The Effects of Anthropogenic Food on the Body Condition, Biochemistry, Stable Isotopes and Egg Quality of Silver Gulls in Tasmania

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Declaration

This thesis contains no material which has been accepted for a degree or diploma by the University of Tasmania or any other institution, and to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due acknowledgement is made in the text of this thesis.

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Abstract

Many studies worldwide have attested to an increase in gull populations following urbanisation, and it is widely presumed that gulls have benefited as a direct consequence. However, foraging at tips and food outlets may induce a health cost in urbanised birds and the benefits of eating anthropogenic food should be questioned; the physiological health effects of ‘garbivor This study was based on the premise that a negative effect on the health and hence fitness of gulls was expected from eating the equivalent o

This research investigated the potential adverse effects of an anthropogenic diet on the health of Silver Gulls (*Larus novaehollandiae*) by comparing birds breeding at a remote, non-urbanised site (Furneaux Island Group, Bass Strait) with those at an urbanised (Hobart) colony in Tasmania, Australia. A variety of approaches were used to assess the health of this species to gain a more comprehensive evaluation. Mass and body condition (measured by an index), stable isotopes in whole blood ($^{13}C/^{12}C$ and $^{15}N/^{14}N$), blood biochemistry (HDL- and total cholesterol, triglycerides, glucose, calcium, sodium, potassium and corticosterone), and egg quality (physical measurements and mass, absolute and proportional chemistries, shell thickness, yolk colour and historic comparisons) were compared between the two gull populations.

Urbanised gulls were heavier and had greater body condition than structurally identical non-urbanised gulls. Analyses of stable isotopes in whole blood suggested that remote, non-urbanised gulls tended to eat from a more marine origin, while urbanised gulls fed from a different food web and from a more freshwater/terrestrial origin. Assessment of

regurgitations suggested that although specific dietary items were generally either human-derived or natural, some overlap existed between sites. The urbanised gulls had higher levels of HDL-cholesterol in their blood. Clutch sizes did not differ, but eggs from the Furneaux Island Group were larger, heavier and had greater yolk mass than those from Hobart, as well as greater carotenoid concentrations in the yolk. Although urbanised Silver Gulls were apparently successful in laying eggs, poorer reproductive success may have resulted from smaller, lighter eggs that contain proportionally less yolk reserves. Overall, the Silver Gull provided a very good model to study the effects of urbanisation on a native species and numerous opportunities exist to focus future research in this area.

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no differences in $^{13}C/^{12}C$ isotope ratios in blood between urban and remote adult Silver Gulls. Similarly, does either population show trophic enrichment (higher $^{15}N/^{14}N$ isotope ratio)? Null hypothesis: There are no differences in the feeding ecology ($^{15}N/^{14}N$ isotope ratios) between urban and remote adult Silver Gulls.

Chapter 4 investigates the effects of anthropogenic food on the body condition of Silver Gulls. A commonly used way to define the health or condition of an adult bird is a function of its size and mass, which may vary with age, sex, season, breeding status and in response to varying food supply and type (Clark 1979, Moreno 1989). Recognising the limitations of body mass alone as a component of such indices, researchers have developed condition indices which render the comparison of individuals within a species valid by correcting for differences in structural size (Owen and Cook 1977). The objectives of this chapter were to determine (i) if the body condition of urban gulls in Hobart has changed over time, (ii) if differences in body condition exist between geographically distant urban colonies, and (iii) if differences in body condition exist between Silver Gulls feeding from anthropogenic sources and natural sources. The main question addressed is: Do physical indices of health (body condition indices) differ between gulls from Hobart and those from the Furneaux Island Group? Null hypothesis There are no differences in body condition indices between urban and remote, non-urban adult Silver Gulls.

Chapter 5 investigates various biochemical parameters in Silver Gulls. Although blood is commonly used to trace changes in the health of birds in clinical situations, there is a comparative paucity of baseline data regarding blood chemistry for wild birds. Hence, the use of blood chemistry as a diagnostic tool to examine avian health has yet to become widely adopted by wildlife managers. This chapter addresses the question: Do blood chemistry parameters (cholesterols, triglycerides, glucose, sodium, potassium, calcium and corticosterone) differ between gulls from Hobart and those from the Furneaux Island Group? *Null hypothesis:* There are no differences in blood chemistry parameters between urban and remote adult Silver Gulls.

Chapter 6 investigates certain aspects of reproductive success in Silver Gulls. Because it is likely that the Silver Gulls from Hobart had more reliable access to foods with a higher fat and/or protein content than Silver Gulls from the Furneaux Island Group, the egg compositions, weights, measurements and eggshell thickness were compared. Egg yolk colour, a measure of carotenoids, was also assessed. Historic egg collection measurements, which predate extensive urbanisation, were compared to contemporary, urbanised eggs from Hobart. The main question addressed was: Are the eggs of Silver Gulls from Hobart higher in quality compared to eggs of Silver Gulls from the Furneaux Island Group? *Null hypothesis:* There are no differences in the clutch sizes, laying dates, egg chemistries, weights, sizes, eggshell thickness or yolk colour between Silver Gulls from urban and remote areas.

