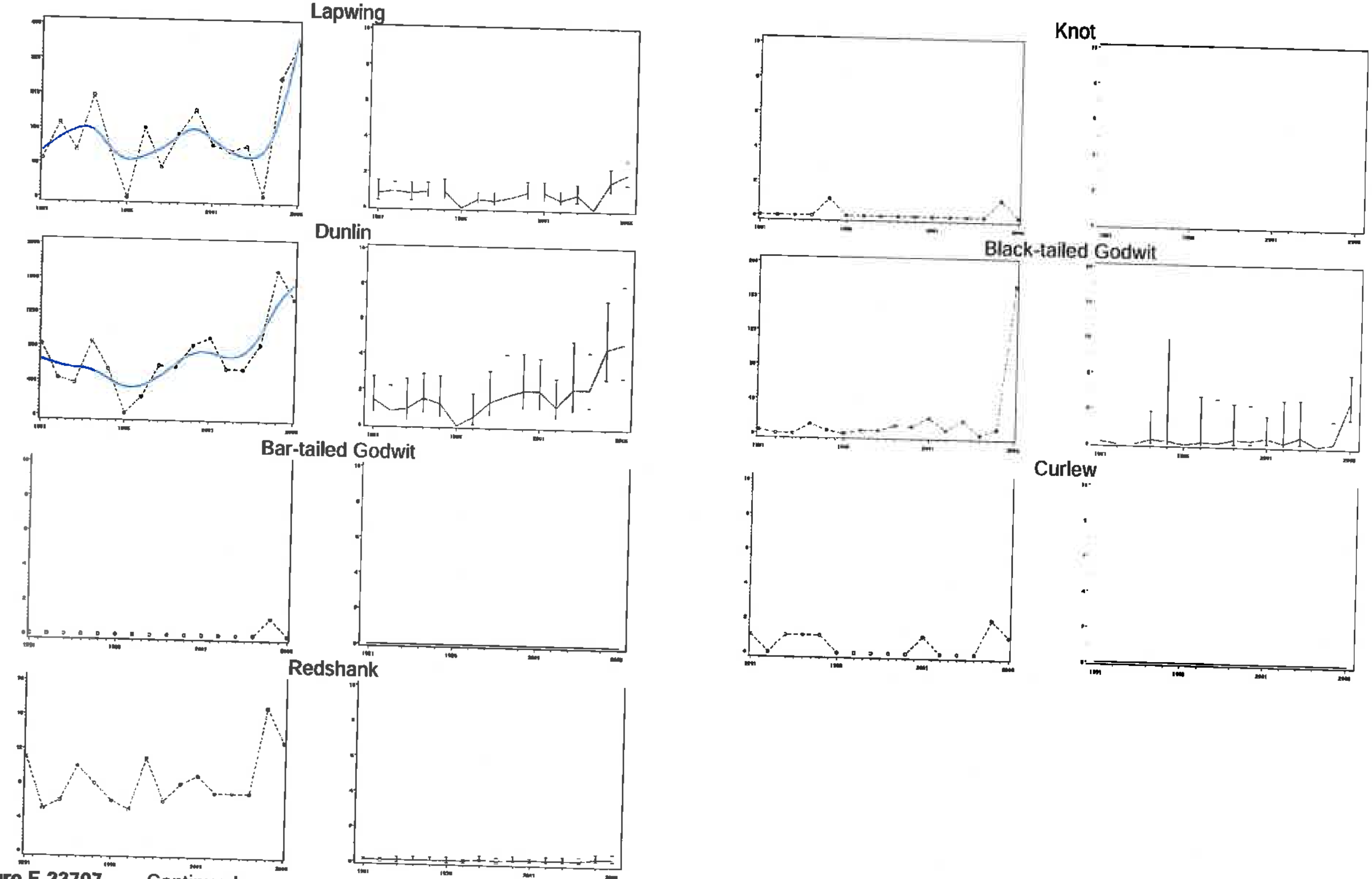

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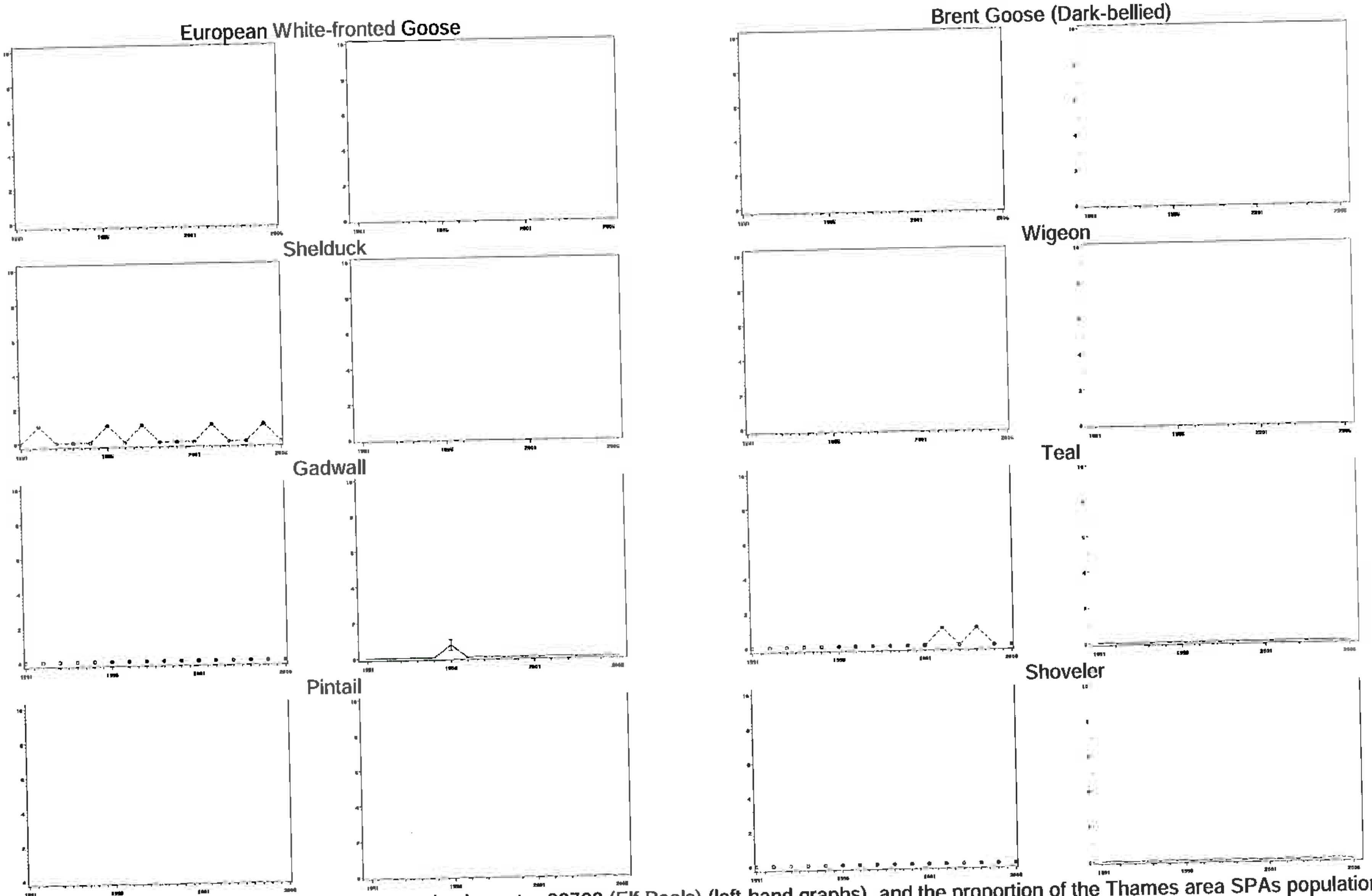
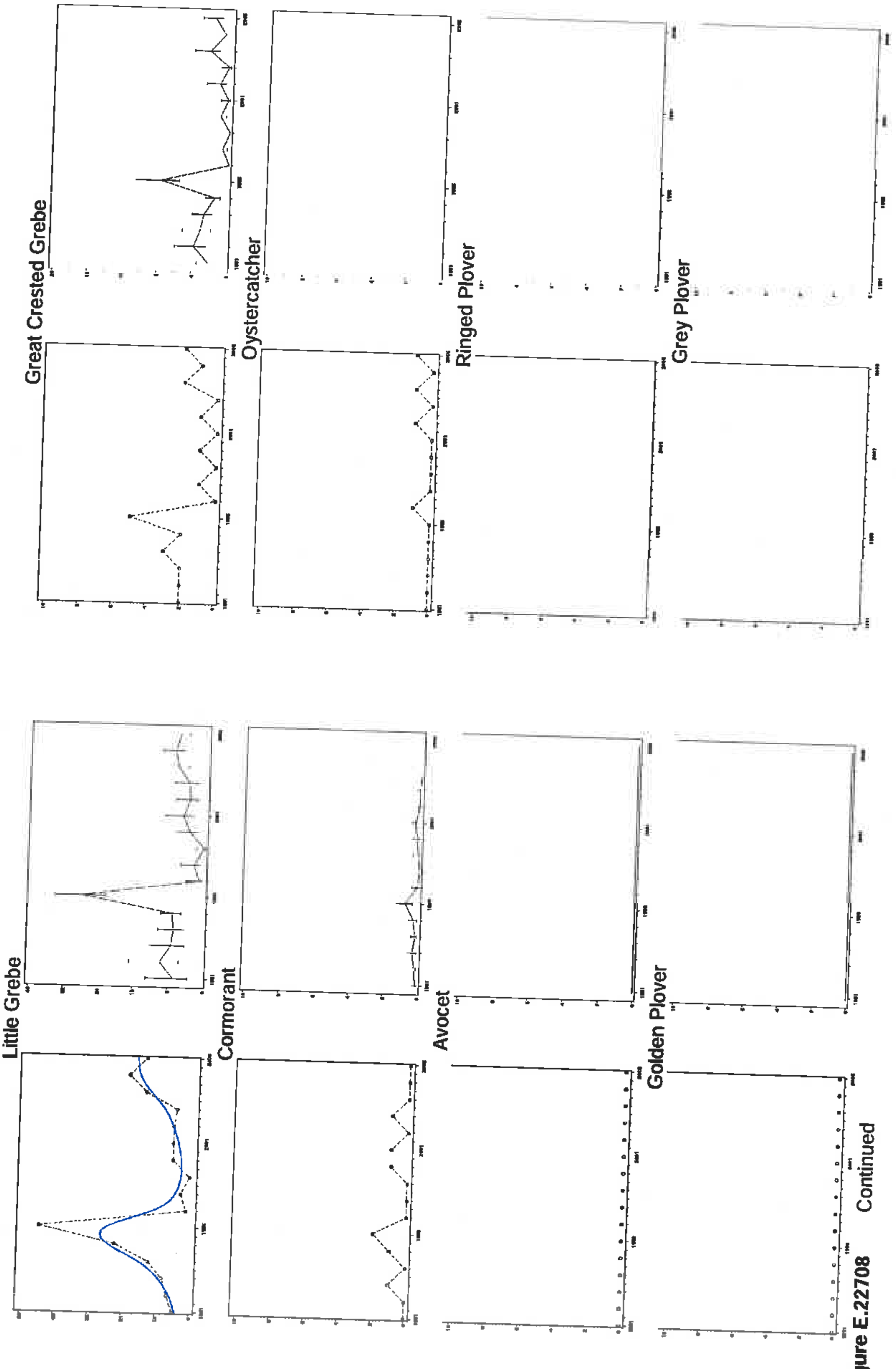


Figure E.22708 Population trends of each species in sector 22708 (Elf Pools) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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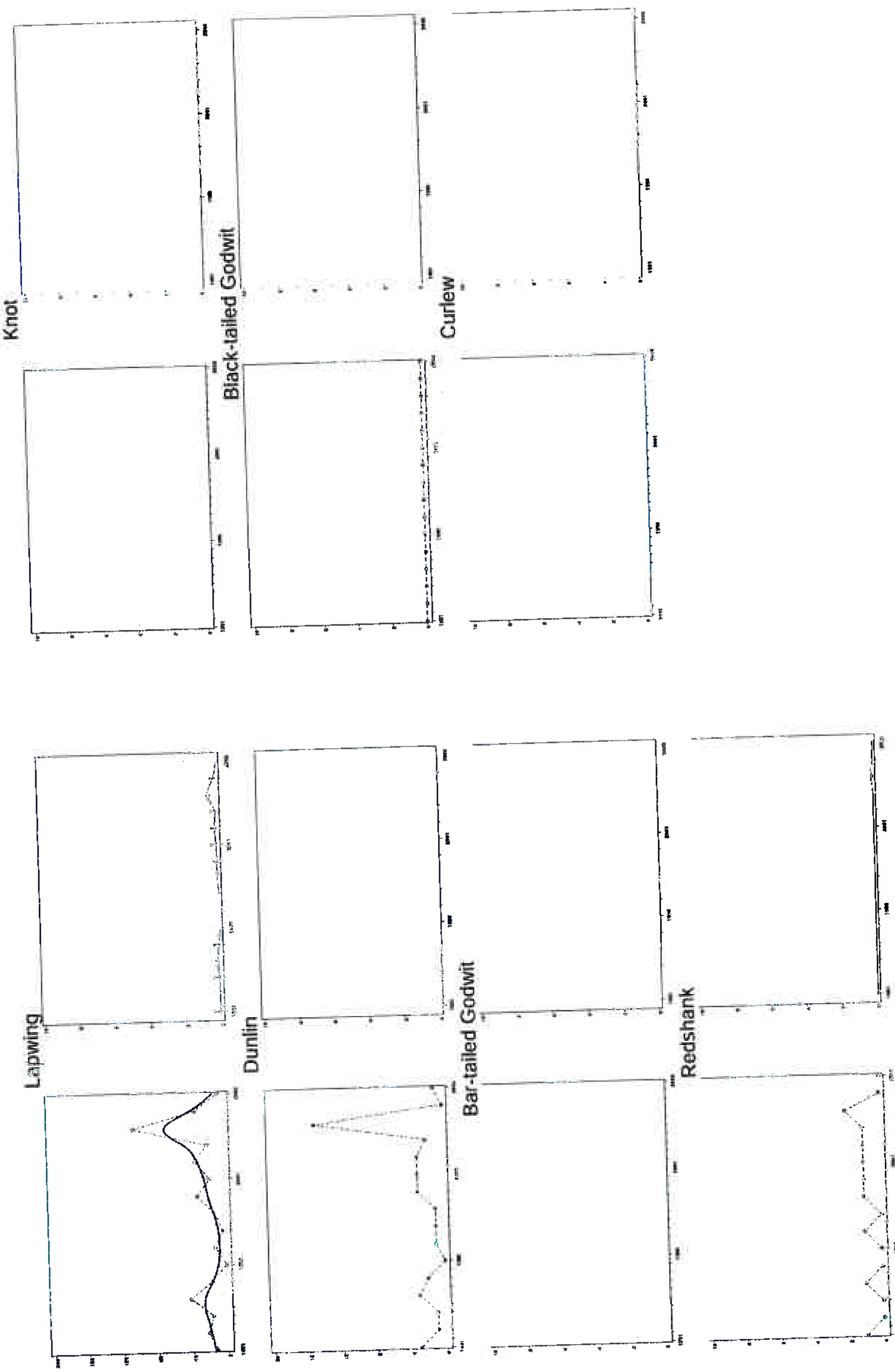

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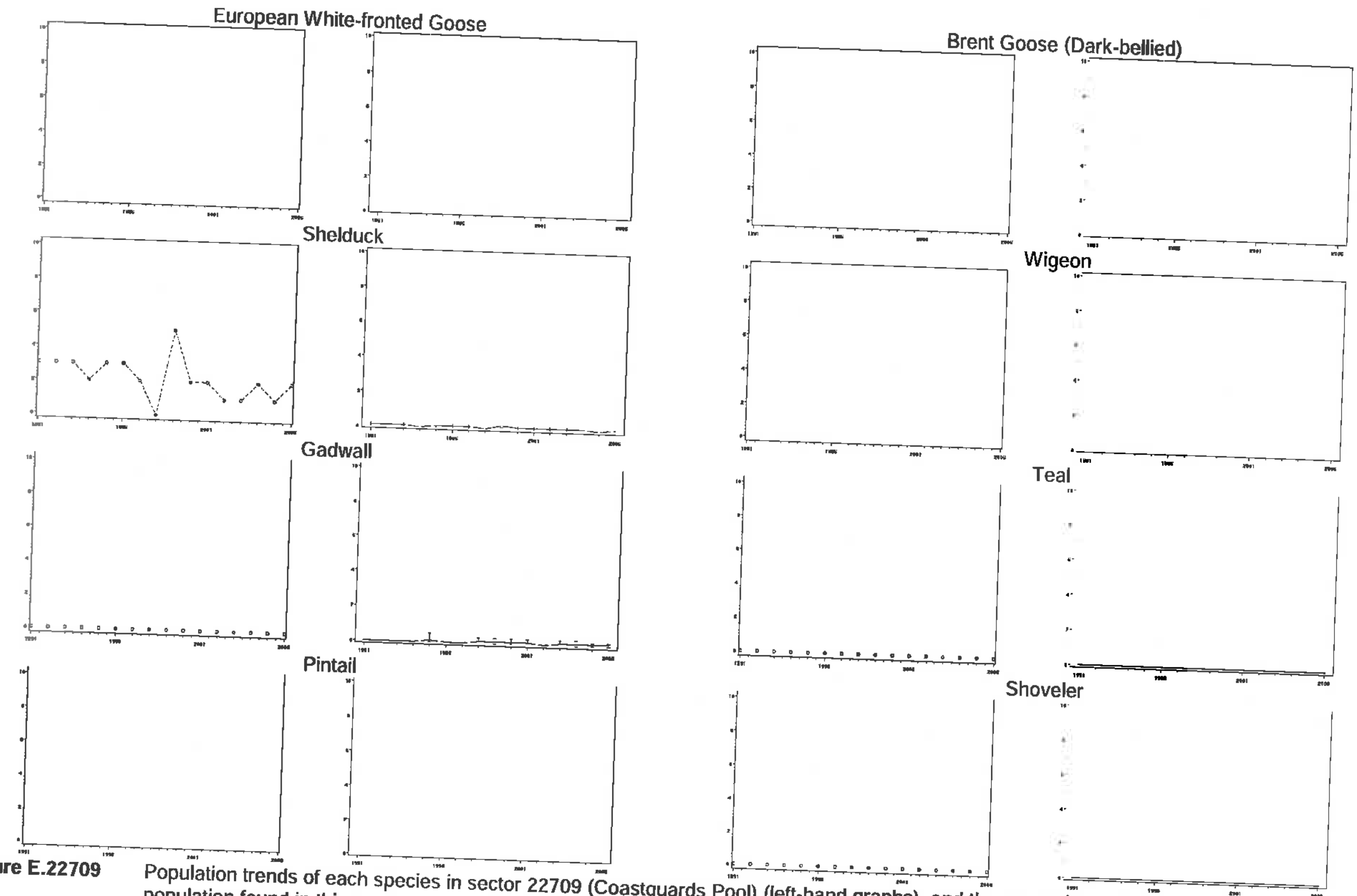
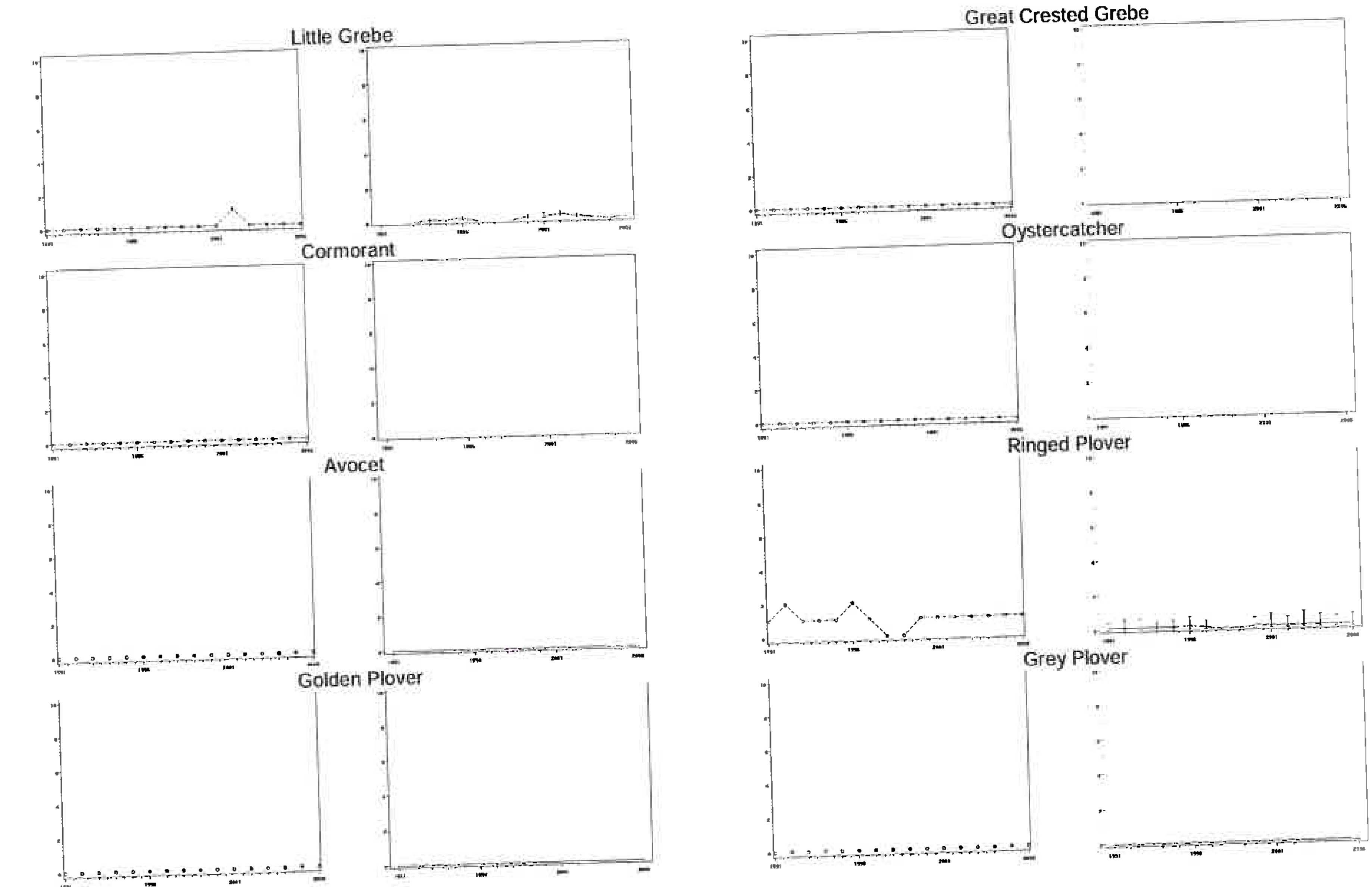


Figure E.22709 Population trends of each species in sector 22709 (Coastguards Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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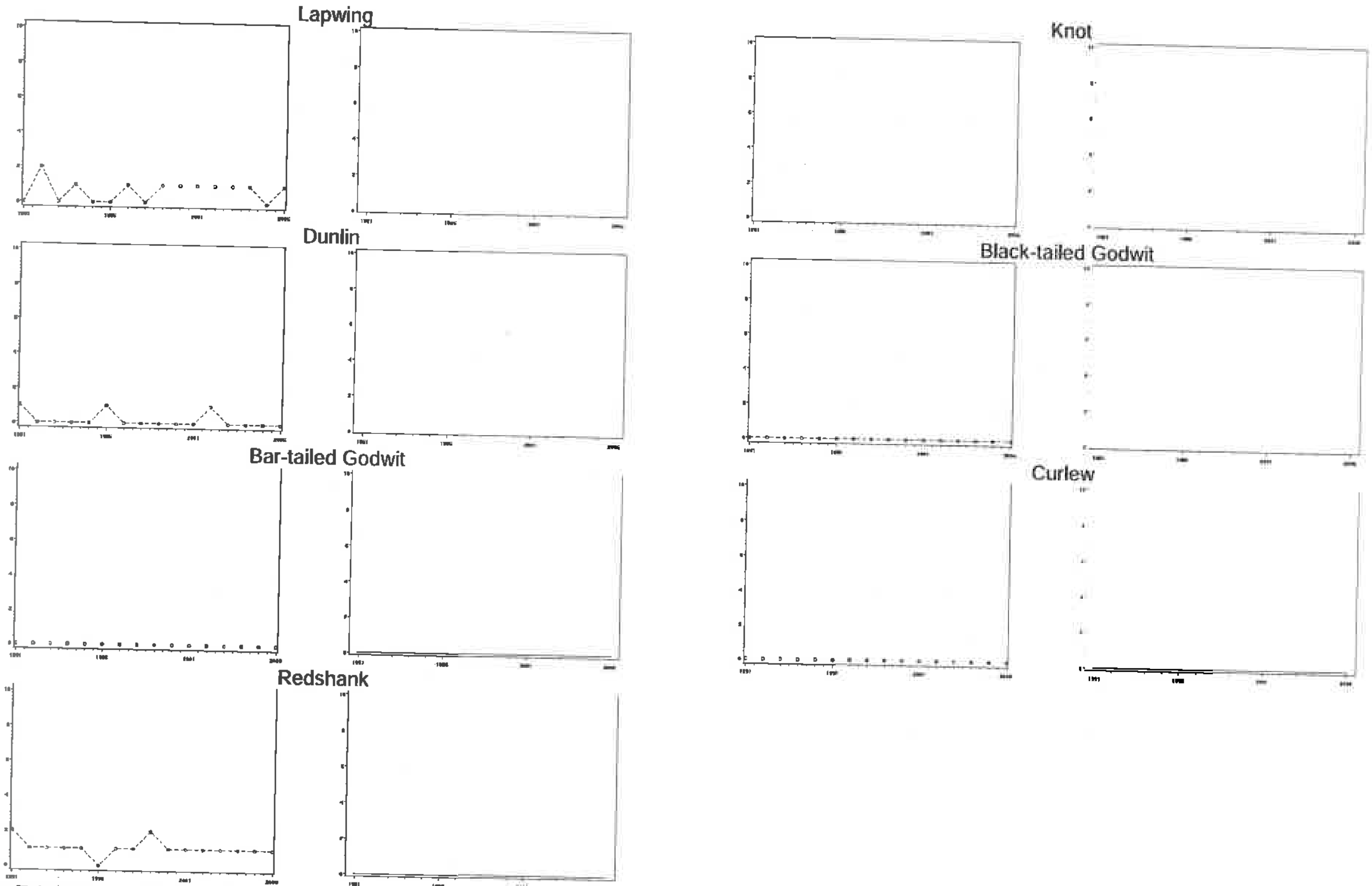

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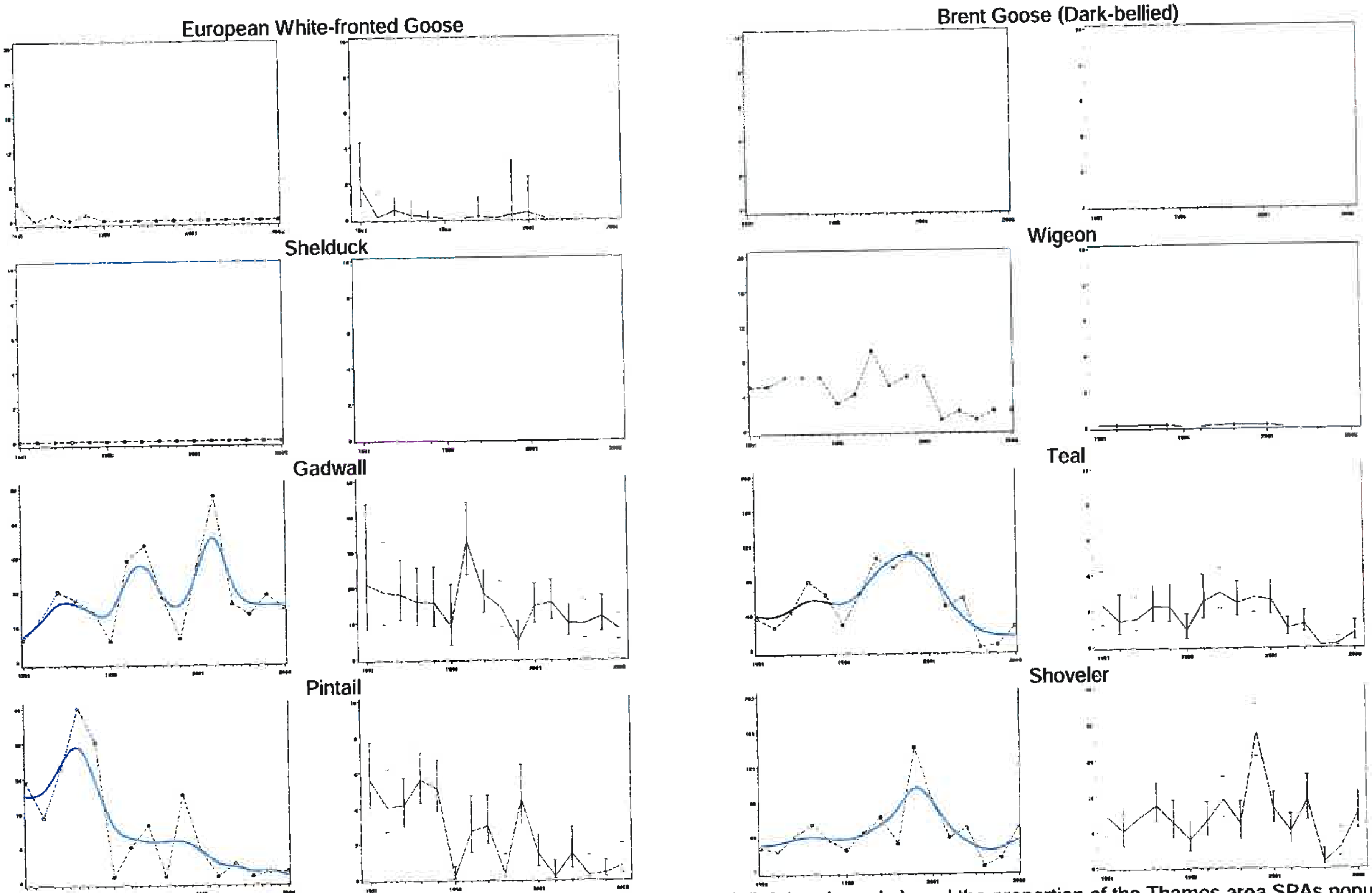
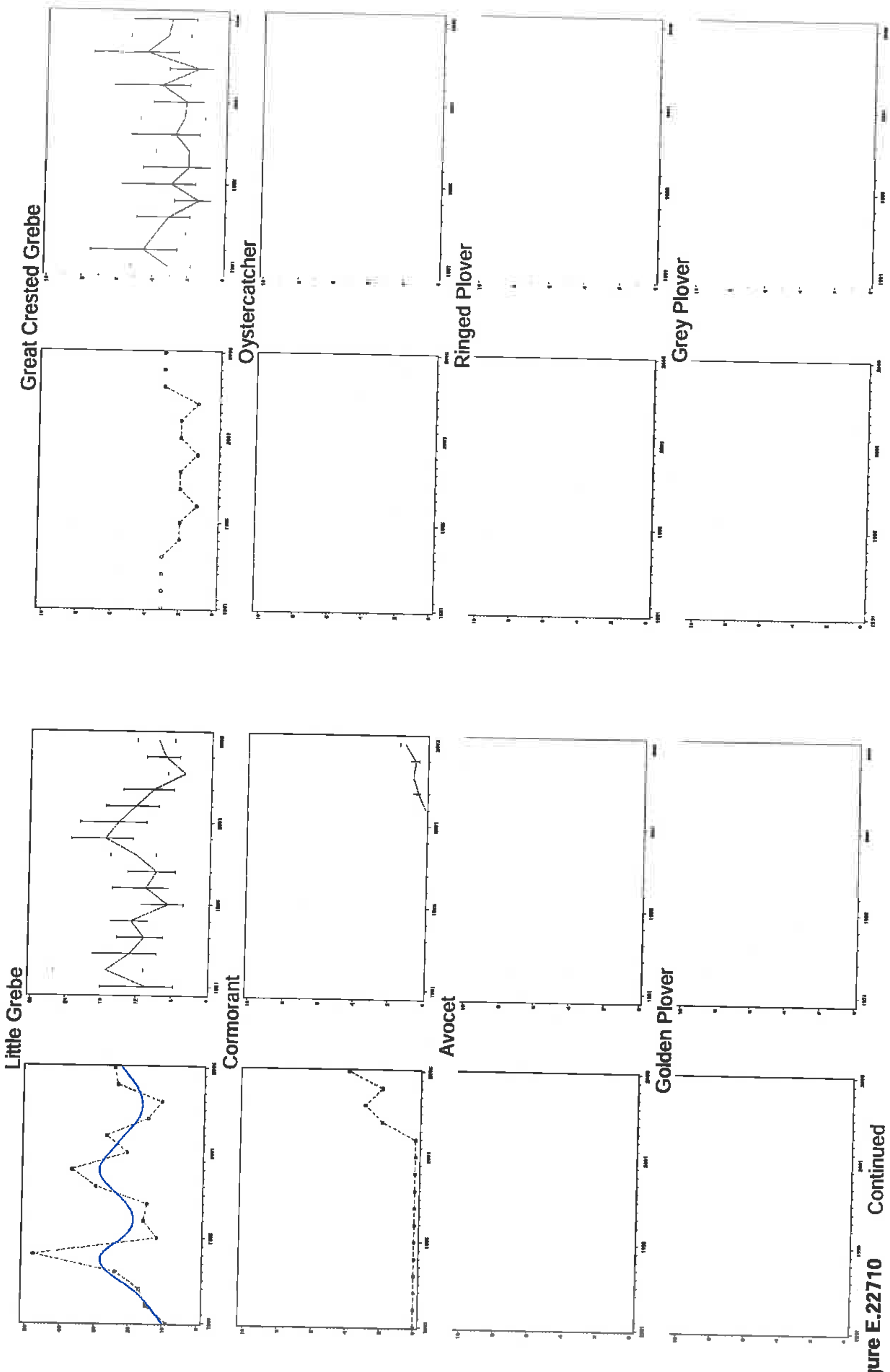


Figure E.22710 Population trends of each species in sector 22710 (North Quarry) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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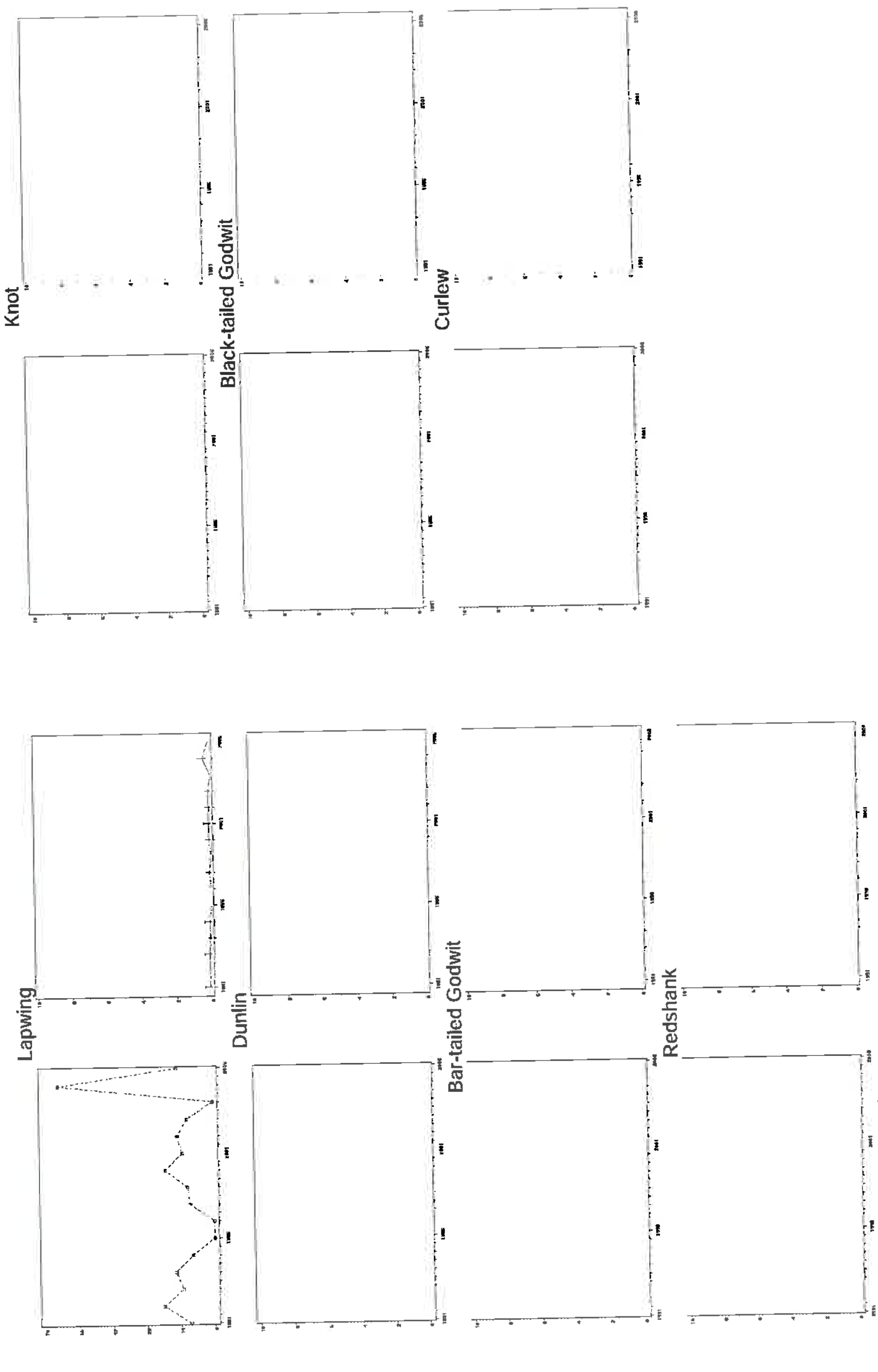

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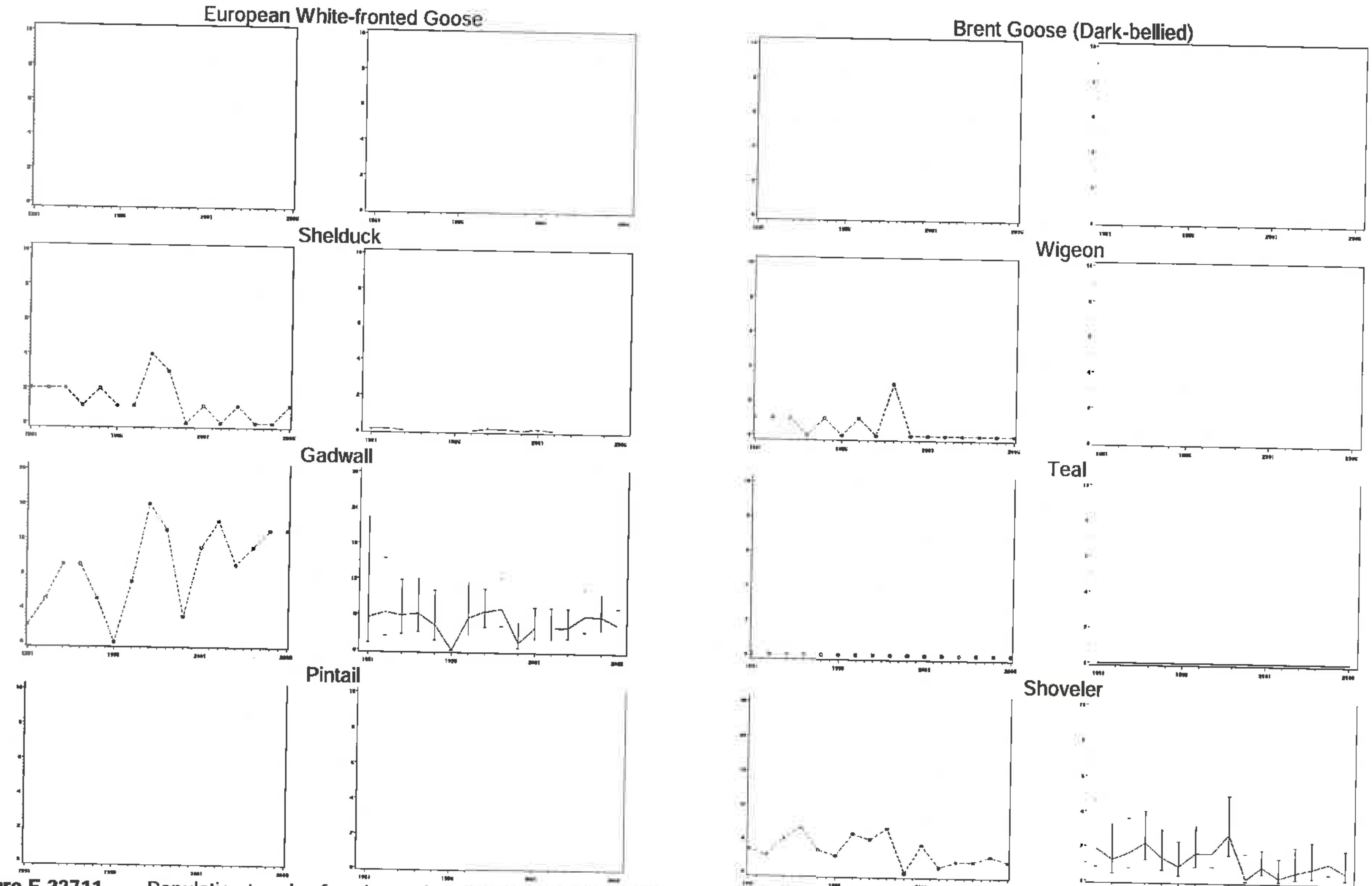
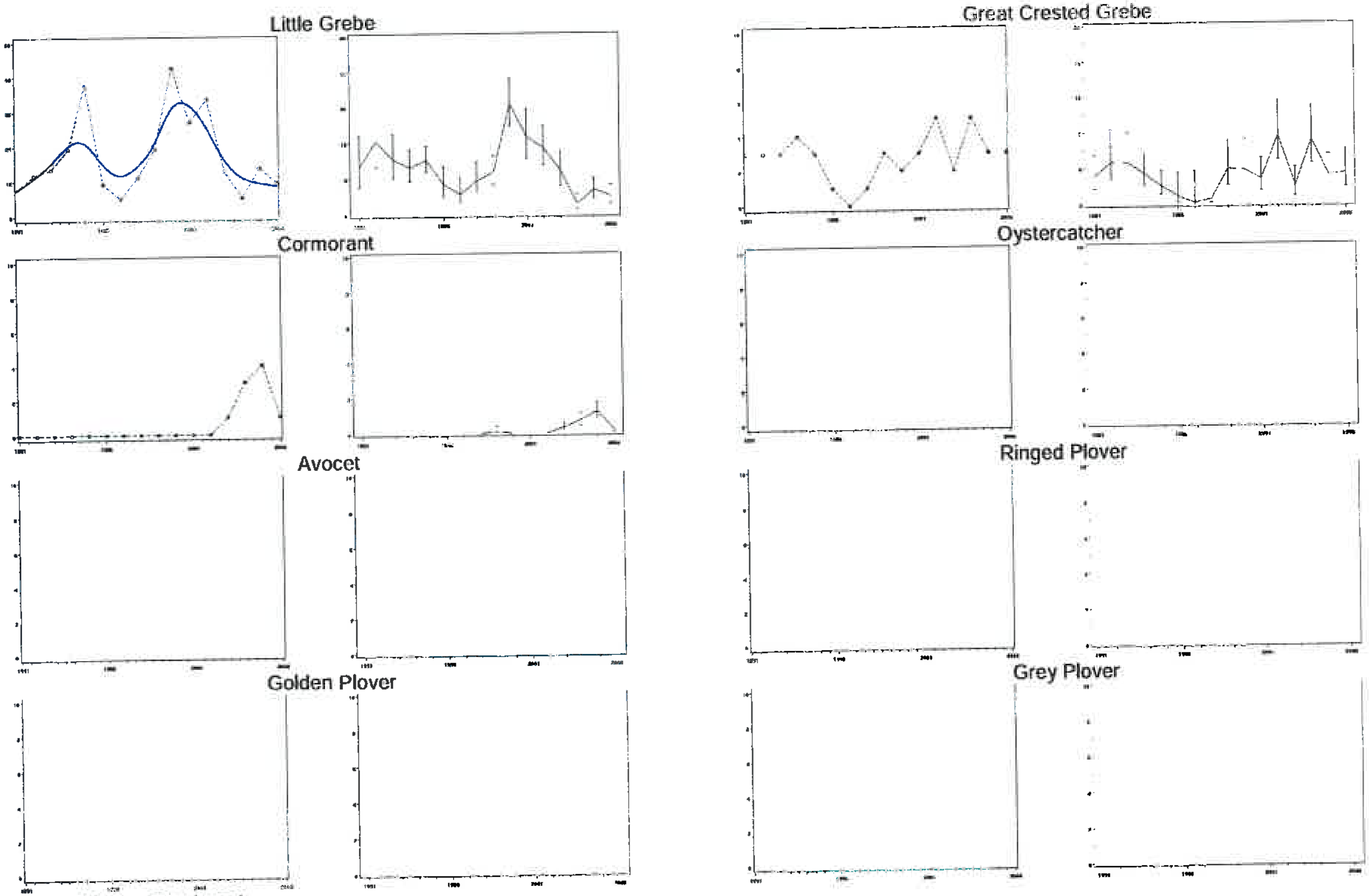


Figure E.22711 Population trends of each species in sector 22711 (South Quarry) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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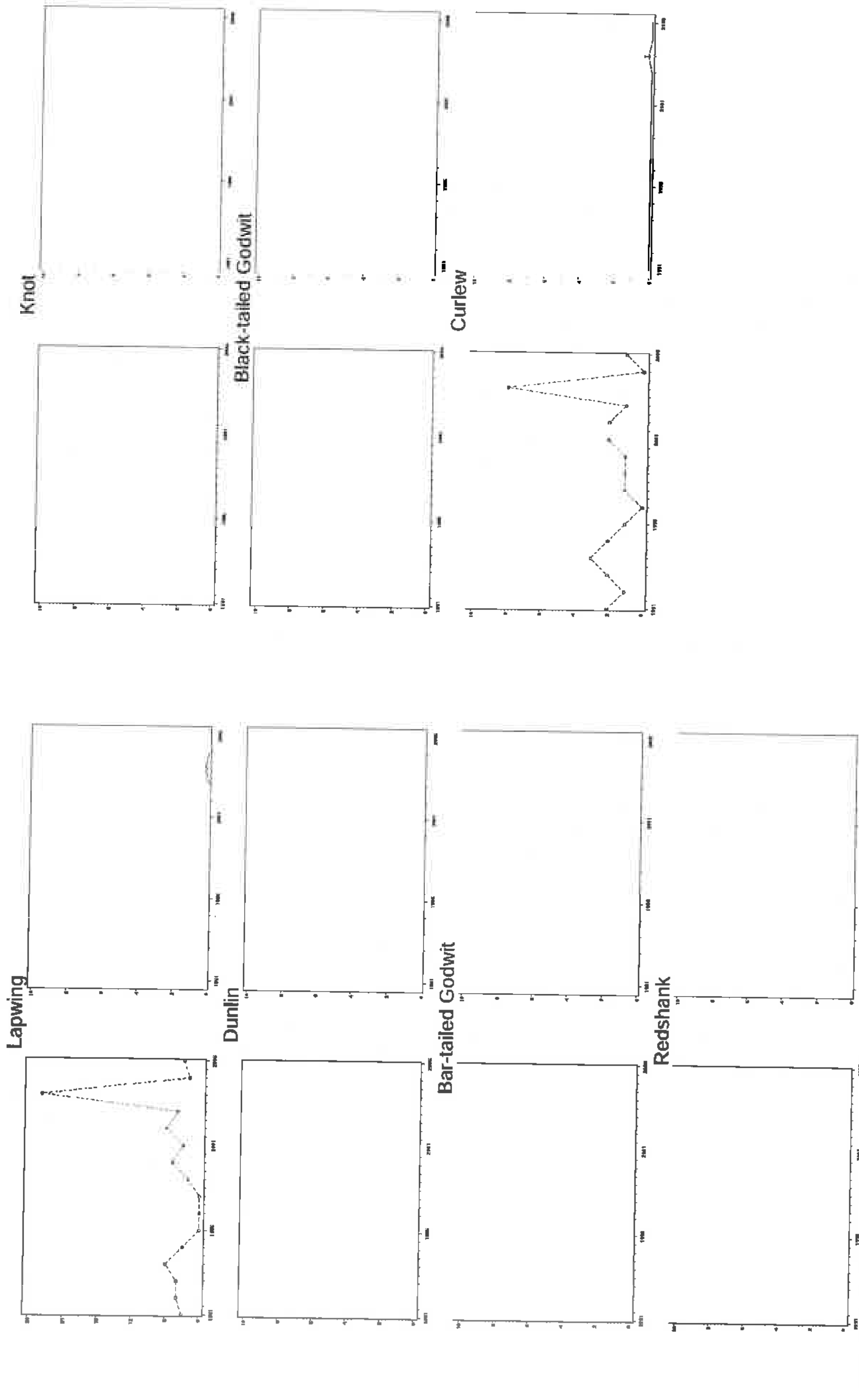

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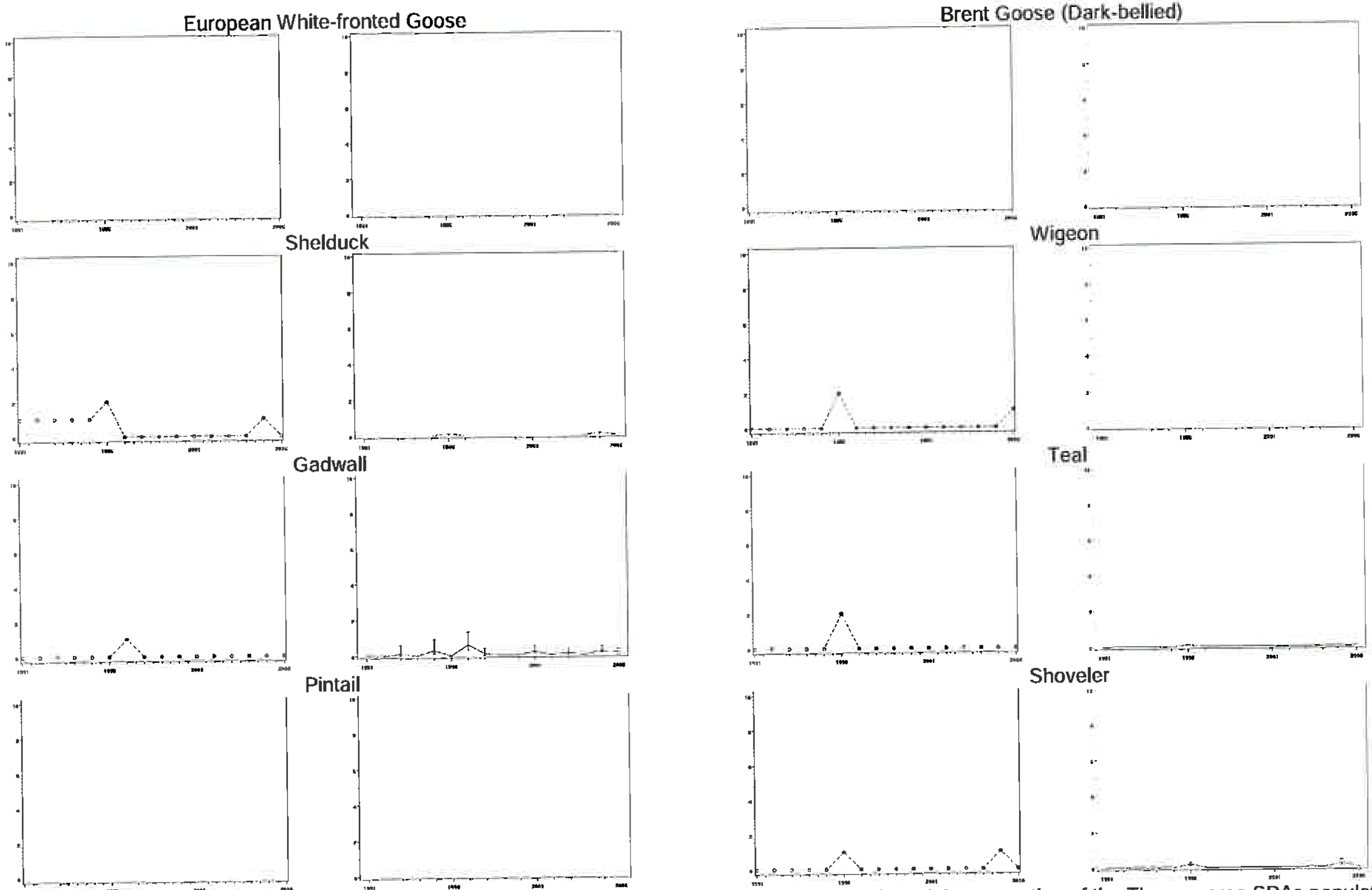
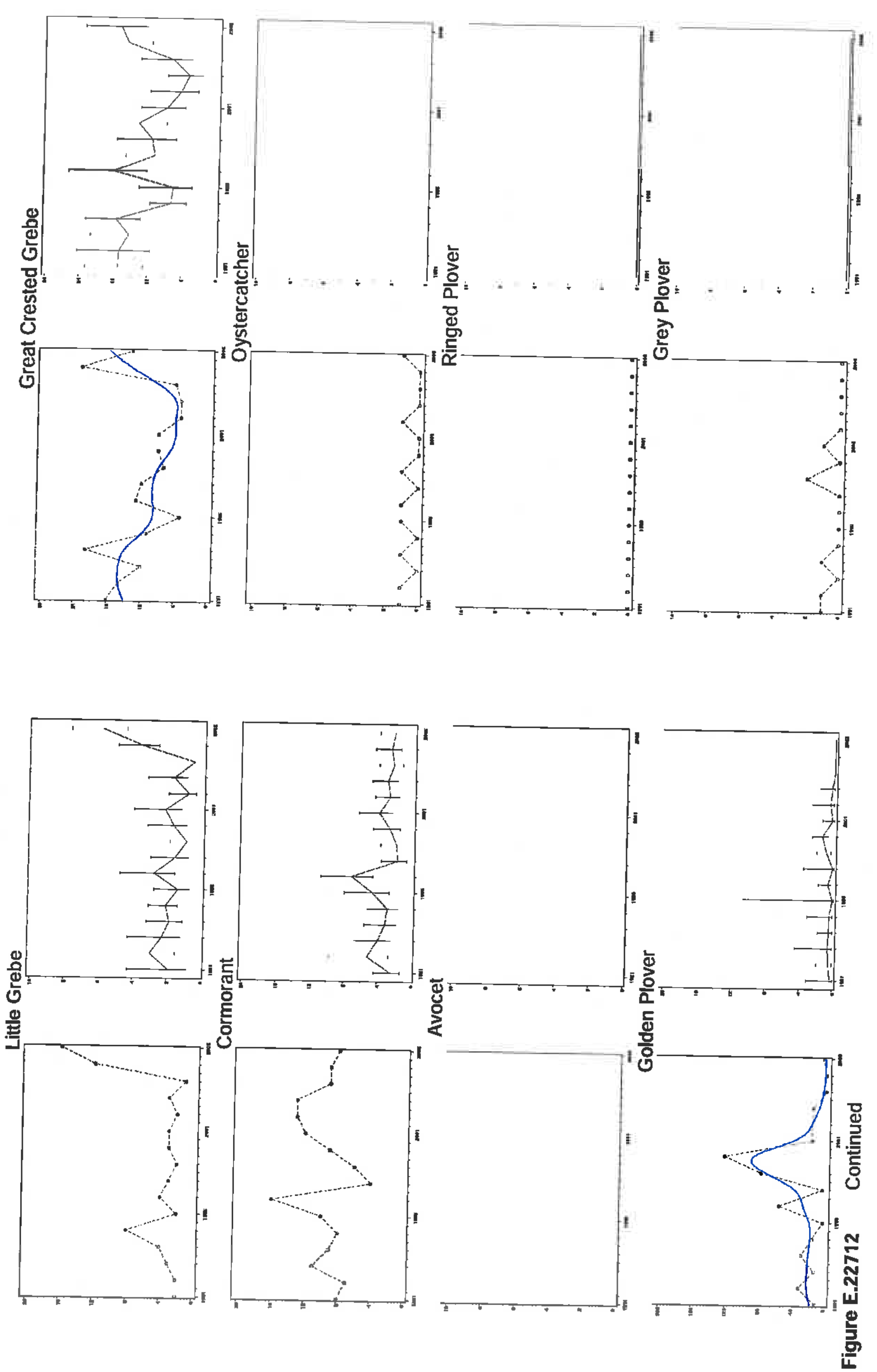


Figure E.22712 Population trends of each species in sector 22712 (Alpha Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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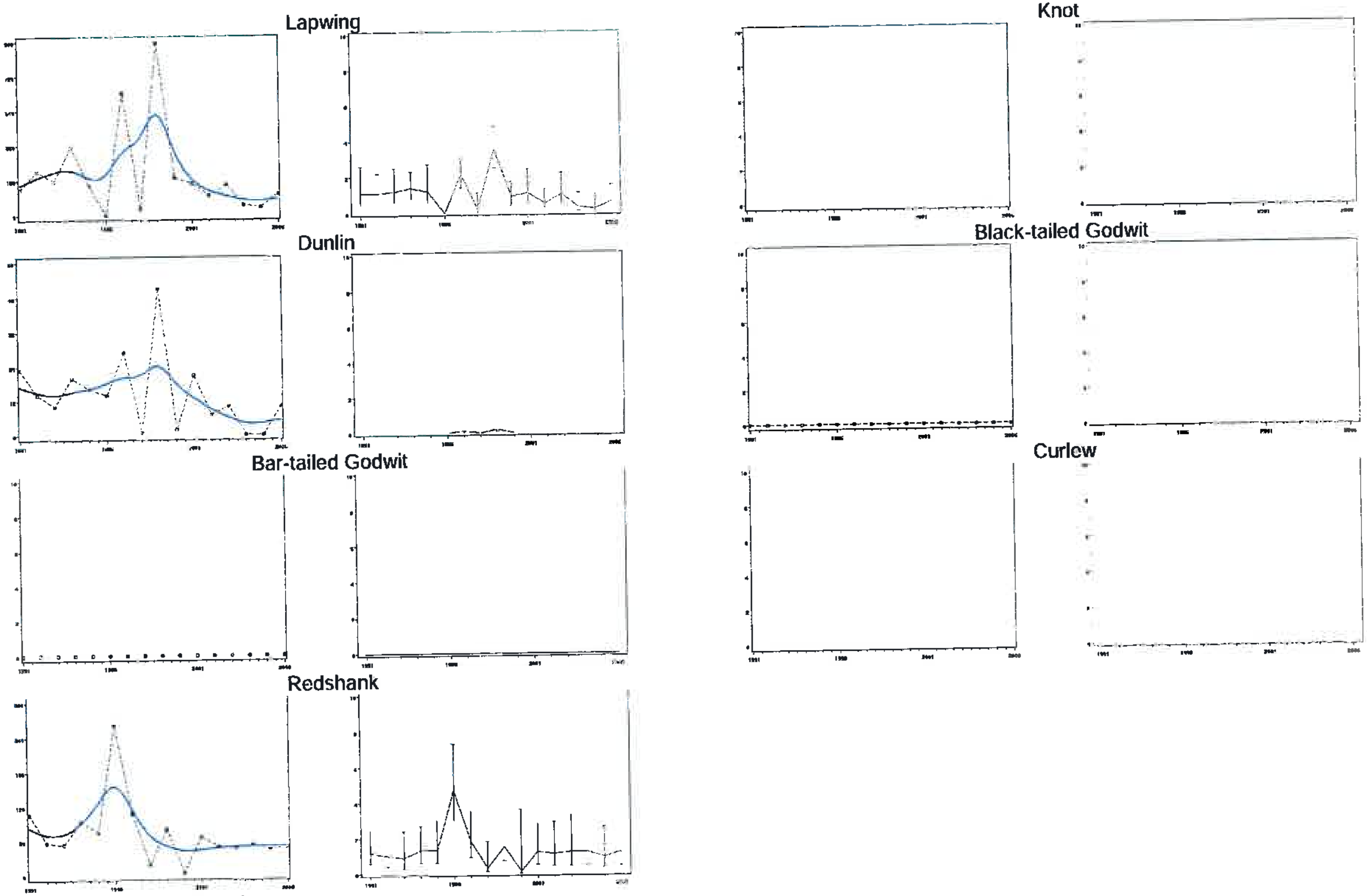

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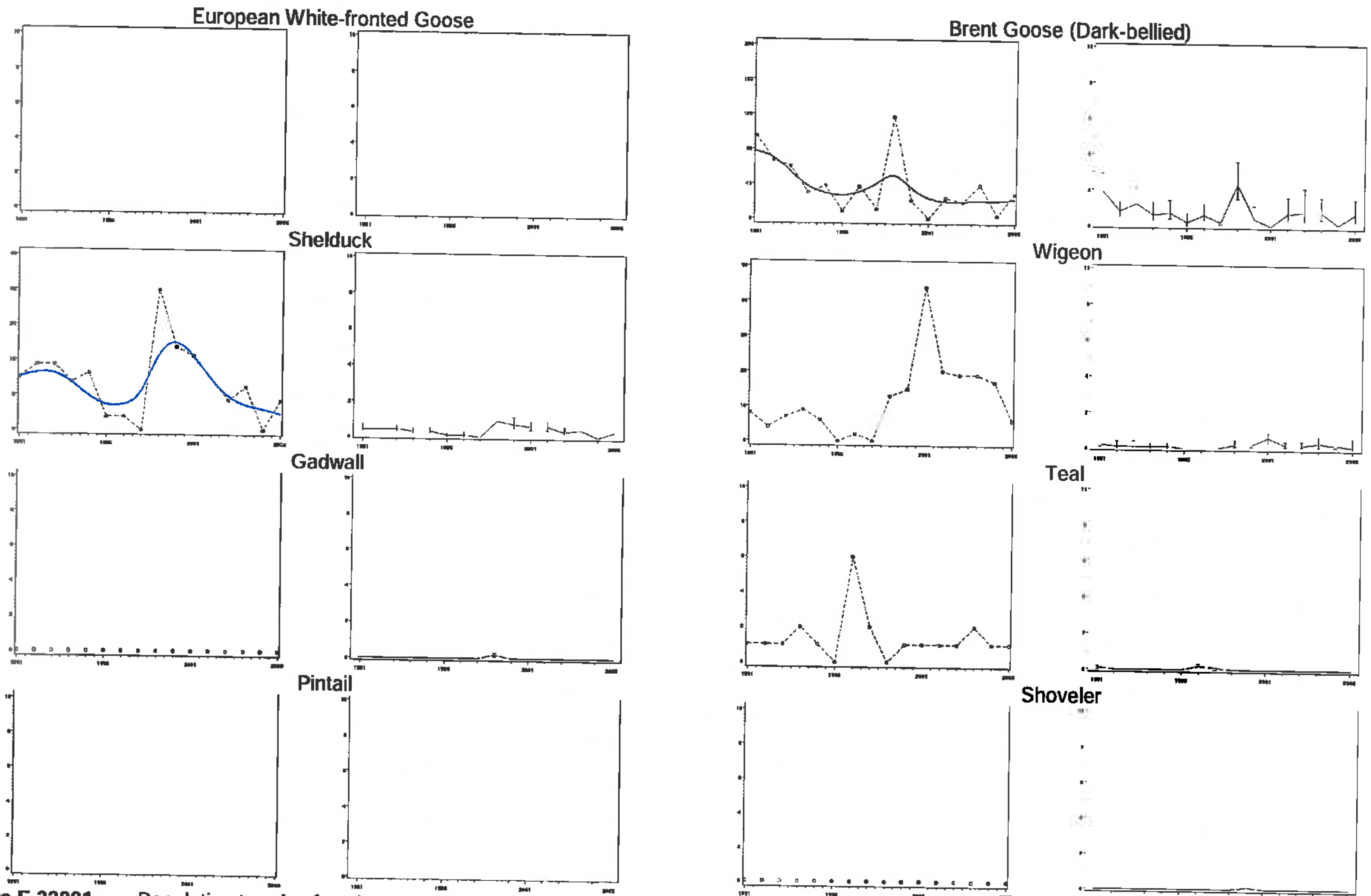
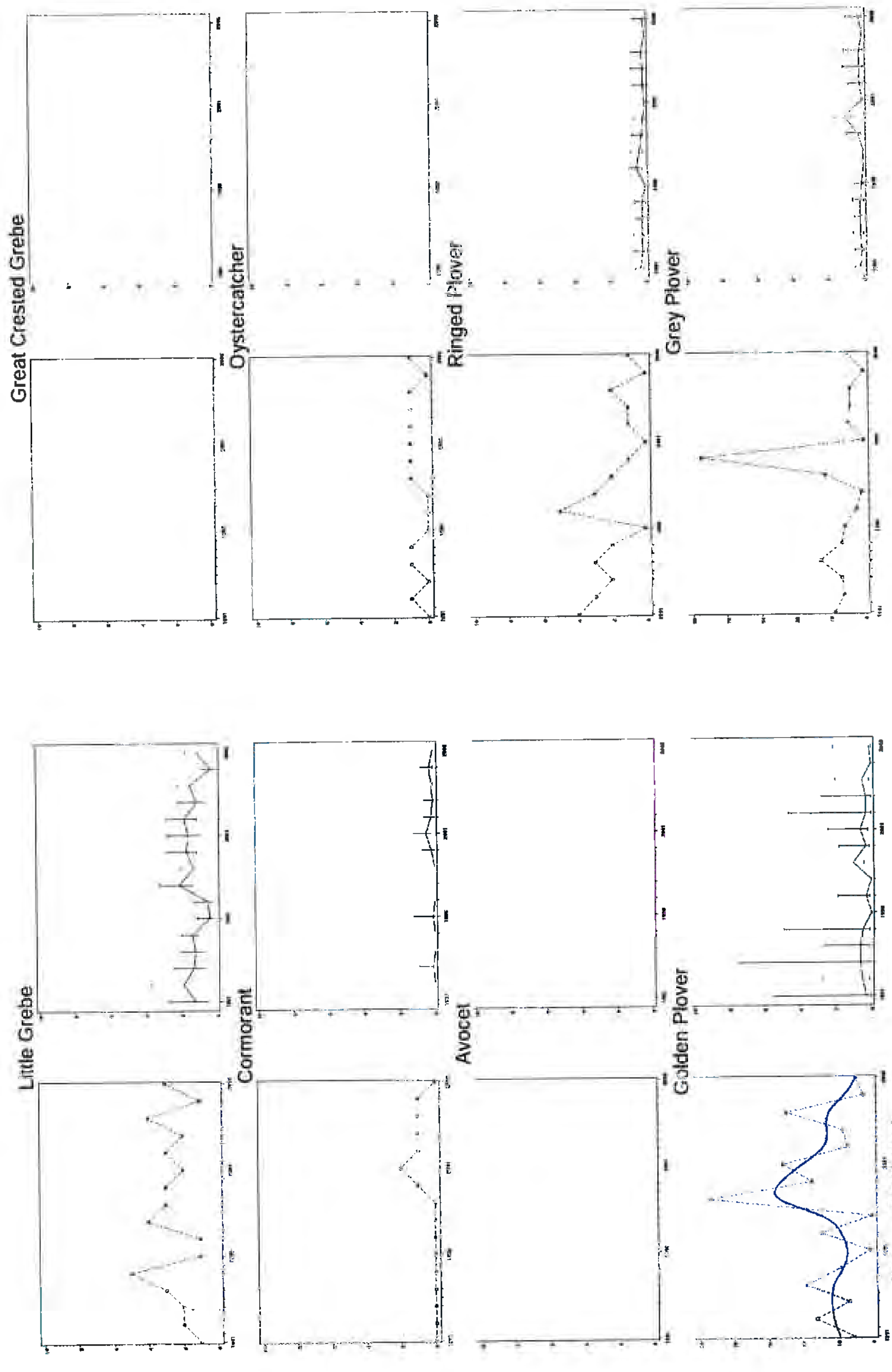


Figure E.22801 Population trends of each species in sector 22801 (St Mary`s Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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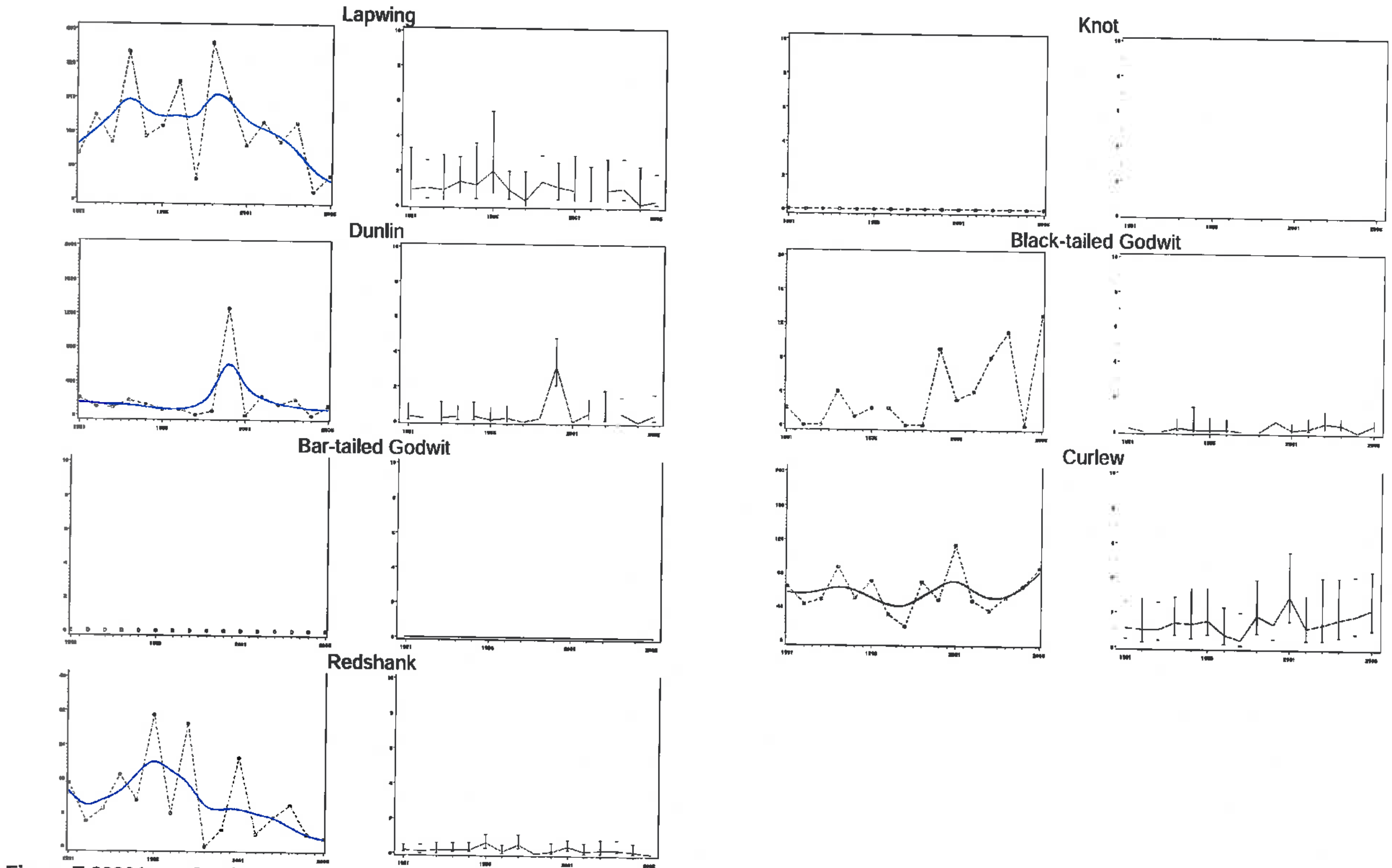

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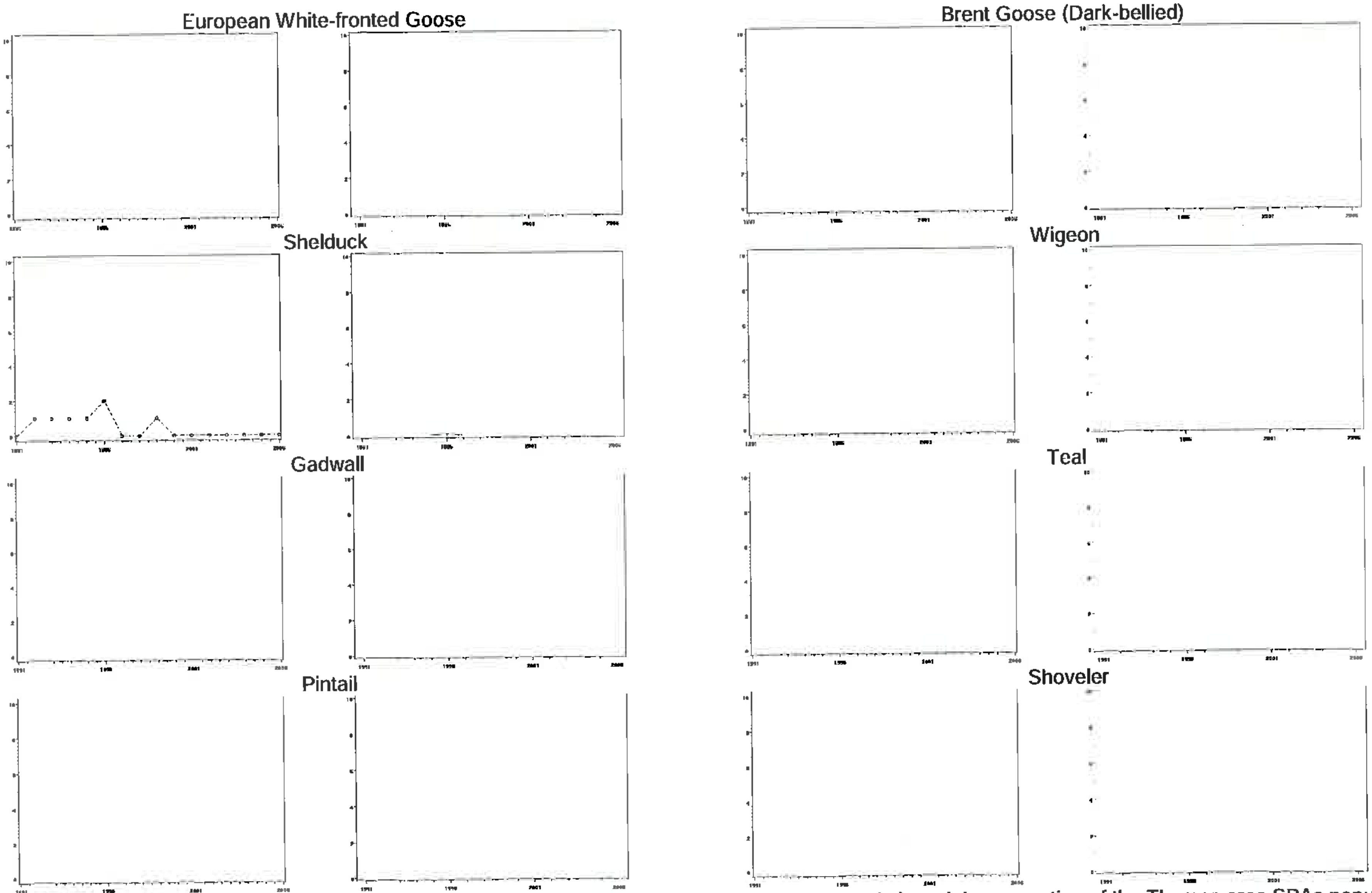
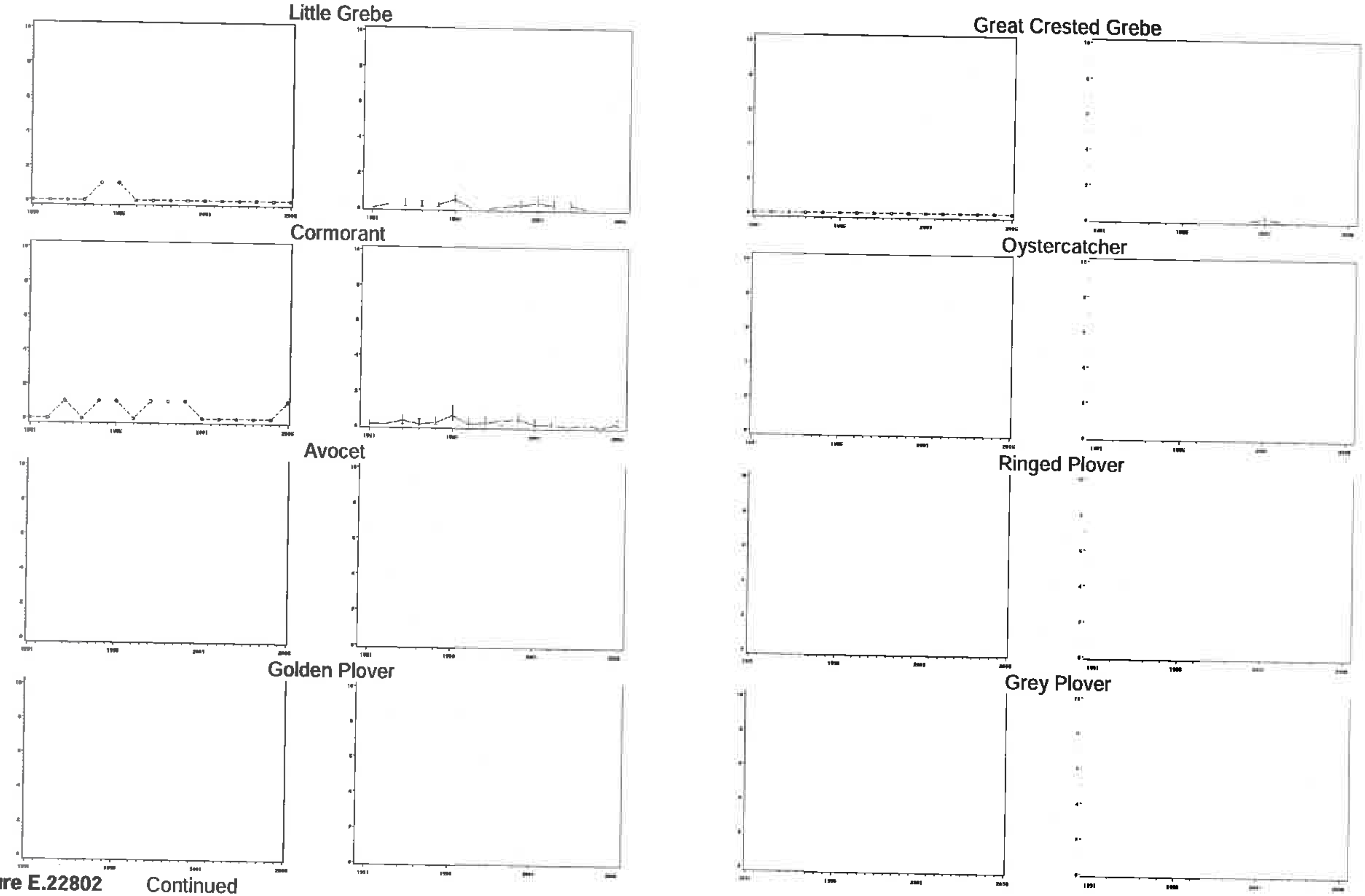


Figure E.22802 Population trends of each species in sector 22802 (Perry`s Farm) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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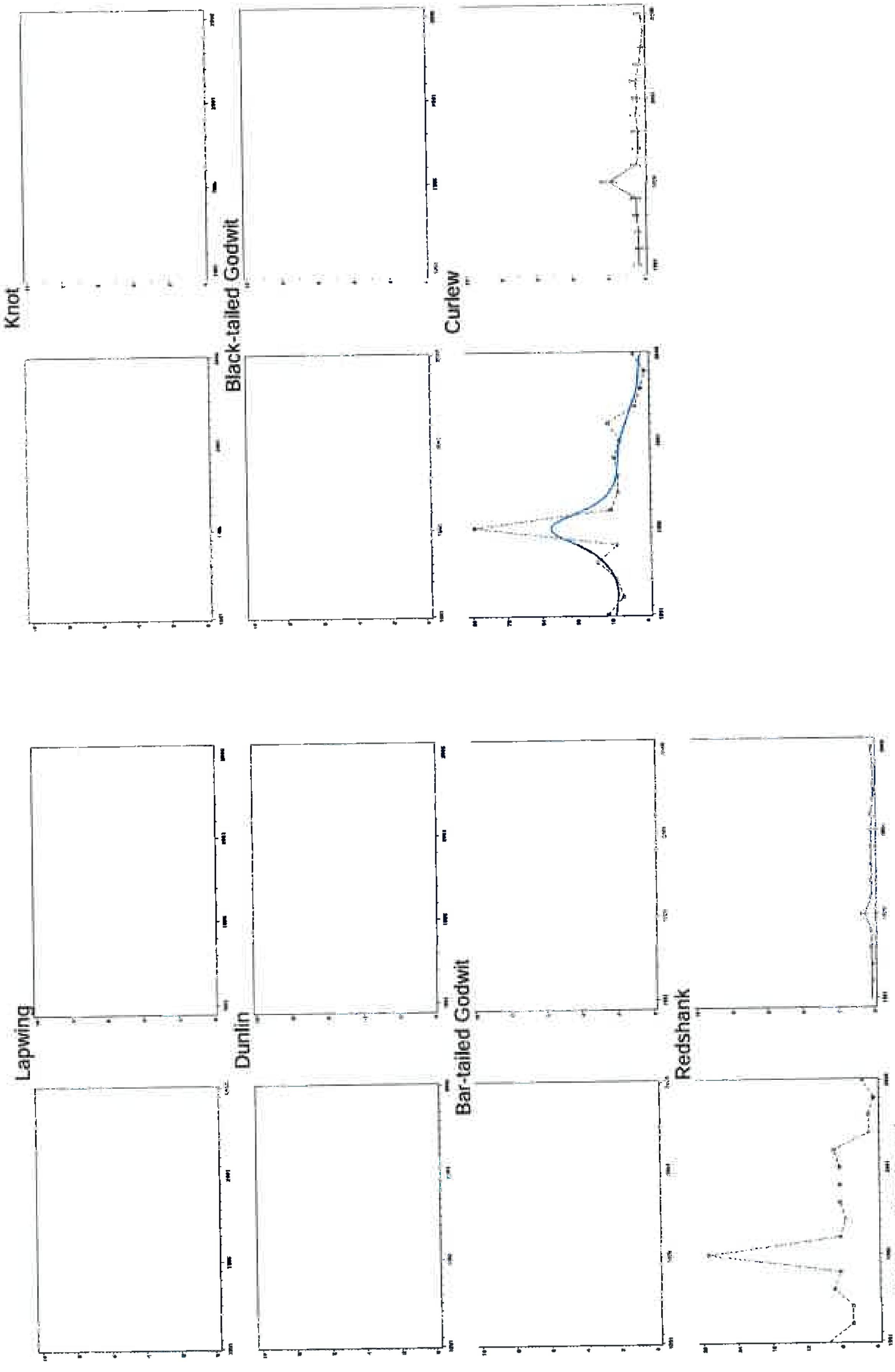

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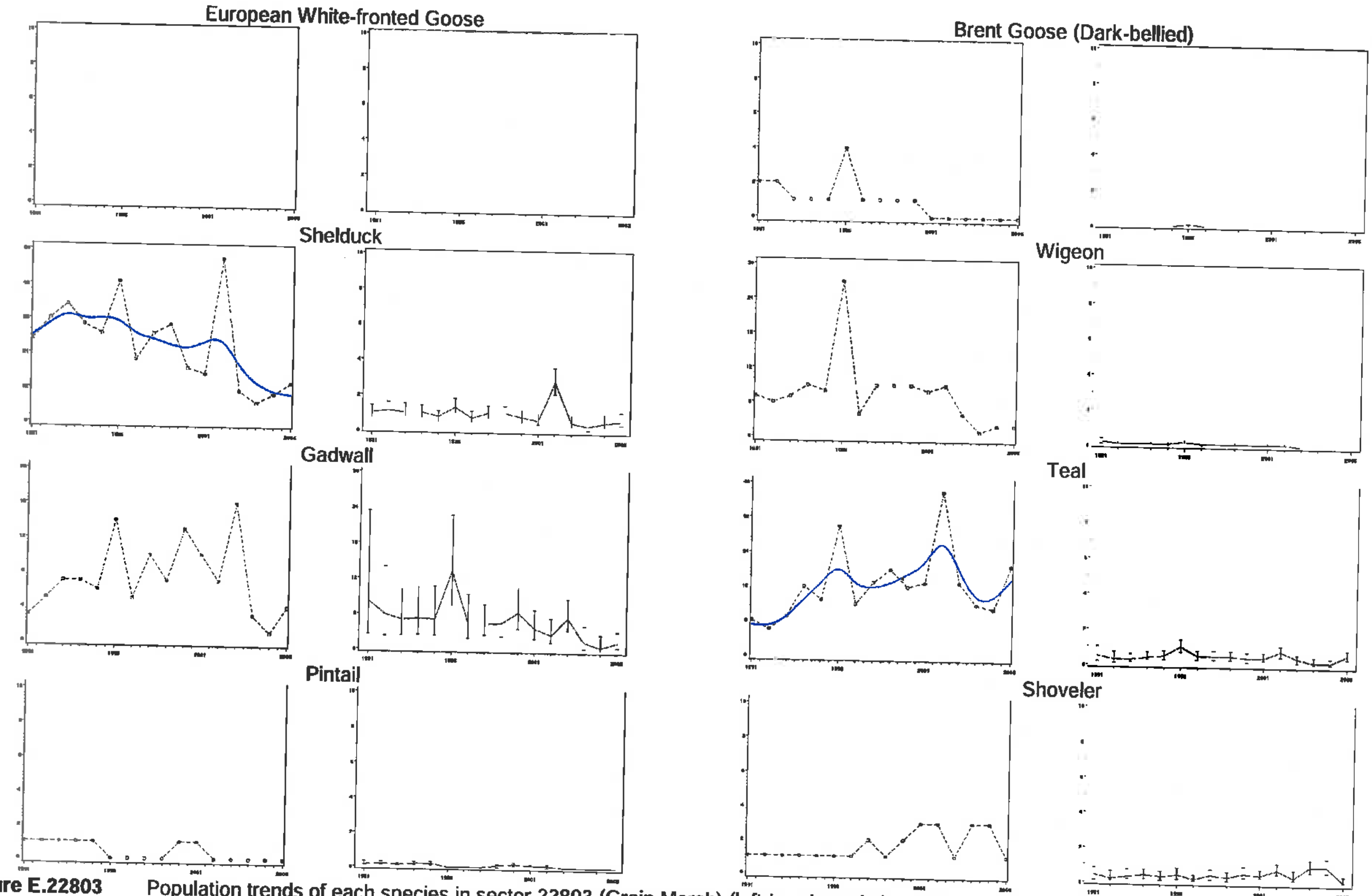
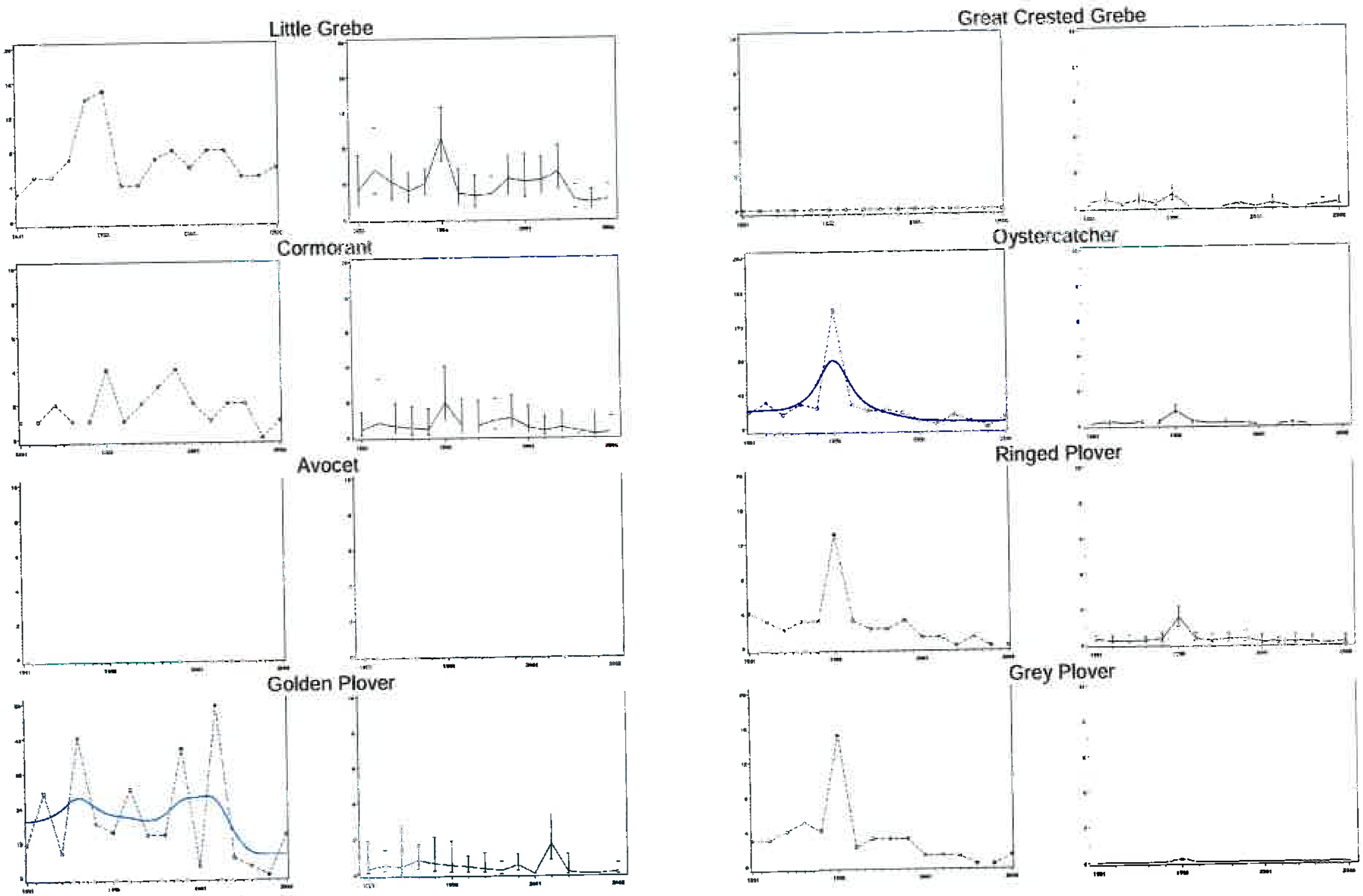


Figure E.22803 Population trends of each species in sector 22803 (Grain Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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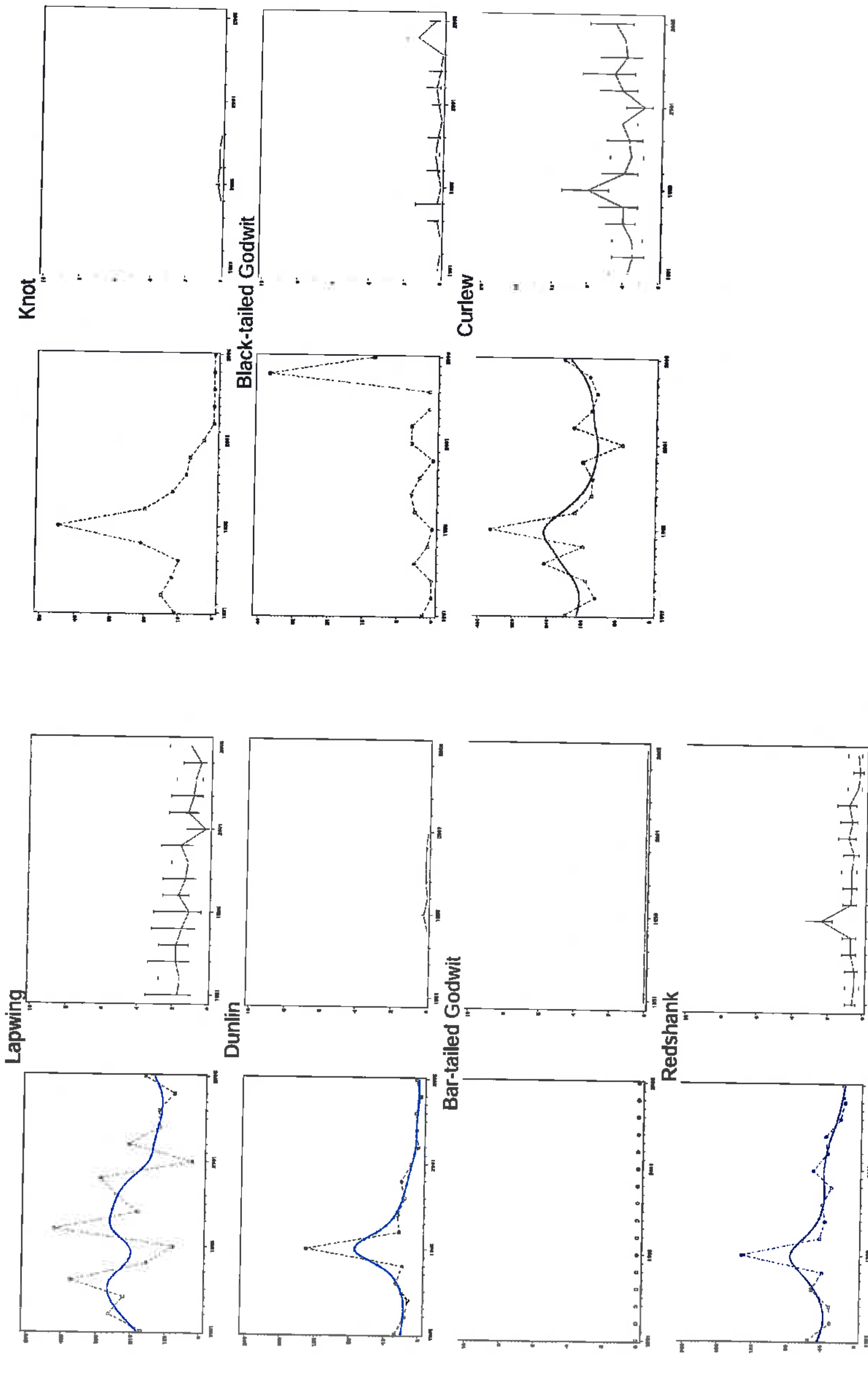

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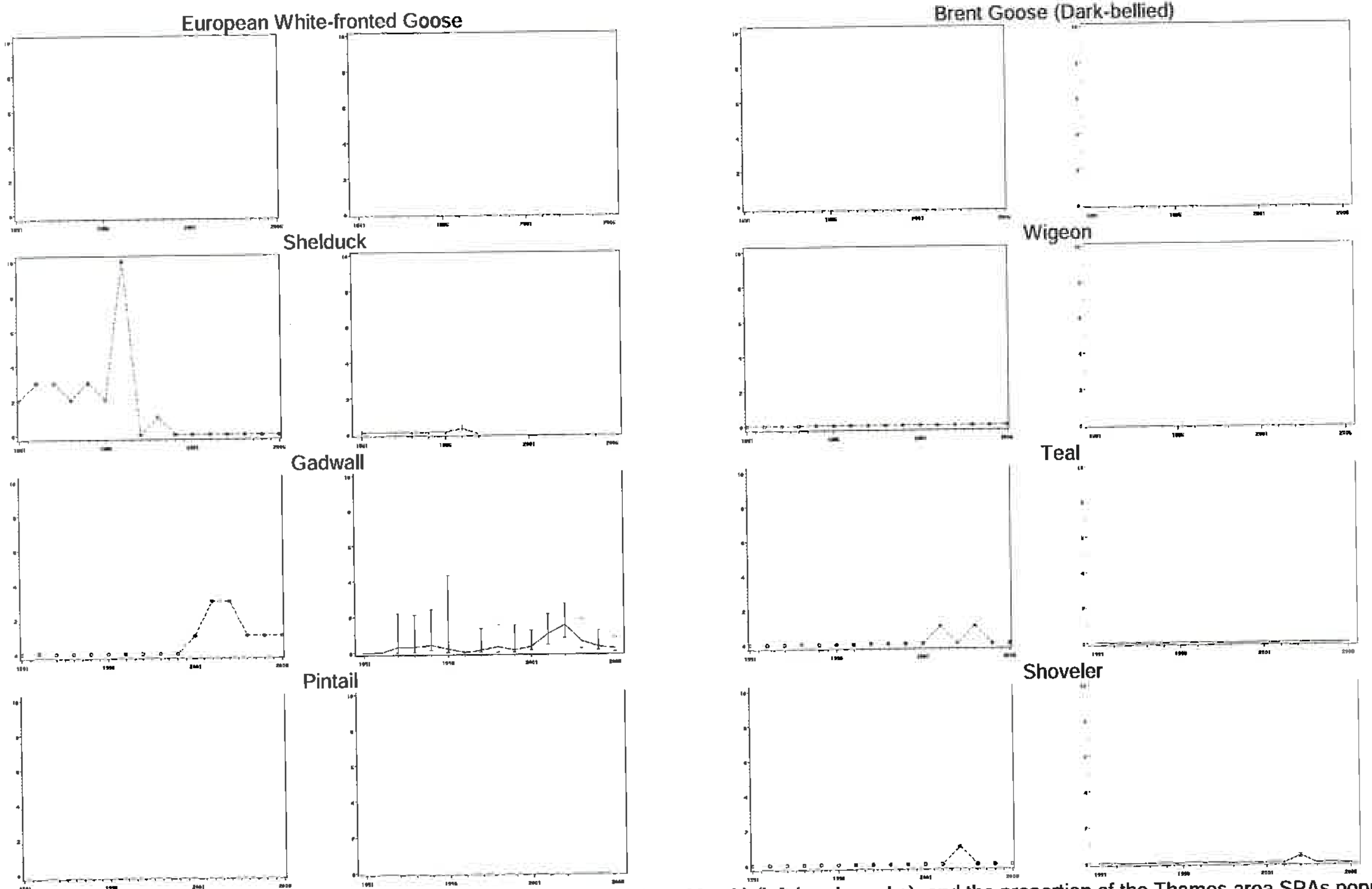
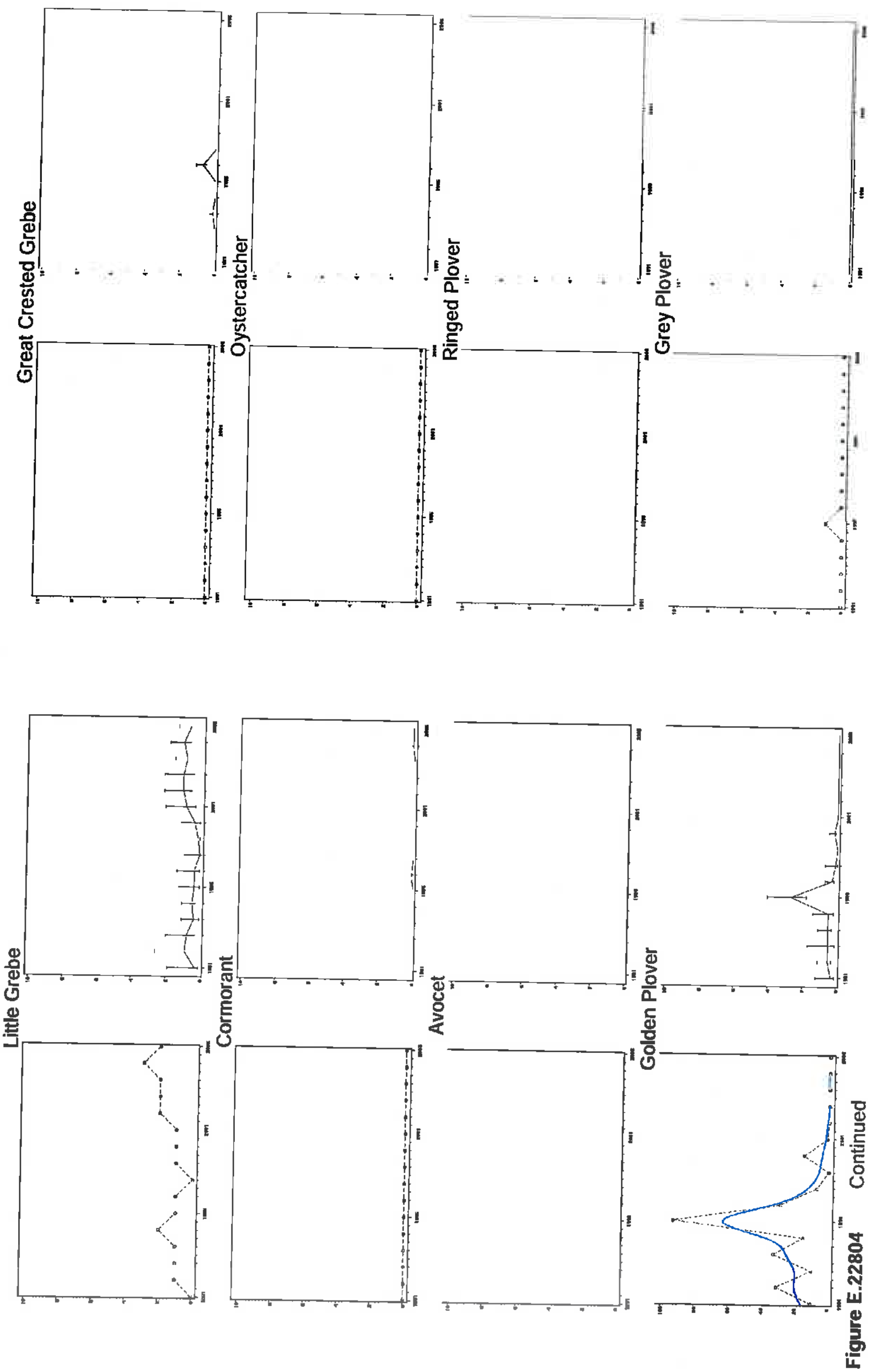


Figure E.22804 Population trends of each species in sector 22804 (Higham Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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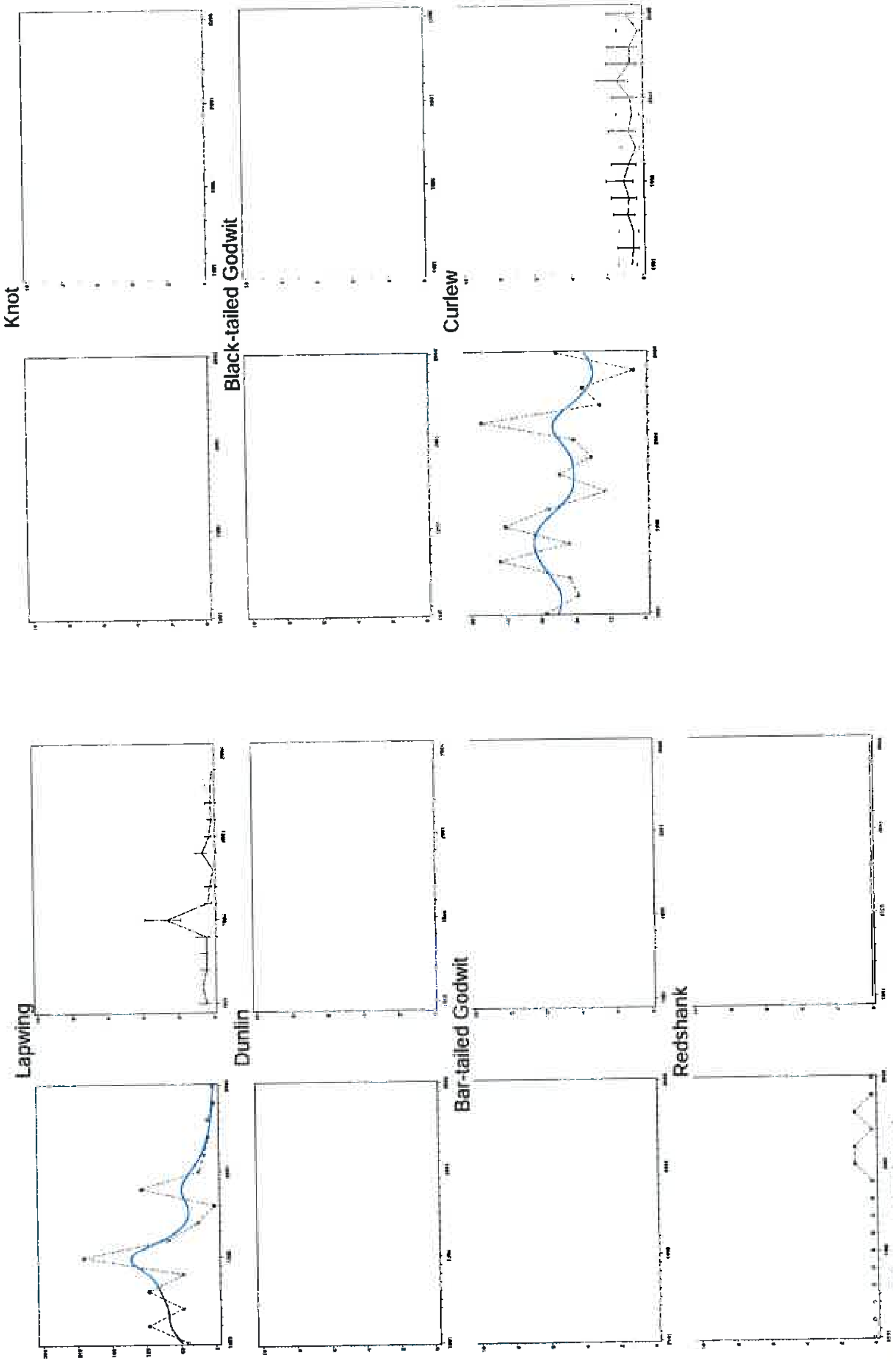

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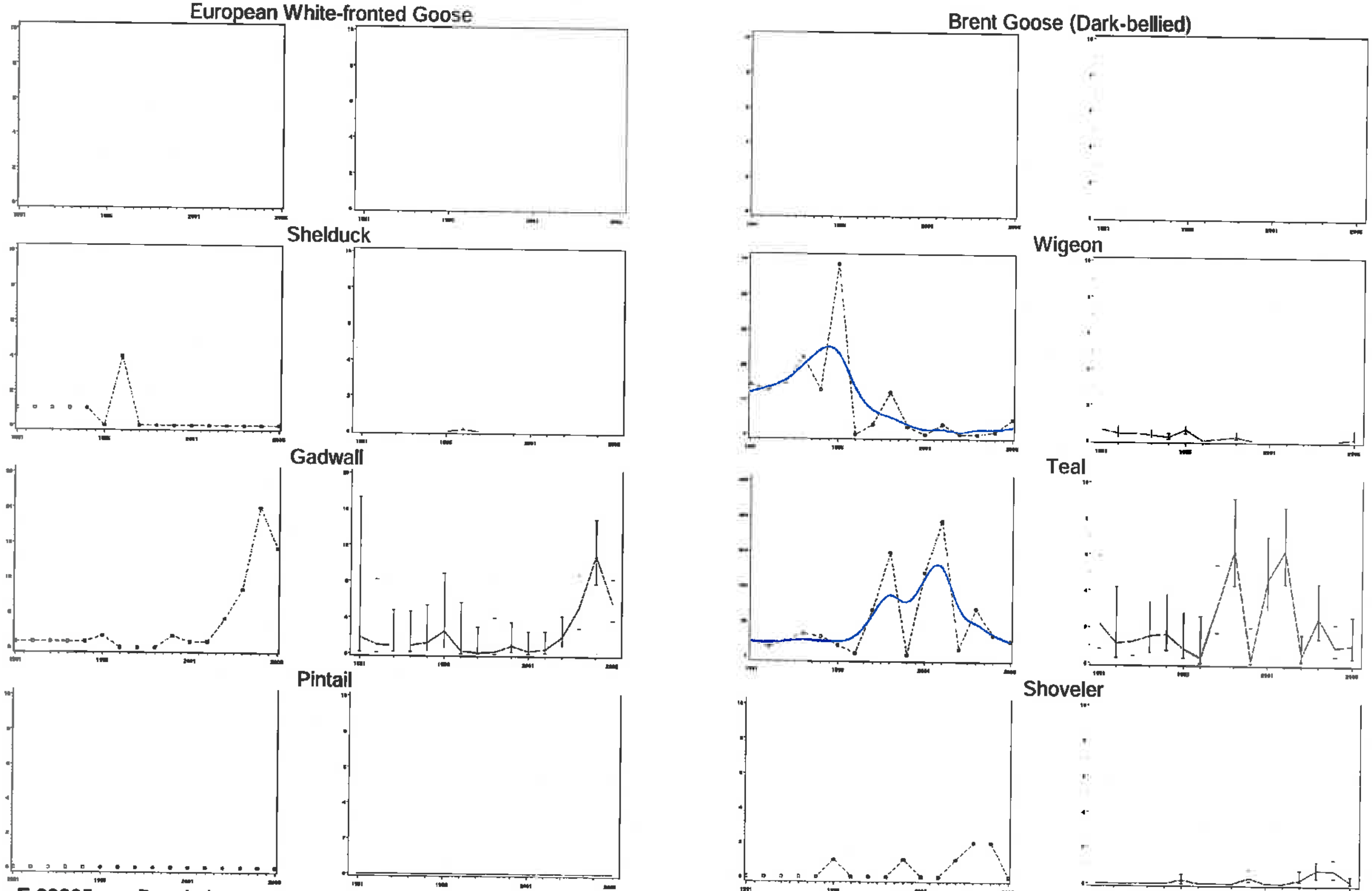
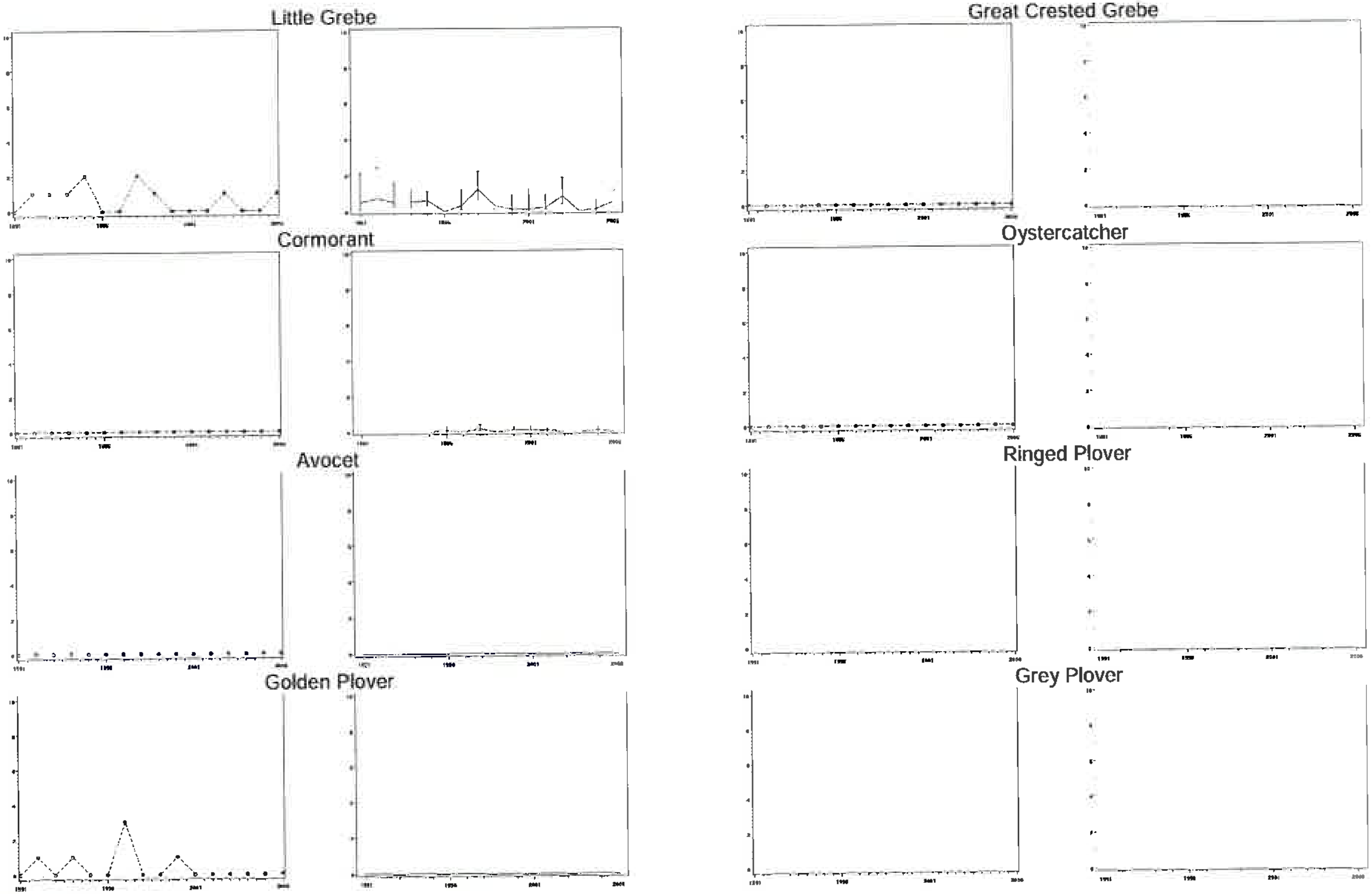


Figure E.22805 Population trends of each species in sector 22805 (Freshwater Yantlet) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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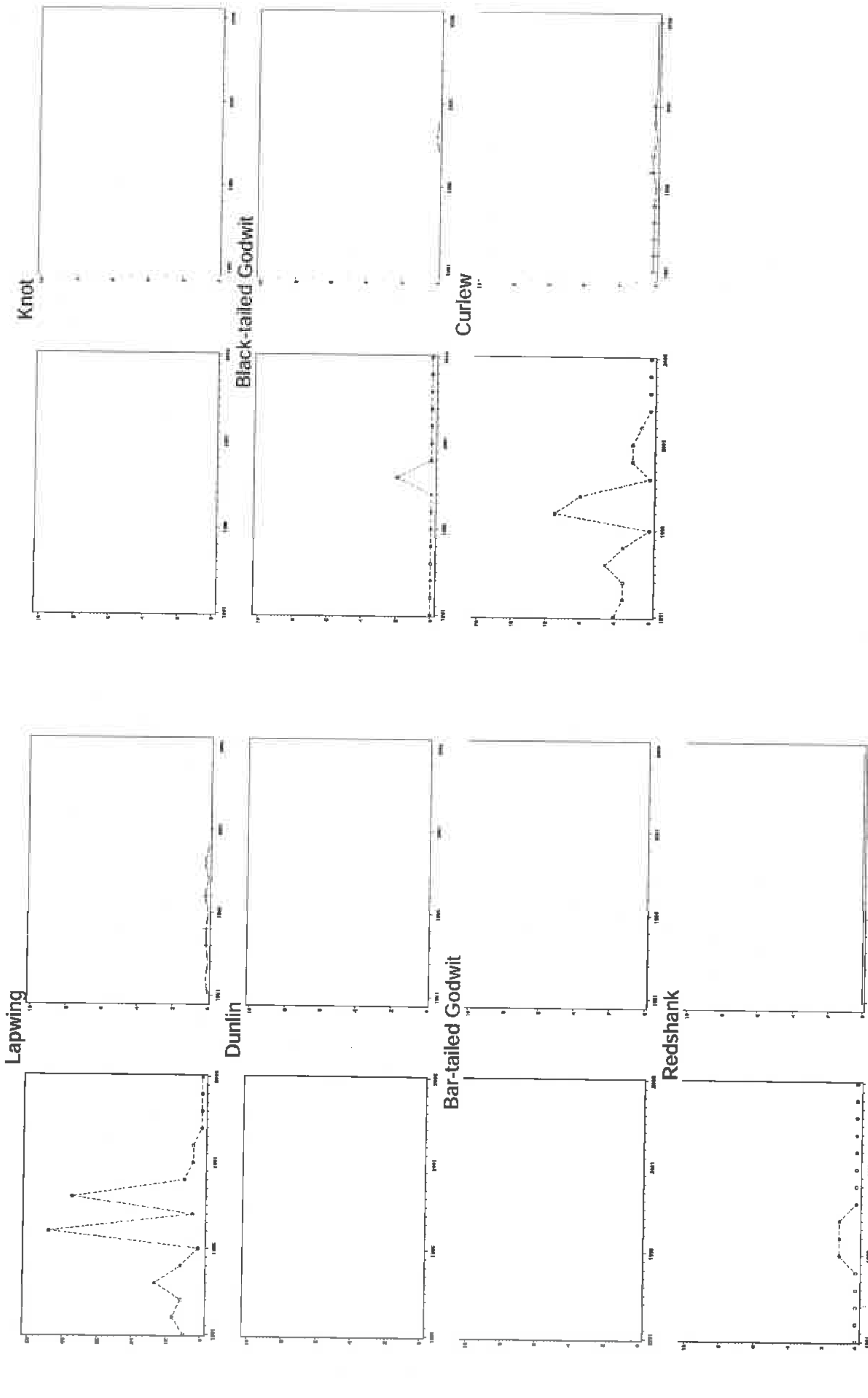

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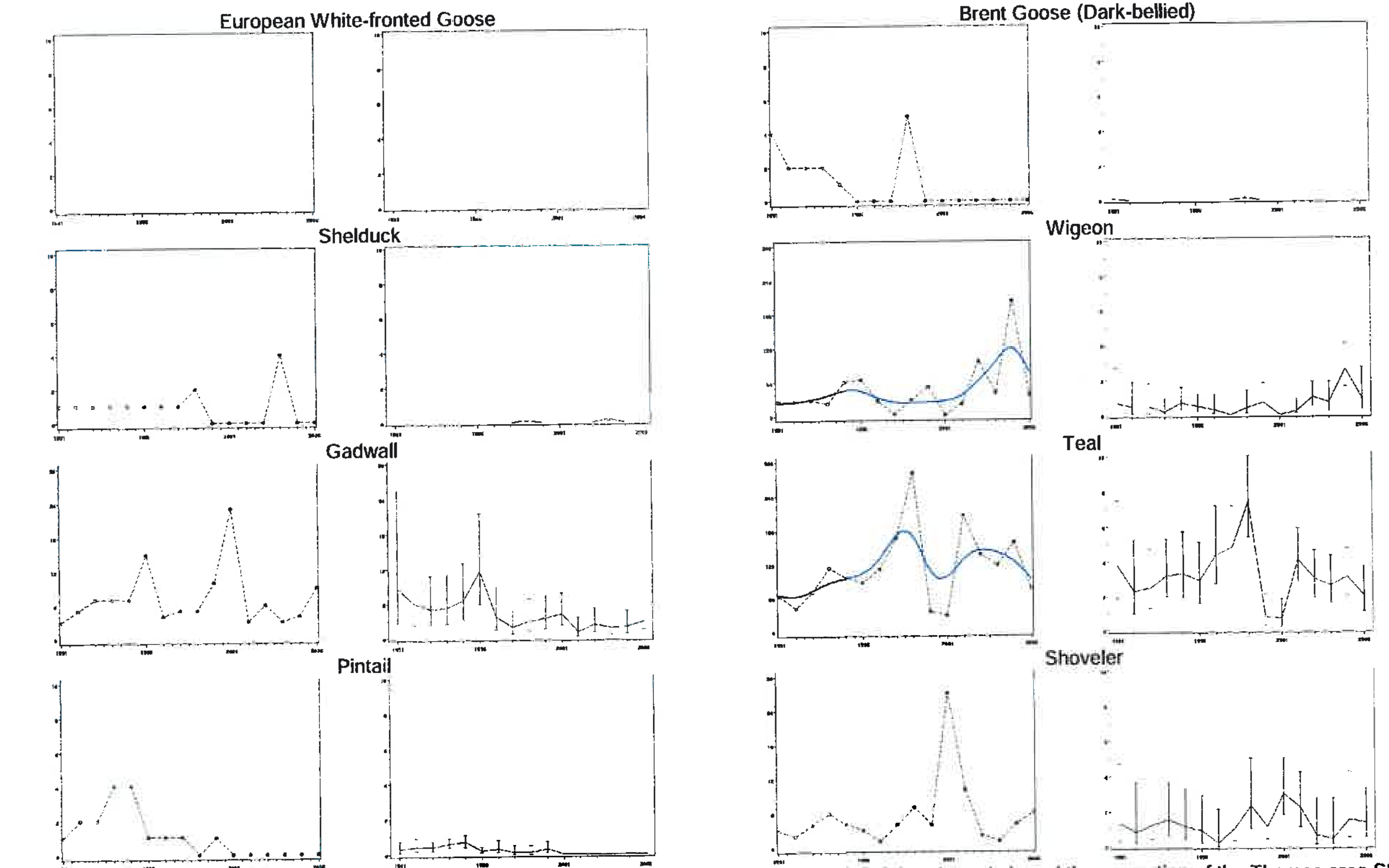
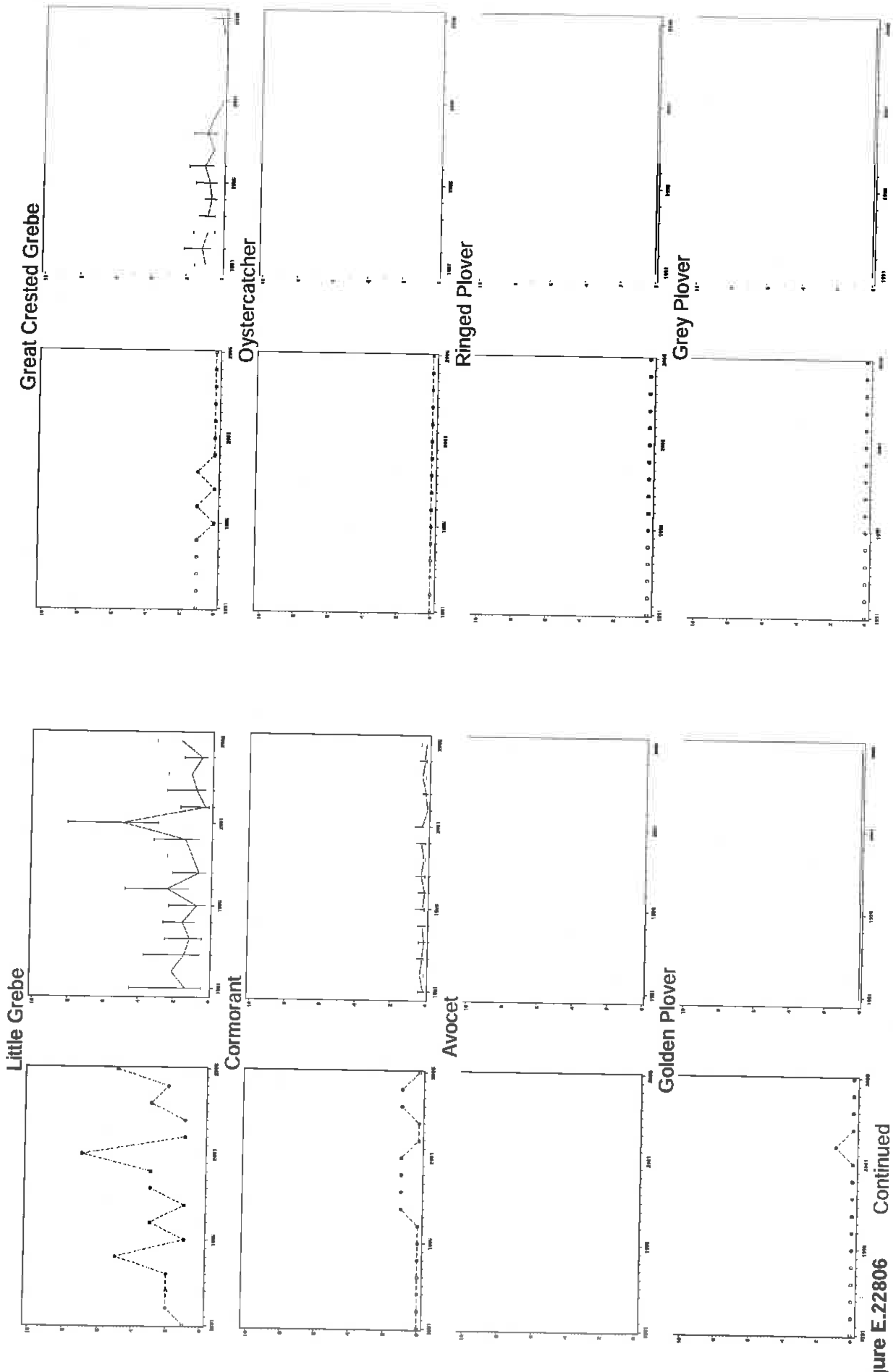


