

CHAPTER 1

General introduction

This study began during an important era of environmental upheaval marked by widespread population declines of raptors and their reproductive failures in Europe as well as North America. The calamitous crash was eventually linked to the agricultural uses of organochlorine pesticides, including DDT and dieldrin (Ratcliffe 1963, 1967). The Peregrine (*Falco peregrinus*) proved to be especially vulnerable to the insidious effects of these synthetic poisons (Hickey 1969). The established knowledge of how the chlorinated hydrocarbons did their damage to the avian community was based on abundant evidence that sub-lethal residues caused eggshell thinning, which resulted in their breakage (Peakall et al. 1990). In addition, the most heavily polluted prey, as well as seed-eating birds that had been deliberately poisoned by agriculturalists, were probably first to fall prey to opportunistic predators including the falcons (Ratcliffe 1993). The subsequent recovery of the Peregrine falcon, now a matter of record, was associated with reduced pesticide levels in eggs and body tissue during the 1980s (Cade et al 1988; Court et al 1990).

The toxic chemical threat caused deep concern about the future of the Peregrine and sparked the 1965 International Madison Peregrine Conference (Hickey 1969). While the main debate about the decline was centred in Europe and eastern North America, the thinly populated Rocky Mountain region did not escape from the harmful spread of industrial pesticides. In the mid 1960s, an extensive survey of the western United States and Canada found less than 30% of known traditional breeding sites still occupied (Enderson 1965). The last of the nests in agricultural regions of southern and central Alberta became vacant by the late 1960s (Dekker 1967; Fyfe 1976). Subsequent checks by federal and provincial biologists found toxic residues in Peregrine eggs in northern Alberta and even on the remote coast of the Arctic Ocean as late as the 1980s (Court et al. 1990; Court 1993).

Meanwhile, ideas formulated during the landmark Madison Conference and the subsequent Peregrine Conference in Sacramento (Cade et al. 1988) led to innovative efforts to restore the Peregrine through captive breeding and reintroductions. Coupled with the efforts by others to reduce and eventually ban the use of certain toxic pesticides, the breeding program became an unqualified success thanks to the expertise and dedicated efforts of falconers. The releases of juve-

nile falcons proved crucial to the re-establishment of the endangered Peregrine in regions where the species had become extinct. By the beginning of this century, Peregrines were well on the way to a near-complete recovery in all of North America (Cade and Burnham 2003; Holroyd 2003), including the Canadian provinces of Alberta and British Columbia, which are the location for the field studies described in this dissertation.

Against the above-described historical background, I was motivated to begin my observations by the need for first-hand information on wild falcons. At that time, now half a century ago, the existing reference books contained a wealth of detail on Peregrine distribution, subspecies, plumages, morphology, and nesting habits (Fischer 1967; Brown and Amadon 1968). As well, food habits had been extensively studied across the falcon's worldwide range, but mainly through the collection of prey remains at nest sites. However, information on its hunting habits was primarily derived from falconry birds, which make their kills under contrived circumstances arranged by the falconer. By contrast, published reports of wild Peregrines in the act of capturing prey were rare and anecdotal (e.g. Beebe 1960; Bent 1961; Herbert and Herbert 1965; Fischer 1967). An exception was the paper by Gustaf Rudebeck (1950), a Swedish ornithologist, who watched migrating raptors at Falsterbo on the south coast of Scandinavia. By way of an explanation for the scarcity of detailed information, the British authority on the species, Derek Ratcliffe (1980:128) argued that "the study of food by direct observation of Peregrines in the act of killing prey is not really a practical proposition.... a vast amount of time would be needed to collect a reasonable sample of observation."

