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KLEPTOPARASITISM IN BIRDS

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Abstract. Kleptoparasitism refers to the interspecific stealing of already procured food, but this paper shows that intraspecific food-stealing is effectively the same behaviour. A comprehensive review of the literature shows that certain orders of birds contain a disproportionate number of kleptoparasitic species. Birds in these orders occupy a limited range of ecological niches and are most commonly either predatory or dietary opportunists. Kleptoparasitism is particularly associated with certain ecological conditions, such as the availability of hosts feeding on large, visible food items and periods of food shortage. Birds show a wide range of socially parasitic feeding interactions of which kleptoparasitism is one extreme. The parasitic pattern of food-stealing is likely to involve frequency-dependent selection and may be an example of an evolutionarily stable strategy.

The term 'clepto-parasitism' or kleptoparasitism was introduced by Rothschild & Clay (1952) to describe the stealing of already procured food by individuals of one species from individuals of another. The same behaviour is also referred to as 'piracy' by many authors (Meinertzhagen 1959, 1964; Ashmole 1971; Nakamura 1972; Hatch 1975; Andersson 1976; Källander 1977) as well as 'food parasitism' (Hopkins & Wiley 1972), 'pilfering' (Rand 1954) and 'robbery' (Hulsman 1976). Although kleptoparasitism is a term that is generally reserved for interspecific stealing of food, the other terms are also used for intraspecific food theft, emphasizing the close relationship between intra- and interspecific feeding patterns. Kleptoparasitic behaviour is known to occur in other animal groups (Wilson 1971), but it appears to be particularly widespread among birds. Species such as frigatebirds (*Fregata* spp.) (Bent 1923; Nelson 1975), skuas (*Stercorarius* spp.) (Meinertzhagen 1959; Grant 1971; Ramsey 1973; Andersson 1976; Furness 1977; Arnason & Grant 1978) and some gulls (*Larus* spp.) (Schmidt 1954; Bergman 1960; Ingolfsson 1969; Hatch 1970; Fuchs 1977; Källander 1977) often procure a significant proportion of their diet through kleptoparasitism. Occasional acts of piracy have been observed in a wide variety of other bird species (see Appendix A).

Most of the recorded instances of kleptoparasitism include only descriptions of the behaviour in a particular species, with little attempt to provide an explanation. Only Rand (1954) has provided any broadly applicable hypotheses to account for the distribution of kleptoparasitism among birds or to demonstrate its relationship to other forms of intra- and interspecific feeding. In this paper we review the occurrence of kleptoparasitism among birds and the ecological conditions under which the behaviour emerges. We discuss food stealing as one of a number of feeding interactions. We also discuss the selective pressures acting to maintain kleptoparasitism as a feeding pattern in a population.

Taxonomic Distribution of Kleptoparasitism in Birds

We have reviewed the ornithological literature of the past 40 years, searching for descriptions of behaviour that could be called kleptoparasitic. Although undoubtedly incomplete, this survey is representative of the species which either kleptoparasitize or act as hosts. The survey (Appendices A, B, C) reveals that birds of some orders are more likely to develop kleptoparasitic habits than those of other orders (Table I). For example, only one duck, the American wigeon (*Anas americana*) is a regular kleptoparasite, although ducks are frequently found in mixed-species flocks and are the hosts of other kleptoparasites (Table I). Among such seed- or fruit-eating orders as Galliformes, Columbiformes, and Psittaciformes, kleptoparasitism has never been observed. Among the Falconiformes and Charadriiformes (particularly Stercorariidae and Laridae), many species have been observed kleptoparasitizing other birds. Although the vast majority of bird species are in the order Passeriformes, the incidence of kleptoparasitism between passerines and other birds is infrequent and sporadic. However, passerines are known to steal from

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Table I. The Occurrence of Kleptoparasitism between Birds

Taxon	No. species in taxon	No. klepto-parasitic species in taxon	No. species acting as hosts in taxon	No. species kleptopara-sitizing these hosts
Sphenisciformes				
Spheniscidae	18	0	3	6
Struthioniformes	1	0	0	0
Rheiformes	2	0	0	0
Casuariiformes	4	0	0	0
Apterygiformes	3	0	0	0
Tinamiformes	45	0	0	0
Gaviiformes				
Gaviidae	4	0	3	4
Podicipediformes				
Podicipedidae	19	0	3	5
Procellariiformes	99	1	7	12
Diomedeidae	13	0	1	1
Procellariidae	61	1	5	10
Hydrobatidae	20	0	1	1
Pelecanoididae	5	0	0	0
Pelecaniformes	58	8	10	23
Phaethontidae	3	0	1	1
Pelecanidae	8	1	1	7
Sulidae	9	2	4	6
Phalacrocoracidae	29	0	3	8
Anhingidae	4	0	0	0
Fregatidae	5	5	1	1
Ciconiiformes	123	7	8	20
Ardeidae	67	4	5	14
Cochleariidae	1	0	0	0
Balaenicipitidae	1	0	0	0
Scopidae	1	0	0	0
Ciconiidae	18	2	2	2
Threskiornithidae	30	1	1	4
Phoenicopteridae	5	0	0	0
Anseriformes	160	3	17	47
Anhimidae	3	0	0	0
Anatidae	157	3	17	47
Falconiformes	298	31	26	60
Cathartidae	7	1	1	1
Saggittariidae	1	0	1	2
Accipitridae	226	22	19	36
Pandionidae	1	0	1	5
Falconidae	63	8	4	16
Galliformes	270	0	0	0
Gruiformes	201	1	4	8
Turnicidae	16	0	0	0
Gruidae	15	0	0	0
Rallidae	130	1	3	7
Otididae	25	0	1	1
(other families)	15	0	0	0
Charadriiformes	325	32	47	132
Jacanidae	8	0	0	0
Rostratulidae	2	0	0	0
Haematopodidae	7	0	1	3

Table I continued

Taxon	No. species in taxon	No. klepto-parasitic species in taxon	No. species acting as hosts in taxon	No. species kleptopara-sitizing these hosts
Charadriidae	70	1	3	7
Scolopacidae	76	0	3	4
Recurvirostridae	9	0	0	0
Phalaropodidae	3	0	0	0
Dromadidae	1	0	0	0
Burhinidae	8	0	0	0
Glareolidae	17	0	0	0
Thinocoridae	4	0	0	0
Chionididae	2	2	0	0
Stercorariidae	5	5	1	1
Laridae	88	23	32	91
Rynchopidae	3	0	1	1
Alcidae	22	1	6	25
Columbiformes	313	0	0	0
Psittaciformes	327	0	0	0
Musophagiformes	23	0	0	0
Cuculiformes	132	0	0	0
Strigiformes	134	2	3	5
Tytonidae	9	0	1	1
Strigidae	125	2	2	4
Caprimulgiformes	98	0	0	0
Apodiformes	385	0	0	0
Coliiformes	6	0	0	0
Trogoniformes	36	0	0	0
Coraciiformes	205	2	2	2
Alcedinidae	91	1	0	0
Todidae	5	0	0	0
Momotidae	8	0	0	0
Meropidae	25	1	0	0
Coraciidae	16	0	1	1
Leptosomatidae	1	0	0	0
Upupidae	2	0	0	0
Phoeniculidae	7	0	0	0
Bucerotidae	50	0	1	1
Piciformes	397	0	0	0
Passeriformes*	5266	23	23	42
Alaudidae	78	0	1	1
Corvidae	110	8	4	6
Paridae	62	2	1	1
Sittidae	22	0	1	2
Cinclidae	5	0	1	1
Troglodytidae	67	0	1	1
Mimidae	35	1	1	1
Turdidae	312	3	7	19
Motacillidae	54	0	1	1
Laniidae	79	4	2	2
Sturnidae	109	1	1	3
Icteridae	94	1	0	0
Ploceidae	301	1	1	2
Fringillidae	459	2	1	2

*Only the families in which kleptoparasitism occurs are included.

insects and spiders' webs more frequently than are other species (Appendix C). The frequency of kleptoparasitism within an order does not appear to be simply a function of the number of species. Rather there appear to be common features between orders which make them more prone to develop kleptoparasitism. It is easy to see, for example, that kleptoparasitism is more common among predatory species such as raptors and gulls than among non-predatory species. What then are the patterns to the incidence of kleptoparasitism?

Interspecific Associations that May Lead to Kleptoparasitism

Association between two species is obviously a prerequisite for the development of kleptoparasitic behaviour. Interspecific associations occur: (1) where predators pursue prey, (2) where the members of one species mob a predatory animal, (3) where individuals forage in mixed-species flocks, (4) where individuals nest in mixed-species aggregations such as seabird colonies, (5) where animals join others in specialized feeding associations such as where one species acts as a 'beater' for another (Rand 1954) and (6) where members of one species feed on the products, scraps or parasites of another (Rand 1954).

1. Association Based on Predation

Many kleptoparasitic species also prey on their host or its young (Meinertzhagen 1959). For example, hawks and eagles prey on ducks and herons, skuas and large gulls kill grebes, auks and passerines, and shrikes hunt passerines (Appendix A). The victim is usually pursued and may well give up its food to the predatory bird as a form of anti-predator behaviour (Meinertzhagen 1941; Grant 1971). This behaviour can then be exploited by the predator as an easy route to already procured food. For example, Temple (1969) observed a turkey vulture (*Cathartes aura*) preying on live great blue heron chicks (*Ardea herodias*) which it took directly from nests. As the chicks grew, however, they were able to defend themselves by pecking the vulture or disgorging food which the vulture then ate or fed to its young. Puffins (*Fratercula arctica*) attempt to escape harassment from gulls and skuas by diving toward the ocean. If they cannot escape, they drop their food which diverts their pursuer (Grant 1971). There are also examples of predatory birds such as kites, accipiters, eagles, falcons and owls sateling prey both from one another (Appendix A) and from mammals (Appendix B). This behaviour usually involves chasing or directly snatching the prey from the other predator.

2. Association Based on Mobbing

When birds mob a predator, it may be carrying or feeding on a prey item. If the mobbing is successful and the predator driven away, food may be left behind which the birds can then eat. Such appears to be the probable origin of magpies (*Pica pica*) stealing prey from a golden eagle (*Aquila chrysaetos*) (Dixon 1933) and of crows (*Corvus* spp.) stealing from marsh hawks (*Circus cyaneus*), falcons (*Falco* spp.) and kites (*Milvus migrans* and *Haliastur sphenurus*) (Bent 1937; Tinning & Tinning 1970; Balfour 1973; Goodwin 1976).

3. Association Based on Mixed-Species Flocks

Kleptoparasitism is common among species which occur in mixed flocks (Rand 1954). Birds in these groups aggregate because of a common attraction to a rich food source or because they share the same habitat (Rand 1954; Friedmann 1967). In winter, migrant sandpipers, herons and ducks feed together along shorelines and on mudflats (Williams 1953; Meyerriecks & Nellis 1967; Recher & Recher 1969; Rees 1969; Goss-Custard 1970; Haverschmidt 1970; Siegfried & Batt 1972; Reynolds 1974a; Dawson 1975; Raffaele 1975); blackbirds (*Turdus merula*), song thrushes (*Turdus philomelos*) and mistle thrushes (*Turdus viscivorus*) are found on lawns and fields in loose mixed-species flocks (Snow 1958); house sparrows, starlings, pigeons (*Columba* spp.) and chaffinches (*Fringilla coelebs*) aggregate in city parks and gardens, on lawns and in farmyards; and various species of tits (*Parus* spp.) travel in loose mixed-species flocks, aggregating around feeding tables. In these flocks individuals frequently supplant or chase one another and show both inter- and intraspecific kleptoparasitism (Miller 1885; Snow 1958; Summers-Smith 1963; Bird et al. 1973; Kushlan 1978a, b; Schindler 1978; Barnard personal observation; Karlsson personal observation). Vultures (*Gyps* spp., *Torgos tracheliotus*, *Neophron percnopterus*, *Necrosyrtes monachus*), kites, marabou storks (*Leptoptilus crumeniferus*), magpies and carnivores congregate around a carcass and commonly fight or steal food from one another (Meinertzhagen 1959; Kruuk 1967; Brown & Amadon 1968; Houston 1975; Pomeroy 1975). Large numbers of gulls, fulmars (*Puffinus* spp.), terns (*Sterna* spp.), skuas, pelicans (*Pelecanus* spp.) and gannets

(*Morus bassanus*) follow fishing boats and aggregate around fish houses, and gulls are found in large numbers at refuse tips where intra- and interspecific aggression and stealing of food is common (Bent 1921; Flynn 1957; Meinertzhagen 1959; Boswall 1960, 1977; Nakamura 1972; Verbeek 1977b). Later in this paper we will discuss in more detail the relationship between intra- and interspecific food stealing.

4. Association Based on Mixed-Species Nesting Colonies

Kleptoparasitism occurs most frequently among colonial seabirds which are crowded together on small nesting islands (Rand 1954). Here, birds steal food from conspecifics as well as from other species which nest nearby. Adult common terns (*Sterna hirundo*) steal both from other adults and from chicks as they are being fed (Ansingh et al. 1960; Hays 1970). In mixed colonies of terns, the birds begin stealing from each other early in the season when they are carrying fish for mating displays. The attacks continue while they are feeding the chicks (Hopkins & Wiley 1972; Dunn 1973; Fuchs 1977). Gulls also nest in tern colonies, and they steal food from one another as well as from terns (Tinbergen 1932; Ammermann 1958; Goethe 1960; Hatch 1970, 1975; Veen 1977). In colonies of puffins and black guillemots (*Cepphus grylle*), jackdaws (*Corvus monedula*) and gulls patrol the ground (Mylne 1960; Birkhead 1974) while skuas fly overhead, attacking the auks as they fly to their burrows (Grant 1971; Arnason & Grant 1978).

5. Association Based on 'Beating'

Many birds take advantage of the feeding activities of other animals which frighten prey or dislodge food, called 'beating' by Rand (1954). Such feeding associations may, in some cases, lead to kleptoparasitism. Antbirds (*Gymnopithys* spp.; *Alethe* spp.) normally follow army or driver ants, feeding on arthropods frightened out of hiding by the ant swarm, but some individuals may occasionally eat the ants or snatch prey directly from their mandibles (Chapin 1939; Rothschild & Clay 1952; Willis 1967, 1968). Similarly, merlins (*Falco columbarius*) may use the hunting activities of other raptors by capturing prey frightened out of hiding (Watson 1977) or by stealing their already procured prey (Meinertzhagen 1959). The carmine bee-eater (*Merops nubicus*) rides on the backs of large birds such as bustards (*Ardeotis* spp.), storks (*Ciconnia* spp.), ostriches (*Struthio camelus*) and secretary birds (*Sagittarius serpentarius*) as well as on large mammals, flying out to catch insects disturbed by its host (North 1944; Jackson 1945; Mackworth-Praed 1946; Grimwood 1964; Boswall 1970; Cunningham-van Someron 1970). Although the bee-eater associations are generally thought to be mutualistic, Moncur (1946) observed a bee-eater taking a large insect from a bustard's bill. Flocks of water birds such as grebes (*Podiceps* spp.), mergansers (*Mergus* spp.), cormorants and pelicans sometimes feed by encircling a school of fish and driving it toward the shore. Egrets and herons run along the shore line spearing fish frightened into the shallows by the flocks (Christman 1957; Parks & Bressler 1963; Emlen & Ambrose 1970; Leck 1971; Fraser 1974) and terns and gulls hover overhead, diving to catch the cornered fish or occasionally to steal an already captured one (Bartholomew 1942; Cottam et al. 1942; Duchrow 1958; Vinicombe 1976). Gulls and terns follow many other species as they feed, including waders (Marshall 1961b; Courser & Dinsmore 1975; Bertin 1977), ducks and mergansers (Ingram 1944; Tebbutt 1961; Gatenby 1968; Gerrard 1975), loons (*Gavia* spp.) and grebes (Pearse 1950; Lehmann 1978), and auks (Alcidae) (Madge 1965; Scott 1972; Cantelo & Gregory 1975; Jones 1975). They sometimes capture aquatic organisms frightened to the surface by the birds' feeding activities, but they also take food by kleptoparasitism (Appendix A).

