Factors influencing the admission of urban nesting Herring Gulls *Larus argentatus* into a rehabilitation centre and post release survival in comparison with wild counterparts

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UNIVERSITY OF SUSSEX

ABSTRACT

Factors influencing the admission of urban nesting Herring Gull *Larus argentatus* into a rehabilitation centre and post release survival in comparison with wild counterparts

By Richard Phillip Thompson

Orphaned and traumatised Herring Gull admissions to Mallydams Wood wildlife rehabilitation centre were reviewed to determine factors affecting likelihood of release and post release survival. Admission categories; orphan, inexperienced juvenile, fishing litter and caught & entangled showed the most likelihood of release, whereas, disease, weakness, collision and shot birds showed the least probability of release. Between 1999 and 2010, 2,796 (84.1%, this excludes birds euthanased within 48 hours) birds were ringed and released. Subsequently, 44 rehabilitated Herring Gulls have been found dead, 46 sick and 2,179 colour ring sightings of birds alive reported from over 200 observers in the British Isles and Continental Europe. Mean survival days for adult birds (848.77 days ± 66) were not significantly different than non-adult birds (722.49 days ± 26). Similarly, distance travelled by adult group (58.69Km ± 13.10) and non-adult group (68.46Km ± 3.89) were comparable. Post release survival within admission groups showed better than expected recovery rates for shot adult birds (47%) and inexperienced juveniles (40%). Data sourced from urban nesting wild chicks in the South West and South East was compared to rescued juvenile birds. No significant differences between the two groups were found for dead birds, but sick birds and re-sighting data showed significant differences. In-house rehabilitation protocols currently in place were tested and indicated that procedures to mitigate animal suffering and yet improve the likelihood of release were appropriate, with only minor improvements required in release criteria. The anthropogenic pressures on urban gull populations and national decline in the sub-species; *Larus argentatus argenteus* could be supplemented through rehabilitated birds. The data suggest that the rehabilitation of Herring Gulls was important from both an animal welfare and population perspective and therefore cost effective.

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FREQUENTLY USED ABBREVIATIONS

BoCC = Birds of Conservation Concern
BOU = British Ornithological Union
BOURC= British Ornithologists Union Records Committee
BRIG = Biodiversity Reporting and Information Group
BTO = British Trust for Ornithology
BWRC = British Wildlife Rehabilitation Council
CCW = Countryside Commission for Wales
dB = Decibel
EURING = European Union for Bird Ringing
EWWC= East Winch Wildlife Centre
g =Gram
K/T = Cretaceous/ Tertiary boundary
Kg = Kilogram
Km = Kilometre
Ksa = Kolomogorov-Smirnov 2 sample
IWRC = International Wildlife Rehabilitation Council
Ma = Million years ago
MWWC= Mallydams Wood Wildlife Centre
NE = Natural England
NGO = Non-Governmental Organisation
NTGG = North Thames Gull Group
PTS = Put to sleep
PVCU = Polyvinyl Chloride Un-plasticised
RSPB = Royal Society for the Protection of Birds
RSPCA = Royal Society for the Prevention of Cruelty to Animals
SGWC= Stapeley Grange Wildlife Centre
SMP = Seabird monitoring programme
SNH = Scottish Natural Heritage
TSC =Taxonomic Sub-committee
U = Mann-Whitney U test
UKBAP = UK Biodiversity Action Plan
UOS = University of Sussex
WHWC = West Hatch Wildlife Centre
WCA = Wildlife & Countryside Act 1981

Websites

Animal Welfare Act 2006

http://www.legislation.gov.uk/ukpga/2006/45/contents

BTO homepage

http://www.bto.org/

BTO Euring Web Recoveries

http://blx1.bto.org/euring/lang/pages/rings.jsp?country=EN

BWRC

http://bwrc.org.uk/

European colour-ringing Birding

http://www.cr-birding.org/

European Exchange Code 2000 Plus

http://www.euring.org/data_and_codes/euring_code_list/index.html

IUCN

http://www.iucnredlist.org/

Metrological Office UK

http://www.metoffice.gov.uk/climate/uk/2005/june.html

RSPCA

http://www.rspca.org.uk/media/facts

Chapter 1

Introductory review of Herring Gull *Larus argentatus* in urban areas and wildlife rehabilitation

"Today more and more of us live in cities and lose any real connection with wild animals and plants."

Sir David Attenborough 2004

1.1 Aims, objectives and why this research is important

I have set out to examine the effectiveness of wildlife rehabilitation in a chosen species, the Herring Gull *Larus argentatus*. I applied analyses to the reasons for admission into a wildlife centre from urban nesting colonies in South East England and factors affecting their rehabilitation and release. Using ring recovery and re-sighting data, I examined the time elapsed and distance between ringing and finding. I compared data from wild nestling Herring Gulls from urban nest sites in the South West and South East with rehabilitated juvenile Herring Gulls. I also re-examined previous analysis which showed a low post-release survival of Herring Gulls and a difference in median distance travelled (Joys *et al.*, 2003). I also reviewed the financial costs, animal welfare issues and ethical questions of Herring Gull rehabilitation. Impartial information is presented for those who consider euthanasia the only option for rescued gulls, and I promote alternative solutions for individual gulls through rehabilitation.

1.2 Gull and Human conflicts

There are undeniably conflicting attitudes to gulls from people who live in cities and towns where urban nesting colonies exist. The increase of gulls in urban habitats over the last 60 years (Rock, 2005) has led gulls to be categorised by some members of the public as a nuisance or pest species on parity with Feral Pigeons *Columba livia.* You only need to read local papers from any coastal town to see the number of articles and letters asking "what is the council going to do about the noise and nuisance from gulls?" Conversely, gulls have numerous supporters expounding the belief that "if you live by the sea, expect "seagulls" to live there". Many people enjoy the interaction with urban gulls by offering food (Campbell, 2007), protecting of nest sites on private houses and promoting of anthropomorphic attributes on known individuals by giving them a name (Photograph 1); a similar relationship can be seen in Lithuania with White Storks *Ciconia ciconia* which return to traditional roof nest sites that have been used for decades (Morkanas pers. comm.). In August 2003, readers of the Rye and Battle Observer newspaper were informed that the local council in the town of Rye were "declaring war on gulls". Rother District Council announced they would like to perform a cull of gulls, highlighting the aggression to residents from dive-bombing birds and complaints from guest house owners that visitors were staying away as they were kept awake all night by the constant calling. During the following months, after researching humane control methods such as oiling the eggs in nests and use of narcotic control on adults, the cost of culling was considered beyond the allocated budget. In October of the same year, the council ruled out the cull. Complaints about urban gulls escalate from April when adults gather in "clubs" (del Hoyo *et al.*, 1996) and commence pre-breeding territorial establishment and courtship, which involves vocalisation, and aggression to conspecifics. When a colony of gulls are disturbed, it is estimated that the sound levels produced may reach 101.9 dB (Blokpoel and Neuman, 1997), with the "long call" of a Herring Gull reaching the higher thresholds. However, depending on the physical characteristic of the noise, such as temporal variation, sound pressure levels and frequency content, noise may produce annoyance and possible sleep deprivation (Environmental noise and health in the UK, 2010). In the context of guidelines outlined by the World Health Organisation Guidelines the sound levels recorded of calls from gulls exceed the acceptable daytime levels of below 55dB and night time levels between 5-10dB lower than during the day (World Health Organisation, 1999). It is not just the noise that the public find to be a cause of concern; gulls also implement inch perfect aerial attacks on people and animals or execute food snatches on the wing, swooping on unexpected alfresco diners. This behaviour has been perfected in Bristol (Rock, 2005), on the University of Sussex campus (Stenning pers comm. 2012) and on the Island of Helgoland off the coast of Germany (Photograph 2). The valuable "prey" may then trigger inter- or intra-species kleptoparasitism (Skorka and Wojcik, 2008; Oscar Garcia *et al.*, 2010), which is normal behaviour for gulls. All this is perceived by humans as antisocial behaviour, but it must be remembered that Herring Gulls have evolved in austere coastal habitats (Cramp and Simmons, 1983). The aggressive protection of chicks through dive-bombing predatory mammals or other gulls (Calladine, 1997) and loud raucous calls that would need to be audible above crashing waves and strong winds are all normal behaviours for this species.

Photograph 1. Adult Herring Gull (A1FV) breeding in Baldslow Road, Hastings, named "Fred"

Photograph 2. Food snatch on the island of Helgoland, Germany.

1.3 The cost of rehabilitation

Wildlife rehabilitation is a restoration process that has only been adequately tested in peer reviewed journals (Gidner-Worthington, 1997; Joys *et al.*, 2003; Molony *et al.*, 2007; Wimberger *et al.*, 2010). The practice of wildlife rescue, "the managed process whereby a displaced, sick, injured or orphaned wild animal regains the health and skills it requires to function normally and live self-sufficiently" (International Wildlife Rehabilitation Council 2005), has grown from public demand in some developed countries of the world and, more recently, developing countries (Karesh, 1995; Cheyne *et al.*, 2012). Globally, the manner with which wildlife rescue is funded varies from one country to another and can occur with or without state aid. In North America, the Oiled Wildlife Care Network (OWCN) receive a proportion of funding for on-going operations through the interest generated from California's Oil Spill Response Trust Fund (OSPTF);further costs are collected from the party responsible for an oil spill. In the State of Victoria, Australia, wildlife centres are currently, in 2012, applying for funding opportunities from the Wildlife Rehabilitation Grant Program worth, $200,000 (Aus.) but compliance to "The Code of Practice (Ministry of Agriculture, 2001)" set down by the government is mandatory. In a recent survey of South African rehabilitation centres, (Wimberger *et al.*, 2010) suggested that lack of direct funding, as well as subjective rehabilitation techniques, may be responsible for reduced animal welfare standards and low post-release survival. He recommends an implementation of minimum standards and a centralisation of control through national or provincial government. It is estimated in England and Wales, annual admissions of traumatised or orphaned wild animals into rescue centres are in the order of 270,000 and 300,000 individuals (Grogan pers. comm. 2012). All this comes with some considerable financial cost and in England and Wales there is no state aid for wildlife rehabilitation organisations. Within the guidelines of the Charity Commission for England and Wales, the majority of organisations, whether it's a small shed in a rescuer's garden or a large wildlife hospital, are providing expertise and facilities for wildlife care exclusively through direct donations, legacies, fundraising or sponsorship. Currently, a few commercial ventures such as the National Seal Centre, Gweek, Cornwall and Hawk Conservancy, Andover, Hampshire undertake limited rehabilitation on seals (Barnett and Westcott, 2001) and birds of prey (Murn and Hunt, 2008). The veterinary profession will also provide humane assistance in the form of first aid to a wild animal (Harris and Jefferies, 1991), free of charge, under their professional code of conduct, but further treatment may require a fee. This will include, where necessary, humane destruction to alleviate further suffering. The

Royal Society for the Prevention of Cruelty to Animals (RSPCA) rescue or collect an average of 170,000 wildlife casualties per year (RSPCA, 2011) tasked through a National Control Centre (NCC) in Doncaster, South Yorkshire by means of 418 field personnel operating in England & Wales which are either euthanased, released immediately or taken to an approved wildlife carer. This total includes 16,639 animals admitted and treated in the four individually built RSPCA wildlife centres in 2011 (RSPCA, 2011). The approximate amount spent annually on all four wildlife centres, including salaries and continuing operation for 2011 was £1.5 million (Kelly pers. comm. 2012). This equates to an average ($\frac{Annual\ budget}{Number\ of\ admissions}$) = £90.09 per wildlife admission to any one of the four RSPCA wildlife centres per annum.

1.4 Permanent captivity or euthanasia?

In wildlife rehabilitation centres all animals admitted are those derived from populations of species normally present within or a visitor to the British Isles. The ethics of many rehabilitation centres is to return animals back to the wild which fulfils the guidelines set down by the British Wildlife Rehabilitation Council (BWRC) and RSPCA, for those centres under such governance (RSPCA, Revised 2010). For those individuals which have injuries or conditions that will prevent a successful release back to the wild, there are two options for a wild animal; permanent captivity or euthanasia. A wildlife rescue centre does not, by its description; capture, purchase, trade or exchange wild animals with other animal collections and therefore does not wish to display animals for commercial gain. The RSPCA does not have the financial resources or accommodation to retain permanently disabled or imprinted animals indefinitely. Zoological gardens currently must justify their existence by informing, educating and providing a reason why an animal is confined for the rest of its life (Stevens and McAlister, 2003). These reasons may be scarcity, danger of imminent extinction or habitat destruction. However, there is a temptation to place into captivity those individuals of rarer species that are admitted into rehabilitation. The source of some reintroductions and captive breeding programmes for endangered native species has been injured or orphaned animals (Bright and Morris, 1994; Dennis and Dixon, 2001; Lima *et al.*, 2005; Mitchell-Jones and White, 2009). Nevertheless, the welfare requirements for these individuals must be met for the duration of their captivity. In long-lived species, such as Herring Gulls, this could be up to 25 years. On finding an injured or orphaned animal, the finder may retain the casualty for a few hours or possibly several days before the animal can be taken or delivered to a rescue centre. It is during this period that many rescuers nurture the casualty and the process of rehabilitation may take on a different perspective. The level of concern for the outcome has a different meaning and what was initially a chance encounter becomes a strong bond. This then raises the expectations of the finder and a solution other than humane destruction is requested from the rescue centre.

The action of euthanasia for those animals unfit for return to the wild is a prescribed method to reduce further suffering in the individual animal. All the decisions to perform euthanasia on a wildlife casualty are founded on operative experience, peer reviewed protocols and/or veterinary advice. In many instances animals are taken into centres and the member of the public will apologize saying "I know there may not be much that can be done for it, but I can't kill it myself" (pers. obs.). Admitting that you are unable to kill an animal humanely seems to be a failure for those kind people who have taken the time to rescue an injured animal, but recognizing they are part of a selective process indicates a desire to do what is right for the individual. There is strict guidance on acceptable methods to perform euthanasia on wildlife and employees within the RSPCA must adhere to those requirements (RSPCA, 2008). Euthanasia in the RSPCA Policy document states:

9.8.1" Where wild animals have to be euthanized; either because they are unable to survive in the wild or because their suffering is severe and not readily treatable, this should be done according to current RSPCA guidelines. Noise and human proximity usually cause fear in wild animals. As a general principle, therefore, the handling of wild animals should be kept to an absolute minimum."

The act of mercy killing a wild bird is not illegal if performed by lay persons providing you operate within the law, principally the Wildlife & Countryside Act 1981 (WCA) which states; "*Notwithstanding anything in the provisions of section 1 or any order made under section 3, a person shall not be guilty of an offence by reason of— (b)the killing of any wild bird if he shows that the bird had been so seriously disabled otherwise than by his unlawful act that there was no reasonable chance of its recovering;"*

1.5 Why bother to rehabilitate a Herring Gull?

The action of providing assistance to an injured bird's immediate needs is not illegal in the England & Wales, under the WCA 1981 which states; *"Notwithstanding anything in the provisions of section 1(Protection of wild birds, their nests and eggs) or any order made under section 3*

(Areas of special protection), a person shall not be guilty of an offence by reason of (a) the taking of any wild bird if he shows that the bird had been disabled otherwise than by his unlawful act and was taken solely for the purpose of tending it and releasing it when no longer disabled"

If it is therefore not an illegal act to deliver first aid, treatment and release a previously sick or injured Herring Gull. There cannot be many people that would ignore an injured or orphaned wild animal and seek to perform an act of kindness and a humane solution including gulls. All gull admissions are either reported to the RSPCA for rescue and collection, or members of the public bring a casualty gull directly to the centre. This requires certain amount of effort and time on behalf of the member of the public, as the wildlife centre involved in the current research is 5 km from the nearest town of Hastings, East Sussex and 9 km from Rye, East Sussex. However, it is plainly not as simple as just proving food and shelter. The fact that a bird can be easily caught will mean that the condition may require immediate expert attention, perhaps from a veterinary surgeon or veterinary nurse. Also, knowledge of the bird's natural history and behavioural requirements will necessitate that correct facilities and husbandry needs are provided. This all comes at a great financial cost if there are numerous admissions to process, so accountability becomes imperative. The survival of an individual within a population is dependent on factors operating from outside (food supply, disease, weather, shelter) or those intrinsically unique to the organism, such as genotype, phenotype or sex. However, the term "redressing the balance" (T.Forward, pers. comm.) has been used when the admission of an animal can be attributed to anthropogenic factors, such as oil spills, litter and shooting. These additional extrinsic factors, to which species may be unable to adapt, are serendipitous, but frequently encountered with the increase in human activity.

Wildlife rehabilitation has always played second fiddle to conservation practice which normally focuses on matters that provide protection to species and habitats rather than individuals within the population (Aitken, 1997), unless the species is of national or international rarity, for example the Great Bustard *Otis tarda* reintroductions on Salisbury Plain, Wiltshire (Osborne, 2005, Burnside *et al.*, 2012). Wildlife rescue and its value in relation to free living populations has been questioned (Sharp, 1996; Jessup, 1998), but where there is a demand from the public to protect the individual it has grown and the profile has increased through media exposure. There is a criticism from conservationists (Aitken, 2004) and farmers (pers. obs.) when species such as the Carrion Crow *Corvus corone* and Herring Gull, which are classified as pests in the UK through legislation or health protection, are taken into centres, rehabilitated and released.

One aim of this study was to determine whether, despite the cost and manpower required to rehabilitate Herring Gulls, the needs of the individual are satisfied and that significant numbers of rehabilitated Herring Gulls continue to thrive in a free living state after a period in captivity.

Chapter II

"It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change".

Charles Darwin

The taxonomy, distribution and ecology of Herring Gull (Pontopiddan, 1763) in the UK- a review

2.1 Introduction to Laridae family

The fossil record of the family Laridae, which includes 50 extant species of gull worldwide (del Hoyo *et al.*, 1996), is placed in the major clade Lari (gulls, auks and allies, including buttonquail) within the order of Charadriiformes (which also includes two other clades: plovers, oystercatchers and allies and sandpipers, jacanas and allies). Molecular dating suggests the origin of this order is in the Cretaceous period between 79 and 102 million years ago (Ma) with at least 14 lineages surviving the mass extinctions at the Cretaceous-Tertiary (K/T) boundary (Baker *et al.*, 2007). However, the first true gulls did not appear until the Lower Miocene, with fossil evidence of *Larus elegans* and *Larus totanides* being found in the Aquitanian Formation 23-20 Ma in France. In the Pleistocene epoch, less than 2 million years ago, fossil remains of modern species, the Mew or Common gull *Larus canis* and Herring Gull have been found in Europe (del Hoyo *et al.*, 1996).

The family Laridae is broadly divided into two species groups; the "hooded" and "white-headed" (Moynihan, 1959). Members of the white-headed group are uniform in appearance, heavy bodied, medium sized with a non-specialist beak, fully webbed feet and long narrow wings, this includes Herring Gulls. Sexes can be differentiated in adult birds from field observations as the male is larger with a bulbous gonys and heavy beak, with a flatter forehead forming a pronounced slope. The females have a more rounded head with a shorter bill (Olsen and Larsson, 2004). The plumage on the dorsal aspect is usually a grey through to near black, with black and white patterned wing tips and completely white below. Carotenoid colouration is present in non-feathered regions, such as the feet, legs and eye ring orbit. The larger gulls have uniformity in possessing a yellow bill with a distinctive red gonydeal spot (Photograph 3) White-headed gulls show variation in the time taken to attain adult plumage but generally they take up to four calendar years, between 28-40 months (Olsen and Larsson, 2004). Winter plumage in adults (Photograph 4) includes dark streaking on head and neck, with a duller beak and orbital ring (del Hoyo *et al.*, 1996). The transition between plumages through moult is a method used to age gulls, but true precision can only be achieved in categorising first year and adult birds (Olsen and Larsson, 2004). Juvenile birds retain grey-brown contour feathers with pale spots and black primary and tail feathers. Juvenile plumage is retained until the first summer, with only moulting of mantle/scapular and some head feathers in the first winter. Juvenile type plumage is retained during the first moult, but adult type feathers progressively replace these in the second and third calendar years, with adult plumage reached in the fourth or fifth year. There is much variability in moult timings and extent in large gulls with this difference seen within populations and regions (Olsen and Larsson, 2004).

Photograph 3, Adult summer plumage. Showing red gonydeal spot (July 2007)

Photograph 4. Adult winter plumage (December 2011)

Most gull species, including the Herring Gull, are typically found at sea level and are associated with marine environments, but more recently gulls are found inland and frequently seen on landfill sites over 85km from the coast (Rock, 2005). During the breeding season, habitat preference may vary from coastal dunes, islands and rocky shores to moorland (Cramp and Simmons, 1983). Currently there are five species of gull breeding on man-made structures in the UK (Calladine *et al.*, 2006), Herring Gull, Lesser Black-backed Gull *Larus fuscus*, Great Black-backed Gull *Larus marinus*, Common Gull, Kittiwake *Rissa tridactyla* and are frequently referred to as “urban-nesting gulls”. Non-breeding habitat choices are more maritime and coastal, with estuaries and harbours also being favoured (del Hoyo *et al.*, 1996), but large landfill sites further inland with adjacent roost sites and expanses of water will attract flocks of wintering gulls (Banks *et al.*, 2007).

Gulls are gregarious birds which breed, roost and often feed in groups, which may number several thousand during non-breeding period (Hickling, 1984; Mitchell *et al.*, 2004; Banks *et al.*, 2007). They are diurnal feeding birds exploiting a variety of food sources. Gulls are adaptable and opportunistic in diet preferences, taking carrion, invertebrates (marine and terrestrial), fish and young birds and also adult birds (Cramp and Simmons, 1983). Many species have adapted to feeding on anthropogenic waste at landfill sites, fishing fleet discard and unwanted foodstuffs in coastal towns (Garthe and Scherp, 2003; Rock, 2005).