If we accept Ratcliffe's claim, then this thesis must be judged an impractical proposition. Indeed, it has taken me an improbably long time to amass the data presented in these chapters. More than 40 years ago, when I first read the singular paper by Rudebeck (1950), I did not think that I would ever match his list of 19 captures observed. As Rudebeck pointed out, the foraging studies of a raptor should involve many different birds, since individuals can vary much in their choice of prey. Consequently, he argued, a study of migrating Peregrines provides a more balanced picture of the species' menu than a pair of adults at their nest site. This was an added inspiration to me during the early years when I began my observation in central Alberta at a time when the Peregrine was an increasingly rare and threatened species. By now, of course, the picture has completely changed for the better, and I eventually beat Rudebeck's score by a factor of 25. The slow rise of my tally of hunts and kills over time is shown in Figure 1.2 and Table 16.1.

From the outset, the objective of my field studies was to collect the largest data set possible on the hunting habits of the Peregrine, based on first-hand observation. Secondly, I was interested in how the prey, in particular shorebirds, attempted to evade capture. This too was an area about which little or nothing had been published at the time.

THE FALCONS

The main subject of this thesis is the **Peregrine Falcon** (*Falco peregrinus*), an aerial hunter of birds believed to be the fastest creature on earth, capable of diving speeds that have been measured at over 350 km/hour (Franklin 1999), and with one of the widest distributions of all avian species. Practically cosmopolitan, it occurs in suitable habitats on all continents with the exception of high arctic tundra, deserts, Iceland, and New Zealand (Brown and Amadon 1968). The nominate form (*F. p. peregrinus*) was described for Britain (Ratcliffe 1980). Worldwide up to 19 subspecies or geographic races have been recognized, three of which breed in North America: *F. p. anatum*, *F. p. pealei*, and *F. p. tundrius* (White et al. 2002). Between them, there are subtle differences in plumage and wing proportions, and their typical ranges are widely separated. The anatum subspecies – formerly known as the Duck Hawk – breeds across the continent; the Peale's falcon is restricted to the Northwest Pacific coast; and *F. p. tundrius* migrates twice yearly between its arctic nesting grounds and tropical wintering ranges. Breeding farthest north, *tundrius* is the smallest North American Peregrine and lightest in colour, which contrasts with Europe, where the biggest and palest Peregrines (*F. p. calidus*) are found at the highest latitudes.

Subjects of secondary prominence in this study are three other falcons, all of which, like the Peregrine, prey on birds. The **Merlin** (*Falco columbarius*) occurs in Europe as well as North America, but the physical differences between them are very minor. The pale *F. c. richardsoni* of central Alberta is somewhat larger than its European conspecifics (Brown and Amadon 1968), but its hunting habits are much the same.

In the past, the circumpolar **Gyrfalcons** (*Falco rusticolus*) were split up into several subspecies or geographic races, but today they are considered one and the same. Both in Eurasia and America individuals vary in colour from nearly white to almost black (Cade et al. 1998; Potapov and Sale 2005).

The **Prairie Falcon** (*Falco mexicanus*) is indigenous to the Americas. It is about the same size as the Peregrine, which occurs mainly near water, but the Prairie Falcon is a dry-country raptor that preys on small mammals as well as on birds, similar to Lanner (*Falco biarmicus*) and Saker Falcons (*Falco cherrug*). In Alberta, the Prairie Falcon is a year-round resident as far north as the latitude of Edmonton (Dekker and Corrigan 2006), whereas the Peregrine is highly migratory. On sympatric breeding range along the rivers that transect the semi-arid plains of central and southern Alberta, the Prairie Falcon competes with the Peregrine for nesting sites.

An early research question I posed, having to do with the pesticide threat and the alarming reports of eggshell thinning and breeding failures, was this: Were northern Peregrines that migrated through Alberta still reproducing at normal levels? And what was the proportion of juveniles in the cohort? Reproductive output is a critical parameter of the health of wildlife population, and Peregrine mortality during the first winter is believed to be high (White et al. 2002). How many first-year falcons survived to make the return migration to the Canadian arctic? No such information was available when I began my 15-year survey of migrating falcons at Beaverhills Lake in central Alberta (Chapter 2).