Figure E.22806 Population trends of each species in sector 22806 (South Allhallows Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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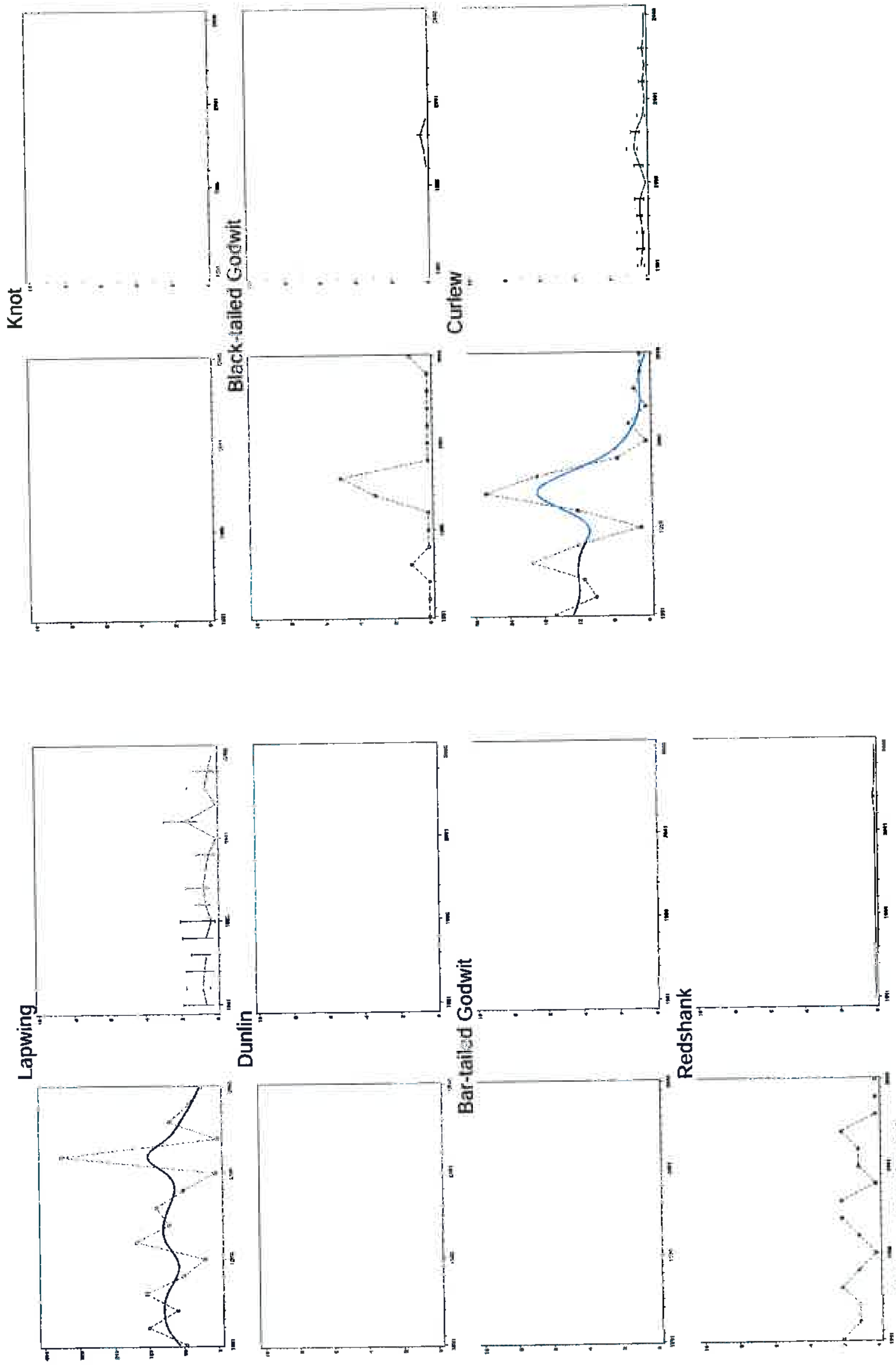

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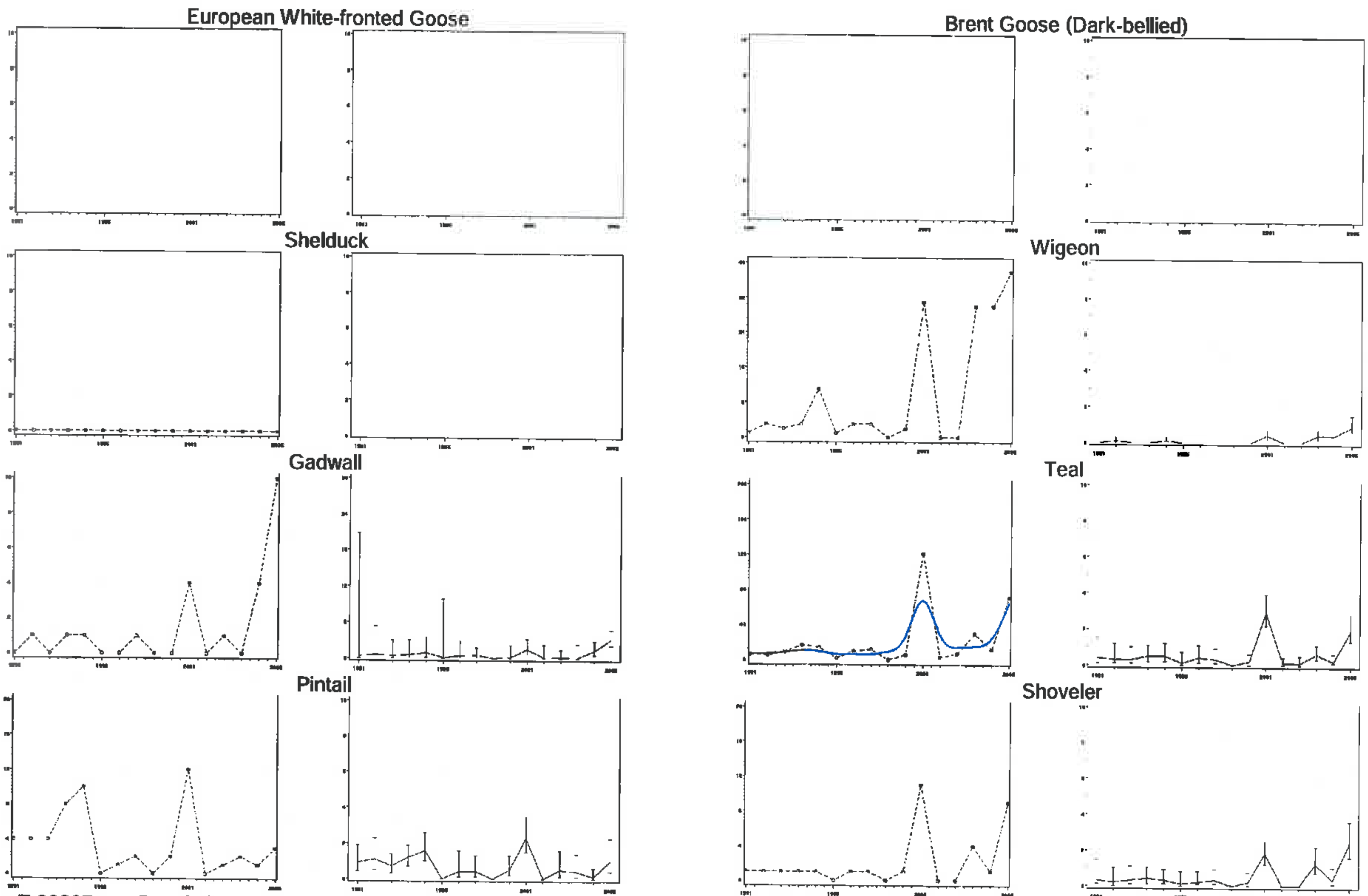
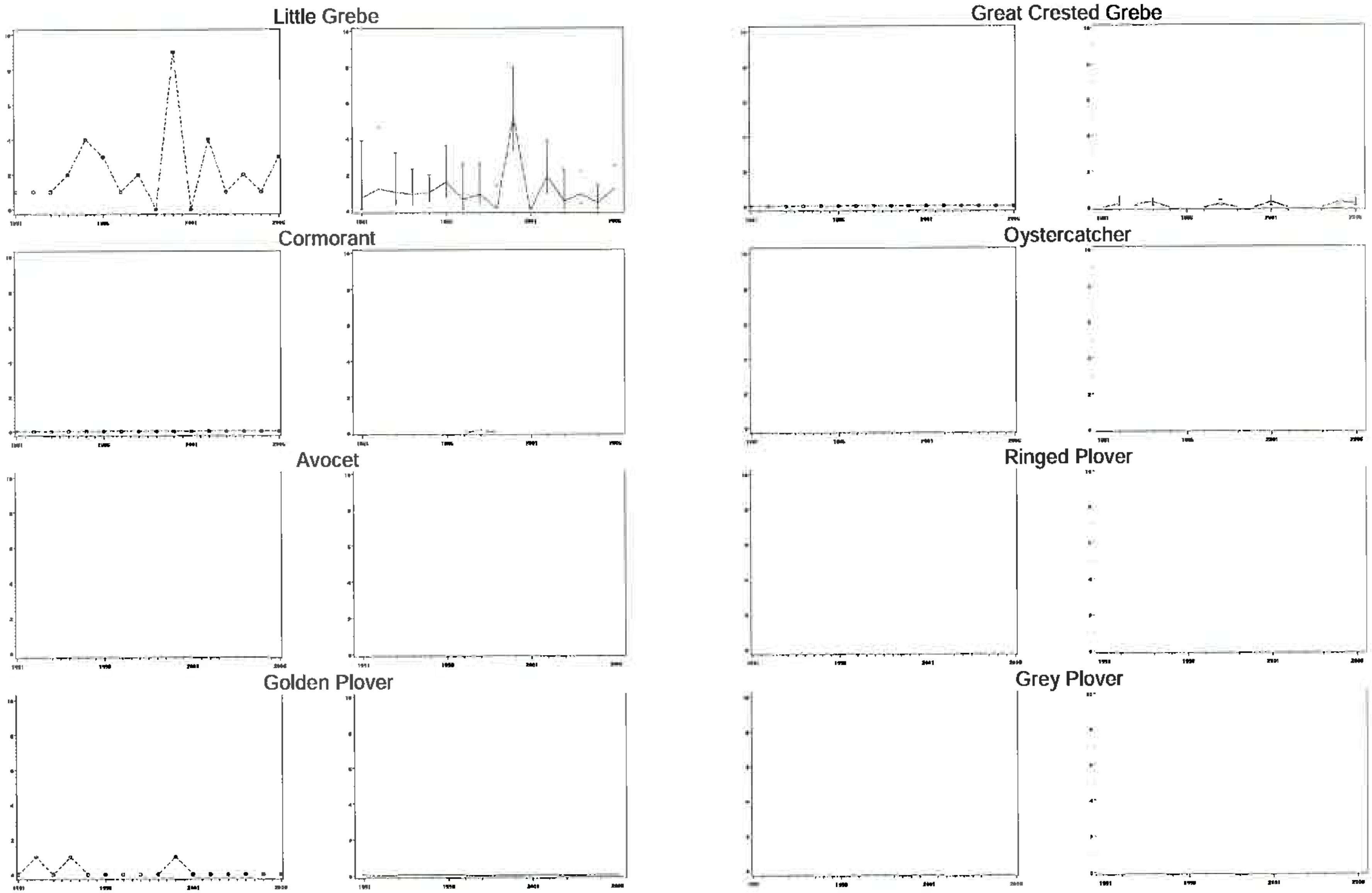


Figure E.22807 Population trends of each species in sector 22807 (Yantlet and Allhallows Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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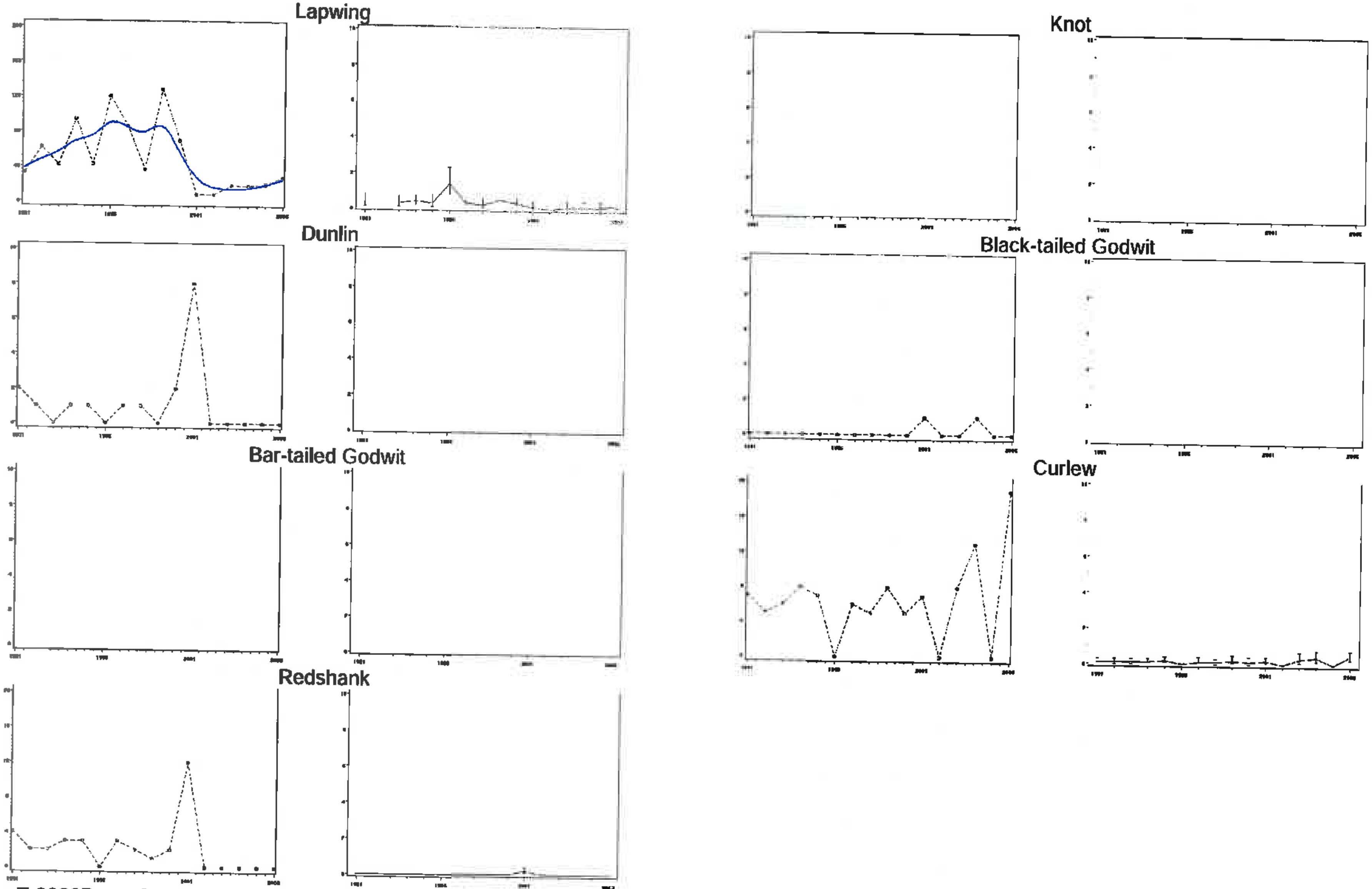

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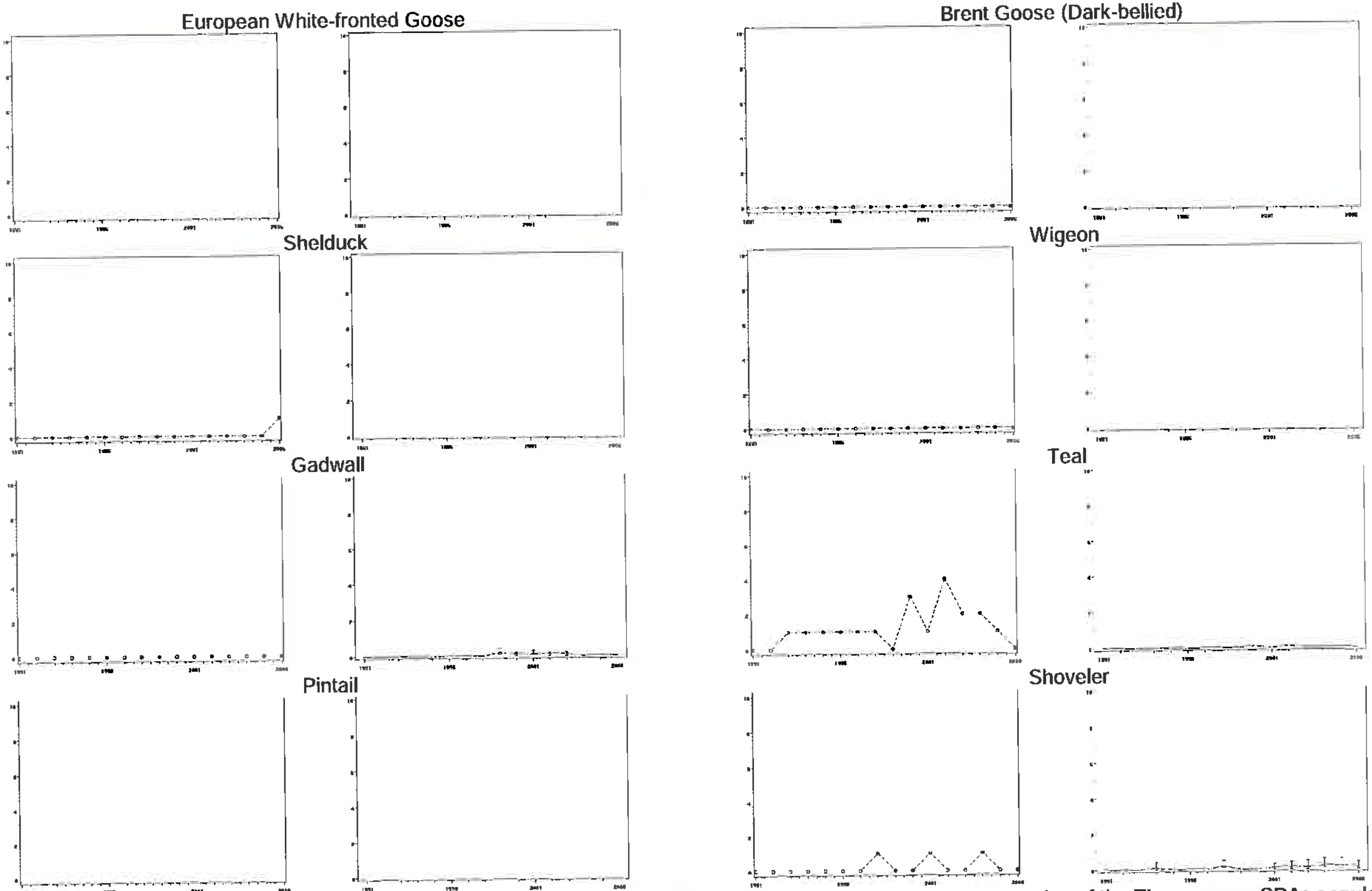
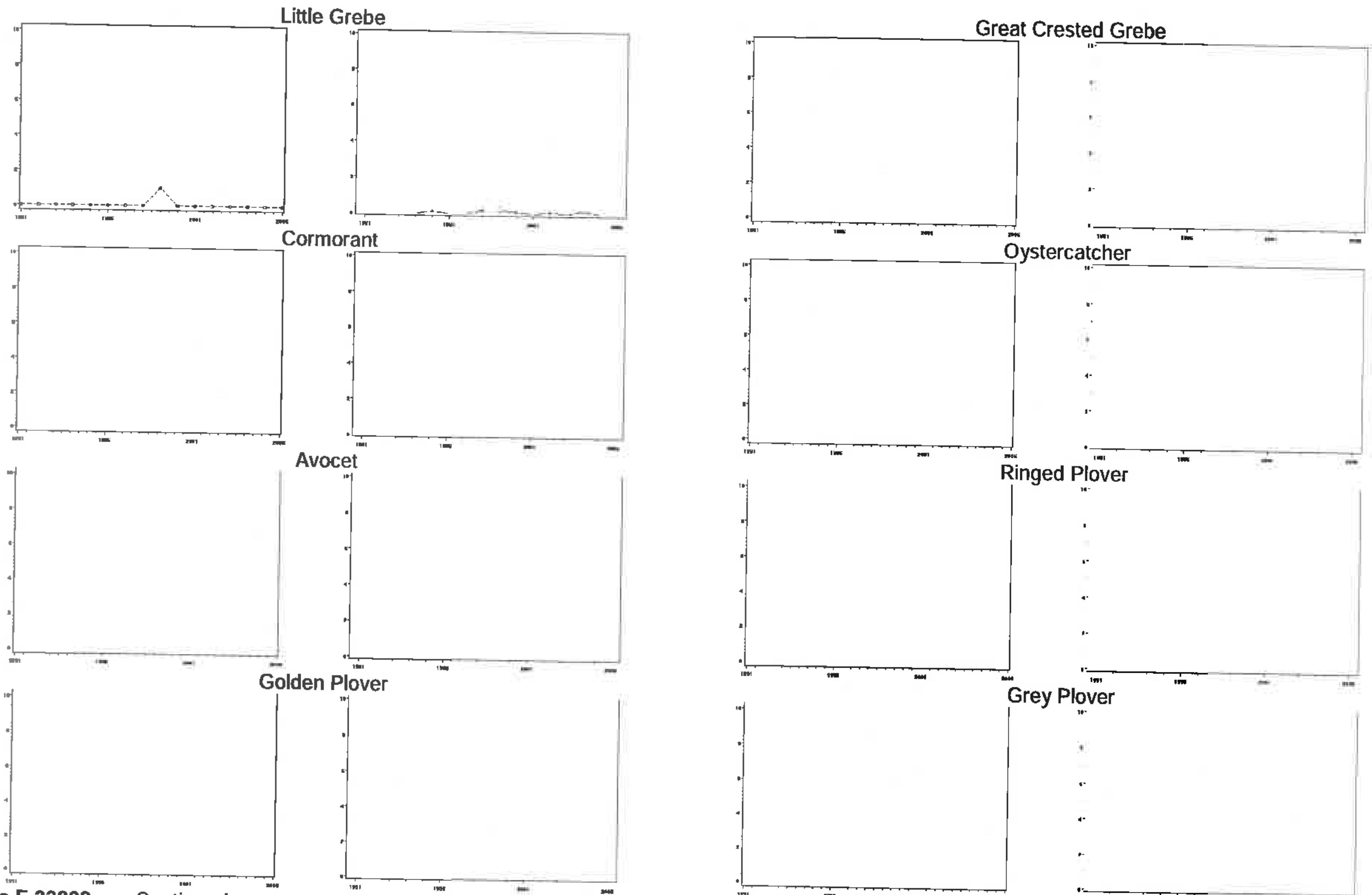


Figure E.22808 Population trends of each species in sector 22808 (Sluice Fleet) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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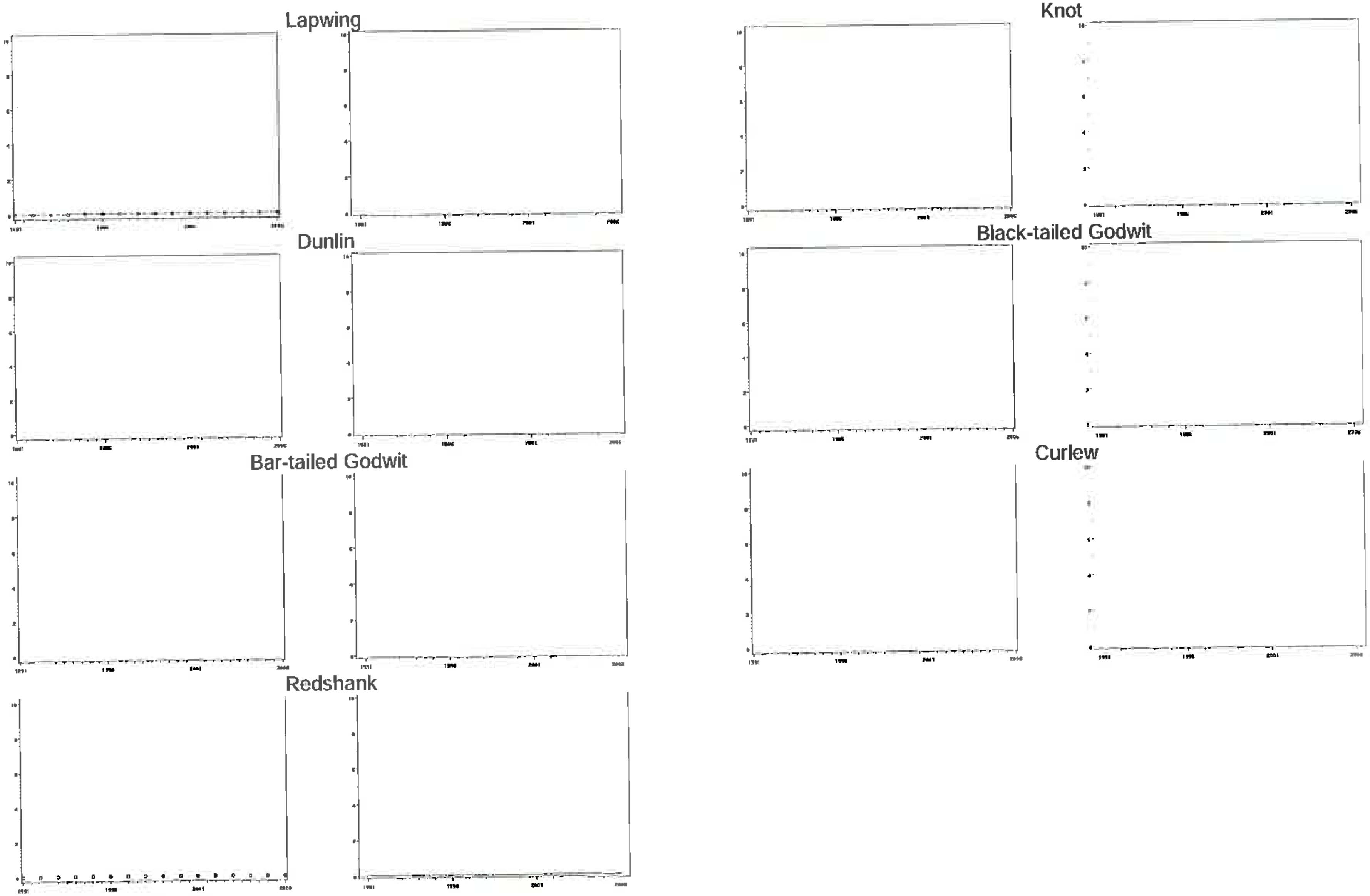

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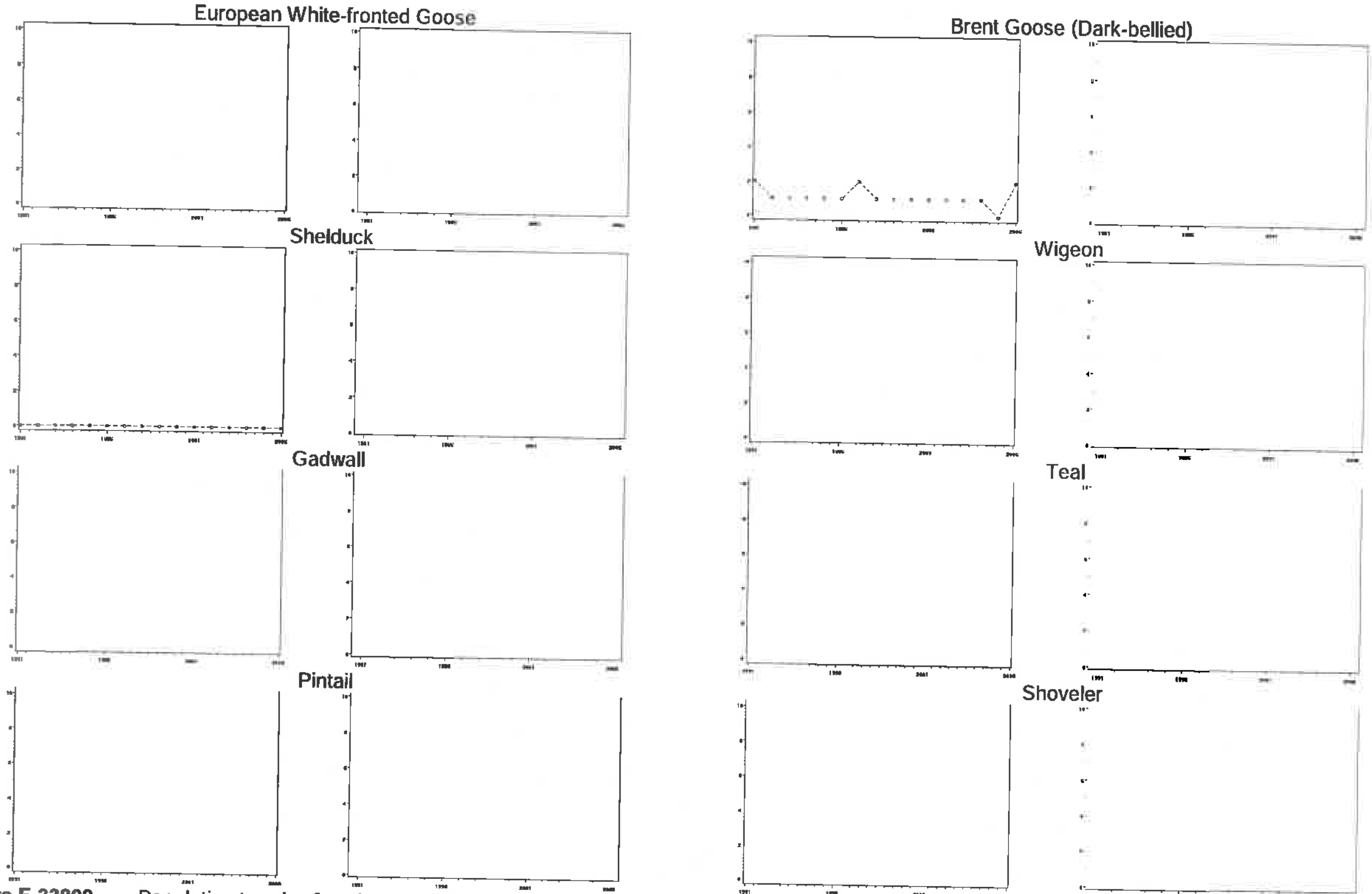
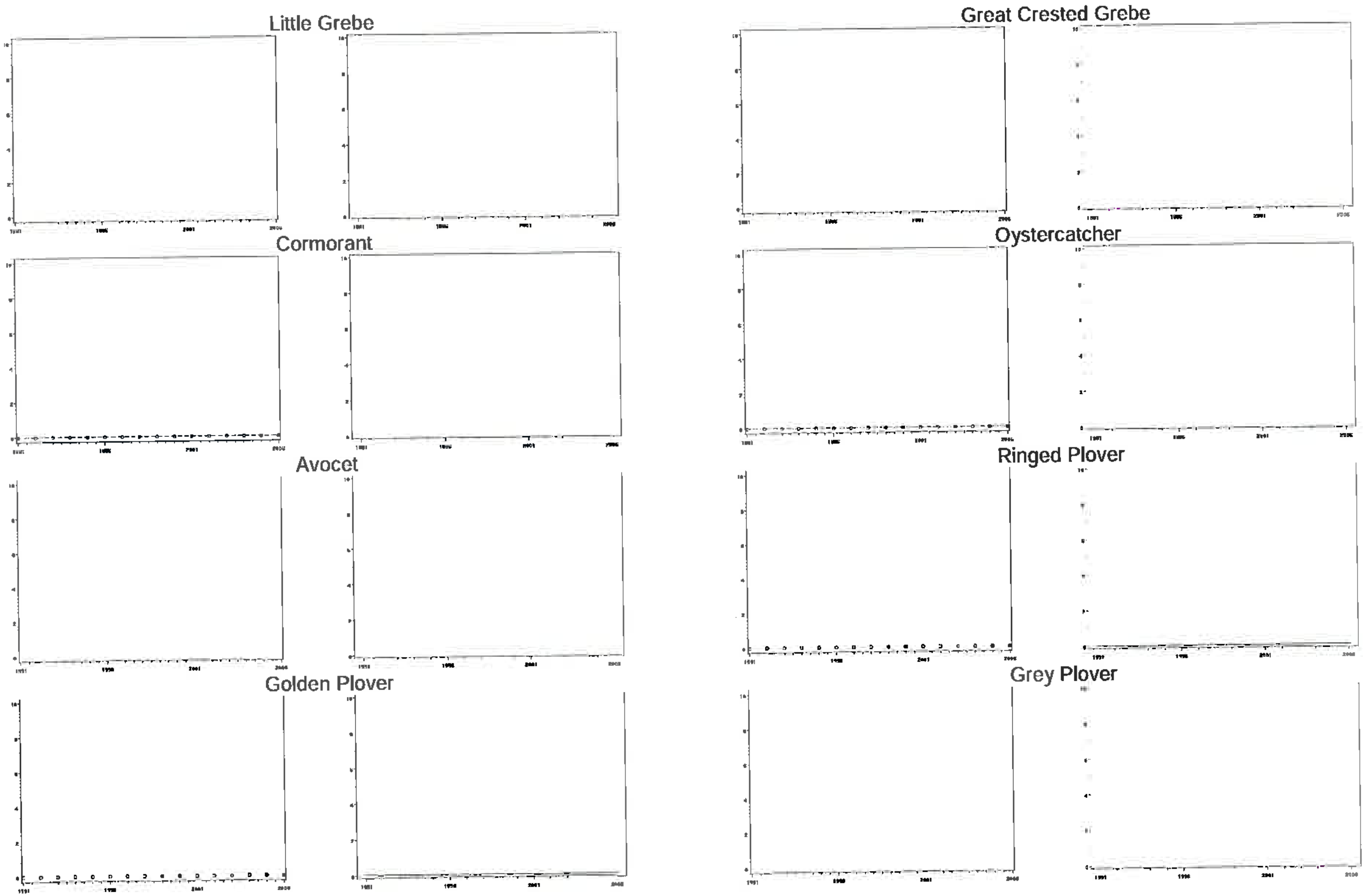


Figure E.22809 Population trends of each species in sector 22809 (Dagnam Fields) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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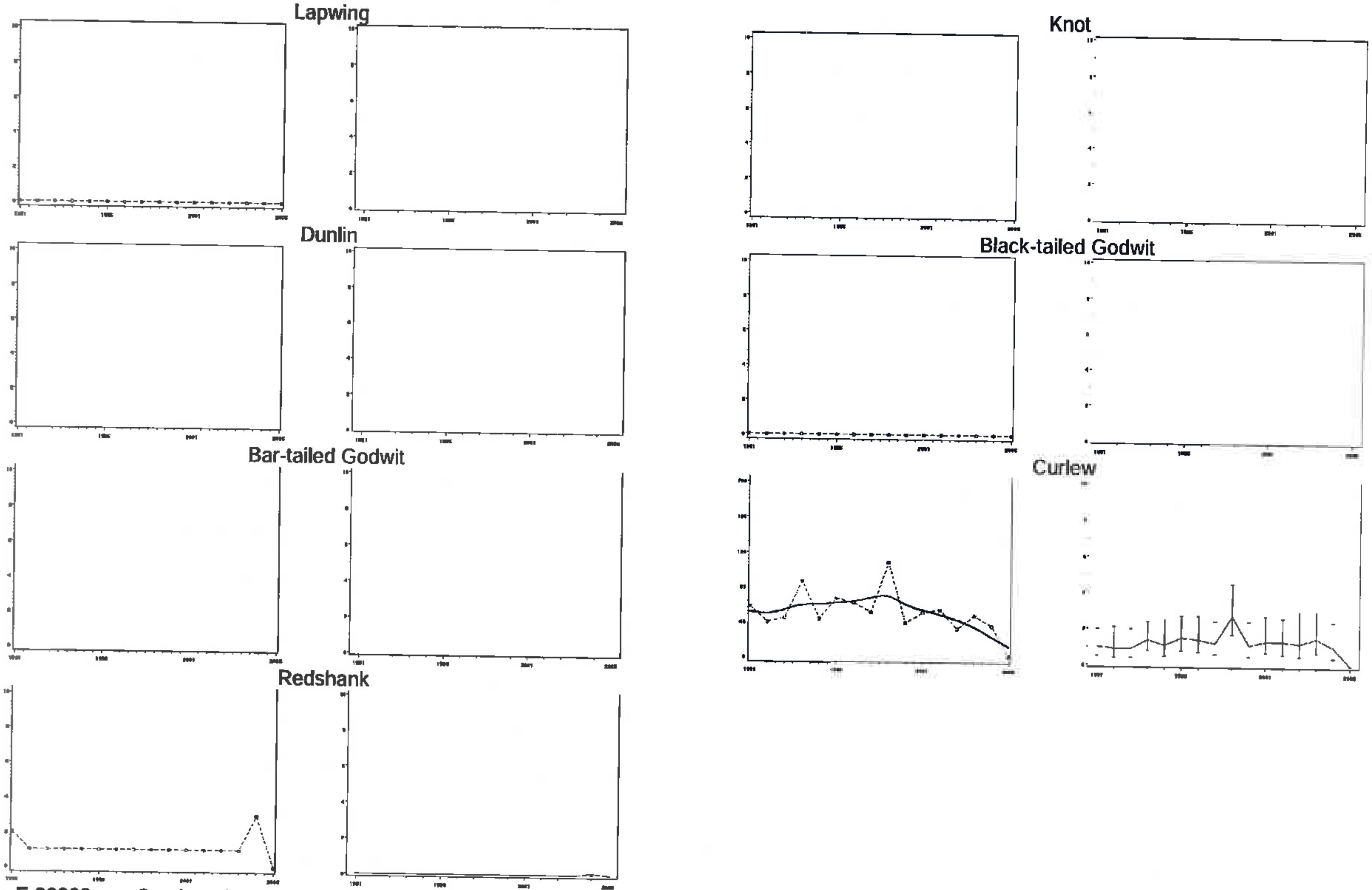

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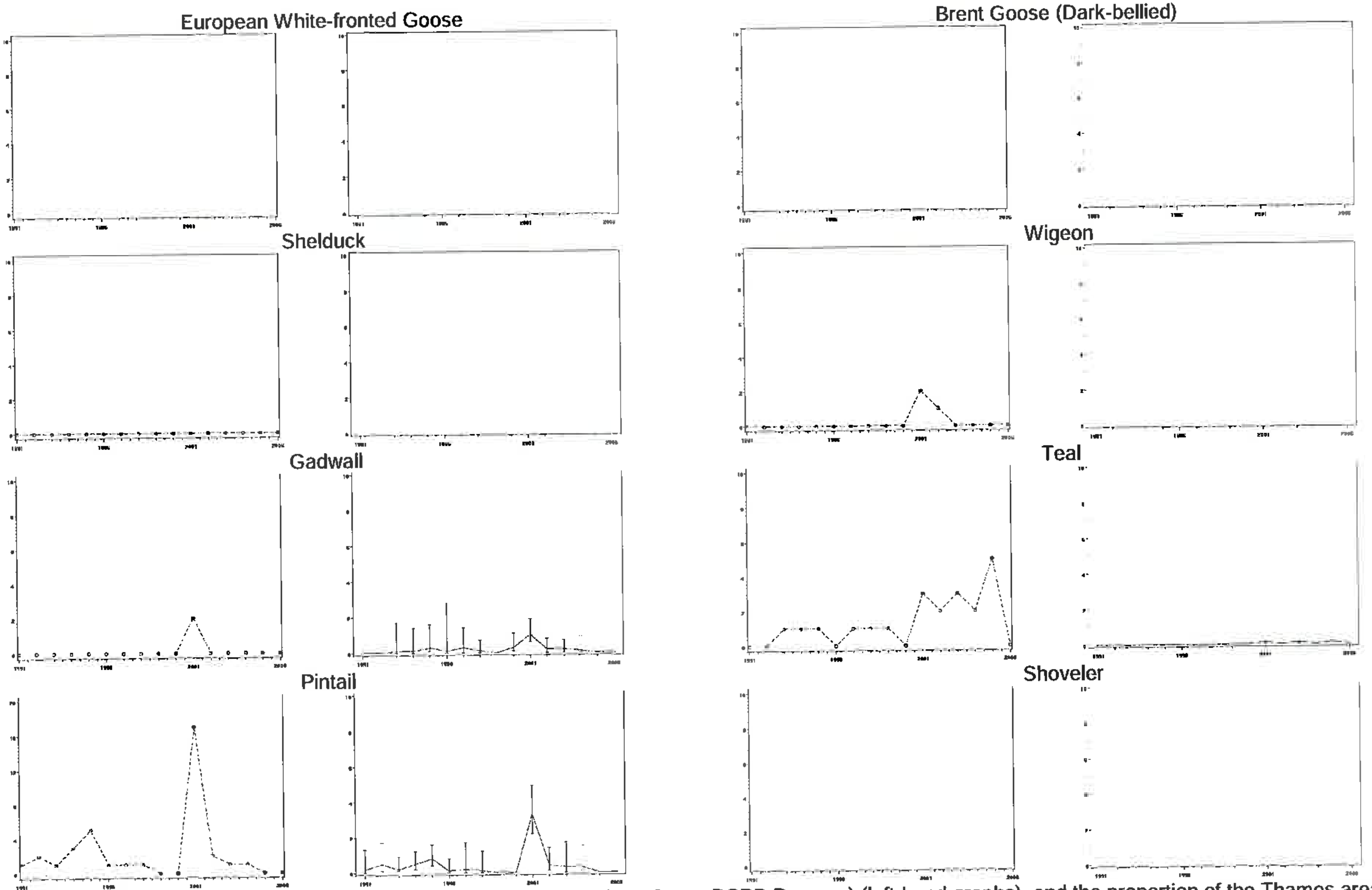
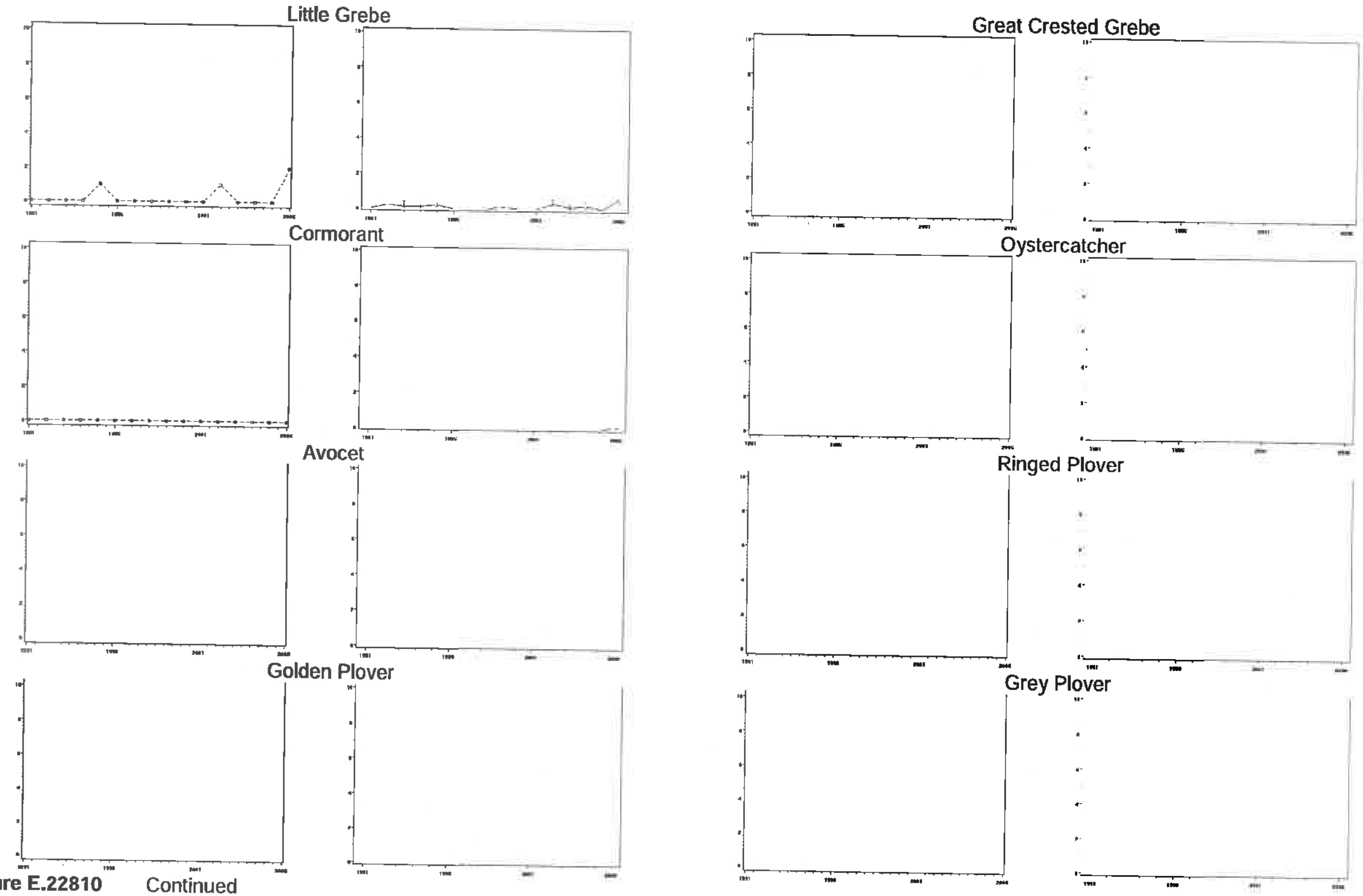


Figure E.22810 Population trends of each species in sector 22810 (Rye Street RSPB Reserve) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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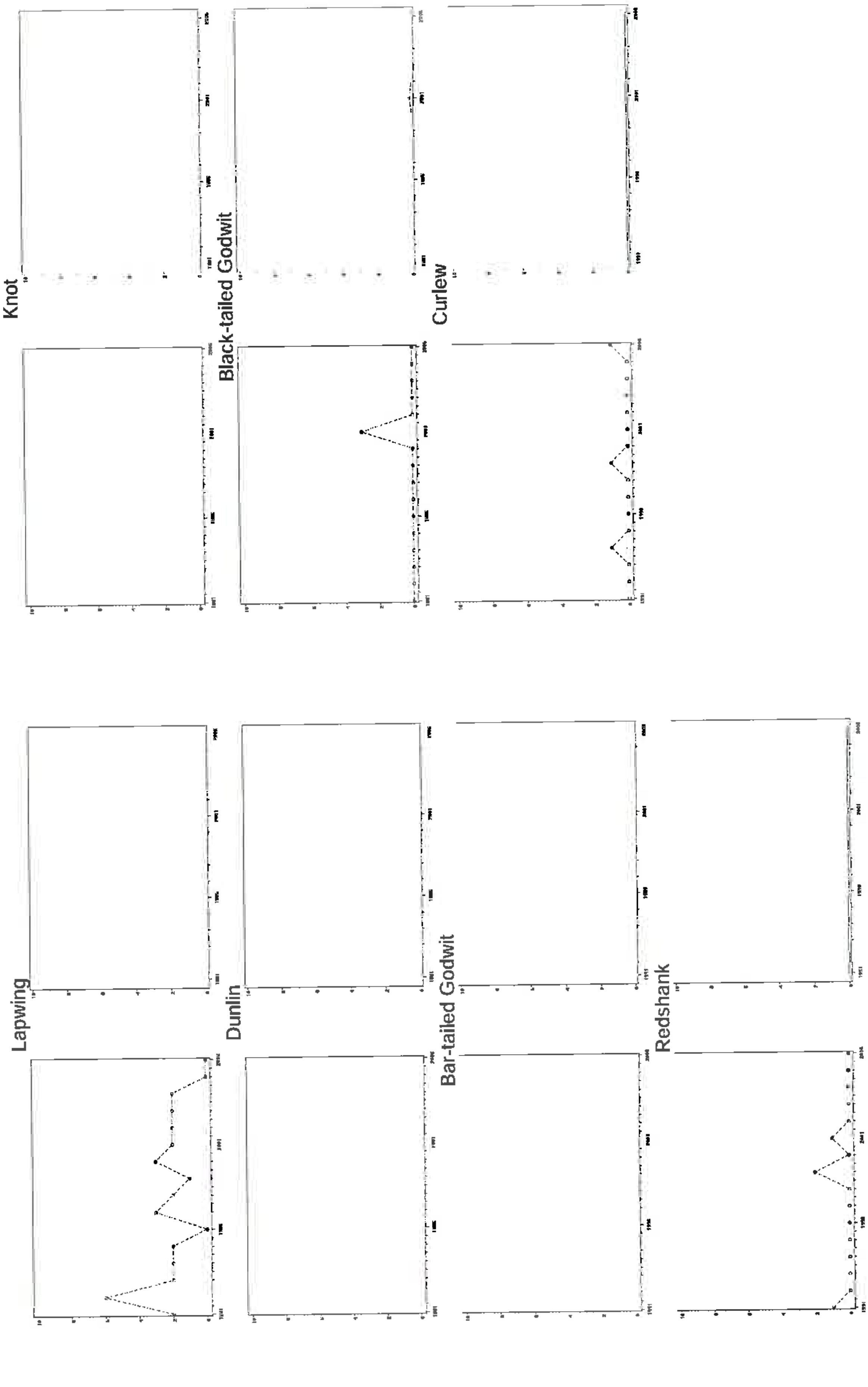

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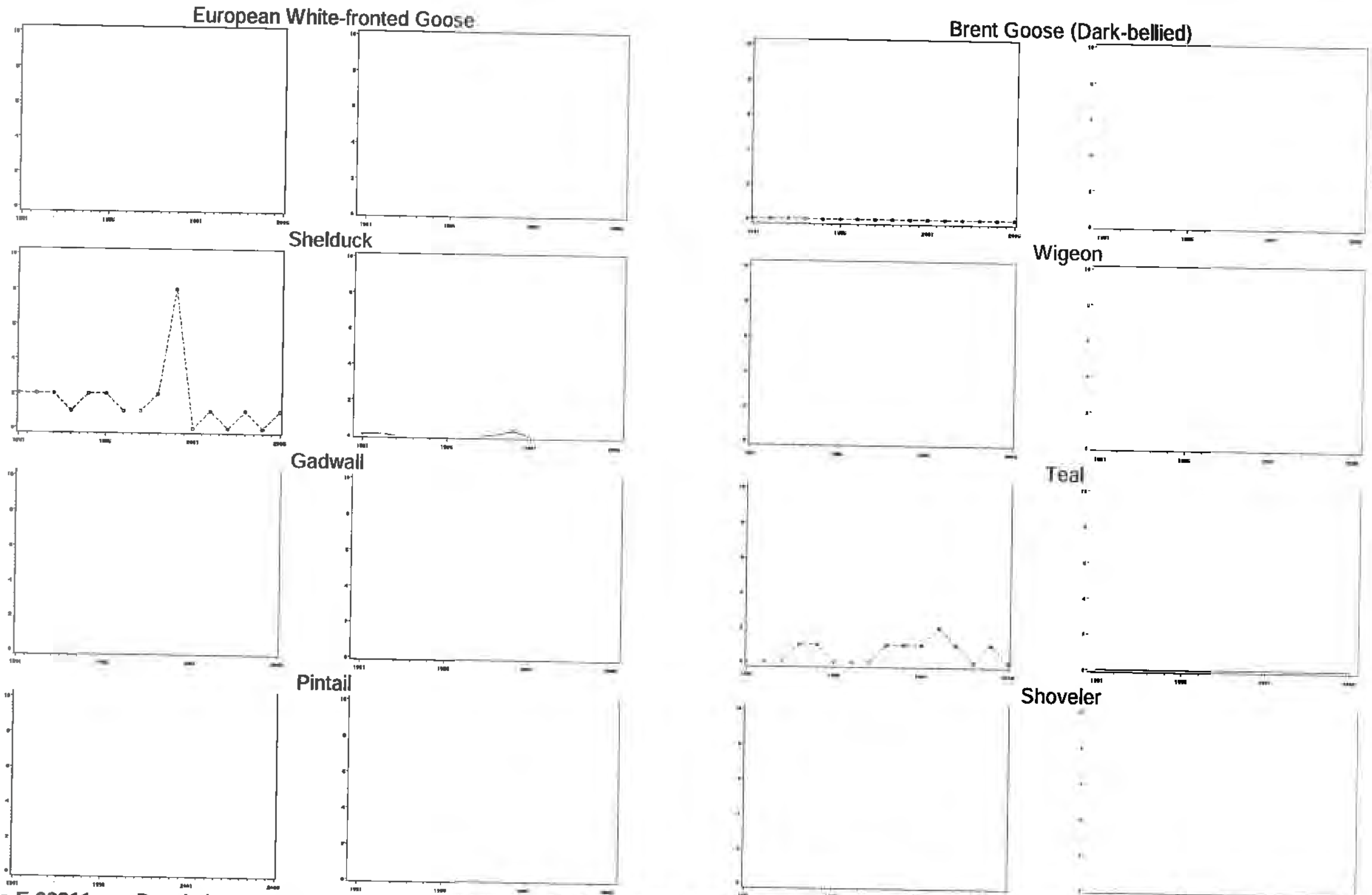
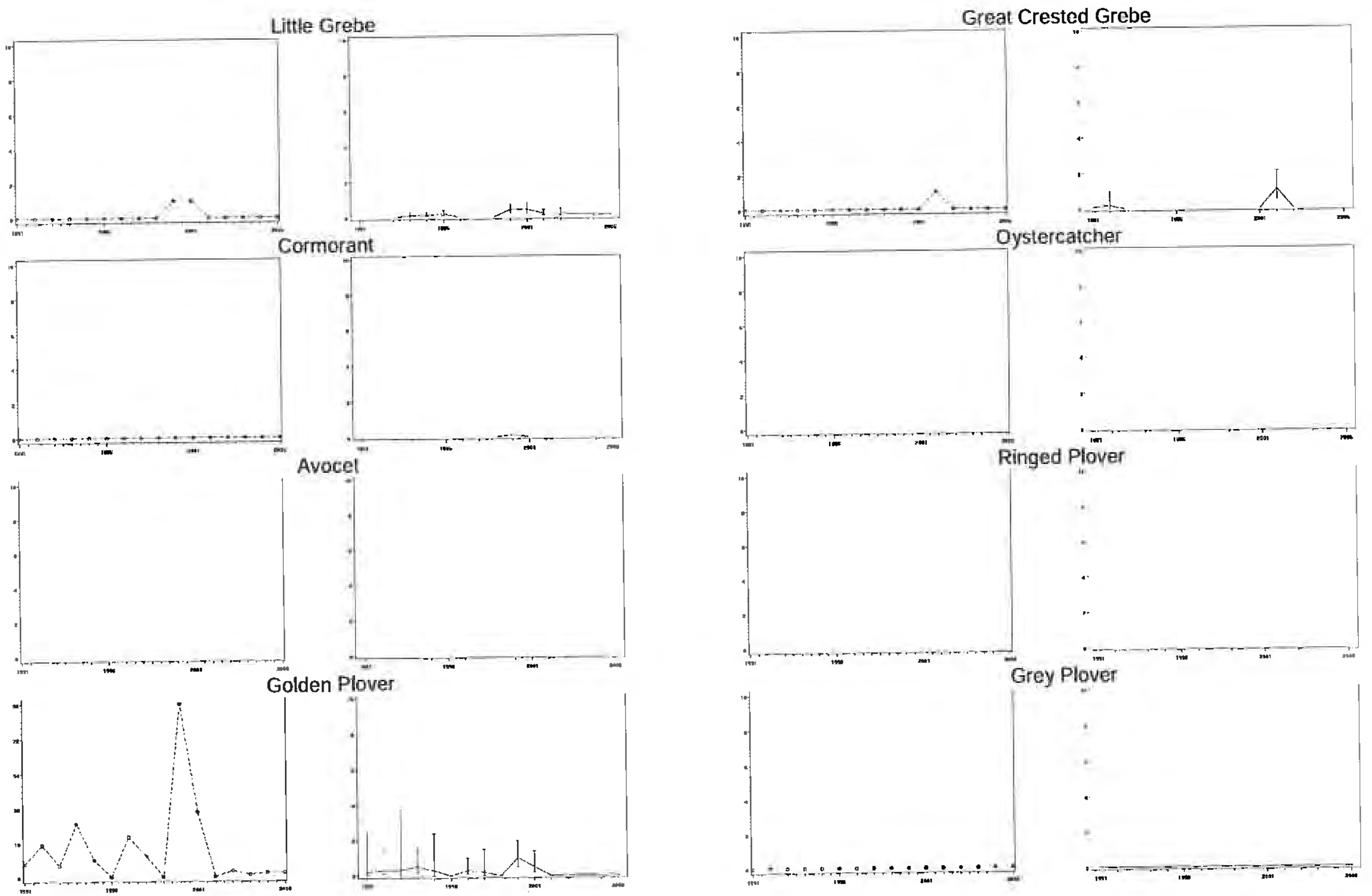


Figure E.22811 Population trends of each species in sector 22811 (Redham Mead) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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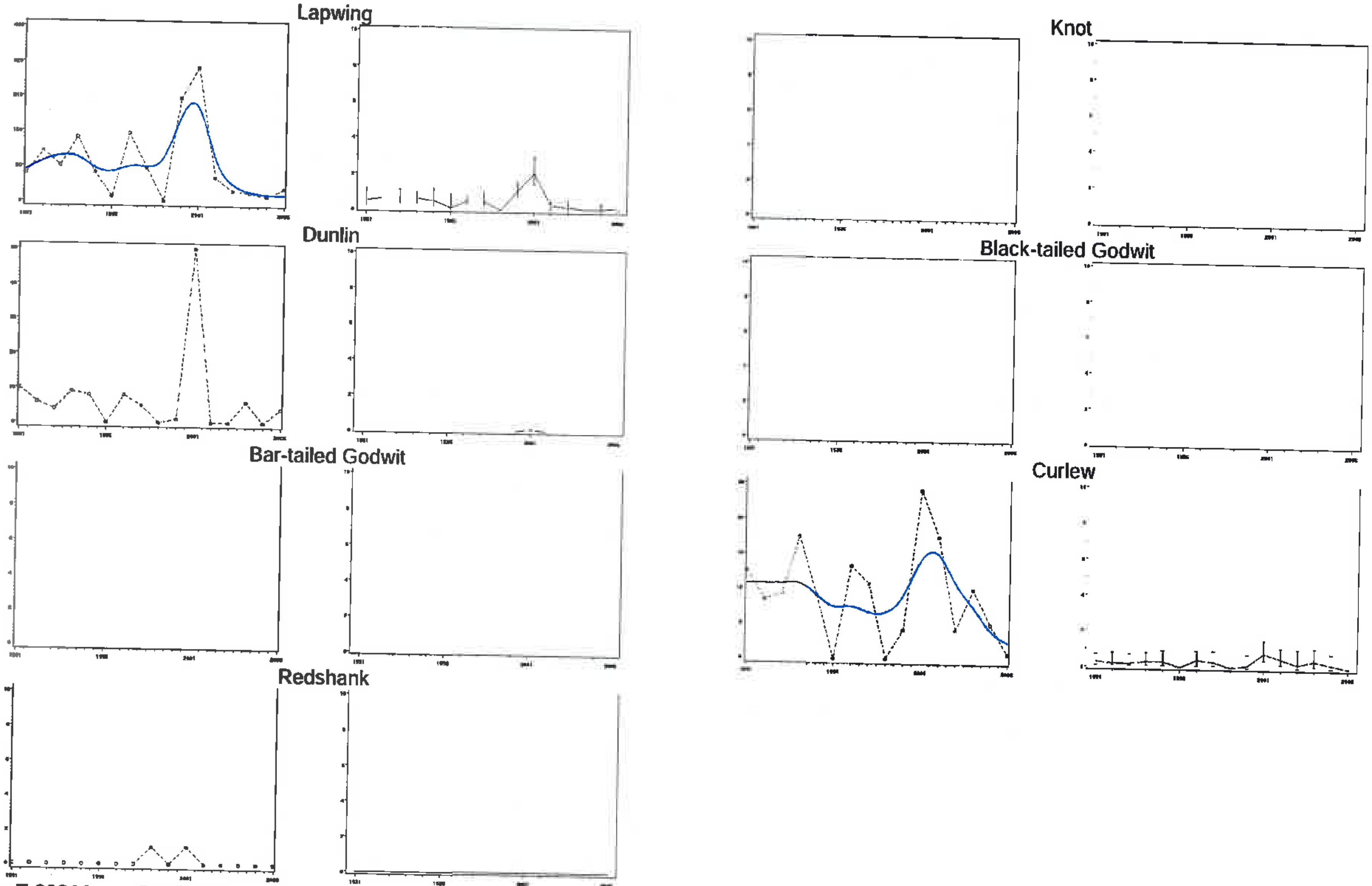

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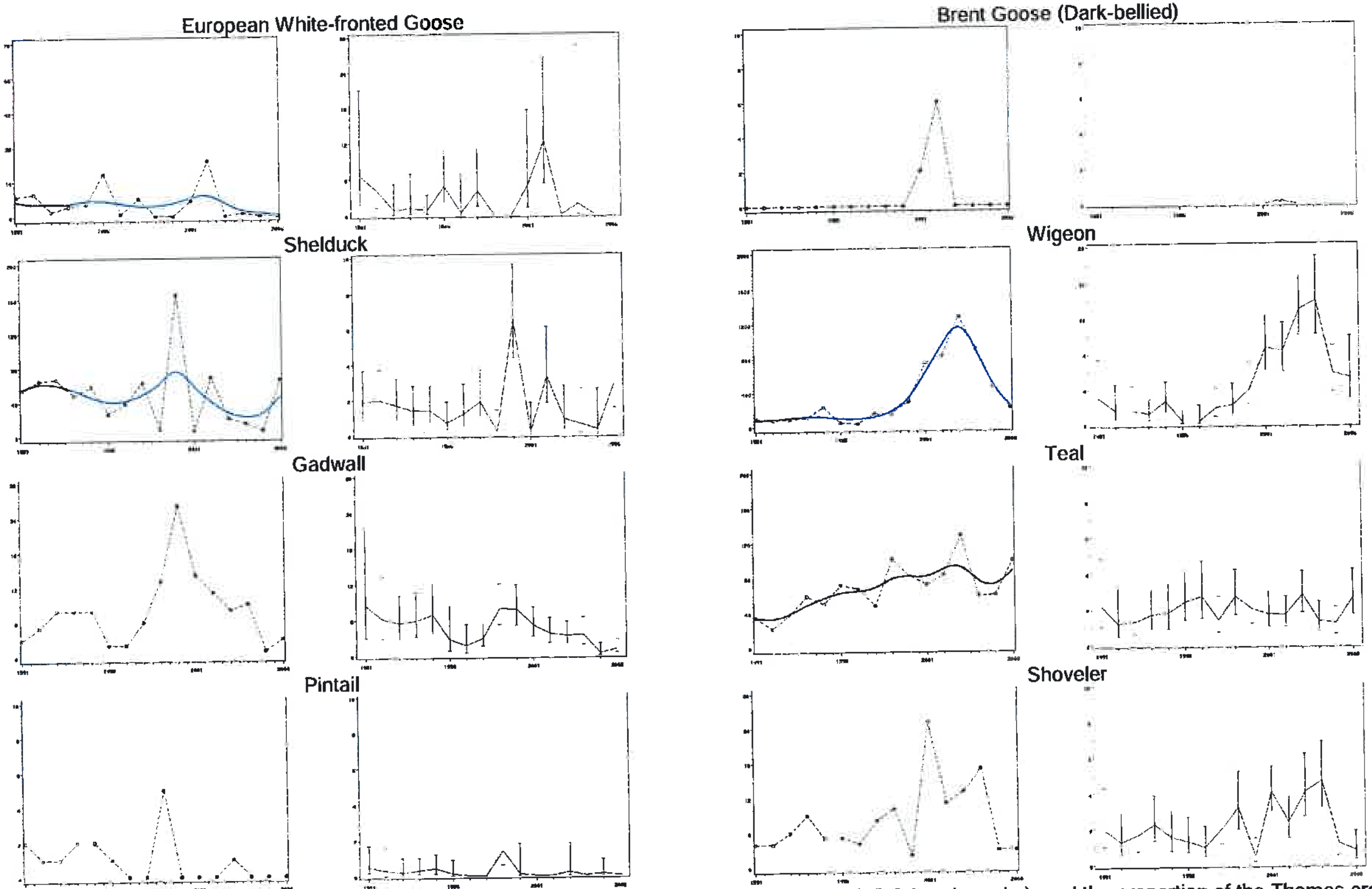
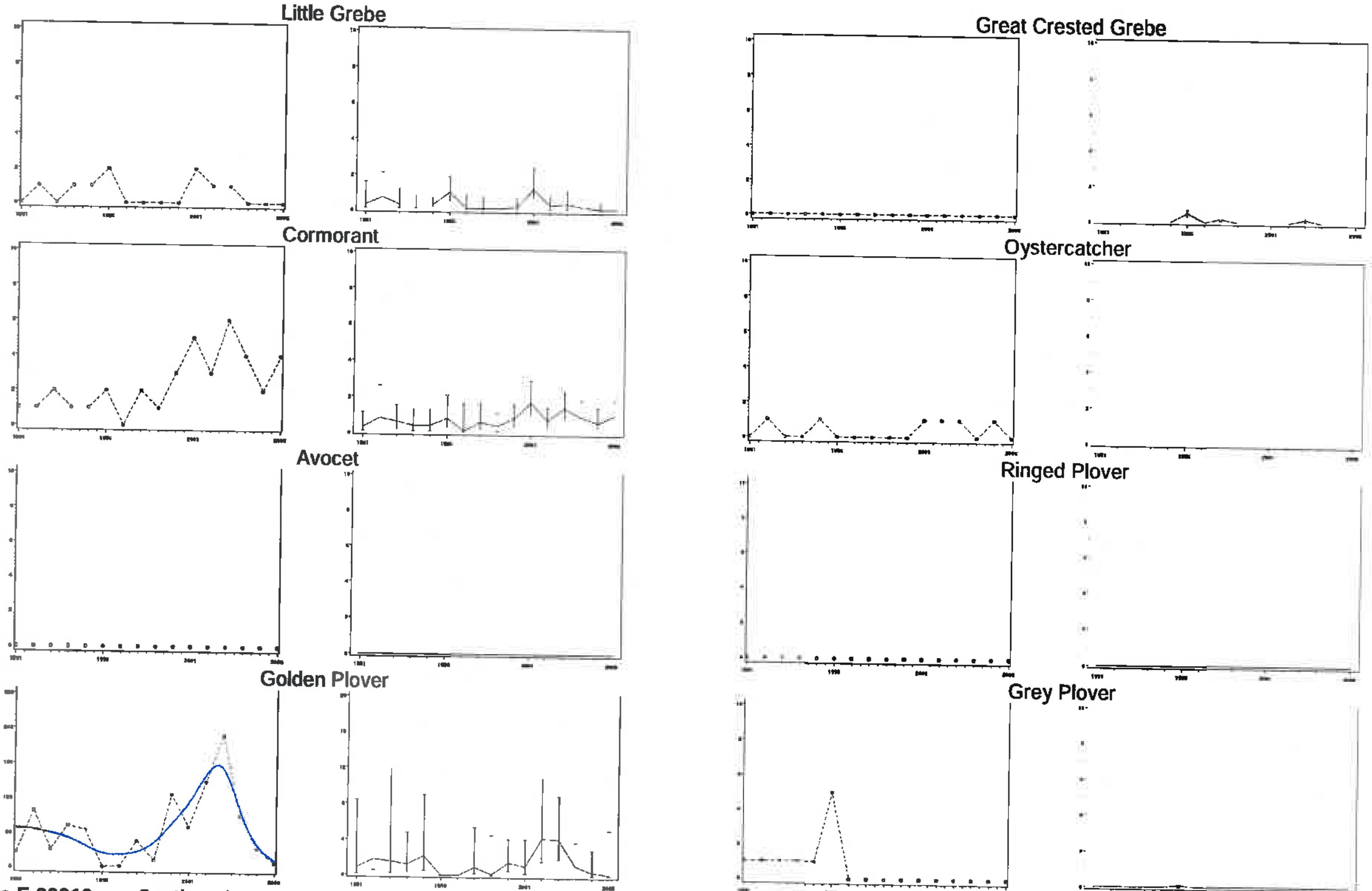


Figure E.22812 Population trends of each species in sector 22812 (Cliffe and Cooling Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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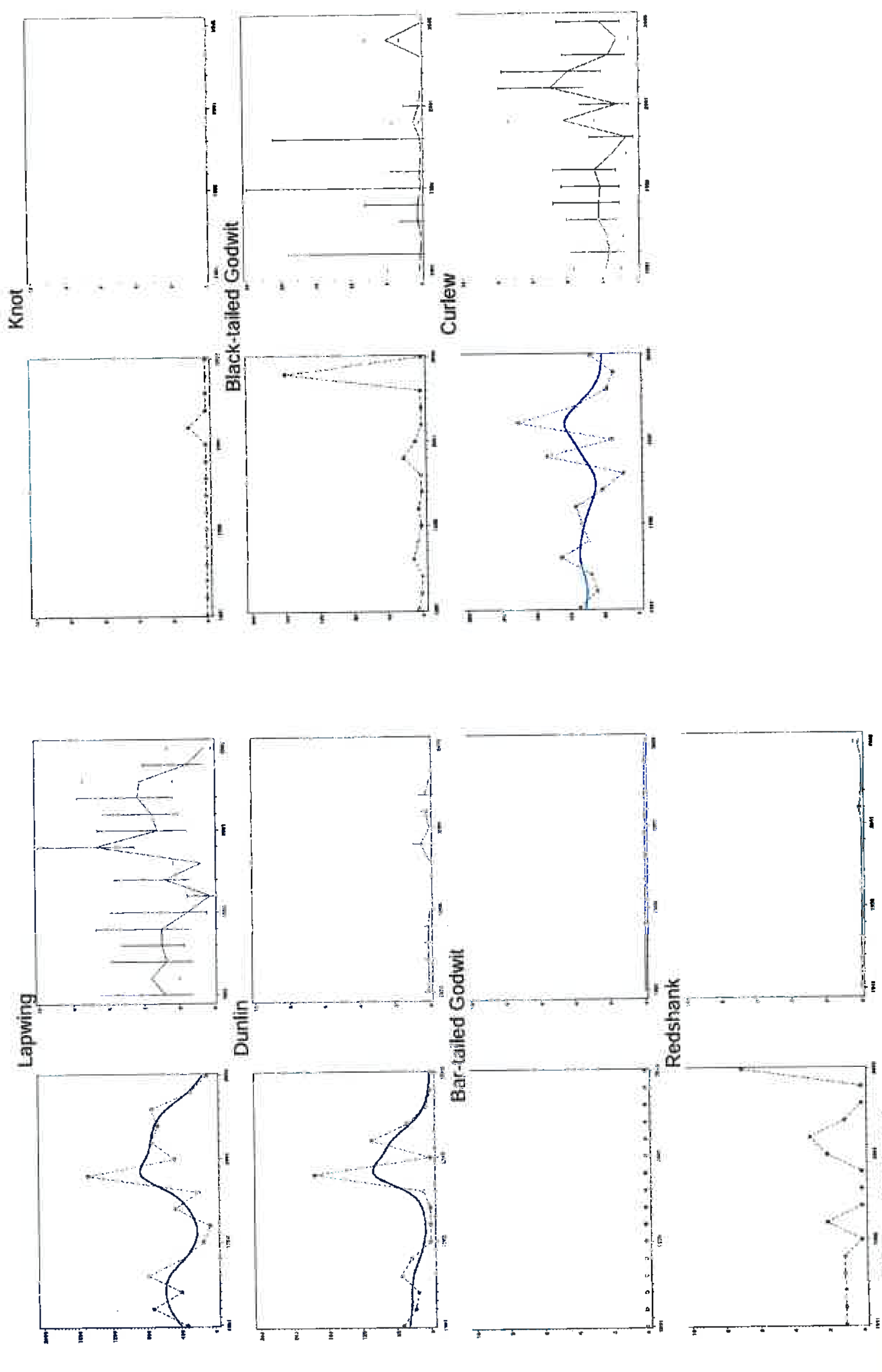

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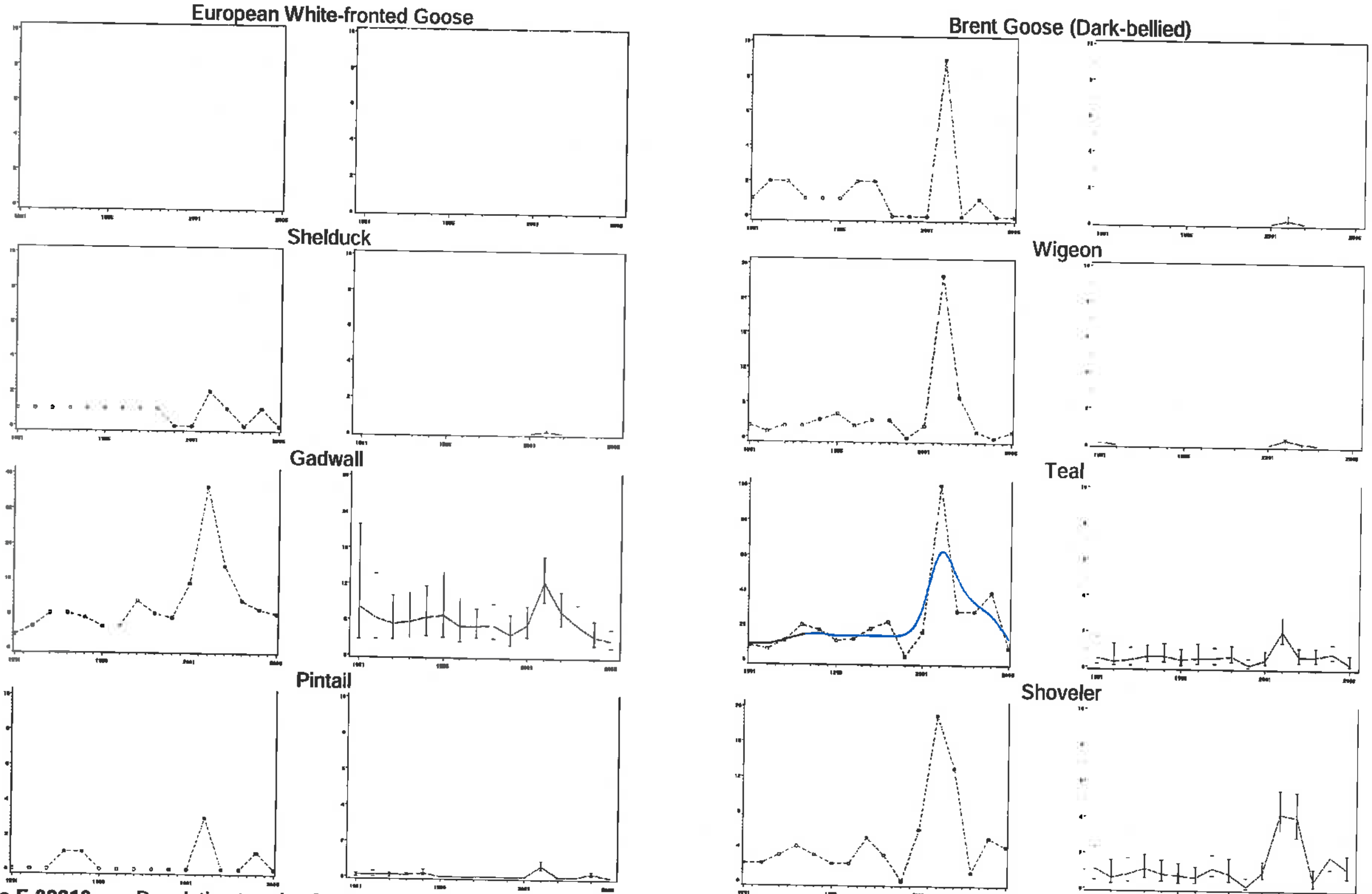
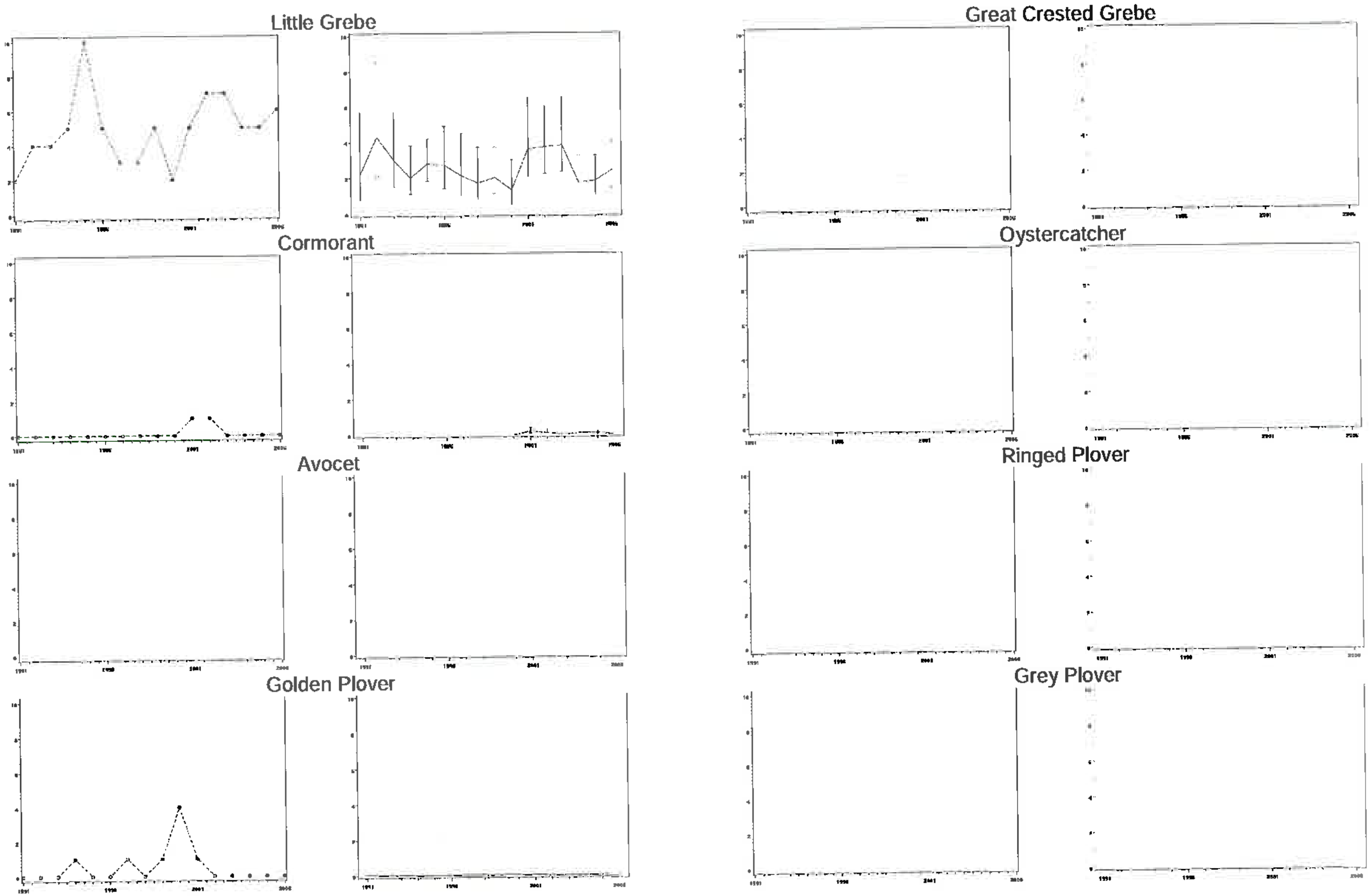


Figure E.22813 Population trends of each species in sector 22813 (Shorne Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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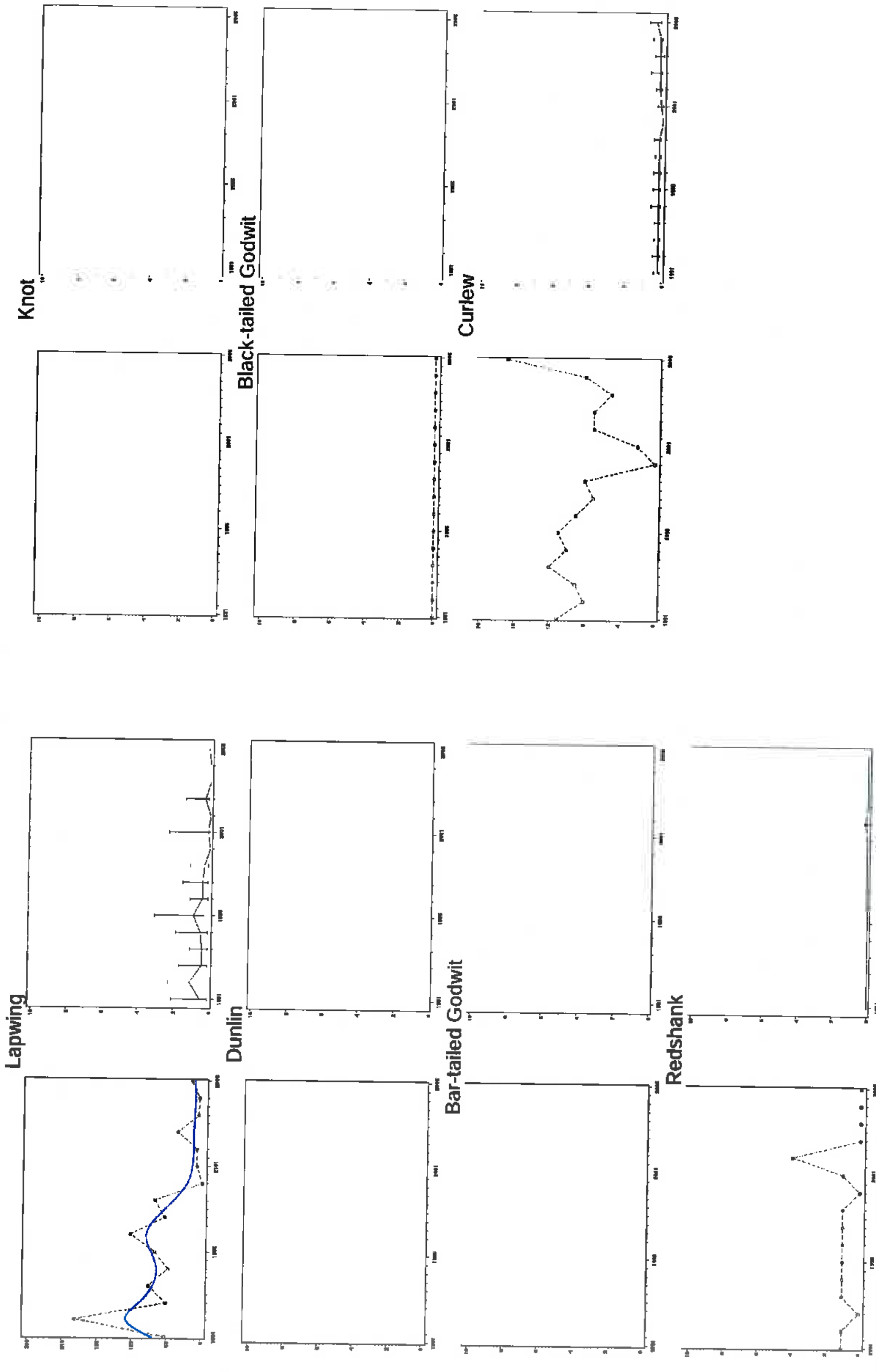

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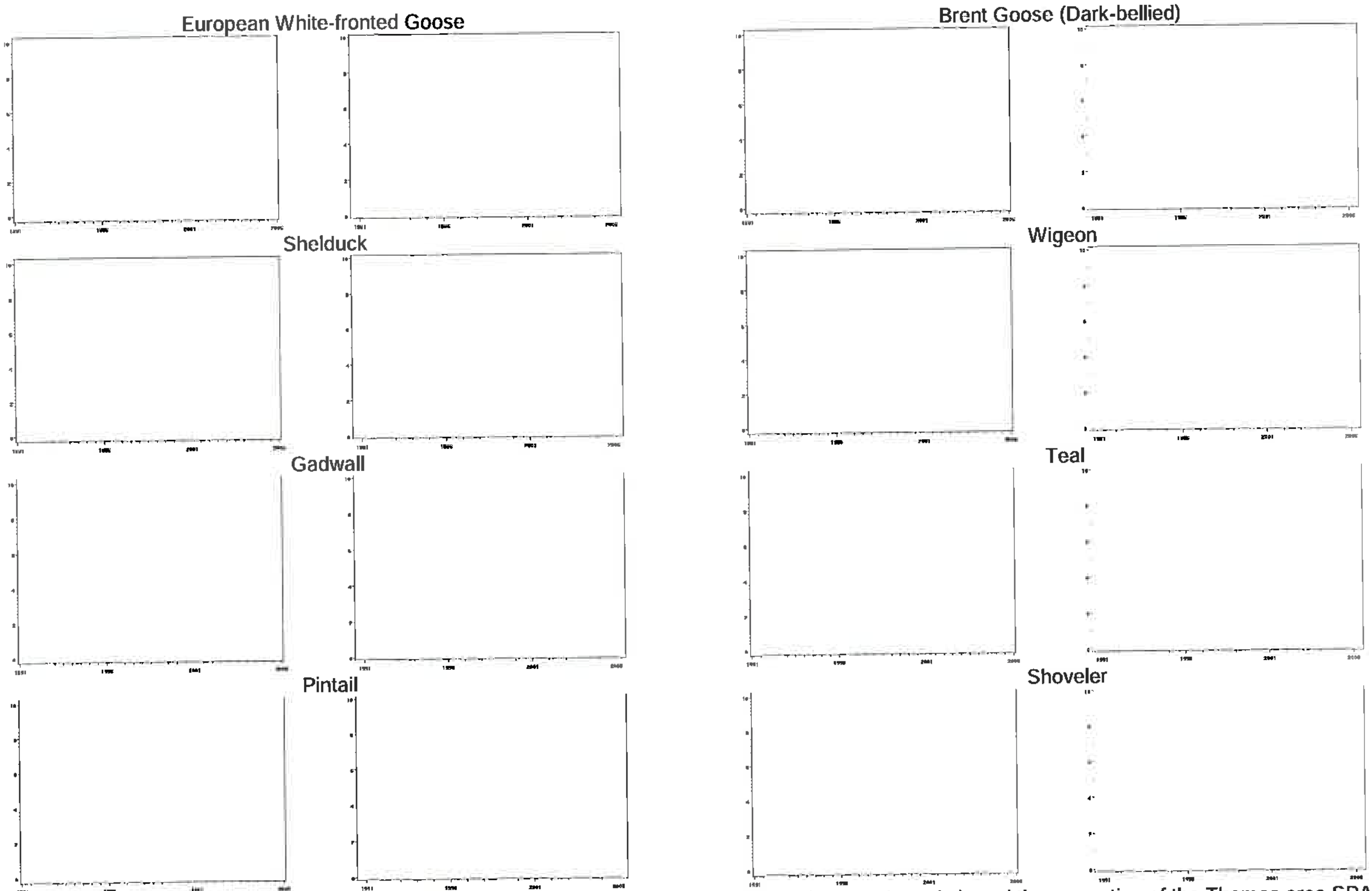
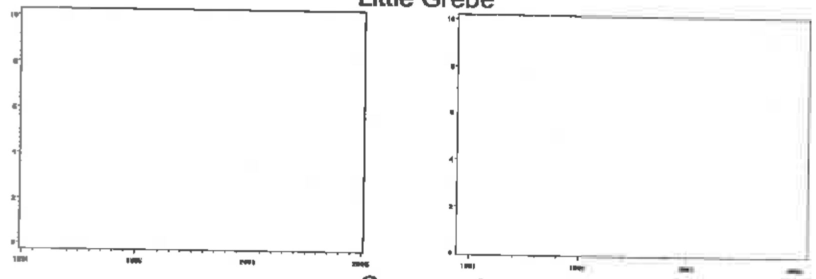
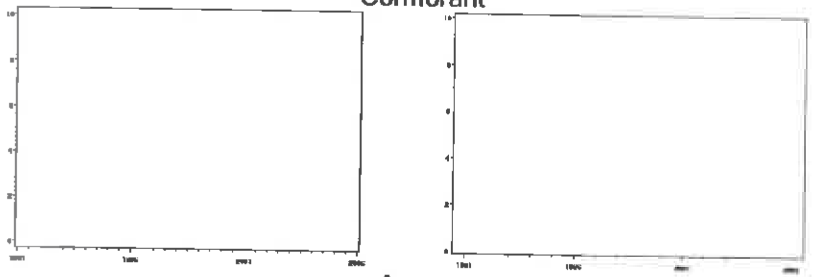


Figure E.22814 Population trends of each species in sector 22814 (Filborough Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

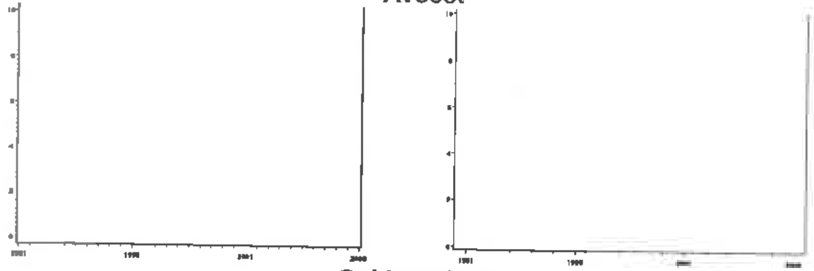
Little Grebe



Cormorant



Avocet



Golden Plover

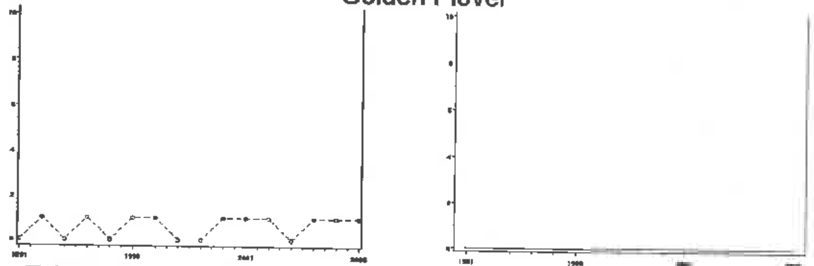
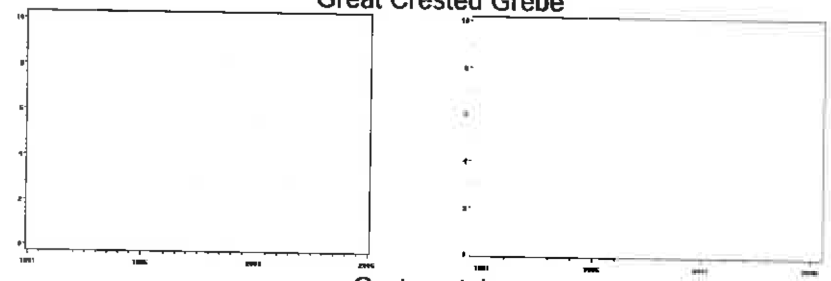
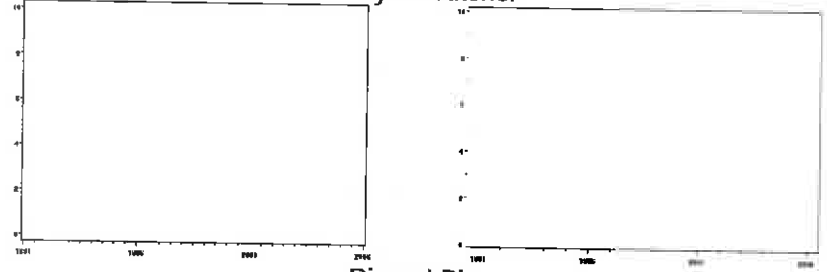


Figure E.22814 Continued

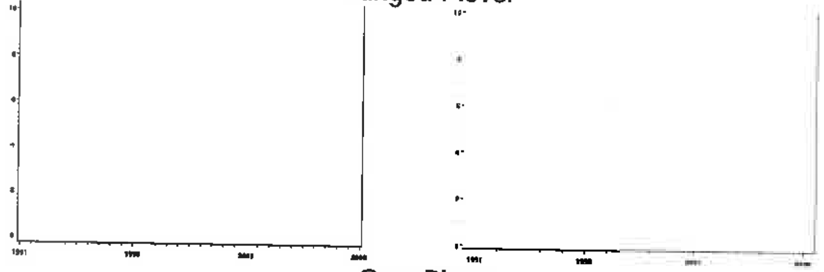
Great Crested Grebe



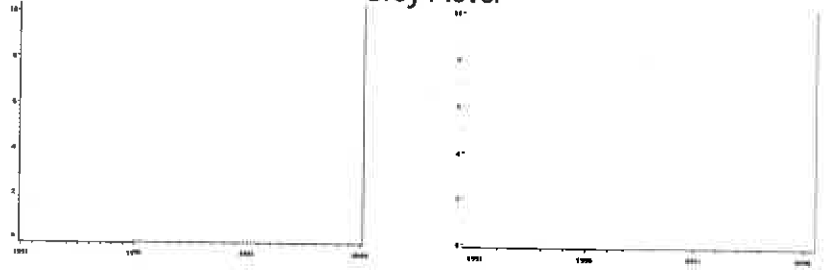
Oystercatcher



Ringed Plover



Grey Plover



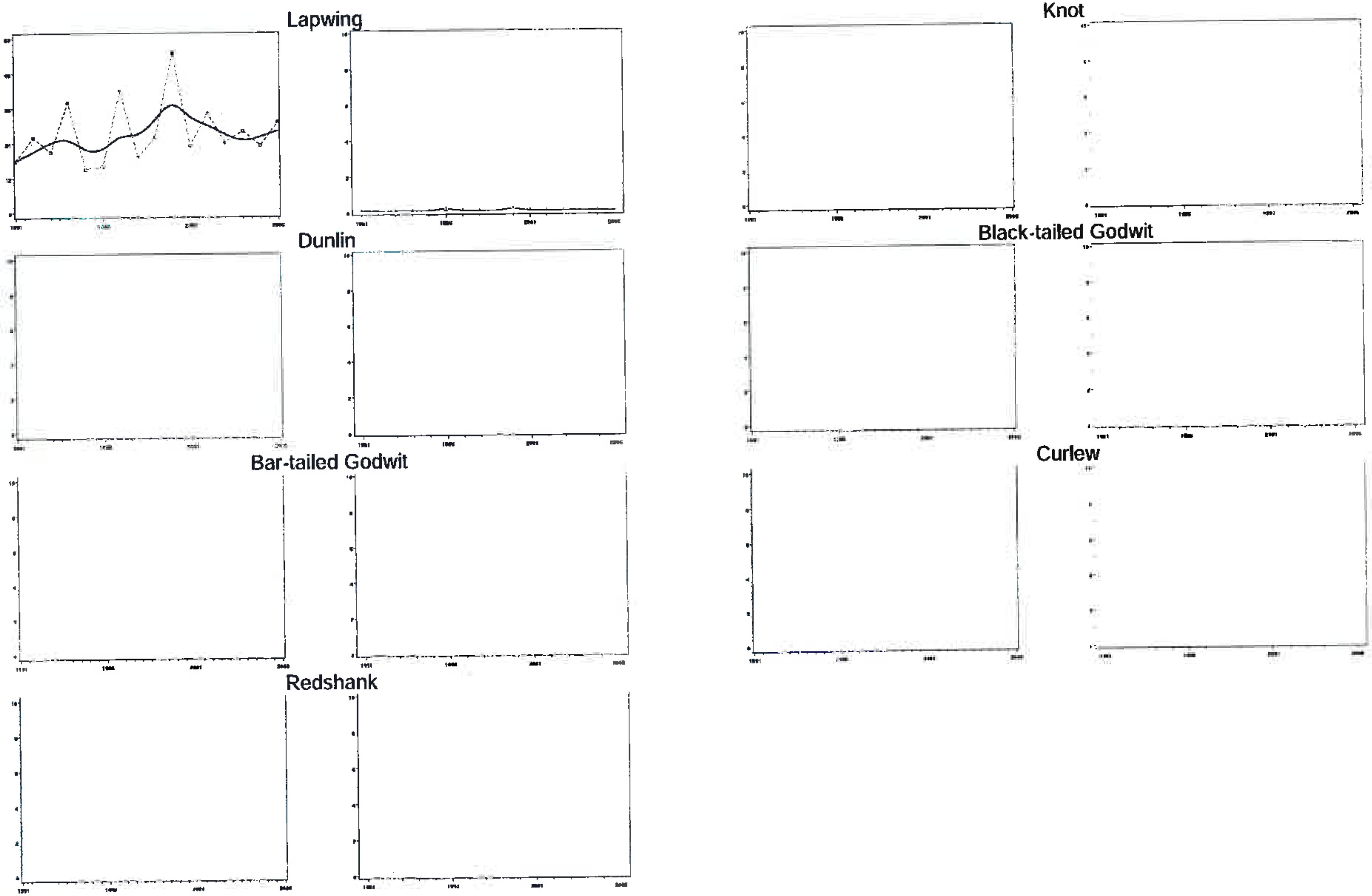


Figure E.22814 Continued

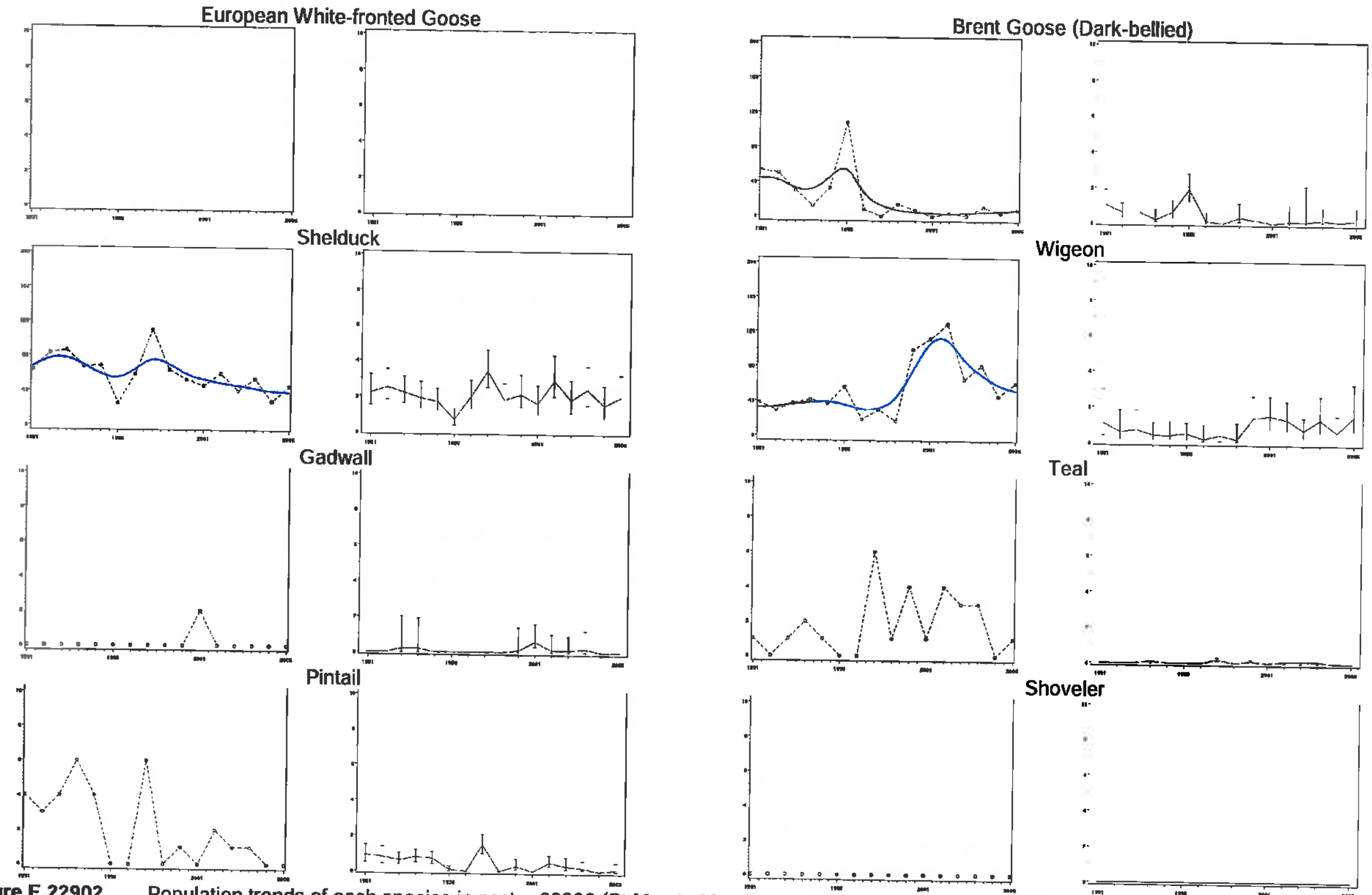
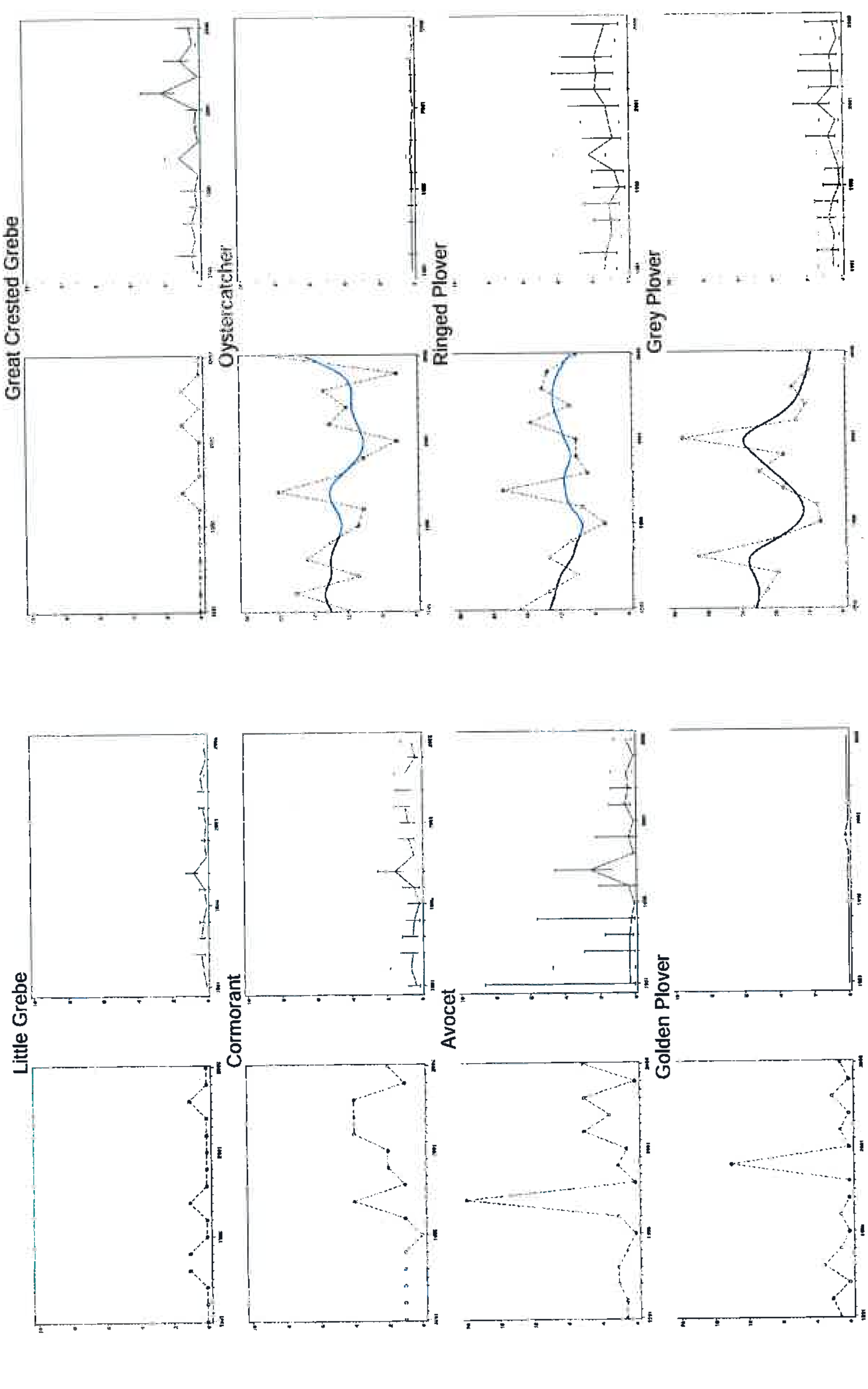


Figure E.22902 Population trends of each species in sector 22902 (St Mary`s Marsh Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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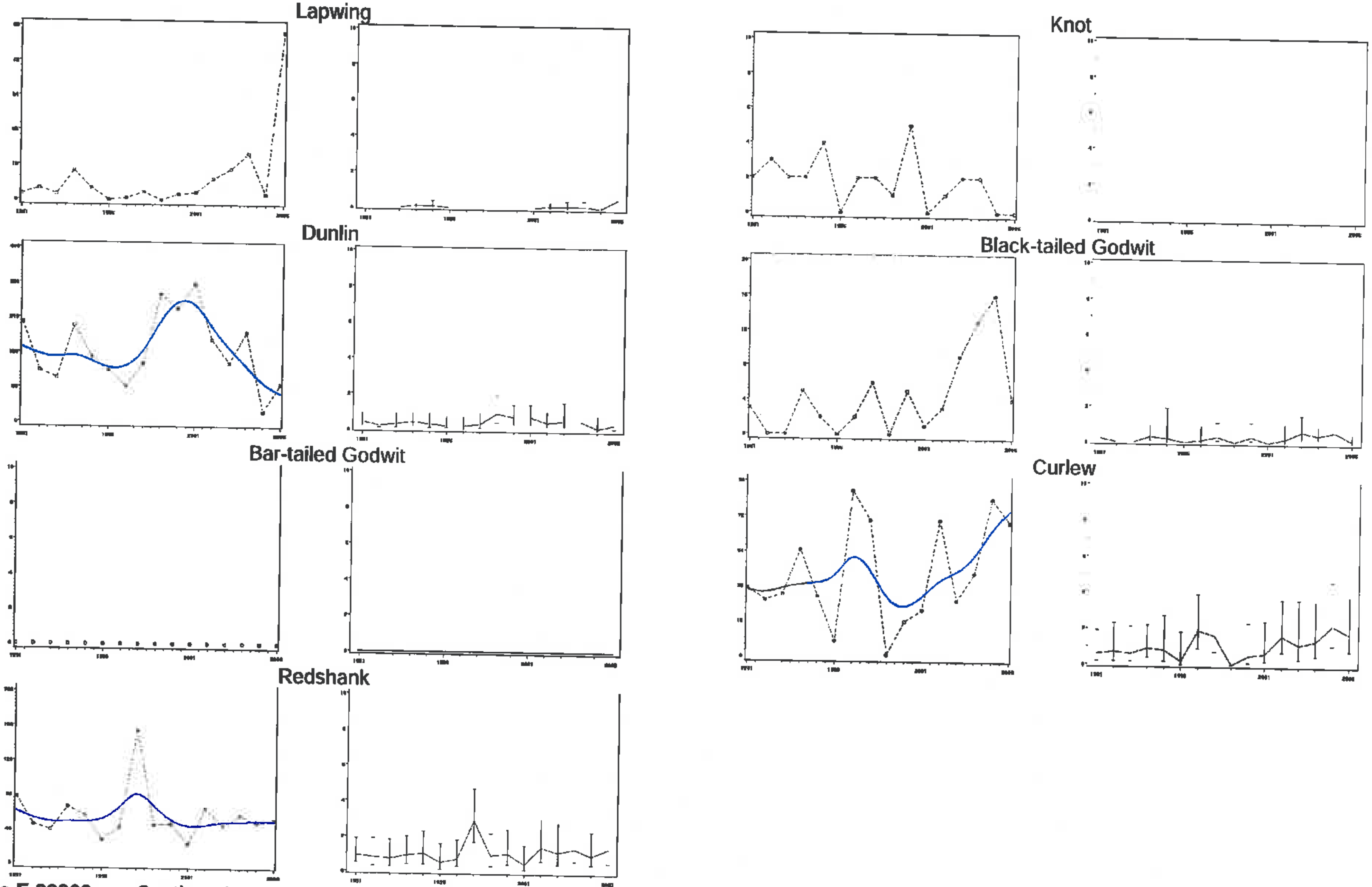


Figure E.22902 Continued

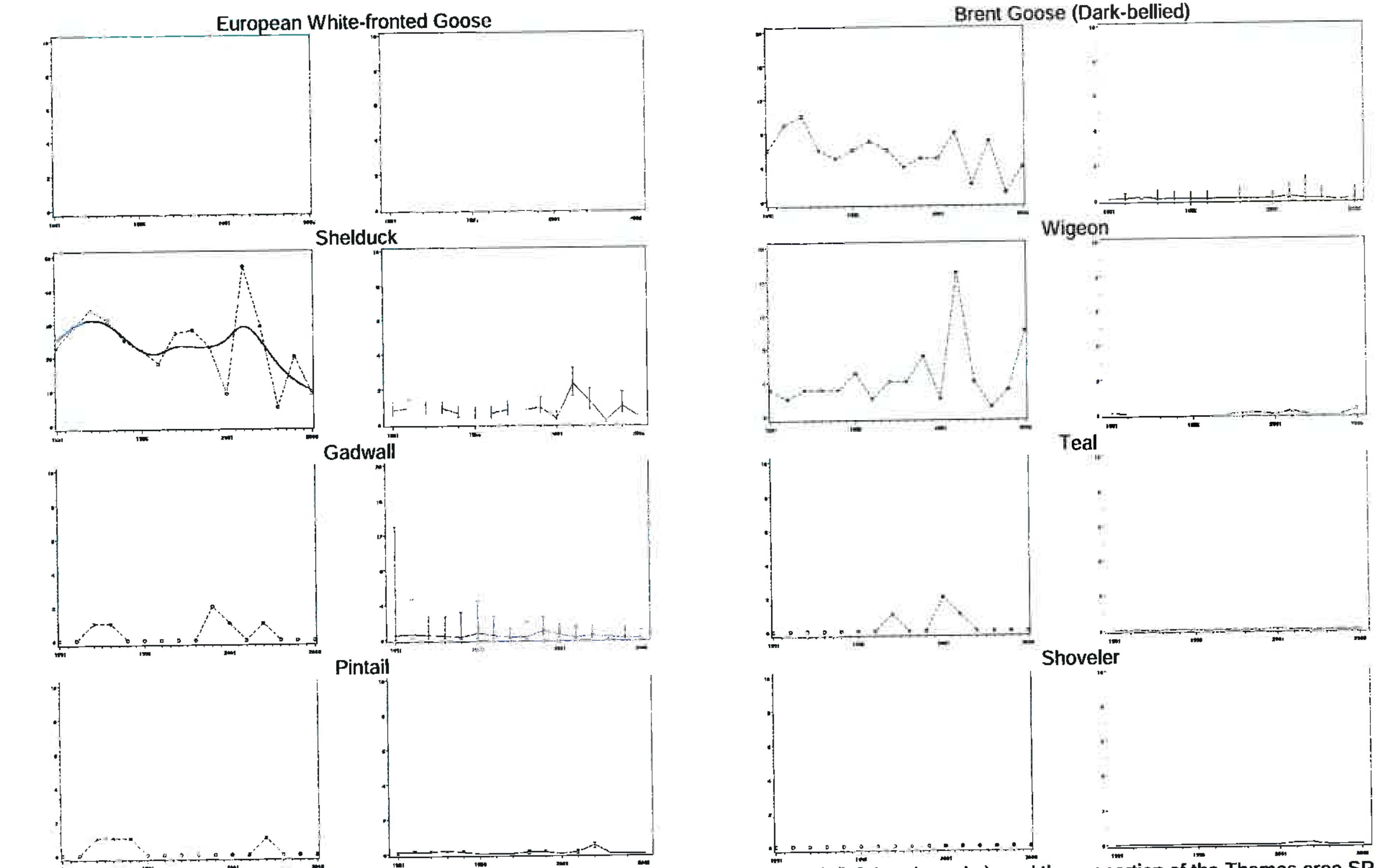
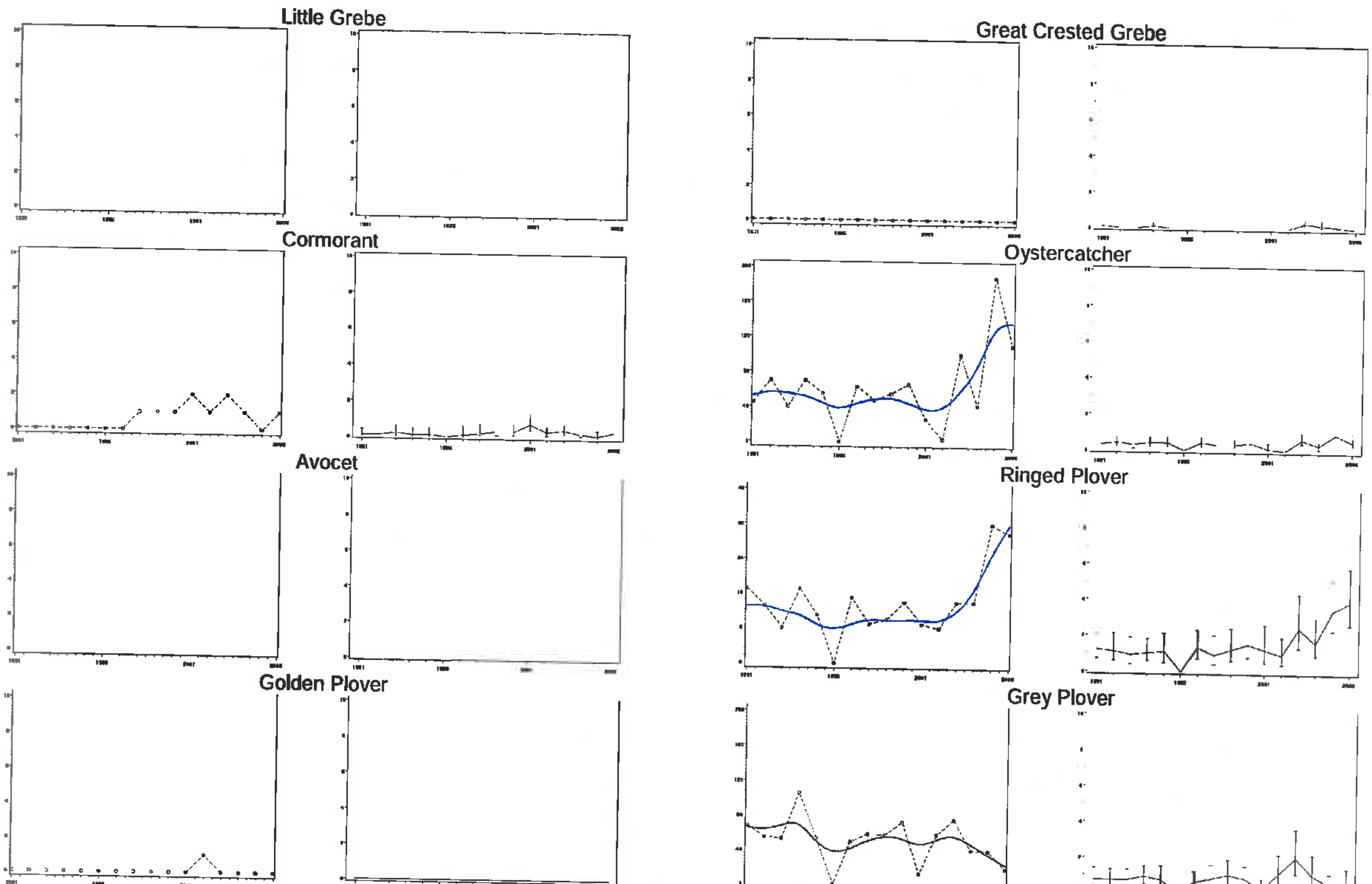


Figure E.22903 Population trends of each species in sector 22903 (North Grain Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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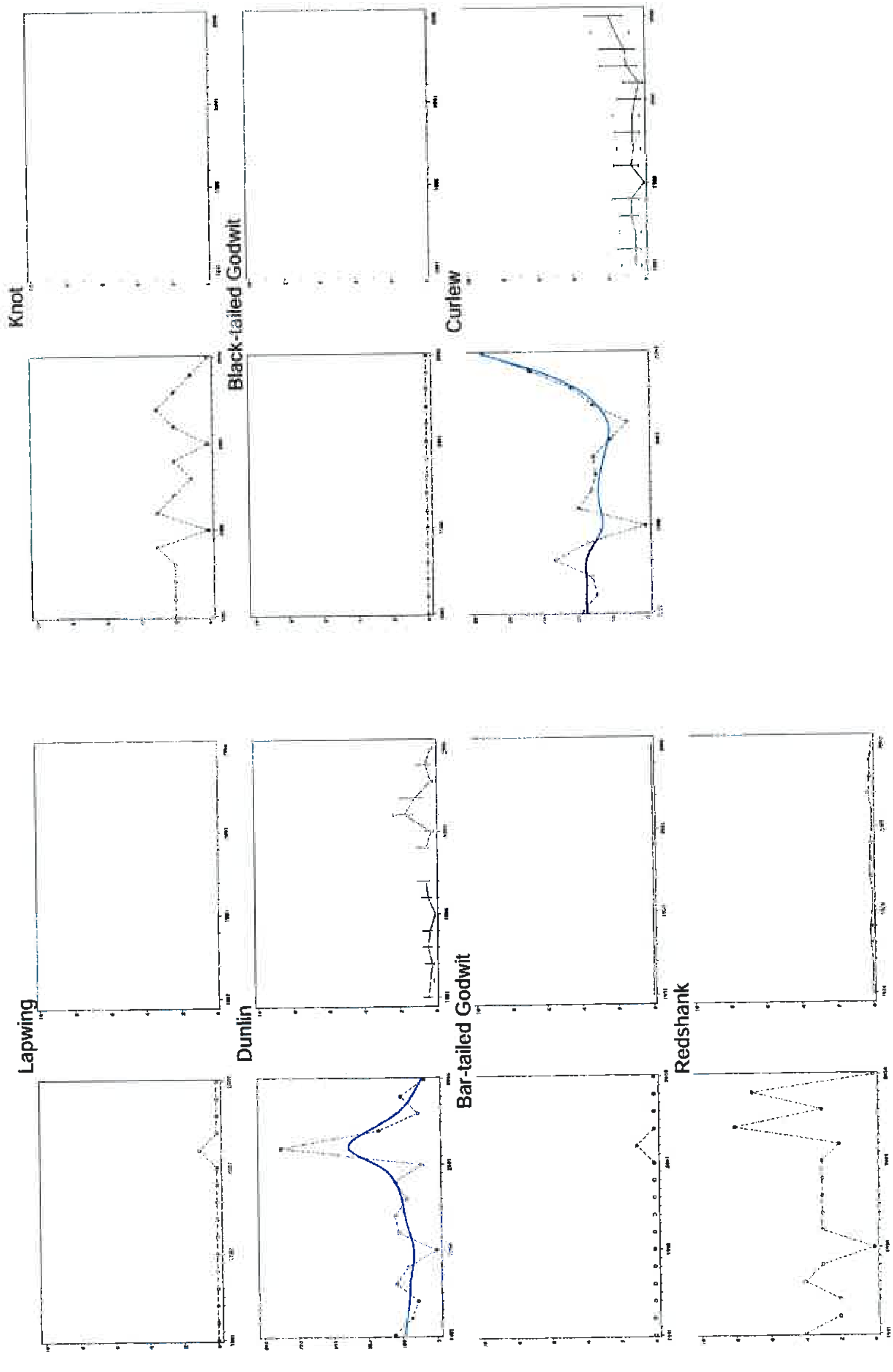

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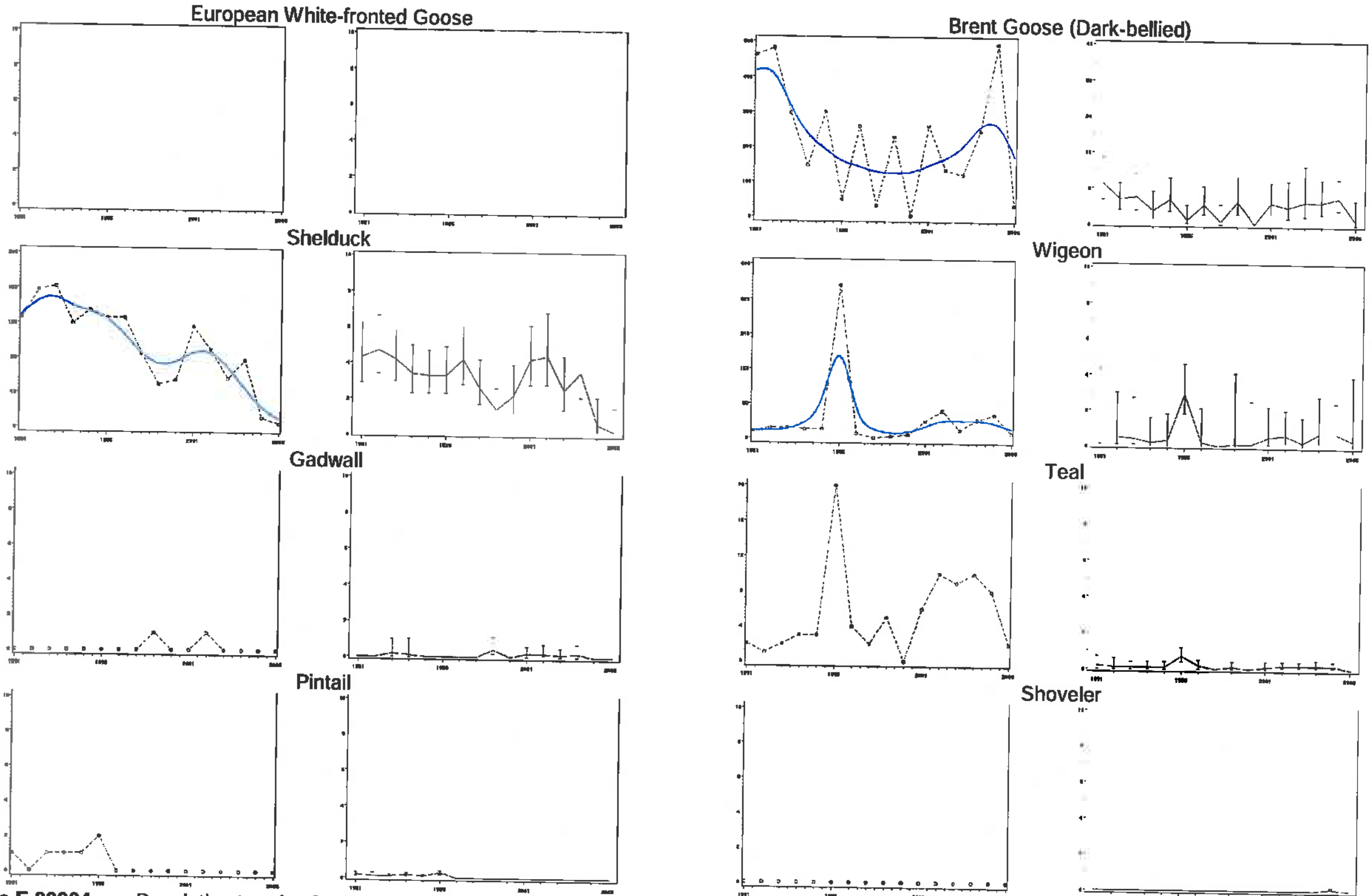
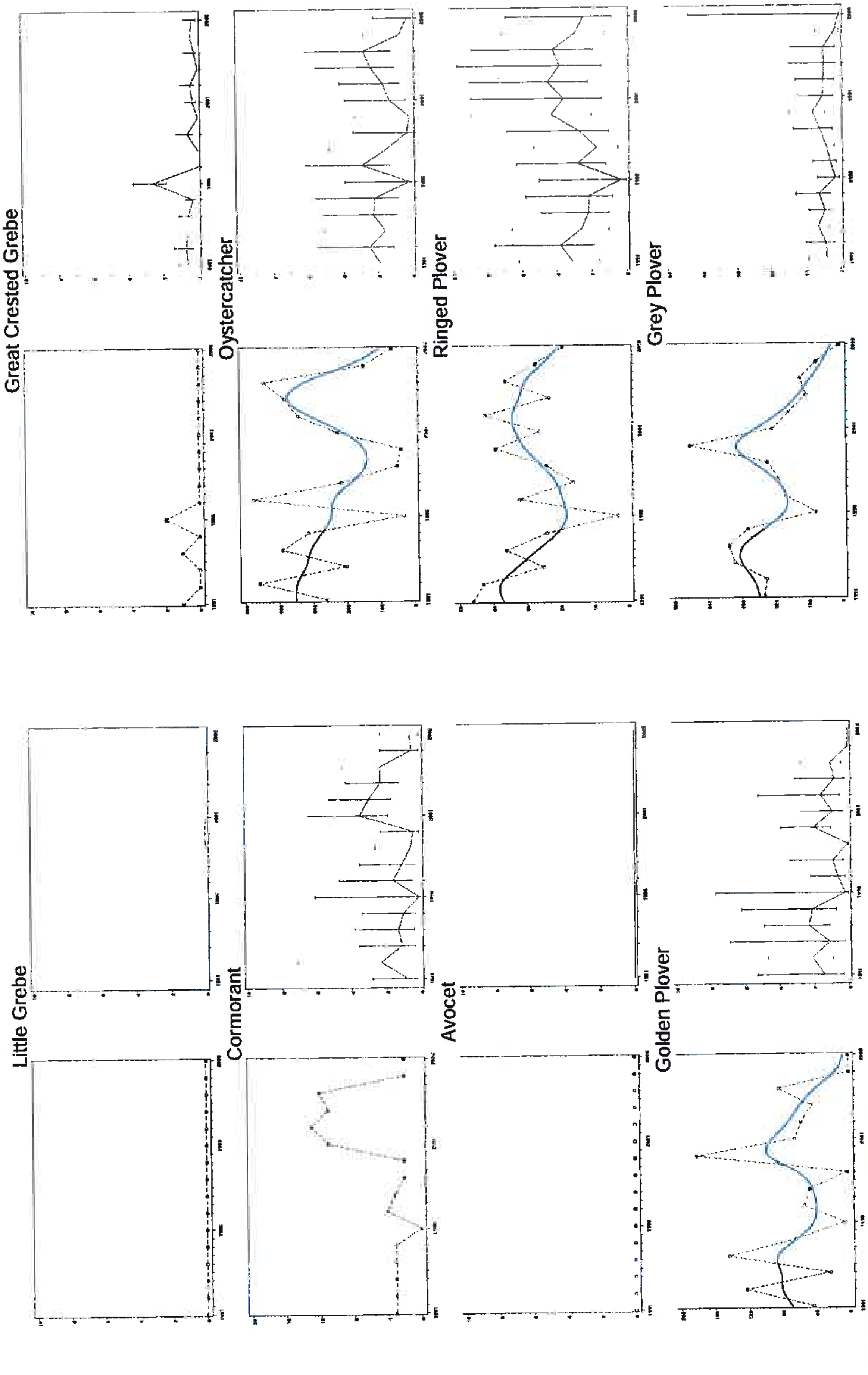