2.2 Re-classification of Herring Gull.

The classification of species within the tribe Larini is complex and deserves explanation of the numerous theories and methods to differentiate the species and subspecies. Species within the taxa have previously been classified according to plumage (Dwight, 1925), behaviour (Moynihan, 1959; Tinbergen, 1953) osteological and integument characters (Chu, 1998) and recent DNA molecular markers (Crochet *et al.*, 2000; Pons *et al.*, 2004; Gay *et al.*, 2007; Sternkopf *et al.*, 2010). For 70 years the challenges of the Herring Gull and Lesser Black-backed gull (Linnaeus, 1758) complex led to these closely related, but morphologically and behaviourally distinct species' being referred to as a ring species (Mayr, 1942; Mayr, 1965). The ring species theory is that a stem population- in this case study- a *Larus sp.*, splits into two, where both populations undergo changes in range or isolation through geographical barriers. Other species identified as a ring species include Greenish Warbler *Phylloscopus trochiloides* and Song Sparrow *Melospiza melodia*. Reproductive isolation and speciation occurs and the consequential distribution area is ring-shaped, in the Herring/ Lesser Black-backed gull complex it is circumpolar. Through intergrading speciation the terminal populations become sympatric but are unable to hybridize with each other (Skelton, 1993). The ring theory has now been questioned due to the presence of outlying parapatric and allopatric populations in the Mediterranean Basin, Siberia, Mongolia and the highlands of Anatolia (Martens and Packert, 2007). Recent development in techniques to identify relatedness through mitochondrial DNA and nuclear DNA has altered the grouping of many species of gull (Crochet *et al.*; 2000, Liebers *et al.*; 2004, Martens and Packert, 2007; Sternkopf *et al.*, 2010).

The species, *L. argentatus* has been classified until recently by the British Ornithological Union (BOU) as a polytypic species with up to 12 subspecies: *argentatus, argenteus, heuglini,* *taimyrensis, vegae, smithsonianus, atlantis, michahellis, armenicus, cachinnans, barabensis* and *mongolicus.* Similarly, the Lesser Black-backed Gull was also classified as a polytypic species with three subspecies, *fuscus, graellsii and intermedius.* Great Black-backed Gulls are monotypic.

The issuing of guidelines from the British Ornithological Union Records Committee (BOURC) (Helbig *et al.*, 2002) has assisted in the assessment of species rank to accommodate developments in the field of taxonomy which includes bio-acoustics and DNA analysis. Subsequently, some species within the Larid family underwent re-classification by the British Ornithological Union (BOU), Taxonomic sub-committee (TSC) fourth report (Sangster *et al.*, 2007; Collinson *et al.*, 2008). The following recommendations have been suggested to better reflect the advances in knowledge in systematics and diagnostic techniques:

- Herring Gull *Larus argentatus* (polytypic) subspecies to include *argentatus* and *argenteus.*
- Lesser Black-backed Gull *Larus fuscus* (polytypic) subspecies to include *fuscus, intermedius, graellsii, heuglini, taimyrensis* and *barabensis.*
- Yellow-legged Gull *Larus michahellis* Naumann, 1840 (polytypic) subspecies to include *michahellis* and *atlantis.*
- Caspian Gull *Larus cachinnans* Pallas, 1811 (monotypic).

2.3 Distribution and habitat of *Larus argentatus* and subspecies

The world distribution of *L. argentatus* and subspecies is circumpolar within the northern hemisphere (Figure 2.1). However, with the recent reclassification of this species, it has been necessary to revise the distribution of *L.argentatus* sp. to exclude the *cachinnans* and *michahellis* groups. In the Western Palaearctic, *L. argentatus argentatus* and *L. argentatus argenteus* breed in two separate zones (Figure 2.2), but there is an intergradation of the races in Western Europe at the English Channel and lower North Sea, Northern Britain and South West Denmark (Olsen and Larsson, 2004) (Figure 2.2). The sub-species *Larus argentatus argenteus* Brehm, 1822 breeds from Iceland along the Atlantic coast and Western Europe including the British Isles (del Hoyo *et al.*, 1996). During the winter, UK populations are supplemented by the dominant species *L. argentatus.* In 1993 the number of wintering Herring Gulls was estimated at 696-763,000 individuals (Banks, *et al*. 2007), although this figure includes a high proportion of wintering Scandinavian birds.

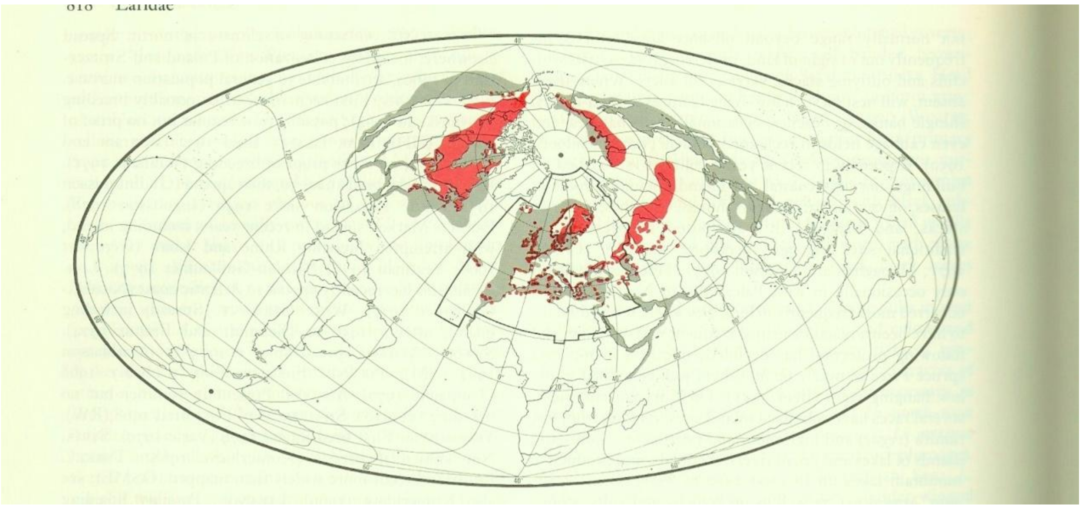


Figure 2.1 World distribution of *Larus argentatus* sp. (Cramp and Simmons, 1983). Please note that this is prior to recent reclassification (see text).

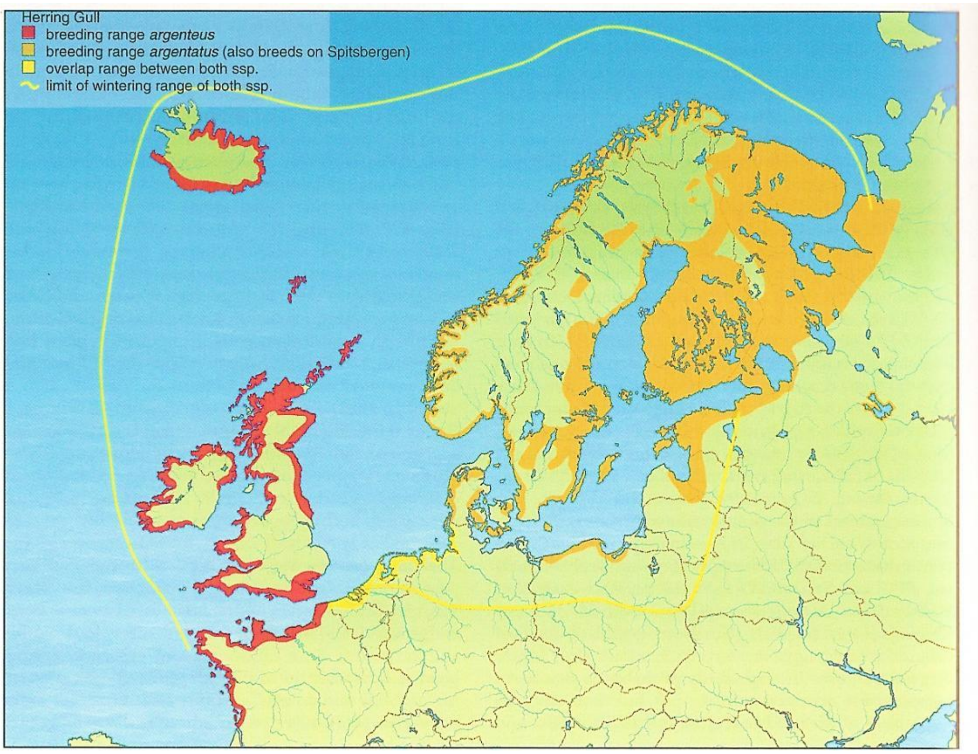


Figure 2.2 Distribution of *Larus argentatus* in the Western Palaearctic showing breeding range of *Larus argentatus/argenteus* and the overlap of both species (Olsen and Larsson, 2004).

The preferred breeding habitats are varied; coastal cliffs and stacks, rocky and grassy islands, sandy beaches, gravel bars, salt-marshes and limestone outcrops (del Hoyo *et al.*, 1996). They are also found breeding in the high Arctic, but not in areas where water is subject to freezing (Cramp and Simmons, 1983). However, there has been an increase in the number of pairs using man-made structures and buildings in Britain and Ireland (Cramp and Simmons, 1983). Between 1998-2002, the Seabird 2000 census estimated the number of breeding pairs for coastal and inland sites in the UK to be between 139,309 – 143,656 pairs (Mitchell *et al.*, 2004).

2.4. Urban nesting population

Before the 1940s there are few, if any; records of roof nesting gulls (Rock, 2005). During the 1960s and 1970s the colonization of coastal towns commenced in the South West and South East (Cramp, 1971). In 1976 it was estimated that the number of Herring Gulls using man-made structures and roof-top nesting was only 2,968 pairs, equivalent to 0.6% of the UK population (Monaghan and Coulson, 1977). In 1994 a survey of roof nesting gulls was conducted during the breeding season revealing the number of pairs had increased to 11,047, (8.2% of the estimated population of 205,700 pairs: (Raven and Coulson, 1997).

The history of roof nesting in Sussex is not well documented, but in 1965, 23 pairs were reported using urban roof-tops (2.8% of the recorded totals for all habitat choices: (Prater, 1985). By 2000, as a result of Seabird 2000 findings, the number using urban sites had increased to 1872 pairs, 97.6% (Newnham *et al.*, 2001). In 2011, breeding was confirmed in 59 tetrads; (a collection of four 1km squares arranged in 2km by 2km square) in East and West Sussex, although there was probable breeding in a further 27 tetrads (Sussex Ornithological Society, 2011). The ecological niche occupied by gulls in the towns and cities does make it difficult to accurately count the number of nesting pairs in urban environments unless nests can be counted from high vantage points on buildings (Rock pers. comm.). Rock (2004) estimated the number of pairs in the Severn Estuary Region to be 23,930 pairs, from a multiplier of 1.48 from previous annual counts undertaken and this assumes a growth rate of 24.7% (Raven and Coulson, 1997). He also predicts that nationally, this figure could exceed one million pairs by 2014, if the current rate is to be believed. However, this figure also includes three other species Lesser Black-backed Gull, Great Black-backed Gull and Kittiwake *Rissa tridactyla (*Raven and Coulson, 2001*)* as well as Herring Gull. Conversely, Coulson (2009) found that the density of breeding gulls in Dumfries, SW Scotland had declined in the same period, but this could have been attributed to the removal of eggs and nests between 2000 and 2007.

2.5 Current conservation status

Despite differing predictions (Rock, 2005; Coulson and Coulson, 2009), the sub-species *L. argentatus argenteus* has seen a decline in breeding (1969-2007) and non-breeding populations (1981-2007) in the past 40 years (Mitchell *et al.*, 2004). The conservation status of birds in Britain is frequently evaluated by the British Ornithological Union. Using the "traffic light" scheme; red, amber and green categories, a list of conditions provide a guide for conservation action for bird species in the UK. Red, being of most concern: globally threatened, historical population decline in UK, or a severe decline (50%)of the breeding population in 25 years, amber: moderate decline (25-49%) in breeding and non-breeding populations and green: species that regularly occur in the UK, but do not qualify under the previous criteria (Eaton *et al.*, 2009). During the most recent species assessments (Birds of Conservation Concern three 2009), the sub-species *argenteus* is one of forty-eight races of polytypic species to be "Red-listed". Although not globally threatened, Figure 2.3 illustrates a rapid population decrease of 40% (1986-2011) as identified under the Seabird Monitoring Programme (SMP).

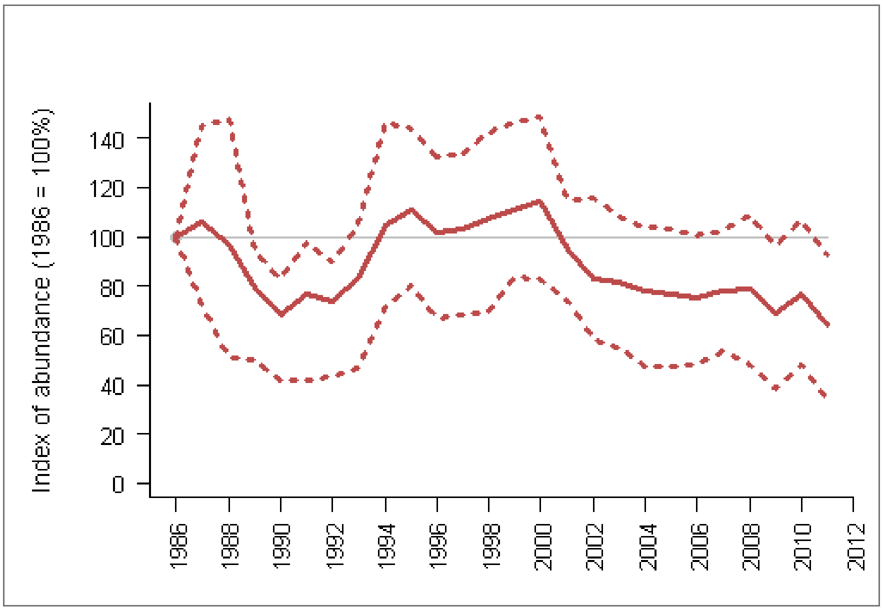


Figure 2.3 Trend abundance index (solid line) of UK Herring Gull 1986-2011 showing a decline in population from 2000 (95% confidence levels dotted line). Reproduced from SMP data (JNCC., 2012).

Under the UK Biodiversity Action Plan (UKBAP) the criteria for selection of the sub-species *L.a.argenteus* and inclusion as a UK priority species was prompted by the international responsibility by UK conservation bodies to recognise a moderate decline in recent times. As a consequence the recommendations of the Biodiversity Reporting and Information Group (BRIG, 2007) highlighted action categories include:

- Fisheries control measures/policy and legislation
- Measures to address impacts of climate change
- Research into other impacts
- Legal protection for species

The sub-species *L.a.argenteu*s also has conservation priority status as a migratory species under a European bird directive 2009/147/EC and is red listed in Birds of Conservation Concern in Ireland.

Chapter III

Description of site, admission categories, rehabilitation methods and bird ringing

"Wrong, we're saved! Seagulls always stay near land! They only go out to sea to die!"
Ned Flanders; The Simpsons, Season 5, Episode 8: "Boy-scoutz N the Hood"

3.1 History of Mallydams wood wildlife centre

In 1961 the RSPCA (Royal Society for the Prevention of Cruelty to Animals) was offered the 26 hectares of woodland situated in Fairlight, East Sussex (TQ9248) known as Mallydams Wood (Figure 3.1). The site was bequeathed to the RSPCA from a generous legacy of the late Horace Quick. The site is north facing, mainly mixed woodland with extensive swathes of rhododendron (*Rhododendron ponticum)*. A small residential property was placed adjacent to the Peter James Lane entrance in 1962. The site was subsequently developed as a field study centre in 1974 with the building of a large classroom with residential facilities for school children to visit the woodland and learn about animal welfare issues and natural science.

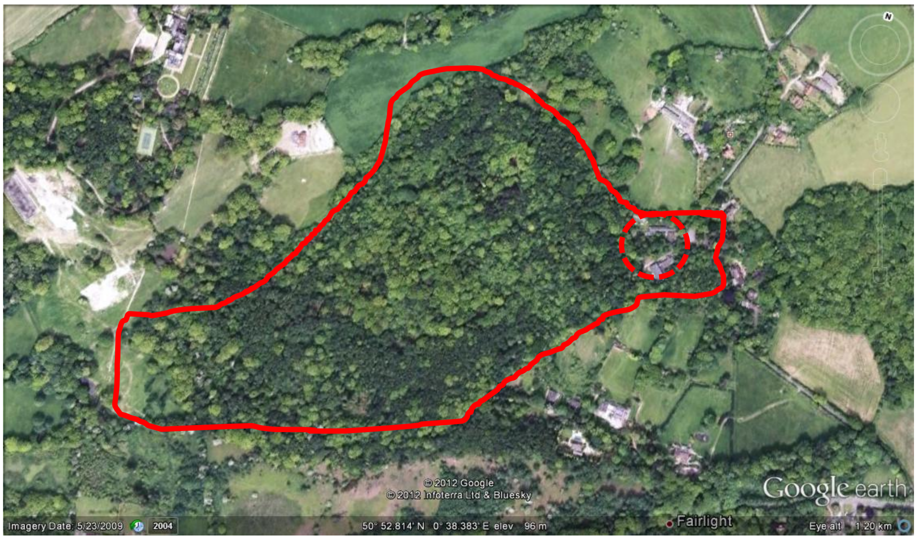


Figure 3.1 Aerial view of Mallydams Wood with the red solid line showing the boundary of the 26 hectares, red dashed circle shows the location of the wildlife & education centre (© 2010 Infoterra Ltd & Bluesky) accessed 2011.

During the first 12 years of the sites history, a small wildlife unit was constructed by the first warden John Goodman. With little or no direct funding the wildlife unit was gaining importance locally as a resource for the treatment of injured animals. The resident warden developed methods of rearing and returning wildlife casualties to their natural environment from 1962 to 1990. From 1990-1996 the number of wildlife casualties admitted to the centre increased (Figure 3.2), necessitating a major redevelopment to improve the facility and compliance with health & safety regulations.

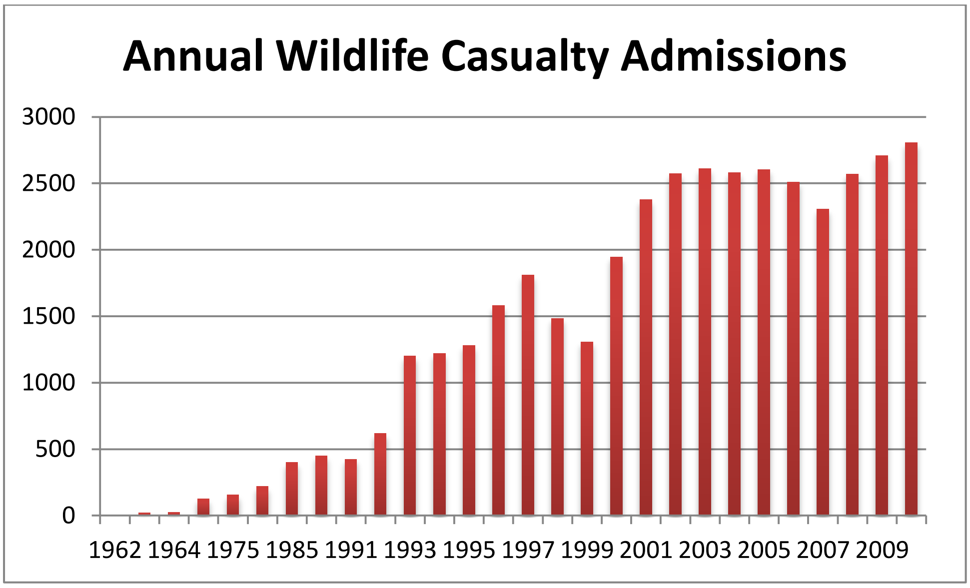


Figure 3.2 Annual totals of wildlife admissions to Mallydams Wood wildlife showing an increase in casualty numbers from the year of opening.

In 1998, the existing wildlife unit was demolished and a new functional centre was re-built opening in July 1999. The custom-made building included three pools which were designed to accommodate oiled Guillemots *Uria aalge* and other key species that had been admitted to the centre; included Herring Gulls. In July 2000, the new wildlife centre was completed with the construction of six aviaries, two with pools, and a facility to hold mammals such as Red Fox *Vulpes vulpes* and Eurasian Badger *Meles meles*. Within the first year the number of admissions increased from 1,307 to 1,946 (49%). Local RSPCA inspectors and animal collection officers brought more sick, injured and orphan birds in for treatment and increased media profile ensured that members of the public identified where to bring wildlife casualties in the Hastings and Rye area. In 2010, the annual total for admissions reached 2,806.

3.2 RSPCA & Mallydams gull rehabilitation protocols

The national protocol for the rehabilitation of all members of the family Laridae was written by experienced personnel from all four RSPCA wildlife centres in 2012 (Appendix A). All those involved in the creation of this document agreed on aspects of the triage, care and release of gull species. Included in the document is information about housing, diets and environmental enrichment. An emphasis was placed on delivering best-practice and a reference manuscript that may be used by field operators or other animal centres when presented sick or injured gulls. The definitive RSPCA protocol focused on the minimum requirements for rehabilitating gull species. Mallydams Wood's gull protocol is an adaptation of the national protocol, taking into account the differences in individual animal housing facilities and staffing levels.

3.3 Admission process and description of categories

All wildlife casualties are accepted through the reception area. The recipient of the wildlife casualty will record specific details from the member of public, RSPCA Inspectors, animal home or other wildlife rescue organisation. The details are recorded onto a Microsoft® Access database before the animal progresses through the rehabilitation centre. Where the animal has been transferred from an outside organisation, information of previous case history is extracted from the veterinary surgery or other welfare centre. Mandatory fields on the database are species, date, age, location found, county, reason for admission and finder's name and address. Each animal on admission is allocated a double sided A5 size treatment card (Appendix B) with a unique case number generated from the admission database. The primary function of the treatment card is to record any observations and veterinary treatment given to the casualty. The card also includes a section to record the final outcome. In due course, details from the card are transferred onto the admissions database. Each bird is examined and assessed by staff or the visiting veterinary surgeon. It is then assigned a temporary aluminium ring with a unique number engraved on the surface.

Those birds with obvious severe injuries, for example compound leg or wing fractures, are euthanized upon admission to alleviate further suffering. All gulls are euthanized using pento-barbitone sodium Ph.Eur 200mg/ml Euthatal® (Manufacturer Meriel). The lethal dosage of 0.4ml to 0.8ml is delivered by intravenous (I/v) or intraperitoneal (I/p) injection. Depending on condition or age, all birds that are not euthanized on admission will be administered immediate first aid and taken through to housing within the centre. Subsequently, all birds which are not orphans or inexperienced juveniles; juvenile birds found fully fledged but unable to sustain continuous flight or in a hazardous environment, are re-examined by the Veterinary Surgeon to diagnose any trauma or disease through radiography, blood tests and anaesthesia. The reasons for admission are immediately recorded on the treatment card and in appropriate fields of the database.

3.3.1 Birds affected by natural causes

There are five admission fields that fall into the broad category heading of "affected by natural causes".