This thesis concludes with a general discussion in Chapter 7, summarizing the major results, comparing them with other synanthropic gulls worldwide, and discussing population trends, management implications, and future research suggestions. The inclusive intention of this research is to contribute beneficial information toward novel approaches in the study of urbanisation and its impacts on native species.

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compare various health indices between these two feeding regimes, the two distant sites were necessary.

2.2.1 Furneaux Island Group

The control sites (no or only limited access to human-derived food) for the study were located in the remote Furneaux Island Group. Here, gulls were assumed to be feeding away from anthropogenic sources (i.e. their 'natural' diet). The island group is comprised of 52 islands and rocks at the eastern end of Bass Strait between Victoria and Tasmania (Figure 2.1). Blood samples were collected from Silver Gulls trapped at Great Dog Island (40°14'47.32 S 148°14'14.64 E) and at Killiecrankie (39°50'08.69 S 147°50'00.19 E). Eggs were collected at Nobby's Rocks (Figure 2.2) (39°49'05.04 S 147°50'22.46 E), a small group (< 0.1 ha) of granite boulders with small patches of boxthorn (*Lycium spp*.), north of Killiecrankie. This population of Silver Gulls, based on a census of Flinders Island and all neighbouring islands observable from binoculars, was estimated to be a maximum of approximately 50 pairs of adult birds (HJA pers. obs.). The breeding population of Silver Gulls in the Furneaux Island Group was much smaller than urbanised areas and the remote colonies were likely to be highly ephemeral. Based on census work of all the smaller outer islands, a cumulative total of 1960 breeding pairs (including nest sites counted as a breeding pair) were surveyed spanning twenty years (Brothers et al. 2001), or less than 100 pairs per year. Both control sites were more than 20 km from any reliable source of anthropogenic food, and the nearest sources beyond that were small tips serving less than 10 households.

2.2.2 Hobart

The Queen's Domain in Hobart (42°52' 34.69 S 147'°20'16.14 E) Tasmania (Figures 2.1 and 2.3) is a large public open space north of the central business district and includes sports centres, the Botanical Gardens and Government House. The River Derwent, headquarters of the Naval Reserve Cadets, slip yards and a bike-riding path flanked the gull colony. Size of colony was estimated to be 1294 active nests, or 2588 breeding adults, on 12 October 2004 (I. Skira, pers. comm.) and 1601 active nests, or 3202 breeding adults, on 14 September 2005 (W. Wakefield pers. com.). The 14 October 2006 estimate was 1964 active nests, or 3928 breeding adults (W. Wakefield, pers. com.). This site was chosen as the treatment colony (i.e. where gulls fed from anthropogenic sources) for both blood and egg collection, based on close proximity to local tips, several restaurants and takeaway shops that were convenient food sources. Area refuse disposal sites include McRobie's Gully Disposal Site (5.5 km direct to colony), operated by the City of Hobart and Glenorchy Disposal Site (10 km direct to colony) operated by the City of Glenorchy.

2.3 Time Frames

Although young Silver Gulls and some adults were classified as being partial migrants, breeding adults tended to show high colony tenacity (Murray and Carrick 1964). The propensity for urbanised gulls to move between remote and urban sites throughout the year meant that the timing of sampling was aimed at their breeding season. Restricting sampling to the breeding season of Hobart gulls ensured that the parameters measured best reflected the effects of localised feeding. Hobart birds were captured between 2-

12 November and 14-24 December 2004 (n = 84), and the Furneaux Island Group birds between 19 November and 2 December 2004 (n = 20). The Hobart birds were then classified into pre-egg, incubating and chick rearing phases. The Furneaux Island Group birds could not be categorized in this manner because some were breeding on inaccessible offshore islands and others were non-breeding residents, hence they were classified as breeders and non-breeders (i.e. bearing or lacking a well-developed brood patch). Eggs of gulls nesting at the Hobart Queen's Domain were collected 1-19 September 2005; eggs on Nobby's Rocks in the Furneaux Island Group were collected 12-18 November 2005. Colonies were visited every day when it was not raining (in order to prevent chilling of eggs and small chicks), and during morning hours to prevent heat stress on warmer days following standard animal ethics protocols.