Figure E.22904 Population trends of each species in sector 22904 (Coombe Bay Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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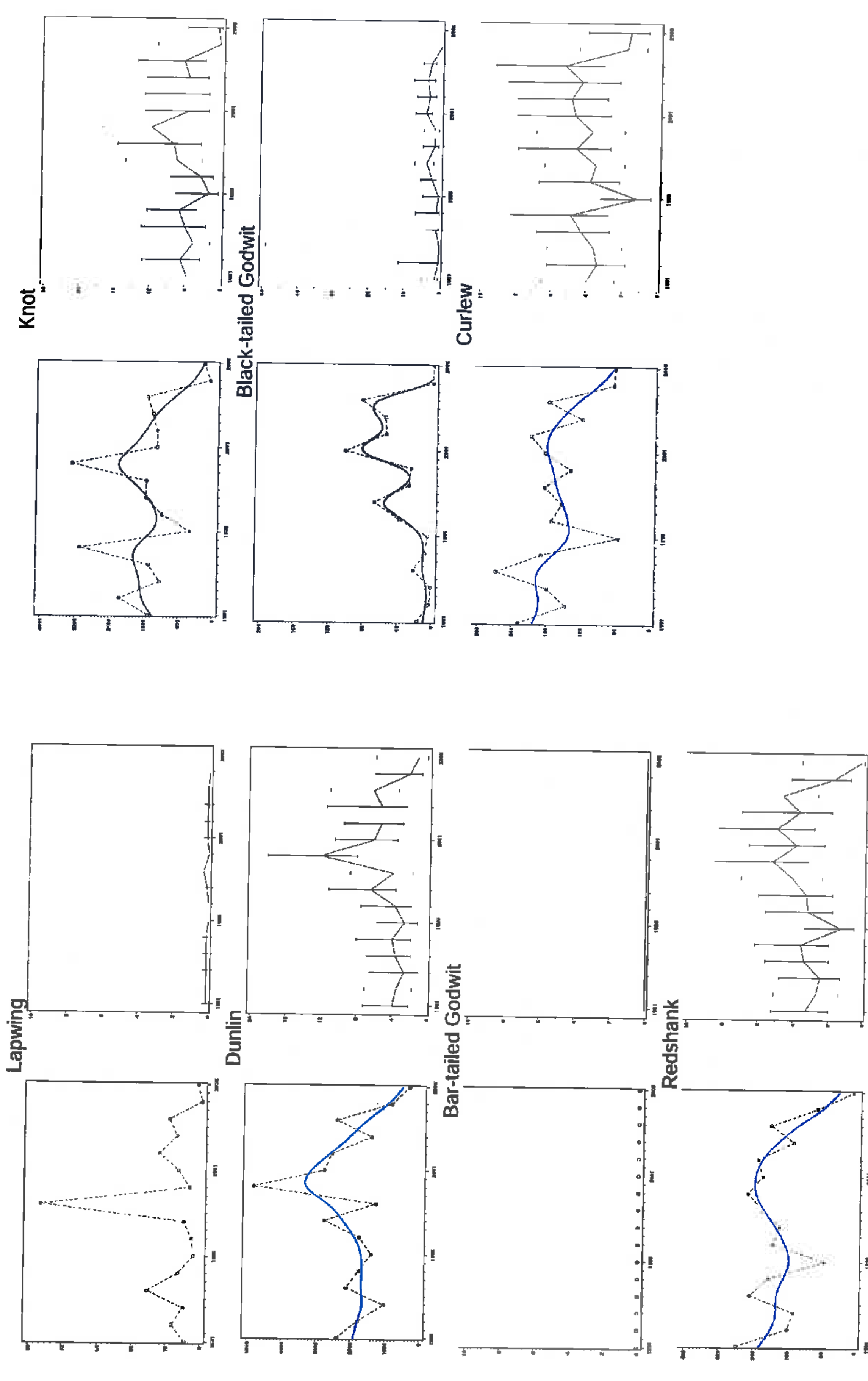

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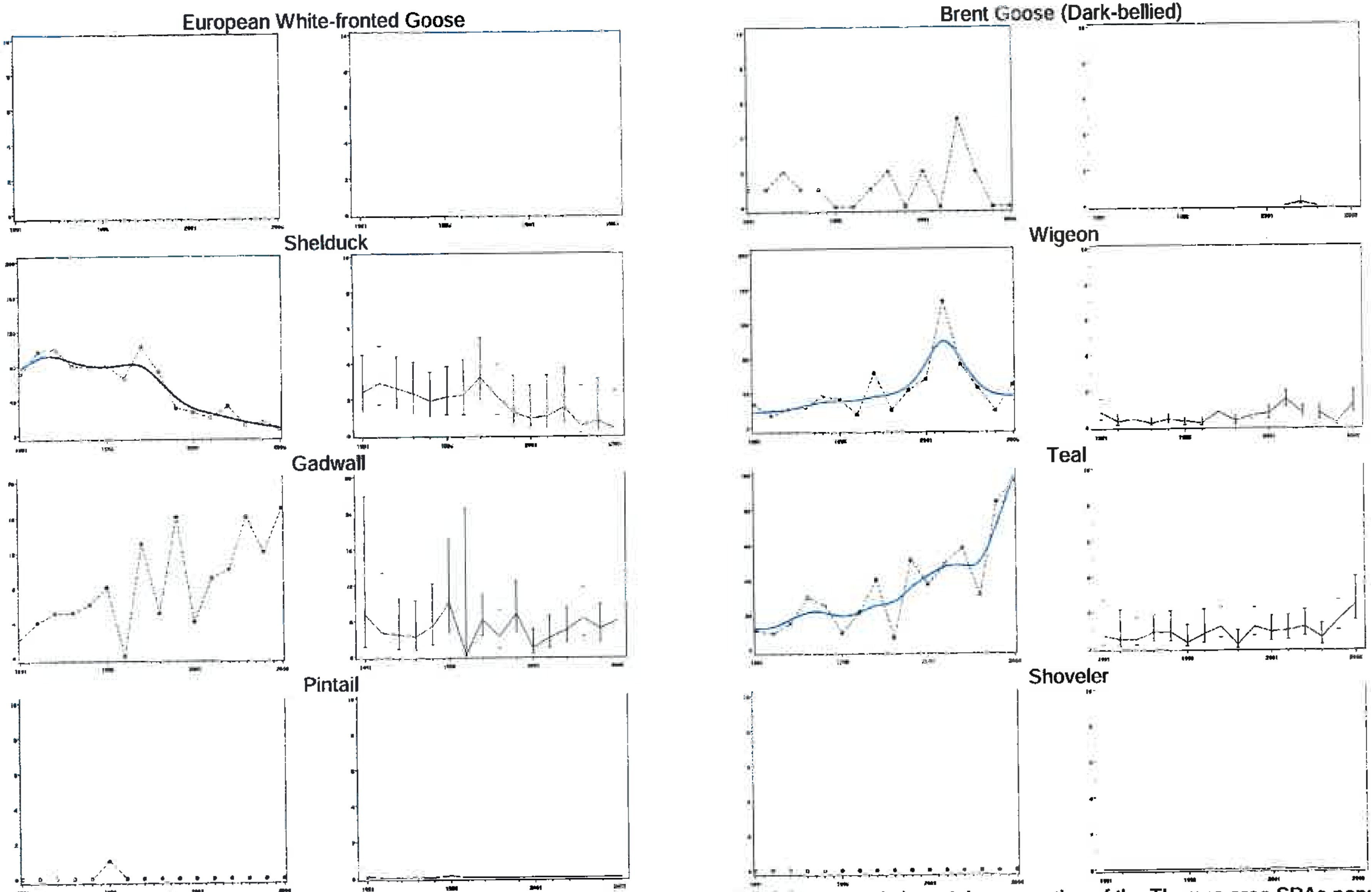
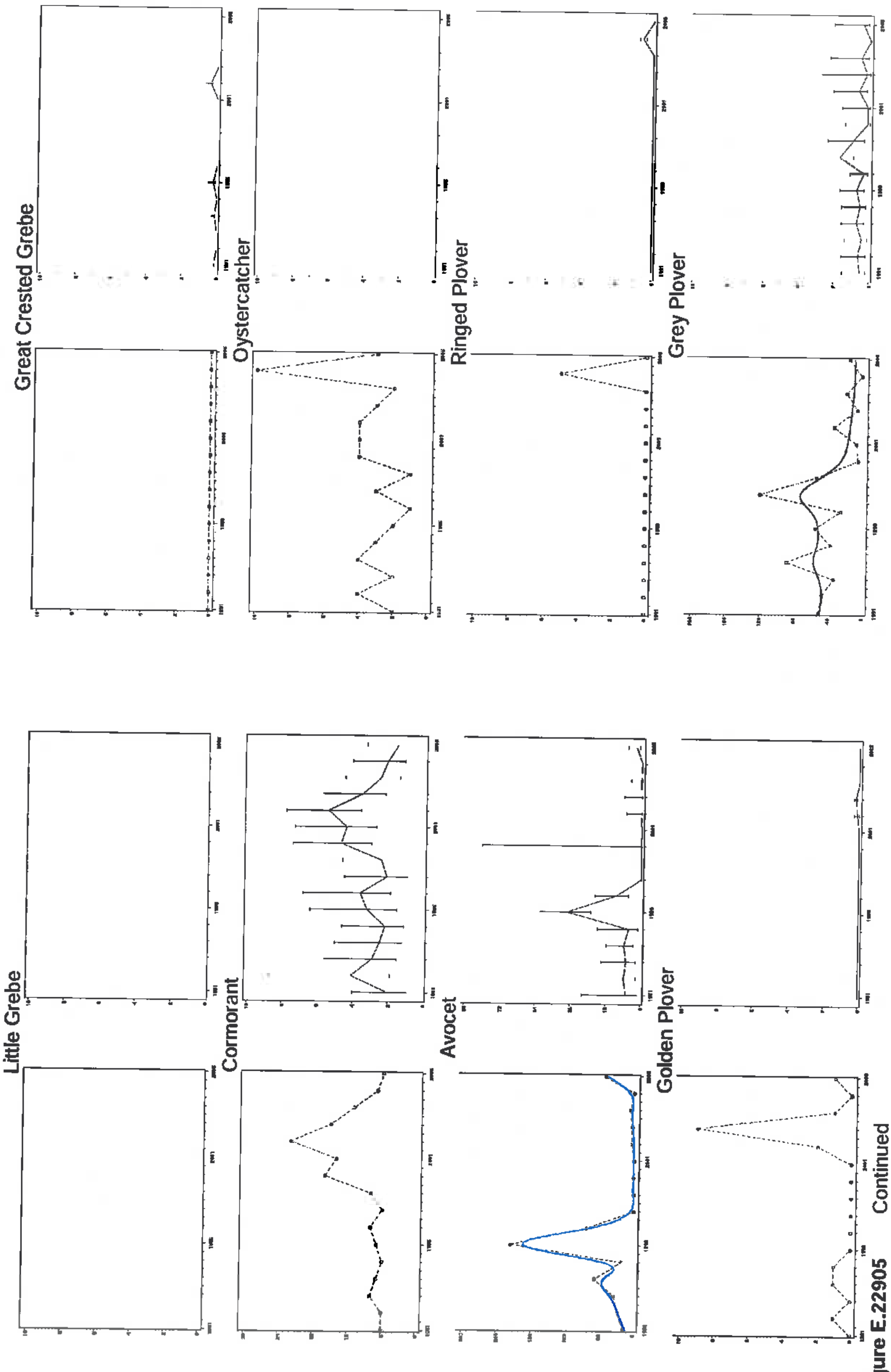


Figure E.22905 Population trends of each species in sector 22905 (Higham Bight) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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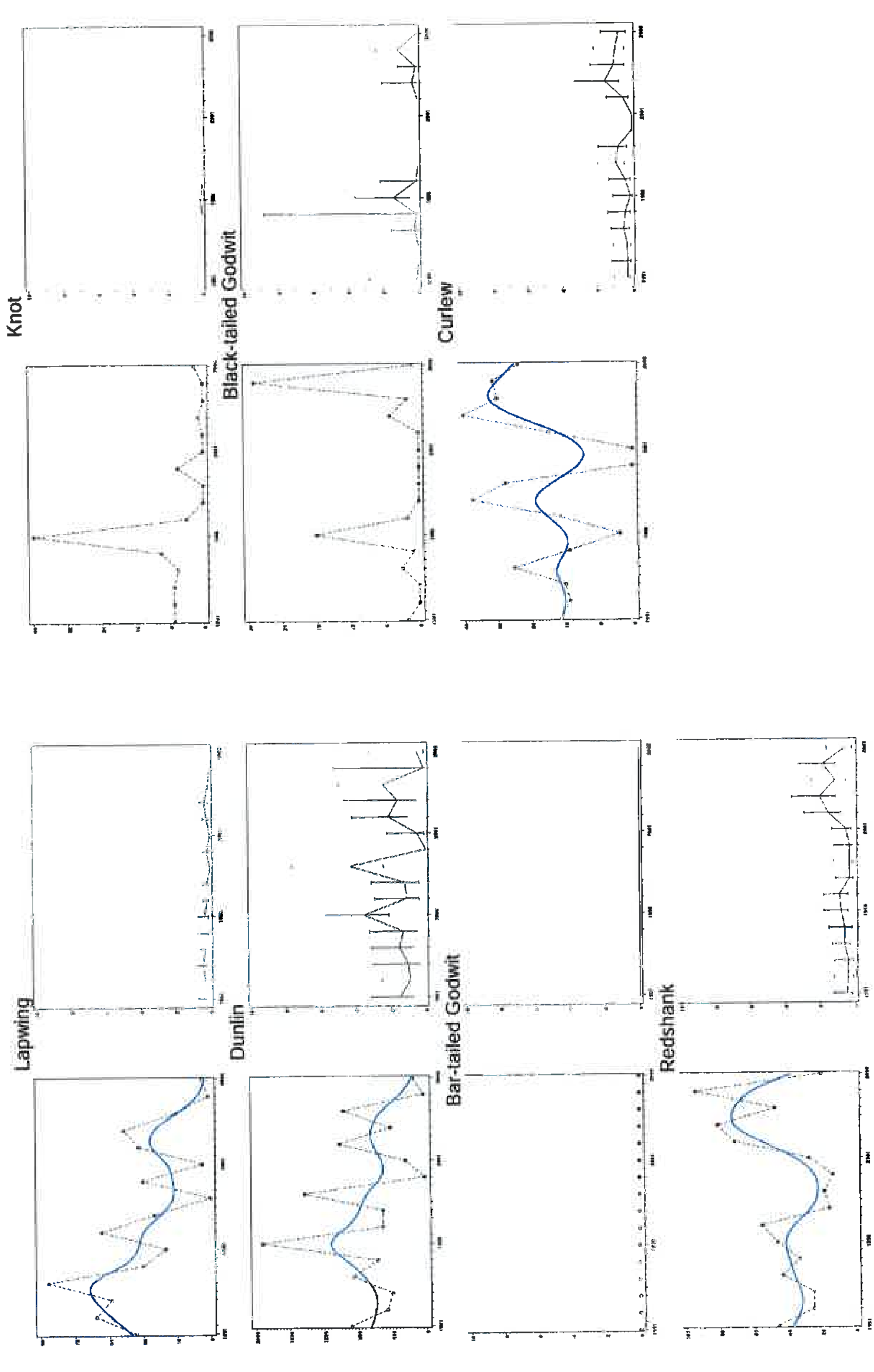

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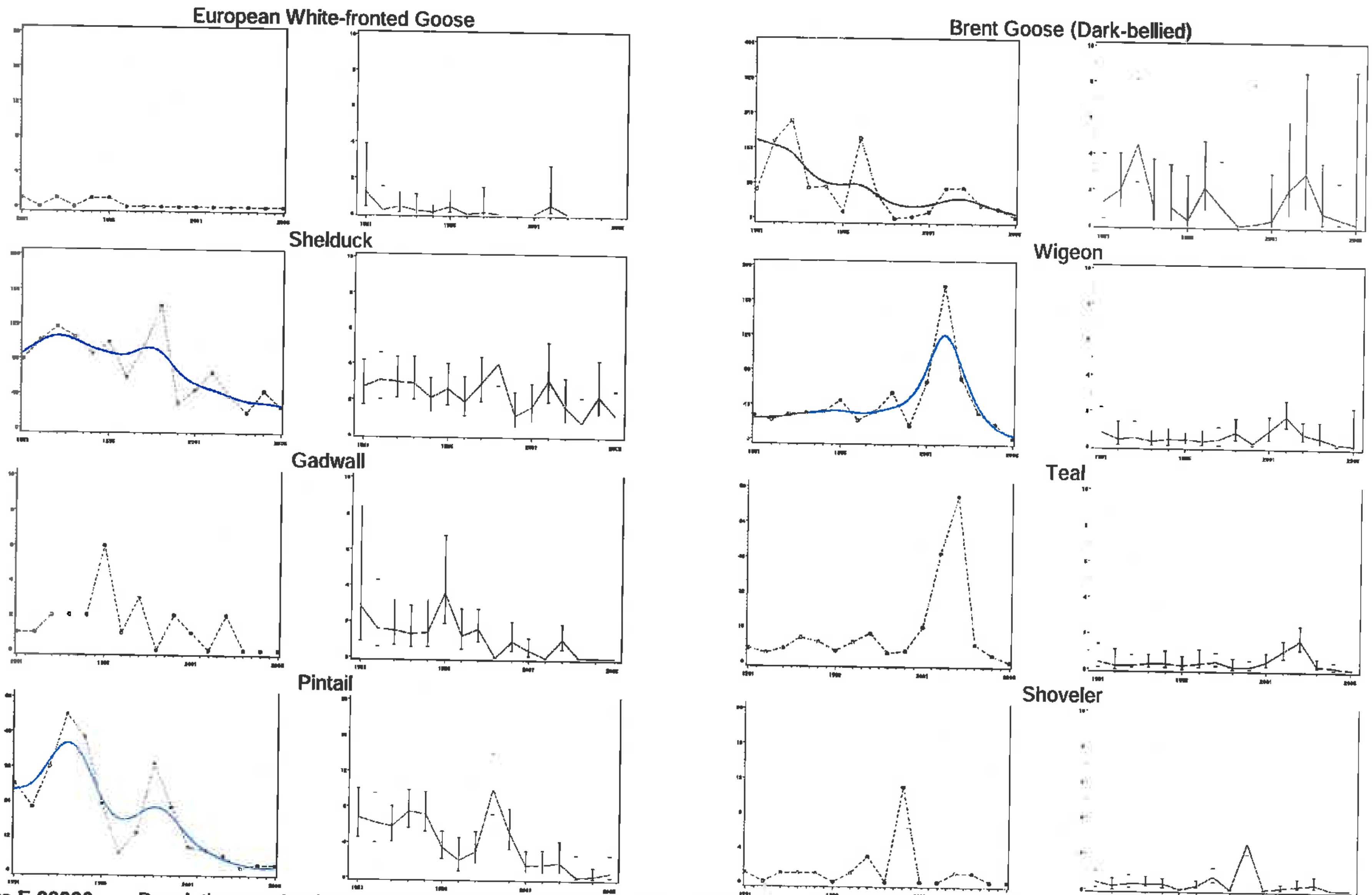
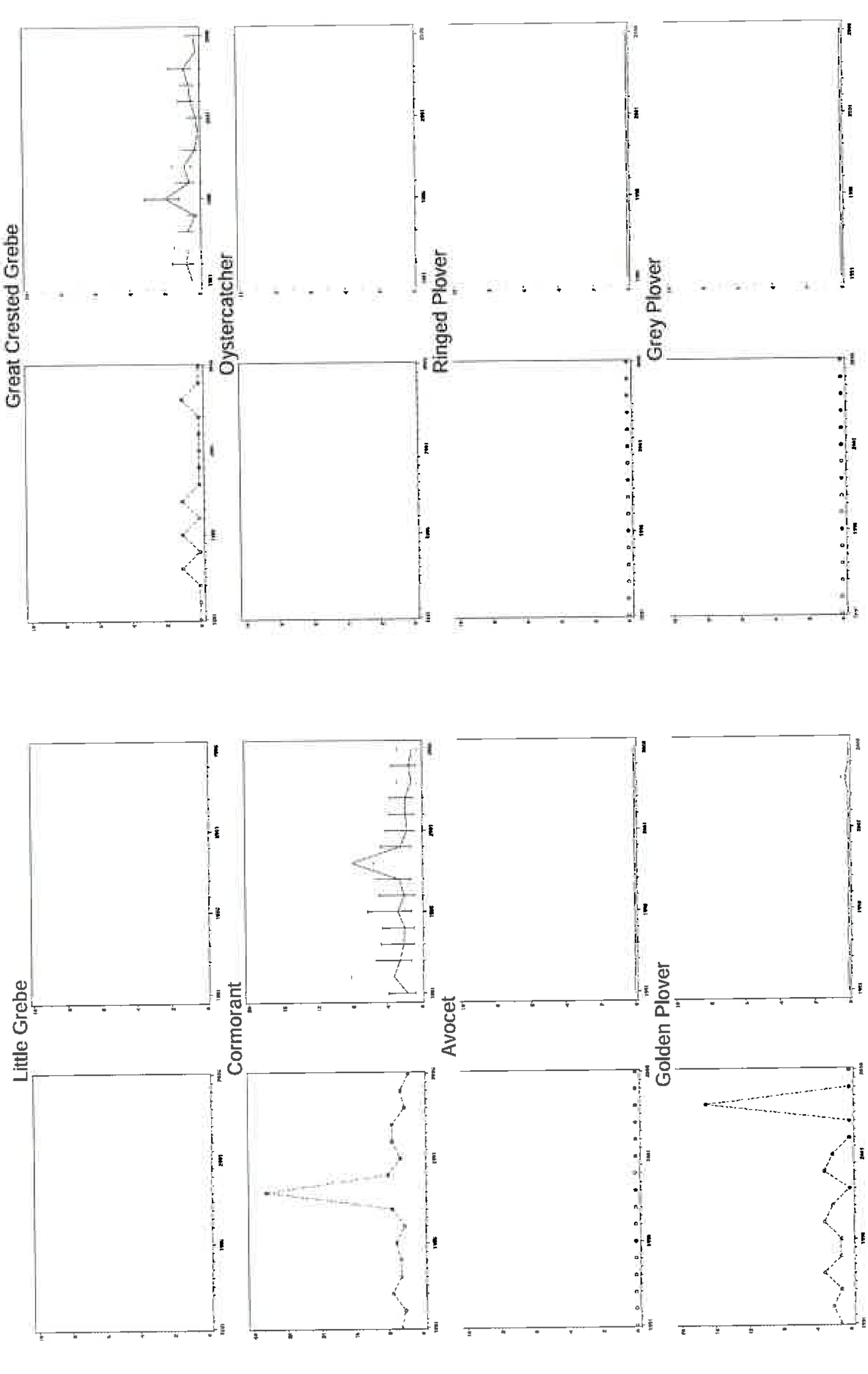


Figure E.22906 Population trends of each species in sector 22906 (Yantlet and Allhallows Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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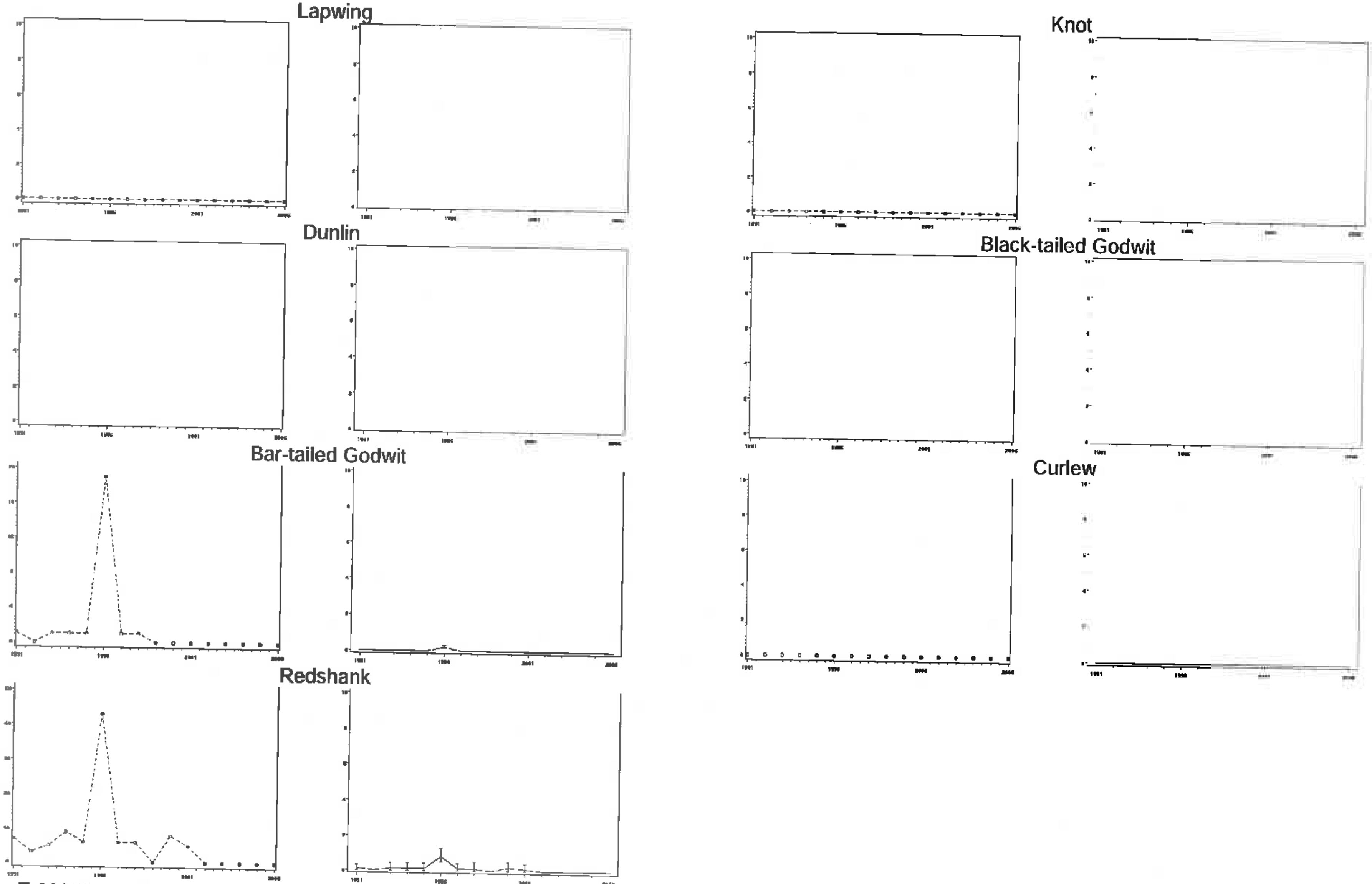

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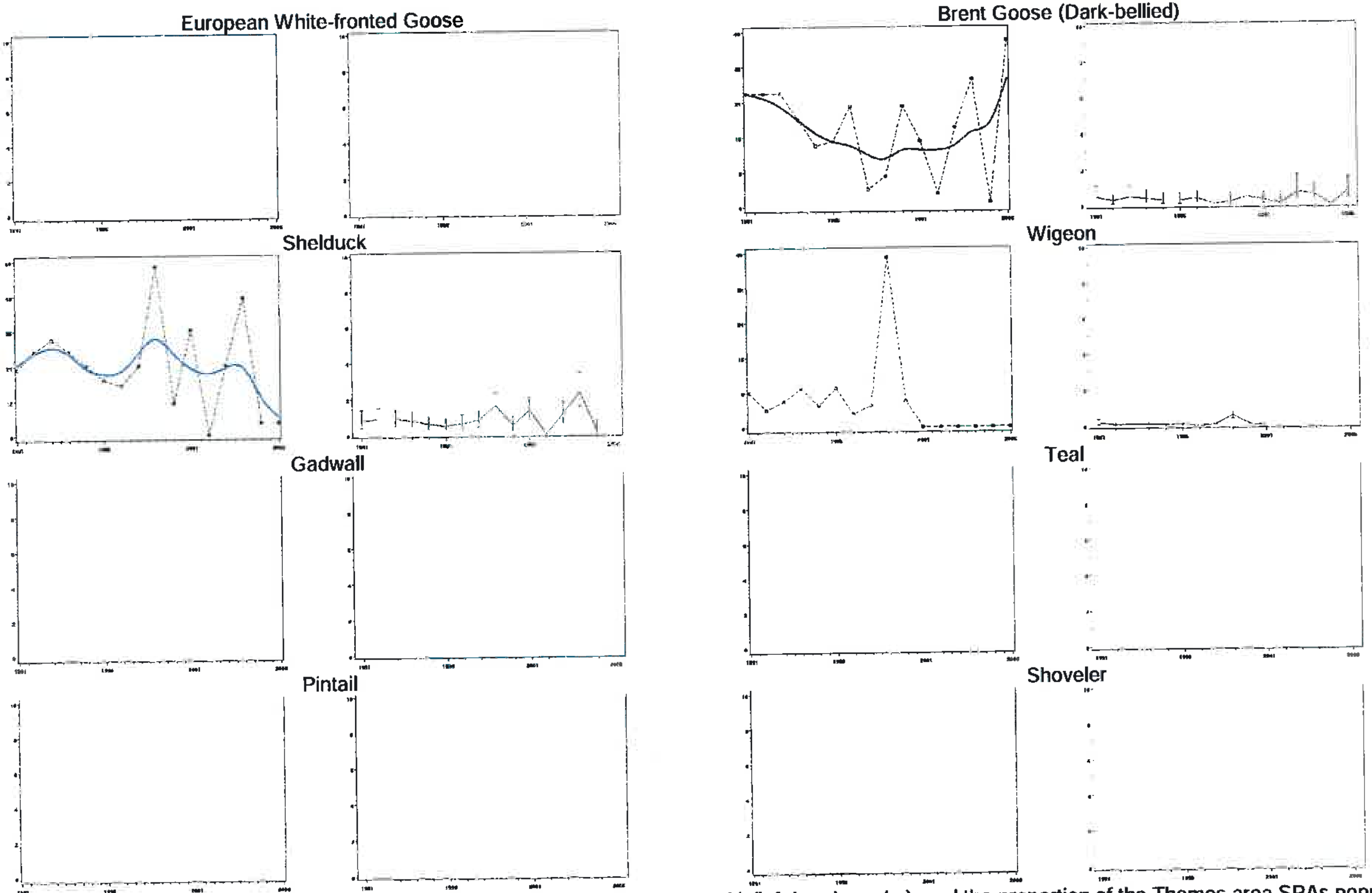
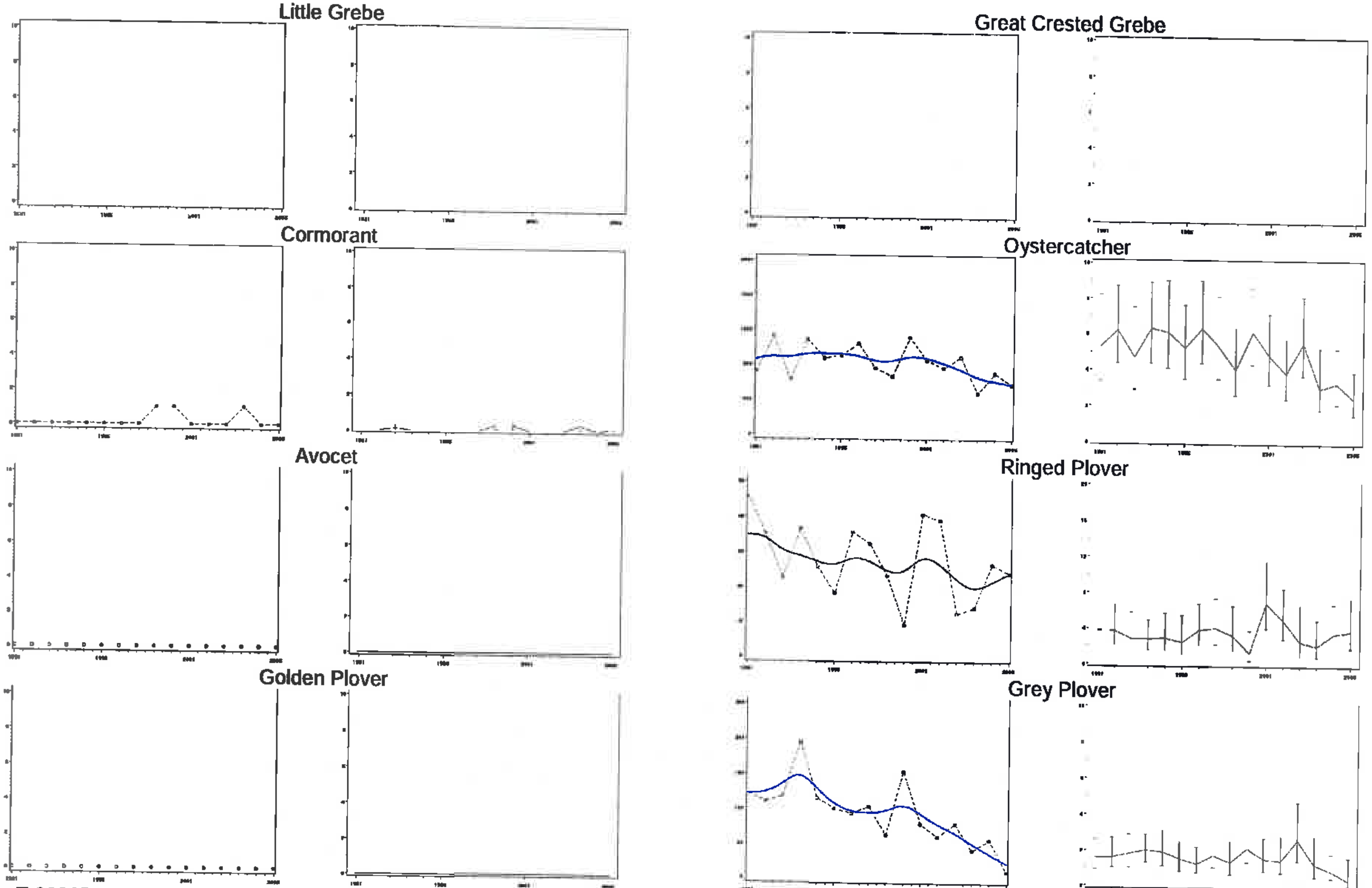


Figure E.22907 Population trends of each species in sector 22907 (Yantlet Beach) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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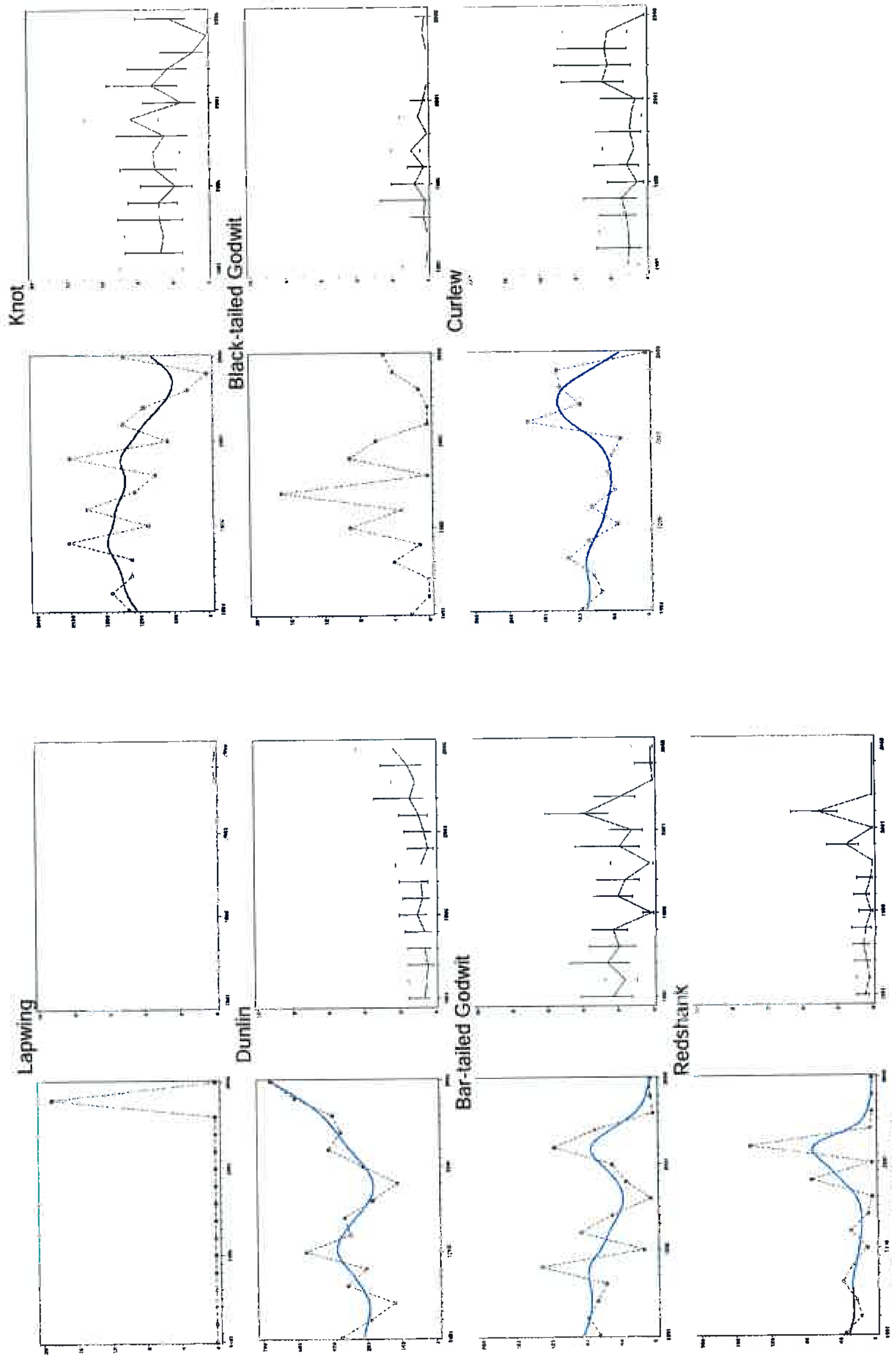

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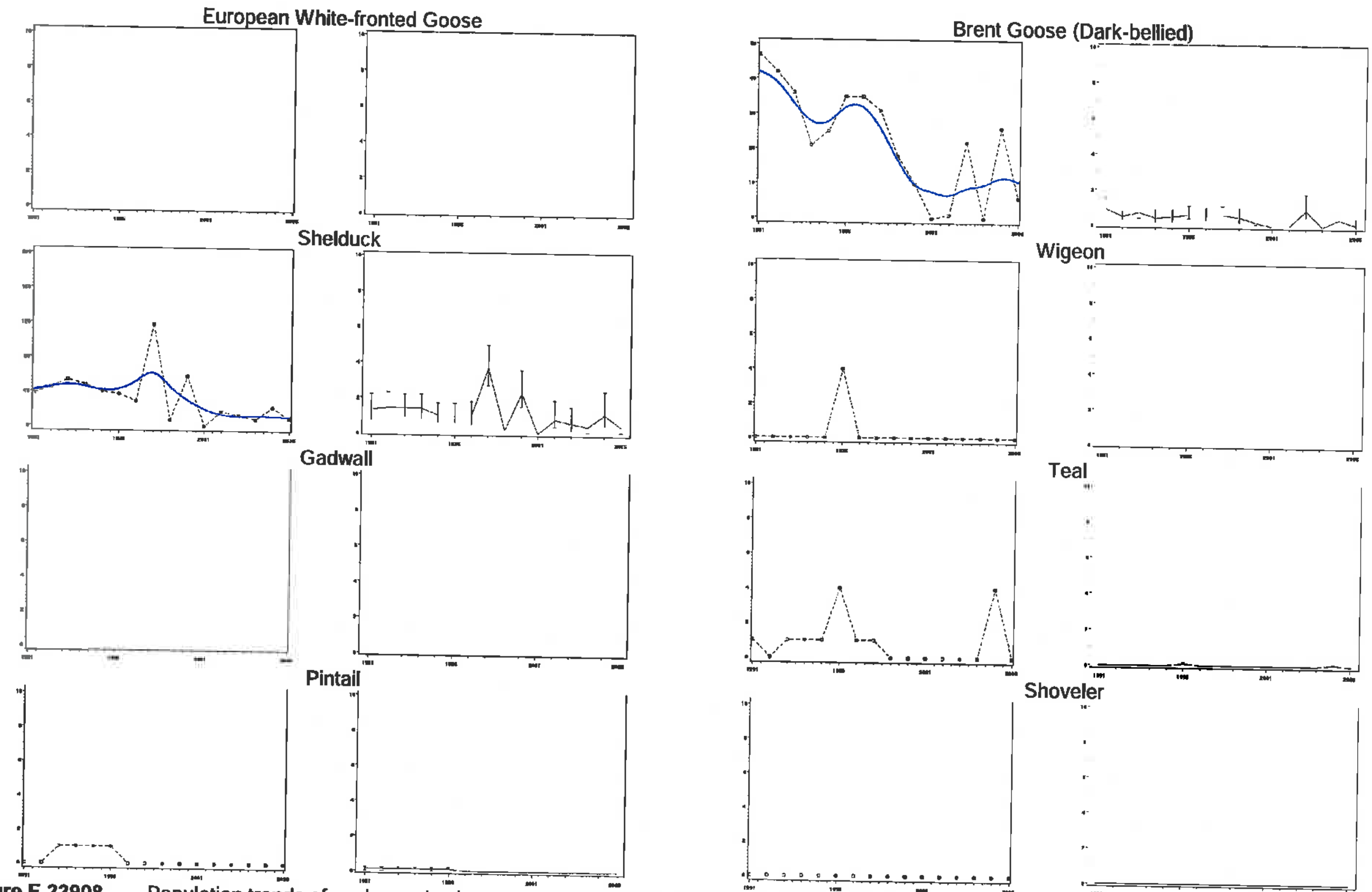
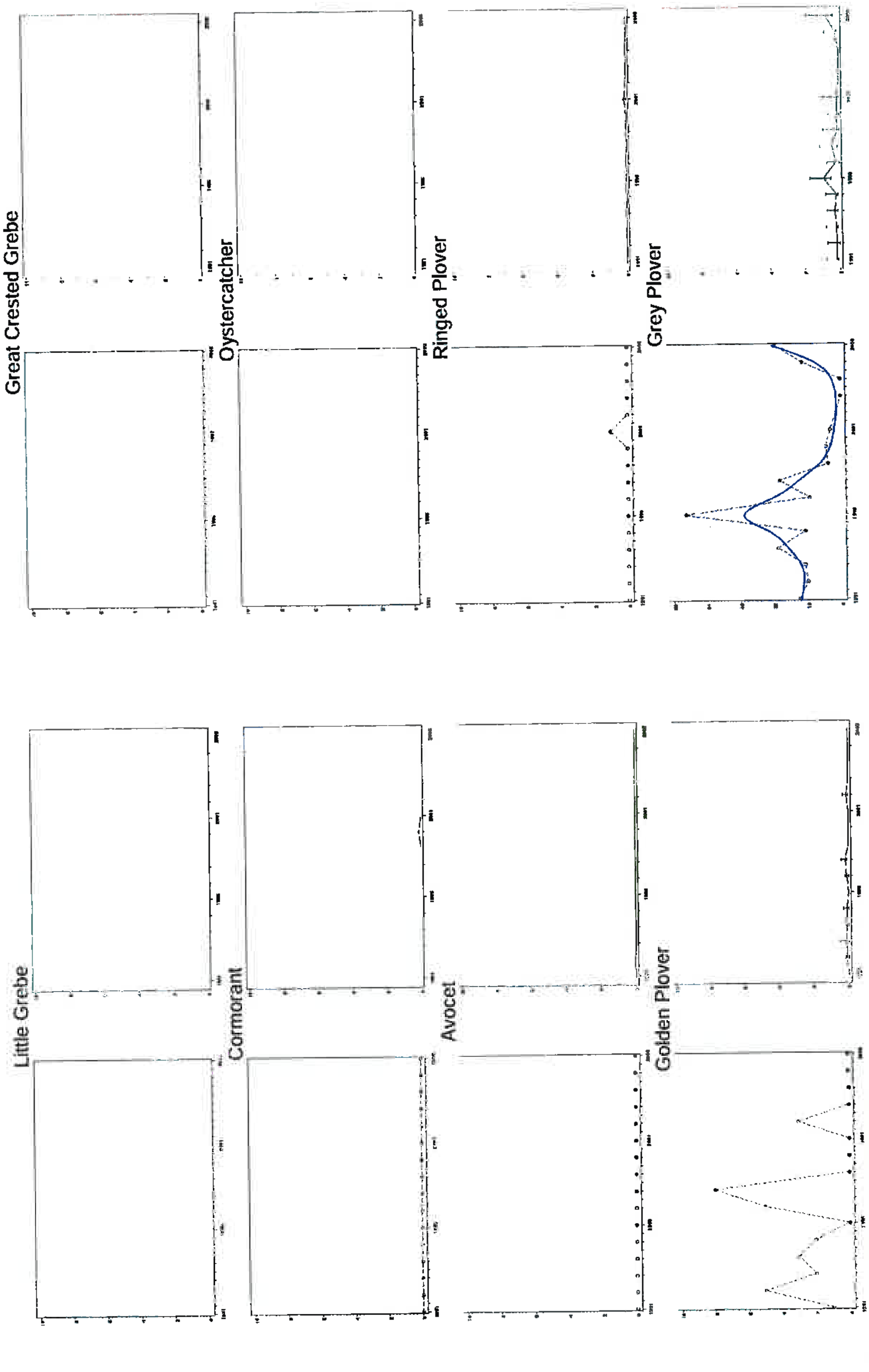


Figure E.22908 Population trends of each species in sector 22908 (Yantlet Saltmarsh and Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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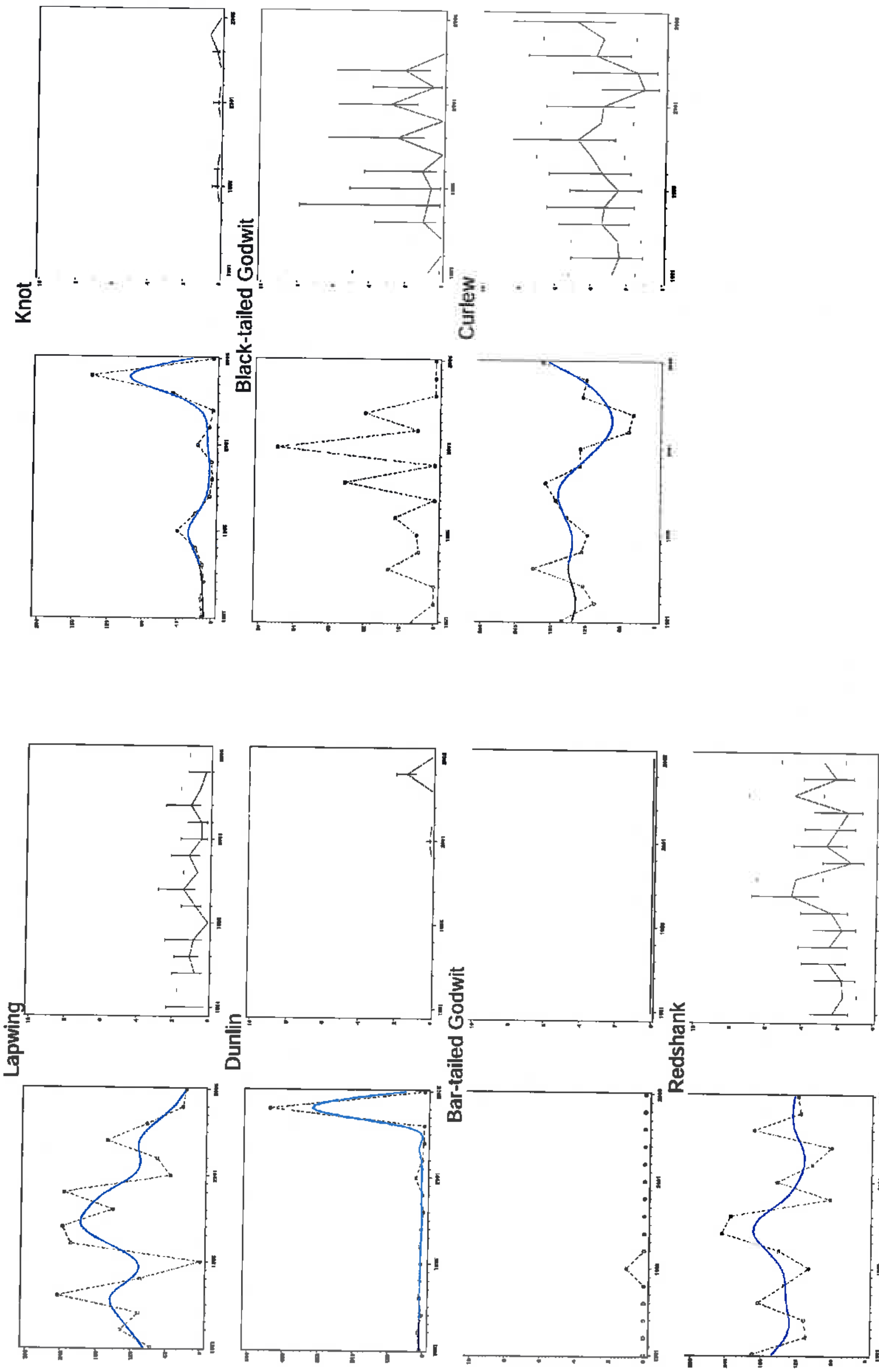

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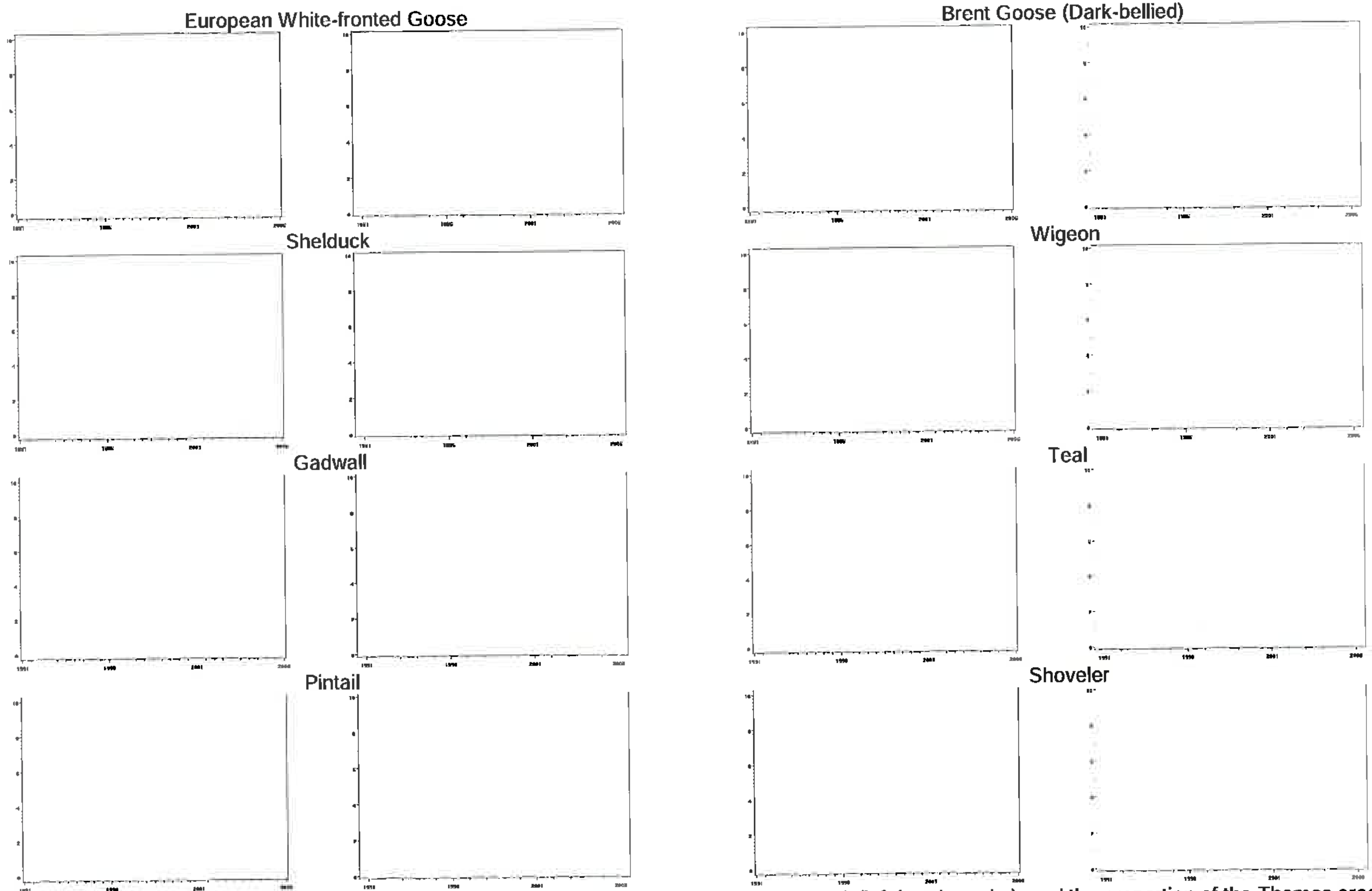
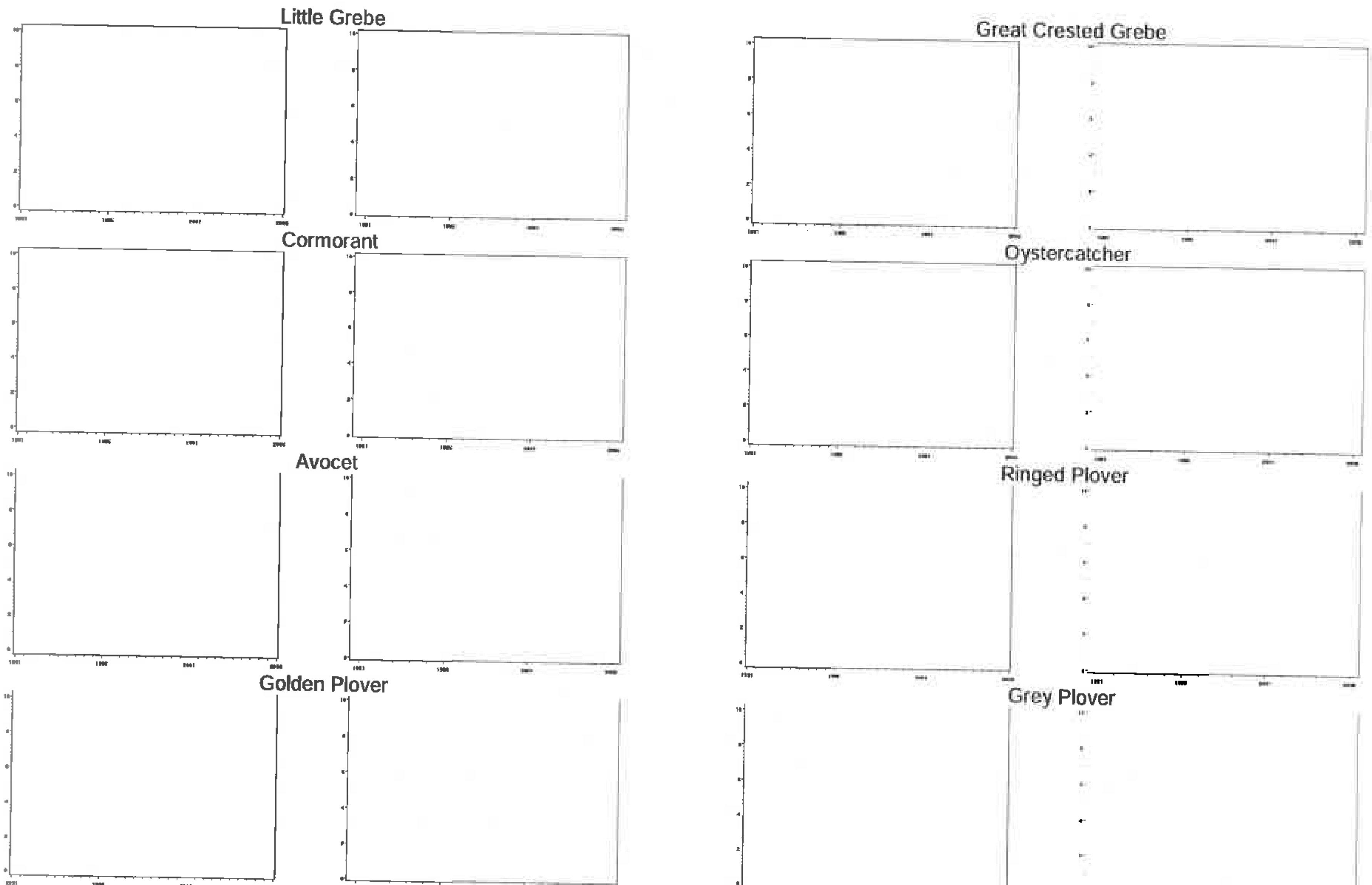


Figure E.22909 Population trends of each species in sector 22909 (Cliffe Creek and Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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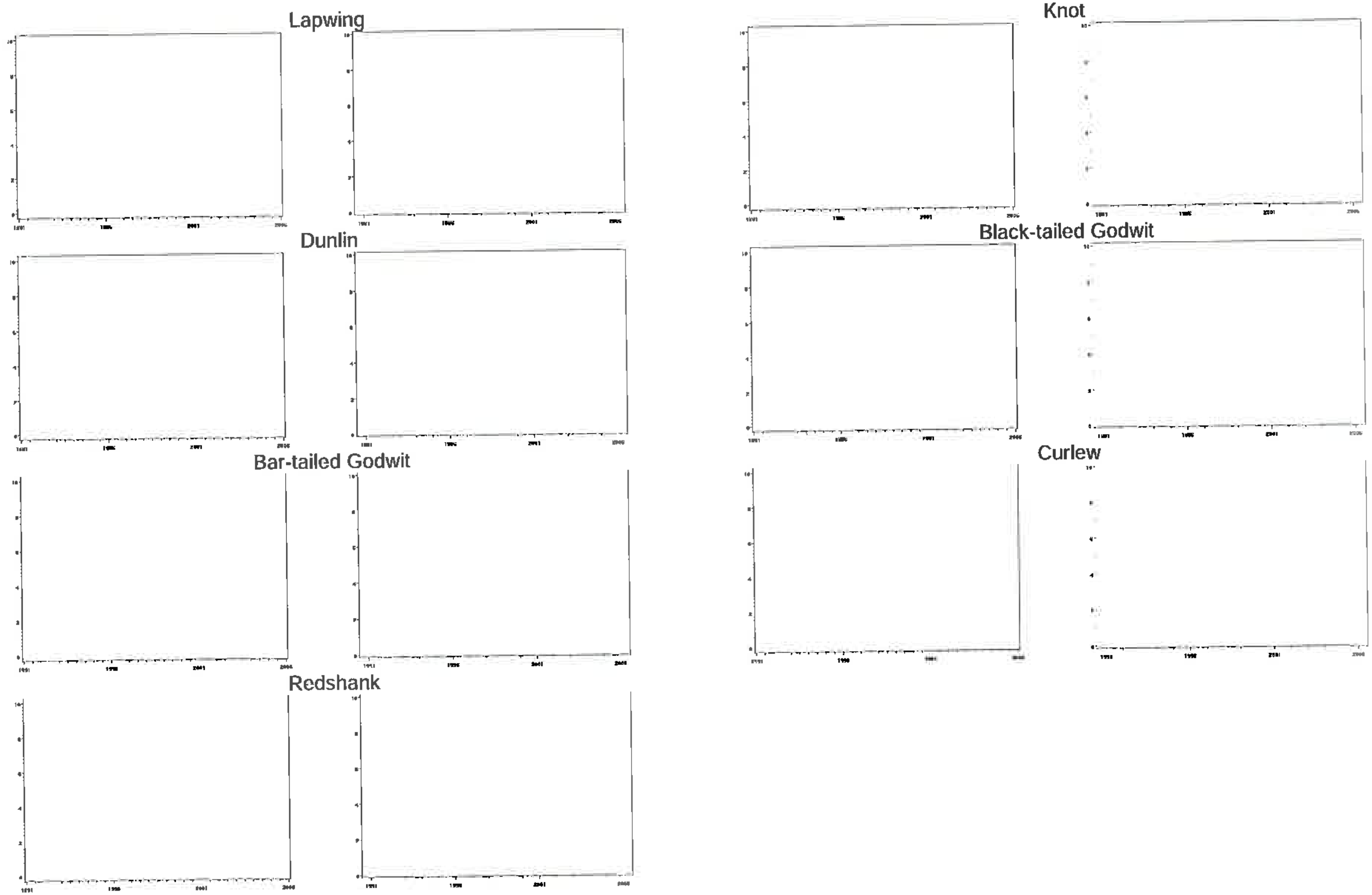

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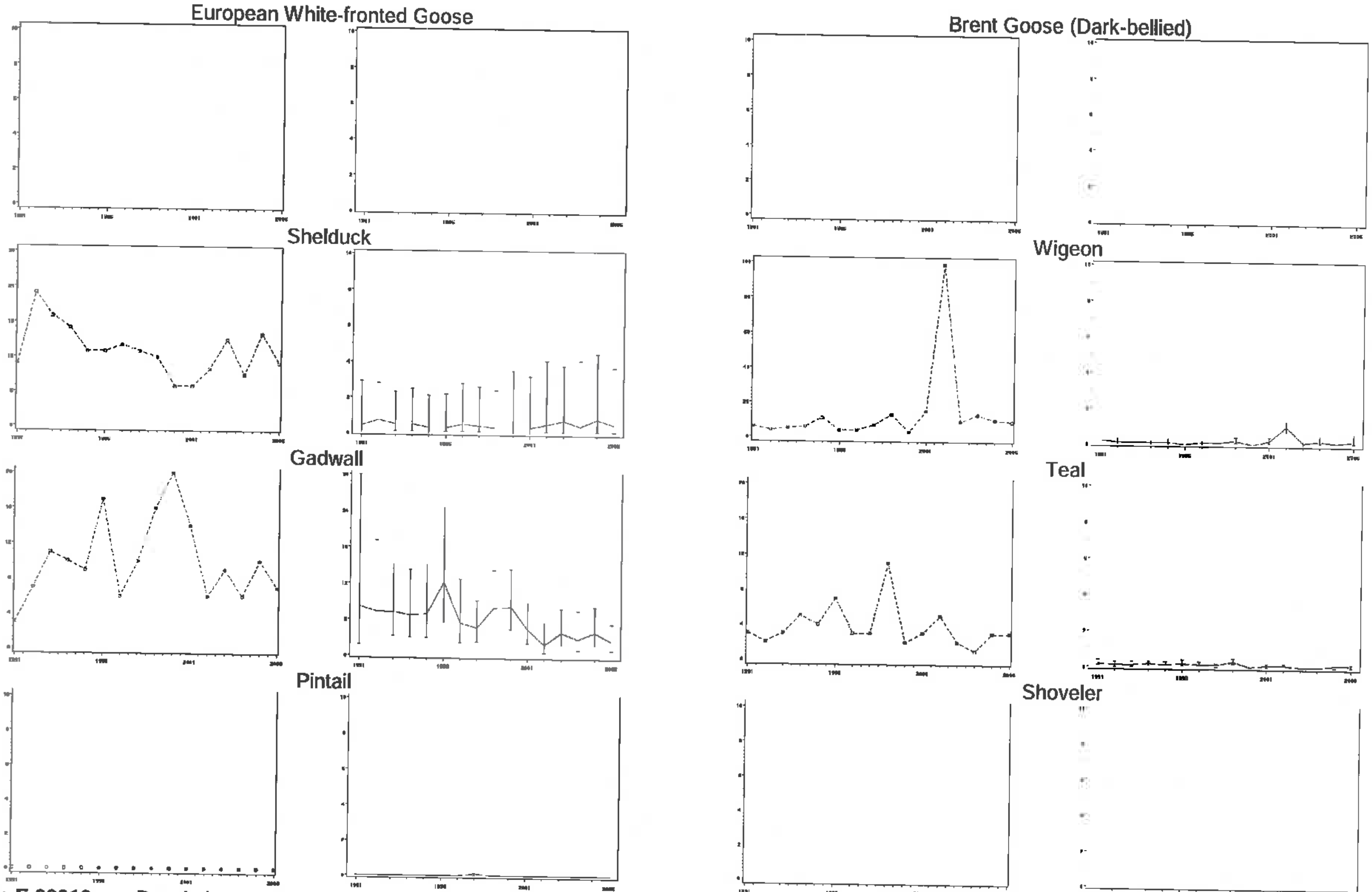
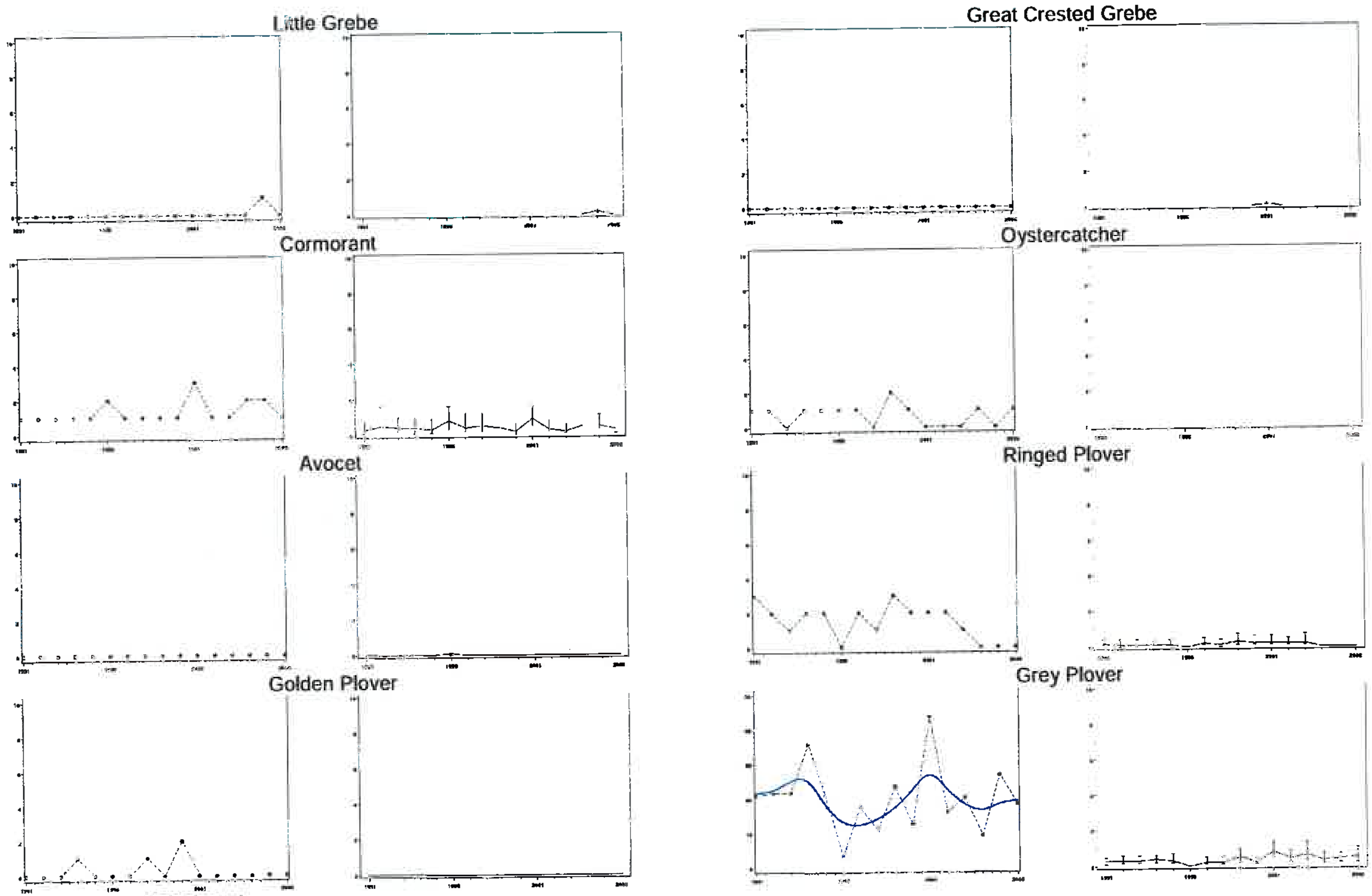


Figure E.22910 Population trends of each species in sector 22910 (Lower Hope Point Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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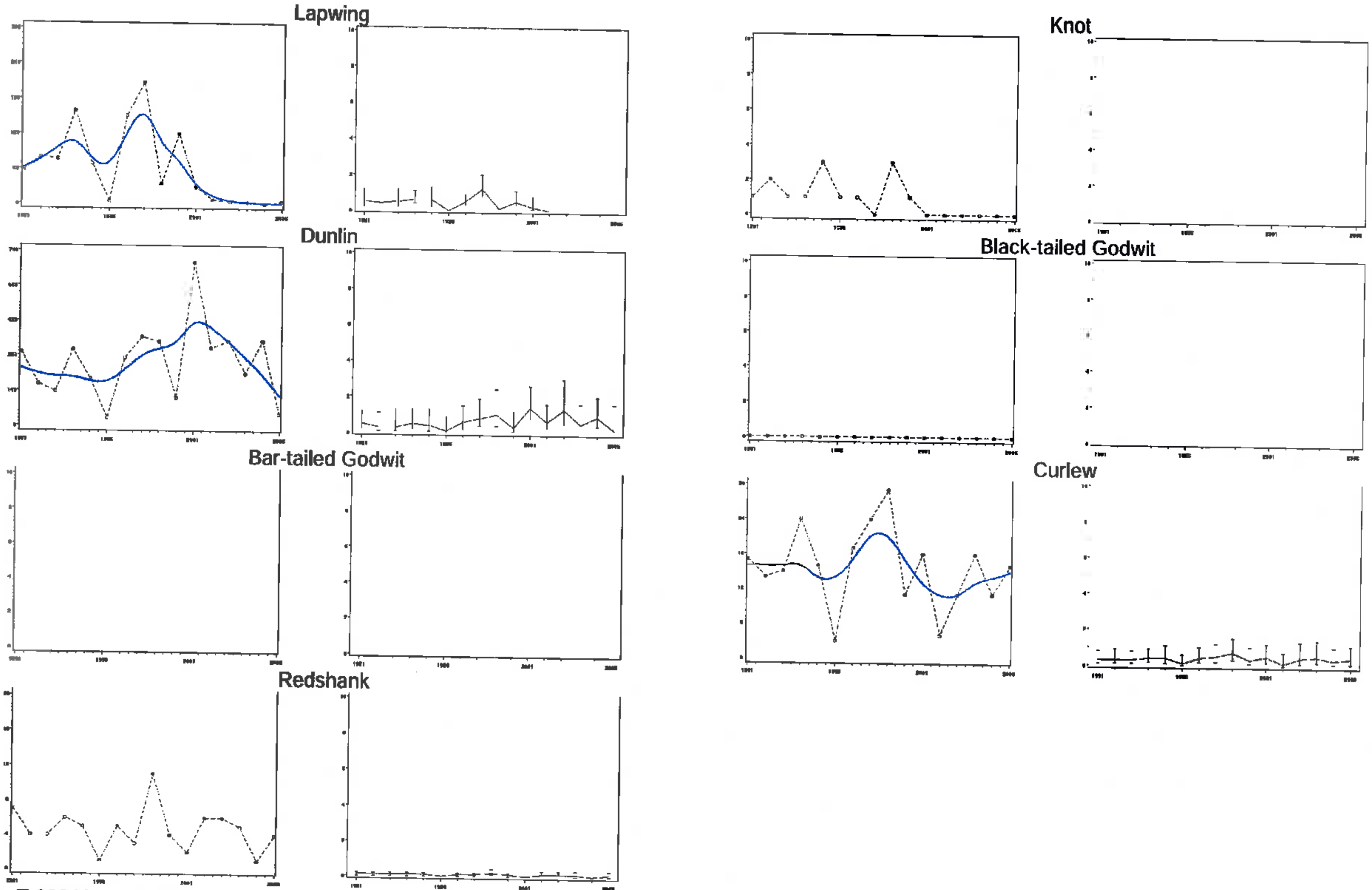

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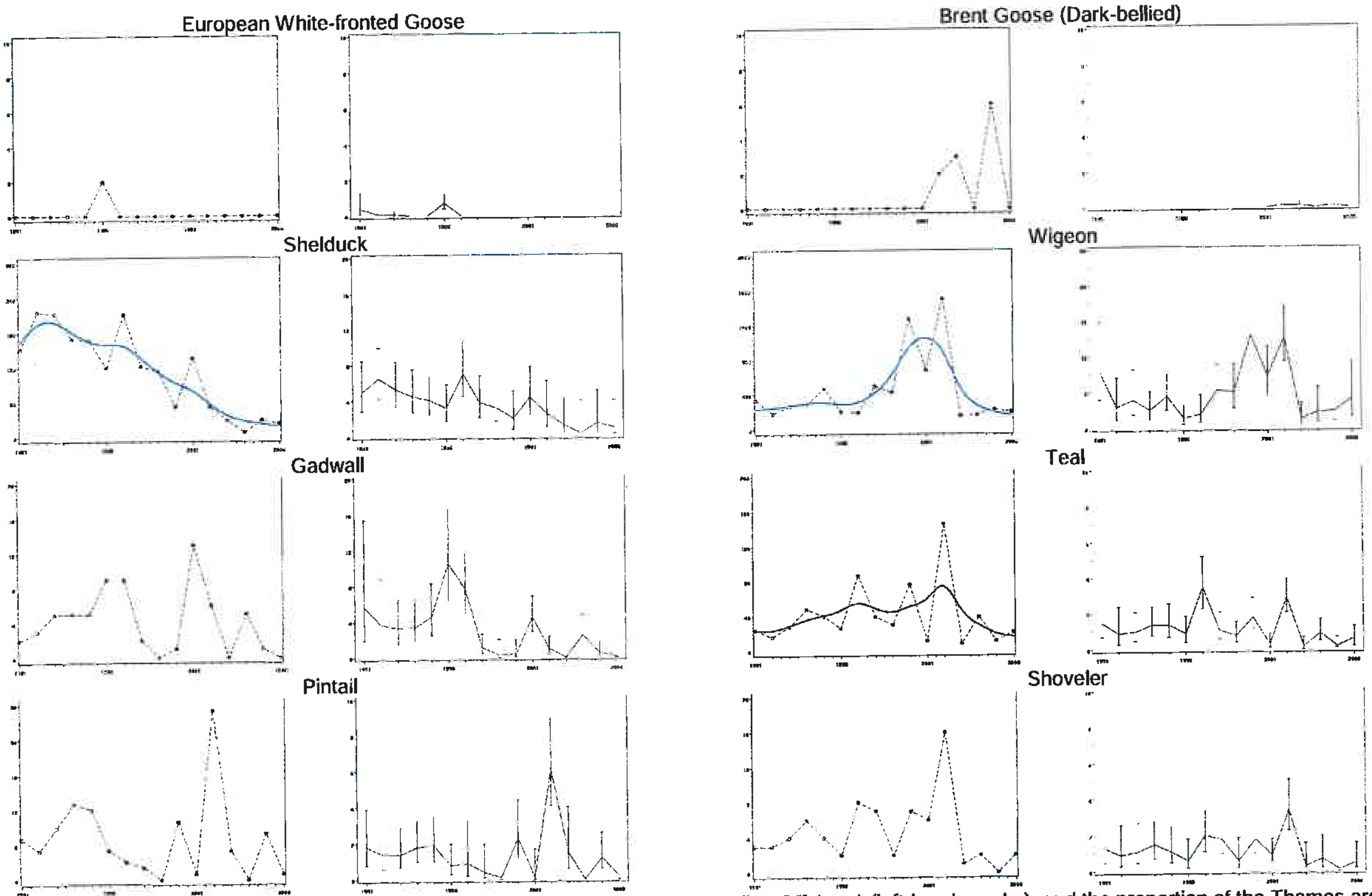
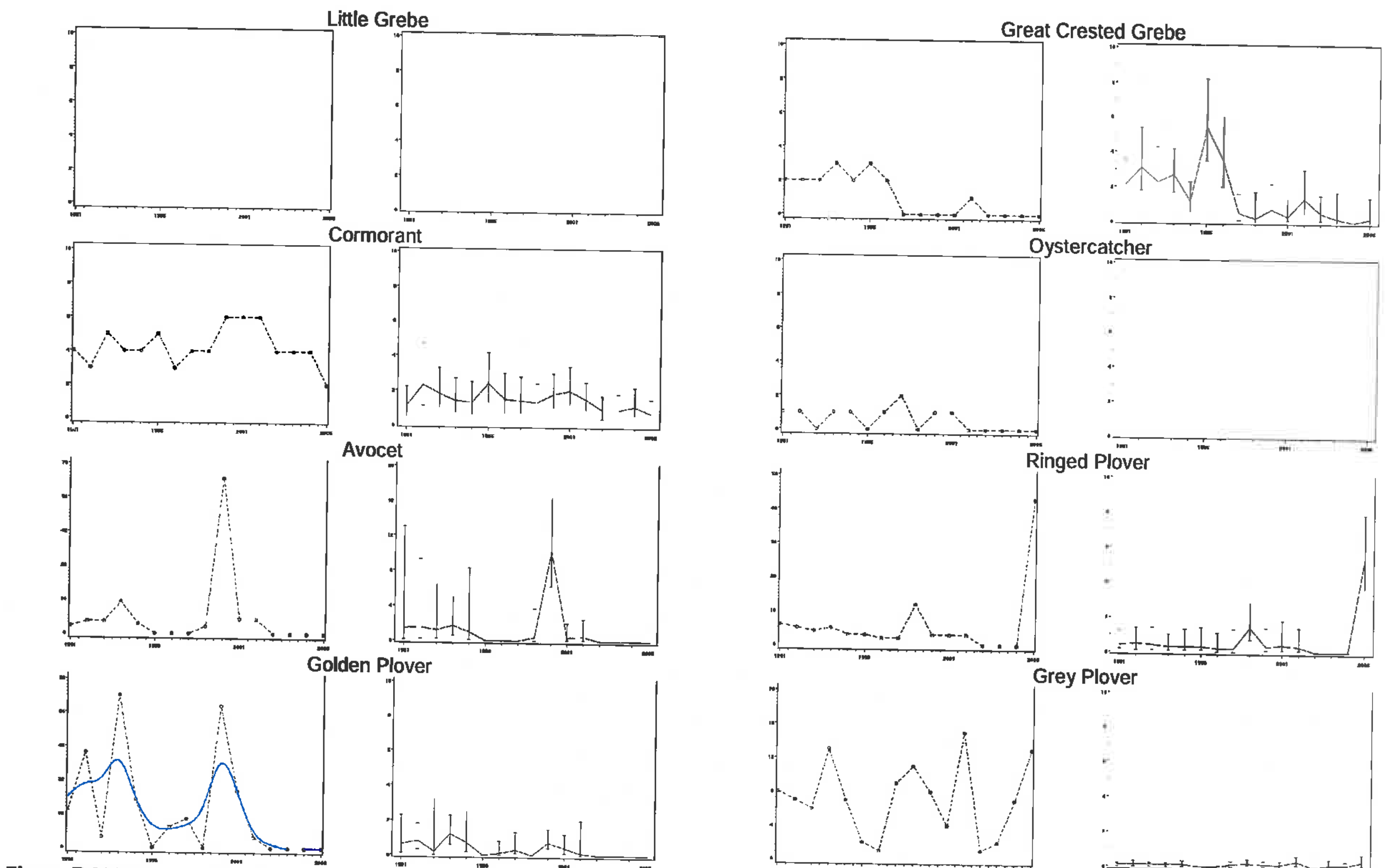


Figure E.22912 Population trends of each species in sector 22912 (Cliffe and Cooling Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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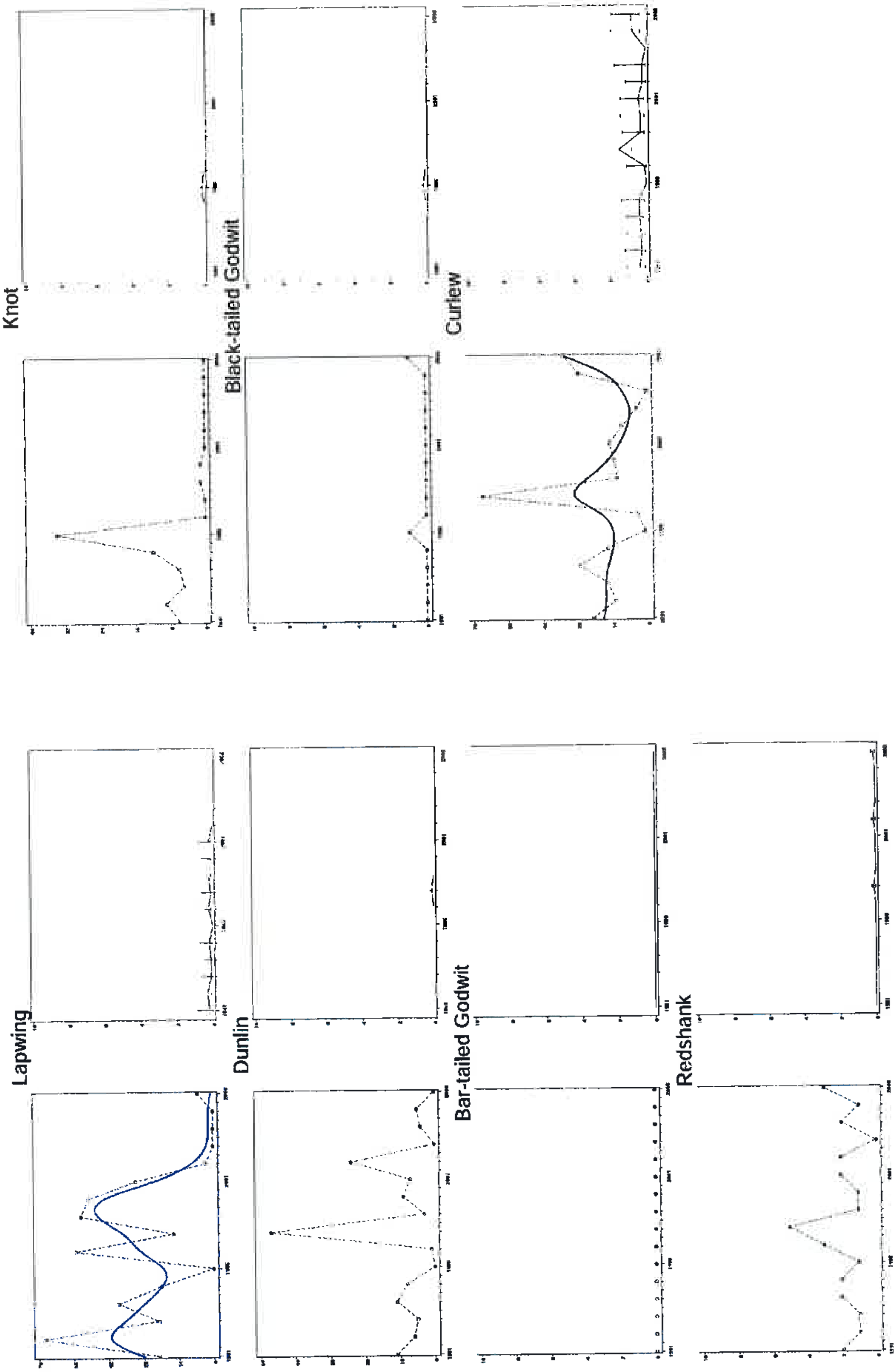

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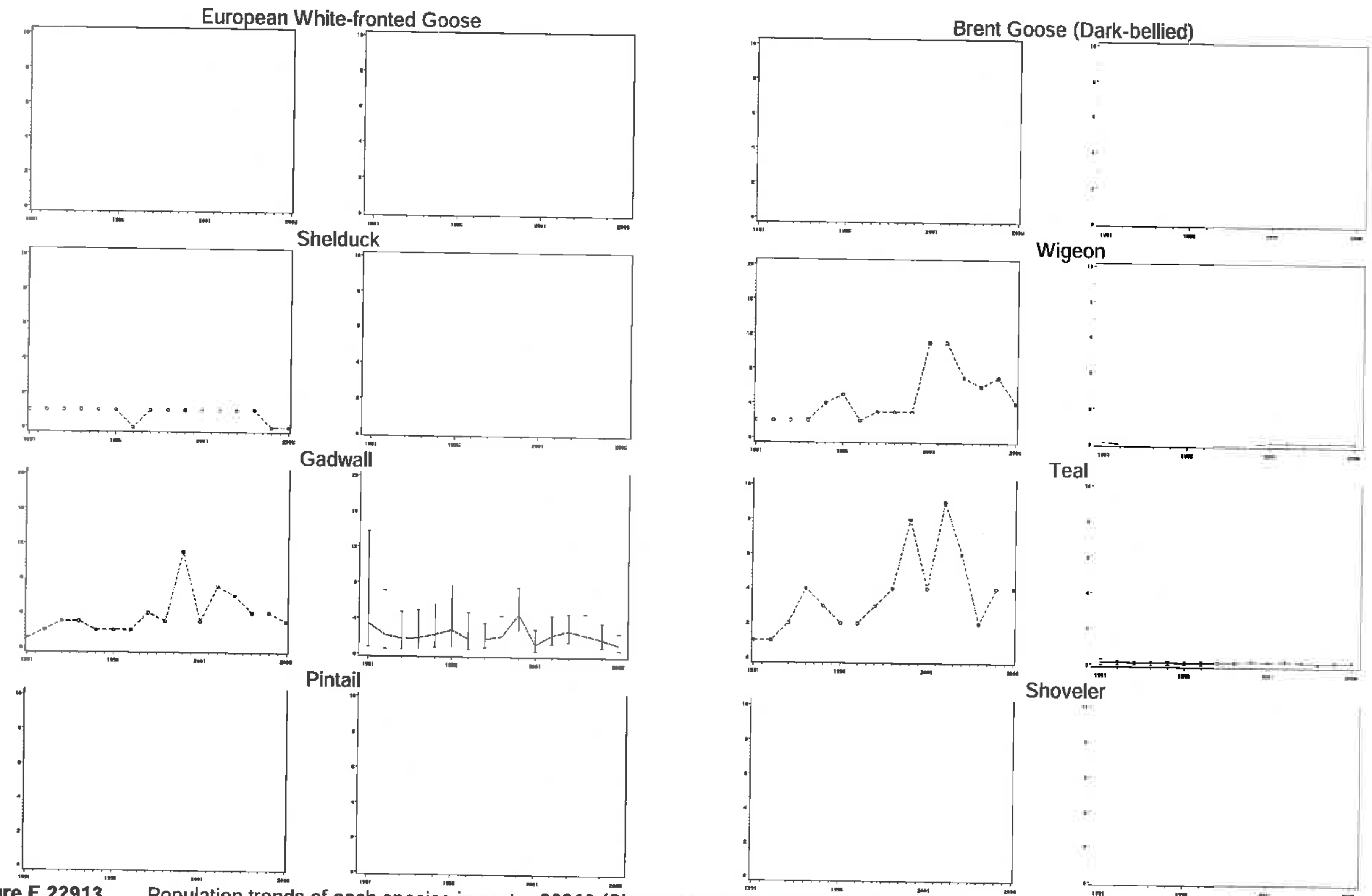
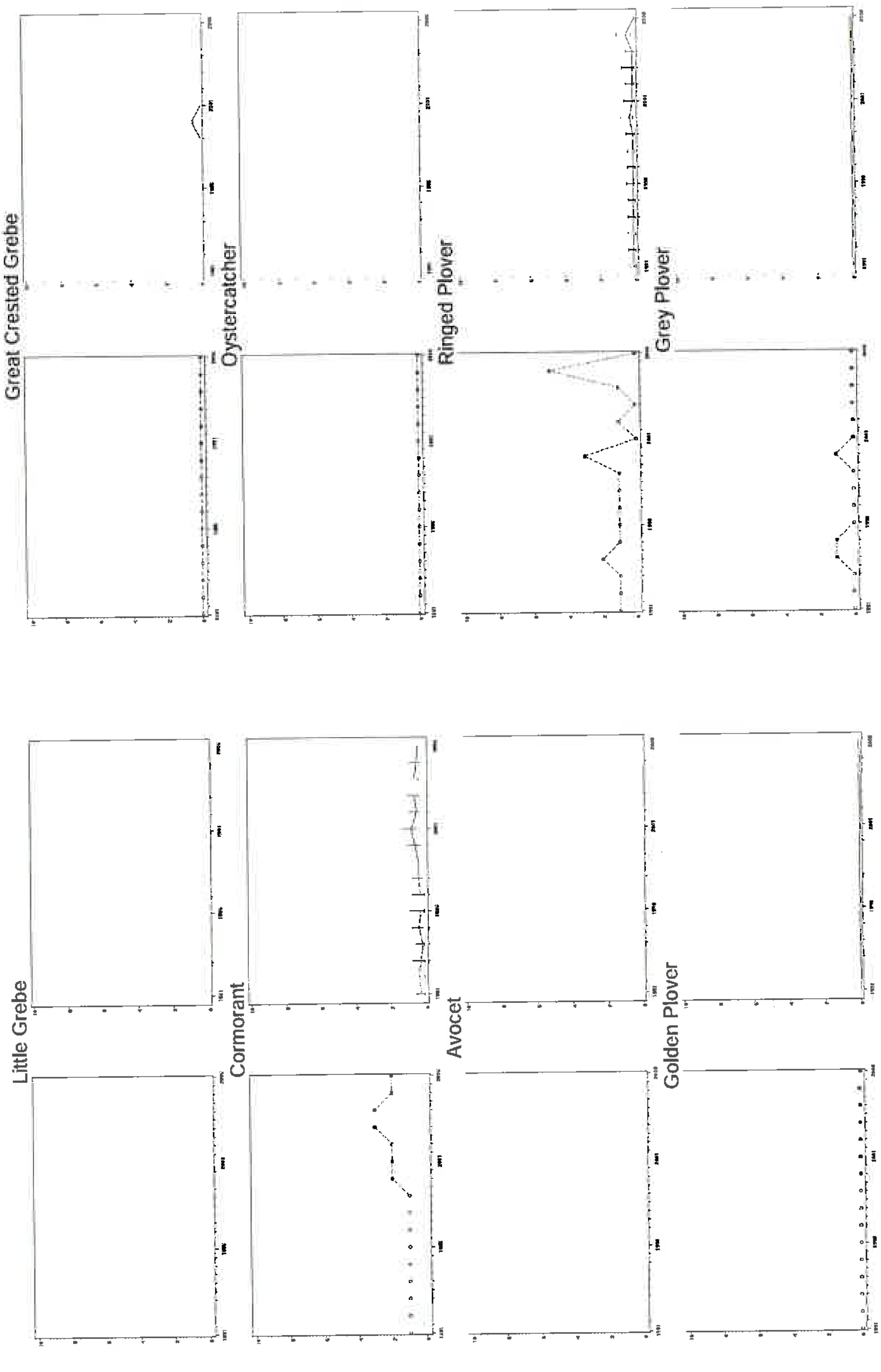


Figure E.22913 Population trends of each species in sector 22913 (Shorne Marshes Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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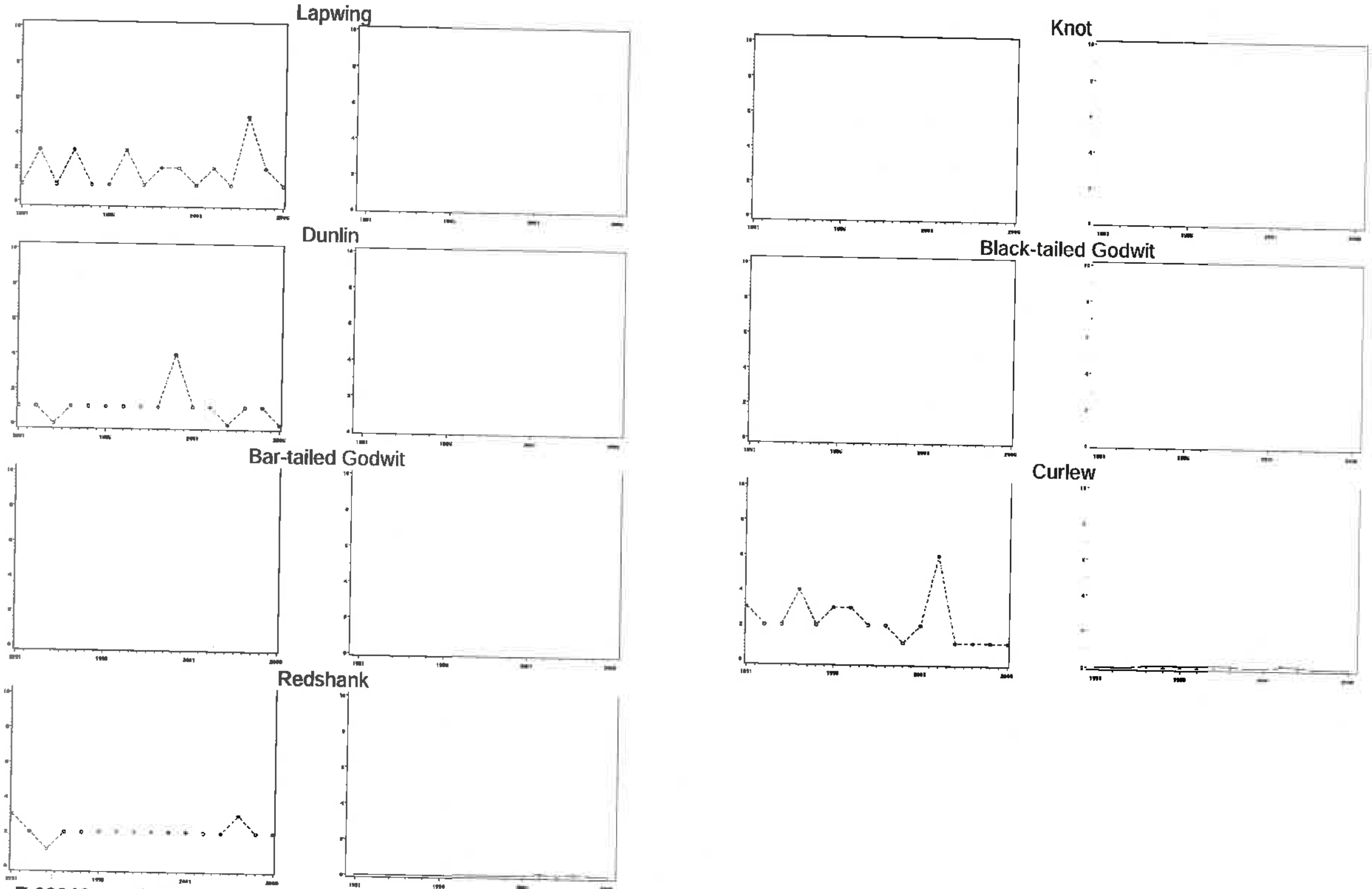

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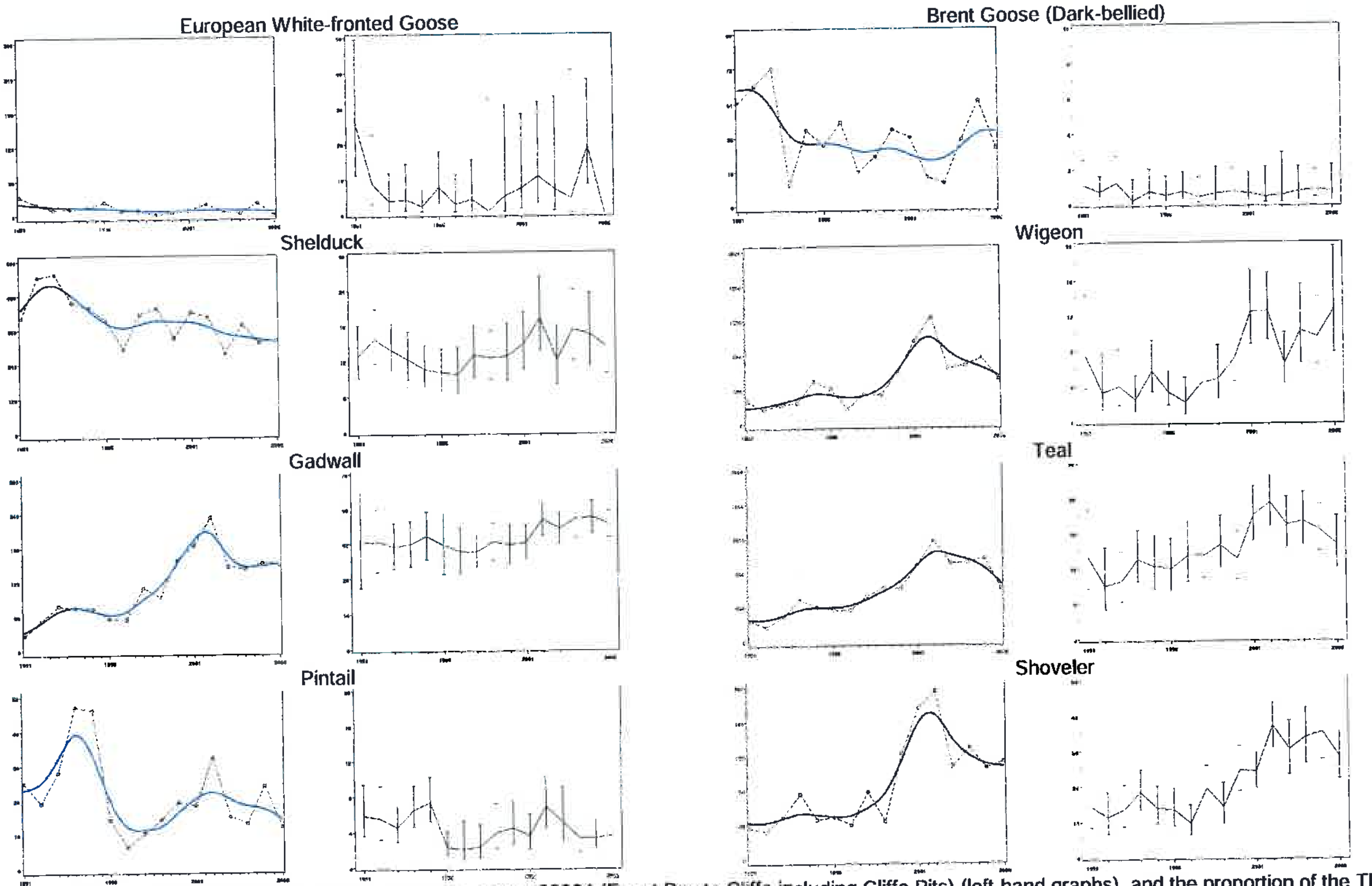


Figure E.22984 Population trends of each species in sector 22984 (Egypt Bay to Cliffe including Cliffe Pits) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

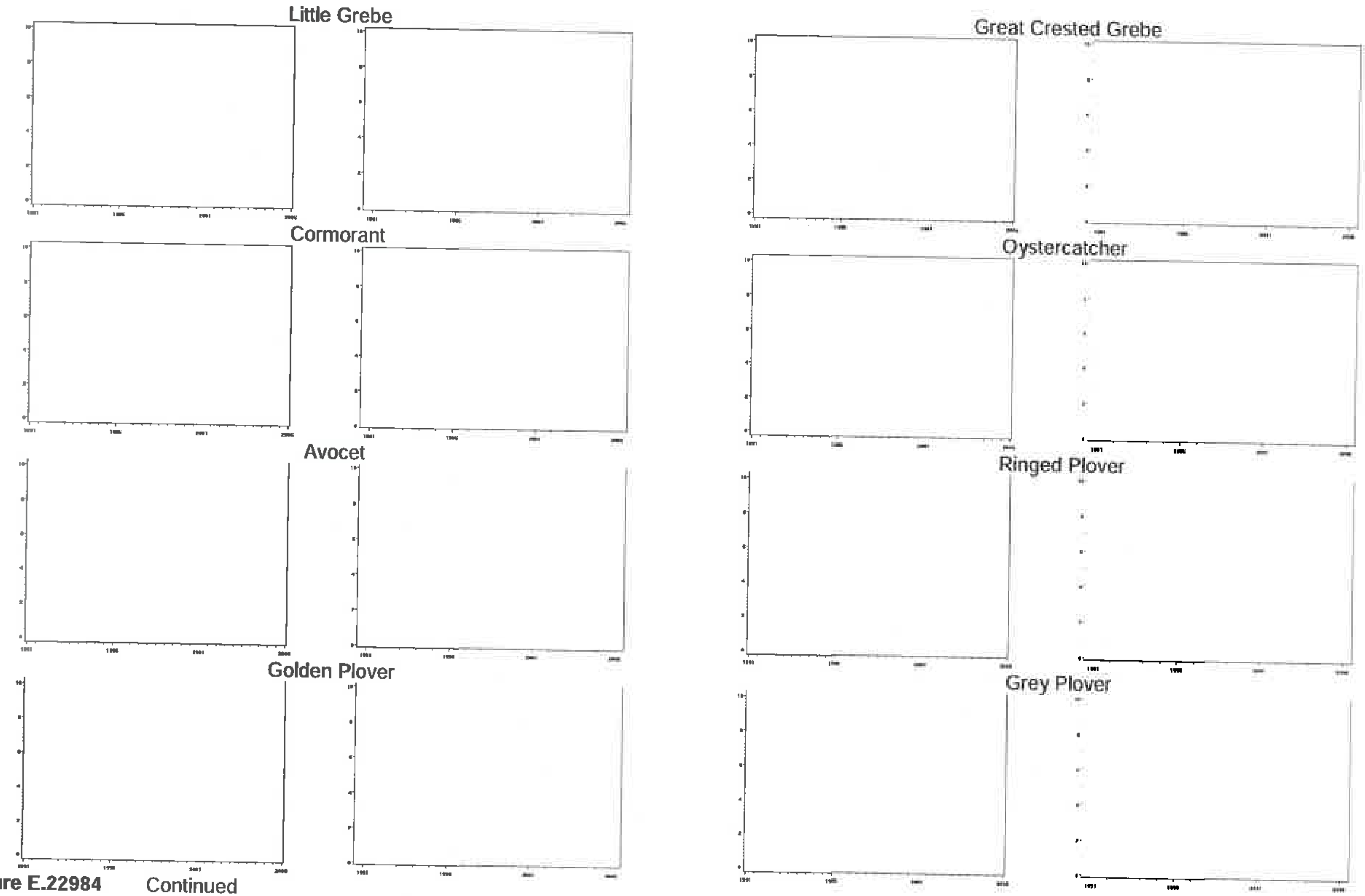
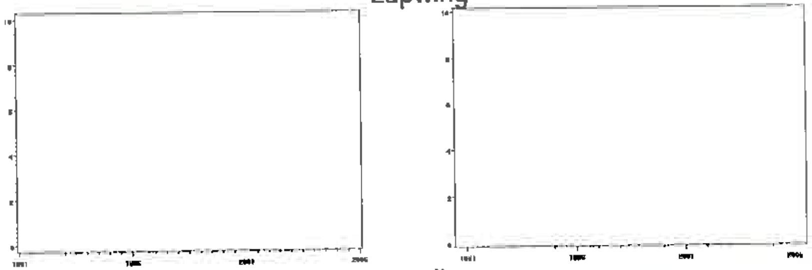
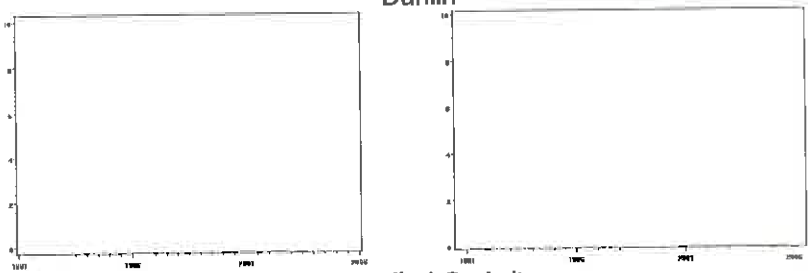


Figure E.22984 Continued

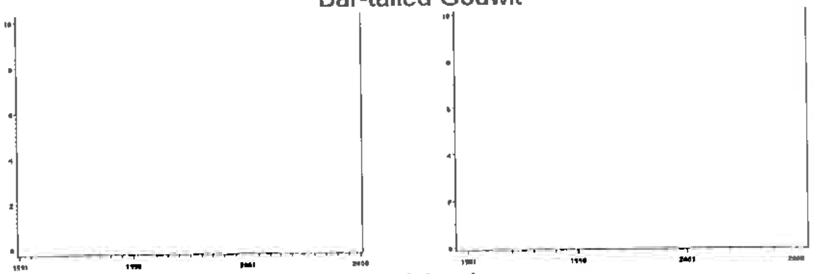
Lapwing



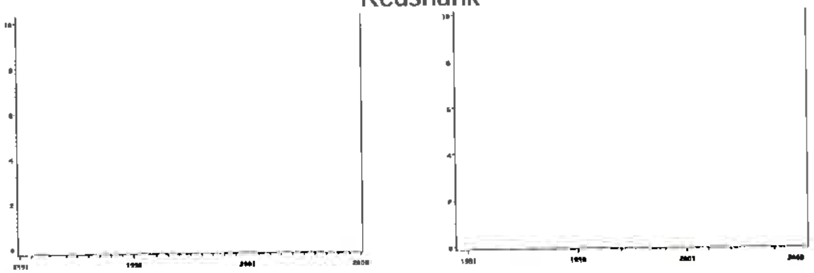
Dunlin



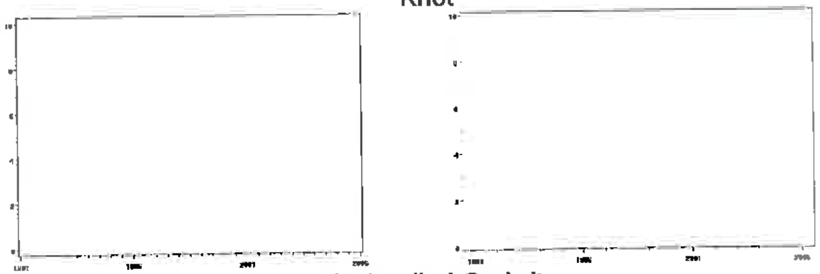
Bar-tailed Godwit



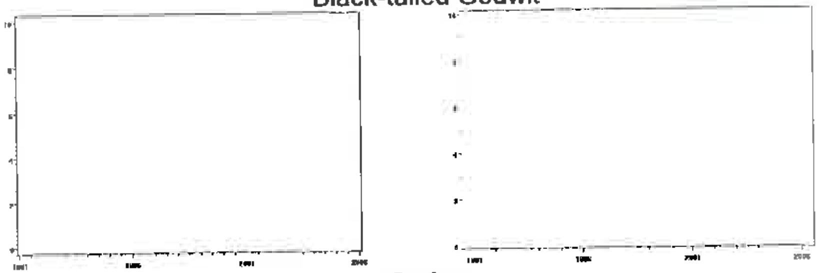
Redshank



Knot



Black-tailed Godwit



Curlew

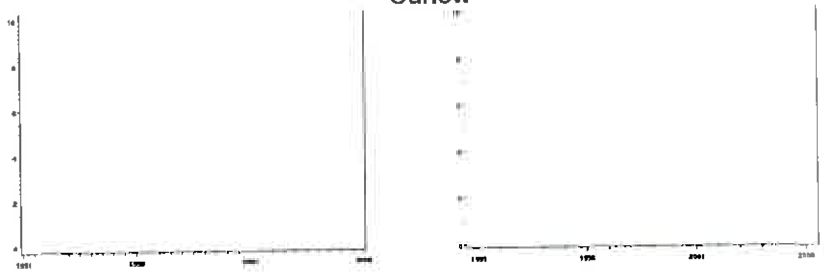


Figure E.22984 Continued

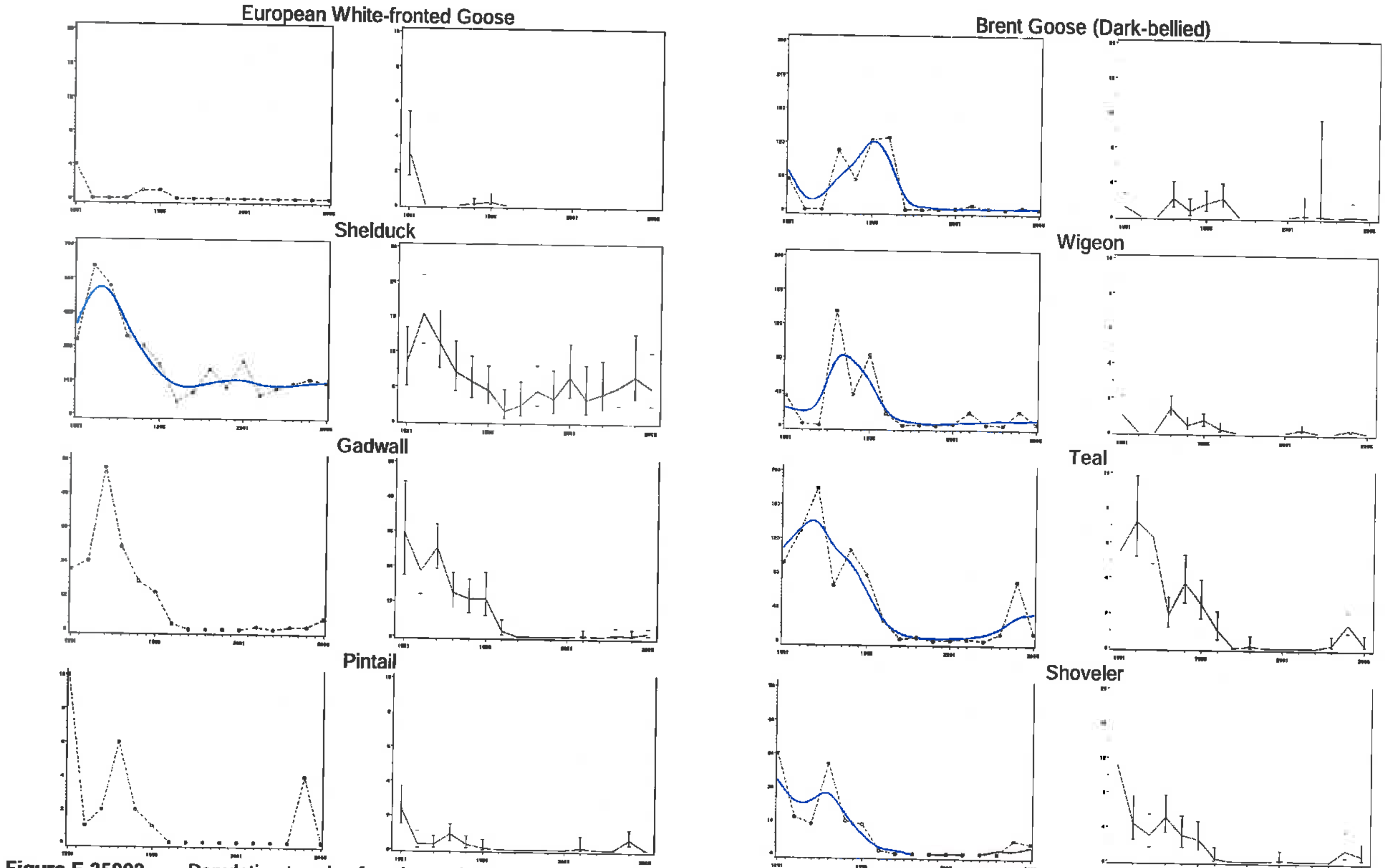
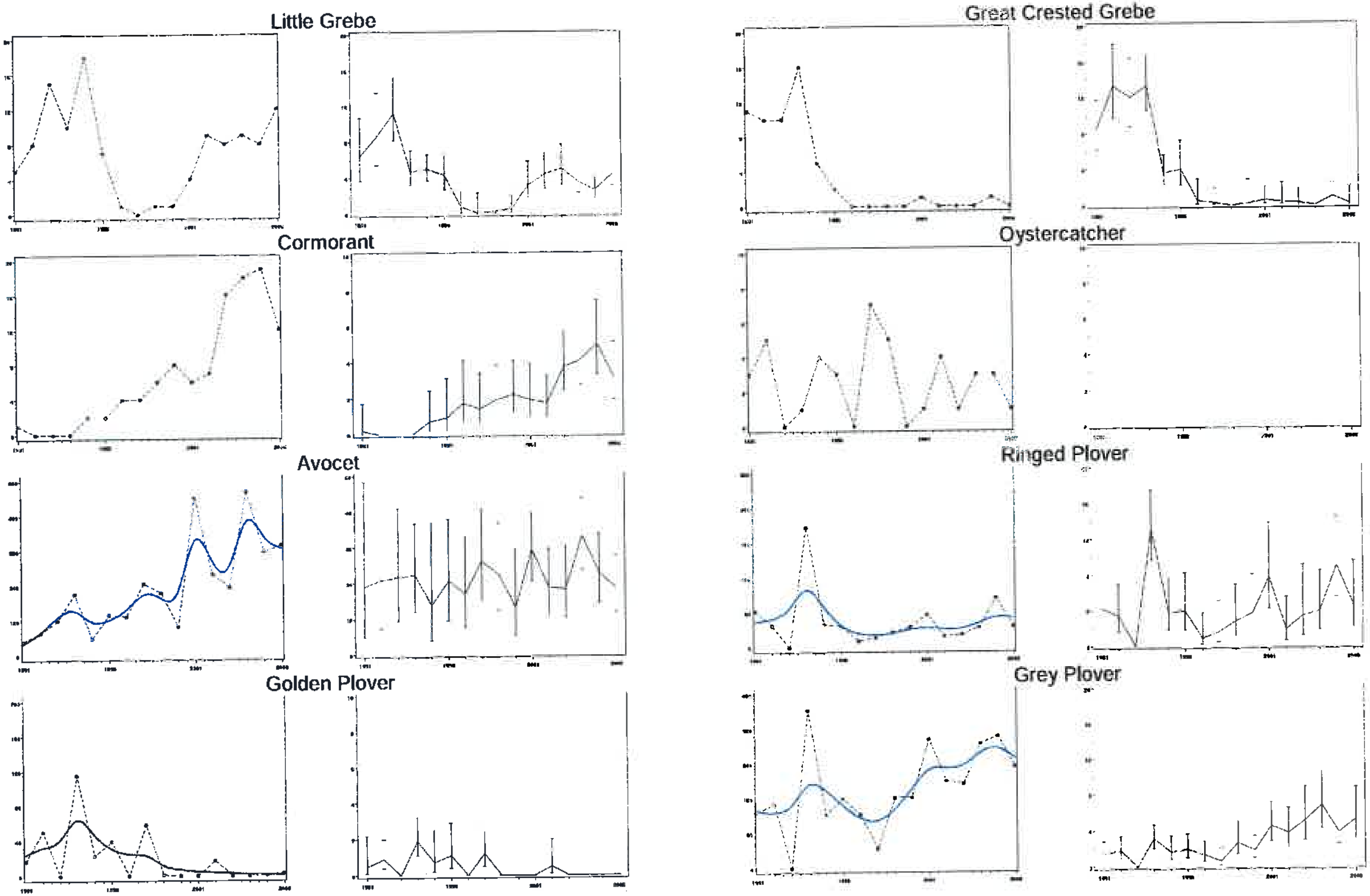


Figure E.25902 Population trends of each species in sector 25902 (Tilbury to Mucking including Mucking Gravel Pits) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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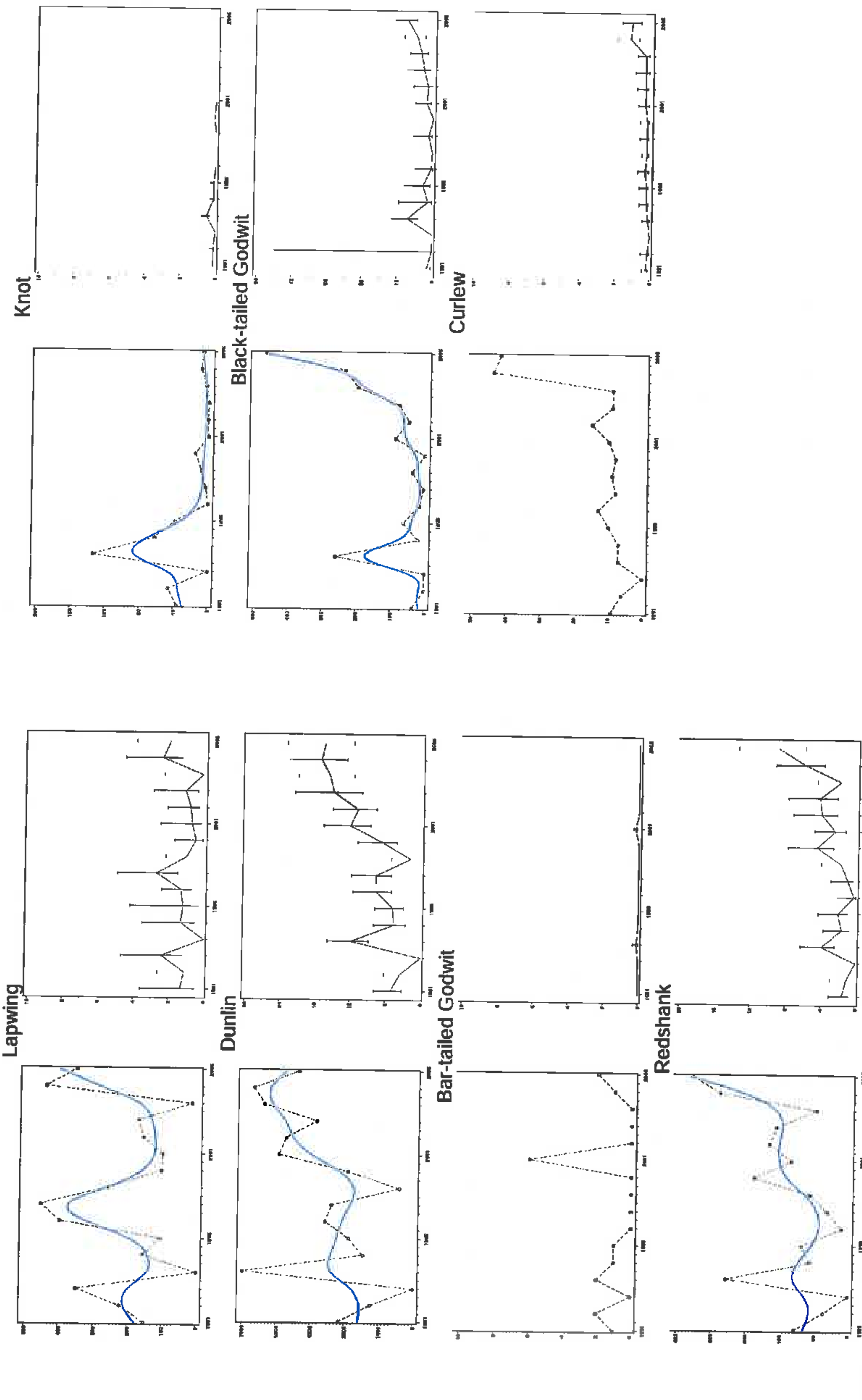

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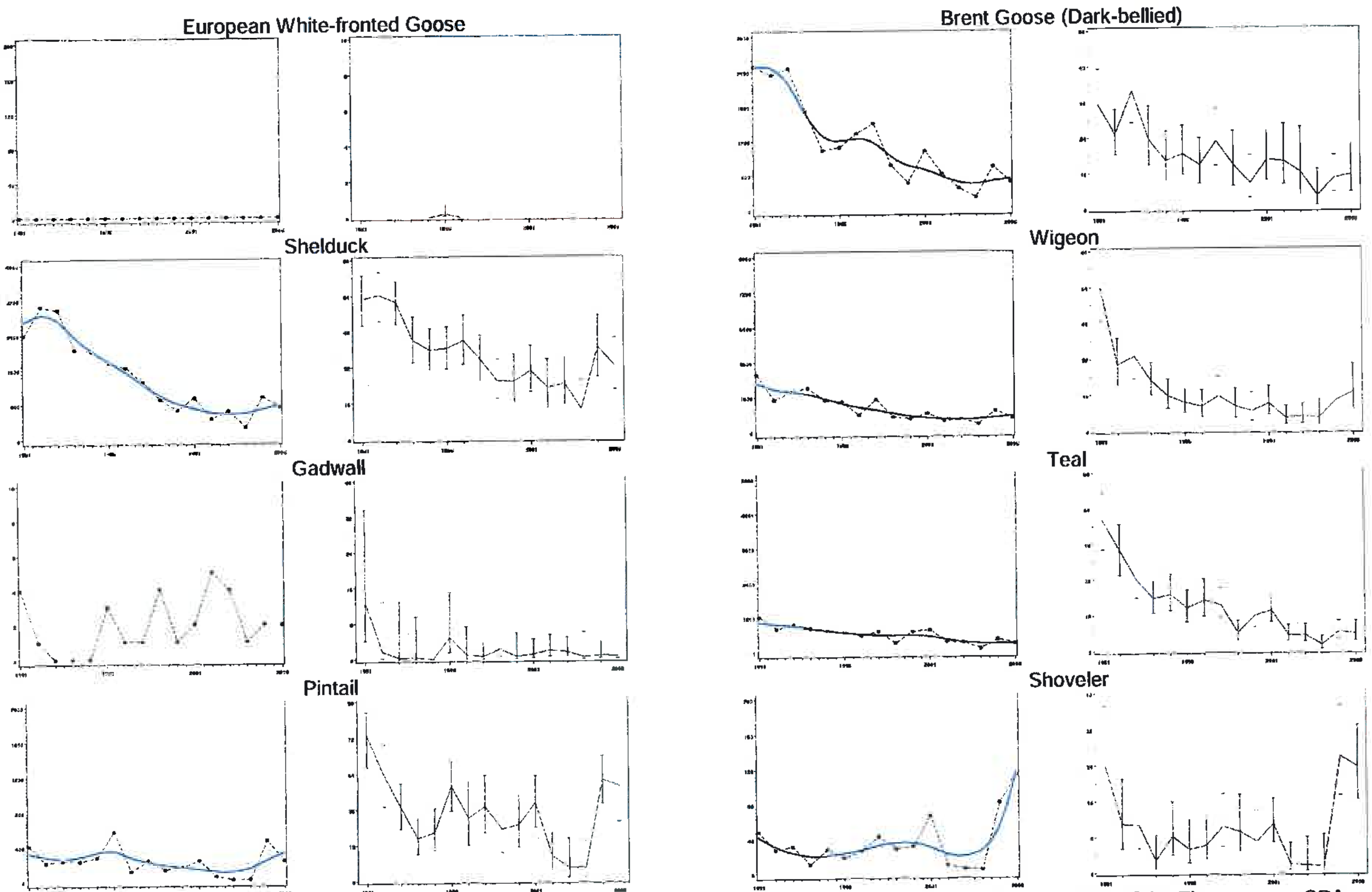
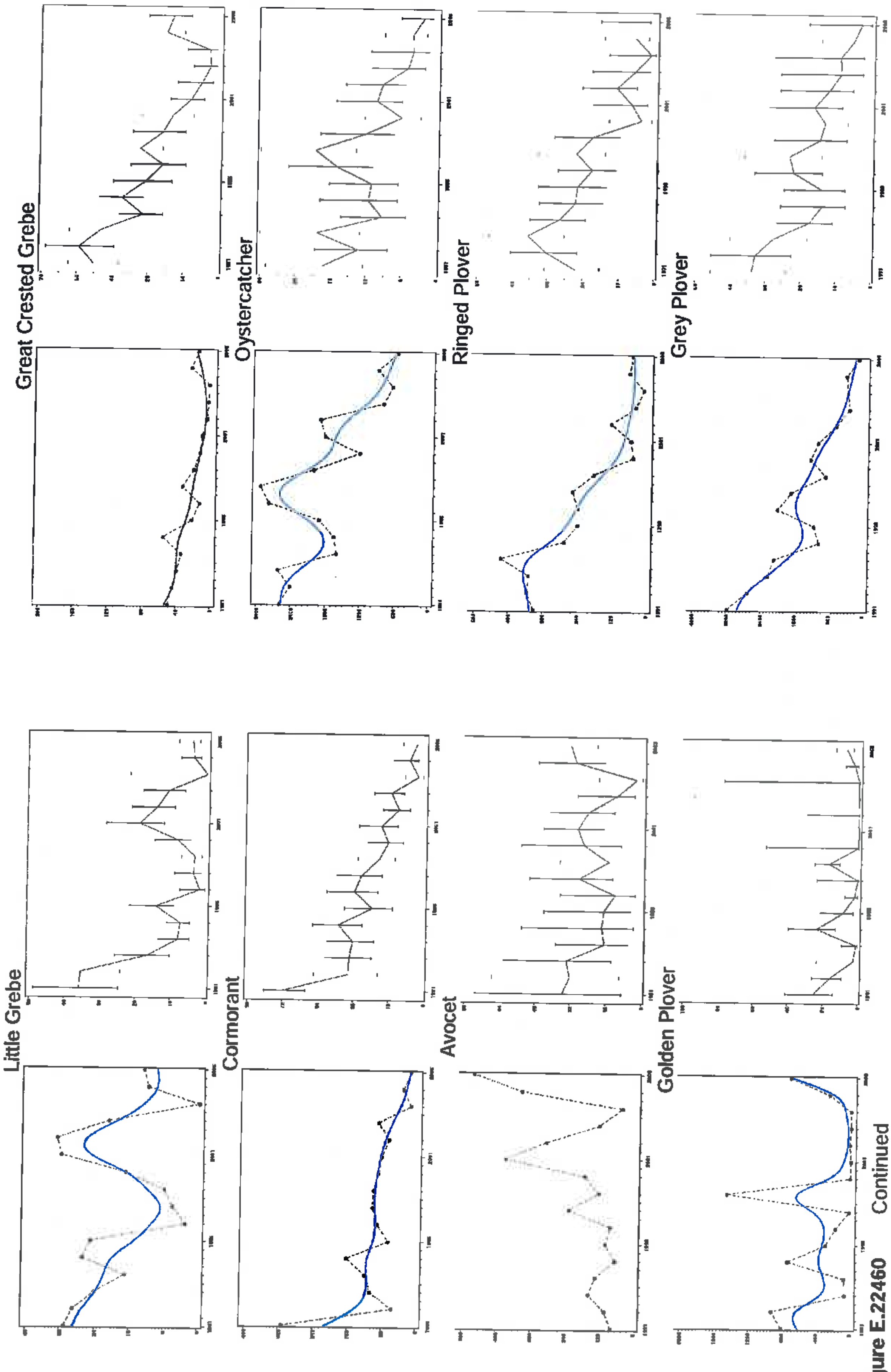