- Attacked by gull
- Attacked by other animal
- Inexperienced juvenile
- Orphan
- Disease/weakness

3.3.1.1 Attacked by gull

Birds admitted under this category have been identified as individuals that have been observed to be injured by conspecifics. Adult admissions from territorial disputes occur from April to June. These admissions show extensive wounds from the base of the maxilla across the forehead to the eye-ring and the base of the mandible around the chin, malar region and the throat. In chicks and juvenile birds intraspecific aggression is seen with wounds on the top of the skull and injuries to the carpal joints in the wing. The wounds occur when the chicks stray from their natal site into neighbouring, occupied nest sites. The wounds can be extensive and expose the underlying skull. Carpal injuries also occur under the same circumstances but normally happen when the chicks have developed functioning wings and aggressor birds will seize the budding wings in an attempt to prevent escape. This damage may be permanent and require euthanasia.

3.3.1.2 Attacked by other species

Birds which have been attacked by species other than conspecifics are placed in this category. A variety of species have been included within the database eg, Domestic Dog *Canus lupus* *familiaris,* Domestic Cat *Felis silvestris domesticus* or Brown Rat *Rattus norvegicus*. Most of the birds attacked by other species are small nestlings which have fallen from roofs or inexperienced juvenile birds on maiden flights. The majority of the injuries will be to the back of the neck of nestlings and the wings of juveniles.

3.3.1.3 Inexperienced juvenile

Admissions of fully fledged chicks that are found away from the nest sites are admitted as "inexperienced juveniles" or "maiden flight" birds. Birds admitted under this category are generally in the centre for less than 12 days. Maiden flights are larger chicks which are close to fledging, but due the nest site choice cannot perform training flights, stretch wings or explore the immediate environment. This puts them into situations where they may fall from the roof tops. These are eloquently called "jumpers" (Rock pers. comm.) due to their inability to fly adequately. Many have flown from roof nest sites and landed in gardens or in the road placing them in peril. Birds admitted under this category are generally healthy and once assessed are placed onto shallow pools to monitor prior to a quick release. A specific hazard for this age group in Hastings, relates to a freshwater concrete boating lake on the seafront promenade. Newly fledged juveniles use the boating lake to congregate and bathe. Many of these birds will not have had access to bathing water on the roof nest sites and if there has not been rain for some time the birds' plumage will be dry and possibly contaminated from food or nest site debris. Young birds which bathe in the boating lake under these circumstances will very quickly become waterlogged and drown due to the sheer sides. A number of wildlife rescuers and members of the public know that these birds can be found under these circumstances and patrol the boating lake on Hastings seafront in July and August with a view to rescue these young birds. Most of these birds are quickly released within 10 days.

3.3.1.4 Orphan

Admissions of nestling and fledgling birds to the centre as orphans are generally between the dates of 25th May to 30th July. The chicks are semi-precocial and generally leave the nest site at 2-3 days (Tinbergen, 1953; Cramp and Simmons, 1983). In urban nesting birds this is when the chicks are most vulnerable. The choice of nest site by parents may have an influence on chick survival in those early hatching days. It is noticeable that during inclement weather, such as high winds and driving rain many chicks fall from nest sites and admission numbers increase.

Where weights of nestlings or fledgling birds are recorded the wide range of weights are 21g-995g (n=390). Chicks are admitted with age ranges between one to two days old, some with egg tooth present, and approximately 20 days where birds are showing juvenile type contour and primary feathers. All small chicks were admitted onto the database as a nestling, fledgling and juvenile. The criteria for admission category of orphan are chicks which are still in down feathers or have primary feathers that do not extend past the tail feathers. Orphans are also chicks which are not showing any other symptoms or problems. Very small orphan chicks that are still showing down feathers are put into crèches of 2-3 chicks. This constitutes a normal clutch for large white headed gulls (Cramp and Simmons, 1983).

3.3.1.5 Disease/weakness

Birds that were admitted with no previous history or less obvious symptoms are classified under the category “disease/weakness”. Weakness in a bird may be due to lack of food, adverse weather conditions, senescence or undiagnosed health issues. Many urban birds from the South Coast are frequently feeding on landfill sites which expose them to numerous forms of bacterial (Nelson *et al.*, 2008) toxins. In many cases, the symptoms are similar: loss of appetite, discoloured faeces and general malaise. Disease is normally diagnosed by the attending veterinary surgeon from clinical signs rather than confirmation from pathology and laboratory findings.

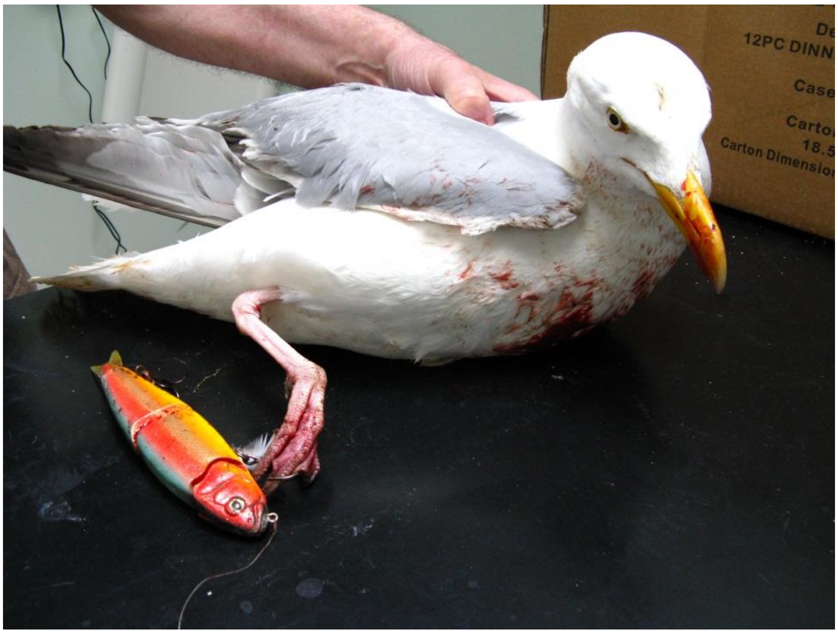
3.3.2 Birds affected by anthropogenic causes

There are eight admission categories which could be attributed to unnatural or human related causes.

- Fishing litter
- Caught/entangled
- Shot
- Poison/botulism
- Poison/neurological
- Oiling/other contaminant
- Injury/collision
- Legal case animal

3.3.2.1 Fishing litter

Throughout the year gulls can be seen foraging along the littoral zone of many beaches. This makes them vulnerable to entanglement or entrapment from fishing litter (Cryer *et al.*, 1987). Admissions associated with this category carry injuries ranging from nylon line that may ligate limbs, to barbed hooks which deeply embed into tissues. Much of the fishing litter is discarded line from sea anglers which has become accessible at low tide to the birds after line has snagged on rocks and snapped with the weights and lures attached. Birds are also attracted to cleverly designed lures which resemble a fish and attempt to eat them. The lures, which are designed for sea fishing, have three hooks and possess a barb at the end. The birds will attempt to eat the lure and the hooks will pierce the flesh around the bill and become embedded. Discarded lures and hooks may also pierce the flesh of the wings, legs and feet (Photograph. 5) rendering the bird immobile and easier to catch.



Photograph 5 Shows an adult gull with the barbed hook from a fishing lure attached to the web of the foot

3.3.2.2 Caught/entangled

Netting is used as a physical deterrent to prevent birds roosting or nesting on chimney stacks, dormera, flat or pitched roofs. Much of the netting used is a knotted polyethylene twine made to a variety of mesh sizes from 19mm to 75mm to deter a variety of species. A high proportion of the netting used to deter gulls is the 75mm size. This enables those who wish to prevent gulls using the roof of a large building reduce the overall weight and cost of the installation. This larger size mesh does however cause problems to large gulls. Many birds that have traditionally bred on the roof site will land on the mesh or in the case of the translucent twine will quickly become entangled by the wings which will generally capture them around the joint of the Humerus or Radius/Ulna. If the bird is trapped for a long period, this can lead to wounds at the Patagium and, if restrained for days, the bird will consequently die from starvation and dehydration if not rescued. This category almost exclusively involves adults caught in netting on roof sites, but juvenile birds are caught when they fledge and alight on adjacent roofs with netting attached (Photograph. 6)

Photograph 6 Nylon netting caught around both tarsus of a juvenile gull causing restriction of blood flow and tissue death.

3.3.2.3 Shot

Birds which are admitted with a history of being flightless or presented with small wounds are initially placed under the category “injured”, but when confirmed through x-ray are re-defined as “shot” if that is the case. Full radiography of the birds can reveal opaque images of .22 or .177 calibre air gun or shotgun pellets located in various areas of the body (Photographs 7 & 8). The majority of shot birds are not released due to the nature of the injury. The number of gulls positively identified that have been shot before 2007 were few and far between. With the installation of an x-ray facility in 2006 all adult birds which were unable to fly or recumbent underwent routine radiography. Birds that are known to be shot in the head are always X-rayed. Photograph. 8 shows a bird which was brought in alive, the pellet surgically removed and released.

Photograph 7 Photograph 8

Photograph 7 The radiograph of an adult gull showing one air gun pellet in the thorax and two in the upper leg muscle.

Photograph 8 Radiograph shows an air gun pellet lodged between the dermal and epidermal layers of tissue in the skull.

3.3.2.4 Botulism

Birds affected by botulism are suffering from a debilitating infection that initiates paralysis through neurotoxins and leads to death in severe untreated cases. The aetiology of the bacterial infection is a *Clostridium botulinum* which is generally associated with rotting organic material which proliferates in anoxic and anaerobic environments (Neimanis *et al.*, 2007). Birds are admitted with symptoms of generalised weakness, paralysis of legs and wings, head tipped up slightly, eyes half closed and viridian green coloured faeces. Birds still show aggression but are unable to put up any defence against predators. Commonly birds admitted with symptoms of paralysis are severely dehydrated due to the bird's inability to access fresh drinking water. The toxic effects of the bacteria act swiftly on the victims by interference of acetylcholine receptors in the synaptic junctions of neurons (*Infectious Diseases of Wild Birds*, 2007). Most admissions with this condition are adult birds. It is not fully understood which environmental factor is the main contributer to botulism outbreaks in birds, but there is a suggestion that low water levels and increase water temperature may create ideal conditions

(Piazza *et al.*, 2011). However, environmental conditions of rotting organic material and heat generated on landfill sites promotes bacterial proliferation and toxigenesis (Ortiz and Smith, 1994). It is assumed that almost all admissions from the Hastings, Bexhill and Rye area are birds that have been feeding on organic material at the Pebsham landfill site in Bulverhythe Road, St Leonards-on-Sea, East Sussex (TQ7709). It is also assumed that the number of adult admissions is due to the birds feeding on easily available organic material at the landfill site to provision chicks during these peak months (Pons and Migot, 1995; Duhem *et al.*, 2003). Generally the birds are in good body condition upon admission due to the swiftness with which the toxins take effect: other complications are limited if they are rescued immediately. Stricken birds will attempt to rehydrate themselves and are therefore often found by water bodies. Locations along the foreshore or other public spaces such as boating or park lakes increase the chances of a prompt rescue. There are seven strains of *C. botulinum* each type designated a letter prefix; A, B, C, D, E, F and G. It is assumed that the majority of birds are suffering from group C botulism, as this is the most frequently encountered (Neimanis *et al.*, 2007). Groups A & E have been recorded in birds sampled from landfill sites (Ortiz and Smith, 1994).

3.3.2.5 Poison/neurological and oiling/other contaminant,

An additional category used between 1999 and -2005 was”poison/neurological”. This type of admission covers those birds which are showing severe ataxia or appear to be in a state of “drunkenness” with head drooping and eyes closed. Generally treatment is ineffective and death occurs within days. It is believed that some of these birds have been exposed to Alpha-Chloralose poison or a similar compound (Seamans and Belant, 1999). Although prohibited for use in free-living birds it is still used in control of the house mouse *Mus domesticus*.

Admissions from the category “oiling/other contaminant” will be those identified as being exposed to oil pollution or other forms of contaminant. Gulls are exposed to contamination from marine environments and industrial waste. Those birds which feed on landfill sites are particularly vulnerable from household waste despite regulations on responsible disposal of hazardous liquids. Both inorganic and organic contamination has been encountered, from fish oil to diesel fuel. An evaluation is made of the contaminant and a risk assessment is conducted to reduce adverse effects to human health. Birds are stabilised before being washed using

Fairy Liquid® (Manufacturer Proctor & Gamble). Birds are retained on pools until full waterproofing of plumage has returned.

3.3.2.6 Injury (cause uncertain), Legal case and other (please note in comments)

Urban gulls are opportunistic feeders and will frequently forage on main thoroughfares. This behaviour shows the high risk but high reward nature of birds in this taxonomic group. As a consequence many birds are victims of road traffic accidents. On examination many traumatic injuries are apparent, which include head trauma and fractured limbs.

Gulls admitted under the category “injury (cause uncertain)” are generally showing obvious fractures of the wings, legs or open wounds. Although this category is a description of the resulting trauma, it may also overlap with other categories such as shot, collision or caught and entangled as most cannot be defined due to lack of knowledge by the finder. The major age groups that fall into this category are adult birds. These birds are mostly found unable to fly enabling them to be easily captured.

The RSPCA is a non-governmental organisation (NGO) with established animal welfare inspectors to investigate animal cruelty and neglect. Birds admitted under the problem category “legal case animal” may form part of a prosecution case and subject to all other causes such as shooting, trapping, poisoning or failing to provide appropriate care or treatment. Birds may be held at the centre and examined by an expert witness or Veterinary surgeon. A category “other (please note in comments)” is normally a default for any admissions where the cause or reason for admission cannot be assigned to any other category. The number of individuals included may be limited as the reason for admission may change as a result of further intelligence or examination. This will be corrected when the outcome is entered onto the database. The final category of “dead on arrival” is assigned to those victims where the bird has expired prior to arrival and has generally not received any first aid or treatment. The nature of the injury or reason for admission is not always recorded.

3.4 Ringing gulls

The British Trust for Ornithology (BTO) is an independent charitable research body combining professional and civilian volunteers who contribute to long term data on bird populations. It is also the organising body for bird-ringing in the United Kingdom and the Republic of Ireland.

The BTO issues the permits to ring birds under general licences from the Country Agencies namely Natural England (NE), Scottish Natural Heritage (SNH) and Countryside Council for Wales (CCW). Since its foundation in 1909 and the formation of current ringing schemes inception in 1937, BTO volunteers and researchers have ringed over 35 million birds with over ½ million individual birds recovered (Wernham *et al.*, 2002). Birds are fitted with a metal ring around the tarsus using a split ring design which is applied using custom-made pliers. The tarsus in each species of bird has been measured and an appropriate ring size assigned. Each ring size is allocated an alphabetic code which may be accessed in the BTO Ringers Manual (Redfern and Clark, 2001). Each ring will be marked with a machine stamped unique alpha-numeric code and the address of the British Museum of Natural History SW7 or the BTO, Thetford, Norfolk. Recently the BTO web address (bto.org.uk) has been embossed on the larger sized rings to make it easier for those reading ring details to obtain a life history for the bird. The retrieval of information from ringed birds can be from a variety of sources. In order to retrieve the correct information it is normally necessary to handle the bird, especially the smaller sizes. Birds may be found dead, re-trapped by qualified ringers or found alive through misadventure or injury. Some of the larger rings can be read in the field using optical equipment.

3.4.1 Use of both conventional and unconventional rings on gulls

All rehabilitated gulls released were fitted with a metal Incoloy ring size "G" with an internal diameter of 11 mm. Incoloy rings are a nickel-chromium alloy which is resistant to surface discolouration and electrolyte corrosion (Redfern and Clark, 2001).

The fitting of an additional colour ring to large bird species has enabled field researchers to identify cohorts or individual birds of a variety of taxa without the need to recapture (Coulson, 1963; Rock, 1999). Since the early 1960s the use of the plastic rings made from the material Darvic®; made from pressed PCVU (Polyvinyl Chloride Un-plasticised) sheets, has many advantages over other composites such as celluloid, as it has increased colour retention, durability and be moulded into shape by immersion in boiling water at 80°C (Coulson, 1963). The original manufacturers were Imperial Chemical Industries® (ICI), but the rights of production were transferred to Weston Vinyl's and then finally to Wardle Storey based in the UK. In 1999 the RSPCA scheme to Darvic ring rehabilitated gulls was authorised through Peter Rock, the large gull colour ring coordinator for the BTO and the European Colour-Ring Birding.

The coding and colour choice was selected by Peter Rock, who recommended his local supplier, Paul Sebastian, Trinity Trophy & Signs, Bristol. The colour ringing scheme commenced in July 2000. The rings are provided individually cut into flat rectangular strips from a 0.75mm thick sheet. The initial scheme was limited to an annual code specifically for Mallydams Wood Wildlife Centre. In 2000, the code was yellow background with three uppercase “A” in black, with dimensions, 55mm x 15mm x 0.75mm. This was fitted to all birds on the right tarsus (Photograph. 9). In 2001 the annual site code and colour altered to Royal blue, with three uppercase “A” in white with dimensions, 55mm x 15mm x 0.65mm. This material was lighter and not a true PCVU. This material was all that was available from the supplier for that year. In 2002, the coding changed again to permit the identification of individuals rather than cohorts in order to improve data collection of individual birds. This defined the codes for the next eight years of the study. The material returned to Darvic, but the dimensions altered to 60mm x 30mm x 0.75mm. This was to accommodate the increase in alpha-numeric codes. The individual codes used were “alpha-numeric-alpha-alpha” all in uppercase commencing with A1AA. Due to issues of confusion between letters when observing rings in the field, some letters are omitted from the sequences. These letters are E, I, O, and Q. The limitations of the coding and the number of admissions each year, dictated the frequencies of change in the numeric coding. The implementation of a four character code (A1AA to A7ZZ), using the “A” as a constant and the numeric as an additional variable generated 3,388 (484 x 7) individual ring codes.

Photograph 9 Darvic rings were placed on the right leg of each bird, with the letter “A” uppermost.

3.4.2 Ringing wild chicks in South East

Three sites were selected to ring wild Herring Gull chicks during the breeding seasons of 2007–2010. Herring Gull chicks as previously mentioned are semi-precocial when hatched and therefore challenging when attempting capture and ringing. The ringing of urban nesting gulls can only be accomplished on specific roof tops and extreme care must be taken on being able to positively identify chicks of the two similar nesting gull species; Herring Gull and Lesser Black-backed Gull (Redfern and Clark, 2001). The majority of chicks were ringed at the University of Sussex (UOS), Falmer, East Sussex (Figure 3.3) as a small number of adults and chicks had been previously ringed in 2007/2008 as part of a study undertaken by Dr Loic Hardouin (Hardoiun *et al*. in prep). Several buildings within the campus were selected due to ease of accessibility and the possession of a parapet to avoid the chicks from prematurely fledging or falling, possibly causing injury or death. The procedure always required two people wearing high visibility jackets and hard hats The second main site selected was the Astor College in Dover, Kent (51°07'37.44"N, 1°17'21.65"E) 2009/2010 due to the size of colony and similar attributes as UOS. The main colony at UOS was visited several times during the months of June & July due to the asynchrony of nesting, thereby increasing the number of chicks that could be ringed. All Herring Gull chicks were fitted with a BTO Incoloy ring (size G) on the left tarsus. The Darvic ringing of the chicks was a little problematic as the height of the ring is 30mm; if this applied too early, and the tarsus has not grown adequately, the bird will be unable to stand or walk. If the chicks were too small to fit the Darvic ring, a metal ring only was applied, but on subsequent visits these birds were recaptured and the Darvic ring fitted. Chicks ringed from a breeding pair on Mallydams Wood Wildlife Centre, Fairlight, East Sussex 2009/2010 Figure 3.1 were also included in the analysis.

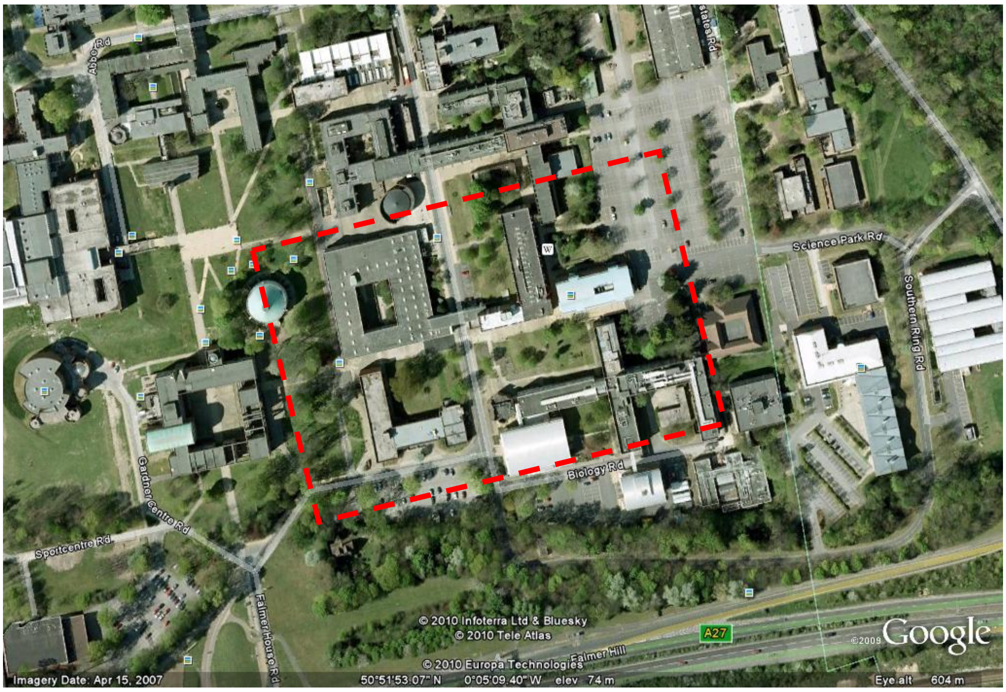


Figure 3.3 Aerial view of University of Sussex campus, red dashed line showing the four main buildings for ringing wild gull chicks (© 2010 Infoterra Ltd & Bluesky) accessed 2011.

3.4.3 Ringing & recovery data from wild chicks in South West

Ringing and recovery data of wild Herring Gull chicks were obtained from Peter Rock, the coordinator and founder of the Severn Estuary Ringing group, who have been ringing urban nesting Herring and lesser black-backed gulls in Bristol, the South West and South Wales since 1980. The additional data were sourced corresponding to the 12 year period (1999-2010) similar to birds released from the rehabilitation centre. All the wild birds ringed were chicks from roof nesting parents. Normally chicks are ringed on buildings that have a significant parapet around a flat roof to avoid premature or accidental fledging. Many of the buildings used have been visited for several years by ringers as part of a long term study. Excluded from this sample set of the South West colonies were those chicks that failed to fledge, found dead at a subsequent visit or found dead within 5km and within 30 days of ringing. The exclusion of recoveries for these chicks was at the discretion of the ringing group.