The decision to include four species of falcons in this thesis was inspired by the opportunities encountered during 48 years in the field, enabling me to compare the success rates of the Peregrine with that of the Merlin (*Falco columbarius*), which also hunted shorebirds at Beaverhills Lake (Chapter 11). The bird-hunting tactics of the Prairie Falcon (*Falco mexicanus*) and the Gyrfalcon (*Falco rusticolus*) were poorly known. Descriptions of their food habits were mainly based on the collection of prey remains at nest sites, as was the case with the Peregrine. The unique chance to compare the methods and success rates of the Prairie Falcon and the Gyrfalcon came about after I had suffered a back injury that prevented me from walking. All I could do at that time was sit in the car and wait for raptor attacks on a flock of feral pigeons at an industrial site in the city of Edmonton. Comparative information on bird-hunting tactics of these two falcons had never before been published. Furthermore, this thesis also details intra- and interspecific klepto-parasitic incidents between all four species, as well as their interaction with other raptors, in particular the American Bald Eagle (*Haliaeetus leucocephalus*).

STUDY AREAS

The study areas include five different locations in Alberta, Canada, three in coastal British Columbia, Canada, (Figure 1.1), and one in the Netherlands.

- (1) 1960–2008. The valley of the Red Deer River in central Alberta. There, Peregrines and Prairie Falcons compete for nesting cliffs and prey.
- (2) 1965–2008. Beaverhills Lake, a 140 km² Ramsar wetland east of Alberta's capital city Edmonton. The lake is surrounded by agricultural fields, rough pastures, and woodlots. Migrating Peregrines and Merlins occur during spring and fall. Merlins also breed in the region. Both species hunt migrating shorebirds.
- (3) 1980–1994. A 5-km² enclave of low-lying agricultural fields on mountainous Vancouver Island in British Columbia. Wintering Peregrines hunt mainly ducks and are frequently harassed by Bald Eagles.
- (4) 1994–2008. Boundary Bay, a 15-km section of coastline and intertidal mud flats near the city of Vancouver. It is a traditional wintering range for Dunlins (*Calidris alpina*), which are preyed upon by Peregrines and Merlins.
- (5) 1995–1996. Langara Island, a heavily forested island well off the coast of British Columbia and just south of Alaska. Locally breeding Peregrines hunted mainly seabirds over the ocean.

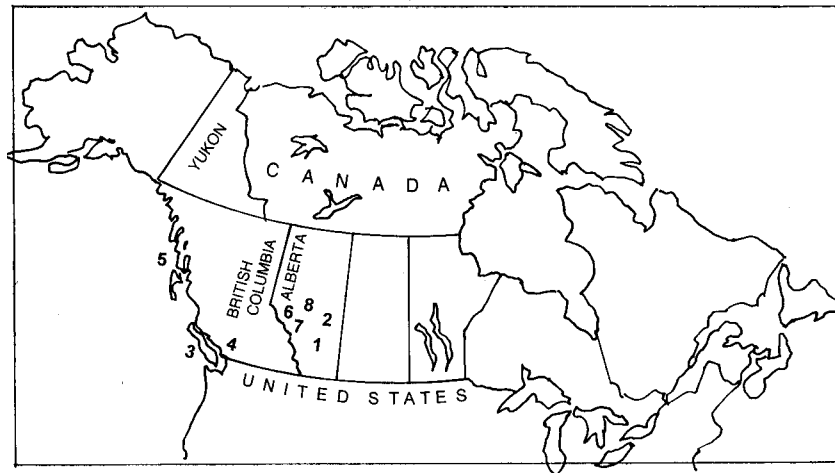
(6) 1998–2008. Wabamun Lake, 60 km west of Edmonton. Over ten years, a pair of Peregrines has nested in a box attached to a lakeside powerplant. The falcons often hunted cooperatively and preyed largely on gulls. Also detailed in this chapter are the interactions of the parent Peregrines and their fledglings, with particular reference to the question of whether the adults teach their young how to hunt.

(7) 1998–2000. The inner city of Edmonton. Over two winters, feral Rock Doves (*Columba livia*), frequenting a grain-loading railway siding, were hunted by Prairie Falcons and Gyrfalcons. Their respective capture methods and success rates are described and compared.