6. Association Based on Scavenging

Many species of birds act as scavengers on the scraps, faeces or parasites or feed on the wounds of other animals (Bent 1946; Rothschild & Clay 1952; Rand 1954; Bowman & Billeb 1965; Amadon 1967; Haverschmidt 1970; McFarland 1974; Goodwin 1976). In penguin colonies sheathbills (*Chionis* spp.) feed on faeces and dropped food, but they also frequently interfere directly with parental feeding. When a penguin is regurgitating food to its chick, the sheathbill frightens the young bird and grabs its food (Hall 1900; Jones 1963; Watson 1975). Many birds ride on or follow large mammals, crocodiles or predatory fish, feeding on the animal's faeces and parasites or picking up dropped fragments of food (Moreau 1933; Ryder 1957; Attwell 1966a, b; Benson 1964; Thomson 1964; Friedmann 1967; Pooley 1967; Olivier & Laurie

1974). Such behaviour may occasionally lead to birds actually stealing from the host as it manipulates its food (Murphy 1936; Cowan 1968). Early in the breeding season, gulls feed on fish dropped by terns, but as the season progresses, this behaviour develops into direct stealing (Hatch 1970). House sparrows follow American robins, picking up dropped fragments of worms (Kalmbach 1940) or snatching worms directly from the robin's bill (Miller 1885; Pershing 1930). Hummingbirds (Trochilidae) use spiders' webs in constructing a nest. Collecting webs for nests may have led to the habit of stealing the entangled prey (Wolf 1970; Young 1971; Burtt et al. 1976; Douglass 1977; Waide & Hailman 1977). In puffin and guillemot colonies, jackdaws, crows and ravens feed on fish fragments dropped near nests, or eat eggs broken by gulls, but in some areas the corvids regularly attack and steal fish directly from the auks (Mylne 1960; Birkhead 1973, 1974; Richford 1978). Gulls and corvids often parasitize the kleptoparasite by following skuas and large gulls as they chase puffins, out-manoeuvering them for the dropped food or picking up scraps from the ground (Meinertzhagen 1941; Belopolskii 1961; Grant 1971; Birkhead 1974; Arnason & Grant 1978). Many species feed on scraps at the kill of a carnivore (Bent 1946; Young 1963; Kruuk 1967; Pomeroy 1975) and some may even follow the predator on the hunt (Bent 1946). Marabou storks depend on vultures to loosen meat from carcasses. The storks either pick up scraps dropped by the vultures, threaten the vultures with their long bills and chase them from the food, or they steal outright from them (Houston 1972, 1975). American wigeons regularly steal aquatic vegetation from diving ducks (*Aythya* spp.), coots, swans, geese (*Anser* spp.) and even muskrats (Rodentia, Cricetidae) (Bent 1923; Forbush 1925; Munro 1949; Wick & Penttilla 1957; Fisher 1975; Johnsgard 1975), but they also simply feed on vegetation loosened by the activities of these hosts (Bent 1923; Munro 1949; Anderson 1974; Bailey & Batt 1974). Rothschild & Clay (1952) suggest that the unusual parasitic behaviour of this duck may have evolved from such non-parasitic feeding associations. Although there are many references to feeding associations between grebes and ducks, coots or herons, these do not apparently lead to kleptoparasitism since the grebes are feeding on a different kind of food from their associate (Ashmole et al. 1956; Hobbs 1958; King 1963; Paulson 1969; Siegfried 1971; Mueller et al. 1972; Robson 1975; Burger & Berruti 1977).

It is clear that wherever there are associations between species, kleptoparasitism may occur. It is equally obvious, however, that kleptoparasitism does not always occur when two species are found together. What kinds of ecological or behavioural conditions make kleptoparasitism particularly likely?

Ecological Conditions Facilitating the Evolution of Kleptoparasitism

1. Large Concentrations of Hosts

For kleptoparasitism to become more than of incidental occurrence, there must be large numbers of available hosts. Such is obviously the case in the large seabird colonies where there are hundreds of auks, gulls, terns and skuas nesting in one restricted locality (Dunn 1973; Veen 1977). Gulls steal from lapwings (*Vanellus vanellus*), eiders (*Somateria mollissima*), and cormorants and wigeons steal from diving ducks only where they are found in large flocks (Bartholomew 1942; Munro 1949; Schmidt 1954; Ingolfsson 1969; Källander 1977; Veen 1977). Sparrows kleptoparasitize digger wasps only where there are large numbers of the insects nesting in one area year after year (Ristich 1953; Brockmann, in press).

2. Large Quantities of Food

Systematic kleptoparasitism by skuas, gulls and terns in seabird colonies occurs only during the nesting season when hosts are returning to their territories with large quantities of food for their offspring or mate (Dunn 1973). The kleptoparasitic tern or jackdaw patrols only at times of the day when the maximum number of hosts are arriving at the nesting area (Hatch 1970; Corkhill 1973; Dunn 1973; Birkhead 1974). When gannets, pelicans, boobies and other birds return to their nests, their crops are filled with large stores of food for the young. A puffin may carry up to 28 sand eels in its beak at one time, making it particularly vulnerable to attack (Lockley 1953). Skuas and frigatebirds apparently judge how much food a booby, tern or auk is carrying, only attacking those with filled crops or beaks (Gibson-Hill 1948; Schmidt 1954; Grant 1971).

3. Large, High-quality Food Items

A tern carrying a large piece of food is more subject to attack from a marauding tern or gull than a bird carrying a small food item (Hopkins & Wiley 1972; Dunn 1973; Fuchs 1977; Veen

1977). However, terns with larger prey may be more vigilant, because attacks on such individuals are not necessarily more successful (Dunn 1973; Fuchs 1977). Only when hosts such as lapwings, thrushes, herons, ducks or swans are feeding on large, energy-rich sources of food such as worms, fish, or edible mussels are they attacked by gulls, herons, thrushes or sparrows (Evans 1908; Pershing 1930; van Tyne 1946; Brian & Brian 1947; Steiniger 1952; Snow 1958; Bergman 1960; Ingolfsson 1969; Bird et al. 1973; Payne & Howe 1976; Källander 1977; Kushlan 1978a, b). In fact, birds only rarely steal plant food from one another (except wigeons and coots, see Appendix A) and when they do, it is often because normal sources of food are not available (Söding 1949; Sage 1963; Siegfried 1972). For example, gulls can apparently tell whether a swan is feeding on vegetation or mussels and attacks only when the swan is bringing a mussel to the surface (Källander 1975). The lower food value of vegetation may make stealing plant material not worth the effort.

4. Food Supply Predictable

If the habits of the host are predictable, then kleptoparasitism is more likely to develop. Puffins repeatedly return to the same burrow with large quantities of fish for their offspring and parent terns return to the same location in the colony to feed their young. Gulls, skuas, terns, and jackdaws simply patrol specific areas in the colony for incoming hosts (Duchrow 1958; Grant 1971) or wait in the grass near the nest (Birkhead 1974).

5. Food Visible

One of the factors that may make kleptoparasitism an expensive strategy is the amount of time and energy invested in chasing hosts without food. Where food is conspicuously carried in the beak or talons as in puffins, terns and raptors, kleptoparasitism is more likely (Zusi 1958; Grant 1971). Only individuals with visible food in the bill are attacked or pursued by a kleptoparasite (Palmer 1941; Brian & Brian 1947; Snow 1958; Zusi 1958; Goethe 1960; Stichmann 1965; Bengtson 1966; Nakamura 1972; Siegfried 1972; Dunn 1973; Fuchs 1977). Aquatic species such as mergansers and eiders which must surface to eat their food (Harrison & Harrison 1962) are more vulnerable than those which capture and swallow their food below the surface such as grebes (Vinicombe 1976). When an individual must manipulate an unusually large prey item at the surface, kleptoparasitism is more likely to occur (Bengtson 1966; Grubb 1971; Reynolds 1977; Kushlan 1978). Birds, such as terns, that present fish during courtship displays are particularly subject to attack (Dunn 1973; Birkhead 1974; Fuchs 1977). Certainly sparrows spend little or no time chasing digger wasps which are not carrying large and conspicuous katydid prey (Brockmann, in press).

6. Food Shortage

Several authors mention that kleptoparasitism by frigatebirds, gulls and terns occurs more frequently during years of a food shortage or during the winter months (Munro 1949; Palmer 1941; Snow 1958; Bergman 1960; King 1966; Hays 1970). Kleptoparasitism is also more common when weather or other physical conditions such as tidal cycles preclude the parasite feeding on its own (Rooth 1958; Zusi 1958; Bengtson 1966; Ingolfsson 1969; Veen 1977). When parasites are feeding chicks and both food and time are at a premium, kleptoparasitism is more common (Rooth 1958; Grant 1971; Hatch 1975). In flocks of antbirds, there is a strict dominance order, with some individuals having primary access to the insects flushed by the army ant swarm. Subordinate individuals presumably do not have as much food available to them and they are the only birds observed actually stealing prey from the ants (Willis 1967, 1968). In a captive group of house sparrows feeding on dispersed seed, the most persistent initiator of interactions was a bird who was lowest in rank in a previously determined dominance order (Barnard 1978). Similarly feeding associations without kleptoparasitism (Bailey & Batt 1974) as well as intraspecific aggression are more frequent when food is scarce (Lockie 1956; Recher & Recher 1969; Goss-Custard 1970).

Behaviour that Facilitates the Evolution of Kleptoparasitism

1. Behaviour of Parasite

Many kleptoparasitic species are opportunists, taking advantage of any small supply of food they can find (Rand 1954). Blackbirds, house sparrows, starlings, shrikes (*Lanius* spp.), and jackdaws are extremely versatile feeders, exploiting a wide variety of ephemeral food supplies (Richardson 1938; Kalmbach 1940; Snow 1958; Caldwell 1966; Birkhead 1974). Kleptoparasitism is only one of a wide range of opportunistic feeding patterns shown by these species.

A particularly good example of a bird developing kleptoparasitism opportunistically is given by Bengtson (1966). He observed a group of horned grebes (*Podiceps auritus*) feeding on an Icelandic lake. Arctic terns (*Sterna paradisaea*) were diving among the grebes. When a surfacing grebe dropped a fish, a tern which was flying overhead, immediately plunged to the surface and retrieved the fish. The next time the grebe brought a fish to the surface, the tern swooped down on it, causing it to dive below the surface and drop its fish. Bengtson had never before seen kleptoparasitic behaviour at this locality and suggested that it may originate by just such accidents.

Acts of kleptoparasitism often involve feats of considerable aerobatic skill (Belopolskii 1961; Bengtson 1966; Hopkins & Wiley 1972; Nakamura 1972; Furness 1977; Källander personal communication). Skuas have been observed flying directly toward puffins, turning over in flight and snatching fish directly from the bill of a flying bird (Andersson 1976). Similarly, kestrels have been observed rolling over in flight, snatching a small mammal from a flying barn owl (*Tyto alba*) (Everett 1968). Snowy and short-eared owls (*Asio flammeus*) steal in a similar manner from marsh hawks and kestrels (Reese 1973; Bildstein & Ashby 1975; Duffy et al. 1976). Such agility may facilitate the emergence of kleptoparasitism as a persistent pattern between some species.

2. Behaviour and Habitat of Host

Some hosts such as swans, mergansers and shrikes bite at or chase the kleptoparasites or evade their attacks in other ways (Lovell 1945; Whitaker 1955; Nilsson 1965; Källander 1977) whereas thrushes, pelicans, ducks and sandpipers do not defend themselves (Pershing 1930; Baldwin 1946; van Tyne 1946; Brian & Brian 1947; Ingolfsson 1969; Bird et al. 1973; Payne & Howe 1976; Dummigan 1977). For many hosts defence may not be energetically worthwhile (Bird et al. 1973). Gulls and jackdaws increase their effectiveness as parasites by hiding in the grass near puffin or guillemot burrows (Mylne 1960; Birkhead 1974). Puffins escape attacks by either dashing headlong into their burrows or by not landing if a parasite is present. Individuals with nests well inland or on shallower slopes suffer significantly higher parasitism than those with nests nearer the shore or on steeper slopes (Grant 1971; Grant & Nettleship 1971; Nettleship 1972). The habitat as well as the behaviour of the host may affect its chances of being parasitized.

Chasing and pursuing an animal to steal its food or waiting for an animal to return with food appears to be expensive in terms of energy and time. Such behaviour would only be profitable under some circumstances. When predatory or opportunistic species are found in the same habitat with species which are feeding on large food items, then kleptoparasitism occasionally becomes a profitable way of obtaining food. When there are considerable numbers of hosts, predictably bringing large quantities of food to a fixed location, and particularly when food is scarce, then kleptoparasitism may become an important source of food. This combination of characteristics appears to account for the frequency with which certain species such as gulls, skuas and terns become kleptoparasites as well as the frequency with which others such as pelicans, auks, terns and thrushes become hosts (Table I).

Intra- and Interspecific Kleptoparasitism Form a Continuum with Other Feeding Interactions

When a number of individuals feed within sight of each other, each inadvertently furnishes information about its feeding success which can be used by others. The various advantages that accrue from interacting socially during feeding, point to the ways in which food thievery may emerge both within and between species. We suggest that there is no fundamental distinction between intra- and interspecific kleptoparasitism and that there is a direct analogy between 'parasitic' individuals within a species and parasitic species within mixed groups.

The advantages gained from a particular pattern of individual behaviour leading to interaction depend on the distribution and type of food being exploited. Since most naturally occurring food is both heterogeneous and to some degree clumped (Taylor 1961; Southwood 1966), it is clearly beneficial for an animal to monitor the feeding success of surrounding individuals. In laboratory experiments with small groups of great tits (*Parus major*), Krebs et al. (1972) found that a tit copies the perch position of a bird that has just found a mealworm. Perch-copying behaviour results in each bird achieving a higher capture rate when in a group than when feeding alone. Similar observations of the enhancing effect of intraspecific social learning on feeding efficiency have been made in a number of other species (Swynnerton

1942; Fisher & Hinde 1949; Hinde & Fisher 1951; Lockie 1956; Klopfer 1959; Turner 1961; Goss-Custard 1970; Murton 1971; Patterson 1975). Similarly, when birds associate in mixed-species flocks, social learning not only results in the location of more profitable food sites and the direction of attention to the most abundant food (Rubenstein et al. 1977), but also increases the probability that an individual will exploit a novel type of food or feeding location. Krebs (1973) found that both black-capped chickadees (*Parus atricapillus*) and chestnut-backed chickadees (*P. rufescens*) were more likely to discover a completely new foraging location if they were in the presence of an experienced bird of the other species. Clearly when birds are feeding socially they are observing the feeding behaviour of other individuals in the group and are taking advantage of this information. However, the examples discussed are 'casual' interactions, that is, individuals are simply capitalizing on available feeding information. Considering the many advantages that accrue from feeding interactions, we might expect selection to favour individuals which *specialize* in intra- or interspecific interactions.

Studies on captive house sparrows by one of us (C.J.B.) show that certain individuals ('copiers') concentrate on interacting (following, copying or snatching food) at the expense of others ('searchers'). In a series of experiments, small groups of house sparrows were allowed to forage for patchily distributed mealworms concealed in wells on a hardboard grid. 'Copiers' not only took a larger proportion of their captures through non-aggressive and aggressive interactions than 'searchers' (58% as compared to 26% for 'searchers') but they also spent much less time searching for food (as defined by characteristic head-cocking and zig-zag hopping). 'Copiers' clearly took advantage of 'searchers' since they made little effort to search for food themselves and depended mainly on the patches of food located by 'searchers' (Krebs & Barnard, in press). Such observations lead naturally to the question of what influences the frequency of searchers and copiers in a population, which we will discuss in the next section.

Although there do not appear to be many other recorded instances of intraspecific parasitism of this kind in birds, such behaviour is a well-known interspecific pattern, as we have shown. For example, Emlen & Ambrose (1970) observed that when snowy egrets used flocks of red-breasted mergansers to locate and obtain fish, they made no attempt to feed prior to the arrival of the mergansers. Only as the mergansers approached the shore, driving fish in front of them, did the egrets begin feeding. When the mergansers moved away, the egrets followed them, and the process was repeated. As Emlen & Ambrose point out, the behaviour of the egrets surpasses the bounds of casual opportunism.