3.4.4 Retrieval of recovery & re-sighting data

Birds which are found dead or recovered alive and reported to the BTO will generate a ringing recovery report (Appendix C). The re-sighting of the Darvic ringed birds in this study have been primarily from birdwatchers and private observers. Observers in the field have various options to inform the original ringers of the field sighting. The BTO has a web site http://blx1.bto.org/euring/lang/pages/rings.jsp?country=EN where a metal ringed bird may be reported; this also includes birds with additional colour rings or tags. These are then passed onto the large gull colour ringing coordinator by means of a Euring Recovery email which is then forwarded to the appropriate ringer. Alternatively the observer may look on the European Colour-ringing birding web site http://www.cr-birding.org/ where details of all species schemes are registered. Observers are then contacted by the ringer with details of the bird's ringing date and circumstances including any history of previous sightings.

Chapter IV

Assembling data and methods of analysis

4.1 Revision of admission categories

Admissions from 1999-2005 were entered onto an in-house Microsoft® Access-version 1998 database that was designed by the author. From 2006 the RSPCA information service department (ISD) installed a Microsoft® Access version 2000 supported database that could be used by all four RSPCA wildlife centres (East Winch Wildlife Centre, Station Road, East Winch, Norfolk, UK; Stapeley Grange Wildlife Centre, London Road, Nantwich, Cheshire, CW5 7JW, UK; West Hatch Wildlife Centre, Taunton, Somerset TA3 5RT; and Mallydams Wood). The fields followed a similar format to the previous database, but some categories within the fields, specifically those relating to reason for admission, varied between the two databases. Consequently many of the reasons for admission between the two systems are slightly different. For example a bird admitted showing symptoms of botulism would be admitted under the specific category, poison/botulism in 1999-2005, in the 2006-2011 system it would be entered under the category poisoning, sub-section botulism. In order to combine both databases, all the admissions cards from 1999-2005 were reviewed and renamed to correspond to the most recent version. Table 4.1 highlights the differences in admission categories but also show the similarities in reasons for admission.

The admissions were entered onto both databases by various staff members and volunteers. The number of different staff or volunteers entering data was seven for the 1999-2005 data and 12 for 2006-2010. Despite having default categories on the drop down menus, individuals could select any one of the 17 (1999-2005) or 18 (2006-2010) categories which was seen to be applicable to the animal on the time of admission. The information was then entered onto an individual record card (Appendix B) for information to be entered by the vet and staff during the animals' progress through the wildlife centre.

Table 4.1 Differences in the fields for both databases used between 1999 and 2010

1999-2005	2006-2010
Attacked by cat	**Attacked by other animal**
Attacked by dog	**Attacked by other animal**
Attacked by crow	**Attacked by other animal**
Attacked by gull	**Attacked by other animal**
Caught/entangled	**Caught/entangled**
Collision	**Collision**
Dead on arrival	**Dead on arrival**
Disease/weakness	**Disease**
Fishing litter	**Fishing litter**
No category	**Garden accident/injury**
No category	**Grounded**
Maiden flight	**Inexperienced juvenile**
Injured	**Injury (cause uncertain)**
Cruelty	**Legal case animal**
Oiled/contaminated	**Oiling/other contaminant**
Orphan	**Orphan**
No category	**Other (please note in comments)**
Poison/Botulism	**Poisoning**
Poison/neurological	**Poisoning**
Shot	**Shot**
No category	**Starvation**
No category	**Weakness**

Subsequent information may reveal that the aetiology for admission may be completely different. For example; a bird is admitted with a dropped wing, but after radiography might show an air gun pellet embedded in body tissue. This would mean the reason for admission may be initially entered as injured but later altered to shot when the final outcome was known. Updating was conducted by the author or trusted volunteers in order to maintain consistency. In order to analyse data from twelve years, analogous causes for admissions from the 18 categories were reduced to just 16 problem categories.

4.2 Identifying age of Herring Gull on admission

The age of gulls on admission was based on assessments by wildlife staff and volunteers. The abundant gull admissions to the centre ensured that most staff or volunteers were able to age gulls through training and experience. In cases of aberrant plumage or birds in moult, specifically during winter months, identification guides and reference books were utilised (Baker, 1993; Olsen and Larsson, 2004; Svensson *et al.*, 2009). Details of the birds' ages admitted from 1999-2005 were added to those on the 2006-2010 databases. The two different databases were combine with several categories needing to be redefined as they were case sensitive and when combined reduced the number to six. The category "pullus" was removed and replaced with "nestling" as this better refers to non-passerine birds, such as gulls, although if released, they were redefined as "juveniles". Those assigned "not known" or "unknown" were reviewed from treatment cards and information from the database, then reassigned an age based on the time of year since some problems are age-specific. All cases collected referring to the age of admissions were cleaned up leaving just five age categories (Table 4.2). Further reductions in the categorical measure were made to differentiate birds that were "Adult" or "Non-adult".

Table 4.2 Age assigned by all staff to Herring Gulls admission 1999-2005 and revised age categories 2006-2010 used in analysis

Assigned age categories 1999	Revised age categories 2006
Pullus	Nestling
Not defined	Fledgling
Juvenile	Juvenile
Immature	Immature
Adult	Adult
Not known	Unknown

4.3 Redefining outcome categories for admissions

The outcome of total gull admissions was collated from two consecutive databases [1999-2005 & 2006-2010 (Table 4.3)]. The combined results varied in description in six categories, by the time interval following admission and time of death "Died within 48 hours", "Died in 24 hours", "Died later", "Died after 48 hours", "Put down (put to sleep [PTS]) in 24 hours" and "PTS within 48 hours", "PTS", "PTS after 48 hours". When recovering the data, some of the categories were case sensitive, therefore adding additional fields and needed to be standardised. Using the combined data from 1999 – 2010 the number of categories were reduced from 21 to 11 to remove duplication of fields (Table 4.3). Further reductions in the outcome fields to "released" or "not released" enabled this variable to be used as the dependent (Table 4.5) in some statistical tests.

Table 4.3 Showing result from Herring Gull admissions from 1999-2005 and 2006-2010 and revised categories used in the analysis.

Assigned outcome categories 1999-2005	Revised outcome categories 2006-2010
Dead on arrival	Dead on arrival
Not defined	Died on admission
Died later	Died after 48 hours
Died in 24 hours	Died within 48 hours
Not defined	PTS on admission
PTS	PTS after 48 hours
Put down in 24 hours	PTS before 48 hours
Escaped	Escaped
Not known	Unknown
Not defined	Predation
Released	Released
Transferred	Transferred

4.4 Collection of observation and recapture data

In this study all 12 years of observations and recoveries were entered onto a Microsoft® Excel version 1993 & 2010 database. Information from each recovery or sighting included BTO ring number, Darvic code, recovery code, date seen, place seen, longitude & latitude and observer.

Details from the rehabilitation process were also entered on the database including case number, date and area released, age, admission reason, days in care and area found. Additional fields included days out and distance travelled.

Four categories of finding within the field of recovery code are described in this study:

- Ring read in the field

This category includes all sightings of birds either from Darvic ring codes or metal ring numbers. These are birds alive and normally healthy.

- Found dead

Birds under this grouping are normal found by members of the public and the number on the metal ring is reported directly to the BTO. This will generate a recovery form which is sent to the secretary of the ringing group. (Appendix D)

- Alive and taken into care

This category is generally birds which have been found sick or injured and either taken back into a wildlife centre or Veterinary surgeries across the UK.

- Intentionally taken

This category includes those birds which have almost exclusively been captured through cannon-nets by the North Thames Gull Group (NTGG) on Pitsea or Rainham Landfill site in Essex.

4.5 Assigning age to released birds

In order to submit annual data to the BTO ringing scheme, the age of each wild bird trapped and ringed must be assigned an alphanumeric code using a system devised and co-ordinated by the European Union for Bird Ringing (EURING). It was mandatory that the system was applied in this study to correctly age all rehabilitated birds and wild ringed chicks. As previously outlined in section 4.2, specific criteria for categorising age is defined by plumage type, physical characteristics and biometrics and, in the case of wild nestlings, unable to fly freely (Baker, 1993). Additional information of ringing date is required due to the use of the calendar year as a substitute to the year hatched. Every age code from 2 upwards changes by two overnight on December 31st – January 1st (+ 2). An example “First year” code 3 changes to “Second year” code 5 and this applies to all age categories up to fully grown birds in 4th calendar years. Table 4.4 illustrate the age codes used during the ringing procedures as defined in guidelines (EURING, 2010).

Table 4.4 Euring codes used when assigning an age to ringed birds. Ages 2, 4, 6, are excluded, as these only apply to birds where the age is unknown.

	Euring code	Age description	+ 2 code
Pullus	1	Nestling or chick; unable to fly freely	
Juvenile	3	First year; fully grown hatched in current Cy	5
2nd year	5	Hatched last Cy now in second Cy	7
3rd year	7	Hatched two Cy before now in third Cy	9
4th year	9	Hatched three Cy before now in Fourth Cy	B (11)
Full grown	8	Hatched more than three Cy (including current year) now age unknown	A (10)

Calendar year (Cy)

4.6 Calculating temporal and spatial intervals from observations

When a bird is found dead, trapped by a ringer or observed, the BTO ringing office generates a recovery form (Appendix C) which automatically calculates the survival days, distance and compass direction travelled from the ringing site and the place of recovery. The recovery form will also include the date of ringing and the recovery date. These details are included on the recovery form which is sent to the ringer when a bird ringed by their ringing group has been found. Those re-sightings and recoveries reported directly to the ringer and not via the BTO office may not include the Latitude or Longitude and therefore a mechanism needs to be in place to calculate the distance travelled by the bird. Where the place of recovery or sighting is known, but not the coordinates, the place name is entered into the search facility on the Google Earth© website to retrieve the correct coordinates in time format (degrees, minutes and seconds). Using Excel trigonometry, the distance travelled was determined from a great circle calculator using non-Euclidean geometry (Consulting, 2011). The formula was tested on known coordinates and distances from BTO recovery forms, which proved comparable accuracy. The complexities of geodesic formalism are not explored in this thesis.

4.7 Statistical methods

Statistical analysis of these data, and thereafter in this thesis, was performed using PASW 19.0 (IBM SPSS Statistics for Windows. Armonk, NY: IBM Corp) with, unless stated a minimum significance level (α) of 5%.

Binary logistic regression was used to identify factors that would affect the likelihood of release. The dependent variable used for admission data was "released or not released", the dependent variable used for survival data was "event or non-event". Other variables available for the statistical model are listed in Table 4.5. Effect sizes are expressed as odds ratios [P (released) or P (not released)]. Odds ratios > 1 indicated birds which were most likely to be released. Table 4.5 shows the goodness of fit for models used predict result in admission categories.

The survival probabilities of rehabilitated / non-rehabilitated and adult/non-adult rehabilitated birds were compared using non-parametric Kaplan-Meier product limit estimator (Kaplan and Meier, 1958); survival rates (median ± S.E) are given in parenthesis. Parametric and nonparametric tests on independent samples were analysed using, T-test, Mann-Whitney U, Kolomogorov-smirnov two sample tests and Wald-Wolfowitz run tests

Table 4.5 Variables available for statistical tests used in analysis and Goodness of fit in prediction models within admission categories.

Variable	Variable type	Description
Result	Categorical	Dependent variable: 1 = released, 0 = not released
Form	Categorical	Dependent variable: 1 = event, 0 = non-event
Age ***	Categorical	Age classes
Age group	Categorical	Adult, non-adult
Group	Categorical	Rehabilitated, non-rehabilitated
Duration*	Categorical	Days in care (see text)
Problem **	Categorical	Reason for admission (see text)
Month	Categorical	January-December
Year	Categorical	1999-2010
Survival	Continuous	Number of days in the wild
Distance	Continuous	Measure in Km from release site to recovery site

N	Hosmer-Lemershow	Cox & Snell	Nagelkerke	% variation explained by model (predicted)
*5370	x^2_3=0.000, p = 1.000	0.425	0.567	82.0 (52.1)
**5370	x^2_3=0.000, p = 1.000	0.011	0.014	54.9 (52.1)
***5370	x^2_3=0.000, p = 1.000	0.021	0.027	56.6 (52.1)

C h a p t e r V

Results

5.1 Annual trends in gull admissions

For the years 1999-2010 a total of 5,447 Herring Gull admissions were recorded for all ages to MWWC shown in Figure 5.1. The annual totals ranged from 202 in 1999 to 655 in 2010, giving an overall increase in admissions of 69%. However, there was a slight decrease during the years 2007/2008.

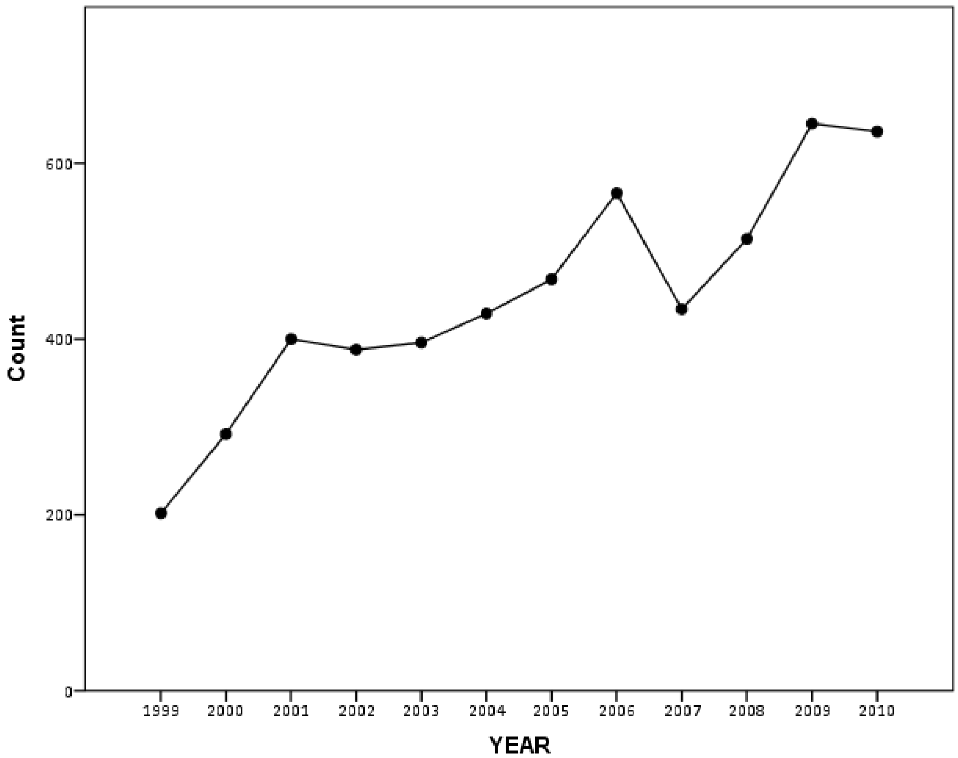


Figure 5.1 Annual totals of Herring Gull admissions showing an increase during the 1999-2010 periods.

There was a significant difference in the relative proportion of birds released each year (Chi-squared test: $\chi^2_{11} = 74.66$, $P < 0.001$)

Three homologous groups were identified within the years (Table 5.1):

- 2005 has the lowest release rate (38.5%)
- 2001, 2004 and 2008 have the next lowest release rates 46.3-48.4%)
- 1999, 2000, 2002, 2003, 2006, 2007, 2009 and 2010 have the highest release rates (52.1 – 59.6%)

Table 5.1 Chi-squared analysis showing annual release rates in ascending order with homologous groups identified by lowercase letters (Chi-squared test: $\chi^2_{11} = 74.66$, $P < 0.001$).

Year	No. not released	No. released	Release rate (%)	Post Hoc
2005	288	180	38.5	a
2001	215	185	46.3	b
2004	225	204	47.6	b
2008	265	249	48.4	b
2006	271	295	52.1	c
2007	205	229	52.8	c
2003	184	212	53.5	c
2002	173	215	55.4	c
2009	287	358	55.5	c
2010	261	375	59.0	c
1999	82	120	59.4	c
2000	118	174	59.6	c
Total	2574	2796		

The admissions accrued from the 12 year period resulted in 17 discrete problem categories. Three distinct groups were classified from the totals based on percentage of total admissions. Group 1 (common) includes four categories $\geq 5\%$, group 2 (less common) five categories ≥1 - $\leq 5\%$ and group 3 (rare) eight categories $\leq 1\%$ of total admissions (Table 5.2). Combined group percentage of total admissions; common 83.2 %, less common 13 %, rare 3.7 %.

The 16 problem categories, were used in the final analysis, excluding category “dead on arrival” (n=6) cases which was omitted to avoid biasing towards birds with no possibility of release. For similar reasons, a further 71 cases from the result/outcome field, were removed from the analysis. Those outcomes excluded from the dataset did not confirm whether a bird was an intentional release or deliberate non-release. The variables included “dead on arrival” (n=15), “escaped“(n=7), “predation” (n=5), “transferred” (n=20) and “unknown” (n=24). The final number of admissions used in the analysis was 5,370 individuals.

Table 5.2 The frequency, percentage and group definitions for all problem categories for 1999-2010 admissions arranged in descending order.

Category	Frequency	% of total	Occurrence
Orphan	2023	37.1	Common
Injury	1394	25.6	Common
Poison/Botulism	697	12.8	Common
Inexperienced juvenile	419	7.7	Common
Collision	262	4.8	Less common
Caught/entangled	212	3.9	Less common
Fishing litter	89	1.6	Less common
Shot	81	1.5	Less common
Poison/Neurological	68	1.2	Less common
Attacked by other animal	51	0.9	Rare
Weakness	39	0.7	Rare

5.2 Problem Categories

Figures 5.2 to 5.4 illustrate the total annual admissions in birds identified under categories common, less common and rare. All groups showed some annual variations in admission percentages over the 12 year study period. Within the common admissions group (Figure 5.2), "orphans" displayed an increase in the number of admissions from 2002 to 2010 and"inexperienced juveniles" which increased to over 10 % in 2004, 2009 and 2010. Other categories from the common group showed annual decreases but fluctuations within years. Admissions of "poison botulism" and "injury (cause uncertain)" both showed an increase in the percentage admitted in 2001 and 2002 respectively, followed by a decrease to 10-15% in 2010. Less common admissions (Figure 5.3) showed an increase in three admission trends over the 12 year period, with "Shot", "Fishing litter" and "Caught and entangled" in period from 2007 – 2010. Birds admitted under "poison_neurological" showed no admissions after 2005. This category was removed from the database in 2006 and re-categorised under a general field of poisoning, which included botulism as the sub-heading. Within the rare admission group (Figure 5.4), the trends were less clear due to the low numbers admitted within each category. The field with the greater percentage is "attacked by other animal" with an increase to ~ 2.5% in 2007. New fields included "other, please note in the comments" appeared in 2006.

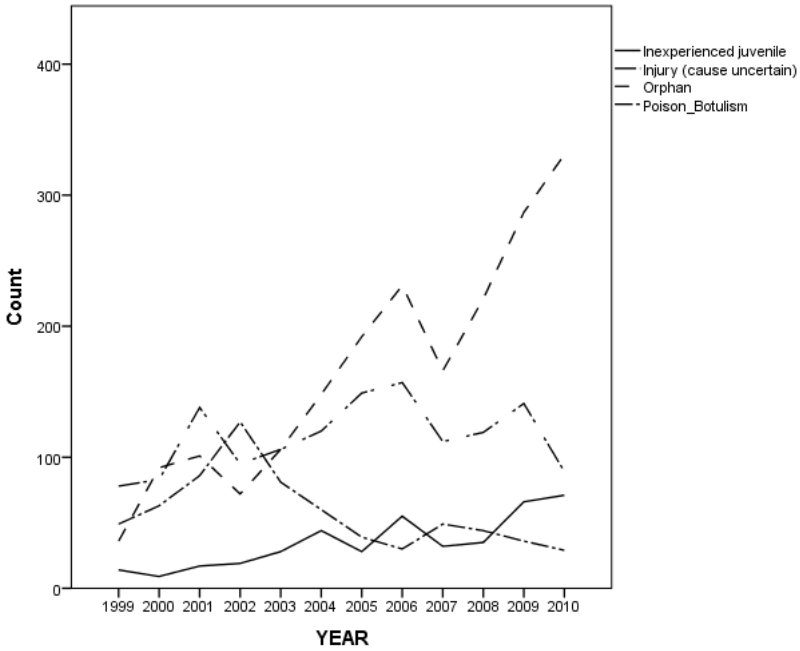


Figure 5.2 Annual totals for individual birds admitted in the common category. In 2002 orphans (dashed line) showed an increase in the number of admissions; however poisoned_botulism (dashed and joining dot line) showed a decrease in numbers.

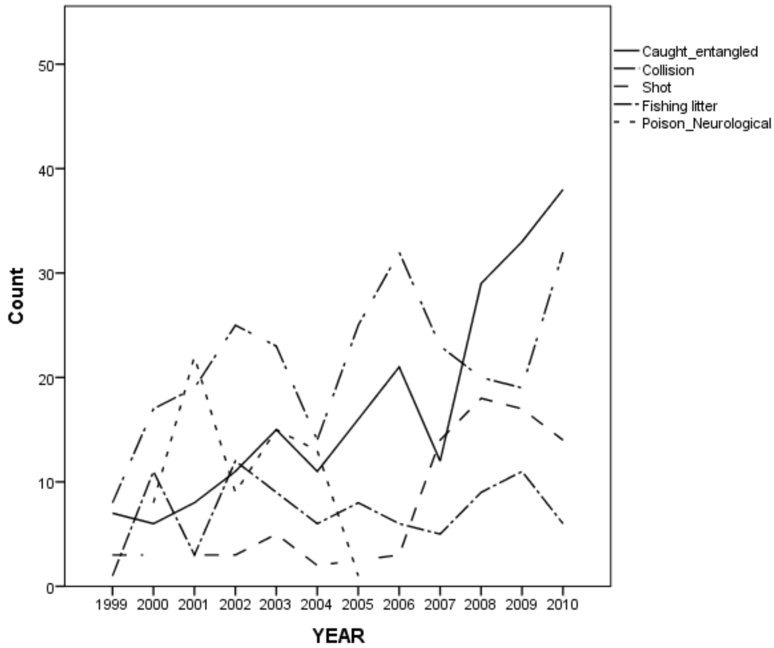


Figure 5.3 Annual totals of individual birds from the less common categories, showing an increase in the number of caught/entangled (solid line) from 2008 and shot (dashed line) gulls from 2006.

