CHAPTER FIVE

POPULATION DYNAMICS OF THE SILVER GULL IN THE PORT LINCOLN REGION

5.1 Introduction

It is well known that food availability affects both reproduction and population dynamics in seabirds (Furness & Monaghan, 1987; Oro *et al*., 1999). An abundant food source can sustain a large population of seabirds. For example, the availability of fisheries discards has been attributed to the increase of many populations of seabirds in the northern hemisphere (Furness *et al.*, 1988; Garthe *et al.*, 1996; Oro, 1997; Walter & Becker, 1997; Huppop & Wurm, 2000; Martinez-Abrain *et al.*, 2002), with the discards available in the North Sea alone having the potential to support 5.9 million seabirds (Walter & Becker, 1997).

Resource availability during winter can be crucial for survival of both adult and juvenile seabirds (Martinez-Abrain *et al.*, 2002), in particular for immature birds as they are learning to forage and so are less successful than adults (Garthe *et al*., 1996). A large increase in the population of Crested Terns in the south-eastern Gulf of Carpentaria, Australia is thought to be due to the availability of trawl discards when the juveniles are learning to forage (Blaber *et al*., 1995). This large 'additional' food source is thought to have reduced juvenile mortality rates, and therefore increased population size (Blaber *et al*., 1995). The availability of fisheries discards has also been found to affect body condition and recruitment rates of seabirds. The availability of this high quality food can increase populations through increased recruitment (Oro *et al*., 1996; Huppop & Wurm, 2000). When a trawling moratorium resulted in no discards for non-breeding Black-backed Gulls and Herring Gulls in the

North Sea, their body condition deteriorated, but increased again when trawling resumed (Huppop & Wurm, 2000). This population also exhibited a seasonal pattern of abundance that reflected this dependence. When trawling stopped over Christmas, the gulls moved elsewhere in search of food, but returned when trawling resumed (Huppop & Wurm, 2000). The attraction of con-specifics also increases recruitment to a colony (Crespin *et al.*, 2006). However, it is also influenced by the availability of nesting sites and once a colony is saturated, birds can be excluded and may form new colonies or not breed at all (Oro & Pradel, 2000).

As mentioned in previous chapters, Silver Gull populations have expanded in urban areas across Australia over the last century. Before European settlement, Silver Gull colonies would have typically been a few hundred breeding pairs, and none would have been larger than 1000 pairs (Ottaway *et al.,* 1988). According to Ottaway *et al.* (1988), all large Silver Gull colonies in Australia (above 1000 breeding pairs) are dependent on human derived food sources during their breeding seasons. The actual population in the Sydney-Wollongong area is estimated at 200,000 to 700,000 gulls (Smith, 1995) with the majority of their diet consisting of human refuse (Smith *et al.*, 1991). However, these populations have now plateaued, having reached the carrying capacity of their food resource (Smith, 1995).

In Port Lincoln, the Silver Gull population had risen from about 3,300 nesting pairs in 1999 to 10,300 nesting pairs in 2003 (Harrison, 2003). Many of these gulls frequent the Southern Bluefin Tuna (SBT) farms off the coast of Port Lincoln during their breeding season. These gulls also forage in urban areas within the city, in particular the refuse depot, although in much smaller numbers than the SBT farms.

The gulls commonly scavenge the high quality, lipid and protein rich baitfish fed to the tuna (Harrison, 2003). The breeding season (March-October) of this population mimics that of the SBT farming season (February-September/October) and is 4-7 months earlier than any other known colonies in the state (Wheeler & Watson, 1963; Ottaway *et al.,* 1988; Harrison, 2003).

Silver Gull numbers at the tuna farms and at breeding colonies are high throughout the tuna and breeding season, with low numbers in Port Lincoln. However, near the end of the tuna season (August/September onwards), when little to no tuna feed is available, there is an influx of gulls into the urban areas. In 2003, about 10,000 Silver Gulls migrated into Port Lincoln in search of food (Harrison, 2003). These gulls become a nuisance throughout the summer, with aggressive scavenging, traffic and safety concerns as large flocks of gulls obscured roads, and possible health implications of gull faeces, particularly with rainwater caught off domestic roofs. Further research is required to ascertain the extent of these issues and if they are an annual problem.

Aims

The aims of this study were:

- To monitor Silver Gull nesting density and population size on the breeding colonies within the Port Lincoln area over several years.
- To determine whether there are any changes in population dynamics and patterns in the urban population of Silver Gulls in the Port Lincoln area.

Hypotheses

H0: There will be no change in nesting Silver Gull abundance in Port Lincoln over time.

HA: There will be a change in nesting Silver Gull abundance in Port Lincoln over time.

H0: There will be no seasonal pattern of Silver Gull abundance in the City of Port Lincoln over each year in relation to the tuna industry.

HA: There will be a change in Silver Gull abundance (of a seasonal nature) in Port Lincoln during each year.

5.2 Methods

5.2.1 Determining Silver Gull Breeding Population Size

Surveys of colonies on Rabbit Island and Sibsey Island were used to determine the breeding population of Silver Gulls in the Port Lincoln area during 2005 and 2006. This was not undertaken during 2004.

The outer boundary of the breeding colony was obtained by walking outside the area occupied by nesting birds and marking waypoints using a handheld Garmin GPS 60 unit. The number of nests in the colony was estimated from extrapolating counts of all the nests (active only) in several randomly selected quadrats. On each island, quadrats were selected across the entire nesting site, over all vegetation types so that a representative sample of each part of the island was selected. From a selected point, approximately 20 x 20 step (~16m) sides (~250m^2) were walked out and marked and each corner was mapped with the GPS (Figures 5.1 & 5.2). All active nests (newly formed nests and those with eggs) within the boundary of the quadrat were counted by at least two people and the average was taken. This was undertaken once for both islands in June 2005 (24/6 for Rabbit Island (5 quadrats) and 7/6 for Sibsey Island (4 quadrats)). In 2006, Sibsey Island was surveyed once in May (7 quadrats), whilst

Rabbit Island was surveyed three times in April (11 quadrats), June (13 quadrats) and August (9 quadrats). Annette Doonan, SARDI Aquatic Sciences, used the waypoints to calculate the areas of the breeding colonies and of each quadrat using ArcView.

Nesting abundance was also obtained for three other islands. Donington Island and Boston Island (Fanny Point) were surveyed in 2005 and 2006 and nesting abundance was calculated by circling the island in a boat (Donington Island) or sitting offshore (Boston Island) and counting the number of nesting pairs. Photos of the colonies were taken from the boat and the number of nesting pairs were counted and compared to the estimate from the boat to reduce error. Louth Island was surveyed during 2006 and nesting abundance was calculated by counting all active nests. Winceby Island also has a colony of nesting gulls but its isolation and difficulty of access meant it was only surveyed in 2003. It was assumed that this colony would still be at least 1000 nesting pairs as was estimated in 2003, but this is likely to be an underestimation.