A more vivid example involves cattle egrets. Individuals of this opportunistic species may feed alone or in flocks (Reynolds 1965). When in flocks they show aggressive interactions (e.g. one bird displacing another) or sometimes leap-frog feeding, i.e. using conspecifics as beaters (Blaker 1969; Wiese & Crawford 1974). Cattle egrets also associate with herds of feeding ungulates which disturb their insect prey (Rice 1963; Skead 1966; Benson & Penny 1971). These associations not only increase their capture rate, but also decrease their energy expenditure (Heatwole 1965; Dinsmore 1973). Where cattle are confined overnight, the egrets do not leave their roosts until the cattle are released in the morning (Rothschild & Clay 1952). Dawn (1959) reported behaviour which takes these associations a stage further. When cattle were resting on the ground, groups of 10 to 20 egrets made repeated, short, circular flights over the herd, bouncing off the ground between the cattle. The beating wings apparently disturbed the cattle, which rose and walked about, disturbing more insects for the egrets. Dawn saw several such incidents which appear to be deliberate attempts by the egrets to change the behaviour of the cattle to obtain food. Bearing in mind the extent to which these birds make use of each other and of other species such as cattle, it is not surprising that, given the opporunity, cattle egrets emerge as classic kleptoparasites (Feare 1975).

It is clear that birds can specialize within a range of socially parasitic behaviour. The precise form of the parasitism, whether using other individuals to locate the food, influencing the behaviour of others so as to increase the amount of food available, or actually stealing food from another individual, depends on the particular feeding opportunities available. Kleptoparasitism is only one form among many socially parasitic feeding interactions which emerge under particular environmental conditions. At present there is no reason to doubt that natural selection acts in essentially the same way whether the association involves intra- or interspecific interactions, but this matter deserves further study.

Is Kleptoparasitism a Feeding 'Strategy'?

One of the striking features of kleptoparasitism is that the behaviour is far more common in some populations than in others (Rand 1954; Bergman 1960; Nilsson 1965; Stichmann 1965; Burton 1968; Neub 1970). In many species kleptoparasitism is simply the result of a chance encounter by a bird pre-adapted to capitalize on a fortuitous feeding opportunity. But for others, kleptoparasitism is often a way of life. When black-headed and common gulls steal from ducks and lapwings, when jaegers pirate auks, when frigatebirds attack boobies and when sheathbills interfere with penguin chicks, the host may be acquiring a significant proportion of its diet through kleptoparasitism. In addition to the ecological factors we have already discussed, the frequency of regular kleptoparasitic behaviour in a population may be also influenced by intraspecific social factors. Kleptoparasitism may be traditional and spreading regionally through observational learning (Neub 1970; Brockmann, in press). But if kleptoparasitism is a regular feeding strategy, then there will be selection against the behaviour if it is not as successful in terms of long term reproductive success, as other feeding strategies in the population (Kushlan 1978b). Furthermore, and this is an important and often overlooked point, the success of a parasite may depend on the number of other kleptoparasites in the population (Arnason 1978). That is, selection for kleptoparasitism may be frequency-dependent (Dawkins, in press).

As an example, consider a population of Arctic skuas. For the purposes of this explanation let us say that in the population there are two feeding strategies: a parasitic one, where the skua chases puffins and steals fish and a predatory one, where the skua actually hunts birds. If there are too many parasitic skuas, competition among them may become so fierce that selection favours predatory birds, and vice versa. There could be an equilibrium ratio of parasites to hunters such that each of the two strategies does equally well: the evolutionarily stable state or ESS of the population. By equally well we mean that the long term reproductive success or pay-off to each strategy is equal. When the population deviates from the ESS, then there is selection against individuals using the feeding method which is more frequent than prescribed by the ESS (Maynard Smith & Price 1973; Ayala & Campbell 1974; Maynard Smith 1974; Dawkins 1976; Maynard Smith & Parker 1976). There is not necessarily one best feeding strategy, but there may be evolutionarily stable ones in a population (Dawkins, in press).

Kleptoparasitism may be a pattern adopted by most members of the population at one time or another (Grant 1971; Dunn 1973; Diamond 1975; Hatch 1975; Arnason & Grant 1978) or it may be characteristic of particular individuals (Young 1971; Corkhill 1973; Birkhead 1974; Evans 1975), but in either case selection acts in a similar way according to the ESS model. When the feeding behaviour is characteristic of particular individuals, then the model predicts that there would be selection for a stable ratio of parasites to hunters. When the feeding behaviour is shown by all individuals in the population, then the model predicts that selection would act on the proportion of decisions taken by those individuals, i.e. there would be selection against individuals who chose to parasitize too frequently.

We have suggested that when kleptoparasitism is a persistent and frequent pattern in a population, then it is possible that it may be an evolutionarily stable feeding strategy. However, there are other possible explanations for the presence of several feeding patterns within a population (Dawkins, in press; Brockmann et al., in press). Animals may steal when they are young (Pettitt 1952) or when no other food is available. The behaviour may result from a particular individual making the best of its current unfortunate circumstances. Only quantitative data comparing relative success of different patterns will resolve the question of whether kleptoparasitism is truly an alternative feeding strategy in a population.

In the initial examples, we chose a simple two strategy system: parasite or predator. However, the descriptions of most observers reveal far more complex sets of possible strategies. Källander (1977) surveyed large numbers of feeding black-headed gulls (*Larus ridibundus*) during winter and found that they were either (1) kleptoparasitizing lapwings, (2) feeding on the ground, (3) hunting from the air, or (4) following the plough. He showed that there were advantages to stealing from lapwings over following the plough, but the pay-offs to each strategy were difficult to measure. The frequency of gulls engaging in these different strategies varied markedly from one census to the next. It is possible that such variation reflects temporal changes in the pay-offs and hence different ESSs. Grant (1971) described seven different feeding strategies of skuas at a seabird colony. Which strategy a skua chose depended on the amount of food involved, the chances of success, the presence of various secondary parasites such as gulls and ravens, and the numbers of other skuas also engaging in the behaviour. If, for example, a skua chose to sit and wait on the ground near puffin burrows, its exact position involved a compromise between an area where the numbers of puffins were high but the numbers of skuas were also high and an area where there were fewer puffins but there were also fewer skuas. Selection should lead to skuas choosing these two localities in the proportions that result in each strategy doing equally well (Fretwell & Lucas 1969; Fretwell 1972).

A parasite may show at least two separate kleptoparasitic strategies: (a) initiate an attack or (b) join an attack already in progress (Hatch 1970, 1975; Verbeek 1977b; Arnason & Grant 1978). As might be expected, the probability of the host losing its prey increases with the numbers of parasites chasing it, but the average yield per parasite decreases with group size. These authors did not measure the relative success of the two strategies. Hatch (1975) showed that when initiators were joined by others, they were less successful than the joiners, but he neglected to show the overall success of the initiator strategy under each condition. It appears that early in the season, when most birds were initiators, joiners did better than initiators (in terms of rate of capture) and vice versa late in the season. Arnason & Grant (1978) mention that although their sample size was small, there appeared to be no significant differences in the relative success of the two strategies. These results are exactly what we would expect if selection is favouring a stable ratio between initiators and joiners.

The hosts could be affected by frequency-dependent selection as well. The probability of a puffin getting to its burrow without being intercepted depends on the height at which it flies, how far inland its nest is and the numbers of both parasites and other puffins present. A lone puffin is an easy target, but one flying with many others can effectively insulate itself from attack (Grant 1971; Nettleship 1972; Arnason & Grant 1978).

It is easy to guess that kleptoparasitism involves frequency-dependent selection, but the details are difficult to measure. Data must include the proportion of different strategies in the population and their relative success at that frequency. Ideally, frequency of a behaviour pattern should be altered experimentally in order to test for the effects of frequency-dependent selection. Whether interest is focussed on the effects of kleptoparasitism on the host population (Tinbergen 1932; Hatch 1970; Nettleship 1972; Birkhead 1974; Fuchs 1977) or on competition between two parasitic species (Hopkins & Wiley 1972; Verbeek 1977a, b) or simply on kleptoparasitism as an intriguing coevolutionary game, it may be important to consider the effects of frequency-dependent selection.

Conclusions

A review of kleptoparasitism among birds makes it abundantly clear that certain orders contain a disproportionate number of kleptoparasitic species. In particular, the Falconiformes and Charadriiformes include about 60% of the recorded species showing kleptoparasitic behaviour although they include only 7% of the known bird species of the world. Clearly the orders containing kleptoparasites have little in common phylogenetically, so what have they in common that facilitates the development of kleptoparasitism?

The above discussion has pointed to several ecological factors which appear to promote kleptoparasitism. An obvious prerequisite is regular association with other individuals and in particular, regular association on or near the feeding grounds. Such associations may occur through mixed-species breeding colonies (e.g. Stercorariidae, Laridae) or feeding flocks (e.g. Anatidae, Turdidae) or they may be the result of predatory interactions (e.g. Accipitridae, Falconidae, Strigidae). Within these categories there are more fine-grained levels of opportunity which govern the emergence of kleptoparasitic relationships. These are mainly the result of the type and abundance of the 'shared' food supply and the opportunities for profitable interactions.

Clearly, where a species feeds on a range of food items, only some of these present opportunities for food-stealing. Selection acts to maintain a relationship between parasite and host if the advantages to the parasite are great enough. There are several modes of interaction, each profitable in different situations. When birds are feeding on small, cryptic and clumped prey such as seeds and small invertebrates, area-copying is more profitable than trying to snatch the prey from the finder's bill; for large prey, such as earthworms, the opposite is true. These rules apply equally to interactions among conspecifics and heterospecifics.

For a wide-ranging species, food sources vary considerably from place to place as do the opportunities for interaction. The range of interactions from intraspecific copying to various forms of social parasitism seen in such species as house sparrows and cattle egrets, reflect the varied range of opportunities for interaction. Both species capitalize on local feeding conditions without specializing on any one food type. This capitalization may take the form of copier individuals or of kleptoparasites in single-species flocks.

The ability of the wide-ranging opportunist to become parasitic is just one route through which kleptoparasitism can emerge. Selection may also act on a more specialized species to reduce its spectrum of feeding patterns and interactions to a few highly profitable ones. Large mixed colonies of fishing birds provide the ideal environment for kleptoparasitism with a plentiful supply of food items which are easily stolen. It is in this kind of environment that we find specialized kleptoparasites such as frigatebirds and skuas. Specializations by frigatebirds include small unwebbed feet, a vestigial uropygial gland which greatly reduces the amount of oil in the feathers and a wing span to body weight ratio which is greater than for any other bird species. These adaptations greatly facilitate aerobatic flight, but they also mean that the birds can no longer enter the water from which most of their food originates (Nelson 1967).

Another type of feeding opportunity arises as a spin-off from predation, as for example, in the association between some accipiters and their prey. Alternatively, many raptors are kleptoparasitic on each other. As Rudebeck (1950, 1951) pointed out, the hunting success of most raptors is generally extremely low, so an immense advantage can be gained by usurping the already immobile prey of another bird.

Although we have talked mainly in terms of predation leading to kleptoparasitism, it is entirely possible for the reverse process to occur. We have found no documented examples of this, but it is not difficult to envisage how it might happen. In the house sparrow–digger wasp relationship, (Brockmann, in press), the sparrows probably did not arrive at their kleptoparasitism through predation on the wasps, but they are known to prey on other large and mobile insects (Summers-Smith 1963). In time individuals may arise which extend their use of the wasps to actually feeding on them.

Apart from the element of feeding opportunity, there are further factors which may determine which species become kleptoparasitic. Agility is clearly an asset if an animal is to be repeatedly successful in interactions, particularly where these interactions take place in the air. From this point of view, birds like Fregatidae and Stercorariidae (and to some extent other larids and corvids), which are built for sustained and manoeuverable flight, are at a great initial advantage and this may be a further reason for their predominance as kleptoparasites. M. Andersson (personal communication) suggests that such morphological and behavioural pre-adaptations are of major importance in the evolution of kleptoparasitism.

There does not appear to be a single clear-cut rule which governs the emergence of kleptoparasitism, rather it arises through a variety of opportunistic channels. A key factor in a species becoming a specialist may be the pay-offs for a kleptoparasitic habit as compared with other feeding strategies. If kleptoparasitism results in obtaining more food at less cost, then there will be rapid selection for the necessary patterns of interaction. However, since selection for kleptoparasitism is likely to be frequency dependent, a stable ratio between parasites and individuals using other feeding strategies may evolve.

Detailed studies of the costs and benefits of kleptoparasitic behaviour with respect to other feeding strategies are badly needed. Such studies will allow us to model and predict the emergence of kleptoparasitism for various species mixtures, in various environments and at different times of the year. They may also allow us to predict the number of parasites in a population. Food-stealing may occur between or within most species, given the kinds of opportunities discussed in this paper, but certain species possess a greater ecological potential to specialize.

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REFERENCES*

Adams, R. G. 1950. Skua-like tactics of great black-backed gulls. *Brit. Birds*, **43**, 382. [1]

Alexander, W. B. 1928. *Birds of the Ocean*. New York: G. P. Putnam's Sons. [2]

Amadon, D. 1967. Galápagos finches grooming marine iguanas. *Condor*, **69**, 311.

Ammermann, D. 1958. Parasitischer Beuteraub bei Möwen. *Die Vogelwelt*, **79**, 181–183. [3]

Anderson, M. G. 1974. American coots feeding in association with canvasbacks. *Wilson Bull.*, **86**, 462–463.

Andersson, A. 1971. Vad gör fiskmåsen i stan? *Meddelanden från Skånes Ornitologiska Förening*, **10**, 1–2. [4]

Andersson, M. 1976. Predation and kleptoparasitism by skuas in a Shetland seabird colony. *Ibis*, **118**, 208–217. [5]

Ansingh, F. H., Koelers, H. J., van der Werf, P. A. & Voous, K. H. 1960. The breeding of the cayenne or yellow-billed sandwich tern in Curaçao in 1958. *Ardea*, **48**, 51–65. [6]

Arnason, E. 1978. Apostatic selection and kleptoparasitism in the parasitic jaeger. *Auk*, **95**, 377–381.

Arnason, E. & Grant, P. R. 1978. The significance of kleptoparasitism during the breeding season in a colony of Arctic skuas *Stercorarius parasiticus* in Iceland. *Ibis*, **120**, 38–54. [7]

Ashmole, N. P. 1971. Sea bird ecology and the marine environment. In: *Avian Biology* (Ed. by D. S. Farner & J. R. King), pp. 223–286. New York: Academic Press.

Ashmole, N. P., Brown, R. G. B. & Tinbergen, N. 1956. Feeding association between coot and little grebe. *Brit. Birds*, **49**, 501.

Attwell, R. I. G. 1966a. Oxpeckers, and their associations with mammals in Zambia. *The Puku, Occ. Pap. Dept. Game & Fish., Zambia*, **4**, 17–48.

Attwell, R. I. G. 1966b. Possible bird-crocodile commensalism in Zambia. *Ostrich*, **37**, 54–55.

Ayala, F. J. & Campbell, C. A. 1974. Frequency- dependent selection. *Ann. Rev. Ecol. Syst.*, **5**, 115–138.

Bailey, R. O. & Batt, B. D. J. 1974. Hierarchy of waterfowl feeding with whistling swans. *Auk*, **91**, 488–493.

Baldwin, W. P. 1940. Bald eagle robbing marsh hawk. *Auk*, **57**, 413. [8]

Baldwin, W. P. 1946. Laughing gull robs brown pelican. *Auk*, **63**, 96–97. [9]

Balfour, E. 1973. Food piracy between kestrel, short-eared owl and hooded crows. *Brit. Birds*, **66**, 227–228. [10]

Bannerman, D. A. 1930. *The Birds of Tropical West Africa*. London: The Crown Agents for the Colonies. [11]

Bannerman, D. A. 1962. *The Birds of the British Isles*. London: Oliver and Boyd. [12]

Barnard, C. J. 1978. Aspects of winter flocking and food-fighting in the house sparrow. D.Phil. Thesis, University of Oxford.

*The numbers in square brackets are referred to in the appendices.

Baroarson, H. R. 1975. Robbing of black guillemots by Arctic terns. *Natturufraedingurinn*, **45**, 37–42. [13]

Bartholomew, G. A. 1942. The fishing activity of double-crested cormorants in San Francisco Bay. *Condor*, **44**, 13–21. [14]

Bartlett, L. M. 1957. Ring-billed gull steals food from coot. *Wilson Bull.*, **69**, 182. [15]

Beebe, F. L. 1960. An instance of piracy by the red-tailed hawk on the peregrine falcon. *Condor*, **60**, 480–481. [16]

Belopolskii, L. O. 1961. *Ecology of Sea Colony Birds of the Barents Sea*. Jerusalem: Israel Program for Scientific Translations. [17]

Bengtson, A. S. 1966. Några iakttagelser rörande pirattendenser hos tärnor och trutar. *Fauna och Flora*, **1966**, 24–30. [18]

Benson, C. W. 1964. Birds associating with ungulates. *Auk*, **81**, 436.