(8) 1999–2002. A section of the North Saskatchewan River flowing through an agricultural region of central Alberta. Along a stretch of water kept ice-free by city effluents, wintering Gyrfalcons and Bald Eagles hunted Mallards (*Anas platyrhynchos*) flying inland to forage on farms.

(9) 2006–2008. (Not indicated on map below). The coast of the Dutch Wadden Sea in Friesland. Here, migrating and wintering Peregrines captured a range of prey including Dunlins.

For further details of the study areas, see chapters 2 to 15.



METHODS

My methods of finding falcons were hands-off and non-intrusive, requiring only patience and keeping my distance. The less disturbance I caused in the field, the better my chances of seeing predator-prey interactions unaffected by the human presence. My main problem was to decide on the question of what constitutes a hunt by a Peregrine, and what should be considered only play or harassment of other birds. This conundrum was discussed at length in the literature (Brown and Amadon 1968; Ratcliffe 1980; Treleven 1980). I too struggled with the ques-

tion of correct interpretation and decided that the only criterion to go by was whether the attack had been completed and the result became known. In this thesis, the terms hunt and attack are used interchangeably for one attempt with known outcome by a falcon at capturing a bird of a species commonly preyed upon. One hunt or attack could include more than one attempt at grabbing that prey. I did not count as hunts any aggressive-looking passes at large birds such as geese, swans, or buteo hawks. Neither was the capture of insects and rodents included in the tables of hunts and kills.

A pass at a flying crow that evades the falcon by a wide margin and is not pursued further could not be considered a serious attempt at capture. On the other hand, any close pass at a bird of a size known to be preyed upon by Peregrines was classified as a hunt even though the target might escape capture or was let go. Over the years, I became convinced of the accuracy of this interpretation. I learned that a hunting adult Peregrine can make a deceptively half-hearted impression, whereas immatures might harass birds vigorously soon after they had eaten their fill. The question of deciding what constitutes a hunt and what not became further confused after I saw falcons grab flying ducks and let them drop into the reeds, or carry them down to the ground but leave them uneaten.

Understanding a creature like the Peregrine may largely lie outside our realm. Perhaps it's easier to empathise with the prey, for humans are familiar with fear. A prey under attack can choose whether or not to react in a timely evasive way. Birds that make a wrong move may end up in the falcon's clutches whether it is hunting in earnest or just playing. In their hurry to get out to the way, some prey are unlucky and hit a barbed-wire fence or overhead wire. On the Pacific coast, I twice saw a Dunlin drop out of a dense flock careening low over the water in panicked agitation, probably induced by fear of falcon attack, but there was no raptor to be seen. It is a moot question, whether these Dunlins had collided with their fellows or perhaps suffered a coronary failure; evidently they were victims of predation in an indirect but fatal way. Both of these Dunlins, splashing as if lifeless into the shallows, were quickly grabbed by Bald Eagles.

The hit or miss moment of a falcon's attack is a split-second affair easily misinterpreted by the human observer. Birdwatchers and waterfowl hunters have told me of seeing falcons fly along a shore and "knock one duck dead after the other, and just letting them drop into the water." Even geese that awkwardly landed or fell down to evade an aggressive Peregrine were believed to have been struck and wounded. Similar reports are contained in Bent (1938). These stories may well have been inspired by the common descriptions in the reference books to the effect that Peregrines hit their prey in mid-air, so that the victim falls to the ground dead or crippled, sometimes with its head cut off by the aerial strike (Ratcliffe 1980). Such events may not be unusual for trained Peregrines that "wait on" high above a falconer until the dogs flush a crouching grouse or partridge from the ground below the falcon. However, a wild Peregrine will smack other creatures only in defence, for instance at the nest site. When foraging for food, it commonly secures the prey in its feet and carries it along. Allowing a

wounded bird to fall might come at the risk of losing it in vegetation. In the few cases in which I have seen a wild falcon hit a bird in the air, sending feathers flying, it looked to me like a failed attempt at grabbing that prey. Some birds, such as Rock Doves and grouse, have loose feathering that easily separates in the claws of a raptor.