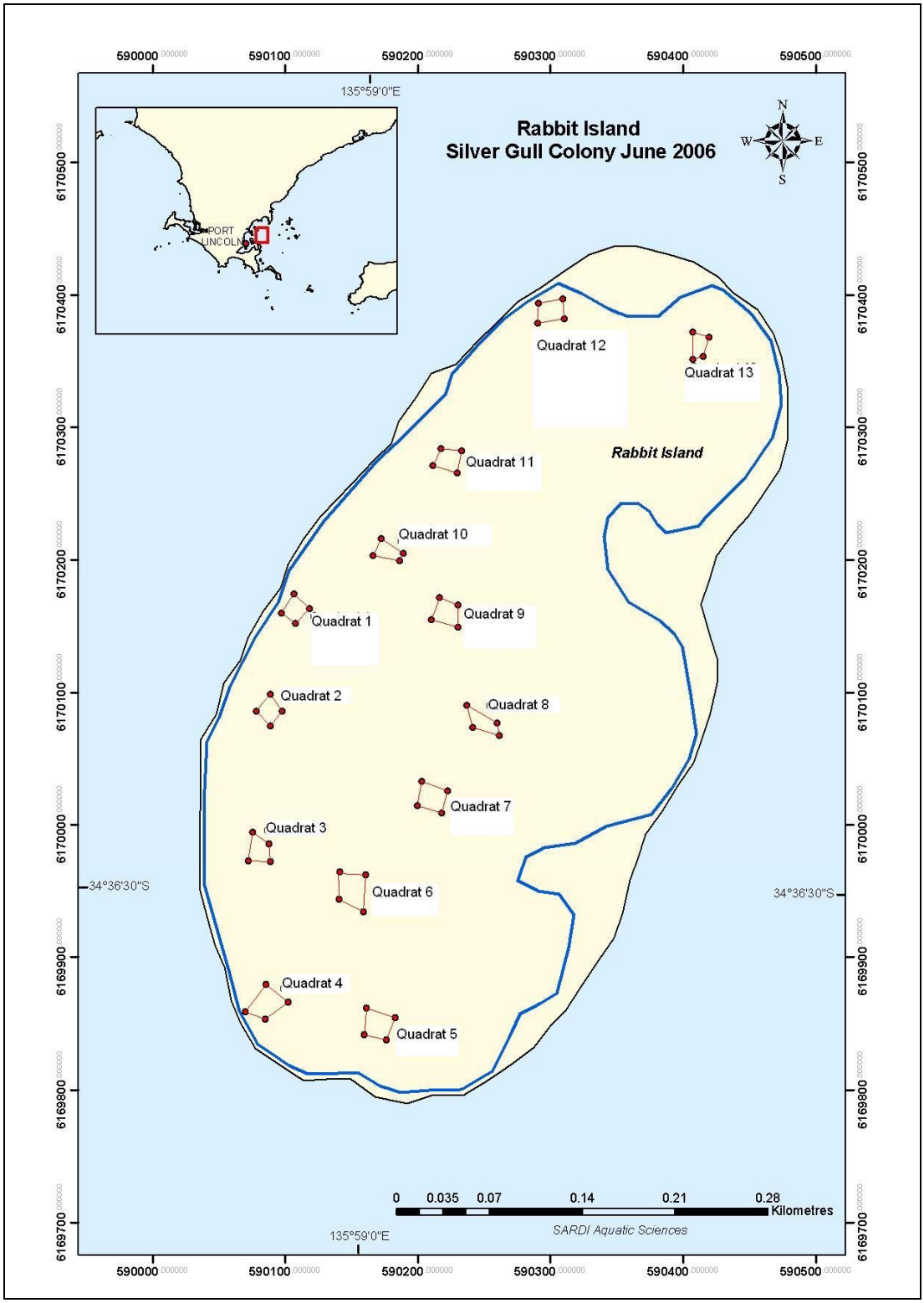

Figure 5.1: The Rabbit Island Silver Gull colony during June 2006. The blue line is the outer boundary and the red squares are the quadrats used to calculate population size.

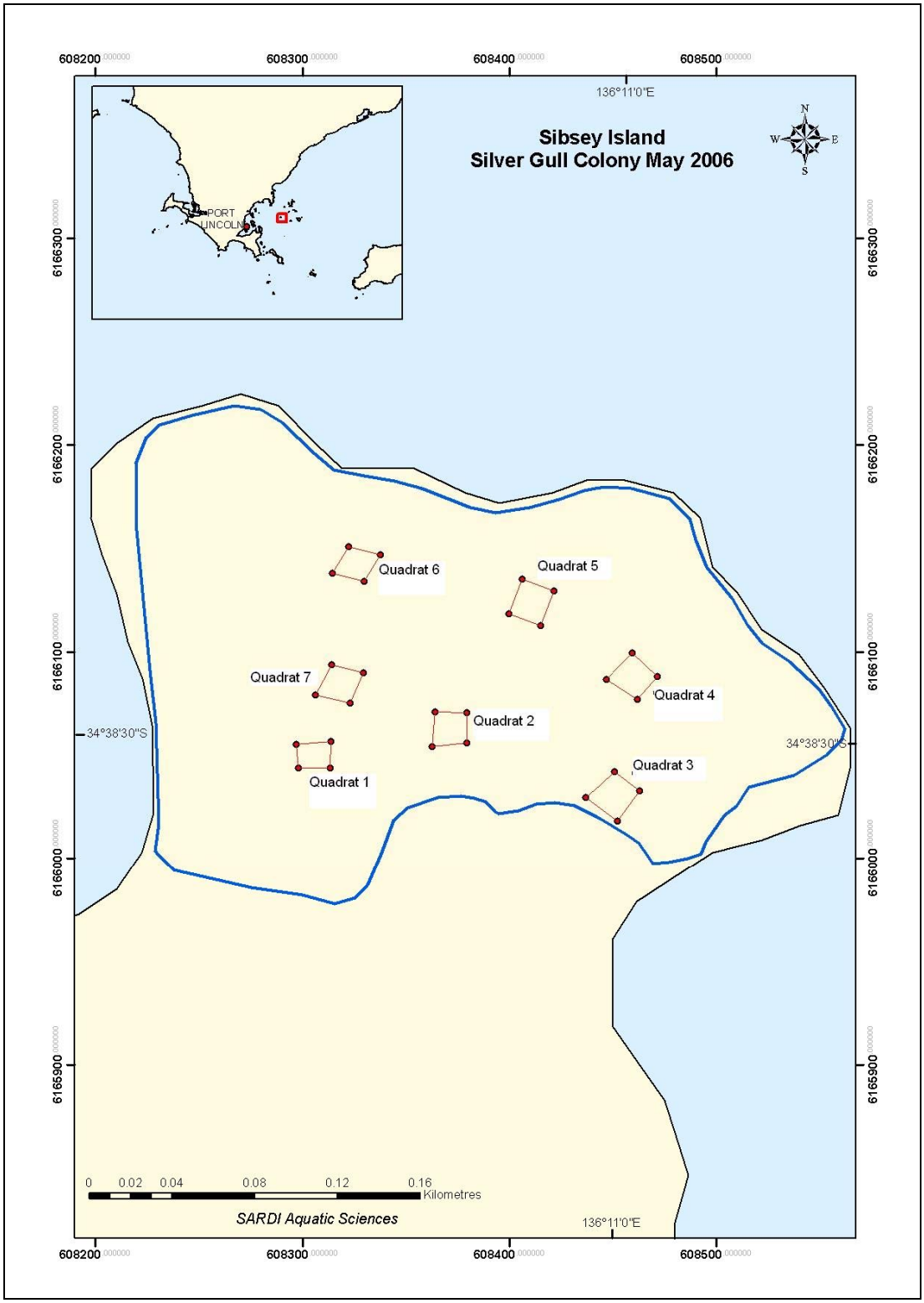

Figure 5.2: The Sibsey Island Silver Gull colony during May 2006. The blue line is the outer boundary and the red squares are the quadrats used to calculate population size.

5.2.2 Monitoring Silver Gull Numbers in Port Lincoln

Silver Gull numbers were monitored bi-monthly from January 2004 to December 2006 at seven sites around Port Lincoln (Figure 5.3) to provide a 'snapshot' of the Silver Gull population for each month. These sites were chosen as they were the sites with the most Silver Gulls present as determined from 2003 surveys (Harrison, 2003).

These observations were performed at approximately the same time of day for each place, each time they were observed (between 12:30pm and 3:30pm). All places were observed on the same day and in the same order each time. This was done so that a 'snapshot' of what was occurring at that specific time was obtained. For sites with high abundance of Silver Gulls such as the refuse depot, the estimation method (Chapter 2.3.2) of counting was used. A hand held counter was used at sites with low abundance (Chapter 2.3.1).

1. Refuse Depot

The refuse depot receives the refuse of about 14,000 people and is open every day except Saturdays, with household waste delivered on weekdays.