Figure E.22460 Population trends of each species in sector 22460 (Medway Estuary) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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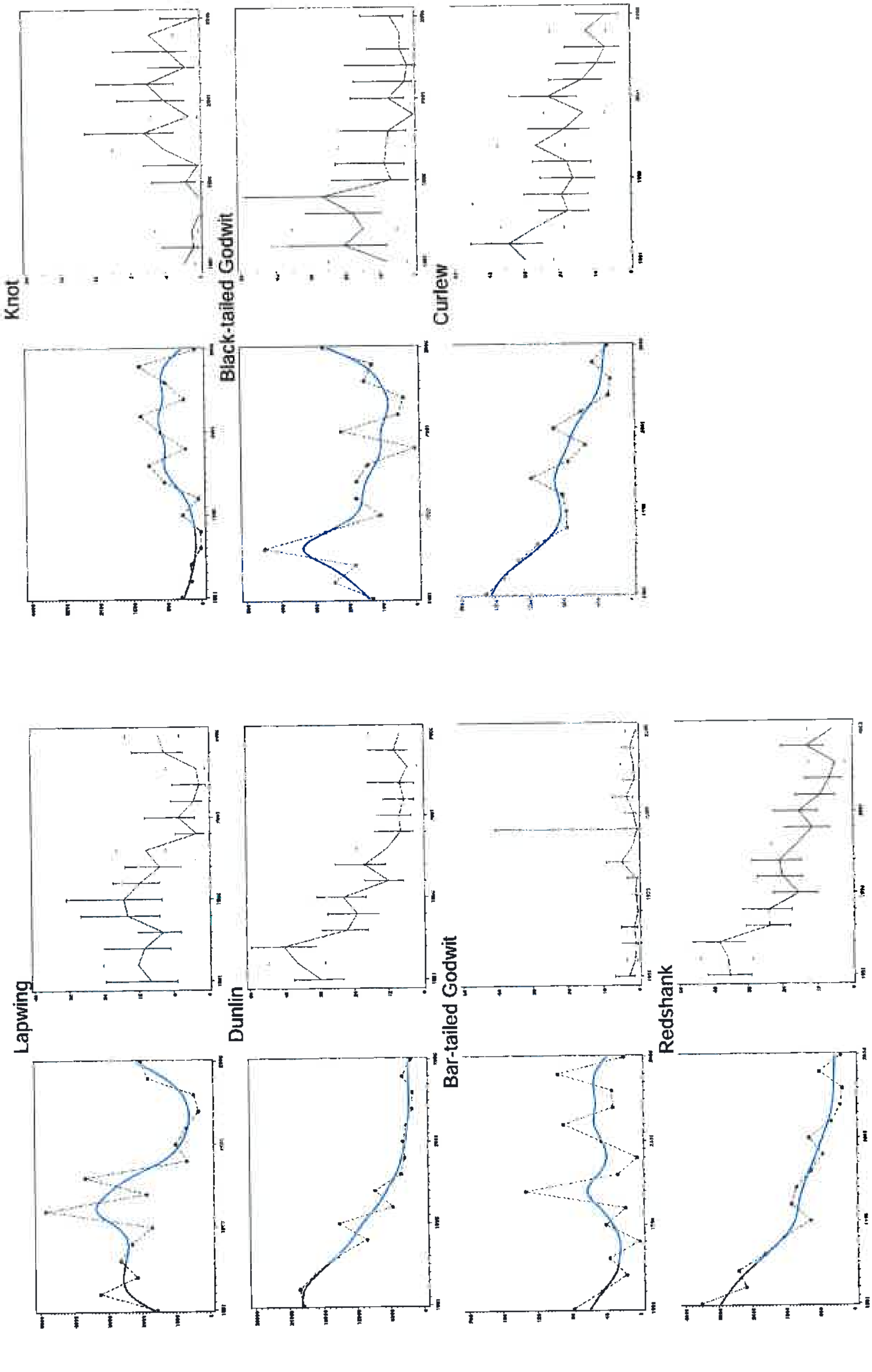

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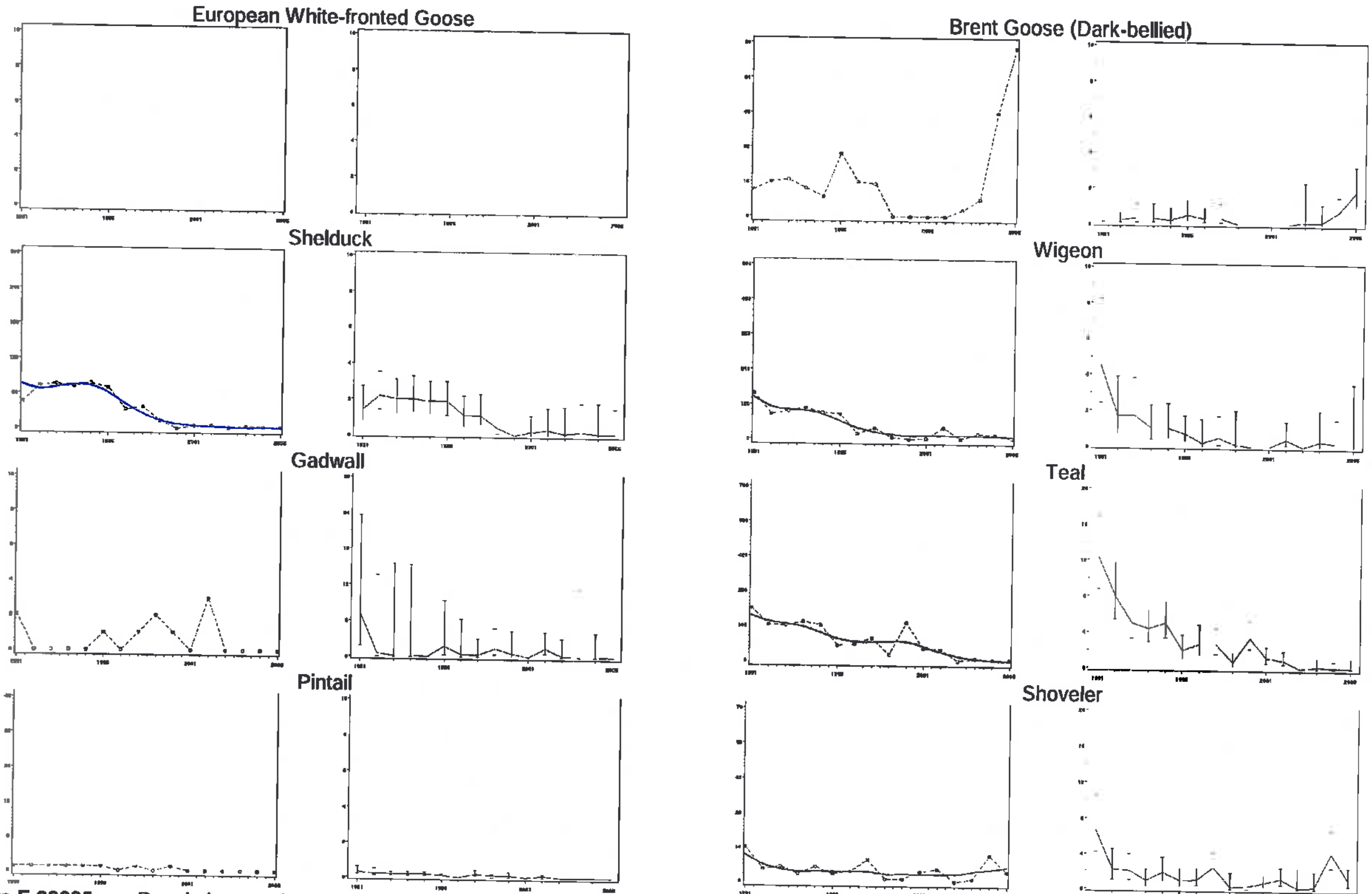
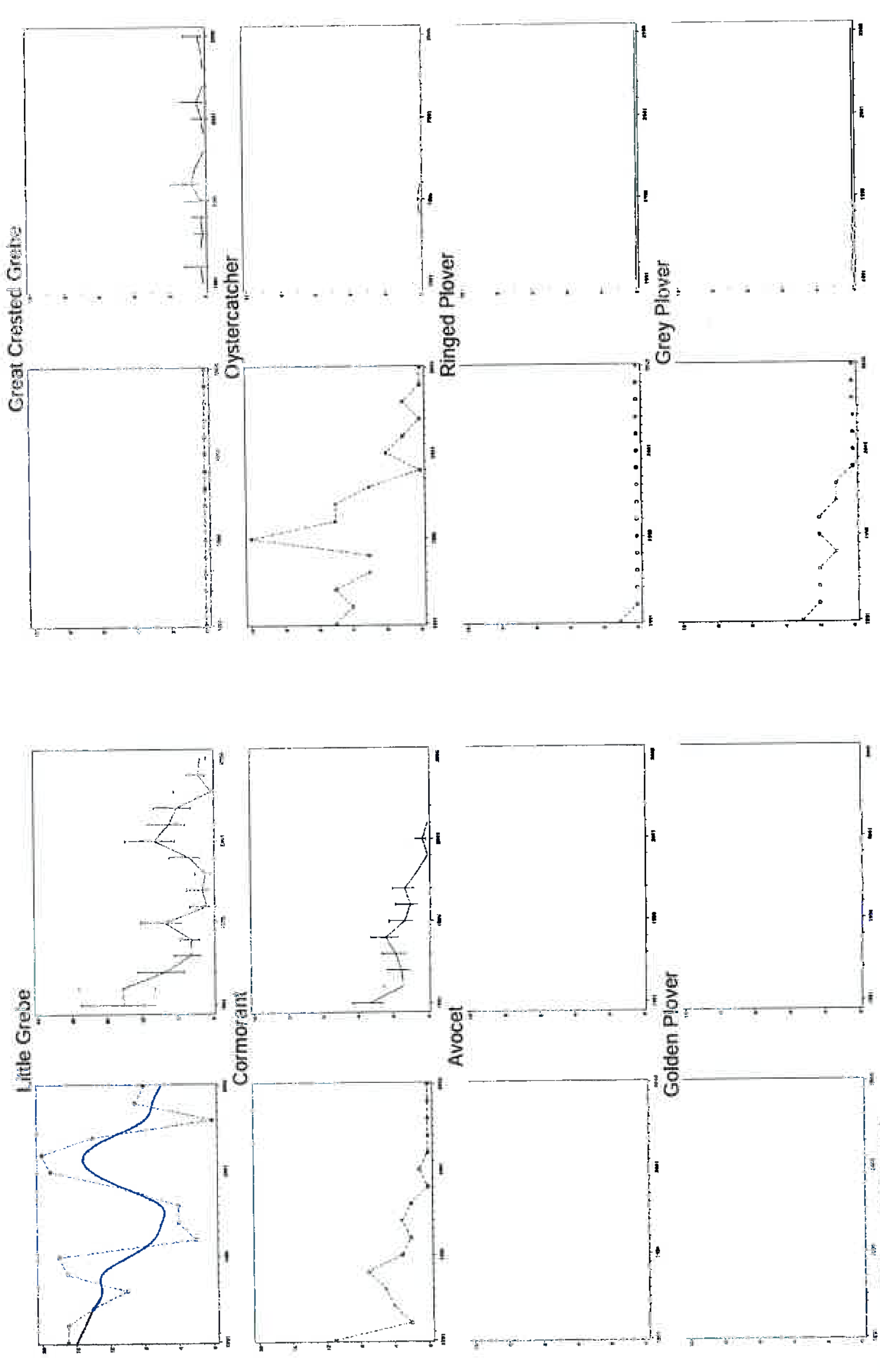


Figure E.22085 Population trends of each species in sector 22085 (South Grain) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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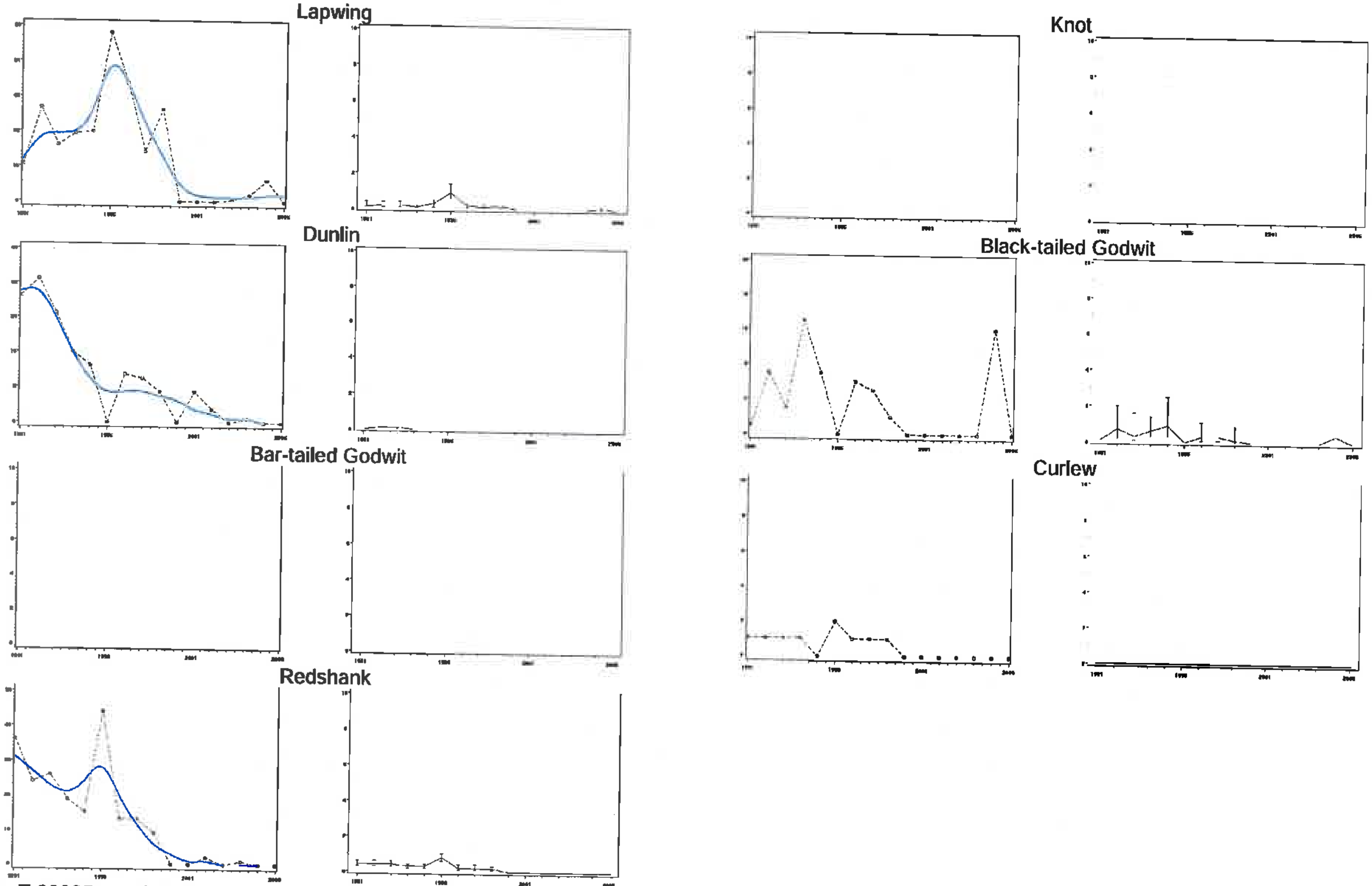

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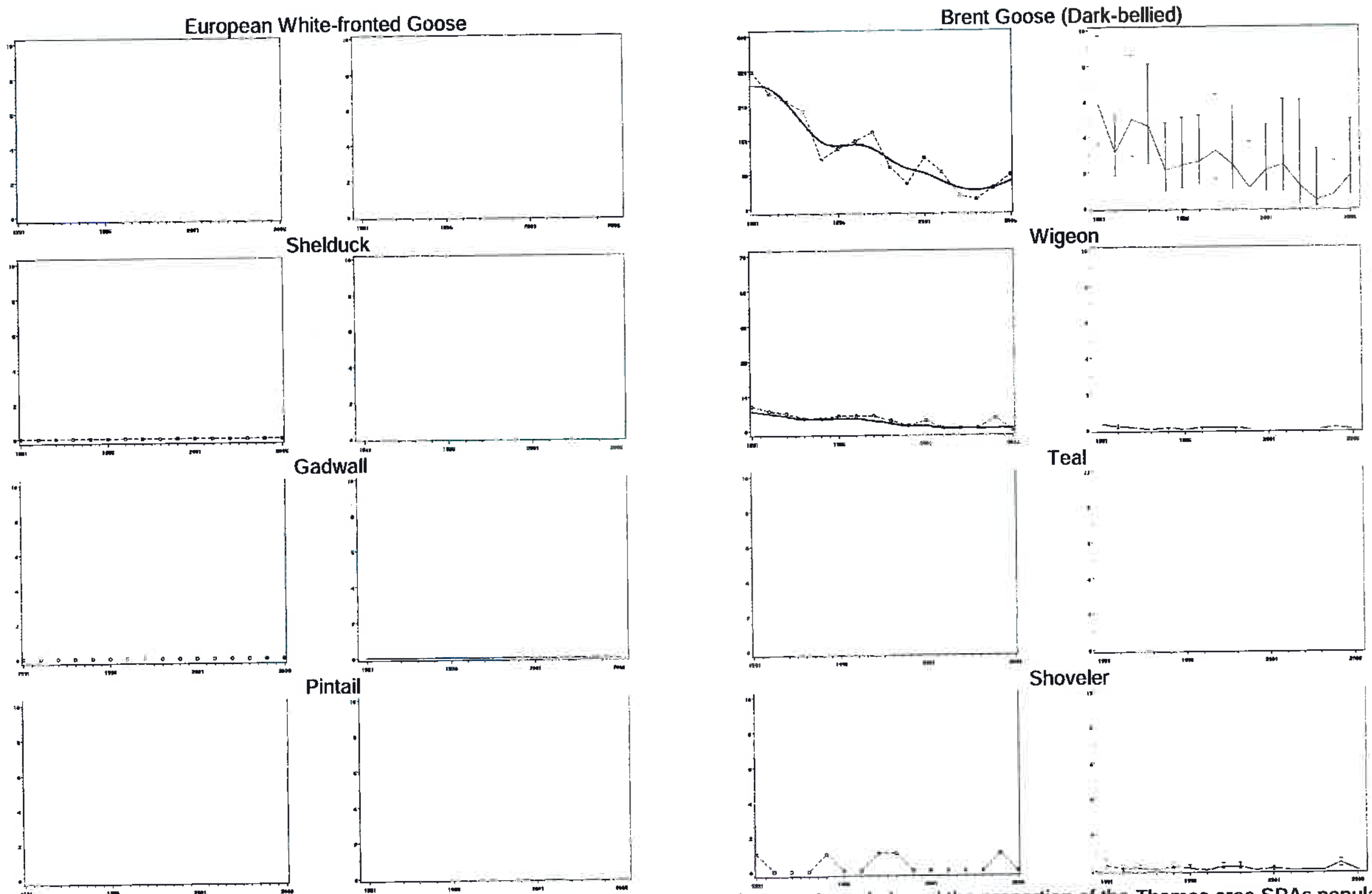
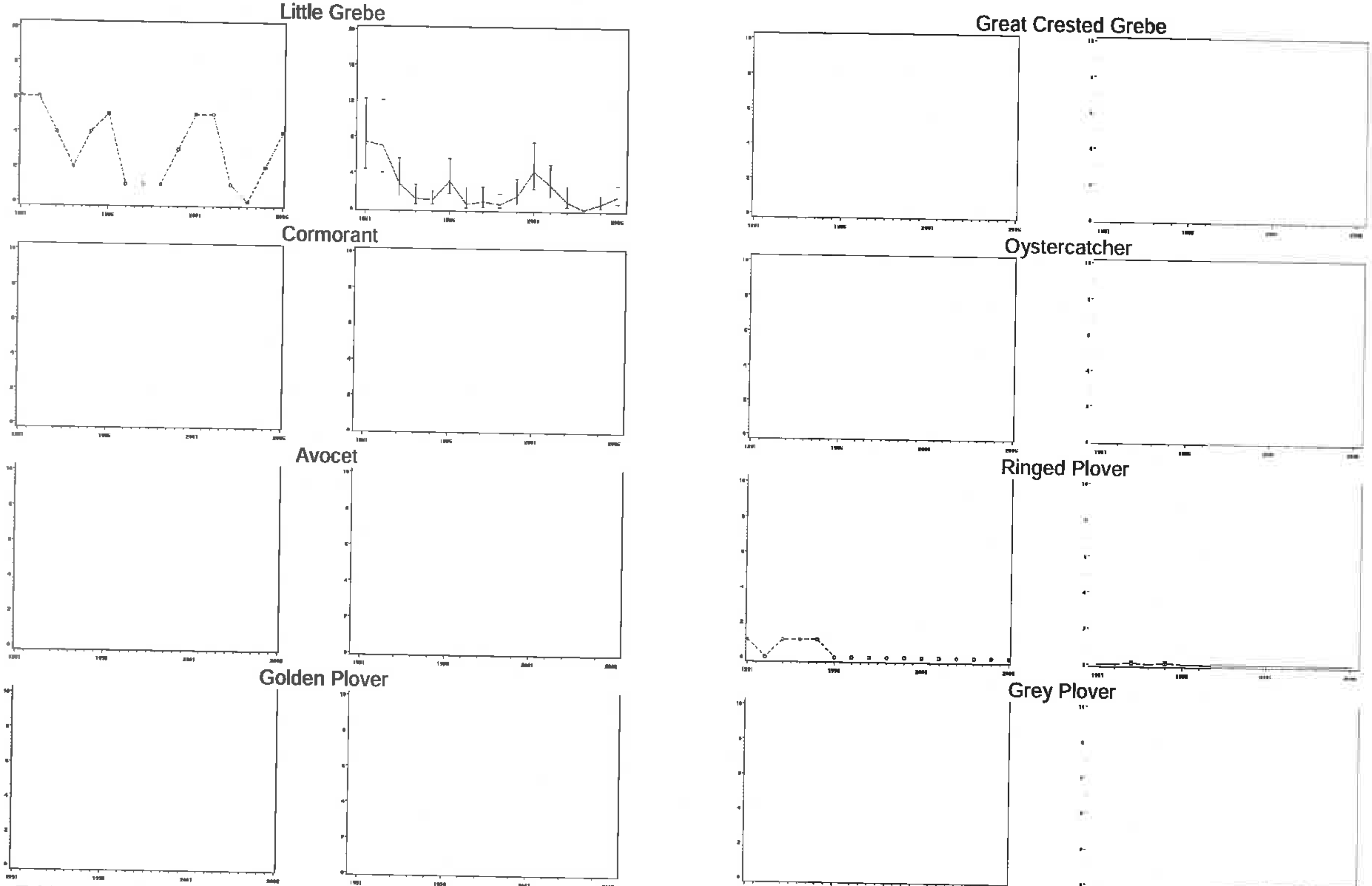


Figure E.22093 Population trends of each species in sector 22093 (South Level) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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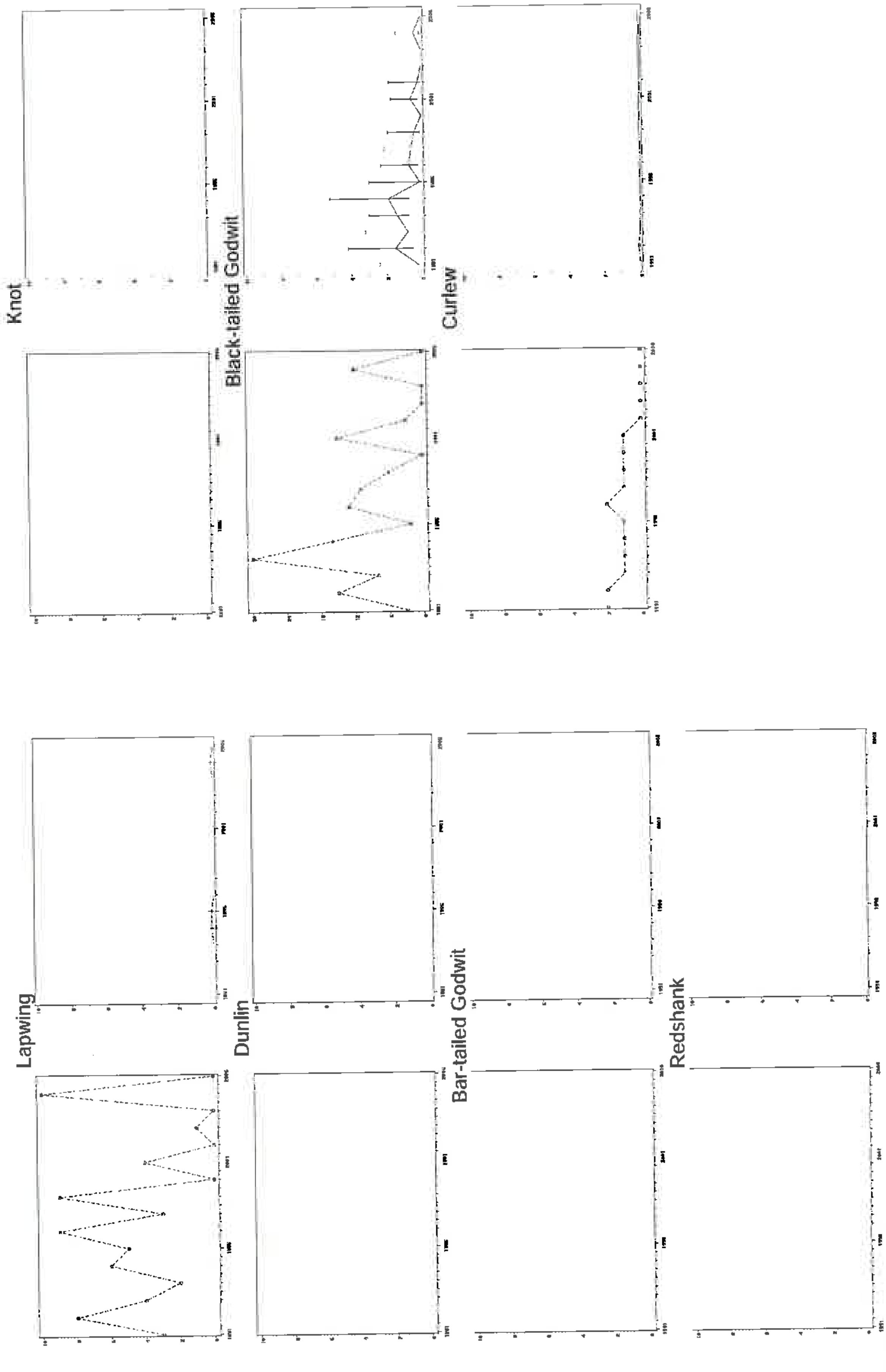

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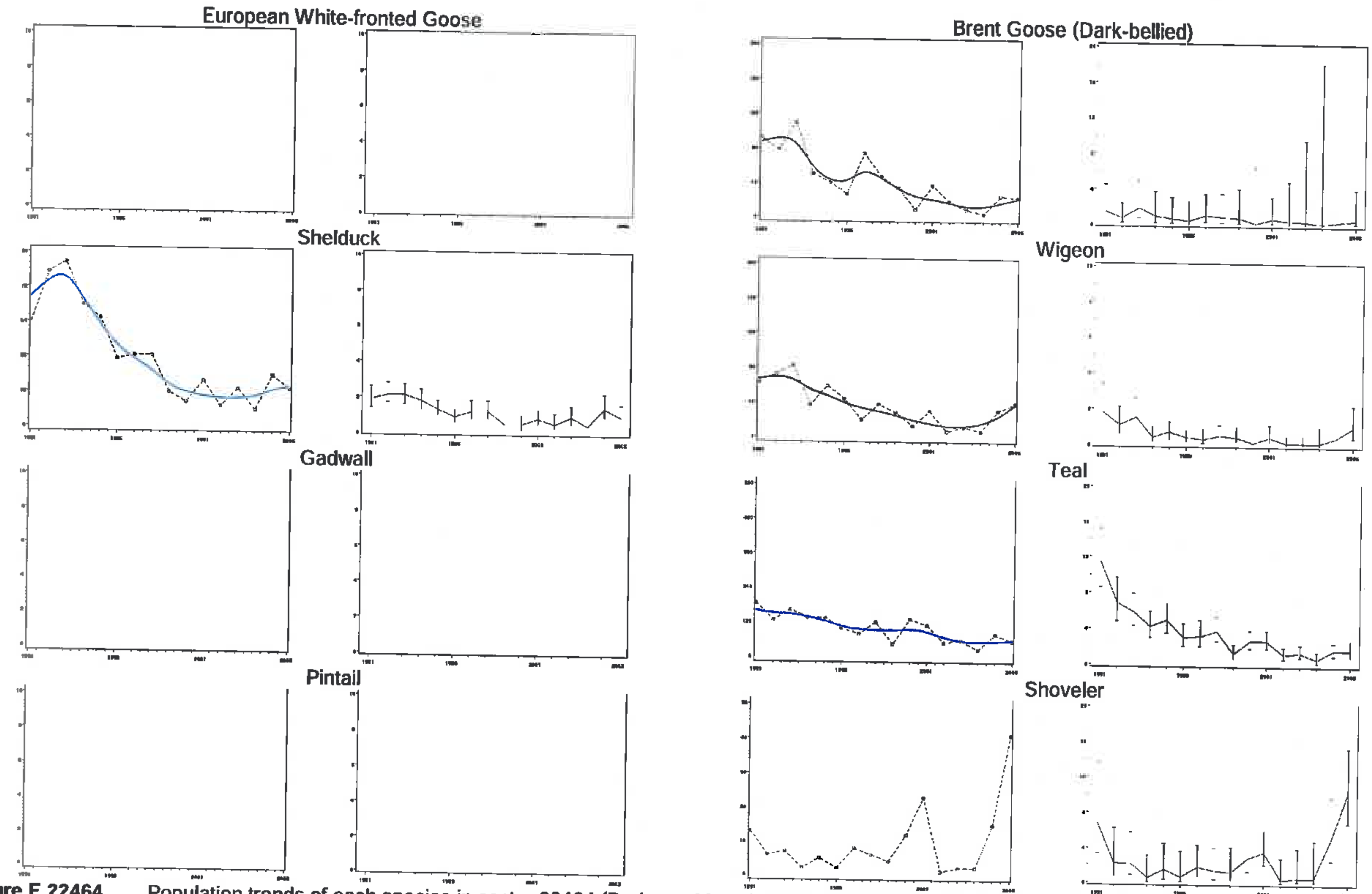
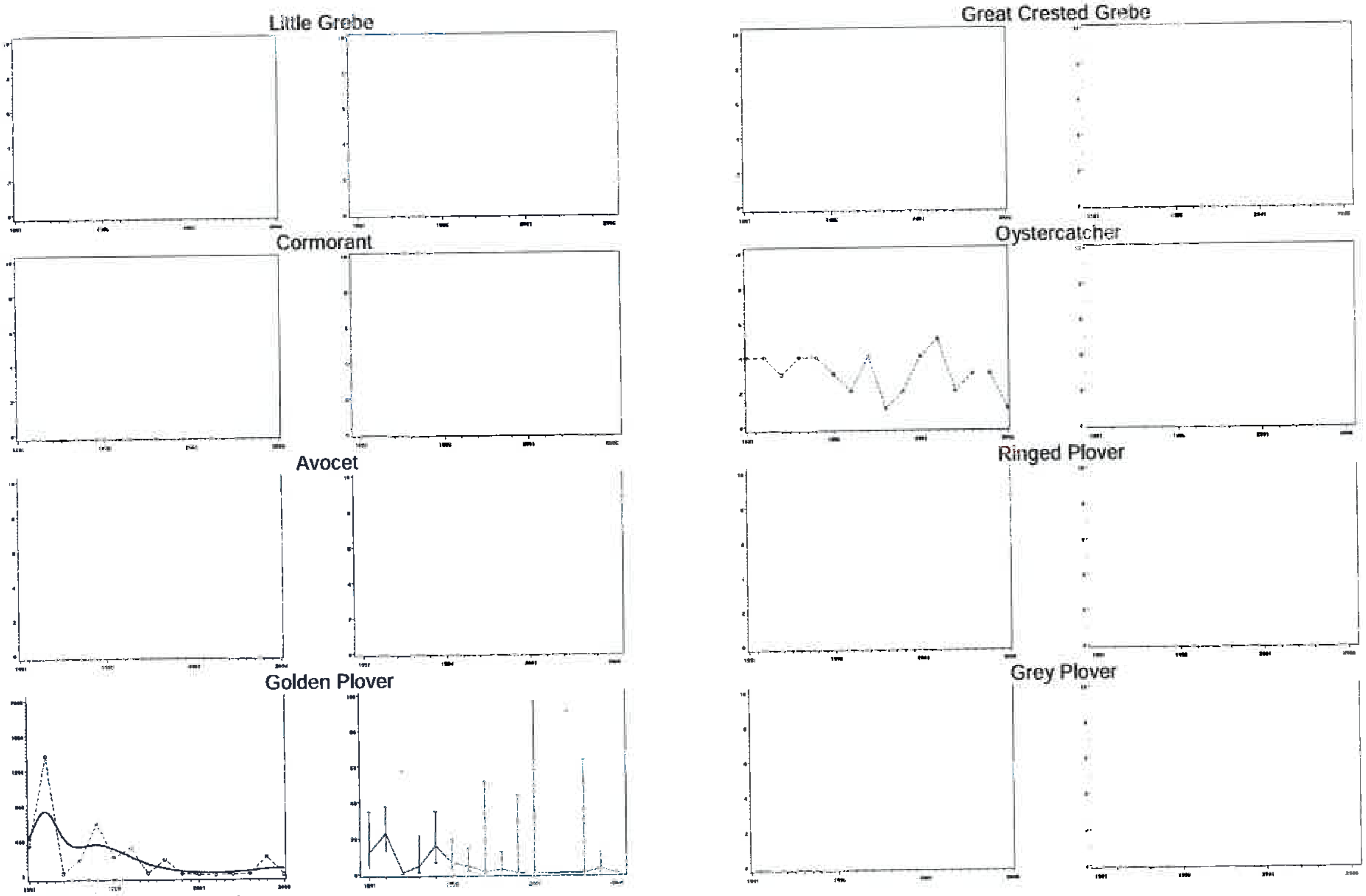


Figure E.22464 Population trends of each species in sector 22464 (Barksore Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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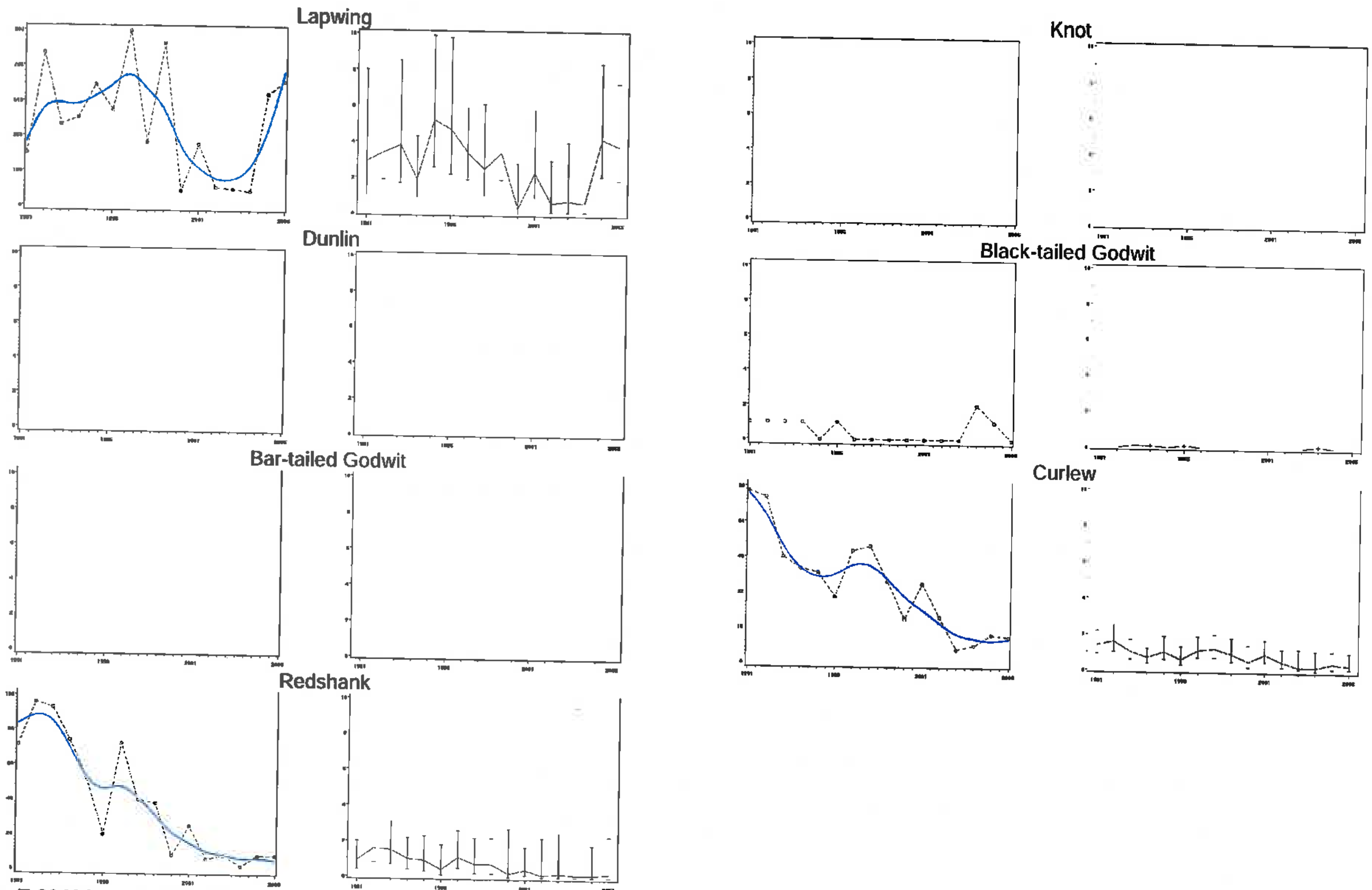

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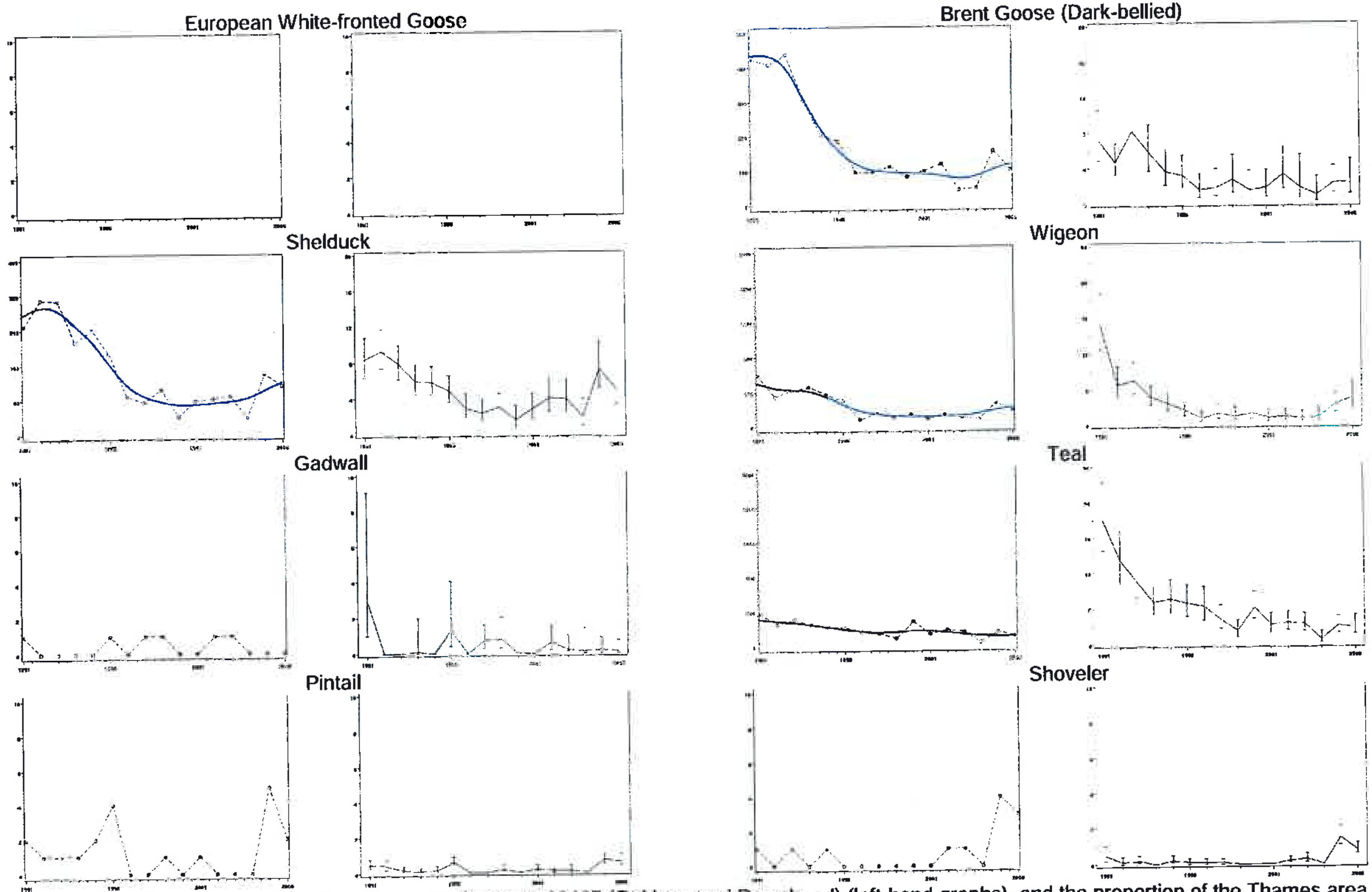
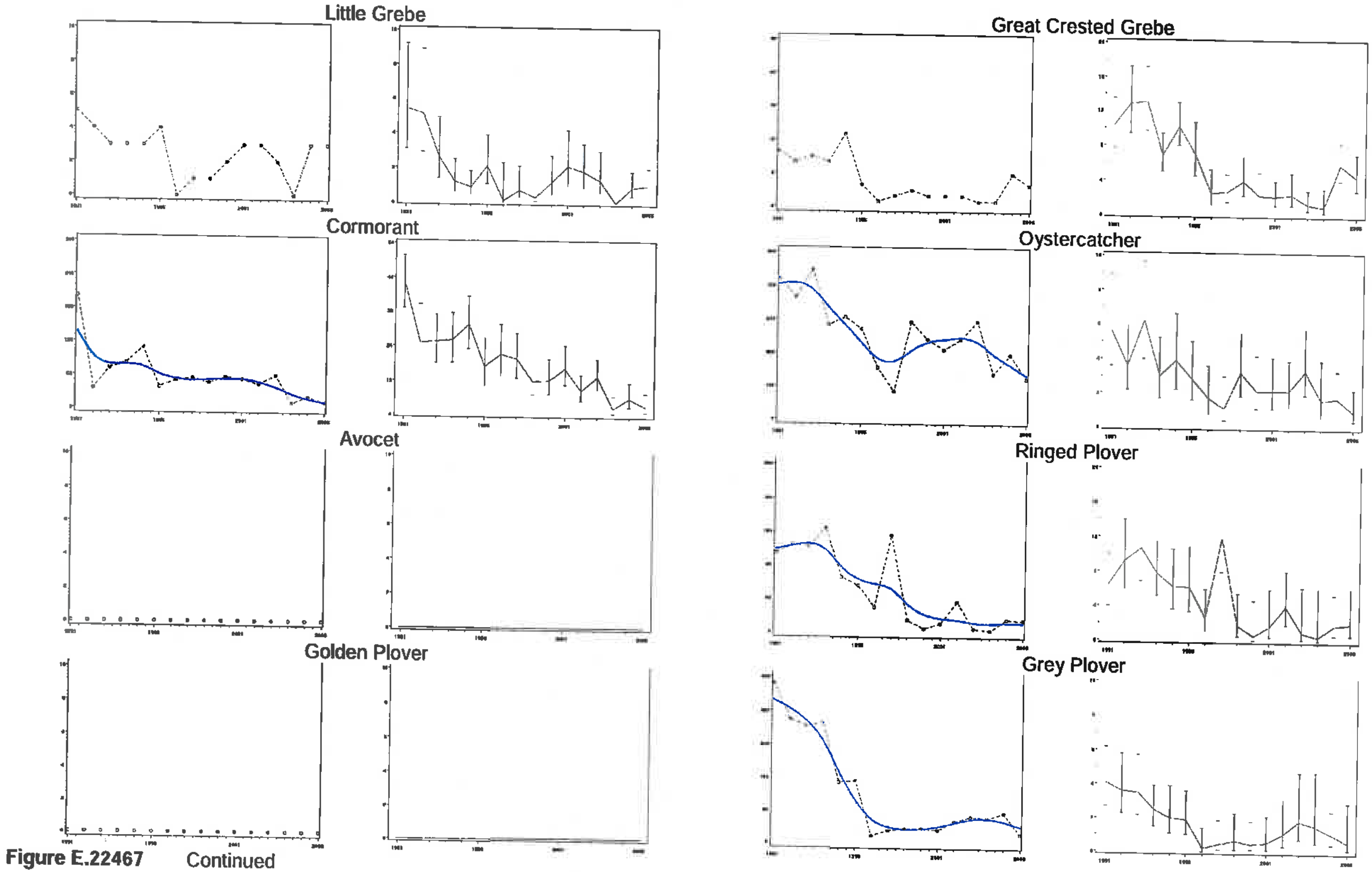


Figure E.22467 Population trends of each species in sector 22467 (Oakham and Downhead) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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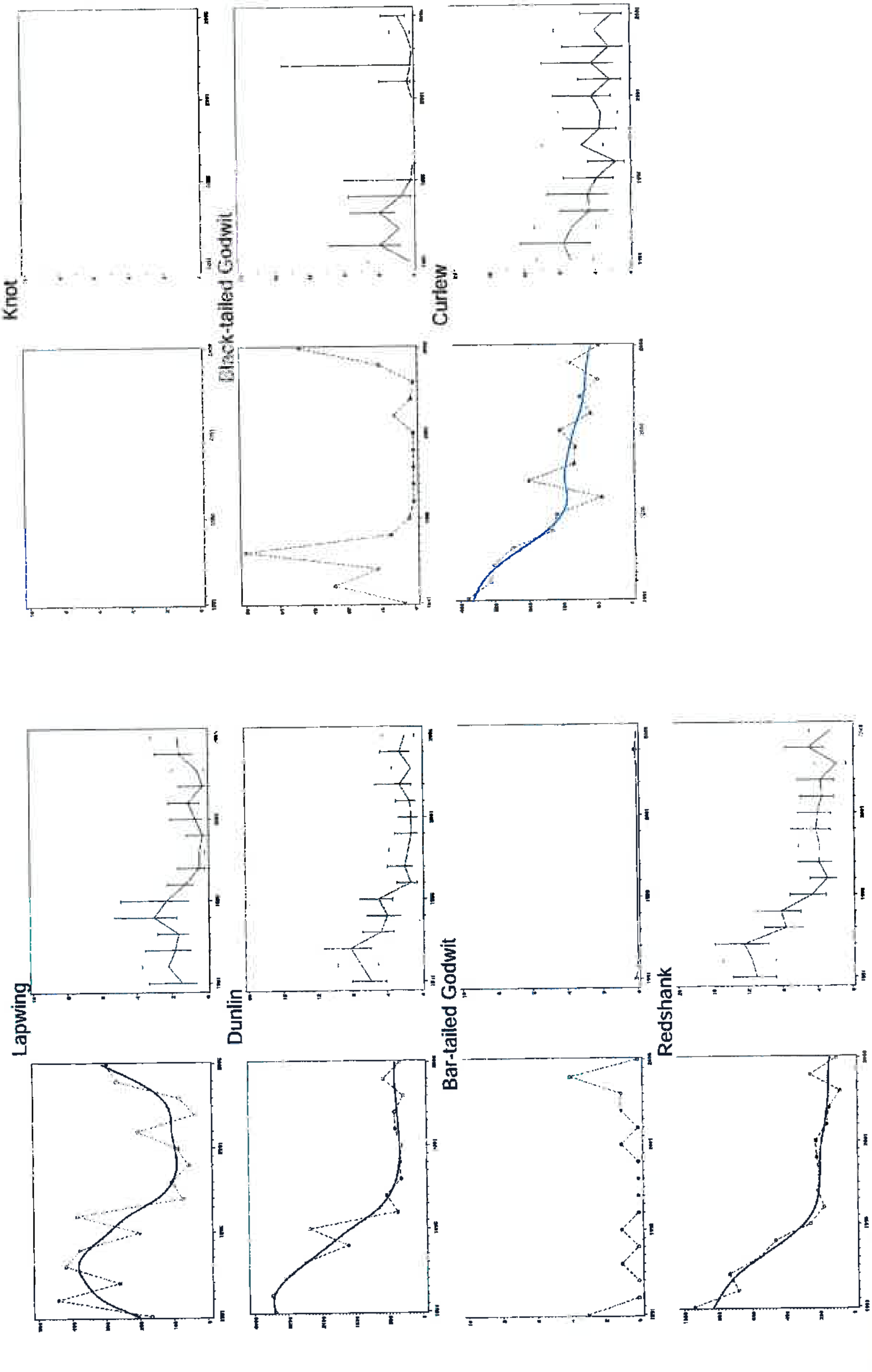

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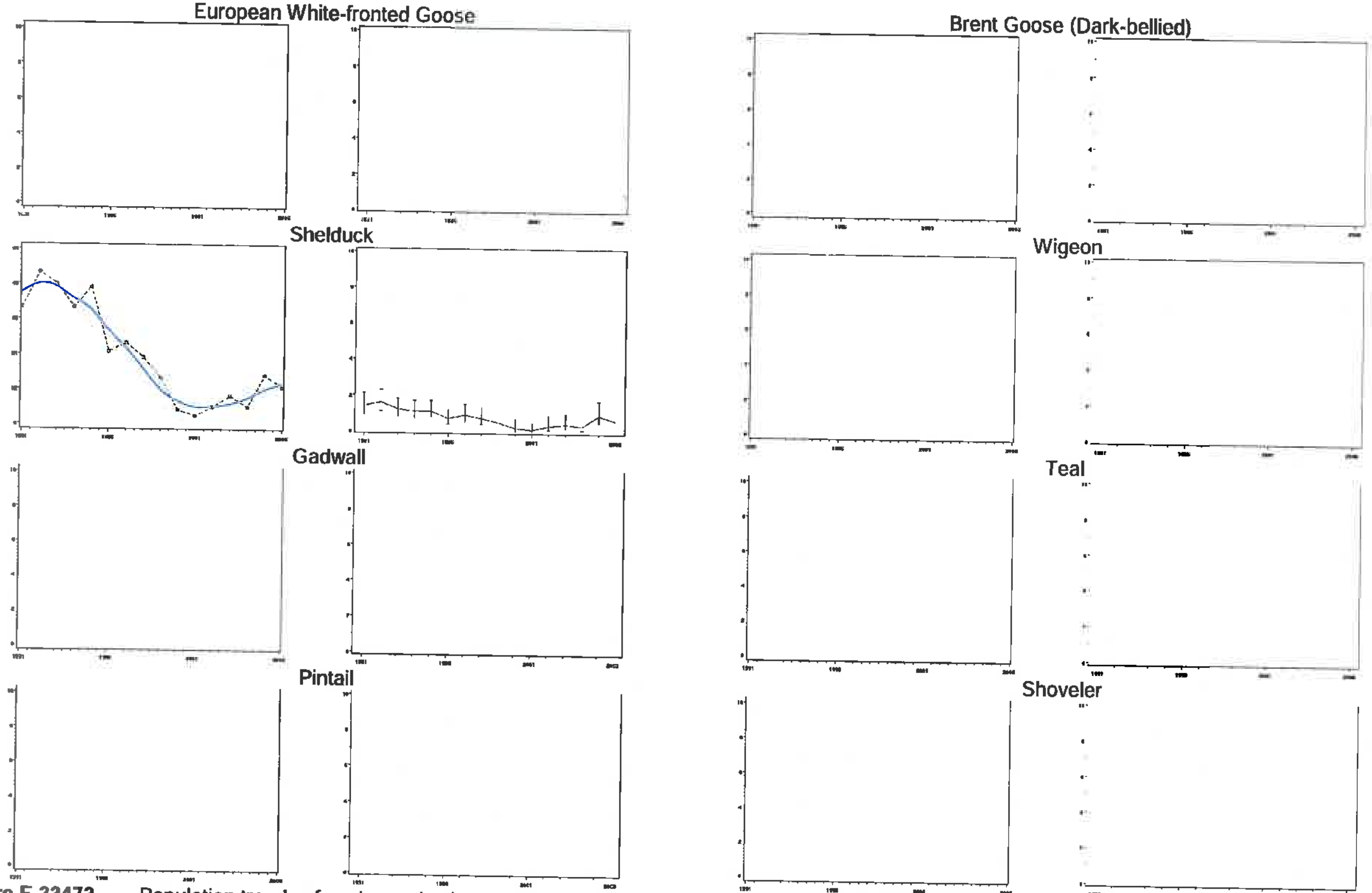
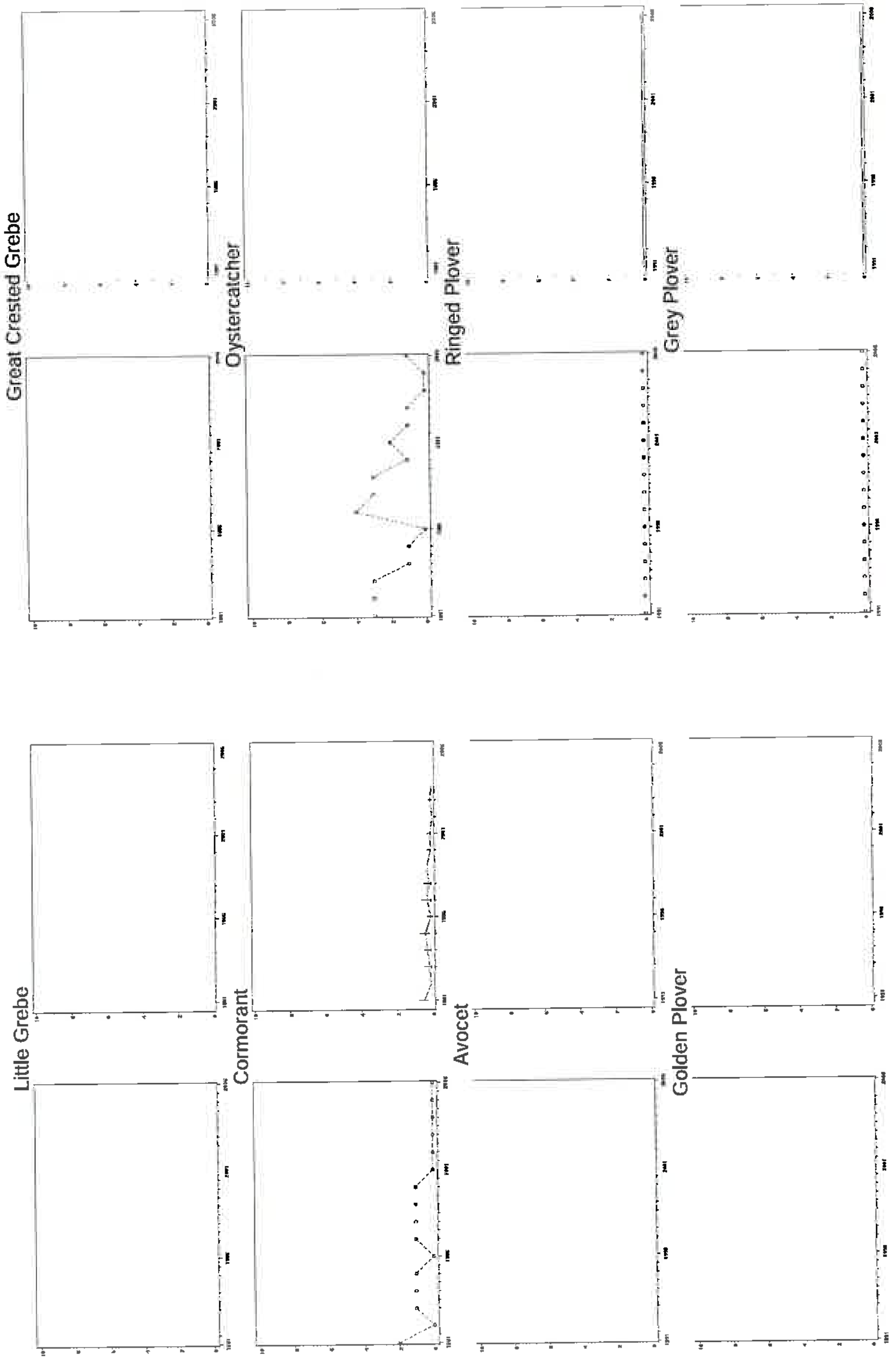


Figure E.22472 Population trends of each species in sector 22472 (South Grain Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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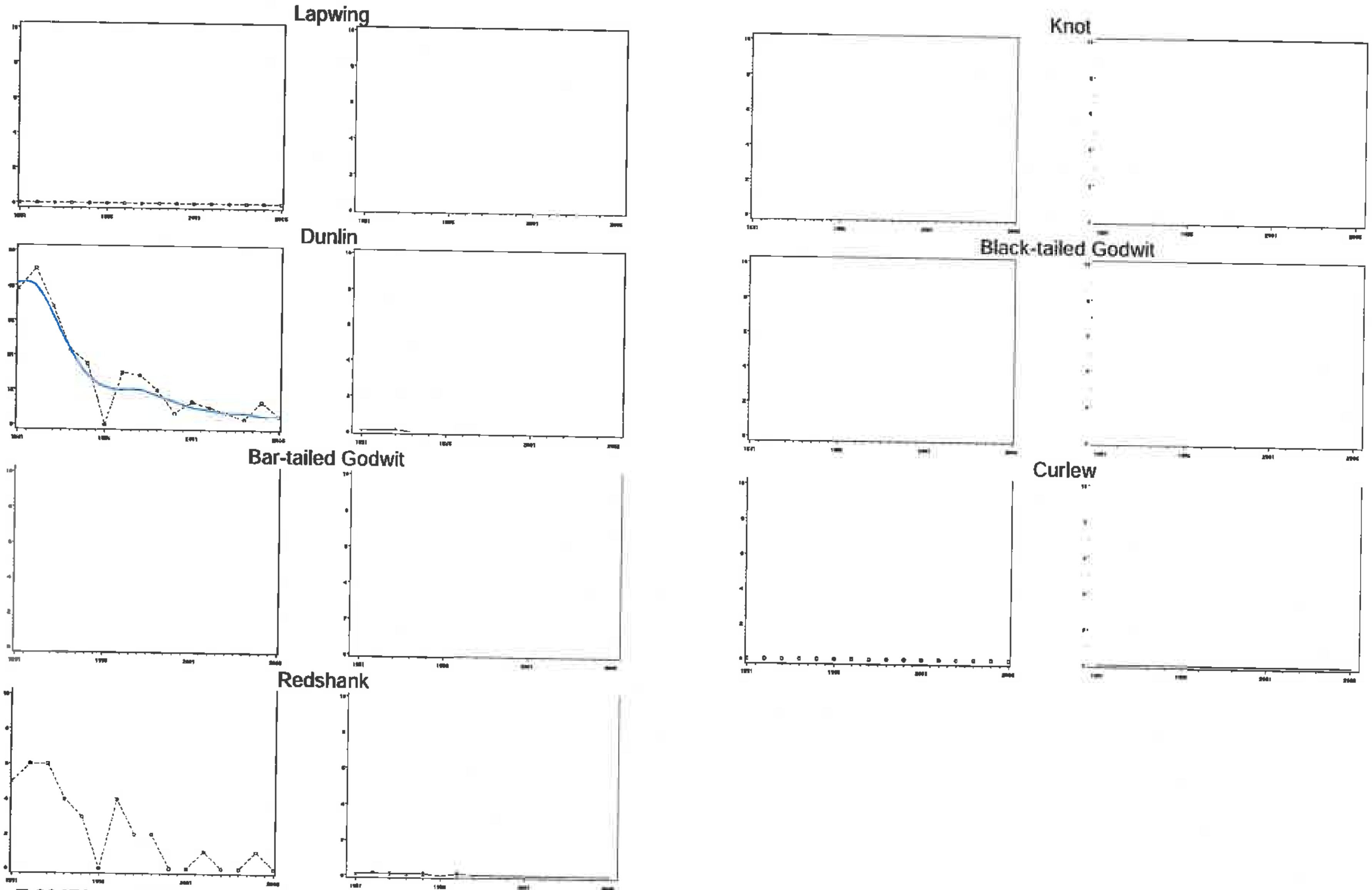

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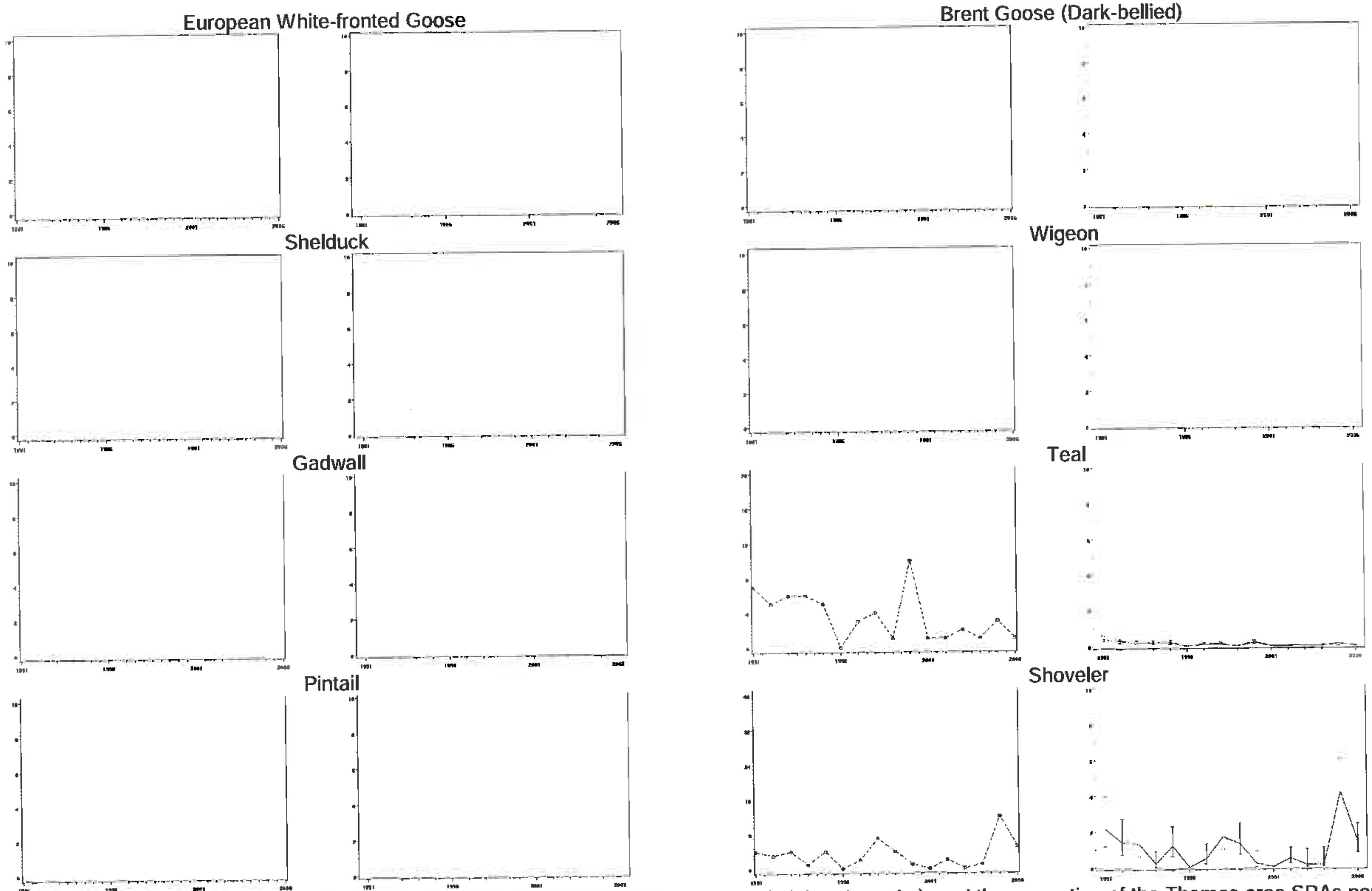
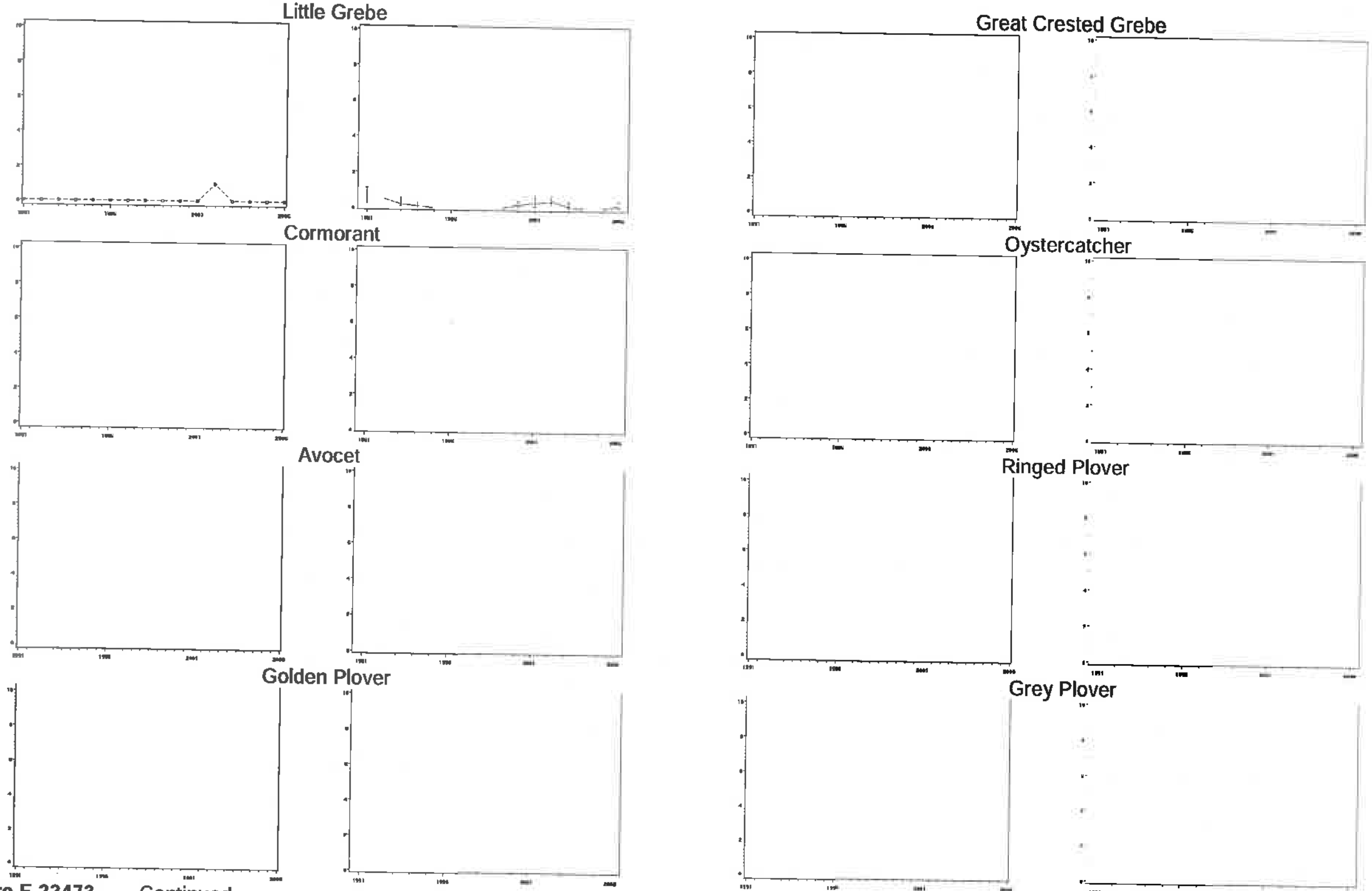


Figure E.22473 Population trends of each species in sector 22473 (Grain Industrial) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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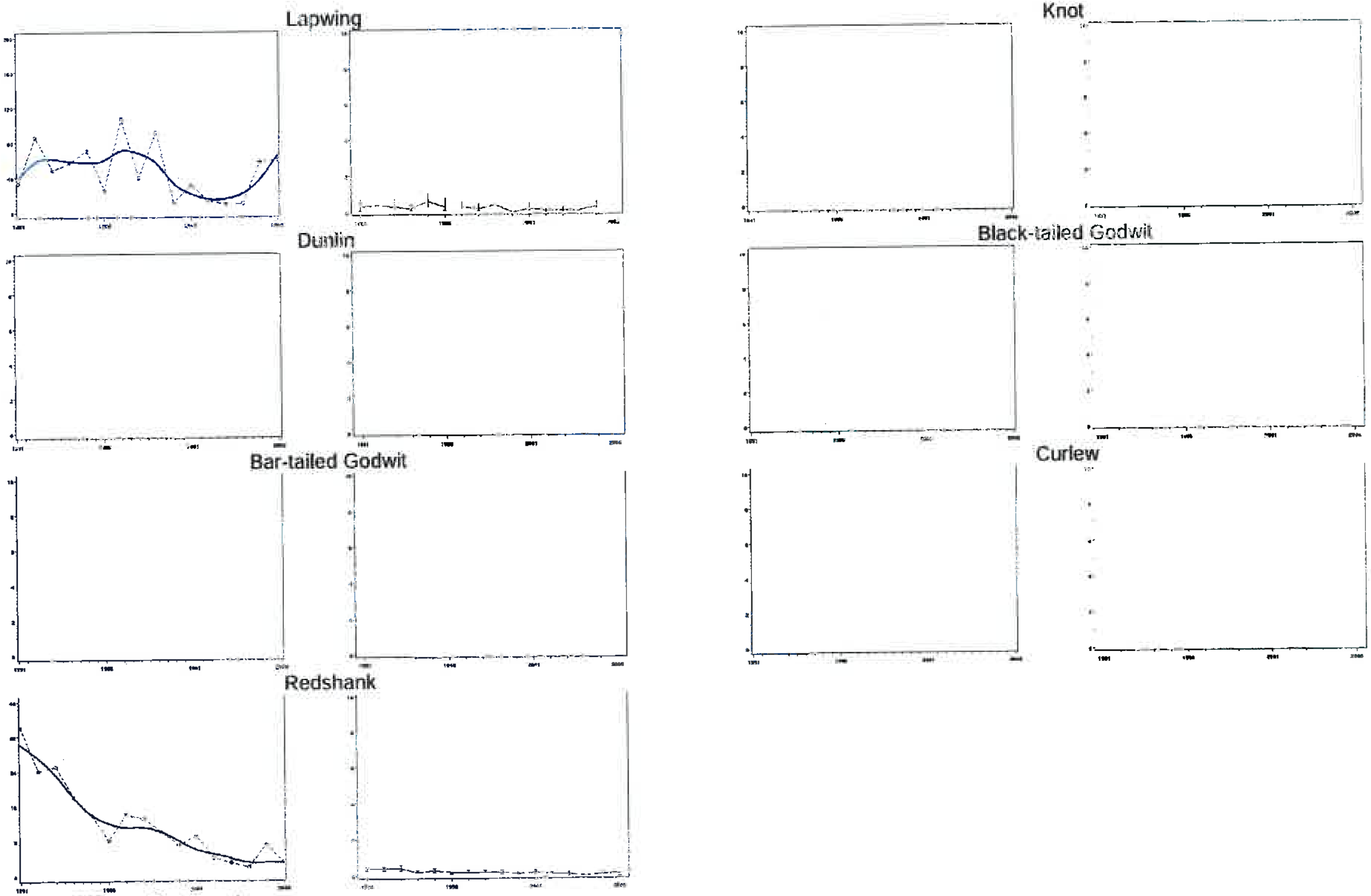

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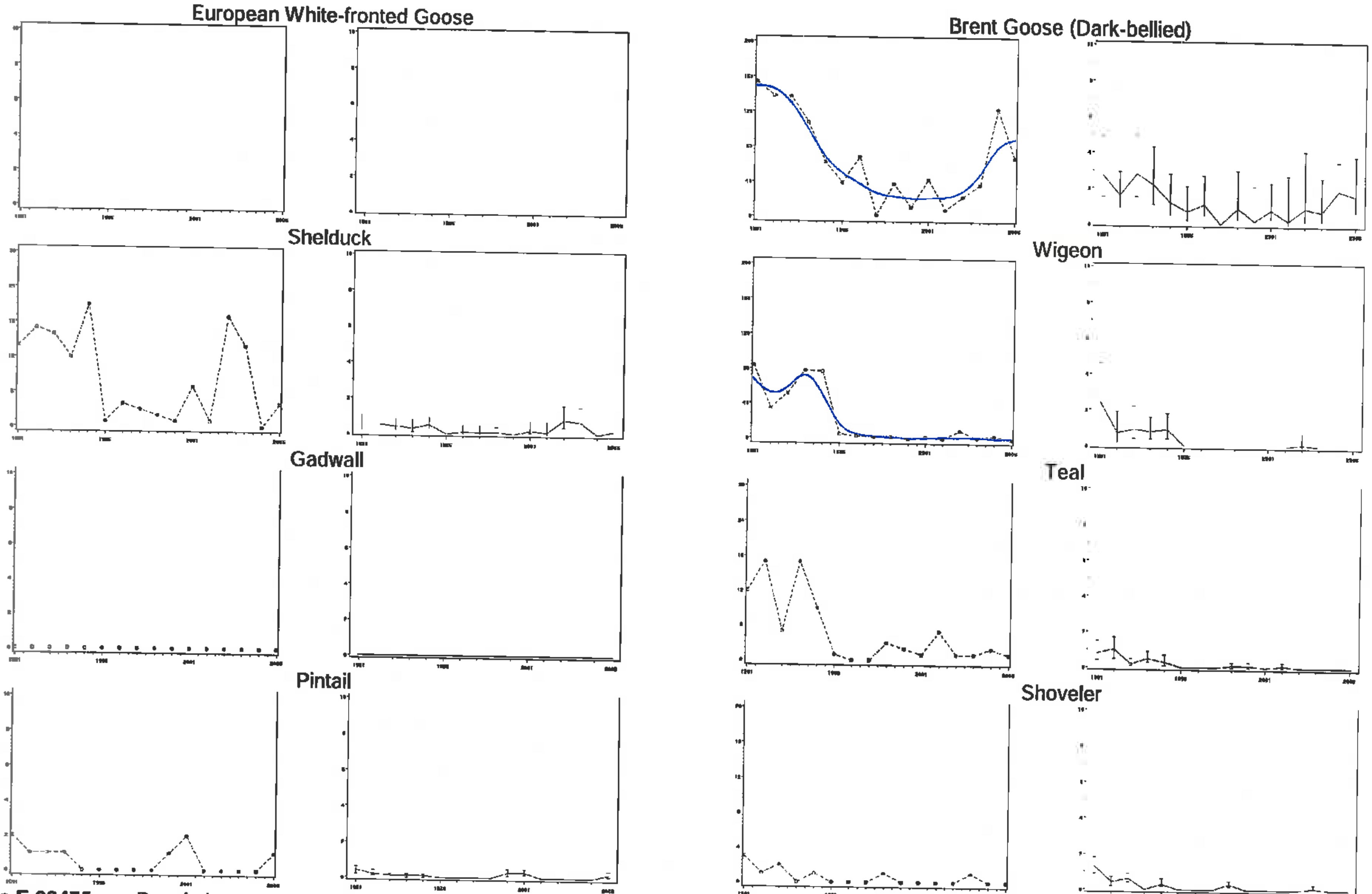
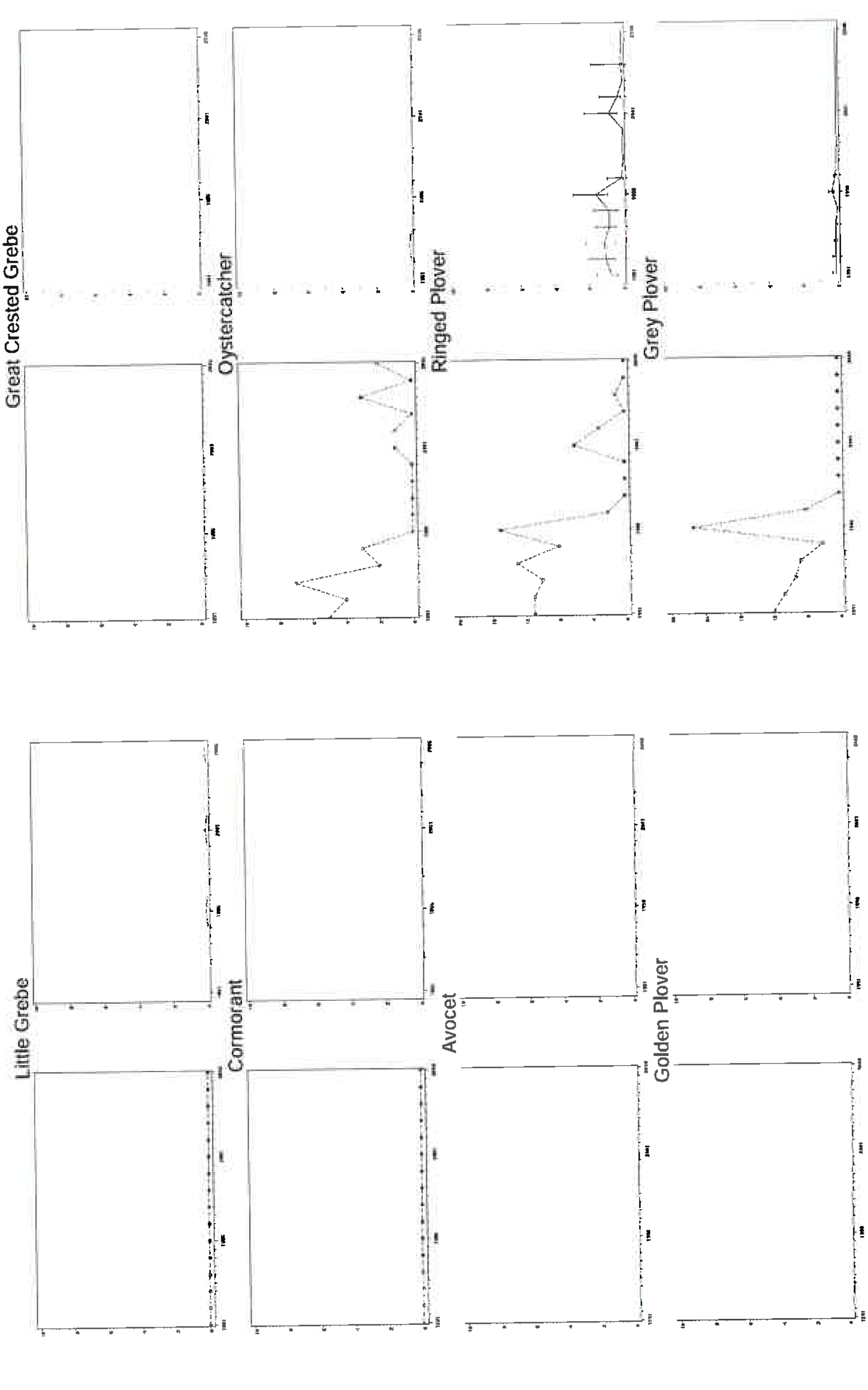


Figure E.22475 Population trends of each species in sector 22475 (Ham Green) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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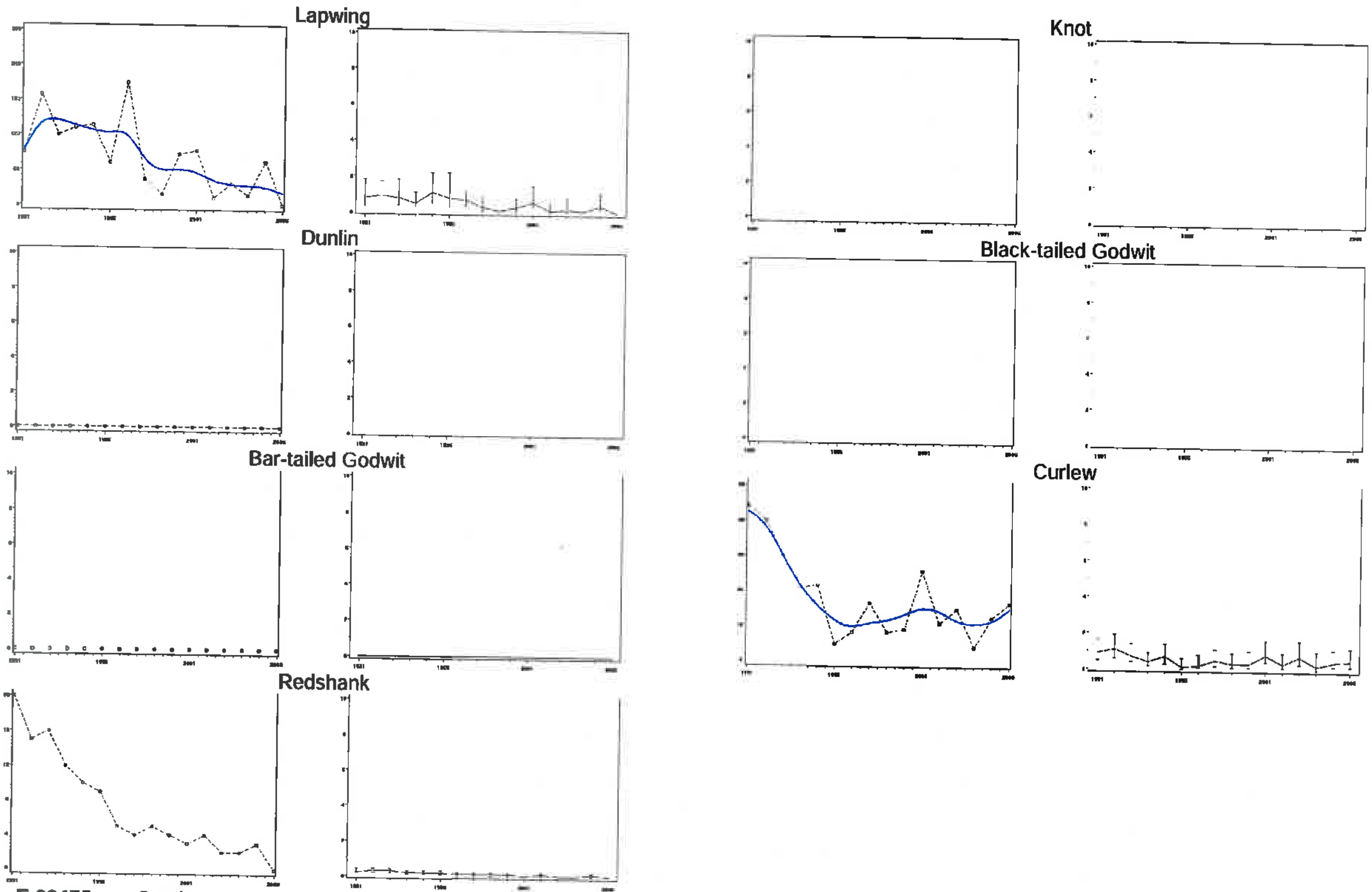

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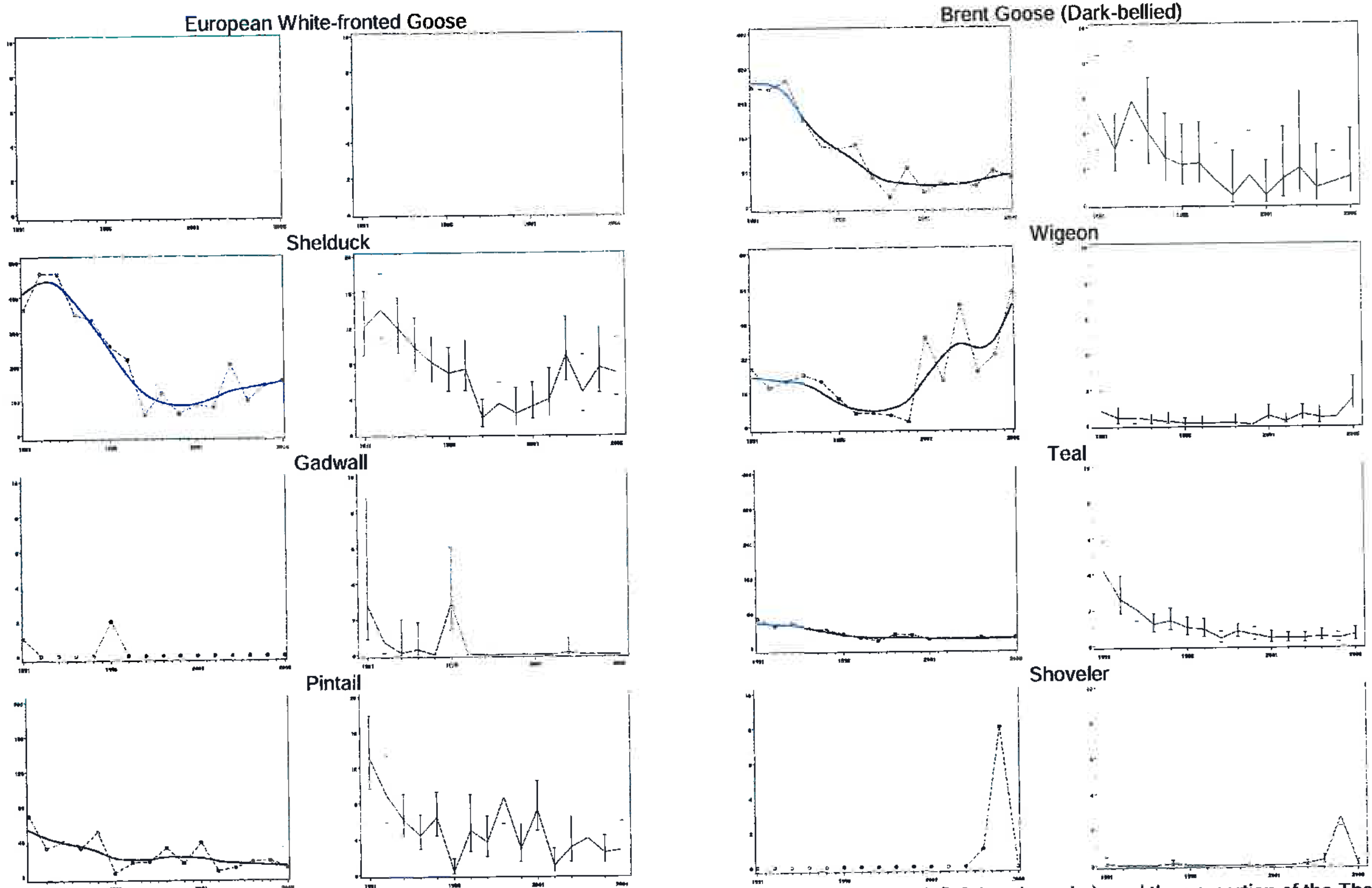
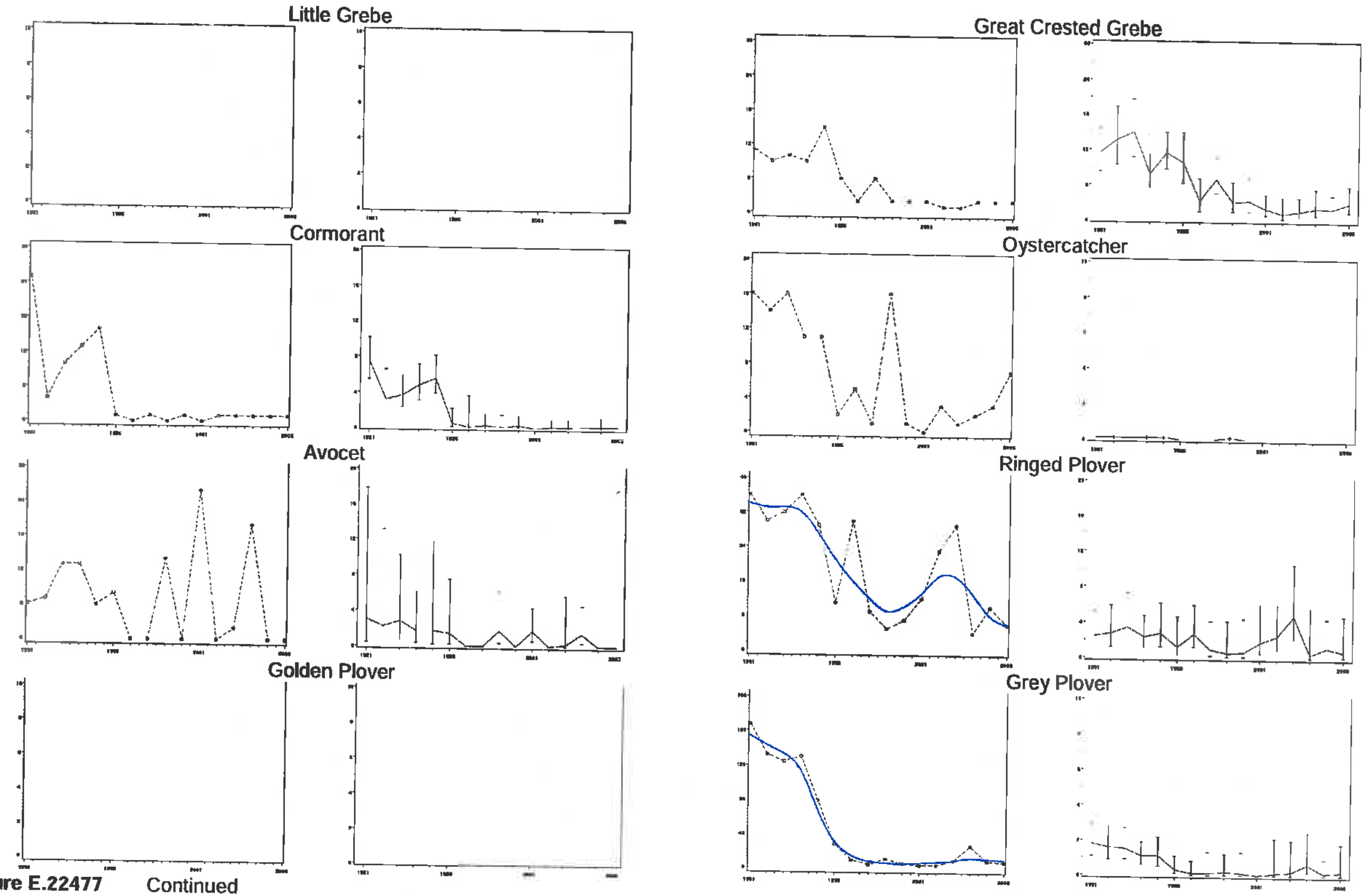


Figure E.22477 Population trends of each species in sector 22477 (Ham Green and Twinney Offshore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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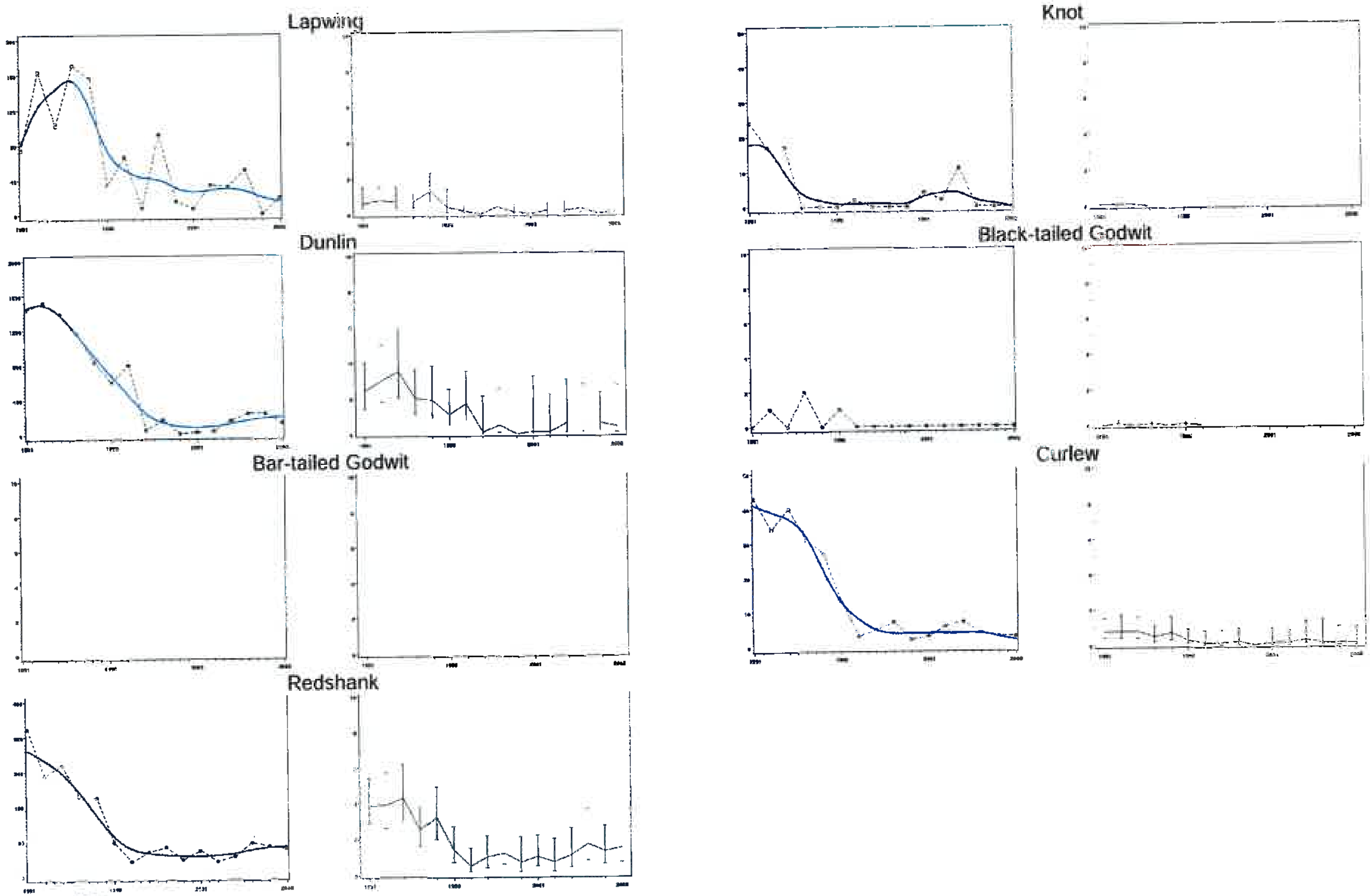

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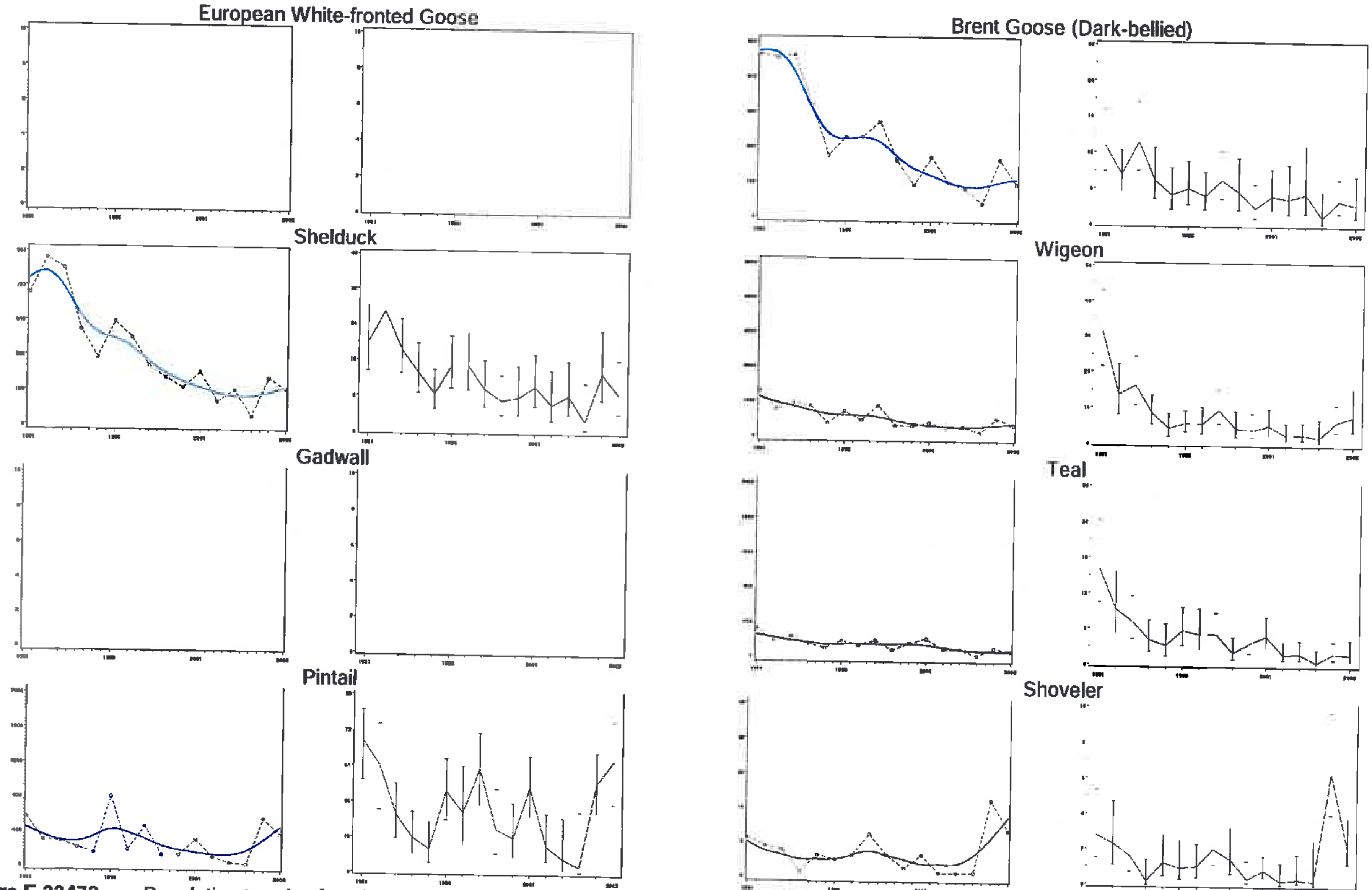
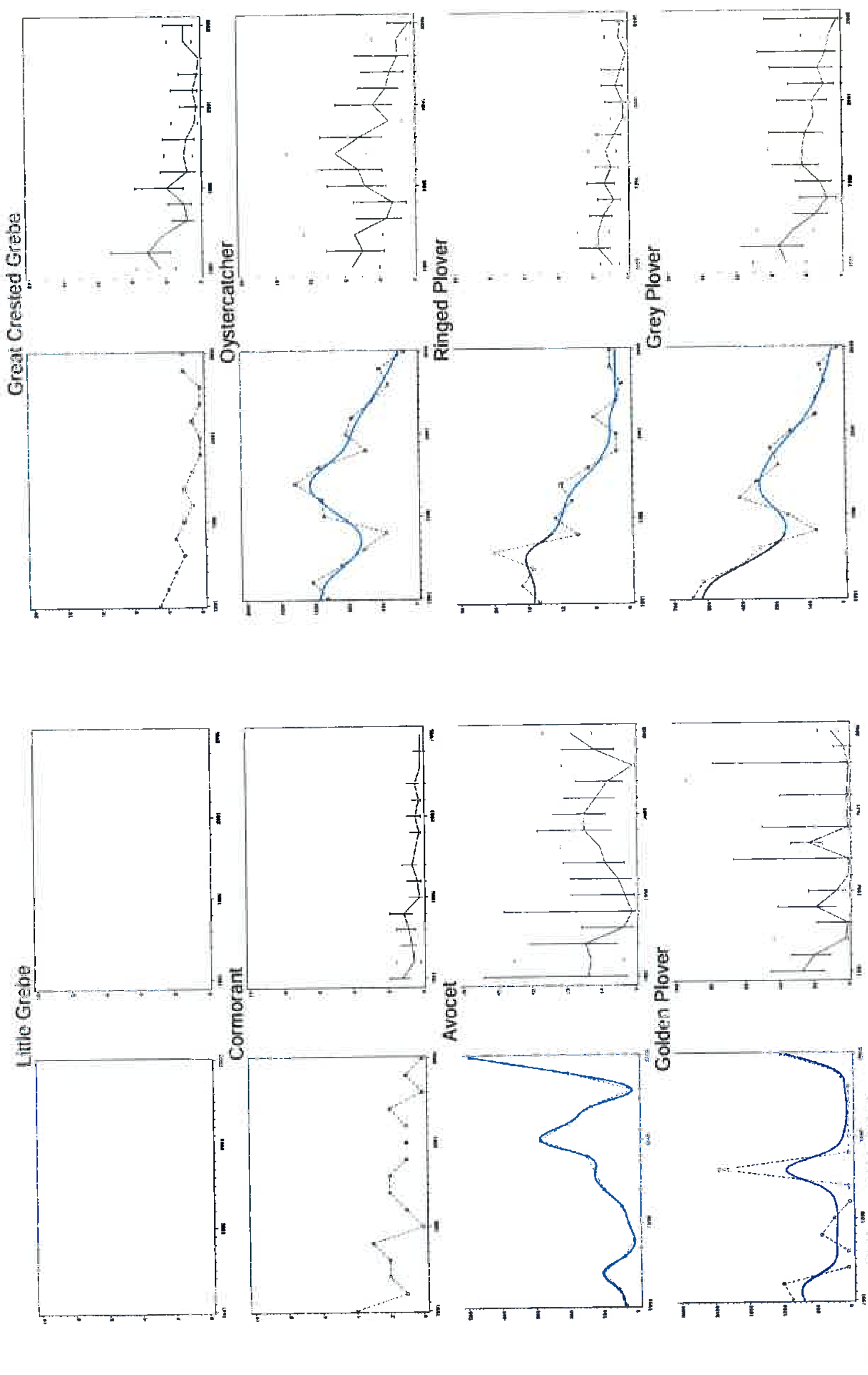


Figure E.22478 Population trends of each species in sector 22478 (Burntwick Island) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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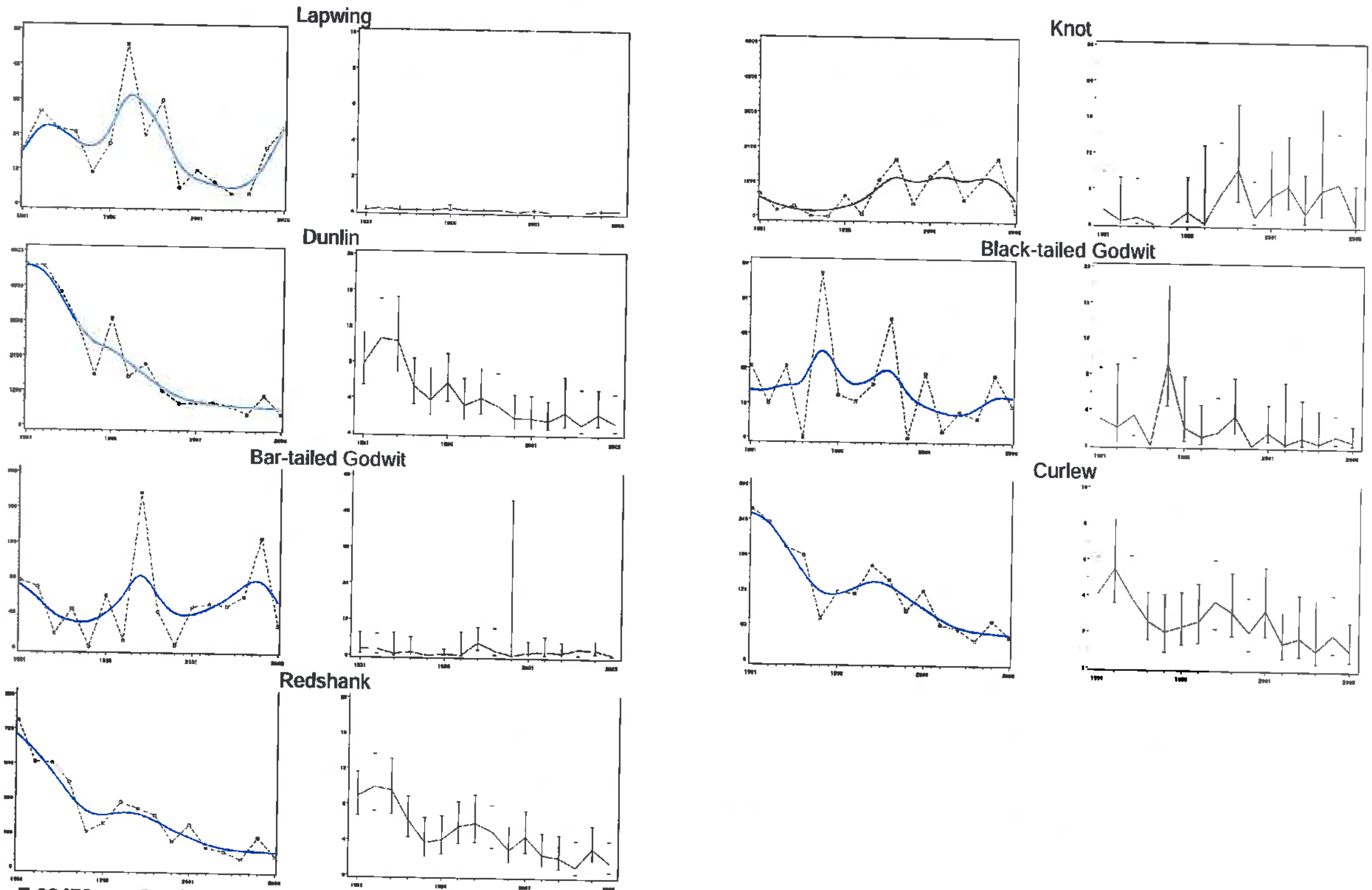

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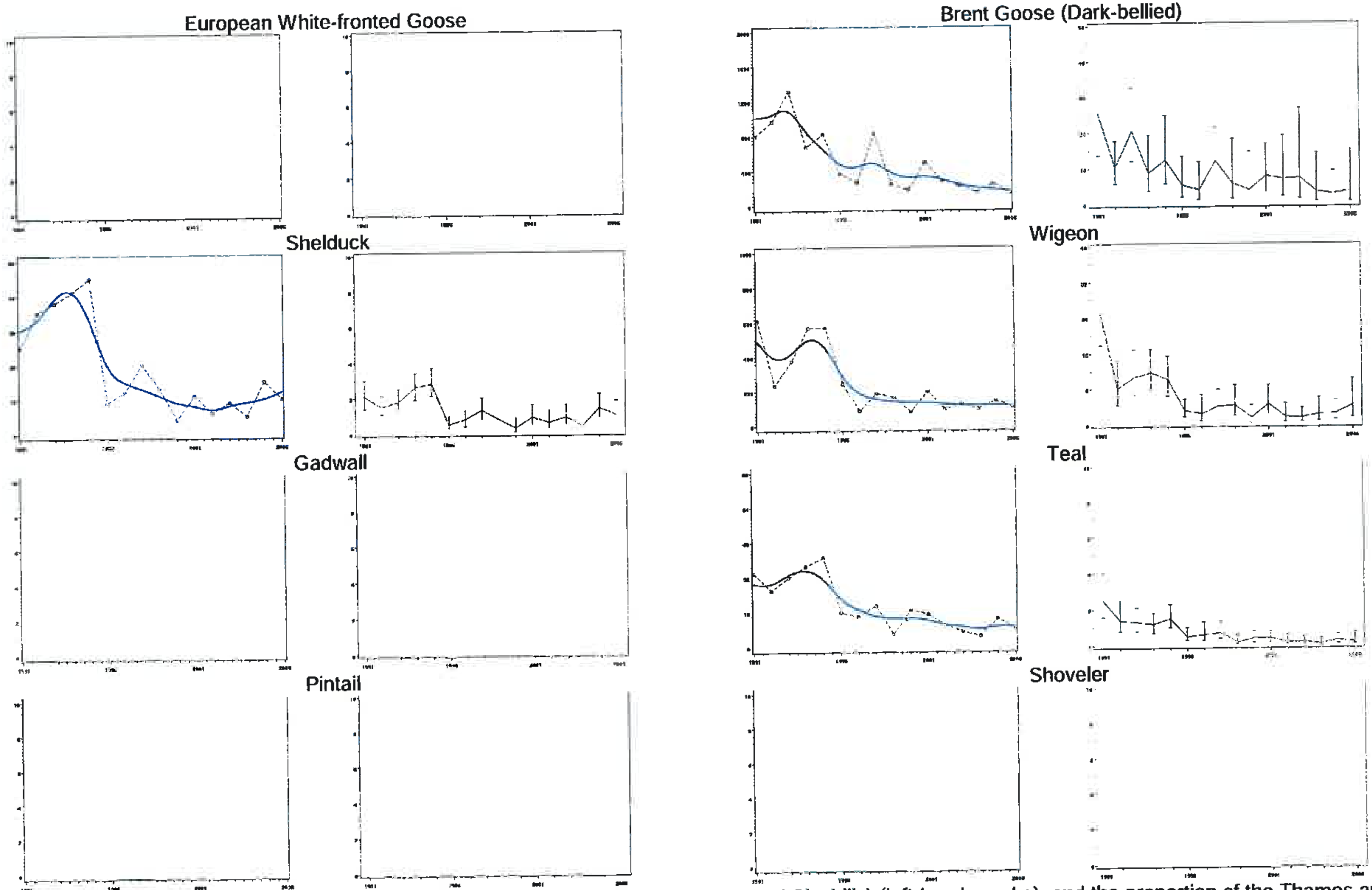
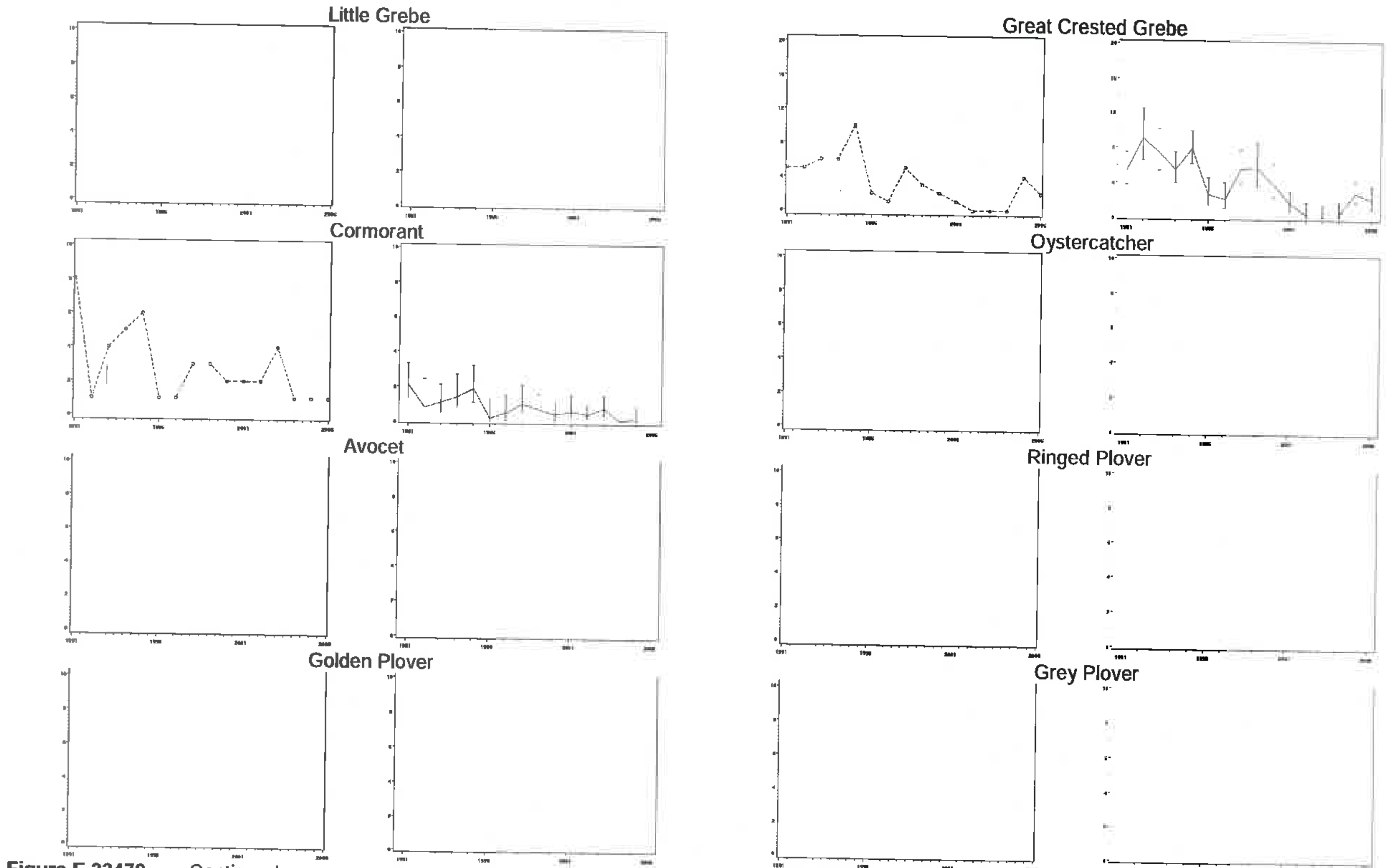


Figure E.22479 Population trends of each species in sector 22479 (Greenborough and Slayhills) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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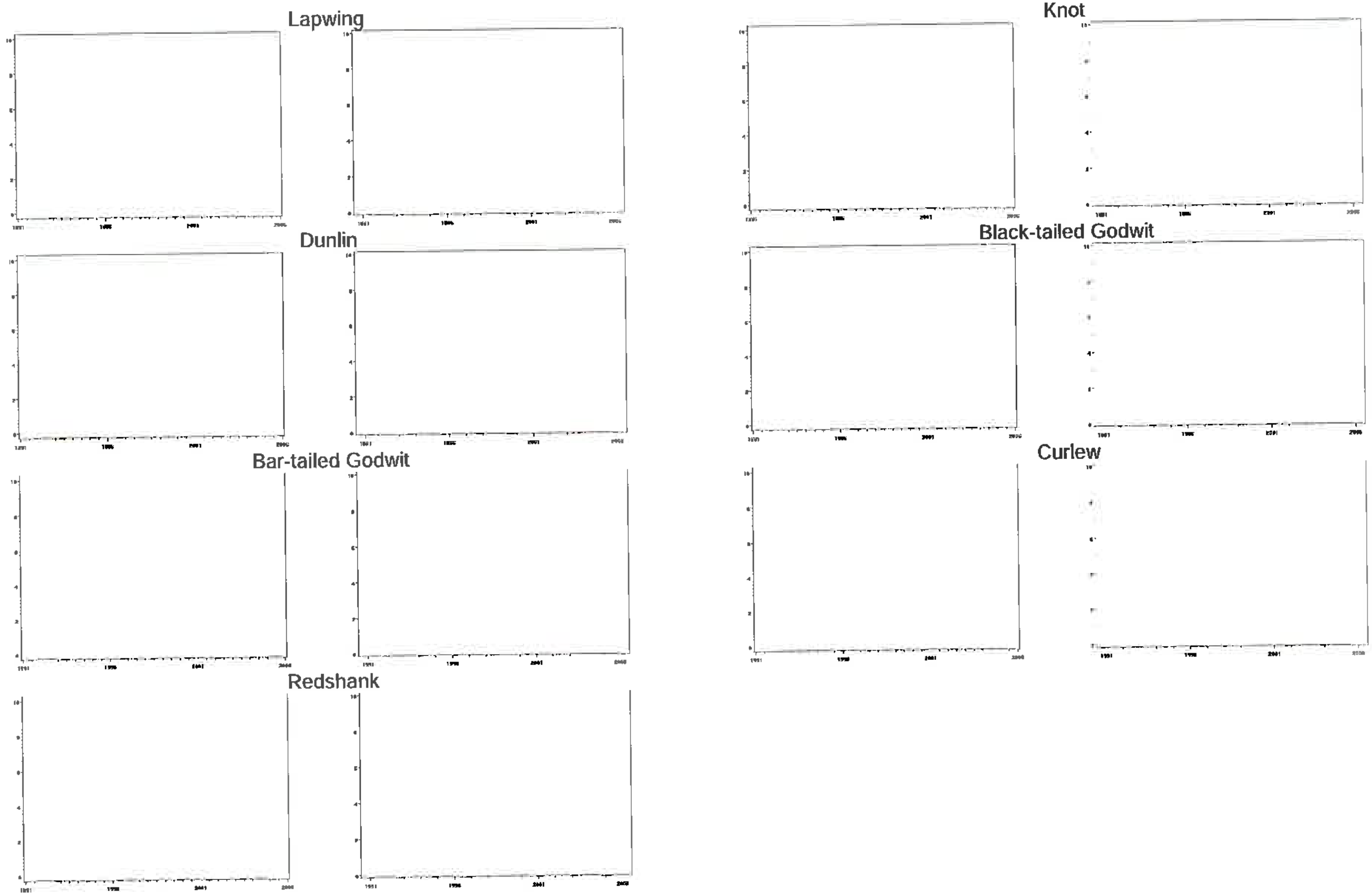

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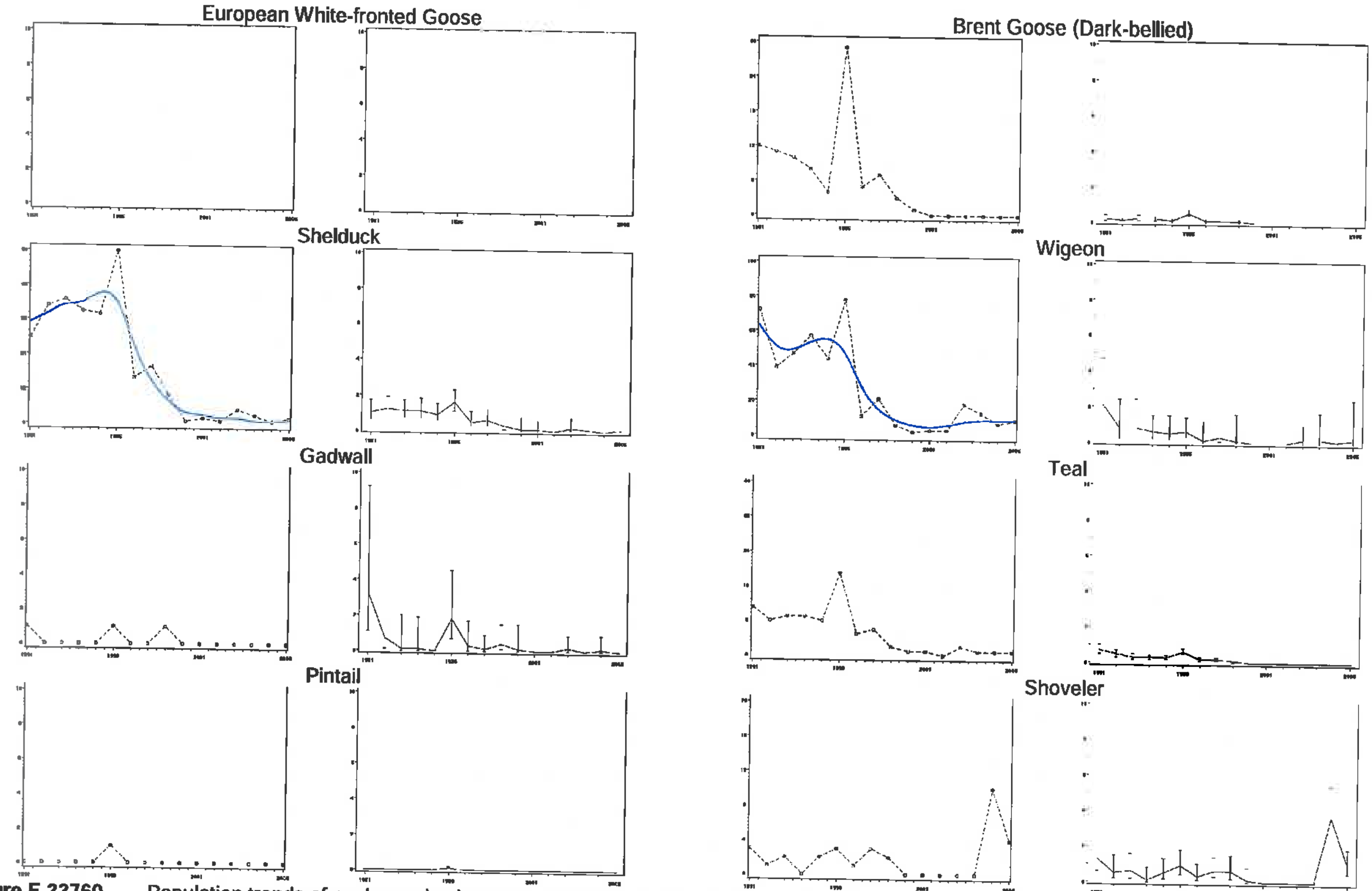
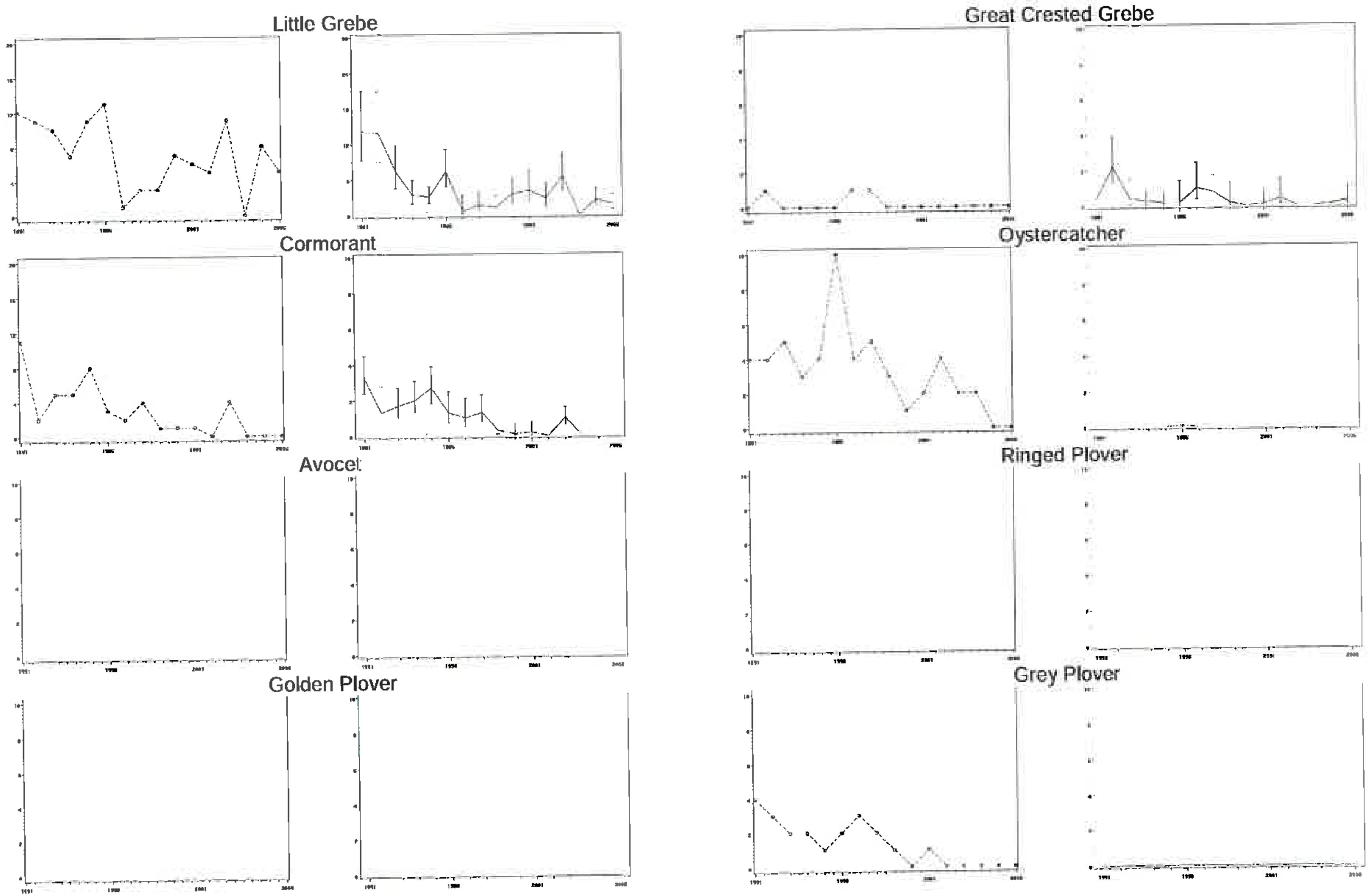


Figure E.22760 Population trends of each species in sector 22760 (Mosco Pool) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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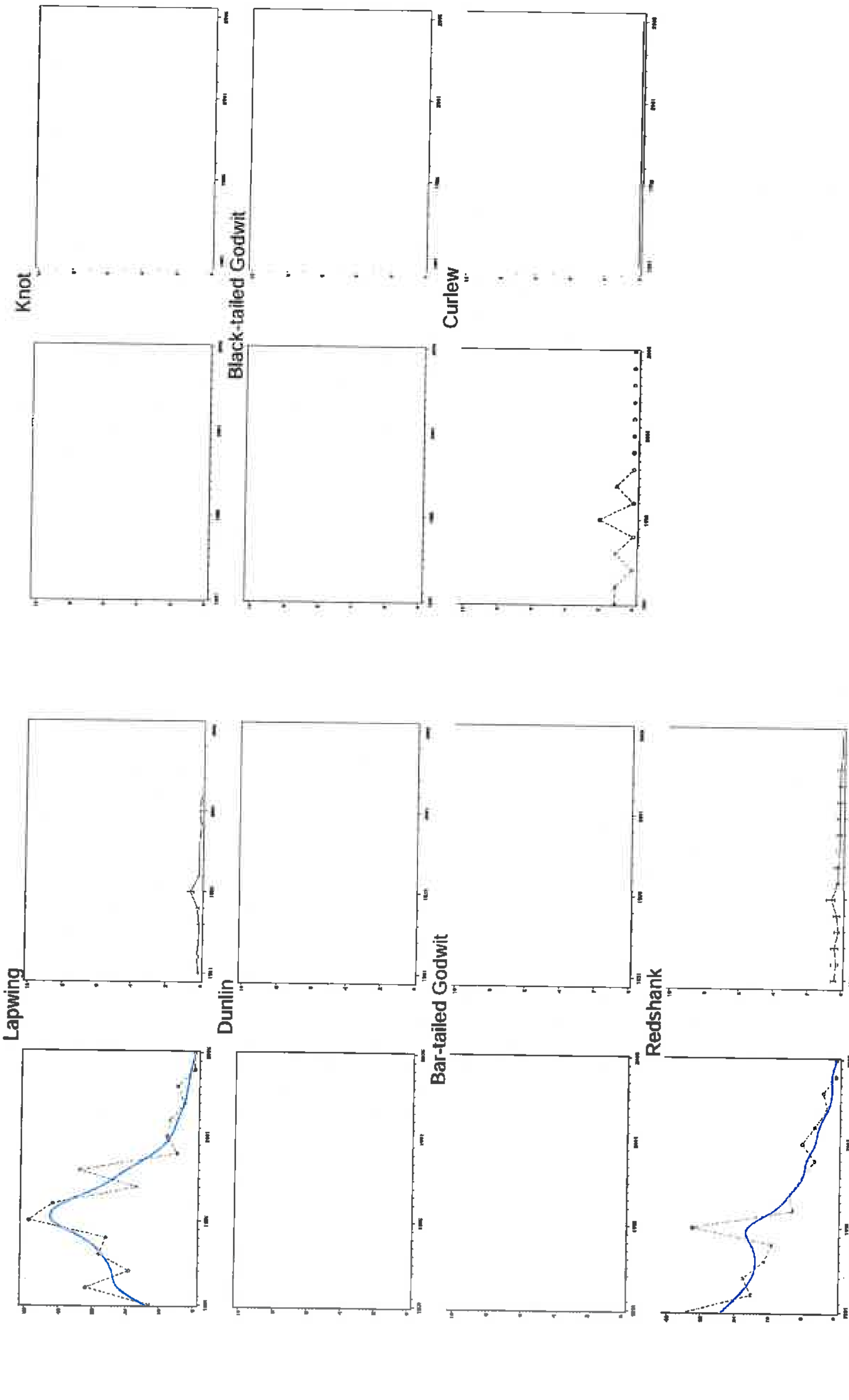