Benson, C. W. & Penny, M. J. 1971. The land birds of Aldabra. *Phil. Trans. Roy. Soc. Lond. B.*, **260**, 417–527.

Bent, H. C. 1921. Life histories of North American gulls and terns. *USNM Bull.*, **113**, 1–345. [19]

Bent, H. C. 1922. Life histories of North American petrels, pelicans and their allies. *USNM Bull.*, **121**, 299–311. [20]

Bent, H. C. 1923. Life histories of North American wildfowl. *USNM Bull.*, **126**, 94. [21]

Bent, H. C. 1926. Life histories of North American marsh birds. *USNM Bull.*, **135**, 366. [22]

Bent, H. C. 1937. Life histories of North American birds of prey, Part 1. *USNM Bull.*, **167**, 89–372. [23]

Bent, H. C. 1938. Life histories of North American birds of prey. Part 2. *USNM Bull.*, **170**, 1–170. [24]

Bent, H. C. 1940. Life histories of North American cuckoos, goatsuckers, hummingbirds and their allies. *USNM Bull.*, **176**, 377. [25]

Bent, H. C. 1946. Life histories of North American jays, crows and titmice. *USNM Bull.*, **191**, 143–315. [26]

Berger, D. D. 1958. Marsh hawk takes prey from short-eared owl. *Wilson Bull.*, **70**, 90. [27]

Bergman, G. 1960. Über neue Futtergewohnheiten der Möwen an den Küsten Finnlands. *Ornis Fennica*, **37**, 11–28. [28]

Bertin, R. I. 1977. Snowy egrets attracted to prey by common tern. *Auk*, **94**, 390–391.

Bezzel, E. 1958. Sturm- und Lachmöwe (*Larus canus* und *L. ridibundus*) als Nahrungsschmarotzer. *Ornithologische Mitteilungen*, **10**, 235. [29]

Bildstein, K. & Ashby, M. 1975. Short-eared owl robs marsh hawk of prey. *Auk*, **92**, 807–808. [30]

Bird, J., Alcock, J. & Erickmann, W. J. 1973. Starlings stealing worms from robins. *Wilson Bull.*, **85**, 480–482. [31]

Birkhead, T. R. 1973. Jackdaws stealing fish from guillemots on Skomer. *Nature in Wales*, **13**, 163–164. [32]

Birkhead, T. R. 1974. Utilization of guillemot *Uria aalge* colonies by jackdaws *Corvus monedula*. *Ornis Scand.*, **5**, 71–81. [33]

Blaker, D. 1969. Behaviour of the cattle egret *Ardeola ibis*. *Ostrich*, **40**, 75–129.

Boase, H. 1948. Starling robbing mistle-thrush. *Brit. Birds*, **41**, 83. [34]

Boswall, J. 1960. Observations on the use by sea-birds of human fishing activities. *Brit. Birds*, **53**, 212–215.

Boswall, J. 1970. The association of the northern carmine bee-eater *Merops n. nubicus* with mammals, birds and motor vehicles in Ethiopia. *Bull. Brit. Ornithol. Club*, **90**, 92–96.

Boswall, J. 1977. The use by seabirds of human fishing activities. *Brit. Birds*, **70**, 79–81.

Bowman, R. I. & Billeb, S. L. 1965. Blood-eating in a Galápagos finch. *Living Bird*, **4**, 29–44.

Boyd, A. W. 1944. Attacks on diving birds by black-headed gulls. *Brit. Birds*, **38**, 14–15. [35]

Boyle, G. 1966. House sparrow robbing wren of food. *Brit. Birds*, **59**, 342. [36]

Boyle, G. L. 1974. Kestrel taking prey from short-eared owl. *Brit. Birds*, **67**, 474–475. [37]

Brian, M. V. & Brian, A. D. 1947. Starlings robbing blackbirds of worms. *Brit. Birds*, **40**, 340. [38]

Brockmann, H. J. House sparrows kleptoparasitize digger wasps. *Wilson Bull.* (In press.) [39]

Brockmann, H. J., Grafen, A. & Dawkins, R. Evolutionarily stable strategies of nesting in a digger wasp. *J. theoret. Biol.* (In press.)

Brown, L. H. 1960. The African fish eagle *Haliaeetus vocifer* especially in the Kavirondo Gulf. *Ibis*, **102**, 285–297. [40]

Brown, L. & Amadon, D. 1968. *Eagles, Hawks and Falcons of the World.* Middlesex: Country Life Books, Hamlyn Publishing Co. Ltd. [41]

Burger, A. E. & Berruti, A. 1977. Dabchicks, *Podiceps ruficollis*, feeding in association with Maccoa ducks, *Oxyura maccoa. Ostrich*, **48**, 47.

Burgess, J. 1975. Kleptoparasitism in black-headed gulls. *Bird Study*, **21**, 279. [42]

Burton, R. W. 1968. Breeding biology of the brown skua *Catharacta skua lönnbergi* (Mathews), at Signy Island, South Orkney Islands. *Brit. Antarctic Surv. Bull.*, **15**, 9–28. [43]

Burtt, E., Sustare, B. D. & Hailman, J. P. 1976. Cedar waxwing feeding from spider web. *Wilson Bull.*, **88**, 157–158. [44]

Caldwell, L. D. 1966. Attack behavior of a loggerhead shrike. *Wilson Bull.*, **79**, 116–117.

Cantelo, J. & Gregory, P. A. 1975. Feeding association between common tern and razorbill. *Brit. Birds*, **68**, 296–297.

Chapin, J. P. 1939. The Birds of the Belgian Congo. Part II. *Bull. Amer. Mus. Nat. Hist.*, **75**, 352.

Christman, G. M. 1957. Some interspecific relations in the feeding of estuarine birds. *Condor*, **59**, 343.

Clegg, T. M. & Henderson, D. S. 1971. Kestrel taking prey from short-eared owl. *Brit. Birds*, **64**, 317–318. [45]

Clements, J. F. 1974. *Birds of the World: A Checklist.* New York: Two Continents Publ. Group Ltd.

Corkhill, P. 1973. Food and feeding ecology of puffins. *Bird Study*, **20**, 207–220. [46]

Cottam, C., Williams, C. S. & Sooter, C. A. 1942. Cooperative feeding of pelicans. *Auk*, **59**, 444–445.

Courser, W. D. & Dinsmore, J. J. 1975. Foraging associates of white ibis. *Auk*, **92**, 599–601.

Cowan, P. J. 1968. Feeding relationships between mullet and herring gulls. *Brit. Birds*, **61**, 31.

Cunningham-van Someron, G. R. 1970. Animated perches and feeding associations of birds in the Sudan. *Bull. Brit. Ornithol. Club*, **90**, 120–122.

Dawkins, R. 1976. *The Selfish Gene.* Oxford: Oxford University Press.

Dawkins, R. Good strategy or evolutionarily stable strategy? In: *Sociobiology: Beyond Nature/Nurture* (Ed. by G. W. Barlow & J. Silverberg). Washington: AAAS Publications. (In press.)

Dawn, W. 1959. Cattle egrets provoke cattle to move and pick flies off bulls. *Auk*, **76**, 97–98.

Dawson, R. 1975. Marsh sandpiper associating with feeding avocets and other species. *Brit. Birds*, **68**, 294–295.

Diamond, A. W. 1975. Biology and behaviour of frigatebirds *Fregata* spp. on Aldabra Atoll. *Ibis*, **117**, 302–323. [47]

Dickson, R. C. 1971. Interaction of short-eared owl, kestrel and hen harrier over pipit prey. *Brit. Birds*, **64**, 543. [48]

Dinsmore, J. I. 1973. Foraging success of cattle egrets, *Bubulcus ibis. Am. Midl. Nat.*, **89**, 242–246.

Dixon, J. S. 1933. Three magpies rob a golden eagle. *Condor*, **35**, 161. [49]

Douglass, J. F. 1977. Prairie warbler feeds from spider web. *Wilson Bull.*, **89**, 158–159. [50]

Duchrow, H. 1958. Stosstauchen und Beuterauben bei Möwen. *Vogelwelt*, **79**, 183–184. [51]

Duffy, D. C., Beehler, B. & Haas, W. 1976. Snowy owl steals prey from marsh hawk. *Auk*, **93**, 839–840. [52]

Dummigan, K. A. 1977. Food-piracy by Iceland gull on oystercatchers. *Brit. Birds*, **70**, 392. [53]

Dunn, E. K. 1973. Robbing behaviour of roseate terns. *Auk*, **90**, 641–651. [54]

Edgar, A. T. 1961. Some observations on white-fronted terns and skuas. *Notornis*, **9**, 120–121. [55]

Elliott, D. 1971. Kestrel apparently robbing weasel of a vole. *Brit. Birds*, **64**, 229. [56]

Emlen, S. T. & Ambrose, H. W. 1970. Feeding interaction of snowy egrets and red-breasted mergansers. *Auk*, **87**, 164–165.

Evans, P. G. H. 1975. Gulls and puffins on North Rona. *Bird Study*, **22**, 239–247.

Evans, W. 1908. The black-headed gull as a persecutor of the lapwing. *Ann. Scot. Nat. Hist.*, **1908**, 255. [57]

Everett, M. J. 1968. Kestrel taking prey from barn owl. *Brit. Birds*, **61**, 264. [58]

Feare, C. J. 1975. Scavenging and kleptoparasitism as feeding methods of Seychelles cattle egrets *Bubulcus ibis. Ibis*, **117**, 388. [59]

Fisher, B. M. 1975. American wigeon steals food from muskrats. *Can. Field Nat.*, **89**, 468. [60]

Fisher, J. A. & Hinde, R. A. 1949. The opening of milk bottles by birds. *Brit. Birds*, **42**, 347–357.

Flynn, J. E. 1957. Gannets robbing gulls. *Brit. Birds*, **50**, 537. [61]

Forbush, E. H. 1925. *Birds of Massachusetts.* Vol. 1., pp. 186, 208. Boston: Massachusetts Dept. Agriculture. [62]

Fraser, W. 1974. Feeding association between little egret and reed cormorant. *Ostrich*, **45**, 262.

Fretwell, S. D. 1972. *Populations in a Seasonal Environment.* Princeton, New Jersey: Princeton University Press.

Fretwell, S. D. & Lucas, H. L. 1969. On territorial behavior and other factors influencing distribution in birds. I. Theoretical development. *Acta Biotheor.*, **19**, 16–36.

Friedmann, H. 1967. Avian symbiosis. In: *Symbiosis* (Ed. by S. D. Henry), pp. 291–316. New York: Academic Press.

Fuchs, E. 1977. Kleptoparasitism of sandwich terns *Sterna sandvicensis* by black-headed gulls *Larus ridibundus*. *Ibis*, **119**, 183–190. [63]

Furness, R. W. 1977. Effects of great skuas on Arctic skuas in Shetland. *Brit. Birds*, **70**, 96–107. [64]

Gate, M. 1978. Behaviour of wintering common gulls and oystercatchers on the Dee Estuary. Edward Grey Institute of Field Ornithology Bird Biology Conference, Oxford. [65]

Gatenby, E. C. 1968. Black-headed gulls feeding in association with shovellers. *Brit. Birds*, **61**, 31.

Gerrard, A. J. 1975. Black-headed gulls associating with feeding goldeneyes. *Brit. Birds*, **68**, 295–296.

Gibson-Hill, C. A. 1948. The Malayan frigate birds. *Malayan Nature J.*, **3**, 109–113. [66]

Gillham, E. H. 1952. Common gulls robbing other birds of food. *Brit. Birds*, **45**, 38. [67]

Glegg, W. E. 1944. Predatory habits of black-headed gulls. *Brit. Birds*, **38**, 57. [68]

Goethe, F. 1960. Felsbrütertum und weitere beachtenswerte Tendenzen bei der Silbermöwe. *Proc. XII Int. Ornithol. Congr.*, **12**, 252–258. [69]

Goodwin, D. 1976. *Crows of the World*. London: British Museum of Natural History. [70]

Goss-Custard, J. D. 1970. Feeding dispersion in some overwintering wading birds. In: *Social Behaviour in Birds and Mammals* (Ed. by J. H. Crook). London: Academic Press.

Grant, P. R. 1971. Interactive behaviour of puffins (*Fratercula arctica* L.) and skuas (*Stercorarius parasiticus* L.). *Behaviour*, **40**, 263–281. [71]

Grant, P. R. & Nettleship, D. N. 1971. Nesting habitat selection by puffins *Fratercula arctica* L. in Iceland. *Ornis. Scand.*, **2**, 81–87.

Grimwood, I. 1964. The northern carmine bee-eater, *Merops nubicus* Gmelin using animal perches. *Bull. Brit. Ornithol. Club*, **84**, 105–106.

Grist, W. R. 1934. Kingfisher robbing dipper of food. *Brit. Birds*, **27**, 304–305. [72]

Grubb, T. C. 1971. Bald eagles stealing fish from common mergansers. *Auk*, **88**, 928–929. [73]

Gruson, E. S. 1976. *Checklist of the Birds of the World*. London: William Collins & Co. Ltd.

Gudmundsson, F. 1954. Icelandic birds. VIII. The Arctic skua (*Stercorarius parasiticus* (L.)). *Natturufraedingurinn*, **24**, 16–21. [74]

Hailman, J. 1964. The Galápagos swallow-tailed gull is nocturnal. *Wilson Bull.*, **76**, 347–354. [75]

Hall, R. 1900. Field-notes on the birds of Kerguelen Island. *Ibis*, **6**, 1–34. [76]

Hamilton, D. & Nash, J. K. 1928. Piratical habits of gulls. *Scot. Natur.*, **17**, 26–27. [77]

Harris, M. P. 1965. The food of some *Larus* gulls. *Ibis*, **107**, 43–53. [78]

Harrison, J. & Harrison, J. 1962. Goosanders 'parasitised' by black-headed gulls. *Ann. Rep. Wildfowl Trust*, **13**, 172–173. [79]

Harrisson, T. H. & Hurrell, H. G. 1933. Numerical fluctuations of the great black-backed gull (*Larus marinus* Linn.) in England and Wales. *Proc. Zool. Soc., Lond.*, **1933**, 191–209. [80]

Hatch, J. J. 1970. Predation and piracy by gulls at a ternery in Maine. *Auk*, **87**, 244–254. [81]

Hatch, J. J. 1975. Piracy by laughing gulls *Larus atricilla*: an example of the selfish group. *Ibis*, **117**, 357–365. [82]

Haverschmidt, F. 1970. Ruddy turnstones making use of yellow-crowned night herons for food-finding. *Wilson Bull.*, **82**, 99.

Hays, H. 1970. Common terns pirating fish on Great Gull Island. *Wilson Bull.*, **82**, 99–100.

Heatwole, H. 1965. Some aspects of the association of cattle egrets with cattle. *Anim. Behav.*, **13**, 79–83.

Hill, M. E. 1945. Shrike robs sparrow hawk. *Condor*, **47**, 129. [83]

Hinde, R. A. & Fisher, J. A. 1951. Further observations on the opening of milk bottles by birds. *Brit. Birds*, **44**, 393–396.

Hobbs, J. N. 1958. Some notes on grebes. *Emu*, **58**, 129–132.

Hogg, R. H. 1977. Food piracy by red-footed falcons. *Brit. Birds*, **70**, 220. [84]

Hopkins, C. D. & Wiley, R. H. 1972. Food parasitism and competition in two terns. *Auk*, **89**, 583–594. [85]

Houston, D. C. 1972. The ecology of Serengeti vultures. D.Phil. Thesis. University of Oxford, Oxford. [86]

Houston, D. C. 1975. Ecological isolation of African scavenging birds. *Ardea*, **63**, 55–64. [87]

Howell, A. H. 1932. *Florida Bird Life*. Tallahassee: Florida Dept. Game and Freshwater Fish. [88]

Hulsman, K. 1976. The robbing behavior of terns and gulls. *Emu*, **76**, 143–149. [89]

Ingolfsson, A. 1969. Behavior of gulls robbing eiders. *Bird Study*, **16**, 45–52. [90]

Ingram, G. C. S. 1944. Feeding habit of the black-headed gull. *Brit. Birds*, **38**, 12–13.