2. Fish Factories and Ravendale Oval

The fish factories process tuna, abalone, wild caught fish, and fresh and frozen tuna feed (baitfish) is transported to and from them. Fish waste and baitfish is potentially available to gulls from all these operations. Ravendale Oval is a large sporting complex between the refuse depot and the marina, where gulls gather.

3. Marina Loading Wharf

The marina berth is used for loading and unloading tuna, fishing boats and smaller boats. It is also popular for recreational fishing.

4. Kirton Point Beach (Oil Wharf Beach) and Jetty

This beach is next to the oil loading wharf and about 1km from the town wharf. Takeaway rubbish and scraps are usually available in the carpark.

5. Wharf

The wharf is used as a mooring berth and a loading wharf for many of the tuna and fishing boats in the area, as well as for loading grain and unloading fertilizer from large ships. During the tuna season spilt baitfish is usually available for gulls and spilt grain in the harvest season. It is also a popular place for recreational fishing.

6. Port Lincoln Foreshore

The Port Lincoln foreshore is the main beach in Port Lincoln and is adjacent to the main shopping precinct. It is about 3km in length and is a popular area for picnics, barbeques and beach activities. It is adjacent to many pubs, cafes and eateries all with alfresco dining. The jetty is situated on this beach and is a popular site for recreational fishers. Consequently there is an abundance of anthropogenic food available along the length of the foreshore.

7. Axel Stenross Boat Ramp and Museum Beach

The Axel Stenross boat ramp was opened in August 2005, and used as a survey site from September 2005. The boat ramp is used by recreational fishers and boaters and has a beach adjacent to it with an outlet for a small freshwater spring. Gulls flock to this site for the freshwater and to roost.

Figure 5.3: Port Lincoln Silver Gull observation points.

5.2.3 Statistical Analysis

Linear Regression and the Curve Estimation procedure (using linear and exponential plot models – normal error distribution) were used to analyse for linear and exponential patterns in annual Silver Gull nesting abundance data using SPSS.

The combined Port Lincoln Silver Gull population abundance data (all seven city sites combined) were analysed as time series data in SPSS. Periodicity or annual patterns were tested through a periodogram (a graph indicating at which period throughout the data there is a cyclic pattern) and spectral density plot (a smoothed version of the periodogram which brings out important structure in the lower peaks) using SPSS.

5.3 Results

5.3.1 Breeding Silver Gull Population Dynamics

Port Lincoln Breeding Silver Gull Population Dynamics

The nesting Silver Gull population in Port Lincoln has increased from 3,300 nesting pairs in 1999 to as high as about 27,800 nesting pairs in 2005, however, it reduced to 20,750 nesting pairs in 2006 (Figure 5.4).

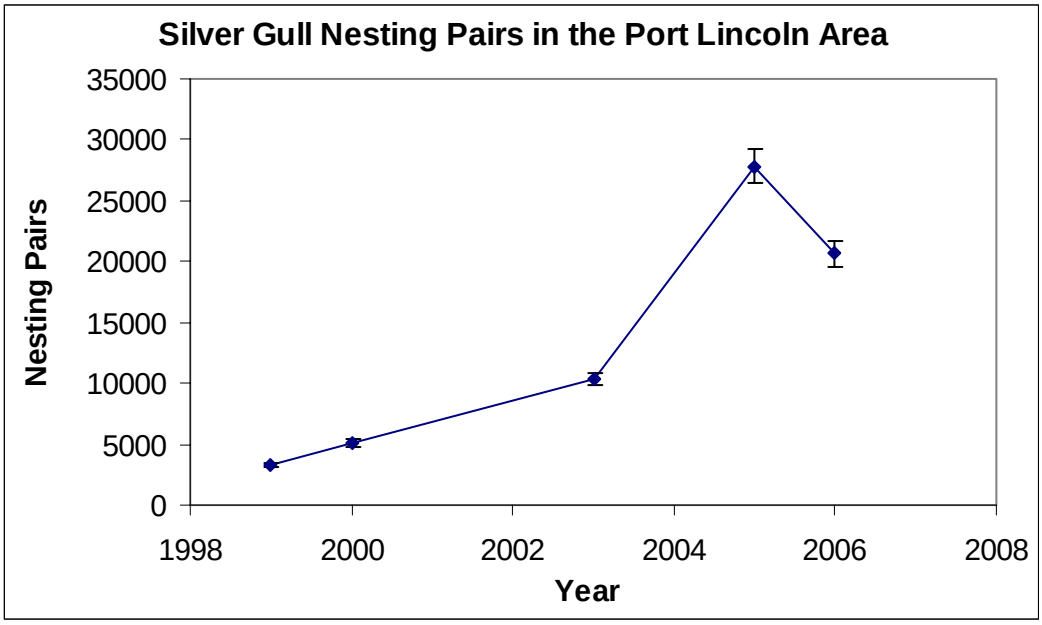

Figure 5.4: Port Lincoln Silver Gull nesting pair abundance.

The dynamics of this population in Port Lincoln have shown a significant (p=0.018) exponential increase since 1999 (Figure 5.5). The increase in numbers from 1999-2003 appears to be linear, however, there was a substantial increase in population size in 2005 which deviated away from the linear trend that was shown from 1999-2003. Exponential regression shows that the coefficient of variation (r^2) was 88%, meaning 88% of the difference in numbers that are shown in the graph was explained by year (Figure 5.5).

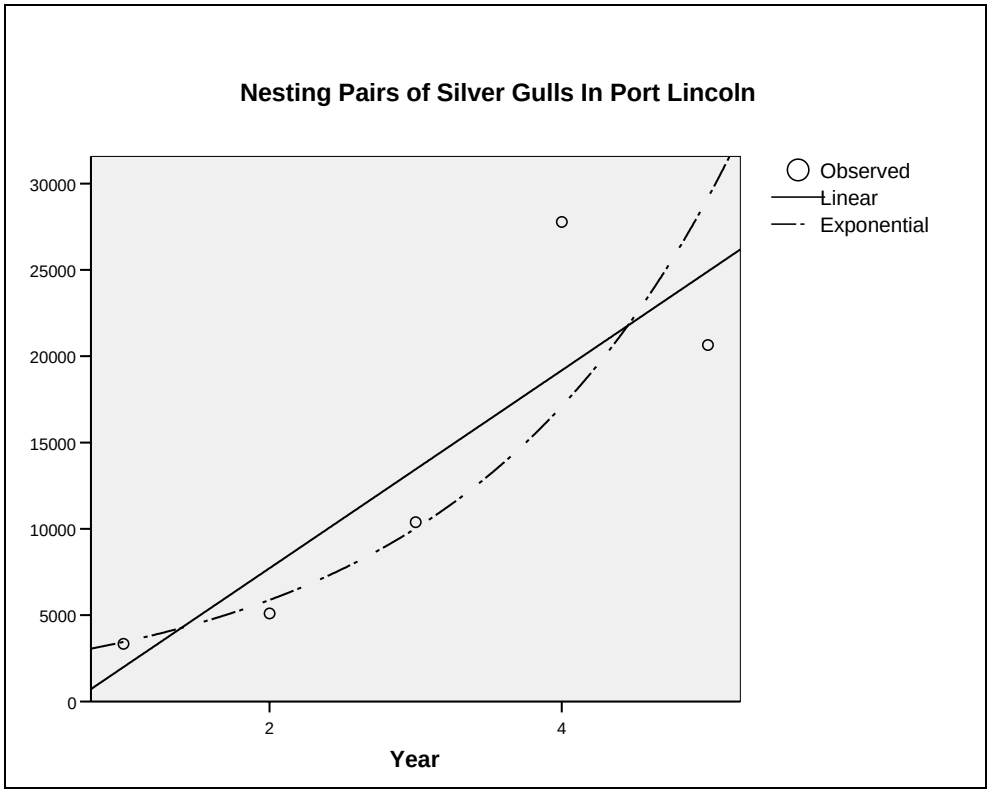

Figure 5.5: A scatterplot showing the linear regression plot model (solid line) and the exponential plot model (broken line) fitted to the Port Lincoln nesting pair abundance data.