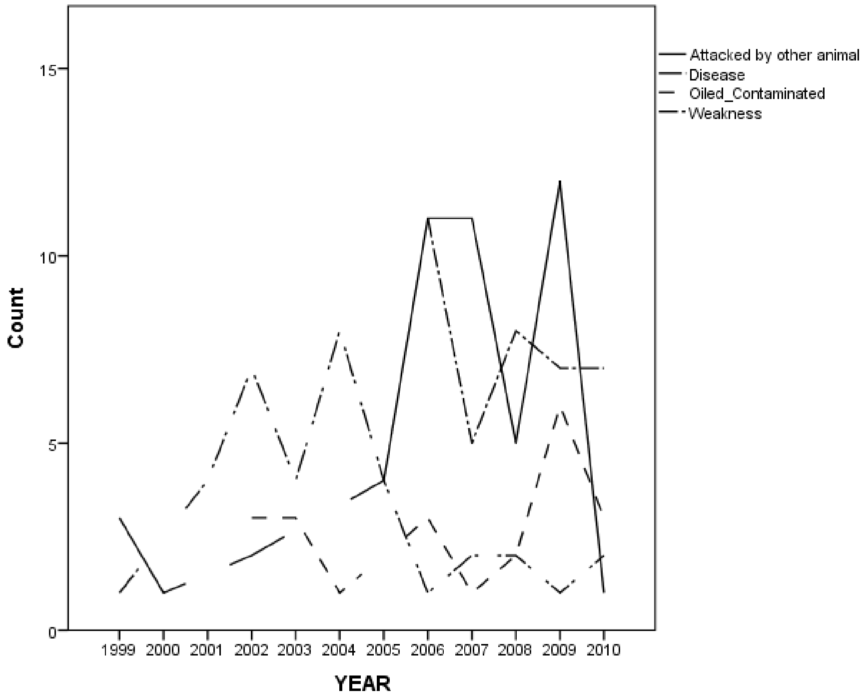


Figure 5.4 Annual totals showing the most numerous admissions of four rare categories (Note that categories with lower admission numbers <0.4 % have been excluded).

5.3 Seasonal & age differences in admission categories

Each of the problem categories shows seasonal changes in the peak months of admission. The increase in admissions for all categories corresponds to the intake of nestling and inexperienced juvenile birds from May to August and adults suffering injury or misadventure during the breeding season (Figure 5.5). Admissions of gulls, predominately adults suffering from botulism, were normally from May to September, with peaks in July & August. Figure 5.6 shows similar trends for admissions <5%, with peak admissions corresponding to pre-breeding, breeding and post-breeding activity. Categories with the greatest admissions during the months June to August were “collision” and “caught and entangled”. Noticeable increases in shot birds were during pre-breeding courtship in May and those in August include “fishing litter”.

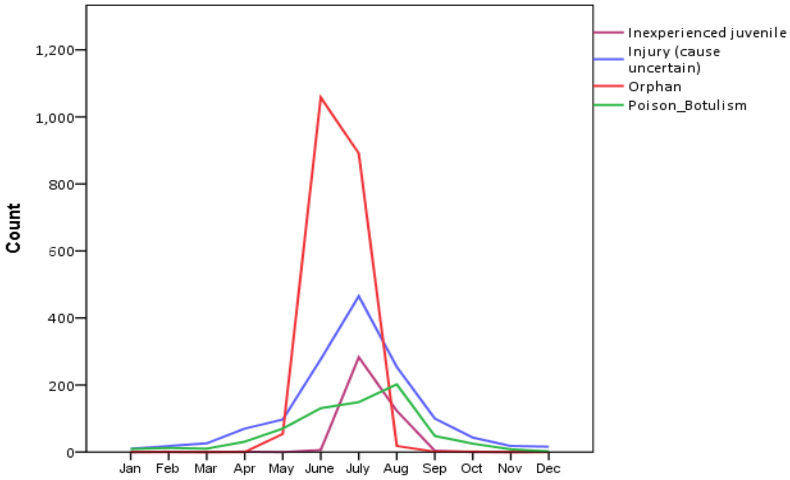


Figure 5.5 Frequency of gull admissions 1999-2010 showing monthly admission of four categories with >5% total, showing increased number of orphaned and inexperienced juveniles birds admitted between May-August

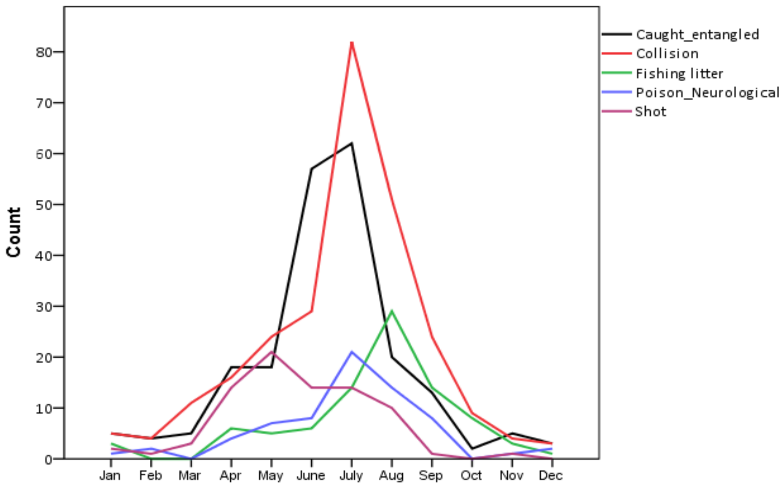


Figure 5.6 Frequency of gull admissions 1999-2010 showing monthly admission of five categories with <5% total.

Figure 5.7 shows the age differences of admitted birds showed variation throughout the 12 year period. The number of birds admitted under category juvenile, fledgling and nestling showed the greatest variation. In Figure 5.7 the vertical interpolation line at 2006 shows when the mandatory fields changed due to the introduction of the official RSPCA database. This changed many fields from Pullus to fledgling and juveniles were re-classified to fledgling or nestling if they were still dependent. There was little variation in the admission of adult birds throughout the study, nevertheless during the 2001 to 2002 season, admissions increased due to consecutive outbreaks of botulism in the Hastings and Bexhill area. The age group immature was consistently under 50 birds per year. Seasonal variation in age admissions show predicted numbers increase during the breeding months of May to August. Successive age groups; nestling, fledgling and juvenile correspond to maturation of chicks which progress through the summer months (Figure 5.8). In July, the highest numbers of juvenile birds were admitted when young birds were beginning to fledge. Adult birds showed a distribution curve which peaked in July with tails in January and December.

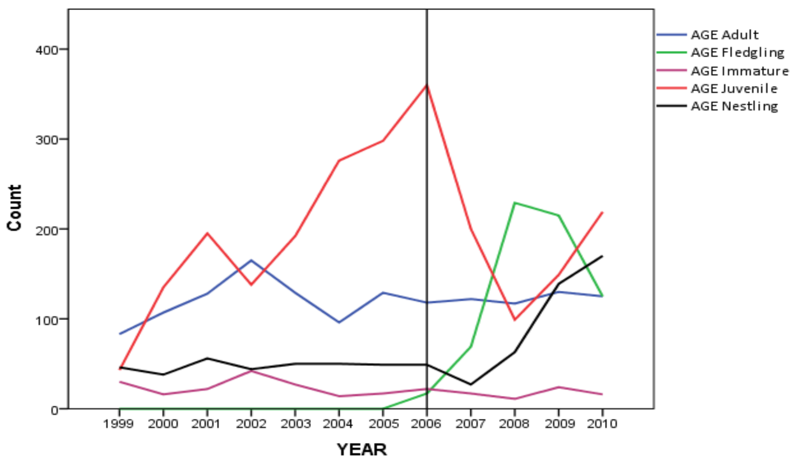


Figure 5.7 Frequency of age admissions showing an overall increase in chick numbers and changes in non-adult age category descriptions in 2006 at the vertical interpolation line.

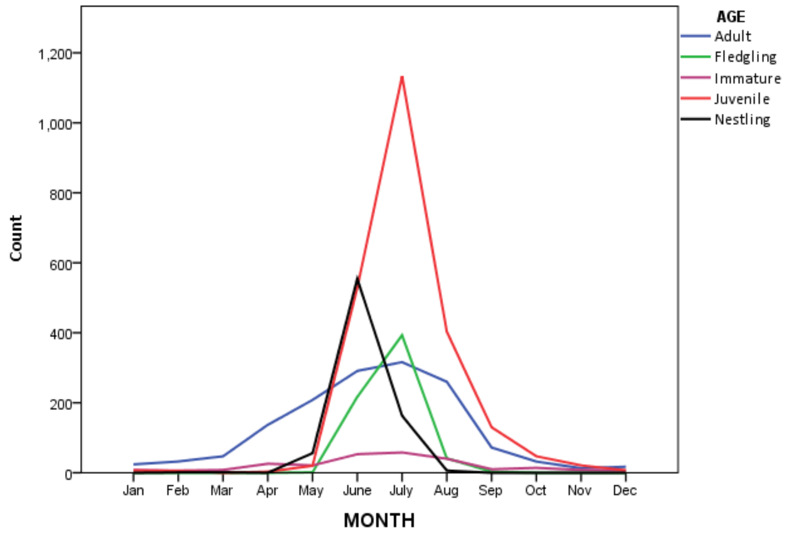


Figure 5.8 Frequency of age admissions by month showing the succession of maturation in age group categories from May – September. Adult admissions increase from April to September.

5.4 Mortality rates in wildlife centre and survival to release

The number of birds recorded released was n=2796, with a range for the study years of 38.5% to 59.6%, with a sample mean of 52.1%, excluding admission and outcome categories previously mentioned in the text (Table 5.3). However, 1024 birds were effectively triaged and humanely euthanased on admission and a further 397 within 48 hours. When these figures were taken into consideration the combined years sample mean for released birds increased to 84.1%.

Table 5.3 Frequency and percentage of outcome categories in timeline order

Outcome category *	Frequency	Percent
PTS on admission	1024	19.11
Died within 48 hours	179	3.3
PTS before 48 hours	397	7.4
Died after 48 hours	101	1.9
PTS after 48 hours	873	16.3
Released	2796	52.1
Total	5370	100.0

* Excluding categories dead on arrival, escaped, transferred and predated

5.5 Factors affecting survival to release.

The percentage of released birds for each reason for admission category showed variation in survival to release rates. Table 5.4 illustrates that not every category was comparable to the overall release rate of 52.1 %. There was a significant difference in the relative proportion of birds released in each problem category (Chi-squared test: χ^2_{15} = 1173.88, P < 0.001). Post hoc analysis shows that six homologous groups were identified showing a significant difference in the rates of release (Table 5.4)

Table 5.4 Chi-squared analysis showing release rates for problem categories in descending order with six homologous groups identified by lowercase letters.(Chi-squared test: χ^2_{15} = 1173.88, P < 0.001)

	Not released	Released	Release rate	Post Hoc
Inexperienced	90	328	78.5	d
Orphan	545	1438	72.5	a
Litter	29	58	66.7	a
Entangled	76	131	63.3	e
Oiled	9	13	59.1	a
Botulism	314	379	54.7	c
Other attack	25	25	50.0	c
Neurological	39	29	42.6	c
Legal	12	7	36.8	b
Gull attack	6	3	33.3	b
Collision	187	70	27.2	f
Shot	58	21	26.6	b
Injury	1105	282	20.3	b
Other	14	3	17.6	b
Disease	31	5	13.9	b
Weakness	34	4	10.5	b

The number of days in care ranged from 1 to 96 days for all admissions. For those not released birds n=2,574, ($\bar{x} = 8.65$ days) which includes bird's euthanised on admission or within 48 hours (Figure 5.9) did not show a normal distribution (skewness, 2.5, kurtosis 6.3). Birds in Figure 5.10 which were released n= 2,796, ($\bar{x} =$ 26.54 days) also did not show a normal distribution for the time in care (skewness 0.9 kurtsosis, 0.4).

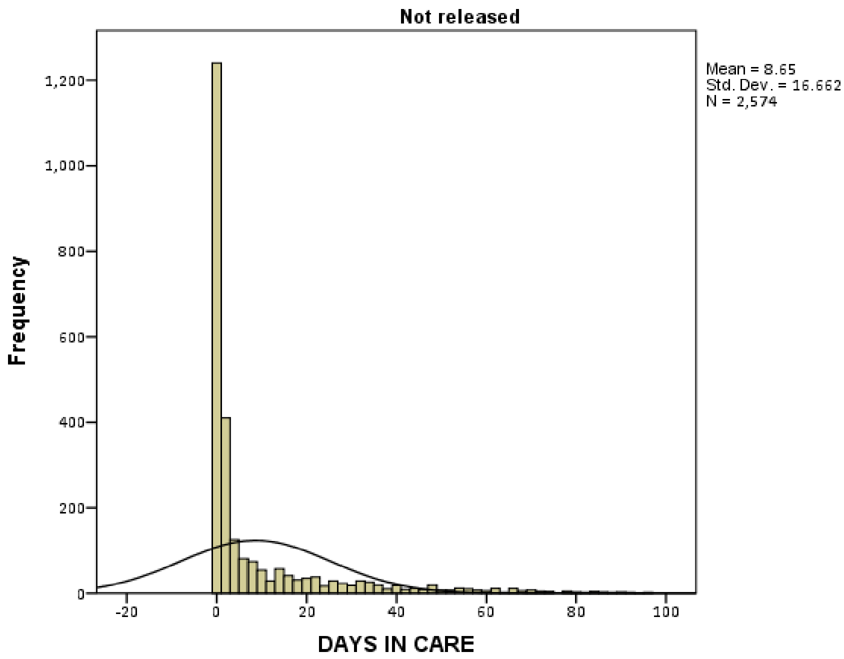


Figure 5.9 Mean number of days in care for non-released birds showing a skewed distribution (skewness, 2.5, kurtosis 6.3).

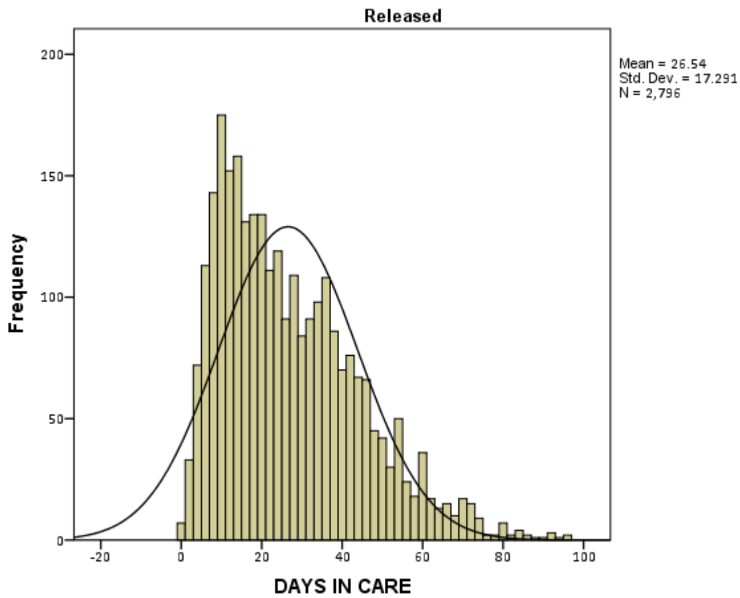


Figure 5.10 Mean of days in care for released birds, showing skewed distribution curve (skewness 0.9 kurtsosis, 0.4).

There was not a significant difference in the median number of days in care for those birds released or not released (*U* = .000; p >0.05). Time in care was subsequently divided into four intervals, “Under 48 hours”, “Two weeks”, “Month” and “More than month” to compare the effect of this variable on release or non-released birds (Figure 5.11). The intervals showed a that very few birds (1.4%) were released in the first 48 hours, subsequently the percentage of birds released increases with each interval (two weeks = 29.1%, month = 32.7%, more than month = 36.8%). A total of 2,796 gulls of all ages were ringed and released during the study period 1999-2010. The largest number of a specific age group ringed was 2,158 nestling, fledgling and juvenile gulls (75.6%), followed by 514 adults (18%). Other age groups were represented by less than 7% of the total. The age group “nestling” showed the highest release rate (62.6%) of all five, with “adult” showing the lowest released rate (42%). Figure 5.12 shows the proportion of birds released in each of the time intervals and the age group. Binary logistic regression was used to compare the effect of age and time in care on the release outcome and predict which was most the likely group and time in care to be released (Table 5.6). These data in Table 5.6 shows there is a significant effect of time in care and the age group adult on surviving to release.

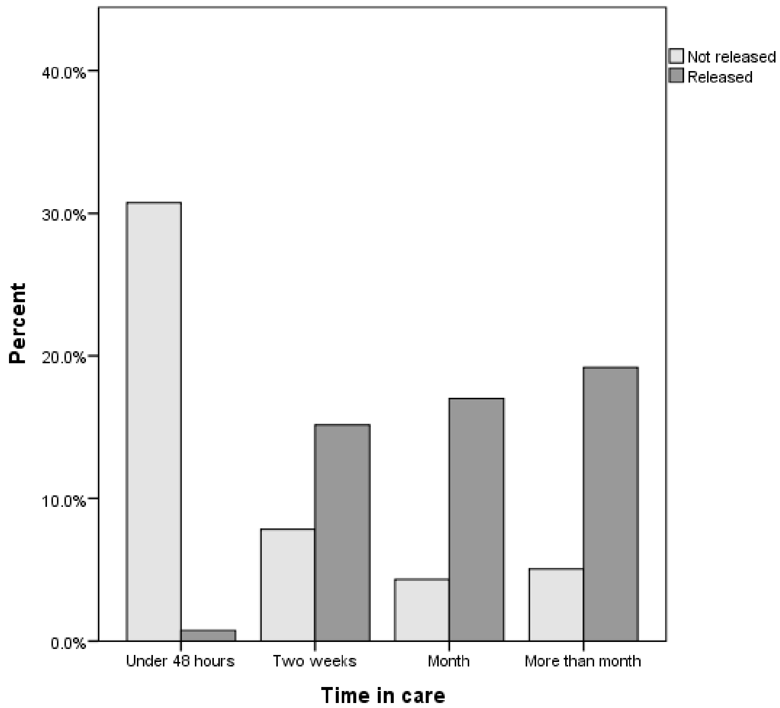


Figure 5.11 Time intervals for the outcome of all gull casualties showing the percentage of birds released or not released.

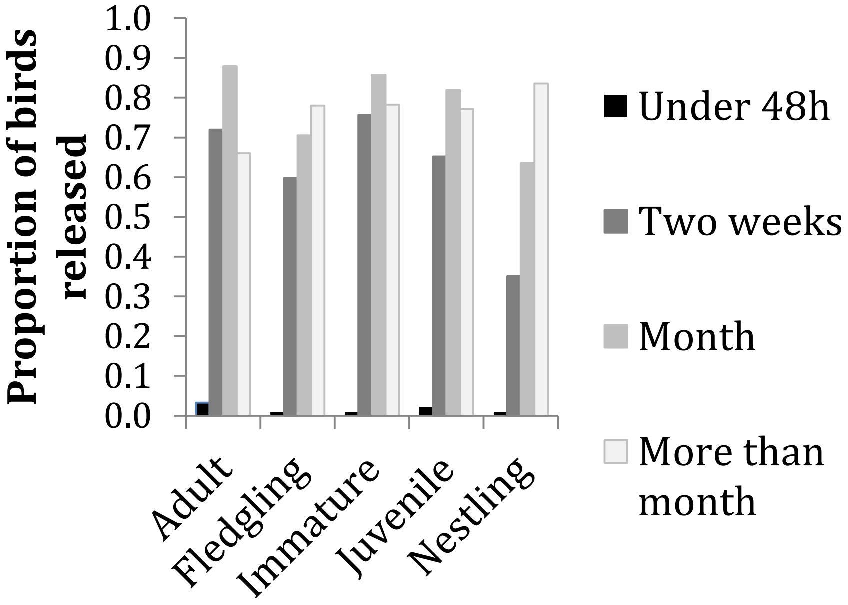


Figure 5.12 Comparison of age class and time in care, showing the proportions of birds released during each time period.

Table 5.5 Summary of binary logistic regression model comparing the effect of age (AGE) and time in care (TIME) on the likelihood of Herring gulls being released from Mallydams RSPCA wildlife hospital. (N=5307 individuals). Model parameters were: specificity = 66%; sensitivity = 98%; overall classification = 83%; Cox & Snell R^2 = 0.437; Nagelkerke's R^2 = 0.583; Hosmer-Lemeshow goodness-of-fit test χ^2_8 < 0.001, P = 1.000. Cut-off threshold value used = 0.5

Variable	**B**	**SE**	**Wald**	**DF**	**Sig.**	**Exp(B)**	**95% CI for Exp(B)**	
							Lower	**Upper**
TIME[<48h]			398.652	3	<0.001			
TIME(2 weeks)	4.335	0.240	324.846	1	<0.001	76.292	47.617	122.232
TIME(1 month)	5.374	0.291	340.116	1	<0.001	215.688	121.842	381.817
TIME(>1 month)	4.056	0.362	125.443	1	<0.001	57.715	28.384	117.355
AGE[Adult]			5.068	4	0.280			
AGE(Nestling)	-1.282	1.028	1.557	1	0.212	0.277	0.037	2.079
AGE(Fledgling)	-1.282	1.028	1.557	1	0.212	0.277	0.037	2.079
AGE(Juvenile)	-0.398	0.339	1.377	1	0.241	0.672	0.345	1.306
AGE(Immature)	-1.397	1.027	1.849	1	0.174	0.247	0.033	1.852
AGE[Adult] * TIME[<48h]			65.938	12	<0.001			
AGE(Nestling) * TIME(2 weeks)	0.737	1.049	0.493	1	0.483	2.089	0.267	16.342
AGE(Nestling) * TIME(1 month)	0.173	1.059	0.027	1	0.870	1.189	0.149	9.469
AGE(Nestling) * TIME(>1 month)	1.883	1.079	3.046	1	0.081	6.576	0.793	54.524
AGE(Fledgling) * TIME(2 weeks)	1.473	1.068	1.903	1	0.168	4.363	0.538	35.391
AGE(Fledgling) * TIME(1 month)	1.091	1.123	0.944	1	0.331	2.977	0.330	26.886
AGE(Fledgling) * TIME(>1 month)	1.898	1.182	2.581	1	0.108	6.674	0.659	67.627
AGE(Juvenile) * TIME(2 weeks)	0.082	0.367	0.050	1	0.822	1.086	0.529	2.230
AGE(Juvenile) * TIME(1 month)	-0.069	0.407	0.029	1	0.866	0.934	0.421	2.072
AGE(Juvenile) * TIME(>1 month)	0.950	0.458	4.301	1	0.038	2.586	1.054	6.348
AGE(Immature) * TIME(2 weeks)	-0.163	1.060	0.024	1	0.878	0.849	0.106	6.780
AGE(Immature) * TIME(1 month)	-0.030	1.063	0.001	1	0.977	0.970	0.121	7.793
AGE(Immature) * TIME(>1 month)	2.360	1.075	4.820	1	0.028	10.593	1.288	87.105
Constant	-3.391	0.217	244.663	1	<0.001	0.034		

5.6 Re-sightings and recoveries of rehabilitated birds

In total, 2,350 events were reported for rehabilitated birds. With 1,472 (62%) duplicate cases and 878 (38%) individual recoveries. The mean survival days and distance travelled for each age group were calculated (Table 5.7). Overall, juvenile birds travelled the furthest with a mean distance 69.51 Km The highest mean survival days, 954.74 days was seen in 1st year birds. Low numbers of released birds in categories 1st year, 2nd year and 3rd year were amalgamated into a non-adult group of birds with juveniles.