There is a simple explanation for the fact that aerial hits can be misinterpreted. Flying ducks and other prey species routinely plunge to the ground or into water to dodge an attacking falcon. The timing of these evasive tactics is so acute that it indeed may look as if the target was struck. For this reason, to decide whether a kill had actually taken place, I have relied on certainties, not assumptions. To be sure of a hit, I either had to see feathers fly when the bird fell down, or see the falcon descend on the spot, either to feed right there or carry the prey off to a distant post.

To determine hunting success rates of the falcons, I divided my observation of hunts (or attacks) into three categories: (A) hunts that took place under perfect viewing conditions and at once allowed me to see whether or not the intended prey was seized; (B) hunts that were partly obscured by distance or vegetation so that the outcome could only be determined subsequently, for instance, if the falcon was found feeding on a prey, or if it flew away to attack elsewhere; and (C) hunts that remained undecided and their results unknown.

This last category included a high percentage of spectacular stoops from a great height, and far-ranging descents at accelerating speed, as well as some very persistent pursuits of fleeing birds that carried on out of sight into the distance or high into the sky. In the Alberta study of migrating falcons, category C observations accounted for 30% of all hunts recorded. Although they contributed much to my appreciation and understanding of the Peregrine as a hunter, they could not be used in calculating hunting success rates. As to the difference between A and B categories, after 15 years of detailed data collection, there was no significant difference (χ^2 chi-square = 0.0039, 1df NS) in their respective success rates of 7.4% and 8.3%. Henceforth, I have combined both categories in my classification of hunts and kills.

Based on experience, I eventually developed some simple strategies to enlarge my chances of observing hunts. The first priority was to select an observation point near a wetland or section of coastline that combined an unobstructed view with the possibility of approaching it without disturbing nearby ducks or shore-birds. I usually sat down or used the parked car as a comfortable blind. Wind direction and sun angle were also of critical importance. However, one of the most unpredictable yet decisive factors was plain good luck to be in the right place at the right time.

My eyesight is by no means good, even quite poor under low light conditions. By way of compensation I continually scan the land or water through wide-angle binoculars. Alerted by their alarm calls and sudden flushing, I take my clues from the prey species. Unfortunately, it is still possible, even likely, to miss the action and only discover the falcon after its strike is over. At close range, a

Peregrine is easily missed. Spotting distant falcons is easier. After noting a far-off rising of shorebirds, I scan the horizon and with luck pick up the Peregrine climbing away after an unsuccessful attack or descending for a new attempt. One of my early mistakes was to hurry to the distant section of shore where the disturbance had just taken place, but falcons seldom strike twice in the same spot after prey have been put on high alert. One low pass by a Peregrine makes ducks flee to the safety of deeper water. Waders often leave the locality. A hunting falcon causes a great deal of unrest among prey species, resulting in the desertion of wide stretches of coastline. By contrast, if a Peregrine has not shown up for some time, loafing ducks dawdle on the shore and sandpipers forage in the shallows without interruption. Noting the general calm, I purposely selected these places to sit down and wait. Frequently scanning the shoreline in either direction, my objective was to spot an approaching falcon before the shorebirds did. If an attack materialized, I could follow the entire hunting sequence from its very beginning. It often involved hours of waiting and strenuous effort of keeping the shaking binoculars focussed on a distant speck of a falcon soaring far inland or at heights estimated to be >1 km. Not all sightings, even those that began with much promise, led to the desired results. But by and large, my efforts proved effective over time.