Silver Gull Populations Dynamics on Individual Breeding Islands

Between 2003 and 2005 the abundance of nesting pairs increased on four of the six islands monitored (the exceptions were Sibsey Island and Winceby Island (which was an estimate only)). However, in 2006 it decreased on 4 of the 6 islands, the exceptions being Donington and Boston Islands (Table 5.1).

Table 5.1: Silver Gull nesting pair abundance at the individual breeding colonies.

	2003	**2005**	**2006**
Rabbit Island	2,000	19,400	13,500
Sibsey Island	7,200	6,400	5,000
Donington Island	150	250	250
Winceby Island	1000	1000	1000
Louth Island	N/A	500	500
Boston Island	0	250	500
TOTAL	**10,350**	**27,800**	**20,750**

Rabbit Island

The population on Rabbit Island has not been continuously monitored, however the population size has been variable since data were first collected in 1982. There was a significant ($p<0.0001$) exponential increase in gull abundance since 1982 (Figures 5.6 & 5.7). There was a linear increase from 1982-1989, however, the increase since 1999 appears to be exponential. Exponential regression shows that 88% (r^2) of the difference in numbers that are shown in the graph are explained by year meaning the population differed substantially each year. However, it is unknown how many more nests Rabbit Island can sustain as during 2005 and 2006 (the highest nesting populations on record) the colony of Silver Gulls covered 16 ha of the 20 ha island (Figure 5.1).

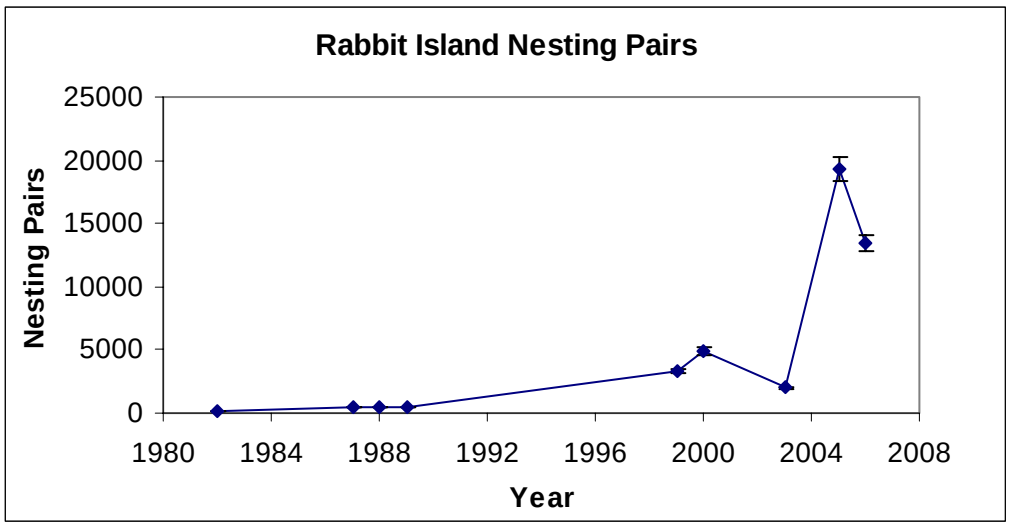

Figure 5.6: Nesting pair abundance on Rabbit Island.

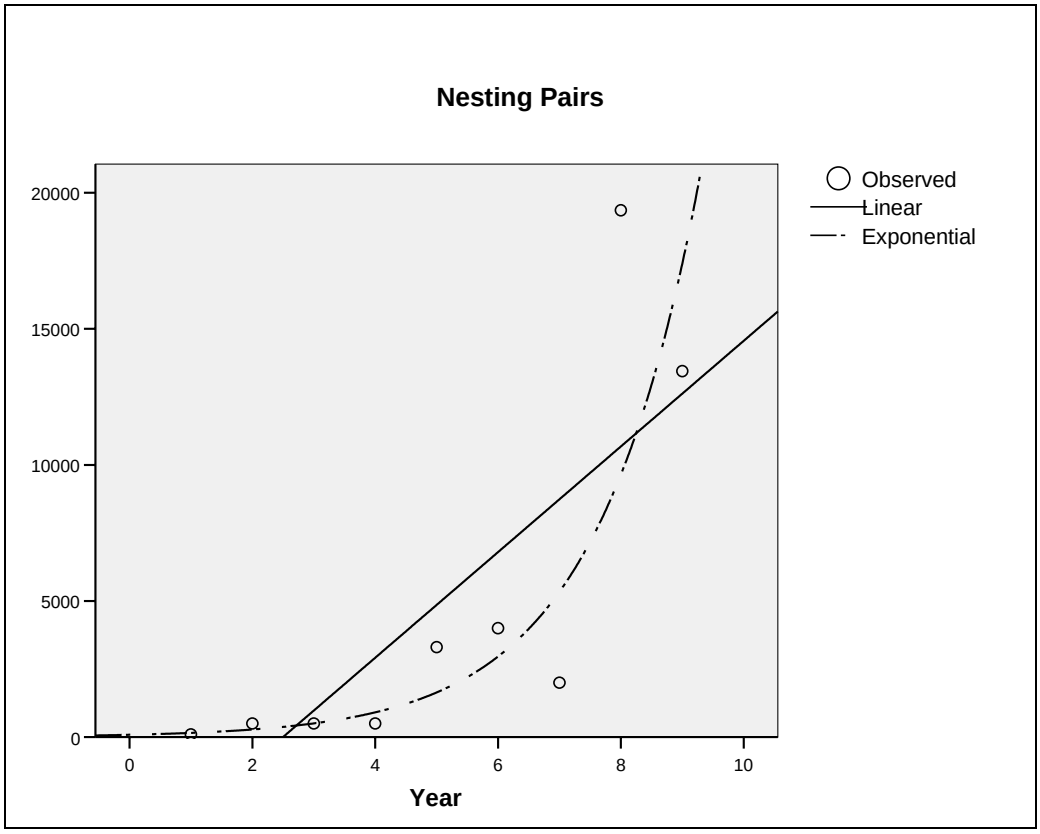

Figure 5.7: A scatterplot showing the linear regression plot model (solid line) and the exponential plot model (broken line) fitted to the Rabbit Island nesting pair abundance data (1982-2006).

Sibsey Island

The nesting Silver Gull population has been declining on Sibsey Island since the initial visit in 2003, when it was the major breeding colony of Port Lincoln gulls for that year (Figure 5.8). Although the decrease showed a linear trend, this was not significant (Figure 5.9: p=0.105) and there were too few data points to fit the regression model. The Silver Gulls breeding colony covered 5.5 ha of the 30 ha island in 2006 (Figure 5.2), a decrease from around 7 ha in 2003.