Jackson, T. H. E. 1945. Some *Merops–Ardeotis* perching associations in Northern Kenya. *Ibis*, **1945**, 284–286.

Jehl, J. R. 1974. The near-shore avifauna of the Middle America west coast. *Auk*, **91**, 681–699. [91]

Johnsgard, A. A. 1975. *Waterfowl of North America*. Bloomington: Indiana University Press. [92]

Johnston, F. J. 1945. Herring-gulls robbing lapwings. *Brit. Birds*, **38**, 278. [93]

Jones, N. V. 1963. The sheathbill, *Chionis alba* (Gmelin), at Signy Island, South Orkney Islands. *Brit. Antarctic Surv. Bull.*, **2**, 53–71. [94]

Jones, W. E. 1975. Kittiwakes associating with feeding razorbills. *Brit. Birds*, **68**, 296.

Källander, H. 1975. Gråtrut *Larus argentatus* som näringsparasit på sångsvan *Cygnus cygnus*. *Anser*, **14**, 29–38. [95]

Källander, H. 1977. Piracy by black-headed gulls on lapwings. *Bird Study*, **24**, 186–194. [96]

Kalmbach, E. R. 1940. Economic status of the English sparrow in the United States. *U.S. Dept. Agric. Tech. Bull.*, **711**, 1–66.

Karlsson, J. 1975a. Några jaktbeteenden hos havsörn *Haliaeetus albicilla* i Skåne. *Fauna och Flora*, **1975**, 211–215. [97]

Karlsson, J. 1975b. Skrattmås rövar byte från skräntärna. Black-headed gull *Larus ridibundus* robbing fish from caspian tern *Hydroprogne tschegrava*. *Anser*, **14**, 200. [98]

King, B. 1963. Feeding association between shovelers and little grebes. *Wildfowl*, **14**, 172.

King, B. 1966. Herring gulls trying to snatch food from great northern divers. *Brit. Birds*, **59**, 247. [99]

Kirby, R. P. 1958. Rough-legged hawk takes prey from marsh hawk. *Wilson Bull.*, **70**, 382. [100]

Klopfer, P. H. 1959. Social interactions in discrimination learning with special reference to feeding behaviour in birds. *Behaviour*, **14**, 282–299.

Krebs, J. R. 1973. Social learning and the significance of mixed-species flocks in chickadees (*Parus* spp.). *Can. J. Zool.*, **51**, 1275–1288.

Krebs, J. R. & Barnard, C. J. Structure and function of bird flocks: a review of the problems. *Proc. XVII Int. Ornithol. Congr.* (in press).

Krebs, J. R., MacRoberts, M. H. & Cullen, J. M. 1972. Flocking and feeding in the great tit *Parus major*—an experimental study. *Ibis*, **114**, 507–530.

Kruuk, H. 1967. Competition for food between vultures in East Africa. *Ardea*, **55**, 171–193. [101]

Kübel, M. & Ullrich, B. 1975. Elster (*Pica pica*) als Beuteparasit des Raubwürgers (*Lanius excubitor*). *J. Ornithologie*, **116**, 323–324. [102]

Kumerloeve, H. 1953. Stosstauchende Lachmöwen (*Larus ridibundus*). *Beitr. z. Vogelk.*, **3**, 243–244. [103]

Kushlan, J. A. 1978a. Feeding ecology of wading birds. In: *Wading Birds*, pp. 249–297. Washington, D.C.: National Audobon Society.

Kushlan, J. A. 1978b. Nonrigorous foraging by robbing egrets. *Ecology*, **59**, 649–653. [104]

Laidlow, T. G. 1908. Food of the black-headed gull. *Ann. Scot. Nat. Hist.*, **1908**, 139–141. [105]

Lamore, D. 1953. Ring-billed gulls stealing fish from female American mergansers. *Wilson Bull.*, **65**, 210–211. [106]

Leck, C. F. 1971. Cooperative feeding in *Leucophoyx thula* and *Podilymbus podiceps*. *Am. Midl. Nat.*, **86**, 241–242.

Lehmann, C. 1978. Die Lachmöwe als Nahrungsschmarotzer bei fütternden Haubentauchern. *Der Falke*, **25**, 133. [107].

Lloyd-Evans, L. 1948. House sparrow robbing mistle thrush of worm. *Brit. Birds*, **41**, 213. [108]

Lockie, J. D. 1956. Winter fighting in feeding flocks of rooks, jackdaws and carrion crows. *Bird Study*, **3**, 180–190.

Lockley, R. M. 1953. *Puffins*. London: J. M. Dent & Sons Ltd. [109]

Lovell, H. B. 1945. Reaction of American mergansers to herring gull depredations. *Wilson Bull.*, **57**, 202. [110]

Lovenskiold, H. L. 1963. *Avifauna Svalbardensis*. Oslo: Norsk Polarinstitutt. [111]

McFarland, C. 1974. Cleaning symbiosis involving Galápagos tortoises and two species of Darwin's finches. *Z. Tierpsychol.*, **34**, 464–483.

Mackworth-Praed, C. W. 1946. Animate perching associations. *Ibis*, **88**, 132.

Madge, S. G. 1965. Little gull associating with feeding razorbills. *Brit. Birds*, **58**, 192.

Marshall, R. V. A. 1961a. Attack and counter-attack between great black-backed gull and heron. *Brit. Birds*, **54**, 116. [112]

Marshall, R. V. A. 1961b. Herons fishing from air. *Brit. Birds*, **54**, 202. [113]

Martin, M. & Barry, T. W. 1978. Nesting behavior and food habits of parasitic jaegers at Anderson River Delta, Northwest Territories. *Can. Field Natur.*, **92**, 45–50. [114]

Massingham, H. J. 1921. Parasitism of black-headed gulls. *Brit. Birds*, **14**, 260–261. [115]

Maynard Smith, J. 1974. The theory of games and the evolution of animal conflicts. *J. theor. Biol.*, **47**, 209–221.

Maynard Smith, J. & Parker, G. A. 1976. The logic of asymmetric contests. *Anim. Behav.*, **24**, 159–175.

Maynard Smith, J. & Price, G. R. 1973. The logic of animal conflict. *Nature, Lond.*, **246**, 15–18.

Meinertzhagen, R. 1941. III. August in Shetland. *Ibis*, **5**, 105–117. [116]

Meinertzhagen, R. 1959. *Pirates and Predators*. London: Oliver & Boyd. [117]

Meinertzhagen, R. 1964. Piracy. In: *A New Dictionary of Birds* (Ed. by A. L. Thomson), p. 633. London: Thomas Nelson & Sons Ltd. [118]

Meyerriecks, A. J. & Nellis, D. W. 1967. Egrets serving as 'beaters' for belted kingfishers. *Wilson Bull.*, **79**, 236–237.

Miller, O. T. 1885. A ruffian in feathers. In: *The House Sparrow* (Ed. by J. H. Gurney, C. Russell & E. Coues). London: William Wesley & Sons. [119]

Moncur, G. 1946. Some further notes on *Merops–Ardeotis* perching associations. *Ibis*, **88**, 236–238. [120]

Moreau, R. E. 1933. The food of the red-billed oxpecker *Buphagus erythrorhynchus* (Stanley). *Bull. Entomol. Res.*, **24**, 325–335.

Moreau, R. E. & Moreau, W. M. 1941. Piracy by *Lanius collaris humeralis*. *Ibis*, **5**, 614–615. [121]

Moreau, W. M. 1947. Kestrel robbing little owl. *Brit. Birds*, **40**, 216–217. [122]

Morony, J. J., Bock, W. J. & Farrand, J. 1975. *Reference List of the Birds of the World*. New York: Dept. Ornithology, American Museum of Natural History.

Morris, D. 1954. The snail eating behaviour of thrushes. *Brit. Birds*, **47**, 33–49. [123]

Mountfort, G. 1971. Kestrel robbing weasel of a vole. *Brit. Birds*, **64**, 543. [124]

Mueller, H. C., Biben, M. G. & Sears, H. F. 1972. Feeding interactions between pied-billed grebes and herons. *Auk*, **89**, 190.

Munro, J. A. 1949. Studies of waterfowl in British Columbia. Baldpate. *Can. J. Res. Sect. D.*, **27**, 289–294. [125]

Murphy, R. C. 1936. *Oceanic Birds of South America*, Vol. 2, pp. 937, 1030, 1146. New York: American Museum of Natural History. [126]

Murton, R. K. 1971. Why do some birds feed in flocks? *Ibis*, **113**, 534–536.

Mylne, C. K. 1960. Techniques of herring gulls and jackdaws preying on puffins. *Brit. Birds*, **53**, 86–88. [127]

Nakamura, K. 1972. A black-tailed gull *Larus crassirostris* obtaining food in flight by piracy. *Tori*, **21**, 303–308. [128]

Nelson, J. B. 1967. Etho-ecological adaptations in the great frigate-bird. *Nature, Lond.*, **214**, 318.

Nelson, J. B. 1975. The breeding biology of frigate birds—a comparative review. *Living Bird*, **14**, 113–155. [129]

Nettleship, D. N. 1972. Breeding success of the common puffin (*Fratercula arctica* L.) on different habitats at Great Island, Newfoundland. *Ecol. Monogr.*, **42**, 239–268. [130]

Neub, M. 1970. Winternahrung und Kommensalismus der Lachmöwe (*Larus ridibundus*). *Ornithologische Mitteilungen*, **22**, 31–35. [131]

Nilsson, L. 1965. Iakttagelser över småskrakens (*Mergus serrator*) beteende under våren. *Vår Fågelvärld*, **24**, 244–256. [132]

Nilsson, L. 1966. Storskrakens (*Mergus merganser*) beteende under vinterhalvåret. *Vår Fågelvärld*, **25**, 148–160. [133]

North, M. E. W. 1944. The use of animate perches by the carmine bee-eater and other African species. *Ibis*, **86**, 171–176.

Olivier, R. C. D. & Laurie, W. A. 1974. Birds associating with hippopotamuses. *Auk*, **91**, 169–170.

Palmer, R. S. 1941. A behavior study of the common tern. *Proc. Boston Soc. Natural History*, **42**, 1–119. [134]

Parks, J. M. & Bressler, S. L. 1963. Observations of joint feeding activities of certain fish-eating birds. *Auk*, **80**, 198–199.

Parmenter, H. E. 1941. Prairie falcon parasitizing marsh hawk. *Condor*, **43**, 157. [135]

Patterson, I. J. 1975. Aggressive interactions in flocks of rooks *Corvus frugilegus* L.: a study in behaviour-ecology. In: *Function and Evolution in Behaviour* (Ed. by G. Baerends, C. Beer & A. Manning), pp. 169–183. Oxford: Clarendon Press.

Paulson, D. R. 1969. Communal feeding in grebes. *Auk*, **86**, 759.

Payne, R. B. & Howe, H. F. 1976. Cleptoparasitism by gulls of migrating shorebirds. *Wilson Bull.*, **88**, 349–350. [136]

Pearse, T. 1921. Parasitism of gulls on ducks. *Brit. Birds*, **15**, 70. [137]

Pearse, T. 1950. Parasitic birds. *Murrelet*, **31**, 14.

Penrose, F. 1915. Black headed gulls and razorbills. *Brit. Birds*, **8**, 174. [138]

Pershing, H. A. 1930. Banditry among birds. *Wilson Bull.*, **42**, 55. [139]

Peters, H. & Aschenbrenner, L. 1958. Sturmmöwen (*Larus canus*) als Nahrungsschmarotzer bei Lachmöwen. *Ornithologische Mitteilungen*, **10**, 94. [140]

Petrides, G. A. 1942. A hummingbird feeding habit. *Auk*, **59**, 444. [141]

Petrides, G. A. 1959. Competition for food between five species of East African vultures. *Auk*, **76**, 104–106. [142]

Pettersson, J. 1977. En iakttagelse av havsörn *Haliaeetus albicilla* som tar byte från kungsörn *Aquila chrysaetos*. *Vår Fågelvärld*, **36**, 54–55. [143]

Pettitt, R. G. 1952. Comparative aggressiveness of the first-year and adult black-headed gull. *Brit. Birds*, **45**, 333–334. [144]

Pomeroy, D. E. 1975. Birds as scavengers of refuse in Uganda. *Ibis*, **117**, 69–81. [145]

Pooley, A. C. 1967. Bird/crocodile and bird/hippopotamus commensalism in Zululand. *Ostrich*, **38**, 11–12.

Prys-Jones, O. E. 1973. Interactions between gulls and eiders in St. Andrew's Bay, Fife. *Bird Study*, **20**, 311–313. [146]

Raffaele, H. 1975. Bahama duck exploiting feeding habits of yellowlegs. *Wilson Bull.*, **87**, 276–277.

Ramsey, A. D. K. 1973. Arctic skuas chasing passerines. *Brit. Birds*, **66**, 168. [147]

Rand, A. L. 1942a. Results of the Archbold Expeditions. No. 42. Birds of the 1936-37 New Guinea expedition. *Bull. Am. Mus. Nat. Hist.*, **79**, 289–366. [148]

Rand, A. L. 1942b. Results of the Archbold Expeditions. No. 44. Some notes on bird behavior. *Bull. Am. Mus. Nat. Hist.*, **79**, 517–524. [149]

Rand, A. L. 1954. Social feeding behavior of birds. *Fieldiana: Zoology*, **36**, 1–71. [150]

Recher, H. F. & Recher, J. A. 1969. Some aspects of the ecology of migrant shorebirds. II. Aggression. *Wilson Bull.*, **81**, 140–154.

Rees, E. I. S. 1969. Feeding association between purple sandpipers and turnstones. *Brit. Birds*, **62**, 155.

Reese, R. A. 1973. Food piracy between kestrels and short-eared owls. *Brit. Birds*, **66**, 227–228. [151]

Reynolds, J. 1965. Feeding habits of cattle egrets. *Brit. Birds*, **58**, 509.

Reynolds, J. F. 1974a. Feeding association between marsh sandpiper and dabbling ducks. *Brit. Birds*, **67**, 477.

Reynolds, J. F. 1974b. Piracy by lanner. *Brit. Birds*, **67**, 25. [152]

Reynolds, J. F. 1977. Attempted food-piracy by gull-billed terns. *Brit. Birds*, **70**, 392–393. [153]

Rice, D. W. 1963. Birds associating with elephants and hippopotamuses. *Auk*, **80**, 196–197.

Richardson, F. 1938. Concentration of English sparrows to feed on oak gall. *Condor*, **40**, 126–127.

Richardson, F. 1948. Frigate-bird bested by brown booby. *Condor*, **50**, 164. [154]

Richford, A. S. 1978. The effect of jackdaws on the breeding of auks on Skomer Island. *Nature in Wales*, **16**, 32–36. [155]

Ristich, S. S. 1953. A study of the prey, enemies and habits of the great golden digger wasp *Chlorion ichneumoneum*. *Can. Entomol.*, **85**, 374–386. [156]

Robinson, H. C. 1927. *The Birds of the Malay Peninsula*. Vol. 1, p. 76. London: H. F. & G. Witherby. [157]

Robson, R. W. 1975. Feeding association between little grebes and feral domestic duck. *Brit. Birds*, **68**, 293–294.

Roos, G. & Jonasson, T. 1964. Konfrontation mellan övervintrande kungsörn (*Aquila chrysaetos*) och havsörn (*Haliaeetus albicilla*). *Vår Fågelvärld*, **23**, 416–418. [158]

Rooth, J. 1958. Relations between black-headed gulls (*Larus ridibundus*) and terns (*Sternus* spec.) in the Netherlands. *7th Bull. Intern. Comm. for Bird Preservation*, **7**, 117–119. [159]

Rothschild, M. & Clay, T. 1952. *Fleas, Flukes and Cuckoos*. London: Collins. [160]

Rubenstein, D. I., Barnett, R. J., Ridgely, R. S. & Klopfer, P. H. 1977. Adaptive advantages of mixed-species feeding flocks among seed-eating finches in Costa Rica. *Ibis*, **119**, 10–21.

Rudebeck, G. 1950. The choice of prey and modes of hunting of predatory birds with special reference to their selective effect. *Oikos*, **2**, 65–88.

Rudebeck, G. 1951. The choice of prey and modes of hunting of predatory birds with special reference to their selective effect. *Oikos*, **3**, 200–231.

Ryder, R. A. 1957. Avian-pinniped feeding associations. *Condor*, **59**, 68–69.