A secondary strategy was to watch perched falcons, sitting on a fence post or fieldstone, until they flew off to start hunting. Finding them became easier over time as I learned their favourite places. However, staring at an inactive falcon is a very boring business that may take hours and still end in failure if I looked away for a minute, or when the falcon eventually flew out of sight. It was prudent not to approach too closely, and resist the desire to see plumage details. Falcons differ in their tolerance of humans. The best thing to do is to keep one's distance so as not to influence their behaviour. Most times I was unable to see the perched falcon with the naked eye, forcing me to keep the binoculars trained for long periods or to squint through the telescope. Providing the falcon eventually became active and decided to fly into my direction, the chances of seeing an interesting hunt were best the greater the initial distance between the bird and my point of observation. A hunting falcon, looking far ahead, often takes a long-range approach before reaching top speed. Of course, just as often it dwindled away into the distance.

The above methods pertain to the difficulties of watching migrating and wintering falcons. Observation can be much more productive near nest sites because territorial adults use the same high perches and begin foraging flights at predictable times of day. These conditions applied to a pair of Peregrines breeding in a nest box attached to a tall chimney of an electricity generating station at Wabamun Lake in Alberta. By contrast, however, at the cliff nesting sites of Peregrines along the Red Deer River, opportunities for recording hunting behaviour were non-existent. There, the falcons did all of their hunting over the adjacent fields out of sight of my observation point in the narrow river valley. They simply flew away or soared to a great height until the trees cut them off from view.

PROJECT OUTLINE AND OBJECTIVES

The above methods were applied to the following sequence of projects and the data collected form the basis for this thesis.

(1) After the Peregrine breeding population of central Alberta had died out, their return became of special concern to provincial and federal government agencies who eventually, with the financial support of a major oil company, organized the release of captive-raised Peregrines along the Red Deer River where the species formerly nested. As a volunteer familiar with the pre-release situation, I assisted wildlife biologists in monitoring the Peregrine's success in returning to the river. My inventory surveys, which began in 1960, continue as of 2008. A unique part of these investigations was the interspecific competition, for nest sites and prey, between Peregrines and Prairie Falcons (Chapter 12).

(2) After the Peregrine had become extinct as a breeding bird in the lower half of the province, I discovered that falcons of unknown origin were still passing through the province in spring and fall. When I notified the Alberta Fish and Wildlife Division, I was hired on a volunteer basis to monitor the migrations at Beaverhills Lake in central Alberta. At that time nothing was known about the spring passage of Peregrines in North America, while fall flights had been continuously monitored on islands off the Atlantic seaboard and along the Texas Gulf coast. In addition to timing the migrations, I kept track of the adult versus immature ratios as a useful parameter of the population dynamics and reproductive health of the migrants. I also collected the remains of birds killed by Peregrines in order to have them analyzed for pesticide residues by an Alberta government laboratory. The program was conducted for 15 years under contract to the Alberta Fish & Wildlife Division, but I continued on my own after 1980, albeit in a less focussed manner, until 2008 (Chapter 2).

(3) Apart from monitoring the spring and fall migrations, my major interest was the foraging habits of wild falcons at Beaverhills Lake. It led to the publication of a very large data set on hunts and kills in 1980 and 1988 (Chapters 3 and 11).

(4) Alberta Peregrines are highly migratory and few if any remain in the Edmonton region after the first week of October. With the objective of studying wintering Peregrines, I travelled in January of each year from 1980 to 1994 to Vancouver Island on the west coast of British Columbia. At the time, little or nothing was known about the food habits of these falcons and their competitive relationship with the Bald Eagle (Chapters 4 and 5).

(5) After having attained an understanding of the Peregrine's winter ecology in the agricultural fields of Vancouver Island, my curiosity led me on to Boundary Bay, a section of the Fraser River Delta on the coast of Pacific Ocean near Vancouver. There, I studied Peregrine predation on Dunlins and ducks. After several years of data collection, I cooperated with researchers from the Canadian Wildlife Service and Simon Fraser University, who had intensively studied shorebird migrations in the delta for decades. A major focus was on the relationship of Peregrine predation rates on Dunlins with the tidal cycle (Chapters 7 to 9).

(6) In 1995, I obtained an invitation from Peregrine researcher Wayne Nelson to accompany him on a nesting survey of Langara Island in the Pacific Ocean, just south of Alaska and west of the mountainous coast of British Columbia. It led to further observation in the following year and unique discoveries of the way these falcons hunted seabirds (Chapter 6).