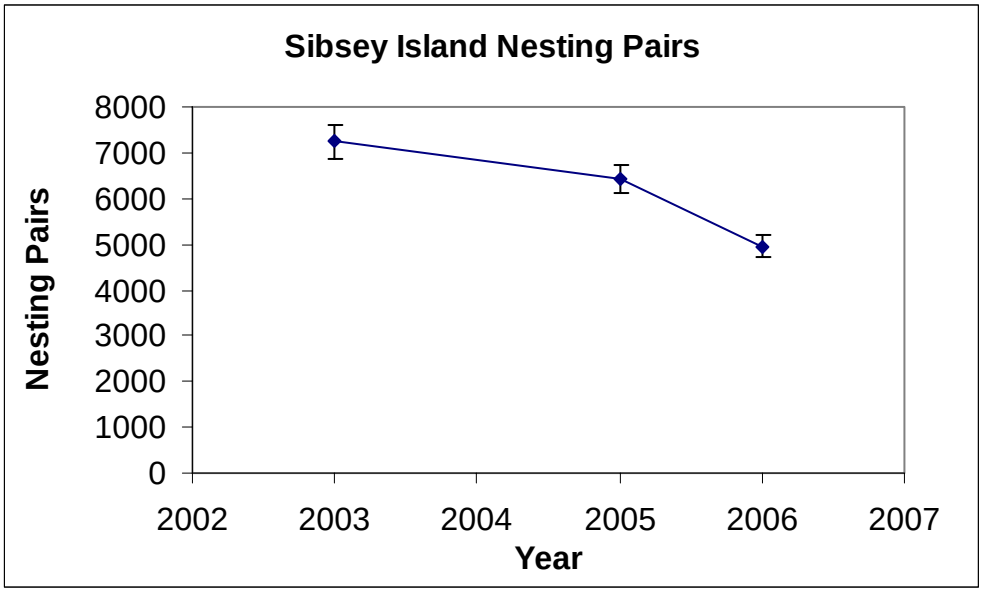

Figure 5.8: Nesting pair abundance on Sibsey Island.

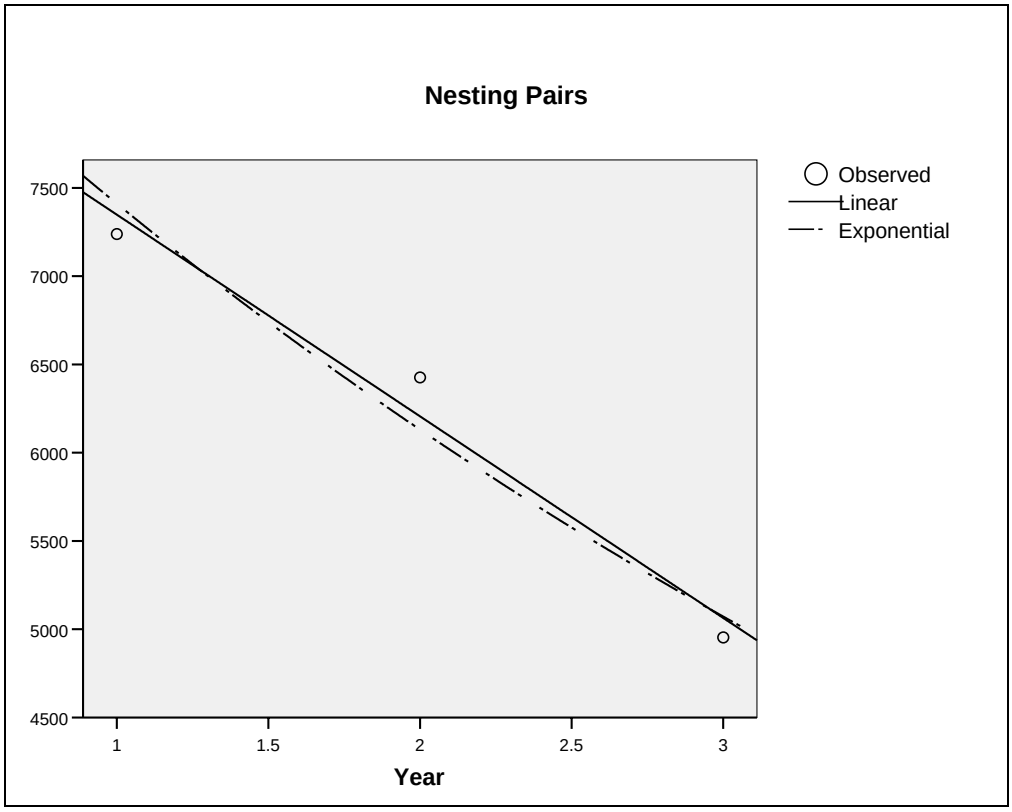

Figure 5.9: A scatterplot showing the linear regression plot model (solid line) and the exponential plot model (broken line) fitted to the Sibsey Island nesting pair abundance data.

5.3.2 Silver Gull Temporal Changes in Abundance in Port Lincoln

The Silver Gull population in Port Lincoln (data for seven sites combined) shows a distinct pattern that occurs each year (Figure 5.10). During January, abundances are high, but from February until June they decrease, and then increase again from July to October. After November they decline slightly but remain high until February of the next year.

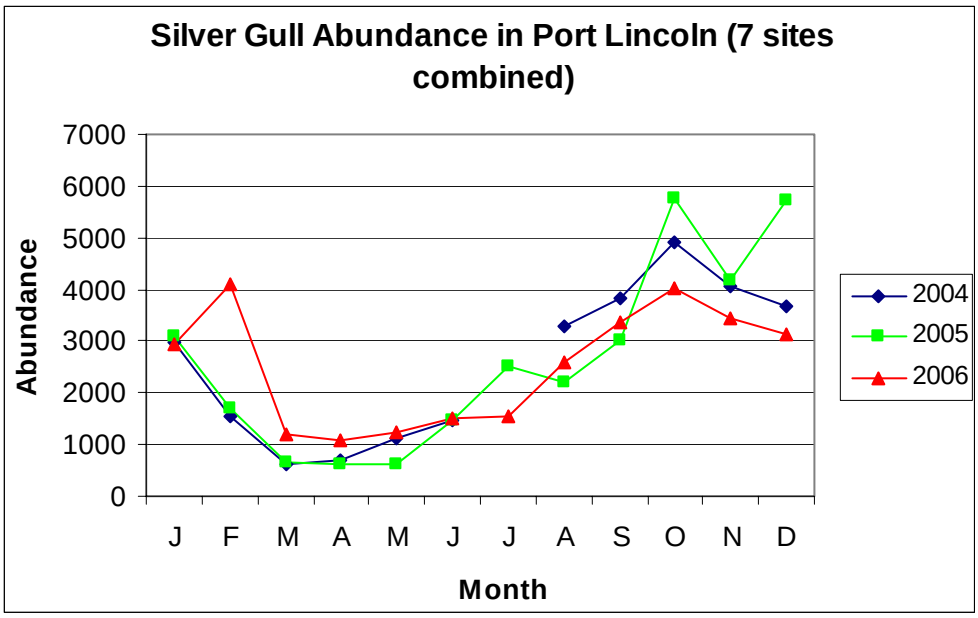

Figure 5.10: Monthly Silver Gull abundance in Port Lincoln from 2004-2006.

The population dynamics of the Silver Gulls in Port Lincoln show evidence of a cyclic pattern which was confirmed by analysis of the time series data with a periodogram (a graph indicating at which period throughout the data there is a cyclic pattern) and a spectral density plot (a smoothed version of the periodogram which brings out important structure in the lower peaks). The periodogram (Figure 5.11) shows one main peak at 0.08. This confirms that an annual cycle is present (as the data are monthly, 12 months in a year and 1/12 = 0.08). A spectral density plot (Figure 5.12) was used to search for within season cycles, but only one main peak

remained confirming the only pattern was the annual cycle.