Sage, B. L. 1955. Black headed gull alighting on back of tufted duck. *Brit. Birds*, **48**, 177. [161]

Sage, B. L. 1957. Magpie robbing kestrel. *Brit. Birds*, **50**, 353. [162]

Sage, B. L. 1963. Gulls 'parasitizing' ducks and other birds. *Ann. Rep. Wildfowl Trust*, **14**, 173–174. [163]

Schindler, P. 1978. Beuteabjagen (Kleptoparasitismus) der Amsel (*Turdus merula*) gegenüber der Singdrossel (*Turdus philomelos*) und der Rotdrossel (*Turdus iliacus*). *Ornithologische Mitteilungen*, **30**, 22–23. [164]

Schipper, W. J. A. 1977. Hunting in three European harriers (*Circus*) during the breeding season. *Ardea*, **65**, 53–72. [165]

Schmidt, G. 1954. Zum Rauben der Schmarotzer-Raubmöwe. *Vogelwelt*, **75**, 147–151. [166]

Schwarz, A. 1960. Ungewöhnlicher Beuteerwerb der Lachmöwe. *Ornithologische Mitteilungen*, **12**, 235. [167]

Scott, R. E. 1972. Little gulls associating with feeding razorbills. *Brit. Birds*, **65**, 259.

Sefton, J. W. 1950. The brown pelican as a scavenger. *Condor*, **52**, 136–137. [168]

Selous, E. 1927. *Realities of Bird Life*. London: Constable & Co. Ltd. [169]

Serventry, D. L., Serventry, V. & Warham, J. 1971. *The Handbook of Australian Sea-birds*. Sydney: A. H. & A. W. Reed. [170]

Siegfried, W. R. 1971. Feeding association between *Podiceps ruficollis* and *Anas smithii*. *Ibis*, **113**, 236–238.

Siegfried, W. R. 1972. Ring-billed gull robbing lesser scaup of food. *Can. Field Natur.*, **86**, 86. [171]

Siegfried, W. R. & Batt, B. D. J. 1972. Wilson's phalaropes forming feeding association with shovelers. *Auk*, **89**, 667–668.

Simmons, K. E. L. 1972. Some adaptive features of seabird plumage types. *Brit. Birds*, **65**, 465–479. [172]

Sims, T. V. 1977. Plovers turn the tables on gulls. *Bird Study*, **24**, 195. [173]

Skead, C. J. 1966. A study of the cattle egret *Ardeola ibis* Linnaeus. *Ostrich Suppl.*, **6**, 109–139.

Slade, B. E. 1977. Food piracy by kestrel. *Brit. Birds*, **70**, 35–36. [174]

Snow, D. W. 1958. *A Study of Blackbirds*. London: George Allen & Unwin Ltd. [175]

Söding, K. 1949. Pfeifenten als Nahrungsschmarotzer bei Blässhühnern. *Ornithologische Mitteilungen*, **2**, 146–147. [176]

Southwood, T. R. E. 1966. *Ecological Methods*. London: Chapman & Hall.

Sprunt, A. 1941. Predation of boat-tailed grackles on feeding glossy ibis. *Auk*, **58**, 587–588. [177]

Stark, A. & Sclater, W. L. 1903. *The Birds of South Africa*, Vol. 3, p. 312. London: R. H. Porter. [178]

Steinbacher, F. 1929. Winterliches Vogelleben am Müggelsee. *J. Ornithologie*, **77**, 480–489. [179]

Steiniger, F. 1952. Bilder vom Tauchen der Silbermöwe. *Vogelwelt*, **73**, 157–159. [180]

Stichmann, W. 1965. Die Lachmöwe (*Larus ridibundus* L.) als Nahrungsschmarotzer. *J. Ornithol.*, **3**, 318–323. [181]

Summers-Smith, D. 1963. *The House Sparrow*. London: Collins.

Svensson, S. 1975. Bofink stjäl föda från nötväcka. *Anser*, **14**, 265–266. [182]

Swynnerton, C. F. M. 1942. Observations and experiments in Africa by the late C. F. M. Swynnerton on wild birds eating butterflies and the preferences shown. *Proc. Linn. Soc. Lond.*, **1942**, 10–46.

Taylor, L. R. 1961. Aggregation, variance and the mean. *Nature, Lond.*, **189**, 732–735.

Tebbutt, C. F. 1961. Black-headed gulls feeding in conjunction with goosanders. *Brit. Birds*, **54**, 284.

Temple, S. A. 1969. A case of turkey vulture piracy on great blue herons. *Wilson Bull.*, **81**, 94. [183]

Thomson, A. L. 1964. Birds associated with elephants and hippopotamuses. *Auk*, **81**, 436.

Tinbergen, N. 1932. Vergelijkende waarnemingen aan enkele Meeuwen en Sterns. *Ardea*, **21**, 1–13. [184]

Tinbergen, N. 1953. *The Herring Gull's World*. London: Collins. [185]

Tinbergen, N. & Norton-Griffiths, M. 1964. Oystercatchers and mussels. *Brit. Birds*, **57**, 64–70. [186]

Tinning, P. C. & Tinning, P. A. 1970. Hooded crows robbing merlin of prey. *Brit. Birds*, **63**, 83. [187]

Turner, E. R. A. 1961. Survival values of different methods of camouflage as shown in a model population. *Proc. Zool. Soc. Lond.*, **136**, 273–284.

van Tyne, J. 1946. Starling and brown thrasher stealing food from robin. *Wilson Bull.*, **58**, 185. [188]

Veen, J. 1977. Functional and causal aspects of nest distribution in colonies of sandwich terns (*Sterna sandvicensis* Lath.). *Behaviour Suppl.*, **20**, 1–193. [189]

Verbeek, N. A. M. 1977a. Comparative feeding ecology of herring gulls *Larus argentatus* and lesser black-backed gulls *Larus fuscus*. *Ardea*, **65**, 25–42. [190]

Verbeek, N. A. M. 1977b. Interactions between Herring and Lesser Black-backed gulls feeding on refuse. *Auk*, **94**, 726–735. [191]

Verner, J. 1965. Flight behavior of the red-footed booby. *Wilson Bull.*, **77**, 229–234. [192]

Vernon, J. D. R. 1972. Feeding habits of the black-headed and common gulls. Part 2—Food. *Bird Study*, **19**, 173–186. [193]

Vinicombe, K. E. 1976. Feeding association between gulls and great crested grebes. *Brit. Birds*, **69**, 506.

Wagner, S. 1962. Über Verhalten und Brutbiologie des Blässhuhns. *Beiträge zur Vogelkunde*, **7**, 381–440. [194]

Waide, R. B. & Hailman, J. P. 1977. Birds of five families feeding from spider webs. *Wilson Bull.*, **89**, 345–346. [195]

Watson, D. 1977. *The Hen Harrier*, pp. 92–94. Berkhamsted: T. & A. D. Poyser. [196]

Watson, G. E. 1975. *Birds of the Antarctic and Sub-Antarctic*. Washington, D.C.: Antarctic Research Series, American Geophysical Union. [197]

Whitaker, L. M. 1955. Cardinal exploits loggerhead shrike's artificial food source. *Wilson Bull.*, **67**, 213–215. [198]

Wick, W. Q. & Penttila, H. E. 1957. Observations on a coot–muskrat relationship. *Condor*, **59**, 341–342. [199]

Wiese, J. H. & Crawford, R. L. 1974. Joint 'leap-frog' feeding by ardeids. *Auk*, **91**, 836–837.

Williams, G. C. 1953. Wilson phalaropes as commensals. *Condor*, **55**, 158.

Willis, E. O. 1967. The behavior of bicolored antbirds. *Univ. Calif. Publ. Zool.*, **79**, 1–127. [200]

Willis, E. O. 1968. Studies of the behavior of lunulated and Salvin's antbirds. *Condor*, **70**, 128–148. [201]

Wilson, E. O. 1971. *Insect Societies*. Cambridge, Mass.: Harvard University Press.

Witherby, H. F. 1941. *The Handbook of British Birds*. Vol. 5, pp. 122–137. London: H. F. & G. Witherby Ltd. [202]

Wolf, L. L. 1970. The impact of seasonal flowering on the biology of some tropical hummingbirds. *Condor*, **72**, 1–14. [203]

Wood, C. R. 1976. Piratical short-eared owl. *Brit. Birds*, **69**, 272. [204]

Young, A. M. 1971. Foraging for insects by a tropical hummingbird. *Condor*, **73**, 36–45. [205]

Young, E. C. 1963. Feeding habits of South Polar Skua *Catharacta maccormicki*. *Ibis*, **105**, 301–318.

Zusi, R. L. 1958. Laughing gull takes fish from black skimmer. *Condor*, **60**, 67–68. [206]

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APPENDIX A: A Review of Kleptoparasitism between Birds (based on taxonomic classification of Clements (1974))

Kleptoparasite*	Host*	Behaviour	Pred.†	References‡
Procellariiformes				
Procellariidae				
Fulmar (*Fulmarus glacialis*)	Gulls (*Larus* spp.)	2, d		71, 117
Pelecaniformes				
Pelecanidae				
Brown Pelican (*Pelecanus occidentalis*)	Gulls (*Larus* spp.)	s		168
Sulidae				
Gannet (*Morus bassanus*)	Herring gull (*Larus argentatus*)	2, s		61
Brown Booby (*Sula leucogaster*)	Masked Booby (*Sula dactylatra*)	2, g		172
	Great Frigatebird (*Fregata minor*)	d		154
Fregatidae				
Frigatebirds (*Fregata* spp.)	Shearwater (*Puffinus* sp.)	7, d		129
	Tropicbird (*Phaethon* sp.)	7, d		21, 129
	Brown Pelican (*Pelecanus occidentalis*)	7, d, s		20, 88
	Red-footed Booby (*Sula sula*)	6, 7, 8, 9, 16, g	×	2, 47, 66, 129, 154, 192
	Brown Booby (*Sula leucogaster*)	7, 8, 9, g	×	20, 88, 126
	Cormorant (*Phalacrocorax* sp.)	7, d	×	2, 20
	Gulls (*Larus* spp.)	6, 7, d	×	2, 20, 129
	Laughing Gull (*Larus atricilla*)	6, d, g	×	19
	Swallow-tailed Gull (*Creagrus furcatus*)	2, d		75
	Terns (*Sterna* spp.)	6, d	×	2, 20, 129
	Noddy Tern (*Anous stolidus*)	6, d, g	×	19
Ciconiiformes				
Ardeidae				
Great Blue Heron (*Ardea herodias*)	Great Egret (*Casmerodius albus*)	5, 6, d		104
	White Ibis (*Eudocimus albus*)	5, 6, d		104
Gray Heron (*Ardea cinerea*)	Great Black-backed gull (*Larus marinus*)	6, 8, d	×	112
Cattle Egret (*Bubulcus ibis*)	Sooty Tern (chicks) (*Sterna fuscata*)	5, 6, g	×	59
Great Egret (*Casmerodius albus*)	Little Blue Heron (*Florida caerulea*)	5, 6, d		104
	White Ibis (*Eudocimus albus*)	5, 6, d		104
Ciconiidae				
Wood Stork (*Mycteria americana*)	Great Blue Heron (*Ardea herodias*)	5, 6, d		104
	Great Egret (*Casmerodius albus*)	5, 6, d		104
	Little Blue Heron (*Florida caerulea*)	5, 6, d		104
	White Ibis (*Eudocimus albus*)	5, 6, d		104
Marabou Stork (*Leptoptilos crumeniferus*)	African White-backed Vulture (*Gyps africanus*)	s		86, 87
Threskiornithidae				
White Ibis (*Eudocimus albus*)	Little Blue Heron (*Florida caerulea*)	5, 6, d		104
Anseriformes				
Anatidae				
European Wigeon (*Anas penelope*)	European Coot (*Fulica atra*)	s		176
American Wigeon (*Anas americana*)	Whistling Swan (*Cygnus* (*Olor*) *columbianus*)	5, d, s		92, 125
	Redhead (*Aythya americana*)	5, d, s		62, 92, 125
	Greater Scaup (*Aythya marila*)	5, d, s		21, 62, 125
	Canvasback (*Aythya valisineria*)	5, d, s		21, 62, 92, 125
	Coot (*Fulica americana*)	5, d, s		21, 62, 160
Common Eider (*Somateria mollissima*)	Common Merganser (Goosander) (*Mergus merganser*)	5, s		18, 92, 125

*If Gruson (1976) and Morony et al. (1975) disagree with Clements, a second common, generic or specific name is given in parentheses.

†The kleptoparasite is also a predator on the host or its young.

‡Each number can be found in square brackets in the References following the appropriate reference.

Falconiformes				
Cathartidae				
Turkey Vulture (*Cathartes aura*)	Great Blue Heron (chicks) (*Ardea herodias*)	8, g		183
Accipitridae				
Honey Buzzard (*Pernis apivorus*)	Secretary Bird (*Sagittarius serpentarius*)	2, d		117
	Peregrine Falcon (*Falco peregrinus*)	6, d		117
Black Kite (*Milvus migrans*)	Marabou Stork (*Leptoptilos crumeniferus*)	7, d		145
	Eagle (*Haliaeetus* sp.)	6, d		41, 117
	Common Buzzard (*Buteo buteo*)	6, d		117
	Hooded Vulture (*Neophron monachus*)	7, d		145
	Egyptian Vulture (*Neophron percnopterus*)	2, d		117
	Peregrine Falcon (*Falco peregrinus*)	2, d		117
	Pied Crow (*Corvus albus*)	7, d		145
European Sparrowhawk (*Accipiter nisus*)	Honey Buzzard (*Pernis apivorus*)	6, d		117
	Common Kestrel (*Falco tinnunculus*)	6, d		174
Savanna Hawk (*Heterospizias meridionalis*)	Maguari Stork (*Euxenura maguari*)	6, d		41
Red-tailed Hawk (*Buteo jamaicensis*)	Peregrine Falcon (*Falco peregrinus*)	2, d		16
Rough-legged Hawk (*Buteo lagopus*)	Marsh Hawk (Hen Harrier) (*Circus cyaneus*)	6, d		41, 100
Tawny Eagle (*Aquila rapax*)	Common Buzzard (*Buteo buteo*)	6, d		117
	African Fish Eagle (*Haliaeetus vocifer*)	6, d		40
	Falcon (*Falco* sp.)	6, d		117
Verreaux's Eagle (*Aquila verreauxii*)	Martial Eagle (*Polemaetus bellicosus*)	6, d		41
African Fish Eagle (*Haliaeetus vocifer*)	Pelican (*Pelecanus* sp.)	6, d		11, 41, 117, 118, 178
	Cormorant (*Phalacrocorax* sp.)	6, d		11
	Heron (*Ardea* sp.)	6, d	×	41, 117, 118, 178
	Kite (*Milvus* sp.)	6, d		41, 178
	Osprey (*Pandion haliaetus*)	6, d		40, 41, 117, 118, 178
White-bellied Sea Eagle (*Haliaeetus leucogaster*)	Whistling Kite (*Haliastur sphenurus*)	6, d		148
	Osprey (*Pandion haliaetus*)	6, d		157
Bald Eagle (*Haliaeetus leucocephalus*)	Common Merganser (*Mergus merganser*)	2, d	×	73
	Vulture (*Cathartes* sp.)	6, g		23, 41, 117
	Marsh Hawk (*Circus cyaneus*)	7, d		8
	Osprey (*Pandion haliaetus*)	6, d		23, 41, 88
White-tailed Eagle (*Haliaeetus albicilla*)	Golden Eagle (*Aquila chrysaetos*)	6, d		143, 158
	Osprey (*Pandion haliaetus*)	2, d		97
Sea Eagle (*Haliaeetus* sp.)	Kite (*Milvus* sp.)	6, d		41
	Osprey (*Pandion haliaetus*)	6, d		41
Lappet-faced Vulture (*Torgos tracheliotus*)	White-headed Vulture (*Trigonoceps occipitalis*)	5, d		101
	Ruppell's Griffon Vulture (*Gyps ruppellii*)	5, d		101, 142
	African White-backed Vulture (*Gyps africanus*)	5, d		101
Ruppell's Griffon Vulture (*Gyps ruppellii*)	African White-backed Vulture (*Gyps africanus*)	5, d		101
African White-backed Vulture (*Gyps africanus*)	Ruppell's Griffon Vulture (*Gyps ruppellii*)	5, d		101
Hooded Vulture (*Necrosyrtes monachus*)	Egyptian Vulture (*Neophron percnopterus*)	5, d		101
Marsh Hawk (Hen Harrier) (*Circus cyaneus*)	Montagu's Harrier (*Circus pygargus*)	7, d		165
	Eurasian Kestrel (*Falco tinnunculus*)	6, d		10, 165, 196
	Peregrine Falcon (*Falco peregrinus*)	6, d		23, 88
	Short-eared Owl (*Asio flammeus*)	6, 7, d		10, 27, 165, 196
Montagu's Harrier (*Circus pygargus*)	Short-eared Owl (*Asio flammeus*)	7, d		165