(7) An opportunity to study the foraging behaviour of breeding Peregrines arrived after reintroduced falcons began using a nest box attached to a high chimney of a coal-fired electrical generating station at Wabamun Lake in central Alberta. There, I began intensive observations in 1998, and by 2004 I had collected a large sample of hunts and kills. An additional area of interest was parent-fledgling interaction. Here too, my observations were carried on after the publication of a 2005 paper on seven years of data collecting (Chapter 10).

(8) Based on long-term research at Beaverhills Lake, I compared the success rates of the Peregrine with that of the Merlin on the same kind of prey, namely small shorebirds and passerines (Chapter 11).

(9) Klepto-parasitic interaction between Bald Eagles and Peregrines became part of the investigations at Boundary Bay, Vancouver Island, and Langara Island (Chapters 5 to 9).

(10) An opportunity to observe the various hunting methods and success rates of the Prairie Falcon and the Gyrfalcon arose in the winters of 1998–2000 when both species preyed on feral Rock Doves in the city of Edmonton. At the time, the existing literature contained very little detail about the bird-hunting habits of either of these falcons (Chapter 13).

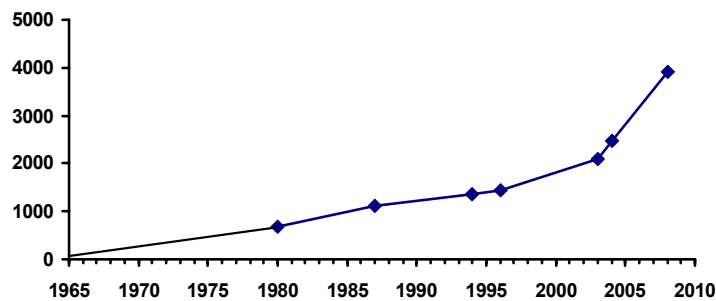
(11) During the winters of 1999–2002, I studied the hunting methods of Gyrfalcons preying on Mallards wintering along an open stretch of river downstream from the city of Edmonton. An interesting factor in the predator-prey dynamics was klepto-parasitic interference from Bald Eagles. Prior to these studies, published information of the Gyrfalcon's food base was mainly restricted to prey remains collected at nest sites (Chapter 14).

(12) In the late fall of 2007 and 2008, I spent three months in the Netherlands to study the foraging habits of migrating and wintering Peregrines on the coast of the Wadden Sea with special reference to Dunlin anti-predation behaviour. In particular, my objective was to determine whether or not the Dunlins wintering on the Dutch coast would engage in over-ocean flocking during high tides when all intertidal habitats were inundated (Chapter 15).

The above studies and data were published over a period of 29 years in six different refereed journals. In the Discussion and Synthesis (Chapter 16) I provide an overview of the major findings.

Figure 1.2. The graphs summarize the slow accumulation of data on the hunting habits of Peregrines, substantiating Ratcliffe's (1980:128) claim to the effect that "a vast amount of time would be needed to collect a reasonable sample of observations." The data points represent the number of hunts and kills reported in my major papers in order of their publication dates (Chapters 3, 5, 6, 8, 10, 15, and additional unpublished data). Depending on location and season, between 1.5 and 5.5 hours of field time were on average required to observe one hunt, with an overall chance of about one in ten hunts ending in a capture. The jogs in the line are caused by variations in the results obtained between locations and seasons. The slow rise in hunts and kills recorded during the first three decades, as compared to the steeper annual increases thereafter, can be explained as follows. During the early years I exclusively watched migrating Peregrines in Alberta, which have a lower success rate than wintering or nesting falcons. As indicated by the graph, records began to increase when I added the observations of falcons wintering in British Columbia, and the line reached its steepest pitch after 2004 with the inclusion of the records of a breeding pair at Alberta's Wabamun Lake.

Accumulated Hunts



Accumulated Kills