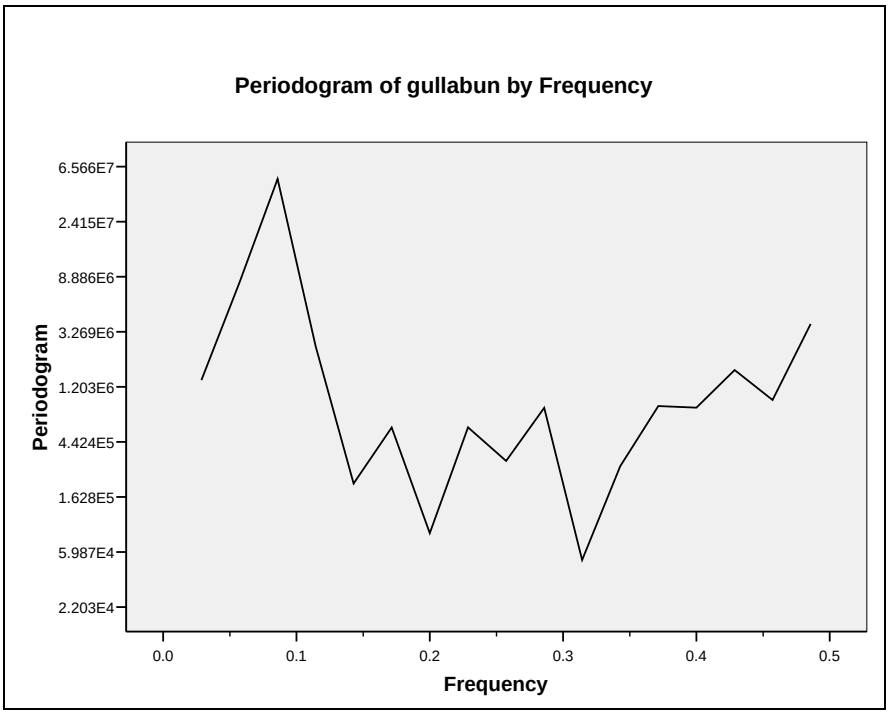

Figure 5.11: Periodogram of gull abundance. This graph shows one main peak at 0.08 which is equal to 1/12. This confirms an annual cycle.

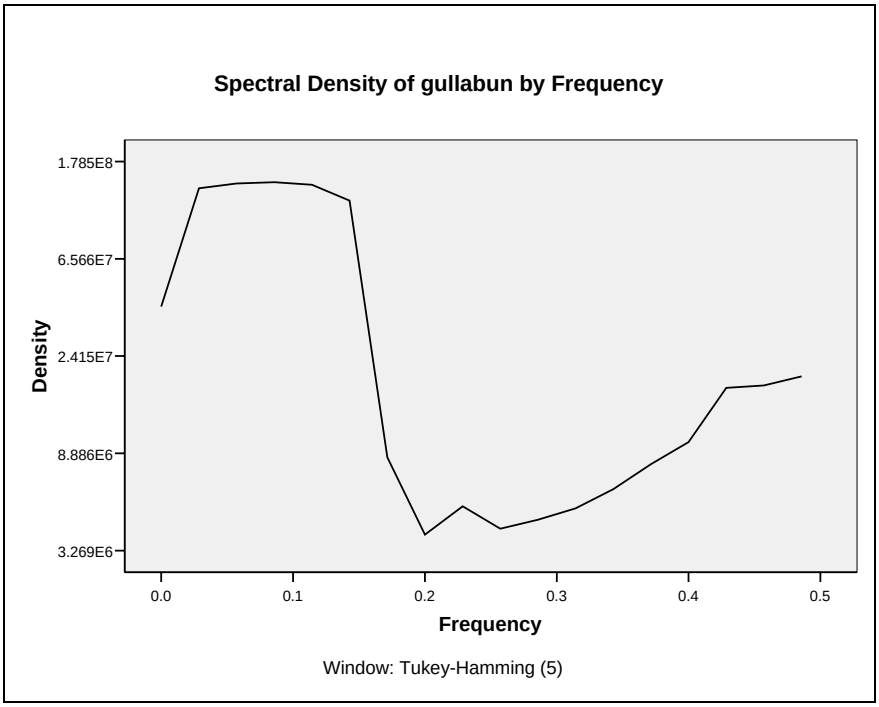

Figure 5.12: A Spectral density plot (smoothed periodogram). This smoothes the data and shows any important structure in the lower peaks of the data. However, this graph shows only the annual cycle present.

Individual Sites

It is evident that most of the Silver Gulls in Port Lincoln frequent the refuse depot, and that this site also has an annual cycle for gull abundance (Figure 5.13). Therefore the pattern observed in the previous section is driven by the trend in abundance at this site. It would seem that this site is only used as a major food source during the tuna farming off-season and lowest during the tuna season (Figure 5.14). There was some evidence of a general decrease in gull abundance at the dump each year. Interestingly there was a large drop in numbers from October to December 2006, which was not observed in previous years. This may have been influenced by the SBT industry catching and farming fish earlier for the 2007 season.

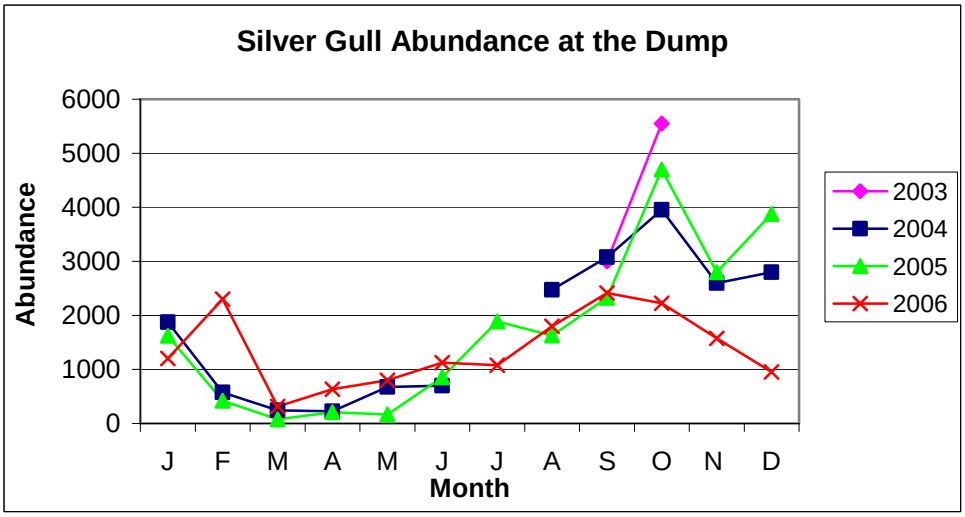

Figure 5.13: Monthly Silver Gull abundance at the refuse depot, Port Lincoln for 2003 (data for 2 months only) and from 2004-2006.

Figure 5.14: Silver Gull abundance at the dump. The top photo was taken during the tuna farming season and the bottom photo was taken during the tuna off-season. Gulls were counted by standing in several specific locations and counting all birds present at that time (being careful not to double count).

Although absolute abundance was much lower at the other sites around Port Lincoln, a similar annual cycle was apparent for gulls at the fish factories (Figure 5.15), however, abundance fluctuated yearly for this site. This annual cycle was also evident at the foreshore (Figure 5.16), with gull abundance increasing each year (possibly influenced by tourist influxes in the summer months). The wharf also exhibited an annual cycle in gull abundance (Figure 5.17), however, whilst abundance was high in January/February, there was no evidence of the rapid increase in October observed at most other sites. There was no pattern evident for gull

abundance at the marina loading wharf (Figure 5.18) or Oil Wharf Beach (Kirton Point Jetty) (Figure 5.19) and as only one full year of observations were undertaken for the Axel Stenross Boat Ramp, no pattern could be ascertained (Figure 5.20).

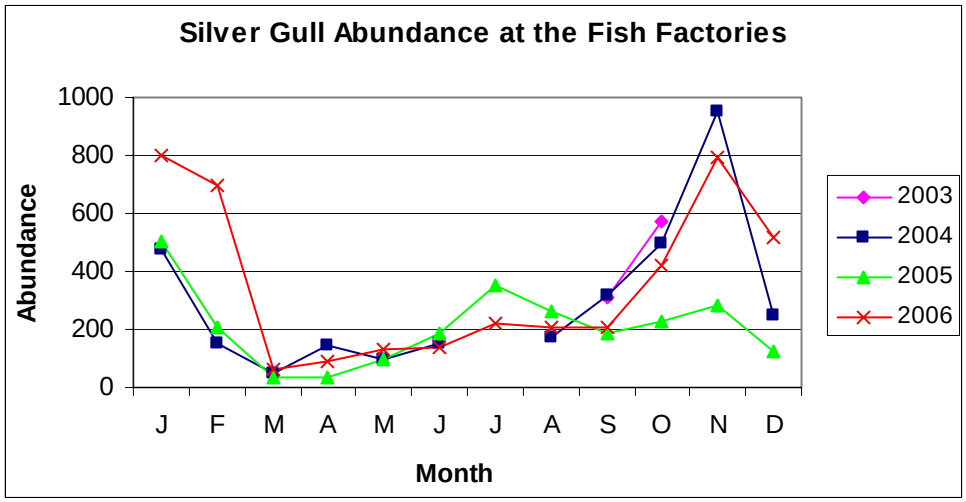

Figure 5.15: Monthly Silver Gull abundance at the fish factories for two months in 2003 and from 2004-2006.