Table 5.6 Mean distance travelled and survival days to the last event for all age groups of rehabilitated birds. When non-adult groups juvenile, 1st year, 2nd year and 3rd year were combined there was no significant difference in each group (t = -.937 df = 876, p = .349).

AGE	Category	N	Minimum	Maximum	Mean	Std. Deviation
Juvenile	Survival days	691	2	4197	718.6	706.0
	Distance/Km	684	<1	1454	69.5	106.9
1st year	Survival days	19	111	2321	954.7	689.6
	Distance/Km	19	2	166	43.7	44.8
2nd year	Survival days	17	7	1443	660.0	476.5
	Distance/Km	17	2	122	56.7	34.0
3rd year	Survival days	2	4	256	130.0	178.1
	Distance/Km	1	19	19	19.0	.
Adult	Survival days	149	5	3669	848.7	805.7
	Distance/Km	149	2	1873	58.6	159.9

When age groups were arranged into the two discrete groups, adult (n= 149) and non-adult (n=728) it improved comparisons of the mean distance travelled and post-release survival probabilities estimates. The mean survival days for adult rehabilitated (848.77 days ± 66) were not significantly different (t = 1.950 df = 876, p = .051) than non-adult rehabilitated (722.49 days ± 26). Similarly, the distance travelled by adult group (58.69Km ± 13.10) and non-adult group (68.46Km ± 3.89) were not significantly different (t = -.937 df = 876, p = .349). Kaplan-Meier (K-M) survivorship curves for adult rehabilitated group and non-adult rehabilitated survival probabilities were compared (Figure 5.13). The curves showed a similar survival of both groups but with survival of non-adults surviving over 4,000 days. However, K-M log rank test show that the difference between the groups was not significant (Log rank 3.07, df = 1, p = .080), and no significant difference in median survival days (χ^2_1 = .517, p = .472) and distribution of survival days (Z = -1.914, p = 0.056)

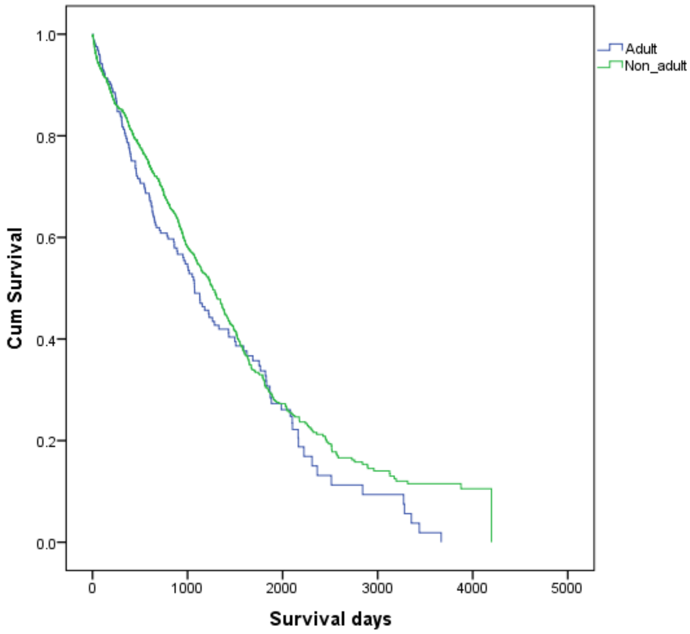


Figure 5.13 Kaplan-Meier survival estimates for adult and non-adult rehabilitated birds with no significant difference in the survival times (K-M log rank 3.07, *df* = 1, *p* = .080),

Table 5.7 displays the recovery rates for rehabilitated birds where compared to admission categories. Five categories exceeded the expected rate (.34). The highest rate was seen in birds within the "shot" category (.47) and the lowest rate in "collision" (.3) and "poisoning" (.3). There were no recovery events for released birds within the categories; attacked by gull/other animal, disease, weakness, other and legal case.

Table 5.7 Recovery rate comparisons between admission categories in descending order.

	No. ringed	No. recovered	Rate
Shot	19	9	47%
Inexperienced juvenile	294	120	40%
Injured	250	93	37%
Orphan	1335	501	37%
Fishing Litter	48	17	35%
Botulism	348	102	29%
Caught and Entangled	123	31	25%
Oiled	12	1	8%
Collision	64	2	3%
Poisoning	29	1	3%
Totals	2522	878	34%

5.7 Comparison between rehabilitated birds and wild chick data

Recovery and ringing data from roof nesting wild non-rehabilitated gull chicks in seven areas of South West England, three in South Wales and three areas of South East England were compared with ringing recoveries from released rehabilitated juvenile birds. Ringed birds from all sites were initially divided into three discrete groups (South West -1, Rehabilitated -2, South East -3,) for analysis, where birds from South Wales were grouped with birds from the South West (Table 5.8). A total of 2,940 juvenile birds and nestlings were ringed at all three sites during the 12 years (Table 5.9). For the purpose of data analysis, the use of the word ‘event’ refers to all sightings and recoveries which include; ring read in the field, found dead, alive and taken into care and intentionally taken. The term ‘non-event’ will refer to fate unknown or no data. Subsequently the two wild chick groups were amalgamated into one group, non-rehabilitated; to compare with rehabilitated birds for two sample analysis tests.

Table 5.8 Frequency of ringed wild chicks and rehabilitated Juveniles from all 14 sites and assigned group codes for analysis

Place name and group code	N	% ringed
Barry (Group 1), (Wild)	4	.1
Bath (Group 1), (Wild)	66	2.2
Bridgend (Group 1), (Wild)	30	1.0
Bristol (Group 1), (Wild)	439	14.9
Cardiff (Group 1), (Wild)	16	.5
Cheltenham (Group 1), (Wild)	5	.2
DOVER (Group 3), (Wild)	50	1.7
FAIRLIGHT (Group 3), (Wild)	5	.2
Gloucester (Group 1), (Wild)	43	1.5
Hinkley Point (Group 1), (Wild)	22	.7
REHABILITATION (Group 2)	2154	73.3
Swindon (Group 1), (Wild)	9	.3
UNIVERSITY OF SUSSEX (Group 3), (Wild)	84	2.9
Worcester (Group 1), (Wild)	13	.4
Total	2940	100.0

Table 5.9 Number of chicks and juvenile birds from the three groups ringed annually during the 12 year period 1999-2010

	South West (wild)	Rehabilitated	South East (wild)	Total
1999	49	108	0	157
2000	61	110	0	171
2001	65	125	0	190
2002	60	112	0	172
2003	73	155	0	228
2004	56	173	0	229
2005	70	130	0	200
2006	51	243	0	294
2007	24	185	28	237
2008	33	198	19	250
2009	44	292	43	379
2010	65	323	45	433
Total	651	2154	135	2940

5.8 Survival estimates for juvenile birds

There were 18,538 events and non-events for all three groups of chicks and juvenile birds including multiple sightings for single birds; South West, n=15,028, 81.1 %, rehabilitated n=3,357, 18.1 %, South East, n=153, 0.8 %. The total number of events only, for the three groups n=16,772, this includes fields ring read in the field, found dead, alive and taken into care and intentionally taken. In Figure 5.14 the number of individual bird events n=1,173, and non-events n=1767 for all three groups are presented. The number of events for each groups, South West, n=480, (Recovery rate 73.7%), rehabilitated, n= 662, (Recovery rate 30.7 %), South East, n= 31, (Recovery rate, 22.9 %).

Figure 5.15 shows that when the number of matching cases for events of each individual bird was examined, for wild birds (South West) the range was between 1 and 208 ($\bar{x} = 22.86$, $\text{includes non} - \text{events}$) and rehabilitated the range was between 1 and 39 ($\bar{\text{x}} = 0.72$, $\text{includes non} - \text{events}$). The difference in the means of both groups; rehabilitated and non-rehabilitated (South West) was significantly different (*t*=28.10, *df* = 2802, *p*=<.001).

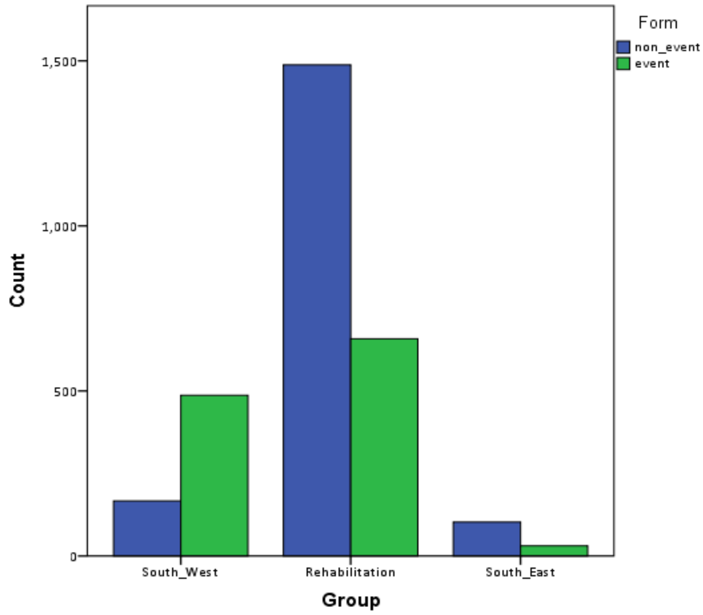


Figure 5.14 Frequency of individual bird resighting and recovery events and non-events for each group of first year gulls showing the differences in each discrete group (χ^2_2 =4.02.38,P =<0.001)

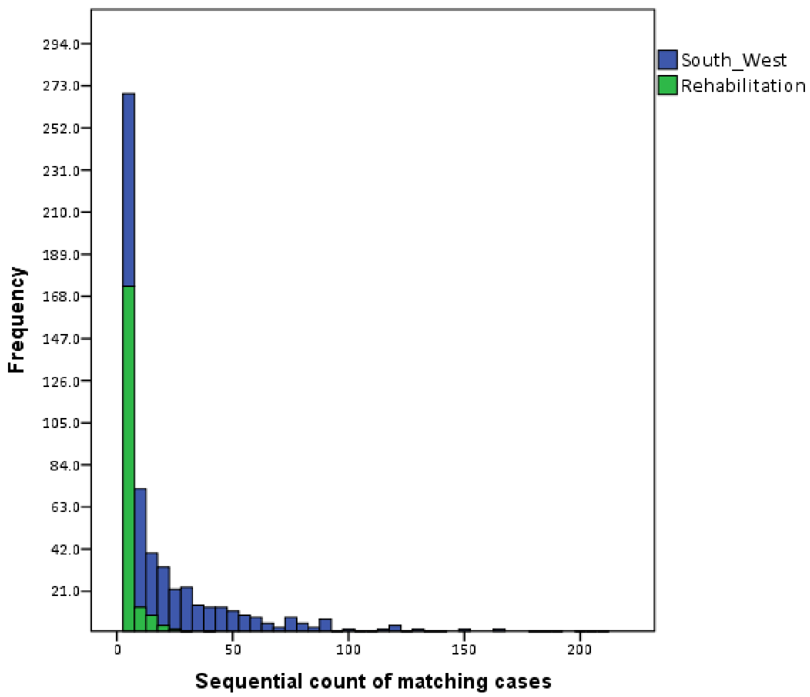


Figure 5.15 Frequency of matching individual case events with the number of sightings ranging from 1 event to 208 events for the same bird showing a significant difference between the two groups (*t*=28.10, *df* = 2802, *p*=<.001), non-events are not included.

Figure 5.16 shows there was a significant difference in the estimated survival function $\hat{S}(t)$, between the three groups (Kaplan Meier (K-M): log rank = 66.04, Wilcoxon (Breslow) = 30.41, *df* = 2, *p* = < .001).

Rehabilitated juvenile birds showed a lower median survival rate based on all known events (median days 432, SE. 36.89) than those non-rehabilitated chicks from the South West (median days 1081, SE. 57.63), but greater than non-rehabilitated chicks from the South East, which showed the lowest median survival rate (median days 267, S.E. 67.33) of all groups compared. It should be noted that non-rehabilitated birds from the South East produced limited recovery data due to less ringed and fewer years included in this study. When all events from groups of non-rehabilitated chicks were combined, the difference between the estimated $\hat{S}(t)$ of non-rehabilitated and rehabilitated was still significant (K-M log rank =60.44, Wilcoxon (Breslow) = 46.75, *df* = 1, *p* < 0.001).

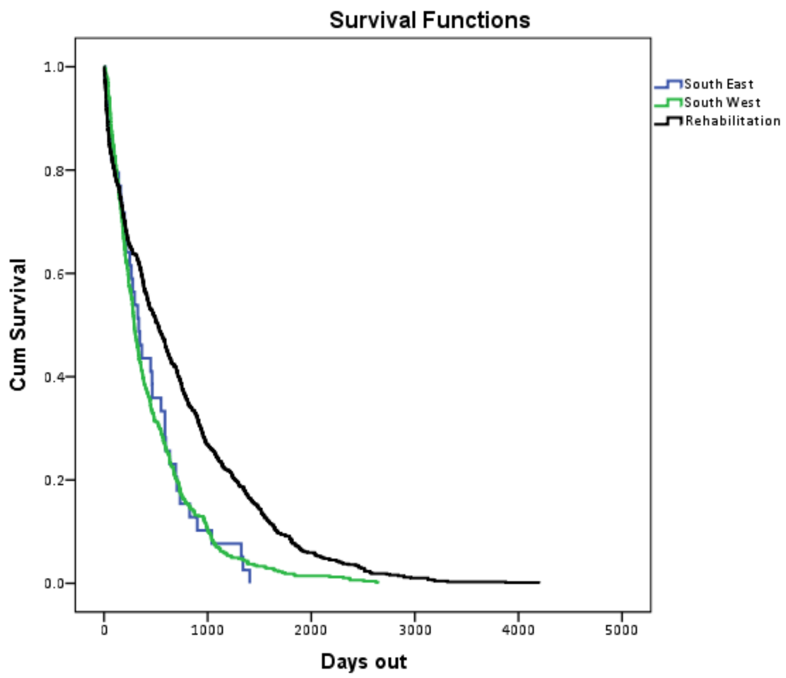


Figure 5.16 Kaplan-Meier survival plot; lines represent the known events for the three discrete groups of juvenile birds showing significant survival function between all three groups (Kaplan Meier (K-M): log rank = 66.04, Wilcoxon (Breslow) = 30.41, *df* = 2, *p* = < .001).

Data from rehabilitated and non-rehabilitated relating to the time elapsed between ringing and the last event was separated into day and year intervals to explore temporal differences between groups. Four time intervals were selected; <60 days, < 1 year (but greater than 60 days), < 4 years (but greater than one year) and > 4 years. Table 5.10 shows that rehabilitated birds were not significantly different in the proportion of events with South East non-rehabilitated cases in all intervals, (> 4 years is not included for SE due to 0 cases). Rehabilitated birds are significantly different in all time intervals when compared to SW non-rehabilitated birds except interval < 4 years. SE birds were proportionally different to SW non-rehabilitated in all intervals except < 4 years.

Table 5.10 Comparison of column proportions (*z* test) and percentage of time interval events where chick groups were significantly different from each other are indicated (* (*p* =0.05, adjusted Bonferroni). Intervals which were not proportionally different are indicated by the same lowercase letters

		South West (Wild)	Rehabilitated	South East (Wild)	Total
<60 days	Count	21*	119_b	5_b	145
	% within group	4.3%	18.0%	16.1%	12.3%
<1 year	Count	94*	175_b	13_b	282
	% within group	19.5%	26.4%	41.9%	24.0%
<4 years	Count	184_a	276_a	13_a	473
	% within group	38.1%	41.7%	41.9%	40.2%
>4 years	Count	184*	92_b	0_b	276
	% within group	38.1%	13.9%	0.0%	23.5%
Total	Count	483	662	31	1176
	% within group	100.0%	100.0%	100.0%	100.0%

5.9 Differences between rehabilitated and non-rehabilitated recovery categories

The survival to the last event data for both independent samples was reviewed using the four discrete recovery categories; ring read in the field, alive taken into care, found dead and intentionally taken. Due to the low number of birds intentionally taken (n=3), these birds were excluded from the analyses. The recovery rate (% of N event /N birds ringed) was calculated for each category and when groups were compared the rate was greater for "Ring read" (63.1%, Rehabilitated =26.41%) in non-rehabilitated and less for non-rehabilitated within

“Taken into care” (0.38%, RH=2.13%). Conversely, the recovery rate for non-rehabilitated (2.3%) in the “Found dead” category was equivalent to rehabilitated (2.4%). Two non-parametric tests were used Kolmogorov-Smirnov 2 sample (Ksa) and Mann Whitney U to test each category for similarities in the distribution of events. Table 5.11 shows that significant differences were found in the categories “Ring read”, between non-rehabilitated n=495 and rehabilitated n= 569 (Ksa, = 2,232, *p* = < .001, Mann-Whitney U, z score -5.590, *p*= <.001) but there were less significant differences in the “Taken into care” category between non-rehabilitated n=3 and rehabilitated n=46 (Ksa = 1.496, *p* = <.05, Mann-Whitney U: z score -2.565, *p*= < .05). However, when the category “Found dead” were compared, the survival of rehabilitated n=44 and non-rehabilitated n=16 (Ksa = .778, *p* = 0.579, Mann-Whitney U: z score -.702, *p*=.483) did not show a significant value therefore the null hypothesis was retained.

Table 5.11 Comparisons in recovery rates for the two groups; ring read (Ksa, = 2,232, *p* = < .001, Mann-Whitney U, z score -5.590, *p*= <.001), taken into care (Ksa = 1.496, *p* = <.05, Mann-Whitney U: z score -2.565, *p*= < .05), found dead (Ksa = .778, *p* = 0.579, Mann-Whitney U: z score -.702, *p*=.483) showing significant values in bold.

		Recovery rate	
Ring Read	Rehabilitated	26%	N= 569
	Non-rehabilitated	63%	N=495
	P< 0.001		
Taken into care	Rehabilitated	2.13%	N=46
	Non-rehabilitated	0.38%	N=3
	P< 0.05		
Found dead	Rehabilitated	2.4%	N=44
	Non-rehabilitated	2.3%	N=16
	Not Sig.		

5.10 Comparison in distance travelled by each group of nestlings or juveniles

The distance between the ringing site and recovery site was recorded in kilometres from the nest sites in non-rehabilitated nestlings from South West, Wales and South East colonies or the release site when referring to rehabilitated birds. A sample size of 1173 events for all three groups, where the distance was entered, ranged from < 1 Km (recorded as 0 Km) to 1454 km. The mean overall distance travelled by rehabilitated birds ($\bar{\chi} = 74.31 Km \pm 4.85$) was greater than both non-rehabilitated South West, ($\bar{\chi} = 54.76\ Km \pm 3.65$) and non-rehabilitated South East ($\bar{\chi} = 59.00\ Km \pm 11.08$). Groups, South West and South East were combined to form the group non-rehabilitated birds, the distance travelled ($\bar{\chi} = 55.02\ Km \pm 3.49$) was still less than rehabilitated birds ($\bar{\chi} = 74.31\ Km \pm 4.85$). The frequency of distances travelled by rehabilitated and non-rehabilitated were not independent (χ^2_3 47.31 p=.001) therefore all groups were divided into measured intervals; < 25Km, < 100Km, <250Km, >250Km, to test for proportionality and association at these intervals. There was a significant proportional difference in both rehabilitated and non-rehabilitated birds recorded in intervals <25Km,< 100Km and <250Km. Only interval > 250 Km was there no significant difference between the two groups (Table 5.12). Generally, there was a significant variance in the mean distance travelled by both groups of chicks (Figure 5.17) within the four intervals. Rehabilitated gull chicks travelled greater mean distances at the < 25Km intervals compared to non-rehabilitated birds (F_{467} =8.218, p = .017, t -9.246, p =<.001), <100km (F_{534} =9.002, p = .003 t -12.929, p=<.001) and > 250 Km (F_{35} =8.218, p =.007, t -2.416, p=.021). There was a no significant variance between the two groups at the < 250 Km interval (F_{129} =1.135, p = .289, t .434, p =.665) but for non-rehabilitated birds the mean distance was slightly further (162.10 Km ± 7.24). From 2007-2010 wild adult & chick ringing in South East produced 48 individual recovery events. During the same period, 326 rehabilitated individual birds were recovered. Figure 5.18 shows that the median survival days to the last event and distance travelled was not significantly different between the two groups (*U* days = -1.490 *df* = 1, p= .136, *U* Km = .905 *df* = 1, p= .366), non-rehabilitated South East birds (456.50 days) (60.61 Km) , rehabilitated (359.50 days) (64.80 Km).

The countries where all rehabilitated birds where observed or recovered numbered 10 in total. The most numerous sightings for individual birds were reported in England n=739 (79.8%), with further sightings in France (n=154). The single adult bird which was re-sighted at the Tampere Landfill site, near Taraste in Finland (61°30N 23°45E) qualified as the furthest record at a distance of 1,874km. Similarly, the single recovery in Lithuania near Palanga (55°55N 21°03E) at a distance of 1,454 Km was the furthest recovery of a juvenile rehabilitated Herring Gull found dead.