2.4 Site Tenacity During the Breeding Season

High colony tenacity during the breeding season was a central assumption throughout this thesis; the levels of all parameters measured were assumed to be the result of local feeding by the gulls. Published literature stated strong site tenacity from breeding adult Silver Gulls in southeast Australia (Murray and Carrick 1964). This site tenacity was verified by the author for southeast Tasmania with band recoveries, re-trapping and band re-sightings records dating back to 1983, generously provided by Dr William Wakefield.

2.5 Field Work

The Queen's Domain in Hobart was easy to access by walking from the central business district. A shaded area next to the Naval Reserve Cadets' building provided a quiet area out of public sight for processing birds directly next to the colony. Access to the Furneaux Island Group proved more difficult, and a ferry from Bridport (2004) or flight from Launceston (2005) to Flinders Island was the first step of the journey. A chartered boat from Lady Barron to Great Dog Island carried the researchers and equipment. The beaches of Great Dog Island were accessed by walking or boating from the field camp, the Newell muttonbirding hut. Researchers drove a utility vehicle to Killiecrankie on Flinders Island and from there rowed a rowboat to Nobby's Rocks.

2.5.1 Transect Line

A 50 m transect line was set in the Hobart colony, extending between a telephone pole in the centre of the colony to a large boulder next to the fence on the southern end of the colony. The line covered all types of substrate, representing all potential nesting habitats: bare earth, shade trees, grasses, and herbs, mainly fennel (*Foeniculum vulgare*). This line was monitored daily on rain-free days starting 7 September 2005 after the first eggs were observed. The line was monitored at least twice per week during the breeding season, flagging and numbering new nests and recording number of eggs, and recording hatching dates, number of chicks and re-nesting attempts. The transect line was monitored until all adults abandoned the nests for the season, with the last new eggs recorded 31 January 2006 and the colony abandoned 20 February 2006.

2.5.2 Trapping Techniques

A variety of non-lethal capture techniques were used to minimise the chances for learning, habituation and avoidance, which sharply reduce capture success when a single technique is used (B. Robertson, pers. comm.). All were well-established techniques used throughout the world and currently approved by the Australian Bird and Bat Banding Scheme. Drop traps were constructed from chicken wire over box frames, placed over the active nest and held up by a stick. Pulling away the stick with fishing line sprung the trap; alternatively, the bird triggered it when the line was placed taut over the nest between the stick and the frame edge. Maze traps were made of chicken wire frames curled inward into a double-ended spiral, which opened in the middle. One spiral end was placed over the active nest; when the gull returned to sit upon the nest, the researcher approached quickly to retrieve it. The bird, which found its way in easily, could not find its escape to the entrance quickly, hindered by the wire maze. These two traps were effective due to the strong instinctive drive for the birds to incubate their eggs or small chicks. A zap net, which can catch several birds at once, is a spring-loaded trap with a net attached to large octopus straps. This type of trap was used on open beaches close to the tide line and was baited with fish or bread to induce birds within trapping range.

2.5.3 Trapping Effort Per Bird

One of the major differences between the urbanised and remote Silver Gull colonies was the resident population of both areas. Thousands of birds were accessible in the Hobart colony, plus other, smaller colonies existed close by, such as the Sorrell Causeway, and Big and Little Spectacle Islands. However, the population of Silver Gulls found in the Furneaux Island Group was much smaller, and finding the breeding site(s) alone was difficult. The difference between the resident populations was in itself an interesting observation and likely caused by the availability (or lack thereof) of a reliable, accessible food source; Furneaux Silver Gull populations probably reflected the carrying capacity of a remote, non-urbanised site. Additionally, urbanised gulls were easy to trap, given their familiarity with humans and association with human food. Furneaux Island Group gulls behaved as truly ‘wild’ birds and flew away when a human first approached. These gulls were generally not interested in the bait (fish or bread) staked in the zap nets, as they were not conditioned to associate humans with food.

One way to quantify this discrepancy in numbers and behaviour was to calculate trapping effort per bird. In Hobart, an estimated 84 hours were spent catching 84 birds, or one bird/hour. In the Furneaux Island Group, an estimated 62 hours were spent to trap 20 birds, or 0.32 birds/hour. An additional 16 hours were spent trying to locate gulls to trap, which lowered the rate to 0.26 birds/hour. Trapping efforts were halted after several days at a single location in the Furneaux Islands if no additional birds were trapped, either because they could not be found or they were too wary to approach the traps.

2.5.4 Morphometric Measurements

The gender of the birds was determined via established methods (Woehler et al. 1989) using head length, where male > 83.4 mm > female (W. Wakefield, unpublished data). Often in Hobart, both birds of the breeding pair were caught on the nest and gender confirmed. A bird was placed into special sized, custom-made calico bag to prevent struggle and injury, and mass was measured with a hand-held spring balance to ± 5 g. Using dial callipers, head length (distance from the tip of the bill to the posterior ridge