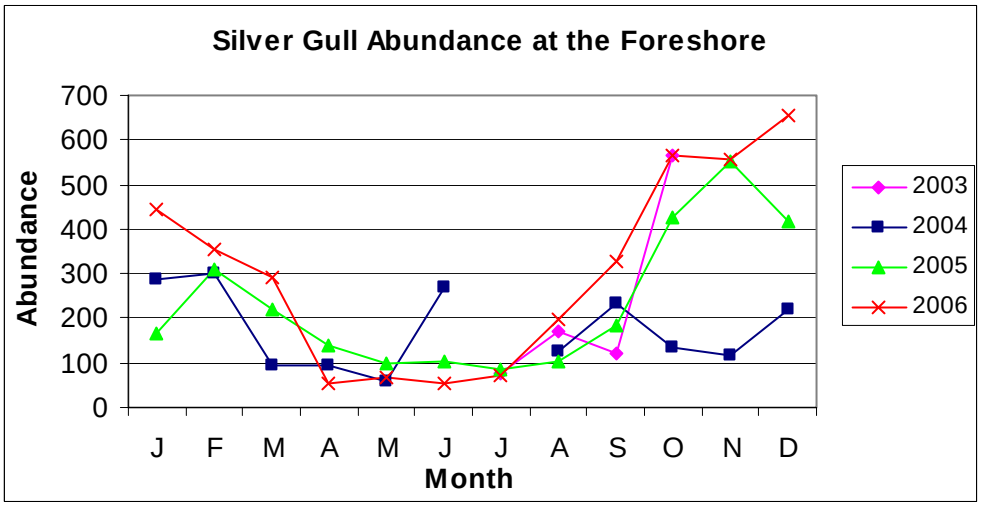

Figure 5.16: Monthly Silver Gull abundance at the foreshore for four months in 2003 and from 2004-2006.

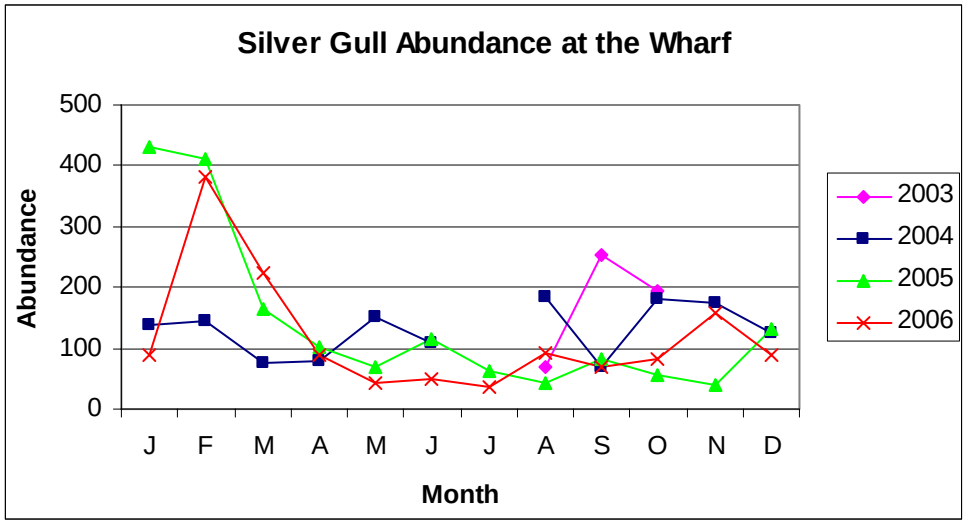

Figure 5.17: Monthly Silver Gull abundance at the wharf for three months in 2003 and from 2004-2006.

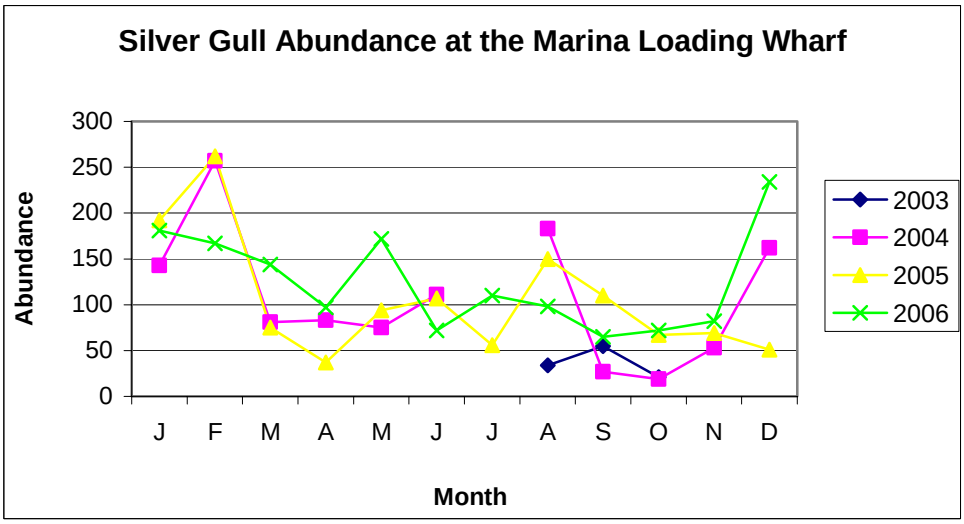

Figure 5.18: Monthly Silver Gull abundance at the marina loading wharf for three months in 2003 and from 2004-2006.

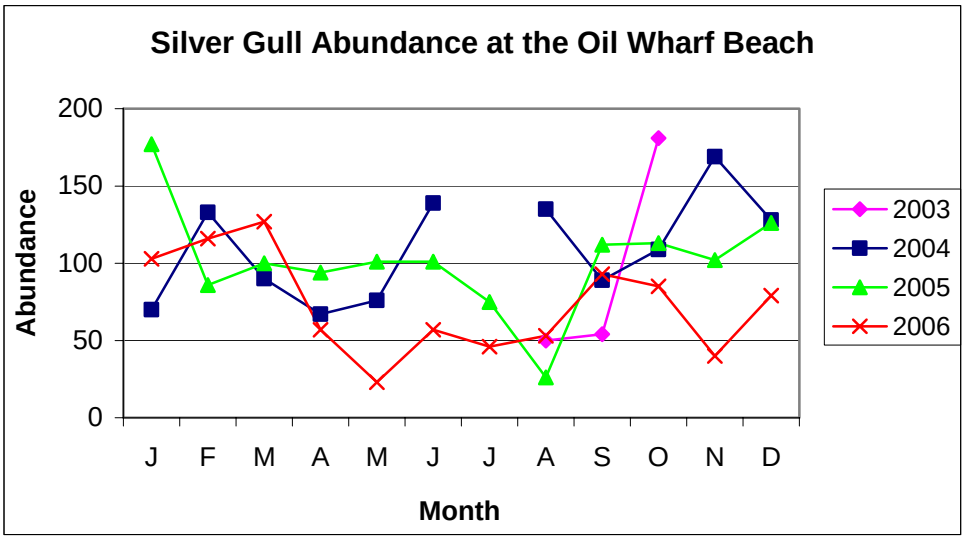

Figure 5.19: Monthly Silver Gull abundance at the Oil Wharf Beach (Kirton Point jetty/beach) for three months in 2003 and from 2004-2006.