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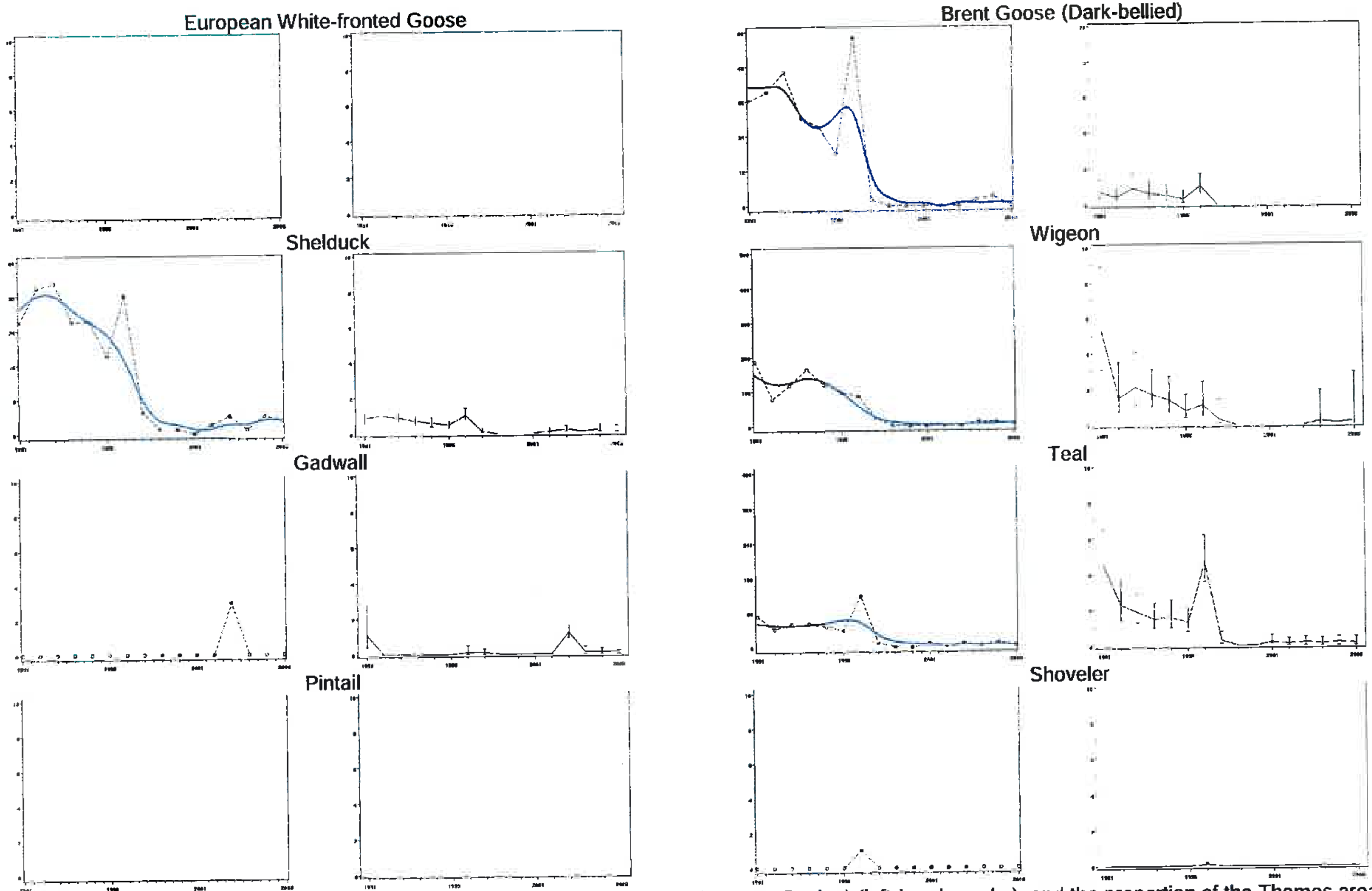
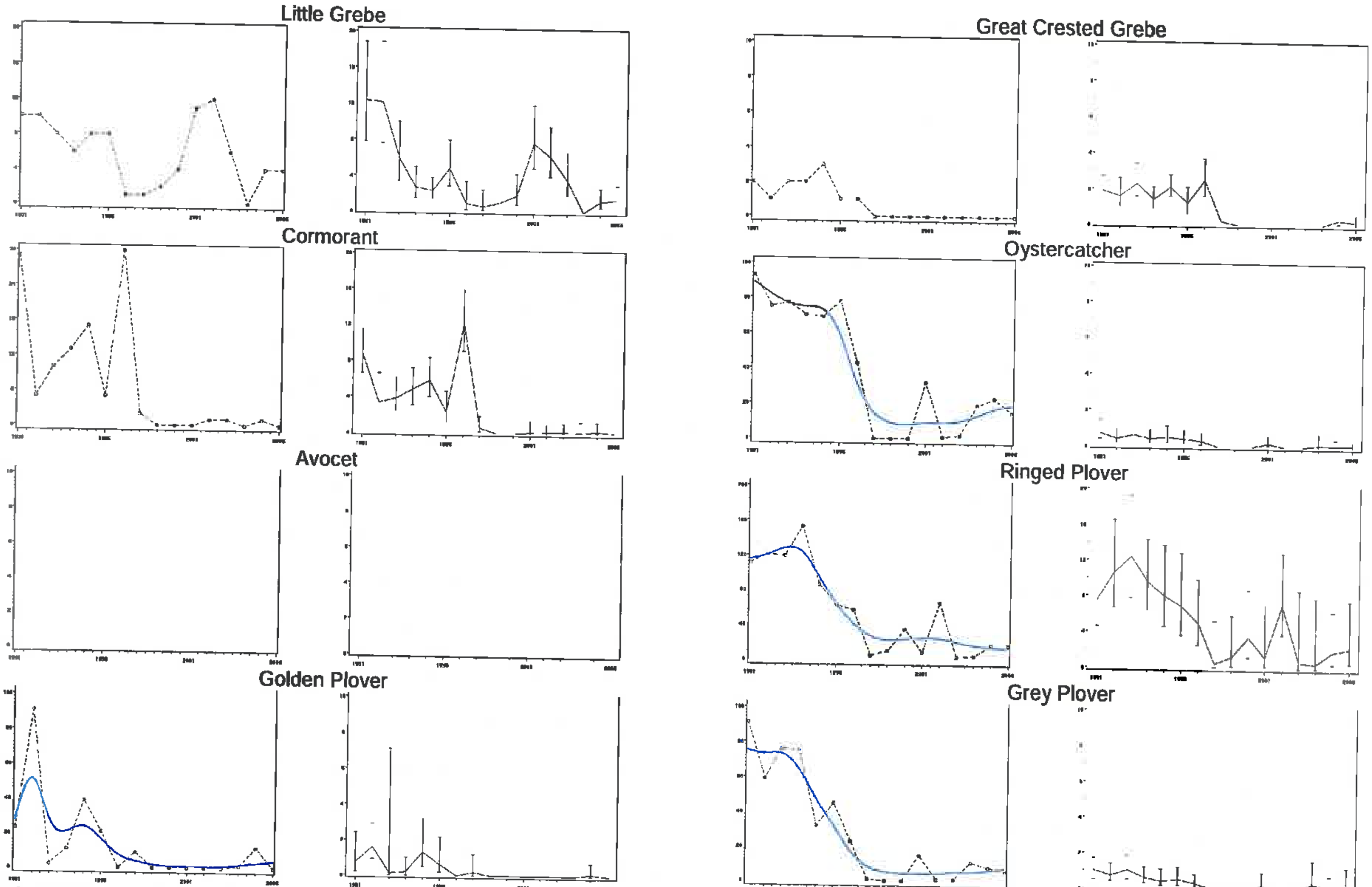


Figure E.22761 Population trends of each species in sector 22761 (Kingsnorth Power Station) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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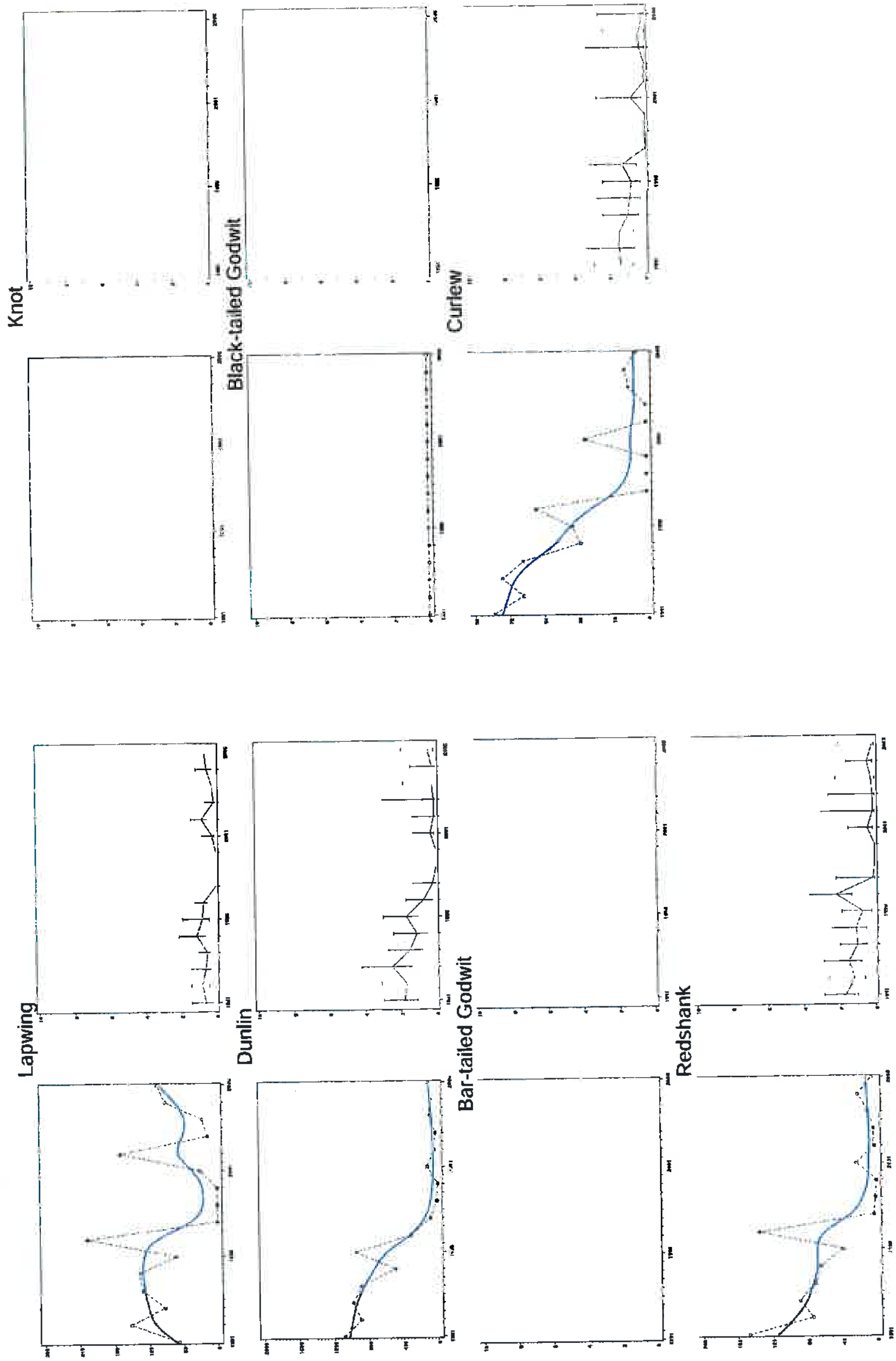

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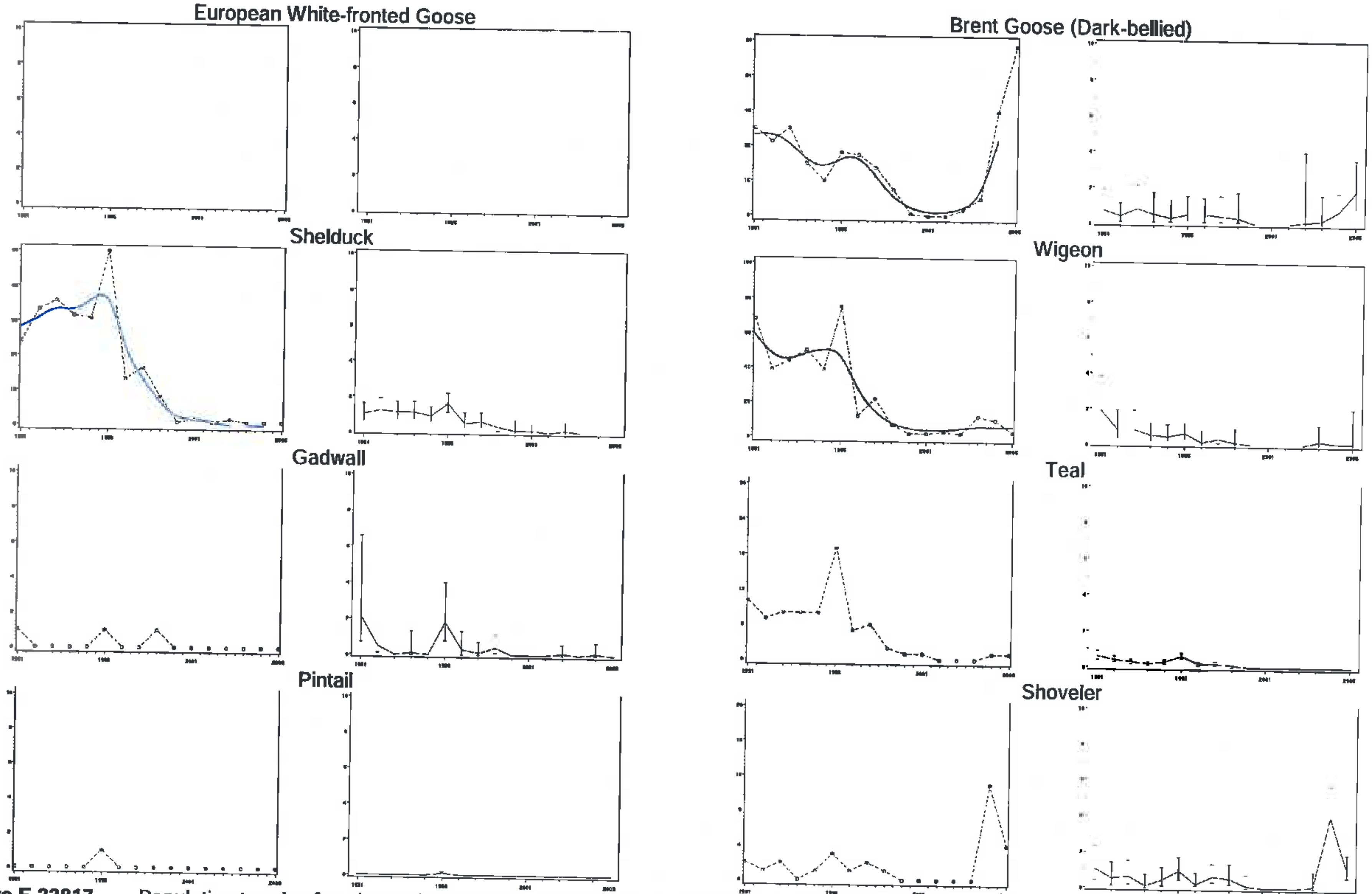
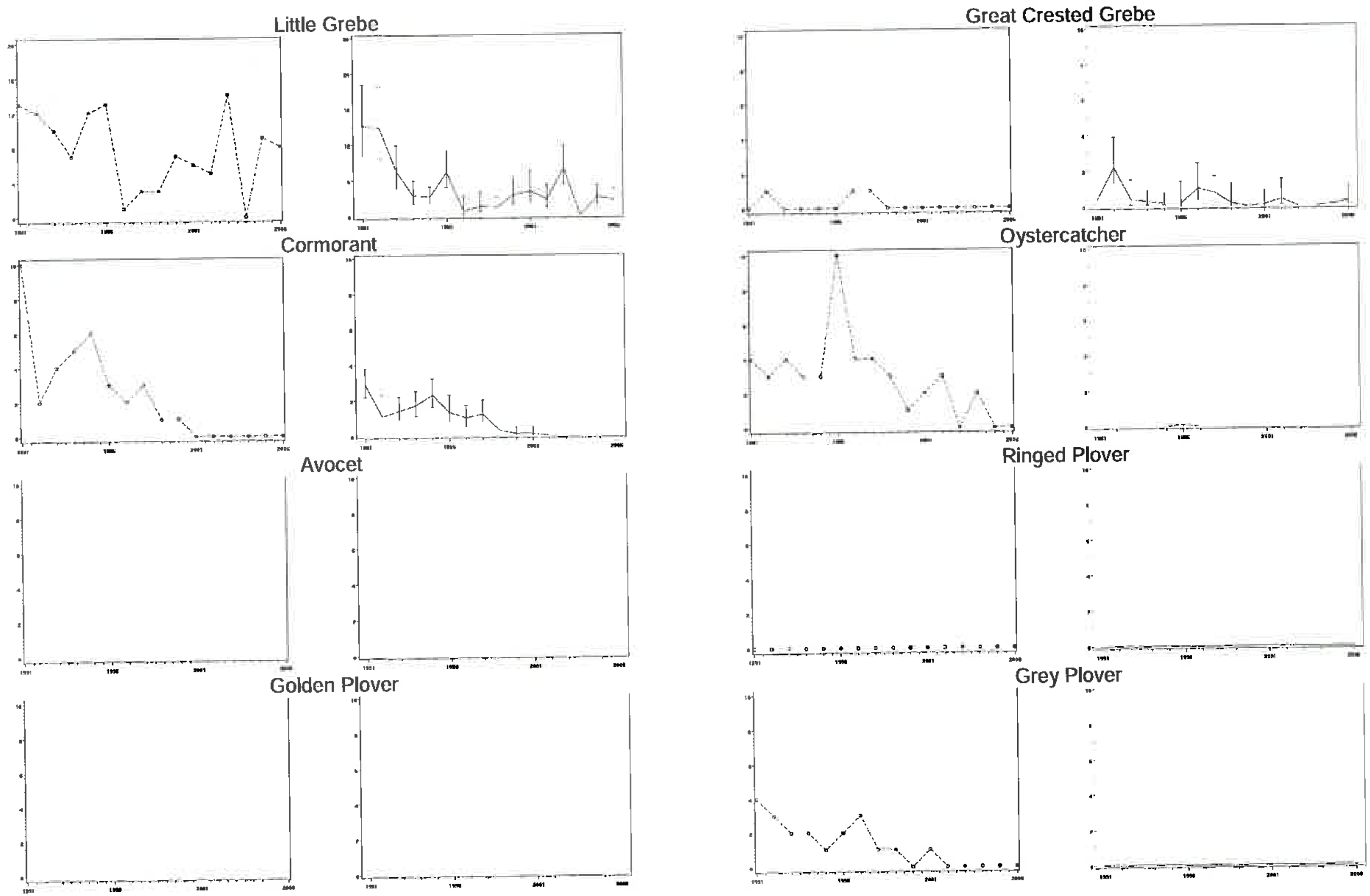


Figure E.22817 Population trends of each species in sector 22817 (Mosco and South Level Pools) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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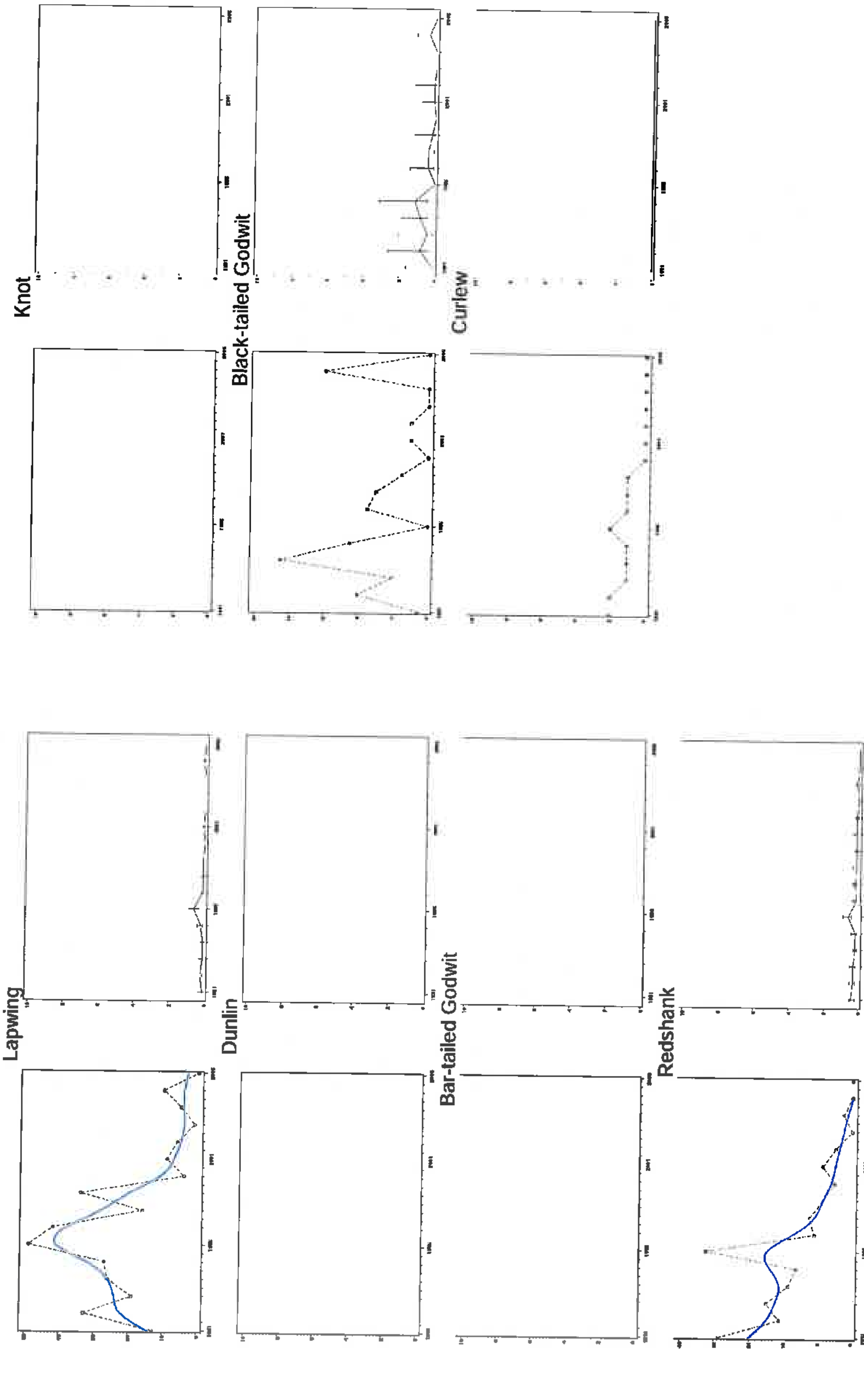

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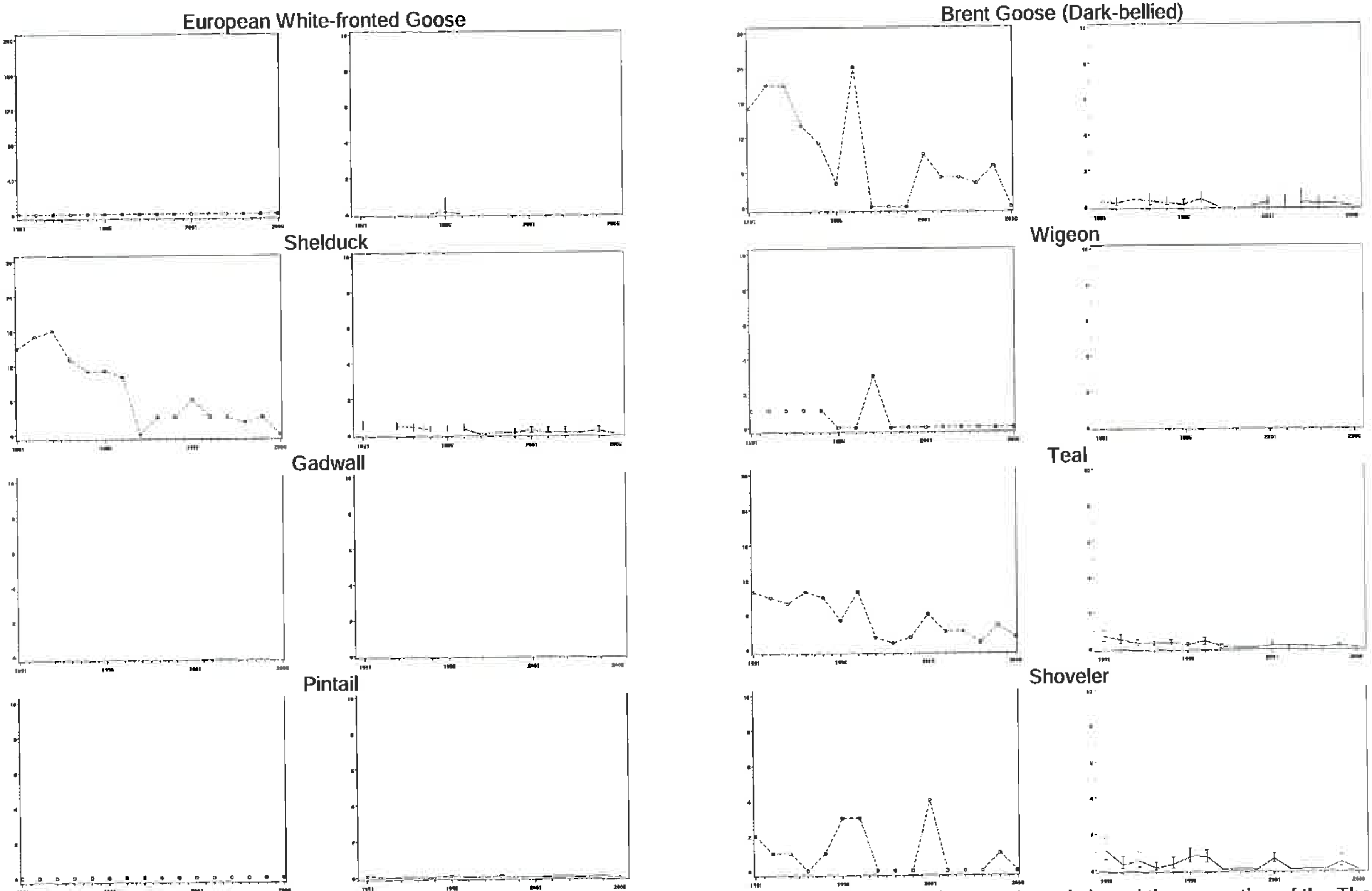
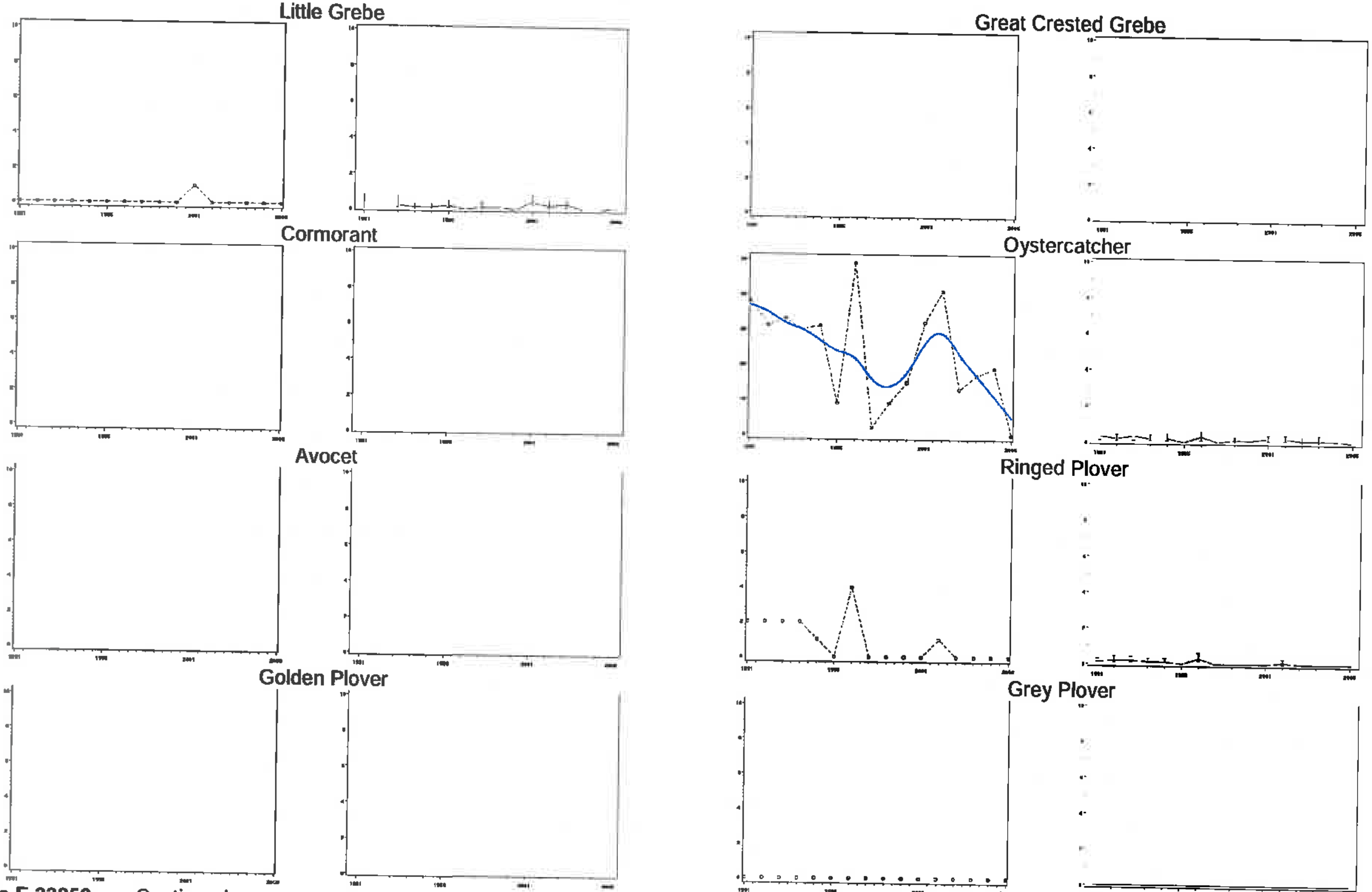


Figure E.22850 Population trends of each species in sector 22850 (Motney Sewage Treatment Works) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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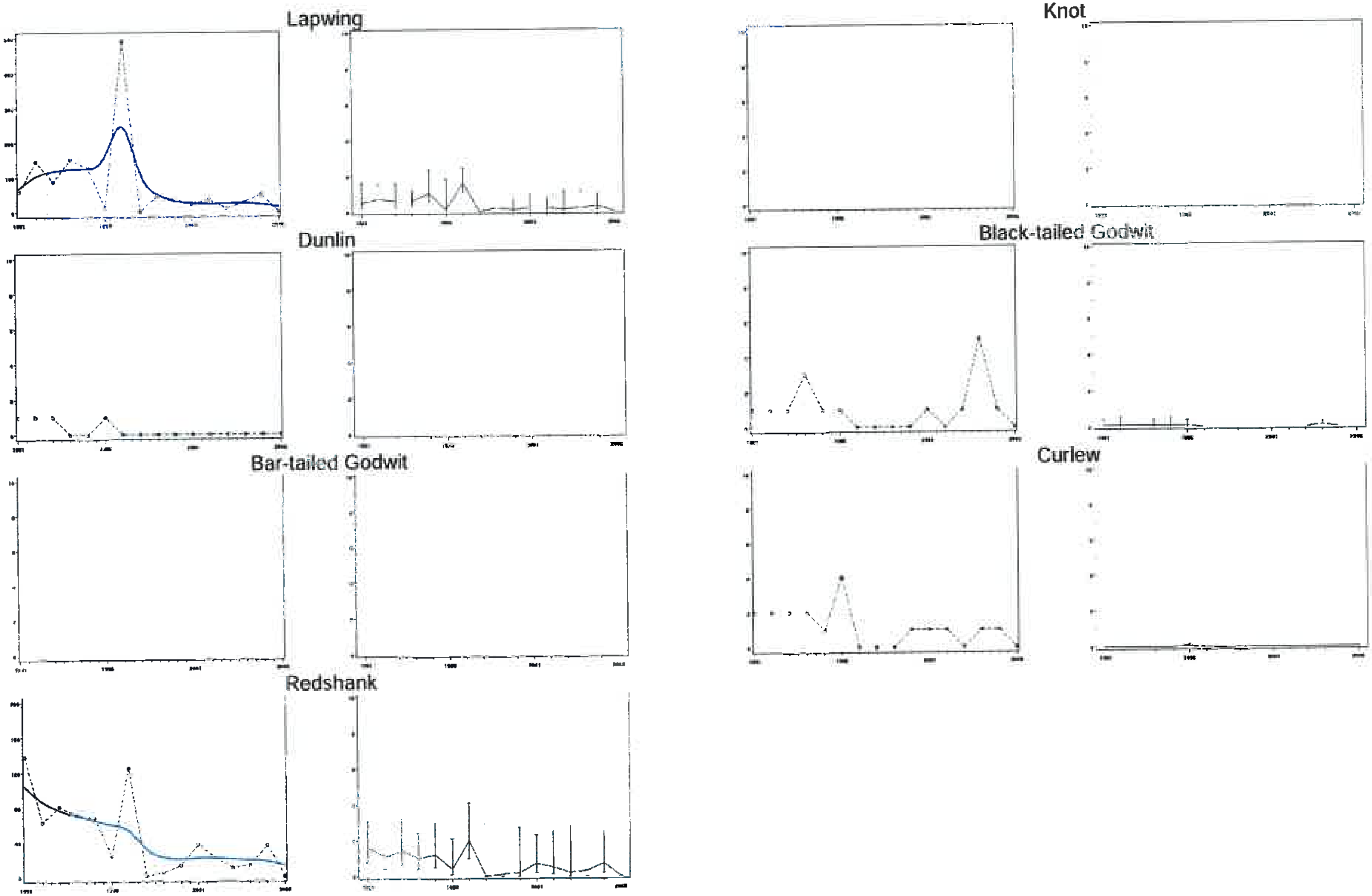

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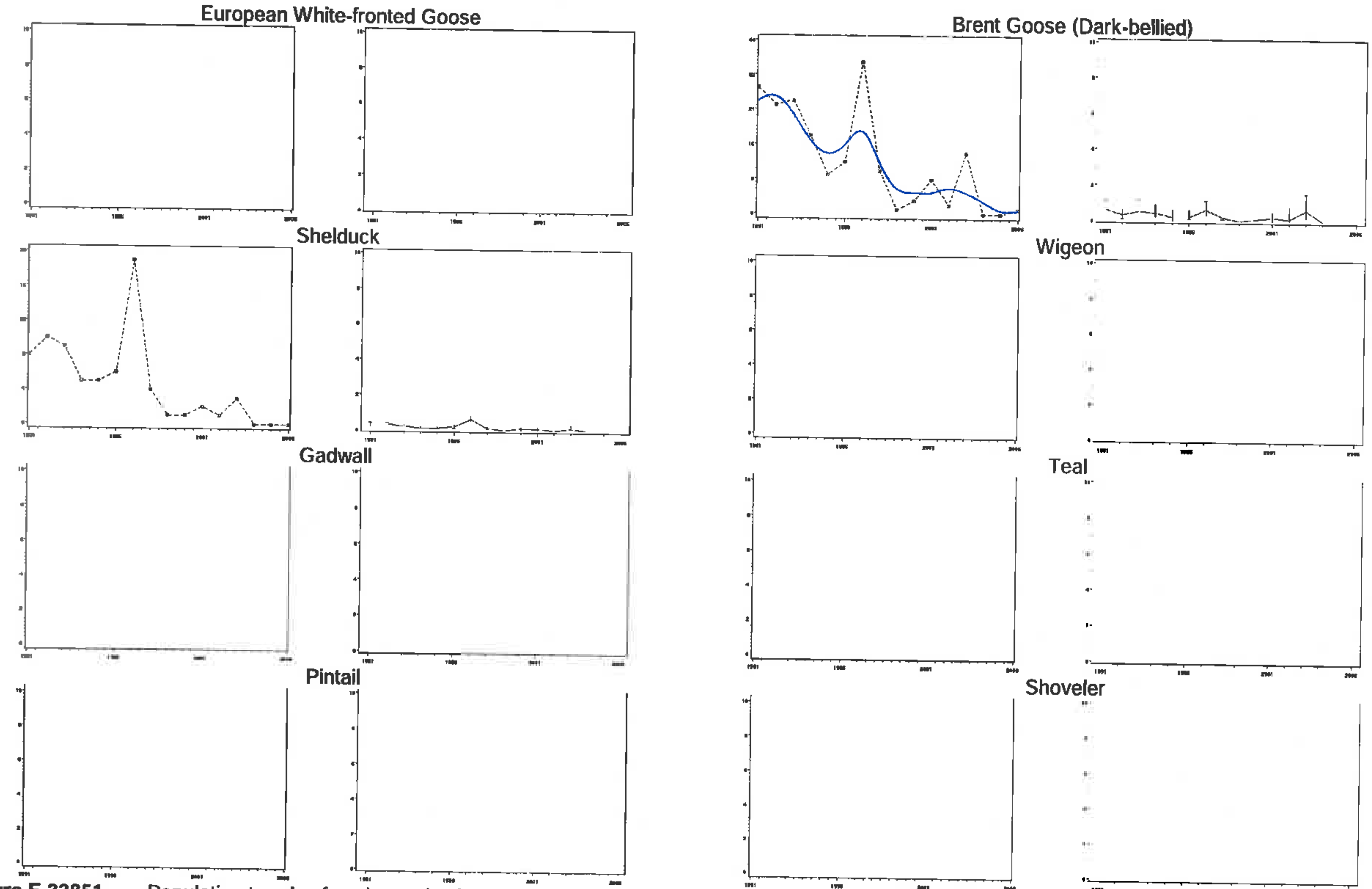
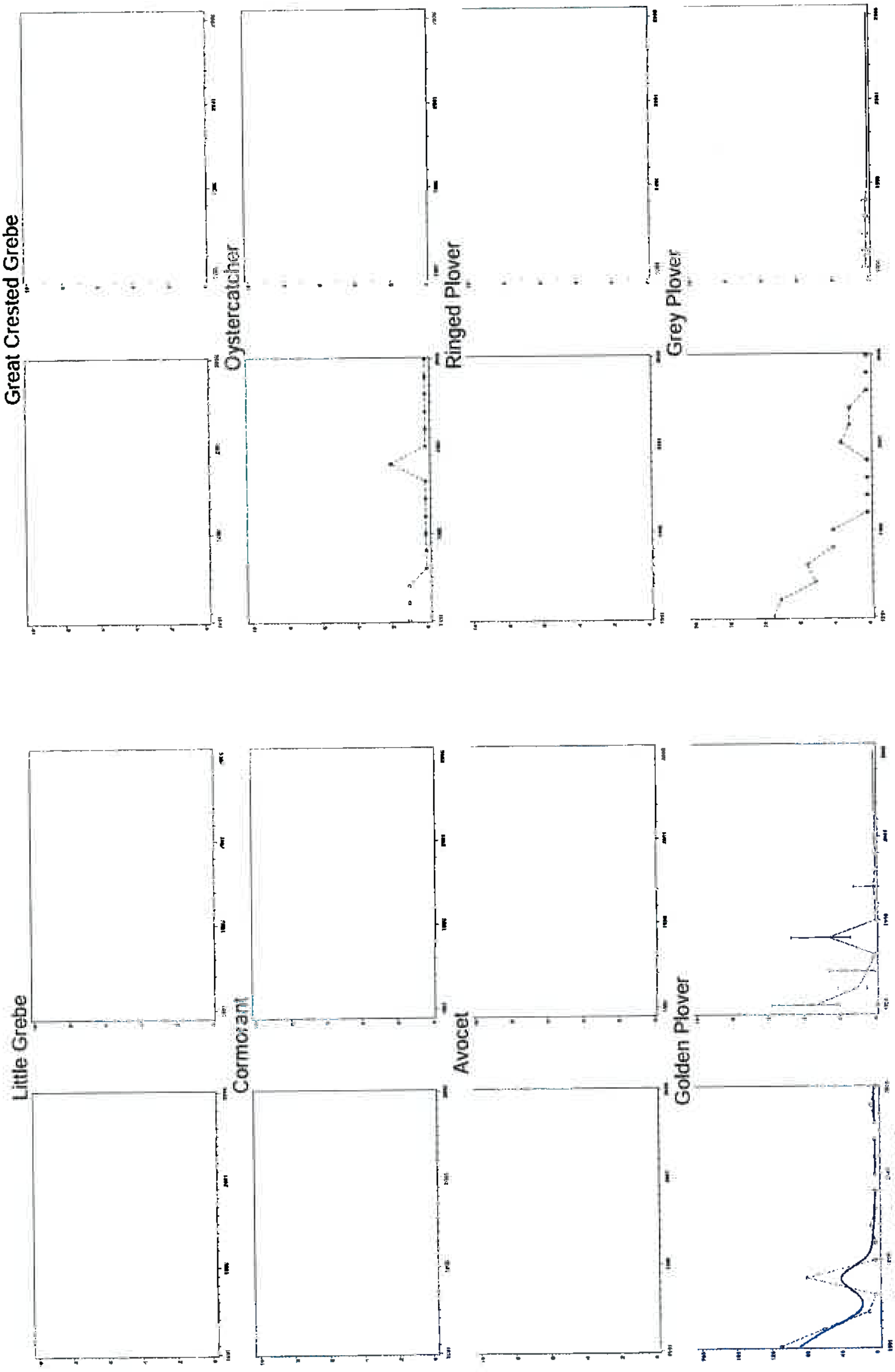


Figure E.22851 Population trends of each species in sector 22851 (Twinney) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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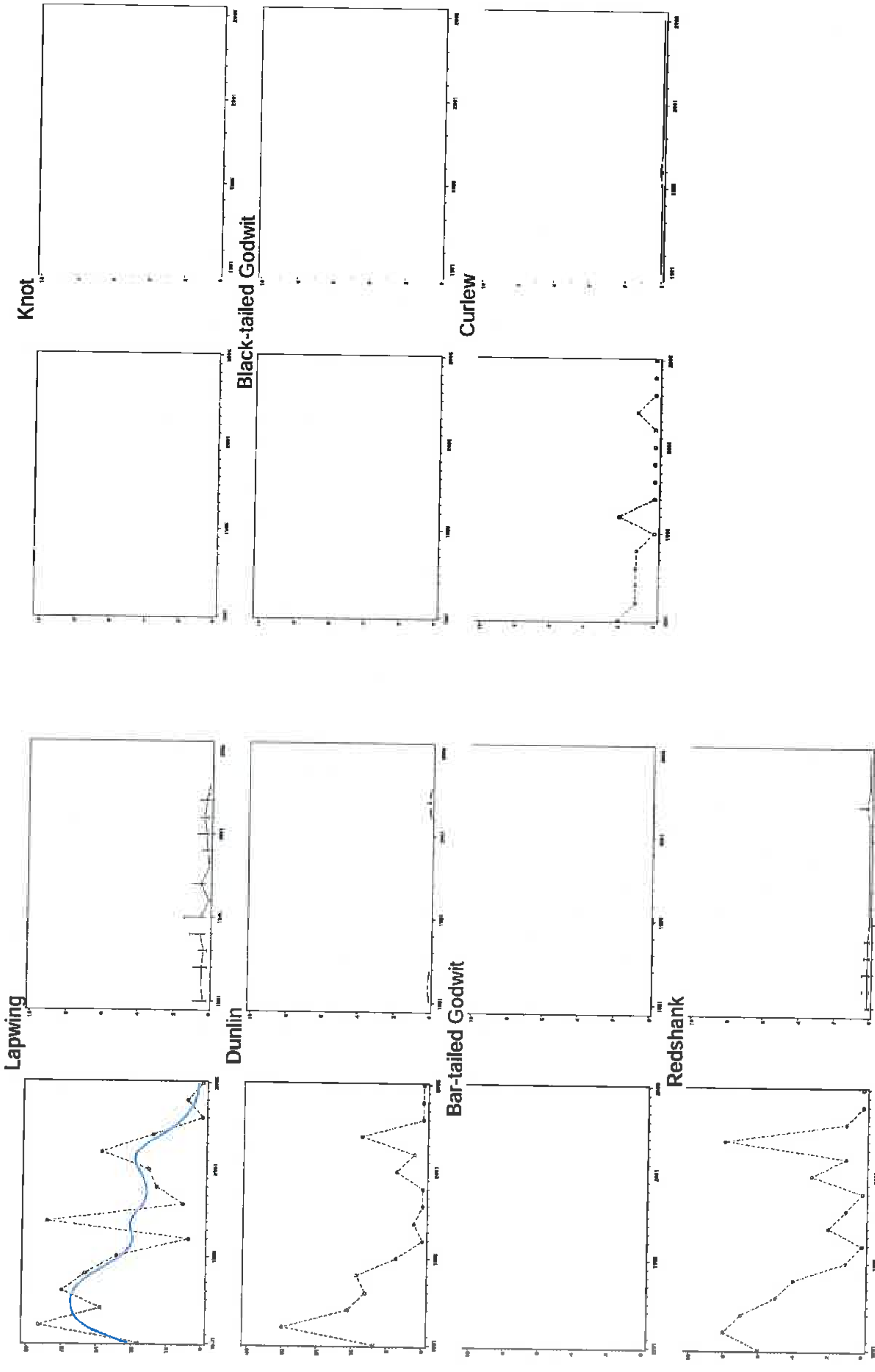

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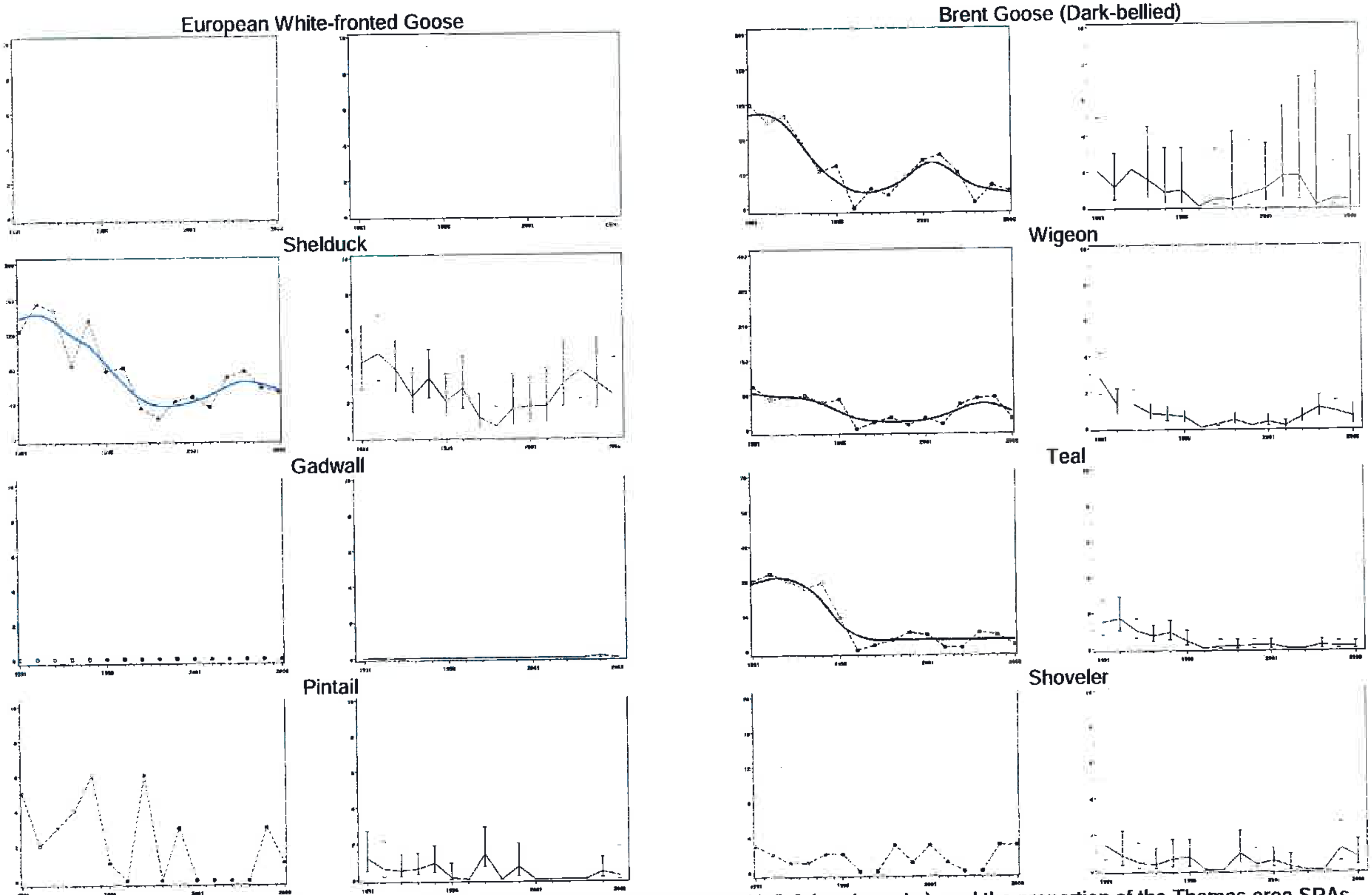
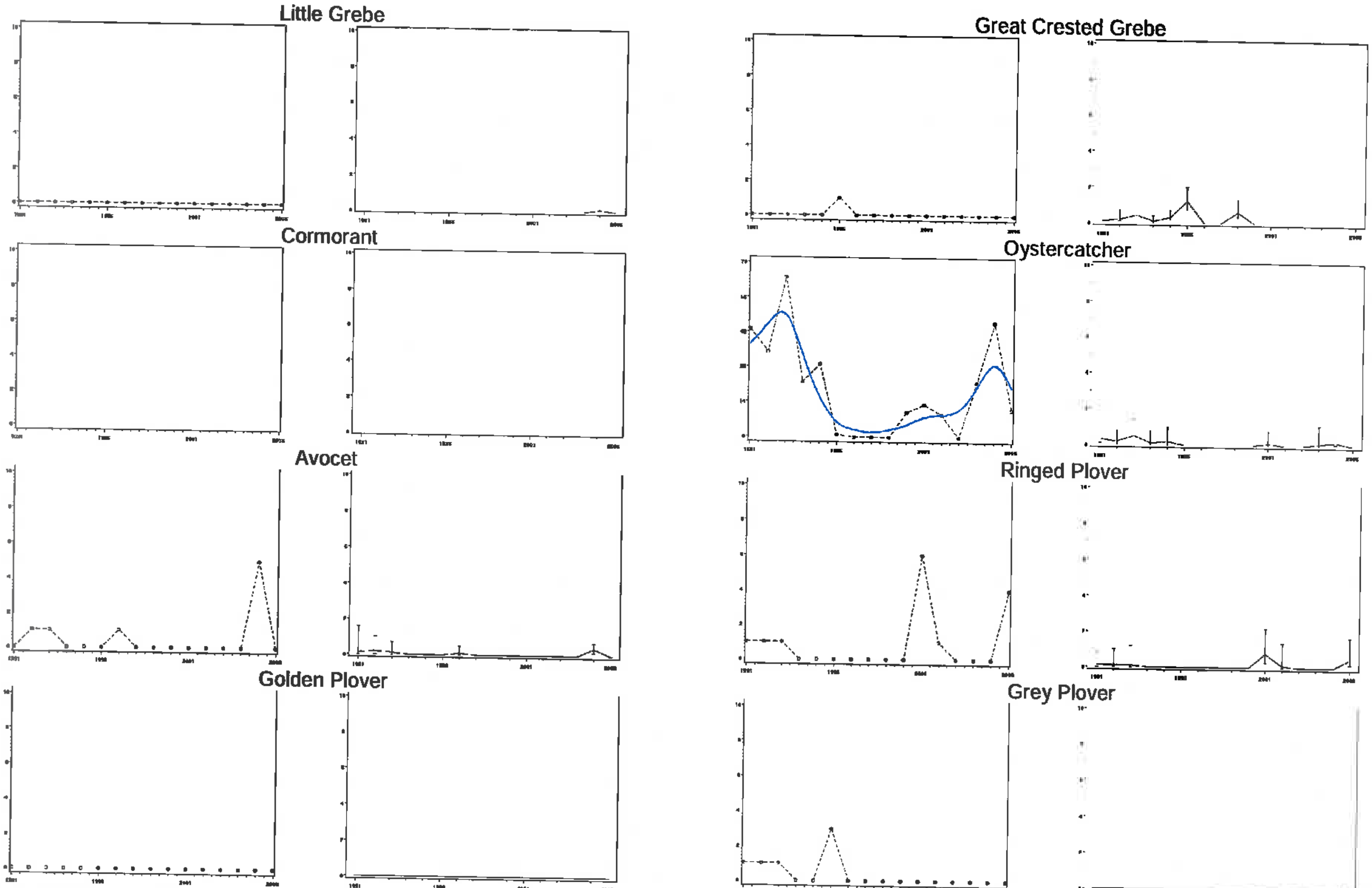


Figure E.22852 Population trends of each species in sector 22852 (Horsham Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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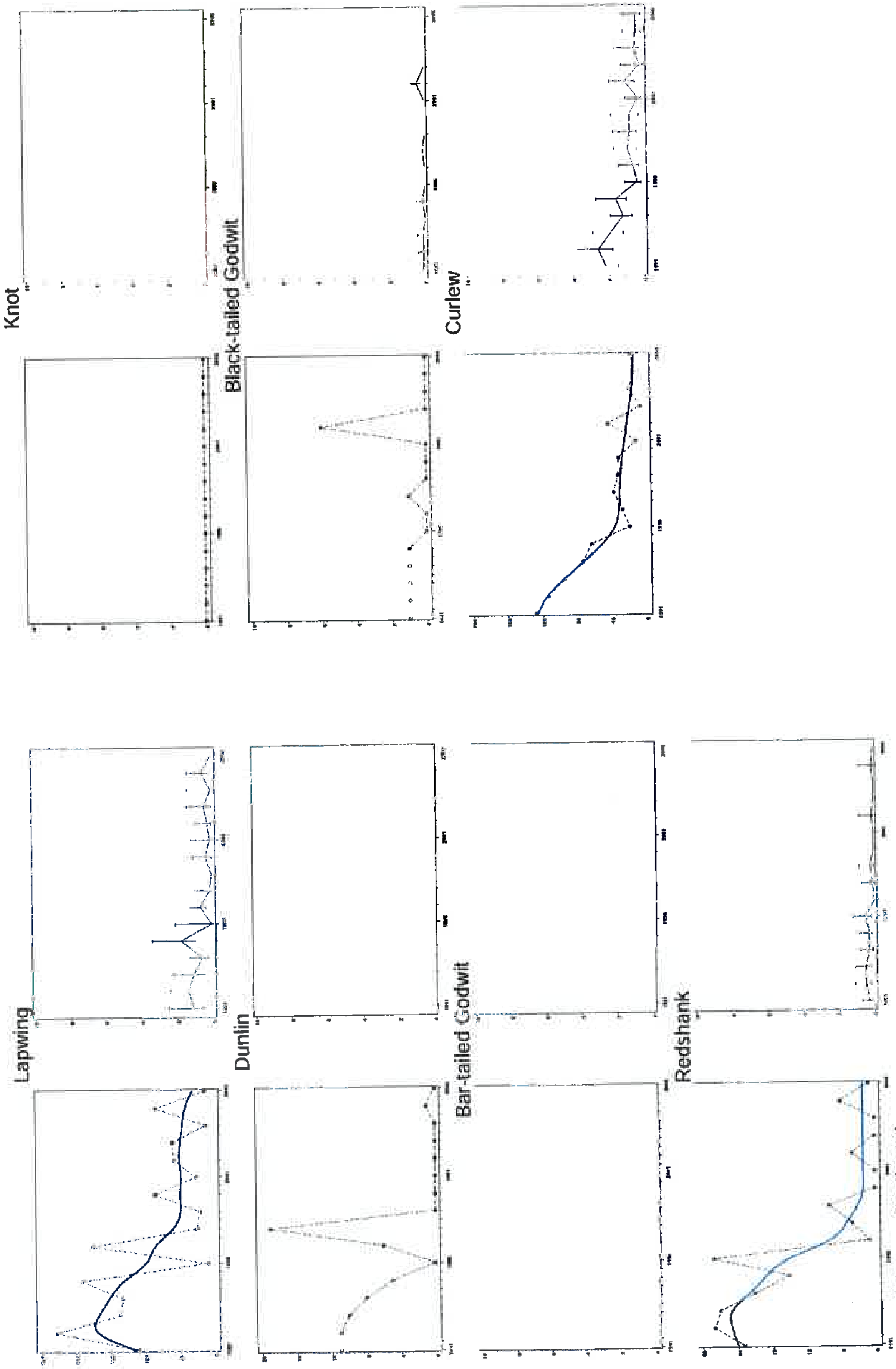

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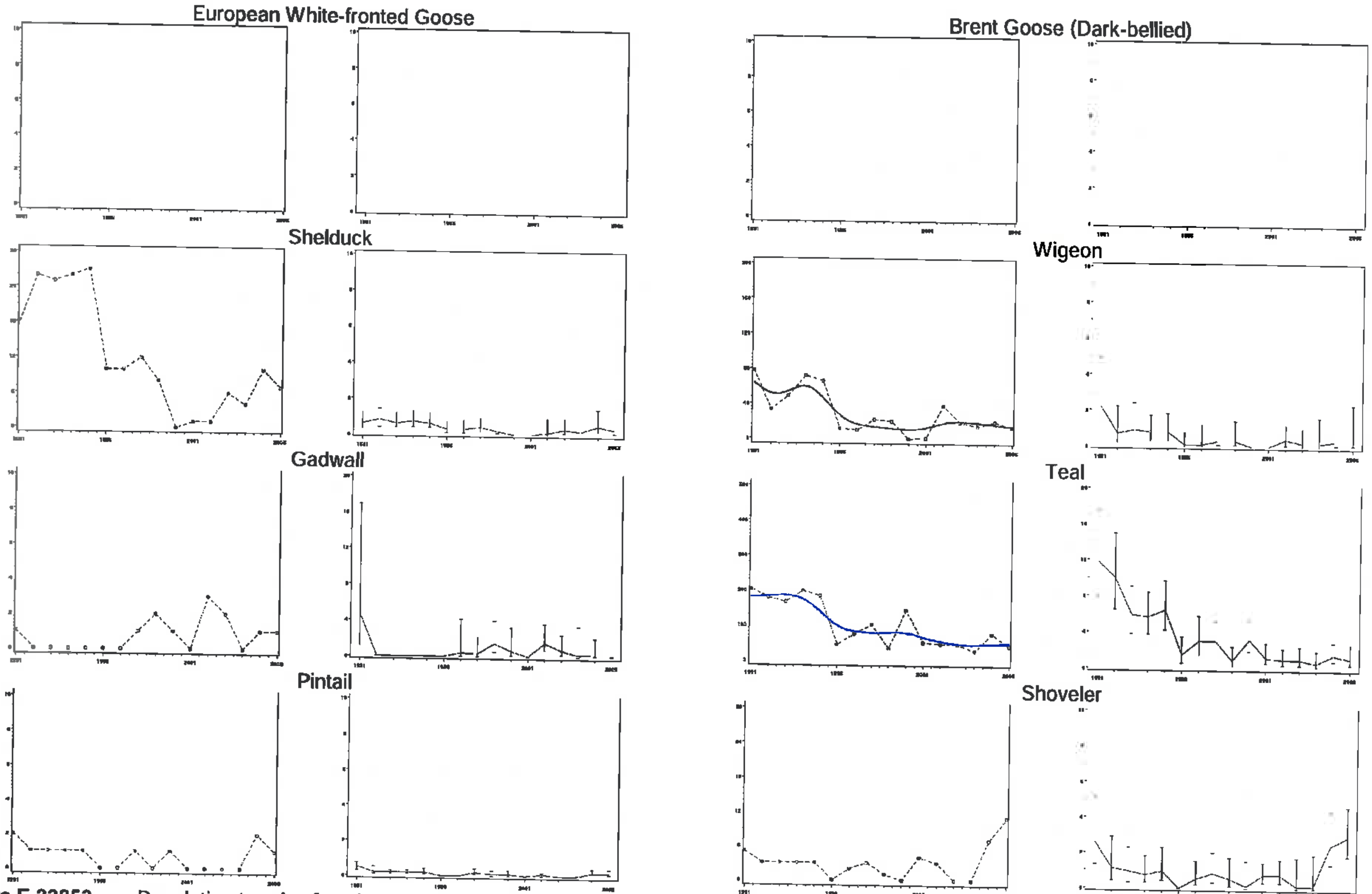
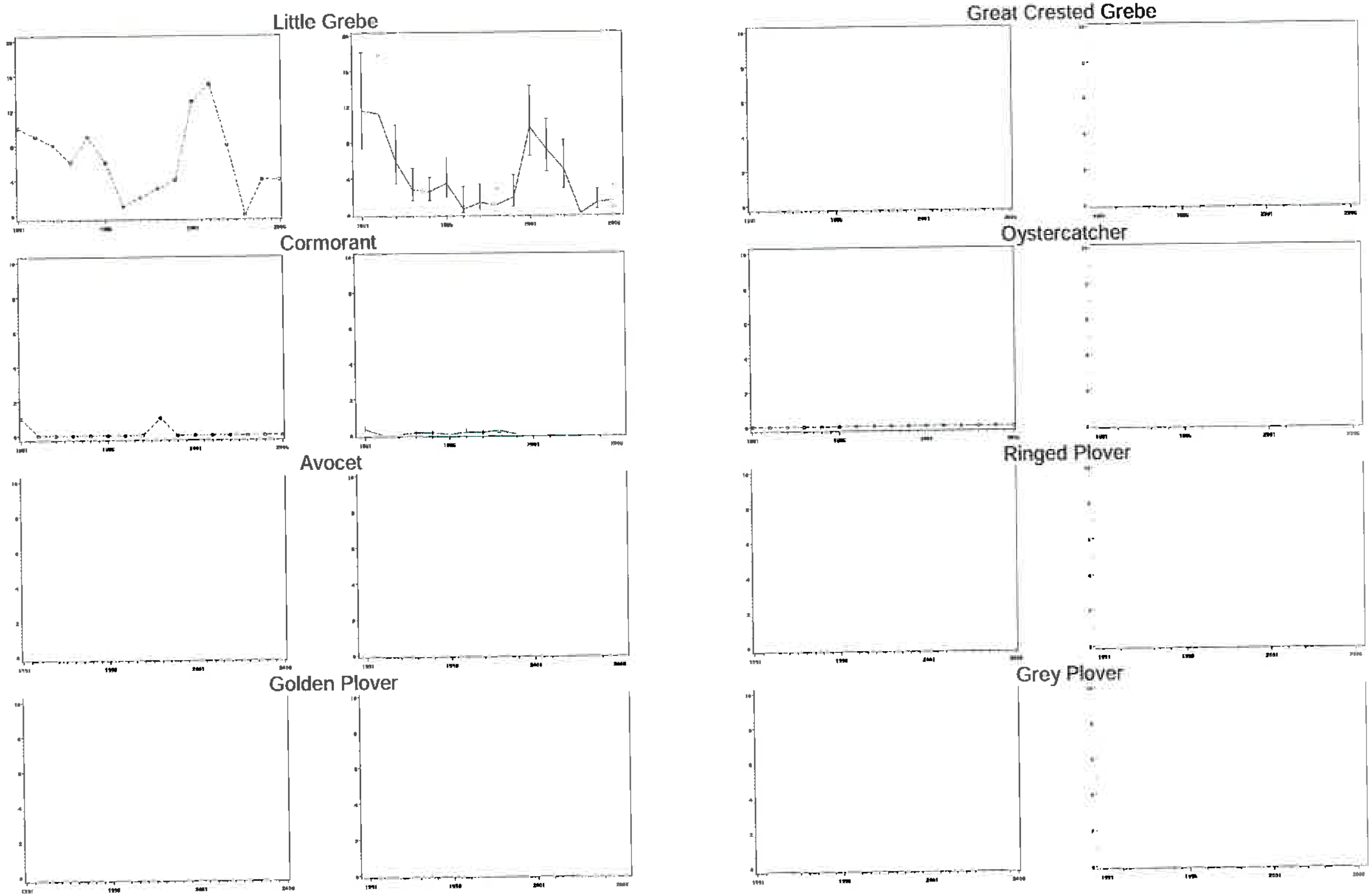


Figure E.22853 Population trends of each species in sector 22853 (House Fleet) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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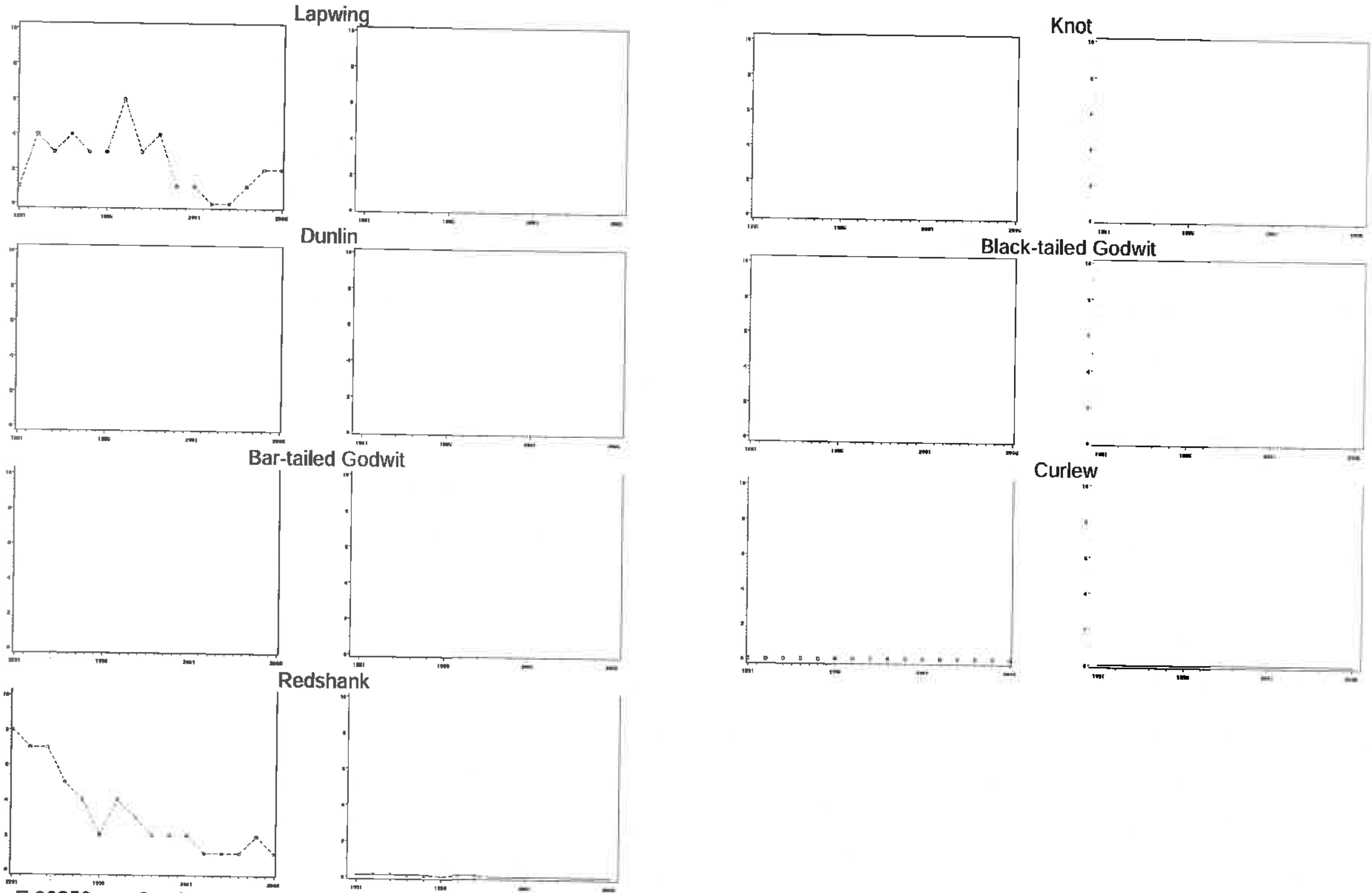

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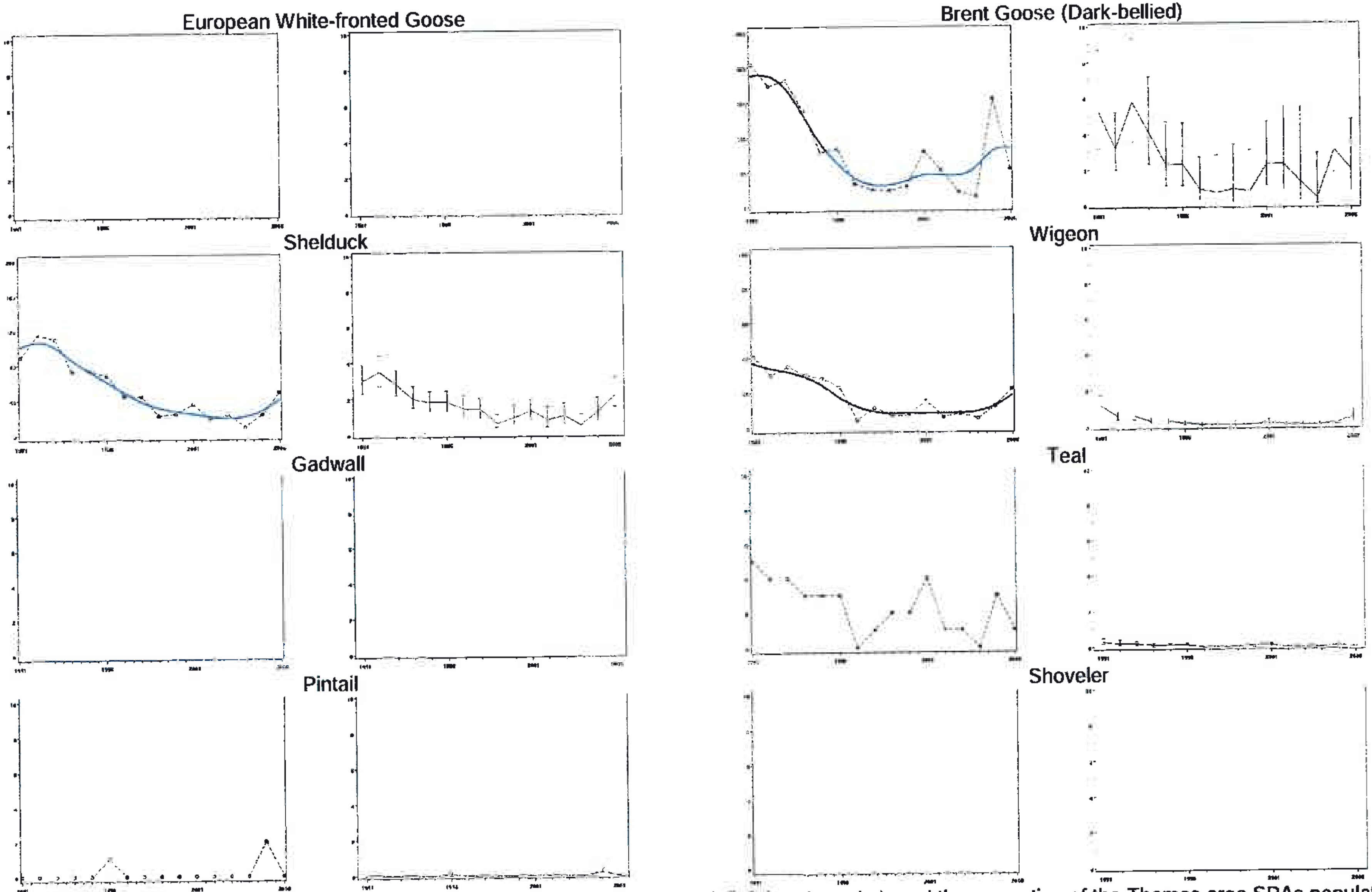
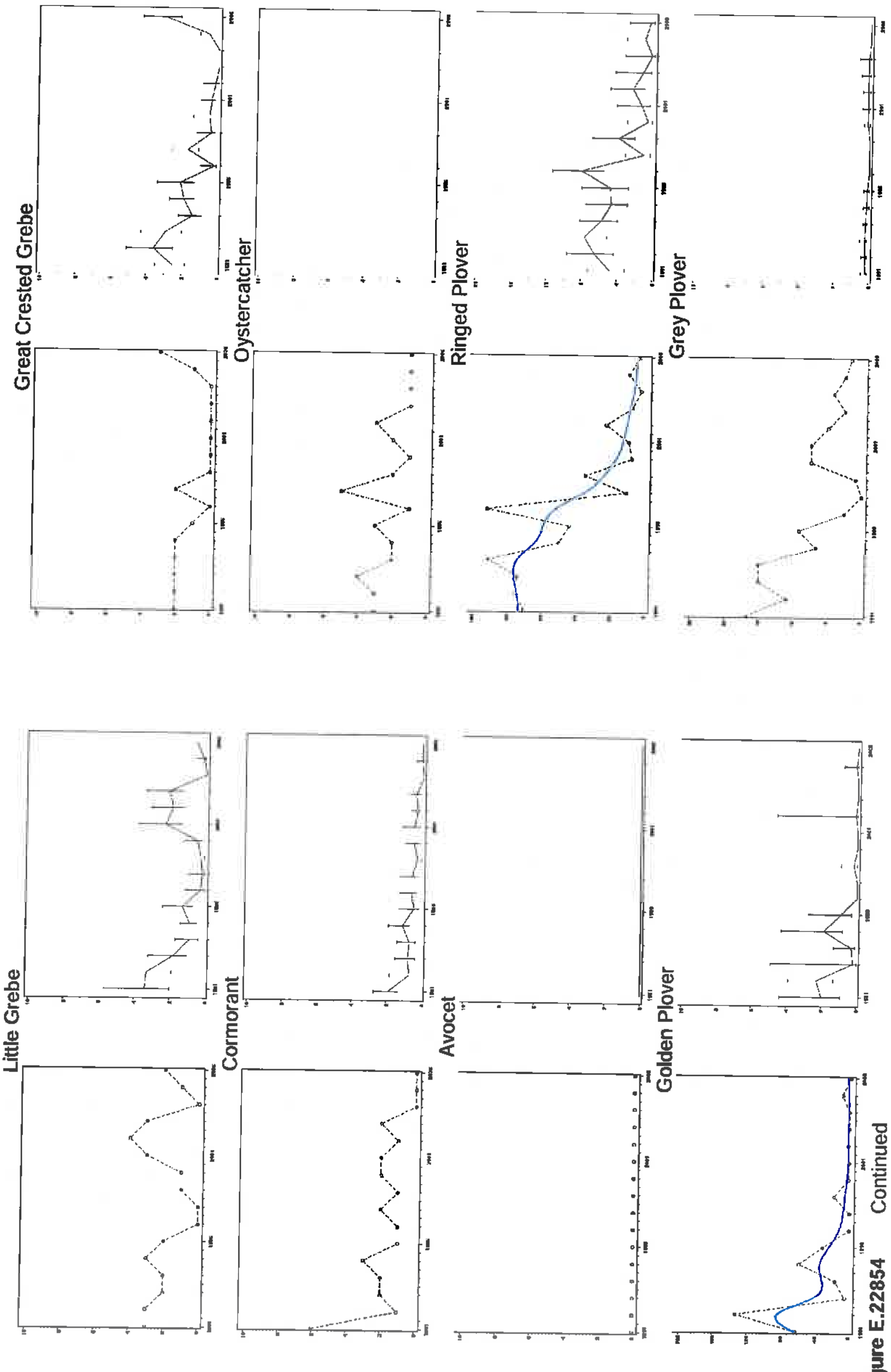


Figure E.22854 Population trends of each species in sector 22854 (Hoo Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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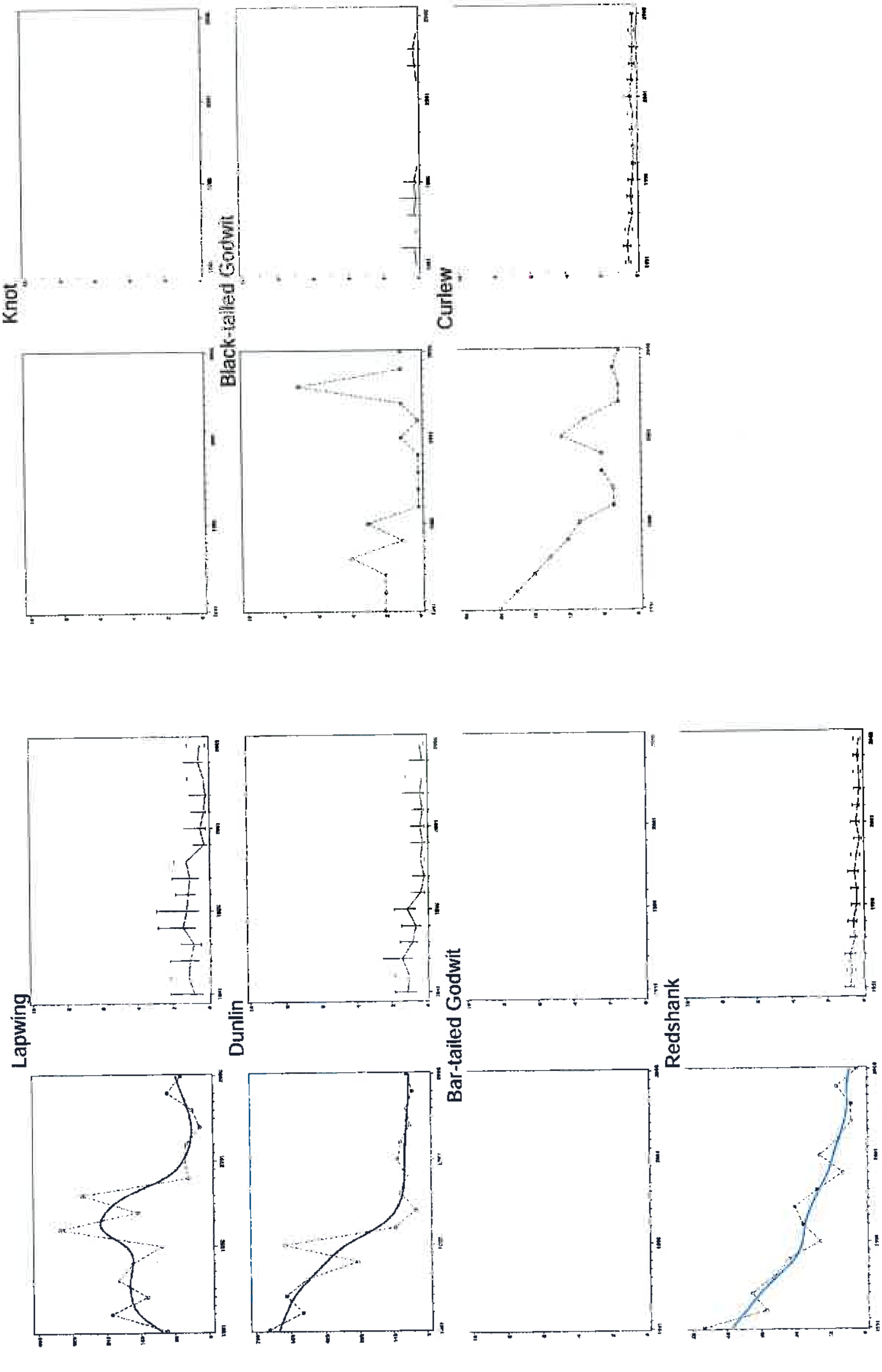

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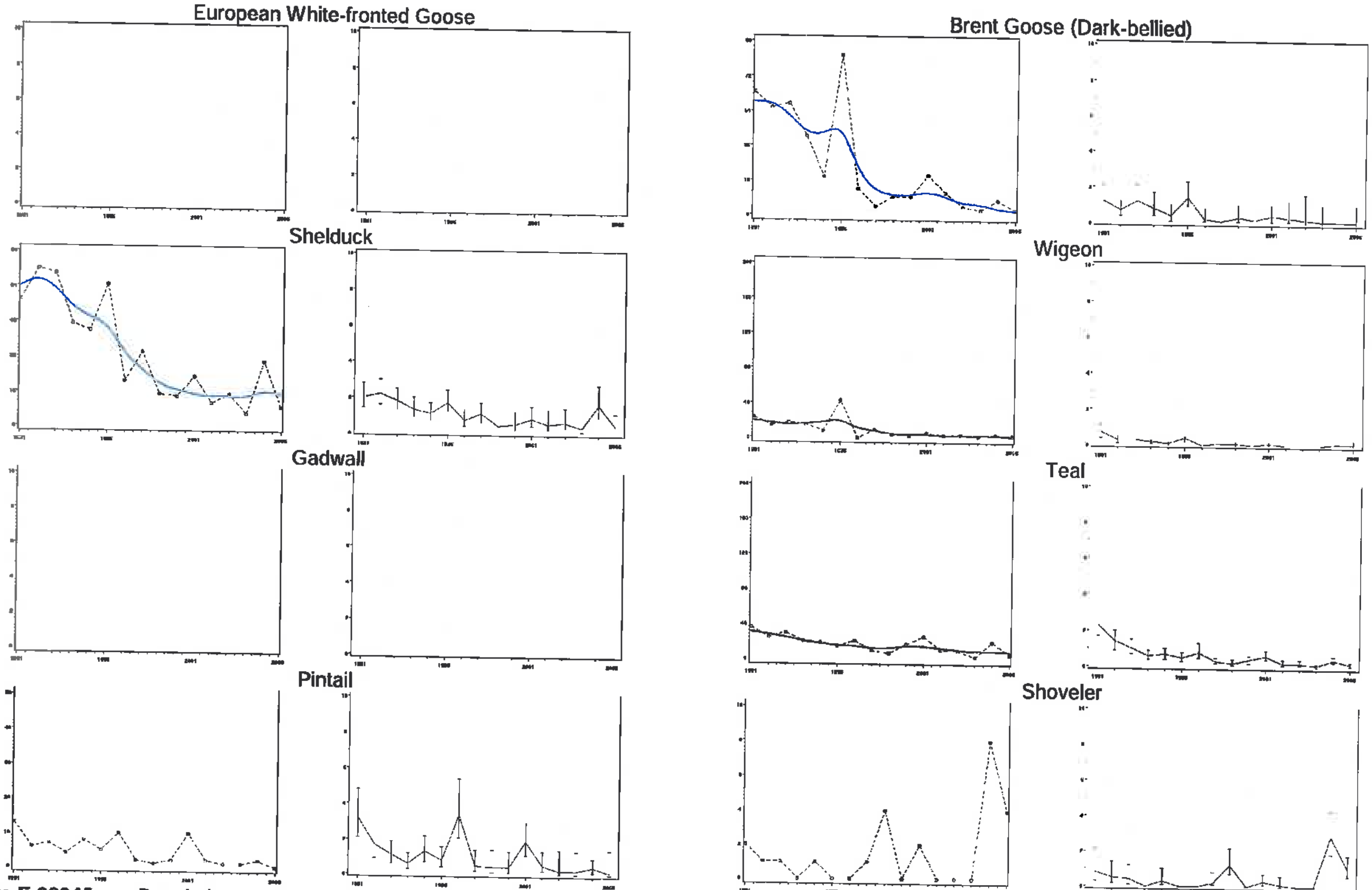


Figure E.22945 Population trends of each species in sector 22945 (Otterham Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

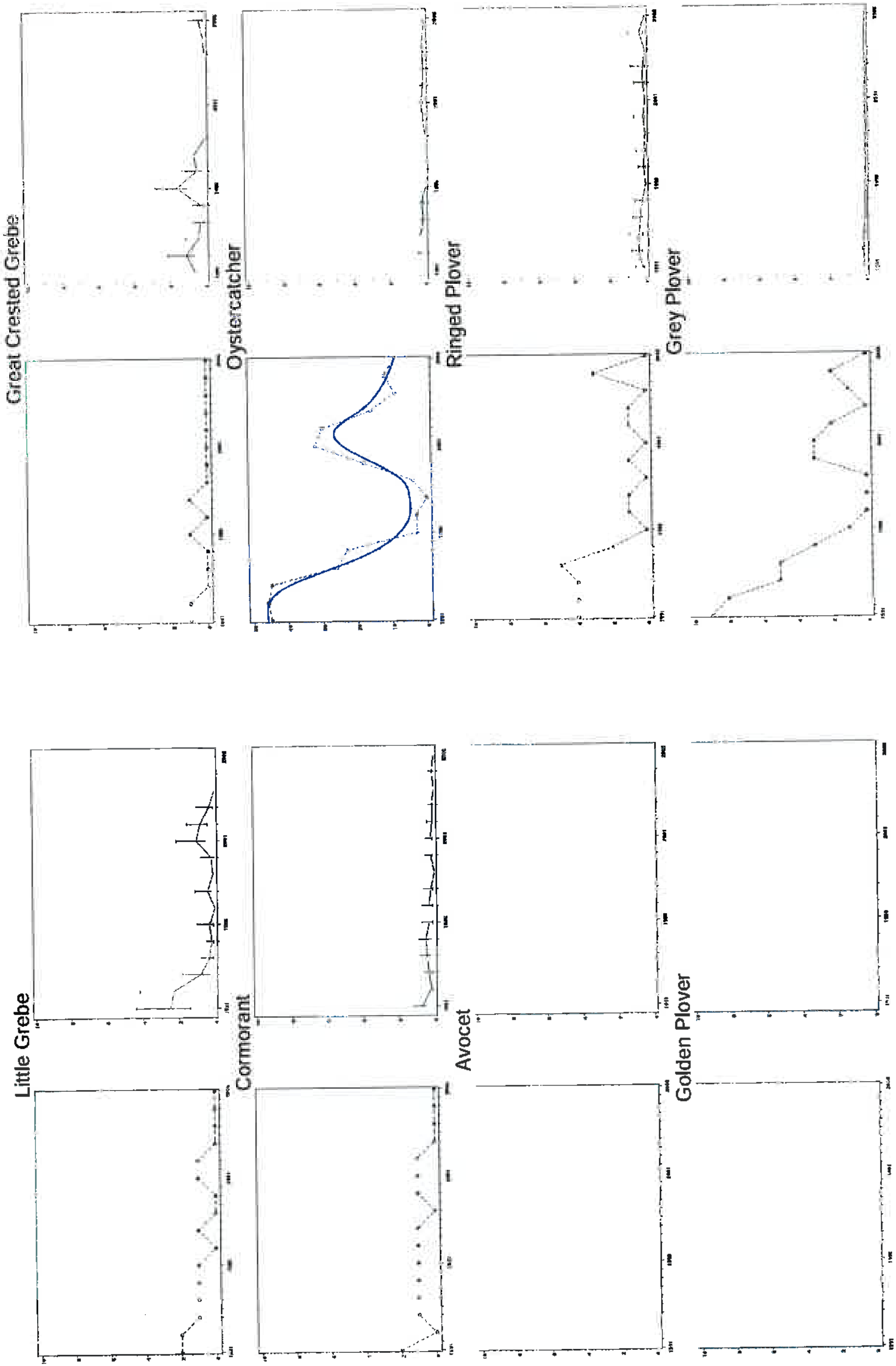
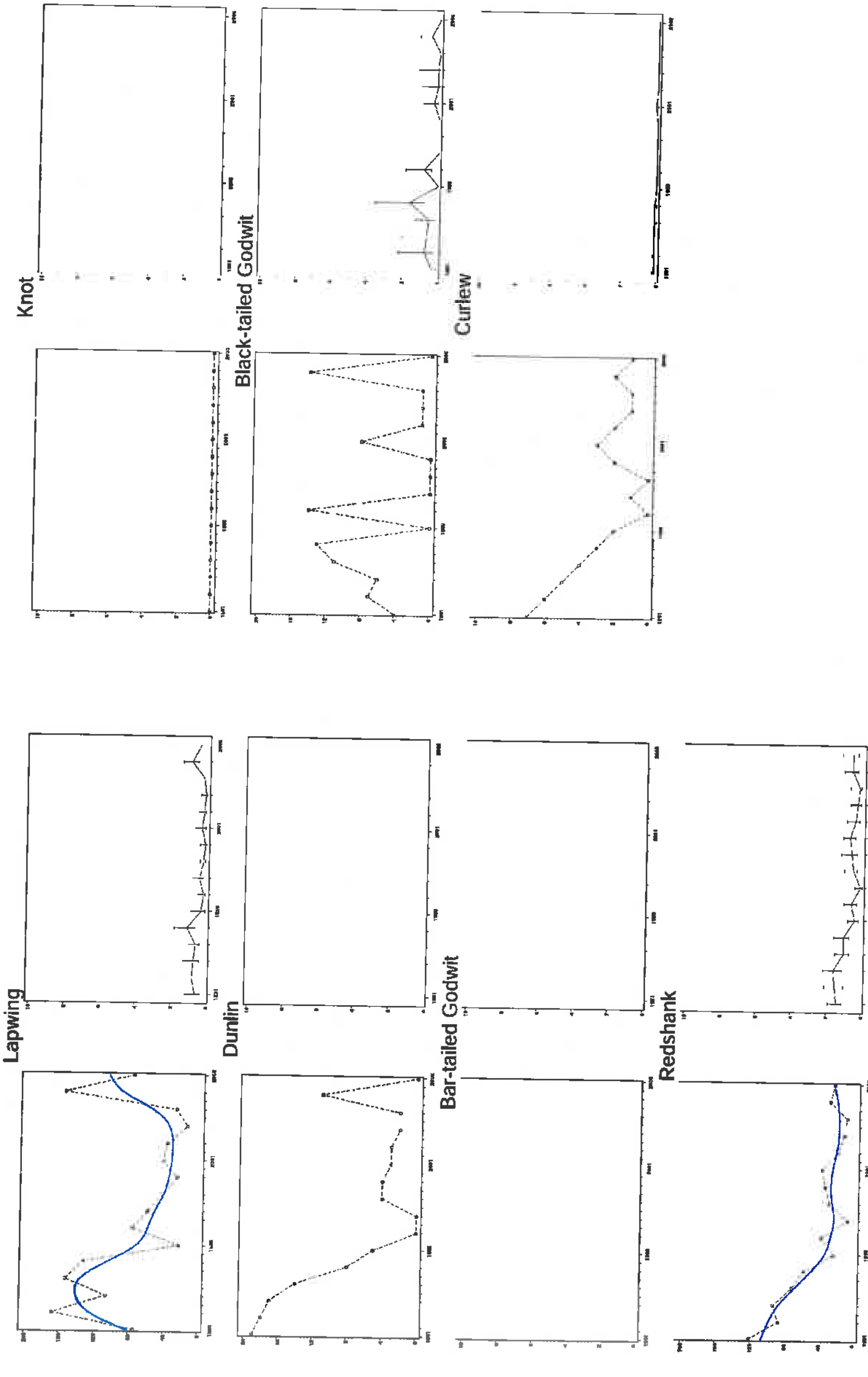


Figure E.22945 Continued



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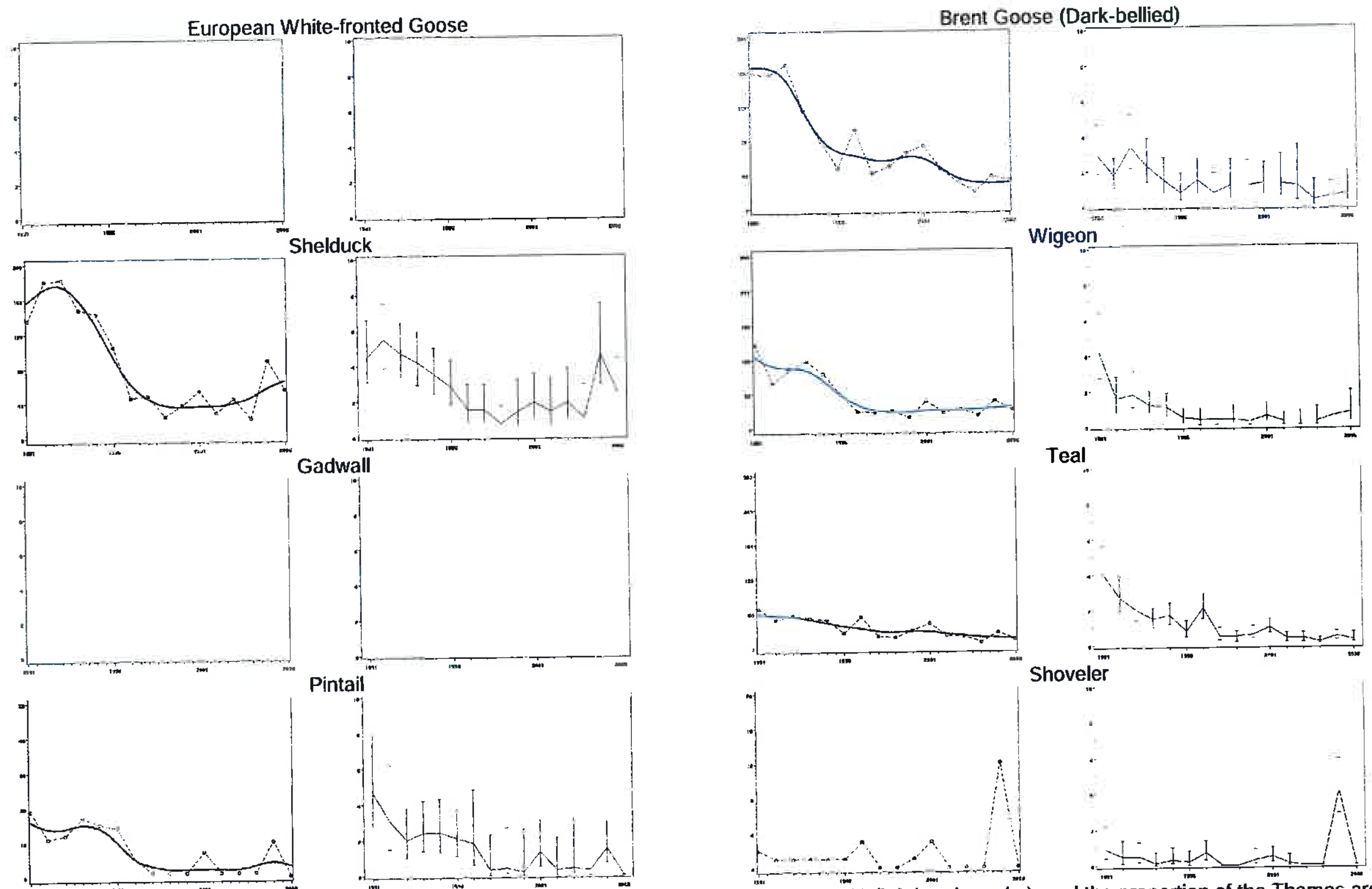
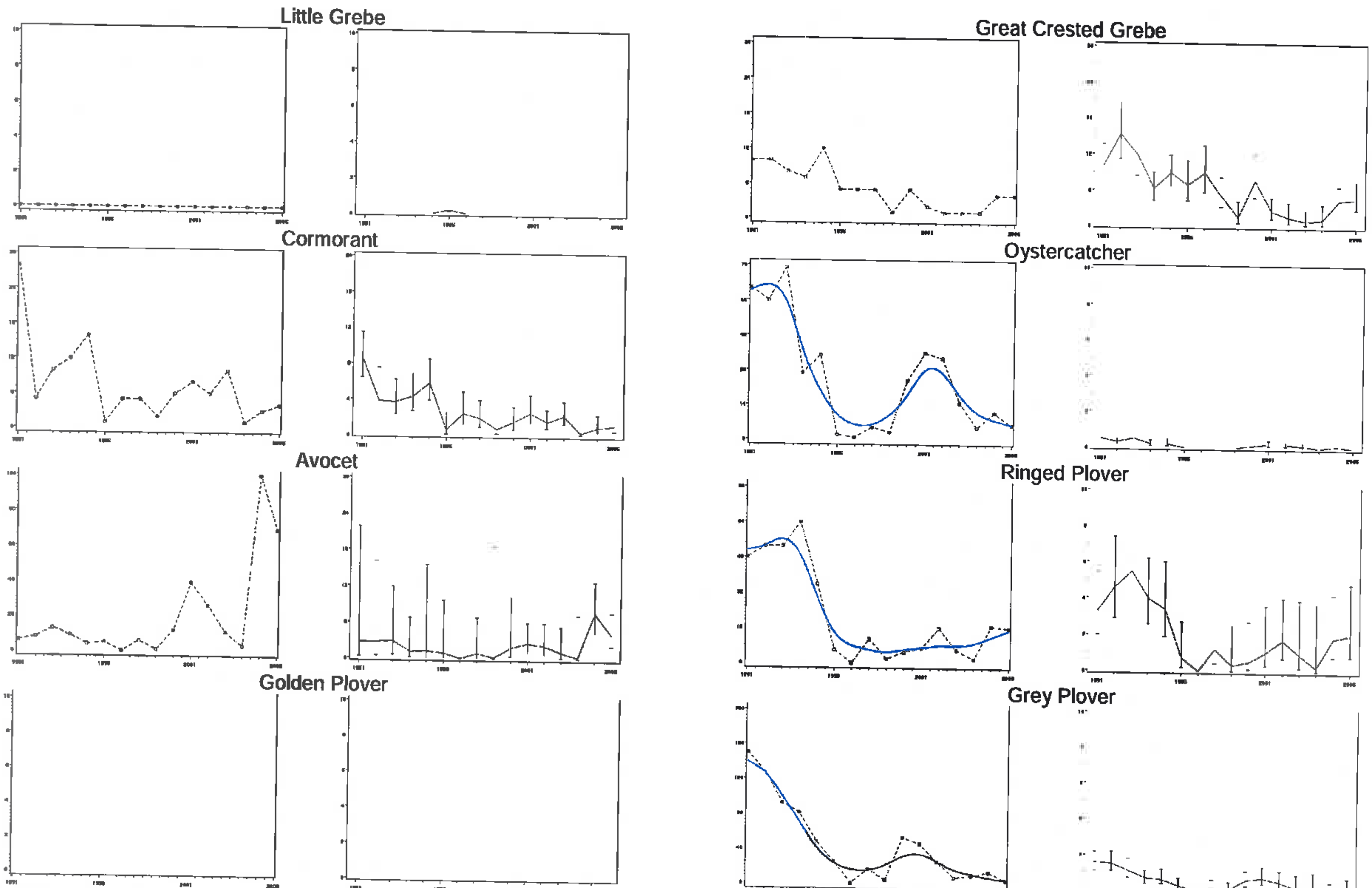


Figure E.22946 Population trends of each species in sector 22946 (Motney Saltings and Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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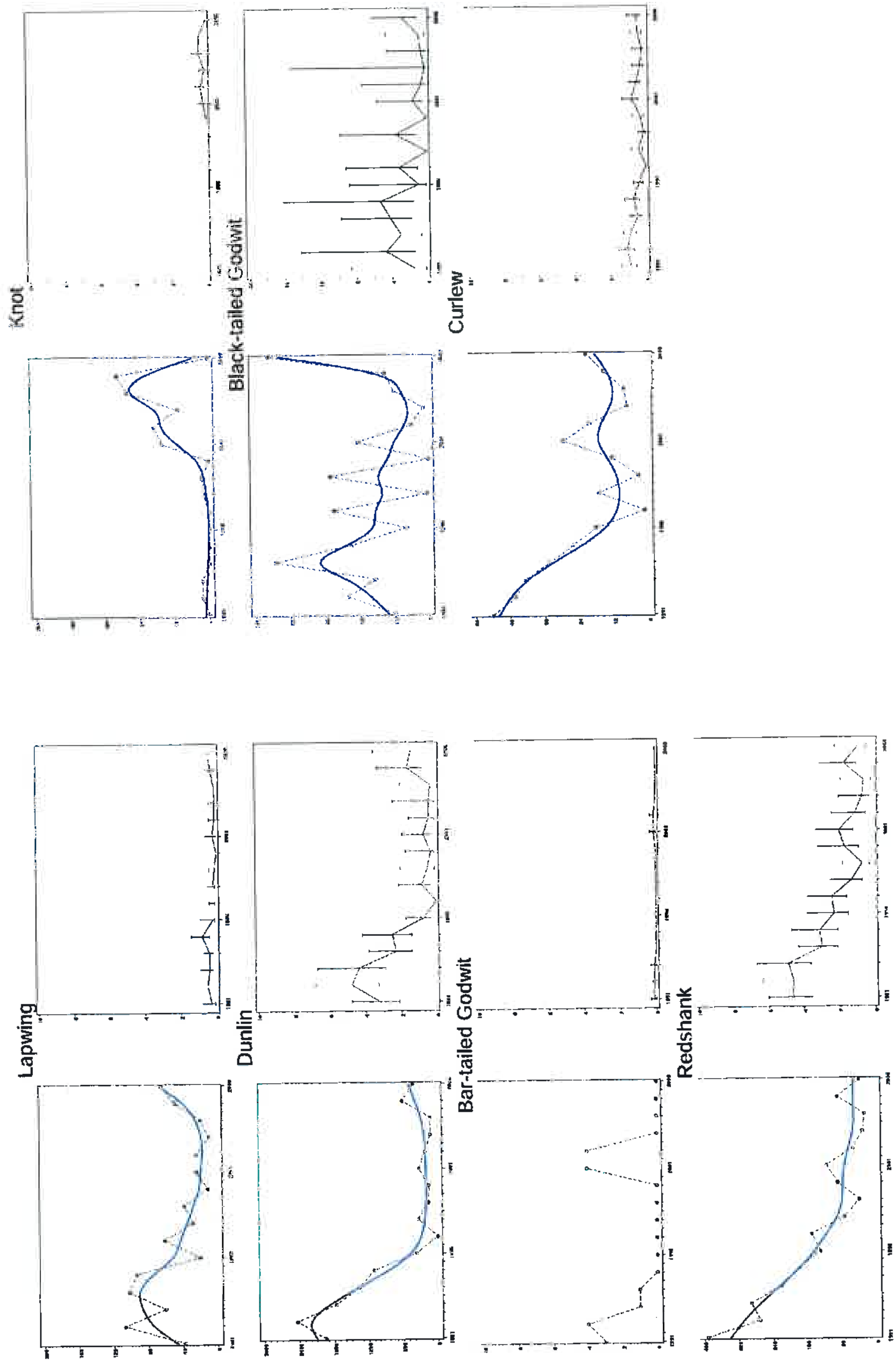

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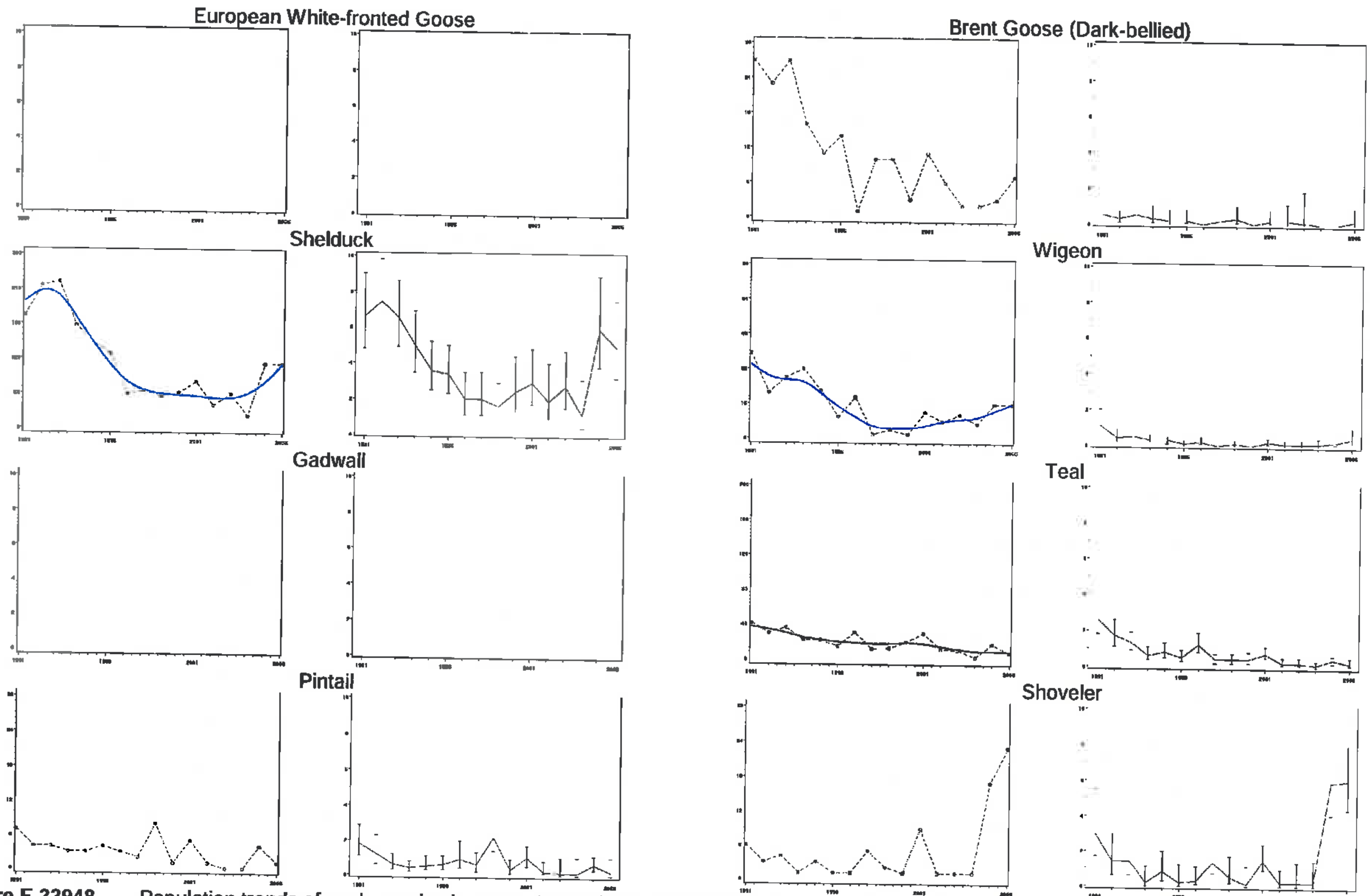
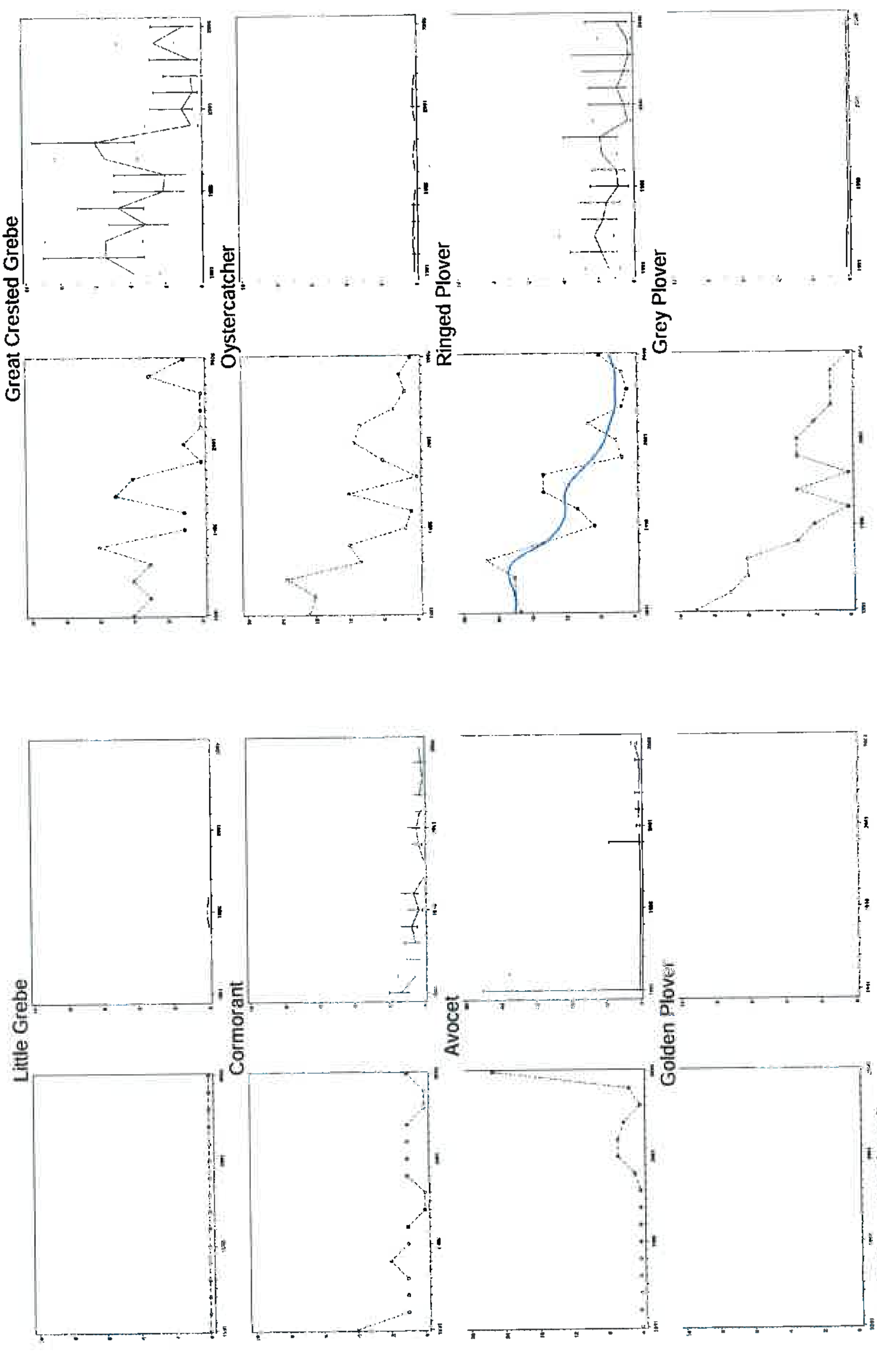


Figure E.22948 Population trends of each species in sector 22948 (Bloors Wharf) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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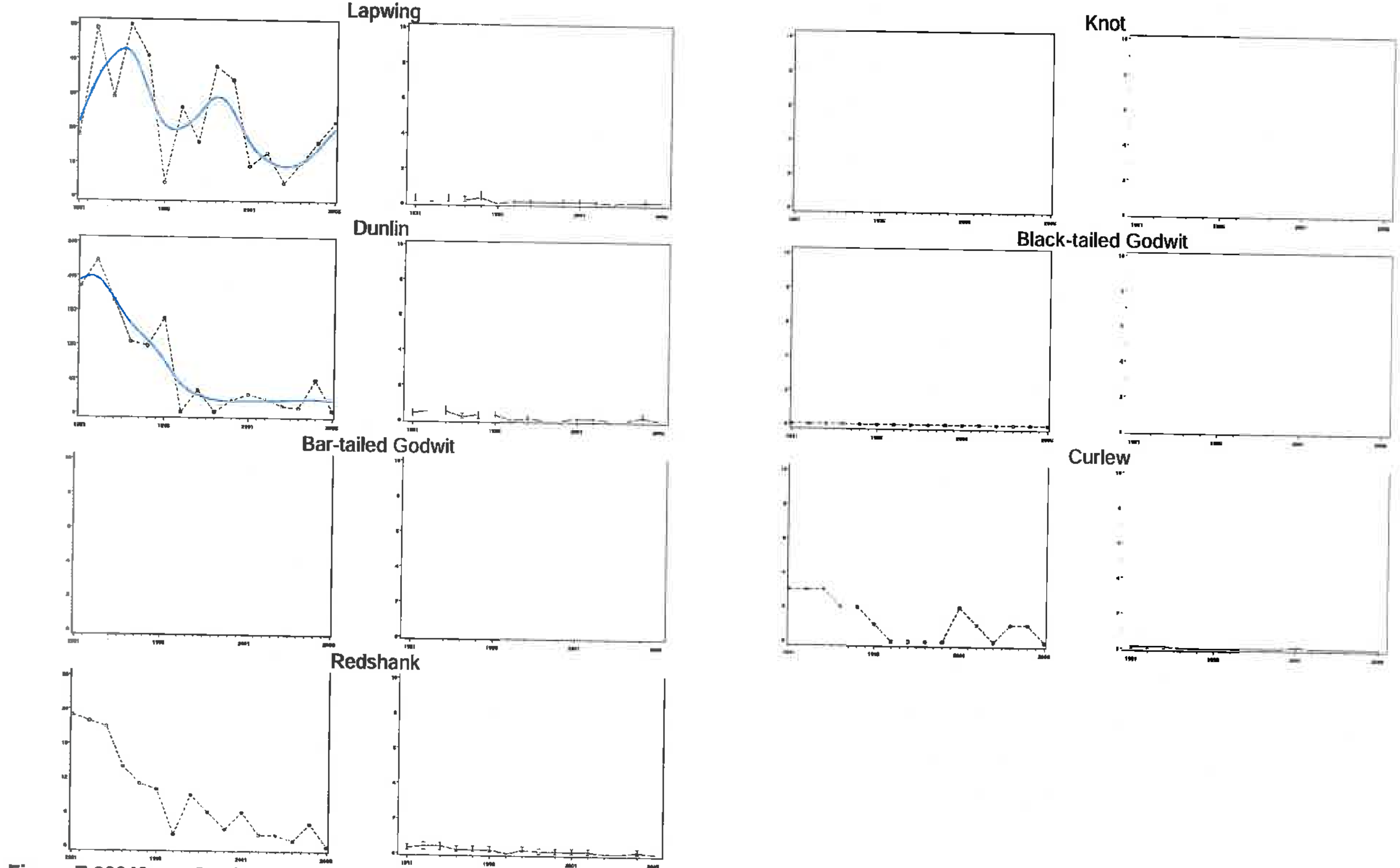

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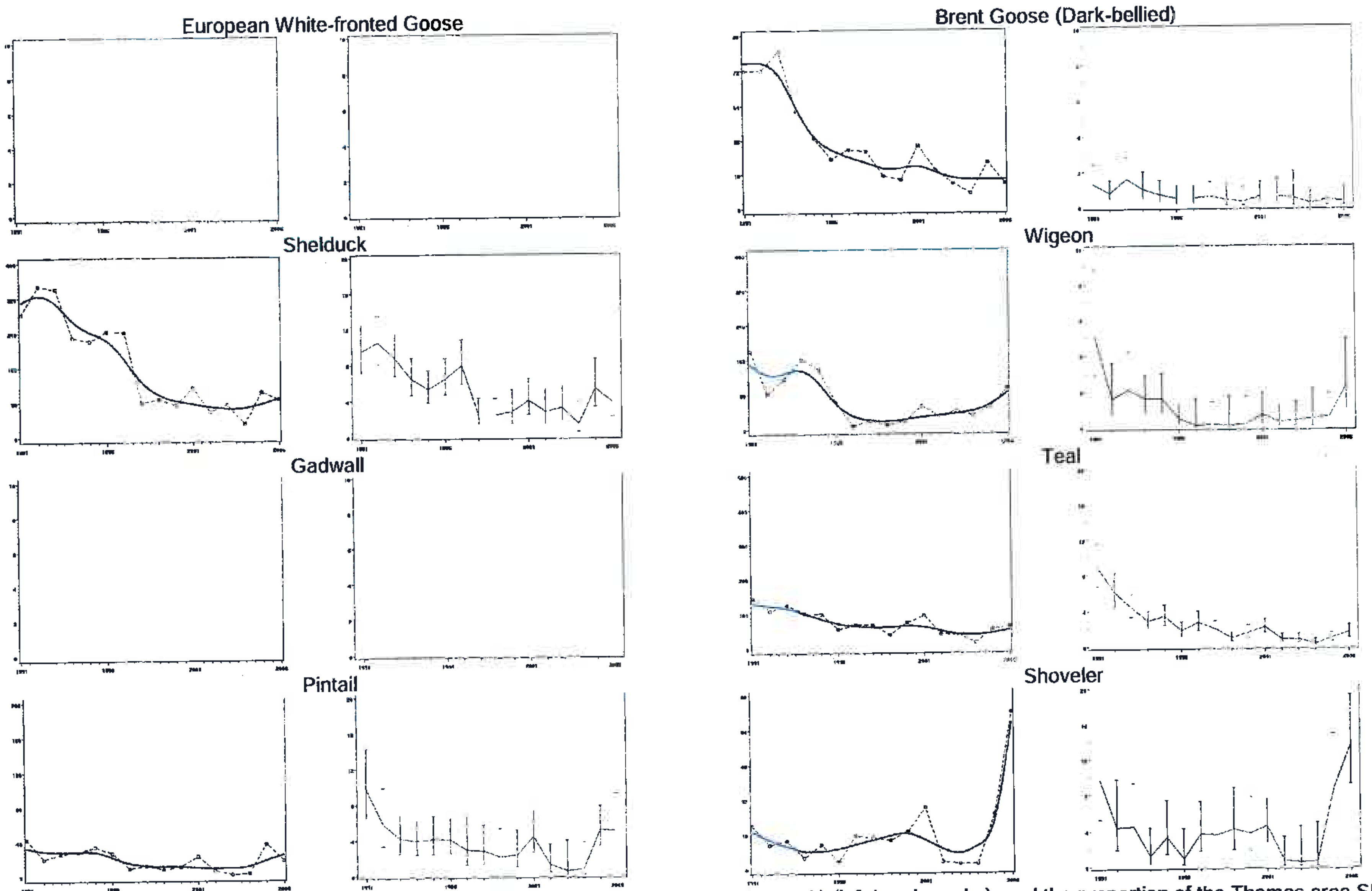
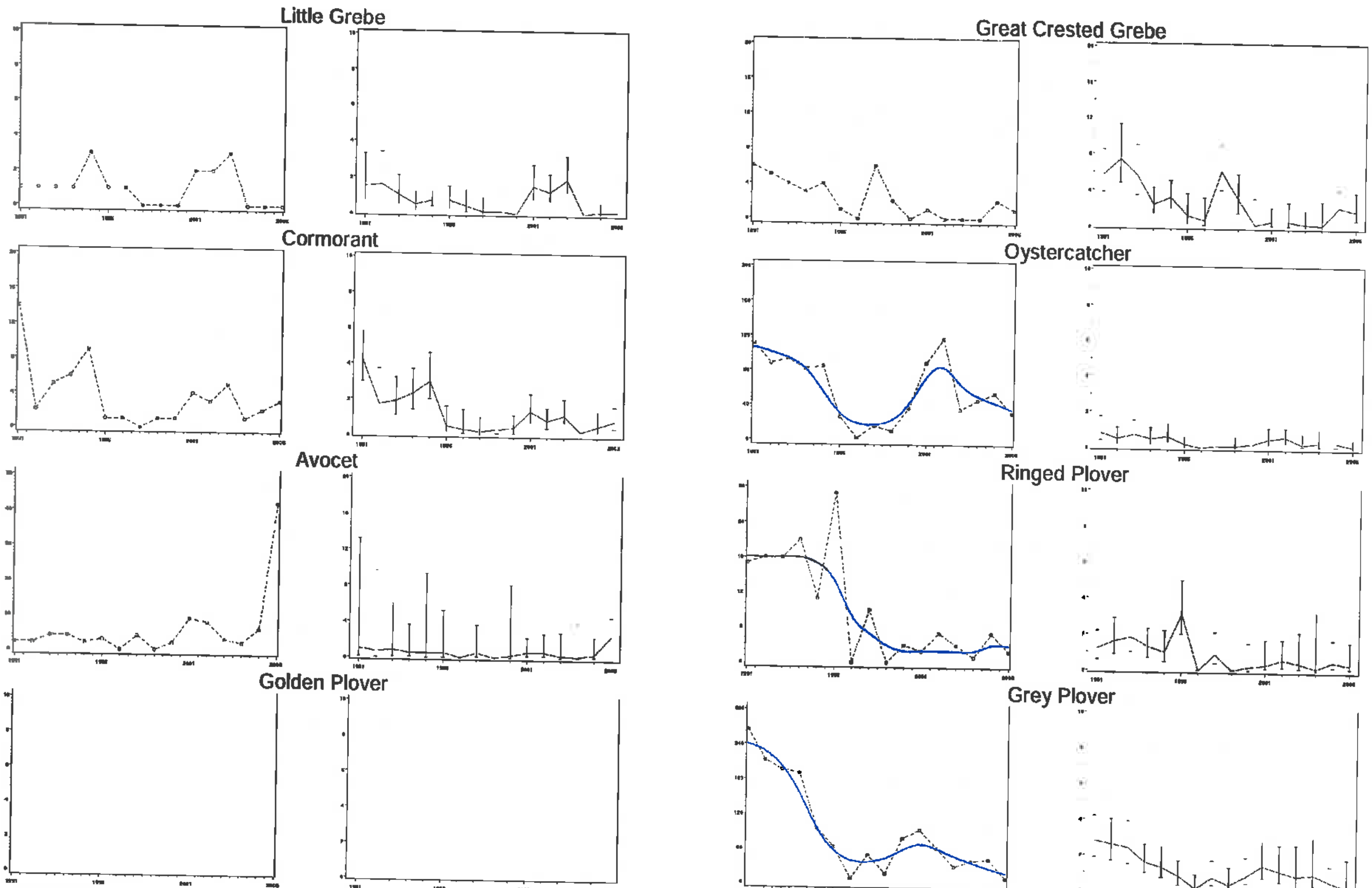


Figure E.22949 Population trends of each species in sector 22949 (Riverside Country Park) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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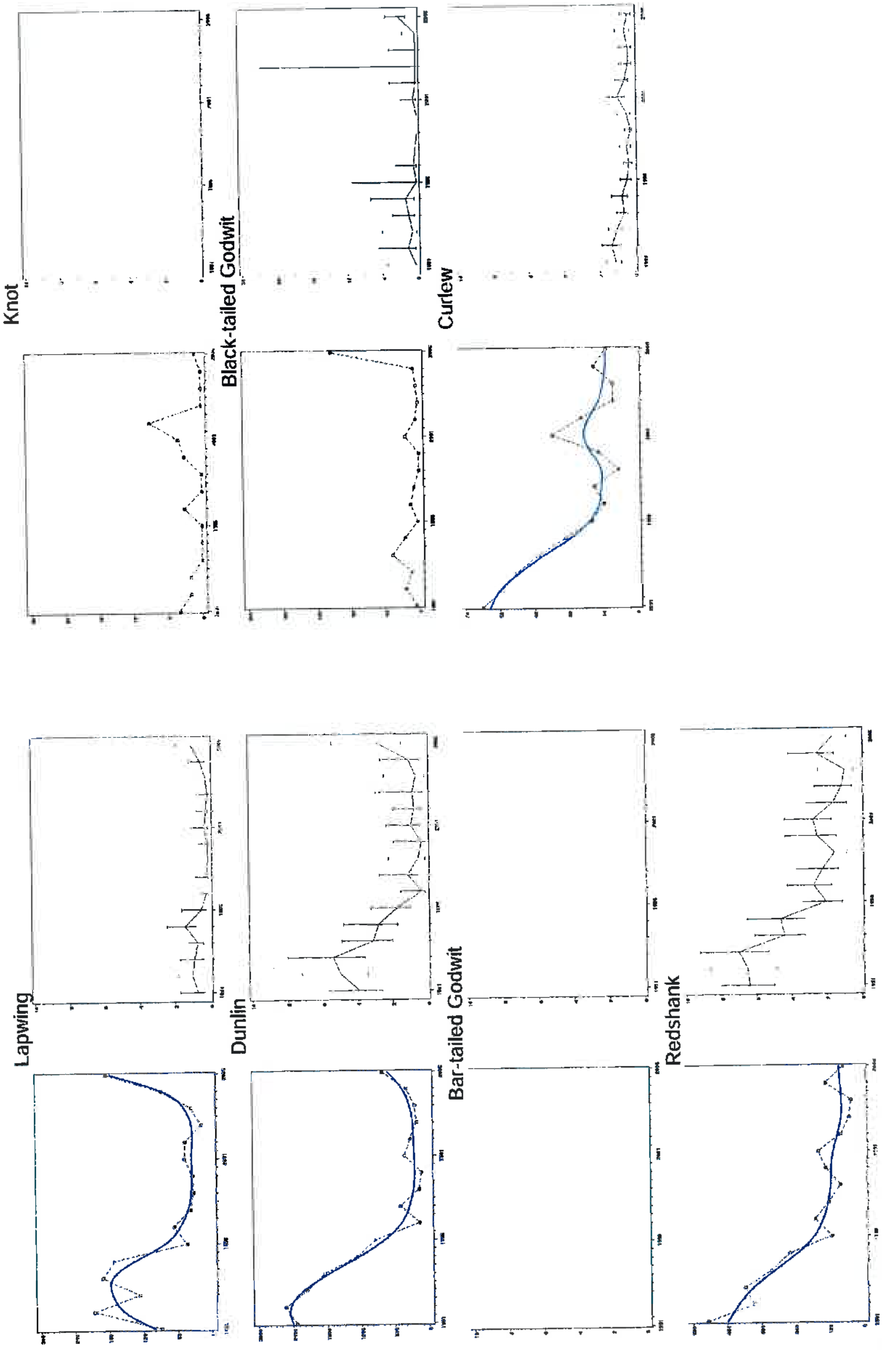