Marsh Harrier (*Circus aeruginosus*)	Marsh Hawk (Hen Harrier) (*Circus cyaneus*)	7, d		165
Bateleur (*Terathopius ecaudatus*)	Secretary Bird (*Sagittarius serpentarius*)	2, d		117
	Ground Hornbill (*Bucorvus* sp.)	2, d		117
Brown Harrier Eagle (*Circaetus cinereus*)	Bateleur (*Terathopius ecaudatus*)	6, d		41
Falconidae				
Northern Crested Caracara (*Caracara cheriway*)	Brown Pelican (*Pelecanus occidentalis*)	7, g		23, 88
(*Polyborus plancus*)	Crow (*Corvus* sp.)	6, d		23
Prairie Falcon (*Falco mexicanus*)	Marsh Hawk (*Circus cyaneus*)	6, d		24, 135
Lanner Falcon (*Falco biarmicus*)	Black-winged Kite (*Elanus caeruleus*)	2, d		152
Peregrine Falcon (*Falco peregrinus*)	European Sparrowhawk (*Accipiter nisus*)	7, d		117
	Marsh Hawk (*Circus cyaneus*)	6, d		23
	Eurasian Kestrel (*Falco tinnunculus*)	6, d		117
Northern Hobby (*Falco subbuteo*)	Eurasian Kestrel (*Falco tinnunculus*)	6, d		45
Merlin (*Falco columbarius*)	European Sparrowhawk (*Accipiter nisus*)	6, d		117
Red-footed Falcon (*Falco vespertinus*)	Eurasian Kestrel (*Falco tinnunculus*)	2, 8, d		84
Eurasian Kestrel (*Falco tinnunculus*)	Barn Owl (*Tyto alba*)	1, 7, s		58
	Little Owl (*Athene noctua*)	2, 7, 8, d		122
	Short-eared Owl (*Asio flammeus*)	2, 6, d		10, 37, 45, 48
Gruiformes				
Rallidae				
American Coot (*Fulica americana*)	Redhead (*Aythya americana*)	5, d, s		22
	Canvasback (*Aythya valisineria*)	5, d, s		22
Charadriiformes				
Charadriidae				
Spur-winged Lapwing (*Hoplopterus* (*Vanellus*) *spinosus*)	Gray-headed Gull (*Larus cirrocephalus*)	3, 5, d, s		173
Chionididae				
Snowy Sheathbill (*Chionis alba*)	King Penguin (*Aptenodytes patagonicus*)	4, 5, 10, d, s	×	197
	Adelie Penguin (*Pygoscelis adeliae*)	4, 5, 10, d, s	×	94, 197
	Chinstrap penguin (*Pygoscelis antarctica*)	4, 5, 10, d, s	×	94, 197
Black-faced Sheathbill (*Chionis minor*)	King Penguin (*Aptenodytes patagonicus*)	4, 5, 10, d, s	×	197
	Adelie Penguin (*Pygoscelis adeliae*)	4, 5, 10, d, s	×	197
	Chinstrap Penguin (*Pygoscelis antarctica*)	4, 5, 10, d, s	×	76, 197
Stercorariidae				
Great Skua (*Catharacta skua*)	Black-browed Albatross (*Diomedea melanophris*)	6, g		76
	Giant Fulmar (*Macronectes giganteus*)	6, 8, g	×	43
	White-chinned Petrel (*Procellaria aequinoctialis*)	6, g	×	76
	Wilson's Storm Petrel (*Oceanites oceanicus*)	6, 8, g, s	×	43
	Gannet (*Morus bassanus*)	6, 8, g	×	5, 64, 116, 117
	Blue-eyed Cormorant (*Phalacrocorax atriceps*)	6, 8, g	×	43
	Heron (*Ardea sp.*)	6, 8, g	×	5, 117
	Parasitic Jaeger (*Stercorarius parasiticus*)	6, d		64
	Herring Gull (*Larus argentatus*)	6, d, g		202
	Lesser Black-backed Gull (*Larus fuscus*)	6, d, g		202
	Kelp Gull (*Larus dominicanus*)	6, 8, g	×	43
	Great Black-backed Gull (*Larus marinus*)	6, d, g		202
	Gulls (*Larus* spp.)	6, 8, g	×	5, 117, 202
	Terns (*Sterna* spp.)	6, 8, g	×	5, 117, 202
	Razorbill (*Alca torda*)	6, d	×	64
	Common Murre (*Uria aalge*)	6, d	×	64
	Common Puffin (*Fratercula arctica*)	6, d	×	5, 7, 64

MacCormick's Skua (*Catharacta maccormicki*)	Blue-eyed Cormorant (*Phalacrocorax atriceps*)	6, d	×	197
Pomarine Jaeger (*Stercorarius pomarinus*)	Shearwaters (*Puffinus* sp.)	6, d, g	×	19
	Black-tailed Gull (*Larus crassirostris*)	6, d		128
	Glaucous Gull (*Larus hyperboreus*)	6, d, g	×	19, 202
	Iceland Gull (*Larus glaucoides* (*leucopterus*))	6, d, g	×	19, 202
	Black-headed Gull (*Larus ridibundus*)	6, d		128
	Herring Gull (*Larus argentatus*)	6, d		202
	Great Black-backed Gull (*Larus marinus*)	6, d		202
	Gulls (*Larus* spp.)	6, d, g	×	19
	Black-legged Kittiwake (*Rissa tridactyla*)	6, d, g	×	19, 128, 202
	Terns (*Sterna* spp.)	6, d, g	×	19
Parasitic Jaeger (Arctic Skua) (*Stercorarius parasiticus*)	Red-throated Loon (*Gavia stellata*)	7, d	×	111
	Northern Fulmar (*Fulmarus glacialis*)	6, 8, g	×	71, 74
	Shearwater (*Puffinus* sp.)	6, 8, g	×	91, 117
	Gannet (*Morus bassanus*)	2, g	×	147, 202
	Ivory Gull (*Pagophila eburnea*)	6, d	×	111
	Herring Gull (*Larus argentatus*)	6, 8, g	×	117, 166
	Glaucous Gull (*Larus hyperboreus*)	6, d		114
	Silver Gull (*Larus novaehollandiae*)	6, d		170
	Bonaparte's Gull (*Larus philadelphia*)	6, 9, d, g	×	19, 134
	Black-legged Kittiwake (*Rissa tridactyla*)	2, 6, 8, 9, d, g	×	7, 17, 19, 64, 71, 74, 111, 147, 166 202
	Common Tern (*Sterna hirundo*)	6, d	×	19, 134
	Arctic Tern (*Sterna paradisaea*)	6, 8, 9, d, g	×	7, 19, 64, 71, 74, 111, 166, 170
	Roseate Tern (*Sterna dougallii*)	6, d	×	19
	White-fronted Tern (*Sterna striata*)	6, 7, 9, d	×	55
	Bridled Tern (*Sterna anaethetus*)	6, d	×	170
	Least Tern (*Sterna albifrons*)	6, d	×	19
	Crested Tern (*Sterna bergii*)	6, d	×	170
	Razorbill (*Alca torda*)	6, d	×	17
	Thick-billed Murre (*Uria lomvia*)	6, d	×	17
	Common Murre (*Uria aalge*)	6, d	×	17
	Black Guillemot (*Cepphus grylle*)	6, d	×	17, 111, 202
	Common Puffin (*Fratercula arctica*)	1, 2, 6, 9, d	×	5, 7, 17, 64, 71, 74, 202
	Skylark (*Alauda arvensis*)	2, d	×	147
	Meadow Pipit (*Anthus pratensis*)	2, d	×	147
Long-tailed Jaeger (*Stercorarius longicaudus*)	Franklin's Gull (*Larus pipixcan*)	6, d	×	91
	Common Tern (*Sterna hirundo*)	6, d	×	134
	Black Tern (*Chlidonias niger*)	6, d	×	105
Laridae				
Heermann's Gull (*Larus heermanni*)	Gannet (*Morus bassanus*)	6, g		19
	Brown Pelican (*Pelecanus occidentalis*)	s		19
Black-tailed Gull (*Larus crassirostris*)	Streaked Shearwater (*Puffinus leucomelas*)	2, 7, d		128
	Japanese Cormorant (*Phalacrocorax capillatus*)	5, s		128
	Little Egret (*Egretta garzetta*)	7, s		128
	Black-headed Gull (*Larus ridibundus*)	2, 7, d		128
	Black-legged Kittiwake (*Rissa tridactyla*)	2, 7, d		128
	Common Tern (*Sterna hirundo*)	2, 7, d		128
	Rhinoceros Auklet (*Cerorhinca monocerata*)	2, 7, d		128
Audouin's Gull (*Larus audouinii*)	Common Shag (*Phalacrocorax aristotelis*)	7, d		51
Ring-billed Gull (*Larus delawarensis*)	Lesser Scaup (*Aythya affinis*)	2, 7, d		171
	Common Merganser (*Mergus merganser*)	6, 7, d		106
	Mergansers (*Mergus* sp.)	7, d		19
	American Coot (*Fulica americana*)	7, d		15
	Black-bellied Plover (*Pluvialis squatarola*)	6, d		136
	Dunlin (*Calidris alpina*)	6, d		136
	Bonaparte's Gull (*Larus philadelphia*)	6, d		136
	Arctic Tern (*Sterna paradisaea*)	2, d		63

Common (Mew) Gull (*Larus canus*)	Little Grebe (*Podiceps ruficollis*)	7, d	×	35, 117
	Mallard (*Anas platyrhynchos*)	7, d, s		28
	European Wigeon (*Anas penelope*)	7, d		163
	Common Goldeneye (*Bucephala clangula*)	2, 7, d, s		28
	Oldsquaw (*Clangula hyemalis*)	7, d, s		28
	Common Merganser (*Mergus merganser*)	5, 7, d		29, 179
	Red-breasted Merganser (*Mergus serrator*)	5, 7, d		103
	European Coot (*Fulica atra*)	7, d		29
	European Oystercatcher (*Haematopus ostralegus*)	6, 7, 8, 10, d		65, 67
	Northern Lapwing (*Vanellus vanellus*)	6, 9, d		67, 96, 193
	Eurasian Golden Plover (*Pluvialis apricaria*)	5, 6, 7, d		193
	Redshank (*Tringa totanus*)	7, 8, d		77
	Black-headed Gull (*Larus ridibundus*)	6, 7, d		3, 29, 67, 140, 184, 193
	Caspian Tern (*Sterna caspia*)	6, 7, d		5*
	Common Tern (*Sterna hirundo*)	6, 7, d		131
	Least Tern (*Sterna albifrons*)	6, 7, d	×	184
	Sandwich Tern (*Thalasseus sandvicensis*)	6, 7, d	×	184
	Jackdaw (*Corvus monedula*)	2, 6, 7, d		4
	Rook (*Corvus frugilegus*)	2, 6, 7, d		67
	Fieldfare (*Turdus pilaris*)	2, 6, 7, d		67
Herring Gull (*Larus argentatus*)	Common Loon (*Gavia immer*)	7, d		99
	Common Shag (*Phalacrocorax aristotelis*)	4, 7, d, s		51, 117
	Whooper Swan (*Cygnus* (*Olor*) *cygnus*)	7, 8, 10, d		51, 95
	Mallard (*Anas platyrhynchos*)	7, d, s	×	28
	Greater Scaup (*Aythya marila*)	2, d	×	180
	Oldsquaw (*Clangula hyemalis*)	7, d, s	×	28
	Common Eider (*Somateria mollissima*)	2, 7, d	×	28, 51, 90, 166, 180
	Black Scoter (*Melanitta nigra*)	2, 7, 8, d	×	163, 166
	Common Merganser (*Mergus merganser*)	2, 7, d, s	×	18, 28, 110, 133, 166
	Red-breasted Merganser (*Mergus serrator*)	2, 7, d, s	×	28, 62, 132
	Northern Lapwing (*Vanellus vanellus*)	6, 9, d		93
	Lesser Black-backed Gull (*Larus fuscus*)	6, 7, 8, d		190
	Common Gull (*Larus canus*)	6, 7, d		3, 184
	Black-headed Gull (*Larus ridibundus*)	6, d		69
	Least Tern (*Sterna albifrons*)	6, 7, d	×	184
	Sandwich Tern (*Thalasseus sandvicensis*)	6, 7, d	×	184
	Black Guillemot (*Cepphus grylle*)	2, d	×	28
	Common Puffin (*Fratercula arctica*)	5, 6, 8, d	×	46, 109, 127, 130, 155
Lesser Black-backed Gull (*Larus fuscus*)	Mallard (*Anas platyrhynchos*)	7, d, s	×	28
	Common Eider (*Somateria mollissima*)	7, s	×	28
	Common Merganser (*Mergus merganser*)	2, 7, d		28, 132
	Red-breasted Merganser (*Mergus serrator*)	2, 7, d		28, 132
	Herring Gull (*Larus argentatus*)	6, 7, 8, 9, d		190, 191
	Black-legged Kittiwake (*Rissa tridactyla*)	6, g		166
	Black Guillemot (*Cepphus grylle*)	7, s	×	28
	Common Puffin (*Fratercula arctica*)	6, 7, d	×	7, 46
Western Gull (*Larus occidentalis*)	Brown Pelican (chicks) (*Pelecanus occidentalis*)	5, 8, g	×	19
	Cormorant (*Phalacrocorax* sp.)	5, s	×	14
Great Black-backed Gull (*Larus marinus*)	Arctic Loon (*Gavia arctica*)	2, d		28
	Red-throated Loon (*Gavia stellata*)	2, d		28
	Shearwater (*Puffinus* sp.)	6, d	×	78, 80
	Gray Heron (*Ardea cinerea*)	7, g	×	78, 112
	Mallard (*Anas platyrhynchos*)	7, d, s	×	28, 166
	Northern Shoveler (*Anas clypeata*)	7, d		166
	Greater Scaup (*Aythya marila*)	7, d		166
	Tufted Duck (*Aythya fuligula*)	7, d	×	80, 166
	Common Eider (*Somateria mollissima*)	2, 7, d	×	28, 90
	Black Scoter (*Melanitta nigra*)	2, 8, d	×	166
	European Coot (*Fulica atra*)	7, d	×	166
	Common Gull (*Larus canus*)	6, 7, d		166
	Herring Gull (*Larus argentatus*)	2, 6, g		1, 3, 184