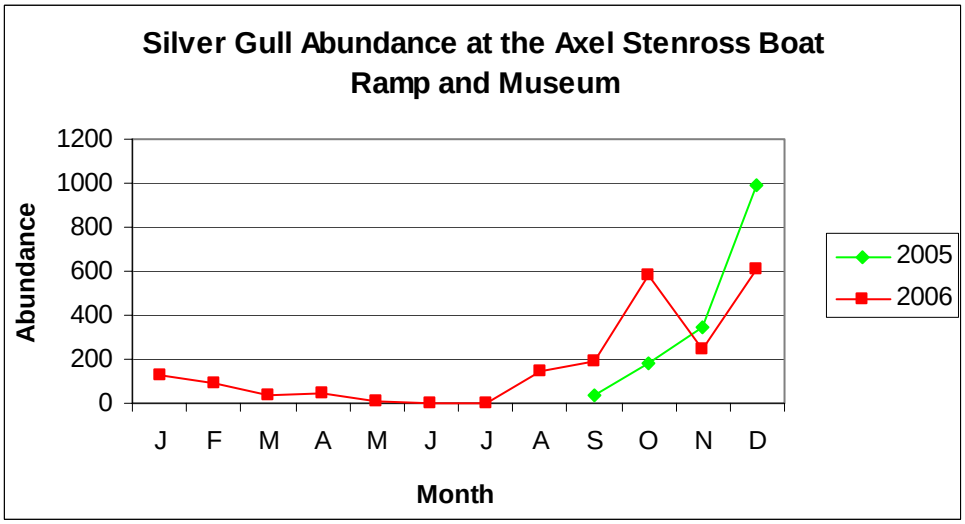

Figure 5.20: Monthly Silver Gull abundance at the Axel Stenross ramp and museum for four months in 2005 and all months in 2006.

5.4 Discussion

Like the human populations of many coastal cities and towns throughout Australia, the population of Silver Gulls in the Port Lincoln area has increased substantially over the last two decades. However, unlike the other documented situations where human refuse has been the main source of food for these abundant populations, this

has not been the case for the Port Lincoln population during their breeding season. The dynamics of the refuse depot population have indicated that this source of food was not the main supply for this population during the breeding season (January to October) because abundance was low during this time. Only a few hundred gulls were observed at the dump at this time, but as many as 30,750 may be present at the tuna farms on any one day (Chapter 3). However, outside of the tuna and breeding season, abundance increased and at least a quarter of the population were present at the dump. At this time of year, human refuse becomes an important food source for this population.

In addition to the population increase, the number of known breeding sites in the area has also increased from one in 1982 (Farlam, unpublished data) to at least seven, with the primary breeding site varying for some of these years. Historically Rabbit Island has been the primary site for these gulls. Numbers were as low as 100 nesting pairs in 1982 and were stable at around 500 nesting pairs from 1987 to 1989 (Farlam, unpublished data). Since 1997, Silver Gull nesting abundance has increased on Rabbit Island and a new nesting colony was established on Louth Island (Schoder, pers. comm.). This coincided with the tuna farms being moved outside of Boston Bay and into the offshore waters of Port Lincoln. Interestingly in 2003, the main breeding colony of Silvers Gulls was found on Sibsey Island, not Rabbit Island. There was an attempt to breed on Rabbit Island at the start of the season, however this was abandoned and breeding was initiated again in July. There may have been some unidentified disturbance that resulted in the abandoned nests which would explain the discarded eggs and dead chicks found. Interestingly, when Rabbit Island was surveyed early in the 2004 breeding season (March) and Sibsey Island during

July, it was evident that the primary breeding site for these gulls had moved back to Rabbit Island, with abundance rapidly increasing there whilst remaining relatively stable on Sibsey Island. Breeding was also initiated on Boston Island in June 2005 and 2006 (season length June-October), where they had not bred since 1999 (Farlam, unpublished data). This demonstrates that this population of gulls is not static, but instead dynamic, moving or establishing new colonies if needed, meaning all islands in the area could be potential breeding sites.

The Port Lincoln nesting population appeared to decrease in 2006, although it was still much higher than any years previous to 2005. The rapid increase from 2003 to 2005 is also worthy of note. The rapid population increase may have been influenced by the unknown occurrence that impacted breeding on Rabbit Island in 2003, as this large increase was unlikely to have be caused by tuna feed alone. The decrease in population observed from 2005 to 2006 may be a result of the carrying capacity of the food source being reached, despite the estimated overall reproductive output during 2005 and 2006 being very similar. It is likely that there was less tuna feed available over the 2005 and 2006 seasons as there were more tuna companies using scaring devices, frozen block feeding or larger baitfish (personal observation). There may have also been competition for nesting space on Rabbit Island as most of the occupiable breeding space was taken in these seasons, and these gulls may have moved elsewhere to breed such as one of the many other local islands not observed in this study. However, the decrease may also be attributed to natural variation.

It must be noted that these population estimates were taken via nesting abundance, not juvenile and immature abundance, and therefore some of the observed population

expansion could be related to recruitment of adults or fledglings from previous years returning to breed (~3 yrs of age – Higgins & Davies, 1996). It is very difficult to measure the survival rate of chicks after fledging as chicks usually disperse from the colony in the first year and gradually move closer to the natal colony in subsequent years, usually returning upon maturation at two to three years of age (Higgins & Davies, 1996). Therefore, the increase of the entire population was not measured. However, many recently hatched immature birds were observed in Port Lincoln from July onwards, showing that at least some chicks dispersed into Port Lincoln at this time, although it is not known how long they stay.

The apparent reliance of this population on tuna feed is also reflected in the temporal changes in abundance and distribution of Silver Gulls in Port Lincoln. The pattern observed was an annual cycle that reflected both the tuna season and the Silver Gull breeding season. In essence, gulls were in low abundance in Port Lincoln during the tuna season with an influx into the urban areas nearing the end of the tuna season. If this population was not reliant on the tuna feed, an influx of gulls into Port Lincoln searching for food after the first laying peak (April) would be expected, as has been exhibited for populations near Sydney, where there is an influx of gulls as adults and young disperse from the colony on completion of breeding (Smith & Carlile, 1992) but this is not the case. Although, some of this pattern may also be influenced by the Silver Gulls searching for freshwater in urban areas during the hot summer months (though this could also be found at freshwater springs and stock water troughs). Interestingly, although there was an annual cycle present, actual peak abundance in the town did not increase to reflect the substantial increase in breeding abundance on the islands each year. While it did increase from 2004 to 2005, and then decreased in

2006, as the breeding population did, the actual increase per annum was at most about 2000 birds, but generally in the hundreds, which was still a very small proportion of the breeding population. It is not clear where the remainder of the breeding colony disperses to after breeding. Silver Gulls are known to disperse up to 1000km from breeding colonies upon cessation of breeding, leading to the suggestion that a proportion of the population is sedentary and a proportion mobile or migratory (Ottoway *et al.*, 1985; Smith, 1995; Higgins & Davies, 1996). Juveniles are believed to migrate further than adults but the majority of birds stay within 150 - 460km of their colony (Ottoway *et al.*, 1985). Thus, it could be suggested that the birds that disperse into Port Lincoln could be sedentary individuals, whilst the remainder that 'disappear' being migratory birds. Due to the scavenging and adaptable nature of this species, the migrating birds could be causing problems elsewhere upon their dispersal. Future research could involve tagging or marking gulls nearing the end of the breeding season and tracking their movements.

In conclusion, the Port Lincoln Silver Gull population has increased markedly over the last two decades. It also appears the population dynamics of the Port Lincoln Silver Gull population is heavily influenced by the availability of food from the tuna farming industry. This is exhibited in the annual cycle of gull abundance in Port Lincoln which closely reflects the SBT farming and Silver Gull breeding season.