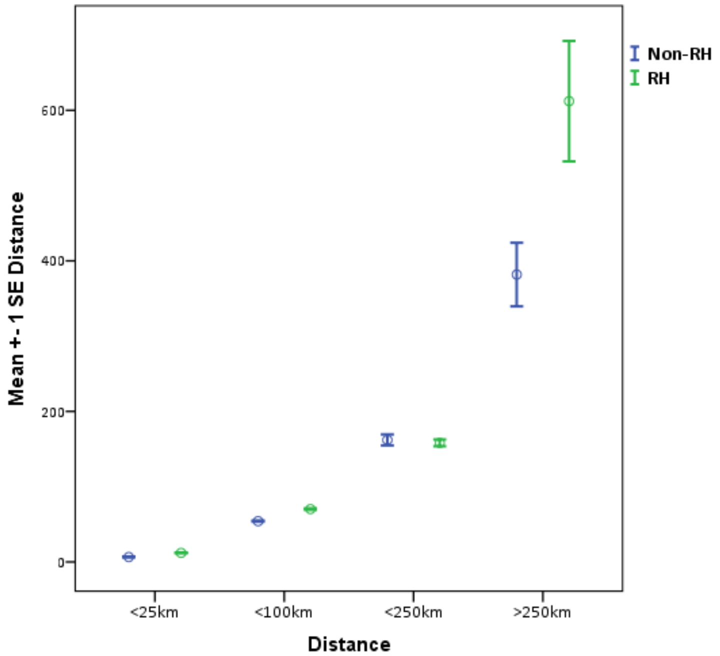


Figure 5.17 The mean distance travelled by rehabilitated, non-rehabilitated birds within the four measured intervals, ± 1 SE

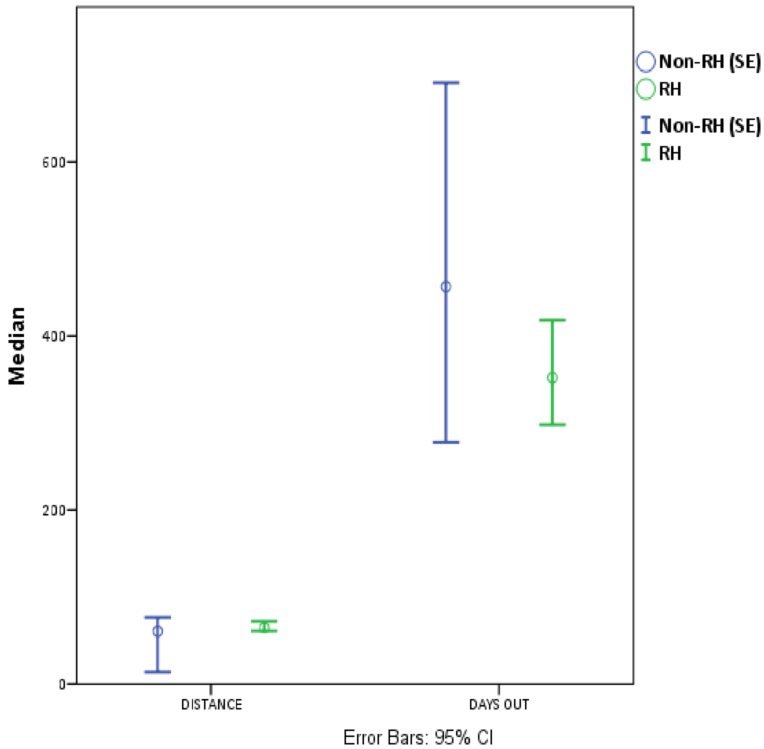


Figure 5.18 Median distance and survival time for all age groups of individual rehabilitated and South East non-rehabilitated birds 2007-2010.

Table 5.12 Mean values for distance travelled by rehabilitated and non-rehabilitated groups within the spatial intervals, showing a difference in the standard deviation as the distance increases.

Distance		Group_code	N	Mean	Std. Deviation	Std. Error Mean
<25km	Distance	Non-rehabilitated	178	6.53	5.900	.442
		Rehabilitated	291	12.00	6.401	.375
<100km	Distance	Non-rehabilitated	285	54.16	13.357	.791
		Rehabilitated	251	70.28	15.496	.978
<250km	Distance	Non-rehabilitated	31	162.10	40.355	7.248
		Rehabilitated	100	158.19	44.749	4.475
>250km	Distance	Non-rehabilitated	17	381.82	174.229	42.257
		Rehabilitated	20	612.15	358.204	80.097

C h a p t e r   V I

"When we return wild animals to nature, we merely return them to what is already theirs. For man cannot give wild animals freedom, they can only take it away."

-Jacques Cousteau

Discussion

The main objective of this study was to establish whether the rehabilitation of Herring Gull is an important enterprise and if they do survive in the wild. In this thesis I also experimentally tested the RSPCA rehabilitation protocols (Appendix A) for the rescue and release of orphaned and traumatised Herring Gulls.

There were three extrinsic factors, time in care, year of admission and problem category and one intrinsic factor, age on admission that predicted the likelihood of release.
The results of this study showed that 52.1% of all admitted gull casualties were successfully returned back to the wild (Table 5.3), nevertheless when individuals euthanased within 48 hours of admission were removed, released birds increased to 84.1%. However, this showed some variation over the 12 years (Table 5.1). Annual fluctuations in mortality rates are related to a number of confounding variables. The two main biotic factors that had a negative effect on the annual release rate were, (1) increase in admissions owing to a sudden influx of nestling or fledgling birds due to unsettled or hot weather and (2) outbreaks of botulism in adult birds during the breeding season. In June 2005, unsettled weather fluctuating between heavy rain and above average temperatures in the South East (Met Office) corresponded to an unprecedented increase in the number of small orphan birds admitted. Consequently, release rates significantly dropped to 38.5% (Table 5.1) which was 35.3% below the expected count for that year. Capacity levels for admissions are arbitrarily fixed by staff during daily reviews, but bottlenecks occur when fledgling birds require space to develop and water to bathe. An abiotic factor that also directly affected the release rate is the transfer of birds from other rescue centres who have exceeded their own holding capacity and need to move birds onto a larger centre with pools. To resolve these issues in subsequent years additional holding areas with pools are made available during June & July and transfers from other organisations are

restricted. Overall, the mean release rate compares favourably with those published studies of rehabilitated birds such as, Mallard *Anas platyrhynchos* (58.25% & 74.2%), Wood Pigeon *Columba palumbus* (45%) and Eurasian Sparrowhawk *Accipter nisus* (24%) (Kelly and Bland, 2006; Drake, 2007; Kelly *et al.*, 2011). Across the range of species taken into wildlife centres, many have limited reasons of admission compared to the Herring Gull. As previously mentioned, Mallard ducks are almost exclusively orphaned birds and Guillemots are solely affected by oil pollution.

This study showed that various admission categories in Herring gull, offered different release rates, each related to the severity of injury or poor prognosis for release. In Table 5.4 the highest release rate observed 78.5%, but not the most numerous admission (7.7%), was for 'Inexperienced juveniles' birds. These birds are generally healthy, displaced large fledglings which have accidentally fallen from nests or maiden flight birds found wandering along roads or in gardens. Occasionally birds will have minor injuries, but will not remain in the centre for long periods of time. It is therefore unsurprising that these birds are successful candidates for rehabilitation and this correlates to the likelihood predictor for days in care of 14-30 days (Table 5.5). The most numerous admissions were 'Orphan' (37.1 %) chicks (Table 5.2); naïve, small dependent birds requiring extended periods of time in care inevitably require some nurturing. However, Herring Gull chicks will self-feed quickly if given encouragement and companionship. The importance of contact with conspecifics ensures that birds do not become imprinted on humans and therefore increases the possibility of release. The release rate for orphan chicks was 72.5% (Table 5.4), this figure compares favourably with studies of other species taken into wildlife centres, for example little owl *Athene noctua* - 53.2% (Molina-Lopez and Darwich, 2011) Tawny owl *Strix aluco* 22% (Griffiths *et al.*, 2010).

Other categories which corresponded to anthropogenic origin showed less predictable release rates (Table 5.4). The rise in the number of birds caught in netting may be attributed to the increase in the use of netting to prevent birds from nesting on buildings with a 49.1% increase from 2008 (Figure 5.3). Birds caught in netting affected all age groups, but predominantly adult birds during territory establishment in the pre-breeding season during May and June (Figure 5.6), but breeding and fledging put at risk young birds exposed to the hazards during precocial explorations around the nest-site in July. Release rate for 'caught & entangled ' birds is dependent on whether the injuries involve ligations around limbs, if this was not the case, the release rate was high at 63.3% (Table 5.4) and the numbers of days in care between 14-30 days, the optimum time for a successful release (Table 5.5). Post release recovery data for this category of admission was found to be 25% (Table 5.7), less than the mean, but indicating that individual birds recover after this trauma. A similar release rate was found in birds admitted with fishing litter issues and injuries, with 66.7% being released (Table 5.7). The seasonality of fishing injuries is confined to the summer and early autumn, (Figure 5.6) peaking in August during the school holidays and fair weather fisherman. Subsequently, post- release survival of this category showed a recovery rate of 35% (Table 5.4) which confirms that once the issues have been rectified, and after a period of spatial and temporal correction, survival should be comparable to wild conspecifics. Another anthropogenic problem encountered were birds which had been 'Shot'. The release rate for this category indicated that the likelihood of release was poor at 26.6% (Table 5.7). In 2006 the installation of an X-ray machine as a diagnostic tool was installed in the wildlife centre. This allowed the centre veterinary surgeon to confirm the presence of air gun or shotgun pellets and consequential injuries. Pre -2006, many flightless birds were given time to regain fitness and flight, but may have been taken to the local vets after a week, a 24 Km round trip, for an X-ray to diagnose the reason for poor progress. The number of birds categorised as "shot" increased from 2006 (Figure 5.3) with an alteration in the protocol for flightless birds, which instigated routine X-rays taken within 24 hours of admissions, specifically for adult gulls. This procedure then determined whether the removal of the pellet is feasible and if flight or locomotion will ever return. The decision to release a bird with a pellet still remaining in the body is certainly not an easy one. A study of lead exposure in mallards revealed that many birds trapped and X-rayed had lead shot in muscle (Tavecchia *et al.*, 2001). Examining the recovery rate for this category the post-release survival appears good at 50% (Table 5.7), but examination of the individual recoveries indicated that two birds were found dead inside 14 days and within 1Km of the release site. Almost all the admission categories, with the exception of orphan and inexperienced juveniles, involve all age groups. Table 5.5 reviews the intrinsic factor age and time in care to predict age groups most and least likely to be released. Adult birds were the group least likely to be released. As mentioned previously, adult birds are confronted by multiple hazards and risks when occupying urban environments and so it is expected that the injuries sustained will be life threatening and in many cases euthanasia is the kindness option, preferably on admission.

Post release survival results indicated that the survival of rehabilitated urban gull juveniles was comparable to that of wild chicks ringed in South East and South West England (Figure 5.14).

Total recovery rates differed in comparison due to a skewed number of ring re-sightings from birds released in the South West (Figure 5.14). The considerable numbers of sightings of birds in the Gloucester, Bristol and Cheltenham areas are due to the Severn Estuary Gull Group (SEGG) efforts to re-sight and identify individually ringed birds of which the majority were ringed by the group. Peter Rock, co-founder and who for over 30 years has personally ringed more than 1,671 Herring Gulls, estimates that, on average, members of the group may spend up to 150 hours per month at landfill sites within the South Estuary Region observing gulls. Figure 5.15 shows the range of events – re-sightings, found dead or alive taken into care, for individual birds from both groups. The maximum re-sightings for a single bird from the South West was 208 (mean =22.8) and rehabilitated birds 39 (mean= .72). Despite over 690 sightings reported in the Hastings area and Dungeness, these figures cannot compare with the concerted effort by the Severn Estuary Gull Group. When the time interval between the groups was examined, the days to the last event was proportionally significant for all but < 4 years (Table 5.10). This indicates that rehabilitated birds survival was proportional to wild chicks during this time interval. The bias of juvenile bird sightings is generally due to colour ring observers wishing to know exactly where the birds were ringed. The origin of ringed gulls in the Western Palearctic could be from a number of European colour ringing schemes, especially in the Netherlands, Belgium, France and Poland. Knowledge of the place ringed may indicate the sub-species of the individual, especially less common birds for example, *L. cachinnans or L. michahellis*.

Survival based on ring recoveries of dead birds has always formed the foundation of comparisons between rehabilitated and non-rehabilitated birds (Sharp, 1996; Jessup, 1998). Joys *et al* (2003) rigorously analysed ring recoveries to investigate the effectiveness of rehabilitation in the UK and consistently found that most taxa or species of bird that underwent a period of time in captivity had a poor survival rate. Species which fared better were Common Buzzard *Buteo buteo*, Mallard, Mute Swan *Cygnus olor* and Eurasian Sparrowhawk. Species which exhibited poor survival rates included; Guillemot, Gannet *Morus bassanus*, Little Owl, Barn Owl *Tyto alba* and Herring Gull. However, results from this study on rehabilitated gulls were encouraging. Embracing analyses comparable to that used by Joys *et al* (2003), rehabilitated juvenile birds released in this study survived better than the wild chicks (BTO data 2003, KSa = 1.65, p = 0.05 , Thompson data 2012, KSa =.778, p = .579).

The distance travelled by each individual was calculated using the release site and the location showing the maximum distance. Overall, the results indicate that rehabilitated birds did travel further than non-rehabilitated birds (Figure 5.17). On further investigation the frequency of observations for each group within the distance interval was significant in all, but < 250Km (Table 5.12). The reasons for this result are not clear due lack of data on individual movements between sightings and therefore the inability to establish if seasonal movement or home range data are an influencing factor; these were not explored in this thesis. However, natal philopatry in seabirds (Coulson and Coulson, 2008) could account for wild chicks remaining within or returning to natal sites in order to acquire territories. Displaced juvenile birds which enter a rehabilitation centre may not acquire this innate behaviour and establishing a home range may need to be learnt.

One of the criteria often offered as a measure of rehabilitation success is whether rehabilitated animals are successful at rearing progeny and so contributing to wild populations. There is some evidence of rehabilitated birds successfully breeding in the wild. An example of Herring Gull breeding success has occurred on the roof of the wildlife centre and adjacent bungalow (pers. obs). In May 2008 a male Herring Gull with a metal ring commenced territorial displays and successfully paired with a ringed female, usurping her from the resident male. During the nest site establishment, the bird was captured when it was embroiled in a beak to beak fight with the now deposed male. The metal ring (GN14219) was read and this revealed the bird had been released from Pett Level, East Sussex, in July 2000. The bird was fitted with an additional Darvic ring-code A6WM as the original yellow Darvic ring was lacking. In 2008, the bird successfully hatched one egg from two, but the chick perished. In 2009, A6WM was back, with we assumed to be the same female and this year three chicks successfully fledged. In 2010 only one from two eggs fledged and similarly in 2011 only one from three eggs fledged. In 2012, all three eggs hatched and all fledged, but this was a different female. During the last six years the number of gulls returning back to the rehabilitation centre has increased, with rehabilitated birds establishing nest site on two other buildings. There has only been evidence of males returning back to the site as pioneers, but A6WM is present to defend the nest site for nine months of the year, only absent from September to early December. To endorse the fecundity of rehabilitated birds, the offspring have also been Darvic ringed and re-sighted alive in Shoreham and Horsham, with one bird returning back to the nest site a year later during the spring (pers. obs.)

Direct intervention has always been seen to be the correct course of action when presented with a sick or injured wild animal, but is intervention always necessary? The action of capture and confinement has a negative effect on wild animals and poor capture technique and unsuitable transport box could cause morbidity or mortality (Dmytryk, 2012). There are isolated incidences where wild animals adjust to injuries or illness and survive without human intervention. A study of *L. fuscus* gulls in Netherlands (Camphuysen, 2011) after a mystery oil spill affected birds during the breeding season showed that small patches of oil will disappear through "weathering off" or deliberate removal from routine preening by the bird. In 46 cases of colour ringed birds observed, only two died, but the majority of birds continued to incubate eggs and rear chicks.

In free living birds there is much evidence from BTO ringers that passerine birds such as Tits, *paridae* and Finches, *fringillidae* are caught in mist nets with missing limbs (Redfern and Clark, 2001) or with conditions such as papillomavirus (Literak *et al.*, 2003; Pennycott, 2003). These birds appear at the time of capture to be coping with the disadvantages caused by disease or injury. Observations of wild gulls *Laridae* and waders occasionally have a missing leg or the lower part of the tarsus removed (pers. obs), most probably due to fishing line ligation or as fledglings in the nest. These birds will adapt to the injury by spending time on water or flying, but over time the limb will atrophy and fall off. This is supported by the admission of two adult gulls in 2001 & 2004 with a lower limb missing, but from unrelated causes of admission which was botulism and collision. In almost all cases where birds are admitted into the wildlife centre with fishing line or netting and consequently severe damage has occurred to the limb, the veterinarian would euthanise the bird. The option to surgically amputate above the encircling wound has not been recommended in my experience, as adjustment to the disability in captivity is poor. It may also contravene sections of the Animal Welfare Act 2006 relating to unnecessary suffering by a reduction in fitness and the animals inability to survive post release. This would be dependent on the definition of whether there has ever been prior ownership or dominion of the individual.

Rehabilitation has always been a controversial discipline to define whether it essentially focuses on animal welfare issues or contains elements which may have conservation values (Aitken, 2004). The action of taking in an injured or orphaned animal will automatically alter the animal's behaviour and in some circumstances such as lack of predator avoidance, increase mortality and/or reduce the chance of survival back in the wild. Post release monitoring is in many ways the only method of measuring the success or failure of intervention in natural or anthropogenic occurring events through wildlife rehabilitation. Without the BTO ringing scheme, which is primarily to measure the survival and dispersal of free-living birds (Baillie, 2001), rehabilitators would be limited in the use of existing systems and procedures to ring rehabilitated birds.

However, in most of the 800 wildlife centres in the UK (Grogan, pers. comm.), very few undertake studies involving post release monitoring and certainly far fewer are published in peer reviewed journals. This figure has increased in the past six years with a number of studies being accepted in journals (Mullineaux, 2007; Kelly *et al.*, 2008; Leighton *et al.*, 2008; Murn and Hunt, 2008; Kelly *et al.*, 2012), with an emphasis on accountability of procedures and post release survival.

The colonisation of towns and cities by avian species is not due to one single cause, such as an easily available food source. The waste management industry followed post war prosperity with a consumer led economic growth which could go on for ever and producing endless waste which needed to be disposed of. In the 1970's that increase required more and more landfill sites.

In Northern Ohio on the Great Lakes the foraging and diets of two colonies of Herring Gull and Ring Billed Gull *larus delawarensis* were compared. Both species used landfill sites for food, travelling the 26 km to forage, but Ring Billed Gulls were more dependent on this food source (98% of the mass/g from anthropogenic sources compared to Herring Gulls 71% mass/g: (Belant *et al.*, 1998). In Hamburg, Germany Rutz, 2008 examined six non-mutually exclusive hypotheses for the invasion of urban Northern Goshawk *Accipter gentilis*, each with an environmental factor; easily available prey items, safe and available nest sites and lack of competition. From an ecological perspective, rehabilitation could be viewed as a chance factor (Skelton, 1993) contributing to balance the additional selective agent introduced through human activity. It cannot be ruled out that anthropogenic pressure will play an integral part of the survival in those species selecting to breed or live in close proximity of humans. Animals that select an unsuitable territory or nest site would be selected out and their offspring would not survive, so the strategy used by roof nesting gulls is high risk, but high reward with supplies human food waste and nest sites; although not true parasitism it has aspects of commensalism. The question whether rehabilitated animals can supplement failing populations hasn't been sufficiently explored in journals or literature. The African penguin *Spheniscus demersus* is a species listed as endangered on the IUCN red data list as there is a declining population (IUCN, 2012). This species has suffered numerous major and incidental oil spills off the Southern tip of Africa. The largest spill *MV Treasure* in 2000 (Crawford *et al.*, 2000) affected 19,000 birds only six years after the previous largest spill in 1994, *Apollo Sea* (Underhill *et al.*, 1999) affecting 10,000 birds. In both spills remedial action was taken to assist oiled birds and in the case of the *MV Treasure*, translocation of populations away from the spill to allow dispersal and biodegradation of oil to occur (Wolfaardt *et al.*, 2001). If no action had been taken in both these high profile incidents, then vast numbers of birds would have perished and with a population that has declined by 60.5% in 28 years (Crawford *et al.*, 2011) to an estimated at 25,262 pairs in 2009, this species could be critically endangered or close to extinction. Although the Herring Gull is not endangered, the numbers of the race *argenteus* are declining in natural habitats. As the populations appear to decline, conversely, the number of birds entering rehabilitation has increased annually by 30.8% over the 12 year study period (Figure 5.1). The origin of the recent decline in the population is not fully understood, but the closing of landfill sites (Belant *et al.*, 1998), increase use of deterrents and adult birds being affected by botulism has been suggested in the UK and Europe (Rock, 2005; Soos and Wobeser, 2006; Neimanis *et al.*, 2007; JNCC., 2012; Sonne *et al.*, 2012). With the reduction in breeding birds this may have a lag effect on productivity which shows a declining trend from 0.6 chicks per pair in 1986, to 0.4 chicks per pair in 2011 (JNCC., 2012). Botulism admissions during the 12 years contributed 12.7% of all admissions and with successful treatment of 379 birds (Table 5.4), which totalled 13.5% of all releases. The re-sighting rate for botulism birds showed that the recovery rate of 29% (Table 5.7) was acceptable and that the rehabilitation of birds admitted in this category is not only worthwhile from an animal welfare viewpoint but also at a population level due to the large number of adults returned back to the wild. As in many city species, urban gull populations may act as a demographic reservoir for regional populations when the capacity level has been reached and vice versa.

6.1 Conclusion

Rehabilitation of wild animals provides an important link between our innate desires to care for the more vulnerable and the natural world. However, it is imperative that personal opinions and prejudices do not obscure our understanding of factors required to provide humane and appropriate actions which benefit the individual animal. The subjective opinions of rehabilitators to what constitutes humane treatment of an individual casualty can be difficult to quantify. Legislation such as the Animal Welfare Act (*Animal Welfare Act*, 2006), if enforced, will safeguard against animal cruelty and suffering. Although the act primarily applies to domestic, farm and captive animals, it's essential that during the period of captivity a wild animal experiences while in rehabilitation, elements of the statute such as Prevention of harm (Unnecessary suffering, Section 4), Promotion of welfare (Duty of person responsible for animal to ensure welfare, Section 9) and Codes of practice (Section 14) need to be satisfied.

I have emphasised throughout this study the importance of accountability, both ethically, in the euthanasia of severe cases upon admission, and scientifically, through the implementation of post release monitoring. Understanding which factors contribute to the survival of wildlife casualties during the rehabilitation process and the subsequent post release survival were a fundamental component of the research for the study. That said, concentrating on a single bird species through the rehabilitation process has advantages which includes less confounding biotic variables, but also limitations if some of the results or recommendation were applied for example to a terrestrial mammal. Nevertheless, the pivotal principles employed in the study are transferrable to other taxa of birds and should yield similar information.