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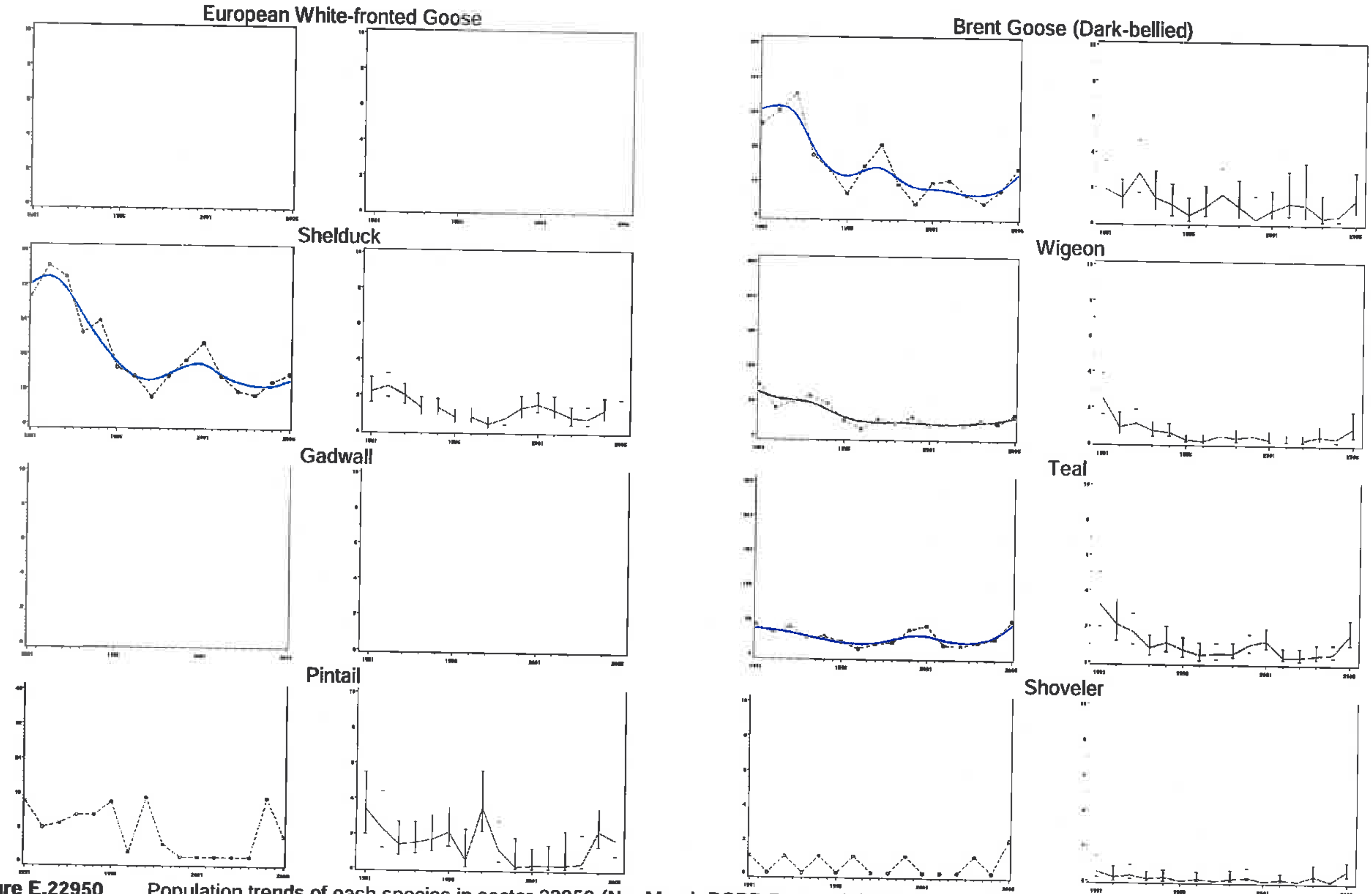
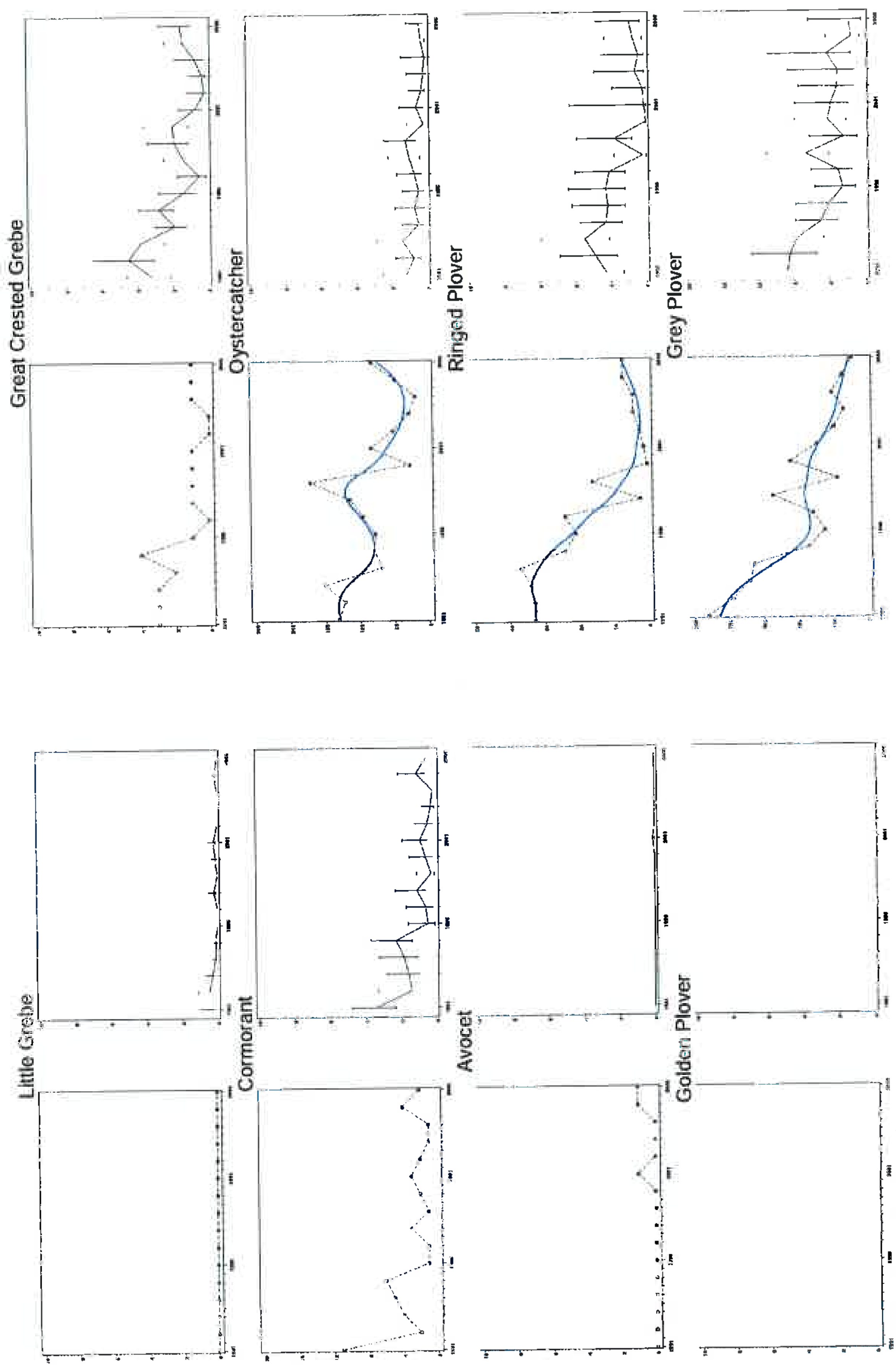


Figure E.22950 Population trends of each species in sector 22950 (Nor Marsh RSPB Reserve) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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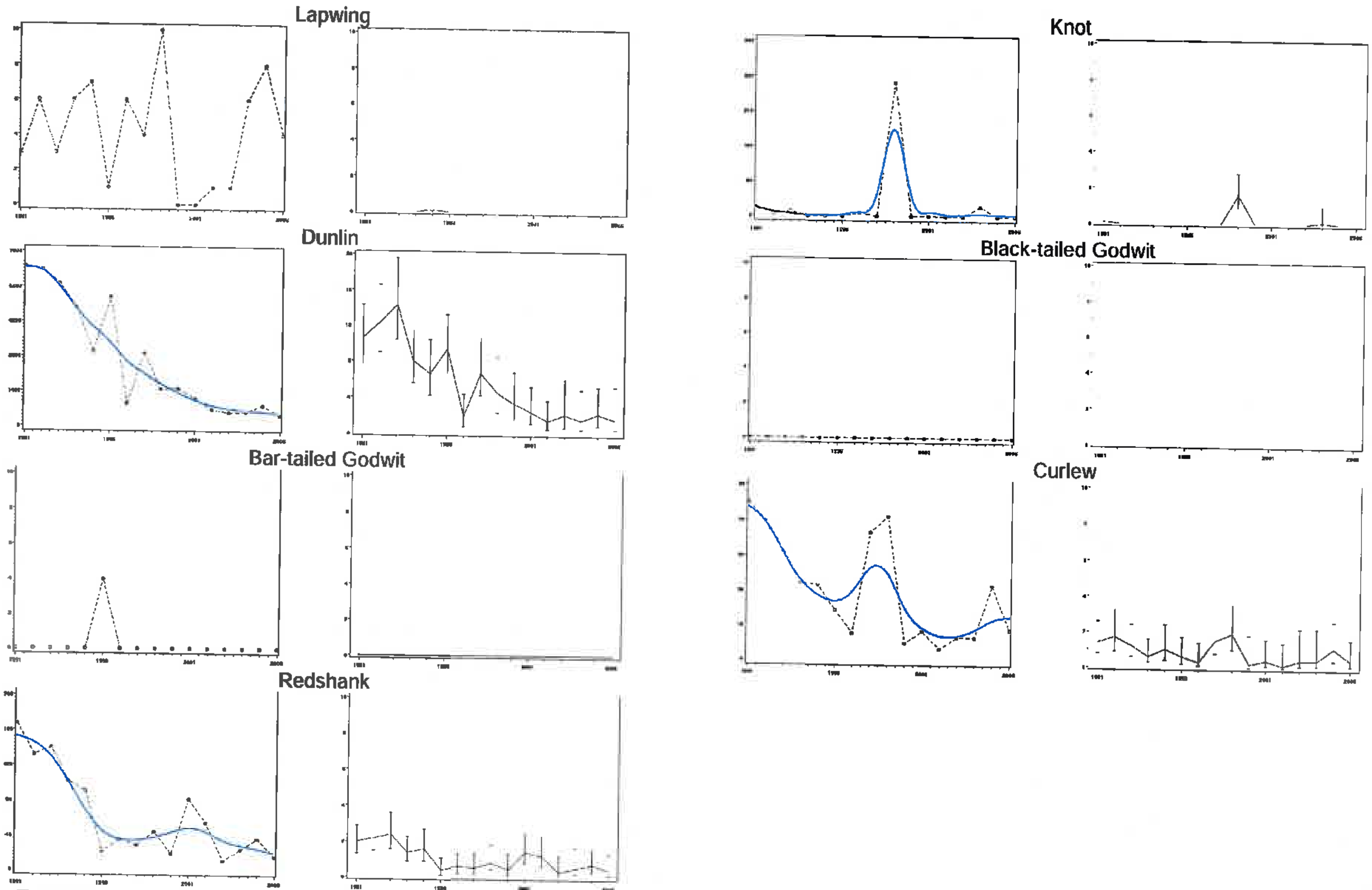

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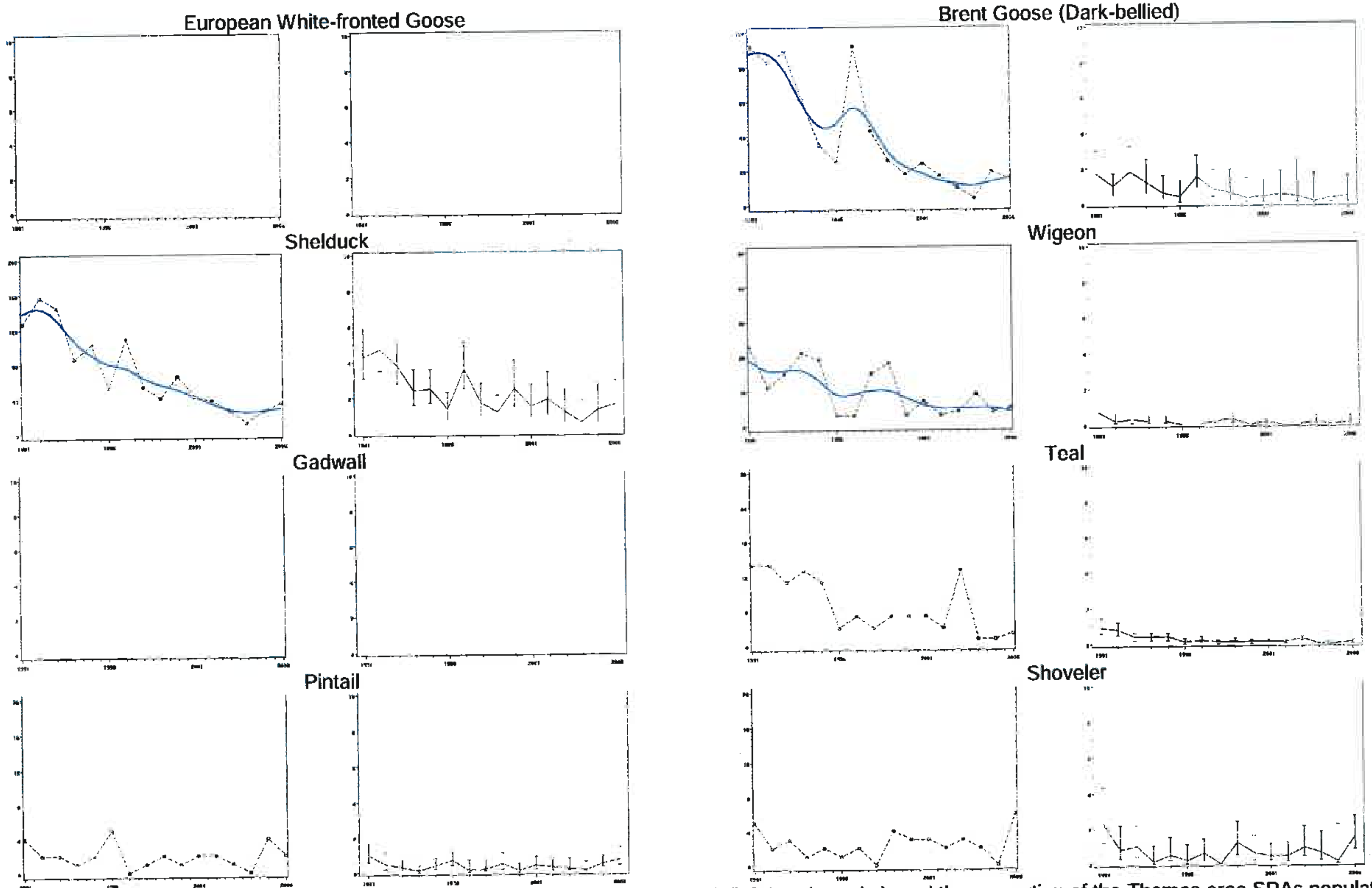
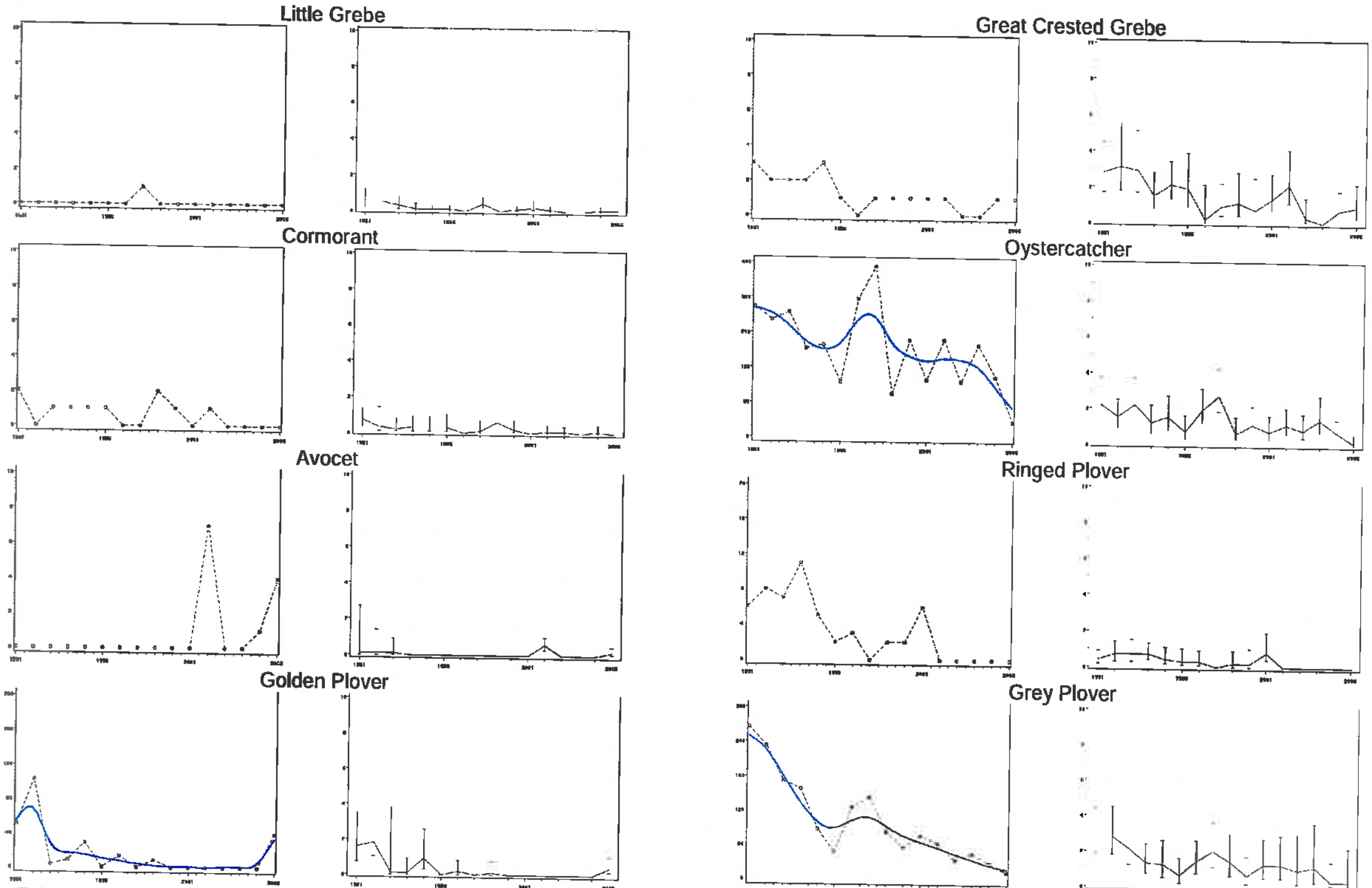


Figure E.22951 Population trends of each species in sector 22951 (Frys Marsh) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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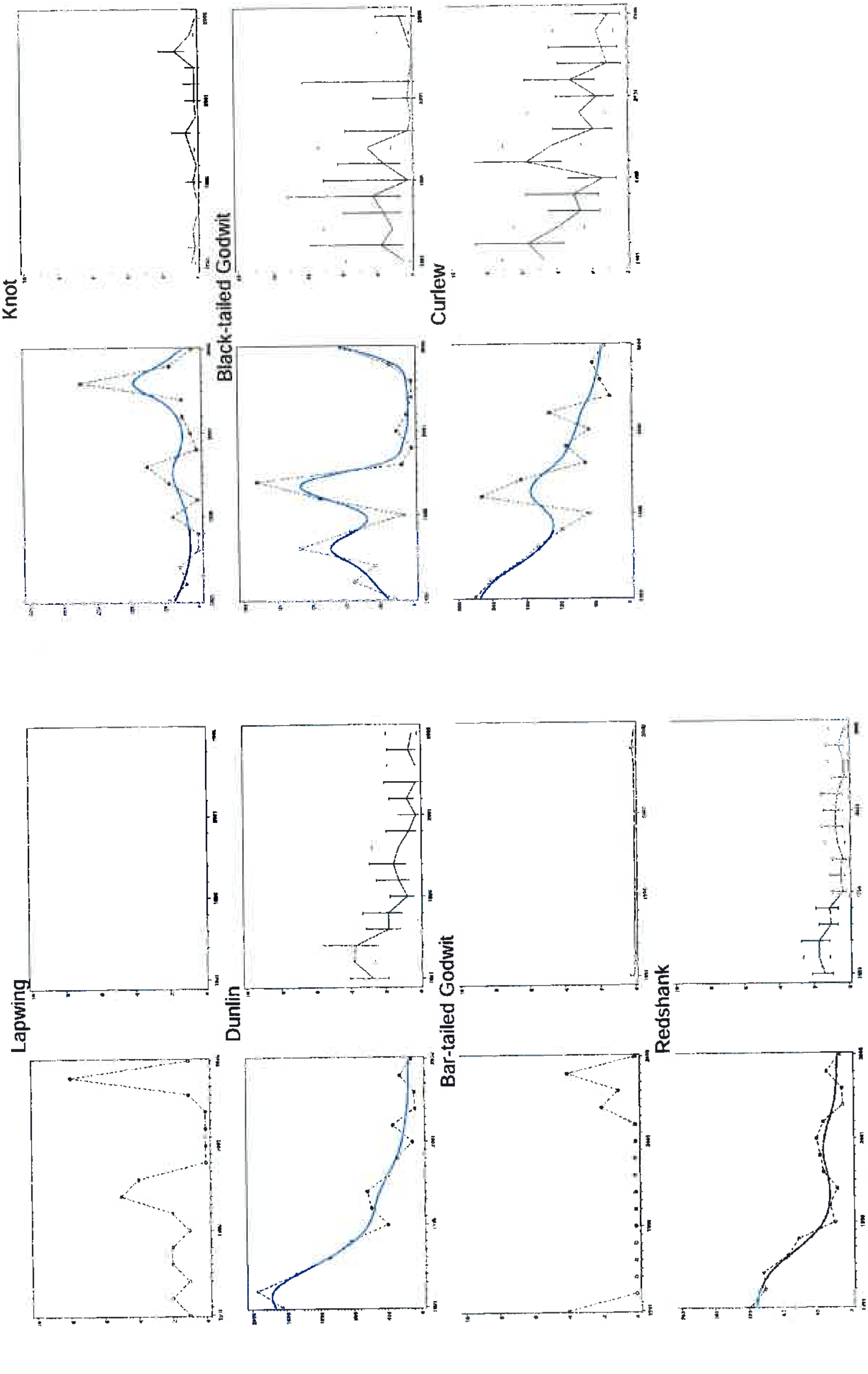

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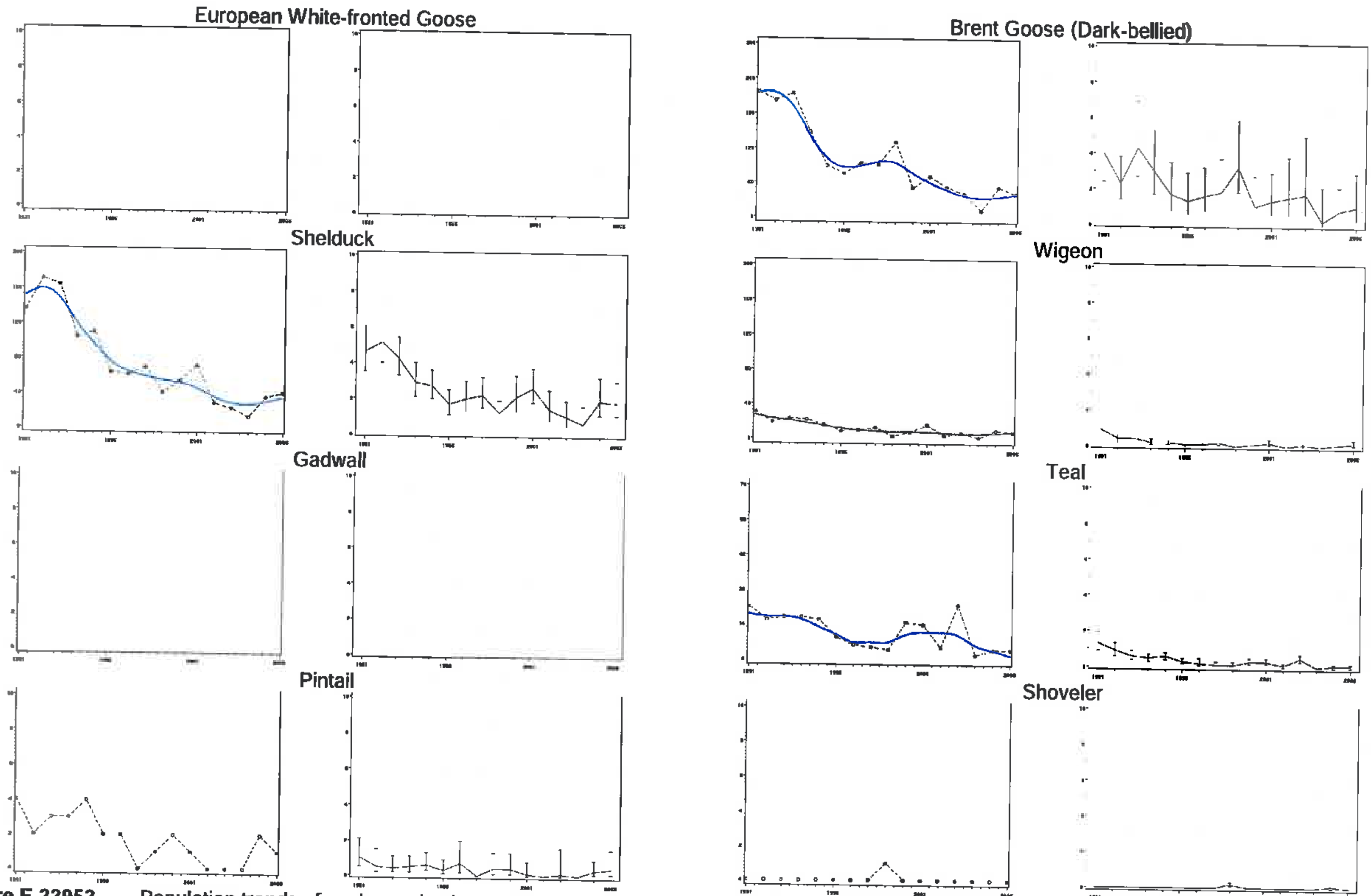
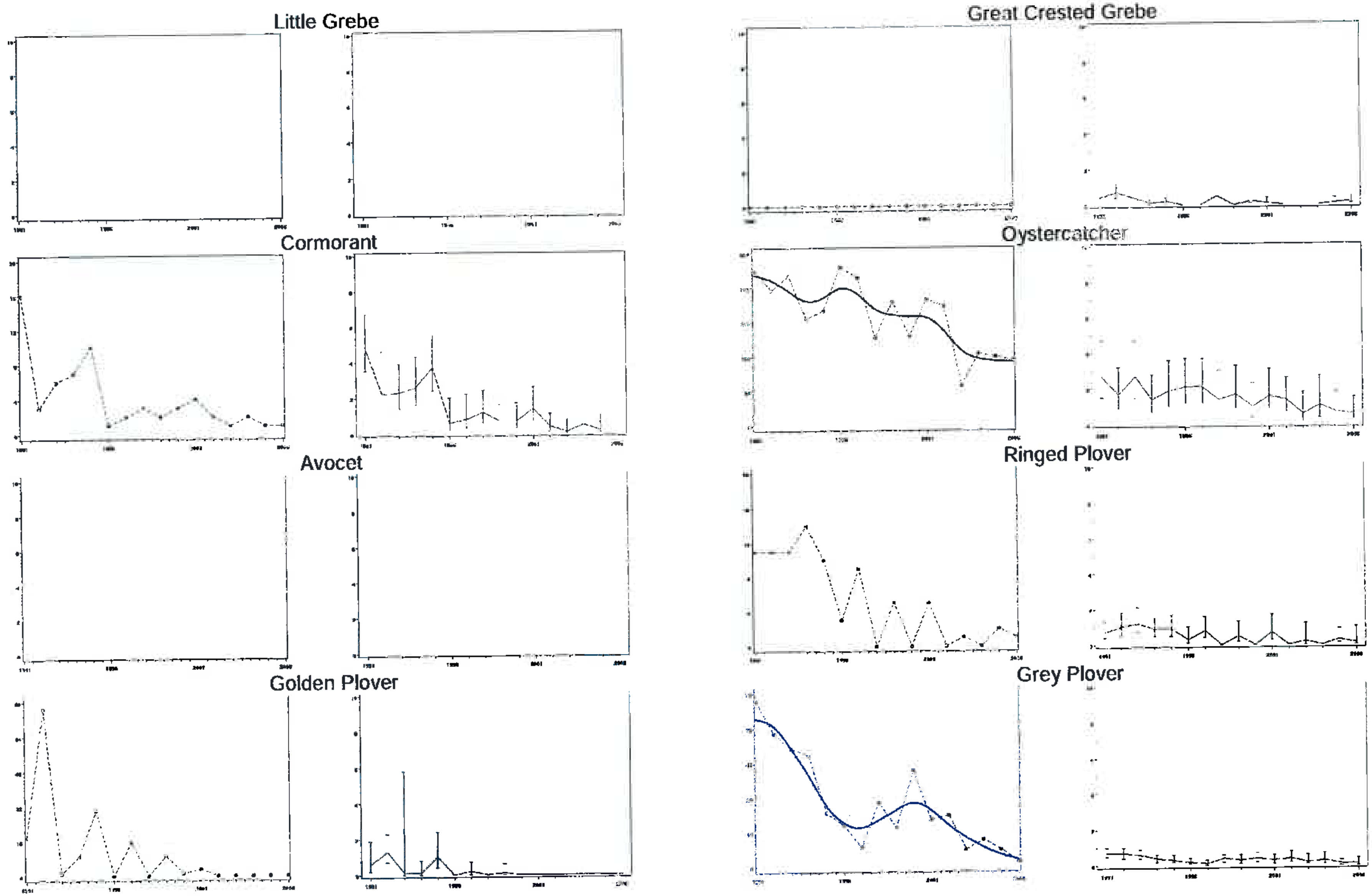


Figure E.22952 Population trends of each species in sector 22952 (Bishop Islands) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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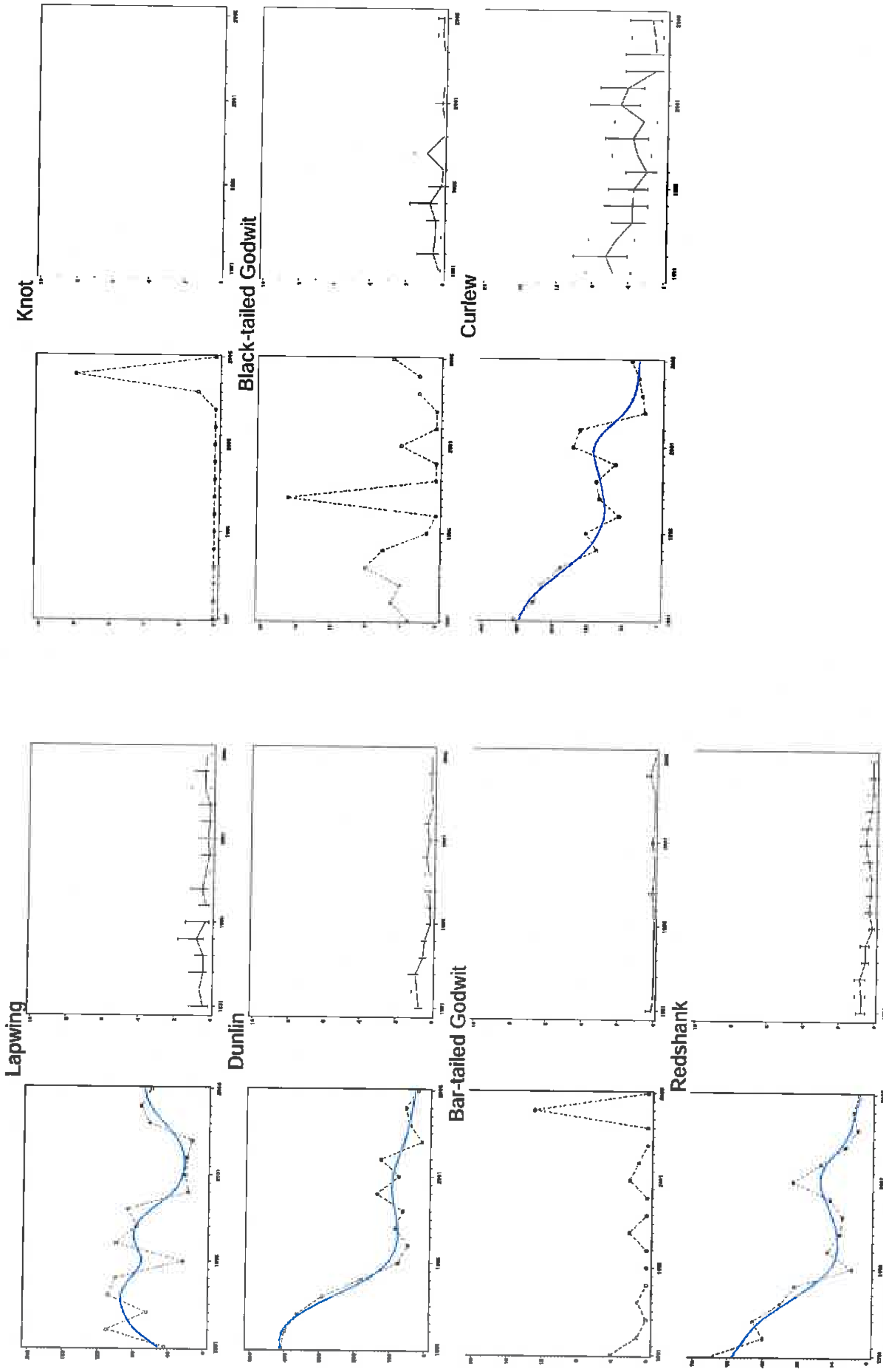

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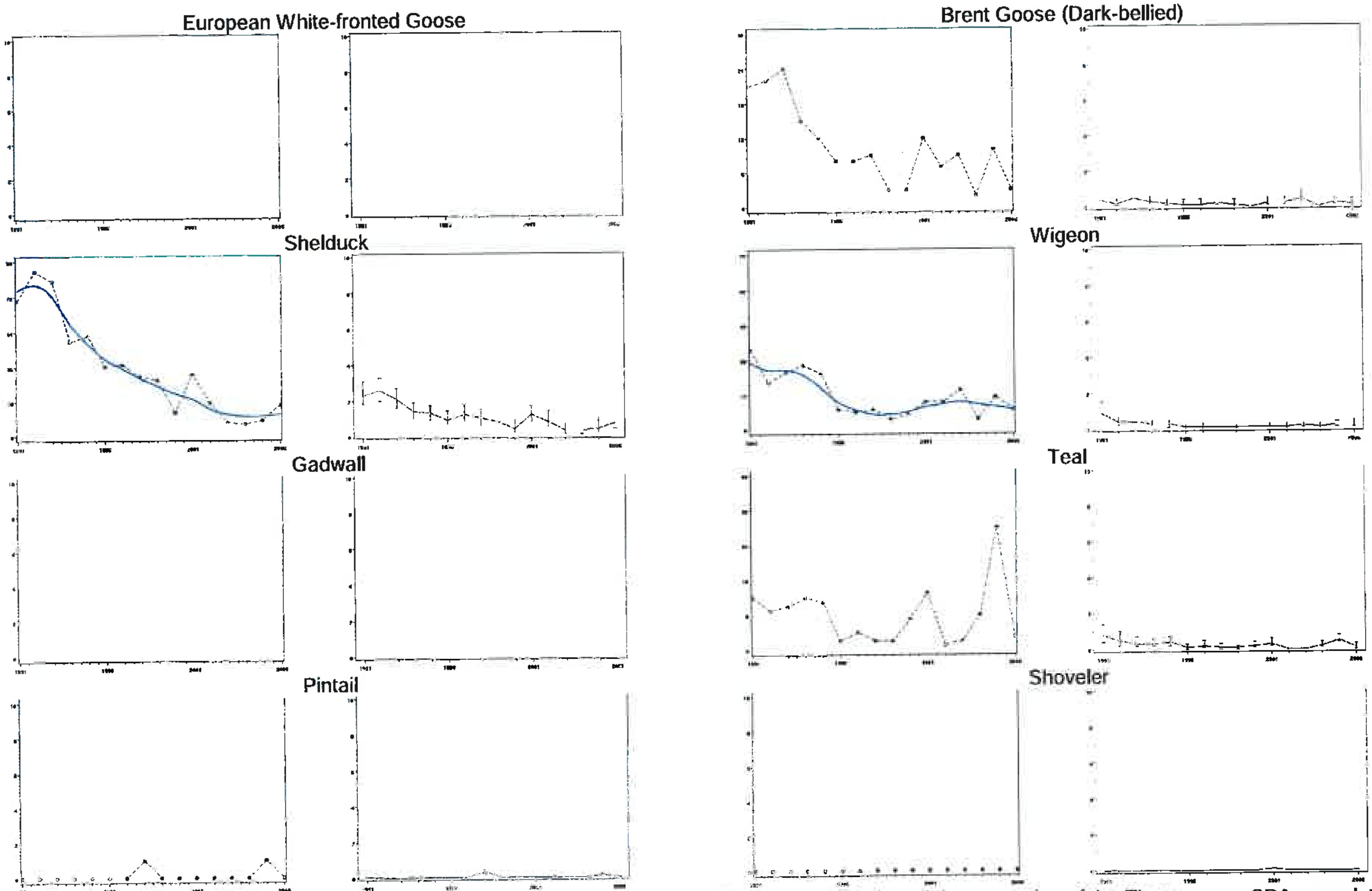
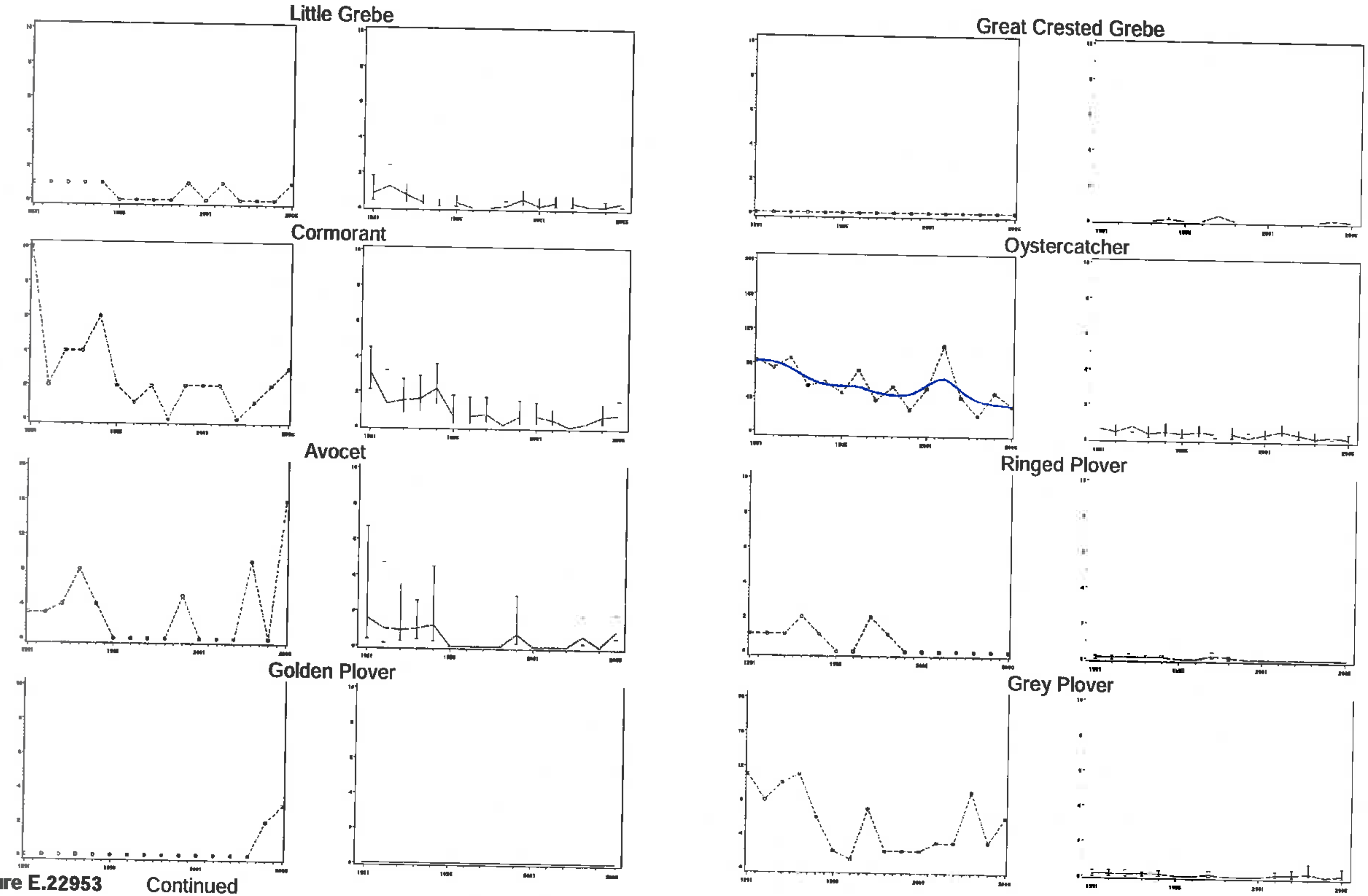


Figure E.22953 Population trends of each species in sector 22953 (Hoo Island) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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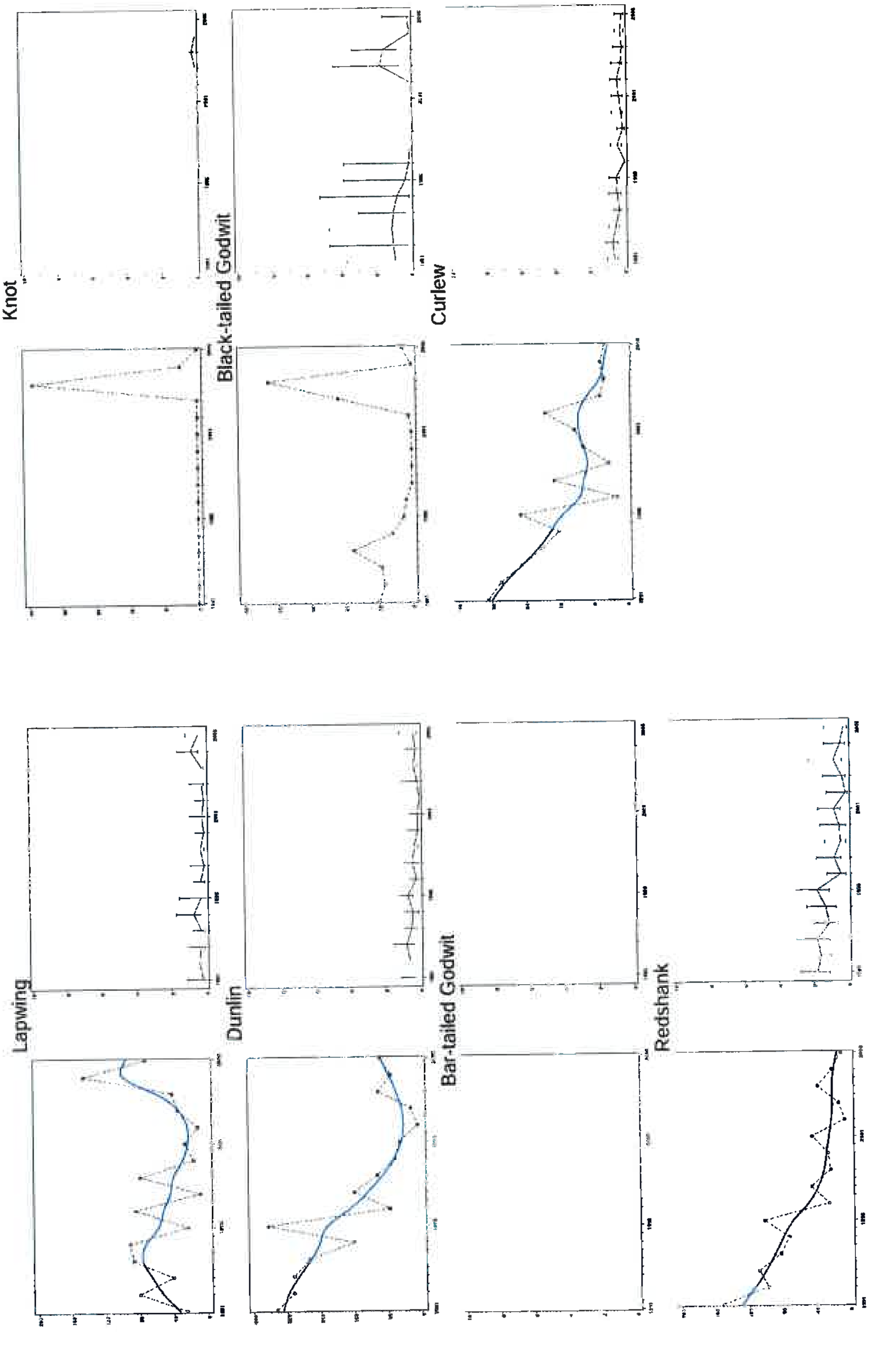

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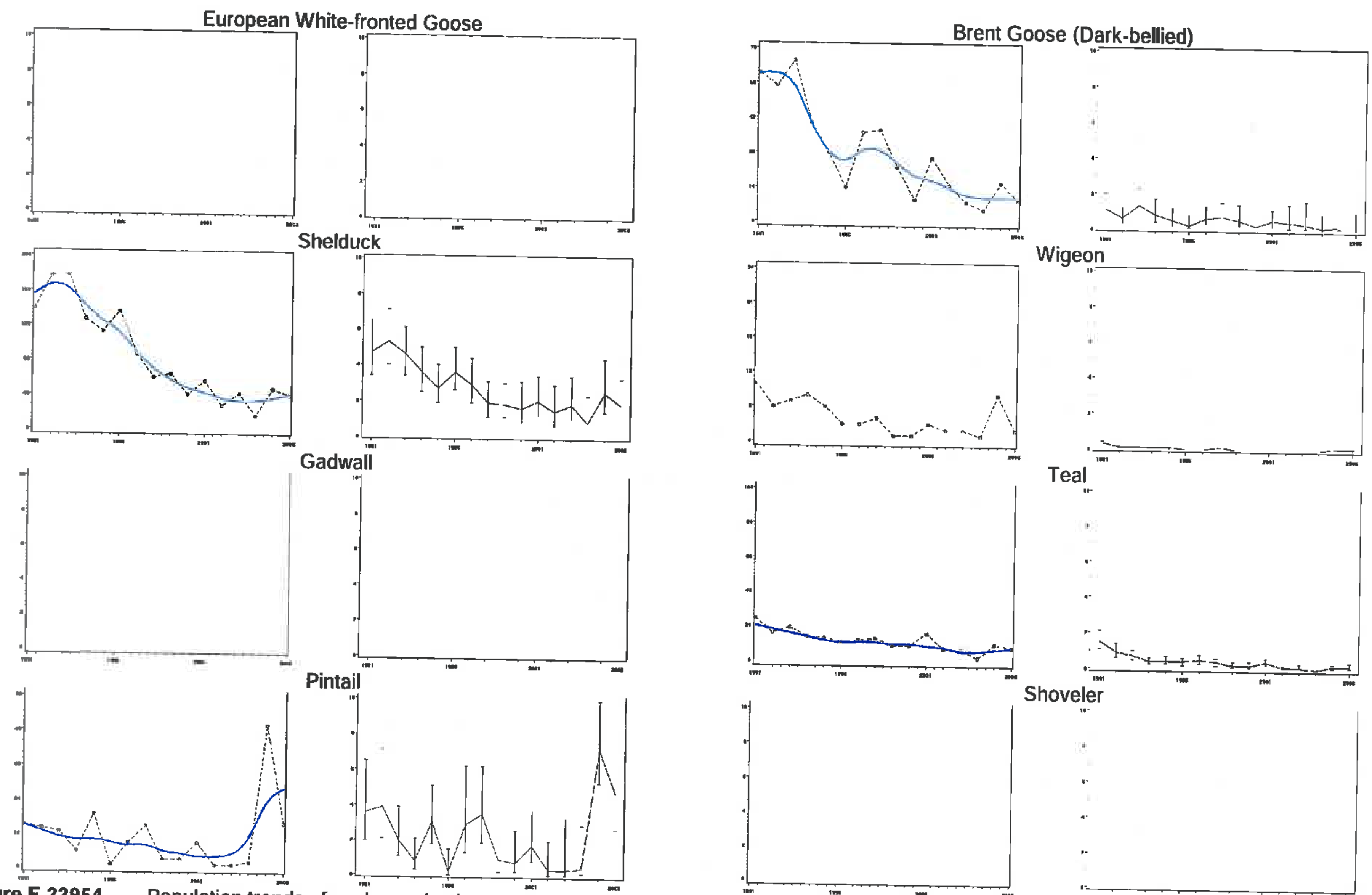
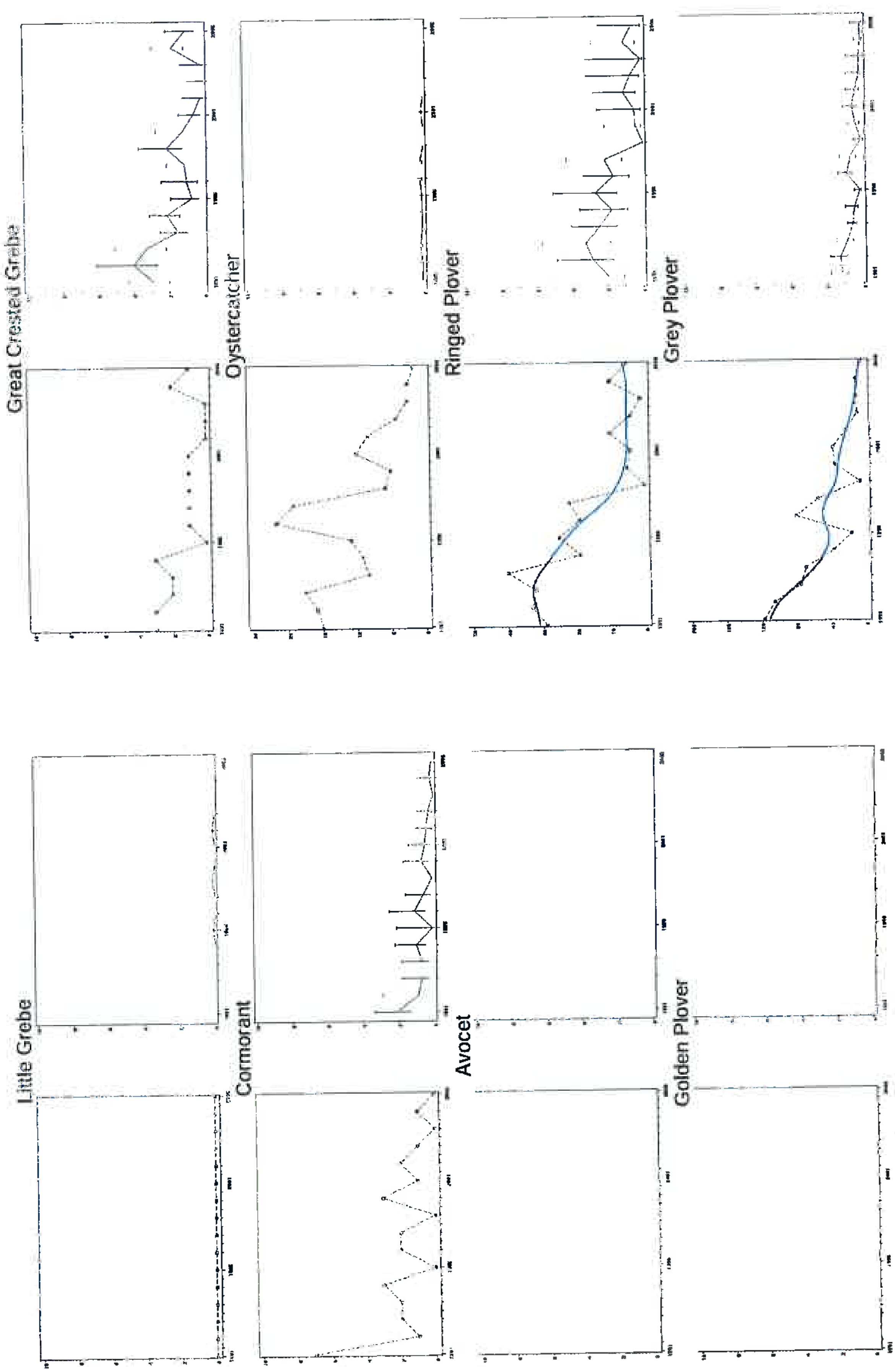


Figure E.22954 Population trends of each species in sector 22954 (Copperhouse Bay) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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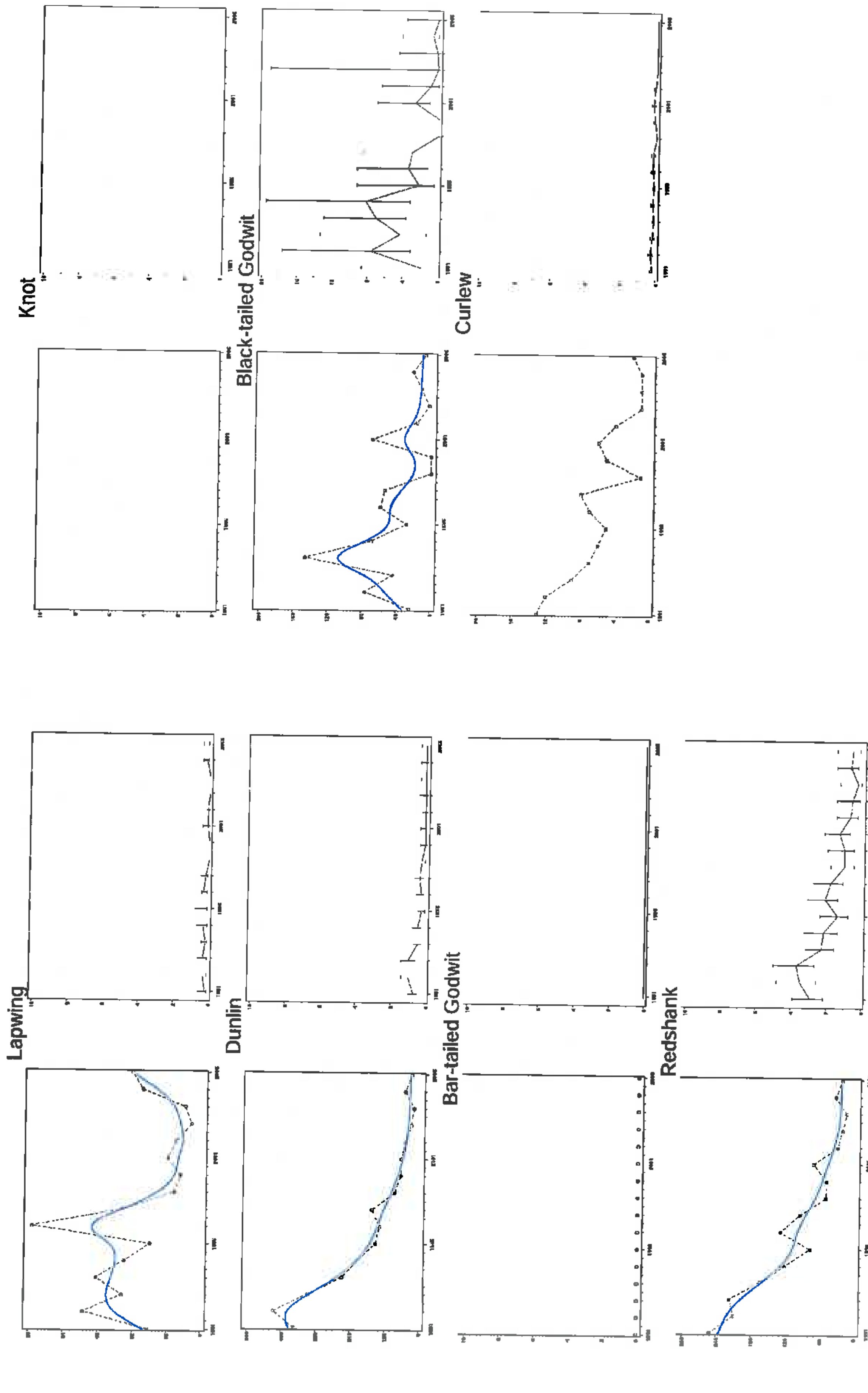

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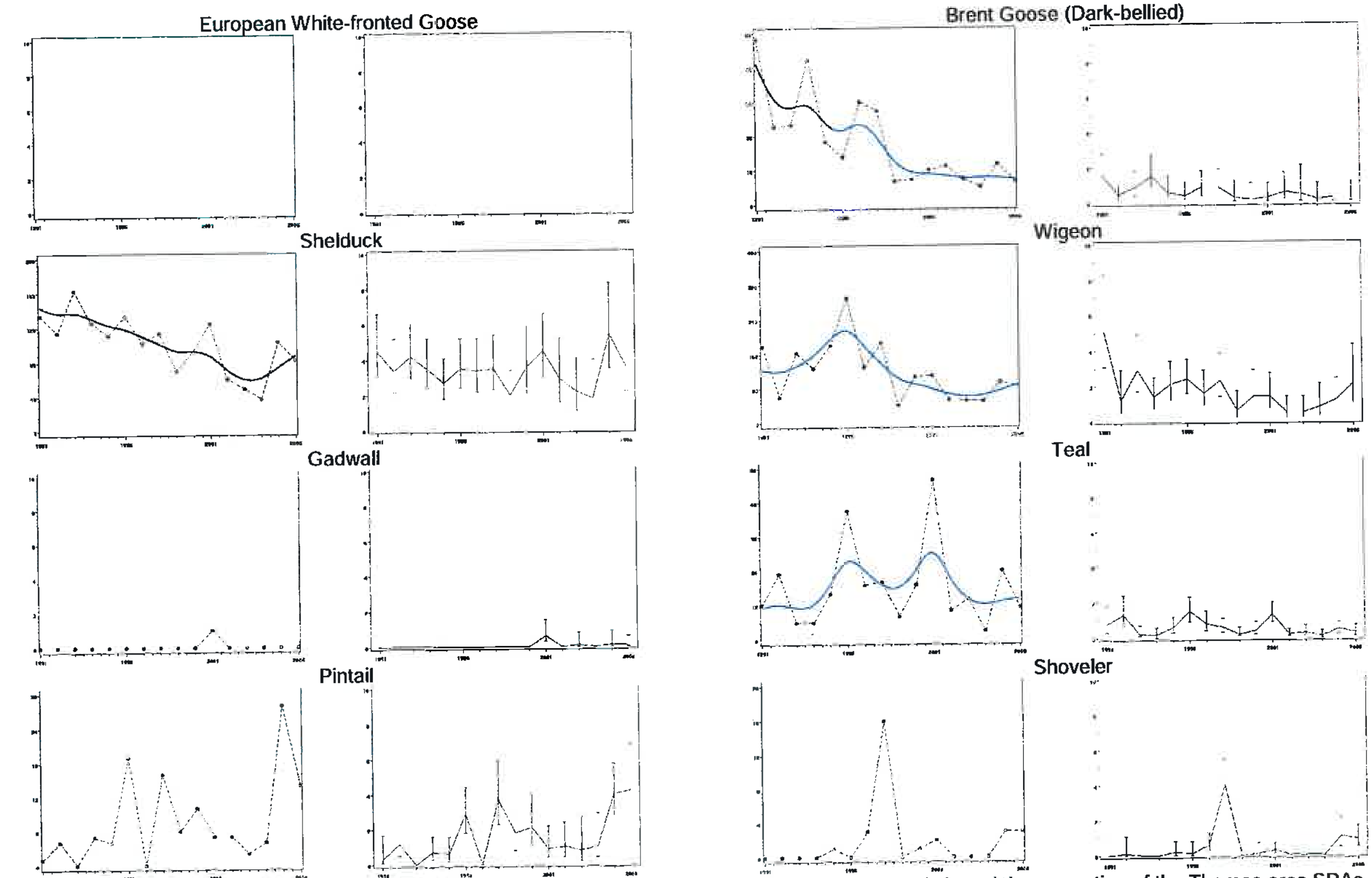
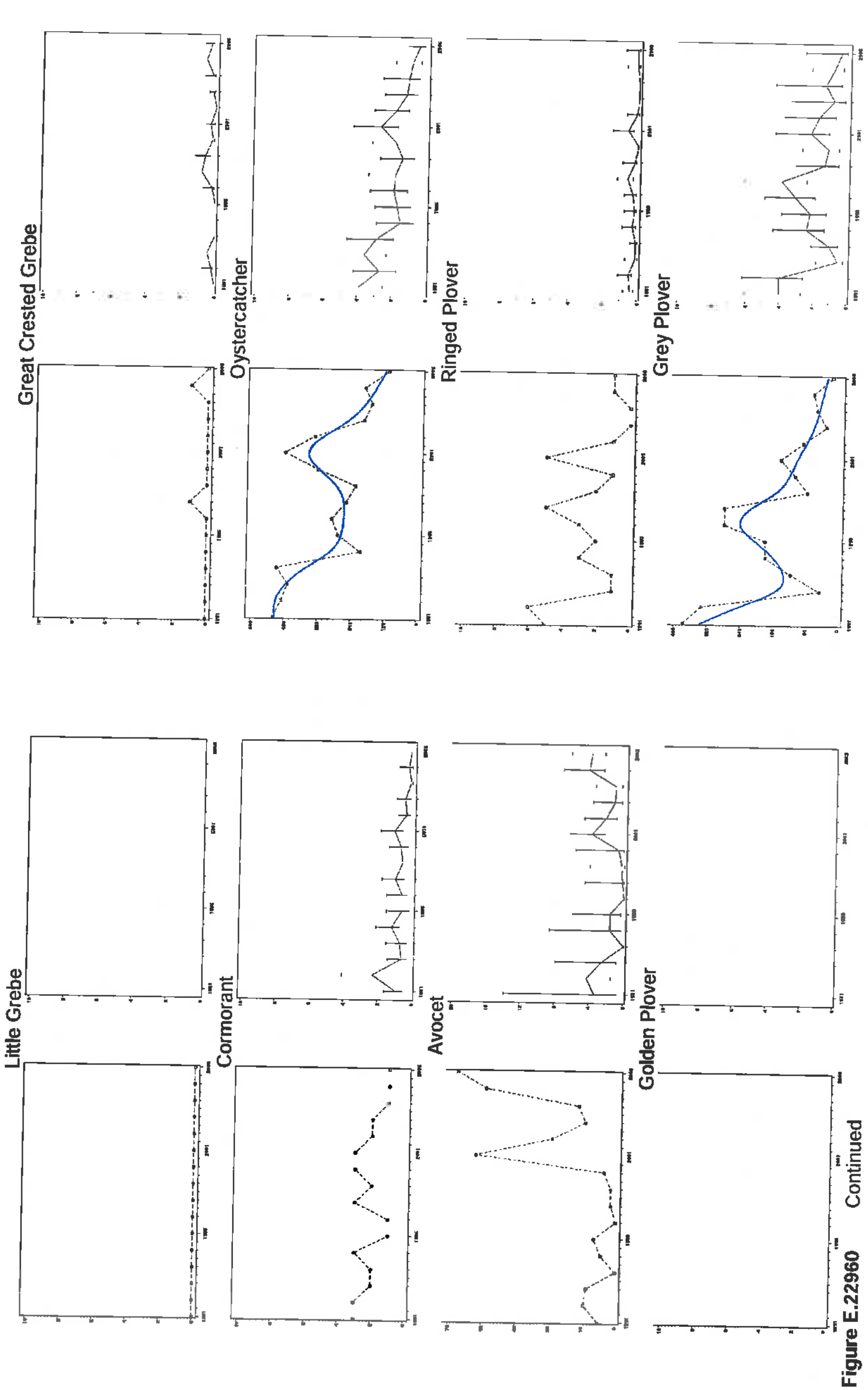


Figure E.22960 Population trends of each species in sector 22960 (Deadmans Island) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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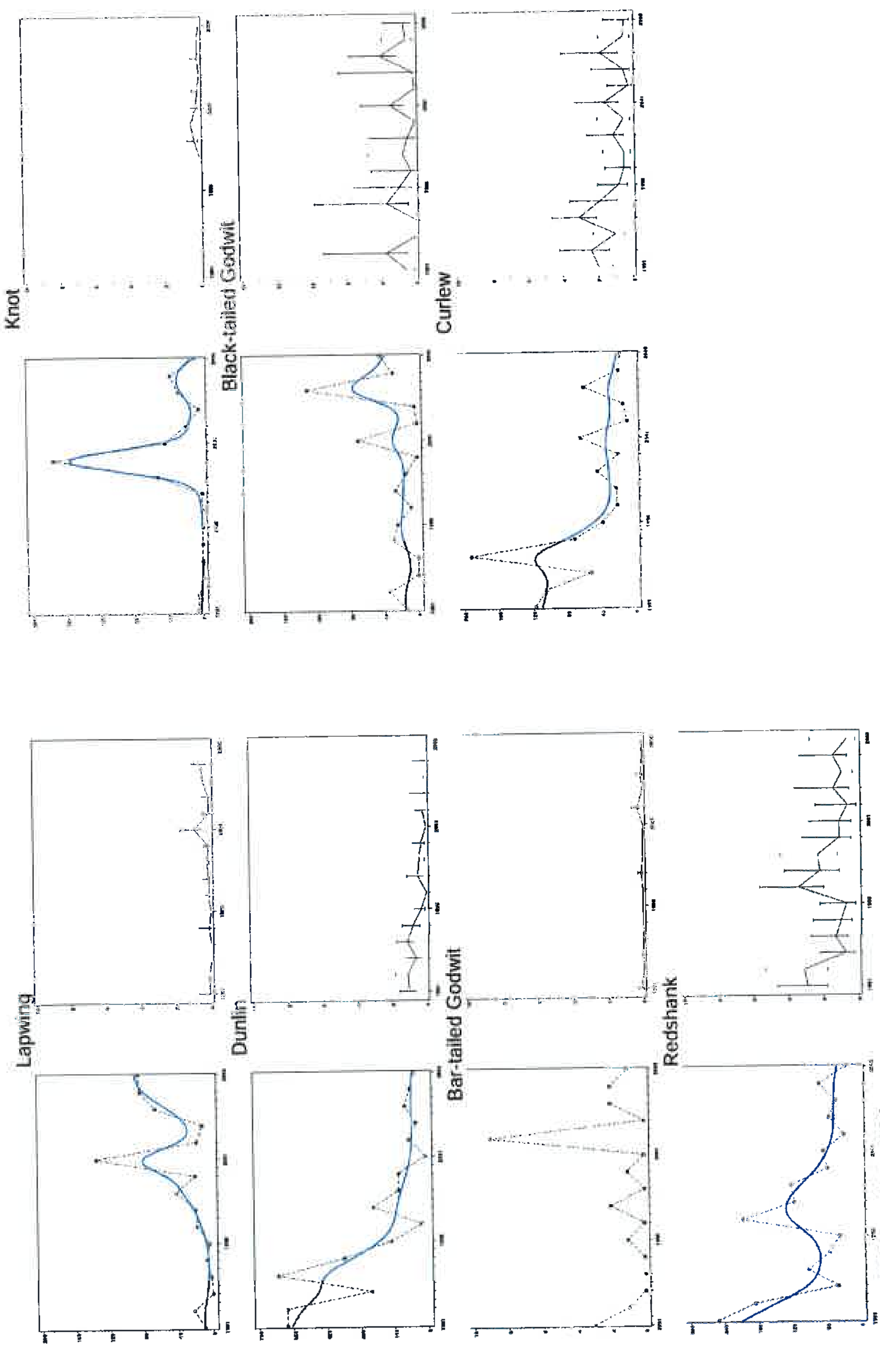

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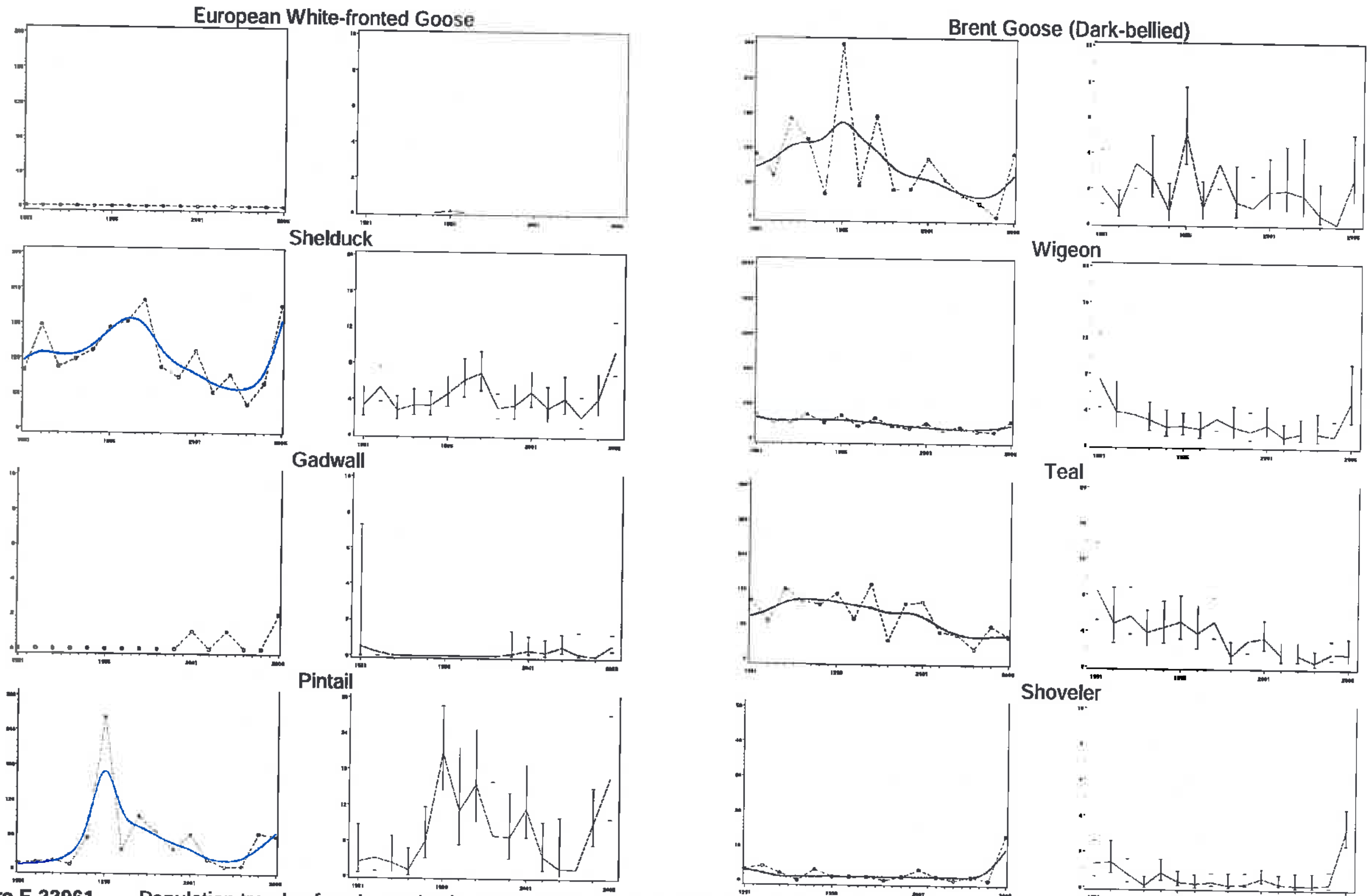
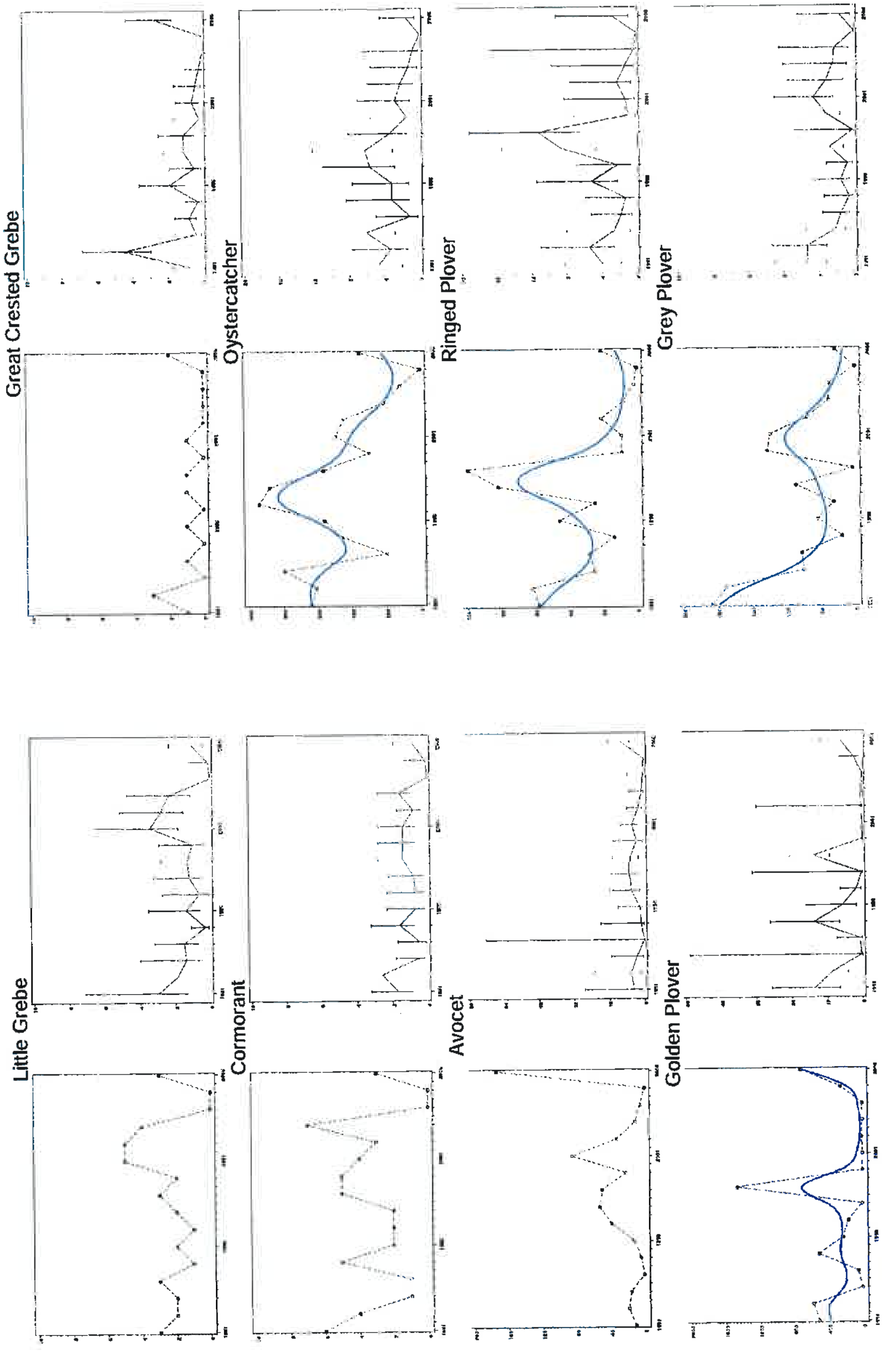


Figure E.22961 Population trends of each species in sector 22961 (Chetney Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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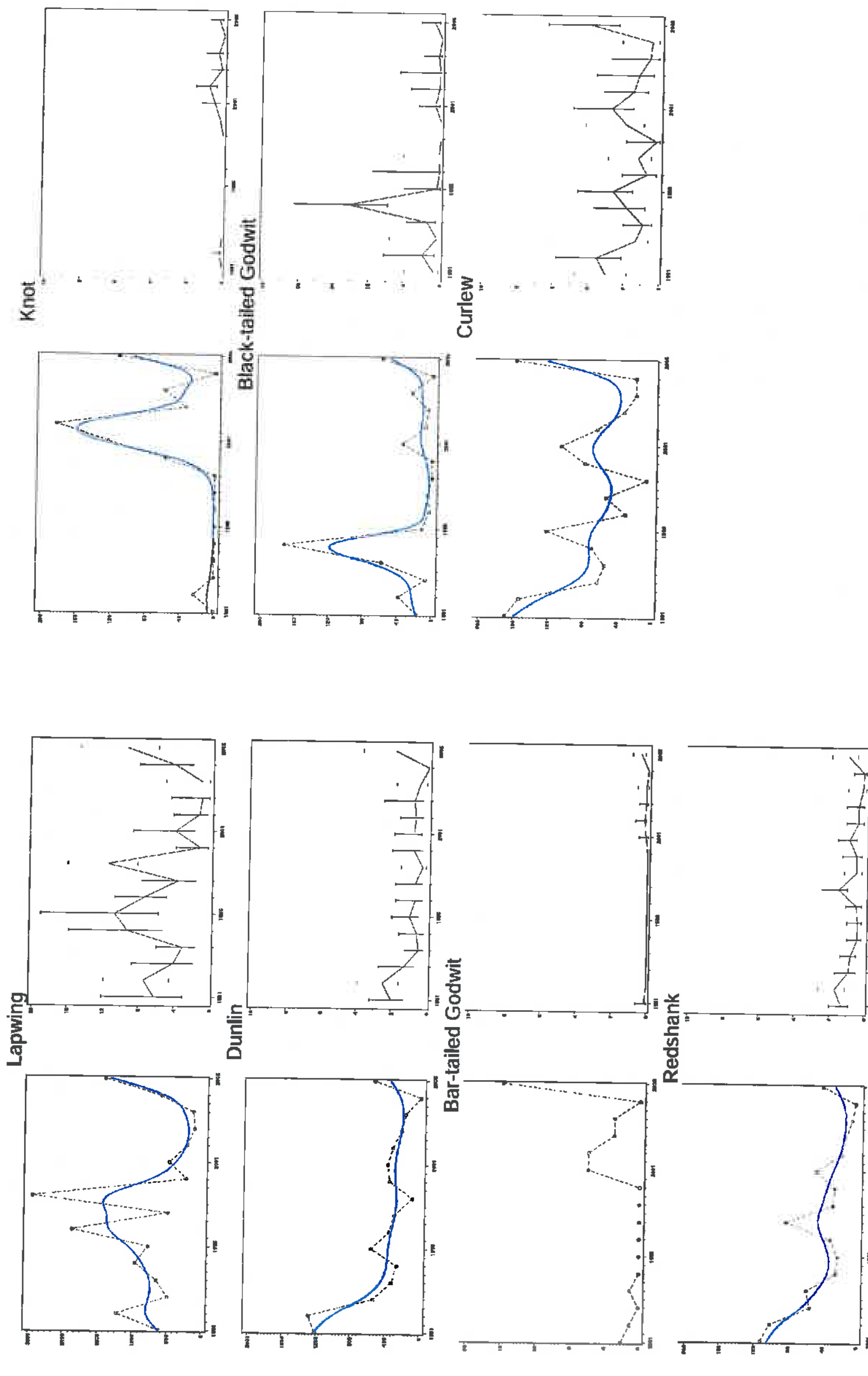

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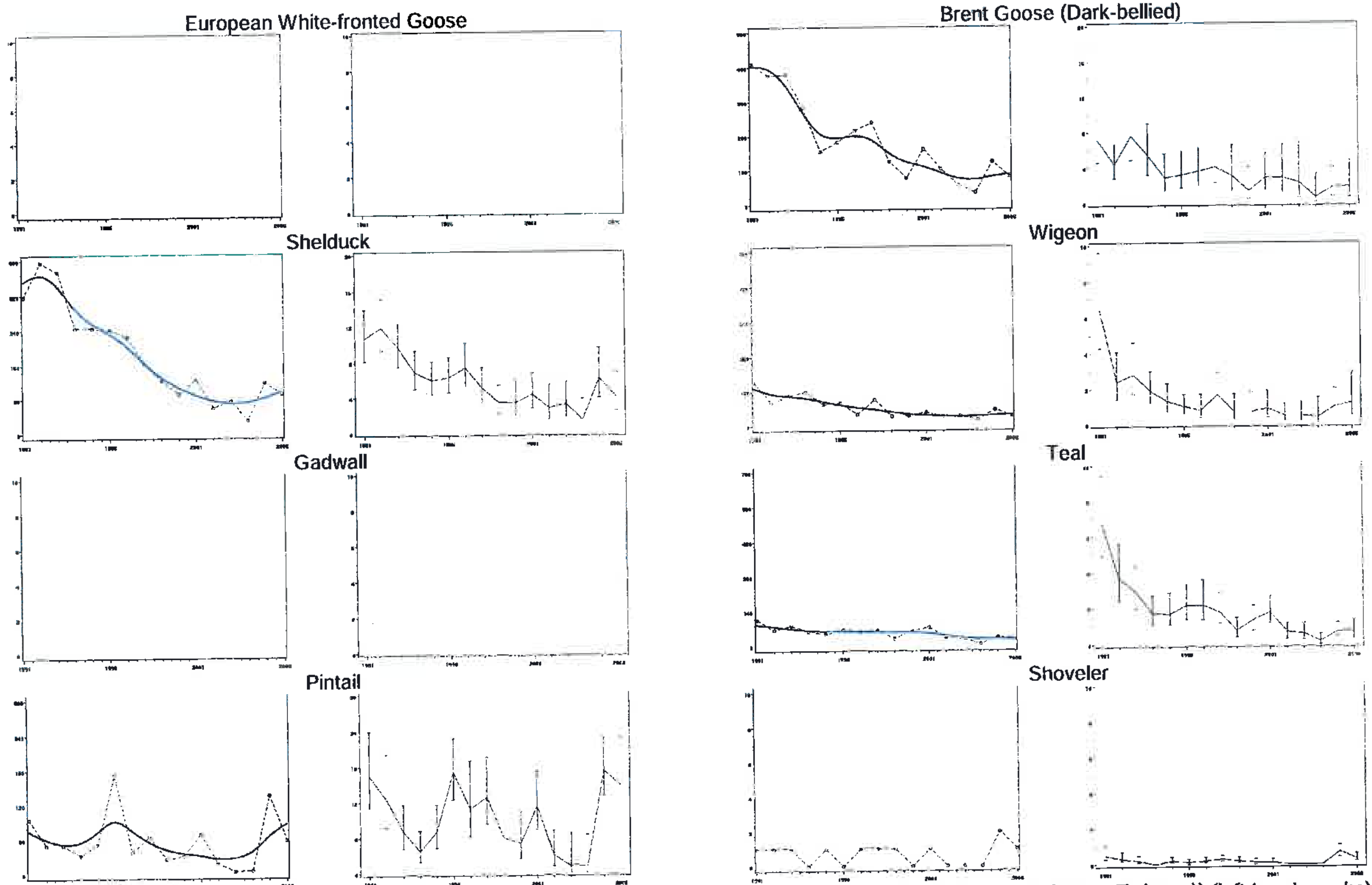


Figure E.22962 Population trends of each species in sector 22962 (Medway Estuary - Milfordhope Marsh (Lower Halstow - Twinney)) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

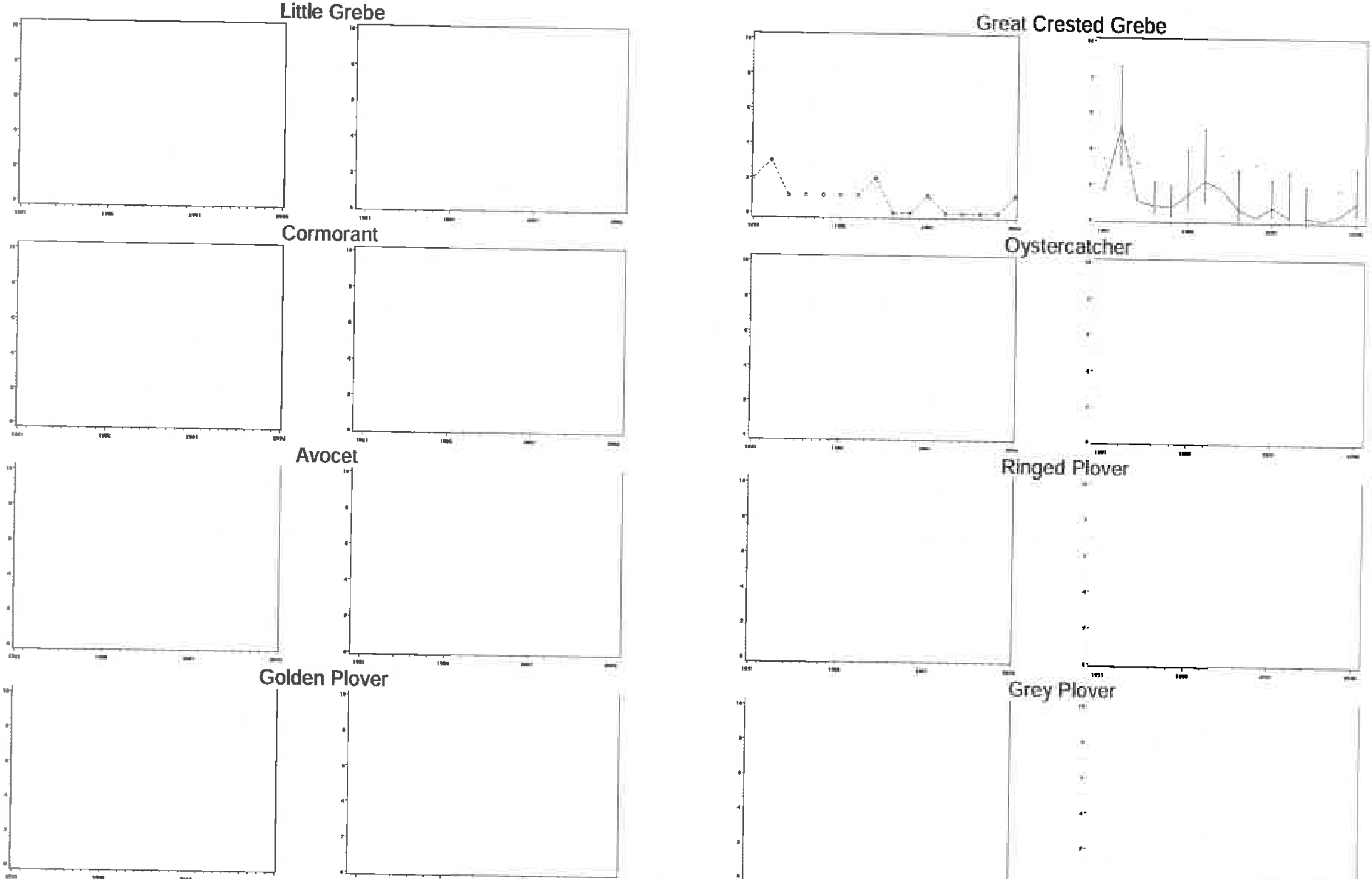
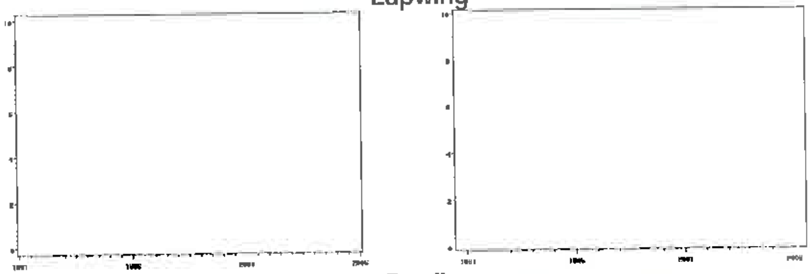
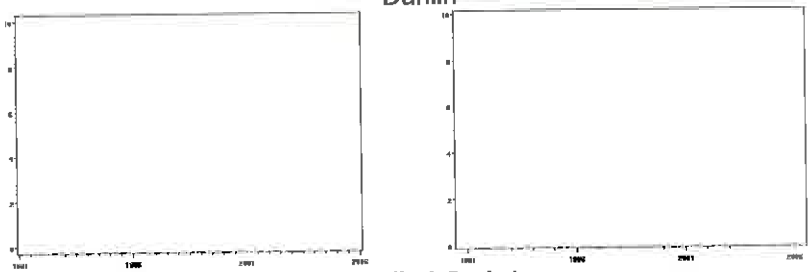


Figure E.22962 Continued

Lapwing

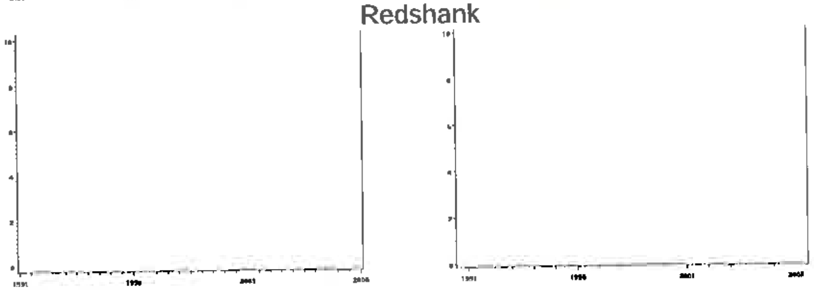


Dunlin

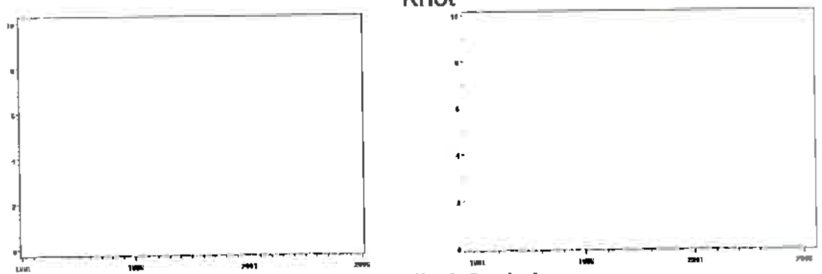


Bar-tailed Godwit

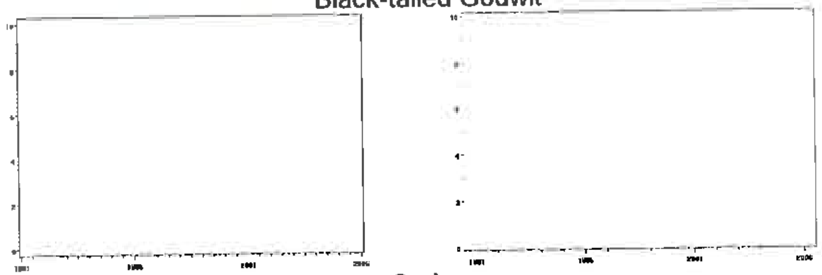
Redshank



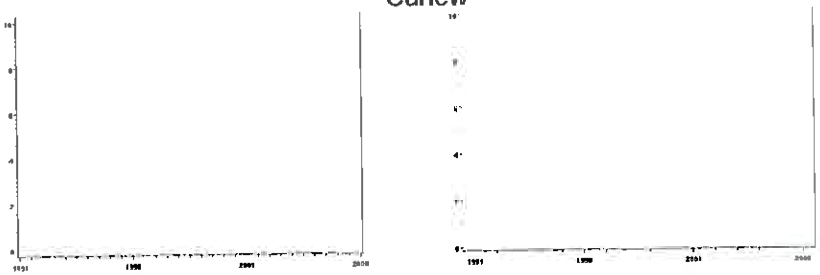
Knot



Black-tailed Godwit



Curlew



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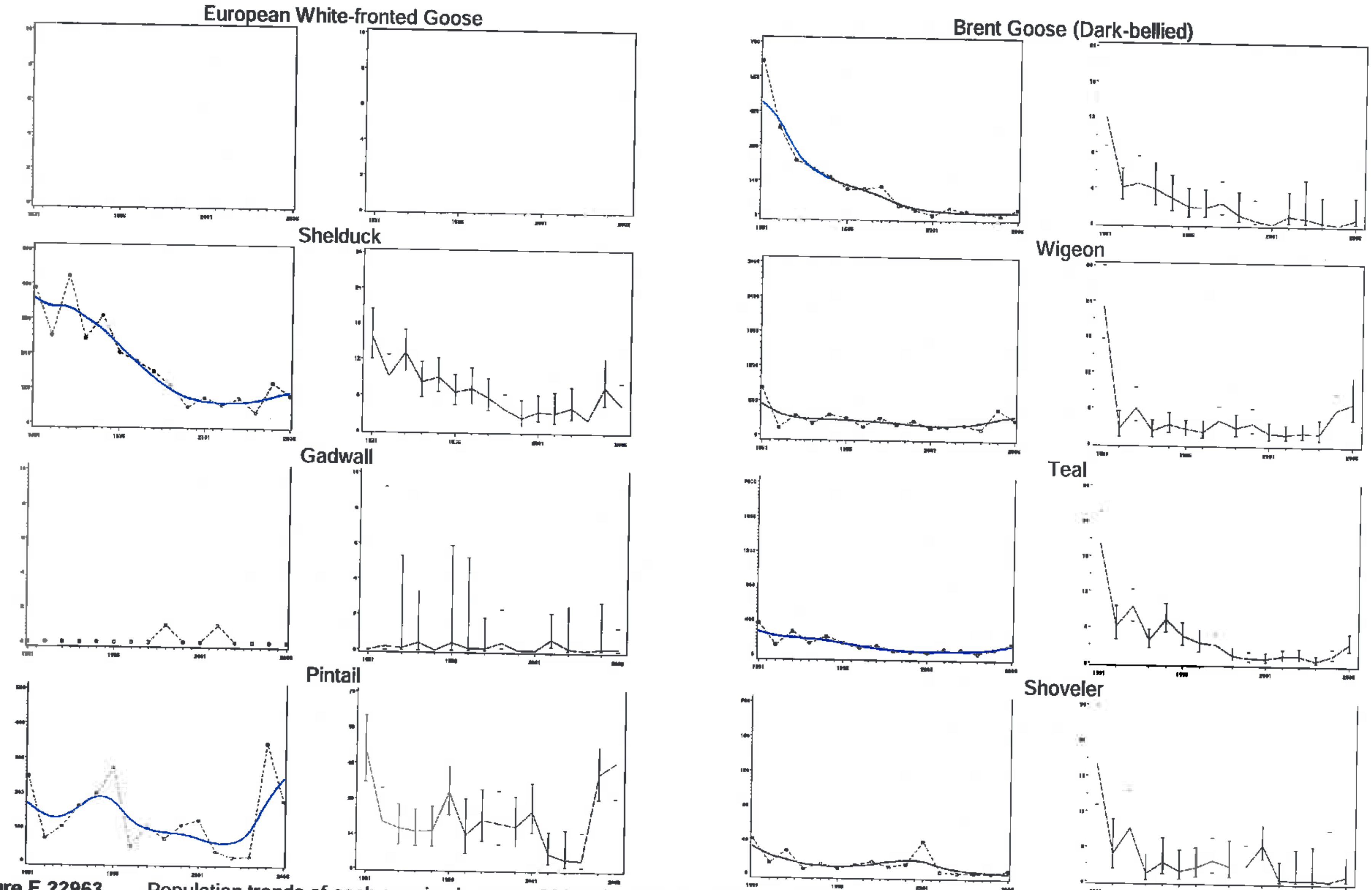
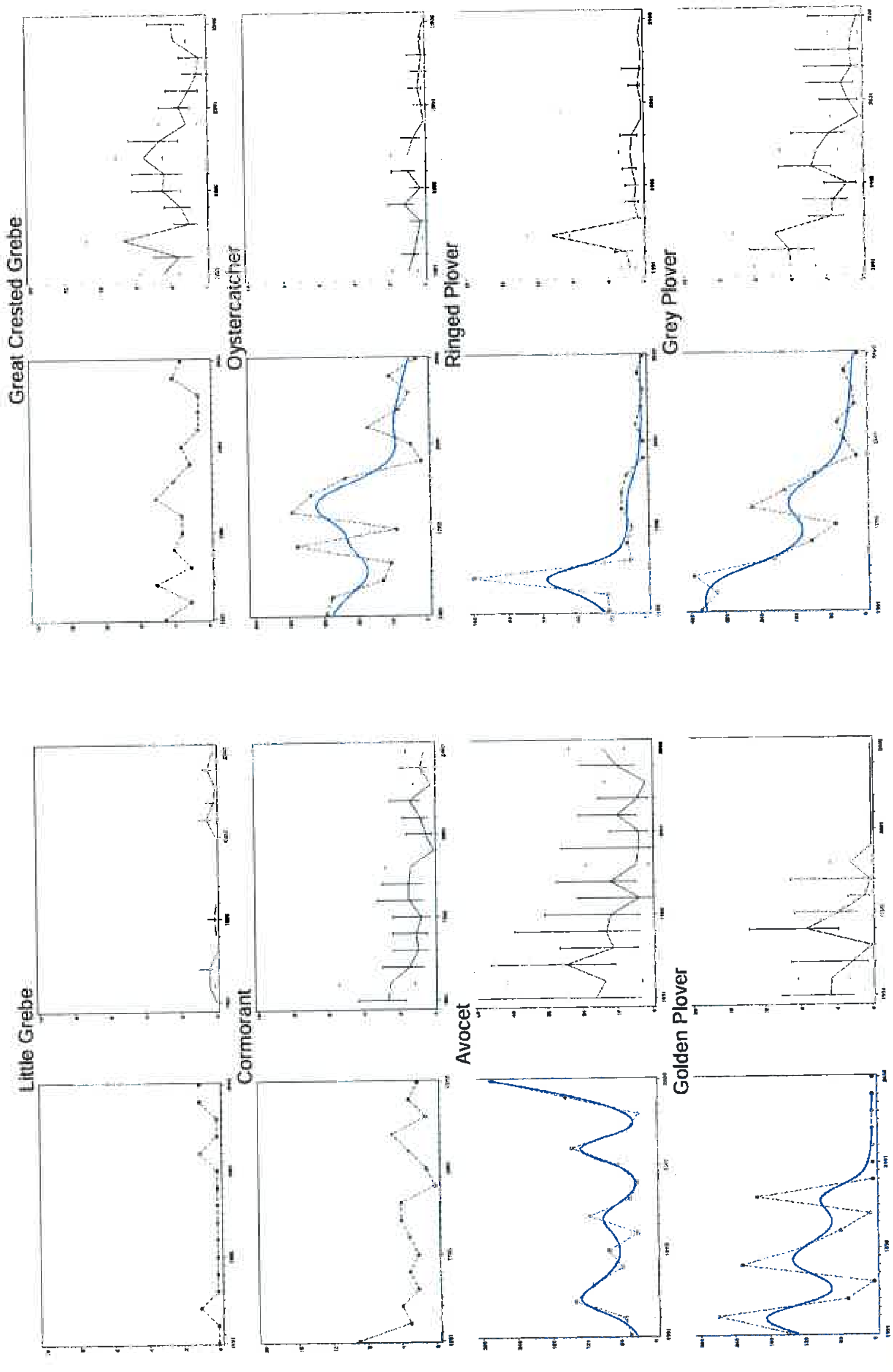


Figure E.22963 Population trends of each species in sector 22963 (Barksore and Funton) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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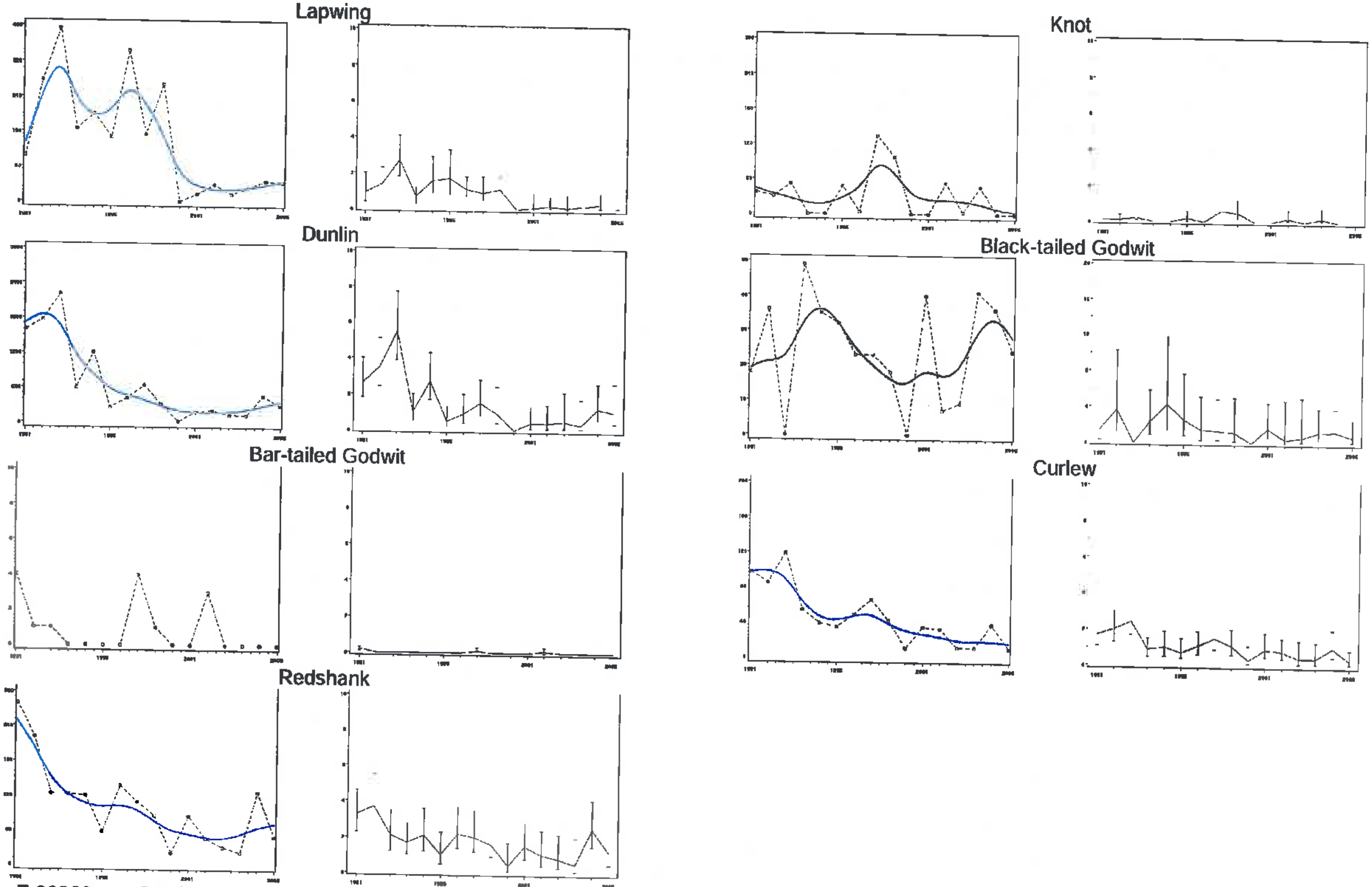


Figure E.22963 Continued

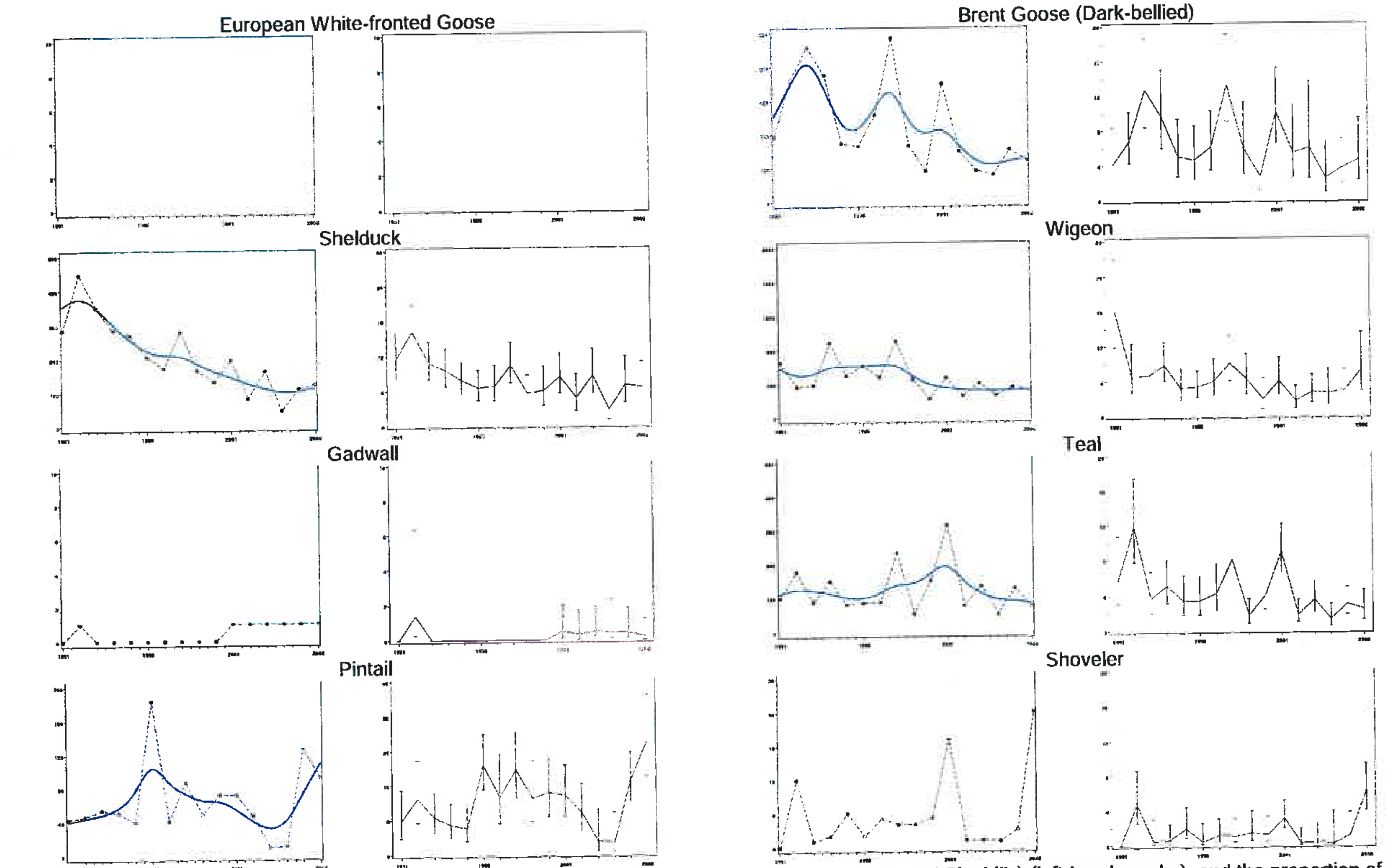
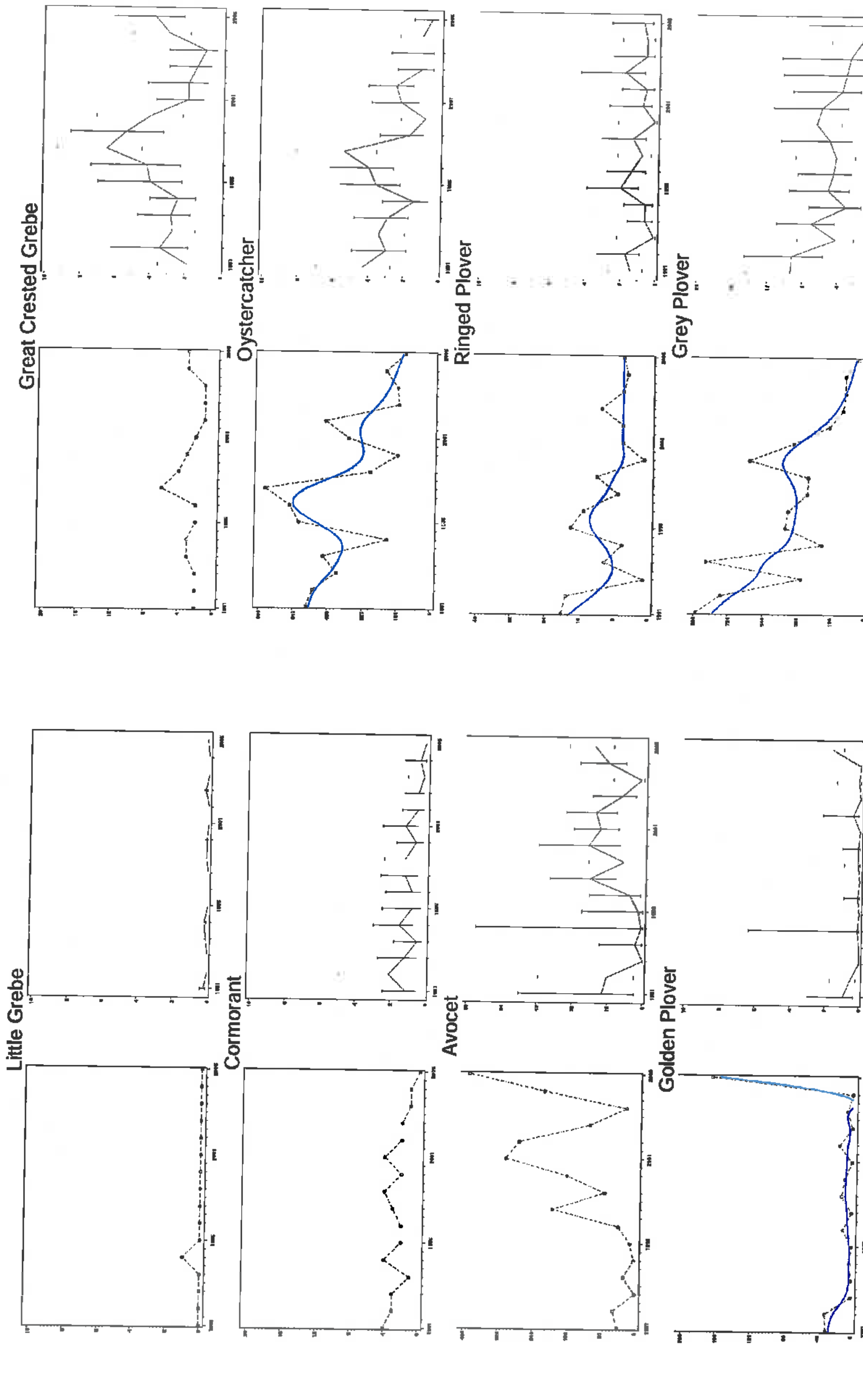


Figure E.22964 Population trends of each species in sector 22964 (Burntwick and Greenborough and Slayhills) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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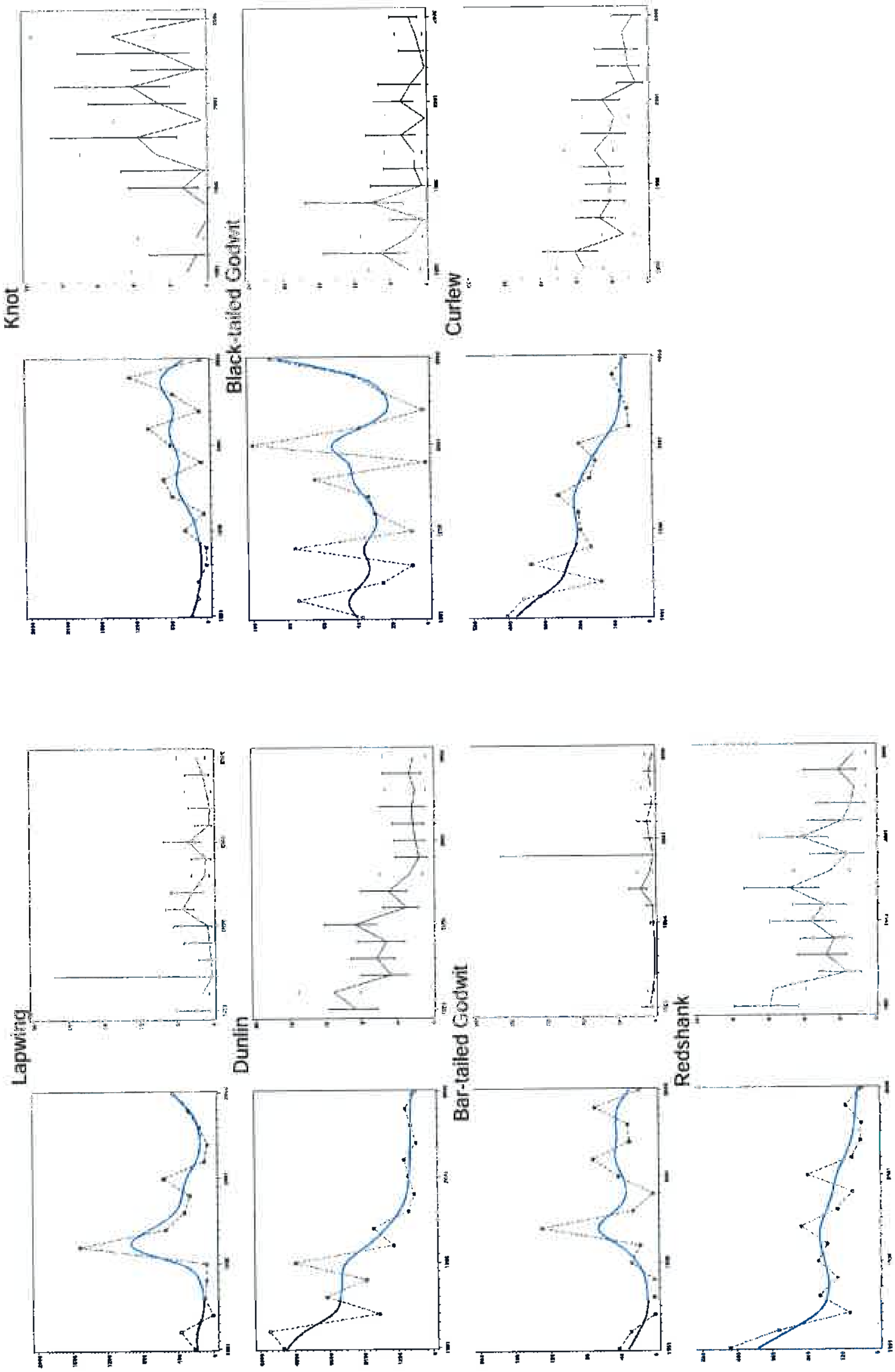

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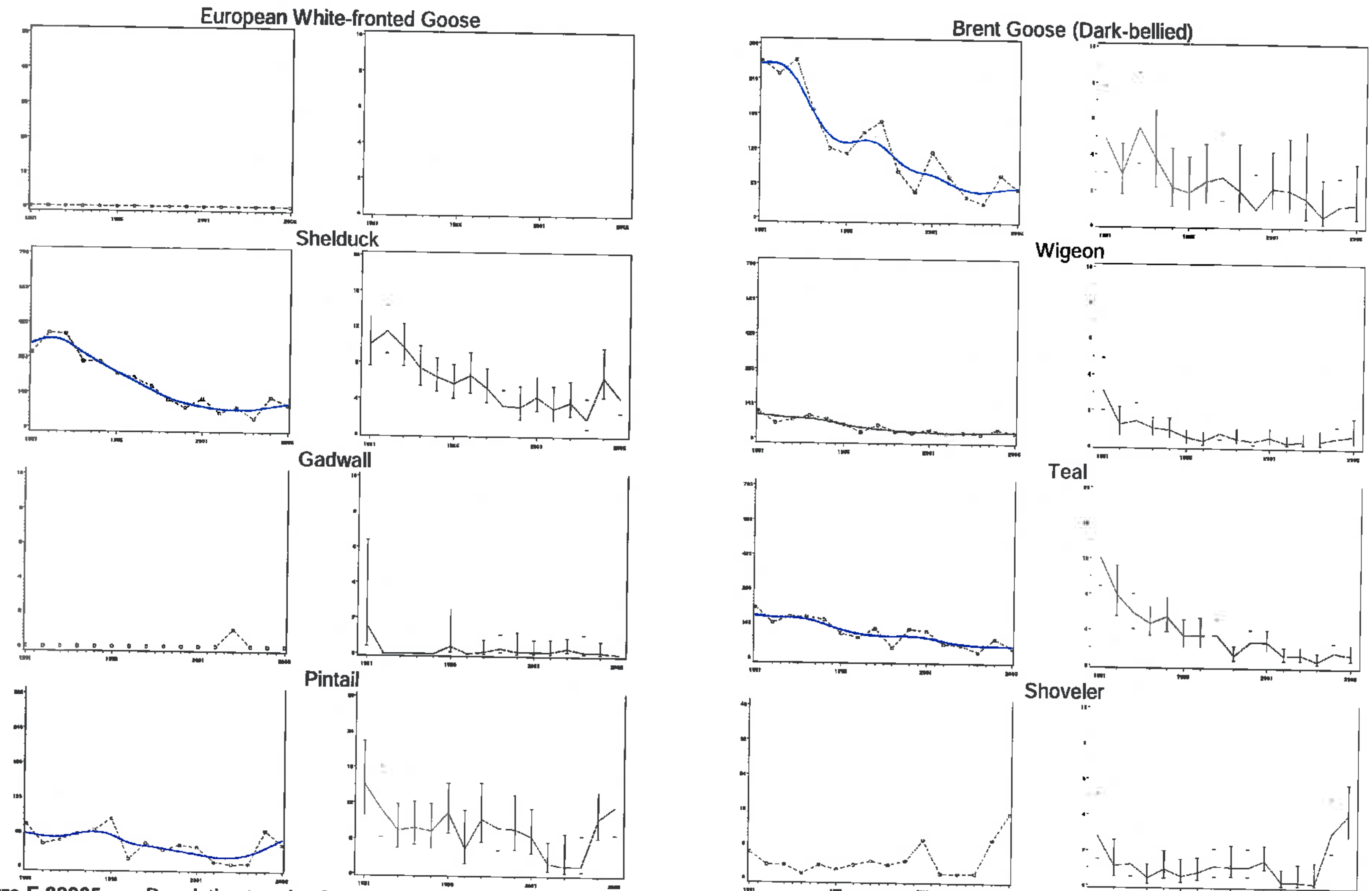
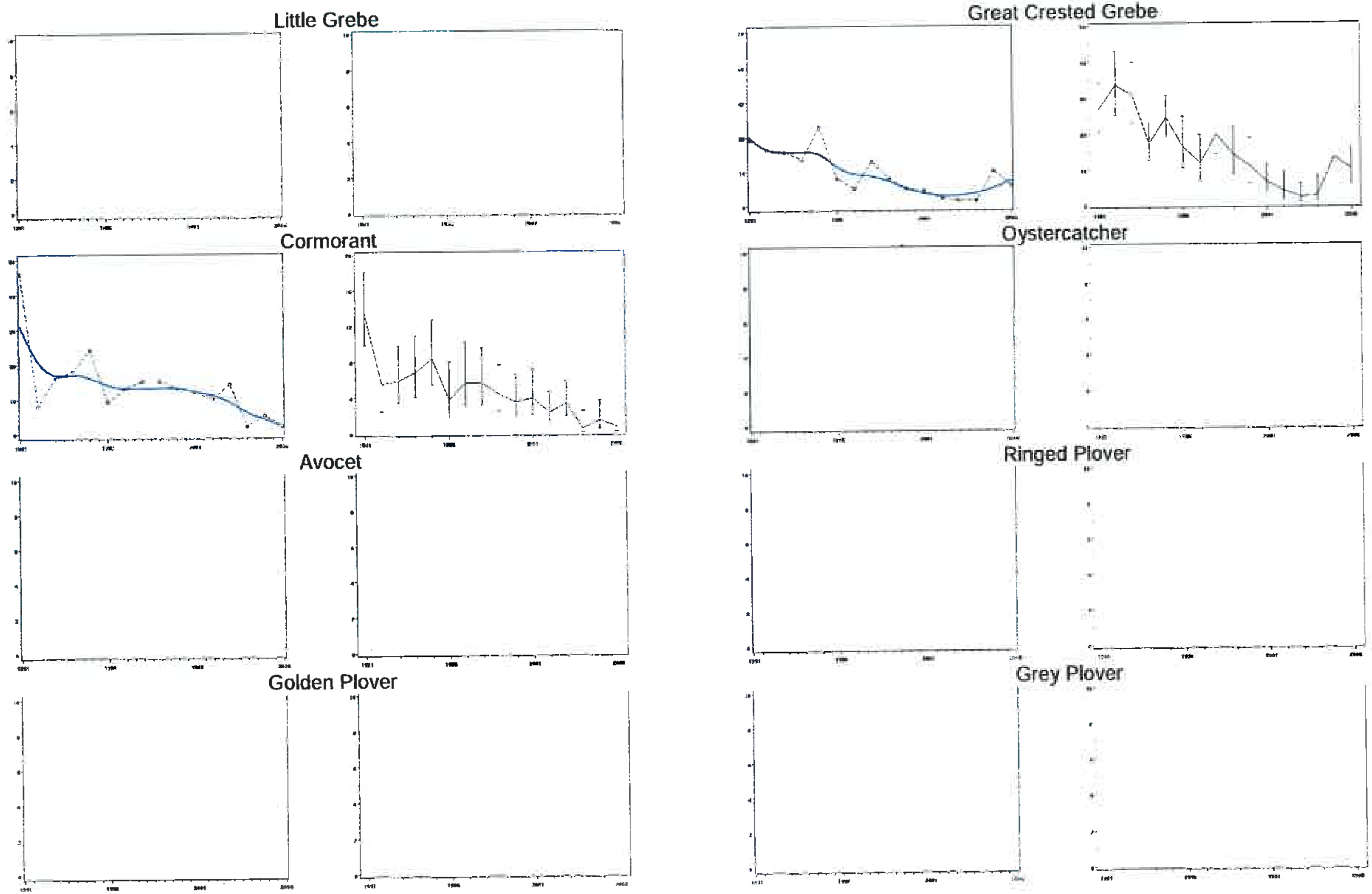


Figure E.22965 Population trends of each species in sector 22965 (Medway Estuary - Ham Green to Chatham) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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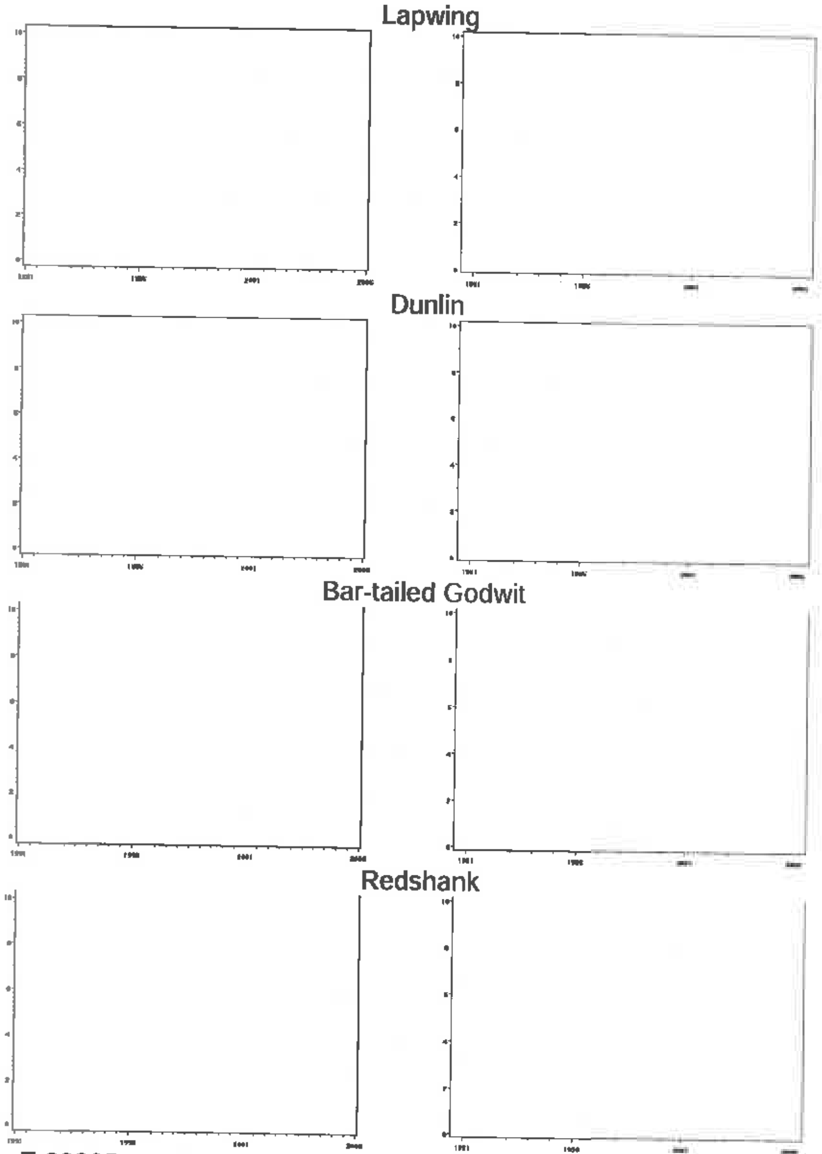