	Common Puffin (*Fratercula arctica*)	6, d	×	46, 78, 80, 130
Glaucous-winged Gull (*Larus glaucescens*)	Cormorant (*Phalacrocorax* sp.)	s		14
	Great Blue Heron (*Ardea herodias*)	5, 7, s		2*
	Mallard (*Anas platyrhynchos*)	2, 7, d, s		28
	Common Goldeneye (*Bucephala clangula*)	5, d		137
	Bald Eagle (*Haliaeetus leucocephalus*)	5, 7, s		2*
Glaucous Gull (*Larus hyperboreus*)	Northern Fulmar (*Fulmarus glacialis*)	6, d, g	×	19
	Common Eider (*Somateria mollissima*)	2, 6, 7, d	×	19, 90, 146
	Ivory Gull (*Pagophila eburnea*)	5, 6, d	×	111
	Black-legged Kittiwake (*Rissa tridactyla*)	6, d, g	×	19
	Razorbill (*Alca torda*)	6, d	×	19
	Black Guillemot (*Cepphus grylle*)	6, d	×	19
Iceland Gull (*Larus (glaucoides) leucopterus*))	European Oystercatcher (*Haematopus ostralegus*)	2, 5, d		53
Laughing Gull (*Larus atricilla*)	Brown Pelican (*Pelecanus occidentalis*)	5, 10, s		9, 19, 20, 82, 88, 117
	Common Tern (*Sterna hirundo*)	6, 9, d		81, 82
	Arctic Tern (*Sterna paradisaea*)	6, 9, d		81, 82
	Sandwich Tern (*Thalasseus sandvicensis*)	4, 5, s		6, 81
	Black Skimmer (*Rynchops nigra*)	6, d		206
Silver Gull (*Larus novaehollandiae*)	Black-naped Tern (*Sterna sumatrana*)	6, 7, d		89
	Bridled Tern (*Sterna anaethetus*)	2, g		89
	Crested Tern (*Sterna bergii*)	4, 6, 7, 8, 9,d	×	89
	Lesser Crested Tern (*Sterna bengalensis*)	2, 4, 6, 7, 9, d		89
Black-headed Gull (*Larus ridibundus*)	Great Crested Grebe (*Podiceps cristatus*)	2, 7, d		28, 35, 79, 107, 131, 144, 163
	Little Grebe (*Podiceps ruficollis*)	2, 6, 7, d		35, 131, 144, 167
	Manx Shearwater (*Puffinus puffinus*)	7, g		193
	Gray Heron (*Ardea cinerea*)	7, d, s		113, 163, 193
	Mallard (*Anas platyrhynchos*)	7, d, s		28, 166
	Northern Shoveler (*Anas clypeata*)	7, d		166
	Common Pochard (*Aythya ferina*)	7, d		79
	Greater Scaup (*Aythya marila*)	7, d		166
	Tufted Duck (*Aythya fuligula*)	7, 8, d		115, 117, 144, 160, 161, 166, 181
	Common Goldeneye (*Bucephala clangula*)	2, 7, d		131, 181
	Black Scoter (*Melanitta nigra*)	7, d		166
	Common Merganser (*Mergus merganser*)	7, d		29, 131, 181
	Red-breasted Merganser (*Mergus serrator*)	5, 7, d		103
	Common Gallinule (*Gallinula chloropus*)	5, 7, d, s		144, 164
	European Coot (*Fulica atra*)	5, 6, 7, 9, d, s		29, 79, 117, 131, 144, 166, 181, 194
	European Oystercatcher (*Haematopus ostralegus*)	4, 5, 6, d, s	×	186, 193
	Northern Lapwing (*Vanellus vanellus*)	2, 5, 6, 7, 8, d	×	42, 57, 68, 77, 96, 105, 163, 169, 185, 193
	Eurasian Golden Plover (*Pluvialis apricaria*)	5, 6, 7, d		42, 77, 96, 193
	Black-tailed Gull (*Larus crassirostris*)	2, 7, d		128
	Common Gull (*Larus canus*)	6, g		166
	Black-legged Kittiwake (*Rissa tridactyla*)	2, 7, d		128
	Caspian Tern (*Hydroprogne caspia*)	7, s		98
	Common Tern (*Sterna hirundo*)	2, 3, 6, d		63, 128, 159, 181
	Least Tern (*Sterna albifrons*)	6, d		184
	Sandwich Tern (*Thalasseus sandvicensis*)	2, 3, 4, 5, 6, d		63, 159, 184, 189
	Razorbill (*Alca torda*)	7, d		138, 193
	Common Murre (*Uria aalge*)	7, d		193
	Carrion Crow (*Corvus corone*)	6, d		117
	Blackbird (*Turdus merula*)	s		42
	Redwing (*Turdus iliacus*)	s		42
	Fieldfare (*Turdus pilaris*)	s		42, 193
	Song Thrush (*Turdus philomelos*)	s		42
	Common Starling (*Sturnus vulgaris*)	5, 7, d		193
Bonaparte's Gull (*Larus philadelphia*)	Black-bellied Plover (*Pluvialis squatarola*)	6, d		136
	Dunlin (*Calidris alpina*)	6, d		136

Black-legged Kittiwake (*Rissa tridactyla*)	Arctic Tern (*Sterna paradisaea*)	6, d	111
	Common Puffin (*Fratercula arctica*)	6, d	7
Sabine's Gull (*Xema sabini*)	Arctic Tern (*Sterna paradisaea*)	6, d	134
Gulls (*Larus* spp.)	Cormorant (*Phalacrocorax* sp.)	s	14
	Tufted Duck (*Aythya fuligula*)	7, d	160
Gull-billed Tern (*Gelochelidon nilotica*)	Greenshank (*Tringa nebularia*)	6, d	153
Common Tern (*Sterna hirundo*)	Great Crested Grebe (*Podiceps cristatus*)	2, d	18, 28
	Diving Ducks (*Somateria* or *Aythya*)	7, d, s	28
	Arctic Tern (*Sterna paradisaea*)	6, 9, d	85
	Least Tern (*Sterna albifrons*)	6, d	134
	Sandwich Tern (*Thalasseus sandvicensis*)	6, d	189
Arctic Tern (*Sterna paradisaea*)	Horned Grebe (*Podiceps auritus*)	2, d	18
	Sandwich Tern (*Thalasseus sandvicensis*)	6, d	189
	Terns (*Sterna* spp.)	6, d	12
	Black Guillemot (*Cepphus grylle*)	7, d	13
Roseate Tern (*Sterna dougallii*)	Common Tern (*Sterna hirundo*)	3, 5, 7, d, s	54
	Arctic Tern (*Sterna paradisaea*)	3, 5, 7, d, s	12, 54
	Black-naped Tern (*Sterna sumatrana*)	6, 7, 9, d	89
	Crested Tern (*Sterna bergii*)	6, 7, d	89
	Sandwich Tern (*Thalasseus sandvicensis*)	3, 5, 7, d, s	54
Brown Noddy (*Anous stolidus*)	Brown Pelican (*Pelecanus occidentalis*)	10, s	19, 117
Alcidae			
Razorbill (*Alca torda*)	Common Puffin (*Fratercula arctica*)	6, d	46
Strigiformes			
Strigidae			
Snowy Owl (*Nyctea scandiaca*)	Marsh Hawk (Hen Harrier) (*Circus cyaneus*)	1, s	52
Short-eared Owl (*Asio flammeus*)	Marsh Hawk (*Circus cyaneus*)	1, s	30
	Eurasian Kestrel (*Falco tinnunculus*)	1, s	151
Coraciiformes			
Alcedinidae			
Common Kingfisher (*Alcedo atthis*)	Dipper (*Cinclus cinclus*)	7, d	72
Meropidae			
Carmine Bee-eater (*Merops nubicus*)	Great Bustard (*Ardeotis arabs*)	10, s	120
Passeriformes			
Corvidae			
Florida Scrub Jay (*Aphelocoma coerulescens*)	Northern Mockingbird (*Mimus polyglottos*)	2, d	149
Black-billed Magpie (*Pica pica*)	Eurasian Kestrel (*Falco tinnunculus*)	8, 10, d	162
	Golden Eagle (*Aquila chrysaetos*)	7, 9, d	49
	Northern Shrike (*Lanius excubitor*)	13	102
Jackdaw (*Corvus monedula*)	Mallard (*Anas platyrhynchos*)	7, d, s	28
	Common Murre (*Uria aalge*)	5, 8, d	32, 33
	Common Puffin (*Fratercula arctica*)	5, 6, 8, d	46, 127, 155
Common Crow (*Corvus brachyrhynchos*)	Marsh Hawk (Hen Harrier) (*Circus cyaneus*)	6, d	23
	Herring Gull (*Larus argentatus*)	11	19
	American Robin (*Turdus migratorius*)	5, d	31
Hooded Crow (*Corvus cornix*)	Merlin (*Falco columbarius*)	6, d	187
	Eurasian Kestrel (*Falco tinnunculus*)	6, d	10
	Common Puffin (*Fratercula arctica*)	6, d	46
Carrion Crow (*Corvus corone*)	Gray Heron (*Ardea cinerea*)	6, g	117
	Black Kite (*Milvus migrans*)	6, 8, 9, d	70
	Eurasian Kestrel (*Falco tinnunculus*)	7, d	70
	Gulls (*Larus* spp.)	7, d	70
	Rook (*Corvus frugilegus*)	7, d	70
Australian Raven (*Corvus coronoides*)	Whistling Kite (*Haliastur sphenurus*)	6, 8, d	70
Common Raven (*Corvus corax*	Common Puffin (*Fratercula arctica*)	4, 6, d	7

Paridae				
Great Tit (*Parus major*)	Marsh Tit (*Parus palustris*)	13		4*
Blue Tit (*Parus caeruleus*)	European Nuthatch (*Sitta europaea*)	13		3*
Mimidae				
Brown Thrasher (*Toxostoma rufum*)	American Robin (*Turdus migratorius*)	5, d		188
Turdidae				
Blackbird (*Turdus merula*)	Song Thrush (*Turdus philomelos*)	5, 12, d		123, 164, 175
	Redwing (*Turdus iliacus*)	5, d		164, 175
	House Sparrow (*Passer domesticus*)	5, d		175
	Chaffinch (*Fringilla coelebs*)	5, d		175
Fieldfare (*Turdus pilaris*)	Blackbird (*Turdus merula*)	5, d		175
Mistle Thrush (*Turdus viscivorus*)	Blackbird (*Turdus merula*)	5, d		1*, 175
	Song Thrush (*Turdus philomelos*)	5, d		1*
	Starling (*Sturnus vulgaris*)	5, d		1*
	House Sparrow (*Passer domesticus*)	5, d		1*
	Chaffinch (*Fringilla coelebs*)	5, d		1*
Laniidae				
Lesser Gray Shrike (*Lanius minor*)	Wheatear (*Oenanthe oenanthe*)	6, d	×	117
Loggerhead Shrike (*Lanius ludovicianus*)	American Kestrel (*Falco sparverius*)	2, s		83
Fiscal Shrike (*Lanius collaris*)	Roller (*Coracias garrulus*)	7, d	×	121
Woodchat Shrike (*Lanius senator*)	Passerines	6, d	×	117
Sturnidae				
Common Starling (*Sturnus vulgaris*)	Blackbird (*Turdus merula*)	2, 5, d		38, 175
	Mistle Thrush (*Turdus viscivorus*)	5, d, s		1*, 34
	American Robin (*Turdus migratorius*)	5, d		31, 150, 188
Icteridae				
Boat-tailed Grackle (*Quiscalus (Cassidix) major*)	Glossy Ibis (*Plegadis falcinellus*)	2, 9, d, s		177
Ploceidae				
House Sparrow (*Passer domesticus*)	Winter Wren (*Troglodytes troglodytes*)	2, 4, d		36
	Blackbird (*Turdus merula*)	5, d		1*
	Mistle Thrush (*Turdus viscivorus*)	s		108
	American Robin (*Turdus migratorius*)	s		119, 139
	Starling (*Sturnus vulgaris*)	5, d		1*
Fringillidae				
Cardinal (*Cardinalis cardinalis*)	Loggerhead Shrike (*Lanius ludovicianus*)	13		198
Chaffinch (*Fringilla coelebs*)	European Nuthatch (*Sitta europaea*)	13		182

Index
1. Parasitic bird flies toward host and then rolls onto back and grabs prey directly from clutches of flying host.
2. Parasitic bird flies directly at host or pursues host over short distances.
3. Parasitic bird robs prey while host is presenting food to mate.
4. Parasitic bird robs food while host is feeding young.
5. Parasitic bird rushes at host who is on the ground or water.
6. Parasitic bird pursues host over long distances in chases.
7. Parasitic bird dives at host from above.
8. Parasitic bird physically contacts host by pecking, pulling feathers or hitting the host with the wings.
9. Several parasitic birds join together.
10. Parasitic bird sits on host's back or head.
11. Crows steal mussels which the gull has dropped on the ground (gulls drop mussels to break them open) (Bent 1921).
12. Blackbirds also steal snails that song thrushes have just opened by pounding on a rock (Morris 1954).
13. Parasite follows host around stealing food as host places food in a cache.
14. Food stolen as host manipulates it prior to eating.
15. Host takes prey from spider's web.
16. Frigatebirds steal nesting material as well as food from their hosts (Verner 1965; Diamond 1975).

d. Parasitic bird picks up food dropped by host.
g. Parasitic bird picks up food disgorged by host.
s. Parasitic bird seizes prey directly from host.

1* Observations by C. J. Barnard, near Oxford, U.K., 1976–1978.
2* Observations by J. R. Krebs, near Victoria, British Columbia, Canada, 1972.
3* Observations by R. J. Cowie, Oxford, U.K., 1978.
4* Observations by J. Karlsson, Lund, Sweden, 1978.
5* Observations by Rolf Wahlin, Lund, Sweden.

APPENDIX B: A Review of Kleptoparasitism Between Birds and Mammals

Kleptoparasite*	Host*	Behaviour	Reference‡
Anseriformes			
Anatidae			
American wigeon (*Anas americana*)	Muskrat (*Ondatra zibethicus*)	5, 8, d, s	60
Falconiformes			
Accipitridae			
Common buzzard (*Buteo buteo*)	Stoat (*Mustela erminea*)	7, d	117
Lappet-faced vulture (*Torgos tracheliotus*)	Jackal (*Canis* sp.)	5, d	101
Kestrel (*Falco tinnunculus*)	Weasel (*Mustela* sp.)	7, d	56, 124
Galliformes			
Phasianidae			
Domestic chicken (*Gallus domesticus*)	Domestic cat (*Felis domesticus*)	5, s	160
Gruiformes			
Rallidae			
American coot (*Fulica americana*)	Muskrat (*Ondatra zibethicus*)	s	199
Charadriiformes			
Laridae			
Gulls (*Larus* sp.)	Seals (*Pinnipedia*)	14, s	117
Inca Tern (*Larosterna inca*)	Sea-lions (*Otaria byronia*)	14, s	126
Strigiformes			
Strigidae			
Short-eared owl (*Asio flammeus*)	Stoat (*Mustela erminea*)	7, d	204
Passeriformes			
Corvidae			
Clark's nutcracker (*Nucifragas columbiana*)	Red squirrel (*Tamiasciurus* sp.)	5, 7, d	26
Carrion Crow (*Corvus corone*)	Domestic dog (*Canis familiaris*)	5, d, s	70
Common Raven (*Corvus corax*)	Domestic dog (*Canis familiaris*)	5, d, s	26

Footnotes and index as per Appendix A.

Meinertzhagen (1959) reviews associations between birds and humans.

APPENDIX C: A Review of Kleptoparasitism Between Birds and Arthropods

Kleptoparasite*	Host*	Behaviour	Reference‡
Apodiformes			
Trochilidae			
Long-tailed hermit (*Phaethornis superciliosus*)	Spider's web	15	205
Green-breasted mango (*Anthracothorax prevostii*)	Spider's web	15	203
Steely-vented hummingbird (*Amazilia saucerottei*)	Spider's web	15	203
Buff-bellied hummingbird (*Amazilia yucatanensis*)	Spider's web	15	195
Anna's hummingbird (*Calypte anna*)	Spider's web	15	25
Ruby-throated hummingbird (*Archilochus colubris*)	Spider's web	15	141, 203
Passeriformes			
Formicariidae			
Bicolored antbird (*Gymnopithys leucaspis*)	Army ants	s	200
Lunulated antbird (*Gymnopithys lunulata*)	Army ants	s	201
Pycnonotidae			
Bulbuls (*Pycnonotus* sp.)	Driver ants: (Formicidae: Dorylinae)	s	160
Troglodytidae			
White-bellied wren (*Uropsila leucogastra*)	Spider's web	15	195
Turdidae			
Alethe (*Alethe* sp.)	Driver ants: (Formicidae: Dorylinae)	s	160
American Robin (*Turdus migratorius*)	Digger wasp (Sphecidae: *Sphex*)	2, d	156
Bombycillidae			
Cedar waxwing (*Bombycilla cedrorum*)	Spider's web (Araneidae)	15	44
Sturnidae			
Starling (*Sturnus vulgaris*)	Digger wasp (Sphecidae: *Sphex*)	2, d	39
Vireonidae			
Yellow-green vireo (*Vireo flavoviridis*)	Spider's web	15	195
Parulidae			
Yellow-rumped warbler (*Dendroica coronata*)	Spider's web	15	195
Prairie warbler (*Dendroica discolor*)	Spider's web (Araneidae)	15	50
Icteridae			
Brown-headed cowbird (*Molothrus ater*)	Digger wasp (Sphecidae: *Sphex*)	2, d	39
Ploceidae			
House sparrow (*Passer domesticus*)	Digger wasp: (Sphecidae: *Sphex*)	2, d	39, 156
Fringillidae			
Blue bunting (*Cyanocompsa parellina*)	Spider's web (Araneidae)	15	195

Footnotes and index as per Appendix A.