The collation and implementation of the species' protocols within RSPCA wildlife centres has created standards which are seen as best practise. The protocols were a merger of all four centres methods without qualifying the procedures through retrospective examination of admission data or post release survival results. However, during the consultation process between the four centres, differences in husbandry and diets highlighted that custom and practise and "we have always done it this way", still prevail. Even so, I would acknowledge that the experience of individual rehabilitators is tantamount to any written document professing to be the definitive method to rehabilitate species of wild animal. Given that all the admissions, in theory should have been sourced from wild populations, a complete understanding of the species in the natural environment is not just desirable but essential for those caring for the casualty animal. Those who rehabilitate sick and injured wild animals will always need to justify their actions or continue to be scrutinised by those who believe that there is no second chance in the natural world. Initiation of an open dialogue or forums within the fraternity of rehabilitators will improve techniques and procedures, potentially alleviate suffering. Post release monitoring of animals is paramount if the treatment conducted and period of captivity are to be validated or reviewed if there is unintentional suffering imposed on those individuals, as well as poor survival rates.

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Appendix A Abridged RSPCA Gull Protocol

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1 PRE-ADMISSION TREATMENT.

This part of the protocol is to provide information for telephone queries regarding gulls and their rehabilitation, prior to receiving a gull at an RSPCA Wildlife Centre. There are two possible scenarios:

A member of the public is reporting a sick/injured or orphaned gull and wants further information as to what to do.
Prior to admission, some animals may be held at a veterinary surgery or other facility. Some, if not all, of these facilities may request information on care of the animal, before they send it to an RSPCA centre.

Does the gull need to be admitted? Try to determine if the bird needs treatment, if it can be treated on site or left alone?

1.1 Information should be collected on the following:

a) Species (often a finding location helps with identification),
b) Extent of injuries, evidence of shock,
c) Body condition, any previous injuries,
d) Age of animal, dependent (non-flying) young (speckled plumage) normally able to fly or breeding adult (basic white plumage),
e) Location animal was found (important to ensure adults are returned to the same area, however, see section 5.4),
f) All records of previous treatment (if from another establishment).

1.2 Advice related to care, e.g. diet, provision of heat etc.

- Collapsed, sick or injured birds require heat but avoid heat where botulism is suspected.
- Don’t feed before transport

1.3 Advice related to the treatment of particular problems.

- All birds should be isolated to avoid fighting small chicks may be kept together.
- Recumbent animals need water and food bowls very close and regular cloacal washes to avoid heavy soiling.

1.4 Advice regarding the fitness of the animal for transport.

- Single adults and small groups of young are transported in a standard pet carrier of 30cm x 45cm x 25cm.
- Watch for heat build-up in boxes containing a number of chicks.
- Ensure boxes are sound when carrying adults.

2 HEALTH AND SAFETY

2.1 Introduction

The RSPCA has developed the Wildlife Centre Protocols to provide guidance and advice on the keeping of certain species of wild animal for rehabilitation. Anybody who intends to treat sick, injured and/or orphaned wild animals must accept that there are risks in doing so. Some wild animals are potentially dangerous and may be capable of causing serious injury. Furthermore, all wild animals have the potential to carry parasites, disease and bacterial infections. Some of these may be passed to humans (zoonoses) or to other animals, either domestic or wild. Barrier nursing methods should be used to minimise the spread of these infections between animals.

***2.2** Risk assessments*

It is recommended that any establishment admitting gulls should complete risk assessments for all areas.
This is a brief summary of some of the possible risks and suggested ways to reduce the effects.

Members of public are advised to use gloves or a suitable alternative (e.g. towel) when handling gulls and to keep dogs etc away from injured wildlife.

Hazards	Control measures	Level of risk
Bites and scratches	Gloves to be used when restraining	Low
Diseases/Zoonoses Campylobactor	Gloves should be worn when handling and wash hands after handling Face masks when washing down enclosures and handling young birds. Treatment areas must be cleaned thoroughly after examination	Low
Parasites	Gloves should be worn when handling	Low

3 DECISION MAKING – TO TREAT OR NOT TO TREAT

3.1 Information should be collected on the following:

A range of information is required to arrive at the most appropriate decision for the animal in care. Information collected under 1.1 on page 85 will be used to make an assessment, as will observations of the bird itself. A veterinary opinion will be taken into full account where necessary.

3.2 Triage

3.2.1 ASSESSMENT RELEVANT TO THE CONDITION OF THE ANIMAL

Options for the animal are: euthanasia, treatment or immediate return to the wild. The considerations listed below will help to guide this decision as many of these conditions indicate a poor survival to release.

Table 1: Conditions that normally indicate euthanasia (see notes below)

Severely and obviously broken wings	PTS
Obviously broken legs	PTS
Broken coracoid (usually identified on x-ray)	PTS
Two limbs missing	PTS
Birds with freshly missing leg	PTS[1]
Orphans with severe secondary problems	PTS[2]
Oiled birds with other problems	PTS
Old breaks	PTS but see notes
Birds showing signs of angel wing	PTS[3]
Any deformity, most often of the beak	PTS
Blind in one or both eyes	PTS

- Euthanasia may also be considered where the bird is unable to lift its head and/or grip firmly with the beak due to severe weakness. Gulls suffering from these symptoms are usually recommended for PTS but some success has been achieved with these cases. These symptoms may indicate the bird is suffering from botulism.
- It should be noted that as these birds are (mostly) large and robust many minor injuries can be treated with success.

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[1] Birds admitted with one leg and which have survived well with that one leg may sometimes be rehabilitated. Full details of the reasons for admission and site of finding must accompany the bird, as this can be essential to the decision-making process.

[2] Minor injuries may be treated in certain individuals.

[3] Although noted as a condition for PTS it is rarely seen on admission. Carpal wing problems in chicks are possibly due to intraspecific conflict at nest site.

3.2.2 ASSESSMENT RELEVANT TO THE CENTRE AND THE MANAGEMENT OF THE ANIMALS

- Is an experienced vet, Wildlife Assistant or wildlife centre supervisor available to see the animal within an appropriate time-scale?
- Is suitable housing/space available to accommodate the animal according to this protocol?
- Are current staffing levels sufficient to give the bird(s) the time required for good rehabilitation?
- What is the predicted intake of animals in the short term?
- Admission numbers will be controlled carefully to avoid overcrowding. Bottlenecks occur when high admissions of small chicks coincide with high incidence of botulism in adults
- A good supply of quality fish must be assured.

3.3 Treatment on admission

3.3.1 IF ANY OF THE FOLLOWING ARE IDENTIFIED PROCEED TO VET EXAMINATION.

- Refer all conditions except apparently healthy chicks and juveniles on maiden flights that may just be “grounded”.
- X-ray all grounded adult birds that do not appear to have symptoms of botulism. This is particularly important where birds are likely to have been shot.

3.3.2 IF NONE OF THE PROBLEMS IDENTIFIED IN 3.3.1 ARE IDENTIFIED.

- Place individual ID ring on every admission. Can be plastic or aluminium but avoid confusion with British Trust for Ornithology (BTO) rings. Use any colour except yellow or red rings as these may cause minor aggression between individuals.
- The use of biometrics is a good way of assessing where chicks and fledglings should enter the system. Measure the wing chord and weigh the bird recording both pieces of information.

Housing

The progression from *Indoor1* to *Indoor 2* to *Outdoor 1* to *Outdoor 2* represents the movement of an animal through the Centre as its condition improves. Not all of the categories will be applicable to all these species, their condition etc. The need for environmental enrichment should be considered and identified wherever possible for each of the following sections.

3.4 Indoor 1 (Intensive care)

Enclosure

Avoid any accommodation with bars or wire mesh for birds of any age. If door has bars, blinds (eg towels placed on the inside of the bars) are used to prevent problems such as damage to the forehead and primary and tail feather breaks and abrasions.

Use a suitable plastic or cardboard box/pet carrier 30 x 45 x 25 cm for:

- Sick, collapsed and injured birds and
- Small chicks under 200 – 250gms.

Chicks can be creched with animals of similar age from admittance in container described above in groups of 2 – 3. Monitor to make sure all birds are feeding and there is no bullying.

Larger accommodation is used for older birds and those that can stand:

Young	60 x 40 x 45
Adult	70 x 40 x 45
Great black-backed gull	71 x 71 x 71

Table 2: Accommodation sizes

Sick, collapsed, cold or thin adults or newly hatched chicks will be given a heat pad placed to the side of the container – this is particularly important for single birds.

Keep great black-backed gulls separate.

Lighting

- Room lighting and normal daylight hours sufficient

Substrate

- Layers of newspaper that can be removed regularly to avoid heavy faecal build-up.
- Towels placed over thick newspaper can be used for recumbent adults, immature birds and large juveniles.

Temperature

- Chicks and sick, emaciated and lethargic young birds and adults should have heat provided. *Vet-bed* including a heated pad for additional heat – this is usually placed alongside of the container.
- Feathered young and injured but bright adults can be kept at room temperature.
- Waterlogged juveniles (usually wet following their maiden flight) will require carefully monitored heat for revival.
- For notes on the thermoregulation of young see O'Connor 1984[i]

Ventilation

- Ensure good ventilation at all times.

Access to Water

- Water for chicks provided only through moist fresh fish provided in small shallow bowls. Do not provide a separate water bowl – this will prevent chicks sitting in water and becoming wet and chilled.
- Adults and immatures are provided with fresh water in a 18cm diameter steel non-spill bowl.

Environmental Enrichment

- For chicks companionship is essential.
- Always match chick weight for weight. Smaller chicks can be mixed with larger but may require feeding for tweezers until seen feeding for themselves..
- For adults in this accommodation they will be sick and due to the possibility of limited space will rarely be provided with additional enrichment (other than food and water). BUT move these birds on as soon as possible.

3.4.1 WHEN TO MOVE TO NEXT STAGE:

Chicks:

- Herring and lesser black backed gull chicks should weigh between 200 & 250gms and/or be self-feeding.

Adults and immatures:

- These should be standing confidently and be self-feeding.

3.5 Indoor 2 (Less intensive monitoring)

Enclosure sizes are all measured in metres (m) by length x width x height.

Enclosure

- Pen or cubicle 2.5 x 1.5 x 2.5m with the ability to take some water facility – see enrichment, later.
- Herring and lesser black-backed gulls are moved into larger areas such as open-topped bays or larger cubicles up to and greater than 2.5 x 1.5m.
- Birds can be creched together.
- Continue to avoid overcrowding and watch for bullies isolating as necessary.
- Adults and immature birds with limited flight and that are still being monitored (eg weight build-up or confirmation of flight) can be moved into a cubicle.
- In these enclosures they will usually stay calm but at early signs of stress birds should be moved on to next stage of accommodation.

Lighting

- Room lighting following normal daylight hours is sufficient.

Substrate

- These areas all have a concrete base incorporating a drain.
- For all ages soft flooring to prevent sores is used: blankets, sheets, *Astroturf*, large towels, rubber mats are all placed over thick newspaper. WARNING: rubber mats may be pecked and destroyed - be vigilant against swallowing.
- Chicks will benefit from the provision of ledges (see environmental enrichment).
- Adults can be provided with a further covering of newspaper to reduce excessive soiling of their plumage and to help maintaining hygiene.
- The production of large amounts of faecal matter during this stage presents a cleaning challenge but regular attention to newspaper changes and "squeegee-ing" areas will keep areas clean.

Ventilation

- Needs to be good.

Access to water

- Provide a pool or large 80 x 30 x 10cm deep water containers to bathe in and encourage preening.
- Introduce water gradually ie just enough to paddle in at this stage start with only 25mm and build up.
- Chicks indoors will be provided with small drinking containers to discourage bathing.

Environmental Enrichment

- Companionship is important but watch for bullying. Isolate bullies as necessary.
- Provide perches in the form of "*Thermalite*" or concrete blocks 45 x 25 x 10cms or cardboard boxes gives access to height. These may reduce contamination of large areas by concentrating droppings in a smaller area.
- Cardboard boxes also provide access to a material that can be pecked and destroyed. This may also reduce aggression to other gulls in care.
- As the birds' feathers develop more enrichment can be provided dropping food items such as day-old chicks for additional enrichment.
- Change enrichment frequently and at irregular intervals to avoid boredom.

3.5.1 WHEN TO MOVE TO NEXT STAGE:

- All birds should be eating well on their own (established by observations) active, waterproof and beginning to make flight.
- Chicks will be developing contour feathers on back and chest. Probably no primaries but may have a little growth to the tail. Herring, lesser black-backed and greater black-backed gulls chicks will still have downy, brown spotty head.
- Weighing will be required for birds under par and/or those that are still on treatment.
- Adults and immature birds can go from here to outdoor 2.

3.6 Outdoor 1

Enclosure sizes are all measured in metres (m) by length x width x height.

Enclosure

- At this stage it is vital that birds have access to clean water to bathe and clean their plumage.
- An enclosure sized 5.5 x 4.5 x 2.5m with sides and roof netted. Sides should be solid for 1 metre from the ground.
- An aviary with a pool is ideal. Ample space for standing must be provided although concrete sides need to be covered with softer material to prevent foot damage. The water will need to be changed twice a day. If no pool is available, large dog beds filled with water can be used. The water will need changing 4 to 5 times a day in this instance.
- A ledge placed off the ground provides high perching.

Substrate

- Concrete base incorporating a drain for easy cleaning.
- Rubber mats or *Astroturf* to protect feet.

Shelter

- Solid side protection should provide sufficient shelter and prevent feathers and beaks poking through mesh. Should not need covered areas, as birds should be waterproof.
- Any waterlogged birds at this stage need further investigation.
- In really bad weather or for vulnerable individuals half *Vari-kennels* or a covered area of the aviary may provide some shelter.

Access to Water

- Provide pool or large container of water preferably with graduated sides.
- Water should be deep enough for bathing and swimming 15 – 20cms

Environmental Enrichment:

At this stage water for both chicks, juveniles and adults is essential and for some will provide enough enrichment on its own but any further activity will always be welcome.

Chicks and juveniles

- The young will investigate all things in the aviary; feathers, twigs, leaves, stones – anything!
- Thick straight branches and chunky blocks to perch on, to peck at and investigate.
- Cardboard boxes are used for shelter and for pecking to destruction.
- Companionship and interaction with other gulls.
- Provision of dead day-old chicks at irregular intervals will provide enrichment as the birds pull and tear the food apart.

Adults

- Little enrichment is required but perches - logs, ledges and blocks – provide flight opportunities and perching.

3.6.1 WHEN TO MOVE TO NEXT STAGE:

- Chicks – now juveniles - will have only contour feathers and primaries that will extend past the end of the tail.

3.7 Outdoor 2

Enclosures

- Larger enclosures dominated by water areas of approximately 7m x 5m are suitable. Ledges are provided for standing and feeding.

Substrate

- Rubber matting distributed around pool sides or where appropriate grass sides.
- However, if outside paddocks are used natural turf and earth is quite appropriate.

Shelter

- These enclosures are almost exclusively used during the summer when admissions are at the highest. Very little shelter. Birds have been assessed based on their ability to thermoregulate and their plumage should repel even the heaviest downpour.

Access to water

- Lots of water are needed at this stage. Water is changed up to twice a day where large numbers are housed. At all times, the ability to maintain a reasonable level of hygiene is paramount. The careful management of faeces in this area is essential.

Environmental enrichment

- The pools provide bathing and perching opportunities. Essentially an area for pre-release assessment.
- Enrichment is predominately through foraging where the birds may find natural twigs, leaves and stones.

3.7.1 WHEN TO MOVE TO NEXT STAGE:

The next stage is release. See section 5.2 on page 95.

4 DIET

4.1 Semi-natural captive diet

Table 3: Adult diet in captivity

Species	Food type	Amount/frequency
Herring, lesser and greater black-backed gulls	Sprats Day-old chick Whitebait sandeels	Feed *ad lib* but usually the equivalent to between 10 and 20 sprats per bird per feed. 1 day old chick daily per bird Give all foods fresh twice daily, but top up food bowls regularly if eating all food. Food can also be scattered around the enclosure.
Kittiwake		
Black-headed gull and common gull	Mealworms can be provided in addition to the above.	

Table 4: Chick diet in captivity

Species	Weight range	Food type	Amount/frequency
Herring, lesser and greater black-	60gms-120gms	Finely chopped sprats or whitebait.	Large amounts offered in enclosures

backed gulls weighing between approximately:	120gms – 250gms	chopped sprats	to avoid competition. Very young chicks are primed 3-4 times daily, until self-feeding. Once self-feeding food is replenished 3-4 times daily. Food can also be scattered around the enclosure.
	250gms – 600gms	Roughly chopped and whole sprats offered simultaneously	
	Over 600gms	All sprats whole, rough chopped Herring or mackerel and a daily day old chick provided whole.	
Kittiwake		Whitebait in initial stages then whole sprats	
Black-headed gull and common gull		Whitebait & some insects	

4.1 Artificial captive diet

Adults & Young

- **No canned domestic animal foods are to be offered.**
- Fish is the preferred diet through all stages and will promote good quality growth.

4.2 Comments on feeding for all species

- No liquidized food is administered.
- Birds are encouraged to self-feed on whole or chopped fish. Severely in appetent animals will be blood tested and x-rayed by an experienced vet to investigate for possible obstructions or other problems. If the bird remains inappetent something is wrong and needs investigating.
- Critical care patients may be tube-fed *Zoolyte* or *Lectade* at the rate of 10% of body weight 4 times in any 24 hours, progressing to AD and *Zoolyte* after the first 24 hours.
- Providing some mealworms may encourage eating.

4.3 Environmental enrichment

- The provision of a variety of food items that the birds can manipulate and investigate and which does not involve pet food or vegetables is among the best enrichment that can be provided.

5 PREPARATION FOR RELEASE

5.1 Training the animal for survival

If birds have been "prepared" using the techniques and advice given above additional "training" may not be required.

5.2 When is animal considered fit for release?

Adults

- Maintaining good plumage by bathing daily.
- Flying well, weatherproof, no sore legions on feet, flight feathers in good condition.
- Adults become agitated, flying frequently and dominating high perches.
- Feeding may drop and with botulism cases, no further green faeces will be evident.

Juveniles

- All of the above.
- Chicks ready to go may eat less food and spend more time swimming than on the side.
- Chicks will drop weight prior to fledging so chicks may not reach the weights above.
- A wing chord of about 360mm in Herring and lesser black-backed gulls is a good indicator the bird is fully fledged.
- Great black-backed gull chicks have a much slower growth rate, so identify these early.

NOTE:
Good body condition score is important, as size may be quite variable in juveniles.

5.3 When to release

- A morning release is best.
- During settled conditions.
- On a receding tide if coastal release.

5.4 Where to release

Adults

- These are released back where they were found. If this is not suitable use the release criteria for juveniles.
- From current ring recovery evidence a release from the rehabilitation centre is appropriate for fully adult Herring, lesser black-backed or great black-backed gulls if the site of finding is less than 50 km distant from the centre.

- However release from a coastal sites that do not have high density of nesting birds may be preferable. Ideally they should not be released inland unless at a Landfill site during opening hours. (ring recovery evidence).
- Black-headed gulls are generally admitted out of the breeding season. Release at sites of known gull concentrations. The UK has large numbers of eastern European birds during the winter so birds could easily be part of this population. (Ring recovery evidence and controls)
- Common gull - Very few breed in southern England the birds found here are therefore mostly wintering population. Release into known common gull roosts and feeding areas.
- Kittiwakes. Always release at coastal areas.

Juveniles

- Herring, lesser- black-backed and great black-backed gulls are released at the coast, ideally at a site with a large tidal reach including rock pools and mudflats.
- Black-headed gull – ideal release will be at an inland water body if the birds are known to occur at these sites. Ideally release with other gulls of the same species.
- Common gull – These birds have a much localised distribution. There is a need to know the breeding distribution or regular occurrences at chosen site of release.

5.5 How to release

- A hard release is ideal for all gull species.
- Adults
  - ✓ Can be released singly or as part of a group.
- Immature
  - ✓ Ideally, immature, artificially reared chicks are released as a group.
  - ✓ Large groups can be successfully released (12 or more birds).

5.6 Information

The following measurements should be taken prior to release.

- Age
- Weight
- Bill depth & total head & maximum wing chord.
- Always check species has been identified correctly before ringing, as confusion between species is possible.

5.7 Marking requirements/tagging

- All gulls should be marked with authorised rings from the BTO. Colour rings can be used to track individual birds. Both activities are undertaken under license from the BTO.
- Ensure any temporary rings and other identification marks used by the centre are removed before release.

Appendix B Mallydams Wood Treatment Card

RSPCA

Mallydams Wood Wildlife Centre

Species	Age	Case	ID
		Ring	

Date	gms	Motions	Eating	Problems/Observations	Treatment	MS
					Diet	

MW-1

RSPCA

Species	Age	Case	ID
		Ring	

Date	gms	Motions	Eating	Observations/Treatment	Result details	MS

Date	
Age	
Weight	
Wing Length	
Bill Length	
Head + bill	
Toe + tartus	

Appendix C Example of a BTO Recovery Form

BTO Ringing Recovery Report Page 1 of 1

Mr P E Jones
Little Ashes
Hog Hill
Winchelsea
East Sussex
TN36 4AH

Rye Bay Ringing Group

BTO
Looking out for birds

11 May 2012

Dear Phil

Here are the details of a recovery of one of your birds.

Species: Herring Gull Scheme: GBT Ring no: **GC42105**

Ringing details

Age: 3 Sex: unknown Sex meth: - P.ringed: - P.alive: - Condition: C
Colour marks added: I Metal marks added: - Act1: - Act2: -
Colour marks left below knee: M, right below knee: WN(A5RR)

Ringing date: 24-Aug-2007
Reg code: PEL Place code: PEL Site name: Pett Level, Winchelsea, East Sussex
County code: GBESU Grid ref: TQ9015 Co-ords: 50deg 54min N 0deg 42min E
Hab1: C6 Hab2: --

Biometrics: Wing: -- mm. Weight: -- g. Time: --hrs

Remarks:

Ringer: Rye Bay Ringing Group, 9139

Finding details

Ring not verified Age: 8 Sex: - Sex meth: -
Colour marks added: - Metal marks added: - Act1: - Act2: -

Finding date: 11-Feb-2012
Reg code: --- Place code: RAI Site name: Rainham Tip, Greater London
County code: GBGLO Grid ref: TQ5278 Co-ords: 51deg 29min N 0deg 11min E
Hab1: F1 Hab2: J1

Biometrics: Wing: -- mm. Weight: -- g. Time: --hrs

Finding condition: 8:20 Movement: --
Controlled Intentionally Taken
Remarks:

Duration: 1632 days Distance: 75 km Direction: 331deg (NNW)
Finder: North Thames Gull Group, 9190

Reference 05032012DISC

BTO, The Nunnery, Thetford, Norfolk IP24 2PU. Tel 01842 750050 e: recoveries@bto.org w: www.bto.org/ringing
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