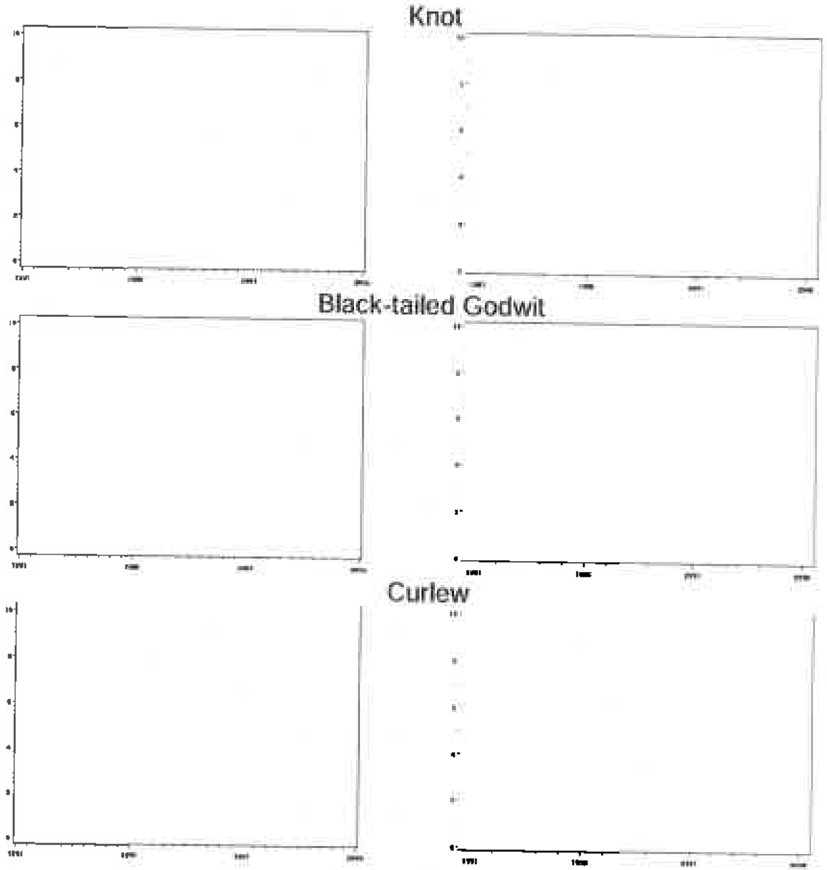

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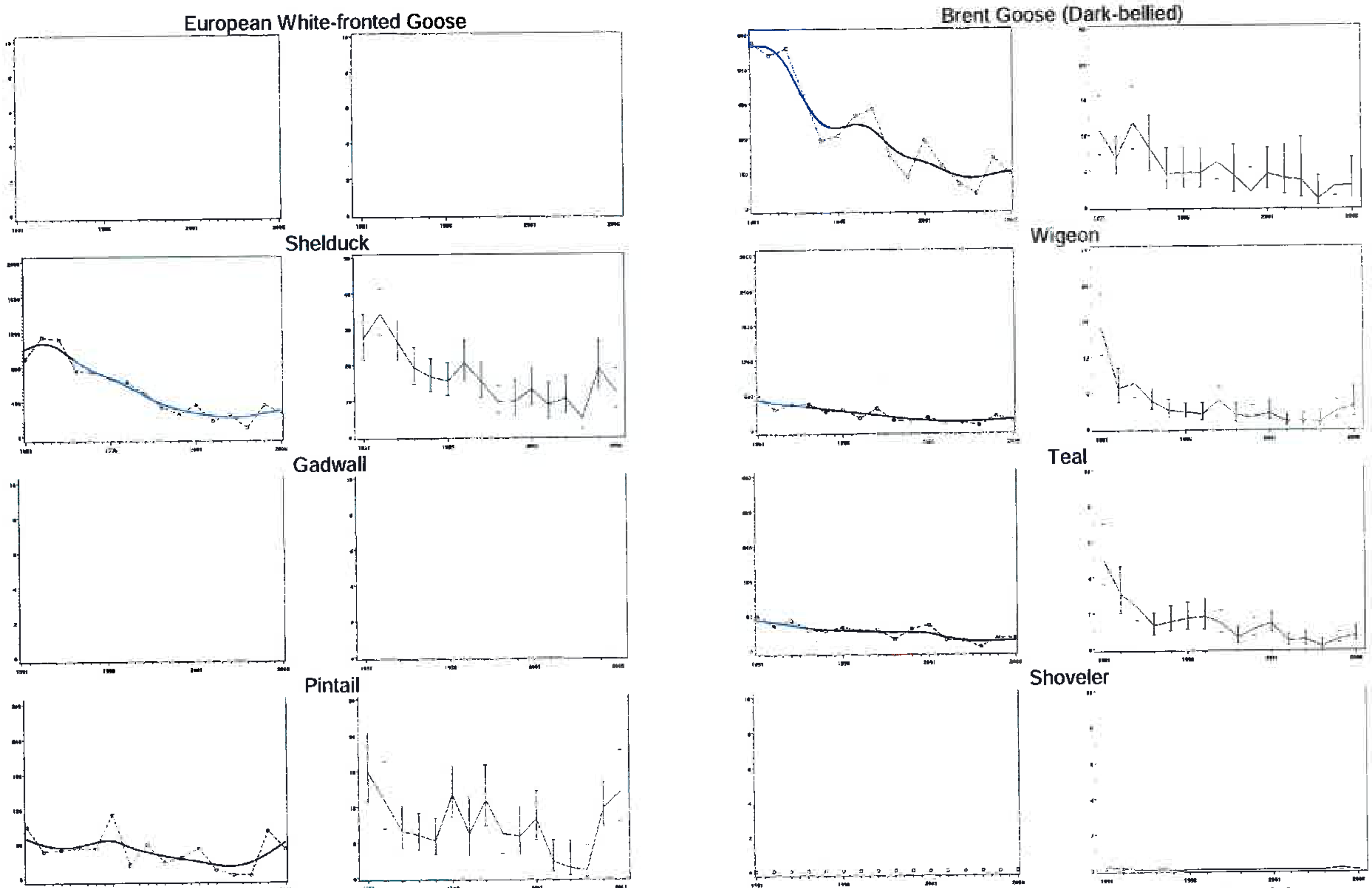
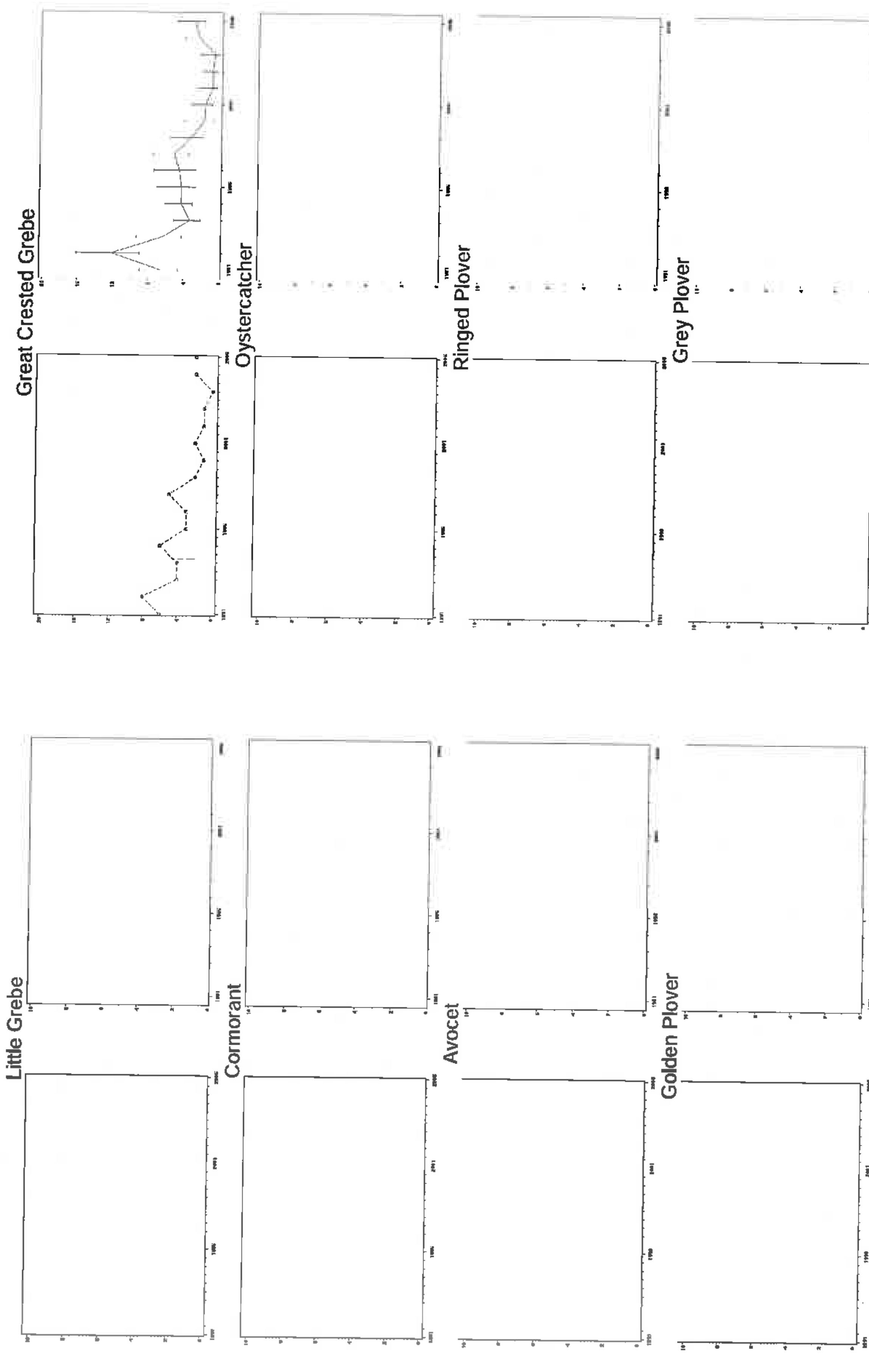


Figure E.22966 Population trends of each species in sector 22966 (Medway Estuary - Nor Marsh (Lower Gillingham)) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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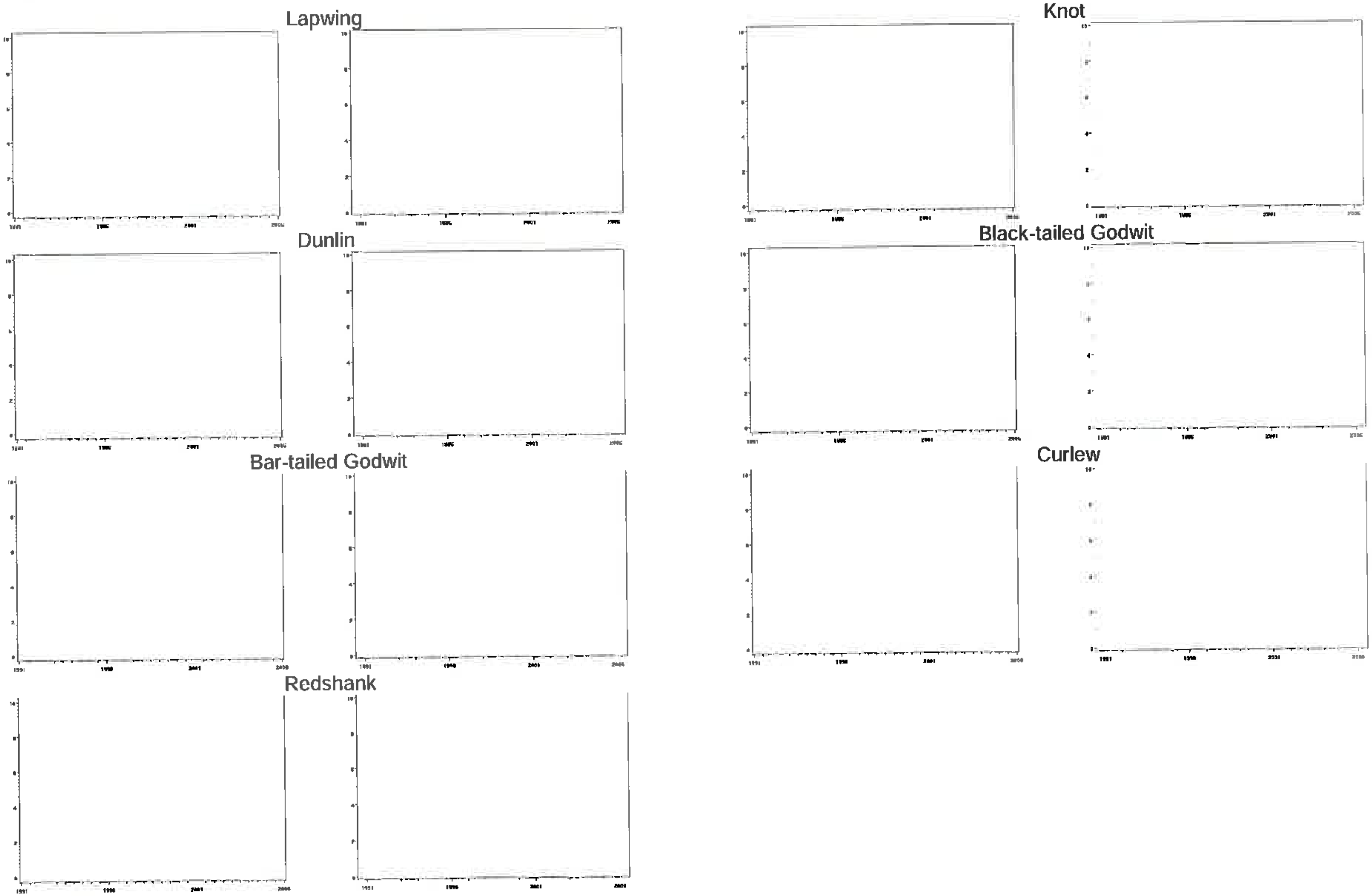

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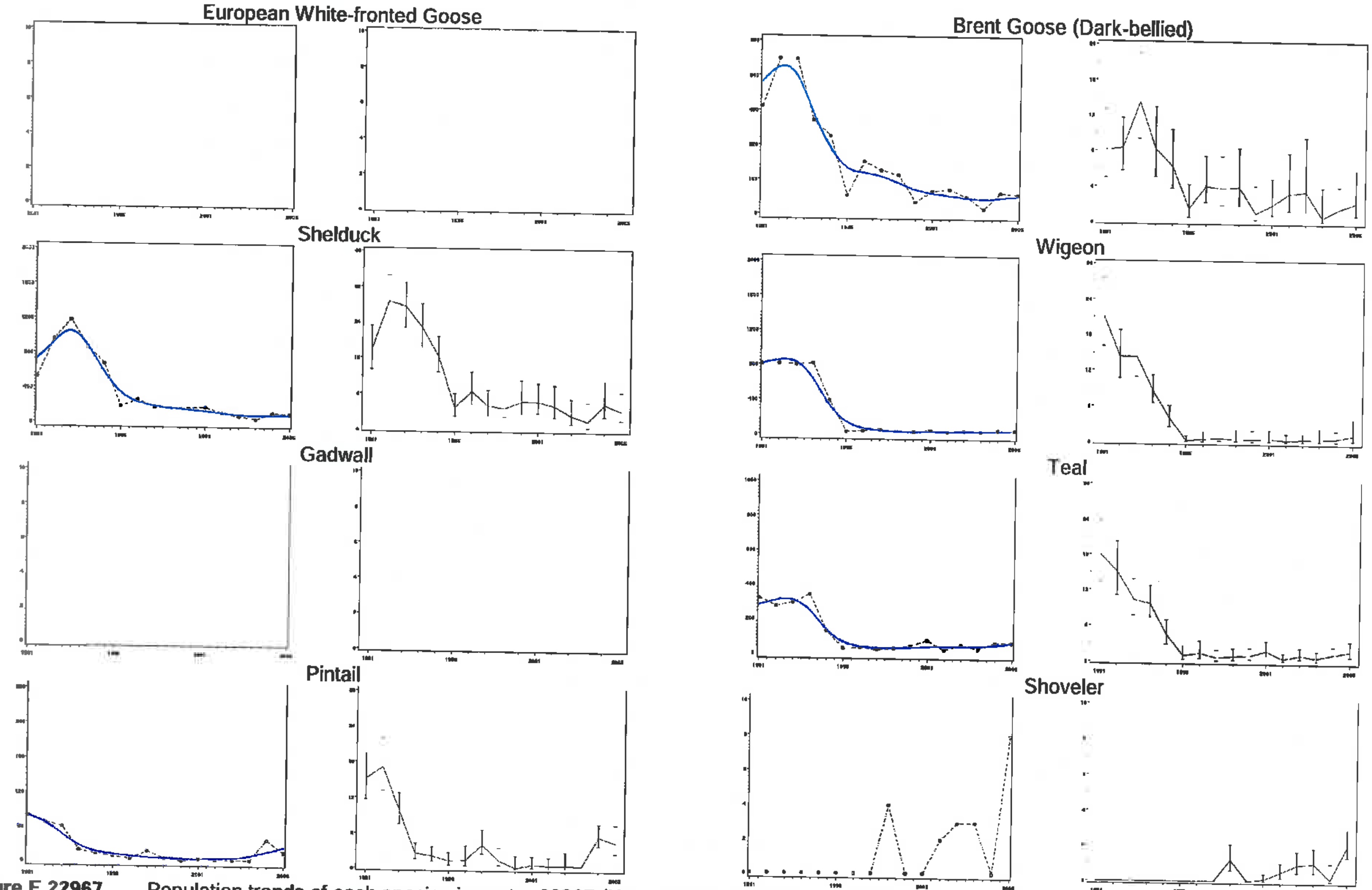
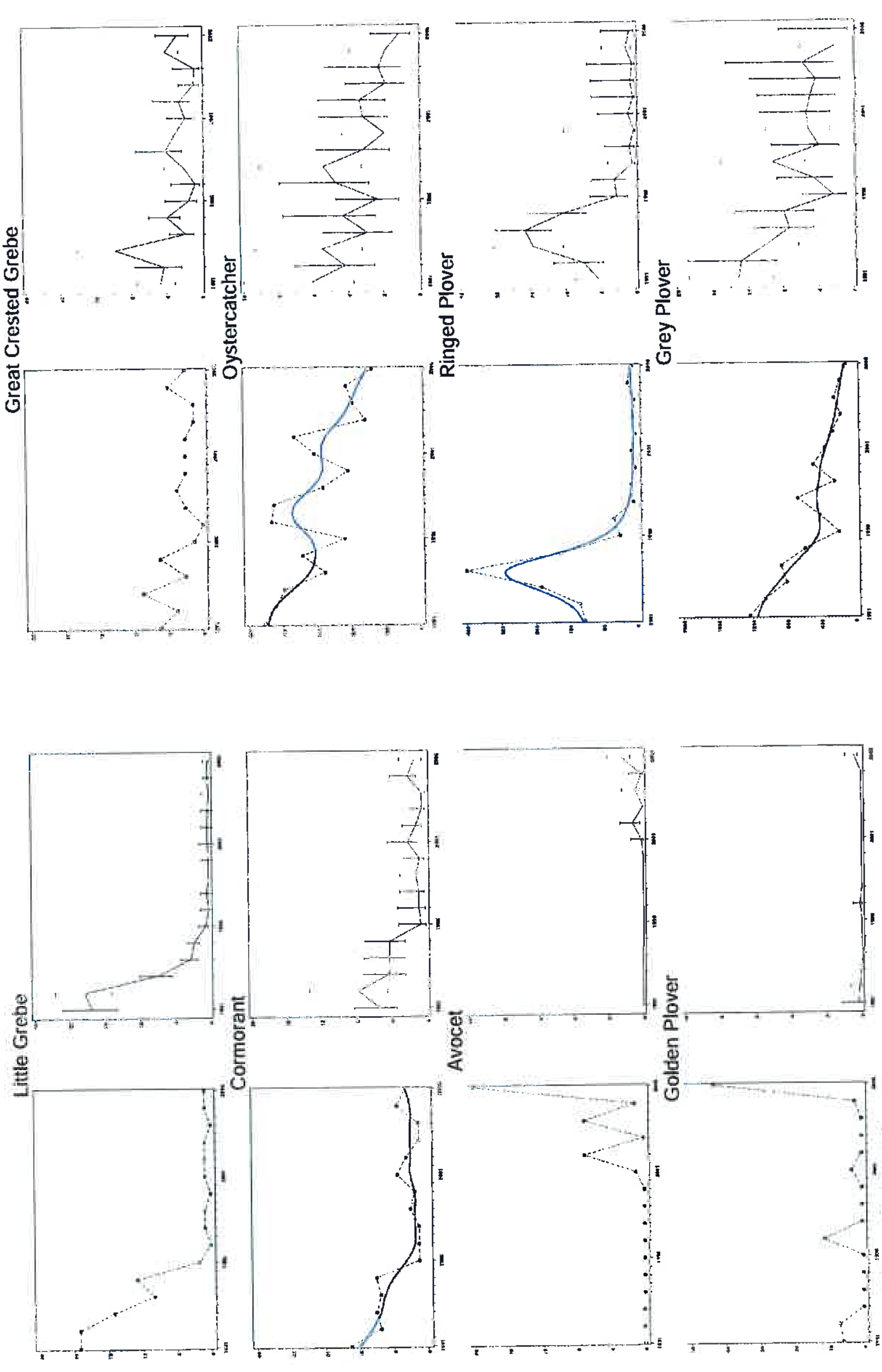


Figure E.22967 Population trends of each species in sector 22967 (Hoo and Nor and Bishop and Copperhouse Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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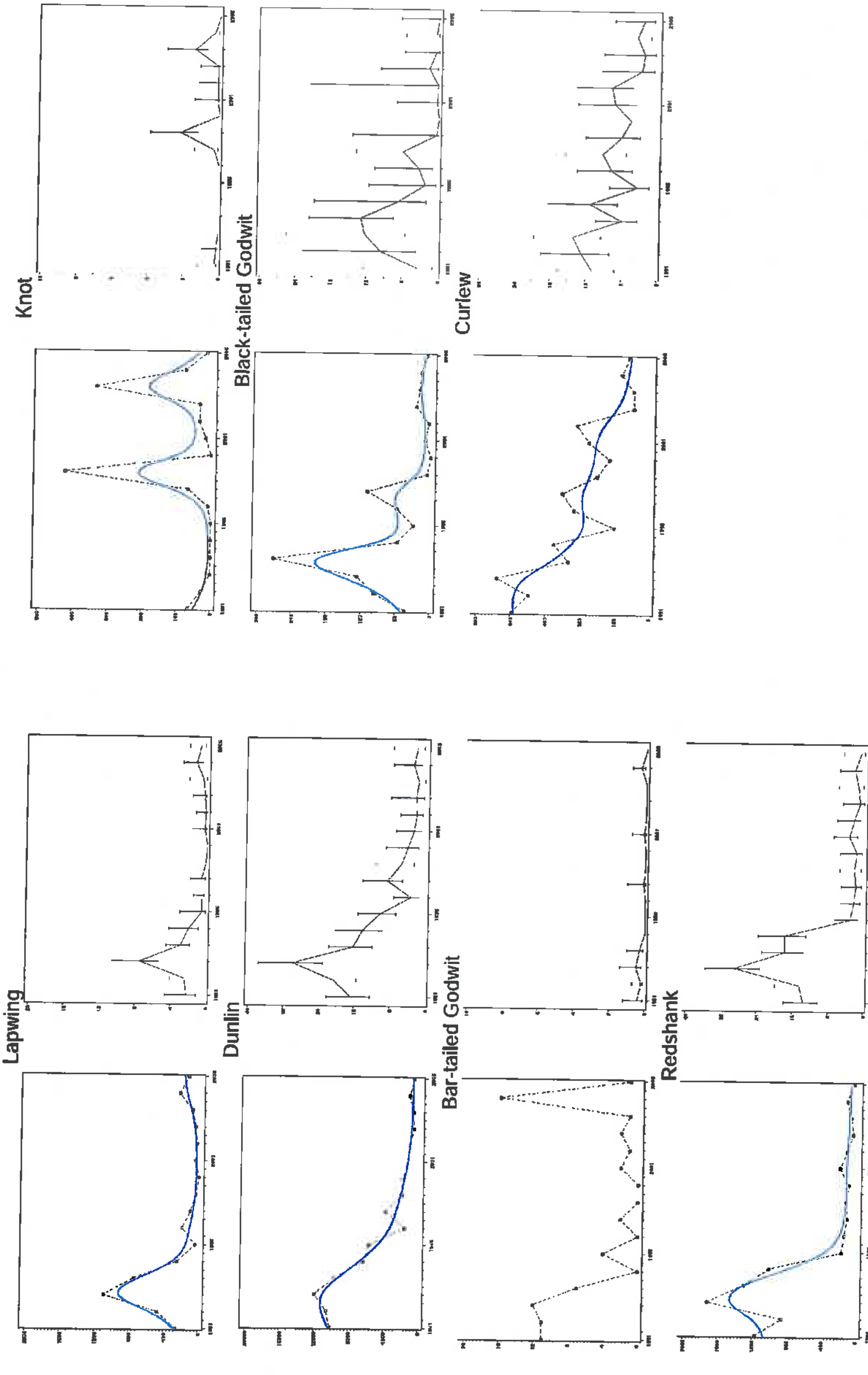

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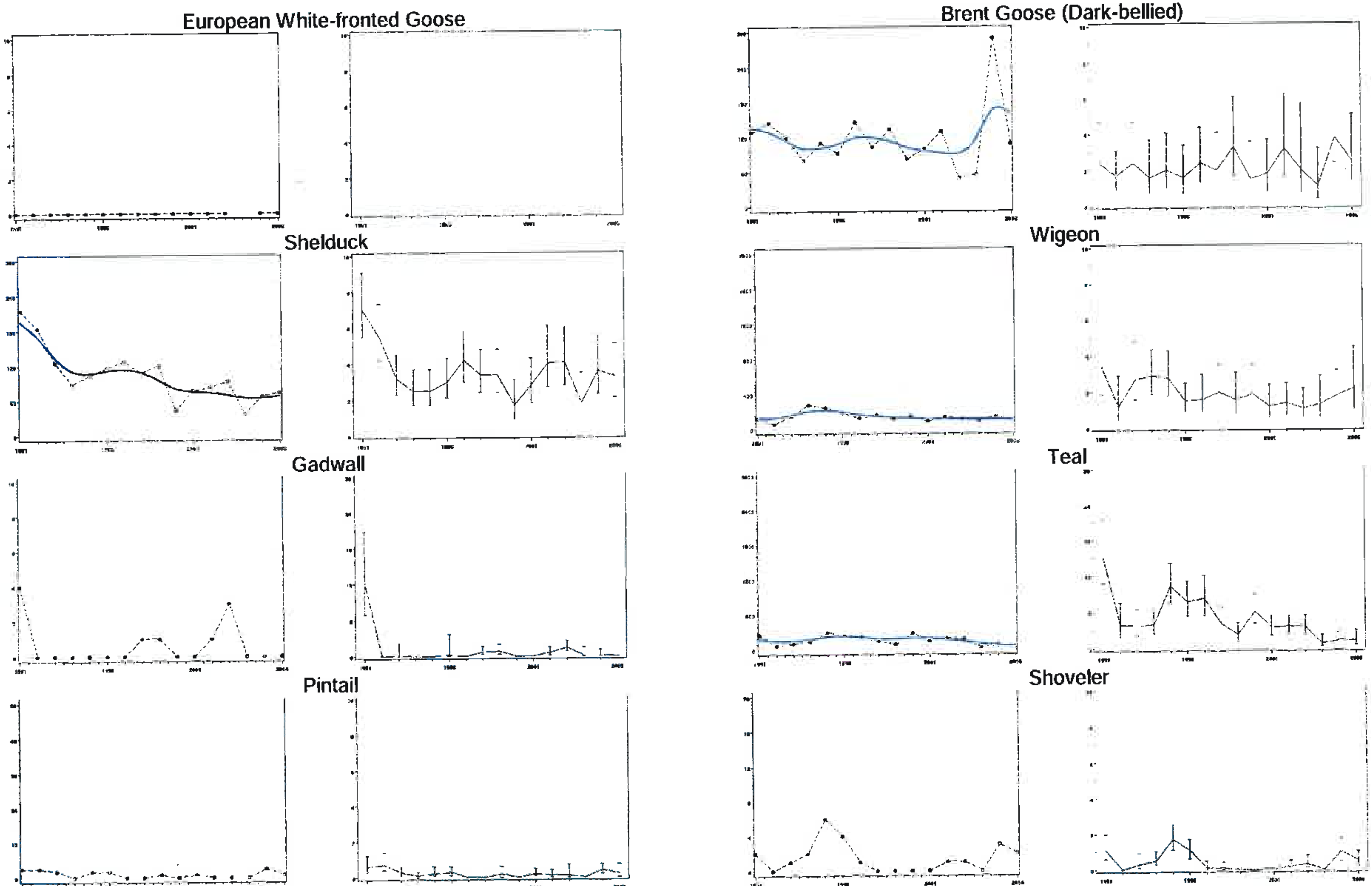
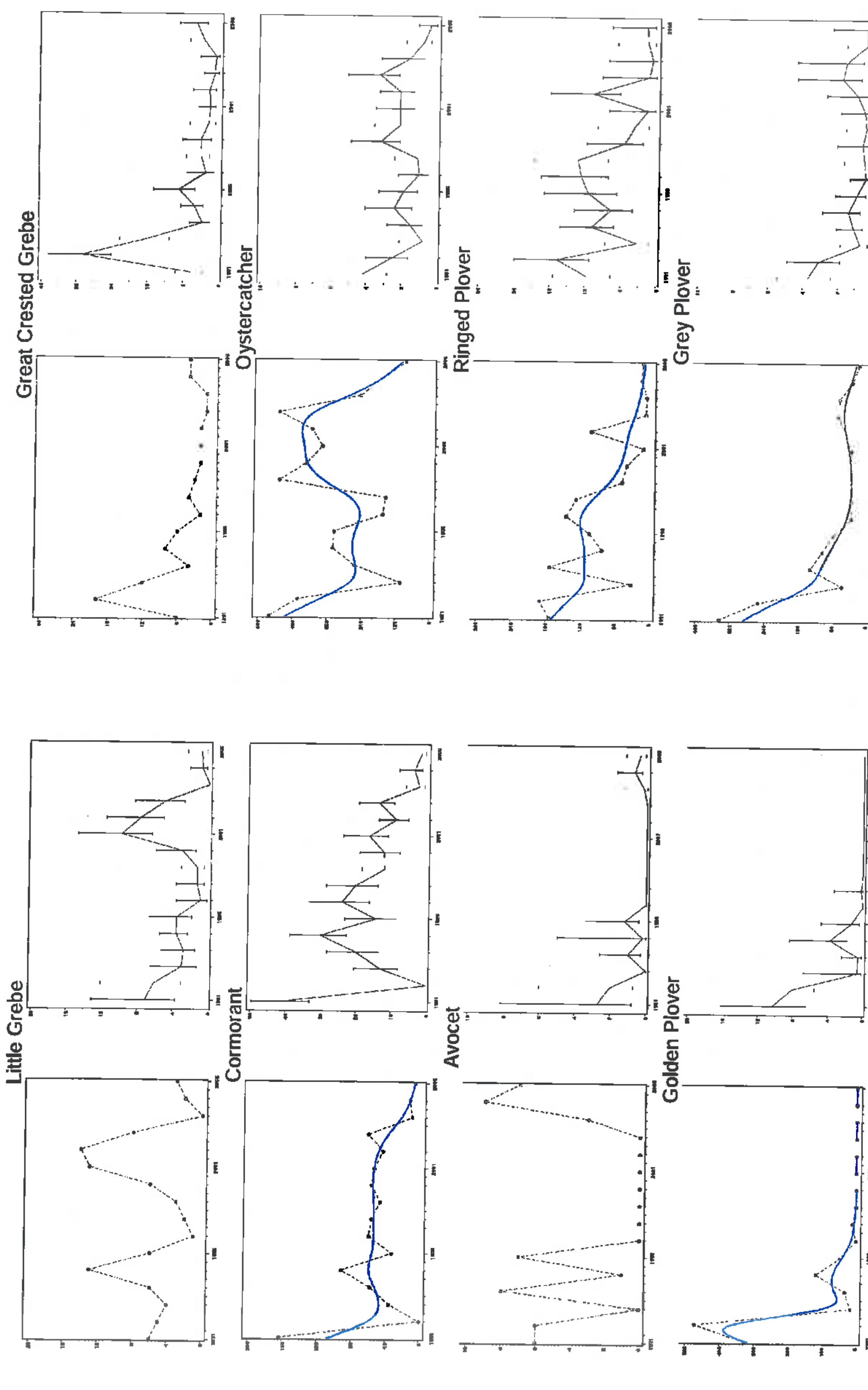


Figure E.22972 Population trends of each species in sector 22972 (Kingsnorth) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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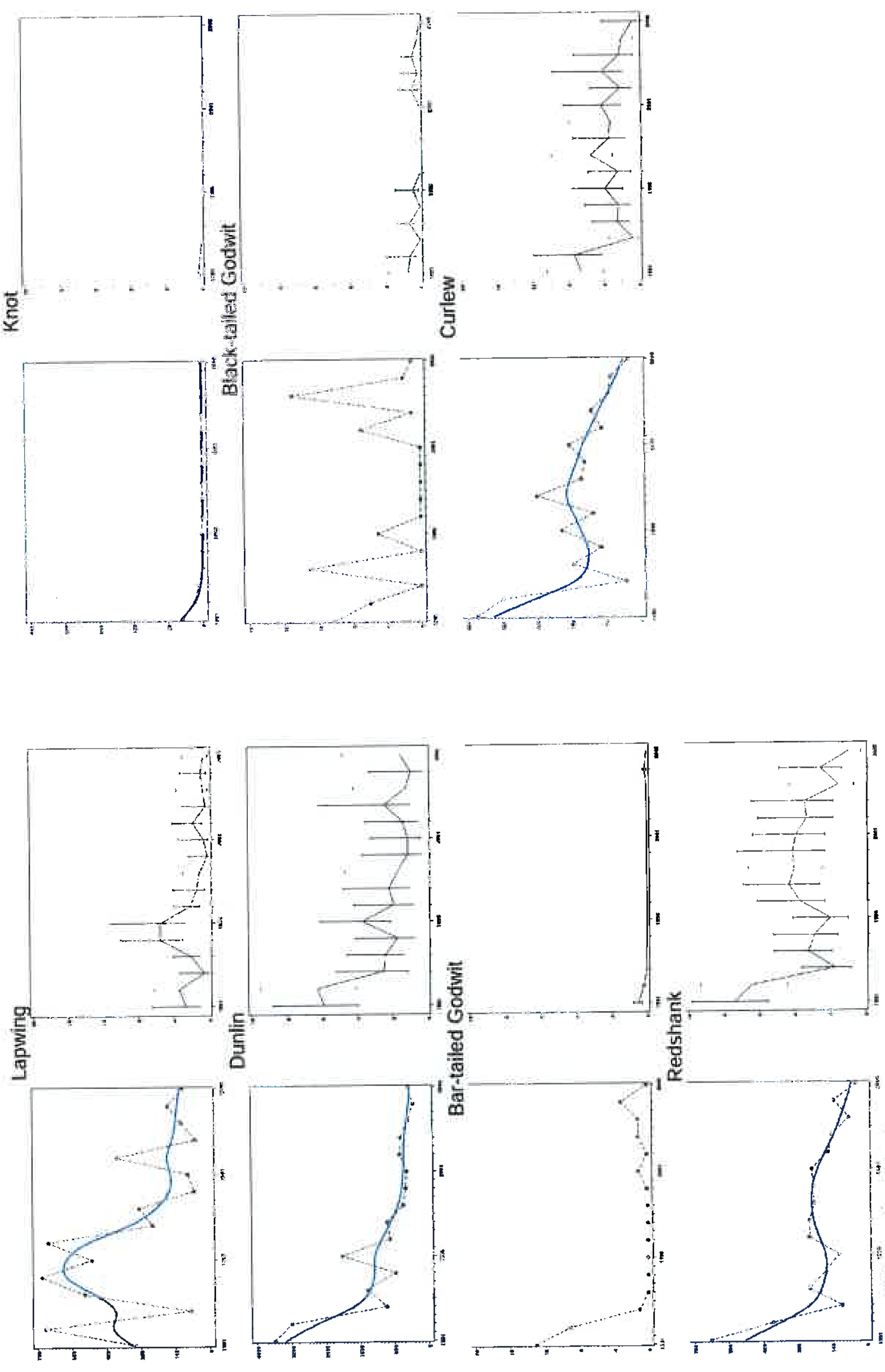

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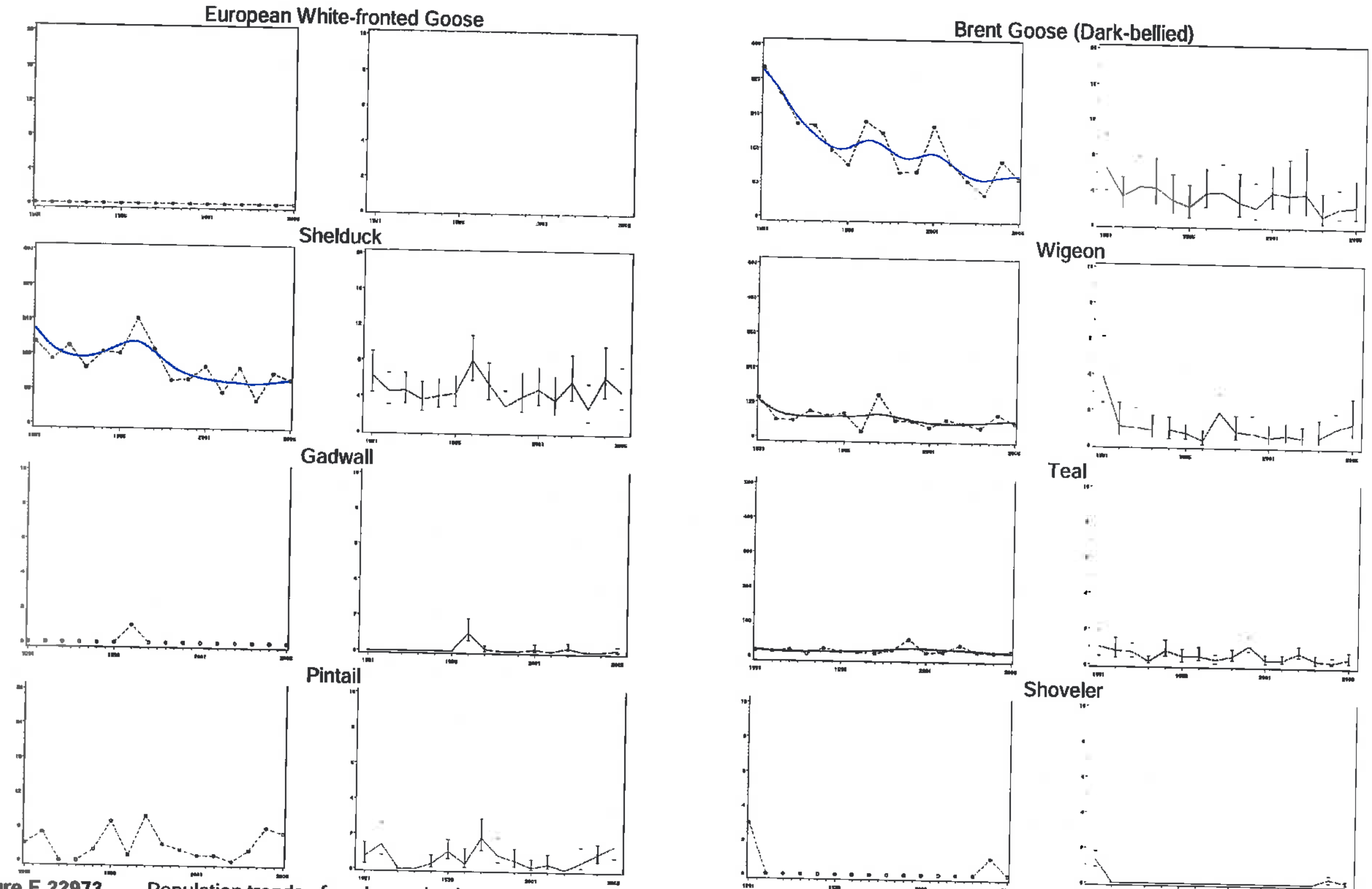
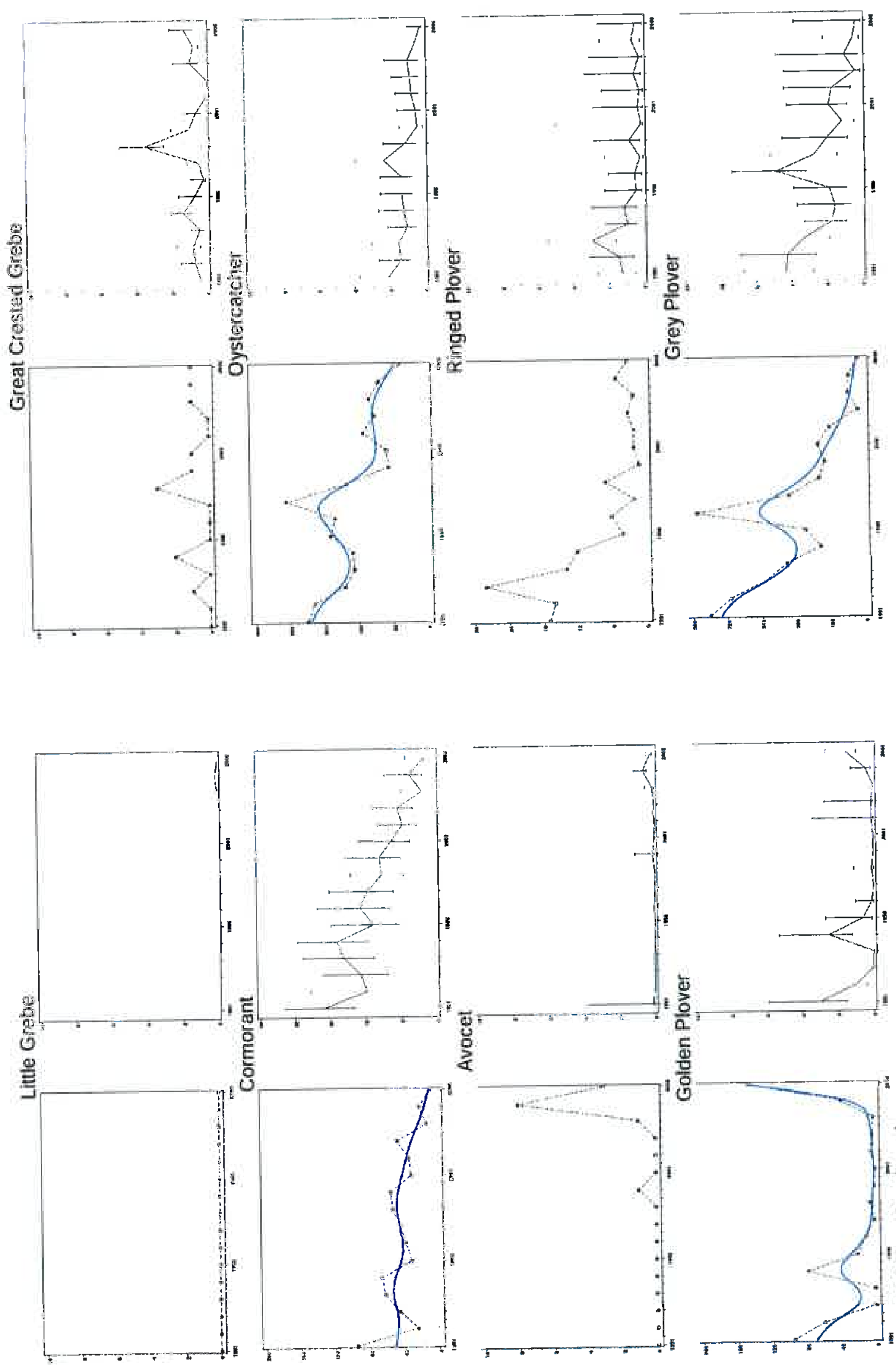


Figure E.22973 Population trends of each species in sector 22973 (Stoke Saltings and Ooze) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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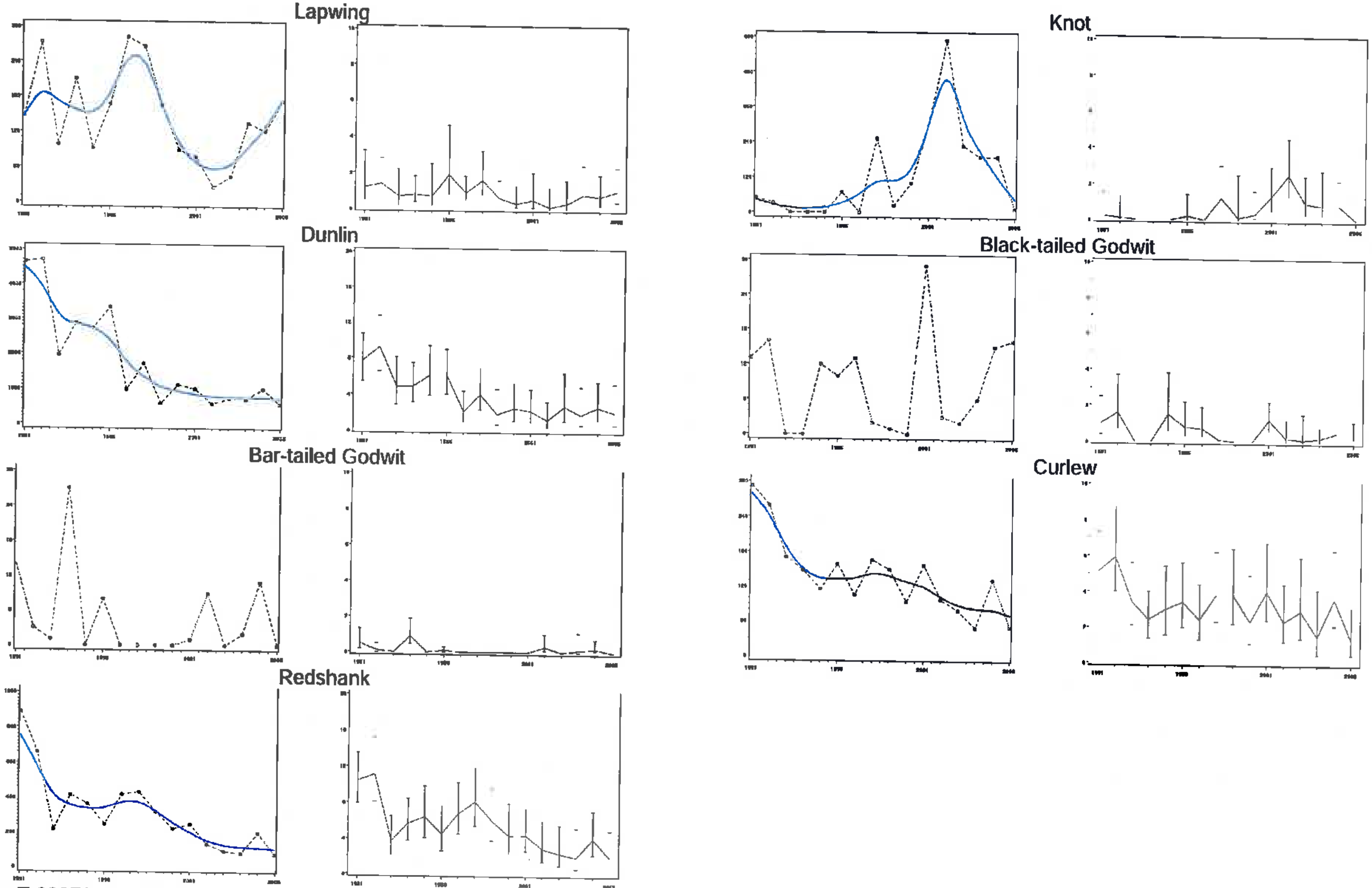

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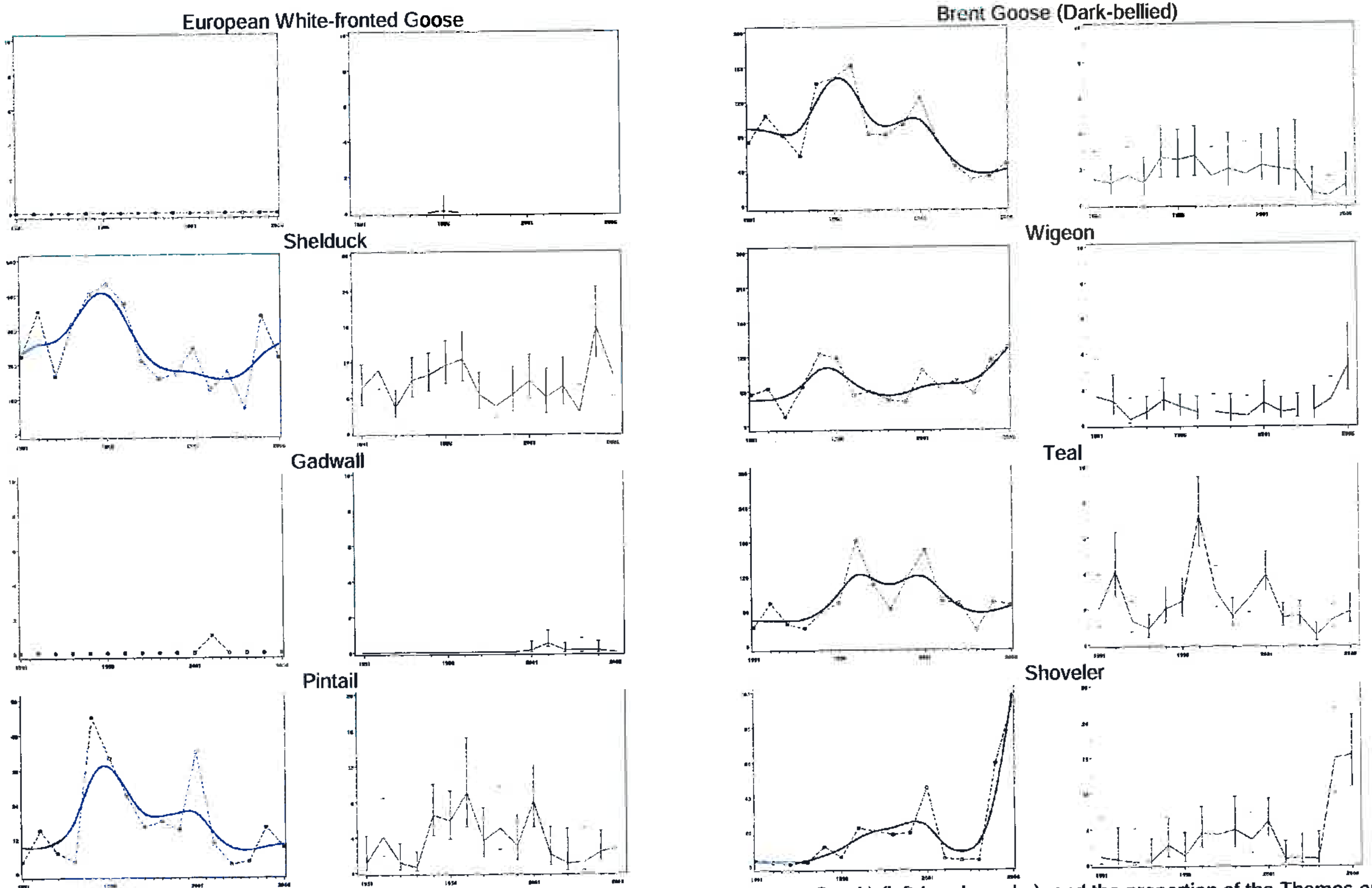
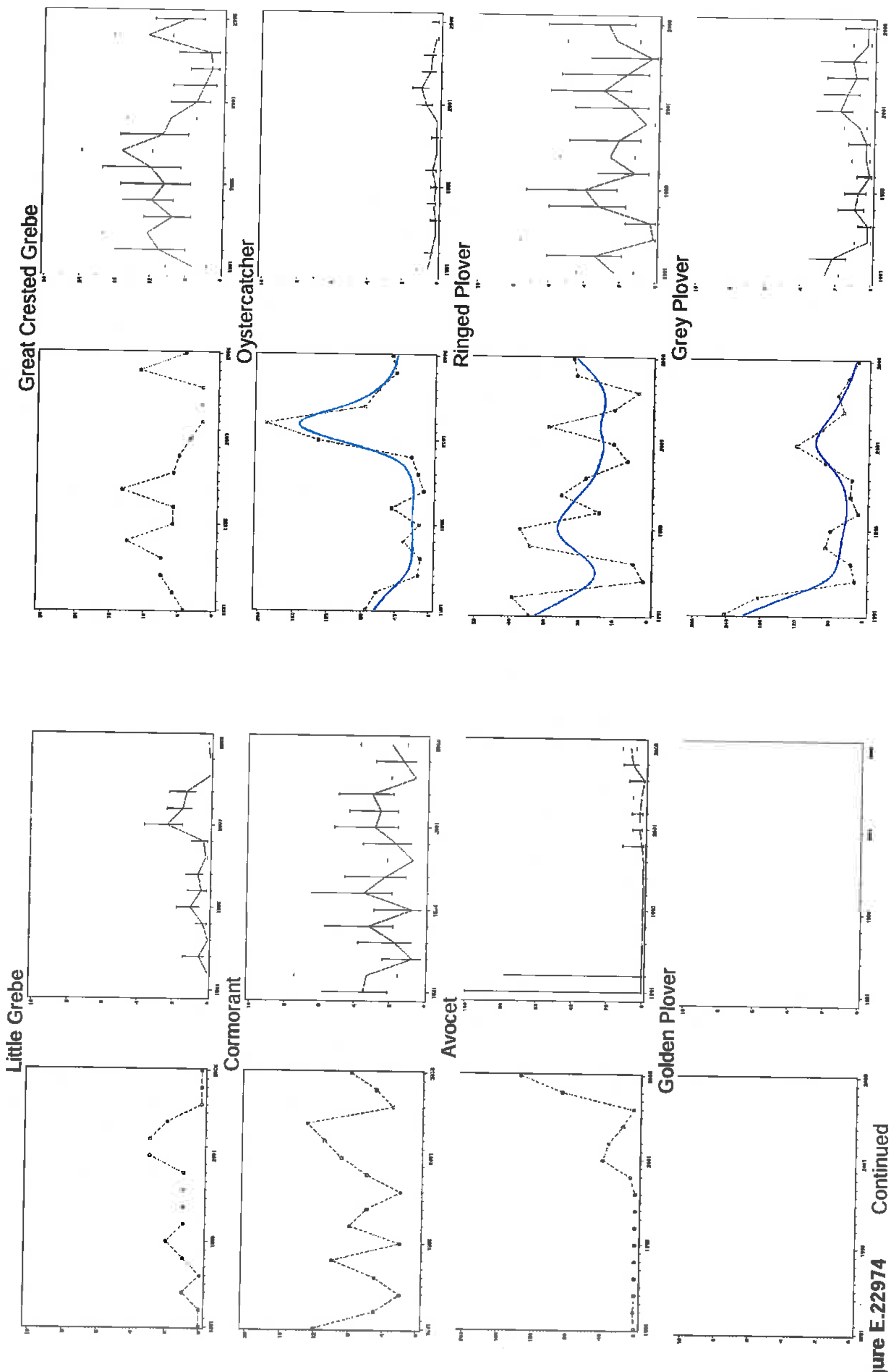


Figure E.22974 Population trends of each species in sector 22974 (Motney and Otterham Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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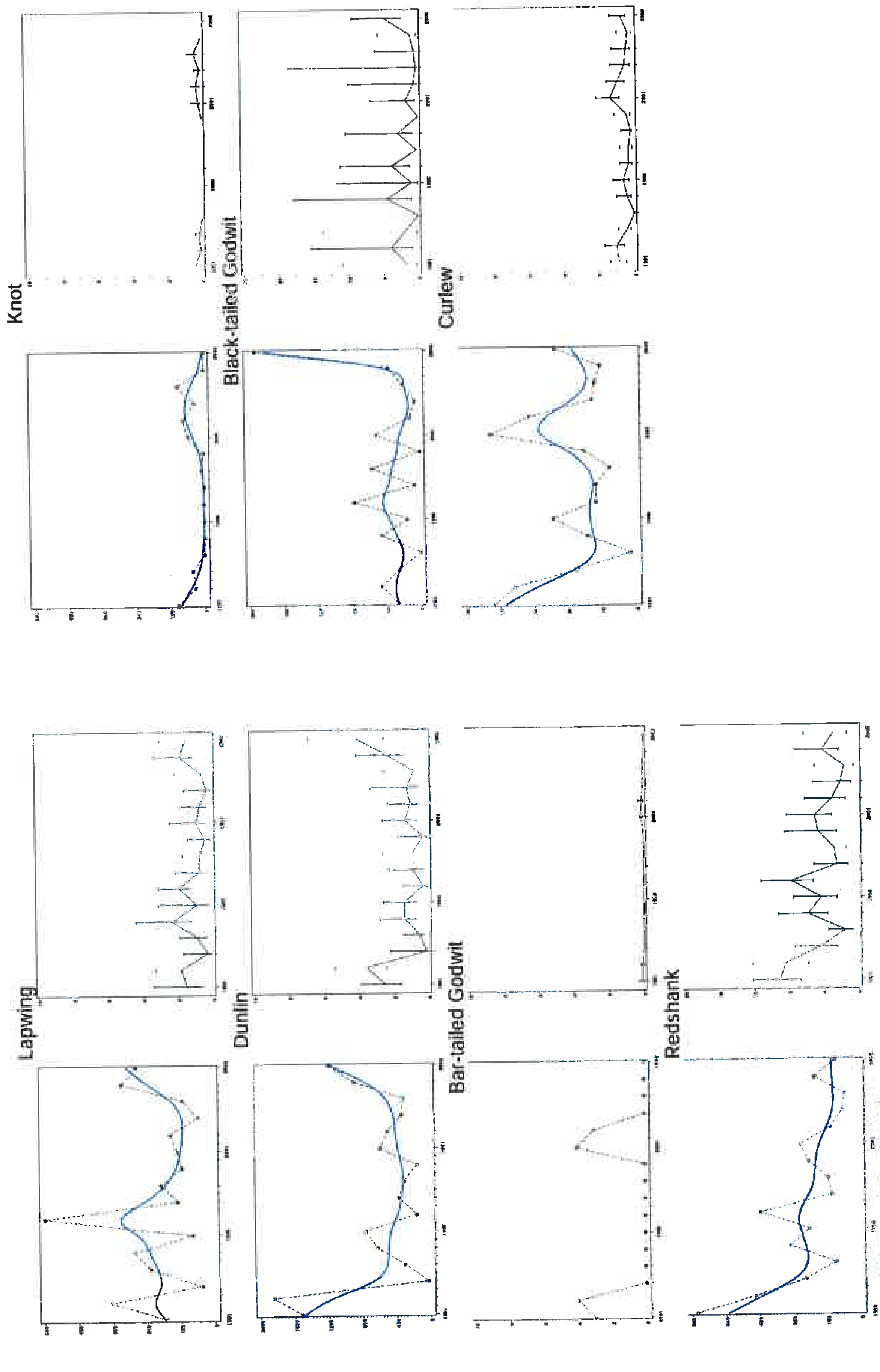

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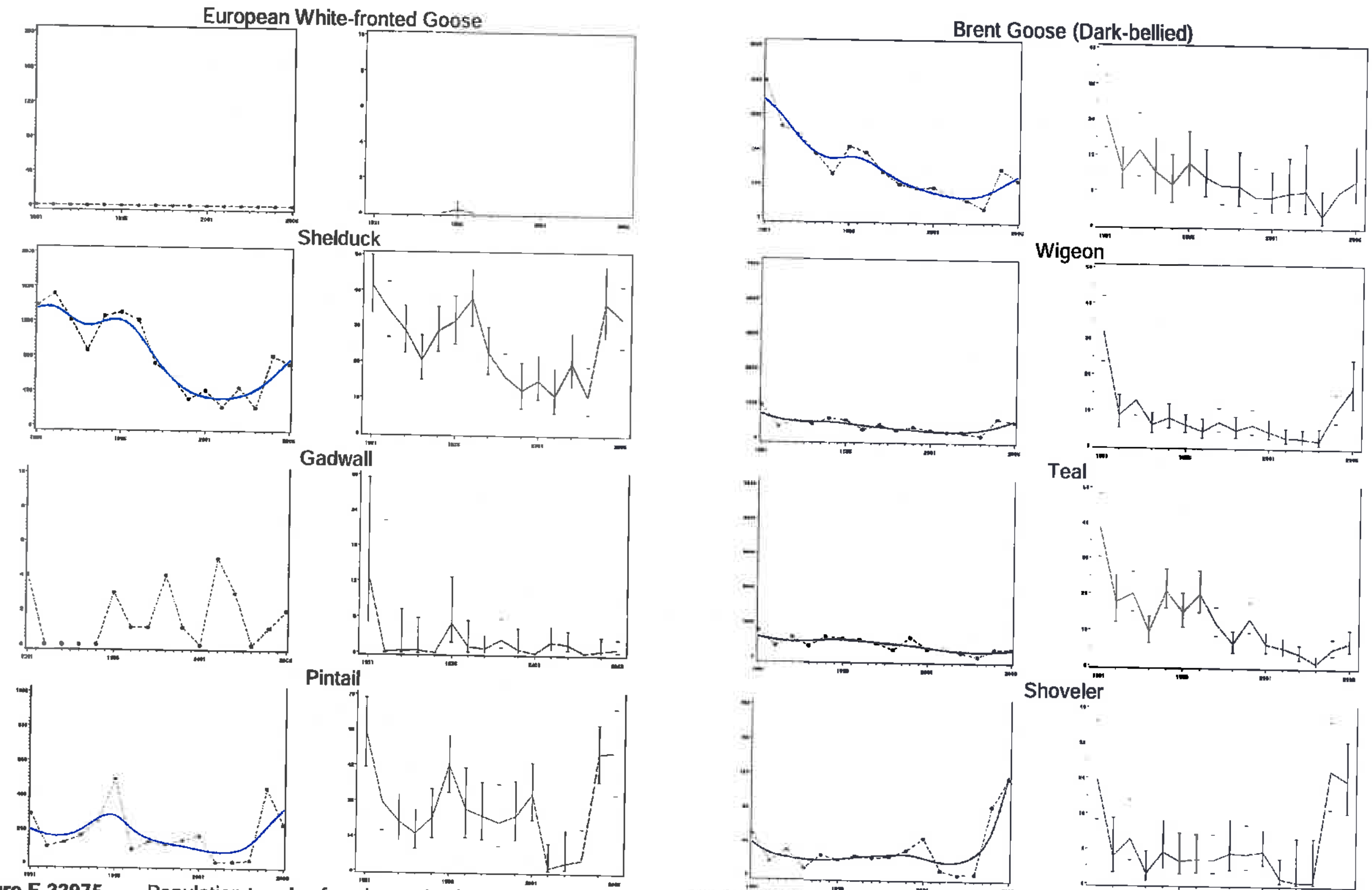
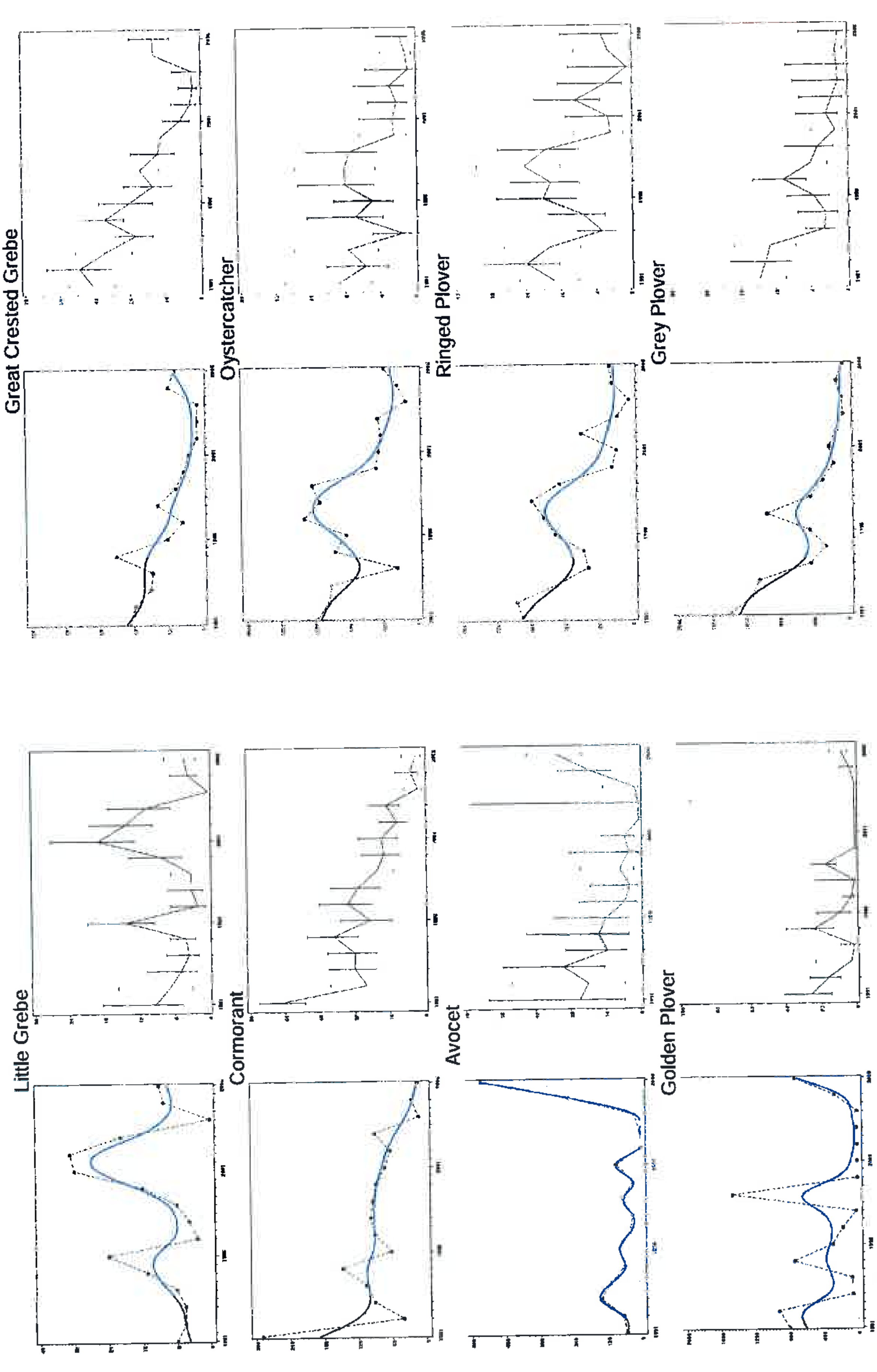


Figure E.22975 Population trends of each species in sector 22975 (Medway Shore) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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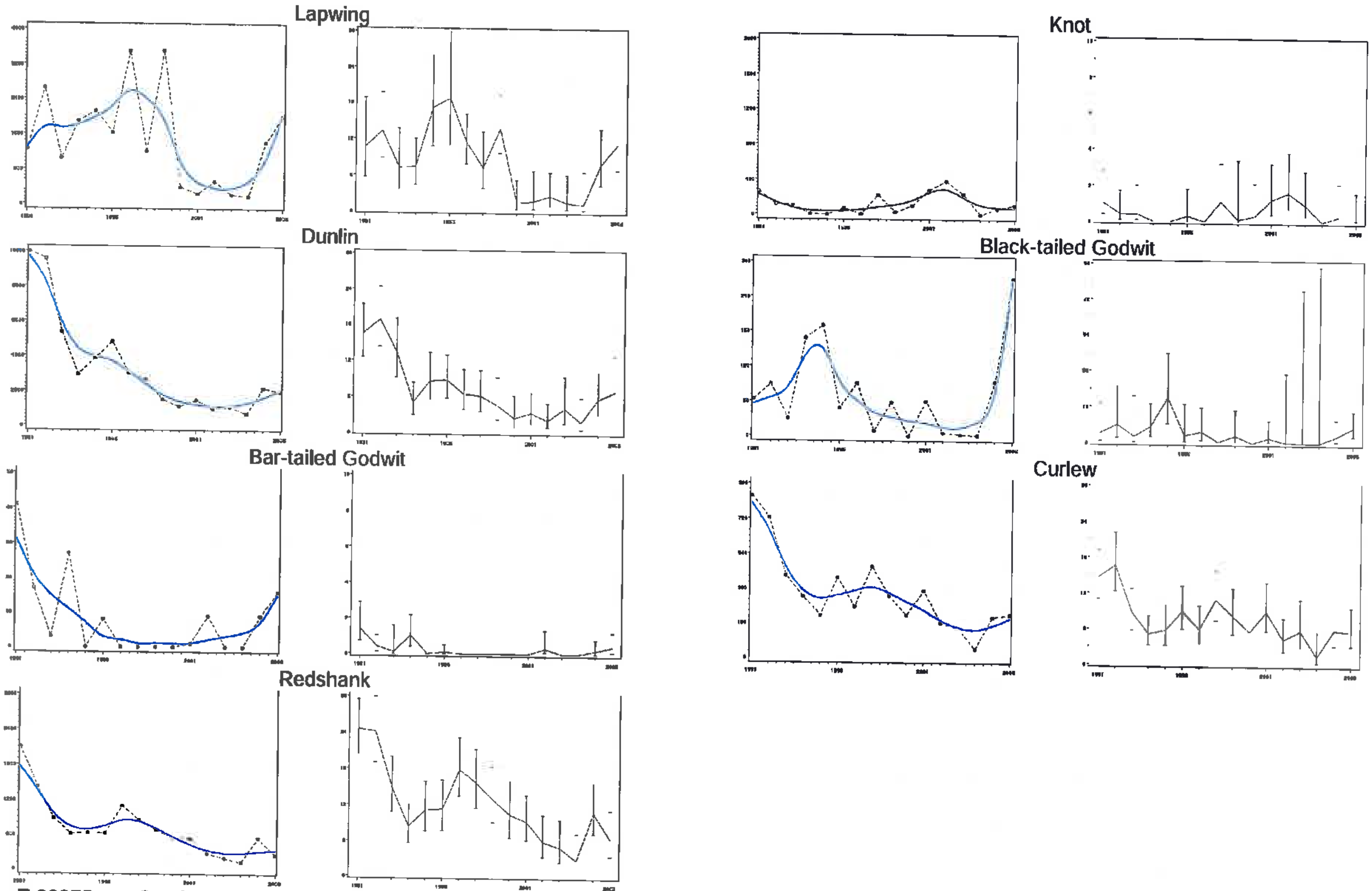

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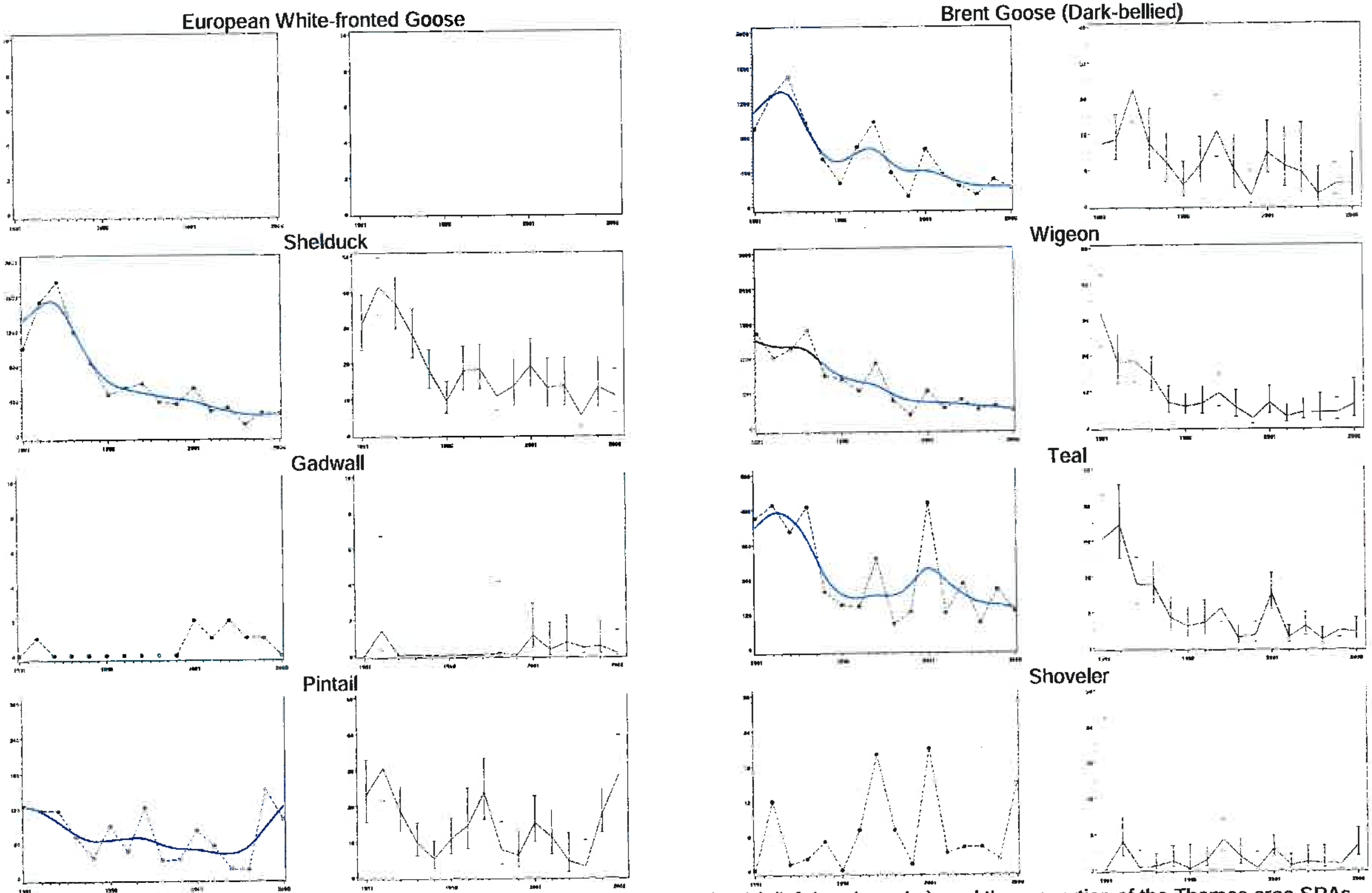
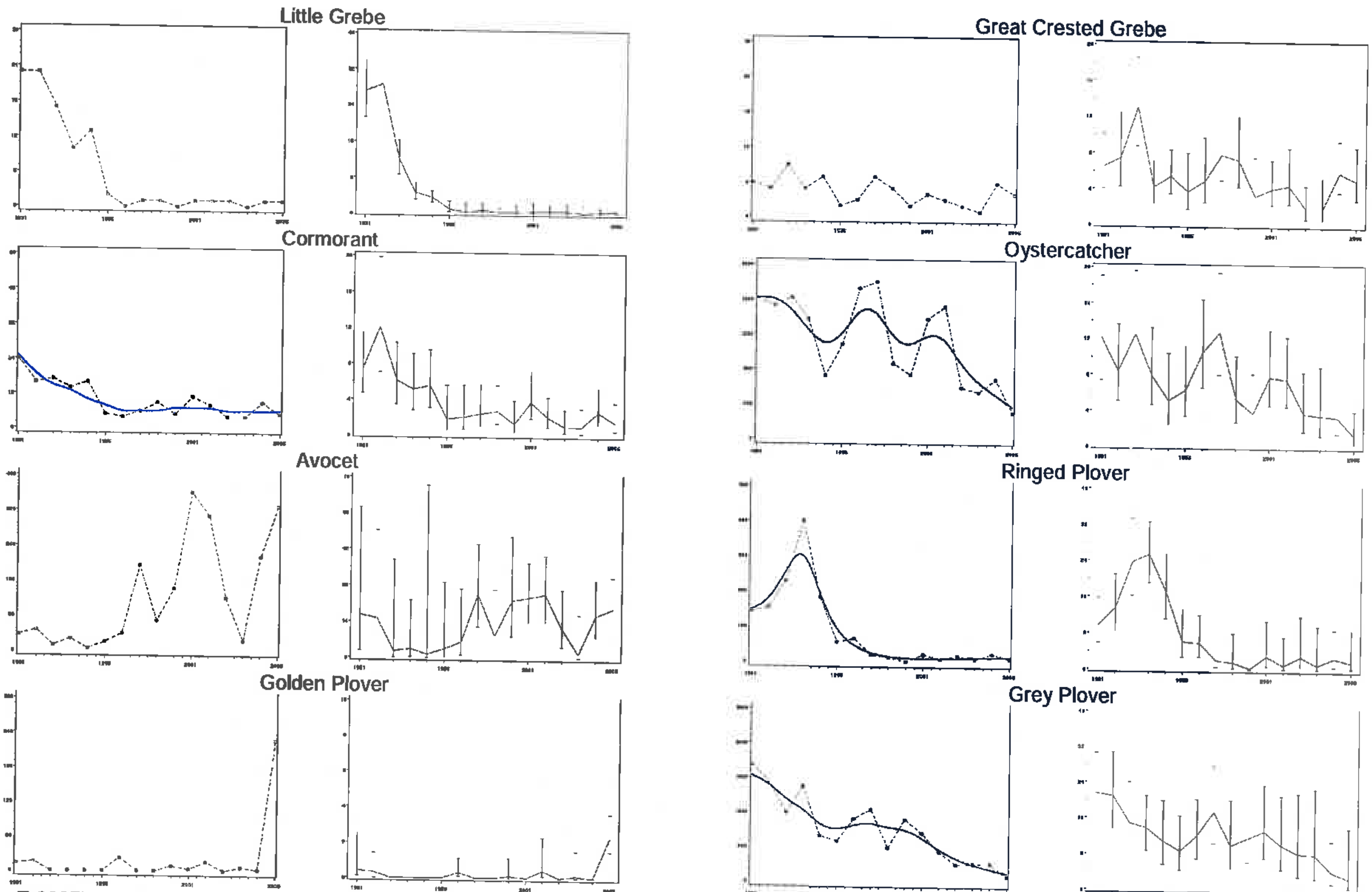


Figure E.22977 Population trends of each species in sector 22977 (Medway Islands) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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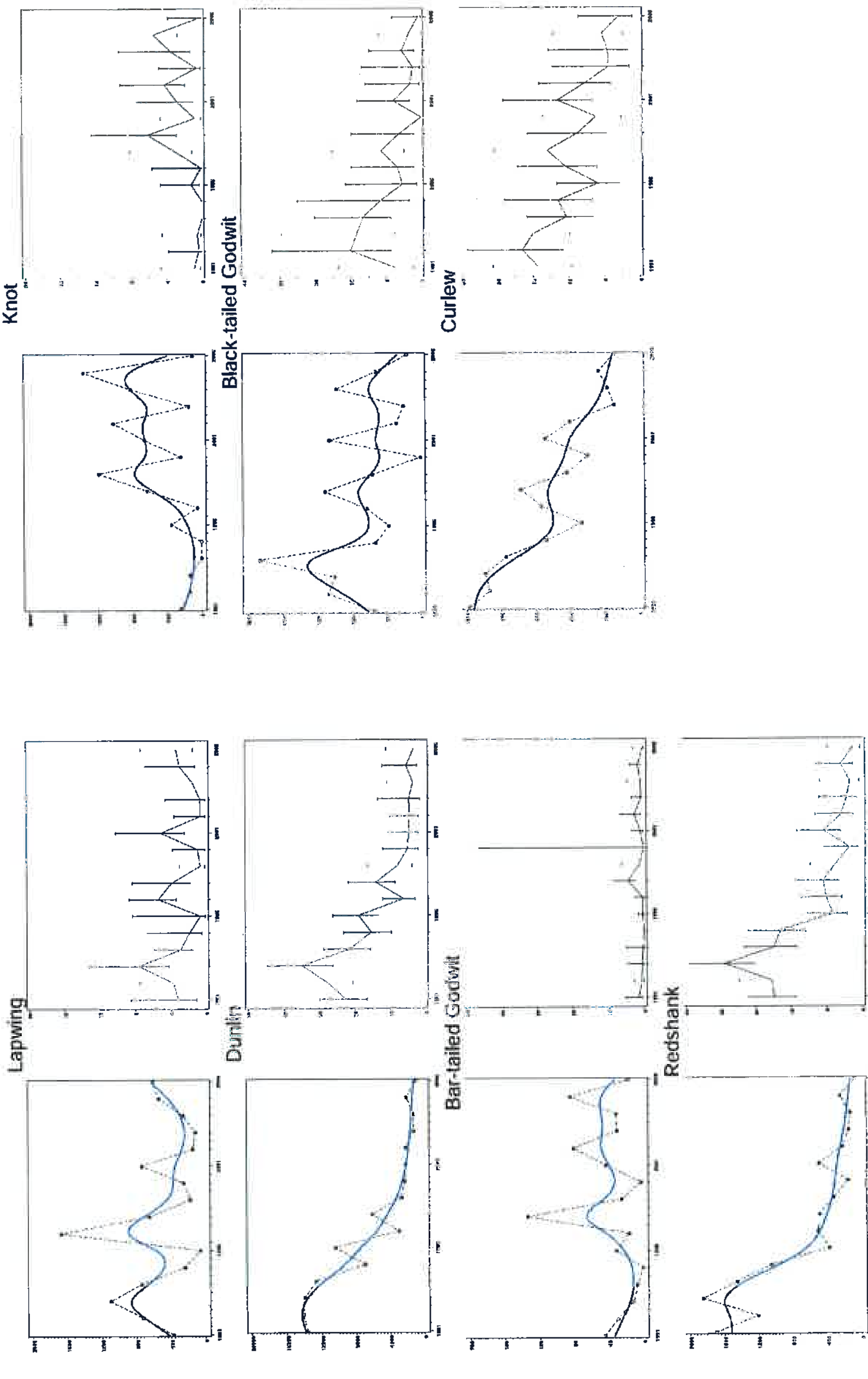

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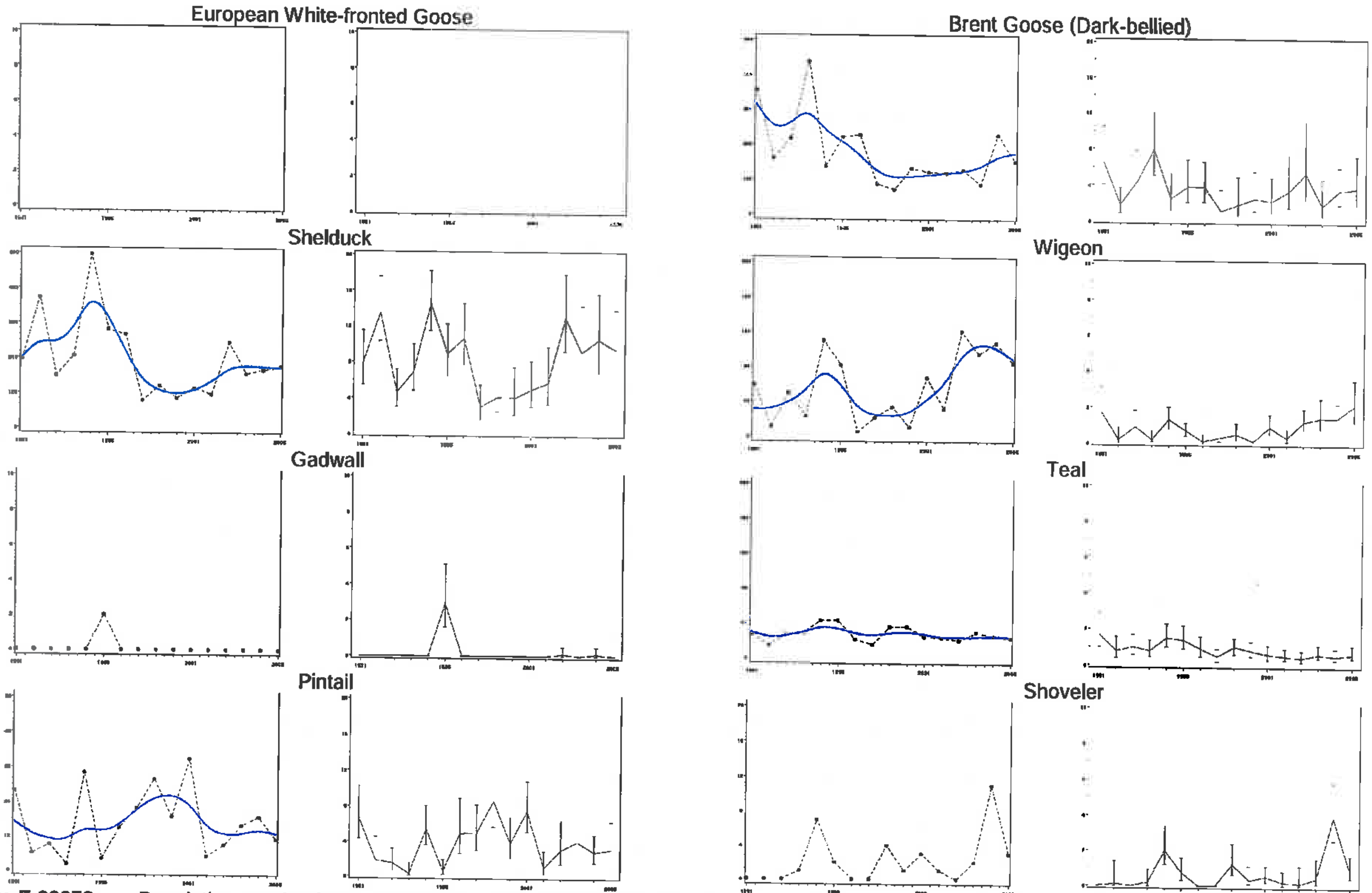
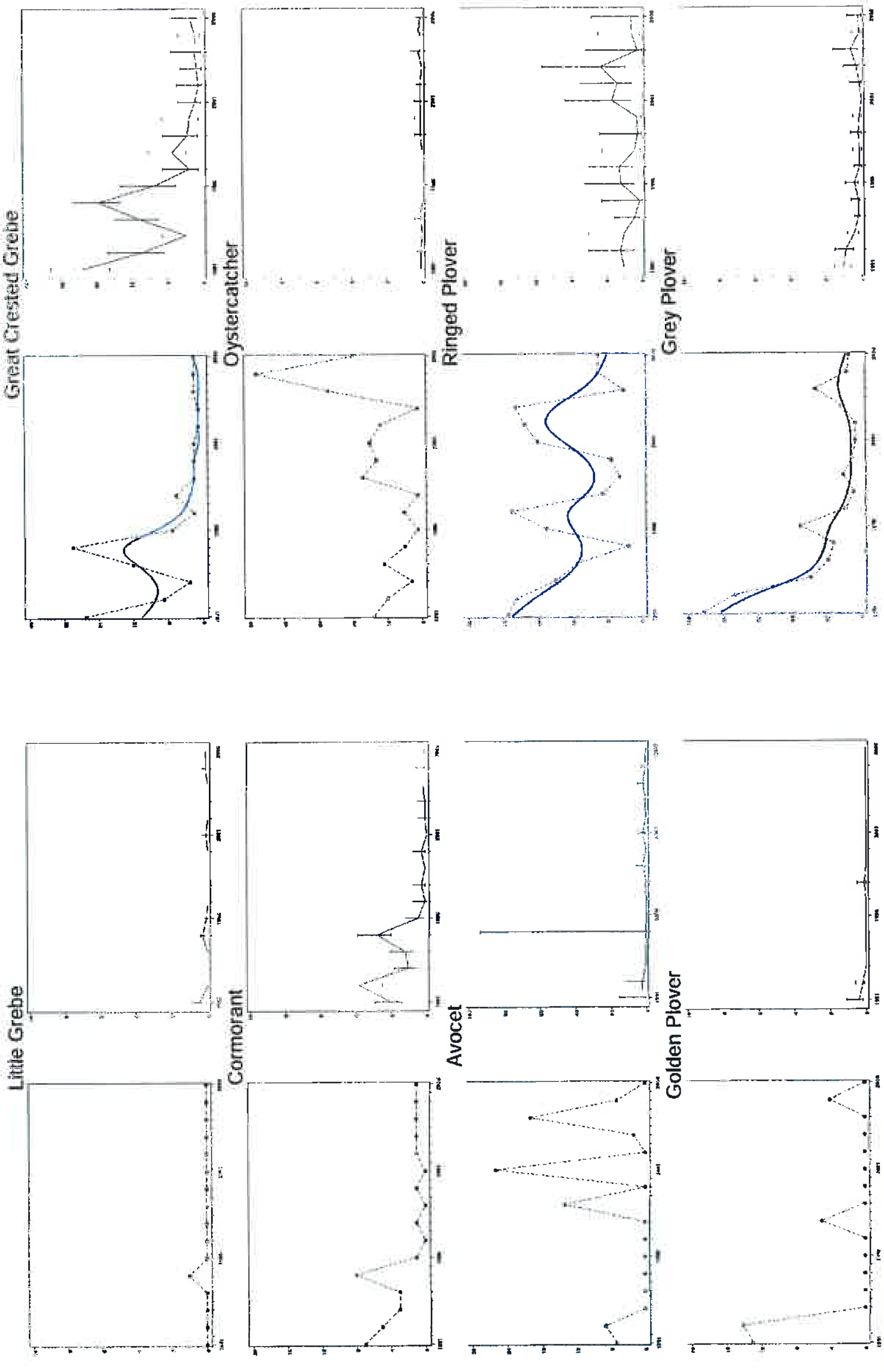


Figure E.22978 Population trends of each species in sector 22978 (Ham Green and Twinney and Horsham) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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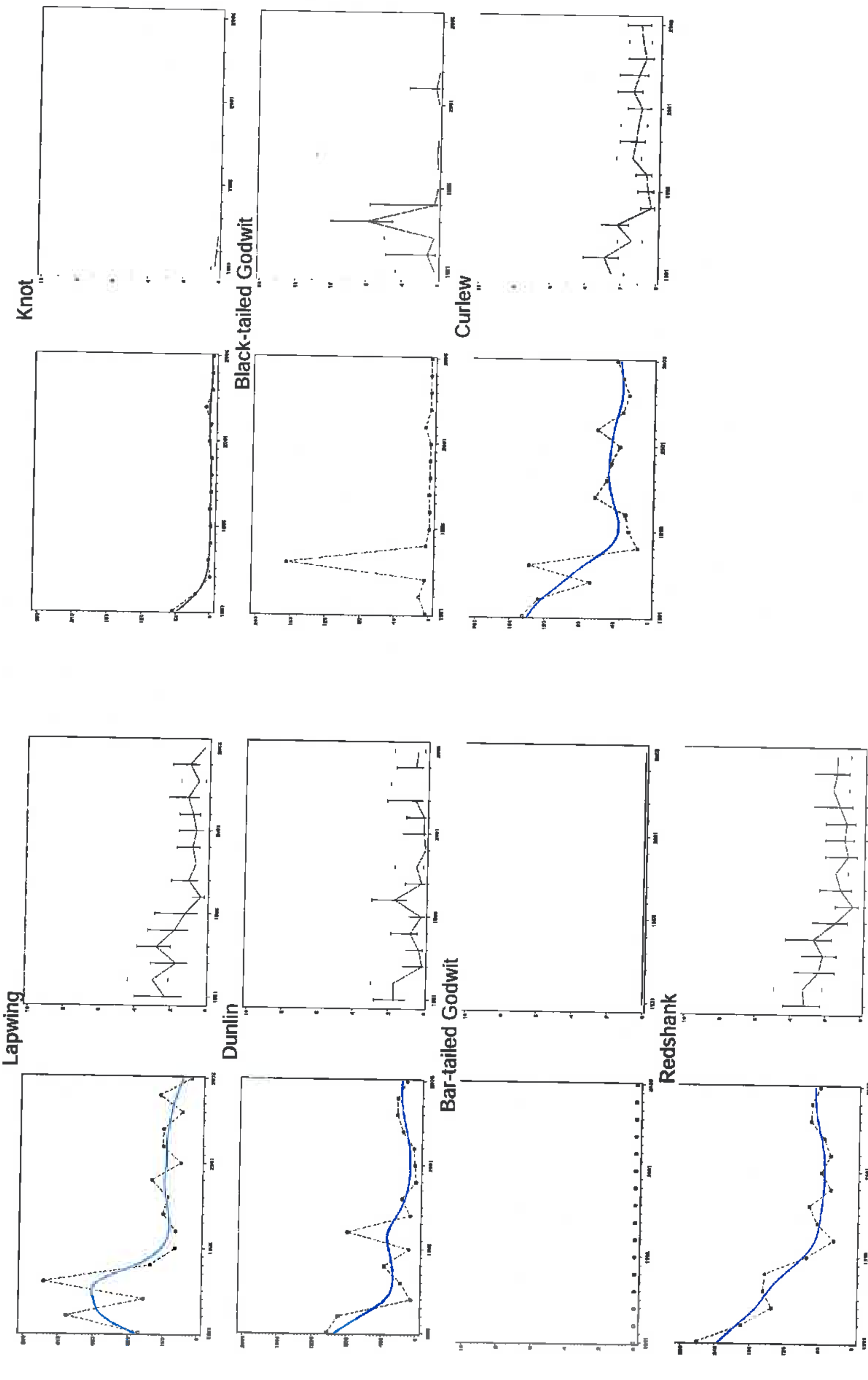

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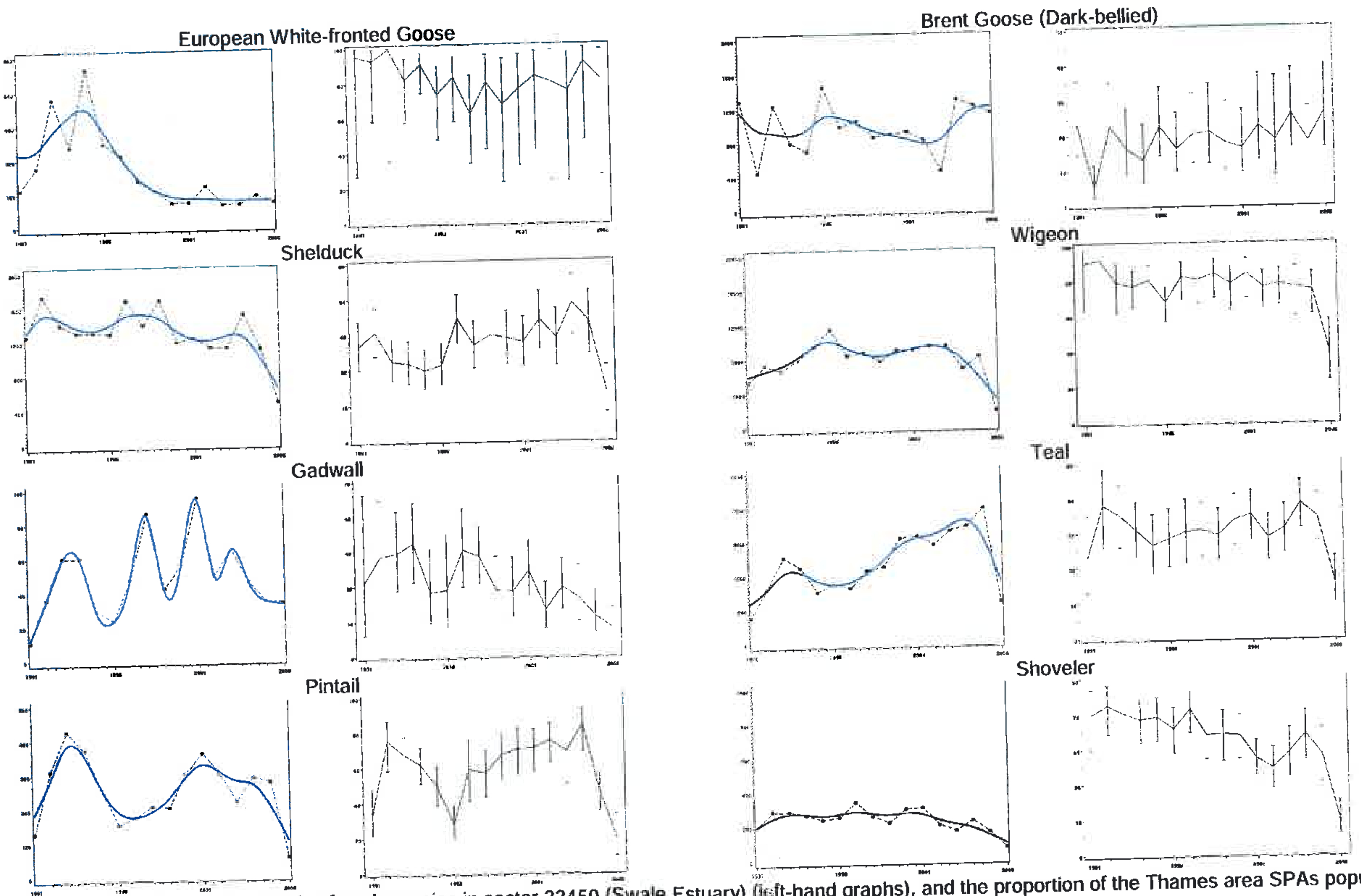
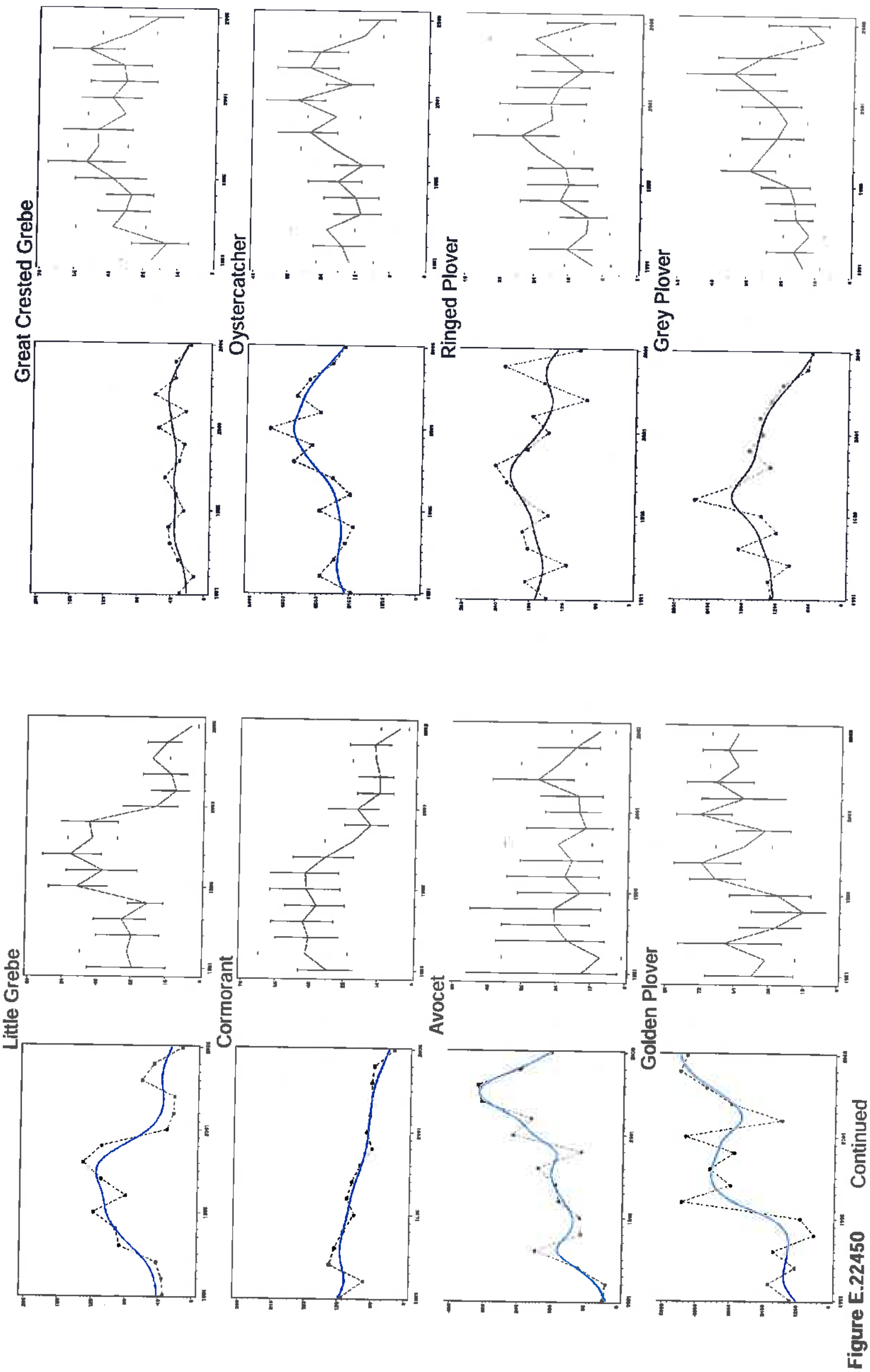


Figure E.22450 Population trends of each species in sector 22450 (Swale Estuary) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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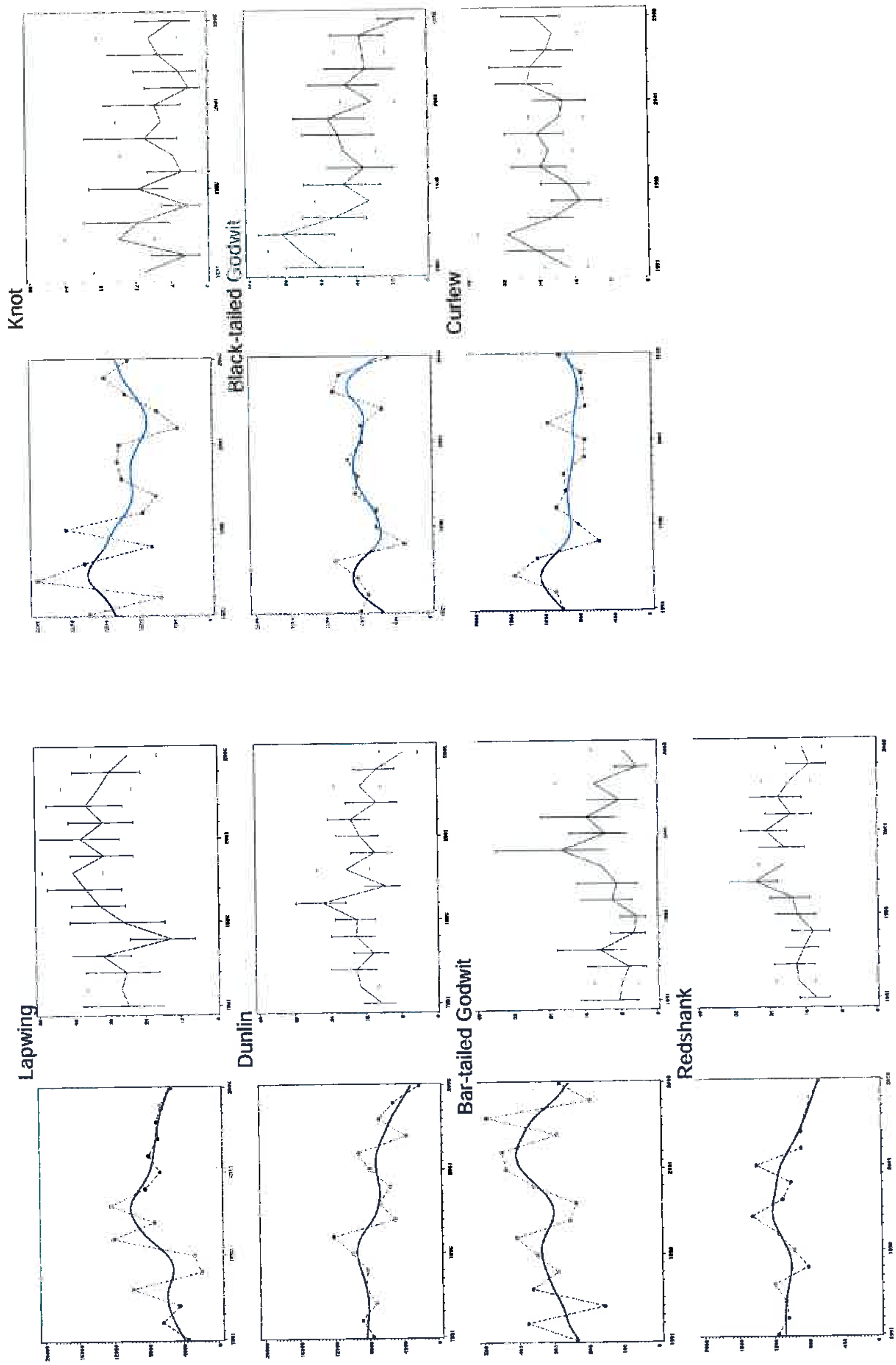

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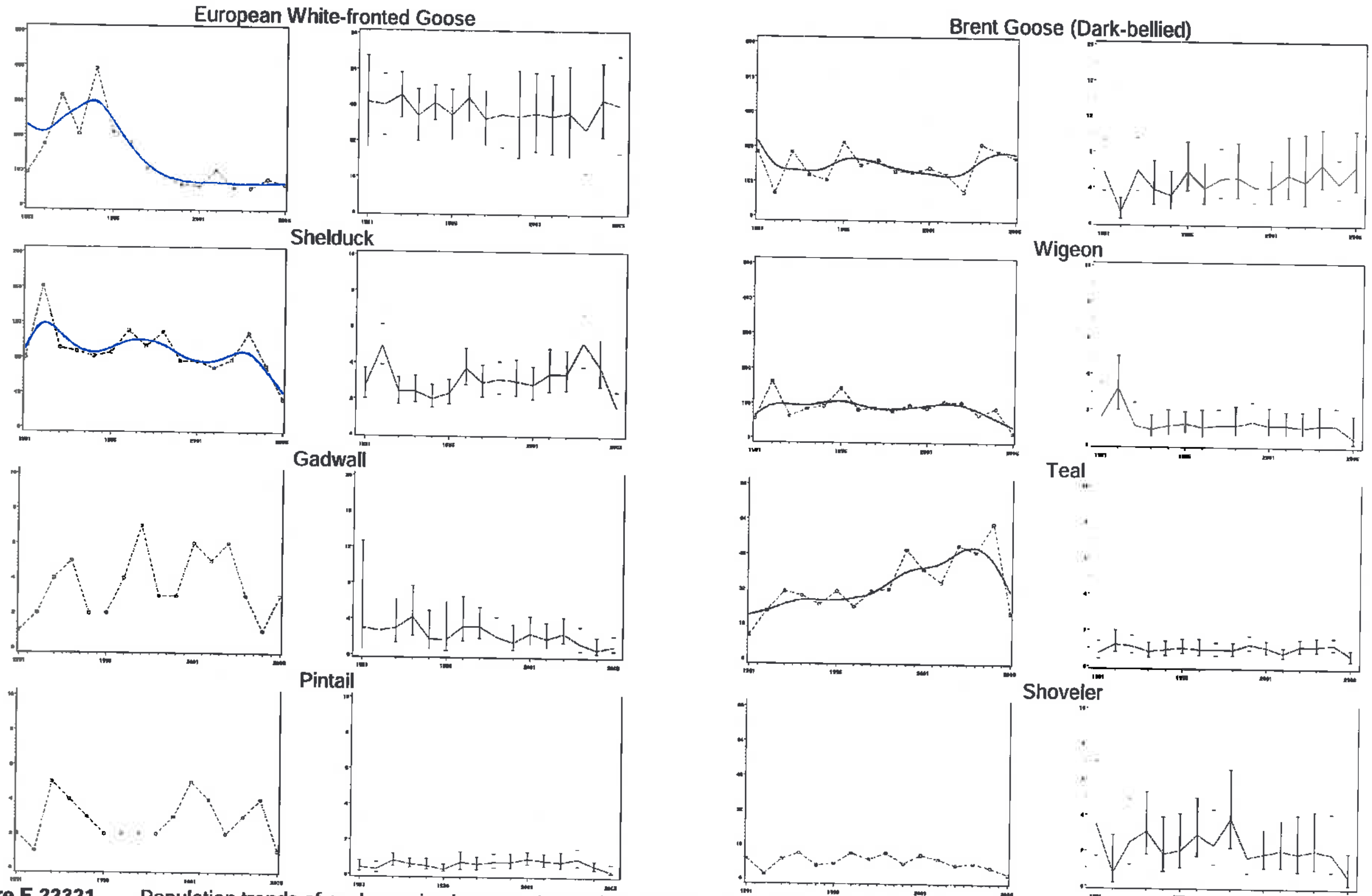
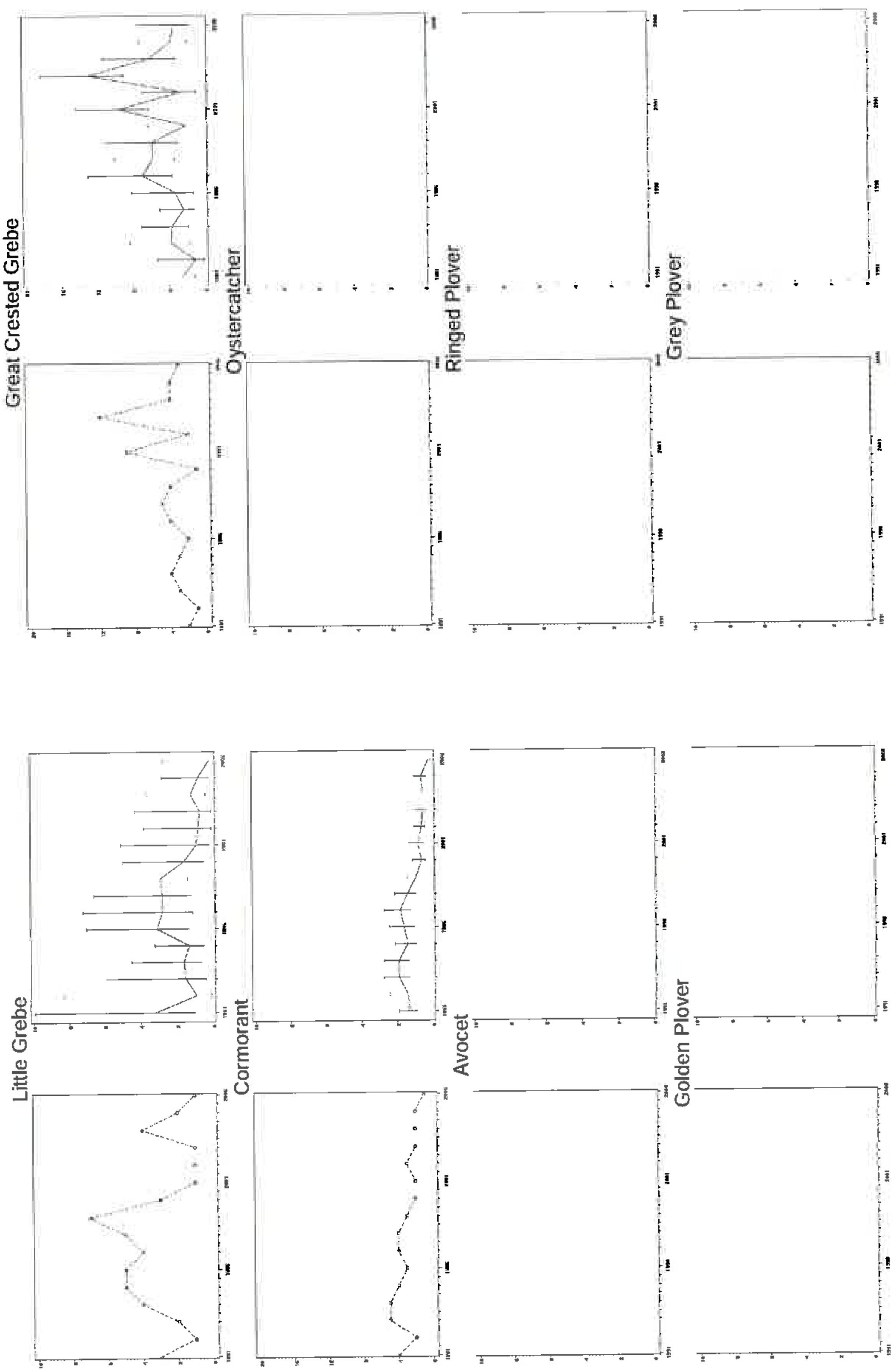


Figure E.22321 Population trends of each species in sector 22321 (Windmill Creek and Capel Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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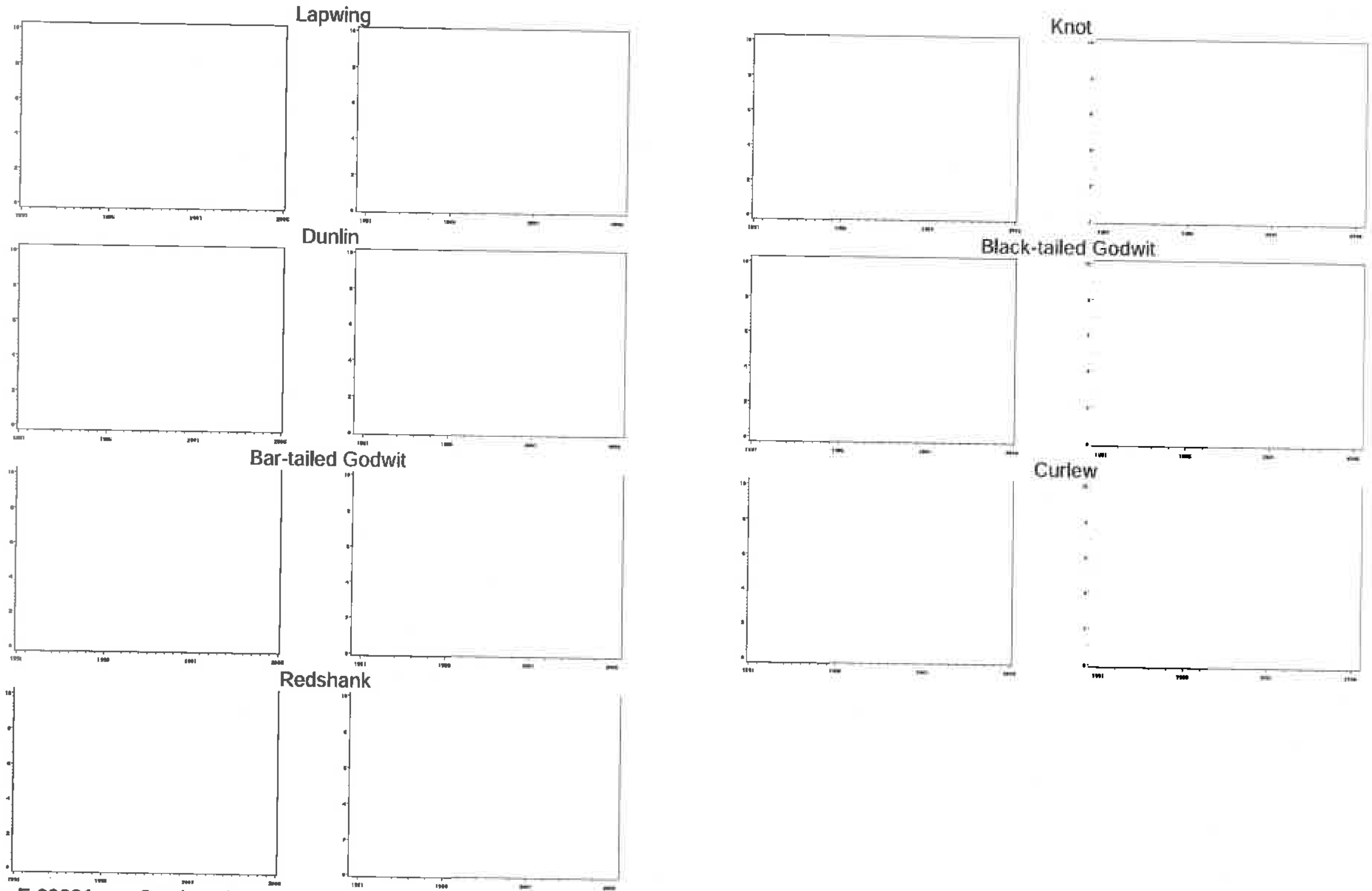

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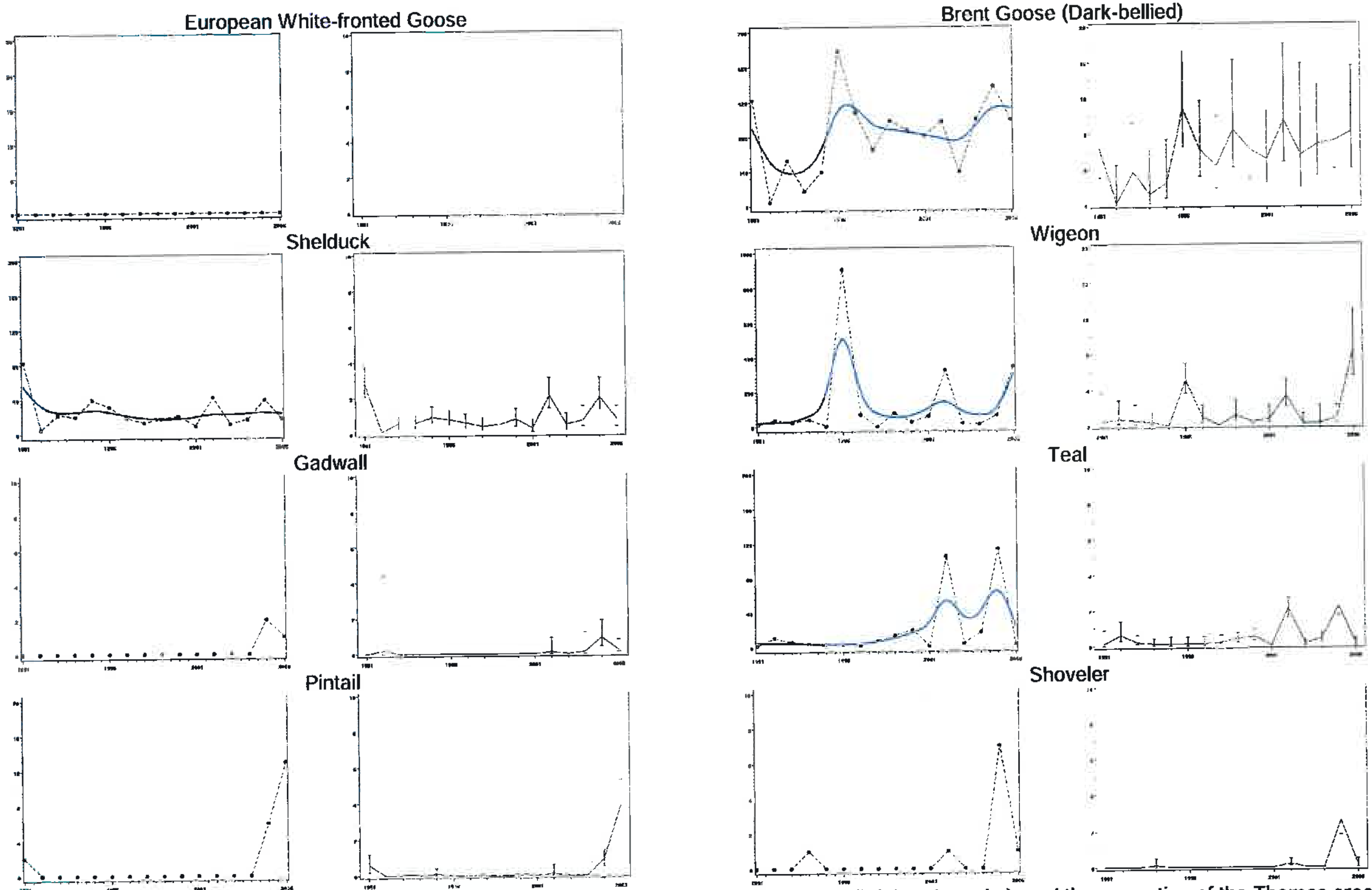
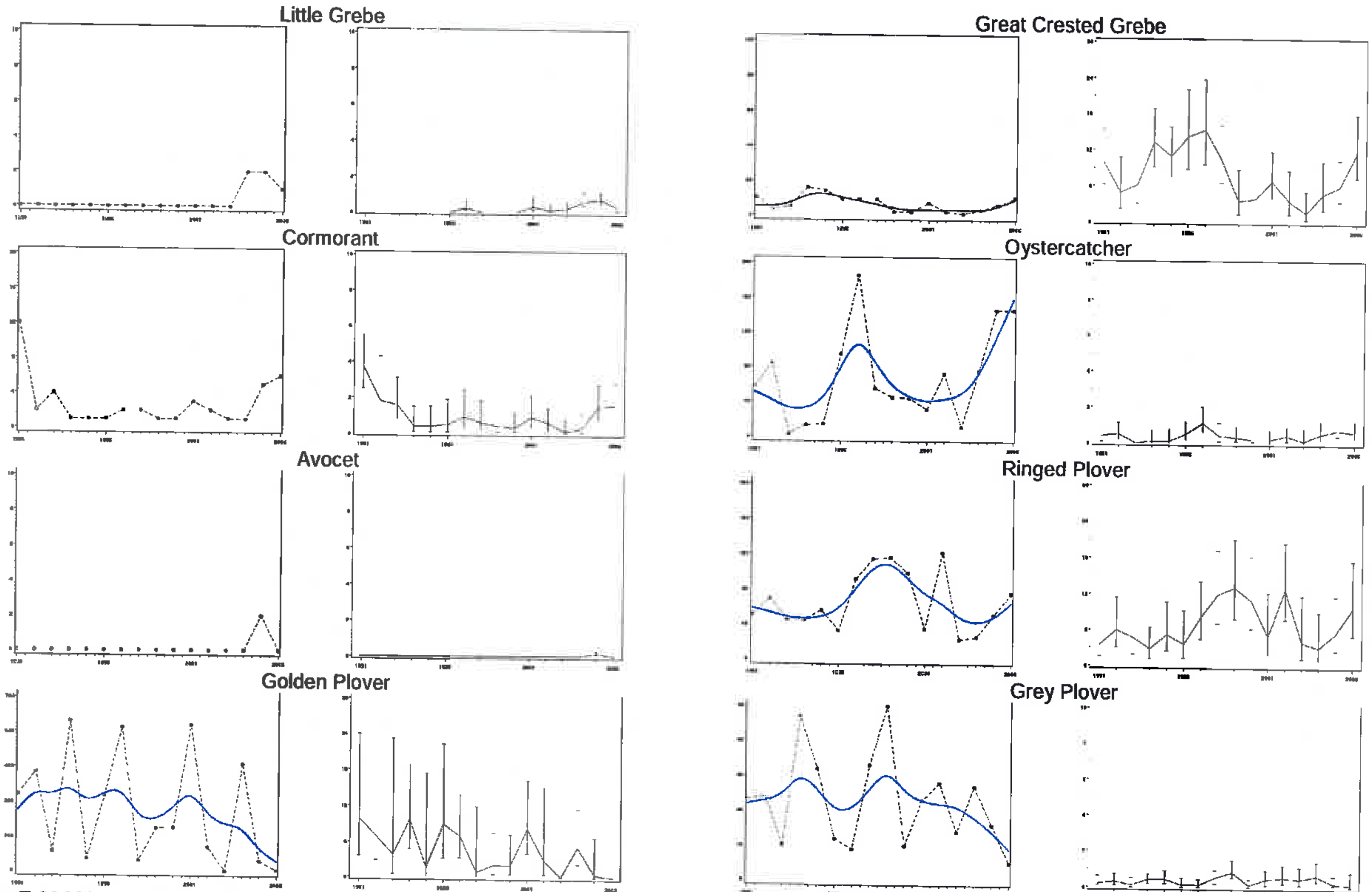


Figure E.22441 Population trends of each species in sector 22441 (Faversham to Whitstable) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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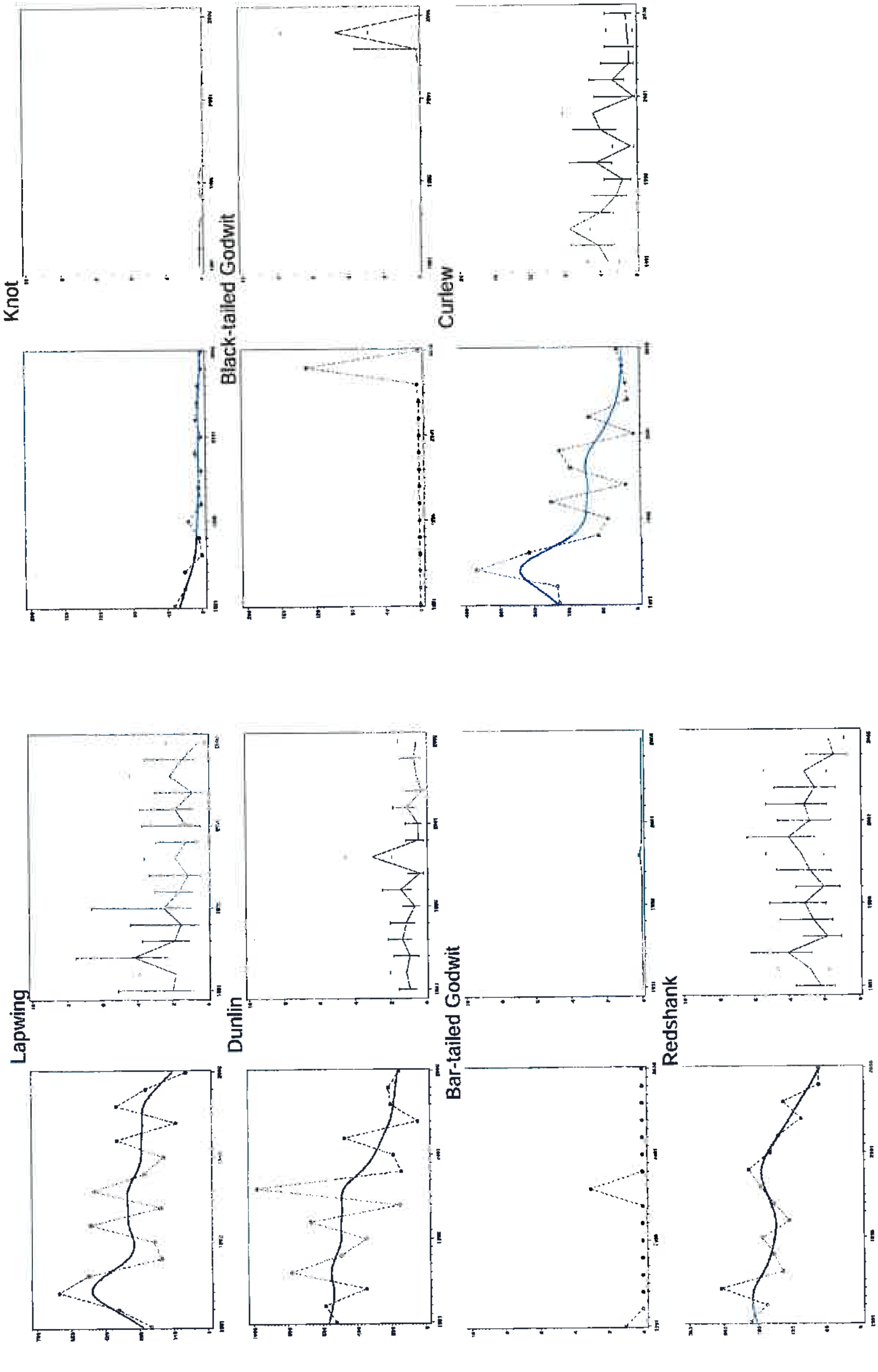

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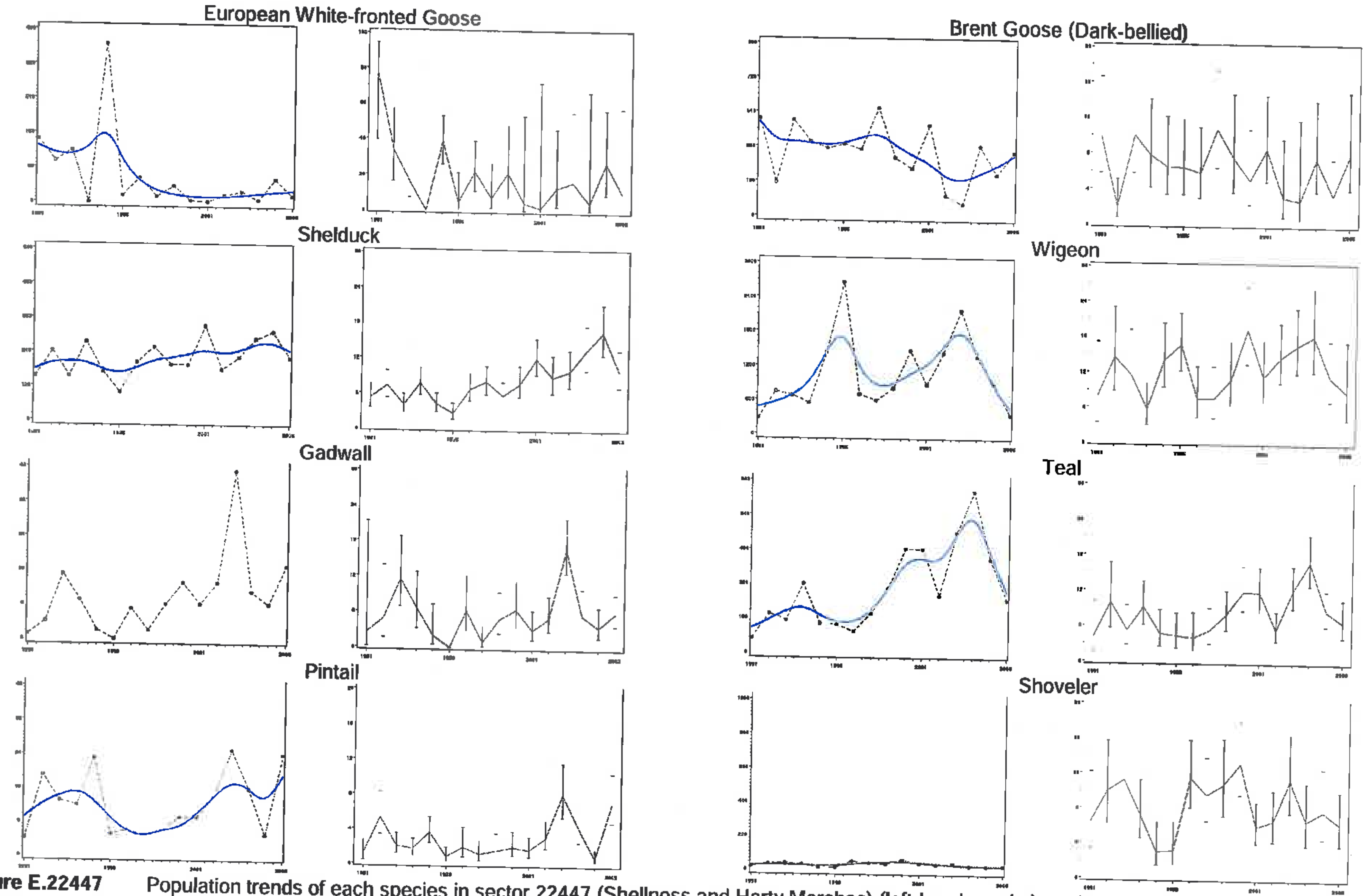
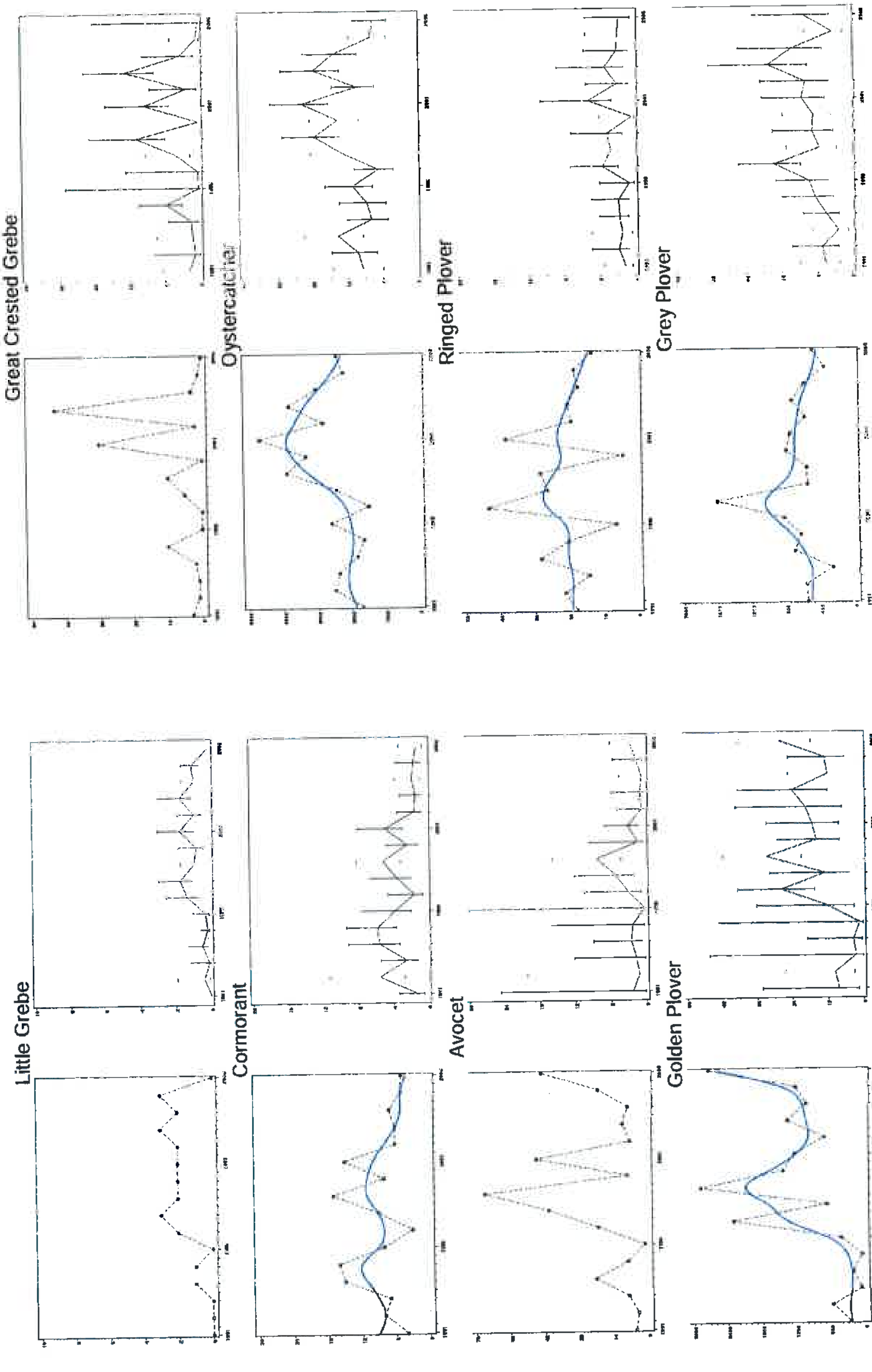


Figure E.22447 Population trends of each species in sector 22447 (Shellness and Harty Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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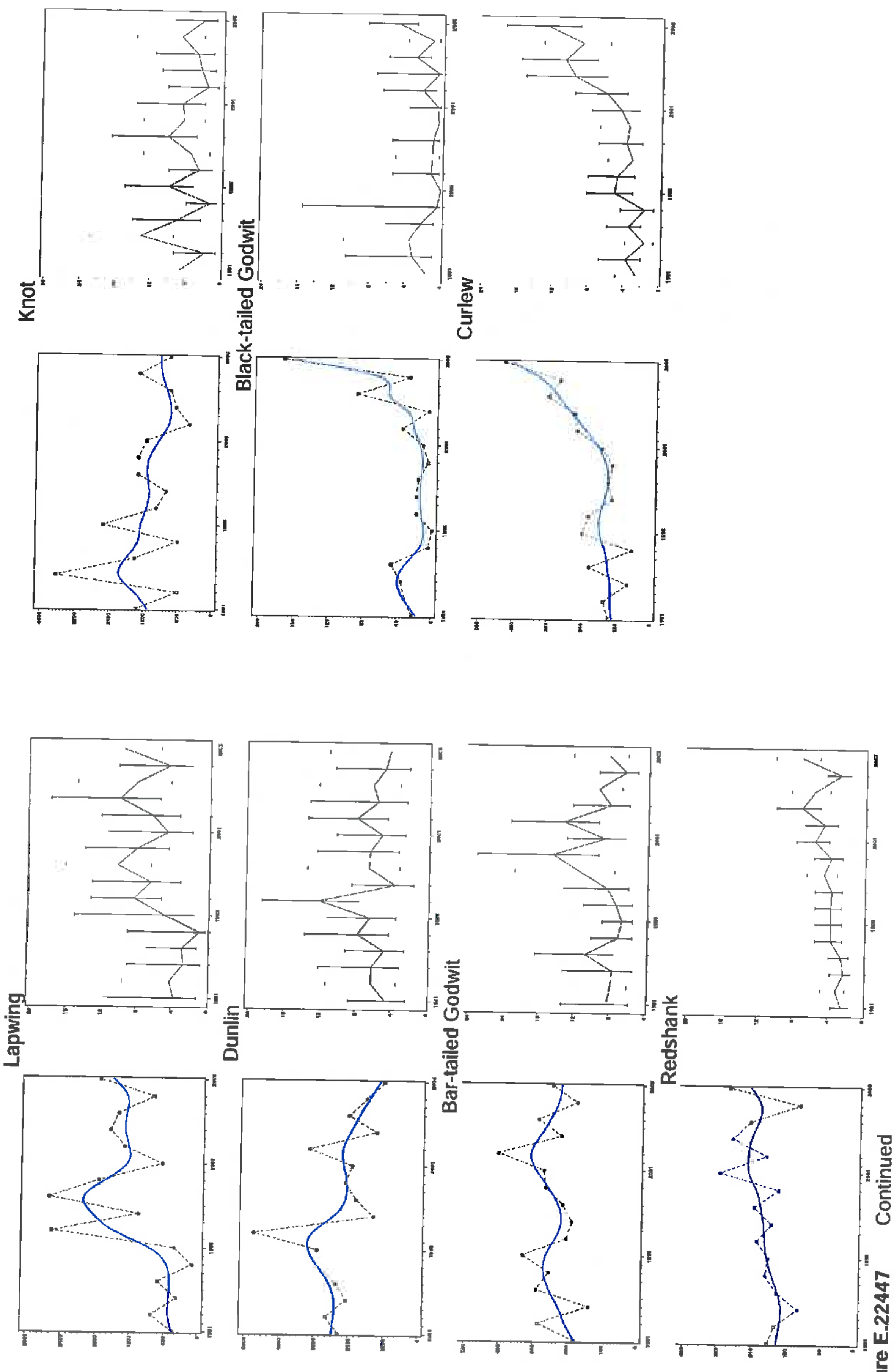

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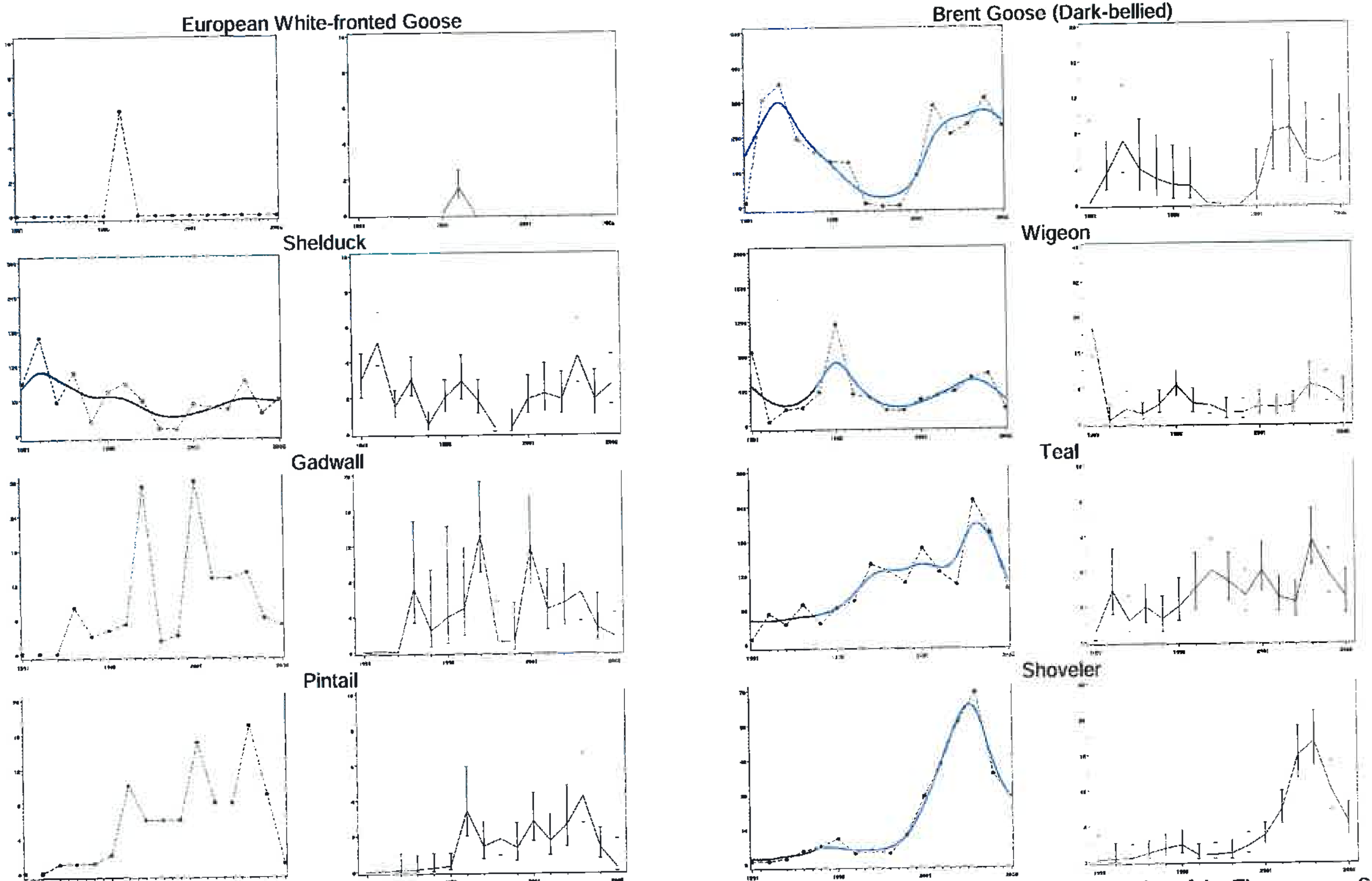
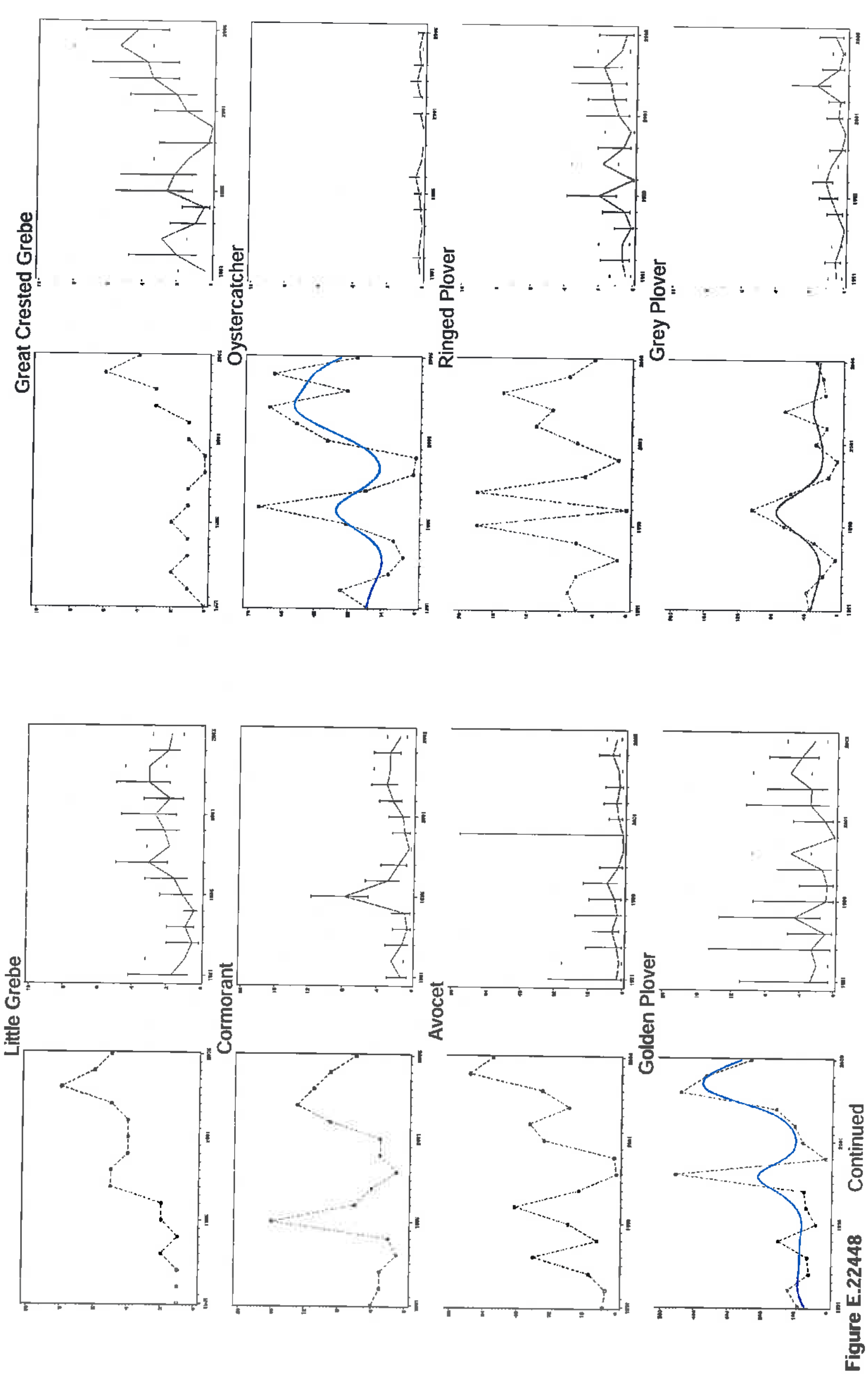


Figure E.22448 Population trends of each species in sector 22448 (Swale - Conyer to Oare) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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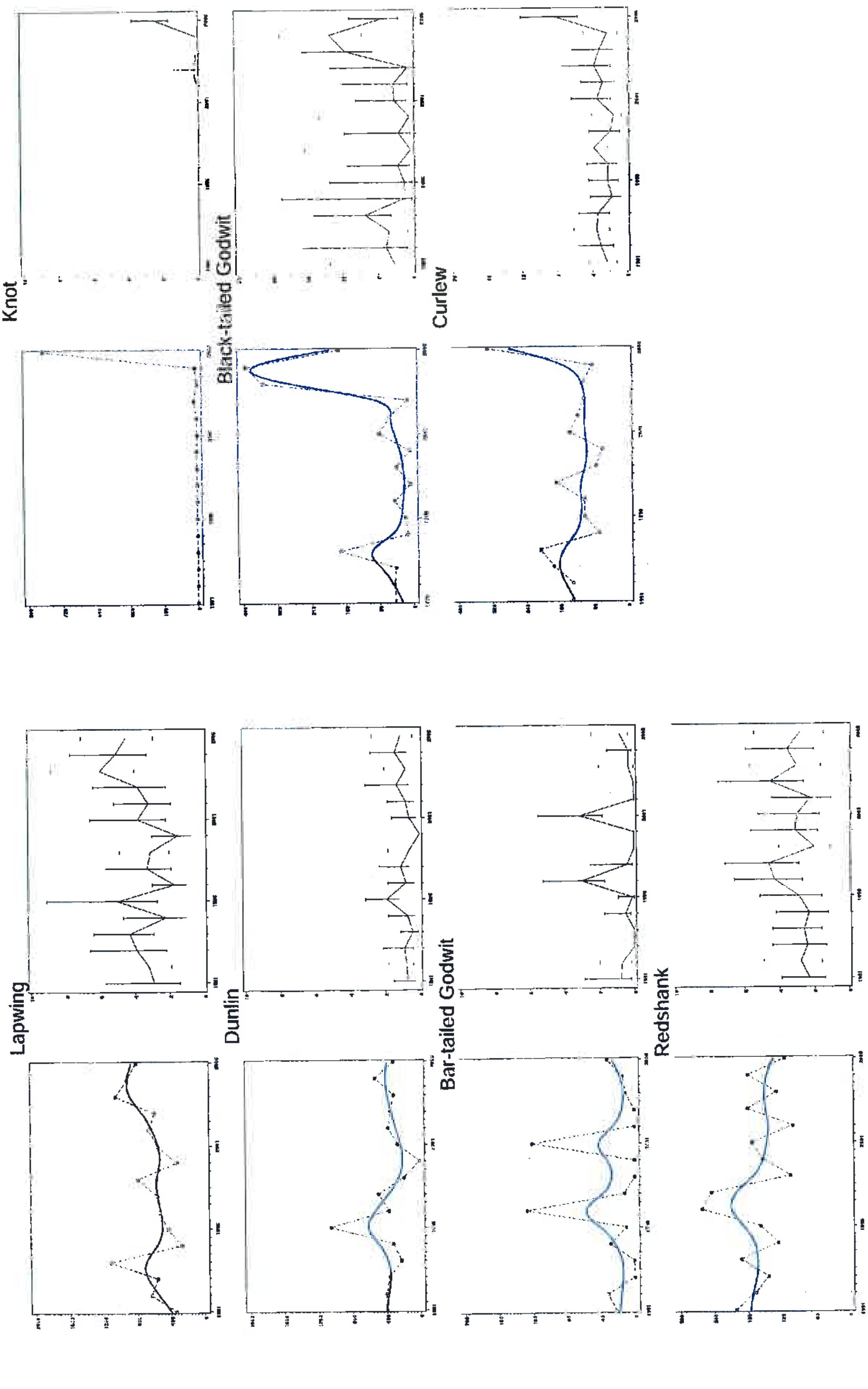

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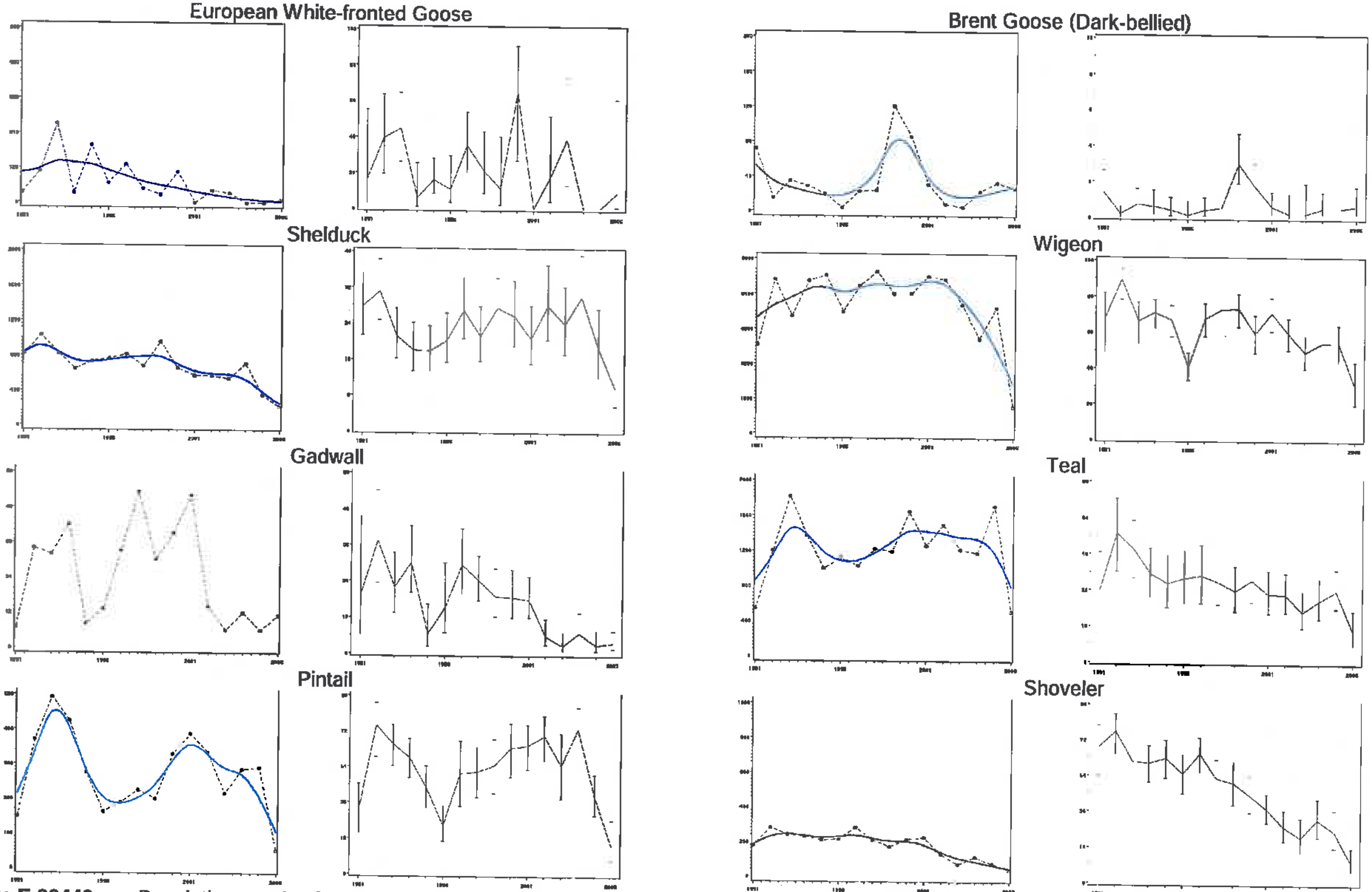
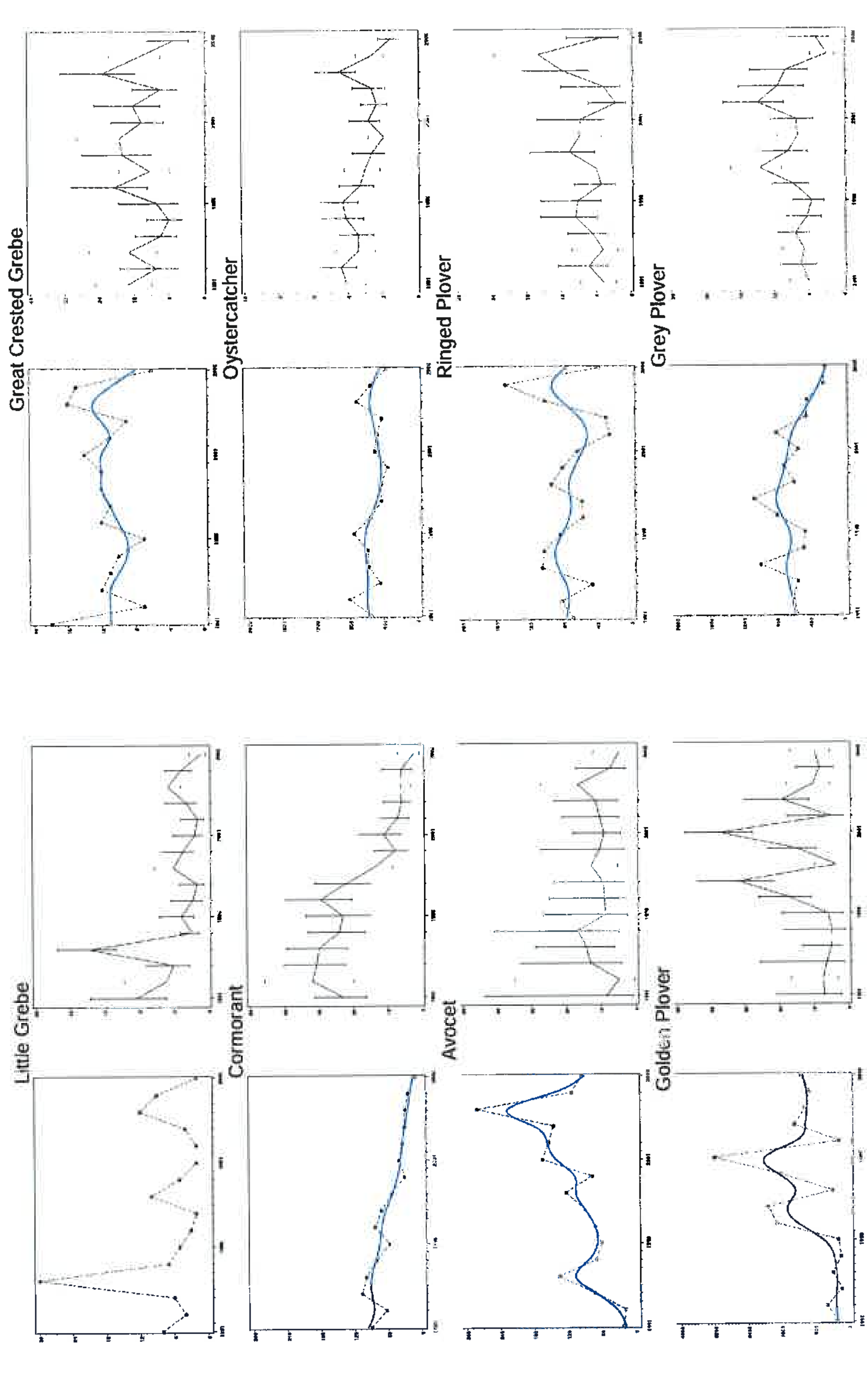


Figure E.22449 Population trends of each species in sector 22449 (Elmley Marshes) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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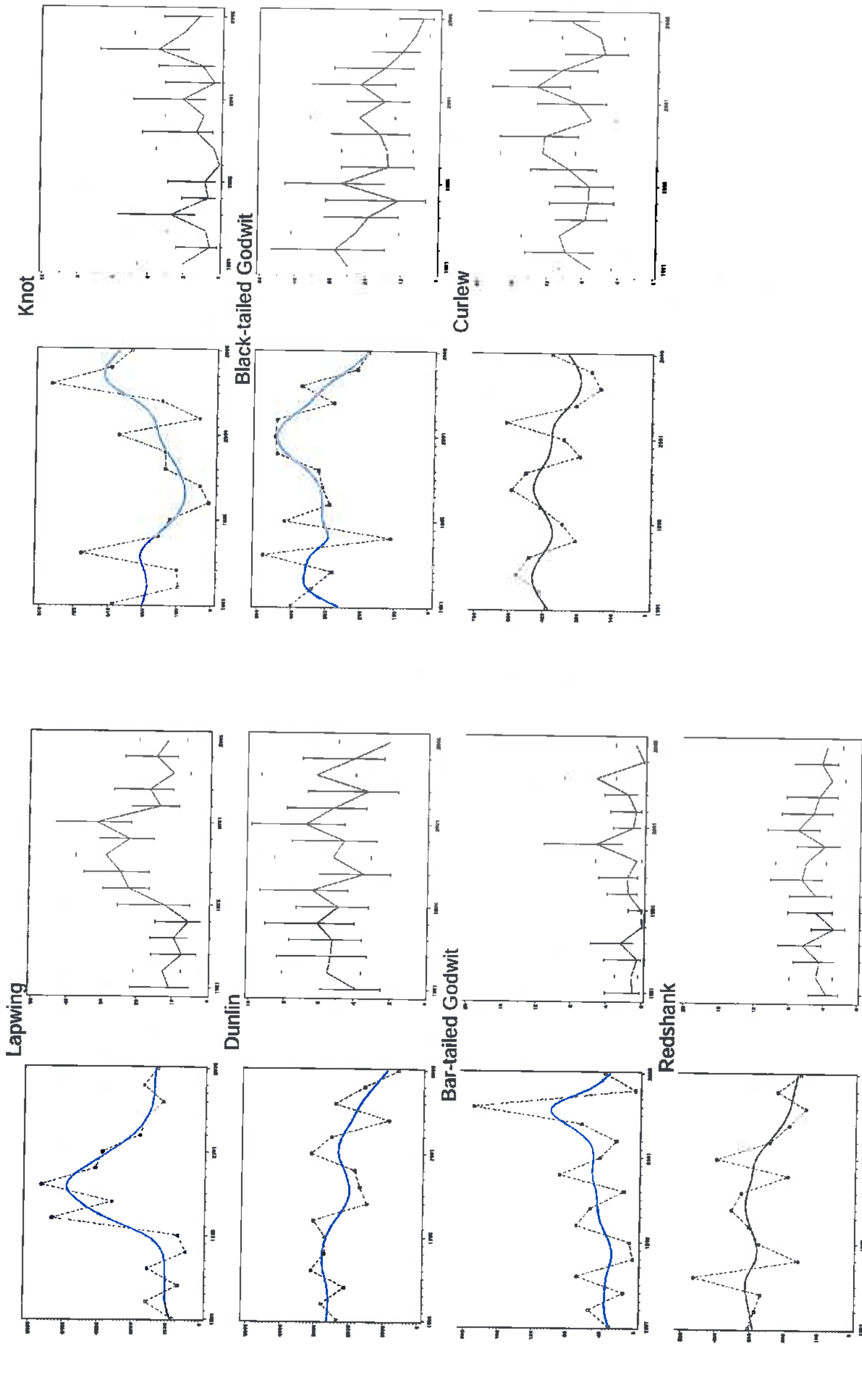

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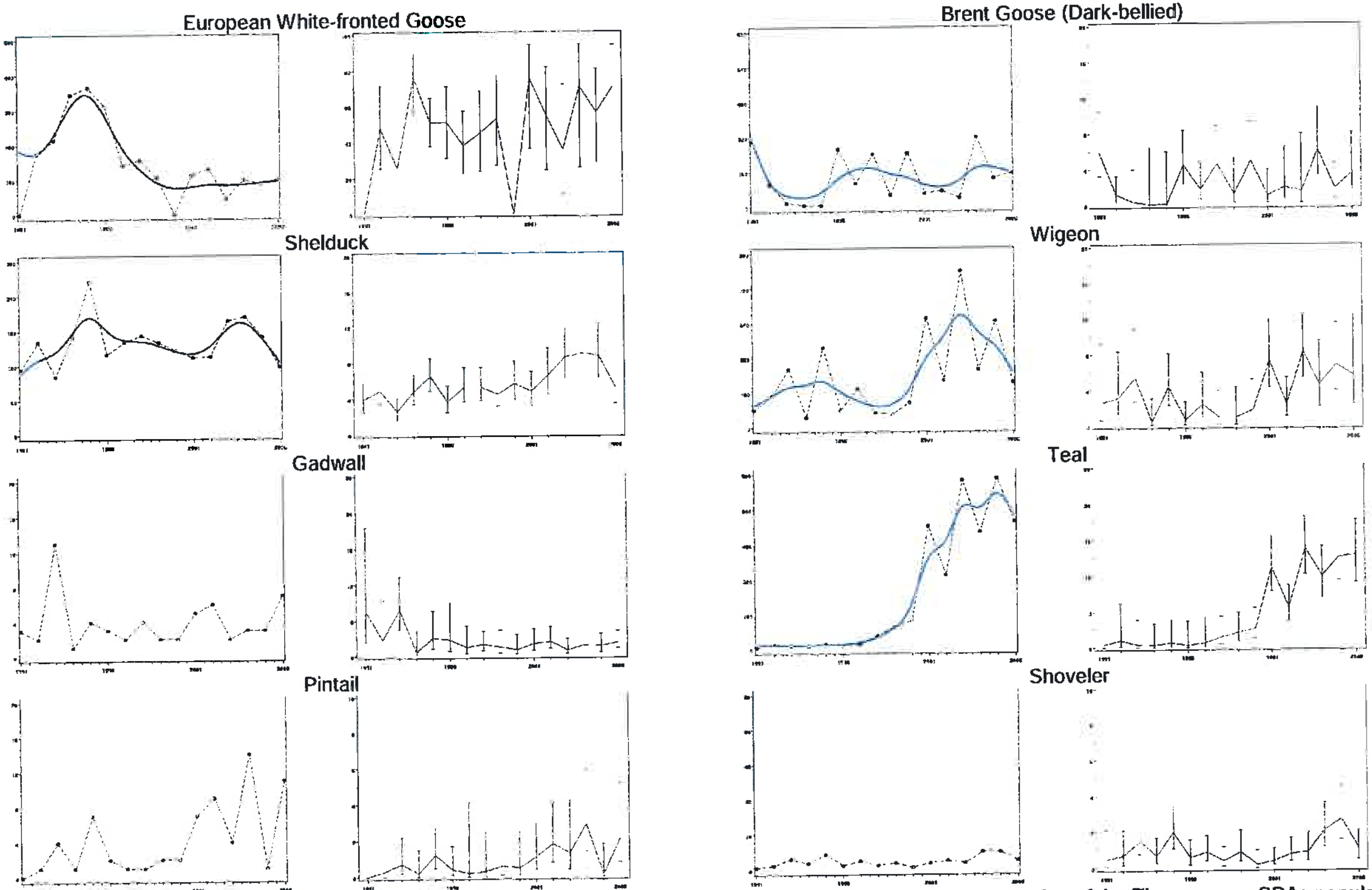
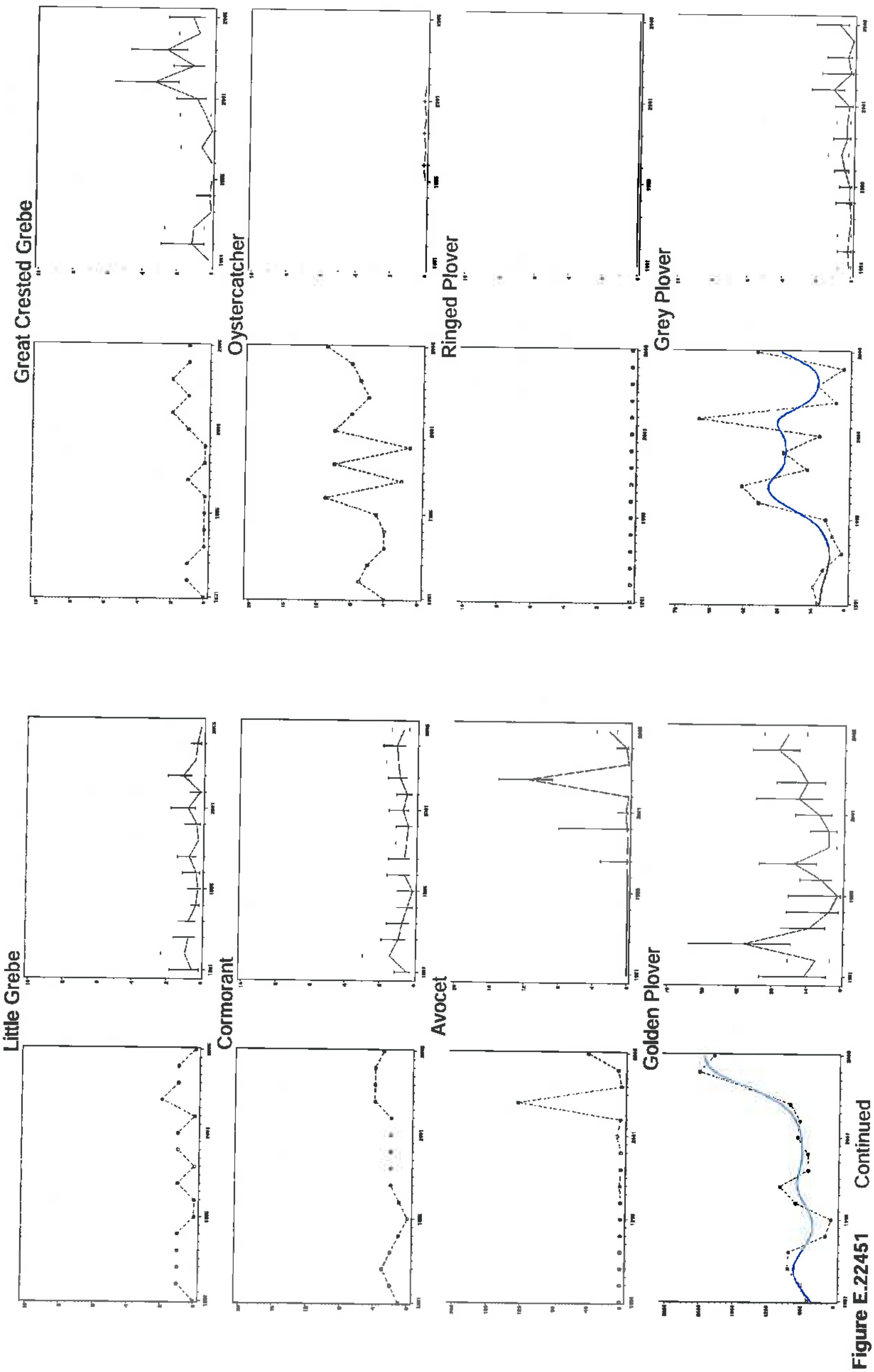


Figure E.22451 Population trends of each species in sector 22451 (Capel Fleet) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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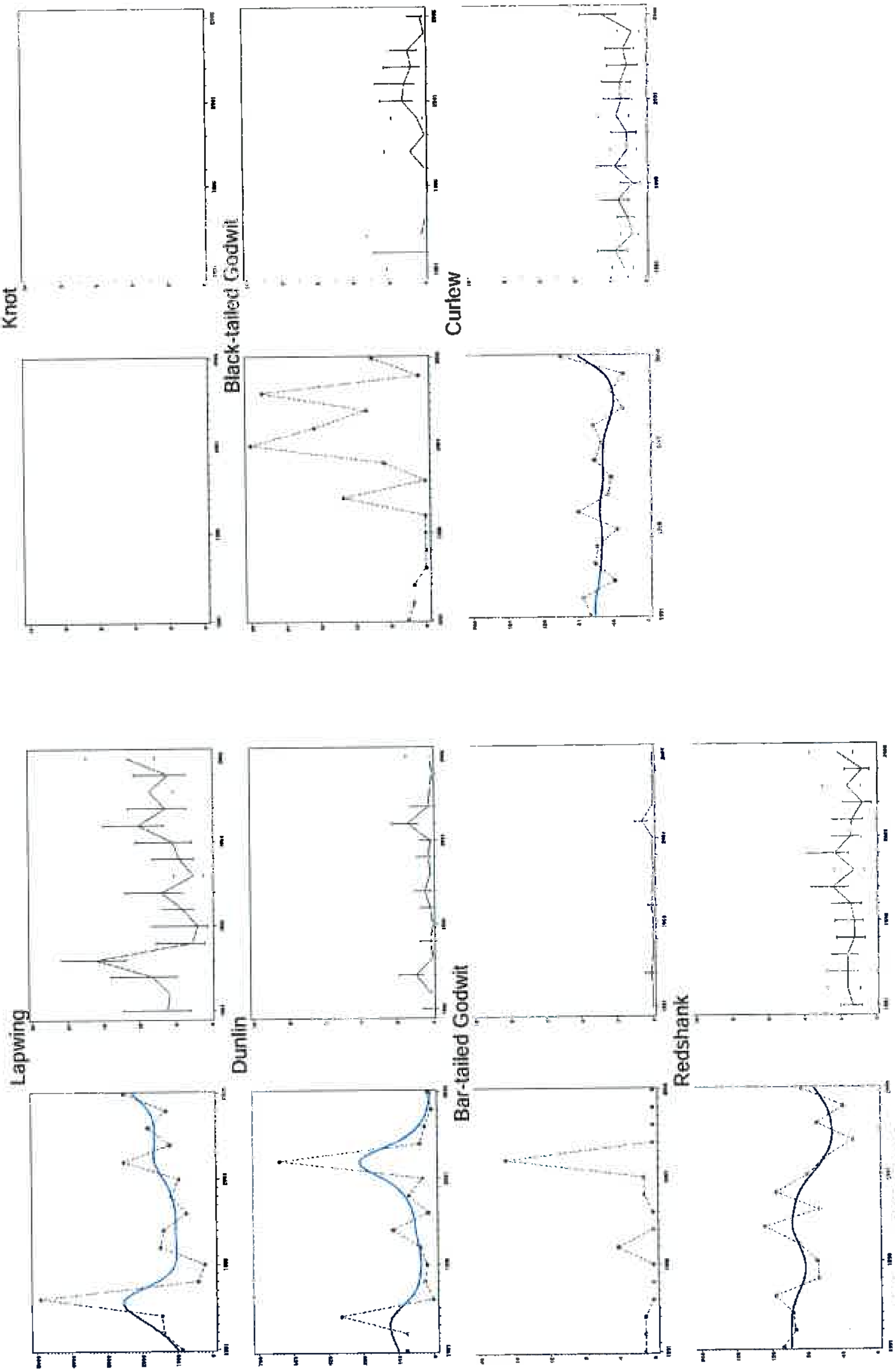

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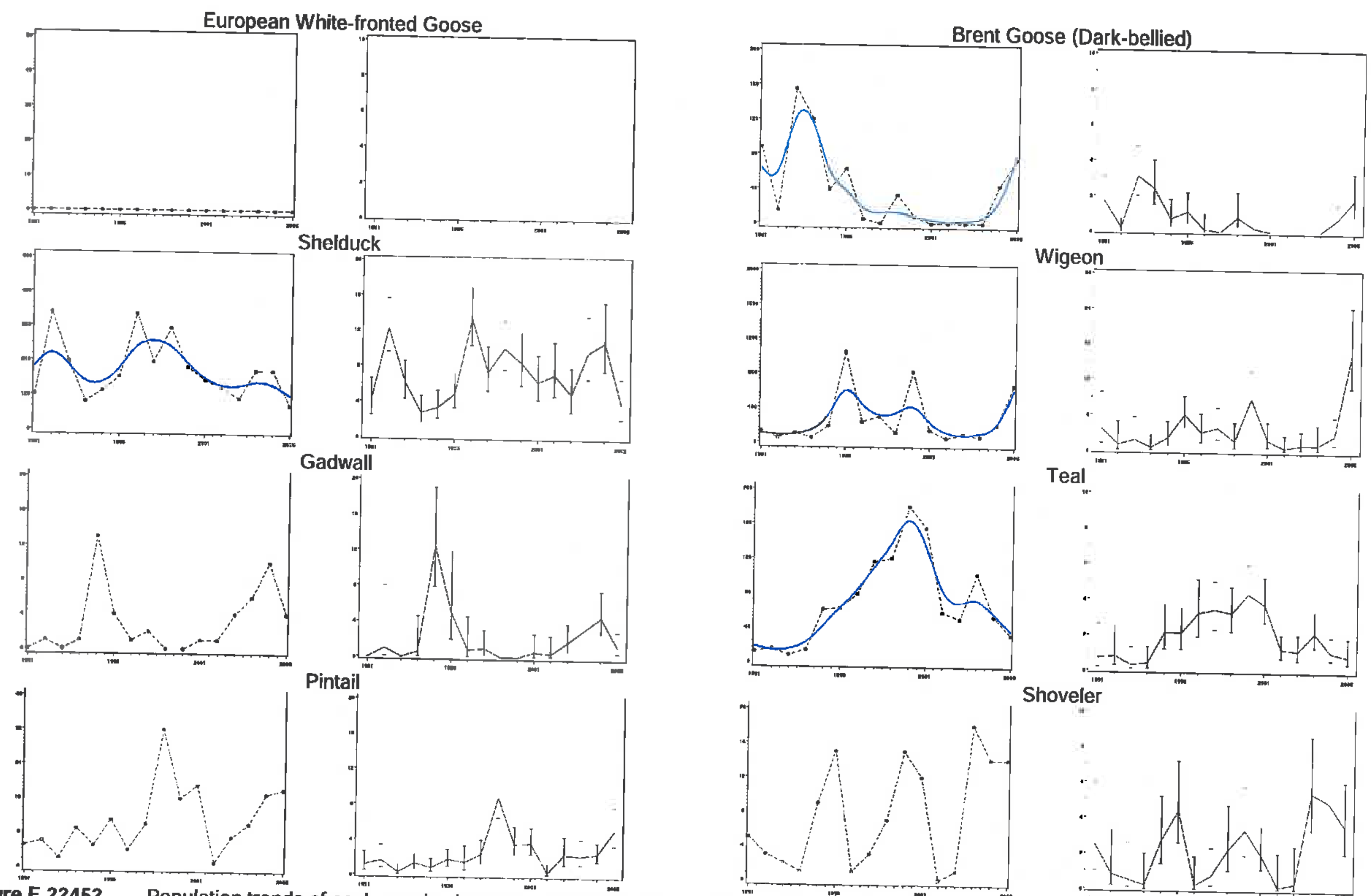
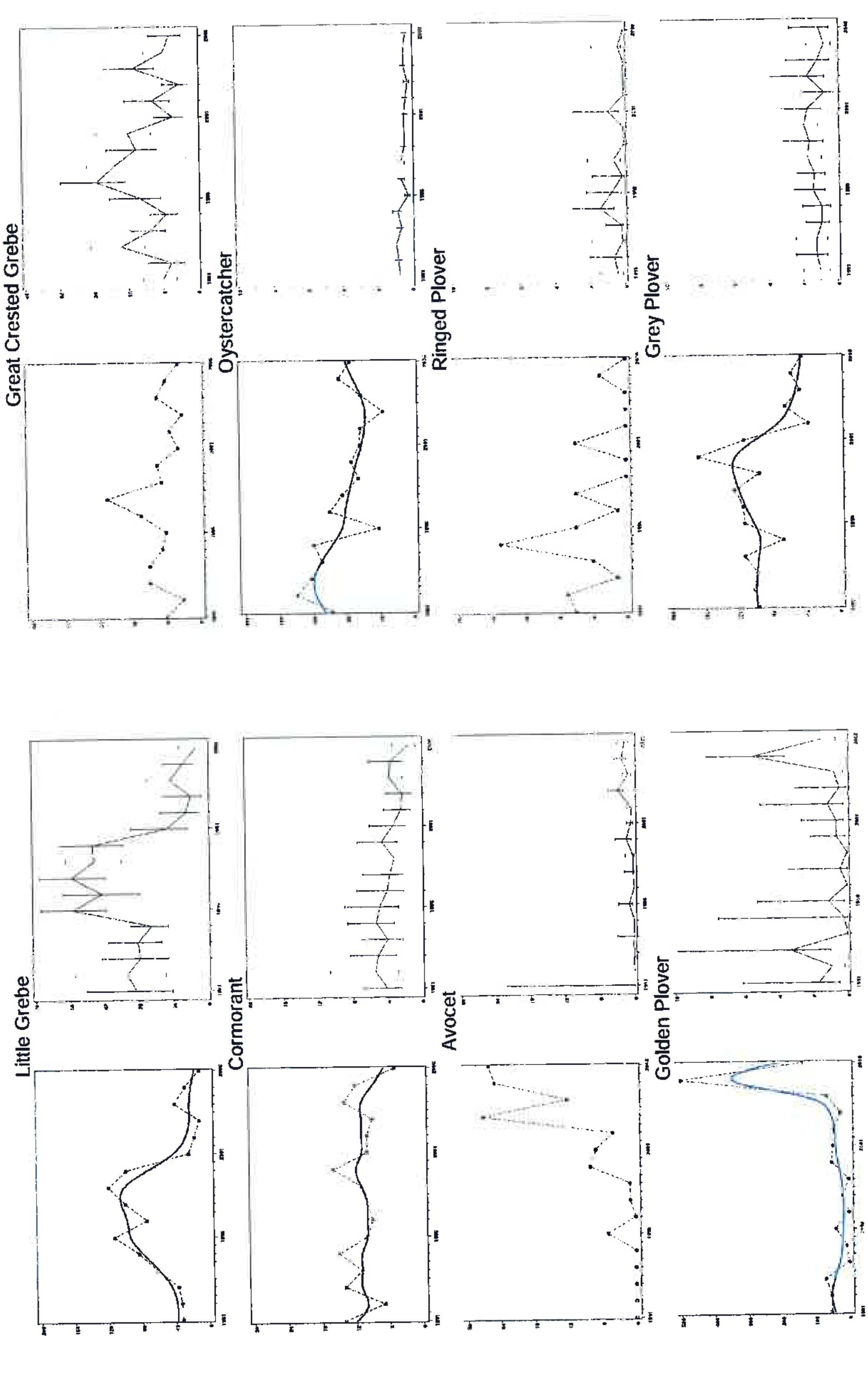


Figure E.22452 Population trends of each species in sector 22452 (Murston to Conyer) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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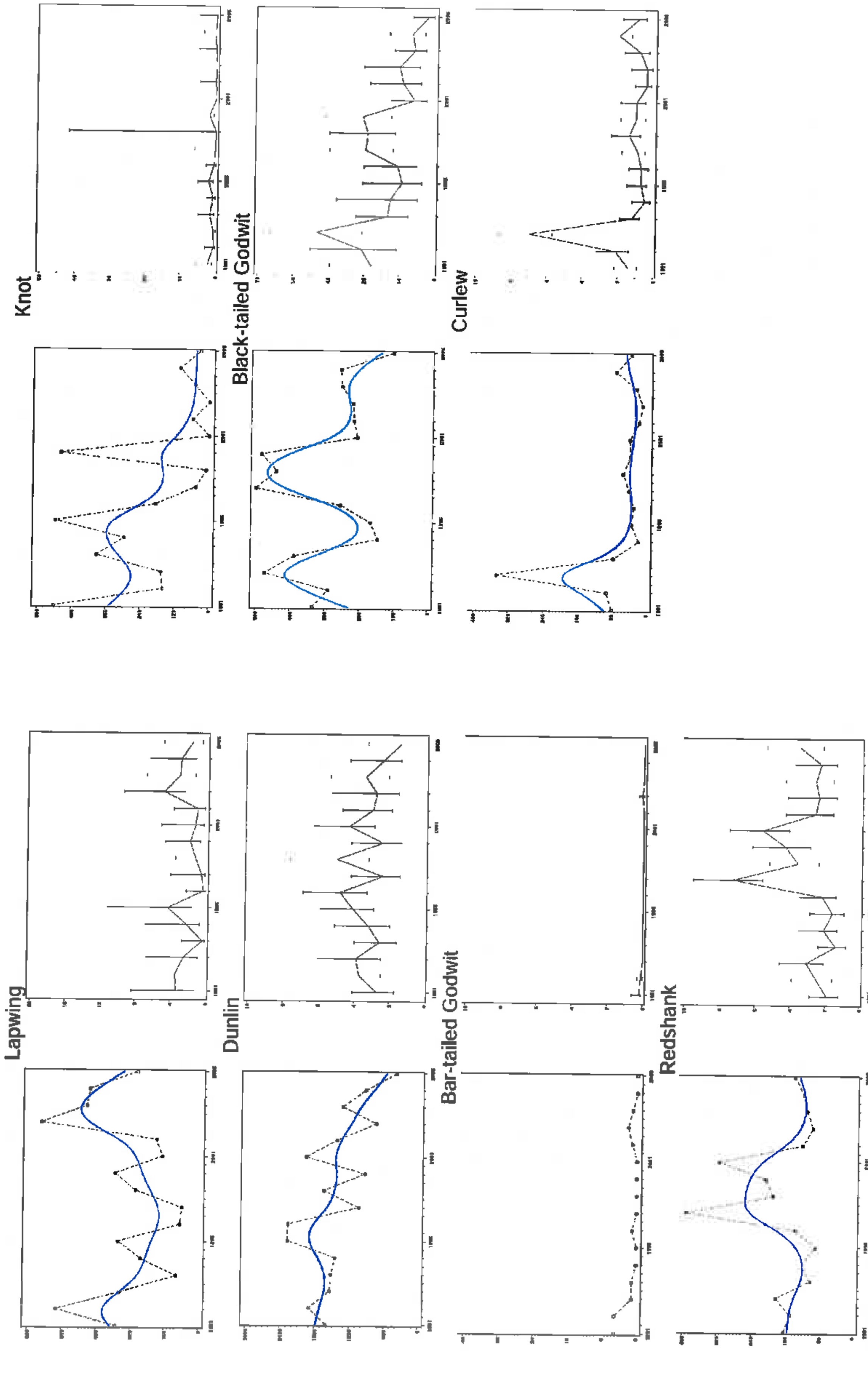

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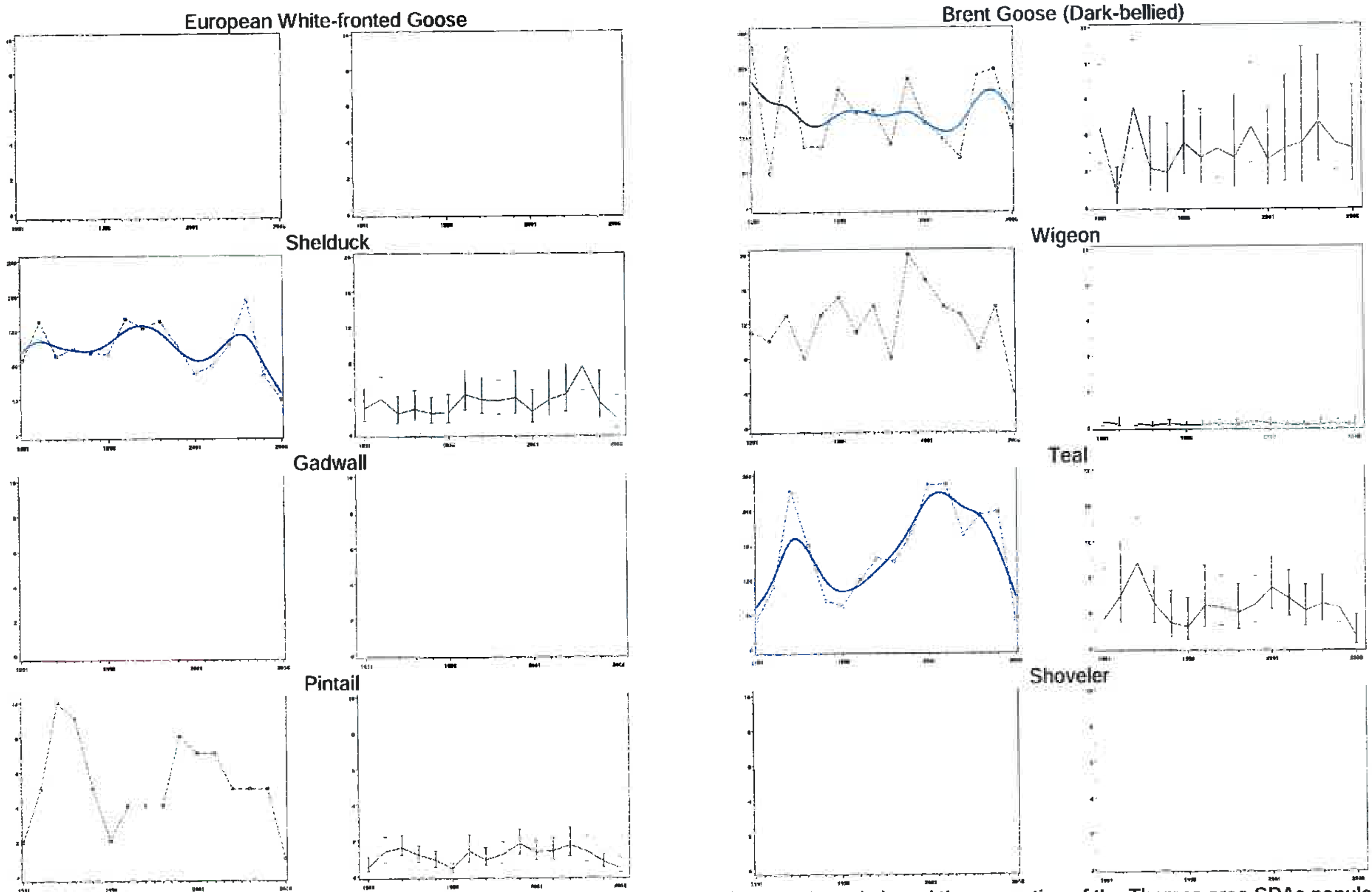
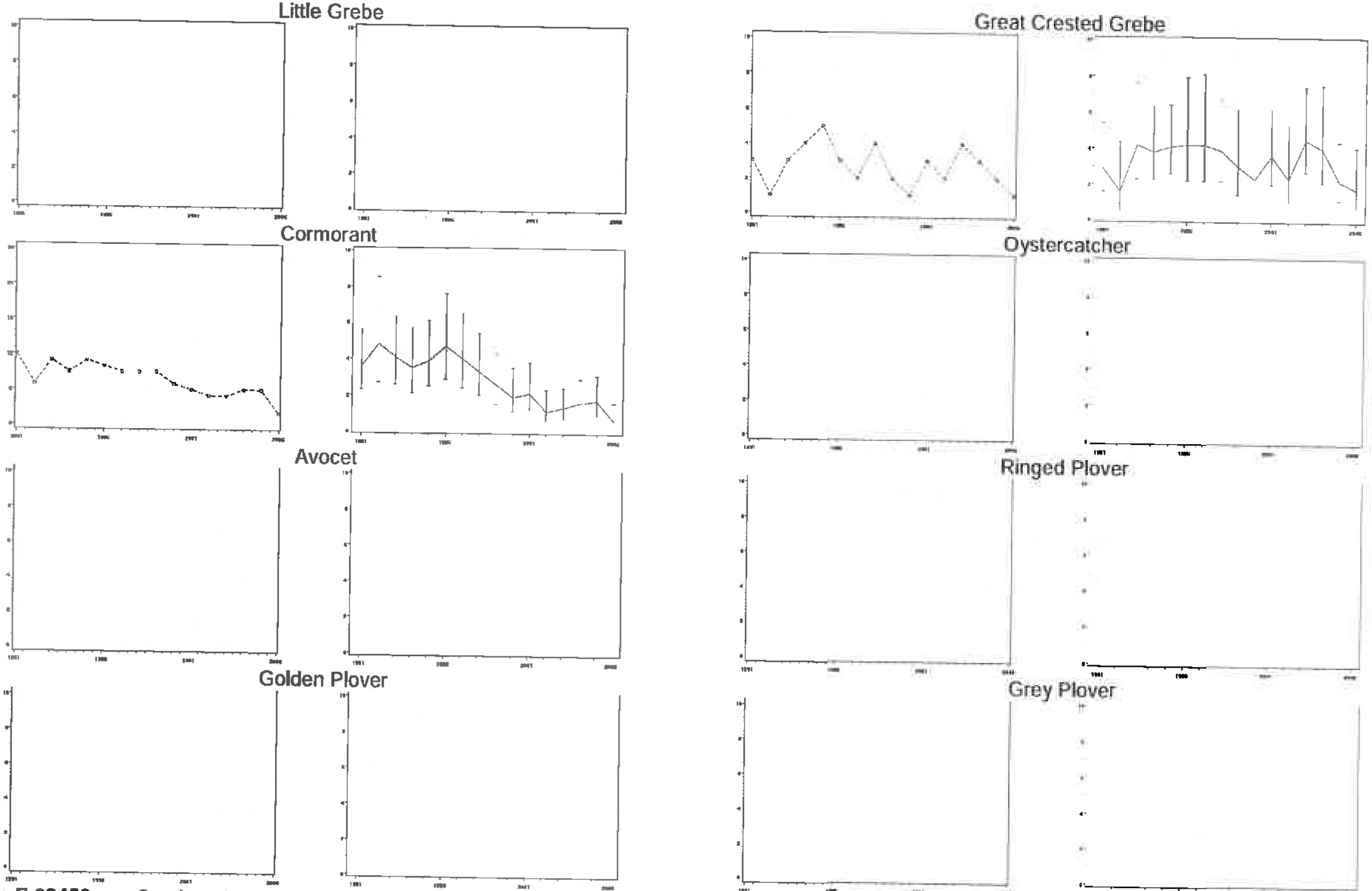


Figure E.22453 Population trends of each species in sector 22453 (Grovehurst) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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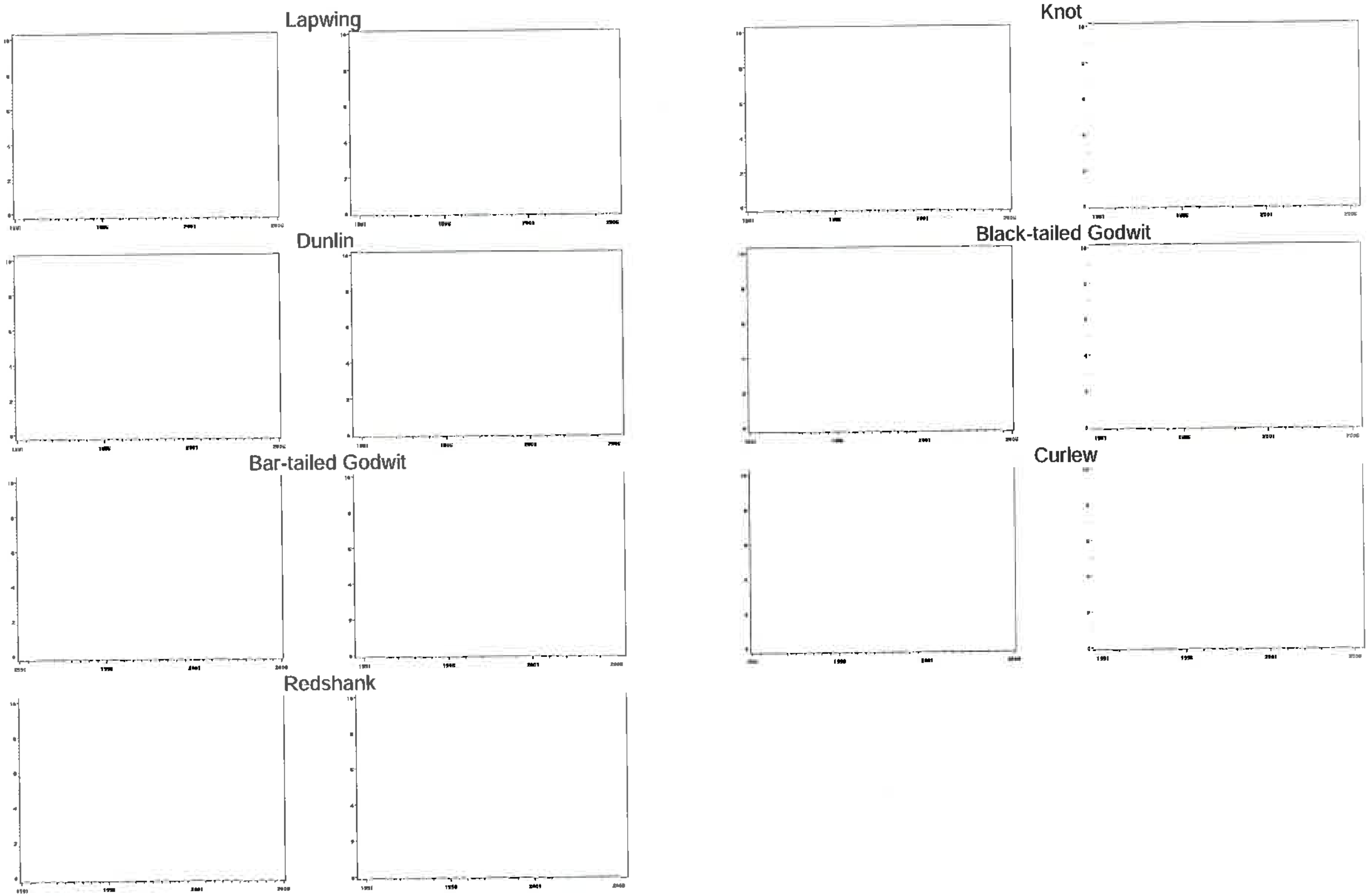

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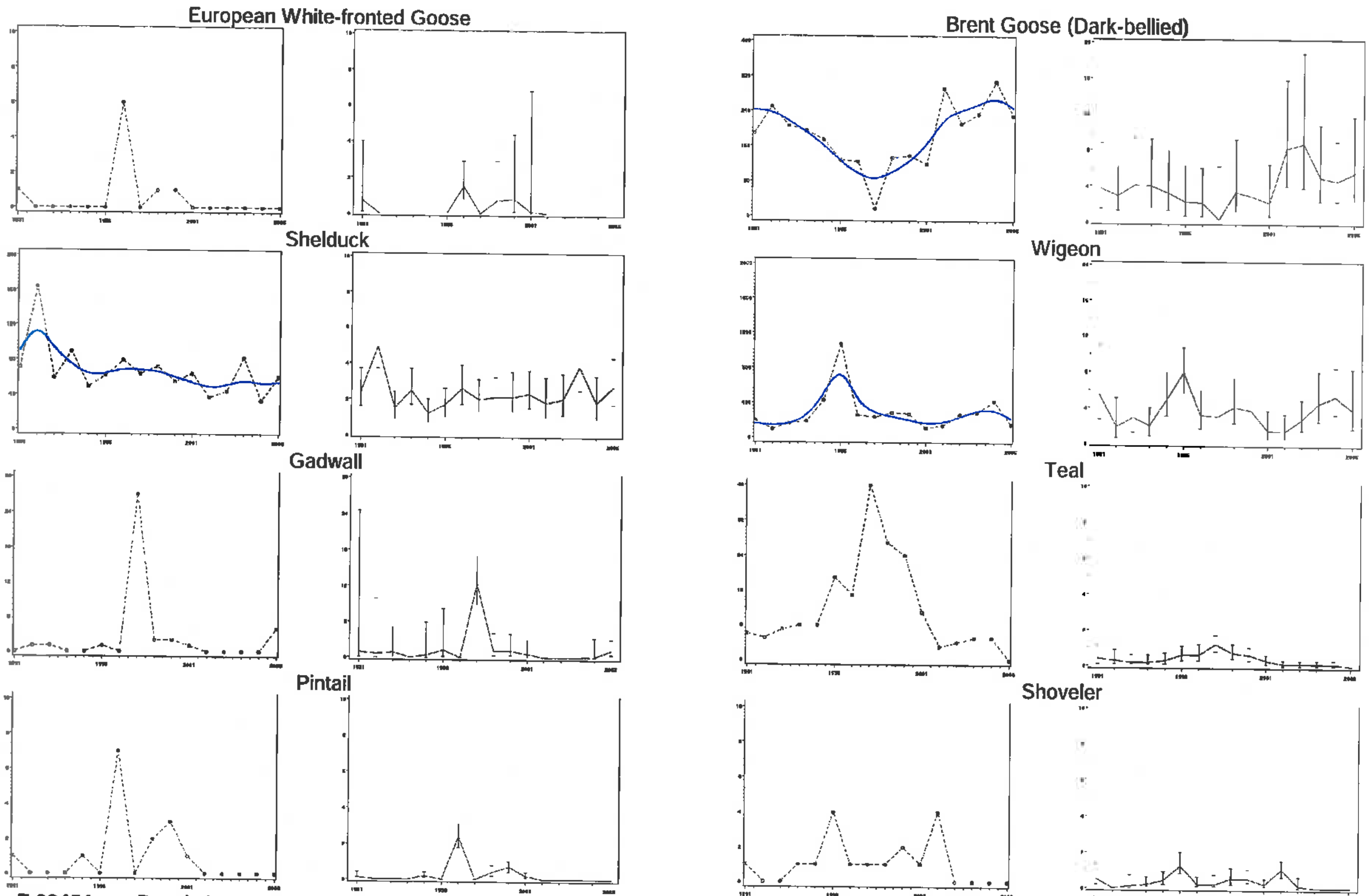
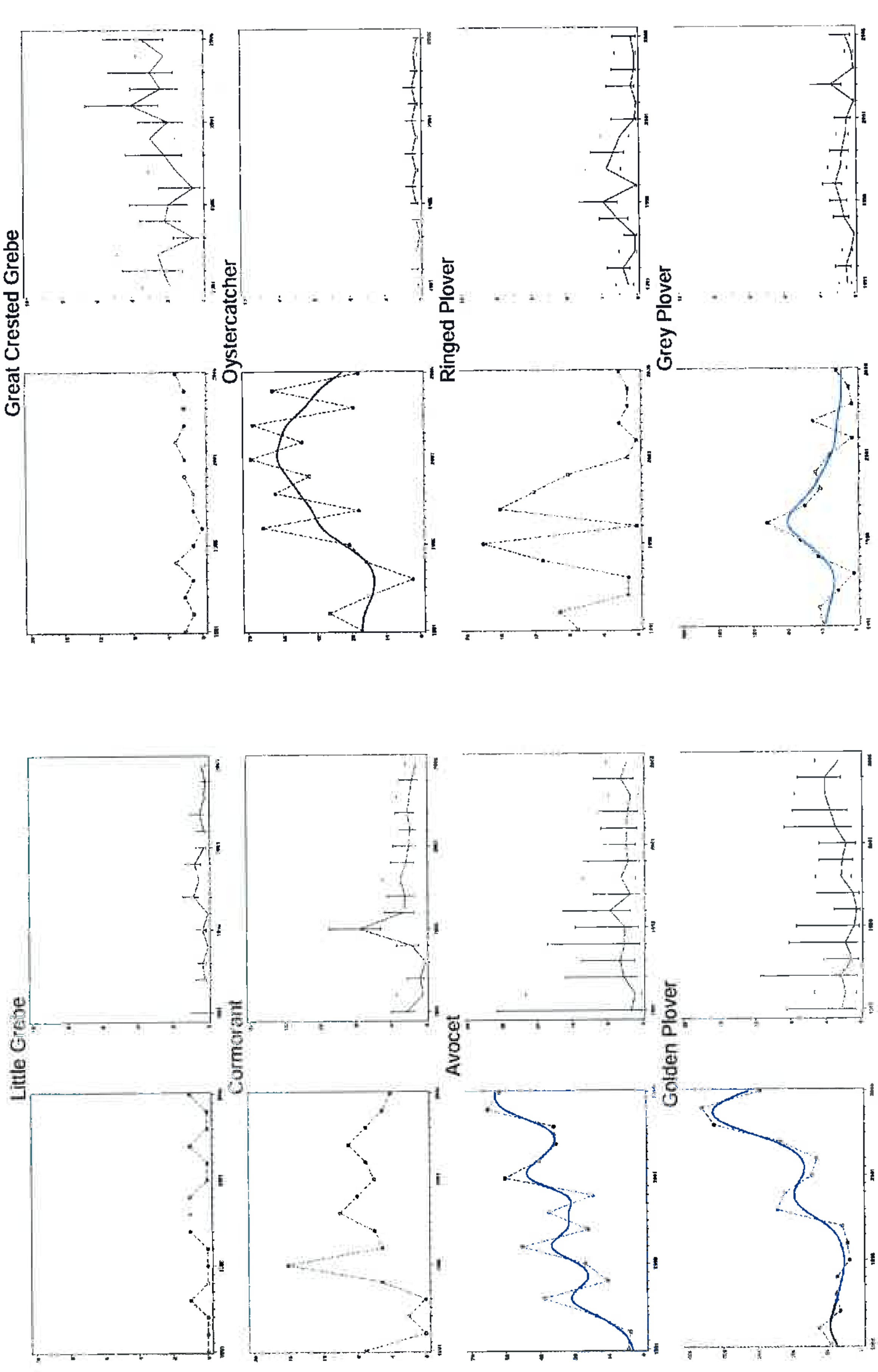


Figure E.22454 Population trends of each species in sector 22454 (Conyer to Luddenham Gut) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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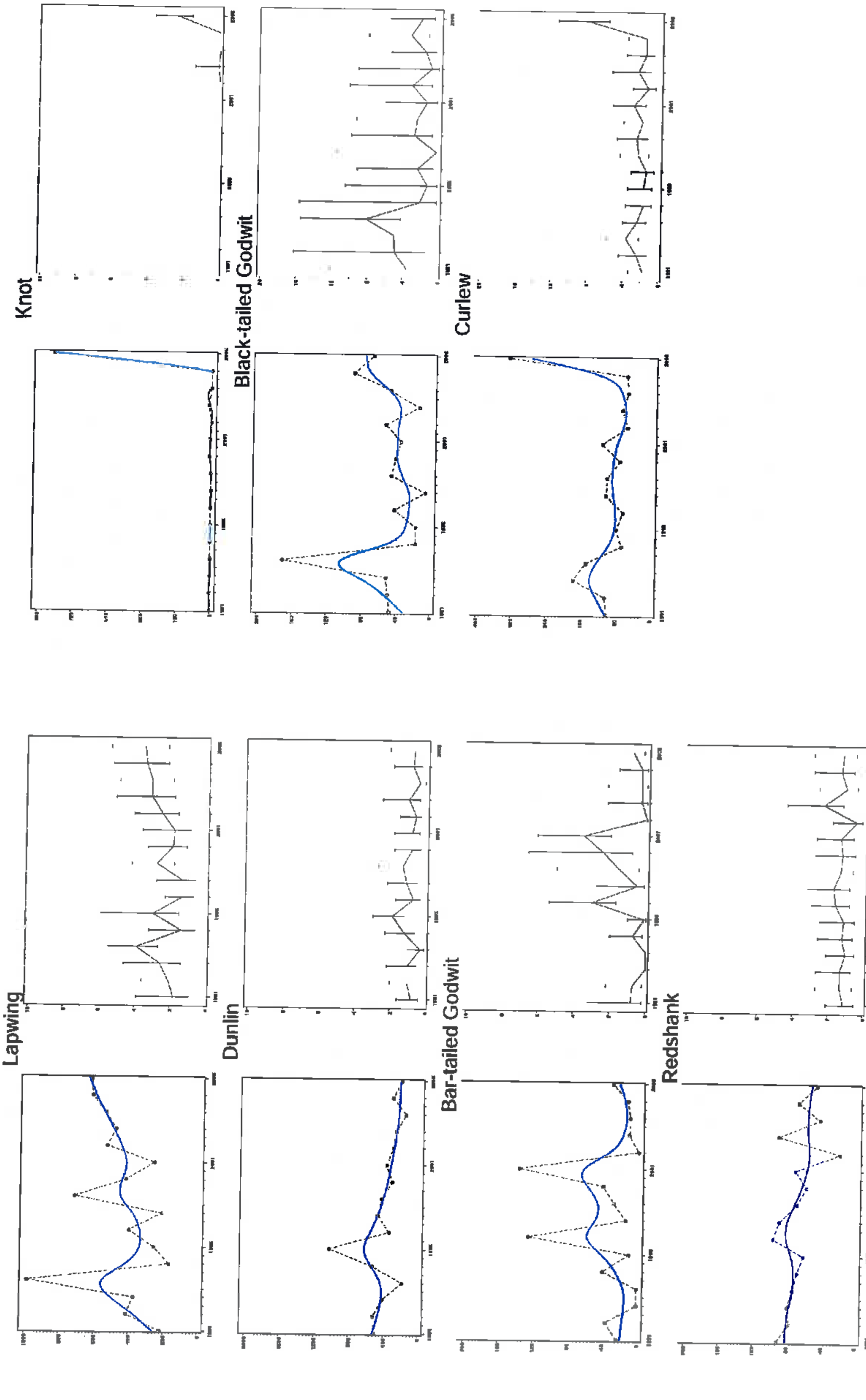

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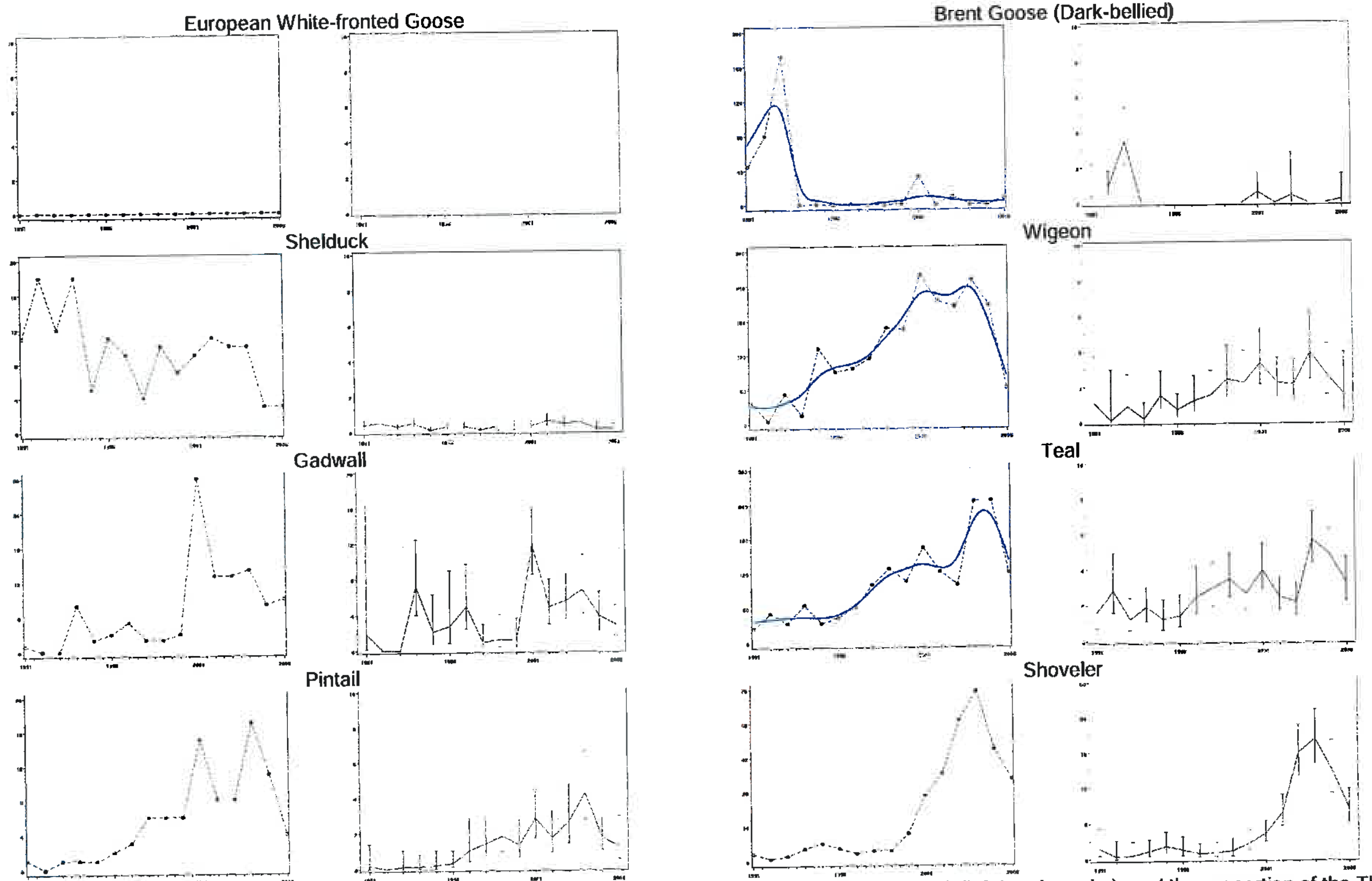
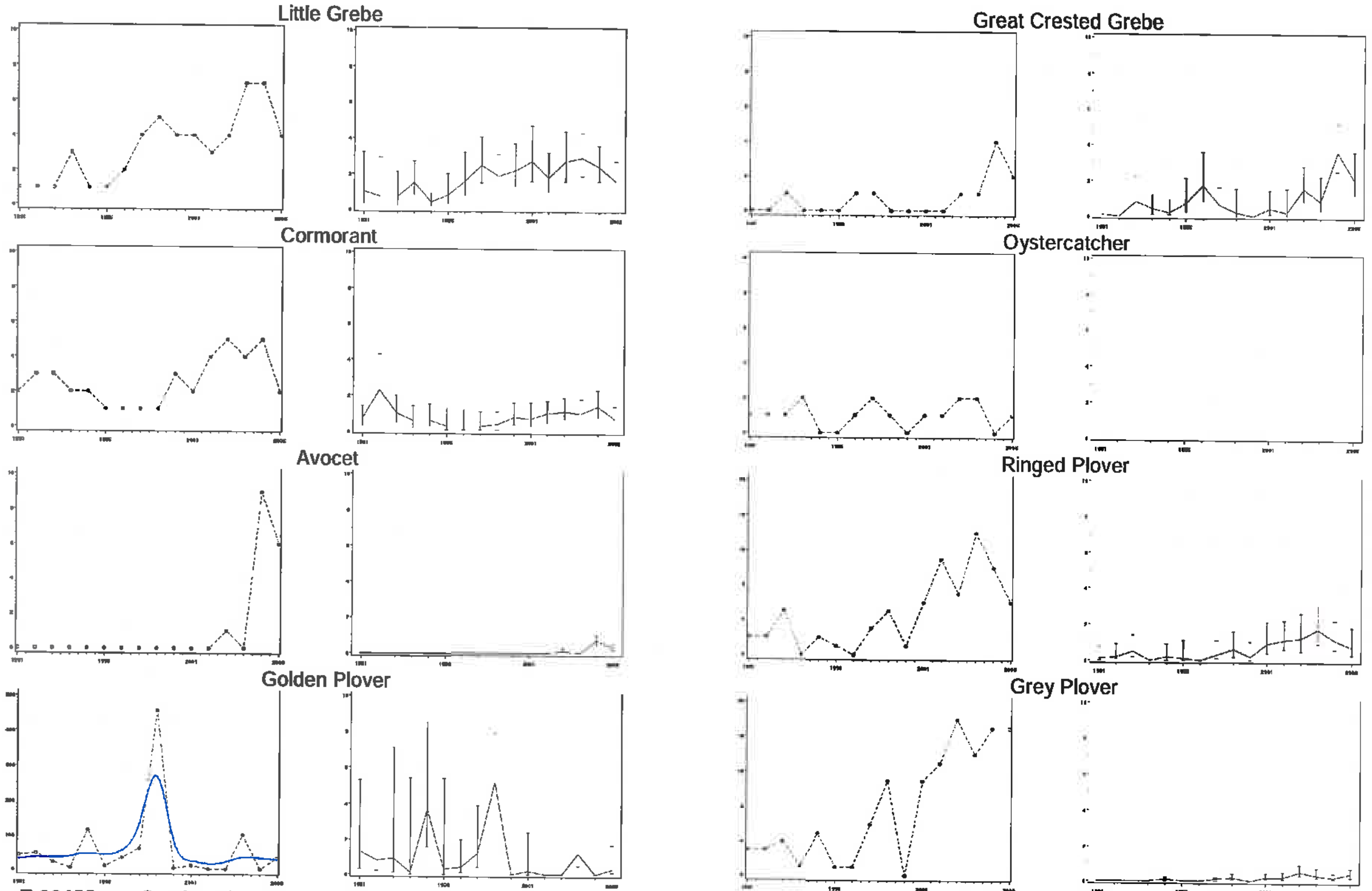


Figure E.22455 Population trends of each species in sector 22455 (Luddenham Gut to Faversham Creek) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).



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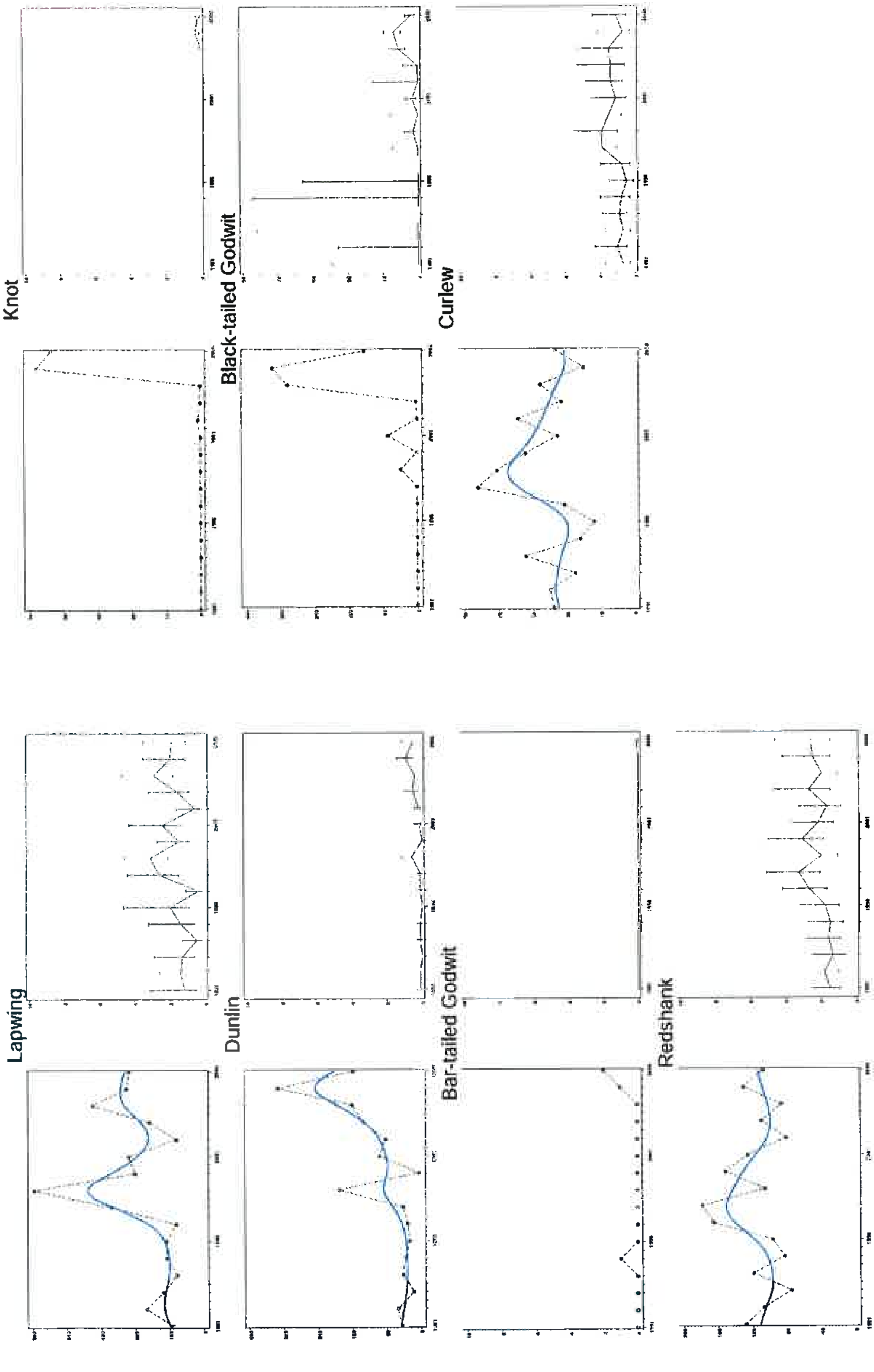

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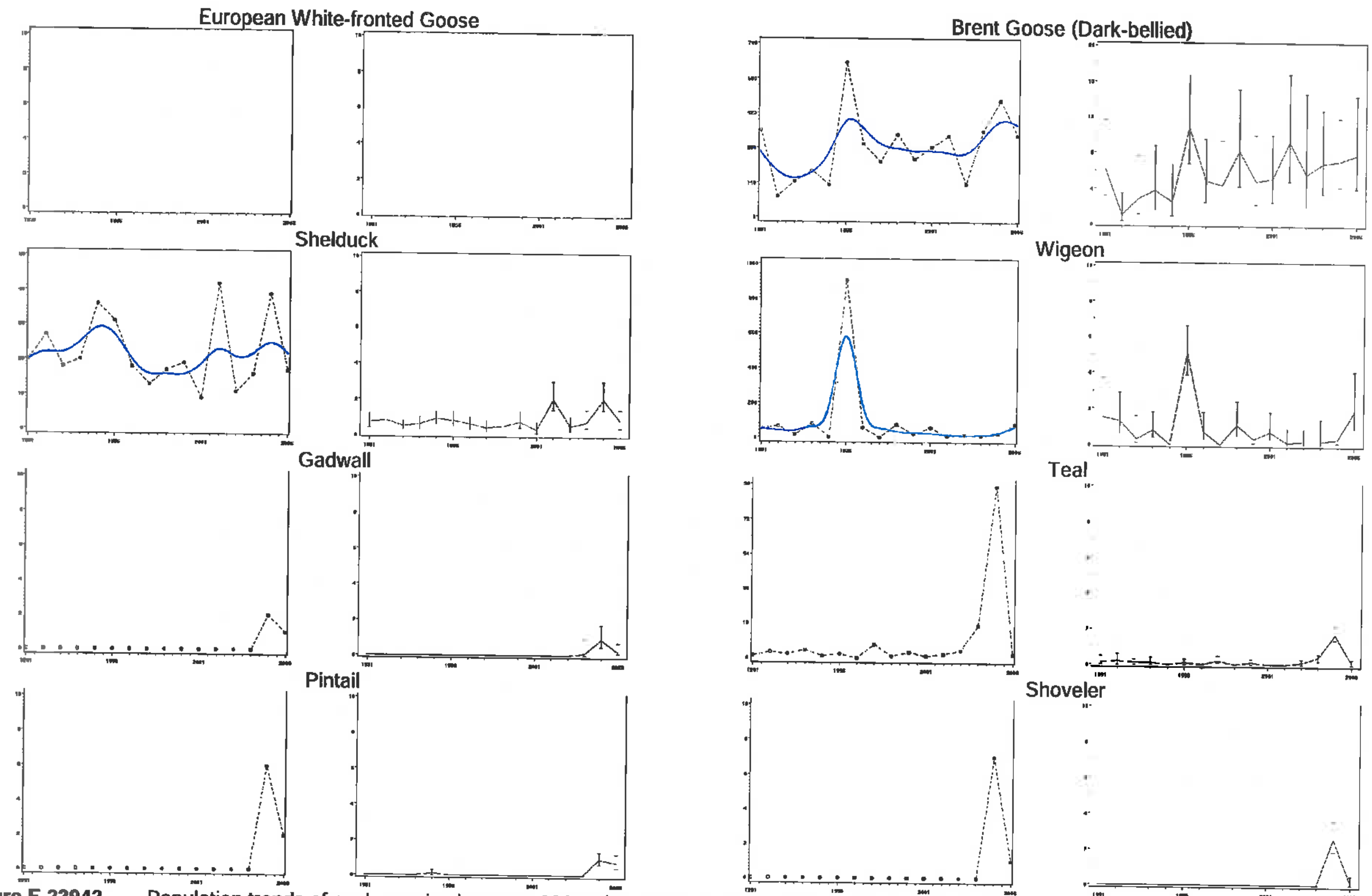

Figure E.22942 Population trends of each species in sector 22942 (South Swale NNR) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

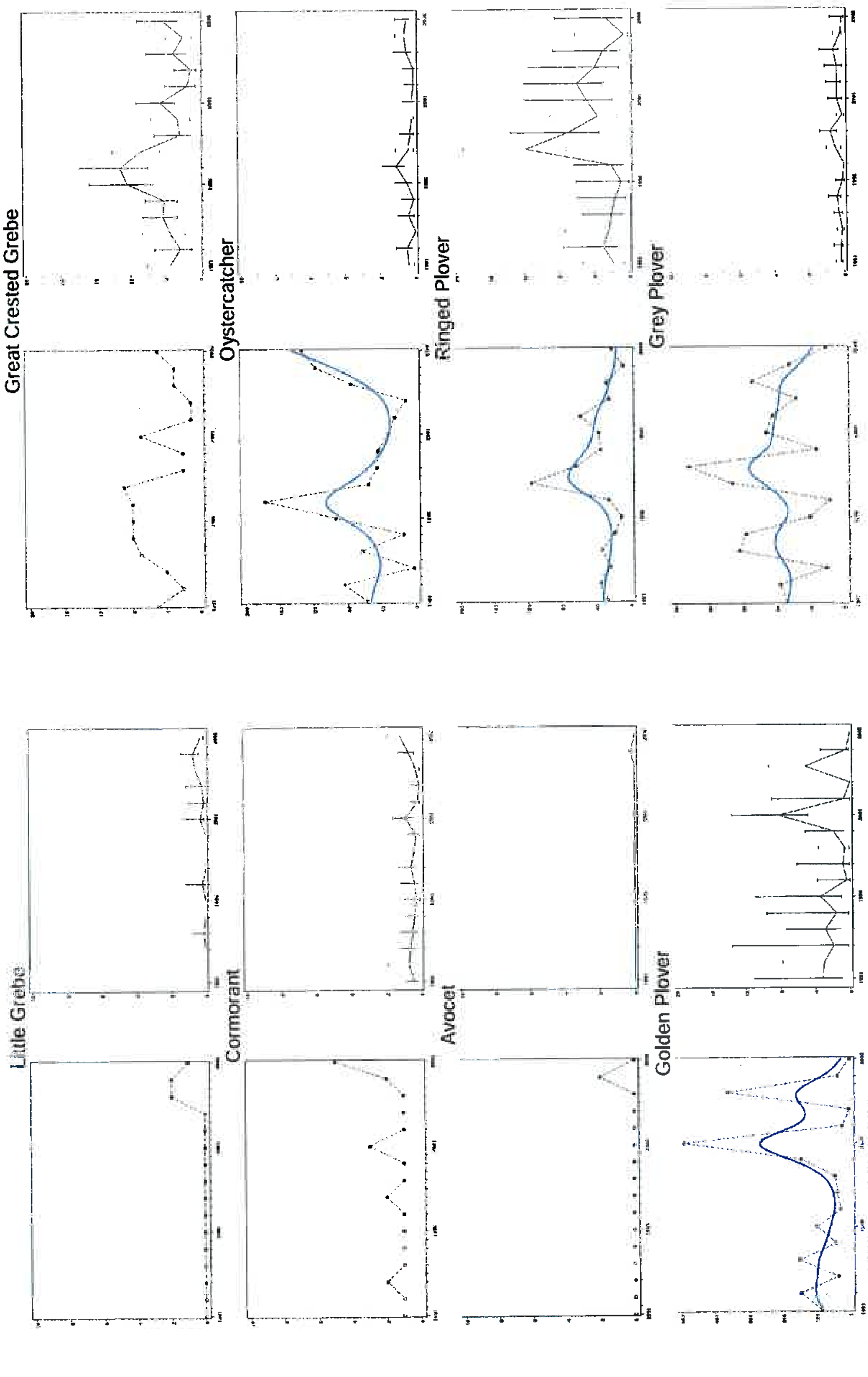

Figure E.22942 Continued

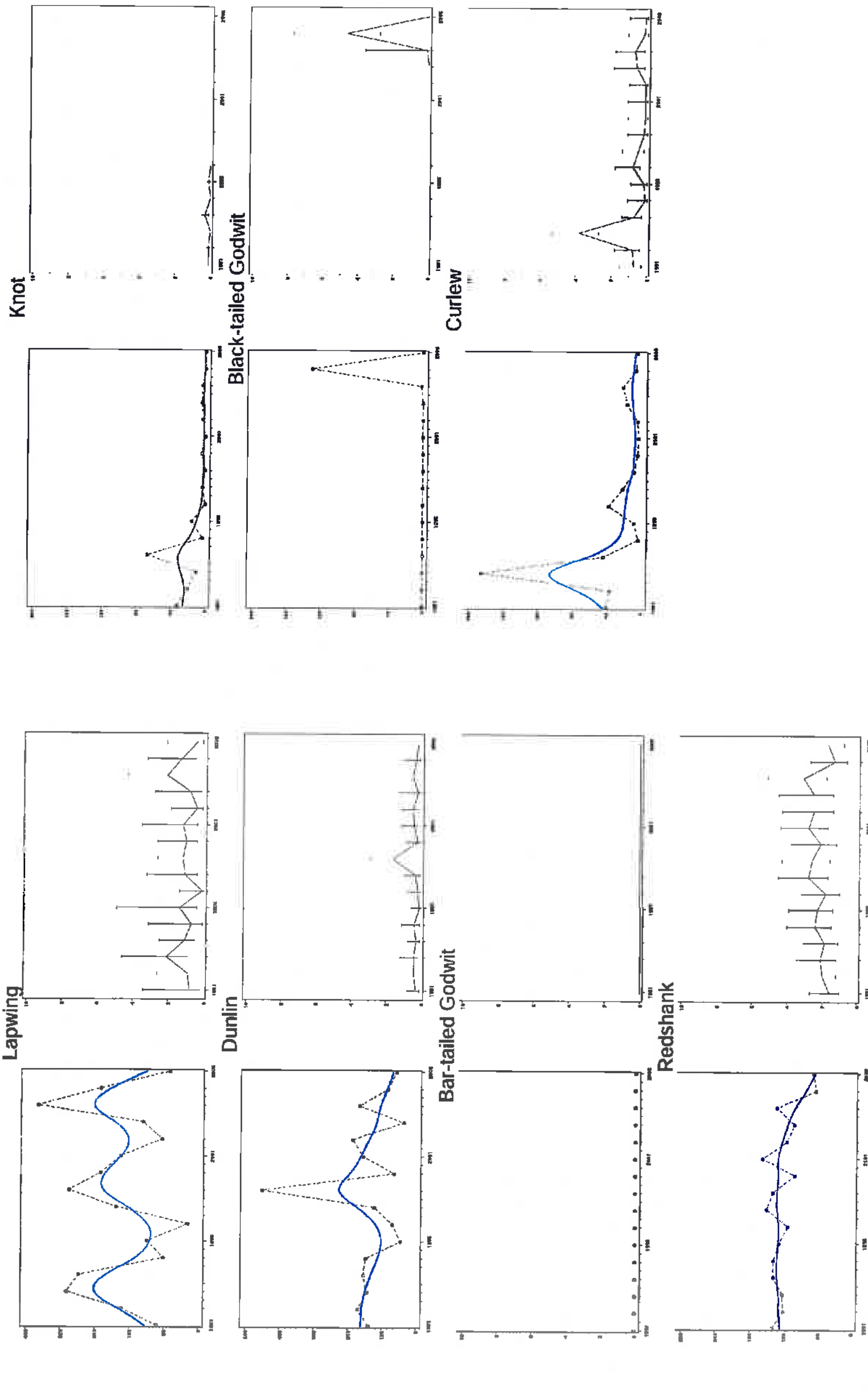

Figure E.22942 Continued

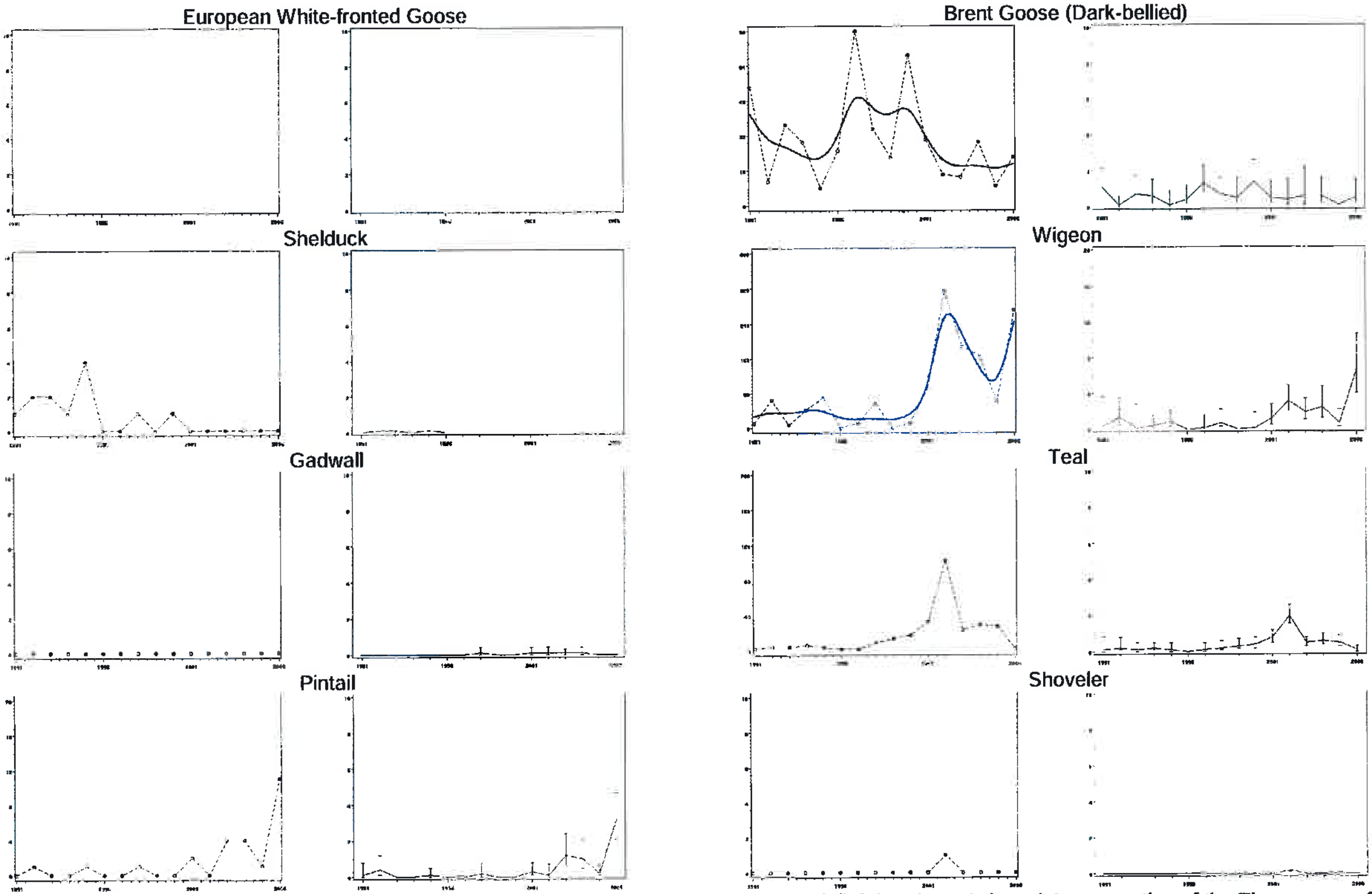

Figure E.22943 Population trends of each species in sector 22943 (Graveney to Whitstable) (left-hand graphs), and the proportion of the Thames area SPAs population found in this sector per year (right-hand graphs).

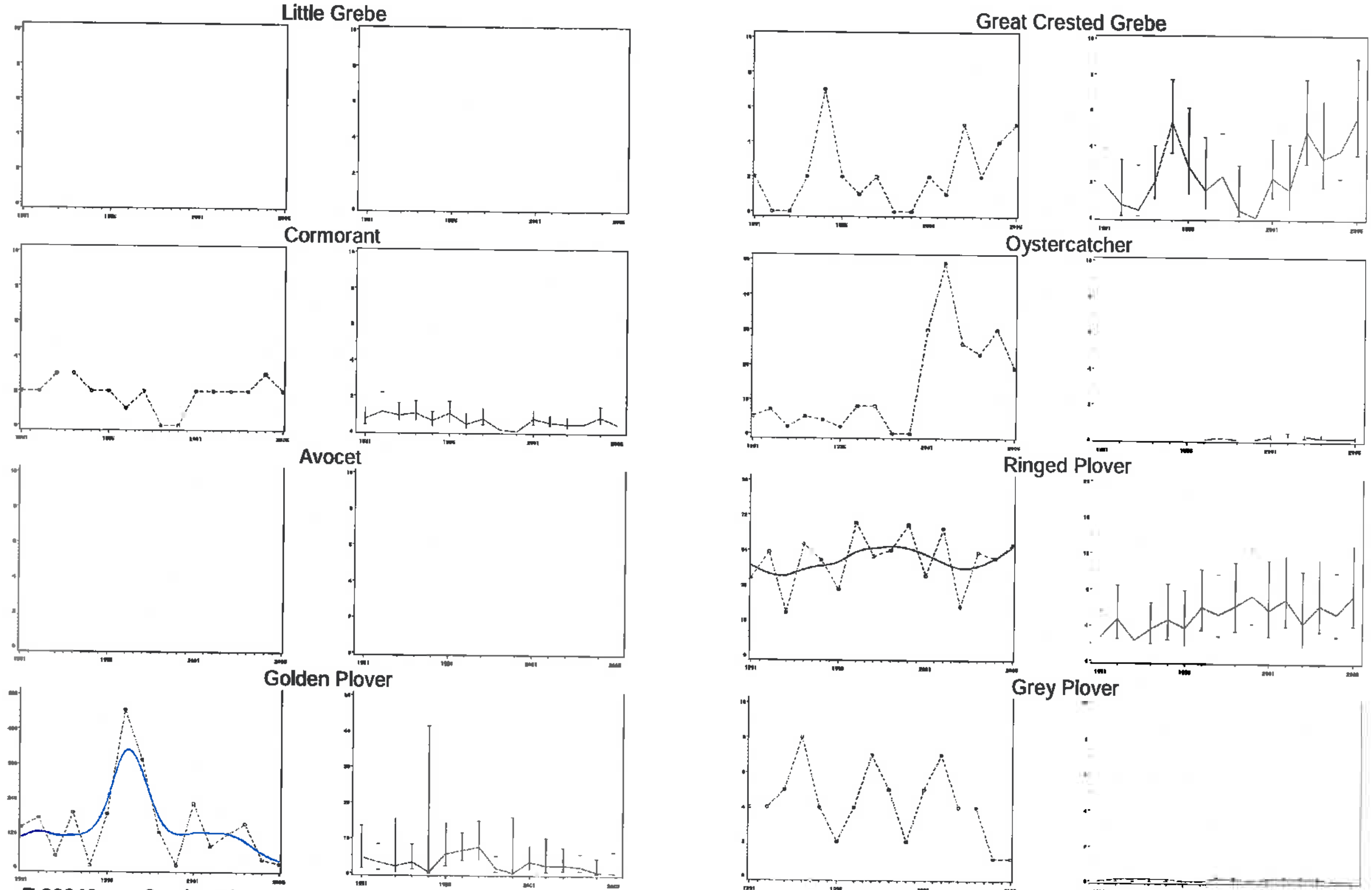

Figure E.22943 Continued

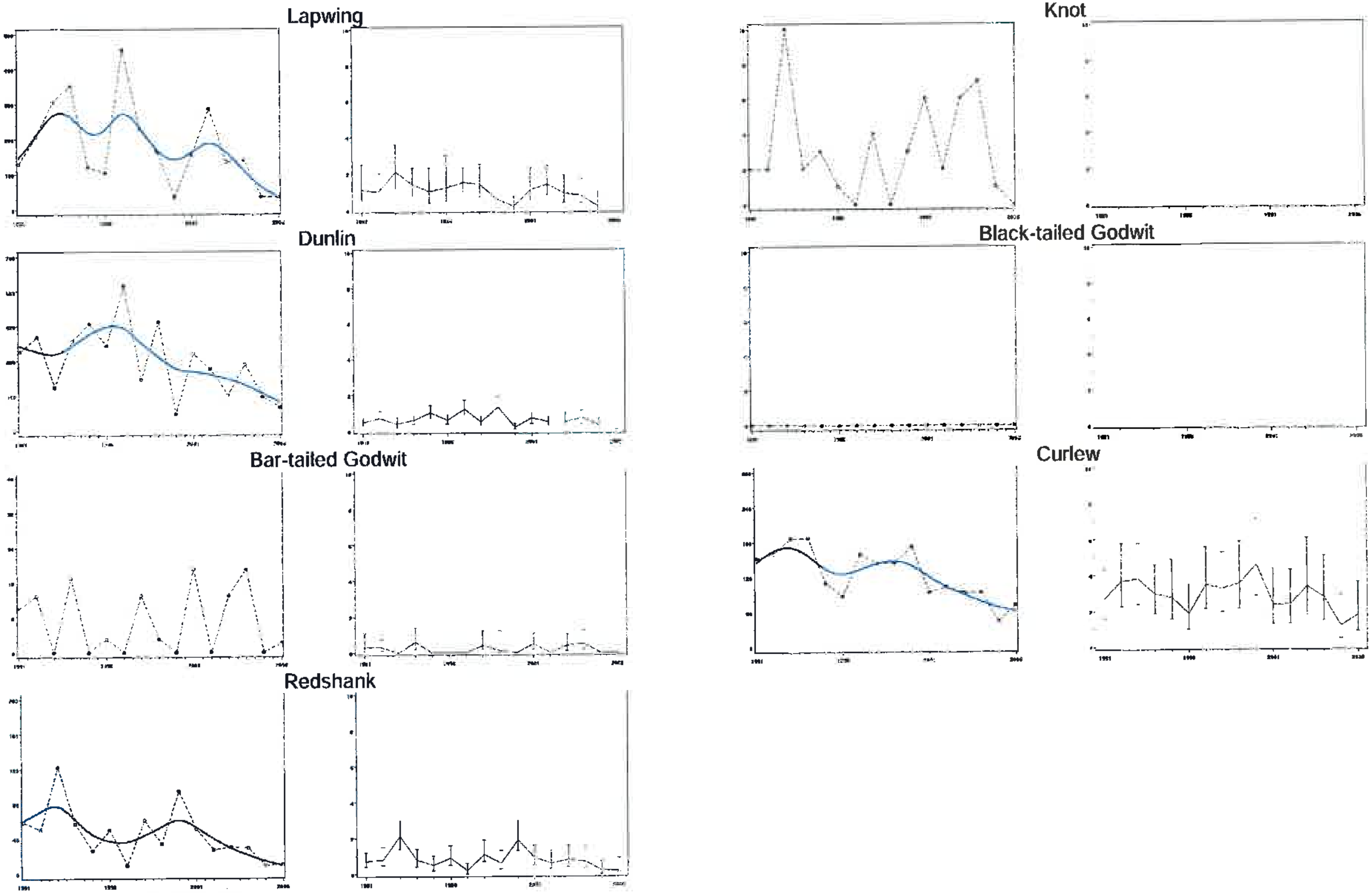

Figure E.22943 Continued

Appendix F

Population trends of each species on the wider Thames Estuary. Two plots are presented for each species / sector 1) the mean winter count (Sep to Mar) with the smoothed trend and 2) the proportional contribution of the Humber SPA towards numbers on the east coast of England.

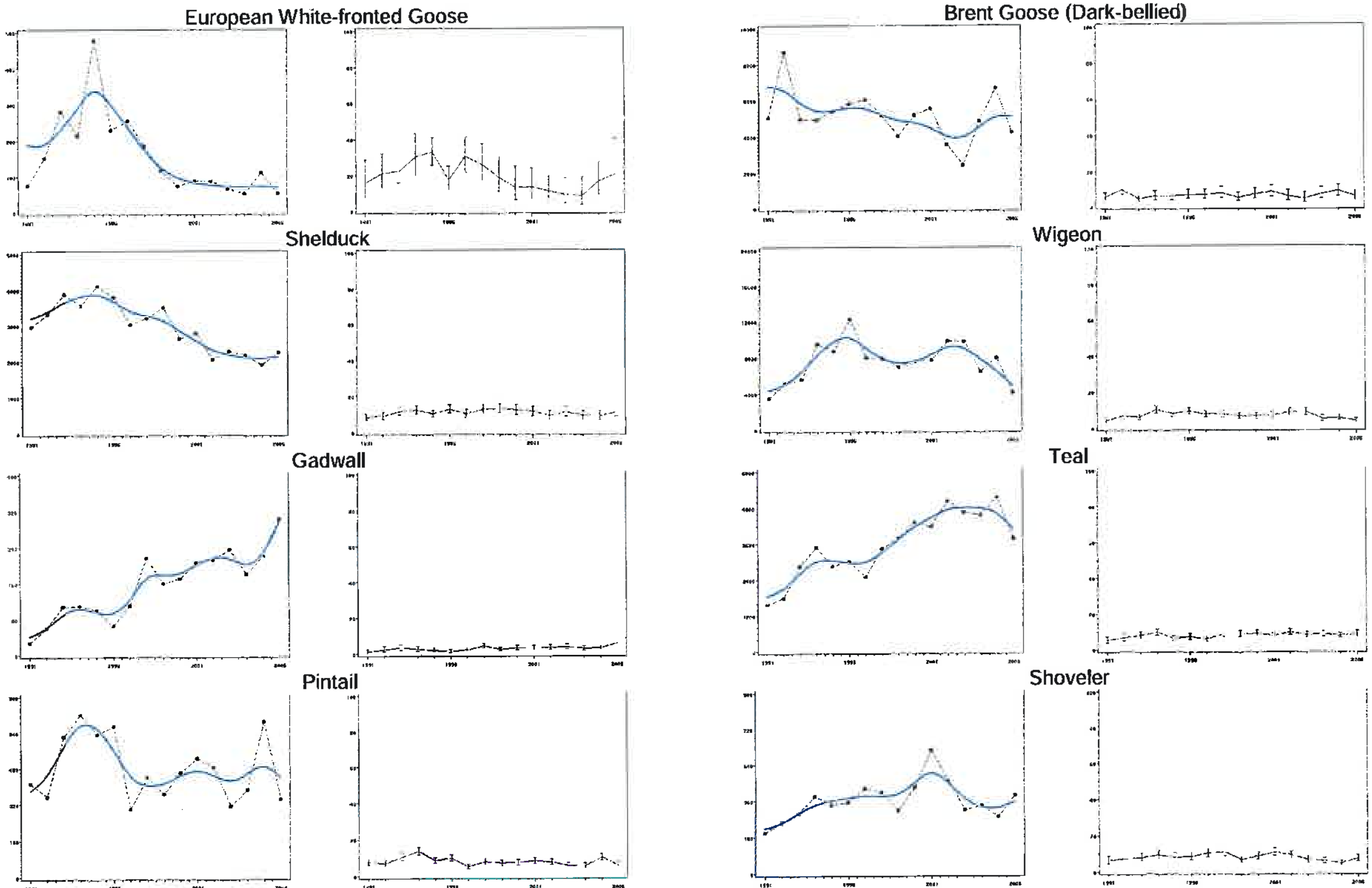

Figure F.C0025 Population trends of each species in sector C0025 (Thames Area SPAs) (left-hand graphs), and the proportion of the East and South-East of England population found in this area per year (right-hand graphs).

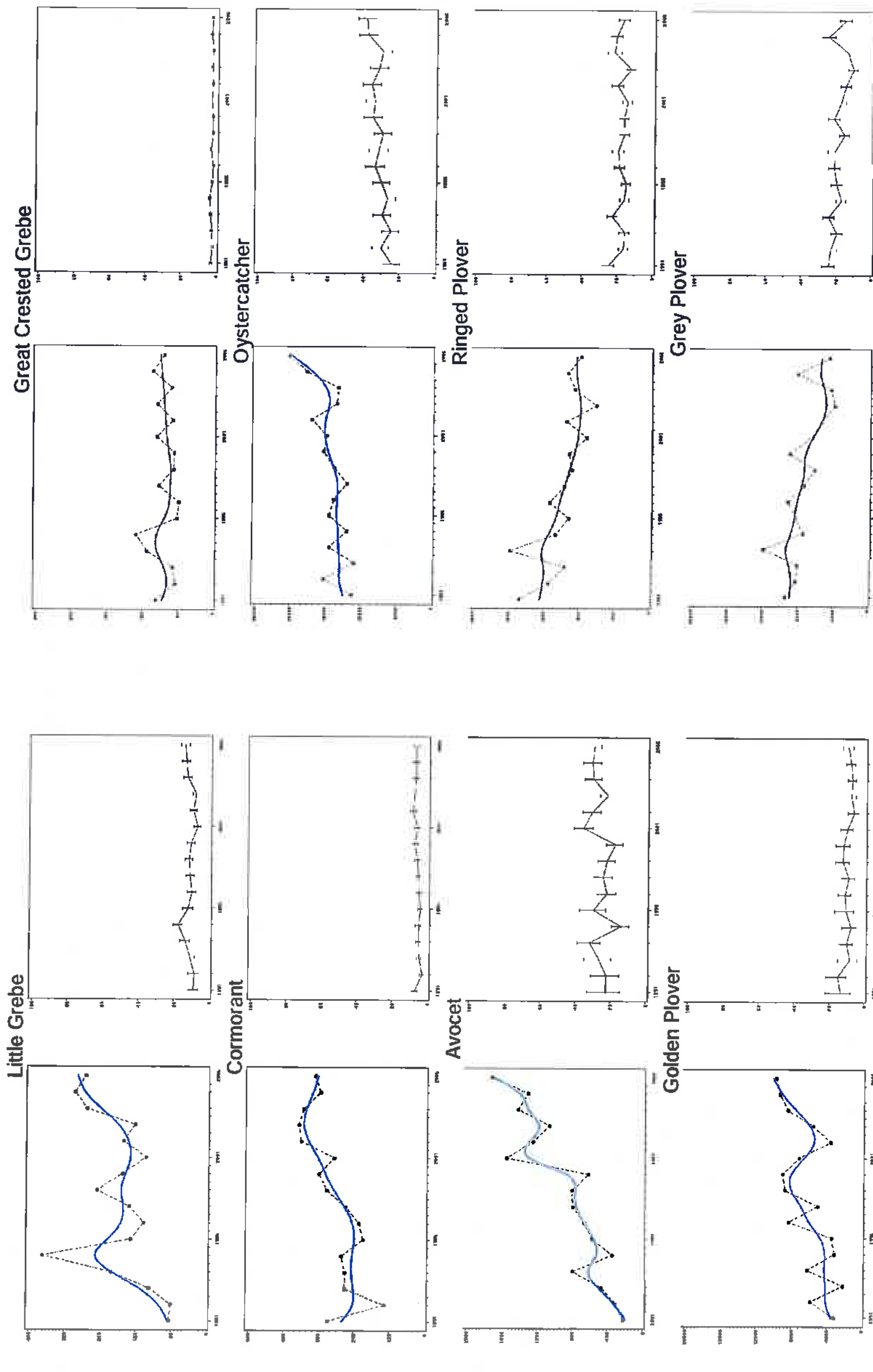

Figure F.C0025 Continued

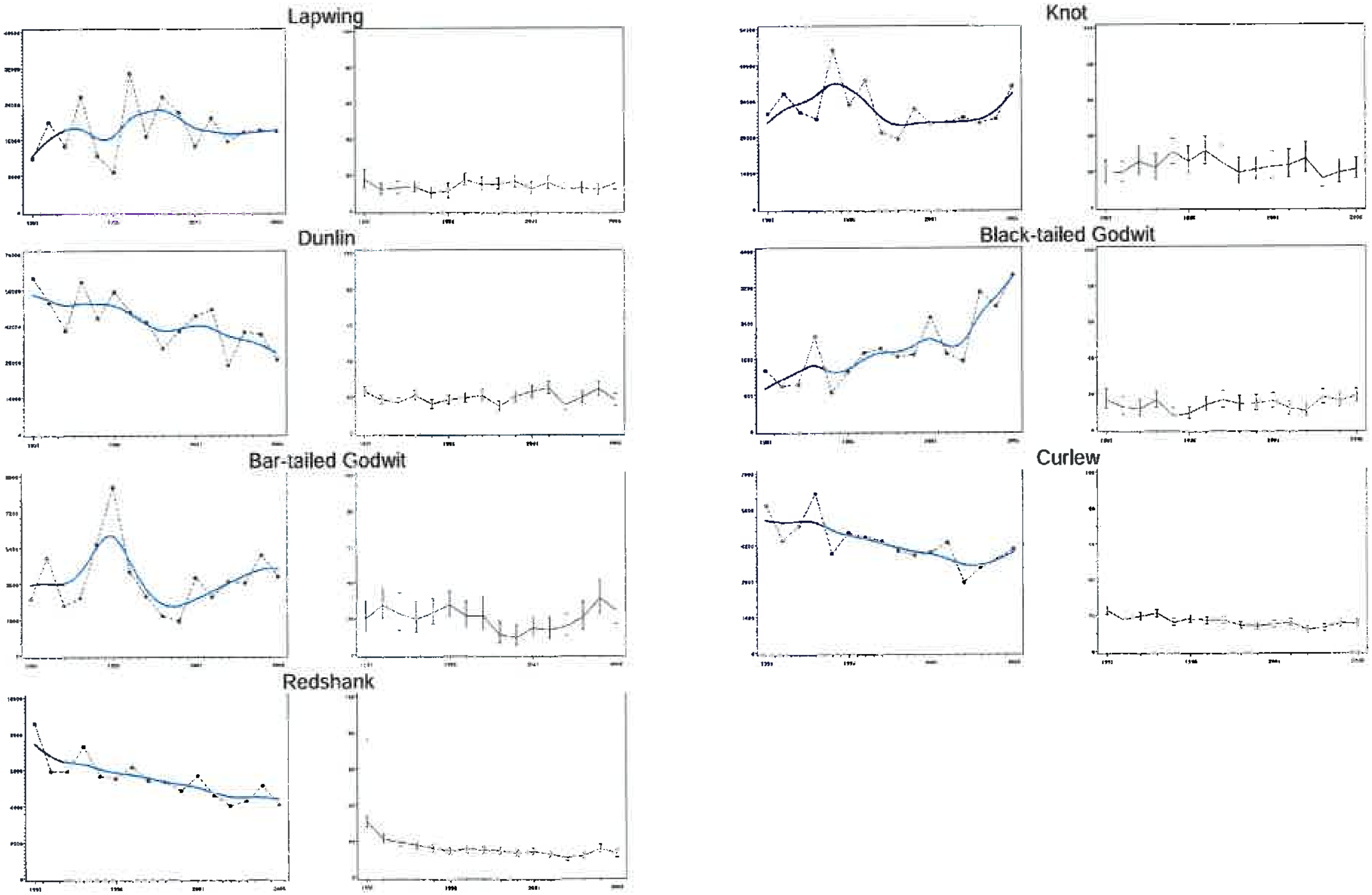

Figure F.C0025 Continued

Appendix G

Table G.i Population trends of each species by sector assessed over three timescales: short- (5-year), medium- (10-year) and long-term (15 year). For each sector, declines are given precedence over increases as the former are of primary concern. Cells are coloured to indicate trend status as follows: Red - a maximum decline in numbers of at least 50% over at least one timescale; Orange - a maximum decline in numbers of at least 25% but less than 50% over at least one timescale; Light green – a maximum increased of at least 33% but less than 100% over at least one timescale; Dark green - a maximum increase of at least 100% on at least one timescale; White - a maximum decline less than 25% and a maximum increase less than 33% on all three timescales. Grey - insufficient data for or too few individuals (arbitrarily taken as an average of ten or less) of, a given species to allow meaningful smoothed trends to be generated. This information is summarised without the underlying values in the main body of the report (Table 3.2.i).

Note: These data are also available in the MS Excel® file 'Thames Results Matrices.xls' sheet 'MatrixOfChange' accompanying this report.

Table G.ii Changes in the proportion of the total site population of each species supported by each sector, assessed over the most recent 15 year period. Cells are coloured to indicate a sector's proportional contribution to numbers on the Humber estuary as a whole, as follows: Red - a highly significant decline ($P < 0.01$); Orange - a significant decline ($P < 0.05$); Light green – a significant increase ($P < 0.05$); Dark green - a highly significant increase ($P < 0.01$); White – no significant trend over the period. Grey - insufficient data for or too few individuals (arbitrarily taken as an average of ten or less) of, a given species to allow a meaningful Logit model to be fitted. This information is summarised without the underlying values in the main body of the report (Table 3.2.ii).

Note: These data are also available in the MS Excel® file 'Thames Results Matrices.xls' sheet 'MatrixOfProportions' accompanying this report.